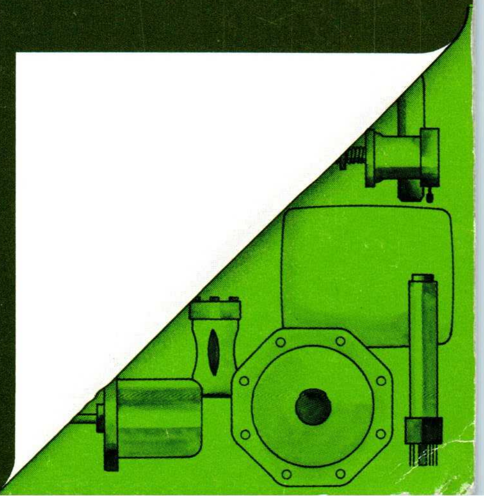
PHILIPS Electronic components and materials

PHILIPS

GENERAL CATALOGUE

1981/82



status guide

The status code letters used in this catalogue indicate the status of the products at 1 May 1981

N = **New design type.** Recommended for new equipment design; production quantities available *after date of publication.*

D = **Design type.** Recommended for equipment design; production quantities available *at date of publication.*

C = **Current type.** No longer recommended for equipment design; available for equipment production and for use in existing equipment.

M = **Maintenance type.** No longer recommended for equipment production; available for maintenance of existing equipment.

General catalogue 1981/82

semiconductors

integrated circuits,
including Signetics products

components
materials

electron tubes

preface

This catalogue lists type numbes, catalogue numbers and brief data of the products of the Electronic components and materials division.
It also includes a replacement guide for electron tubes.
The semiconductor replacement guide is available as separate book.

Dealing as it does with so extensive a range of products, the catalogue is necessarily concise, the data it contains being in many cases too brief to support a definitive product selection. For complete data, we refer you to our system of Data Handbooks. That system, which now comprises fourty-six volumes, is divided into four series distinguished by colour:

• **S series**	Semiconductors	**Red**
• **IC series**	Integrated circuits	**Purple**
• **C series**	Components and materials	**Green**
• **T series**	Electron tubes	**Blue**

The contents of each volume are listed on pages IV to VII.
The catalogue section in which a product is listed also tells you the series and volume number of the Data Handbook in which you will find its complete data.

Editor
July 1981

Note
Dimensions in tables and drawings are in mm, unless otherwise stated.

GENERAL CONTENTS

For detailed information
Handbook series (survey pages IV to VII)

handbook survey
semiconductors (red series)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code. Books with the purple cover will replace existing red covered editions as each is revised.

Part 1	**March 1980**	**S1 03-80** **(SC1b 05-77)**	**Diodes** Small-signal germanium diodes, small-signal silicon diodes, special diodes, voltage regulator diodes ($<$ 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes
Part 2	**May 1980**	**S2 05-80** **(SC1a 08-78)**	**Power diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes ($>$ 1,5 W), rectifier stacks, thyristors, triacs
Part 3	**April 1980**	**S3 04-80** **(SC2 11-77, partly)** **(SC3 01-78, partly)**	**Small-signal transistors**
Part 4	**September 1981**	**S4 09-81** **(SC2 06-79)**	**Low-frequency power transistors**
Part 4a	**December 1978**	**SC4a 12-78**	**Transmitting transistors and modules**
Part 5	**October 1980**	**S5 10-80** **(SC3 01-78, partly)**	**Field-effect transistors**
Part 7	**December 1980**	**S7 12-80** **(SC4c 07-78)**	**Microminiature semiconductors for hybrid circuits**
Part 8	**April 1980**	**S8 06-81** **(SC4b 09-78)**	**Devices for optoelectronics** Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photo-conductive devices
Part 10	**September 1981**	**S10 09-81** **(SC3 01-78, partly)**	**Wideband transistors and wideband hybrid IC modules**

integrated circuits (purple series)

Part 1	May 1980	IC1 05-80	Bipolar ICs for radio and audio equipment
Part 2	May 1980	IC2 05-80	Bipolar ICs for video equipment
Part 3	December 1981	IC3 12-81 (SC6b 08-79)	ICs for digital systems in radio, audio and video equipment
Part 4	October 1980	IC4 10-80	Digital integrated circuits LOCMOS HE4000B family
Part 5	November 1981	IC5 11-81	ECL 10 000 series and 100 000 series
Part 6	—	IC6 (SC5a 11-76)	Professional analogue ICs
Part 7	May 1981	IC7 05-81	Signetics bipolar memories
Part 8	May 1981	IC8 05-81	Signetics analogue circuits
Part 9	November 1981	IC9 11-81	Signetics TTL logic

handbook survey

components and materials (green series)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	July 1979	CM1 07-79	**Assemblies for industrial use** PLC modules, high noise immunity logic FZ/30 series, NORbits 60-series, 61-series, 90-series, input devices, hybrid integrated circuits, peripheral devices
Part 2	June 1981	C2 06-81 (CM3a 09-78)	**FM tuners, television tuners, video modulators, surface acoustic wave filters**
Part 3	January 1981	C3 01-81 (CM3b 10-78)	**Loudspeakers**
Part 4a	November 1978	CM4a 11-78	**Soft Ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	February 1979	CM4b 02-79	**Piezoelectric ceramics, permanent magnet materials**
Part 6	May 1981	C6 05-81 (CM6 04-77)	**Electric motors and accessories** Permanent magnet synchronous motors, stepping motors, direct current motors
Part 7a	January 1979	CM7a 01-79	**Assemblies** Circuit blocks 40-series and CSA70 (L), counter modules 50-series, input/output devices
Part 8	September 1980	C8 09-81 (CM8 06-79)	**Variable mains transformers**
Part 9	August 1979	CM9 08-79	**Piezoelectric quartz devices** Quartz crystal units, temperature compensated crystal oscillators
Part 10	October 1980	C10 10-80	**Connectors**
Part 11	December 1979	CM11 12-79	**Non-linear resistors** Voltage dependent resistor (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)
Part 12	November 1979	CM12 11-79	**Variable resistors and test switches**
Part 13	December 1979	CM13 12-79	**Fixed resistors**
Part 14	April 1980	C14 04-80 (CM2b 02-78)	**Electrolytic and solid capacitors**
Part 15	May 1980	C15 05-80 (CM2b 02-78)	**Film capacitors, ceramic capacitors, variable capacitors**

electron tubes (blue series)

Part 1	February 1980	T1 02-80 (ET1a 12-75)	**Tubes for r.f. heating**
Part 2	April 1980	T2 04-80 (ET1b 08-77)	**Transmitting tubes for communications**
Part 2b	May 1978	ET2b 05-78	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	June 1980	T3 06-80 (ET2a 11-77)	**Klystrons, travelling-wave tubes, microwave diodes**
Part 3	January 1975	ET3 01-75	**Special Quality tubes, miscellaneous devices**
Part 4	September 1980	T4 09-80 (ET2a 11-77)	**Magnetrons**
Part 5	August 1981	T5 08-81	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 6	July 1980	T6 07-80 (ET6 01-77)	**Geiger-Müller tubes**
Part 7a	March 1977	ET7a 03-77	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	May 1979	ET7b 05-79	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	July 1979	ET8 07-79	**Picture tubes and components** Colour TV picture tubes, black and white TV pictures tubes, monitor tubes, components for colour television, components for black and white television
Part 9	June 1980	T9 06-80 (ET9 03-78)	**Photo and electron multipliers** Photomultiplier tubes, phototubes, single channel electron multipliers, channel electron multiplier plates
Part 10	May 1981	T10 05-81 (ET5b 12-78)	**Camera tubes and accessories, image intensifiers**

CONTENTS SEMICONDUCTORS

For detailed information
Handbooks S1 to S10

letter symbols

C_d	Diode capacitance
C_{rb}	Feedback capacitance (common base)
C_{rd}	Feedback capacitance (common drain)
C_{re}	Feedback capacitance (common emitter)
C_{rs}	Feedback capacitance (common source)
CMRR	Common mode rejection ratio
D*	Detectivity
d_{im}	Intermodulation distortion
d_{cm}	Cross-modulation distortion
$E_{e\,tr}$	Irradiance to trigger a device
F	Noise figure
f	Frequency
f_{hfe}	Frequency at which h_{fe} is -3 dB
f_T	Transition frequency
$\Delta \frac{1}{g_{fs}}$	Difference in transfer impedance
$\Delta \frac{g_{os}}{g_{fs}}$	Difference in penetration factor
G_p	Power gain
G_{UM}	Maximum unilateral power gain
h_{fe}	Small-signal current gain
h_{FE}	D.C. current gain
$\frac{\Delta I}{\Delta T}$	Equivalent differential current change with temperature
I_A	Anode current
dI_A/dT	Rate of rise of anode current
I_{ARM}	Repetitive peak anode current
I_B	D.C. (or average) base current
I_C	D.C. (or average) collector current
$I_{(CL)SM}$	Non-repetitive peak clamping current
I_{CM}	Peak value of I_C
I_D	Off-state current
I_{DSS}	Drain current (source short-circuited to gate)
I_{DSX}	Drain cut-off current (specified conditions)
I_e	Radiant intensity
I_F	Forward current (d.c. or average)
$I_{F(AV)}$	Total average forward current
I_{FM}	Peak forward current
I_{FRM}	Repetitive peak forward current
I_{FSM}	Non-repetitive peak forward current
I_{FWM}	Working peak forward current
I_{GSS}	Gate cut-off current (source short-circuited to drain)
I_{GT}	Gate-cathode current that will trigger all devices
I_H	Holding current
I_{ISM}	Non-repetitive peak input current
$I_{O(AV)}$	Average output current
I_{opt}	Output current at optimum operation
I_{ORM}	Repetitive peak output current
I_R	Reverse (cut-off) current
$I_{R(D)}$	Dark reverse current
I_{RRM}	Repetitive peak reverse current
I_{SDX}	Source cut-off current (specified conditions)
I_{SGO}	Source current (open drain)
I_T	On-state current
dI_T/dt	Rate of rise of on-state current
$I_{T(AV)}$	Average on-state current
I_{TRM}	Repetitive peak on-state current
$I_{T(RMS)}$	R.M.S. value of the on-state current
I_{TSM}	Non-repetitive peak on-state current
I_{TWM}	Working peak on-state current
I_v	Luminous intensity
I_Z	Working current (d.c. or average)
I_{ZM}	Peak working current
I_{ZRM}	Repetitive peak working current
I^2t	I squared t for fusing
N	Light sensitivity
P_D	Drive power
P.E.P.	Peak envelope power
P_L	Load power
P_o	Output power
P_{opt}	Optimum output power
P_{RRM}	Repetitive peak reverse power dissipation
P_{RSM}	Non-repetitive peak reverse power dissipation
P_S	Source power
P_{tot}	Total power dissipation
P_{ZRM}	Repetitive peak reverse power dissipation
P_{ZSM}	Non-repetitive peak reverse power dissipation
r_D	Diode series resistance
r_{diff}	Differential resistance
r_{do}	Initial dark resistance
r_{DSoff}	Drain-source resistance (off)
$r_{ds\,on}$	Drain-source resistance (on) at specified frequency
R_L	Load resistance
r_{lo}	Initial illumination resistance
S_F, S_Z	Temperature coefficient of the working voltage
T_{amb}	Ambient temperature
T_c	Colour temperature
t_d	Forward conduction delay
t_f	Fall time
T_h	Heatsink temperature
T_j	Junction temperature
T_{mb}	Mounting base temperature
t_{off}	Turn-off time
t_{on}	Turn-on time
t_q	Circuit commutated turn-off time
t_r	Rise time
t_{rr}	Reverse recovery time
t_{tot}	Total recovery time
V_{AK}	Anode-cathode voltage
V_B	Supply voltage
V_{CBO}	Collector-base voltage (open emitter)
V_{CEO}	Collector-emitter voltage (open base)
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CERM}	Peak value of V_{CER}
V_{CES}	Collector-emitter voltage (emitter to base)
V_{CESM}	Peak value of V_{CES}
V_{CEsat}	Collector-emitter saturation voltage
$V_{(CL)R}$	Output clamping voltage
dV_{com}/dt	Rate of rise of commutating voltage that will not trigger any device
V_D	Continuous off-state voltage
dV_D/dt	Rate of rise of off-state voltage
V_{DB}	Drain-substrate voltage
V_{DRM}	Repetitive peak off-state voltage
V_{DS}	Drain-source voltage
V_{DWM}	Crest working off-state voltage
V_F	Continuous forward voltage
V_{GA}	Anode gate-anode voltage
V_{GK}	Cathode gate-cathode voltage
ΔV_{GS}	Gate-source voltage difference
$\frac{d\Delta V_{GS}}{dT}$	Thermal drift of gate-source voltage difference
V_{GT}	Gate-cathode voltage that will trigger all devices
V_I	Input stand-off voltage (transient suppressors)
V_{IRM}	Repetitive peak input voltage
$V_{I(RMS)}$	R.M.S. value of the input voltage
V_{IWM}	Crest working input voltage
V_n	Equivalent noise voltage
V_O	Output voltage
$V_{(opt)}$	Output voltage at optimum operation
$V_{(P)GS}$	Gate-source cut-off voltage
V_R	Continuous reverse voltage; stand-off voltage
V_{RRM}	Repetitive peak reverse voltage
V_{RWM}	Crest working reverse voltage
V_{SB}	Source-substrate voltage
V_Z	Working voltage
$\frac{\Delta V}{\Delta T}$	Equivalent differential voltage change with temperature
y_{fs}	Transfer admittance (common source)
η	Efficiency
α 50%	Beamwidth between half-intensity directions
λ_{peak}	Wavelength at peak spectral response or emission
ϕ_e	Radiant output power

semiconductor index

In this alphanumeric list we present all semiconductors mentioned in this catalogue.
The second column gives the page on which abridged data can be found.
The third column is a code for the kind of product and the part of the Data Handbook System in which full information is given.

* = series

key to product code

D	Displays	S8	PC	Germanium point contact diodes	S1	Th	Thyristors	S2
FET	Field-effect transistors	S5	PDT	Photodiodes or transistors	S8	Tra	Transmitting transistors and modules	SC4a(S6)
GB	Germanium gold-bonded diodes	S1	Ph	Photoconductive devices	S8	Tri	Triacs	S2
I	Infrared devices	S8	PhC	Photocouplers	S8	Vrf	Voltage reference diodes	S1
LCD	Liquid crystal displays	—	R	Rectifier diodes	S1/S2	Vrg	Voltage regulator diodes	S1/S2
LED	Light-emitting diodes	S8	Sm	Small signal transistors	S3	WBM	Wideband hybrid IC modules	S10
Mm	Microminiature semiconductors for hybrid circuits	S7	Sp	Special diodes (low leakage)	S1	WBT	Wideband transistors	S10
P	Low-frequency power transistors and modules	S4	St	Rectifier stacks	S2	WD	Silicon whiskerless diodes	S1
			T	Tuner diodes	S1			

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*** = series**

type	page	product code	type	page	product code	type	page	product code	type	page	product code
BDX78	A58	P	**BF579**	A98	Mm	**BFR64**	A89	WBT	**BGY35**	A84	Tra
BDX91	A58	P	**BF622**	A100	Mm	**BFR65**	A89	WBT	**BGY36**	A84	Tra
BDX92	A58	P	**BF623**	A100	Mm	**BFR84**	A72	FET	**BGY38**	A84	Tra
BDX93	A58	P	**BF660**	A98	Mm	**BFR90;A**	A89	WBT	**BGY40A;B**	A84	Tra
BDX94	A58	P	**BF767**	A98	Mm	**BFR91;A**	A89	WBT	**BGY41A;B**	A84	Tra
BDX95	A58	P	**BF819**	A58	P	**BFR92;R***	A99	Mm	**BGY43**	A84	Tra
BDX96	A58	P	**BF857**	A58	P	**BFR93;R***	A99	Mm	**BGY50**	A90	WBM
BDY90;A	A58	P	**BF858**	A58	P	**BFR94**	A89	WBT	**BGY51**	A90	WBM
BDY91	A58	P	**BF859**	A58	P	**BFR95**	A89	WBT	**BGY52**	A90	WBM
BDY92	A58	P	**BF869**	A58	P	**BFR96;S**	A89	WBT	**BGY53**	A90	WBM
BF115	A66	Sm	**BF870**	A59	P	**BFS17;R**	A99	Mm	**BGY54**	A90	WBM
BF180	A66	Sm	**BF871**	A58	P	**BFS18;R**	A98	Mm	**BGY55**	A90	WBM
BF181	A66	Sm	**BF872**	A59	P	**BFS19;R**	A98	Mm	**BGY56**	A90	WBM
BF182	A66	Sm	**BF936**	A66	Sm	**BFS20;R**	A98	Mm	**BGY57**	A90	WBM
BF183	A66	Sm	**BF939**	A66	Sm	**BFS21;A**	A74	FET	**BGY58**	A90	WBM
BF184	A66	Sm	**BF960**	A72	FET	**BFS22A**	A84	Tra	**BGY59**	A91	WBM
BF185	A66	Sm	**BF967**	A66	Sm	**BFS23A**	A84	Tra	**BGY60**	A91	WBM
BF198	A66	Sm	**BF970**	A66	Sm				**BGY70**	A91	WBM
BF199	A66	Sm	**BF979**	A66	Sm	**BFT24**	A89	WBT	**BGY71**	A91	WBM
BF200	A66	Sm	**BF980**	A72	FET	**BFT25;R**	A99	Mm	**BGY74**	A91	WBM
BF240	A66	Sm	**BF981**	A72	FET	**BFT44**	A66	Sm	**BGY75**	A91	WBM
BF241	A66	Sm	**BF982**	A72	FET	**BFT45**	A66	Sm	**BLV10**	A84	Tra
BF245*	A72	FET	**BFQ10**	A74	FET	**BFT46**	A99	Mm	**BLV11**	A84	Tra
BF256*	A72	FET	**BFQ11**	A74	FET	**BFT92;R**	A99	Mm	**BLV20**	A84	Tra
BF324	A66	Sm	**BFQ12**	A74	FET	**BFT93;R**	A99	Mm	**BLV21**	A84	Tra
BF370	A66	Sm	**BFQ13**	A74	FET	**BFW10**	A72	FET	**BLV30**	A84	Tra
BF410*	A72	FET	**BFQ14**	A74	FET	**BFW11**	A72	FET	**BLV31**	A84	Tra
BF419	A58	P	**BFQ15**	A74	FET	**BFW12**	A72	FET	**BLV32F**	A84	Tra
BF422	A66	Sm	**BFQ16**	A74	FET	**BFW13**	A72	FET	**BLV33;F**	A84	Tra
BF423	A66	Sm	**BFQ17**	A99	Mm	**BFW16A**	A89	WBT	**BLV36**	A84	Tra
BF450	A66	Sm	**BFQ18A**	A99	Mm	**BFW17A**	A89	WBT	**BLV57**	A84	Tra
BF451	A66	Sm	**BFQ19**	A99	Mm	**BFW30**	A89	WBT	**BLW29**	A85	Tra
BF457	A58	P	**BFQ22;S**	A89	WBT	**BFW61**	A72	FET	**BLW31**	A85	Tra
BF458	A58	P	**BFQ23**	A89	WBT	**BFW92**	A89	WBT	**BLW32**	A85	Tra
BF459	A58	P	**BFQ24**	A89	WBT	**BFW93**	A89	WBT	**BLW33**	A85	Tra
BF469	A58	P	**BFQ32**	A89	WBT	**BFX34**	A66	Sm	**BLW34**	A85	Tra
BF470	A58	P	**BFQ34**	A89	WBT	**BFX89**	A89	WBT	**BLW50F**	A85	Tra
BF471	A58	P	**BFQ42**	A84	Tra	**BFY50**	A66	Sm	**BLW60;C**	A85	Tra
BF472	A58	P	**BFQ43**	A84	Tra	**BFY51**	A66	Sm	**BLW64**	A85	Tra
BF480	A66	Sm	**BFQ51**	A89	WBT	**BFY52**	A66	Sm	**BLW75**	A85	Tra
BF494	A66	Sm	**BFQ52**	A89	WBT	**BFY55**	A66	Sm	**BLW76**	A85	Tra
BF495	A66	Sm	**BFQ53**	A89	WBT	**BFY90**	A89	WBT	**BLW77**	A85	Tra
BF496	A66	Sm	**BFQ63**	A89	WBT	**BG1895***	A25	R	**BLW78**	A85	Tra
BF510	A99	Mm	**BFQ68**	A89	WBT	**BG1897***	A25	R	**BLW79**	A85	Tra
BF511	A99	Mm	**BFR29**	A72	FET	**BG2000***	A25	R	**BLW80**	A85	Tra
BF512	A99	Mm	**BFR30**	A99	Mm	**BG2097***	A25	R	**BLW81**	A86	Tra
BF513	A99	Mm	**BFR31**	A99	Mm	**BGY22;A**	A84	Tra	**BLW82**	A86	Tra
BF536	A98	Mm	**BFR49**	A89	WBT	**BGY23;A**	A84	Tra	**BLW83**	A86	Tra
BF550;R	A98	Mm	**BFR53;R**	A99	Mm	**BGY32**	A84	Tra	**BLW84**	A86	Tra
BF569	A98	Mm	**BFR54**	A66	Sm	**BGY33**	A84	Tra	**BLW85**	A86	Tra

semiconductor index

* = series

key to product code

D	Displays	S8
FET	Field-effect transistors	S5
GB	Germanium gold-bonded diodes	S1
I	Infrared devices	S8
LCD	Liquid crystal displays	—
LED	Light-emitting diodes	S8
Mm	Microminiature semiconductors for hybrid circuits	S7
P	Low-frequency power transistors and modules	S4
PC	Germanium point contact diodes	S1
PDT	Photodiodes or transistors	S8
Ph	Photoconductive devices	S8
PhC	Photocouplers	S8
R	Rectifier diodes	S1/S2
Sm	Small signal transistors	S3
Sp	Special diodes (low leakage)	S1
St	Rectifier stacks	S2
T	Tuner diodes	S1
Th	Thyristors	S2
Tra	Transmitting transistors and modules	SC4a(S6)
Tri	Triacs	S2
Vrf	Voltage reference diodes	S1
Vrg	Voltage regulator diodes	S1/S2
WBM	Wideband hybrid IC modules	S10
WBT	Wideband transistors	S10
WD	Silicon whiskerless diodes	S1

* = series

type	page	product code
BZX91	A11	Vrf
BZX92	A11	Vrf
BZX93	A11	Vrf
BZX94	A11	Vrf
BZY91*	A12	Vrg
BZY93*	A12	Vrg
BZY95*	A12	Vrg
BZY96*	A12	Vrg
CNX21	A112	PhC
CNX35	A112	PhC
CNX36	A112	PhC
CNX38	A112	PhC
CNY50*	A112	PhC
CNY62	A112	PhC
CNY63	A112	PhC
CQ209S	A109	D
CQ216X;Y	A109	D
CQ327;R	A109	D
CQ330;R	A109	D
CQ331;R	A109	D
CQ332;R	A109	D
CQ427;R	A109	D
CQ430;R	A109	D
CQ431;R	A109	D
CQ432;R	A109	D
CQL10	A104	LED
CQW10	A104	LED
CQW11	A105	LED
CQW12	A104	LED
CQX10*	A104	LED
CQX11*	A105	LED
CQX12*	A105	LED
CQX51*	A104	LED
CQX54	A104	LED
CQX55 to 58	A104	LED
CQX60 to 63	A101	LED
CQX64	A105	LED
CQX65 to 68	A105	LED
CQY74	A105	LED
CQX75 to 78	A105	LED
CQY11B;C	A104	LED
CQY24B*	A104	LED
CQY49B;C	A104	LED
CQY50	A104	LED
CQY52	A104	LED
CQY54*	A104	LED
CQY58A*	A104	LED
CQY89A*	A104	LED
CQY94*	A105	LED
CQY95*	A105	LED
CQY96*	A105	LED
CQY97*	A105	LED
LC1509	A110	LCD
LC1612	A110	LCD
LC2011	A110	LCD
LC2213	A110	LCD
LC2411	A110	LCD
LC2418	A110	LCD
LC3820	A110	LCD
LC5130	A110	LCD
LC7020	A110	LCD
LC7030	A110	LCD
LC7038	A110	LCD
LC8131	A110	LCD
LC076101	A110	LCD
LC114046	A110	LCD
OA47	A9	GB
OA90	A9	PC
OA91	A9	PC
OA95	A9	PC
OM320	A92	WBM
OM321	A92	WBM
OM322	A92	WBM
OM323;A	A92	WBM
OM335	A92	WBM
OM336	A92	WBM
OM337;A	A92	WBM
OM339	A92	WBM
OM345	A92	WBM
OM350	A92	WBM
OM360	A92	WBM
OM361	A92	WBM
OM370	A92	WBM
OM931	A61	P
OM961	A61	P
OSB9110*	A25	St
OSB9210*	A25	St
OSB9410*	A25	St
OSM9110*	A25	St
OSM9210*	A25	St
OSM9410*	A25	St
OSS9110*	A25	St
OSS9210*	A25	St
OSS9410*	A25	St
PH40	A17	R
PH70	A18	R
PH2369	A68	Sm
RPY58A	A102	Ph
RPY86	A108	I
RPY87	A108	I
RPY88	A108	I
RPY89	A108	I
RPY93	A108	I
RPY96	A108	I
1N821;A	A11	Vrf
1N823;A	A11	Vrf
1N825;A	A11	Vrf
1N827;A	A11	Vrf
1N829;A	A11	Vrf
1N3879	A22	R
1N3880	A22	R
1N3881	A22	R
1N3882	A22	R
1N3889	A22	R
1N3890	A22	R
1N3891	A22	R
1N3892	A22	R
1N3899	A22	R
1N3900	A22	R
1N3901	A22	R
1N3902	A22	R
1N3903	A22	R
1N3909	A23	R
1N3910	A23	R
1N3911	A23	R
1N3912	A23	R
1N3913	A23	R
1N4009	A8	WD
1N4148	A8	WD
1N4150	A8	WD
1N4151	A8	WD
1N4154	A8	WD
1N4446	A8	WD
1N4448	A8	WD
1N4531	A9	WD
1N4532	A9	WD
1N5060	A19	R
1N5061	A19	R
1N5062	A19	R
2N918	A70	Sm
2N929	A46	Sm
2N930	A46	Sm
2N1613	A70	Sm
2N1711	A70	Sm
2N1893	A70	Sm
2N2218;A	A70	Sm
2N2219;A	A70	Sm
2N2221;A	A70	Sm
2N2222;A	A70	Sm
2N2297	A70	Sm
2N2368	A70	Sm
2N2369;A	A70	Sm
2N2483	A46	Sm
2N2484	A46	Sm
2N2894;A	A70	Sm
2N2904;A	A70	Sm
2N2905;A	A70	Sm
2N2906;A	A70	Sm
2N2907;A	A70	Sm
2N3019	A70	Sm
2N3020	A70	Sm
2N3375	A87	Tra
2N3553	A87	Tra
2N3632	A87	Tra
2N3823	A72	FET
2N3866	A87	Tra
2N3924	A87	Tra
2N3926	A87	Tra
2N3927	A87	Tra
2N3966	A73	FET
2N4030	A70	Sm
2N4031	A70	Sm
2N4032	A70	Sm
2N4033	A70	Sm
2N4091	A73	FET
2N4092	A73	FET
2N4093	A73	FET
2N4391	A73	FET
2N4392	A73	FET
2N4393	A73	FET
2N4427	A87	Tra
2N4856	A73	FET
2N4857	A73	FET
2N4858	A73	FET
2N4859	A73	FET
2N4860	A73	FET
2N4861	A73	FET
2N5415	A70	Sm
2N5416	A70	Sm
3N211	A72	FET
368BPY	A101	PDT
375CQY	A101	—

small-signal diodes

Whiskerless
- high surge immunity
- high resistance to shock
- two-way heat transfer
- low leakage
- simple, sturdy construction
- hermetic capsule
- as good as, or better than MIL-S-19500

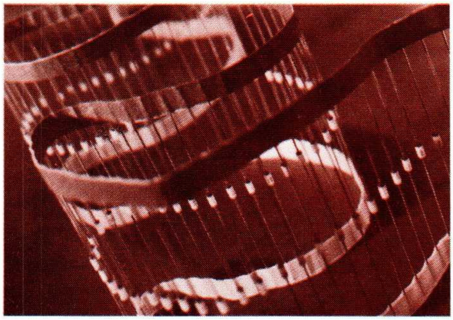
We supply
- to any world standardized JEDEC or PRO ELECTRON specification
- to any customer specification
- BS or CECC approved products; further information on request

Whiskerless in SOD-27 (DO-35)

max. values

	type	status	V_R (V_{RRM}) V	I_F mA	I_{FRM} mA	t_{rr} * ns	C_d pF	V_F at I_F = mA 10 V	20 V	30 V	50 V	100 V	200 V
general purpose	**BA220**	D	(10)	200	400	4	2,5	0,75	0,8	0,84	0,88	0,95	1,05
	BA316	D	10	100	225	4	2	0,85	0,92	0,97	1,02	1,1	—
	BA317	D	30	100	225	4	2	0,85	0,92	0,97	1,02	1,1	—
	BA318	D	50	100	225	4	2	0,85	0,92	0,97	1,02	1,1	—
	BAX14	D	20	500	2000	300▲	35	—	—	—	—	0,85	0,92
see stabistors	**BA314**	D	—	100	250	—	140	0,83	0,87	0,89	0,92	0,96	—
	BA314A	D	—	100	250	—	110	0,81	0,85	0,88	0,93	1	—
	BA315	D	(5)	100	225	—	3	0,79	0,85	0,89	0,95	1,05	—
high-speed switching	**BAW62**	D	75	100	225	4**	2	0,78	0,8	0,82	0,88	1	1,28
	1N4009	D	25	—	—	2	4	—	—	1	—	—	—
	1N4148	D	75	150	450	4	4	1	—	—	—	—	—
	1N4151	D	50	200	450	2	2	—	—	—	1	—	—
	1N4154	D	25	200	450	2	4	—	—	1	—	—	—
	1N4446	D	75	200	450	4	4	—	1	—	—	—	—
	1N4448	D	75	200	450	4	4	—	—	—	—	1	—
high-speed core gating	**BAV10**	D	60	300	600	6▲▲	2,5	0,75	0,78	0,8	0,85	0,92	1
	1N4150	D	50	300	600	6▲▲	2,5	0,74	—	—	0,86	0,92	1
high-speed, high voltage	**BAV18**	D	50	250	625	50▲	5	0,8	—	—	—	1	1,25
	BAV19	D	100	250	625	50▲	5	0,8	—	—	—	1	1,25
	BAV20	D	150	250	625	50▲	5	0,8	—	—	—	1	1,25
	BAV21	D	200	250	625	50▲	5	0,8	—	—	—	1	1,25
avalanche for telephony	**BAX12**	D	90	400	800	50▲	35	0,75	—	—	0,84	0,90	1
	BAX12A	C									at 400 mA:		1,25
rectifier applications	**BAX18**	D	75	500	2000	—	35	—	—	—	0,80	0,86	0,91
											at 400 mA:		1
avalanche	**BAS11**	N	300	350	900	1000▲▲	10	—	—	—	at 300 mA: 1,1 V; at 900 mA: 1,3 V		

* I_F = 10 mA to I_R = 60 mA, R_L = 100 Ω. Measured at I_R = 1 mA.
** I_F = 10 mA to I_R = 10 mA, R_L = 100 Ω. Measured at I_R = 1 mA.
▲ I_F = 30 mA to I_R = 30 mA, R_L = 100 Ω. Measured at I_R = 3 mA.
▲▲ I_F = 400 mA to I_R = 400 mA, R_L = 100 Ω. Measured at I_R = 40 mA.



Whiskerless in hard glass envelopes for demanding service in industry and telephony.

Low leakage (picoampere) diodes for clamping, holding, peak followers, delay, log amps, IGFETS.

Bandolier packed (9000 diodes per reel) for simple mechanical or manual handling.

Whiskerless in DO-34 (miniature axial lead envelope)

max. values

	type	status	V_R	I_F	I_{FRM}	t_{rr} *	C_d	V_F at I_F = mA					
								1	10	20	50	100	400
			V	mA	mA	ns	pF	V	V	V	V	V	V
general purpose	**1N4531** **1N4532**	D	75	150	450	4	4	—	1	—	—	—	—

Low leakage

type	status	case	V_R	I_F	I_R at	V_R and	T_j	C_d	V_F at I_F = 10 mA
			V	mA	pA	V	°C		
BAV45	D	TO-18(3)	20	50	5	5	25	1,3	1
					10	20	25		
					250	5	80		
BAV45A	N	TO-72(7)	BAV45A = two diodes BAV45 in one envelope						

Point contact

	type	status	case	V_R	I_F	I_{FRM}	t_{rr}	C_d	V_F at I_F = mA		
									0,1	10	30
				V	mA	mA	ns	pF	V	V	V
general	**OA90**			20	8	45				1,5	3,2
purpose	**OA91**	C	DO-7	90	50	150	—	—	0,25	1,9	3,3
	OA95			90	50	150				1,5	2,6
a.m. and f.m. detection	**AA119** **2-AA119**	C	DO-7	30	35	100	—	—	0,3	2,2	4

Gold bonded

	type	status	case	V_R	I_F	I_{FRM}	t_{rr}**	C_d	V_F at I_F = mA		
									0,1	10	30
				V	mA	mA	ns	pF	V	V	V
general purpose	**AAZ15** **AAZ17**	C	DO-7	75 50	140	250	350	2	0,57	0,9	1,1
general purpose and switching	**AAZ18** **OA47**	C	DO-7	20 25	130 110	300 150	70	2,5 3,5	0,5 0,65	0,75 1,1	—

* I_F = 10 mA to I_R = 60 mA, R_L = 100 Ω. Measured at I_R = 1 mA.
** I_F = 10 mA to I_R = 10 mA, R_L = 100 Ω. Measured at I_R = 1 mA.

tuner diodes

Testing of low-power diodes.

Variable capacitance

	type	status	case	V_R V	C_d pF	at V_R V	C_d ratio	at V/V	r_D Ω	at C_d pF
a.f.c. in radio and television	**BB119**	D	DO-35	15	20 to 25	4	>1,3	4/10	1,5	20-25
	BB417	D	DO-34	20	2,2 to 4	15	2	4/15	1,2	9
radio a.m.	**BB112**	D	SOD-69	12	440 to 540	1	>15	1/9	1,5	440
	BB130	N	SOD-69	30	450 to 550	1	>23	1/28	2	450
	BB212	D	TO-92(6)	12	500 to 620	0,5	>23	0,5/8	3	500
radio f.m.	**BB204B**	D	TO-29(6)	30	37 to 42	3	2,65	3/30	0,4	38
	BB204G	D	TO-29(6)	30	34 to 39	3	2,65	3/30	0,4	38
	BB304	N	TO-92(6)	30	42 to 47,5	2	1,65	2/8	0,4	38
television, v.h.f.	**BB105G**	C	SOD-23	28	1,8 to 2,8	25	>4	3/25	1,2	9
	BB109G	C	SOD-23	28	4,3 to 6	25	>5	3/25	0,6	25
	BB405G	D	DO-34	28	1,8 to 2,5	25	>4,3	3/25	1,2	9
	BB809	D	DO-34	28	4,5 to 6	25	>5	3/25	0,6	25
	BB909A / **BB909B**	D	DO-34	30	2,6 to 3 / 2,8 to 3,2	28	>12	1/28	1	30
bands IV & V to 860 MHz	**BB105B**	C	SOD-23	28	2,0 to 2,3	25	>4,5	3/25	0,8	9
	BB405B	D	DO-34	28	2 to 2,3	25	>4,5	3/25	0,8	9

Band switching

	type	status	case	V_R V	C_d pF	at V_R V	I_F mA	r_D Ω	at I_F mA
tv v.h.f.	**BA243**	C	DO-35	20	2	15	100	1	10
	BA244	C	DO-35	20	2	15	100	0,5	10
	BA482	D	DO-34	35	1,2	3	100	0,7	3
	BA483	D	DO-34	35	1,0	3	100	1,2	3
radio	**BA223**	D	DO-35	20	3,5	6	50	1,5	10
	BA423	N	DO-34	20	2,5	3	50	1,2	10

Various

	type	status	case	V_R V	C_d pF	at V_R V	I_F mA	F dB	r_D Ω	at I_F mA
Schottky barrier u.h.f. mixer	**BA280**	C	SOD-23	4	1	0	30	typ 6,5	15	5
PIN diode	**BA379**	C	SOD-52	30	typ 0,3 (900 MHz)	0	20	—	6,5	10 (35 MHz)

Note
All BB105, BB106, BB109, BB205 and BB405 types will be supplied in matched sets. Over the voltage range 0,5 V to 28 V the diodes in a set are capacitance matched to within 3%, for all mentioned types except 6%, for BB105G.

voltage reference diodes

With very low temperature coefficient;
ideal for top-class voltage reference sources.

type	status	case	reference voltage at I_Z V (nom)	mA	voltage tolerance (±)%	I_{ZM} (I_{ZRM}) mA	$\|S_Z\|$ at %/°C	I_Z mA	r_{diff} max Ω	at I_Z mA
BZX90	D						<0,01			
BZX91	D						<0,005			
BZX92	D	DO-34	6,5	7,5	5	50	<0,002	7,5	15	7,5
BZX93	D						<0,001			
BZX94	D						<0,0005			
1N821	D						<0,01			
1N823	D						<0,005			
1N825	D	DO-34	6,2	7,5	5	50	<0,002	7,5	15	7,5
1N827	D						<0,001			
1N829	D						<0,0005			
1N821A	N						<0,01			
1N823A	N						<0,005			
1N825A	N	DO-34	6,2	7,5	5	50	<0,002	7,5	10	7,5
1N827A	N						<0,001			
1N829A	N						<0,0005			
BZV10							<0,01			
BZV11		DO-34					<0,005			
BZV12	D	or	6,5	2	5	50	<0,002	2	50	2
BZV13		DO-35					<0,001			
BZV14							<0,0005			

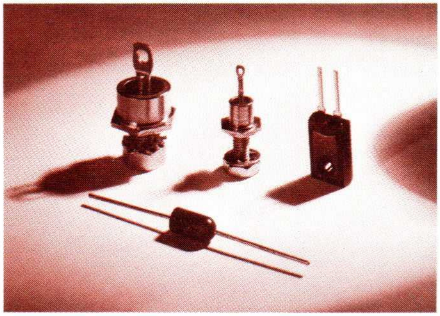
stabistors

Low-voltage regulator diodes — used in forward direction
for all shifting, coupling, clamping, protecting, bias regulating.

type	status	case	V_F at I_F = 1 mA min V	max V	V_F at I_F = 10 mA min V	max V	I_{FRM} mA	V_R = V_{RRM} V	S_F and r_{diff} typ at I_F = 1 mA mV/°C	Ω
BA314	D	DO-35	0,68	0,76	0,75	0,83	250	—	−1,8	30
BA315			0,59	0,66	0,71	0,79	225	—	−2,1	50
BZV46-C1V5	D	DO-35	1,35	1,55	—	—	120	4	−3,7	20
BZV46-C2V0			2,0	2,3			80		−5,6	30
BZX75-C1V4			1,16	1,34	1,33	1,47			−4	60
BZX75-C2V1	C	DO-7	1,75	2,05	1,99	2,21	250	10	−6	90
BZX75-C2V8			2,33	2,70	2,66	2,94			−8	120
BZX75-C3V6			3,02	3,45	3,42	3,78			−10	150

1. For BZY78 S_Z values: +0,006 at T_j = −40 to +25°C.
   −0,004 at T_j = 25 to 100°C.
2. For BA314 to 315 see also small-signal diodes (whiskerless).
3. For BZV46 V_F, S_F and r_{diff} are measured at I_F = 5 mA.

voltage regulator diodes



Medium to high power (Handbook S2)

- smoothing
- limiting
- regulating
- protecting

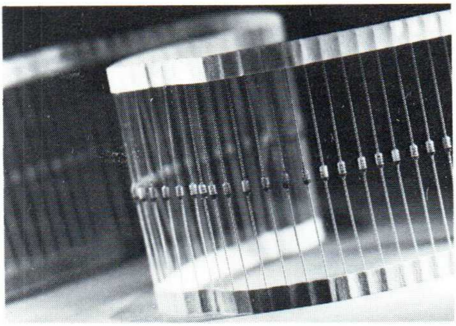
Normal polarity (cathode to stud) **no end-letter**
Reverse polarity (anode to stud) **R**
Both polarities available **(R)**

Regulated voltage	Suppression stand-off voltage
4,7 V	3,6 V
5,1 V	3,9 V
5,6 V	4,3 V
6,2 V	4,7 V
6,8 V	5,1 V
7,5 V	5,6 V
8,2 V	6,2 V
9,1 V	6,8 V
10 V	7,5 V
11 V	8,2 V
12 V	9,1 V
13 V	10 V
15 V	11 V
16 V	12 V
18 V	13 V
20 V	15 V
22 V	16 V
24 V	18 V
27 V	20 V
30 V	22 V
33 V	24 V
36 V	27 V
39 V	30 V
43 V	33 V
47 V	36 V
51 V	39 V
56 V	43 V
62 V	47 V
68 V	51 V
75 V	56 V
82 V	62 V

	BZY96 series	BZY95 series	BZX70 series	BZW70 series	BZY93 series	BZY91 series	BZW86 series	BZW91 series
$P_{tot\ max}$ for **voltage regulator service**		2,5 W		—	20 W	100 W	—	—
P_{RSM} max for **transient suppressor service**	190 W		700 W	700 W	700 W	9,5 kW	25 kW	27 kW
Regulated voltage	4,7 V – 9,1 V	10 V – 75 V	7,5 V – 75 V	7,5 V – 75 V	7,5 V – 75 V	7,5 V – 75 V	10 V – 75 V	8,2 V – 82 V
Outline	DO-1	DO-1	SOD-18	SOD-18	DO-4	DO-5	DO-30	DO-5
Polarity	normal	normal	normal	normal	both	both	both	both
Status	D	D	D	C	D	D	D	C

Transient suppressor bridges

type no.	V_I V	$V_{O(CL)}$ V	$I_{(CL)SM}$ A
BZW10-12	12	30	50
BZW10-15	15	34	40



Low power (Handbook S1)

- low leakage current
- low differential resistance
- sharp knee
- high surge immunity
- standard or custom specifications
- standardized envelopes
- types in DO-35 envelopes bandolier packed

Series number	**BZX55—...**	**BZX79—...**	**BZV85—...**	**BZX85—...**	**BZT03—...**	**BZX87—...**
P_{tot} (mW)	**400**	**400**	**1000**	**1100**	**1300**	**1500**
up to Tamb (°C)	50	50	25	25	45	25
Voltage tolerance (%)	5	5 or 2 *	5	5	5	5
I_{FRM} (mA)	250	250	—	400	—	400
I_{ZRM} (mA)	—	—	—	—	—	—
P_{ZSM} (mA)	30	30	—	100	—	100
$T_{j\ max}$ (°C)	200	200	—	200	175	200
Case	DO-35	DO-35	DO-41	DO-41	SOD-57	SOD-51
Status	D	D	D	N	N	D
Nominal voltage range (V)	2,4-75	2,4-75	5,1-75	6,2-75	9,1-270	5,1-75

* 4,7 to 75 V (suffixes B4V7 to B75) available with 2% tolerance.

rectifier diodes

selection guide

General purpose (pages A17 to A19)

$I_{F(AV)max}$ A		V_{RRMmax} (V) 150	200	300	400	500	600	800	1000	1200	1400	1600
1,4	BYX22						●			●		
1,5	BYX45						●	●	●	●	●	
2	BYW54						●					
2	BYW55							●				
2	BYW56								●			
2	1N5059		●									
2	1N5060				●							
2	1N5061						●					
2	1N5062							●				
6	BYX49			●			●			●		
6	BYX38			●			●			●		
6	BY249			●			●		●			
9,5	BYX39						●	●	●	●	●	
10	BYX98			●			●			●		
10	BYX72	●		●		●						
12	BYX42			●			●			●		
15	BYX99			●			●			●		
20	BYX25						●	●	●	●	●	
30	BYX96			●			●			●		●
40	PH40		●				●		●			
47	BYX97			●			●			●		●
48	BYX52			●			●			●		
48	BYX56						●	●	●	●	●	
70	PH70		●				●		●			
150	BYX32						●	●	●	●		●

Bridges (page A18)

$I_{O(AV)max}$ A		$V_{I(RMS)}$ (V) 50	60	80	140	220	280	425
1	BY179						●	
1,2	BY164		●					
1,5	BY256			●				
1,5	BY257						●	
4,8	BY224					●	●	
4,8	BY225	●		●				
12	BY260				●		●	●
25	BY261				●		●	●

Efficiency diodes (page A19)

I_{FWMmax} A		V_{RRMmax} 50	600	750	1200	1500
1,2*	BY188	●				
4	BY448					●
4	BY458				●	
5	BY223					●
5	BY228					●
5	BY438				●	
10	BY277		●	●		

* $I_{F(AV)max}$

Fast-recovery rectifier diodes

$I_{F(AV)max}$ A		V_{RRMmax} (V) 50	100	150	200	300	350	400	500	600	800	1000
Super-fast types (page A20)												
7	BYV29				•	•		•				
7	BYX50				•	•						
12	BYV30				•	•		•				
35	BYV92				•	•		•				
Ultra-fast (page A21)												
2	BYV27*	•	•	•	•							
3,5	BYV28*	•	•	•	•							
7	BYW29	•	•	•	•							
2 × 10	BYV32	•	•	•	•							
12	BYW30	•	•	•	•							
25	BYW31	•	•	•	•							
35	BYW92	•	•	•	•							
50	BYW93	•	•	•	•							
70	BYW94	•	•	•	•							
Very-fast types (pages A22/A23)												
1,5	BYV95*				•			•		•		
1,5	BYV96*										•	•
3	BYW95				•			•		•		
3	BYW96										•	•
6	1N3879	•										
6	1N3880		•									
6	1N3881				•							
6	1N3882					•						
12	1N3889	•										
12	1N3890		•									
12	1N3891				•							
12	1N3892					•						
14	BYX30*				•	•		•	•	•		
20	1N3899	•										
20	1N3900		•									
20	1N3901				•							
20	1N3902					•						
20	1N3903							•				
22	BYX46*				•	•		•	•	•		
30	1N3909	•										
30	1N3910		•									
30	1N3911				•							
30	1N3912					•						
30	1N3913							•				
Fast types (page A23)												
7	BY229				•			•		•	•	•
7	BYW19										•	•
7	BYX71						•			•		
14	BYV24										•	•
40	BYW25										•	•

* With avalanche characteristics.

rectifier diodes
selection guide

Schottky barrier (page A20)

$I_{F(AV)}$ A		V_{RRMmax} (V) 30	35	40	45
10	BYV19	●	●	●	●
2 × 10	BYV33	●	●	●	●
15	BYV20	●	●	●	●
28	BYV21	●	●	●	●
56	BYV22	●	●	●	●
70	BYV23	●	●	●	●

E.H.T. rectifiers (page A24)

$I_{F(AV)max}$ mA		V_{RRMmax} (kV) 1,8	7,5	12,5	18	23	27,5	37,5	115 to 225
2	BY477					●			
2	BY478						●		
2,5	BY409			●					
2,5	BY476				●				
4	BY509			●					
4	BY510			●					
5	BY184	●							
50	BYX35							●	
200	BYX90		●						
200	BYX91								●

E.H.T. power rectifier stacks: see page A25

Voltage tripler units (page A25)

E.H.T. output: 1,7 mA; 27,5 kV

BG1895 – 541/641
BG1897 – 541/542
BG1897 – 641/642
BG2000 – 641/642
BG2097 – 641/642

abridged data

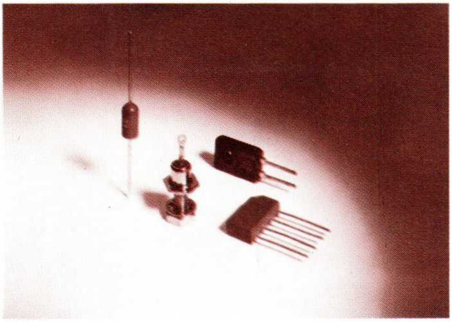
Normal polarity (cathode to stud)	**no end-letter**
Reverse polarity (anode to stud)	**R**
Both polarities available	**(R)**

General purpose

type		status	case	RATINGS $I_{F(AV)}$ A	V_{RRM} V	V_{RWM} V	I_{FRM} A	I_{FSM} and I^2t T_{jmax}; t = 10 ms A	 A^2s
BYX10		C	DO-14	**0,36**	1600	800	3	15	—
BY226 **BY227**		C	SOD-18	**1,33**	650 1250	450 800	10	50	—
BYX22	– 600 – 1200	C	DO-1	**1,4**	600 1200	400 800	15	40	—
BY527*		C	SOD-57	**2**	1250	800	12	50	—
BYX49	– 300(R) – 600(R) – 1200(R)	C	SOD-38	**6**	300 600 1200	200 400 800	20	40	8
BY249	– 300(R) – 600(R) – 1000(R)	N	TO-220AC	**6**	300 600 1000	200 400 800	20	40	8
BYX38	– 300(R) – 600(R) – 1200(R)	D	DO-4(1)	**6**	300 600 1200	200 400 800	50	50	13
BYX98	– 300(R) – 600(R) – 1200(R)	D	DO-4(1)	**10**	300 600 1200	200 400 800	75	75	28
BYX72	– 150(R) – 300(R) – 500(R)	C	SOD-38	**10**	150 300 500	100 200 400	50	100	50
BYX42	– 300(R) – 600(R) – 1200(R)	D	DO-4(1)	**12**	300 600 1200	200 400 800	60	125	75
BYX99	– 300(R) – 600(R) – 1200(R)	D	DO-4(1)	**15**	300 600 1200	200 400 800	180	180	162
BYX96	– 300(R) – 600(R) – 1200(R) – 1600(R)	D	DO-4(5)(6)	**30**	300 600 1200 1600	200 400 800 800	400	400	800
PH40	– 200(R) – 600(R) – 1000(R)	D	DO-5	**40**	200 600 1000	200 500 800	200	400	800

* With avalanche characteristics.

rectifier diodes
abridged data



General purpose				RATINGS					
type		status	case	$I_{F(AV)}$	V_{RRM}	V_{RWM}	I_{FRM}	I_{FSM} and I^2t T_{jmax}; t = 10 ms	
				A	V	V	A	A	A^2s
BYX97	– 300(R) – 600(R) – 1200(R) – 1600(R)	D	DO-5(2)	**47**	300 600 1200 1600	200 400 800 800	550	800	3200
BYX52	– 300(R) – 600(R) – 1200(R)	C	DO-5(1)	**48**	300 600 1200	200 400 800	450	800	3200
PH70	– 200(R) – 600(R) – 1000(R)	D	DO-5	**70**	200 600 1000	200 500 800	350	1000	5000
BYX32	– 600(R) – 800(R) – 1000(R) – 1200(R) – 1600(R)	D	SOD-8	**150**	600 800 1000 1200 1600	600 800 1000 1200 1200	750	1600	12800

Bridges				INPUT				OUTPUT	
type		status	case	$V_{I(RMS)}$	V_{IRM}	V_{IWM}	I_{ISM}	$I_{O(AV)}$ **R loaded**	I_{ORM}
				V	V	V	A	**A**	A
BY179		D	SOD-28	280	800	400	25	**1**	5
BY164		D	SOD-28	60	120	85	25	**1,2**	5
BY256		D	SOD-28	80	200	112	50	**1,5**	8
BY257		D	SOD-28	280	600	400	50	**1,5**	8
BY224	– 400 – 600	D	SOT-112	220 280	400 600	350 400	100	**4,8**	50
BY225	– 100 – 200	D	SOT112	50 80	100 200	70 112	100	**4,8**	50
BY260	– 200 – 400 – 600	D	—	140 280 425	200 400 600	200 400 600	125	**12**	20
BY261	– 200 – 400 – 600	D	—	140 280 425	200 400 600	200 400 600	320	**25**	75

Normal polarity (cathode to stud)	no end-letter
Reverse polarity (anode to stud)	R
Both polarities available	(R)

Efficiency diodes

type		status	case	RATINGS $I_{F(AV)}$ A	I_{FWM} A	V_{RRM} V	I_{FRM} A	CHARACTERISTICS t_d min µs	t_{tot} max µs	t_{rr} max ns
BY188A		C	SOD-18	1,2	—	50	10	0	—	—
BY188B								0,7		
BY188G		N	SOD-57	1,5	—	50	10	0,5	—	—
BY223		C	SOD-38	—	5	1500	10	—	20	—
BY228		D	SOD-64	—	5	1500	10	—	20	—
BY277	– 600R	C	SOD-38	—	10	600	20	—	—	400
	– 750R					750				
BY438		D	SOD-64	—	5	1200	10	—	20	—
BY448		D	SOD-57	—	4	1500	8	—	20	—
BY458		D	SOD-57	—	4	1200	8	—	20	—

Avalanche

type		status	case	RATINGS $I_{F(AV)}$ A	V_{RWM} V	I_{FRM} A	I_{FSM} and I^2t T_{jmax}; t = 10 ms A	A^2s	P_{RRM} t = 10 µs kW	P_{RSM} kW
	– 600R				600					
	– 800R				800					
BYX45	– 1000R	C	DO-1	1,5	1000	15	40	8	0,8	2,5
	– 1200R				1200					
	– 1400R				1400					
BYW54					600					
BYW55		D	SOD-57	2	800	12	50	—	—	1
BYW56					1000					
1N5060					400					
1N5061		D	SOD-57	2	600	12	50	—	—	1
1N5062					800					
	– 600(R)				600					
	– 800(R)				800					
BYX39	– 1000(R)	D	DO-4(1)	9,5	1000	100	125	78	2	4
	– 1200(R)				1200					
	– 1400(R)				1400					
	– 600(R)				600					
	– 800(R)				800					
BYX25	– 1000(R)	D	DO-4(3)	20	1000	440	360	650	3	18
	– 1200(R)				1200					
	– 1400(R)				1400					
	– 600(R)				600					
	– 800(R)				800					
BYX56	– 1000(R)	D	DO-5(1)	48	1000	450	800	3200	6,5	40
	– 1200(R)				1200					
	– 1400(R)				1400					

rectifier diodes
abridged data

Schottky barrier				RATINGS						CHARACTERISTICS	
type		status	case	$I_{F(AV)}$	V_{RRM}	V_{RWM}	I_{FRM}	I_{FSM} and I^2t T_{jmax}; t = 10 ms		t_{rr} max	V_{Fmax} at I_F $T_j = 100°C$
				A	V	V	A	A	A^2s	ns	V A
BYV19	– 30	N	TO-220AC	**10**	36	30	—	200	200	180pF	0,55/10
	– 35				42	35					
	– 40				48	40					
	– 45				54	45					
BYV33 (Double)	– 30	N	TO-220AB	**2×10**	36	30	—	2×200	200	2×220pF	0,55/10
	– 35				42	35					
	– 40				48	40					
	– 45				54	45					
BYV20	– 30	D	DO-4(1)	**15**	36	30	—	300	450	520pF	0,6/15
	– 35				42	35					
	– 40				48	40					
	– 45				54	45					
BYV21	– 30	D	DO-4(3)	**28**	36	30	—	550	1500	1150pF	0,55/30
	– 35				42	35					
	– 40				48	40					
	– 45				54	45					
BYV22	– 30	D	DO-5	**56**	36	30	—	1000	5000	2100pF	0,55/50
	– 35				42	35					
	– 40				48	40					
	– 45				64	45					
BYV23	– 30	D	DO-5	**70**	36	30	—	1500	11250	2500pF	0,55/70
	– 35				42	35					
	– 40				48	40					
	– 45				54	45					
Super fast types											
BYV29	– 200	N	TO-220AC	**7**	200	200	80	80	32	60	1,2/5
	– 300				300	300					
	– 400				400	400					
BYX50	– 200(R)	D	DO-4(1)	**7**	200	200	80	80	32	100	1,95/20
	– 300(R)				300	300					
BYV30	– 200(R)	D	DO-4(1)	**12**	200	200	140	150	112	100	1,35/10
	– 300(R)				300	300					
	– 400(R)				400	400					
BYV92	– 200(R)	D	DO-5	**35**	200	200	500	500	1250	100	1,4/100
	– 300(R)				300	300					
	– 400(R)				400	400					

Ultra fast types

type		status	case	RATINGS $I_{F(AV)}$ A	V_{RRM} V	V_{RWM} V	I_{FRM} A	I_{FSM} and I^2t, T_{jmax}; t = 10 ms: A	I_{FSM} and I^2t, T_{jmax}; t = 10 ms: A^2s	CHARACTERISTICS t_{rr} max ns	V_{Fmax} at I_F, $T_j = 25°C$: V/A
BYV27	– 50	D	SOD-57	**2**	50	50	15	50	—	25	0,88/3
	– 100 *				100	100					
	– 150				150	150					
	– 200				200	200					
BYV28	– 50	D	SOD-64	**3,5**	50	50	25	80	—	30	0,75/3
	– 100 *				100	100					
	– 150				150	150					
	– 200				200	200					
BYW29	– 50	D	TO-220AC	**7**	50	50	80	80	32	35	0,85/5
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYV32 (Double)	– 50	D	TO-220AB	**2 × 10**	50	50	300	2 × 150	112	35	0,85/5
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYW30	– 50	D	DO-4(1)	**12**	50	50	200	200	200	35	0,85/10
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYW31	– 50	D	DO-4(1)	**25**	50	50	320	320	500	50	0,85/20
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYW92	– 50	D	DO-5	**35**	50	50	500	500	1250	50	0,95/35
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYW93	– 50	D	DO-5	**50**	50	50	800	800	3200	60	0,85/50
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					
BYW94	– 50	D	DO-5	**70**	50	50	1500	1500	11250	60	0,85/70
	– 100				100	100					
	– 150				150	150					
	– 200				200	200					

* With avalanche characteristics.

rectifier diodes
abridged data

Very fast types			RATINGS						CHARACTERISTICS	
type	status	case	$I_{F(AV)}$	V_{RRM}	V_{RWM}	I_{FRM}	I_{FSM} and I^2t T_{jmax}; t = 10 ms		t_{rr} max	V_{Fmax} at I_F $T_j = 25°C$
			A	V	V	A	A	A^2s	ns	V / A
BYV95 –A –B* –C	D	SOD-57	**1,5**	200 400 600	200 400 600	10	35	—	250	1,6/3
BYV96 –D* –E	D	SOD-57	**1,5**	800 1000	800 1000	10	35	—	300	1,6/3
BYW95 –A –B* –C	D	SOD-64	**3**	200 400 600	200 400 600	15	70	—	250	1,5/5
BYW96 –D* –E	D	SOD-64	**3**	800 1000	800 1000	15	70	—	300	1,5/5
1N3879(R) **1N3880(R)** **1N3881(R)** **1N3882(R)**	D	DO-4(1)	**6**	50 100 200 300	50 100 200 300	75	75	28	200	1,4/6
1N3889(R) **1N3890(R)** **1N3891(R)** **1N3892(R)**	D	DO-4(1)	**12**	50 100 200 300	50 100 200 300	140	140	100	200	1,4/12
BYX30 –200(R) –300(R) –400(R) –500(R) –600(R)	C C D D D	DO-4(3)	**14**	— — — — —	200 300 300 500 600	310	250	312	200	2,1/14
1N3899(R) **1N3900(R)** **1N3901(R)** **1N3902(R)** **1N3903(R)**	D	DO-5	**20**	50 100 200 300 400	50 100 200 300 400	100	225	250	200	1,4/20
BYX46 –200(R) –300(R) –400(R) –500(R) –600(R)	D	DO-4(3)	**22**	— — — — —	200 300 400 500 600	400	300	450	200	2,0/50

* With avalanche characteristics.

Very fast types (continued)				RATINGS						CHARACTERISTICS
type	status	case	$I_{F(AV)}$	V_{RRM}	V_{RWM}	I_{FRM}	I_{FSM} and I^2t T_{jmax}; t = 10 ms		t_{rr} max	V_{Fmax} at I_F $T_j = 25°C$
			A	V	V	A	A	A^2s	ns	V A
1N3909(R)				50	50					
1N3910(R)				100	100					
1N3911(R)	D	DO-5	**30**	200	200	125	300	450	200	1,4/30
1N3912(R)				300	300					
1N3913(R)				400	400					

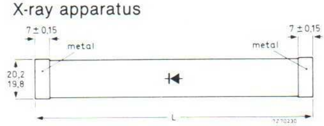
Fast types

BYX71 – 350(R)	C	SOD-38	**7**	350	300	25	60	—	450	1,25/5
BYX71 – 600(R)				600	500					
BYW19 – 800(R)	C	SOD-38	**7**	800	800	75	40	—	450	2,3/20
BYW19 – 1000(R)				1000	800					
BY229 – 200(R)				200	150					
BY229 – 400(R)				400	300					
BY229 – 600(R)	D	TO-220AC	**7**	600	500	75	60	—	450	1,85/20
BY229 – 800(R)				800	600					
BY229 – 1000(R)				1000	800					
BYV24 – 800(R)	N	DO-4(1)	**14**	800	650	130	150	112	450	1,7/20
BYV24 – 1000(R)				1000	800					
BYW25 – 800(R)	D	DO-5	**40**	800	650	600	550	1500	450	2,25/150
BYW25 – 1000(R)				1000	800					

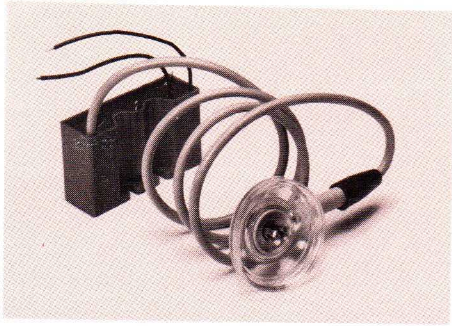
rectifier diodes
abridged data

E.H.T. rectifiers

type		status	case	leads	$I_{F(AV)}$ max mA	V_{RRM} max kV	for use in
BY184		C	SOD-34(1)	long	5	1,8	colour tv V_{g2} supply
BY184G		N					
BY409		C	SOD-34(1)	long	2,5*	12,5	high-voltage multipliers and colour tv
BY476		C	SOD-56	min 22 mm	2,5	18	high-voltage multipliers, tiny vision and black-and-white tv
BY477		C	SOD-56		2	23	high-voltage rectifiers for black-and-white tv
BY478						27,6	
BY509		D	SOD-61		4	12,5	triplers, diode-split transformers
BY510		D	SOD-61		4	12,5	3-layer split transformer (V_{RSM} = 17 kV)
BYX90		C	SOD-18B		200	7,5	main application in sub-assembly (BYX91) for X-ray equipment
BYX91	– 90K	C	L = max 143 mm		200	115	X-ray apparatus
	– 120K		L = max 171 mm			150	
	– 150K		L = max 231 mm			190	
	– 180K		L = max 231 mm			225	



* 4 mA up to T_{amb} = 77°C, as clamping diode in tripler circuits.

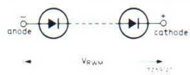
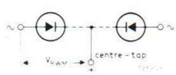
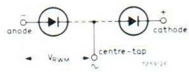


Voltage tripler units.
Non-flammable units for e.h.t. supply in colour tv.

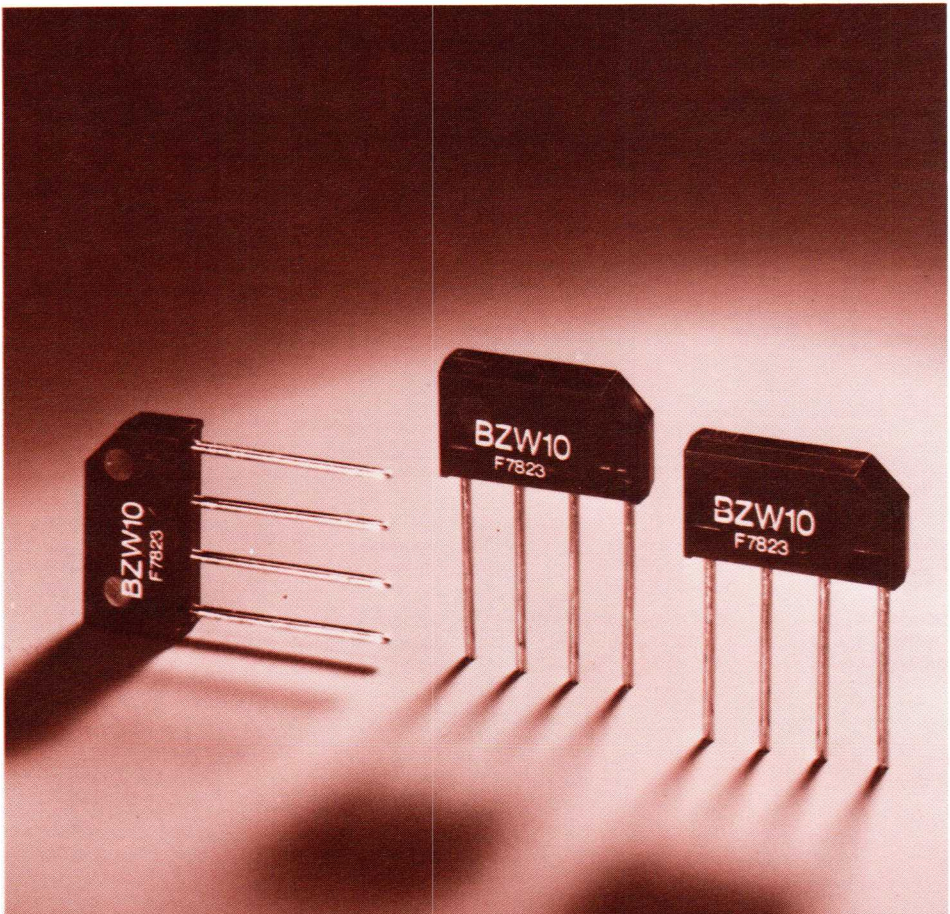
Voltage tripler units

type	status	case sizes in mm	T_{amb} max °C	RATINGS INPUT $V_{i(p-p)}$ kV	OUTPUT $V_{O(EHT)}$ kV	$I_{O(EHT)}$ mA	$I_{O(FOC)}$ mA
BG1895 –541 –641	D	25,5 × 75 × 45	65	10	27,5	1,7	400
BG1897 –541 –542	D	25,5 × 103,5 × 58	65	10	27,5	1,7	85
BG1897 –641 –642	D	25,5 × 103,5 × 58	65	10	27,5	1,7	85
BG2000 –541 –641	N	24 × 52 × 51	65	10	27,5	1,7	400
BG2097 –641 –642	N	24 × 80 × 57	65	10	27,5	1,7	—

E.H.T. power rectifier stacks

type	status	$I_{F(AV)}$	V_{RWM}	for use in	
OSS9110-3 to 30 **OSS9210-3 to 30** **OSS9410-3 to 30**	D	3,5 A (6 A in oil) 5 A (20 A in oil) 10 A (30 A in oil)	3 kV to 30 kV	single-phase rectifiers	
OSB9110-4 to 30 **OSB9210-4 to 30** **OSB9410-4 to 30**	D	7 A (12 A in oil) 10 A (40 A in oil) 20 A (60 A in oil)	2 kV to 15 kV	two-phase half-wave circuits	
OSM9110-4 to 30 **OSM9210-4 to 30** **OSM9410-4 to 30**	D	3,5 A (6 A in oil) 5 A (20 A in oil) 10 A (30 A in oil)	2 kV to 15 kV	bridges and voltage doublers, single or three-phase	

BZW10 transient suppression bridge for telephones



thyristors and triacs
selection guide

General purpose thyristors (pages A28, A29)

$I_{T(RMS)}$ A		VRRMmax(V) 50	100	200	300	400	500	600	650	800	1000	1200	1400	1600
1	BT149	●	●	●		●	●	●						
1,6	BTX18		●	●	●	●	●							
12	BT151						●		●					
16	BTY79					●	●	●		●	●			
16	BTW38							●		●	●	●		
16	BTW42							●		●	●	●		
20	BT152					●		●		●				
25	BTW45					●		●		●	●	●		
25	BTW47									●	●	●	●	●
25	BTY87					●	●	●		●				
25	BTY91					●	●	●		●				
31	BTW92									●	●	●	●	●
32	BTW40					●		●		●				
70	BTV24							●		●		●	●	
140	BTW23							●		●	●	●	●	●

Fast turn-off thyristors (page A30)

$I_{T(RMS)}$ A			VDRMmax(V) 500	600	750	800	1000	1200	1400	1600
6	BT153		●							
8	BT154	ASCR construction			●					
15	BT155	ASCR construction				●				
24	BTW30S					●	●	●		
31	BTW31W					●	●	●		
40	BTW63	ASCR construction		●		●				
110	BTW33					●	●	●		

Fast gate turn-off thyristors (page A31)

$I_{T(AV)}$ A		I_{TCRM} A	VDRMmax(V) 500	600	750	850	1000	1300	1500	1600
2,2	BT157	10						●	●	
6,5	BTW58	25					●	●	●	
10	BTV58	25		●		●	●			
12	BTW59	50						●	●	
15	BTV59	50		●		●	●			

Triacs (pages A32/A33)

$I_{T(RMS)}$ A		VDRMmax(V) 400	500	600	650	800	1000	1200	1400	1600
4	BT136		●	●		●				
8	BT137		●	●		●				
12	BT138		●	●		●				
15	BTW43G			●		●	●	●		
15	BTW43H			●		●	●	●		
16	BT139		●	●		●				
25	BTX94H	●		●		●	●	●		
25	BTX94J	●		●		●	●	●		
55	BTV34G			●		●	●	●	●	
55	BTV34H			●		●	●	●	●	

Trigger devices (page A31)

Diac BR100: $V_{(BO)} = 28$ to 36 V; $I_{FRM} < 2$ A. Thyristor tetrode BRY39: $V_{RRMmax} = 70$ V; $I_{Tmax} = 250$ mA.

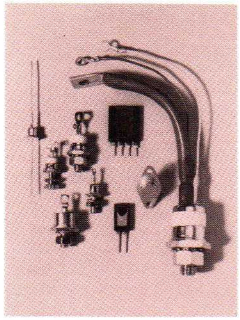
thyristors
abridged data

Normal polarity (cathode to stud) **no end-letter**
Reverse polarity (anode to stud) **R**
Both polarities available **(R)**

General purpose

type	suffix = V_{RRM} max	status	case	RATINGS $I_{T(RMS)}$ A	$I_{T(AV)}$ A	I_{TRM} A	I_{TSM} and I^2t $T_{j\,max}$; 10 ms A	A²s	dI_T/dt A/µs	CHARACTERISTICS dV_D/dt max * V/µs	V_{GT}▲ min V	I_{GT}▲ min mA
BT149 F A B D E M	– 50 – 100 – 200 – 400 – 500 – 600	D	TO-92	**1**	0,6	15	15	1	30	10	0,8	0,7
BTX18	– 100 – 200 – 300 – 400 – 500	D	TO-39(2)	**1,6**	1	10	10	—	—	15	2	5
BT151	– 500(R) – 650(R)	D	TO-220AB(3)	**12**	7,5	65	100	50	50	50	1,5	15
BTY79	– 400R – 500R – 600R – 800R – 1000R	D	TO-64(1)	**16**	10	75	150	112	50	50	1,5	30
BTW38	– 600R – 800R – 1000R – 1200R	D	TO-64(1)(2)	**16**	10	75	150	112	50	50	1,5	50
BTW42	– 600R – 800R – 1000R – 1200R	D	TO-64(1)(2)	**16**	10	75	150	112	50	200▲▲	1,5	50
BT152	– 400R – 600R – 800R	D	TO-220AB(3)	**20**	13	200	200	200	200	200	1,5	32
BTW45	– 400R – 600R – 800R – 1000R – 1200R	D	TO-48(1)(2)	**25**	16	200	300	450	100	200▲▲	1,5	75

* At $T_j = T_{j\,max}$.　▲ $V_D = 6$ V, $T_j = 25$°C.　▲▲ Up to 1000 V/µs on request.



General purpose

type	suffix = V_{RRM} max	status	case	RATINGS $I_{T(RMS)}$ A	$I_{T(AV)}$ A	I_{TRM} A	I_{TSM} and I^2t $T_{j\,max}$; 10 ms A	A^2s	dI_T/dt A/µs	CHARACTERISTICS dV_D/dt max * V/µs	V_{GT}▲ min V	I_{GT}▲ min mA
BTW47	– 800R – 1000R – 1200R – 1400R – 1600R	C	TO-48(1)(2)	**25**	16	150	300	450	200	300▲▲	3,5	100
BTY87	– 400R – 500R – 600R – 800R	C	TO-48(1)	**25**	16	140	140	100	20	20	3,5	65
BTY91	– 400R – 500R – 600R – 800R	C	TO-48(1)	**25**	16	200	200	200	20	20	3	40
BTW92	– 800R – 1000R – 1200R – 1400R – 1600R	D	TO-48(1)(2)	**31**	20	200	400	800	300	300▲▲	3,5	100
BTW40	– 400R – 600R – 800R	D	TO-48(1)(2)	**32**	20	200	400	800	100	100	1,5	75
BTV24	– 600R – 800R – 1200R – 1400R	D	TO-65	**70**	45	500	800	3200	100	200▲▲	2,5	100
BTW23	– 600R – 800R – 1000R – 1200R – 1400R – 1600R	C	TO-94(1)(2)	**140**	90	1250	2000	20000	300	200▲▲	2,5	150

* At $T_j = T_{j\,max}$.

▲ $V_D = 6$ V, $T_j = 25°C$.

▲▲ Up to 1000 V/µs on request.

thyristors
abridged data

Fast turn-off thyristors for motor control and 3-phase inverters. Excellent dI_T/dt and dV_D/dt ratings mean fewer protection components.

For use in high-frequency applications such as
- choppers
- pulse circuits
- frequency converters
- d.c. supplies

Fast turn-off

type	suffix = V_{RRM} max	status	case	RATINGS $I_{T(RMS)}$ A	$I_{T(AV)}$ A	I_{TRM} (I_{TM}) A	I_{TSM} and I^2t $T_{j\,max}$; 10 ms A	A²s	dI_T/dt A/µs	CHARACTERISTICS t_q max µs	dV_D/dt* max V/µs	V_{GT}▲ min V	I_{GT}▲ min mA
BT153		D	TO-220AB(3)	**6**	4	30	40	—	200	14	200	2,5	40
BT154				**8**	5	240	—	18	60	2,4			
BT155	– 600RK	D	TO-220AB(3)	**15**	9,5	90	110	60	60	4	200	2,0	100
	– 600RN									6			
	– 600RP									8			
	– 800RK									4			
	– 800RN									6			
	– 800RP									8			
BTW30	– 800RS – 1000RS – 1200RS	D	TO-48(2)	**24**	16	150	150	115	100	15	200	2,5	200
BTW31	– 800RW – 1000RW – 1200RW	C	TO-48(2)	**31**	22	240	240	290	100	20	200	2,5	200
BTW63	– 600RK	D	TO-48	**40**	25	250	370	700		4		2,0	250
	– 600RN									6			
	– 600RP									8			
	– 800RK									4			
	– 800RN									6			
	– 800RP									8			
BTW33	– 800R – 1000R – 1200R	C	TO-94(2)	**110**	80	750	1500	11250	100	25	200	2,5	150

* At $T_j = T_{j\,max}$.
▲ $V_D = 6$ V, $T_j = 25$°C.

Fast gate turn-off thyristors

type	suffix = V_{DRM} max	status	case	V_{DW} V	$I_{T(AV)}$ A	I_{TCRM} A	I_{TSM} T_{jmax} A	I^2t 10 ms A^2s	dV_D/dt msx kV/μs	V_{GT} min V	I_{GT} min mA	t_f max ns	V_{Tmax} at I_T V/A
BT157	– 1300R – 1500R	N	TO-220AB	1200 1300	**2,2**	10	20	2	10	1,5	200	250	3/2,5
BTW58	– 1000R – 1300R – 1500R	D	TO-220AB	650 1200 1300	**6,5**	25	50	12,5	10	1,5	200	250	3/5
BTV58	– 600R – 850R – 1000R	D	TO-220AB	400 600 800	**10**	25	75	28	10	1,5	200	250	1,8/5
BTW59	– 1300R – 1500R	N	TO-238 *	1200 1300	**12**	50	90	40	10	1,5	250	300	3/10
BTV59	– 600R – 850R – 1000R	N	TO-238 *	400 600 800	**15**	50	100	50	10	1,5	250	300	1,8/15

* with isolated base

trigger devices

Diac BR100 — status D

Breakover voltage	$V_{(BO)}$	28 to 36 V
Repetitive peak current	I_{FRM}	max 2 A
Breakback voltage	V_O	min 5 V

Thyristor tetrode BRY39 in TO-72(3) — status D

Ratings		Characteristics at $T_j = 25°C$		
$V_D = V_R$	max 70 V	V_{GKT}	>	0,5 V
I_{TSM} at $T_{j\,max}$		I_{GKT}	>	1 μA
t = 10 μs	max 3 A	$-V_{GAT}$	>	1 V
I_T	max 250 mA	$-I_{GAT}$	>	100 μA
dI_T/dt	max 20 A/μs			

triacs
abridged data

High quality triacs for motor control, furnace control, heating, light dimming, contactor drive, static switching, etc. They have a high surge capability and, due to the high commutating characteristics, are excellent for use with three-phase systems.

Triacs

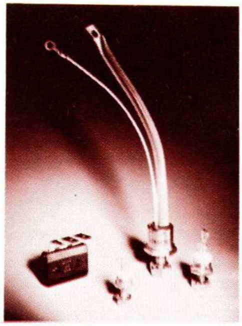
type	suffix = V_{DRM} max	status	case	RATINGS $I_{T(RMS)}$ A	I_{TRM} A	I_{TSM} and I^2t $T_{j\,max}$; 10 ms A	A²s	dI_T/dt A/µs	CHARACTERISTICS dV_D/dt max at $T_{j\,max}$ ** normal V/µs	commutating at $-dI_T/dt$ V/µs	A/ms	V_{GT}▲ min V	I_{GT}▲ min mA
BT136	−500 −600 −800	D	TO-220AB(2)	**4**	25	25		10	50	10	1,8	1,5	35 *
BT137	−500 −600 −800	D	TO-220AB(2)	**8**	55	55	15	20	50	10	3,6	1,5	35 *
BT138	−500 −600 −800	D	TO-220AB(2)	**12**	90	90	40	30	50	10	5,4	1,5	35 *
BT139	−500 −600 −800	D	TO-220AB(2)	**16**	115	115	65	30	50	10	7,2	1,5	35 *

* Variants with different gate sensitivities are available as follows:

Suffix to type no.	$I_{GT\,min}$
G	50 mA
F	25 mA
E	10 mA
D	5 mA

** It should be noted that a change in gate sensitivity does have effect on the commutation characteristics and dV_D/dt.

▲ $V_D = 12$ V, $T_j = 25°C$.



Letters G, H or J are added to the main type number to indicate the $-dI_T/dt$ value at which the specified dV_{com}/dt max occurs.

Triacs

type	suffix = V_{DRM} max	status	case	RATINGS $I_{T(RMS)}$ A	I_{TRM} A	I_{TSM} and I^2t $T_{j\,max}$; 10 ms A	A^2s	dI_T/dt A/µs	CHARACTERISTICS dV_D/dt max at $T_{j\,max}$ normal V/µs	commutating V/µs	at $-dI_T/dt$ A/ms	V_{GT}▲ min V	I_{GT}▲ min mA
BTW43G	– 600 – 800 – 1000 – 1200	D	TO-64(2)	**15**	50	120	72	50	200	10	5	2,5	100
BTW43H	– 600 – 800 – 1000 – 1200	D	TO-64(2)	**15**	50	120	72	50	200	10	12	2,5	100
BTX94H	– 400 – 600 – 800 – 1000 – 1200	D	TO-48(1)	**25**	100	250	320	50	100	30	25	3	150
BTX94J	– 400 – 600 – 800 – 1000 – 1200	D	TO-48(1)	**25**	100	250	320	50	100	30	50	3	150
BTV34G	– 600 – 800 – 1000 – 1200 – 1400 – 1600	D	TO-65	**55**	300	350	612	50	200	30	25	2,5	200
BTV34H	– 600 – 800 – 1000 – 1200 – 1400 – 1600	D	TO-65	**55**	300	350	612	50	200	30	50	2,5	200

▲ $V_D = 12$ V, $T_j = 25$°C.

transistor selection guide

P

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

P_{tot} max W		V_{CEO} V_{DS} max V	type no.	page
0,03	N	5	BFT24	A66
0,05	N	5	BFT25;R	A99
	N	20	BC146	A44
	P		BC200	A44
0,14	P	20	BF979	A66
0,145	N	20	BF184	A66
	N		BF185	A66
	N	30	BF115	A66
0,15	N	12	BFQ22;S	A89
	P		BFQ24	A89
	P	15	BFQ52	A89
	N		BFQ53	A89
	N	20	BF180	A66
	N		BF181	A66
	N		BF182	A66
	N		BF183	A66
	N		BF200	A66
	P		BF579	A98
	F	30	BFW12	A72
	F		BFW13	A72
	N	32	BCW60	A97
	P		BCW61	A97
	N	40	BCY87	A74
	N		BCY88	A74
	N		BCY89	A74
	N	45	BCX70	A97
	P		BCX71	A97
0,16	P	30	BF967	A66
	P	35	BF970	A66
0,18	P	12	BFQ23	A89
	N		BFR91	A89
	P	15	BFQ51	A89
	N		BFR49	A89
	N		BFR90	A89
	N		BFR90A	A89
0,19	N	10	BFW93	A89
	N	15	BFW92	A89
0,2	N	12	BFR93;R	A99
	P		BFT93;R	A99
	N	15	BF480	A66
	N		BFR92;R	A99
	N		BFR92A;R	A99
0,2	P	15	BFT92;R	A99
	N		BFX89	A89
	N		BFY90	A89
	N		2N918	A70
	P	20	BF767	A98
	P	25	BF660	A98
	N	30	BC848;R	A96
	N		BC849;R	A96
	P		BC858;R	A96
	P		BC859;R	A97
	P		BF536	A98
	M		BFR29	A72
	M		BSV81	A73
	P	40	BF550;R	A98
	P		BF569	A98
	N	45	BC847;R	A96
	N		BC850;R	A96
	P		BC857;R	A96
	P		BC860;R	A97
	N	65	BC846;R	A96
	P		BC856;R	A96
0,225	M	18	BF980	A72
	M	20	BF960	A72
	M		BF981	A72
	M		BF982	A72
0,25	N	10	BFR53;R	A99
	N		BFW30	A89
	N	12	BFR93A;R	A99
	N		BSV52;R	A100
	N	15	BFQ63	A89
	N		BFS17;R	A99
	P		BSR12;R	A100
	P	20	BF936	A66
	N		BFS18;R	A98
	N		BFS19;R	A98
	N		BFS20;R	A98
	F	25	BFR30	A99
	F		BFR31	A99
	F		BFT46	A99
	P	30	BF324	A66
	F		BFQ10	A74
	F		BFQ11	A74
	F		BFQ12	A74
	F		BFQ13	A74
	F		BFQ14	A74
	F		BFQ15	A74
	F		BFQ16	A74
0,25	N	40	BF240	A66
	N		BF241	A66
	P		BF450	A66
	P		BF451	A66
	F		BSR56	A99
	F		BSR57	A99
	F		BSR58	A99
0,255	P	25	BF939	A66
0,3	N	12	BFR91A	A89
	N	20	BC108	A44
	N		BC109	A44
	P		BC179	A44
	N		BCY57	A46
	F		BF410	A72
	N		BF494	A66
	N		BF495	A66
	N		BF496	A66
	F		BF510	A99
	F		BF511	A99
	F		BF512	A99
	F		BF513	A99
	P	25	BF178	A44
	F		BFW61	A72
	F	30	BC264	A72
	F		BF245	A72
	F		BF256	A72
	F		BFS21	A74
	F		BFS21A	A74
	F		BFW10	A72
	F		BFW11	A72
	F		2N3823	A72
	F		2N3966	A73
	N	45	BC107	A44
	P		BC177	A44
	N		BCY56	A46
	N		2N929	A46
	N		2N930	A46
0,31	P	25	BC808;R	A96
	N		BC818;R	A96
	P	45	BC807;R	A96
	N		BC817;R	A96
0,35	P	25	BCY72	A46
	P	32	BCF29;R	A98
	P		BCF30;R	A98
	N		BCF32;R	A98
	N		BCF33;R	A98

transistor selection guide

P

P listed by power dissipation
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Excluding r.f. power devices and devices for optoelectronics

P_{tot} max W		V_{CEO} V_{DS} max V	type no.	page
0,35	P	32	BCW29;R	A97
	P		BCW30;R	A97
	N		BCW31;R	A97
	N		BCW32;R	A97
	N		BCW33;R	A97
	P	40	BCY70	A46
	N		BSR17;R	A100
	P		BSR18;R	A100
	F		BSV78	A73
	F		BSV79	A73
	F		BSV80	A73
	P	45	BCF70;R	A98
	N		BCF81;R	A98
	P		BCW69;R	A97
	P		BCW70;R	A97
	N		BCW71;R	A97
	N		BCW72;R	A97
	N		BCW81;R	A97
	P		BCY71	A46
	N	60	BCV71;R	A97
	N		BCV72;R	A97
	P		BCW89;R	A97
	N	80	BSS64;R	A100
	P	100	BSS63;R	A100
0,36	P	12	2N2894	A70
	P		2N2894A	A70
	N	15	BSX19	A68
	N		BSX20	A68
	N		2N2368	A70
	N		2N2369	A70
	N		2N2369A	A70
	M	27	3N211	A72
	F	30	2N4859	A73
	F		2N4860	A73
	F		2N4861	A73
	F	40	2N4856	A73
	F		2N4857	A73
	F		2N4858	A73
	N	60	2N2483	A46
	N		2N2484	A46
0,4	P	40	2N2906	A70
	P		2N2907	A70
	P	60	2N2906A	A70
	P		2N2907A	A70
0,425	P	25	BCX18;R	A98
	N		BSX20;R	A98
	N	30	BSR13;R	A100
	N	40	BSR14;R	A100
	P		BSR15;R	A100
	P	45	BCX17;R	A98
	N		BCX19;R	A98
	P	60	BSR16;R	A100
0,5	N	15	BF370	A66
	N		BFQ19	A99
	P		BFQ32	A89
	N		BFR54	A66
	N		BFR96	A89
	N		PH2369	A68
	N	25	BF199	A66
	N	30	BC548	A45
	N		BC549	A45
	P		BC558	A45
	P		BC559	A45
	N		BF198	A66
	N		2N2221	A70
	N		2N2222	A70
	N	40	2N2221A	A70
	N		2N2222A	A70
	N	45	BC547	A45
	N		BC550	A45
	P		BC557	A45
	P		BC560	A45
	N	65	BC546	A45
	P		BC556	A45
	N	100	BSS38	A68
	P		BSS68	A68
0,6	P	32	BCY33A	A46
	P		BCY34A	A46
	P	40	2N2904	A70
	P		2N2905	A70
	P	60	2N2904A	A70
	P		2N2905A	A70
	P	64	BCY30A	A46
	P		BCY31A	A46
	P		BCY32A	A46
0,7	N	15	BFR96S	A89
0,8	N	20	BC375	A45
	P		BC376	A45
	N		BFY52	A66
	P	25	BC328	A44
	N		BC338	A44
0,8	N	30	BFY51	A66
	N		BSX60	A68
	N		2N2218	A70
	N		2N2219	A70
	N	35	BFY50	A66
	N		BFY55	A66
	N		2N2297	A70
	P	40	BSV15	A68
	N		2N2218A	A70
	N		2N2219A	A70
	P	45	BC327	A44
	N		BC337	A44
	N		BSR50	A68
	P		BSR60	A68
	N		BSS50	A68
	P		BSS60	A68
	N		BSX59	A68
	N		BSX61	A68
	N	50	2N1613	A70
	N		2N1711	A70
	N	60	BSR51	A68
	P		BSR61	A68
	N		BSS51	A68
	P		BSS61	A68
	P		BSV16	A68
	P		2N4030	A70
	P		2N4032	A70
	N	80	BSR52	A68
	P		BSR62	A68
	N		BSS52	A68
	P		BSS62	A68
	P		BSV17	A68
	N		2N1893	A70
	N		2N3019	A70
	N		2N3020	A70
	P		2N4031	A70
	P		2N4033	A70
	N	100	BSW66A	A68
	N	120	BSW67A	A68
	N	150	BSW68A	A68
0,83	N	250	BF422	A66
	P		BF423	A66
0,87	N	60	BFX34	A66
1	N	15	BFQ18A	A99
	N	20	BC368	A45
	P		BC369	A45

transistor selection guide

P

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Excluding r.f. power devices and devices for optoelectronics

P_{tot} max W		V_{CEO} V_{DS} max V	type no.	page
1	N	25	BFQ17	A99
	N		BSW41A	A68
	N	32	BCY58	A46
	P		BCY78	A46
	N	45	BC635	A45
	P		BC636	A45
	P		BCX51	A98
	N		BCX54	A98
	N		BCY59	A46
	P		BCY79	A46
	N	60	BC637	A45
	P		BC638	A45
	P		BCX52	A98
	N		BCX55	A98
	P		BSR30	A100
	P		BSR31	A100
	N		BSR40	A100
	N		BSR41	A100
	N	80	BC639	A45
	P		BC640	A45
	P		BCX53	A98
	N		BCX56	A98
	P		BSR32	A100
	P		BSR33	A100
	N		BSR42	A100
	N		BSR43	A100
	P	200	BST15;R	A100
	P		2N5415	A70
	N	250	BF622	A100
	P		BF623	A100
	P	300	BST16;R	A100
	P		2N5416	A70
1,5	N	25	BFR95	A89
	N		BFW16A	A89
	N		BFW17A	A89
1,8	F	40	2N4091	A73
	F		2N4092	A73
	F		2N4093	A73
	F		2N4391	A73
	F		2N4392	A73
	F		2N4393	A73
	N	250	BF469	A58
	P		BF470	A58
	N	300	BF471	A58
	P		BF472	A58
2,25	N	18	BFQ34	A89
2,5	N	25	BFR94	A89
3,5	N	25	BFR64	A89
3,7	N	40	BC140	A44
	P		BC160	A44
	N	60	BC141	A44
	P		BC161	A44
4,5	N	18	BFQ68	A89
5	N	25	BFR65	A89
	N	40	BSX45	A68
	N	45	BDX42	A57
	P		BDX45	A57
	N	60	BDX43	A57
	P		BDX46	A57
	N		BSV64	A68
	N		BSX46	A68
	N	80	BDX44	A57
	P		BDX47	A57
	N		BSX47	A68
	N	250	BF869	A58
	P		BF870	A59
	P		BFT45	A66
	N	300	BF871	A58
	P		BF872	A59
	P		BFT44	A66
6	N	160	BF457	A58
	N		BF857	A58
	N	250	BF419	A58
	N		BF458	A58
	N		BF819	A58
	N		BF858	A58
	N	300	BF459	A58
	N		BF859	A58
8	N	45	BD135	A51
	P		BD136	A51
	N		BD825	A53
	P		BD826	A53
	N		BDW55	A57
	P		BDW56	A57
	N	60	BD137	A51
	P		BD138	A51
	N		BD827	A53
	P		BD828	A53
	N		BDW57	A57
	P		BDW58	A57
8	N	80	BD139	A51
	P		BD140	A51
	N		BD829	A53
	P		BD830	A53
	N		BDW59	A57
	P		BDW60	A57
10	N	45	BD839	A53
	P		BD840	A53
	N	60	BD841	A53
	P		BD842	A53
	N	80	BD843	A53
	P		BD844	A53
	N	100	BD845	A53
	P		BD846	A54
	N	120	BD847	A53
	P		BD848	A54
	N	140	BD849	A53
	P		BD850	A54
12,5	N	45	BD226	A51
	P		BD227	A51
	N		BD813	A53
	P		BD814	A53
	N	60	BD228	A51
	P		BD229	A51
	N		BD815	A53
	P		BD816	A53
	N		BD230	A51
	P		BD231	A51
	N		BD817	A53
	P		BD818	A53
15	N	20	BD329	A52
	P		BD330	A52
	N	45	BD131	A51
	P		BD132	A51
	N	60	BDX35	A57
	N		BDX36	A57
	N	80	BDX37	A57
20	N	400	BUX86	A59
	N	450	BUX87	A59
25	N	45	BD233	A51
	P		BD234	A51
	N	60	BD235	A51
	P		BD236	A51

transistor selection guide

P

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

P_{tot} max W		V_{CEO} V_{DS} max V	type no.	page
25	N	80	BD237	A51
	P		BD238	A51
30	N	40	BDT29	A55
	P		BDT30	A55
	N	45	BD239	A51
	P		BD240	A51
	N		BD933	A54
	P		BD934	A54
	N	60	BD239A	A51
	P		BD240A	A51
	N		BD935	A54
	P		BD936	A54
	N		BDT29A	A55
	P		BDT30A	A55
	N	80	BD239B	A51
	P		BD240B	A51
	N		BD937	A54
	P		BD938	A54
	N		BDT29B	A55
	P		BDT30B	A55
	N	100	BD239C	A51
	P		BD240C	A51
	N		BD939	A54
	P		BD940	A54
	N		BDT29C	A55
	P		BDT30C	A55
	N	120	BD941	A54
	P		BD942	A54
	N	150	BD941A	A54
	P		BD942A	A54
36	N	22	BD433	A52
	P		BD434	A52
	N	32	BD435	A52
	P		BD436	A52
	N	45	BD437	A52
	P		BD438	A52
40	N	22	BD943	A54
	P		BD944	A54
	N	32	BD945	A54
	P		BD946	A54
	N	40	BDT31	A55
	P		BDT32	A55
	N	45	BD241	A52
	P		BD242	A52
	N		BD675	A53
	P		BD676	A53
	N		BD947	A54
	P		BD948	A54
40	N	60	BD241A	A52
	P		BD242A	A52
	N		BD677	A53
	P		BD678	A53
	N		BD949	A54
	P		BD950	A54
	N		BDT31A	A55
	P		BDT32A	A55
	N		BDY92	A58
	N	80	BD241B	A52
	P		BD242B	A52
	N		BD679	A53
	P		BD860	A53
	N		BD951	A54
	P		BD952	A54
	N		BDT31B	A55
	P		BDT32B	A55
	N		BDY91	A58
	N	100	BD241C	A52
	P		BD242C	A52
	N		BD681	A53
	P		BD682	A53
	N		BD953	A54
	P		BD954	A54
	N		BDT31C	A55
	P		BDT32C	A55
	N		BDY90	A58
	N	120	BD683	A53
	P		BD684	A53
	N		BD955	A54
	P		BD956	A54
	N	150	BD957	A54
	P		BD958	A54
	N	400	BUX84	A59
	N	450	BUX85	A59
45	PM	50	BUZ10	A60
	PM	100	BUZ20	A60
	PM	200	BUZ30	A60
50	P	60	BDT60	A55
	N		BDT61	A55
	P	80	BDT60A	A55
	N		BDT61A	A55
	P	100	BDT60B	A55
	N		BDT61B	A55
	P	120	BDT60C	A55
	N		BDT61C	A55
	N	400	BUW84	A59
	N	450	BUW85	A59
60	N	45	BD201	A51
	P		BD202	A51
	N	60	BD203	A51
	P		BD204	A51
	N		BD331	A52
	P		BD332	A52
	N	80	BD333	A52
	P		BD334	A52
	N		BDX77	A58
	P		BDX78	A58
	N	100	BD335	A52
	P		BD336	A52
	N	120	BD337	A52
	P		BD338	A52
	N	150	BU807	A59
	N	200	BU806	A59
62,5	N	60	BD645	A52
	P		BD646	A53
	N	80	BD647	A52
	P		BD648	A53
	N	100	BD649	A52
	P		BD650	A53
	N	120	BD651	A52
	P		BD652	A53
	P	130	BDT20	A54
	N		BDT21	A54
	PM	200	BUZ31	A60
	PM		BUZ33	A60
	PM	500	BUZ40	A60
	PM		BUZ41	A60
	PM	800	BUZ80	A60
	PM		BUZ83	A60
	PM	1000	BUZ50	A60
65	N	40	BDT41	A55
	P		BDT42	A55
	N	45	BD243	A52
	P		BD244	A52
	N	60	BD243A	A52
	P		BD244A	A52
	N		BDT41A	A55
	P		BDT42A	A55
	N	80	BD243B	A52
	P		BD244B	A52
	N		BDT41B	A55
	P		BDT42B	A55
	N	100	BD243C	A52
	P		BD244C	A52
	N		BDT41C	A55
	P		BDT42C	A55

transistor selection guide

P

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

P_{tot} max W		V_{CEO} V_{DS} max V	type no.	page
70	N	375	BU426	A59
	N	400	BU426A	A59
	N		BUV82	A59
	N	450	BUV83	A59
78	PM	200	BUZ34	A60
	PM	500	BUZ43	A60
	PM		BUZ44	A60
	PM	1000	BUZ53	A60
80	N	800	BUY89	A59
90	P	60	BDT62	A55
	N		BDT63	A56
	N		BDT91	A56
	P		BDT92	A56
	P		BDX62	A57
	N		BDX63	A57
	N		BDX91	A58
	P		BDX92	A58
	P	80	BDT62A	A55
	N		BDT63A	A56
	N		BDT93	A56
	P		BDT94	A56
	P		BDX62A	A57
	N		BDX63A	A57
	N		BDX93	A58
	P		BDX94	A58
	P	100	BDT62B	A55
	N		BDT63B	A56
	N		BDT95	A56
	P		BDT96	A56
	P		BDX62B	A57
	N		BDX63B	A57
	N		BDX95	A58
	P		BDX96	A58
	P	120	BDT62C	A55
	N		BDT63C	A56
	P		BDX62C	A57
	N		BDX63C	A57
100	N	60	BDV91	A56
	P		BDV92	A57
	N	80	BDV93	A56
	P		BDV94	A57
	N	100	BDV95	A56
	P		BDV96	A57
	N	400	BUS11	A59
	N		BUX46	A59
	N		BUX80	A59
100	N	450	BUS11A	A59
	N		BUX46A	A59
	N		BUX81	A59
	PM	500	BUZ45	A60
	PM	800	BUZ84	A60
	PM	1000	BUZ54	A60
115	N	375	BU826	A59
	N	400	BU826A	A59
117	P	60	BDX64	A57
	N		BDX65	A57
	P	80	BDX64A	A57
	N		BDX65A	A57
	P	100	BDX64B	A57
	N		BDX65B	A57
	P	120	BDX64C	A57
	N		BDX65C	A57
125	P	60	BDT64	A56
	N		BDT65	A56
	P		BDV64	A56
	N		BDV65	A56
	P	80	BDT64A	A56
	N		BDT65A	A56
	P		BDV64A	A56
	N		BDV65A	A56
	P	100	BDT64B	A56
	N		BDT65B	A56
	P		BDV64B	A56
	N		BDV65B	A56
	P	120	BDT64C	A56
	N		BDT65C	A56
	P		BDV64C	A56
	N		BDV65C	A56
	N	400	BUS12	A59
	N		BUX47	A59
	N		BUX90	A59
	N	450	BUS12A	A59
	N		BUX47A	A59
	N	700	BU508	A59
150	P	60	BDX66	A58
	N		BDX67	A58
	P	80	BDX66A	A58
	N		BDX67A	A58
	P	100	BDX66B	A58
	N		BDX67B	A58
	P	120	BDX66C	A58
	N		BDX67C	A58
175	N	400	BUS13	A59
	N		BUX48	A59
	N	450	BUS13A	A59
	N		BUX48A	A59
200	P	80	BDV66A	A56
	N		BDV67A	A56
	P	100	BDV66B	A56
	N		BDV67B	A56
	P	120	BDV66C	A56
	N		BDV67C	A56
	P	150	BDV66D	A56
	N		BDV67D	A56
250	N	400	BUS14	A59
	N		BUX98	A59
	N	450	BUS14A	A59
	N		BUX98A	A59

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V

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

V_{CEO} V_{DS} max V		P_{tot} max W	type no.	page
5	N	0,03	BFT24	A66
	N	0,05	BFT25;R	A99
10	N	0,19	BFW93	A89
	N	0,25	BFR53;R	A99
	N		BFW30	A89
12	N	0,15	BFQ22;S	A89
	P		BFQ24	A89
	P	0,18	BFQ23	A89
	N		BFR91	A89
	N	0,2	BFR93;R	A99
	P		BFT93;R	A99
	N	0,25	BFR93A;R	A99
	N		BSV52;R	A100
	N	0,3	BFR91A	A89
	P	0,36	2N2894	A70
	P		2N2894A	A70
15	P	0,15	BFQ52	A89
	N		BFQ53	A89
	P	0,18	BFQ51	A89
	N		BFR49	A89
	N		BFR90	A89
	N		BFR90A	A89
	N	0,19	BFW92	A89
	N	0,2	BF480	A66
	N		BFR92;R	A99
	N		BFR92A;R	A99
	P		BFT92;R	A99
	N		BFX89	A89
	N		BFY90	A89
	N		2N918	A70
	N	0,25	BFQ63	A89
	N		BFS17;R	A99
	P		BSR12;R	A100
	N	0,36	BSX19	A68
	N		BSX20	A68
	N		2N2368	A70
	N		2N2369	A70
	N		2N2369A	A70
	N	0,5	BF370	A66
	N		BFQ19	A99
	P		BFQ32	A89
	N		BFR54	A66
	N		BFR96	A89
	N		PH2369	A68
	N	0,7	BFR96S	A89
	N	1	BFQ18A	A99
18	M	0,225	BF980	A72
	N	2,25	BFQ34	A89
	N	4,5	BFQ68	A89
20	N	0,05	BC146	A44
	P		BC200	A44
	P	0,14	BF979	A66
	N	0,145	BF184	A66
	N		BF185	A66
	N	0,15	BF180	A66
	N		BF181	A66
	N		BF182	A66
	N		BF183	A66
	N		BF200	A66
	P		BF579	A98
	P	0,2	BF767	A98
	M	0,225	BF960	A72
	M		BF981	A72
	M		BF982	A72
	P	0,25	BF936	A66
	N		BFS18;R	A98
	N		BFS19;R	A98
	N		BFS20;R	A98
	N	0,3	BC108	A44
	N		BC109	A44
	P		BC179	A44
	N		BCY57	A46
	F		BF410	A72
	N		BF494	A66
	N		BF495	A66
	N		BF496	A66
	F		BF510	A99
	F		BF511	A99
	F		BF512	A99
	F		BF513	A99
	N	0,8	BC375	A45
	P		BC376	A45
	N		BFY52	A66
	N	1	BC368	A45
	P		BC369	A45
	N	15	BD329	A52
	P		BD330	A52
22	N	36	BD433	A52
	P		BD434	A52
	N	40	BD943	A54
	P		BD944	A54
25	P	0,2	BF660	A98
	F	0,25	BFR30	A99
	F		BFR31	A99
	F		BFT46	A99
	P	0,255	BF939	A66
	P	0,3	BF178	A44
	F		BFW61	A72
	P	0,31	BC808;R	A96
	N		BC818;R	A96
	P	0,35	BCY72	A46
	P	0,425	BCX18;R	A98
	N		BCX20;R	A98
	N	0,5	BF199	A66
	P	0,8	BC328	A44
	N		BC338	A44
	N	1	BFQ17	A99
	N		BSW41A	A68
	N	1,5	BFR95	A89
	N		BFW16A	A89
	N		BFW17A	A89
	N	2,5	BFR94	A89
	N	3,5	BFR64	A89
	N	5	BFR65	A89
27	M	0,36	3N211	A72
30	N	0,145	BF115	A66
	F	0,15	BFW12	A72
	F		BFW13	A72
	P	0,16	BF967	A66
	N	0,2	BC848;R	A96
	N		BC849;R	A96
	P		BC858;R	A96
	P		BC859;R	A97
	P		BF536	A98
	M		BFR29	A72
	M		BSV81	A73
	P	0,25	BF324	A66
	F		BFQ10	A74
	F		BFQ11	A74
	F		BFQ12	A74
	F		BFQ13	A74
	F		BFQ14	A74
	F		BFQ15	A74
	F		BFQ16	A74
	F	0,3	BC264	A72
	F		BF245	A72
	F		BF256	A72
	F		BFS21	A74
	F		BFS21A	A74

transistor selection guide

V

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

V_{CEO} V_{DS} max V		P_{tot} max W	type no.	page
30	F	0,3	BFW10	A72
	F		BFW11	A72
	F		2N3823	A72
	F		2N3966	A73
	F	0,36	2N4859	A73
	F		2N4860	A73
	F		2N4861	A73
	N	0,425	BSR13;R	A100
	N	0,5	BC548	A45
	N		BC549	A45
	P		BC558	A45
	P		BC559	A45
	N		BF198	A66
	N		2N2221	A70
	N		2N2222	A70
	N	0,8	BFY51	A66
	N		BSX60	A68
	N		2N2218	A70
	N		2N2219	A70
32	N	0,15	BCW60	A97
	P		BCW61	A97
	P	0,35	BCF29;R	A98
	P		BCF30;R	A98
	N		BFC32;R	A98
	N		BCF33;R	A98
	P		BCW29;R	A97
	P		BCW30;R	A97
	N		BCW31;R	A97
	N		BCW32;R	A97
	N		BCW33;R	A97
	P	0,6	BCY33A	A46
	P		BCY34A	A46
	N	1	BCY58	A46
	P		BCY78	A46
	N	36	BD435	A52
	P		BD436	A52
	N	40	BD945	A54
	P		BD946	A54
35	P	0,16	BF970	A66
	N	0,8	BFY50	A66
	N		BFY55	A66
	N		2N2297	A70
40	N	0,15	BCY87	A74
	N		BCY88	A74
	N		BCY89	A74
	P	0,2	BF550;R	A98
	P		BF569	A98
40	N	0,25	BF240	A66
	N		BF241	A66
	P		BF450	A66
	P		BF451	A66
	F		BSR56	A99
	F		BSR57	A99
	F		BSR58	A99
	P	0,35	BCY70	A46
	N		BSR17;R	A100
	P		BSR18;R	A100
	F		BSV78	A73
	F		BSV79	A73
	F		BSV80	A73
	F	0,36	2N4856	A73
	F		2N4857	A73
	F		2N4858	A73
	P	0,4	2N2906	A70
	P		2N2907	A70
	N	0,425	BSR14;R	A100
	P		BSR15;R	A100
	N	0,5	2N2221A	A70
	N		2N2222A	A70
	P	0,6	2N2904	A70
	P		2N2905	A70
	P	0,8	BSV15	A68
	N		2N2218A	A70
	N		2N2219A	A70
	F	1,8	2N4091	A73
	F		2N4092	A73
	F		2N4093	A73
	F		2N4391	A73
	F		2N4392	A73
	F		2N4393	A73
	N	3,7	BC140	A44
	P		BC160	A44
	N	5	BSX45	A68
	N	30	BDT29	A55
	P		BDT30	A55
	N	40	BDT31	A55
	P		BDT32	A55
	N	65	BDT41	A55
	P		BDT42	A55
45	N	0,15	BCX70	A97
	P		BCX71	A97
	N	0,2	BC847;R	A96
	N		BC850;R	A96
	P		BC857;R	A96
	P		BC860;R	A97
45	N	0,3	BC107	A44
	P		BC177	A44
	N		BCY56	A46
	N		2N929	A46
	N		2N930	A46
	P	0,31	BC807;R	A96
	N		BC817;R	A96
	P	0,35	BCF70;R	A98
	N		BCF81;R	A98
	P	0,35	BCW69;R	A97
	P		BCW70;R	A97
	N		BCW71;R	A97
	N		BCW72;R	A97
	N		BCW81;R	A97
	P		BCY71	A46
	P	0,425	BCX17;R	A98
	N		BCX19;R	A98
	N	0,5	BC547	A45
	N		BC550	A45
	P		BC557	A45
	P		BC560	A45
	P	0,8	BC327	A44
	N		BC337	A44
	N		BSR50	A68
	P		BSR60	A68
	N		BSS50	A68
	P		BSS60	A68
	N		BSX59	A68
	N		BSX61	A68
	N	1	BC635	A45
	P		BC636	A45
	P		BCX51	A98
	N		BCX54	A98
	N		BCY59	A46
	P		BCY79	A46
	N	5	BDX42	A57
	P		BDX45	A57
	N	8	BD135	A51
	P		BD136	A51
	N		BD825	A53
	P		BD826	A53
	N		BDW55	A57
	P		BDW56	A57
	N	10	BD839	A53
	P		BD840	A53
	N	12,5	BD226	A51
	P		BD227	A51
	N		BD813	A53
	P		BD814	A53

transistor selection guide

V

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

V_{CEO} V_{DS} max V		P_{tot} max W	type no.	page
45	N	15	BD131	A51
	P		BD132	A51
	N	25	BD233	A51
	P		BD234	A51
	N	30	BD239	A51
	P		BD240	A51
	N		BD933	A54
	P		BD934	A54
	N	36	BD437	A52
	P		BD438	A52
	N	40	BD241	A52
	P		BD242	A52
	N		BD675	A53
	P		BD676	A53
	N		BD947	A54
	P		BD948	A54
	N	60	BD201	A51
	P		BD202	A51
	N	65	BD243	A52
	P		BD244	A52
50	N	0,8	2N1613	A70
	N		2N1711	A70
	PM	45	BUZ10	A60
60	N	0,35	BCV71;R	A97
	N		BCV72;R	A97
	P		BCW89;R	A97
	N	0,36	2N2483	A46
	N		2N2484	A46
	P	0,4	2N2906A	A70
	P		2N2907A	A70
	P	0,425	BSR16;R	A100
	P	0,6	2N2904A	A70
	P		2N2905A	A70
	N	0,8	BSR51	A68
	P		BSR61	A68
	N		BSS51	A68
	P		BSS61	A68
	P		BSV16	A68
	P		2N4030	A70
	P		2N4032	A70
	N	0,87	BFX34	A66
	N	1	BC637	A45
	P		BC638	A45
	P		BCX52	A98
	N		BCX55	A98
	P		BSR30	A100
	P		BSR31	A100
	N		BSR40	A100
	N		BSR41	A100
60	N	3,7	BC141	A44
	P		BC161	A44
	N	5	BDX43	A57
	P		BDX46	A57
	N		BSV64	A68
	N		BSX46	A68
	N	8	BD137	A51
	P		BD138	A51
	N		BD827	A53
	P		BD828	A53
	N		BDW57	A57
	P		BDW58	A57
	N	10	BD841	A53
	P		BD842	A53
	N	12,5	BD228	A51
	P		BD229	A51
	N		BD815	A53
	P		BD816	A53
	N	15	BDX35	A57
	N		BDX36	A57
	N	25	BD235	A51
	P		BD236	A51
	N	30	BD239A	A51
	P		BD240A	A51
	N		BD935	A54
	P		BD936	A54
	N		BDT29A	A55
	P		BDT30A	A55
	N	40	BD241A	A52
	P		BD242A	A52
	N		BD677	A53
	P		BD678	A53
	N		BD949	A54
	P		BD950	A54
	N		BDT31A	A55
	P		BDT32A	A55
	N		BDY92	A58
	P	50	BDT60	A55
	N		BDT61	A55
	N	60	BD203	A51
	P		BD204	A51
	N		BD331	A52
	P		BD332	A52
	N	62,5	BD645	A52
	P		BD646	A53
	N	65	BD243A	A52
	P		BD244A	A52
	N		BDT41A	A55
	P		BDT42A	A55
60	P	90	BDT62	A55
	N		BDT63	A56
	N		BDT91	A56
	P		BDT92	A56
	P		BDX62	A57
	N		BDX63	A57
	N		BDX91	A58
	P		BDX92	A58
	N	100	BDV91	A56
	P		BDV92	A57
	P	117	BDX64	A57
	N		BDX65	A57
	P	125	BDT64	A56
	N		BDT65	A56
	P		BDV64	A56
	N		BDV65	A56
	P	150	BDX66	A58
	N		BDX67	A58
64	P	0,6	BCY30A	A46
	P		BCY31A	A46
	P		BCY32A	A46
65	N	0,2	BC846;R	A96
	P		BC856;R	A96
	N	0,5	BC546	A45
	P		BC556	A45
80	N	0,35	BSS64;R	A100
	N	0,8	BSR52	A68
	P		BSR62	A68
	N		BSS52	A68
	P		BSS62	A68
	P		BSV17	A68
	N		2N1893	A70
	N		2N3019	A70
	N		2N3020	A70
	P		2N4031	A70
	P		2N4033	A70
	N	1	BC639	A45
	P		BC640	A45
	P		BCX53	A98
	N		BCX56	A98
	P		BSR32	A100
	P		BSR33	A100
	N		BSR42	A100
	N		BSR43	A100
	N	5	BDX44	A57
	P		BDX47	A57
	N		BSX47	A68

transistor selection guide

V

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

V_{CEO} V_{DS} max V		P_{tot} max W	type no.	page
80	N	8	BD139	A51
	P		BD140	A51
	N		BD829	A53
	P		BD830	A53
	N		BDW59	A57
	P		BDW60	A57
	N	10	BD843	A53
	P		BD844	A53
	N	12,5	BD230	A51
	P		BD231	A51
	N		BD817	A53
	P		BD818	A53
	N	15	BDX37	A57
	N	25	BD237	A51
	P		BD238	A51
	N	30	BD239B	A51
	P		BD240B	A51
	N		BD937	A54
	P		BD938	A54
	N		BDT29B	A55
	P		BDT30B	A55
	N	40	BD241B	A52
	P		BD242B	A52
	N		BD679	A53
	P		BD680	A53
	N		BD951	A54
	P		BD952	A54
	N		BDT31B	A55
	P		BDT32B	A55
	N		BDY91	A58
	P	50	BDT60A	A55
	N		BDT61A	A55
	N	60	BD333	A52
	P		BD334	A52
	N		BDX77	A58
	P		BDX78	A58
	N	62,5	BD647	A52
	P		BD648	A53
	N	65	BD243B	A52
	P		BD244B	A52
	N		BDT41B	A55
	P		BDT42B	A55
	P	90	BDT62A	A55
	N		BDT63A	A56
	N		BDT93	A56
	P		BDT94	A56
	P		BDX62A	A57
	N		BDX63A	A57
	N		BDX93	A58
	P		BDX94	A58
80	N	100	BDV93	A56
	P		BDV94	A57
	P	117	BDX64A	A57
	N		BDX65A	A57
	P	125	BDT64A	A56
	N		BDT65A	A56
	P		BDV64A	A56
	N		BDV65A	A56
	P	150	BDX66A	A58
	N		BDX67A	A58
	P	200	BDV66A	A56
	N		BDV67A	A56
100	P	0,35	BSS63;R	A100
	N	0,5	BSS38	A68
	P		BSS68	A68
	N	0,8	BSW66A	A68
	N	10	BD845	A53
	P		BD846	A54
	N	30	BD239C	A51
	P		BD240C	A51
	N		BD939	A54
	P		BD940	A54
	N		BDT29C	A55
	P		BDT30C	A55
	N	40	BD241C	A52
	P		BD242C	A52
	N		BD681	A53
	P		BD682	A53
	N		BD953	A54
	P		BD954	A54
	N		BDT31C	A55
	P		BDT32C	A55
	N		BDY90	A58
	PM	45	BUZ20	A60
	P	50	BDT60B	A55
	N		BDT61B	A55
	N	60	BD335	A52
	P		BD336	A52
	N	62,5	BD649	A52
	P		BD650	A53
	N	65	BD243C	A52
	P		BD244C	A52
	N		BDT41C	A55
	P		BDT42C	A55
	P	90	BDT62B	A55
	N		BDT63B	A56
	N		BDT95	A56
	P		BDT96	A56
100	P	90	BDX62B	A57
	N		BDX63B	A57
	N		BDX95	A58
	P		BDX96	A58
	N	100	BDV95	A56
	P		BDV96	A57
	P	117	BDX64B	A57
	N		BDX65B	A57
	P	125	BDT64B	A56
	N		BDT65B	A56
	P		BDV64B	A56
	N		BDV65B	A56
	P	150	BDX66B	A58
	N		BDX67B	A58
	P	200	BDV66B	A56
	N		BDV67B	A56
120	N	0,8	BSW67A	A68
	N	10	BD847	A53
	P		BD848	A54
	N	30	BD941	A54
	P		BD942	A54
	N	40	BD683	A53
	P		BD684	A53
	N		BD955	A54
	P		BD956	A54
	P	50	BDT60C	A55
	N		BDT61C	A55
	N	60	BD337	A52
	P		BD338	A52
	N	62,5	BD651	A52
	P		BD652	A53
	P	90	BDT62C	A55
	N		BDT63C	A56
	P		BDX62C	A57
	N		BDX63C	A57
	P	117	BDX64C	A57
	N		BDX65C	A57
	P	125	BDT64C	A56
	N		BDT65C	A56
	P		BDV64C	A56
	N		BDV65C	A56
	P	150	BDX66C	A58
	N		BDX67C	A58
	P	200	BDV66C	A56
	N		BDV67C	A56
130	P	62,5	BDT20	A54
	N		BDT21	A54

transistor selection guide

V

P listed by power dissipation
V listed by voltage

N = n-p-n
P = p-n-p
F = FET
M = MOS-FET
PM = power MOS

Excluding r.f. power devices and devices for optoelectronics

V_{CEO} V_{DS} max V		P_{tot} max W	type no.	page
140	N	10	BD849	A53
	P		BD850	A54
150	N	0,8	BSW68A	A68
	N	30	BD941A	A54
	P		BD942A	A54
	N	40	BD957	A54
	P		BD958	A54
	N	60	BU807	A59
	P	200	BDV66D	A56
	N		BDV67D	A56
160	N	6	BF457	A58
	N		BF857	A58
200	P	1	BST15;R	A100
	P		2N5415	A70
	PM	45	BUZ30	A60
	N	60	BU806	A59
	PM	62,5	BUZ31	A60
	PM		BUZ33	A60
	PM	78	BUZ34	A60
250	N	0,83	BF422	A66
	P		BF423	A66
	N	1	BF622	A100
	P		BF623	A100
	N	1,8	BF469	A58
	P		BF470	A58
	N	5	BF869	A58
	P		BF870	A59
	P		BFT45	A66
	N	6	BF419	A58
	N		BF458	A58
	N		BF819	A58
	N		BF858	A58
300	P	1	BST16;R	A100
	P		2N5416	A70
	N	1,8	BF471	A58
	P		BF472	A58
	N	5	BF871	A58
	P		BF872	A59
	P		BFT44	A66
	N	6	BF459	A58
	N		BF859	A58
375	N	70	BU426	A59
	N	115	BU826	A59
400	N	20	BUX86	A59
	N	40	BUX84	A59
	N	50	BUW84	A59
	N	70	BU426A	A59
	N		BUV82	A59
	N	100	BUS11	A59
	N		BUX46	A59
	N		BUX80	A59
	N	115	BU826A	A59
	N	125	BUS12	A59
	N		BUX47	A59
	N		BUX90	A59
	N	175	BUS13	A59
	N		BUX48	A59
	N	250	BUS14	A59
	N		BUX98	A59
450	N	20	BUX87	A59
	N	40	BUX85	A59
	N	50	BUW85	A59
	N	70	BUV83	A59
	N	100	BUS11A	A59
	N		BUX46A	A59
	N		BUX81	A59
	N	125	BUS12A	A59
	N		BUX47A	A59
	N	175	BUS13A	A59
	N		BUX48A	A59
	N	250	BUS14A	A59
	N		BUX98A	A59
500	PM	62,5	BUZ40	A60
	PM		BUZ41	A60
	PM	78	BUZ43	A60
	PM		BUZ44	A60
	PM	100	BUZ45	A60
700	N	125	BU508	A59
800	PM	62,5	BUZ80	A60
	PM		BUZ83	A60
	N	80	BUY89	A59
	PM	100	BUZ84	A60
1000	PM	62,5	BUZ50	A60
	PM	78	BUZ53	A60
	PM	100	BUZ54	A60

l.f. general purpose transistors
abridged data

Polarity indication P = p-n-p
N = n-p-n

type	polarity	status	case	RATINGS V_{CBO} V	V_{CEO} V	I_C A	P_{tot} W	at T_{amb} (T_{case}) °C	CHARACTERISTICS h_{FE} min-max	at I_C mA	F typ dB	f_T typ MHz	V_{CEsat} typ mV	at I_C/I_B A/mA
BC107	N	D	TO-18(1)	50	45	0,1	0,3	25	110-450	2	2	300	200	0,1/5
BC108				30	20				110-800		2			
BC109				30	20				200-800		1,2			
BC107A,B				50	45				**A** 110-220		2			
BC108A,B,C				30	20				**B** 200-450		2			
BC109B,C				30	20				**C** 420-800		1,2			
BC140-6,10,16	N	C	TO-39(1)	80	40	1	3,7	(45)	**6** 40-100	100	—	>50	600	1/100
BC141-6,10,16				100	60				**10** 63-160					
									16 100-250					
BC146/01	N	C	SOT-42	20	20	0,05	0,05	45	80-200	0,2	2	150	—	—
BC146/02									140-350		1,5			
BC146/03									280-550		2			
BC160-6,10,16	P	C	TO-39(1)	40	40	1	3,7	(45)	**6** 40-100	100	—	>50	600	1/100
BC161-6,10,16				60	60				**10** 63-160					
									16 100-250					
BC177	P	D	TO-18(1)	50	45	0,1	0,3	25	75-260	2	2	150	250	0,1/5
BC178				30	25				75-500		2			
BC179				25	20				125-500		1			
BC178A,B				30	25				**A** 125-260		2			
BC179A,B				25	20				**B** 240-500		1			
BC200/01	P	C	SOT-42	20	20	0,05	0,05	45	50-105	0,2	2	90	—	—
BC200/02									85-200		1,5			
BC200/03									165-400		2			
BC327	P	D	TO-92(2)	(50)	45	0,5	0,8	25	100-600	100	—	100	700	0,5/50
BC328				(30)	25				100-600					
BC327-16,25,40				(50)	45				**16** 100-250					
BC328-16,25,40				(30)	25				**25** 160-400					
									40 250-600					
BC337	N	D	TO-92(2)	(50)	45	0,5	0,8	25	100-600	100	—	200	700	0,5/50
BC338				(30)	25				100-600					
BC337-16,25,40				(50)	45				**16** 100-250					
BC338-16,25,40				(30)	25				**25** 160-400					
									40 250-600					

SOT-42

TO-92

TO-18

TO-39

type	polarity	status	case	RATINGS V_{CBO} (V_{CES}) V	V_{CEO} V	I_C A	P_{tot} at T_{amb} W	°C	CHARACTERISTICS h_{FE} at I_C min-max	mA	F typ dB	f_T typ MHz	V_{CEsat} at I_C/I_B max mV	A/mA
BC368	N	D	TO-92(3)	25	20	1	1	25	85-375	500	—	60	500	1/100
BC369	P													
BC375	N	D	TO-92(2)	25	20	1	0,8	25	60-340	150	—	150	500	05/50
BC376	P													
BC546				80	65				110-450					
BC547				50	45				110-800					
BC548	N	D	TO-92(2)	30	30	0,1	0,5	25	110-800	2	2	300	600	0,1/5
BC546A,B				80	65				**A** 110-220					
BC547A,B,C				50	45				**B** 200-450					
BC548A,B,C				30	30				**C** 420-800					
BC549				30	30				200-800					
BC550	N	D	TO-92(2)	50	45	0,1	0,5	25	200-800	2	1,4	300	600	0,1/5
BC549B,C				30	30				**B** 200-450					
BC550B,C				50	45				**C** 420-800					
BC556				80	65				75-250					
BC557				50	45				75-475					
BC558				30	30				75-475					
BC556A	P	D	TO-92(2)	80	65	0,1	0,5	25		2	2	150	650	0,1/5
BC557A,B				50	45				**A** 125-250					
BC558A,B				30	30				**B** 220-475					
BC558C				30	30				**C** 420-800					
BC559				30	30				125-475					
BC560				50	45				125-475					
BC559A,B	P	D	TO-92(2)	30	30	0,1	0,5	25	**A** 125	2	1	150	650	0,1/5
BC559C				30	30				**C** 420-800					
BC560A,B				50	45				**B** 220-475					
BC560C				50	45				**C** 420-800					
BC635				45	45				40-250					
BC637	N	D	TO-92(3)	60	60	1	1	25	40-160	150	—	130	500	0,5/50
BC639				100	80				40-160					
BC636				45	45				40-250					
BC638	P	D	TO-92(3)	60	60	1	1	25	40-160	150	—	50	0,5	0,5/50
BC640				100	80				40-160					

l.f. general purpose transistors
abridged data

Polarity indication P = p-n-p
N = n-p-n

type	polarity	status	case	RATINGS V_{CBO} (V_{CES}) V	V_{CEO} V	I_C A	P_{tot} W	at T_{amb} (T_{mb}) °C	CHARACTERISTICS h_{FE} min-max	at I_C mA	F typ dB	f_T typ MHz	V_{CEsat} max V	at I_C/I_B A/mA
BCY30A				64	64				10- 35					
BCY31A				64	64				15- 60					
BCY32A	P	C	TO-5(1)	64	64	0,05	0,6	25	20- 70	20	8	7	0,55	0,02/3
BCY33A				32	32				10- 35					
BCY34A				32	32				15- 60					
BCY56	N	D	TO-18(1)	45	45	0,1	0,3	25	100-450	2	1,5	85	typ 0,2	0,1/10
BCY57				25	20				200-800			100		
BCY58VII									VII 120-220					
VIII,IX,X				(32)	32				VIII 180-310					
BCY59VII	N	D	TO-18(1)			0,2	1	45 (T_{case})	IX 250-460	2	2	280	0,7	0,1/2,5
VIII,IX,X				(45)	45				X 380-630					
BCY70				50	40				100		2			
BCY71	P	D	TO-18(1)	45	45	0,2	0,35	25	100-400	10	0,8	450	0,5	0,05/5
BCY72				30	25				100		2,0			
BCY78VII									VII 120-220					
VIII,IX,X				(32)	32				VIII 180-310					
BCY79VII	P	D	TO-18(1)			0,2	1	45 (T_{case})	IX 250-460	2	2	180	0,8	0,1/2,5
VIII,IX				(45)	45				X 380-630					
2N929	N	C	TO-18(1)	(45)	45	0,03	0,3	25	100-350	0,01	—	80	1	0,01/0,5
2N930									150-600					
2N2483	N	C	TO-18(1)	(60)	60	(0,05)	0,36	(25)	40-120	0,01	—	80	0,35	0,001/0,1
2N2484									100-500					

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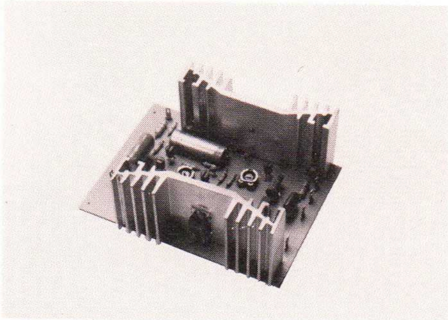

25 W, 4 Ω hi-fi audio amplifier using Darlington transistors.

General purpose Darlingtons

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-126 (SOT-32)					
BD675	BD676			45	
BD677	BD678			60	
BD679	BD680	40	4	80	A53
BD681	BD682			100	
BD683	BD684			120	
BDX42	BDX45			45	
BDX43	BDX46	5	1	60	A57
BDX44	BDX47			80	
SOT-82					
BD331	BD332			60	
BD333	BD334	60	6	80	A52
BD335	BD336			100	
BD337	BD338			120	
TO-220 (SOT-78)					
BD645	BD646			60	
BD647	BD648	62,5	8	80	A52
BD649	BD650			100	A53
BD651	BD652			120	
BDT61	BDT60			60	
BDT61A	BDT60A	50	4	80	A55
BDT61B	BDT60B			100	
BDT61C	BDT60C			120	
BDT63	BDT62			60	
BDT63A	BDT62A	90	10	80	A55
BDT63B	BDT62B			100	A56
BDT63C	BDT62C			120	
BDT65	BDT64			60	
BDT65A	BDT64A	125	12	80	A56
BDT65B	BDT64B			100	
BDT65C	BDT64C			120	

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
SOT-93					
BDV65	BDV64			60	
BDV65A	BDV64A	125	12	80	A56
BDV65B	BDV64B			100	
BDV65C	BDV64C			120	
BDV67A	BDV66A			80	
BDV67B	BDV66B	200	16	100	A56
BDV67C	BDV66C			120	
BDV67D	BDV66D			150	
TO-3 (SOT-3)					
BDX63	BDX62			60	
BDX63A	BDX62A	90	8	80	A57
BDX63B	BDX62B			100	
BDX63C	BDX62C			120	
BDX65	BDX64			60	
BDX65A	BDX64A	117	12	80	A57
BDX65B	BDX64B			100	
BDX65C	BDX64C			120	
BDX67	BDX66			60	
BDX67A	BDX66A	150	16	80	A58
BDX67B	BDX66B			100	
BDX67C	BDX66C			120	

l.f. power transistors
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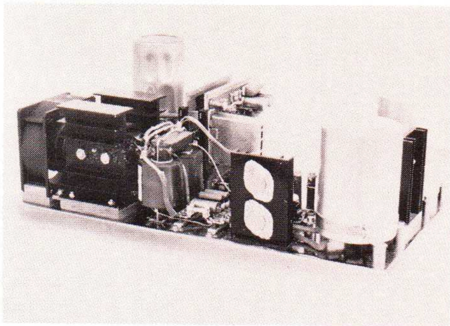
General purpose

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-126 (SOT-32)					
BD131	BD132	15	3	45	A51
BD135	BD136	8	1	45	A51
BD137	BD138			60	
BD139	BD140			80	
BD226	BD227	12,5	1,5	45	A51
BD228	BD229			60	
BD230	BD231			80	
BD233	BD234	25	2	45	A51
BD235	BD236			60	
BD237	BD238			80	
BD329	BD330	15	3	20	A52
BD433	BD434	36	4	22	A52
BD435	BD436			32	
BD437	BD438			45	
TO-202 (SOT-128)					
BD813	BD814	12,5	2	45	A53
BD815	BD816			60	
BD817	BD818			80	
BD825	BD826	8	1	45	A53
BD827	BD828			60	
BD829	BD830			80	
BD839	BD840	10	1,5	45	A53
BD841	BD842			60	
BD843	BD844			80	
BD845	BD846	10	1,5	100	A53 A54
BD847	BD848			120	
BD849	BD850			140	

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-220 (SOT-78)					
BD201	BD202	60	8	45	A51
BD203	BD204			60	A51
BDX77	BDX78			80	A58
BD239	BD240	30	3	45	A51
BD239A	BD240A			60	
BD239B	BD240B			80	
BD239C	BD240C			100	
BD241	BD242	40	5	45	A52
BD241A	BD242A			60	
BD241B	BD242B			80	
BD241C	BD242C			100	
BD243	BD244	65	8	45	A52
BD243A	BD244A			60	
BD243B	BD244B			80	
BD243C	BD244C			100	
BD933	BD934	30	3	45	A54
BD935	BD936			60	
BD937	BD938			80	
BD939	BD940			100	
BD941	BD942			120	
BD941A	BD942A			150	
BD943	BD944	40	5	22	A54
BD945	BD946			32	
BD947	BD948			45	
BD949	BD950			60	
BD951	BD952			80	
BD953	BD954			100	
BD955	BD956			120	
BD957	BD958			150	
BDT29	BDT30	30	1	40	A55
BDT29A	BDT30A			60	
BDT29B	BDT30B			80	
BDT29C	BDT30C			100	



1000 W, 18 V, mains-fed switched-mode power supply containing forward converter with 2 × BUX80 in parallel; efficiency at full load is 80 %.

General purpose

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-220 (SOT-78) (continued)					
BDT31	BDT32			45	
BDT31A	BDT32A	40	3	60	A55
BDT31B	BDT32B			80	
BDT31C	BDT32C			100	
BDT41	BDT42			40	
BDT41A	BDT42A	65	6	60	A55
BDT41B	BDT42B			80	
BDT41C	BDT42C			100	
BDT91	BDT92			60	
BDT93	BDT94	90	10	80	A56
BDT95	BDT96			100	

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
SOT-93					
BDV91	BDV92			60	A56
BDV93	BDV94	100	10	80	A57
BDV95	BDV96			100	
TO-3 (SOT-3)					
BDX91	BDX92			60	
BDX93	BDX94	90	8	80	A58
BDX95	BDX96			100	

Power MOS transistors - see page A60

Television video signals and driver applications

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-126 (SOT-32)					
BF419		6	0,1	250	A58
BF457				160	
BF458		6	0,1	250	A58
BF459				300	
BF469	BF470	1,8	0,03	250	A58
BF471	BF472			300	

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-202 (SOT-128)					
BF819		6	0,1	250	A58
BF857			0,1	160	
BF858		6	2	250	A58
BF859			2	300	
BF869	BF870	5	0,05	250	A58
BF871	BF872			300	

l.f. power transistors
selection guide

Deflection and Industrial

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-126 (SOT-32)					
BDX35		15	5	60	A57
BDX36				60	
BDX37				80	
BDW55	BDW56	8	1	45	A57
BDW57	BDW58			60	
BDW59	BDW60			80	
BUX86		20	0,5	400	A59
BUX87				450	
SOT-82					
BUW84		50	2	400	A59
BUW85				450	
TO-220 (SOT-78)					
BUX84		40	2	450	A59
BUX85				450	
BDT21	BDT20	62,5	8	130	A54
BU806		60	8	200	A59
BU807				150	
SOT-93					
BU426		70	6	375	A59
BU426A				400	
BU508		125	8	700	A59
BU508A				700	
BU826		115	6	375	A59
BU826A				400	
BUV82		70	6	400	A59
BUV83				450	

polarity NPN	PNP	P_{tot} (W)	I_C (A)	V_{CEO} (V)	page
TO-3 (SOT-3)					
BDY90		40	10	100	A58
BDY90A			12		
BDY91		40	10	80	A58
BDY92				60	
BUS11		100	5	400	A59
BUS11A				450	
BUS12		125	8	400	A59
BUS12A				450	
BUS13		175	15	400	A59
BUS13A				450	
BUS14		250	30	400	A59
BUS14A				450	
BUX46		100	5	400	A59
BUX46A				450	
BUX47		125	8	400	A59
BUX47A				450	
BUX48		175	15	400	A59
BUX48A				450	
BUX80		100	10	400	A59
BUX81				450	
BUX90		125	12	400	A59
BUX98		250	30	400	A59
BUX98A				450	
BUY89		80	6	800	A59

abridged data

Polarity indication P = p-n-p
N = n-p-n

				RATINGS					CHARACTERISTICS					
type	polarity	status	case	V_{CBO} (V_{CERM}) V	V_{CEO} V	I_C A	P_{tot} W	at T_{mb} °C	h_{FE} min—max	at I_C A	f_{hfe} typ kHz	f_T typ MHz	V_{CEsat} max V	at I_C/I_B A/mA
BD131 **BD132**	N P	C	TO-126	70 45	45 45	3	15	60	40	0,5	—	>60	0,7	2/200
BD135 **BD137** **BD139**	N	D	TO-126	45 60 100	45 60 80	1	8	70	40—250	0,15	—	250	0,5	0,5/50
BD136 **BD138** **BD140**	P	D	TO-126	45 60 100	45 60 80	1	8	70	40—250	0,15	—	75	0,5	0,5/50
BD201 **BD203**	N	D	TO-220	60 60	45 60	8	60	25	30	3 2	25	>3	1	3/300
BD202 **BD204**	P	D	TO-220	60 60	45 60	8	60	25	30	3 2	25	>3	1	3/300
BD226 **BD228** **BD230**	N	D	TO-126	45 60 100	45 60 80	1,5	12,5	62	40—250 40—160 40—160	0,15	—	125	0,8	1/100
BD227 **BD229** **BD231**	P	D	TO-126	45 60 100	45 60 80	1,5	12,5	62	40—250 40—160 40—160	0,15	—	50	0,8	1/100
BD233 **BD235** **BD237**	N	D	TO-126	45 60 100	45 60 80	2	25	25	40—250	0,15	—	>3	0,6	1/100
BD234 **BD236** **BD238**	P	D	TO-126	45 60 100	45 60 80	2	25	25	40—250	0,15	—	>3	0,6	1/100
BD239 **BD239A** **BD239B** **BD239C**	N	N	TO-220AB	45 60 80 100	45 60 80 100	3	30	25	15	1	—	>3	0,6	1/200
BD240 **BD240A** **BD240B** **BD240C**	P	N	TO-220AB	45 60 80 100	45 60 80 100	3	30	25	15	1	—	>3	0,6	1/200

l.f. power transistors
abridged data

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM}) V	 V_{CEO} V	 I_C A	 P_{tot} at W	 T_{mb} °C	CHARACTERISTICS h_{FE} min—max	 at I_C A	 f_{hfe} typ kHz	 f_T typ MHz	 V_{CEsat} max V	 at I_C/I_B A/mA
BD241 **BD241A** **BD241B** **BD241C**	N	N	TO-220AB	45 60 80 100	45 60 80 100	5	40	25	25	1	—	>3	1,2	3/600
BD242 **BD242A** **BD242B** **BD242C**	P	N	TO-220AB	45 60 80 100	45 60 80 100	5	40	25	25	1	—	>3	1,2	3/600
BD243 **BD243A** **BD243B** **BD243C**	N	N	TO-220AB	45 60 80 100	45 60 80 100	8	65	25	15	3	—	>3	1,5	6/1000
BD244 **BD244A** **BD244B** **BD244C**	P	N	TO-220AB	45 60 80 100	45 60 80 100	8	65	25	15	3	—	>3	1,5	6/1000
BD329 **BD330**	N P	C	TO-126	32	20	3	15	45	85—375	0,5	—	130 100	0,5	2/200
BD331 **BD333** **BD335** **BD337**	N	D	SOT-82	60 80 100 120	60 80 100 120	6	60	25	750	3	60	7	2	3/12
BD332 **BD334** **BD336** **BD338**	P	D	SOT-82	60 80 100 120	60 80 100 120	6	60	25	750	3	60	7	2	3/12
BD433 **BD435** **BD437**	N	D	TO-126	22 32 45	22 32 45	4	36	25	85—475 85—475 85—375	0,5	—	>3	0,5 0,5 0,7	2/200 2/200 3/300
BD434 **BD436** **BD438**	P	D	TO-126	22 32 45	22 32 45	4	36	25	85—475 85—475 85—375	0,5	—	>3	0,5 0,5 0,7	2/200 2/200 3/300
BD645 **BD647** **BD649** **BD651**	N	D	TO-220	80 100 120 140	60 80 100 120	8	62,5	25	750	3	50	—	2	3/12

SOT-82

TO-126

TO-202

TO-220

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM}) V	V_{CEO} V	I_C A	P_{tot} at W	T_{mb} °C	CHARACTERISTICS h_{FE} min—max	at I_C A	f_{hfe} typ kHz	f_T typ MHz	V_{CEsat} max V	at I_C/I_B A/mA
BD646				60	60									
BD648	P	D	TO-220	80	80	8	62,5	25	750	3	100	—	2	3/12
BD650				100	100									
BD652				120	120									
BD675				45	45									
BD677				60	60									
BD679	N	D	TO-126	80	80	4	40	25	750	1,5	—	7	2,5	1,5/6
BD681				100	100									
BD683				120	120									
BD676				45	45									
BD678				60	60									
BD680	P	D	TO-126	80	80	4	40	25	750	1,5	—	7	2,5	1,5/6
BD682				100	100									
BD684				120	120									
BD813				45	45									
BD815	N	D	TO-202	60	60	2	12,5	25	25	1	—	>3	0,6	1/100
BD817				100	80									
BD814				45	45									
BD816	P	D	TO-202	60	60	2	12,5	25	25	1	—	>3	0,6	1/100
BD818				100	80									
BD825				45	45									
BD827	N	D	TO-202	60	60	1	8	50	25	0,5	—	250	0,5	0,5/50
BD829				100	80									
BD826				45	45									
BD828	P	D	TO-202	60	60	1	8	50	25	0,5	—	75	0,5	0,5/50
BD830				100	80									
BD839				45	45									
BD841	N	D	TO-202	60	60	1,5	10	62	40—250	0,15	—	125	0,8	1/100
BD843				100	80									
BD840				45	45									
BD842	P	D	TO-202	60	60	1,5	10	62	40—250	0,15	—	50	0,8	1/100
BD844				100	80									
BD845				100	100									
BD847	N	N	TO-202	120	120	1,5	10	25	30	0,5	—	150	1,0	0,5/50
BD849				140	140									

l.f. power transistors
abridged data

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM}) V	V_{CEO} V	I_C A	P_{tot} at W	T_{mb} °C	CHARACTERISTICS h_{FE} min—max	at I_C A	f_{hfe} typ kHz	f_T typ MHz	V_{CEsat} max V	at I_C/I_B A/mA
BD846				100	100									
BD848	P	N	TO-202	120	120	1,5	10	25	30	0,5	—	75	1,0	0,5/50
BD850				140	140									
BD933		D		45	45									
BD935		D		60	60									
BD937	N	D	TO-220AB	100	80	3	30	25	40—250	0,15	—	3	0,6	1/100
BD939		D		120	100									
BD941		D		140	120									
BD941A		N		160	150									
BD934		D		45	45									
BD936		D		60	60									
BD938	P	D	TO-220AB	100	80	3	30	25	40—250	0,15	—	3	0,6	1/100
BD940		D		120	100									
BD942		D		140	120									
BD942A		N		160	150									
BD943				22	22									
BD945	N	D	TO-220AB	32	32	5	40	25	85—475	0,5	—	3	0,5	2/200
BD947				45	45									
BD944				22	22									
BD946	P	D	TO-220AB	32	32	5	40	25	85—475	0,5	—	3	0,5	2/200
BD948				45	45									
BD949		D		60	60									
BD951		D		80	80									
BD953	N	D	TO-220AB	100	100	5	40	25	40	0,5	—	3	1	2/200
BD955		D		120	120									
BD957		N		150	150									
BD950		D		60	60									
BD952		D		80	80									
BD954	P	D	TO-220AB	100	100	5	40	25	40	0,5	—	3	1	2/200
BD956		D		120	120									
BD958		N		150	150									
BDT20	P	N	TO-220AB	130	130	8	62,5	25	500	3	—	—	1,5	1/2
BDT21	N													

TO-220

type	polarity	status	case	RATINGS					CHARACTERISTICS					
				V_{CBO} (V_{CERM})	V_{CEO}	I_C	P_{tot} at	T_{mb}	h_{FE} at	I_C	f_{hfe} typ	f_T typ	V_{CEsat} max at	I_C/I_B
				V	V	A	W	°C	min—max	A	kHz	MHz	V	A/mA
BDT29	N	N	TO-220AB	40	40	1	30	25	15/75	1	—	>3	0,7	1/125
BDT29A				60	60									
BDT29B				80	80									
BDT29C				100	100									
BDT30	P	N	TO-220AB	40	40	1	30	25	15/75	1	—	>3	0,7	1/125
BDT30A				60	60									
BDT30B				80	80									
BDT30C				100	100									
BDT31	N	N	TO-220AB	40	40	3	40	25	10/50	3	—	—	1,2	3/375
BDT31A				60	60									
BDT31B				80	80									
BDT31C				100	100									
BDT32	P	N	TO-220AB	40	40	3	40	25	10/50	3	—	—	1,2	3/375
BDT32A				60	60									
BDT32B				80	80									
BDT32C				100	100									
BDT41	N	N	TO-220AB	40	40	6	65	25	15/75	3	—	>3	1,5	6/600
BDT41A				60	60									
BDT41B				80	80									
BDT41C				100	100									
BDT42	P	N	TO-220AB	40	40	6	65	25	15/75	3	—	>3	1,5	6/600
BDT42A				60	60									
BDT42B				80	80									
BDT42C				100	100									
BDT60	P	D	TO-220AB	60	60	4	50	25	750	1,5	>25	—	2,5	1,5/6
BDT60A				80	80									
BDT60B				100	100									
BDT60C				120	120									
BDT61	N	D	TO-220AB	60	60	4	50	25	750	1,5	25	—	2,5	1,5/6
BDT61A				80	80									
BDT61B				100	100									
BDT61C				120	120									
BDT62	P	N	TO-220AB	60	60	10	90	25	1000	3	100	—	2	3/12
BDT62A				80	80									
BDT62B				100	100									
BDT62C				120	120									

l.f. power transistors
abridged data

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM}) V	V_{CEO} V	I_C A	P_{tot} at T_{mb} W	°C	CHARACTERISTICS h_{FE} at I_C min—max	A	f_{hfe} typ kHz	f_T typ MHz	V_{CEsat} at I_C/I_B max V	A/mA
BDT63	N	D	TO-220AB	60	60	10	90	25	1000	3	50	—	2	3/12
BDT63A				80	80									
BDT63B				100	100									
BDT63C				120	120									
BDT64	P	D	TO-220AB	60	60	12	125	25	1000	5	—	—	2	5/20
BDT64A				80	80									
BDT64B				100	100									
BDT64C				120	120									
BDT65	N	D	TO-220AB	60	60	12	125	25	1000	5	—	—	2	5/20
BDT65A				80	80									
BDT65B				100	100									
BDT65C				120	120									
BDT91	N	D	TO-220AB	60	60	10	90	25	20—200	4	>20	4	1	4/400
BDT93				80	80									
BDT95				100	100									
BDT92	P	D	TO-220AB	60	60	10	90	25	20—200	4	>20	4	1	4/400
BDT94				80	80									
BDT96				100	100									
BDV64	P	D	SOT-93	60	60	12	125	25	1000	5	100	—	2	5/20
BDV64A				80	80									
BDV64B				100	100									
BDV64C				120	120									
BDV65	N	D	SOT-93	60	60	12	125	25	1000	5	70	—	2	5/20
BDV65A				80	80									
BDV65B				100	100									
BDV65C				120	120									
BDV66A	P	N	SOT-93	100	80	16	200	25	1000	10	60	—	2	10/40
BDV66B				120	100									
BDV66C				140	120									
BDV66D				160	150									
BDV67A	N	N	SOT-93	100	80	16	200	25	1000	10	60	—	2	10/40
BDV67B				120	100									
BDV67C				140	120									
BDV67D				160	150									
BDV91	N	D	SOT-93	60	60	10	100	25	20	4	—	>3	1	4/400
BDV93				80	80									
BDV95				100	100									

TO-3

TO-126

TO-220

SOT-93

type	polarity	status	case	RATINGS					CHARACTERISTICS					
				V_{CBO} (V_{CERM})	V_{CEO}	I_C	P_{tot} at	T_{mb}	h_{FE} at	I_C	f_{hfe} typ	f_T typ	V_{CEsat} at max	I_C/I_B
				V	V	A	W	°C	min—max	A	kHz	MHz	V	A/mA
BDV92				60	60									
BDV94	P	D	SOT-93	80	80	10	100	25	20	4	—	>4	1	4/400
BDV96				100	100									
BDW55				45	45									
BDW57	N	D	TO-126	60	60	1	8	95	40—250	0,15	—	250	0,5	0,5/50
BDW59				100	80									
BDW56				45	45									
BDW58	P	D	TO-126	60	60	1	8	95	40—250	0,15	—	75	0,5	0,5/50
BDW60				100	80									
BDX35				60	60								0,9	
BDX36	N	C	TO-126	60	60	5	15	75	45—450	0,5	—	100	0,7	5/500
BDX37				80	80								0,9	
BDX42				60	45								1,6	1/4
BDX43	N	C	TO-126	80	60	1	5	100	1500	0,5	—	—	1,6	1/1
BDX44				100	80								1,3	0,5/0,5
BDX45				60	45								1,6	1/4
BDX46	P	C	TO-126	80	60	1	5	100	1500	0,5	—	—	1,6	1/1
BDX47				100	80								1,3	0,5/0,5
BDX62				60	60									
BDX62A	P	C	TO-3	80	80	8	90	25	1000	3	100	—	2	3/12
BDX62B				100	100									
BDX62C				120	120									
BDX63				80	60									
BDX63A	N	C	TO-3	100	80	8	90	25	1000	3	100	—	2	3/12
BDX63B				120	100									
BDX63C				140	120									
BDX64				60	60									
BDX64A	P	C	TO-3	80	80	12	117	25	1000	5	80	—	2	5/20
BDX64B				100	100									
BDX64C				120	120									
BDX65				80	60									
BDX65A	N	C	TO-3	100	80	12	117	25	1000	5	50	—	2	5/20
BDX65B				120	100									
BDX65C				140	120									

l.f. power transistors
abridged data

TO-3

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM})	V_{CEO}	I_C	P_{tot} at	T_{mb}	CHARACTERISTICS h_{FE} at	I_C	f_{hfe} typ	f_T typ	V_{CEsat} max at	I_C/I_B
				V	V	A	W	°C	min—max	A	kHz	MHz	V	A/mA
BDX66 **BDX66A** **BDX66B** **BDX66C**	P	C	TO-3	60 80 100 120	60 80 100 120	16	150	25	1000	10	60	—	2	10/40
BDX67 **BDX67A** **BDX67B** **BDX67C**	N	C	TO-3	80 100 120 140	60 80 100 120	16	150	25	1000	10	50	—	2	10/40
BDX77 **BDX78**	N P	D	TO-220	100 80	80 80	8	60	25	30	2	>25	>3	1	3/300
BDX91 **BDX93** **BDX95**	N	C	TO-3	60 80 100	60 80 100	8	90	25	20	3	—	>4	0,8	3/300
BDX92 **BDX94** **BDX96**	P	C	TO-3	60 80 100	60 80 100	8	90	25	20	3	—	>4	0,8	3/300
BDY90 **BDY90A** **BDY91** **BDY92**	N	D	TO-3	120 120 100 80	100 100 80 60	10 12 10 10	40	70	30—120	5	—	70	1	10/1000 12/1000 10/1000 10/1000
BF419	N	D	TO-126	300	250	0,1	6	90	typ 45	0,02		90	11	0,2/20
BF457 **BF458** **BF459**	N	D	TO-126	160 250 300	160 250 300	0,1	6	90	26	0,03	—	90	1	0,03/6
BF469 **BF471**	N	D	TO-126	250 300	250 (300)	0,05	1,8	114	50	0,025	—	60	—	—
BF470 **BF472**	P	D	TO-126	250 300	250 (300)	0,05	1,8	114	50	0,025	—	60	—	—
BF819	N	D	TO-202	300	250	0,1	6	75	typ 45	0,02	—	90	11	0,2/20
BF857 **BF858** **BF859**	N	D	TO-202	160 250 300	160 250 300	0,1	6	75	26	0,03	—	90	1	0,03/6
BF869 **BF871**	N	D	TO-202	250 300	250 (300)	0,05	5	25	50	0,025	—	60	—	—

TO-126

TO-202

TO-220

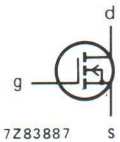
SOT-82

SOT-93

type	polarity	status	case	RATINGS V_{CBO} (V_{CERM}) V	V_{CEO} V	I_C A	P_{tot} at W	T_{mb} °C	CHARACTERISTICS h_{FE} min—max	at I_C A	t_{fmax} T_{mb}95°C µs	f_T typ MHz	V_{CEsat} max V	at I_C/I_B A/mA
BF870	P	D	TO-202	250	250	0,05	5	25	50	0,025	—	60	—	—
BF872				300	(300)									
BU426	N	D	SOT-93	(800)	375	6	70	73	typ 30	0,6	1	6	1,5	2,5/500
BU426A				(900)	400									
BU508	N	N	SOT-93	(1500)	700	8	125	25			0,7typ	—	5	4,5/2000
BU508A			SOT-93	(1500)	700	8	125				0,7typ		1	4,5/2000
BU806			TO-220	400	200	8	60				0,2typ		1,5	5/50
BU807			TO-220	330	150	8	60				0,2typ		1,5	5/50
BU826			SOT-93	(800)	375	6	115				0,6		2	2,5/55
BU826A			SOT-93	(900)	400	6	115				0,6		2	2,5/55
BUS11	N	D	TO-3	(850)	400	5	100	25	typ 30	0,5	0,8	—	1,5	3/600
BUS11A				(1000)	450	5	100			0,5				2,5/500
BUS12				(850)	400	8	125			—				6/1200
BUS12A				(1000)	450	8	125			—				5/1000
BUS13				(850)	400	15	175			—				10/2000
BUS13A				(1000)	450	15	175			—				8/1600
BUS14				(850)	400	30	250			—				20/4000
BUS14A				(1000)	450	30	250			—				16/3200
BUV82	N	D	SOT-93	(850)	400	6	70	73	typ 30	0,6	1	6	1,5	2,5/500
BUV83				(1000)	450									
BUW84	N	D	SOT-82	(800)	400	2	50	25	typ 50	0,1	1,4	20	1,5	0,3/30
BUW85				(1000)	450	2	50		typ 50	0,1	1,4	20		0,3/30
BUX46				(850)	400	5	100		typ 30	0,5	0,8	—		3/600
BUX46A				(1000)	450	5	100		typ 30	0,5	0,8	—		2,5/500
BUX47				(850)	400	8	125		typ 30	—	0,8	—		6/1200
BUX47A				(1000)	450	8	125		typ 30	—	0,8	—		5/1000
BUX48				(850)	400	15	175		typ 30	—	0,8	—		10/2000
BUX48A				(1000)	450	15	175		typ 30	—	0,8	—		8/1600
BUX80	N	D	TO-3	(800)	400	10	100	40	typ 30	1,2	0,8	6	1,5	5/1000
BUX81			TO-3	(1000)	450	10	100	40	typ 30	1,2	0,8	6	1,5	5/1000
BUX84			TO-220AB	(800)	400	2	40	50	typ 50	0,1	1,4	20	1,0	1/200
BUX85			TO-220	(1000)	450	2	40	50	typ 50	0,1	1,4	20	1,0	1/200
BUX86			TO-126AB	(800)	400	0,5	20	60	typ 50	0,05	1,3	20	3,0	0,2/20
BUX87			TO-126	(1000)	450	0,5	20	60	typ 50	0,05	1,3	20	3,0	0,2/20
BUX90	N	N	TO-3	(650)	400	12	125	25			0,8typ	—	1,5	5/50
BUX98		D		(850)	400	30	250	25			0,8typ	—	1,5	20/4000
BUX98A		D		(1000)	450	30	250	25			0,8typ	—	1,5	16/3200
BUY89		D		(1500)	800	6	80	60			0,5typ	7	1	4,5/2000

l.f. power transistors

power MOS transistors n-channel enhancement

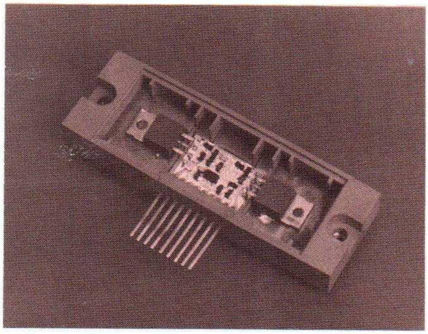


- very low on-state resistance
- drain-source voltages up to 1000 V
- drain currents up to 14 A (continuous)
- microcomputer and TTL compatibility

Intended for use in motor control, SMPS, welding, dc/dc and dc/ac converters.

type	status	case	V_{DS} V	P_{tot} W	I_D A	I_{GSS} max nA	I_{DSS} max mA	$r_{ds\ on}$ max Ω	C_{rs} typ pF	$t_{d\ on}$ typ ns	t_f typ ns
BUZ10	N	TO-220	50	45	12	100	1	0,1	120	20	60
BUZ20	N	TO-220	100	45	8	100	1	0,2	100	20	60
BUZ23	N	TO-3	100	62,5	8	100	1	0,2	100	20	60
BUZ30	N	TO-220	200	45	5,5	100	1	0,75	100	20	60
BUZ31	N	TO-220	200	62,5	12,5	100	1	0,2	100	20	60
BUZ33	N	TO-3	200	62,5	6,4	100	1	0,75	100	20	60
BUZ34	N	TO-3	200	78	14	100	1	0,2	100	20	60
BUZ40	N	TO-220	500	62,5	2	100	1	4,5	30	30	100
BUZ41	N	TO-220	500	62,5	5	100	1	1,1	30	30	100
BUZ43	N	TO-3	500	78	2,5	100	1	4,5	30	30	100
BUZ44	N	TO-3	500	78	5,6	100	1	1,1	30	30	100
BUZ45	N	TO-3	500	100	8,6	100	1	0,6	100	50	100
BUZ80	N	TO-220	800	62,5	2,6	100	1	4	30	40	100
BUZ83	N	TO-3	800	62,5	2,9	100	1	4	30	40	100
BUZ84	N	TO-3	800	100	4,7	100	1	2	100	60	100
BUZ50	N	TO-220	1000	62,5	2,8	100	1	3,5	30	40	100
BUZ53	N	TO-3	1000	78	3	100	1	3,5	30	40	100
BUZ54	N	TO-3	1000	100	4,7	100	1	2	100	60	100

l.f. power modules
hybrid integrated circuits

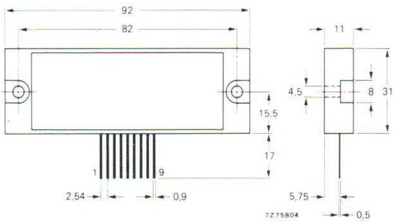


Audio power amplifiers

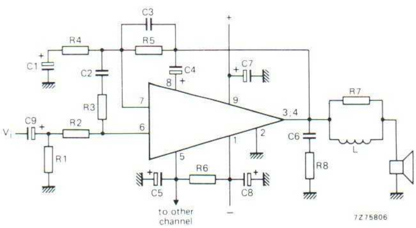
- thin-film substrate
- output power up to 60 W
- good ripple rejection
- high stability for complex loads
- built-in short-circuit protection (SOAR protected)
- low transient distortion
- low harmonic distortion

type	status	P_o at $d_{tot} < 0{,}2\%$ $R_L = 4\ \Omega$	P_o at $d_{tot} < 0{,}2\%$ $R_L = 8\ \Omega$	d_{tot} at $P_o = 1$ W; f = 1 kHz	power bandwidth (−3 dB)	p_o at $R_L = 4\ \Omega$ $d_{tot} = 0{,}7\%$
OM931	D	>30 W at ±23 V	>30 W at ±26 V	typ 0,02%	20 Hz to 40 kHz	typ 40 W
OM961	D	>60 W at ±31 V	>60 W at ±35 V			typ 75 W

Dimensions (mm)



Application information
Example of an output amplifier



List of components:

R1 = 10 kΩ (0,25 W)		C1 = 47 μF (10 V)
R2 = 4,7 kΩ (0,25 W)		C2 = 270 pF (10%)
R3 = 300 Ω (0,25 W)		C3 = 120 pF (10%)
R4 = 680 Ω (0,25 W)		C4 = 100 μF
R5 = 10 kΩ (0,25 W)		C5 = 470 μF
R6 = 22 Ω (0,5 W)		C6 = 100 nF
R7 = 2,2 Ω (0,25 W)		C7 = 10 μF (63 V)
R8 = 10 Ω (0,5 W)		C8 = 10 μF (63 V)
		C9 = 1 μF (63 V)

L = 4 μH

R_L = 4 or 8 Ω

h.f. transistors
selection guide

Television — Radio

Polarity indication P = p-n-p
N = n-p-n
J = Junction-FET
M = MOS

type	polarity	Television: tuner preamp u.h.f.	tuner preamp v.h.f.	mixer or self-osc. mixer u.h.f.	mixer or self-osc. mixer v.h.f	oscillator u.h.f.	oscillator v.h.f.	vision amp i.f.	video output	Radio: r.f. amp a.m.	r.f. amp f.m.	mixer or self-osc. mixer a.m.	mixer or self-osc. mixer f.m.	i.f. amplifier
BF198	N							●						
BF199	N							●						
BF240	N									●		●	●	●
BF241	N									●		●	●	●
BF324	P				●		●				●			
BF370	N							●						
BF410	J										●		●	
BF422	N								●					
BF423	P								●					
BF450	P									●		●	●	●
BF451	P									●		●	●	●
BF480	N	●	●			●								
BF494	N						●				●	●	●	●
BF495	N						●			●	●	●	●	●
BF496	N		●								●			
BF936	P						●							
BF939	P		●		●									
BF960	M*	●												
BF967	P	●		●										
BF970	P			●										
BF979	P	●	●	●										
BF980	M*	●												
BF981	M*		●		●									
BF982	M*		●		●						●		●	

* For abridged data of MOS-FETs, see page A72.

