PHILIPS

DATA HANDBOOK

PHILIPS ELECTRONIC COMPONENTS AND MATERIALS

COMPONENTS AND MATERIALS

PART 5 JUNE 1971

Memory products

Magnetic heads

Quartz crystals

Microwave devices

Variable mains transformers

Electro-mechanical components

COMPONENTS AND MATERIALS

Part 5 **June 1971**

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DATA HANDBOOK SYSTEM

To provide you with a comprehensive source of information on electronic components, subassemblies and materials, our Data Handbook System is made up of three series of handbooks, each comprising several parts.
The three series, identified by the colours noted, are:

ELECTRON TUBES (9 parts)	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS (5 parts)	RED
COMPONENTS AND MATERIALS (5 parts)	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued annually; the contents of each series are summarized on the following pages.
We have made every effort to ensure that each series is as accurate, comprehensive and up-to-date as possible, and we hope you will find it to be a valuable source of reference. Where ratings or specifications quoted differ from those published in the preceding edition they will be pointed out by arrows. You will understand that we can not guarantee that all products listed in any one edition of the handbook will remain available, or that their specifications will not be changed, before the next edition is published. If you need confirmation that the pusblished data about any of our products are the latest available, may we ask that you contact our representative. He is at your service and will be glad to answer your inquiries.

January 1970

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 — **January 1971**

Transmitting tubes (Tetrodes, Pentodes)
Associated accessories

Part 2 — **March 1971**

Tubes for microwave equipment

Part 3 — **March 1970**

Special Quality tubes
Miscellaneous devices

Part 4 — **April 1971**

Receiving tubes

Part 5 — **May 1971**

Cathode-ray tubes
Photo tubes
Camera tubes
Photoconductive devices
Associated accessories

Part 6 — **June 1970**

Photomultiplier tubes
Scintillators
Photoscintillators
Radiation counter tubes
Semiconductor radiation detectors
Neutron generator tubes
Associated accessories

Part 7 — **July 1970**

Voltage stabilizing and reference tubes
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

Part 8 — **August 1970**

T.V. Picture tubes

Part 9 — **January 1971**

Transmitting tubes (Triodes)
Tubes for R.F. heating (Triodes)
Associated accessories

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Diodes and Thyristors **September 1970**

General
Signal diodes
Tunnel diodes
Variable capacitance diodes
Voltage regulator diodes
Rectifier diodes
Thyristors, diacs, triacs
Rectifier stacks
Accessories
Heatsinks

Part 2 Low frequency; Deflection **October 1970**

General
Low frequency transistors (low power)
Low frequency power transistors
Deflection transistors
Accessories

Part 3 High frequency; Switching **November 1970**

General
High frequency transistors
Switching transistors
Accessories

Part 4 Special types **December 1970**

General
Transmitting transistors
Microwave devices
Field effect transistors
Dual transistors
Microminiature devices for thick- and thin-film circuits
Beam lead devices for thick- and thin-film circuits
Photo devices
Accessories

Part 5 Integrated Circuits **March 1971**

General
Digital integrated circuits
  DTL (FC family)
  TTL (FJ family)
  MOS (FD family)
Linear integrated circuits

COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Circuit Blocks, Input/Output Devices — **September 1970**

Circuit blocks 100 kHz Series
Circuit blocks 1-Series
Circuit blocks 10-Series
Circuit blocks 20-Series
Circuit blocks 40-Series
Counter modules 50-Series
Norbits 60-Series, 61-Series
Circuit blocks 90-Series
Circuit blocks for ferrite core memory drive
Input/output devices

Part 2 Resistors, Capacitors — **December 1970**

Fixed resistors
Variable resistors
Non-linear resistors
Ceramic capacitors
Polyester, polycarbonate, polystyrene, paper capacitors
Electrolytic capacitors
Variable capacitors

Part 3 Radio, Audio, Television — **February 1971**

FM tuners
Coils
Piezoelectric ceramic resonators and filters
Loudspeakers
Audio and mains transformers
Television tuners
Components for black and white television
Components for colour television
Deflection assemblies for camera tubes

Part 4 Magnetic Materials, White Ceramics — **April 1971**

Ferrites for radio, audio and television
Ferroxcube potcores and square cores
Small coils, assemblies and assembling parts
Ferroxcube transformer cores
Piezoxide
Permanent magnet materials

Part 5 Memory Products, Magnetic Heads, Quartz Crystals, Microwave Devices, Variable Transformers, Electro-mechanical Components — **June 1971**

Ferrite memory cores
Matrix planes, matrix stacks
Complete memories
Magnetic heads
Quartz crystal units, crystal filters
Isolators, circulators
Variable mains transformers
Electro-mechanical components

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CARACAS

Memory products

Preface

The following pages describe a complete range of memory products, from individual ferrite cores to complete assemblies comprising stacked matrix planes and their associated driving circuits.
Cores with switching times ranging from 0.1 µs to 10 µs and cores with low temperature coefficients, as well as a complete selection of matrices based on these cores, are listed. Besides, relatively slow memories for industrial use as well as fast memories for computers are offered.
In brief, the memory products described in this portion of the handbook, comprise the following:

ferroxcube memory cores
matrix planes
matrix stacks
complete magnetic core memories
delay line memories

FERROXCUBE MEMORY CORES

STANDARD TYPES

core size (mil)	core type	nominal operating conditions						relevant typical output characteristics				
		T (°C)	I (mA)	C4 [1] (mA/degC)	DR	t_r (μs)	t_d (μs)	uV_1 (mV)	rV_1 (mV)	wV_z (mV)	t_p (μs)	t_s (μs)
150	6E1 [2]	40	346	2.7	0.50	0.8	12	120	115	30	3.5	8
50	6D5 [2]	40	365	2.0	0.50	0.2	1.5	64	60	7	0.54	1.15
50	6D9 [2]	40	450	1.7	0.50	0.2	1.5	60	58	8	0.55	1.20
50	6C1 [2]	40	500	2.0	0.50	0.2	1.1	63	60	8	0.48	0.93
50	6C2 [2]	25	805	1.1	0.50	0.25	1.2	100	98	7	0.45	1.0
30	6F3	70	740	1.3	0.50	0.15	0.6	60	58	5	0.25	0.50
30	6F8	40	655	3.7	0.50	0.1	0.5	55	53	6	0.20	0.39
20	6H2	25	963	1.4	0.50	0.05	0.26	50	49	4	0.110	0.215
20	6H3	25	890	3.6	0.50	0.05	0.24	49	48	4	0.100	0.200
20	6H4	25	710	2.7	0.50	0.05	0.27	66	63	5	0.115	0.225
20	6H5	60	800	1.7	0.50	0.05	0.25	72	69	7.5	0.105	0.195
20	6H9	25	800	2.0	0.50	0.05	0.25	64	61	8.5	0.110	0.210
18	6H6	60	778	1.3	0.50	0.05	0.20	59	57	5	0.095	0.175
14	6V2	25	855	1.9	0.50	0.03	0.16	41	40	4	0.070	0.130

1) Rate of change of full drive current for constant uV_1

2) Maintenance type

On the following pages the various cores are arranged according to type numbers.

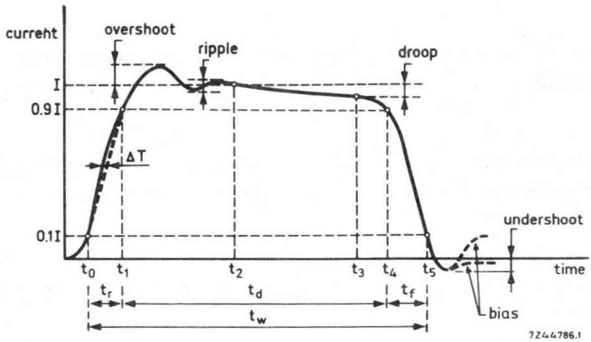
Note: Offers for cores differing from those of our range may be made on request.

INTRODUCTION

CORE CHARACTERISTICS

The characteristic properties of a Ferroxcube Memory Core are described in terms of its response to a set of defined test conditions. Under these test conditions, the core is effectively coupled to two circuits, drive current pulses being carried by one and response voltage pulses being induced in the other. The two circuits are so arranged that, in the absence of a core, negligible coupling exists between them.

THE CURRENT PULSE, used in the measurement of memory cores.



The following definitions apply to the current pulse which is used in the measurement of Memory Cores.

Amplitude

I The magnitude of the current pulse immediately after the leading edge transients (overshoot and ripple) have decreased to less than 0.1 % of the current magnitude.

Times

t_0 Time origin. The time when the leading edge of the current pulse reaches 10 % of the amplitude of the current pulse.

t_1 The time when the leading edge of the current pulse first reaches 90 % of the amplitude of the current pulse.

t_2 The time when the leading edge transients have decreased to less than 0.1 % of the current magnitude.

t_3 The time for the end of the straight part of the top of the pulse.

t_4 The time when the trailing edge of the current pulse reaches 90 % of the amplitude of the current pulse.

t_5 The time when the trailing edge of the current pulse reaches 10 % of the amplitude of the current pulse.

Time intervals

t_r Rise time, the time interval $t_0 - t_1$

t_d Pulse duration, the time interval $t_1 - t_4$

t_f Decay time (Fall time), the time interval $t_4 - t_5$

Linearity of leading edge

Over the region t_0 to t_1, the maximum deviation in time of the actual pulse from a straight line joining the 10% and 90% points, expressed as a percentage of the rise time. For measurement purposes this is less than 2%.

Overshoot

The extent to which the maximum instantaneous current exceeds the Pulse Amplitude I, expressed as a percentage of I. For measurement purposes this is less than 1%.

Ripple

When the overshoot is followed by a damped oscillation this is known as ripple, this effect should be less than 1% for measurement purposes.

Droop

The decrease in current over the time interval t_2 to t_3 expressed as a percentage of I, per microsecond. For measurement purposes this is less than 1% per μs.

Undershoot

The maximum instantaneous value of the reverse current swing following the trailing edge of the pulse, expressed as a percentage of I. For measurement purposes, this is normally less than 1%.

Bias

A residual current flowing at all times in the test circuit. For measurement purposes this is less than 1%.

The Exponential pulse

When used, this pulse is defined in terms of the constants of the generating circuit.

Kinds of current pulses

I_r Full Read Pulse

The current pulse which, when applied to a core in the "one" state, will leave it in the "zero" state.

I_w Full Write Pulse

The current pulse which, when applied to a core in the "zero" state, will leave it in the "one" state. This corresponds to the superimposed partial write selection pulses in a coincident current matrix.

I_{pr} Partial Read Pulse

A pulse of the same polarity as the Full Read Pulse which, when applied to a core in the "one" state, is insufficient in amplitude to bring it to the "zero" state.

I_{pw} Partial Write Pulse

A pulse of the same polarity as the Full Write Pulse which, when applied to a core in the "zero" state, is insufficient in amplitude to bring it to the "one" state.

D.R. Disturb Ratio

The ratio of the amplitude of the Partial Read or Write Pulse to the amplitude of the full Read or Write Pulse. In a matrix working under ideal conditions, I_{pw} = 0.5 I_w and the Disturb Ratio = 0.5. For core measurement purposes, it is usual to consider the case where the Full Pulses are less than the recommended nominal and the Partial Pulses are greater than half the recommended Full Pulse.

For example: If the recommended full drive current is I_{nom} and if

$I_r = I_w = I_{nom} - 10\%$ and $I_{pr} = I_{pw} = 0.5\ I_{nom} + 10\%$

then $$D.R. = \frac{1.1\ (0.5\ I_{nom})}{0.9\ (I_{nom})} = \frac{0.55}{0.9} = 0.61$$

Notes The read and write pulses are of opposite polarity.
I_{nom} is used for the nominal value of a full current pulse.

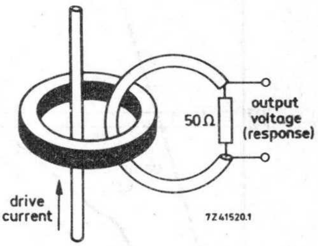
TEST CONDITIONS

All individual cores are tested upon meeting the specification on the relevant data sheet. Moreover, sample tests at several temperatures are carried out according to Mil Standard 105 D (inspection level II). An A.Q.L. of 0.015 is handled in testing cores of 30 mil and smaller.

Drive Pulses

Linear pulses are normally used and the amplitude and rise time of drive pulses are stated on the individual data sheets.

Deviation from linearity	< 2 %
Overshoot	< 1 %
Ripple	< 1 %
Droop	< 1 %
Undershoot	< 1 %
Bias	< 1 %



Sense Circuit

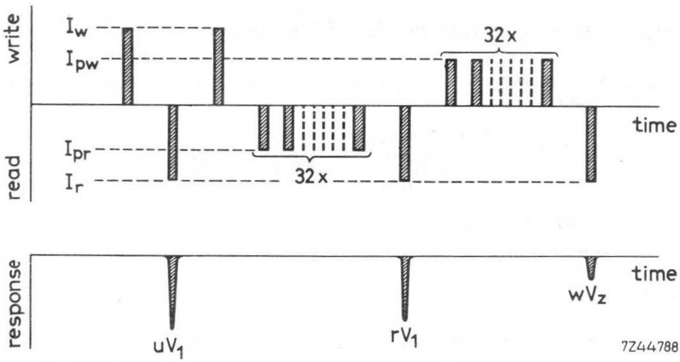
The core being measured is coupled to one turn of the sense circuit, this being terminated in 50 Ω.

Temperature

The temperatures at which core properties have been measured is stated on the individual data sheets. Where equivalents are shown for temperatures other than the test temperatures, the rate of change of full drive current for a constant disturb ratio of 0.61 is used to calculate the currents required to drive the core.

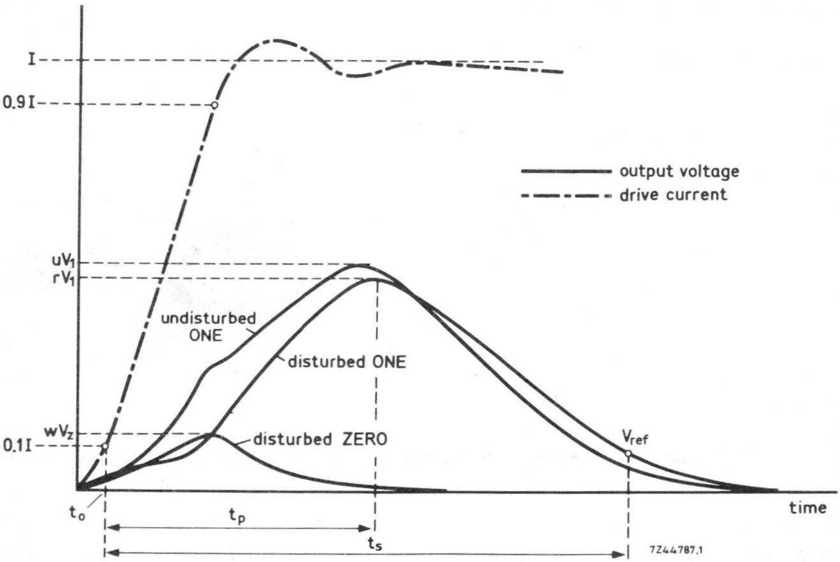
Pulse Sequence

Cores are measured while being subjected to a sequence of pulses designed to cycle the core through a number of states.
The following indicates a typical pulse train used for core measurement:



The pulse repetition frequency is 30 **kHz**. The values of the rV_1 and wV_z response voltages are read after 32 partial disturb pulses, to make sure that the remanent flux density has reached its lowest value.

RESPONSES



System of symbols for core response voltage

The response voltages induced in the sense circuit coupled to the core are measured with the sense circuit terminated in a specified resistance.

Symbols for the various response voltages are built up of the letter V, together with pre-subscripts and post-subscripts. Unless otherwise stated, the peak value of the response is indicated by this symbol.

Post-subscripts

The post-subscripts indicate the type of read pulse (either partial or full) giving rise to the response voltage and also the polarity of the last full-pulse preceding the read pulse, i.e. read or write polarity.

When the response is caused by a full read pulse, the post subscript is:

1 when the last full pulse preceding this was a write pulse (i.e. the core had been storing "one").

z when the last full pulse preceding this was a read pulse (i.e. the core had been storing "zero").

When the response is caused by a partial read pulse the post subscript is:

p1 when the last full pulse preceding this was a write pulse (i.e. the core had been storing "one").

pz when the last full pulse preceding this was a read pulse (i.e. the core had been storing "zero").

Pre-scripts:

The pre-scripts indicate the partial pulses applied to the core between the read pulse at which the response is observed, and the last full pulse applied before that read pulse. These are:

u when there have been no partial pulses (i.e. the core is undisturbed).

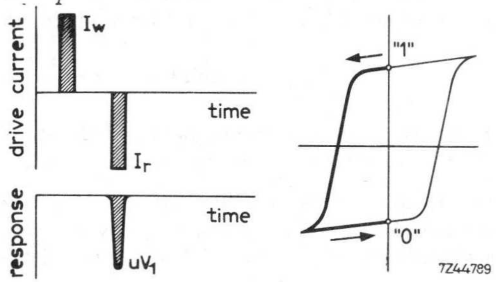
r when there have been one or more partial read pulses.

w when there have been one or more partial write pulses.

Response voltages

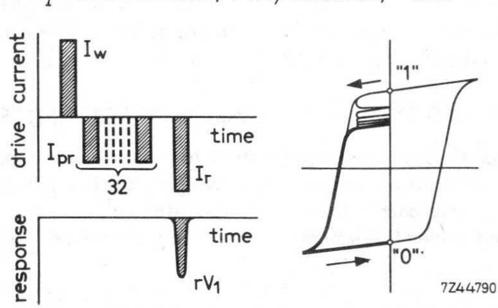
The following are the principal response voltages, which are used in Memory Core data sheets:

uV_1 Undisturbed "One"



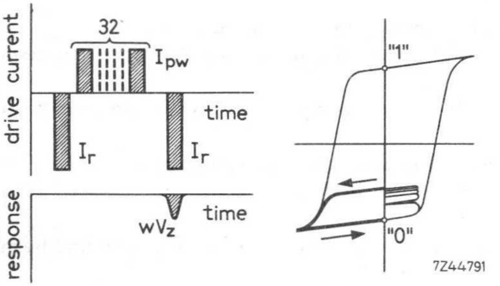
The peak value of the response voltage, obtained at a full read pulse, preceded by a full write pulse.

rV_1 Read disturbed, Fully selected, "One"



The peak value of the response voltage, obtained at a full read pulse, preceded by a full write pulse followed by a number of partial read pulses.

wV_z Write disturbed, Fully selected, "Zero"



The peak value of the response voltage, obtained at a full read pulse, preceded by a full read pulse followed by a number of partial write pulses.

$UR = uV_1 - rV_1$

The difference between the value of uV_1 and rV_1.
This value is a measure for the rectangularity of the hysteresis loop.

Response Times

The following times are used in Memory Core data sheets to describe core responses.

- t_o Time Origin. The time when the leading edge of the current pulse reaches 10% of the amplitude of the current pulse. The time origin is the point from which the following response times are measured.
- t_p Peak Time. The time interval between the time origin, t_o, and the time at which (rV_1) attains its peak amplitude.
- t_s Switching Time. The time interval between the time origin, t_o, and the time at which rV_1 falls to V_{ref} for the last time, ignoring any trailing edge transient.

Notes When it is necessary to refer to the Peak Time or Switching Time of a response voltage other than the rV_1 characteristic, the symbol t_p or t_s may be used, qualified with a symbol in parenthesis to indicate to which response voltage it applies (e.g. t_p (uV_1); t_s (wV_z)).

"V_{ref}" should normally be equal to 0.1 rV_1. Because it is impractical to measure rV_1 of each core of a series of cores exactly and then to adjust for 0.1 rV_1 at each core again, t_s is measured with respect to V_{ref}.

NOMINAL OPERATING CONDITIONS AND TYPICAL RESPONSE CHARACTERISTICS

On each data sheet nominal operating conditions are stated in order to compare one core type with another. These conditions are nominal in as much as, although practical, they will not necessarily be the optimum under any particular set of circumstances.
Typical response characteristics obtained under these nominal operating conditions can be obtained from the data.

QUICK REFERENCE DATA

The new data sheets contain the following quick reference data on the front page:

Switching time, this is the switching time at nominal operating conditions and $V_{ref} = 0.1\ rV_1$

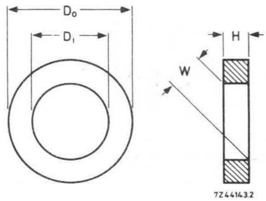
Temperature range, classified as follows:

Standard temperature range,	up to 55 °C
Medium temperature range,	up to 75 °C
Wide temperature range,	up to 100 °C

50 mil FERROXCUBE MEMORY CORE

The 6C1 memory core is intended for use in a coincident current memory. Cycle times of 5 μs can be obtained. Making allowance for a tolerance of ± 10% of the drive current, the optimum drive current is 500 mA at T_{amb} = 40 °C.

Dimensions



D_o = 1.27 mm (50 mil)
D_i = 0.76 mm (30 mil)
H = 0.30 mm (12 mil)
W = 0.33 mm (13 mil)

nominal operating conditions

T_{amb}	25	40 °C
$I_r = I_w = I_{nom}$	530	500 mA
DR	0.50	0.50
t_r (linear)	0.2	0.2 μs
t_d	1.1	1.1 μs

typical response values

T_{amb}	25	40 °C
uV_1	63	63 mV
rV_1	60	60 mV
wV_z	8	8 mV
t_p	0.46	0.48 μs
t_s	0.87	0.93 μs

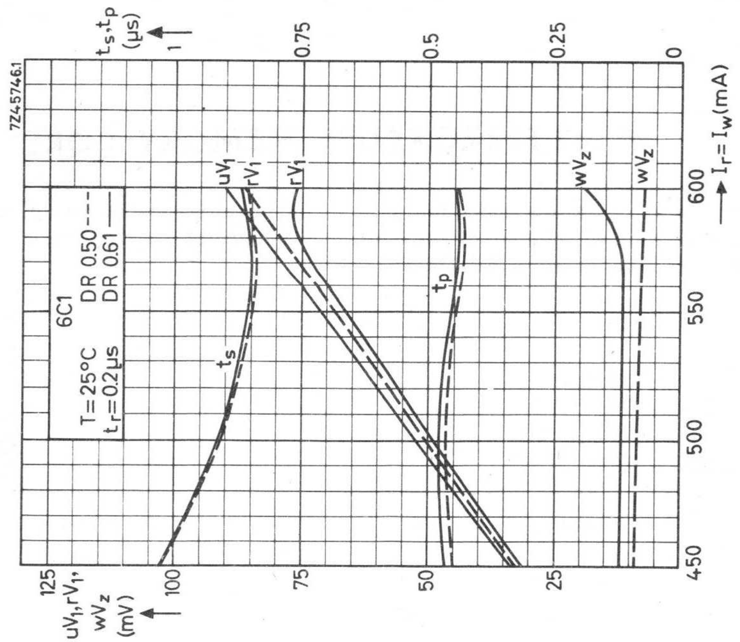
test conditions

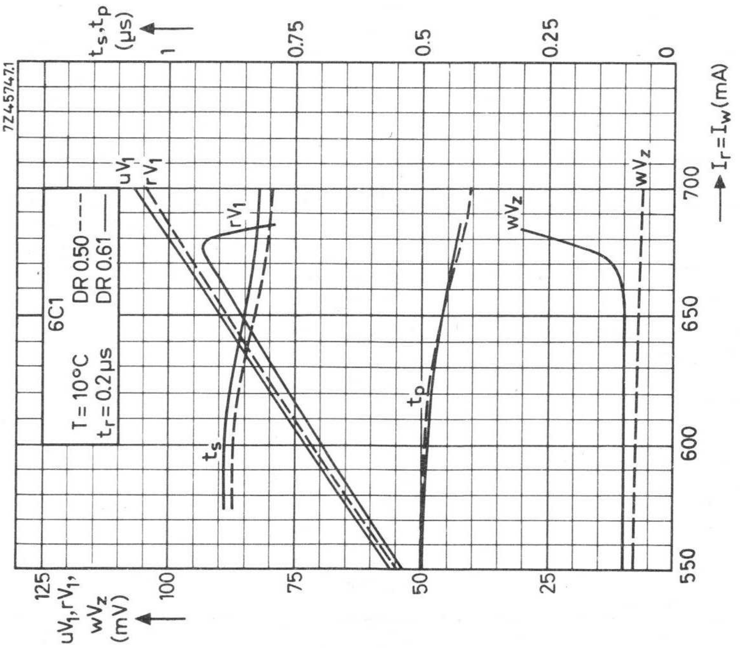
T_{amb}	40 °C
$I_r = I_w = I_{nom}$ - 10%	450 mA
$I_{pr} = I_{pw} = 0.5\, I_{nom}$ + 10%	275 mA
DR	0.61
Number of disturb pulses	32
t_r (linear)	0.2 μs
t_d	≥ 2.0 μs
V_{ref}	3.6 mV

guaranteed values at specified test conditions

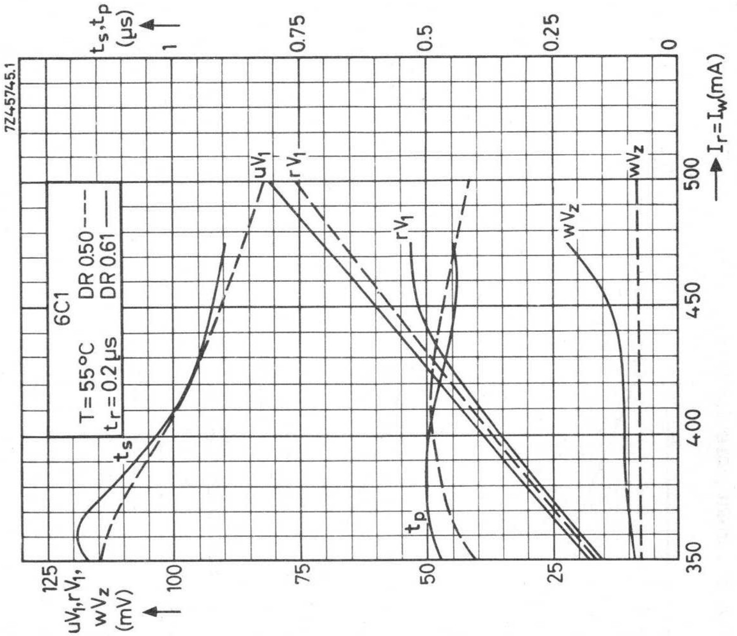
rV_1	44 ± 9 mV
wV_z	≤ 13 mV
UR	≤ 5 mV
t_p	0.49 ± 0.09 μs
t_s	0.975 ± 0.125 μs

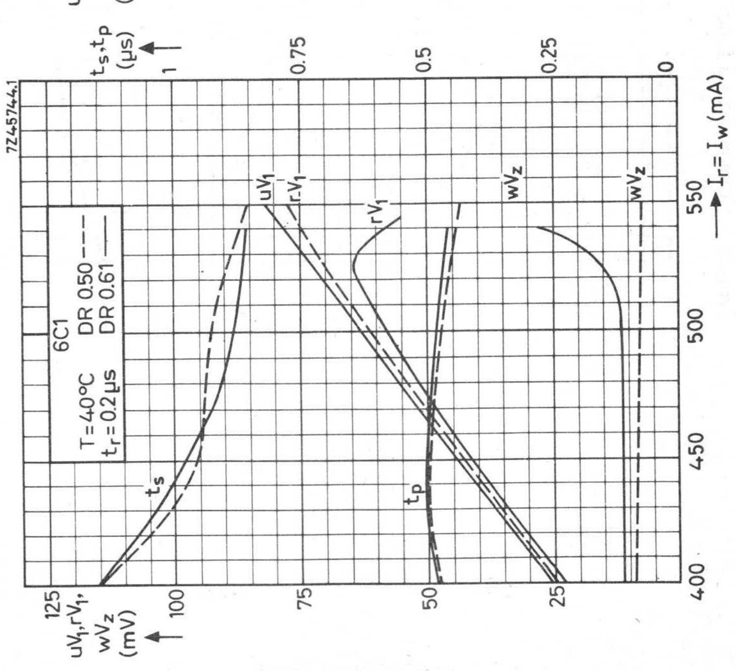
Typical performance as a function of drive current at different temperatures.



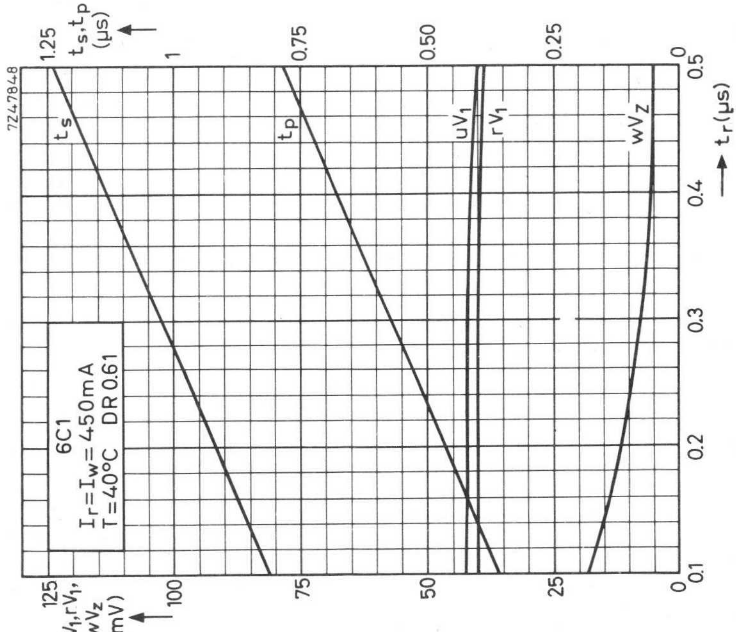


Typical performance as a function of drive current at different temperatures.





Typical performance as a function of current pulse rise time.

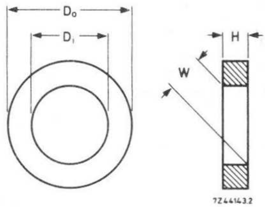


50 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA	
Switching time	1.0 μs
Wide temperature range	

DIMENSIONS

D_o = 1.25 mm (49 mil)
D_i = 0.75 mm (30 mil)
H = 0.40 mm (16 mil)
W = 0.25 mm (10 mil)



APPLICATION

This core has been developed for use in a coincident current memory, in particular in 3 D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	°C
$I_r = I_w = I_{nom}$	805	mA
D. R.	0.50	
t_r (linear)	0.25	μs
t_d	1.2	μs

typical response values		
uV_1	100	mV
rV_1	98	mV
wV_z	7	mV
t_p	0.45	μs
t_s (V_{ref} = 0.1 rV_1)	1.0	μs

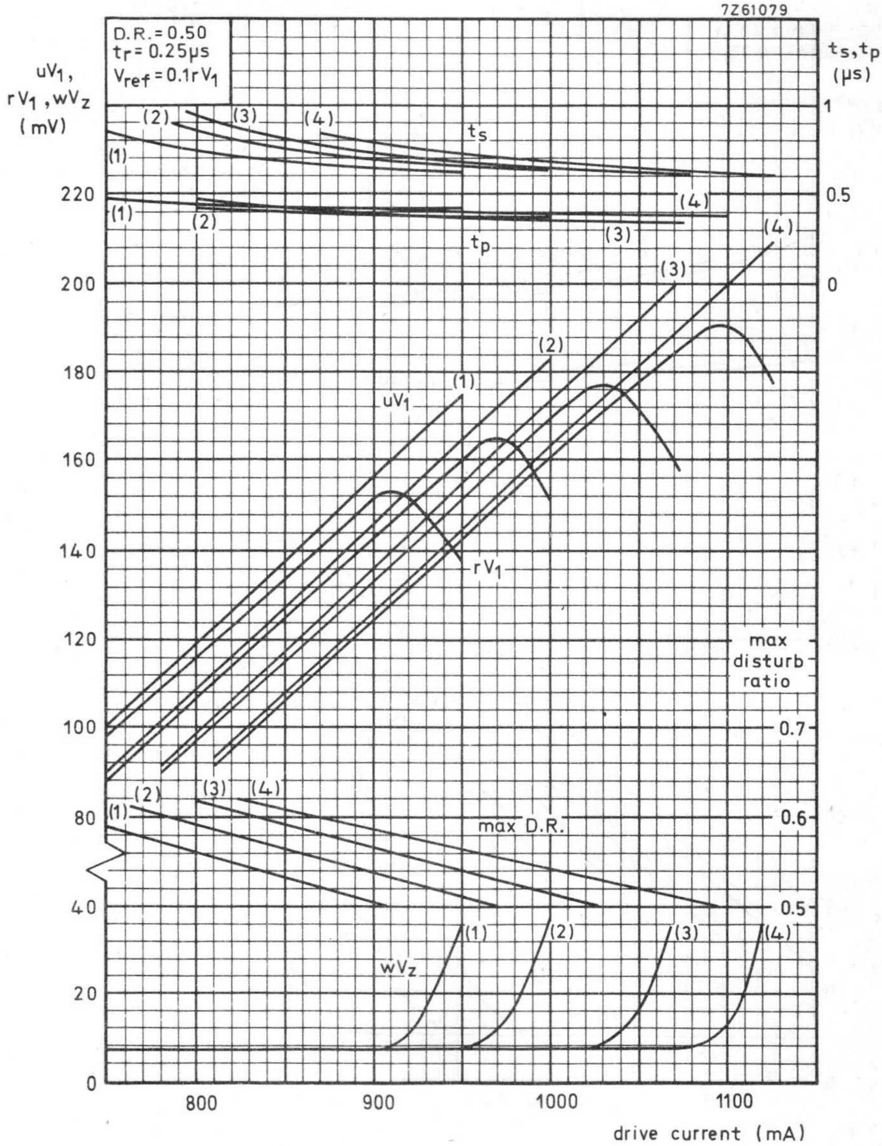
Drift with temperature (average over the range 0 to 75 °C)		
Rate of change of full drive current for constant uV_1	1.10	mA/degC
Rate of change of full drive current at break point and D. R. = 0.61	1.80	mA/degC
Rate of change of uV_1 for constant drive current	0.40	mV/degC

TESTS AND REQUIREMENTS

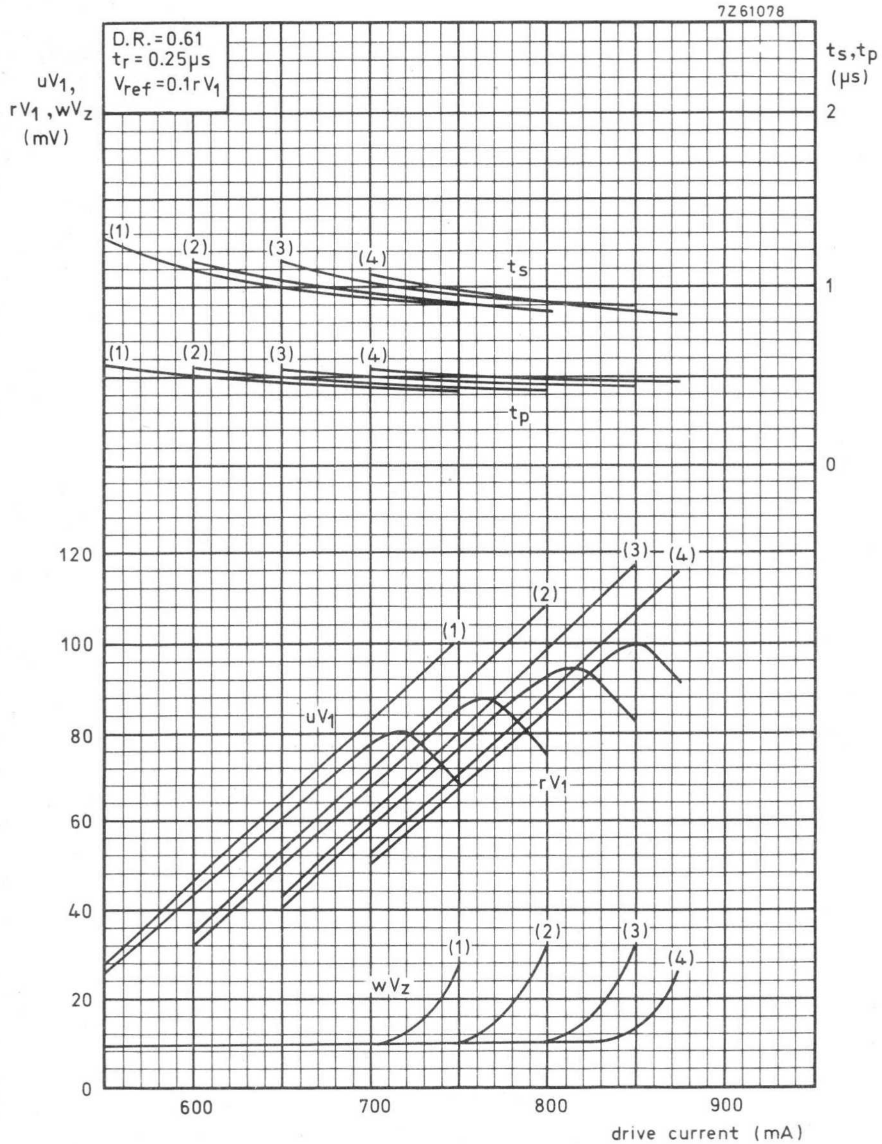
test conditions				equivalent at	
T_{amb}	70	0	^oC	T_{amb} = 25	^oC
$I_r = I_w$	680	763	mA	725	mA
$I_{pr} = I_{pw}$	415	465	mA	442	mA
D.R.	0.61	0.61		0.61	
Number of disturb pulses	32	32		32	
t_r (linear)	0.25	0.25	μs	0.25	μs
t_d	2.5	2.5	μs	2.5	μs
V_{ref}	4.5	4.5	mV	4.5	mV

acceptance limits at test conditions					
rV_1	69 ± 9	70 ± 12	mV	70 ± 12	mV
wV_z	≤ 11.5	≤ 11.5	mV	≤ 11.5	mV
UR	≤ 6	≤ 5	mV	≤ 5	mV
t_p	0.52 ± 0.06	0.52 ± 0.06	μs	0.52 ± 0.06	μs
t_s	1.09 ± 0.12	1.075 ± 0.125	μs	1.075 ± 0.125	μs

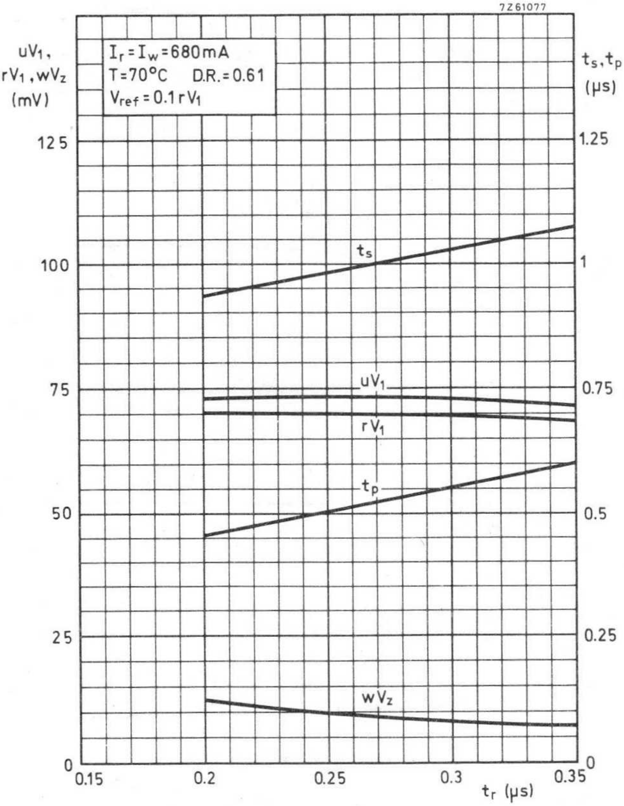
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 75 °C, (2) = 50 °C, (3) = 25 °C, (4) = 0 °C



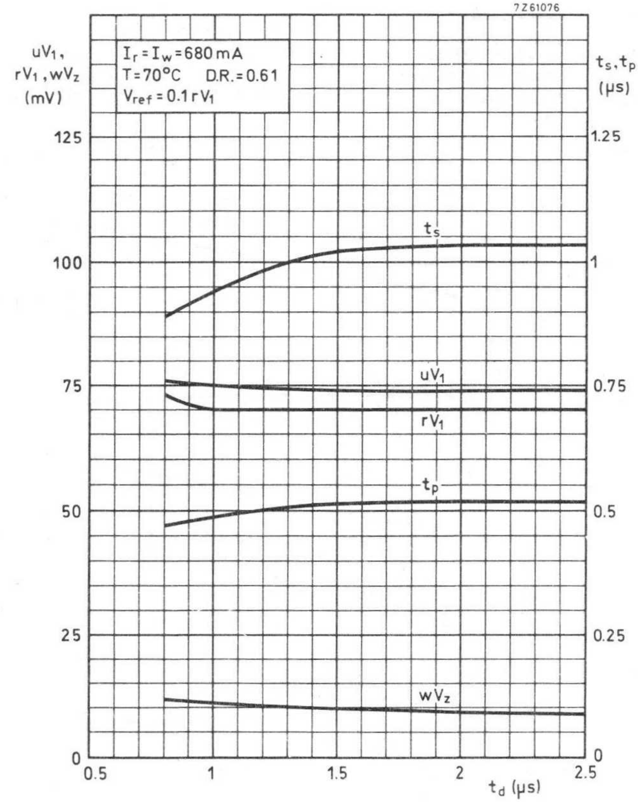
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 75 ^{o}C, (2) = 50 ^{o}C, (3) = 25 ^{o}C, (4) = 0 ^{o}C



Typical core performance as a function of current pulse rise time.



Typical core performance as a function of current pulse duration.

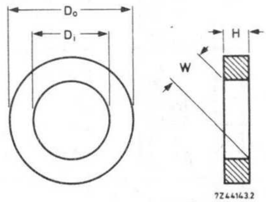


50 mil FERROXCUBE MEMORY CORE

The 6D5 memory core is intended for use in a coincident current memory. Cycle times of 6 µs can be obtained. Making allowance for a tolerance of ± 10% of the drive current, the optimum drive current is 365 mA at T_{amb} = 40 °C.

Dimensions

D_o = 1.27 mm (50 mil)
D_i = 0.80 mm (30 mil)
H = 0.38 mm (16 mil)
W = 0.30 mm (11.8 mil)



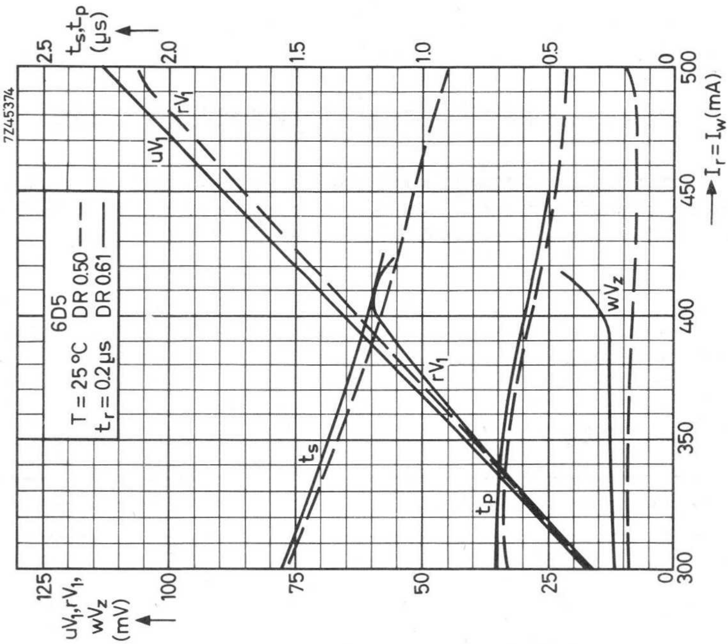
nominal operating conditions			
T_{amb}	25	40	°C
$I_r = I_w = I_{nom}$	395	365	mA
DR	0.50	0.50	
t_r (linear)	0.2	0.2	µs
t_d	1.5	1.5	µs

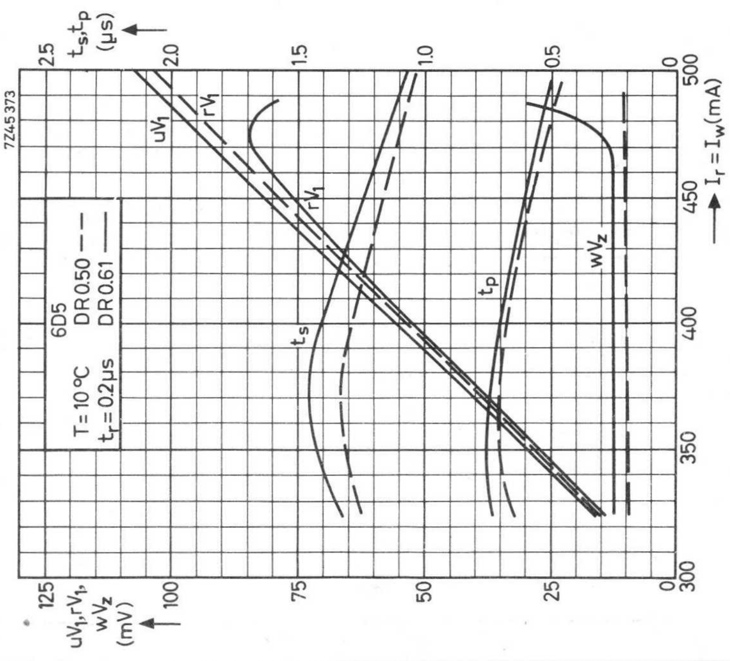
typical response values			
T_{amb}	25	40	°C
uV_1	64	64	mV
rV_1	62	60	mV
wV_z	9	7	mV
t_p	0.58	0.54	µs
t_s	1.18	1.15	µs

test conditions		
T_{amb}	40	°C
$I_r = I_w = I_{nom}$ - 10%	330	mA
$I_{pr} = I_{pw} = 0.5\, I_{nom}$ + 10%	200	mA
DR	0.61	
Number of disturb pulses	32	
t_r (linear)	0.2	µs
t_d	≥ 4	µs
V_{ref}	4.5	mV

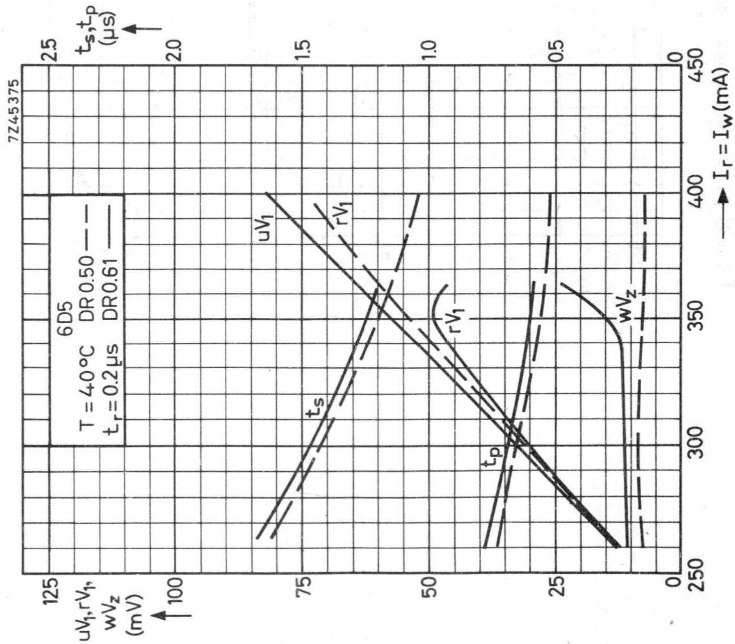
guaranteed values at specified test conditions		
rV_1	48 ± 7	mV
wV_z	≤ 15	mV
UR	≤ 5.5	mV
t_p	0.62 ± 0.10	µs
t_s	1.40 ± 0.17	µs

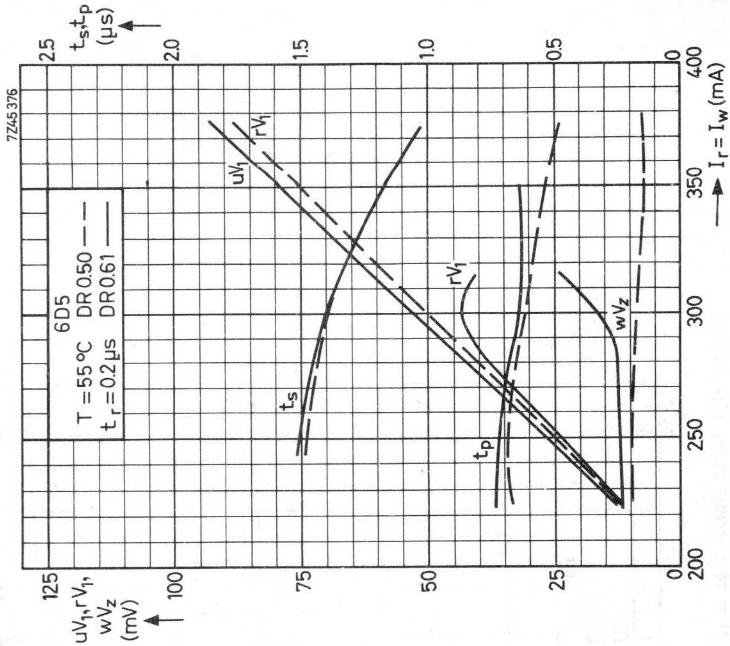
Typical performance as a function of drive current at different temperatures.



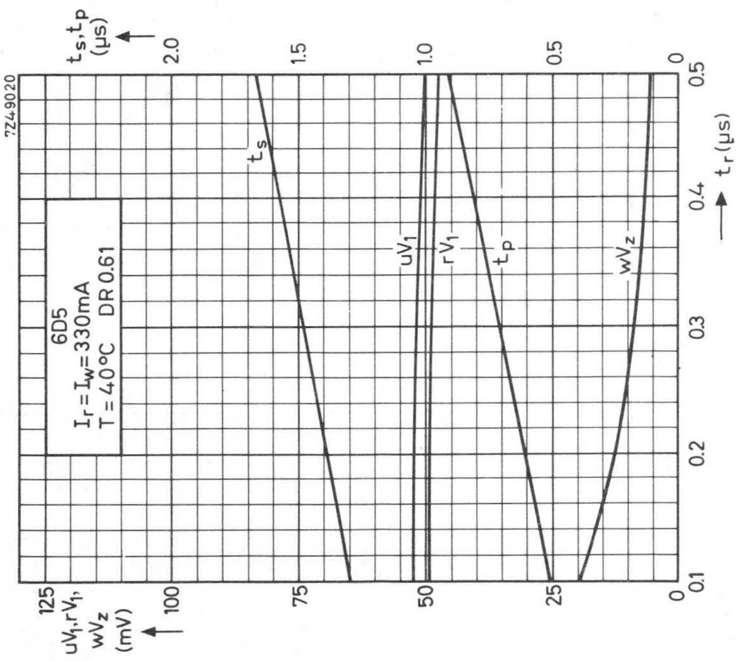


Typical performance as a function of drive current at different temperatures.





Typical performance as a function of current pulse rise time.

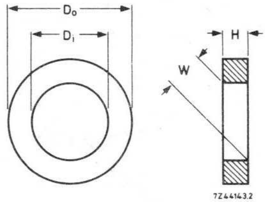


50 mil FERROXCUBE MEMORY CORE

The 6D9 memory core is intended for use in a coincident current memory. Cycle times of 5 µs can be obtained. Making allowance for a tolerance of ± 10% of the drive current, the optimum drive current is 450 mA at T_{amb} = 40 °C.

Dimensions

D_o = 1.34 mm (50 mil)
D_i = 0.80 mm (30 mil)
H = 0.40 mm (15 mil)
W = 0.28 mm (11 mil)



nominal operating conditions

T_{amb}	25	40 °C
$I_r = I_w = I_{nom}$	475	450 mA
DR	0.50	0.50
t_r (linear)	0.2	0.2 µs
t_d	1.5	1.5 µs

typical response values

T_{amb}	25	40 °C
uV_1	60	60 mV
rV_1	58	58 mV
wV_z	8	8 mV
t_p	0.55	0.55 µs
t_s	1.20	1.20 µs

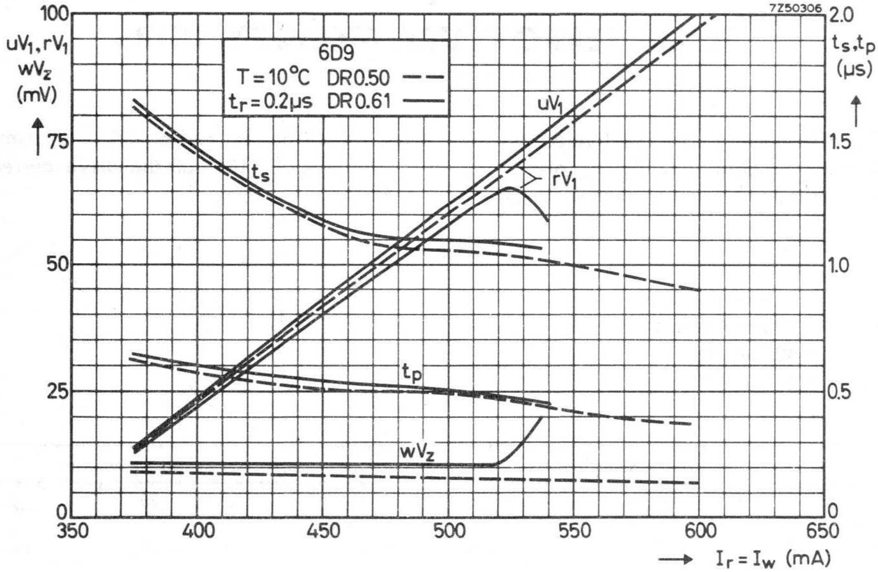
test conditions

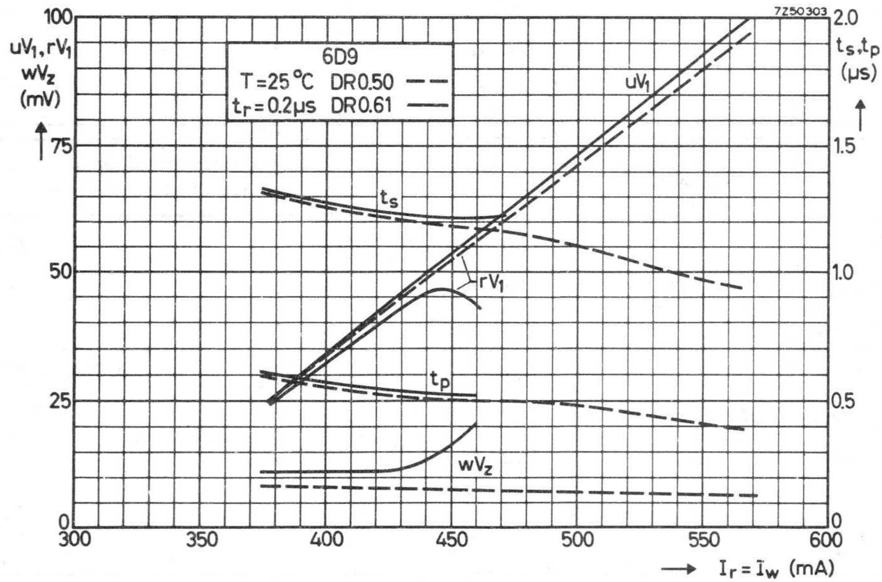
T_{amb}	40 °C
$I_r = I_w = I_{nom}$ - 10%	405 mA
$I_{pr} = I_{pw} = 0.5\, I_{nom}$ + 10%	247 mA
DR	0.61
Number of disturb pulses	32
t_r (linear)	0.2 µs
t_d	≥ 1.5 µs
V_{ref}	5 mV

guaranteed values at specified test conditions

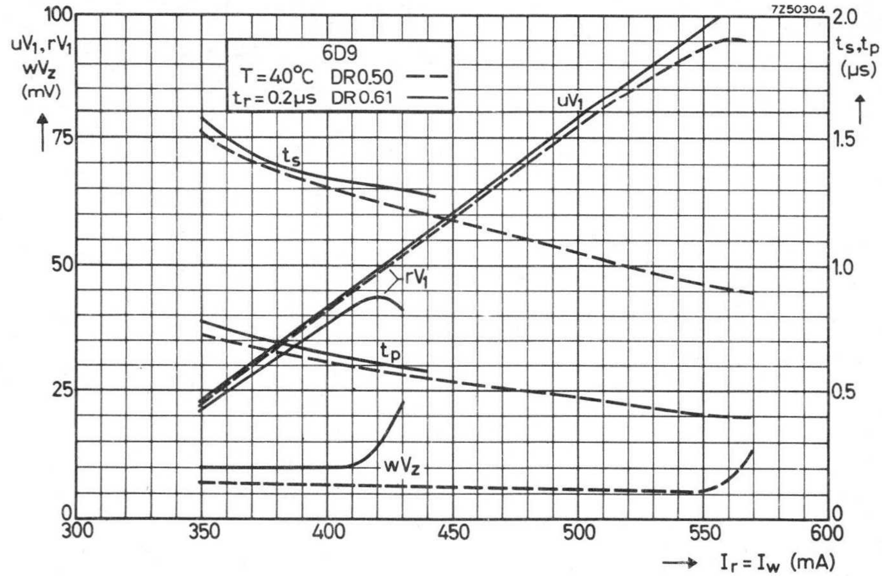
rV_1	≥ 37 mV
wV_z	≤ 11 mV
UR	—
t_p	0.55 - 0.70 µs
t_s	≤ 1.4 µs

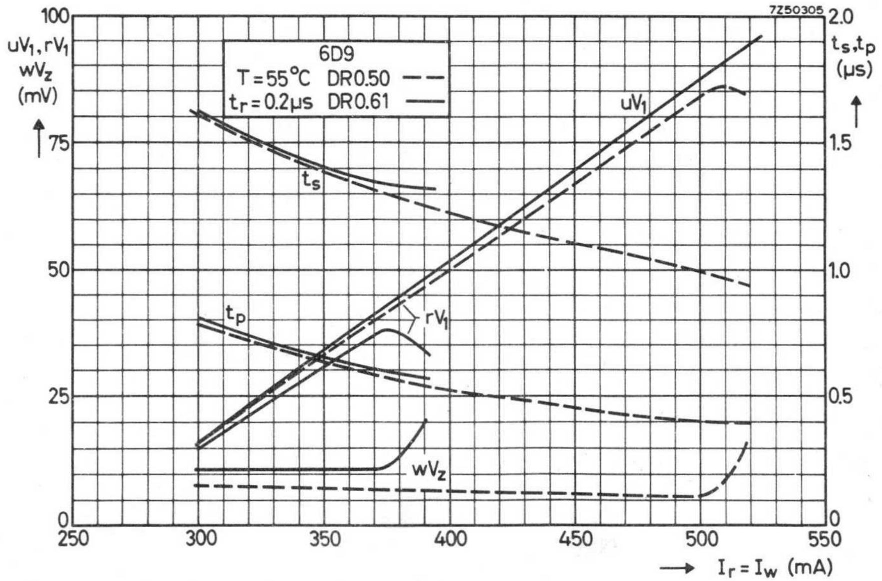
Typical performance as a function of drive current at different temperatures.





Typical performance as a function of drive current at different temperatures.





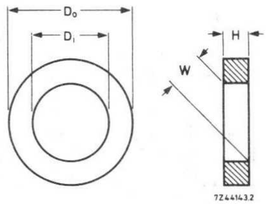
150 mil FERROXCUBE MEMORY CORE
150 mil FERROXCUBE SWITCH CORE

MEMORY CORE

The 6E1 memory core is intended for use in a coincident current memory. Cycle times of 40 µs can be obtained. Making allowance for a tolerance of ± 10% of the drive current, the optimum drive current is 346 mA at T_{amb} = 40 °C.

Dimensions

D_o = 3.8 mm (150 mil)
D_i = 2.2 mm (85 mil)
H = 1.5 mm (60 mil)
W = 0.5 mm (20 mil)

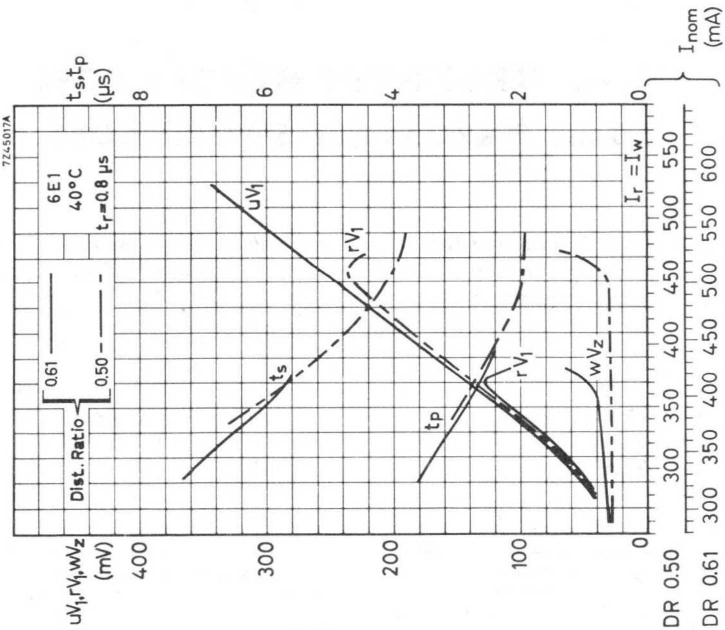


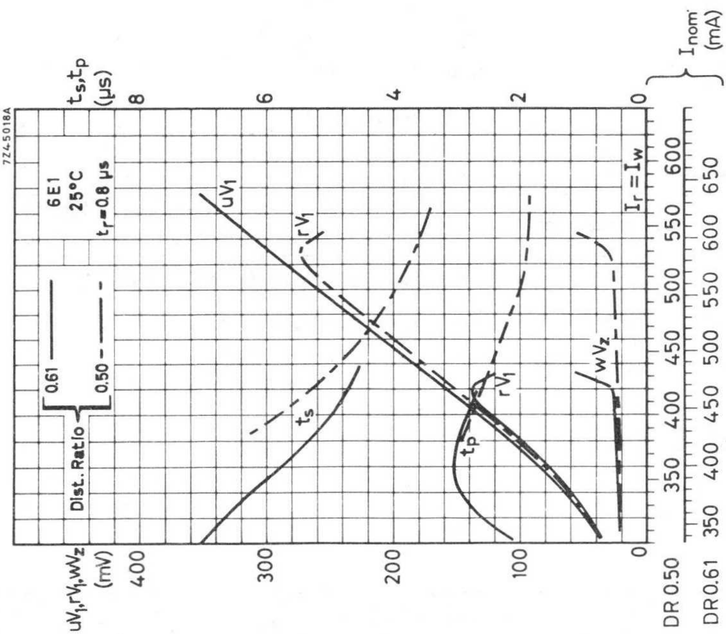
nominal operating conditions		
T_{amb}	40	°C
$I_r = I_w = I_{nom}$	346	mA
DR	0.50	
t_r (linear)	0.8	µs
t_d	12	µs

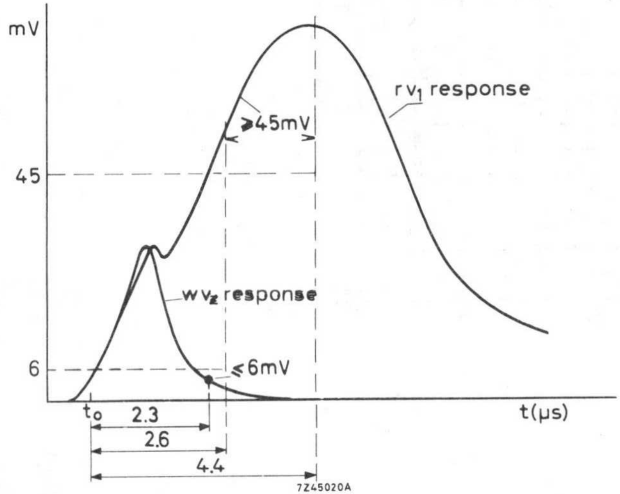
typical response values		
T_{amb}	40	°C
uV_1	120	mV
rV_1	115	mV
wV_z	30	mV
t_p	3.5	µs
t_s	8	µs

test conditions		
T_{amb}	40	°C
$I_r = I_w = I_{nom}$ - 10%	311.5	mA
$I_{pr} = I_{pw} = 0.5\ I_{nom}$ + 10%	191	mA
DR	0.61	
Number of disturb pulses	32	
t_r (linear)	0.8	µs
t_d	≥ 25	µs
V_{ref}	5	mV

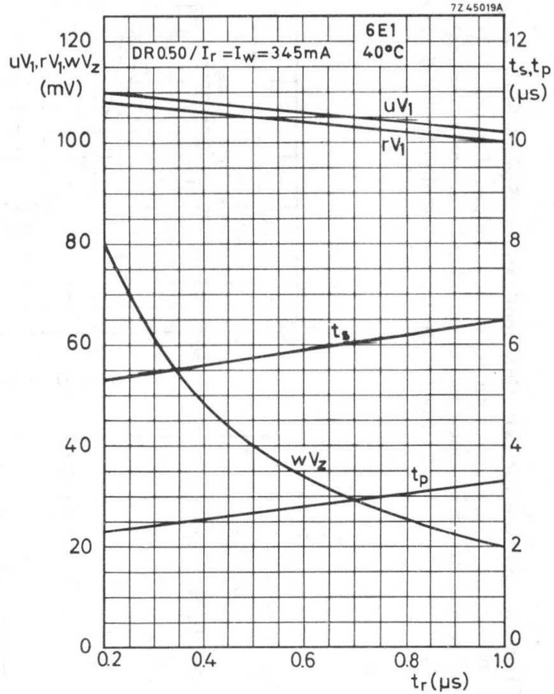
guaranteed values at specified test conditions			
rV_1 (2.6 < t < 4.4 µs)	≥	45	mV
wV_z (at t = 2.3 µs)	≤	6	mV
t_s	≤	10.5	µs


7Z45017A
6E1
40°C
t_r=0.8 µs
Dist. Ratio
0.61
0.50
uV_1
rV_1
t_s
t_p
wV_z
t_s, t_p (µs)
uV_1, rV_1, wV_z (mV)
$I_r = I_w$
I_{nom} (mA)
DR 0.50
DR 0.61


7Z45018A
6E1
25°C
t_r=0.8 µs
Dist. Ratio
0.61
0.50
uV_1
rV_1
t_s
t_p
wV_z
t_s, t_p (µs)
uV_1, rV_1, wV_z (mV)
$I_r = I_w$
I_{nom} (mA)
DR 0.50
DR 0.61



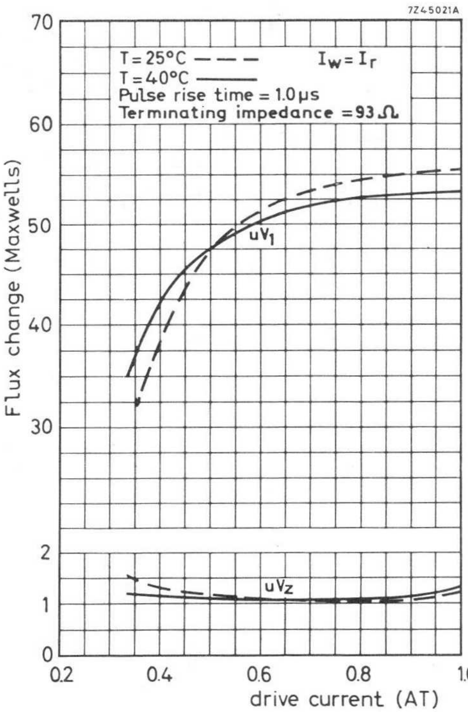
Explanation of the difference between the "typical response values" and the "guaranteed values at specified test conditions".

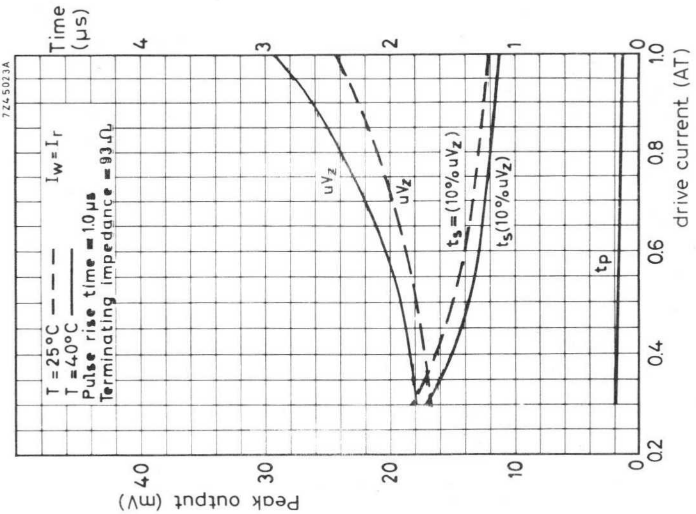


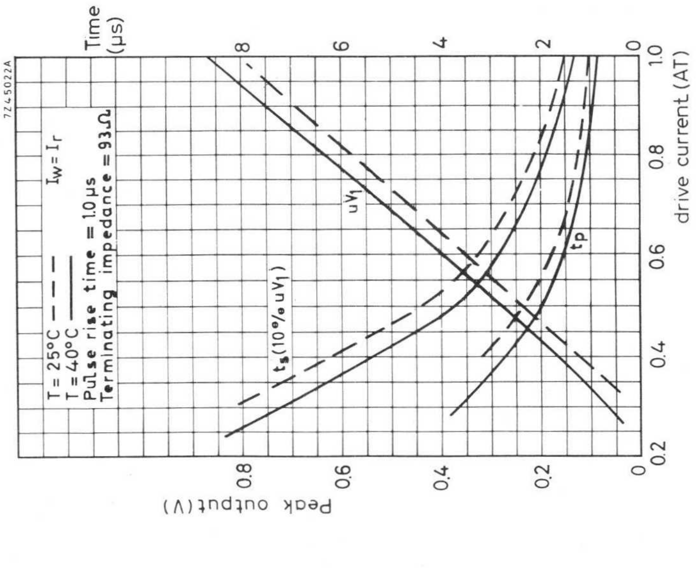
SWITCH CORE

The core 6E1 is also suitable for switching applications. Some information, which is of particular interest for these applications is given below. For practical use of this information reference should be made to the periodical Electronic Applications, Volume 20, No.4, 1959-1960: "Analysis of Ferrite Core Switching for Practical Applications".

Typical properties		
l	0.90	cm
A	0.012	cm^2
ϕm	0.27×10^{-6}	Vs
r	1.2	Ω
$(AT)_o$	0.28	amp.turns
t_r	1.0	μs



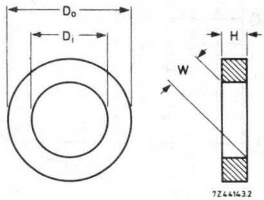

7Z45023A
T = 25°C
T = 40°C
Pulse rise time = 1.0 μs
Terminating impedance = 93 Ω
$I_W = I_r$
uV_z
uV_z
$t_s = (10\% \, uV_z)$
$t_s (10\% \, uV_z)$
t_p
Peak output (mV)
Time (μs)
drive current (AT)
0
10
20
30
40
0.2
0.4
0.6
0.8
1.0
1
2
3
4


7Z45022A
T = 25°C
T = 40°C
Pulse rise time = 1.0 μs
Terminating impedance = 93 Ω
$I_W = I_r$
uV_1
$t_s (10\% \, uV_1)$
t_p
Peak output (V)
Time (μs)
drive current (AT)
0
0.2
0.4
0.6
0.8
1.0
2
4
6
8

30 mil FERROXCUBE MEMORY CORE
wide temperature range

The 6F3 memory core is intended for use in a coincident current memory. Cycle times of 1.5 μs can be obtained. Making allowance for a tolerance of ±10% of the drive current, the optimum drive current is 740 mA at T_{amb} = 70 °C.