Industrial

Industrial

	type	polarity	f_T min MHz
general purpose; selected by f_T	**BSS68**	P	50
	BSS38	N	60
	2N3020	N	80
	2N3019	N	100
	2N4030	P	100
	2N4031	P	100
	2N4032	P	150
	2N4033	P	150
	BFY50	N	typ 140
	BFY51	N	typ 160
	BFY52	N	typ 185
	2N2904	P	200
	2N2904A	P	200
	2N2905	P	200
	2N2905A	P	200
	2N2906	P	200
	2N2906A	P	200
	2N2907	P	200
	2N2907A	P	200
	2N2218	N	250
	2N2218A	N	250
	2N2219	N	250
	2N2221	N	250
	2N2221A	N	250
	2N2222	N	250
	2N2219A	N	300
	2N2222A	N	300
	BFR54	N	500
line output transistor for wideband oscilloscopes	**BFW45**	N	80
h.f. and v.h.f oscillators and amplifiers, output stages of servo amplifiers	**BFY55**	N	60
	2N2297	N	60
	2N918	N	900
d.c. to h.f. amplifiers; also for switching	**2N1893**	N	50
	2N1613	N	60
	2N1711	N	70
u.h.f. low-power amplifier, e.g. for pocket phones	**BFT24**	N	1200
high-voltage transistors	**BFT44**	P	typ 60
	BFT45	P	typ 60

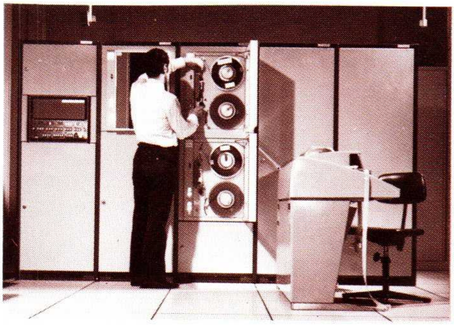
switching transistors
selection guide

Medium speed
High speed
Trigger devices

Polarity indication P = p-n-p
N = n-p-n

Medium-speed transistors

	type	polarity	V_{CEO} (V_{CER}) V	P_{tot} W	t_{off} max ns
drivers for numerical indicator tubes	**BSS38**	N	100	0,5	1000
	BSS68	P	100	0,5	—
drivers, e.g. for print hammers	**BSR50**	N	(45)	0,8	1500
	BSR51	N	(60)	0,8	1500
	BSR52	N	(80)	0,8	1500
	BSR60	P	(45)	0,8	1500
	BSR61	P	(60)	0,8	1500
	BSR62	P	(80)	0,8	1500
	BSS50	N	(45)	0,8	1500
	BSS51	N	(60)	0,8	1500
	BSS52	N	(80)	0,8	1500
	BSS60	P	(45)	0,8	1500
	BSS61	P	(60)	0,8	1500
	BSS62	P	(80)	0,8	1500
	BSV64	N	60	5	1200
general industrial and switching	**BFT44**	P	300	5	125
	BFT45	P	250	5	125
	BSV15	P	40	0,8	650
	BSV16	P	60	0,8	650
	BSV17	P	80	0,8	650
	BSX45	N	40	5	850
	BSX46	N	60	5	850
	BSX47	N	80	5	850
switching inductive loads	**BSW66A**	N	100	0,8	1000
	BSW67A	N	120	0,8	1000
	BSW68A	N	150	0,8	1000
saturated switching	**2N2894**	P	12	0,36	90
amplifiers and switching circuits	**2N3019**	N	80	0,8	—
	2N3020	N	80	0,8	—
	2N5415	P	200	1	—
	2N5416	P	300	1	—
inverting, regulating, etc.	**BFX34**	N	60	0,87	1200
for abridged data see l.f. transistors	**BCY58**	N	32	0,33	800
	BCY59	N	45	0,33	800
	BDY90	N	100	40	1500
	BDY91	N	80	40	1500
	BDY92	N	60	40	1500
general purpose	**BF115**	N	30	0,45	—
	BF180	N	20	0,15	—
	BF181	N	20	0,15	—
	BF182	N	20	0,15	—
	BF183	N	20	0,15	—
	BF184	N	20	0,145	—
	BF185	N	20	0,145	—
	BF200	N	20	0,15	—
	BFR54	N	15	0,5	—
	PH2369	N	15	0,5	21



High-speed transistors

	type	polarity	V_{CEO} (V)	P_{tot} (W)	t_{off} max (ns)
core driving	**BSX59**	N	45	0,8	60
	BSX60	N	30	0,8	70
	BSX61	N	45	0,8	100
saturated switching	**BSX19**	N	15	0,36	18
	BSX20	N	15	0,36	21
	2N2368	N	15	0,36	15
	2N2369	N	15	0,36	18
	2N2369A	N	15	0,36	18
	2N2894A	P	12	0,36	35

	type	polarity	V_{CEO} (V)	P_{tot} (W)	t_{off} max (ns)
saturated switching and driver applications for industrial service	**2N2904**	P	40	0,6	100
	2N2904A	P	60	0,6	100
	2N2905	P	40	0,6	100
	2N2905A	P	60	0,6	100
	2N2906	P	40	0,4	100
	2N2906A	P	60	0,4	100
	2N2907	P	40	0,4	100
	2N2907A	P	60	0,4	100
	2N2218	N	30	0,8	—
	2N2218A	N	40	0,8	285
	2N2219	N	30	0,8	—
	2N2219A	N	40	0,8	285
	2N2221	N	30	0,5	—
	2N2221A	N	40	0,5	285
	2N2222	N	30	0,5	—
	2N2222A	N	40	0,5	285

Trigger devices

BR101
BRY39
BRY56

PNPN devices for relay and lamp drivers, sensing networks for temperature control, oscillators, timers, pulse shapers, and as replacements for relays, silicon controlled switches, programmable unijunction transistors.
The BRY39 can also be used for driving numerical indicator tubes.

type	status	case	RATINGS V_{GA} (V)	V_{EBO} V_{GK} (V)	I_{ERM} I_{ARM} 10 μs; $\delta = 0{,}01$ (A)	dI_A/dt (A/μs)	P_{tot} (mW)	CHARACTERISTICS V_{AK} max (V)	I_H max (mA)	t_r max (ns)
BR101	D	TO-72(3)	50	5	2,5	—	275	1,4	1	—
BRY39	D	TO-72(3)	70	5	2,5	20	275	1,4	1	80
BRY56	D	TO-92(4)	70	70	2,5	20	300	1,4	—	80

h.f. and switching transistors

abridged data

				RATINGS					CHARACTERISTICS		
type	polarity	status	case	V_{CBO}	V_{CEO}	I_C	P_{tot} at	T_{amb} (T_{mb})	h_{FE} at min—max	I_C	f_T typ
				V	V	mA	W	°C		mA	MHz
BF115	N	C	TO-72(2)	50	30	30	0,145	45	45—165	1	230
BF180	N	D	TO-72(1)	30	20	20	0,15	25	13	2	675
BF181	N	D	TO-72(1)	30	20	20	0,15	25	13	2	600
BF182	N	D	TO-72(1)	25	20	15	0,15	25	10	2	650
BF183	N	D	TO-72(1)	25	20	15	0,15	25	10	3	800
BF184	N	C	TO-72(2)	30	20	30	0,145	45	75—750	1	300
BF185	N	C	TO-72(2)	30	20	30	0,145	45	34—140	1	220
BF198	N	D	TO-92(1)	40	30	25	0,5	25	27	4	400
BF199	N	D	TO-92(1)	40	25	25	0,5	25	37	7	550
BF200	N	D	TO-72(1)	30	20	20	0,15	25	15	3	650
BF240	N	D	TO-92(1)	40	40	25	0,25	25	65—220	1	380
BF241	N	D	TO-92(1)	40	40	25	0,25	25	35—125	1	350
BF324	P	D	TO-92(2)	30	30	25	0,25	45	25	4	450
BF370	N	N	TO-92(2)	40	15	100	0,5	25	40	10	>490
BF422	N	D	TO-92(3)	250	250	50	0,83	25	50	25	>60
BF423	P	D	TO-92(3)	250	250	50	0,83	25	50	25	>60
BF450	P	D	TO-92(1)	40	40	25	0,25	45	60—200	1	325
BF451	P	D	TO-92(1)	40	40	25	0,25	45	30—90	1	325
BF480	N	D	SOT-37(4)	20	15	20	0,2	60	10	10	2000
BF494	N	D	TO-92(1)	30	20	30	0,3	75	typ 115	1	260
BF495	N	D	TO-92(1)	30	20	30	0,3	75	typ 67	1	200
BF496	N	D	TO-92(1)	30	20	20	0,3	75	—	—	550
BF936	P	D	TO-92(2)	30	20	25	0,25	45	—	—	350
BF939	P	D	TO-92(2)	30	25	20	0,255	55	—	—	675
BF967	P	D	SOT-37(1)	30	30	20	0,16	55	15	3	900
BF970	P	D	SOT-37(1)	40	35	30	0,16	55	25	3	850
BF979	P	D	SOT-37(1)	20	20	20	0,14	55	15	2	1350
BFR54	N	D	TO-92(1)	40	15	350	0,5	25	40	10	600
BFT24	N	D	SOT-37(2)	8	5	2,5	0,03	135	40	1	2300
BFT44	P	D	TO-39(1)	300	300	500	5	(50)	50—150	10	70
BFT45	P	D	TO-39(1)	250	250	500	5	(50)	50—150	10	70
BFX34	N	D	TO-39(1)	120	60	2	0,87	25	40—150	2000	100
BFY50	N	D	TO-39(1)	80	35	1000	0,8	25	112	150	140
BFY51	N	D	TO-39(1)	60	30	1000	0,8	25	123	150	160
BFY52	N	D	TO-39(1)	40	20	1000	0,8	25	142	150	185
BFY55	N	D	TO-39(1)	80	35	1000	0,8	25	40—120	150	>60

SOT-37

TO-39

TO-72

TO-92

CHARACTERISTICS

V_{CEsat} max V	at I_C/I_B mA/mA	F typ dB	at f MHz	$C_{re}(C_c)$ typ pF	at f MHz	G_{UM} typ dB	at f MHz	t_{off} max ns	at I_C A	type
—	—	4	100	0,65	0,45	—	—	—	—	**BF115**
—	—	7	800	0,28	10,7	12	900	—	—	**BF180**
—	—	6,8	900	0,28	10,7	11	900	—	—	**BF181**
—	—	7,4	800	0,33	10,7	11	900	—	—	**BF182**
—	—	—	—	0,33	10,7	13	900	—	—	**BF183**
—	—	3	0,2	0,65	0,45	—	—	—	—	**BF184**
—	—	4	100	0,65	0,45	—	—	—	—	**BF185**
—	—	3	35	0,2	10,7	42	35	—	—	**BF198**
—	—	—	—	0,3	10,7	43	35	—	—	**BF199**
—	—	2,7	200	0,28	10,7	22	200	—	—	**BF200**
—	—	<3,5	0,2	0,27	1	—	—	—	—	**BF240**
—	—	<3,5	0,2	0,27	1	—	—	—	—	**BF241**
—	—	3	100	0,1	1	—	—	—	—	**BF324**
—	—	—	—	1,6	1	—	—	—	—	**BF370**
—	—	—	—	<1,6	1	—	—	—	—	**BF422**
—	—	—	—	<1,6	1	—	—	—	—	**BF423**
—	—	2	0,1	0,35	1	—	—	—	—	**BF450**
—	—	2	0,1	0,35	1	—	—	—	—	**BF451**
—	—	3,8	800	—	—	—	—	—	—	**BF480**
—	—	4	100	0,85	0,45	—	—	—	—	**BF494**
—	—	4	100	0,85	0,45	—	—	—	—	**BF495**
—	—	2,5	200	0,8	10,7	27	200	—	—	**BF496**
—	—	5	200	0,9	—	—	—	—	—	**BF936**
—	—	25	200	0,7	0,5	—	—	—	—	**BF939**
—	—	4	800	0,45	0,5	—	—	—	—	**BF967**
—	—	4,5	800	0,45	1	—	—	—	—	**BF970**
—	—	4,5	800	0,65	0,5	—	—	—	—	**BF979**
0,25	10/1	—	—	(<4)	1	10	200	—	—	**BFR54**
1,25	1/0,1	3,8	500	<0,4	1	17	500	—	—	**BFT24**
1,4	100/10	—	—	(<15)	1	—	—	125	0,5	**BFT44**
1,4	100/10	—	—	(<15)	1	—	—	125	0,5	**BFT45**
1	5000/500	—	—	36	1	—	—	1200	5	**BFX34**
0,7	500/50	—	—	12	1	—	—	360	0,15	**BFY50**
1	500/50									**BFY51**
1	500/50									**BFY52**
1	1000/100									**BFY55**

h.f. and switching transistors
abridged data

				RATINGS						CHARACTERISTICS		
type	polarity	status	case	V_{CBO} V	(V_{CER}) V_{CEO} V	I_C (I_{CM}) mA	P_{tot} W	at T_{amb} (T_{case}) °C		h_{FE} min—max	at I_C mA	f_T typ MHz
BSR50				60	(45)							
BSR51	N	D	TO-92(3)	80	(60)	1000	0,8	25		2000	500	—
BSR52				100	(80)							
BSR60				60	(45)							
BSR61	P	D	TO-92(3)	80	(60)	1000	0,8	25		2000	500	—
BSR62				100	(80)							
BSS38	N	D	TO-92(2)	120	100	100	0,5	25		20	4	>60
BSS50				60	(45)							
BSS51	N	D	TO-39(1)	80	(60)	1000	0,8	25		2000	500	—
BSS52				100	(80)							
BSS60				60	(45)							
BSS61	P	D	TO-39(1)	80	(60)	1000	0,8	25		2000	500	—
BSS62				100	(80)							
BSS68	P	D	TO-92(2)	110	100	100	0,5	25		30	25	50
BSV15-6,10,16					40				**6**	40—100		
BSV16-6,10,16	P	C	TO-39(1)	—	60	1000	0,8	25	**10**	63—160	100	50
BSV17-6,10					80				**16**	100—250		
BSV64	N	D	TO-39(1)	100	60	2000	5	(50)		40	2000	100
BSW41A	N	M	TO-18(1)	40	25	300	1	(25)		15	500	150
BSW66A				100	100							
BSW67A	N	D	TO-39(1)	120	120	1000	0,8	25		30	500	130
BSW68A				150	150							
BSX19	N	D	TO-18(1)	40	15	(500)	0,36	25		20—60	10	500
BSX20										40—120		600
BSX45-6,10,16					40				**6**	40—100		
BSX46-6,10,16	N	C	TO-39(1)	—	60	1000	5	(25)	**10**	63—160	100	50
BSX47-6,10					80				**16**	100—250		
BSX59					45							450
BSX60	N	D	TO-39(1)	70	30	1000	0,8	25		30—90	500	475
BSX61					45							475
PH2369	N	D	TO-92(1)	40	15	(500)	0,5	25		40—120	10	>500

TO-18

TO-39

TO-92

CHARACTERISTICS

V_{CEsat} max V	at I_C/I_B mA/mA	F typ dB	at f MHz	C_c typ pF	at f MHz	G_{UM} typ dB	at f MHz	t_{off} max ns	at I_C A	type
1,3	500/0,5	—	—	—	—	—	—	1500	1	**BSR50** **BSR51** **BSR52**
1,3	500/50	—	—	—	—	—	—	1500	0,5	**BSR60** **BSR61** **BSR62**
0,7	4/0,4	—	—	$C_{re} < 4{,}5$	1	—	—	1000	0,015	**BSS38**
1,6	1000/4 1000/1 1000/4	—	—	—	—	—	—	1500	0,5	**BSS50** **BSS51** **BSS52**
1,6	1000/4 1000/1 1000/4	—	—	—	—	—	—	1500	0,5	**BSS60** **BSS61** **BSS62**
0,25	25/2,5	—	—	5	1	—	—	—	—	**BSS68**
1	500/25	—	—	20 20 15	1	—	—	650	0,1	**BSV15-6,10,16** **BSV16-6,10,16** **BSV17-6,10**
1	5000/500	—	—	80	1	—	—	1200	5	**BSV64**
0,7	500/35	—	—	8	1	—	—	60	0,5	**BSW41A**
0,4	500/50	—	—	20	1	—	—	typ 900	0,5	**BSW66A** **BSW67A** **BSW68A**
1,5	100/10	—	—	4	1	—	—	18 21	0,1 0,1	**BSX19** **BSX20**
1 1 0,9	1000/100 1000/100 500/25	—	—	25 20 15	1	—	—	850	0,1	**BSX45-6,10,16** **BSX46-6,10,16** **BSX47-6,10**
1,2 1,3 1,3	500/50	—	—	6	1	—	—	60 70 100	0,5	**BSX59** **BSX60** **BSX61**
0,6	100/10	—	—	4	1	—	—	21	0,1	**PH2369**

h.f. and switching transistors

abridged data

				RATINGS					CHARACTERISTICS		
type	polarity	status	case	V_{CBO} V	V_{CEO} (V_{CER}) V	I_C (I_{CM}) mA	P_{tot} W	at T_{amb} °C	h_{FE} min—max	at I_C mA	f_T typ MHz
2N918	N	C	TO-72(1)	30	15	50	0,2	25	20	3	>900
2N1613			TO-39(1)	75	(50)	(1000)	0,8		40—120	150	60
2N1711			TO-39(1)	75	(50)	(1000)	0,8		100—300	150	70
2N1893			TO-39(1)	120	80	500	0,8		40—120	150	50
2N2218	N	D	TO-39(1)	60	30	800	0,8	25	40—120	150	250
2N2219			TO-39(1)				0,8		100—300		
2N2221			TO-18(1)				0,5		40—120		
2N2222			TO-18(1)				0,5		100—300		
2N2218A	N	D	TO-39(1)	75	40	800	0,8	25	40—120	150	250
2N2219A			TO-39(1)				0,8		100—300		
2N2221A			TO-18(1)				0,5		40—120		
2N2222A			TO-18(1)				0,5		100—300		
2N2297	N	C	TO-39(1)	80	35	1000	0,8	25	40—120	150	>60
2N2368	N	C	TO-18(1)	40	15	(500)	0,36	25	20— 60	10	>400
2N2369						(500)			40—120		>500
2N2369A						200			40—120		>500
2N2894	P	C	TO-18(1)	12	12	200	0,36	25	40—150	30	—
2N2894A									40—120		
2N2904	P	D	TO-39(1)	60	40	600	0,6	25	40—120	150	>200
2N2905			TO-39(1)				0,6		100—300		
2N2906			TO-18(1)				0,4		40—120		
2N2907			TO-18(1)				0,4		100—300		
2N2904A	P	D	TO-39(1)	60	60	600	0,6	25	40—120	150	>200
2N2905A			TO-39(1)				0,6		100—300		
2N2906A			TO-18(1)				0,4		40—120		
2N2907A			TO-18(1)				0,4		100—300		
2N3019	N	D	TO-39(1)	140	80	1000	0,8	25	100—300	150	>100
2N3020									40—120		>80
2N4030	P	D	TO-39(1)	60	60	1	0,8	25	25	500	>100
2N4031				80	80				25		>100
2N4032				60	60				70		>150
2N4033				80	80				70		>150
2N5415	P	D	TO-39(1)	200	200	1000	1	50	30—150	50	>15
2N5416				350	300				30—120		

TO-18

TO-39

TO-72

CHARACTERISTICS

V_{CEsat} max V	at I_C/I_B mA/mA	F typ dB	at f MHz	C_c max pF	at f MHz	G_{UM} typ dB	at f MHz	t_{off} max ns	at I_C A	type
0,4 1,5 1,5 5	10/1 150/15 150/15 150/15	< 6 < 12 < 8 —	60 0,001 0,001 —	3 25 25 15	0,14 1 1 —	36 — — —	200 — — —	—	—	**2N918** **2N1613** **2N1711** **2N1893**
0,4	150/15	—	—	8	0,1	—	—	—	—	**2N2218** **2N2219** **2N2221** **2N2222**
0,3	150/15	— 4 — 4	0,001	8	0,1	—	—	285	0,15	**2N2218A** **2N2219A** **2N2221A** **2N2222A**
1,0	1000/100	—	—	12	0,5	—	—	—	—	**2N2297**
0,25 0,25 0,2	10/1	—	—	4	0,14	—	—	15 18 18	0,01	**2N2368** **2N2369** **2N2369A**
0,2 0,19	30/3	—	—	6 4,5	0,14	—	—	90 35	0,03	**2N2894** **2N2894A**
0,4	150/15	—	—	8	0,1	—	—	100	0,15	**2N2904** **2N2905** **2N2906** **2N2907**
0,4	150/15	—	—	8	0,1	—	—	100	0,15	**2N2904A** **2N2905A** **2N2906A** **2N2907A**
0,2	150/15	—	—	12	1	—	—	—	—	**2N3019** **2N3020**
0,5	500/50	—	—	20	1	—	—	400	0,5	**2N4030** **2N4031** **2N4032** **2N4033**
2,5 2,0	50/5	—	—	15	1	—	—	125	0,5	**2N5415** **2N5416**

field-effect transistors

n-channel

In a charge preamplifier such as this, used with Ge(Li) radiation detector systems, FETs are chosen for their high input resistance and low noise characteristics.

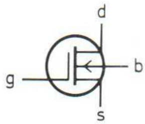
Amplifiers — Junction · FET

type	status	case	RATINGS ± V_{DS} V	P_{tot} mW	at T_{amb} °C	CHARACTERISTICS − I_{GSS} max nA	I_{DSS} min—max mA	− $V_{(P)GS}$ max V	$\|Y_{fs}\|_{min}$ f = 1 kHz mA/V	C_{rs} typ pF	F typ db	V_n max µV
BC264A	D	TO-92(5)	30	300	25	10	2 — 4,5	>0,5	2,5	1,2	<2	—
BC264B							3,5— 6,5		3			
BC264C							5 — 8		3,5			
BC264D							7 —12		4			
BF245A	D	TO-92(5)	30	300	75	5	2 — 6,5	8	3	1,1	1,5	—
BF245B							6 —15					
BF245C							12 —25					
BF256A	D	TO-92(5)	30	300	75	5	3 — 7	—	4,5	0,7	7,5	—
BF256B							6 —13					
BF256C							11 —18					
BFW10	D	TO-72(4)	30	300	25	0,1	8 —20	8	3,5	0,6	<2,5	—
BFW11							4 —10	6	3			
BFW12	D	TO-72(4)	30	150	110	0,1	1 — 5	2,5	2	<0,8	—	0,5
BFW13							0,2— 1,5	1,2	1			
BFW61	D	TO-72/4)	25	300	25	1,0	2 —20	8	2	<2	—	—
2N3823	D	TO-72(4)	30	300	25	0,5	4 —20	8	3,5	<2	<2,5	—
BF410A	D	TO-92(5)	20	300	75	10	0,7— 3,0	typ 0,8	2,5	<0,4	1,5	—
BF410B							2,5— 7,0	1,5	4			
BF410C							6 —12	2,2	6			
BF410D							10 —18	3	7			

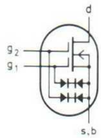
Amplifiers — MOS · FET

type	status	case	RATINGS V_{DB} V	V_{DS} V	P_{tot} mW	at T_{amb} °C	CHARACTERISTICS ± I_{GSS} max pA	± $I_{G1\text{-}SS}$ ± $I_{G2\text{-}SS}$ max nA	I_{DSS} mA	− $V_{(P)GS}$ − $V_{(P)G1\text{-}S}$ max V	$\|Y_{fs}\|$ f = 1 kHz min mA/V	C_{rs} typ fF	F max dB
BF960	D	SOT-103	—	20	225	75	—	100	4—20	3,5	9	25	typ 1,4
BF980	N	SOT-103	—	18	225	75	—	25	—	1,3	17	25	typ 2,8
BF981	D	SOT-103	—	20	225	75	—	100	4—25	2,5	10	25	2
BF982	N	SOT-103	—	20	225	75	—	25	—	1,3	20	30	typ 1,2
BFR29	D	TO-72(5)	30	—	200	25	10	—	10—40	4	6	<700	5
BFR84	D	TO-72(6)	—	20	300	25	—	10	20—55	3,8	12	30	3
3N211	N	TO-72(6)	—	27	360	25	—	10	6—40	—	17	5-50	4

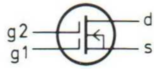
junction FET



single-gate MOS-FET



dual-gate MOS-FET protected



dual-gate MOS-FET unprotected

Most of our components are backed by application publications. For this subject, ask for Application Book "Field-effect transistors".

Switching — Junction · FET

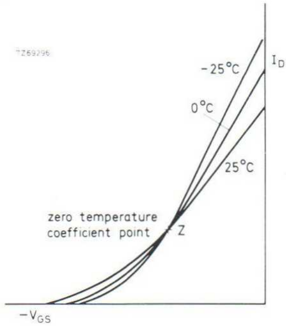
type	status	case	RATINGS $\pm V_{DS}$ V	P_{tot} mW	at T_{amb} (T_{case}) °C	CHARACTERISTICS $-I_{GSS}$ max nA	I_{DSS} min mA	$-V_{(P)GS}$ max V	$r_{ds\ on}$ max Ω	C_{rs} max pF	t_{on} max ns	t_{off} max ns
BSV78							50	11	25		10	10
BSV79	D	TO-18(2)	40	350	25	0,25	20	7,0	40	5	15	15
BSV80							10	5,0	60		15	25
2N3966	D	TO-72(4)	30	300	25	0,1	2	6	220	1,5	120	100
2N4091							30	10	30		25	40
2N4092	D	TO-18(2)	40	1800	(25)	0,2	15	7,0	50	5	35	60
2N4093						(I_{SGO})	8	5,0	80		60	80
2N4391							50	10	30			20
2N4392	D	TO-18(2)	40	1800	(25)	0,1	25	5,0	60	3,5	15	35
2N4393							5	3,0	100			50
2N4856							50	10	25		9	25
2N4857	D	TO-18(2)	40	360	25	0,25	20	6	40	8	10	50
2N4858							8	4	60		20	100
2N4859							50	10	25		9	25
2N4860	D	TO-18(2)	30	360	25	0,25	20	6	40	8	10	50
2N4861							8	4	60		20	100

Switching — MOS · FET

type	status	case	RATINGS V_{DB} V_{SB} V	P_{tot} mW	at T_{amb} °C	CHARACTERISTICS $\pm I_{GSS}$ max pA	I_{DSX} I_{SDX} max nA	$r_{ds\ on}$ max Ω	r_{DSoff} min GΩ	C_{rs} max pF	C_{rd} max pF
BSV81	D	TO-72(5)	30	200	25	10	1	50	10	0,5	0,5

field-effect transistors

n-channel



Temperature dependence of the I_D—V_{GS} characteristic of an n-channel FET

Differential amplifiers

Note: BFS..types: matched pairs in SOT-52.
BFQ..types: dual transistors in TO-71(1).

type	status	RATINGS individual transistor $\pm V_{DS}$ V	P_{tot} (T_{amb}) mW (°C)	total device P_{tot} (T_{amb}) mW (°C)	CHARACTERISTICS individual transistor $-I_{GSS}$ max nA	I_{DSS} mA	$-V_{(P)GS}$ max V	total device $\lvert\Delta V_{GS}\rvert$ max mV	$\left\lvert\frac{d\Delta V_{GS}}{dT}\right\rvert$ max µV/°C	$\left\lvert\Delta\frac{1}{g_{fs}}\right\rvert$ max Ω	$\left\lvert\Delta\frac{g_{os}}{g_{fs}}\right\rvert$ max µV/V	CMRR min dB
BFQ10								5	5	6	10	100
BFQ11								10	5	6	30	90
BFQ12								10	10	12	30	90
BFQ13	D	30	250	250	0,1	0,5-10	3,5	10	20	12	30	90
BFQ14			(75)	(75)				15	20	12	30	90
BFQ15								20	40	20	30	90
BFQ16								50	50	30	100	80
BFS21	C	30	300	30	0,5	>1	6	20	75	15	1000	60
BFS21A			(25)	(100)				10	40	7,5	500	66

dual transistors

differential amplifiers

Dual transistors in TO-71(2) — polarity n-p-n

type	status	RATINGS individual transistor V_{CEO} V	I_C mA	P_{tot} (T_{amb}) mW (°C)	CHARACTERISTICS individual transistor h_{FE} min-max	at I_C mA	F max dB	f_T min MHz	$\frac{I_{1C}}{I_{2C}}$	total device V_{1BE}-V_{2BE} max mV	$\left\lvert\frac{\Delta V}{\Delta T}\right\rvert$ max µV/°C	$\left\lvert\frac{\Delta I}{\Delta T}\right\rvert$ max nA/°C
											T_{amb} = −20	to +90°C
BCY87					100—450	0,05	3		0,9 —1,11	3	3	0,5
BCY88	D	40	30	150	120—600	0,5	4	50	0,8 —1,25	6	6	2
BCY89				(25)	100—600	10	4		0,67—1,5	10	10	10

BFQ10 to 16; see above.

r.f. power transistors and modules
recommended types

For complete range see selection guide.

$\boxed{}$ = MODULE

P_o (W)	H.F. 1,6-30 MHz	V.H.F. band I/II 30-175 MHz	V.H.F. band III transposers 175-225 MHz	U.H.F. communication 225-470 MHz	U.H.F. band IV/V transposers 470-860 MHz
200	BLW 96				
160	BLW 95	BLW 95			
150	BLX 15	BLX 15			
130	BLW 77	BLW 77	BLV 36		
100		BLW 78			
80	BLW 76	BLW 76			
65	BLW 50 F				
50	BLX 14	BLY 90, BLY 94			
45	BLW 86	BLW 60 C, BLW 85, BLX 39, BLW 86			
40	BLX 39			BLX 95	
31		$\boxed{\text{BGY 38}}$			
30	BLW 60 C, BLW 78, BLW 85			BLW 82	
28		BLW 31			
25	BLX 13 C, BLW 83	BLY 89 C, BLW 84, BLY 93 C, BLW 87		BLX 94 A	
21			BLV 33		
20				BLX 69 A	
18		$\boxed{\text{BGY 32}}$ $\boxed{\text{BGY 35}}$ $\boxed{\text{BGY 33}}$ $\boxed{\text{BGY 36}}$			
17,5			BLV 33 F		
15	BLW 87, BLY 89 C	BLY 88 C, BLV 11, BLY 92 C, BLV 21			
14		$\boxed{\text{BGY 43}}$	BLW 75	$\boxed{\text{BGY 41 A}}$ $\boxed{\text{BGY 41 B}}$	
10	BLY 88 C, BLV 11, BLY 92 C, BLV 21		BLW 64, BLV 32 F	BLW 81, BLW 91	
8		BLY 87 C, BLV 10, BLY 91 C, BLV 20		$\boxed{\text{BGY 40 A}}$ $\boxed{\text{BGY 40 B}}$	
7,5					BLV 57
7				BLX 68, BLX 93 A, $\boxed{\text{BGY 23}}$ $\boxed{\text{BGY 23 A}}$	
6			BLV 31		
5					
4		BFS 22 A, BFQ 43, BFS 23 A		BLW 80, BLW 90	
3,5					BLW 98, BLX 98
2,5				BLX 66, BLX 92 A, $\boxed{\text{BGY 22}}$ $\boxed{\text{BGY 22 A}}$	
2		BFQ 42		BLW 79, BLX 65, BLW 89	BLW 34
1,7			BLV 30		
1,6			BLX 93 A		
1,3	BLY 91 C, BLV 20				
1	BLY 87 C, BLV 10			BLX 91 A, 2 N 3866	BLW 33, BLX 97
0,7			BLX 92 A		
0,5			$\boxed{\text{BGY 55}}$		BLW 32, BLX 96
0,45			BLX 91 A		

r.f. power transistors and modules

selection guide

Main r.f. power application areas with applicable transistors and modules

For detailed information Handbook S6

	type number	status	envelope	V_{CE} V	P_L(P.E.P.) W	G_p dB
s.s.b. class-AB	**BLY92A**	C	SOT-48		10	20
f = 28 MHz; d_3; $d_5 < -30$ dB	**BLY92C**	D	SOT-120		10	20
	BLV21	D	SOT-123	28	10	20
	BLX13	C	SOT-56		25	18
	BLX13C	D	SOT-120		25	18
	BLW83	D	SOT-123		25	18
	BLX39	D	SOT-120	28	40	17
	BLW86	D	SOT-123		45	17
	BLX14	C	SOT-55		50	13
	BLW76	D	SOT-121	28	80	13
	BLW77	D	SOT-121	28	130	12
	BLW50F	D	SOT-123	50	50	18
	BLX15	D	SOT-55	50	150	14
	BLW95	D	SOT-121	50	160	14
	BLW96	D	SOT-121	50	200	13,5
s.s.b. class-A	**BLY91A**	C	SOT-48		1,3	
f = 28 MHz; d_3; $d_5 < -40$ dB	**BLY91C**	D	SOT-120	26	1,3	20
	BLV20	D	SOT-123		1,3	
	BLY92A	C	SOT-48		2,5	
	BLY92C	D	SOT-120		2,5	20
	BLV21	D	SOT-123	26	2,5	20
	BLX13	C	SOT-56		8	18
	BLX13C	D	SOT-120		8	20
	BLW83	D	SOT-123		10	20
	BLX39	D	SOT-120	26	15	18
	BLW86	D	SOT-123		17	20
	BLW78	D	SOT-121		30	18
	BLW50F	D	SOT-123	45	16	19,5
	BLW96	D	SOT-121	40	40	18
s.s.b. class-AB	**BLY88A**	C	SOT-48			
f = 28 MHz; d_3; $d_5 < -30$ dB	**BLY88C**	D	SOT-120	13,5	10	18
	BLV11	D	SOT-123			
	BLY89A	C	SOT-56			
	BLY89C	D	SOT-120	13,5	15	18
	BLW87	D	SOT-123			
	BLW60	C	SOT-56			
	BLW60C	D	SOT-120	12,5	30	18
	BLW85	D	SOT-123			
s.s.b. class-A	**BLY87A**	C	SOT-48			
f = 28 MHz; d_3; $d_5 < -40$ dB	**BLY87C**	D	SOT-120	12	1	18
	BLV10	D	SOT-123			
	BLY88A	C	SOT-48			
	BLY88C	D	SOT-120	12	2	18
	BLV11	D	SOT-123			
	BLY89A	C	SOT-56			
	BLY89C	D	SOT-120	12	6	18
	BLW87	D	SOT-123			

	type number	status	envelope	f MHz	V_{CE} V	P_L W	G_p dB
v.h.f. base stations	**2N3866**	D	TO-39			1	15
class-B operation	**BFS23A**	D	TO-39			4	10
	BLY91A	C	SOT-48	175	28	8	12
	BLY91C	D	SOT-120			8	12
	BLV20	D	SOT-123			8	12
	BLY92A	C	SOT-48			15	10
	BLY92C	D	SOT-120			15	10
	BLV21	D	SOT-123	175	28	15	10
	BLY93A	C	SOT-56			25	9
	BLY93C	D	SOT-120			25	9
	BLW84		SOT-123	175		25	9
	BLX39		SOT-120	175		45	7,5
	BLW86	D	SOT-123	175	28	45	7,5
	BLY94		SOT-55	175		50	7
	BLW76		SOT-121	108		80	8
	BLW78		SOT-121	150	28	100	6
	BLW77		SOT-121	87,5	28	130	7,5
	BLX15	D	SOT-55	108	50	150	7,5
	BLW95		SOT-121	108	50	160	7,0
	BLW96		SOT-121	108	50	200	6,5
v.h.f. mobile transmitters	**2N4427**	D	TO-39		12	1	10
class-B operation	**BFQ42**	D	TO-39		13,5	2	11
	BFS22A	D	TO-39	175	13,5	4	8
	BFQ43	D	TO-39 ▲		13,5	4	12
	BLY87A	C	SOT-48		13,5	8	9
	BLY87C	D	SOT-120			8	12
	BLV10	D	SOT-123			8	9
	BLW29	D	SOT-120	175	13,5	15	10
	BLY88A	C	SOT-48			15	7,5
	BLY88C	D	SOT-120			15	7,5
	BLV11	D	SOT-123			15	7,5
	BLY89A	C	SOT-56			25	6
	BLY89C	D	SOT-120	175	13,5	25	6
	BLW87	D	SOT-123			25	6
	BLW31	D	SOT-120			28	9
	BLW60	C	SOT-56			45	5,5
	BLW60C	D	SOT-120	175	12,5	45	5,5
	BLW85	D	SOT-123			45	5
	BLY90	D	SOT-55			50	5
v.h.f. modules	**BGY32**	D		68 to 88	12,5	18	22,6
for mobile transmitters	**BGY33**	D		80 to 108	12,5	18	22,6
	BGY43	N	SOT-132	148 to 174	12,5	13	19,4
	BGY35	D		132 to 156	12,5	18	20,8
	BGY36	D		148 to 174	12,5	18	20,8
	BGY38	D		156 to 163	13,5	28	20,5

▲ Emitter connected to case

r.f. power transistors and modules

selection guide

	type number	status	envelope	f MHz	V_{CE} V	P_L W	G_p dB
u.h.f. modules for mobile transmitters	**BGY22**	D	SOT-75A	380 to 512	13,5	2,5	17
	BGY22A	D		420 to 480	12,5	2,5	17
	BGY23	D		380 to 480	13,5	7,0	4,5
	BGY23A	D		420 to 480	12,5	7,0	4,5
	BGY40A	D	SOT-132C	400 to 440	12,5	7,5	18,8
	BGY40B	D	SOT-132C	440 to 470	12,5	7,5	18,8
	BGY41A	D	SOT-132C	400 to 440	12,5	13	19,4
	BGY41B	D	SOT-132C	440 to 470	12,5	13	19,4
u.h.f. base stations class-B operation	**2N3866**	D	TO-39	470	28	1	7
	BLX91A	D	SOT-48	470	28	1	11
	BLW89	D	SOT-122	470	28	2	12
	BLX92A	D	SOT-48	470	28	2,5	11
	BLW90	D	SOT-122	470	28	4	11
	BLX93A	D	SOT-48	470	28	7	8,5
	BLW91	D	SOT-122	470	28	10	9
	BLX94A	D	SOT-48	470	28	25	6
	BLX94C	D	SOT-122	470	28	25	6,5
	BLX95	D	SOT-56	470	28	40	4,5
u.h.f. mobile transmitters class-B operation	**BLX65**	D	TO-39	470	12,5	2	6
	BLW79	D	SOT-122			2	9
	BLX66	D	SOT-48 ▲			2,5	8,5
	BLX67	C	SOT-48			2,5	8,5
	BLW80	D	SOT-122			4	8
	BLX68	C	SOT-48	470	12,5	7	5
	BLW81	D	SOT-122		12,5	10	6
	BLX69A	D	SOT-48		13,5	20	4
	BLW82	D	SOT-119		12,5	30	5

▲ Without stud.

TV transposer types for application in band III, IV and V.

- gold-gold bonding for high reliabilty
- high power gain offering cheaper line-up
- sophisticated ion-implantation technology
- modern encapsulation giving optimum heatsinking
- complete line-up with small-signal driver transistors

TV transposer circuits

	type number	envelope	f MHz	$P_{o\ sync}$ W	d_{im} dB	G_p dB	V_{CE} V	I_C mA
band III; class-A operation	**BGY55** •	SOT-115	225	0,25 0,45	– 60 – 55	17	24	200
	BLV30	SOT-122	225	1,5	– 60	18	25	460
	BLV31	SOT-122	225	5	– 58	15	25	800
	BLW64	SOT-56	225	10	– 55	10	25	1600
	BLV32F	SOT-160	225	10	– 55	16	25	1600
	BLW75	SOT-105	225	14	– 55	8	25	2400
	BLV33F	SOT-119	225	16	– 55	13,5	25	3200
	BLV33	SOT-147	225	19	– 55	9	25	3200
	BLV36	SOT-161	225	35	– 55	12	25	2 × 2600
band III; class-AB operation	**BLV33F**	SOT-119	225	85 *		10,5	28	4250
	BLV33	SOT-147	225	90 *		6,5	28	4460
	BLV36	SOT-161	225	125 *		10,5	28	2 × 3430
band IV-V; class-A operation	**BFR965** •	SOT-37	860	0,12	– 60	10	10	70
	BFQ34 •	SOT-122	860	0,3	– 60	11	15	120
	BLW32	SOT-122	860	0,5	– 60	11	25	150
	BFQ68 •	SOT-122	860	0,7	– 60	10	15	240
	BLW33	SOT-122	860	1,0	– 60	10	25	300
	BLW34	SOT-122	860	1,8	– 60	9	25	600
	BLW98	SOT-122	860	3,5	– 60	6,5	25	850
	BLV57	SOT-161	860	6	– 60	8	25	2 × 850
band IV-V; class-AB operation	**BLV57**	SOT-161	860	30 *		6	25	2 × 1100

* At 1 dB power gain compression.
• See handbook S10.

r.f. power transistors and modules

line-ups

Recommended circuit line-ups in the main r.f. power application areas. A comprehensive range of output power levels is indicated together with our recommended types in the particular line-up configuration. The necessary input power level for each line-up is indicated in the first column. More detailed application information as well as computer aided design parameters are available on request.

S.S.B. transmitters (1,5 to 30 MHz)

input power mW	1st stage		2nd stage	3rd stage	P_L(P.E.P.) W	V_{CE} V	stud S flange F
30	BLY87C	*	2 × BLY89C		**30**		S
30	BLV10	*	2 × BLW87		**30**		F
50	BLY88C	*	2 × BLW60C		**50**	13	S
50	BLV11	*	2 × BLW85		**50**		F
100	BLY89C	*	4 × BLW60C		**100**		S
100	BLW87	*	4 × BLW85		**100**		F
50	BLY91C	*	2 × BLX13C		**50**		S
50	BLV20	*	2 × BLW83		**50**		F
150	BLW83	*	2 × BLW76		**150**	28	F
250	2 × BLW83	*	2 × BLW77		**250**		F
500	2 × BLW86	*	4 × BLW77		**450**		F
300	2 × BLX13C	**	2 × BLX15		**250**		S
300	2 × BLW83	**	2 × BLW96		**350**		F
600	2 × BLX39	**	4 × BLX15		**500**	50	S
600	2 × BLW50F	*	4 × BLW95		**500**		F
40	BLY91C	**	2 × BLW78 **	8 × BLX15	**1000**		S/F
40	BLV20	**	4 × BLW50F	8 × BLW96	**1200**		F

Military communication transmitters (25 to 80 MHz)

input power mW	1st stage		2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
5	BFR96 •	*	2 × BFQ42		**2**	7,5	—
15	2N4427	*	2 × BLW80		**6**	13	S
50	BLW79	*	2 × BLW29		**25**	13	S
50	BLW89	*	2 × BLY92C		**25**	28	S
20	2N3866	*	2 × BLY91C	2 × BLX39	**90**	28	S
20	2N3866	*	2 × BLV20	2 × BLW86	**90**	28	F

• See Handbook S10.
* Class-A operation.
** 28 V supply voltage; class-A operation.

Mobile transmitters (68 to 87,5 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
20	2N4427	BLY87C		**8**		S
20	2N4427	BLV10		**8**		F
35	2N4427	BLW29		**14**		S
10	BSX19 •	BGY32		**18**	13	F
70	BFQ42	BLW31		**28**		S
160	BFQ43	BLW60C		**45**		S
160	BFQ43	BLW85		**45**		F

Base stations (68 to 87,5 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
65	BFS23A	BLY93C		**25**	28	S
65	BFS23A	BLW84		**25**	28	F
125	BLX92A	BLX39		**50**	28	S
15	2N3866	BLV21	BLW78	**100**	28	F
50	2N3866 **	BLY93C **	BLX15	**150**	50	S
50	2N3866 **	BLW84 **	BLW95	**150**	50	F

F.M. broadcast transmitters (87,5 to 108 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
100	BLW90	BLX39		**50**	28	S
40	2N3866	BLV21	BLW78	**100**	28	F
60	BLW90 **	BLX39 **	BLX15	**150**	50	S
60	BLW90 **	BLW50F	BLW95	**150**	50	S/F
100	BLW90 **	BLX39 **	2 × BLX15	**250**	50	S
100	BLW90 **	BLW50F	2 × BLW95	**250**	50	SF

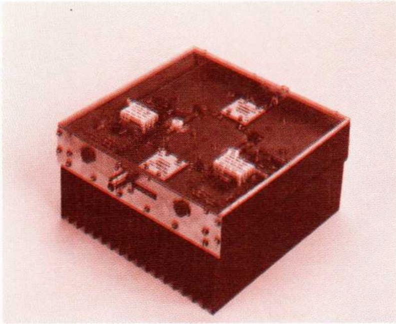
A.M. aircraft transmitters (118 to 136 MHz)

input power mW	1st stage	2nd stage	3rd stage	$P_{L(carr)}$ W	V_{CE} V	stud S flange F
110	BLX92A	BLY93C		**6**		S
240	BLY91C	BLX39		**12**		S
240	BLV20	BLW86		**12**	13/28	F
100	BLX92A	BLY93C	BLW78	**25**		S/F
100	BLX92A	BLW84	BLW78	**25**		S/F

• See Handbook S3.
** 28 V supply voltage.

r.f. power transistors and modules

line-ups



TV band III amplifier with 2 × BLV33

Portable and mobile transmitters (132 to 174 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
40	2N4427	BFQ43		**2**	7,5	—
100	2N4427	BLY87C		**8**	13	S
100	2N4427	BLV10		**8**	13	F
125	BFQ42	BLW29		**14**	13	S
150	BGY36			**18**	13	F
250	BFQ43	BLW31		**28**	13	S
120	BFQ42	BLW29	BLW60C	**45**	13	S
150	BGY36	BLW85		**45**	13	F

Base stations (132 to 174 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
200	BLY91C	BLY93C		**25**		S
200	BLV20	BLW84		**25**		F
25	2N3866	BLY91C	BLX39	**50**	28	S
25	2N3866	BLV20	BLW86	**50**		F
200	BFS23A	BLY93C	2 × BLX39	**100**		S
200	BFS23A	BLW84	2 × BLW86	**100**		F

TV transposers (Band III: 174 to 230 MHz)

input power mW	1st stage	2nd stage	3rd stage	4th stage	$P_{o\ sync}$ W	$P_{o\ sat}$ W	V_{CE} V
6	BGY55 •	2 × BLV31			**10**	**10**	25
7	BLV30	2 × BLV32F			**20**	**20**	25
3	BGY55 •	2 × BLV31	2 × BLV33		**30**	**40**	25
6	BLV30	2 × BLV33F	4 × BLV33		**60**	**75**	25
2	BGY55 •	2 × BLV31	4 × BLV33	8 × BLV33	**100**	**140**	25

TV transmitters (Band III: 174 to 230 MHz)

input power mW	1st stage	2nd stage	3rd stage	$P_{o\ sync}$ W	V_{CE} V
8	BGY55 •	2 × BLV31	2 × BLV33F	**130**	28
10	BLV30	2 × BLV32F	2 × BLV36	**250**	28
35	BLV30	2 × BLV33F	4 × BLV36	**470**	28
75	2 × BLV30	4 × BLV33F	8 × BLV36	**900**	28

• See Handbook S10.

Notes

1. For transposers the input power corresponds with $P_{o\ sync}$.
2. $P_{o\ sync}$ for transposers is the peak sync output power for a three-tone intermodulation distortion of −54 dB (vision carrier −8 dB, sound carrier −7 dB, sideband signal −16 dB) without pre-correction.
3. $P_{o\ sat}$ is the maximum peak sync output power for transposers with pre-correction taking into account that the sound carrier still must be added.
4. In the transmitter line-ups the output stage operates in class-AB, the driver stages in class-A.
5. $P_{o\ sync}$ for transmitters is the peak sync output power at 1 dB power gain compression.

Portable and mobile transmitters (400 to 470 MHz)

input power mW	1st stage	2nd stage	3rd stage	P_L W	V_{CE} V	stud S flange F
15	BFR96 •	BLW79	BLW80	**2**	7,5	S
100	BGY40A BGY40B			**7,5**	12,5	F
50	BLW79	BLW80	BLW81	**10**	13	S
150	BGY41A BGY41B			**13**	12,5	F
220	BLW79	BLW81	BLX69A	**18**	13	S
100	BGY41A BGY41B	BLW82		**30**	13	F

Base stations (400 to 470 MHz)

input power mW	1st stage	2nd stage	3rd stage	4th stage	P_L W	V_{CE} V	stud S flange F
45	BLX91A	BLW91	BLX94C		**25**	28	S
250	BLW90	BLX94C	BLX95		**40**	28	S
45	BLX91A	BLW91	BLX94C	2 × BLX95	**70**	28	S

TV transposers (Band IV/V: 470 to 860 MHz)

input power mW	1st stage	2nd stage	3rd stage	4th stage	$P_{o\ sync}$ W	$P_{o\ sat}$ W	V_{CE} V
5	BFQ34 •	BFQ68 •	2 × BFQ68 •		**1,4**	**1,4**	15
6	BLW32	BLW33	2 × BLW34		**4,4**	**5,7**	25
2	BLW32	BLW33	2 × BLW34	2 × BLW98	**8**	**8**	25
3	BLW32	BLW33	2 × BLW34	2 × BLV57	**13**	**15**	25
10	BFQ68 •	2 × BLW34	2 × BLW98	4 × BLV57	**23**	**30**	25
14	BFQ68 •	2 × BLW34	2 × BLV57	8 × BLV57	**38**	**60**	25

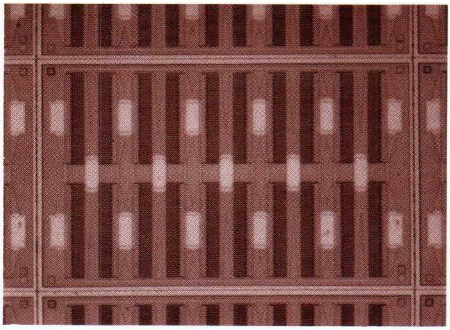
TV transmitters (Band IV/V: 470 to 860 MHz)

input power mW	1st stage	2nd stage	3rd stage	4th stage	$P_{o\ sync}$ W	V_{CE} V
12	BFR96S •	BFQ68 •	2 × BLW34	2 × BLV57	**45**	28
30	BFQ34 •	2 × BLW33	2 × BLV57	4 × BLV57	**85**	28
80	BFQ68•	2 × BLW34	4 × BLV57	8 × BLV57	**165**	28

• See Handbook S10.

r.f. power transistors and modules

abridged data



Crystal of BLV33

For detailed information
Handbook S6

type number	status	envelope	mode of operation	f MHz	V_{CE} V	output power W	G_p dB
BFQ42	D	TO-39	c.w. class-B	175	13,5	2	11
BFQ43		TO-39			13,5	4	12
BFS22A		TO-39			13,5	4	8
BFS23A		TO-39			28	4	10
BGY22	D	SOT-75A	c.w.	380 to 512	13,5	2,5	17
BGY22A				420 to 480	12,5	2,5	17
BGY23				380 to 480	13,5	7	4,5
BGY23A				420 to 480	12,5	7	4,5
BGY32	D	SOT-132	c.w.	68 to 88	12,5	18	22,6
BGY33	D			80 to 108	12,5	18	22,6
BGY35	D			132 to 156	12,5	18	20,8
BGY36	D			148 to 174	12,5	18	20,8
BGY38	D	SOT-132A	c.w.	156 to 163	13,5	28	20,5
BGY40A	D	SOT-132C	c.w.	400 to 440	12,5	7,5	20
BGY40B	D	SOT-132C	c.w.	440 to 470	12,5	13	19,4
BGY41A	D	SOT-132C	c.w.	400 to 440	12,5	7,5	18,8
BGY41B	D	SOT-132C	c.w.	440 to 470	12,5	13	19,4
BGY43	D	SOT-132B	c.w.	148 to 174	12,5	13	19,4
BLV10	D	SOT-123	c.w. class-B	175	13,5	8	9
BLV11	D	SOT-123	c.w. class-B	175	13,5	15	8
BLV20	D	SOT-123	c.w. class-B	175	28	8	12
BLV21	D	SOT-123	c.w. class-B	175	28	15	10
BLV30	D	SOT-122	class-A	224,25	25	1,5 (note 1)	18
BLV31	D	SOT-122	class-A	224,25	25	5 (note 1)	15
BLV32F	D	SOT-160	class-A	224,25	25	11	16,8
BLV33	D	SOT-147	class-A	224,25	25	19 (note 2)	9
			class-AB	224,25	28	90	6,5
BLV33F	D	SOT-119	class-A	224,25	25	16 (note 2)	13,5
			class-AB	224,25	28	85	10,5
BLV36	N	SOT-161	class-A	224,25	25	35 (note 2)	12
			class-AB	224,25	28	125	10,5
BLV57	N	SOT-161	class-A	860	25	6 (note 1)	8
			class-AB	860	25	30	6

Notes: 1. $P_{o\ sync}$ at $d_{im} < -60$ dB. 2. $P_{o\ sync}$ at $d_{im} < -55$ dB.

Our data handbooks are unique in the amount of information they contain. For standard operating conditions:

- read-off curves for power gain, input impedance, output impedance $\left.\right\}$ versus operating frequency
- circuit schematic
- print layout
- component mounting diagram
- VSWR curves
- d.c. SOAR curve
- r.f. SOAR curve

type number	status	envelope	mode of operation	f MHz	V_{CE} V	output power W		G_p dB
BLW29	D	SOT-120	c.w. class-B	175	13,5	15		10
BLW31	D	SOT-120	c.w. class-B	175	13,5	28		9
BLW32	D	SOT-122	class-A	860	25	0,5	(note 1)	11
BLW33	D	SOT-122	class-A	860	25	1,0	(note 1)	10
BLW34	D	SOT-122	class-A	860	25	1,8	(note 1)	9
BLW50F	D	SOT-123	s.s.b. class-A	1,6 to 28	45	0 to 16	(note 3)	19,5
			s.s.b. class-AB	1,6 to 28	50	10 to 65	(note 4)	18
BLW60	C	SOT-56	c.w. class-B	175	12,5	45		5
			s.s.b. class-AB	1,6 to 28	12,5	3 to 30	(note 4)	19,5
BLW60C	D	SOT-120	c.w. class-B	175	12,5	45		5
			s.s.b. class-AB	1,6 to 28	12,5	3 to 30	(note 4)	19,5
BLW64	D	SOT-56	class-A	224,25	25	10	(note 2)	9,5
BLW75	D	SOT-105	class-A	224,25	25	14	(note 2)	8
BLW76	D	SOT-121	s.s.b. class-AB	1,6 to 28	28	8 to 80	(note 4)	13
			c.w. class-B	108		80		7,9
BLW77	D	SOT-121	s.s.b. class-AB	1,6 to 28	28	15 to 130	(note 4)	12
			c.w. class-B	87,5		130		7,5
BLW78	D	SOT-121	c.w. class-B	150	28	100		6
			s.s.b. class-A	28	26	35	(note 3)	19,5
			s.s.b. class-AB					
BLW79	D	SOT-122	c.w. class-B	470	12,5	2		9
				175				13,5
BLW80	D	SOT-122	c.w. class-B	470	12,5	4		8
				175				15

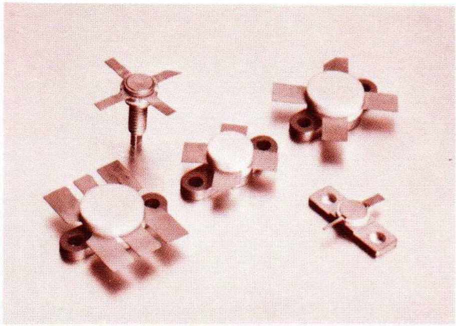
Notes: 1. $P_{o\ sync}$ at $d_{im} < -60$ dB. 2. $P_{o\ sync}$ at $d_{im} < -55$ dB. 3. P.E.P. at $d_3 < -40$ dB. 4. P.E.P. at $d_3 < -30$ dB.

r.f. power transistors and modules

abridged data

type number	status	envelope	mode of operation	f MHz	V_{CE} V	output power W	G_p dB
BLW81	D	SOT-122	c.w. class-B	470 175	12,5	10	6 13,5
BLW82	D	SOT-119	c.w. class-B	470	12,5 13,5	30	5 6,1
BLW83	D	SOT-123	s.s.b. class-A s.s.b. class-AB	1,6 to 28	26 28	0 to 10 3 to 30	20 21
BLW84	D	SOT-123	c.w. class-B	175	28	25	9
BLW85	D	SOT-123	c.w. class-B s.s.b. class-AB	175 1,6 to 28	12,5	45 3 to 30 (note 1)	5 19,5
BLW86	D	SOT-123	c.w. class-B s.s.b. class-AB s.s.b. class-A	175 1,6 to 28 1,6 to 28	28 28 26	45 5 to 47,5 (note 1) 17 (note 2)	7,5 19 22
BLW87	D	SOT-123	c.w. class-B	175	13,5	25	6
BLW89	D	SOT-122	c.w. class-B	470	28	2	12
BLW90	D	SOT-122	c.w. class-B	470	28	4	11
BLW91	D	SOT-122	c.w. class-B	470	28	10	9
BLW95	D	SOT-121	s.s.b. class-AB	1,6 to 28	50	20 to 160 (note 4)	14
BLW96	D	SOT-121	s.s.b. class-AB c.w. class-B	1,6 to 28 108	50 50	25 to 200 (note 4) 200	13,5 6,5
BLW98	D	SOT-122	class-A	860	25	3,5 (note 1)	6,5
BLX13	C	SOT-56	s.s.b. class-A s.s.b. class-AB c.w. class-B	28 28 70	26 28 28	0 to 8 (note 3) 25 (note 4) 25	18 18 17
BLX13C	D	SOT-120	s.s.b. class-A s.s.b. class-AB	1,6 to 28	26 28	0 to 8 (note 3) 3 to 25 (note 4)	20 21
BLX14	C	SOT-55	s.s.b. class-A s.s.b. class-AB c.w. class-B c.w. class-B	1,6 to 28 1,6 to 28 70 30	28	15 (note 3) 7,5 to 50 (note 4) 50 50	13 13 7,5 16
BLX15	D	SOT-55	s.s.b. class-AB s.s.b. class-A c.w. class-B c.w. class-B	1,6 to 28 1,6 to 28 70 108	50 40 50 50	20 to 150 (note 4) 30 (note 3) 150 150	14 14 10 7,5
BLX39	D	SOT-120	c.w. class-B s.s.b. class-AB s.s.b. class-A	175 1,6 to 28 1,6 to 28	28 28 26	45 5 to 42,5 (note 4) 15 (note 3)	7,5 19 20
BLX65	D	TO-39	c.w. class-B	470 175	12,5	2	6 12
BLX66	D	SOT-48	c.w. class-B	470 175	12,5	2,5 3	8,5 20
BLX67	C	SOT-48	c.w. class-B	470 175	12,5	2,5 3	8,5 20

Notes: 1. $P_{o\ sync}$ at $d_{im} < -60$ dB. 2. $P_{o\ sync}$ at $d_{im} < -55$ dB. 3. P.E.P. at $d_3 < -40$ dB. 4. P.E.P. at $d_3 < -30$ dB.



type number	status	envelope	mode of operation	f MHz	V_{CE} V	output power W	G_p dB
BLX68	C	SOT-48	c.w. class-B	470 175	12,5	7 7,2	5 12,6
BLX69A	D	SOT-48	c.w. class-B	470	13,5	20	4
BLX91A	D	SOT-48	c.w. class-B	470	28	1	11
BLX92A		SOT-48				2,5	11
BLX93A		SOT-48				7	8,5
BLX94A		SOT-48				25	6
BLX95	D	SOT-56	c.w. class-B	470	28	40	4,5
BLX96	C	SOT-48	class-A	860	25	0,5 (note 1)	6
BLX97		SOT-48				1,0 (note 1)	5,5
BLX98		SOT-48				3,5 (note 1)	5
BLY87A	C	SOT-48	c.w. class-B	175	13,5	8	9
BLY87C	D	SOT-120				8	12
BLY88A	C	SOT-48				15	7,5
BLY88C	D	SOT-120				15	8
BLY89A	C	SOT-56				25	6
BLY89C	D	SOT-120				25	6
BLY90	D	SOT-55	c.w. class-B	175	12,5	50	5
BLY91A	C	SOT-48	c.w. class-B	175	28	8	12
BLY91C	D	SOT-120				8	12
BLY92A	C	SOT-48				15	10
BLY92C	D	SOT-120				15	10
BLY93A	C	SOT-56	c.w. class-B	175	28	25	9
BLY93C	D	SOT-120				25	9
BLY94	D	SOT-55				50	7
2N3375	C	TO-60	c.w. class-B	100 400	28	7,5 3	8,8 4,8
2N3553	C	TO-39	c.w. class-B	175	28	2,5	10
2N3632	C	TO-60		175		13,5	5,9
2N3866	D	TO-39		400		1	10
2N3924	C	TO-39	c.w. class-B	175	13,5	4	6
2N3926		TO-60				7	5,4
2N3927		TO-60				12	4,8
2N4427	D	TO-39	c.w. class-B	175	12	1	10

Note: 1. $P_{o\ sync}$ at $d_{im} < -60$ dB.

wideband transistors
selection guide

- low noise
- excellent linearity
- high output voltage
- long-term reliability

Wideband transistors for MATV and CATV

BFQ34, BFQ68 and **BFR94** meet all NCTA cross-modulation and DIN intermodulation requirements. We guarantee 12-channel cross-modulation distortion to NCTA standard (better than −105 dB) and three-tone intermodulation to DIN-standard.

Corresponding types in SOT-23 or SOT-89

	SOT-23	SOT-89
BFQ23	**BFT93**	—
BFQ34	—	**BFQ18A**
BFR90;A	**BFR92;A**	—
BFR91;A	**BFR93;A**	—
BFR96	—	**BFQ19**
BFW16A	—	**BFQ17**
BFW30	**BFR53**	—
BFY90	**BFS17**	—

Interdigitated emitter and collector prevent "hot spots" and diffused emitter ballast resistors avoid second breakdown.

Ti-Pt-Au metallization:
Gold for conduction;
Titanium for adhesion;
Platinum as migration barrier.

Application	Recommended types
wideband aerial amplifiers band I to V (40-860 MHz). wideband distribution amplifiers.	BFQ22, 22S, 23, 24, 32, 34, 68 BFR90, 90A, 91, 91A, 95, 96, 96S BFW30, BFW92, 93, BFX89, BFY90
low noise wideband amplifiers in measuring equipment. r.f. amplifiers and mixers for communication systems (microwave link radar i.f. amplifiers).	BFQ22, 22S, 23, 24, 34, 68 BFR49, BFR90, 90A, 91, 91A, BFY90
high output channel and band aerial amplifiers in driver and final stages. channel amplifiers in CATV and MATV.	BFQ34, BFQ68, BFR64, 65, BFR95 BFW16A, 17A
high-voltage output stages in CATV and MATV wideband amplifiers.	BFQ34, BFQ68, BFR94

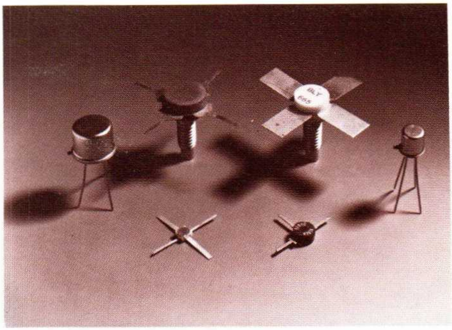
Tetrode MOS-FETS for v.h.f. and u.h.f. applications

- high gain
- extremely low noise
- excellent gain control
- silicon nitride glass barrier passivation for high reliability

Characteristics, measured at $V_{DS} = 10$ V; $I_D = 7$ mA; $V_{G2\text{-}S} = 4$ V

BF960 (UHF)	status D	y_{fs} typ 12 mA/V	F typ 2,8 dB at f = 800 MHz	SOT-103
BF980 (UHF)	N	y_{fs} typ 21 mA/V	F typ 2,8 dB at f = 800 MHz	SOT-103
BF981 (VHF)	D	y_{fs} typ 14 mA/V	F typ 0,7 dB at f = 200 MHz	SOT-103
BF982 (VHF)	D	y_{fs} typ 25 mA/V	F typ 1,2 dB at f = 200 MHz	SOT-103

abridged data



Wideband transistors

* VSWR at output < 2 measured at $f_{(2q-p)}$.
$f_p = 202$ MHz, $f_q = 205$ MHz or
$f_p = 798$ MHz, $f_q = 802$ MHz.
** Intermodulation distortion measured according to DIN three-tone test.

type all n-p-n	status	case	CIRCUIT VALUES (typ) f MHz	 P_o* mW	 G_p (GUM) dB	 V_{CE} V	 I_C mA	RATINGS V_{CEO} V	 I_{CM} mA	 P_{tot} mW	CHARACTERISTICS h_{FE}	 f_T typ GHz	 F typ dB
BFX89	D	TO-72	200 800	6	22 7	10	8	15	50	200	20-150	1,2	3,3 7,0
BFW92	D	SOT-37	200 800	8	23 11	10	10	15	50	190	20-150	1,6	4 at 500 MHz
BFY90	D	TO-72	200 800	12	23 8	10	14	15	50	200	25-150	1,4	2,5 5,5
BFW30	D	TO-72	200 800	15	21 7,5	5	30	10	100	250	> 25	1,6	< 5,0 at 500 MHz
BFW93	D	SOT-37	200 800	15	(22) (10,5)	5	30	10	100	190	> 25	1,7	< 5,0 at 500 MHz
BFW16A	D	TO-39	200 800	150 90	16 6,5	18	70	25	300	1500	> 25	1,2	< 6,0 —
BFW17A	D	TO-39	200	150	16	18	70	25	300	1500	> 25	1,1	—
BFR64	D	SOT-48	200 800	150 90	16 6,5	20	70	25	500	3500	> 25	1,2	6,0 —
BFR65	D	SOT-48	200 800	450 —	19 4,5	20	200	25	1000	5000	> 30	> 1,2	— —

type	polarity	status	case	CHARACTERISTICS (typ) d_{im}** dB	 at $f_{(p+q-r)}$ MHz	 V_o mV	 V_{CE} V	 I_C mA	GUM typ dB	F typ dB	at f MHz
BFQ22; S	N	D	TO-72	—	—	—	—	—	16,0	1,9	500
BFQ23	P	D	SOT-37	−60	493,25	300	5	30	16,5	2,4	500
BFQ24	P	D	TO-72	—	—	—	—	—		2,4	500
BFQ32	P	D	SOT-37	−60	493,25	500	10	50	14	3,75	500
BFQ34	N	D	SOT-122	−60	793,25	1200	15	120	16	8	500
BFQ51	P	D	SOT-37	—	—	—	—	—	19	2,6	500
BFQ52	P	D	TO-72	—	—	—	—	—	17	2,7	500
BFQ53	N	D	TO-72	—	—	—	—	—	18	2,4	500
BFQ63	P	N	TO-72	—	—	—	—	—	11,5	2,3	500
BFQ68	N	D	SOT-122	−60	793,25	1600	15	240	13	—	800
BFR49	N	D	SOT-100	—	—	—	—	—	17	2,5	1000
BFR90; A	N	D	SOT-37	−60	493,25	150	10	14	19,5	2,4	500
BFR91	N	D	SOT-37	−60	493,25	300	5	30	16,5	1,9	500
BFR91A	N	D	SOT-37	−60	793,25	425	8	30	14	1,6	800
BFR94	N	D	SOT-48	−60	493,25	700	20	90	13,5	5	200
BFR95	N	D	TO-39	−61	194,25	1000	18	80	13,5	9	200
BFR96	N	D	SOT-37	−60	493,25	500	10	50	16	3,3	500
BFR96S	N	D	SOT-37	−60	793,25	700	10	70	11,5	4	800
BFT24	N	D	SOT-37	—	—	—	—	—	17	3,8	500

wideband modules

Wideband amplifier modules for every CATV requirement

We understand reliability. Our CATV modules give you the same high performance and reliability that you have come to expect with our well-known CATV/MATV transistors. A push-pull cascode circuit is used in the modules: cascode to reduce transistor non-linearities and noise, and push-pull to meet the highest requirements for second order distortion.

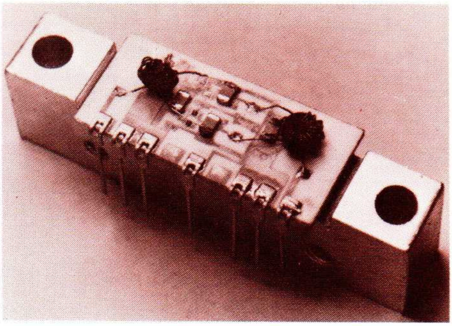
The silicon epitaxial high frequency transistors used in the modules are of proven reliability. Sputter etched titanium-platinum-gold metallization + silicon nitride glass barrier prevent electromigration. And gold-to-gold interconnections from crystal to substrate with 25 μm gold wire ensure freedom from "purple plague". Ballasting resistors are employed to obtain excellent second breakdown performance and a special configuration provides optimal current sharing.

Crystals are eutectically bonded to the substrate which is high quality alumina for good thermal conductivity and high strength. Some of the high stability evaporated NiCr resistors are laser trimmed for optimum d.c. current adjustment. The aluminium heatsink, nickel plated for solderability, is very firmly attached to the substrate for reliable operation. It will withstand extremely wide temperature variations.

All this, coupled with 100% inspection, adds up to very good high frequency performance in terms of high output voltages at low distortion and low noise over a wide operating temperature range with small spreads in power gain and d.c. current.

40 to 300 MHz

Characteristics		Pre-amplifiers				Final amplifiers and line extenders				
		BGY50	BGY52	BGY54	BGY56	BGY51	BGY53	BGY55	BGY57	BGY58
Max. d.c. current at $V_B = +24$ V	mA	180	180	180	180	220	220	220	220	340
Power gain at f = 50 MHz	dB	12,5 ± 0,4	16,4 ± 0,4	17 ± 0,4	22 ± 0,6	12,5 ± 0,4	16,4 ± 0,4	17 ± 0,4	22 ± 0,6	33 ± 1
Slope cable equivalent 40-300 MHz	dB	+ 0,2 to + 0,8	0 to + 1	0 to + 1	0 to + 1	+ 0,2 to + 0,8	0 to + 1	0 to + 1	0 to + 1	+ 0,5 to + 1,5
Max. flatness of gain 40-300 MHz	dB	± 0,2	± 0,1	± 0,1	± 0,2	± 0,2	± 0,1	± 0,1	± 0,2	± 0,3
Min. return losses $Z_S = Z_L = 75$	dB	18	18	18	20	18	18	18	20	20
Min. output voltage at Intermod. dist. − 60 dB to DIN 45004B; f = 300 MHz	dBmV	61	61	61	61,5	63,5	63,5	63,5	64	64
Max. second order dist. at $V_O = 50$ dBmV; f = 210 MHz	dB	− 68	− 68	− 68	− 64	− 70	− 70	− 70	− 66	− 68
Max. noise figure f = 40 to 300 MHz	dB	7	6	6	6	8	7	7	7	6



Our team of CATV Applications Engineers and our product development team work in close cooperation.
Their technical support and advice are also available to customers.

More data on the devices listed below is available from the addresses listed on the back cover.

Notes
Module BGY60 is a 2 × 17 dB interstage amplifier

Data on the types BGY59, 60, 70, 71, 74 and 75 are preliminary.

40 to 440 MHz

BGY59	BGY60	Characteristics		Pre-amplifiers BGY70	Pre-amplifiers BGY74	Final amplifiers BGY71	Final amplifiers BGY75
340	340	Max. d.c. current at $V_B = +24V$	mA	180	180	220	220
38,5 ± 1	33,3 ± 1	Power gain at f = 50 MHz	dB	12,5 ± 0,4	17 ± 0,4	12,5 ± 0,4	17 ± 0,4
0 to + 1	+ 0,5 to + 1,5	Slope cable equivalent 40-440 MHz	dB	+ 0,2 to + 0,8	+ 0,5 to + 1,5	+ 0,2 to + 0,8	+ 0,5 to + 1,5
± 0,3	± 0,3	Max. flatness of gain 40-440 MHz	dB	± 0,2	± 0,1	± 0,2	± 0,1
20	20	Min. return losses $Z_S = Z_L = 75$	dB	18	18	18	18
64	64	Min. output voltage at Intermod. dist. – 60 dB to DIN 45004B; up to 440 MHz	dBmV	62,5	62,5	65	65
– 68	– 66	Max. second order dist. at $V_O = 50$ dBmV; f = 265 MHz	dB	– 68	– 68	– 70	– 70
6	6	Max. noise figure f = 40 to 440 MHz	dB	7	6	8	7

wideband modules
hybrid i.c. amplifiers

For use in RATV, MATV and CATV systems and for general purposes in v.h.f. and u.h.f. applications.

All amplifiers:

frequency range	f	40 to 860 MHz
source and load (characteristic) imp.	$R_s = R_l + Z_o$	75 Ω
operating ambient temperature	T_{amb}	− 20 to + 70°C
operating mounting-base temperature (OM323; A and OM337; A)	T_{mb}	− 30 to + 100°C
pinning (except OM322)	suitable for 0,1-inch grid	
finish	resin coated	

Typical characteristics at V_B = 24 V ± 10%

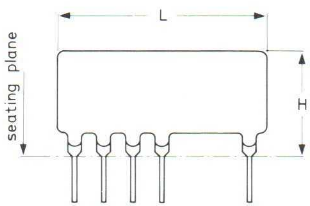
type	status	gain $\lvert s_f \rvert^2$ dB	$V_{O(rms)}$* dBμV	supply current mA	noise figure dB	max VSWR typical values input	max VSWR typical values output	dimensions L mm	dimensions H mm
OM320	C	15,5	92	23	5,5	2,2	2,5	30	12
OM321	C	15,5	98	33	6	2,5	2	30	12
OM322	C	15	103	60	7	1,7	1,7	—	—
OM323; A**	C	15	113	100	9	1,9	2,3	30	18
OM335	C	27	98	35	5,5	1,9	3,2	30	18
OM336	C	22	105	65	7	1,4	1,6	30	19
OM337; A**	C	26	112	115	9,8	2,3	1,8	30	18
OM339	C	28	105	67	6	1,5	1,5	30	19

Improved design techniques for h.f. performance resulted in reduced dimensions of the 12 V range.

Typical characteristics at V_B = 12 V ± 10%

type	status	gain $\lvert s_f \rvert^2$ dB	$V_{O(rms)}$* dBμV	supply current mA	noise figure dB	max VSWR typical values input	max VSWR typical values output	dimensions L mm	dimensions H mm
OM345	D	12	97	11,5	5,5	2,0	1,4	14	8
OM350	D	18	98	18	6	1,5	1,9	19	9
OM360	D	23	105	55	7	1,3	1,5	27	9
OM361	D	28	105	50	6	1,5	1,7	27	9
OM370	D	28	111	105	7	2,3	1,9	27	22

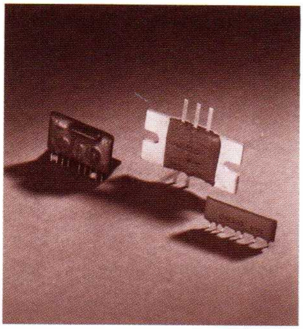
* Minimum output voltage at − 60 dB intermodulation distortion (DIN 45004, par. 6.3: 3-tone, f = 470 MHz).
** The OM323A and OM337A need an external collector-coil and output capacitor, the OM323 and OM337 have these built-in.

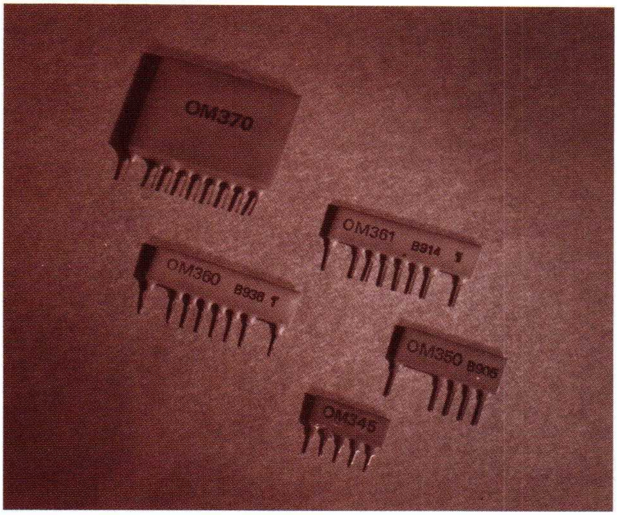


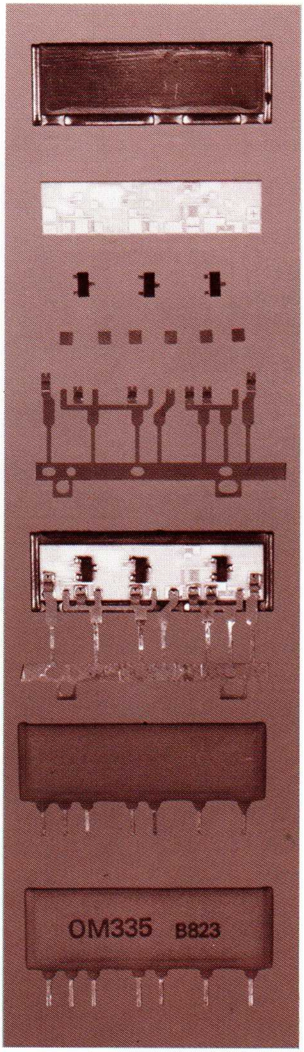
Conversion table for 75 Ω impedance

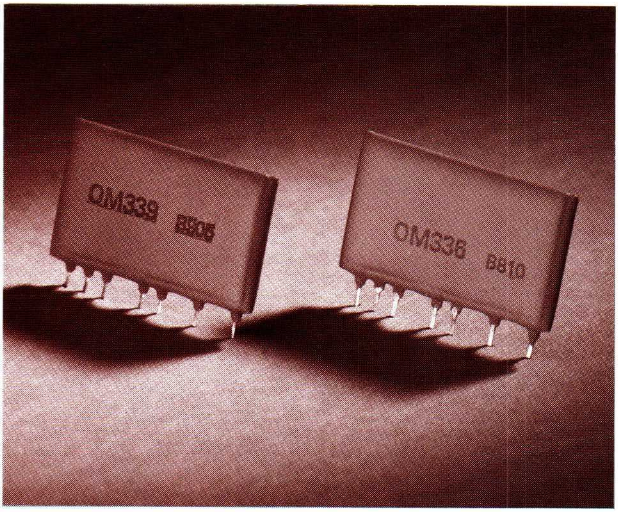
dBμV	mV	dBm
92	39,8	− 16,75
98	79,4	− 10,75
103	141,3	− 5,75
105	177,8	− 3,75
112	398,1	+ 3,25
113	446,7	+ 4,25

A selection from our range of hybrid IC amplifiers









microminiature semiconductors for hybrid circuits

quoted values are max., unless otherwise specified

High speed switching diodes

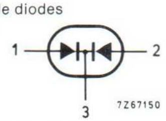
				RATINGS			CHARACTERISTICS					
type	code on case	status	case	V_R V	I_F mA	I_{FRM} mA	t_{rr}* ns	C_d pF	1 mA mV	V_F at 10 mA mV	I_F 50 mA mV	100/150 mA mV
BAS16	A6	D	SOT-23	75	250	250	6	2	715	855	1000	—/1250
BAS19	A8			100								
BAS20	A81	D	SOT-23	150	200	625	50	5	—	—	—	1000/—
BAS21	A82			200								
BAV70	A4 ▲							1,5				
BAV99	A7 ▲	D	SOT-23	70	250	250	6	1,5	715	855	1000	—/1250
BAW56	A1 ▲							2				
Stabistor diode												
BAS17	A91	D	SOT-23	—	—	250	—	140	760	830	—	960/—
Schottky barrier diode												
BAT17	A3	D	SOT-23	4	30	—	—	1	450	600	—	—
Band switch diode												
BAT18	A2	D	SOT-23	35	100	—	—	1	—	—	—	1200/—

Variable capacitance diodes

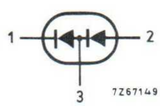
				RATINGS	CHARACTERISTICS					
type	code on case	status	case	V_R V	C_d at pF	V_R V	C_d ratio at typ	V/..V	r_D at Ω	C_d pF
BBY31	S1	D	SOT-23	28	1,8-2,8	25	5	3/25	1,2	9
BBY40	S2	D	SOT-23	28	4,3-6	25	5 to 5,6	3/25	0,6	25

▲ Double diodes

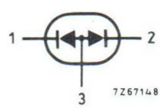
BAV70



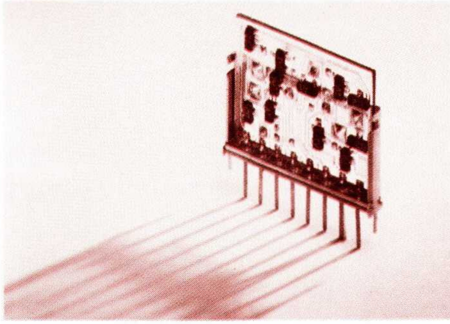
BAV99



BAW56



* I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω. Measured at I_R = 1 mA



Voltage regulator diodes

Series number	**BZX78— . . .**	**BZX84— . . .**	**BZV49— . . .**
P_{tot} (mW)	1000	350	1000
Voltage tolerance (%)	5	5 (2% tolerance on request)	5
I_{FRM} (mA)	400	250	250
I_{ZRM} (mA)	limited by P_{ZRM} max	250	limited by P_{tot} max
Case	SOT-89	SOT-23	SOT-89
Status	N	D	N
Range	5,1 to 75 V	2,4 to 75 V	2,4 to 75 V

For branding code see Handbook S7

microminiature semiconductors for hybrid circuits

code for substrate dimensions

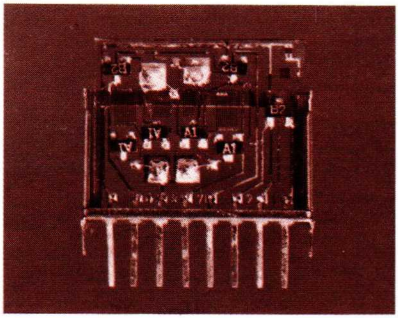
Polarity indication P = p-n-p
N = n-p-n

Low frequency transistors

type	code on case	polarity	status case	RATINGS V_{CBO} (V_{CES}) V	V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS h_{FE} min – max	at I_C mA	F max dB	f_T typ MHz	V_{CEsat} max mV	at I_C mA
general purpose, low level													
BC807-16;R	5A;5AR		D					100 – 250					
BC807-25;R	5B;5BR	P	SOT-23	(50)	45	500	310(b)	160 – 400	100	—	100	700	500
BC807-40;R	5C;5CR							250 – 600					
BC808-16;R	5E;5ER		D					100 – 250					
BC808-25;R	5F;5FR	P	SOT-23	(30)	25	500	310(b)	160 – 400	100	—	100	700	500
BC808-40;R	5G;5GR							250 – 600					
BC817-16;R	6A;6AR		D					100 – 250					
BC817-25;R	6B;6BR	N	SOT-23	(50)	45	500	310(b)	160 – 400	100	—	200	700	500
BC817-40;R	6C;6CR							250 – 600					
BC818-16;R	6E;6ER		D					100 – 250					
BC818-25;R	6F;6FR	N	SOT-23	(30)	25	500	310(b)	160 – 400	100	—	200	700	500
BC818-40;R	6G;6GR							250 – 600					
BC846A;R	1A;1AR	N	D	80	65	100	200(a)	110 – 220	2	2	300	600	100
BC846B;R	1B;1BR		SOT-23					200 – 450					
BC847A;R	1E;1ER		D					110 – 220					
BC847B;R	1F;1FR	N	SOT-23	50	45	100	200(a)	200 – 450	2	2	300	600	100
BC847C;R	1G;1GR							420 – 800					
BC848A;R	1J;1JR		D					110 – 220					
BC848B;R	1K;1KR	N	SOT-23	30	30	100	200(a)	200 – 450	2	2	300	600	100
BC848C;R	1L;1LR							420 – 800					
BC849B;R	2B;2BR	N	D	30	30	100	200(a)	200 – 450	2	4	300	600	100
BC849C;R	2C;2CR		SOT-23					420 – 800					
BC850B;R	2F;2FR	N	D	50	45	100	200(a)	200 – 450	2	4	300	600	100
BC850C;R	2G;2GR		SOT-23					420 – 800					
BC856A;R	3A;3AR	P	D	80	65	100	200(a)	125 – 250	2	10	150	650	100
BC856B;R	3B;3BR		SOT-23					220 – 475					
BC857A;R	3E;3ER	P	D	50	45	100	200(a)	125 – 250	2	10	150	650	100
BC857B;R	3F;3FR		SOT-23					220 – 475					
BC858A;R	3J;3JR		D					125 – 250					
BC858B;R	3K;3KR	P	SOT-23	30	30	100	200(a)	220 – 475	2	10	150	650	100
BC858C;R	3L;3LR							420 – 800					

The P_{tot} rating of these microminiature devices depends on the dimensions of the ceramic substrate on which each device is mounted, as well as on T_{amb}. Dimensions of the ceramic substrate are indicated by a code letter between brackets placed after the P_{tot} value.

Code (a): 7 mm × 5 mm × 0,6 mm.
(b): 15 mm × 15 mm × 0,6 mm.
(c): area = 2,5 cm²; thickness = 0,7 mm.



Low frequency transistors

type	code on case	polarity	status case	RATINGS V_{CBO} (V_{CES}) V	V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS h_{FE} min – max	at I_C mA	F max dB	f_T typ MHz	V_{CEsat} max mV	at I_C mA
general purpose, low level													
BC859A;R	4A;4AR	P	D SOT-23	30	30	100	200(a)	125 – 250	2	4	150	650	100
BC859B;R	4B;4BR							220 – 475					
BC859C;R	4C;4CR							420 – 800					
BC860A;R	4E;4ER	P	D SOT-23	50	45	100	200(a)	125 – 250	2	4	150	650	100
BC860B;R	4F;4FR							220 – 475					
BC860C;R	4G;4GR							420 – 800					
BCW29;R	C1;C4	P	D SOT-23	32	32	100	350(a)	120 – 260	2	10	150	300	10
BCW30;R	C2;C5	P						215 – 500			150	300	
BCW31;R	D1;D4	N						110 – 220			300	250	
BCW32;R	D2;D5	N						200 – 450			300	250	
BCW33;R	D3;D6	N						420 – 800			300	250	
BCW60A	AA	N	D SOT-23	32	32	200	150(a)	120 – 220	2	6	250	350	10
BCW60B	AB							180 – 310					
BCW60C	AC							250 – 460					
BCW60D	AD							380 – 630					
BCW61A	BA	P	D SOT-23	32	32	200	150(a)	120 – 220	2	6	180	250	10
BCW61B	BB							180 – 310					
BCW61C	BC							240 – 460					
BCW61D	BD							380 – 630					
BCW69;R	H1;H4	P	D SOT-23	50	45	100	350(a)	120 – 260	2	10	150	300	10
BCW70;R	H2;H5	P						215 – 500			150	300	
BCW71;R	K1;K4	N						110 – 220			300	250	
BCW72;R	K2;K5	N						200 – 450			300	250	
BCV71;R	K7;K71	N	D SOT-23	80	60	100	350(a)	110 – 220	2	10	300	250	10
BCV72;R	K8;K81	N		80	60			200 – 450			300	250	
BCW81;R	K3;K31	N		50	45			420 – 800			300	250	
BCW89;R	H3;H31	P		80	60			120 – 260			150	300	
BCX70G	AG	N	D SOT-23	(45)	45	200	150(a)	120 – 220	2	6	250	350	10
BCX70H	AH							180 – 310					
BCX70J	AJ							250 – 460					
BCX70K	AK							380 – 630					
BCX71G	BG	P	D SOT-23	(45)	45	200	150(a)	120 – 220	2	6	180	250	10
BCX71H	BH							180 – 310					
BCX71J	BJ							250 – 460					
BCX71K	BK							380 – 630					

microminiature semiconductors for hybrid circuits

code for substrate dimensions

Polarity indication P = p-n-p
N = n-p-n

Low frequency transistors

type	code on case	polarity	status case	RATINGS V_{CBO} (V_{CES}) V	V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS h_{FE} min – max	at I_C mA	F max dB	f_T typ MHz	V_{CEsat} max mV	at I_C mA
general purpose — also for switching and driver applications (industrial)													
BCX17;R	T1;T4	P		(50)	45						100		
BCX18;R	T2;T5	P	D SOT-23	(30)	25	500	425(b)	100 – 600	100		100	620	500
BCX19;R	U1;U4	N		(50)	45						200		
BCX20;R	U2;U5	N		(30)	25						200		
BCX51	—	P		45	45			40 – 250					
BCX52	—	P	D SOT-89	60	60	1000	1000(c)	40 – 160	150		50	500	500
BCX53	—	P		100	80			40 – 160					
BCX54	—	N		45	45			40 – 250					
BCX55	—	N	D SOT-89	60	60	1000	1000(c)	40 – 160	150		130	500	500
BCX56	—	N		100	80			40 – 160					
general purpose — low level — low noise													
BCF29;R	C7;C77	P						120 – 160			150	300	
BCF30;R	C8;C9	P	D SOT-23	32	32	100	350(a)	215 – 500	2	4	150	300	10
BCF32;R	D7;D77	N						200 – 450			300	250	
BCF33;R	D8;D81	N						420 – 800			300	250	
BCF70;R	H7;H71	P	D SOT-23	50	45	100	350(a)	215 – 500	2	4	150	300	10
BCF81;R	K9;K91	N						420 – 800			300	250	

High frequency transisitors

type	code on case	status case	RATINGS V_{CBO} V	V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS h_{FE} min – max	at I_C mA	F typ dB	at f MHz	f_T typ MHz	C_{re} typ pF	at f MHz
polarity n-p-n													
BFS18;R	F1;F4				30		30/125	1	4	100	200	0,85	
BFS19;R	F2;F5	D SOT-23	30	20	30	250(a)	65/225	1	4	100	260	0,85	1
BFS20;R	G1;G4				25		40/—	7	—	—	450	0,35	
polarity p-n-p													
BF536	G3	D SOT-23	30	30	25	200(a)	25/—	1	5	200	350	—	—
BF550;R	G2;G5	D SOT-23	40	40	25	200(a)	50/—	1	2	0,1	325	0,5	1
BF569	G6		40	35	30	200(a)	25/—	3	4,5	800	900	0,33	1
BF579	G7	D SOT-23	20	20	25	150(a)	20/—	10	4,5	800	1350	0,46	0,5
BF660	G8		40	30	25	200(a)	30/—	3	—	—	650	0,65	1
BF767	G9		30	30	20	200(a)	15/—	3	4	800	900	0,3	0,5

The P_{tot} rating of these microminiature devices depends on the dimensions of the ceramic substrate on which each device is mounted, as well as on T_{amb}. Dimensions of the ceramic substrate are indicated by a code letter between brackets placed after the P_{tot} value.

Code (a): 7 mm × 5 mm × 0,6 mm.
(b): 15 mm × 15 mm × 0,6 mm.
(c): area = 2,5 cm²; thickness = 0,7 mm.

Wideband transistors				RATINGS				CHARACTERISTICS				
type	polar-ity	code on case	status case	V_{CBO} V	V_{CEO} V	I_C mA	P_{tot} mW	h_{FE} min	f_T typ GHz	G_{UM} typ dB	at f MHz	V_o typ (d_{im} = −60 dB) mV
BFQ17	N	—	D SOT-89	40	25	150	1000(c)	25	1,2	16-6,5	200/800	—
BFQ18A				25	15	150	1000(c)	25	3,6	—	—	700
BFQ19				20	15	75	500(c)	25	5	18,5-7,5	200/800	—
BFR53;R	N	N1;N4	D SOT-23	18	10	50	250(a)	25	2	22-10,5	200/800	100
BFR92;R	N	P1;P4	D	20	15	25	200(a)	25	5	18	500	150
BFR93;R		R1;R4	SOT-23	15	12	35				16,5		300
BFR92A;R	N	P2;P5	D	20	15	25	200(a)	40	5	16	800	150
BFR93A;R		R2;R5	SOT-23	15	12	35	250(a)			14		425
BFS17;R	N	E1;E4	D SOT-23	25	15	25	250(a)	20/150	1,3	—	—	100
BFT25;R	N	V1;V4	D SOT-23	8	5	2,5	50(a)	20	2,3	25-12	200/800	—
BFT92;R	P	W1;W4	D	20	15	25	200(a)	20	5	18	500	150
BFT93;R		X1;X4	SOT-23	15	12	35				16,5		300

Field-effect transistors				RATINGS		CHARACTERISTICS					
type	code on case	status	case	± V_{DS} V	P_{tot} mW	$-I_{GSS}$ max nA	I_{DSS} min/max mA	$-V_{(P)GS}$ max V	y_{fs} at 1 kHz min mA/V	C_{rs} max pF	V_n max μV
general purpose – low level amplifiers											
BF510	S6	D	SOT-23	20	300	10	0,7/3	0,8 (typ)	2,5	0,4	—
BF511	S7						2,5/7	1,5 (typ)	4,0		
BF512	S8						6/12	2,2 (typ)	4,0		
BF513	S9						10/18	3 (typ)	3,5		
BFR30	M1	D	SOT-23	25	250(a)	0,2	4/10	5	1	1,5	0,5
BFR31	M2						1/5	2,5	1,5		
BFT46	M3	D	SOT-23	25	250(a)	0,2	0,2/1,5	1,0	1,0	1,5	0,5
BSR56	M4	D	SOT-23	40	250(a)	1	50/—	10	—	5	—
BSR57	M5						20/100	6			
BSR58	M6						8/80	4			

microminiature semiconductors for hybrid circuits

code for substrate dimensions

The P_{tot} rating of these microminiature devices depends on the dimensions of the ceramic substrate on which each device is mounted, as well as on T_{amb}.
Dimensions of the ceramic substrate are indicated by a code letter between brackets placed after the P_{tot} value.

Code (a): 7 mm × 5 mm × 0,6 mm.
(b): 15 mm × 15 mm × 0,6 mm.
(c): area = 2,5 cm²; thickness = 0,7 mm.

Switching

type	code on case	polarity	status	case	RATINGS V_{CBO} V	V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS h_{FE} at min/max	I_C mA	V_{CEsat} max V	I_C mA	t_{off} max ns	at I_C mA
BSV52;R	B2;B4	N	D	SOT-23	20	12	100	250(a)	40/120	10	0,25	10	18	10
BSS63;R	T3;T6	P	D	SOT-23	110	100	100	350(a)	30/—	25	0,25	25	—	—
BSS64;R	U3;U6	N			120	80			20/—	10	0,2	50	1000	15
BSR12;R	B5;B8	P	D	SOT-23	15	15	100	250(a)	30/120	50	0,45	100	30	30
BSR13;R	U7;U71	N	D	SOT-23	60	30	800	425(b)	100/300	150	0,4	150	—	—
BSR14;R	U8;U81	N			75	40	800				0,3	150	285	150
BSR15;R	T7;T71	P			60	40	600				1,6	500	100	150
BSR16;R	T8;T81	P			60	60	600				1,6	500	100	150
BSR17;R	U9;U91	N	D	SOT-23	60	40	200	350(a)	100/300	10	0,3	50	250	10
BSR18;R	T9;T91	P	N	SOT-23	40	40	200	350(b)	50/150	10	0,95	50	260	10
BSR30		P	D	SOT-89	70	60	1000	1000(c)	40/120	100	1,2	500	650	100
BSR31					70	60			100/300					
BSR32					90	80			40/120					
BSR33					90	80			100/300					
BSR40		N	D	SOT-89	70	60	1000	1000(c)	40/120	100	0,5	500	1000	100
BSR41					70	60			100/300					
BSR42					90	80			40/120					
BSR43					90	80			100/300					
BST15;R	—;—	P	D	SOT-89	200	200	1000	1000(c)	30/150	50	2,5	50	125	500
BST16;R	—;—	P	D	SOT-89	350	300	1000	1000(c)	30/120	50	2,0	50	125	500
BRY61		PNPN	D	SOT-23	$V_{GA} < 70$ V		$I_A < 180$ mA		$I_P < 5\,\mu A$	$I_V > 30\,\mu A$				

Video black and white and colour tv

type	polarity	status	case	RATINGS V_{CBO} V	V_{CEO} V	I_C mA	P_{tot} at W	T_{amb} °C	CHARACTERISTICS h_{FE} at min	I_C mA	f_T MHz
BF622	N	D	SOT-89	250	250	20	1(c)	25	50	25	>60
BF623	P										

fibre-optic communications
emitters-receivers

Optical fibre technology has matured to the point where it is a serious contender to take over many of the traditional tasks of coaxial cable. Amongst its advantages are

- very large bandwidth, high information capacity
- immunity to electromagnetic interference
- low attenuation, independent of frequency
- electrical isolation of input and output, no earth-loop problems
- wide-range temperature independence

As input and output devices for optical fibres, the emitters and receivers listed here are but the first in a projected range of Philips products for fibre-optic signal transfer in the broadcasting and telecommunication industries.

Emitters

CQX60 GaAlAs LEDs emitting 300 μW/sr at 830 nm.
CQX61 150 μW/sr at 830 nm.
Enlarged TO-18 coupled to a small light guide for use in active connectors.

CQX62 GaAlAs LEDs emitting 300 μW/sr at 830 nm.
CQX63 150 μW/sr at 830 nm.
Enlarged TO-18 with fibre pigtail of 200 μm core diameter.

375CQY AlGaAs double heterostructure diode laser, coupled to a 50 μm graded index silica fibre; radiant output power 3 mW, at 850 nm.
Built-in high speed PIN diode for monitoring.

Receivers

BPW44 Si-PIN diode in enlarged TO-18 with fibre pigtail of 200 μm diameter.

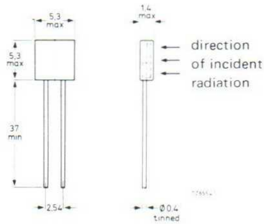
BPW45 Si PIN diode with built-in light guide for use in BNC, TNC and SMA optical connectors.

368BPY Si avalanche photodiode, hermetically sealed in modified TO-18.
Coupled directly to a graded-index quartz fibre of 50 μm core diameter.

photoconductive devices
photosensitive devices

These devices are mainly used in combination with a light source for go/no-go detection as in card readers, barriers, and industrial safety devices.

Photoconductive devices



CdS cells

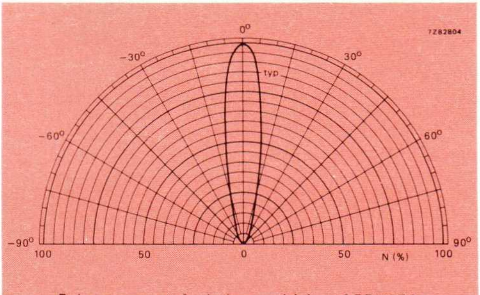
type	status	P max mW	V max V	r_{do} min MΩ	r_{lo} * typ kΩ
plastic encapsulated					
RPY58A	D	100	50	0,2	0,6

Photosensitive devices

Diodes		RATINGS			CHARACTERISTICS			
type	status	V_R V	I_F mA	P_{tot} mW	N * typ nA/lx	$I_{R(D)}$ at max μA	V_R V	λ_{pk} nm
BPX40	D	18	5	—	14	0,5	15	800
BPX41	D	18	10	—	40	1	15	800
BPX42	D	12	50	—	150	5	10	800
BPW50	D	32	—	150	—	0,03	10	930

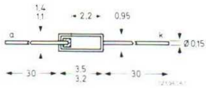
* $V_R = 0$; $T_C = 2700$ K.

Transistors — n-p-n		RATINGS			CHARACTERISTICS			λ_{peak} typ 800 nm	
type	status	V_{CEO} V	I_C mA	P_{tot} mW	N μA/lx	$I_{CEO(L)}$ at min mA	E_e mW/cm²	$I_{CEO(D)}$ at max μA	V_{CE} V
BPW22A-1 **-11**	D	50	25	100	—	1,5 5,0	1	0,1	30
BPX25 **BPX29**	D	32	100	300	>5 >0,25	—	7,7	0,5	24
BPX71 **BPX71-203** **-204**	D	50	20	50	—	0,5 4 7	20	0,025	30
BPX72 **BPX72D** **E** **F**	D	30	25	180	—	0,5 0,85 1,4 2,4	4,75	0,1	20
BPX95C-1 **-2**	D	30	25	100	—	3 10	1	0,1	20

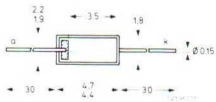


Polar response of relative sensitivity of BPX95C.

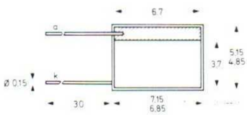
BPX40



BPX41

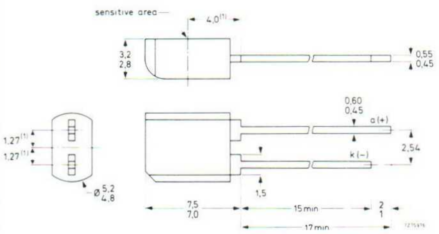


BPX42

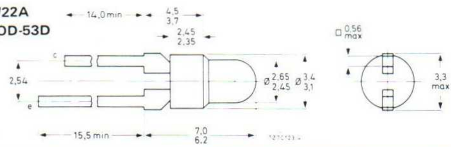


Note: BPX40 to 42 are unencapsulated.

BPW50
in SOD-67

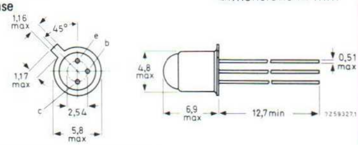


BPW22A
in SOD-53D

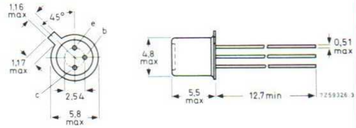


BPX25 in TO-18 (except for lens)
collector to case

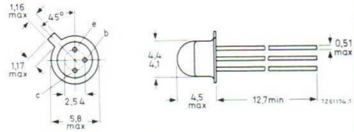
dimensions in mm



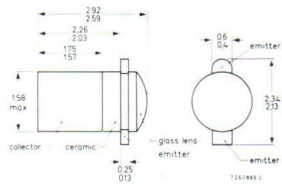
BPX29 in TO-18 (except for window)
collector to case



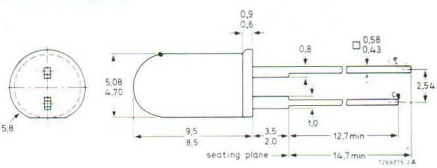
BPX72
in SOT-70



BPX71
in DO-31



BPX95C in SOD-63



light emitting diodes

LEDs combine the advantages of semiconductors (long life, reliability, etc.) with the high brightness of incandescent lamps. There is a huge increase in applications of LEDs in the consumer field — in tv channel indicators, bar graph arrays for level indications, etc.

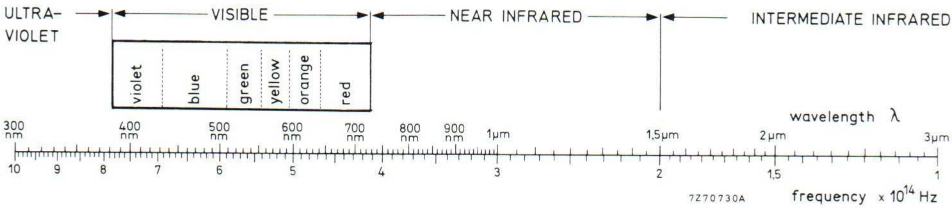
Infrared

type	status	RATINGS I_F mA	V_R V	P_{tot} mW	CHARACTERISTICS $\varnothing_e$ min μW	I_e min μW/sr	measured λ_{pk} typ nm	at α50% typ deg.	I_F mA
CQL10 (laser)	D	—	—	—	typ 5000	—	780	60 * 34 **	—
CQY11B	D	30	2	50	60	typ 64	880	72	20
CQY11C	D	30	2	50	typ 50	typ 1250	880	7	20
CQY49B	D	100	2	150	—	300	930	80	50
CQY49C	D	100	2	150	—	3000	930	15	50
CQY50	D	100	2	150	160	180	930	35	20
CQY52	D	100	2	150	400	450	930	35	20
CQY58A-I **-II**	D	50	5	100	typ 1000	1000 3000	930	20	20
CQY89A-1 **-2**	D	130	5	215	7000	9000 15000	930	40	100

Red

type	status	RATINGS I_F mA	V_R V	P_{tot} mW	CHARACTERISTICS I_v typ mcd	α50% typ deg.	measured at I_F mA
CQW10	D	20	5	60	1,5	100	10
CQX10-I	D	30	5	120	> 0,7	50 ***	10
II					1,0 to 2,2		
III					2,6 to 3,5		
IV					> 3		
CQX51-I	D	20	3	60	1,6 to 4,2	55	10
II					3 to 7		
III					5 to 11		
CQX54	N	20	5	60	20	20	10
CQX55 to 58	N	30	5	120	1	—	10
CQY24B-I	D	50	3	100	> 0,7	55	20
II					1,0 to 2,2		
III					1,6 to 3,5		
IV					> 3		
CQY54	D	50	3	100	> 0,3	80	20
CQY54-I					0,7 to 1,6		
II					1,0 to 2,2		
III					> 1,6		

* perpendicular to the junction plane.
** parallel to the junction plane.
*** in plane of connections.



Green

type	status	RATINGS I_F mA	V_R V	P_{tot} mW	CHARACTERISTICS I_v typ mcd	$\alpha 50\%$ typ deg.	measured at I_F mA
CQW11	D	20	5	60	1,5	100	10
CQX11-I	D	30	5	120	>0,7	50*	10
II					1,0 to 2,2		
III					1,6 to 3,5		
IV					>3		
CQX64	N	20	5	60	20	20	10
CQX65 to 68	N	30	5	120	1	—	10
CQY94-I	D	20	3	60	>0,7	60	10
II					1,0 to 2,2		
III					1,6 to 3,5		
IV					>3		
CQY95	D	20	3	60	>0,3	60	10
CQY95-I					0,7 to 1,6		
II					1,0 to 2,2		
III					>1,6		

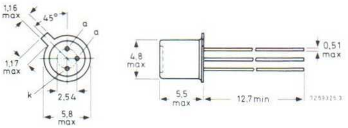
Yellow

type	status	I_F mA	V_R V	P_{tot} mW	I_v typ mcd	$\alpha 50\%$ typ deg.	I_F mA
CQW12	D	20	5	60	1,5	100	10
CQX12-I	D	30	5	120	>0,7	50*	10
II					1,0 to 2,2		
III					1,6 to 3,5		
IV					>3		
CQX74	N	20	5	60	20	20	10
CQX75 to 78	N	30	5	120	1	—	10
CQY96-I	D	20	3	60	>0,7	60	10
II					1,0 to 2,2		
III					1,6 to 3,5		
IV					>3		
CQY97	D	20	3	60	>0,3	60	10
CQY97-I					0,7 to 1,6		
II					1,0 to 2,2		
III					>1,6		

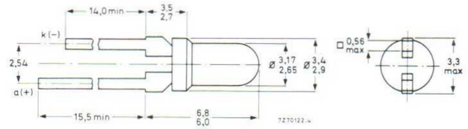
* In plane of connections.

light emitting diodes

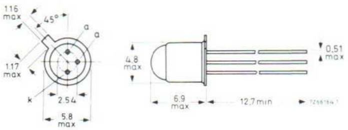
CQY11B in TO-18 (except for window)



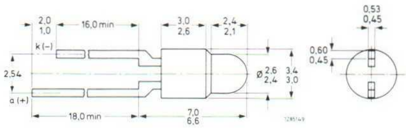
CQY54, 95, 97 in SOD-53C



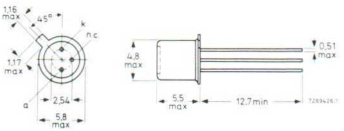
CQY11C in TO-18 (except for lens)



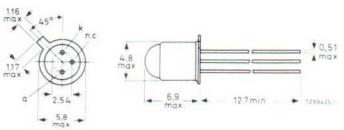
CQY58A in SOD-53D



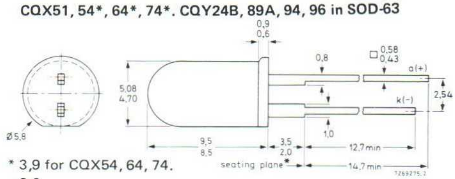
CQY49B in TO-18 (except for window)



CQY49C in TO-18 (except for lens)

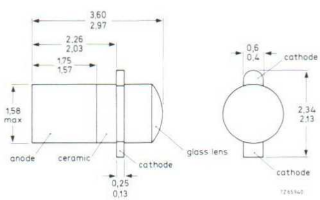


CQX51, 54*, 64*, 74*. CQY24B, 89A, 94, 96 in SOD-63

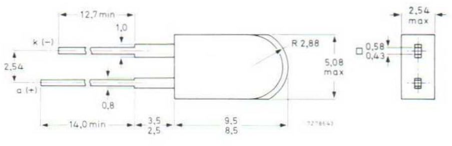


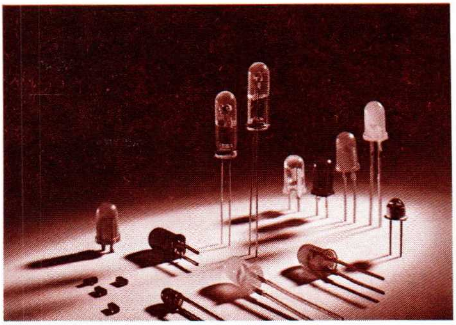
* 3,9 for CQX54, 64, 74.
2,6

CQY50 and 52 in DO-31 (except for length)

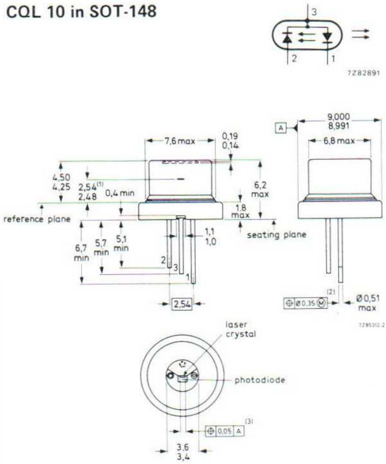


CQX10 to 12 in SOD-65

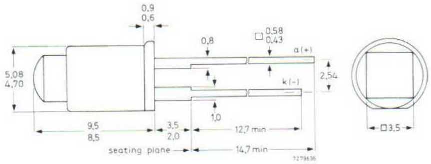




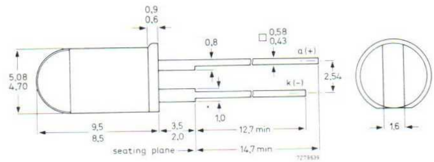
CQL 10 in SOT-148



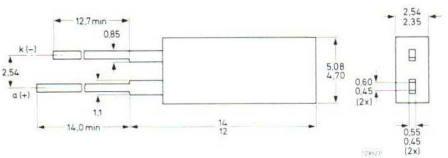
CQX55, 65, 75 in SOD-63C



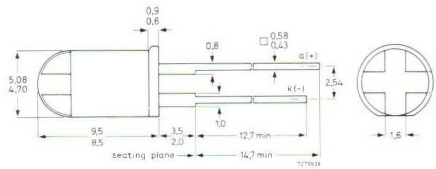
CQX56, 66, 76 in SOD-63T



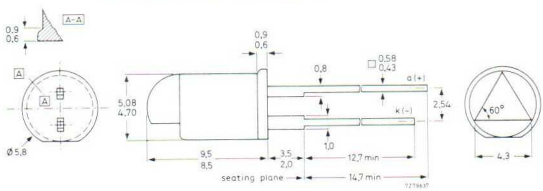
CQW10



CQX57, 67, 77 in SOD-63P



CQX58, 68, 78 in SOD-63M



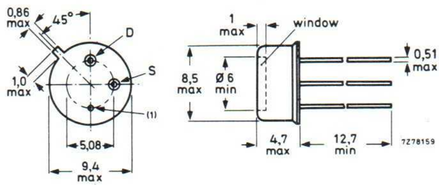
infrared detectors

The detectors shown on this page are our standard range and are not representative of the numerous types we produce for specialist applications and to customer's specifications. The devices shown here are room temperature devices, whereas most of the non-standard types are dewar cooled. For further information contact our local sales engineer.

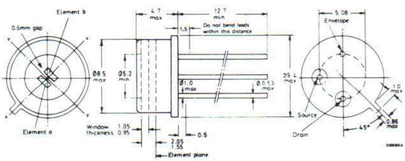
type	status	operating temperature K	spectral response µm	responsivity typ V/W	N.E.P. typ W/Hz$^{1/2}$
RPY86	D	298	6,5 ± 0,5 to > 14	(10 µm, 10) 600	(10 µm, 10, 1) $0{,}9 \times 10^{-9}$
RPY87	D	298	1,0 to > 15	(6 µm, 10) 500	(6 µm, 10, 1) $1{,}05 \times 10^{-9}$
RPY88	D	298	6,5 ± 0,5 to > 14	(10 µm, 10) 300	(10 µm, 10, 1) $1{,}65 \times 10^{-9}$
RPY89	D	298	1,0 to > 15	(6 µm, 10) 250	(6 µm, 10, 1) $2{,}0 \times 10^{-9}$
RPY93	D	298	6,5 ± 0,5 to > 14	(10 µm, 10) 800*	(10 µm, 10, 1) $1{,}4 \times 10^{-9}$*
RPY96	D	298	6,5 ± 0,5 to > 14	(10 µm, 10) 130	(10 µm, 10, 1) $3{,}5 \times 10^{-9}$

* Each element.

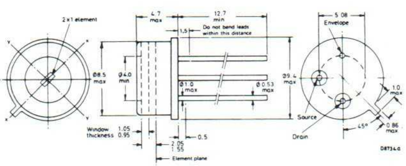
RPY86 to 89 in SOD-49D



RPY93 in SOT-49E (low profile TO-5)



RPY96 in SOT-49F (low profile TO-5)



displays

Segment read-out displays

type		status	height of character mm	RATINGS I_F mA	V_R V	CHARACTERISTICS I_v at μcd	I_F mA	λ_{pk} nm
CQ209S	1½-digit red LEDs	N	12,7	20	3	100	5	700
CQ216X	2-digit super-red LEDs common cathode	N	12,7	20	3	50	5	630
CQ216Y	common anode	N	12,7	20	3	50	5	630
CQ327 **CQ330** **CQ331** **CQ332**	compact 4-digit red LED clock displays common cathode	N	15	20	3	200	5	700
CQ327R **CQ330R** **CQ331R** **CQ332R**	common anode	N	15	20	3	200	5	700
CQ427 **CQ430** **CQ431** **CQ432**	4-digit red LED clock displays common cathode	N	15	20	3	100	5	700
CQ427R **CQ430R** **CQ431R** **CQ432R**	common anode	N	15	20	3	100	5	700

series connection	common cathode	common anode	fully displayed fonts
CQ209S	–	–	
–	**CQ216X**	**CQ216Y**	
–	**CQ327** **CQ427**	**CQ327R** **CQ427R**	
–	**CQ330** **CQ430**	**CQ330R** **CQ430R**	
–	**CQ331** **CQ431**	**CQ331R** **CQ431R**	
–	**CQ332** **CQ432**	**CQ332R** **CQ432R**	

liquid crystal displays

For detailed information please refer to
VIDELEC Ltd.
Hardstrasse 5
CH - 5600 Lenzburg / Switzerland
Tel : 064/50 11 91
Telex : 68570 videc ch

Liquid Crystal Displays for digital wrist-watches

Standard Sizes

Type	Overall dimensions	Digit height	Standard designs
LC1509	14,8 × 9,0 mm	3,6 mm	3,5 or 4 digits
LC1612	15,7 × 12,4 mm	4,3 mm	3,5 or 6 digits
LC2011	20,5 × 11,5 mm	4,7 mm	3,5 or 4 or 6 digits
LC2213	22,5 × 13,2 mm	4,7 mm	up to 6 digits
LC2411	23,9 × 11,5 mm	5 mm	up to 6 digits
LC2418	23,9 × 18,0 mm	4,6 mm	up to 12 digits

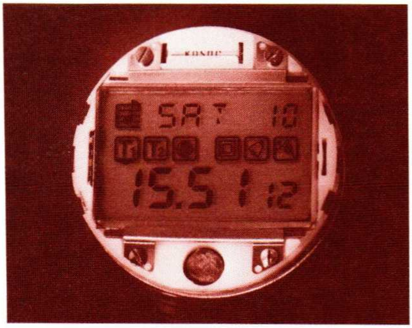
Custom-designed lay-outs and other glass formats available on request.
Connecting mode : Elastomeric
Viewing mode : Transmissive, transflective

Liquid Crystal Displays for industrial applications

Standard Sizes

Type	Overall dimensions	Digit height	Standard designs
LC2011	20,5 × 11,5 mm	4,7 mm	4 or 5 digits
LC2411	23,9 × 11,5 mm	3,8 mm	8 digits
LC3820	38,0 × 20,3 mm	8 mm	4 or 8 digits
LC5130	50,7 × 30,4 mm	12,7 mm	3,5 or 4 digits, bargraph
LC7020	69,8 × 20,3 mm	8 mm	up to 16 digits
LC7030	69,8 × 30,4 mm	12,7 mm	6 digits, bargraph
LC7038	69,8 × 38,0 mm	17,8 mm	3,5 or 4 digits
LC8131	81,1 × 38,0 mm	18,0 mm	5 digits
LC076101	76,2 × 101,6 mm	76,0 mm	1 digit
LC114046	114,0 × 46,0 mm	24 mm	5 digits

Custom-designed lay-outs and other glass formats available on request.
Connecting mode : Elastomeric or DIL - pin Connectors
Viewing mode : Transmissive, transflective or reflective



- High quality workmanship
- Low power consumption
- Attractive standard designs
- Very high contrast
- Service life > 50.000 hours
- Multiplex possible
- Outdoor/automotive specification

LC 2418112 - 101
12-digit watch display

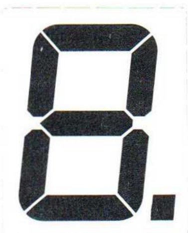
LC 161260 - 100
digit height 3,3 mm

LC 221360 - 003
digit height 4,7 mm

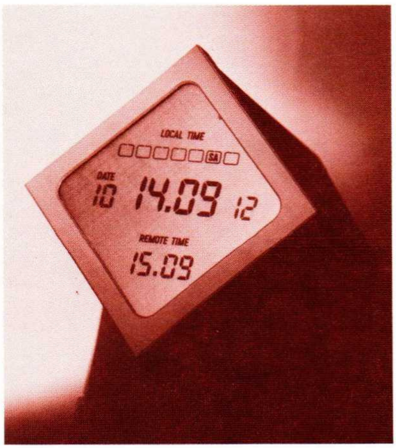
LC 513040 - 301
digit height 12,7 mm

LC 703831 - 300
digit height 17,8 mm

LC 76101 10 - 300
digit height 76,0 mm

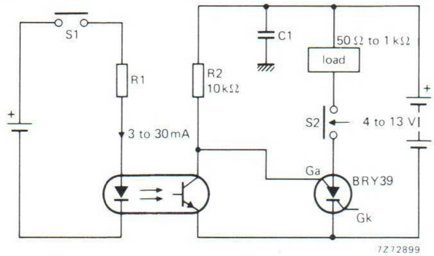


Large area clock display
100 × 100 mm



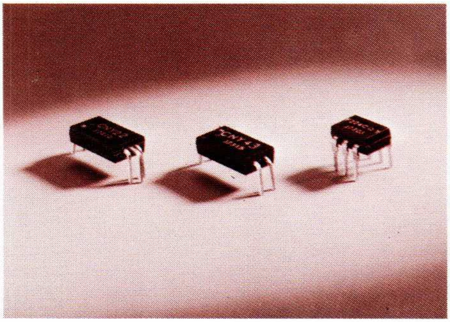
photocouplers

Photocouplers offer the isolator/transfer characteristics previously confined to relays, transformers, etc. but in a completely solid-state form and with all the advantages such as compactness, compatibility, long life and reliability. They are widely used in telephony and for input/output isolation in computer peripherals and subscriber telephones. They are also ideal in over-current sensor circuits, motor control (a.c. and d.c.), analogue circuits for multiplexing, or as isolators between equipments where one chassis is earthed and the other live or floating (tv set and video recorder, for example).



Triggering an SCS via a photocoupler.

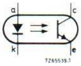
type	status	RATINGS diode I_F mA	V_R V	P_{tot} mW	transistor V_{CEO} V	I_C mA	P_{tot} mW	CHARACTERISTICS photocoupler I_C/I_F min %	V_{CEsat} max V	isolation test voltage (d.c.) V
CNX21	N	100	5	100	30	25	100	20	0,4	10 000
CNX35	D	100	3	200	30	100	200	40	0,15	4400
CNX36	D	100	3	200	30	100	200	80	0,15	4400
CNX38	D	100	3	150	80	100	200	50	0,4	4300
CNY50-1	D	100	3	150	35	100	150	25	—	1000
-2								40	—	
CNY62	D	100	3	150	50	100	200	25	0,4	5300
CNY63	D	100	3	150	30	100	200	50	0,4	4300

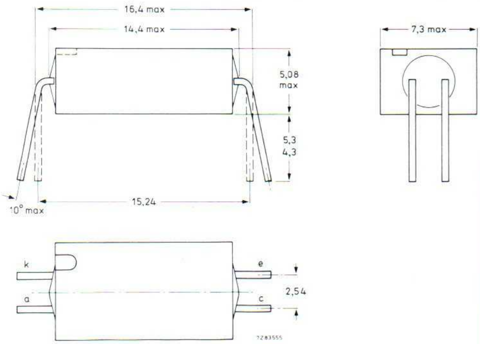


Encapsulations used for our range of photocouplers.

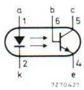
Dimensions in mm

CNX21

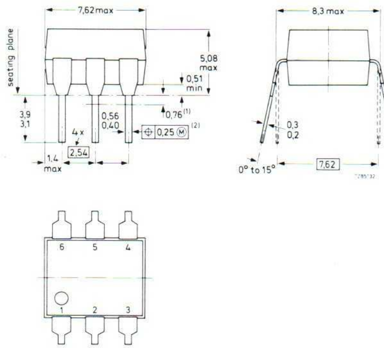




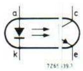
CNX35, 36, 38



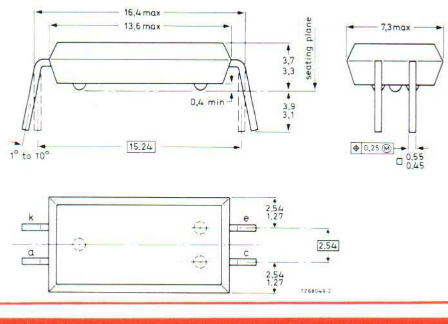
SOT-90



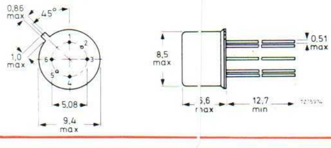
CNY62, 63



SOT-91B



CNY50 in SOT-104B



successor types

The list of successor types is specially included to guide your future new design or re-design plans.
It has little use when seeking direct replacement types.
For that purpose use our separate book Replacement guide for Semiconductors.

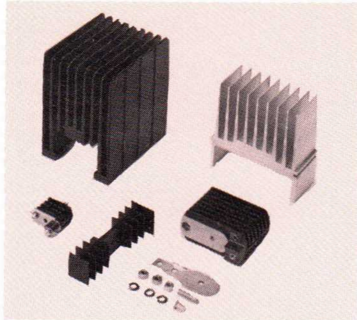
Successors of current types

current type	successor
BAX12A	BAX12
BAX14A	BAX14
BAX18A	BAX18
BB105B/G	BB405B/G
BB109	BB809
BC147 to 149	BC547 to 549
BC157 to 159	BC557 to 559
BDX62	BDT62
BDX63	BDT63
BDX64	BDT64; BDV64
BDX65	BDT65; BDV65
BDX91 to 96	BDV91 to 96 or BDT91 to 96
BFS21	BFQ15
BFS21A	BFQ14
BFS28	BFR84
BGY23	BGY40
BLW60	BLW60C; BLW85
BLW64	BLV32F
BLW75	BLV33F
BLX15	BLW95
BLX39	BLW86
BLX66	BLW79
BLX67	BLW80
BLX68	BLW81
BLX91A	BLW89
BLX92A	BLW90
BLX93A	BLW91
BLX94A	BLX94C
BLX96	BLW32
BLX97	BLW33
BLX98	BLW98
BLY87A	BLY87C; BLV10
BLY88A	BLY88C; BLV11; BLW29
BLY89A	BLY89C; BLW87
BLY91A	BLY91C; BLV20
BLY92A	BLY92C; BLV21
BLY93A	BLY93C; BLW84
BTW47	BTW45
BTW31	BTW63
BTY87	BTW38; BTW45
BTY91	BTW45
BY206	BYV95B
BY206A	BYV95B
BY207	BYV95C
BY208-600	BYV95C
BY208-800	BYV96D
BY208-1000	BYV96E
BY406A	BYV95B
BY407A	BYV95C
BY226	1N5061/1N5062
BY227	1N5062/BYW56
BYX22	BYX49
BYX30-200(R)	1N3891(R)
BYX30-300(R)	1N3892(R)
BYX55-350	BYV95B/BYW95B
BYX55-600	BYV95C/BYW95C
BZW70	BZX70
BZW91	BZY91
BZX75-C1V4	BZV46-C1V5
BZX75-C3V6	BZX79-C3V6
2N929	BCY58; BCY59
2N930	BCY58; BCY59
2N2368	BSX19
2N2369; 69A	BSX20

Successors of maintenance types

maintenance type	successor
AAY21	AAZ18
AAY30	AAZ17; AAZ18
AAY32	AAZ17; AAZ18
AAZ13	AAZ18
AC127/01	AC187/01; BC368
ASY26	2N2894(A)
ASY27	2N2894(A)
ASY28	BSX19; BSX20
ASY29	BSX19; BSX20
BA182	BA482
BAX13	BAW62
BAX15	BAS11
BAX16	BAV20
BAX17	BAV21
BB106	BB809
BCY55	BCY87
BD291	BD201
BD292	BD202
BD293	BD203
BD294	BD204
BD295	BDX77
BD296	BDX78
BF194	BF494
BF195	BF495
BF196	BF198
BF197	BF199
BFX44	BSX20
BTW41H	BTW41G
BY208	BYV95/96
BZX61	BZT03
BZY88	BZX79
BZZ14 to 29	BZV15

accessories and heatsinks



Accessories

type	description	application
56201j	Insulating bushes (height 5 mm)	TO-3
56201d	Mica washer	TO-3
56234	Mounting strip	Heatsinks
56245	Distance disc of insulating material	TO-5; TO-39
56246	Distance disc of insulating material	TO-18; TO-72
56261a	2 insulating bushes (height 6,5 mm)	TO-3
56262A	Mica washer; insulating ring; plain washer	DO-4; TO-64
56264A	Mica washer; insulating ring; soldering tag	DO-4; DO-5; TO-48
56295	PTFE bush; 2 mica washers; plain washer; soldering tag	DO-4; TO-64
56316	Mica washer	SOD-38
56326	Metal washer	TO-126 (SOT-32)
56333	Metal washer; mica washer; insulating bush	TO-126 (SOT-32)
56339	Mica washer	TO-3
56352	Mounting support	TO-3
56353	Clip	TO-126; SOT-82
56354	Mica insulator	TO-126; SOT-82
56359b	Mica insulator	TO-220
56359c	Insulating bush	TO-220
56359d	Rectangular insulating bush	TO-220
56360a	Rectangular washer	TO-220
56363	Clip (direct mounting)	TO-220
56364	Clip; to be used in conjunction with 56367 or 56369	TO-220
56366	Clip	SOT-112
56367	Alumina insulators, to be used in conjunction with 56364	TO-220
56368a	Mica insulator	SOT-93
56368b	Insulating bush	SOT-93
56369	Mica insulator, to be used with 56364	TO-220
56378	Mica insulator	SOT-93
56379	Clip	SOT-93
56387a	Mica insulator (up to 300 V)	TO-126
56387b	Insulating bush (up to 300 V)	TO-126

Heatsinks

type	
56230	HE
56231	HE
56253	DH
56256	DH
56268	DH
56290	HE
56312	DH
56313	DH
56314	DH
56315	DH
56348	DH
56350	DH

DH = Diecast heatsink
HE = Heatsink extrusion

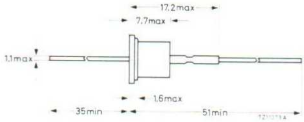
heatsinks
selection guide

Rectifier diodes
Thyristors
Triacs

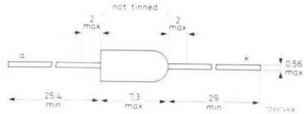
K-code to DIN 41882	K15	K9	K9	K3	K3	K3	K1,1	K1,1	Extrusions		
type	56268	56256	56350	56253	56312	56348	56313	56314	56230	56231	56290
BYX38	●								●		●
BYX39	●	●							●		●
BYX50	●								●		●
1N3879 to 3882	●								●		●
1N3889 to 3892	●	●							●	●	●
BYX98	●	●							●	●	●
BYX42	●	●							●	●	●
BYV20		●							●	●	●
BYV24		●							●	●	●
BYX99		●							●	●	●
BYX30		●							●	●	●
BYX25		●							●	●	●
BYX46		●							●	●	●
BYW30		●	●								
BYV30		●									
BYW31			●			●					
BYV21		●									
BYX96						●			●	●	
BYW92				●	●		●		●	●	
BYV92				●					●	●	
BYV22									●	●	
BYW93				●					●	●	
BYX56				●					●	●	
BYX97					●		●		●	●	
BYX32											
BYX52				●					●	●	
1N3899 to 3902				●							
1N3909 to 3912				●							
BYW25					●		●				
PH40					●		●				
PH70					●		●				
BYW94					●	●	●				
BYV23					●	●	●				
BTY79	●	●									●
BTW38	●	●	●			●					●
BTW42	●	●	●			●					●
BTY87				●					●	●	●
BTY91				●					●	●	●
BTW47				●	●		●		●	●	●
BTW30S					●		●		●	●	●
BTW45				●	●		●		●	●	●
BTW40				●	●		●		●	●	●
BTW92				●	●		●		●	●	●
BTW31W					●		●		●	●	●
BTW63					●		●		●	●	●
BTW24								●	●	●	
BTW33											
BTW23											
BTW43			●								●
BTX94				●					●	●	●
BTW34								●	●	●	

cases

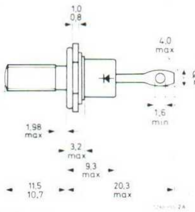
DO-1



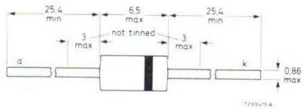
DO-14



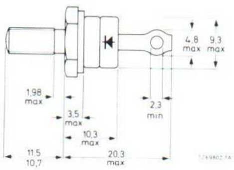
DO-4(1) 10-32 UNF
DO-4(2) M5



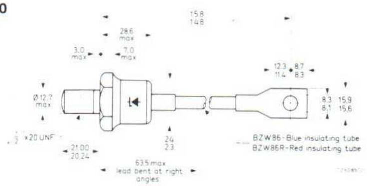
DO-15 (SOD-40)



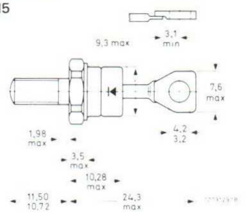
DO-4(3) 10-32 UNF
DO-4(4) M5



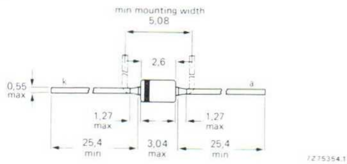
DO-30



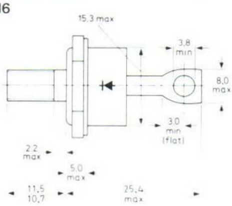
DO-4(5) 10-32 UNF
DO-4(6) M5



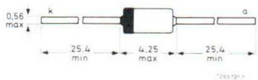
DO-34



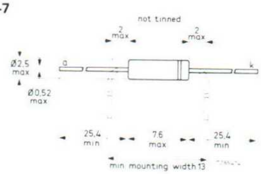
DO-5(1) ¼ " x 28 UNF
DO-5(2) M6



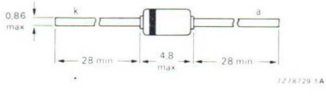
DO-35



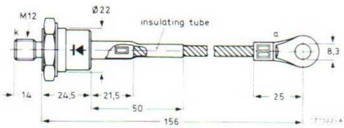
DO-7



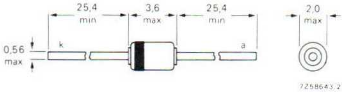
DO-41



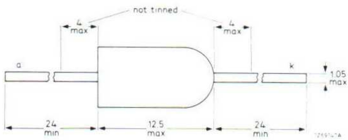
SOD-8



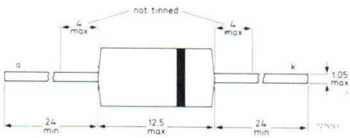
SOD-17 (DO-35)



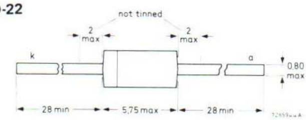
SOD-18



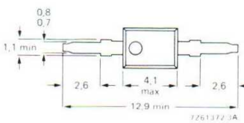
SOD-18B



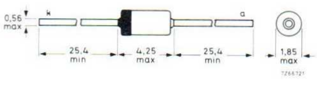
SOD-22



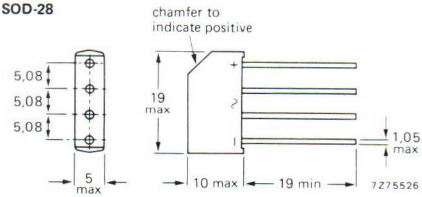
SOD-23



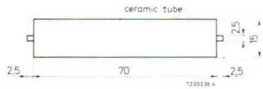
SOD-27 (DO-35)



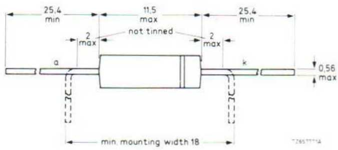
SOD-28



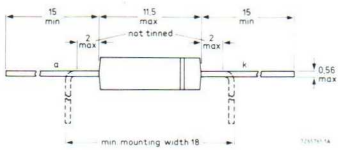
SOD-29



SOD-34(1) long leads

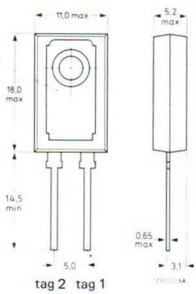


SOD-34(2) medium leads



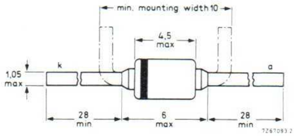
SOD-38

For polarity consider
tag 1 = base-plate as
mounting base

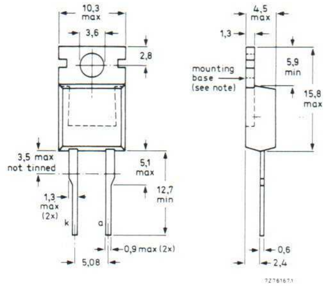


cases

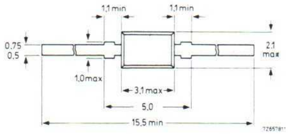
SOD-51



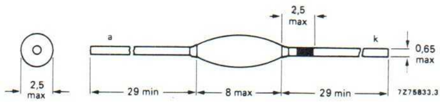
SOD-59



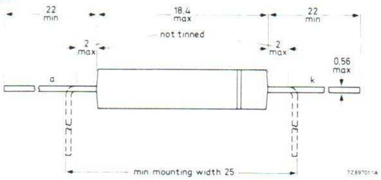
SOD-52



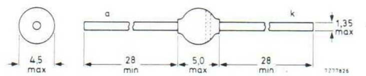
SOD-61



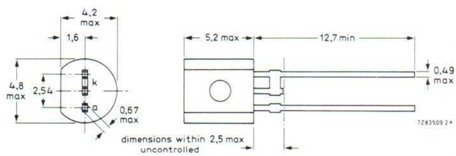
SOD-56



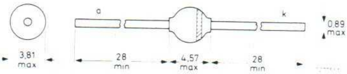
SOD-64



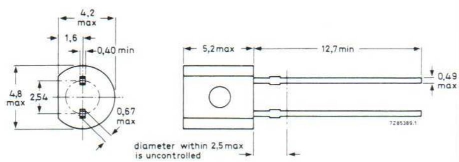
SOD-69



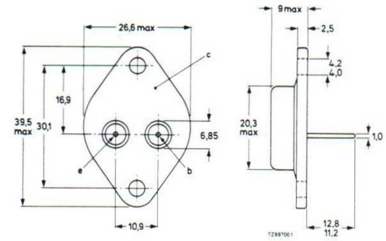
SOD-57



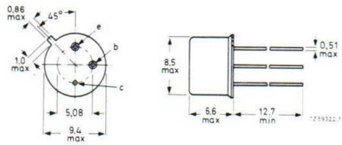
SOD-70



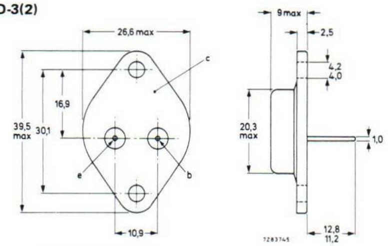
TO-3(1)



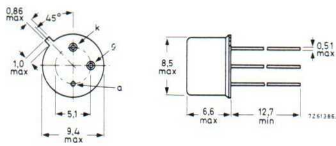
TO-39(1)



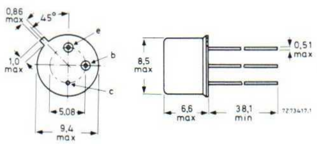
TO-3(2)



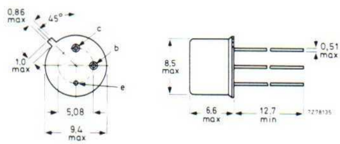
TO-39(2)



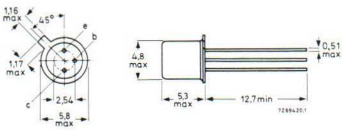
TO-5(1) collector to case



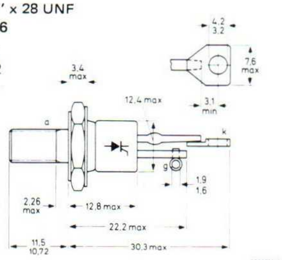
TO-39(3)



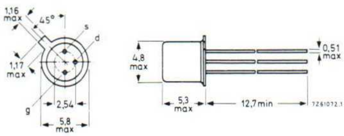
TO-18(1)



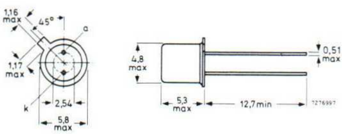
TO-48(1) ¼" × 28 UNF
TO-48(2) M6
triac k = T_1
a = T_2



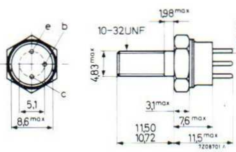
TO-18(2)



TO-18(3) (2 leads)

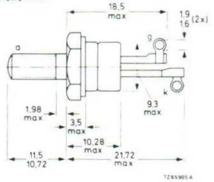


TO-60

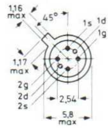


cases

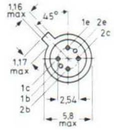
TO-64(1) 10-32 UNF
TO-64(2) M5

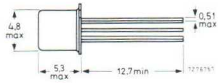


TO-71(1)

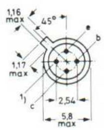


TO-71(2)

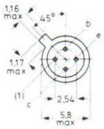




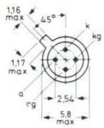
TO-72(1)



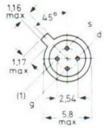
TO-72(2)

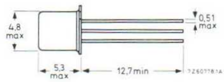


TO-72(3)



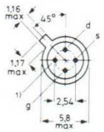
TO-72(4)



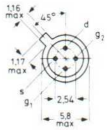


1) = shield lead (connected to case)

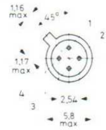
TO-72(5)

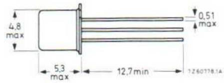


TO-72(6)

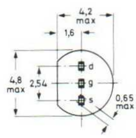


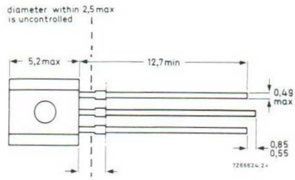
TO-72(7)





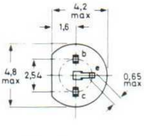
TO-92



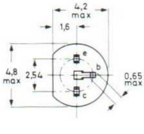


TO-92 variants

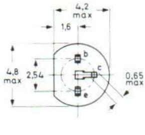
TO-92(1)

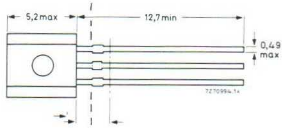


TO-92(2)

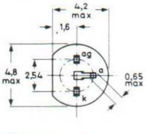


TO-92(3)

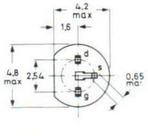




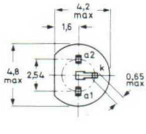
TO-92(4)

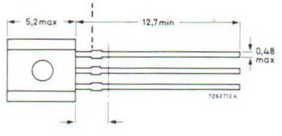


TO-92(5)

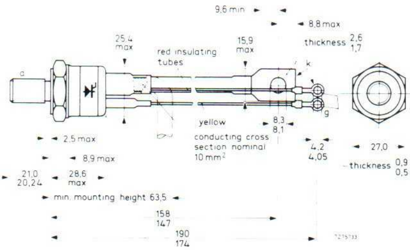


TO-92(6)

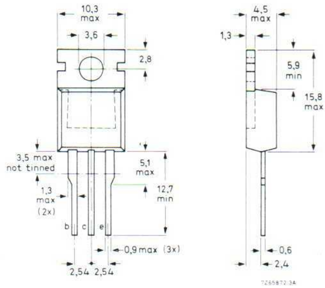




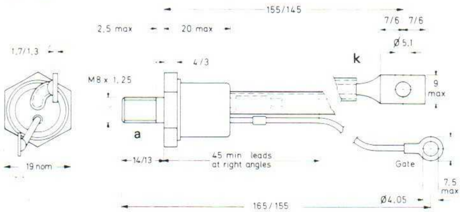
TO-94(1) ½" x 20 UNF
TO-94(2) M12



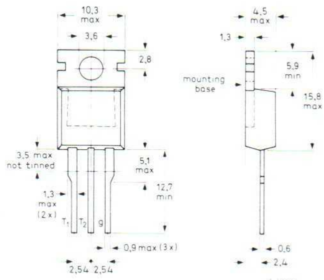
TO-220(1)



TO-103
triac: k = T_1
a = T_2

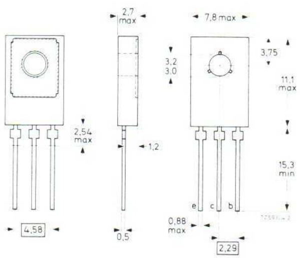


TO-220AB(2)

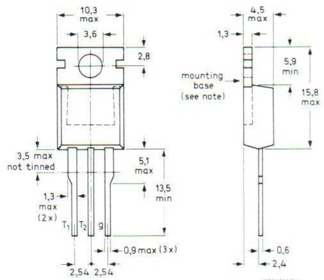


For BYV32: $T_1 = a_1$; $T_2 = k$; $g = a_2$

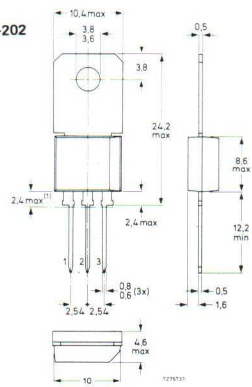
TO-126



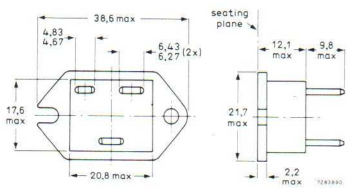
TO-220AB(3)



TO-202

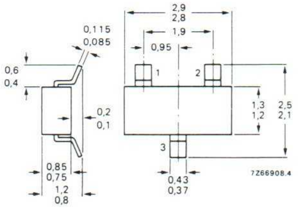


TO-238AA

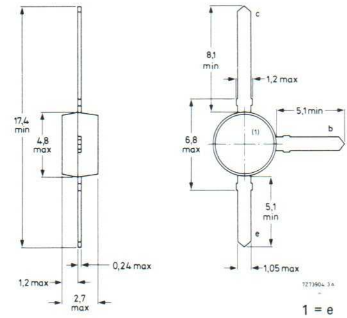


cases

SOT-23

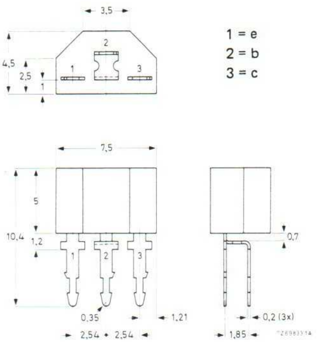


SOT-37(1)

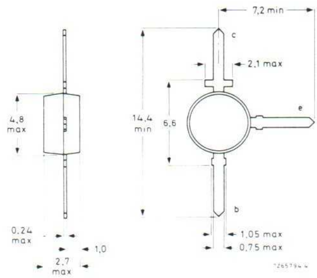


1 = e
2 = b
3 = c

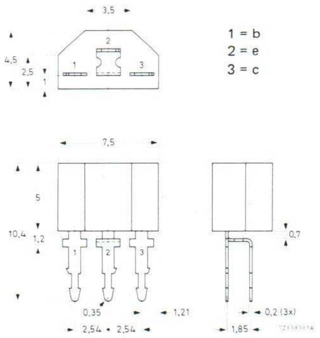
SOT-25(1)



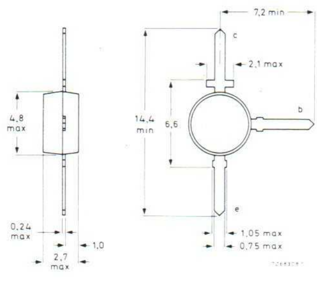
SOT-37(2)



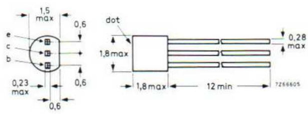
SOT-25(2)



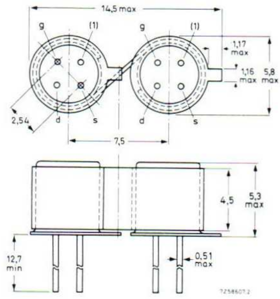
SOT-37(4)



SOT-42

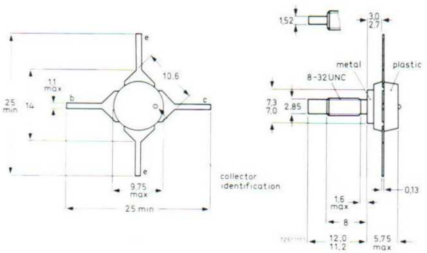


SOT-52

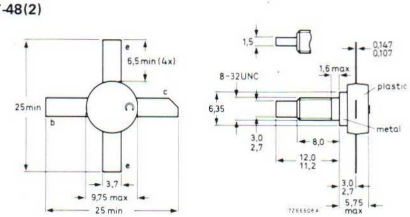


(1) = shield lead (connected to case)

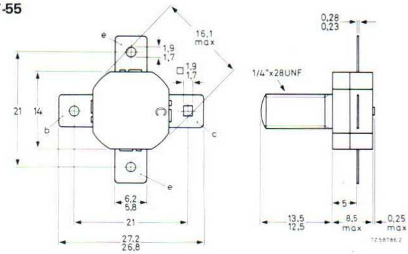
SOT-48(1)



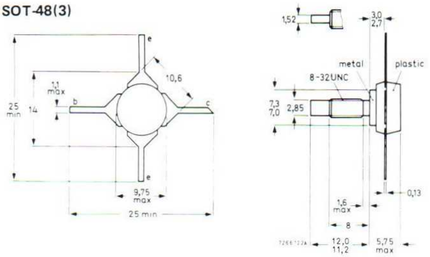
SOT-48(2)



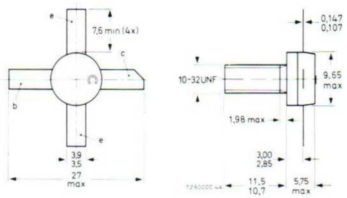
SOT-55



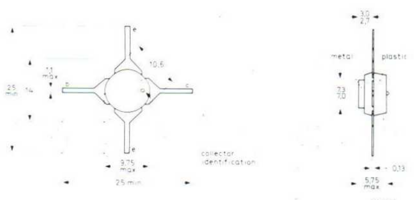
SOT-48(3)



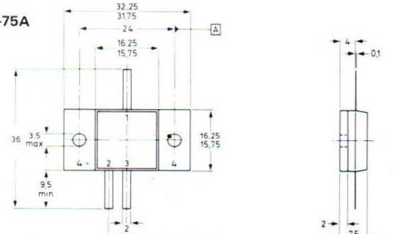
SOT-56



SOT-48(4)

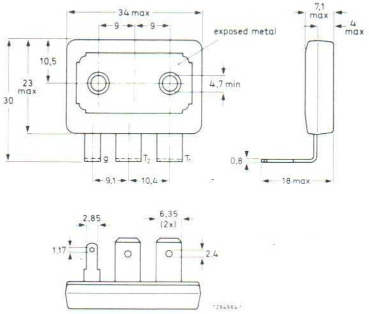


SOT-75A

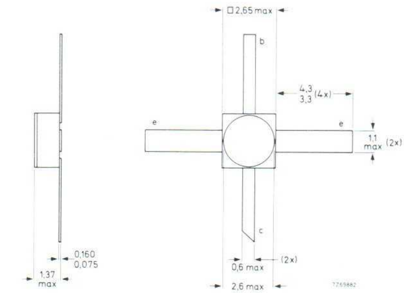


1 input
2 + V_B
3 output
4 r.f. and d.c. ground

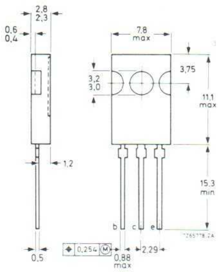
SOT-80



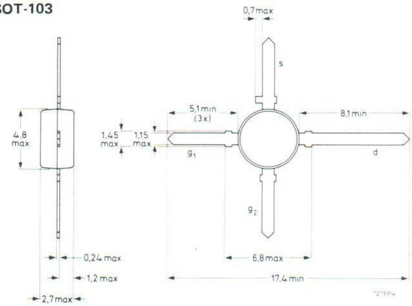
SOT-100



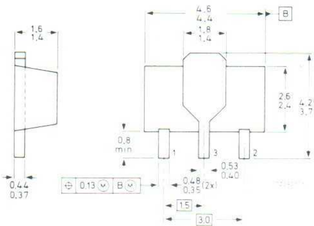
SOT-82



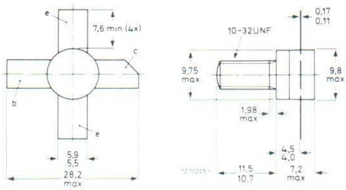
SOT-103



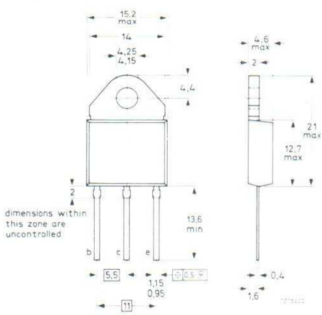
SOT-89



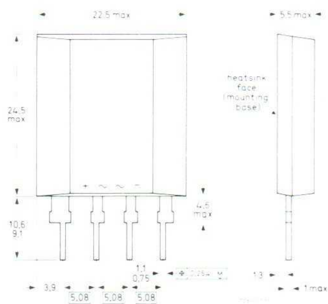
SOT-105



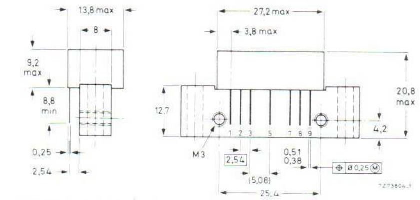
SOT-93

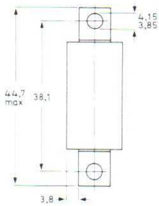


SOT-112



SOT-115

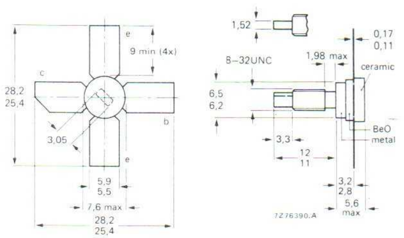




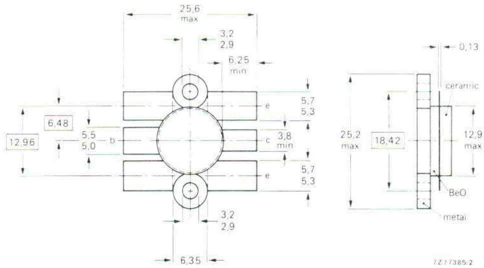
Terminal connections

1	= input
2, 3, 7, 8	= common
5	= $+V_B$
9	= output

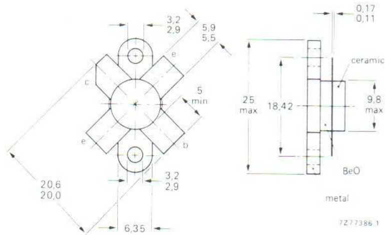
SOT-122



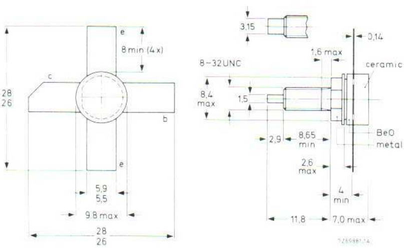
SOT-119



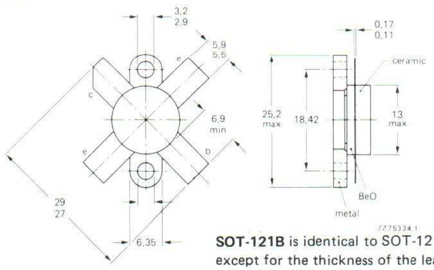
SOT-123



SOT-120

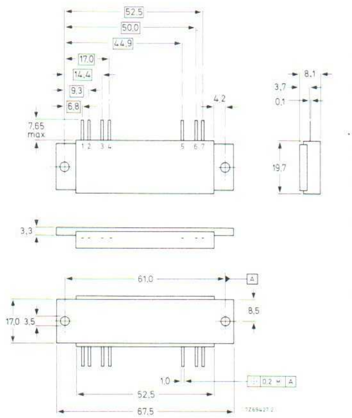


SOT-121A



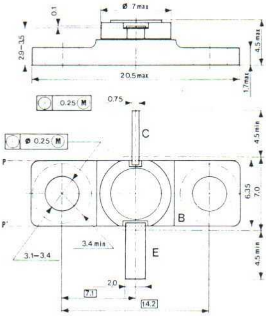
SOT-121B is identical to SOT-121A except for the thickness of the leads which lies between 0,23 and 0,27 mm.

SOT-132

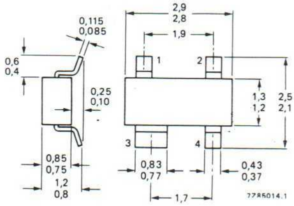


cases

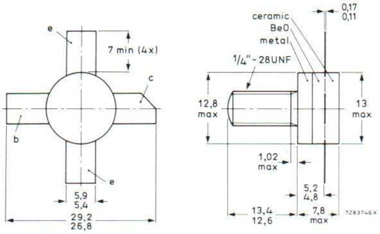
FO-53



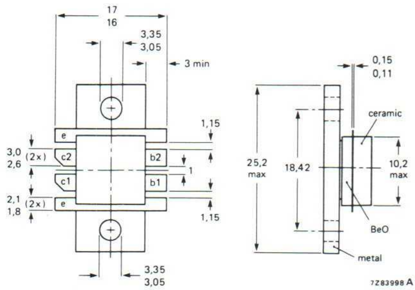
SOT-143



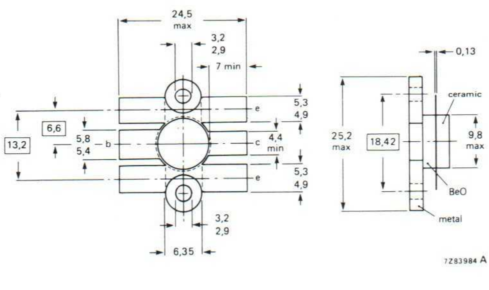
SOT-147



SOT-161



SOT-160



CONTENTS
INTEGRATED CIRCUITS

For detailed information Handbooks IC1 to IC5 and Signetics integrated circuits.

radio-audio
selection guide

For detailed information
Handbook IC 1

AM channels

TDA1072	AM receiver circuit
TEA5550	AM car radio receiver circuit

FM channels

TCA 420A	hi-fi FM/IF amplifier
TDA1576	FM/IF system for car radios and hi-fi
TEA5560	FM/IF system for car radios and hi-fi

AM/FM combined channels

TBA570A; AQ	AM/FM radio receiver circuit with integrated audio preamplifier
TBA700	AM/FM radio receiver circuit with integrated audio amplifier (1W)
TDA5700; Q	AM/FM radio receiver circuit
TDA5701; Q	AM/FM radio receiver circuit

Stereo decoders

TDA1005A; AT	frequency multiplex PLL stereo decoder
TDA1578	PLL stereo decoder for car radios and hi-fi

Interference suppressors

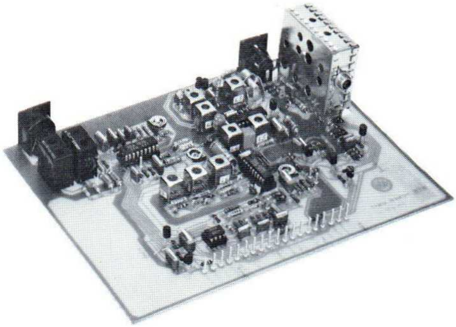
TDA1001A; AT	interference absorption circuit

D.C. controlled audio circuits

TCA730A	d.c. volume and balance stereo control circuit
TCA740A	d.c. treble and bass stereo control circuit
TDA1028	signal-sources switch (2 × four channels)
TDA1029	signal sources switch (4 × two channels)
TDA 1074	dual electronic stereo potentiometer circuit

Voltage stabilizers

TCA530	voltage stabilizer for electronic tuning
TCA750	multi-stabilizer for electronic tuning



Digital tuner with stop-pulse generator for AM/FM search tuning systems using TDA1576, TDA1578 and TDA1072

Audio power amplifiers

TCA760B	2 W audio power amplifier
TDA1010	6 W audio power amplifier for car radio and mains-fed applications
TDA1011	2 to 6 W audio power amplifier } for portable and mains-fed applications
TDA1011A	2 to 6 W audio power amplifier with inverted input/output } for portable and mains-fed applications
TDA1013	4 W audio power amplifier with d.c. volume control for television applications
TDA1020	11 W audio power amplifier for car radio applications (pin-to-pin compatible with the TDA1010)
TDA1510	24 W BTL or 2 × 12 W stereo power amplifier for car radio applications
TDA1512	12 to 20 W hi-fi audio power amplifier for television and mains-fed applications
TDA2611A	5 W audio power amplifier for television applications

Recorder amplifiers

TDA1002A	recording and playback amplifier
TDA1012	recording/playback and 2 W audio power amplifier

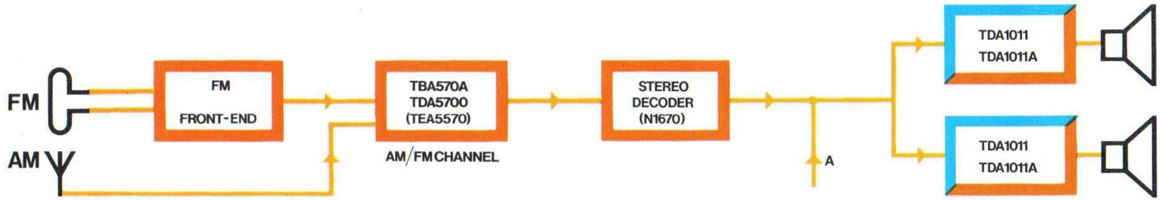
Motor speed control ICs

TDA1003A	motor regulator and bias/erase oscillator circuit for portable recorders
TDA1006A	motor regulator with automatic tape-end indicator for car cassette recorders
TDA1059B	motor speed regulator with thermal shut-down
TDA1059C	motor speed regulator
TDA1533	PLL motor speed control circuit for hi-fi applications

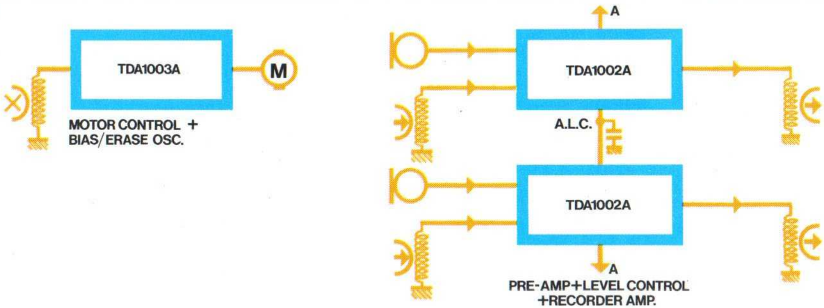
Miscellaneous

OM200/S2	integrated amplifier for use in hearing aids
TAA263	low-level amplifier
TAA320	integrated MOST amplifier
TAA320A	integrated MOST level sensor
TDA1008	gating/frequency divider for electronic musical instruments

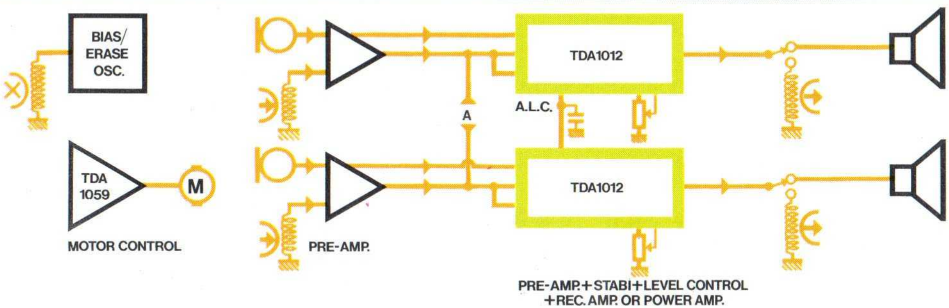
PORTABLE RADIO RECORDER CONCEPT



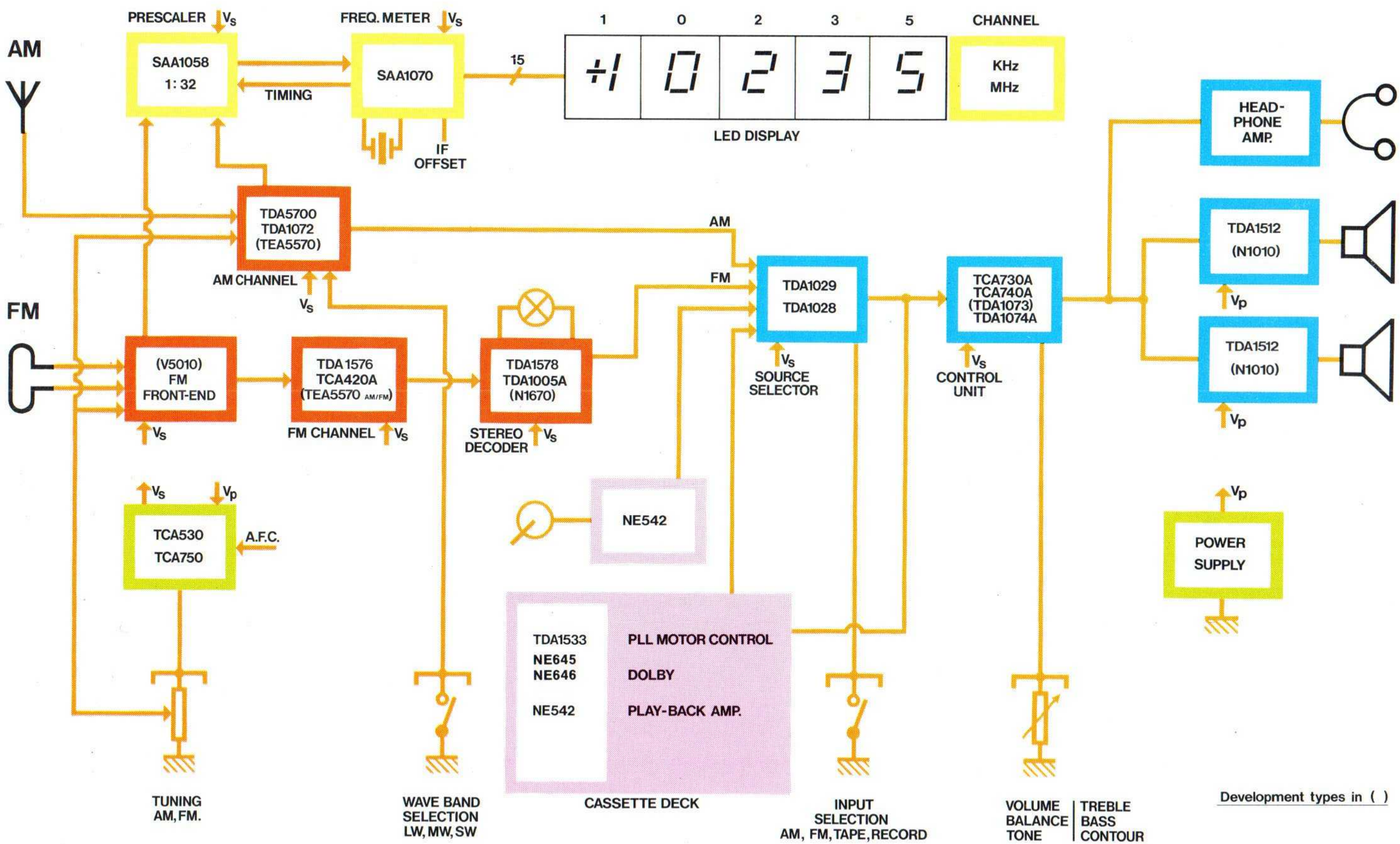
HIGH PERFORMANCE



ECONOMICAL

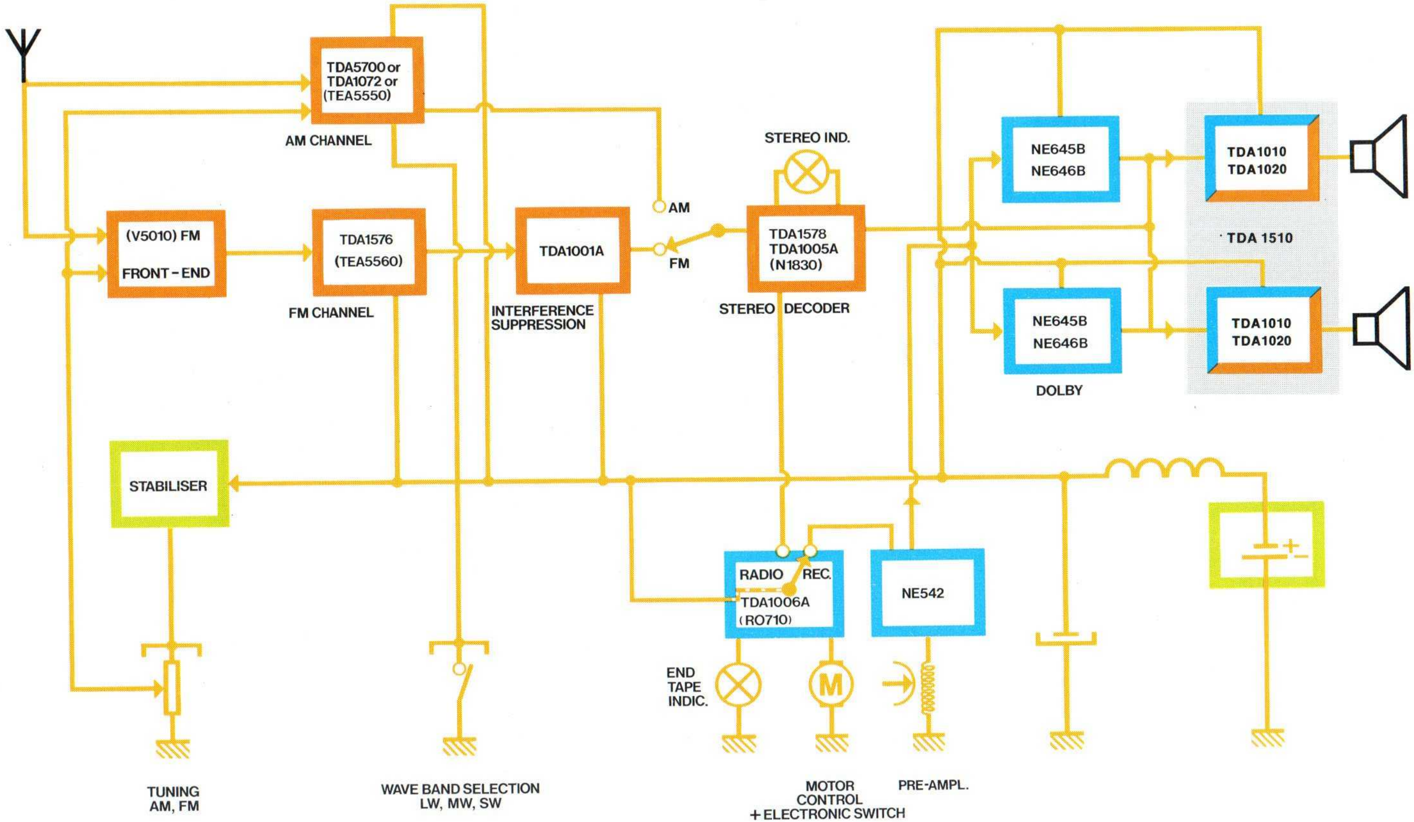


HI-FI CONCEPT



Development types in ( )

CAR RADIO PLAYER CONCEPT



video
selection guide

For detailed information
Handbook IC 2

Vision i.f. circuits

Economical circuits

TDA2540; Q	i.f. amplifier and demodulator; n-p-n tuners
TDA2541; Q	i.f. amplifier and demodulator; p-n-p tuners
TDA2542; Q	i.f. amplifier and demodulator; for E and L standards; p-n-p tuners
TDA2544	i.f. amplifier and demodulator; MOS tuners

High-performance circuits

TDA3540; Q	i.f. amplifier and demodulator; n-p-n tuners
TDA3541; Q	i.f. amplifier and demodulator; p-n-p tuners

Colour decoding circuits

TCA640	chrominance amplifier for SECAM or PAL/SECAM decoders
TCA650	chrominance demodulator for SECAM or PAL/SECAM decoders
TCA660B	contrast, saturation and brightness control circuit for colour difference and luminance signals
TDA3500	video control combination
TDA3501	video control combination
TDA3505	video control combination
TDA3510	PAL decoder
TDA3520	SECAM decoder
TDA3560	PAL decoder
TDA3561	PAL decoder
TDA3562	PAL decoder
TDA3570	NTSC decoder
TDA3590	SECAM/PAL transcoder

Vertical deflection circuits

TDA2652	vertical deflection circuit (20 AX; 30 AX systems)
TDA2653	vertical deflection circuit (large screen; 30 AX systems)
TDA2653A	vertical deflection circuit (large screen; 30 AX systems)
TDA2654	vertical deflection circuit (monochrome, 110°; tiny-vision colour, 90°)
TDA2655A	vertical deflection circuit (CTV; 90°)
TDA3650	vertical deflection circuit (large screen; 30 AX systems)
TDA3651	vertical deflection circuit
TDA3652	vertical deflection circuit

video
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Sync processors; horizontal; vertical

TDA2571A; AQ	horizontal synchronization and vertical 625 divider system
TDA2575A; AQ	horizontal synchronization and vertical 525 divider system
TDA2576A	horizontal oscillator combination with vertical 625 divider system
TDA2577	horizontal combination with vertical oscillator
TDA2593	horizontal combination
TDA2594	horizontal combination with transmitter identification
TDA3576	horizontal synchronization and vertical 625 divider system

Sound circuits

TCA420A	hi-fi FM/IF amplifier
TDA1512	12 to 20 W hi-fi audio power amplifier
TDA2543	AM/IF sound circuit (French system)
TDA2545	quasi-split sound circuit
TDA2546	quasi-split sound circuit
TDA2610; A	4 to 7 W audio power amplifier
TDA2611A	5 W audio power amplifier
TDA2612	10 W hi-fi audio power amplifier
TDA2791	television sound combination (volume, treble, bass)
TDA2795	stereo/dual sound identification decoder

Video recorder circuits

TDA2700	562,5 kHz oscillator
TDA2710	chrominance signal/mixer
TDA2720	colour sub-carrier oscillator
TDA2730	FM limiter/demodulator

Miscellaneous

TAA550	voltage stabilizer for electronic tuning
TCA530	voltage stabilizer for electronic tuning
TCA750	multi-stabilizer for electronic tuning
TDA0820	double balanced modulator/demodulator
TDA2581; Q	control circuit for SMPS
TDA2582; Q	control circuit for PPS

digital systems
remote control systems

For detailed information
Handbook IC3

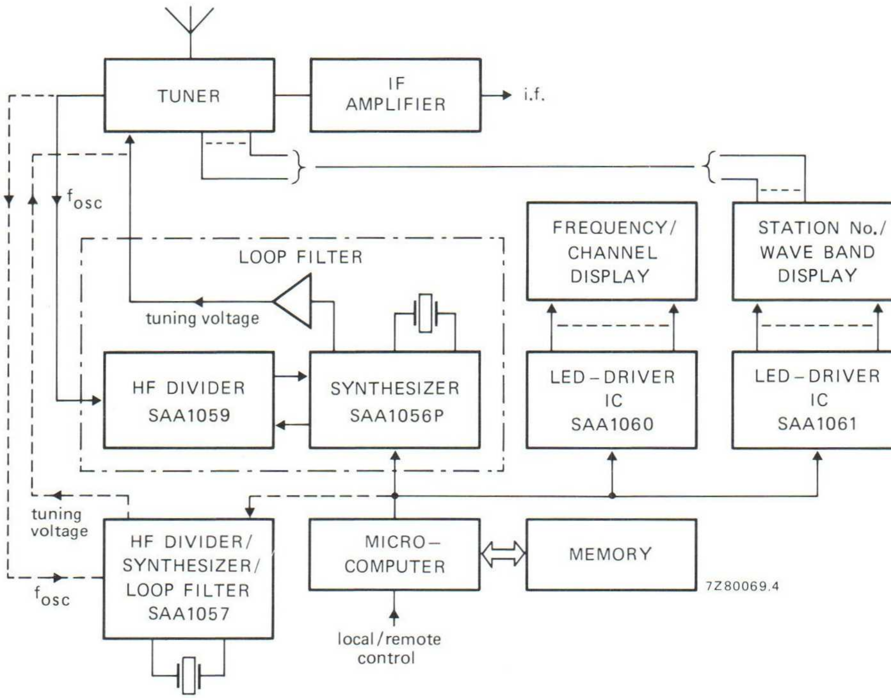
Three systems are offered to suit different requirements.

SAF1032P; SAF1039P	simple and inexpensive system with 3 analogue functions and 32 commands
SAA5000A; SAA5012 family	specially designed for optimum co-operation with touch control ICs and the Teletext decoder circuits with 32 commands and 4 analogue functions
SAB3021; SAB3023 family; SAB3042	sophisticated system with 2 x 64 commands for radio and video applications

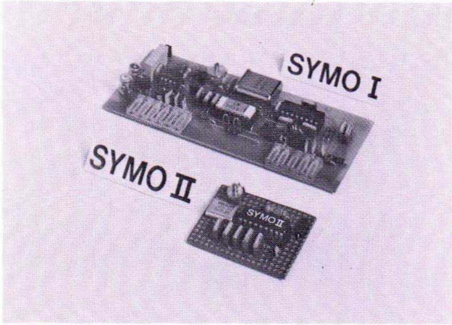
digital systems

radio tuning system

- Crystal-controlled phase-locked-loop tuning system for high stability
- LSI circuits designed for direct drive of displays and control functions
- Controlled data format (serial 3-line bus) minimises connections to the SAA1056P, SAA1060 and SAA1061
- Simple passive coupling to the tuner oscillator due to highly sensitive input of the SAA1059
- Software programmable reference frequency
- Low radiation from the display driver in duplex operation mode
- Remote control of all functions, including i.f. part



Basic tuning system for AM/FM receivers. The functions enclosed by the dotted line (SYMO I) can alternatively be performed by a single IC, the SAA1057 (SYMO II). The microcomputer provides a flexible interface between the local/remote control and the tuning and display sections.



Tuning section

- Tuner module
- **SAA1059** input preamplifier and divider
- **SAA1056P** synthesizer module
- **SAA1057** divider/synthesizer/loop filter
- Amplifier and loop-filter for the tuning voltage

A phase-locked-loop is employed to maintain stable, accurate tuning. The oscillator output of the tuner is amplified and processed to become a square-wave which is passed to a frequency divider circuit with a software programmable dividing factor. The output of the programmable frequency divider is compared with a crystal-stabilized reference frequency. The output of the comparator is amplified and filtered to be used as the tuner control voltage, providing a closed-loop control system. The SAA1057 combines the functions of preamplifier, divider, synthesizer and loop filter in one IC. The user controls the system via a microcomputer, which generates the appropriate dividing factor for the programmable frequency divider. Circuitry can easily be added to provide search tuning.

Display section

The display section is driven from the serial data bus, its function being to display data such as frequency, channel number, station number, waveband etc. However, the design of the serial-to-parallel decoders allows control as well as display of general system functions and messages, such as:

- Volume, balance, bass or treble settings
- Filter or mono/stereo switch positions
- Unit status, such as cassette rewinding, recording or end-of-record

A number of serial-to-parallel decoder ICs are available to drive LED or LCD displays from the serial data bus:

- **SAA1060** 16-bit serial-to-parallel decoder for 4½ digit drive in duplex mode
- **SAA1061** 16-bit serial-to-parallel decoder without duplex mode
- **SAA1062** 17 or 20-bit serial-to-parallel decoder for 17 or 20 segment drive
- **MH100** LCD duplex driver, 40 segments
- **MH110** LCD duplex driver, 60 segments and 2 LEDs
- **MH111** LCD duplex driver, 64 segments

Controls

The tuning system can be locally and remotely controlled. If the SAB3021 remote control system is used, the SAB3042 infrared decoder can be used to provide a microcomputer-compatible output. A complete set of local controls can then be provided by an extra SAB3021.

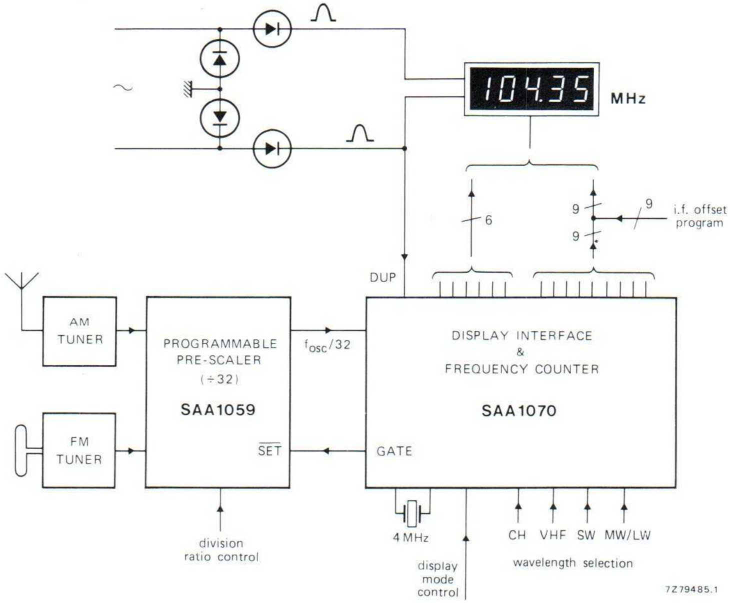
frequency measurement and display system

This system has been specifically designed to measure the frequency to which an a.m./f.m. radio is tuned and to provide a digital LED display of either the tuned frequency or the associated v.h.f. channel number. It is based on two ICs and can be used with v.h.f. (f.m.), short-wave, medium-wave and longwave and can be programmed to compensate for a wide range of i.f. frequencies.

The following features are provided:

- Mains zero-crossing switching to reduce interference
- Multiple sampling to stabilize display during short-term local oscillator drift
- Requires only a single 8 V a.c. supply
- Suitable for use with a wide range of i.f.: for a.m. 449 kHz to 472 kHz; for f.m. 10,6 MHz to 10,775 MHz
- Compact circuitry with few peripheral components
- Facilities for 'freezing', testing and blanking the display
- Flicker suppression
- High input sensitivity allows direct drive from radio local oscillators

The principle of the frequency measuring and display system is illustrated below. The main components of the system are an integrated programmable prescaler (SAA1059), an integrated display interface and frequency counter (SAA1070), a 4 MHz quartz crystal and a 4½-digit seven-segment LED display.



Block diagram of a digital frequency indicator

video tuning system (VTS)

VTS is the successor of the TRD concept, using the same tuning principles and remote control transmitter SA3021, but is based on microcomputer control rather than on dedicated circuits, to guarantee optimum design flexibility. It is possible to realize very economic designs by using a simple microcomputer such as the MAB8021. If more features are required, more sophisticated systems can be designed by using the MAB8048 or the MAB8400 family. An attractive aspect is that the tuning part of these different systems is the same.
The following circuits can be used;

Control

SAF1039P	remote transmitter for 32 commands
SAB3021	remote transmitter for 128 commands (successor of the SAB3011)
SAB3042B	remote control decoder for 128 commands with an asynchronous bus to the microcomputer an IBUS to videotex circuits, e.g. Teletext and interactive videotex inputs for local keyboard (31 mask-programmable commands possible)
TDB2033	signal amplifier (successor of the TDB1033)

Tuning system

SAB3024	computer interface for tuning systems; this is a microcomputer peripheral for tuning
SAB3034	analogue and tuning circuit; a microcomputer peripheral for tuning and 6 analogue functions
SAB3013	computer controlled analogue memory providing 6 analogue functions
SAB1018;A	sensitive 950 MHz divider-by-256
SAB1077	sensitive 1 GHz divider-by-248/256
SAB1009B	wide-band limiting amplifier
SAB1046	1 GHz divider-by-256

Display

SAA1060	control and drive circuit for LED display of station and channel numbers
SAA1061	control and drive circuit for LED display of station or channel numbers
SAB3016	control and drive circuit for on-screen display
SAB3044	LED display decoder/driver

Additional optional circuits

SAB3015	non-volatile memory
SAB3019	timer/clock circuit; microcomputer controlled

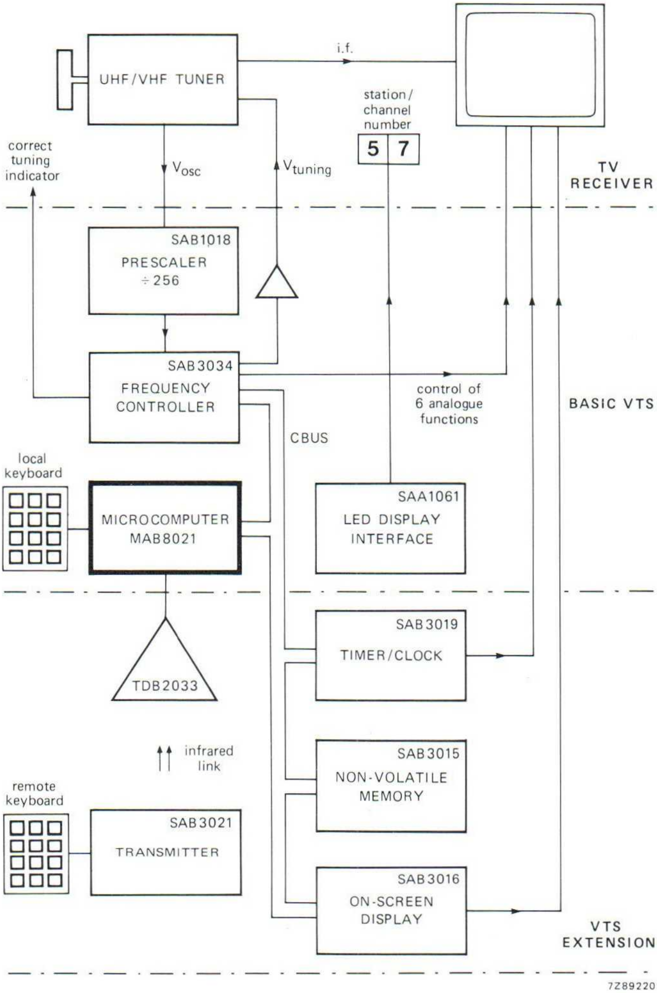
Example of a basic VTS

The block diagram on next page shows a simple low-cost VTS which is based on an MAB8021 microcomputer. The basic system performs the following functions:

- Direct access to all channels by entering two digits on the local keyboard
- Stepping sequentially through the channels in one or both directions
- Search tuning in one or both directions
- LED display of channel number

The basic system can be extended as follows:

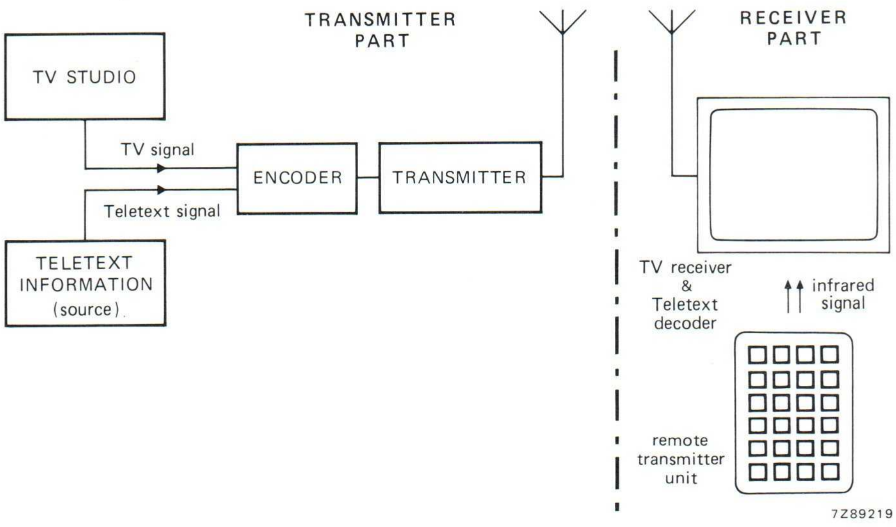
- Remote control can be added by connecting the TDB2033 amplifier directly to the microcomputer, and using the infrared transmitter SAB3021 or SAF1039P
- A non-volatile memory can be added to provide preset station facilities and set the analogue levels to user-selected values at switch-on (e.g. SAB3015)
- Control of a maximum of 6 analogue values from the remote control is possible by using the option of the SAB3034 tuning and analogue control circuit
- Additional features like on-screen display and timer/clock functions are possible by adding the appropriate circuits
- Direct control of text-decoder systems from the MAB8021 microcomputer is possible by suitable software



A basic VTS system with extension for station memory, analogue function control and remote control.

Teletext/broadcast antiope

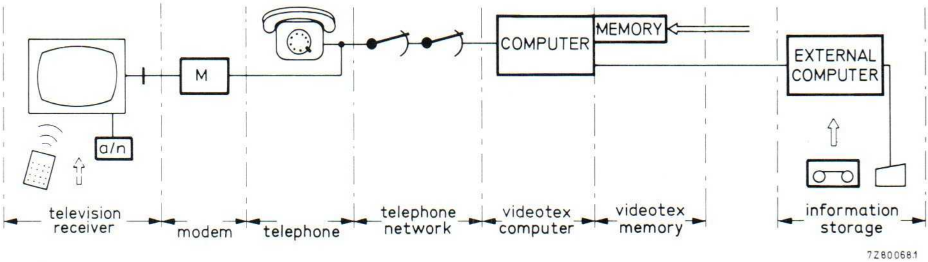
Teletext is a system whereby additional digital information is broadcast within the composite TV signal to provide information displayed upon the TV screen. With the necessary decoding circuits in the receiver, 'pages' of text can be displayed in place of, or superimposed upon, the displayed TV picture.
Teletext information is transmitted during the vertical flyback blanking period of the TV signal. The Teletext decoding circuits process and store this information.
The Teletext decoder can be operated by any of the three available remote control transmitters SAB3021, SAA5000A or SAF1039P.
Broadcast antiope is an alternative system similar to Teletext but using a slightly different method of coding the information.



Basic Teletext system

Interactive videotex

Interactive videotex is a data communication system providing a two-way exchange of information. The information transfer takes place via a conventional telephone line and the information is displayed upon the TV screen. The conversational nature of the system means that it is not necessary to transfer all the available information, but only that requested. This means that vastly more pages can be made available and the capture time for any page can be reduced. The system does not depend upon the availability of a transmitted signal.
The video data is coded in the same manner as for Teletext, but is transmitted over the public telephone network. This results in low data transfer rates due to the limited bandwidth of the telephone system. Typical data rates are: source to subscriber 1200 baud, subscriber to source 75 baud.



The interactive videotex system

Text decoder components

A range of LSI circuits has been developed to allow simple construction of text decoders. These dedicated LSI circuits perform the task of timing, video processing, control-and-data-aquisition, and character generation. The requirements of different markets have led to the development of alternative versions of the control-and-acquisition and character generator circuits. The page information store consists of standard RAM circuits.

Teletext decoder ICs

SAA5020	Teletext timing chain circuit (625 lines)
SAA5025A; B	Teletext timing chain circuit (525 lines)
SAA5030	Teletext video processor
SAA5040A; B	Teletext aquisition and control circuit
SAA5041; 42; 43	Teletext aquisition and control circuit
SAA5050	Teletext character generator (English, 625 lines)
SAA5051	Teletext character generator (German, 625 lines)
SAA5052	Teletext character generator (Swedish, 625 lines)

Antiope decoder ICs

SAA5120	Antiope teletext timing chain circuit (French, 625 lines)
SAA5125	Antiope teletext timing chain circuit (525 lines)
SAA5150	Antiope teletext character generator (French, 625 lines)
SAA5155	Antiope teletext character generator (525 lines)

Interactive videotex

MAB8021	8-bit microcomputer
MAB8048	8-bit microcomputer
MAB8400	8-bit microcomputer
SAA5020	timing chain circuit (625 lines)
SAA5025; B	timing chain circuit (525 lines)
SAA5050	character generator (English, 625 lines)
SAA5051	character generator (German, 625 lines)
SAA5052	character generator (Swedish, 625 lines)
SAA5070	interactive videotex receiving system (LUCY)
SAA5120	Antiope timing chain circuit (French, 625 lines)
SAA5125	Antiope timing chain circuit (525 lines)
SAA5150	Antiope character generator (French, 625 lines)
SAA5155	Antiope character generator (525 lines)

LOCMOS
HE4000B family

For detailed information
Handbook IC4

The LOCMOS HE4000B range is a fully buffered digital integrated circuit family which meets the Jedec-B specification. The members of this family are plug-in replacements for the well-known C-MOS 4000 and 14500 ranges. The HE family has the same advantages as conventional C-MOS circuits, plus the additional LOCMOS advantages. Recommended supply voltage range 3 to 15 V.

LOCMOS means Local Oxidation Complementary MOS.

Inputs and outputs are protected against electrostatic effects in a wide variety of device-handling situations. However, to be totally safe, it is desirable to take handling precautions into account.

Advantages of the C-MOS:
- low power dissipation — typically 10 nW per gate (static)
- wide operating supply voltage range
- wide operating temperature range from −40 to +85 °C
- high d.c. fan-out
- inputs and outputs are protected against electrostatic voltages

In addition to these, the LOCMOS HE4000B range has:
- buffered outputs on **all** circuits
- higher speed
- higher packing density — essential for MSI/LSI
- excellent noise immunity

The HE family is designed with standardized output drive characteristics which, combined with relative intensitivy to output capacitance loading, simplify system design.

Family ratings
Limiting values in accordance with the Absolute Maximum System (IEC 134)

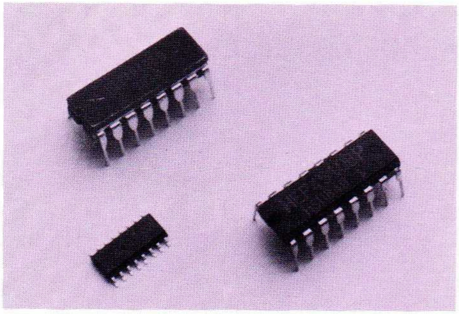
supply voltage	V_{DD}		−0,5 to +18	V
voltage on any input	V_I		−0,5 to (V_{DD} + 0,5)	V
d.c. current into any input or output	± I	max.	10	mA
power dissipation per package for plastic and ceramic DIL				
for T_{amb} = −40 to +60 °C	P_{tot}	max.	400	mW
for T_{amb} = +60 to +85 °C	derate linearly with 8 mW/°C to 200 mW			
power dissipation per package for plastic flat pack				
for T_{amb} = −40 to +70 °C	P_{tot}	max.	200	mW
for T_{amb} = +70 to +85 °C	derate linearly with 5 mW/°C to 125 mW			
power dissipation per output	P	max.	100	mW
operating ambient temperature	T_{amb}		−40 to +85	°C
storage temperature	T_{stg}		−65 to +150	°C

Family characteristics (d.c.) at $V_{SS} = 0$

Type numbers have a suffix which signifies the type of package: P = plastic DIL; D = ceramic DIL; T = flat pack

parameter	symbol	$T_{amb} = -40\,°C$ min	max	$T_{amb} = +25\,°C$ min	max	$T_{amb} = +85\,°C$ min	max	V_{DD} V	conditions
Quiescent device current for gates	I_{DD}(µA)	—	1,0	—	1,0	—	7,5	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD}
		—	2,0	—	2,0	—	15,0	10	
		—	4,0	—	4,0	—	30,0	15	
Quiescent device current for buffers, and flip-flops	I_{DD}(µA)	—	4,0	—	4,0	—	30	5	
		—	8,0	—	8,0	—	60	10	
		—	16,0	—	16,0	—	120	15	
Quiescent device current for MSI	I_{DD}(µA)	—	20	—	20	—	150	5	
		—	40	—	40	—	300	10	
		—	80	—	80	—	600	15	
Quiescent device current for LSI	I_{DD}(µA)	—	50	—	50	—	375	5	
		—	100	—	100	—	750	10	
		—	200	—	200	—	1500	15	
Output voltage LOW $\|I_O\| + 1$ µA	V_{OL}(V)	—	0,05	—	0,05	—	0,05	5	
		—	0,05	—	0,05	—	0,05	10	$V_I = V_{SS}$ or V_{DD}
		—	0,05	—	0,05	—	0,05	15	
Output voltage HIGH $\|I_O\| + 1$ µA	V_{OH}(V)	4,95	—	4,95	—	4,95	—	5	
		9,95	—	9,95	—	9,95	—	10	$V_I = V_{SS}$ or V_{DD}
		14,95	—	14,95	—	14,95	—	15	
Input voltage LOW $\|I_O\| + 1$ µA (buffered stages only)	V_{IL}(V)	—	1,5	—	1,5	—	1,5	5	$V_O = 0,5$ or 4,5 V
		—	3,0	—	3,0	—	3,0	10	$V_O = 1,0$ or 9,0 V
		—	4,0	—	4,0	—	4,0	15	$V_O = 1,5$ or 13,5 V
Input voltage HIGH $\|I_O\| + 1$ µA (buffered stages only)	V_{IH}(V)	3,5	—	3,5	—	3,5	—	5	$V_O = 0,5$ or 4,5 V
		7,0	—	7,0	—	7,0	—	10	$V_O = 1,0$ or 9,0 V
		11,0	—	11,0	—	11,0	—	15	$V_O = 1,5$ or 13,5 V
Input voltage LOW $\|I_O\| + 1$ µA (unbuffered stages only)	V_{IL}(V)	—	1	—	1	—	1	5	$V_O = 0,5$ or 4,5 V
		—	2	—	2	—	2	10	$V_O = 1,0$ or 9,0 V
		—	2,5	—	2,5	—	2,5	15	$V_O = 1,5$ or 13,5 V
Input voltage HIGH $\|I_O\| + 1$ µA (unbuffered stages only)	V_{IH}(V)	4	—	4	—	4	—	5	$V_O = 0,5$ or 4,5 V
		8	—	8	—	8	—	10	$V_O = 1,0$ or 9,0 V
		12,5	—	12,5	—	12,5	—	15	$V_O = 1,5$ or 13,5 V
Output (sink) current LOW	I_{OL}(mA)	0,52	—	0,44	—	0,36	—	5	$V_O = 0,4$; $V_I = 0$ or 5 V
		1,3	—	1,1	—	0,9	—	10	$V_O = 0,5$; $V_I = 0$ or 10 V
		3,6	—	3,0	—	2,4	—	15	$V_O = 1,5$; $V_I = 0$ or 15 V
Output (source) current HIGH	$-I_{OH}$(mA)	0,52	—	0,44	—	0,36	—	5	$V_O = 4,6$; $V_I = 0$ or 5 V
		1,3	—	1,1	—	0,9	—	10	$V_O = 9,5$; $V_I = 0$ or 10 V
		3,6	—	3,0	—	2,4	—	15	$V_O = 13,5$; $V_I = 0$ or 15 V
Output (source) current HIGH	$-I_{OH}$(mA)	1,7	—	1,4	—	1,1	—	5	$V_O = 2,5$ V; $V_I = 0$ or 5 V
Input leakage current	$\pm I_{IN}$(µA)	—	0,3	—	0,3	—	1,0	15	$V_I = 0$ or 15 V
Three-state output leakage current; HIGH	I_{OZH}(µA)	—	1,6	—	1,6	—	12,0	15	output returned to V_{DD}
Three-state output leakage current; LOW	$-I_{OZL}$(µA)	—	1,6	—	1,6	—	12,0	15	output returned to V_{DD}
Input capacitance per unit load	C_{IN}(pF)	—	—	—	7,5	—	—	—	digital inputs

Functional index



Ceramic DIL, plastic DIL, and flat pack (SO-package)

NAND gates	**HEF4011B**	quadruple 2-input NAND gate
	HEF4011UB	quadruple 2-input NAND gate
	HEF4012B	dual 4-input NAND gate
	HEF4023B	triple 3-input NAND gate
	HEF4068B	8-input NAND gate
AND gates	**HEF4073B**	triple 3-input AND gate
	HEF4081B	quadruple 2-input AND gate
	HEF4082B	dual 4-input AND gate
NOR gates	**HEF4000B**	dual 3-input NOR gate and inverter
	HEF4001B	quadruple 2-input NOR gate
	HEF4001UB	quadruple 2-input NOR gate
	HEF4002B	dual 4-input NOR gate
	HEF4025B	triple 3-input NOR gate
	HEF4078B	8-input NOR gate
OR gates	**HEF4071B**	quadruple 2-input OR gate
	HEF4072B	dual 4-input OR gate
	HEF4075B	triple 3-input OR gate
Inverters and buffers	**HEF4007UB**	dual complementary pair and inverter
	HEF4041B	quadruple true/complement buffer
	HEF4049B	hex inverting buffers
	HEF4050B	hex non-inverting buffers
	HEF4069UB	hex inverter
	HEF4502B	strobed hex inverter/buffer
	HEF40097B	3-state hex non-inverting buffer
	HEF40098B	3-state hex inverting buffer
	HEF40244B	octal buffer with 3-state outputs
Complex gates	**HEF4030B**	quadruple EXCLUSIVE-OR gate
	HEF4070B	quadruple EXCLUSIVE-OR gate
	HEF4077B	quadruple EXCLUSIVE-NOR gate
	HEF4085B	dual 2-wide 2-input AND-OR-invert gate
	HEF4086B	4-wide 2-input AND-OR-invert gate
Flip-flops	**HEF4013B**	dual D-type flip-flop
	HEF4027B	dual JK flip-flop
	HEF4076B	quadruple D-type flip-flop with 3-state outputs
	HEF40174B	hex D-type flip-flop
	HEF40175B	quadruple D-type flip-flop
	HEF40374B	octal D-type flip-flop with 3-state outputs
Schmitt triggers	**HEF4093B**	quadruple 2-input NAND Schmitt trigger
	HEF40106B	hex Schmitt trigger

Functional index

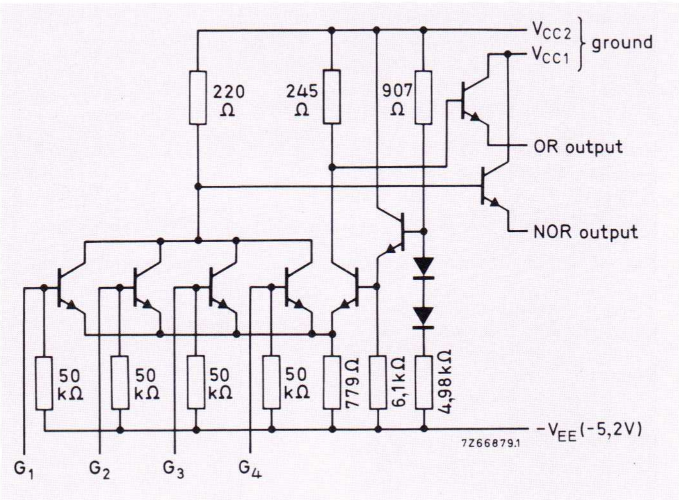
Counters	**HEF4017B**	5-stage Johnson counter
	HEF4018B	presettable divide-by-n counter
	HEF4020B	14-stage binary counter
	HEF4022B	4-stage divide-by-8 Johnson counter
	HEF4024B	7-stage binary counter
	HEF4029B	synchronous up/down counter, binary/decade counter
	HEF4040B	12-stage binary counter
	HEF4059B	Programmable divide-by-n counter
	HEF4060B	14-stage ripple-carry binary counter/divider and oscillator
	HEF4510B	BCD up/down counter
	HEF4516B	binary up/down counter
	HEF4518B	dual BCD up counter
	HEF4520B	dual binary counter
	HEF4521B	24-stage frequency divider
	HEF4522B	programmable 4-bit BCD down counter
	HEF4526B	programmable 4-bit binary down counter
	HEF4534B	real time 5-decade counter
	HEF4737B; V	quadruple static decade counters
	HEF4751V	universal divider
	HEF40160B	4-bit synchronous decade counter with asynchronous reset
	HEF40161B	4-bit synchronous binary counter with asynchronous reset
	HEF40162B	4-bit synchronous decade counter with synchronous reset
	HEF40163B	4-bit synchronous binary counter with synchronous reset
	HEF40192B	4-bit up/down decade counter
	HEF40193B	4-bit up/down binary counter
Registers	**HEF4006B**	18-stage static shift register
	HEF4014B	8-bit static shift register
	HEF4015B	dual 4-bit static shift register
	HEF4021B	8-bit static shift register
	HEF4031B	64-stage static shift register
	HEF4035B	4-bit universal shift register
	HEF4094B	8-stage shift-and-store bus register
	HEF4517B	dual 64-bit static shift register
	HEF4557B	1-to-64-bit variable length shift register
	HEF4731B; V	quadruple 64-bit static shift registers
	HEF40194B	4-bit bidirectional universal shift register
	HEF40195B	4-bit universal shift register
Digital multiplexers	**HEF4019B**	quadruple 2-input multiplexer
	HEF4512B	8-input multiplexer with 3-state output
	HEF4519B	quadruple 2-input multiplexer
	HEF4539B	dual 4-input multiplexer

Decoders and demultiplexers	**HEF4028B**	1-of-10 decoder
	HEF4511B	BCD to 7-segment latch/decoder/driver
	HEF4514B	1-of-16 decoder/demultiplexer with input latches
	HEF4515B	1-of-16 decoder/demultiplexer with input latches
	HEF4543B	BCD to 7-segment latch/decoder driver for liquid crystal and LED displays
	HEF4555B	dual 1-of-4 decoder/demultiplexer
	HEF4556B	dual 1-of-4 decoder/demultiplexer
Analogue switches and multiplexers/ demultiplexers	**HEF4016B**	quadruple bilateral switches
	HEF4051B	8-channel analogue multiplexer/demultiplexer
	HEF4052B	dual 4-channel analogue multiplexer/demultiplexer
	HEF4053B	triple 2-channel analogue multiplexer/demultiplexer
	HEF4066B	quadruple bilateral switches
	HEF4067B	16-channel analogue multiplexer/demultiplexer
Latches	**HEF4042B**	quadruple D-latch
	HEF4043B	quadruple R/S latch with 3-state outputs
	HEF4044B	quadruple R/S latch with 3-state outputs
	HEF4508B	dual 4-bit latch
	HEF4724B	8-bit addressable latch
	HEF40373B	octal transparent latch with 3-state outputs
Multivibrators and timers	**HEF4047B**	monostable/astable multivibrator
	HEF4528B	dual monostable multivibrator
	HEF4538B	dual precision monostable multivibrator
	HEF4541B	programmable timer
	HEF4753V	universal timer module
Arithmetic units	**HEF4008B**	4-bit binary full adder
	HEF4531B	13-input parity checker/generator
	HEF4532B	8-input priority encoder
	HEF4585B	4-bit magnitude comparator
Memories	**HEF4505B**	64-bit, 1-bit per word random access read/write memory
	HEF4720B; V	256-bit, 1-bit per word random access memories
Special functions	**HEF4046B**	phase-locked loop
	HEF4104B	quadruple low to high voltage translator with 3-state outputs
	HEF4527B	BCD rate multiplier
	HEF4738V	IEC/IEEE bus interface
	HEF4739V	digital voltmeter circuit
	HEF4750V	frequency divider
	HEF4752V	a.c. motor control circuit
	HEF4754V	18-element bargraph LCD driver
	HEF40245B	octal bus transceiver with 3-state outputs

ECL 10 000 (GX family)

The GX family of ECL silicon monolithic integrated circuits is designed for high speed central processors and digital communication systems.
With 2,0 ns typical propagation delay and only 25 mW power dissipation per gate, this family offers an excellent speed-power product and so is recommended for high speed large system design.

Basic gate circuit



GX family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

supply voltage (d.c.)	V_{EE}	max	−8,0	V
input voltage	V_I	0 to V_{EE}		
output current	I_O	max	50	mA
storage temperature	T_{stg}	−55 to +125		°C
junction temperature	T_j	max	125	°C

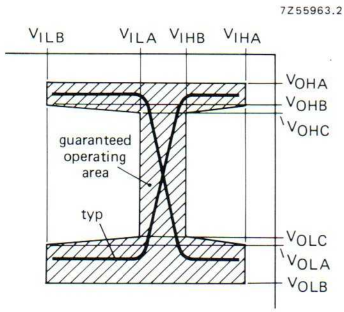
Family characteristics (d.c.) at V_{CC} = ground; V_{EE} = −5,2 V

Each GX circuit has been designed to meet the d.c. specifications shown in the test table below, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed-circuit board and transverse air flow > 2,5 m/s is maintained.

Outputs are terminated via a 50 Ω resistor to −2,0 V. Test values for applied conditions are given in the table and defined in the figure.

Test table

T_{amb}	0°C	25°C	75°C	
V_{IHA}	−0,840	−0,810	−0,720	V
V_{IHB}	−1,145	−1,105	−1,045	V
V_{ILA}	−1,490	−1,475	−1,450	V
V_{ILB}	−1,870	−1,850	−1,830	V



	symbol		T_{amb} 0°C	25°C	75°C		conditions
output voltage HIGH	V_{OH}	min	−1000	−960	−900	mV	inputs at V_{IHA}
		typ		−880		mV	
		max	−840	−810	−720	mV	
output voltage LOW	V_{OL}	min	−1,870	−1,850	−1,830	V	inputs at V_{ILB}
		typ		−1,720		V	
		max	−1,665	−1,650	−1,625	V	
output threshold voltage HIGH	V_{OHC}	min	−1020	−980	−920	mV	inputs at V_{IHB}
output threshold voltage LOW	V_{OLC}	max	−1,645	−1,630	−1,605	V	inputs at V_{ILA}
input current HIGH	I_{IH}	max		265		μA	V_{IHA} for input under test
input current LOW	I_{IL}	min		10		μA	V_{ILB} for input under test

ECL

ECL 10000 (GX family)

Functional index

Gates	**GXB10100**	quadruple 3-input NOR gate (1 input common)
	GXB10101	quadruple 2-input OR/NOR gate (1 input common)
	GXB10102	quadruple 2-input, 3 NOR and 1 OR/NOR gate
	GXB10103	quadruple 2-input, 3 OR and 1 OR/NOR gate
	GXB10104	quadruple 2-input, 3 AND and 1 AND/NAND gate
	GXB10105	triple 2-3-2 input OR/NOR gate
	GXB10106	triple 4-3-3 input NOR gate
	GXB10107	triple 2-input EXCLUSIVE-OR/EXCLUSIVE-NOR gate
	GXB10108	dual 3-input AND/NAND gate
	GXB10109	dual 4-5 input OR/NOR gate
	GXB10110	dual 3-input/3-output OR gate (line driver)
	GXB10111	dual 3-input/3-output NOR gate (line driver)
	GXB10113	quadruple EXCLUSIVE-OR gate (with enable)
	GXB10117	dual 2-wide 2-3 input OR-AND/OR-AND-invert gate
	GXB10118	dual 2-wide 3-input OR-AND gate
	GXB10119	4-wide 4-3-3-3 input OR-AND gate
	GXB10121	4-wide OR-AND/OR-AND-invert gate
	GXB10210	high speed dual 3-input/3-output OR gate
	GXB10211	high speed dual 3-input/3-output NOR gate
Interfaces	**GXB10112**	dual 3-input/3-output (1 OR and 2 NOR) line driver
	GXB10114	triple line receiver
	GXB10115	quadruple line receiver
	GXB10116	triple line receiver
	GXB10124	quadruple TTL to ECL translator
	GXB10125	quadruple ECL to TTL translator
	GXB10129	quadruple TTL/IBM bus receiver/latch
	GXB10188	hex buffer (non-inverting)
	GXB10189	hex inverter
Flip-flops	**GXB10130**	dual D-type latch
	GXB10131	dual D-type master-slave flip-flop
	GXB10133	quadruple latch with D-type inputs and enable outputs
	GXB10135	dual JK master-slave flip-flop
	GXB10175	quint D-latch with common reset and two wired-OR common clock inputs
	GXB10176	hex D-type master-slave flip-flop
	GXB10231	high speed dual D-type master-slave flip-flop
Counters and registers	**GXB10136**	universal hexadecimal counter
	GXB10137	universal decade counter
	GXB10141	4-bit universal shift register

Type numbers have a suffix which signifies the type of package: P = plastic DIL; D = ceramic DIL; E = metal-ceramic (for memories only)

Complex	**GXB10132**	dual 2-input multiplexer with clocked D-type latches and common reset
	GXB10134	dual 2-input multiplexer with clocked D-type latches
	GXB10158	quadruple 2-to-1 multiplexer (non-inverting)
	GXB10159	quadruple 2-to-1 multiplexer (inverting)
	GXB10160	12-bit parity checker/generator
	GXB10161	3-bit decoder with two enable inputs (1 of 8 lines LOW)
	GXB10162	3-bit decoder with two enable inputs (1 of 8 lines HIGH)
	GXB10164	8-input multiplexer with enable input
	GXB10165	8-input priority encoder
	GXB10170	9-bit parity checker/generator
	GXB10171	dual 2-bit decoder (one of four lines LOW)
	GXB10172	dual 2-bit decoder (one of four lines HIGH)
	GXB10173	quadruple 2-input multiplexer with latched outputs
	GXB10174	dual 4-to-1 multiplexer (with enable)
	GXB10179	look-ahead carry block
	GXB10180	dual 2-bit adder/subtractor
	GXB10181	4-bit arithmetic logic unit
	GXB10190	quadruple differential receiver/MST-ECL translator
	GXB10191	hex ECL-MST translator
Memories	**GXB10139**	256-bit, 8-bits per word PROM
	GXB10140	64-bit, 1-bit per word RAM (90 Ω output)
	GXB10142	fast 64-bit, 1-bit per word RAM
	GXB10144	256-bit, 1-bit per word RAM
	GXB10145	64-bit, 4-bits per word RAM
	GXB10146	1024-bit, 1-bit per word RAM
	GXB10148	64-bit, 1-bit per word RAM (50 Ω output)
	GXB10149	1024-bit, 4-bits per word PROM
	GXB10155	16-bit, 2-bits per word CAM (content addressable memory)
	GXB10405	128-bit, 1-bit per word RAM
	GXB10415	1024-bit, 1-bit per word RAM
	GXB10422	256, 4-bit read-write RAM

miscellaneous types

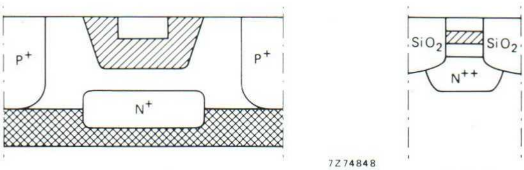
type number	description	temp. range °C	supply voltage V	power dissipation mW	number of pins DIL
SAA1059	125 MHz amplifier and divider-by-32/33	−20 to +80	5	760	16
SAB1009B	wideband limiting amplifier	0 to +70	5	75	14
SAB1018	sensitive 950 MHz divider-by-256	0 to +70	5	300	14
SAB1018A	sensitive 950 MHz divider-by-256	0 to +70	5	300	8
SAB1034	1,05 GHz divider-by-4	0 to +75	−5,2	250	14
SAB1046	1 GHz divider-by-256	0 to +70	5	320	14
SAB1047	divider-by-64	0 to +70	−5,2	250	14
SAB1048	divider-by-4	0 to +70	−5,2	250	14
SAB1077	sensitive 1 GHz divider-by-248/256	0 to +70	5	200	14
SAB1078	600 MHz divider-by-10/11	0 to +70	5	300	16
SAB1534P	1,5 GHz divider-by-4	0 to +75	−5,2	250	14
SAB1801D	dual differential D-type flip-flop	0 to +75	−5,2	310	14
SAF1034E	1,05 GHz divider-by-4	−40 to +85	−5,2	250	14
SAF1534E	1,5 GHz divider-by-4	−40 to +85	−5,2	250	14
TDA1077P, D	two-tone generator for telephone dialling	−25 to +70	3	180	16

Applications

- high speed instrumentation (counters and frequency meters, synthesizers, oscilloscopes, nuclear instrumentations)
- radio and television tuning systems
- telecommunications

ECL 100 000 (HX family)

To satisfy the needs of new generations of computer and telecommunication systems in standard and LSI circuit design, a new technological process has been developed using oxide lateral isolation. The process is called SUBILO and permits the manufacture of integrated circuits with ultra-high speeds and high integration density. Instead of conventional planar junction isolation technology, SUBILO uses a process that results in a considerable reduction in transistor area and an increase integration density. By using an increase in silicon oxide instead of isolation diffusion 'p', and removing the part between the emitter and isolation oxide, SUBILO technology results in a further reduction of transistor area. At the same time, the collector-base capacitance decreases, which is an important improvement in the dynamic performance of the transistor.



Planar process in comparison with SUBILO technology.

		planar	SUBILO	
Transistor area		3000	700	μm^2
Transition frequency	f_T	1,5	4,5	GHz
Application		ECL 10 000 (GX family)	ECL 100 000 (HX family)	

HX family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

supply voltage (d.c.)	$-V_{EE}$	max	7	V; typ 4,5 V
input voltage	V_I		0 to −4,5	V
output current	I_O	max	55	mA
storage temperature	T_{stg}		−55 to +125	°C
junction temperature	T_j	max	125	°C

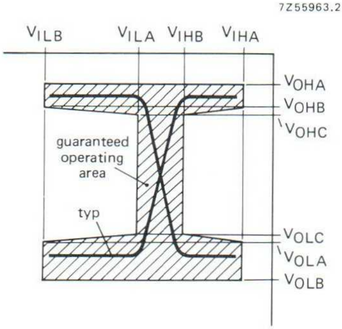
ECL 100000 (HX family)

Family characteristics (d.c.) at V_{CC} = ground; V_{EE} = −4,5 V

Each ECL circuit has been designed to meet the d.c. specifications shown in the test table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed-circuit and transverse air flow > 2,5 m/s is maintained. Test values are given in the table and defined in the figure.

Test table

V_{IHA}	−0,88 V
V_{IHB}	−1,165 V
V_{ILA}	−1,475 V
V_{ILB}	−1,81 V



Test table V_{CC} = ground; V_{EE} = −4,5 V; T_{amb} = 0 to +75 °C; R_L = 50 Ω at −2 V

characteristic	symbol		value	unit
Output voltage HIGH	V_{OH}	min (B)	−1,025	V
		typ	−0,955	V
		max (A)	−0,88	V
Output voltage LOW	V_{OL}	min (B)	−1,81	V
		typ	−1,705	V
		max (A)	−1,62	V
Output threshold voltage HIGH	V_{OHC}		−1,035	V
Output threshold voltage	V_{OLC}		−1,61	V

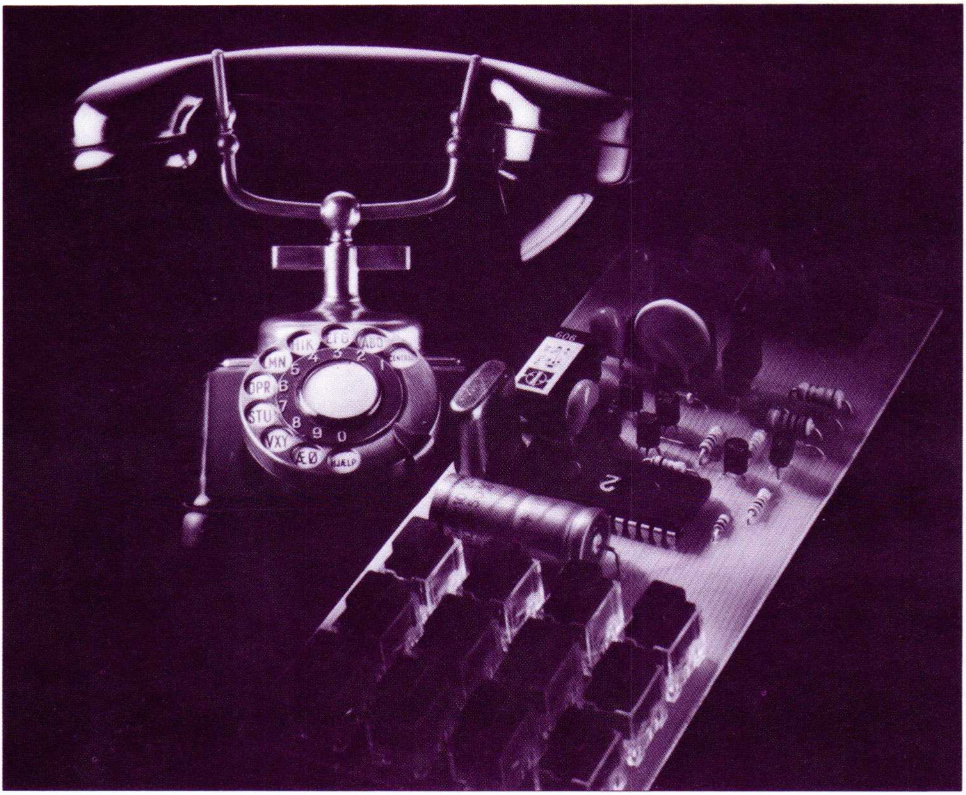
Functional index

Gates	**100101**	triple 5-input OR/NOR gate
	100102	quintiple 2-input OR/NOR gate with common enable
	100107	quintiple exclusive OR/NOR gate with compare
	100112	quadruple double fan-out OR/NOR gate
	100117	triple 1-2-2-input OR/AND-OR/NAND gate
	100118	2-4-4-4-5-input OR/AND-OR/NAND gate
Driver	**100123**	hex bus driver
Interface	**100114**	quintiple differential line receiver
	100122	9-bit buffer gate
	100175	5-bit 100k to 10k interface with latch
	100255	5-bit ECL/TTL interface
Flip-flops	**100131**	triple D flip-flop
	100150	hex D latch flip-flop
	100151	hex D master-slave flip-flop
Matrix	**100158**	8-bit shift matrix
Multiplexers	**100155**	quadruple 2-way multiplexer latch
	100163	dual 8-bit multiplexer
	100164	16-input multiplexer
	100171	triple bit 4-way multiplexer
Memories	**100142**	4 × 4 CAM
	100415; A	1024 × 1 bit RAM
	100422; A	256 × 4 bit RAM
Counters and registers	**100136**	multipurpose counting register
	100141	8-bit universal shift register
	100145	16 × 4 register file
Complex	**100156**	mask-merge selector
	100160	dual 9-bit parity generator/8-bit comparator
	100165	universal priority encoder
	100166	9-bit comparator
	100170	universal decoder
	100180	fast 6-bit adder
	100181	4-bit ALU binary/decimal

C-MOS
interrupted current-loop dialling circuits

The MH320, MH321 and MH323 are single chip silicon-gate C-MOS integrated circuits. They are intended to convert pushbutton keyboard entries into streams of correctly-timed line current interruptions. The input data is derived from a telephone keyboard with a 3 x 4 pushbutton matrix. Numbers with up to 23 digits can be retained in a RAM for redial. A delayed reset is built-in for line power breaks.

For the last seventy years, rotary electromechanical telephone dials have been faithfully dialling numbers by interrupting the current in the telephone lines. The much heavier traffic that must be handled by modern exchanges has resulted in the introduction of a much faster dialling system using combinations of two audio frequency tones generated by electronic pushbutton telephones. Meanwhile, integrated circuits MH320, MH321 and MH323 merge the old with the new by allowing pushbutton telephones to be used with exchanges not yet equipped with decoders for two-tone dialling.



Common features of MH320, MH321 and MH323

- Operation from 2,5 V to 6 V supply
- Static standby operation down to 1,8 V
- Low current consumption; typ. 40 μA
- Low static standby current; typ. 1 μA
- On-chip oscillator for 3,58 MHz crystal
- Fully decoded and debounced inputs for 3 × 4 matrix keyboard
- All inputs with pull-up/pull-down (except CE)
- 23-digit capacity for redial operation
- Circuit reset for line power breaks; > 160 ms
- Dialling pulse frequency: 10 Hz
- Test pulse frequency: 932 Hz
- Hold facility for lengthening the inter-digit period
- Memory overflow possibility (with internally disabled redial)
- All inputs are internally protected against electrostatic charges
- High input noise immunity

Additional features of MH321 and MH323

The MH321 can regenerate access pauses during redial. During the original entry, access pauses are stored either automatically or via the keyboard. A regenerated access pause can be terminated during redial in three ways: automatically after a built-in time, or via the keyboard, or with an external dial tone recogniser circuit. This makes the circuit very suitable for redial in PABX (Private Automatic Branch Exchange) systems. The MH321 is pin to pin compatible with the DF320 and the MT4320 (however, including additional functions).

- 23-digit capacity, including access pauses, for redial operation
- Selectable dialling pulse frequency: 10 Hz, 16 Hz and 20 Hz
- Circuit reset for line power breaks; > 160 ms (10 Hz dialling pulse frequency)
- Selectable dialling pulse mark/space ratios; 2:1 or 3:2
- Access pause generation automatically or via the keyboard
- Access pause reset:
  automatically after 3 s (10 Hz dialling pulse frequency)
  via the keyboard
  with external tone recogniser

Further features of MH323

- Selectable circuit reset for line power breaks; > 160 ms or > 320 ms (10 Hz dialling pulse frequency)
- Selectable inter-digit pause (t_{id}); 8 or 9 times the pulse period (T_{DP})
- Access pause reset:
  automatically after 3 s or 6 s (10 Hz dialling pulse frequency)
  via the keyboard
  with external tone recogniser

Package outlines

MH320; MH321
18-lead DIL; plastic (SOT-102G)
18-lead DIL; ceramic (SOT-133)

MH323
28-lead DIL; plastic (SOT-117D)
28-lead DIL; ceramic (SOT-135)

C-MOS

ICs for digital watches

Faselec circuits for digital quartz crystal watches feature a very low power consumption.
The only external components required for the oscillator are the quartz crystal and a trimmer.
All circuits are equipped with a 12/24 h bonding option.
The chips are delivered in trays and in addition to the normal 100 % electrical tests they are optically inspected for minute die faults which could endanger the reliability.

Standard products for digital watches; 32 kHz

type	digits	functions										supply current	
		12 hours	24 hours	minutes	seconds	weekday flag	date	month (set mode)	month	chrono 23.59.59.99	alarm 4 kHz	typ μA	max μA
MJ7	8 + weekday	×	×	×	×	×	×	×				1,6	2,5
MJ11-2	6 + weekday	×	×	×	×	×	×	×				1,2	2,5
MJ123	4	×	×	×	×		×		×			1,2	2,5
MJ125	4	×	×	×	×		×		×			1,2	2,5
MJ150	6 + weekday	×	×	×	×	×	×	×			×	1,6	2,5
MJ160	6 + weekday	×	×	×	×	×	×	×		×		1,6	2,5

ICs for analogue watches

Faselec circuits for quartz crystal analogue watches feature a very low power consumption. The regulated oscillator concept adapts the current consumption to the individual characteristics of the quartz crystal used. Thus ensuring operation for an extremely wide range of crystals with the lowest possible current consumption. The oscillator circuits used also result in a very good frequency stability (typically $0{,}1 \times 10^{-6}/100$ mV).
All our analogue watch ICs are available as chips or in a miniature plastic package. As an additional service, Faselec can assemble the chips on printed-circuit board according to customers specifications.

Standard products for analogue watches; 32 kHz. Supply current typ. 0,3 μA

with bipolar motor

type	output cycle time	pulse duration
MB101	1 s	7,8 ms
MB102	60 s	7,8 ms
MB103	12 s	7,8 ms
MB104	5 s	7,8 ms
MB106	1 s	23,4 ms
MB107	10 s	7,8 ms
MB109	30 s	7,8 ms
MB140	1 s	13,7 ms
MB141	5 s	13,7 ms
MB142	30 s	23,4 ms
MB143	1 s	9,8 ms
MB144	20 s	7,8 ms
MB145	10 s	3,9 ms
MB146	1 s	3,9 ms

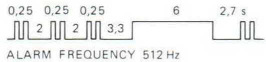
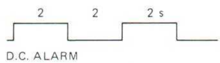
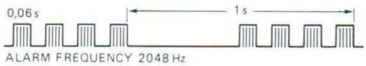
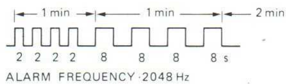
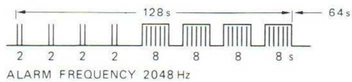
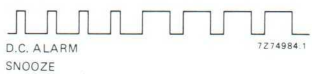
with unipolar motor

type	output cycle time	pulse duration
MB105	1 s	3,9 ms
MB125	1 s	3,17 ms
MB126	30 s	3,42 ms

C-MOS
ICs for analogue clocks

Our range of ICs for analogue quartz clocks includes types suitable for both unipolar and bipolar motors.
A number of alarm output options are available.
All circuits have an extremely low power consumption.
All external connections are protected against voltages built-up by static charges.
All circuits are in DIL-8 plastic packages.

Standard products for analogue clocks

type	motor type	output cycle time	pulse duration	supply current typ.	quartz crystal frequency	alarm output
MB512	bipolar	2 s	1 s	25 μA	4,19 MHZ	
MB513	bipolar	2 (1) s	32 ms	25 μA	4,19 MHz	
MB515	bipolar	2 (1) s	46,8 ms	25 μA	4,19 MHz	
MB522	unipolar	1 s	7,8 ms	25 μA	4,19 MHz	
MB523	unipolar	1 s	7,8 ms	25 μA	4,19 MHz	
MB531	bipolar	2 s	1 s	25 μA	4,19 MHz	
MB551A	bipolar	1 s	46,8 ms	25 μA	4,19 MHz	
MB551B	bipolar	1 s	46,8 ms	25 μA	4,19 MHz	
MB561 **MB562**	bipolar	2 (1) s	46,8 ms	2 μA	32 kHz	

LCD duplex drivers clock/timer

LCD (liquid crystal display) duplex drivers MH100, MH110, MH111

Single-chip, silicon-gate C-Mos ICs. They are intended to interface a microcomputer with an LCD, via a serial data input, and with an LCD drive capability in a duplex manner. These circuits are specially designed for low voltage applications. The only external components required are a resistor and a capacitor for the one-point built-in oscillator.

Features

- Supply voltage of 2,25 V to 6,5 V
- Low current consumption
- Serial data input
- Bus control
- One-point built-in oscillator
- Expansion possibility

Drive capability

MH100 : 40 LCD segments
MH110 : 60 LCD segments and two LED driver outputs
MH111 : 64 LCD segments

Package outlines

MH100 : 28-lead flat-pack, plastic (SO-28; SOT-136A)
MH110; MH111 : 40-lead DIL, plastic (SOT-129)
40-lead flat-pack, plastic (SO-40; SOT-158)

SAB3019 · clock/timer with serial I/O

The SAB3019 is a C-MOS IC designed to operate with a microcomputer. It contains a digital clock, as well as an additional register for storing an alarm time both for minutes, hours, days and months. The timebase is the 50 Hz line frequency or a 32,768 kHz quartz crystal oscillator.
The data transfer, as setting and reading of the time counter and time register, passes over a serial 3-line bus (IBUS).
The circuit operates at 5 V and has a standby mode at 1,5 V.
The SAB3019 is suitable in user programmable time switching functions for microcomputer-controlled systems.

Features

- Operating supply voltage of 5 V
- Standby mode at 1,3 V to 2,6 V
- 50 Hz line frequency or crystal-controlled clock circuit (automatic selection with priority for 50 Hz input)
- Time register with 24-bit memory
- Comparison between clock and timer contents
- Microcomputer adapted, with serial bus for data input/output

Package outline

16-lead DIL, plastic (SOT-38).

TTL
survey

Signetics offers the designer the industry's broadest line of digital integrated circuit families in both plastic and cerdip packages.
The key characteristics of the major Signetics product lines are outlined below. Complete listing of all the devices in each family and application selector guides are provided on the following pages. Full data sheets for design purposes can be obtained from your local Signetics Sales Office or Distributor.

Family characteristics

	SSI gates propagation delay	**Flip-flops** toggle rate	**MSI ALU** 4-bit add time
Standard TTL 7400 Series SSI and MSI 8200 Series MSI 9300 and 9600 Series MSI Standard "gold doped" TTL is the industry's longest selling digital logic family still in high volume production. New system designs generally favor the Low Power Schottky TTL equivalent functions.	10 ns at 10 mW	25 MHz	28 ns
Low Power Schottky TTL 74LS00 Series SSI and MSI Low power Schottky provides the same speed as standard TTL at 1/5 the power. The power savings and LSI potential are encouraging the use of 74LS in most new system designs.	10 ns at 2 mW	30 MHz	21 ns
Schottky TTL 74S00 Series SSI, MSI and 82S00 Series MSI Schottky TTL uses a diode clamp design to insure the highest speed possible at TTL logic levels.	3 ns at 30 mW	90 MHz	11 ns

Functional index

			74	74LS	74S
Gates	**7400**	quadruple 2-input positive NAND gate	•	•	•
	7401	quadruple 2-input positive NAND gate with open collector output	–	•	–
	7402	quadruple 2-input positive NOR gate	•	•	•
	7403	quadruple 2-input positive NAND gate with open collector output	•	–	•
	7408	quadruple 2-input positive AND gate	•	•	•
	7410	triple 3-input positive NAND gate	•	•	•
	7411	triple 3-input positive AND gate	•	•	•
	7420	dual 4-input positive NAND gate	•	•	•
	7421	dual 4-input positive AND gate	•	•	–
	7425	dual 4-input positive NOR gate (with strobe)	•	–	–
	7426	quadruple 2-input NAND gate with open collector output	•	•	–
	7427	triple 3-input NOR gate	•	–	–
	7430	8-input positive NAND gate	•	•	–
	7432	quadruple 2-input positive OR gate	•	•	•
	7450	expandable dual 2-wide 2-input AND-OR-invert gate	•	–	–
	7451	dual 2-wide 2-input AND-OR-invert gate	•	•	•
	7454	4-wide 2-input AND-OR-invert gate	–	•	–
	7464	4-2-3-2-input AND-OR-invert gate	–	–	•
	7486	quadruple 2-input EXCLUSIVE-OR gate	•	•	•
	74133	13-input NAND gate	–	–	•
	74134	12-input NAND gate with three-state outputs	–	–	•
	74135	quadruple EXCLUSIVE-OR/NOR gate	–	–	•
	74136	quadruple EXCLUSIVE-OR with open collector output	–	•	–
	74260	dual 5-input NOR gate	–	•	•
	74266	quadruple EXCLUSIVE-NOR	–	•	–
Buffers, inverters	**7404**	hex inverter	•	•	•
	7405	hex inverter with open collector output	•	•	•
	7406	hex inverter buffer/driver with open collector output	•	–	–
	7407	hex buffer/driver with open collector output	•	–	–
	7416	hex inverter buffer/driver with open collector output	•	–	–
	7417	hex buffer/driver with open collector output	•	–	–
	7428	quadruple 2-input positive NOR buffer	•	–	–
	7433	quadruple 2-input positive NOR buffer with open collector output	•	•	–
	7437	quadruple 2-input positive NAND buffer	•	•	•
	7438	quadruple 2-input positive NAND buffer with open collector output	•	•	•
	7439	quadruple 2-input positive NAND buffer with open collector output	•	–	–
	7440	dual 4-input positive NAND buffer	•	•	•

			74	74LS	74S
Bus drivers transceivers	**74125**	quadruple bus buffer gate with three-state outputs	•	•	–
	74126	quadruple bus buffer gate with three-state outputs	•	•	–
	74128	quadruple 2-input positive NOR buffer	•	–	–
	74240	octal inverter buffer with three-state output	–	•	–
	74241	octal buffer with three-state output	–	•	–
	74242	quadruple inverting transceiver with three-state output	–	•	–
	74243	quadruple transceiver with three-state output	–	•	–
	74244	octal buffer with three-state output	–	•	–
	74365A	hex three-state buffer with common enable	•	•	–
	74366A	hex three-state inverter with common enable	•	•	–
	74367A	hex three-state buffer, 4-bit and 2-bit	•	•	–
	74368A	hex three-state inverter, 4-bit and 2-bit	•	•	–
Flip-flops	**7413**	dual NAND Schmitt trigger	•	•	–
	7414	hex Schmitt trigger	•	•	–
	7473	dual JK master-slave flip-flop	•	•	–
	7474	dual D-type edge-triggered flip-flop	•	•	•
	7476	dual JK master-slave flip-flop	•	•	–
	74107	dual JK master-slave flip-flop	•	•	–
	74109	dual JK positive edge-triggered flip-flop	•	•	–
	74112	dual JK negative edge-triggered flip-flop	–	•	•
	74113	dual JK positive edge-triggered flip-flop	–	•	•
	74121	monostable vibrator	•	–	–
	74123	retriggerable monostable multivibrator	•	–	–
	74132	quadruple Schmitt trigger	•	•	–
	74173	quadruple D-type flip-flop (three-state) (8T10)	•	•	–
	74174	hex D-type flip-flop with clear	•	•	•
	74175	quadruple D-type edge-triggered flip-flop	•	•	•
	74221	dual monostable multivibrator	•	–	–
	74273	octal D-type flip-flop with clear	–	•	•
	74364	octal flip-flop (three-state)	–	•	–
	74374	octal flip-flop (three-state)	–	•	–
	74377	octal D-type flip-flop with clear	–	•	–
	74378	hex flip-flop with clear	–	•	–

TTL
7400 series

Functional index

			74	74LS	74S
Shift registers	**7491**	8-bit shift register	•	–	–
	7494	4-bit shift register parallel-in/serial-out	•	–	–
	7495A	4-bit left-right shift register	•	–	–
	7495B	4-bit left-right shift register	–	•	–
	7496	5-bit shift register	•	•	–
	74164	8-bit parallel-out serial shift register	•	•	–
	74165	parallel-load 8-bit shift register	•	–	–
	74166	8-bit shift register	•	–	–
	74170	4 × 4 register file	•	•	–
	74172	16-bit multiple port register file	–	–	•
	74178	4-bit parallel access shift register (8270)	•	–	•
	74179	4-bit parallel access shift register (8271)	•	–	•
	74194	4-bit bidirectional universal shift register	•	•	•
	74195	4-bit parallel-access shift register	•	•	•
	74199	8-bit shift register	•	–	–
	74295B	4-bit right-shift left-shift register	–	•	–
	74395A	4-bit cascadeable shift register (three-state)	–	•	–
	74670	4 × 4 register file (three-state)	–	•	–
Counters	**7490**	decade counter	•	•	–
	7492	divide-by-twelve counter	•	•	–
	7493	4-bit binary counter	•	•	–
	74160	synchronous 4-bit decade counter	•	–	–
	74160A	synchronous 4-bit decade counter	–	•	–
	74161	synchronous 4-bit binary counter	•	–	–
	74161A	synchronous 4-bit binary counter	–	•	–
	74162	synchronous 4-bit decade counter	–	–	–
	74162A	synchronous 4-bit decade counter	–	•	–
	74163	synchronous 4-bit binary counter	•	–	–
	74163A	synchronous 4-bit binary counter	–	•	–
	74176	presettable decade counter/latch (8280)	•	–	–
	74177	presettable binary counter/latch (8281)	•	–	–
	74190	synchronous up/down counter (BCD)	•	–	–
	74191	synchronous up/down counter (binary)	•	•	–
	74192	synchronous decade up/down counter	•	•	–
	74193	synchronous 4-bit binary up/down counter	•	•	–
	74196	presettable decade counter/latch (8290)	•	–	•
	74197	presettable binary counter/latch (8291)	•	•	•
	74290	decade counter	–	•	–
	74293	4-bit binary counter	–	•	–

			74	74LS	74S
Latches	**7475**	quadruple bistable latch	•	•	–
	74116	dual 4-bit latch with clear	•	–	–
	74279	quadruple S-R latch	•	–	–
	74363	octal latch (three-state)	–	•	–
	74373	octal latch (three-state)	–	•	–
	74375	quadruple latch	–	•	–
Decoders-drivers	**7445**	BCD-to-decimal decoder/driver with open collector output	•	–	–
	74140	dual 4-input NAND line driver	–	–	•
	74145	BCD-to-decimal decoder/driver with open collector output	•	–	–
Decoder-multiplexers	**7442**	BCD-to-decimal decoder	•	•	–
	74138	3-line to 8-line decoder/demultiplexer	–	•	•
	74139	dual 2-line to 4-line decoder/demultiplexer	–	•	•
	74147	10-line to 4-line priority encoder	•	–	–
	74148	8-line to 3-line priority encoder	•	–	–
	74150	16-line to 1-line multiplexer	•	–	–
	74151	8-line to 1-line multiplexer	•	•	•
	74153	dual 4-line to 1-line multiplexer	•	•	•
	74154	4-line to 16-line decoder/demultiplexer	•	•	–
	74155	dual 2-line to 4-line decoder/demultiplexer	•	•	–
	74156	2-line to 4-line decoder demultiplexer	•	•	–
	74157	quadruple 2-input data selector (non-inverting)	•	•	•
	74158	quadruple 2-input data selector (inverting)	•	•	•
	74251	data selector/multiplexer with three-state outputs	–	•	•
	74253	dual 4-line to 1-line data selector/multiplexer	–	•	•
	74257A	quadruple 2-line to 1-line data selector/multiplexer	–	•	•
	74258A	quadruple 2-line to 1-line data selector/multiplexer	–	•	•
	74298	quadruple 2-input multiplexer with storage	•	•	–
Arithmetic units	**7483**	4-bit binary full adder	•	–	–
	7483A	4-bit binary full adder	–	•	–
	7485	4-bit magnitude comparator	•	•	•
	74180	8-bit odd/even parity checker	•	–	–
	74181	4-bit arithmetic logic unit	•	•	•
	74182	look-ahead carry generator	–	–	•
	74280	9-bit odd/even parity generator/checker	–	–	•
	74283	4-bit adder	–	•	–
	74350	4-bit shifter with three-state outputs (AM25S10)	–	–	•
Memories	**7489**	16 × 4 RAM with open collector output	–	–	•
	74189	16 × 4 RAM with three-state output	–	–	•
	74289	16 × 4 RAM with open collector output	–	–	•

TTL
8200, 9300 and 9600 series

Functional index

Arithmetic units	**8268**	gated full adder
	82S82	4-bit arithmetic unit
	82S83	4-bit BCD adder
Counters	**8280**	presettable decade counter
	8281	presettable binary counter
	9310	4-bit decade counter
	9316	4-bit binary counter
Decoders/display drivers	**8250**	binary-to-octal decoder
	82S50	binary-to-octal decoder
	8252	BCD-to-decimal decoder
	9301	BCD-to-decimal decoder
Flip-flops	**9602**	dual monostable multivibrator
Multiplexers	**8230**	8-input digital multiplexer
	8233	2-input, 4-bit digital multiplexer
	8234	2-input, 4-bit digital multiplexer
	8266	2-input, 4-bit digital multiplexer
	9309	dual 4-input multiplexer
	9312	8-input digital multiplexer
	9322	data selector multiplexer
Parity functions	**8242**	quadruple EXCLUSIVE-NOR
	82S42	quadruple EXCLUSIVE-NOR
	8262	9-bit parity generator and checker
	82S62	9-bit parity generator and checker
	9324	5-bit comparator
Registers/latches	**8202**	10-bit buffer register
	8271	4-bit shift register
	8273	10-bit serial-in, parallel-out shift register
	8274	10-bit parallel-in, serial-out shift register
	8276	8-bit serial shift register
	8277	dual 8-bit shift register
	9300	4-bit shift register
	9334	8-bit addressable latch

interface — 8T00 series

Functional index

Translators/buffers	**8T80**	quadruple 2-input NAND gate (high voltage)
Timing circuits	**8T20**	bidirectional one shot
	8T22	retriggerable monostable multivibrator (74122/9601)
Line drivers receivers transceivers	**8T09**	quadruple three-state bus driver
	8T10	quadruple three-state D-type bus flip-flop
	8T13	dual low impedance line driver
	8T14	triple line receiver/Schmitt trigger
	8T15	dual communications line driver
	8T16	dual communications line receiver
	8T23	dual IBM 360/370 line driver (75123)
	8T24	triple IBM 360/370 line receiver (75124)
	8T25	dual MOS to TTL interface
	8T26A	quadruple three-state bus transceiver (inverting)
	8T28	quadruple three-state bus transceiver (non-inverting)
	8T34	quadruple bus transceiver (three-state outputs) (DM 8834)
	8T37	hex bus receiver/Schmitt trigger (DM 8837)
	8T38	quadruple bus transceiver (open collector) (DM 8838)
	8T95/97	high-speed hex three-state buffer
	8T96/98	high-speed hex three-state inverter
	8T245	octal transceiver
	8T380	quadruple bus receiver with hysteresis/Schmitt trigger
	8T3404	6-bit latch
Decoders drivers	**8T04**	7-segment decoder display driver (active-LOW outputs)
	8T05	7-segment decoder display driver (active-HIGH outputs)
	8T06	7-segment decoder display driver (active-LOW outputs)

bipolar memories
cross reference

AMD	Signetics
2700	82S16
2701	82S17
27S02/3101A	3101A
54S289	82S25
27S08	82S23
27S09	82S123
27S12	82S130
27S13	82S131
27S15	82S115
27S20	82S126
27S21	82S129
27S29	82HS147
27S33	82S137
27S03	74S189
27S180	82S180
27S181	82S181
27S185	82S185

Fairchild	Signetics
10415	10146
10416	10149
93403	82S25
93404	3101A
93405	74S189
93411	82S17
93417	82S126
93419	82S09/82S19
93421	82S16
93427	82S129
93431	82S23
93436	82S130
93446	82S131
93450	82S180
93451	82S181
93L451	82LS181
93453	82S137
93458	82S101
93459	82S100
93478	82S210
93479	82S212

Harris	Signetics
HM7602	82S23
HM7603	82S123
HM7610	82S126
HM7611	82S129
HM7620	82S130
HM7621	82S131
HM7643	82S137
HM7647	82S115
HM7649	82HS147
HM7680	82S180
HM7681	82S181
HM7681R	82S183
HM7685	82S185
HM76161	82S191

Intel	Signetics
3101	82S25
3101A	3101A
3106	82S16
3107	82S17
3601	82S126
3602	82S130
3608	82S180
3621	82S129
3622	82S131
3625	82S137
3628	82S181
3636	82S191

Parts are pin for pin functional replacements except where noted. Signetics supplies most devices in both commercial and military temperature ranges.

Intersil	Signetics
5501	82S25
5523A	82S16
55333A	82S17
5600	82S23
5603A	82S126
5604	82S130
5610	82S123
5623A	82S129
5624	82S131
56S26	82S137

Motorola	Signetics
4064	82S25
4256	82S16
5005	82S126
7642	82S137
7680	82S180
7681	82S181
10139	10139
10149	10149
82100	82S100
82101	82S101

MMI	Signetics
5560	82S25
6300-1	82S126
6301-1	82S129
6305-1	82S130
6306-1	82S131
6330	82S23
6331	82S123
6349	82HS147
6353-1	82S137
6380	82S180
6381	82S181
6530	82S17
6531	82S16
6560	3101A
6561	74S189
H6555	82S09
63S1681	82S191

National	Signetics
54S289	82S25
74S188	82S23
74S189	74S189
74S206	82S17
74S287	82S129
74S288	82S123
74S387	82S126
74S472	82HS147
74S570	82S130
74S571	82S131
74S573	82S137
82S185	82S185
85S228	82S181
85S229	82S180

TI	Signetics
54S289	82S25
74S188	82S23
74S189	74S189
74S287	82S129
74S288	82S123
74S289	3101A
74S387	82S126
74S455	82S185
74S472	82HS147
74S476	82S137
74S478	82S181
74S479	82S180
74LS478	82LS181

bipolar memories
selection guide

device	organi-zation	output circuit[1]	output logic[2]	access time (ns)[4]	temperature range[3]	package	no. of pins	max. I_{CC} (mA)[4]
CAMs								
10155	8X2	OE	—	13	C	F,N	18	140
RAMs								
82S25	16X4	OC	B	50	M,C	F,N	16	105
3101A	16X4	OC	B	35	M,C	F,N	16	105
54/74S189	16X4	TS	B	35	M,C	F,N	16	110
82S16	256X1	TS	T	50	M,C	F,N	16	115
82S17	256X1	OC	T	50	M,C	F,N	16	115
82S09	64X9	OC	T	45	M,C	I,N	28	190
82S19	64X9	OC	B	35	M,C	I,N	28	190
82S210	256X9	TS	B	60	C	F,N	24	185
82S212	256X9	TS	B	45	C	F	24	185
8X350 **	256X8	TS	B	N/A	M,C	F	22	185
PROMs								
82S23	32X8	OC	—	50	M,C	F,N	16	77
82S123	32X8	TS	—	50	M,C	F,N	16	77
10139	32X8	OE	—	20	C	F,N	16	145
82S126	256X4	OC	—	50	M,C	F,N	16	120
82S129	256X4	TS	—	50	M,C	F,N	16	120
10149	256X4	OE	—	20	C	F	16	150
10049	256X4	OE	—	60	M,C	F,N	24	175
82S130	512X4	OC	—	50	M,C	F,N	16	140
82S131	512X4	TS	—	50	M,C	F,N	16	140
82S115	512X8	TS	—	60	M,C	F,N	24	175
82HS147*	512X8	TS	—	45	C	F,N	20	155
82S137	1024X4	TS	—	60	M,C	F,N	18	140
82HS137*	1024X4	TS	—	45	M,C	F,N	18	140
82LS181	1024X8	TS	—	175	M,C	F,N	24	80
82S180	1024X8	OC	—	70	M,C	F,N	24	175
82S181	1024X8	TS	—	70	M,C	F,N	24	175
82PS181*	1024X8	TS	—	70	M,C	F,N	24	185
82S183	1024X8	TS	—	60	M,C	F,N	24	175
82S2708	1024X8	TS	—	225	M	F	24	85
82S185	2048X4	TS	—	100	M,C	I,N	18	120
82HS185*	2048X4	TS	—	70	M,C	I,N	18	120
82S191	2048X8	TS	—	80	M,C	I,N	24	175
82HS191*	2048X8	TS	—	60	M,C	F,N	24	175

* To be announced
** Only available with 8X300 or 8X330

device	organi-zation	output circuit[1]	output logic[2]	access time (ns)[4]	temperature range[3]	package	no. of pins	max. I_{CC} (mA)[4]
FPLAs								
82S100	16X48X8	TS	—	50	M,C	F,N	28	170
82S101	16X48X8	OC	—	50	M,C	F,N	28	170
82S152*	18X32X10	OC	I/O	40	M,C	F,N	20	155
82S155*	18X32X10	TS	I/O	40	M,C	F,N	20	155
FPGAs								
82S150*	18X12	OC	I/O	20	M,C	F,N	20	155
82S151*	18X12	TS	I/O	20	M,C	F,N	20	155
82S102	16X9	OC	—	35	M,C	F,N	28	170
82S103	16X9	TS	—	35	M,C	F,N	28	170
FPLSs								
82S104	16X48X8	OC	R	90	M,C	F,N	28	180
82S105	16X48X8	TS	R	90	M,C	F,N	28	180
82S154*	16X32X12	OC	I/O,R	65	M,C	F,N	20	155
82S155*	16X32X12	TS	I/O,R	65	M,C	F,N	20	155
82S156*	16X32X12	OC	I/O,R	65	M,C	F,N	20	155
82S157*	16X32X12	TS	I/O,R	65	M,C	F,N	20	155
82S158*	16X32X12	OC	I/O,R	65	M,C	F,N	20	155
82S159*	16X32X12	TS	I/O,R	65	M,C	F,N	20	155

* To be announced

Notes
1. Output circuit:
   OE = Open emitter
   OC = Open collector
   TS = 3-state
2. Output logic:
   T = Transparent — input data appears on output during Write
   B = Blanked — output is blanked during Write
3. Temperature range:
   C = Commercial (0 °C to +75 °C)
   M = Military (−55 °C to +125 °C)
   All ECL 10,000 series (−30 °C to +85 °C)
4. Commercial (0 °C to +75 °C)

analogue
survey of Philips' types

type no.	number of pins	plastic DIL	plastic SIL	ceramic DIL	plastic SO	metal can	description
CA3046	14	X					transistor array; 3 individual NPN's, 2 common emitter NPN's
SAA1027	16	X		(X)			stepper motor control/drive circuit; 4 phases, 500 mA per phase
SAA1029	16	X					triple AND-gate with very high noise immunity for industrial appl.
SAA1049	14	X					revolution counter interfacing with breaker contacts of motorcar
TAA960	10					X	triple amplifier especially for active filters
TAA970	10					X	microphone amplifier, especially for PXE transducers
TBA673	10					X	modulator/demodulator circuit
TBA915	9		X			X	audio amplifier; high efficiency, low current
TCA210	14	X			X		audio pre-amplifier and power-amplifier; 500 mW
TCA220	16	X		X			high gain triple op. amp; differential inputs, emitter follower outputs
TCA240	16	X			X		dual modulator/demodulator; two identical long-tail-pair circuits
TCA280A	16	X					general purpose power control IC for triggering triacs or thyristors
TCA520	8	X			X		op. amp for low voltage, low current applications
TCA580	16	X					gyrator; replacement for wound inductors
TCA770	14	X			X		limiter amplifier, FM-detector, audio pre-amplifier; 100-500 kHz
TCA980	4		(X)			X	microphone amplifier for low impedance transducers
TDA1023	16	X					trigger IC for triacs and thyristors for proportional power control
TDA1024	8	X					zero-cross power detection and trigger circuit for triacs and thyristors
TDA1060	16	X		X			general purpose, high performance switched mode power supply IC
TDA1078	14	X				X	high performance op. amp; slew rate 800 V/µs, GB product 2 GHz
TDA1092	8	X			X		window discriminator for watching car battery-voltage
TDA3081	16	X					transistor array; seven common collector NPN-transistors
TDA3082	16	X					transistor array; seven common emitter NPN-transistors
TDA3083	16	X			X		transistor array; five individual NPN-transistors
TDB1080	16	X			X		limiter amplifier, FM-detector, class B audio amplifier
TEA1003	8	X					level discriminator; AC trigger level 40 mV (r.m.s.)
TEA1005	16	X					six fold latch/driver; output 150 mA, 5-30 V

Visual quality control using a scanning electron microscope.

analogue
survey of Signetics' types

Consumer/communication circuits

NE/SE540	power driver
NE542	dual preamp
NE544/644	servo amplifier
NE570/571	analogue compandor
SA571	analogue compandor
μA758	stereo decoder
TBA120S	TV sound IF
TCA440	AM receiver
CA3089	FM IF system
LM381, 381A	dual preamp
LM387	dual preamp
MC1496/1596	balanced modulator/demodulator
NE5044/45	7 channel encoder/decoder set
NE5046	2 channel decoder
NE545/645/646	Dolby noise processor

Peripheral interface

NE590	addressable peripheral drivers
NE591	addressable peripheral drivers
NE/SE592	video amp
*μA733/733C	video amp
MC1488	quad line driver
MC1489/1489A	quad line receiver
*DS8820/8820A	dual differential line receiver
*DS8830	dual differential line receiver

Comparators

*NE521/522	high speed dual differential comparator
*NE/SE527	high speed voltage comparator
*NE/SE529	high speed voltage comparator
*LM111/211/311	voltage comparator
*LM119/219/319	dual voltage comparator
*LM139/239/339	quad voltage comparator
LM193/293/393	dual voltage comparator

MOSFET-analogue/digital switches (D-MOS)

SD5000/5001/5002	quad switch array IC

Op amps

NE/SE530	high slew rate op amp
NE/SE531	high slew rate op amp
*NE/SE532	dual op amp
NE/SE535	single high slew rate op amp
NE/SU536	FET input op amp
NE/SE538	high slew rate op amp
NE5512	dual op amp
NE5514	quad op amp
NE5517	dual transconductance amp
NE5517A	dual transconductance amp
NE/SE5530	dual high slew rate
NE/SE5532	dual low noise high slew rate
NE/SE5532A	dual low noise high slew rate
NE/SE5533	dual low noise high slew rate
NE/SE5533A	dual low noise high slew rate
NE/SE5534	low noise high slew rate
NE/SE5534A	low noise high slew rate
NE/SE5535	dual high slew rate op amp
NE/SE5538	dual high slew rate op amp
NE5539	very high slew rate op amp
*MC1456	high performance op amp
*MC1458/1558	dual op amp
*μA741/741CC	general purpose op amp
*μA747/747C	dual op amp
*μA748/748C	general purpose op amp
LF355	BIFET input op amp
LF356	BIFET input op amp
LM301A	high performance op amp
*LM124/224/324	quad op amp
*LM158/258/358	dual op amp
LM13600/13600A	dual transconductance amp

Monolithic sample and hold circuits

NE/SE5537	low leakage sample and hold
LF198/398	sample and hold

* Available with military processing (see military section)

D/A/D converters

MC1408-6	8-bit D/A converter, 2 LSB accuracy
MC1408-7	8-bit D/A converter, 1 LSB accuracy
MC1408-8	8-bit D/A converter, $\frac{1}{2}$ LSB accuracy
*MC1508-8	8-bit D/A converter, $\frac{1}{2}$ LSB accuracy
NE5007	8-bit D/A converter, 1 LSB accuracy
*NE/SE5008	8-bit D/A converter, $\frac{1}{2}$ LSB accuracy
*N/SE5009	8-bit D/A converter, $\frac{1}{4}$ LSB accuracy
*N/SE5018	8-bit D/A converter subsystem, $\frac{1}{2}$ LSB accuracy, V_{out}
*NE/SE5019	8-bit D/A converter subsystem, $\frac{1}{4}$ LSB accuracy, V_{out}
NE/SE5118	8-bit D/A converter subsystem, $\frac{1}{2}$ LSB accuracy, I_{out}
NE/SE5119	8-bit D/A converter subsystem, $\frac{1}{4}$ LSB accuracy, I_{out}
NE/SE5020	10-bit D/A converter subsystem, 1 LSB accuracy, I_{out}

Timers

NE/SE558	quad timer
*NE/SE555	timer
*NE/SE556	dual timer
NE/SE556-1	dual timer

Phase locked loops

*NE/SE564	phase locked loop
NE/SE565	phase locked loop
NE/SE566	function generator
*NE/SE567	tone decoder PLL

Transistor arrays

ULN2001/3/4	Darlington transistor array
CA3183	high voltage transistor array
CA3081	transistor array
CA3082	transistor array

Display drivers

DS8880	display decoder driver
DS8880-1	display decoder driver — 100 V outputs
NE582	LED digit driver
NE587/9	7 segment LED display driver
NE/SA594	vacuum fluorescent display driver

Video amplifiers

NE/SE592	video amp
*μA733/733C	video amp

Power control circuits

*μA723/723A	precision voltage regulator
SE/NE5553/4	dual tracking regulators
SE/NE5560	SMPS control circuit
SG1524, 2524, 3524	SMPS control circuit

SO-range

HSO311D	SO-8 single gen. purpose comparator
HSO324D	SO-14 quad op amp
HSO339D	SO-14 quad voltage comparator
HSO13600D/AD	SO-8 dual transconductance amp
HSO1458D	SO-8 dual op amp
HSO532D/358D	SO-8 dual op amp
HSO555D	SO-8 timer
HSO592D	SO-14 video amp
HSO556D	SO-14 dual timer
HSO5534D	SO-8 low noise op amp
HSO5044D	SO-16 seven channel R.C. encoder
HSO5045D	SO-16 seven channel R.C. decoder
HSO5512D	SO-8 dual high performance op amp
HSO5517D/AD	SO-16 dual transconductance amp
HSO723CD	SO-14 precision voltage regulator
HSO741CD	SO-8 general purpose op amp
HSO747CD	SO-14 dual general purpose op amp

* Available with military processing (see military section)

Fairchild cross reference

Fairchild

prefix	device type	package type	temperature range	
µA	XXX	D = C-dip P = plastic dip T = mini dip H = metal can U = TO-220 W = TO-92 K = TO-3	C = commercial/industrial consumer o °C to 70 °C or 75 °C – 40 °C to + 85 °C	M = military – 55 °C to 125 °C

Signetics

prefix	device type	package type	temperature range	
original manufacturer's prefix	XXX	F,I = C-dip N = plastic dip H = metal can U = TO-220 K = TO-3 H = TO-39 S = TO-92	C = commercial/industrial consumer 0 °C to 70 °C or 75 °C – 40 °C to + 85 °C	M = military – 55 °C to 125 °C

Fairchild	Signetics
µA301ATC	LM301AN
µA311TC	LM311N
µAF355H	LF355H
µAF356H	LF356H
µA555C	NE555NH
µA556PC	NE556N
µA556DC	NE556F
µA723DC	µA723CF
µA723DM	µA723F

Fairchild	Signetics
µA723PC	µA723CN
µA723PM	µA723N
µA733DC	µA733CF
µA733DM	µA733F
µA733PC	µA733CN
µA740HC	µA740CH
µA741TC	µA741CN
µA747DC	µA747CF

Fairchild	Signetics
µA747DM	µA747F
µA747PC	µA747CN
µA747PM	µA747N
µA748TC	µA748CN-8
µA758PC	µA758N
µA1458HC	MC1458H
µA1458H	MC1458H
µA1458TC	MC1458N

Motorola cross reference

Motorola

prefix	device type	package type
MC	XXXX (different numbers) are used for variations in operating temperature)	G = metal can L = C-dip P = plastic K = TO-3

Signetics

prefix	device type	package type
original manufacturer's prefix	XXXX	F,I = C-dip N = plastic dip H = metal can U = TO-220 K = TO-3 H = TO-39 S = TO-92

Motorola	Signetics
MLM2902P	SA534N
MLM301AP1	LM301AN
MLM324L	LM324F
MLM324P	LM324N
MC1455G	NE555H
MC1455P1	NE555N
MC3456P	NE556N
MC3456L	NE556F
MC1408L-8	MC1408-8F
MC1408L-7	MC1408-7F

Motorola	Signetics
MC1408L-6	MC1408-6F
MC1458L	MC1458F
MC1458P1	MC1458N-8
MC1458P2	MC1458N-14
MC1489AL	MC1489AF
MC1489L	MC1489F
MC1496L	MC1496F
MC1558L	MC1558F
MC1596L	MC1596F
MC1723CL	μA723CF

Motorola	Signetics
MC1723L	μA723F
MC1733CL	μA733CF
MC1733L	μA733F
MC1741CP1	μA741CN-8
MC1747CL	μA747CF
MC1747L	μA747F
MLM565CP	μA565N
MC1723CL	μA723CF
MC1723L	μA723F

National cross reference

National

prefix	device type	package type
LM,LH = linear	first digit 1 or 7 = −55 °C 2 = −25 °C to +85 °C 3 or 8 = 0 °C to 70 °C or 75 °C	D = C-dip N = plastic dip H = metal can N = mini-dip K = TO-3 P = TO-202 T = TO-220 Z = TO-92

Signetics

prefix	device type	package type
original manufacturer's prefix	XXXX	F,I = C-dip N = plastic dip H = metal can U = TO-220 K = TO-3 H = TO-39 S = TO-92

National	Signetics
LF198	SE5537
LF198	LF198
LF355N	LF355N
LF356N	LF356N
LM111D	LM111F
LM124D	LM124F
LM124N	LM124N
LM124AD	LM124AF
LM124AN	LM124AN
LM158N	SE532N
LM211D	LM211F
LM224D	LM224F
LM224N	LM224N
LM224AD	LM224AF
LM224AN	LM224AN
LM239N	LM239N
LM239D	LM239F
LM258N	LM258N
LM301AN	LM301AN
LM311D	LM311F
LM311N	LM311N

National	Signetics
LM311N-14	LM311N-14
LM324D	LM324F
LM324N	LM324N
LM324AD	LM324AF
LM324AN	LM324AN
LM339D	LM339F
LM339N	LM339N
LM339AN	LM339AN
LM358N	NE532N
LM555N	SE555N
LM555CN	NE555N
LM556D	SE556F
LM556N	SE556N
LM556CD	NE556F
LM556CN	NE556N
LM565CH	NE565H
LM565CN	NE565N
LM566CH	NE566H
LM566CN	NE566N
LM567CN	NE567N
LM723N	µA723N

National	Signetics
LM723CN	µA723CN
LM733D	µA733F
LM733CD	µA733CF
LM741CN	µA741CN
LM747D	µA747F
LM747CN	µA747CN
LM748CN	µA748CN
LM1458N	MC1458N
LM1488J	MC1488F
LM1489J	MC1489F
LM1489AJ	MC1489AF
LM1496H	MC1496H
LM1558H	MC1558H
LM1596H	MC1596H
LM2902N	SA534N
LM2903N	LM2903N
LM2904N	SA532N
DM8820J	DS8820F
DM8830J	DS8830F
DM8880J	DS8880F

Raytheon cross reference

Raytheon

prefix	device type	package type	temperature range
R	XXX	D = C-dip T,H = metal can DP,N = plastic	M = −55 °C to 125 °C C = 0 °C to 70 °C

Signetics

prefix	device type	package type
original manufacturer's prefix	XXX	F,I = C-dip N = plastic dip H = metal can U = TO-220 K = TO-3 H = TO-39 S = TO-92

Raytheon	Signetics
LM111D	LM111F
LM211D	LM211F
LM301AN	LM301AN
LM311D	LM311F
LM311N	LM311N
RC555DN	NE555N
RM555DN	SE555N
RC592D	NE592F

Raytheon	Signetics
RM592D	SE592F
RC592DP	NE592N
RM592DP	SE592N
RM723DP	µA723N
RC733D	µA733CF
RM733D	µA733F
RC733DP	µA733CN
RC741DN	µA741CN

Raytheon	Signetics
RM741DN	µA741N
RC747DP	µA747CN
RM747DP	µA747N
RC748DN	µA748CN
RC1458DN	MC1458N
RC1556DN	MC1456N
RC4531DN	NE531N

analogue
Texas Instruments cross reference

Texas Instruments

prefix	device type	package type
SN,TL or original manufacturer's prefix	XXXXX first digit 5 = −55 °C to 125 °C 7 = 0 °C to 70 °C XXXX	P = plastic mini-dip N = 14, 16 pin dip J = 14, 16 pin C-dip L = metal can K = TO-3 KC = TO-220 S = TO-92

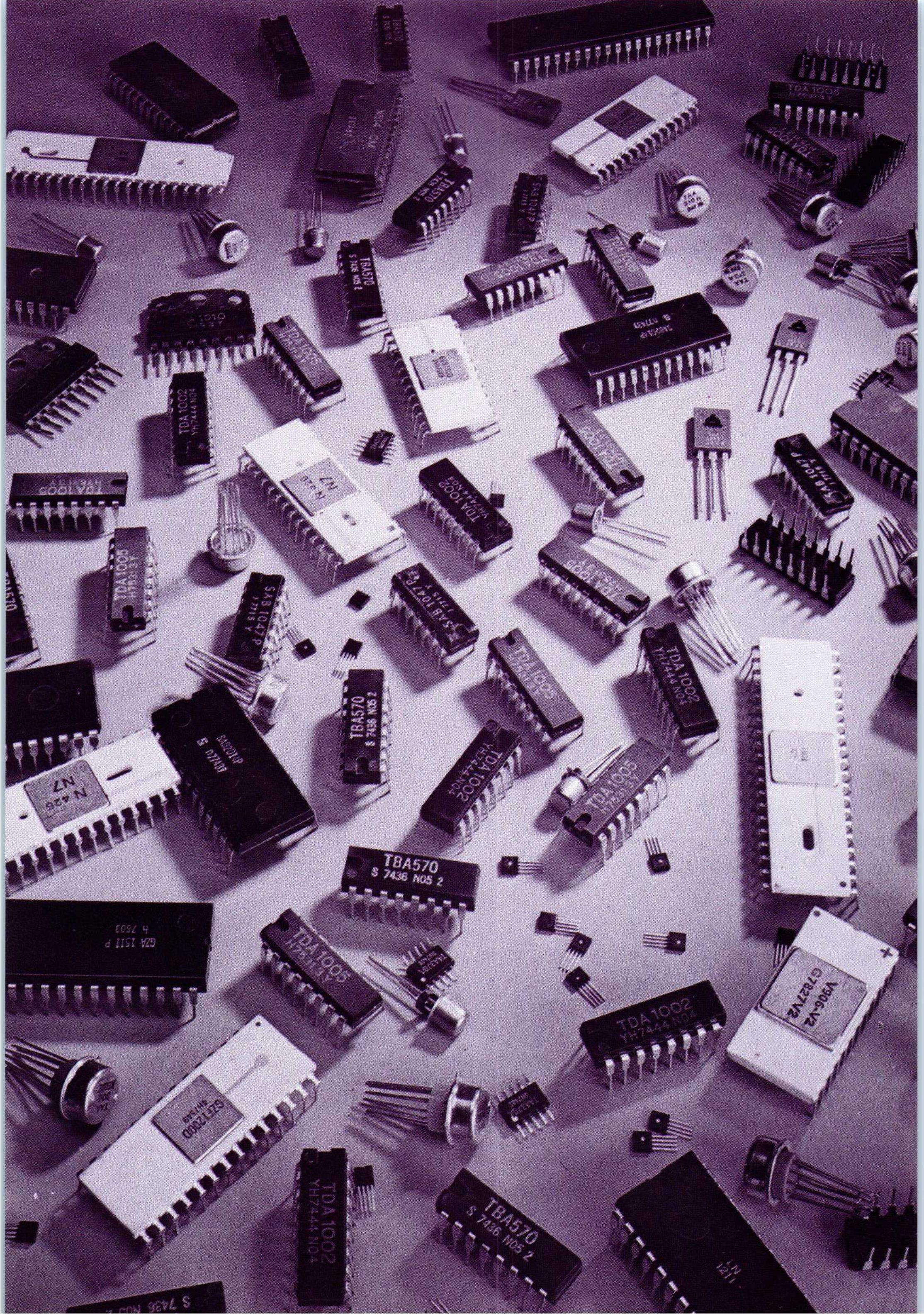
Signetics

prefix	device type	package type
original manufacturer's prefix	XXXX	F,I = C-dip N = plastic dip H = metal can U = TO-220 K = TO-3 H = TO-39 S = TO-92

Texas Instruments	Signetics
LM3302P	M3302N
SN52111J	LM111F
SN52555L	SE555H
SN52723N	µA723N
SN52733J	µA733F
SN52733N	µA733N
SN72301AP	LM301AN
SN72311J	LM311F

Texas Instruments	Signetics
SN72311N	LM311N
SN72311P	LM311N
SN72555P	NE555N
SN72723N	µA723CN
SN72733J	µA733CF
SN72733N	µA733CN
SN72741P	µA741CN
SN72747N	µA747CN

Texas Instruments	Signetics
SN72748P	µA748CN
SN75182J	DS8820F
SN75182N	DS8820N
SN75183J	DS8830F
SN75183N	DS8830N
SN75188J	MC1488F
SN75189J	MC1489F
SN75189AJ	MC1489AF


TBA570
S 7436 N05 2
TDA1002
YH7444 N04
TDA1005
SAB1047P
N7
N426
V906-V2
G7827V2
GZA 1511 P
TDA1002
YH7444 N04
TBA570
S 7436 N05 2

operational amplifiers

selection guide

- All types have input and output protection.
- A_{VOL} = large signal voltage gain.
- CMRR = Common mode rejection ratio.
- PSRR = power supply rejection ratio.
- P = power dissipation.

device no.	com-plexity	temp. range	max input voltage offset	max input voltage drift	max input current offset	max input current bias	min A_{VOL}	typ BW $A_V = 1$	typ slew rate	diff. input voltage
			mV	µV/°C	nA	nA	V/mV	MHz	V/µs	V
NE530	Sing.	Ind.	6,0	6●	80	200	25	3,0	35	± 30
SE530	Sing.	Ind.	3,0	15	20	100	25	3,0	35	± 30
NE536	Sing.	Ind.	30●	30●	5pA■	0,1▲	25	1,0	6,0	± 30
SU536	Sing.	Ext.	30	20●	5pA■	3,0	50	1,0	6,0	± 30
SE538	Sing.	Mil.	3,0	15	20	100	25	6,0	60	± 30
NE538	Sing.	Ind.	6,0	6●	80	200	25	6,0	60	± 30
NE5534A	Sing.	Ext.	4,0▲		300▲	1500▲	30▲	10,0	13	± 5
SE5534A	Sing.	Mil.	3,0		500	1500	25	10,0	13	± 5
NE5539	Sing.	Ind.	5		2 µA	20	50	1200	600	
µA741	Sing.	Mil.	6,0		500	1500	25	1,0	0,5	± 30
µA741C	Sing.	Ind.	7,5		300	800	15	1,0	0,5	± 30
µA748	Sing.	Mil.	6,0		500	1500	25	1,0	0,5	± 30
µA748C	Sing.	Ind.	7,5		300	800	25	1,0	0,5	± 30
LM158	Dual	Mil.	7,0	7●	100	300	25	1,0		32
LM258	Dual	Ext.	9,0	7●	150	500	15	1,0		32
LM358	Dual	Ind.	9,0	7●	150	500	15	1,0		32
MC1458	Dual	Ind.	7,5		300	800	15	1,0	0,8	± 30
MC1558	Dual	Mil.	6,0		500	1500	25	1,0	0,5	± 30
NE532	Dual	Ind.	7,5	7●	150	500	15	1,0		32
SA532	Dual	Ext.	7,5	7,5●	150	500	15	1,0		32
SE532	Dual	Mil.	7,0	7●	100	300	25	1,0		32

NOTES

1 Military −55 °C - +125 °C
Extended −25 °C - +85 °C
Industrial 0 °C - +70 °C

2 Specifications guaranteed over full temperature range unless otherwise indicated by following marks:
● Typical over full temperature range ▲ Guaranteed at 25 °C ■ Typical at 25 °C

typical common mode rej. ratio	typical common mode volt. range	typ PSRR	supply voltage (op.) min	supply voltage (op.) max	output current	max supply current	min output volt.swing	internal compen-sation	input noise volt.	packages
dB	V	dB	V	V	mA	mA	V		nV/$\sqrt{Hz}$	
90	± 13	70	± 15	± 18	25▲	3,0	± 12	yes		H,N,FE
90	± 13	70	± 15	± 18	25▲	3,0	± 12	yes		H,N,FE
80	± 11	80	± 6	± 20	5,0	8,0▲	± 12	yes		H
80	± 11	86	± 6	± 18	5,0	5,5▲	± 12	yes		H
90	± 13	70	± 15	± 22	25▲	3,6	± 12	yes		H,N,FE
90	± 13	70	± 15	± 18	25▲	2,2●	± 12	yes		H,N,FE
100	± 13	100	± 3	± 22	38■	6,5▲	± 12	yes	4,5	H,N,FE
100	± 13	100	± 3	± 22	38■	9,0	± 12	yes	4,5	H,N,FE
85	± 1,7	37	± 5	± 10		18	± 2,3	no		N
90	± 13	100	± 3	± 22	5,0	2,5	± 12	yes		N,FE
90	± 13	100	± 3	± 18	5,0	2,8▲	± 12	yes		N,FE
90	± 13	90	± 3	± 22	5,0	2,8	± 12	no		N,F
90	± 13	90	± 3	± 18	5,0	2,8	± 12	no		N,F
70	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		H
65	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		H,N,FE
65	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		H,N,FE
90	± 13	90	± 3	± 18	5,0	5,6▲	± 12	yes		H,N,FE
90	± 13	90	± 3	± 22	5,0	5,0▲	± 12	yes		H,N,FE
70	$V_S - 1,5$	100	3	30	40	1,2	$V_S - 2$	yes		H,N,FE
70	$V_S - 1,5$	100	3	30	40	1,2	$V_S - 2$	yes		N
70	$V_S - 1,5$	100	3	30	40	1,2	$V_S - 2$	yes		H,FE

operational amplifiers
selection guide

- All types have input and output protection.
- A_{VOL} = large signal voltage gain.
- CMRR = Common mode rejection ratio.
- PSRR = power supply rejection ratio.
- P = power dissipation.

device no.	com-plexity	temp. range	max input voltage offset	max input voltage drift	max input current offset	max input current bias	min A_{VOL}	typ BW $A_V = 1$	typ slew rate	diff. input voltage
			mV	µV/°C	nA	nA	V/mV	MHz	V/µs	V
NE5512	Dual	Ind.	3		20	20	50	1	1	
SE5512	Dual	Mil.	1,5		10	10	50	1	1	
NE5517	Dual	Ind.	5		0,6 µA	8 µA		2	50	± 5
NE5517A	Dual	Ind.	2		0,6 µA	7 µA		2	50	± 5
SE5530	Dual	Mil.	3,0	15	20	100	25	3,0	35	± 30
NE5530	Dual	Ind.	6,0	6●	80	200	25	3,0	35	± 30
NE5532A	Dual	Ind.	5,0		200	1000	10	10	9	± 5
NE5533A	Dual	Ind.	5,0		400	2000	15	10	13	± 5
SE5535	Dual	Mil.	3,0	15	20	100	25	1,0	15	± 30
NE5535	Dual	Ind.	6,0	6●	80	200	25	1,0	15	± 30
SE5538	Dual	Mil.	3,0	15	20	100	25	6,0	60	± 30
NE5538	Dual	Ind.	6,0	6●	80	200	25	6,0	60	± 30
µA747	Dual	Mil.	6,0		500	1500	25	1,0	0,5	± 30
µA747C	Dual	Ind.	7,5		300	800	15	1,0	0,5	± 30
LM124	Quad	Mil.	7,0	7●	100	300	25	1,0		32
LM224	Quad	Ext.	9,0	7●	150	500	15	1,0		32
LM324	Quad	Ind.	9,0	7●	150	500	15	1,0		32
SA534	Quad	Ext.	9,0	7●	150	500	15	1,0		32
NE5514	Quad	Ind.	5		20	20	50	1	1	
SE5514	Quad	Mil.	2		10	10	50	1	1	

NOTES
1 Military − 55 °C - + 125 °C
Extended − 25 °C - + 85 °C
Industrial 0 °C - + 70 °C
2 Specifications guaranteed over full temperature range unless otherwise indicated by following marks:
● Typical over full temperature range ▲ Guaranteed at 25 °C ■ Typical at 25 °C

typical common mode rej. ratio dB	typical common mode volt. range V	typ PSRR dB	supply voltage (op.) min V	supply voltage (op.) max V	output current mA	max supply current mA	min output volt.swing V	internal compen-sation	input noise volt. nV/$\sqrt{Hz}$	packages
100	± 13,7	110		± 16		5	± 13		30	N,FE
100	± 13,7	110		± 16		5	± 13		30	N,FE
110	± 13,5			± 18		typ 2,6	± 12			N
110	± 13,5			± 22		typ 2,6	± 12			N
90■		70	± 3	± 22		3,6	± 13	yes		H,N
90■		70	± 3	± 18		2,2	± 13	yes		H,N
100		80	± 5	± 22		16	± 15	yes	6	H,FE,N
100		80	± 5	± 22		8	± 15	yes	4,5	N,F
90	± 13	70	± 3	± 22	5,0	3,3	± 12	yes		H,N
90	± 13	70	± 3	± 18	5,0	2,0●	± 12	yes		H,N
90	± 13	70	± 15	± 22	25▲	3,6	± 12	yes		H,N
90	± 13	70	± 15	± 18	25▲	2,2●	± 12	yes		H,N
90	± 13	90	± 3	± 22	5,0	3,3	± 12	yes		F,H,N
90	± 13	90	± 3	± 18	5,0	3,3	± 12	yes		F,H,N
85	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		F
85	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		F,N
85	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		F,N
85	$V_S - 1,5$	100	3	30	40	2,0	$V_S - 2$	yes		N,F
100	13,7	110		± 16		10	± 13		30	F,N
100	13,7	110		± 16		10	± 13		30	F,N

comparators/voltage regulators
selection guides

Comparators

type no.	complexity	temp. range	max input offset volt. mV	max input current bias μA	max input current offset μA	supply voltage V	response time (typ) ns
LM111[1]	single	military	4,00	0,15	0,02	± 15	200
LM211	single	extended	4,00	0,15	0,02	to	200
LM311	single	industrial	10,0	0,30	0,07	+ 5 and GND	200
NE527[2]	single	industrial	10,0	4,00	1,00	± 5 to ± 15	16
SE527	single	military	6,00	4,00	1,00	and GND	16
NE529[2]	single	industrial	10,0	50,0	15,0	± 5 to ± 15	12
SE529	single	military	6,00	36,0	9,00	and GND	12
LM119[3]	dual	military	7,00	1,00	0,10	± 15	80
LM219	dual	extended	7,00	1,00	0,10	to	80
LM319	dual	industrial	10,0	1,20	0,30	± 5 and GND	80
LM193[3]	dual	military	9,00	0,30	0,10	± 1 to ± 18	1300
LM293	dual	extended	9,00	0,40	0,15	or	1300
LM393	dual	industrial	9,00	0,40	0,15	+2 to +36 GND	1300
NE521[4]	dual	industrial	10,0	40,0	12,0	+5, −5, GND	7
NE522	dual	industrial	10,0	40,0	12,0	+5, −5, GND	9
LM139[3]	quad	military	9,00	0,30	0,10		1300
LM239	quad	extended	9,00	0,40	0,15	± 1 to ± 18 or	1300
LM339	quad	industrial	9,00	0,40	0,15	+2 to +36	1300
LM139A[3]	quad	military	4,00	0,30	0,10	+2 to +36	1300
LM239A	quad	extended	4,00	0,40	0,15	and GND	1300
LM339A	quad	industrial	4,00	0,40	0,15		1300

NOTES
1. With strobe; will work from single supply
2. Complementary output gates with individual strobes
3. Will operate from single or dual supplies
4. Ultra high speed

Voltage regulators

type no.	polarity and function	input volt. range V	output volt. range V	max output current mA	peak output current mA	typ line regulation %	typ load regulation %
μA723[2]	precision adjustable	9,5–40	2,0–37	125	150	0,1	0,6
NE5554	dual polarity regulator	± 18- ± 32	± 15	200	400	100mV	50mV
NE5553	dual polarity regulator	± 18- ± 32	± 12	200	400	100mV	50mV

common mode voltage range V	output voltage V_{OL}max V	V_{OH}min V	output structure	voltage gain (typ) V/mV	TTL fan out	max diff. input voltage V	packages
± 14	0,4		O.C.	200	5	± 30	F,T
± 14	0,4		O.C.	200	5	± 30	F,N,T
± 14	0,4		O.C.	200	5	± 30	F,N,T
± 6	0,5	2,7	TTL		5	± 5	F,K,N
± 6	0,5	2,5	TTL		5	± 5	F,K
± 6	0,5	2,7	TTL		5	± 5	F,K,N
± 6	0,5	2,5	TTL		5	± 5	F,K
± 13	0,6		O.C.	40	2	± 5	K,F
± 13	0,6		O.C.	40	2	± 5	K,F
± 13	0,6		O.C.	40	2	± 5	F,K,N
0 to V_S-2	0,7		O.C.	200	2	36	T
0 to V_S-2	0,7		O.C.	200	2	36	N,T
0 to V_S-2	0,7		O.C.	200	2	36	N,T
± 3	0,5	2,7	TTL		12	± 6	F,N
± 3	0,5		O.C.		12	± 6	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N
0 to V_S-2	0,7		O.C.	200	2	36	F,N

typ quiesc. current mA	min ripple rejection dB	min dropout voltage V	av temp. coefficient mV/K	packages with corresponding max θ	θj-c K/W	θj-a K/W		θj-c K/W	θj-a K/W
2,3	74	3,0	0,015	TO-100	25	150	TO-16	65	150
5,7	50	3,0	1	TO-39	25	150	N	33	95
5,7	50	3,0	1	TO-39	25	150	N	33	95

D/A converters
selection guide

type no.	number of bits	acc. %	output			int. ref.	int. latch	package	temp. range		reliability	
			V	I	T				coml.	mil	sure II	supr II
MC1408-6	8	.78		X				N,F	X		X	
MC1408-7	8	.39		X				N,F	X		X	X
MC1408-8	8	.19		X				N,F	X		X	X
MC1508-8	8	.19		X				F		X	X	X
NE5007	8	.39		X	X			N,F	X		X	X
NE5008	8	.19		X	X			N,F	X		X	X
NE5009	8	.1		X	X			N,F	X		X	X
SE5008	8	.19		X	X			F		X	X	X
SE5009	8	.1		X	X			F		X	X	X
NE5018	8	.19	X			X	X	N,F	X		X	X
NE5019	8	.1	X			X	X	N,F	X		X	X
SE5018	8	.19	X			X	X	F		X	X	X
SE5019	8	.1	X			X	X	F		X	X	X
NE5118	8	.19		X		X	X	N,F	X		X	
NE5119	8	.1		X		X	X	N,F	X		X	
SE5118	8	.19		X		X	X	F		X	X	
SE5119	8	.1		X		X	X	F		X	X	
NE5020	10	.1	X			X	X	N,F	X		X	

cross reference

AMD	Signetics
AmDAC08	SE5008, DAC08
AmDAC08A	SE5009, DAC08A
AmDAC08C	NE5007, DAC08C
AmDAC08E	NE5008, DAC08E
Am1408L6	MC1408-6
Am1408L7	MC1408-7
Am1408L8	MC1408-8
Am1508L8	MC1508-8
SSS1408A-6	MC1408-6
SSS1408A-7	MC1408-7
SSS1408A-8	MC1408-8
SSS1508A-8	MC1508-8

Analog Devices	Signetics
AD559KD	NE5008, DAC08E
AD559SD	SE5008, DAC08
AD1408-7D	MC1408-7
AD1408-8D	MC1408-8
AD1508-8D	MC1508-8

Fairchild	Signetics
μA0801	SE5008, DAC08
μA0801A	SE5009, DAC08A
μA0801C	NE5007, DAC08C
μA0801E	NE5008, DAC08E
μA0801H	NE5009, DAC08H
μA0802ADC	MC1408-8
μA0802BDC	MC1408-7
μA0802CDC	MC1408-6
μA0802DM	MC1508-8

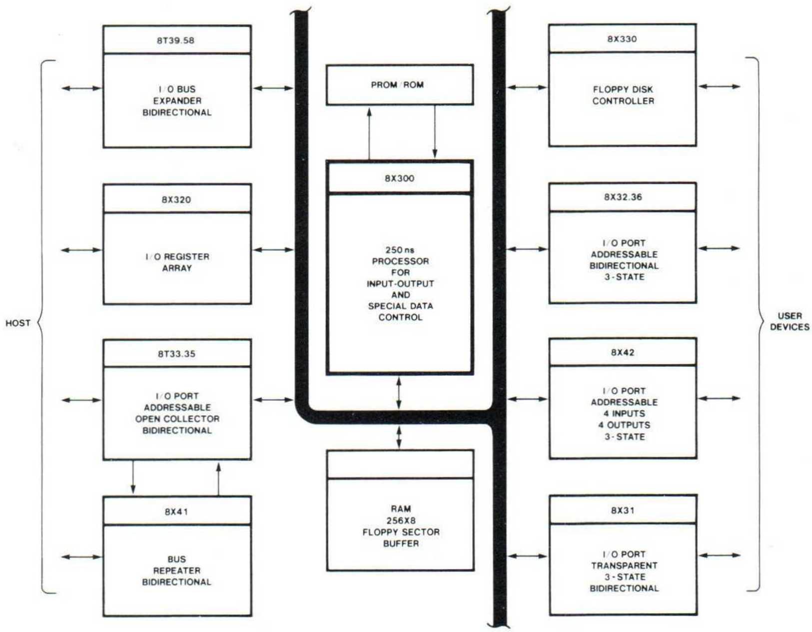
Motorola	Signetics
MC1408L-6	MC1408-6
MC1408L-7	MC1408-7
MC1408L-8	MC1408-8
MC1508L-8	MC1508-8

National Semiconductor	Signetics
DAC0800L	SE5008, DAC08
DAC0800LC	NE5008, DAC08E
DAC0801LC	NE5007, DAC08C
DAC0802L	SE5009,DAC08A
DAC0802LC	NE5009, DAC08H
DAC0806LC	MC1408-6
DAC0807LC	MC1408-7
DAC0808L	MC1508-8
DAC0808LC	MC1408-8
LMDAC08	SE5008, DAC08
LMDAC08A	SE5009, DAC08A
LMDAC08C	NE5007, DAC08C
LMDAC08E	NE5008, DAC08E
LMDAC08H	NE5009, DAC08H
LM1408-6	MC1408-6
LM1408-7	MC1408-7
LM1408-8	MC1408-8
LM1508-8	MC1508-8

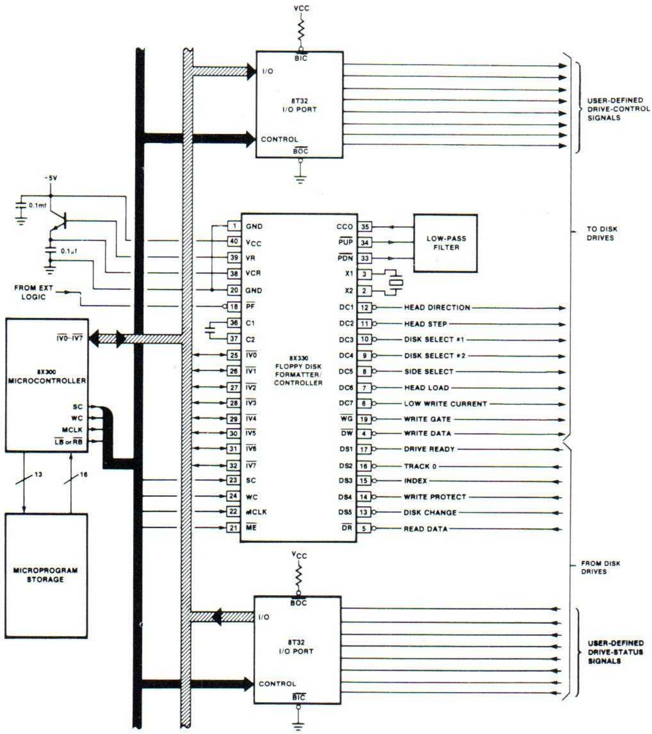
Precision Monolithics	Signetics
DAC08	SE5008, DAC08
DAC08A	SE5009, DAC08A
DAC08C	NE5007, DAC08C
DAC08E	NE5008, DAC08E
DAC08H	NE5009, DAC08h
SSS1408A-6	MC1408-6
SSS1408A-7	MC1408-7
SSS1408A-8	MC1408-8
SSS1508A-8	MC1508-8

As shown below, the Bipolar LSI Microprocessor family is headed by the 8X300 Microcontroller and supported with an ever-expanding progeny of Input/Output devices and CPU-support chips. In a single package, the 8X300 brings Speed, Flexibility, and Economy to those systems designers that require reliable bit-stream management in the areas of industrial control, input/output control, and both data and telecommunications. The entire family of parts is TTL-compatible and requires one power supply.

Although the 8X300 and its supporting hardware/software products provide cost-effective solutions in today's marketplace, the future is even brighter. Redesigns and next-generation products are already in process. The results being: increased thruput, higher performance, assured availability and, lower systems cost by reducing parts count. A typical 8X300-based subsystem is shown opposite.



8X300 microcontroller family



Typical Interface Using an 8X300 Microcontroller

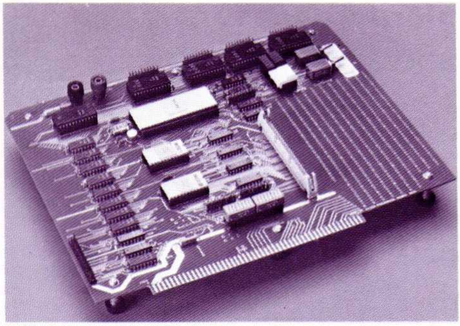
microprocessors
bipolar

Microprocessors	
†8X300	8-bit microcontroller
†N3002	2-bit central processing unit

Sequencers	
8X02A	10-bit control store sequencer
†N3001	microprogram control unit
82S104/105	field programmable logic sequencer

I/O interface circuits	
†8T31/8X31	8-bit bidirectional port
†8T32/8X32	adressable input/output port for 8X300 (field programmable)
†8T33	adressable input/output port for 8X300 (field programmable)
8T35	adressable input/output port for 8X300 (field programmable)
8T36/8X36	adressable input/output port for 8X300 (field programmable)
8T34	quad bus transceiver with 3-state outputs
†8T37	hex bus receiver with hysteresis-Schmitt trigger
8T38	quad bus transceiver (open collector)
*8T39	bus expander for 8X300
*8T58	bus expander for 8X300
†8T80	quad 2-input NAND interface gate hex inverter interface element
†8T90	quad 2-input NAND interface gate hex inverter interface element
8T93	high speed hex inverter (pnp inputs)
8T94	hex inverter high speed open collector (pnp inputs)
†8T95	high speed hex 3-state buffer
†8T96	high speed hex 3-state buffer
†8T97	high speed hex 3-state inverter
†8T98	high speed hex 3-state inverter
†8T126	quad transceiver, inverting, separate enables
†8T127	quad transceiver, inverting, separate enables
†8T128	quad transceiver, non-inverting, separate enables
†8T129	quad transceiver, non-inverting, separate enables
†8T26A	quad transceiver, inverting
†8T28	quad transceiver, non-inverting
74LS240	octal non-inverting drivers
74LS241	octal inverting drivers
74LS242	quad inverting transceivers
74LS243	quad non-inverting transceivers
74LS244	octal inverting drivers
8X41	asynchronous bidirectional bus extender
8X42	synchronous 4-input/4-output I/O port

Notes
† = available to military temp/processing specifications.
* = plan to meet military temp/processing specifications.



8X300 evaluation kit

Special purpose circuits

8X320	bus interface register array
8X330	floppy disc formatter controller
8X350	256X8 bipolar for 8X300
8X01A/9401	CRC generator/checker
9403	64-bit FIFO buffer memory
8X60	4k FIFO RAM controller

Memories (PROMS)

†**82S126** (open collector)	1024-bit bipolar PROM (256 × 4)
†**82S129** (three-state)	1024-bit bipolar PROM (256 × 4)
†**82S130** (open collector)	2048-bit bipolar PROM (512 × 4)
†**82S131** (three-state)	2048-bit bipolar PROM (512 × 4)
†**82S115** (three-state)	4096-bit bipolar PROM (512 × 8)
82HS147 (three-state)	4096-bit bipolar PROM (512 × 8)
†**82S137** (three-state)	4096-bit bipolar PROM (1024 × 4)
†**82S181** (three-state)	8192-bit bipolar PROM (1024 × 8)
†**82S185** (three-state)	8192-bit bipolar PROM (2048 × 4)
†**82S191** (three-state)	16 384-bit bipolar PROM (2048 × 8)

Memories (RAMS)

†**82S25** (open collector)	64-bit bipolar scratch pad memory (16 × 4)
3101A (open collector)	64-bit bipolar scratch pad memory (16 × 4)
†**54/74S189** (three-state)	64-bit bipolar scratch pad memory (16 × 4)
†**82S16** (three-state)	256-bit bipolar RAM (256 × 1)
†**82S17** (open collector)	256-bit bipolar RAM (256 × 1)
†**82S09** (open collector)	576-bit bipolar RAM (64 × 9)
82S19 (open collector)	576-bit bipolar RAM (64 × 9)
82S210 (three-state)	2304-bit bipolar RAM (256 × 9)

Support circuits (logic)

74LS364	octal D-type registers, high V_{OH}
74LS374	octal D-type registers, high V_{OH}
74LS377	octal D-type registers, with enable

Note
† = available to military temp/processing specifications.

Field programmable logic arrays

FPLAs

†82S100 (three-state)	bipolar field programmable logic array (16 × 48 × 8)
†82S101 (open collector)	bipolar field programmable logic array (16 × 48 × 8)

FPGAs

82S102 (open collector)	bipolar field programmable gate array (16 × 9)
82S103 (three-state)	bipolar field programmable gate array (16 × 9)

Development hardware and kits

DMS	development system for 8X300
DMS 2KMC	8X300 user system
8X300KT100SK	8X300 evaluation kit
8T32 programmer	available from Data I/O
8T32 PRO programmer	available from Philips

Development software

MCCAP/1	8X300 cross assembler (MCCAP) in 800 bpi EBCDIC or ASCII format
56711	microassembler in 800 bpi EBCDIC format

Both programs are also available on GE Mark III timesharing service.

semi-custom logic

Today, the systems designer is looking for a technology that can bring together complex support functions, minimum parts count, simple design techniques, extended reliability, and reduced cost. Such a technology is *here* in the form of Semi-Custom ISL Gate Arrays from Signetics.

Semi-Custom LSI Design (T^2L Compatible) Gate Arrays

The 8A1200 ISL Gate Array is an uncommitted logic array (or masterslice) of 1200 NAND-gate equivalents featuring up to 10 inputs and 4 outputs per gate. Each 4-nanosecond gate uses only 168 microwatts of power and the speed/power product of each gate is 0.08 picojoules. In addition to 1144 discrete gates, 52 Schottky buffers are provided to increase the drive output for a given logic design; for external input and output, 36 I/O buffers are provided on the perimeter of the array. These buffers can be configured to perform a variety of input-voltage/output-drive functions. The 8A1200 is fabricated using a standard low-power Schottky process and is a cost-effective replacement for LS/ST^2L logic. The ISL technology also meets the demanding requirements of Military applications.

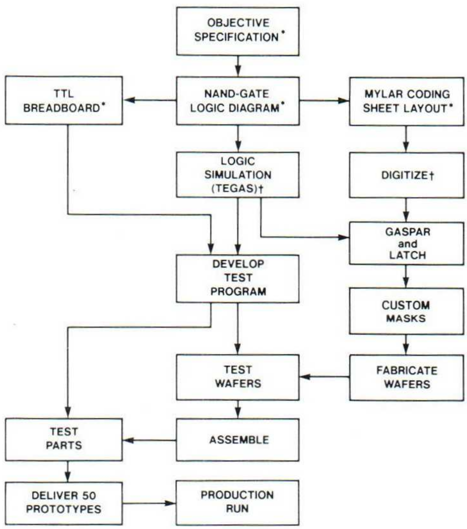
Each gate is accessible by paths reserved for custom metal interconnection. These interconnections are made according to customer specification. All logic gates in the array are preprocessed. The design engineer simply interconnects the gates by specifying the custom routing of metal layers along the regular access paths. To allow for easier interconnections and higher packing densities, the 8A1200 uses two layers of metal.

Composite Cell Logic (CCL)

Composite Cell Logic is a Semi-Custom IC approach consisting of three predesigned logic-function libraries; each can be used as symbolic building blocks and interconnected to implement a desired logic function. In so doing, the user can create a Semi-Custom chip with functional and physical characteristics that precisely agree with system needs. The CCL approach is an efficient and cost-effective solution for replacement or upgrading of LS/ST^2L logic configurations.

While CCL is technically capable of replacing up to 1000 gates, it is most cost-effective at the 100 to 600 gate level; at this point, the 8A1200 takes over. Using CCL, the designer must only be able to perform symbolic logic design with conventional gates and flip-flops; many popular logic functions are designed into preprogrammed subnetworks that are complete, both schematically and topologically. The subnetworks can be interconnected to form more complex functions. The program steps required to implement a CCL-based design are identical to those shown for the 8A1200.

PROGRAM STEPS



* Provided by customer.

† Optionally provided by customer to Signetics specs.

microprocessors
MOS

8-bit single chip microcomputers. 8400 Family

8405	0,5k bytes ROM/32 bytes RAM
8410	1k bytes ROM/64 bytes RAM
8420	2k bytes ROM/64 bytes RAM
8440	4k bytes ROM/128 bytes RAM
8400	Piggy-back version of 84XX for development purposes

Microprocessors and microcomputers

2650A, A-1	8-bit microprocessor
8021	8-bit microcomputer, 1k bytes ROM/64 bytes RAM
8035L	8-bit microcomputer (ROM-less 8048), 64 bytes RAM
***8039**	8-bit microcomputer (ROM-less 8049), 128 bytes RAM
8048	8-bit microcomputer, 1k bytes ROM/64 bytes RAM
***8049**	8-bit microcomputer, 2k bytes ROM/128 bytes RAM

I/O peripheral interfaces

2636	programmable video interface
2637	universal video interface
2651	programmable communications interface
2652	multi-protocol communications controller
2653	polynominal generator-checker
2661	enhanced programmable communications interface
2681	dual asynchronous communications interface
8243	input/ouput expander

LSI support devices

2621	PAL TV sync generator
2622	NTSC TV sync generator

CRT chip set

***2670**	display character and graphics generator
***2671**	programmable keyboard and communications controller
***2672**	programmable video timing controller
***2673**	video attributes controller

Development software

56714	2650 cross assembler for 32-bit computer
56713	2650 cross assembler for 16-bit computer
56716	2650 cross simulator for 32-bit computer
56715	2650 cross simulator for 16-bit computer

* To be announced

Development systems

Super TWIN **TW09110050JA**	Fully configured disk-based prototyping system, with: dual processor, memory, dual-drive floppy disk unit, general-purpose I/O card. Includes: 16k slave and 16k master memory, CRT entry/editing system terminal, LP hard-copy output printer, and the TWICE hardware/software in-circuit emulation package. Complete systems software and documentation, including a system reference manual, an operator's guide, and re-locatable assembler manual.
Basic TWIN **TW0910050JA**	Functionally complete disk-based prototyping system, with: dual processor, memory, and dual drive floppy disk unit. Includes 16k slave and 16k master memory and the TWICE hardware/software in-circuit emulation package. Complete systems support software and documentation, including a systems reference manual, an operator's guide, and re-locatable assembler. TW09002001JJ system software diskette, containing: SDOS (Signetics Disk Operating System), with file management routines, debug software (in-circuit emulation support), PROM programming, system monitor, and I/O functions. Text editor to support interactive, line-oriented data entry, modification, and output of text files. Resident assembler — an easy-to-use symbolic assembler that generates 2650 object code on disk for immediate execution.
Part no.	
TW09001000JJ	Formatted blank diskettes (box of 10) for use with the TWIN system
TW90012071JE	1702 PROM programmer card
TW90012081JE	82S115 PROM programmer card
TW90012011JE	General purpose I/O card
TW90019021JE	Maintenance panel
TW09210050JH	Line printer (with cables) for 50Hz mains
TW09210060JH	Line printer (with cables) for 60Hz mains
TW09201050JI	CRT terminal (with cables) for 50Hz mains
TW09201060JI	CRT terminal (with cables) for 60Hz mains
TW90012091JF	Card extender
TW09006000JJ	Maintenance manual
TW90014191JB	Standard terminal cable
TW09009000JJ	Field maintenance kit
TW11000161JF	Prototype user card (wire wrap)
TW09003000JJ	Operator's guide (manual)
TW09004000JJ	System reference manual
TW09005000JJ	Assembly language manual
TW90012061JE-A	2650A/A-1 slave processor
TW90013011JB-A	2650A/A-1 TWICE cable
TW09001001JJ-D	SDOS version 4.0 — enchanced operating system with re-locatable micro assembler, real-time analysis support and additional PROM programming support
TW90012032/2048/2064/2080	High speed master/slave memory board
TW90012092JF	Real-time hardware analyser board

microprocessors
MOS

The Industrial Microcomputer System · IMS

IMS offers a wide selection of compatible system funtions on individual modules. Many different types of modules allow design of unique microcomputer systems for most applications. Other modules are in preparation and the range is being continually extended.

Modules plug into a printed circuit back panel on which the system bus is implemented. This arrangement allows any combination of modules.

On the hardware side, IMS modules consist of single Eurocards which are small (160 x 100 mm) and provide only the functions you need with a minimum of redundant circuitry. Eurocards are built to an internationally accepted standard. So with IMS you are assured of compatibility now and in the future.

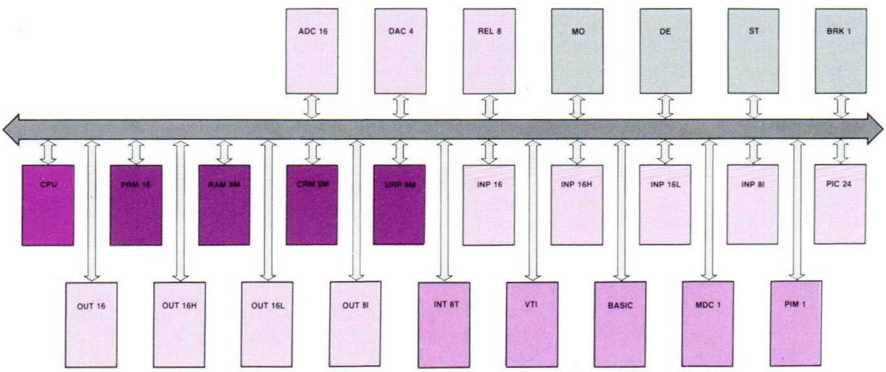
On the software side, IMS has a low-cost Microcomputer Development System called MODEST. This was no afterthought. On the contrary, it was made the starting point of the IMS design, so it can be a starting point for your software development.

MO, DE and ST modules, together constituting MODEST, provide on-site development, debug and programming facilities.

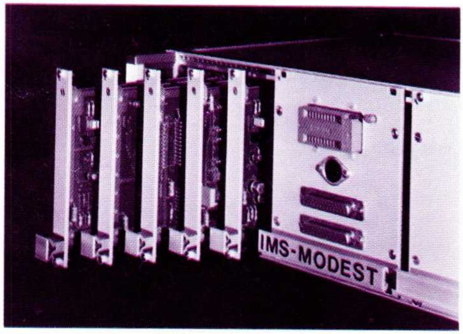
MO contains the 8k bytes MODEST program in four 2716 EPROMs as well as 1k bytes RAM.
DE is the interfacing control module.
ST carries the 2716 EPROM programmer as well as the parallel printer connector.

The MODEST modules fully exploit the functional approach of IMS. Add a VDU so that you can see just what you are doing — in the lab, in the factory or on site. Use MODEST to test your program and to program the EPROMs. Then take it away to the next job.

The modular IMS concept



Survey of IMS - cards



IMS-CPU1
- 2650 microprocessor (2 MHz version)
- Up to 4k bytes (E)PROM
- Five (E)PROM types selectable
  2708 2716 2758 82S181 82S191
- 1k bytes static RAM
- Memory enable for memory expansion
- All control lines are fully buffered
- X-TAL oscillator on board, external clock possible
- DMA

IMS-PRM16
- Up to 16k bytes (E)PROM
  divided into blocks of 4k bytes
- Five (E)PROM types selectable
  2708 2716 2758 82S181 82S191
- Memory enable for memory expansion

IMS-RAM8M
- 8k bytes of static RAM
- Divided into blocks of 4k bytes
- Memory enable for memory expansion

IMS-CRM8M
- 8k bytes of CMOS RAM
- Divided into blocks of 4k bytes
- Battery back-up (500 hours retention)
- Memory enable for memory expansion

IMS-URP8M
- Up to 8k bytes (E)PROM
- Four (E)PROM types
- Up to 1k bytes static RAM
- Forced branch generator
- Page selection
- Memory enable for memory expansion

IMS-INP16
- 16 inputs
- Latch or buffer mode
- Max. 2064 inputs addressable
- Optional RC-filters per input

IMS-INP16L
- Input level +5 V
- TTL and CMOS compatible

IMS-INP16H
- Input level +24 V
- RC-filter at each input (2 ms)

IMS-INP8I
- 8 inputs
- Opto coupled inputs
- Front connection F068
- Filter at each input
- Max. 2064 inputs addressable

IMS-PIC24
- RS-232 interface (2651)
- Audio cassette interface
- 24 programmable I/O-lines (2655)
- Only +5 V power supply

IMS-OUT16
- 16 outputs
- Output current max. 300 mA
- Max. 2064 outputs addressable
- Optional pull-up resistor or clamp diode
- VCE max. +35 V

IMS-OUT16L
- Pull-up resistors
- VCE max. +35 V

IMS-OUT16H
- Protection diode
- VCE max. +70 V

IMS-OUT8I
- 8 outputs
- Opto-coupled outputs
- Grounded load drivers
- Output current 500 mA
- Front connection F068

Survey of IMS - cards

IMS-INT8T
— 8 priority interrupts
— Interrupt mask register
— Optional RC-filter per input
— Programmable level-select
— Three programmable timer/counters

*** IMS-VTI**
— Teletext IC's 5020 5050
— 1k bytes video RAM
— Programmable via I/O-procedures
— Teletext character and graphics capability
— Parallel keyboard input at the front
— RGB-video outputs

*** IMS-MDC1**
— Provides control for two ELA-type MDCR 220 mini digital cassette recorders
— Tape capacity 40 blocks of 1k bytes at both sides of the tape

IMS-PIM1
— To be used in conjunction with PIC24
— 2716 EPROM programmer
— Only +5 V power supply
— Parallel printer interface with programmable logic I/O-levels

IMS-TTY
— RS-232 interface
— Current loop via Opto-couplers
— Audio cassette interface
— LEDs for flag and sense

*** IMS-ADC16**
— 16 analogue input-channels
— 12 bit resolution
— Six input ranges
— Single or differential-mode
— Modes, ranges and channel software programmable
— Conversion time < 50 µs
— 4 bits data for channel display

*** IMS-DAC4**
— Up to 4 DAC's
— Resolution 8 bits Signetics 5018
12 bits DATEL DAC-681
— Five output ranges
— $\pm\frac{1}{4}$ LSB linearity
— Ranges and channel software programmable

IMS-MO
— See URP8M
— Comes with MODEST program in EPROMS + front panel

IMS-DE
— See PIC 24 with front panel

IMS-ST
— See PIM1 with front panel

*** IMS-BASIC**
— See URP8M
— BASIC program in EPROMS with front panel

*** IMS-BRK1**
— Hardware breakpoint setting in RAM or ROM
— Sync signal at breakpoint

*** IMS-REL8**
— Contains 8 mains rated relays

* To be announced.

microprocessor and microcomputer courses

In the Philips microprocessor and microcomputer training programme all aspects of microprocessors are covered extensively and in depth: computer basics, the design of microcomputer systems, tools which can be used in the design cycle, details about specific products, and the consequences of the use of microprocessors.