Dimensions



D_o = 0.82 mm (30 mil)
D_i = 0.50 mm (20 mil)
H = 0.21 mm (8 mil)
W = 0.20 mm (7.9 mil)

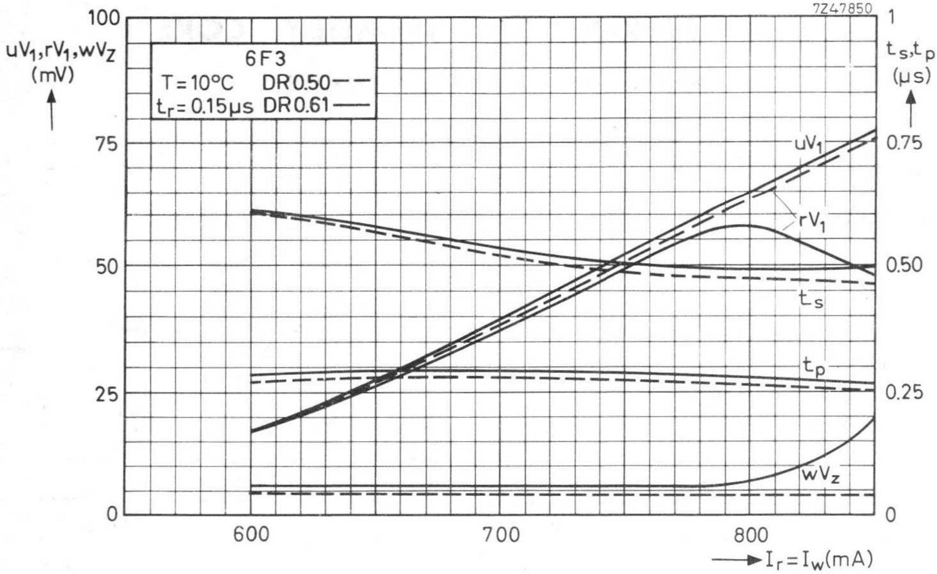
nominal operating conditions			
T_{amb}	10	70	°C
$I_r = I_w = I_{nom}$	820	740	mA
DR	0.50	0.50	
t_r (linear)	0.15	0.15	μs
t_d	0.6	0.6	μs

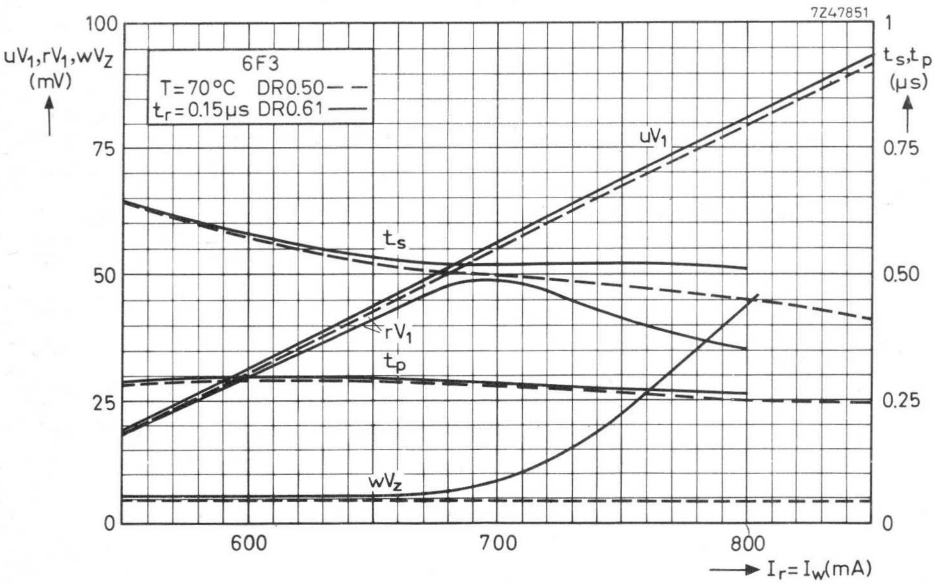
typical response values		
T_{amb}	10-70	°C
uV_1	60	mV
rV_1	58	mV
wV_z	5	mV
t_p	0.25	μs
t_s	0.50	μs

test conditions				
T_{amb}		10	70	°C
$I_r = I_w = I_{nom} - 10\%$		740	665	mA
$I_{pr} = I_{pw} = 0.5\,I_{nom} + 10\%$		450	405	mA
DR		0.61	0.61	
Number of disturb pulses		32	32	
t_r (linear)		0.15	0.15	μs
t_d	≥	1.5	1.5	μs
V_{ref}		3.5	3.5	mV

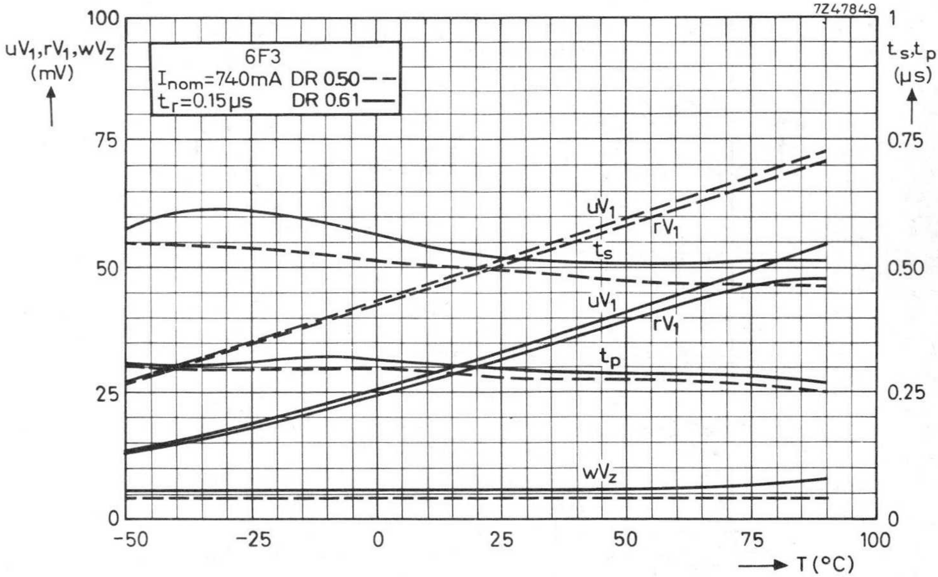
guaranteed values at specified test conditions			
rV_1		40-60	mV
wV_z	≤	8.5	mV
UR	≤	5.5	mV
t_p		0.26-0.34	μs
t_s		0.50-0.60	μs

Typical performance as a function of drive current at different temperatures.

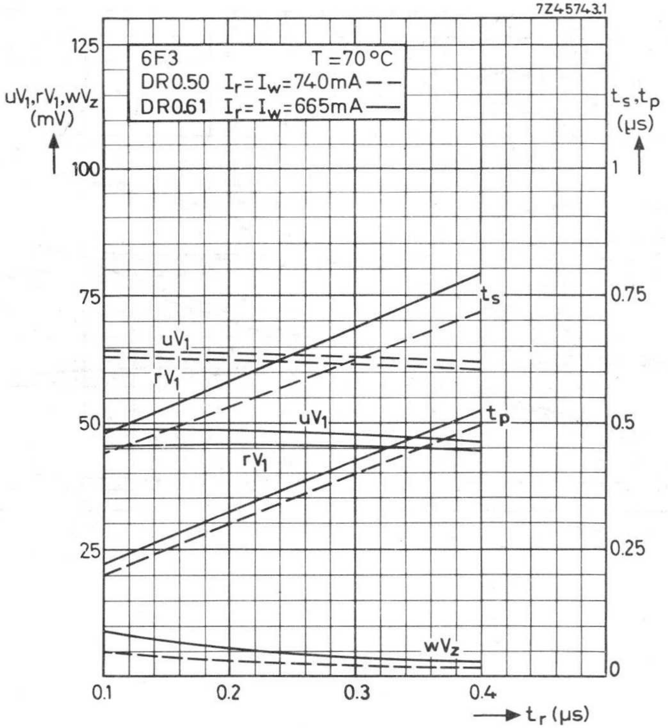




Typical performance as a function of temperature.



Typical performance as a function of current pulse rise time.

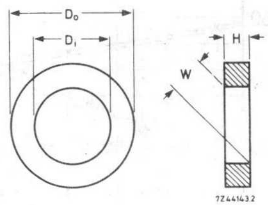


30 mil FERROXCUBE MEMORY CORE

The 6F8 memory core is intended for use in a coincident current memory. Cycle times of 1.5 μs can be obtained. Making allowance for a tolerance of ± 10% of the drive current, the optimum drive current is 655 mA at T_{amb} = 40 °C.

Dimensions

D_o = 0.81 mm (30 mil)
D_i = 0.50 mm (20 mil)
H = 0.165 mm (6.5 mil)
W = 0.22 mm (8.6 mil)



nominal operating conditions

T_{amb}	25	40	°C
$I_r = I_w = I_{nom}$	710	655	mA
DR	0.50	0.50	
t_r (linear)	0.1	0.1	μs
t_d	0.5	0.5	μs

typical response values

T_{amb}	25	40	°C
uV_1	55	55	mV
rV_1	53	53	mV
wV_z	5	6	mV
t_p	0.22	0.20	μs
t_s	0.40	0.39	μs

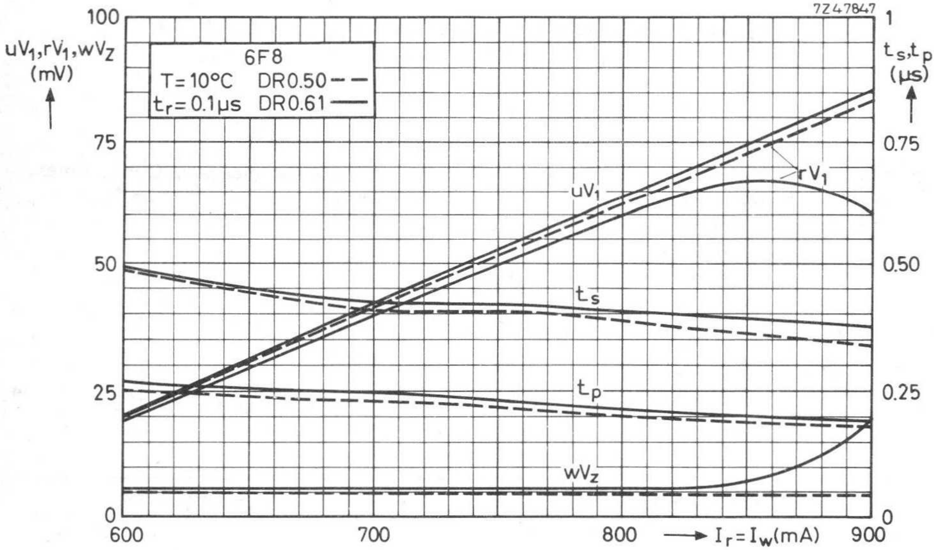
test conditions

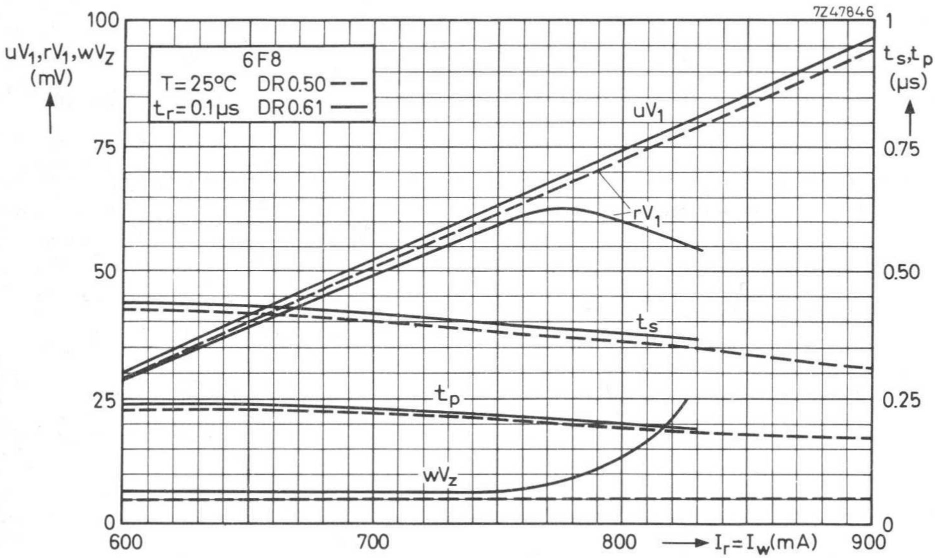
T_{amb}		40	°C
$I_r = I_w = I_{nom}$ - 10%		590	mA
$I_{pr} = I_{pw} = 0.5\ I_{nom}$ + 10%		360	mA
DR		0.61	
Number of disturb pulses		32	
t_r (linear)		0.1	μs
t_d	≥	1.5	μs
V_{ref}		3.5	mV

guaranteed values at specified test conditions

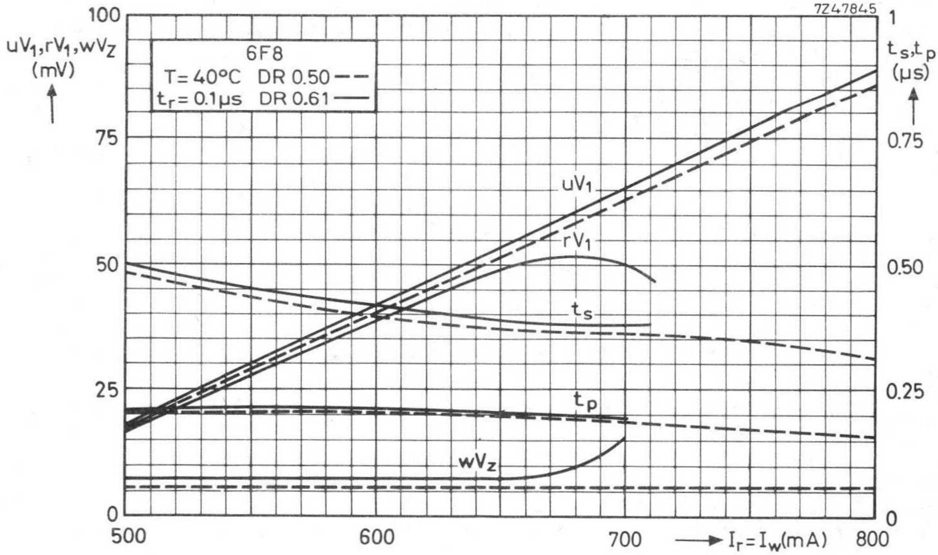
rV_1		42 ± 7	mV
wV_z	≤	9.5	mV
UR	≤	5	mV
t_p		0.233 ± 0.033	μs
t_s		0.39 ± 0.04	μs

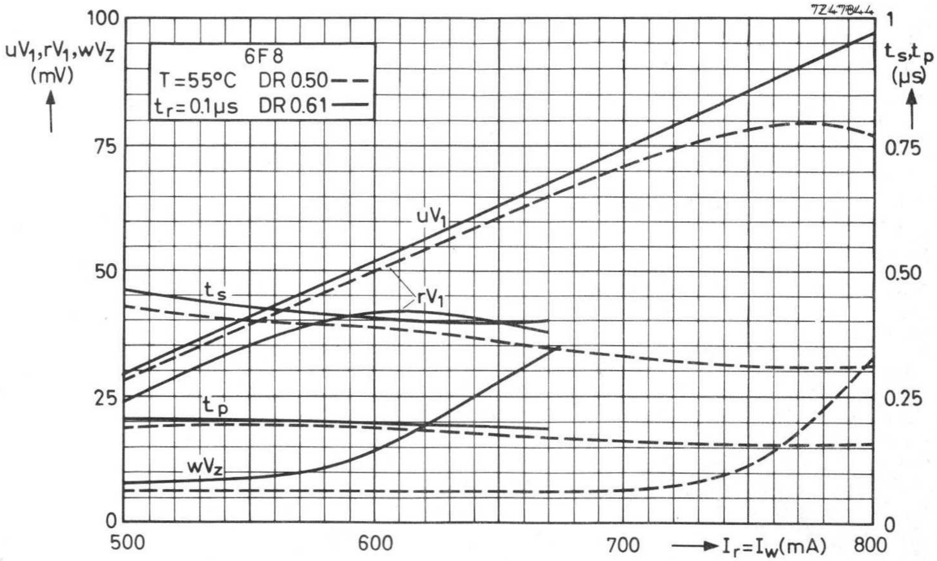
Typical performance as a function of drive current at different temperatures.



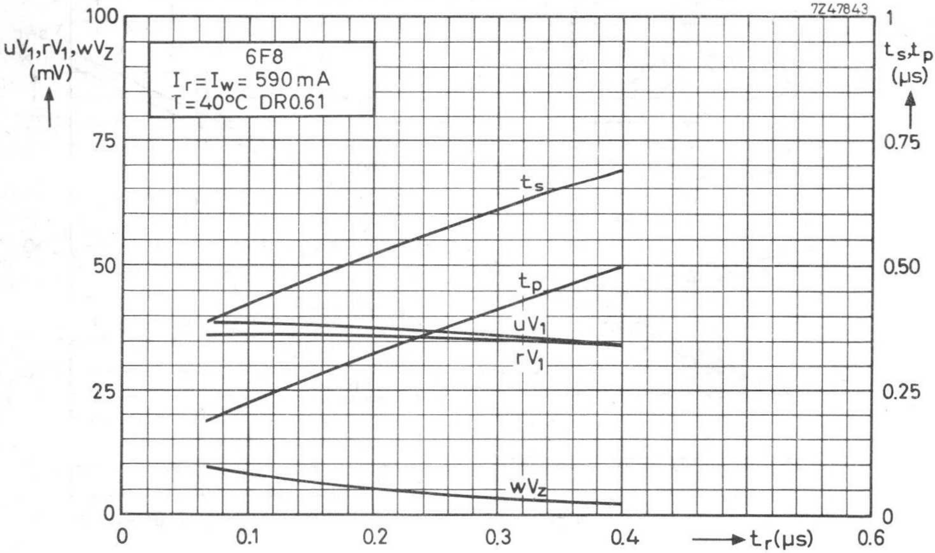


Typical performance as a function of drive current at different temperatures.





Typical performance as a function of current pulse rise time.

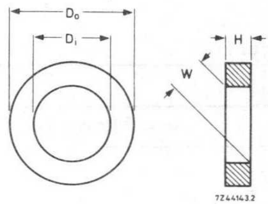


20 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA	
Switching time	0.215 μs
Medium temperature range	

DIMENSIONS

D_o = 0.53 mm (21 mil)
D_i = 0.33 mm (13 mil)
H = 0.10 mm (4 mil)
W = 0.16 mm (6.3 mil)



APPLICATION

This core has been developed for use in a coincident current memory, in particular in 3 D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	°C
$I_r = I_w = I_{nom}$	963	mA
D.R.	0.50	
t_r (linear)	0.05	μs
t_d	0.26	μs

typical response values		
uV_1	50	mV
rV_1	49	mV
wV_z	4	mV
t_p	0.110	μs
t_s ($V_{ref} = 0.1\ rV_1$)	0.215	μs

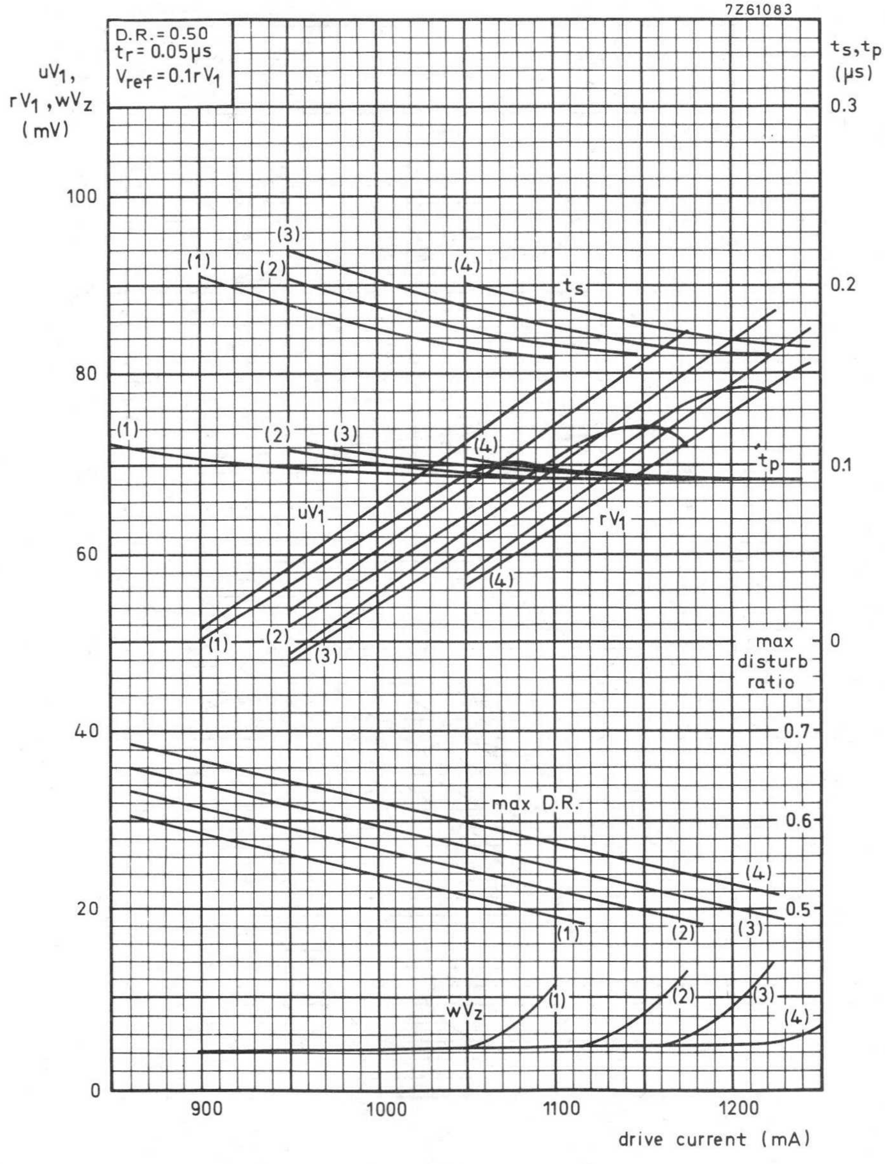
Drift with temperature (average over the range 0 to 75 °C)		
Rate of change of full drive current for constant uV_1	1.4	mA/degC
Rate of change of full drive current at break point and D.R. = 0.61	2.3	mA/degC
Rate of change of uV_1 for constant drive current	0.22	mV/degC

TESTS AND REQUIREMENTS

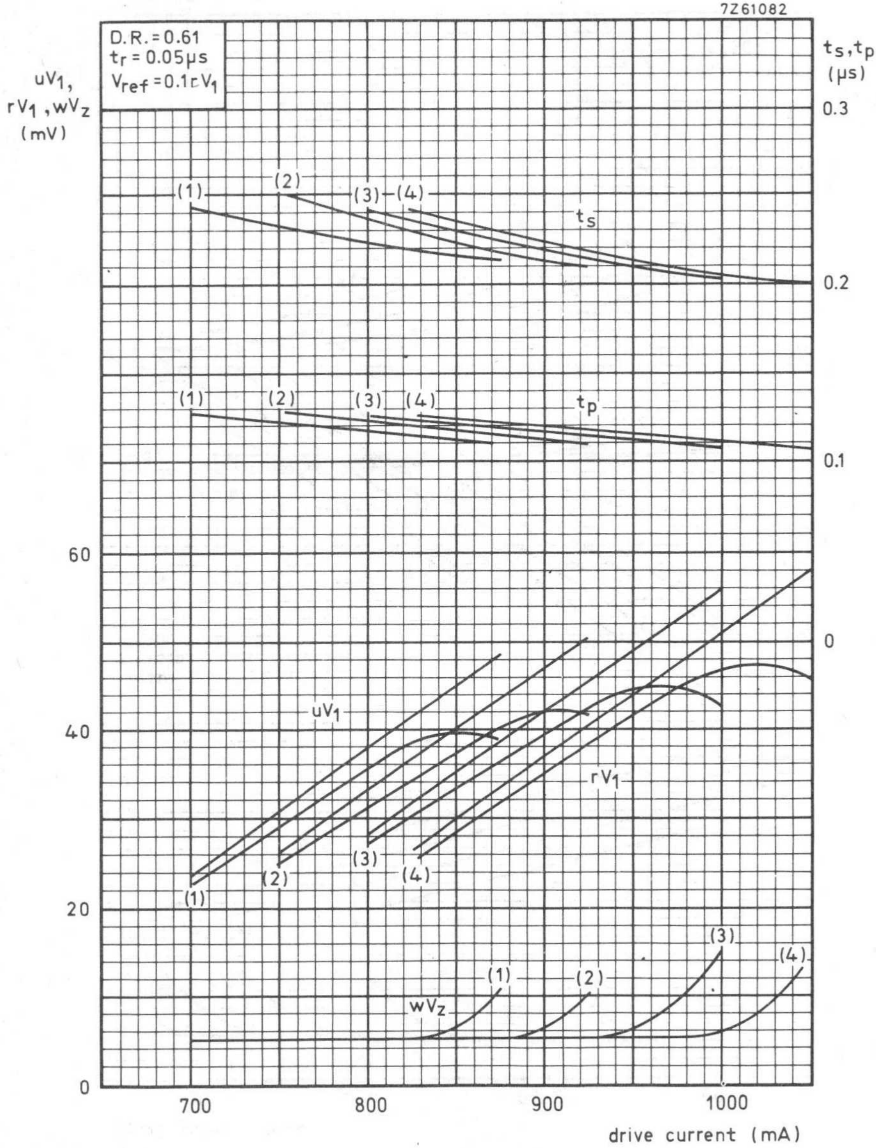
test conditions				equivalent at	
T_{amb}	70	10	^oC	T_{amb} = 25	^oC
$I_r = I_w$	810	900	mA	875	mA
$I_{pr} = I_{pw}$	495	550	mA	534	mA
D.R.	0.61	0.61		0.61	
Number of disturb pulses	32	32		32	
t_r (linear)	0.05	0.05	μs	0.05	μs
t_d	0.50	0.50	μs	0.50	μs
V_{ref}	3	3	mV	3	mV

acceptance limits at test conditions					
rV_1	37 ± 7	37 ± 7	mV	37 ± 7	mV
wV_z	≤ 8	≤ 8	mV	≤ 8	mV
UR	≤ 5.5	≤ 5.5	mV	≤ 5.5	mV
t_p	0.120 ± 0.025	0.120 ± 0.025	μs	0.120 ± 0.025	μs
t_s	0.227 ± 0.033	≤ 0.260	μs	≤ 0.260	μs

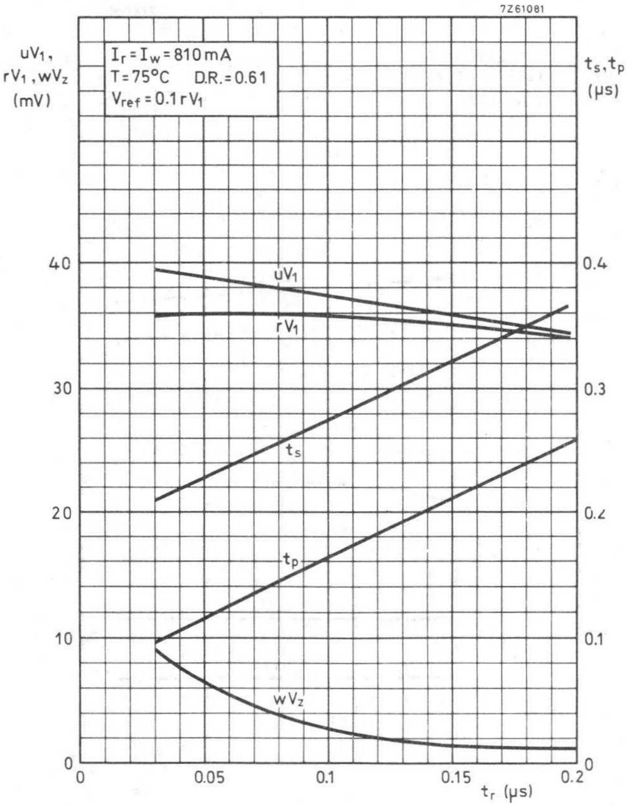
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 75 °C, (2) = 50 °C, (3) = 25 °C, (4) = 0 °C.



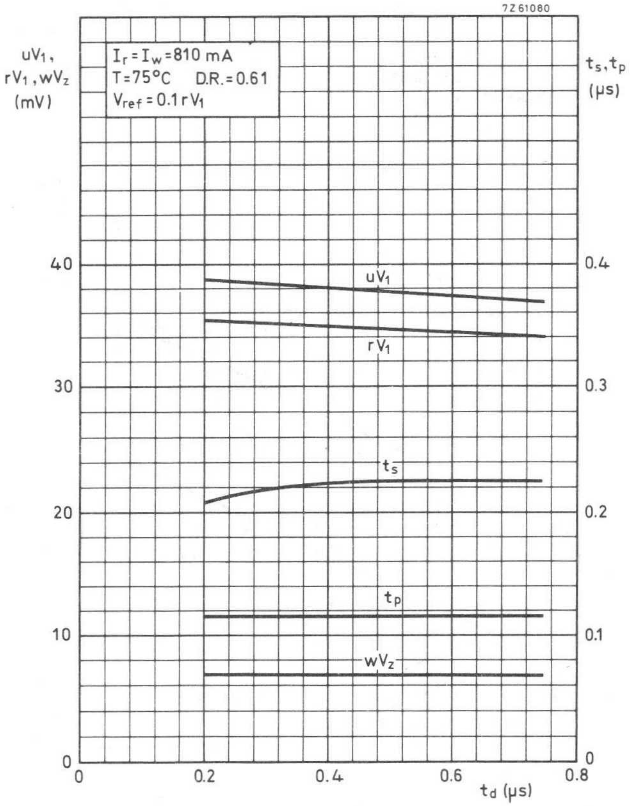
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 75 ^{o}C, (2) = 50 ^{o}C, (3) = 25 ^{o}C, (4) = 0 ^{o}C



Typical core performance as a function of current pulse rise time.



Typical core performance as a function of current pulse duration.

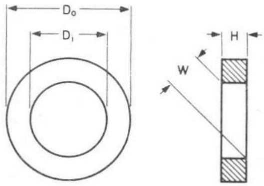


20 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA		
Switching time	0.20	μs
Standard temperature range		

DIMENSIONS

D_o = 0.55 mm (22 mil)
D_i = 0.34 mm (13 mil)
H = 0.10 mm (4 mil)
W = 0.17 mm (6.7 mil)



APPLICATION

This core has been developed for use in a coincident current memory, in particular in 3 D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	^oC
$I_r = I_w = I_{nom}$	890	mA
D.R.	0.50	
t_r (linear)	0.05	μs
t_d	0.24	μs

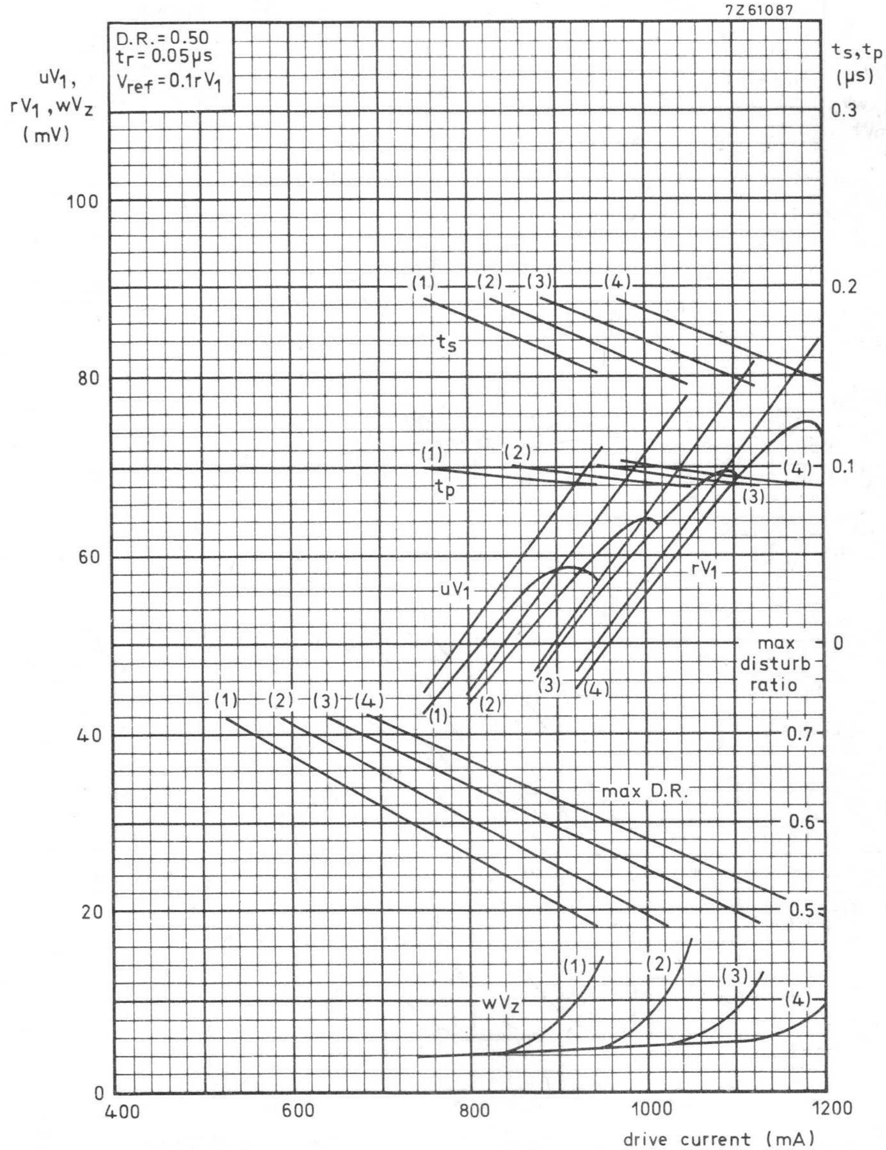
typical response values		
uV_1	49	mV
rV_1	48	mV
wV_z	4	mV
t_p	0.10	μs
t_s (V_{ref} = 0.1 rV_1)	0.20	μs

Drift with temperature (average over the range 10 to 55 ^oC)		
Rate of change of full drive current for constant uV_1	3.6	mA/degC
Rate of change of full drive current at break point and D.R. = 0.61	4.7	mA/degC
Rate of change of uV_1 for constant drive current	0.48	mV/degC

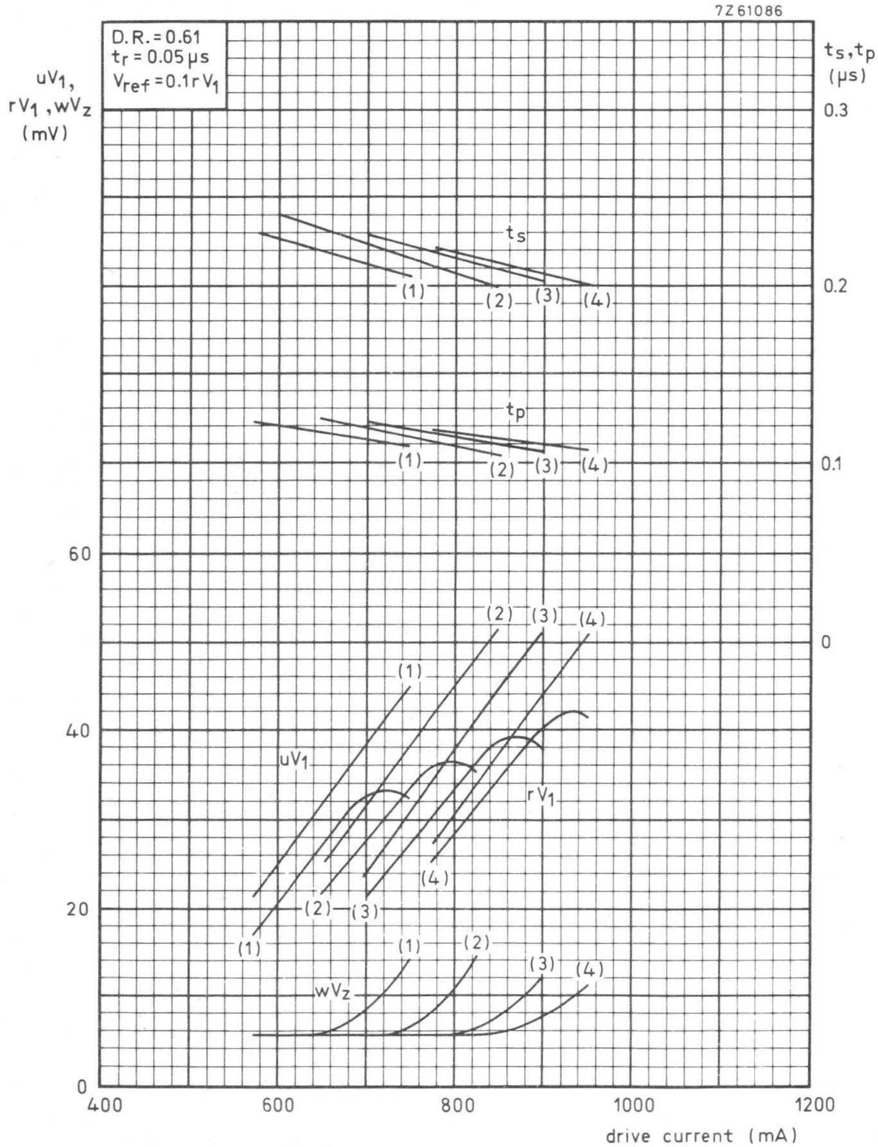
TESTS AND REQUIREMENTS

test conditions			equivalent at	
			T_{amb} = 25	^{o}C
T_{amb}	40	^{o}C		
$I_r = I_w$	750	mA	800	mA
$I_{pr} = I_{pw}$	460	mA	488	mA
D.R.	0.61		0.61	
Number of disturb pulses	32		32	
t_r (linear)	0.05	μs	0.05	μs
t_d	0.45	μs	0.45	μs
V_{ref}	5	mV	5	mV
acceptance limits at test conditions				
rV_1	36 ± 5	mV	36 ± 5	mV
wV_z	≤ 9	mV	≤ 9	mV
UR	≤ 5.5	mV	≤ 5.5	mV
t_p	0.11 ± 0.02	μs	0.11 ± 0.02	μs
t_s	0.20 ± 0.03	μs	0.20 ± 0.03	μs

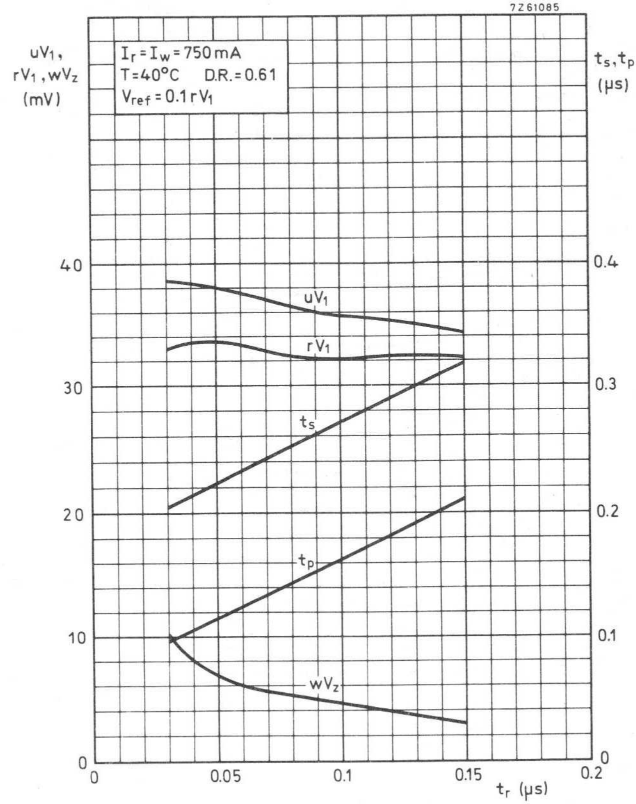
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 55 °C, (2) = 40 °C, (3) = 25 °C, (4) = 10 °C



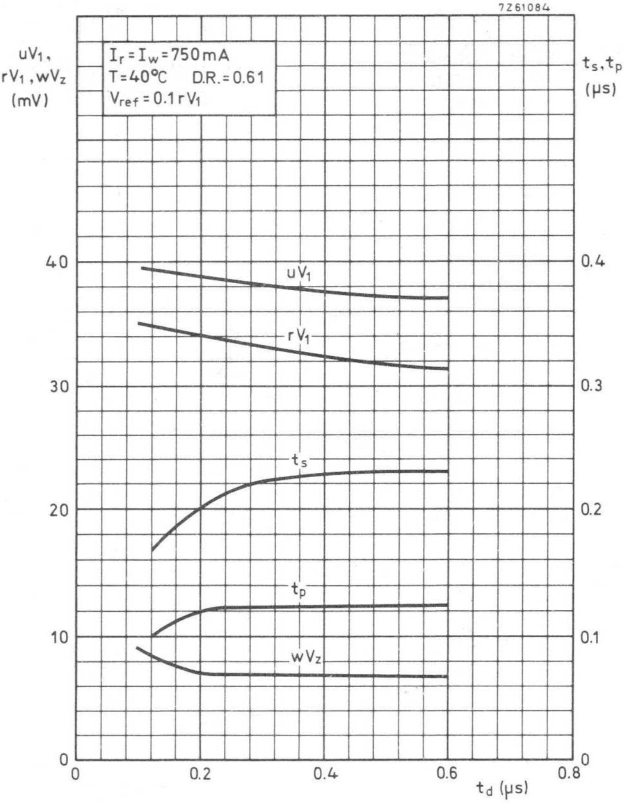
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 55 °C, (2) = 40 °C, (3) = 25 °C, (4) = 10 °C



Typical core performance as a function of current pulse rise time.



Typical core performance as a function of current pulse duration.

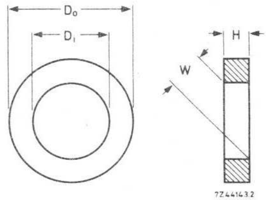


20 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA	
Switching time	0.225 μs
Standard temperature range	

DIMENSIONS

D_o = 0.53 mm (21 mil)
D_i = 0.33 mm (13 mil)
H = 0.13 mm (5 mil)
W = 0.14 mm (5.5 mil)



APPLICATION

This core has been developed for use in a coincident current memory, in particular in 3 D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	^oC
$I_r = I_w = I_{nom}$	710	mA
D.R.	0.50	
t_r (linear)	0.05	μs
t_d	0.27	μs

typical response values		
uV_1	66	mV
rV_1	63	mV
wV_z	5	mV
t_p	0.115	μs
t_s ($V_{ref} = 0.1\ rV_1$)	0.225	μs

Drift with temperature (average over the range 10 to 55 ^oC)		
Rate of change of full drive current for constant uV_1	2.7	mA/degC
Rate of change of full drive current at break point and D.R. = 0.61	4.3	mA/degC
Rate of change of uV_1 for constant drive current	0.53	mV/degC

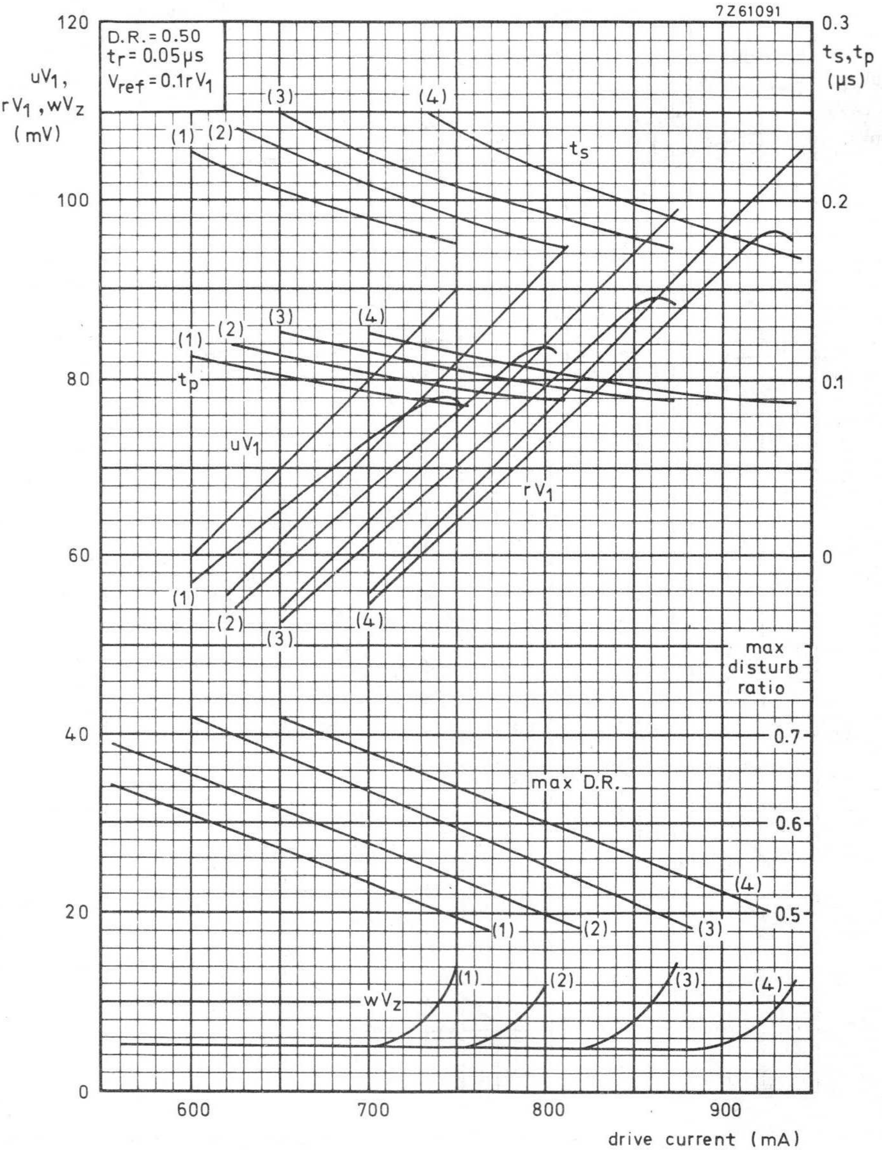
TESTS AND REQUIREMENTS

test conditions			
T_{amb}	45	25	^{o}C
$I_r = I_w$	600	640	mA
$I_{pr} = I_{pw}$	360	385	mA
D.R.	0.60	0.60	
Number of disturb pulses	32	32	
t_r (linear)	0.05	0.05	μs
t_d	0.30	0.30	μs
V_{ref}	3	3	mV

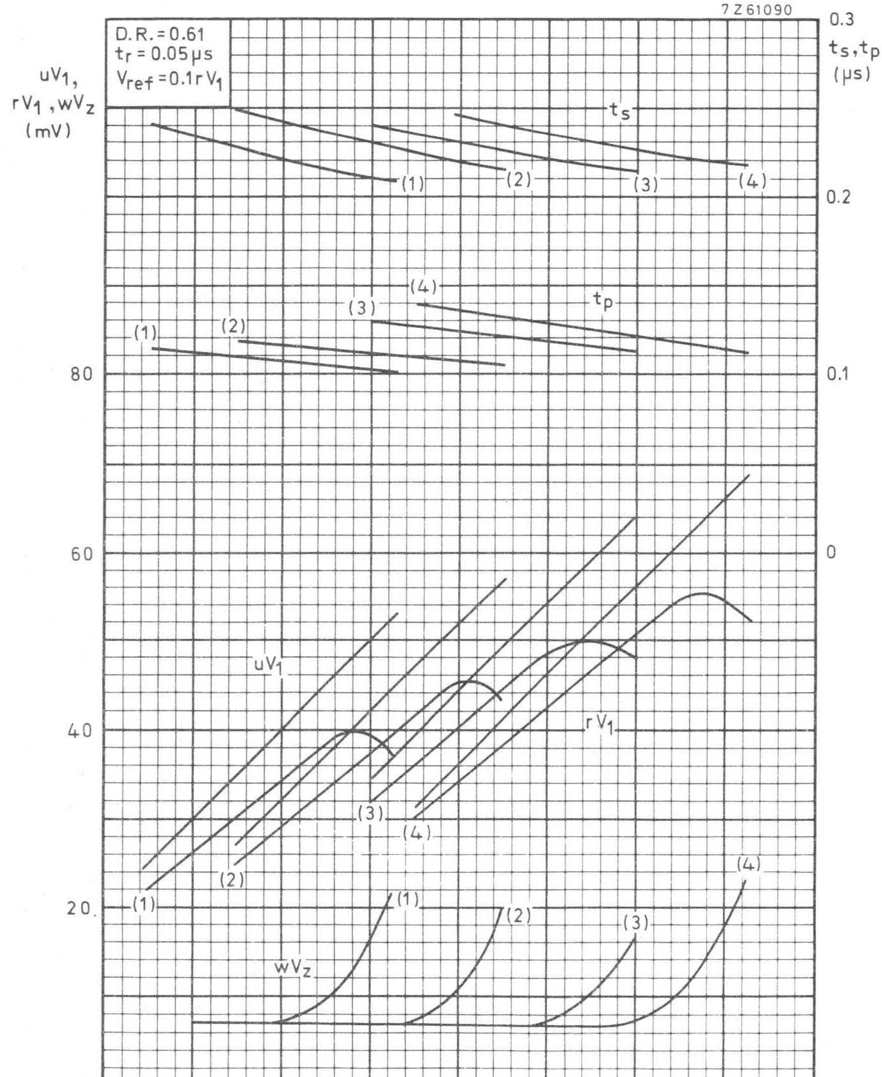
acceptance limits at test conditions			
rV_1	42 ± 5	$\geq$ 31 *)	mV
wV_z	$\leq$ 11	$\leq$ 11	mV
UR	$\leq$ 6	$\leq$ 6	mV
t_p	0.13 ± 0.02	0.13 ± 0.02	μs
t_s	0.25 ± 0.03	0.25 ± 0.03	μs

*) measured at 0.13 μs

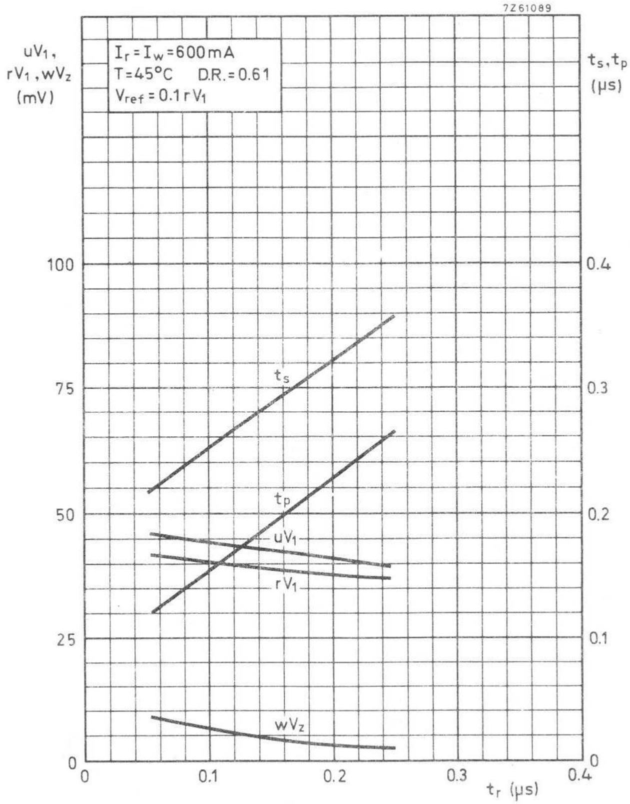
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 55 °C, (2) = 40 °C, (3) = 25 °C, (4) = 10 °C



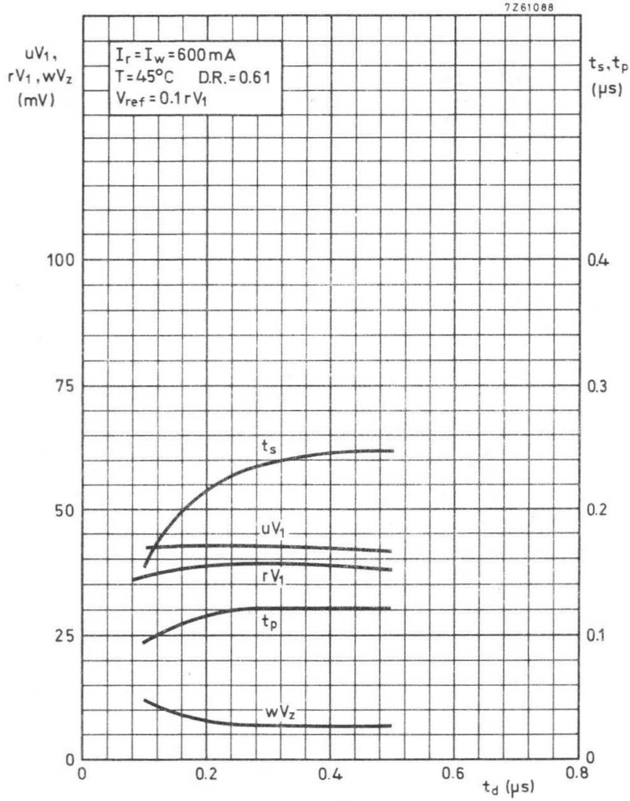
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 55 °C, (2) = 40 °C, (3) = 25 °C, (4) = 10 °C



Typical core performance as a function of current pulse rise time.



Typical core performance as a function of current pulse duration.

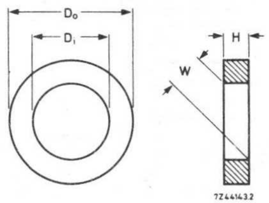


20 mil FERROXCUBE MEMORY CORE — wide temperature range

The 6H5 memory core is intended for use in a coincident current memory, in particular in $2\frac{1}{2}$D systems. Cycle times of 0.65 μs can be obtained. Making allowance for a tolerance of ±10% of the drive current, the optimum drive current is 805 mA at T_{amb} = 60 °C.

Dimensions

D_o = 0.54 mm (20 mil)
D_i = 0.34 mm (13 mil)
H = 0.127 mm (5 mil)
W = 0.15 mm (5.9 mil)



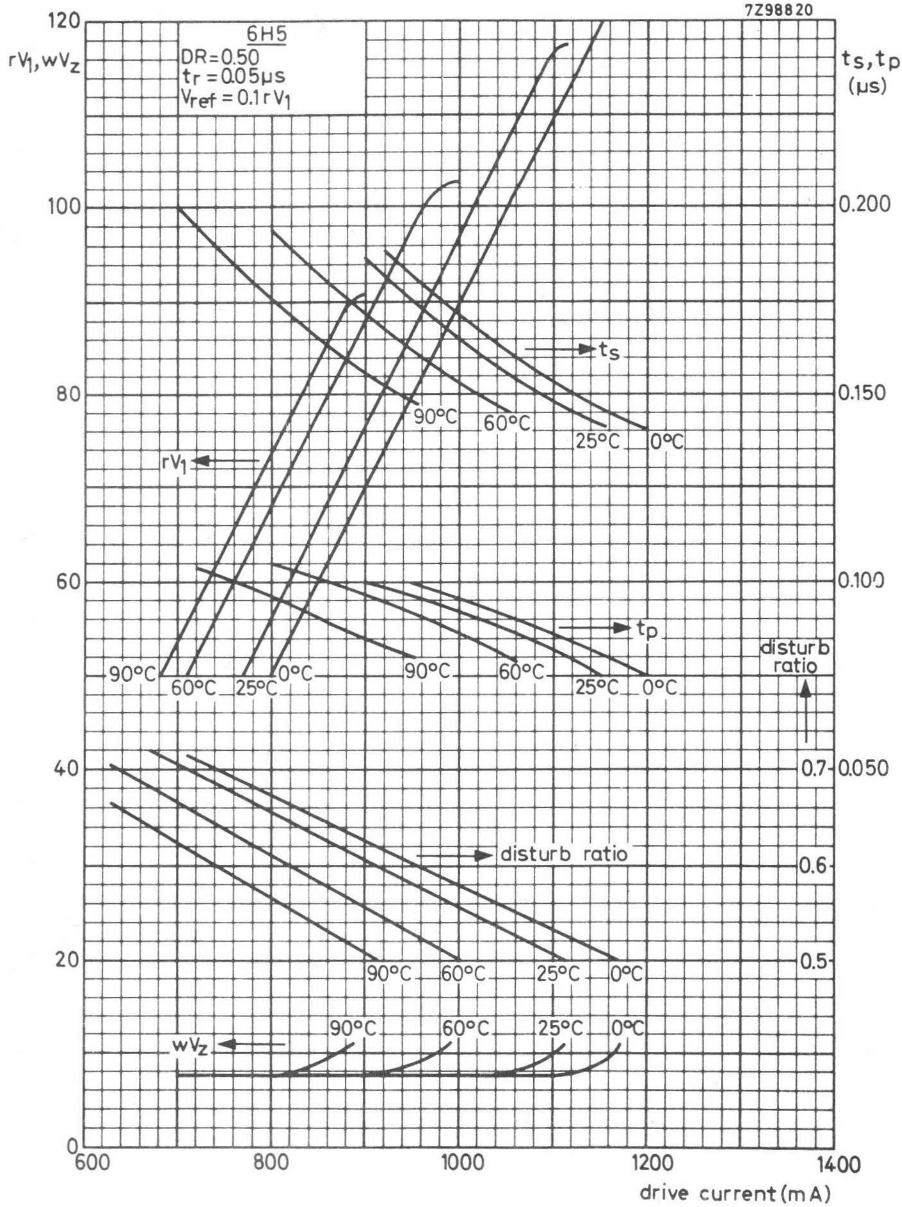
nominal operating conditions			
T_{amb}	25	60	°C
$I_w = I_r = I_{nom}$	865	800	mA
DR	0.50	0.50	
t_r (linear)	0.05	0.05	μs
t_d	0.25	0.25	μs

typical response values		
T_{amb}	25-60	°C
uV_1	72	mV
rV_1	69	mV
wV_z	7.5	mV
t_p	0.105	μs
t_s	0.195	μs

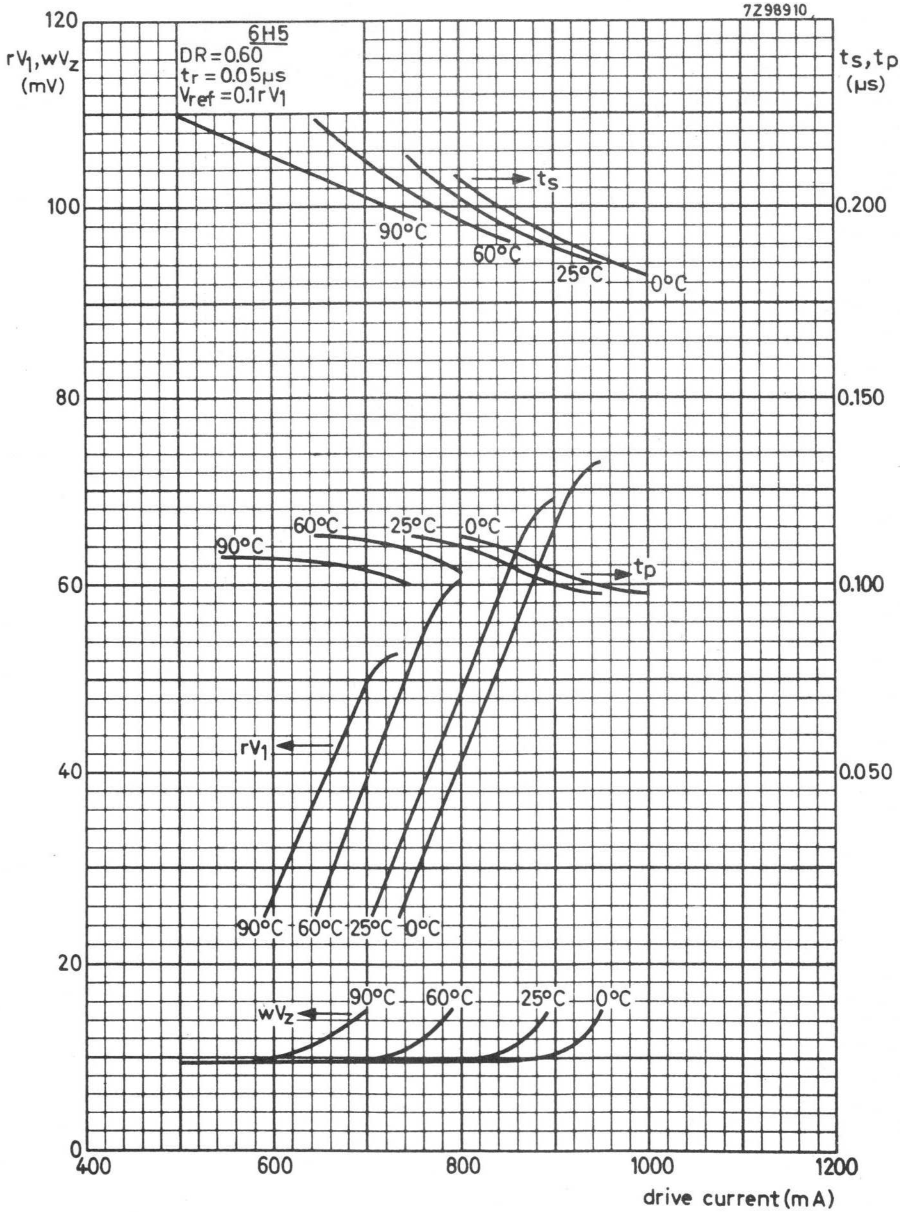
test conditions			
T_{amb}	25	60	°C
$I_w = I_r = I_{nom} - 10\%$	780	725	mA
$I_{pw} = I_{pr} = 0.5\,I_{nom} + 10\%$	475	430	mA
DR	0.61	0.59	
t_r (linear)	0.05	0.05	μs
t_d	≥ 0.30	0.30	μs
V_{ref}	6	6	mV

guaranteed values at specified test conditions		
rV_1	42.5 ± 7.5	mV
wV_z	≤ 13	mV
UR	≤ 6	mV
t_p	0.110 ± 0.020	μs
t_s	0.195 ± 0.025	μs

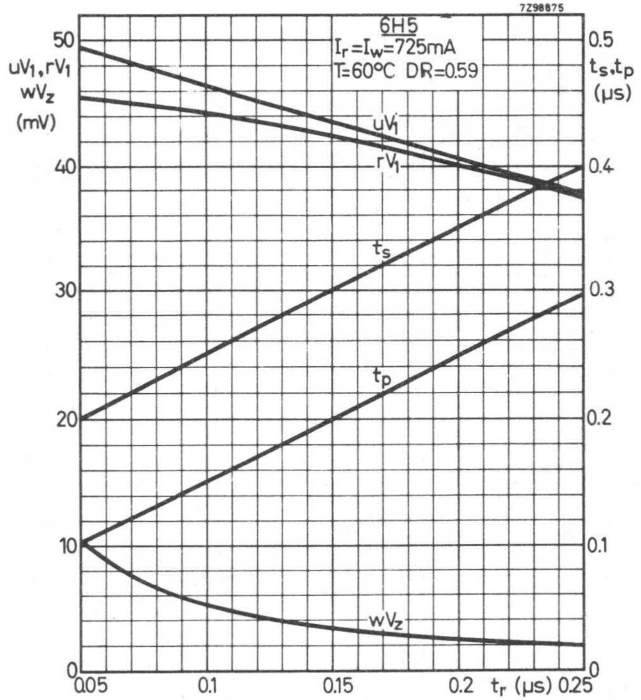
Typical core performance as a function of drive current at different temperatures and DR = 0.50.



Typical core performance as a function of drive current at different temperatures and DR = 0.60.



Typical core performance as a function of current pulse rise time.

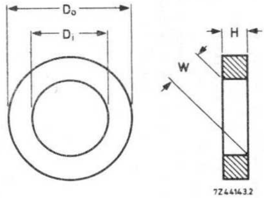


18 mil FERROXCUBE MEMORY CORE
wide temperature range

The 6H6 memory core is intended for use in a coincident current memory, in particular in $2\frac{1}{2}$D systems. Cycle times of 0.5 μs can be obtained. Making allowance for a tolerance of $\pm$10% of the drive current, the optimum drive current is 780 mA at T_{amb} = 60 °C.

Dimensions

D_o = 0.44 mm (18 mil)
D_i = 0.275 mm (11 mil)
H = 0.11 mm (4 mil)
W = 0.12 mm (4.7 mil)



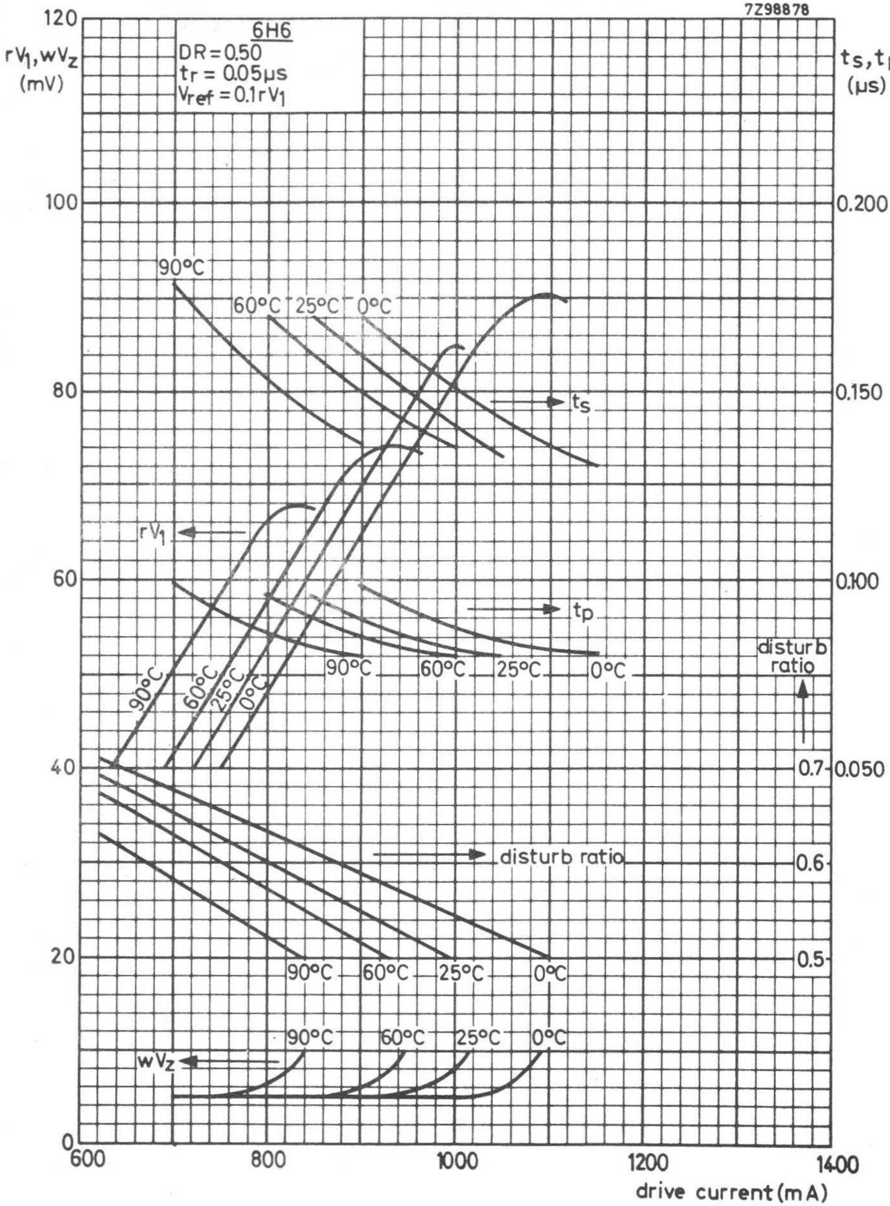
nominal operating conditions			
T_{amb}	25	60	°C
$I_w = I_r = I_{nom}$	825	778	mA
DR	0.50	0.50	
t_r (linear)	0.05	0.05	μs
t_d	0.20	0.20	μs

typical response values		
T_{amb}	25-60	°C
uV_1	59	mV
rV_1	57	mV
wV_z	5	mV
t_p	0.095	μs
t_s	0.175	μs

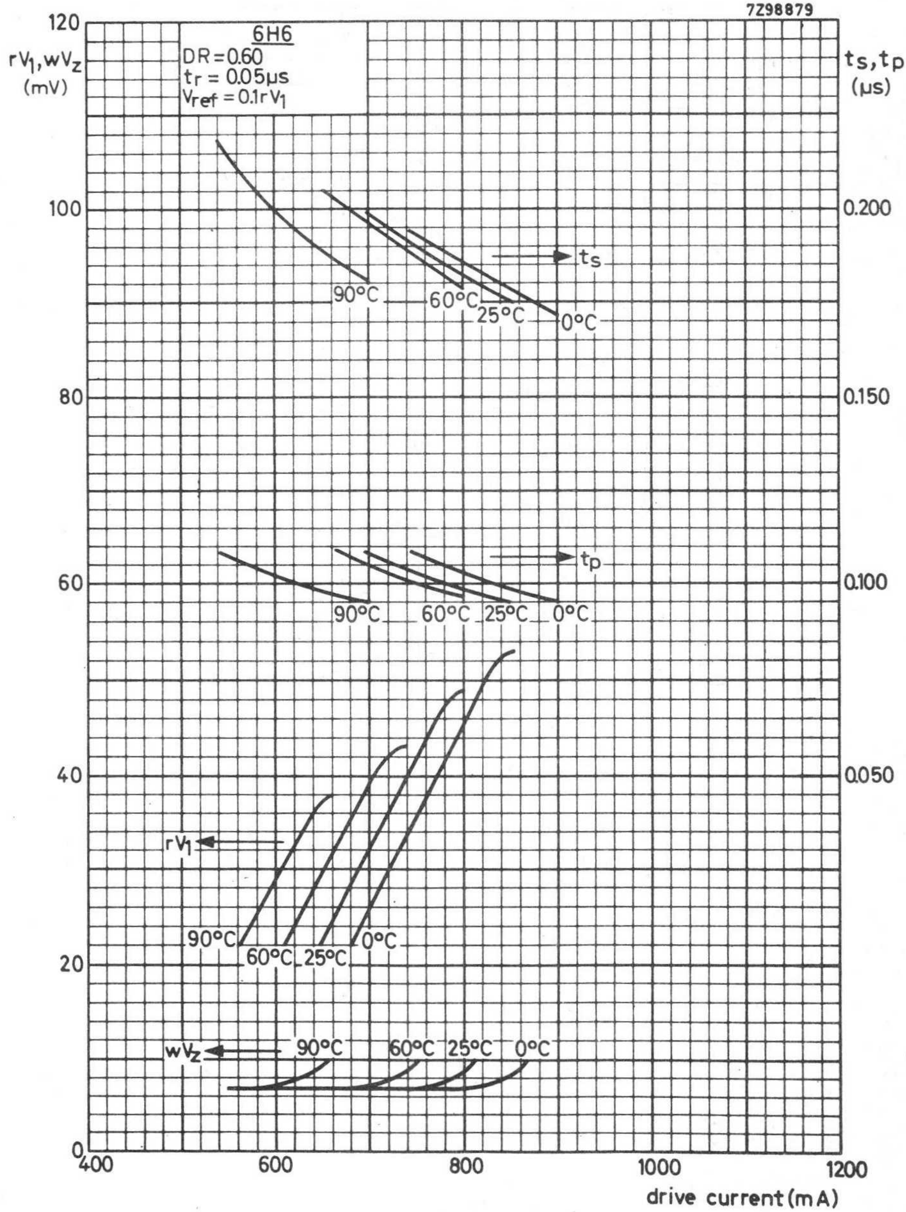
test conditions				
T_{amb}		25	60	°C
$I_w = I_r = I_{nom} - 9\%$		750	700	mA
$I_{pw} = I_{pr} = 0.5\, I_{nom} + 9\%$		450	420	mA
DR		0.60	0.60	
t_r (linear)		0.05	0.05	μs
t_d	$\geq$	0.30	0.30	μs
V_{ref}		10	10	mV

guaranteed values at specified test conditions		
rV_1	**38.5 ± 5.5**	mV
wV_z	$\leq$ **11**	mV
UR	$\leq$ **6.5**	mV
t_p	0.095 $\pm$ **0.020**	μs
t_s	0.155 $\pm$ **0.020**	μs

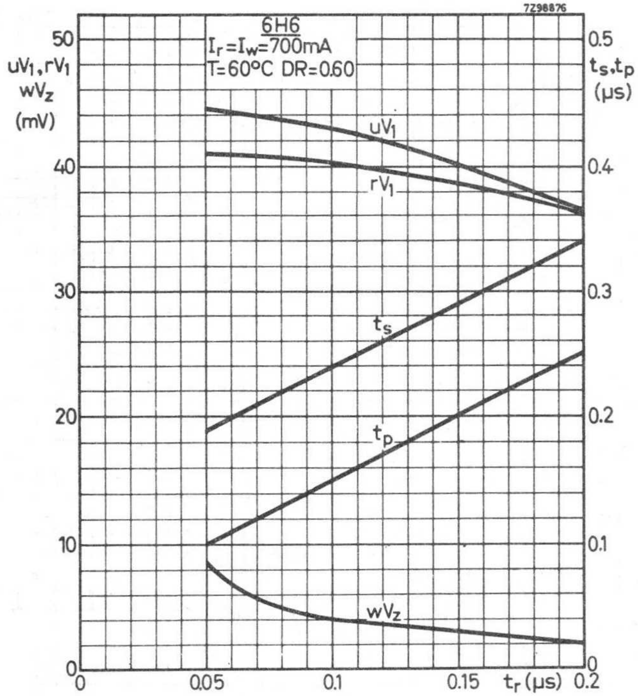
Typical core performance as a function of drive current at different temperatures and DR = 0.50.



Typical core performance as a function of drive current at different temperatures and DR = 0.60.



Typical core performance as a function of current pulse rise time.

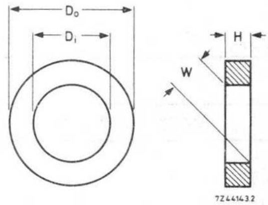


20 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA		
Switching time	0.21	μs
Medium temperature range		

DIMENSIONS

D_o = 0.54 mm (21 mil)
D_i = 0.34 mm (13 mil)
H = 0.13 mm (5 mil)
W = 0.15 mm (5.9 mil)



APPLICATION

This core has been developed for use in a coincident current memory, in particular in 3 D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	^oC
$I_r = I_W = I_{nom}$	800	mA
D.R.	0.50	
t_r (linear)	0.05	μs
t_d	0.25	μs

typical response values		
uV_1	64.0	mV
rV_1	61.0	mV
wV_z	8.5	mV
t_p	0.11	μs
t_s (V_{ref} = 0.1 rV_1)	0.21	μs

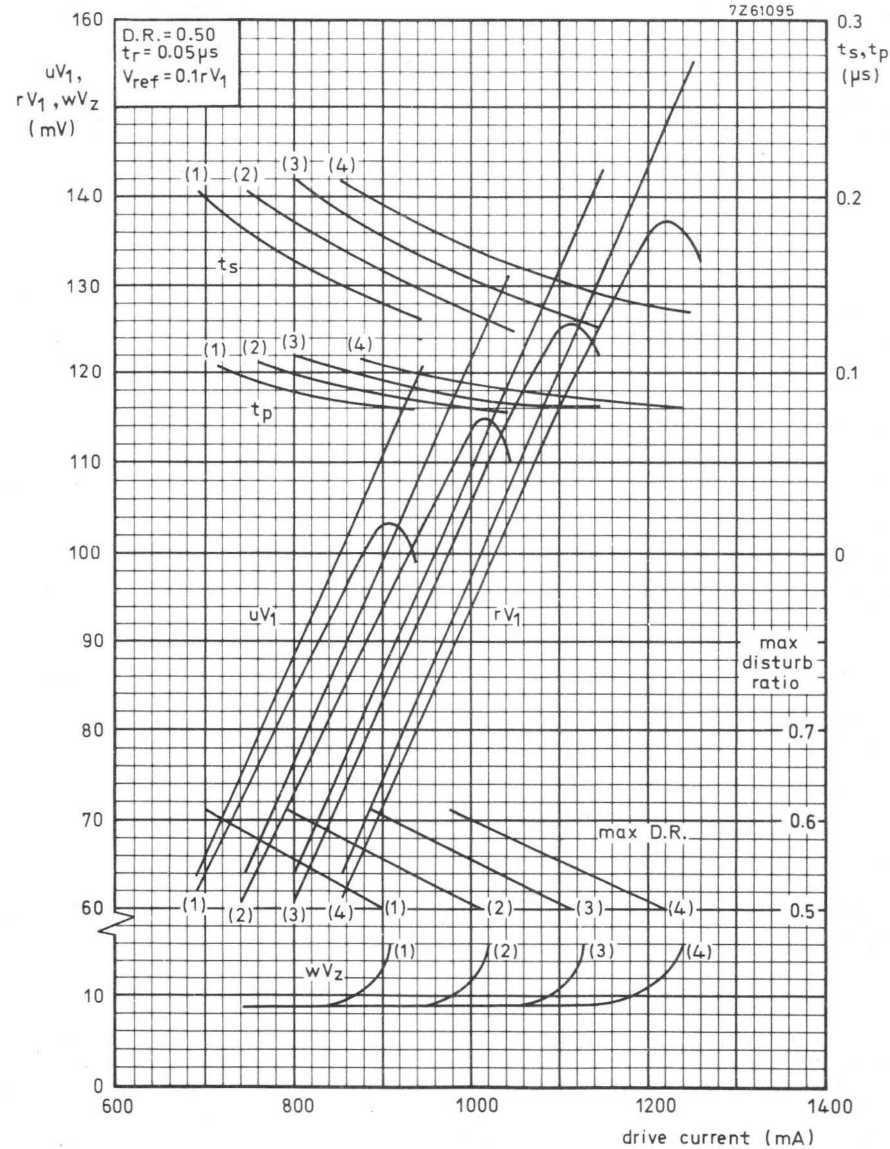
Drift with temperature (average over the range 0 to 75 ^oC)		
Rate of change of full drive current for constant uV_1	2.0	mA/degC
Rate of change of full drive current at break point and D.R. = 0.61	3.6	mA/degC
Rate of change of uV_1 for constant drive current	0.5	mA/degC

TESTS AND REQUIREMENTS

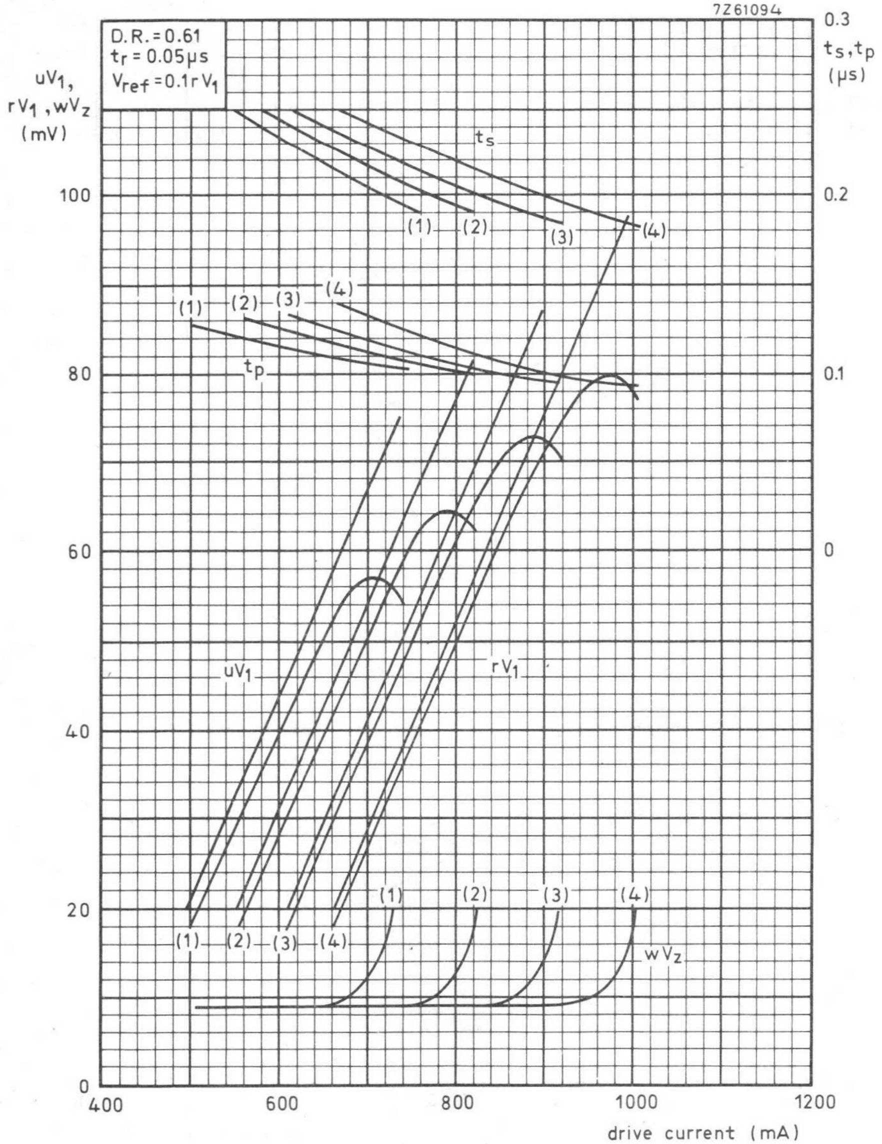
test conditions			
T_{amb}	75	25	^oC
$I_r = I_w$	620	720	mA
$I_{pr} = I_{pw}$	378	439	mA
D.R.	0.61	0.61	
Number of disturb pulses	32	32	
t_r (linear)	0.05	0.05	μs
t_d	0.40	0.40	μs
V_{ref}	5	5	mV

acceptance limits at test conditions			
rV_1	44 ± 5	44 ± 6	mV
wV_z	≤ 12.0	≤ 12.0	mV
UR	≤ 6.0	≤ 5.5	mV
t_p	0.12 ± 0.02	0.12 ± 0.02	μs
t_s	0.23 ± 0.02	0.23 ± 0.025	μs

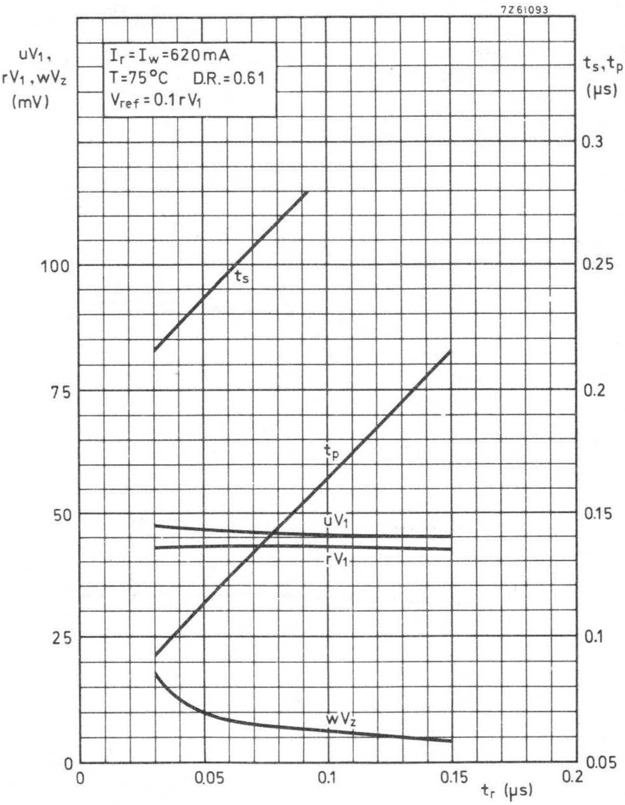
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 75 °C, (2) = 50 °C, (3) = 25 °C, (4) = 0 °C



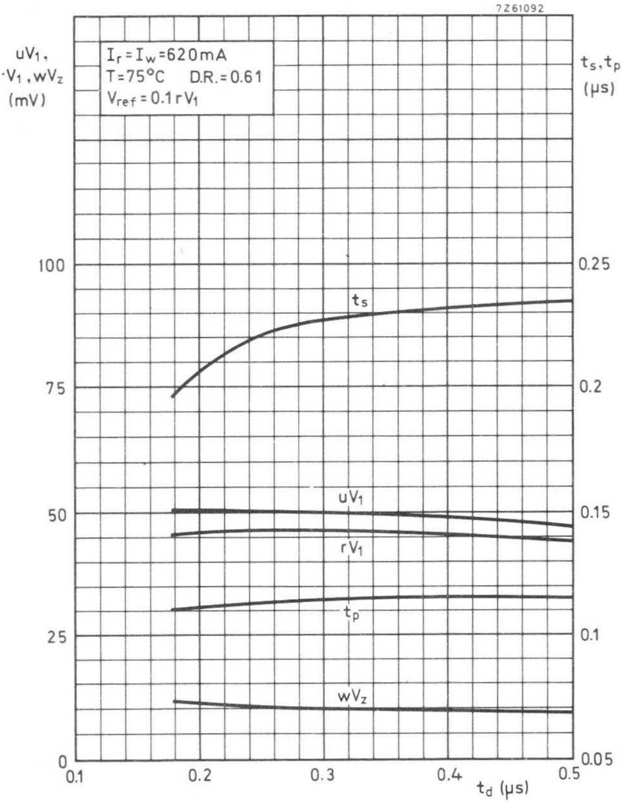
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 75 ^{o}C, (2) = 50 ^{o}C, (3) = 25 ^{o}C, (4) = 0 ^{o}C



Typical core performance as a function of current pulse rise time.



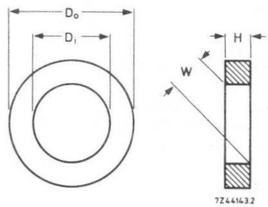
Typical core performance as a function of current pulse duration.



14 mil FERROXCUBE MEMORY CORE

QUICK REFERENCE DATA	
Switching time	0.13 μs
Wide temperature range	

DIMENSIONS



D_o = 0.355 mm (14 mil)
D_i = 0.230 mm (9 mil)
H = 0.075 mm (3 mil)
W = 0.110 mm (4.3 mil)

APPLICATION

This core has been developed for use in a coincident current memory, in particular in $2\frac{1}{2}$ D systems.

ELECTRICAL DATA

nominal operating conditions		
T_{amb}	25	^oC
$I_r = I_w = I_{nom}$	855	mA
D.R.	0.50	
t_r (linear)	0.03	μs
t_d	0.16	μs

typical response values		
uV_1	41	mV
rV_1	40	mV
wV_z	4	mV
t_p	0.07	μs
t_s ($V_{ref} = 0.1\ rV_1$)	0.13	μs

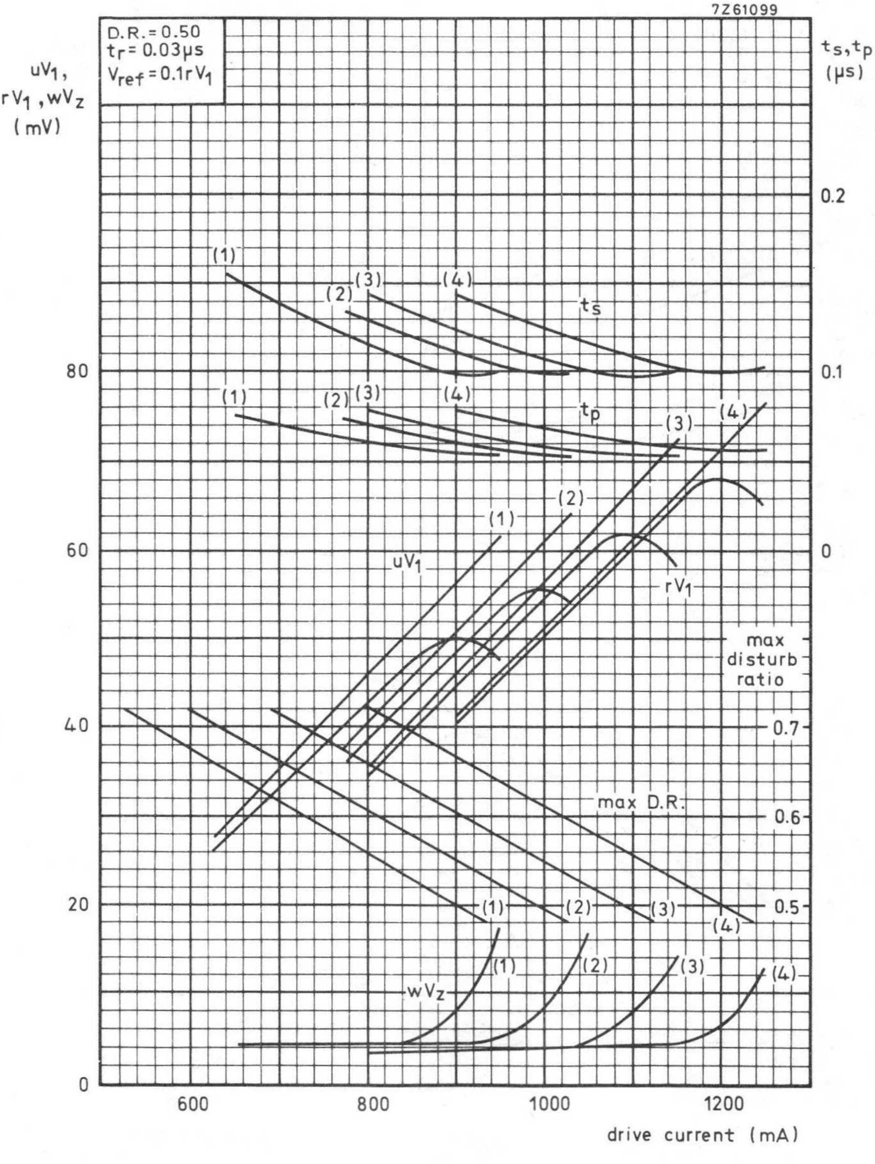
Drift with temperature (average over the range 0 to 75 ^oC)		
Rate of change of full drive current for constant uV_1	1.9	mA/degC
Rate of change of full drive current at break point and D.R. = 0.61	3.9	mA/degC
Rate of change of uV_1 for constant drive current	0.2	mV/degC

TESTS AND REQUIREMENTS

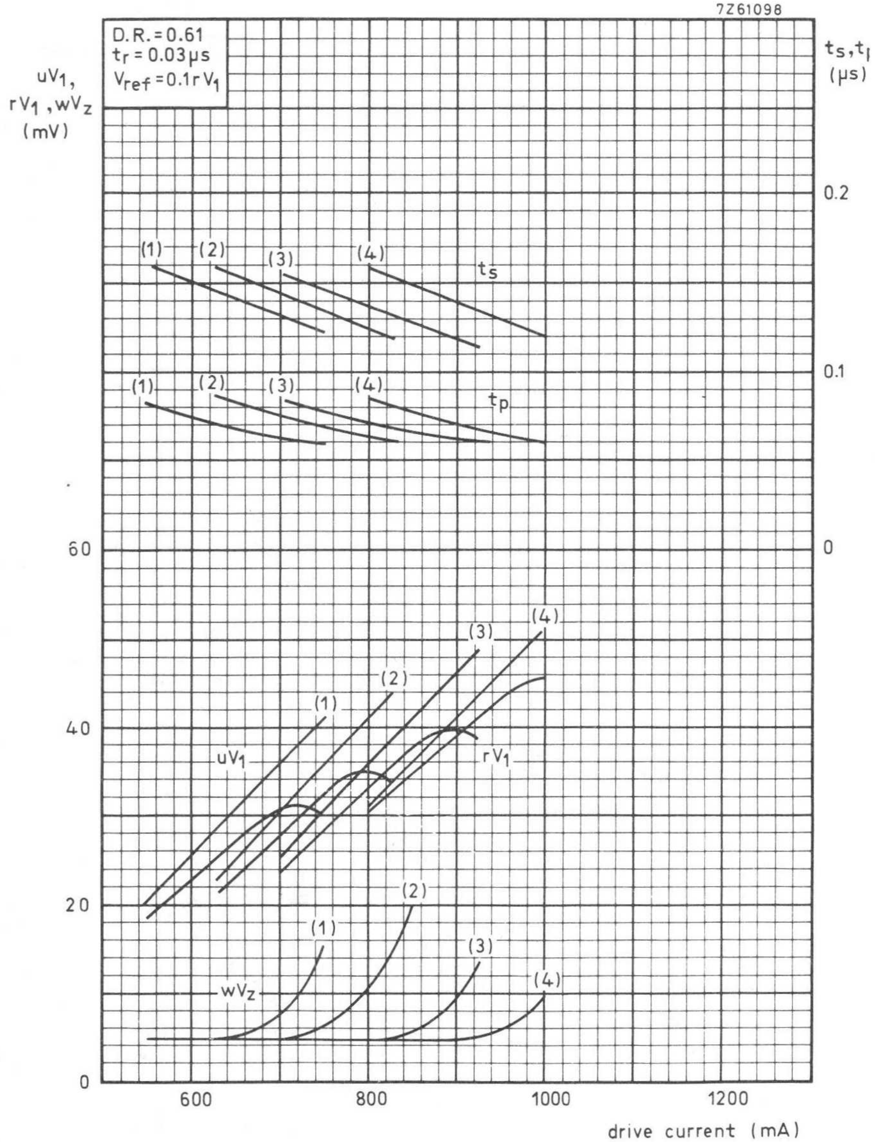
test conditions			equivalent at	
T_{amb}	75	^oC	T_{amb} = 25	^oC
$I_r = I_w$	675	mA	770	mA
$I_{pr} = I_{pw}$	412	mA	470	mA
D.R.	0.61		0.61	
Number of disturb pulses	32		32	
t_r (linear)	0.03	μs	0.03	μs
t_d	0.30	μs	0.30	μs
V_{ref}	10	mV	10	mV

acceptance limits at test conditions				
rV_1	29 ± 4	mV	30 ± 5	mV
wV_z	≤ 8	mV	≤ 7	mV
UR	≤ 5.5	mV	≤ 4.5	mV
t_p	0.069 ± 0.011	μs	0.072 ± 0.012	μs
t_s	0.110 ± 0.014	μs	0.113 ± 0.015	μs

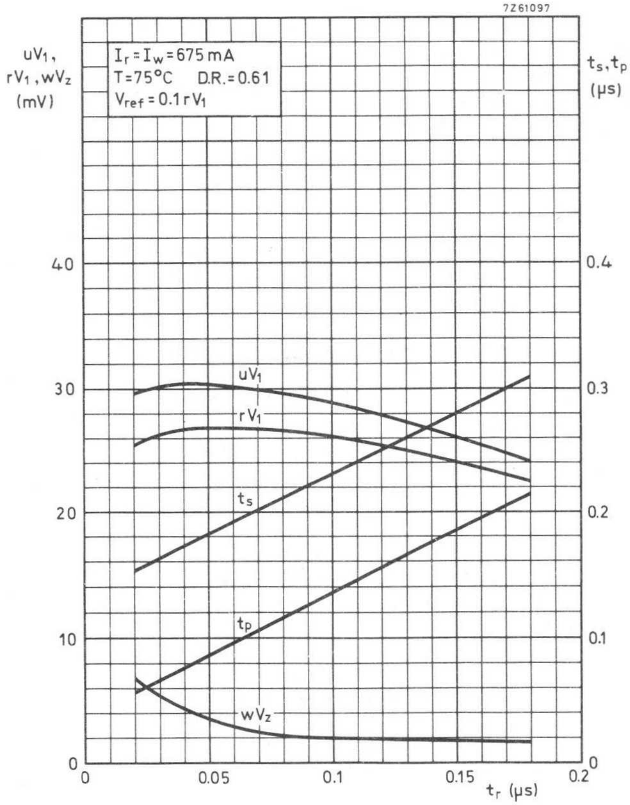
Typical core performance as a function of drive current at different temperatures and DR = 0.50.
(1) = 75 °C, (2) = 50 °C, (3) = 25 °C, (4) = 0 °C



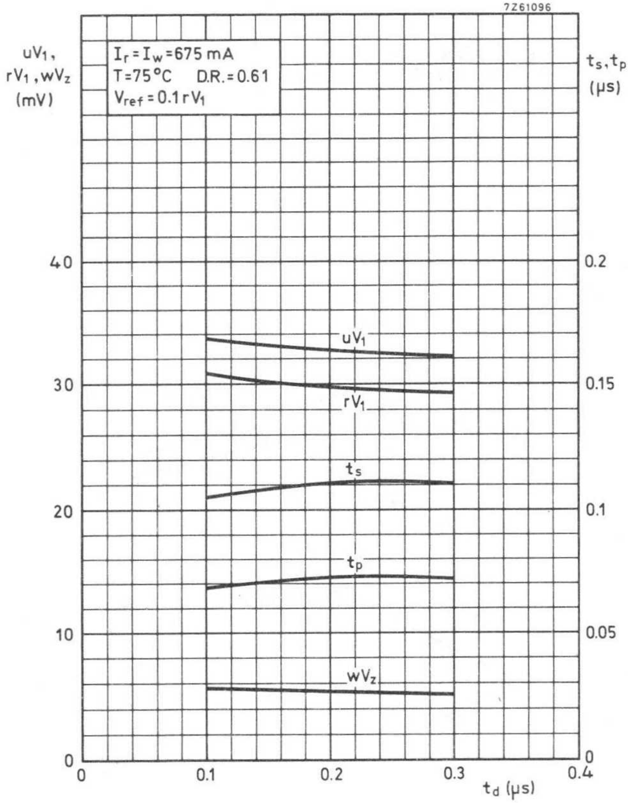
Typical core performance as a function of drive current at different temperatures and DR = 0.61.
(1) = 75 °C, (2) = 50 °C, (3) = 25 °C, (4) = 0 °C



Typical core performance as a function of current pulse rise time.



Typical core performance as a function of current pulse duration.



MATRIX PLANES AND STACKS

INTRODUCTION

SYSTEMS

We can supply matrix planes and stacks for the three following memory systems:

(A) 2D-systems (word organised memories)
(B) 3D-systems (bit organised memories)
(C) $2\frac{1}{2}$D-systems

The characteristics of these systems, together with their advantages and disadvantages, will be discussed in the following.

(A) Linear select 2D (word organised) system

In most word organised memories the matrices have two X and one or two Y wires through each core. As an example a 2D-array for 8 words of 4 bits is depicted in Fig. 1.

Writing (or restoration) of information in a core is performed by coincidence of two partial write current pulses with an amplitude I_{pw}, one contributed by the selected "write word wire", the other by the selected bit wire. For writing a "0" the bit wire is not energised. In the given example the information 1011 is written in the memory. All the cores in the energised bit wires are disturbed by the partial write pulses. As the magnetic state of the half-selected cores must not be altered, the partial write current amplitude must not exceed a certain limit (break current).

The read (or clear) operation is effected by sending a full read current pulse (I_r) through the decoded "read word wire", driving all the cores on this wire to the "0" state. The output signals are sensed on the sense wire. There are no disturbed cores, so that the read current amplitude is not limited by the core properties but by the driving circuits only. As a consequence a shorter switching time can be realised for the read than for the write operation.

For memories with a small number of words only one matrix plane may suffice; for memories with a large number of words several matrix planes may be required, each containing the same number of words and the full number of bits. For instance, the matrix of Fig. 1 can be folded along the dashed line forming two planes of 4 words-4 bits.

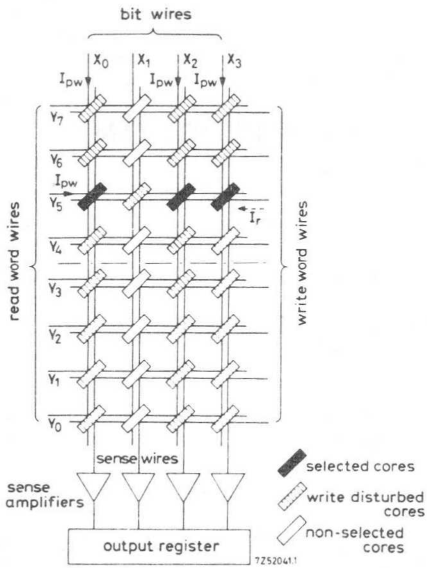


Fig.1. 2D array for 8 words of 4 bits

The advantages of the 2D system are:

1. Fast memories can be realised.
2. Either a wide tolerance on the drive currents or a wide temperature range is permissible.
3. Discrimination between "1" and "0" gives no problems.
4. Core requirements are not severe.

A disadvantage with respect to the other systems is the large number of selection circuits needed. For that reason the 2D system with two X and two Y wires is applied in small and fast memories.
On the other hand, the low cost of wiring is attractive for matrix planes with a very large number of cores. For that reason the 2D system with only 1X and 1Y wire through each core is applied in mass memories.

Word address matrix planes with 2X-2Y, 2X-1Y and 1X-1Y wiring can be supplied on request. (A standard range cannot be realised, because the number of words and the word length vary from memory to memory, and both determine the mechanical dimensions of 2D matrix planes.)

Stacks will be delivered with already interconnected bit and sense wires.

(B) 3D (bit organised) system

The traditional 4-wire coincident current system provides a reliable and relatively inexpensive approach to the storage of information.
As an example a memory of 16 words, 4 bits is depicted in Fig.2. The read or clear operation is effected by coincidence of two partial write pulses with an amplitude I_{pr}, one through the selected X line, the other through the selected Y line. The four fully selected cores are set to the "0" state, which induces a voltage pulse in each sense wire. The pulses are amplified and transferred to the output register as "ones" or "zeros" depending on the previous state of the cores.
The cores in the selected rows and columns are "read disturbed". The sense wires are threaded in such a way that the e.m.f.'s generated by the disturbed cores cancel each other.

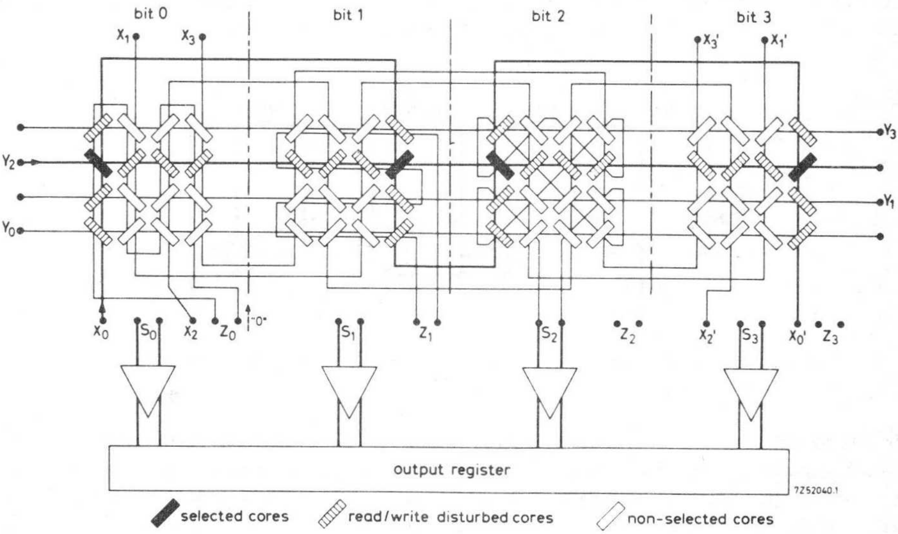


Fig.2. 3D array for 16 words of 4 bits.
In bits 0, 1 and 3 the S wire has not been drawn, in bits 2 and 3 the Z wire.

After reading a word, new information can be written in the relevant cores by means of the corresponding X, Y and Z current drivers. For writing all "ones" partial write pulses (I_{pw}) are sent through the two selected X and Y wires, as for the read operation, but in opposite direction. In Fig.2 the cores X_0Y_2 (solid) have been selected for storing the word 1111, while the other cores (hatched) in the selected rows and columns are "write disturbed".

For writing a "zero" the same X and Y pulses are needed as for writing "ones", but the switching to the "1" state must be prevented by sending an opposite partial write pulse ($-I_{pw}$) through the selected Z wire. (The Z wire may run parallel to the X wires in one matrix and parallel to the Y wires in another, see Bits 0 and 1 in Fig.2). All cores situated on a non-selected row or column are read disturbed, generating inhibit noise on the sense wire. The inhibit noise should be damped out before a successive read operation may start.

As during the read and the write operations cores are disturbed, the read, write and inhibit currents must have an upper limit.

For memories with a large number of cores it is impracticable to arrange all cores in one plane, not only for reasons of wiring and size but mainly because differing propagation delays in the drive lines and differing characteristic impedances should be avoided. This is realised by distributing the cores over a number of stacked matrix planes; for instance, the memory of Fig.2 can be folded along the dashed lines so that the X wires also have short interconnections, see Fig.3.

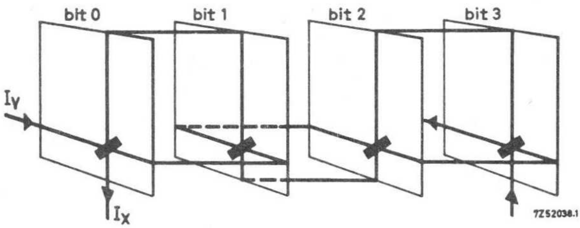


Fig.3. Principle of series connection of the X wire and of the Y wire for one word of four bits in the 3D system.

In bit organised memories each matrix plane contains normally a number of cores which equals the total number of words and the number of planes equals the number of bits per word. The number of selection circuits is minimal if the core array is a square with sides of 2^n cores. These facts permit us to offer a standard range of matrix planes, of which the sizes 32 x 32, 64 x 64 and 128 x 128 are preferred types.

Advantages of the 3D system are:

1. Inexpensive selection system.
2. Memories up to 10^6 bits can be realised.

Disadvantages are:

1. Limited temperature range in fast memories due to the inhibit dissipation.
2. Upper limits for all drive currents.

(C) 2½D system

This is a three-wire hybrid of the 2D and the 3D system. An X, a Y and an S wire are threaded through each core. Reading of information conforms to the 3D system and writing conforms to the 2D system. Thus, for reading and for writing "ones" two coincident partial drive currents are needed (I_{pr} and I_{pw}, respectively); for writing "zeros" the X wires are not energised.

The sense wire can be laid along the X wires, see Fig.4, or threaded diagonally as in the 3D system. The crossing in the middle of the S wire is for mutual cancellation of disturb signals generated in the upper and lower part of the columns.

To obtain equal propagation delay times for the X and Y drive lines, the total number of columns (length of the Y wire) should approximately be equal to the number of rows (length of the X wire). As a consequence, the matrices for each bit have always an oblong form.

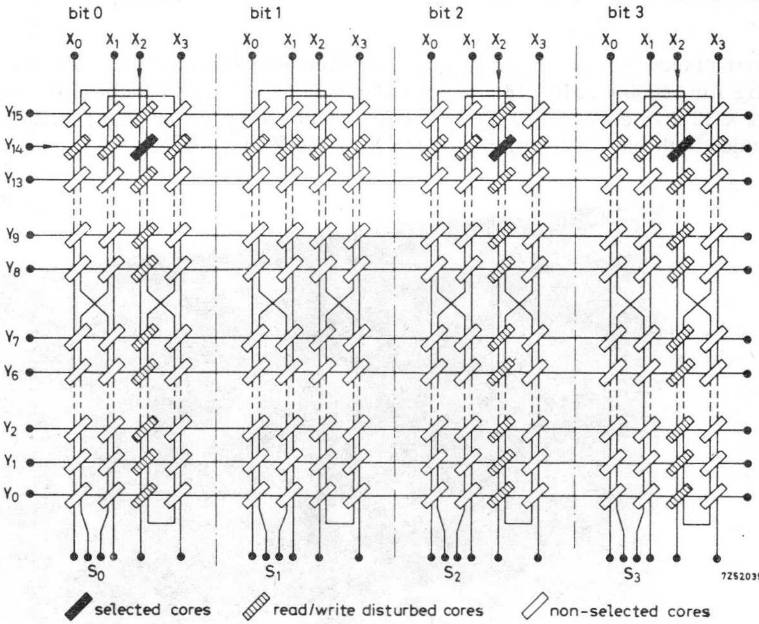


Fig.4. $2\frac{1}{2}$D matrix plane for 64 words of 4 bits. The arrows indicate the writing of the word 1011.

In the read operation each sense wire receives much more noise from the disturbed cores of the selected column than from the cores of the selected row. This noise can be reduced to improve the discrimination between "ones" and "zeros" by applying the "staggered read mode".

In the staggered read mode the I_{prx} pulse starts some nanoseconds earlier than the I_{pry} pulse, while the selected core is read during the latter. By this measure, only the disturb signals from the selected short row will contribute to the noise level. The resulting good discrimination between "1" and "0" signals permits a larger number of cores per sense line (words per bit). The extra time lost due to the staggered read mode is amply compensated by the time gained due to the absence of a recovery time for inhibit noise.

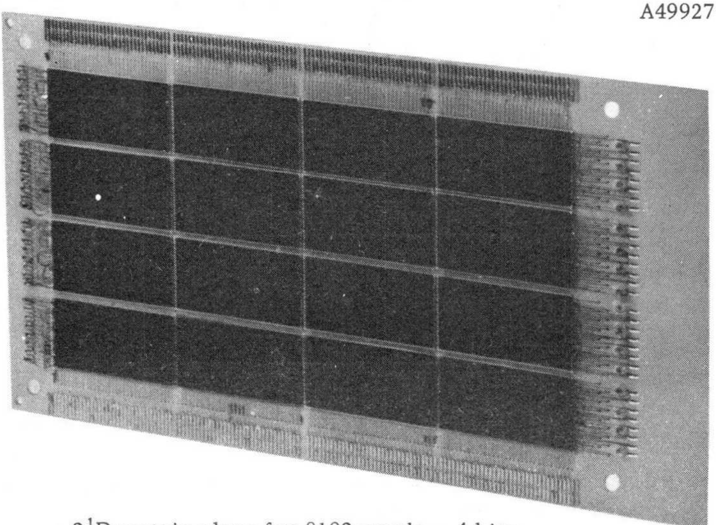
The $2\frac{1}{2}$D system has the following advantages:

1. Minimal heat dissipation in the matrix.
2. No inhibit noise on the sense wire.
3. The matrix planes are less expensive.
4. A large number of words per bit is possible.

A disadvantage is the larger number of selection circuits, compared with 3D systems.

No matrix planes for the $2\frac{1}{2}$D system have been standardised yet, but favourable types are for 16000 words - 18 bits; two planes with 512 x 32 x 9 cores or one plane with 512 x 32 x 18 cores. $2\frac{1}{2}$D matrix planes can be supplied on request. Stacks will be provided with interconnections for the X or the Y drive lines.

A49927-2



$2\frac{1}{2}$D matrix plane for 8192 words - 4 bits

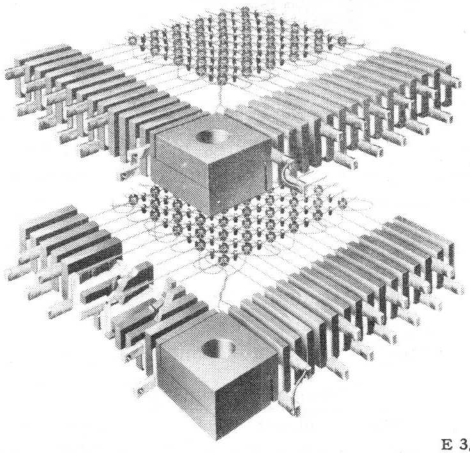
STANDARD MATRIX PLANES FOR 3D SYSTEMS

The matrices for bit organised memories consist of a number of magnetic cores arranged in rows and columns through which four copper wires are threaded according to the M.I.T. system, namely:

2 drive wires (X wire, Y wire)
1 inhibit wire (Z wire)
1 sense wire (S wire)

A matrix plane is a frame with one, two or four matrices. The multi-matrix planes may have separate sense and inhibit wires per matrix.
All matrix planes are used in two versions [1]: left-hand and right-hand matrix planes, which have a mirror-symmetrical tag lay-out. On a stack of alternate left-hand and right-hand planes this allows an easy series connection of the drive wires.

Moreover, the inhibit wires run along the X (or Y) wires in left-hand planes and along the Y (or X) wires in right-hand planes. By this measure equal characteristic impedances for the X and Y drive lines are maintained in a stack.



E 3/13

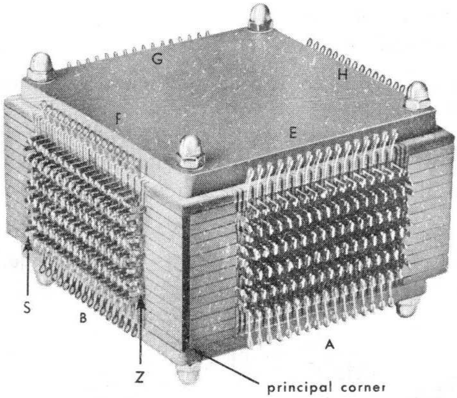
The corner of a plane at the crossing of the X_0 and Y_0 wires is called Principal Corner, and it is indicated by a marking dot. Left-hand and right-hand planes can be identified by their differing catalog numbers.

Matrix planes with 50 mil, 30 mil and 20 mil cores are available in standard types. Deviating types can also be supplied.

1) Except four-fold matrix planes with 50 mil cores.

Stacks

A stack is built up from alternate left-hand and right-hand planes, starting with a left-hand plane.
A termination plane and an aluminium protective plate are provided at both the top and the bottom of the stack.



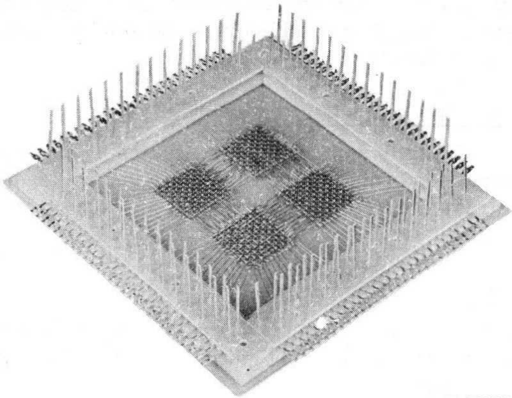
Stack of 50 mil planes

The tags of two adjacent planes are so near to each other that all X and, respectively, all Y drive wires are connected in series by means of dip-soldering. The X and Y drive lines thus obtained, end or start on the rigid terminals which have been inserted in the termination planes.

A coloured stroke indicates the principal corner of the stack. This is the corner at which the X_0 and Y_0 drive lines cross each other. Moreover, the bottom protection plate has been marked A, B, C, D and the top plate E, F, G, H, to identify the connections of the stacks: see photograph.
If required, a stack will be supplied with interconnection leads.

In a stack of four-fold planes an interconnection plane can be used instead of the top termination plane. The former contains wiring that connects one half of the X drive lines to the other half and does the same with the Y drive lines.
The beginnings and the ends of all drive lines are thus accessible at the bottom termination plane, and with one pair of XY drive pulses 4 bits per plane can be read out at once.
Example: A stack of 5 matrix planes with 4 x 16 x 16 cores, when provided with an interconnection plane, functions as a stack of 20 planes with 16 x 16 cores.
This method is attractive since a smaller stack height is obtained for the same number of bits and, in addition, because stacks of multi-matrix planes are cheaper than functionally identical single matrix planes.
Interconnection planes are made in two versions: one for an odd number of matrix planes and one for an even number.
For stacks of two-section matrices interconnecting planes are also available.

PLATRICES (with 50 mil L.T.C. cores)



RZ 21192-1

Platrices are matrix planes that can be mounted direct on a printed-wiring board. They are designed for use specially in desk-size book-keeping machines, desk calculators, invoicing machines, cash registers, but also in other applications such as machine tool equipment and measuring apparatus. In these applications the Platrices make a valuable contribution towards increased production and circuit economy because of their outstanding features and low cost.

Features

Cost-saving frame design

Conventional matrix planes usually have a relatively expensive cut frame construction. For the Platrices a simple and yet rigid frame of paper-base laminate is used, which is particularly suitable for mass production.
The frames can also be made of epoxy paper laminate, however, at increased prices.

Standardised dimensions

Standardisation on the basis of the most current matrix sizes used in desk-size office machines, has resulted in a standard range of only 4 sizes. Non-standard types can only be supplied when sufficiently large quantities are concerned.

Temperature independent

The use of L.T.C. cores (type 6C2) permits the Platrices to operate within a wide temperature range (10 - 70 ^{o}C) without current compensation.

Low drive currents

The X, Y and Z wires run twice through each core, permitting low drive currents and, therefore, the use of relatively simple drive and selection circuits.
Wiring of the core is according to the M.I.T. system.

Special pinning adapted to printed-wiring techniques.

The Platrices are provided with plug-in connection pins having a pitch of 5.08 mm or 5.0 mm. This construction enables direct mounting and soldering of the Platrices on printed-wiring boards with a pitch of 2.54 mm (0.1 inch), or 2.50 mm (satisfying the German D.I.N.).

Ruggedized construction

The Platrices are highly resistant to shock and vibration and are protected against damage thanks to a protection plate being glued on to the cores, wiring and frame by means of a special lacquer.

Stacks

Stacks of maximum 4 Platrices with series connected drive wires can be supplied. All drive lines are available at the bottom plane, so that also a stack can easily be mounted on a printed-wiring board.

CORE MATRICES ON PRINTED-WIRING BOARDS

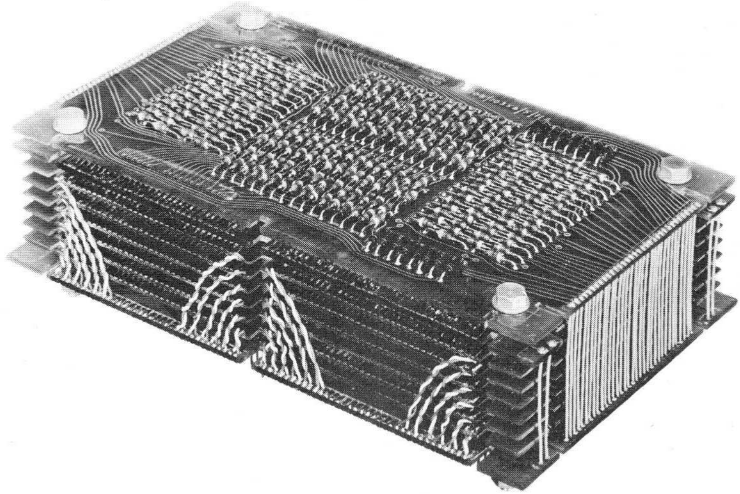
Apart from the conventional matrices wired to a frame, we can supply matrices wired direct to a printed-wiring board.

For the 3D system, stacks of these printed-wiring matrix boards can be integrated with an additional p.w. board on which the selection diodes and parallel resistors are mounted (see photograph).

For the $2\frac{1}{2}$D system, the selection diodes can be mounted around the matrix.

This method has the following advantages:

1. Associated diodes and resistors can be easily integrated in the stack, thus reducing the number of connections.
2. The spacing between the p.w. board, and the copper clad to which the cores are glued guarantee small temperature differences in the stack.
3. The fixing of the cores to the p.w. boards gives a considerably improved resistance to shock and vibration.
4. Both sides of the boards can be easily provided with a matrix, which results in a reduced stack height.



8k Memory Stack RZ 23279-3

Two standard ranges for the 3D system are available; with 30 mil cores and with 20 mil cores.

TEST METHOD

All cores in each plane are tested to make sure that they satisfy the core specification. Planes are tested at 23 °C with marginal drive currents.
Each core is tested with the pulse patterns, shown on next page.

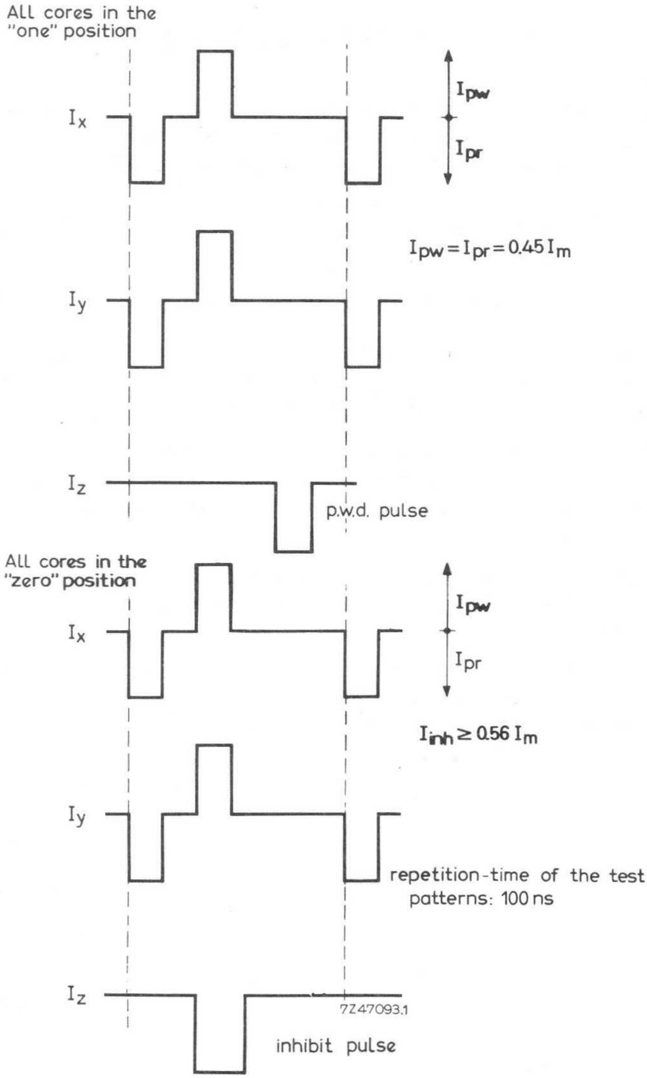
The "1" output of each core is measured with all cores in the "1" state (best pattern). The cores are tested to guarantee a minimum "1" output at max. and min. values of switching and peaking time (t_s and t_p).

Furthermore, the disturb sensitivity of the cores is tested by increasing the disturb ratio up to min. 0.62.
This is done by measuring the output with and without a post-write disturb (p.w.d.) pulse. If the difference of these values exceeds a given limit, the core is replaced. This is also a check on whether the sense wire passes through all cores.

The "0" output of each core is measured with all cores in the "0" state (best pattern). The cores are tested to guarantee maximum permissible "0" output. This also checks whether the inhibit wires pass through all cores and whether the noise cancellation of the sense wire is adequate.

Sample tests are carried out with all the cores set in worst pattern, checking the peak value of the "0" output (peak delta noise) and the "0" output at peaking time of the "1" output.

Besides the electromagnetic testing, the planes are tested on insulation resistance and on the d.c. resistance of the X, Y, Z, and S wire.
After assembly a stack is functionally tested.


All cores in the "one" position
I_x
I_{pw}
I_{pr}
$I_{pw} = I_{pr} = 0.45\, I_m$
I_y
I_z
p.w.d. pulse
All cores in the "zero" position
I_x
I_{pw}
I_{pr}
$I_{inh} \geq 0.56\, I_m$
I_y
repetition-time of the test patterns: 100 ns
I_z
7Z47093.1
inhibit pulse

ORDERING INFORMATION

Standard matrix planes and Platrices

Please order under the catalog number as published in the data sheets.
We reserve the right to deliver matrix planes and Platrices printed with the catalog number, even when ordered under the old type number. The old type number will be printed only when specially requested.

Stacks

Stacks will get a catalog number when an order has been received.
Please state the desired number of matrix planes, their catalog number(s) and further details.

MATRIX PLANES, STACKS AND BOXES WITH 50mil CORES

MATRIX PLANES

Description

The frames consist of 8 standard resin bonded fibre strips (S.R.B.F.) in 4 pairs. Between each pair of strips, gold-plated bronze tags for terminating the wires are inserted. The strips have grooves spaced at 50 mil (1.27 mm) in which the wires run to the soldering tags. On these tags the wires are wrapped and dipsoldered. The matrices are wired with copper enamelled wire S.W.G.40 (0.12 mm diameter.) The cores are arranged according to the "closed" pattern configuration and can be of type 6C1, 6D5, 6C2 or 6D9. Brass bushes in the corners of the frames facilitate the use of 3 mm tie rods for clamping the frames in a stack together.
Lacquered matrices for improved performance are available.

The sense wire of single-matrix planes consists of four parts which have been series connected by interconnection of appropriate soldering tags, see Figs 5 and 6. The matrix planes have been provided with extra parallel connections so that the inhibit terminals are located above each other when the planes are stacked. As can be seen, a left-hand plane can easily be transformed into a right-hand one by turning it over 90°: only two interconnections of the sense wire need be changed.

Note: Four-fold planes are available in only one version, see Fig.7. In these planes each matrix is provided with separate sense and inhibit wires. In one half of the matrices the inhibit wiring runs along the X wires and in the other half along the Y wires, to insure equal characteristic impedances for the X and Y drive lines. In a stack successive planes are rotated at 180° with respect to each other.

Worst-case pattern

In order to test planes on the most unfavourable "1" and "0" outputs, the cores must be set according to the basic worst-case pattern indicated below the relevant wiring diagram.

Standard range

A number of types have been standardised on core pattern wiring, types of core and construction.

Catalog number, for ordering: 2722 043 .....
suffix, see Table 1

Table 1. (Preferred types are underlined)

core pattern	wiring X Y Z S	core type	unlacquered		lacquered	
			left	right	left	right
			suffix	suffix	suffix	suffix
32 x 32	1 1 1 1	6C1	05001	05081	05011	05091
		6D5	05021	05101	05031	05111
		6C2	05041	05121	05051	05131
		6D9	05061	05141	05071	05151
64 x 64	1 1 1 1	6C1	06001	06081	06011	06091
		6D5	06021	06101	06031	06111
		6C2	06041	06121	06051	06131
		6D9	06061	06141	06071	06151
2 x 16 x 32	1 1 2 2	6C1	20001	20081	20011	20091
		6D5	20021	20101	20031	20111
		6C2	20041	20121	20051	20131
		6D9	20061	20141	20071	20151
2 x 32 x 64	1 1 2 2	6C1	21001	21081	21011	21091
		6D5	21021	21101	21031	21111
		6C2	21041	21121	21051	21131
		6D9	21061	21141	21071	21151
4 x 16 x 16	1 1 4 4	6C1	25001		25011	
		6D5	25021		25031	
		6C2	25041		25051	
		6D9	25061		25071	
4 x 32 x 32	1 1 4 4	6C1	26001		26011	
		6D5	26021		26031	
		6C2	26041		26051	
		6D9	26061		26071	
4 x 64 x 64	1 1 4 4	6C1	27001		27011	
		6D5	27021		27031	
		6C2	27041		27051	
		6D9	27061		27071	

Table 2. The dimensions A to D refer to Figs 1 and 2.

core pattern	outer dimensions planes in mm		pitch of mounting holes in mm	
	length A	width B	length C	width D
32 x 32	80	80	59.5	59.5
64 x 64	120	120	100.2	100.2
2 x 16 x 32	80	85	59.5	64.5
2 x 32 x 64	120	125	100.2	105.2
4 x 16 x 16	85	85	64.5	64.5
4 x 32 x 32	125	125	105.2	105.2
4 x 64 x 64	208	208	186.7	186.7

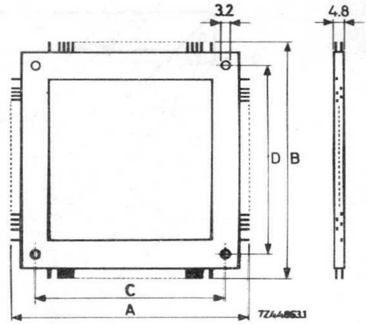


Fig.1. Dimensions in mm

STACKS

For general information on stacking and stacks see sections "Introduction" and "Ordering information", which precede the data sheets.

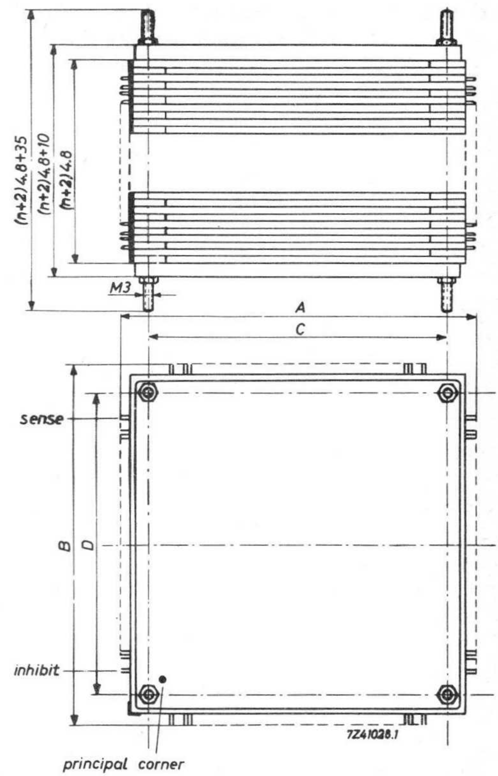


Fig.2. Dimensions in mm

n = number of matrix planes
Dimensions A to D:
- see Table 2.

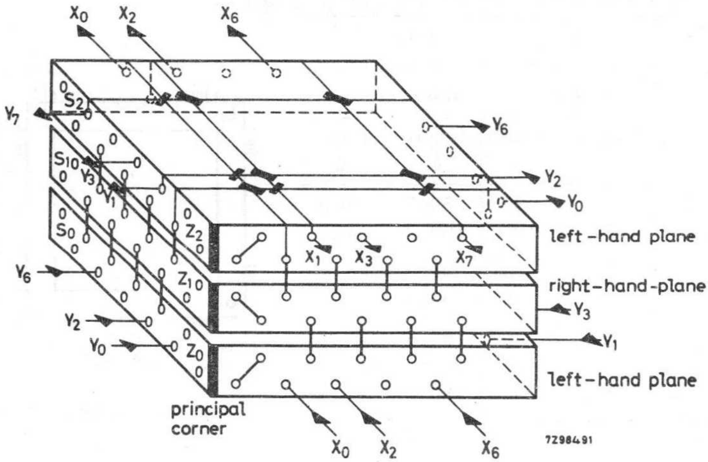


Fig.3. Principle of the connections to a stack having an odd number of single-matrix planes. The arrows indicate the write current direction.

WIRING DIAGRAM

MATRIX PLANE

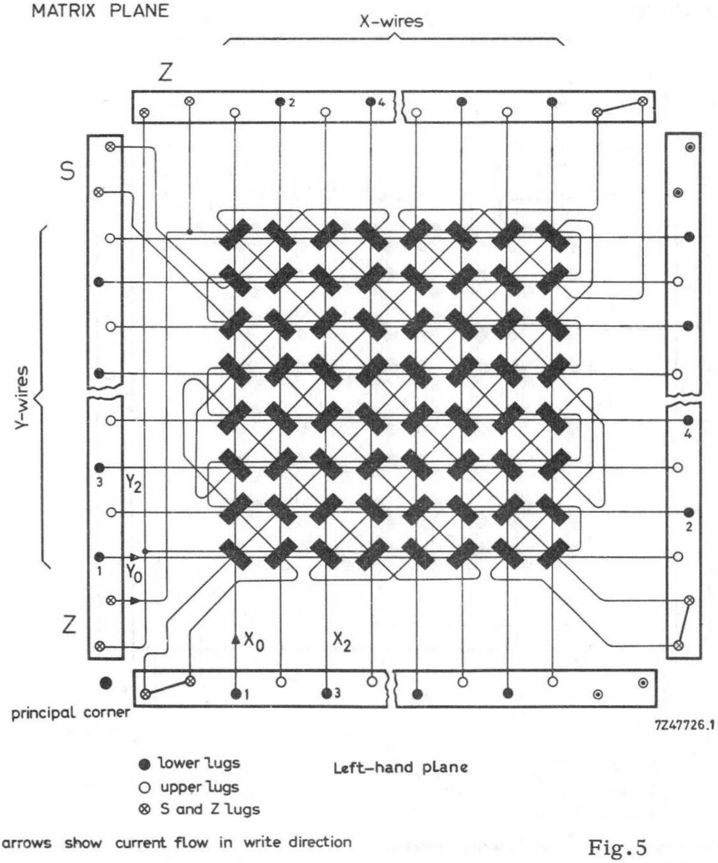


Fig.5

Worst-case pattern (for left-hand planes):

	1	1	0	0	1	1	0	0
	0	0	1	1	0	0	1	1
	0	0	1	1	0	0	1	1
	1	1	0	0	1	1	0	0
	1	1	0	0	1	1	0	0
	0	0	1	1	0	0	1	1
	0	0	1	1	0	0	1	1
principal corner	1	1	0	0	1	1	0	0

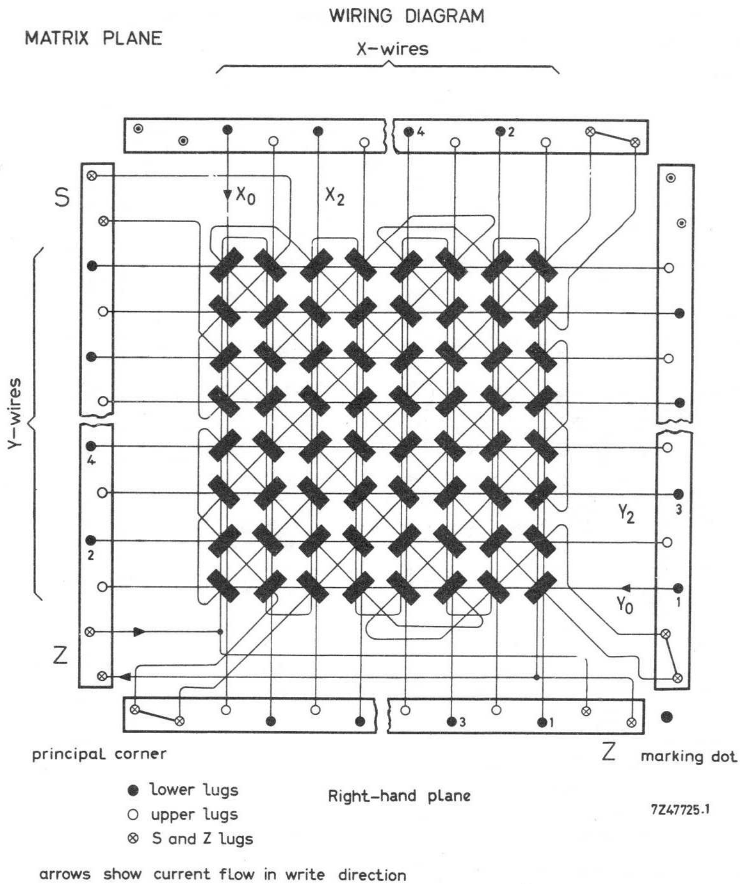
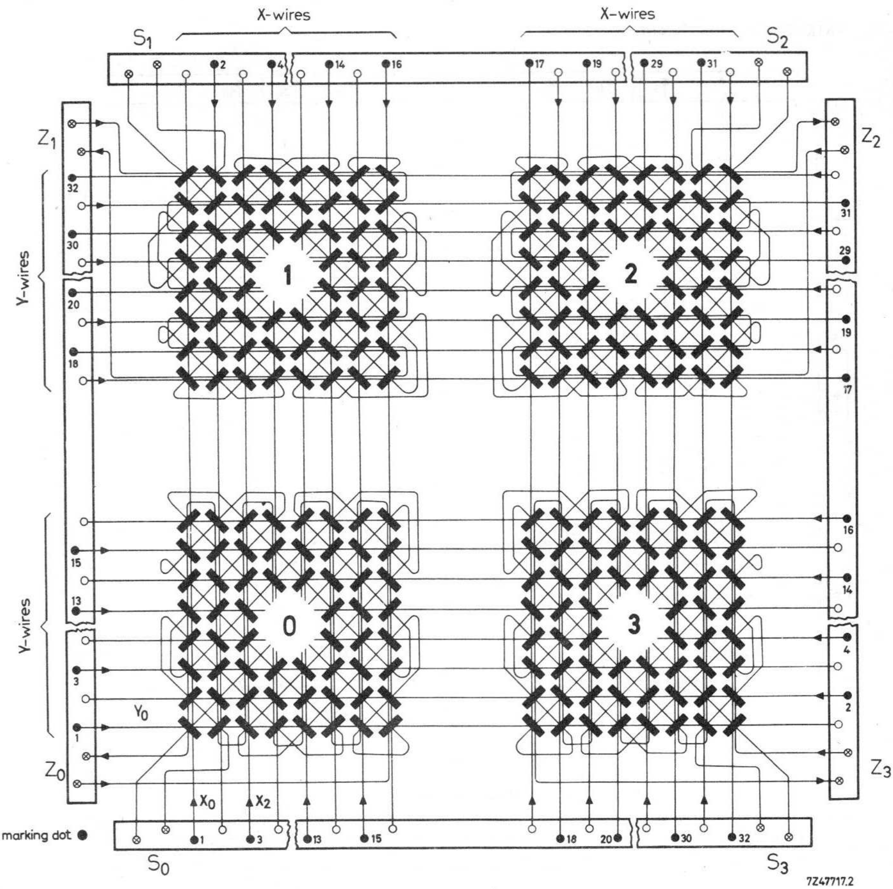


Fig.6.

Worst-case pattern (for right-hand planes):

	1	0	0	1	1	0	0	1
	1	0	0	1	1	0	0	1
	0	1	1	0	0	1	1	0
	0	1	1	0	0	1	1	0
	1	0	0	1	1	0	0	1
	1	0	0	1	1	0	0	1
	0	1	1	0	0	1	1	0
principal corner	0	1	1	0	0	1	1	0



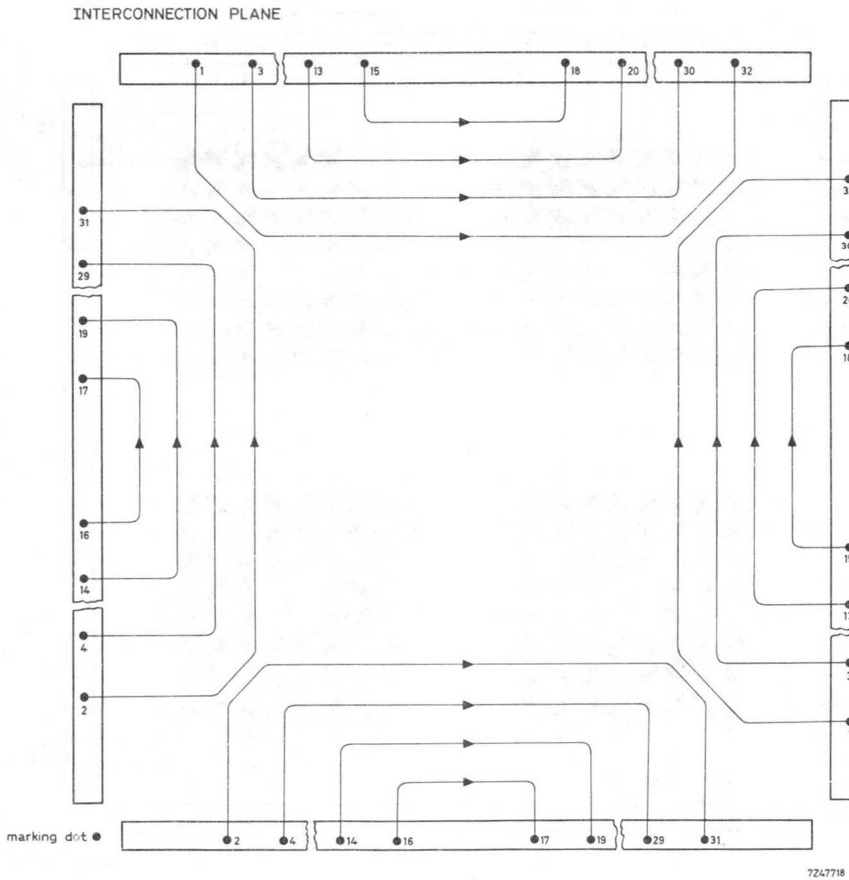
● lower tags
○ upper tags
⊗ S and Z tags

Fig. 7. Matrix plane 4 x 16 x 16

Arrows show current in write direction for odd plane. Starting with the position shown successive planes of a stack are rotated 180°.

Worst-case pattern

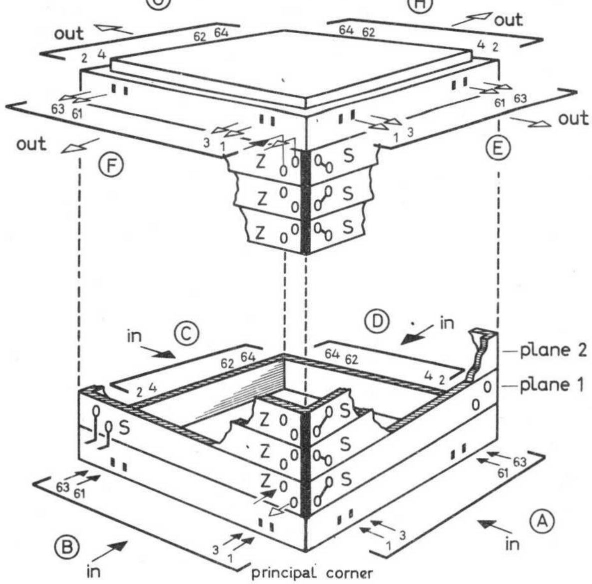
	1	1	0	0	1	1	0	0
	0	0	1	1	0	0	1	1
	0	0	1	1	0	0	1	1
	1	1	0	0	1	1	0	0
	1	1	0	0	1	1	0	0
	0	0	1	1	0	0	1	1
	0	0	1	1	0	0	1	1
principal corner	1	1	0	0	1	1	0	0



● Lower lugs — the interconnection plane is placed on top of the stack in the same position as that of topmost plane

arrows show current flow in the write direction for a stack with odd number of planes

Fig.8.



current in ↓	current out ↑
$A_1 - A_{63}$	$E_1 - E_{63}$
$B_1 - B_{63}$	$F_1 - F_{63}$
$C_2 - C_{64}$	$G_2 - G_{64}$
$D_2 - D_{64}$	$H_2 - H_{64}$

7Z44966A

Fig. 9. Connections to a stack having an even number of planes with 64 x 64 cores. The arrows are drawn in write current direction.

PLATRICES AND STACKS WITH 50 mil LTC CORES

PLATRICES

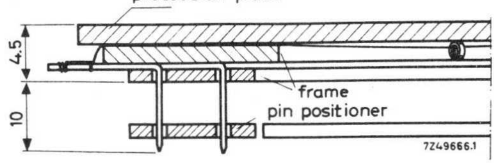
Platrices are matrix planes that can be mounted direct on a printed-wiring board. They are designed for use specially in desk-size book-keeping machines, desk calculators, invoicing machines, cash registers, but also in other applications such as machine tool equipment and measuring apparatus.
The wiring of the cores is based on the coincident current system.

CONSTRUCTION

The Platrices are built up from a frame, terminals, matrix (cores and wiring), a protection plate and four pin-positioning strips. Frames, plates and strips are made of paper-base laminate (preferred types) or of epoxy paper laminate.

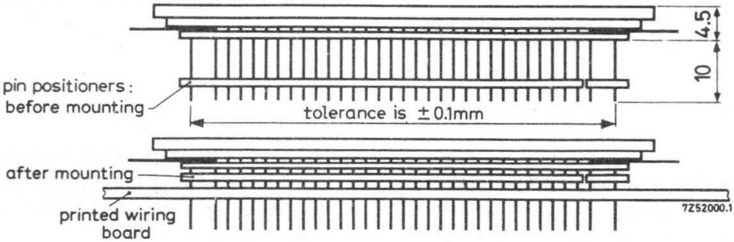
The frame consists of four pairs of strips, glued together, which hold the terminals in between. The terminals are L-shaped, forming single rows of soldering tags horizontally and double rows of pins vertically. The ends of the matrix wires are wrapped around the tags and then dip-soldered. See detail A.

The rows of pins are destined for mounting in a printed-wiring board. The distances between adjacent pins in a row and between adjacent rows are 5.08 or 5.0 mm, adjacent rows are shifted 2.54 or 2.50 mm with respect to each other. Consequently, the Platrices can be mounted on a printed-wiring board with a grid of 2.54 or 2.50 mm pitch. Before a Platrix is stacked upon another, all pins are cut-off (see the section STACKS).
Cores and wiring are sealed to the protection plate by means of a special lacquer.



Detail A

The four pin positioners are drawn towards the ends of the pins to facilitate mounting (see Detail B).
For connections to the Platrices and hole patterns in the printed-wiring boards see the relevant figures



Detail B

STANDARD RANGE OF PLATRICES

core pattern	catalog number 2722 051				outer dimensions over the tags (mm)
	paper-base (preferred)		epoxy paper		
	2.50 grid	2.54 grid	2.50 grid	2.54 grid	
16x16	02041	02051	02061	02071	82x 82
4x 8x8	22041	22051	22061	22071	82x 82
4x 4x16	28041	28051	28061	28071	82x 82
16x32	10041	10051	10061	10071	82x122
4x 8x16	29041	29051	29061	29071	82x122
4x12x12	24041	24051	24061	24071	102x102
32x32	05041	05051	05061	05071	122x122
2x16x32	20041	20051	20061	20071	122x122
4x16x16	25041	25051	25061	25071	122x122

Non-standard types can be supplied only if sufficiently large quantities are concerned.

ELECTRICAL DATA

Cores and wiring

The Platrices are provided with type 6C2 cores, which have a low temperature coefficient. To reduce the drive current by a factor two, the "X", "Y" and "Z" wires are wired twice through each core. The sense wire is single. See the wiring diagrams.

Nominal conditions

Drive currents I_x, I_y, I_z	
amplitude	185 mA
pulse rise time	0.3-0.6 μs
pulse duration	1.2 μs
Strobe time for "1" output	0.45-0.75 μs
Ambient temperature	10-70 ^{o}C

Recommended load impedance of sense wire: 115 Ω in parallel with 100 pF.
To obtain a favourable one-zero ratio the pulse rise time must be chosen as low as possible.

Typical response

Output "1" signal during strobe time	35 mV
Output "0" signal during strobe time in worst pattern	2 mV
Switching time	1.3-1.6 μs

Test conditions

Each core in the Platrix is tested on the "one" output signal, with marginal drive currents, disturb ratio 0.61. The Platrices meet the MIL specifications STD 202.

Drive current	I_x	I_y	I_z	
amplitude	170	170	200	mA
pulse rise time	0.3	0.3	0.3	μs
pulse duration	1.5	1.5	2	μs
Strobe time for "1" output		0.45-0.75		μs
Ambient temperature		10-70		^{o}C

Worst pattern

	1	1	0	0
	0	0	1	1
principal	0	0	1	1
corner	1	1	0	0

Accepted limits (at test conditions)

Output "1" signal during strobe time	$\geq$ 25 mV
Output "0" signal during strobe time in worst pattern	$\leq$ 3 mV
Switching time	$\leq$ 1.4 μs
Insulation resistance	$\geq$ 100 MΩ
Maximum permissible interwinding voltage	80 V

STACKS

Stacks of maximum 4 standard Platrices having series-connected drive wires can be supplied. The stacks can be mounted direct on a printed-wiring board which possesses all tracks necessary for the ingoing and outgoing X and Y-drive currents, as well as tracks for the S and Z wires of the lowest plane.

CONSTRUCTION

The number of different elements which complete a stack depends on the type of the Platrices used.

main elements in a stack of		
single-fold Platrices:	two-fold Platrices:	four-fold Platrices:
cover plate	cover plate	cover plate
–	interconnection wires for X drive lines	interconnection wires for X- and Y-drive lines
2 or 4 Platrices with cut-off pins	2 or 4 Platrices with cut-off pins	1 or 3 Platrices with cut-off pins
bottom frame (with pins)	bottom frame (with pins)	1 Platrix with pins

The bottom frames have a construction identical to that of Platrices but they have no cores and wiring; they facilitate the connection of both the bottom and the top end-tags of the drive lines to printed-wiring pins. No bottom frame is necessary for stacks of four fold platrices because there all drive lines already start and end on the lowest plane.
The cover plates bear the catalog number of the stack and also serve for protection of the interconnection wires.
The pin-positioners are taken from the Platrices before the pins are cut-off, but they are re-positioned to cover the stubs.
For connections to the stacks see the relevant figures; for the hole patterns in the printed wiring boards the hole patterns given for the corresponding Platrices should be consulted.

STANDARD RANGE OF STACKS

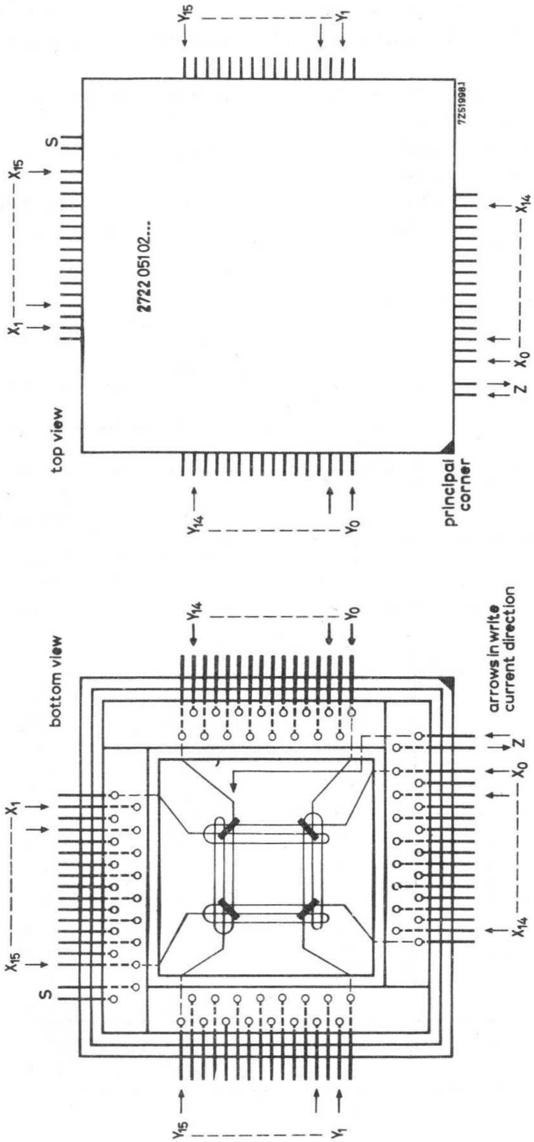
core pattern per plane	number of planes	catalog number 2722 058			
		paper-base (preferred)		epoxy paper	
		2.50 grid	2.54 grid	2.50 grid	2.54 grid
16x16	2 4	20321 20331	20341 20351	20361 20371	20381 20391
4x 8x8	2 4	20401 20411	20421 20431	20441 20451	20461 20471
4x 4x16	-	-	-	-	-
16x32	2 4	20241 20251	20261 20271	20281 20291	20301 20311
4x 8x16	2 4	20561 20571	20581 20591	20601 20611	20621 20631
4x12x12	2 4	20481 20491	20501 20511	20521 20531	20541 20551
32x32	2 4	20081 20091	20101 20111	20121 20131	20141 20151
2x16x32	2 4	20161 20171	20181 20191	20201 20211	20221 20231
4x16x16	2 4	20001 20011	20021 20031	20041 20051	20061 20071

ELECTRICAL DATA

The electrical data are identical to those of the Platrices.