Everyone, from those who require only a superficial knowledge to those who will become deeply involved technically, will find courses with a valuable content.

The course programme is divided into three parts:

- Introduction to the microprocessor and familiarization with basic technical concepts. By following these courses alone, you will get a feeling for this new technology.
- Courses about the microcomputer components and microcomputer system design. After following these courses you will be able to understand and start working with microcomputer components.
- Courses about development tools which can be used during system design. After following these courses you will be able to cope with all practical development problems.

The courses are given by experts in computer techniques, system design, and system design tools.

microprocessors
course selection guide

Number	Name	Subjects	Who should attend	Required knowledge
1 (1 day)	Technical introduction to microcomputers	Microcomputer concepts; buzz words; design examples	Managers; marketing personnel; everybody interested in micro-processors	Technical interest
2 (1 day)	General introduction to microelectronics and microcomputers	The world of the micro-processor; economic and technical consequences	Managers; marketing personnel; everybody interested in micro-processors	Technical interest; Course No. 1
3 (3 days)	Microcomputer fundamentals	Computer basics; structures and techniques	Engineers without computer background	Basic technical training in electronics
4 (3 days)	2650 Intensive workshop	2650 Hardware and software interface	Engineers who want to design with any general purpose microprocessor	Course No. 3
5 (2 days)	IMS Microcomputer Card System	IMS cards and development system	Engineers who want to use micro-computer boards	2650 Knowledge
6 (3 days)	Intensive workshop on Single-Chip Micro-computers	8048, 8021 and 8400 Hardware and software interface	Engineers who want to design with 8048, 8021 and 8400	Course No. 3
7 (2 days)	8X300 Intensive workshop	8X300 Hardware and software interfaces	Engineers who want to design with 8X300	Course No. 3
8 (3 days)	Programming techniques	Software programming techniques and tricks	Hardware and soft-ware design engineers	Knowledge of microprocessors
9 (4 days)	Microcomputer Hardware	Computer components and sub-systems	Hardware and soft-ware design engineers	Course No.3
10 (4 days)	Microcomputer Development Tools	Design cycle and tools; Philips Microcomputer Development System	Hardware and soft-ware design engineers	Knowledge of microprocessors
11 (4 days)	PASCAL	Structured programming; PASCAL	Hardware and soft-ware design engineers	Course No. 8
12 (3 days)	Microcomputer troubleshooting	System debugging; advanced tools	Hardware and soft-ware design engineers	Course No. 10

military products
process levels

The Signetics Mil 38510/883 program is organized to provide a broad selection of processing options, structured around the most commonly requested customer flows.
The program is designed to provide our customers:

- Fully compliant 883 flows on all products.
- Standard processing flows to help minimize the need for custom specs.
- Cost savings realized by using standard processing flows in lieu of custom flows.
- Better delivery lead times by minimizing spec negotiation time, plus allows customers to buy product off-the-shelf or in various stages of production rather than waiting for devices started specifically to custom specs.

The following explains the different processing options available to you. Special device marking clearly distinguishes the type of screening performed. Refer to tables.

JAN qualified (JB)
JAN qualified product is designed to give you the optimum in quality and reliability. The JAN processing level is offered as the result of the government's product standardization programs, and is monitored by the Defense Electronic Supply Center (DESC), through the use of industry-wide procedures and specifications.

JAN qualified products are manufactured, processed and tested in a government certified facility to Mil-M 38510, and appropriate device slash sheet specifications. Design documentation, lot sampling plans, electrical test data and qualification data for each specific part type has been approved by the Defense Electronic Supply Center (DESC) and products appear on the DESC qualified products list (QPL-38510).

Group B testing, per Mil-Std-883 method 5005, is performed on each six weeks of production on each slash sheet for each package type. Group C, per Mil-Std-883 method 5005, is performed every ninety days for each microcircuit group. Group D testing, per Mil-Std-883 method 5005, is performed every six months for each package type.

In addition to the common specs used throughout the industry for processing and testing, JAN qualified products also possess a requirement for a standard marking used throughout the IC industry.

MIL-STD-883, level B
Processing to this option is ideal when no JAN slash sheets are released on devices required. Product is processed to Mil-Std-883 method 5004, and is 100% electrically tested to industry data sheets.
Devices are selectively available as custom processed parts with electricals screened to the JAN slash sheets.

MIL-STD-883, level C
If you need a Military temperature range device, but do not require burn in screening performed, our 883C product is ideal.
883C parts are the standard full Mil-Temperature range product to the Signetics data sheet parameters and screened to Mil-Std-883, class C.

military products

military generic data

Signetics has a new program for those customers who require quality conformance data on their products. This program allows our customers to obtain reliability information without the necessity of running Groups B, C and D inspections for their particular purchase order. It provides for the customer something that has not been readily available before in the semiconductor industry in that all military generic data is controlled and audited by both government inspection in the case of JAN data and Signetics quality assurance.

Signetics military generic data is compiled by the Military Products Division based on data from:

1. JAN quality conformance lots.
2. Data generated by quality conformance lots run for other reliability programs. Refer to table.

A military generic family is defined as consisting of die function and package type families.

- Allows our customers to qualify Signetics products based on existing quality conformance data performed at Signetics.
- Allows our customers to reduce costs and improve deliveries.
- Provides assurance that all Signetics die function families and packages meet Mil-M-38510 and customer reliability requirements.
- Provides and attributes summary to the customer backed by lot identity and traceability.

Definition and qualifying manufacturing periods for generic data

qualified sub-groups	qualifies	option 1	option 2
A	Electrical Test	Group A is performed on each lot or sublot of Signetics devices.	Group A is performed on each lot or sublot of Signetics devices.
B	Package Same package construction and lead finish.	Data selected from devices manufactured within 6 weeks of the manufacturing period on the same production line through final seal.	Data selected from devices manufactured within 24 weeks of the manufacturing period.
C	Die/Process Devices representing the same process families.	Data selected from representative devices from the same microcircuit group and sealed within 12 weeks of the manufacturing period.	Data selected from the representative devices from the same micro-circuit group and sealed within 48 weeks of the manufacturing period.
D	Package Same package construction and lead finish.	Data selected from the devices representing the same package construction and lead finish manufactured within the 24 weeks of manufacturing period. If specific data not available, Option 2 will be supplied.	Data selected from the devices representing the same package construction and lead finish manufactured within the 52 weeks of manufacturing period.

Summary
Package availability
Products processing matrix

X = applicable

Military summary

	JB JAN qualified	RB 883B	RC 883C
54	X	X	X
54LS	X	X	X
54S	X	X	X
82	X	X	X
8T	—	X	X
93xx	X	X	X
96xx	—	X	X
Analogue	X	X	X
Bipolar Memory	X	X	X
Microprocessor	—	X	X

Military package availibility

JAN case outline and lead finish	Signetics military package types						
	metal can		dual-in-line				
	8-pin	10-pin	8-pin	14-pin	16-pin	18-pin	24-pin
PB	—	—	FE	—	—	—	—
CB	—	—	—	F	—	—	—
EB	—	—	—	—	F	—	—
JB	—	—	—	—	—	—	F
DB	—	—	—	W	—	—	—
FB	—	—	—	—	W	—	—
ZC	—	—	—	—	—	—	Q
GC	H	—	—	—	—	—	—
IC	—	H	—	—	—	—	—
VB	—	—	—	—	—	I	—

All products listed are also available in Die form.

Military products processing matrix

process level and marking	pre-cap visual	burn-in	functional test	d.c./a.c. at 25°C	d.c./a.c. at temp.	QPL	offshore assembly
JB JM38510xxxxx	2010, cond. B	yes	100%	100%	100%	yes	no
RB Sxxxx 883B	2010, cond. B	yes	100%	100%	100%	no	yes
RC Sxxxx 883C	2010, cond. C	no	100%	100% d.c. sample a.c.	sample d.c. only	no	yes

military products
requirements and screening flows

description of requirements and screens	MIL-M-38510 and MIL-STD-883 requirements, methods and test conditions	require-ment	processing levels class S	JAN qualified (JB)	883B (RB)	883C (RC)
General Mil-M-38510						
1 Pre-certification a Prod. assurance program plan b Manufacturer's certification	The manufacturer shall establish and implement a products assurance program plan and provide for a manufacturer survey by the qualifying activity, Para. 3.4.1.1	—	X	X	n.a.	n.a.
2 Certification	Received after manufacturer has completed a successful survey, Para. 3.4.1.2	—	X	X	n.a.	n.a.
3 Device qualification	Device qualification shall consist of subjecting the desired device to groups A, B, C and D of Method 5005 to tightened LTPD, Para. 3.4.1.2	—	X	X	n.a.	n.a.
4 Traceability	Traceability maintained back to a production lot, Para. 3.4.6	—	X	X	X	X
5 Country of origin	Devices must be manufactured, assembled, and tested within the U.S. or its territories, Para. 3.2.1	—	X	X	n.a.	n.a.
Screening per method 5004 of Mil-Std-883						
6 Internal visual (pre-cap)	2010. cond. A or B	100 %	XA	XB	XB	XB
7 Stabilization bake	1008. cond. C min; (24 h at 150°C)	100 %	X	X	X	X
8 Temperature cycling For class B and C devices thermal shock may be substituted, 1011, cond. A; (15 cycles, 0 to +100°C)	1010. cond. C (10 cycles, −65 to +150°C)	100 %	X	X	X	X
9 Constant acceleration	2001, cod. E; (30 kg in YI plane)	100 %	X	X	X	X
10 Visual inspection	There is not test metod for this screen; it is intended only for the removal of 'Catastrophic Failures' defined as 'Missing Leads, Broken Packages or Lids Off'.	100 %	X	X	X	X
11 Seal (hermeticity)	1014					
a Fine	cond. A or B ($5{,}0 \times 10^{-8}$ cm^3/s)	100 %	X	X	X	X
b Gross	cond. C2 min.	100 %	X	X	X	X
12 Interim electricals (pre-burn-in)	Pre applicable device specification	100 % optional	100 % read & record	slash sheet	data sheet	n.a.
13 Burn-in	1015. cond. as specified (min 160 h at 125°C)	100 %	100 % 240 h	X	X	n.a.

X = applicable
n.a. = not applicable

description of requirements and screens	MIL-M-38510 and MIL-STD-883 requirements, methods and test conditions	requirement	processing levels: class S	JAN qualified (JB)	883B (RB)	883C (RC)
Screening per method 5004 of Mil-Std-883 (cont.)						
14 Final electricals	Per applicable device specification	100 %	100 % read & record	slash sheet	data sheet	data sheet
a Static tests, at 25°C	Sub-group 1		X	X	X	X
b Static tests, at +125°C	Sub-group 2		X	X	X	n.a.
c Static tests, at −55°C	Sub-group 3		X	X	X	n.a.
d Dynamic test, at 25°C	Sub-group 4 (for linear product mainly)		X	X	X	X
e Functional test, at 25°C	Sub-group 7		X	X	X	X
f Switching test, at 25°C	Sub-group 9		X	X	X	n.a.
15 Percent Defective Allowable (PDA)	A PDA of 10 % is a normal requirement applied against the static test at 25°C (A-1). This is controlled by the slash sheets for JB products. For RB 10 % is standard.	10 %	10 %	X	X	n.a.
16 Marking (between brackets meaning of xxxx)	Fungus inhibiting paint	100 %	3 % funct'l	JM38510 /xxxx (slash sheet no)	Sxxxx /883B	Sxxxx /883C
17 X-ray	2012		100 %	n.a.	n.a.	n.a.
18 External visual	2009	100 %	X	X	X	X
Quality conformance inspection per method 5005 of Mil-Std-883						
19 Group A	Electrical tests — final electricals (no 14 above) repeated on a sample basis. (Sub-groups 1 to 11 as specified).	each lot	X	X	X	X
20 Group B	Package functional and constructional related test i.e. package dimensions, resistance to solvents, internal visual and mechanical, bond strength and solderability.	every 6 weeks per package group	X	X	generic data available	
21 Group C	Die related tests i.e. 1000 h operating life, temperature cycling and constant acceleration.	every 3 months per microcircuit type	X	X	generic data available	
22 Group D	Package related tests i.e. physical dimensions, lead fatigue, thermal shock, temperature cycle, moisture resistance, mechanical shock, vibration variable frequency constant acceleration and salt atmosphere.	every 6 months per package type	X	X	generic data available	

military products
JAN 38510 type numbers - what they mean

The following chart is offered for your reference to help take some of the mystery out of JAN part number marking. For an example, we will take the marking for a 5400F processed to JAN and explain its meaning as well as other options.

JM 38510 **/001** **04** **B C B**

MILITARY DESIGNATOR

calls out MIL-M-38510 JAN IC
The "J" in the marking is very important.
If it's not there it's not a JAN device.
DO NOT be confused by JAN equivalents marked M38510.

DETAIL SPECIFICATION

refers to detail slash sheet spec. 001, 002, 003····
A slash sheet detail spec will usually represent a family of devices with similar functions.

i.e. the /001

detail spec represents many positive NAND gates such as the 5400, 5401, 5403, 5410, 5420 and 5430 etc.
The /002 detail spec on the other hand represents many flip-flop functions such as the 5472, 5473, 54107, 5476, 5474, 5470 and so on for the rest of the slash sheets.

DEVICE TYPE

refers to a specific part type under the detail spec.
This, plus the detail spec no. will denote a part type.
i.e.:

detail spec	+	dev. type	=	generic type
001		01	=	5430
001		02	=	5420
001		03	=	5410
001		04	=	5400

detail spec	+	dev. type	=	generic type
002		01	=	5472
002		02	=	5473
002		03	=	54107

and so on for the rest of the slash sheets.

Actual marking for our 5400F as it appears on the device.

S AAAA
JM38510
00104
BCB
CDKB

date code

Signetics manufacturer's code (per Mil-M-35810)

DEVICE GLASS

calls out processing to either class S, B or C of MIL-STD-883

CASE OUTLINE

This code denotes the package i.e.:

A = $\frac{1}{4}'' \times \frac{1}{4}''$ flat pack 14 pin
B = $\frac{1}{4}'' \times \frac{1}{8}''$ flat pack 14 pin
C = $\frac{1}{4}'' \times \frac{3}{4}''$ 14 pin dual in-line
D = $\frac{1}{4}'' \times \frac{3}{8}''$ flat pack 14 pin
E = $\frac{1}{4}'' \times \frac{3}{4}''$ 16 pin dual in-line
F = $\frac{1}{4}'' \times \frac{3}{8}''$ flat pack 16 pin
G = 8 lead metal can
H = $\frac{1}{4}'' \times \frac{1}{4}''$ 10 pin flat pack
I = 10 lead metal can
J = $\frac{1}{2}'' \times 1\frac{1}{4}''$ 24 pin dual in-line
K = $\frac{3}{8}'' \times \frac{1}{2}''$ 24 pin flat pack
L = $\frac{3}{8}'' \times \frac{1}{2}''$ 24 pin flat pack
Z = $\frac{1}{4}'' \times \frac{3}{8}''$ 24 pin flat pack

LEAD FINISH

A = Kovar or alloy 42 with hot solder dip
B = Kovar or alloy 42 with tin plate
C = Kovar or alloy with gold plate

5400 series

		JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
Gates						
5400	quadruple 2-input positive NAND gate	/00104	1	1	F	W
5402	quadruple 2-input positive NOR gate					
5408	quadruple 2-input positive AND gate					
5410	triple 3-input positive NAND gate					
5411	triple 3-input positive AND gate	—	—	—	F	W
5420	dual 4-input positive NAND gate	/00102	1	1	F	W
5426	quadruple 2-input NAND gate with open collector output	/00805	1	—	F	—
5430	8-input positive NAND gate					
5432	quadruple 2-input positive OR gate	/16101	1	1	F	W
5451	dual 2-wide 2-input AND-OR-invert gate					
5454	4-wide 2-input AND-OR-invert gate					
5486	quadruple 2-input EXCLUSIVE-OR gate	/00701	1	1	F	W
54133	13-input NAND gate					
54134	12-input NAND gate with three-state outputs					
54136	quadruple EXCLUSIVE-OR with open collector output					
54260	dual 5-input NOR gate					
54266	quadruple EXCLUSIVE-NOR					
Buffers, inverters						
5404	hex inverter	/00105	1	1	F	W
5428	quadruple 2-input positive NOR buffer					
5433	quadruple 2-input positive NOR buffer with open collector output	—	—	—	F	W
5437	quadruple 2-input positive NAND buffer					
5440	dual 4-input positive NAND buffer					

	54 LS series					54 S series				
	JM385 10 slash sheet	**JAN qualified**		**Mil-Std 883**		**JM385 10 slash sheet**	**JAN qualified**		**Mil-Std 883**	
		DIP	Flatpack	DIP	Flatpack		DIP	Flatpack	DIP	Flatpack
5400	/30001	1	1	F	W	/07001	1	1	F	W
5402	/30301	1	1	F	W	/07301	1	1	F	W
5408	/31004	1	1	F	W	/08003	2	2	F	W
5410	/30005	1	1	F	W	/07005	1	1	F	W
5411						/08001	1	1	F	W
5420	/30007	1	1	F	W	/07006	—	—	F	W
5426										
5430	/30009	—	—	F	W					
5432	/30501	1	1	F	W					
5451	/30401	1	1	F	W	/07401	1	1	F	W
5454	/30402	1	1	F	W					
5486	/30502	1	1	F	W	/07501	1	1	F	W
54133						/07009	1	1	F	W
54134						/07010	2	2	F	W
54136	—	—	—	F	W					
54260	—	—	—	F	W	—	—	—	F	W
54266	/30303	1	1	F	W					
5404	/30003	1	1	F	W	/07003	1	1	F	W
5428	/20204	—	—	F	W					
5433	—	—	—	F	W					
5437	/30202	1	1	F	W					
5440	/30201	1	1	F	W	/07201	1	1	F	W

5400 series

		JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
Bus drivers transceivers						
54125	quadruple bus buffer gate with three-state output					
54126	quadruple bus buffer gate with three-state output					
54240	octal inverter buffer with three-state output					
54241	octal buffer with three-state output					
54242	quadruple bus inverting transceiver with three-state output					
54243	quadruple bus transceiver with three-state output					
54244	octal buffer with three-state output					
54245	octal transceiver with three-state output					
54365A	hex three-state buffer with common enable	/16301	1	—	F	R
54366A	hex three-state inverter with common enable	/16302	1	—	F	R
54367A	hex three-state buffer, 4-bit and 2-bit	/16303	1	—	F	R
54368A	hex three-state inverter, 4-bit and 2-bit	/16304	1	—	F	R
54640	octal transceiver					
Flip-flops						
5414	hex Schmitt trigger	/15102	—	—	F	W
5473	dual JK master-slave flip-flop	/00202	1	1	F	W
5474A	dual D-type edge-triggered flip-flop	/00205	1	1	F	W
5476	dual JK master-slave flip-flop	/00204	1	1	F	W
54107	dual JK master-slave flip-flop					
54109	dual JK positive edge-triggered flip-flop	—	—	—	F	W
54112	dual JK negative edge-triggered flip-flop					
54113	dual JK positive edge-triggered flip-flop					
54121	monostable vibrator	/01201	1	1	F	W
54122	retriggerable monostable multivibrator	/01202	—	—	—	—
54123	retriggerable monostable multivibrator	/01203	1	1	F	W
54132	quadruple Schmitt trigger	/15103	1	1	F	W
54173	quadruple D-type flip-flop (three-state) (8T10)					
54174	hex D-type flip-flop with clear	/01701	1	1	F	W
54175	quadruple D-type edge-triggered flip-flop	/01702	1	1	F	W
54273	octal D-type flip-flop with clear					
54374	octal flip-flop (three-state)					
54377	octal D-type flip-flop with clear					

	54 LS series					54 S series				
	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
54125	/32301	1	1	F	W					
54126	/32302	1	1	F	W					
54240	/32401	*	—	F	—					
54241	/32402	*	—	F	—					
54242	/32801	*	*	F	W					
54243	/32802	*	*	F	W					
54244	/32403	*	—	F	—					
54245	/32803	*	—	*	—					
54365A	/32201	1	1	F	W					
54366A	/32202	—	—	F	W					
54367A	/32203	1	1	F	W					
54368	/32204	1	1	F	W					
54640	—	—	—	*	*					
5414	/31302	1	1	F	W					
5473	/30101	*	1	F	W					
5474A	/30102	1	1	F	W	/07101	1	1	F	W
5476	/30110	1	1	F	W					
54107	/30108	1	1	F	W					
54109	/30109	1	1	F	W					
54112	/30103	1	1	F	W	/07102	1	1	F	W
54113	/30104	1	1	F	W	/07103	*	*	F	W
54121										
54122										
54123										
54132	/31303	1	1	F	W					
54173	—	—	—	F	W					
54174	/30106	1	1	F	W	/07105	—	—	F	W
54175	/30107	1	1	F	W					
54273	/32501	2	—	F	W					
54374	/32503	—	—	F	—					
54377	/32504	—	—	F	—					

5400 series

		JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
Shift registers						
5491	8-bit shift register	—	—	—	F	W
5495B	4-bit left-right shift register					
5496	5-bit shift register	/00902	1	1	F	W
54164	8-bit parallel-out serial shift register	/00903	1	—	F	—
54165	parallel-load 8-bit shift register	/00904	—	—	F	W
54194A	4-bit bidirectional universal shift register	/00905	*	*	F	W
54195A	4-bit parallel-access shift register	/00906	*	*	F	W
54295B	4-bit right-shift left-shift register					
54395A	4-bit cascadeable shift register (three-state)					
54670	4 × 4 register file (three-state)					
Counters						
5490	decade counter					
5492	divide-by-twelve counter					
5493	4-bit binary counter	/01302	1	1	F	W
54160	synchronous 4-bit decade counter	/01303	1	1	F	W
54160A	synchronous 4-bit decade counter					
54161	synchronous 4-bit binary counter	/01306	1	1	F	W
54161A	synchronous 4-bit binary counter					
54162A	synchronous 4-bit decade counter					
54163	synchronous 4-bit binary counter	/01304	1	1	F	W
54163A	synchronous 4-bit binary counter					
54168	up/down counter					
54169	up/down counter					
54190	synchronous up/down counter (BCD)	—	—	—	*	*
54191	synchronous up/down counter (binary)	—	—	—	*	*
54192	synchronous decade up/down counter					
54193	synchronous 4-bit binary up/down counter	/01309	1	1	F	W
54197	presettable binary counter/latch (8291)					
54290	decade counter					
54293	4-bit binary counter					
54393	dual binary ripple counter					
54490	dual decade ripple counter					

	54 LS series					54 S series				
	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
5491										
5495B	/30603	1	1	F	W					
5496	/30604	1	1	F	W					
54164	/30605	1	1	F	W					
54165										
54194A	/30601	—	—	F	W	/07601	—	—	—	—
54195A	/30602	1	1	F	W	/07602	—	—	—	—
54295B	/30606	1	1	F	W					
54395A	/30607	1	1	F	W					
54670	—	—	—	F	W					
5490	/31501	1	1	F	W					
5492	/31610	1	1	F	W					
5493	/31502	1	1	F	W					
54160										
54160A	/31503	—	—	F	W					
54161										
54161A	/31504	*	*	F	W					
54162A	/31511	—	—	F	W					
54163										
54163A	/31512	1	1	F	W					
54168	/31505	—	—	*	*					
54169	/31506	—	—	*	*					
54190	/31513	1	1	F	W					
54191	/31509	1	1	F	W					
54192	/31507	*	*	F	W					
54193	/31508	1	1	F	W					
54197	/32002	*	*	F	W					
54290	/32003	1	1	F	W					
54293	/32004	1	1	F	W					
54393	/32702	*	*	F	W					
54490	/32703	2	2	F	W					

5400 series

		JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
Latches						
5475	quadruple bistable latch	/01501	1	1	F	W
5477	quadruple bistable latch	/01502	—	—	—	W
54116	dual 4-bit latch with clear	/01503	2	—	F	W
54279	quadruple S-R latch	—	—	—	F	W
54373	octal latch (three-state)					
54375	quadruple latch					
Decoders-drivers						
5446A	BCD to 7-segment decoder/driver	/01006	—	—	F	W
5447A	BCD to 7-segment decoder/driver	/01007	—	—	F	W
54140	dual 4-input NAND line driver					
Decoder-multiplexers						
5442	BCD-to-decimal decoder	/01001	1	1	F	W
5443	excess 3 to decimal decoder	/01002	—	—	F	W
54138	3 to 1 of 8-line decoder/demultiplexer					
54139	dual 2-line to 4-line decoder/demultiplexer					
54148	8-line to 3-line priority encoder	/15602	—	—	*	*
54151	8-line to 1-line multiplexer	/01406	1	1	F	W
54153	dual 4-line to 1-line multiplexer	/01403	1	1	F	W
54154	4-line to 16-line decoder/demultiplexer					
54156	2-line to 4-line decoder demultiplexer					
54157	quadruple 2-input data selector (non-inverting)	/01405	1	1	F	W
54158	quadruple 2-input data selector (inverting)					
54251A	data selector/multiplexer with three-state outputs					
54253	dual 4-line to 1-line data selector/multiplexer					
54257A	quadruple 2-line to 1-line data selector/multiplexer					
54258A	quadruple 2-line to 1-line data selector/multiplexer					
54298	quadruple 2-input multiplexer with storage					
Arithmetic units						
5483	4-bit binary full adder	/00602	1	1	F	W
5483A	4-bit binary full adder					
5485	4-bit magnitude comparator	/15001	1	1	F	W
54180	8-bit odd/even parity checker	/01901	1	1	F	W
54181	4-bit arithmetic logic unit	/01101	1	—	F	—
54182	look-ahead carry generator					
54261	2 × 4 parallel binary multiplier decoder					
54280	9-bit odd/even parity generator/checker					
54283	4-bit adder					

	54 LS series					54 S series				
	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack	JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
5475	—	—	—	F	W					
5477										
54116										
54279	/31602	*	*	F	W					
54373	/32502	*	—	F	—					
54375	/31604	*	2	F	W					
5446A										
5447A										
54140						/08101	1	1	F	W
5442	/30703	*	*	F	W					
5443										
54138	/30701	*	*	F	W	/07701	—	—	—	—
54139	/30702	*	*	F	W	/07702	*	*	F	W
54148										
54151	/30901	—	—	*	*	/07901	1	1	F	W
54153	/30902	1	1	F	W	/07902	1	1	F	W
54154	—	—	—	F	Q					
54156	/32602	2	2	F	W					
54157	/30903	—	—	F	W	/07903	1	1	F	W
54158	/30904	—	—	F	W	/07904	1	1	F	W
54251A	/30905	—	—	*	*	/07905	—	—	*	*
54253	/30908	*	*	F	W	—	—	—	F	W
54257A	/30906	1	1	*	*	/07906	—	—	—	—
54258A	/30907	1	1	*	*	/07907	—	—	—	—
54298	/30909	2	2	F	W					
5483										
5483A	/31201	—	—	F	W					
5485	/31101	1	1	F	W	/08201	1	—	F	—
54180										
54181	/30801	1	—	F	W	/07801	1	—	F	*
54182						/07802	—	—	*	*
54261	/31801	*	*	F	W					
54280						/07703	—	—	—	—
54283	/31202	—	—	F	W					

82, 93, 96 series

		JM385 10 slash sheet	JAN qualified DIP	JAN qualified Flatpack	Mil-Std 883 DIP	Mil-Std 883 Flatpack
Counters						
8280	presettable decade counter	—	—	—	F	W
8281	presettable binary counter	—	—	—	F	W
Decoders/display drivers						
8250	binary-to-octal decoder	/15204	—	—	F	W
Flip-flops						
9602	dual monostable multivibrator	/01205	*	*	F	W
Multiplexers						
8233	2-input, 4-bit digital multiplexer	—	—	—	F	W
8234	2-input, 4-bit digital multiplexer	—	—	—	F	W
8266	2-input, 4-bit digital multiplexer	—	—	—	F	W
9309	dual 4-input multiplexer	/01404	1	1	F	W
9322	data selector multiplexer	—	—	—	F	W
Registers/latches						
8202	10-bit buffer register	—	—	—	I	Q
8271	4-bit shift register	—	—	—	F	W
8273	10-bit serial-in, parallel-out shift register	—	—	—	F	W

8T interface series

		JM385 10 slash sheet	Mil-Std 883 DIP	Flatpack
Translators/buffers				
8T18	dual 2-input NAND gate (high voltage to TTL)	—	F	W
8T80	quadruple 2-input NAND gate (high voltage)	—	F	W
8T90	hex inverter (high voltage)	—	F	W
Timing circuits				
8T22	retriggerable monostable multivibrator (54122/9601)	—	F	W
Line drivers, receivers, transceivers				
8T09	quadruple three-state bus driver	—	F	W
8T13	dual low impedance line driver	—	F	W
8T26A	quadruple three-state bus transceiver (inverting)	—	F	R
8T28	quadruple three-state bus transceiver (non-inverting)	—	F	W
8T37	hex bus receiver/Schmitt trigger	—	F	W
8T38	quadruple bus transceiver (open collector) (DM 8838)	—	F	W
8T95	high-speed hex three-state buffer/inverter	—	F	R
8T97	high-speed hex three-state buffer/inverter	—	F	R
8T98	high-speed hex three-state buffer/inverter	—	F	R
8T126	quadruple three-state transceiver	—	F	W
8T127	quadruple three-state transceiver	—	F	W
8T128	quadruple three-state transceiver	—	F	W
8T129	quadruple three-state transceiver	—	F	W
Decoders drivers				
8T05	7-segment decoder display driver (active-HIGH outputs)	—	F	W
Input/Output ports				
8T31	8-bit bidirectional input/output port	—	*	*
8T32	programmable 8-bit input/output port (three-state), IV byte	—	I	*
8T33	programmable 8-bit input/output port (open collector), IV byte	—	I	*
8T35	asynchronous programmable 8-bit input/output port (open collector)	—	I	W

military products
bipolar memory

device	organization	package *		output circuit	number of pins	JAN M-38510 slash sheet	pkg	qual status
PROMs								
82S23	32 × 8	F	R	OC	16	/20701	F	QPL II
82S115	512 × 8	I	R	TS	24	/20803	F/I	QPL II
82S123	32 × 8	F	W	TS	16	/20702	F	QPL II
82S126	256 × 4	F	W	OC	16	/20301	F	QPL I
82S129	256 × 4	F	R	TS	16	/20302	F	QPL I
82S130	512 × 4	F	R	OC	16	/20401	F	QPL II
82S131	512 × 4	F	R	TS	16	/20402	F	QPL I
82S137	1024 × 4	F,I	R	TS	18	/20602	F/I	QPL II
82S141	512 × 8	F,I	R	TS	24	/20802	F/I	QPL II
82S181	1024 × 8	F,I	R,G	TS	24	/20904	F	QPL II
82LS181	1024 × 8	F	R	TS	24	—	—	—
82S185	2048 × 4	I	R	TS	18	/20902	I	QPL II
82S2708	1024 × 8	F	R	TS	24	/20905	I	QPL II
82S191	2048 × 8	I	R,G	TS	24	/21002	I	QPL II
FPLF								
82S100	16 × 48 × 8	I	R,G	TS	28	/draft	I	planned
82S101	16 × 48 × 8	I	R	OC	28			
82S102	16 × 9	I	R	OC	28			
82S103	16 × 9	I	R	TS	28			
82S106	16 × 48 × 8	I	R	OC	28			
82S107	16 × 48 × 8	I	R	OC	28			
PLAs								
82S200	16 × 48 × 8	I	R	TS	28			
82S201	16 × 48 × 8	I	R	OC	28			
RAMs								
54S189	16 × 4	F	R	TS	16			
54S301	256 × 1	F	R	OC	16			
82S09	64 × 9	I	R	OC	28			
82S19	64 × 9	I	R	OC	28			
82S16	256 × 1	F	R	TS	16			
82S25	16 × 4	F	R	OC	16			

* R = BeO flat pack
F = cerdip
I = ceramic DIP

bipolar microprocessors

Microprocessors

product	description	availability DIP	flatpack
3001	microprogram control unit	I	R
3002	central processing element (2-bit slice)	I	R
8X300	interpreter/microcontroller	I	*

Support circuits

Logic

product	description	DIP	flatpack
54123	retriggerable monostable multivribator	F	R
54180	8-bit odd/even parity checker	F	R
54LS194	4-bit bidirectional shift register	I	*
54LS195	4-bit parallel access shift register	I	*
54LS365	high speed hex three-state buffer	F	W
54LS366	high speed hex three-state buffer	F	W
54LS367	high speed hex three-state buffer	F	W
54LS368	high speed hex three-state buffer	F	W

Interface

product	description	DIP	flatpack
8T09	quad bus driver with three-state output	F	W
8T13	dual line driver	F	W
8T26A	quad bus driver/receiver (three-state)	F	W
8T28	quad bus non-inverting driver/receiver (three-state)	F	W
8T32	programmable 8-bit I/O port (three-state), IV byte	I	*
8T35	asynchronous programmable 8-bit I/O port (open collector)	I	*
8T95	high speed hex buffer (three-state)	F	R
9T97	high speed hex buffer (three-state)	F	R
8T98	high speed hex inverter (three-state)	F	R
8T126	quad three-state transceivers	F	W
8T127	quad three-state transceivers	F	W
8T128	quad three-state transceivers	F	W
8T129	quad three-state transceivers	F	W

* Under development

military products
analogue

Operational amplifiers

type	description	package DIP	package CAN
LF155	J-FET op amp		H
LF156	J-FET op amp		H
LH2101A	dual op amp	F	
LM101A	high perf op amp	F	H
LM124	quad op amp	F	
LM158	dual op amp		H
MC1556	high perf op amp	F	H
MC1558	dual op amp	F	H
SE532	dual op amp		H
SE5512	dual op amp	FE	H
SE5532	dual op amp	F,FE	H
SE5532A	dual op amp	FE	
SE5534	low noise op amp	F,FE	H
SE5534A	low noise op amp	FE	H
SE5537	sample and hold amp	FE	H
SE5539	high freq op amp	F	—
μA747	dual op amp	F	H

Comparators

type	description	DIP	CAN
SE521	dual differential comparator	F	
SE522	dual differential comparator	F	
SE527	voltage comparator	F	H
SE529	voltage comparator	F	H
LH2111	dual voltage comparator	F	
LM111	voltage comparator	F	H
LM139/A	quad voltage comparator	F	
LM193/A	dual voltage comparator		H

Differential amplifiers

type	description	DIP	CAN
SE511	dual differential amplifier	F	
μA733	video amplifier	F	H

Phase locked loops

type	description	DIP	CAN
SE564	phase locked loop	F	H
SE567	tone decoder PLL	F	H

Timers

type	description	package DIP	package CAN
SE555	timer	F,FE	H
SE556-1	dual timer	F	
SE558	quad timer	F	

Voltage regulators

type	description	DIP	CAN
SE5553	dual track regulator	F	H
SE5554	dual track regulator	F	H
μA723	adj volt regulator	F	H

Dual line receivers

type	description	DIP	CAN
DS7820/A	dual line receiver	F	—
DS7830/A	dual diff line driver	F	—

D to A converters

type	description	DIP	CAN
DAC-08	8-bit mult DAC	F,Q	H
MC1508-8	8-bit mult DAC	F	—
SE5008	8-bit mult DAC	F	—
SE5009	8-bit mult DAC	F	—
SE5018	8-bit μP-comp DAC	F	—
SE5019	8-bit μP-comp DAC	F	—
SE5118	8-bit μP-comp DAC	F	—
SE5119	8-bit μP-comp DAC	F	—

MOS-FET switch

type	description	DIP	CAN
SD210	switch N-channel enhance	EE	—
SD211	switch N-channel enhance	EE	—
SD5002	quad analogue switch	I	

SMPS control circuits

type	description	DIP	CAN
SE5560	SMPS controller	F	—
SG1524	reg pulse width modulator	F	—

JAN M-38510

type	description	slash sheet	package	qualif. status
LH2101A	dual op amp	10105BEB	F	QPL1
LM101A	high perf op amp	10103BCB	F	QPL1
LM101A	high perf op amp	10103BPB	FE	QPL1
LM101A	high perf op amp	10103BGC	H	QPL1
LM124	quad op amp	11005BCB	F	1981
SE5537	sample and hold amp			1981
μA741	general purpose op amp	10101BGC	H	QPL1
μA747	dual op amp	10102BIC	H	QPL1
SE555	timer	10903BCB	F	QPL1
SE555	timer	10903BPB	FE	QPL1
SE555	timer	10901BGC	H	QPL1
SE556-1	dual timer	10902BCB	F	QPL1
DAC-08	8-bit mult DAC	11301BCB	F	1981
SG1524	reg pulse width modulator			1981

notes

notes

Computerized on-slice testing of integrated circuits: one in an extensive series of quality-control checks that ensures the conformity and long-life reliability of the delivered product.

CONTENTS RESISTORS

For detailed information
Handbook C13

fixed resistors
survey

resistor type		resistance range	tolerance ± %	dissipation W	at T °C	type number	page
Carbon film		1 Ω to 10 MΩ	5; 10	0,2	70	CR16	
				0,33		CR25	
				0,5		CR37	C4-C5
			5	0,67		CR52	
				1,15		CR68	
				2		CR93	
Metal film	standard	1 Ω to 1 MΩ	5	0,2		SFR16	
			5; 2	0,33	70	SFR25	C6
			5; 2	0,5		SFR30	
	non-flammable	1 Ω to 15 kΩ	5	0,33	70	NFR25	C7
	CECC 40101	51 Ω to 100 kΩ	1; 2	0,25	70	MR16	
	CECC 40101	1 Ω to 1 MΩ	0,5; 1; 2	0,4	70	MR25	
				0,5		MR30	C8-C9
				1		MR52	
	MIL-R-10509F	10 Ω to 1 MΩ	0,1; 0,25;	0,1	125	MR24E; MR24C	
			0,5; 1	0,125		MR34E; MR34C	
				0,25		MR54E; MR54C	
				0,5		MR74E; MR74C	C10
				0,125	70	MR24D	
				0,25		MR34D	
				0,5		MR54D	
				0,75		MR74D	
	precision failure level R	4,99 Ω to 1 MΩ	0,5; 0,25; 0,1	0,25		MPR24	
				0,40		MPR34	C11
	precision failure level S	24 Ω to 100 kΩ	0,05; 0,025; 0,01	0,125		MPR24	
				0,25		MPR34	
	high voltage	220 kΩ to 22 MΩ	1; 5; 10	0,25	70	VR25	
		220 kΩ to 33 MΩ	1; 5	0,5		VR37	C12
		100 kΩ to 68 MΩ	1; 5	1		VR68	
	power	2,2 Ω to 27 kΩ	5	1,6	70	PR37	C13
		2,2 Ω to 51 kΩ		2,5		PR52	

resistor type		resistance range	tolerance ± %	dissipation W	at T °C	type number	page
Wirewound	cemented	0,1 Ω to 33 kΩ	5; 10	4	40	AC04	C14
				5		AC05	
				7		AC07	
				10		AC10	
				15		AC15	
				20		AC20	
		0,1 Ω to 12 kΩ	5; 10	1	70	ACL01	C15
				2		ACL02	
				3		ACL03	
	enamelled	4,7 Ω to 100 kΩ	5	4	70	WR0617E	C16
				7		WR0825E	
				11		WR0842E	
				17		WR0865E	
	rectangular	0,15 Ω to 22 kΩ	5; 10	4	70	EH04	C17
				5		EH05	
				7		EH07	
				9		EH09	
				17		EH17	
	with side terminations	1 Ω to 120 kΩ	5; 10	8 to 100	40	2322 321	C18
				8 to 250		2322 323	
	adjustable	1,2 Ω to 47 kΩ	5; 10	10 to 100	40	2322 322	
				10 to 250		2322 324	

fixed resistors
carbon film

CR16 CR25 CR37
CR52 CR68 CR93
Status C

For detailed information
Handbook CM13

style	limiting voltage V(r.m.s.)	rated dissipation at T_{amb} = 70°C W	resistance range	tolerance ± %	series	catalogue no. YYZ
CR16	150	**0,2**	10 Ω – 220 kΩ	5	E24	2322 210 13. . .
			270 kΩ – 1 MΩ	10	E12	2322 210 12. . .
CR16 on reel			10 Ω – 220 kΩ	5	E24	2322 210 23. . .
			270 kΩ – 1 MΩ	10	E12	2322 210 22. . .
CR25	150	**0,33**	1 Ω – 1 MΩ	5	E24	2322 211 13. . .
			1,2 MΩ – 10 MΩ	10	E12	2322 211 12. . .
CR25 on reel			1 Ω – 1 MΩ	5	E24	2322 211 23. . .
			1,2 MΩ – 10 MΩ	10	E12	2322 211 22. . .
CR25A	250	**0,33**	1 Ω – 1 MΩ	5	E24	2322 106 33. . .
			1,2 MΩ – 10 MΩ	10	E12	2322 106 32. . .
CR37	350	**0,5**	1 Ω – 1 MΩ	5	E24	2322 212 13. . .
			1,2 MΩ – 10 MΩ	10	E12	2322 212 12. . .
CR37 on reel			1 Ω – 1 MΩ	5	E24	2322 212 23. . .
			1,2 MΩ – 10 MΩ	10	E12	2322 212 22. . .
CR52*	500	**0,67**	1 Ω – 1 MΩ	5	E24	2322 213 13. . .
CR68*	750	**1,15**	1 Ω – 1 MΩ	5	E24	2322 214 13. . .
CR93*	1000	**2**	10 Ω – 1 MΩ	5	E24	2322 215 13. . .

Basic specification	IEC 115-1, 115-2
Climatic category (IEC 68)	55/155/56
Stability after load	see nomogram

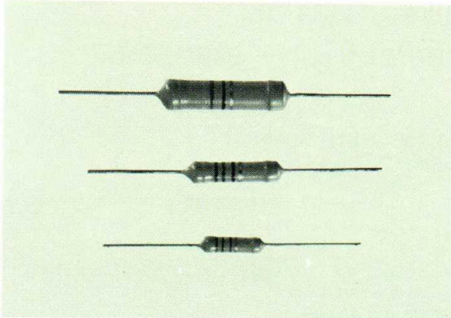
Composition of catalogue no.

YY first two digits of resistance value

Z	code for decade
8	1 to 9,1 Ω
9	10 to 91 Ω
1	100 to 910 Ω
2	1 to 9,1 kΩ
3	10 to 91 kΩ
4	100 to 910 kΩ
5	1 to 9,1 MΩ
6	10 MΩ

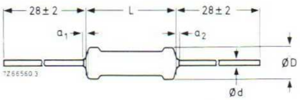
Example: CR25 (not on reel), 10 Ω, 5%: 2322 211 13109

*For values > 1 MΩ see high-voltage resistors VR37 and VR68.



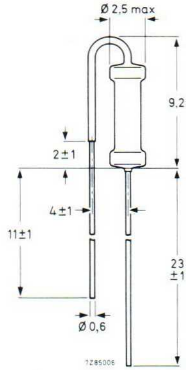
Dimensions

style	D_{max}	L_{max}	d	$a_1 + a_2$
CR16	1,6	4,0	0,5	⩽1,0
CR25	2,5	6,5	0,6	⩽1,0
CR37	3,7	10	0,7	⩽1,0
CR52	5,2	16,5	0,8	⩽1,2
CR68	6,8	18	0,8	⩽1,2
CR93	9,0	31,7	0,8	⩽1,2



Style CR25A

The bent lead is partly covered with an insulating lacquer having a breakdown voltage of at least 50 V (d.c.)



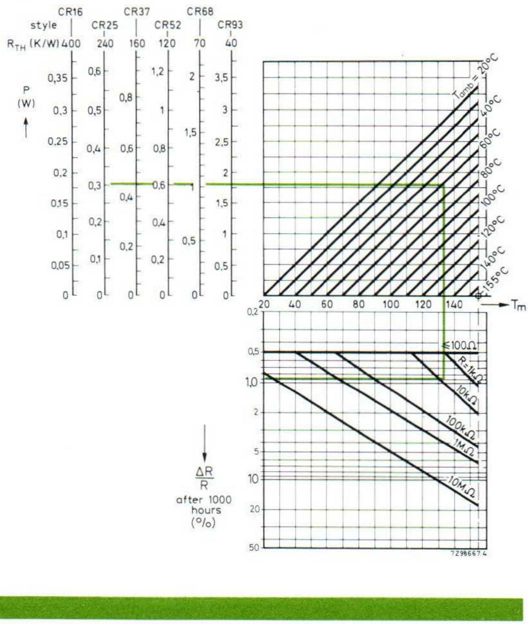
Nomogram to find style or stability

Example
What is the stability of a 10 kΩ resistor, style CR25, operating at 0,3 W in an ambient of 60°C?

Find 0,3 W on CR25 style column.

Follow the line right, down, left, to the stability axis. ΔR/R is 1% over 1000 working hours.

Use the reverse procedure to find right style for a given stability and dissipation.



fixed resistors
metal film – standard

SFR16, SFR25, SFR30
Status D

Ammopack is an abbreviation of "ammunition packing", which is a cardboard box, in which a bandolier of resistors is zig-zag folded.

style	limiting voltage V(r.m.s.)	**rated dissipation at T_{amb} = 70°C W**	resistance range	tolerance ± %	series	catalogue no.
SFR16	150	**0,20**	10 Ω to 100 kΩ	5	E24	2322 180 PXYYZ
SFR25	250	**0,33**	1 Ω to 1 MΩ	5; 2	E24	2322 181 PXYYZ
SFR30	350	**0,50**	1 Ω to 1 MΩ	5; 2	E24	2322 182 PXYYZ

Temp. coef. SFR16	≤200 . 10^{-6}/K
SFR25, 30	≤250 . 10^{-6}/K
Noise	≤0,1 μV/V
SFR16, R > 68 kΩ	≤0,5 μV/V
Basic specification	IEC 115-1 and 115-2
Climatic category (IEC 68)	55/155/56
Stability after load	ΔR/R max. 1% + 0,05 Ω

Composition of catalogue no.

P code for style and packing, see table

X	code for tolerance	**YY**	first two digits of resistance value
3	5%		
4	2%		

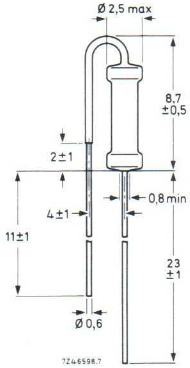
Z	code for decade		
8	1 to 9,1 Ω	**2**	1 to 9,1 kΩ
9	10 to 91 Ω	**3**	10 to 91 kΩ
1	100 to 910 Ω	**4**	100 to 910 kΩ
		5	1 MΩ

Table for P, code for style and packing

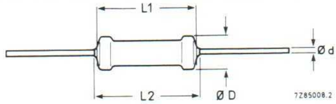
type and style	packing	quantity	P
SFR16, style 2	ammopack	1000	1
	on reel	5000	2
SFR25, style 1	ammopack	1000	1
	on reel	5000	2
	ammopack	5000	7
SFR25, style 2	ammopack	1000	5
	on reel	5000	6
	ammopack	5000	4
SFR25, style 2, 26 mm	ammopack	2000	0
SFR25, "stand-up"	box	1000	3
SFR30, style 1	ammopack	1000	1
	on reel	5000	2

Dimensions

Stand-up version, SFR25A.



Standard version, style 1 and style 2, see table.



Style 2 is specially made to obtain a minimum "clean lead to clean lead" dimension, L2.

type and style	D max.	L1 max.	L2 max.	d
SFR16, style 2	1,6	3,7	4,0	0,5
SFR25, style 1	2,5	6,5	8,5	0,6
SFR25, style 2	2,5	6,5	7,0	0,6
SFR30, style 1	3,0	8,5	9,5	0,7

metal film – non-flammable

NFR25
Status D

These resistors have been specially designed to meet the safety requirements in audio and video applications, in circuits where protection against overloads is needed, e.g. in power supply circuits. The resistor will become open circuited within a certain range of overload, without the risk of fire.

style	limiting voltage V(r.m.s.)	**rated dissipation at T_{amb} = 70°C W**	resistance range	tolerance ± %	series	catalogue no. **XXYYZ**
NFR25	250	**0,33**	1 Ω to 15 kΩ	5	E24	2322 205 . . . . .

Temperature coefficient	⩽250 . 10^{-6}/K
Basic specifications	IEC 115-1, 115-2
Climatic category (IEC 68)	55/155/56
Stability after endurance test	ΔR/R max. 1%

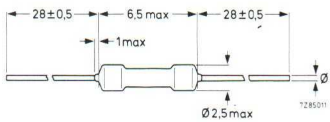
Composition of catalogue no.

XX packing:
13 1000 items on bandolier
23 5000 items taped, on reel

YY first two digits of resistance value

Z code for decade
8 1 to 9,1 Ω
9 10 to 91 Ω
1 100 to 910 Ω
2 1 to 9,1 kΩ
3 10 to 15 kΩ

Dimensions



fixed resistors
metal film

MR16 MR25 MR30 MR52
Status D

All types have CECC approval

style	limiting voltage V(r.m.s.)	**rated dissipation at T_{amb} = 70°C W**	resistance range	tolerance ± %	series	temperature coefficient ± 10^{-6}/K	catalogue no. YYYZ
MR16	150		51,1 Ω to 100 kΩ	1	E24/E96	50	2322 150 5....
	150	**0,25**	51 Ω to 100 kΩ	2	E24	100	2322 150 4....
MR16	150		51,1 Ω to 100 kΩ	1	E24/E96	50	2322 150 2....
on reel	150		51 Ω to 100 kΩ	2	E24	100	2322 150 1....
MR25	250		1 Ω to 1 MΩ	0,5	E192	50*	2322 151 7....
	250		1 Ω to 1 MΩ	1	E24/E96	50*	2322 151 5....
	250	**0,4**	1 Ω to 1 MΩ	2	E24	100	2322 151 4....
MR25	250		1 Ω to 1 MΩ	1	E96	50*	2322 151 2....
on reel	250		1 Ω to 1 MΩ	2	E24	100	2322 151 1....
MR30	350			0,5	E192	50*	2322 152 7....
	350			1	E24/E96	50*	2322 152 5....
	350	**0,5**	1 Ω to 1 MΩ	2	E24	100	2322 152 4....
MR30	350			1	E96	50*	2322 152 2....
on reel	350			2	E24	100	2322 152 1....
MR52	500	**1**	4,99 Ω to 1 MΩ	1	E96	100	2322 153 5....

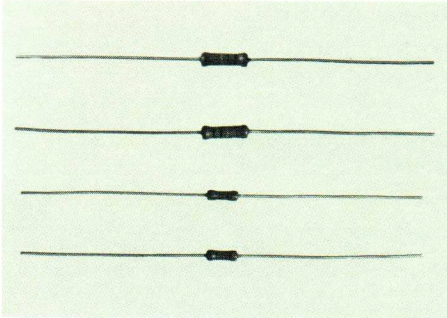
Basic specification	IEC 115-1
	CECC 40401
Climatic category (IEC 68)	55/155/56

Composition of catalogue no.

YYY first three figures of resistance value

Z	code for decade
8	1 to 9,76 Ω
9	10 to 97,6 Ω
1	100 to 976 Ω
2	1 to 9,76 Ω
3	10 to 97,6 kΩ
4	100 to 976 kΩ
5	1 MΩ

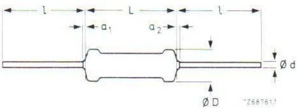
* For values ⩽ 49,9 Ω: 100 . 10^{-6}/K



A professional style of resistor that is also widely used in consumer equipment. It meets the high standards required for test and measuring equipment, for communications equipment, etc. The lacquer is non-flammable and is resistant to all the usual cleansing solvents.

Dimensions

style	D_{max}	L_{max}	l	d	$a_1 + a_2$
MR16	1,6	4,0	28 ± 2	0,5	⩽ 1
MR25	2,5	6,5	28 ± 2	0,6	⩽ 1
MR30	3	10	28 ± 2	0,6	⩽ 1
MR52	5,2	16,5	38 ± 3	0,6	⩽ 1

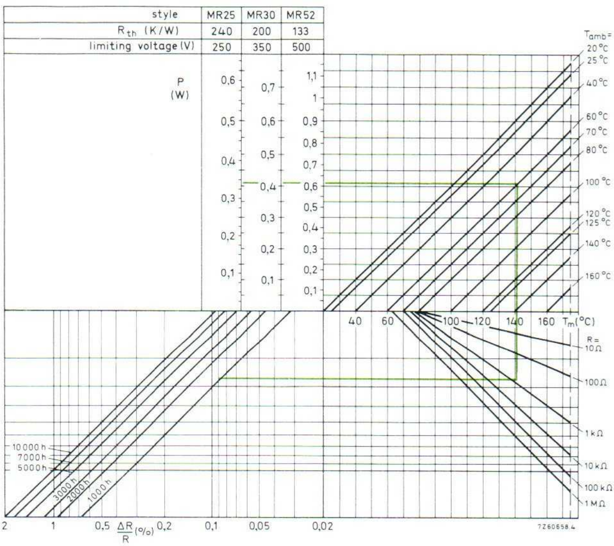


Nomogram to find style or stability

Example

What is the stability of a 1 kΩ metal film resistor, style MR25, operating at 0,33 W in an ambient of 60°C? Find 0,33 W on MR25 style column. Follow the line right, down, left, to where it intersects the 1000 h line.

ΔR/R is 0,28% over 1000 working hours. Use the reverse procedure to find right style for a given stability and dissipation. If a resistor style MR52 is loaded with 1 W, the hot-spot temperature will rise above 175°C, however the stability will be as good as at 175°C.



fixed resistors
metal film

MR24E/C/D MR34E/C/D
MR54E/C/D MR74E/C/D
Status D

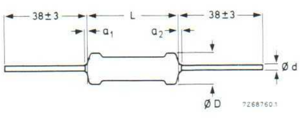
These resistors are intended for demanding applications where MIL-STD is required. They meet MIL-R-10509F in all respects and can be supplied with tolerances down to 0,1% and, to special order, in non-standard resistance values.

style	max voltage (r.m.s.) V	**rated dissipation W**	resistance range and tolerance	max. temp. coef. $\pm 10^{-6}$/K	MIL style	style code **PPP**
	at T_{amb} = 125°C		0,1/0,25/0,5% for E192 series 1% E96 series			
MR24E	200	**0,1**	49,9 Ω – 1 MΩ	25	RN55E	160
MR24C	200	**0,1**	49,9 Ω – 1 MΩ	50	RN55C	161
MR34E	250	**0,125**	49,9 Ω – 1 MΩ	25	RN60E	163
MR34C	250	**0,125**	49,9 Ω – 1 MΩ	50	RN60C	164
MR54E	300	**0,25**	49,9 Ω – 1 MΩ	25	RN65E	166
MR54C	300	**0,25**	49,9 Ω – 1 MΩ	50	RN65C	167
MR74E	350	**0,5**	24,9 Ω – 1 MΩ	25	RN70E	169
MR74C	350	**0,5**	24,9 Ω – 1 MΩ	50	RN70C	170
	at T_{amb} = 70°C		1% E96 series			
MR24D	200	**0,125**	10 Ω – 1 MΩ	100	RN55D	162
MR34D	300	**0,25**	10 Ω – 1 MΩ	100	RN60D	165
MR54D	350	**0,5**	10 Ω – 1 MΩ	100	RN65D	168
MR74D	500	**0,75**	10 Ω – 1 MΩ	100	RN70D	171

Basic specification MIL-R-10509F
Stability after load ΔR/R max 0,5% + 0,05Ω

Dimensions

style	D_{max}	L_{max}	d	$a_1 + a_2$
MR24E/C/D	2,5	6,5	0,6	⩽ 1
MR34E/C/D	3,1	10,5	0,6	⩽ 1
MR54E/C/D	5,2	16,5	0,6	⩽ 1
MR74E/C/D	6,8	20,5	0,8	⩽ 1



Composition of catalogue no. 2322 PPP XYYYZ

PPP style code

X	tolerance code*
1	± 1%
2	± 0,5%
3	± 0,25%
4	± 0,1%

YYY first three figures of resistance value*

Z	code for decade*
9	10 to 98,8 Ω
1	100 to 988 Ω
2	1 to 9,88 kΩ
3	10 to 98,8 kΩ
4	100 to 988 kΩ
5	1 MΩ

Example
Style MR24E; 261 Ω; 0,25%.
Catalogue no. 2322 160 32611.

*For resistance values and tolerances mentioned below, use numbers shown.

value Ω	last 5 digits XYYYZ of cat. no. 0,1%	0,25%	0,5%	1%
29,9	92102	92122		
39,9	92103	92123		
49,9	92104	92124	92134	92144
59,9	92105	92125		
69,9	92106	92126		
79,9	92107	92127		
89,9	92108	92128		
99,9	92109	92129		

Marking: (to MIL-R-10509 F).
Each resistor is marked with MIL style value and tolerance in MIL code manufacturer's identification symbol.

metal film - precision resistors

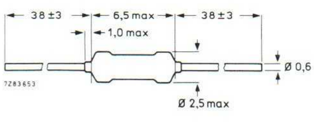
MPR24 MPR34
Status D

- high stability
- low temperature coefficient

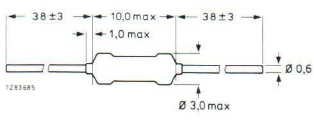
style and failure level	limiting voltage V(d.c.)	rated dissipation at $T_{amb} = 70°C$ W	resistance range	tolerance ± %	temperature coefficient ± 10^{-6}/K	catalogue no.
MPR24 level R	250	0,250	4,99 Ω to 1 MΩ 4,99 Ω to 100 kΩ	0,5; 0,25; 0,1	25, 15 10, 5	2322 141 .....
MPR24 level S	250	0,125	24 Ω to 100 kΩ	0,05; 0,02; 0,01	25, 15, 10, 5	2322 141 .....
MPR34 level R	250	0,40	4,99 Ω to 1 MΩ 4,99 Ω to 100 kΩ	0,5; 0,25; 0,1	25, 15 10, 5	2322 142 .....
MPR34 level S	250	0,25	24 Ω to 100 kΩ	0,05; 0,02; 0,01	25, 15, 10, 5	2322 142 .....

Category level R	55/155/56
level S	25/125/56
Specification based on	CECC 40300 MIL-R-10509 MIL-R-55182 DIN44061
Temperature characteristic between −20 and +70°C	ΔR/R max ± 0,0025% (TC25) ΔR/R max ± 0,0015% (TC15) ΔR/R max ± 0,0010% (TC10) ΔR/R max ± 0,0005% (TC5)
Vibration test	10 Hz to 500 Hz; 0,75 mm or 98 m/s^2
Air pressure (lower limit)	8,5 kN/m^2
Stability after load	ΔR/R max 0,05% + 0,01 Ω

Dimensions



MPR24



MPR34

fixed resistors
metal film – high voltage

VR25 VR37 VR68
Status D

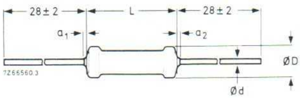
A range of metal-glazed resistors up to 68 MΩ, especially intended for stability and reliability at high voltages. They are commonly used as protection resistors in tv and radio touch control systems.

style	limiting voltage V(r.m.s.)	limiting voltage V(d.c.)	**rated dissipation at $T_{amb} = 70°C$ W**	resistance range	tolerance ± %	series	catalogue no.
VR25	1150	1600	**0,25**	220 kΩ to 15 MΩ 220 kΩ to 10 MΩ 12 to 22 MΩ	1 5 10	E24, E96 E24 E12	2322 241 PXYYZ
VR37	2500	3500	**0,5**	220 kΩ to 33 MΩ	5 1	E24 E24, E96	2322 242 PXYYZ
VR68	7000	10000	**1,0**	100 kΩ to 68 MΩ	5 1	E24 E24, E96	2322 244 PXYYZ

Max body temperature (hot spot)	155°C
Temperature coefficient	± max 200 10^{-6}/K
Dielectric withstanding voltage of the insulation for 1 minute	min 700 V(r.m.s.)
Basic specification	IEC 115, type 1B
Climatic category (IEC 68)	55/155/56
Noise	VR25: ⩽ 5 μV/V VR37; VR68: ⩽ 2,5 μV/V
Stability after 1000 h max load	VR25 ΔR/R⩽3% VR37 ΔR/R⩽2,5% VR68 ΔR/R⩽2,5%

Dimensions

style	L_{max}	D_{max}	$a_1 + a_2$	d
VR25	6,5	2,5	⩽ 1,0	0,6
VR37	10	3,7	⩽ 1,0	0,7
VR68	18	6,8	⩽ 1,2	0,8



Composition of catalogue no.

I Tolerance 1%

P = 8

XYY	first three digits of resistance value

Z	code for decade
4	100 to 976 kΩ
5	1 to 9,76 MΩ
6	10 to 68 MΩ

II Tolerance 5 or 10%

P	code for packing
1	in box
2	on reel

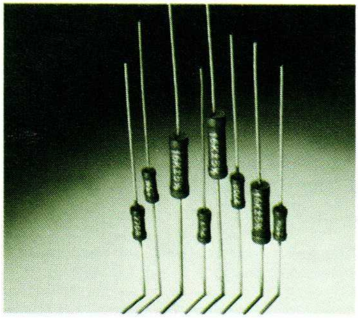
X	code for tolerance
2	10%
3	5%

YY	first two digits of resistance value

Z	code for decade
4	100 to 910 kΩ
5	1 to 9,1 MΩ
6	10 to 68 MΩ

metal film – power

PR37 PR52
Status D



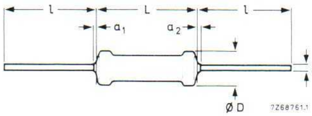
style	limiting voltage V(r.m.s.)	**rated dissipation at T_{amb} = 70°C W**	resistance range	tolerance ± %	series	catalogue no.
PR37	500	**1,6**	2,2 Ω to 27 kΩ	5	E24	2322 191 PXXYZ
PR52	500	**2,5**	2,2 Ω to 51 kΩ	5	E24	2322 192 PXXYZ

Max. body temperature (hot spot)	300°C
Basic specification	MIL-R-11804/E, char. G
Climatic category (IEC 68)	55/200/56
Stability after 1000 h max. load	
required	ΔR/R⩽5%
typical	ΔR/R = 2,5%

Dimensions

Version with straight leads (on bandolier in box)

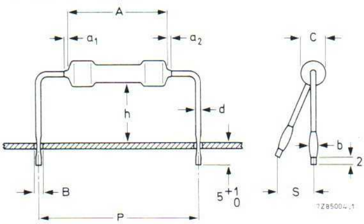
style	D_{max}	L_{max}	l	$a_1 + a_2$	d_{max}
PR37	3,9	10,0	38 ± 2	⩽ 1	0,6 and 0,8
PR52	5,2	16,7	38 ± 2	⩽ 1,2	0,6



Version with cropped and formed leads
pitch = 7e for PR37; 10e for PR52

B Ø max	b	d	h	S max.
1	1,1 + 0,1	0,6	8 + 2	2
1	1,1 + 0,1	0,6	15 + 2	3
1,2	1,3 + 0,1	0,8	8 + 2	2
1,2	1,3 + 0,1	0,8	15 + 2	3

PR37: P = 17,8 ± 3
PR52: P = 25,4 ± 4



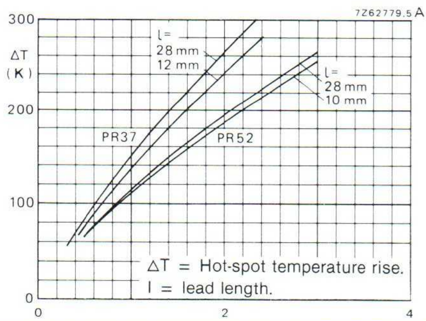
Composition of catalogue no.

P version code
3 straight leads, Ø0,6
4 cropped and formed leads, Ø0,6
5 straight leads, Ø0,8
6 cropped and formed leads, Ø0,8

XX first two digits of resistance value

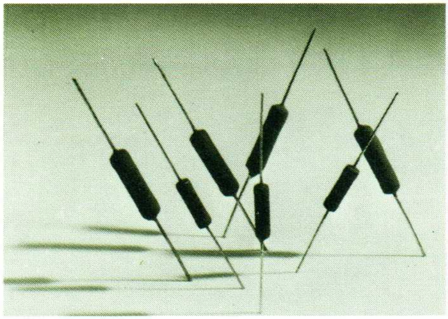
Y **0** for straight leads
or
Y code for mounting height of cropped and formed leads
0 h = 8 mm
1 h = 15 mm

Z code for decade
8 2,2 to 9,1 Ω
9 10 to 91 Ω
1 100 to 910 Ω
2 1 to 9,1 kΩ
3 10 to 51 kΩ



fixed resistors
cemented wirewound

AC04 AC05 AC07
AC10 AC15 AC20
Status D



These wirewound resistors are specially designed to dissipate high loads in a small volume.
The resistor is coated with a green silicon cement which is non-flammable and cannot drip at high overloads.

style	rated dissipation (W) T_{amb} 40°C	T_{amb} 70°C	resistance range E24 series	tol. ± %	catalogue no. YYZ
AC04	**4**	**3,5**	0,1 to 8,2 Ω	10	2322 329 34...
			10 Ω to 4,7 kΩ	5	2322 329 04...
AC05	**5**	**4,7**	0,1 to 8,2 Ω	10	2322 329 35...
			10 Ω to 5,6 kΩ	5	2322 329 05...
AC07	**7**	**5,8**	0,1 to 8,2 Ω	10	2322 329 37...
			10 Ω to 10 kΩ	5	2322 329 07...
AC10	**10**	**8,4**	0,68 to 8,2 Ω	10	2322 329 40...
			10 Ω to 15 kΩ	5	2322 329 10...
AC15	**15**	**12,5**	0,82 to 8,2 Ω	10	2322 329 45...
			10 to 22 kΩ	5	2322 329 15...
AC20	**20**	**16**	1,2 to 8,2 Ω	10	2322 329 50...
			10 Ω to 33 kΩ	5	2322 329 20...

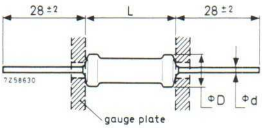
Composition of catalogue no.

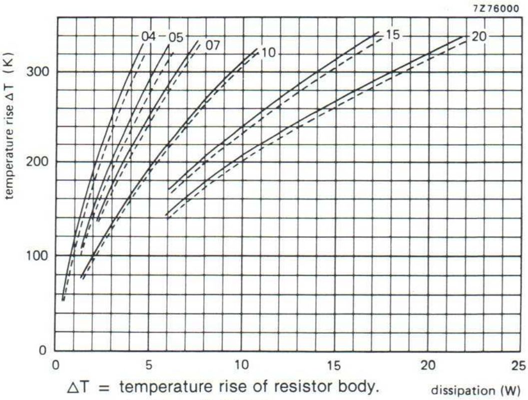
YY	first two digits of resistance value
Z	code for decade
7	0,1 to 0,82 Ω
8	1 to 8,2 Ω
9	10 to 91 Ω
1	100 to 910 Ω
2	1 to 9,1 kΩ
3	10 to 33 kΩ

Maximum body temperature		350°C
Temperature coefficient	R⩾10 Ω	−80 to +140.10^{-6}/K
	R<10 Ω	600.10^{-6}/K
Basic specification		IEC 266
Climatic category (IEC 68)		40/200/56
Stability after load		ΔR/R max 5%

Dimensions

style	D_{max}	L_{max}	d
AC04	6	19	0,6
AC05	8	19	0,8
AC07	8	27	0,8
AC10	8	44	0,8
AC15	10	51	0,8
AC20	10	67	0,8





ΔT = temperature rise of resistor body.
——— lead length 25 mm
.... lead length 10 mm

cemented wirewound

ACL01 ACL02 ACL03
Status D

style	rated dissipation (W) $T_{amb} = 70°C$	resistance range	tol. %	series	catalogue no. YYZ
ACL01	**1,0**	0,1 to 8,2 Ω	10	E12	2306 300 02...
		10 Ω to 3,9 kΩ	5	E24	2306 300 03...
ACL02	**2,0**	0,18 to 8,2 Ω	10	E12	2306 301 02...
		10 Ω to 8,2 kΩ	5	E24	2306 301 03...
ACL03	**3,0**	0,27 to 8,2 Ω	10	E12	2306 302 02...
		10 Ω to 12 kΩ	5	E24	2306 302 03...

Max. body temperature	350°C
Basic specification	IEC publication 266
Climatic category, (IEC 68, DIN40045)	40/200/56
Stability after 1000 h load	ΔR/R max 3%

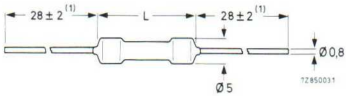
Composition of catalogue no.

YY first two digits of resistance value

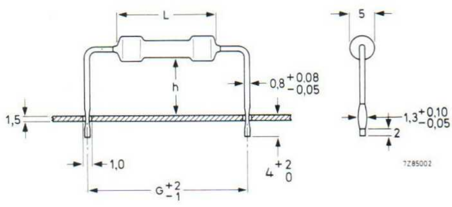
Z	code for decade
7	0,1 to 0,91 Ω
8	1 to 9,1 Ω
9	10 to 91 Ω
1	100 to 910 Ω
2	1 to 9,1 kΩ
3	10 to 22 kΩ

Dimensions

Standard version with straight leads.



Special version with cropped and formed leads.

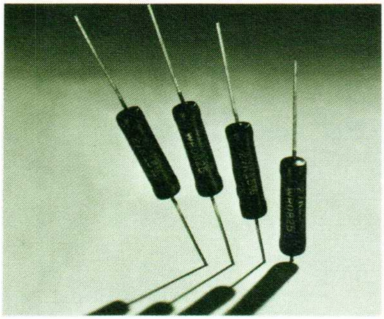


style	L_{max}	G	h
ACL01	16	20	8 or 15
ACL02	24	27,5	8 or 15
ACL03	34	–	8 or 15

Marking
Each resistor is marked with: resistance value, tolerance on resistance and rated dissipation at $T_{amb} = 70°C$.
Example: 10 R 5%
1 W

fixed resistors
enamelled wirewound

WR0617E WR0825E
WR0842E WR0865E
Status D



These resistors have a permissible hot-spot temperature of 400°C. The leads are of a special material with high thermal resistance to counter temperature effects of the solder joint. The coating is a high quality vitreous enamel.

style	rated dissipation at $T_{amb} = 70°C$ W	resistance range	tol. %	series	catalogue no. YYZ
WR0617E	4	4,7 Ω to 4,7 kΩ	5	E24	2322 330 22. . .
		4,7 to 47 Ω	10	E12	2322 330 21. . .
WR0825E	7	6,8 Ω to 27 kΩ	5	E24	2322 330 32. . .
		6,8 to 27 Ω	10	E12	2322 330 31. . .
WR0842E	11	10 Ω to 56 kΩ	5	E24	2322 330 42. . .
WR0865E	17	15 Ω to 100 kΩ	5	E24	2322 330 52. . .

Max. body temperature (hot spot)	400°C
Basic specification	IEC 266, type 2
Climatic category (IEC 68)	55/200/56
Stability after 1000 h max. load	ΔR/R max 5%

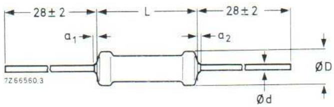
Composition of catalogue no.

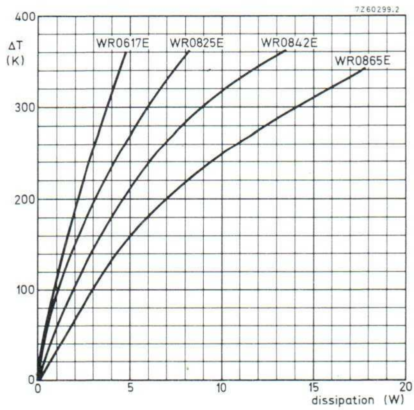
YY first two digits of resistance value

Z	code for decade
8	4,7 to 9,1 Ω
9	10 to 91 Ω
1	100 to 910 Ω
2	1 to 9,1 kΩ
3	10 to 91 kΩ
4	100 kΩ

Dimensions

style	D_{max}	L_{max}	d	a_{max}
WR0617E	6	19	0,7	3
WR0825E	8	27	0,8	3
WR0842E	8	44	0,8	3
WR0865E	8	67	0,8	3





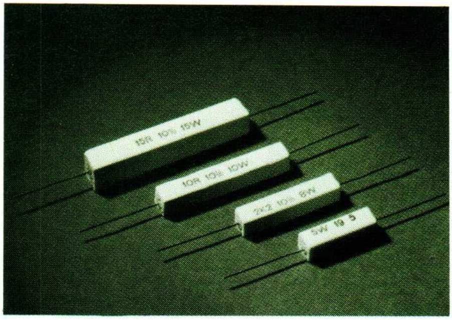
ΔT = temperature rise of resistor body.

Marking
Each resistor is marked with resistance value (R for Ω, K for kΩ)
e.g. 27 Ω = 27R
27 kΩ = 27K

tolerance
style

rectangular wirewound

EH04 EH05 EH07
EH09 EH17
Status D



Resistors especially designed for high dissipation in a small volume. The rectangular package makes mounting quick and simple.

style	**rated dissipation at $T_{amb} = 70°C$ W**	resistance range	tol. ± %	series	catalogue no. YYZ
EH04	**4**	0,1 to 8,2 Ω	10	E12	2306 335 02...
		10 Ω to 3,9 kΩ	5	E24	2306 335 03...
EH05	**5**	0,15 to 8,2 Ω	10	E12	2306 330 02...
		10 Ω to 6,8 kΩ	5	E24	2306 330 03...
EH07	**7**	0,27 to 8,2 Ω	10	E12	2306 331 02...
		10 Ω to 12 kΩ	5	E24	2306 331 03...
EH09	**9**	0,33 to 8,2 Ω	10	E12	2306 332 02...
		10 Ω to 15 kΩ	5	E24	2306 332 03...
EH17	**17**	0,47 to 8,2 Ω	10	E12	2306 333 02...
		10 Ω to 22 kΩ	5	E24	2306 333 03...

Max body temperature (hot spot)	350°C
Basic specification	IEC 266
Climatic category (IEC 68)	40/200/56
Stability after 1000 h rated dissipation	ΔR/R max 5%

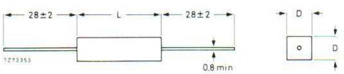
Composition of catalogue no.

YY first two digits of resistance value

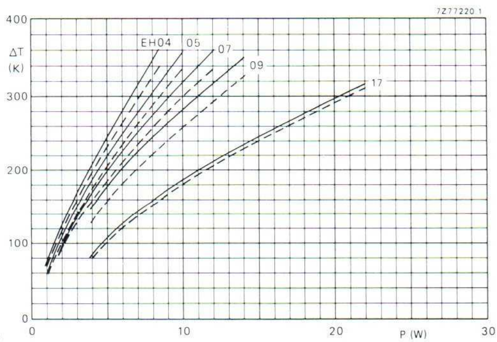
Z	code for decade
7	0,15 to 0,91 Ω
8	1 to 9,1 Ω
9	10 to 91 Ω
1	100 to 910 Ω
2	1 to 9,1 kΩ
3	10 to 22 kΩ

Dimensions

style	D_{max}	L_{max}
EH05	7,2	26
EH07	7,2	36
EH09	7,2	46
EH17	10,2	62

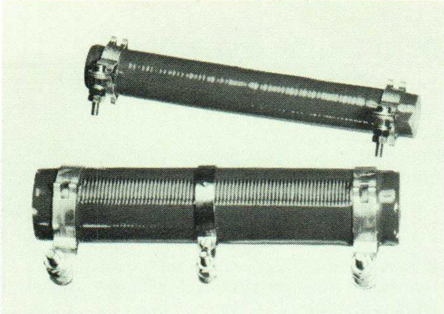


Marking
Each resistor is marked with resistance value (R for Ω, K for kΩ)
e.g. 27 Ω = 27R
15 kΩ = 15K
tolerance on resistance in ± %
rated dissipation at $T_{amb} = 70°C$



——— lead length 22 mm
------------ lead length 28 mm
ΔT = temperature rise of resistor body.

fixed resistors
wirewound



2322 321 to 324
fixed or adjustable, with side terminals
Status D

P_{max} 40°C W	coating	resistance range	tolerance ± %	catalogue no. fixed YYZ	adjustable YYZ
8	cement	1 to 100 Ω	10	323 14. . .	–
		110 to 150 Ω	5	323 34. . .	–
	enamel	160 Ω to 6,8 kΩ	5	321 34. . .	–
10	cement	1,2 to 27 Ω	10	323 12. . .	324 12. . .
		30 to 300 Ω	5	323 32. . .	324 32. . .
	enamel	330 Ω to 12 kΩ	5	321 32. . .	–
		330 Ω to 3,3 kΩ	5	–	322 32. . .
16	cement	1,5 to 2,7 Ω	10	323 10. . .	324 10. . .
		3 to 620 Ω	5	323 30. . .	324 30. . .
	enamel	680 Ω to 24 kΩ	5	321 30. . .	–
		680 Ω to 6,8 kΩ	5	–	322 30. . .
25	cement	2,7 to 15 Ω	10	323 08. . .	324 08. . .
		16 to 820 Ω	5	323 28. . .	324 28. . .
	enamel	1 to 39 kΩ	5	321 28. . .	–
		1 to 9,1 kΩ	5	–	322 28. . .
40	cement	4,7 Ω to 1,6 kΩ	5	323 26. . .	324 26. . .
	enamel	1,8 to 75 kΩ	5	321 26. . .	–
		1,8 to 18 kΩ	5	–	322 26. . .
60	cement	3 Ω to 2,2 kΩ	5	323 24. . .	324 24. . .
	enamel	2,4 to 68 kΩ	5	321 24. . .	–
		2,4 to 24 kΩ	5	–	322 24. . .
100	cement	6,8 Ω to 4,3 kΩ	5	323 23. . .	324 23. . .
	enamel	4,7 to 120 kΩ	5	321 23. . .	–
		4,7 to 47 kΩ	5	–	322 23. . .
160	cement	10 Ω to 47 kΩ	5	323 22. . .	324 22. . .
250	cement	16 Ω to 11 kΩ	5	323 21. . .	324 21. . .

Rated dissipation, when mounted on metal plate	1,2 x P_{max}
Temperature coefficient	– 50 to + 140 10^{-6}/K
Climatic category (IEC 68)	55/155/56

Dimensions

P W	L_{max}	D_{max}	d_{min}	K	H	E	B	A	thread
8	26	11,5	5	2,5	14	–	–	–	–
10	41	11,5	4,2	4	14	–	5	2,8	–
16	62	11,5	4,2	4	14	–	5	2,8	–
25	64	16	7,2	4	20	–	6	3,2	–
40	103	16	7,2	4	20	–	6	3,2	–
60	103	32	12,5	6	33	8,5	6	–	M4
100	165	32	12,5	6	33	8,5	6	–	M4
160	165	44	20	8	40	10	8	–	M5
250	256	44	20	8	40	10	8	–	M5

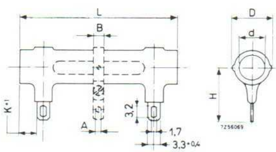
Composition of catalogue no.

YY first two digits of resistance value

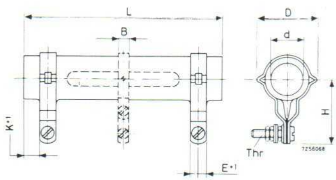
Z code for decade

Z	
8	1 to 8,2 Ω
9	10 to 82 Ω
1	100 to 820 Ω
2	1 to 8,2 kΩ
3	10 to 82 kΩ
4	100 to 120 kΩ

P ⩽ 40 W



P ⩾ 60 W



variable resistors
survey

**For detailed information
Handbook C12**

Preset potentiometers

miniature carbon	CTP10	2322	410		C20
carbon	CTP14	2322	409		C21
	CTP18	2322	411		C22 – C23
cermet	MTP10	2322	482		C24
wirewound	TWP22	2322	011		C25
multiturn carbon	CMP10	2322	412		
	CMP20	2322	413		
	CMP40	2322	414		C26 – C27

Control potentiometers

carbon	CP16-series	2322	3. .		C28 – C31
	CP23-series	2322	3. .		C32 – C35
slide carbon	CSP60	2322	42.		C36 – C37
	CSP40	2322	43.		C38 – C39
	CSP25	2322	415		C40
wirewound	WP23	2322	012		
		2322	013		C41
	WP22	2322	018		
		2322	020		C42
	WP24	2322	003		
		2322	010		C43
	WP42	2322	004		C44

Focus potentiometers

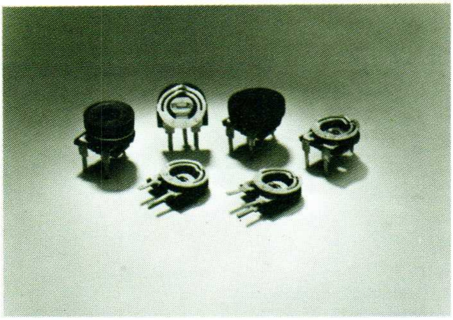
carbon		2322	460	90009; 11; 12	C45
cermet		2322	460	90016; 18; 22	C46
		2322	460	90027; 28; 29	C47 – C48

Test switches

		2422	136	7. . . .	C49

variable resistors
preset potentiometers

CTP10 – miniature carbon
10 mm – linear law
Status D



Resistance range (E3-series), linear law	47 Ω to 4,7 MΩ
Max dissipation at T_{amb} = 40°C	0,1 W
at T_{amb} = 70°C	0,05 W
Ambient temperature	–25 to 70°C

Composition of catalogue no. 2322 410 XYYZZ

X	code for knob
0	without knob
4	with knob (450. . only) cat. no. of knob: 4322 047 00190
6	with knob (611. . and 633. . only) cat. no. of knob: 4322 047 27740

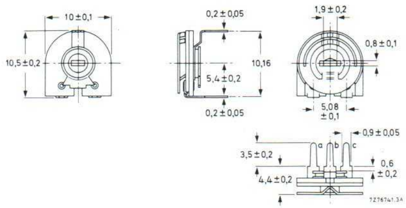
YY	code for mounting
11	vertical mounting
33	horizontal mounting
50	vertical mounting

ZZ resistance code

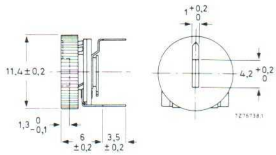
nom value ± 20%	I_{max} slider mA	ZZ
47 Ω	46	91
100	32	51
220	21	52
330	17	69
470	15	53
1 kΩ	10	54
2,2	6,7	55
4,7	4,6	56
10	3,2	57
22	2,1	58
47	1,5	59
100	1,0	61
220	0,7	62
470	0,32	63
1 MΩ	0,15	64
2,2	0,068	65
4,7	0,032	66

Dimensions

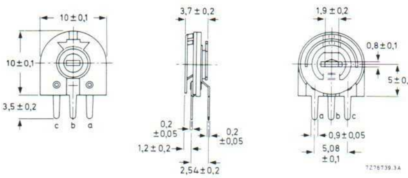
Horizontal mounting **033**



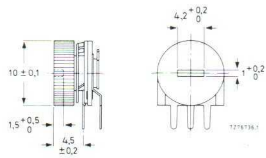
633



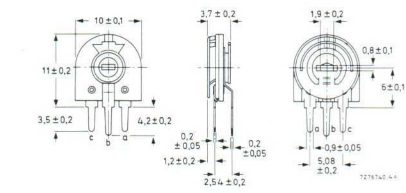
Vertical mounting **050**



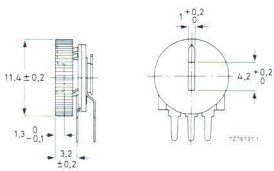
450



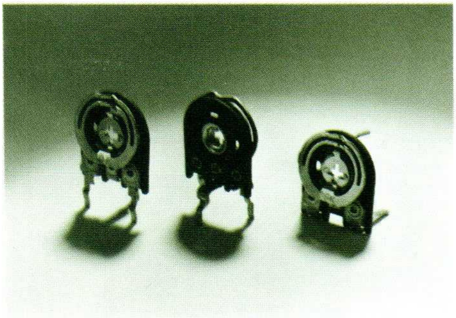
Vertical mounting **011**



611



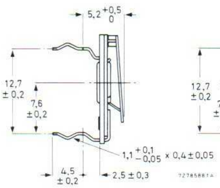
CTP14 – carbon
14 mm – linear law
Status D



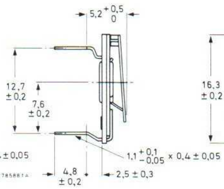
Resistance range	47 Ω to 4,7 MΩ
Max. dissipation at T_{amb} = 40°C	0,3 W
Operating temperature	– 55 to + 100°C
Climatic category IEC 68	55/100/10

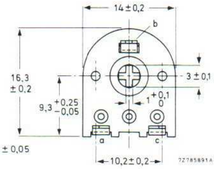
Dimensions

Horizontal mounting
snap-in pins

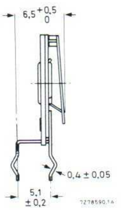


straight pins

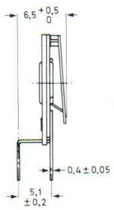


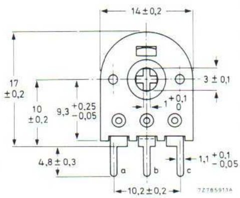


Vertical mounting
snap-in pins



straight pins





Composition of cat. no. 2322 409 XYYZZ

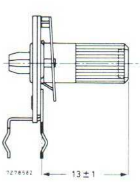
X code for knob
- **0** without knob
- **1** with knob at base-plate side
- **2** with knob at carbon-track side
- **4** with adjustment wheel at carbon-track side

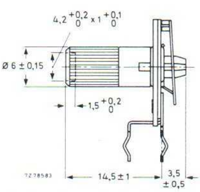
YY code for pins
- **33** snap-in pins for horizontal mounting
- **13** straight pins for horizontal mounting
- **22** snap-in pins for vertical mounting
- **02** straight pins for vertical mounting

ZZ resistance code

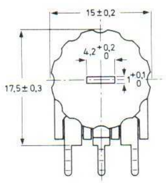
nom value ± 20%	I_{max} slider mA	ZZ
47 Ω	65	91
100	45	51
220	30	52
330	24,5	69
470	20,6	53
1 kΩ	14,1	54
2,2	9,5	55
4,7	6,5	56
10	4,5	57
22	3	58
47	2	59
100	1,4	61
220	0,9	62
470	0,6	63
1 MΩ	0,4	64
2,2	0,3	65
4,7	0,2	66

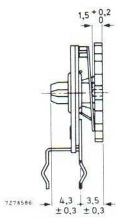
Knob sizes





Wheel sizes





variable resistors
preset potentiometers

CTP18 – carbon
18 mm – linear law
Status C

Resistance range (E3-series), linear law	47 Ω to 4,7 MΩ
Max. dissipation at T_{amb} = 25°C	0,25 W
70°C	0,15 W
Operating temperature	–25 to 70°C

Dimensions

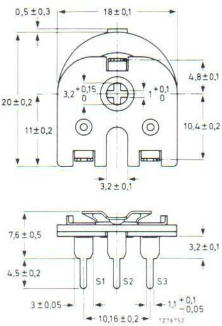


Fig. 1
2322 411 033. .

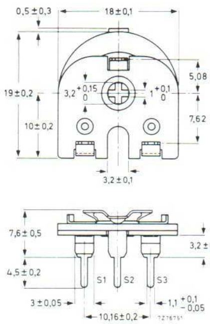


Fig. 2
2322 411 083. .

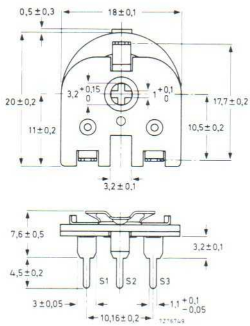


Fig. 3
2322 411 084. .

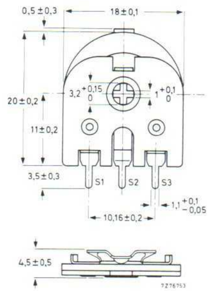


Fig. 4
2322 411 022. .

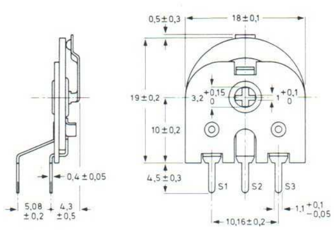


Fig. 5
2322 411 072. .

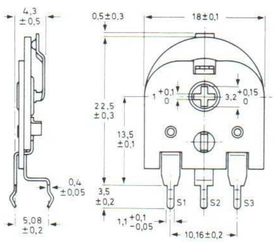
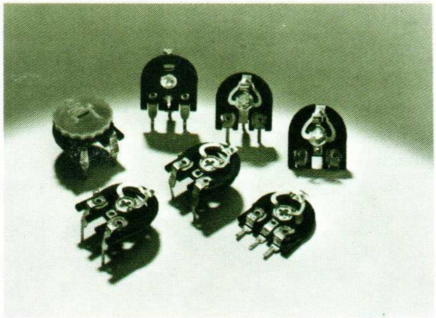
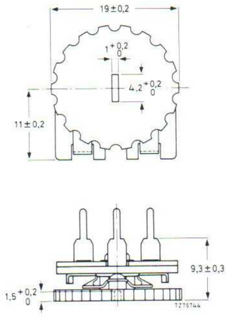
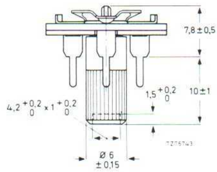


Fig. 6
2322 411 073. .







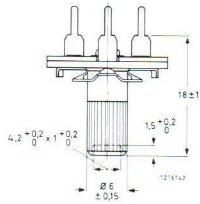


Fig. 7
2322 411 433. .

Fig. 8
2322 411 133. .

Fig. 9
2322 411 233. .

Composition of catalogue no. 2322 411 XYYZZ

X	code for knob
0	without knob
1	with knob at base-plate side
2	with knob at carbon-track side
3	with adjustment wheel at base-plate side (only for vertical mounting versions)
4	with adjustment wheel at carbon-track side

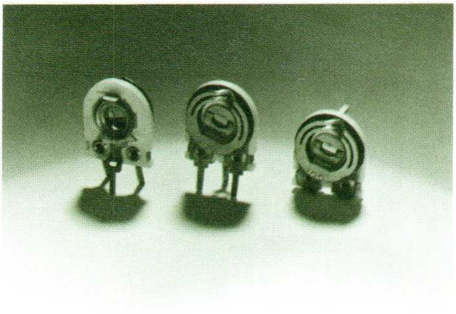
YY	code for pins
22	with pins for vertical mounting (Fig. 4)
33	with pins for horizontal mounting (Fig. 1)
72	with pins for vertical mounting (according to DIN 44150, Fig. 5)
73	with pins for vertical mounting (Fig. 6)
83	with pins for horizontal mounting (according to DIN 44150, Fig. 2)
84	with pins for horizontal mounting (according to DIN 44151, Fig. 3)

Note: catalogue no. of adjustment wheel : 4322 047 08230;
catalogue no. of adjustment knob : 4322 047 08280.

ZZ resistance code

nom value ± 20%	I_{max} slider mA	ZZ
47 Ω	72	91
100	50	51
220	34	52
330	27,5	69
470	20	53
1 kΩ	16	54
2,2	11	55
4,7	7,3	56
10	5	57
22	3,4	58
47	2,3	59
100	1,6	61
220	1,1	62
470	0,7	63
1 MΩ	0,5	64
2,2	0,2	65
4,7	0,1	66

variable resistors
preset potentiometers



MTP10 – cermet
10 mm – linear law
Status D

Max dissipation at T_{amb} = 70°C	0,5 W
Operating temperature	– 55 to 125°C

Dimensions

Horizontal mounting

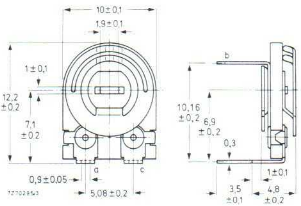


Fig. 1

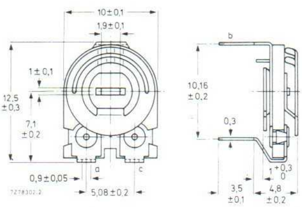


Fig. 2

Vertical mounting

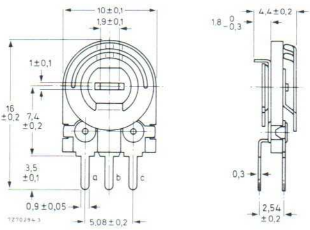


Fig. 3

Composition of catalogue no. 2322 482 XYZZZ

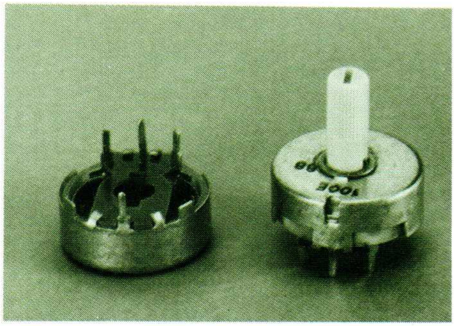
X	code for mounting
2	for horizontal mounting (Fig. 1)
3	for vertical mounting (Fig. 3)
4	for horizontal mounting (Fig. 2)

Y	code for tolerance
0	± 20%
2	± 10%

ZZZ resistance code

nominal resistance	ZZZ
100 Ω	101
150	151
220	221
330	331
470	471
680	681
1 kΩ	102
1,5	152
2,2	222
3,3	332
4,7	472
6,8	682
10	103
15	153
22	223
33	333
47	473
68	683
100	104
150	154
220	224
330	334
470	474
680	684
1 MΩ	105
1,5	155
2,2	255
3,3	335
4,7	475
6,8	685

TWP22 – wirewound
linear law
Status D



Max dissipation at T_{amb} =	40°C	2 W
	70°C	1,5 W
Operating temperature		– 10 to 70°C
Climatic category (IEC 68)		10/070/21

Composition of catalogue no. 2322 011 YYZZZ

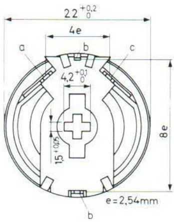
YY	code for knob
02	without tap or knob
03	with tap, without knob
22	without tap, with knob
23	with tap and knob

ZZZ resistance code

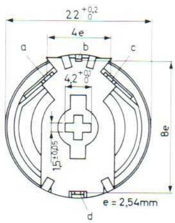
resistance value in Ω	ZZZ
2,2	228
3,3	338
4,7	478
6,8	688
10	109
15	159
22	229
33	339
47	479
68	689
100	101
120	121
150	151
180	181
220	221
330	331
470	471
680	681
1000	102
4700	472
11 + 11	229
50 + 50	101
150 + 150	301

Dimensions

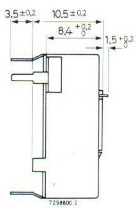
without tap



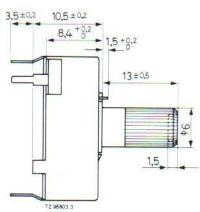
with tap



without knob



with knob

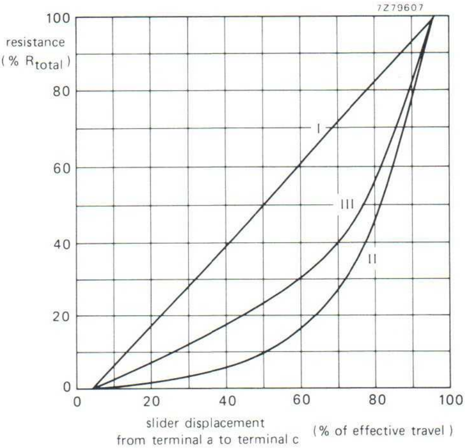


variable resistors
preset potentiometers

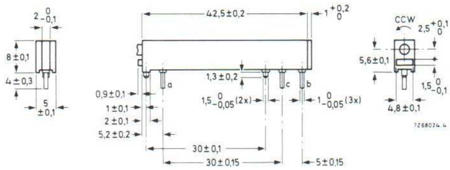
CMP10, CMP20, CMP40 – multiturn carbon
10, 20 and 40 turns – linear and other laws
Status D

Precision multiturn preset potentiometers, widely used in tv and radio tuning.

Operating temperature	– 25 to 70°C
Climatic category IEC 68	25/070/21



Dimensions (for scale indicator and adjustment provisions see next page).



Composition of catalogue no. 2322 41P XYYZZ

P code for number of turns of spindle
2 20 turns
3 10 turns
4 40 turns

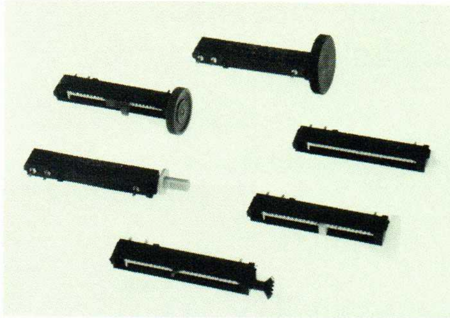
X code for indicator type
8 without indicator but with dust cover
0 without indicator
1/5 with indicator (see next page)

YY code for adjustment provision
(see next page)

ZZ resistance code, see table

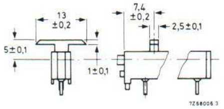
Resistance code ZZ in catalogue no.

nominal resistance	linear law, curve I	logarithmic law, curve II	special law, curve III
100 Ω	01		
220	02		
470	03		
1 kΩ	04	24	
2,2	05	25	
4,7	06	26	
10	07	27	
22	08	28	
47	09	29	
100	11	31	38
220	12	32	
470	13	33	
1 MΩ	14	34	
2,2	15	35	
4,7	16		

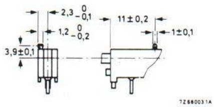


X code for indicator type

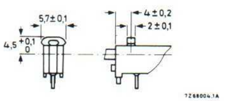
1



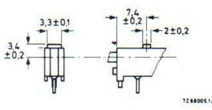
2



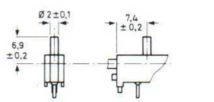
3



4



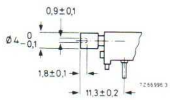
5



YY code for adjustment provision YY

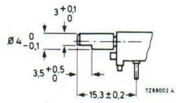
slotted

51



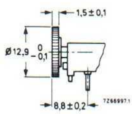
shabed

52

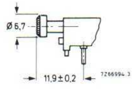


gear-wheels

82

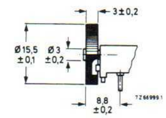


83



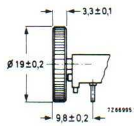
knobs

61



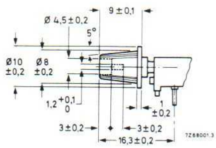
approx. 60 notches

62

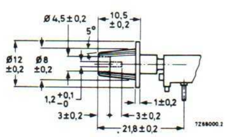


approx. 48 notches

63



64



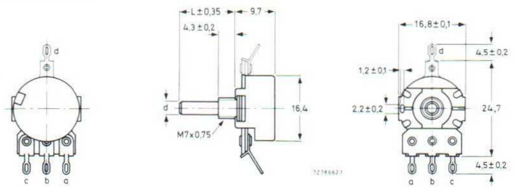
variable resistors
control potentiometers

CP16 – carbon
16 mm – linear and other laws
Status D

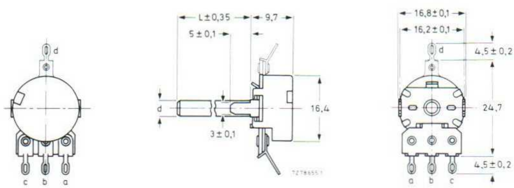
Widely used in video and audio equipment.

Max dissipation at T_{amb} = 40°C	
linear	0,1 W
others	0,05 W
Operating temperature	– 10 to 70°C
Climatic category IEC 68	10/070/21
Breaking capacity of switch	12 V(d.c.) 2A

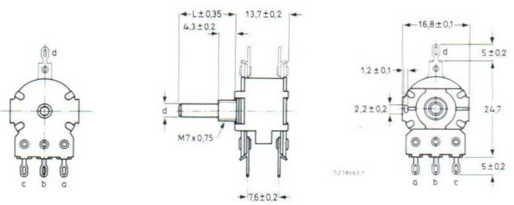
Dimensions



Single potentiometer with mounting bushing

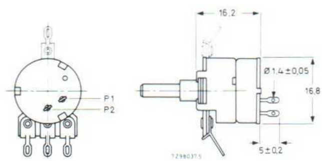


Single potentiometer with twist tags

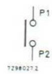


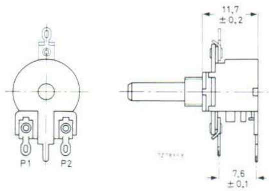
Tandem potentiometer

Switches



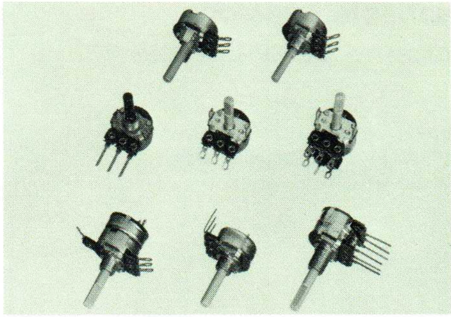
Single potentiometer
with s.p.s.t. rotary switch
(spring actuated).



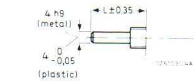


Single potentiometer
with s.p.s.t. rotary switch
(direct operating).

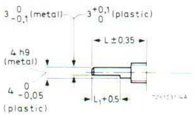
For d and L see Spindles



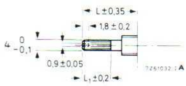
Spindles



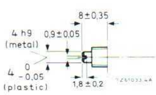
plain



flat-faced

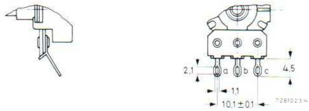


knurled

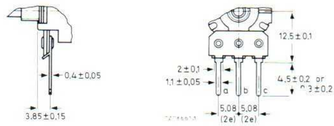


slotted

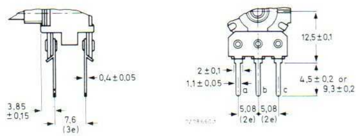
Connecting terminals



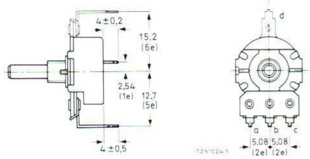
Solder tags



Long or short printed-wiring pins (single potentiometer)



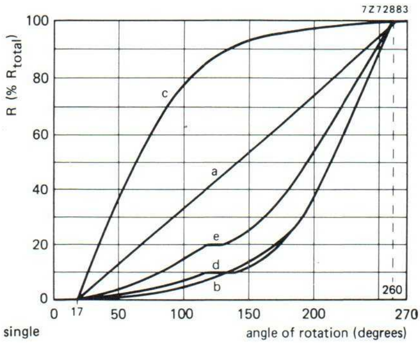
Long or short printed-wiring pins (tandem potentiometer)



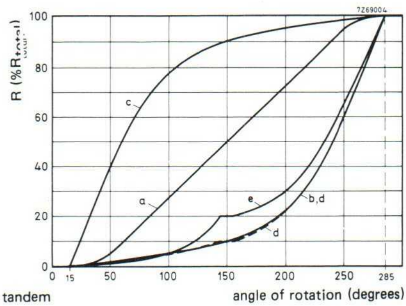
Bent printed-wiring pins (single potentiometer)

variable resistors
control potentiometers

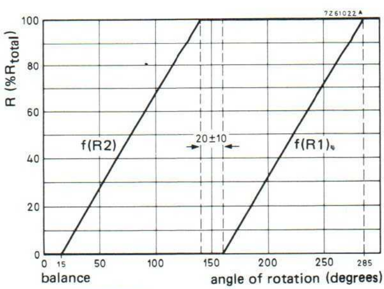
CP16 – carbon
16 mm – linear and other laws
Status D



single



tandem



balance
(for tandem only)

Composition of catalogue no. 2322 XXX YYYZZ

XXX Code for type and switch

without switch

380 single

389 single, with bent p.w. pins (only available with mounting bushing and p.w. pins of 9,3 mm length)

390 tandem

with switch

381 single, with s.p.s.t. rotary switch, spring actuated (only available with mounting bushing)

387 single, with s.p.s.t. rotary switch, direct operating (plastic spindle only)

YYY code for terminals, mounting facility, spindle type and length L

ZZ resistance code

YYY code for terminals, mounting facility, spindle type and length L

solder tags				p.w. pins, length 4,5 mm				p.w. pins, length 9,3 mm			
mounting bushing		twist tags		mounting bushing		twist tags		mounting bushing		twist tags	
metal spindle	plastic spindle	metal spindle	plastic spindle	metal spindle	plastic spindle	metal spindle	plastic spindle	metal spindle	plastic spindle	metal spindle	plastic spindle
0..	**7**..	**2**..	**4**..	**0**..	**7**..	**2**..	**4**..	**1**..	**6**..	**3**..	**5**..

L =	10 mm	= .11
	12 mm	= .09
	15 mm	= .12
	17 mm	= .13
	19 mm	= .14
plain	20 mm	= .15
	22 mm	= .17
	24 mm	= .19
	25 mm	= .01
	28 mm	= .02
	30 mm	= .03
	10 mm	= .42 (L_1 = 3,5 mm)
flat	15 mm	= .44 (L_1 = 8,5 mm)
faced	20 mm	= .45 (L_1 = 8,5 mm)
	20 mm	= .46 (L_1 = 13,5 mm)
knurled	10 mm	= .26 (L_1 = 5 mm)
(plastic	15 mm	= .27 (L_1 = 9 mm)
only)	20 mm	= .28 (L_1 = 9 mm)
slotted		= .10

L =	10 mm	= .61
	12 mm	= .59
	15 mm	= .62
	17 mm	= .63
	19 mm	= .64
plain	20 mm	= .65
	22 mm	= .67
	24 mm	= .69
	25 mm	= .51
	28 mm	= .52
	30 mm	= .53
	10 mm	= .92 (L_1 = 3,5 mm)
flat	15 mm	= .94 (L_1 = 8,5 mm)
faced	20 mm	= .95 (L_1 = 8,5 mm)
	20 mm	= .96 (L_1 = 13,5 mm)
knurled	10 mm	= .76 (L_1 = 5 mm)
(plastic	15 mm	= .77 (L_1 = 9 mm)
only)	20 mm	= .78 (L_1 = 9 mm)
slotted		= .60

Resistance code ZZ in catalogue no.

nominal resistance	linear law curve a	log. law curve b	rev. log law curve c	balance curve f
220 Ω	02			
470	03			
1 kΩ	04	24	44	
2,2	05	25	45	
4,7	06	26	46	
10	07	27	47	91
22	08	28	48	92
47	09	29	49	93
100	11	31	51	94
220	12	32	52	95
470	13	33	53	96
1 MΩ	14	34	54	97
2,2	15	35	55	
4,7	16			

Resistance code ZZ in catalogue no.

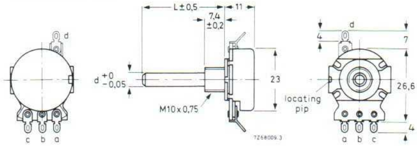
nominal resistance	tap at 10% curve d	tap at 20% curve e
5 + 42 kΩ	72	
20 + 200	67	
50 + 420	73	
100 + 900	64	
2 + 8		76
5 + 17		82
10 + 37		86
20 + 80		77
50 + 170		83
100 + 370		87
0,5 + 1,7 MΩ		84

variable resistors
control potentiometers

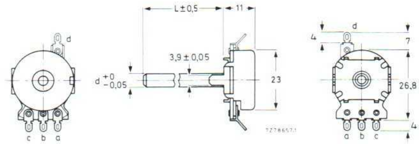
CP23 – carbon
23 mm – linear and other laws
Status D

Widely used in video and audio equipment.

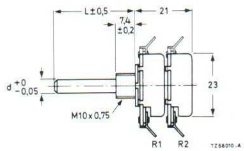
Potentiometers



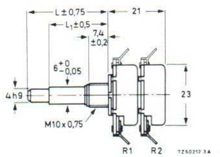
Single with mounting bushing



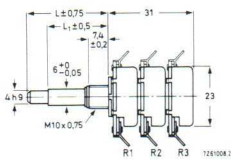
Single with twist tags



Tandem



Twin

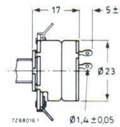


Triple

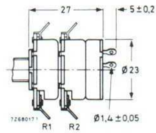
For d, L and L_1 see composition of catalogue no.

Max dissipation at T_{amb} = 40°C	
linear	0,25 W
others	0,125 W
Working temperature	– 10 to 70°C
Climatic category IEC 68	10/070/21
Breaking capacity of switch	250 V(a.c.)

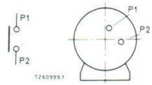
Switches

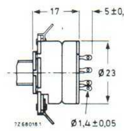


S.P.S.T. rotary switch (single)

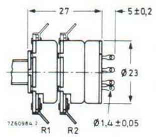


S.P.S.T. rotary switch (tandem or twin)

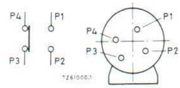


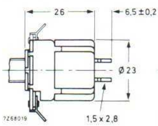


S.P.D.T. rotary switch (single)

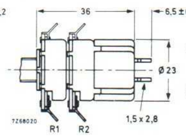


S.P.D.T. rotary switch (tandem)

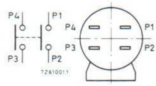


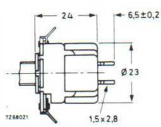


D.P.S.T. rotary switch (single)

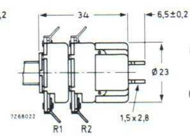


D.P.S.T. rotary switch (tandem or twin)

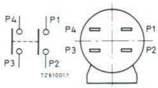


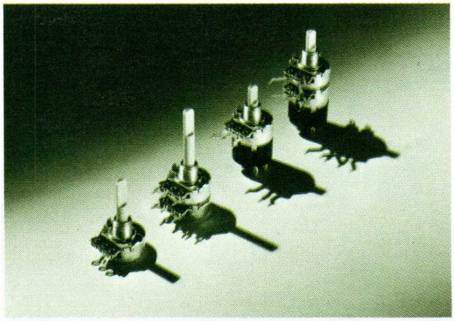


D.P.S.T. push-pull switch (single)

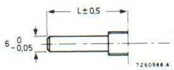


D.P.S.T. push-pull switch (tandem or twin)

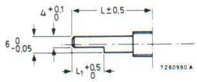




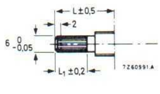
Spindles



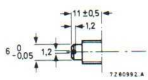
plain



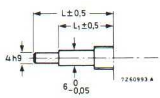
flat faced



knurled



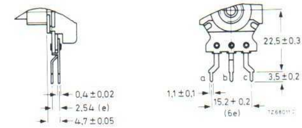
slotted



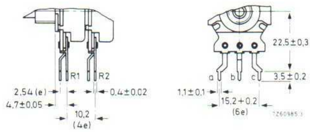
twin/triple

Connecting terminals

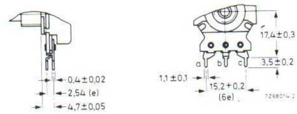
Solder tags



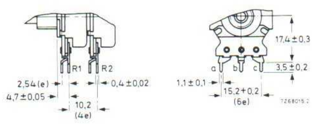
Long printed-wiring pins, pin distance 15,2 mm (6e) (single potentiometer).



Long printed-wiring pins, pin distance 15,2 mm (6e) (tandem potentiometer).



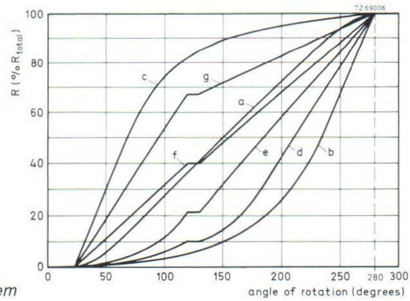
Short printed-wiring pins, pin distance 15,2 mm (6e) (single potentiometer).



Short printed-wiring pins, pin distance 15,2 mm (6e) (tandem potentiometer).

variable resistors
control potentiometers

CP23 – carbon
23 mm – linear and other laws
Status D



Single and tandem

Composition of catalogue no. 2322 XXX YYYZZ
Single and tandem types

XXX code for type and switch

without switch
350 single
360 tandem

with s.p.d.t. rotary switch
352 single
363 tandem

with s.p.s.t. rotary switch
353 single
362 tandem

with d.p.s.t. push-pull switch 2A
355 single
365 tandem

with d.p.d.t. rotary switch
357 single
366 tandem

ZZ code resistance, see table next page

YYY code for terminals, mounting facility, type, and length of plastic spindle

solder tags
mounting bushing **7**. .
twist tags **4**. .

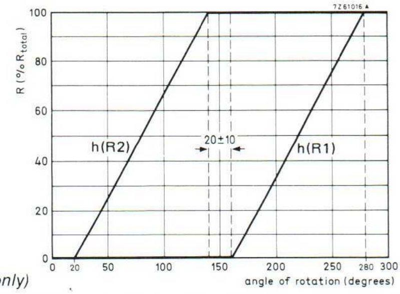
type	length
plain ø 6 mm	17 mm = .13
	18 mm = .06
	19 mm = .14
	20 mm = .15
	22 mm = .17
	25 mm = .01
	30 mm = .03
	35 mm = .04
	40 mm = .05
	60 mm = .07
	70 mm = .08
	90 mm = .09
flat faced	18 mm = .40
	25 mm = .41
	28 mm = .42
	30 mm = .13
	35 mm = .44
	40 mm = .45
	60 mm = .47
	70 mm = .48
	90 mm = .49
knurled	18 mm = .11
	30 mm = .12
	60 mm = .31
slotted	= .10

long p.w. pins
mounting bushing **3**. .
twist tags **5**. .

type	length
plain ø 6 mm	17 mm = .63
	18 mm = .56
	19 mm = .64
	20 mm = .65
	22 mm = .67
	25 mm = .51
	30 mm = .53
	35 mm = .54
	40 mm = .55
	60 mm = .57
	70 mm = .58
	90 mm = .59
flat faced	18 mm = .90
	25 mm = .91
	28 mm = .92
	30 mm = .93
	35 mm = .94
	40 mm = .95
	60 mm = .97
	70 mm = .98
	90 mm = .99

short p.w. pins
mounting bushing **2**. .
twist tags **6**. .

type	length
knurled	18 mm = .61
	30 mm = .62
	70 mm = .81
slotted	= .60



Balance (tandem only)

Composition of catalogue no. 2322 XXX $YZ_1Z_1Z_2Z_2$
Twin and triple types

XXX code for type, switch and hollow spindle

steel hollow spindle		plastic hollow spindle	
without switch		without switch	
370	twin	**470**	twin
378	triple	**478**	triple
with s.p.d.t. rotary switch		with s.p.d.t. rotary switch	
372	twin	**472**	twin
with s.p.s.t. rotary switch		with s.p.s.t. rotary switch	
373	twin	**473**	twin
with d.p.s.t. push-pull switch 2A		with d.p.s.t. push-pull switch 2A	
375	twin	**475**	twin
with d.p.s.t. rotary switch		with d.p.s.t. rotary switch	
376	twin	**476**	twin

Y code for spindle lengths

	steel hollow spindle		plastic hollow spindle
6	18 and 30,5 mm	**0**	18 and 30,5 mm
7	30 and 42,5 mm	**1**	30 and 42,5 mm

Z_1Z_1 code for resistance law and nominal resistance of potentiometer R_1, see table below

Z_2Z_2 code for resistance law and nominal resistance of potentiometer R_2, see table below

Resistance code ZZ in catalogue no.

nominal resistance	linear law curve a	log. law b	rev. log. law c	balance h
220 Ω	02			
330	19		59	
470	03	23	43	
1 kΩ	04	24	44	
2,2	05	25	45	
4,7	06	26	46	
10	07	27	47	
22	08	28	48	92
47	09	29	49	93
100	11	31	51	94
220	12	32	52	95
470	13	33	53	96
1 MΩ	14	34	54	97
2,2	15	35	55	
4,7	16			

Resistance code ZZ in catalogue no.

nominal resistance	tap at 10% curve d	20% e	40% f	67% g
20 + 200 kΩ	67			
50 + 420	73			
100 + 900	64			
0,2 + 2 MΩ	68			
0,5 + 1,7 kΩ		81		
5 + 17		82		
10 + 37		86		
20 + 80		77		
50 + 170		83		
100 + 370		87		
200 + 800		78		
0,5 + 1,7 MΩ		84		
400 + 600 kΩ			89	
200 + 100				65

variable resistors
control potentiometers

CSP60 – slide carbon
60 mm – linear and other laws
Status D

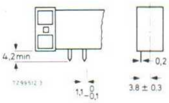
Widely used in video and audio equipment.

Max dissipation at T_{amb} = 40°C	
linear	0,4 W
others	0,2 W
Operating temperature	– 10 to 70°C
Climatic category IEC 68	10/070/21

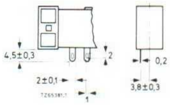
Dimensions

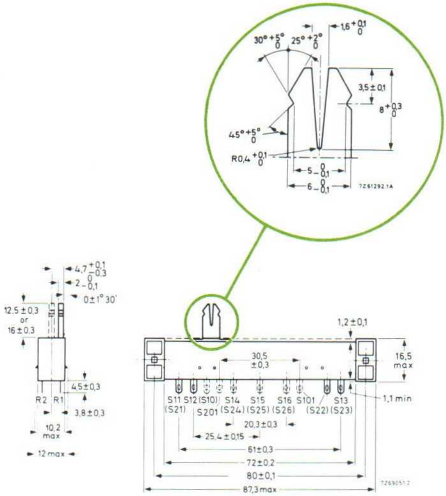
Additional terminals for tandem are shown in brackets.

printed-wiring pins



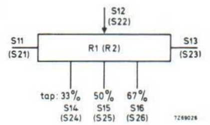
solder tags

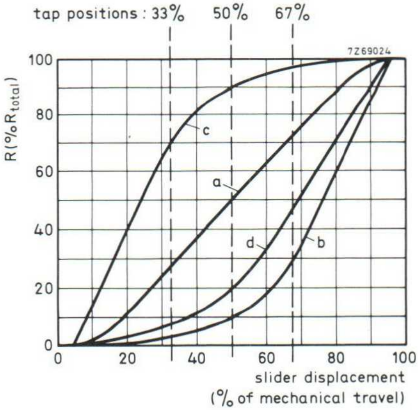


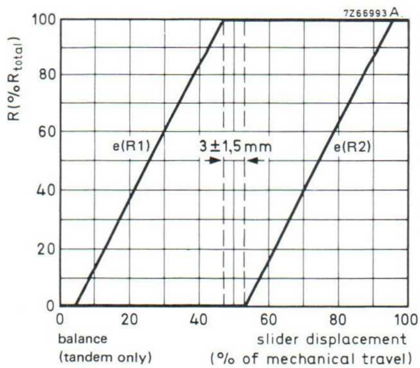


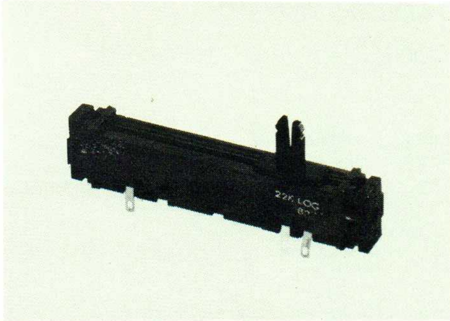
marking is always placed at the beginning of R1 (S11)

earthing screen
S101; S201 external
S10 internal









Composition of catalogue no. 2322 42P QXYZZ

P code for type
4 single
9 tandem

Q code for adjustment provision
0 asymmetrically placed } length 12,5 mm
1 symmetrically placed } length 12,5 mm

2 asymmetrically placed } length 16 mm
3 symmetrically placed } length 16 mm

X code for terminals and screening
0 without screening } with solder tags
1 with internal screening* } with solder tags
2 with internal and external screening* } with solder tags
3 with external screening } with solder tags

5 without screening } with printed-wiring pins
6 with internal screening* } with printed-wiring pins
7 with internal and external screening* } with printed-wiring pins
8 with external screening } with printed-wiring pins

Y code for taps
0 without taps
1 tap at 1/3
2 tap at 1/2
4 taps at 1/3 and 2/3

ZZ resistance code, see table below

*Only for tandem potentiometers.

Resistance code ZZ in catalogue no.

nominal resistance	linear law curve a	log. law curve b	rev. log. law without tap, or with tap at 1/3 of the total travel curve c	semi-log. law curve d	balance without tap only curve e
220 Ω	02				
330	19				
470	03			63	
1 kΩ	04	24	44	64	
2,2	05	25	45	65	
4,7	06	26	46	66	
10	07	27	47	67	87
22	08	28	48	68	88
47	09	29	49	69	89
100	11	31	51	71	91
220	12	32	52	72	92
470	13	33	53	73	93
1 MΩ	14	34	54	74	94
2,2	15	35	55	75	95
4,7	16	36	56	76	96
10	17				

variable resistors
control potentiometers

CSP40 – slide carbon
40 mm – linear and other laws
Status D

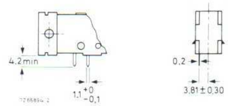
Widely used in video and audio equipment.

Max dissipation at T_{amb} = 40°C	
linear	0,25 W
others	0,125 W
Operating temperature	– 10 to 70°C
Climatic category IEC 68	10/070/21

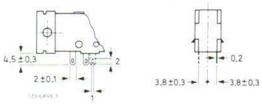
Dimensions

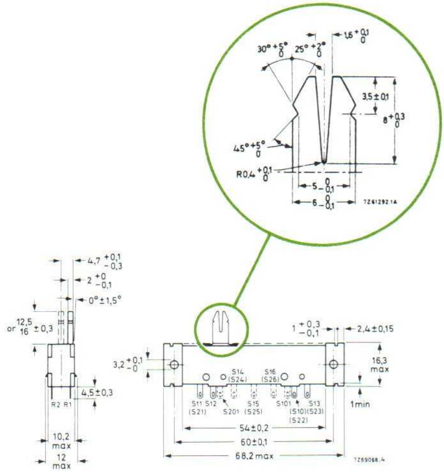
Additional terminals for tandem are shown in brackets.

printed-wiring pins



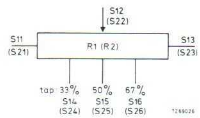
solder tags

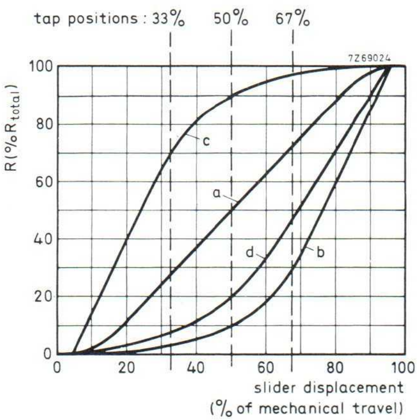


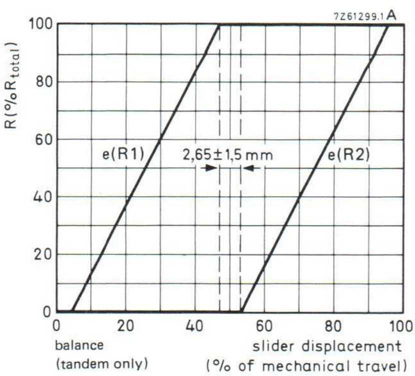


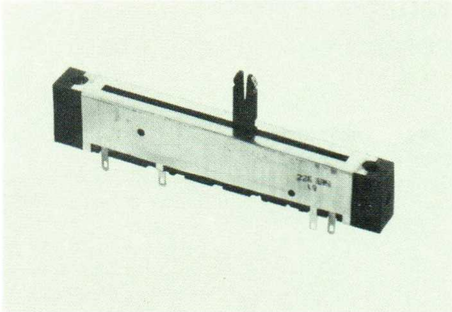
marking is always placed at the beginning of R1 (S11)

earthing screen
S101; S201 external
S10 internal







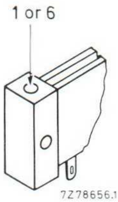


Composition of catalogue no. 2322 43P QXYZZ

P code for screw-mounting facility

single
- **0** without screw-mounting facility
- **1** with screw-mounting facility

tandem
- **5** without screw-mounting facility
- **6** with screw-mounting facility



Q code for adjustment provision
- **0** asymmetrically placed } length 12,5 mm
- **1** symmetrically placed } length 12,5 mm
- **2** asymmetrically placed } length 16 mm
- **3** symmetrically placed } length 16 mm

X code for terminals and screening
- **0** without screening
- **1** with internal screening* } with solder tags
- **2** with internal and external screening* } with solder tags
- **3** with external screening } with solder tags
- **5** without screening
- **6** with internal screening* } with printed-wiring pins
- **7** with internal and external screening* } with printed-wiring pins
- **8** with external screening } with printed-wiring pins

Y code for tap
- **0** without tap
- **1** tap at 1/3
- **2** tap at 1/2
- **4** taps at 1/3 and 2/3

ZZ code for resistance law and nominal resistance, see table below

*Only for tandem potentiometers.

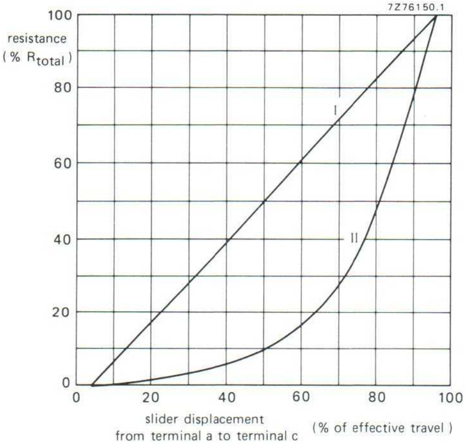
Resistance code ZZ in catalogue no.

nominal resistance	linear law curve a	log. law curve b	rev. log. law curve c	semi-log. law curve d	balance without tap only curve e
220 Ω	02				
330	19				
470	03			63	
1 kΩ	04	24	44	64	
2,2	05	25	45	65	
4,7	06	26	46	66	
10	07	27	47	67	87
22	08	28	48	68	88
47	09	29	49	69	89
100	11	31	51	71	91
220	12	32	52	72	92
470	13	33	53	73	93
1 MΩ	14	34	54	74	94
2,2	15	35	55	75	95
4,7	16				

variable resistors
control potentiometers

CSP25 – slide carbon
25 mm – linear and logarithmic laws
Status D

Nominal resistance	linear law	1 kΩ – 4,7 MΩ
	logarithmic law	1 kΩ – 2,2 MΩ
Climatic category, IEC 68		25/070/21



Composition of catalogue no. 2322 415 X00ZZ

X code for slider
1 symmetrically placed
2 asymmetrically placed

ZZ resistance code

Resistance code ZZ in catalogue no.

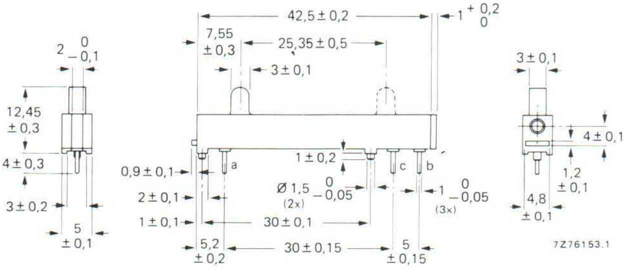
nominal resistance	linear law curve I	logarithmic law curve II
1 kΩ	04	24
2,2	05	25
4,7	06	26
10	07	27
22	08	28
47	09	29
100	11	31
220	12	32
470	13	33
1 MΩ	14	34
2,2	15	35
4,7	16	

Dimensions

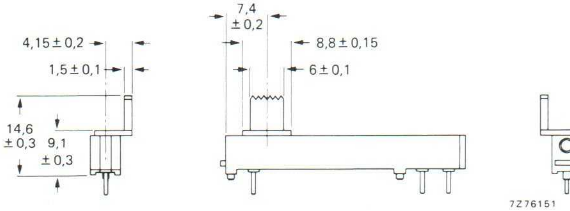
Potentiometer with symmetrically placed slider.

S_1 and S_3 beginning and end terminals

S_2 slider terminal

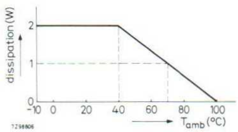


Potentiometer with asymmetrically placed slider.

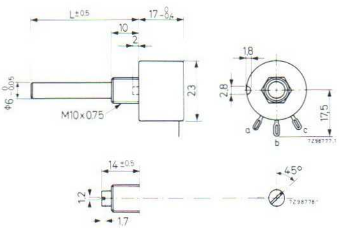


WP23 – wirewound
linear law – 2 W
Status M

Max dissipation



Dimensions



supplied with nut
catalogue no. of spare nuts: 4322 047 00350

Example
For a potentiometer with a nominal resistance value of 10 Ω, tolerance ± 10%, with slotted plastic spindle, the catalogue no. is 2322 012 01109.

Composition of catalogue no. 2322 01P XYZZZ

P	code for spindle material
2	plastic
3	steel

X	code for spindle type	
0	length 14 mm slotted plastic spindle	
2	length 17 mm	plain spindle
3	length 25 mm	plain spindle
4	length 50 mm	plain spindle
5	length 60 mm	plain spindle
6	length 20 mm	plain spindle
7	length 30 mm	plain spindle

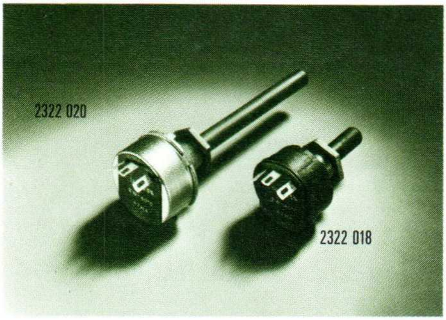
Y	code for tolerance
1	± 10%
2	± 5% (R_n > 47 Ω)

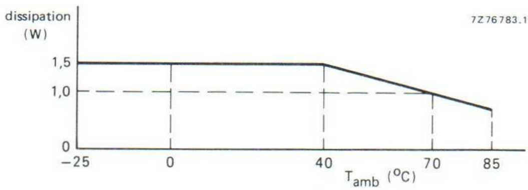
ZZZ resistance code

resistance value Ω	temperature coefficient 10^{-6}/K	ZZZ
2,2	0 to +600	228
3,3		338
4,7		478
6,8		688
10		109
15		159
22	−25 to +25	229
33		339
47		479
68		689
100		101
150		151
220	0 to +140	221
330		331
470		471
680		681
1000		102
1500		152
2200		222
3300		332
4700		472
6800		682
10 000	−20 to +140	103
15 000		153
22 000		223

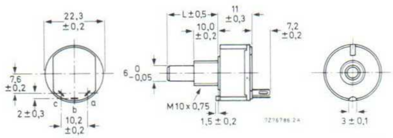
variable resistors
control potentiometers

WP22 – wirewound
linear law – 2 W
Status D

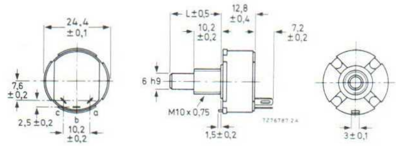




Dimensions



Potentiometer with plastic case and spindle 2322 018



Potentiometer with metal case and spindle 2322 020

Example
For a potentiometer with a nominal resistance value of 10 Ω, tolerance ± 10%, with slotted plastic spindle, the catalogue no. is 2322 018 01109.

Composition of catalogue no. 2322 0PP XYZZZ

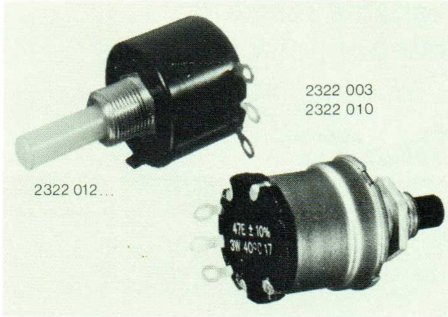
PP	code for case and spindle material
18	plastic
20	metal

X	code for spindle type
0	slotted spindle; length 16 mm
2	plain spindle; length 17 mm
3	plain spindle; length 20 mm
4	plain spindle; length 30 mm
5	plain spindle; length 60 mm

Y	code for tolerance
1	± 10% (2322 018 only)
2	± 5% (2322 020 only)

ZZZ resistance code

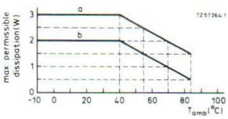
resistance value Ω	temperature coefficient 10^{-6}/K	ZZZ
2,2		228
3,3		338
4,7		478
6,8		688
10	−25 to +600	109
15		159
22		229
33		339
47		479
68		689
100	−25 to +25	101
150		151
220		221
330		331
470		471
680		681
1000	0 to +140	102
1500		152
2200		222
3300		332
4700		472
6800	−20 to +20	682
10 000		103



WP24 – wirewound
linear law – 3 W
Status C

Max dissipation

Curve a: mounted on a metal chassis 100 x 100 x 1 mm
Curve b: mounted on an insulating panel



Composition of catalogue no. 2322 0PP XYZZZ

PP	code for tags
03	with solder tags at the side
10	with solder tags at the bottom

X	code for spindle type
0	slotted spindle; length L = 14 mm
2	plain spindle; length L = 17 mm
3	plain spindle; length L = 20 mm
4	plain spindle; length L = 30 mm
5	plain spindle; length L = 60 mm

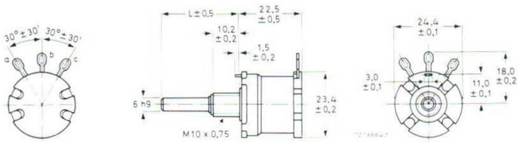
Y	code for tolerance and tap	
1	± 10%	
2	± 5% (R_n > 47 Ω)	
6	± 10%	with tap at 50% of
7	± 5% (R_n > 47 Ω)	effective angle of rotation

ZZZ resistance code

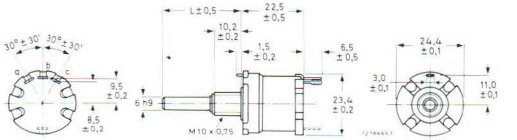
resistance value Ω	temperature coefficient 10^{-6}/K	ZZZ
2,2	0 to + 600	228
3,3		338
4,7		478
6,8		688
10		109
15		159
22		229
33	− 25 to + 600	339
47		479
68	− 25 to + 25	689
100		101
150		151
220		221
330	− 25 to + 140	331
470		471
680	0 to + 140	681
1000		102
1500		152
2200		222
3300		332
4700		472
6800		682
10 000	− 20 to + 140	103
15 000		153
22 000		223

Dimensions

2322 003

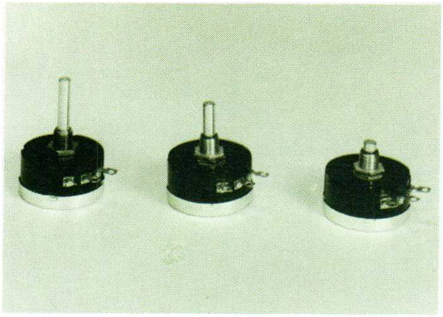


2322 010

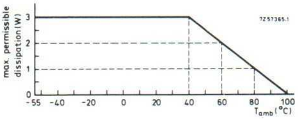


variable resistors
control potentiometers

WP42 – wirewound
linear law – 3 W
Status C



Max dissipation



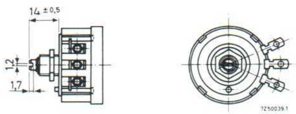
Composition of catalogue no. 2322 004 XYZZZ

X	code for spindle type
2	slotted spindle; length = 14 mm
3	plain spindle; length = 20 mm
4	plain spindle; length = 25 mm
5	plain spindle; length = 30 mm
6	plain spindle; length = 35 mm
7	plain spindle; length = 80 mm

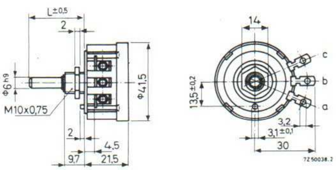
Y	code for tolerance
1	± 10%
2	± 5% (R_n > 75 Ω)

Dimensions

2322 004 2



2322 004 3 to 7



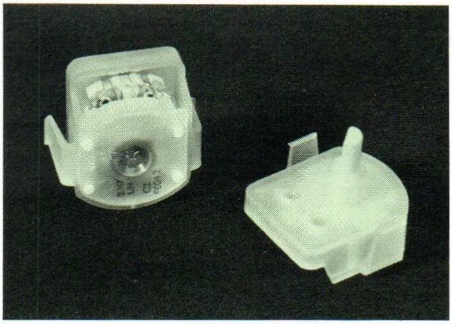
supplied with nut
catalogue no. of spare nuts: 4322 047 00350

ZZZ resistance code

resistance value Ω	temperature coefficient 10^{-6}/K	ZZZ
10		109
15		159
20		209
25	0 to +600	259
35		359
50		509
75		759
100		101
150		151
200		201
250		251
350	−25 to +25	351
500		501
750		751
1000		102
1500		152
2000		202
2500		252
3500		352
5000		502
7500	0 to +140	752
10 000		103
15 000		153
20 000		203
25 000		253
35 000	−20 to +20	353
50 000		503

focus potentiometers

2322 460 900. . – carbon
23 mm – linear law
Status C



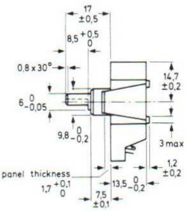
2322 460 90009/11/12

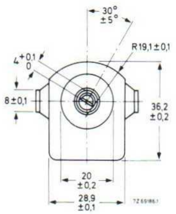
Max dissipation at T_{amb} = 40°C

linear	1 W
Operating temperature	– 10 to 70°C
Climatic category IEC 68	10/070/21

nominal resistance	catalogue no.
470 kΩ	2322 460 90009
10 MΩ	2322 460 90011
2,7 MΩ	2322 460 90012

Dimensions





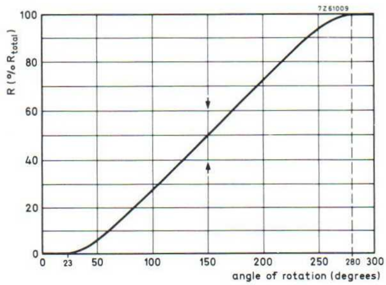
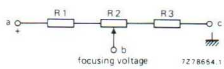


Diagram of units 2322 460 90016
90018
90022

(see next page)



a = focus output voltage of tripler unit
b = focusing voltage
c = earth

variable resistors
focus potentiometer units

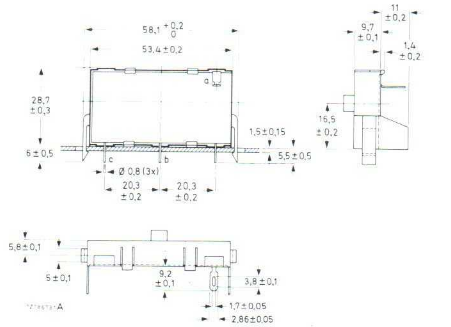
2322 460 90016/90018/90022 – cermet
Status D

For low-bi colour picture tubes
focusing voltage approx. 4,5 kV.

2322 460 90016

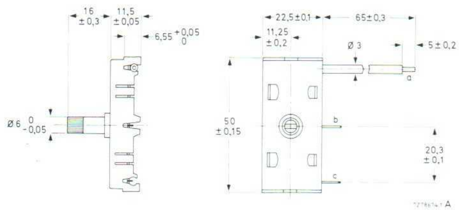
Nominal resistance	24 MΩ ± 20%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21

Dimensions



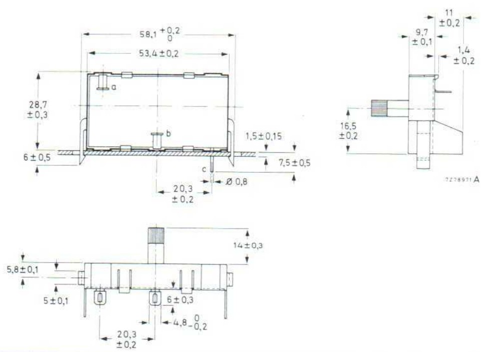
2322 460 90018

Nominal resistance	59 mΩ ± 20%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21



2322 460 90022

Nominal resistance	24 MΩ ± 10%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21



Potentiometer units with different resistance values and resistance ratios, connecting terminals and spindles are available on request.

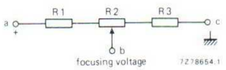
2322 460 90027/90028/90029 – cermet
Status D

2322 460 90027

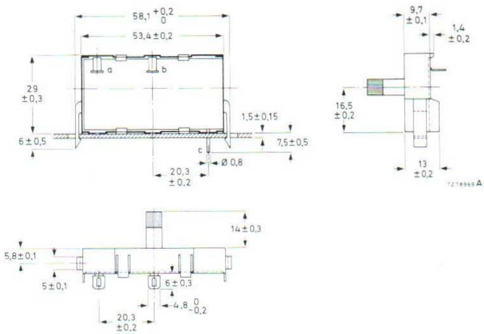
Dimensions

Nominal resistance	24 MΩ ± 10%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21

Diagram



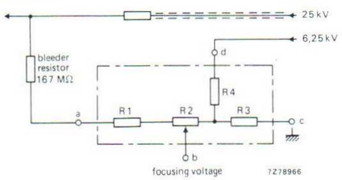
a = focus output voltage
of e.h.t. device (8,3 kV)
b = focusing voltage
c = earth

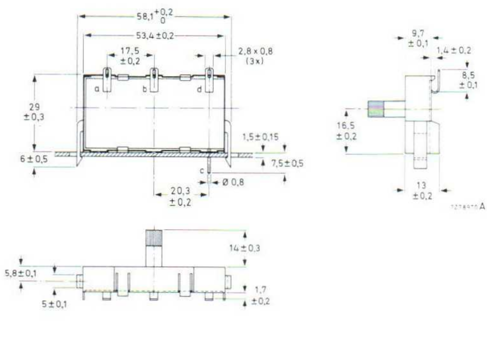


2322 460 90028

Nominal resistance	83 MΩ ± 15%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21

Diagram





a = e.h.t. voltage via bleeder resistor
b = focusing voltage
c = earth
d = 6,25 kV connection

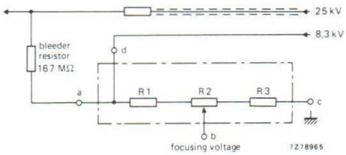
variable resistors
focus potentiometer units

For hi-bi colour picture tubes,
focusing voltage approx. 7 kV.

2322 460 90029

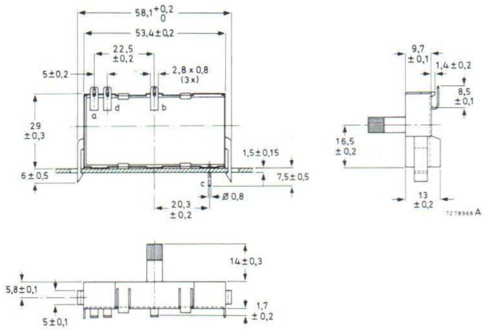
Nominal resistance	83 MΩ ± 15%
Max dissipation at 70°C	3,8 W
Climatic category, IEC 68	20/070/21

Diagram



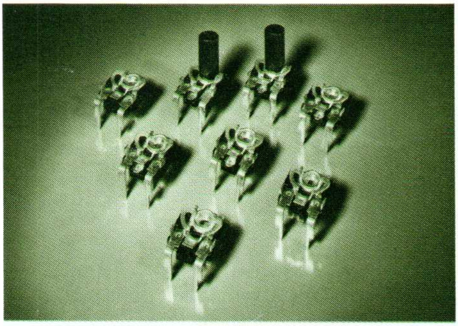
a = e.h.t. voltage via bleeder resistor
b = focusing voltage
c = earth
d = 8,3 kV connection

Dimensions



Potentiometer units with different resistance values and resistance ratios, connecting terminals and spindles are available on request.

test switches



2422 136 7. . . .
Status D

Dimensions

horizontal mounting

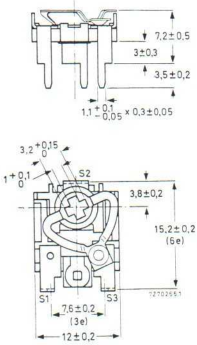


Fig. 1

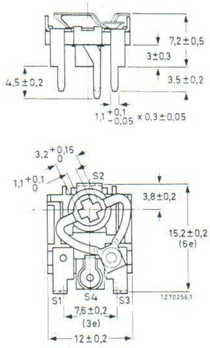


Fig. 2

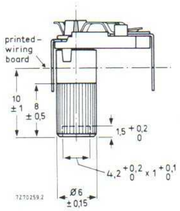


Fig. 3

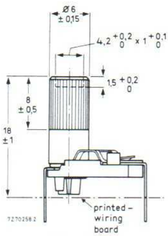


Fig. 4

vertical mounting

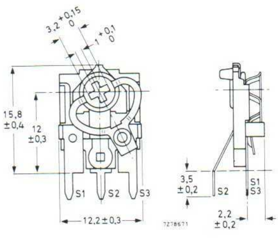


Fig. 5

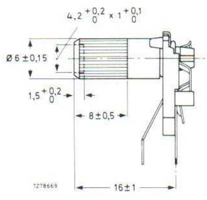


Fig. 7

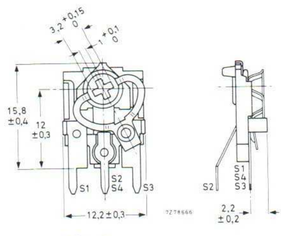


Fig. 6

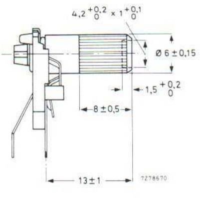


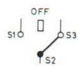
Fig. 8

Composition of catalogue no. 2422 136 7XYYZ

X code for knob
0 without knob
1 with knob at base-plate side (Figs. 3 and 7)
2 with knob at selector-contact side (Figs. 4 and 8)

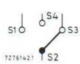
YY code for mounting
33 horizontal mounting (Figs. 1 to 4)
72 vertical mounting (Figs. 5 to 8)

Z code for switches
2 with 2 active switch connections; with off-position (Figs. 1 and 5)



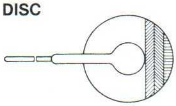
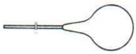
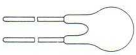
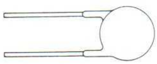
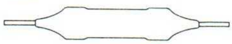
4 with 2 active switch connections; without off-position

3 with 3 active switch connections (Figs. 2 and 6)



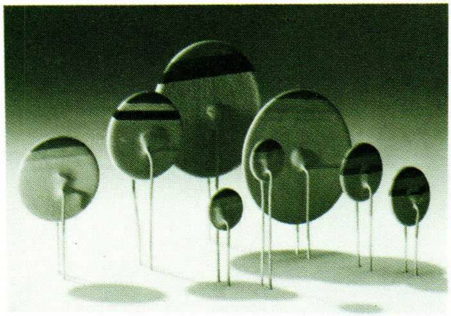
non-linear resistors
VDR – survey

For detailed information
Handbook CM11

type	voltage V	current mA	dissipation W	β-value	catalogue no.	status	page
DISC							
	8 to 330	100 to 1	0,8	0,14 to 0,40	2322 552 0. . . .	D	C51
	8 to 330	100 to 1	1	0,14 to 0,40	2322 553 0. . . .		
	8 to 330	100 to 1	2	0,14 to 0,40	2322 554 0. . . .		
	8 to 330	100 to 1	3	0,14 to 0,40	2322 555 0. . . .		
SMALL DISC							
	2,7 to 68	1	0,25	0,11 to 0,28	2322 581 03. . .	D	C53
	48	0,05	0,1	0,035	2322 592 90004	D	C53
	60 to 460				62322 592	D	C54
					2322 593		
					2322 594		
					2322 595		
ROD							
	56 to 1300	1 to 10	0,8	0,16 to 0,36	2322 564 02. . .	D	C52
					2322 564 90. . .		

VDR

2322 552 2322 553 – discs
2322 554 2322 555



Very suitable for voltage stabilization, contact protection and spark suppression. These types consist of a disc provided with two tinned solid copper wires.

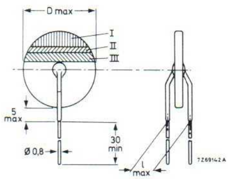
Series no.	552	553	554	555
Max dissipation	0,8	1	2	3 W
Diameter D_{max}	14,5	20	27,5	42,5 mm
Operating temperature				
at zero power	– 25 to 125°C			
at max power	0 to 55°C			
β between 0,3 and 3 x I_{nom}	0,14 to 0,40			

Composition of catalogue no. 2322 55X 0YYYZ

55X series no.

Z	tolerance on V
1	20%, untipped
2	10%, silver tipped

Dimensions



Marking
Each resistor is marked with three coloured bands, indicating the code e.g. 116: I = brown
II = brown
III = blue

colour code	
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
grey	8
white	9

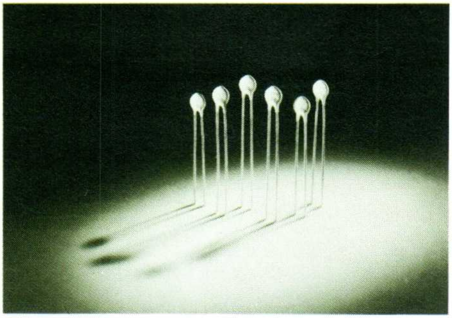
YYY code in catalogue no.

I_{nom} mA	V at I_{nom} V	552 series YYY	552 series ℓ_{max} mm	553 series YYY	553 series ℓ_{max} mm	554 series YYY	554 series ℓ_{max} mm	555 series YYY	555 series ℓ_{max} mm
100	8	116	9	116	9	116	9	116	9
	10	118	9	118	9	118	9	118	9
	12	120	9	120	9	120	9	120	9
	15			122	9	122	9	122	9
	18					124	9	124	9
	22							126	9
	27							128	9
	33							130	9
10	8	216	9						
	10	218	9	218	9				
	12	220	9	220	9	220	9		
	15	222	9	222	9	222	9		
	18	224	9	224	9	224	9		
	22	226	9	226	9	226	9	226	9
	27	228	9	228	9	228	9	228	9
	33	230	9	230	9	230	9	230	9
	39	232	9	232	9	232	9	232	9
	47	234	9	234	9	234	9	234	9
	56	236	9	236	9	236	9	236	9
	68	238	9	238	9	238	9	238	9
	82			240	9	240	9	240	9
	100					242	9	242	9
	120					244	9	244	9
	150					246	9	246	9
	180					248	9	248	9
	220							250	10
	270							252	10
1	56	336	9						
	68	338	9	338	9				
	82	340	9	340	9				
	100	342	9	342	9				
	120	344	9	344	9				
	150	346	9	346	9	346	9		
	180	348	10	348	10	348	9		
	220	350	10	350	10	350	9	350	10
	270	352	10	352	10	352	10	352	10
	330	354	10	354	10	354	10	354	11

non-linear resistors

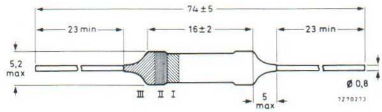
VDR

2322 564 – rod
2322 592 – small disc



2322 564

Dimensions



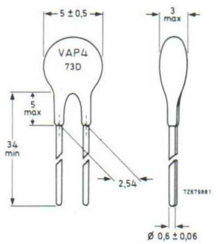
The rods are used for stabilization of voltages, protection of contacts, etc. They are provided with two axial tinned solid copper wires and are tan lacquered, but not insulated.

P_{max} = 0,8 W

I_{nom} mA	V at I_{nom} V(d.c.)	tolerance on V in %	β-value	colour code; I, II, III	catalogue no. 2322 564.....
10	470	10	0,20 – 0,25	green	02582
10	560	10	0,18 – 0,23	blue	02602
10	680	10	0,18 – 0,23	violet	02622
10	910	10	0,17 – 0,22	white	90014
10	1200	20	0,17 – 0,22	grey	02681
10	1200	10	0,17 – 0,22	brown	02682
10	1300	10	0,16 – 0,21	red	90015
2	950	10	0,16 – 0,21	black, blue	90005

2322 592 90004

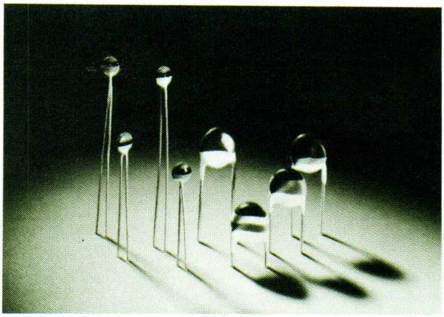
Dimensions



These VDRs are for relay contact protection in telephone exchanges, etc. and are homologated in France under NF C 93-277/UTE 93-277 and in Belgium under certificate number 73-209.

Nom d.c. voltage	48	V
Nom dissipation	0,1	W
Operating temperature	– 55 to 85	°C
Climatic category		
NF C 20-600, par. 4.3	454(55/085/56)	
β-value between 0,1 and 1 mA	typ 0,035	

2322 581 – small disc



When you need a low β at a low voltage this titanium oxide disc is excellent for your application.

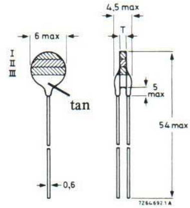
Operating temperature		
at zero power	– 25 to 85	°C
at max power	0 to 55	°C
Max dissipation	0,25	W
Tolerance on voltage at 1 mA	± 10, ± 20	%

d.c. voltage at 1 mA V	max β-value between 1-10 mA	capacitance nF	catalogue no. 2322 581 0XXXY
2,7	0,28	40	0304.
3,3	0,28	35	0306.
3,9	0,28	29	0308.
4,7	0,25	24	0310.
5,6	0,25	21	0312.
6,8	0,22	18	0314.
8,2	0,22	16	0316.
10	0,22	14	0318.
12	0,22	12	0320.
15	0,22	11	0322.
18	0,22	9,5	0324.
22	0,20	8	0326.
27	0,20	7	0328.
33	0,20	5,5	0330.
39	0,20	5	0332.
47	0,20	4	0334.
56	0,20	3	0336.
68	0,20	2	0338.

XXX shown as I, II, III

Y	tolerance
1	20%
2	10%

Dimensions



Marking
Each resistor is marked with three coloured bands
Example: .308.
I = orange = 3
II = black = 0
III = grey = 8

non-linear resistors
VDR

2322 592 2322 593
2322 594 2322 595 – small discs

Zinc oxide disc VDRs especially designed for voltage transient or spark suppression, contact protection, protection against secondary lightning effects, etc.