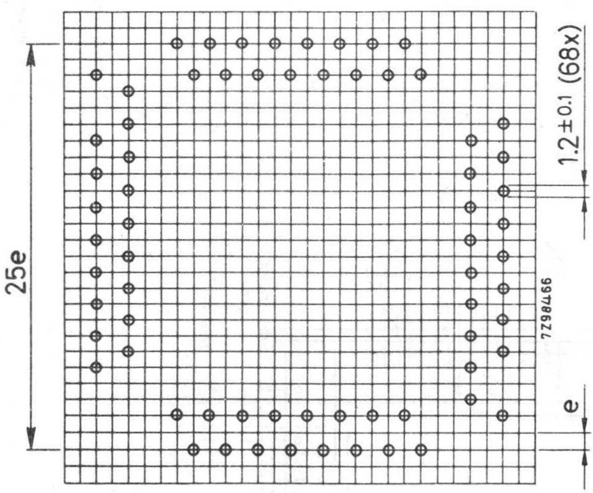
CONNECTIONS AND HOLE PATTERNS

16 x 16

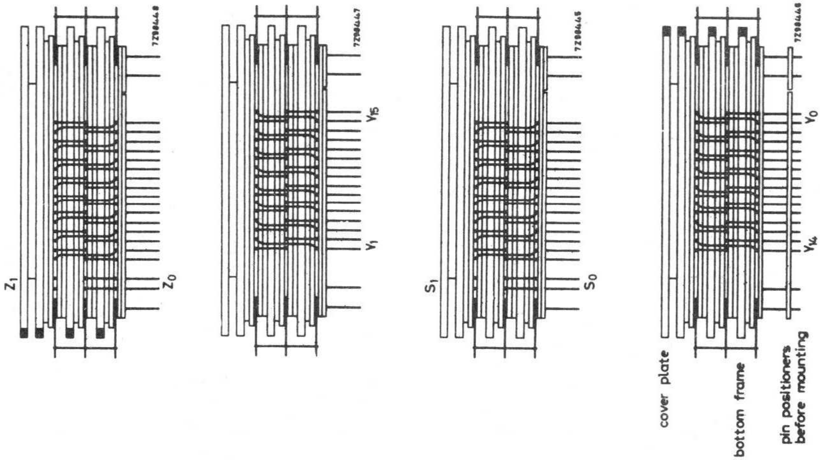


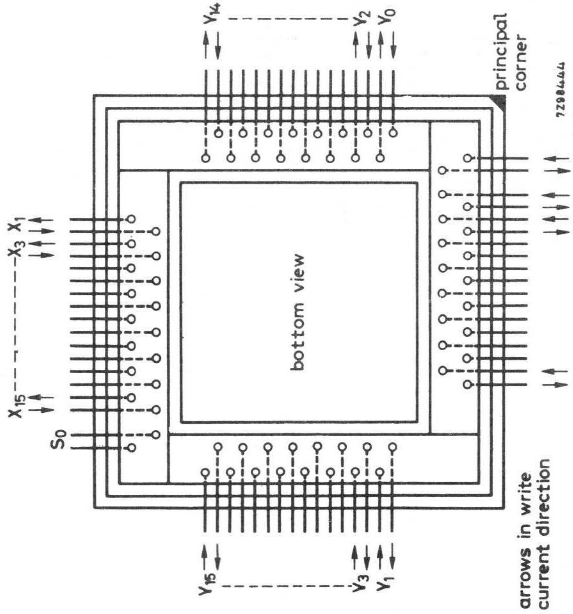
Platrix 16 x 16

Component side.

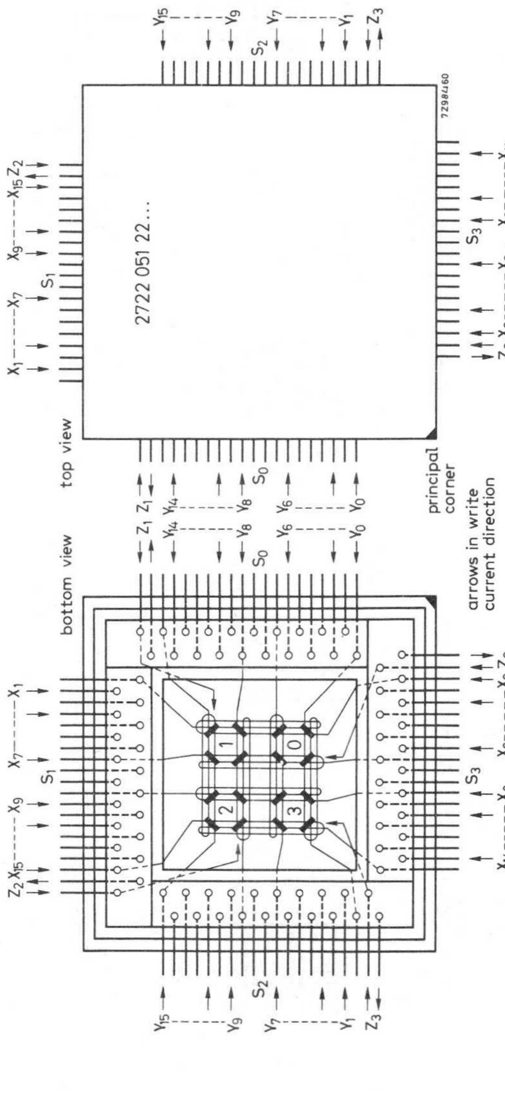


Hole pattern for Platrix 16 x 16
e = 2.50 or 2.54 mm

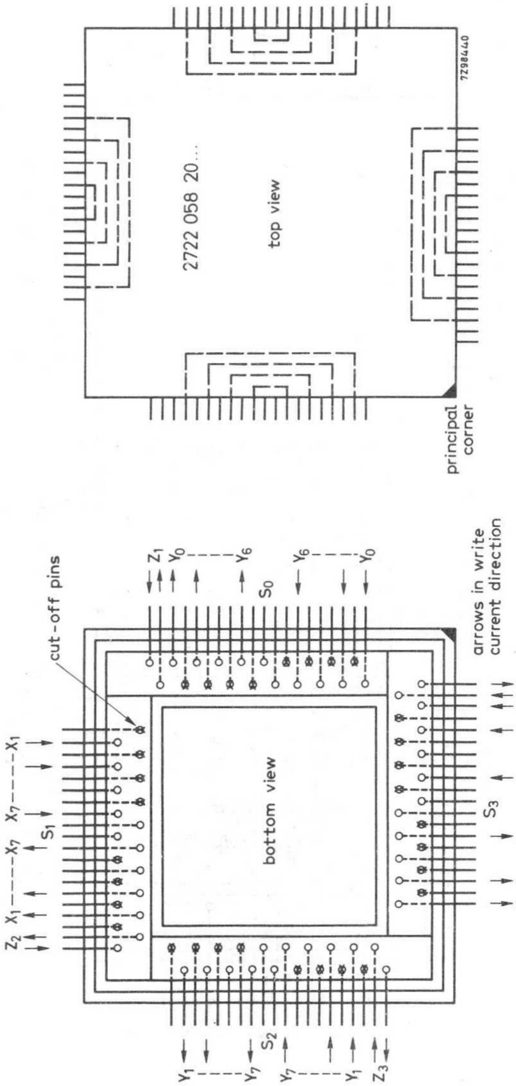




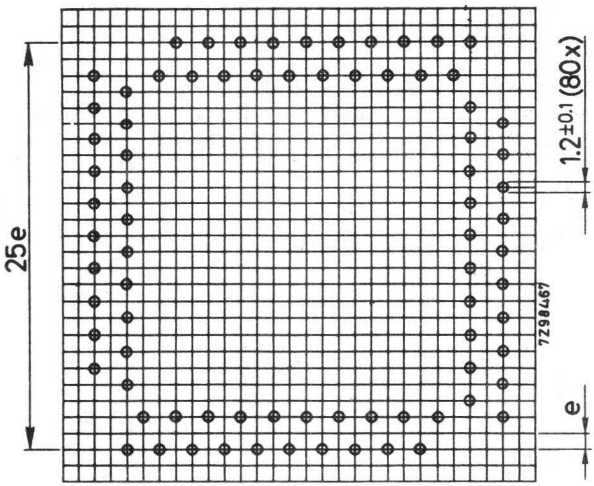
Stack of two Platrices 16 x 16. The hole pattern is identical to that of Platrix 16 x 16 except superfluous holes for cut-off pins.



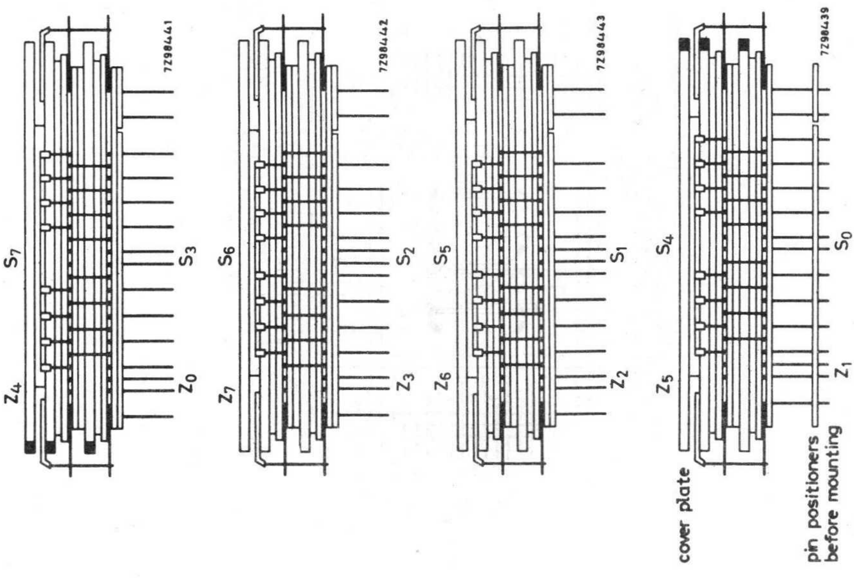
Platrix 4 x 8 x 8



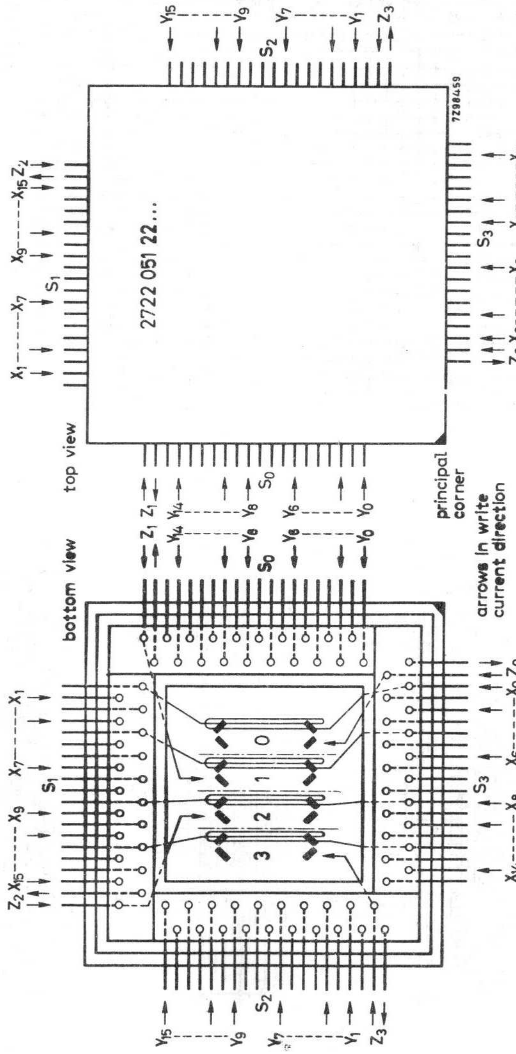
Stack of two Platrices 4 x 8 x 8 x 8. For side views see below. The hole pattern is identical to that of Platrix 4 x 8 x 8 except superfluous holes for cut-off pins.



Hole pattern for Platrix 4 x 8 x 8
e = 2.50 or 2.54 mm
Component side.



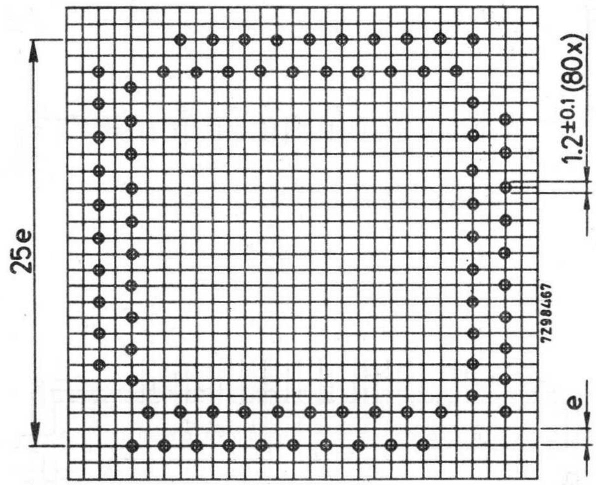
Stack of two Platrices 4 x 8 x 8, side views



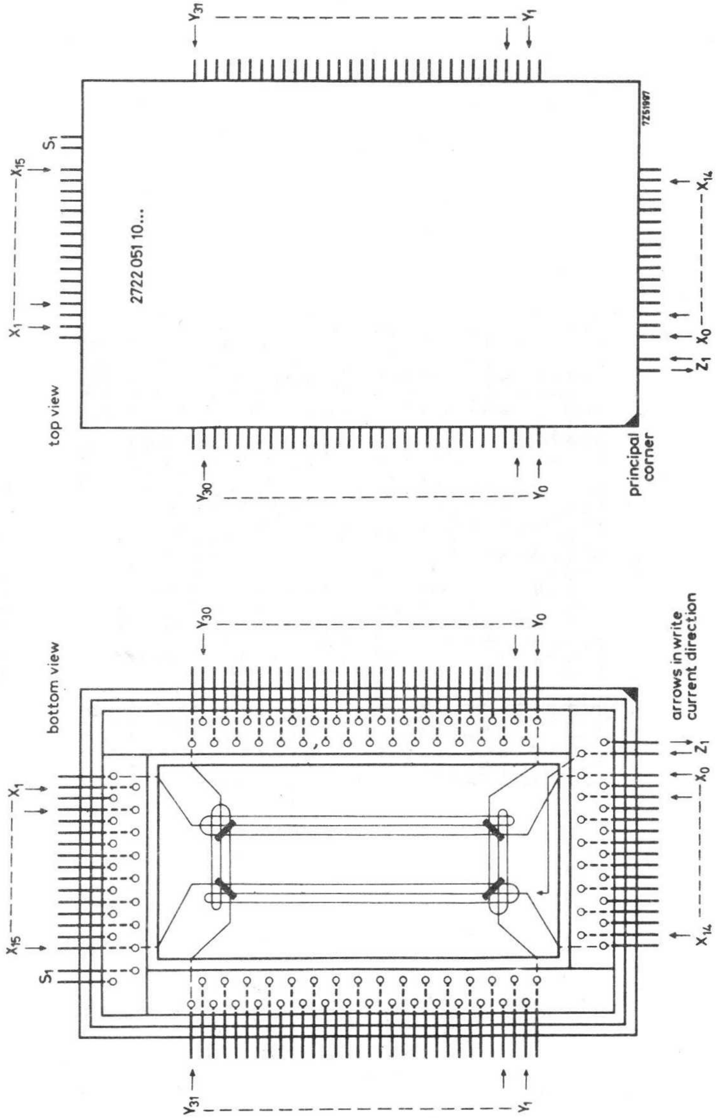
Platrix 4 x 4 x 16

4 x 4 x 16

Component side.

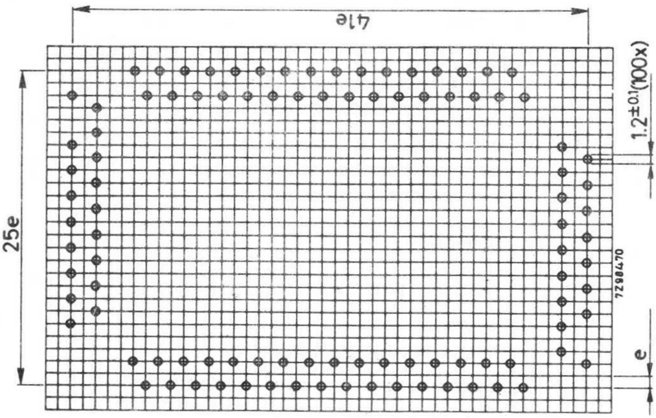


Hole pattern for Platrix 4 x 4 x 16
e = 2.50 or 2.54 mm



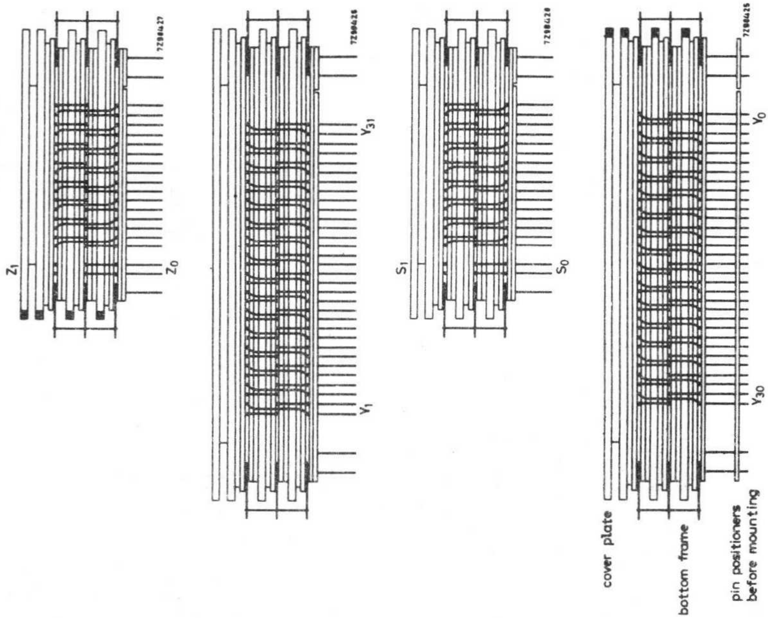
Platrix 16 x 32

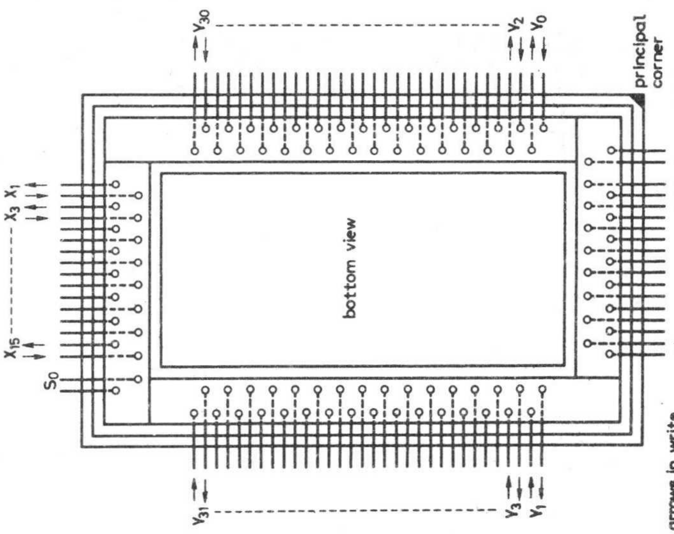
16 x 32



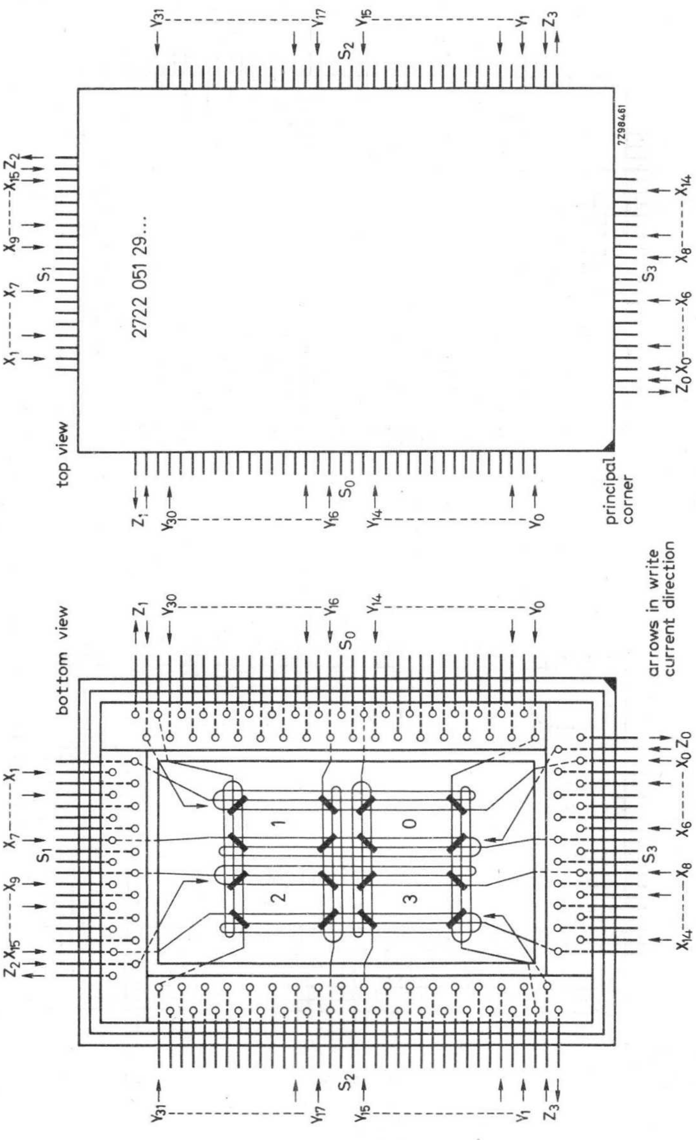
Component side.

Hole pattern for Platrix 16 x 32
e = 2.50 or 2.54 mm



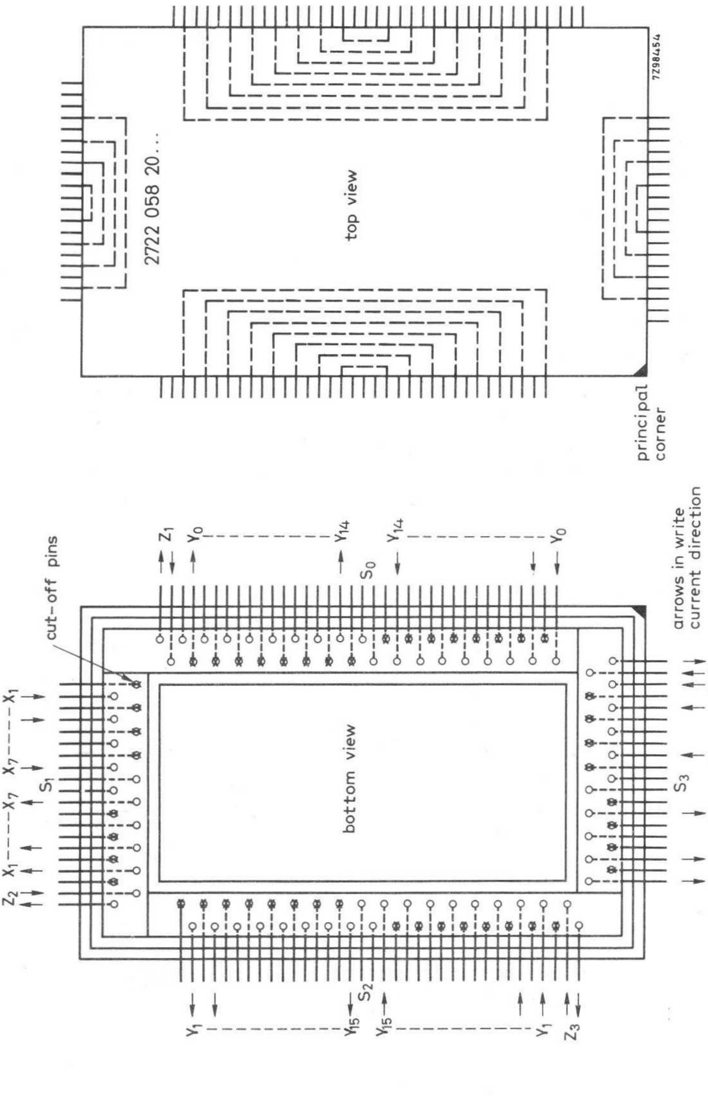


Stack of two Platrices 16 x 32. The hole pattern is identical to that of Platrix 16 x 32 except superfluous holes for cut-off pins.

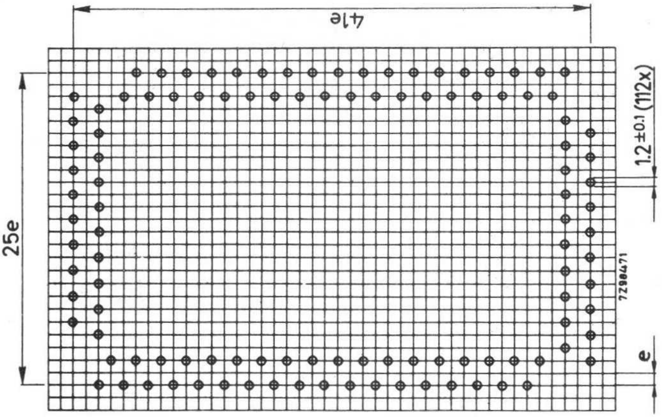


Platrix 4 x 8 x 16

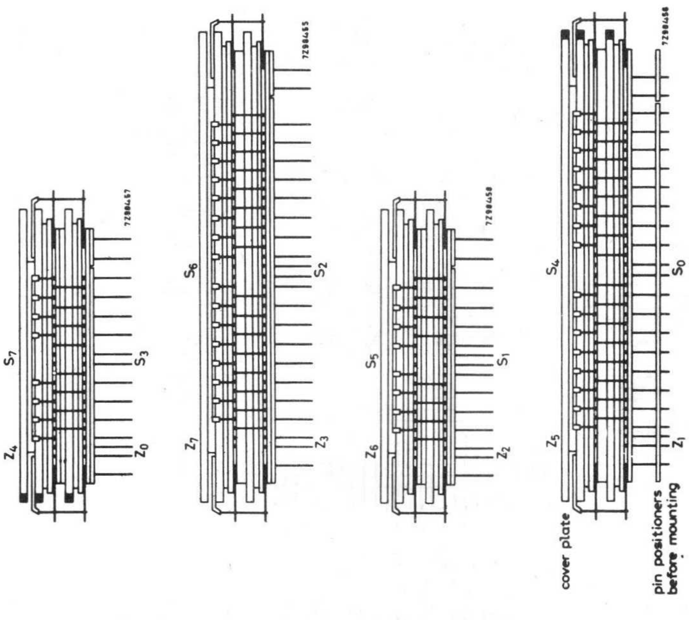
4 x 8 x 16



Stack of two Platrices 4 x 8 x 16. For side views see below. The hole pattern is identical to that of Platrix 4 x 8 x 16 except superfluous holes for cut-off pins.

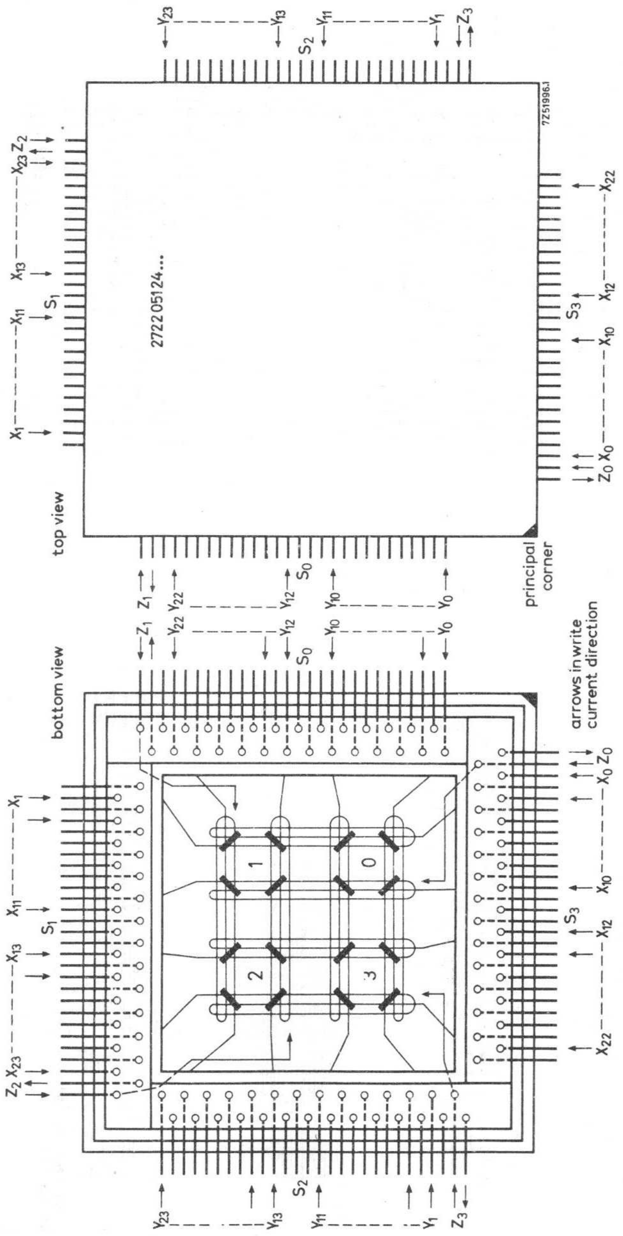


Hole pattern for Platrix 4 x 8 x 16
e = 2.50 or 2.54 mm
Component side.



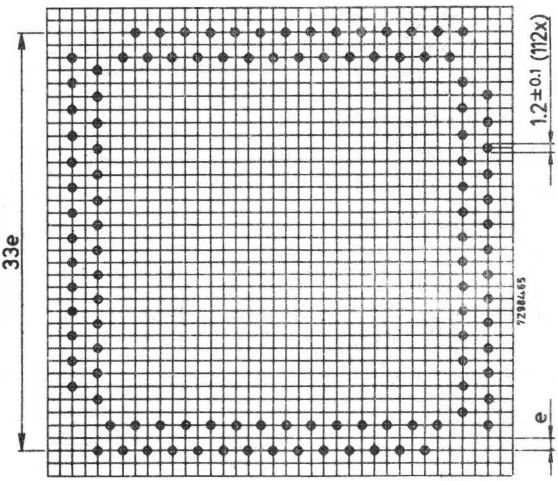
Stack of two Platrices 4 x 8 x 16, side views

4 x 12 x 12

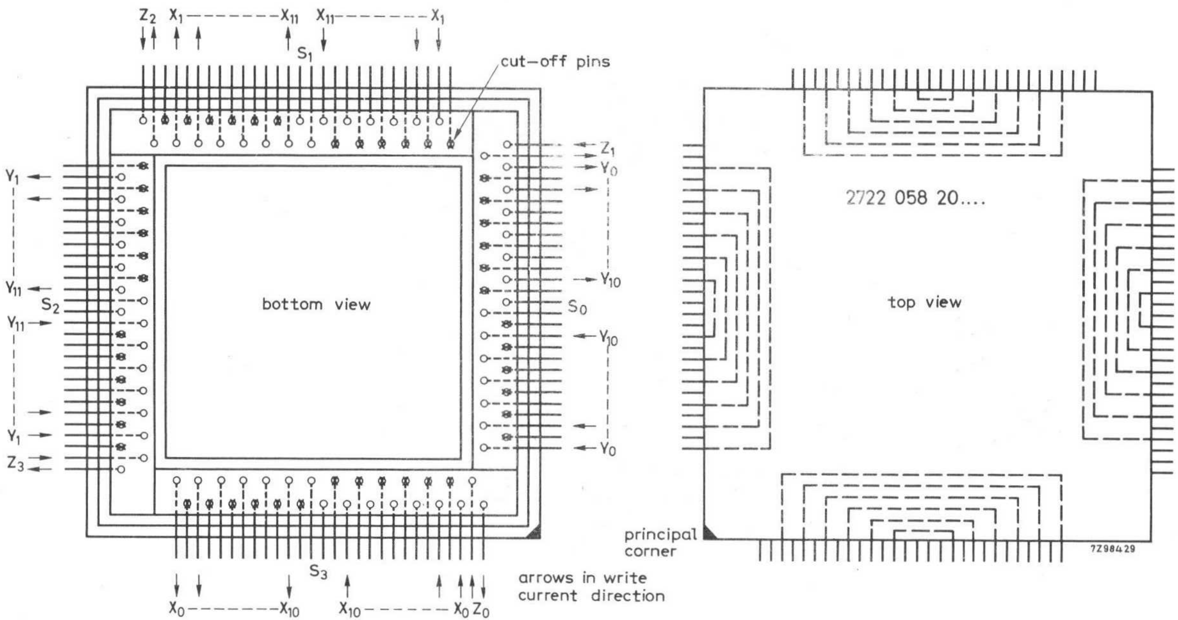


Platrix 4 x 12 x 12

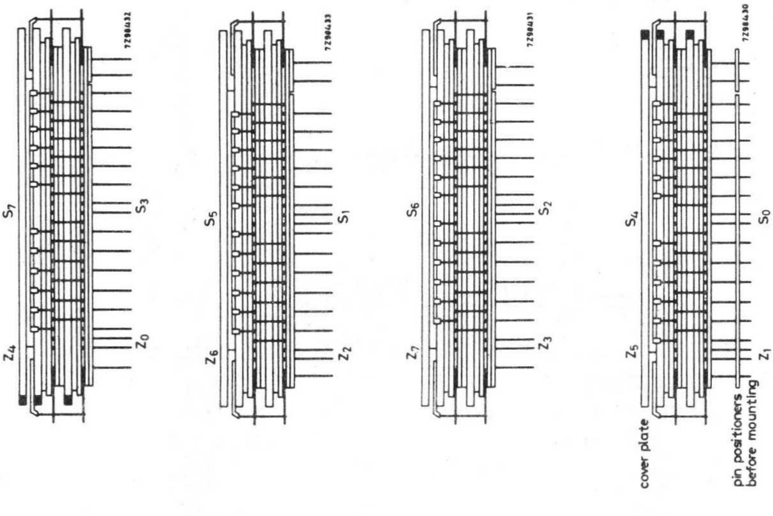
Component side.



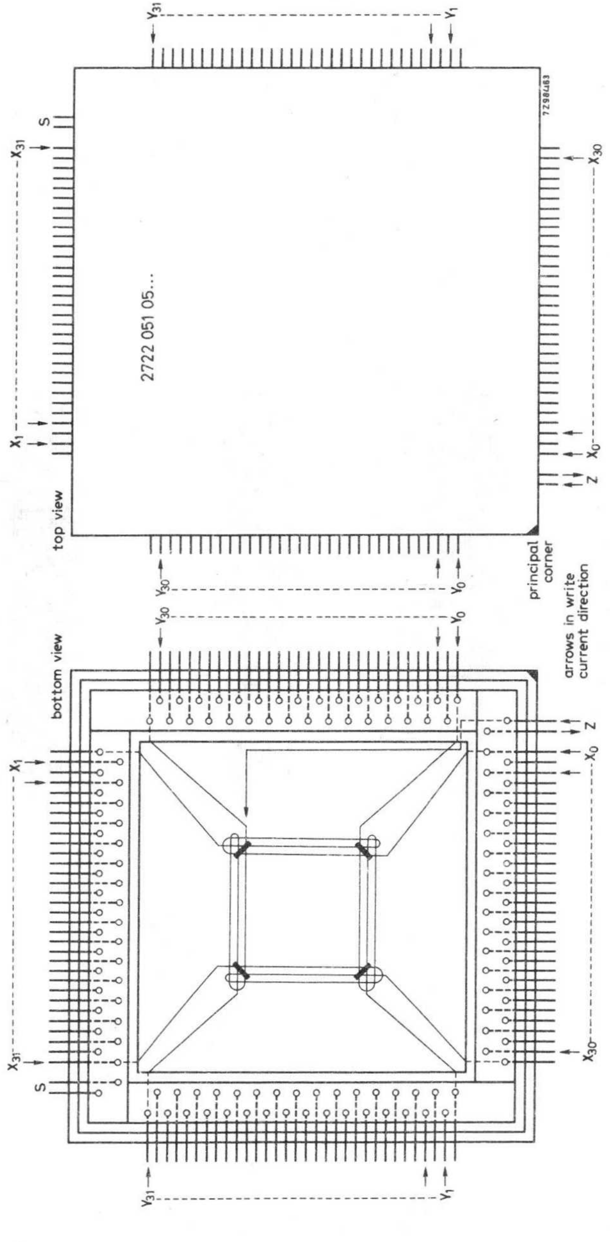
Hole pattern for Platrix 4 x 12 x 12
e = 2.50 or 2.54 mm



Stack of two Platrices 4 x 12 x 12. For side views see below. The hole pattern is identical to that of Platrix 4 x 12 x 12 except superfluous holes for cut-off pins.



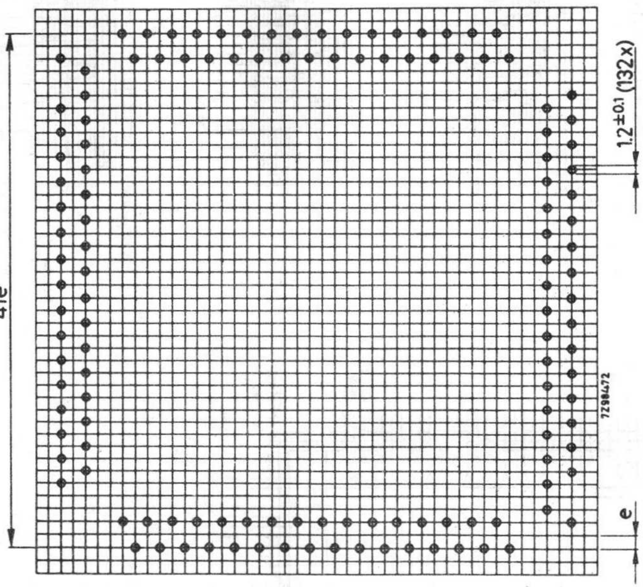
Stack of two Platrices 4 x 12 x 12, side views



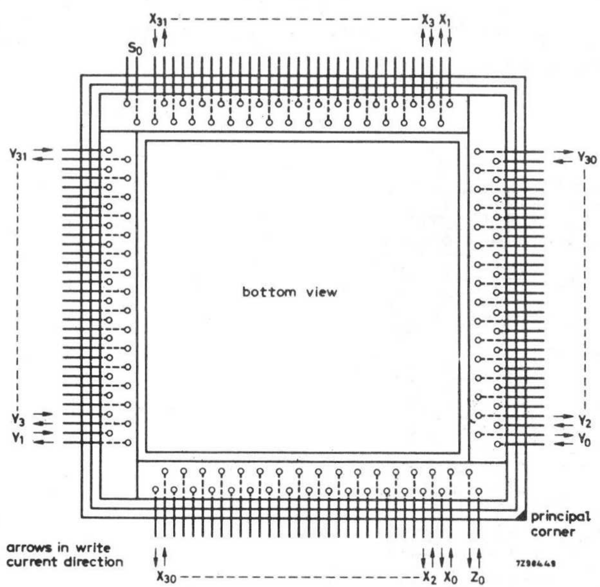
Platrix 32 x 32

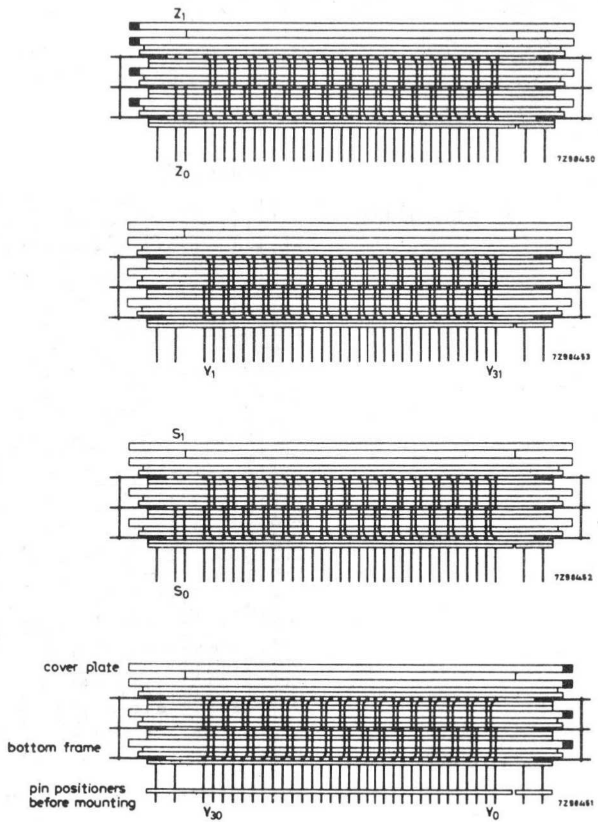
32 x 32

Component side.

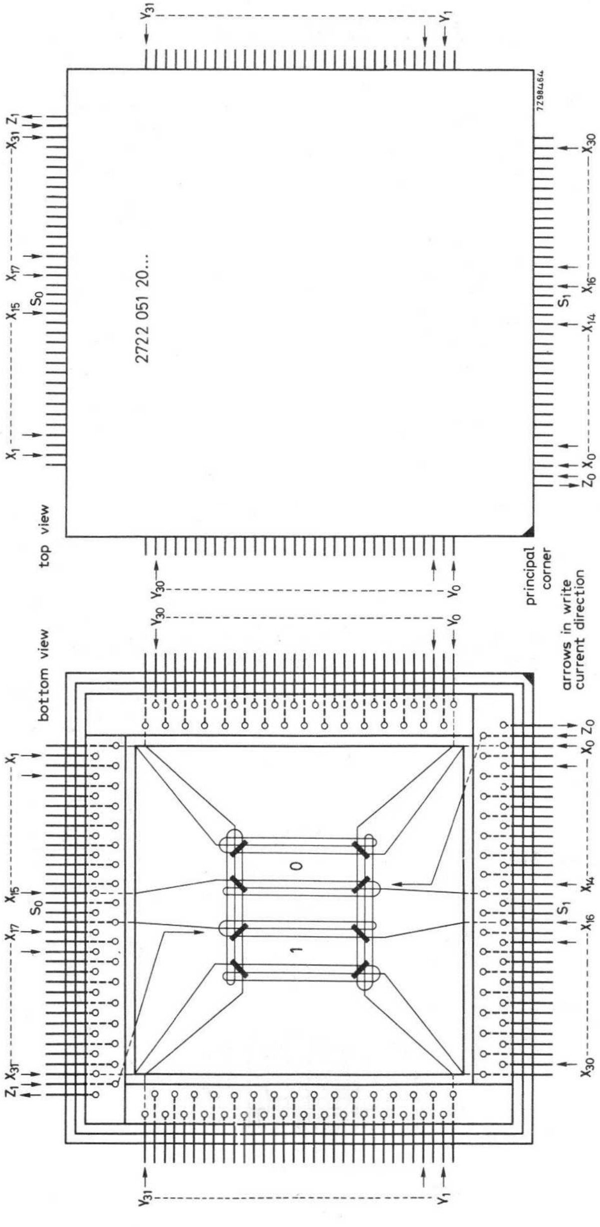


Hole pattern for Platrix 32 x 32
e = 2.50 or 2.54 mm



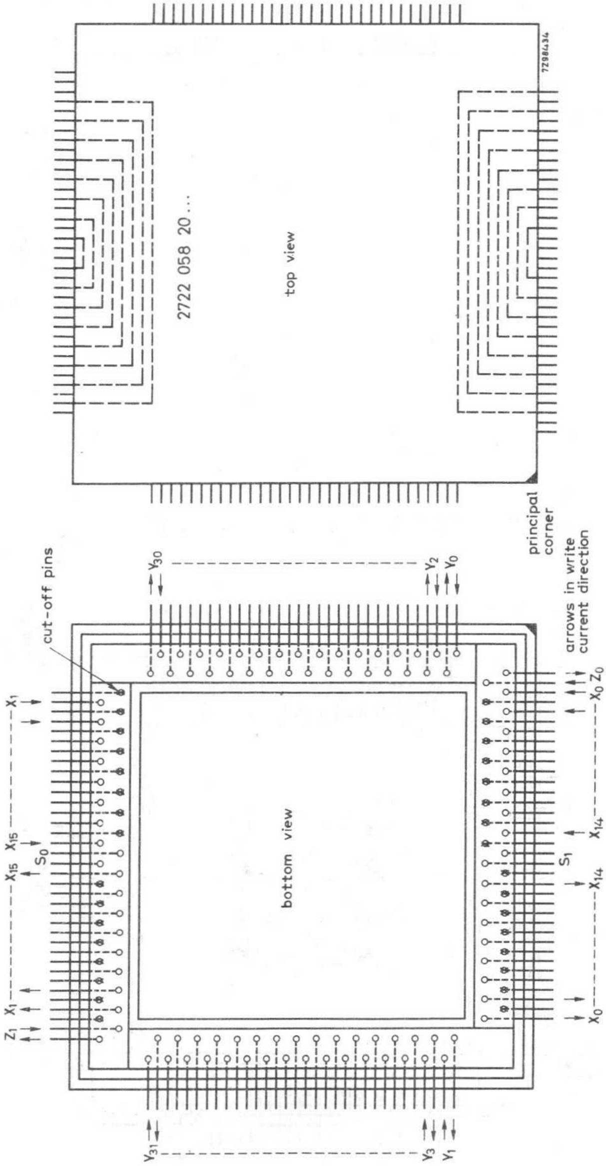


Stack of two Platrices 32 x 32. The hole pattern is identical to that of Platrix 32 x 32 except superfluous holes for cut-off pins.

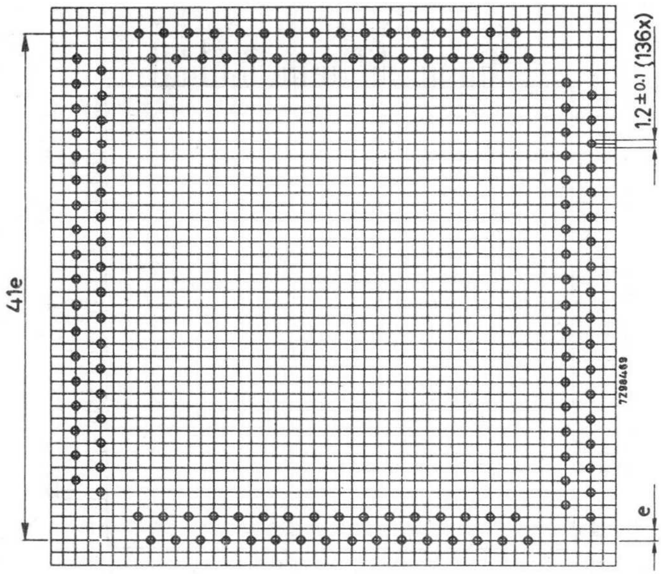


Platrix 2 x 16 x 32

2 x 16 x 32

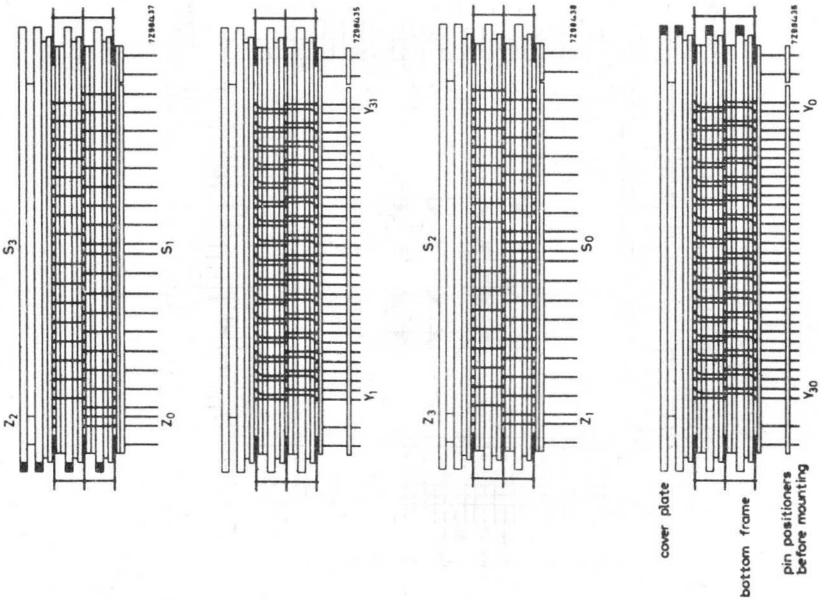


Stack of two Platrices 2 x 16 x 32. For side views see below. The hole pattern is identical to that of Platrix 2 x 16 x 32 except superfluous holes for cut-off pins.

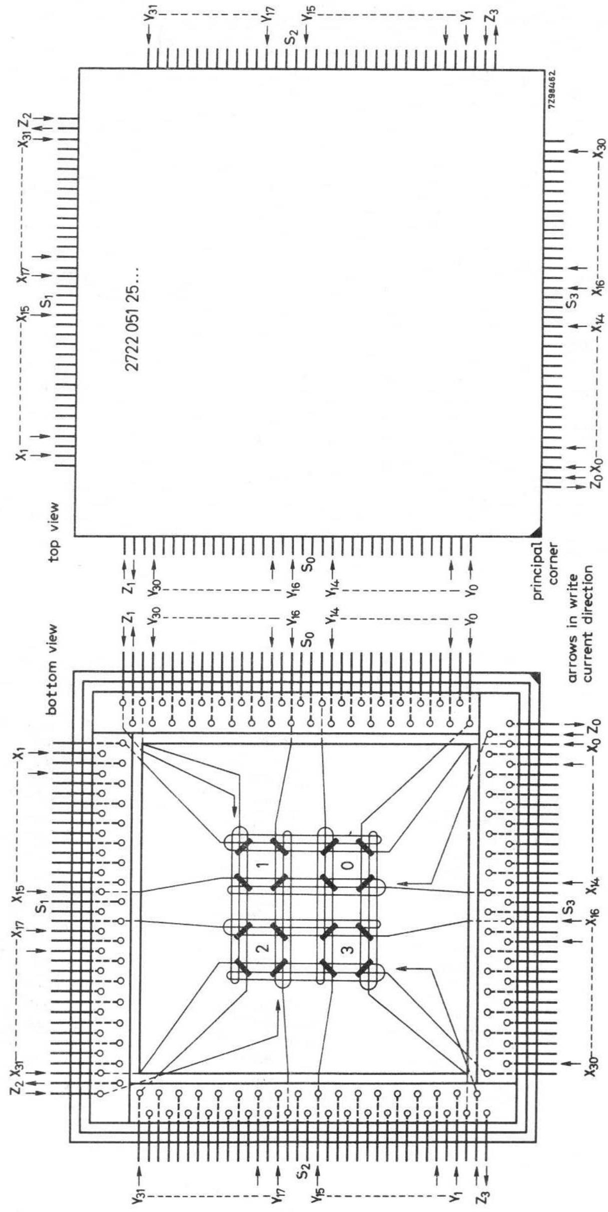


Component side.

Hole pattern for Platrix 2 x 16 x 32
e = 2.50 or 2.54 mm



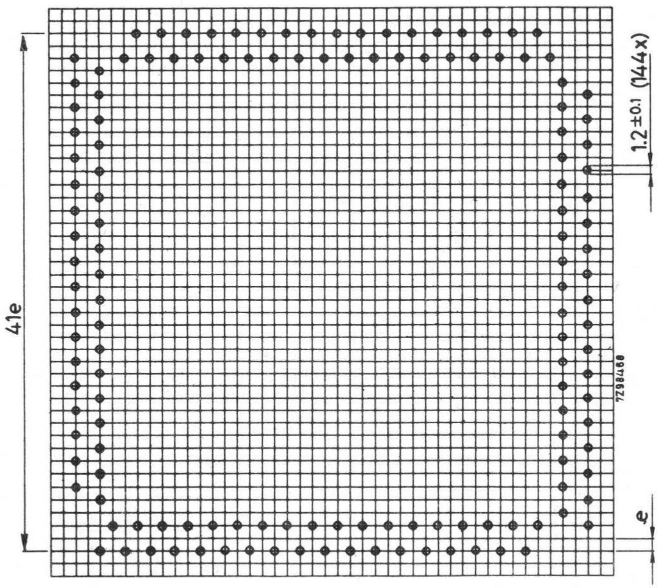
Stack of two Platrices 2 x 16 x 32, side views



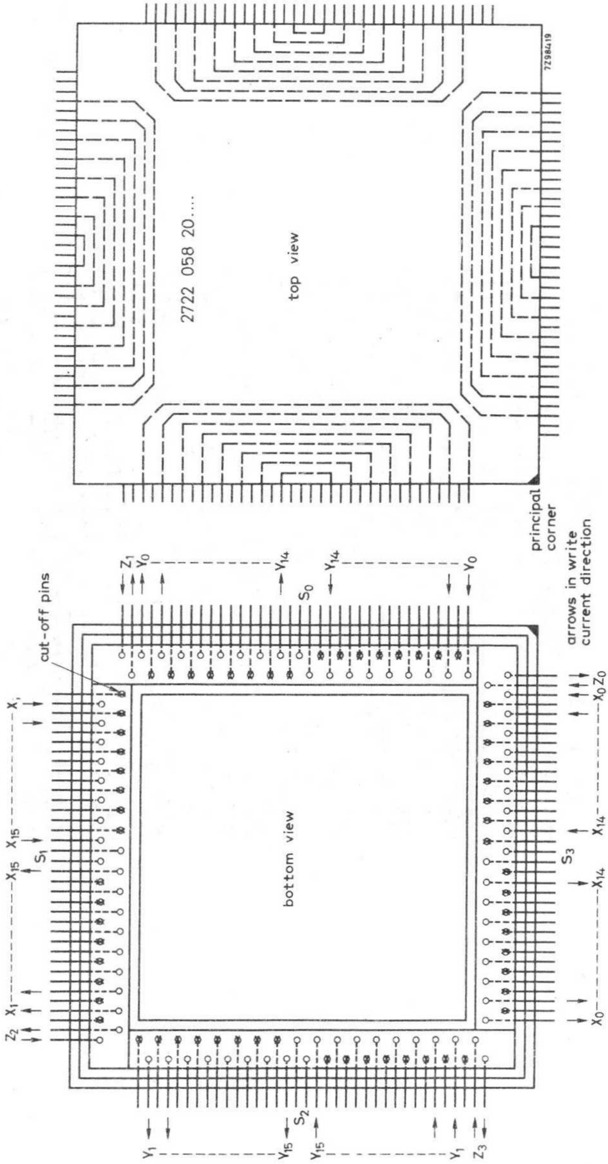
Platrix 4 x 16 x 16

4 x 16 x 16

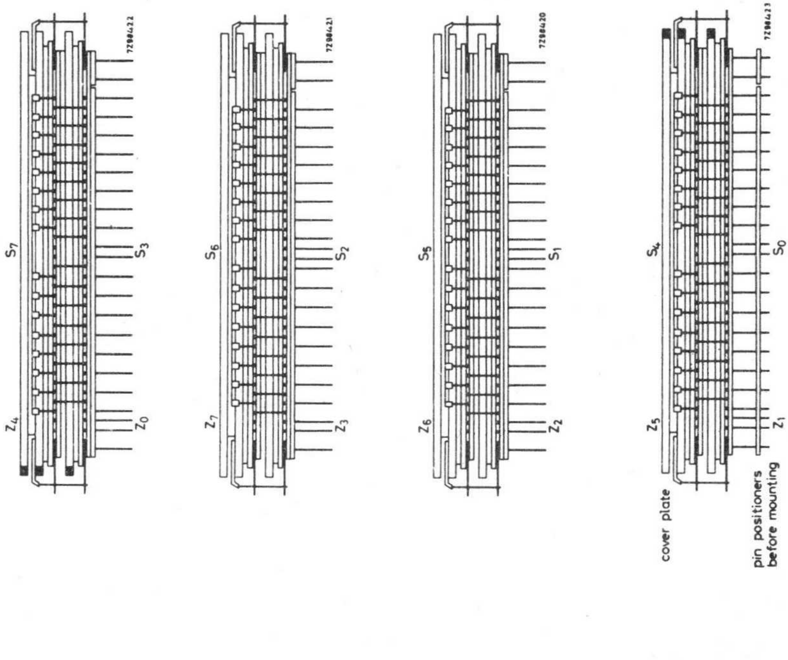
Component side.



Hole pattern for Platrix 4 x 16 x 16
e = 2.50 or 2.54 mm



Stack of two Platrices 4 x 16 x 16. For side views see below. The hole pattern identical to that of Platrix 4 x 16 x 16 except superfluous holes for cut-off pins.



Stack of two Platrices 4 x 16 x 16, side views

MATRIX PLANES AND STACKS
WITH 30mil CORES

MATRIX PLANES

Description

The frame construction is similar to that of the matrix planes with 50 mil cores. The frames are made of glass-epoxy strips of 1.6 mm x 9.5 mm, the pitch of the grooves is 0.76 mm. The diameter of the X, Y and S wires is 0.08 mm: the inhibit wire has a diameter of 0.1 mm to minimize the dissipation in the matrix.

All the matrices of the 30 mil standard range are lacquered, to reduce the magnetostriction caused by the steep leading edge of the inhibit pulse and to improve the mechanical properties.

To obtain a very low noise level a new way of sense wiring, which differs from the normal M.I.T., has been applied. Consequently the worst-case patterns differ from those of the 50 mil type. Moreover, the "open" core configuration has been applied.

Each type of matrix plane has two versions, a left-hand and a right-hand plane.

Matrix planes with 128 x 128 cores are provided with 4 inhibit wires and 4 sense wires. The cores are laid out in 4 areas but, unlike with 4 x 64 x 64 planes, the inhibit wires are distributed over four parallel parts of the plane.
Since the bits are stored per plane only one at a time, the sense wires could be interlaced (2 wires per 2 diagonal mats). In this way the number of cores which contribute to the delta noise is halved, reducing the delta noise signal by a factor 2. Consequently a better "one" and "zero" discrimination has been realized.

The planes 64 x 128 also have interlaced sense wires. To keep the influence between the inhibit and the sense wires as small as possible, each inhibit wire has been coupled with one sense wire over 2048 cores only. Moreover, the connections of sense and inhibit wires are kept far apart.

Standard range (30 mil pitch of grooves)

A number of types have been standardized on core pattern, type of core and construction.

Catalog number, for ordering, 2722 044 .....
suffix see table

Preferred types are underlined.

core pattern	wiring X Y Z S	core type 2)	lacquered left suffix	lacquered right suffix	dimensions in mm Figs.1 and 2 A x B	C x D
4 x 32 x 32	1 1 4 4	6F8 6F3	26061 26081	26071 26091	89.3 x 89.3	69.3 x 69.3
2 x 32 x 64	1 1 2 2	6F8 6F3	21061 21081	21071 21091	85.5 x 89.3	65.5 x 69.3
<u>64 x 64</u>	1 1 1 1	6F8 6F3	06061 06081	06071 06091	85.5 x 85.5	65.5 x 65.5
<u>4 x 64 x 64</u>	1 1 4 4	6F8 6F3	27061 27081	27071 27091	138.3 x 138.3	118.1 x 118.1
64 x 128 1)	1 1 2 2	6F8 6F3	36061 36081	36071 36091	85.5 x 139.5	65.5 x 118.8
<u>2 x 64 x 128</u> 1)	1 1 4 4	6F8 6F3	35061 35081	35071 35091	138.3 x 139	118.1 x 118.8
<u>128 x 128</u> 1)	1 1 4 4	6F8 6F3	08061 08081	08071 08091	139 x 139	118.8 x 118.8

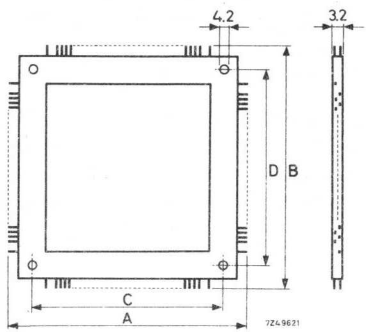


Fig.1. Dimensions in mm

1) Matrices with interlaced sense wiring.

2) The 6F8 core is the successor type of the 6F2 core; the only difference is that the type 6F8 has closer tolerances for the guaranteed response values than the type 6F2.

Worst-case patterns

In order to test planes on the most unfavourable "1" and "0" outputs, the cores must be set in conformity to the relevant basic worst-case pattern indicated below.

Matrix plane 64 x 64

1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0

Matrix plane
64 x 128

1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0

Matrix planes
4 x 32 x 32
2 x 32 x 64
4 x 64 x 64
2 x 64 x 128
128 x 128

1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0

STACKS

For general information on stacking and stacks, see sections "Introduction" and "Ordering information", which precede the data sheets.

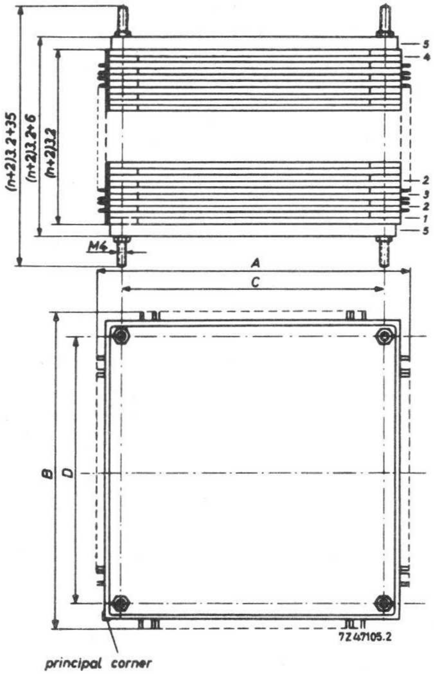


Fig. 2 Dimensions in mm

n = number of planes
For dimensions A to D see standard range table.

1 = termination plane
2 = left-hand matrix plane
3 = right-hand matrix plane
4 = termination plane or interconnection plane
5 = aluminium protection plate

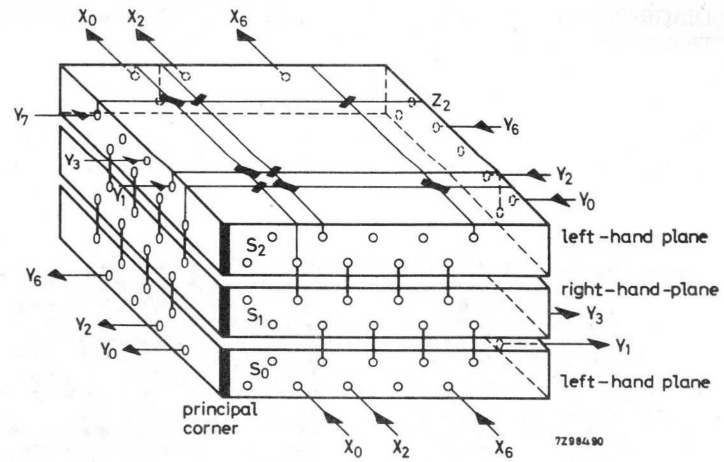
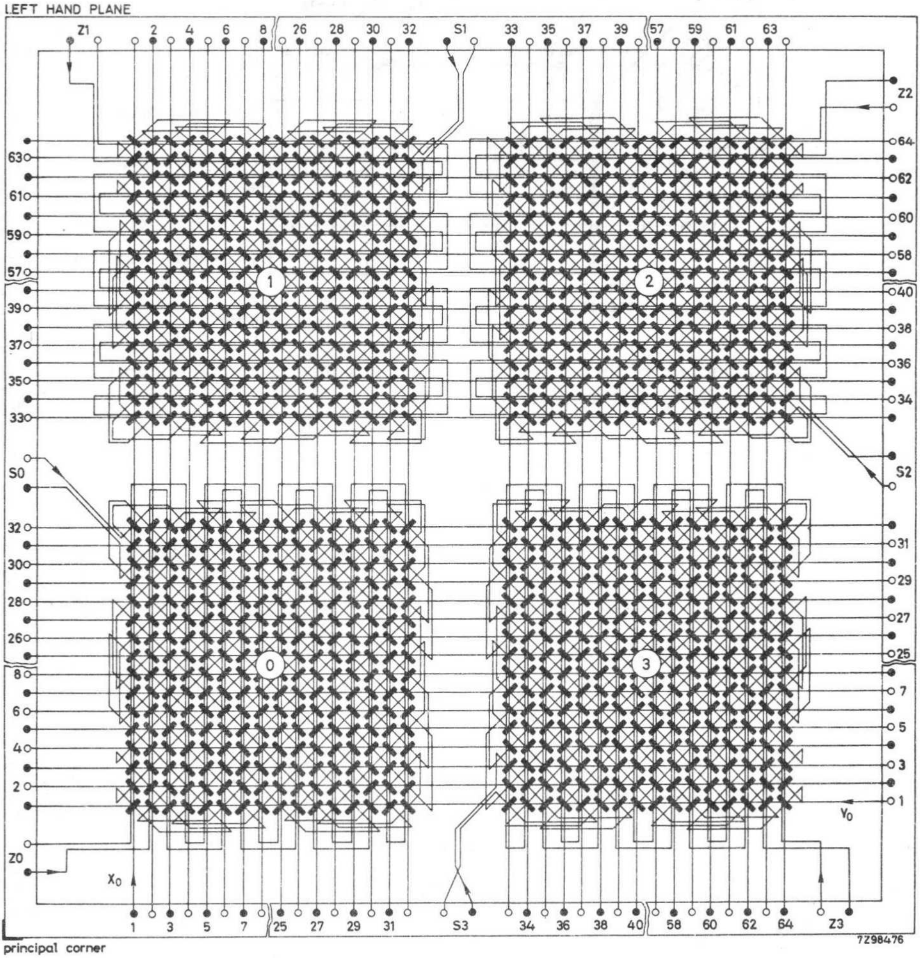


Fig.3 Principle of the connections to a stack having an odd number of single-matrix planes

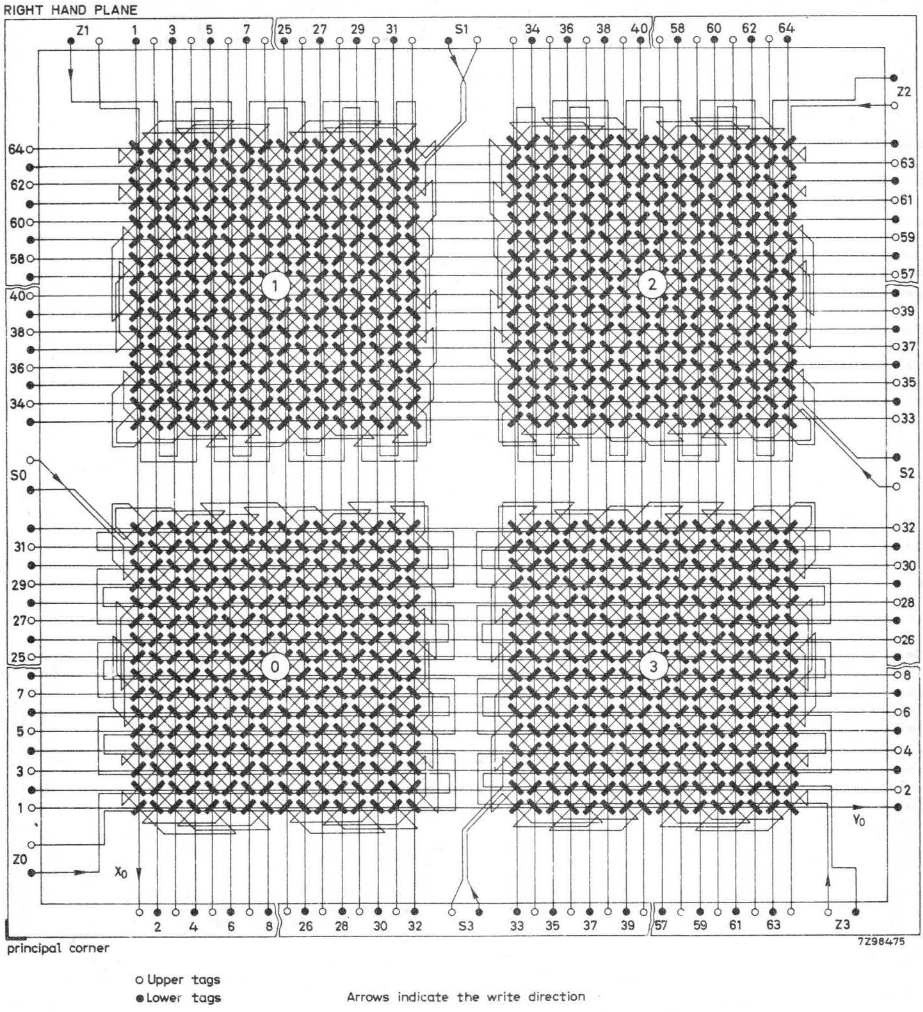
WIRING DIAGRAMS OF MATRIX PLANES AND INTERCONNECTION PLANES-CONNECTIONS TO STACKS



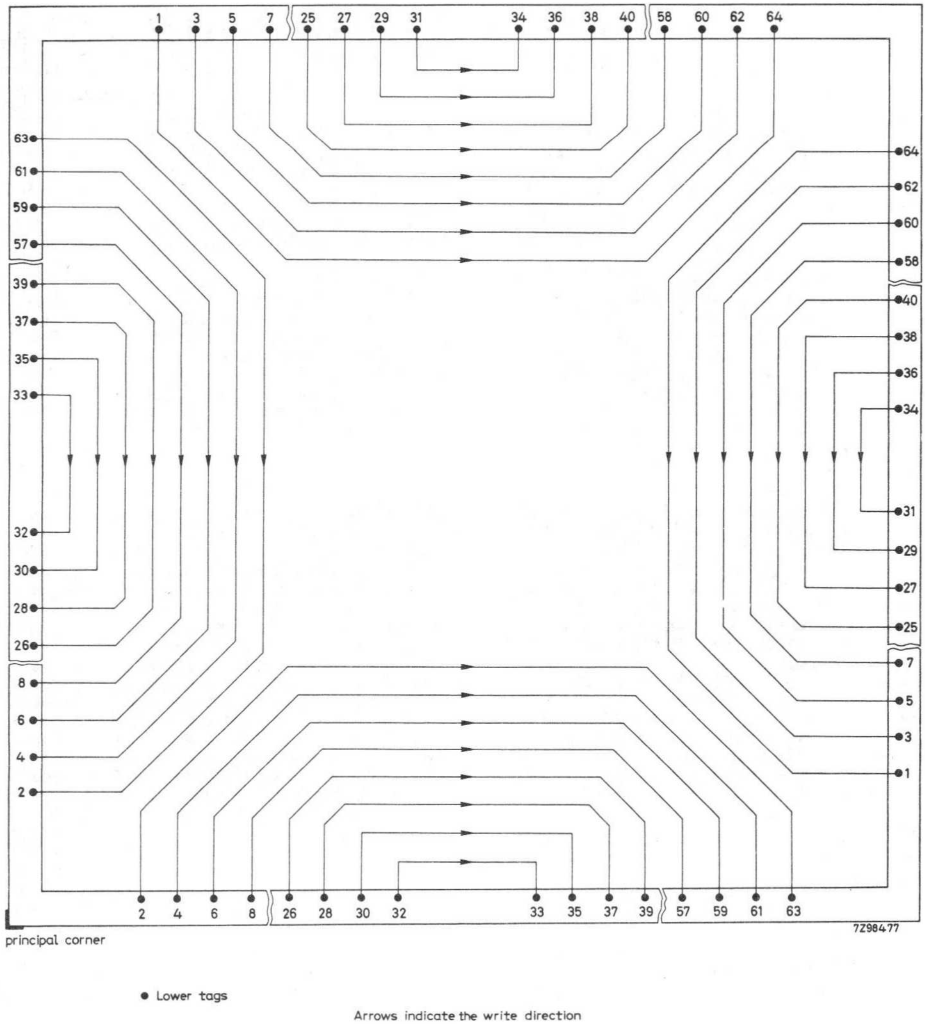
○ Upper tags
● Lower tags

Arrows indicate the write direction

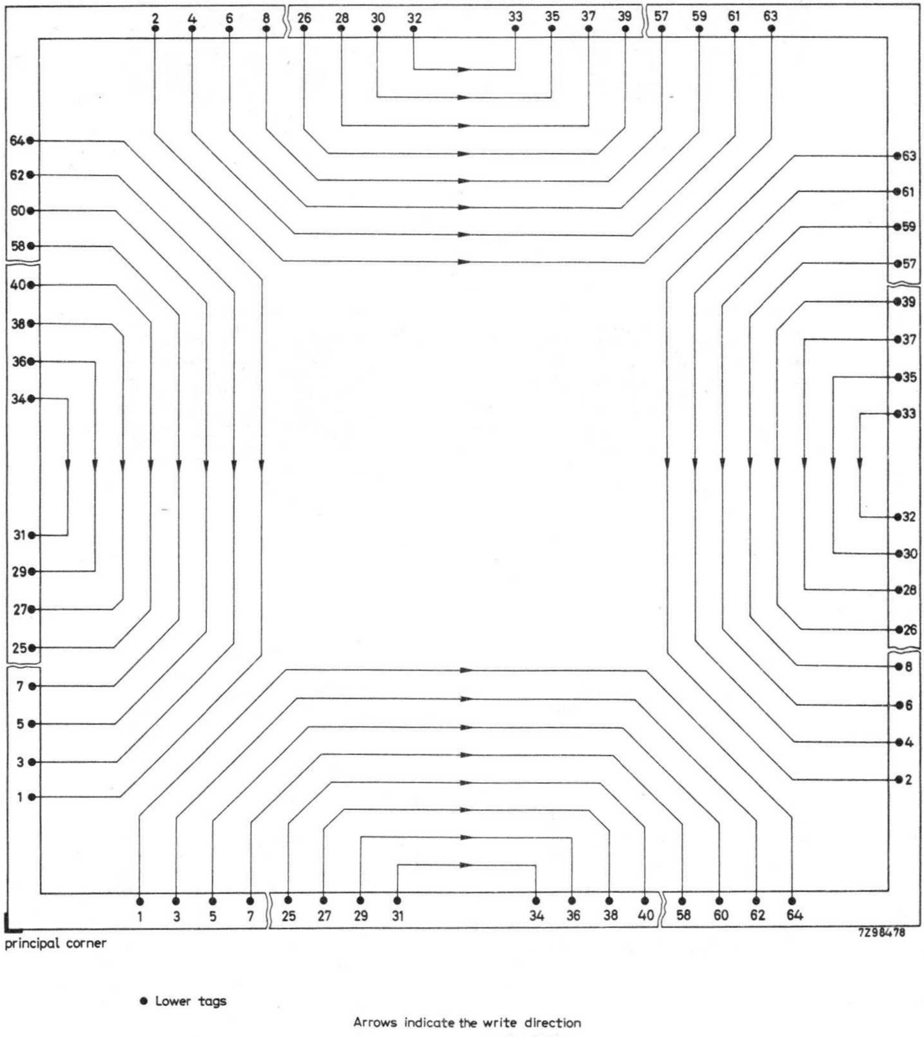
4 x 32 x 32 left-hand matrix plane



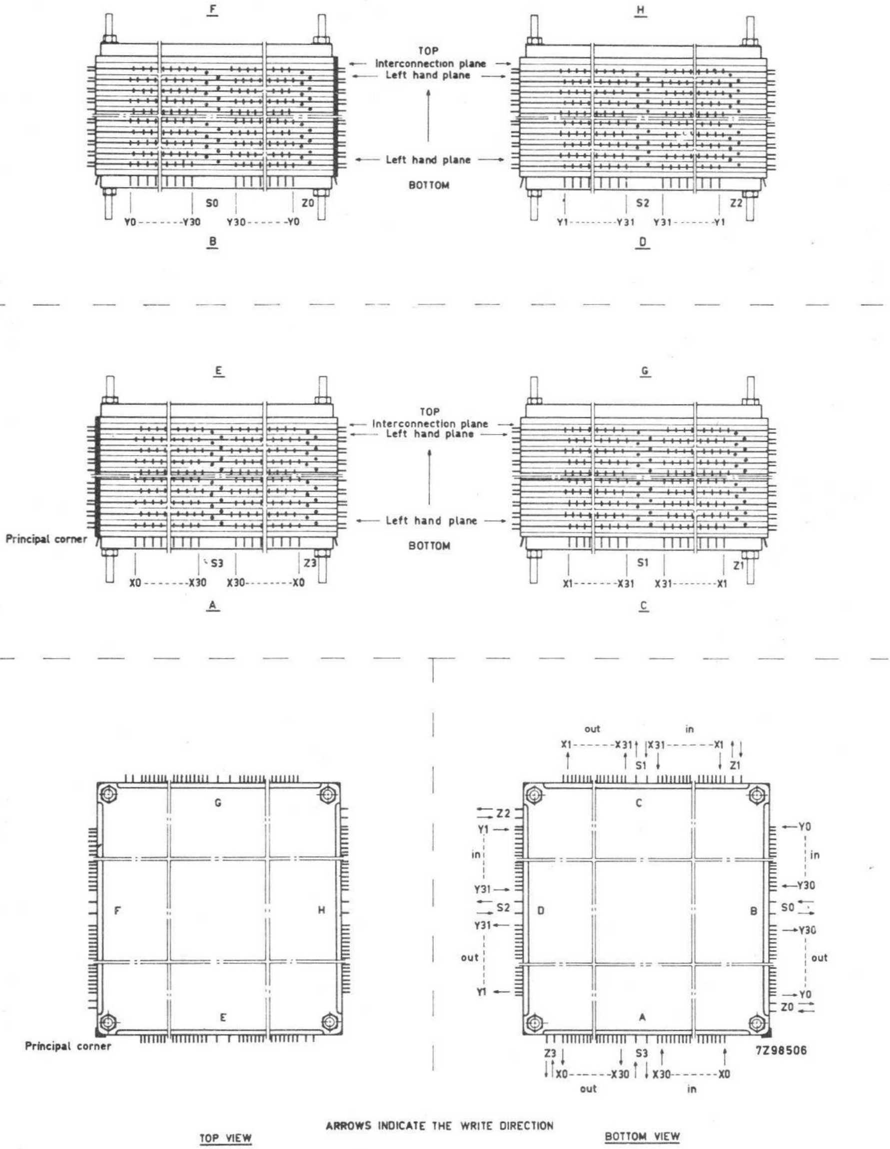
4 x 32 x 32 right-hand matrix plane



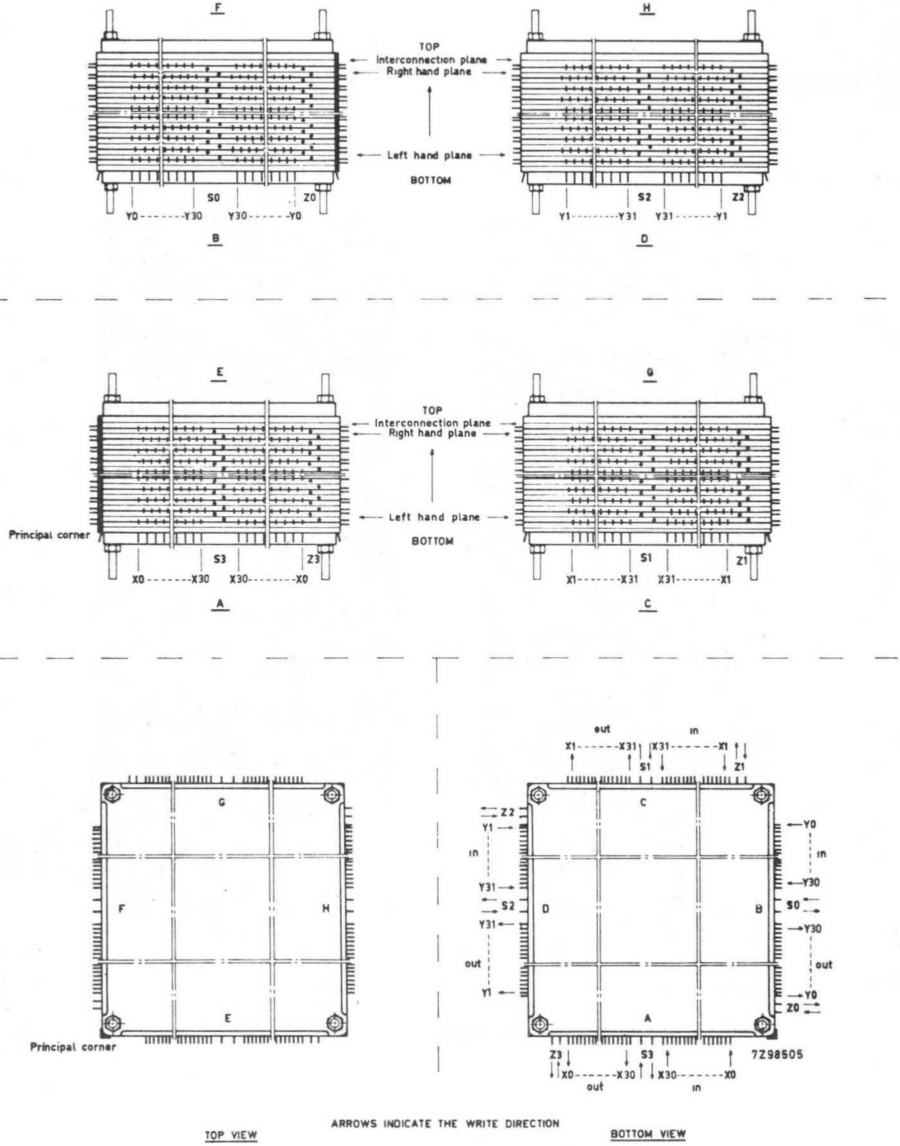
Interconnection plane for a stack with an odd
number of matrix planes 4 x 32 x 32



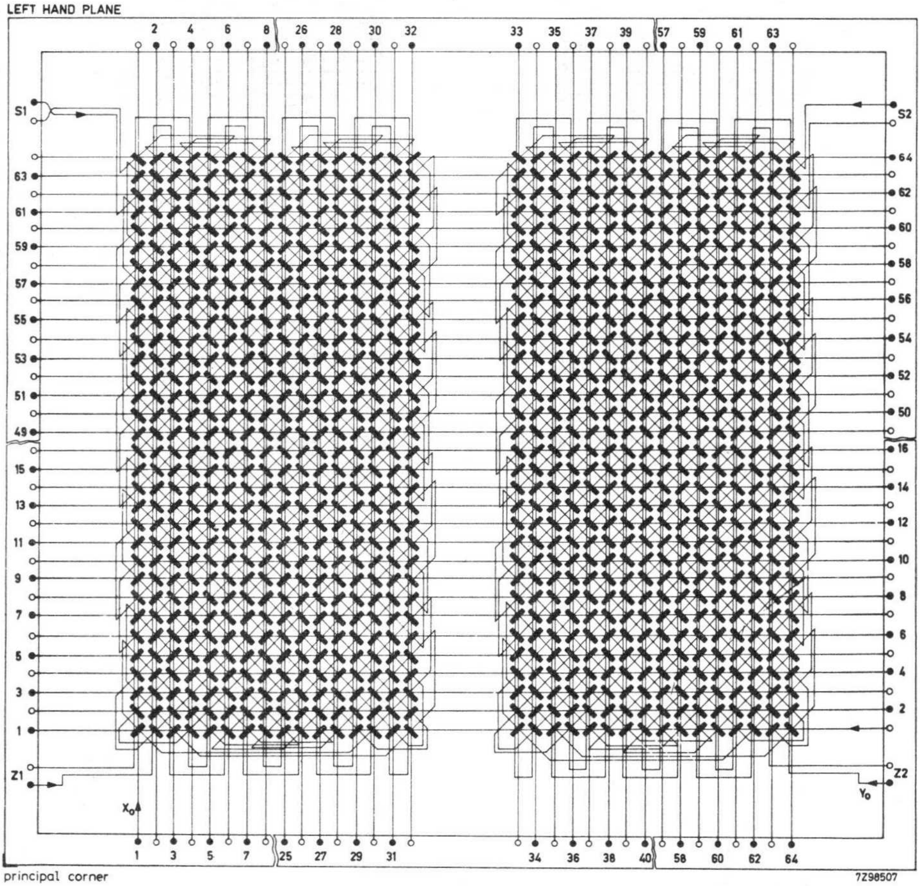
Interconnection plane for a stack with an even number of matrix planes 4 x 32 x 32



Stack with an odd number of matrix planes 4 x 32 x 32



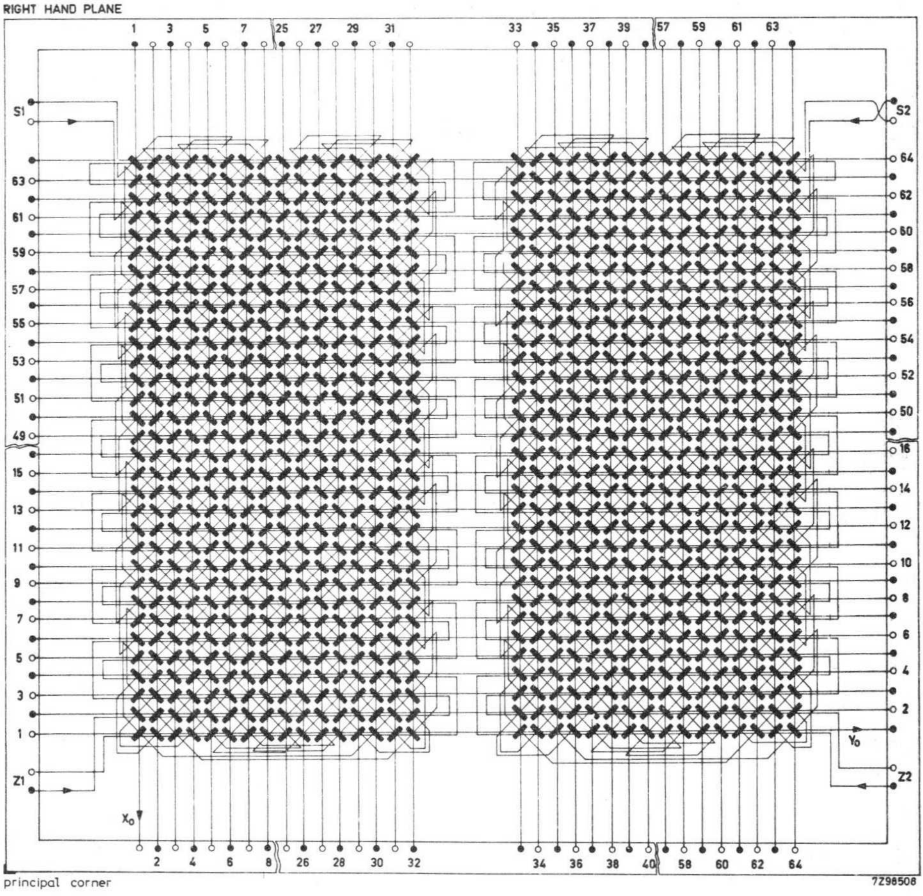
Stack with an even number of matrix planes 4 x 32 x 32



○ Upper tags
● Lower tags

Arrows indicate the write direction

2 x 32 x 64 left-hand matrix plane

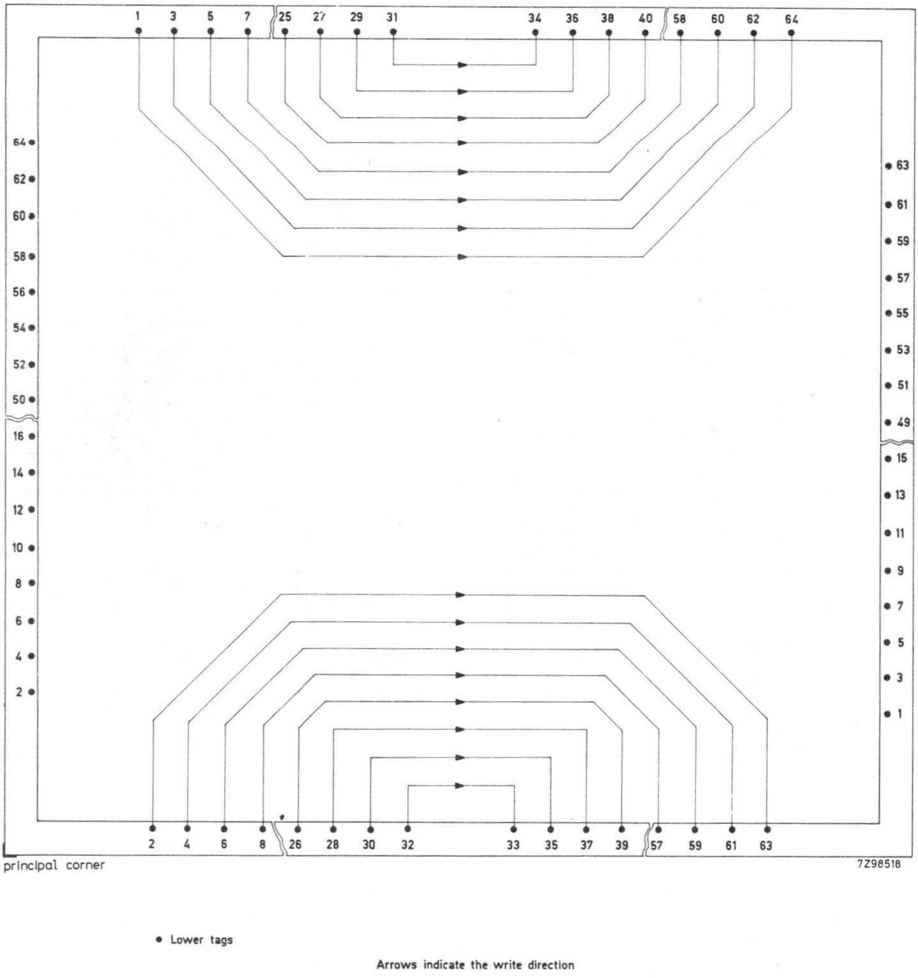


○ Upper tags

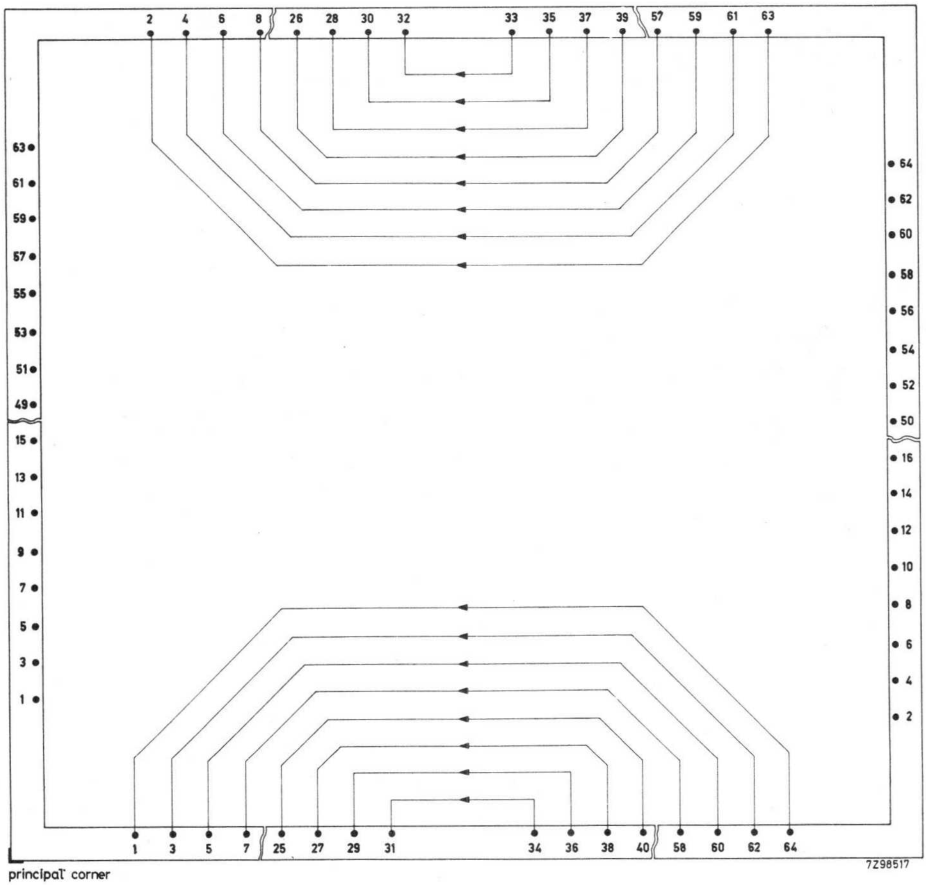
● Lower tags

Arrows indicate the write direction

2 x 32 x 64 right-hand matrix plane



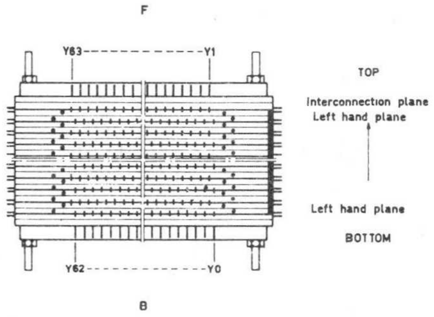
Interconnection plane for a stack with an odd
number of matrix planes 2 x 32 x 64

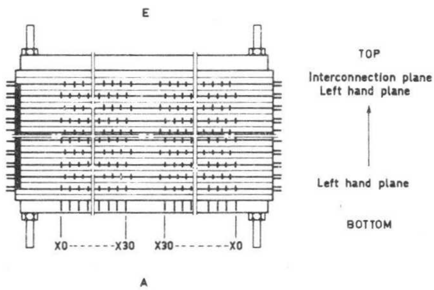


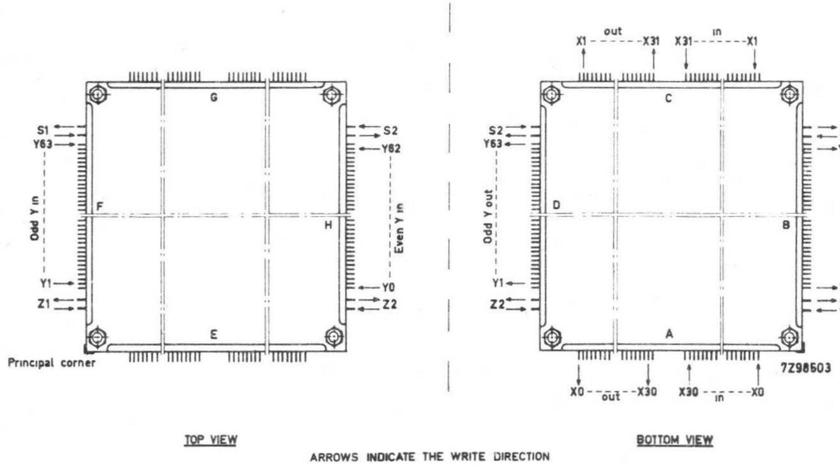
• Lower tags

Arrows indicate the write direction

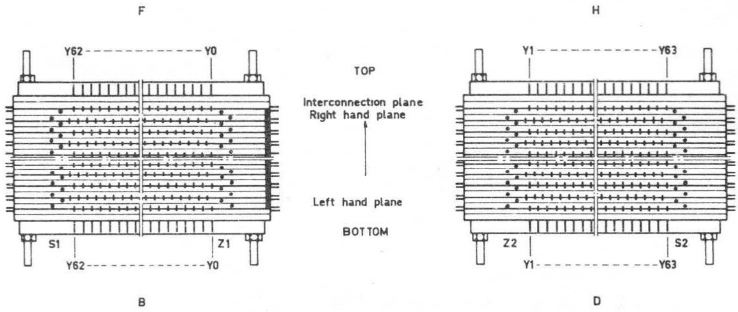
Interconnection plane for a stack with an even number of matrix planes 2 x 32 x 64

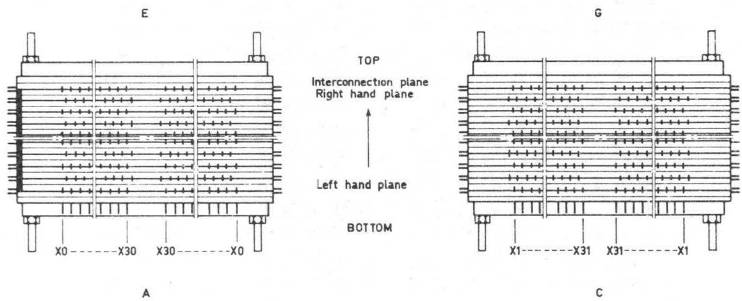


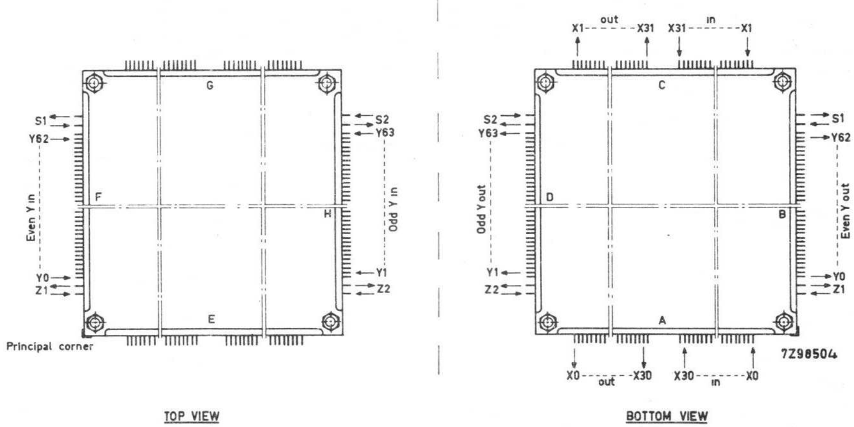




Stack with an odd number of matrix planes 2 x 32 x 64

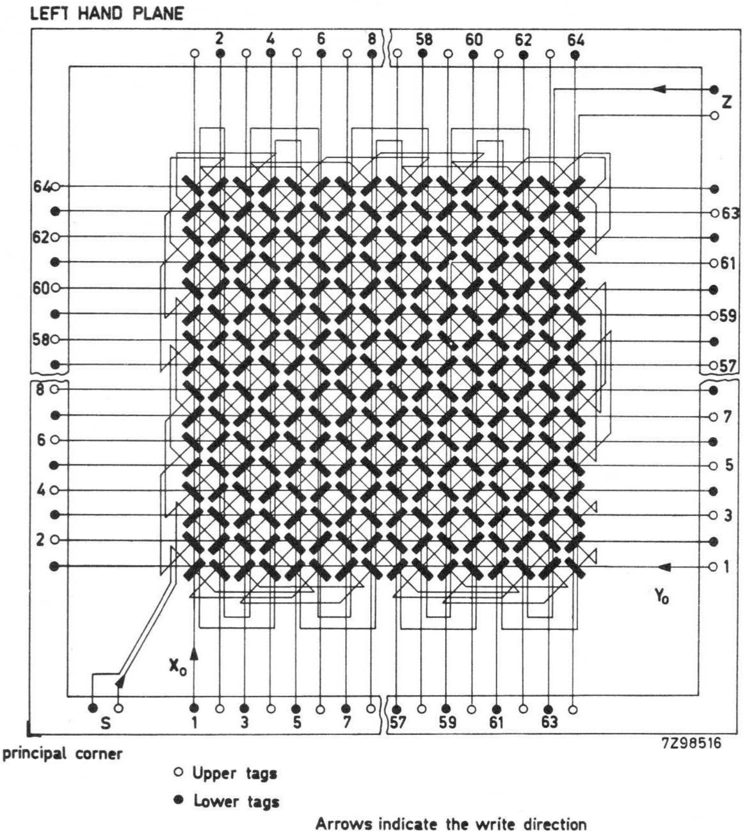






ARROWS INDICATE THE WRITE DIRECTION

Stack with an even number of matrix planes 2 x 32 x 64

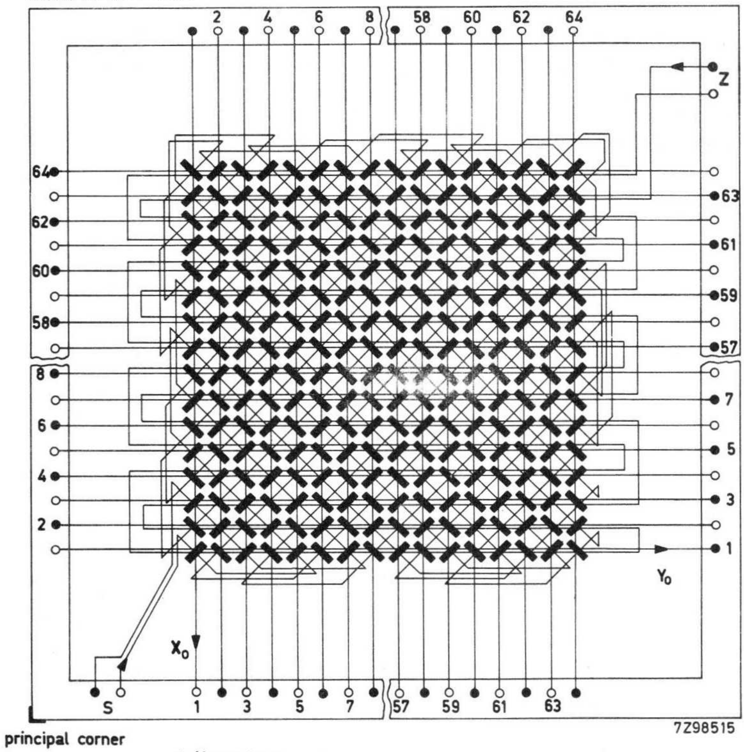


WORST PATTERN

1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0

64 x 64 left-hand matrix plane

RIGHT HAND PLANE



○ Upper tags

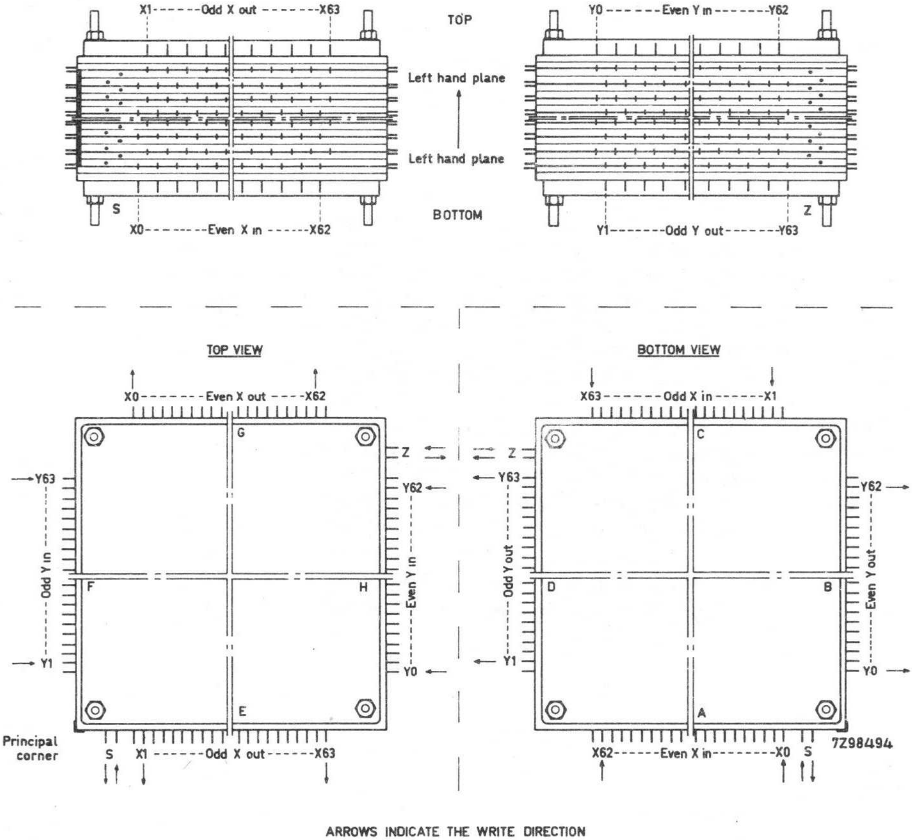
● Lower tags

Arrows indicate the write direction

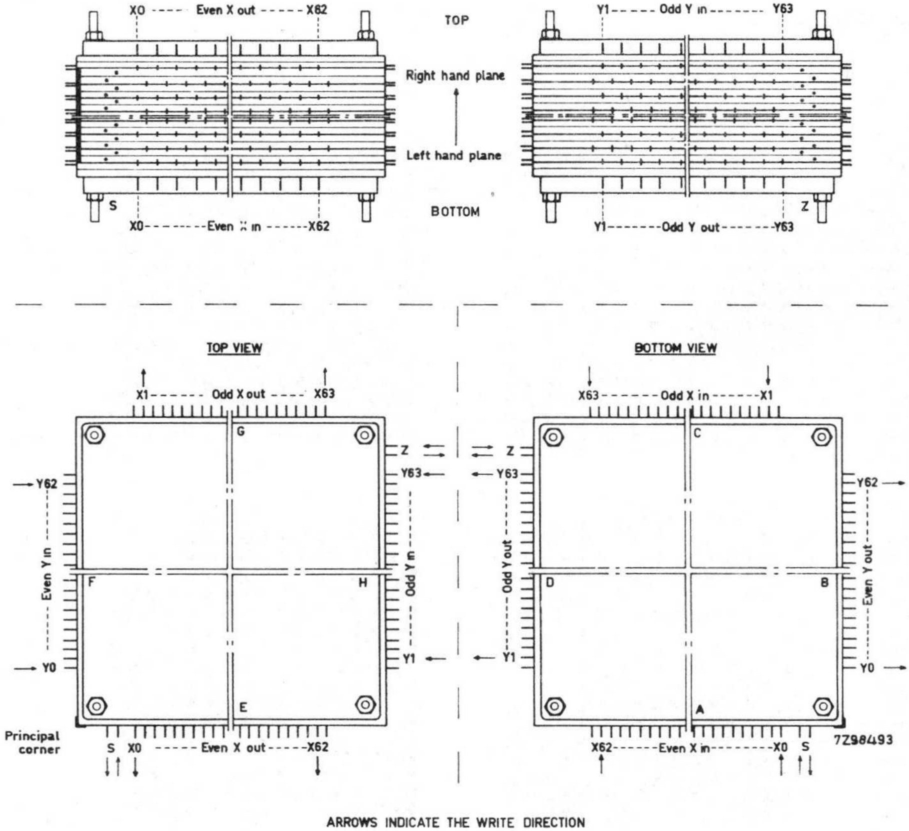
WORST PATTERN

1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0

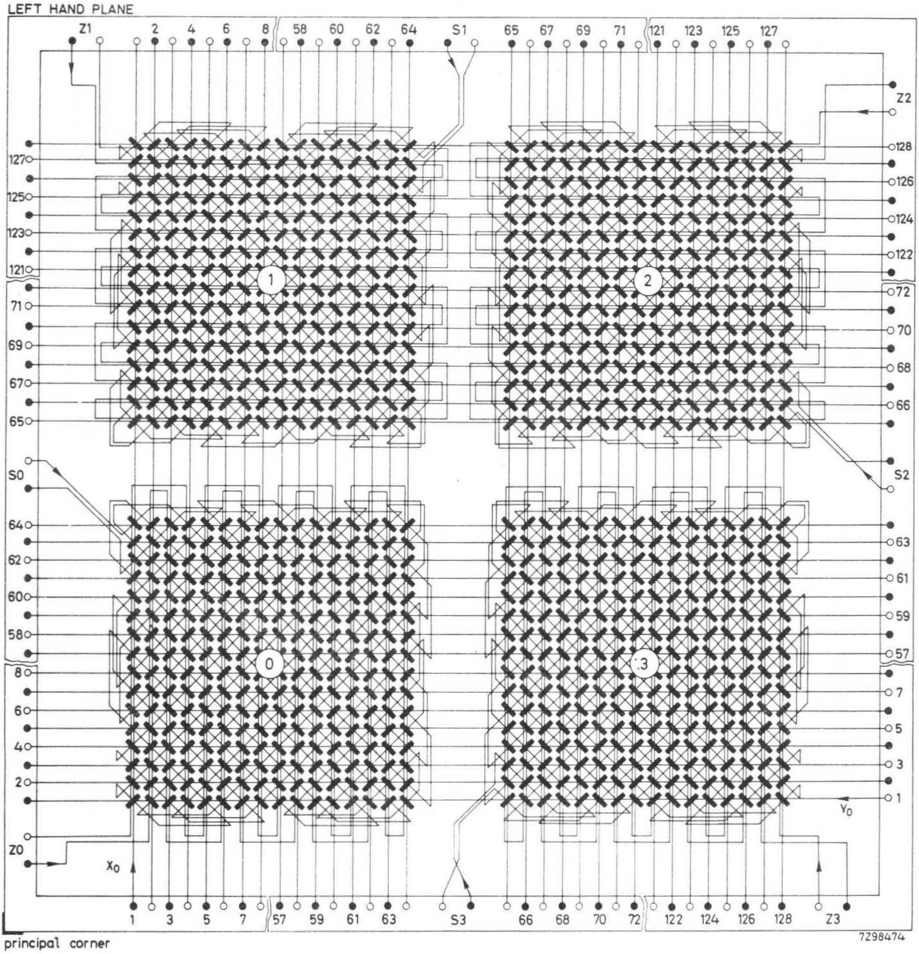
64 x 64 right-hand matrix plane



Stack with an odd number of matrix planes 64 x 64



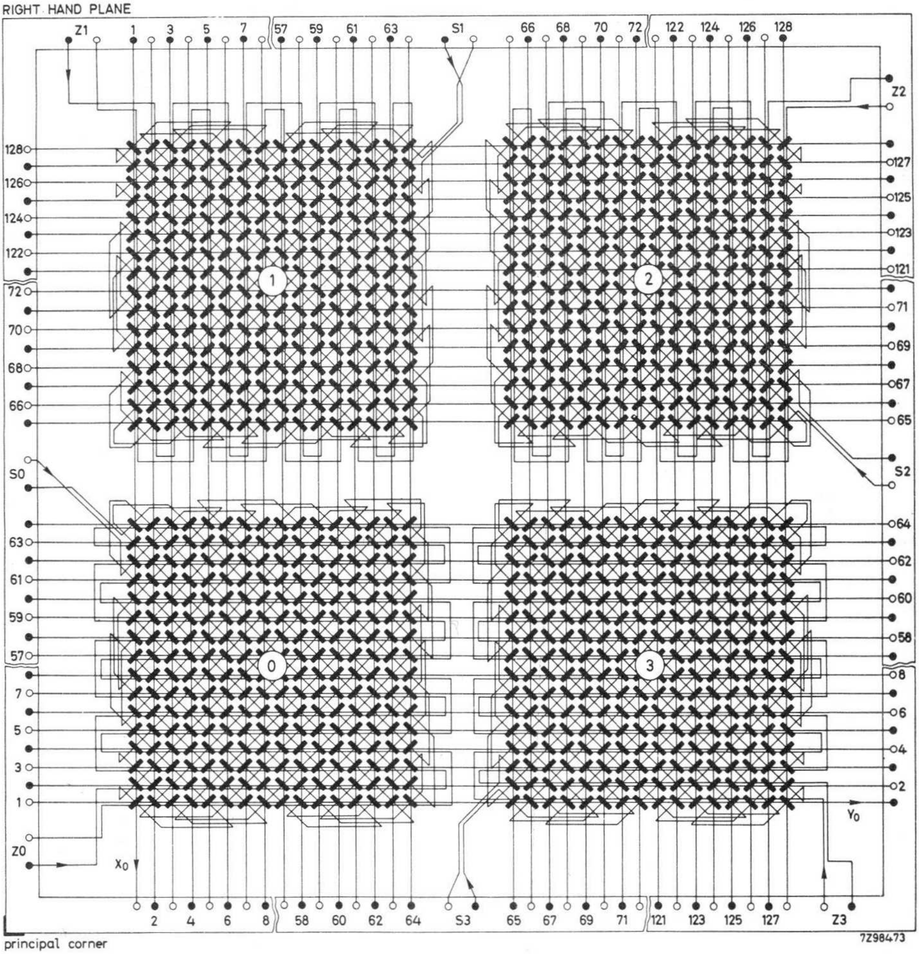
Stack with an even number of matrix planes 64 x 64



○ Upper tags
● Lower tags

Arrows indicate the write direction

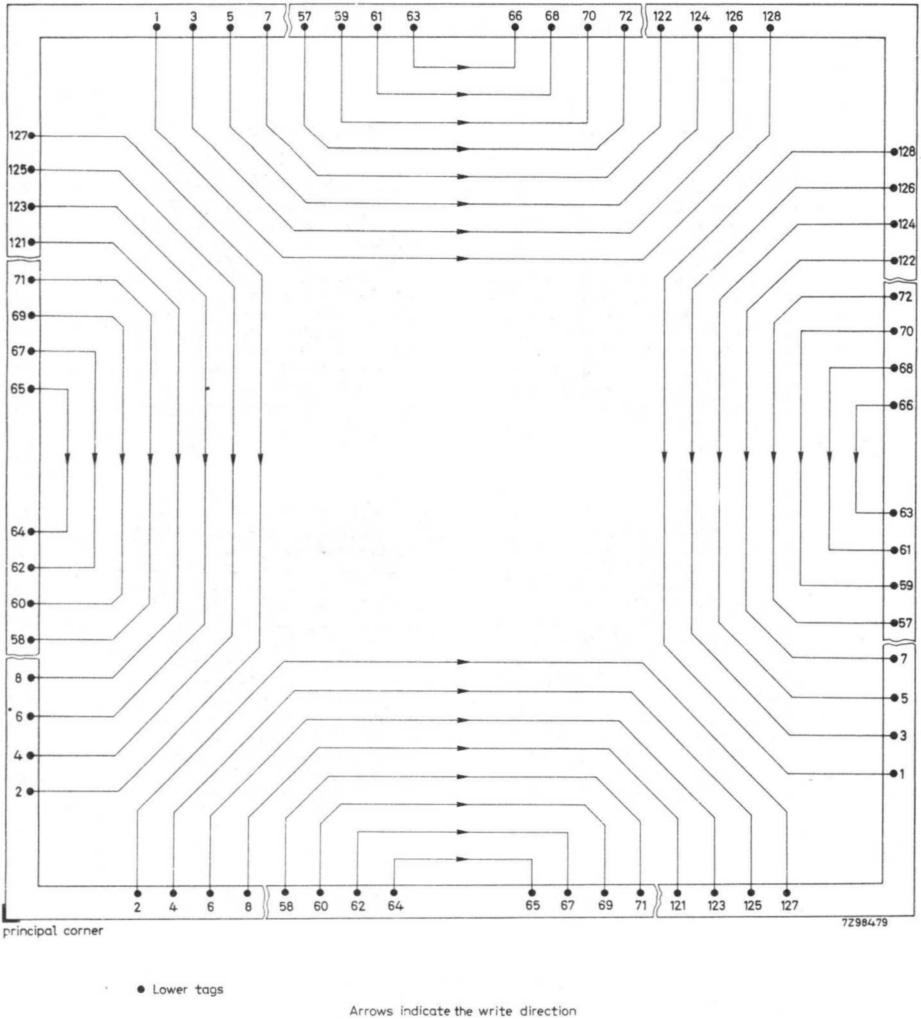
4 x 64 x 64 left-hand matrix plane



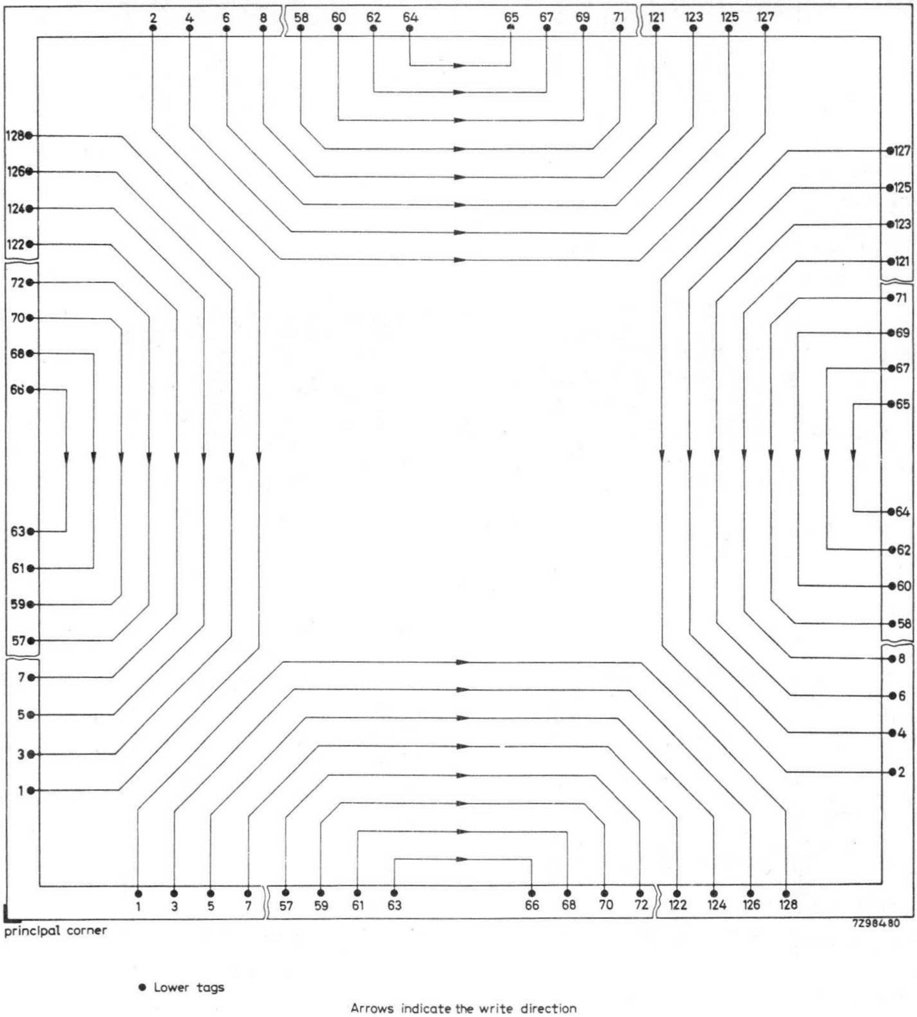
○ Upper tags
● Lower tags

Arrows indicate the write direction

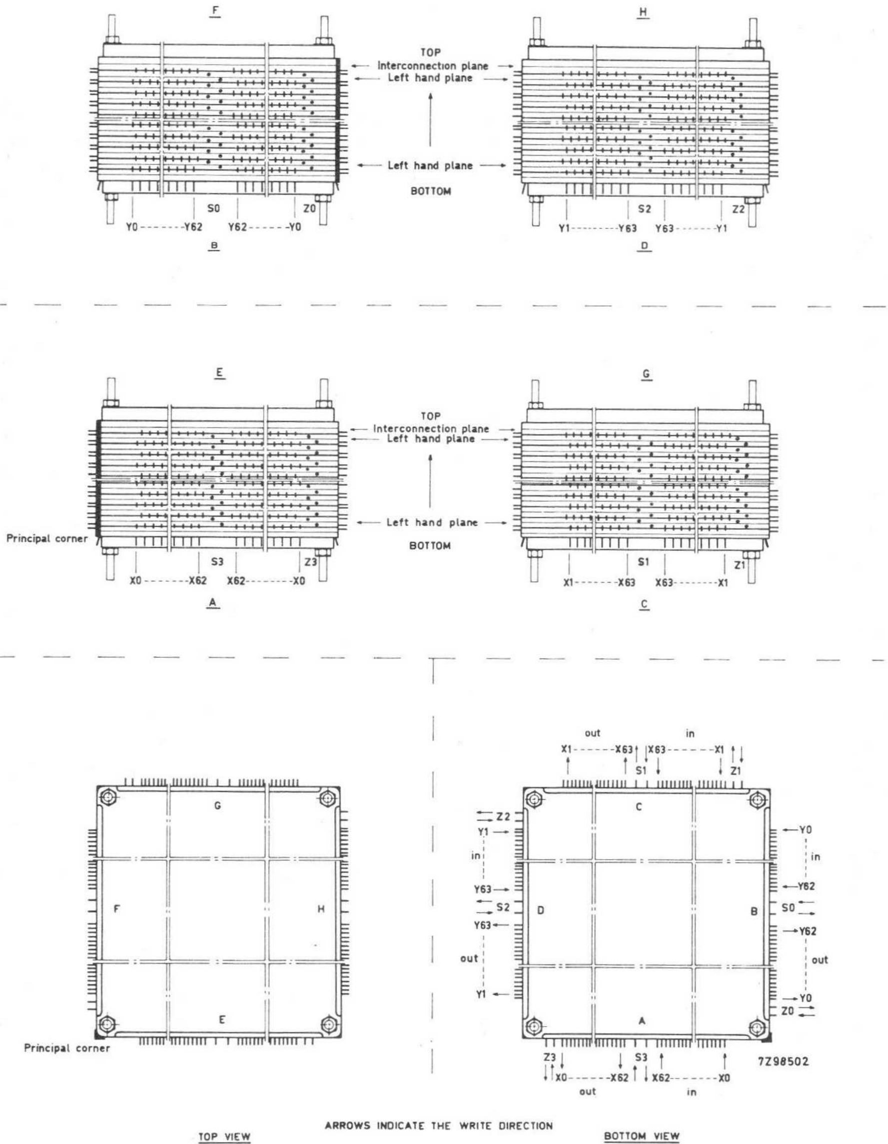
4 x 64 x 64 right-hand matrix plane



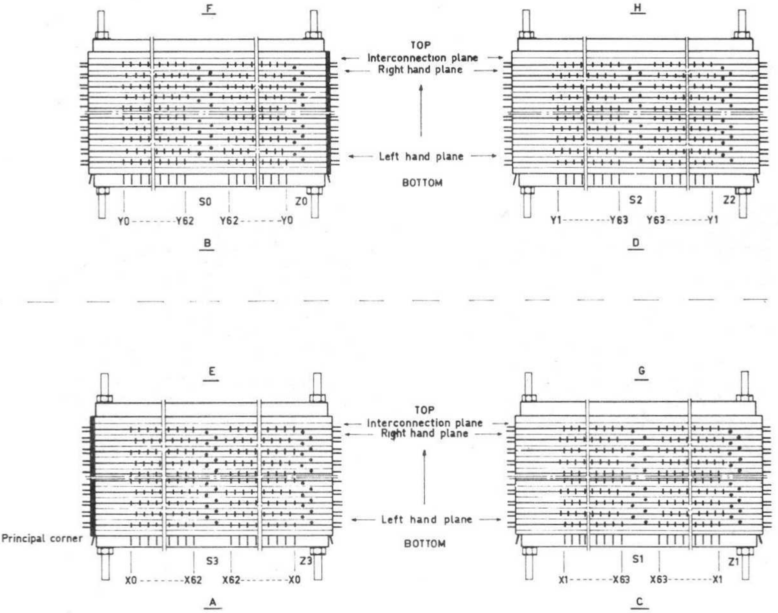
Interconnection plane for a stack with an odd
number of matrix planes 4 x 64 x 64

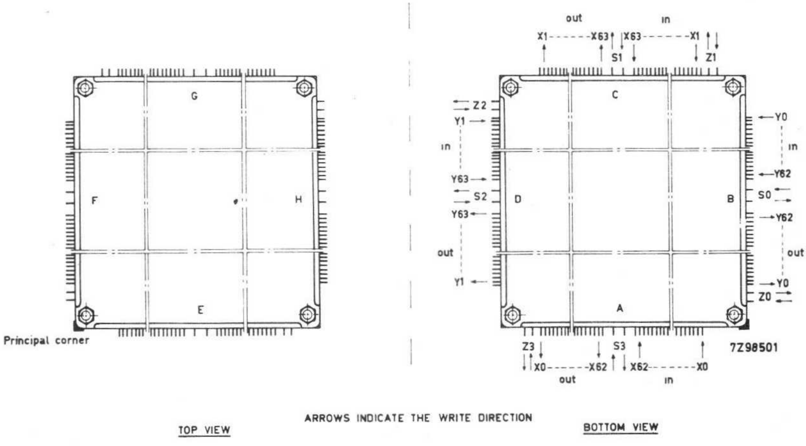


Interconnection plane for a stack with an even number of matrix planes 4 x 64 x 64

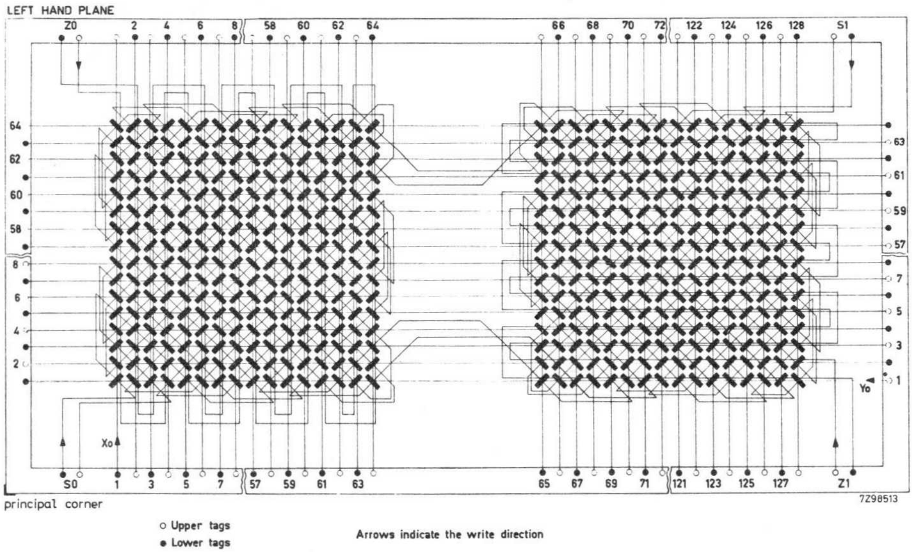


Stack with an odd number of matrix planes 4 x 64 x 64

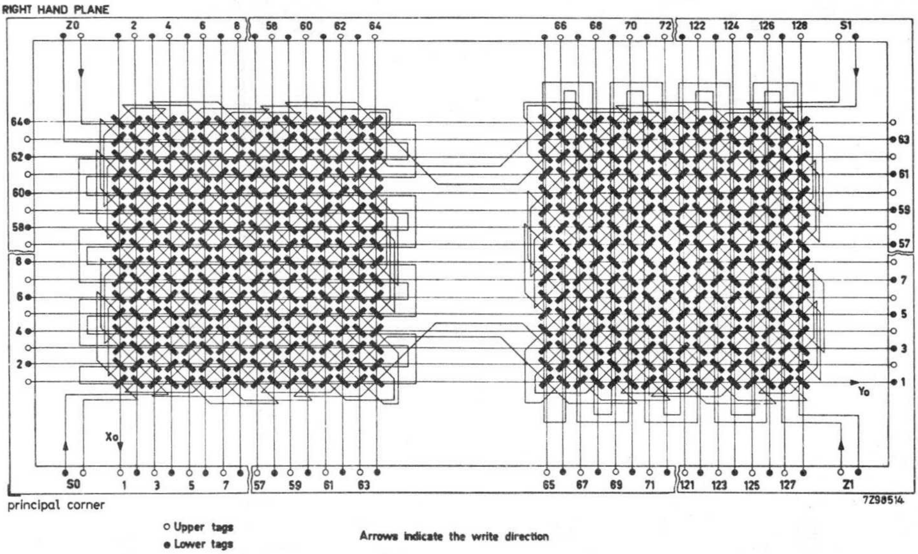




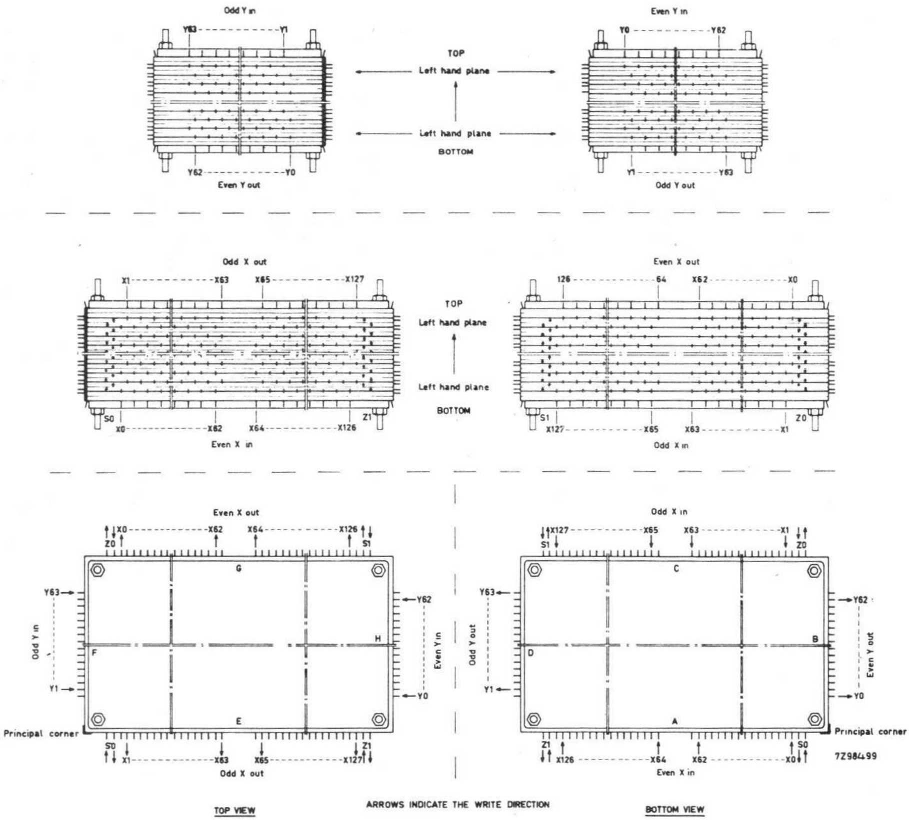
Stack with an even number of matrix planes 4 x 64 x 64



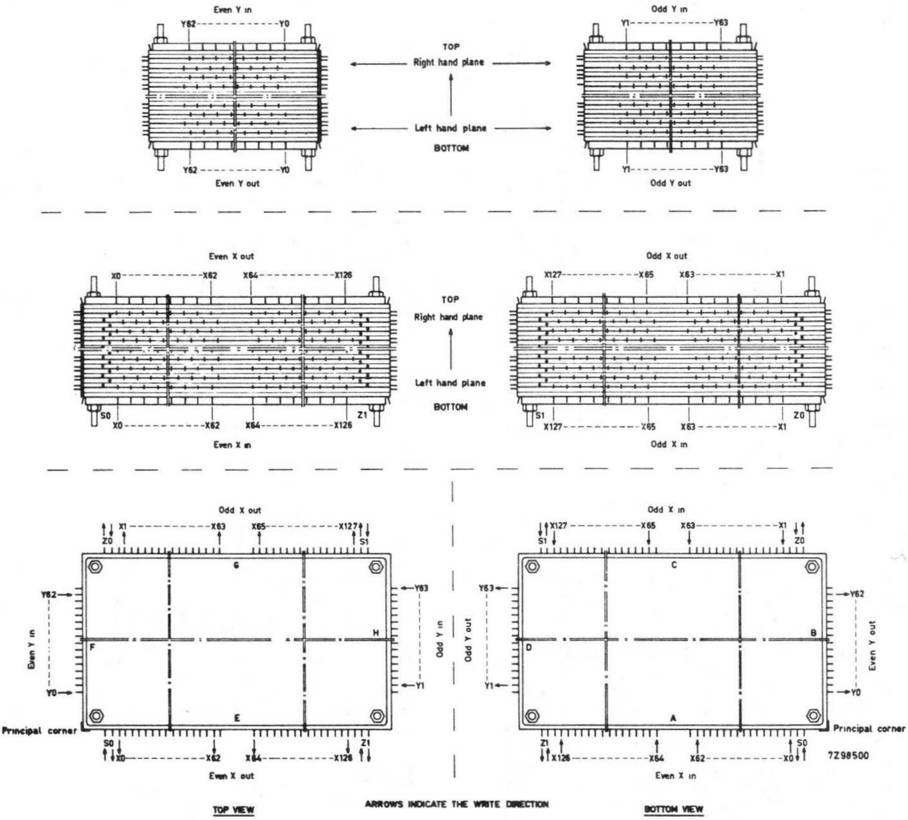
64 x 128 left-hand matrix plane



64 x 128 right-hand matrix plane

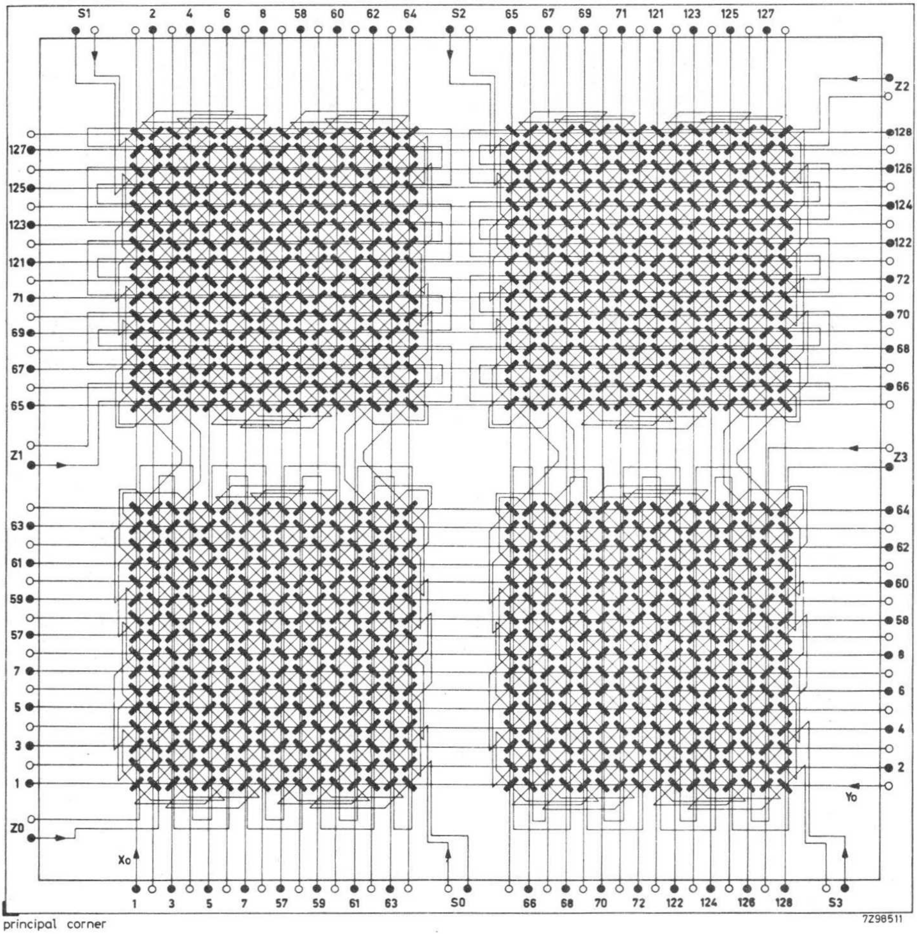


Stack with an odd number of matrix planes 64 x 128



Stack with an even number of matrix planes 64 x 128

LEFT HAND PLANE



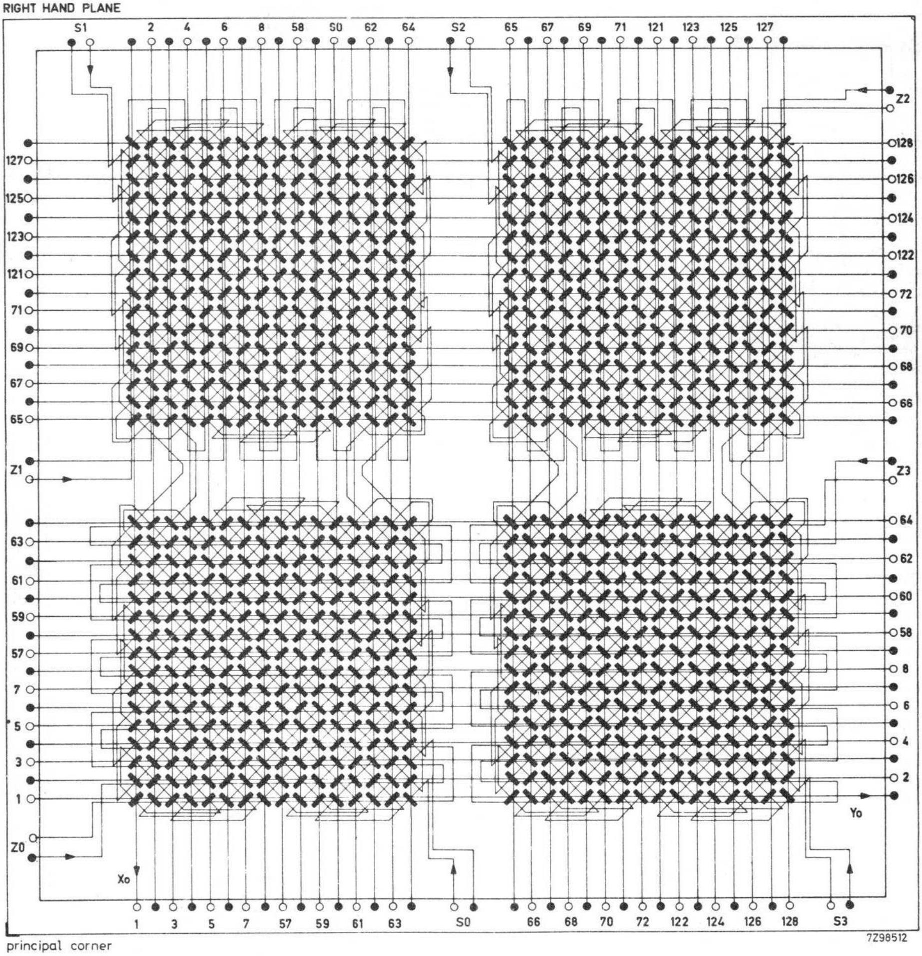
○ Upper tags

● Lower tags

Arrows indicate the write direction

2 x 64 x 128 left-hand matrix plane

RIGHT HAND PLANE



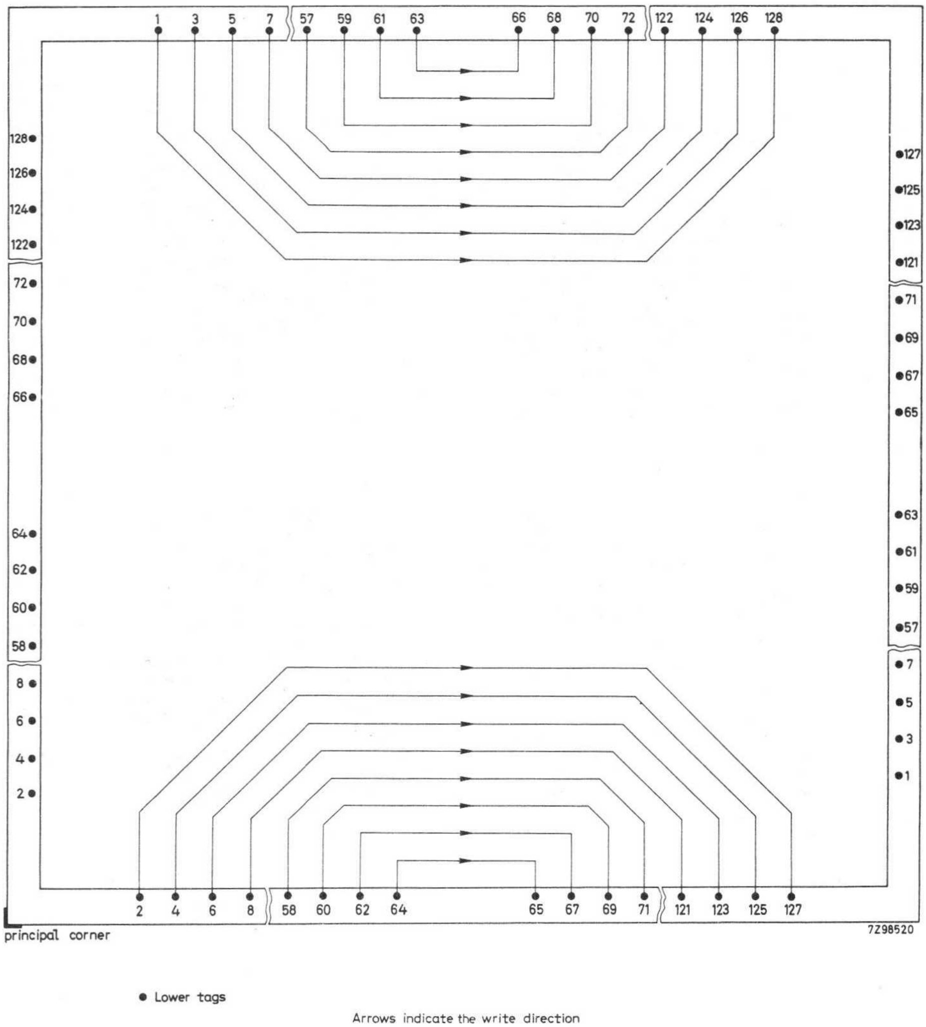
principal corner

○ Upper tags

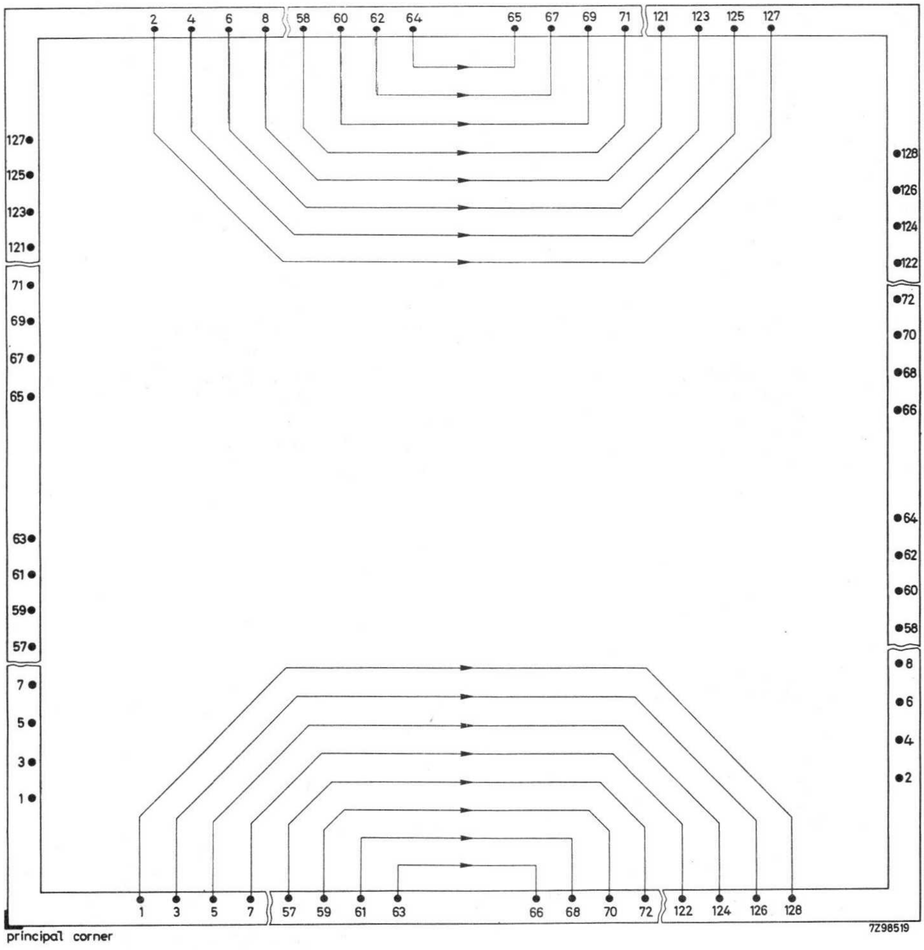
● Lower tags

Arrows indicate the write direction

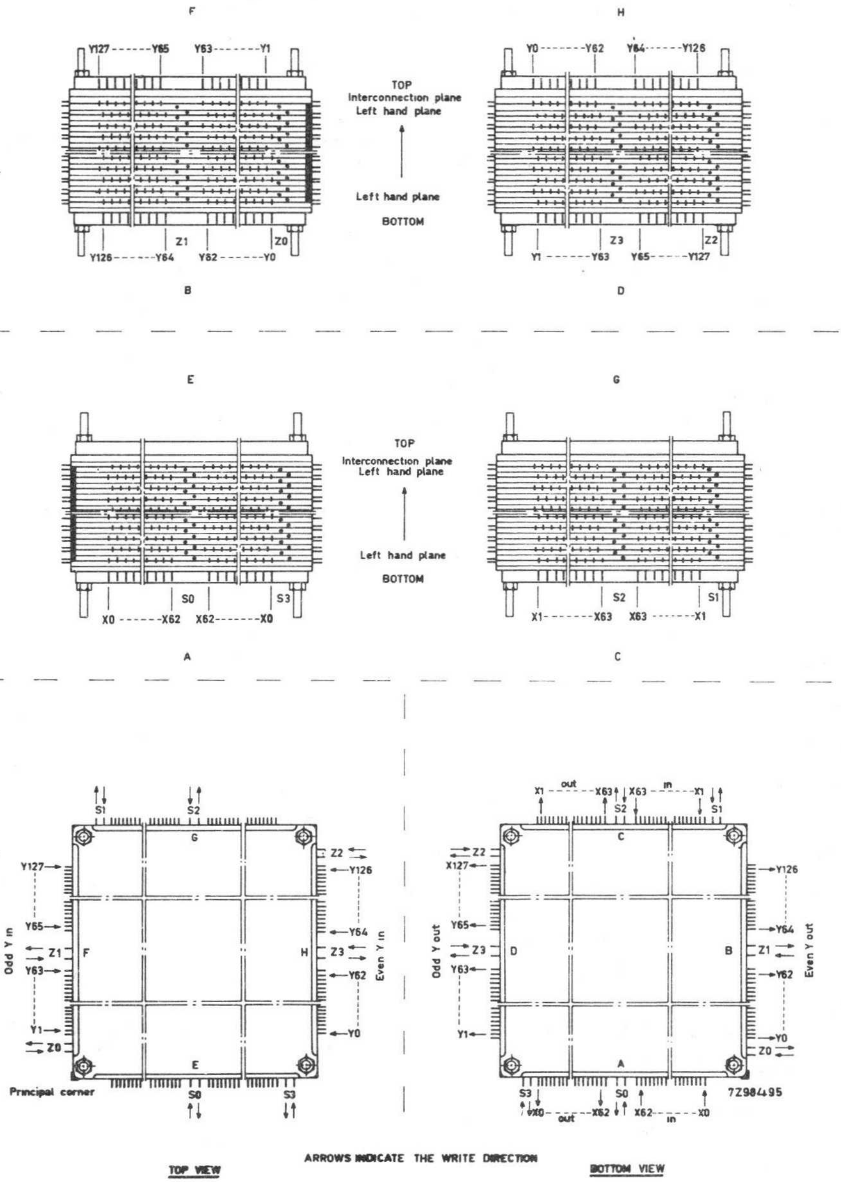
2 x 64 x 128 right-hand matrix plane



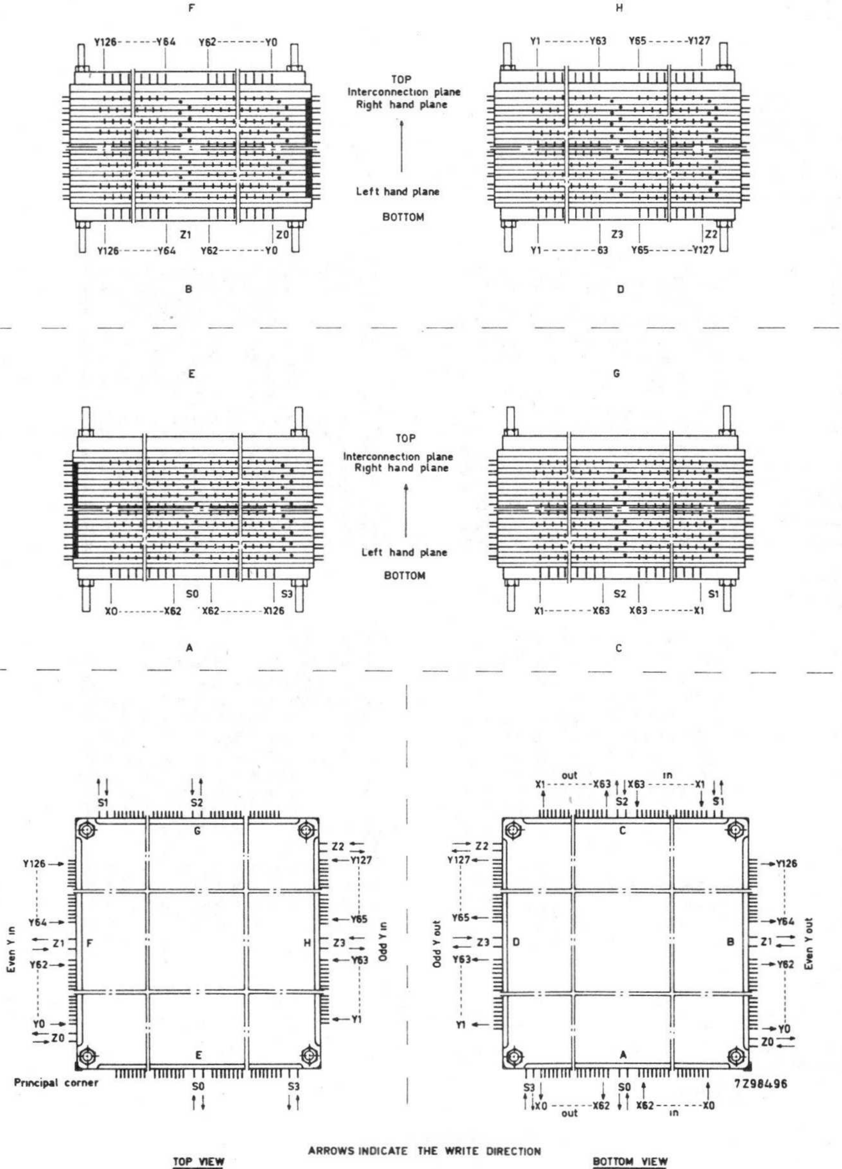
Interconnection plane for a stack with an odd number of matrix planes 2 x 64 x 128