Operating temperature at zero power – 40 to 125 °C

max r.m.s. working voltage	varistor voltage*		transient energy 8/20 μs				max clamping voltage				suffix of catalogue number
	min	max	592	593	594	595	at 50 A 592	at 100 A 593	at 100 A 594	at 100 A 595	
V	V	V	J	J	J	J	V	V	V	V	
60	90	110	2,3	5	7	11	220	220	220	220	6002
75	108	132	2,6	6	8	12	240	260	245	235	7502
95	135	165	3,0	8	9	15	295	315	305	295	9502
130	185	225	4,5	10	13	20	405	430	410	390	1312
150	216	264	5,0	12	14	23	470	490	470	450	1512
175	243	297	5,5	14	16	26	525	550	525	505	1712
230	324	396	7,0	18	21	34	675	720	700	680	2312
250	351	429	7,5	20	23	36	745	780	755	730	2512
275	387	473	8,5	21	25	40	820	850	820	805	2712
300	423	517	9,5	23	27	43	905	930	900	875	3012
420	612	748	14	34	38	62	1340	1310	1310	1275	4212
460	675	825	16	37	40	67	1480	1490	1440	1400	4612

* Voltage at a current of 1 mA, impulse time 10 ms.

Dimensions

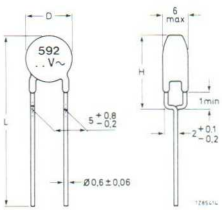


Fig. 1

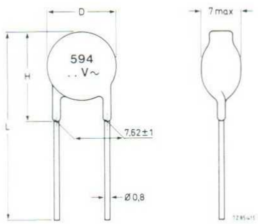
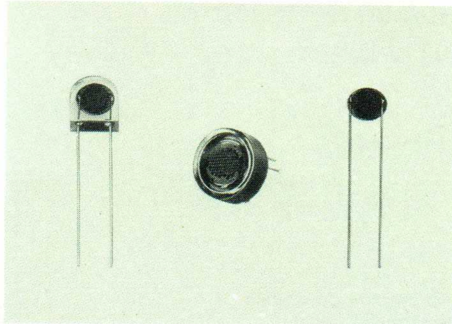


Fig. 2

basic catal. no.	Fig.	D	H	L	packing
2322 592 3	1	7	11	31	on tape on reel (TDK)
2322 592 6	1	7	11	31	in box
2322 593 3	1	9	13	33	on tape on reel (TDK)
2322 593 6	1	9	13	33	in box
2322 594 6	2	12,5	14	33	in box
2322 595 6	2	16	19	38	in box

LDR

2322 600

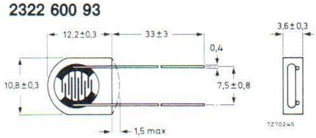


The light dependent resistors are intended for non-critical on-off applications, in which a lamp or a relay is operated either directly (low power) or via a suitable amplifier (high power) e.g. in toys.

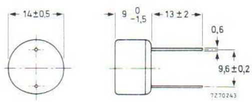
P max mW	V_{peak} max V	R_D min MΩ	R_L at 1000 lux 2850 K Ω	catalogue no.	status
plastic encapsulated					
100	150	10	75 – 300	2322 600 93001	D
100	150	1	<110	93002	
200	110	10	75 – 300	95001	D
200	110	10	<250	95003	
200	110	1	<110	95006	
200	110	10	<190	95007	
lacquered					
100	150	10	75 – 300	2322 600 94001	D

Dimensions

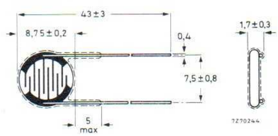
2322 600 93



2322 600 95



2322 600 94



non-linear resistors
NTC thermistors – survey

For detailed information
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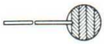
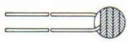
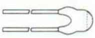
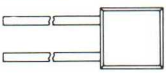
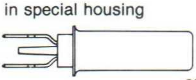
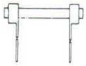
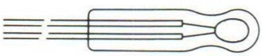
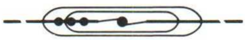
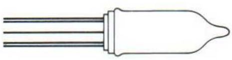
type	catalogue no.	status	page
DISC			
	2322 610 1. . . .	D	C57
	2322 642 6. . . .	D	C61
	2322 611 . . . . . 2322 644 90012	D D	C58 C60
	2322 640 1. . . . 2322 640 90012 2322 640 90014	D D	C59 C60
	2322 643 1. . . . 2322 644 1. . . .	D	C62
	2322 644 90004 2322 644 90005	D	C62
moulded 	2322 640 90004 2322 640 90005 2322 640 90013 2322 640 90015	D	C63
in special housing 	2322 640 90011 2322 640 90021	D	C60

type	catalogue no.	status	page
ROD			
	2322 635 . . . . . 2322 636 . . . . . 2322 637	D	C64
MINIATURE BEAD			
	2322 634 0. . . .	D	C66
	2322 634 1. . . .	D	C66
glass encapsulated 	2322 627 1. . . . 2322 627 4. . . .	D	C65
	2322 627 2. . . . 2322 627 31. . .	D D	C65 C67
	2322 634 2. . . .	D	C66
INDIRECTLY HEATED			
	2322 628 90016 2322 628 90017	D	C67

NTC thermistors

2322 610 1. . . .

Resistance range at 25°C	1,1 to 1300 Ω
Dissipation	max 1 W
Operating temperature	
at zero power	−25 to 125°C
at max power	0 to 55°C

Catalogue no. 2322 610 1XYYY

X	tolerance
2	10% (silver tipped)
1	20% (untipped)

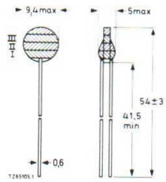
YYY code in catalogue no.

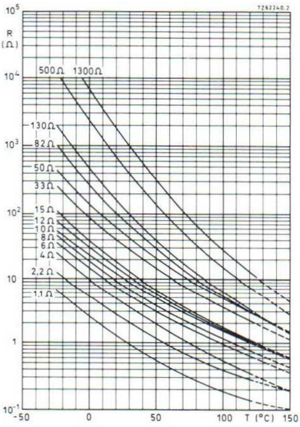
R_{25} Ω	$B_{25/85}$ ± 5% K	YYY
1,1	2600	118
2,2	2675	228
4	2800	408
6	2825	608
8	2900	808
10	2950	109
12	3050	129
15	3125	159
33	3250	339
50	3300	509
82	4400	829
130	4600	131
500	5200	501
1300	5450	132

Dimensions

Coloured bands give last three digits of catalogue no. I and II follow standard colour code. III is standard except: gold = 8, black = 9.

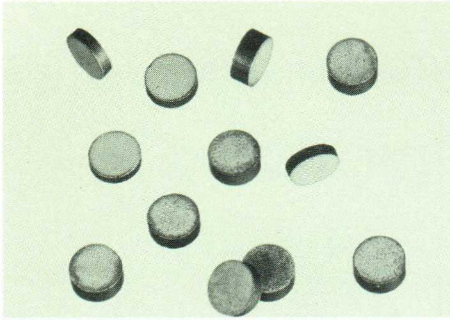
Example
228 = red, red, gold





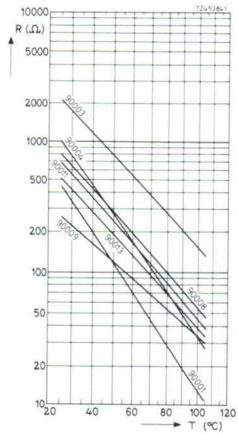
non-linear resistors
NTC thermistors

2322 611 – disc



This range of discs has been developed for temperature sensors for the cooling water in motor cars. The NTCs are specified at a medium temperature (40 to 50°C) and a higher temperature (96,5 to 100°C), so that a high accuracy at the working temperature is obtained.
They are also suitable for temperature control in household appliances, such as washing machines.

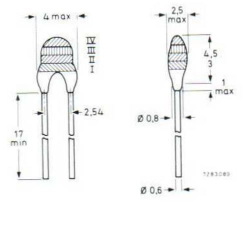
resistance in Ω at					diameter	catalogue no.
25°C	40°C	50°C	96,5°C	100°C	mm	2322 611 900. .
270		97 – 143		29,5 – 36,5	6,9 ± 0,2	09
500		92,5 – 134		12 – 15	6,9 ± 0,2	01
500		175 – 215		35 – 43	6,9 ± 0,2	13
700		207 – 264		41,4 – 48,6	6,9 ± 0,2	11
800		244 – 315		48,0 – 58,6	6,9 ± 0,2	08
1000		221,5 – 318,5		30 – 36	6,9 ± 0,2	04
2200	1030 – 1310		147 – 173		7,0 ± 0,3	03

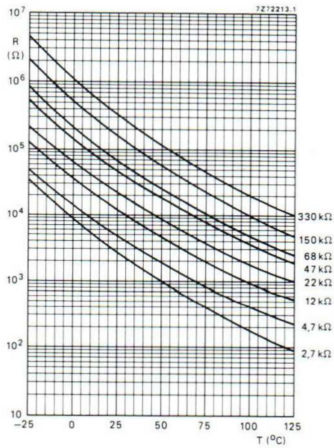


Resistance at +25°C		2,7 to 330	kΩ
$B_{25/85}$		3660 to 4150	K
Max dissipation		0,25	W
Dissipation factor		7,5	mW/K
Operating temperature range	at zero power	−25 to 125	°C
	at max power	0 to 55	°C
Application		intended for general use	

R_{25}	$B_{25/85}$ ±5%	$B_{25/25}$	temperature coefficient at +25°C	catalogue number 2322 640 1....		
Ω	K	K	%/K	R_{25} ±5%	R_{25} ±10%	R_{25} ±20%
2 700	4000	3800	−4,50	3272	2272	1272
4 700	3660	3440	−4,12	3472	2472	1472
12 000	3700	3540	−4,17	3123	2123	1123
22 000	3700	3420	−4,17	3223	2223	1223
47 000	3850	3570	−4,33	3473	2473	1473
68 000	3880	3590	−4,37	3683	2683	1683
150 000	4050	3740	−4,56	3154	2154	1154
330 000	4150	3830	−4,67	3334	2334	1334

Dimensions





Colour code according to standard code

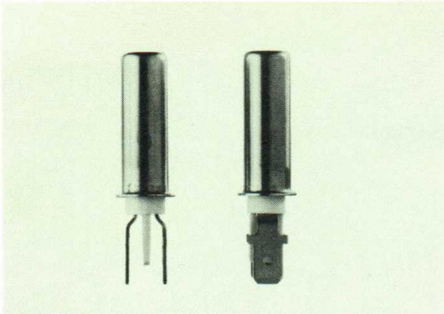
Example: 4700 Ω

I yellow
II violet
III red

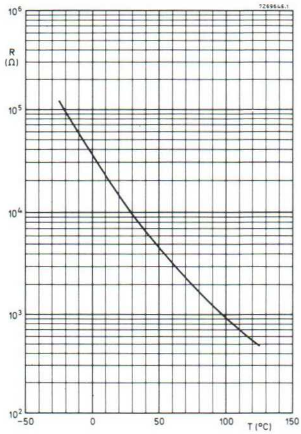
* A silver band (IV) is added to the colour code only for 10% tolerance.

non-linear resistors
NTC thermistors

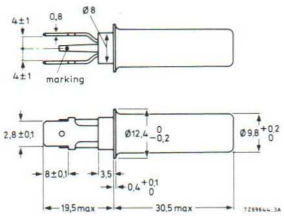
2322 640 90011; 90021
2322 640 90012; 90014



2322 640 90011/21	90011	90021	
Resistance at: 25°C	12 ± 7%	12 ± 5,5%	kΩ
90°C	1,3 ± 5%	1,3 ± 3,5%	kΩ
Marking (between connectors)	brown	orange	
$B_{25/85}$	3725		K
Max dissipation	0,25		W
Operating temperature			
at zero power continuously	−25 to 110		°C
for max 24 h	−25 to 130		°C
at max power	0 to 55		°C
Application area	washing machines		

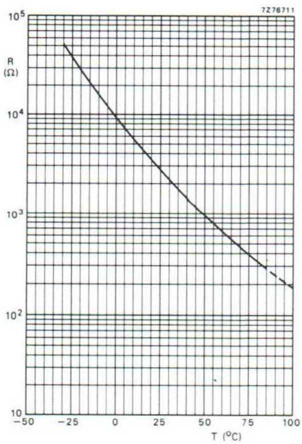


Dimensions

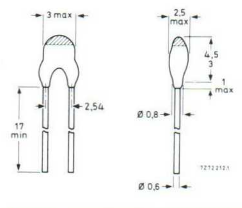


stainless steel package

2322 640 90012/14	90012	90014	
Resistance at:			
−31,5 to −28,5°C	50	–	kΩ
−21,5 to −18,5°C	27	–	kΩ
−11,5 to −8,5°C	15	15	kΩ
+23,5 to +26,5°C	–	2,7	kΩ
$B_{25/85}$	4000	4000	K
Max dissipation	0,25	0,25	W
Operating temperature			
at zero power	−55 to 85	−55 to 85	°C
at max power	−55 to 55	−55 to 55	°C
Application area	general	general	



Dimensions

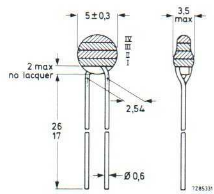


2322 640 90012 grey body – brown cap
2322 640 90014 grey body – red cap

2322 642 6 – disc

Resistance range (E6) at 25°C	3,3 Ω to 470	kΩ
Max dissipation at 55°C	0,5	W
Thermal time constant, free air approx.	17	s
Operating temperature at zero power	– 25 to 125	°C

Dimensions



Coloured bands I, II and III give last three digits of catalogue no.

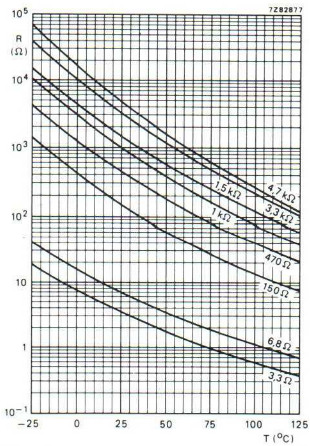
gold = 8,
black = 9

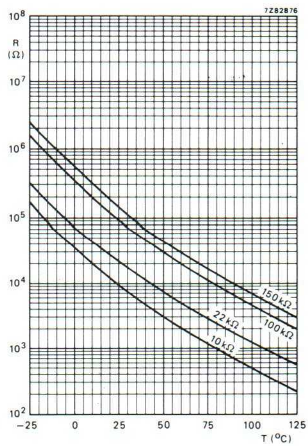
Example
338 = orange, orange, gold

R_{25}	$B_{25/85}$ ± 5% K	catalogue no.
3,3 Ω	2675	2322 642 6X338
4,7	2750	6X478
6,8	2800	6X688
10	2875	6X109
15	2950	6X159
22	3025	6X229
33	3100	6X339
47	3150	6X479
68	3225	6X689
100	3300	6X101
150	3375	6X151
220	3475	6X221
330	3575	6X331
470	3650	6X471
680	3725	6X681
1 kΩ	3825	6X102
1,5	3975	6X152
2,2	4125	6X222
3,3	4250	6X332
4,7	4350	6X472
6,8	4400	6X682
10	4275	6X103
15	4200	6X153
22	4275	6X223
33	4350	6X333
47	4400	6X473
68	4500	6X683
100	4600	6X104
150	4650	6X154
220	4700	6X224
330	4750	6X334
470	4800	6X474

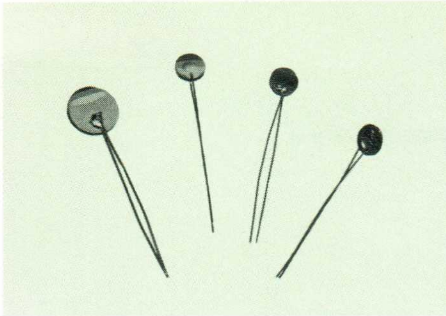
X is code for tolerance on R_{25}

1: 20% (no colour band IV)
2: 10% (band IV silver)
3: 5% (band IV gold)





non-linear resistors
NTC thermistors



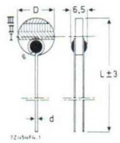
2322 643 1
2322 644 1 – disc
2322 644 9

2322 643 1 and 2322 644 1

Resistance range at 25°C		150 to 4700 Ω
Operating temperature at zero power		– 25 to 125°C
Max dissipation at 25°C	2322 643	1 W
	2322 644	1,5 W
Thermal time constant	2322 643	55 s
	2322 644	120 s

P_{max} W	R_{25} Ω	$B_{25/85}$ ± 5% K	catalogue no.	
1	150	3500	2322 643 1X151	X is code for tolerance
	470	3750	471	on R_{25}
	1500	4000	152	1: 20%
	4700	4200	472	2: 10% (silver band)
1,5	150	3600	2322 644 1X151	
	470	3900	471	
	1500	4200	152	
	4700	4300	472	

Dimensions



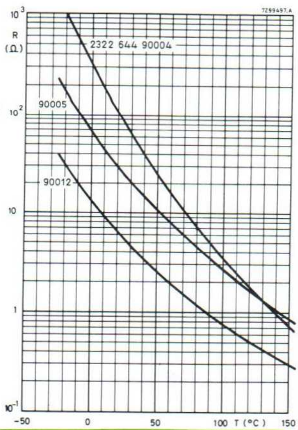
	D	L	d
2322 643 1	9 ± 0,5	54	0,6
2322 644 1	15 ± 0,7	58	0,8

Coloured bands give last three digits of catalogue no.
I and II follow standard colour code
III is standard except:
gold = 8,
black = 9

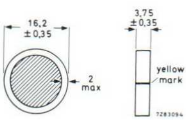
Example
152 = brown, green, red

2322 644 9 for surge limitation in tv

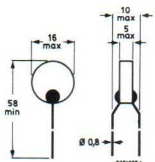
Catalogue no. 2322 644.....	90004	90005	90012	
Resistance at 25°C	82 (± 20%)	>15	5(± 20%)	Ω
at T_{amb} = 25°C; I_{rms} = 1,7 A	<0,85	–	–	Ω
= 2,2 A	–	<1	<0,5	Ω
Dissipation factor	19	17	–	mW/K
$B_{25/85}$	4650	3350	2975	K
Rep. peak voltage (50 – 60 Hz) max	345	380	–	V
Thermal time constant	115	148	–	s
Operating temperature				
at zero power		– 25 to 155		°C
at max power		0 to 55		°C



Dimensions

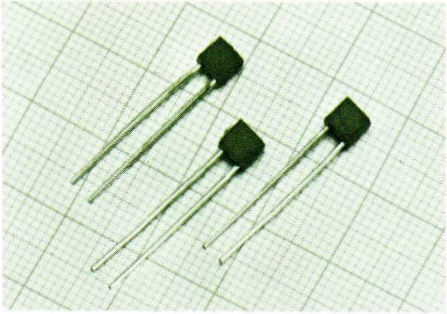


90012



90004
90005

2322 640 90004 90005
90013 90015

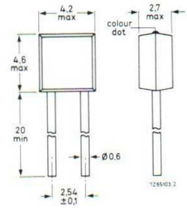


Temperature sensing elements for domestic and professional/industrial applications with rugged housing and great reliability. They can be built-in directly, are resistant to industrial atmospheres and can also be cast-in.

2322 640 90004/5	90004	90005	
Resistance at: 25 °C	12000 ±7%	–	Ω
100°C	950 ±5%	16700 ±7%	Ω
200°C	–	1120 ±7%	Ω
Max dissipation	0,25	0,25	W
$B_{25/85}$	3750	4300	K
Operating temperature			
at zero power	–10 to 125	–25 to 200	°C
at max power	0 to 55	0 to 55	°C
Application area	general purpose	high temperature control	

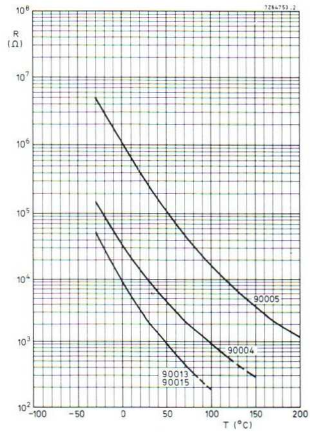
2322 640 90013/15	90013	90015	
Resistance at:			
–31,5 to –28,5°C	50	–	kΩ
–21,5 to –18,5°C	27	–	kΩ
–11,5 to – 8,5°C	15	15	kΩ
+23,5 to +26,5°C	–	2,7	kΩ
$B_{25/85}$	4000	4000	K
Max dissipation	0,25	0,25	W
Operating temperature			
at zero power	–55 to 85	–55 to 85	°C
at max power	–55 to 55	–55 to 55	°C
Application area	deep-freezers	room temp control	

Dimensions

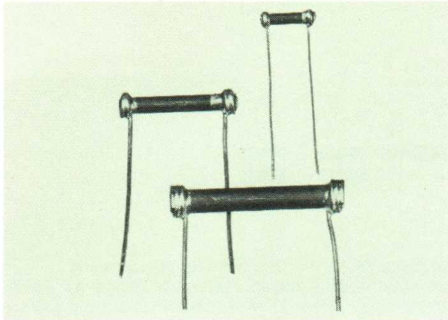


body colour: dark grey

Marking:
2322 640 90004: grey dot
2322 640 90005: blue dot
2322 640 90013: brown dot
2322 640 90015: red dot



non-linear resistors
NTC thermistors

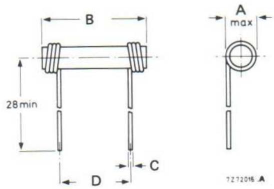


2322 635 to 637 – rods

P_{max} at $T_{amb} = 25°C$ W	R_{25} ± 20% kΩ	$B_{25/85}$ ± 5% K	dissipation factor mW/K	thermal time const. s	catalogue no.
0,6	4,7	3300	5	30	2322 635 01 472
	15	3600			153
	47	3925			473
	150	4075			154
	330	4250			334
	470	4300			474
1,5	4,7	3250	10	55	2322 636 01472
	15	3550			153
	47	4000			473
	150	4150			154
2,3	4,7	3200	17	105	2322 637 01472
	15	3550			153
	47	3750			473
	150	4200			154

max operating temperature 155°C.

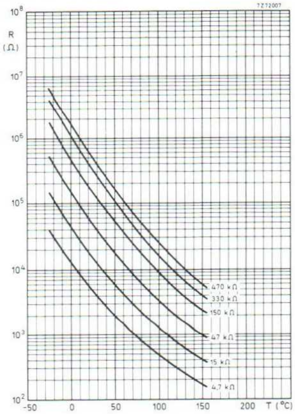
Dimensions



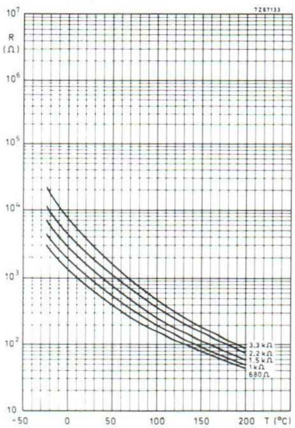
series	A(max)	B ± 1	C	D ± 0,8
635	3,7	11	0,4	7,6
636	5,2	21	0,8	15,2
637	6,7	31	0,8	25,4

colour code	R_{25} kΩ
orange	4,7
green	15
blue	47
white	150
yellow/blue	330
yellow/orange	470

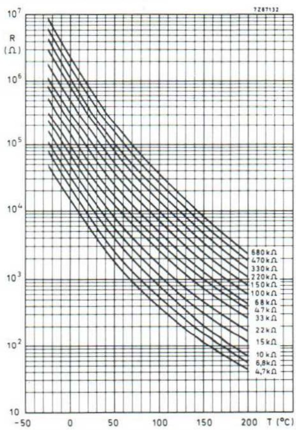
2322 635 to 637



2322 627 (next page)



2322 627 (next page)



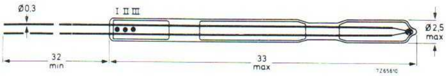
2322 627 1
2322 627 2 – miniature beads
2322 627 4

Miniature thermistors are used for temperature sensing, temperature compensation, air-flow measurements, vacuum measurements, delaying relays, and in medical science for temperature and breathing measurements.

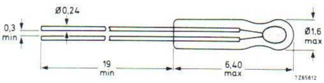
Catalogue no.	2322 627 1. . . .	2322 627 2. . . .	2322 627 4. . . .	
Resistance range (E6-series) at 25°C	0,68 to 680	0,68 to 680	0,68 to 680	kΩ
$B_{25/85}$	2200 to 4100	2200 to 4100	2200 to 4100	K
Max dissipation	100	100	100	mW
Dissipation factor	0,7	0,7	0,6	mW/K
Thermal time constant	14	10	9,5	s
Operating temperature				
at zero power	– 25 to 200	– 25 to 200	– 25 to 200	°C
at max power	0 to 55	0 to 55	– 25 to 55	°C

Dimensions

2322 627 1. . . .

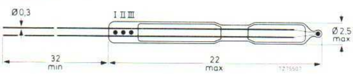


2322 627 2. . . .



This device is not code-marked.
The catalogue no. is marked on each box of 100 pieces.

2322 627 4. . . .



coloured dots I, II, III
stand for code ZZZ in table

example: 681 I blue
II grey
III brown

tolerance 10% = silver dotted

For graphs see opposite.

Composition of catalogue no. 2322 627 XYZZZ

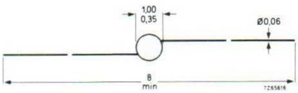
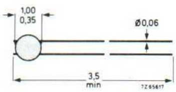
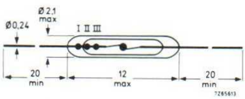
X code for style
Y code for tolerance on R_{25}
1 20%
2 10%
ZZZ code for resistance value

R_{25}	$B_{25/85}$ ± 5% K	code ZZZ
680 Ω	2200	681
1 kΩ	2375	102
1,5	2500	152
2,2	2600	222
3,3	2750	332
4,7	3725	472
6,8	3775	682
10	3875	103
15	3800	153
22	3850	223
33	3800	333
47	3850	473
68	3900	683
100	3800	104
150	3880	154
220	3920	224
330	3980	334
470	4030	474
680	4100	683

non-linear resistors
NTC thermistors

2322 634 – miniature beads

Resistance range: 680 Ω – 680 kΩ (E6-series)

		dissipation max mW	dissipation factor mW/K	thermal time constant s
2322 634 0		–	–	–
2322 634 1		–	–	–
2322 634 2		60	0,4	9

Coloured dots I, II, III stand for code ZZZ in table (see previous page)

Composition of catalogue no. 2322 634 XYZZZ

X code for style

Y code for tolerance on R_{25}

1 20%

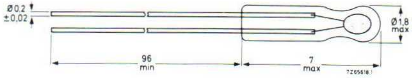
2 10%

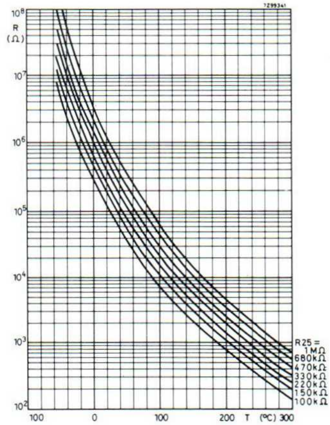
ZZZ code for resistance value (see previous page)

2322 627 31 – miniature bead
2322 628 – miniature bead indirectly heated

2322 627 31

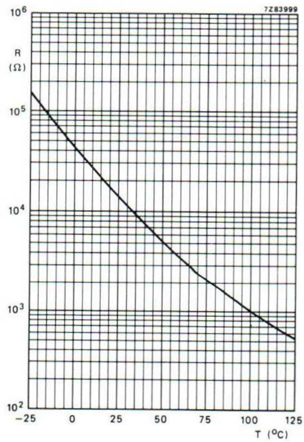
Resistance range (E6 series) at 25°C	100 kΩ to 1 MΩ
Max dissipation	100 mW
$B_{25/85}$	3800 to 4200 K
Operating temperature	
at zero power	−55 to 300°C
at max power	0 to 55°C

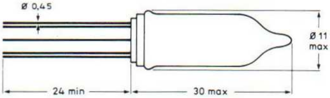


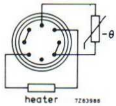


R_{25} ± 20%	$B_{25/85}$ ± 5% K	catalogue no. 2322 627 31...
100 kΩ	3800	104
150	3880	154
220	3920	224
330	3980	334
470	4030	474
680	4100	684
1 MΩ	4200	105

2322 628 90016/17		**90016**	**90017**
Resistance at 25°C	I_h = 0	15 kΩ ± 30%	15 kΩ ± 30%
	I_h = 17 mA	max 55 Ω	max 35 Ω
B25/85		3860 K	
Operating temperature		−25 to 85 °C	
Thermistor: max dissipation (W_h = 0)		15 mW	
Heater: resistance (± 6%)		200 Ω	
max dissipation (W_{th} = 0)		65 mW	



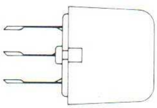
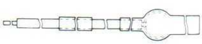
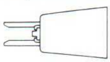
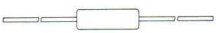
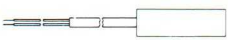




non-linear resistors
PTC thermistors – survey

All types have status D

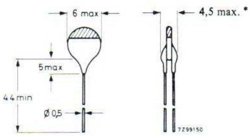
For detailed information
Handbook CM11

type	R_{25} Ω	switch temp. °C	maximum voltage V	diss. factor mW/K	temp. coeff. %/K	catalogue no.	page
DISC 	70 to 100	105	460 (r.m.s.)	11,5	35	2322 662 93006	C75
	250 ± 25%	6	25 (d.c.)	6	5	660 91001	C69
	50 to 60 ± 30%	30 to 105	25 (d.c.)	7	7 to 40	660 91006/9	
	750 to 1500	115	245 (r.m.s.)	7	26	660 93001	C75
	30 to 50 ± 15 Ω	25 to 110	40 to 50 (d.c.)	6 to 8,5	9 to 75	661 91002/5	C70
	36 to 50	115	180 (d.c.)	13	35	662 91001	
	45 to 60	75	265 (r.m.s.)	20	20	662 93036	C71
	80 to 120	75	265 (r.m.s.)	15,3	35	662 93066	
	≤0,6	85	16 (d.c.)	27	10	664 91086	C76
	30 to 250	70 to 150	25 (d.c.)	5,7	18 to 38	672 91002/35	C77
DUAL DISC for degaussing	25 and 8		245 (r.m.s.)			662 98001	
	30 and 8	75	265 (r.m.s.)	13,5	25	662 98003	C72
	1000 to 6000 and 40		265 (r.m.s.)			662 98009	
	400 to 2400 and 10		140 (r.m.s.)			662 98013	C72
	PTC: 40 NTC: 130	65 (PTC)	265 (r.m.s.)	12,5	26 (PTC)	662 98012	
MOTOR PROTECTION DISC 		68 to 137	15 (d.c.)	7	18 to 38	672 92045/53	C73
DISC for compensation of telephone line variations							
	115 ± 25	97	33 (d.c.)		>10	672 98001	C73
	120 ± 30	145	34 (d.c.)		>8	670 90003	C73
HEATING ELEMENT 			100 – 240 (r.m.s.)			680 90047	C74
			100 – 240 (r.m.s.)			680 90071	
			100 – 240 (r.m.s.)			680 90134	
			100 – 265 (r.m.s.)			680 90259	
PTCs for overload protection	1,65 to 1500	115	60, 245, 265	3,5 – 20			C78-C79

2322 660 – disc

Catalogue no. 2322 660.....	91001	91006	91007	91008	91009	
Resistance at 25°C; V(d.c.) ⩽ 1,5 V	250	60	50	50	50	Ω
tolerance	25	30	30	30	30	%
Switch temperature	6	30	50	80	105	°C
Temperature coefficient	5	7	16	23	40	%/K
Thermal time constant	17	20	18	18	–	s
Dissipation factor	6		7			mW/K
Max d.c. voltage	25		25			V
Operating temperature						
at zero power	– 25 to 155		– 10 to 125			°C
at max voltage	0 to 55		0 to 55			°C

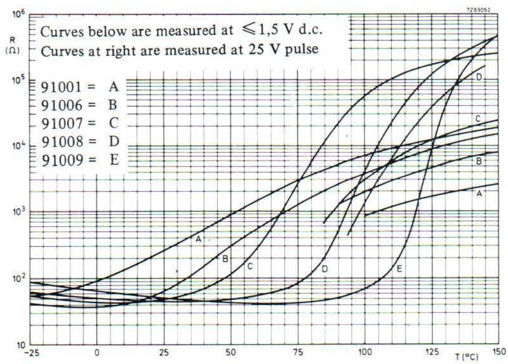
Dimensions



* For 91001 3,2 mm max.

colour code

none	91001
red	91006
orange	91007
yellow	91008
green	91009

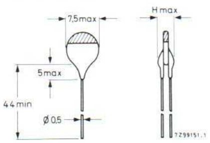


non-linear resistors
PTC thermistors

2322 661 – disc

Catalogue no. 2322 661.	91002	91003	91004	91005	
Resistance at 25°C; V(d.c.) ⩽ 1,5 V tolerance 15%	50	40	30	50	Ω
Switch temperature	80	110	45	25	°C
Temperature coefficient	18	75	16	9	%/K
Thermal time constant	50	50	50	40	s
Dissipation factor	8,5	8,5	8,5	6	mW/K
Max d.c. voltage	50	50	50	40	V
Operating temperature					
at zero power		– 10 to 125			°C
at max voltage		0 to 55			°C

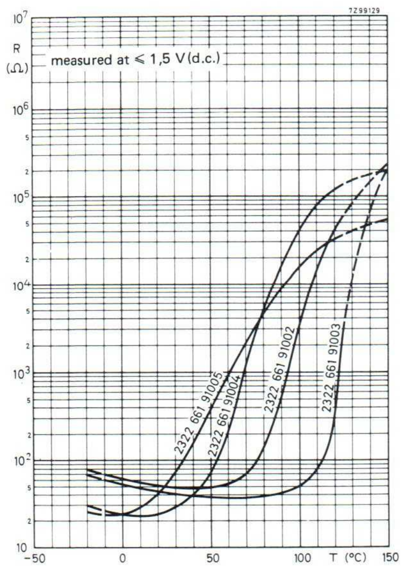
Dimensions



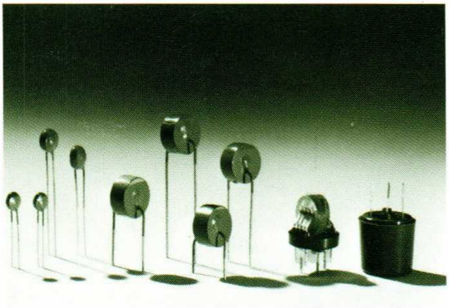
H_{max}
For 91002, 03, 04: 6 mm
For 91005: 5 mm

colour code

yellow	91002
green	91003
orange	91004
red	91005



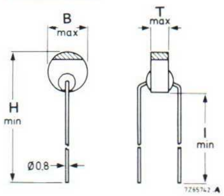
2333 662 – disc



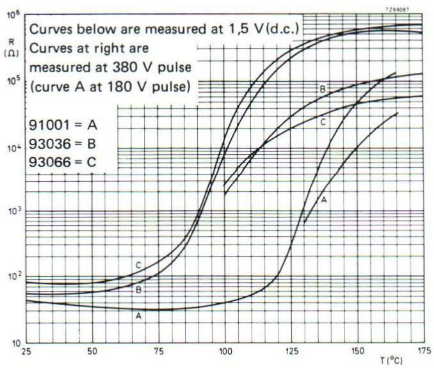
662 91001 is designed for contact protection for telegraph relays.
The other two PTC thermistors are used as the degaussing element in colour tv receivers, but have far wider applications as protective and delay devices.

Catalogue no. 2322 662.....	91001	93036	93066	
Resistance at 25°C; V(d.c.) ⩽ 1,5 V	36 to 50	45 to 60	80 to 120	Ω
Switch temperature	115	75	75	°C
Temperature coefficient	35	20	35	%/K
Dissipation factor	13	20	15,3	mW/K
Max d.c. voltage	180	–	–	V
Max r.m.s. voltage	–	265	265	V
Operating temperature				
at zero power	0 to 155	–25 to 155		°C
at max voltage	0 to 55	0 to 60		°C

Dimensions

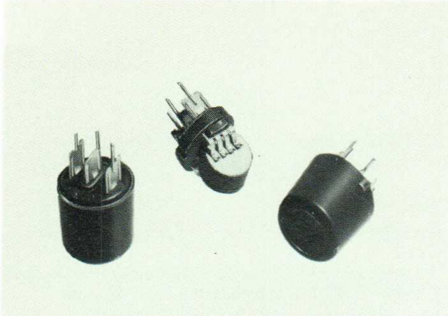


	colour code	T	B	H	I
91001	none	4,8	10,8	45	34
93036	green	6,5	12,6	51	38,4
93066	red	5,5	10,5	52	41,5



non-linear resistors
PTC thermistors

2322 662 98 – dual degaussing thermistors

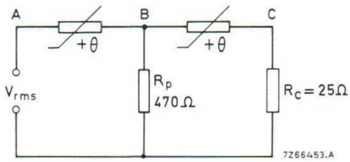


Intended for use in colour tv.
Because of the excellent thermal contact between the two discs inside the package, the stabilized current through the coil is limited to 2 mA.
The assembly is constructed for p.c.b. mounting.

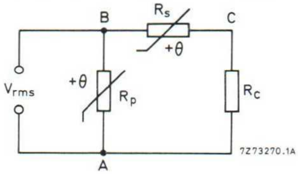
Catalogue no. 2322 662.	98001	98003	98009	98012	98013	
Resistance at 25°C; V(d.c.) ⩽1,5 V						
mains PTC	25	30	3000	–	400 to 2400	Ω
coil PTC	8	8	40	40	10	Ω
NTC				130		Ω
Current through degaussing coil:						
min inrush peak current (at V_{rms})	5 (200 V)	5 (220 V)	5 (200 V)	5,8 (200 V)	10 (100 V)	A
max idle peak current						
after 5 s	70	70	70	70	140	mA
after 30 s	5	5	5	12	10	mA
after 3 minutes	2	2	2	–	5	mA
after 4 minutes				5,8		mA
Switch temperature	75	75	–	65	mains PTC 170	°C
					coil PTC 70	°C
Temperature coefficient	25	25	–	26	mains PTC 20	%/K
					coil PTC 16	%/K
Dissipation factor	13,5	13,5	–	12,5	–	mW/K
Max r.m.s. voltage	245	265	265	265	140	V
Operating temperature						
at zero power	25 to 155	25 to 155	– 25 to 125	– 25 to 125	– 25 to 125	°C
at max voltage	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	°C

Measuring circuits

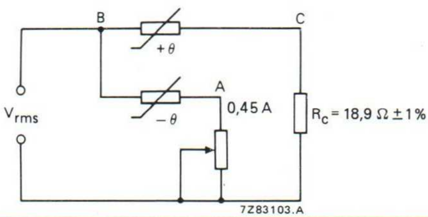
for 98001 and 98003



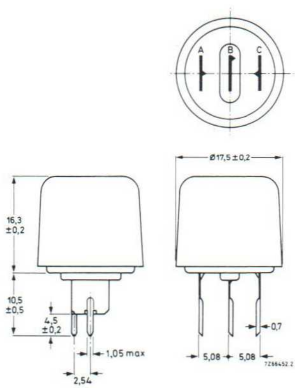
for 98009 (R_C = 25 Ω)
and 98013 (R_C = 6,2 Ω)



for 98012

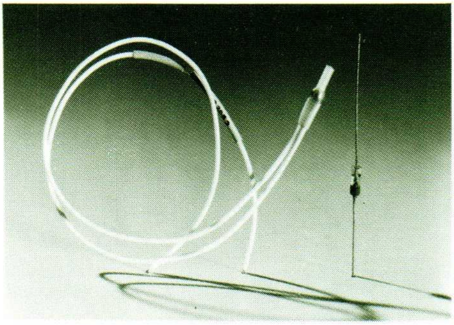


Dimensions



2322 672 920 – for protection of motors against excessive temperatures

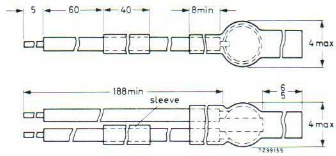
2322 672 98001 – telephone line current stabilizer (TPE)



2322 672 920

Resistance at T_{ref}*	– 5°C; V ⩽ 1,5 V(d.c.)	<550	Ω
	+ 5°C	>1330	Ω
	+ 15°C; V_{pulse} = 7,5 V	>4000	Ω
Dissipation factor		7	mW/K
Max d.c. voltage		15	V
Operating temperature at zero power		– 20 to (T_{ref} + 30)	°C
	at max voltage	– 20 to (T_{ref} + 15)	°C

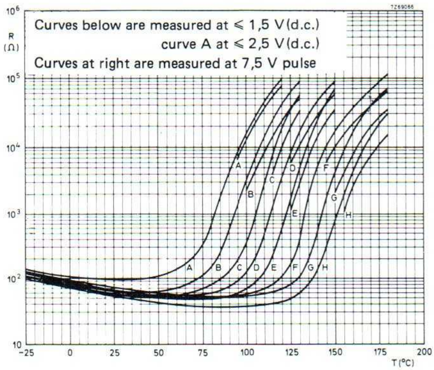
Dimensions



last digits of catalogue no. are printed on sleeve

T_{ref}* °C	T_{switch} °C	temperature coefficient %/K	catalogue no.	curve
80	68	18	2322 672 92045	A
90	75	21	92046	B
100	88	31	92047	C
110	99	33	92048	D
120	113	38	92049	E
130	123	27	92051	F
140	130	33	92052	G
150	137	33	92053	H

* Temperature at which the thermistor makes the protective system operative.



2322 672 98001 (TPE), 2322 670 90003 (TPJ)

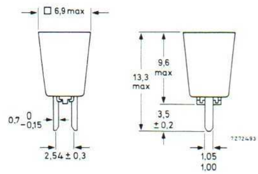
For resistances of up to 1000 Ω in telephone lines, the subscriber current will be within 31,5 mA and 48 mA with TPE, within 30 mA and 50 mA with TPJ.

Current compensation by selecting the right resistor is not necessary; it can be done automatically by a TPE or TPJ.

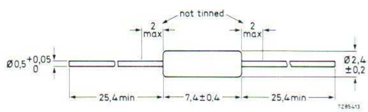
		TPE	TPJ
Resistance at	25°C	115 ± 25 Ω	120 ± 30 Ω
	155°C	>15 kΩ	>2 kΩ
Switch temperature approx.		97°C	145°C
Temperature coefficient		>10%/K	>8%/K
Max d.c. voltage at 40°C		33 V	34 V
Response time		⩽10 s	⩽2 s
Operating temperature			
at zero power		– 25 to 155°C	– 25 to 155°C
at max voltage		+ 5 to 55°C	0 to 40°C

Dimensions

TPE



TPJ



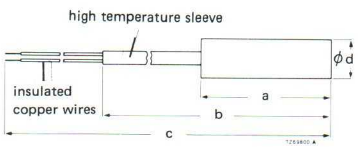
non-linear resistors
PTC thermistors

2322 680 900 – heating elements

Heating elements with high initial dissipation going to a stabilized temperature (in standard test tube). Intended for hair curling tongs.

catalogue no. 2322 680.....		90047	90071	90134	90259	
voltage range (r.m.s.)		100 to 240	100 to 240	100 to 240	100 to 265	V
max inrush power	at 120 V	–	200	200	–	W
	at 220 V	500	–	–	500	W
approx. steady-state power (in test tube)	at 120 V	–	17	15	–	W
	at 220 V	15	–	–	17	W
temperature on test tube after 20 min	at 120 V	⩾170	172 ± 8	172 ± 8	⩾145	°C
	at 220 V	185 ± 8	–	–	–	°C
	at 240 V	–	⩽195	⩽195	165 ± 8	°C
insulation of coating		double	single	double	double	
dielectric withstanding voltage between terminals and coating (r.m.s.)		⩾6	⩾6	⩾4	⩾6	kV
dimensions	a	60 ± 2	50 ± 2	60 ± 2	50 ± 2	
	b	170 ± 7	no sleeve	170 ± 7	160 ± 7	
	c	210 ± 7	245 ± 7	210 ± 7	210 ± 7	
	d	12,45 + 0 − 0,25	14,75 + 0 − 0,25	10,6 + 02 − 0,2	14,75 + 0 − 0,25	

Dimensions

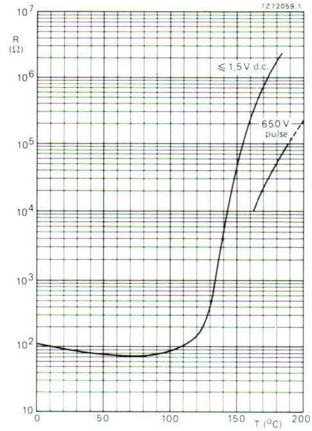


2322 662 93006
2322 660 93001 – **discs**

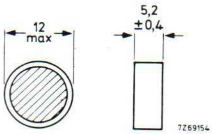
662 93006 is suitable for fluorescent lamp starter
660 93001 is suitable for stair-well lighting control

2322 662 93006

Resistance value at 25°C	70 to 100 Ω
Max current at 600 V r.m.s. at 25°C	5 mA
Switch temperature	120°C
Temperature coefficient	+ 35 %/K
Max r.m.s. voltage	460 V
Dissipation factor	11,5 mW/K
Operating temperature	
at zero power	– 25 to 175°C
at max voltage	0 to 85°C

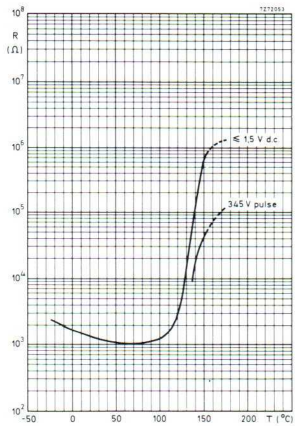


Dimensions

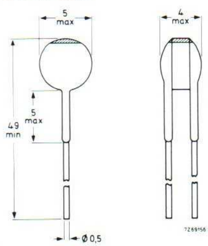


2322 660 93001

Resistance value at 25°C	750 to 1500 Ω
Resistance value at 175°C V_{pulse} = 345 V	70 kΩ
Switch temperature	+ 115°C
Temperature coefficient	+ 26 %/K
Max r.m.s. voltage	245 V
Dissipation factor	7 mW/K
Operating temperature	
at zero power	– 25 to 155°C
at max voltage	0 to 55°C



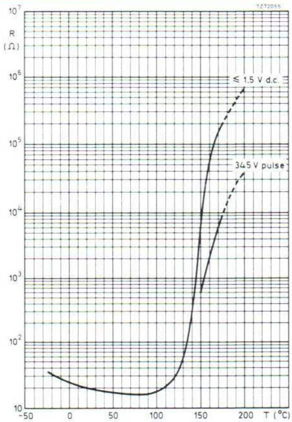
Dimensions



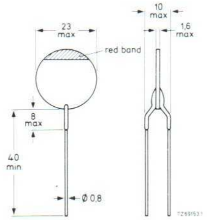
2322 664 91086 – disc

For protection purposes in relay coils, loudspeakers, etc.

Resistance value at 25°C	max 0,6 Ω
Resistance value at 150°C	
V_{pulse} = 16 V	min 40 Ω
Switch temperature	85°C
Temperature coefficient	+ 10 %/K
Max d.c. voltage	16 V
Dissipation factor	27 mW/K
Operating temperature	
at zero power	– 25 to 155°C
at max voltage	– 25 to 55°C



Dimensions

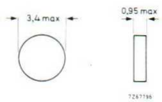


2322 672 91 – disc

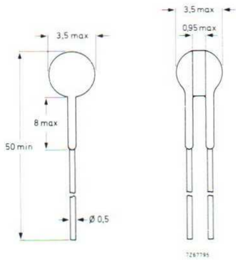
Intended as temperature sensors in domestic appliances, fire alarms, car electronics.

Resistance value between -20 and $(T_S - 10)$ °C	30 to 250 Ω
Resistance value at $(T_S + 25)$ °C and $V_{pulse} = 7{,}5$ V	⩾4000 Ω
Switch temperature, T_S	70 to 150°C
Temperature coefficient	18 to 38%/K
Max d.c. voltage	25 V
Dissipation factor (version with leads)	5,7 mW/K
Operating temperature at zero power	-25 to $(T_S + 40)$ °C
at max voltage	0 to $(T_S + 25)$ °C

Dimensions



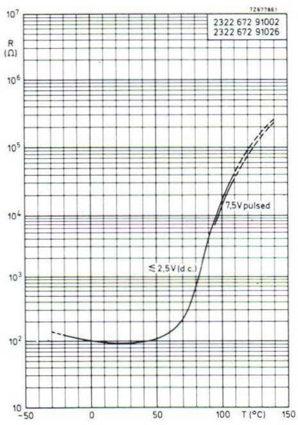
version without leads

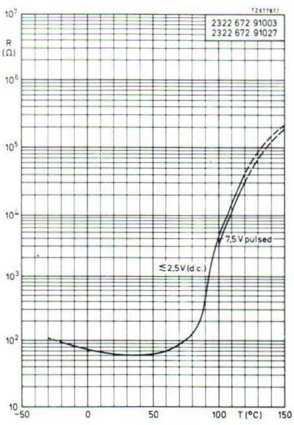


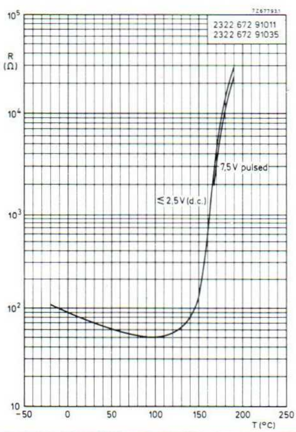
version with leads

2322 672 91XXX

T_S °C	temperature coefficient %/K	balance voltage V(d.c.)	voltage dependence β at $(T_S + 25)$°C	colour code for version with leads	**XXX** with leads	**XXX** without leads
70	18	19	0,32	violet	002	026
80	21	27	0,40	grey	003	027
90	31	16	0,36	white	004	028
100	33	17	0,35	black	005	029
110	38	11	0,36	brown	006	031
120	27	34	0,38	red	007	032
130	33	13	0,34	orange	008	033
140	33	20	0,35	yellow	009	034
150	23	20	0,31	green	010	035





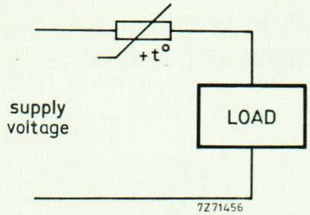


non-linear resistors
PTC thermistors for overload protection

This range of PTCs is suitable for current-sensitive switching, or overload protection at current switching levels from the milliampere region to more than one ampere, with circuit supply voltages up to 245 V.

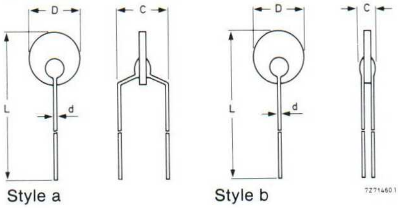
catalogue no.	R_{25} (± 25%)	T_s	V_{max} at 55°C	I_{stat} peak at 25°C	at 55°C	I_{max} at 0°C and 60 V	t_{resp} max at 25°C and I_{max}	D	I_{res}	dimensions style	line
2322...	Ω	°C	V	A	A	A	s	mW/K	mA		
664 91002	1,65	115	60	0,85	0,64	7,5	3	20	63	a	6
664 91003	1,65	115	60	0,75	0,57	6,5	3	15	53	b	8
663 91002	2,3	115	60	0,63	0,47	5,25	3	15	51	a	7
663 91003	2,3	115	60	0,50	0,37	4,5	3	10	36	b	9
662 91006	3,7	115	60	0,44	0,33	3,5	3	12	39	a	8
662 91007	3,7	115	60	0,35	0,26	2,75	3	7,5	29	b	10
662 91004	5,6	115	60	0,34	0,25	2,7	3	11	31	a	9
662 91005	5,6	115	60	0,26	0,195	2	3	6,5	22	b	11
661 91019	9,4	115	60	0,25	0,19	1,9	3	10	28	a	10
661 91021	9,4	115	60	0,18	0,135	1,3	3	5	16	b	12
660 91017	25	115	60	0,09	0,068	0,65	3	4	12,5	b	13
672 91016	55	115	60	0,059	0,044	0,4	3	3,5	10,5	b	14

catalogue no.	R_{25} (± 25%)	T_s	V_{max} at 55°C	I_{stat} peak at 25°C	at 55°C	I_{max} at 0°C and 245 V	t_{resp} max at 25°C and I_{max}	D	I_{res}	dimensions style	line
2322...	Ω	°C	V	A	A	A	s	mW/K	mA		
664 93014	3,7	115	245	0,55	0,41	4,9	6	20	18	a	1
664 93015	3,7	115	245	0,5	0,38	4,5	6	15,5	17	b	1
663 93006	6	115	245	0,4	0,3	3,0	6	16	16	a	2
663 93007	6	115	245	0,33	0,25	2,5	6	11	13	b	2
662 93017	10	115	245	0,27	0,2	1,8	7	12,5	14	a	3
662 93018	10	115	245	0,235	0,175	1,5	7	9	10	b	3
662 93015	15	115	245	0,215	0,162	1,3	7	11	14	a	4
662 93016	15	115	245	0,162	0,120	1	7	6,5	8,5	b	4
661 93001	25	115	245	0,150	0,115	0,9	7	10	11,5	a	5
661 93002	25	115	245	0,115	0,087	0,7	7	5,5	7	b	5
660 93006	70	115	245	0,059	0,045	0,25	8	4	5,5	b	6
660 93011	120	115	245	0,045	0,034	0,19	8	4	5	b	6
672 93003	150	115	245	0,036	0,027	0,1	8	4	4,5	b	7
660 93012	600	115	245	0,020	0,015	0,085	8	4	4,5	b	6
660 93013	1200	115	245	0,014	0,011	0,060	8	4	4,5	b	6
660 93014	1500	115	245	0,013	0,010	0,055	8	4	4,5	b	6



The principle of PTC overload protection.

Dimensions



Style

line	D (±5%)	L (±5)	d	C (±0,5)
1	20	60	0,8	8,5
2	16	58	0,8	8,5
3	12	56	0,8	8,5
4	10	55	0,8	8,5
5	8	54	0,8	8,5
6	20	60	0,8	6,8
7	16	58	0,8	6,8
8	12	56	0,8	6,8
9	10	55	0,8	6,8
10	8	54	0,8	6,8

Style b

line	D (±5%)	L (±5)	d	C (±1)
1	20	60	0,5	4
2	16	58	0,5	4
3	12	56	0,5	4
4	10	55	0,5	4
5	8	54	0,5	4
6	4,5	52,5	0,5	4
7	3	51,5	0,5	4
8	20	60	0,5	2,5
9	16	58	0,5	2,5
10	12	56	0,5	2,5
11	10	55	0,5	2,5
12	8	54	0,5	2,5
13	4,5	52,5	0,5	2,5
14	3	51,5	0,5	2,5

standard series to IEC 63
values in a decade for resistors and capacitors

E192	E96	E48
100	100	100
101		
102	102	
104		
105	105	105
106		
107	107	
109		
110	110	110
111		
113	113	
114		
115	115	115
117		
118	118	
120		
121	121	121
123		
124	124	
126		
127	127	127
129		
130	130	
132		
133	133	133
135		
137	137	
138		
140	140	140
142		
143	143	
145		
147	147	147
149		
150	150	
152		
154	154	154
156		
158	158	
160		
162	162	162
164		
165	165	
167		

E192	E96	E48
169	169	169
172		
174	174	
176		
178	178	178
180		
182	182	
184		
187	187	187
189		
191	191	
193		
196	196	196
198		
200	200	
203		
205	205	205
208		
210	210	
213		
215	215	215
218		
221	221	
223		
226	226	226
229		
232	232	
234		
237	237	237
240		
243	243	
246		
249	249	249
252		
255	255	
258		
261	261	261
264		
267	267	
271		
274	274	274
277		
280	280	

E192	E96	E48
284		
287	287	287
291		
294	294	
298		
301	301	301
305		
309	309	
312		
316	316	316
320		
324	324	
328		
332	332	332
336		
340	340	
344		
348	348	348
352		
357	357	
361		
365	365	365
370		
374	374	
379		
383	383	383
388		
392	392	
397		
402	402	402
407		
412	412	
417		
422	422	422
427		
432	432	
437		
442	442	442
448		
453	453	
459		
464	464	464
470		
475	475	

E192	E96	E48
481		
487	487	487
493		
499	499	
505		
511	511	511
517		
523	523	
530		
536	536	536
542		
549	549	
556		
562	562	562
569		
576	576	
583		
590	590	590
597		
604	604	
612		
619	619	619
626		
634	634	
642		
649	649	649
657		
665	665	
673		
681	681	681
690		
698	698	
706		
715	715	715
723		
732	732	
741		
750	750	750
759		
768	768	
777		
787	787	787
796		
806	806	

E192	E96	E48
816		
825	825	825
835		
845	845	
856		
866	866	866
876		
887	887	
898		
909	909	909
920		
931	931	
942		
953	953	953
965		
976	976	
988		

E24	E12	E6	E3
10	10	10	10
11			
12	12		
13			
15	15	15	
16			
18	18		
20			
22	22	22	22
24			
27	27		
30			
33	33	33	
36			
39	39		
43			
47	47	47	47
51			
56	56		
62			
68	68	68	
75			
82	82		
91			

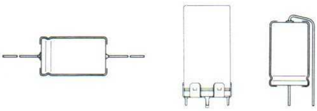
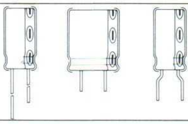
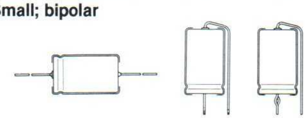
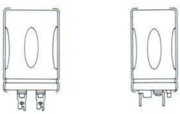
CONTENTS CAPACITORS

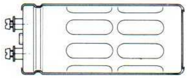
For detailed information
Handbook CM2b

electrolytic and solid capacitors
survey

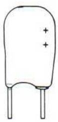
For detailed information
Handbook C14

ALUMINIUM ELECTROLYTIC CAPACITORS

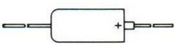
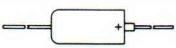
type	series number 2222. . .	application	nominal capacitance μF	rated voltage (U_R) V	status	page
Miniature/small						
	030 031	long-life, general, industrial	0,33 to 1000	6,3 to 100	D	C84
	032 033	long-life, general, industrial	68 to 15 000	6,3 to 100	D	C85
	041	general, industrial	1 to 22	160 to 385	D	C86
	042 043	long-life, general, industrial	6,8 to 220	160 to 385	D	C87
Miniature/small 	035	general	0,47 to 470	6,3 to 100	D	C88
Small 	108	extra long-life, industrial	2,2 to 2200	6,3 to 63	D	C90
Small; bipolar 	039	long-life, general, industrial	1 to 47	U_R (a.c.) = 63 V_p U_R (d.c.) = 63 V	D	C89
Large 	050 052	long-life, industrial	47 to 68 000	10 to 385	D	C91

type	series number 2222. . .	application	nominal capacitance μF	rated voltage (U_R) V	status	page
Large 	114 115	long-life, industrial military	150 to 220 000	10 to 385	D	C92
Maintenance types	015 016	long-life, general, industrial	0,47 to 680	4 to 100		
	034	general	0,47 to 3300	6,3 to 100		
	071 073	long-life, industrial	680 to 47 000	6,3 to 63	M	C93
	105	long-life, industrial	220 to 1000	400		
	106 107	long-life, military	1500 to 150 000	6,3 to 100		

SOLID ALUMINIUM CAPACITORS

type	series number 2222. . .	application	nominal capacitance μF	rated voltage (U_R) V	status	page
Miniature; resin dipped 	122	long-life, general, industrial	0,1 to 68	6,3 to 40	D	C94
Small  CECC approval pending	123	extra long-life, military, industrial	2,2 to 1000	6,3 to 40	D	C95
Maintenance type	121	long-life, military, industrial	2,2 to 330	6,3 to 50	M	C95

SOLID TANTALUM CAPACITORS

type	series number 2222. . .	application	nominal capacitance μF	rated voltage (U_R) V	status	page
Hermetic seal; to MIL-C-39003/01 	141	polarized or d.c. biased circuits	0,1 to 330	6 to 75	D	C96
Hermetic seal 	143	polarized or d.c. biased circuits	0,1 to 330	6 to 50	D	C97

electrolytic and solid capacitors
aluminium electrolytic

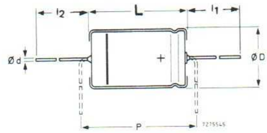
2222 030 / 2222 031
- **Miniature**
- **Axial leads (on bandoliers) or single ended**
- **General**

Selection chart for C_{nom} – U_R and relevant case sizes

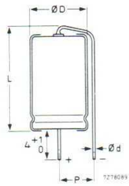
C_{nom} (E6 series) μF	U_R (V) (R5 series) 6,3	10	16	25	40	63	100
0,33						2	
0,47						2	
0,68						2	
1					2	2	
1,5						2	
2,2					1	2	2
3,3			1		2	2	
4,7			1			2	3
6,8		1			2	2	3
10	1			2	2	3	4, 5a
15			2		2	3	
22		2		2	3	4, 5a	5
33	2		2		3		6
47		2		3	4, 5a	5	7
68	2		3			6	
100		3		4, 5a	5	7	
150	3		4, 5a	5	6		
220		4, 5a	5	6	7		
330		5	6	7			
470	5	6	7				
680	6	7					
1000	7						

Tolerance on nominal capacitance	–10 to +50%
Category temperature range	–40 to +85 °C
Endurance test case size 1	500 h at 85 °C
	1000 h at 70 °C
case sizes 2 to 7	2000 h at 85 °C
Basic specification	IEC 384-4
	long-life grade
Detail specification	DIN 41316
Climatic category IEC 68	40/085/56

Dimensions (mm)



style 1, axial leads



style 3, single ended

case size	style	d	D max	L max	P min
1	1	0,6	3,5	11	15
1	3	0,6	3,5	13	2,5
2	1	0,6	5,0	10,5	15
2	3	0,6	5,0	12,5	2,5
3	1	0,6	6,3	10,5	15
3	3	0,6	6,3	12,5	3,5
5a	1	0,6	8,5	11,5	15
5a	3	0,6	8,5	13	5
4	1	0,8	6,9	18,5	25
4	2,3	0,8	6,9	21,5	5
5	1	0,8	8,5	18,5	25
5	2,3	0,8	8,5	21,5	5
6	1	0,8	10,5	18,5	25
6	2,3	0,8	10,5	21,5	7,5
7	1	0,8	10,5	25	30
7	2,3	0,8	10,5	28	7,5

Composition of catalogue no. 2222 03P QXYYZ

P	code for case size
0	case size 1, 2, 3, 5a
1	case size 4, 5, 6, 7

Q	code for style and packing
2	style 1, on bandoliers on reel
3	style 1, on bandoliers in box
8	style 3

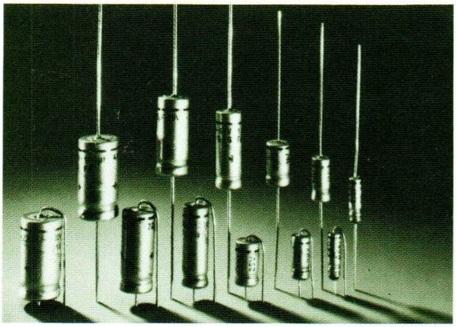
X	code for U_R
3	6,3 V
4	10 V
5	16 V
6	25 V
7	40 V
8	63 V
9	100 V

YY first two digits of capacitance value in μF

Z	code for multiplier
7	0,01
8	0,1
9	1
1	10
2	100
3	1000

2222 032 / 2222 033

- Small
- Axial leads or single ended
- Long-life
- General and industrial

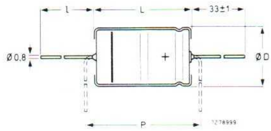


Selection chart for C_{nom} – U_R and relevant case sizes

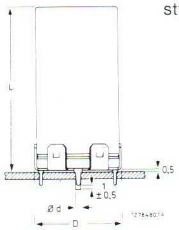
C_{nom} (E6 series)	U_R (V) (R5 series)						
µF	6,3	10	16	25	40	63	100
68							00
100							01
150						00	02
220						01	03
330					01	02	04
470				00	01	02	05
680			00	01	02	03	05
1000		00	01	02	03	05	
1500	00	01	02	03	04	05	
2200	01	02	03	04	05		
3300	02	03	04	05	05		
4700	03	04	05	05			
6800	04	05	05				
10000	05	05					
15000	05						

Tolerance on nominal capacitance		– 10 to + 50%
Category temperature range		– 40 to + 85°C
Endurance test at 85°C	032	5000 h
	033	2000 h
Basic specification		IEC 384-4, long-life grade
		DIN 41316 (6,3 to 63 V)
		DIN 41332 (100 V)
Climatic category IEC 68		40/085/56
DIN 40040		GPF

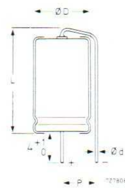
Dimensions (mm)



style 1, axial leads



style 2, p.w. pins



style 3, single ended

case size	style	d	l_{min}	D max	L max	P min
00	1	0,8	54	10,5	30,5	35
00	3	0,8		10,5	34	7,5
01	1	0,8	54	13	30,5	35
01	3	0,8		13	34	7,5
02	1	0,8	54	15,5	30,5	35
02	3	0,8		15,5	34	10
03	1	0,8	54	18,5	30,5	35
03	2	0,8		20,5	32	
03	3	0,8		20,5	34	10
04	1	0,8	33	18,5	41,5	45
04	2	1		20,5	43	
05	1	0,8	33	21,5	41,5	45
05	2	1		23,5	43	

Composition of catalogue no. 2222 03P QXYYZ

P	code for case size
2	case size 00 to 03
3	case size 04, 05

Q	code for style
1	style 1
4	style 2
8	style 3

X	code for U_R
3	6,3 V
4	10 V
5	16 V
6	25 V
7	40 V
8	63 V
9	100 V

YY first two digits of cap. value in µF

Z	code for multiplier
7	0,01
8	0,1
9	1
1	10
2	100
3	1000

electrolytic and solid capacitors
aluminium electrolytic

2222 041
- **miniature**
- **axial leads or single ended**
- **general and industrial**

Selection chart for $C_{nom} - U_R$ and relevant case sizes

C_{nom} (E3 series)	U_R (V) (R5 series)			
μF	160	250	350	385
1				4
2,2		4		5
4,7	4	5	6	7
10	5	7		
22	7			

Tolerance on nominal capacitance	−10 to +50%
Category temperature range	−40 to +85 °C
Endurance test at 85 °C, U_R applied	2000 h
Basic specification	IEC 384-4, general purpose grade DIN 41316
Climatic category IEC 68	40/085/56
DIN 40040	GPF

Composition of catalogue no. 2222 041 QXYYZ

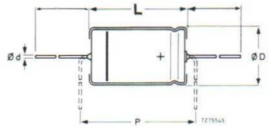
Q	code for style and packing
2	style 1, on bandolier, on reel
3	style 1, on bandolier, in box
8	style 3

X	code for U_R
1	160 V
3	250 V
5	350 V
8	385 V

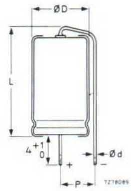
YY first two digits of capacitance value in μF

Z	code for multiplier
8	0,1
9	1
1	10

Dimensions (mm)



style 1, axial leads



style 3, single ended

case	style	d style 3	D max	L max	P min
4	1	0,8	6,9	18,5	25
4	3	0,8	6,9	21,5	5
5	1	0,8	8,5	18,5	25
5	3	0,8	8,5	21,5	5
6	1	0,8	10,5	18,5	25
6	3	0,8	10,5	21,5	7,5
7	1	0,8	10,5	25	30
7	3	0,8	10,5	28	7,5

2222 042 / 2222 043

- small
- axial leads or single ended
- general and industrial applications

Selection chart for $C_{nom} - U_R$ and relevant case sizes

C_{nom} (E3 series) μF	U_R (V) (R5 series) 160	250	350	385
6,8			00	00
10		00	01	01
15		01	01	02
22	00	01	02	03
33	01	02	03	04
47	02	03	04	04
68	02	04	05	05
100	03	05		
150	04			
220	05			

Tolerance on nominal capacitance	− 10 to + 50%
Category temperature range	− 40 to + 85 °C
Endurance test at 85 °C	2000 h
Basic specification	IEC 384-4, type 1, long-life grade
Climatic category IEC 68	40/085/56

Composition of catalogue no. 2222 04P QXYYZ

P code for case size
2 00 to 03
3 04, 05

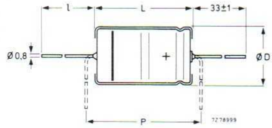
Q code for style
1 style 1
4 style 2
8 style 3

X code for U_R
1 160 V
3 250 V
5 350 V
8 385 V

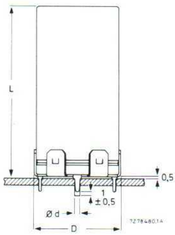
YY first two digits of capacitance value in μF

Z code for multiplier
8 0,1
9 1
1 10

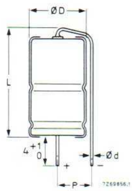
Dimensions (mm)



Style 1, axial leads



Style 2, p.w. pins



Style 3, single ended

case	style	d	l min	D max	L max	P min
00	1	0,8	54	10,5	30,5	35
00	3	0,8		10,5	34	7,5
01	1	0,8	54	13	30,5	35
01	3	0,8		13	34	7,5
02	1	0,8	54	15,5	30,5	35
02	3	0,8		15,5	34	10
03	1	0,8	54	18,5	30,5	35
03	2	0,8		20,5	32	
03	3	0,8		20,5	34	10
04	1	0,8	33	18,5	41,5	45
04	2	1		20,5	43	
05	1	0,8	33	21,5	41,5	45
05	2	1		23,5	43	

electrolytic and solid capacitors
aluminium electrolytic

2222 035
- **Miniature and small types**
- **Single ended**
- **General purpose**

Selection chart for C_{nom} – U_R and relevant case sizes.

C_{nom} (E6 series) (μF)	U_R (V) (R5 series) 6,3	10	16	25	35	40	50	63	100
0,47								11	11
1								11	11
1,5								11	11
2,2								11	11
3,3								11	11
4,7								11	12
6,8								11	12
10							11	12	13
15						11		12	13
22					11	12	12	13	14
33			11			12		13	15
47		11		12			13	14	16
68			12			13	14	15	17
100		12		13			15	16	18
150	12		13	14		15	16	17	18
220		13	14	15		16	17	18	19
330	13	14	15	16		17	18	19	20
470		15	16	17		18		19	
680	15	16	17	18		19	19	20	
1000	16	17	18	19	19		20		
1500	17	18	19	20					
2200	18		19						
3300	19		20						
4700	20								

Tolerance on nominal capacitance	± 20%
Category temperature range	– 40 to + 85°C
Endurance test	1000 h at 85°C
Basic specification	IEC 384-4, general purpose grade DIN 41332
Climatic category IEC 68	40/085/56
DIN 40040	GPF

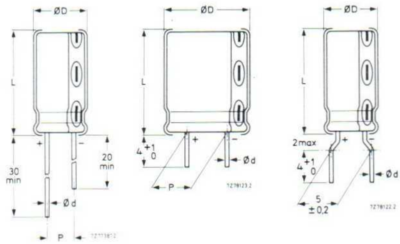
Composition of catalogue no. 2222 035 QXYYZ
(not for U_R = 35 or 50 V)

Q	style and packing
2	style 1 on bandoliers on reel
3	bandoliers in ammopack
5	style 1 in box
6	style 2, size 14/20 in box; style 3, size 11/13 in box
8	style 2, size 11/13 in box

X	code U_R
3	6,3 V
4	10 V
5	16 V
6	25 V
7	40 V
8	63V
9	100V

YY	first two digits of capacitance value in μF
Z	**code for multiplier**
7	0,01
8	0,1
9	1
1	10
2	100

Dimensions (mm)



style 1	style 2	style 3
straight long leads	straight short leads	bent short leads

case size	d	D_{max}	L_{max}	P
11	0,5	5,5	12,0	2,0
12	0,6	6,5	12,0	2,5
13	0,6	8,5	13,0	3,5
14	0,6	10,5	13,0	5,0
15	0,6	10,5	17,0	5,0
16	0,6	10,5	21,0	5,0
17	0,6	13,0	21,0	5,0
18	0,6	13,0	26,0	5,0
19	0,8	16,5	26,0	7,5
20	0,8	16,5	32,0	7,5

Catalogue nos U_R = 35 or 50 V (last 5 digits)

nom. cap μF	style 1 in box	style 1 on tape	style 2	style 3
U_R = 35 V				
22	90003	90034	90004	90005
1000	90006		90007	
U_R = 50 V				
10	90008	90035	90009	90011
22	90012	90036	90013	90014
47	90015	90037	90016	90033
68	90017	90039	90018	
100	90019		90021	
150	90022		90023	
220	90024		90025	
330	90026		90027	
680	90028		90029	
1000	90031		90032	

2222 039
- **small**
- **bipolar**
- **axial leads**
- **long life**
- **general**

Selection chart for C_{nom} – U_R and relevant case sizes

U_R V	C_{nom} (E6 series) μF	case size
63	1,0	00
	1,5	00
	2,2	00
	3,3	00
	4,7	00
	6,8	00
	10	01
	15	01
	22	02
	33	02
	47	03

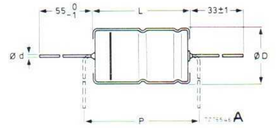
Tolerance on nominal capacitance	– 20 to + 20%
Rated voltage U_R (r.m.s.) frequency > 15 Hz	63 V peak (40 V r.m.s.), provided ripple current remains within specified limits
Rated voltage U_R (d.c.)	63 V in both directions
Category temperature range	– 40 to + 85 °C
Endurance test at 85 °C	5000 h
Basic specification	IEC 384-4, long-life grade
Category, IEC 68	40/085/56

Composition of catalogue no. 2222 039 18YYZ

YY first two digits of capacitance value in μF

Z	code for multiplier
8	0,1
9	1

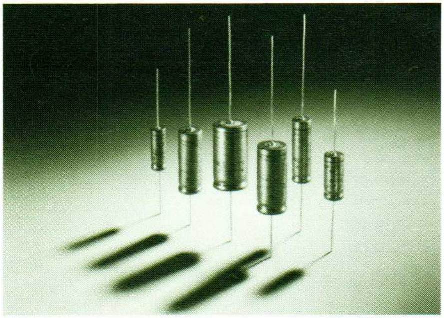
Dimensions (mm)



style 1 axial leads

case size	d	D_{max}	L_{max}	P_{min}	D_{max}
00	0,8	10,5	30,5	35	10,5
01	0,8	13,0	30,5	35	13,0
02	0,8	15,5	30,5	35	15,5
03	0,8	18,5	30,5	35	18,5

electrolytic and solid capacitors
aluminium electrolytic

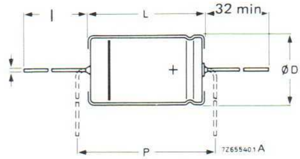


2222 108
- **small**
- **axial leads**
- **long life**
- **industrial**

Selection chart for C_{nom} – U_R and relevant case sizes

C_{nom} (E6 series)	U_R (V)					
µF	6,3	10	16	25	40	63
2,2						5
3,3						5
4,7						5
6,8						5
10						5
15					5	6
22					5	6
33				5	6	00
47				5	6	00
68			5		00	01
100		5		6	01	02
150	5		6	00	01	03
220		6	00	01	02	
330	6	00			03	
470	00		01	02		
680		01	02	03		
1000	01	02	03			
1500	02	03				
2200	03					

Dimensions



case	l_1 min	D max	L max	P min
5	32	8,5	18,5	25
6	32	10,5	18,5	25
00	54	10,5	30,5	35
01	54	13,0	30,5	35
02	54	15,5	30,5	35
03	54	18,5	30,5	35

Tolerance on nominal capacitance		– 10 to + 50%
Category temperature range		– 40 to + 85°C
Typical life time at 85°C,	case size 5, 6	> 6000 h
U_R applied	case sizes 00 to 03	> 10 000 h
Basic specification		IEC 384-4, long-life grade
		DIN 41240 (IA)
		NF C93-110 (type 1)
Climatic category	IEC 68	40/085/56
	DIN 40040	GPF (56 days)
	NF C93-001	554
Approvals (case sizes 00 to 03)		CECC 30301 027

Composition of catalogue no. 2222 108 PXYYZ

P	code for case size
1	case 5, 6
3	00 to 03

X	code for U_R
3	6,3 V
4	10 V
5	16 V
6	25 V
7	40 V
8	63 V

YY first two digits of capacitance value in µF

Z	code for multiplier
8	0,1
9	1
1	10
2	100

2222 050 / 2222 052

- **large**
- **solder tags or printed wiring pins**
- **long life**
- **industrial**

Selection chart for $C_{nom} - U_R$ and relevant case sizes

C_{nom} (E6 series) µF	U_R (V) 10	16	25	40	63	100	250	385
47								1
68								2
100							1	3
150							2	4
220							3	5/6
330							4	7
470						1	5/6	8
680						2	7	
1 000					1	3	8	
1 500				1	2	4		
2 200			1	2	3	5/6		
3 300		1	2	3	4	7		
4 700	1	2	3	4	5/6	8		
6 800	2	3	4	5/6	7	9		
10 000	3	4	5/6	7	8			
15 000	4	5/6	7	8	9			
22 000	5/6	7	8	9				
33 000	7	8	9					
47 000	8	9						
68 000	9							

Tolerance on nominal capacitance	−10 to +30%
Category temperature range	−40 to +85 °C
Endurance test at 85 °C, at U_R	2000 h
Basic specification	IEC 384-4, long-life grade; DIN 41240
Dimensional specification	DIN 41238
Climatic category, IEC 68	40/085/56

Composition of catalogue no. 2222 050 PXYYZ (U_R<250 V)
052 PXYYZ ($U_R \geqslant$250 V)

P	code for terminals
1	solder tags
4	p.w. pins, case size 6 only
5	p.w. pins, except case size 6
6	solder tag with bolt and nut

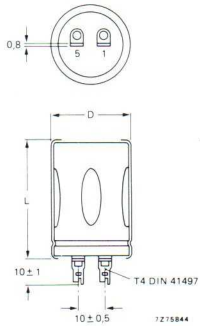
X	code for UR
4	10 V
5	16 V
6	25 V
7	40 V
8	63 V for 050 385 V for 052
9	100 V
3	250

YY first two digits of capacitance value in µF

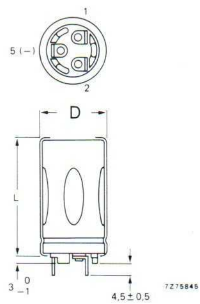
Z	code for multiplier
9	1
1	10
2	100
3	1000

Dimensions (mm)

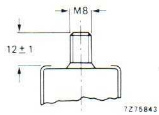
Solder tags



Printed-wiring pins



Bolt version



case size	Dmax solder tags	pw pins	Lmax
1	25,6	26	36,3
2	25,6	26	46,3
3	30,6	31	46,3
4	35,6	36	46,3
5	35,6	36	56,3
6	–	41	46,3
7	40,6	41	56,3
8	40,6	41	76,3
9	40,6	41	106,3

Accessories

- Metal mounting clamps;
- Synthetic nuts and rubber washers for insulated mounting of bolt version.

electrolytic and solid capacitors
aluminium electrolytic

2222 114 / 2222 115
- **large**
- **screw terminals**
- **long life**
- **industrial**

Selection chart for C_{nom} – U_R and relevant case sizes.

C_{nom} (E6 series) µF	U_R (V) (R5 series) 10	16	25	40	63	100	250	350	385
150									10
220									11
330							10		12a
470							11		14
680							12a	14	15a
1 000						10	14	15a	16a
1 500						10	15a		16a
2 200					10	11	16a		17
3 300				10	10	12a	16a		
4 700			10	10	11	14	17		
6 800			10	11	12a	15a			
10 000		10	11	12a	14	16a			
15 000	10	11	12a	14	15a	16a			
22 000	11	12a	14	15a	16a	17			
33 000	12a	14	15a	16a	16a				
47 000	14	15a	16a	16a	17				
68 000	15a	16a	16a	17					
100 000	16a	16a	17						
150 000	16a	17							
220 000	17								

Tolerance on nominal capacitance	– 10 to + 30%
Category temperature range	– 40 to + 85 °C
Endurance test at 85 °C	5000 h
Basic specification	IEC 384-4; long-life grade
	DIN 41240
Detail specification	DIN 41248
Climatic category IEC 68	40/085/56
DIN 40040	GPF (56 days)
NF C93-001	554

Composition of catalogue no. 2222 114 PXYYZ (U_R<250 V)
115 PXYYZ (U_R≥250 V)

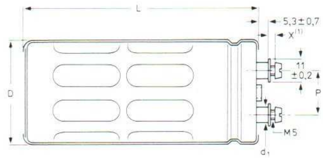
P	code for version
1	normal version
5	bolt version

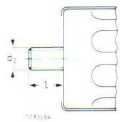
X	code for U_R
4	10 V
5	16 V for 114; 350 V for 115
6	25 V
7	40 V
8	63 V for 114; 385 V for 115
9	100 V
3	250 V

Z	code for multiplier
2	100
3	1 000
4	10 000

YY	first two digits of capacitance value in µF

Dimensions (mm)





bolt version

case size	D max	L max	P ± 0,1	d_1 max	d_2 x l (bolt version)
10	36,5	63	13,0	8,2	M8 x 12
11	36,5	83	13,0	8,2	M8 x 12
12a	36,5	108	13,0	8,2	M8 x 12
14	51,5	83	22,0	8,2	M12 x 16
15a	51,5	108	22,0	8,2	M12 x 16
16a	66,5	108	28,5	11,2	M12 x 16
17	76,5	108	32,0	11,2	M12 x 16

Accessories

- Metal mounting clamps;
- Synthetic nuts and rubber washers for insulated mounting of the bolt version.

electrolytic and solid capacitors
maintenance types

2222 015 / 2222 016

- **miniature**
- **axial leads (on bandoliers) or single ended**
- **long life**
- **general and industrial**

Nominal capacitance range (E6)	0,47 to 680 μF
Tolerance on nominal capacitance	−10 to +50%
Rated voltage range, U_R (R5)	4 to 100 V
Case sizes	3 to 7
Category temperature range	−40 to +85°C
Endurance test at 85 °C, U_R applied	2000 h
Basic specification	IEC 384-4 long-life grade
Climatic category IEC 68	40/085/56
DIN 40040	GPF

2222 034

- **miniature and small types**
- **single ended**
- **general purpose**

Nominal capacitance range (E6)	0,47 to 3300 μF
Tolerance on nominal capacitance	±20%
Rated voltage range, U_R (R5)	6,3 to 100 V
Case sizes	11 to 20
Category temperature range	−40 to +85 °C
Endurance test	1000 h at 85 °C
Basic specification	IEC 384-4, general purpose grade DIN 41332
Detail specification	DIN 41259
Climatic category IEC 68	40/085/56
DIN 40040	GPF

2222 071 / 2222 073

- **large**
- **solder tags or printed wiring pins**
- **long life**
- **industrial**

Nominal capacitance range (E6)	680 to 47 000 μF
Tolerance on nominal capacitance	−10 to +50%
Rated voltage range, U_R (R5)	6,3 to 63 V
Case sizes	5, 6(a), 7, 8(a), 9(a), 10
Category temperature range	−40 to +85 °C
Typical life time at 85 °C	> 5000 h
Basic specification	IEC 384-4 long-life grade DIN 41238 (print version only)
Climatic category IEC 68	40/085/56

2222 105

- **large**
- **screw terminals**
- **long life**
- **industrial**

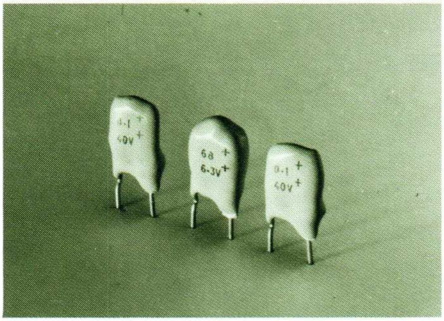
Nominal capacitance range (E6)	220 to 1000 μF
Tolerance on nominal capacitance	−10 to +30%
Rated voltage, U_R, at < 60 °C	400 V
Derated voltage, 0,94 x U_R, at 60 to 85 °C	375 V
Case sizes	11, 12, 14 to 16
Category temperature range	−25 to +85 °C
Endurance test at 85 °C, U_R applied	2000 h
Basic specification	IEC 384-4, long-life grade
Climatic cat., IEC 68, at U_R	25/060/56
at 0,94 x U_R	25/085/56

2222 106 / 2222 107

- **large**
- **screw terminals**
- **long life**
- **industrial and military**

Nominal capacitance range (E6)		1500 to 150 000 μF
Tolerance on nominal capacitance		−10 to +50%
Rated voltage, U_R, (R5)		6,3 to 100 V
Case sizes		11, 12, 14 to 16
Category temp. range,	2222 106	−40 to +85 °C
	2222 107	−25 to +85 °C
Typical life time at 85 °C, U_R applied		> 5000 h
Basic specification		IEC 384-4 long-life grade
Climatic category IEC 68	2222 106	40/085/56
DIN 40040		GPF (56 days)
NF C93-001		554
IEC 68	2222 107	25/085/56
DIN 40040		HPF (56 days)
C93-001		654
Approvals		U.K. Post Office D2186 M.O.D. (Navy) DEF5134-1 FOA/FTL (Sweden)

electrolytic and solid capacitors
solid aluminium



2222 122

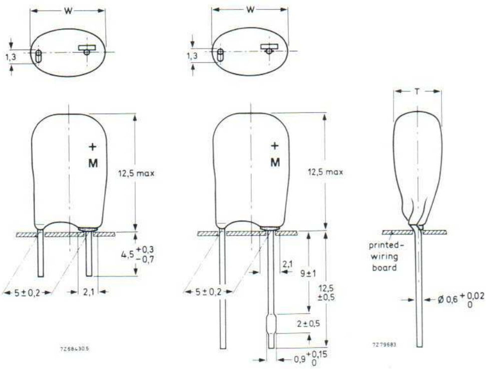
- **miniature**
- **single ended**
- **resin dipped**
- **long life**
- **general and industrial**

Selection chart for $C_{nom} - U_R$ and relevant case sizes

C_{nom} (E6 series)	U_R (V) (R5 series)				
µF	6,3	10	16	25	40*
0,1					1
0,15					1
0,22					1
0,33					1
0,47					2
0,68				1	2
1				1	3
1,5				1	4
2,2			1	2	4**
3,3			1	2	4**
4,7		1	2	3	
6,8		1	2	4	
10	1	2	3	4**	
15	2	2	4		
22	2	3			
33	3	4			
47	4				
68	4				

* 85 °C < T ⩽ 125 °C: 25 V.
** Available on request.

Dimensions (mm)



style 1 style 2

case size	W_{max}	T_{max}
1	8	3,5
2	8	4,5
3	8	5
4	8	6

Tolerance on nominal capacitance	± 20%; ± 10% on request
Category temperature range	− 55 to + 125 °C
Endurance test at 85 °C, U_R applied	5000 h
Basic specification	IEC 384-4; long-life grade
Climatic category IEC 68	55/125/56
Approval	CECC 30 302-002

Composition of catalogue no. 2222 122 PXYYZ

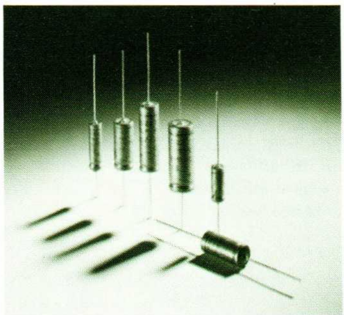
P	code for style
5	style 1
7	style 2

X	code for U_R
3	6,3 V
4	10 V
5	16 V
6	25 V
7	40 V

Z	code for multiplier
7	0,01
8	0,1
9	1

YY first two digits of capacitance value in µF

solid aluminium



2222 123

- **high cv in small sizes**
- **small**
- **axial leads**
- **long life**
- **industrial and military**

Selection chart for C_{nom} – U_R and relevant case sizes

C_{nom} (E6 series)	U_R (V) (R5 series)				
µF	6,3	10	16	25	40
2,2					1
3,3					1
4,7					1
6,8					1
10			1	1	2
15			1		2
22			1	2	3
33		1	2	3	4
47	1	2	3	3	4
68		2	3	4	5
100	2	3	4	5	6
150	3	4	5	6	
220		4	6		
330	4	5			
470	5	6			
680	6				
1000	6				

Tolerance on nominal capacitance	–20 to +20%
Category temperature range	–55 to +125 °C
Endurance test at 125 °C, U_R applied	5000 h
Basic specification	IEC 384-4 long-life grade
Climatic category IEC 68 U_R = 6,3 to 40 V	55/125/56
Approvals (pending)	CECC 30 302-003

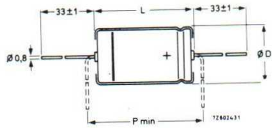
Composition of catalogue no. 2222 123 1XYYZ

X	code for U_R
3	6,3 V
4	10 V
5	25 V
6	25 V
7	40 V

YY first two digits of capacitance value in µF

Z	code for multiplier
8	0,1
9	1
1	10

Dimensions (mm)



case size	D_{max}	L_{max}	P_{min}
1	6,6	17,5	20
2	6,6	23	25
3	8,3	23	25
4	10,4	23	25
5	10,4	32	35
6	12,9	32	35

Maintenance type

2222 121

- small
- axial leads
- long life
- industrial and military

Nominal capacitance range (E6)	2,2 to 330 µF
Tolerance on nominal capacitance	–20 to +20%
Rated voltage range (R5)	6,3 to 50 V
Case sizes	1 to 6
Category temperature range	–55 to +125°C
Endurance test at 125°C, U_R applied	5000 h
Basic specification	IEC 384-4 long-life grade
Climatic IEC 68	
U_R = 6,3 to 40 V	55/125/56
U_R = 50 V	55/085/56
Approvals (except for U_R = 50 V)	CECC 30 302 001

electrolytic and solid capacitors
solid tantalum

2222 141 to MIL-C-39003/01, style CSR13
- **metal case**
- **hermetic seal**
- **axial leads**

Selection chart for $C_{nom} - U_R$ and relevant case sizes

C_{nom} (E12 series)	U_R (V)				
μF	10	15	20	50	75
0,1				A	A
0,12				A	A
0,15				A	A
0,18				A	A
0,22				A	A
0,27				A	A
0,33				A	A
0,39				A	A
0,47				A	A
0,56				A	A
0,68				A	A
0,82				A	B
1				A	B
1,2			A	B	B
1,5			A	B	B
1,8			A	B	B
2,2			A	B	B
2,7		A		B	B
3,3		A		B	B
3,9	A			B	B
4,7	A			B	C

C_{nom} (E12 series)	U_R (V)						
μF	6	10	15	20	35	50	75
5,6	A				B	C	C
6,8	A				B	C	C
8,2				B		C	C
10				B		C	C
12				B		C	D
15				B		C	D
18			B			C	
22			B		C	D	
27		B		C	D		
33		B		C	D		
39		B		C	D		
47	B			C	D		
56	B		C	D			
68			C	D			
82		C		D			
100		C		D			
120		C	D				
150	C		D				
180	C	D					
220		D					
270	D						
330	D						

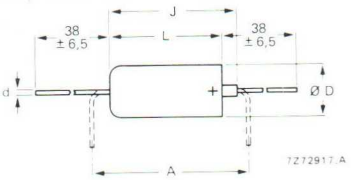
Tolerance on nominal capacitance		± 20%, ± 10%
Category temperature range	at U_R	− 55 to + 85 °C
	at 0,67 x U_R	− 55 to + 125 °C
Basic specification		MIL-C-39003/01, style CSR 13
Climatic category, IEC 68	at U_R	55/085/56
	at 0,67 x U_R	55/125/56

Composition of catalogue no. 2222 141 YYYYZ

YYYY dash number of failure rate level to MIL-C-39003/1E

Z	code for case size
1	case A
2	case B
3	case C
4	case D

Dimensions (mm)



case size	A	D		L ± 0,79	J_{max}	d ± 0,05
A	12,7	3,43	+ 0,41 − 0,38	7,26	10,72	0,51
B	17,8	4,70		12,04	15,49	0,51
C	25,4	7,34		17,42	20,88	0,64
D	27,9	8,92		19,96	23,42	0,64

2222 143
- **metal case**
- **hermetic seal**
- **axial leads**

Selection chart for C_{nom} – U_R and relevant case sizes

C_{nom} (E6 series) µF	U_R (V) 6	10	15	20	35	50
0,1					A	A
0,12					A	A
0,15					A	A
0,18					A	A
0,22					A	A
0,27					A	A
0,33					A	A
0,39					A	A
0,47					A	A
0,56					A	A
0,68					A	A
0,82					A	A
1					A	A
1,2				A	B	B
1,5				A	B	B
1,8				A	B	B
2,2				A	B	B
2,7			A		B	B
3,3			A		B	B
3,9		A			B	B
4,7		A			B	B
5,6	A				B	C

C_{nom} (E6 series) µF	U_R (V) 6	10	15	20	35	50
6,8	A				B	C
8,2				B	C	C
10				B	C	C
12				B	C	C
15				B	C	C
18			B		C	C
22			B		C	D
27		B		C	D	
33		B		C	D	
39		B		C	D	
47	B			C	D	
56	B		C	D		
68			C	D		
82		C		D		
100		C		D		
120		C	D			
150	C		D			
180	C	D				
220		D				
270	D					
330	D					

Tolerance on nominal capacitance		± 20%, ± 10%
Category temperature range	at U_R	– 55 to + 85 °C
	at 0,67 x U_R	– 55 to + 125 °C
Endurance test at 85 °C, U_R applied		2000 h
Basic specification		MIL-C-39003
Climatic category, IEC 68	at U_R	55/085/56
	at 0,67 x U_R	55/125/56

Composition of catalogue no. 2222 143 PXYYZ

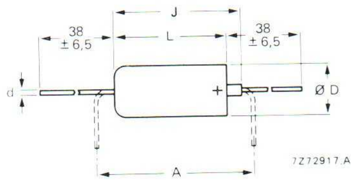
P	code for tolerance
1	± 20%
8	± 10%

X	code for U_R
3	6 V
4	10 V
5	15 V
6	20 V
7	35 V
8	50 V

YY first two digits of capacitance value in µF

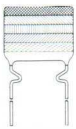
Z	code for multiplier
1	10
9	1
8	0,1
7	0,01

Dimensions (mm)



case size	A	D		L ± 0,79	J_{max}	d ± 0,05
A	12,7	3,43		7,26	10,72	0,51
B	17,8	4,70	+ 0,41	12,04	15,49	0,51
C	25,4	7,34	– 0,38	17,42	20,88	0,64
D	27,9	8,92		19,96	23,42	0,64

film capacitors
survey

description	series number 2222 . . . and status	main application	rated capacitance	rated voltage (U_R d.c.) V	page
Polyester and polycarbonate capacitors					
Metallized polyester and polycarbonate film capacitors (MKT and MKC); moulded 	341 D	coupling, decoupling, timing and delay	0,10 to 6,8 μF 0,047 to 2,2 μF 0,010 to 1,0 μF 0,010 to 0,47 μF 0,010 to 0,15 μF	100 250 400 630 1000	C101
Metallized polyester and polycarbonate film capacitors (MKT and MKC): potted 	344 D	coupling, decoupling, timing and delay	0,15 to 10 μF 0,047 to 10 μF 0,022 to 2,2 μF 0,010 to 1,0 μF 0,0047 to 0,47 μF	63 100 250 400 630	C102
Polyester film/foil capacitors (KT); lacquered 	347 D	coupling, decoupling, high currents, steep pulses	0,015 to 1,0 μF 0,010 to 0,68 μF 0,0047 to 0,33 μF 0,0010 to 0,15 μF	100 250 400 630	C106
Metallized polyester film capacitors (MKT); lacquered 	352 D	coupling, decoupling, timing and delay	0,047 to 6,8 μF 0,001 to 2,2 μF 0,010 to 1,0 μF 0,010 to 0,47 μF	100 250 400 630	C104 C105
Polypropylene capacitors					
Polypropylene film/foil capacitors (KP); potted 	357 5 D	tv defelction, a.c. motor commutation, high currents, high voltages, steep pulses	0,039 to 0,82 μF	250	C107
Polypropylene capacitors (KP/MKP); series construction 	357 6 357 7 357 8 357 9 D		0,047 to 0,33 μF 0,018 to 0,22 μF 0,0082 to 0,15 μF 0,0010 to 0,013 μF	630 1000 1500 2000	C108 C109

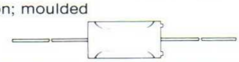
Polypropylene capacitors

description	series number 2222 ... and status	main application	rated capacitance	rated voltage (U_R d.c.) V	page
Polypropylene film/foil capacitors (KP); axial type 	455 to 457 N D	tuning circuits, filter networks, high stability, high precision, low losses	3300 to 56 000 pF 1800 to 36 000 pF 47 to 20 000 pF	63 160 250	C114 C115

Polystyrene capacitors

Polystyrene film/foil capacitors (KS); sleeved 	424 to 431 D	tuning circuits, filter networks, high stability, high precision, low losses	2000 to 39 000 pF 1100 to 16 000 pF 620 to 11 000 pF 51 to 5 600 pF	63 160 250 630	C110 C111
Polystyrene film/foil capacitors (KS); wrapped end-filled 	444 to 447 D		43 000 to 162 000 pF 18 000 to 82 000 pF 12 000 to 47 000 pF 6 200 to 24 000 pF	63 160 250 630	C112
Polystyrene film/foil capacitors (KS); potted 	443 D	LC-filters, tuning circuits, high precision, high stability, high reliability	100 to 34 000 pF	63	C113

Dual dielectric capacitors

Metallized polyester/paper film capacitors (MKT-P) for radio interference suppression; moulded 	330 0. . . D	small household appliances, radio and tv	0,01 to 0,47 μF	250 (r.m.s.)	C103
potted 	330 4. . . D		0,01 to 1 μF	250 (r.m.s.)	C103

film capacitors
metallized film – new types

2222 365
2222 366
2222 368

2222 365 – status N

- Epoxy lacquered type (MKT)
- Supplied on tape

Rated capacitance range (E12-series)	0,0039 to 0,27 μF
Tolerance on rated capacitance	± 10% and ± 20% (± 5% on request)
Rated voltage U_R (d.c.)	100 V, 250 V, 400 V
Rated voltage U_R (a.c.), 50 to 60 Hz	63 V, 160 V, 220 V
Rated temperature	85 °C
Climatic category, IEC 68 (CECC 30400)	40/100/21
Basic specification	IEC 384-2, general-purpose grade (CECC 30400)

2222 366 – status N

- Epoxy lacquered type (MKT)

Rated capacitance range (E12-series)	0,01 to 0,27 μF
Tolerance on rated capacitance	± 10% and ± 20% (± 5% on request)
Rated voltage U_R (d.c.)	100 V, 250 V, 400 V
Rated voltage U_R (a.c.) 50 to 60 Hz	63 V, 160 V, 220 V
Rated temperature	85 °C
Climatic category IEC 68 (CECC 30400)	40/100/21
Basic specification	IEC 384-2. general-purpose grade (CECC 30400)

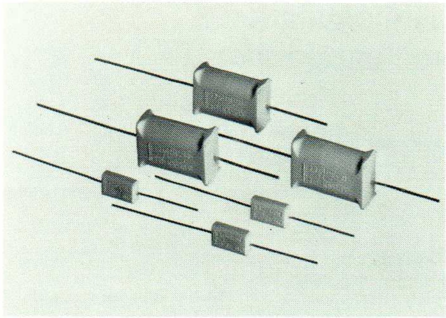
2222 368 – under development

- Epoxy lacquered type (MKT)

Rated capacitance range (E12-series)	0,01 to 1 μF
Tolerance on rated capacitance	± 10% and ± 20%
Rated voltage U_R (d.c.)	100 V, 250 V, 400 V
Rated voltage U_R (a.c.), 50 to 60 Hz	63 V, 160 V, 220 V
Rated temperature	85 °C
Climatic category IEC 68 (CECC 30400)	40/100/21
Basic specification	IEC 384-2, long-life grade (CECC 30400)

film capacitors
metallized film

2222 341 (mepolesco)



Coupling and decoupling capacitors in an axial version for use in general industrial and other professional applications where severe environmental conditions are encountered.

Selection chart for $C_R - U_R$ and relevant sizes

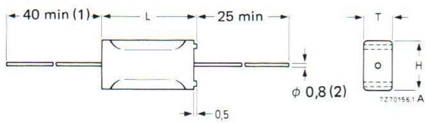
	U_R (V)					
C_R (E6) (E12 on req.) µF	100 (d.c) 63 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	250 (d.c) 160 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	400 (d.c) 220 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	630 (d.c) 220 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	1000 (d.c) 250 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
0,010			4,7 x 14,5 x 8,7	4,7 x 14,5 x 8,7	6,5 x 18 x 10,4	103
0,015			4,7 x 14,5 x 8,7	5,5 x 14,5 x 9,4	7,6 x 18 x 11,5	153
0.022			4,7 x 14,5 x 8,7	6,5 x 14,5 x 10,4	7,4 x 23,5 x 11,5	223
0,033			4,7 x 14,5 x 8,7	6,5 x 18 x 10,4	8,7 x 23,5 x 12,8	333
0,047		4,7 x 14,5 x 8,7	6,5 x 14,5 x 10,4	7,6 x 18 x 11,5	10,4 x 23,5 x 14,4	473
0,068		4,7 x 14,5 x 8,7	6,5 x 18 x 10,4	7,4 x 23,5 x 11,5	10,4 x 31 x 14,6	683
0,1	4,7 x 14,5 x 8,7	5,5 x 14,5 x 9,4	7,6 x 18 x 11,5	8,7 x 23,5 x 12,8	12,4 x 31 x 19,5	104
0,15	4,7 x 14,5 x 8,7	6,5 x 18 x 10,4	7,4 x 23,5 x 11,5	10,4 x 23,5 x 14,4	15 x 31 x 22	154
0,22	6,5 x 14,5 x 10,4	7,6 x 18 x 11,5	8,7 x 23,5 x 12,8	10,4 x 31 x 14,6		224
0,33	6,5 x 18 x 10,4	7,4 x 23,5 x 11,5	10,4 x 23,5 x 14,4	12,4 x 31 x 19,5		334
0,47	7,6 x 18 x 11,5	8,7 x 23,5 x 12,8	10,4 x 31 x 14,6	15 x 31 x 22		474
0,68	7,4 x 23,5 x 11,5	10,4 x 23,5 x 14,4	12,4 x 31 x 19,5			684
1	8,7 x 23,5 x 12,8	10,4 x 31 x 14,6	15 x 31 x 22			105
1,5	10,4 x 23,5 x 14,4	12,4 x 31 x 19,5				155
2,2	10,4 x 31 x 14,6	15 x 31 x 22				225
3,3	12,4 x 31 x 19,5					335
4,7	12,4 x 31 x 19,5					475
6,8	15 x 31 x 22					685

Tolerance	5, 10 and 20%
Category temperature range	− 55 to + 100°C
Test voltage (d.c.)	1,6 x U_R
Insulation resistante	
C ≤ 0,33 µF; U_R ≥ 250 V (d.c.)	R > 30 000 MΩ
U_R = 100 V (d.c.)	R > 15 000 MΩ
C > 0,33 µF; U_R ≥ 250 V (d.c.)	RC > 10 000 s
U_R = 100 (V d.c.)	RC > 5 000 s
Tan δ at 10 kHz	
dielectric: polycarbonate	≤ 75 x 10^{-4}
PETP	≤ 150 x 10^{-4}
Climatic category IEC 68	55/100/56
Basic specification	IEC 304-2

Max steepness (pulse loads)

U_R (d.c.)	L = 14,5	18	23,5	31	mm
100 V	9	5,6	4	3	V/µs
250 V	25	14	10	7,5	V/µs
400 V	40	22	16	12	V/µs
630 V	70	37	26	19	V/µs
1000 V	–	50	40	35	V/µs

Dimensions (mm)



(1) 50 mm | where
(2) 1 mm | L = 31 mm

Composition of catalogue no. 2222 341 YY ZZZ

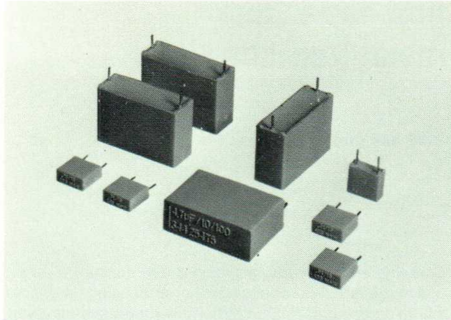
YY code for tolerance

dielectric	V (d.c.)	5%	10%	20%
polycarbonate	100	23	29	28
	250	47	49	48
	400	57	59	58
	630	62	61	60
	1000		71	70
PETP	100	25	27	26
	250	87	89	88
	400	53	55	54

ZZZ capacitance code (see table)

film capacitors
metallized film

2222 344 (nugget)



Coupling and decoupling capacitors of well-defined shape with radial leads. For use in general industrial and professional applications where environmental conditions are of prime importance.

Selection chart for $C_R - U_R$ and relevant sizes

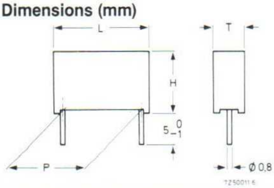
C_R (E6) (E12 on req.) µF	U_R (V) 63 (d.c) 40 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	100 (d.c) 63 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	250 (d.c) 160 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	400 (d.c) 200 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	630 (d.c) 220 (r.m.s) $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
0,0047					4,5 x 10,5 x 10	472
0,0068					4,5 x 10,5 x 10	682
0,01				4,5 x 13 x 10	4,5 x 13 x 10	103
0,015				4,5 x 13 x 10	5 x 13 x 11	153
0,022			4,5 x 10,5 x 10	4,5 x 13 x 10	6 x 13 x 12	223
0,033			4,5 x 10,5 x 10	4,5 x 13 x 10	6 x 17,5 x 11,5	333
0,047		4,5 x 10,5 x 10	4,5 x 13 x 10	5 x 17,5 x 11	7 x 17,5 x 13	473
0,068		4,5 x 10,5 x 10	4,5 x 13 x 10	6 x 17,5 x 11,5	8,5 x 17,5 x 14,5	683
0,1		4,5 x 13 x 10	5 x 17,5 x 11	7 x 17,5 x 13	6,5 x 26 x 15,5	104
0,15	4,5 x 10,5 x 10	4,5 x 13 x 10	6 x 17,5 x 11,5	8,5 x 17,5 x 14,5	7,5 x 26 x 16,5	154
0,22	4,5 x 13 x 10	5 x 13 x 11	7 x 17,5 x 13	6,5 x 26 x 15,5	9 x 26 x 19	224
0,33	5 x 13 x 11	5 x 17,5 x 11	8,5 x 17,5 x 14,5	7,5 x 26 x 16,5	11 x 30 x 20,5	334
0,47	6 x 13 x 12	6 x 17,5 x 11,5	6,5 x 26 x 15,5	9,5 x 26 x 19	13,5 x 30 x 23	474
0,68	6 x 17,5 x 11,5	7 x 17,5 x 13	7,5 x 26 x 16,5	11 x 30 x 20,5		684
1	7 x 17,5 x 13	8,5 x 17,5 x 14,5	9,5 x 26 x 19	13,5 x 30 x 23		105
1,5	8,5 x 17,5 x 14,5	6,5 x 26 x 15,5	11 x 30 x 20,5			155
2,2	6,5 x 26 x 15,5	8,5 x 26 x 18	13,5 x 30 x 23			225
3,3	8,5 x 26 x 18	9,5 x 26 x 19				335
4,7	9,5 x 26 x 19	11 x 30 x 20,5				475
6,8	11 x 30 x 20,5	13,5 x 30 x 23				685
10	13,5 x 30 x 23	15 x 30 x 25				106

Tolerance	5, 10 and 20%
Category temperature range	−55 to +100°C
Test voltage (d.c.)	1,6 x U_R
Insulation resistante	
C ⩽ 0,33 µF; U_R ⩾ 250 V (d.c.)	R > 30 000 MΩ
U_R ⩽ 100 V (d.c.)	R > 15 000 MΩ
C > 0,33 µF; U_R ⩾ 250 V (d.c.)	RC > 10 000 s
U_R ⩽ 100 (V d.c.)	RC > 5 000 s
Tan δ at 10 kHz	
dielectric: polycarbonate	⩽ 75 x 10^{-4}
PETP	⩽ 150 x 10^{-4}
Climatic category IEC 68	55/100/56
Basic specification	IEC 384-2

Max steepness in V/µs (pulse loads)

U_R (d.c.) V	L = 10,5	13	17,5	26	30 mm
63	4,2	2,6	1,7	1,4	6,3
100	9	5,6	13,5	3	12,5
250	25	14	9	7,5	42
400	40	22	14	12	67
630	70	37	23	19	125

Dimensions (mm)



L	P
10,5	7,5
13	10
17,5	15
26	22,5
30	27,5

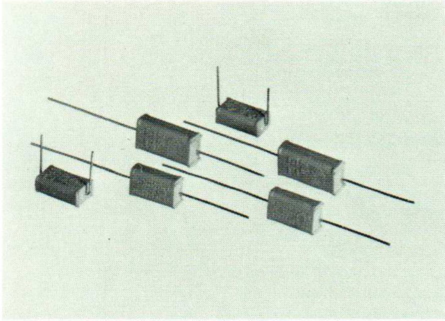
Composition of catalogue no. 2222 344 YY ZZZ

YY code for tolerance

dielectric	V(d.c.)	5%	10%	20%
polycarbonate	100	22	21	20
	250	43	45	44
	400	52	51	50
	630	62	61	60
PETP	63		15	14
	100	23	25	24
	250	42	41	40
	400	53	55	54

ZZZ capacitance code (see table)

2222 330 (r.i.s.)
Metallized PETP/paper dielectric



Interference suppression capacitors, dual dielectric, single section type. Designed for radio interference suppression in consumer and general industrial applications (class X).

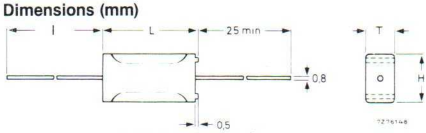
Selection chart for C_R, tolerance and relevant size

C_R (E6) µF	style 1 T x L x H (max)	l	d	catalogue number 2222 330 .... tol. ± 10%	tol. ± 20%
0,01	6,5 x 18 x 10,4	40	0,8	01103	00103
0,015	6,5 x 18 x 10,4	40	0,8	01153	00153
0,022	6,5 x 18 x 10,4	40	0,8	01223	00223
0,033	6,5 x 18 x 10,4	40	0,8	01333	00333
0,047	6,5 x 18 x 10,4	40	0,8	01473	00473
0,068	7,6 x 18 x 11,5	40	0,8	01683	00683
0,1	7,4 x 23,5 x 11,5	40	0,8	01104	00104
0,15	8,7 x 23,5 x 12,8	40	0,8	01154	00154
0,22	10,4 x 23,5 x 14,4	40	0,8	01224	00224
0,33	10,4 x 31 x 14,6	50	1,0	01334	00334
0,47	12,4 x 31 x 19,5	50	1,0	01474	00474

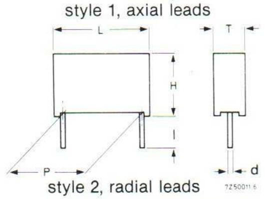
C_R (E6) µF	style 2 T x L x H	P ± 0,4	d	catalogue number 2222 330 ..... l = 5 − 1 tol. ± 10%	l = 5 − 1 tol. ± 20%	l = 25 + 2 tol. ± 10%	l = 25 + 2 tol. ± 20%
0,01	5 x 17,5 x 11	15	0,8	41103	40103	45103	44103
0,015	5 x 17,5 x 11	15	0,8	41153	40153	45153	44153
0,022	5 x 17,5 x 11	15	0,8	41223	40223	45223	44223
0,033	5 x 17,5 x 11	15	0,8	41333	30333	45333	44333
0,047	6 x 17,5 x 11,5	15	0,8	41473	40473	45473	44473
0,068	7 x 17,5 x 13	15	0,8	41683	40683	45683	44683
0,1	8,5 x 17,5 x 14,5	15	0,8	41104	40104	45104	44104
0,15	6,5 x 26 x 15,5	22,5	0,8	41154	40154	45154	44154
0,22	7,5 x 26 x 16,5	22,5	0,8	41224	40224	45224	44224
0,33	9,5 x 26 x 19	22,5	0,8	41334	40334	45334	44334
0,47	13,5 x 31 x 23	27,5	0,8	41474	40474	45474	44474
0,68	15 x 31 x 25	27,5	0,8	41684	40684	45684	44684
1,0	18 x 31 x 28	27,5	1,0	41105	40105	45105	44105

Rated voltage, U_R (r.m.s.) 50 to 60 Hz		250 V
Test voltage (d.c.)		
Style 1, axial leads		750 V
Style 2, radial leads		1075 V
Insulation resistance		> 15 000 MΩ
Tan δ at 10 kHz		⩽ 130 x 10^{-4}
Rated temperature		85°C
Climatic category,	IEC 68	40/085/21
	DIN 40040	GPF
Approval	both styles	VDE 0560-7, class X
	style 2 only	SEMKO

Dimensions (mm)



style 1, axial leads



style 2, radial leads

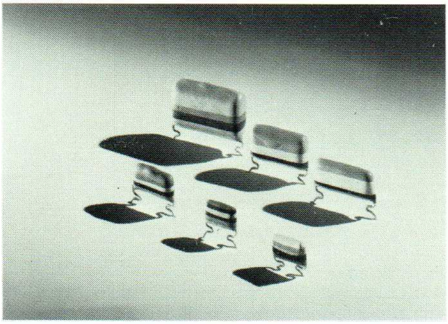
film capacitors
metallized film

2222 352 (f.f.c.)

Coupling and decoupling capacitors, colour coded and in a radial lead version: for use in general purpose applications.

Selection chart for $C_R - U_R$ and relevant sizes

C_R (E12) µF	U_R(V) 100 (d.c.) 63 (a.c.) $T_{max} \times L_{max} \times H_{max}$	250 160 $T_{max} \times L_{max} \times H_{max}$	400 220 $T_{max} \times L_{max} \times H_{max}$	630 220 $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
0,001					102
0,0012					122
0,0015					152
0,0018					182
0,0022					222
0,0027	–	4,5 x 12,5 x 12,5	–	–	272
0,0033					332
0,0039					392
0,0047					472
0,0056					562
0,0068					682
0,0082					822
0,01				4,5 x 12,5 x 12,5	103
0,012				5 x 12,5 x 13	123
0,015	–	4 x 12,5 x 12	4,5 x 12,5 x 12,5	5,5 x 12,5 x 13,5	153
0,018				6 x 12,5 x 14	183
0,022				6,5 x 12,5 x 14,5	223
0,027			5 x 12,5 x 13	5,5 x 17,5 x 14,5	273
0,033	–	4,5 x 12,5 x 12	5,5 x 12,5 x 13,5	6 x 17,5 x 15	333
0,039			6 x 12,5 x 14	6,5 x 17,5 x 15,5	393
0,047		4,5 x 12,5 x 12	6,5 x 12,5 x 14,5	7 x 17,5 x 16	473
0,056		4,5 x 12,5 x 12,5	5,5 x 17,5 x 14,5	6 x 22,5 x 15	563
0,068	4,5 x 12,5 x 12,5	4,5 x 12,5 x 12,5	6 x 17,5 x 15	6,5 x 22,5 x 15,5	683
0,082		4,5 x 12,5 x 12,5	6,5 x 17,5 x 15,5	7 x 22,5 x 16	823
0,1		5 x 12,5 x 13	7 x 17,5 x 16	7,5 x 22,5 x 16,5	104
0,12		5,5 x 17,5 x 14,5	6 x 22,5 x 15	8,5 x 22,5 x 17,5	124
0,15	5 x 12,5 x 13	6 x 17,5 x 15	6,5 x 22,5 x 15,5	9,5 x 22,5 x 18,5	154
0,18	5,5 x 12,5 x 13,5	6,5 x 17,5 x 15,5	7 x 22,5 x 16	8,5 x 30 x 17,5	184
0,22	6 x 12,5 x 14	7 x 17,5 x 16	7,5 x 22,5 x 16,5	9,5 x 30 x 18,5	224
0,27	6,5 x 12,5 x 14,5	6 x 22,5 x 15	8,5 x 22,5 x 17,5	9 x 30 x 21	274
0,33	5,5 x 17,5 x 14,5	6,5 x 22,5 x 15,5	9,5 x 22,5 x 18,5	10 x 30 x 22	334
0,39	6 x 17,5 x 15	7 x 22,5 x 16	8,5 x 30 x 17,5	11 x 30 x 23	394
0,47	6,5 x 17,5 x 15,5	7,5 x 22,5 x 16,5	9,5 x 30 x 18,5	12 x 30 x 24	474
0,56	7 x 17,5 x 16	8 x 22,5 x 17	9 x 30 x 21		564
0,68	6 x 22,5 x 15	9 x 22,5 x 18	10 x 30 x 22		684
0,82	6,5 x 22,5 x 15,5	8 x 30 x 17	11 x 30 x 23		824
1	7 x 22,5 x 16	9 x 30 x 18	12 x 30 x 24		105
1,2	7,5 x 22,5 x 16,5	8,5 x 30 x 20,5			125
1,5	8,5 x 22,5 x 17,5	9,5 x 30 x 21,5			155
1,8	9,5 x 22,5 x 18,5	10,5 x 30 x 22,5			185
2,2	8,5 x 30 x 17,5	11,5 x 30 x 23,5			225
2,7	9,5 x 30 x 18,5				275
3,3	9 x 30 x 21				335
3,9	10 x 30 x 22				395
4,7	11,5 x 30 x 23,5				475
5,6	12,5 x 30 x 24,5				565
6,8	14 x 30 x 26				685



Tolerance	10 and 20%
Test voltage between terminals	1,6 x U_R
Category temperature range	– 40 to + 100°C
Tan δ at 10 kHz	≤ 150 x 10^{-4}
Insulation resistance C ≤ 0,33 μF	R > 30 000 MΩ*
at 20°C C > 0,33 μF	RC > 10 000 s* (MΩ x μF)
Climatic category IEC 68	40/100/21
Basic specification	IEC 348-2

* Except 100 V version: R >15 000 MΩ
RC> 5 000 s.

Max steepness in V/μs (pulse load)

U_R V(d.c.)	dimension L (mm) 12,5	17,5	22,5	30
100	9	5,6	4	3
250	25	14	10	7,5
400	40	22	16	12
630	70	37	26	19

band	I/II	III	IV	V
black	0	1	20%	
brown	1	10		100
red	2	10^2		250
orange	3	10^3		
yellow	4	10^4		400
green	5	10^5		
blue	6			630
violet	7			
grey	8			
white	9		10%	

I/II first two digits of cap. value in pF
III multiplier
IV tolerance
V rated voltage

Composition of catalogue no. 2222 352 YY ZZZ

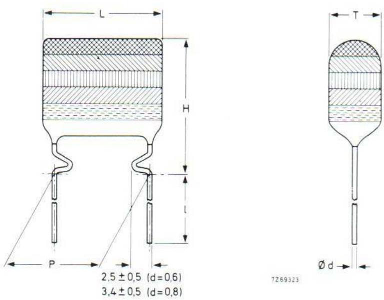
YY code for U_R, tolerance and leads

dielectric	U_R	%	long leads	short leads
PETP	100	20	24	27
		10	25	28
	250	20	44	47
		10	45	48
	400	20	54	57
		10	55	58
	630	20	64	67
		10	65	68

ZZZ capacitance code (see table)

Dimensions (mm)

L	d	P	long leads l	short leads l
12,5	0,6	10,16 ± 0,3	17 ± 4	5 – 1
17,5	0,8	15,24 ± 0,3	17 ± 4	5 – 1
22,5	0,8	20,32 ± 0,3	25 ± 4	5 – 1
30	0,8	27,94 ± 0,3	23 ± 4	5 – 1



Note: Version with long straight leads available on request (2222 342 series).

film capacitors
film/foil

2222 347 (p.p.c.)

PETP dielectric
A radial lead, lacquer-encapsulated capacitor for coupling and decoupling where steep pulses are encountered.

Selection chart for $C_R - U_R$ and relevant sizes

C_R (E6) (E12 on req.) nF	U_R (V) 100 (d.c.) 50 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	250 (d.c.) 80 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	400 (d.c.) 125 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	630 (d.c.) 200 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
1,0				5,5 x 13,5 x 13	102
1,5				5,5 x 13,5 x 13	152
2,2				4,5 x 13,5 x 12	222
3,3				5,5 x 13,5 x 13	332
4,7			4,5 x 13,5 x 12	6 x 13,5 x 13	472
6,8			5,5 x 13,5 x 13	7 x 13,5 x 14,5	682
10		5 x 13,5 x 12,5	6 x 13,5 x 13,5	6 x 19 x 14,5	103
15	4,5 x 13,5 x 12	5,5 x 13,5 x 13	7 x 13,5 x 14,5	7 x 19 x 15,5	153
22	5,5 x 13,5 x 13	6,5 x 13,5 x 14	6 x 19 x 14,5	8 x 19 x 16,5	223
33	6 x 13,5 x 13,5	5,5 x 19 x 14	7 x 19 x 15,5	7 x 27 x 18,5	333
47	7 x 13,5 x 14,5	6,5 x 19 x 15	8 x 19 x 16,5	8,5 x 27 x 20	473
68	6 x 19 x 14,5	7,5 x 19 x 16	7 x 27 x 18,5	10,5 x 27 x 22	683
100	7 x 19 x 15,5	6,5 x 27 x 18	8,5 x 27 x 20	11 x 32 x 22,5	104
150	8 x 19 x 16,5	8 x 27 x 19,5	10,5 x 27 x 22	13,5 x 32 x 25	154
220	7 x 27 x 18,5	9,5 x 27 x 21	11 x 32 x 22,5		224
330	8,5 x 27 x 20	10 x 32 x 21,5	13,5 x 32 x 25		334
470	10,5 x 27 x 22	12 x 32 x 23,5			474
680	11 x 32 x 22,5	15 x 32 x 26,5			684
1000	13,5 x 32 x 25				105

Tolerance		10 and 20%
Test voltage		2 x U_R
Category temperature range		− 40 to + 100°C
Tan δ at 10 kHz		< 110 x 10^{-4}
Insulation resistance	C ⩽ 330 nF	R > 50 000 MΩ
at 20°C	C > 330 nF	RC > 16 500 s
Climatic category IEC 68		40/100/21
Basic specification		IEC 348-11
Pulse steepness		limited by circuit

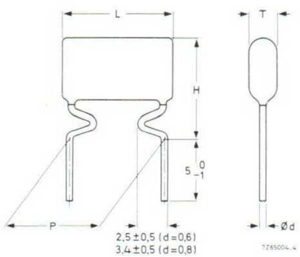
Composition of catalogue no. 2222 347 YY ZZZ

YY code for tolerance

U_R	%	YY
100	20	20
	10	21
250	20	40
	10	41
400	20	50
	10	51
630	20	60
	10	61

ZZZ capacitance code (see table)

Dimensions (mm)



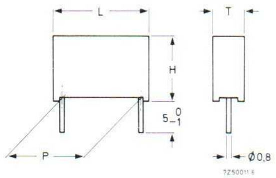
L	P	d
13,5	10,16 (4e)	0,6
19	15,24 (6e)	0,8
27	22,86 (9e)	0,8
32	27,94 (11e)	0,8

Polypropylene dielectric, potted type
These capacitors are intended for applications where high currents and steep pulses occur, e.g. in deflection units in tv receivers.

Selection chart for $C_R - U_R$ and relevant sizes

C_R (E12) μF	250 (d.c.) 160 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
0,039	8 x 21,5 x 15	393
0,047	8 x 21,5 x 15	473
0,056	8 x 21,5 x 15	563
0,068	10 x 21,5 x 17	683
0,082	10 x 21,5 x 17	823
0,10	8,5 x 29 x 18,5	104
0,12	8,5 x 29 x 18,5	124
0,15	8,5 x 29 x 18,5	154
0,18	10 x 29 x 20	184
0,22	10 x 34 x 20	224
0,27	10 x 34 x 20	274
0,33	12 x 34 x 22	334
0,39	12 x 34 x 22	394
0,47	15 x 34 x 25	474
0,56	15 x 34 x 25	564
0,68	18 x 34 x 28	684
0,82	18 x 34 x 28	824

Dimensions (mm)



L	P ± 0,4
21,5	15,0
29	22,5
34	27,5

Composition of catalogue no. 2222 357 5 Y ZZZ

Y code for tolerance

1 ± 10%
2 ± 5%

ZZZ capacitance code (see table)

Tolerance	± 5 and ± 10%	
Test voltage (d.c.)	2 x U_R	
Rated temperature	85°C	
T_{amb}	23°C	85°C
Insulation resistance, $C_R \leqslant 0,1\ \mu$F	R > 50 000 MΩ	> 500 MΩ
$C_R > 0,1\ \mu$F	RC > 5000 s	> 50 s
Tan δ at 100 kHz		
for capacitors with pitch P = 15 or 22,5 mm	$\leqslant 10 \times 10^{-4}$	
for capacitors with pitch P = 27,5 mm		
$C_R \leqslant 0,33\ \mu$F	$\leqslant 15 \times 10^{-4}$	
$0,33\ \mu F < C_R \leqslant 0,47\ \mu$F	$\leqslant 20 \times 10^{-4}$	
$C_R > 0,47\ \mu$F	$\leqslant 25 \times 10^{-4}$	
Climatic category, IEC 68	40/085/56	
Pulse steepness	limited by circuit	

film capacitors
film/foil

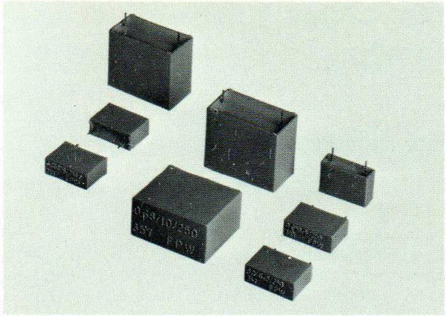
2222 357 6
2222 357 7
2222 357 8
2222 357 9

Selection chart for $C_R - U_R$ and relevant sizes

C_R (E6) (E12 on req.) µF	U_R (V) 630 (d.c.) 300 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	1000 (d.c.) 400 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	1500 (d.c.) 600 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	2000 (d.c.) 700 (r.m.s.) $T_{max} \times L_{max} \times H_{max}$	cap. code ZZZ
0,0010				8,5 x 29 x 18,5 *	102
0,0012				8,5 x 29 x 18,5 *	122
0,0015				8,5 x 29 x 18,5 *	152
0,0018				8,5 x 29 x 18,5 *	182
0,0022				8,5 x 29 x 18,5 *	222
0,0027				8,5 x 29 x 18,5 *	272
0,0033				8,5 x 29 x 18,5 *	332
0,0039				8,5 x 29 x 18,5 *	392
0,0047				8,5 x 29 x 18,5 *	472
0,0056				8,5 x 29 x 18,5 *	562
0,0068				8,5 x 29 x 18,5 *	682
0,0075				8,5 x 29 x 18,5 *	752
0,0082			8,5 x 29 x 18,5 *	10 x 29 x 20 *	822
0,010			8,5 x 29 x 18,5 *	10 x 29 x 20 *	103
0,012			8,5 x 29 x 18,5 *	10 x 29 x 20 *	123
0,015			8,5 x 29 x 18,5 *	10 x 29 x 20 *	153
0,018		8,5 x 29 x 18,5 *	8,5 x 29 x 18,5		183
0,022		8,5 x 29 x 18,5 *	8,5 x 29 x 18,5		223
0,027		8,5 x 29 x 18,5 *	8,5 x 29 x 18,5		273
0,033		8,5 x 29 x 18,5	10 x 29 x 20		333
0,039		8,5 x 29 x 18,5	10 x 29 x 20		393
0,047	8,5 x 29 x 18,5	10 x 29 x 20	10 x 34 x 20		473
0,056	8,5 x 29 x 18,5	10 x 29 x 20	12 x 34 x 22		563
0,068	10 x 29 x 20	10 x 34 x 20	12 x 34 x 22		683
0,082	10 x 29 x 20	12 x 34 x 22	15 x 34 x 25		823
0,10	10 x 29 x 20	12 x 34 x 22	15 x 34 x 25		104
0,12	10 x 34 x 20	15 x 34 x 25	18 x 34 x 28		124
0,15	12 x 34 x 22	18 x 34 x 28	18 x 34 x 28		154
0,18	12 x 34 x 22	18 x 34 x 28			184
0,22	15 x 34 x 25	18 x 34 x 28			224
0,27	18 x 34 x 28				274
0,33	18 x 34 x 28				334

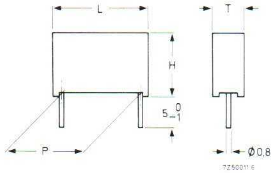
* Especially suited for fly-back purposes, tolerance 5%

Polypropylene/metallized polypropylene, series construction
The construction of this capacitor enables it to withstand high currents, high voltages and steep pulses. It is commonly used in television sets in deflection circuits and c.a. motor control.



Tolerance	± 5 and ± 10%	
Test voltage (d.c.)	1,6 x U_R	
Rated temperature	85°C	
T_{amb}	23°C	85°C
Insulation resistance, $C_R \leqslant 0,1\ \mu F$	R > 50 000 MΩ	> 500 MΩ
$C_R > 0,1\ \mu F$	RC > 5000 s	> 50 s
Tan δ at 100 kHz		
for P = 22,5 mm	$\leqslant 10 \times 10^{-4}$	
for P = 27,5 mm	$\leqslant 15 \times 10^{-4}$	
Climatic category, IEC 68	40/085/56	
Pulse steepness	limited by circuit	

Dimensions (mm)



L	P ± 0,4
29	22,5
34	27,5

Composition of catalogue no. 2222 357 YY ZZZ

YY code for voltage and tolerance

V (d.c.)	5%	10%
630	62	61
1000	72	71
1500	82	81
2000	92	–

ZZZ capacitance code (see table)

film capacitors
film/foil

2222 424 to 2222 431 (micropoco)

Polystyrene dielectric
Due to their narrow tolerances, high stability, and low losses these axial lead capacitors are very suitable for use in tuned circuits and filters.
Capacitors are also available on reel.

Selection chart for $C_R - U_R$ and relevant sizes

	U_R (V)				
C_R pF	63 (d.c.) 25 (r.m.s.) $D_{max} \times L_{max}$	160 (d.c.) 63 (r.m.s.) $D_{max} \times L_{max}$	250 (d.c.) 125 (r.m.s.) $D_{max} \times L_{max}$	630 (d.c.) 250 (r.m.s.) $D_{max} \times L_{max}$	cap. code ZZZZ
51				3,8 x 10,9	5109
56				3,8	5609
62				3,8	6209
68				3,8	6809
75				3,8	7509
82				3,8	8209
91				3,8	9109
100				3,8	1001
110				3,8	1101
120				3,8	1201
130				3,8	1301
150				3,8	1501
160				3,8	1601
180				3,8	1801
200				3,8	2001
220				3,8	2201
240				3,8	2401
270				3,8	2701
300				3,8	3001
330				4	3301
360				4	3601
390				4	3901
430				4	4301
470				4,5	4701
510				4,5	5101
560			3,8 x 10,9	4,5	5601
620			3,8	4,5	6201
680			3,8	4,5	6801
750			4	5	7501
820			4	5	8201
910			4	5	9101
1000			4	5	1002
1100		3,8 x 10,9	4,5	5	1102
1200		4 x 10,9	4,5 x 10,9	5 x 10,9	1202
1300		4	4,5	5 x 15	1302
1500		4	4,5	5	1502
1600		4	5	5,5	1602
1800		4	5	5,5	1802
2000	3,8 x 10,9	4,5	5	5,5	2002
2200	3,8	4,5	5	5,5	2202
2400	3,8	4,5	5 x 15	5,5	2402
2700	4	4,5	5	6	2702
3000	4	5	5	6,5	3002

Composition of catalogue no. 2222 4XX YZZZZ

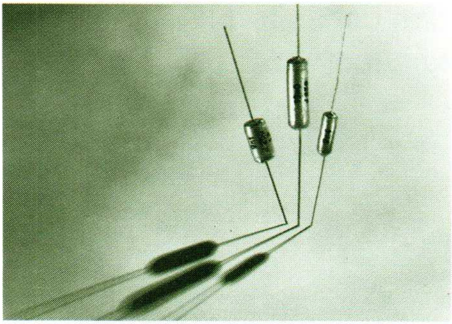
XX code for U_R and packing

24	U_R = 63 V	packed in boxes
25	150 V	packed in boxes
26	250 V	packed in boxes
27	630 V	packed in boxes
28	63 V	on bandolier on reel
29	150 V	on bandolier on reel
30	250 V	on bandolier on reel
31	630 V	on bandolier on reel

Y code for tolerance

2	5%	packed in boxes
3	2%	packed in boxes
4	1%	packed in boxes
6	5%	on bandolier on reel
7	2%	on bandolier on reel
8	1%	on bandolier on reel

ZZZZ capacitance code (see table)

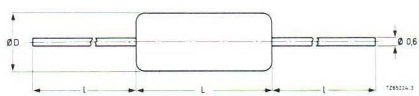


Selection chart for $C_R - U_R$ and relevant sizes

	U_R (V)				
C_R pF	63 (d.c.) 25 (r.m.s.) $D_{max} \times L_{max}$	160 (d.c.) 63 (r.m.s.) $D_{max} \times L_{max}$	250 (d.c.) 125 (r.m.s.) $D_{max} \times L_{max}$	630 (d.c.) 250 (r.m.s.) $D_{max} \times L_{max}$	cap. code ZZZZ
3 300	4	5	5	6,5	3302
3 600	4	5	5	7	3602
3 900	4	5	5	7	3902
4 300	4,5	5 x 15	5	7,5	4302
4 700	4,5	5	5,5	8	4702
5 100	4,5	5	5,5	8	5102
5 600	4,5	5	6	8	5602
6 200	5	5	6		6202
6 800	5	5,5	6,5		6802
7 500	5 x 15	5,5	6,5		7502
8 200	5	6	7		8202
9 100	5	6	7,5		9102
10 000	5	6	7,5		1003
11 000	5,5	6,5	7,5		1103
12 000	5,5	6,5			1203
13 000	5,5	6,5			1303
15 000	5,5	7			1503
16 000	6	7			1603
18 000	6				1803
20 000	6				2003
22 000	6,5				2203
24 000	6,5				2403
27 000	7				2703
30 000	7				3003
33 000	7,5				3303
36 000	7,5				3603
39 000	8				3903

Tolerance		5% (E24), 2% (E48) and 1% (E21, E48 and E96)
Capacitance series		E24 (E48 and E96 on request)
Test voltage (d.c.)		2 x U_R
Temperature range 63 V		−40 to +70°C
160 V to 630 V		−40 to +85°C
Tan δ at 1 MHz	$C_R \leq 1$ nF	$\leq 10 \times 10^{-4}$
at 100 kHz	$C_R \leq 20$ nF	$\leq 5 \times 10^{-4}$
at 10 kHz	$C_R > 20$ nF	$\leq 5 \times 10^{-4}$
Insulation resistance at 23°C to 70°C		R> 100 000 MΩ

Dimensions (mm)



film capacitors
film/foil

2222 444 to 2222 447 (wrapped end-filled)

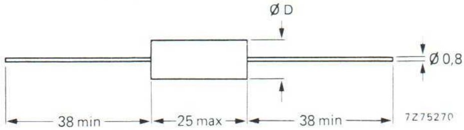
These polystyrene "wrapped end-filled" types are for use in circuits where precision, reliability and low losses are important e.g. in tuned circuits, filter networks, etc.

Selection chart for C_R – U_R and relevant sizes

C_R nF	d.c. 63 V / a.c. 25 V	D_{max} 160 V / 63 V	250 V / 125 V	630 V / 250 V
6,2				7,5
6,8				7,5
7,5				8
8,2				8
9,1				8,5
10				9
11				9
12			7	9,5
13			7	10
15			7,5	10,5
16			7,5	11
18		6,5	8	11,5
20		7	8,5	12
22		7	8,5	12,5
24		7,5	9	12,5
27		7,5	9,5	
30		8	10	
33		8,5	10,5	
36		8,5	10,5	
39		9	11	
43	7	9,5	11,5	
47	7,5	9,5	12	
51	7,5	10		
56	8	10,5		
62	8,5	11		
68	8,5	11,5		
75	9	12		
82	9,5	12,5		
91	9,5			
100	10			
110	10,5			
120	11			
130	11,5			
150	12			
160	12,5			
162	12,5			

Tolerance	± 5% (E24) ± 2% (E48) ± 1% (E96)
Rated temperature: 63 V	70°C
125 to 500 V	85°C
Tan δ at 100 kHz; $C \leqslant 20$ nF at 10 kHz; $C > 20$ nF	$\leqslant 5 \times 10^{-4}$
Climatic category, IEC 68; 63 V	40/070/56
160 to 630 V	40/085/56
Basic specification	IEC 384-7

Dimensions (mm)



Composition of the catalogue no. 2222 44P XYYYZ

P code for U_R

4 63 V
5 125 V
6 250 V
7 500 V

X code for tolerance

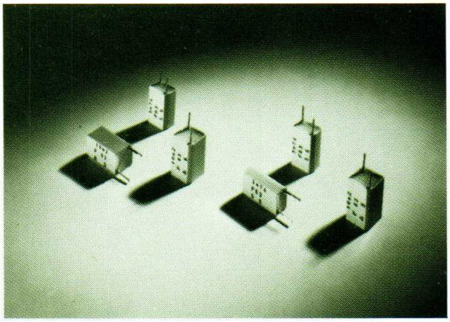
2 ± 5%
3 ± 2%
4 ± 1%

YYY first three digits of capacitance value in nF

Z code for multiplier

2 0,01
3 0,1
4 1

2222 443 (p.f.c.)



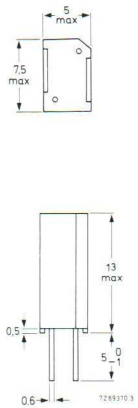
Polystyrene dielectric
Professional LC filters need these very stable and accurate capacitors (as in telephony equipment).
The 443 series, in combination with our ferrites, offer an advantage when it comes to package density.

Rated capacitance range (E96 series), C_R	100 to 34 000 pF
tolerance	± 1%
Rated voltage, U_R (d.c.)	63 V
(a.c.) 50 to 60 Hz	25 V
Test voltage	2 x U_R
Rated temperature	
class 1	70°C
class 3	85°C
Insulation resistance at 23°C	> 500 000 MΩ
at 70°C	> 100 000 MΩ
Tan δ	
at 1 MHz, $C_R \leqslant$ 500 pF	$\leqslant$ 5 x 10^{-4}
at 1 MHz, 500 pF < $C_R \leqslant$ 10 000 pF	$\leqslant$ 10 x 10^{-4}
at 100 kHz, for 1000 pF < C $\leqslant$ 10 000 pF	$\leqslant$ 10 x 10^{-4}
at 100 kHz, for 10 000 pF < C $\leqslant$ 15 000 pF	$\leqslant$ 15 x 10^{-4}
at 10 kHz, for C > 15 000 pF	$\leqslant$ 10 x 10^{-4}
Climatic category IEC 68	
class 1	40/070/56
class 3	55/085/56
Basic specification	IEC 384-7

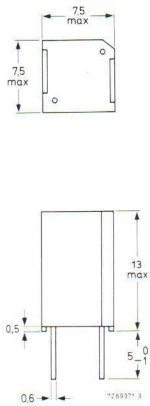
Composition of catalogue no. 2222 443 XYYYZ

X	code for style
4	style 1: $C_R \leqslant$ 3920 pF or style 2; C_R > 3920 pF or style 3; C_R > 15 000 pF
8	style 2; $C_R \leqslant$ 3920 pF
YYY	first three digits of capacitance value in pF
Z	code for multiplier
1	1
2	10
3	100

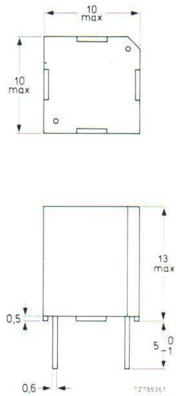
Dimensions (mm)



Style 1, capacitors of rated capacitance range 100 to 3920 pF.



Style 2, capacitors of rated capacitance range 100 to 12 100 pF.



Style 3, capacitors of rated capacitance > 15 000 pF.

film capacitors
film/foil

2222 455 to 2222 457

For precision, reliability and low losses
(tuned circuits, filter networks, etc.).

Selection chart for C_R – U_R and relevant sizes

C_R pF	U_R (V) 250 (d.c.) 125 (r.m.s.) $D_{max} \times L_{max}$	cap. code ZZZZ
47		4709
51		5109
56		5609
62		6209
68		6809
75		7509
82		8209
91		9109
100		1001
110		1101
120		1201
130		1301
150	4 x 11	1501
160		1601
180		1801
200		2001
220		2201
240		2401
270		2701
300		3001
330		3301
360		3601
390		3901
430		4301
470		4701
510		5101
560		5601
620		6201
680		6801
750		7501
820	4,5 x 11	8201
910		9101
1 000		1002
1 100		1102
1 200		1202
1 300		1302
1 500		1502
1 600		1602

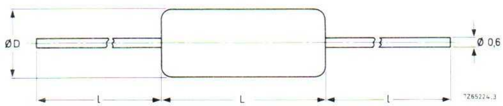
C_R pF	U_R (V) 63 (d.c.) 25 (r.m.s.) $D_{max} \times L_{max}$	160 (d.c.) 63 (r.m.s.) $D_{max} \times L_{max}$	250 (d.c.) 125 (r.m.s.) $D_{max} \times L_{max}$	cap. code ZZZZ
1 800	–			1802
2 000	–	4 x 11	4,5 x 11	2002
2 200	–			2202
2 400	–	4 x 11	5 x 11	2402
2 700	–	4 x 11	5 x 11	2702
3 000	–	4,5 x 11	5 x 11	3002
3 300	4 x 11	4,5 x 11	4,5 x 15	3302
3 600	4 x 11	4,5 x 11	4,5 x 15	3602
3 900	4 x 11	4,5 x 11	4,5 x 15	3902
4 300	4 x 11	5 x 11	4,5 x 15	4302
4 700	4,5 x 11	5 x 11	5 x 15	4702
5 100	4,5 x 11	5 x 11	5 x 15	5102
5 600	4,5 x 11	5 x 15	5 x 15	5602
6 200	4,5 x 11	4,5 x 15	5,5 x 15	6202
6 800	5 x 11	4,5 x 15	5,5 x 15	6802
7 500	5 x 11	4,5 x 15	5,5 x 15	7502
8 200	5 x 11	5 x 15	6 x 15	8202
9 100	5 x 15	5 x 15	6 x 15	9102
10 000	4,5 x 15	5 x 15	6,5 x 15	1003
11 000	4,5 x 15	5,5 x 15	6,5 x 15	1103
12 000	4,5 x 15	5,5 x 15	7 x 15	1203
13 000	5 x 15	5,5 x 15	7 x 15	1303
15 000	5	6 x 15	7,5 x 15	1503
16 000	5	6 x 15	7,5 x 15	1603
18 000	5,5	6,5 x 15	8 x 15	1803
20 000	5,5	6,5 x 15	8 x 15	2003
22 000	5,5	7 x 15		2203
24 000	6	7 x 15		2403
27 000	6	7,5 x 15		2703
30 000	6,5 x 15	7,5 x 15		3003
33 000	6,5	8 x 15		3303
36 000	7	8 x 15		3603
39 000	7			3903
43 000	7,5			4303
47 000	7,5			4703
51 000	8			5103
56 000	8			5603

Tolerance	±5% (E24-series)
	±2% (E24-series and E48-series
Test voltage for 1 min	
between terminals	2 x U_R (d.c.)
between interconnected terminals and coating	2 x U_R (d.c.) (minimum 400 V)
Rated temperature	85°C

	ambient temperature	
Insulation resistance	23°C	85°C
R between terminals	> 100 000 MΩ	> 100 000 MΩ

Tan δ (tangent of the loss angle)	
Tan δ at 1 MHz, for $C_R \leqslant$ 1000 pF	$\leqslant 10 \times 10^{-4}$
Tan δ at 100 kHz,	
for 1000 pF < $C_R \leqslant$ 5000 pF	$\leqslant 10 \times 10^{-4}$
for 5000 pF < $C_R \leqslant$ 20 000 pF	$\leqslant 15 \times 10^{-4}$
Tan δ at 10 kHz for C_R > 20 000 pF	$\leqslant 10 \times 10^{-4}$
Climatic category, IEC 68	40/100/21

Dimensions (mm)



Composition of catalogue no. 2222 XXX YZZZZ

XXX code for U_R

455 U_R = 63 V
456 160 V
457 250 V

Y code for tolerance and packing

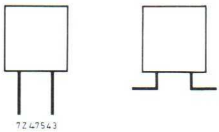
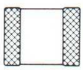
2 5% packed in boxes
3 2% packed in boxes

6 5% on bandolier on reel
7 2% on bandolier on reel

ZZZZ capacitance code (see table)

ceramic capacitors
survey

For detailed information
Handbook C15.

version	application	capacitance range pF	rated d.c. voltage V	series 2222. . .	status	page
plate	tuning	0,56 – 560	100	631, 632 638 641/643	D	C117
	tuning	0,47 – 270	500	650	D	C119
	coupling and decoupling	1 000 – 22 000 180 – 4 700 1 000 – 10 000	63 100 100	629 630 640	D	C118
	coupling and decoupling	100 – 2 700	500	655	D	C120
tubular 	tuning coupling and decoupling	3,3 – 180 150 – 1 500 1 500 – 22 000	50 50 50, 25 or 16	2020 561	D	C121 C122 C122
chip 	tuning coupling and decoupling	10 – 33 000 180 – 470 000	50 50	851/856	D	C123

Composition of catalogue no. 2222 PPP XXYYZ (see next page)

PPP style

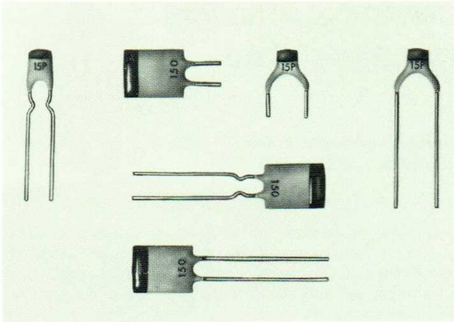
XX code for size and tolerance (see table)

YY first two digits of capacitance value in pF

Z	code for multiplier
7	0,01
8	0,1
9	1
1	10

miniature plate

tuning – type 1B
2222 631 632 638
2222 641 642 643



Low voltage capacitors for use in h.f. circuits where their excellent electrical properties and small size, compared with mechanical trimmers, offer definite advantages.

Available values

capacitance range (E12) and relevant size size I	II	III	IV	V	temperature and coefficient 10^{-6}/K	corresponding colour code	code XX in cat. no.
0,56 to 6,8	8,2	–	–	–	+ 100	red/violet	03
–	10 to 15	18 to 22	27 to 33	39 to 47			04
1,8 to 8,2	–	–	–	–	0	black	09
10 to 33	39 to 68	82 to 120	–	–			10
3,9 to 8,2	–	–	–	–	– 75	red	27
10 to 18	22 to 39	47 to 56	68 to 82	100 to 120			28
3,9 to 8,2	–	–	–	–	– 150	orange	33
10 to 22	27 to 68	82 to 100	120 to 150	–			34
3,9 to 8,2	–	–	–	–	– 220	yellow	39
10 to 22	27 to 47	56 to 68	82 to 100	120 to 150			40
4,7 to 8,2	–	–	–	–	– 330	green	45
10 to 27	33 to 56	68 to 82	100 to 120	150 to 180			46
6,8 to 8,2	–	–	–	–	– 470	blue	51
10 to 33	39 to 68	82 to 100	120 to 150	180 to 220			52
3,9 to 8,2	–	–	–	–	– 750	violet	57
10 to 47	56 to 100	120 to 150	180 to 220	270 to 330			58
18 to 82	100 to 180	220 to 270	330 to 390	470 to 560	– 1500	orange/orange	70

Tolerance $C < 10$ pF	0,25 pF
$C \geqslant 10$ pF	± 2%
Rated voltage (d.c.)	100 V
with test voltage (d.c.)	300 V
Category temperature range	– 55 to + 85 °C
Insulation resistance	> 10 000 MΩ
Tan δ $C < 50$ pF	$\leqslant 15(15/C + 0{,}7)10^{-4}$; max $55\text{x}10^{-4}$
$C > 50$ pF	$\leqslant 15 \times 10^{-4}$
Basic specification	IEC 384-8, type 1B
Climatic category IEC 68	55/085/21

size	W_{max}	H_{max}
I	3,6	3,7
II	4,5	4,7
III	5,1	5,3
IV	6,2	6,4
V	6,2	8,6

Dimensions (mm)

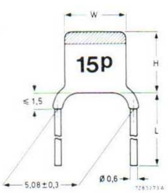


Fig. 1.

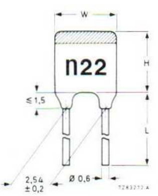


Fig. 2.

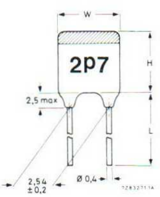


Fig. 3.

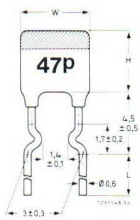


Fig. 4.

style	L	pitch
638	⩾ 15	0,2 inch
642	6^{+0}_{-2}	0,2 inch
631	⩾ 15	0,1 inch
641	6^{+0}_{-2}	0,1 inch
632	⩾ 15 flexible leads	
643	⩾ 10	

ceramic capacitors
miniature plate

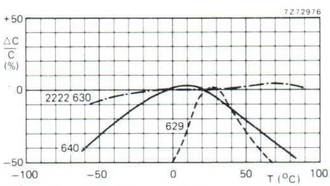
coupling and decoupling – type 2
2222 629 630 640

Low voltage capacitors for use in a wide variety of electronic equipment where a non-linear change in capacitance with temperature is acceptable. Their small size is also advantageous. With values up to 22 nF these three styles complement our lower capacitor ranges of type 1 capacitors.