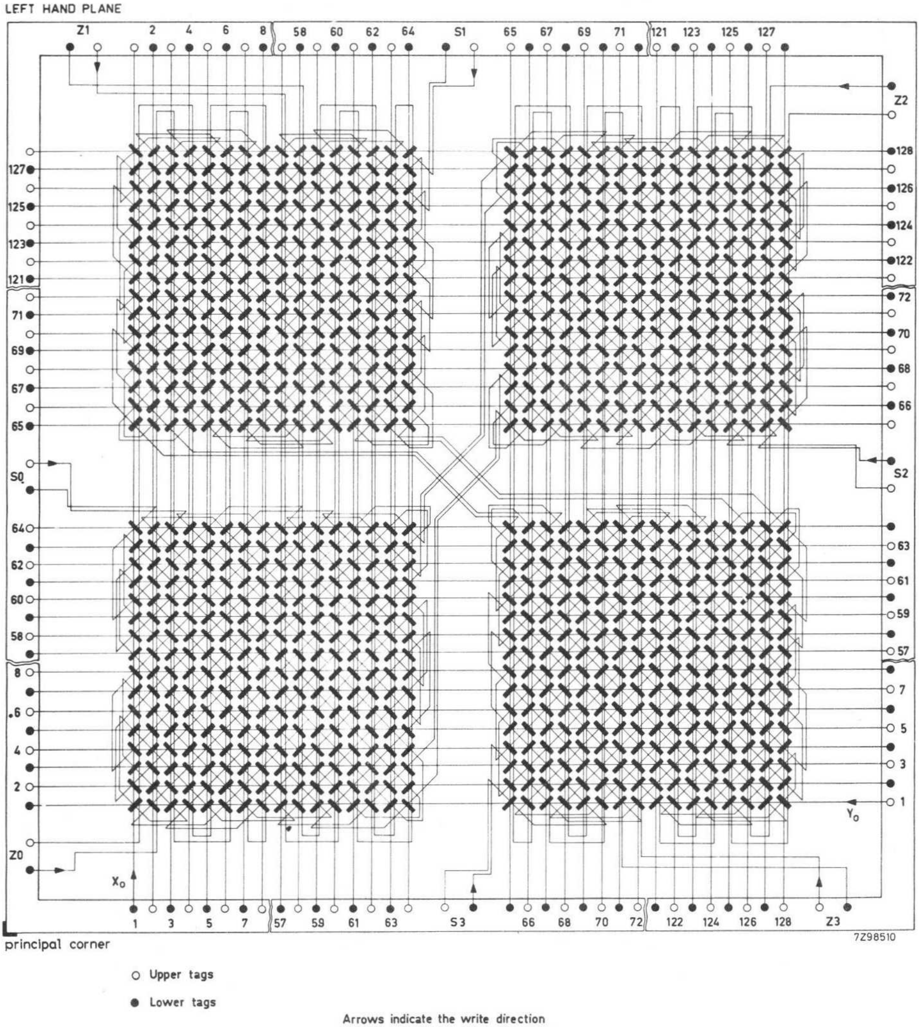
Interconnection plane for a stack with an even number of matrix planes 2 x 64 x 128



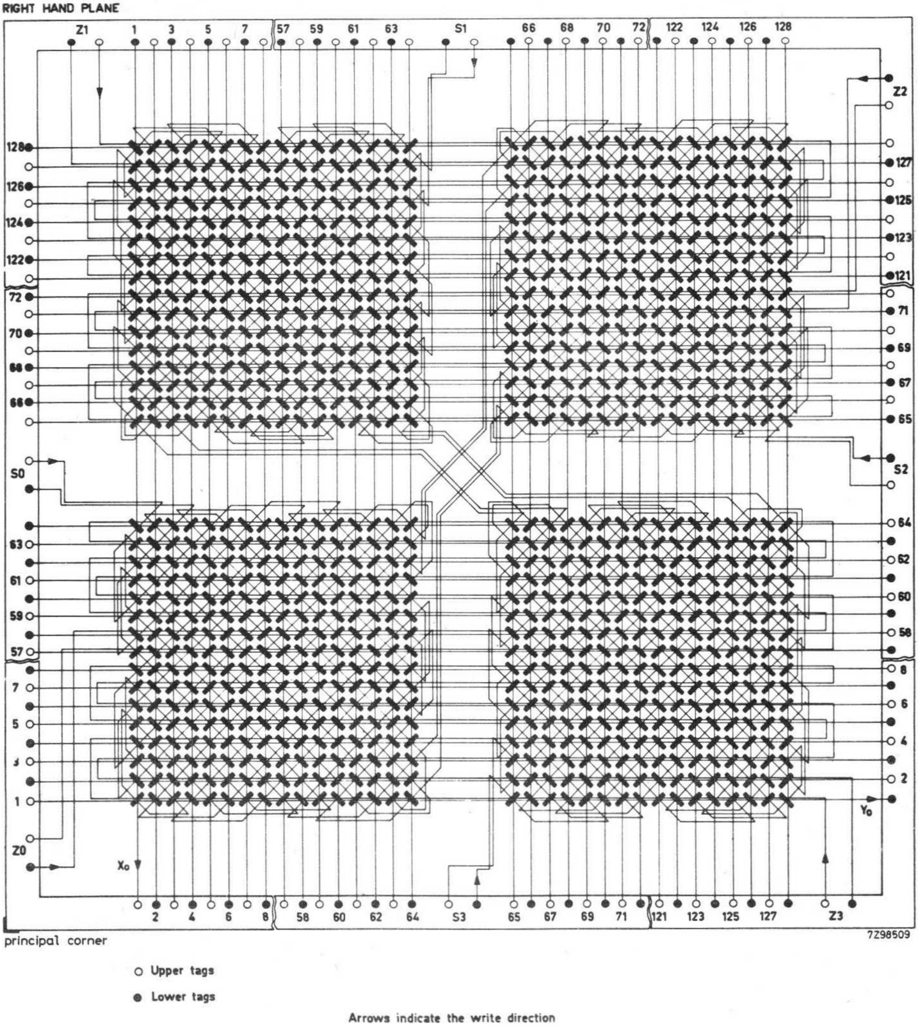
Stack with an odd number of matrix planes 2 x 64 x 128



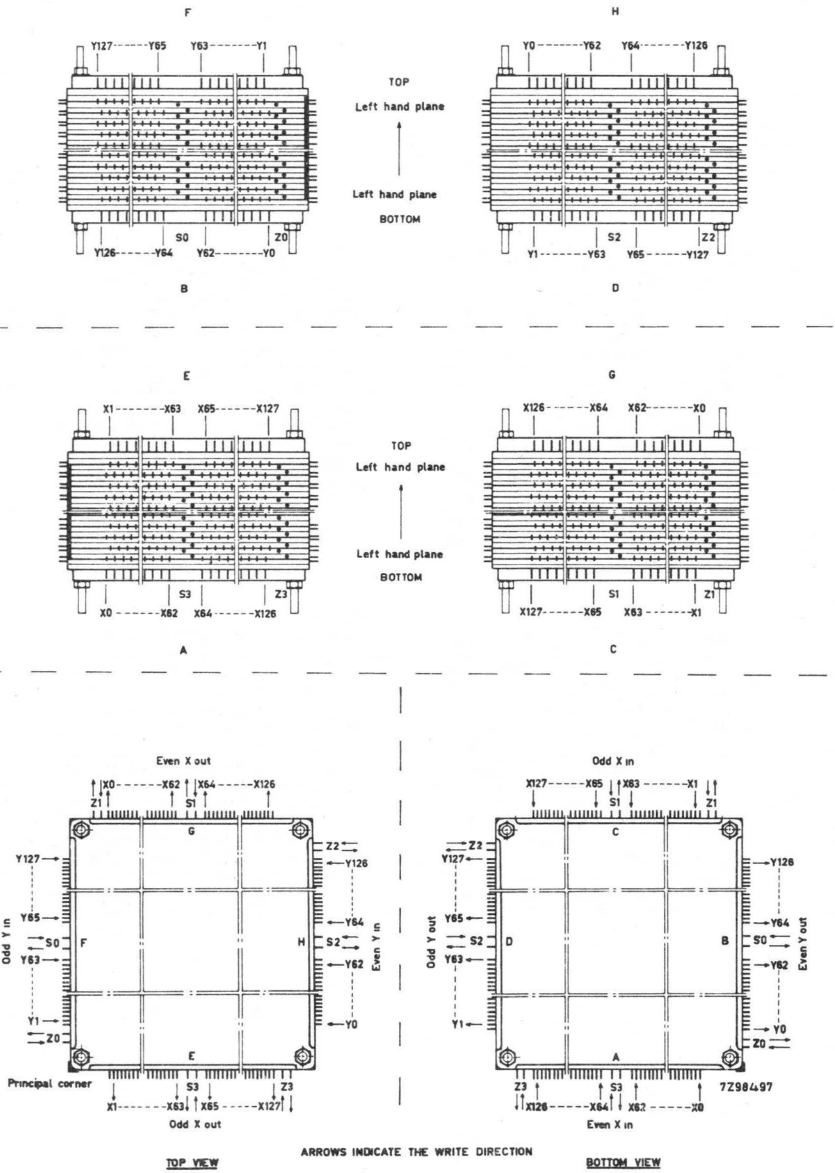
Stack with an even number of matrix planes 2 x 64 x 128



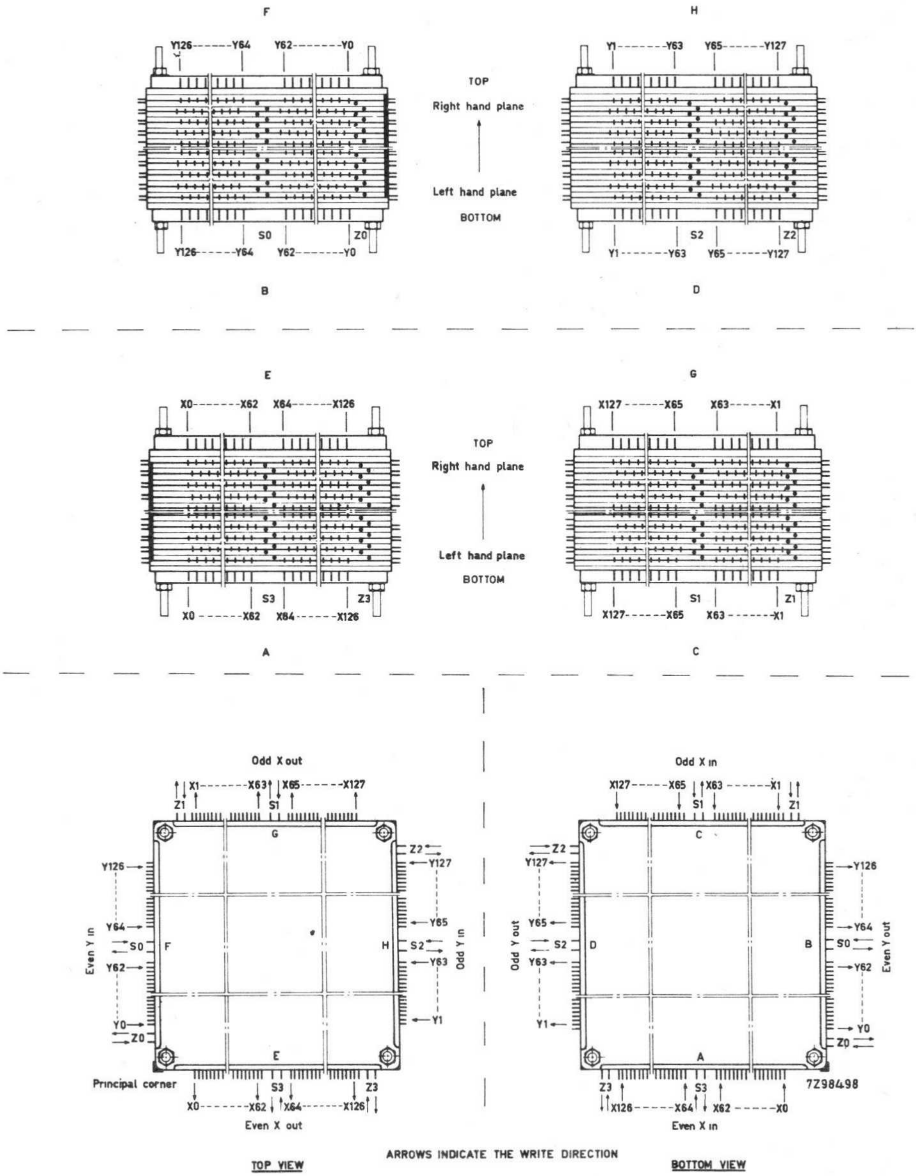
128 x 128 left-hand matrix plane



128 x 128 right-hand matrix plane

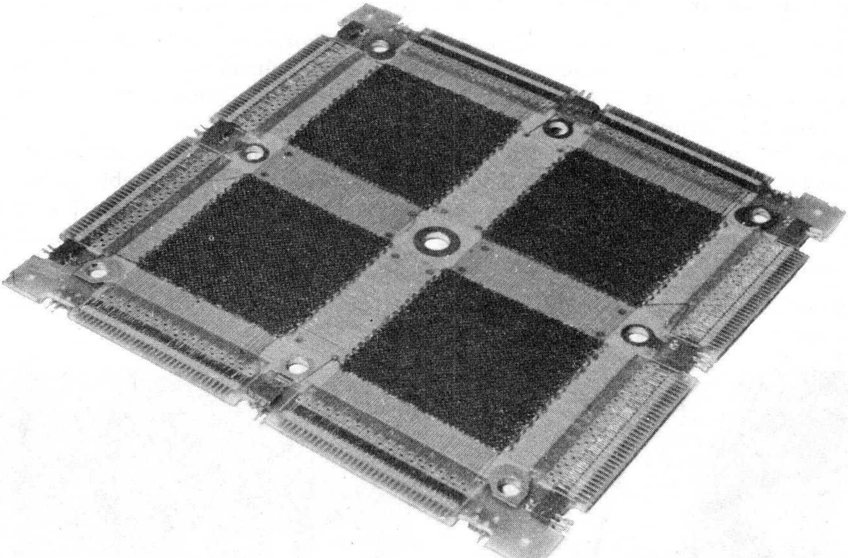


Stack with an odd number of matrix planes 128 x 128



Stack with an even number of matrix planes 128 x 128

3D CORE MATRICES ON PRINTED-WIRING BOARDS



RZ 27607-4

APPLICATION

Core matrices mounted and lacquered directly on special printed-wiring boards are used because of many benefits over frame mounted matrices, in particular:
- temperature differences within a stack are greatly reduced, thus reducing average cycle time;
- layout and interconnections are greatly simplified;
- stack assembly is strengthened;
- stack height is reduced.

DESCRIPTION

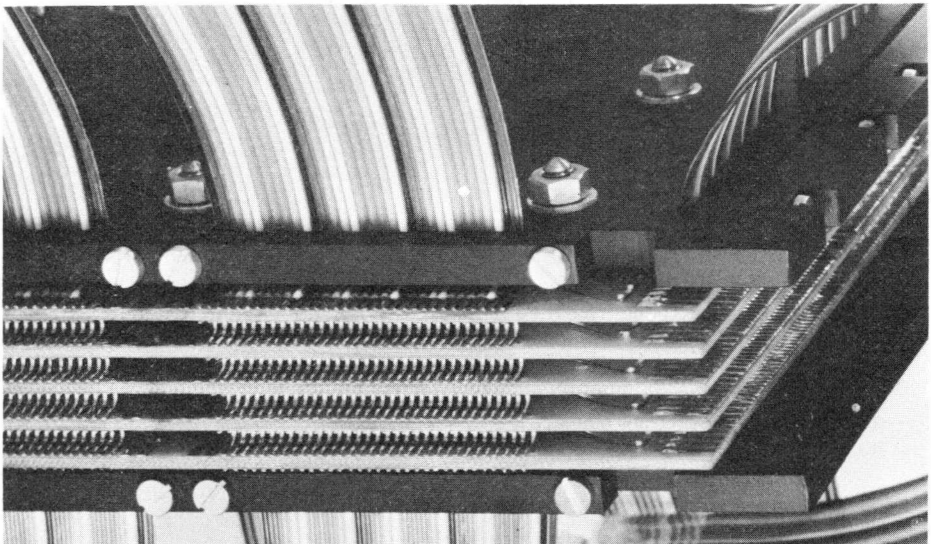
The core matrix is secured to the copper-clad surface of the glass-epoxy board by a lacquering process, the lacquer being a special type which ensures efficient heat transfer and establishes good thermal contact between the cores and their wires and the copper surface, which acts as a heat-sink. Spacers placed between the boards of a complete stack ensure good heat conductance to the two sheet metal plate "Stack heat-sinks" which can be placed at either end of the stack. These heat-sinks serve also as physical protection (See photograph).

The core matrix is divided into four 32 by 32 core (1k) sub-matrices or four 64 by 64 core (4k) sub-matrices enabling 1k-to 16k-word capacities to be obtained. The number of bits required determine how many matrices have to be stacked together; the interconnections between these are achieved by using comb-type contact springs. For the 4k-and 8k-word versions the necessary interconnections of the drive wires are provided by means of a "turn-over plane". If in the stack is one board which is occupied only at one side by a core matrix, the other side can be made into a turn-over plane. No turn-over plane is required for the 16k-word version.

The board mounting method can be used also to incorporate the associated selection diodes, mounted on a separate board, into the stack; the number of off-lead wires is reduced in this manner. If no diode boards are desired, the stack can be equipped with a special "termination plane".

Because the cores and wires of each board are firmly embedded in lacquer, and 9 spacer bolts are used (4 bits with the 1-to 4k-word versions), the assembly is highly resistant to damage from vibration; in addition the solid stack heat-sinks impart great rigidity to the assembly. The memory stack complies fully with the mechanical requirements of MIL STD 202C.

Height of the stack is less than conventional frame-mounted core stacks, because matrices are placed on both sides of each board.



RZ 25282-2

Stack with heat-sinks.

STANDARD RANGE

Catalogue number for ordering 2722 061..... suffix, see table

core pattern	wiring X Y Z S	core type	suffix	main dimensions
2 x (4 x 32 x 32)	1 1 4 4	6F8 6F3	26011 26001	Fig.1
2 x (2 x 32 x 64)	1 1 2 2	6F8 6F3	21011 21001	Fig.1
2 x (64 x 64)	1 1 1 1	6F8 6F3	06011 06001	Fig.1
2 x (4 x 64 x 64)	1 1 4 4 1 1 4 4 1 1 8 4 1 1 8 4	6F8 6F3 6F8 6F3	27011 27001 27031 27021	Fig.2
2 x (2 x 64 x 128)*	1 1 4 4 1 1 4 4 1 1 8 4 1 1 8 4	6F8 6F3 6F8 6F3	35011 35001 35031 35021	Fig.2
2 x (128 x 128)*	1 1 4 4 1 1 4 4 1 1 8 4 1 1 8 4	6F8 6F3 6F8 6F3	08011 08001 08031 08021	Fig.2

* Matrices with interlaced sense wiring

MECHANICAL DATA

Core type	6F8 or 6F3
Core pitch	30 mil
Spacing between printed wiring boards	3.2 mm

Main dimensions of the printed-wiring board (in mm)

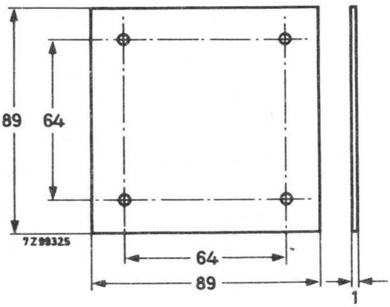


Fig. 1

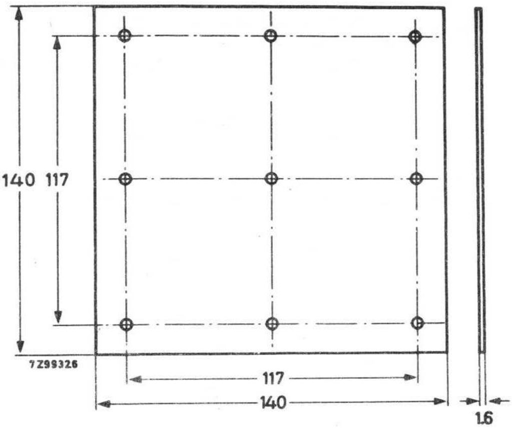


Fig. 2

ELECTRICAL DATA

Characteristic impedance of X and Y wires	Z_{0X}, Z_{0Y}	90	Ω
Z wires	Z_{0Z}	85	Ω
S wires	Z_{0S}	95	Ω
Resistance of X and Y wires	R_X, R_Y	1.02	Ω
Z wires	R_Z	17.1	Ω/submatrix
S wires	R_S	16.3	Ω/submatrix
Inductance of X and Y wires	L_X, L_Y	0.9	μH
Z wires	L_Z	4.7	μH
S wires	L_S	5.7	μH
Nominal partial write pulse at 25 °C ambient	$I_{pw(nom)}$	400	mA
Nominal partial read pulse at 25 °C ambient	$I_{pr(nom)}$	400	mA
Cycle time	t_c	2	μs
Switching time at 3 mV reference (best pattern)	t_s	0.55	μs
Output voltage with load impedance of 150 Ω (best pattern)		> 50	mV
Current temperature compensation		1.33	mA/degC

MATRIX PLANES AND STACKS WITH 20mil CORES

MATRIX PLANES

Description

The frames are of glass-epoxy resin and have a thickness of 3.2 mm. They are fitted with special X and Y lower tags which bridge a gap of 1.6 mm made between adjacent planes in a stack by means of spacers. Including the soldering tags the thickness of a matrix plane is 3.2 + 1.6 = 4.8 mm. The pitch of the grooves is 0.635 mm (25 mil). The diameter of the wires is 0.06 mm. Matrix planes with 6H3 cores and with the L.T.C. cores 6H2 are available. All planes of the 20 mil standard range are lacquered.

The spacing between the adjacent planes provide a better cooling of the matrices; moreover forced air cooling can be applied: As a consequence of the small switching time of the cores high drive currents are needed, so that especially the inhibit wire will contribute to a large heat dissipation.

The cores are placed in the "open" core configuration.
For each core pattern in the standard range there are two types of wiring: one identical to a 30 mil matrix plane and one having twice as much Z wires. With the latter type higher speeds can be obtained for the memory.
For nearly all types of matrix plane the sense wiring is interlaced, which minimizes delta noise.

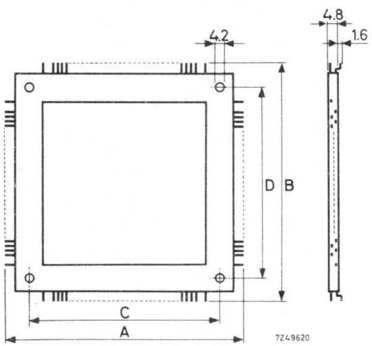


Fig.1. Dimensions in mm

Standard range

A number of types have been standardised on core pattern, wiring, types of core and construction.

Catalog number, for ordering 2722 045 .....
suffix, see table

Preferred types are underlined.

core pattern	wiring X Y Z S	core type	lacquered left suffix	lacquered right suffix	dimensions in mm Figs.1 and 2 A x B	dimensions in mm Figs.1 and 2 C x D
64 x 64	1 1 1 1*	6H3	06021	06041	76 x 76	55.7 x 55.7
	1 1 1 1*	6H2	06031	06051		
	1 1 2 2	6H3	06061	06071		
	1 1 2 2	6H2	06081	06091		
<u>4 x 64 x 64</u>	1 1 4 4*	6H3	27021	27041	119.3 x 119.3	99.5 x 99.5
	1 1 4 4*	6H2	27031	27051	119.3 x 119.3	99.5 x 99.5
	1 1 8 8	6H3	27061	27071	122 x 122	102.1 x 102.1
	1 1 8 8	6H2	27081	27091	122 x 122	102.1 x 102.1
64 x 128	1 1 2 2	6H3	36021	36031	76 x 120	55.7 x 100.1
	1 1 2 2	6H2	36041	36051		
	1 1 4 2	6H3	36061	36071		
	1 1 4 2	6H2	36081	36091		
<u>2 x 64 x 128</u>	1 1 4 4	6H3	35021	35031	119.3 x 120	99.5 x 100.1
	1 1 4 4	6H2	35041	35051		
	1 1 8 4	6H3	35061	35071		
	1 1 8 4	6H2	35081	35091		
<u>128 x 128</u>	1 1 4 4	6H3	08021	08031	120 x 120	100.1 x 100.1
	1 1 4 4	6H2	08041	08051		
	1 1 8 4	6H3	08061	08071		
	1 1 8 4	6H2	08081	08091		

* Matrices without interlaced sense wiring.

Unlacquered planes can be supplied on request.

Worst-case pattern

In order to test planes on the most unfavourable "1" and "0" outputs, the cores must be set in conformity to the relevant basic worst-case pattern indicated below.

Matrix plane 64 x 64

1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0

Matrix plane 64 x 128

1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0

Matrix planes
128 x 128
2 x 64 x 128
4 x 64 x 64

1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0

1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0

STACKS

For general information on stacking and stacks see sections "Introduction" and "Ordering information", which precede the data sheets.

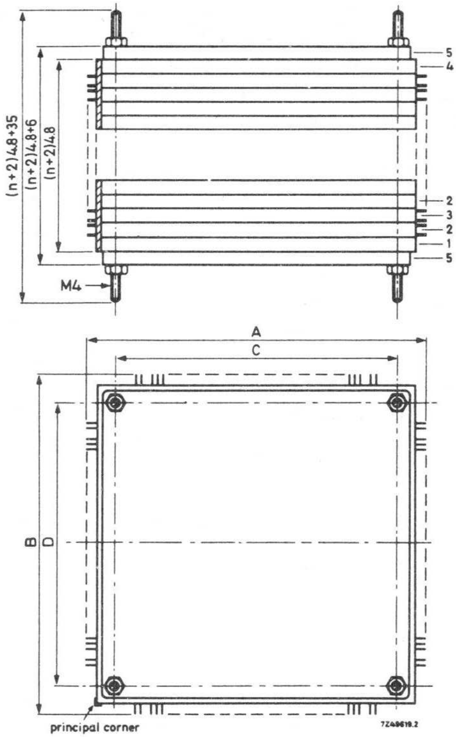


Fig.2. Dimensions in mm

n = number of planes (1, 2, 3 and 4)
For dimensions A to D see standard range table.
1 = termination plane
2 = left-hand matrix plane
3 = right-hand matrix plane
4 = termination plane or interconnection plane
5 = aluminium protection plate

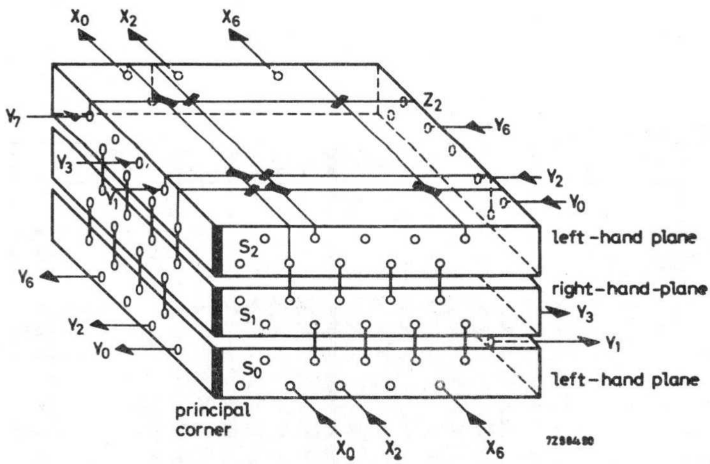


Fig.3. Principle of the connections to a stack having an odd number of single-matrix planes.
Arrows indicate the write current direction.

WIRING DIAGRAMS OF MATRIX PLANES AND INTERCONNECTION PLANES - CONNECTIONS TO STACKS

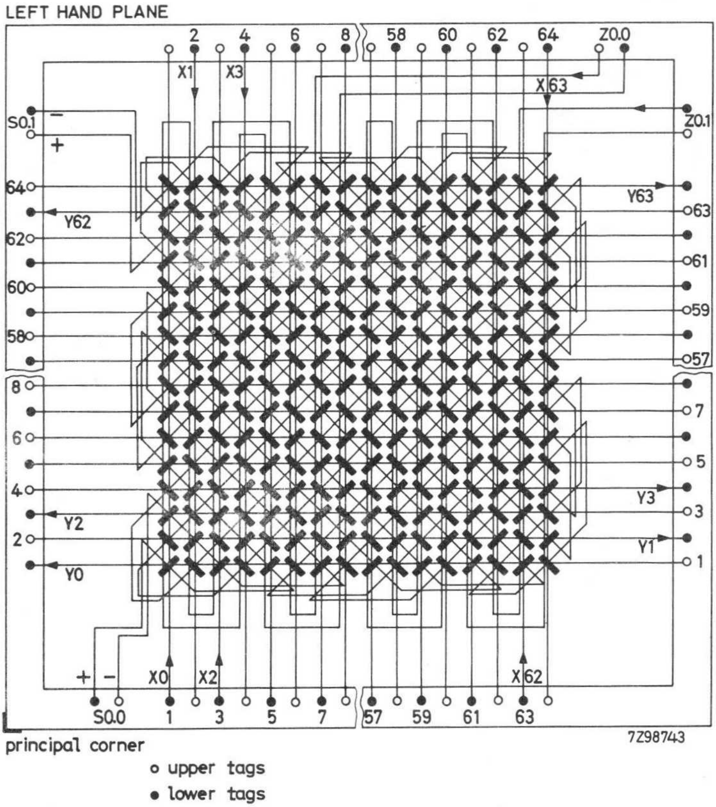
Of the following types of matrix planes and stacks the wiring diagrams and stack connections are identical to those of the corresponding 30 mil type:

core pattern	wiring X	Y	Z	S
64 x 64	1	1	1	1
4 x 64 x 64	1	1	4	4
64 x 128	1	1	2	2
2 x 64 x 128	1	1	4	4
128 x 128	1	1	4	4

The drawings for the other types are given in the next pages.

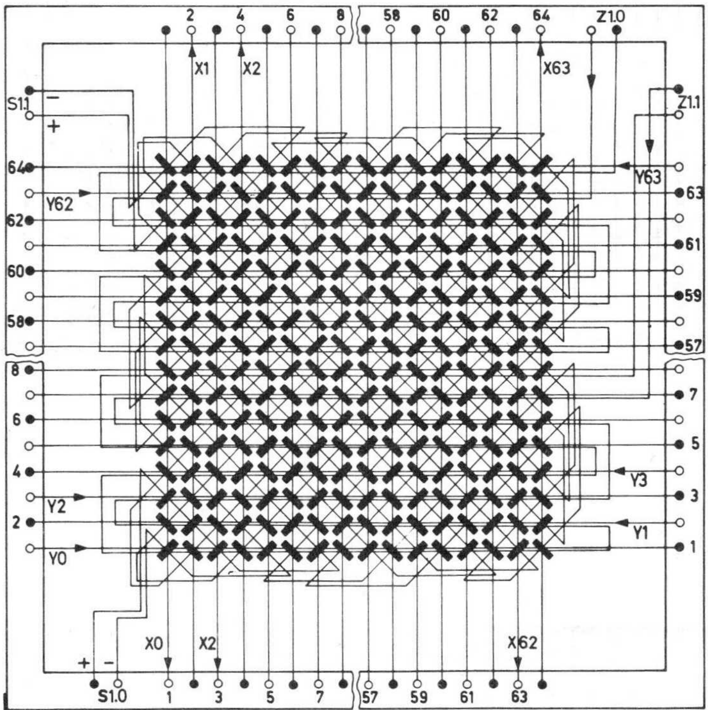
NOTES

1. Arrows indicate the write current direction.
2. The output voltage polarity for a '1' signal on the sense wires is indicated at the relevant connection points.



64 x 64 - 1X, 1Y, 2Z, 2S - left hand matrix plane

RIGHT HAND PLANE

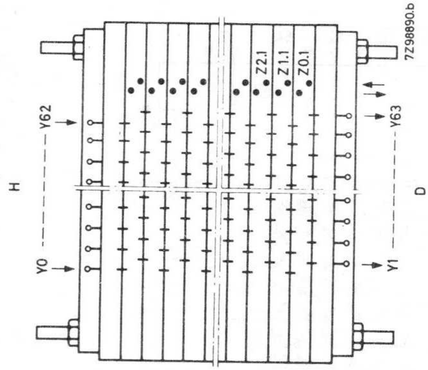


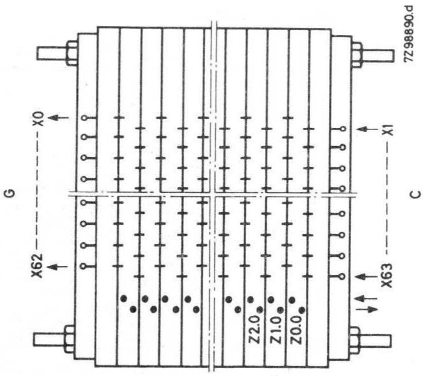
○ upper tags

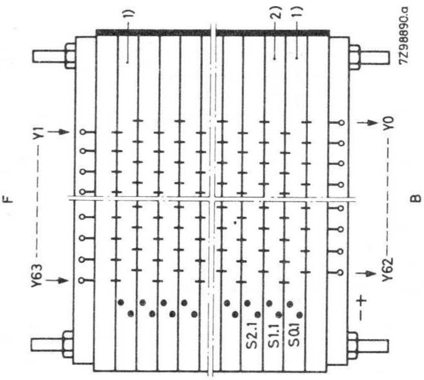
● lower tags

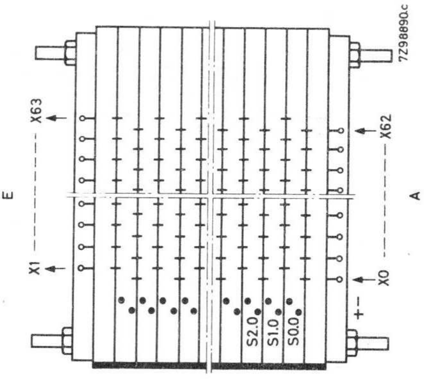
64 x 64 - 1X, 1Y, 2Z, 2S - right hand matrix plane

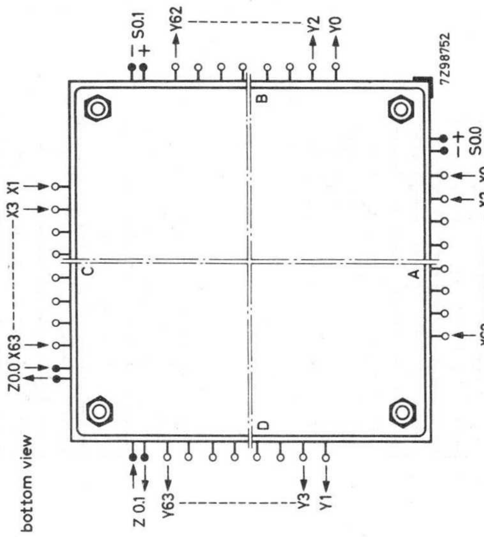
MATRIX PLANES AND STACKS WITH 20 mil CORES

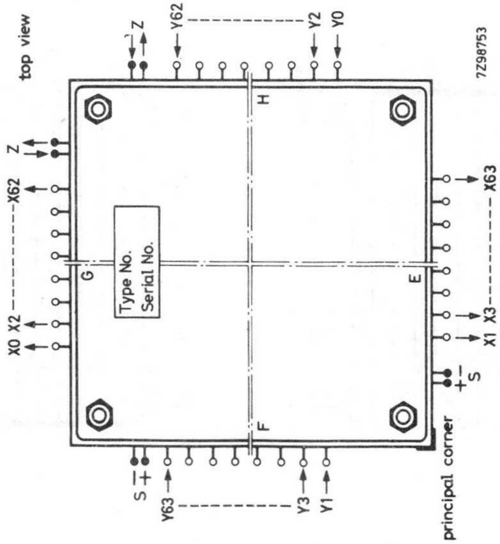






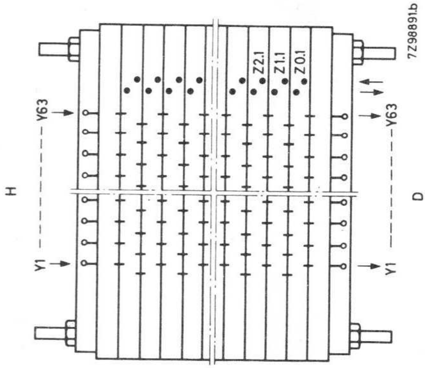


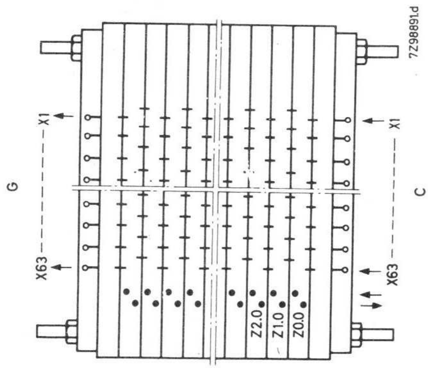




Stack with an odd number of matrix planes 64 x 64 - 1X, 1Y, 2Z, 2S

1) Left hand plane
2) Right hand plane


H
D
Y1
Y63
Z2.1
Z1.1
Z0.1
7Z98891.b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C
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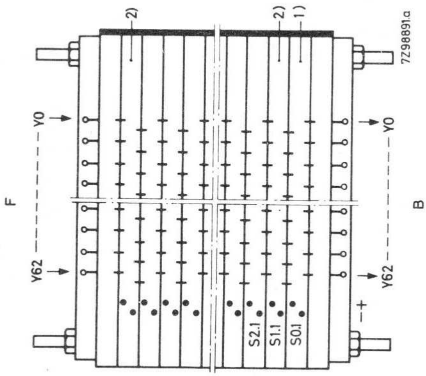
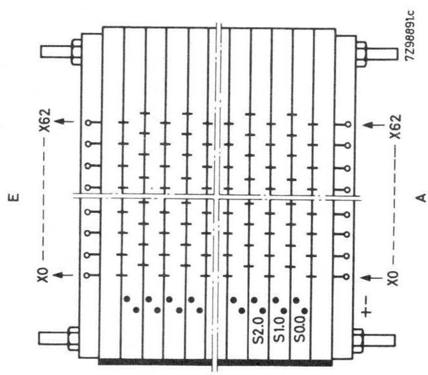
X63
Z2.0
Z1.0
Z0.0
7Z98891.d


F
B
Y0
Y62
S2.1
S1.1
S0.1
2)
1)
7Z98891.a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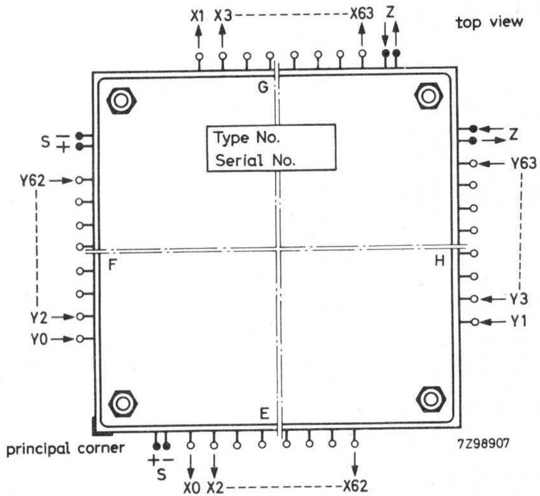
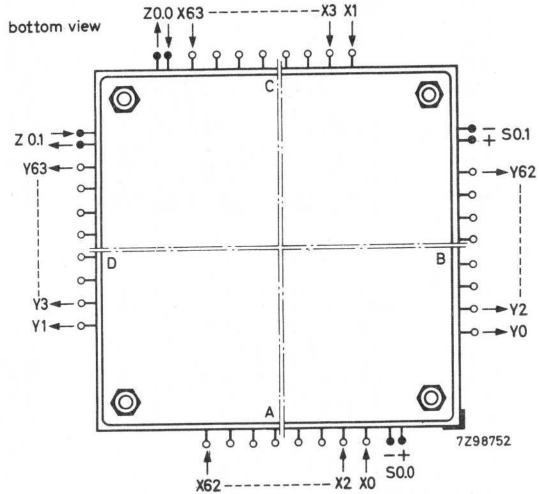
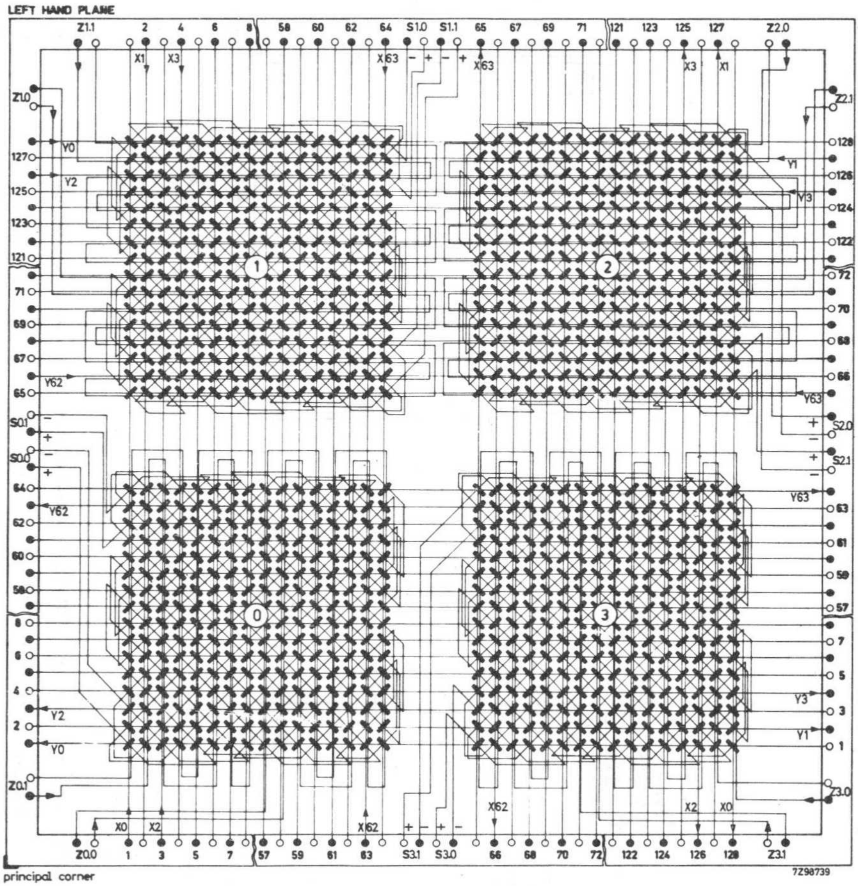
S0.0
7Z98891.c





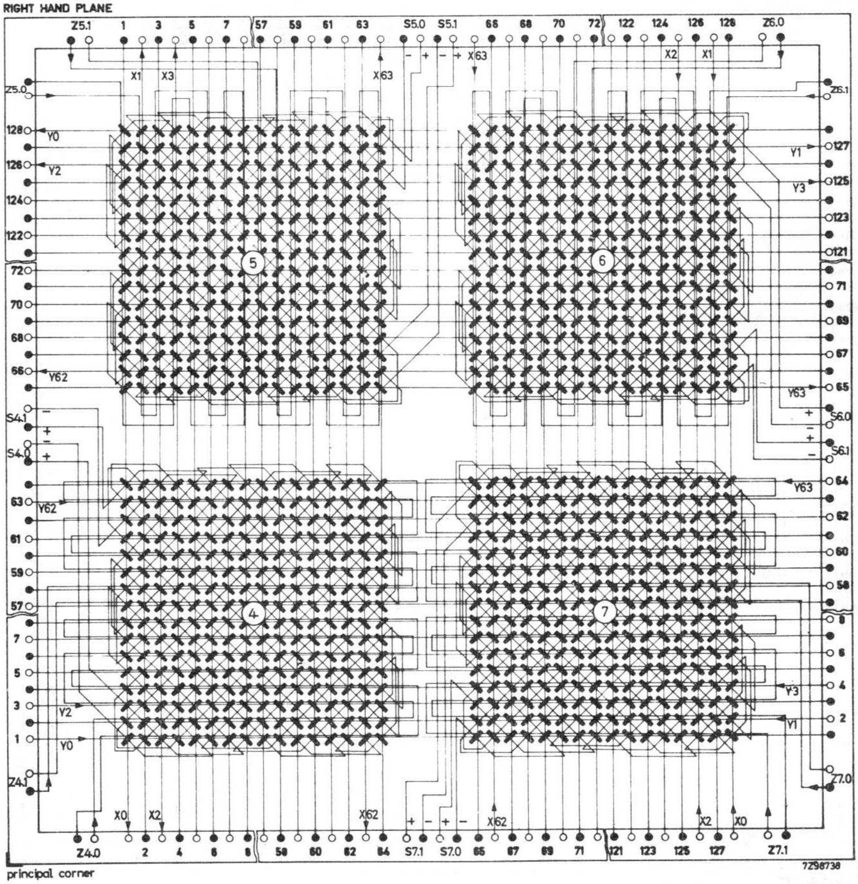
Stack with an even number of matrix planes 64 x 64 - 1X, 1Y, 1Z, 1S

1) Left hand plane
2) Right hand plane



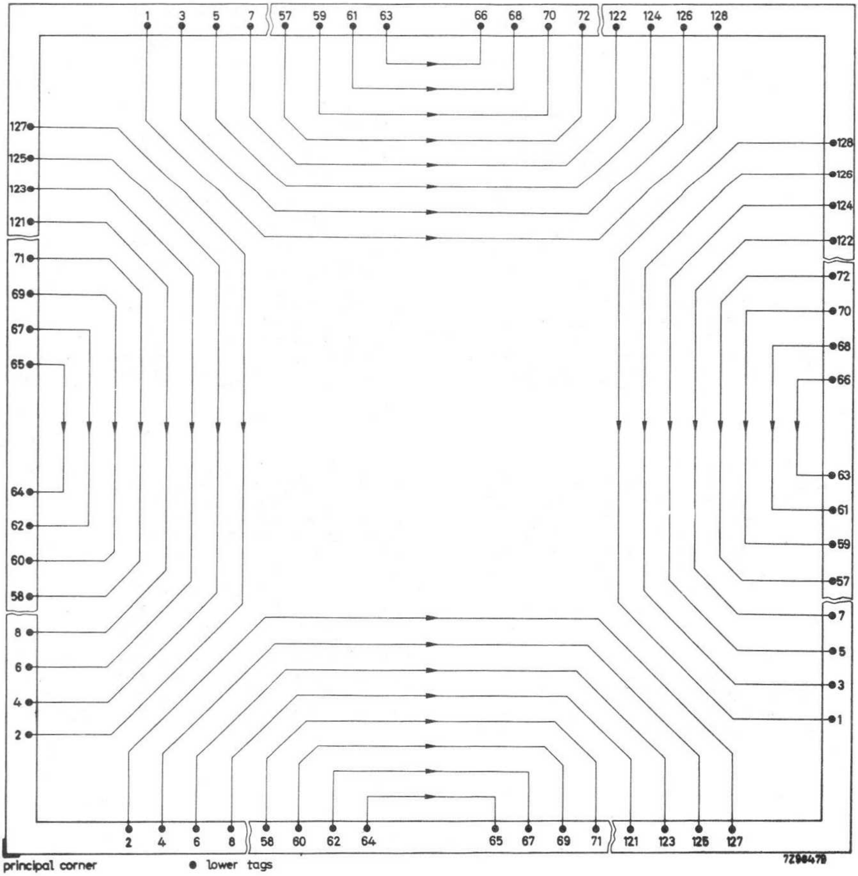
○ upper tags
● lower tags

4 x 64 x 64 - 1X, 1Y, 8Z, 8S - left hand matrix plane

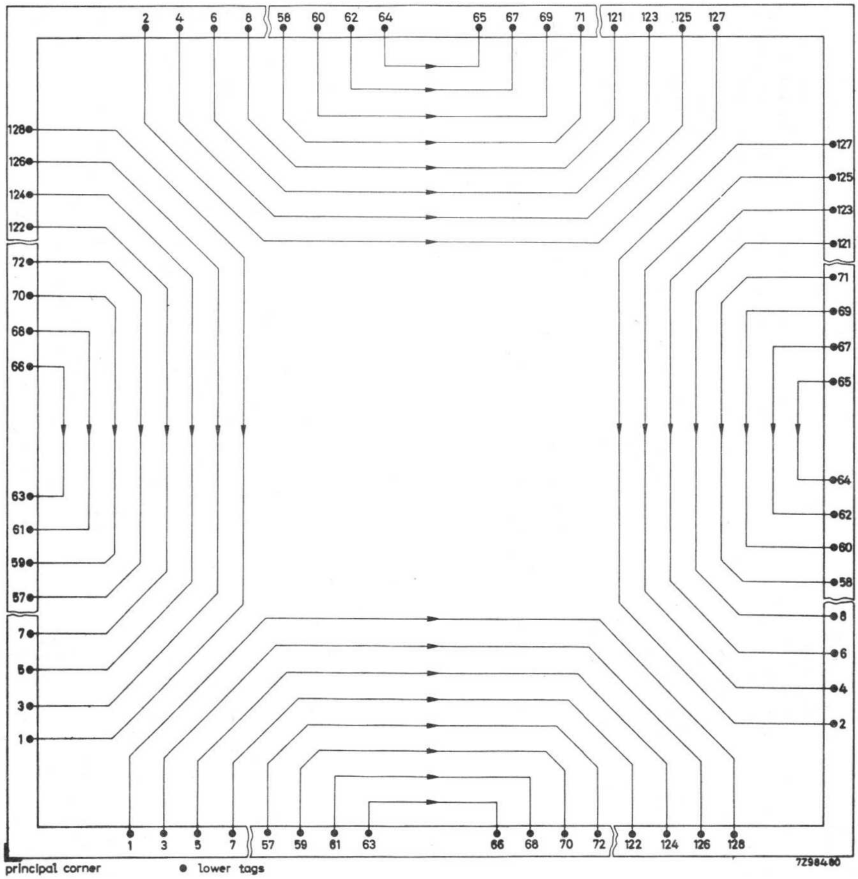


○ upper tags
● lower tags

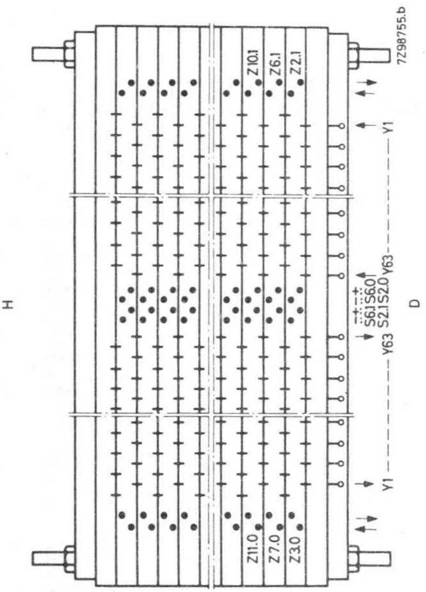
4 x 64 x 64 - 1X, 1Y, 8Z, 8S - right hand matrix plane



Interconnection plane for a stack with an odd number of matrix planes 4 x 64 x 64



Interconnection plane for a stack with an even number of matrix planes 4 x 64 x 64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D
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Z10.1
Z6.1
Z2.1
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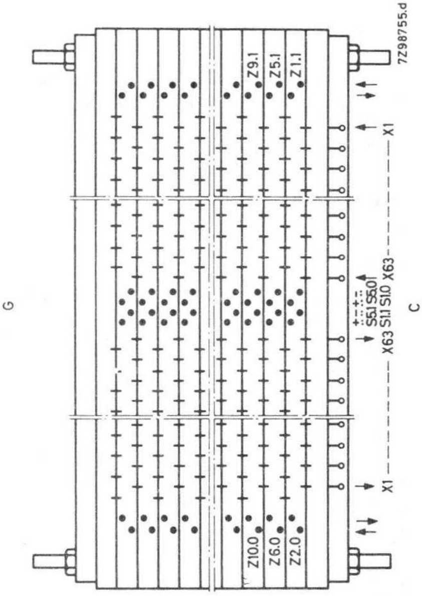
Y63
S6.1 S6.0
S2.1 S2.0
Y63
Y1
Z11.0
Z7.0
Z3.0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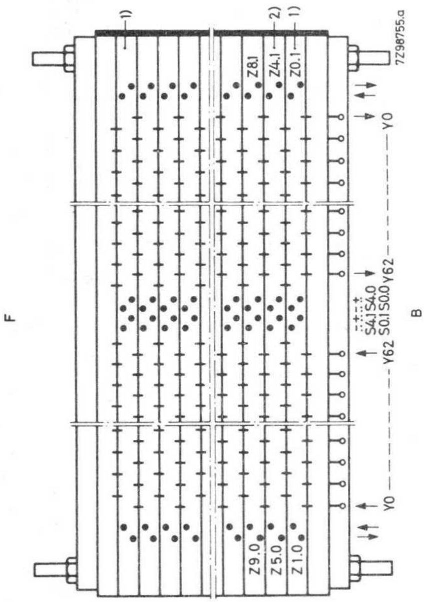
Z5.1
Z1.1
X1
X63
S6.1 S6.0
S1.1 S1.0
X63
X1
Z10.0
Z6.0
Z2.0


F
B
7Z98755.a
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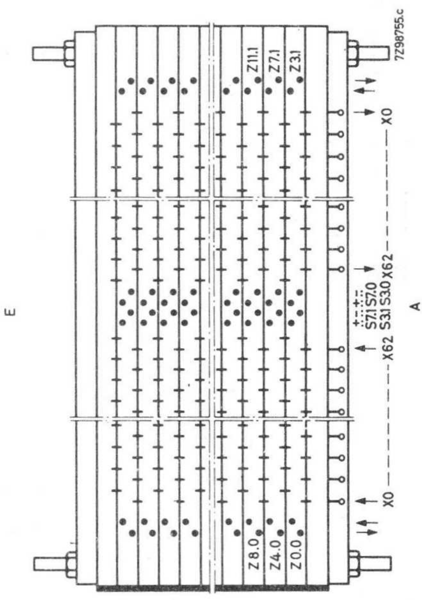
2)
1)
Z8.1
Z4.1
Z0.1
Y0
Y62
S4.1 S4.0
S0.1 S0.0
Y62
Y0
Z9.0
Z5.0
Z1.0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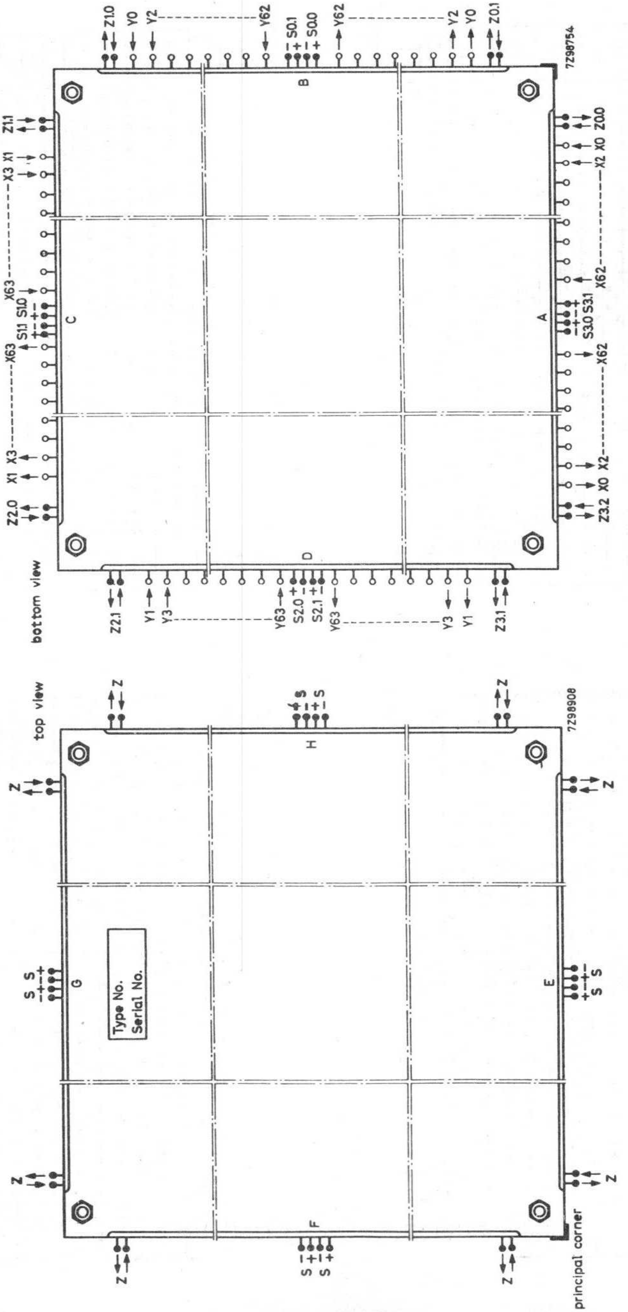
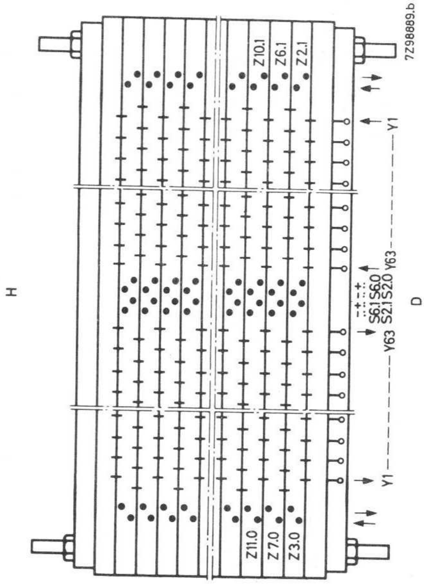
Z0.0



Stack with an odd number of matrix planes 4 x 64 x 64 - 1X, 1Y, 8Z, 8S

1) Left-hand plane
2) Right-hand plane.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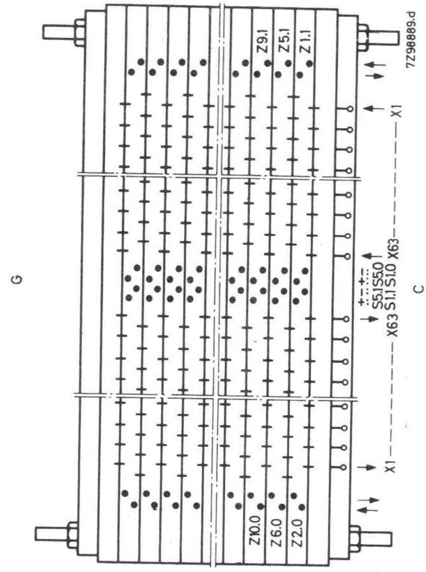
Z10.1
Z6.1
Z2.1
Z11.0
Z7.0
Z3.0
Y1
Y63
S6.1 S6.0
S2.1 S2.0


G
C
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Z9.1
Z5.1
Z1.1
Z10.0
Z6.0
Z2.0
X1
X63
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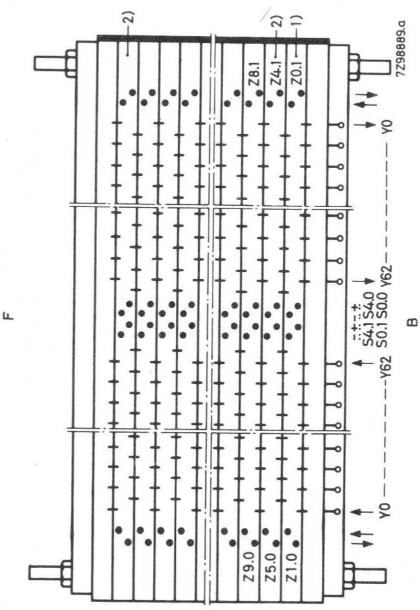
S1.1 S1.0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B
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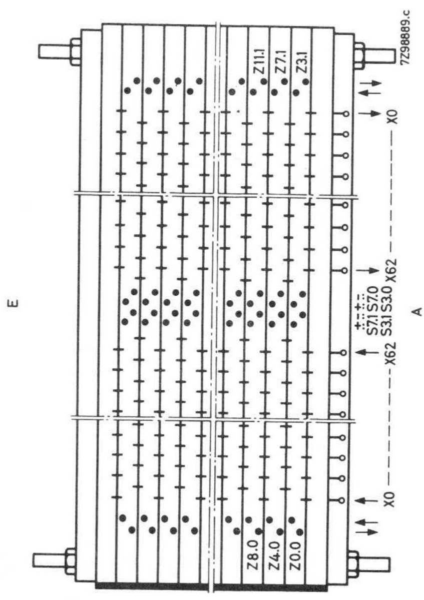
Z8.1
Z4.1
Z0.1
Z9.0
Z5.0
Z1.0
Y0
Y62
S4.1 S4.0
S0.1 S0.0
1)
2)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A
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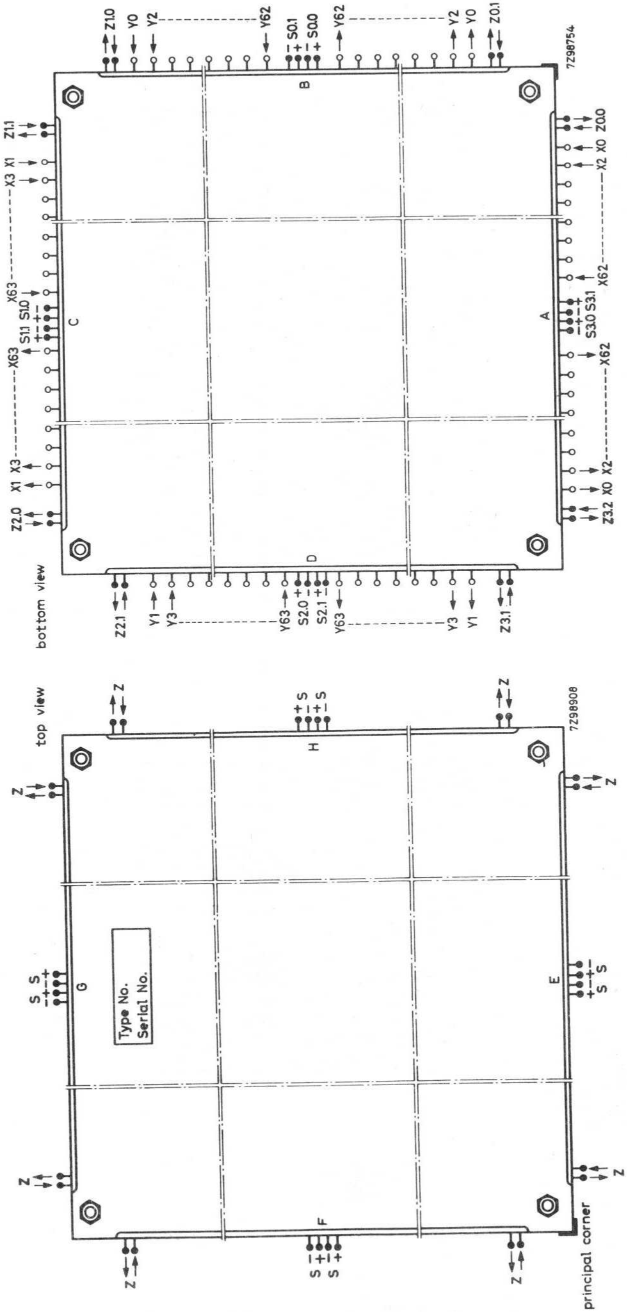
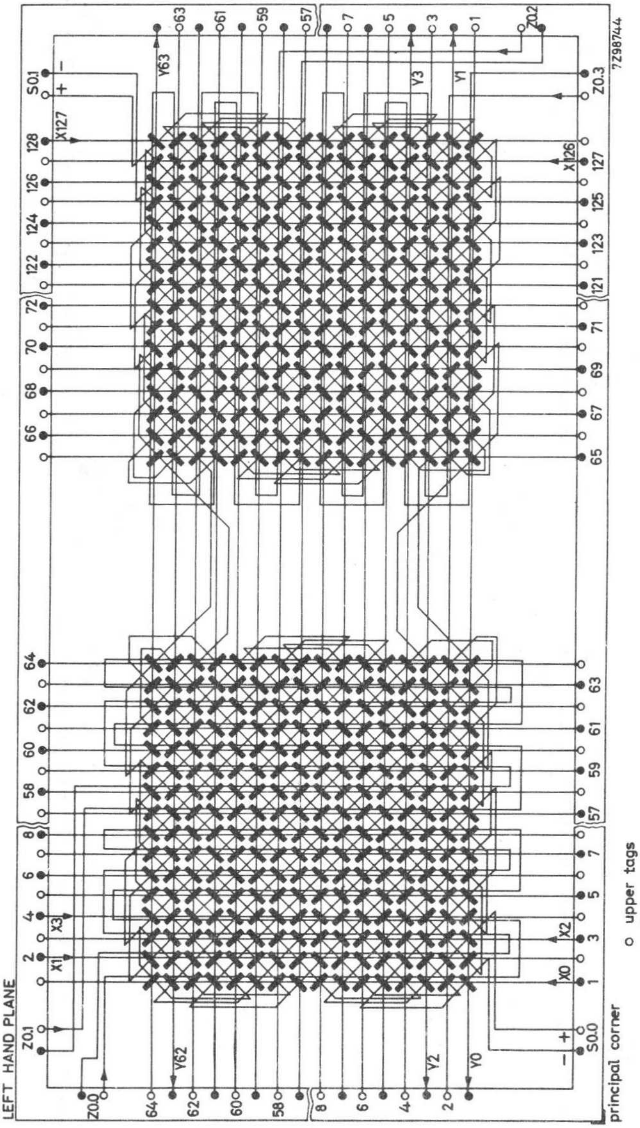
Z7.1
Z3.1
Z8.0
Z4.0
Z0.0
X0
X62
S7.1 S7.0
S3.1 S3.0

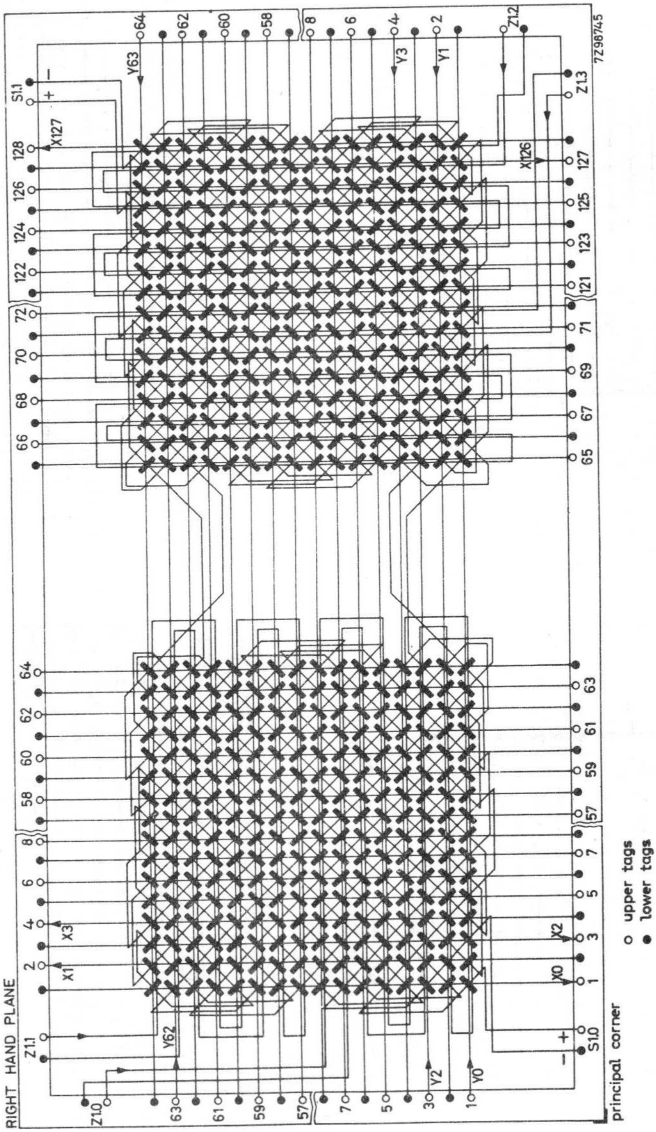


Stack with an even number of matrix planes 4 x 64 x 64 - 1X, 1Y, 8Z, 8S

1) Left-hand plane
2) Right-hand plane.

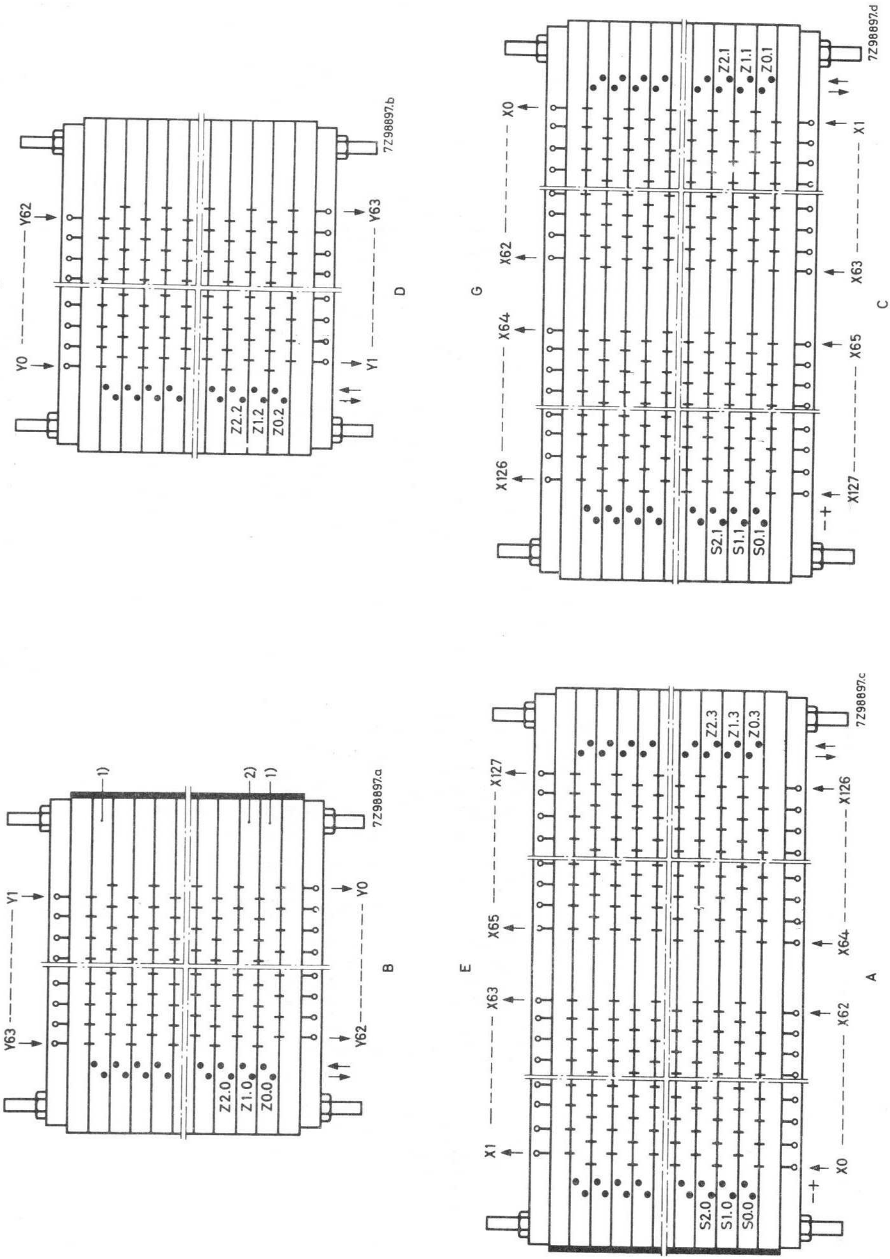


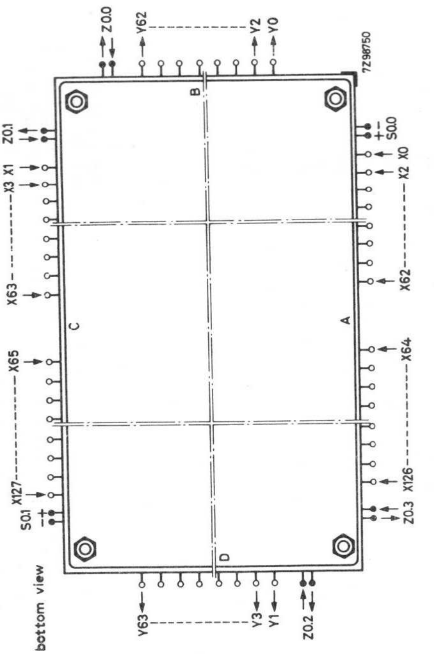
64 x 128 - 1X, 1Y, 4Z, 2S - left hand matrix plane

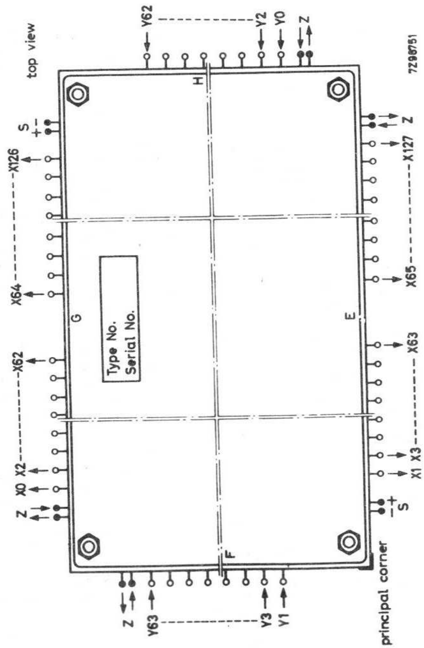


64 x 128 - 1X, 1Y, 4Z, 2S - right hand matrix plane

MATRIX PLANES AND STACKS WITH 20 mil CORES

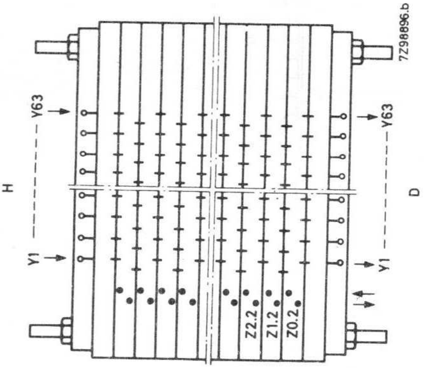


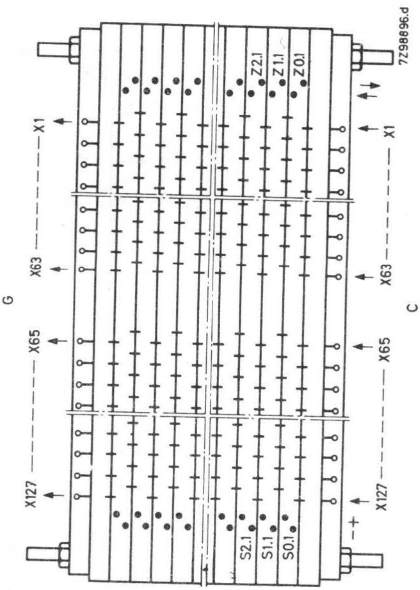


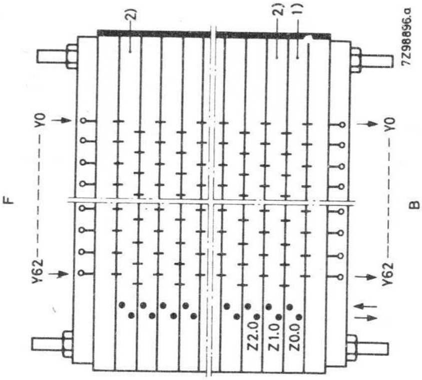


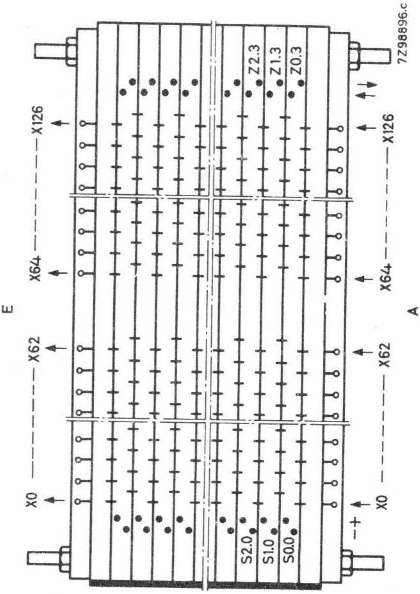
Stack with an odd number of matrix planes 64 x 128 - 1X, 1Y, 4Z, 2S

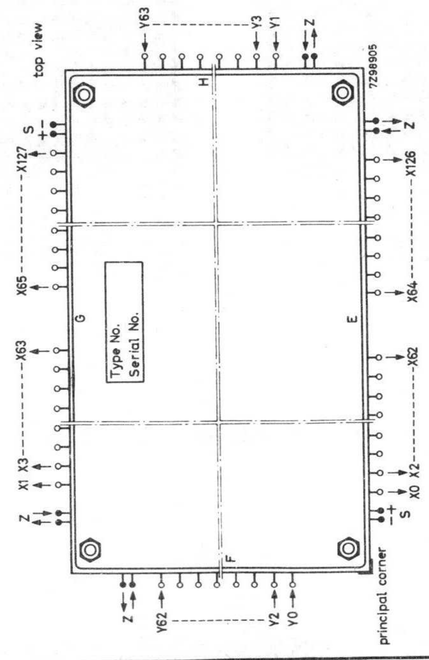
1) Left-hand plane
2) Right-hand plane.

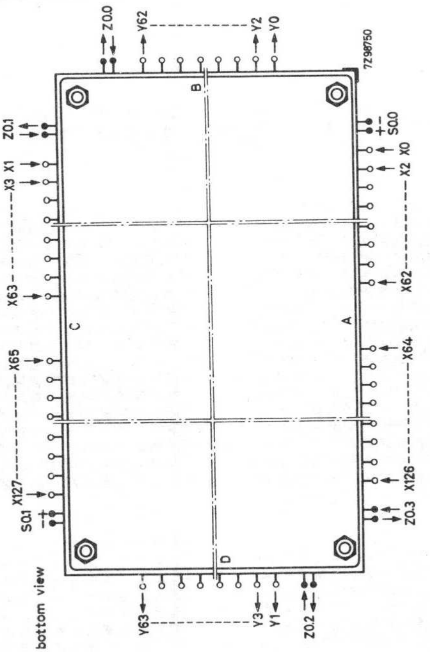

H
D
Y63
Y1
Z2.2
Z1.2
Z0.2
7Z98896.b


G
C
X1
X63
X65
X127
Z2.1
Z1.1
Z0.1
S2.1
S1.1
S0.1
7Z98896.d


F
B
Y0
Y62
2)
1)
Z2.0
Z1.0
Z0.0
7Z98896.a

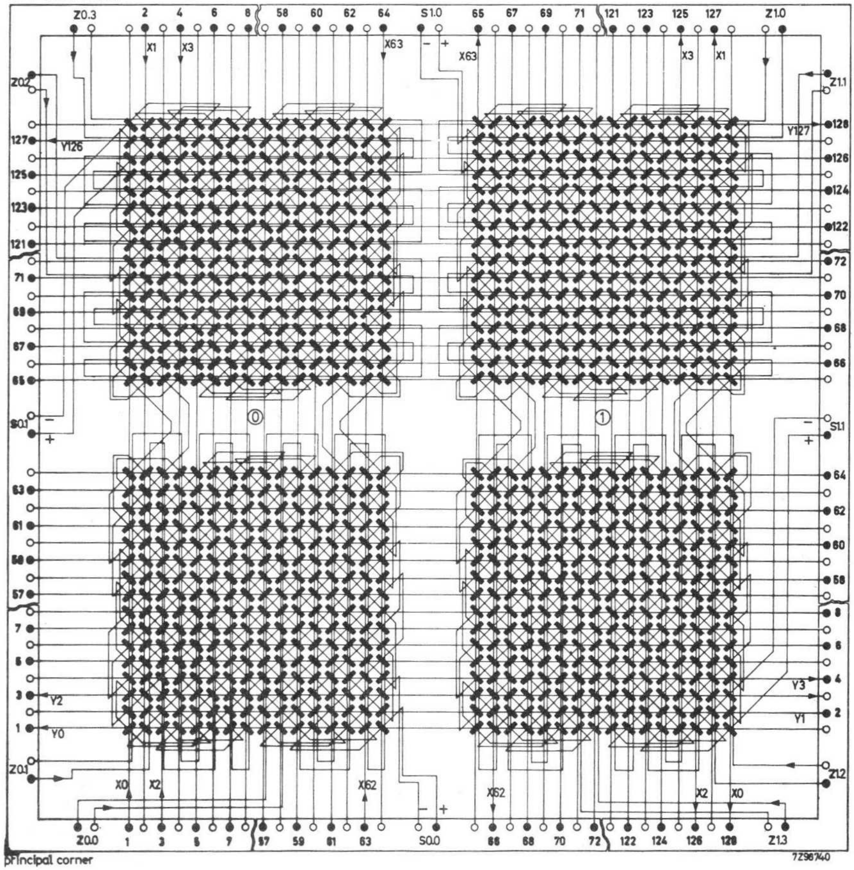

E
A
X0
X62
X64
X126
Z2.3
Z1.3
Z0.3
S2.0
S1.0
S0.0
7Z98896.c





Stack with an even number of matrix planes 64 x 128 - 1X, 1Y, 4Z, 2S

1) Left-hand plane
2) Right-hand plane

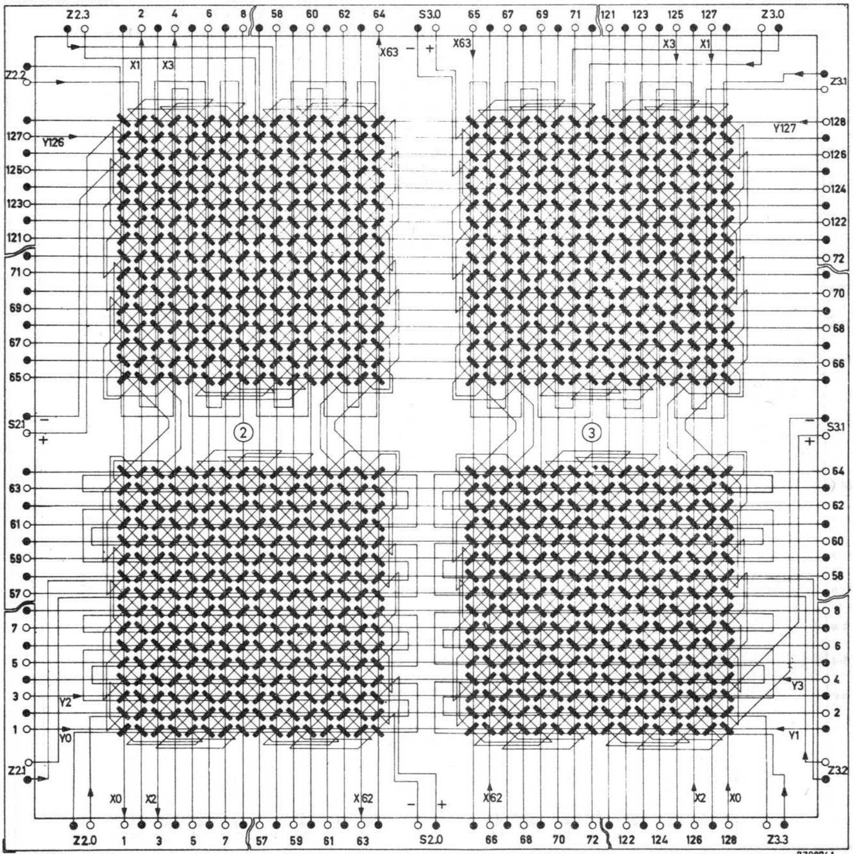


○ upper tags

● lower tags

2 x 64 x 128 - 1X, 1Y, 8Z, 4S - left hand matrix plane

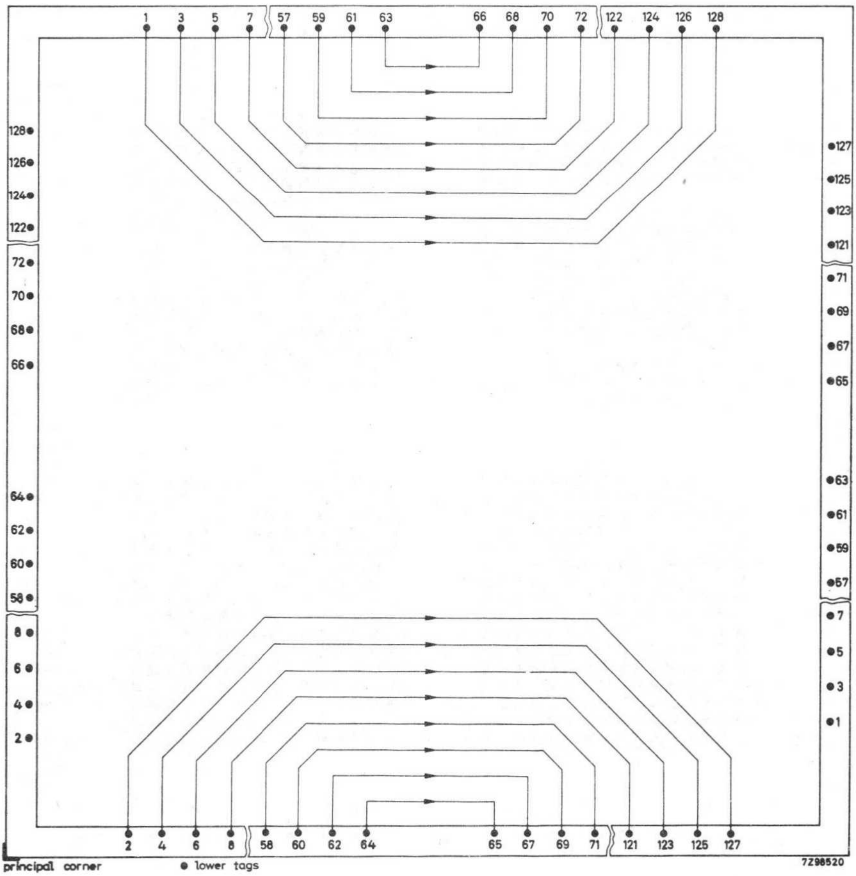
RIGHT HAND PLANE



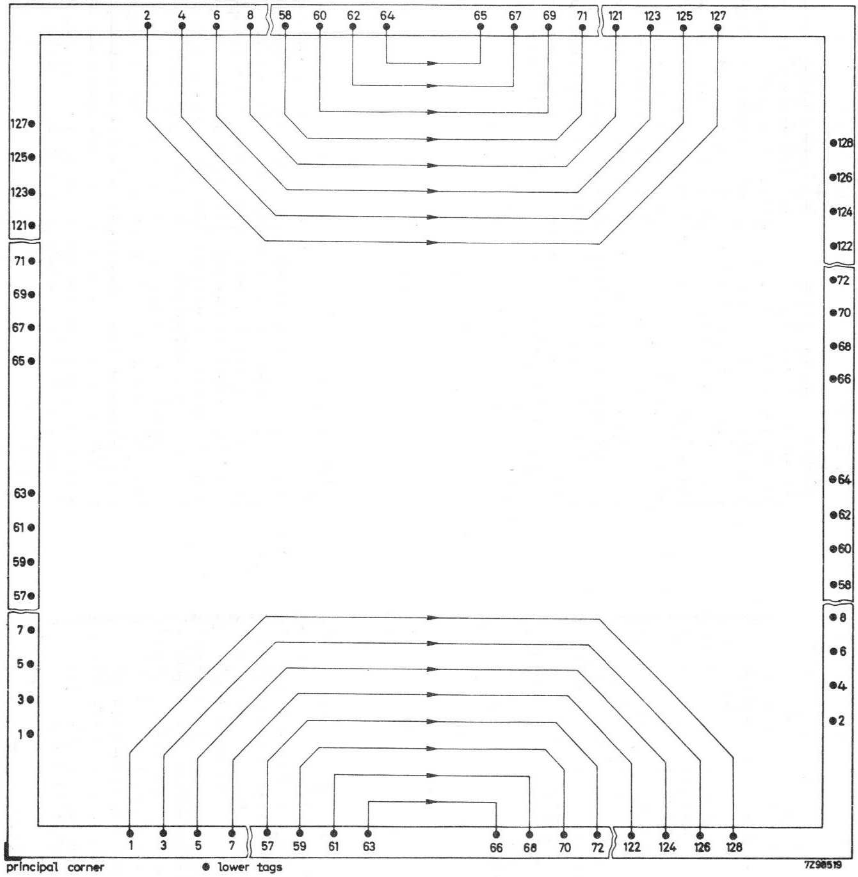
○ upper tags

● lower tags

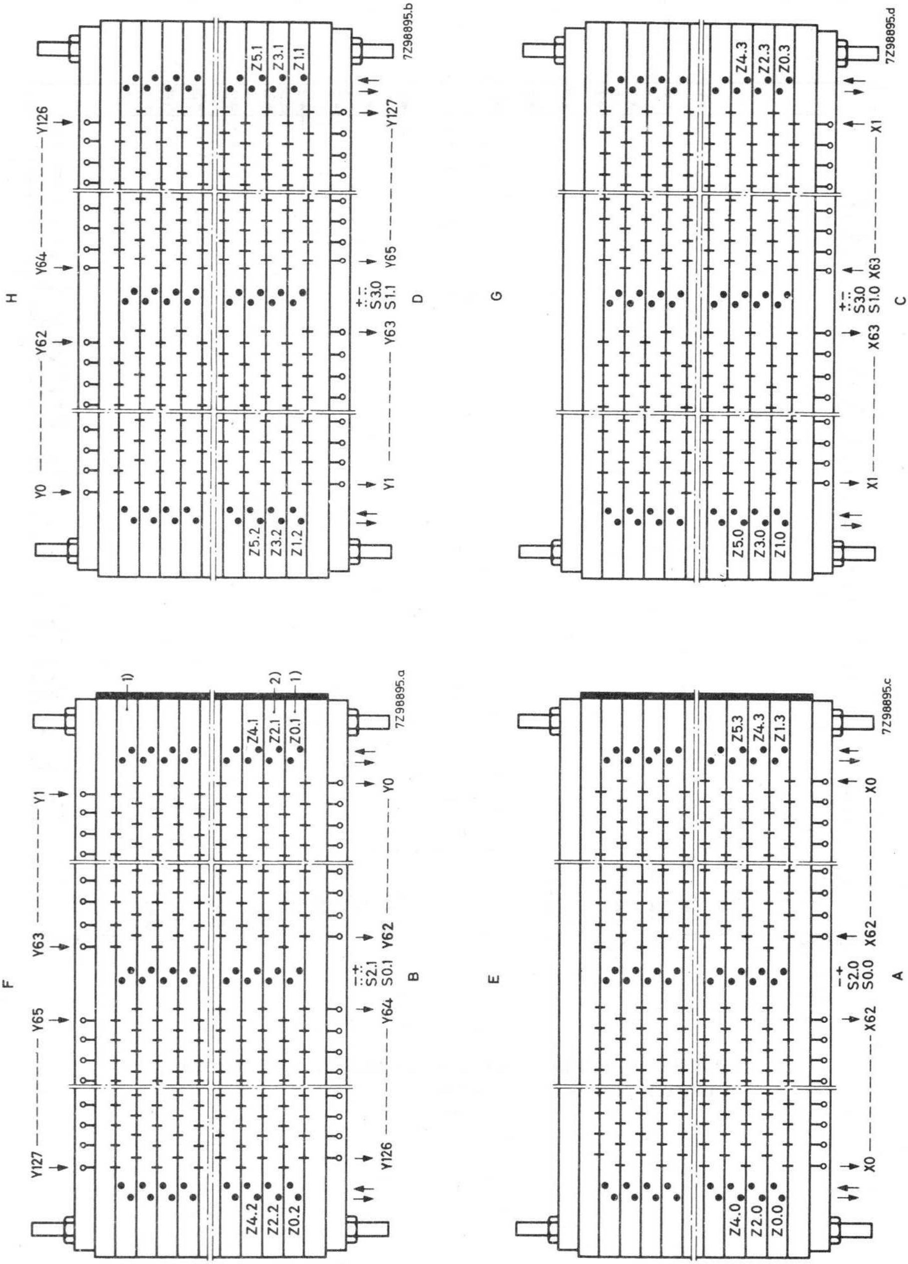
2 x 64 x 128 - 1X, 1Y, 8Z, 4S - right hand matrix plane

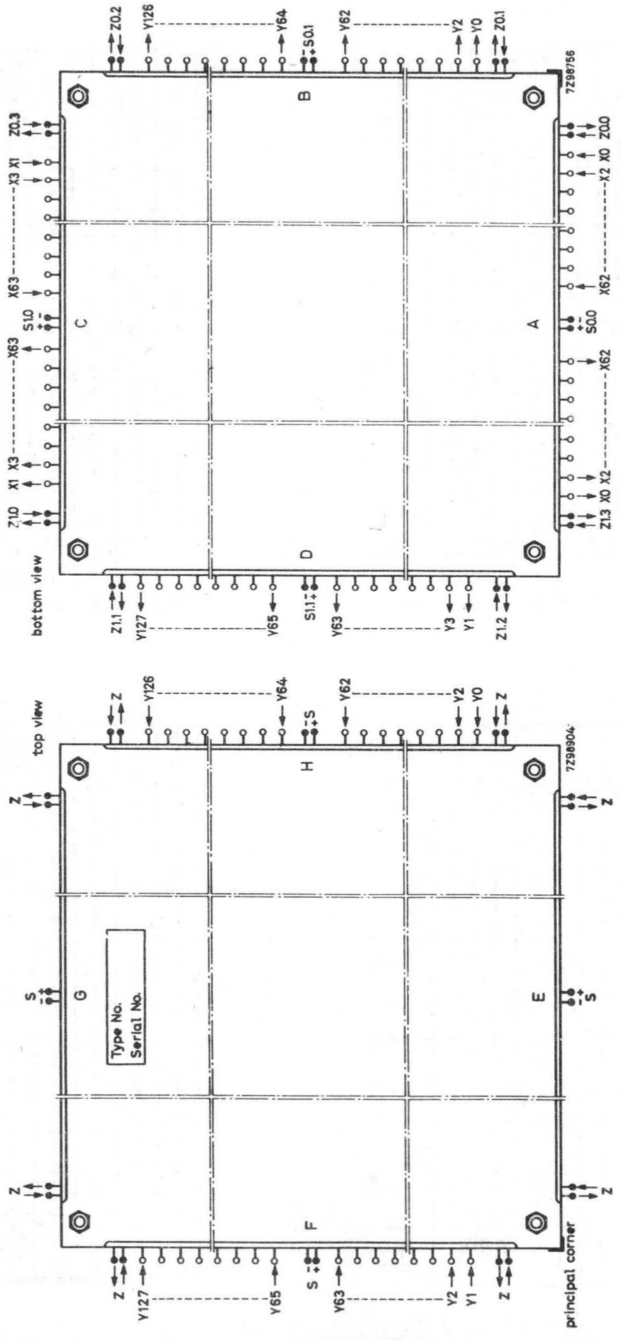


Interconnection plane for a stack with an odd number of matrix planes 2 x 64 x 128

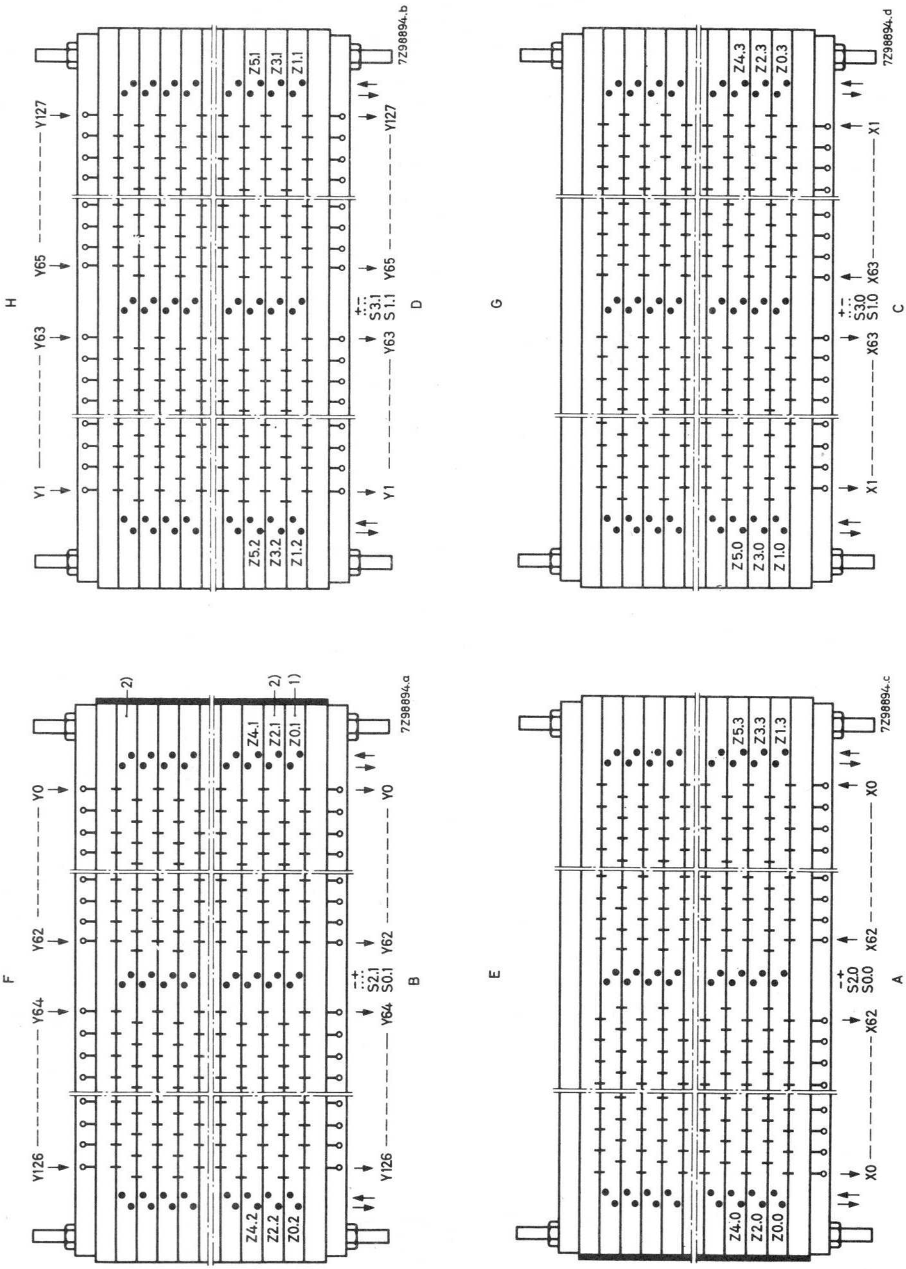


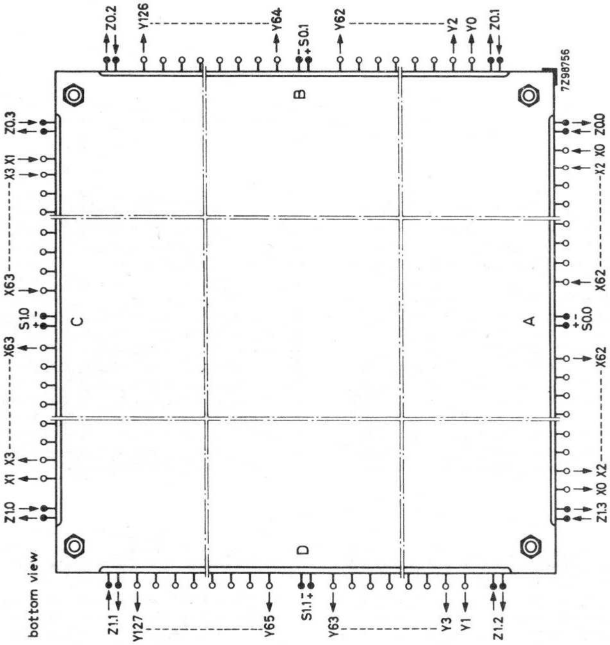
Interconnection plane for a stack with an even number of matrix planes 2 x 64 x 128

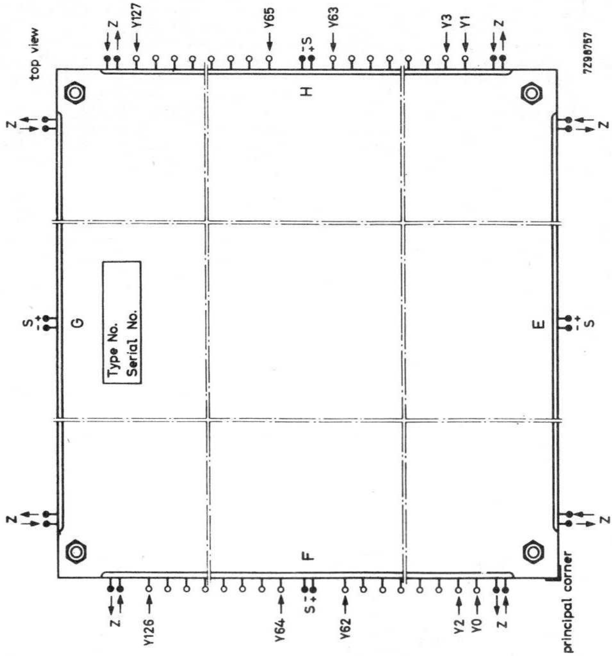

7Z98895.b
7Z98895.d
7Z98895.a
7Z98895.c
A
B
C
D
E
F
G
H



Stack with an odd number of matrix planes 2 x 64 x 128 - 1X, 1Y, 8Z, 4S
1) Left-hand plane
2) Right-hand plane.


H
D
G
C
F
B
E
A
7Z98894.a
7Z98894.b
7Z98894.c
7Z98894.d
Y0
Y62
Y64
Y126
Y1
Y63
Y65
Y127
X0
X62
X1
X63
Z4.1
Z2.1
Z0.1
Z4.2
Z2.2
Z0.2
Z5.1
Z3.1
Z1.1
Z5.2
Z3.2
Z1.2
Z5.3
Z3.3
Z1.3
Z4.0
Z2.0
Z0.0
Z4.3
Z2.3
Z0.3
Z5.0
Z3.0
Z1.0
S2.1
S0.1
S3.1
S1.1
S2.0
S0.0
S3.0
S1.0
1)
2)



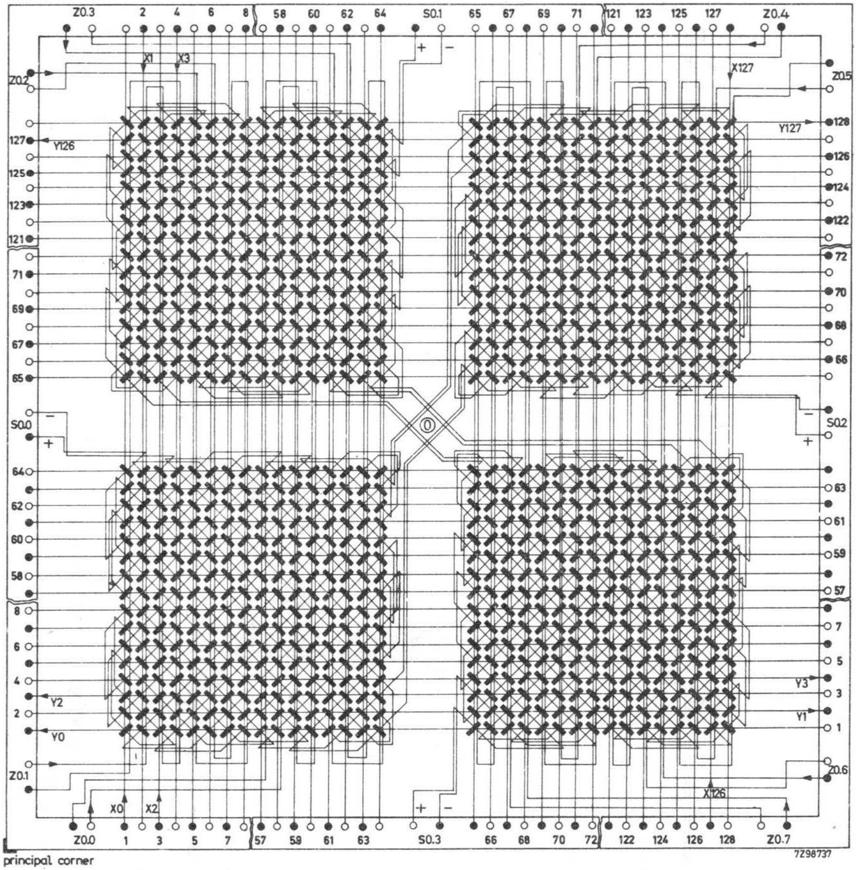


Stack with an even number of matrix planes 2 x 64 x 128 - 1X, 1Y, 8Z, 4S

1) Left-hand plane

2) Right-hand plane.

LEFT HAND PLANE

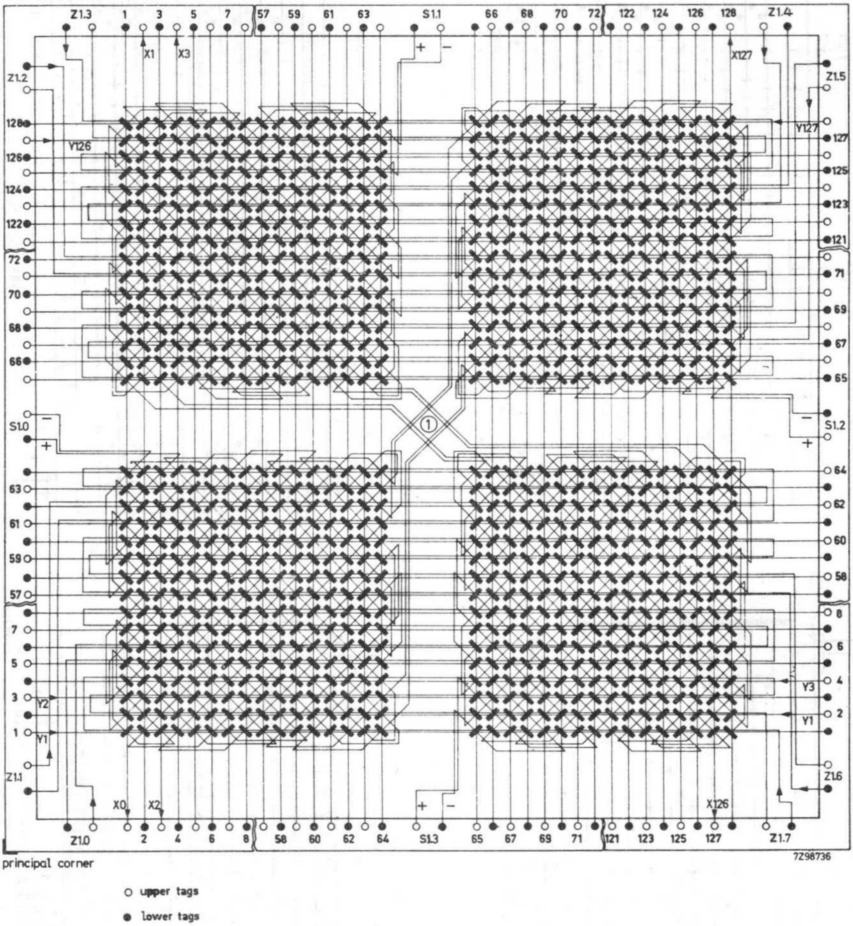


○ upper tags

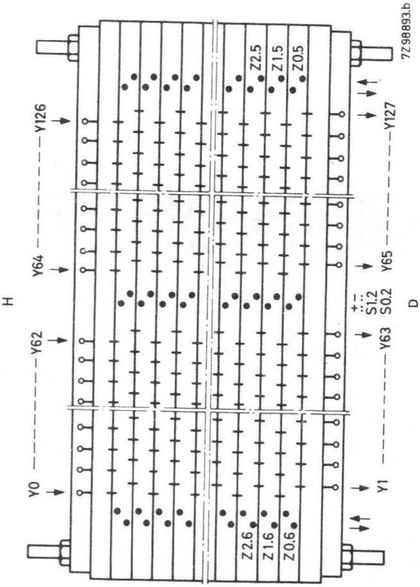
● lower tags

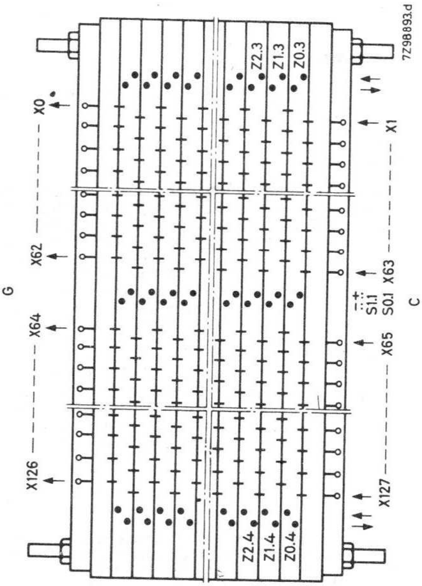
128 x 128 - 1X, 1Y, 8Z, 4S - left hand matrix plane

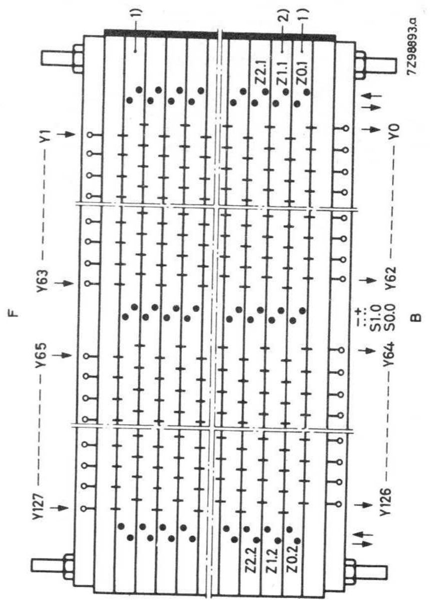
RIGHT HAND PLANE

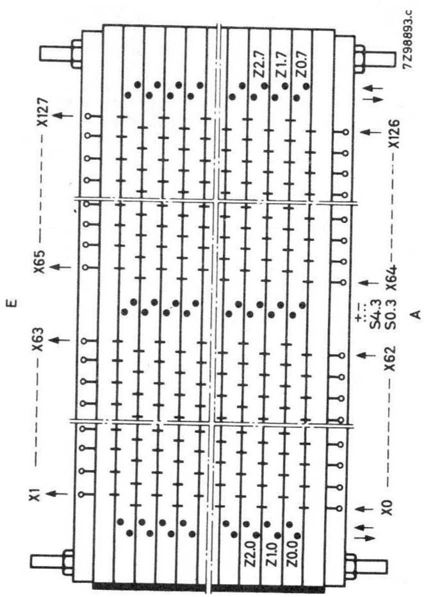


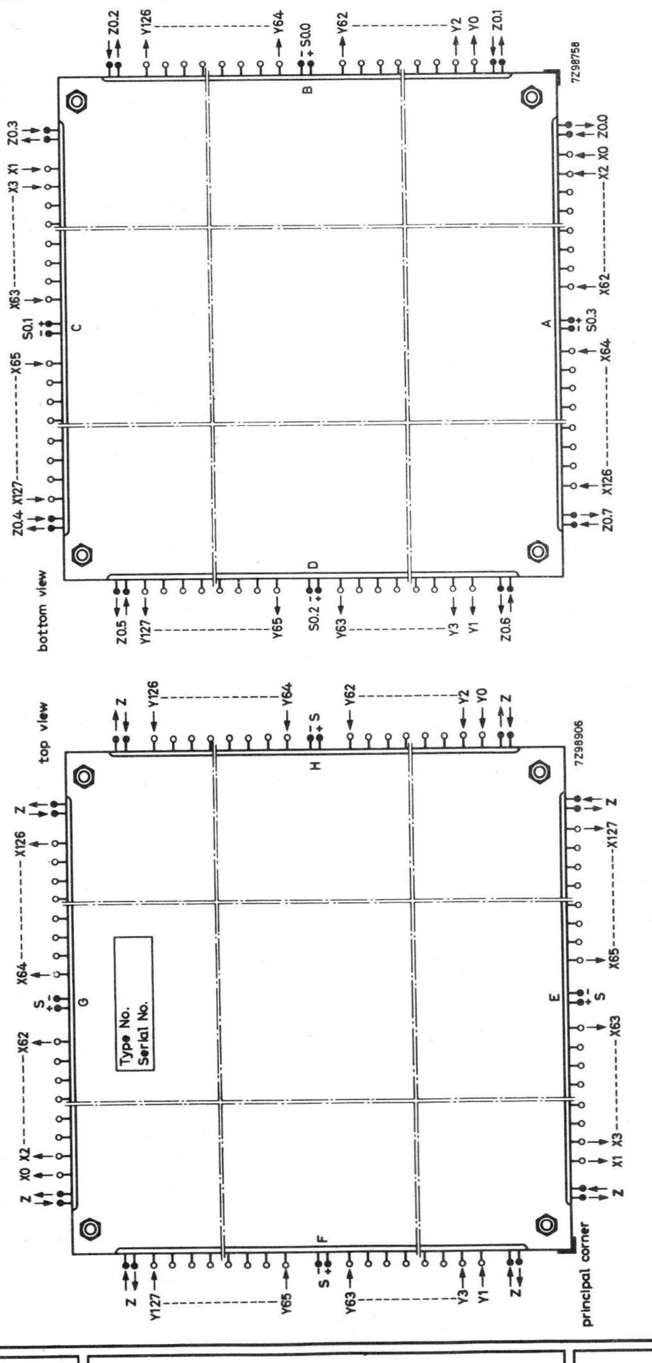
128 x 128 - 1X, 1Y, 8Z, 4S - right hand matrix plane


Y126
Y64
H
Y62
Y0
Z2.5
Z1.5
Z0.5
Y127
Y65
S1.2
S0.2
D
Y63
Y1
Z2.6
Z1.6
Z0.6
7Z98893.b


X0
X62
G
X64
X126
Z2.3
Z1.3
Z0.3
X1
X63
S1.1
S0.1
C
X65
X127
Z2.4
Z1.4
Z0.4
7Z98893.d


1)
2)
1)
Y1
Y63
F
Y65
Y127
Z2.1
Z1.1
Z0.1
Y0
Y62
S1.0
S0.0
B
Y64
Y126
Z2.2
Z1.2
Z0.2
7Z98893.a


X127
X65
E
X63
X1
Z2.7
Z1.7
Z0.7
X126
X64
S4.3
S0.3
A
X62
X0
Z2.0
Z1.0
Z0.0
7Z98893.c

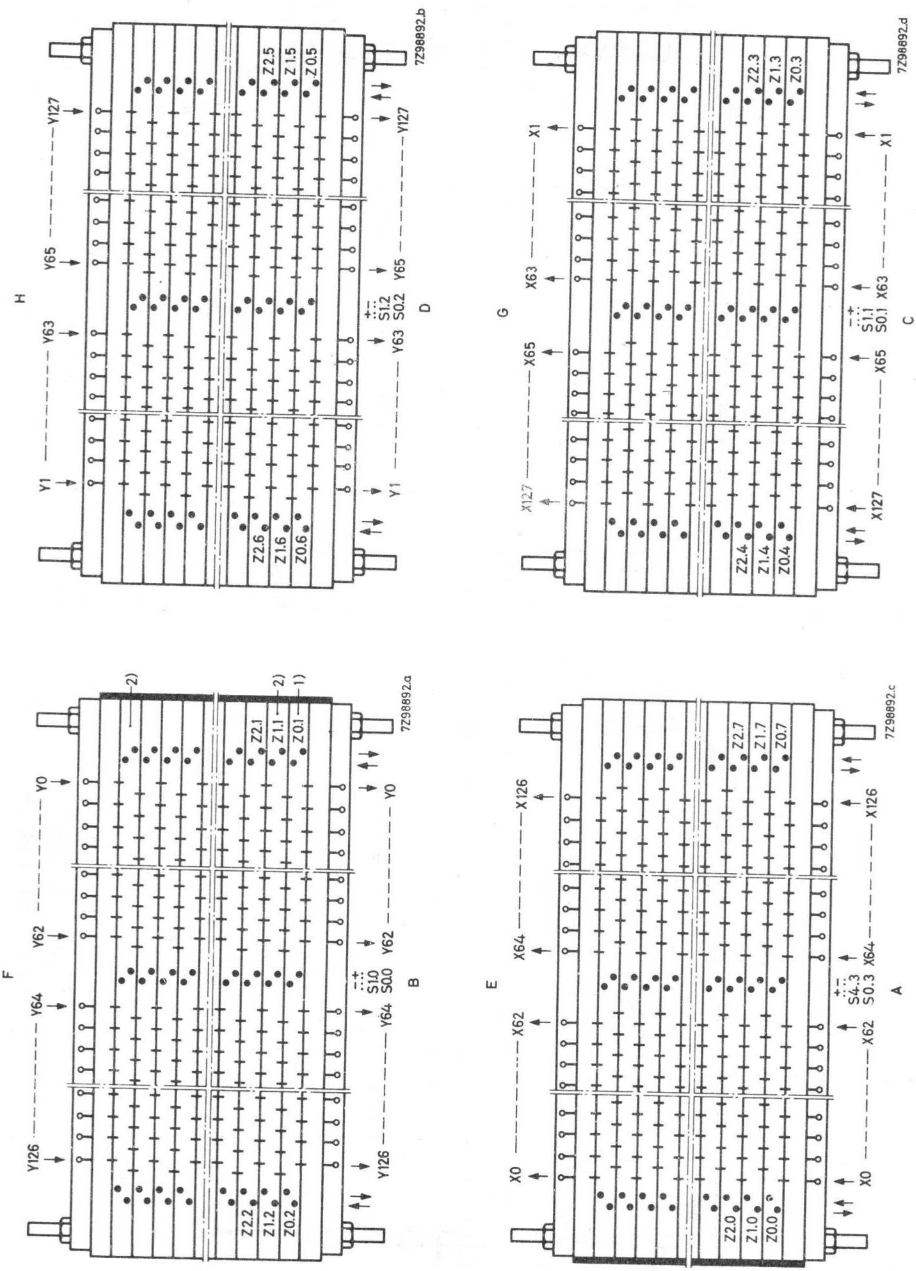


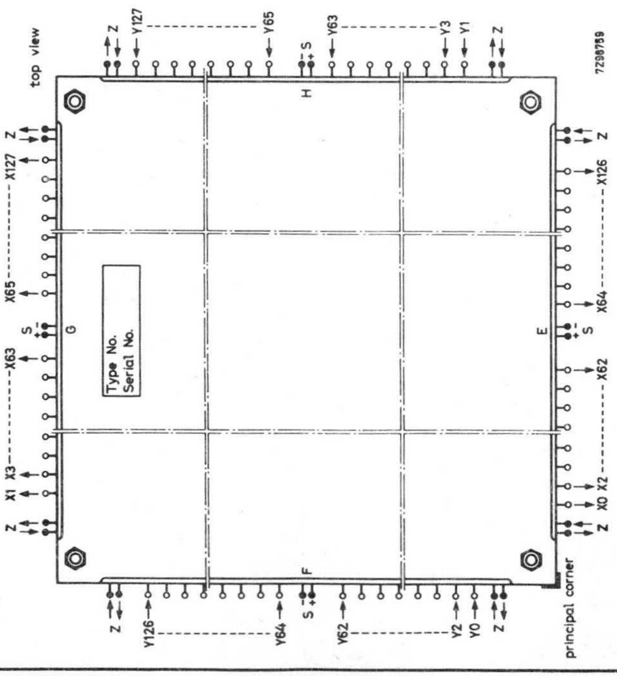
Stack with an odd number of matrix planes 128 x 128 - 1X, 1Y, 8Z, 4S

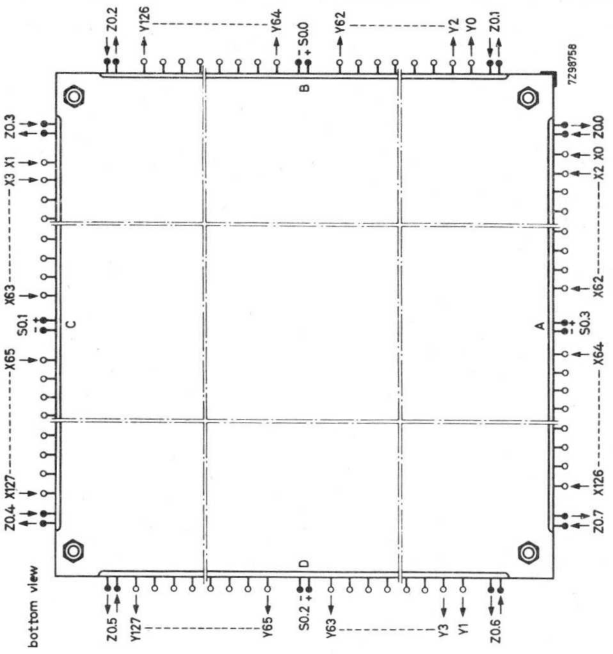
1) Left-hand plane

2) Right-hand plane

MATRIX PLANES AND STACKS WITH 20 mil CORES



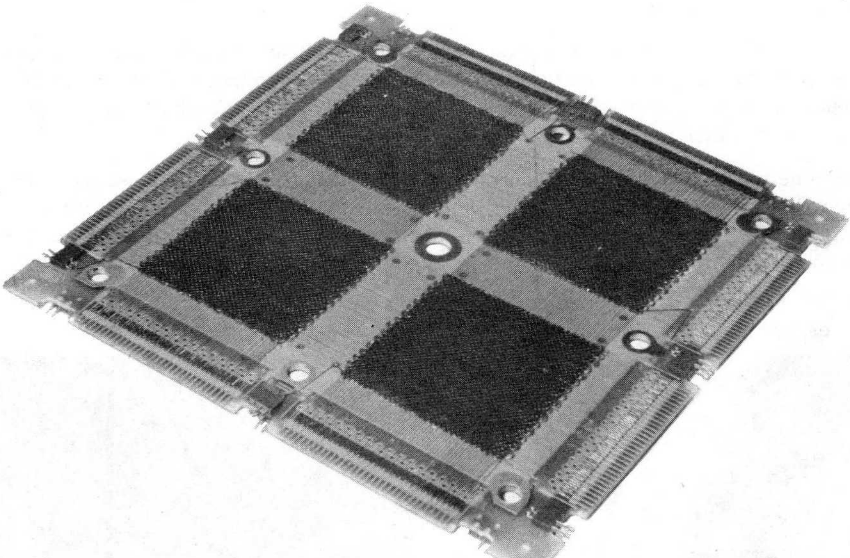




Stack with an even number of matrix planes 128 x 128 - 1X, 1Y, 8Z, 4S

1) Left-hand plane
2) Right-hand plane

3D CORE MATRICES ON PRINTED-WIRING BOARDS



RZ 27607-4

APPLICATION

Core matrices mounted and lacquered directly on special printed-wiring boards are used because of many benefits over frame mounted matrices, in particular:
- temperature differences within a stack are greatly reduced, thus reducing average cycle time;
- layout and interconnections are greatly simplified;
- stack assembly is strengthened;
- stack height is reduced.

DESCRIPTION

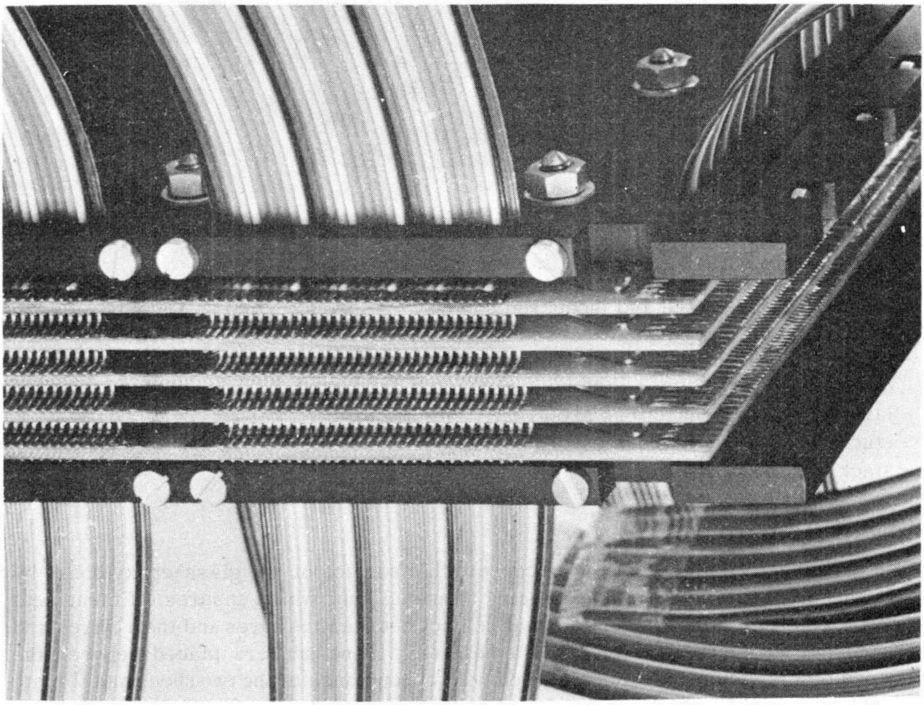
The core matrix is secured to the copper-clad surface of the glass-epoxy board by a lacquering process, the lacquer being a special type which ensures efficient heat transfer and establishes good thermal contact between the cores and their wires and the copper surface, which acts as a heat-sink. Nine spacers placed between the boards of a complete stack ensure good heat conductance to the two sheet metal plate "Stack heat-sinks" which can be placed at either end of the stack. These stack heat-sinks serve also as physical protection (See photograph).

The core matrix is divided into four 64 by 64 core (4k) sub-matrices, enabling 4k, 8k and 16k word capacity to be obtained. The number of bits required determine how many matrices have to.be stacked together; the interconnections between these are achieved by using comb-type contact springs. For the 4k- and 8k-word versions the necessary interconnections of the drive wires are provided by means of a "turn-over-plane". If in the stack there is one board which is occupied only at one side by a core matrix, the other side can be made into a turn-over plane. No turn-over plane is required for the 16k word version.

The board mounting method can be used also to incorporate the associated selection diodes, mounted on a separate board, into the stack; the number of off-lead wires is reduced in this manner. If no diode boards are desired, the stack can be equipped with a special "termination plane".

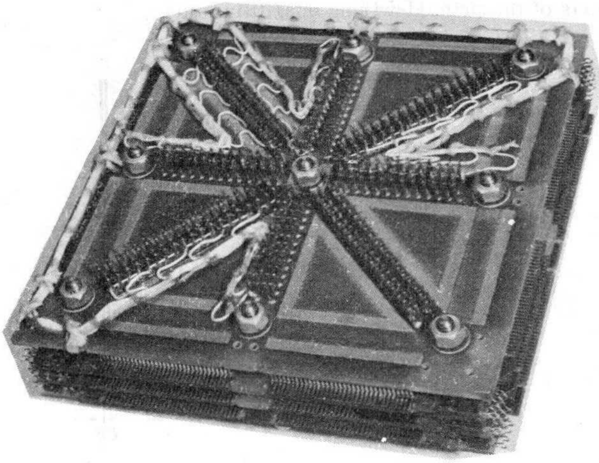
Because the cores and wires of each board are firmly embedded in lacquer, and 9 spacer bolts are used, the assembly is highly resistant to damage from vibration, in addition the solid stack heat-sinks impart great rigidity to the assembly. The memory stack complies fully with the mechanical requirements of MIL STD 202C.

Height of the stack is less than conventional frame-mounted core stacks, because matrices are placed on both sides of each board.



RZ 25282-2

Stack with heat-sinks.



RZ 27607-2

Stack with termination plane. The comb type contact springs are visible between the boards.

STANDARD RANGE

Catalogue number for ordering 2722 062 ..... suffix, see table

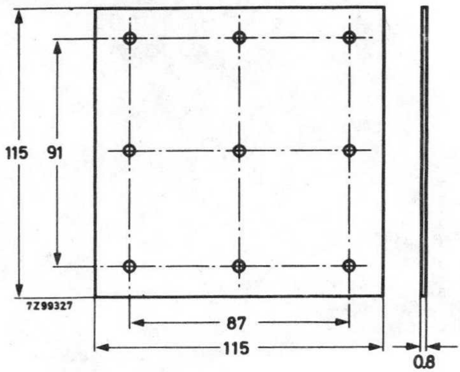
core pattern	wiring X Y Z S	core type	suffix
2 x (4 x 64 x 64)	1 1 4 4 *	6H2	27001
	1 1 4 4 *	6H3	27011
	1 1 4 8	6H2	27021
	1 1 4 8	6H3	27031
2 x (2 x 64 x 128)	1 1 4 4	6H2	35001
	1 1 4 4	6H3	35011
	1 1 4 8	6H2	35021
	1 1 4 8	6H3	35031
2 x (128 x 128)	1 1 4 4	6H2	08001
	1 1 4 4	6H3	08011
	1 1 4 8	6H2	08021
	1 1 4 8	6H3	08031

* Matrices without interlaced sense wiring.

MECHANICAL DATA

Core type	6H2 or 6H3
Core pitch	20 mil
Spacing between printed wiring boards	3.2 mm

Main dimensions of the printed-wiring board (in mm)



ELECTRICAL DATA

Characteristic impedance of X and Y wires	Z_{0X}, Z_{0Y}	83	Ω
Z wires	Z_{0Z}	85	Ω
S wires	Z_{0S}	125	Ω
Resistance of X and Y wires	R_X,R_Y	1.16	Ω
Z wires	R_Z	7.8	Ω/submatrix
S wires	R_S	29.0	Ω/submatrix
Inductance of X and Y wires	L_X,L_Y	0.38	μH
Z wires	L_Z	2.4	μH
S wires	L_S	3.8	μH
Nominal partial write pulse at 25 °C ambient	$I_{pw(nom)}$	480	mA
Nominal partial read pulse at 25 °C ambient	$I_{pr(nom)}$	480	mA
Cycle time	t_c	1	μs
Switching time at 3 mV reference (best pattern)	t_s	0.23	μs
"One" output voltage with load impedance of 150 Ω (best pattern)		> 30	mV
Current temperature compensation		1.35	mA/deg C

COMPLETE MAGNETIC CORE MEMORIES

INTRODUCTION

A magnetic core memory is an equipment for the storage of digital information and can be used in data handling, process control, machine tool control, stock control, traffic control systems, nuclear energy analysis, instrumentation and electronic telephone exchanges.

Our magnetic core memories are complete memories consisting of digital circuit blocks and a ferrite core matrix stack which are assembled in shelves for standard 19" rack mounting.

Their production is based on a long experience in mass production of ferrite memory cores, matrices and stacks as well as circuit blocks. Therefore they offer an economical and highly reliable contribution to their application fields.

The high reliability is specially due to:

- Worst-case design of all circuits, where calculations have been performed with end of life data of all components.
- Professional semiconductors being used throughout.
- Severe control procedure of all components and sub-assemblies, before, during and after the whole production process.
- Testing of the complete memory under severe circumstances:

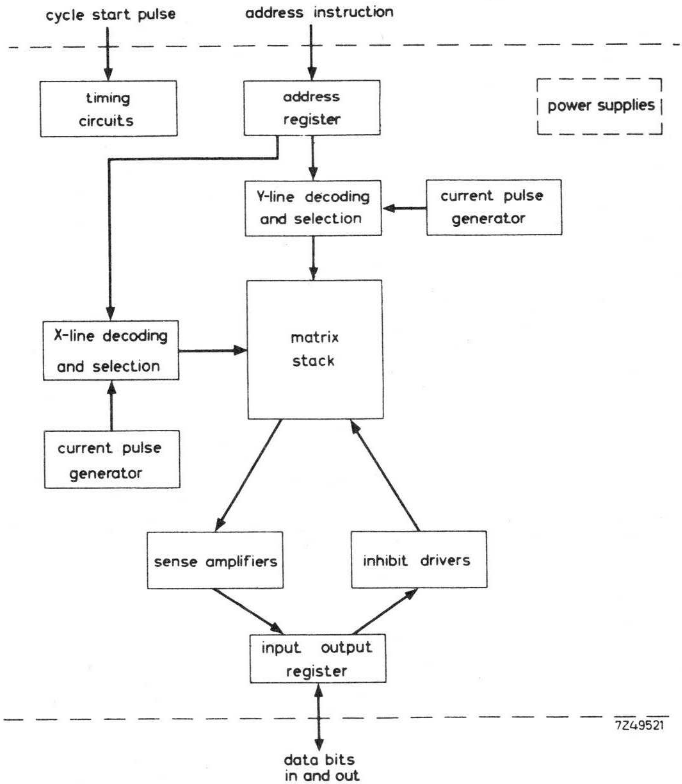
  1. extreme voltage tolerances
  2. extreme temperatures
  3. worst-pattern test programme for checking the margins of the memories.

In our memory systems use is made of plug-in printed circuit boards to mount all the circuitry.

SELECTION GUIDE (For small capacities see also the section "Delay line memories".)

Capacity	Memory type	Cycle time	Access time	Mounting	Page
256/4	FI-11	6 μs	1 μs	p.c. board	A255
1 k/8	FI-2	4 μs	0.6 μs	p.c. board	A243
1 k/8	FI-21	1.6 μs	0.4 μs	p.c. board	A259
80, 160/17	FI-23	8 μs	2 μs	p.c. board	A263
1, 2, 4, 8 k/6-18	FI-3	3 μs	1 μs	19 inch rack	A247
4 k/8-40, 8 k/8-20, 16 k/8-10	FI-4	1 μs	0.39 μs	19 inch rack	A251
4 k/18 – 16 k/18	FI-41	1 μs	0.4 μs	p.c. board	A267
8, 16, 24, 32 k/18	32P06	0.64 μs	0.28 μs	19 inch rack	A271
512 k/9, 256 k/18, 128 k/36	500G2	2.5 μs	1.2 μs	19 inch rack	A275

BLOCK DIAGRAM OF THE COMPLETE MEMORIES



SOME DEFINITIONS

Cycle time : the minimum time between two successive cycle start pulses.

Access time : the time interval between receiving a cycle start pulse and the store output becoming available.

4 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	1 k/8
Cycle time	4 μs
Access time	0.6 μs
Data save output line	
Modules can be paralelled to obtain larger capacities	
Single power supply (+12 V)	
Random access	

DESCRIPTION

A random access ferrite core memory system built on five interconnected printed circuit cards. Incorporating integrated circuit as well as discrete components the system comprises decoding, drive, data and timing circuitry. All input-output lines are terminated with a single connector.

MECHANICAL DATA

Dimensions

width	82	mm
height	121.8	mm
depth	205	mm

Mounting

Components mounted on epoxy-glass printed circuit cards, bolted together to form a rigid module which can be plugged into a mounting chassis.

ENVIRONMENTAL DATA

Ambient temperature	0 to 55 °C
Humidity	0 to 90% (without condensation)
Shock	1000 bumps of 10 g
Vibration	5 to 150 Hz at 5 g max.
Cooling	by natural convection of air

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
1024	8

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/write	4 μs	0.6 μs
clear/write	4 μs	

Input signals

P_{st}	start command
P_W	write command
L_{cl}	clear level
L_{res}	timing reset
L_{prot}	data protection level
$S_{b\,n}$	selection bit (n = 1, 2)
$A_{b\,n}$	address bits (n = 0 ... 9)
$D_{bi\,n}$	data signals (n = 1 ... 14)

Output signals

P_{wcc}	write cycle complete pulse
P_{da}	data available pulse
$D_{bo\,n}$	data signals (n = 1 ... 8)

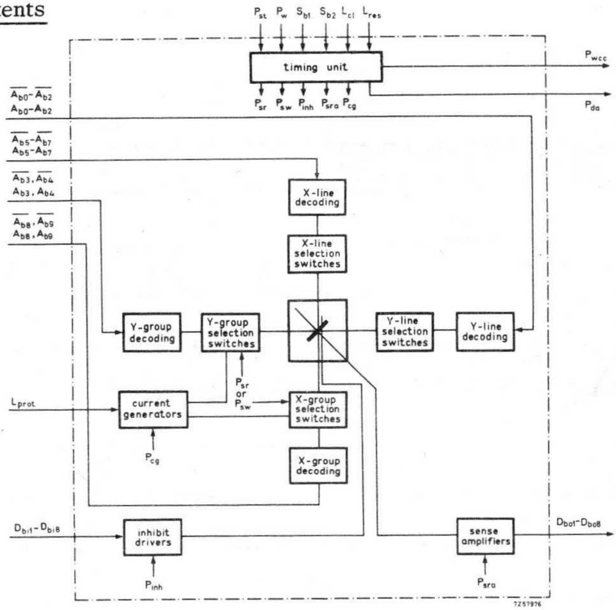
Output signals

P_{wcc}	write cycle complete pulse
P_{da}	data available pulse
$D_{bo\,n}$	data signals (n = 1 ... 8)

Interface

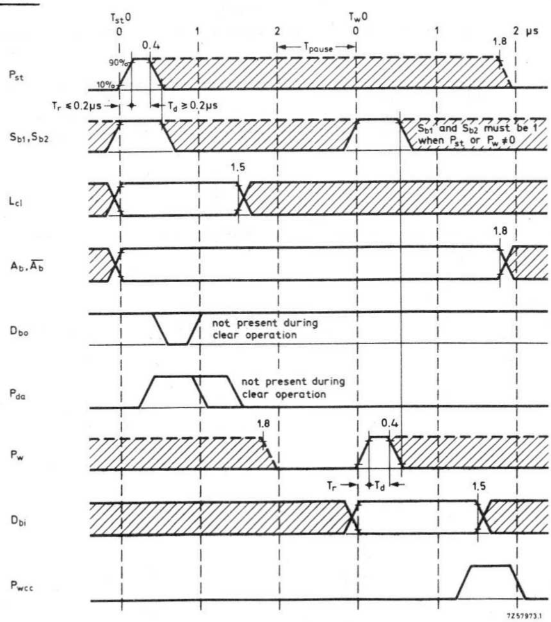
Interconnections		via twisted pairs
Input levels	"1"	+2.2 to +6.5 V
	"0"	0 to +0.4 V
Output levels	"1"	+3.6 to +4.4 V
	"0"	0 to +0.4 V
Power consumption (d.c.)		+12 V, 3 A

Memory contents

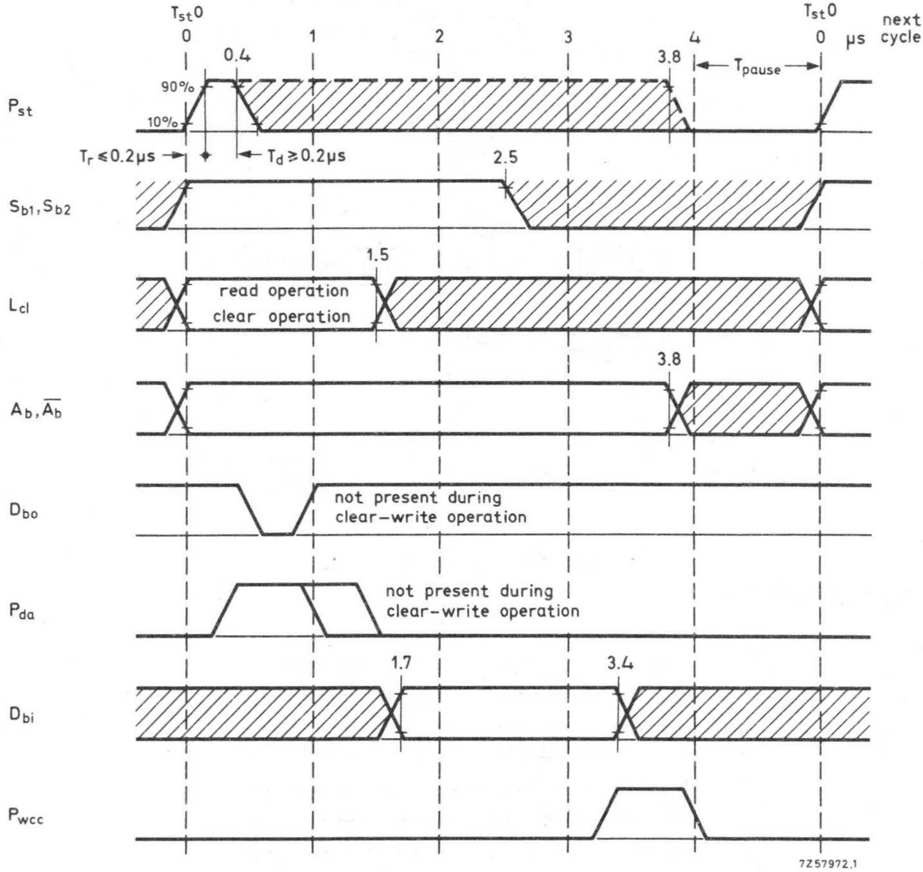


Block diagram of the FI-2

Timing diagram



Timing of Read- and Clear-Modify-Write (split-cycle) modes



Timing of Read-Restore , Read- and Clear-Write (full-cycle) modes.

3 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	from 1 k/6 to 8 k/18
Cycle time	3 μs
Access time	1 μs
Mode of operation	half cycle/split cycle/full cycle
Output signals of address register available	
Optional counting address register, power supply and memory retention	

DESCRIPTION

FI-3 random access memory systems are available in four different capacities and over 1000 models.
FI-3 systems can be ordered complete with address register/counter, memory retention, and power supplies. Optional random or sequential operation.

MECHANICAL DATA

Dimensions

width	485 mm
height	135 mm
depth	325 mm

Mounting

Components mounted on epoxy-glass printed circuit cards which are plugged into a mounting chassis fitting a 19 inch rack.

ENVIRONMENTAL DATA

Ambient temperature	0 to 50°C
Humidity	0 to 90% (without condensation)
Shock (without power supply)	1000 bumps of 5 g
Vibration (without power supply)	5 to 55 Hz at 2 g max.
Cooling	by natural convection of air (without power supply)

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
1024	6-18
2048	6-18
4096	6-18
8192	6-18

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	3 μs	1 μs
clear/write	3 μs	
read/write	4 μs	1 μs
read only	2 μs	1 μs
write only	2 μs	

Input signals

P_r	read command
P_w	write command
L_{hc}/f_c	half-full cycle level
$P_{cdi\ n}$	data signals in (n = 1 ... 18)
L_r/seq.	random/sequential level
L_{sc}	split-cycle level
$P_{ca\ n}$	address signals (n = 0 ... 12)

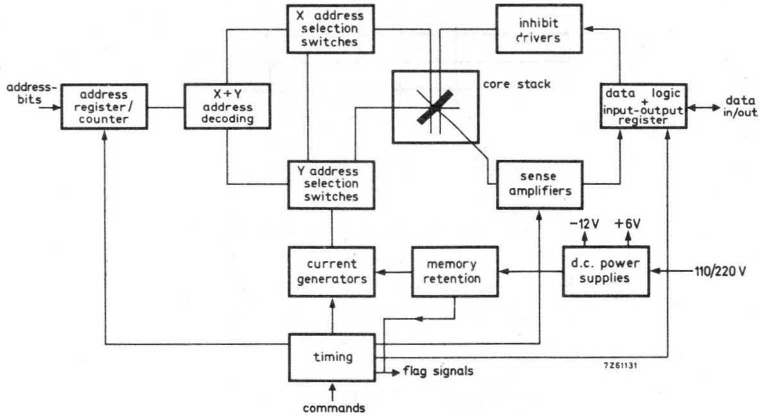
Output signals

P_{cc}	cycle complete pulse
P_{cda}	data available pulse
$P_{cdo\ n}$	data signals out (n = 1 ... 18)
$P_{ca\ n}$	address signals out (n = 0 ... 12)

Interface

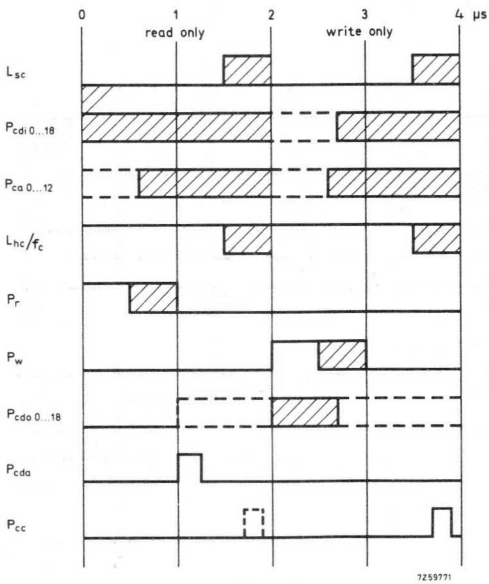
Interconnections	via twisted pairs
Input levels "1"	+2.8 to +6.5 V
"0"	0 to +0.4 V
Output levels "1"	+3.5 to +6.5 V
"0"	0 to +0.4 V
Power consumption (d.c.)	+6 V, 6.4 A (for 4k/18)
	−12 V, 4.3 A (for 4k/18)

Memory contents

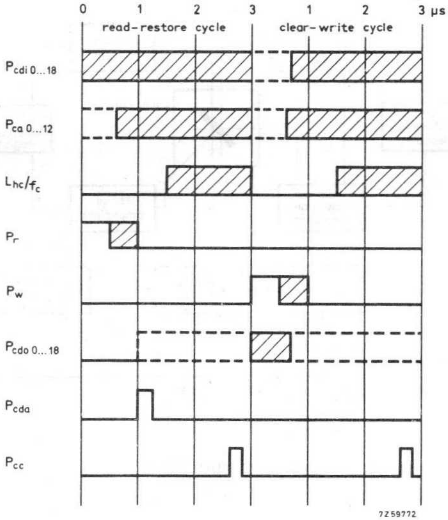


Block diagram of the FI-3

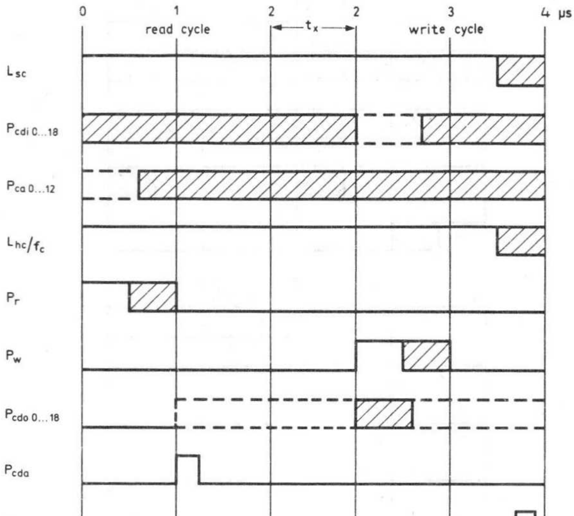
Timing diagram



Half cycle modes



Read restore and clear-write



Read modify write

1 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	4 k/8-40, 8 k/8-20, 16 k/8-10
Cycle time	1 μs
Access time	0.39 μs
a.c. and d.c. data retention	optional
Built-in power supply (for capacities up to 4 k/20 and 8 k/10)	optional
Parity generation and check	optional
Random access	

DESCRIPTION

FI-4 series random access memory systems are available in capacities from 4096 words of 8 to 40 bits, 8192 words of 8 to 20 bits and 16 k words of 8 to 10 bits. The range covers over 35 types with various options and capacities. All systems are designed for full/split cycle mode. The FI-4 is built with components mounted on printed circuit cards which plug into a card cage; the core stack too, is a plug-in assembly.

For capacities larger than 4 k/20 an external power supply (19 inch rack mounted) is optionally available.

MECHANICAL DATA

Dimensions

width	485 mm
height	134 mm
depth	268 mm

Mounting

Components mounted on epoxy-glass printed circuit cards which are plugged into a mounting chassis fitting a 19 inch rack.