Available values: refer to relevant drawing

capacitance pF	size 629	size 630	size 640	code XXX in catalogue no.
180		I		181
220		I		221
270		I		271
330		I		331
390		I		391
470		I		471
560		I		561
680		I		681
820		I		821
1000	I	II	I	102
1200		II		122
1500		II	I	152
1800		II		182
2200	I	III	I	222
2700		III		272
3300		IV	II	332
3900		IV		392
4700	I	IV	II	472
6800			III	682
10000	II		IV	103
22000	IV			223

Series 2222 . . .	**629**	**630**	**640**	
E series	E3	E12	E6	
Tolerance	– 20/ + 80	10	– 20/ + 50	%
Rated voltage (d.c.)	63	100	100	V
Test voltage (d.c.)	200	300	300	V
Category temperature range	– 10 to + 55	– 55 to + 85	– 55 to + 85	°C
Insulation resistance	> 1000	> 1000	> 3000	MΩ
Tan δ at 1 kHz	< 3,5	< 3,5	< 3,5	%
Climatic category IEC 68	10/055/21	55/085/21	55/085/21	
Basic specification	IEC 384-9	IEC 384-9	IEC 384-9	



Dimensions (mm)

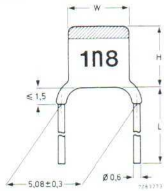


Fig. 1.

catalogue no.	L
2222 629 03 XXX 2222 630 03 XXX 2222 640 03 XXX	⩾ 15
2222 629 06 XXX 2222 630 06 XXX 2222 640 06 XXX	6^{+0}_{-2}

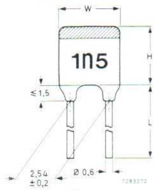


Fig. 2.

catalogue no.	L
2222 629 01 XXX 2222 630 01 XXX 2222 640 01 XXX	⩾ 15
2222 629 05 XXX 2222 630 05 XXX 2222 640 05 XXX	6^{+0}_{-2}

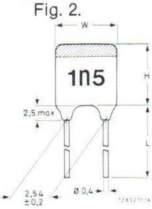


Fig. 3.

catalogue no.	L
2222 629 02 XXX 2222 630 02 XXX 2222 640 02 XXX	⩾ 15

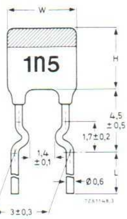
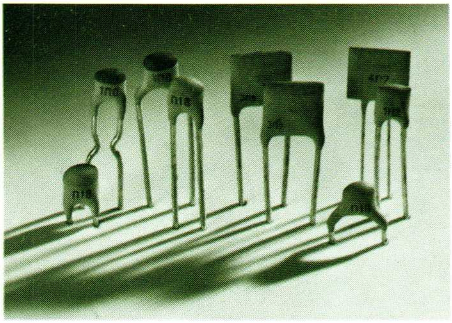


Fig. 4.

catalogue no.	L
2222 629 07 XXX 2222 630 07 XXX 2222 640 07 XXX	⩾ 10

size	W_{max}	H_{max}
I	3,6	3,7
II	4,5	4,7
III	5,1	5,3
IV	6,2	6,4

tuning – type 1B
2222 650 – 500 V

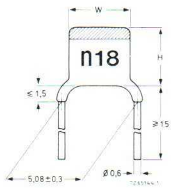


Available values

capacitance pF	temperature coefficient + 100 x 10^{-6}/K size	last digits	0 x 10^{-6}/K size	last digits	– 150 x 10^{-6}/K size	last digits	– 750 x 10^{-6}/K size	last digits	– 1500 x 10^{-6}/K size	last digits
0,47	I	03477								
0,68	I	03687								
0,82			I	09827						
1,0	I	03108	I	09108						
1,2	I	03128	I	09128						
1,5	I	03158	I	09158						
1,8	I	03188	I	09188			I	57188		
2,2	I	03228	I	09228	I	33228	I	57228		
2,7	I	03278	I	09278	I	33278	I	57278		
3,3	I	03338	I	09338	I	33338	I	57338		
3,9	I	03398	I	09398	I	33398	I	57398		
4,7	II	03478	I	09478	I	33478	I	57478		
5,6	II	03568	I	09568	I	33568	I	57568		
6,8	II	03688	II	09688	I	33688	I	57688		
8,2	II	03828	II	09828	II	33828	I	57828	I	69828
10	III	04109	II	10109	II	34109	I	58109	I	70109
12	III	04129	II	10129	II	34129	I	58129	I	70129
15	III	04159	III	10159	II	34159	I	58159	I	70159
18	IV	04189	III	10189	II	34189	II	58189	I	70189
22	IV	04229	III	10229	III	34229	II	58229	I	70229
27	V	04279	IV	10279	III	34279	II	58279	I	70279
33	V	04339	IV	10339	IV	34339	II	58339	II	70339
39			V	10399	IV	34399	II	58399	II	70399
47			V	10479	V	34479	III	58479	II	70479
56					V	34569	III	58569	II	70569
68							IV	58689	II	70689
82							IV	58829	II	70829
100							IV	58101	III	70101
120							V	58121	III	70121
150									IV	70151
180									IV	70181
220									IV	70221
270									V	70271

Tolerance on	C ⩽ 8,2 pF	± 0,25 pF
	C ⩾ 10 pF	± 2%
Rated voltage (d.c.)		500 V
Category temperature range		– 55 to 85 °C
Insulation resistance		> 10 000 MΩ
Climatic category IEC 68		55/085/21

Dimensions (mm)



size	W max	H max
I	3,6	3,7
II	4,5	4,7
III	5,1	5,3
IV	6,2	6,4
V	6,2	8,6

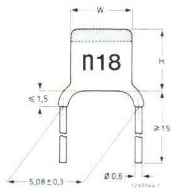
ceramic capacitors
miniature plate

coupling and decoupling – type 2
2222 655 – 500 V

Available values

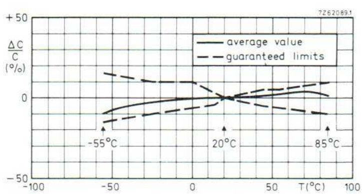
capacitance pF	size	catalogue number
100	I	2222 655 03101
120	I	03121
150	I	03151
180	I	03181
220	I	03221
270	I	03271
330	I	03331
390	II	03391
470	II	03471
560	II	03561
680	II	03681
820	II	03821
1000	III	03102
1200	III	03122
1500	IV	03152
1800	IV	03182
2200	IV	03222
2700	V	03272

Dimensions (mm)



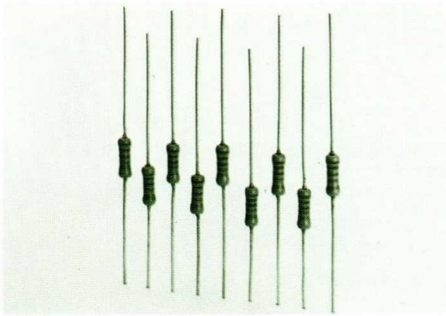
size	W max	H max
I	3,6	3,7
II	4,5	4,7
III	5,1	5,3
IV	6,2	6,4
V	6,2	8,6

Tolerance on capacitance	± 10%
Rated d.c. voltage	500 V
Test voltage (d.c.)	1250 V
Insulation resistance	> 3000 MΩ
Tan δ at 1 kHz	< 3,5%
Category temperature range	−55 to +85 °C
Climatic category IEC 68	55/085/21
Basic specification	IEC 187 (2C2)



tubular

tuning – type 1
2020 561



Available values in E12 series

temperature coefficient	cap. values pF	code XX in catalogue no. 1 to 1,8 pF ±7% in box	on reel	2,2 to 8,2 pF ±10% in box	on reel	10 to 180 pF ±5% in box	on reel
NP0 ± 60	3,3 to 68	–	–	02	31	03	32
N30 ± 60	3,3 to 68	–	–	04	33	05	34
N80 ± 60	3,3 to 51	–	–	06	35	07	36
N150 ± 60	3,3 to 51	–	–	08	37	09	38
N220 ± 60	3,3 to 82	–	–	10	39	11	40
N330 ± 60	4,7 to 68	–	–	12	41	13	42
N470 ± 60	6,8 to 82	–	–	14	43	15	44
N750 ± 120	8,2 to 120	–	–	16	45	17	46
SL	1 to 180	18	47	19	48	20	49

Rated voltage (d.c.)	50 V
Test voltage (d.c.)	150 V
Temperature range	−30 to +85 °C
Insulation resistance	> 10 000 MΩ

Composition of catalogue number 2020 561 XXYYZ

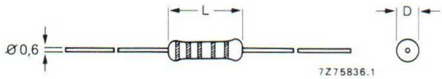
XX code for tolerance and packing (see table)

YY first two digits of capacitance value in pF

Z code for multiplier

8	0,1
9	1
1	10
2	100
3	1000

Dimensions (mm)



size	L max	D max	W
125	7,1	2,8	52^{+2}_{-1}
250	9,1	3,0	

ceramic capacitors

Coupling and decoupling – type 2 and 3
2020 561

Available values with size and temperature characteristic

capacitance	pF	size	rated d.c. voltage U_R (V)	temp. charact.	code XX for tolerance and packing ± 10% in box	± 10% on reel	± 20% in box	± 20% on reel	± 30% in box	± 30% on reel
Type 2	150									
E12	180									
	220									
	270									
	330									
	390	125	50	2B4	21	50	–	–	–	–
	470									
	560									
	680									
	820									
	1 000									
	1 000		50	2E4	–	–	23	52	–	–
	1 200									
	1 200	250	50	2B4	21	50	–	–	–	–
	1 500									
Type 3	1 500			3C4	–	–	24	53	27	56
E6	1 500			3B4	22	51	–	–	–	–
	2 200			3C4	–	–	24	53	27	56
	2 200	125	50	3B4	22	51	–	–	–	–
	3 300			3C4	–	–	24	53	27	56
	3 300			3B4	22	51	–	–	–	–
	4 700			3C4	–	–	24	53	27	56
	4 700			3B4	22	51	–	–	–	–
	6 800	125	25	3C4	–	–	25	54	28	57
	10 000	125	25	3C4	–	–	25	54	28	57
	15 000	125	25	3C4	–	–	–	–	28	57
	22 000	250	25	3C4	–	–	–	–	28	57
	22 000	125	16	3D4	–	–	–	–	30	59

		type 2	type 3
Test voltage (d.c.) for 1 to 5 s			
temp. characteristics 2B4 and 2E4		3 x U_R	
temp. characteristics 3B4 and 3C4			1,5 x U_R
temp. characteristic 3D4			18 V
Insulation resistance at U_R after 1 min:	50 V types	min 10 000 MΩ	
	25 V and 16 V types		min 1000 MΩ
Tan δ at 1 kHz, 1 ± 0,5 V		max 1,5% (1000 pF char. 2B4 max 2,5%)	max 1,5% (22 000 pF char. 3B4 max 3%)
Temperature range		– 30 to + 85 °C	– 30 to + 85 °C

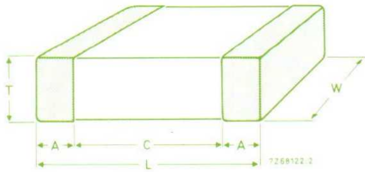
Composition of catalogue no. 2020 561 XXYYZ: see preceding page

multilayer chip

2222 851 to 856 (in boxes)
861; 863 (on tape, on reel)

Microminiature multilayer ceramic capacitors with a very high capacitance per unit volume. They are ideal for hybrid integrated circuits where they are used for coupling, by-passing, blocking, frequency discrimination, etc.

Dimensions (mm)



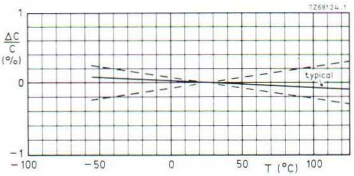
Available types

size	L	W	T min.	T max.	A min.	A max.	C min.	NP0 (E12 series) pF	X7R (E12 series) pF	Z5U (E6 series) pF
0805	2,0 ± 0,15	1,25 ± 0,15	0,51	1,27	0,25	0,75	0,4	10 – 1000	180 – 22 000	2 200 – 33 000
1206	3,2 ± 0,15	1,6 ± 0,15	0,51	1,60	0,3	1,0		33 – 3300	680 – 56 000	10 000 – 100 000
1210	3,2 ± 0,3	2,5 ± 0,2	0,51	1,90	0,3	1,0		47 – 2700	220 – 100 000	100 000 – 220 000
1808	4,5 ± 0,3	2,0 ± 0,2	0,51	1,90	0,3	1,0		100 – 3300	2 200 – 150 000	100 000 – 330 000
1812	4,5 ± 0,3	3,2 ± 0,3	0,51	1,90	0,3	1,0		330 – 5600	4 700 – 270 000	100 000 – 470 000
2220	5,7 ± 0,4	5,0 ± 0,4	0,51	1,90	0,3	1,0		470 – 10 000	12 000 – 470 000	100 000 – 1 000 000

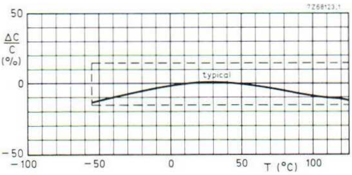
Tolerance NP0	± 10%, ± 5%
X7R	± 20%, ± 10%
Z5U	– 20% to + 80%, ± 20%
Rated voltage (d.c.)	50 V (EIA), 63 V (IEC)
Category temperature range	
NP0, X7R	– 55 to + 125 °C
Z5U	10 to 85 °C
Insulation resistance NP0	> 100 000 MΩ
X7R C⩽10 000 pF	> 100 000 MΩ
C>10 000 pF	R_{ins} x C > 1000 s
Z5U C⩽25 000 pF	> 4 000 MΩ
>25 000 pF	R_{ins} x C > 100 s
Climatic category IEC 68	
NP0, X7R	55/125/56
Z5U	+ 10/085/56

Typical capacitance change as a function of temperature. Dotted lines indicate the limits.

NP0



X7R



Composition of catalogue no. 2222 PPP XXYYZ

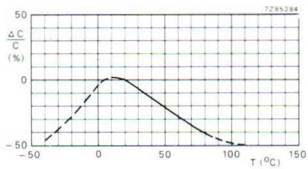
PPP	code for style and packing		
851	size	0805 bulk	861 on tape, on reel
852		1210 bulk	
853		1206 bulk	863 on tape, on reel
854		1808 bulk	
855		1812 bulk	
856		2220 bulk	

XX	code for tolerance	
12	NP0	5%
13		10%
47	X7R	10%
48		20%
58	Z5U	20%
59		– 20% to + 80%

YY first two digits of capacitance value in pF

Z	code for multiplier
9	1
1	10
2	100
3	1000
4	10 000
5	100 000

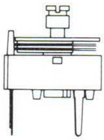
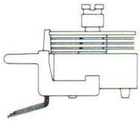
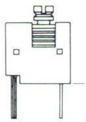
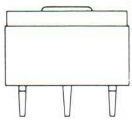
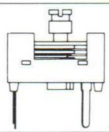
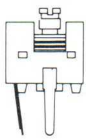
Z5U

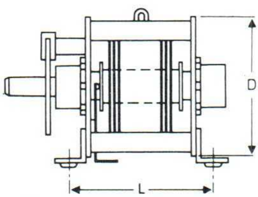


variable capacitors
survey

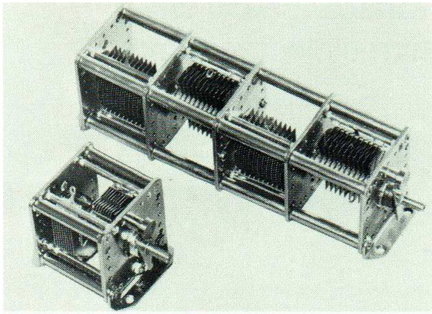
For detailed information
Handbook C15

(1) Top and bottom adjustment.
(2) Top adjustment only.

Film dielectric trimmers			capacitance max. C_{min}/min. C_{max} pF	rated d.c. voltage V	dimensions range mm	cat. no. 2222 followed by	page
 	(1)		1,5/5 to 4/20	150	ø 5	808.	C126
			1,4/5,5 to 3/40	250	ø 7,5		C127
			2,5/15 to 6/100	250	ø 10		C128
			11/120	150	ø 13,5		C130
	(1)		1,2/3,5 1,8/10 2/18	300	6 x 8	809 05001 809 05002 809 05003	C132
	(2)	single stator split stator diff. type	2,5/20 to 7/100 1,5/5 to 3/25 2/12 to 7/150	200	11 x 14	809 070. .	C131
	(1)		4/40 5/60	300	10 x 11	809 08002 809 08003	C132
	(1)		1,4/5,5 2/9 2/18	300	8 x 9	809 09001 809 09002 809 09003	C132

Precision tuning capacitors	capacitance range (pF)				catalogue number	
temperature range −40 to +85°C	stator types	40 x 40 mm linear	60 x 60 mm linear	60 x 60 mm logarithmic		
	single 1 - 4 gangs	16 - 250	100 - 640	100 - 500	2222 805. .	C125
	split 1 - 4 gangs	10 - 64	25 - 125	25 - 125		
	differential 1 gang	64 - 160	–	–		

precision tuning capacitors



2222 805

- Used in the top flight of telecommunication and measuring equipment.
- High stability under extreme conditions.
- Close law tolerance.
- Design flexibility.

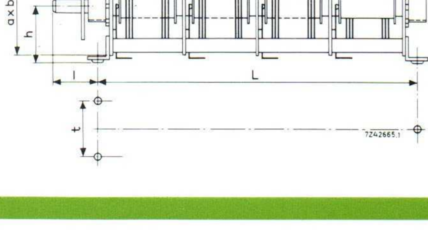
	linear law a x b = 40 x 40 mm				**linear law** a x b = 60 x 60 mm				**logarithmic law** a x b = 60 x 60 mm			
	single-stator or differential type		split-stator type		single-stator type		split-stator type		single-stator type		split-stator type	
nom swing pF	C_{min} ± 1 pF pF	d.c. test voltage V	C_{min} ± 1 pF pF	d.c. test voltage V	C_{min} ± 1 pF pF	d.c. test voltage V	C_{min} ± 1 pF pF	d.c. test voltage V	C_{min} ± 1 pF pF	d.c. test voltage V	C_{min} ± 1 pF pF	d.c. test voltage V
10			3	3000								
16	8	2500	3,6	2000								
25	8,5	2000	4	2000			5	4000			5	2500
32							5	3000			5	2500
40	9	1500	4	1600			5	3000			5,5	2000
50							5	2500			5,5	2000
64	9	1000	4	1300			5,5	2000			5,5	1600
80							5,5	2000			5,5	1600
100	10	1000			14,5	2000	5,5	2000	13	1500	5,5	1600
125					15	2000	6	1600	13	1250	5,5	1300
160	11	800			15,5	1500			14,5	1000		
200					16	1250			14,5	1000		
250	11,5	650			16	1250			14	1000		
320					17,5	1000			14	800		
400					19	1000			14	800		
500					20,5	1000			14	650		
640					21,5	800						

Rated d.c. voltage	50 to 75% of test voltage depending on ambient conditions
Category temperature range	−40 to +85°C
Temperature coefficient	20 to 50 10^{-6}/K
Insulation resistance	> 10 000 MΩ
Contact resistance	⩽ 5 mΩ

We supply standard products or custom designs to meet your specific needs – including special laws and gear mechanisms.

Dimensions (mm)

a x b		40 x 40	60 x 60
L	1 gang	45	67
	2 gangs	76,5	117,5
	3 gangs	108	168
	4 gangs	139,5	218,5
t		22	35
c		31,5	50,5
l		16	18
h		22,5	32,5
f		10	14,5



variable capacitors
film dielectric trimmers

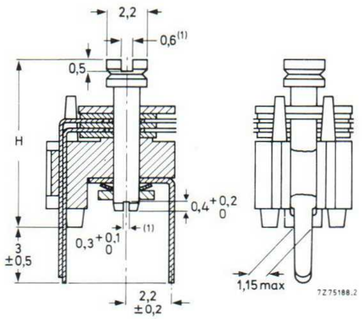
2222 808 – 5 mm dia.

High stability trimmers for consumer or professional use, vertical or horizontal on PCB mounting.

reference C_{min}/C_{max} pF	guaranteed max. C_{min} min. C_{max} pF	tan δ at C_{max} x 10^{-4} 1 MHz	100 MHz	temperature coefficient 10^{-6}/K	min. f_{res} at C_{max} MHz	colour of base	H_{max} mm	catalogue number
1,2/5	1,5/5	< 10	< 25			grey	6,8	2222 808 23508
1,4/10	2/10	< 10	< 25	– 200 ± 300	500	yellow	6,8	2222 808 23109
1,6/15	2,5/15	< 10	< 25	– 50 ± 200	400	blue	8,8	2222 808 23159
3,5/20	4/20	< 10	< 25	– 50 ± 200	300	green	8,8	2222 808 23209

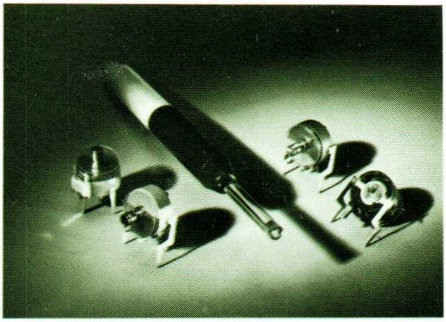
Rated voltage (d.c.)	150 V
Test voltage (d.c.) for 1 minute	300 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	– 40 to + 70 °C
Climatic category (IEC 68)	40/070/21

Dimensions (mm)



(1) Angle between screwdriver adjustment slots is arbitrary.

2222 808 – 7,5 mm dia.



reference C_{min}/C_{max} pF	guaranteed max. C_{min} min. C_{max} pF	tan δ at C_{max} x 10^{-4} 1 MHz	100 MHz	temperature coefficient 10^{-6}/K	min. f_{res} at C_{max} MHz	colour of base	Fig.	catalogue number
1,2/6	1,4/5,5	≤10	≤25	– 400 ± 300	850	grey	1	2222 808 11558
1,4/9	2/9	≤10	≤15	– 500 ± 450	480	yellow	1	2222 808 00018
1,4/10	2/10	≤10	≤25	– 200 ± 400	480	yellow	1	2222 808 11109
							2	2222 808 51109
1,6/15	2/15	≤10	≤25	– 200 ± 350	450	blue	1	2222 808 11159
1,8/18	2/18	≤10	≤15	– 400 ± 200	350	green	1	2222 808 00016
1,8/22	2/22	≤10	≤25	– 250 ± 350	350	green	1	2222 808 11229
							2	2222 808 51229
1,8/27	2/27	≤50		– 250 ± 300	350	red	1	2222 808 11279
							2	2222 808 51279
2/33	3/33	≤10		– 250 ± 300	300	tan	1	2222 808 11339
2/40	3/40	≤50		– 250 ± 300	300	violet	1	2222 808 11409

Rated voltage (d.c.)	250 V
Test voltage (d.c.) for 1 minute	500 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	
C_{max} = 10, 15, 22, 33 pF	– 40 to + 70°C
C_{max} = 5,5, 9, 18, 27, 40 pF	– 40 to + 85°C
Climatic category (IEC 68)	
C_{max} = 10, 15, 22, 33 pF	40/070/21
C_{max} = 5,5, 9, 18, 27, 40 pF	40/085/21

Dimensions (mm)

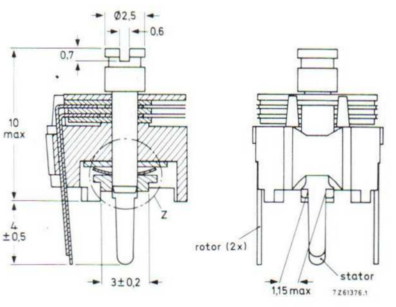


Fig. 1 Version with vertical spindle.

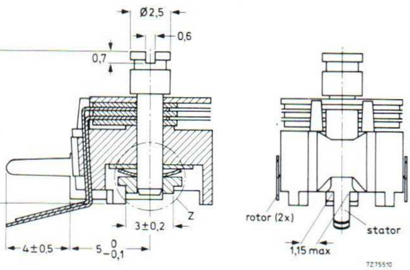


Fig. 2 Version with horizontal spindle.

variable capacitors
film dielectric trimmers

2222 808 – 10 mm dia.

High stability trimmers for consumer or professional use, vertical or horizontal on PCB mounting.

reference C_{min}/C_{max} pF	guaranteed max. C_{min} min. C_{max} pF	tan δ at C_{max} x 10^{-4} 1 MHz	100 MHz	temperature coefficient 10^{-6}/K	min. f_{res} at C_{max} MHz	colour of base	Fig.	catalogue number
1,8/15	2,5/15	≤10	≤25	– 150 ± 500	420	blue	1	2222 808 32159
							2	2222 808 31159
							3	2222 808 61159
2,5/25	3/22,5	≤10	≤25	– 150 ± 400	200	green	1	2222 808 32229
							2	2222 808 31229
							3	2222 808 61229
4/40	5,5/40	≤10	≤25	– 150 ± 350	200	grey	1	2222 808 32409
							2	2222 808 31409
							3	2222 808 61409
4/50	5,5/50	≤10	≤25	– 500 ± 150	170	yellow	1	2222 808 01006
							2	2222 808 01029
4,5/70	5,5/65	≤10	≤25	– 200 ± 300	170	yellow	1	2222 808 32659
							2	2222 808 31659
							3	2222 808 61659
							3*	2222 808 64659
5/90	6/80	≤50	–	– 100 ± 300	170	red	1	2222 808 32809
							2	2222 808 31809
							2*	2222 808 34809
							3	2222 808 61809
							3*	2222 808 64809
5/105	6/100	≤50	–	– 100 ± 300	170	violet	1	2222 808 32101
							2	2222 808 31101
							3*	2222 808 64101

* Version with hexagonal head for spanner adjustment.

Rated voltage (d.c.)	250 V
Test voltage (d.c.) for 1 minute	500 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	
C_{max} = 15, 22,5, 40, 65 pF	– 40 to + 70°C
C_{max} = 50, 80, 100 pF	– 40 to + 85°C
Climatic category (IEC 68)	
C_{max} = 15, 22,5, 40, 65 pF	40/070/21
C_{max} = 50, 80, 100 pF	40/085/21

Dimensions (mm)

Versions with vertical spindle

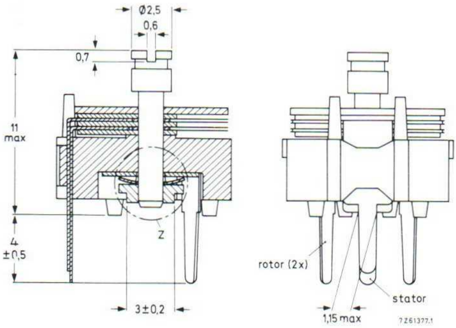


Fig. 1

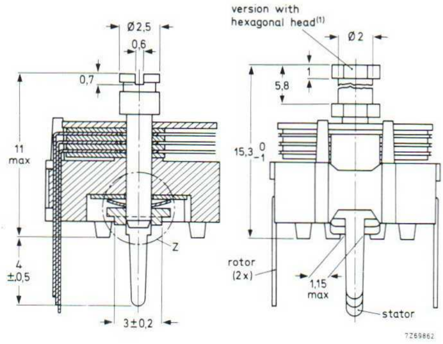


Fig. 2

Version with horizontal spindle

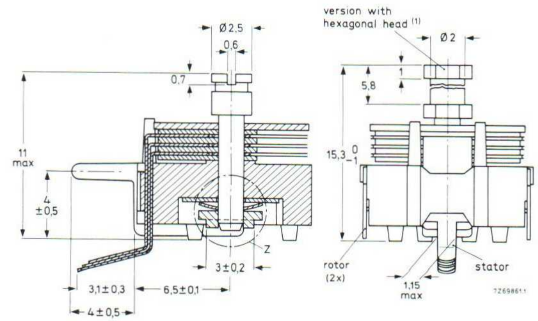


Fig. 3

variable capacitors
film dielectric trimmers

2222 808 – 13,5 mm dia.

High stability trimmers for consumer or professional use, vertical or horizontal on PCB mounting.

reference C_{min}/C_{max} pF	guaranteed max. C_{min} min. C_{max} pF	tan δ at C_{max} at 1 MHz x 10^{-4}	temperature coefficient 10^{-6}/K	f_{res} at C_{max} MHz	colour of base	Fig.	catalogue number
8/130	11/120	⩽50	0 ± 300	>150	green	1	2222 808 41121
8/130	11/120	⩽50	0 ± 300	>150	green	1*	2222 808 44121
8/130	11/120	⩽50	– 200 ± 300	>150	green	2	2222 808 71121
8/130	11/120	⩽50	– 200 ± 300	>150	green	2*	2222 808 74121

* Version with hexagonal head for spanner adjustment

Rated voltage (d.c.)	150 V
Test voltage (d.c.) for 1 minute	300 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	– 40 to + 85°C
Climatic category (IEC 68)	40/085/21

Dimensions (mm)

Fig. 1 Version with vertical spindle

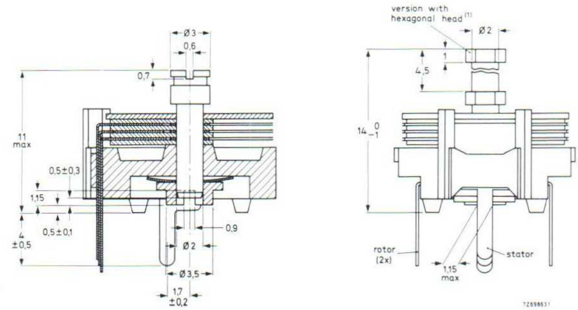
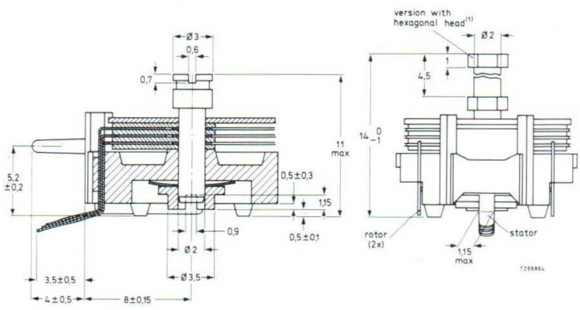
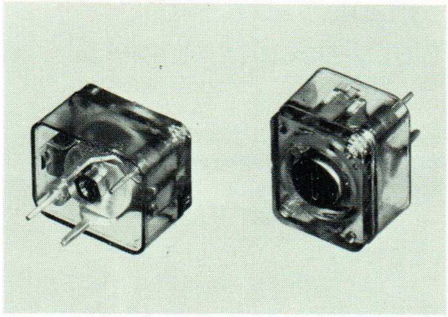


Fig. 2 Version with horizontal spindle



variable capacitors
film dielectric trimmers

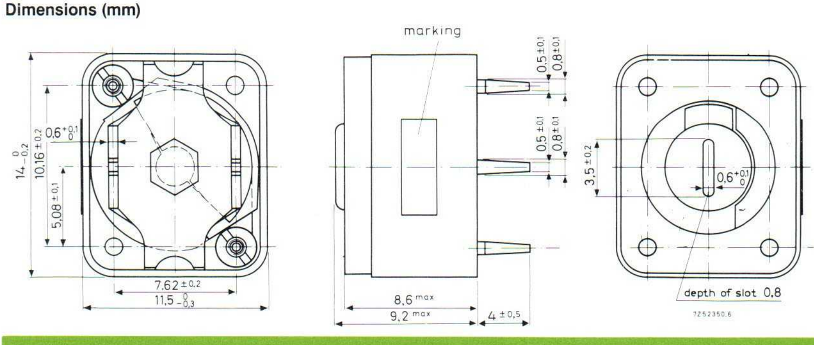
2222 809 07. – high temperature



type	C_{max} pF	C_{min} pF	max. tan δ at 100 MHz	catalogue number
single-stator	⩾ 20	⩽ 2,5	17×10^{-4}	2222 809 07004
	⩾ 40	⩽ 4	17×10^{-4}	07008
	⩾ 60	⩽ 5	25×10^{-4}	07011
	⩾ 80	⩽ 6	25×10^{-4}	07013
	⩾ 100	⩽ 7	25×10^{-4}	07015
split-stator	⩾ 5	⩽ 1,5	17×10^{-4}	07001
	⩾ 10	⩽ 2	17×10^{-4}	07002
	⩾ 15	⩽ 3	25×10^{-4}	07003
	⩾ 20	⩽ 3	25×10^{-4}	07005
	⩾ 25	⩽ 3	25×10^{-4}	07007
differential	⩾ 12	⩽ 2	17×10^{-4}	07018
	⩾ 20	⩽ 2,5	17×10^{-4}	07006
	⩾ 40	⩽ 4	17×10^{-4}	07009
	⩾ 60	⩽ 5	25×10^{-4}	07012
	⩾ 80	⩽ 6	25×10^{-4}	07014
	⩾ 100	⩽ 7	25×10^{-4}	07016
	⩾ 150	⩽ 7	–	07107

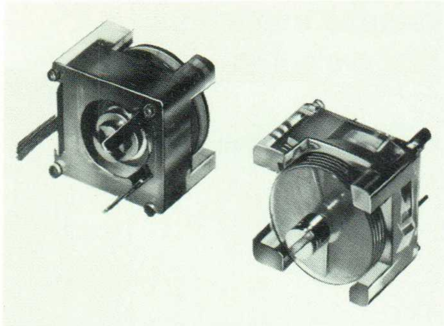
Rated voltage (d.c.)	200 V
Test voltage (d.c.) for 1 minute	400 V
Tan δ at 1 MHz	max. 10×10^{-4}
differential cap. with C_{max} ⩾ 150 pF	max. 50×10^{-4}
Contact resistance	max. 5 mΩ
Insulation resistance	
between stator and rotor	min. 10 000 MΩ
Temperature coefficient	$(0 \pm 200) \times 10^{-6}$/K
Category temperature range	– 40 to + 125°C
Climatic category (IEC 68)	40/125/21

Dimensions (mm)



variable capacitors
film dielectric trimmers

2222 809 050
2222 809 080 – high-temperature
2222 809 090



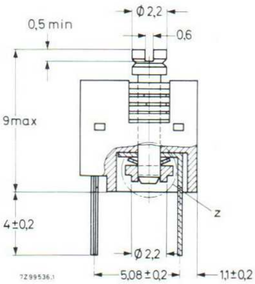
C_{max}* pF	C_{min}* pF	max. tan δ at 1 MHz	max tan δ at 100 MHz	temperature coefficient** 10^{-6}/K	min. f_{res} at C_{max} MHz	catalogue number 2222 809	
⩾ 3,5	⩽ 1,2	10 x 10^{-4}	20 x 10^{-4}	– 250 ± 150	850		05001
⩾ 10	⩽ 1,8	10 x 10^{-4}	20 x 10^{-4}	– 350 ± 150	580		05002
⩾ 18	⩽ 2	25 x 10^{-4}	40 x 10^{-4}	– 350 ± 150	360		05003
⩾ 40	⩽ 4	10 x 10^{-4}	25 x 10^{-4}	– 250 ± 150	170		08002
⩾ 60	⩽ 5	10 x 10^{-4}	25 x 10^{-4}	– 250 ± 150	150		08003
						2 tags	3 tags
⩾ 5,5	⩽ 1,4	10 x 10^{-4}	15 x 10^{-4}	– 250 ± 150	850	09004	09001
⩾ 9	⩽ 2	10 x 10^{-4}	15 x 10^{-4}	– 250 ± 150	580	09005	09002
⩾ 18	⩽ 2	10 x 10^{-4}	15 x 10^{-4}	– 250 ± 150	360	09006	09003

Rated voltage (d.c.)	300 V
Test voltage (d.c.) for 1 minute	600 V
Contact resistance	max. 5 mΩ
Insulation resistance between stator and rotor	min. 10 000 MΩ
Category temperature range	– 40 to + 125 °C
Climatic category (IEC 68)	40/125/21

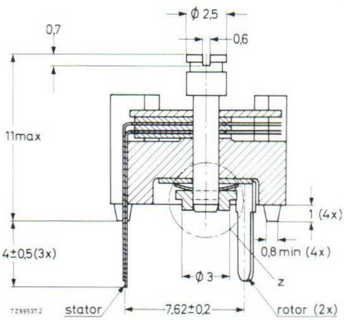
* Measured at 200 kHz.
** C at 60 to 80% of C_{max}; ΔT from + 20 to + 125 °C.

Dimensions (mm)

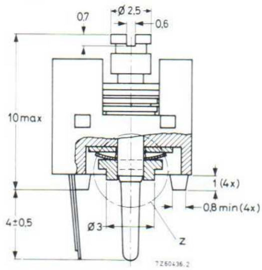
050 series



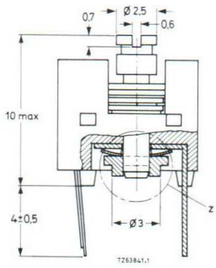
080 series



090 series
3-tag version



2-tag version

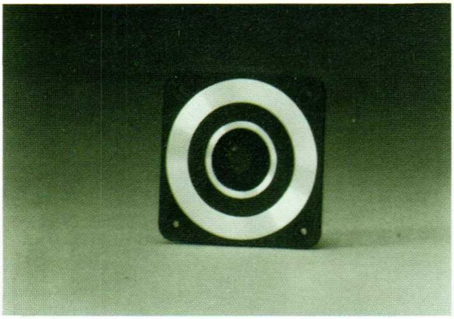


CONTENTS COMPONENTS FOR RADIO, AUDIO, TV

For detailed information
Handbooks C3, C2 and T8

loudspeakers
high power – high-fidelity to DIN 45 500

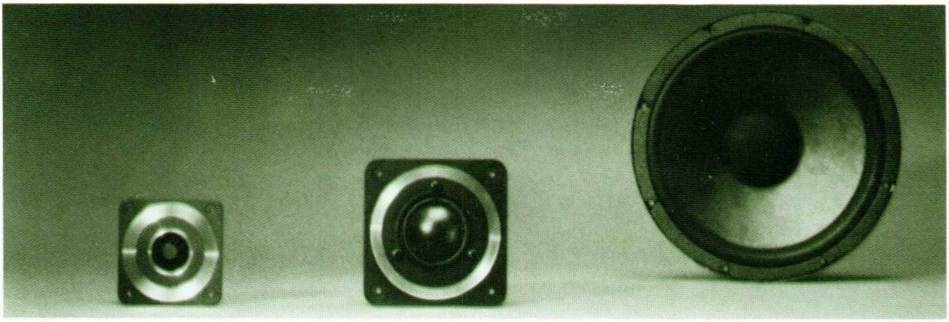
For detailed information Handbook C3



System powers tabulated below are for complete two or three-way systems making use of the listed loudspeakers; recommended enclosure volumes are listed on page C137.

Dome tweeters

type	status	system power W	resonance frequency Hz	rated frequency range kHz	overall dia. mm	baffle hole dia. mm	total depth mm	surround material	magnet system
3/4 inch									
square – non exposed									
AD 00400/T4; T8	N	70	1500	3 to 22	83□	73	26	textile	ceramic
AD 00800/T4; T8	N	70	1500	3 to 22	83□	73	23	textile	ceramic
AD 00900/T4; T8	N	70	1900	4 to 22	58□	55	28	textile	screened ceramic
1 inch									
round – non exposed									
AD 0140/T4; T8; T15	D	20/40	1200	2 to 22	94Ø	75	25	polycarb.	ceramic
AD 0141/T4; T8; T15	D	20/50	1450	2 to 22	94Ø	75	25	textile	ceramic
AD 0162/T4; T8; T15	D	20/50	1000	2 to 22	94Ø	75	32	polycarb.	ceramic
AD 0163/T4; T8; T15	D	20/50	1300	2 to 22	94Ø	75	32	textile	ceramic
AD 01634/T4; T8	N	20/50	2000	2 to 22	94Ø	75	32	textile ferrofluid	ceramic
square – non exposed									
AD 01420/T4; T8; T15	N	50/70	950	1,5 to 22	96□	85	36	paper	ceramic with pot
AD 01430/T4; T8; T15	N	50/70	1100	1,8 to 22	96□	85	36	textile	ceramic with pot
AD 0146/T4; T8	N	20/50	1450	2 to 22	70/80□	63	17	textile	ceramic
AD 01630/T4; T8; T15	N	20/50	1300	2 to 22	96□	85	33	textile	ceramic
AD 01632/T4; T8; T15	N	50/70	1300	2 to 22	96□	85	33	paper	ceramic
square – non exposed - with aluminium trim rings									
AD 01411/T4; T8	N	20/50	1450	2 to 22	96□	85	25	textile	ceramic
AD 01421/T4; T8	N	50/70	950	1,5 to 22	96□	85	36	paper	ceramic with pot
AD 01431/T4; T8	N	50/70	1100	1,8 to 22	96□	85	36	textile	ceramic with pot
AD 01631/T4; T8; T15	N	20/50	1300	2 to 22	96□	85	33	textile	ceramic
AD 01633/T4; T8; T15	N	50/70	1300	2 to 22	96□	85	33	paper	ceramic
square – semi exposed									
AD 01610/T4; T8; T15	N	20/50	1250	2 to 22	96□	85	32	textile	ceramic
square – exposed									
AD 01600/T4; T8; T15	N	20/50	1250	2 to 22	96□	85	28	textile	ceramic
square – exposed - with aluminium trim rings									
AD 01605/T4; T8; T15	N	20/50	1250	2 to 22	96□	85	28	textile	ceramic



Cone tweeters

type	status	system power W	resonance frequency Hz	rated frequency range kHz	overall dia. mm	baffle hole dia. mm	total depth mm	surround material	magnet system
2 inch									
round									
AD 2000TP	N	16,7▲	–	0,5 to 22	50Ø	44	23	paper	piezo ceramic
AD 2096/T4; T8; T15	N	10	1300	3 to 17	50Ø	43	27	paper	steel alloy
AD 20300/T4; T8; T15	N	10	1300	3 to 17	50Ø	44	24	paper	ceramic
square									
AD 2200TP	N	16,7▲	–	0,5 to 22	53□	44	23	paper	piezo ceramic
AD 2296/T4; T8; T15	N	10	1300	3 to 17	50□	43	27	paper	steel alloy
AD 22300/T4; T8; T15	N	10	1300	3 to 17	53□	44	24	paper	ceramic
2¼ inch									
square									
AD 2273/T4; T8	N	10	1000	1,5 to 15	58□	54	27	paper	ceramic
AD 2274/T4; T8	N	10	1000	1,5 to 15	58□	54	38	paper	screened ceramic

Dome squawkers

2 inch									
AD 0210/Sq4; Sq8	D	60	350	0,5 to 5	134	112	108	paper	ceramic
AD 0211/Sq4; Sq8	D	60	350	0,5 to 5	134	112	108	textile	ceramic
AD 02110/Sq4; Sq8	N	80	340	0,5 to 5	134	112	103	textile	ceramic
AD 02150/Sq4; Sq8	N	80	340	0,5 to 5	134	122	98	textile	ceramic
AD 02160/Sq4; Sq8	N	80	320	0,5 to 10	134	122	85	textile	ceramic

Cone squawkers

5 inch									
AD 5060/Sq4; Sq8	D	40	210	0,4 to 5	129	96	107	textile	ceramic
AD 50600/Sq4; Sq8	N*	60	–	0,4 to 5	115	100	106	textile	ceramic
AD 50600/DSq4; DSq8	N*	60	–	0,4 to 5	115	100	106	textile	ceramic
AD 50601/Sq4; Sq8	N*	80	–	1,5 to 5	115	100	48	textile	ceramic
AD 50601/DSq4; DSq8	N*	80	–	1,5 to 5	115	100	48	textile	ceramic
AD 5061/Sq4; Sq8	D	80	680	1,5 to 5	129	96	50	textile	ceramic
AD 5062/Sq4; Sq8	D	60	220	0,4 to 5	129	96	107	textile	ceramic
AD 50800/Sq4; Sq8	N*	40	–	0,4 to 5	115	100	106	textile	ceramic
AD 50800/DSq4; DSq8	N*	40	–	0,4 to 5	115	100	106	textile	ceramic
AD 50801/Sq4; Sq8	N	60	–	1,5 to 5	115	100	44	textile	ceramic
AD 50801/DSq4; DSq8	N*	60	–	1,5 to 5	115	100	44	textile	ceramic

▲ system voltage
* in development

loudspeakers
high power – high-fidelity to DIN 45 500

Woofers

type	status	system power W	resonance frequency Hz	rated frequency range kHz	overall dia. mm	baffle hole dia. mm	total depth mm	surround material	magnet system
4 inch									
AD 4060/W4; W8	N	15/30	60	0,06 to 10	102	95	52	rubber	ceramic
AD 40500/W4; W8	N	15	60	0,035 to 2	102	95	60	rubber	ceramic
AD 40501/W4; W8	N	20	72	0,07 to 10	102	95	60	rubber	ceramic
AD 40900/W4; W8	N	8	80	50 to 5000	102	95	54	foam	screened ceramic
AD 40910/W4; W8	N	18	72	50 to 5000	102	95	54	rubber	screened ceramic
5 inch									
AD 5060/W4; W8	D	10	60	0,05 to 5	129	108	56	rubber	ceramic
7 inch									
AD 70601/W4; W8	N	30	45	0,04 to 3	166	142	68	rubber	ceramic
AD 70610/W4; W8	N	30	45	0,05 to 4	166	142	68	textile	ceramic
AD 70611/W4; W8	N	30	45	0,05 to 4	166	142	68	textile	ceramic
AD 70650/W4; W8	N	40	45	0,07 to 5	166	142	72	rubber	ceramic
AD 70655/W8	N	50	32	20 to 1500	166	142	88	rubber	ceramic
8 inch									
AD 80601/W4; W8	N	50	42	0,05 to 4	204	180	86	rubber	ceramic
AD 80602/W4; W8	N	50	42	0,05 to 4	204	180	86	foam	ceramic
AD 80603/W4; W8	N	50	38	0,05 to 2	204	180	86	foam	ceramic
AD 80604/W4; W8	N	50	38	0,05 to 2	204	180	86	rubber	ceramic
AD 80605/W6	N	30	50	40 to 3000	204	180	82	foam	ceramic
AD 80651/W4; W8	N	60	39	0,05 to 4	204	180	88	rubber	ceramic
AD 80652/W4; W8	N	60	39	0,05 to 4	204	180	88	foam	ceramic
AD 80671/W4; W8	N	70	35	0,04 to 3	204	180	88	rubber	ceramic
AD 80672/W4; W8	N	70	35	0,04 to 3	204	180	88	foam	ceramic
10 inch									
AD 10100/W4; W8	D	40	25	0,03 to 1	261	227	131	rubber	ceramic
AD 10200/W4; W8	N	80	28	0,02 to 2	261	227	116	rubber	ceramic
AD 10250/W4; W8	N	100	28	0,02 to 2	261	227	118	rubber	ceramic
AD 10600/W4; W8	N	40	39	0,05 to 2,5	261	227	105	foam	ceramic
AD 10650/W4; W8	N	60	20	0,04 to 3	261	227	113	foam	ceramic
12 inch									
AD 12200/W4; W8	N	80	23	0,03 to 1,5	311	280	119	rubber	ceramic
AD 12250/W4; W8	N	100	26	0,04 to 2	311	280	121	rubber	ceramic
AD 12600/W4; W8	N	40	28	0,04 to 2	261	227	110	foam	ceramic
AD 12650/W4; W8	N	60	22	0,03 to 2	261	227	115	rubber	ceramic

passive radiators recommended combinations

Passive radiators

type	status	catalogue no.	effective cone area m^2	total moving mass g	overall dia. mm	baffle hole dia. mm	surround material
AD 8001	N	2422 259 80001	$2{,}5 \times 10^{-2}$	33,9	204	180	rubber
AD 8002	N	2422 259 80002	$2{,}5 \times 10^{-2}$	33,9	204	180	foam
AD 1200	N	2422 259 12001	5×10^{-2}	51,6	311	279	rubber

Recommended loudspeaker combinations (4 and 8 Ω)

woofer	squawker	tweeter	cross-over frequency kHz	enclosure volume litres	power handling capacity W
AD 40910/W4(8)	—	AD 2296/T8(15)	4	5, bass reflex	15
AD 70601/W4(8)	—	AD 2296/T4(8)	2,4	9	20
AD 70601/W4(8)	—	AD 0141/T8(15)	1,6	9	25
AD 80652/W4(8)	AD 5060/Sq4(8)	AD 0140/T4(8)	0,7 and 3	25	40
AD 80652/W4(8) with AD 8002	AD 0211/Sq4(8)	AD 01630/T8(15) or AD 01631/T8(15)	o,7 and 2,4	35	50
9710/M8	—	—	—	40, bass reflex	25
AD 12650/W8	AD 5061/Sq8	AD 0141/T8	2,1 and 8	60	60
AD 12200/W8 with AD 1200	AD 0211/Sq4(8)	AD 01605/T4(8)	0,8 and 5	100	100

For more information our book "Building Hi-Fi speaker systems" and Technical notes TN102 to 108 and TN119 to 128 are currently available - more will follow.

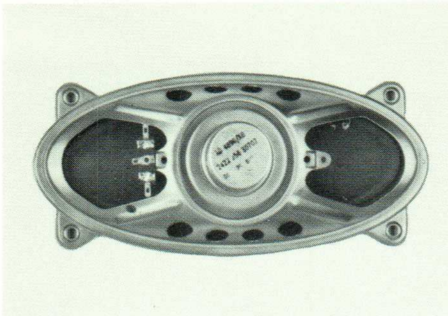
loudspeakers
full-range – round

type	status	max. power W	resonance frequency Hz	rated frequency range kHz	overall dia. mm	baffle hole dia. mm	total depth mm	surround material	magnet system
1 1/4 inch									
AD 0198/Z8; Z15; Z25	D	0,3	500	0,3 to 7	31	26,5	14,3	poly-carbonate	steel alloy
2 inch									
AD 2099/Z8; Z15; Z25	D	0,5	420	0,3 to 4	50	46	18	paper	steel alloy
2 1/2 inch									
AD 2071/Z4; Z8; Z15; Z25; Z50; Z150	D	1	360	0,2 to 4	64	59	20	paper	ceramic
3 inch									
AD 3071/Y4; Y8; Y15; Y25; Y50; Y150	D	2	250	0,1 to 6	81	72	23	paper	ceramic
AD 3080/M4	N	6	155	0,1 to 12	87	77	37	textile	ceramic
AD 3080/X4	N	10	85	0,03 to 15	87	77	37	textile	ceramic
AD 3371/Y4; Y8; Y15; Y25; Y50; Y150	D	22	250	0,1 to 6	81	72	28	paper	ceramic
4 inch									
AD 4060/M4; M8	N	13	95	0,07 to 20	102	94	52	textile	ceramic
AD 4072/X4; X8; X15; X25	D	3	170	0,08 to 15	105	96	30,5	paper	ceramic
AD 4074/X4; X8; X15; X25	N	3	170	0,08 to 15	105	96	44	paper	scr. ceramic
AD 4085/X4; X8; X15	D	3	150	0,08 to 14	104	96	36	paper	ceramic
AD 4095/X4; X8; X15; X25	N	3	150	0,08 to 15	105	96	40	paper	steel alloy
AD 40400/M4	N	15	110	0,05 to 20	102	94	49	textile	ceramic
AD 40800/M4	N	15	115	0,06 to 20	87	77	46	textile	ceramic
AD 40900/M4; M25	N	8	90	0,06 to 20	105	96	54	foam	scr. comp. ceramic
AD 4472/X4; X8; X15; X25	D	3	170	0,08 to 15	105	96	30,5	paper	ceramic
AD 4474/X4; X8; X15; X25	N	3	170	0,08 to 15	105	96	44	paper	scr. ceramic
AD 4481/X4	D	6	140	0,09 to 14	105	96	39	textile	ceramic
AD 4485/X4; X8; X15	N	3	150	0,1 to 13	104	96	36	paper	ceramic
AD 4495/X4; X8; X15; X25	N	3	150	0,08 to 15	105	96	40	paper	steel alloy

9710/M8

type	status	max. power W	resonance frequency Hz	rated frequency range kHz	overall dia. mm	baffle hole dia. mm	total depth mm	surround material	magnet system
5 inch									
AD 5061/M4; M8	D	15	85	0,07 to 20	129	108	55	textile	ceramic
AD 5062/M4	N	20	85	0,07 to 20	102	94	52	textile	ceramic
AD 5081/M4; M8; M15; M25	D	6	135	0,06 to 14	120	108	49	paper	ceramic
AD 5081/X4; X8; X15; X25	D	6	140	0,06 to 14	120	108	49	paper	ceramic
5 1/4 inch									
AD 51600/P4	N	20	78	0,06 to 8	130	115	58	textile	ceramic
7 inch									
AD 7062/M4; M8	D	30	45	0,04 to 18	166	141	68	rubber	ceramic
AD 7063/M4; M8	D	15	70	0,04 to 18	166	141	69	textile	ceramic
AD 7064/M4; M8	N	15	70	0,04 to 18	166	141	69	textile	ceramic
AD 7065/M4; M8	N	20	70	0,08 to 20	155	142	72	textile	ceramic
AD 7080/M4; M8; M15	D	6	105	0,08 to 15	166	141	58	paper	ceramic
AD 7080/X4; X8	D	6	115	0,08 to 10	166	141	58	paper	ceramic
AD 7081/M4	D	10	105	0,08 to 15	166	141	58	paper	ceramic
AD 7090/M4; M8	D	4	105	0,07 to 18	166	141	63	paper	steel alloy
AD 7090/X4; X8	D	4	115	0,07 to 13	166	141	63	paper	steel alloy
AD 70620/M4; M8	N	30	45	0,05 to 13	166	142	69	rubber	ceramic
AD 70630/M4; M8	N	15	60	0,06 to 15	166	142	69	textile	ceramic
8 inch									
AD 8081/M4; M8	D	8	75	0,05 to 14	206	176	68	paper	ceramic
AD 8081/X4; X8	D	8	95	0,07 to 11	206	176	68	paper	ceramic
AD 8082/M4; M8	N	13	95	0,07 to 11	206	176	68	paper	ceramic
AD 8082/X8	N	13	95	0,07 to 11	206	176	68	paper	ceramic
8 1/2 inch									
9710/M8	D	20	50	0,04 to 19	217	195	96	paper	ceramic
10 inch									
AD 1065/M4; M8; M15	D	10	55	0,06 to 18	261	227	113	paper	ceramic
12 inch									
AD 1265/M4; M8; M15	D	20	45	0,03 to 18	315	278	134	paper	ceramic
AD 12100/M4; M8; M15	D	25	45	0,03 to 13	315	278	152	paper	ceramic
AD 12100/HP4; HP8	D	50	60	0,04 to 12	315	278	152	textile	ceramic

loudspeakers
full-range – oval



type	status	max. power W	resonance frequency Hz	rated frequency range kHz	overall size mm	baffle hole size mm	total depth mm	surround material	magnet system
3 inch x 5 inch									
AD 3595/X4; X8; X15; X25; X50	N	3	180	0,09 to 15	76x131	66x121	43	paper	steel alloy
3 inch x 8 inch									
AD 3880/X4; X8; X15	D	4	120	0,09 to 15	82x205	72x195	51	paper	ceramic
AD 3890/X4; X8; X15; X25	D	4	120	0,09 to 15	82x205	72x195	56	paper	steel alloy
3 1/2 inch x 6 inch									
AD 4682/X4; X8; X15; X25	D	6	140	0,08 to 13	95x155	82x140	51	paper	ceramic
AD 4684/X4; X8; X15; X25	D	6	140	0,08 to 13	95x155	82x140	55	paper	scr. ceramic
AD 4685/X4; X8	N	4	140	0,07 to 15	95x155	82x142	49	paper	ceramic
AD 4692/X4; X8; X15; X25	D	4	140	0,08 to 13	95x155	82x140	55	paper	steel alloy
AD 4695/X4; X8; X15; X25	N	4	140	0,08 to 12	95x155	82x140	51	paper	steel alloy
AD 46920/X4; X8; X15; X25	N	4	140	0,08 to 13	95x155	82x150	55	paper	cer. comp.
4 inch x 6 inch									
AD 4681/M4; M8; M25	D	6	135	0,1 to 20	102x154	89x141	48	paper	ceramic
AD 4681/X4; X8; X15; X25	D	6	140	0,1 to 20	102x154	89x141	48	paper	ceramic
AD 4683/M4; M8; M15; M25	D	6	140	0,1 to 20	102x154	89x141	52	paper	scr. ceramic
AD 4683/X4; X8; X15; X25	D	6	140	0,1 to 20	102x154	89x141	52	paper	scr. ceramic
AD 4686/X4; X8; X15; X25	N	6	140	0,1 to 20	102x154	89x141	45	paper	ceramic
AD 4691/M4; M8; M15; M25	D	6	135	0,1 to 20	102x154	89x141	52	paper	steel alloy
AD 4691/X4; X8; X15; X25	D	6	140	0,1 to 12	102x154	89x141	52	paper	steel alloy
AD 4696/X4; X8; X15; X25	N	6	140	0,1 to 12	102x154	89x141	45	paper	steel alloy
4 inch x 8 inch									
AD 4891/X4; X8; X15; X25	N	10	110	0,07 to 10	96x210	82x192	54	paper	steel alloy
AD 48900/X4; X8; X15; X25	N	10	110	0,07 to 10	96x210	82x192	54	paper	cer. comp.
5 inch x 7 inch									
AD 5780/M4; M8; M15; M25	D	6	100	0,07 to 20	133x183	110x160	57	paper	ceramic
AD 5780/X4; X8; X15; X25	D	6	115	0,08 to 10	133x183	110x160	57	paper	ceramic
AD 5790/X4	D	4	115	0,08 to 10	133x183	110x160	62	paper	steel alloy
AD 57900/X4; X8	D	4	115	0,08 to 10	133x183	110x160		paper	cer. comp.
AD 5791/M4; M8	N	10	100	0,07 to 19	133x183	110x160	62	paper	steel alloy

coding system

AD •• ••/••

- nominal cone size (inches) and shape of flange
- magnet system
- audio response
- rated impedance (Ω)

Nominal cone size (inches) and shape of flange

00 = ¾	dome
01 = 1 to 1¼	dome
02 = 2	dome
10 = 10	round
12 = 12	round
20 = 2 to 2½	round
22 = 2 to 2½	square
30 = 3	round
33 = 3	square
35 = 3 x 5	oval
38 = 3 x 8	oval
40 = 4	round
44 = 4	square
46 = 4 x 6	oval
48 = 4 x 8	oval
50 = 5	octagonal
57 = 5 x 7	oval
70 = 7	octagonal
80 = 8	octagonal

Magnet system

10 = ceramic,	102 mm Ø
40 to 49 = ceramic,	60 mm Ø
400 to 449 = ceramic,	60 mm Ø
60 to 64 = ceramic,	72 mm Ø
600 to 649 = ceramic,	72 mm Ø
65 to 67 = ceramic,	90 mm Ø
650 to 679 = ceramic,	90 mm Ø
70 to 74 = ceramic,	30 mm Ø
80 to 84 = ceramic,	53 mm Ø
800 to 849 = ceramic,	53 mm Ø
85 to 89 = ceramic,	46 mm Ø
90 to 94 = steel alloy,	18 mm Ø
900 to 949 = ceramic, with compensation magnet,	46 mm Ø
95 to 97 = steel alloy,	14 mm Ø
98, 99 = steel alloy,	10 mm Ø
100 = ceramic,	130 mm Ø
200 = ceramic,	125 mm Ø
250 = ceramic,	138 mm Ø

Audio response

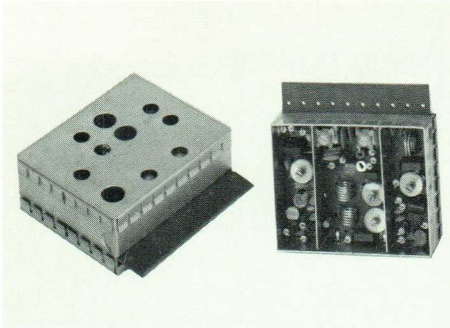
high power	**HP**
double cone, smooth response over wide frequency range	**M**
squawkers; for mid-range frequencies	**Sq**
cone squawker with dust cap	**DSq**
tweeter; for high frequencies	**T**
tweeter with piezo-oxide	**TP**
woofer; for very low frequencies	**W**
notably higher response level at about 3 kHz	**Z**
notably higher response level in the region 2 to 6 kHz	**Y**
as Y, but wider frequency range	**X**

Rated impedance (Ω)

4
8
15
25
50
150

tuners
f.m. radio – diode tuning

For detailed information
Handbook C2

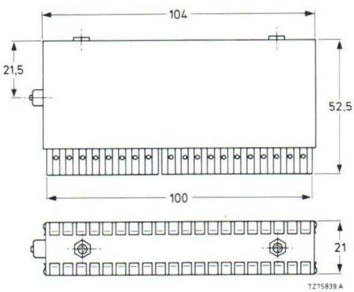


A range of variable capacitance diode tuners covering the inexpensive, medium, and hi-fi classes. They are manufactured in large series with consequent advantages in quality and in price. The use of fully automated production facilities also promotes consistently high quality standards.

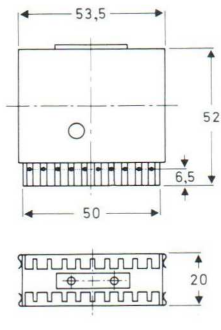
type	**FD1A***	**FD1B****	**FD1D**	**FD1W****	**FD12/1**
catalogue no. 4312 020	80030	80090	80060	800111	80120
status	D	D	D	D	D
frequency range (MHz)	87,5 to 108	87,5 to 108	87,5 to 108	87,5 to 108	87,5 to 108
oscillator frequency	$f_{osc} > f_{aer}$	$f_{osc} > f_{aer}$	$f_{osc} > f_{aer}$	$f_{osc} > f_{aer}$	$f_{osc} > f_{aer}$
input impedance (Ω)	75/300	75/300	75/300	75	75
d.c. voltage (V)					
supply	12	12	12	12	20 and 30
tuning	3;8 to 28	3,8 to 28	2 to 12	3,8 to 28	3,8 to 27
i.f. frequency (MHz)	10,7	10,7	10,7	10,7	10,7
i.f. bandwidth (– 3 dB) (kHz)	270	270	230	300	300
gain (dB)	30	30	38	28	40
noise figure (dB)	6	6,5	4	6	5
number of tuned circuits	4	4	2	4	5

* Also available without a.f.c. under type number FD1, catalogue no. 4312 020 80020.
**Suited for digital tuning systems.

Dimensions (mm)



Main dimensions of type FD12/1



Main dimensions of types FD1A, FD1B, FD1D, FD1W.

tv – diode tuning

This range of tuners covers all C.C.I.R. systems, including the U.K. system and the C.C.I.R. derivatives: Eastern Europe, Italy, Ireland, Australia, New Zealand, South Africa and South America. Versions are available for n-p-n and p-n-p a.g.c. direction. All tuners are pluggable to facilitate servicing.

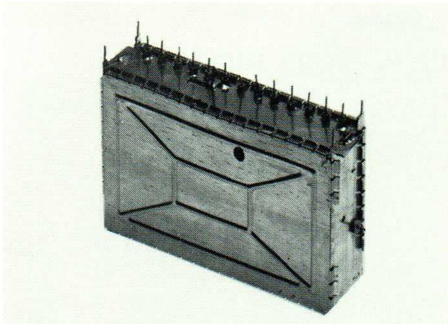
type no.	**ELC2004**	**ELC2060**	**ELC2070**	**ELC3082**
catalogue no.	3122 128 64171	3122 128 56991	3122 128 54200	3122 127 19680
status	D	D	D	D
C.C.I.R. system	B and G v.h.f. and u.h.f.	B and G v.h.f. and u.h.f.	I v.h.f. and u.h.f.	M and N v.h.f.
channel coverage				
band I	NZ1 to R4	0 to 4	–	A2 to A6 (low v.h.f.)
band III	M4 to E12	5 to 11	4 to 13	A7 to A13 (high v.h.f.)
band IV and V	E21 to E69	28 to 63	21 to 69	–
i.f. frequency (MHz)				
picture	38,9	36,875	38,9	45,75
sound	33,4	31,375	32,9	41,25
input impedance (Ω)	75/300	75/300	75/300	75/300
d.c. voltage (V)				
supply	11	12	12	12
tuning	0,5 to 28	0,5 to 28	0,5 to 28	0,5 to 28
switching	11	12	–	12
power gain (dB)				
band I	⩾ 24	⩾ 25	–	⩾ 24
band III	⩾ 24	⩾ 25	⩾ 24	⩾ 25
band IV and V	⩾ 25	⩾ 25	⩾ 25	–
typical noise figure (dB)				
band I	5,5	7	–	7
band III	6	7	6,5	7,5
band IV and V	7	9	9,5	–
a.g.c. range (dB)				
band I	⩾ 40	⩾ 40	–	⩾ 40
band III	⩾ 40	⩾ 40	⩾ 40	⩾ 40
band IV and V	⩾ 30	⩾ 30	⩾ 30	–
dimensions max (mm)				
thickness	28,6	28,6	28,6	28,6
length	109	109	109	98,6
height	67	67	67	59

pitch of the connecting pins
2,54 mm (0,1 inch)

type no.	**UV411**	**U322/U322LO***		**U323**
catalogue no.	3122 127 24360	3122 128 54252/64851		3122 127 22540
status	N	D		D
C.C.I.R. system	B and G	G and H	I and K	M
	v.h.f. and u.h.f.	u.h.f.		u.h.f.
channel coverage				
band I	NZ1 to C	–		–
band III	M4 to E12	–		–
band IV and V	E12 to E69	E21 to E69		A14 to A78
i.f. frequency (MHz)				
picture	38,9	38,9	39,5	45,75
sound	33,4	33,4	33,5	21,25
input impedance (Ω)	75	75		75
d.c. voltage (V)				
supply	12	12		12
tuning	1 to 28	1 to 28		1 to 28
switching	–	–		–
power gain (dB)				
band I	⩾ 22	–		–
band III	⩾ 22	–		–
band IV and V	⩾ 20	⩾ 19		typ 24
typical noise figure (dB)				
band I	5	–		–
band III	5	–		–
band IV and V	6	7,5		8
a.g.c. range (dB)				
band I	⩾ 40	–		–
band III	⩾ 40	–		–
band IV and V	⩾ 30	⩾ 30		⩾ 30
dimensions max (mm)				
thickness	23,5	18		18
length	93,3	83		83
height	73	50		50

* Suited for digital tuning systems.

pitch of the connecting pins
2,54 mm (0,1 inch)



type no.	**U341/U341LO***		**U342/U342LO***		**UF5**	**VF5**	
catalogue no.	3122 127 41490/43390		3122 127 25130/41510		3111 108 60810	3111 108 60740	
status	N		N		D	D	
C.C.I.R. system	I and K	G and H	G and H	I and K	L	E	L and L'
	u.h.f.		u.h.f.		u.h.f.	v.h.f.	
channel coverage							
band I	–		–		–	F2, F4	A to C
band III	–		–		–	F5 to F12	1 to 6
band IV and V	E21 to E69		E21 to E69		E21 to E69	–	–
i.f. frequency (MHz)							
picture	39,5	38,9	38,9	39,5	32,7	32,7	32,7
sound	33,5	33,4	33,4	33,5	39,2	43,85	39,2
input impedance (Ω)	75		75		75	75	
d.c. voltage (V)							
supply	12		12		12	12	
tuning	1 to 28		1 to 28		0,3 to 28	0,4 to 28	
switching	–		–		–	–	
power gain (dB)							
band I	–		–		–	⩾ 19	
band III	–		–		–	⩾ 21	
band IV and V	⩾ 19		⩾ 20		⩾ 14	–	
typical noise figure (dB)							
band I	–		–		–	⩾ 8	
band III	–		–		–	⩾ 8	
band IV and V	6,5		6		6,5	–	
a.g.c. range (dB)							
band I	–		–		–	⩾ 40	
band III	–		–		–	⩾ 40	
band IV and V	⩾ 30		⩾ 30		⩾ 30	–	
dimensions max (mm)							
thickness	18		18		22	22	
length	83		83		83	83	
height	50		50		52	52	

* Suited for digital tuning systems.

pitch of the connecting pins
2,54 mm (0,1 inch)

tuners
tv – diode tuning

type no.	**V314/V314LO***	**V317/V317LO***	**V334/334LO***
catalogue no.	3112 218 51350/51420	3112 218 51370/51490	3122 218 51480/51540
status	D	N	N
C.C.I.R. system	B and G v.h.f.	B and G v.h.f.	B and G v.h.f.
channel coverage			
band I	N21 to R4	E2 to E5	N21 to C
band III	M4 to E12	S2 to S19	M4 to E12
band IV and V	–	–	–
i.f. frequency (MHz)			
picture	38,9	38,9	38,9
sound	33,4	33,4	33,4
input impedance (Ω)	75	75	75
d.c. voltage (V)			
supply	12	12	12
tuning	1 to 28	1 to 28	1 to 28
switching	–	–	–
power gain (dB)			
band I	⩾ 20	⩾ 20	⩾ 20
band III	⩾ 20	⩾ 20	⩾ 20
band IV and V	–	–	–
typical noise figure (dB)			
band I	6	5,5	6
band III	7,5	8	8
band IV and V	–	–	–
a.g.c. range (dB)			
band I	⩾ 40	⩾ 30	⩾ 40
band III	⩾ 40	⩾ 40	⩾ 40
band IV and V	–	–	–
dimensions max (mm)			
thickness	18	18	18
length	83	83	83
height	52	52	52

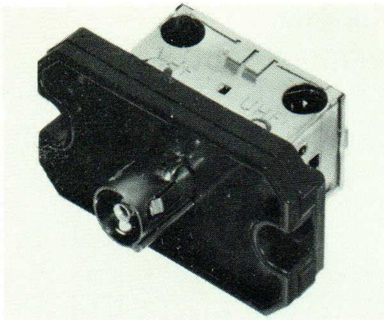
* Suited for digital tuning systems.

pitch of the connecting pins
2,54 mm (0,1 inch)

coaxial aerial input assemblies 75Ω

This range of coaxial aerial input assemblies is unique in that it is fully approved as meeting all current national European safety regulations for consumer equipment. Deposition of the relevant approval numbers is sufficient to obtain approval for apparatus in which the assemblies are fitted. Relevant approvals (numbers available on request) include:

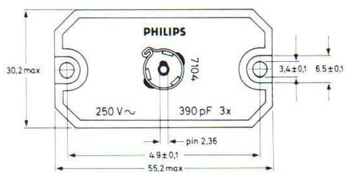
VDE	SEMKO
SEV	NEMKO
KEMA	E.I.
DEMKO	B.S.I.

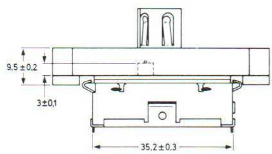


catalogue no.	attenuation max v.h.f. and u.h.f. dB	reflection max v.h.f. I %	v.h.f. III %	u.h.f. %	height max mm
3122 127 10260	1	15	15	25	22
3122 127 10450	1	25	25	30	29
3122 127 14730	1	35	15	35	29
3122 127 21300	1	15	15	25	24

type selection

catalogue no.	filter		attenuation MHz	dB
3122 127 10260	without v.h.f. and u.h.f.	IN—assembly—OUT v.h.f. and u.h.f.	–	–
3122 127 10450	with v.h.f. and u.h.f.	IN—assembly OUT v.h.f.	470 700	≥ 13 typ 23
		u.h.f.	100 230	typ 40 ≥ 15
3122 127 14730	with high-pass	as . . . 10260	1 5 10	typ 60 typ 40 ≥ 25
3122 127 21300	without	as . . . 10260	–	–





video modulators

For use in video tape recorders (VCR),
TV cameras, video games, video information
systems, closed circuit TV video systems.

type no. catalogue no. status	**REMO101** 3103 128 51160 N	**REMO201** 3103 128 51200 N	**REMO301** 3103 128 51210 N
C.C.I.R. system	G	I	L
Channels	E30 to E40	E30 to E40	E30 to E40
Supply voltage (V)	12	12	12
Video input voltage (V p-p)	1	1	1
Video input impedance (kΩ)	> 50	> 50	> 50
Modulation depth (%)	–	–	87 to 95
Intercarrier sound frequency (MHz)	5,5	6	–
Sound frequency	–	–	6,5
Sound input voltage (V r.m.s.)	1	1	1
Pre-emphasis (μs)	50	50	–
Sound input impedance (kΩ)	> 30	> 30	> 5
Output voltage (mV r.m.s.)	4,0 to 7,3	4,0 to 7,3	> 4,0
Output impedance (Ω)	75	75	75
Dimensions (mm)			
thickness	19,8	19,8	19,8
length	88	88	88
height	74,6	74,6	74,6

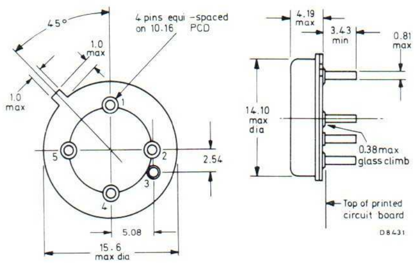
surface acoustic wave filters

For detailed information
Handbook C2

Lithium niobate surface wave devices for use as i.f. bandpass filters in colour and monochrome TV receivers.
Their use in place of conventional LC circuitry improves the amplitude and group delay characteristics as well as avoiding the need for critical adjustments in receiver production. The response characteristics are stable with life.

type status	**RW153A** N		**RW171** D		**RW173** N		**RW300** N	
C.C.I.R. system	I		B and G		B and G		L and L'	
	Freq. MHz	Amp. dB	Freq. MHz	Amp. dB	Freq. MHz	Amp. dB	Freq. MHz	Amp. dB
Vision carrier	39,5	−6	38,9	−6	38,9	−6	32,7	−6
Sound carrier	33,5	typ −19	33,4	typ −18,5	33,4	typ −18,5		
Sound trap v.h.f.							43,85	< −40
Sound trap u.h.f.							39,2	< −40
Adjacent vision trap	31,5	< −40	31,9	< −40	31,9	< −40	40,7	< −35
Adjacent sound trap	41,5	typ −46					31,2	< −40
Adjacent sound trap system B			40,4	< −46	40,4	< −46		
Adjacent sound trap system G			41,4	< −40	41,4	< −40		
Insertion loss (300 Ω source and load)	37,0	typ 16	37,0	typ 20	37,0	typ 16	36,0	typ 23
Operating temperature range	−10 to +70°C		−10 to +70°C		−10 to +70°C		−10 to +70°C	

5-lead-TO-8



Connections:
1. balanced output
2. input high
3. can (earth)
4. input (earth)
5. balanced output

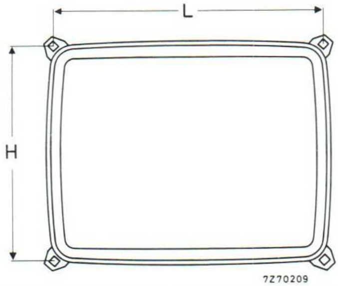
black and white tv
picture tubes

For detailed information
Handbook T8

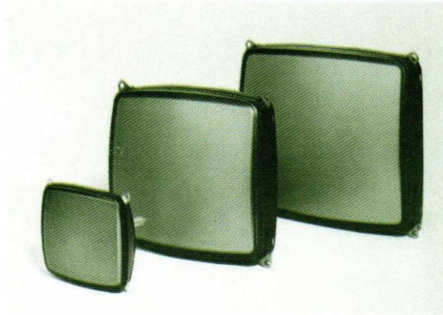
• tube with quick-heating cathode
a picture in 5 seconds

type	status	def. angle	neck dia-meter	typical operating conditions V_f/I_f	V_{g2}	V_{g4}	V_a	V_{KR}	overall length max	useful screen diag. min	lug position (see next page) Fig.	A
		deg.	mm	V/mA	V	V	kV	V	mm	mm		mm
9 INCH (9V)												
• **9V ATP**	D	90	20	11/140	130	0 to 130	10	45 to 65	227	229	1	27,5
12 INCH (12V)												
• **A31-410W**	C	110	20	11/140	250	0 to 350	12 to 15	32 to 58	233	295	1	27,6
• **A31-510W**	D	110	20	11/140	130	0 to 130	12 to 15	30 to 50	233	295	1	27,6
• **12V CUP4**	D	90	20	11/140	130	0 to 130	12 to 15	45 to 65	280	292,2	–	–
• **A31-322W**	D	90	20	11/140	130	0 to 130	12 to 15	45 to 65	280	292,2	1	28,5
14 INCH (13V)												
• **A34-510W**	D	110	20	11/140	130	0 to 130	12 to 15	30 to 50	247	322	1	32
• **A34-111W**	D	90	20	11/140	130	0 to 130	12 to 15	45 to 65	287	322	1	29
17 INCH (16V)												
A44-120W	C	110	28,6	6,3/300	400	0 to 400	20	36 to 66	291	413	3	40
• **A44-510W**	D	110	20	11/140	130	0 to 130	12 to 15	30 to 50	288	413	3	40
• **A44-520W**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	291	413	3	40
• **16VCBP4**	D	110	20	11/140	130	0 to 130	15	30 to 50	288	413	2	32
• **16VCFP4**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	291	413	2	32

Dimensions



type	L x H mm
9 inch	212 x 160
12 inch (110°)	267,5 x 204,4
12 inch (90°)	273,3 x 190,2
14 inch	290 x 226
17 inch	363,5 x 288,5
20 inch	414 x 331
24 inch	496 x 392



type	status	def. angle (deg.)	neck diameter (mm)	typical operating conditions V_f/I_f (V/mA)	V_{g2} (V)	V_{g4} (V)	V_a (kV)	V_{KR} (V)	overall length max (mm)	useful screen diag. min (mm)	lug position (see below) Fig.	A (mm)
20 INCH (19V)												
A50-120W	C	110	28,6	6,3/300	400	0 to 400	20	36 to 66	319	473	3	45
• **A50-520W**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	319	473	3	45
• **19VGYP4**	C	110	28,6	6,3/240	130	0 to 130	20	42 to 62	319	473	2	34
• **19VFWP4**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	319	473	2	30
24 INCH (23V)												
A61-120W	C	110	28,6	6,3/300	400	0 to 400	20	36 to 66	370	577,5	3	38,5
• **A61-520W**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	370	577,5	3	38,5
• **A61-522W**	D	110	28,6	6,3/240	130	0 to 130	20	42 to 62	370	577,5	2	38,5

Lug position

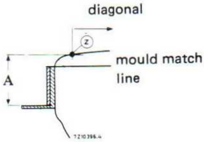


Fig. 1

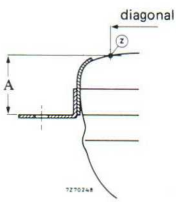


Fig. 2

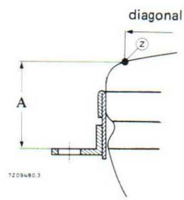


Fig. 3

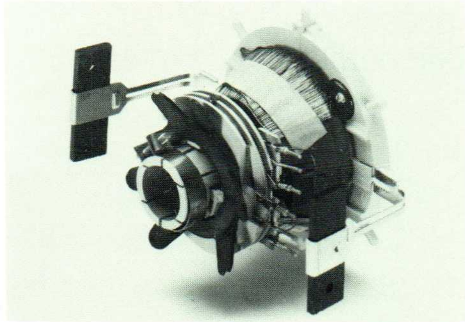
black and white tv
recommended combinations

Picture	A31-410W A31-510W	A44-120W A44-520W	A50-120W A50-520W	A61-120W A61-520W
deflection angle (deg.)	110	110	110	110
neck diameter (mm)	20	28	28	28
screen diagonal (cm)	31	44	50	61
screen diagonal (inch)	12	17	20	24

Deflection unit	**AT1074/01**	**AT1040/15**
Line output transformer	**AT2140**	**AT2048/12**
Line output transistor (see semiconductors)	**BU407**	**BU205**
Line driver transformer	**AT4043/64**	**AT4043/87**
Linearity control unit		**AT4042/14**

deflection units

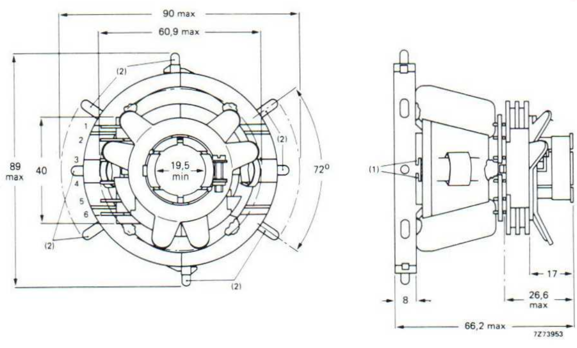
For detailed information
Handbook T8



AT1074/01

type	AT1038/40	AT1040/15	AT1071/03	AT1076/01*	AT1074/01	
catalogue no.	3122 137 17530	3122 137 12160	3122 137 17070	3106 108 55560	3122 137 17910	
status	D	D	D	D	D	
Deflection angle	110	110	90	90	110/90	deg.
Inductance						
line coils	0,69	3,32	0,093	0,47	0,255	mH
field coils	14,1	17	14	72	28,9	mH
Resistance						
line coils	1,1	6,1	0,15	0,95	0,56	Ω
field coils parallel	7,6	7,5	6,75	–	10,8	Ω
series	30,4	–	27	40,0	–	Ω
Sensitivity						
deflection current edge to edge						
at an e.h.t. of	17	18	16	10	11	kV
in line direction	4,4	2,3	9,3	2,7	5,27/4,25	A(p-p)
in field direction	1,08	1,1	0,9	0,24	0,58/0,48	A(p-p)
Dimensions						
length	83,5	75,4	90	66	66,2	mm
flared end o.d.	123	108,5	128	64	90	mm
clamping ring i.d.	29,7	29,68	29,7	20,9	19,5	mm

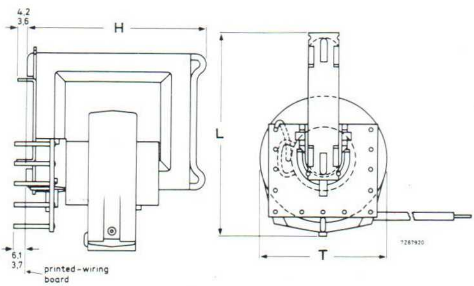
* type AT1076/01 is for 31 cm tubes. Data given are also valid for type AT1076/02 which is for 24 cm tubes.



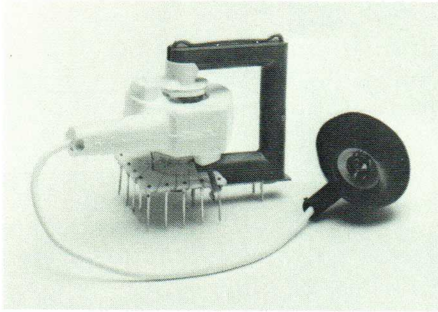
AT1074/01

black and white tv
line output transformers

type	AT2048/12	AT2102/02	AT2102/04	
catalogue no.	3122 138 31650	3122 138 35610	3122 138 35740	
status	D	D	D	
Supply				
voltage	188	12	24	V
current	212	1700	820	mA
Output				
e.h.t. current min	35	30	30	μA
e.h.t. voltage max	17,7	14,7	17	kV
e.h.t. internal resistance	4	11	6,5	mΩ
Auxiliary voltages	−300 (peak)	6,3 (r.m.s.)	6,3 (r.m.s.)	V
	+60 (peak)	11 (r.m.s.)	25 (d.c.)	V
	−60 (peak)	66 (d.c.)	70 (d.c.)	V
	7,7 (r.m.s.)	790 (d.c.)	800 (d.c.)	V
Line deflection				
current	2,2	5,0	4,6	A(p-p)
Line output transistor	**BU205**	**BU426**	**BU426**	
booster diode		**BYX71**	**BYX71-600**	
e.h.t. rectifier	stack	incorporated	incorporated	
Dimensions				
T	47,5	50	78	mm
L	78,6	77	70	mm
H	67	56,5	70	mm

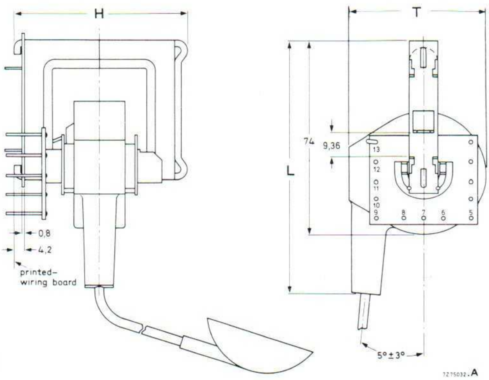


AT2048/12



AT2140

type	AT2102/06	AT2140	AT2140/10	AT2140/16	
catalogue no.	3122 138 35952	3119 108 31000	3111 108 32260	3111 108 32260	
status	D	D	M	D	
Supply					
voltage	24	10,4	8,8	12	V
current	955	860	920	620	mA
Output					
e.h.t. current min	30	25	25	25	μA
e.h.t. voltage max	17	10,2	11	12,5	kV
e.h.t. internal resistance	8	<5,5	8	8	MΩ
Auxiliary voltages	6,4 (r.m.s.)	11,2 (r.m.s.)	15 (d.c.)	11 (r.m.s.)	V
	87,6 (d.c.)	+ 350 (d.c.)	75 (d.c.)	60 (d.c.)	V
	905 (d.c.)	+ 100 (d.c.)	200 (d.c.)		V
	– 144 (d.c.)	+ 13 (d.c.)			V
		+ 25 (d.c.)			
Line deflection					
current	4,4	4,9	4,2	3	A(p-p)
Line output transistor	**BU426A**	**BU407**	**BU406**	**BU406**	
booster diode	**BY229-800**		**BYX71**	**–**	
e.h.t. rectifier	incorporated	incorporated	incorporated	incorporated	
Dimensions					
T	61	52	49	43,5	mm
L	78	96	78	45	mm
H	70	66	66	44	mm



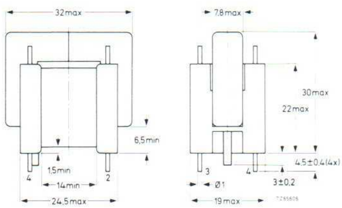
AT2140

black and white tv

line driver transformer
dynamic focusing transformer
linearity control units

Line driver transformers

type	AT4043/56 (12 V)	AT4043/59 (24 V)	AT4043/64 (12 V)	AT 4043/87	
catalogue no.	3111 108 32290	3111 138 93520	8222 279 52121	3122 138 26060	
status	M	D	D	D	
inductance	5,8	6,1	1,2	76 ± 12%	mH
transformation ratio	4:1	4,18:1	2:1	29:1	
max operating temperature	95	95	95	100	°C



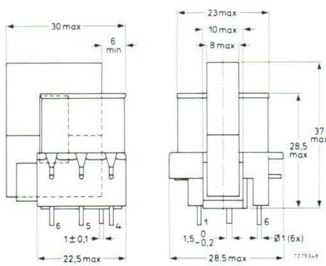
AT4043/87

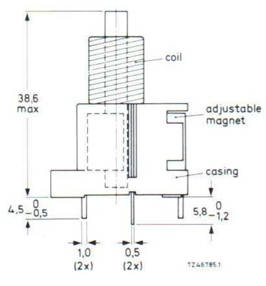
Dynamic focusing transformer

type	AT4043/67
catalogue no.	3122 138 96570
status	D
inductance	⩾ 1 H
voltage ratio (Esec/Eprim)	60,75 ± 5%
max. operating temperature	95 °C

Linearity control units

type	AT4036	AT4042/14	AT4042/42	
catalogue no.	3122 108 39270	3112 208 30410	3122 138 95970	
status	D	M	D	
adjustment range	1,05 – 1,95	–	9 – 18	V
pre-adjusted	–	17	–	V(p-p)
deflection current	6	2,2	5	A(p-p)
recommended damping resistor	220	1500	820	Ω





AT4036

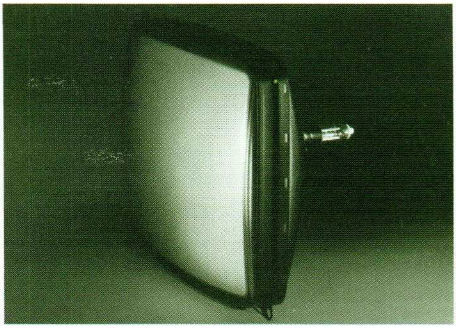
notes

notes

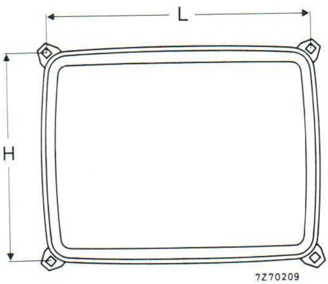
colour tv
picture tubes

For detailed information Handbook T8

- high brightness
- pigmented phosphors
- self-converging
- in-line guns
- quick-heating cathodes
- no N-S correction



type	status	def. angle	neck diameter	overall length max	useful screen diag. min	table	typical operating conditions V_f/I_f	$V_{a,g4}$	V_{g3}	V_{g2}
		deg.	mm	mm	mm		V/mA	kV	kV	V
14 INCH										
A37-570X	D	90	29,1	345,1	335,4	1	6,3/685	25	4,7-5,5	310-560
▲A37-590X*	N	90	29,1	352,9	335,4	1	6,3/685	25	6,6-7,5	390-760
13VATP22	D	90	29,1	345,1	335,4	2	6,3/685	25	4,7-5,5	310-560
▲13VBYP22*	N	90	29,1	352,9	335,4	2	6,3/685	25	6,6-7,5	390-760
16 INCH										
A42-570X	N	90	29,1	374,0	382,3	1	6,3/685	25	4,7-5,5	310-560
▲A42-580X	D	90	29,1	384,4	382,3	1	6,3/685	25	6,6-7,5	390-760
▲A42-590X*	N	90	29,1	384,4	382,3	1	6,3/685	25	6,6-7,5	390-760
▲15VATP22	D	90	29,1	384,4	382,3	2	6,3/685	25	6,6-7,5	390-760
▲15VBAP22*	N	90	29,1	384,4	382,3	2	6,3/685	25	6,6-7,5	390-760
20 INCH										
▲A51-540X	D	110	36,5	357,9	480,0	1	6,3/720	25	6,5-7,5	560-800
A51-570X	D	90	29,1	433,5	480,0	1	6,3/685	25	4,7-5,5	310-560
▲A51-580X	D	90	29,1	441,2	480,0	1	6,3/685	25	6,6-7,5	390-760
▲A51-590X*	D	90	29,1	441,2	480,0	1	6,3/685	25	6,6-7,5	390-760
▲19VKUP22	D	90	29,1	441,2	480,0	2	6,3/685	30	8-9	390-760
▲19VMRP22*	N	90	29,1	441,2	480,0	2	6,3/685	30	8-9	390-760
22 INCH										
▲A56-540X	D	110	36,5	389,8	530,6	1	6,3/720	25	6,5-7,5	560-800
26 INCH										
▲A66-540X	D	110	36,5	427,6	617,8	1	6,3/720	25	6,5-7,5	560-800



▲ Tube with hi-bi gun
* With appropriate deflection unit it forms a self converging and raster correction free assembly.

Table 1 – Push through types

type	L x H mm
14 inch	311,4 x 243,2
16 inch	355,8 x 276,7
20 inch	434,0 x 337,0
22 inch	476,5 x 370,0
26 inch	549,0 x 422,0

Table 2 – Non-push through types

type	L x H mm
14 inch	311,4 x 243,2
16 inch	351,2 x 274,2
20 inch	434,2 x 336,8

colour tv
recommended combinations

Picture tube/defl. unit	**A37-570X/AT1205** **13VATP22/AT1200**	**A37-590X/AT1206** **13VBYP22/AT1201**	**A42-570X/AT1215** **A42-580X/AT1215** **15VATP22/AT1210**
deflection angle	90°	90°	90°
screen diagonal	37 cm	37 cm	42 cm
Multipole	**AT1052**	**AT1052**	**AT1052**
Degaussing coil			
single insulation	**3122 138 96710**	**3122 138 99840**	**3122 138 94440**
double insulation			
Mains filter choke		**AT4043/55**	
Switched mode driver transformer	**AT4043/58**	**AT4043/78**	**AT4043/58**
Switched mode transformer	**AT2097/01**		**AT2097/01**
Mains transformer		**TS561/2 or TS521**	
Current sensing transformer			
Input choke		**AT4043/77**	
Power-pack system supply choke			
Sync. power-pack transformer		**AT2076/80**	
Line output transformer	**AT2076/51 or /81**		**AT2076/51 or /81**
Power-pack system line choke			
Line driver transformer			
Linearity control unit	**AT4042/42**		**AT4042/42**
East-West correction			
bridge coil			**AT4043/68**
loading coil			

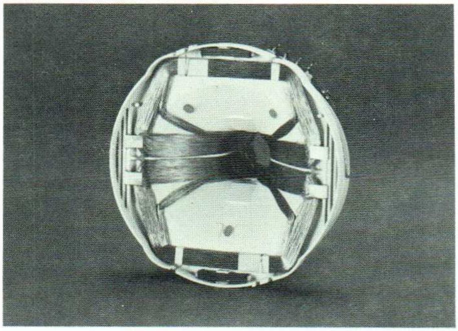
Picture tube/defl. unit	**A42-590X/AT1216** **15VBAP22/AT1211**	**A51-570X/AT1237** **A51-580X/AT1237** **19VKUP22/AT1232**	**A51-590X/AT1236/AT1480** **19VMRP22/AT1231**
deflection angle	90°	90°	90°
screen diagonal	42 cm	51 cm	51 cm
Multipole	**AT1052**	**AT1052**	**AT1052**
Degaussing coil			
single insulation	**3122 138 99850**	**3122 138 94440**	**3122 138 94440**
double insulation			
Mains filter choke	**AT4043/55**		**AT4043/55**
Switched mode driver transformer	**AT4043/78**	**AT4043/58**	**AT4043/78**
Switched mode transformer		**AT2097/01**	
Mains transformer	**TS561/2 or TS521**		**TS561/2 or TS521**
Current sensing transformer			
Input choke	**AT4043/77**		**AT4043/77**
Power-pack system supply choke			
Sync. power-pack transformer	**AT2076/80**		**AT2076/80**
Line output transformer		**AT2076/51 or /81**	
Power-pack system line choke			
Line driver transformer			
Linearity control unit		**AT4042/42**	
East-West correction			
bridge coil		**AT4043/68**	
loading coil			

colour tv
recommended combinations

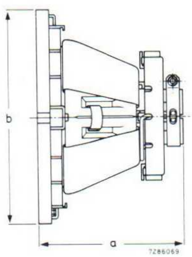
Picture tube/defl. unit	**A51-540X/AT1250**	**A56-540X/AT1260 /AT1261**	**A66-540X/AT1270 /AT1271**
deflection angle screen diagonal	110° 51 cm	110° 56 cm	110° 66 cm
Multipole			
Degaussing coil single insulation double insulation	 **3122 138 75940 or** **3122 138 94380**	 **3122 138 75940 or** **3122 138 94380**	 **3122 138 75580 or** **3122 138 94350**
Mains filter choke	**AT4043/55**	**AT4043/55**	**AT4043/55**
Switched mode driver transformer	**AT4043/45**	**AT4043/45**	**AT4043/45**
Switched mode transformer			
Mains transformer	**TS561/2**	**TS561/2**	**TS561/2**
Current sensing transformer	**AT4043/46**	**AT4043/46**	**AT4043/46**
Input choke			
Power-pack system supply choke	**AT4043/52**	**AT4043/52**	**AT4043/52**
Sync. power-pack transformer	**AT2076/70**	**AT2076/70**	**AT2076/70**
Line output transformer			
Power-pack system line choke	**AT4043/53**	**AT4043/53**	**AT4043/53**
Line driver transformer			
Linearity control unit	**AT4042/42 or /30**	**AT4042/42 or /30**	**AT4042/42 or /30**
East-West correction bridge coil loading coil			

deflection units

For detailed information
Handbook T8



type		AT1200			AT1201	AT1205/00	AT1206/20	
		type 1	type 4	type 5	type 1			
status		D	D	D	D	D	D	
Deflection angle		90	90	90	90	90	90	deg.
Inductance								
line coils		1,88	2,1	2,3	1,95	2,3	1,95	mH
field coils		112	106	23	34,4	23	34,4	mH
Resistance								
line coils		2,0	2,1	2,25	1,75	2,25	1,75	Ω
field coils		51,3	42,5	12,2	13,6	12,2	13,6	Ω
Sensitivity								
deflection current								
edge to edge								
at an E.H.T. of		25	25	25	25	25	25	kV
in line direction		3,0	2,8	2,75	3,0	2,75	3,0	A(p-p)
in field direction		0,42	0,43	0,87	0,87	0,87	0,87	A(p-p)
Dimensions								
length	a	85,5	85,5	85,5	102,5	85,5	102,5	mm
flared end o.d.	b	122	122	122	142,1	122	142,1	mm



colour tv
deflection units

type		AT1210	AT1211	AT1215/00	AT1216/20	AT1231	AT1232	
		type F	type 1			type I	type II	
status		D	D	D	D	D	D	
Deflection angle		90	90	90	90	90	90	deg.
Inductance								
line coils		2,3	1,94	2,3	1,94	1,91	1,55	mH
field coils		23	32	23	32	29	109	mH
Resistance								
line coils		2,25	1,75	2,25	1,75	1,75	1,8	Ω
field coils		12,2	13,9	12,2	13,9	13,6	52	Ω
Sensitivity								
deflection current								
edge to edge								
at an E.H.T. of		25	25	25	25	25	25	kV
in line direction		2,75	3,0	2,75	3,0	3,0	3,35	A(p-p)
in field direction		0,87	0,86	0,87	0,86	0,82	0,42	A(p-p)
Dimensions								
length	a	85,5	102,5	85,5	102,5	102,5	85,5	mm
flared end o.d.	b	122	142,1	122	142,1	142,1	122	mm

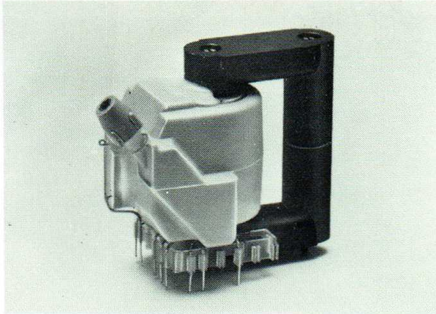
type		AT1232		AT1236/20	AT1237/00	AT1237/40	AT1480/20	
		type III	type V					
status		D	D	N	D	D	D	
Deflection angle		90	90	90	90	90	90	deg.
Inductance								
line coils		1,98	1,76	1,91	2,3	1,66	1,9	mH
field coils		115	109	29	23	28,5	29	mH
Resistance								
line coils		2,1	1,9	1,75	2,25	1,9	2,2	Ω
field coils		61	52	13,6	12,4	15	13,6	Ω
Sensitivity								
deflection current								
edge to edge								
at an E.H.T. of		25	25	25	25	25	25	kV
in line direction		2,98	3,15	3,0	2,75	3,25	3,08	A(p-p)
in field direction		0,41	0,42	0,82	0,86	0,80	0,86	A(p-p)
Dimensions								
length	a	85,5	85,5	102,5	85,5	85,5	102	mm
flared end o.d.	b	122	122	142,1	122	122	130	mm

colour tv
deflection units

type		AT1250	AT1260	AT1261*	AT1270/00	AT1271*	
status		D	D	N	D	N	
Deflection angle		110	110	110	110	110	deg.
Inductance							
line coils		1,53	1,50	1,50	1,50	1,50	mH
field coils		9,7	10,0	10,0	9,7	9,7	mH
s.v.m. coils				4,2		3,5	μH
Resistance							
line coils		1,4	1,3	1,3	1,3	1,3	Ω
field coils		6,2	5,9	5,9	5,85	5,85	Ω
s.v.m. coils				5,6		2,5	Ω
Sensitivity							
deflection current edge to edge							
at an E.H.T. of		25	25	25	25	25	kV
in line direction		4,8	5,0	5,0	5,1	5,1	A(p-p)
in field direction		2,0	1,95	1,95	2,0	2,0	A(p-p)
Dimensions							
length	a	131	131	131	131	131	mm
flared end o.d.	b	210	210	210	210	210	mm

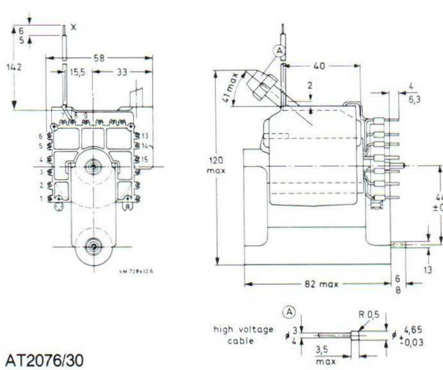
* With scan velocity modulation (s.v.m.) for improved picture sharpness.

transformers

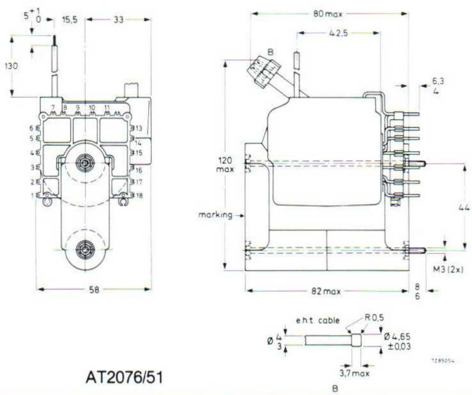


Diode split line output transformers

type	**AT2076/30**	**AT2076/51**		**AT2076/81**	
catalogue no.	3122 138 35120	3122 138 35990		3122 138 36241	
status	M	D		D	
Supply		deflection angle			
		90°	110°	90° and 110°	
voltage	148	151,5	151	150	V
current	660	291	477	620	mA
Output					
e.h.t. current	1,5	1	1,5	1,5	mA
e.h.t. voltage	25	25	25	25	kV
e.h.t. internal resistance	2	2,45	1,86	2	MΩ
Taps in primary	+520 (peak)	+112 (peak)	+114 (peak)	+114 (peak)	V
	+335 (peak)	+515 (peak)	+520 (peak)	+520	V
	+105 (peak)	+1050 (peak)	+1060 (peak)	+980	V
		+1080 (peak)	+1090 (peak)	+1070	V
Auxiliary voltages	+160 (peak)	−275 (peak)	−280 (peak)	+32 (d.c.)	V
	−160 (peak)	−146 (peak)	−149 (peak)	25 (d.c.)	V
	+335 (peak)	+62 (peak)	+64 (peak)	16,5 (d.c.)	V
	−335 (peak)	+223 (peak)	+227 (peak)	225 (d.c.)	V
	+322 (peak)	+322 (peak)	+326 (peak)	8,1 (r.m.s.)	V
Line deflection current	6,5	2,85	5,3		A(p-p)
Load inductance	1,12				mH
Fly-back time	11,3	11,45	11,4	11,4	μs



AT2076/30



AT2076/51

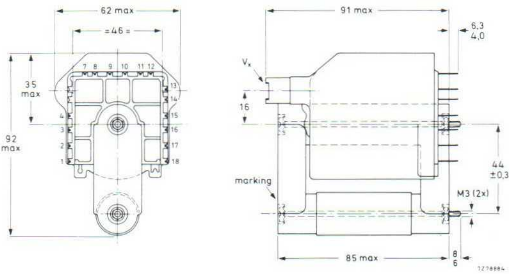
colour tv
transformers

Simplified synchronous power pack (S^2p^2) transformer

type	**AT2076/80**				
catalogue no.	3122 138 36201				
status	D				
Supply voltage	292	V			
Output					
e.h.t. current	0,7	mA			
e.h.t. voltage	23	kV			
e.h.t. int. res. R_i	1,8	MΩ			
Auxiliary voltages	7,8 (r.m.s.)	V	+ 26 (d.c.) V	+ 15 (d.c.) V	+ 180 (d.c.) V
V_{Focus}	7	kV			

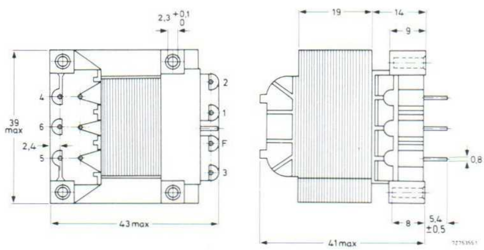
Synchronous power pack transformer

type	**AT2076/73**				
catalogue no.					
status	D				
Supply voltage	292	V			
Supply current	345	mA			
Output					
e.h.t. current	1,6	mA			
e.h.t. voltage	25	kV			
e.h.t. int. res. R_i	1	MΩ			
Auxiliary voltages	3,8 (r.m.s.)	V	8 (d.c.) V	24 (d.c.) V	147 (d.c.) V
	7,7 (r.m.s.)	V	18 (d.c.) V	33 (d.c.) V	225 (d.c.) V



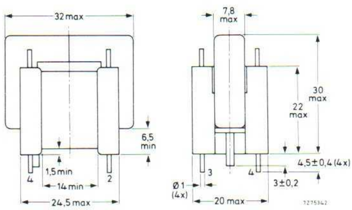
Mains transformer

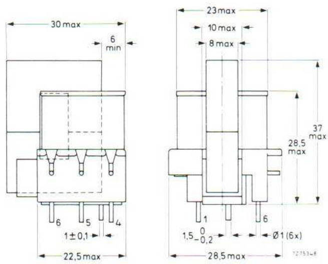
type	**TS561/2**	
catalogue no.	3122 138 36191	
status	D	
primary voltage	(2-F)	110 V
	(3-F)	220 V
secondary voltage	(4-6 = 6-5)	17,4 V



Driver transformers

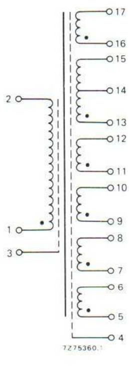
type	**AT4043/03**	**AT4043/45**	**AT4043/58**	**AT4043/78**	
catalogue no.	3122 138 25881	3122 138 90290	3122 138 91400	–	
status	N	D	D	D	
inductance (primary)	⩾350	⩾16	⩾220	⩾6,80	mH
leakage inductance (secondary)	⩽6	⩽6	⩽5	⩽6	μH
transformation ratio	22:1	5:1	10:1	3,2:1	
max operating temperature	115	115	115	115	°C

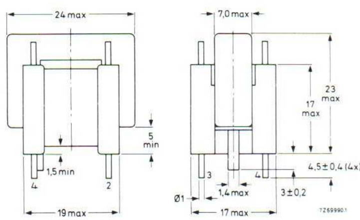




Switched-mode transformer

type	**AT2097/01**
catalogue no.	3122 138 91930
status	D
inductance, primary (8-6)	16 mH ± 10%
leakage inductance (7-5)	⩽1,5 μH
max working temperature	115 °C
transformation ratio	
8-6/7-5	36,5
8-6/4-3	6,5



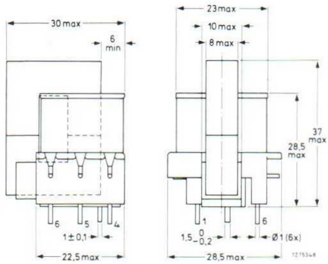


Line driver transformer **AT4043/87** See page C156

colour tv
transformers

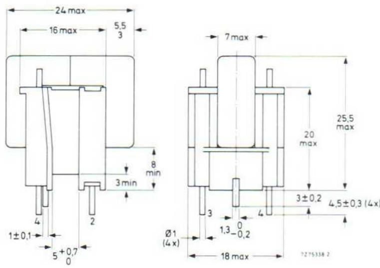
Thyristor trigger and transistor driver transformers

type	**AT4043/48**	**AT4043/63**	
catalogue no.	3122 138 90580	3122 138 93410	
status	N	N	
inductance (primary)	⩾6	⩾1,9	mH
inductance (secondary)	0,66	0,22	mH
transformation ratio	3:1	3:1	
max operating temperature	80	80	°C



Current sensing tranformers

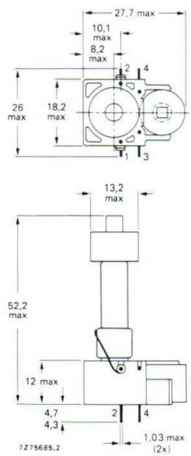
type	**AT4043/46**	**AT4043/47**	
catalogue no.	3122 138 90300	3122 138 93390	
status	D	N	
inductance (secondary)	⩾700	⩾125	mH
turns ratio	1:800	1:100	
max operating temperature	115	115	°C



adjustment and correction

Multipole unit

type	**AT1052**
catalogue no.	
status	D
horizontal/vertical colour purity adjustment (2-pole)	>13 mm
static convergence	
red opposite to blue in any direction (4-pole)	>5 mm
red-blue with respect to green in any direction (6-pole)	>2,5 mm
outer diameter	73 mm
thickness	32 mm



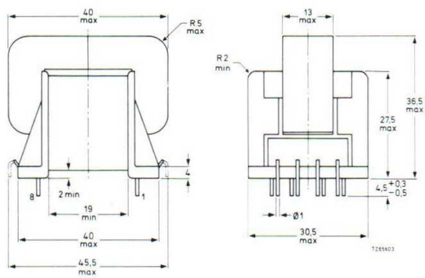
AT4042/42

Linearity control units

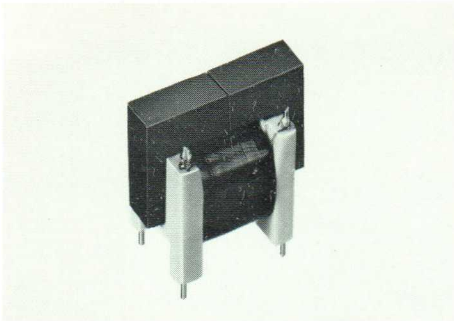
type	**AT4042/30**	**AT4042/42**	
catalogue no.		3122 138 95970	
status	D	D	
adjustment range		9-18	V
pre-adjusted	17,5		V
deflection current	5,1A	5	A(p-p)
recommended damping resistor	820	820	Ω

Power pack system supply choke

type	**AT4043/52**
catalogue no.	3122 138 93410
status	D
inductance	9 mH
resistance	2,2 Ω
max current	1,4 A (peak)
max operating temperature	115 °C



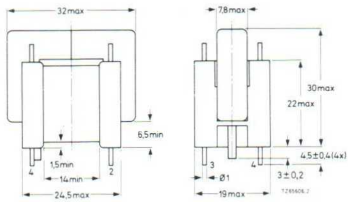
colour tv
adjustment and correction



Bridge coil AT4043/38

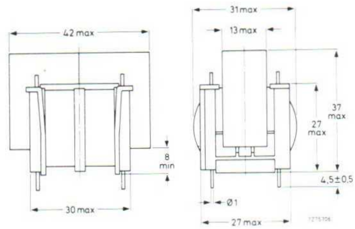
Power pack system line choke

type	**AT4043/53**
catalogue no.	3122 138 93420
status	D
inductance	12 mH
resistance	9,2 Ω
max current	525 mA (peak)
max operating temperature	115 °C



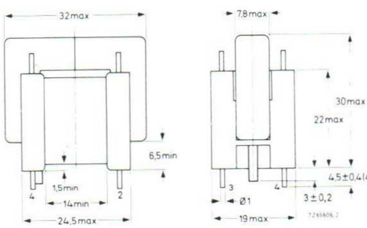
Mains filter choke

type	**AT4043/55**
catalogue no.	3122 138 93240
status	D
inductance	⩾25 mH
resistance	0,5 Ω
capacitance	37 pF
max current	2 A
max operating temperature	115 °C

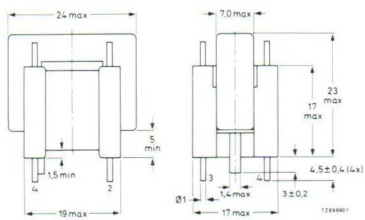


Bridge coil

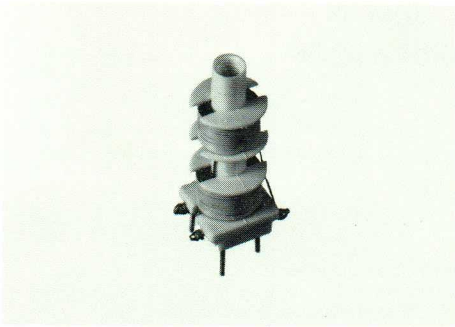
type	**AT4043/38**	**AT4043/68**	
catalogue no.	3122 138 73330	3122 138 96550	
status	D	D	
inductance (primary)	425	520	μH
resistance (primary)	0,24	0,6	Ω
max voltage	400	800	V(p-p)
max current	6,7	2,9	A(p-p)
max operating temperature	100	100	°C



AT4043/38

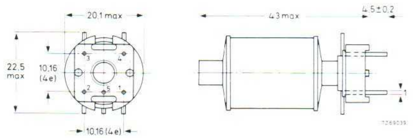


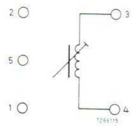
AT4043/68



East-West correction loading coil

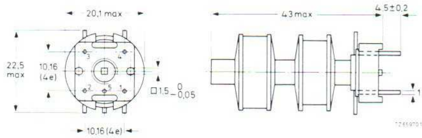
type	**AT4044/20**	
catalogue no.	3122 138 71890	
status	D	
inductance between pins 3 and 4	1 – 5,3	mH
resistance between pins 3 and 4	2	Ω
max operating temperature	95	°C

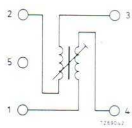




Balancing coil

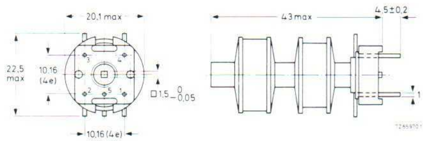
type	**AT4044/26**	
catalogue no.	3122 138 71910	
status	D	
inductance between pins 1 and 4	13 – 63	μH
pins 2 and 3	63 – 13	μH
d.c. resistance between pins 1 and 4	0,15	Ω
pins 2 and 3	0,15	Ω
max operating temperature	95	°C

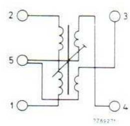




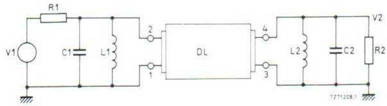
4-pole adjusting coil

type	**AT4044/27**	
catalogue no.	3122 138 72390	
status	D	
inductance between pins 3 and 5	33 – 150	μH
pins 4 and 5	150 – 33	μH
d.c. resistance between pins 1 and 2	0,23	Ω
pins 3 and 4	0,18	Ω
max operating temperature	95	°C





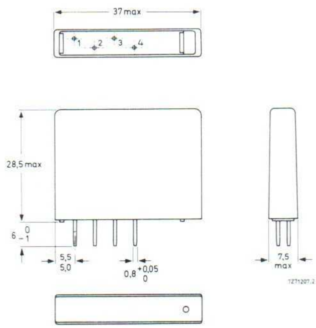
colour tv
delay lines



Maintain accurate phase relationship between input and output for the whole life of the receiver. Our delay lines fit nicely between our chrominance ICs.

type	DL600	DL610	DL700▲	DL710▲▲	
catalogue no. 4322	027 84620	027 84640	027 84700	027 84710	
status	C	C	C	C	
Application	European PAL	European PAL/SECAM	European PAL	European PAL/SECAM	
Nominal frequency	4,433619	4,433619	4,433619	4,433619	MHz
Bandwidth at −3 dB	3,43 to 5,23	3,43 to 5,23	3,43 to 5,23	3,43 to 5,23	MHz
Phase delay time τ	63,943 ±0,005	63,943 ±0,005	63,943 ±0,005	63,943 ±0,005	μs μs
Max drift of τ from 10 to 60 °C, relative to 25 °C	5	5	5	5	ns
Spurious signals with respect to 1 τ-signal					
3 τ-signals	⩽ −30	−30*	−30	−30*	dB
other reflections	⩽ −30	−30*	−30	−30*	dB
Insertion loss ±3 dB	9	9	9	9	dB
Max input voltage	10	10	10	10	V(p-p)
Storage temperature range	−40 to +70	−40 to +70	−40 to +70	−40 to +70	°C
Termination					
R_1, R_2	560	560	390	390	Ω
reactance X1, X2**	350	350	278	278	Ω
coil adjustment range	−19 to +36	−19 to +36	−19 to +36	−19 to +36	%

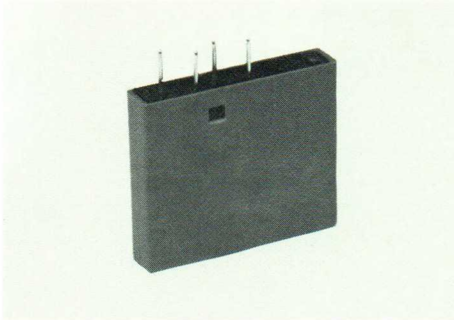
Dimensions (mm)



▲ Will be replaced by DL701 with 3 dB better spurious
▲▲ Will be replaced by DL711 signal suppression

* f = 3,9 to 4,75 MHz

** $X = \dfrac{\omega_0 L}{1 - \omega_0^2 LC}$

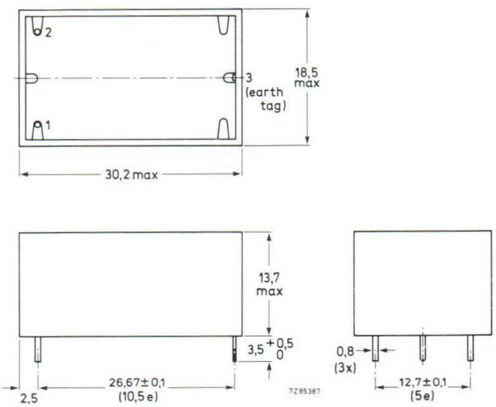


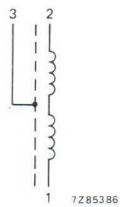
type	**DL720**	**DL750**	
catalogue no. 4322	027 84720	027 84750	
status	C	C	
Application	Argentine PAL-N	NTSC	
Nominal frequency	3,582056	3,579545	MHz
Bandwidth at −3 dB	2,8 to 4,5	2,8 to 4,5	MHz
Phase delay time τ	63,929 $\pm$0,004	63,555 $\pm$0,004	μs μs
Max drift of τ from 10 to 60 °C, relative to 25 °C	5	5	ns
Spurious signals with respect to 1 τ-signal			
3 τ-signals	$\leqslant -22$	-30	dB
other reflections	$\leqslant -28$	-28	dB
Insertion loss $\pm$3 dB	9	9	dB
Max input voltage	10	10	V(p-p)
Storage temperature range	-40 to $+70$	-40 to $+70$	°C
Termination			
R_1, R_2	560	560	Ω
reactance X1, X2**	405	405	Ω
coil adjustment range	-19 to $+36$	-19 to $+36$	%

$$^{**}X = \frac{\omega_0 L}{1 - \omega_0^2 LC}$$

colour tv
luminance delay lines

type	DL270	DL330	DL470	
catalogue no.	3122 138 99420	3122 138 96042	3122 138 99471	
status	D	D	D	
Delay	270 ± 10%	330 ± 10%	470 ± 10%	ns
Characteristic impedance	0,9	1	1,15	kΩ
Group delay				
at 3,5 MHz	max. 30	max. 30	max. 45	ns
at 5,0 MHz	max. 60	max. 60	max. 60	ns
Bandwidth at −3 dB	5	5	5	MHz
Ripple with 2 τ-pulse on pin 2	max. 2,5	max. 2,5	max. 3	%
Breakdown voltage between pins 2 and 3	min. 50	min. 50	min. 50	V (d.c.)
Permissible temperature range	−25 to +70	−25 to +70	−25 to +70	°C



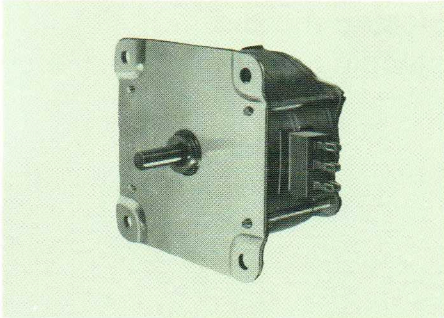


notes

notes

electric motors
synchronous motors

**For detailed information
Handbook C6**



9904 111 33. . ., 9904 111 34. . .

Uni-directional Synchronous Motors – 9904 110 series

The uni-directional motors employ the shaded pole principle to determine the direction of rotation electrically, thus making mechanical devices such as ratchets etc., redundant. Their compact size makes these motors ideal for many timing applications which include:

- Central heating timers
- Domestic appliance meters
- Prepayment meters
- Domestic and professional visual display drives.

type	voltage	speed* rev/min	torque mNm	size mm
9904 110 02 series	24 V to 220 V	250	3	ø 51 x 12
9904 110 05 series		250	0,5	ø 35 x 10
9904 110 06 series (silent type)		250	0,25	ø 35 x 10
9904 110 09 series		375	0,08	ø 20 x 10

Reversible Synchronous Motors – 9904 111 series

The reversible motors are constructed with two stator coils, the direction of rotation being determined electrically by the use of an external phasing capacitor.
This extremely efficient design approach enables the motors to be used where high torque is required as well as in applications where the reversibility of the drive is necessary. The motors are widely used in:

- Business machines
- Scientific apparatus
- Hi-fi record deck drives
- Industrial timers
- Valve actuators
- Radar aerial drives

9904 111 06 series	24 V to 220 V	250	37	ø 44 x 76
9904 111 27 series		250	70	ø 68 x 58
9904 111 28 series		250	70	ø 68 x 58
9904 111 31 series		250	20	ø 51 x 25
9904 111 32 series		250	7	ø 35 x 21
9904 111 33 series		250	70	69 x 41
9904 111 34 series		250	70	69 x 41
9904 111 35 series		250	33	ø 56 x 33,5
9904 111 36 series		250	33	ø 56 x 33,5

Several types are available with different voltage ratings and or pinion. Counter-clockwise uni-directional motors are also available.

* at 50 Hz; 60 Hz version available

Advancing technology in the electronics field has ensured that the full advantage of stepping motors can be taken, even in applications where cost is a prime consideration. Completely integrated stepping drive circuits are available, and of particular significance is the advent of the microprocessor. The mutual compatibility of digital signal processing and digital motion makes the stepping motor the ideal choice in the many application areas where microprocessors are being introduced.

The application areas for stepping motors are virtually limitless, but some of the more common uses are listed here:

- Computer peripheral equipment
- Paper tape readers
- 'Incremental' medical pumps
- X - Y position tables
- Slave clock drives
- Variable speed drives in explosive environments
- Paper drives in line-printers

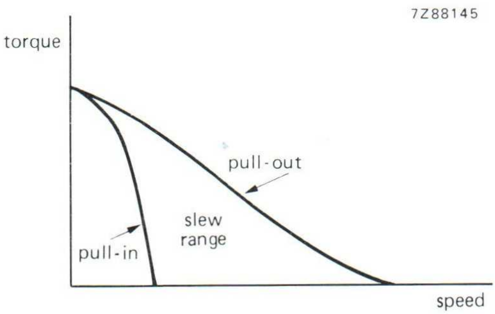
Operating Principles

The Philips range of permanent magnet stepping motors employs multiple-pole rotors and stators to achieve small step angles. The magnetic field produced by the energized stator coils can be held stationary or rotated about the axis of the motors by sequential switching of the coil currents, which results in identical behaviour of the rotor.

All stepping motor systems encompass three interrelated system functions. These are:

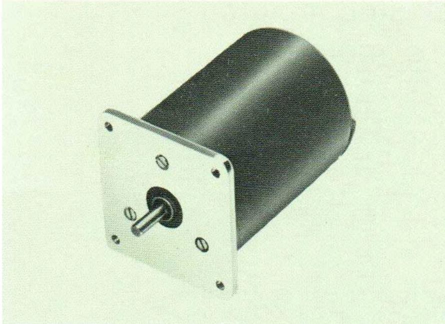
1. a source of control information, usually in the form of step command pulses and a direction command signal.
2. a motor drive circuit to convert the control information into stator coil currents which will in turn bring about the desired motion of the rotor. This can be incorporated into the user's design or purchased as a module.
3. the motor itself and its load.

The important characteristic curve of the stepping motor is the torque versus speed graph, shown below in its general form. A specific curve can only apply to a motor in combination with a particular electronic drive system.



The pull-in curve defines the limiting-conditions under which a motor with frictional load only can start or stop without losing steps. Higher speeds are possible within the slew range but the motor must be accelerated gradually to points within this area.

As with synchronous motors, the inertial load to be driven is an important consideration for the stepping system designer. Ample torque must be reserved for accelerating the moving parts of the system.



Permanent magnet stepping motors

4-phase unipolar motors

type	step-angle	nom. voltage	max. pull-in steps/s	max torque mNm	size mm
9904 112 06 series	7,5°		200	50	ø 44 x 76
9904 112 27 series	7,5°		275	110	ø 68 x 58
9904 112 28 series	15°	5 V	200	65	ø 68 x 58
9904 112 31 series	7,5°	and	400	24	ø 51 x 25
9904 112 32 series	7,5°	12 V	600	7	ø 35 x 21
9904 112 33 series	7,5°		275	110	□ 69 x 41
9904 112 34 series	15°		200	65	□ 69 x 41
9904 112 35 series	7,5°		300	65	ø 56 x 33
9904 112 36 series	15°		200	60	ø 56 x 33

8-phase unipolar motors

9904 112 29 series	3,45°	5 V	700	250	ø 69 x 100
9904 112 30 series	7,5°	and 12 V	500	165	ø 69 x 100

Hybrid stepping motors

4-phase

9904 115 23101	1,8°	40 V	300	380	57 x 52

Stepping Motor Electronics

for 4 phase unipolar stepping motors

Integrated Drive Circuit SAA 1027

The cost and complexity of stepping motor systems has been drastically reduced by the introduction of the SAA 1027, an extremely reliable integrated drive circuit housed in a 16 – pin DIL plastic capsule.

4 – phase Drive Unit 131 03003

Constructed as a plug-in PCB module, the 131 03003 provides the same function as the SAA 1027. It operates from a 5 V d.c. supply and allows higher torque at high speeds than the integrated circuit used alone.

8 phase Drive Unit 131 03004

for 8 phase unipolar stepping motors

This unit includes all the design features of its 4 – phase equivalent.

electric motors
d.c. motors

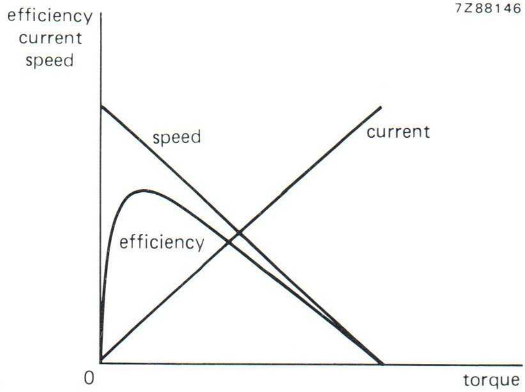
A versatile range of highly reliable motors
covering a wide range of applications

Operating Principles

Permanent magnet DC motors have several inherent features of performance which make them uniquely suitable as prime movers in certain applications. These features include:

- High power output within a given frame size
- Ability to operate over a wide range of shaft speeds
- Very high output torque stationary and at low speeds
- Automatic increase of output torque when load torque is increased.

The three important characteristic curves of a typical DC motor are shown. All permanent magnet DC motors have performance curves of this form.



Iron rotor types with carbon brush commutation

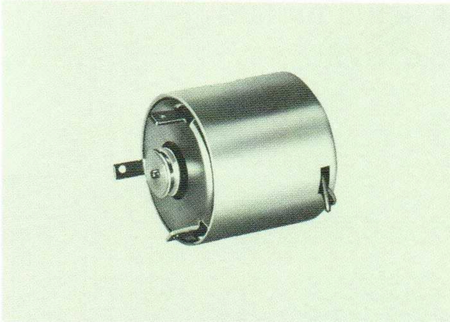
Housed in a sturdy polyacetal resin case which gives excellent resistance to corrosive substances, these units are ideal as efficient drives in applications where a high degree of speed stability is not required. The commutator and brush construction has been designed for long life and a built-in voltage dependent resistor reduces radio interference.

Applications include:

- Process control equipment
- Special automotive devices
- Paper transport mechanisms
- Ribbon drives in line-printers

nominal voltage V	speed at nominal torque rev/min	nominal torque mNm	direction of rotation	remarks	dia. mm	length of housing mm	catalogue number
12	5900	5	reversible		34	40	9904 120 09601
12*	330	25	reversible	with reduction	38	64	52602
12*	60	150	reversible	with reduction	38	64	52605
12*	23	150	reversible	with reduction	38	64	52607
12*	8,2	50	reversible	with reduction	38	64	52609

* Also available in 6 V (9904 120 524. . .) and 24 V (9904 120 527. . .) versions.



Iron rotor types with precious metal commutation

These motors are frequently used with electronic speed control circuits so that the rotor speed is maintained within narrow limits under wide variations in load and temperature.

In many cases the motors are used in systems where their speed is controlled by back e.m.f. sensing. Alternatively, certain types are available with a built-in 72 pole pair tachogenerator to meet more exacting performance requirements.

All the motors in the range are of course equally suitable in applications where precise speed control is not required.

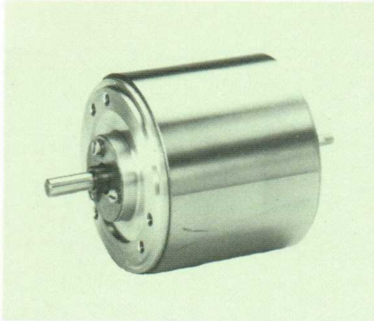
An integral peak voltage suppression system couples with the precious metal commutation to give low interference, low noise and long life.

Applications include:

- Cassette and tape recorders
- Hi-Fi record decks
- Echo sounders
- Laboratory instruments
- Portable chart drives

nominal voltage V	speed at nominal torque rev/min	nominal torque mNm	direction of rotation	remarks	dia. mm	length of housing mm	catalogue number
4,8	2000	1	c.w.	with pulley	34	27	4322 010 71020
9,4-16	2000	1	c.w.	with pulley	35	33	71220
9,4-16	2000	1	c.w.		35	33	71280
5,5	2400	1	c.c.w.		27	21	72190
5,5	2400	1	c.w.		27	21	72320
7,5	2400	1,3	c.w.		27	21	72360
7,5	2400	1,3	c.c.w.		27	21	72370
4,3	2000	1	rev.		34	23,6	04780
7	2000	1	rev.		34	23,6	59590
7	2000	1	rev.	with tachogenerator	34	32,7	59920

electric motors
d.c. motors

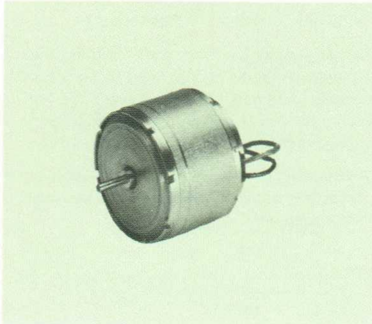


A versatile range of highly reliable motors covering a wide range of applications.

Ironless rotor types

These low Inertia types have been designed for applications where fast response to input signal variations is required. The 9-segment precious metal plated commutator construction and multi-leaf noble-metal plated brushes ensure long life and accurate control over a wide speed range. The optical commutation that is achieved makes these motors ideal for use as servomotors and tachogenerators.
Some variants in the range are available with ball races to further enhance the low noise, smooth running and long life characteristics.
The great diversity of applications for these motors includes:

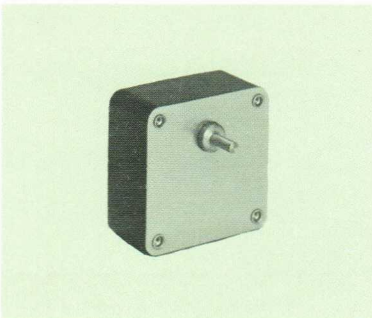
- Hi-fi tape recorders
- Chart recorder pen drives
- Print head drives
- 'Floppy disc' drives
- Cash registers
- Power-driven optical systems
- Fast-response actuators
- X - Y plotters



type	nom voltage V	nom speed rev/min	torque mNm	size mm
4322 010 75 series	12/24	2800	10	ø 40 x 40
4322 010 76 series	12/24	3100	5	ø 29 x 40
4322 010 77 series	9	5000	0,3	ø 19 x 15
4322 010 78 series	30	2150	100	ø 66 x 64

Gearboxes

The 130 01 series and 200 series gearboxes are directly available in preferred ratios; otherwise to special order.
The first is a general purpose gear unit, which has been designed for use with many of the unidirectional and reversible synchronous motors.
The second has been designed specifically for the reversible synchronous motors and is suitable for applications requiring high torque outputs.

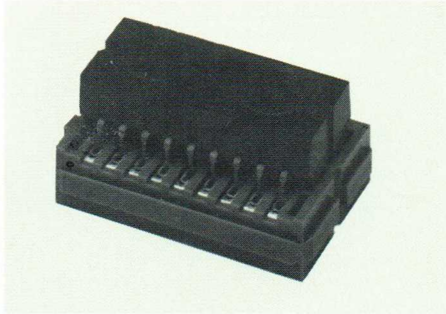


type	ratios	max permissible load (mNm)	size (mm)
9904 130 01 series	19	200	72 x 23
9912 200 00 series	20	3000	70 x 70
9912 200 01 series	20	10000	52 x 52
9912 200 02 series	20	100000	70 x 70

notes

notes

functional units



Logic
Input/output devices
Mains filters

For detailed information
Handbook CM1

High noise immunity logic
HNIL · FZ/30 series Status D
A comprehensive range of logic elements in 14-16-20 lead plastic dual in-line encapsulations specially designed for low speed digital applications in industrial control, computer periphery equipment and data processing.

- quadruple 2-input NAND gate
- dual 5-input NAND gate
- dual 5-input power NAND gate
- dual AND-AND-OR gate
- quadruple logic interface gate
- dual 4-input NAND gate
- triple 3-input NAND gate
- sextuple inverter with strobe input
- dual 4-input NAND Schmitt trigger
- quadruple 2-input AND gate
- dual NAND gate/quadruple inverter
- quadruple EXCLUSIVE-OR gate
- quadruple NOR gate
- quadruple OR gate
- single JK master-slave flip-flop
- dual JK master-slave flip-flop
- quadruple D-type latch flip-flop
- decimal counter
- 4-bit binary counter
- single synchronous 4-bit shift register
- monostable multivibrator
- single BCD-decimal decoder NIT-driver
- BCD 7-segment decoder driver
- dual lamp/relay driver
- timer unit
- short-circuit-proof power stages

NORbits 60/61/90 series Status D
These units are housed in transfer-moulded encapsulations and can be mounted on printed-circuit boards or by means of a special chassis.

60-series
Based on NOR-logic, these units have been designed for static switching devices for industrial control systems.

- dual 4-input NOR gate
- quadruple 2 x 2 + 2 x 3 input NOR gate
- dual low power amplifier
- dual inverter amplifier
- timer unit
- dual active input switch filter
- high power amplifier
- grounded load driver

61-series
The units of this series have been designed as an extension to the NORbit range in order to facilitate using NORbits in thyristorized power control circuits.

- universal power amplifier
- dual trigger transformer
- rectifier and synchronization assembly
- dual NOR gate with diode resistor networks

90-series
The trigger logic counterpart of the 60-series; they are intended for counting and shifting.

- flip-flop
- twin trigger gate
- pulse shaper

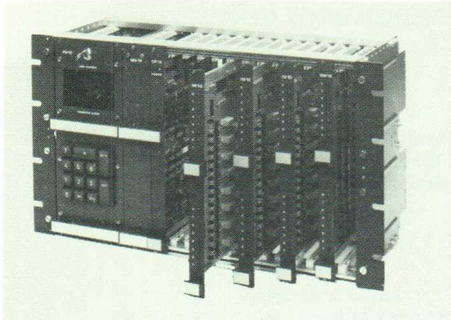
Accessories for FZ/30, and 60/61/90 series
Comprise printed-circuit boards, stickers, power supply units, empty case assemblies, mounting accessories, flexible printed wiring, breadboard blocks, logic supply units, thyristor trigger transformers, and logic simulators.

Input/output devices Status D
In this series the following units are available.

- iron vane switched reeds, IVSR
- electronic proximity detectors, EPD, PSD24

Mains filters Status D
Intended to be used between mains supply connection terminals and the mains input of control systems or between transient generating equipment and its supply. Housed in metal casings, types for 0,5 A and 2,4 A are available.

PLC modules



Programmable logic controller modules, Status D

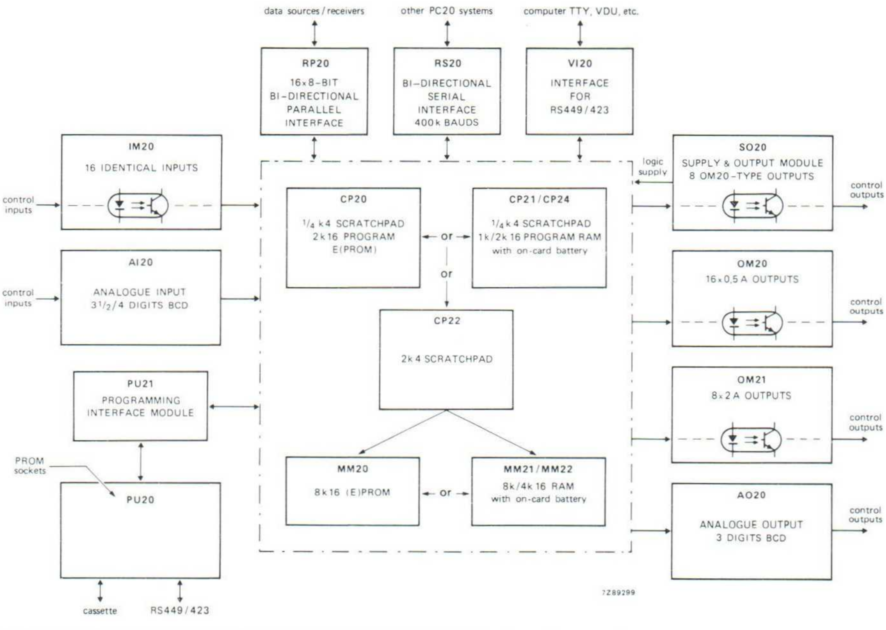
With these modules a PLC can be assembled for industrial controls where the complexity and expense of full computer control cannot be justified.

- input modules, IM10, IM11, LX10
- output modules, OM10, OM12
- memory modules, MM10, MM11, MM12
- Central processors, CP10, CP11
- programming unit, PU10
- back panels, BP11 to 16
- interface module, PI10

PC20 series – new generation of programmable controller modules

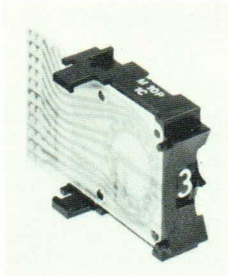
PC20 modules give more flexibility, higher speed.

- input module, IM20; status D
- output modules, OM20, status D; OM21, status N
- supply and output module, SO20; status D
- analogue input module. AI20; status N
- analogue output module, AO20; status N
- remote parallel data transfer module, RP20; status N
- remote serial data transfer module, RS20; status N
- RS449/423 interface, VI20; status N
- central processors, CP20, CP21, status D
  CP22, CP24, status N
- memory modules, MM20, MM21, MM22; status N
- programming unit, PU20; status D
- programming unit interface, PU21; status D
- back panels, BP22; status D
  BP23, BP25, BP26; status N
- small controller cabinet, SC20; status D



thumbwheel switches

All types status D



Type M

These quality-engineered switches are designed for use either as preset devices in digital systems handling numerical data, or as positioning switches.

Typical applications include computers, business machines, automatic machine tools, test equipments, process controls, telemetering and utility controls.

Choice of types

This comprehensive range is available in three basic versions:

'M' for direct thumb operation
'F' for pushbutton operation
'E' miniature size for direct mounting on printed-circuit boards

Choice of functions

Decimal switches – single or double pole
Coding switches – '1248'
Decoding switches – '1248' positive logic
Decoding switches – '1248' negative logic

Specifications

	'M' type	'F' type	'E' type
d.c. working voltage	250 V	100 V	36 V
dielectric (for 1 min.) d.c.	750 V	500 V	500 V
d.c. current switching capacity	0,5 A	0,5 A	0,15 A
max. current carrying capacity	3 A	1,5 A	1 A
contact resistance	< 100 mΩ	< 100 mΩ	< 100 mΩ
operating temperature range	−55 to +85°C	−25 to +70°C	−20 to +85°C
guaranteed life	10^6 steps	10^6 steps	25 x 10^4 steps
max. operating torque/force	35 mNm	6 N	15 mNm
weight (approx.)	10 g	6 g	2 g
max. number of positions	12	16	16

Miscellaneous

- Internally lit versions available
- Terminals for lug soldering, wire-wrapping or printed-circuit board reflow soldering available
- Rotor limit stops can be inserted
- Sealed versions available
- Special colours and engraving according to user's specification
- End-pieces and spacers available

hybrid integrated circuits

Inductive proximity detectors OM286 and OM287
Status D

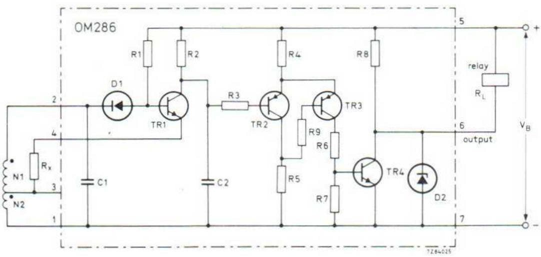
For hybrid IC wide-band amplifiers and I.F. power modules see section semiconductors.

The small OM286 and OM287 circuits fit inside an M8 CENELEC cylindrical form (A) of proximity detector and require only the addition of a coil and adjustment resistor to complete. Shown are the OM286 and completed inductive proximity detectors in plastic and metal studs.

OM286 (positive supply voltage) and OM287 (negative supply voltage) hybrid ICs are for use in small inductive proximity detectors. They have been made long and narrow (max. width 5 mm) to fit inside the smallest hollow stud, the M8 of CENELEC cylindrical form (A) proximity detector. The OM286 and OM287 succeed the slightly larger OM186 and OM187 and feature protection against reversed connection to the supply, and higher output current. The circuits are manufactured using thick-film techniques. The circuit comprises a Hartley oscillator, rectifier stage, Schmitt trigger and high current output stage suitable for driving electro mechanical relays, lamps and audible alarms directly. The oscillator coil is not incorporated in the IC.

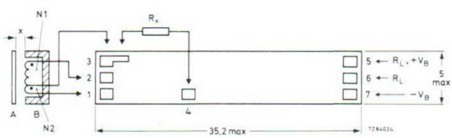
D.C. supply voltage range	V_B	4,5 to 30 V
Output current at $V_B > 24$ V	I_O	max. 250 mA
Switching distance; depends on R_x and oscillator coil	x	typ. 1 to 5 mm
Hysteresis in switching distance	Δx	3 to 10%
Switching frequency	f	< 5 kHz
Operating ambient temperature range	T_{amb}	-40 to $+85$°C

Circuit diagram of the OM286.



The circuit diagram of the OM287 is similar with all polarities (transistors, diodes and supply) reversed.

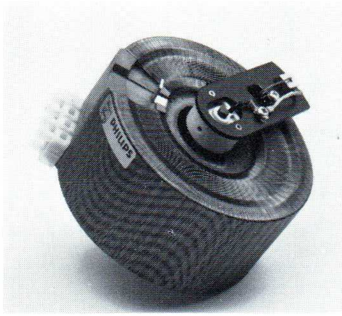
Dimensions (mm)



Note that the supply polarities to points 5 and 7 are given for the OM286; for OM287 the polarities are, point 5 $-$ V_B and point 7 $+$ V_B.

A = metal actuator
B = open potcore or potcore half with coil
x is the switching distance.
The maximum height of the circuits including the substrate thickness is 1,7 mm.

variable mains transformers



For detailed information
Handbook C8

Variable mains transformers

Applications:
- distortion-free voltage control for measuring equipment, voltage stabilizers, etc.
- power control for electric heating, heat sealing of plastics, motor speed
- current control for galvanising plants
- light control in hotels, cinemas, homes, etc.
- ventilation control in buildings, livestock houses, greenhouses, etc.

Features:
- continuous voltage control
- small dimensions and high efficiency
- very low stray losses
- corrosion resistant
- long life
- simple servicing
- ganging possibilities
- adjustable spindle length
- low coil resistance
- high overload characteristics

Our range comprises bench and panel mounting versions.
- standard types: input voltages from 42 to 276 V, frequency range 50-400 Hz; output voltages 0 to 276 V, output current 0,25 to 23 A
- transformers with separate windings: input voltage 220 V, frequency range 50-60 Hz; output voltage 0-242 V, output current 3 A

Accessories

- ganging units: 2 or 3 transformers on one shaft, connected in series, parallel, star or open delta circuit
- motor drive modules: revolution times from 6 s to 40 min, complete with gearbox, motor, phasing capacitor, switch set and ganging unit
- control knobs with dial calibration 0-100%, 0-115%, 0-260 V, 0-270 V
- chokes for parellel mounting
- A.C. stabilizer module: input voltage 220 $^{+10\%}_{-15\%}$; output voltage 5-115% of input voltage, stabilized

connectors

For detailed information
Handbook C10

Originally designed to satisfy the severest requirements of our own professional equipment, our present range covers a wide field where good, reliable connectors are a must. Contact spring design and body material choice is based on international standards, thus resulting in real professional products, meeting IEC and military standards.

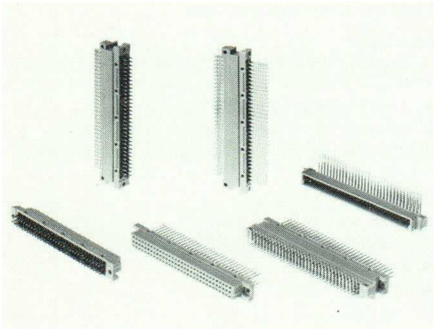
Applications
- telecommunication
- data processing
- instrumentation and control

Body materials
- phenol
- diallylphthalate
- polyester
- polycarbonate
- phenolphormaldehyde
- thermoplastic

Contact material, pins and springs
- phospor bronze or brass, gold surfaced

Contact terminations
- solder tags
- dip-solder pins, straight and 90° angled
- pins for wire-wrapping
- pins for mini wire-wrapping
- crimp
- insulation displacement

Types
- printed-wiring connectors (female) for chassis or panel mounting, fixed length or length to choice; pitches 2,54 – 3,81 – 3,96 and 5,08 mm (0,1 – 0,15 – 0,156 and 0,2 inch)
- two-part connectors, for board to panel or chassis, fixed length; pitches 2,54 – 3,81 – 5,08 mm (0,1 – 0,15 – 0,2 inch)
- interconnectors (male), for board mounting, fixed length; pitch 3,96 mm (0.156 inch)
- jumper connectors, used as jumper or permanent link between circuit parts, female with two sockets, pins loose or on strip; pitch 2,54 mm (0,1 inch)
- modular connector system, interconnecting electronic functions (modules) either vertically or in stacks, length to choice; pitch 2,54 mm (0,1 inch)
- subminiature rack and panel connectors developed to meet dimensional standards of MIL-STD-C-24308
- various mounting accessories
- crimping tools: pneumatic crimping machine, hand crimp tools
- ribbon cable connector system
- cable assemblies



Examples of F068-I connectors.

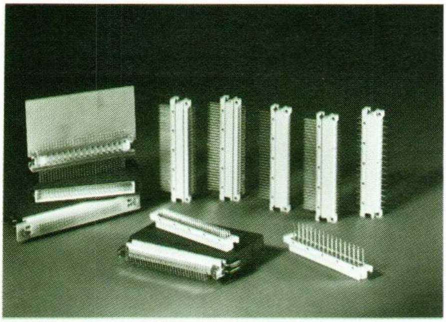
printed-wiring connectors and interconnectors

Maintenance types

	type number	pitch mm (in)	number of contacts	terminations	current at 20 °C A	mechanical endurance insertions
Printed-wiring connectors						
	**F045**	5,08 (0,2)	3 to 54 (single row) 6 to 108 (double row)	solder tags	4,5	300
	**F046**	3,81 (0,15)	6 to 45 (single row) 12 to 90 (double row)	solder tags	4,5	300
	**F047**	3,96 (0,156)	6, 10, 15, 18, 22 (single row) 12, 20, 30, 36, 44 (double row) 6, 10, 15, 18, 22 (bridged)	solder tags	5,5	250
	**F050**	3,96 (0,156)	6, 10, 15, 18, 22 (single row) 12, 20, 30, 36, 44 (double row) 6, 10, 15, 18, 22 (bridged)	solder tags	5,5	100
	**F053**	3,96 (0,156)	6, 10, 15, 18, 22, 28, 36, 43 (single row) 12, 20, 30, 36, 44, 56, 72, 86 (double row)	dip-solder pins or pins for wire-wrapping	4	250
Printed-wiring interconnectors						
	**F051**	3,96 (0,156)	6, 10, 15, 18, 22 (single row) 12, 20, 30, 36, 44 (double row) Mates with F047, F050 and F053	board edge contacts	5,5	300
Two-part printed-wiring connectors						
	F054	2,54 (0,1)	32, 48, 64 (double row)	solder tags, dip-solder pins or pins for wire-wrapping	3,5	300

connectors

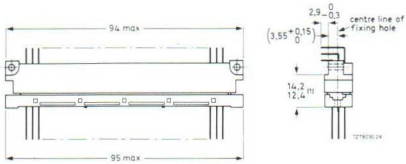
F068-I – 2,54 mm; 2 A at 20 °C



Eurocard
two-part printed wiring connectors
to IEC 603-2, DIN 41612, VG 95324
Status D

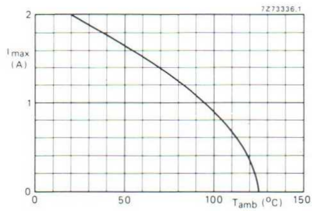
Contact pitch and number of contacts		
style B (2 rows)	2,54 mm (0,1 in)	32 or 64
style C (3 rows)	2,54 mm (0,1 in)	64 or 96
	5,08 mm (0,2 in)	32
Board thickness	1,42 to 1,78 mm	
Terminations male part	90° angled dip-solder pins*	
	straight dip-solder pins*	
	solder tags	
	90° angled pins for wire wrapping	
Terminations female part	pins for wire wrapping	
	straight dip-solder pins	
	solder tags	
	90° angled dip-solder pins	
Current at T_{amb} = 20 °C	2 A	
Mechanical endurance		
to IEC and DIN	400 insertions and 100 insertions	
to VG	500 insertions	
Climatic category		
to IEC and DIN	55/125/56	
to VG	65/125/56	
Detail specifications	IEC 603-2, DIN 41612 and VG 95324	

* Mail part dip-solder pins are also available with protruding earth contacts.



(1) reliable contact range

Combination of connector parts.



Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

These connectors are designed for use in applications where high quality and high density packaging of electronic circuits are required. They can be used on single Eurocards (100 mm x 160 mm), double Eurocards (233,3 mm x 160 mm) and 19-in racks according to DIN 41494.

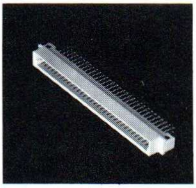
The connectors consist of a male part to be fitted to a printed-wiring board and a female part to be mounted on a chassis or a back panel. Both parts have a grey body of glass-fibre-filled thermoplastic material; the contact insert of the female part is of glass-fibre-filled diallylphthalate. The contact springs of the female part are of phosphor bronze; the contact pins of the male part are of brass; the contact surfaces are gold on nickel plating. The contact terminations of both parts are tinned or gold flashed.
The male parts with dip-solder pins can be supplied with protruding earth contacts, which are approximately 1 mm longer than the other contacts. No special provisions are required for polarization. Cable hoods, locking clips and brackets are available for various applications. An external keying system can be employed to ensure correct positioning of the board in a rack.

★ available with protruding earth contacts
▲ available to German mil spec VG 95324 with certificate

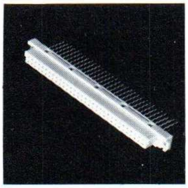
Accessories
- cable hoods and associated parts
- receptacle for attaching female connector to the pins for wire-wrapping of another female connector
- coding system
- mounting brackets for fitting female connector with 90° dip-solder pins to edge of PCB
- various locking parts

Style B (2-row body)

Male

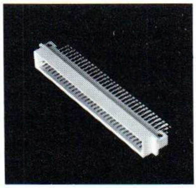


Female



Style C (3-row body)

Male



Female

	Style B Male		Style B Female		Style C Male			Style C Female		
number of contacts	1 x 32	2 x 32	1 x 32	2 x 32	2 x 16*	2 x 32	3 x 32	2 x 16*	2 x 32	3 x 32
pitch (mm)	2,54	2,54	2,54	2,54	5,08	2,54	2,54	5,08	2,54	2,54
row spacing (mm)	–	2,54	–	2,54	5,08	5,08	2,54	5,08	5,08	2,54

Style C Male: * even numbered pins only

Style C Female: * even numbered pins only

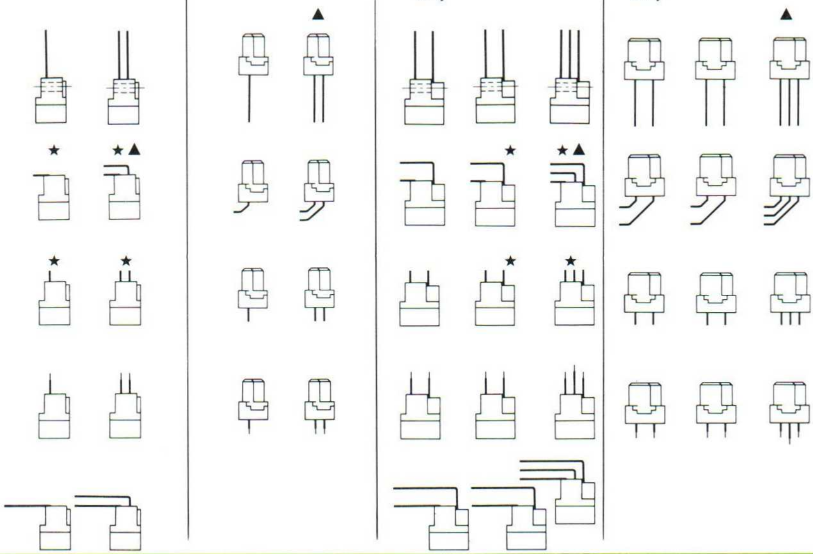
straight pins for wire-wrapping

90° dip-solder pins

straight dip-solder pins

solder tags

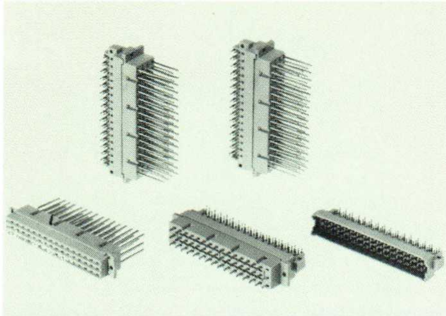
90° pins for wire-wrapping



connectors

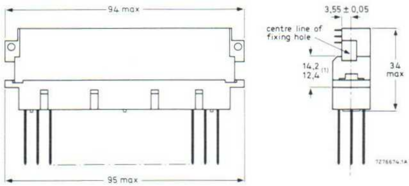
F068-II – 5,08 mm;
5,5 A at 20 °C

Eurocard
two-part printed wiring connectors
to IEC 130-17 and DIN 4612
Status D



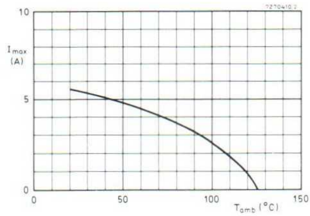
Contact pitch and number of contacts		
style F	5,08 mm (0,2 in)	32 or 48
style G	5,08 mm (0,2 in)	64
Board thickness	1,42 to 1,78 mm	
Terminations male part	90° angled dip-solder pins* straight dip-solder pins solder tags*	
Terminations female part	straight dip-solder pins pins for wire wrapping solder tags	
Current at T_{amb} = 20 °C	5,5 A	
Mechanical endurance	400 insertions	
Climatic category IEC 68	55/125/56	
Detail specifications	IEC 130-17 and DIN 41612	

* With or without protruding earth contacts.



(1) reliable contact range

Combination of connector parts.



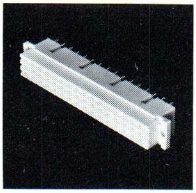
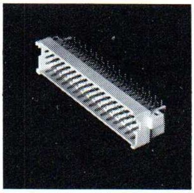
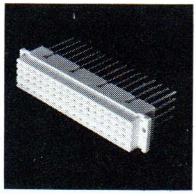
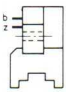
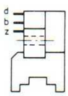
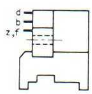
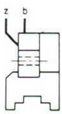
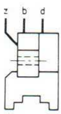
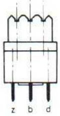
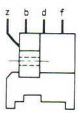
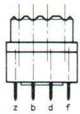
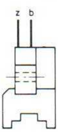
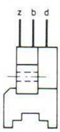
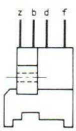
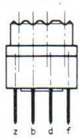
Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

For use in applications where high current and/or high voltage operation is required. For signal connections the complementary F068-I series of connectors can be employed. The combination of F068-I and F068-II connectors is ideal for a wide range of professional applications, including those having severe industrial environments.

The connectors consist of a male part to be fitted to a printed-wiring board and a female part to be mounted on a chassis or a back panel. Both parts have a grey body of glass-fibre-filled thermoplastic material.
The contact springs of the female part are of phosphor bronze, the contact pins of the male part are of brass; the contact surfaces are gold on nickel plating. The contact terminations of both parts are tinned. The contact springs of the female part are reinforced with a steel spring, which gives an extra guarantee for reliable functioning under severe conditions of continuous load, vibration, etc. Female parts with non-reinforced springs are also available. The male parts with 90° angled dip-solder pins or solder tags can be supplied with protruding earth contacts, which are approx. 1,5 mm longer than the other contacts.

No special provisions are required for polarization.

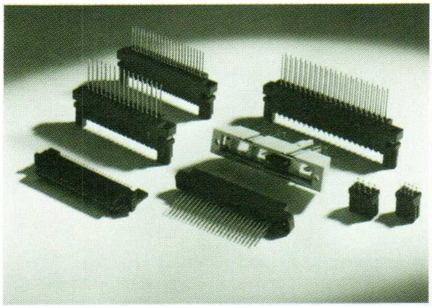
all connectors use even numbered pins only.
all male connectors available with protruding earth contacts.
all female connectors available with reinforced contacts.

	Style F (3-row body)				**Style G** (4-row body)	
	Male		Female		Male	Female
						
number of contacts	2 x 16	3 x 16	2 x 16	3 x 16	4 x 16	4 x 16
pitch (mm)	5,08	5,08	5,08	5,08	5,08	5,08
row spacing (mm)	5,08	5,08	5,08	5,08	5,08	5,08
straight pins for wire-wrapping						
90° dip-solder pins						
straight dip-solder pins						
solder tags						

connectors

F080 – 3,81 mm; 2,5 A at 20 °C
F081 – 2,54 mm; 2 A at 20 °C

two-part printed wiring connectors
long-life
Status D

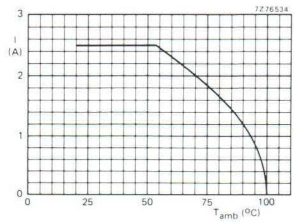


	F080	F081
Contact pitch	3,81 mm (0,15 inch)	2,54 mm (0,1 inch)
Number of contacts, double row	32, 42	48, 64
test plug, double row	8	8
Board thickness	1,42 to 1,78 mm	1,42 to 1,78 mm
Terminations male part	pins for wire-wrapping	pins for wire-wrapping
Terminations female part	solder tags	solder tags or solder tags with eyelet (only for 48 contacts)
Terminations test plug	solder tags with eyelet	solder tags with eyelet
Current at T_{amb} = 20 °C	2,5 A	2 A
Mechanical endurance	500 insertions	500 insertions
Climatic category IEC 68	10/100/21	10/100/21

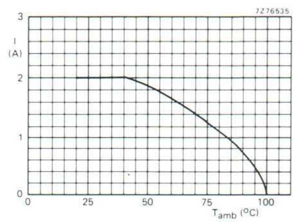
Long-life PCCs
These PC connectors were specially developed to meet the ultra-high reliability standards of telecommunications authorities, for which Philips is a major system supplier. Such standards involve a minimum of 500 insertions while retaining a gas-tight contact, which is approx. equivalent to a 25-year service life. At the same time these particular connectors, the F080/081 series, were specified with narrow tolerance dimensions in order to allow at least three PCCs to be mounted along one edge. As well as setting demanding specifications, telecommunications authorities are also big connector users. The F080/081 series are therefore proof of our ability to produce customized connectors in volume, as well as to high quality standards. For both types a test plug is available in order to monitor circuit parameters.

The connector bodies are formed from dark green glass fibre/ phenolformaldehyde. The contact springs and pins are of phosphor bronze with a 2,5 μm gold plating (min) over 1 μm (min) of nickel. Contact mating length is along 3,5 mm.

F080



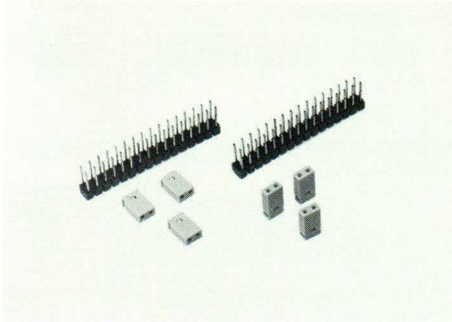
F081



Maximum current per contact, equally on all contracts as a function of ambient temperature (20% derated).

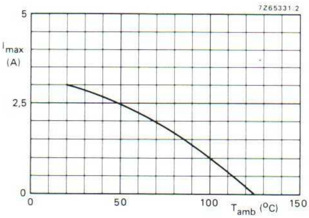
F088 – 2,54 mm; 3 A at 20 °C

two-part jumper connector
Status D



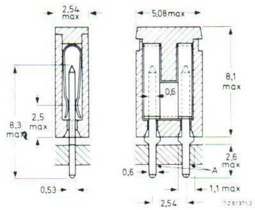
Contact pitch	2,54 mm (0,1 in)
Number of contacts	2
Board thickness	1,42 to 1,78 mm
Terminations	dip-solder pins

Current at T_{amb} = 20 °C	3 A
Mechanical endurance	150 insertions
Climatic category IEC 68	55/125/21



Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

Dimensions (mm)



The connector consists of two contact pins for dip-solder mounting and a female plug. The plug is moulded in grey glass-fibre-filled thermoplastic. The contact springs in the plug and the pins are of phosphor bronze, the springs are shaped to provide two contact surfaces.

The contact faces are hard gold plated. The pins can be supplied either loose or in a mounting strip with 2 x 16 pins which can be removed after dip soldering.

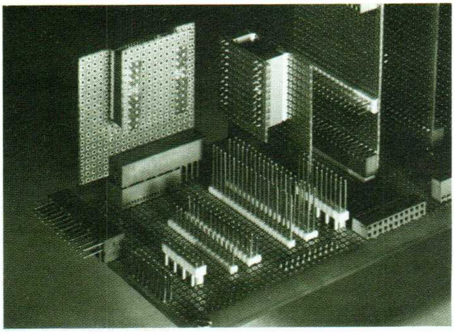
If the contact pins are to be permanently interconnected, a modified wire wrapping can be used instead of the female plug. The female plug also mates with the male headers (11 mm pin length) of the F095 modular connector system. (Meats more severe shock/vibration requirements then.)

connectors

F095 – 2,54 mm; 3 A at 20 °C

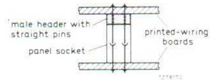
modular connector system
Status D

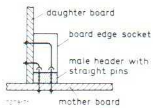
This modular connector system has been developed to provide a simple, flexible yet reliable means of interconnecting electronic circuit boards and modules in applications where maximum packing density is of major importance.

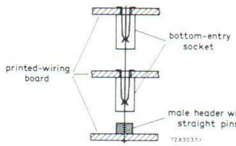


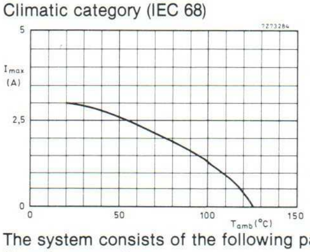
Contact pitch	2,54 mm (0,1 in)
Number of contacts	
Female connectors	
board edge socket, single row	2 to 32
board edge socket, double row	4 to 130
panel socket, single row	2 to 32
panel socket, double row	4 to 100
bottom-entry socket, single row	2 to 32
bottom-entry socket, double row	4 to 20
Male connectors	
male header, straight pins, single row	2 to 32
male header, straight pins, double row	4 to 64
male header, 90° angled pins, single row	2 to 32
male header, 90° angled pins, double row	4 to 20
male header block, 90° angled pins, double row	4 to 60
Board thickness	1,42 to 1,78 mm
Terminations	dip-solder pins pins for wire wrapping
Current at T_{amb} = 20 °C	3 A
Mechanical endurance	300 and 100 insertions (25 insertions for bottom-entry socket)
Climatic category (IEC 68)	55/125/21

Example of F095 connectors









Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

The system consists of the following parts (see examples).

Female connectors:

board edge sockets for connecting daughter boards at right angles to mother boards in vertically stacked card systems;
panel sockets for horizontally stacking printed-wiring boards;
bottom-entry sockets for horizontal or vertical interconnection of printed wiring boards.

Male connectors:

male headers with straight or 90° angled pins for accommodating mini wire wrapping joints or mating panel sockets, board edge sockets and flat cable connectors (e.g. F303).

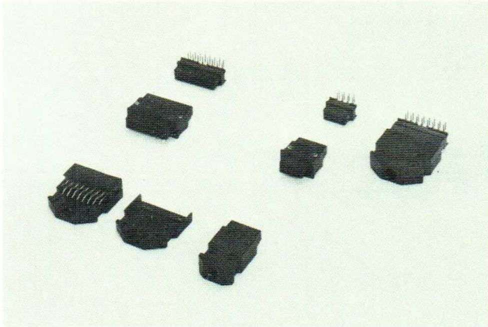
The board edge sockets, panel sockets and cable connectors have a body of flame retardent, glass-fibre-filled thermosetting material. The sockets are provided with pins for dip or wave soldering.

The male headers and the bottom-entry sockets have a body of flame retardent, glass-fibre-filled thermoplastic polyester material. They are provided with dip-solder pins or pins for wire wrapping.

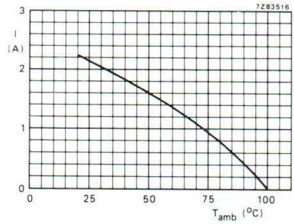
The contact springs and pins are of gold finished phosphor bronze; the electrical contact surfaces are gold on nickel plated.

F120 – 2,2 A at 20 °C

Test connector assembly
Status D



Contact pitch	3,175 mm (0,125 in)
Number of contacts	8, 16
Board thickness	1,42 to 1,78 mm
Terminations	
spring contact box	dip-solder pins
test cord plug	solder pins
Current at T_{amb} = 20 °C	2,2 A
Mechanical endurance	500 insertions
Climatic category, IEC 68	10/100/21



Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

For testing purposes in telephone and telegraph transmission equipment.

This test connector assembly consists of three parts:
- a spring contact box, to be fitted to a printed-wiring board, for use as a contact socket of test points;
- a U-link, for interconnecting each pair of opposite contact springs of the spring contact box;
- a test cord plug.

The test cord plug can be directly inserted into the spring contact box, or via the U-link for testing purposes.

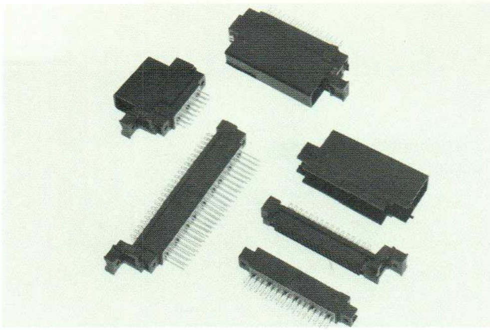
All parts have a black, flame retardent, glass-fibre-filled, polyphenylene body. They are provided with a snap-lock system, which is such that when removing the test cord plug from the U-link, the latter will remain in position in the spring contact box.

The contact springs are of phosphor bronze. The contact surfaces are on nickel plating.

No special provisions are required for polarization.

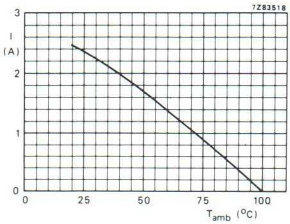
connectors

F121 – 2,5 A at 20 °C



Rack and panel connectors
Status D

Contact pitch	3 mm
Number of connections	16, 32, 48
Terminations	
male part	straight or 90° angled dip-solder pins, or pins for wire wrapping
female part	solder tags
Current at T_{amb} = 20 °C	2,5 A
Mechanical endurance	500 insertions
Climatic category (IEC 68)	10/100/21



Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).

For use in data processing, telecommunication and general industrial equipment, as a rack and panel connector.

These connectors consist of three parts:
- a male part to be fitted to a rack or a panel;
- a female part to be used as a cable part;
- a cable hood.

All parts have a black, flame retardent, glass-fibre-filled, polyphenylene body.

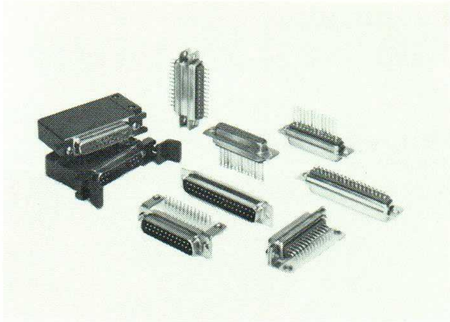
The contact springs are of phosphor bronze. The contact surfaces are fold on nickel plating.

The connectors are provided with a locking device.

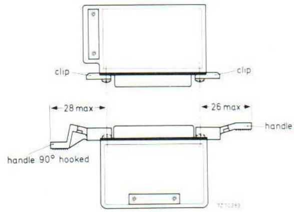
No special provisions are required for polarization.

F161 – 7,5 A at 20°C

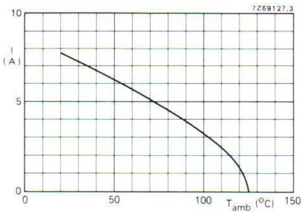
subminiature rack and panel connectors
Status D



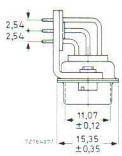
Number of contacts	9, 15, 25, 37 and 50
Terminations	solder cups dip-solder pins, straight or 90° angled pins for wire wrapping crimp-on snap-in
Current at T_{amb} = 20 °C	7,5 A
Mechanical endurance	500 insertions
Climatic category IEC 68	55/125/21
Dimensions	according to MIL-STD-C-24308



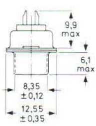
Cable hood and locking device.



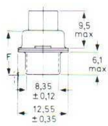
Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).



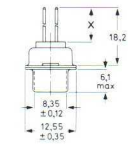
90° dip-solder



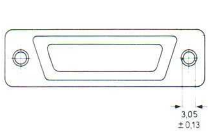
solder cup

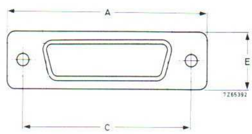


crimp



wire wrapping
dip-solder





Dimensions in mm (P = pin; S = socket)

number of connections	A ±0,35	C ±0,12	E ±0,35	F ±0,25
9(P)	30,8	25,0	12,55	10,7
9(S)	30,8	25,0	12,55	10,9
15(P)	39,15	33,3	12,55	10,7
15(S)	39,15	33,3	12,55	10,9
25(P)	53,0	47,05	12,55	10,7
25(S)	53,0	47,05	12,55	10,9
37(P)	69,3	63,5	12,55	10,7
37(S)	69,3	63,5	12,55	10,9
50(P)	66,9	61,1	15,35	10,7
50(S)	66,9	61,1	15,35	10,9

X = 6 mm for dip-soldering
X = 12,7 mm for wire wrapping

For rack and panel connection in industrial, telecommunication and data processing equipment.

The connectors consist of a red glass-fibre polycarbonate insulating block, mounted in a shell of passivated, zinc-plated steel. The insulating block contains a number of contact pins or sockets, which are made of a copper alloy and are gold plated on a nickel layer.

Different types of pin and socket terminations are available: for hand or dip-solder, wire wrapping or crimp applications. For the latter application the contact pins and sockets are supplied on reels, while the insulating block of the connector contains only a number of holes allowing the crimpable pins and sockets to be loaded into the block. The contacts can be crimped with MIL-standardized tools. Hand and pneumatic crimping tools are available.

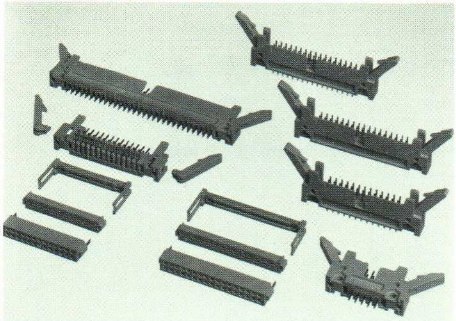
The connectors meet the dimensional requirements of MIL-STD-C-24308.

If a connector is to be used as a cable plug or socket, it can be fitted with a cable hood and locking device.

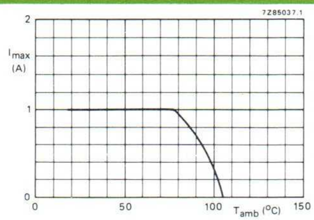
connectors

F303 – 2,54 mm; 1 A at 20 °C

ribbon cable connector system
Status D
(Extension under development)



Contact pitch	2,54 mm (0,1 in)
Number of contracts, double row	10, 14, 16, 20, 26, 34, 40, 50 and 60
Terminations	
cable connector	insulation displacement termination
male header	straight dip-solder pins
	90° angled dip-solder pins
	straight pins for wire wrapping
	90° angled pins for wire wrapping
Current at T_{amb} = 20 °C	1 A
Mechanical endurance	200 insertions
Climatic category, IEC 68	55/105/21



Maximum current per contact, equally on all contacts, as a function of ambient temperature (20% derated).
Current restriction of 1 A caused by cable specification.

This range of ribbon cable connectors and mating headers is designed to provide a simple, yet reliable means of interconnecting electronic circuits in applications where high quality and high packing density are required.

This connector range consists of a series of female cable connectors to be fitted to flat ribbon cable and a series of mating male headers. Cable connectors and male headers have a grey body of flame retardent, glass-fibre-filled thermoplastic polyester. The male headers are provided with straight or 90° angled dip-solder pins or pins for wire wrapping; the cable connectors have contact springs with terminations for insulation displacement.

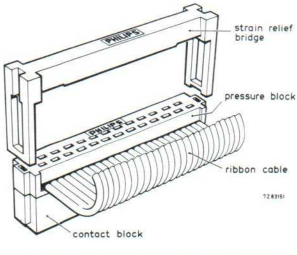
The cable connectors consist of a block containing the contact springs, and a pressure block in which the cable has to be inserted. During the insulation displacing both blocks are firmly pressed together and locked by two retaining barbs, which enter lugs at the ends of the pressure block. The contacts of the assembled cable connector can be electrically probed through holes in the upper surface of the pressure block.

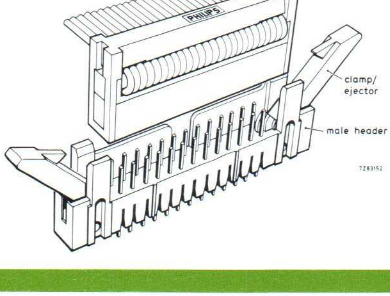
The contact springs are of beryllium copper, the contact pins are of brass; the contact surfaces are gold on nickel plating, the contact terminations are gold flashed.

Ribbon cables with stranded or solid wires are supplied on reels.

A range of accessories is available:
- clamp/ejectors for clamping a cable connector to a male header, which also serve as ejectors for easy separation;
- strain relief bridge, for relieving stress on the terminations of the cable connector;
- internal coding system, to ensure correct positioning;
- appropriate tools for terminating the cable connectors to ribbon cables.

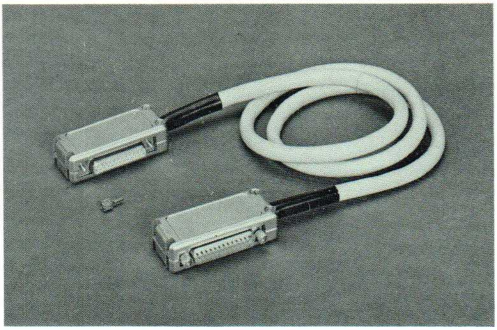
Note: The cable connectors also mate with male headers of the F095 modular connector system.





F501 – 1,5 A at 20 °C

cable assembly
Status D

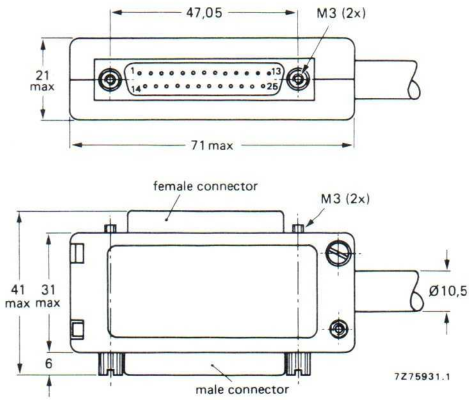


Number of connections	25
Cable length	600, 750, 1000, 1200, 2000, 4000, 10 000 mm
Current at T_{amb} = 20 °C	1,5 A
Climatic category, IEC 68	25/070/21
Basic specification	IEC 625-1

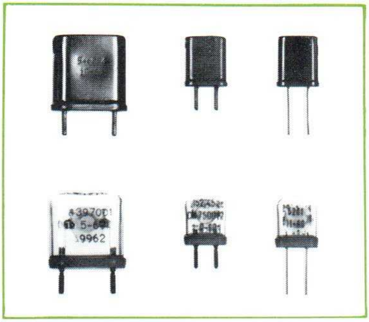
This cable assembly is used for interconnecting programmable test and measuring instruments according to the IEC Standard-Interface System.
Cable assemblies to IEEE and adaptors to IEC/IEEE are under development.

The cable assembly consists of a multicore cable, which is terminated at both ends with a combination plug and socket.
The cable contains 24 wires, twisted in pairs, of which 16 are used as signal paths and 8 as logic ground returns. It is provided with an outer screen.
The combination plug and socket consists of an F161 25-pole male connector and a 25-pole female connector mounted back-to-back and connected in parallel. Each pair of connectors is assembled in a metal housing, consisting of two identical parts, fitted with two screws and nuts. Two knurled screws at the male side facilitate the fitting of the connector combination to other cable assemblies or to the male output connector of the instrument to be interconnected.
The cable and the connectors are designed according to the requirements laid down in IEC 625-1.

Screws are available for mounting the output connectors of instruments, facilitating the locking of IEC Standard-Interface cables.



piezoelectric quartz devices



For detailed information
Handbook CM9

Each device consists of a quartz crystal element with electrodes, mounted in a glass or metal holder.
The AT-cut types cover the frequency ranges listed below.

Quartz crystals for professional applications – high precision

- fundamental frequencies 1,6 to 25 MHz
- third overtone 10 to 75 MHz
- fifth overtone 50 to 125 MHz

Available in either standard glass or metal holders, the latter being either solder sealed or resistance welded. They provide stable frequencies under severe temperature conditions, as in oscillator circuits in communication equipment, for example.

Test methods:
passive network (IEC – π network)
crystal test oscillator 150 A and printer processor 2000A
crystal test set TS-193A (British military standard)
crystal impedance meter TS-330/TSM (U.S. Army standard)
crystal impedance meter TS-683/TSM (U.S. Army standard)

Quartz crystals for special applications

- In resistance welded metal holder RW-43, with the following frequencies:

3 000,000 kHz	4 194,812 kHz	6 000,000 kHz
3 200,000 kHz	4 782,720 kHz	6 144,000 kHz
3 276,800 kHz	4 905,021 kHz	7 151,223 kHz
3 579,545 kHz	4 915,200 kHz	7 159,090 kHz
3 686,400 kHz	5 000,000 kHz	7 164,112 kHz
4 000,000 kHz	5 060,000 kHz	8 000,000 kHz
4 194,304 kHz	5 120,000 kHz	8 867,238 kHz

  Quartz crystals with other frequencies and quartz crystals in holder RW-45/RW-80 available on request.

- In all-glass holder HC-27/U
  10 000,000 kHz, high precision

How to specify when ordering

1. nominal frequency in kHz
2. mode of vibration
3. accuracy of adjustment ...x 10^{-6}
4. frequency drift over temperature range ...x 10^{-6}
5. temperature range ... °C
6. series resonance or load capacitance in parallel or in series with unit ... pF
7. type of holder

Temperature compensated crystal oscillators (TCXO)

Frequency range	4,5 to 15 MHz frequency adjustable with external trimmer		
Frequency tolerance	$\pm 1 \times 10^{-6}$	$\pm 1{,}5 \times 10^{-6}$	$\pm 2 \times 10^{-6}$
Temperature range	0 to +50°C	–10 to +60°C	–20 to +70°C
Frequency range	20 to 50 MHz frequency adjustable with external trimmer		
Frequency tolerance	$\pm 2 \times 10^{-6}$		
Temperature range	–20 to +70°C		

These modules comprise a quartz crystal oscillator and a thermally controlled circuit to compensate frequency changes over the whole temperature range. The hermetically sealed metal housing is filled with dry nitrogen. TCXOs find application in synthesizers, instrumentation, electronic timing devices, mobilophones, etc.

notes

notes

permanent magnet materials

For detailed information
Handbook C16

RES, Ferroxdure and Ticonal are among the most advanced permanent magnet materials available today. Magnets are made from these materials in a vast range of shapes and sizes, and the cost/weight/performance factor is excellent. Properly used, the strength of these magnets will remain practically unchanged throughout an indefinite lifetime. They are used mostly to transduce energy from one form to another, or to exert a force. This catalogue contains only a small selection of what is already being done: much more is possible.

energy transduction

- **Electrical/mechanical:** in motors, meters, loudspeakers, beam deflectors, mass spectrometers
- **Mechanical/electrical:** in generators, alternators, dynamos, microphones, pick-ups
- **Mechanical/heat:** in hysteresis/torque and eddy-current instruments

force exertion

- **On a magnetic material:** in attraction, repulsion, holding, lifting
- **On a moving electrical charge:** in magnetrons, klystrons, image intensifiers

materials and shapes

- **Anisotropic ceramic Ferroxdure**
  segments: in motors, magnetos
  rings: in loudspeakers
  discs and blocks: in metal separators, chucks, clamping plates

- **Isotropic ceramic Ferroxdure**
  segments: in small d.c. motors
  rings: in synchronous motors, alternators, dynamos
  blocks: in microphones, telephones, pick-ups, watches, reed switches
  tubes and rods: in tv convergence units, linearity controls

- **Anisotropic plastic-bonded Ferroxdure**
  wide range of shapes

- **Isotropic plastic-bonded Ferroxdure**
  wide range of shapes: where flexible products and/or
  complex magnetizing patterns are required

- **Anisotropic metal alloy Ticonal**
  rods, rings, discs, blocks and slugs: in watches, loudspeakers, microphones, telephones, meters, magnetos, motors, eddy-current brakes

- **Anisotropic sintered Cobalt Samarium magnets (RES)**
  blocks, slugs, rings, segments: in applications requiring highest magnetic energies

- **Anisotropic plastic-bonded Rare Earth Cobalt magnets (REM)**
  wide range of shapes: in applications requiring complex magnets
  with high magnetic energies

permanent magnet materials
survey of material grades

The term **typical value** ("typ") denotes a value which frequently occurs; it is not intended to be an average or mean value. Typical values enable the user to compare various grades.

The **minimum values** ("min") quoted are guaranteed for specified test pieces. Minimum values of B_r and H_{cB} do not occur simultaneously. The minimum value of B_r coincides with an H_{cB} well above the quoted typical value, whereas the minimum value of H_{cB} is coupled with a high value of B_r.

	max BH product		remanence		coercivity		polarization coercivity		B and H at $(BH)_{max}$		saturation field strength
	$(BH)_{max}$ (kJ/m³)		B_r (mT)		H_{cB} (kA/m)		H_{cJ} (kA/m)		B_d(mT)	H_d(kA/m)	H_{sat} (kA/m)
	typ	min	typ	min	typ	min	typ	min	typ	typ	min
Anisotropic ceramic Ferroxdure, $SrFe_{12}O_{19}$, (Ferroxdure 300: $BaFe_{12}O_{19}$) Magnets are pressed and sintered and may be ground.											
FXD 300	29,5	27,8	400	390	159	143	163	147	240	123	557
FXD 425	33,0	31,5	420	410	225	215	240	225	200	160	875
FXD 330	25,5	23,9	370	360	239	223	247	231	180	143	876
FXD 375	27,0	25,5	380	370	265	250	275	260	190	145	955
FXD 380	27,8	26,2	390	380	263	247	279	263	188	148	955
FXD 400	31,5	30,0	410	400	265	250	275	260	200	160	955
FXD 270	21,5	19,9	340	330	263	247	334	318	165	131	1114
FXD 405	24,0	22,5	360	350	270	255	340	325	175	140	1115
FXD 410	27,0	25,5	380	370	280	270	320	305	190	145	1115
Isotropic ceramic Ferroxdure, $BaFe_{12}O_{19}$ Magnets are pressed or extruded, sintered and may be ground.											
FXD 100	7,6	7,2	220	210	135	130	220				typ 800
Anisotropic plastic-bonded Ferroxdure, $BaFe_{12}O_{19}$ Magnets are produced by injection moulding.											
FXD SP130	11	10	240	230	175	167	240				typ 800
FXD SP170	14	13	270	260	196	188	260				typ 800

	max BH product $(BH)_{max}$ (kJ/m³) typ	min	remanence B_r (mT) typ	min	coercivity H_{cB} (kA/m) typ	min	polarization coercivity H_{cJ} (kA/m) typ	min	B and H at $(BH)_{max}$ B_d(mT) typ	H_d(kA/m) typ	saturation field strength H_{sat} (kA/m)

Isotropic plastic-bonded Ferroxdure, $BaFe_{12}O_{19}$

Magnets from SP5, SP10 and SP50 are produced by injection moulding, P30 and P40 by extruding; the suffix "F" denotes flame-retardant material to UL94 V-1.

	$(BH)_{max}$ typ	min	B_r typ	min	H_{cB} typ	min	H_{cJ} typ	min	B_d typ	H_d typ	H_{sat}
FXD SP5F	0,7		max 65	60	50	45	190				typ 800
FXD SP10/SP10F	0,9	0,8	80	75	58	54	190				typ 800
FXD P30	2,8	2,4	125	115	88	84	190				typ 800
FXD P40/P40F	3,6	3,2	145	135	96	88	190				typ 800
FXD SP50	4,4	4	155	150	104	100	190				typ 800

Anisotropic metal alloy Ticonal

Magnets are cast and may be ground.

	$(BH)_{max}$ typ	min	B_r typ	min	H_{cB} typ	min	H_{cJ} typ	min	B_d typ	H_d typ	H_{sat}
Ticonal 500	40,6	37,4	1250	1200	52,5	50,1			1000	40,6	min 239
Ticonal 550	43,8	39,8	900	850	123	115			550	79,6	min 478
Ticonal 570	45,4	42,2	1320	1260	51,7	49,4			1070	42,2	min 239
Ticonal 600	47,8	43,8	1310	1260	54,1	51,7			1090	43,8	min 239
Ticonal 900	79,6	67,7	1100	1000	115	111			900	79,6	min 478

Anisotropic sintered Cobalt Samarium magnets

	$(BH)_{max}$ typ	min	B_r typ	min	H_{cB} typ	min	H_{cJ} typ	min	B_d typ	H_d typ	H_{sat}
RES 160	128	120	810	790	600	560		1100			min 1100
RES 190	154	144	890	870	670	620		1100			min 1100

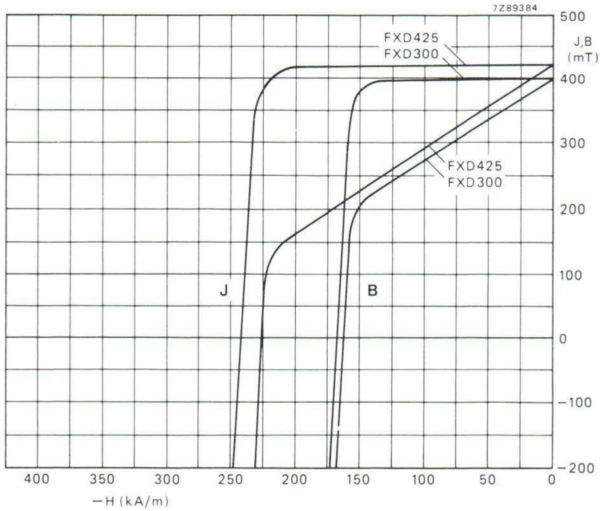
Anisotropic plastic-bonded Rare Earth Cobalt magnets

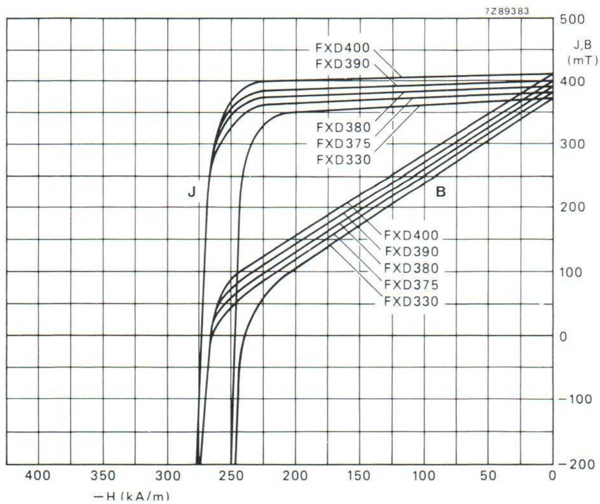
	$(BH)_{max}$ typ	min	B_r typ	min	H_{cB} typ	min	H_{cJ} typ	min	B_d typ	H_d typ	H_{sat}
REM 50	46	42	490	470	355	345		1100			min 2400
REM 60	53	48	540	510	335	325	540	520			min 1200

permanent magnet materials
demagnetization curves

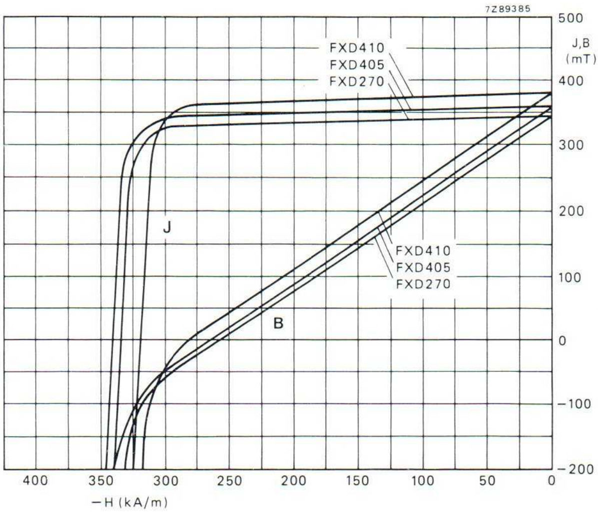
Ferroxdure magnets

Except for FXD 300 the curves have a long straight section. Magnets made from these materials can, therefore, be subjected to strong demagnetization, in some cases until B = 0, and yet recoil to nearly their original flux density after the demagnetization influence is removed.



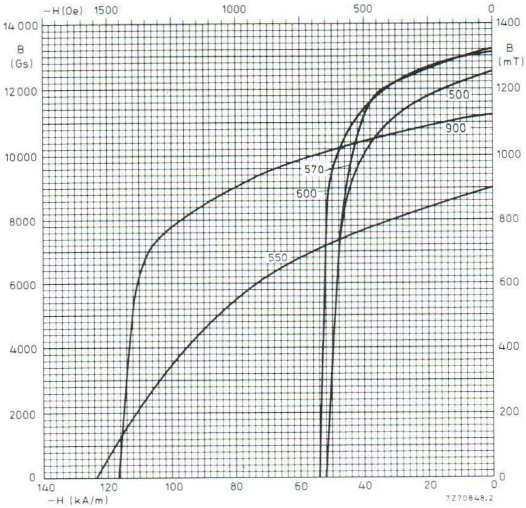


These curves also have a long straight section. Magnets made from these materials can, therefore, be subjected to strong demagnetization, up to B = 0, and yet recoil to nearly their original flux density after the demagnetization influence is removed.
Ferroxdure 100 curve added for comparison.

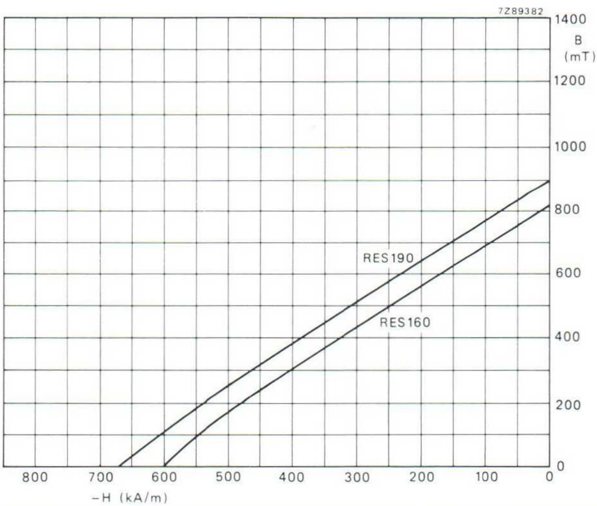


permanent magnet materials
demagnetization curves

Metal magnets



Permanent magnets from Ticonal (and FXD 300) should generally be magnetized only after being built into their magnetic circuit since their demagnetization curves permit little self-demagnetization. Furthermore, magnetization after assembly considerably simplifies handling and the removal of magnetic particles from the magnet.

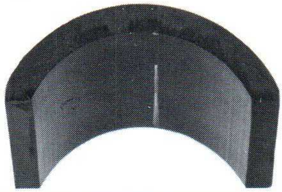


Rare Earth Cobalt magnets, characterized by high resistance to demagnetization.

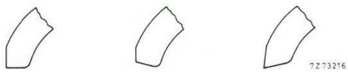
segments

Updated lists of those Ferroxdure segment magnets for which tools exist are available on request. For special applications please let us have details so that our computer can calculate the optimum design.

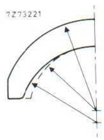
Inside radii with angle up to 170°

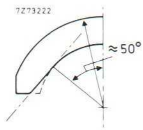


Variants on the feet

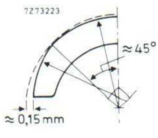


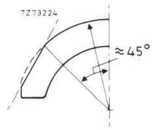
Variants on the inner radii





Variants on the outer radii



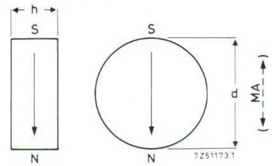


Design advisory service: customers can make use of our experts for assistance in the choice of material, design and magnetization, especially if custom-made products are required.

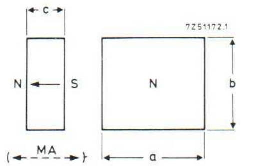
permanent magnet materials
magnetization

Magnetization possibilities and how to specify them. Symbol ←MA→ stands for the preferred direction of magnetization in anisotropic material (magnetic axis). Symbol S→N stands for the direction of magnetization in magnetized magnets.

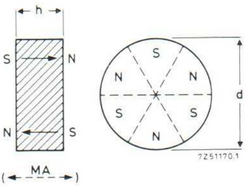
Isotropic and anisotropic magnets



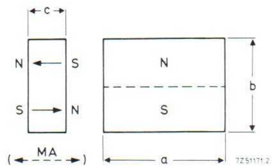
diametrical
(to be used also for rings and cylinders).



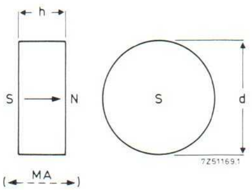
perpendicular to a x b.



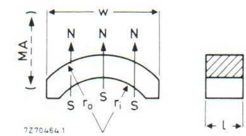
axial, n poles,
neutral zones radial
(in the example n = 6).



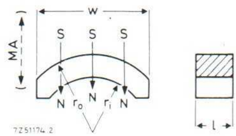
perpendicular to a x b, n poles,
neutral zone parallel to side a
(in the example n = 2).



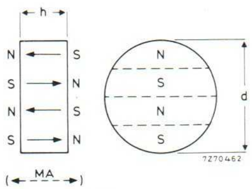
axial



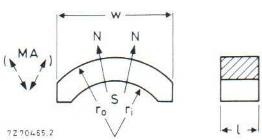
parallel (also called diametrical),
S-pole inside.



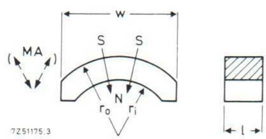
parallel (also called diametrical),
N-pole inside.



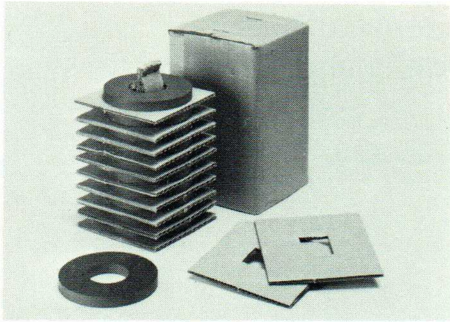
axial, n poles,
neutral zones in parallel
(in the example n = 4).



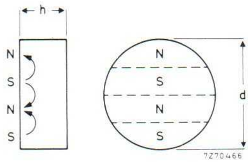
radial, S-pole inside.



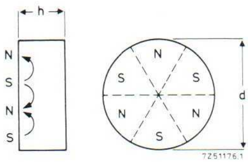
radial, N-pole inside.



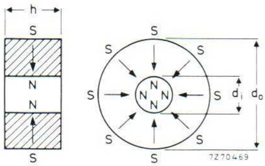
Isotropic magnets only



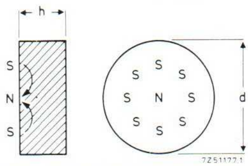
lateral, n parallel poles on one face only, (in the example n = 4).



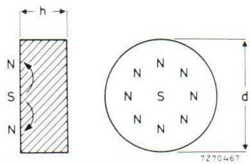
lateral, n pole sectors on one face only, (in the example n = 6).



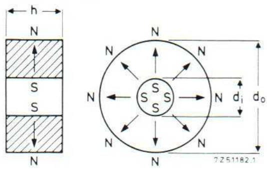
radial, N-pole inside.



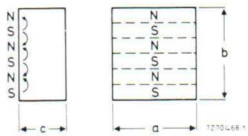
lateral, 2 poles on one face only, centred N-pole with concentric S-pole.



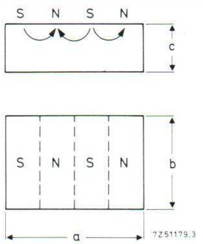
lateral, 2 poles on one face only, centred S-pole with concentric N-pole.



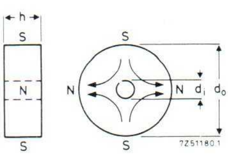
radial, S-pole inside.



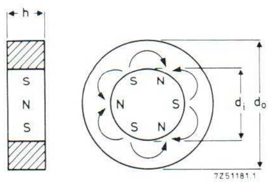
lateral, n poles on one a x b face, poles parallel to side a (in the example n = 6).



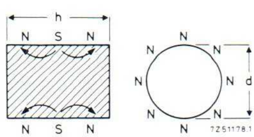
lateral, n poles on one a x b face, poles parallel to side b (in the example n = 4).



lateral, n poles on outer circumference, neutral zones axial (in the example n = 4).



lateral, n poles on inner circumference, neutral zones axial (in the example n = 6).

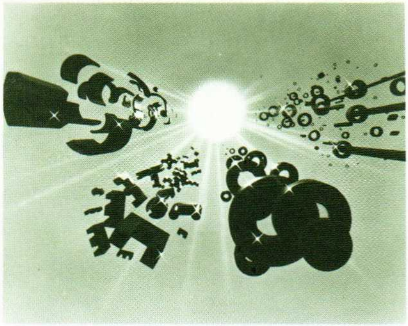


lateral, n annular poles (in the example n = 3).

Ferroxcube
MnZn and NiZn ferrites

Technical data

	unit	3B	3B7	3B8
Initial permeability μ_i				
at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25$ °C		900 ± 20%	2300 ± 20%	2300 ± 20%
at $\hat{B} = 0{,}7$ to 1 mT, $\theta = 10$-70°C				
at $\hat{B} = 0{,}7$ to 1 mT, $\theta = 25$-70°C				
Induction B, ballistically measured at				
H = 250 A/m, $\theta = 25$°C				
$\theta = 100$°C				
H = 800 A/m, $\theta = 25$°C	mT	~345	~430	~490
$\theta = 70$°C			~345	
$\theta = 100$°C		~230		~380
Eddy current and residual loss factor				
$\frac{\tan\delta}{\mu_i}$ at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25$°C,				
f = 4 kHz			⩽ 1	⩽ 1,2
f = 50 kHz				
f = 100 kHz			⩽ 5	⩽ 5
f = 250 kHz	x 10^{-6}			
f = 450 kHz		⩽ 50		
f = 500 kHz				
f = 1000 kHz				
Power loss P at 16 kHz, $\hat{B} = 200$ mT				
$\theta = 25$°C				
$\theta = 50$°C	kW/m³ (= mW/cm³)			
$\theta = 100$°C				
Hysteresis material constant,				
η_B at $\hat{B} = 0{,}3$ to 1,2 mT, f = 100 kHz,				
$\theta = 25$°C	x $10^{-3}T^{-1}$			
$\hat{B} = 1{,}5$ to 3,0 mT, f = 4 kHz,				
$\theta = 25$°C			⩽ 1,1	⩽ 1,0
d.c. sensitivity constant β_F at				
$\frac{\mu_e \cdot NI_0}{l_e} = 1{,}20 \cdot 10^5$ A/m				⩽ 120
$= 1{,}80 \cdot 10^5$ A/m	x 10^{-6}			⩽ 300
$= 2{,}60 \cdot 10^5$ A/m				⩽ 1000
Resistivity ϱ measured with d.c. current	Ωm	⩾ 0,2	⩾ 1	⩾ 1
Disaccommodation factor D_F, between 10 and 100 min after demagnetization at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25 \pm 1$°C	x 10^{-6}	⩽ 10	⩽ 4,3	⩽ 8
Temperature factor of permeability				
α_F at $\hat{B} \leqslant 0{,}1$ mT, $\theta = +5$ to $+25$°C				0 to +4
$+25$ to $+55$°C	x 10^{-6}/K	0 to +3		0 to +4
$+25$ to $+70$°C			−0,6 to +0,6	
Curie point	°C	⩾ 150	⩾ 170	⩾ 200
Mass density	kg/cm³	4700 to 4900	4700 to 4900	4700 to 4900



3C2	3C6	3C8	3C10	3C11
900 ± 25%	1700 ± 25%	2000 ± 25%	2000 ± 20%	4000 ± 25%
	⩾ 290	⩾ 330		
~350			≈450	≈380
~245				
			⩽ 3	⩽ 2
			⩽ 7	⩽ 20
	⩽ 170	⩽ 110	≈ 140	≈ 110
	⩽ 160			
	⩽ 140	⩽ 100	≈ 90	≈ 140
⩾ 0,1	⩾ 1	⩾ 1	⩾ 1	⩾ 1
0 to + 4,5				
⩾ 150	⩾ 190	⩾ 200	⩾ 190	⩾ 130
4700 to 4900	4750 to 4850	4750 to 4850	4750 to 4850	

Ferroxcube
MnZn and NiZn ferrites

Technical data

	unit	3D3	3E1	3E2
Initial permeability μ_i				
at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25$ °C		750 ± 20%	3800 ± 20%	
at $\hat{B} = 0{,}7\text{-}1$ mT, $\theta = 10\text{-}70$°C				
at $\hat{B} = 0{,}7\text{-}1$ mT, $\theta = 25\text{-}70$°C				$\geqslant 5000$
Induction B, ballistically measured at				
H = 250 A/m, $\theta = 100$°C				
H = 800 A/m, $\theta = 25$°C	mT	~350	~350	~355
$\theta = 70$°C			~270	~260
Eddy current and residual loss factor $\frac{\tan\delta}{\mu_i}$ at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25$°C,				
f = 4 kHz			$\leqslant 2{,}5$	$\leqslant 2{,}5$
f = 30 kHz				
f = 50 kHz	$\times 10^{-6}$			
f = 100 kHz		$\leqslant 8$	$\leqslant 20$	$\leqslant 15$
f = 500 kHz		$\leqslant 14$	$\leqslant 200$	
f = 1000 kHz		$\leqslant 30$		
Power loss P at 16 kHz, $\hat{B} = 200$ mT				
$\theta = 25$°C				
$\theta = 50$°C	kW/m³ (= mW/cm³)			
$\theta = 100$°C				
Hysteresis material constant, η_B at $\hat{B} = 0{,}3\text{-}1{,}2$ mT, f = 100 kHz,				
$\theta = 25$°C	$\times 10^{-3}T^{-1}$	$\leqslant 1{,}8$		
$\hat{B} = 1{,}5\text{-}3{,}0$ mT, f = 4 kHz,				
$\theta = 25$°C	$\times 10^{-3}T^{-1}$		$\leqslant 1{,}1$	$\leqslant 1{,}1$
Resistivity ϱ measured with d.c. current	Ωm	$\geqslant 1{,}5$	$\geqslant 0{,}3$	$\geqslant 0{,}1$
Disaccommodation factor D_F, between 10 and 100 min after demagnetization at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25 \pm 1$°C	$\times 10^{-6}$	$\leqslant 12$	$\leqslant 4{,}3$	$\leqslant 1{,}9$
Temperature factor of permeability				
α_F at $\hat{B} \leqslant 0{,}1$ mT, $\theta = +5$ to $+25$°C			1 ± 1	
+25 to +55°C	$\times 10^{-6}$/K		1 ± 1	
+25 to +70°C		0 to +2	1 ± 1	
Curie point	°C	$\geqslant 150$	$\geqslant 125$	$\geqslant 130$
Mass density	kg/cm³	4500 to 4900	4700 to 4900	4700 to 4900

3E4	3E5	3H1	3H2	3H3
4700 ± 20%	10 000 ± 20%	2300 ± 20%	2300 ± 20%	2000 ± 20%
		~360	400	
		~280		
≤ 2,5	≤ 3	≤ 1	≤ 1	
	≤ 25			1,2 ± 0,4
≤ 20	≤ 75	≤ 5	≤ 5	2 ± 0,5
≤ 200				
				≤ 0,5
≤ 0,85	≤ 0,85	≤ 0,85	≤ 1,1	≤ 0,6 (100 kHz)
≥ 0,3		≥ 1	≥ 1	
≤ 4,3	≤ 2,0	≤ 4,3	≤ 4,3	≤ 3,0
1 ± 1	0,60 ± 0,60	1 ± 0,5		0,7 ± 0,25
1 ± 1	0,60 ± 0,60	1 ± 0,5	1,2 ± 0,6	0,7 ± 0,25
1 ± 1	0,60 ± 0,60	1 ± 0,5	1,2 ± 0,6	0,7 ± 0,25
≥ 125	≥ 115	≥ 130	≥ 160	≥ 160
4700 to 4900		4700 to 4900	4700 to 4900	

Ferroxcube
MnZn and NiZn ferrites

Technical data

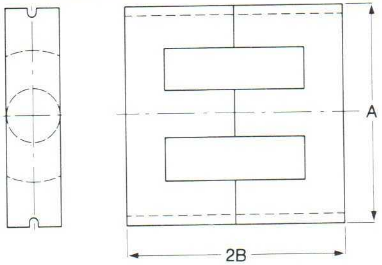
	unit	4A4
Initial permeability μ_i at $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25°C$		500 ± 20%
Induction B, ballistically measured at		
H = 800 A/m, θ = 25°C	mT	~270
θ = 70°C	mT	~210
H = 1600 A/m, θ = 25°C	mT	
θ = 100°C	mT	
H = 2000 A/m, θ = 25°C	mT	
θ = 70°C	mT	
H = 2400 A/m, θ = 25°C	mT	
θ = 70°C	mT	
θ = 100°C	mT	
H = 3200 A/m, θ = 25°C	mT	
θ = 100°C	mT	
H = 4800 A/m, θ = 25°C	mT	
θ = 100°C	mT	
Eddy current and residual loss factor $\frac{\tan\delta}{\mu_i}$ at $\hat{B} \leqslant 0{,}1$ mT, θ = 25°C,		
f = 500 kHz	$\times 10^{-6}$	$\leqslant 30$
f = 700 kHz	$\times 10^{-6}$	
f = 1 MHz	$\times 10^{-6}$	
f = 1,5 MHz	$\times 10^{-6}$	$\leqslant 40$
f = 2 MHz	$\times 10^{-6}$	$\leqslant 70$
f = 3 MHz	$\times 10^{-6}$	
f = 5 MHz	$\times 10^{-6}$	
f = 10 MHz	$\times 10^{-6}$	
f = 25 MHz	$\times 10^{-6}$	
f = 40 MHz	$\times 10^{-6}$	
Hysteresis material constant, η_B at $\hat{B}$ = 0,3-1,2 mT, f = 100 kHz, or θ = 25°C	$\times 10^{-3}T^{-1}$	$\leqslant 1{,}8$
Resistivity ϱ measured with d.c. current	Ωm	$\geqslant 10^3$
Dielectric constant ε at 1 MHz, θ = 25°C		15-20
Disaccommodation factor D_F, between 10 and 100 min after demagnetization, $\hat{B} \leqslant 0{,}1$ mT, $\theta = 25 \pm 1°C$	$\times 10^{-6}$	$\leqslant 5$
Temperature factor of permeability α_F at $\hat{B} \leqslant 0{,}1$ mT, θ = +5 to +25°C	$\times 10^{-6}$/K	
+25 to +55°C	$\times 10^{-6}$/K	
+25 to +70°C	$\times 10^{-6}$/K	10 ± 5
Curie point	°C	$\geqslant 135$
Mass density	kg/m³	4700 to 5100

4B1	4C6	4D1	4D2	4E1
250 ± 20%	120 ± 20%	50 ± 20%	60 ± 10%	15 ± 20%
~325				
~260				
	~380			
	~350			
		~240		
		~220		
				~175
				~165
⩽ 70				
⩽ 90				
⩽ 140				
	⩽ 40			
		⩽ 180		
		⩽ 210		
	⩽ 100	⩽ 300	⩽ 100	⩽ 300
			⩽ 200	
			⩽ 600	⩽ 360
	⩽ 6,2			
⩾ 10^3	⩾ 10^3	⩾ 10^3	⩾ 10^3	⩾ 10^3
	10-15			
	⩽ 10			
	1 ± 3			
0 to +8	3 ± 3	0 to +15		0 to +15
			0 to +15	
⩾ 250	⩾ 350	⩾ 400	⩾ 350	⩾ 500
4400 to 4800	4000 to 5000	4000 to 4400		3500 to 4000

Ferroxcube
EC-cores

EC-cores have a round centre pole to make strip winding easy, and ensuring a high copper factor and low leakage inductance; they meet the IEC65 standards for creepage distance (2 x 4 mm) and clearance between terminal pins and core. All cores are made of Ferroxcube grade 3C8 for good high-frequency performance and are assumed to be used in *pairs* in a core configuration.

Dimensions (mm)



	A	2B
EC35/17/10	35,3	34,6
EC41/19/12	41,6	39
EC52/24/14	53,5	48,4
EC70/34/17	71,7	69

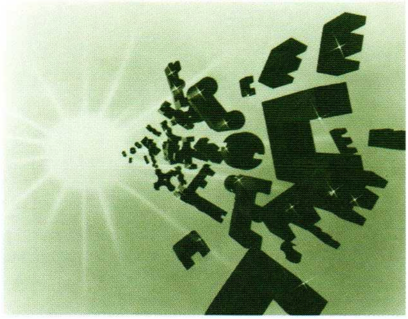
Typical maximum core loss, P_C, at various switching frequencies for a pair of EC-cores in a forward converter at 0,21 tesla peak flux density (unidirectional magnetization) and 100°C core temperature.

EC-core	P_C(W) 25 kHz	50 kHz
EC35/17/10	138	276
EC41/19/12	263	526
EC52/24/14	328	656
EC70/34/17	590	1180

Max. power, P_{max}, available at the secondary for the core used as a transformer.

P_{max}(W) flyback converter 25 kHz	50 kHz	forward converters 25 kHz	50 kHz
10	25	50	90
20	50	85	150
40	100	170	240
100	270	400	560

	EC35/17/10	**EC41/19/12**	**EC52/24/14**	**EC70/34/17**	
core constant, C_1	0,918	0,735	0,581	0,514	
effective core volume, V_e	6530	10800	18800	40100	mm^3
effective magnetic path length, l_e	77,4	89,3	105	144	mm
effective core cross-section, A_e	84,3	121	180	279	mm^2
centre pole cross-section, A_{cp} min	66,5	100,3	133,8	201,1	mm^2
mean length of turn, l_w	50	60	73	95	mm
effective window cross-section, A_w	63,6	93,5	153	383	mm^2
surface area of fully wound core, A_c	4350	5900	9100	17000	mm^2
hot-spot temperature rise per watt loss, $\Delta T/P_{loss}$	17,5	15,7	10	6,5	°C/W



Material sorts
1. reinforced polyteraphthalate, UL grade 94-V0
2. reinforced phenolformaldehyde, UL grade 94-V1
3. reinforced polyamide, UL grade HB

coil formers	EC35		EC41		EC52		EC70	
material sort	2	1	3	1	3	1	3	1
min. window area in mm²	97,5	97	136	138	212	210	466	464
mean length of turn in mm	50	53	60	62	73	70	95	96
approximate mass in g	6	7	10	10	15	18	35	36
max. working temp. in °C	140		120		120		120	
number of pins inserted	11	13	–	9	–	11	–	15
max. number of pin positions			18	12	22	14	30	19
pin thickness in mm	0,8		1,2		1,2		1,2	
grid in mm	5,08	5,08	7,62	5,08 and 7,62	7,62	5,08 and 7,62	7,62	5,08 and 7,62
mounting	H	H	H	H/V	H	H/V	H	H/V
pin positioning, see Fig.		1		2,3/4,5		6,7/8,9		10,11/12,13

H = horizontal mounting V = vertical mounting

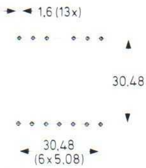


Fig. 1

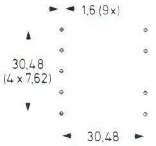


Fig. 2

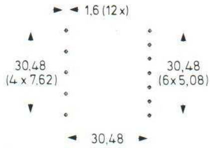


Fig. 3

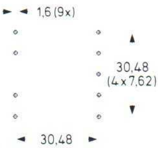


Fig. 4

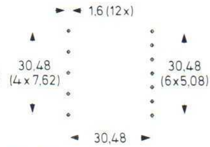


Fig. 5

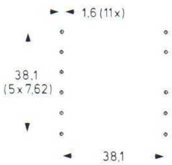


Fig. 6

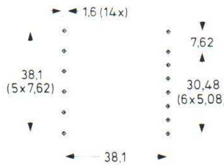


Fig. 7

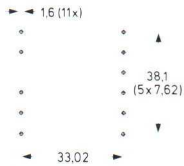


Fig. 8

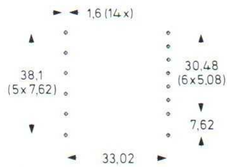


Fig. 9

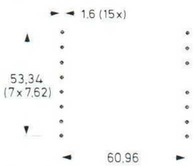


Fig. 10

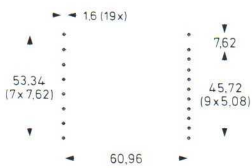


Fig. 11

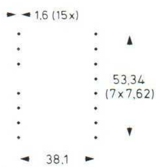


Fig. 12

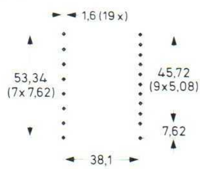
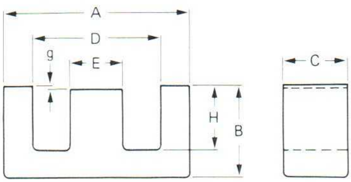


Fig. 13

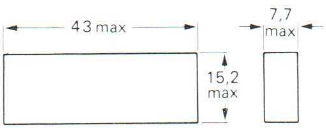
Ferroxcube
E-cores

We distinguish three grades:
FXC grade 3E1 - for wideband and pulse transformers.
FXC grades 3C6 and 3C8 - for power applications (high magnetic saturation and low losses).
Cores with air gap Δ available on request.
The coil formers cover most popular EE combinations.

Dimensions (mm)



	A max	B max	C max	D min	E max	H min
E20/10/5	20,7	10,2	5,3	12,8	5,2	6,3
E25/13/7	25,8	12,9	7,5	17,25	7,65	8,7
E30/15/7	30,8	15,2	7,3	19,5	7,2	9,7
E42/21/15	43,0	21,2	15,2	29,5	12,2	14,8
E42/21/20	43,0	21,2	20,0	29,5	12,2	14,8
E42/33/15	43,0	33,2	15,2	29,5	12,2	14,8
E55/28/21	56,2	27,8	21,0	37,5	17,2	18,5
E65/32/13	66,5	32,8	13,7	44,2	20,0	22,2
E65/33/27	66,5	32,8	27,4	44,2	20,0	22,2



I 42/7/15 to be used in combination with E42/21/15

Coil formers

	EE20/20/5				EE30/30/7		EE42/42/15	EE55/55/21	EE65/65/13
material sort	1	2	2	1	2	3	3	3	3
min. window area in mm^2	27	27	27	80	80	178	178	250	394
mean length of turn in mm	38	38	38	56	56	93	93	116	150
approximate mass in g	0,5	0,5	0,5	1,3	1,3	4	4	9	13
max. temp. for dipsolder during 5 to 6 s in °C		400	400		400				
max. working temp. in °C	130	130	130	130	130	180	180	180	180
number of pins		8	6		10		10		
availability mounting parts		x	x		x		x		
pin thickness in mm		0,8	0,8		0,8		1		

Material sorts
1 = polycarbonate
2 = phenolformaldehyde, reinforced with glass fibre
3 = reinforced polyamide

All electrical properties are guaranteed for EE or EI combinations without airgap. The cores must be selected at random and pressed together.

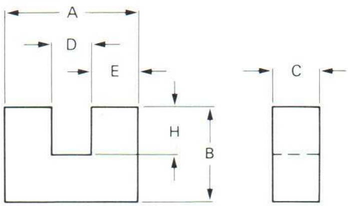
combination	grade	guaranteed values			corresponding measuring conditions					effective dimensions		
		max. loss W	min.ind.B mT	$A_L \pm 25\%$ nH	μ_e	T °C	$\hat{B}$ mT	$\hat{H}$ A/m	f kHz	le mm	Ae mm^2	Ve mm^3
EE20/20/5	3E1			2405	2627	25	0,1		4	42,8	31,2	1340
EE20/20/5	3C6	0,3				25	200		16	42,8	31,2	1340
		0,25				100	200		16			
			275			100		250	16			
EE25/25/7	3C8	0,65				25	200		16	57,5	55	3160
			340			25		250	16			
EE30/30/7	3E1			3330	2970	25	0,1		4	66,9	59,7	4000
EE42/42/15	3E1			7555	3210	25	0,1		4	97,0	182	17600
EE42/42/15	3C8	2,0				100	200		16	97,0	182	17600
			315			100		250	16			
			90			100		50	16			
EE42/42/20	3C8	2,6				100	200		16	98	236	23100
			315			100		250	16			
			90			100		50	16			
EE42/54/20	3C8	3,5				25	200		16	122	236	28800
		3,2				100	200		16			
			315			100		250	16			
EI42/29/15	3E1			10265	3000	25	200		16	67,2	183	12300
EE55/55/21	3E1			11937	3307	25	0,1		4	123	354	43700
EE55/55/21	3C8	5,5				25	200		16	123	354	43700
		5,0				100	200		16			
			315			100		250	16			
EE55/55/25	3C8	6,2				25	200		16	123	420	52000
		5,7				100	200		16			
			315			100		250	16			
EE65/65/27	3E1			15450	3382	25	0,1		4	147	532	78200
EE65/65/27	3C8	9,5				25	200		16	147	532	78200
		8,7				100	200		16			
			315			100		250	16			

Ferroxcube
U-cores

U10, U15, U20, U25, U30 – FXC grade 3C8

These U-cores are for use in power supplies. Their excellent magnetic and electrical properties make them the designer's choice for small, light weight and highly efficient power supplies.
U-cores are ideal in suppression applications. In case of premagnetisation, the influence of d.c. on the inductance of the choke can be reduced by using U-cores in combination with spacers to get an airgap.

Dimensions (mm)



	A max	B max	C max	D min	E min	H min
U10/8/3	10,2	8,2	2,9	4	2,9	5,1
U15/11/6	15,9	11,65	6,25	5	4,8	5,57
U20/16/7	21,6	15,8	7,5	6	7,2	8
U25/20/13	25,5	20	12,5	8	8	11
U30/25/16	32	25,5	16	10	9,8	14,5

Technical data measured at 16 kHz

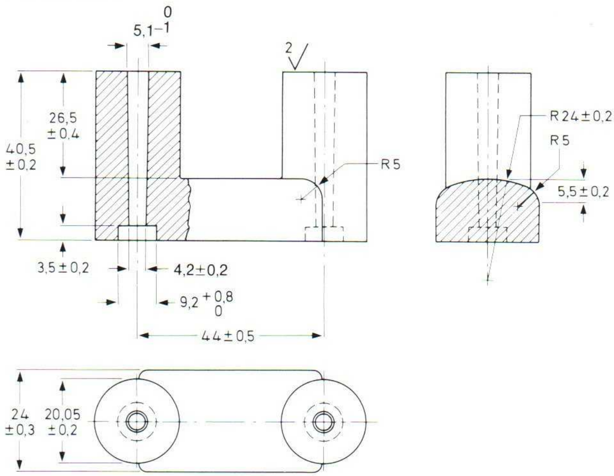
type 2 cores	grade	temperature θ (°C)	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W/pair)	effective dimensions l_e (mm)	A_e (mm²)	V_e (mm³)
U10/8/3	3C8	25 ± 5	200	–		38,4	8,63	331
		25 ± 5	≥ 140	50				
		100 ± 5	200	–				
		100 ± 5	≥ 315	250				
U15/11/6	3C8	25 ± 5	200	–	≤0,18	48	30	1440
		25 ± 5	≥ 140	50	–			
		100 ± 5	200	–	≤0,16			
		100 ± 5	≥ 315	250	–			
U20/16/7	3C8	25 ± 5	200	–	≤0,46	68	56	3800
		100 ± 5	200	–	≤0,42			
		100 ± 5	≥ 100	50	–			
		100 ± 5	≥ 315	250	–			
U25/20/13	3C8	25 ± 5	200	–	≤1,1	86	100	8600
		100 ± 5	200	–	≤1,0			
		100 ± 5	≥ 100	50	–			
		100 ± 5	≥ 315	250	–			
U30/25/16	3C8	25 ± 5	200	–	≤2,4	111	157	17400
		100 ± 5	200	–	≤2,0			
		100 ± 5	≥ 335	400	–			

Coil formers for small U-cores can be made available after special agreement.

U64 – FXC grade 3C8

Specially for line output transformers in colour television receivers.

Dimensions (mm)



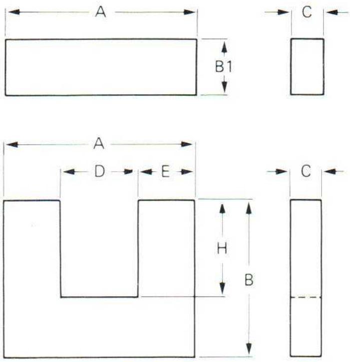
Technical data measured at 16 kHz

Type-Grade	Temperature	Induction	Field strength	Losses	Effective dimensions		
2 cores	θ (°C)	$\hat{B}$ (mT)	$\hat{H}$ (A/m)	(W/pair)	l_e (mm)	A_e (mm²)	V_e (mm³)
U64/40/20-3C8	25 ± 5	200	–	⩽8,5	210	290	61000
	100 ± 5	200	–	⩽7,0			
	100 ± 5	⩾330	250	–			

Ferroxcube
UI-cores

High power to several kilowatts? Simple. Just stack up several U-cores into one big E core with a square centre leg, or use UI and UU combinations. The result: low losses and high efficiency without weight penalty.

Dimensions (mm)

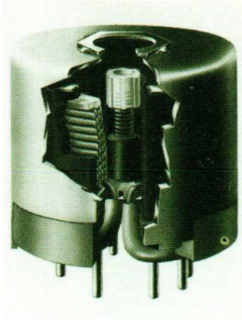


	A max	B max	B1 max	C max	D min	E max	H min
U93/52/30	94,8	52,5		30	36,2	28	23,5
I 93/28/30	94,8		28	30			
U93/76/16	94,8	76,5		16	36,2	28	47
I 93/28/16	94,8		28	16			
U93/76/30	94,8	76,5		30	36,2	28	47
I 93/28/30	94,8		28	30			
U100/57/25	103,6	57,5		25,4	47	25,4	30,3
I 100/25/25	103,6		26,2	25,4			

Technical data measured at 16 kHz

type	grade	temperature θ (°C)	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W/pair)	effective dimensions l_e (mm)	A_e (mm²)	V_e (mm³)
U93/52/30	3C6	25 ± 5	200	–	≤26,9	204	780	158 000
I 93/28/30	3C6	100 ± 5	200	–	≤22,2			
		100 ± 5	≥ 290	250	–			
U93/76/16	3C6	25 ± 5	200	–	≤18,2	254	420	107 000
I 93/28/16	3C6	100 ± 5	200	–	≤15,0			
		100 ± 5	≥ 290	250	–			
U93/76/30	3C6	25 ± 5	200	–	≤28	254	780	200 000
I 93/28/30	3C6	100 ± 5	200	–	≤34			
		100 ± 5	≥ 290	250	–			
U100/57/25	3C6	25 ± 5	200	–	≤26,8	244	640	157 700
I 100/25	3C6	100 ± 5	200	–	≤22,1			
		100 ± 5	≥ 290	250	–			

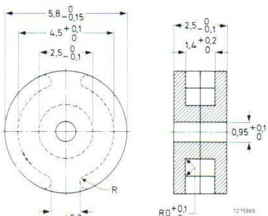
potcores



Ferroxcube potcores in grades 3B7, 3D3, 3H1, 4C6 have been specially developed for stable low loss filter coils. In grades 3E1, 3E4 for low level transformers and in grade 3B8 for low power application.

The dimensions of types P11/7 to P42/29 are in accordance with I.E.C. specification 133 and specifications of several national standardization commissions.

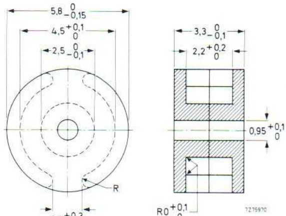
P5,8/2,5



3H1 core set with AL 715 ± 30%

No coil formers.
No mounting parts.

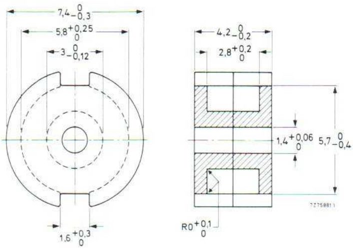
P5,8/3,3



3H1 core set with AL 820 ± 25%

Coil former with one section.
No mounting parts.

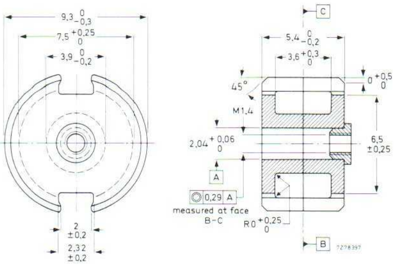
P7,4/4,2



Core sets without adjuster nut
AL 63 ± 3% 3H1
AL 100 ± 3% 3H1
AL 970 ± 25% 3H1

Coil former with one section.
No mounting parts.

P9/5



Core sets with adjuster nut

AL	
16 ± 1%	4C6
25 ± 1%	4C6
40 ± 1%	4C6
63 ± 1%	3B7, 3H1
100 ± 1,5%	3B7, 3H1
160 ± 2%	3B7, 3H1
250 ± 5%	3H1

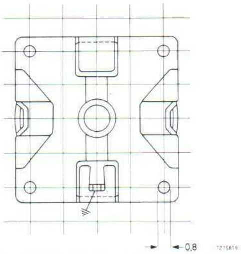
Core sets without adjuster nut

AL	
1260 ± 25%	3B7, 3H1

Coil formers with one section.
No mounting parts.

Inductance adjusters for core sets with AL values from 63 to 160.

P11/7



Core sets with adjuster	
AL 16 ± 1%	3D3, 4C6
25 ± 1%	3D3, 4C6
40 ± 1%	3D3, 4C6
63 ± 1%	3D3
100 ± 1%	3B7, 3D3, 3H1
160 ± 1,5%	3B7, 3H1
250 ± 3%	3B7, 3H1

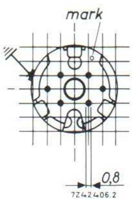
Core sets without adjuster	
AL 100 ± 1%	3B8
250 ± 3%	3B8
400 ± 8%	3B8
1700 ± 25%	3B7, 3B8, 3H1
3075 ± 25%	3E1

Mounting parts for printed wiring board: tag plate, container, spring.

Coil formers with one section

Inductance adjusters for core sets with AL values from 40 to 250.

P14/8



Core sets with adjuster	
AL 25 ± 1%	4C6
40 ± 1%	3D3, 4C6
63 ± 1%	3D3, 4C6
100 ± 1%	3B7, 3D3, 3H1
160 ± 1,5%	3B7, 3H1
250 ± 2%	3B7, 3H1
315 ± 2%	3B7, 3H1
400 ± 2%	3B7, 3H1
630 ± 3%	3H1

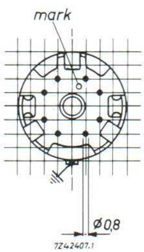
Core sets without adjuster	
AL 250 ± 2%	3B8
400 ± 2%	3B8
630 ± 3%	3B8
2200 ± 25%	3B7, 3B8, 3H1
4050 ± 25%	3E1

Mounting parts for printed wiring board: tag plate, container, spring.

Coil formers with one and two sections.

Inductance adjusters for core sets with AL values form 25 to 400.

P18/11



Core sets with adjuster nut	
AL 25 ± 1%	4C6
40 ± 1%	3D3, 4C6
63 ± 1%	3B7, 3D3, 3H1, 4C6
100 ± 1%	3B7, 3D3, 3H1
160 ± 1%	3B7, 3D3, 3H1
250 ± 1,5%	3B7, 3D3, 3H1
400 ± 2%	3B7, 3D3, 3H1
630 ± 3%	3B7, 3D3, 3H1
1000 ± 5%	3H1

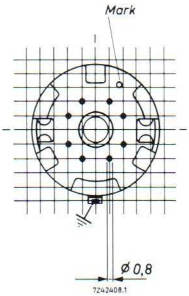
Core sets without adjuster nut	
AL 400 ± 2%	3B8
630 ± 3%	3B8
3650 ± 25%	3B7, 3B8, 3H1
5900 ± 25%	3E1

Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one, two and three sections.

Inductance adjusters for core sets with AL values from 25 to 630.

P22/13



Core sets with adjuster nut

AL 25 ± 1%	4C6
40 ± 1%	3D3, 4C6
63 ± 1%	3D3, 4C6
100 ± 1%	3B7, 3D3, 3H1, 4C6
160 ± 1%	3B7, 3D3, 3H1
250 ± 1,5%	3B7, 3D3, 3H1
315 ± 2%	3B7, 3H1
400 ± 2%	3B7, 3H1
630 ± 3%	3B7, 3H1
1000 ± 3%	3B7, 3H1
1250 ± 3%	3H1

Core sets without adjuster nut

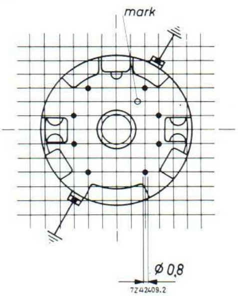
AL 160 ± 1%	3B8
400 ± 2%	3B8
2500 ± 10%	3B7
4650 ± 25%	3B7, 3B8, 3H1
7450 ± 25%	3E1
10 000 ± 25%	3E4

Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one, two and three sections.

Inductance adjusters for core sets with AL values from 35 to 630.

P26/16



Core sets with adjuster nut

AL 63 ± 1%	3B7, 3H1, 4C6
100 ± 1%	3B7, 3D3, 3H1, 4C6
160 ± 1%	3B7, 3D3, 3H1,
250 ± 1%	3B7, 3D3, 3H1
315 ± 1,5%	3B7, 3H1
400 ± 2%	3B7, 3D3, 3H1
630 ± 3%	3B7, 3H1
1000 ± 3%	3B7, 3H1
1600 ± 3%	3B7, 3H1

Core sets without adjuster nut

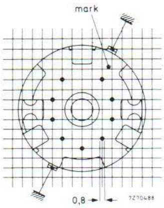
AL 250 ± 1%	3B8
400 ± 2%	3B8
630 ± 3%	3B8
1600 ± 3%	3B8
5900 ± 25%	3B7, 3B8, 3H1
9650 ± 25%	3E1

Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one, two and three sections.

Inductance adjusters for core sets with AL values from 63 to 1000.

P30/19



Core sets with adjuster nut

AL 100 ± 1%	3B7, 3D3
160 ± 1%	3B7, 3D3
250 ± 1%	3B7, 3D3, 3H1
315 ± 1,5%	3B7
400 ± 1,5%	3B7, 3H1
630 ± 2%	3B7, 3H1
1000 ± 3%	3B7, 3H1
1600 ± 3%	3B7, 3H1
2500 ± 3%	3B7, 3H1

Core sets without adjuster nut

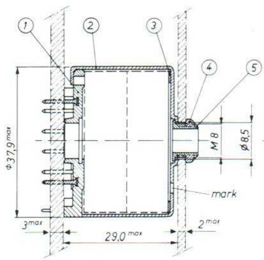
AL 630 ± 2%	3B8
7500 ± 25%	3B7, 3B8, 3H1
11 000 ± 25%	3E1

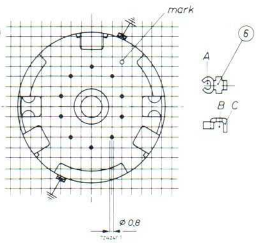
Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one, two and three sections.

Inductance adjusters for core sets with AL values form 100 to 1600.

P36/22





Core sets with adjuster nut

AL 40 ± 1%	3B7, 3H1
100 ± 1%	3B7, 3H1
160 ± 1%	3D3, 3H1
250 ± 1%	3B7, 3B8, 3D3, 3H1
400 ± 1%	3B7, 3D3, 3H1
630 ± 2%	3B7, 3H1
1000 ± 3%	3B7, 3H1
1250 ± 3%	3H1
1600 ± 3%	3B7, 3H1
2500 ± 3%	3H1

Core sets without adjuster nut

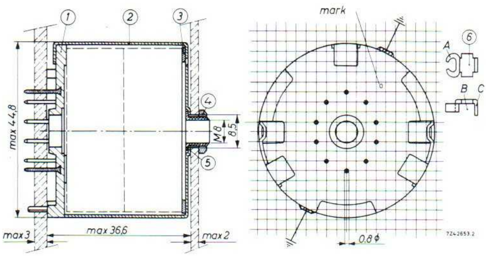
AL 315 ± 1,5%	3B8
400 ± 1,5%	3B8
9500 ± 25%	3B7, 3B8, 3H1
14400 ± 25%	3E1

Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one, two and three sections.

Inductance adjusters for core sets with AL values from 160 to 1600.

P42/29



Core sets with adjuster nut

AL	100 ± 1%	3B7, 3H1
	250 ± 1%	3B7, 3H1
	400 ± 1%	3B7, 3H1
	630 ± 2%	3B7, 3H1
	1000 ± 3%	3B7, 3H1
	1600 ± 3%	3B7, 3H1

Core sets without adjuster nut

AL	2500 ± 10%	3B7
	10 250 ± 25%	3B7, 3H1

Mounting parts for printed wiring board (and panel mounting): tag plate, container, spring (and fixing bush, nut).

Coil formers with one and two sections.

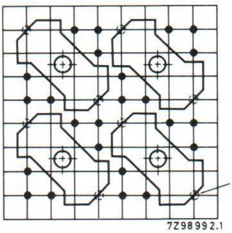
Inductance adjusters for core sets with AL values from 250 to 1600.

square cores

Ferroxcube square cores in grades 3B7, 3D3, 3H1, 3H3, 4C6 have been specially developed for stable low loss filter coils, in grades 3E1, 3E4, 3E5 for low level transformers and in grades 3B8, 3C8 for small power applications.

Square cores are in accordance with I.E.C. specification 431 and other specifications of several national standardization commissions.

RM4



2 clips with earth tag for mounting on printed wiring board.

Core sets with adjuster nut

AL	40 ± 1%	3H1
	63 ± 1,5%	3H1
	100 ± 2%	3H1
	160 ± 5%	3H1
	250 ± 10%	3H1

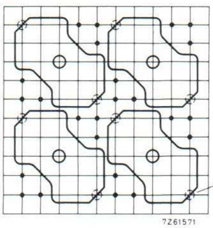
6 pins coil formers with one section.

Core sets without adjuster nut

AL	1600 ± 25%	3H1
	2790 ± 25%	3E4

Inductance adjusters for core sets with AL values from 40 to 250.

RM5



2 clips with earth tag for mounting on printed wiring board.

Core sets with adjuster nut

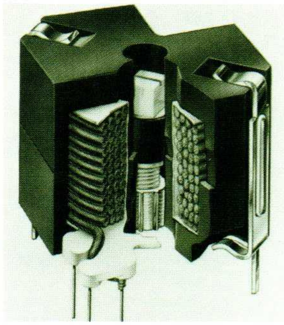
AL	16 ± 1%	4C6
	25 ± 1%	3D3, 4C6
	40 ± 1%	3D3, 4C6
	63 ± 1%	3B7, 3D3, 3H1, 3H3, 4C6
	100 ± 1%	3B7, 3D3, 3H1, 3H3
	160 ± 2%	3B7, 3H1, 3H3
	250 ± 3%	3B7, 3H1, 3H3
	315 ± 5%	3B7, 3H1, 3H3
	400 ± 5%	3B7, 3H1, 3H3

4 and 6 pins coil formers with one section.

Core sets without adjuster nut

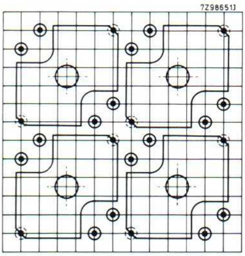
AL	1960 ± 25%	3B7, 3H1
	3450 ± 25%	3E1
	4600 ± 25%	3E4
	4975 ± 25%	3E4 (without centre hole)
	6500 ± 25%	3E5 (without centre hole)

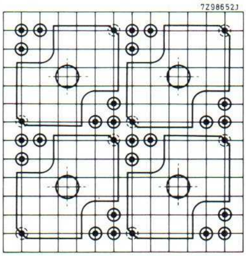
Inductance adjuster for core sets with AL values from 40 to 400.



Square cores have the advantage over pot cores that they have coil formers with pins on which the ends of the windings are directly soldered after winding; no loose leading-out wires.
Moreover the mounting parts of square cores consist of only 2 clips with earth tag.

RM6R





2 clips with earth tag for mounting on printed wiring board.

4 and 6 pins coil formers with one and two sections.

Inductance adjusters for core sets with AL values from 40 to 630.

▲ without centre hole

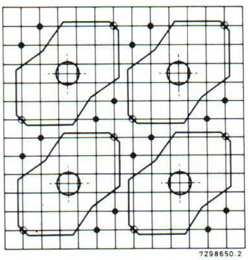
Core sets with adjuster nut

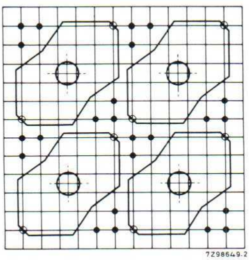
AL	25 ± 1%	4C6
	40 ± 1%	3B7, 3D3, 3H1, 4C6
	63 ± 1%	3B7, 3D3, 3H1, 4C6
	100 ± 2%	3B7, 3D3, 3H1
	160 ± 2%	3B7, 3D3, 3H1, 3H3
	200 ± 2%	3H1, 3H3
	250 ± 2%	3B7, 3H1, 3H3
	315 ± 2%	3B7, 3H1, 3H3
	400 ± 2%	3B7, 3H1, 3H3
	630 ± 3%	3B7, 3H1, 3H3
	1000 ± 10%	3B7, 3H1
	1250 ± 10%	3B7, 3H1

Core sets without adjuster nut

AL	40 ± 1%	3B8 ▲
	160 ± 2%	3B8 ▲
	2640 ± 25%	3B7, 3H1
	3000 ± 25%	3B8 ▲
	4780 ± 25%	3E1
	6100 ± 25%	3E4
	6710 ± 25%	3E4 ▲
	9500 ± 25%	3E5 ▲

RM6S





2 clips with earth tag for mounting on printed wiring board.

4 and 6 pins coil formers with one and two sections.

Inductance adjusters for core sets with AL values from 40 to 630.

▲ without centre hole

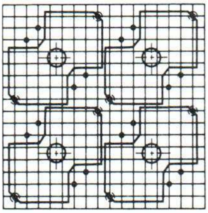
Core sets with adjuster nut

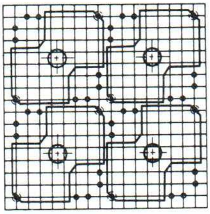
AL	16 ± 1%	4C6
	25 ± 1%	4C6
	40 ± 1%	3D3, 4C6
	63 ± 1%	3D3, 4C6
	100 ± 2%	3D3
	160 ± 2%	3B7, 3D3, 3H1
	200 ± 2%	3H1, 3H3
	250 ± 2%	3B7, 3H1, 3H3
	315 ± 2%	3B7, 3H1, 3H3
	400 ± 2%	3B7, 3H1, 3H3
	630 ± 3%	3B7, 3H1, 3H3
	1000 ± 10%	3B7, 3H1
	1250 ± 10%	3B7, 3H1

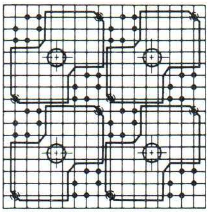
Core sets without adjuster nut

AL	2480 ± 25%	3B7, 3B8, 3H1
	4400 ± 25%	3E1
	4840 ± 25%	3E1 ▲
	5500 ± 25%	3E4
	6050 ± 25%	3E4 ▲
	8800 ± 25%	3E5 ▲

RM8







7Z68397

2 clips with earth tag for mounting on printed wiring board.
4, 8 and 12 pins coil formers with one section.
8 pins coil formers with two sections.
Inductance adjusters for core sets with AL values from 40 to 630.

Core sets with adjuster nut

AL	40 ± 1%	3D3, 4C6
	63 ± 1%	3B7, 3D3, 3H1
	100 ± 1%	3B7, 3D3, 3H1, 4C6
	160 ± 1,5%	3B7, 3D3, 3H1, 4C6
	250 ± 2%	3B7, 3H1
	315 ± 2%	3B7, 3H1
	400 ± 3%	3B7, 3H1
	630 ± 3%	3B7, 3H1
	1000 ± 10%	3B7, 3H1
	1250 ± 10%	3B7, 3H1

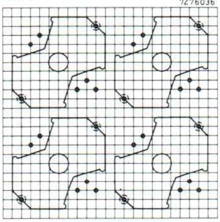
Core sets without adjuster nut

AL	250 ± 2%	3B8 ▲
	400 ± 3%	3B8 ▲
	3400 ± 25%	3B7, 3H1
	3840 ± 25%	3B8 ▲
	5500 ± 25%	3E1
	6300 ± 25%	3E1 ▲
	7100 ± 25%	3E4
	8000 ± 25%	3E4 ▲

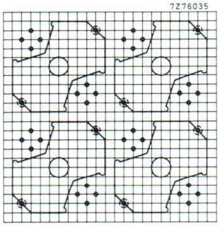
▲ without centre hole

RM10

7Z76036



7Z76035



2 clips with earth tag for mounting on printed wiring board.
5 and 8 pins coil formers with one section.
3 pins coil formers with two sections.
Inductance adjusters for core sets with AL values from 315 to 1000.

Core sets with adjuster nut

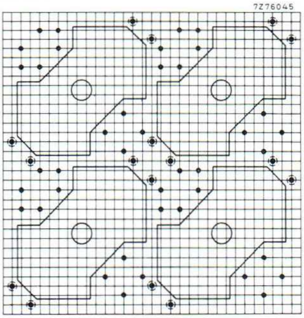
AL	160 ± 2%	3H1
	250 ± 2%	3H1
	315 ± 2%	3H1
	400 ± 3%	3H1
	630 ± 4%	3H1
	1000 ± 10%	3H1
	1600 ± 10%	3H1

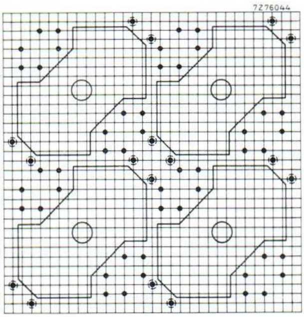
Core sets without adjuster nut

AL	160 ± 2%	3B8, 3C8
	250 ± 2%	3C8
	315 ± 2%	3B8, 3C8
	400 ± 3%	3B8, 3C8
	630 ± 4%	3B8, 3C8
	1000 ± 10%	3C8
	4065 ± 25%	3C8
	4765 ± 25%	3H1
	5310 ± 25%	3B8
	10 000 ± 25%	3E4

All 3B8 cores are without centre hole.

RM14





2 clips with each 2 earth tags for mounting on printed wiring board.

10 and 12 pins coil formers with one section.

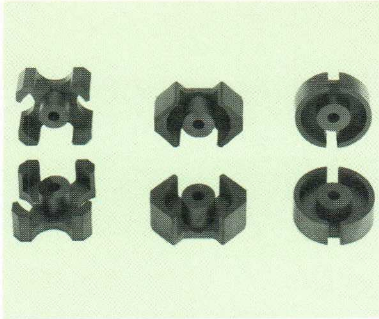
Core sets with adjuster nut

AL 630 ± 3%	3B8

Core sets without adjuster nut

AL	160 ± 1%	3B8
	250 ± 2%	3B8
	400 ± 2%	3B8
	630 ± 3%	3B8
	1000 ± 5%	3B8
	1600 ± 10%	3B8
	2500 ± 10%	3B8
	6940 ± 25%	3B8

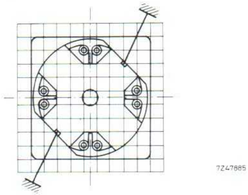
cross cores



Ferroxcube cross cores in grades 3H1 have been specially developed for stable low loss filter coils, in grades 3B7, 3H1, 3E1 for low level transformers and in grade 3B8 for small power applications.
Cross cores are in accordance with I.E.C. specification 226 and other specifications of several national standardization commissions.

Cross cores have the advantage over pot cores that they have coil formers with pins on which the ends of the windings are directly soldered after winding: no loose leading-out wires.

X22



Mounting parts for printed wiring board:
container, cover.

Core sets with adjuster nut

AL 160 ± 1%	3H1
250 ± 1,5%	3H1
400 ± 2%	3H1
630 ± 3%	3H1

Core halves with air gap

0,02 mm	3H1
0,05 mm	3H1
0,15 mm	3E1, 3H1
0,25 mm	3H1

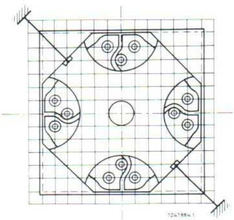
8 pins coil former with one section.

Core sets without adjuster nut

AL 160 ± 1%	3H1
250 ± 1%	3H1
400 ± 1%	3H1
630 ± 1%	3H1
1000 ± 10%	3H1
1600 ± 10%	3H1
4200 ± 25%	3B7, 3B8, 3H1
6080 ± 25%	3E1

Inductance adjuster for core sets with AL values from 160 to 630.

X30



Core sets without adjuster

AL 5230 ± 25%	3B8, 3H1
7780 ± 25%	3E1

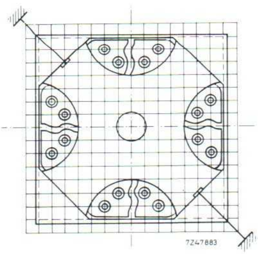
Mounting parts for printed wiring board:
container, cover.

Core halves with air gap

0,02 mm	3H1
0,05 mm	3H1
0,15 mm	3H1
0,25 mm	3H1

No core sets with adjuster nut.
No adjusters.
12 pin coil former with one section.

X35



Core sets without adjuster

AL 315 ± 3%	3H1
400 ± 3%	3H1
630 ± 3%	3H1
1000 ± 3%	3H1
1600 ± 3%	3B8, 3H1
2000 ± 10%	3B8, 3H1
2500 ± 10%	3B8
6450 ± 25%	3B8, 3H1

Mounting parts for printed wiring board:
container cover.

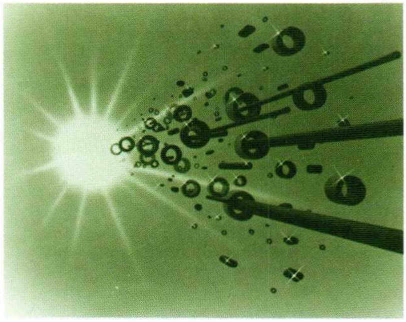
Core halves with air gap

0,02 mm	3H1
0,05 mm	3H1
0,15 mm	3H1
0,25 mm	3H1

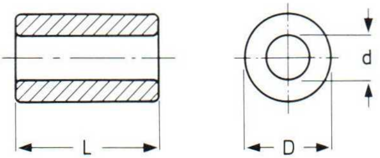
No core sets with adjuster.
No adjusters.
16 pins coil former with one section.

beads

Thread the beads onto leads of a domestic appliance, or even a diode in a TV power supply, and perhaps it's all y need to meet the requirements for interference suppressi Three special grades of materials have been developed f this application: 3S1, 3S2 and 4S3.
Minimum bead impedances are guaranteed at the frequencies in the table below. Bead kits, covering a wid selection of types, are available too, with full instruction: in case you want to experiment.



Dimensions (mm)



Guaranteed minimum bead impedances

grade	dimensions			|Zs| in ohms at various frequencies					
				frequency in MHz					
	D	d	L	1	3	10	30	100	300
	3	0,7	4	24	38	39	31	26	23
	3	0,7	10	58	95	97	77	66	58
	3	1,0	4	18	29	30	24	20	18
	3	1,0	10	44	72	73	59	50	44
3S1	5	0,7	4	32	52	53	42	36	32
	5	0,7	10	79	128	131	105	89	79
	5	1,5	4	20	31	32	26	22	20
	5	1,5	10	48	78	80	64	55	48
	5	2,0	4	15	24	24	20	17	15
	5	2,0	10	37	60	61	49	42	37
	3	0,7	4	4	12	25	32	42	27
	3	0,7	10	9	20	63	81	104	67
	3	1,0	4	3	9	19	25	32	20
	3	1,0	10	7	23	48	61	79	51
	5	0,7	4	5	16	24	44	57	37
	5	0,7	10	12	40	85	110	142	91
	5	1,5	4	3	10	21	27	35	22
	5	1,5	10	7	25	52	68	87	55
3S2	5	2,0	4	2	8	16	20	26	17
	5	2,0	10	6	19	40	51	66	43
	8	1,5	4	4	14	29	38	48	31
	8	1,5	10	10	34	72	93	120	77
	8	2,0	4	4	11	24	31	40	26
	8	2,0	10	9	28	60	77	100	64
	8	3,0	4	2	8	17	22	28	18
	8	3,0	10	6	20	42	55	71	45
	3	0,7	4	1	3	11	27	50	57
	3	0,7	10	2	9	28	67	126	140
	3	1,0	4	1	3	9	20	38	43
	3	1,0	10	2	8	21	50	95	107
	5	0,7	4	2	5	16	36	68	77
	5	0,7	10	4	12	38	90	170	190
	5	1,5	4	1	3	9	22	41	47
	5	1,5	10	2	7	23	55	104	116
4S3	5	2,0	4	1	2	7	17	32	36
	5	2,0	10	2	6	18	42	80	89
	8	1,5	4	1	4	13	31	57	65
	8	1,5	10	3	10	32	77	145	161
	8	2,0	4	1	3	11	26	49	55
	8	2,0	10	2	19	27	64	121	134
	8	3,0	4	1	3	8	18	34	38
	8	3,0	10	2	6	19	45	85	95

Ferroxcube
twin beads and wideband h.f. chokes

Ferroxcube twin beads for symmetrical transformers in TV antenna inputs guarantee good coupling and a very low noise component. For interference suppression problems with motors, ignition systems, or television, our wideband h.f. chokes wound on Ferroxcube can be the answer. Compared with air cored chokes, they have the following advantages:

- wideband
- small volume and no parasitic resonances
- no additional damping resistor is needed.

Dimensions (mm) and parameters

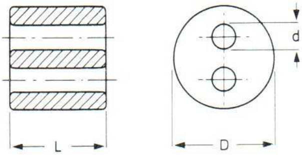


Fig. 1

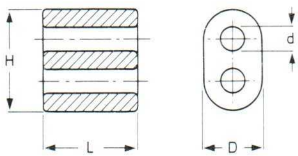
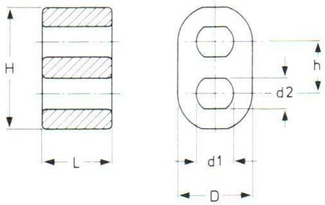


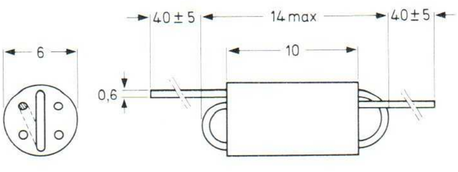
Fig. 2

Fig.	D	d	d_2	L	H	grade
	5,6	0,9	–	6,35	–	**4B1**
	5,6	0,95	–	4,5	–	**4D1**
1	5,9	0,75	–	12,4	–	**4B1**
	6,6	1,05	–	5	–	**4B1**
	6,6	1,05	–	12,4	–	**4B1**
	7,2	0,7	–	5,1	–	**4A1**
2	8,5	3,5	–	8	14	**4B1**
	8,5	3,5	–	14	14	**4B1**
3	8,6	2,6	3,45	8	13,8*	**4C6**

* h = 6 ± 0,25 mm

Fig. 3



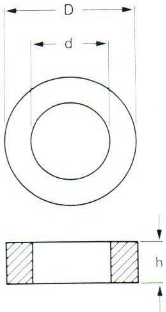


number of turns	Z_{max} kΩ	f at Z_{max} MHz	decrease of impedance: frequency range (MHz)	decrease of impedance: dB	grade
1,5	0,35 ± 20%	120	10-300	≤7	**3B**
1,5	0,45 ± 20%	250	80-300	≤3	**4B1**
2,5	0,75 ± 20%	50	10-220, 30-100	≤7, ≤3	**3B**
2,5	0,85 ± 20%	180	50-300, 80-220	≤6, ≤3	**4B1**
2 x 1,5	0,90 ± 20%	50	10-220, 30-100	≤7, ≤3	**3B**
2 x 1,5	1,00 ± 20%	110	50-300, 80-220	≤7, ≤3	**4B1**

toroids

Although toroids are well known for their use in pulse transformers and broadband transformers, you can also use them to advantage in interference suppression filter coils when the d.c. current is low. Having no air gap, they have little magnetic stray field, and a high permeability. Their losses are low due to the favourable properties of Ferroxcube. They are barrel finished and can be obtained in nylon insulated and non-coated versions.

Effective dimensions and mass



D x d x h of coated toroids mm	D x d x h of non-coated toroids mm	l_e mm	$\Sigma \frac{l_e}{A_e}$ mm^{-1}	V_e mm^3	mass g
4,3 x 1,9 x 1,4	4 x 2,2x 1,1	9,46	9,56	9,37	0,045
6,3 x 3,7 x 2,3	6 x 4 x 2	15,5	7,75	31,0	0,15
9,4 x 5,6 x 3,4	9 x 6 x 3	23,3	5,17	105	0,50
14,5 x 8,5 x 5,5	14 x 9 x 5	35,5	2,85	445	2,14
23,6 x 13,4 x 7,6	23 x 14 x 7	57,0	1,81	1790	8,6
29,6 x 18,4 x 8,1	29 x 19 x 7,5	75,0	2,01	2580	13
36,6 x 22,4 x 10,6	36 x 23 x 10	92,0	1,42	5600	29
36,6 x 22,4 x 15,6	36 x 23 x 15	92,0	0,942	8500	44

Grades and sizes

grade	μtor	colour coating	dimensions* mm
3E1	2700 ± 20% at 25°C	green	26 x 19 x 7,5
			36 x 23 x 10
			36 x 23 x 15
3E2	>5000 at +25 to +70°C	blue	4 x 2,2x 1,1
			6 x 4 x 2
			9 x 6 x 3
			14 x 9 x 5
			23 x 14 x 7
4C6	>100 at +5 to +55°C	violet	6 x 4 x 2
			9 x 6 x 3
			14 x 9 x 5
			23 x 14 x 7
			36 x 23 x 15

* These dimensions refer to non-coated toroids.

Ferroxcube
rod and tube cores

Rods can be effectively used for interference suppression because of their relatively high insensitivity to premagnetization. Tubes also, used in the same way as beads, may help you fulfil your specific suppression requirements.
Our preferred range is listed below; full range information in our Handbook.

Dimensions (mm)

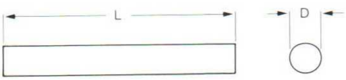
Rod cores

dia. group	length group	dia. tol. group	corresponding length
1,6	5-30	−0,2	5-30
		−0,05	5-8
		−0,03	5-8
2,0	5-30	−0,2	5-30
		−0,05	5-10
		−0,03	5-10
2,5	5-30	−0,25	5-30
		−0,05	5-10
3,1	5-30	−0,25	5-30
		−0,1	5-25
		−0,05	5-16
4,0	8-30	−0,3	8-30
		−0,1	8-30
		−0,05	8-20
5,0	10-50	−0,3	10-50
		−0,1	10-40
6,3	10-60	−0,3	10-60
		−0,1	10-45
10,0	20-100	−0,5	20-100

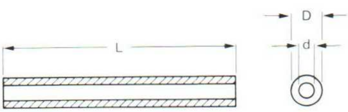
Tube cores

outer dia. group	length group	outer dia tol. group	corresponding length	inner dia	inner dia tol. group	grade
				min. inner dia 1,6	+0,15	
2,5	2,5-30	−0,3	2,5-30			3B
		−0,1	2,5-20			3C2
3,1	3 -30	−0,3	3 -30	≤2	+0,2	3C6
		−0,1	3 -25			3D3
		−0,05	3 -25			3H2
4,0	4 -40	−0,3	4 -40			4A4
		−0,1	4 -30	≤3	+0,2	4B1
		−0,05	4 -30			4C1
5,0	5 -50	−0,3	5 -50			4C6
		−0,1	5 -50	≤4	+0,3	4E1
		−0,05	5 -30			
6,3	10 -60	−0,3	10 -60			
		−0,1	10 -50			
8,0	20 -60	−0,4	20 -60			

Rod cores



Tube cores



Length tolerances

length	tolerance class coarse	fine
< 6	0 −0,4	0 −0,2
6-8	0 −0,5	0 −0,3
8-10	0 −0,6	0 −0,4
10-13	0 −0,7	0 −0,4
13-16	0 −0,8	0 −0,4
16-20	0 −0,9	0 −0,4
> 20	0 −4%	0 −0,4

notes

piezoelectric ceramics
principal properties

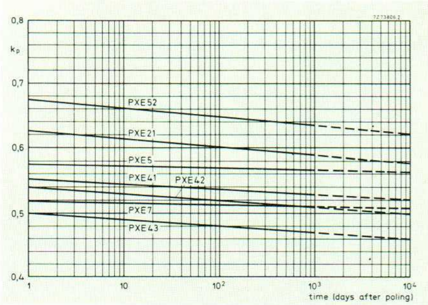
The following grades, consisting of modified lead zirconate titanates are distinguished according to their electrical and mechanical properties and field of application.

As we are optimizing the specific properties continuously, new grades may well be added to our existing range at any time.

We recommend that designers keep themselves informed of our latest technological developments.

The properties of components manufactured from PXE are dependent on the dimensions of the product and method of manufacture, and also on the measuring level. Therefore a meaningful interpretation of the properties of the material is best done in consultation with the supplier.

property and symbol		unit	PXE5
thermal data			
Curie temperature		°C	285
specific heat		J/kg °C	420
thermal conductivity		W/m °C	1,2
mechanical data			
density ϱ_m		10^3 kg/m^3	7,65
compliance	s_{33}^E	10^{-12}/Pa	17,2
	s_{11}^E		15,3
	s_{55}^E		38,5
Poisson's ratio σ			≈0,3
mechanical quality factor for radial mode Q_m^E			≈80
frequency constants	N_p^E	Hz m or m/s	2000
	$N_3^D = \frac{1}{2}v_3^D$		1900
	$N_1^E = \frac{1}{2}v_1^E$		1460
	$N_5^E = \frac{1}{2}v_5^E$		930
compressive strength		10^6 Pa	>600
tensile strength			≈80
electrical data			
relative permittivity	$\varepsilon_{33}^T/\varepsilon_0$		1800
($\varepsilon_0 = 8{,}85.10^{-12}$ F/m)	$\varepsilon_{11}^T/\varepsilon_0$		1800
resistivity ϱ_{el} (25°C)		10^{12} Ωm	1
time constant $\varrho_{el}\,\varepsilon_{33}^T$ (25 °C)		min	>250
dielectric loss factor tan δ		10^{-3}	20
electro-mechanical data			
coupling factor	k_p		0,60
	k_{33}		0,69
	k_{31}		0,35
	k_{15}		0,66
piezoelectric charge constants	d_{33}	10^{-12} C/N or m/V	362
	d_{31}		– 175
	d_{15}		515
piezoelectric voltage constants	g_{33}	10^{-3} Vm/N or m^2/C	22,7
	g_{31}		– 11,0
	g_{15}		32,5
time stability			
coupling factor k_p		relative change per time decade (%)	– 0,5
permittivity ε_{33}^T			– 1
frequency constant N_p^E			0,5
quality factor Q_m^E			
dielectric loss factor tan δ			



Stability as a function of time.

PXE52*	PXE7	PXE21	PXE41	PXE42	PXE43
170	320	270	315	325	300
420	420	420	420	420	420
1,2	1,2	1,2	1,2	1,2	1,2
7,80	7,75	7,75	7,90	7,70	7,70
19,8	15,8	18,6	14,6	15,3	12,6
15,1	12,5	15,1	12,2	12,7	11,3
	33,2		37,0		
0,3	≈0,3	≈0,3	≈0,3	≈0,3	0,3
≈50	≈80	≈80	≈1000	≈750	1000
2000	2200	2000	2200	2200	2350
1860	2000	1900	2000	2015	2050
	1640		1620		
	1025		950		
>600	>600	>600	>600	>600	>600
≈80	≈80	≈80	≈80	≈80	≈80
3500	820	1750	1200	1300	1000
	1200		1400		
	1	0,1	0,05		
	>100	>25	>7		
20	20	18	2,5	2,5	2
0,63	0,56	0,62	0,58	0,58	0,50
0,73	0,70	0,72	0,68	0,68	0,63
0,37	0,32	0,37	0,34	0,34	0,30
	0,64		0,70		
570	220	385	268	285	210
−250	−99	−180	−119	−130	−95
	405		480		
18,4	35,7	25,0	25,2	25,0	25,0
−8,1	−13,5	−11,6	−11,6	−11,0	−10,7
	38		38,5		
−0,7	−0,5	−1,5	−1,5	−2,5	−2
−2,5	−0,5	−1,5	1	−6,0	−4,5
+0,6	1,0	0,5	0,5	1,5	1
			10		
			−10		

Unless otherwise specified the values given are nominal ones measured at 20 ± 5 °C.

* Preliminary data.

piezoelectric ceramics
multimorph and bimorph flexure elements

Multimorph strips can be used for both mono and stereo high-output pick-up heads as well as for fine movement control and detection systems in industrial applications. Bimorph plates are used to transmit and receive ultrasound in air, movement detection, etc.

Multimorph elements

Maximum capacitance (pF): 52 x length in mm

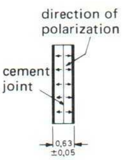
Maximum bending moment: $1{,}6 \times 10^{-3}$ Nm

Minimum bending moment to fracture: $7{,}5 \times 10^{-3}$ Nm

These **PXE5** elements are available in various lengths.

length (mm)	catalogue number outer electrode negative	positive
9,6	4322 020 04760	4322 020 04750
12,7	02480	02460
15,5	02490	02470
70	04830	–

Bimorph plates

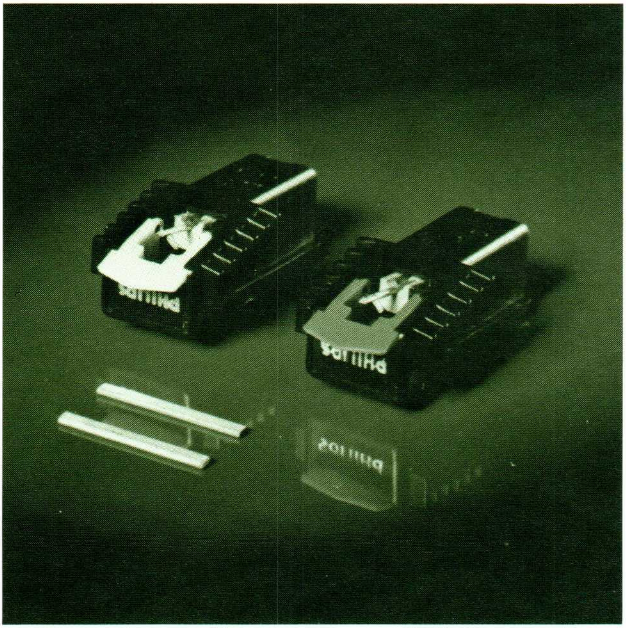


Resonance frequency: 34,5 ± 3,0 kHz

Capacitance at 1 kHz: 1450 ± 290 pF

Dimensions: 8 x 8 x 0,63 mm
Material grade: **PXE5**
Catalogue number: 4322 020 08120

Bimorph plates with other dimensions are available on request.

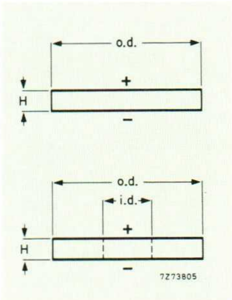


Stereo pick-up head with PXE multimorph elements.

high-intensity transducers

discs

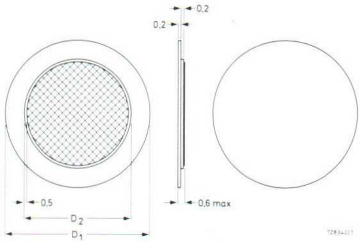
rings



The electrodes of the discs and rings are silver-plated. The direction of polarization is axial. The electrode which has been connected to the positive terminal of the polarization apparatus, is identified.

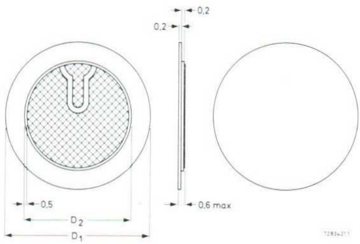
PXE41 underwater acoustics	**PXE42** ultrasonic cleaning	**PXE43** ultrasonic welding drilling machining	catalogue number
ø 20 x ø 6 x 5			4322 020 06170
	ø 20 x ø 6 x 5		06130
		ø 20 x ø 6 x 5	06290
ø 25,4 x ≈ 10,2 (200 kHz)			05750
ø 31,75 x ≈ 14,3 (151 kHz)			05240
	ø 38 x 6,35		05660
	ø 38,1 x ø 12,7 x 4		06090
	ø 38,1 x ø 12,7 x 6,35		06040
		ø 38,1 x ø 19,1 x 5	06160
	ø 38,1 x ø 19,1 x 6,35		06070
ø 50 x 3			05590
		ø 50 x ø 20 x 5	06150
	ø 50 x ø 20 x 6		06050
		ø 50 x ø 20 x 6	06140
	ø 50,5 x ø 17 x 6,35		06120

Discs glued on membrane



Material: **PXE52**

D_1 mm	D_2 mm	capacitance nF	catalogue number
12,5	10	6	4322 020 08860
20	16	15	4322 020 08820
27	20	25	4322 020 08840
35	25	40	4322 020 08850

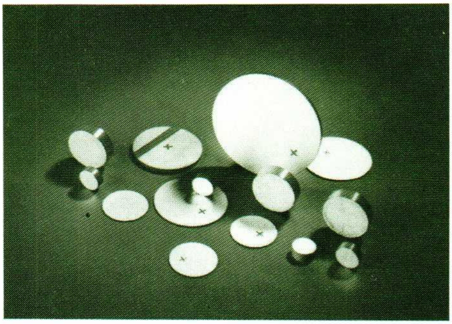


Material: **PXE52**

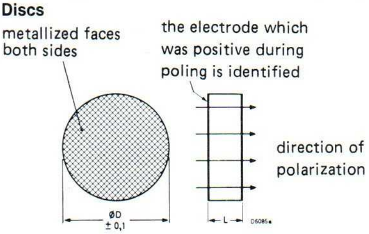
D_1 mm	D_2 mm	capacitance nF	catalogue number
20	16	12	4322 020 08870*
27	20	22	4322 020 08880*
35	25	35	4322 020 08890*

* Also available with concentric feedback electrode.

discs and plates



Discs

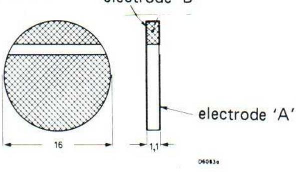


dimensions D x L (mm	catalogue number
3 x 0,5	4322 020 05250
5 x 0,2	05260
0,3	05270
0,5	05280
1	05300
2	05310
10 x 0,3	05330
0,5	05340
1	02330
2	05350
3	05360
5	05370

dimensions D x L (mm)	catalogue number
16 x 0,3	4322 020 05400
0,5	05410
1,1	02250
2	05420
3	02300
25,4 x 0,5	05430
1	05440
2	05450

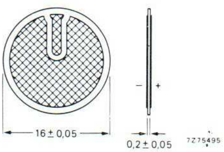
material grade: **PXE5**

Feedback discs



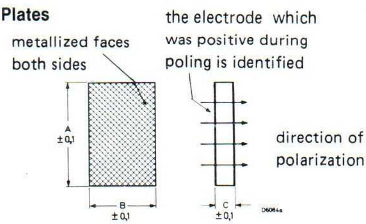
Polarity of electrode 'A' during poling:

negative, catalogue number 4322 020 02260
positive, catalogue number 4322 020 02270
Material grade: **PXE5**
Electrode 'B' is a wrap-around electrode.



Three-electrode disc for tone generation
catalogue number 4322 020 05963
Material grade: **PXE5**

Plates

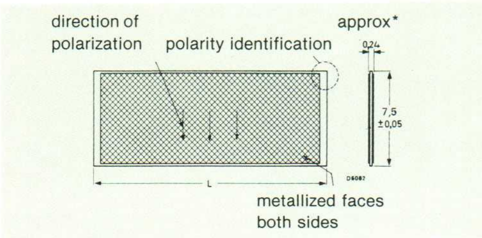


dimensions A x B x C (mm)	material grade	catalogue number
2,54 x 2,54 x 2,56	PXE21	4322 020 07310
6 x 4 x 0,5	PXE5	07150
12 x 6 x 0,5	PXE5	07050
12 x 6 x 1	PXE5	07060
16 x 12 x 1	PXE5	02310

piezoelectric ceramics
delay line transducers and material

Electro-mechanical transducers for converting electric signals to acoustic signals and vice versa after the signals have travelled through an acoustic delay medium.
Example: chrominance delay lines in colour tv.

Transducers

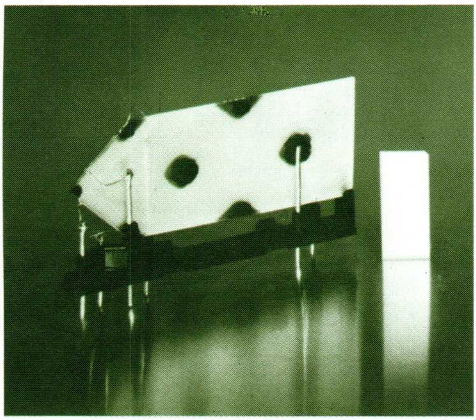


* Frequency of shear vibration:
4,1 MHz ± 0,1 MHz

dimansions L (mm)	catalogue number
29 ± 0,05	4322 040 02910

Material grade: **PXE7**

Typical delay line with plastic housing removed.



notes

notes

notes

notes

CONTENTS ELECTRON TUBES

For detailed information
Handbooks T1 to T11

special quality tubes

Pentodes, triodes and double triodes offer a choice from one or more special features:

- **long life**
- **shock and vibration resistant**
- **high reliability**

For detailed information
Handbook ET3

Pentodes

A wide range of pentodes for many areas of application.
All types are indirectly heated.
Life test for most types is 10 000 h.
Base fitting depends on tube type:

- octal
- noval
- magnoval
- miniature 7 pin
- subminiature

Applications in:

- a.f. and r.f. amplifiers, frequencies up to 400 MHz
- oscillators
- wide-band output tubes for television equipment, etc.
- mixers
- stabilized d.c. power supplies
- output stage for video amplifiers
- telephone equipment

Triodes

For amplifiers, oscillators and multivibrators, etc.
All types are indirectly heated.
Base fitting depends on tube type:

- noval
- subminiature

Double triodes

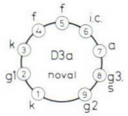
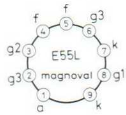
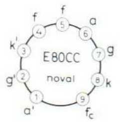
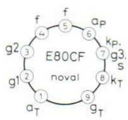
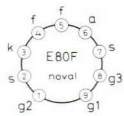
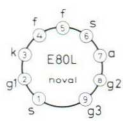
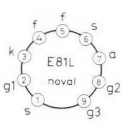
All types are indirectly heated.
Life test for most types is 10 000 h.
Many types have gold-plated pins.
Base fitting depends on tube type:

- noval
- miniature 7 to 10 pin

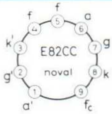
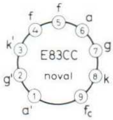
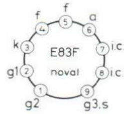
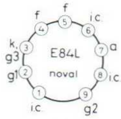
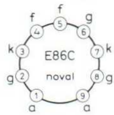
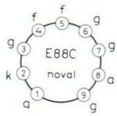
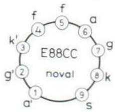
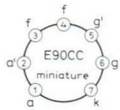
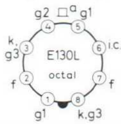
Applications in:

- h.f., i.f., a.f. and d.c. amplifiers
- cascade circuits
- mixers
- phase inverters
- multivibrators
- computer circuits

a.f. pentode E80F

D3a wide-band pentode	$V_f = 6{,}3$ V $I_f = 0{,}315$ A	$V_{ba} = 190$ V $V_{bg2} = 160$ V $V_{g3} = 0$ V $V_{bg1} = +10$ V	$R_k = 400\ \Omega$ $I_a = 22$ mA $I_{g2} = 6$ mA $S = 35$ mA/V	$R_i = 120$ kΩ $\mu_{g2g1} = 80$ $R_{eq} = 150\ \Omega$	
E55L wide-band output pentode	$V_f = 6{,}3$ V $I_f = 0{,}6$ A	$V_a = 125$ V $V_{g2} = 125$ V $V_{g1} = -3$ V	$V_{g3} = 0$ V $I_a = 50$ mA $I_{g2} = 5{,}5$ mA	$S = 45$ mA/V $R_i = 20$ kΩ $\mu_{g2g1} = 30$ $W_a = \max 10$ W	
E80CC	$V_f = 6{,}3$ V $I_f = 0{,}6$ A or $V_f = 12{,}6$ V $I_f = 0{,}3$ A	$V_a = 250$ V $R_k = 920\ \Omega$	$I_a = 6$ mA $S = 2{,}7$ mA/V	$R_i = 10$ kΩ $\mu = 27$	
E80CF	$V_f = 6{,}3$ V $I_f = 0{,}33$ A	Pentode $V_{ba} = 170$ V $V_{bg2} = 170$ V $R_k = 155\ \Omega$	 $I_a = 10$ mA $I_{g2} = 2{,}8$ mA $S = 6{,}2$ mA/V	 $R_i = 0{,}4$ MΩ $\mu_{g2g1} = 40$	
		Triode $V_{ba} = 100$ V $R_k = 120\ \Omega$	 $I_a = 14$ mA $S = 5$ mA/V	 $R_i = 3{,}6$ kΩ $\mu = 18$	
E80F a.f. pentode	$V_f = 6{,}3$ V $I_f = 0{,}3$ A	Operating $V_{ba} = 250$ V $V_{bg2} = 250$ V $R_a = 0{,}22$ MΩ $R_{g2} = 1{,}2$ MΩ	 $R_k = 1{,}5$ kΩ $R_{g1} = 1$ MΩ $R_{g1'} = 0{,}68$ MΩ	 $I_a = 0{,}8$ mA $I_{g2} = 0{,}17$ mA $V_o/V_i = 175$	
E80L	$V_f = 6{,}3$ V $I_f = 0{,}7$ A	Operating as class-A power amplifier $V_a = 200$ V $V_{g2} = 200$ V $V_{g3} = 0$ V $R_k = 130\ \Omega$	 $I_a = 30$ mA $I_{g2} = 4{,}1$ mA	 $R_{a\sim} = 7$ kΩ $W_o = 2{,}7$ W $d_t = 10\%$ $W_a = \max 8$ W	
E81L	$V_f = 6{,}3$ V $I_f = 0{,}375$ A	Operating as class-A power amplifier $V_a = 210$ V $V_{g2} = 210$ V $V_{g3} = 0$ V $R_k = 120\ \Omega$	 $I_a = 20$ mA $I_{g2} = 5{,}3$ mA	 $R_{a\sim} = 15$ kΩ $W_o = 1$ W $d_t = 5\%$ $W_a = \max 4{,}5$ W	

special quality tubes

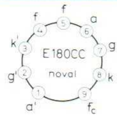
E82CC	$V_f = 6{,}3$ V $I_f = 0{,}3$ A or $V_f = 12{,}6$ V $I_f = 0{,}15$ A	$V_a = 250$ V $R_k = 800\ \Omega$	$I_a = 10{,}5$ mA $S = 2{,}2$ mA/V	$R_i = 7{,}7$ kΩ $\mu = 17$	
E83CC	$V_f = 6{,}3$ V $I_f = 0{,}3$ A or $V_f = 12{,}6$ V $I_f = 0{,}15$ A	$V_a = 250$ V $R_k = 1{,}6$ kΩ	$I_a = 1{,}25$ mA $S = 1{,}6$ mA/V	$R_i = 62{,}5$ kΩ $\mu = 100$	
E83F	$V_f = 6{,}3$ V $I_f = 0{,}3$ A	$V_a = 210$ V $V_{g2} = 120$ V $V_{g3} = 0$ V $R_k = 165\ \Omega$	$I_a = 10$ mA $I_{g2} = 2{,}1$ mA $S = 9$ mA/V	$R_i = 0{,}5$ MΩ $\mu_{g2g1} = 38$ $R_{eq} = 750\ \Omega$	
E84L	$V_f = 6{,}3$ V $I_f = 0{,}76$ A	Operating as class-A power amplifier $V_a = 250$ V $V_{g2} = 250$ V $R_k = 135\ \Omega$	 $I_a = 48$ mA $I_{g2} = 5{,}5$ mA	 $R_{a\sim} = 4{,}5$ kΩ $W_o = 5{,}7$ W $d_t = 10\%$ $W_a = \max\ 13{,}5$ W	
E86C u.h.f. triode	$V_f = 6{,}3$ V $I_f = 0{,}165$ A	$V_{ba} = 185$ V $V_{bg} = +8$ V $R_k = 800\ \Omega$	$I_a = 12$ mA $S = 14$ mA/V $R_i = 4{,}8$ kΩ	$\mu = 68$ $R_{eq} = 250\ \Omega$ f up to 800 MHz	
E88C u.h.f. triode	$V_f = 6{,}3$ V $I_f = 0{,}165$ A	$V_a = 160$ V $V_g = -1{,}25$ V	$I_a = 12{,}5$ mA $S = 13{,}5$ mA/V $R_i = 5{,}2$ kΩ	$\mu = 70$ $R_{eq} = 240\ \Omega$ f up to 1000 MHz	
E88CC	$V_f = 6{,}3$ V $I_f = 0{,}3$ A	$V_{ba} = 100$ V $V_{bg} = +9$ V $R_k = 680\ \Omega$	$I_a = 15$ mA $S = 12{,}5$ mA/V	$\mu = 33$ $R_{eq} = 300\ \Omega$	
E90CC double triode for computer application	$V_f = 6{,}3$ V $I_f = 0{,}4$ A	$V_a = 100$ V $V_g = -2{,}1$ V	$I_a = 8{,}5$ mA $S = 6$ mA/V	$R_i = 4{,}5$ kΩ $\mu = 27$	
E130L	$V_f = 6{,}3$ V $I_f = 1{,}7$ A	Operating as class-A power amplifier $V_a = 250$ V $V_{g2} = 150$ V $V_{g1} = -15{,}5$ V	 $I_a = 100$ mA $I_{g2} = 18$ mA	 $R_{a\sim} = 2{,}7$ kΩ $W_o = 11{,}5$ W $d_t = 10\%$ $W_a = \max\ 27{,}5$ W	

special quality tubes

Pentode E83F

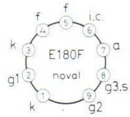
E180CC
double triode for computer application

$V_f = 6,3$ V, $I_f = 0,4$ A or $V_f = 12,6$ V, $I_f = 0,2$ A
$V_a = 150$ V, $V_g = -1,85$ V
$I_a = 8,5$ mA, $S = 6,4$ mA/V
$R_i = 7,2$ kΩ, $\mu = 46$



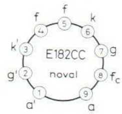
E180F
wide-band pentode

$V_f = 6,3$ V, $I_f = 0,3$ A
$V_{ba} = 190$ V, $V_{bg2} = 160$ V, $V_{g3} = 0$ V, $V_{bg1} = +9$ V
$R_k = 630$ Ω, $I_a = 13$ mA, $I_{g2} = 3,3$ mA, $S = 16,5$ mA/V
$R_i = 90$ kΩ, $\mu_{g2g1} = 50$, $R_{eq} = 330$ Ω



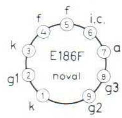
E182CC
double triode for computer application

$V_f = 6,3$ V, $I_f = 0,64$ A or $V_f = 12,6$ V, $I_f = 0,32$ A
$V_a = 120$ V, $V_g = -2$ V
$I_a = 36$ mA, $S = 15$ mA/V
$R_i = 1,6$ kΩ, $\mu = 24$



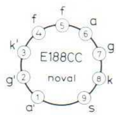
E186F
wide-band pentode

$V_f = 6,3$ V, $I_f = 0,32$ A
$V_{ba} = 190$ V, $V_{bg2} = 160$ V, $V_{g3} = 0$ V, $V_{bg1} = +9$ V
$R_k = 630$ Ω, $I_a = 13$ mA, $I_{g2} = 3,3$ mA, $S = 16,5$ mA/V
$R_i = 100$ kΩ, $\mu_{g2g1} = 53$, $R_{eq} = 330$ Ω



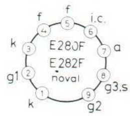
E188CC

$V_f = 6,3$ V, $I_f = 0,335$ A
$V_{ba} = 100$ V, $V_{bg} = +9$ V, $R_k = 680$ Ω
$I_a = 15$ mA, $S = 12,5$ mA/V
$\mu = 33$, $R_{eq} = 250$ Ω



E280F
wide-band pentode

$V_f = 6,3$ V, $I_f = 0,315$ A
$V_{ba} = 190$ V, $V_{bg2} = 160$ V, $V_{g3} = 0$ V, $V_{bg1} = +8$ V
$R_k = 370$ Ω, $I_a = 20$ mA, $I_{g2} = 6$ mA, $S = 26$ mA/V
$R_i = 100$ kΩ, $\mu_{g2g1} = 60$, $R_{eq} = 220$ Ω

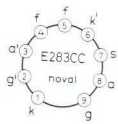


E282F
wide-band pentode

$V_f = 6,3$ V, $I_f = 0,35$ A
$V_{ba} 125$ V, $V_{bg2} = 125$ V, $V_{g3} = 0$ V, $V_{bg1} = +12$ V
$R_k = 300$ Ω, $I_a = 35$ mA, $I_{g2} = 11$ mA
$S = 26$ mA/V, $\mu_{g2g1} = 27$, $R_{eq} = 200$ Ω

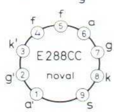
E283CC
a.f. double triode

$V_f = 6,3$ V, $I_f = 0,33$ A
Operating $V_{ba} = 250$ V, $R_a = 47$ kΩ, $R_k = 1,2$ kΩ
$I_a = 1,18$ mA, $V_o/V_i = 37,5$



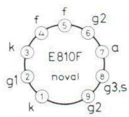
E288CC
r.f. double triode

$V_f = 6,3$ V, $I_f = 0,475$ A
$V_{ba} = 100$ V, $V_{bg} = +9$ V, $R_k = 350$ Ω
$I_a = 30$ mA, $S = 20$ mA/V, $R_i = 1,25$ kΩ
$\mu = 25$, $R_{eq} = 200$ Ω



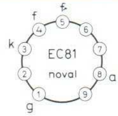
E810F
wide-band pentode

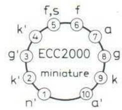
$V_f = 6,3$ V, $I_f = 0,34$ A
$V_{ba} = 135$ V, $V_{bg2} = 165$ V, $V_{g3} = 0$ V, $V_{bg1} = +12,5$ V
$R_k = 360$ Ω, $I_a = 35$ mA, $I_{g2} = 5$ mA, $S = 50$ mA/V
$R_i = 42$ kΩ, $\mu_{g2g1} = 57$, $R_{eq} = 110$ Ω

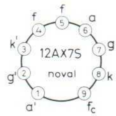


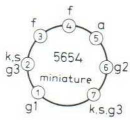
special quality tubes

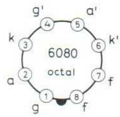
EC81 u.h.f. osc. triode	$V_f = 6{,}3$ V $I_f = 0{,}175$ A	$V_a = 150$ V $V_g = -2$ V	$I_a = 30$ mA $S = 5{,}5$ mA/V	$\mu = 16$ f up to 750 MHz
ECC2000 v.h.f. double triode	$V_f = 6{,}3$ V $I_f = 0{,}335$ A	$V_a = 90$ V $V_g = -1{,}4$ V $V_{a'} = 90$ V $V_{g'} = -1{,}4$ V $V_{Sn'} = 0$ V	$I_a = 27$ mA $S = 22$ mA/V $I_a = 27$ mA $S = 17{,}5$ mA/V	$\mu = 28$ $R_{eq} = 150\ \Omega$ $\mu = 27$ $R_{eq} = 200\ \Omega$
12AX7S a.f. double triode	$V_f = 6{,}3$ V $I_f = 0{,}3$ A or $V_f = 12{,}6$ V $I_f = 0{,}15$ A	$V_a = 250$ V $V_g = -2$ V	$I_a = 1{,}2$ mA $S = 1{,}6$ mA/V	$R_i = 62{,}5$ kΩ $\mu = 100$
5654 wide-band pentode	$V_f = 6{,}3$ V $I_f = 0{,}175$ A	$V_a = 120$ V $V_{g2} = 120$ V $V_{g1} = -2$ V	$I_a = 7{,}5$ mA $I_{g2} = 2{,}5$ mA	$S = 5$ mA/V $R_i = 0{,}34$ MΩ
6080 double triode series reg.	$V_f = 6{,}3$ V $I_f = 2{,}5$ A	$V_a = 100$ V $R_k = 300\ \Omega$	$I_a = 100$ mA $S = 6{,}5$ mA/V	$R_i = 300\ \Omega$ $\mu = 2$ $W_a =$ max 13 W
6189 double triode	$I_f = 6{,}3$ V $I_f = 0{,}3$ A or $V_f = 12{,}6$ V $I_f = 0{,}15$ A	$V_a = 250$ V $V_g = -8{,}5$ V	$I_a = 10{,}5$ mA $S = 2{,}2$ mA/V	$\mu = 17$
6201 double triode	$V_f = 6{,}3$ V $I_f = 0{,}3$ A or $V_f = 12{,}6$ V $I_f = 0{,}15$ A	$V_a = 250$ V $R_k = 200$ kΩ	$I_a = 10$ mA $S = 5{,}5$ mA/V	$R_i = 10{,}9$ kΩ $\mu = 60$
18042 pentode	$V_f = 18$ V $I_f = 0{,}1$ A	$V_a = 210$ V $V_{g2} = 120$ V $V_{g3} = 0$ V $R_k = 165\ \Omega$	$I_a = 10$ mA $I_{g2} = 2{,}1$ mA $S = 9$ mA/V	$R_i = 0{,}5$ MΩ $\mu_{g2g1} = 38$ $R_{eq} = 750\ \Omega$
18045 output pentode	$V_f = 18$ V $I_f = 0{,}13$ A	Operating as class-A power amplifier $V_a = 210$ V $V_{g2} = 210$ V $V_{g3} = 0$ V $R_k = 120\ \Omega$	 $I_a = 20$ mA $I_{g2} = 5{,}3$ mA $S = 11$ mA/V	 $R_{a\sim} = 15$ kΩ $\mu_{g2g1} = 36$ $W_o = 1$ W $d_t = 5\%$ $W_a =$ max 4,5 W

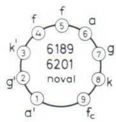


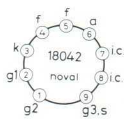


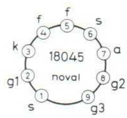




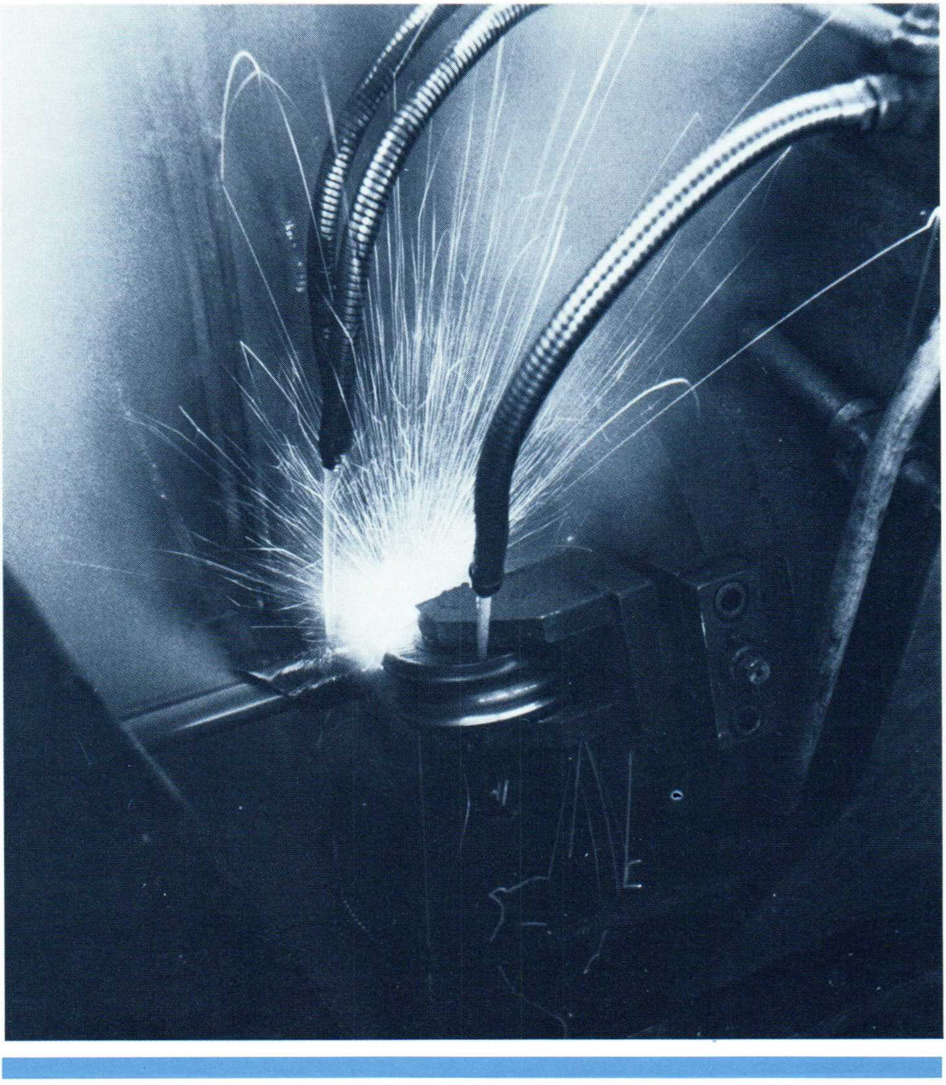








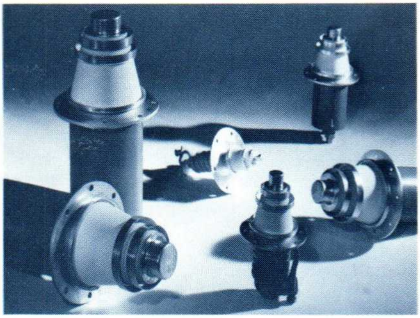
A single YD1202 supplies the r.f. heating coil of this induction welding machine, which makes pipes from flat strip. (Courtesy of Neirotti s.p.a., Villa Nova d'Asti, Italy.)



tubes for r.f. heating

COOLING: FA = forced air, N = natural, W = water, WH = water (helix), V = vapour

type	status	oscillator output power kW	cooling	frequency at full ratings max. MHz	V_f V	I_f A	V_a kV	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
TBL2/300	C	**0,27**	FA	470	3,4	19	1,75	0,34	1,8	0,3	72 × 41,5
TB2.5/300 **TB2.5/400**	C	**0,29**	N	40 50	6,3	5,4 5,8	2	0,17	2,5 2,7	0,135 0,15	133 × 62
TBL2/400	C	**0,34**	FA	470	3,4	19	2	0,38	2,2	0,4	81 × 41,5
TB3/750	C	**0,9**	N	50	5	14,1	3,5	0,325	3,8	0,35	151 × 87
TB4/1250	C	**1,55**	N	100	10	9,9	4	0,535	4	0,45	213 × 118
TB4/1500	C	**1,58**	N	50	5	32,5	5	0,43	7	0,5	240 × 130
YD1240 **YD1244**	D	**2,67**	FA	250	6,3	33	5	0,75	5,5	1,5	173 × 67,5 173 × 109,5
TB5/2500	C	**2,73**	N	50	6,3	32,5	6	0,6	7	0,8	256 × 155
YD1352S	D	**3**	WH	5	5	6,1	5	0,8	5	2	165 × 41,7
TBL6/4000	C	**4**	FA	50	6,3	65	7	0,9	8	1,7	177,5 × 86
YD1150 **YD1152**	D	**4,75**	FA WH	85	6,3	33	5	1	7,2	2,5	173 × 122,8 207 × 131
TBH7/8000 **TBL7/8000** **TBW7/8000**	C	**6**	WH FA W	50	12,6	33	6	1,5	7	6	219 × 130 195 × 122,6 190 × 70,5
TBH6/6000 **TBL6/6000** **TBW6/6000**	C	**6,9**	WH FA W	50	12,6	33	6	1,5	6	6 5 6	219 × 130 195 × 122,6 190 × 70,5
TBH7/9000 **TBL7/9000** **TBW7/9000**	C	**7,2**	WH FA W	50	12,6	33	7,2	1,5	8	6	211 × 130 186 × 122,6 224 × 86
YD1160 **YD1161** **YD1162**	D	**8,8**	FA W WH	85	6,3	66	6,5	1,8	7,2	5	192 × 122,8 192 × 62 227 × 131
TAW12/20	M	**9,5**	W	28	21,5	80	10	1,4	12	18	578 × 163
YD1173	D	**13,2**	FA	50	5,4	65	10	1,75	12	10	219 × 160



type	status	oscillator output power kW	cooling	frequency at full ratings max. MHz	V_f V	I_f A	V_a kV	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
YD1170 **YD1172**	D	**15,4**	FA WH	120	5,8	130	6	3,4	7,2	10	219 × 160 223 × 115
TBH6/14 **TBL6/14** **TBW6/14**	C	**17,7**	WH FA W	30	6,3	136	7	3,5	8	15 10 15	351 × 185 315 × 163 330 × 163
TBH12/25 **TBL12/25** **TBW12/25**	C	**25**	WH FA W	30	8	98	12	3,2	13	20 15 20	410 × 185 386 × 198 376 × 190
YD1175 **YD1177**	D	**26,2**	FA WH	120	5,8	130	10	3,4	12	10 15	219 × 160 244 × 131
TBH12/38 **TBL12/38** **TBW12/38**	C	**30**	WH FA W	30	8	130	12	4,5	13	20 15 20	422 × 190 404 × 192 422 × 190
YD1180 **YD1182**	D	**31,6**	FA WH	100	7	175	7,5	5,4	9	15 20	241 × 192 292 × 130,5
YD1185 **YD1186** **YD1187**	D	**50**	FA FA WH	100	7	175	12	5,33	14,4	15 15 20	241 × 192 241 × 192 292 × 130,5
YD1192	D	**62,7**	WH	100	8,4	235	8	10	9,6	40	351 × 160,5
YD1195	D	**90**	FA	30	8,4	235	12	9,75	14,4	30	294 × 216
YD1197	D	**108**	WH	30	8,4	235	12	12	15	50	351 × 160,5
YD1202	D	**163**	WH	30	12,2	250	12	18	15	80	460 × 191
YD1212	D	**240**	WH	30	12,6	380	14	23,5	16,8	120	460 × 191
YD1010 **YD1012**	C	**280**	W V	30	18	280	12	29	16	120 180	656 × 218 650 × 315
YD1432	D	**374**	WH	30	14	555	12	40	15	180	605 × 191
YD1342	D	**480**	WH	30	14	555	16	42	19,5	240	625 × 230

transmitting tubes
telegraphy and f.m. broadcast service

COOLING: **FA = forced air** **WH = water (helix)**
N = natural **V = vapour**
W = water **H = heatsink**

Triodes — class C

type	status	output power kW	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
TB2.5/300	C	**0,39**	N	75	6,3	5,4	2,5	0,2	2,5	0,135	132 × 62
TB2.5/400				150		5,8			3	0,15	
TBL2/300		**0,48**		175			2,5	0,26	2,5	0,3	72 × 41,5
TBL2/400	C	**0,6**	FA	900	3,4	19	2	0,4	2,2	0,4	83 × 41,5
TBL2/500		**0,67**		400			2,5	0,38	2,7	0,5	83 × 41,5
TB3/750	C	**1,2**	N	100	5	14,1	4	0,38	4	0,35	151 × 87
TB4/1250		**1,69**			10	9,9		0,54		0,45	213 × 118
TBH6/6000			WH							6	219 × 130
TBL6/6000	C	**6,9**	FA	75	12,6	33	6	1,5	6	5	195 × 122,6
TBW6/6000			W							6	190 × 70,5
TBL7/8000	C	**9,5**	FA	30	12,6	33	6,5	2	7,2	6	195 × 122,6
TBW7/8000			W								190 × 70,5
TBL6/20	M	**17**	FA	110	6,3	154	5	4,8	5,5	10	277 × 169,5
TAW12/20	M	**22**	W	28	21,5	80	12	2,7	12	18	578 × 163
TBL12/40	C	**41**	FA	30	8	130	12	4,5	13	15	404 × 225
YD1000			W							45	380 × 140
YD1001	C	**120**	FA	10	12,6	160	15	9,8	16	35	380 × 300
YD1002			V							60	380 × 218
YD1010	C	**360**	W	10	18	280	15	29,3	15	120	656 × 218
YD1012			V							180	650 × 315

Tetrodes

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
QE05/40 **QE05/40F** **QE05/40H** **QE05/40K**	M	**52**	N	60	6,3 12,6 26,5 13,5	1,25 0,625 0,3 0,585	0,6	150	112	0,6	20	97 × 44 96 × 44 97 × 44 96,8 × 42,1
YL1250	M	**52**	N	75	6,75 13,5	1,2 0,6	0,55	235	136	0,55	25	59 × 44,5
YL1370 **YL1371** **YL1372**	M	**63**	N	60	6,3 12,6 26,5	1,125 0,562 0,3	0,6	200	150	0,6	27	96 × 44
QC05/35	M	**65**	N	60	1,6	3,2	0,6	180	150	0,65	25	97 × 44
YL1100 **YL1101**	M	**80**	FA	1200	26,5 6,3	0,52 2,1	0,9	300	170	1	115	49,6 × 32,2
QB3/200	C	**280**	N	50	6	3,5	3	250	115	3	65	111 × 60,5
QE08/200 **QE08/200H**	C	**290**	N	30	6,3 26,5	3,9 0,85	1	250	385	1,1	100	150 × 72
QEL1/150 **QEL1/150H**	C	**370**	FA	150	6 26,5	2,6 0,58	2	250	250	2	250	62,7 × 41,7
7609	C	**370**	FA	150	26,5	0,58	2	250	250	2	250	62,7 × 41,7
QB3/300 **QB3/300GA**	C	**375**	N	120	5	6,5	3	350	167	3	125	130,8 × 62 144 × 69,1
QEL2/275 **QEL2/275H**	C	**390**	FA	500	6 26,5	2,6 0,58	2	250	250	2	250	62,7 × 41,7
YL1110	M	**730**	FA	1215	6,3	7,85	2,5	400	500	2,5	700	61 × 53,1
QBL4/800	C	**930**	FA	120	5	13,5	4	500	315	4	500	120 × 67
QB3.5/750 **QB3.5/750GA**	C	**1000**	N	75	5	14,1	4	500	310	4	250	151,8 × 87 161 × 87
QB4/1100 **YL1460**	C	**1100**	N	110	5	14,1	4	500	350	4	400	151,5 × 100

transmitting tubes

telegraphy and f.m. broadcast service

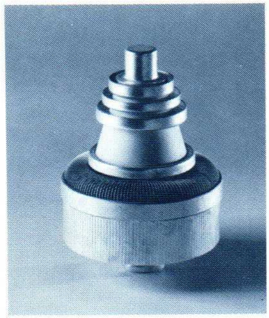
COOLING: FA = forced air
N = natural
W = water
WH = water (helix)
V = vapour
H = heatsink

Tetrodes (cont.)

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
QB4/1100GA **YL1461**	C	**1100**	N	110	5	14,1	4	500	350	4	400	161 × 87
QB5/1750	C	**1760**	N	75	10	9,9	5	600	440	5	500	209 × 118
QBL3.5/2000		**2100**	FA	1000	3,6	58	4,3	600	850	4,5	1500	215 × 89
YL1540	D	**2200**	FA	260	4,2	53	4	700	1200	4,2	1800	122 × 63
QB5/2000 **YL1440**	C D	**2400**	N FA	30 260	7,5 4,2	22,6 53	5 3	600	600 980	5,5 4	800 1500	248 × 153 125 × 63
QBL5/3500 **QBW5/3500**	C	**4100**	FA W	75	6,3	32,5	5	800	1100	5	3 kW	169 × 97 160 × 70,5
YL1420 **YL1470**	D	**11 kW**	FA	260	6,3	120	7	600	2300	8,5	6 kW 8 kW	174 × 125,1
YL1430	D	**18 kW**	FA	260	8	120	8	700	3500	9,5	12 kW	211 × 164,2
YL1520	D	**25 kW**	FA	260	11,5	120	8,5	700	4600	9,5	18 kW	225 × 164,2

Pentodes

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a V	V_{g2} V	I_a mA	V_a max. V	W_a max. W	h × dia. max. mm
PE06/40E **PE06/40N** **PE06/40P**	M	**45**	N	20	12,6 6,3 6,3	0,65 1,3 1,3	600	300	110	600	25	146 × 51 146 × 51 134 × 51
PE1/100	C	**132**	N	60	12,6	1,3	1000	250	177	1000	45	100 × 47



YL1470

Double tetrodes

type	status	output power (W)	cooling	f at full ratings max. (MHz)	V_f (V)	I_f (A)	V_a (V)	V_{g2} (V)	I_a (mA)	V_a max. (V)	W_a max. (W)	h × dia. max. (mm)
QQE02/5	M	**5,8**	N	500	6,3 12,6	0,6 0,3	180	180	27,5	250	3	66,7 × 22
YL1220	M	**5,8**	N	500	6,75 13,5	0,56 0,28	180	180	27,5	250	3	66,7 × 22
QQE04/5	M	**7**	N	960	6,3 12,6	0,6 0,3	250	160	35	400	8	63 × 44,5
YL1360	M	**7**	N	960	13,5	0,28	250	160	35	400	8	63 × 44,5
QQC03/14 [1]	M	**11**	N	200	3,15	1,65	250	160	45	300	7	77,8 × 22
QQE03/12	M	**12**	N	200	6,3 12,6	0,82 0,41	300	175	37,5	300	5	78 × 22
YL1210	M	**12**	N	200	6,75 13,5	0,72 0,36	300	175	37,5	300	5	78 × 22
YL1130 [1]	M	**13**	N	200	1,1	2,9	275	170	42,5	300	4	72,9 × 22
YL1240	M	**21**	N	200	6,75 13,5	0,8 0,4	400	180	45	400	7,5	82,7 × 30,1
QQE04/20	M	**26**	N	200	6,3 12,6	1,6 0,8	750	200	24	750	7,5	84 × 51
YL1190 [1]	M	**26**	N	200	1,1	4,2	350	132	70	400	8	73,9 × 30,2
QQC04/15 [1]	M	**26,6**	N	186	3,15 6,3	1,36 0,68	600	200	30	600	6	100 × 32
YL1020 [1]	M	**35**	N	200	1,6	4	600	250	50	600	10	86 × 46
YL1030 [1]	M	**45**	N	200	2,1	4,5	400	250	100	750	20	106 × 46
QQE03/20 **QQE03/32**	M	**48**	N	200	6,3 12,6	1,3 0,65	600	250	50	600	10	85,5 × 46
QQE06/40	M	**90**	N	250	6,3 12,6	1,8 0,9	600	250	100	750	20	108,5 × 49
YL1060	M	**132**	N	175	6,3 12,6	1,8 0,9	900	245	110	1000	30	103 × 44,6

[1]) Quick heating.

transmitting tubes

a.m. broadcast service

COOLING: FA = forced air
N = natural
W = water
WH = water (helix)
V = vapour
H = heatsink

Triodes — r.f. class C modulation

type	status	output power	cooling	f at full ratings max.	V_f	I_f	V_a	I_a	V_a max.	W_a max.	h × dia. max.
		kW		MHz	V	A	kV	A	kV	kW	mm
TB2.5/300		**0,204**	N	75	6,3	5,4	2	0,128	2,5	0,135	132,8 × 62
TB2.5/400	C	**0,205**	N	150	6,3	5,8	2	0,128	2,4	0,1	132 × 62
TBL2/300		**0,505**	FA	175	3,4	19	2	0,335	2	0,2	72 × 41,5
TB4/1250		**1,05**	N	100	10	9,9	3	0,45	3	0,3	213 × 118
TBL6/6000	C	**4,7**	FA	75	12,6	33	5	1,2	5	4	195 × 122,6
TBW6/6000			W								190 × 70,5
TAW12/20	M	**9,5**	W	28	21,5	80	10	1,4	12	18	578 × 163
TBL12/40	C	**27,5**	FA	30	8	130	10	3,5	10	10	404 × 225
YD1000			W								380 × 140
YD1001	C	**66**	FA	30	12,6	160	11	7,6	11,5	30	380 × 300
YD1002			V								380 × 218
YD1010	C	**165**	W	30	18	280	11	19	11	80	656 × 218
YD1012										120	650 × 315
YL1640	D	**125**	W	30	10	280	11	15	13	150	515 × 270
YL1660		**520**			23	500	12	54	13,5	500	572 × 260

Pentodes — r.f. class C anode and screen-grid modulation

type	status	output power	cooling	f at full ratings max.	V_f	I_f	V_a	V_{g2}	I_a	V_a max.	W_a max.	h × dia. max.
		W		MHz	V	A	V	V	mA	V	W	mm
PE06/40E					12,6	0,65						146 × 51
PE06/40N	M	**40**	N	20	6,3	1,3	500	100	114	600	25	146 × 51
PE06/40P					6,3	1,3						134 × 51
PE1/100	C	**75**	N	60	12,6	1,3	800	250	120	1000	45	108 × 47

Tetrodes — r.f. class C anode and screen-grid modulation

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
QC05/35	M	**34**	N	60	1,6	3,2	0,475	135	94	0,48	14	97 × 44
QE05/40 **QE05/40F** **QE05/40H** **QE05/40K**	M	**34**	N	60	6,3 12,6 26,5 13,5	1,25 0,625 0,3 0,58	0,475	135	94	0,48	13,3	97 × 44
YL1370 **YL1371** **YL1372**	M	**42**	N	60	6,3 12,6 26,5	1,125 0,562 0,3	0,475 0,475	165	125	0,48	18	96 × 44
YL1100 **YL1101**	M	**45**	FA	1200	26,5 6,3	0,52 2,1	0,7	250	130	0,8	75	49,6 × 32,2
QE08/200 **QE08/200H**	C	**130**	N	30	6,3 26,5	3,9 0,85	0,6	250	300	0,65	67	150 × 72
QB3/200	C	**230**	N	150	6	3,5	2,5	250	110	2,5	45	111 × 60,5
QEL1/150 **QEL1/150H**	C	**230**	FA	150	6 26,5	2,6 0,58	1,6	250	200	1,6	165	62,7 × 41,7
7609	C	**230**	FA	150	26,5	0,58	1,6	250	200	1,6	165	62,7 × 41,7
QEL2/275 **QEL2/275H**	C	**235**	FA	500	6 26,5	2,6 0,58	1,5	250	200	1,5	165	62,7 × 41,7
QB3/300 **QB3/300GA**	C	**300**	N	120	5	6,5	2,5	350	152	2,5	83	130,8 × 64 144 × 69,1
QB3.5/750 **QB3.5/750GA**	C	**510**	N	75	5	14,1	3	400	225	3,2	165	151,8 × 87 161 × 87
YL1110	M	**600**	FA	1215	6,3	7,85	2	400	500	2	400	61 × 53,1
QB4/1100GA **YL1461**	C	**630**	N	75	5	14,1	3	500	275	3,2	270	151,5 × 100
QB4/1100 **YL1460**	C	**630**	N	75	5	14,1	3	500	275	3,2	270	161 × 87
QB5/1750	C	**1200**	N	75	10	9,9	4	600	380	4	330	209 × 118
QBL5/3500 **QBW5/3500**	C	**2700**	FA W	110	6,3	32,5	4	800	900	4	2000	169 × 97 160 × 70,5
YL1010 **YL1012**	C	**55 kW**	W V	30	10	200	10	800	7,4 A	10	20 kW 30 kW	306,5 × 140 315 × 218

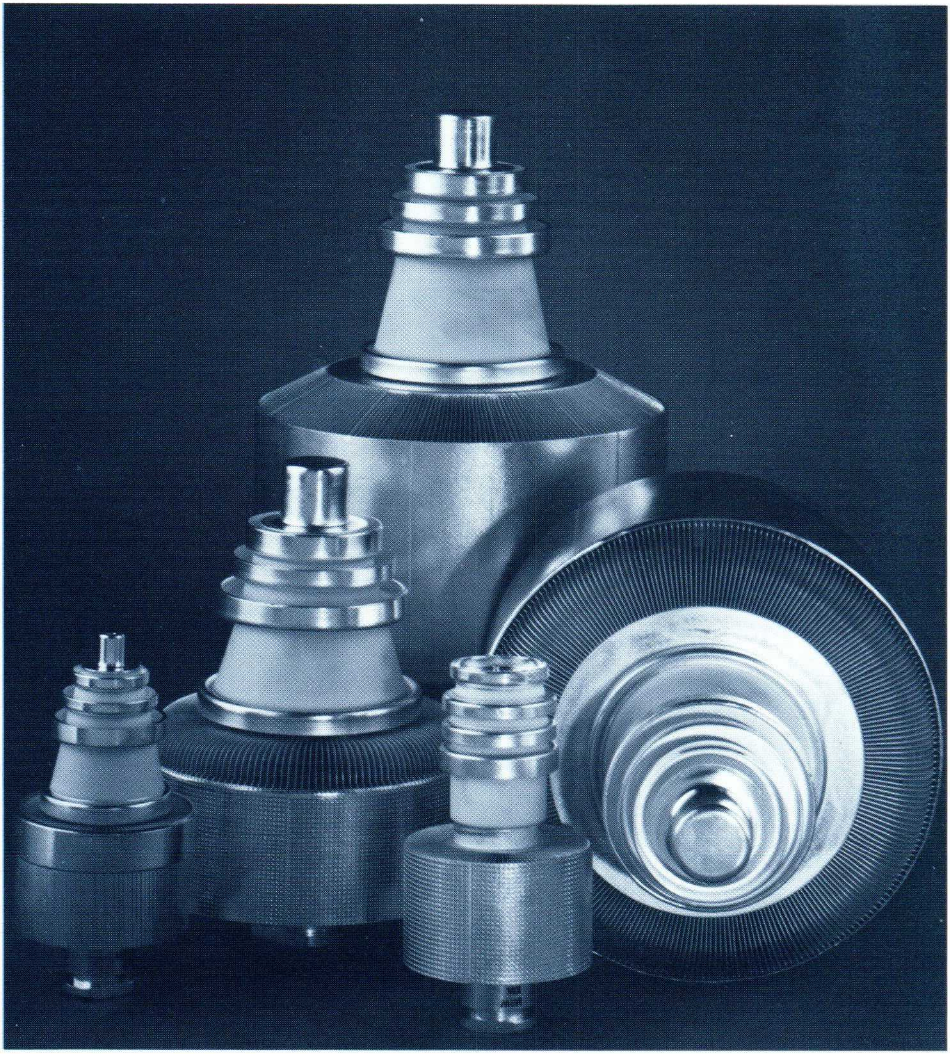
transmitting tubes
a.m. broadcast service

COOLING: FA = forced air WH = water (helix)
N = natural V = vapour
W = water H = heatsink

Double tetrodes — r.f. class C anode and screen-grid modulation

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a V	V_{g2} V	I_a mA	V_a max. V	W_a max. W	h × dia. max. mm
QQE02/5	M	**3,5**	N	500	6,3 12,6	0,6 0,3	180	180	20	200	2	66,7 × 22
YL1220	M	**3,5**	N	500	6,75 13,5	0,56 0,28	180	180	20	200	2	66,7 × 22
QQE03/12	M	**7,1**	N	200	6,3 12,6	0,82 0,41	200	175	33,5	240	3,3	78 × 22
YL1210	M	**7,1**	N	200	6,75 13,5	0,72 0,36	200	175	33,5	240	3,3	78 × 22
YL1020 *)	M	**13**	N	200	1,6	4	300	250	40	500	7	86 × 46
YL1240	M	**13,5**	N	200	6,75 13,5	0,8 0,4	320	140	37,5	320	5	82,7 × 30,1
YL1190 *)	M	**15**	N	200	1,1	4,2	280	150	50	330	5,5	73,9 × 30,1
QQE04/20	M	**17**	N	200	6,3 12,6	1,6 0,8	600	200	18	600	5	84 × 51
QQC04/15	M	**17,5**	N	186	3,15 6,3	1,36 0,68	450	200	25	480	4	100 × 32
QQE03/20 **QQE03/32**	M	**31**	N	200	6,3 12,6	1,3 0,65	500	250	40	500	10	85,5 × 46
YL1030 *)	M	**32**	N	200	2,1	4,5	400	250	75	600	14	106 × 46
QQE06/40	M	**71**	N	250	6,3 12,6	1,8 0,9	600	250	75	600	14	108,5 × 49
YL1060	M	**85**	N	175	6,3 12,6	1,8 0,9	750	250	90	800	21	103 × 44,6

* Quick heating.



transmitting tubes

a.f. modulator service - two tubes

COOLING: FA = forced air, N = natural, W = water, WH = water (helix), V = vapour, H = heatsink

Triodes

type	status	output power kW	cooling	V_f V	I_f A	V_a kV	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
TB2.5/300		**0,7**		6,3	5,4	2,5	0,356	2,5	0,135	132 × 62
TB2.5/400		**0,7**		6,3	5,8	2,5	0,356	3	0,15	132 × 62
YD1130	C	**1,31**	N	5	14,1	3	0,666	3	0,4	151,5 × 87
TB3/750		**1,55**		5	14,1	4	0,54	4	0,35	151 × 87
TB4/1250		**2,29**		10	9,9	4	0,736	4	0,45	213 × 118
TBL6/6000		**13,3**	FA	12,6	33	6	3	6	5	195 × 122,6
TBW6/6000	C	**13,3**	W	12,6	33	6	3	6	6	190 × 70,5
TBL12/40		**19,2**	FA	8	130	10	3,2	13	15	404 × 225
TBL7/8000	C	**20**	FA	12,6	33	7	4	7,2	6	195 × 122,6
TBW7/8000			W							190 × 70,5
TAW12/20	M	**42**	W	21,5	78	12	49	12	18	578 × 163
YD1000			W		160				45	380 × 140
YD1001	C	**78**	FA	12,6	12,6	12	9,5	12	35	380 × 300
YD1002			V		12,6				60	380 × 218
YD1140	C	**106**	W	17,5	196	10	16	15	100	620 × 240
YD1141			FA						45	660 × 286
YD1012	C	**450**	V	18	280	12	52	12	180	650 × 315
YL1640	D	**150**	W	10	280	11	20	15	150	515 × 270
YL1660	D	**660**	W	23	500	12	78	15	500	572 × 260

Pentode

type	status	output power W	cooling	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
PE1/100	C	**194**	N	12,6	1,3	1	250	0,268	1	45	108 × 47

Tetrodes

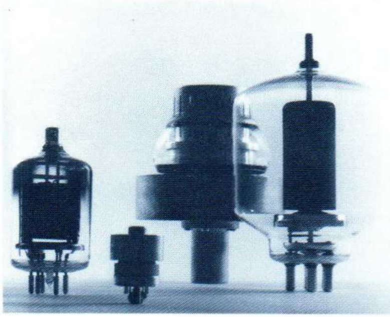
type	status	output power W	cooling	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
QE05/40 **QE05/40F** **QE05/40H** **QE05/40K**	M	**90**	N	6,3 12,6 26,5 13,5	1,25 0,625 0,3 0,585	0,6	165	206	0,6	20	97 × 44
YL1150	C	**200**	N	6,3 12,6	1,9 0,95	0,6	250	520	0,75	75	125,5 × 51
QB3/200	C	**270**	N	6	3,5	1,8	250	220	3	65	111 × 60,5
QB3/300 **QB3/300GA**	C	**550**	N	5	6,5	2,5	350	302	3	125	130,8 × 62 144 × 69,1
QEL2/275 **QEL2/275H**	C	**600**	FA	6 26,5	2,6 0,58	2	350	500	2	250	62,7 × 41,7
7609	C	**630**	FA	26,5	0,58	2	300	500	2	250	62,7 × 41,7
QEL1/150 **QEL1/150H**	C	**630**	FA	6 26,5	2,6 0,58	2	300	500	2	250	62,7 × 41,7
YL1340 **YL1341**	C	**770**	FA	6 26,5	3,2 0,73	2,2	400	580	2,5	350	62,7 × 41,7
QB3.5/750GA **QBL3.5/2000**	C	**1,24 kW**	N	5	14,1	3	300	550	4	250	151,8 × 87 161 × 87
QB5/1750	C	**2,22 kW**	N	10	9,9	5	600	580	5	500	209 × 118
QBL5/3500 **QBW5/3500**	C	**9,5 kW**	N W	6,3	32,5	5	800	2,92 A	5	3 kW	169 × 97 160 × 70,5
YL1091	C	**320 kW**	V	20	345	11	1500	44 A	12	150 kW	532 × 315
Double tetrodes											
QQE03/12	M	**17,5**	N	6,3 12,6	0,82 0,41	0,3	200	100	0,3	14	78 × 22
QQC04/15	M	**18**	N	3,15 6,3	1,36 0,68	0,45	200	65	0,6	12	100 × 32
QQE03/20 **QQE03/32**	M	**23,5**	N	6,3 12,6	1,3 0,65	0,5	250	73	0,6	20	85,5 × 46
QQE06/40	M	**86**	N	6,3 12,6	1,8 0,9	0,6	250	200	0,6	40	108,5 × 49

transmitting tubes
single side-band amplifier service

COOLING: FA = forced air, N = natural, W = water, WH = water (helix), V = vapour, H = heatsink

Tetrodes

type	status	output power P.E.P. W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
YL1100 **YL1101**	M	**40**	FA	1200	26,5 6,3	0,52 2,1	0,85	300	100	1	115	49,6 × 32,2
YL1370 **YL1371** **YL1372**	M	**49**	N	30	6,3 12,6 26,5	1,125 0,562 0,3	0,6	200	125	0,6	27	96 × 44
QB3/200	C	**87**	N	30	6	3,5	2,5	405	70	3	65	111 × 60,5
YL1150	C	**111**	N	60	6,3 12,6	1,9 0,95	0,6	250	325	0,75	75	125,5 × 51
QE08/200 **QE08/200H** **YL1290**	C	**220**	N	30	6,3 26,5 19	3,9 0,85 2,3	0,75	310	270	0,825	100	150 × 72
QEL1/150 **QEL1/150H**	C	**300**	FA	500	6 26,5	2,6 0,58	2	300	250	2	250	62,7 × 41,7
QEL2/275 **QEL2/275H**	C	**300**	FA	500	6 26,5	2,6 0,58	2	350	250	2	250	62,6 × 41,7
YL1340 **YL1341**	C	**318**	FA	175	6 26,5	3,2 0,73	2,2	300	215	2,5	350	62,6 × 41,7
QEL2/200	M	**400**	FA	500	6	2,6	2	400	350	2	250	62,6 × 41,7
8621	M	**436**	FA	500	25,6	0,56	2	350	310	2	250	62,6 × 41,7
QB3.5/750 **QB3.5/750GA**	C	**510**	N	30	5	14,1	4	550	180	4	275	151,8 × 87 161 × 87
QB4/1100 **QB4/1100GA**	C	**650**	N	110	5	14,1	4	705	250	4	400	151,5 × 100 161 × 87
YL1110	M	**680**	FA	1215	6,3	7,85	2,5	450	350	2,5	600	61 × 53,1
QB5/1750	C	**900**	N	30	10	9,9	5	700	280	5	500	209 × 118



Tubes for s.s.b.

Tetrodes (cont.)

type	status	output power P.E.P. kW	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
QB5/2000	C	**1,3**	N	30	7,5	22,6	4	600	0,465	5,5	0,8	248 × 153
YL1181 **YL1182**	C	**3**	FA V	30	5	64	4,5	800	1,33	6	4	178 × 100 178 × 122
QBL5/3500 **QBW5/3500**	C	**4,4**	N W	30	6,3	32,5	5	800	1,3	5	3	169 × 97 160 × 70,5
YL1120	M	**5,1**	FA	60	12,6	14,5	5	700	1,8	5,5	4	202 × 159
YL1010 **YL1011** **YL1012**	C	**33**	W FA V	30	9	200	10	1200	5,9	12	30 30 45	306,5 × 140 321,5 × 215 315 × 218
YL1091	C	**120**	V	30	20	345	9	1500	21	15	150	532 × 315
YL1541	D	**2,1**	A	30	4,2	53	4	700	900	4,5	4	63 × 122

Double tetrodes

type	status	output power W	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a mA	V_a max. kV	W_a max. W	h × dia. max. mm
YL1070	D	**141**	N	7	6,3 12,9	1,8 0,9	1	250	131	1	30	103,8 × 44,6
YL1071	D	**141**	H	7	13,25 26,5	0,866 0,433	1	250	131	1	30	103,8 × 44,19

transmitting tubes
television service

COOLING: **FA = forced air** **N = natural** **W = water** **WH = water (helix)** **V = vapour** **H = heatsink**

Triodes

type	status	output power sync kW	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	I_a sync black A	V_a max. kV	W_a max. sync kW	h × dia. max. mm
TBL6/6000 *) **TBW6/6000 ***	C	**9**	FA W	75	12,6	33	5	3,8	5	5	195 × 122,6 190 × 70,5
TBL6/20	M	**17**	FA	88	6,3	154	6	4,8	5,5	10	277 × 169,5

Tetrodes

type	status	output power sync kW	cooling	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a sync black A	V_a max. kV	W_a max. sync kW	h × dia. max. mm
QEL1/150 **QEL1/150H**	C	**0,25**	FA	216	6 26,5	2,6 0,58	1,25	300	0,305	1,25	0,25	62,7 × 41,7
YL1590	D	**0,3**	FA	1000	3,5	50	3	550	0,25	3,6	1,5	62,7 × 41,7
QEL2/275 **QEL2/275H**	C	**0,44**	FA	216	6 26,5	2,6 0,58	2	350	0,355	2	0,25	62,7 × 41,7
QBL4/800	C	**0,6**	FA	220	5	13,5	2,4	500	0,4	3	0,5	120 × 67
YL1540 **YL1440**	D	**1,15** **1,55**	FA	260	4,2	53	3	700 500	0,7	4	2 1,5	122 × 63,3 125 × 63,3
QBL3.5/2000	M	**2,2**	FA	1000	3,6	58	4,32	600	0,9	4,5	1,5	215 × 89
YL1181 **YL1182**	C	**5,5**	FA V	230	5	64	4	600	1,5	4,2	4 6	178 × 100 178 × 122
YL1560	D	**6**	FA	1000	5	130	5	700	1,75	6	6	153 × 120,3
QBL5/3500 *) **QBW5/3500 *)**	C	**8**	FA W	110	6,3	32,5	5	800	2,7	5	3	169 × 97 160 × 70,5
YL1420 **YL1580**	D	**8,6** **12**	FA	260 1000	6,3 7	120 130	5 6	600 800	2,1 2,7	6,5 7,2	6 12	174 × 125,1
YL1430	D	**18,4**	FA	260	8	120	7	700	2,9	9	12	211 × 164,2
YL1520	D	**27,5**	FA	260	11,5	120	8	700	4	9	18	226 × 164,2
YL1610 **YL1630**	D	**12** **38**	FA	260	8 7,5	120 190	6 8,5	700 800	3,1 5,4	7 10	14 30	187 × 164 229 × 215

*) Two tubes in push-pull.

television transposer service

COOLING: forced air

Triodes for TV transposer service

Triodes

type	status	output power sync W	power gain dB	f at full ratings max. MHz	V_f V	I_f A	V_a kV	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
YD1270	D	**25**	19	1000	6,3	1,2	1,5	0,12	1,7	0,2	88,6 × 50,5
YD1303	D	**25**	20	1000	5	2	1,2	0,15	2	0,15	55,5 × 68,1
YD1300	D	**25**	20	1000	5	2	1,7	0,17	2	0,3	55,2 × 45,4
YD1302	D	**35**	20	1000	5	2	1.7	0,17	2	0,325	64,2 × 54,1
YD1304	D	**55**	19	1000	5	2,2	1,8	0,18	2	0,325	64,2 × 54,1
YD1333	C	**110**	16,5	1000	6,3	5,3	2	0,25	3,5	0,9	88,5 × 71
YD1334	D	**110**	16,5	1000	6,3	5,3	2,5	0,25	3,5	1,8	96,5 × 96
YD1330	C	**220**	16,5	1000	6,3	5,3	3	0,42	3,5	1,8	106 × 71
YD1336	D	**220**	16,5	1000	6,3	5,3	3	0,42	3,5	1,8	96,5 × 96
YD1335	D	**550**	15	1000	6,3	5,3	3,5	0,25	3,8	1,9	96,5 × 96

Tetrodes

type	status	output power sync kW	power gain dB	f at full ratings max. MHz	V_f V	I_f A	V_a kV	V_{g2} V	I_a A	V_a max. kV	W_a max. kW	h × dia. max. mm
YL1590	D	**0,22**	14	860	3,5	50	3	600	0,55	4,5	1,5	62,7 × 41,7
YL1440	D	**0,55**	15	260	4,2	53	2,5	600	0,73	4	1,5	125 × 63,3
YL1560	D	**2,2**	16	1000	5	130	5	800	1,5	6	6	153 × 120,3
YL1420	D	**2,5**	15	260	6,3	120	4	700	1	6,5	6	173 × 125,1
YL1430	D	**7**	15	260	8	120	6	800	1,2	9	12	211 × 164,2
YL1520	D	**10,5**	16	260	11,5	120	8	900	1,8	9	18	225 × 164,2
YL1630	D	**20**	17	260	7,5	190	8	900	2,5	10	30	229 × 215

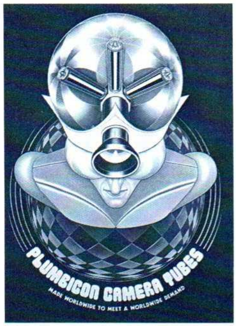
amplifier circuit assemblies

COOLING: forced air

type	band	output power kW	carrier frequency range MHz	power gain x	tube used	dimensions in mm
Vision						
40771	IV + V	**0,5**	470 to 860	32	YD1335	627 × 239 × 182
40776	III	**1,15**	170 to 260	96	YL1540	600 × 345 × 320
40755	I	**1,2**	48 to 83	14	YL1440	516 × 323 × 323
40743	III	**1,55**	170 to 260	23	YL1440	673 × 333 × 323
40757	I	**6,25**	55,25 to 67,25 77,25 to 83,25	16 18,5	YL1420	700 × 500 × 500
40745	III	**8,6**	170 to 230	24	YL1420	600 × 620 × 370
40747	III	**18,4**	170 to 230	25	YL1430	600 × 620 × 370
40759	I I	**13,2** **20**	55,25 to 67,25 77,25 to 83,25	20 24	YL1430 YL1520	700 × 500 × 500
40768	III	**27,5**	170 to 230	28,5	YL1520	685 × 415 × 650
Sound						
40756	I	**2,4**	53 to 88	26	YL1440	516 × 323 × 323
40778	II	**2,4**	88 to 108	200	YL1540	330 × 300 × 300
40777	III	**2,4**	170 to 260	200	YL1540	600 × 345 × 320
40744	III	**2,4**	170 to 260	26	YL1440	673 × 333 × 323
40758	I	**10,5**	53 to 88	32	YL1420	700 × 500 × 500
40775	II	**10,5**	88 to 108	200	YL1470	400 × 360 × 555
40746	III	**10,5**	170 to 230	32	YL1420	600 × 620 × 370
40760	I I	**13** **25**	53 to 88	32,5 31	YL1430 YL1520	700 × 500 × 500
40748	III	**13**	170 to 230	33	YL1430	600 × 620 × 370
Vision and sound						
40770	IV + V	**35 W** **55 W**	470 to 860 470 to 860	100 63	YD1300 YD1302	482 × 246 × 88
40771	IV + V	**0,11** **0,22**	470 to 860 470 to 860	40 40	YD1334 YD1336	525 × 340 × 148
40743	III	**0,55**	175 to 225	30	YL1440	673 × 333 × 323
40745	III	**2,5**	175 to 225	30	YL1420	600 × 620 × 370
40747	III	**7**	175 to 225	32	YL1430	600 × 620 × 370
40768	III	**10,5**	175 to 225	42	YL1520	685 × 415 × 650

camera tubes
selection guide

For detailed information
Handbook T10



30 mm (1¼ inch)	25 mm (1 inch)	18 mm (⅔ inch)
• standard **XQ 1020** **XQ 1023** extended red response **XQ 1025** extended red response and infrared filter	• high resolution **XQ 1070** **XQ 1073** extended red response **XQ 1075** extended red response and infrared filter	• high resolution **XQ 1427** **XQ 1428**
• high resolution • light bias **XQ 1410** **XQ 1413** extended red response **XQ 1415** extended red response and infrared filter	• high resolution • light bias • low output capacitance • ACT (Anti-Comet-Tail) gun **XQ 1080** **XQ 1083** extended red response **XQ 1085** extended red response and infrared filter	
• high resolution • light bias • ACT (Anti-Comet-Tail) gun **XQ 1520** **XQ 1523** extended red response **XQ 1525** extended red response and infrared filter	• very high resolution • light bias • low output capacitance • ACT (Anti-Comet-Tail) gun **XQ 1500** **XQ 1503** extended red response **XQ 1505** extended red response and infrared filter	
	• very high resolution • diode gun (DBC) • light bias **XQ 2070**	• very high resolution • diode gun (DBC) **XQ 2427** as above, plus • low output capacitance **XQ 3427**

camera tubes

Plumbicon® tubes - 1¼ inch (30 mm)

- **magnetic focusing and deflection**
- **separate mesh construction**

For detailed information
Handbook T10

Maintenance types — **300 mA; 6,3 V**

type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes (next page)
XQ1020	215	S	●	●	●	●	●	●	
XQ1023	215	ER	●	●	●	●			
XQ1025	215	ER(F)	●	●	●	●			1

Current types
- provision for light bias
- high resolution

190 mA; 6,3 V

type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes (next page)
XQ1410	215	SHR	●	●	●	●	●	●	
XQ1413	215	ER	●	●	●	●			
XQ1415	215	ER(F)	●	●	●	●			1

Current types
- anti-comet-tail electron gun (ACT)
- provision for light bias
- high resolution

190 mA; 6,3 V

type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes (next page)
XQ1520	215	SHR	●	●	●	●	●	●	
XQ1523	215	ER	●	●	●	●			
XQ1525	215	ER(F)	●	●	●	●			1

Abbreviations used in the tables

- photoconductive layer
  - S = standard
  - SHR = special high resolution
  - ER = with extended red response
  - ER(F) = with extended red response and infrared reflecting filter on anti-halation glass disc
- quality grade
  - Br = broadcast
- applications
  - B/W = for black and white cameras
  - L = for luminance channel
  - R = for red chrominance channel
  - G = for green chrominance channel
  - B = for blue chrominance channel

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Plumbicon® tubes - 1 inch (25 mm)

- **magnetic focusing and deflection**
- **separate mesh construction**

Maintenance types — **95 mA; 6,3 V**

rear loading type	front loading type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes
XQ1070/02	**XQ1070/03**	163	SHR	●	●	●	●	●	●	2
XQ1073/02	**XQ1073/03**	163	ER	●	●		●			2
XQ1075/02	**XQ1075/03**	163	ER(F)	●	●		●			1

Maintenance types

- anti-comet-tail electron gun (ACT)
- provision for light bias

95 mA; 6,3 V

rear loading type	front loading type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes
XQ1080	**XQ1090**	163	SHR	●	●	●	●	●	●	
XQ1083	**XQ1093**	163	ER	●	●		●			
XQ1085	**XQ1095**	163	ER(F)	●	●		●			1

Design types

- high resolution anti-comet-tail electron gun (ACT)
- provision for light bias

190 mA; 6,3 V

rear loading type	front loading type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes
XQ1500	**XQ1510**	163	SHR	●	●	●	●	●	●	
XQ1503	**XQ1513**	163	ER	●	●		●			
XQ1505	**XQ1515**	163	ER(F)	●	●		●			1

New design types

- high resolution
- provision for light bias
- diode gun for highlight handling (DBC)

95 mA; 6,3 V

rear loading type	front loading type	max length mm	photo-conductive layer	quality grade Br	applications B/W	L	R	G	B	notes
XQ2070/02	**XQ2070/03**	163	SHR	●	●	●	●	●	●	
XQ2073/02	**XQ2073/03**	163	ER	●	●		●			
XQ2075/02	**XQ2075/03**	163	ER(F)	●	●		●			1

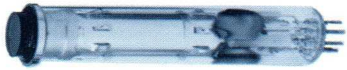
Notes

1. With infrared reflecting filter on anti-halation glass disc.
2. Without anti-halation glass disc: add suffix /01 to type number.

camera tubes

Plumbicon® tubes - ⅔ inch (18 mm)

- **magnetic focusing and deflection**
- **separate mesh construction**



Design types — **95 mA; 6,3 V**

type	max length mm	photo-conductive layer	quality grade Br	Ind	applications B/W	L	R	G	B
XQ1427	105	ER SHR	●		●		●	●	●
XQ1428	105	ER SHR		●	●		●	●	●

New design types
- very high resolution
- diode gun for highlight handling (DBC)

95 mA; 6,3 V

type	max length mm	photo-conductive layer	Br	Ind	B/W	L	R	G	B
XQ2427	105	ER SHR	●		●		●	●	●

- low output capacitance (LOC)
- very high resolution
- diode gun for highlight handling (DBC)

95 mA; 6,3 V

type	max length mm	photo-conductive layer	Br	Ind	B/W	L	R	G	B
XQ3427	105	ER SHR	●		●		●	●	●

Accessories for Plumbicon tubes

	1¼″ dia. all magnetic		1″ dia. all magnetic						⅔″ dia. all magnetic	
	light bias	ACT and light bias	/02 versions light bias	/03 versions light bias	ACT and light bias	ACT and light bias	DBC and light bias	DBC and light bias		DBC LOC
	rear loading	rear loading	rear loading	front loading	rear loading	front loading	rear loading	front loading	front loading	front loading
example	**XQ1410**	**XQ1520**	**XQ1070/02**	**XQ1070/03**	**XQ1080**	**XQ1090**	**XQ2070/02**	**XQ2070/03**	**XQ1427**	**XQ3427**
coil unit B/W	**AT1113/01**		**AT1116S** (front loading)			**AT1119/01** (rear loading)			**AT1109/01S** **AT1106S**	**AT1109/10S**
coil unit colour	**AT1113/..***		**AT1116/..*** (front loading)			**AT1115/..*** (rear loading)			**AT1109/01*** **AT1106***	**AT1109/..***
socket	**56021** **56025**	**56025**	**56098**		**56026**				**56049**	
light bias lamp	**56106**		**56106**		**56027**		**56106**			
adapters**										
B/W		**56122**								
R		**56123**								
G		**56124**								
B		**56125**								
	56126▲ **56139▲▲**									
mask		**56029**	**56028**						**56033**	**56030**

* Computer selected triplet (digits after the stroke identify variants).
** Adapters for fixed light bias for XQ1410 to XQ1415 and XQ1520 to XQ1525.
▲ Adapter for adjustable light bias for XQ1410 to XQ1415 for use in Marconi Mark VIII camera (variant).
▲▲ Adapter for fixed light bias for XQ1410 to XQ1415 for use in RCA TK47 camera.

Vidicon and Newvicon® tubes

- **wide application range**
- **choice of photoconductive layers**
- **variety of sizes**

1-inch – magnetic focusing and deflection

All types 95 mA; 6,3 V

type	max length mm	mesh	photo-conductive layer	quality grade Br	HI	Ind	applications Med	MS	GP
XQ1031	130	I	A		●	●		●	
XQ1032	130	I	A			●		●	●
XQ1240	159	S	A	●	●			●	
XQ1241	159	S	A			●		●	●
XQ1280	159	S	B				●		
XQ1285*	159	S	B				●		
XQ1440	159	S	Nw		●	●		●	
XQ1442*	160	S	Nw			●		●	

* Fibre-optic faceplate

⅔ inch – magnetic focusing and deflection

type	max length mm	mesh	photo-conductive layer	Br	HI	Ind	Med	MS	GP
XQ1270	105	I	A			●		●	●
XQ1271	105	S	A			●		●	●
XQ1274	108	S	Nw		●	●		●	
XQ1276**	108	S	Nw			●		●	

** Extended red response

⅔ inch – electrostatic focusing and magnetic deflection

type	max length mm	mesh	photo-conductive layer	Br	HI	Ind	Med	MS	GP
XQ1272	105	S	A			●		●	●
XQ1275	108	S	Nw		●	●		●	

Accessories for Vidicon and Newvicon tubes

type	deflection (and focusing) coil unit	socket
XQ1031, XQ1032, XQ1440, XQ1442 **XQ1240, XQ1241** **XQ1280, XQ1285**	**AT1102/01, KV9G** **AT1116S** or equivalent	**56098** or equivalent
XQ1270, XQ1271, XQ1274, XQ1276	**KV12S, AT1109/01S** **AT1106S**	**56049** or equivalent
XQ1272, XQ1275	**KV19G** or equivalent	

Abbreviations used in the tables

I = integral mesh
S = separate mesh
A = standard layer (Vidicon)
B = layer with peak response at approx. 475 nm (Vidicon)
Nw = cadmium and zinc telluride layer (Newvicon tubes)
Br = for bl. and white and colour broadcast cameras, telecine
HI = for high-quality bl. and white cameras in sub-broadcast, medical, educational and industrial applications
Ind = for black and white cameras in non-critical industrial applications
Med = in medical or industrial X-ray equipment, coupled with an image intensifier
MS = in cameras for military, surveillance, and scientific applications
GP = general purpose tube for low-cost cameras

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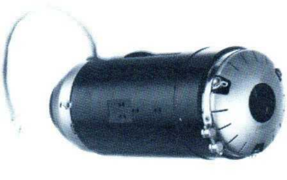
deflection units

AT1119/01 and AT1115/01



AT1113/01 and /03

AT1106

tube diameter	type number and catalogue no.	triplet or single	inductance mH		resistance Ω			current mA			remarks
			line coils	frame coils	line coils	frame coils	focus coils	p-p line	p-p frame	d.c. focus	
30 mm (1¼″)	**AT1113/03** 3122 107 10570	T	0,93	21	2,3	62	148	210	32	103	rear loading + alignment coils
	AT1113/06 3122 107 11040	T	0,93	22	2,3	61	148	210	32	103	ditto + sleeve *
	AT1113/08 3122 137 14470	T	0,93	22	2,3	61	148	210	32	103	ditto + sleeve *
	AT1113/10 3122 137 17290	T	0,93	22	2,3	61	148	210	32	103	ditto + sleeve *
	AT1113/01 3122 108 84400	S	0,93	21	2,3	62	148	210	32	103	ditto
25 mm (1″)	**AT1115/01** 3122 137 12710	T	0,79	26	2,2	62	1718	260	36	32	rear loading + alignment coils
	AT1119/01 3122 137 12700	S	0,79	26	2,2	62	1718	260	36	32	ditto
	AT1116/03 3122 137 13880	T	0,81	28	2,2	62	140	255	34	108	front loading + alignment coils + sleeve *
	AT1116/04 3122 137 14530	T	0,79	1,1	2,2	2,5	140	280	200	108	ditto
	AT1116/06 3122 137 15040	T	0,79	28	2,2	62	140	280	34	108	front loading + alignment coils
	AT1116/S 3122 137 15050	S	0,79	28	2,2	62	140	280	34	108	front loading + alignment coils
	AT1102/01 3122 137 10580	S	1,1	22	2,6	84	3604	148	23	17	for Vidicon tube
	K V 9 G 9390 288 80...	S	1,6	70	4,4	125	104	200	29	140	for Vidicon tube *
18 mm (⅔″)	**AT1106** 3122 137 15820	T	0,48	6,9	2,3	48	64	230	48	135	front loading + alignment rings
	AT1106/S 3122 137 18550	S	0,48	6,9	2,3	48	64	230	48	135	ditto
	AT1109/01 3122 137 18280	T	0,91	2,8	3,8	12,7	60	260	114	120	rear loading + alignment rings
	AT1109/01S 3122 137 18290	S	0,91	2,8	3,8	12,7	60	260	114	120	ditto
	AT1109/10 3122 137 18730	T	0,91	2,8	3,8	12,7	60	256	112	120	for LOC tubes
	AT1109/10S 3122 137 18720	S	0,91	2,8	3,8	12,7	60	256	112	120	for LOC tubes
	K V 12 S 9320 258 20...	S	0,86	28,7	3,2	146	55	160	25	120	for Vidicon *
	K V 19 G 9320 271 20...	S	0,9	23	4,6	146	—	160	25	—	for electrostatic focus Vidicon *

* Data on request.

night vision components

Night vision systems enable one to see at night or even in total darkness. They can be split into two categories:
— direct view systems
— video-based systems

Image intensifiers are usually supplied for the first category. With these, scenes can be viewed at very low available light levels (e.g. overcast moonless night). Only appropriate optics and a power supply (usually two standard 1,5 V batteries) are needed to complete the system. Infra-red thermal imaging detectors are usually supplied for the second category. These record temperature differences in the scene. They are effective in total darkness or through haze and smoke. Opto-mechanical scanning, cryogenic cooling, signal processing and display, as well as infra-red optics and power supplies are needed to complete these much more complex systems.

Infra-red thermal imaging detectors

Everything emits thermal radiation. The amount depends on temperature. Living organisms, plants, animals, people, are usually at a higher temperature than their surroundings and can be detected against the background by thermally sensitive detectors. The most suitable wavebands for detection are 3 to 5 μm and 8 to 14 μm. Atmospheric absorption (attenuation) is least in these wavebands.

The most effective detectors today are of cadmium-mercury telluride, which for high signal-to-noise ratio should be cooled to sub-zero temperatures. Typical temperature resolutions of 0,1 to 0,3 K are possible (at room temperature).

Three cooling techniques are employed:

- thermo-electric (Peltier) with which temperatures around 200 K are readily obtained. This is adequate for the 3 to 5 μm waveband detectors.
- Joule-Thomson, which uses the expansion of high pressure gas to cool detectors to 77 K as is desirable for the 8 to 14 μm band.
- closed cycle (e.g., Stirling) engines. These are also used for the 8 to 14 μm band.

All detectors need to be in a vacuum encapsulation (dewar) with shields to reduce heat losses and environmental influences. Our range of cadmium-mercury telluride detectors are supplied in four standard encapsulations, identified as M1 to M4, which allow a variety of detector arrays to meet customers' specifications and to suit various scanning methods and speeds. Other encapsulations can also be supplied.

Basic details of detectors

type series	spectral band μm	operating temp. K	cooling method	number of elements
M1RPY	3 to 5	195	thermo electric	up to 64
M2RPY	8 to 14	77	Joule-Thomson	up to 50
M3RPY	8 to 14	77	Stirling engine	up to 55
M4RPY	3 to 5	220	thermo electric	1

Typical performance of CMT arrays of 50 elements

	3 to 5 μm	8 to 14 μm	units
element dimensions	50×50	50×50	μm
field of view (full angle)	60	50	deg
operating temperature	195	80	K
element bias current	1	4	mA
element resistance	300	50	Ω
cut-off wavelength (50% point)	$5{,}7 \pm 0{,}2$	$11{,}5 \pm 0{,}5$	μm
D * (λ_{pk}, 5 kHz, 1)	$8{,}2 \times 10^{10}$	$4{,}7 \times 10^{10}$	cmHz$^{1/2}$/W
D * (500 K, 5 kHz, 1)	$1{,}4 \times 10^{10}$	$2{,}5 \times 10^{10}$	cmHz$^{1/2}$/W
responsivity (500 K, 800 Hz)	$1{,}0 \times 10^4$	$1{,}5 \times 10^4$	V/W
time constant	2	0,3	μs

night vision components
image intensifiers

Image intensifiers are characterised by:

- diameter and sensitivity of the photocathode. S25 photocathodes, sensitive up to 900 nm are used in our image intensifiers.
- gain mechanism, i.e. electron acceleration or multiplication (using micro-channel plates, MCPs). Luminance gains of up to 70 000 are possible.
- focusing and/or image inversion method: electro-optic focusing (with image inversion) fibre optic (twister) image inversion. Proximity focusing using the axial field between two parallel plates.

category and types	I/O dia. mm	input	output	P.S.U.	gain	photo-cathode sensitivity white 2856K	800 nm	850 nm
I First generation								
A. Electro-optic inverter types								
XX1050	25/25	FO	FO	n.i.	100	175	10	3
XX1060/01	25/25	FO	FO	incl.	50 000	220	15	6
XX1063	25/25	FO	FO	incl.	50 000	220	15	6
25XX	50/16	FO	FO	n.i.	1 000	200	15	10
P500 series	34/40 × 25	glass	FO	n.i.				
B. Proximity focussed types								
XX1100	38/38	glass	glass	n.i.	20	50 at 420 nm		
XX1230	30/30	glass	FO	n.i.	20	50 at 420 nm		
II Second generation, micro-channel plate (MCP)								
A. Electro-optic inverter types								
XX1306	18/18	FO	FO	incl.	35 000	200	10	6
XX1330	50/40	FO	FO	n.i.	100 000	210	12	8
XX1332	50/40	FO	FO	incl.	45 000	200	15	8
XX1370	34/40 × 25	glass	FO	n.i.	5 000	30 at 420 nm		
XX1380	20/30	FO	FO	incl.	7 000	240	20	15
XX1381	20/30	FO	FO	incl.	7 000	240	20	15
XX1382	20/30	FO	FO	incl.	7 000	240	20	15
XX1382FL	20/30	FO	FO	incl.	< 7 000 adj.	240	20	15
XX1383	20/30	FO	FO	incl.	7 000	240	20	15
XX1383FL	20/30	FO	FO	incl.	≤ 7 000 adj.	240	20	15
XX1385	20/30	FO	FO	n.i.	100 000	240	20	15
XX1500	18/18	FO	FO	incl.	5-50 000 adj.	280	28	15
XX1500TV	15 × 11/18	FO	FO	incl.	65 000	280	28	15
XX1501	18/18	FO	FO, concave	incl.	5-50 000 adj.	280	28	15
18XX	20/30	FO	FO	incl.	7 000	210	12	8
21XX	20/30	FO	FO	n.i.	100 000	250	25	15
B. Proximity focussed types								
XX1390	18/18	glass	glass non inverted	n.i.	15 000	220	12	4
XX1410	18/18	FO	FO, concave inverted	incl.	10 000	240	20	15
P451	18/18	FO	FO flat n.inv.	n.i.	10 000	240	20	15
P452	18/18	FO	FO flat inv.	n.i.	10 000	240	20	15
P453	18/18	FO	FO flat inv.	incl.	10 000	240	20	15
P454	18/18	FO	FO flat n.inv.	incl.	10 000	240	20	15
P455	18/18	FO	FO flat n.inv.	incl.	10 000	240	20	15

- use or not of switched mode power supply (SMPS). SMPS incorporates such features as:
  automatic gain control.
  automatic brightness control.
  fast recovery from flash exposure.
  highlight suppression (intrinsic to micro-channel plate I.Is).
- limiting resolution or, more appropriate for night viewing systems, modulation transfer function (MTF) at relatively low spatial frequencies.

MTF (%) at lp 2,5	7,5	15	optical length (mm)	mass (g)	status	remarks
92	86	70	61	175	M	single stage diode
86	65	35	183	880	M	3 stage cascade
86	65	35	183	880	M	3 stage cascade
90	55	25				
			250	1 100	N ▲	similar to XX1370 but w/o MCP
12 lp/mm			4	120	N ▲	electr. shutter 5-500 ns
12 lp/mm			3	200	N ▲	electr. shutter 5-500 ns
87	70	35	41	200	M	superseded by XX1500
80	55	20	100	500	▲	
80	55	20	100	850	D	
13 lp/mm			250	1 100	▲	streak camera tube
92	75	45	80	350	D	
92	75	45	80	350	D	
92	75	45	80	350	D	
92	75	45	80	350	▲	
92	75	45	80	350	D	
92	75	45	80	350	▲	
92	75	45	80	350	▲	
85	65	30	54,6	185	N	
85	65	30	54,6	185	N ▲	for LLL.T.V.
85	65	30	54,6	185	N ▲	
92	75	45	80	350	M	dev. type no. of XX1380
92	75	45	80	200	▲	
25 lp/mm			2	35	D	
86	58	20	26,6	< 100	D	
86	58	20	19	< 100	N ▲	derivates of XX1410
86	58	20	27	< 100	N ▲	
86	58	20	27	< 100	N ▲	
86	58	20	19	< 100	N ▲	
86	58	20	12,3	< 100	N ▲	

▲ semi-customized

cathode-ray tubes
instrument tubes

Mono-accelerator
Post-deflection accelerator

Note particularly the flat-faced range:
- include rectangular tubes
- rugged construction
- compactness
- high current efficiency
- high control sensitivity

Types listed have GH (H) or G phosphors
Other phosphors on request.

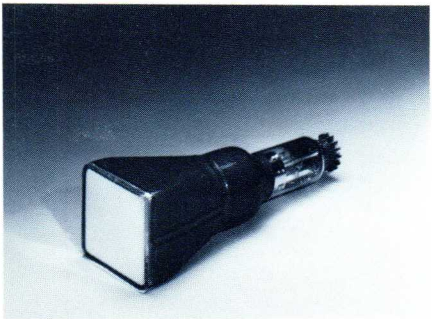
Heater: 6,3 V/300 mA
Deflection: symmetrical x and y
unless otherwise stated

For detailed information Handbook T5

Mono-accelerator tubes

type	status	min useful screen mm	min useful scan hor. mm	min useful scan vert. mm	typ deflection coefficient hor. V/cm	typ deflection coefficient vert. V/cm	typ accelerator voltage V	max overall length mm	notes
DH3-91	M	∅28	full	full	56,5	49	500	105	
DG7-5 **DG7-6**	M M	∅65	full	full	62,5	40	800	160	DG7-6 asymmetrical horizontal deflection
DG7-31 **DG7-32**	M M	∅65	full	full	37	21	500	172	DG7-31 asymmetrical horizontal deflection
Flat faces									
D7-190GH **D7-191GH**	D D	∅64	60	50	29	11,5	1000	225	D7-191GH heater 6,3 V/95 mA
D7-221GH **D7-222GH**	D D	60 × 36	60	36	12,5	20	1000	225	D7-221GH heater 6,3 V/95 mA D7-222GH heater 6,3 V/240 mA
D10-160GH **D10-161GH**	D D	∅85	80	60	32	13,7	1500	260	D10-161GH heater 6,3 V/95 mA
D13-480GH **D13-481GH**	D D	∅114	100	80	31,3	14,4	2000	310	D13-481GH heater 6,3 V/95 mA
D14-251GH **D14-252GH**	D D	100 × 80	100	80	23	13,5	2000	333	D14-251GH heater 6,3 V/95 mA D14-252GH heater 6,3 V/240 mA

All design types (status D) with post-deflection accelerator (p.d.a.) are now in rectangular bulb and equipped with a mesh. Special attention is drawn to the D14-262GH, D14-292GH and D14-302GH/93 new rectangular tubes with domed mesh, offering distinct performance advantages over other p.d.a. technologies in a rectangular bulb — particularly with respect to overall length and uniformity of line width over the full screen area.

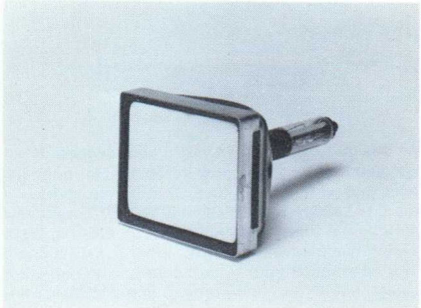


D14-262GH

Post-deflection accelerator tubes — flat faced

type	status	min useful screen mm	min useful scan hor. mm	min useful scan vert. mm	typ deflection coefficient hor. V/cm	typ deflection coefficient vert. V/cm	typ accelerator voltage first kV	typ accelerator voltage final kV	max overall length mm	post delection accelerator	notes
Single beam											
DH7-11	M	∅68	60	45	10,7	3,65	1,2	1,2	296	helix	heater 6,3 V/95 mA
D10-170GH	M	∅85	80	60	13	3,5	1	6	335	mesh	
D12-120GH	N	80 × 64	80	60	15,6	4,1	1,5	10	335		heater 6,3 V/95 mA
D13-27GH	M	∅114	full	80	24	11,5	1,5	3	354	helix	
D14-120GH **D14-121GH** **D14-122GH** **D14-123GH**	D D D D	100 × 80	100	80	15,5	4,2	1,5	10	385	mesh	121 and 123 with side connections to x and y plates 122 and 123 with rotation coil
D14-162GH/09	M	100 × 80	100	80	15,2	4,1	1,5	10	407,5	mesh	with internal graticule and rotation coil
D14-261GH **D14-262GH**	D	100 × 80	100	80	19,5	10,5	2	4	333	mesh	heater 6,3 V/95 mA heater 6,3 V/240 mA
D14-292GH	D	100 × 80	100	80	12,8	6,3	2	10	343	mesh	heater 6,3 V/240 mA
D14-302GH/93	D	100 × 80	100	80	8,7	4,7	2,2	16,5	394	mesh	heater 6,3 V/240 mA
D18-120GH	M	120 × 100	120	100	15,5	4,5	2	10	454	mesh	
Split beam											
E14-100GH **E14-101GH**	D D	100 × 80	100	80	13,5	9	1,5	10	425	mesh	E14-101GH without rotation coils
High-frequency tubes with internal graticule											
D14-240GH/37	D	100 × 80	100	80	9	3	2	20	385	mesh	with correction coil unit on request. Wide-band oscilloscopes 100-250 MHz
D13-500GH/01	M	100 × 60	100	60	13,5	1,7	2,5	15	492	mesh	with delay line system and correction coils. Wide-band oscilloscopes over 300 MHz

cathode-ray tubes
monitor and data display tube



M17-141W

Monitor and display tubes

W is the standard screen. Certain applications require screens of a different persistence and/or colour (e.g. GH, GR, GM). Tubes with such screens are supplied to special order.
Heater 6,3 V/300 mA (liable to change to 6,3 V/240 mA); magnetic deflection; electrostatic focusing.

type	status	min useful screen hor. mm	min useful screen vert. mm	defection angle deg	neck diameter mm	typ accelerator voltage first V	typ accelerator voltage final kV	max overall length mm	notes
M17-140W	D	124	93	70	28	400	14	234	
M17-141W	D	124	93	70	28	600	16	240	with bonded faceplate and metal mounting band
M24-100W / **M24-101W**	D / D	190	140	90	28	600	16	260	
M31-130W / **M31-131W**	D	257	195	90	28	600	16	310	M24-101W, M31-131W, M38-121W with integral protection and mounting lugs
M38-120W / **M38-121W**	D / D	290	226	110	28	400	16	279,5	
M38-200W / **M38-200GH**	N	290	226	70	36,8	800	18	484,5	very high resolution tube for e.g. full page document display (over 3000 TV lines with shrinking raster method) with rim band and mounting lugs

Recommended combinations of monitor and display tubes and deflection components *

tube	deflection unit	line output transformer	line output transistor	line driver transformer	dynamic focusing transformer	linearity control unit
M17-140W / **M17-141W**	AT1071/07	AT2102/02	BD160			AT4036
M24-100W / **M24-101W** / **M31-130W** / **M31-131W**	AT1071/03	AT2102/02	BD160			AT4036
M38-120W / **M38-121W**	AT1038/40	AT2102/04 or AT2102/06	BU426	AT4043/59	AT4043/67	AT4042/42
M38-200W / **M38-200GH**	AT1991					

* See "Components for radio, audio, t.v.", part "black and white t.v."

projection tubes
flying spot scanner tubes
storage tubes

Projection tubes

Heater 6,3 V/300 mA; magnetic deflection and focusing

type	status	min useful screen hor. mm	min useful screen vert. mm	deflection angle deg	neck diameter mm	typ accelerator voltage first V	typ accelerator voltage final kV	max overall length mm	notes
MG13-38 **MU13-38** **MY13-38**	C	92	69	47	38	—	50	374	green phosphor blue phosphor red phosphor
MW13-38	C	92	69	47	38	—	50	374	white phosphor

Flying spot scanner tubes

Heater 6,3V/300 mA; magnetic deflection

type	status	min useful screen mm	deflection angle deg	neck diameter mm	typ accelerator voltage first V	typ accelerator voltage final kV	max overall length mm	focusing
Q7-100GU	D	∅60	36	28	600	16	211	electrostatic
Q13-110BA **Q13-110GU**	C	∅108	40	38	—	25	347	magnetic

Storage tubes — with variable persistence, internal graticule and correction coils, flat faced

type	status	min useful screen mm	min useful scan hor. mm	min useful scan vert. mm	typ deflection coefficient hor. V/cm	typ deflection coefficient vert. V/cm	typ accelerator voltage first kV	typ accelerator voltage final kV	min writing speed * div/ms	min storage time ** minute	max overall length mm
L14-111GH/55	D	90 × 72	90	72	9,5	4,1	1,5	8,5	250	1,5	445
L14-131GH/55	D	90 × 72	90	72	9,5	8,5	1,5	8,5	125	1,5	445
L14-140GH/95	N	90 × 72	90	72	18,5	4,8	3	10	250	1	450

* Defined as the maximum speed at which a trace is just visible against a "just black" background. If some background is tolerated the writing speed can be raised.

** Defined as the time taken for the background to rise from zero luminance to 10% of saturated luminance. At reduced intensity the storage time can be longer.

Screen phosphors and equivalents

type designation Pro Electron	old	JEDEC	fluorescence colour	phosphorescence colour	persistence	typical use
BA	C	—	purplish-blue	—	very short	black and white flying spot scanners
BE	B	P11	blue	blue	medium short	oscillography and photography
GH	H	P31	green	green	medium short	general purpose oscillography
GJ	G	P1	yellowish-green	yellowish-green	medium	general purpose oscillography
GM	P	P7	purplish-blue	yellowish-green	long	low-speed oscillography
GP	—	P2	bluish-green	green	medium short	medium-speed oscillography, photography
GR	—	P39	green	green	long	monitoring and display devices
GU	—	—	white	white	very short	colour flying spot scanners
GY	—	P43	green	green	medium	oscillography
KC	—	—	yellow green	yellow green	medium short	data graphic display tube
W	W	P4	white	—	medium short	television and monitoring devices
WA	—	—	white	—	medium short	studio monitors (white point matched to colour tv white point, D6500)
WE	—	P45	white	white	medium short	with high burning resistivity (thanks to rare earth additives)

data graphic display tubes monochrome CRTs

For detailed information Handbook T8

Data Graphic Displays

- **white or green phosphor**
- **integral implosion protection**
- **quick-heating cathodes**

type	status	def. angle (deg.)	neck diameter (mm)	typical operating conditions V_f/I_f (V/mA)	V_{g2} (V)	V_{g4} (V)	V_a (kV)	V_{KR} (V)	overall length max (mm)	useful screen diag. min (mm)	lug position (see next page) Fig.	A (mm)
9 INCH												
M24-302W **M24-302GH** **M24-302GR**	C	90	20	11/140	130	0-130	12-15	45-65	227	228	1	27,5
M34-303W * **M24-303GH** * **M24-303GR** *	C	90	20	11/140	130	0-130	12-15	45-65	232,5	228	1	33
12 INCH												
M31-334W **M31-334GH** **M31-334GR**	C	90	20	11/140	130	0-130	12-15	45-65	280	292	2	28,5
M31-333W * **M31-333GH** * **M31-333GR** *	C	90	20	11/140	130	0-130	12-15	45-65	285,5	292	2	34
M31-326W **M31-326GH** **M31-326GR**	N ▲	110	28,6	6,3/240	400	0-400	17	40-70	241	295	3	24,8
M31-325W * **M31-325GH** * **M31-325GR** *	N ▲	110	28,6	6,3/240	400	0-400	17	40-70	246,5	295	3	30,3
15 INCH												
M38-328W **M38-328GH** **M38-328GR**	N ▲	110	28,6	6,3/240	400	0-400	17	40-70	279	352	4	25,7
M38-327W * **M38-327GH** * **M38-327GR** *	N ▲	110	28,6	6,3/240	400	0-400	17	40-70	284,5	352	4	31,2

* With anti-reflective face-plate.
▲ Resolution: 1500 lines.

data graphic display tubes
monochrome CRTs

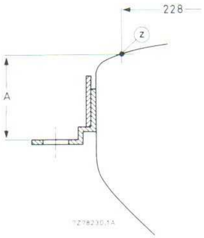


Fig. 1

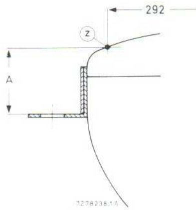


Fig. 2

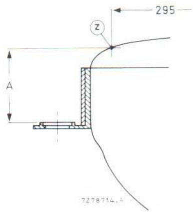


Fig. 3

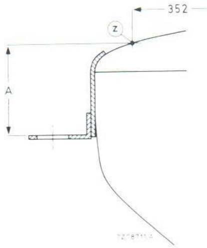


Fig.4

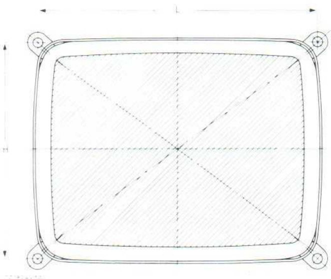


Fig. 5

type	L × H mm
9 inch	212 × 160
12 inch	273,3 × 190,2
15 inch	311,4 × 244,5

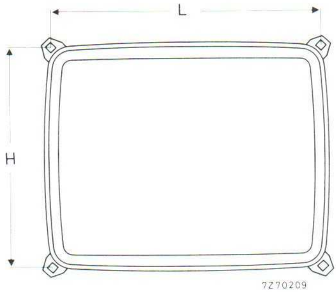
Recommended combinations of data graphic display tubes and deflection components *

tube	deflection unit	line output transformer	line output transistor	line driver transformer	dyn.focus./shift transformer	linearity control unit
M24-302 **M24-303**	AT1071/03	AT2102/02	BU426	AT4043/64		AT4036
M31-333 **M31-334**	AT1071/03	AT2102/02	BU426	AT4043/64		AT4036
M31-325 **M31-326**	AT1038/40	AT2102/06	BU426A	AT4043/59	AT4043/67	AT4042/42
M38-327 **M38-328**	AT1039/00	AT2076/51	BU508	AT4043/87	AT4043/29	AT4043/42

* See "Components for radio, audio, t.v.", part "black and white t.v."

Data Graphic Displays

type	status	def. angle	neck dia-meter	overall length max	useful screen diag. min	resolution	typical operating conditions V_f/I_f	$V_{a,g4}$	V_{g3}	V_{g2}
		deg.	mm	mm	mm		V/mA	kV	kV	V
10 inch										
M25-100X	N	76	29,1	322,6	213,6	570 × 490 pixels	6,3/662	22	4,8-5,7	250-570
12 inch										
M32-100X	N	76	29,1	359,1	287,1	720 × 630 pixels	6,3/662	2,3	5,1-5,9	250-570
14 inch										
M37-102X	N	90	29,1	360,6	335,4	800 × 690 pixels	6,3/662	25	5,5-6,5	250-570
16 inch										
M42-105X	N	90	29,1	389,1	376,6	850 × 740 pixels	6,3/662	25	5-6	250-570
20 inch										
M51-105X	N	90	29,1	446,2	474,9	900 × 780 pixels	6,3/662	25	5,5-6,5	250-570



type	L × H mm
M25-100X	211,0 × 146,8
M32-100X	269,3 × 209,2
M37-102X	313,8 × 245,8
M42-105X	355,8 × 276,7
M51-105X	435,2 × 336,0

microwave products
magnetrons

Cooling: FA = forced air
H = heatsink
N = natural
V = vapour
W = water

Magnetrons for communications

type	status	cooling	W_{op} kW	frequency range GHz
YJ1023	M	N	20	34,512 to 35,200
YJ1180 YJ1181	D	FA	200	9,050 X-band
YJ1180L XJ1181L	D	FA	200	8,850 X-band
YJ1180H YJ1181H	D	FA	200	9,150 X-band
YJ1320 YJ1321	D	FA	65	16,5 Ku-band
5586	M	FA	800	2,700 to 2,900
55029 55530	M	FA	250	9,405 to 9,505 9,345 to 9,405
55031/01 55031/02	M	FA	250	9,168 to 9,260 9,260 to 9,345
55032/01 55032/02	M	FA	250	9,003 to 9,085 9,085 to 9,168

Magnetrons for microwave heating

type	status	cooling	W_o kW	V_a kV	I_a A	frequency MHz
YJ1160 YJ1162 YJ1164	C	W FA W	2,5	4,95	0,8	2450 2450 2375
YJ1193 * YJ1193E * YJ1194 *	D	W	6	7,3	1,25	2450 2450 2375
YJ1195 * YJ1195E *	D	W	6	7,3	1,25	2450
YJ1280	M	FA	1,5	5,7	0,38	2450
YJ1441 *	C	FA	2,5	5,5	0,7	2450
YJ1442 *	D	W	3	5,8	0,8	2450
YJ1443 *	D	W	3	5,8	0,8	2375
YJ1481 *	M	FA	1,55	6	0,37	2450
YJ1500 *	D	FA	1,1	4	0,38	2450
YJ1510 * ▲	D	FA	0,265	2,9	0,15	2450
YJ1520 * YJ1521 * YJ1522 *	D	FA	0,85	4,15	0,3	2450
7090 ▲	O	FA	0,2	1,65	0,2	2450

* With integral filter
▲ For diathermic applications

klystrons

High-power klystrons

type	status	cooling	W_o kW	gain dB	frequency range MHz
YK1000	M	W/FA	11	30	400 to 620
YK1001	M	FA	11	30	470 to 860
YK1002	M	W/FA/V	11	30	470 to 860
YK1004	M	W/FA	11	30	610 to 790
YK1005	M	FA	11	40	470 to 860
YK1110	C	W	6000	30	2998 ± 5
YK1151	M	FA	25	40	470 to 860
YK1190	D	V/W	45		470 to 610
YK1191	D	V/W	45		590 to 720
YK1192	D	V/W	45		710 to 860
YK1195	D	V/W	58		470 to 610
YK1196	D	V/W	58		590 to 720
YK1197	D	V/W	58		710 to 860
YK1198	D	V/W	58		800
YK1210	D	FA	1,15	50	11800 to 12200
YK1220	D	V/W	16,5		470 to 860
YK1230	D	V/W	27		470 to 860
YK1300	D	W	600		499,7

Reflex klystrons

type	status	cooling	W_o mW	output	frequency range MHz
YK1090	C	N/FA	400	waveguide	10,5 to 12,2
YK1091	C	N/FA	400	waveguide	10,5 to 12,2

Travelling-wave tubes

type	status	cooling	W_o W	gain dB	frequency range GHz
LB6-25	M	N/FA	25	38	5,925 to 6,425
YH1090	M	N	25	42	3,4 to 4,2
YH1170	M	H	20	45	5,8 to 8,5
YH1172	M	H	22	45	7,0 to 8,0
	M	H	17	42	8,0 to 8,5
7537	M	N	6	36	4,4 to 5,0
55340	M	N	8	39	3,8 to 4,2

Diodes

type	status	I_c mA	V_f V	I_f mA	frequency MHz
EA52/53	M		6,3	300	1000
8020	M	100	5	6000	

microwave products
semiconductor diodes

Schottky barrier mixer diodes

type	maximum operating frequency GHz	typical noise figure dB	typical impedance Z_{if} Ω	operating temperature °C	case
BAT10	12	7,0	600	– 55 to + 150	—
BAT11	12	6,5	320	– 55 to + 150	—
BAT38	40	≤ 10	1000	– 55 to + 150	SOD-49
BAT39 (CV7762)	18	6,0	350	– 55 to + 100	SOD-42
BAT40	18	≤ 7,8	350	0 to + 80	SOD-49
BAT50(R)	12	6,2	400	– 55 to + 100	(B.S.)SO-26
BAT51 (CV7776) **BAT51R (CV7777)**	18	7,0	350	– 55 to + 100	DO-37
BAT52(R)	18	8,0	350	– 55 to + 100	DO-37
BAT59	40	8,5	1000	– 55 to + 100	SOD-42
BAV22(R)	12	7,0	425	– 55 to + 100	(B.S.)SO-26
BAV72	40	≤ 10	1050	– 55 to + 150	SOD-50
BAV96A **BAV96B** **BAV96C** **BAV96D**	12	7,5 7,0 6,5 6,0	325	– 55 to + 150	SOD-50
BAW95D **BAW95E** **BAW95F** **BAW95G**	12	7,8 7,2 6,8 6,3	415	– 55 to + 150	DO-22
BAS22 **BAS23** **BAS24** **BAS25**	18	5,7	300	– 55 to + 150	beam lead

Schottky barrier detector diodes

type	description	frequency range GHz	typical tangential sensitivity dBm	typical 1/f noise dB	typical video impedance Ω	case
BAS46	for user in X-band Doppler radar systems	1 to 12	– 55	10	850	DO-23
BAV75	low level detector applications	1 to 12	– 50	10	310	SOD-31
BAV97	low level detector applications	1 to 12	– 54	10	500	SOD-50
BAT10	low level detector applications	1 to 12	– 50	12	600	—
BAT11	low level detector applications	1 to 12	– 52	10	320	—

Normal polarity (cathode to stud)	**no end-letter**
Reverse polarity (anode to stud)	**R**
Both polarities available	**(R)**

Backward diodes

type	description	case	frequency range GHz	typical tangential sensitivity dBm	min. figure of merit	typical video impedance Ω
AEY17	germanium bonded backward diode for use at X-band	SOD-42	1 to 18	−53	120*	300
AEY29(R)	germanium bonded backward diode for use at J-band	DO-37	12 to 18	−53	50**	300
AEY31 **AEY31A**	subminiature germanium bonded backward diode for use up to J-band	SOD-50	1 to 18	−53 −50	120* 50*	300
AEY32	subminiature germanium bonded backward diode for use up to Q-band	SOD-50	18 to 40	—	50	4000

* Measured at 9.375 GHz. ** Measured at 16,5 GHz in JAN 201 holder.

Gunn effect devices

type	description	case	operating voltage V	frequency range GHz	P_{out} typ mW	P_{tot} at 25°C max W
CXY11A **CXY11B** **CXY11C**	GaAs bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	SOD-31	7,0	8 to 12	8,0 12 20	1,0
CXY14A **CXY14B** **CXY14C**	GaAs bulk effect devices employing the Gunn effect to produce c.w. oscillations in J-band	SOD-31	7,0	12 to 18	8,0 12 20	1,0
CXY19 **CXY19A** **CXY19B**	GaAs bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	SOD-31	12	8 to 12	150 250 325	6,0 6,0 7,5
CXY21	GaAs bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	SOD-31	8,0	8 to 12	50	2,5
CXY24A **CXY24B**	GaAs bulk effect devices employing the Gunn effect to produce c.w. oscillations in Q-band	special	3,5	30 to 38	30 60	4,0

Impatt diodes

type	description	case	frequency range GHz	power output min mW	operating voltage V
BXY50	high power diodes for use as oscillators or negative resistance amplifiers	SOD-45	8 to 10	500	90
BXY51			10 to 12	400	80
BXY52			12 to 14	300	70
BXY60			6 to 8	650	120

microwave products
semiconductor diodes

Multiplier varactor diodes

type	description	case	capacitance (pF)	at V_R (V)	V_R max (V)	maximum transit time (ps)	typical cut-off frequency (GHz)
BAY96	silicon planar diode for use in high efficiency multiplier circuits, input powers up to 30 W	DO-4	16 35	40 6	120	—	25
BXY27	silicon planar epitaxial varactor diode for use in multipliers up to S-band and input powers up to 10 W	SOD-31	4,5	6	55	—	100
BXY28	silicon planar epitaxial varactor diode for use in high frequency multipliers in the 2 to 4 GHz range	SOD-31	1,5	6	45	—	120
BXY29	silicon planar epitaxial varactor diode for use in frequency multipliers circuits in the 4 to 8 GHz range	SOD-31	1,0	6	25	—	120
BXY32	silicon planar step recovery diode for high order frequency multipliers with outputs in X-band	SOD-31	0,75	6	20	150	150
BXY35A	silicon planar epitaxial varactor diodes for frequency multipliers up to 18 GHz, available in a variety of outlines	DO-4	9	6	100	—	25
BXY36B,C,D,E			5	6	70	500	75
BXY37B,C,D,E		**B** SOD-31	3	6	70	350	100
BXY38B,C,D,E		**C** SOD-43	1,6	6	50	300	120
BXY39B,C,D,E		**D** SOD-44	1,0	6	40	200	150
BXY40B,C,D,E		**E** SOD-45	0,65	6	25	150	180
BXY41B,C,D,E			0,4	6	25	100	200
BXY56 **BXY57**	high efficiency silicon diodes for multipliers with output frequencies in C- and X-bands	SOD-31	2,0 3,0	6 6	60 60	— —	160 140
1N5152 **1N5153**	silicon planar epitaxial varactor diodes for use in multipliers up to S-band	SOD-31 SOD-43	6 6	6 6	75 75	— —	100 100
1N5155	silicon planar epitaxial varactor diode for use in multipliers up to C-band	SOD-31	2	6	35	—	120
1N5157	silicon planar epitaxial varactor diode for use in multipliers up to X-band	SOD-31	0,8	6	20	—	200

Special purpose varactor diodes

type	description	case	capacitance at V_R pF	capacitance at V_R V	V_R max V	series resonant frequency GHz	typical cut-off frequency GHz
CAY10	gallium arsenide diode, diffused mesa type, for use in microwave parametric amplifiers, frequency multipliers and switches	SOD-31	0,4	0	6	10	240
CXY10	gallium arsenide diode with a high cut-off frequency for use in parametric amplifiers, frequency multipliers and switches	SOD-46	0,2	0	6	30	350
CXY12	gallium arsenide diode with a high cut-off frequency for use in frequency multipliers up to Q-band	SOD-46	0,25	6	10	29	500

type	description	case	frequency range GHz	attenuation dB	insertion loss dB
CXY22A **CXY22B**	gallium arsenide devices for limiter applications from C- to X-band	SOD-31	2-7 7-12	20 16	0,2 0,3

type	description	case	excess noise ratio dB	C_j pF	I_r mA
BAT31	silicon avalanche device for use as noise source from 10 Hz to 18 GHz	SOD-31	34	0,6	5,0

Tuning varactor diodes

type	description	case	min capacitance ratio $\frac{CT\ 0\ V}{CT\ 60\ V}$	capacitance at $V_R = 4$ V min pF	capacitance at $V_R = 4$ V max pF	V_R max V
BXY53	silicon planar epitaxial tuning devices	SOD-31	4,0	0,8	1,2	60
BXY54			6,5	3,7	5,7	60
BXY55			7,0	12	18	60
CXY23A	gallium arsenide schottky barrier varactor diodes	SOD-31	3,0	0,8	1,2	12
CXY23B				1,2	1,8	
CXY23C				1,6	2,5	
CXY23D				2,5	3,5	

microwave products
transistors

GaAs field-effect transistors

type	f	V_{DS}	I_D	NF_{opt} min	G_a typ	P_{L1} min	G_p min	case
	GHz	V	mA	dB	dB	mW	dB	
CFX13	12	3	10	3,5	6,5			FO-92
CFX21	11	6	40			50	7	FO-92
CFX31	10,7	10	80			typ 250	typ 7	FO-92

Small-signal N.P.N. transistors

type	f	V_{CE}	I_C	NF_{opt} typ	G_a typ	$R_{th\ j\text{-}c}$	case
	GHz	V	mA	dB	dB	K/W	
LAE6000Q	2	10	4	1,8	12	230	SOT-100

Power linear devices (CW class A — common emitter)

type	f	V_{CE}	I_C	P_{L1} min	G_p min	$R_{th\ j\text{-}mb}$	case
	GHz	V	mA	mW	dB	K/W	
LAE4001R	4	15	25	85	8,5	210	SOT-100
LAE4002S	4	18	30	125	7,5	200	SOT-100
LBE1001T	1	20	35	typ 150	typ 13	120	FO-45
LBE/LCE1004R	1	15	100	400	8	30	FO-45/FO-46
LBE/LCE1010R	1	15	200	800	7	17	FO-45/FO-46
LBE/LCE2003S	2	18	30	200	10	65	FO-45/FO-46
LBE/LCE2005Q	1,65	12	80	300	7	45	FO-45/FO-46
LBE/LCE2008T	1,65	20	150	800	6	26	FO-45/FO-46
LBE/LCE2009S	2	18	110	700	9	36	FO-45/FO-46
LKE1004R	1	15	100	320	8	30	FO-53
LKE2002T	2	15	70	200	9	45	FO-53
LKE2004T	2	15	140	300	6,5	30	FO-53
LKE2015T	2	20	200	1250	7,5	11	FO-53
LKE21004R	2,1	15	140	400	8	22	FO-53
LKE21050T	2,1	20	1200	5000	7	4	FO-53
LKE27010R	2,7	16	200	630	7	12	FO-53
LKE27025R	2,7	16	650	typ 2450	typ 7	6	FO-53
LKE32001QC	3	12	50	90	7	45	FO-53
LKE32002T	3	20	65	200	8	45	FO-53
LKE32004T	3	20	130	620	8	22	FO-53
LTE42002T	4	20	65	150	5,8	45	FO-41A
LTE42005S	4,2	18	110	450	6,6	36	FO-41B
LTE42008R	4,2	16	250	800	7	12	FO-41B
LV2327E40R	2,7	16	1000	32	7	4	FO-83
LV3742E24R	3,7 to 4,2	16	800	2400	5,5	5	FO-83

Power linear devices (CW · class B)

type	f GHz	V_{CC} V	η_C min %	P_L min W	G_p min dB	$R_{th\ j\text{-}mb}$ K/W	case
PEE1001T	1	18	typ 45	typ 1	typ 5,5	35	FO-38
PEE1001U	1	28	55	1,5	6	25	FO-38
PEE1003U	1	28	49	3,7	5,9	18	FO-38
PEE1005U	1	28	53	7	5,4	10	FO-38
PEE1010U	1	28	60	9	6,5	6	FO-38
PKB12010U	1,2	28	45	10	9	6,5	FO-53
PKB20010U	2	28	typ 42	8	5	4	FO-53
PKB23001U	2	28	25	0,8	6	30	FO-53
PKB23003U	2	28	38	2,5	8	18	FO-53
PKB23005U	2	28	43	5	6	7	FO-53
PKB23007T	2,3	22	32	6,5	8,1	6	FO-53
PKB25006T	2,45	21	typ 35	typ 7	typ 8	6	FO-53
PKB27005U	2,7	28	25	4	6	6	FO-53
PKB3000U	3	28	25	0,5	8	45	FO-53
PKB3001U	3	28	30	1	9	22	FO-53
PKB3003U	3	28	30	3	6	11	FO-53
PKB3005U	3	28	30	5	5	8,5	FO-53
PKB32001U	3	28	30	1	7	22	FO-53
PKB32003U	3	28	30	2,4	5,7	11	FO-53
PKB32005U	3	28	28	4,5	4,8	6,6	FO-53
PTB42001X	4,2	24	28	0,8	5	22	FO-41B
PTB42002X	4,2	24	28	1,6	5	12	FO-41B
PV3742B4X	3,7 to 4,2	24	25	4	6	6,5	FO-83

Power devices for pulse operation (pulse duration 10 μs, duty factor 1%)

type	f GHz	V_{CC} V	η_C typ %	P_L typ W	G_P typ dB	case
MRB12175YR	1,09	50	30	250	8	FO-67
MRB12350YR	1,09	50	34	460	7,6	FO-67
MSB12900Y	1,09	50	35	900	7,8	2FO-67
MS1011B700Y	1,025 to 1,150	50	30	700	5,5	2FO-67

microwave products
circulators and isolators

Mobile and fixed radio communication — coaxial

Mobile and fixed radio communication — coaxial

frequency range MHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
72 to 73	i	25	20	02911	20	23	0,7	0,6	1,25	1,2	0 to 55	Nfem	350
73 to 74	i	25	20	02731	20	23	0,7	0,6	1,25	1,2	0 to 55	Nfem	350
83 to 84	i	25	20	02721	20	23	0,7	0,6	1,25	1,2	0 to 55	Nfem	350
86,5 to 87,5	i	25	20	02861	20	23	0,7	0,6	1,25	1,2	0 to 55	Nfem	350
138 to 141	i	25	20	02901	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
	c	110		05001	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
144,5 to 147,5	i	25	20	02951	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
153,5 to 156,5	i	25	20	02961	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
156,9 to 162,1	c	110		03831	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
157,9 to 163,1	c	110		03841	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
165,4 to 170,6	c	110		03851	22	24	0,4	0,3	1,2	1,15	0 to 55	Nfem	350
160 to 178	c	500		01871	20	24	0,35	0,3	1,25	1,15	– 10 to 60	Nfem	2100
	c	1000		01901	20	24	0,35	0,3	1,25	1,15	– 10 to 40*	HF7/16fem	2150
225 to 400	c	60		03732	16	19	1,4	0,9	1,5	1,3	– 40 to 80	Nfem	400
	c	60		03722	16	19	1,4	0,9	1,5	1,3	– 40 to 80	SMAfem	380
225 to 270	c	150		01931	18	21	0,35	0,2	1,35	1,25	0 to 70	Nfem	725
	c	500		03171	20	24	0,35	0,3	1,25	1,15	– 10 to 60	Nfem	2100
	c	1000		03181	20	24	0,35	0,3	1,25	1,15	– 10 to 40*	HF7/16fem	2150
270 to 330	c	60		03421	18	21	0,35	0,2	1,35	1,25	0 to 70	SMAfem	725
	c	150		01941	18	21	0,35	0,2	1,35	1,25	0 to 70	Nfem	725
330 to 400	c	150		01951	18	21	0,35	0,3	1,35	1,25	0 to 70	Nfem	725
400 to 470	i	25	20	02711	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nfem	350
	c	100		03411	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nfem	400
	c	300		01572	20	25	0,35	0,20	1,25	1,15	– 10 to 60	Nfem	1200
406 to 414	ic	70	70	02931	45	55	0,8	0,5	1,25	1,2	– 10 to 60	Nfem	800
450 to 458	ic	70	70	02981	45	55	0,8	0,5	1,25	1,2	– 10 to 60		800
460 to 468	ic	70	70	02851	45	55	0,8	0,5	1,25	1,2	– 10 to 60	Nfem	800
462 to 468	c	60	60	01555	25	30	0,5	0,3	1,2	1,1	– 10 to 60	Nfem	400
510 to 514	ic	70	70	02921	45	55	0,8	0,5	1,25	1,2	– 10 to 60	Nfem	800
600 to 960	c	10		05171	16	20	1,3	0,8	1,4	1,25	– 25 to 65	SMAfem	
	i	10	1	06011	16	20	1,3	0,8	1,4	1,25	– 25 to 65	SMAfem	
790 to 1000	c	100		03811	20	25	0,5	0,3	1,25	1,14	– 10 to 60	SMAfem	400
	i	50	10	02741	20	25	0,5	0,35	1,25	1,15	– 25 to 65	SMAfem	400
	c	100		03261	20	25	0,5	0,3	1,25	1,14	– 10 to 60	Nfem	400
	c	100		03263	20	25	0,5	0,3	1,25	1,14	– 10 to 60	Nfem	400

Meaning of c/i in column 2
c circulator
i isolator

TV band III — coaxial
TV band IV/V — coaxial

TV band III — coaxial

frequency range MHz	c/i	forward power max c.w. W	peak W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
173 to 204	c	500	1800	01861	20	24	0,35	0,3	1,25	1,15	– 10 to 60	Nfem	2100
	c	1000	1800	01891	20	24	0,35	0,3	1,25	1,15	– 10 to 40*	HF7/16	2150
200 to 320	c	500	1800	01851	20	24	0,35	0,3	1,25	1,15	– 10 to 60	Nfem	2100
	c	1000	1800	01881	20	24	0,35	0,3	1,25	1,15	– 10 to 40*	HF7/16	2150

TV band IV/V — coaxial

frequency range MHz	c/i	forward power max c.w. W	peak W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
470 to 600	i	10	20	02691	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nfem	400
	c	100	200	01551	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nfem	400
	c	300	500	01582	20	25	0,35	0,20	1,25	1,15	– 10 to 60	Nfem	1200
	c	300	500	01632	20	25	0,35	0,20	1,25	1,15	– 10 to 60	HF7/16	1200
	c	500	900	01121	22	24	0,35	0,25	1,2	1,15	– 10 to 70	Nfem	2080
	c	500	900	03141	20	24	0,35	0,25	1,25	1,15	– 10 to 70	HF7/16	2200
	c	2000	2000	01261	20	24	0,35	0,17	1,25	1,12	– 10 to 40	HF7/16	2200
	c	2000	8000	03001	20	25	0,4	0,30	1,25	1,15	5 to 65	EIA1 5/8"	3900
600 to 800	i	10	20	02701	20	25	0,5	0,35	1.25	1,15	– 10 to 60	Nfem	400
	i	10	20	02751	20	25	0,5	0,35	1,25	1,15	– 10 to 60	SMAfem	400
	c	50	100	03821	20	25	0,5	0,35	1,25	1,15	– 10 to 60	SMAfem	400
	c	100	200	01561	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nfem	400
	c	100	200	03971	20	25	0,5	0,35	1,25	1,15	– 10 to 60	Nmale	400
	c	300	500	01601	20	25	0,35	0,25	1,25	1,15	– 10 to 60	Nfem	1200
	c	300	500	01651	20	25	0,35	0,25	1,25	1,15	– 10 to 60	HF7/16	1200
	c	500	900	03191	22	24	0,35	0,25	1,2	1,15	– 10 to 70	Nfem	2080
	c	500	900	03151	20	24	0,35	0,25	1,25	1,15	– 10 to 70	HF7/16	2200
	c	2000	2000	01331	20	24	0,35	0,17	1,25	1,13	– 10 to 40	HF7/16	2200
590 to 720	c	300	500	01592	20	25	0,35	0,20	1,25	1,15	– 10 to 60	Nfem	1200
	c	300	500	01642	20	25	0,35	0,20	1,25	1,15	– 10 to 60	HF7/16	1200
	c	500	900	01131	22	24	0,35	0,25	1,2	1,15	– 10 to 70	Nfem	2080
	c	500	900	03201	20	24	0,35	0,25	1,25	1,15	– 10 to 70	HF7/16	2200
	c	2000	2000	01281	22	27	0,35	0,15	1,2	1,1	– 10 to 40	HF7/16	2200
	c	2000	8000	03011	20	25	0,4	0,30	1,25	1,15	5 to 65	EIA1 5/8"	3900
710 to 860	c	300	500	01612	20	25	0,35	0,20	1,25	1,15	– 10 to 60	Nfem	1200
	c	300	500	01662	20	25	0,35	0,25	1,25	1,15	– 10 to 60	HF7/16	1200
	c	500	900	01141	22	24	0,35	0,25	1,2	1,15	– 10 to 70	Nfem	2080
	c	500	900	03211	20	24	0,35	0,25	1,25	1,15	– 10 to 70	HF7/16	2200
	c	2000	2000	01271	22	26	0,35	0,16	1,2	1,15	– 10 to 40	HF7/16	2200
	c	2000	8000	01981	20	25	0,4	0,30	1,25	1,15	5 to 65	EIA1 5/8"	3900
790 to 1000	c	100	200	03261	20	25	0,5	0,30	1,25	1,14	– 10 to 60	Nfem	400

microwave products
circulators and isolators

Microwave communication — coaxial
— waveguide

Microwave communication — coaxial

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
1,427 to 1,535	c	10		03802	20	23	0,4	0,3	1,25	1,15	0 to 55	Nfem	400
	i	10	1	02492	20	23	0,4	0,3	1,25	1,15	0 to 55	Nfem	400
1,470 to 1,620	i	1	1	02521	20	23	0,4	0,3	1,25	1,15	0 to 55	Solder pin	
	i	15	2	02631	20	23	0,4	0,3	1,25	1,15	0 to 55	SMAfem	
1,590 to 1,800	i	1	1	02531	20	23	0,4	0,3	1,25	1,15	0 to 55	Solder pin	
	i	15	2	02641	20	23	0,4	0,3	1,25	1,15	0 to 55	SMAfem	
1,760 to 1,940	i	1	1	02541	20	23	0,4	0,3	1,25	1,15	0 to 55	Solder pin	
	i	15	2	02651	20	23	0,4	0,3	1,25	1,15	0 to 55	SMAfem	
1,890 to 2,110	i	1	1	02551	20	23	0,4	0,3	1,25	1,15	0 to 55	Solder pin	
	i	15	2	02661	20	23	0,4	0,3	1,25	1,15	0 to 55	SMAfem	
1,700 to 2,100	i	15	2	02571	26	28	0,25	0,2	1,11	1,09	0 to 55	SMAfem + m	
	i	15	2	02581	26	28	0,25	0,2	1,11	1,09	0 to 55	SMAm + fem	
	cc	30		04051	26	28	0,25	0,2	1,11	1.09	0 to 55	SMAfem + m	800
1,900 to 2,300	i	15	2	02591	26	28	0,25	0,2	1,11	1,09	0 to 55	SMAfem + m	
	i	15	2	02601	26	28	0,25	0,2	1,11	1,09	0 to 55	SMA + fem	
	cc	30		04061	26	28	0,25	0,2	1,11	1,09	0 to 55	SMAfem + m	800
3,8 to 4,2	c	10		03431	25	27	0,25	0,2	1,12	1,10	– 10 to 70	SMAfem	110
	cc	10		04031	25	27	0,25	0,2	1,12	1,10	– 10 to 70	SMAfem	220
4,4 to 5	c	10		03441	25	27	0,25	0,2	1,12	1,10	– 10 to 70	SMAfem	110
	cc	10		04041	25	27	0,25	0,2	1,12	1,10	– 10 to 70	SMAfem	220
7,99 to 10,2	i	5	1	02231	20	22	0,4	0,35	1,25	1,23	– 10 to 70	SMAfem	30
8,9 to 9,6	i	5	1	02501	20	22	0,4	0,35	1,25	1,23	– 10 to 70	SMAfem	30

Microwave communication — waveguide

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
3,4 to 3,8	c	50		02242	28	35	0,2	0,15	1,08	1,04	0 to 55	UER40	750
	cc	50		02262	28	35	0,4	0,15	1,08	1,04	0 to 55	UER40	1500
3,8 to 4,2	c	50	02232	02232	28	35	0,2	0,15	1,08	1,04	0 to 55	UER40	750
	cc	50		02252	28	35	0,4	0,15	1,08	1,04	0 to 55	UER40	1500
4,6 to 5,0	i	10	1	01101	30	35	0,5	0,30	1,05	1,03	10 to 40	UER48	
5,925 to 6,425	c	200		02211	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	200	3	04001	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	20	2	01191	30	35	0,3	0,15	1,05	1,03	– 10 to 70	UER70	1450
6,425 to 7,125	c	200		02311	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	200	3	04051	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	20	2	01251	30	35	0,3	0,15	1,05	1,03	– 10 to 70	UER70	1450
6,825 to 7,425	i	20	2	01231	30	35	0,3	0,15	1,05	1,03	– 10 to 70	UER70	1450
7,125 to 7,750	c	200		02321	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	200	3	04061	28	35	0,2	0,15	1,08	1,04	0 to 55	UER70	
	i	20	2	01291	30	33	0,3	0,20	1,05	1,03	– 10 to 70	UER70	1450
8,2 to 11,2	c	50		02071	22	30	0,5	0,30	1,18	1,15	10 to 40	UBR100	

Navigation — coaxial
General purpose, octave bandwidth — coaxial
Industrial heating — waveguide
X band radar — waveguide

Navigation — coaxial

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
0,96 to 1,225	c	100	1000	03591	20	22	0,5	0,35	1,25	1,20	– 10 to 60	Nfem	460
4,2 to 4,4	i	10	peak	02471	23	27	0,3	0,15	1,2	1,1	– 55 to 90	SMAfem	110

General purpose, octave bandwidth — coaxial

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
2 to 4	c	50		01491	20	24	0,5	0,35	1,25	1,15	– 10 to 70	Nfem	300
	c	50		01501	20	24	0,5	0,35	1,25	1,15	– 10 to 70	SMAfem	300
	i	50	5	02091	20	24	0,5	0,35	1,25	1,1	– 10 to 70	Nfem	300
	i	50	5	02101	20	24	0,5	0,35	1,25	1,1	– 10 to 70	SMAfem	300
3 to 6	c	20		01511	20	27	0,5	0,3	1,25	1,1	– 10 to 70	SMAfem	120
	i	20	5	02071	20	27	0,5	0,3	1,25	1,1	– 10 to 70	SMAfem	120
4 to 8	c	10		01811	20	23	0,5	0,3	1,25	1,15	– 10 to 70	SMAfem	100
	i	10	1	02111	20	27	0,5	0,3	1,25	1,15	– 10 to 70	SMAfem	100
7 to 12,4	c	10		01822	20	23	0,6	0,4	1,25	1,15	– 10 to 70	SMAfem	60
	i	10	1	02122	20	25	0,6	0,35	1,25	1,12	– 10 to 70	SMAfem	60
7,9 to 10,2	i	5	1	02231	20	22	0,4	0,35	1,25	1,23	– 10 to 70	SMAfem	30
8,9 to 9,6	i	5	1	02501	20	22	0,4	0,35	1,25	1,23	– 10 to 70	SMAfem	30
12 to 18	c	5		03301	18	22	0,6	0,35	1,3	1,2	– 10 to 70	SMAfem	20
	i	5	1	02221	18	22	0,6	0,35	1,25	1,2	– 10 to 70	SMAfem	20

Industrial heating — waveguide

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
2,35 to 2,4	i	6,5	6,5	02024 *	20	26	0,4	0,3	1,2	1,1	▲	PDR26	4700
	i(L)	6,5	6,5	02025 *	20	26	0,4	0,3	1,2	1,1	▲	monitor	4700
2,425 to 2,475	i	6,5	6,5	02004 *	20	26	0,3	0,2	1,2	1,1	▲	output:	4700
	i(L)	6,5	6,5	02005 *	20	26	0,3	0,2	1,2	1,1	▲	Nfem	4700

X band radar — waveguide

frequency range GHz	c/i	cw power max forw. W	cw power max refl. W	cat. no. 2722 162	isolation min dB	isolation typ dB	insertion loss max dB	insertion loss typ dB	v.s.w.r. max	v.s.w.r. typ	temperature range °C	connector type	mass approx. g.
8,5 to 9,6	i	1		01222 •	15		0,6		1,15		10 to 70	UBR100	400
	i	5		01361	30		0,5		1,05		– 10 to 70	UBR100	
	i	10		01211	30		0,5		1,05		– 10 to 70	UBR100	420
	i	10		01261	55		1,2		1,20		– 10 to 70	UBR100	600
10,025 to 10,325	i	1		01531	20		0,4		1,25		– 40 to 85	UBR100	

* These types are water cooled; air cooled versions for max 3 kW can be made available on request.

• Rugged helicoil construction, phase shift spread ± 5°.

▲ Water inlet temperature 10 to 40°C
Water outlet temperature max 50°C
Storage temperature – 10 to 70°C

microwave products

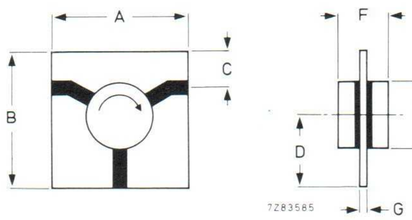
microstrip circulators and isolators

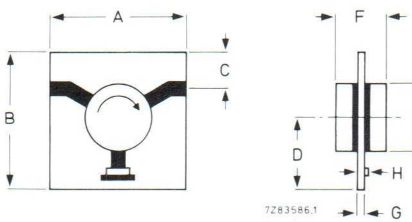
Covering the frequency range 1,7 to 15,25 GHz, the series can provide about 20 dB isolation (typically 22 to 25 dB) with insertion losses down at around 0,3 dB.

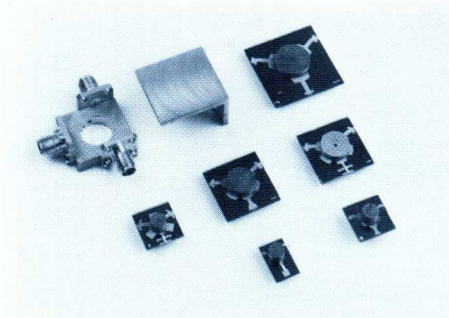
max. power (c.w.)	10 W
max. reverse power	100 mW
storage temperature	− 55 to 125°C

frequency range GHz	catalogue number 2722 169..... circulator	test jig	catalogue number 2722 169..... isolator	test jig	isolation min dB	typ dB	insertion loss max dB	typ dB	v.s.w.r. max	typ	operating temperature °C
1,7 to 1,9	03161		01161								
1,9 to 2,1	03171	00141	01171	00151	20	22	0,5	0,3	1,25	1,15	− 10 to 60
2,1 to 2,3	03181		01181								
2,2 to 2,5	03001	00021	01191	00161	20	22	0,4	0,25	1,25	1,2	0 to 50
3 to 3,5	03011	00031	01201	00171	20	22	0,4	0,3	1,2	1,15	0 to 50
3,6 to 4,2	03041	00041	01041	00051	20	25	0,4	0,25	1,2	1,1	− 10 to 70
4,4 to 5,0	03051		01051								
4,7 to 5,2	03061		01061								
5,9 to 6,5	03071	00061	01071	00071	20	25	0,4	0,20	1,2	1,1	− 10 to 70
6,4 to 7,1	03081		01081								
7,1 to 7,7	03091		01091								
7,7 to 8,5	03101	00081	01101	00091	20	25	0,4	0,25	1,2	1,1	− 10 to 70
8,5 to 9,6	03111		01111		20	25	0,4	0,25	1,2	1,1	
8,0 to 10,4	03121	00101	01121	00111	20	22	0,4	0,25	1,25	1,15	− 10 to 70
8,0 to 12,0	03131		01131		17	19	0,5	0,40	1,35	1,25	
9,0 to 11,5	03141		01141		20	22	0,4	0,25	1,25	1,15	
14,4 to 15,25	03151	00121	01151	00131	20	22	0,5	0,30	1,25	1,15	− 10 to 70

Dimensions (mm) — tolerances ± 0,05 mm unless otherwise stated.
See tables next page.







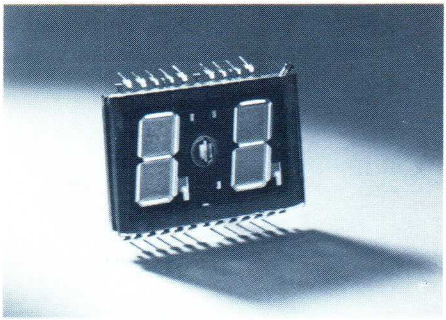
Circulators

catalogue number	A	B	C	D ± 0,2	E	F max	G ± 0,0025	H max
2722 169 03161	38,1	38,1	8	21	16,5	7	1,02	
03171	38,1	38,1	8	21	16,5	7	1,02	
03181	38,1	38,1	8	21	16,5	7	1,02	
03001	25,4	25,4	8	13	12	7	1,02	
03011	25,4	25,4	5,5	14	12	7	1,02	
03041	18,98	18,98	5	10	9,5	7	1,02	
03051	12,62	12,62	4	6,3	5,2	8	1,02	
03061	12,62	12,62	4	6,3	5,2	8	1,02	
03071	12,62	12,62	4	6,3	5,2	10	1,02	
03081	12,62	12,62	4	6,3	5,2	10	1,02	
03091	12,62	12,62	4	6,3	5,2	10	1,02	
03101	10,40	12,62	4,5	5,8	5,2	7	0,51	
03111	8,17	9,85	2,95	5	5,2	7	0,51	
03121	8,17	9,85	2,95	5	5,2	7	0,51	
03131	8,17	9,85	3,4	4,65	4,3	7	0,51	
03141	8,17	9,85	3,4	4,65	4,3	7	0,51	
03151	6,32	7,6	2,5	3,6	3	8	0,51	

Isolators

catalogue number	A	B	C	D ± 0,2	E	F max	G ± 0,0025	H max
2722 169 01161	38,1	38,1	8	21	16,5	7	1,02	1,7
01171	38,1	38,1	8	21	16,5	7	1,02	1,7
01181	38,1	38,1	8	21	16,5	7	1,02	1,7
01191	25,4	25,4	8	13	12	7	1,02	1,7
01201	25,4	25,4	5,5	14	12	7	1,02	1,7
01041	18,98	18,98	5	10	9,5	7	1,02	1,7
01051	12,62	12,62	4	6,3	5,2	8	1,02	1,7
01061	12,62	12,62	4	6,3	5,2	8	1,02	1,7
01071	12,62	12,62	4	6,3	5,2	10	1,02	1,7
01081	12,62	12,62	4	6,3	5,2	10	1,02	1,7
01091	12,62	12,62	4	6,3	5,2	10	1,02	1,7
01101	10,40	16	3,5	10,2	5,2	7	0,51	1,3
01111	8,17	12,62	2,4	8,4	5,2	7	0,51	1,3
01121	8,17	12,62	2,4	8,4	5,2	7	0,51	1,3
01131	8,17	12,62	2,4	8,4	4,3	7	0,51	1,3
01141	8,17	12,62	2,4	8,4	4,3	7	0,51	1,3
01151	6,32	11	2,5	7,0	3	8	0,51	1,3

gas-filled tubes



Segment indicator tubes
Dry reed switches

For detailed information
Handbook T7

Segment indicator tubes

Cold cathode, long life, indicator tube in a flat envelope.
Two or more tubes may be stacked horizontally.
Suitable for direct drive with 30 V ICs.

type	characters	character height mm	execution (digits)	decade pitch mm
ZM1550	formed by 7 segments	15	2	17,78
ZM1551	+ − 1 and 7 segments	15	1½	17,78
ZM1560	formed by 7 segments	26,1	1	25,4

Dry reed switches

Single pole, single throw, dry reed switches having normally open contacts.
The devices are intended for general industrial applications such as push buttons and relays.

series	**RI-22**	**RI-23**	**RI-42**	**RI-43** for telephone
maximum glass length (mm)	15	15	21	21
maximum glass diameter (mm)	2,8	2,54	4	4
maximum switched power (W)	10	10	10	10
maximum switched voltage (V)	200	200	350 *	200
maximum switched current (mA)	500	500	500	500

Life expectancy minimum 10^8 operations with a failure rate $< 10^{-8}$.
RI-22 and RI-23 are available in 4 groups of AT selections.
* RI-42 is a switch with a high breakdown voltage of at least 1000 V.

Thyratrons
Ignitrons
High-voltage rectifying tubes
Accessories

Thyratrons

Mercury vapour and inert gas-filled triode and tetrode thyratrons. Applications in relay service, motor control, igniter firing, etc.
Average currents ranging from 100 mA to 25 A.

Ignitrons

B, C and D-size ignitrons used in single and three-phase resistance welding control equipment and in similar a.c. control applications.
Maximum demand power varies from 600 kVA for a B-size to 3225 kVA for a D-size ignitron.

igniter current: max. 12 A
igniter voltages: 150 to 180 V

High voltage rectifying tubes

A series of rectifying tubes either xenon-gas filled or mercury-vapour filled.
Mainly for use in transmitters, etc.
Peak inverse voltages from 2 to 27 kV
Output currents range from 250 mA to 10 A.

Associated accessories

Include: cooling water connections for ignitrons
bimetal time delay relays for thyratrons and high-voltage rectifiers
water saving thermostats
protecting thermostats

Geiger-Mueller tubes

For detailed information
Handbook T 6

Cylinder types

	status	appli-cation	γ counting rate ct/s	at R/h	sensitive length mm	plateau thresh-old V	plateau length V	max slope %/V	max dead time µs	max back-ground, shielded ct/min	dose rate range R/h
ZP1200	C	γ	210	10^{-2}	40	400	200	0,04	90	10	10^{-4} to 1
ZP1210	D	γ	1000	10^{-2}	140	400	100	0,15	200	70	4.10^{-4} to 2.10^{-1}
ZP1220	D	γ	1600	10^{-2}	240	400	100	0,1	200	90	10^{-4} to 10^{-1}
ZP1300	D	β,γ	350	1	8	500	100	0,3	11	1	10^{-2} to 2.10^{3}
ZP1310	D	β,γ	1400	1	16	500	150	0,15	15	2	10^{-3} to 3.10^{2}
ZP1311▲	D	γ	1400	1	16	500	150	0,15	15	2	10^{-3} to 3.10^{2}
ZP1320	D	β,γ	7400	1	28	500	150	0,08	45	12	10^{-3} to 10^{2}
ZP1330	D	β,γ	900	10^{-2}	75	450	350	0,02	70	30	10^{-3} to 10

▲ With Sn filter

Glass types

	status	appli-cation	γ counting rate ct/s	at R/h	sensitive length mm	plateau thresh-old V	plateau length V	max slope %/V	max dead time µs	max back-ground, shielded ct/min	dose rate range R/h
ZP1500*	M	β,γ	700	10^{-2}	70	450	150	0,15	60	50	
ZP1501*	M	β,γ	700	10^{-2}	70	450	150	0,15	60	50	
ZP1520*	M	β,γ	—	—	60	400	100	0,15	100	50	

Window types

	status	appli-cation	γ counting rate ct/s	at R/h	window φ (mm)	th**	plateau thresh-old V	plateau length V	max slope %/V	max dead time µs	max back-ground, shielded ct/min	dose rate range R/h
ZP1400	D	β,γ	210	10^{-2}	9	(3)	400	200	0,04	90	10	10^{-4} to 1
ZP1410	D	α,β,γ	320	10^{-2}	19,8	(1)	450	250	0,02	175	15	10^{-4} to 3
ZP1430	D	α,β,γ	450	10^{-2}	27,8	(1)	450	250	0,04	190	25	10^{-4} to 2
ZP1431	D	β,γ	450	10^{-2}	27,8	(4)	450	250	0,04	190	25	10^{-4} to 2
ZP1441	M	$\alpha,\beta,(\gamma)$	160	10^{-2}	19,8	(1)	500	200	0,09	65	5	10^{-2} to 10
ZP1442	D	$\beta,(\gamma)$	160	10^{-2}	19,8	(3)	500	200	0,09	65	8	10^{-2} to 10
ZP1451	M	$\alpha,\beta,(\gamma)$	330	10^{-2}	27,8	(1)	500	250	0,07	60	9	10^{-4} to 3
ZP1452	D	$\beta,(\gamma)$	330	10^{-2}	27,8	(3)	500	250	0,07	60	18	10^{-4} to 3
ZP1460	D	$\beta,(\gamma)$	930	10^{-2}	51	(5)	700	400	0,04	45	45	3.10^{-5} to 10^{-1}

X-ray types

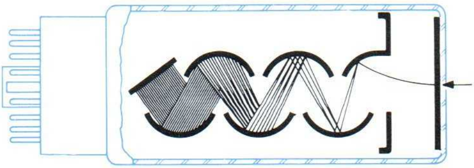
	status	appli-cation	γ counting rate ct/s	at R/h	window φ (mm)	th**	plateau thresh-old V	plateau length V	max slope %/V	max dead time µs	max back-ground, shielded ct/min	dose rate range R/h
ZP1600	D	6 to 20 keV	600	10^{-2}	φ 19,8	(4)	1600	400	0,07	110	25	
ZP1610	D	2,5 to 40 keV	—		7 × 18	(2)	1900	working voltage 1460 to 1850 V				

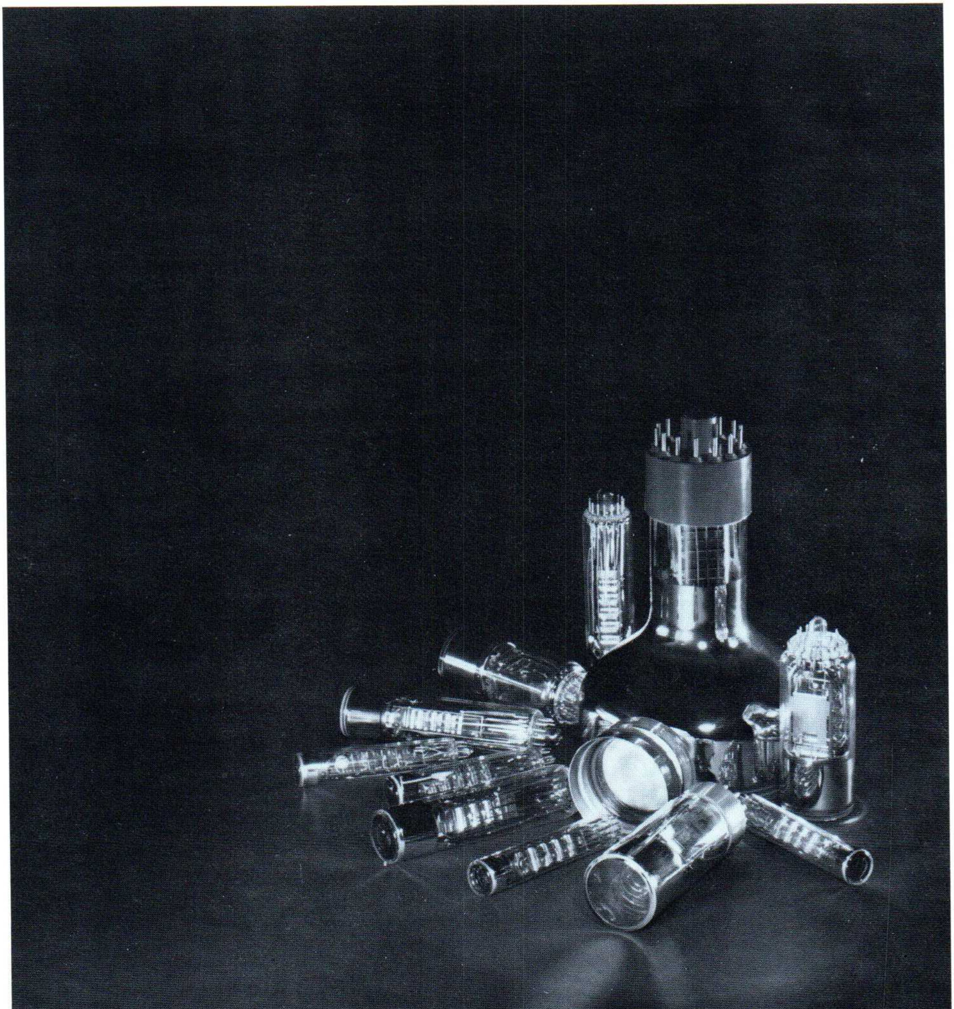
Special type

	status	appli-cation	γ counting rate ct/s	at R/h	sensitive length mm		plateau thresh-old V	plateau length V	max slope %/V	max dead time µs	max back-ground, shielded ct/min	dose rate range R/h
ZP 1700	M	cosmic-ray guard tube	1300	10^{-2}	—	—	800	400	0,03	1000	70	4.10^{-2} to 10

* Detailed information on request.
** Window thickness in mg/cm² (1) = 1,5 to 2,0 (2) = 2,0 to 2,5 (3) = 2,0 to 3,0 (4) = 2,5 to 3,5 (5) = 3,5 to 4,0

photomultipliers





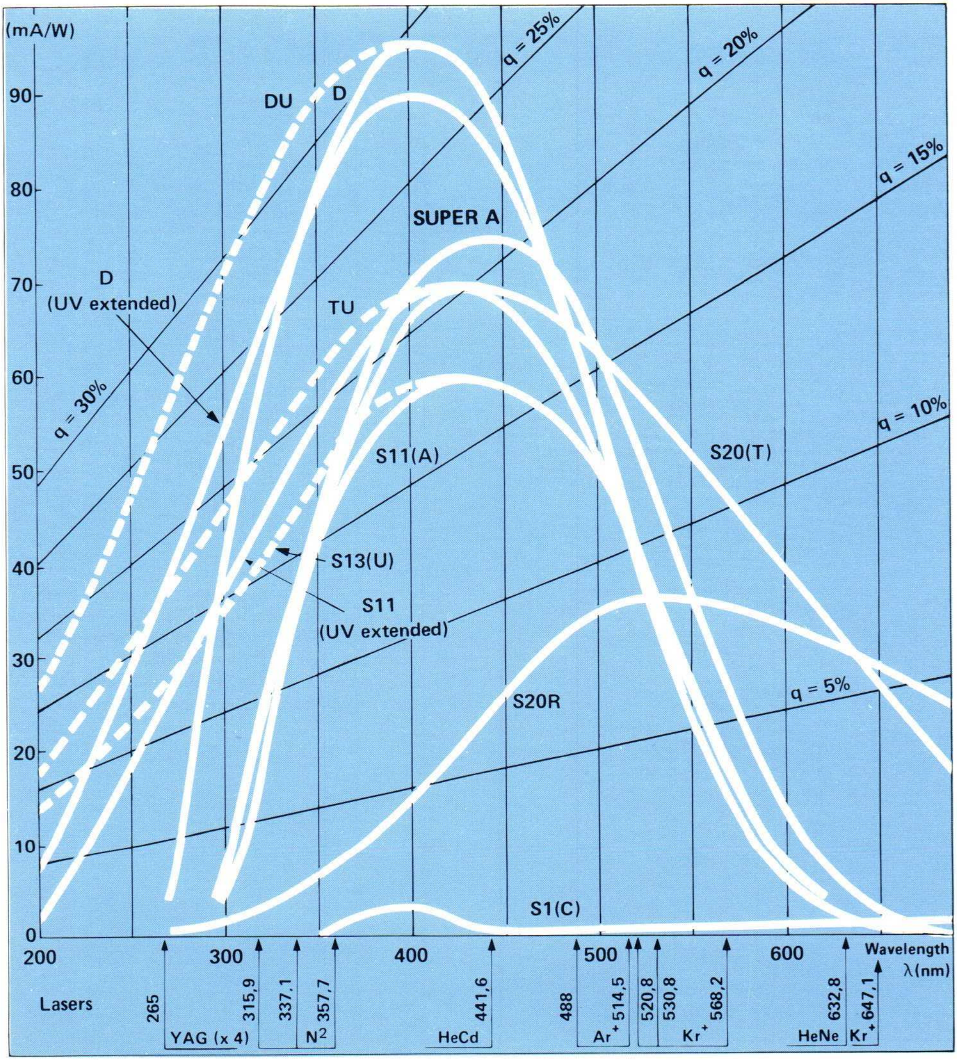
photomultipliers
survey

For detailed information
Handbook T 9

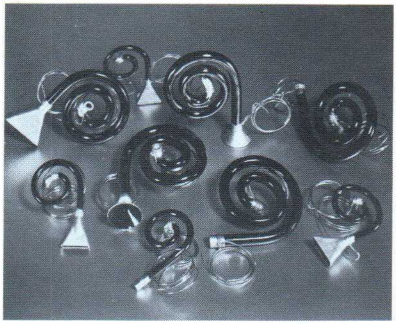
photocathode spectral sensitivity characteristic	useful dia mm	type	status	number of stages	photocathode spectral sensitivity, N_{kr} mA/W	at λ (nm)	anode luminous sensitivity or gain A/lm	at total voltage V	rise time ns	socket
S11 (A)	14	**XP1920**	M	6	60	437	0,2*	700	2,0	FE1004
SUPER A	32	**XP2008**	D	10	70	437	60	1180	2,5	FE1012
	32	**XP2010**	M	10	80	437	60	1180	2,5	FE1012
	32	**XP2060**	C	10	70	437	60	1180	2,5	FE1112
S11 (UV extended)	110	**XP2040**	M	14	70	437	3×10^7	2000	2,0	FE1020
S13 (U)	32	**PM2018B**	N	10	75	437	60*	1350	2,5	FE1012
Bialkali (D)	14	**PM1911**	N	10	70	400	10^6	1250	2,3	FE1004
	23	**PM2962**	N	8	75	400	7*	1100	1,8	FE1114
	23	**PM2972**	N	10	75	400	60*	1200	2,0	FE1114
	23	**PM2982**	N	11	75	400	210*	1350	1,9	FE1114
	32	**XP2012**	D	10	77	400	60*	1350	2,5	FE1112
VB =	44	**PM2102**	D	10VB	85	400	12*	1250	10	FE2019
Venetian blind	44	**XP2020**	D	12	85	400	3×10^7	2200	1,5	FE1020
	44	**XP2202**	D	10	75	400	60*	1400	3,5	FE2019
	44	**PM2211**	N	12	75	437	3×10^7	1900	4,0	FE2019
	44	**XP2212**	D	12	75	400	3×10^7	1900	4,0	FE2019
	44	**XP2230**	D	12	85	400	3×10^7	2300	1,6	FE2021
	44	**XP2232**	M	12	80	400	3×10^7	1900	2,0	FE2019
	44	**PM2242B**	D	6	80	400	2×10^4	2000	1,6	FE1020
	44	**XP2262**	D	12	80	400	3×10^7	1850	2,0	FE2019
	68	**PM2312**	D	12	85	400	3×10^7	2000	2,5	FE2019
	70	**PM2412**	D	10VB	105	400	12*	1250	11	FE2019
	110	**XP2050**	D	10VB	95	400	12*	1270	16	FE1014
D (UV extended)	14	**XP1931**	N	10	70	400	10^6	1250	2,3	FE1004
	110	**XP2041**	D	14	85	400	3×10^7	2200	2,0	FE1020
DU	44	**XP2020Q**	D	12	80	400	3×10^7	2200	1,5	FE1020
S20 (T)	14	**XP1117**	M	9	13	698	30	1520	3,5	FE1004
	23	**PM2963**	N	8	16	698	6	1050	2,0	FE1114
	32	**XP2013B**	C	10	20	698	60	1250	2,5	FE1012
	32	**PM2023B**	N	8	20	698	6	1050	2,5	FE1012
	44	**XP2203B**	D	10	16	698	60	1460	3,5	FE1014
	44	**XP2233B**	D	12	15	698	3×10^7	2050	2,0	FE1020
TU	44	**PM2254B**	D	12	15	698	3×10^7	2300	1,5	FE1020
S20R	32	**XP1017**	M	10	6,5	858	60	1470	3,5	FE1012
S1 (C)	32	**150CVP**	M	10	1,4	903	10	1600	3,5	FE1012

* Anode spectral sensitivity (kA/W)

typical photocathode spectral sensitivity



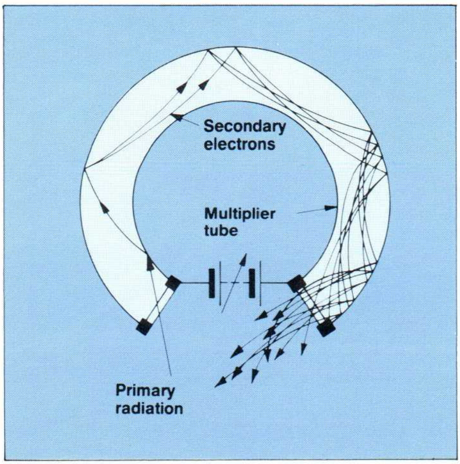
channel electron multipliers



Single channel electron multipliers

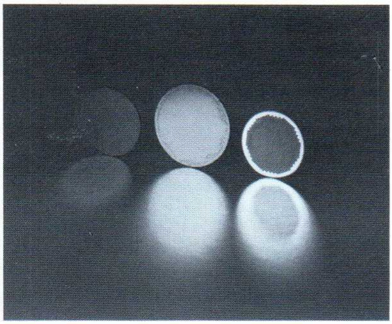
type [1]	input size and shape mm	background [2] cps	nominal resistance GΩ	typical starting voltage [2] kV	gain	maximum operating voltage kV	status
B310 . ./01	1.25 dia. tubular	0,1	3	2,5	$1{,}3 \times 10^8$	4,0	C
B312 . ./01	2,0 × 8,0 rectangular	0,2	3	2,5	$1{,}3 \times 10^8$	4,0	C
B314 . ./01	2,0 × 8,0 rectangular	0,2	3	2,5	$1{,}3 \times 10^8$	4,0	C
B318 . ./01	5,0 dia. conical	0,25	3	2,5	$1{,}3 \times 10^8$	4,0	C
B330 . ./01	1,25 dia. tubular	0,1	3	2,5	$1{,}5 \times 10^8$	4,0	C
B410 . ./01	2,2 dia. tubular	0,1	3	2,0	$1{,}5 \times 10^8$	3,5	C
B413 . ./01	3,5 × 15,5 rectangular	0,25	3	2,0	$1{,}7 \times 10^8$	3,5	C
B419 . ./01	10,0 dia. conical	0,25	3	2,0	$1{,}7 \times 10^8$	3,5	M
X919 . .	10,0 dia. conical	0,15	0,6	1,5	$3{,}0 \times 10^8$	4,0	N

[1] The type number should be completed with AL for **open output** or BL for **closed output** when ordering, e.g. B413AL/01 or B413BL/01. The X919. . is the first in a series of new devices for high count-rate purposes; it takes over from the B419. ./01 in new designs. In the future, the whole series will be superseded by corresponding new multipliers.
[2] Equivalent threshold of $2{,}0 \times 10^7$ electrons.



Function

Single channel electron multipliers consist of a hollow glass tube with an internal resistive surface having a high secondary emission coefficient. Operating in vacuum with a potential difference between the end electrodes one electron entering the input gives as many as ~ 10^8 electrons at the output.



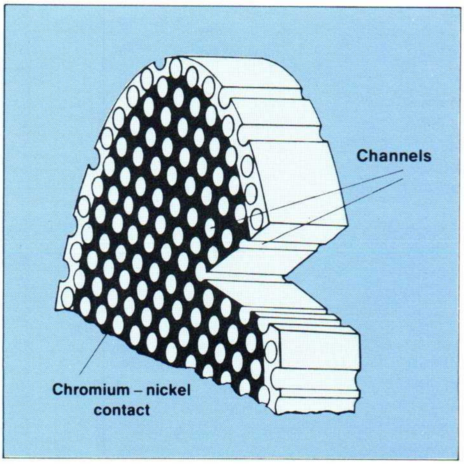
Channel electron multiplier plates

type	channel diameter µm	plate mm	dimensions useful mm	thickness mm	resistance MΩ	channel pitch µm	status
G12-25SE	12,5	∅25	∅>19	0,5	500	15	N
G12-36	12,5	∅36	∅>32,5	0,5	65	15	N
G12-36DT	12,5	∅36	∅>32,5	1,0	125	15	N
G12-46	12,5	∅46	∅>42	0,5	45	15	N
G12-46DT	12,5	∅46	∅>42	1,0	75	15	N
G25-20 × 50	25	20 × 50	>18,8 × 48,8	1,0	35	31	M
G25-25	25	∅27,1	∅>26,5	1,0	50	31	M
G25-50	25	∅53,0	∅>51,8	1,0	10	31	M
G25-70	25	∅70,0	∅>68	1,0	5	31	M

Plates G12-36DT and G12-46DT can be delivered with either 0° or 13° channel bias. When ordering add /0 or /13 to the type number. All other plates have a channel bias of 13°.
Resistance matched pairs of equal diameter plates can be supplied for high gain applications using two plates in cascade: add /A to the type number when ordering.
On special request, plates can be supplied with a central hole and other dimensions.

Function

Channel electron multiplier plates consist of an array of many channels fused together. Plates are operated in vacuum and each channel consists of a hollow glass tube having an resistive internal surface with high secondary emission coefficient. Applying 1 kV across the plate results in a gain of $\sim 10^3$.



replacement guide for electron tubes

type to be replaced	replacement
1CP31	DH3-91
2B29	(QQE06/40); (5894)
2B32	QQE04/20; 832A
2B46	QE05/40; 6146
2B52	QQE03/20; 6252
2B94	QQE06/40; 5894
2C39BA	7289
2D21	PL2D21; PL5727
2D21W	PL5727
2D21WA	PL5727
2G57	PL5557
2G402A	DCX4/1000
2V/530A	(DCG9/20)
2V/530E	(DCG9/20)
2V/531E	(DCG9/20)
3-400Z	(YD1130)
3ALP1	DG7-5
3AMP1A	DG7-32
3BKP31	DH7-11
3BYP31	DH7-11
3C500E	TB4/1500
3C800E	TB5/2500
3CX100A5	7289
3F65	QB3/200
3L030K	TBL2/300
3L050K	TBL2/500
3R188E	TBH6/6000
3R199E	TBH7/8000
3S013T-1	TB2,5/300
3S035T-1	TB3/750
3V/390A	PL5599
3V/490A	(PL105)
3V/531E	(DCG12/30)
4-65A	QB3/200
4-125A	QB3/300GA
4-250A	QB3.5/750GA
4-400A	QB4/1100GA; YL1461
4B13	QB2/250
4CX250B	QEL2/275
4CX250F	QEL2/275H
4CX250FG	8621
4CX250R	7580W
4CX350A	YL1340; 8321
4CX350F	YL1341; 8322
4D21	QB3/300GA; 4-125A
4F15R	QEL1/150; 4X150A
4F20R	4X150D
4F21	QB3/300; 6155
4G/280K	PL2D21; PL5727
4H/135M	QEL1/150; 4X150A

type to be replaced	replacement
4H/136M	QEL1/150; 4X150D
4H/160M	QEL2/275; 4X250B
4J	QQE06/40; 5894
4X150A	QEL1/150
4X150D	QEL1/150H
4X250B	QEL2/275
4X500A	QBL4/800
5C/100A	QB2/250; 813
5D22	QB3.5/750GA; 4-250A
5F20RA	QEL2/275
5F22	QB3.5/750GA
5F23	QB4/1100GA
5T23	TB3/750
5T68	TB4/1250; 5868
6AQ4	EC91
6AS6W	5725
6F50R	QBL4/800; 4X500A
6Q4	EC80
6R4	EC81
6T40	TB4/1500
6T50	TB5/2500
6T51	(TB5/2500)
6T61R	(TB4/1250)
6T66R	(TB4/1500)
7T54RA	(TBL6/14)
7T62R	(TB5/2500)
8T45R	TBL12/25
8T87RB	TBL12/38
11E13	QQE03/12; 6360
20A2	PL6574
20A3	PL2D21; PL5727
20PE11	XQ1270
20PE13	XQ1271
20PE14	XQ1272
20PE19	XQ1272
20PE20	XQ1272
21A1	PL6574
25PE14	(XQ1400); (XQ1401); (XQ1402)
43QV26	(XQ1240)
43QV26/P	(XQ1241)
43QV26/R	(XQ1241)
43QV26/T	(XQ1240); (XQ1241)
45BA6	367
52QV26	(XQ1240); (XQ1280)
55QV26	(XQ1241)
57	PL5559
63QV26	(XQ1240)
63QV26/P	(XQ1241)
100R	8020
105A	PL105

type to be replaced	replacement	type to be replaced	replacement
172	(PL105)	2260IND, BAE, ENT	XQ1241
272	PL5557	2260ROE	XQ1240; XQ1280
287A	PL5557	2800	XX1306
309	PL5557	3101	(XQ1400)
500D0058	F23XX	3102	(XQ1401)
502A	(PL2D21); (PL5727)	3103	(XQ1402)
575A	(DCG6/18GB)	3300	(XQ1070)
631	PL5559	3301	(XQ1070)
652	ZX1051	3302	(XQ1071)
657	ZX1051	3303	(XQ1071)
673	(DCG6/18)	3350	(XQ1072)
676	(PL105)	3861B	QEL1/150; 4X150A
710	PL5684/C3JA	3874A	QB2/250; 813
715	PL5557	3078A	(DCG9/20)
807	QE06/50	3885A	DCX4/1000
813	QB2/250	4078A	(DCG9/20)
829B	(QQE06/40); (5894)	4078GA	(DCG9/20)
832	QQE04/40; 832A	4078Z	(DCG9/20)
832A	QQE04/20	4101	(XQ1440)
833A	(TB4/1250)	4101X	(XQ1440)
857B	(DCG7/100B)	4102	(XQ1440)
869	(DCG9/20)	4103	(XQ1440)
869A	(DCG9/20)	4260	PL5557
872A	ZY1000	4261	PL5557
873	(DCG6/6000)	4440	XP1011
884	(PL2D21); (PL5727)	4463	(XP1002)
885	(PL2D21); (PL5727)	4478	(XQ1032)
967	PL5557	4501	(XQ1274)
1170	(XQ1270); (XQ1271)	4502	(XQ1274)
1171	(XQ1270); (XQ1271)	4503	(XQ1274)
1172	(XQ1270); (XQ1271)	4507	(XP1230)
1173	(XQ1270); (XQ1271)	4517	(PM2012B); (XP2010)
1180	(XQ1270); (XQ1271)	4522	XP2041
1181	(XQ1270); (XQ1271)	4523	(XP2000)
1182	(XQ1270); (XQ1271)	4524	(XP2030)
1183	(XQ1270); (XQ1271)	4532	(XQ1401)
1191	(XQ1270); (XQ1271)	4532A	(XQ1400)
1192	(XQ1270); (XQ1271)	4532AMR	(XQ1402)
1193	(XQ1270); (XQ1271)	4543	XQ1240
1255FIM	(XQ1031)	4591L,R,G,B	55875L,R,G,B
1255NOR	(XQ1031)	4592L,R,G,B	(XQ1020L,R,G,B)
1255IND	(XQ1032)	4593	XQ1023P
1707	PL5557	4594	XQ1025R
2100A	8020	4803	XX1063
2255FI	(XQ1285)	4804	S30XQ
2255FIM, NOR	(XQ1240)	4816	(55876/01)
2255IND, BAE, ENT	(XQ1241)	4817	(XQ1022)
2255ROE	(XQ1240); (XQ1280)	4844	XX1306
2260	(XQ1285)	5121	DCX4/1000
2260FIM, NOR	XQ1240	5545	PL5545

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
5551	ZX1051	6159A	QE05/40H
5551A	ZX1051	6159B	YL1372
5557	PL5557	6189	E82CC
5559	PL5559	6198	(XQ1031); (XQ1032)
5656KS	(XP2000)	6199	PM2060B; (XP2008)
5684	PL5684/C3JA	6227	E80L
5727	PL5727	6252	QQE03/20
5762/7C24	(YD1120)	6292	(XP2000)
5763	QE03/10; M8096	6308	(ZZ1000)
5819	(XP2000)	6326	(XQ1031); (XQ1032)
5861	EC55	6342A	PM2202B
5866	TB2.5/300	6342A/V1	PM2202FLB
5867	TB3/750	6346	(ZX1051)
5868	TB4/1250	6360(A)	QQE03/12
5869	(DCG/6000)	6363	(XP2030)
5870	DCG12/30	6364	(54AVP)
5894	QQE06/40	6414XX	XX1063
5895	QQC04/15	6508	DCG9/20
5920	E90CC	6511	(ZX1061)
5923	TBW6/6000	6524	(QQE03/20); (6252)
5924	TBL6/6000	6617	TBW12/25
5960-00-082-4124	XQ1031; XQ1032	6618	TBL12/25
800-0602	(XQ1031)	6681	E83CC
5960-00-958-0083	XQ1031; XQ1032	6686	E81L
5960-17-035-0700	XQ1241	6688	E180F
5960-99-038-0698	XX1063	6689	E83F
038-0699	XX1063	6693	DCG6/18
038-0717	XX1060/01	6786	DCG7/100B
5960-99-038-0732	XX1332	6810A	(56AVP)
118-1616	XQ1241	6816	YL1101
6011	PL5684/C3JA	6850	(QQE03/20)
6075	QBW5/3500	6883	QE05/40F
6076	QBL5/3500	6883A	QE05/40F
6076A	(QBL5/3500)	6883B	YL1371
6079	QB5/1750	6884	YL1100
6083	PE1/100	6894	(DCG6/18GB)
6084	E80F	6895	(DCG6/18)
6085	E80CC	6903	(XP1004)
6086	18042	6922	E88CC
6096	E95F	6923	EA52
6097B	(XP2000)	6939	QQE02/5
6097KB	(XP2000)	6960	TBW7/8000
6097KL	(XP2000)	6960A	(TBW7/8000)
6097L	(XP1000)	6961	TBL7/8000
6146	QE05/40	6961A	(TBL7/8000)
6146A	QE05/40	7004	TBL2/300
6146B	YL1370	7014XX	XX1306
6155	QB3/300	7034	QEL1/150; 4X150A
6156	QB3.5/750	7035	QEL1/150H; 4X150D
6159	QE05/40H	7038	(XQ1031)

type to be replaced	replacement	type to be replaced	replacement
7062	E180CC	7986	TB2.5/400
7064	(XP2000)	8008A	ZY1001
7065	(XP2008)	8032	QE05/40K
7092	TB5/2500	8032A	YL1371
7102	150CVP	8042	QC05/35
7114XX	XX1332	8053	XP2000
7119	E182CC	8054	XP2030
7136	DCG6/18GB	8055	XP2050
7203	QEL2/275; 4CX250B	8063	PL5684/C3JA
7204	QEL2/275H; 4CX250F	8078	TB4/1500
7213	YL1280	8116	YL1071
7226	(XQ1031); (XQ1032)	8117A	YL1070
7237	(TBL7/8000); (6961)	8118	YL1020
7262A	XQ1031; XQ1032	8119	TBL2/400
7265	(56TVP)	8120	TBL2/500
7290	XQ1280	8163	YD1130
7291	(XQ1031)	8165	QB3/200
7308	E188CC	8177	QBL3.5/2000
7320	E84L	8179	QB5/2000
7325	(XQ1031); (XQ1032)	8223	E288CC
7377	QQE04/5	8228	ZZ1000
7378	QE08/200	8233	E55L
7459	(YD1120)	8254	EC1000
7527	YL1460	8255	E88C
7527A	YL1461	8268	TBW7/9000
7534	E130L	8269	TBL7/9000
7580	QEL2/200	8270	ZT1000
7580W	YL1170	8298A	YL1370; 6146B
7643	E80CF	8321	YL1340
7645	(QQE02/5); (6939)	8322	YL1341
7650	YL1110	8408	YL1130
7696	XP2000	8429	YL1120
7704	QBL5/4000	8436	EC158
7721	D3a	8438	QB41100GA; YL1461
7722	E280F	8438A	YL1461
7735	(XQ1032)	8457	YL1210
7735A	(XQ1031): (XQ1032)	8458	YL1240
7735B	(XQ1031)	8463	YL1000
7737	E186F	8482	ZT1001
7753	TBL6/4000	8484	(XQ1031)
7767	PM1910	8485	(XQ1240)
7788	E810F	8505	YL1250
7800	(TBL12/40)	8507	(XQ1241)
7804	TBL6/14	8507A	(XQ1240)
7805	TBW6/14	8541	XQ1241
7806	TBL12/38	8541A	XQ1240
7807	TBW12/38	8552	YL1371
7836	QE08/200H	8560	YL1320
7854	YL1060	8566	XQ1240
7983	QQC03/14	8572	(XQ1240); (XQ1241)

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
8572A	XQ1240	9012	YL1630
8575	XP2230	9514B	(XP2230)
8577	YL1220	9514S	(XP2230)
8579	YL1150	9524B	PM1982
8580	YL1190	9526B	(150UVP)
8585/V1	XX1050	9530B	(54AVP)
8585/V2	XX1050	9558B	(XP1002)
8586	XX1060/01	9558F	(XP1002)
8591	TBH6/14	9558QB	(XP1003)
8592	TBH7/8000	9594B	(XP2020)
8593	TBH7/9000	9596B	(XP1002)
8594	TBH12/38	9597B	(56TVP)
8603	YL1310	9597QB	(56TUVP)
8604	XQ1240	9620	XQ1241
8610	TBH6/6000	9635B	(XP2230)
8625	(XQ1240)	9635QB	(56DUVP)
8626	XQ1240	9656F	(XP2000)
8637	YL1300	9656KB	XP2000
8644	XP1117	9656KL	XP2000
8654	YL1230	9656KQB	XP1004
8666	YD1170	9656KR	XP2000
8668	YD1172	9656QB	(XP1004)
8680	YD1212	9658F	(XP1002)
8683	YL1360	9684B	(56CVP)
8728	YD1150	9677F1,F2	XQ1240
8730	YD1152	9677M,P	XQ1241
8731	YD1160	9677S1,S2,SC	XQ1240
8732	YD1161	9698B	(XP1117)
8733	YD1162	9708B	(XP2030)
8734	YD1173	9709B	(54AVP)
8735	YD1182	9734B	PM1982
8736	YD1192	9734QB	(150UVP)
8744	YL1330	9758B	(XP2030)
8752	YD1202	9813B	(XP2020)
8801	YD1180	9814B	(XP2020)
8812	YL1420	9812PA	XQ1241
8813	YL1430	9815B	(XP2020)
8814	YL1440	9817PA	XQ1240
8844	(XQ1271)	9820QB	(XP1230Q)
8867	YD1352S	9734B	PM1982
8888	YL1470	9750KB	XP2000
8913	YD1195	9757B	(XP2000)
8915	YL1520	9758KB	(XP2030)
8918	YD1342	9791KB	(XP2050)
8929	(XQ1272)	9810KB	56AVP
8935	YD1185	9811KB	(50AVP)
8936	YD1187	9812KB	XP1000
8937	YD1197	9813KB	56DVP
8952	YD1175	9813KQB	56DUVP
8958	YD1177	9841B	PM2202; PM2232; (XP2230)

type to be replaced	replacement	type to be replaced	replacement
9814KB	(XP2230B)	ASG6574	PL6574
9816KB	56TVP	ATS25	QE06/50; 807
9816KQB	56TUVP	AX4-125A	QB3/300; 6155
9817KB	(56TVP)	AX4-250A	QB3.5/750; 6156
9820B	(XP1230)	AX105	PL105
9821B	PM2312	AX224	DCX4/1000
9824B	(PM1980)	AX228	(DCX4/5000)
9825B	PM1912	AX230	DCX4/5000
9826	PM1912	AX5551	ZX1051
9826B	PM1912	AX5551A	ZX1051
9855	XP2040	AX9900	TB2.5/300; 5866
9856	PM2202	AX9901	TB3/750; 5867
10067B,F,G,SC	(XQ1031)	AX9902	TB4/1250; 5868
10667M,S	(XQ1032)	AX9903	QQE06/40; 5894
18042	6086	AX9904	TBW6/6000; 5923
55850F,S,SR	(XQ1031)	AX9904R	TBL6/6000; 5924
55850N,AM	(XQ1032)	AX9905	QQC04/15; 5895
55851F,S	XQ1240	AX9907	QBW5/3500; 6075
55851SR	XQ1240; XQ1280	AX9907R	QBL5/3500; 6076
55851N,AM	XQ1241	AX9908	QB5/1750; 6079
55852F,S	(XQ1240)	AX9909	PE1/100; 6083
55852N,AM	(XQ1241)	AX9910	QQE03/20; 6252
55875L,R,G,B	55875L,R,G,B	B1135	TB3/750; 5867
56000	8020	B1152	TB4/1500
A4051	QE06/50; 807	B1153	TB5/2500
ACS4	QBL5/3500; 6076	BK42	ZX1051
ACT70	YD1120	BK42A	ZX1051
ACT100	(TBL6/14); (7804)	BK42B	(ZX1051)
AG575A	(DCG6/18IGB)	BK42C	ZX1051
AG869B	(DCG9/20)	BT5	PL5559
AG5005	(DCG7/100)	BT17	(PL105)
AG5006	(DCG6/18)	BT19	(PL5557)
AGR9950	(DCG6/6000)	BT29	PL255
AGR9951	(DCG6/6000)	BT91	PL5544
AH213	(DCG9/20)	BR191B	YD1120
AJ5551	ZX1051	BR1126	YD1230
AJ5551A	ZX1051	BR1160	YD1120
AJ6346	(ZX1051)	BR1162	TBL7/8000
AR14	ZX1051	BR1165	TBL6/6000
AR14T	(ZX1051)	BR1181	(YD1175)
AR14TP	(ZX1051)	BR1182	(YD1185)
AR14TWS	(ZX1051)	BR1195	YD1150
ASG5007	(DCG12/30)	BR1196	YD1160
ASG5017	PL5557	BR1512	YD1240
ASG5121	PL2D21; PL5727	BR1512A	YD1244
ASG5155A	(PL255)	BR1513	(YD1180)
ASG5545	PL5545	BR1514	YD1185
ASG5727	PL5727	BTW6-3	(TBW6/14)
ASG5830	(DCG7/100)	BW1162	TBW7/8000
ASG6011	PL5684/C3JA	BW1162J3	TBH7/8000

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
BW1165	TBW6/6000	CV635	(TB4/1250); (5868)
BW1165J3	TBH6/6000	CV788	QQE04/20; 832A
BW1181J3	(YD1177)	CV797	PL2D21; PL5727
BW1182J2	(YD1187)	CV1350	TB3/750; 5867
BW1183J2	(YD1192)	CV1351	TB4/1250; 5868
BW1184J2	YD1202	CV1510	QE04/10
BW1185J2	YD1212	CV1572	QE06/50; 807
BW1195J3	YD1152	CV1835	DCX4/1000
BW1196	YD1161	CV1838	QQC04/15; 5895
BW1196J3	YD1162	CV1865	EC81
BW1513J2	(YD1182)	CV1886	EC80
C932	(XQ1031); (XQ1032)	CV1888	EC81
C933	(XQ1031)	CV1905	QB3/200; 4-65A
C3JA	PL5684/C3JA	CV1924	TB2.5/300; 5866
C144	(QQE06/40); (5894)	CV2129	M8096; QE03/10; 5763
C178A	QQE06/40; 5894	CV2130	QB3/300; 6155
C180	QQE04/120; 832A	CV2131	QB3.5/750; 6156
C1108	QB3/300; 6155	CV2175	DG7-5
C1112	QB3.5/750; 6156	CV2210	PL5544
C1134	QQE03/20; 6252	CV2215	PL5545
C1136	QB4/1100; YL1460; 7527	CV2253	PL6574
C7151W	(XP1017)	CV2302	DH3-91
C31000A	(56TVP)	CV2466	QQE02/5; 6939
C33031DPI	XX1306	CV2487	QEL2/275; 4CX250B
C33004	XX1050	CV2492	E88CC
C33004A	XX1050	CV2518	DCX4/5000
C33095PI	XX1060/01	CV2519	QEL1/150; 4X150A
C70007A	(56CVP)	CV2666	(QQE06/40); (5894)
C70102B	(XP1116)	CV2729	E80F
CCa	(E88CC)	CV2753	PL5684/C3JA
CE305	(PL5557)	CV2797	QQE06/40; 5894
CE308	(PL105)	CV2798	QQE03/12; (6360)
CE309	PL5557	CV2799	QQE03/20; 6252
CE311	PL3C23A	CV2876	PL5727
CK5654	E95F	CV2957	PL5557
CK5725	5725	CV2963	QB3.5/300GA; 4-125A
CQIO.3-1	QEL2/275	CV2964	QB3.5/750GA; 4-250A
CR1100	QBL5/3500; 6076	CV2967	8020
CR1501	YL1430	CV3522	QB5/1750; 6079
CR1502	YL1440	CV3523	QE05/40; 6146
CST2/12	(PL255)	CV3599	QQV5-P10; 3E29
CT1/2500	PL5559	CV3611	5586
CV5	(DCG4/5000)	CV3879	QB4/1100GA; 4-400A
CV26	QB2/250; 813	CV3926	TBL6/6000; 5924
CV124	QE06/50; 807	CV3991	4X150D
CV273	TD03-10	CV3998	E180F; E186F
CV309	QE04/10	CV4003	E82CC
CV417	EC91; 6AQ4	CV4010	E95F
CV424	QQE06/40; 5894	CV4011	5725
CV483	QE04/10	CV4018	PL5727

type to be replaced	replacement	type to be replaced	replacement
CV4108	E188CC	E5022	(XQ1427); (XQ1428); (XQ1274)
CV5027	PL5559	E5036	(XQ1400)
CV5140	EA52; 6923	E5038	(XQ1285)
CV5171	DP7-5	E5040,R,G,B	(XQ1020,R,G,B)
CV5188	E182CC	E5054	(XQ1022)
CV5214	E90CC	E5055,R	(XQ1023,R)
CV5216	E95F	E5058	(XQ1400)
CV5219	QBL5/3500; 6076	E5061	(XQ1274); (XQ1428)
CV5231	E188CC	E5062	(XQ1275)
CV5234	PL5684/C3JA	E5063	(XQ1070); (XQ1440)
CV5269	DG7-6	E5064	(XQ1070); (XQ1440)
CV6240	XX1060/01	E5067	(XQ1275)
CV8884	DH7-11; 3BYP31	E5070	(XQ1241)
CW1100	QBW5/3500; 6075	E5072	(XQ1274); (XQ1428)
DET22	TD03-10	E5073	(XQ1070); (XQ1440)
DET22G	EC55; 5861	E5074	(XQ1070); (XQ1440)
DG7-1	DG7-5; 3ALP1	E5091	(XQ1070); (XQ1440)
DG7-2	DG7-6	E5092	(XQ1427)
DG7-3	DG7-5; 3ALP1	E5093	(XQ1428)
DG7-4	DG7-6	E5095	(XQ1275)
DG7-5	3ALP1	E5100	(XQ1285)
DG7-32	3AMP1A	E5134R	(XQ1024R)
DH3-91	1CF31	E5139A	(XQ1272)
DH7-11	3BYP31	E5153	(XQ1070); (XQ1440)
DH7-91	DH7-11	E5165	(XQ1275)
DHM10-93	E10-12GH	E5171	(XQ1285); (XQ1442)
DN7-1	DG7-5; 3ALP1	E5172	(XQ1274)
DN7-2	DG7-6	E5173	(XQ1070); (XQ1440)
DN7-3	DG7-5; 3ALP1	E5174	(XQ1070); (XQ1440)
DN7-4	DG7-6	E5175	(XQ1275)
DN7-5	DG7-5; 3ALP1	E5185A	(XQ1272)
DQ5	(DCG6/18)	E5187	(XQ1272)
DQ5B	(DCG6/18GB)	E5195A	(XQ1275)
DQ5C	(DCG6/18)	E5250	(XQ1285); (XQ1442)
DQ6	(DCG6/20)	E5270	(XQ1070); (XQ1440)
DQ7	(DCG7/100B)	E5271	(XQ1070); (XQ1440)
DR7-3	DG7-5	EF575A	DCG6/18GB
DR7-4	DG7-6	EL-C3JA	PL5684/C3JA
DR7-5	DG7-5	EN91	PL2D21; PL5727
DR7-6	DG7-6	ES85	(TB2.5/300); (5866)
DR869B	(DCG9/20)	ES204A	TB3/750; 5867
DX2	DCX4/1000	ES833	(TB4/1250); (5868)
DX274	QBW5/3500; 6075	ES833A	(TB4/1250); (5868)
DX285	YJ1180	ESU103	DCX4/1000
DX290	YJ1320	ESU575	(DCG6/18GB)
E91N	PL5727	ESU673	DCG6/18
E152A	QB3/300; 6155	F672B	DCG9/20
E250A	QB3.5/750; 6156	F369A	(DCG9/20)
E1955	PL2D21; PL5727	F369B	(DCG9/20)
E5001	(XQ1070); (XQ1440)	F869B	DCG9/20

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
F4700	XX1050	HT17	PL5557
F4706	XX1060/01	ITK3-1	(YD1152)
F4720	XX1062	ITK5-1	(YD1162)
F4721	XX1060/01; XX1063	ITK10-2	(YD1177)
F4747	F23XX	ITK12-1	(YD1172)
F9475	XX1060/01	ITK15-2	(YD1187)
FG17	PL5557	ITK30-2	(YD1197)
FG27A	(PL5559)	ITK60-2	(YD1202)
FG57	PL5559	ITK120-2	(YD1432)
FG97	(PL5557)	ITK200-1	(YD1342)
FG98A	(PL5557)	ITL3-1	(YD1150)
FG105	PL105	ITL5-1	(YD1160)
FG172	(PL105)	ITL10-2	(YD1175)
FG271	ZX1051	ITL12-1	(YD1170)
FTL2-1	TBL6/4000	ITL15-2	(YD1185)
FTL3-2	(TBL7/8000); (6961)	ITL30-2	(YD1195)
G101dv	DX4/1000	K1295	(XP2000)
G20/5d	HDLG9/20	K1322	(XP2008)
GD85WR	(ZZ1000)	K1361	(XP2008)
GL2D21	PL2D21; PL5727	K1390	(XP2030)
GL57	PL5559	K1404	(XP1117)
GL414	PL5559	K1427	(XP1004)
GL575A	(DCG6/18GB)	K1428	(XP2000)
GL673	(DCG6/18)	K1430	(XP2030)
GL807	QE06/50; 807	K1447	(XP1002)
GL813	QB2/250; 813	K1500	(XP2000)
GL829B	(QQE06/40); (5894)	K3017	YK1190
GL832A	QQE04/20; 832A	K3018	YK1191
GL5551	ZX1051	K3082	YK1190
GL5551A	ZX1051	K3083	YK1191
GL5557	PL5557	K3084	YK1192
GL5559	PL5559	KT8	(QE06/50); (807)
GL5720	(PL5559)	L4261	F23XX
GL5855	(PL255)	M7075	XQ1271
GL6011	(PL5684/C3JA)	M542	5586
GL6159	QE05/40H; 6159	MC13-16	Q13-110BA
GL6346	(ZX1051)	ME1504	PL5559
GLE5000/3/12	DCG6/18	MI1050	ZX1051
GLE20000/2.5/10	DCG9/20	MI1053	ZX1051
GRG250/3000	PL5557	MI2053A	ZX1051
GTR83X	(ZZ1000)	MK13-16	(Q13-110GU)
GXU1	DCX4/1000	ML4-125A	QB3/300GA; 4-125A
GXU2	DCX4/5000	ML4-250A	QB3.5/750GA; 4-250A
H8362	(XQ1070/01)	ML4-400A	QB4/1100GA; 4-400A
H8397	(XQ1427); (XQ1428)	ML833A	(TB4/1250); (5868)
H8397A	(XQ1427)	ML869A	(DCG9/20)
H9311	(XQ1428)	ML6198	(XQ1031); (XQ1032)
HF255	(DCG9/20)	MT17	PL5557
HS200	(XQ1031)	MT57	PL5559
HS201	(XQ1031); (XQ1032)	MT105	PL105

type to be replaced	replacement	type to be replaced	replacement
MT5544	PL5544	P8022	(XQ1070,R,G,B)
MT5557	PL5557	P8022X	(XQ1072)
MT5559	PL5559	P8023A	XQ1073
MW13-32	MW13-38	P8023F	(XQ1073)
MX9648	F23XX	P8024	(XQ1073)
NL710	PL5559	P8024F	(XQ1075)
NL715	PL5557	P8024IG	(XQ1074)
NL869B	(DCG9/20)	P8073	XX1050
NL1005	ZX1051	P8076	XX1063
NL1005A	ZX1051	P8130	(XQ1020); (XQ1410); (5587)
NL1031	ZX1051	P8131	(XQ1020); (XQ1410); (5587)
NL1051A	ZX1051	P8132A	(XQ1413)
NL1051A/P	ZX1051	P8132F	(XQ1415)
NL6989/C6J/KL	PL5545	P8133A	(XQ1413)
NL-C6JK/Ne	PL5545	P8133F	(XQ1415)
NU832	QQE04/20; 832A	P8136	(XQ1520)
OT400	(TB4/1250); (5868)	P8138	(XQ1525)
P2-12	QQE04/20; 832A	P8142	(XQ1070/02)
P2-0B	(QQE06/40) (5894)	P8144A	(XQ1073/02)
P810	(XQ1032)	P8144F	(XQ1075/02)
P813	(XQ1031)	P8145	(XQ1080); (XQ1500)
P820	(XQ1031)	P8146A	(XQ1083); (XQ1503)
P826	(XQ1032)	P8146F	(XQ1085); (XQ1505)
P826/4478	(XQ1032)	PE06/40E	PE06/40N
P841	(XQ1240)	PL2D21	PL5727
P841X	(XQ1240); (XQ1280)	PL17	PL5557
P842	XQ1240	PL21	PL2D21; PL5727
P842X	(XQ1240); (XQ1280)	PL57	PL5559
P843	(XQ1240)	PL5551	ZX1051
P844	XQ1240	PL5551A	ZX1051
P846	(XQ1240)	PL6011	PL5684/C3JA
P847	XQ1240	PL6549	(QB3/200)
P848	(XQ1241)	PL6755	PL6755A
P848D	(XQ1241)	PM55	XP1002
P849	XQ1241	Q160-1	(QB3/300); (6155)
P849D	XQ1241	Q400-1	(QB4/1100); 7527
P862	(XQ1241)	Q450-1	QB4/1100; 7527
P896	XX1060/01	QB2/250	813
P8000,L,R,G,B	55875,L,R,G,B	V02-6	QQE02/5; 6939
P8000IG,R,G,B	55875IG,R,G,B	QQV03-10	QQE03/12; 6360
P8000X	55876/01	V03-20A	QQE03/20; 6252
P8001,L,R,G,B	(XQ1020,L,R,G,B)	QQV04-15	QQE04/20; 832A
P8001X	(XQ1022)	QQV04-16	QQE04/5; 7377
P8003	(XQ1023)	QQV06-40	(5894)
P8003F	(XQ1025)	QQV06-40A	QQE06/40; 5894
P8005	(XQ1410,L,R,G,B)	QQV07-40	(QQE6/40); 829B
P8007	(XQ1413R)	QQZ03-10	QQC03/14; 7983
P8007F	(XQ1415R)	QQZ03-20	YL1020; 8118
P8021	XQ1070,R,G,B	QQZ04-15	QQC04/15; 5895
P8021X	XQ1072	QQZ06-40	YL1030

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
QV03-12	QE03/10; 5763	RR3-1250	DCX4/5000
QV04-7	QE04/10	RR3-1250B	DCX4/5000
QV06-20	QE05/40; 6146	RS612	(TB2.5/400)
QV06-20B	QE05/40F; 6883	RS613	TB2.5/300; 5866
QV06-20C	QE05/40H; 6159	RS614	TB2.5/400
QV08-100	QE08/200	RS630	TB3/750; 5867
QV08-100B	YL1290	RS631	TB4/1250; 5868
QV1-150A	QEL1/150	RS685	QB3/300; 6155
QV1-150D	QEL1/150H; 4X150D	RS686	QB3.5/750; 6156
QV2-250C	QEL2/275; 4CX250B	RS687	QB5/1750; 6079
QY3-65	QB3/200; 4-65A	RS1002A	QB4/1100; 7527
QY3-125	QB3/300; 6155	RS1003	(YL1200)
QY3-125B	QB3/300GA; 4-125A	RS1006B	TB2.5/400
QY3-1000A	QBL3.5/2000; 8177	RS1007	QB3/300; 6155
QY4-250	QB3.5/750; 6156	RS1009	QQE06/40; 5894
QY4-250B	QB3.5/750GA; 4-250A	RS1011L	(TBL6/20)
QY4-400	QB4/1100; 7527	RS1011W	(TBW6/20)
QY4-400B	QB4/1100GA; 4-400A	RS1012L	YL1181
QY4-500A	QBL4/800; 4X500A	RS1012V	YL1182
QY5-500	QB5/1750; 6079	RS1016	TB4/1250; 5868
QY5-800	QB5/2000; 8179	RS1019	QQE03/20; 6252
QY5-3000A	QBL5/3500; 6076	RS1026	TB3/750; 5867
QY5-3000W	QBW5/3500; 6075	RS1029	QQE03/12; 6360
QZ06-20	QC05/35; 8042	RS1036	TB4/1500
R189	PM2018B	RS1041V	YD1012
R208	XP1004	RS1041W	YD1010
R329	XP2230	RS1046	TB5/2500; 7092
R375	(XP1003)	RS1082CL	YL1011
R464	(56DVP)	RS1082CV	YL1012
R550	XP1002	RS1082CW	YL1010
R562	(XP1003)	RS1084CJ	YL1570
R580	PM2012B; XP2010	RS2002V	YL1091
R592	PM2013B	RS2002W	YL1090
R593	PM2013B	RS2021L	YD1001
R594	XP2030	RS2021V	YD1002
R632	(XP1116)	RS2021W	YD1000
R654	PM1910	RS2022CL	(YL1430)
R750	PM1910	RS2032CL	(YL1470)
R762	PM1918	RS3005CJ	YD1152
R763	(XP1117)	RS3005CL	YD1150
R877	XP2015	RS3010CJ	YD1162
R878	XP2000	RS3010CL	YD1160
RD300S	TB3/750	RS3026CJ	(YD1182)
RG4-3000	DCG6/18	RS3026CL	(YD1180)
RK807	QE06/50; 807	RS3040CJ	(YD1187)
RL17	PL5557	RS3040CL	(YD1185)
RL21	PL2D21; PL5727	RS3060CJ	(YD1197)
RL57	PL5559	RS3060CL	(YD1195)
RL16989/Ne	(PL5545)	RS3150CJ	(YD1202)
RR3-250;1835	DCX4/1000	RS3300CJ	(YD1432)

type to be replaced	replacement	type to be replaced	replacement
RY12-100	8020	TH558	YL1660
S1.5/80dv	PL5545	TH581	YL1640
S15/5d	(DCG12/30)	TH1586	5586
S15/40	(DCG7/100)	TH5040	(DCG9/20)
S15/40i	(DGC7/100)	TH5090	(DCG6/18GB)
S50XQ	570XQ	TH5130	(DCG6/18)
S4075	XQ1274	TH5521V/B	DCX4/1000
S4076	XQ1440	TH6011	PL5557
S4092	XQ1275	TH6031	PL5559
S4093	XQ1442	TH6050	(PL5559)
S4113	XQ1276	TH6120	(PL105)
SBS	ZX1051	TH7020	ZX1051
SR6	ZZ1000	TH7021	(ZX1051)
SR44	ZZ1000	TH7023	ZX1051
SRS360	TB3/750; 5867	TH9303	XX1063
SRS361	TB2.5/300; 5866	TH9473	XX1050
SRS362	TB4/1250; 5868	TH9475	XX1060/01
SRS455	QB3/300; 6155	TH9540	S58XQ
SRS456	QB3.5/750; 6156	TQ2	(PL5527)
SRS457	QB5/1750; 6079	TQ2/3	(PL6755A)
SRS4451	QQE06/40; 5894	TQ2/12	(PL255)
SRS4452	QQE3/20; 6252	TQ6	(DCG12/30)
Ste1000/2.5/15	PL5559	TQ7	(DCG7/100)
Ste1300/01/05	PL2D21; PL5727	TT10	QB2/250
Ste1500/15/45	(DCG7/100)	TT15	(QQE04/20); (832A)
Ste2500/6/40	PL105	TT16	QB3/300GA; 4-125A
T130-1	(TB2.5/400)	TT16D	QB3/300; 6155
T300-1	(TB4/1250); (5868)	TT17	PL5557
T350-1	(TB3/750); (5867)	TT20	QQE03/20; 6252
T380-1	TB3/750; 5867	TX2/3	PL5544
T500-1	TB4/1250; 5868	TX12-20W	(TAW12/20)
TA12/20000K	TAW12/20	TX920	PL5559
TC2/250	TB3/750; 5867	TXM100	PL2D21
TC2/3000	TB3/750; 5867	TY2-125	TB2.5/300; 5866
TD03-10G	EC55; 5861	TY2-150	TB2.5/400
TD2-300A	TBL2/300; 7004	TY3-250	TB3/750; 5867
TD2-400A	TBL2/400; 8119	TY4-350	(TB4/1250); (5868)
TD2-500A	TBL2/500; 8120	TY4-400	TB3/750; 5867
TFZ103	(PL5544)	TY4-400C	YD1220
TFZ106B	(PL5545)	TY4-500	TB4/1250; 5868
TG57	(PL5559)	TY5-500	TB4/1500
TH294	YD1337	TY6-12A	TBL6/20
TH302	(YD1300)	TY6-12W	TBW6/20
TH306	YD1300	TY6-800	TB5/2500; 7092
TH308	(YD1333)	TY6-1250A	TBL6/4000; 7753
TH316	YD1302	TY6-3000A	YD1230
TH326	YD1304	TY6-5000A	TBL6/6000; 5924
TH328	(YD1333)	TY6-5000B	YD1120
TH336	YD1303	TY6-5000H	TBH6/6000; 8610
TH338	YD1336	TY6-5000W	TBW6/6000; 5923

replacement guide for electron tubes

type to be replaced	replacement	type to be replaced	replacement
TY7-6000A	TBL7/8000; 6961	VX7400	DCX4/5000
TY7-6000H	TBH7/8000; 8592	WE17	PL5557
TY7-6000W	TBW7/8000; 6960	WL2D21	PL2D21; PL5727
TY8-15A	TBL6/14; 7804	WL17	PL5557
TY8-15H	TBH16/14; 8591	WL57	PL5559
TY8-15W	TBW6/14; 7805	WL105	PL105
TY8-6000A	TBL7/9000; 8269	WL172	(PL105)
TY8-6000H	TBH7/9000; 8593	WL414	(PL255)
TY8-6000W	TBW7/9000; 8268	WL502A	PL5727
TY12-15A	TBL12/40; 7800	WL575A	(DCG6/18GB)
TY12-20A	TBL12/38; 7806	WL624	(PL105)
TY12-20H	TBH12/38; 8594	WL631	PL5559
TY12-20W	TBW12/38; 7807	WL632A	(PL5559)
TY12-25A	TBL12/25; 6618	WL676	(PL105)
TY12-25W	TBW12/25; 6617	WL807	PL807
TY12-120W	YD1010	WL813	QB2/250; 813
TY12-250A	TBL12/25; 6618	WL864B	(DCG9/20)
TY74	(PL5557)	WL885	(PL2D21); (PL5727)
TY76	(PL5559)	WL5551	ZX1051
TY77	(PL5559)	WL5551A	ZX1051
TY78	(PL5559)	WL5557	PL5557
TY84	(PL5559)	WL5559	PL5559
TY85	(PL105)	WL5720	(PL5559)
TY6030	(PL5559)	WT210-0001	PL2D21; PL5727
TY6050	(PL5559)	WT210-0015	PL5727
TY6100	(PL5559)	WT210-0056	PL5559
TY6120	(PL105)	WT210-0062	PL5557
TY6220	(PL5545)	WT210-0069	PL5557
U-70/08	(ZX1051)	WT210-0071	ZX1051
U-70/08P	(ZX1051)	WT210-0074	PL105
UE967	PL5557	WT210-0079	PL105
UY807	QE06/50; 807	WT272	PL5557
V40	8020	WTT11	PL5559
V1103	QQE03/12; 6360	WTT117	PL5557
VJ5551	ZX1051	WTT118	PL105
VJ5551A	ZX1051	XB767A	(PL2D21); (PL5727)
VT39A	(DCG9/20)	XG1-2500	(PL5559)
VT79	(QE06/50); (807)	XG2-12	PL255
VT88	(QQE04/20); (823H)	XG2-25	PL260
VT88A	QQE04/20; 832A	XG2-500	(PL5557)
VT100	QE06/50; 807	XG2-6400	(PL105)
VT100A	(QE06/50); (807)	XG5-500	PL5557
VT118	QQE04/20; 832A	XG15-10	DCG7/100B
VT144	QB2/250	XG15-12	(DCG7/100B)
VT259	(QQE06/40); (5894)	XGQ2-6400	PL105
VT267	8020	XN3	ZM1080
VT286	QQE04/20; 832A	XQ1001	(XQ1240)
VT510	QQE04/10	XQ1002	(XQ1240)
VTP7386	(PL5545)	XQ1003	(XQ1241)
VX550A	DCX4/1000	XQ1004	(XQ1241)

type to be replaced	replacement
XQ1005	XQ1240; XQ1280
XQ1006	XQ1240
XQ1007	XQ1240; XQ1241
XQ1008	XQ1241
XQ1030	XQ1031; XQ1032
XQ1040	XQ1240
XQ1041	XQ1240; XQ1280
XQ1042	XQ1240
XQ1043	XQ1241
XQ1044	XQ1241
XQ1050	(XQ1240)
XQ1051	(XQ1240); (XQ1280)
XQ1052	(XQ1240)
XQ1053	(XQ1241)
XQ1054	(XQ1241)
XQ1060	(XQ1240); (XQ1280)
XQ1061	(XQ1240)
XQ1062	(XQ1240)
XQ1063	(XQ1241)
XQ1064	(XQ1241)
XQ1065	(XQ1240)
XQ1066	(XQ1285)
XQ1067	(XQ1285)
XQ1180	XQ1280
XQ1181	XQ1280
XQ1200	(XQ1400)
XQ1201	(XQ1401)
XQ1202	(XQ1402)
XQ1205	(XQ1400)
XQ1206	(XQ1401)
XQ1207	(XQ1402)
XQ1220	XQ1230
XQ1250	XQ1400
XQ1290	XQ1280
XQ1291	XQ1240
XQ1292	XQ1240
XQ1293	XQ1241
XQ1294	XQ1241
XQ1295	XQ1240
XQ1296	XQ1280
XQ1297	XQ1280
XQ1310	XQ1271
XQ1315	XQ1272
XQ1330	S7001
XQ1331	S7002
XQ1332	S7003; S7004
XQ1450 series	(XQ1440)
XQ1460 series	(XQ1274)
XR11-600	PL5684/C3JA
XR1-1600A	PL5684/C3JA
XR1-3200	PL5544
YD1331	YD1333
ZT1011	PL5684/C3JA

notes

The trigger calorimeter used in the CERN NA5 experiment for investigating deep inelastic hadron-hadron collisions using combined wavelength-shifting acrylic rods (doped with BBQ and Yellow 323) to draw separated signals from the photon and hadron part of the calorimeter onto 240 pairs of XP2008 and XP2013 B photomultiplier tubes.

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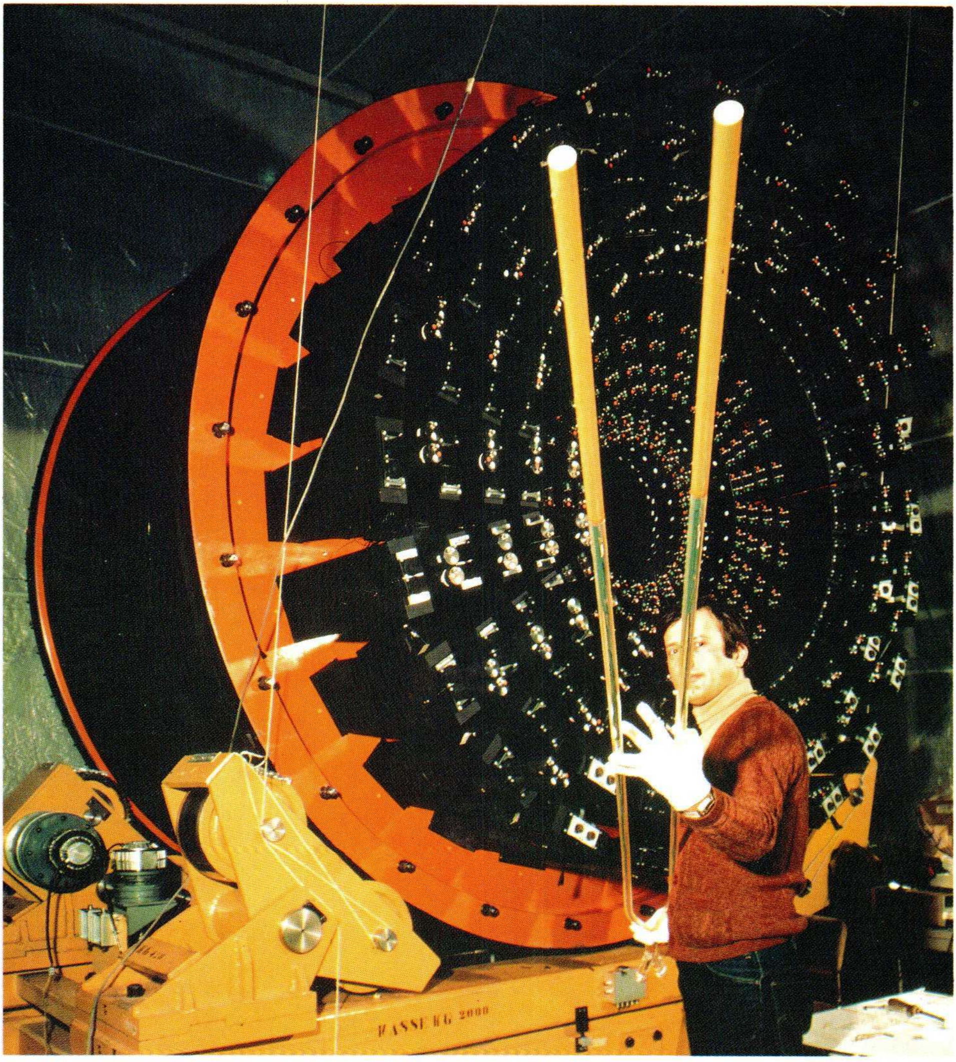

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