ENVIRONMENTAL DATA

Ambient temperature	0 to 50 °C
Humidity	0 to 90% (without condensation)
Shock	30 bumps
Vibration	10 to 500 Hz max.
Cooling	with built-in blowers

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
4096	8-40
8192	8-20
16384	8-10

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	1 μs	0.39 μs
clear/write	1 μs	
read/write	1 μs	0.39 μs

Input signals

R_c	read command
W_c	write command
$L_{fc/sc}$	full cycle/split cycle level
$A_{b\,n}$	address bits (n = 0 ... 11)
$D_{bi\,n}$	data signals (n = 1 ... 40)
B_c	byte control input
M_r	memory retention input

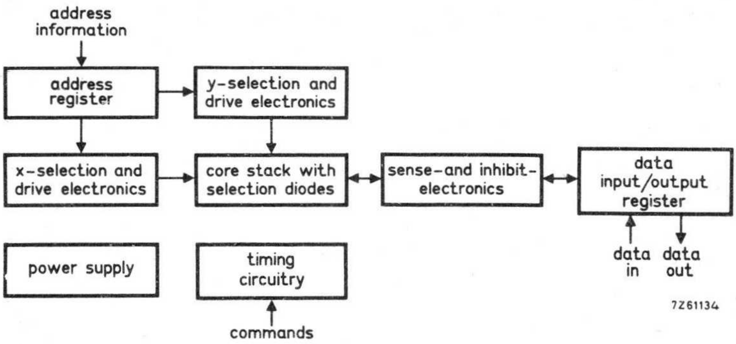
Output signals

$D_{bo\,n}$	data signals (n = 1 ... 40)
D_a	data available pulse
P_{wcc}	write cycle complete signal
L_b	memory busy
D_{pe}	data parity error indication (optional)

Interface

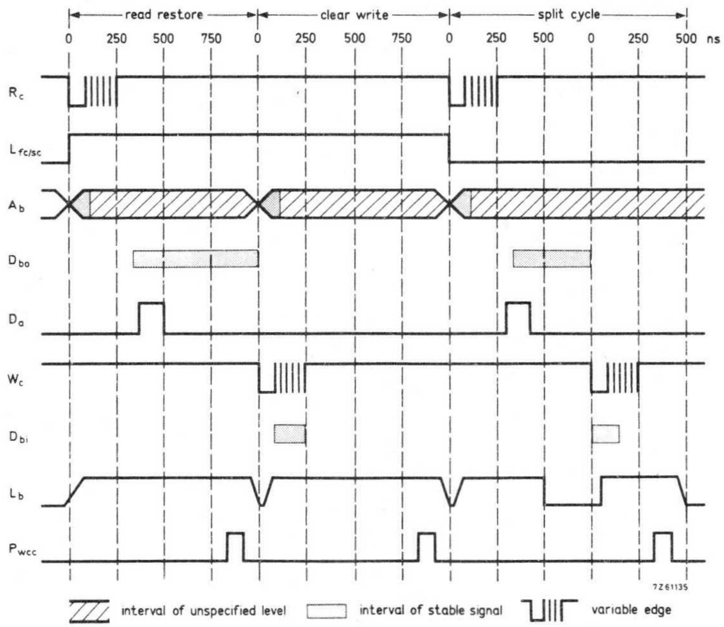
Interconnections	via twisted pairs
Input levels "1"	+2.4 to +5.5 V (at 0 mA)
"0"	0 to +0.4 V (at 20 mA)
Output levels "1"	+2.4 to +5.5 V (at 0.5 mA)
"0"	0 to +0.4 V (at 20 mA)
Power consumption (d.c.)	
for capacities of 4k/24 and larger	+5 V, 6 A −5 V, 1 A +15 V, 15 A +24 V, 1 A −24 V, 1 A
for capacities up to 4k/20	+5 V, 3 A +15 V, 10 A −15 V, 1.5 A
Power requirement (a.c.)	115 V/220 V , 50-60 Hz

Memory contents



Block diagram of the FI-4

Timing diagram



6 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacity	256/4
Cycle time	6 μs
Access time	1 μs
Mode of operation	half cycle
DTL/TTL compatible	
Random access	

DESCRIPTION

A 3D, 4-wire core memory system for random access equipped with 50 mil LTC-cores.
The system comprises integrated circuits as well as discrete components mounted on two separate p.w. boards.
The respective sections of the system are: address decoder, word-selection electronics, core stack, inhibit drivers, sense-amplifiers, and timing circuitry.

MECHANICAL DATA

Dimensions

width	20.3 mm (data panel) +11.5 mm (selection panel)
height	160 mm
depth	150 mm

Mounting

Components mounted on two epoxy-glass printed circuit cards, which can be plugged into a mounting chassis.

ENVIRONMENTAL DATA

Ambient temperature	0 to 55 °C
Humidity	0 to 90% (without condensation)
Shock	1000 bumps of 10 g.
Vibration	5 to 150 Hz at 5 g max.
Cooling	by natural convection of air

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
256	4

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/write	6 μs	1 μs
read only	3 μs	1 μs
write only	3 μs	

Input signals

R_c	read command
W_c	write command
W_p	write timing pulse
$W_{d\ n}$	data signals (n = 1 ... 4)
$A_{r\ n}$	address signals (n = 0 ... 7)
L_c	clear level

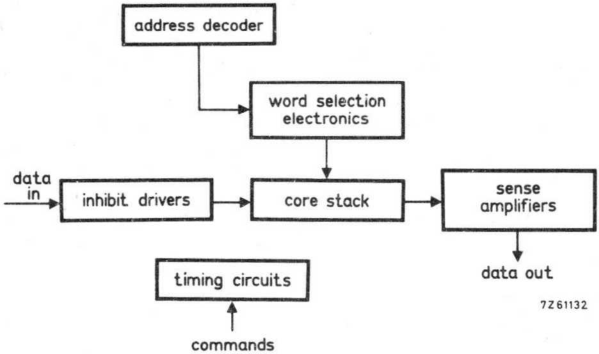
Output signals

$S_{a\ n}$	data signals (n = 1 ... 4)

Interface

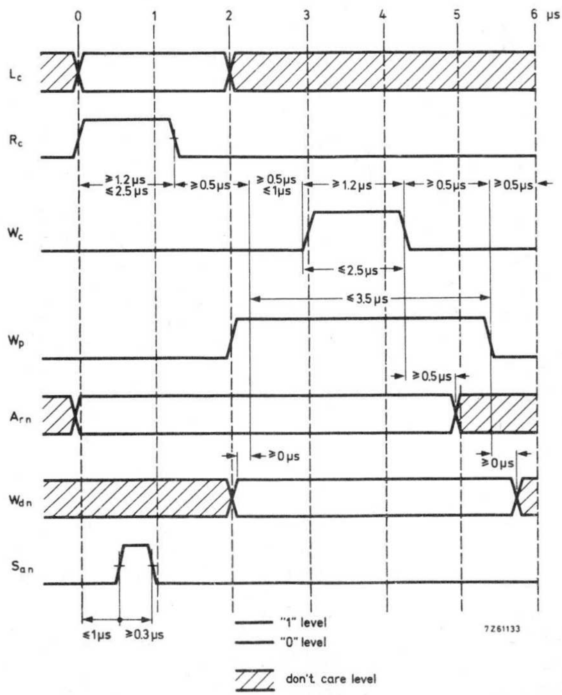
Interconnections	via twisted pairs
Input levels "1"	+2.2 to +5.5 V
"0"	0 to 0.6 V
Output levels "1"	+2.2 to +5.5 V
"0"	0 to +0.6 V
Power consumption (d.c.)	+5 V, 0.95 A
	−6 V, 0.5 A
	+12 V, 0.8 A

Memory contents



Block diagram of the FI-11

Timing diagram



1.6 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	1 k/8
Cycle time	1.6 μs
Access time	0.4 μs
Modules can be paralelled to obtain larger capacities	
Data retention	
DTL/TTL compatible	
Random access	

DESCRIPTION

A 3D3 wire core memory system equipped with 20 mil cores. Integrated circuits are used throughout this system which can easily be paralelled to obtain larger capacities.

MECHANICAL DATA

Dimensions

width	83 mm
height	122 mm
depth	212 mm

Mounting

Components mounted on epoxy-glass printed circuit cards, bolted together to form a rigid module which can be plugged into a mounting chassis.

ENVIRONMENTAL DATA

Ambient temperature	0 to 55 °C
Humidity	0 to 90% (without condensation)
Shock	1000 bumps of 10 g
Vibration	5 to 150 Hz at 5 g max.
Cooling	by natural convection of air

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
1024	8

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	1.6 μs	0.4 μs
clear/write	1.6 μs	
read/write	1.6 μs	0.4 μs
read only	0.6 μs	0.4 μs
write only	1.0 μs	

Input signals

P_{st}	start command
P_{W}	write command
L_{hc}	half/full cycle level
L_{cl}	clear/read level
$S_{b\ n}$	selection bit (n = 1, 2)
$L_{ab\ n}$	address bit (n = 0 ... 1)
$L_{wbi\ n}$	data signal (n = 1 ... 8)

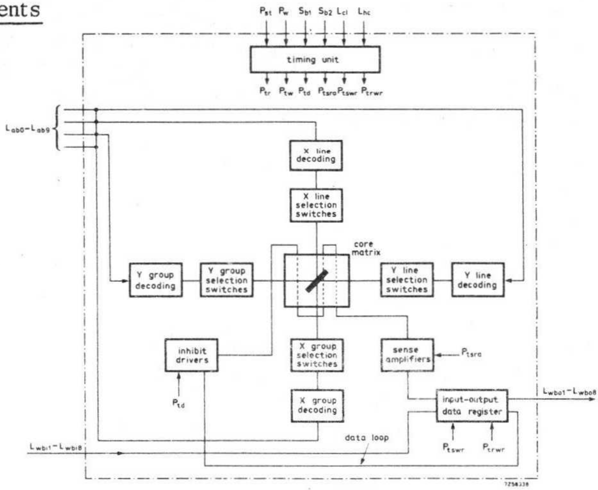
Output signals

$L_{wbo\ n}$	data signal (n = 1 ... 8)

Interface

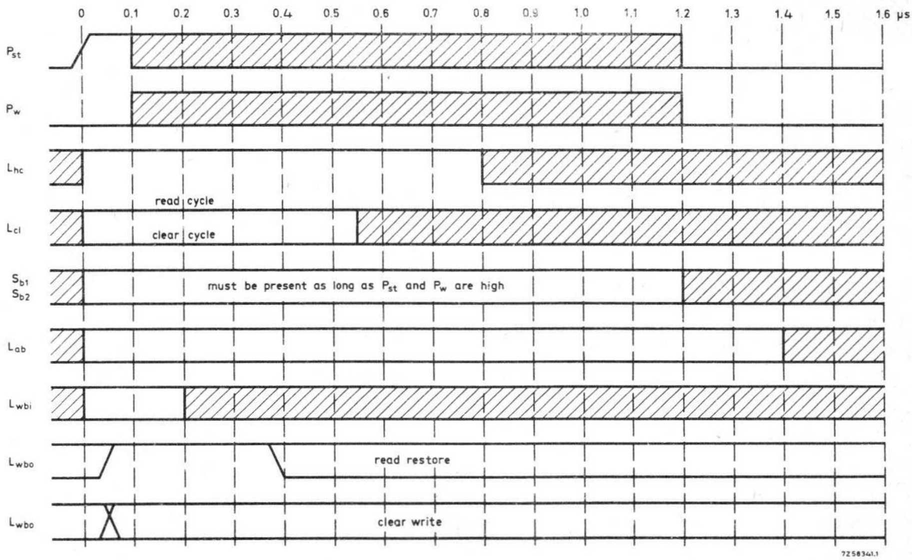
Interconnections	via twisted pairs
Input levels "1"	+2.2 to +5.5 V
"0"	0 to +0.6 V
Output levels "1"	+2.5 to +12 V
"0"	0 to +0.4 V
Power consumption (d.c.)	+5 V, 3.5 A
	−5 V, 4.5 A

Memory contents



Block diagram of the FI-21

Timing diagram



Timing of Read-Restore and Clear-Write (full cycle) modes

8 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	80/17 and 160/17
Cycle time	8 μs
Access time	2 μs
Decimal organized address	
Data save input line	
Random access	

DESCRIPTION

A random access memory system built as a plug-in unit consisting of three circuit cards. It is equipped with the latest integrated circuits for logic, sense and interface circuits to ensure reliable operation. An interface line is provided to ensure that stored data is not lost during on and off switching.

MECHANICAL DATA

Dimensions

width	50 mm
height	204 mm
depth	165 mm

Mounting

Components mounted on epoxy-glass printed circuit cards, bolted together to form a rigid module which can be plugged into a mounting chassis.

ENVIRONMENTAL DATA

Ambient temperature	0 to 50 °C
Humidity	0 to 90% (without condensation)
Shock	1000 bumps of 10 g
Vibration	5 to 150 Hz at 5 g max.
Cooling	no special requirements when memory modules are mounted in vertical position

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
80	17
160	17

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	8 μs	2 μs
clear/write	8 μs	

Input signals

P_s	start cycle
P_r	read allow level
P_a	address 21 lines decimal organized
D_i	data in 17 lines
R_d	d.c. retention
R_a	a.c. retention

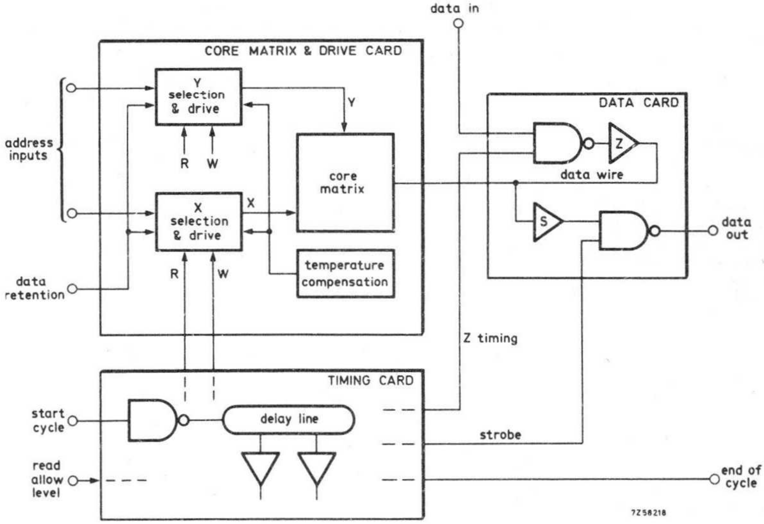
Output signals

D_o	data out 17 lines
P_c	end of cycle

Interface

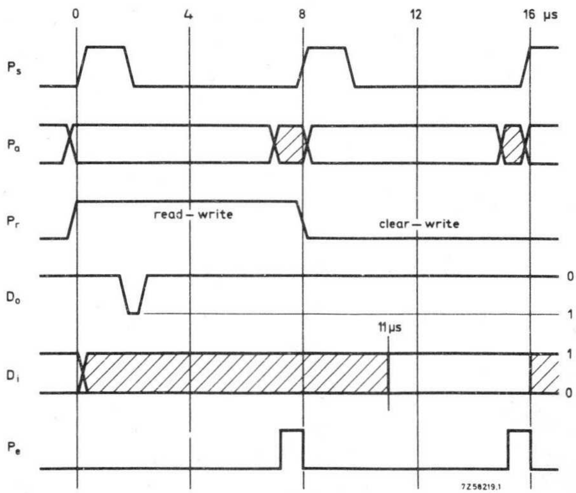
Interconnections	via twisted pairs
Input levels "1"	+2.0 to +6.5 V
"0"	−0.5 to +0.9 V
Output levels "1"	+2.8 to +6.5 V
"0"	0 to +0.5 V
Power consumption (d.c.)	+5 V (±5%), 3 A max.
	−5 V (±5%), 0.6 A max.

Memory contents



Block diagram of the FI-23

Timing diagram



1 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	from 4k/18 to 16k/18
Cycle time	1 μs
Access time	< 0.4 μs
DTL/TTL compatible	

DESCRIPTION

The FI-41 memory system is a random access memory using 20 mil cores in a 3 D-4 wire arrangement.
The self contained unit is built up of two main p.c. boards, a core stack in between and a timing board. Capacities up till 16 k words can be obtained without additional logic. For each 8 k word capacity only one timing board is required.

MECHANICAL DATA

Dimensions

width	63.5 mm
height	255 mm
depth	330 mm

Mounting

Components mounted on epoxy-glass printed circuit cards, bolted together to form a rigid module which can be plugged into a mounting chassis.

ENVIRONMENTAL DATA

Ambient temperature	0 to 55 ^{o}C
Humidity	0 to 90% (without condensation)
Shock	3 bumps of 2 g
Vibration	5 to 150 Hz at 1 g max.
Cooling	no special requirements when memory modules are mounted in vertical position and free airflow is possible.

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
4096	18
8192	18
12288	18
16384	18

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	1 μs	0.4 μs
clear/write	1 μs	
read/mod. write	1 μs	0.4 μs
read only	0.6 μs	0.4 μs
write only	0.6 μs	

Input signals

P_i	initiate pulse
M_o	mode of operation
F_h	determines full or half cycle
A_i	address information
D_i	data input
M_r	memory retention

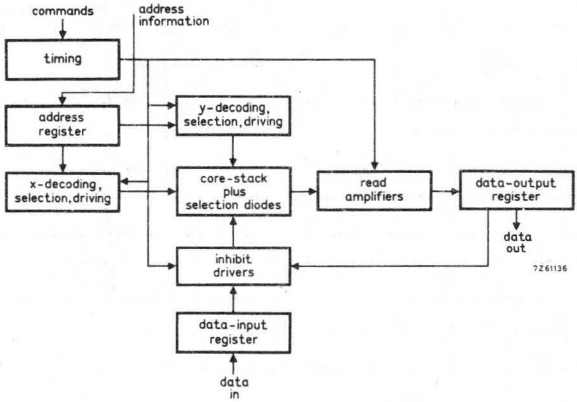
Output signals

D_o	data output

Interface

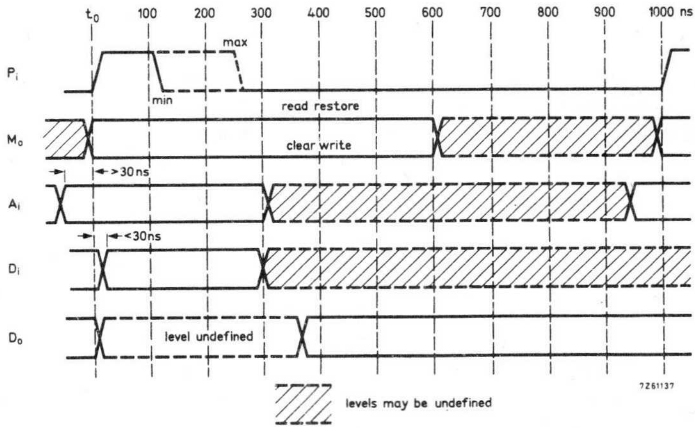
Interconnections	via twisted pairs
Input levels "1"	+2.5 to +5.25 V
"0"	0 to +0.5 V
Output levels "1"	+2.8 to +5.25 V
"0"	0 to +0.5 V
Power consumption (d.c.)	+5 V, 1.5 A
(per 4k/18)	+12 V, 1.0 A
	+24 V, 4.0 A

Memory contents

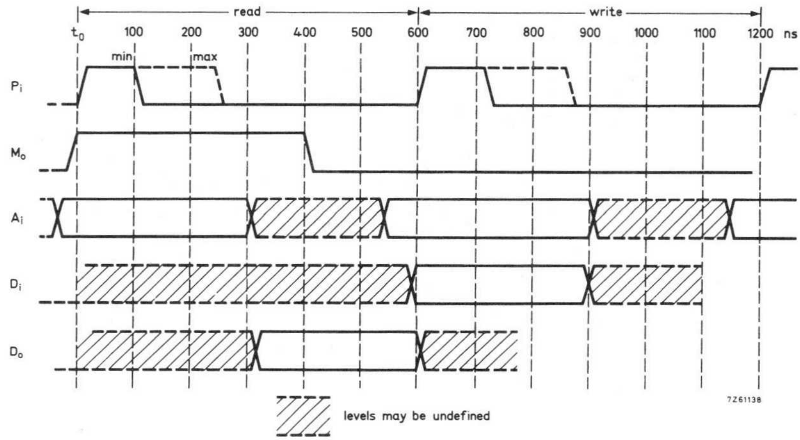


Block diagram of the FI-41

Timing diagram



Full cycle operation



Half cycle operation (read half cycle followed by write half cycle)

0.64 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	from 8 k/18 to 32 k/18
Cycle time	$\leq$ 0.64 μs
Access time	$\leq$ 0.28 μs
Mode of operation	read/write and clear/write in split cycle
Random access	
Field expandable	

DESCRIPTION

This P memory is a $2\frac{1}{2}$ D three-wire high speed ferrite core memory for random access. The input and output signals have standard logic levels. The capacity can be changed by plugging in or removing a stack and some electronics. This type is particularly suitable to serve as a high-speed main-frame memory or for use in buffer applications. All components including the core matrices are mounted on epoxy-glass printed circuit boards.

MECHANICAL DATA

Dimensions

width	472 mm
height	444 mm
depth	400 mm

Mounting

Components mounted on epoxy-glass printed circuit cards, which are plugged into a mounting chassis fitting a 19 inch rack.

ENVIRONMENTAL DATA

Ambient temperature	0 to 45 °C
Humidity	0 to 90% (without condensation)
Shock	3 bumps of 5 g
Vibration	5 to 100 Hz at 0.5 g max.
Cooling	by natural convection of air

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
8192	18
16384	18
24576	18
32768	18

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/write (split cycle)	0.64 μs	0.28 μs
clear/write (split cycle)	0.64 μs	

Input signals (all signals single railed)

R_r	read request signal
W_r	write request signal
S_n	address signals (n = 0 ... 14)
C_w	clear word signal
$D_{i\,n}$	data input signals (n = 0 ... 17)
S_o	store operate level

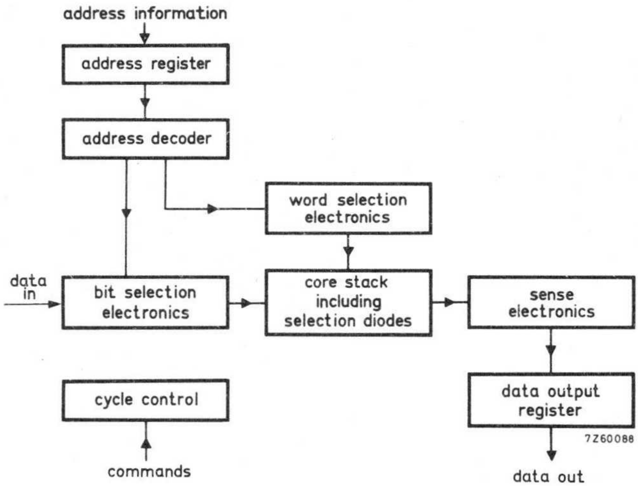
Output signals (all signals single railed)

$D_{o\,n}$	data output signals (n =0 ... 17)
S_r'	store ready level

Interface

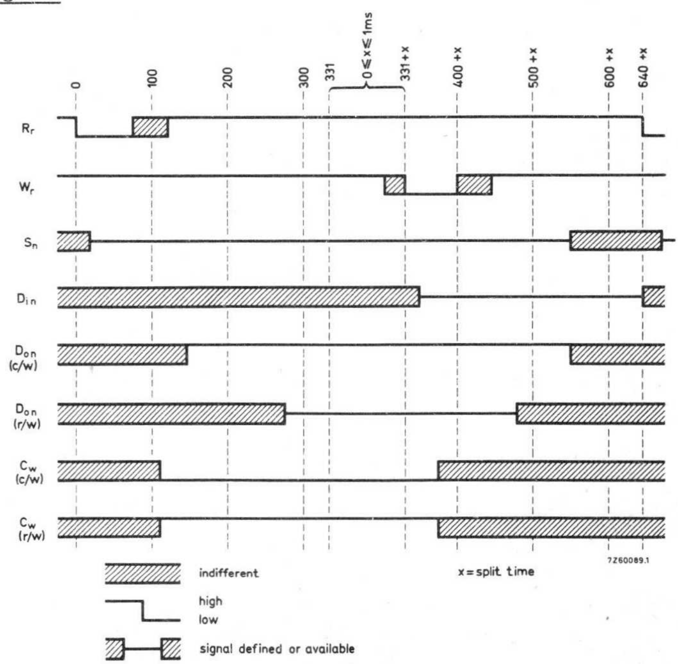
Interconnections	by means of 75 Ω coaxial cables
Input levels "1"	+2.85 to +3.15 V
"0"	0 to +0.5 V
Output levels "1"	+2.85 to +8.0 V
"0"	0 to 0.5 V
Power consumption (d.c.)	+5 V, 7 A (incl. built in tester 10.5 A)
	-5 V, 16.5 A
	+12 V, 1.4 A
	-12 V, 4.5 A
	+15 V, 7.2 A } all "1", average
	-15 V, 7.2 A } 5.6 A

Memory contents



Block diagram of the 32P06

Timing diagram



2.5 μs CORE MEMORY SYSTEM

QUICK REFERENCE DATA	
Capacities	512 k/9, 256 k/18, 128 k/36
Cycle time	≤ 2.5 μs
Access time	≤ 1.2 μs
Memory retention	
Built-in power supplies	
Random access	

DESCRIPTION

A $2\frac{1}{2}$ D organized random access mass-memory. Word length and/or word capacity can be increased by combining 500 G2 memories into memory banks of virtually unlimited size. Inputs and outputs are gated in order to interleave several memories. In addition the word structure is inherently flexible: one byte (9 bits), two byte (18 bits) and four byte (36 bits) words are available as standard options.

MECHANICAL DATA

Dimensions

width	457 mm
height	1498 mm
depth	508 mm

Mounting

Components mounted on epoxy-glass printed circuit cards which are plugged into a mounting chassis fitting a 19 inch rack.

ENVIRONMENTAL DATA

Ambient temperature	10 to 40 °C
Humidity	0 to 90% (without condensation)
Shock	3 bumps of 2 g
Vibration	5 to 45 Hz at 0.7 g max.
Cooling	with built-in blowers

ELECTRICAL DATA

Memory capacity

number of words	number of bits/word
524 288	9
262 144	18
131 072	36

Memory speed (see also timing diagrams)

mode of operation	cycle time	access time
read/restore	2.5 μs	1.2 μs
read mod. /write	2.5 μs	1.2 μs
clear/write	2.5 μs	

Input signals

M_s	module-selection
R_r	read-request
W_r	write-request
M_o	mode of operation level
D_i	data input signals
A_i	address input
S_o	strobe data output

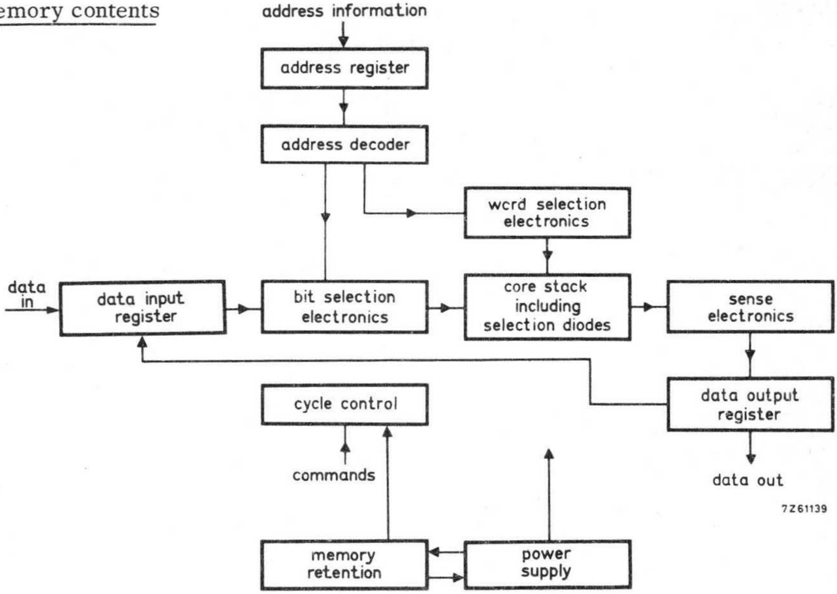
Output signals

D_o	data output signals
D_a	data available
M_b	memory busy
M_r	memory ready

Interface

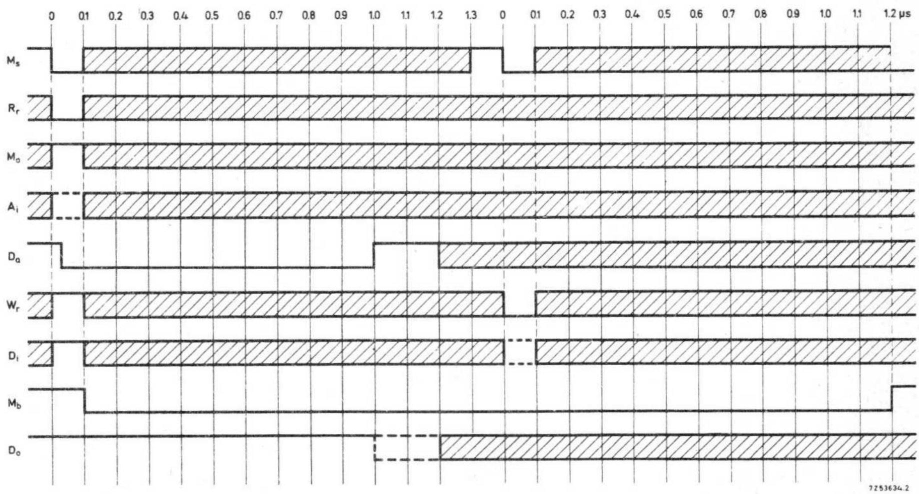
Interconnection	by means of coaxial cables
Input levels "1"	−1 to +1.2 V
"0"	+2.3 to +6.6 V
Output levels "1"	0 to 0.5 V
"0"	permissible sink current is 150 mA with V_{ce} at 0.3 V
Power consumption (d.c.)	−6 V, 6 A
	+6 V, 9.5 A
	+12 V, 7.5 A
	+ 30 V, 2.5 A
	10-21 V, 0.05 A
	48 V, 7 A

Memory contents



Block diagram of the 500G2

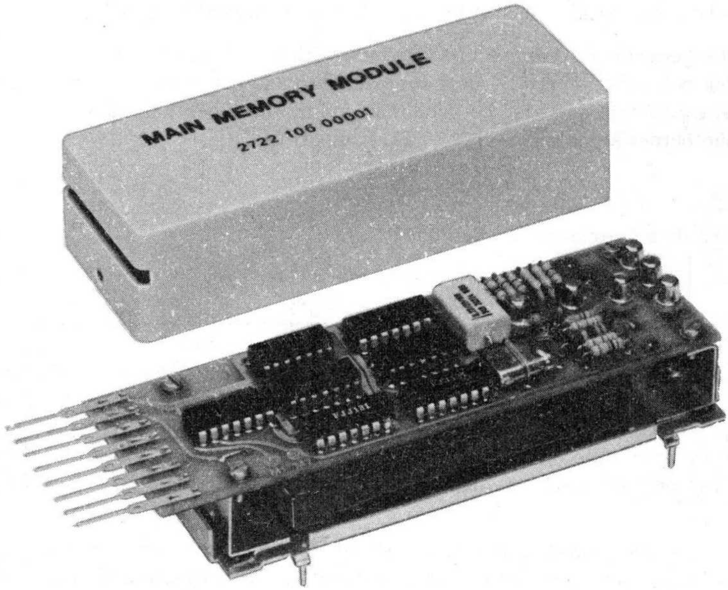
Timing diagram



Timing of Read-Modify-Write (split-cycle) mode

DELAY LINE MEMORIES

DELAY LINE MEMORY MODULES



A 51942

INTRODUCTION

These Memory Modules are small, 256-bit serial access memory elements, designed to succeed the larger, more expensive core memories, flip-flop shift registers, or mechanical relay systems in a wide range of office machines where the total capacity required is less than 2048 bits.

Besides their primary function as an office machine memory, our modules can also be used for speed reduction after high-speed analogue-to-digital conversion, as a buffer stage in teletype communication, in the small, special-purpose computers used for machine tool numerical control and message-switching and as a "refresher" (prolongation) memory in numerical display cathode-ray tube circuits.

DESCRIPTION

The memory module contains:

a) a memory element, which is a digitally operated glass delay line,
b) a crystal controlled clock generator (only for types GDM11, GDM21),
c) input/output circuitry.

The electronics mainly consist of international standard TTL IC's.

The clock generator produces clock pulses with a stable frequency.
The clock pulses sequentially gate the data into and out of the memory module.
External equipment can also be synchronized by the clock pulses.
The input/output signals are DTL/TTL compatible.

Versions

There are three versions available:

type No.	function	capacity (bits)	data rate (MHz)	delay time (μs)	catal. No.
GDM11	main module	256	0.5	515	2722 106 00001
GDM12	sub-module	256	0.5/4	515/64.5	2722 106 00011
GDM21	main module	256	4	64.5	2722 106 00021

A single main module (GDM11 or GDM21) can be used as a memory. Sub-modules GDM12 can only be used together with a main module, in order to extend the capacity.

The main module provided the clock pulses for the sub-modules on the output pins KL, $\overline{KL}$ and S, these pins are to be connected to the respective pins KL, $\overline{KL}$, and S of the sub-modules.

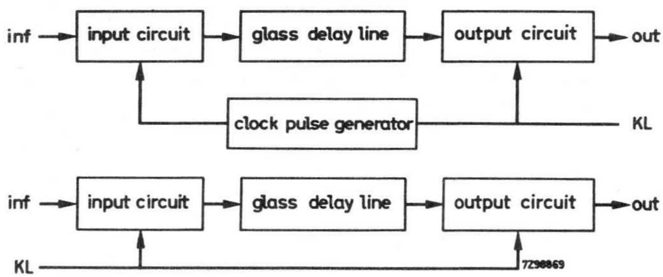
One main module can drive up to 7 sub-modules, thus the maximum obtainable capacity is 2048 bits.

The input/output lines from the sub-modules are seperately fed-out, therefore the sub-modules and a main module can be connected in series or in parallel.

Block circuit diagrams

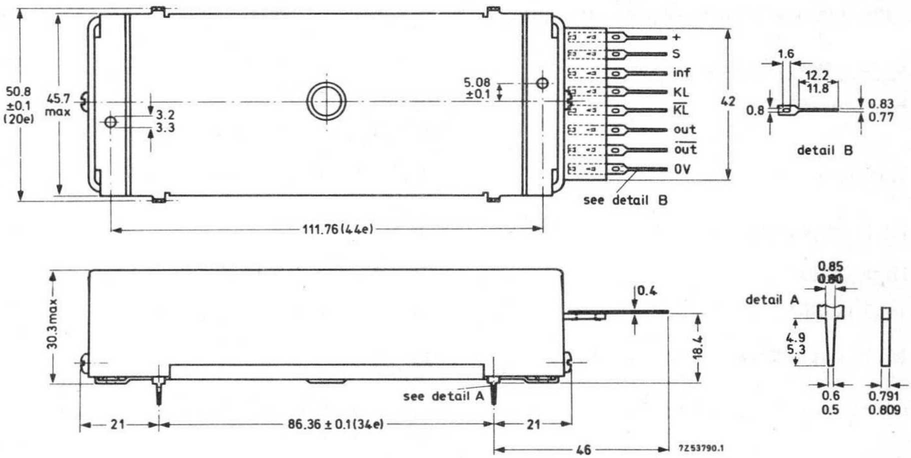
GDM11
GDM21

GDM12



MECHANICAL DATA

Dimensions in mm



Weight : 220 g

Vibration test: complies with method 201A of MIL-STD-202C

Shock test : complies with method 205B of MIL-STD-202C, however 3 times in 6 directions 40 g (0.4 N)

Wiring requirements

If the length of the wiring to the memory exceeds 20 cm, each signal wire should be twisted with an earth wire, which is connected to a common level at both sides. Then the max. length of the wiring amounts to 50 cm provided that the max. capacitive load is not exceeded.

The 8 input/output pins are fed through a slot in the cap of the housing. These connections can be soldered or wrapped.

ENVIRONMENTAL DATA

Ambient temperature range	0 to 55 °C
Storage temperature range	-20 to 70 °C
Max. relative humidity	90 % (without condens)

ELECTRICAL DATA

Interface levels and currents

A positive current value indicates a current flowing towards the module.
Voltages are with respect to 0 V pin.

Data input (pin Inf.)	
High level	$\geq$ 2.0 V, I = max. 40 μA; but $\leq$ 5.5 V, I = max. 1 mA
Low level	$\leq$ 0.8 V; $\geq$ 0 V; –I = max. 1.6 mA
Data output (pins out, $\overline{\text{out}}$)	complementary
High level	$\geq$ 2.4 V; $\leq$ 5.0 V, –I = max. 0.4 mA
Low level	$\leq$ 0.4 V; $\geq$ 0 V, I = max. 16 mA
Max. capacitive load for each output	50 pF
Clock output (pins KL, $\overline{\text{KL}}$)	complementary (modules GMD11 and GMD21 only)
KL high level	$\geq$ 2.4 V, $\leq$ 5.0 V; I = max. 1.16 mA – n x 0.04 mA
KL low level	$\leq$ 0.4 V, $\geq$ 0 V; I = max. 46 mA – n x 1.6 mA
$\overline{\text{KL}}$ high level	$\geq$ 2.4 V, $\leq$ 5.0 V; –I = max. 1.04 – n x 0.12 mA
$\overline{\text{KL}}$ low level	$\leq$ 0.4 V, $\geq$ 0 V; I = max. 41 mA – n x 4.8 mA
Sync output (pin S)	Do not connect to other than pin S of sub-modules

n = the number of sub-modules driven by a main module.

Maximum capacitive load for each output	50 pF

Supply (pins + and 0 V)

D.C. voltage		5 V $\pm$ 5%
D.C. current,	main modules	< 150 mA
	sub-module	< 100 mA

TIMING REQUIREMENTS

If not mentioned otherwise the time values are measured at the 1.5 V points on the edges.

Data input (pin Inf.)

The logic level of the data input must be present for a period of at least 90 ns directly preceding the trailing edge of the KL pulse. Outside this time the data input may be arbitrary. There are no requirements for the edges.

Data output (pins out and $\overline{\text{out}}$)

The logic level of the data output is present at 35 ns after the trailing edge of the KL pulse and remains stable until the trailing edge of the next KL pulse.
A data bit gated into the module at KL pulse number m will become available at the output terminal at KL pulse m + 255 and will remain available until KL pulse m + 256.

Clock output (pins KL and $\overline{\text{KL}}$ on modules GDM11 and GDM21)

The KL pulse is delayed by typically 13 ns on the $\overline{\text{KL}}$ pulse, by the presence of an inverter between the pulses. The duration of the pulses is < 150 ns and > 100 ns.
The frequency of the pulses KL and $\overline{\text{KL}}$ is:

$$\frac{3.958500\ \text{MHz}}{p} \pm 0.01\ \%$$

where p = 8 for GDM11
p = 1 for GDM21

Magnetic heads

Audio and instrumentation magnetic heads
Digital (tape) magnetic heads

SURVEY

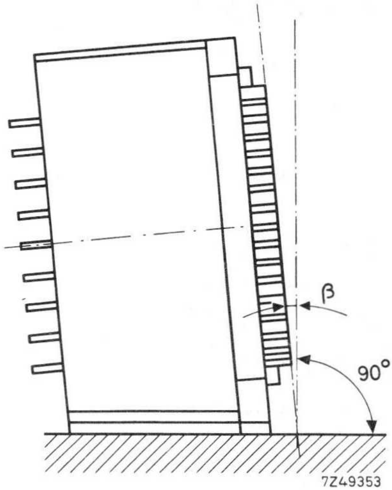
	type	number of tracks	tape width (inch)	catalogue number	page
audio magnetic heads (studio)	erase	1	$\frac{1}{4}$	2722 131 00021	B11
	erase	2	$\frac{1}{4}$	2722 131 00031	B19
	record	1	$\frac{1}{4}$	2722 132 01071	B11
	record	2	$\frac{1}{4}$	2722 132 01081	B19
	record	2 (stereo)	$\frac{1}{4}$	2722 132 01091	B29
	reproduce	1	$\frac{1}{4}$	2722 132 02101	B11
	reproduce	2	$\frac{1}{4}$	2722 132 02111	B19
	reproduce	2 (stereo)	$\frac{1}{4}$	2722 132 02121	B29
audio magnetic heads (voice filing)	record	4	$\frac{1}{4}$	2722 132 11001	B37
	record	8	$\frac{1}{2}$	2722 132 11011	B37
	record	17	1	2722 132 11021	B37
	reproduce	4	$\frac{1}{4}$	2722 132 12001	B37
	reproduce	8	$\frac{1}{2}$	2722 132 12011	B37
	reproduce	17	1	2722 132 12021	B37
instrumentation magnetic heads	record	3 + 1 [1])	$\frac{1}{2}$	2722 133 01001	B47
	record	4	$\frac{1}{2}$	2722 133 01011	B47
	record	7 + 1 [1])	1	2722 133 01021	B47
	reproduce	3 + 1 [1])	$\frac{1}{2}$	2722 133 02001	B47
	reproduce	4	$\frac{1}{2}$	2722 133 02011	B47
	reproduce	7 + 1 [1])	1	2722 133 02021	B47
digital (tape) magnetic heads	write/read[2])	7 dual gap	$\frac{1}{2}$	2722 135 03041	B89
	write/read[3])	7 dual gap	$\frac{1}{2}$	2722 135 03071	B95
	write/read	9 dual gap	$\frac{1}{2}$	2722 135 03091	B101
	write/read[4])	9 single gap	$\frac{1}{2}$	2722 135 03321	B105
	write/read[5])	7 single gap	$\frac{1}{2}$	2722 135 03331	B109
	write/read[6])	9 single gap	$\frac{1}{2}$	2722 135 03341	B113
	write/read[7])	7 single gap	$\frac{1}{2}$	2722 135 03351	B117

[1]) Data tracks + annotation tracks.
[2]) Selfinductance of the coils: 30 μH $\pm$ 20% (write side), 330 μH $\pm$ 20% (read side).
[3]) Selfinductance of the coils: 125 μH $\pm$ 15% (write side), 1 mH $\pm$ 15% (read side).
[4]) Selfinductance of the coil: 4 mH ± 15%
[5]) Selfinductance of the coil: 8 mH ± 15%
[6]) Selfinductance of the coil: 1.45 mH ± 15%
[7]) Selfinductance of the coil: 0.55 mH ± 15%
(footnotes 4–7) refers to each half coil

DEFINITIONS

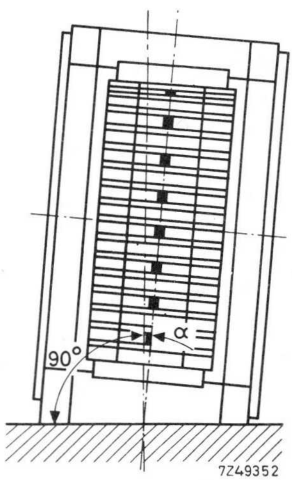
Tilt (β)

The tilt is the angle between the line through the centres of the gaps and the line perpendicular to the reference surface of the head in a plane perpendicular to the tangent plane on the head surface.



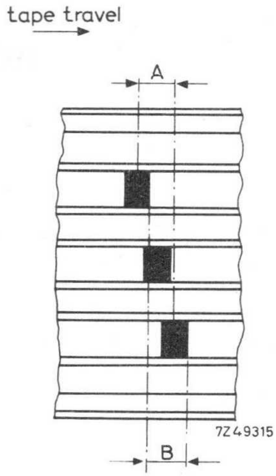
Azimuth (α)

The azimuth is the angle between the line through the centres of the gaps and a line perpendicular to the reference surface of the head in the tangent plane on the head surface.



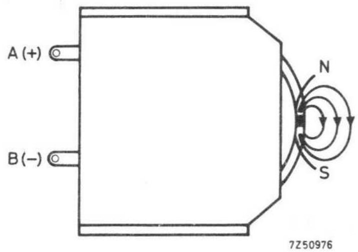
Gap scatter

For a reproduce head the gap scatter is that distance which embraces the centre lines of the gaps (distance A). For a record head the gap scatter is that distance which embraces the trailing edges of the gaps (distance B).



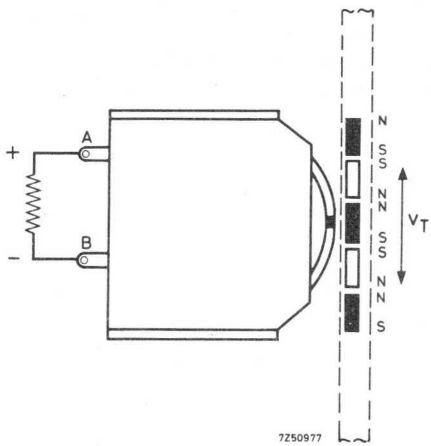
Polarity record head

When a d.c. current flows through the head from tag A to tag B (tag A plus potential, tag B minus potential) then the head has a north pole on the same side of the head as that where the plus tag is situated.



Polarity reproduce head

When a magnetic dipole moves along the head in a way shown in the adjacent figure, tag A will have a plus potential and tag B will have a minus potential (plus tag and north pole on the same side of the head), when the head is provided with a load.



Dynamic crosstalk

Dynamic crosstalk is the interference in a channel which has its origin in an adjacent channel. It is defined as the logarithmic ratio of the relevant output voltages. The dynamic crosstalk is measured in the following manner.

Direct recording

Record head : normal bias current is applied to two adjacent tracks. One track, say A, is left without signal applied and the other track, say B, has normal signal current applied.

Reproduce head: the output voltage from both corresponding tracks is measured. The output voltage from track A' = V_I and the output voltage from track B' = V_{II}.

Dynamic crosstalk = $20 \log \frac{V_I}{V_{II}}$ dB.

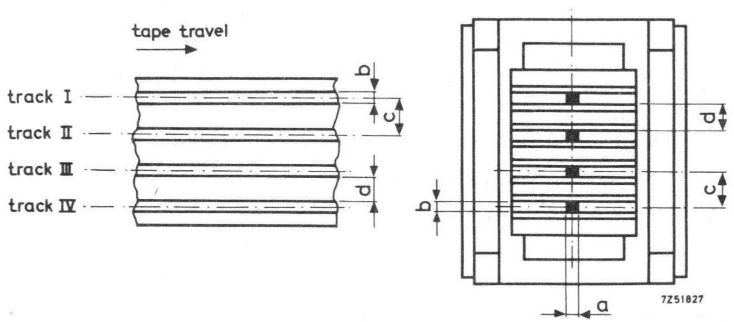
F.M. recording

Record head : one track, say A, is left without signal and an adjacent track, say B, has normal signal current applied.

Reproduce head: the output voltage from both corresponding tracks is measured. The output voltage from track A' = V_I and the output voltage from track B' = V_{II}.

Dynamic crosstalk = $20 \log \frac{V_I}{V_{II}}$ dB.

Head-and tape geometry



a = gap length
b = track width
c = centre track distance
d = intertrack distance

SYMBOLS AND TEST CONDITIONS

symbol	description	test condition
d_3	third harmonic distortion	
f_b	bias frequency	
f_s	signal frequency	
f_r	resonance frequency of each coil	measured with an external capacitance of 10 pF
I_b	bias current	
I_s	signal current	
L	selfinductance of each coil	
Q	quality factor of each coil	
R_0	d.c. resistance of each coil	
R_1	insulation resistance between two coils	at 200 V_{dc}
R_2	insulation resistance between each coil and housing	at 200 V_{dc}
R_3	insulation resistance between each coil and earth tag	at 200 V_{dc}
R_4	insulation resistance between housing and earth tag	at 200 V_{dc}
R_5	resistance between tape contact surface and earth tag	at 50 V_{dc}
V_o	output voltage of reproduce head	
v_t	tape velocity	

GENERAL

INTRODUCTION

The range of audio heads to be described in these data sheets is designed for use in high quality professional equipment, as used in the broadcast field and music industries.

The special features of these audio heads are:
- low wear due to the hardness of the core material, thus offering long head life
- perfect alignment of gaps in two-track heads
- exceedingly small gap scatter, which is achieved by the closely controlled production technique
- stable output characteristics throughout the life of the head
- very close tolerances with small spread in series production thus achieving absolute interchangeability of tapes
- good overall frequency performance, low distortion and low inherent core losses
- good crosstalk suppression
- very good signal/noise ratio
- small dimensions, resulting in design freedom for the mechanical construction of the recorders.

CONSTRUCTION

Starting from polished high density ferroxcube parts a single-track or two-track head assembly is made. In the latter heads the separation between the tracks is formed by non-magnetic ceramic material and ferroxcube shielding.
The complete head to tape contact area consists of wear resistant ceramics. The obtained assembly provided with coils is mounted in an aluminium housing. The datum surface of the housing is machined with respect to the gap line and the front surface of the head.

TYPES

tape width	type of head	number of tracks	catalogue number
$\frac{1}{4}$ inch	erase	1	2722 131 00021
$\frac{1}{4}$ inch	erase	2	2722 131 00031
$\frac{1}{4}$ inch	record	1	2722 132 01071
$\frac{1}{4}$ inch	reproduce	1	2722 132 02101
$\frac{1}{4}$ inch	record	2	2722 132 01081
$\frac{1}{4}$ inch	reproduce	2	2722 132 02111
$\frac{1}{4}$ inch	record	2 (stereo)	2722 132 01091
$\frac{1}{4}$ inch	reproduce	2 (stereo)	2722 132 02121

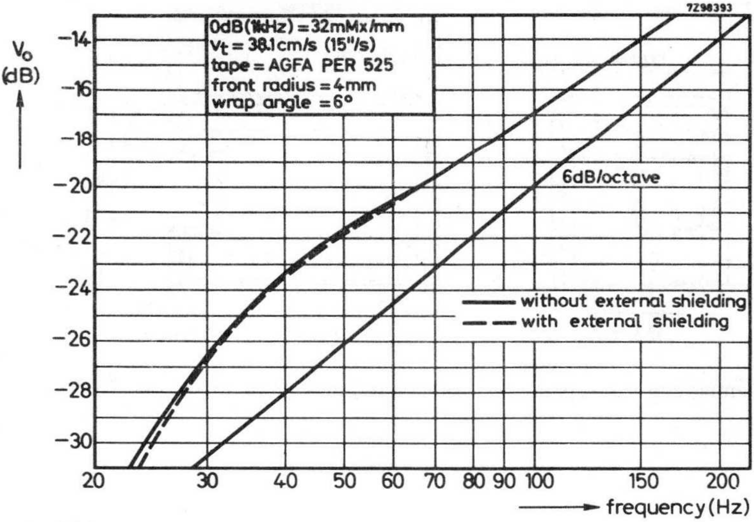
TECHNICAL PERFORMANCE

The data and the typical curves can be found in the data sheets of the audio heads concerned.

The dynamic characteristics have been determined, applying a tape tension of 70 g, a wrap angle of 2x6° and a bias frequency of 100 kHz.
For each set of heads curves on the following dynamic characteristics, measured at tape speeds of 38.1 and 19.05 cm/s, are given:

- Replay characteristic of the reproduce head as such, measured with the appropriate DIN tape, shown together with the characteristic of a reproduce amplifier and the overall characteristic, obtained applying this amplifier.
- Same characteristics as mentioned above but measured with a tape on which the recording has been made using the relevant record head and applying nominal write currents.
- Influence of variation of bias current on reproduce-head output at different frequencies and on distortion.
- Influence of variation of signal current on reproduce-head output and distortion at 1 kHz.
- For the two-track heads also the dynamic crosstalk as a function of the frequency is given applying nominal signal and bias currents. It should be noted, that the crosstalk level at high frequency must be considered against the 0 dB level. The "fall-off" of the overall characteristic at the high frequencies is mainly due to the frequency response of the tape when recording at high (0 dB) level and not by the head as such (compare the more flat overall characteristics obtained with the DIN test tapes recorded at −20 dB level).
- Erase efficiency of the erase heads, as a function of the erase current.

The typical low-frequency response curve of the reproduce heads (see below), being identical for all heads, measured at a tape speed of 38.1 cm/s is shown in comparison with the 6 dB/octave line. The deviation of the 6 dB/octave line will be less than 1 dB down to 30 Hz.

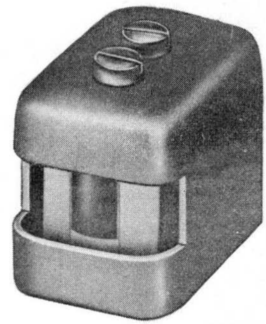


ACCESSORIES

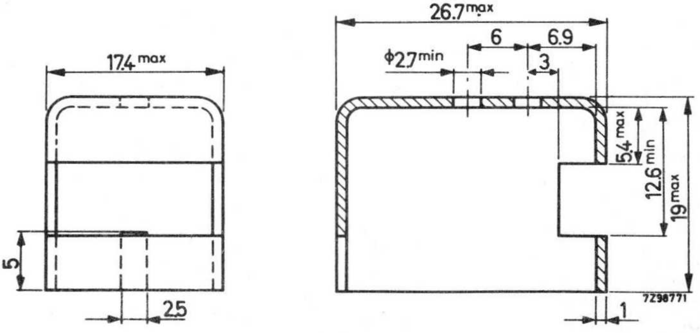
Two screening cans to fit the audio heads are available:
- for record heads, catalogue number 4322 021 43971
- for reproduce heads, catalogue number 4322 021 43981.

Material: High permeability nickel-iron alloy, 1 mm thick.

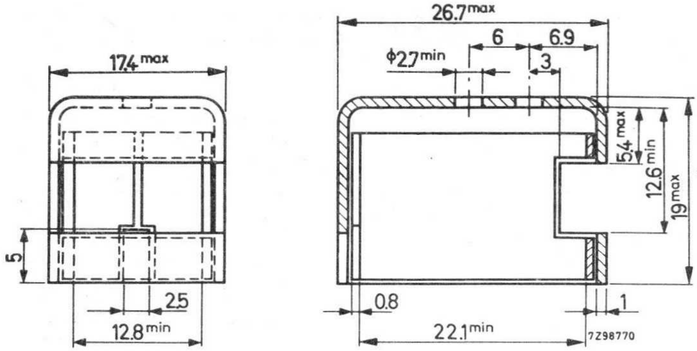
Recommended fixing screws to secure the screening can to the audio head: M 2.5 x 4 mm long.



A 51929

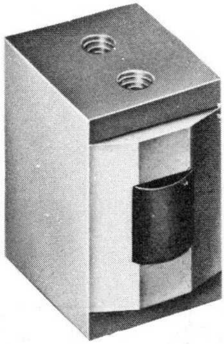


Screening can for record heads, catalogue number 4322 021 43971



Screening can for reproduce heads, catalogue number 4322 021 43981

AUDIO MAGNETIC HEADS
(studio)



A 51799-1

Audio magnetic head	2722 131 00021	erase head
	2722 132 01071	record head
	2722 132 02101	reproduce head
Number of tracks		1
Tape width		$\frac{1}{4}$ inch

APPLICATION

For professional sound recording and reproduction.

TECHNICAL PERFORMANCE

Electrical test specification

Static performance

	erase head	record head	reproduce head
L	1.7 ± 0.2 mH *)	7 ± 0.8 mH **)	75 ± 8 mH **)
Q	≥ 25 *)	≥ 25 **)	≥ 15 **)
f_r	> 800 kHz	> 450 kHz	> 100 kHz
R_0	$4 \pm 0.5\ \Omega$	$3.9 \pm 0.5\ \Omega$	$54 \pm 6\ \Omega$
R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ	> 1000 MΩ

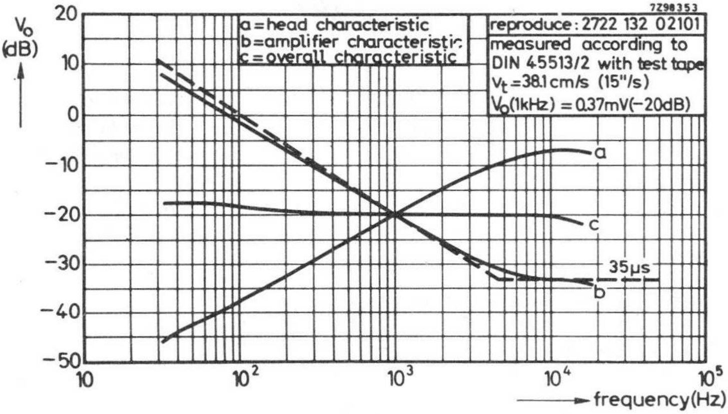
Dynamic performance

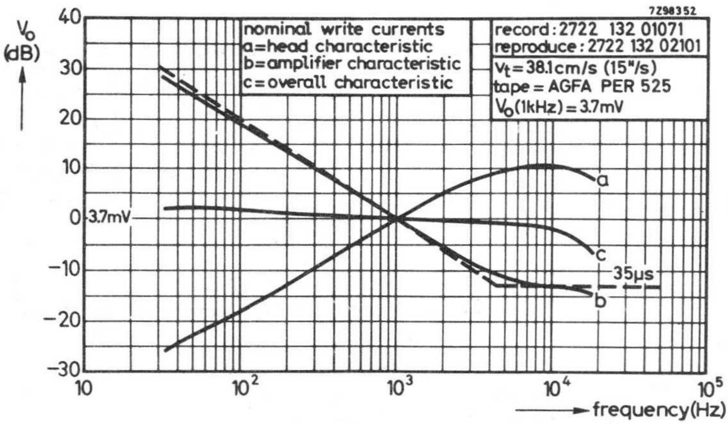
Test tape	BASF LGR
Tape velocity	19.05 cm/s (7.5 inch/s)
Tape tension	75 g

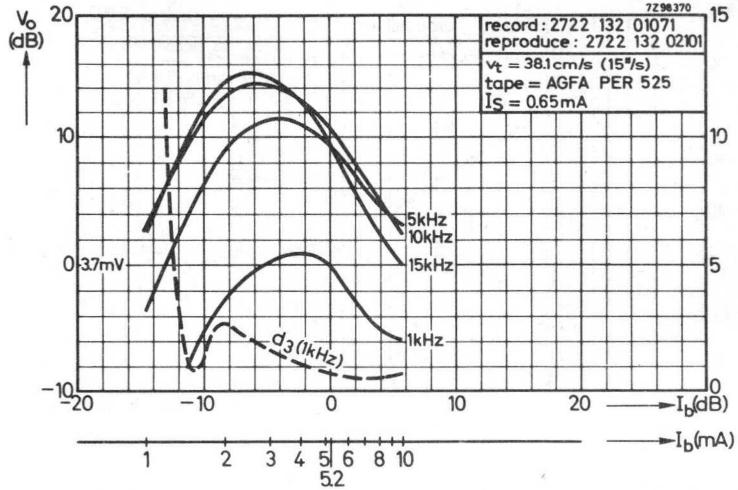
*) Measured at 100 mV, 100 kHz.
**) Measured at 80 mV, 10 kHz.

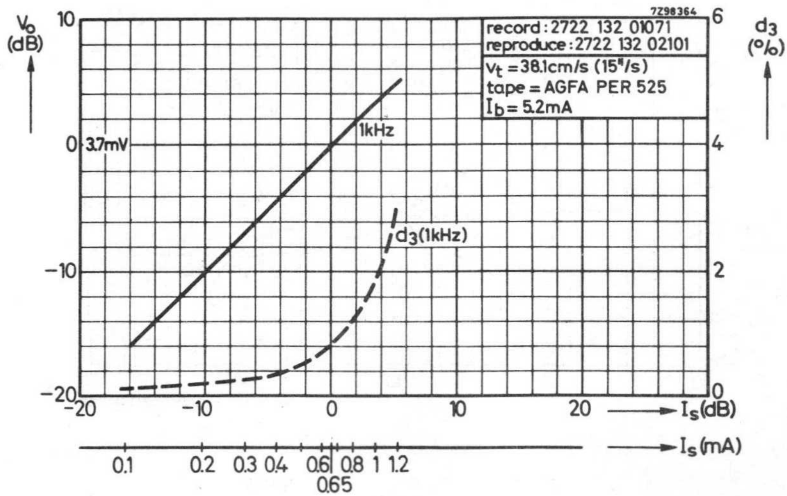
	erase head	record head	reproduce head
Erase current at 100 kHz	85 mA		
Erase efficiency (erasing a signal of 1 kHz with a 3% harmonic distortion)	$\geq$ 74 dB		
Bias current at 100 kHz, optimal for 1 kHz		4 $\pm$ 0.1 mA	
Signal current at 1 kHz for drive at 32 mMx/mm		0.7 $\pm$ 0.1 mA	
Output voltage at 1 kHz, 32 mMx/mm			3.7 $\pm$ 0.4 mV

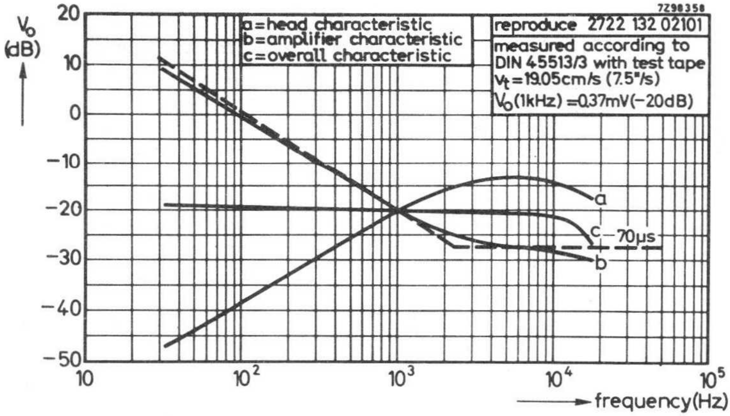
Typical curves

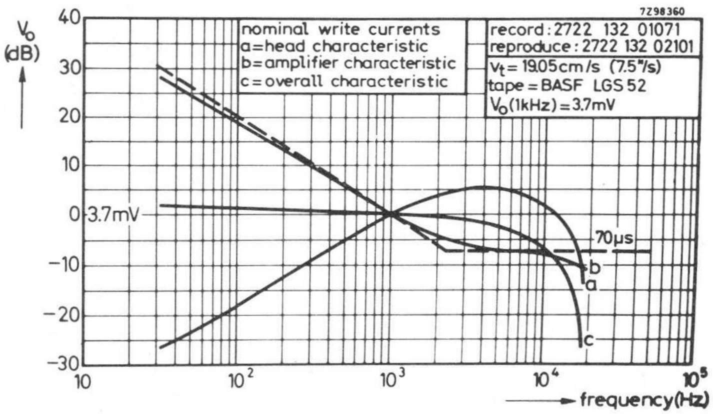


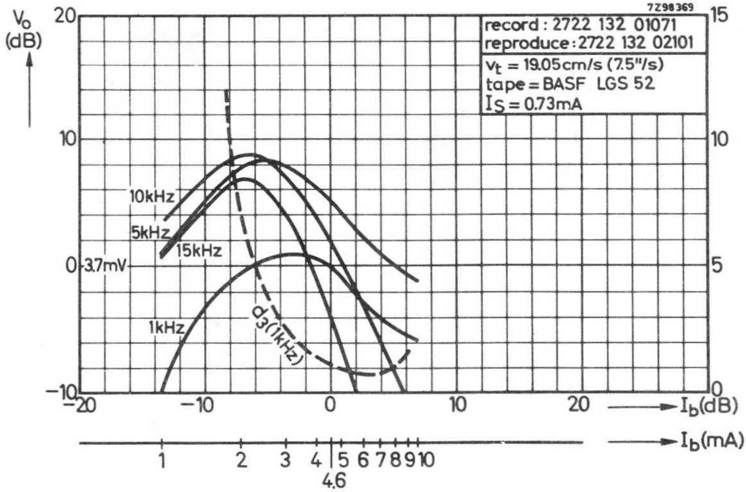


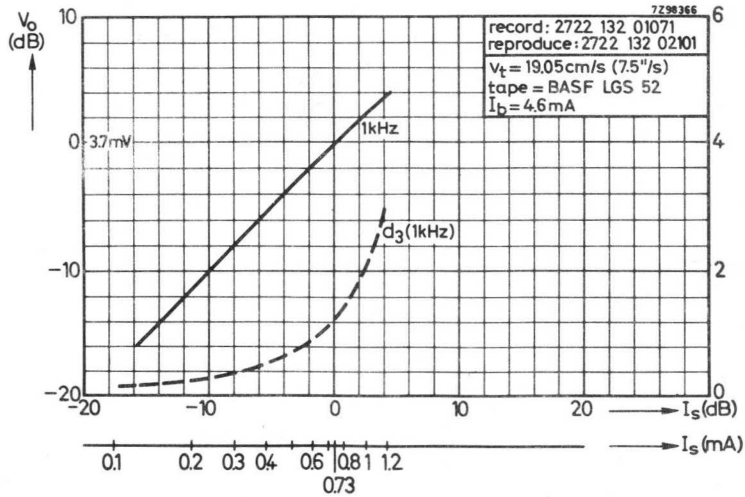

7Z98370
V_o (dB)
record: 2722 132 01071
reproduce: 2722 132 02101
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_S = 0.65 mA
3.7mV
5kHz
10kHz
15kHz
1kHz
d_3 (1kHz)
I_b(dB)
I_b(mA)
5.2

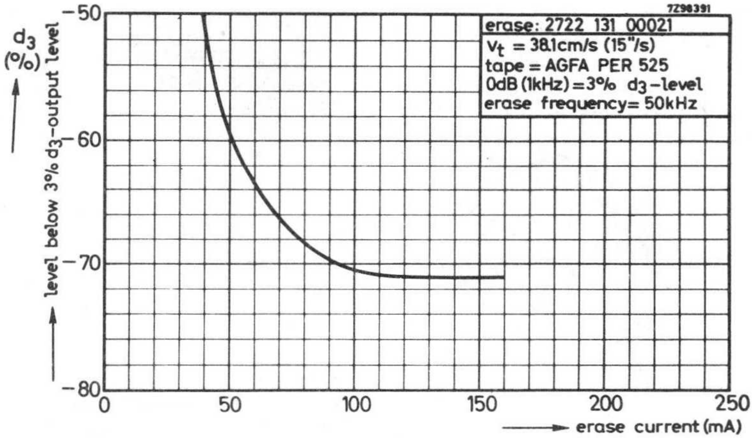

7Z98364
V_o (dB)
d_3 (%)
record: 2722 132 01071
reproduce: 2722 132 02101
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_b = 5.2 mA
3.7mV
1kHz
d_3(1kHz)
I_s(dB)
I_s(mA)
0.65

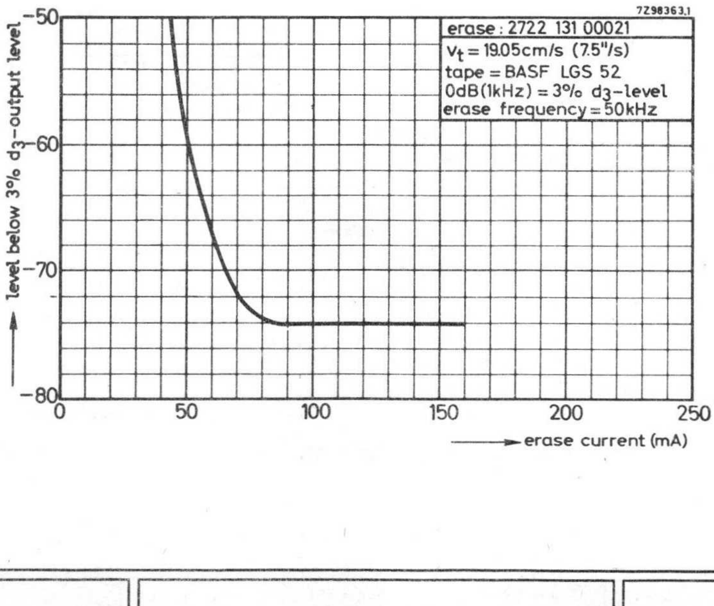

7Z98358
a=head characteristic
b=amplifier characteristic
c=overall characteristic
reproduce 2722 132 02101
measured according to
DIN 45513/3 with test tape
v_t=19.05cm/s (7.5"/s)
V_o(1kHz)=0.37mV(−20dB)
V_o (dB)
20
10
0
−10
−20
−30
−40
−50
10
10^2
10^3
10^4
10^5
frequency(Hz)
a
c
70µs
b


7Z98360
nominal write currents
a=head characteristic
b=amplifier characteristic
c=overall characteristic
record: 2722 132 01071
reproduce: 2722 132 02101
v_t= 19.05cm/s (7.5"/s)
tape = BASF LGS 52
V_o(1kHz) = 3.7mV
V_o (dB)
40
30
20
10
0
3.7mV
−10
−20
−30
10
10^2
10^3
10^4
10^5
frequency(Hz)
70µs
b
a
c


7Z98369
V_o (dB)
d_3 (%)
record : 2722 132 01071
reproduce : 2722 132 02101
v_t = 19.05 cm/s (7.5"/s)
tape = BASF LGS 52
I_S = 0.73 mA
10kHz
5kHz
15kHz
1kHz
0 3.7mV
d_3(1kHz)
I_b(dB)
I_b(mA)
4.6

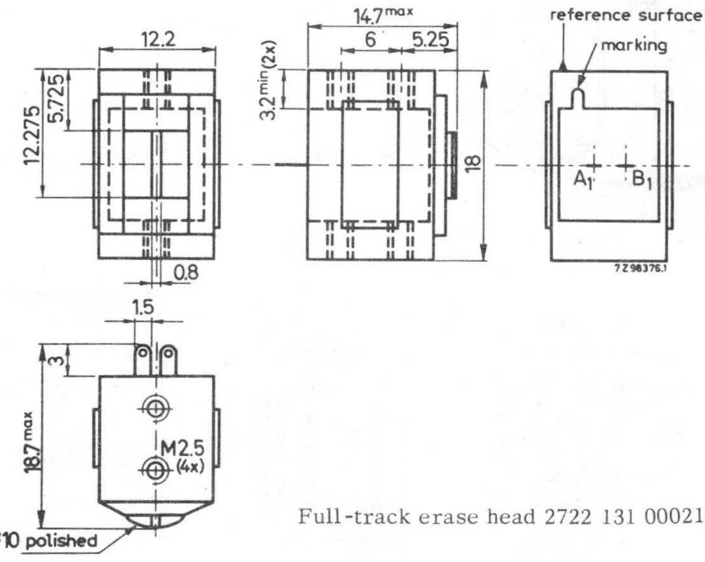

7Z98366
V_o (dB)
d_3 (%)
record : 2722 132 01071
reproduce : 2722 132 02101
v_t = 19.05 cm/s (7.5"/s)
tape = BASF LGS 52
I_b = 4.6 mA
1kHz
0 3.7mV
d_3(1kHz)
I_s(dB)
I_s(mA)
0.73


7Z98391
erase: 2722 131 00021
v_t = 38.1cm/s (15"/s)
tape = AGFA PER 525
0dB (1kHz) = 3% d_3-level
erase frequency = 50kHz
d_3 (%)
level below 3% d_3-output level
-50
-60
-70
-80
0
50
100
150
200
250
erase current (mA)

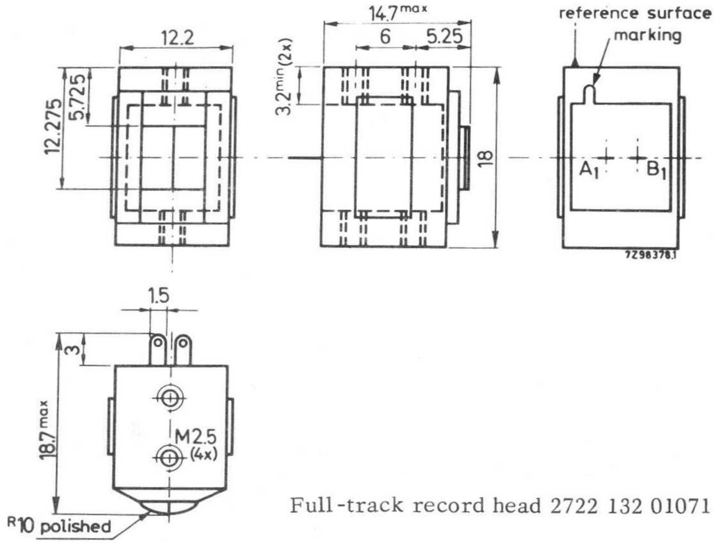

7Z98363.1
erase: 2722 131 00021
v_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
0dB (1kHz) = 3% d_3-level
erase frequency = 50kHz
level below 3% d_3-output level
-50
-60
-70
-80
0
50
100
150
200
250
erase current (mA)

Mechanical data

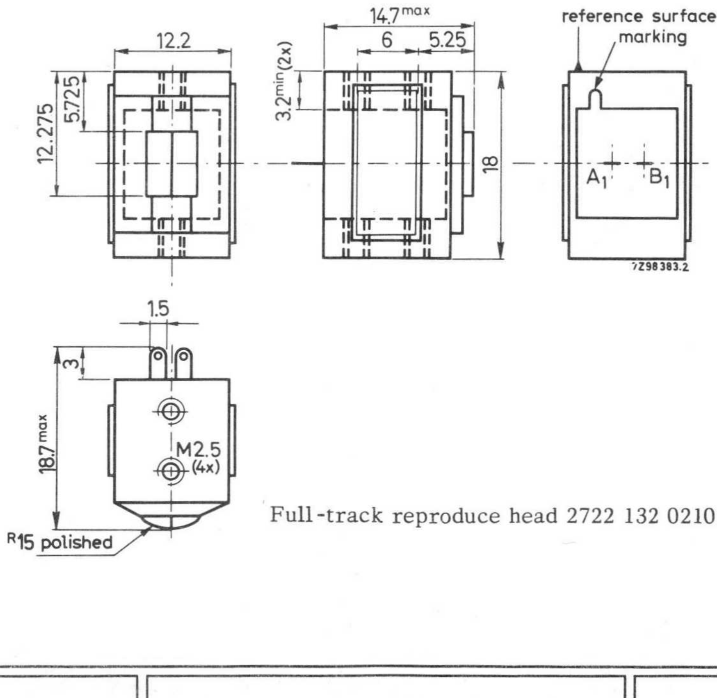
Gap length	
erase head	2 x 0.1 mm
record head	7 μm
reproduce head	4 μm
Number of tracks	1
Track width	6.55 $\pm$ 0.4 mm
Azimuth	
erase head	< 5 minutes of arc
record and reproduce heads	< 2 minutes of arc
Tilt	< 3 minutes of arc



Full-track erase head 2722 131 00021

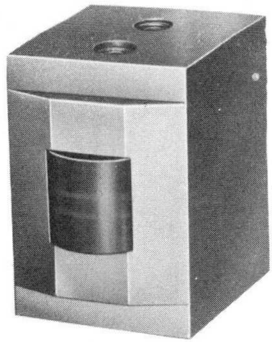


Full-track record head 2722 132 01071



Full-track reproduce head 2722 132 02101

AUDIO MAGNETIC HEADS
(studio)



A 50743

Audio magnetic head	2722 131 00031	erase head
	2722 132 01081	record head
	2722 132 02111	reproduce head
Number of tracks		2
Tape width		$\frac{1}{4}$ inch

APPLICATION

For professional sound recording and reproduction.

TECHNICAL PERFORMANCE

Electrical test specification

Static performance

	erase head	record head	reproduce head
L	1.7 ± 0.2 mH *)	7 ± 0.8 mH **)	75 ± 0.8 mH **)
Q	≥ 25 *)	≥ 23 **)	≥ 20 **)
f_r	> 800 kHz	> 450 kHz	> 100 kHz
R_0	$3 \pm 0.4\ \Omega$	$6.6 \pm 0.8\ \Omega$	$88 \pm 10\ \Omega$
R_1, R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ	> 1000 MΩ

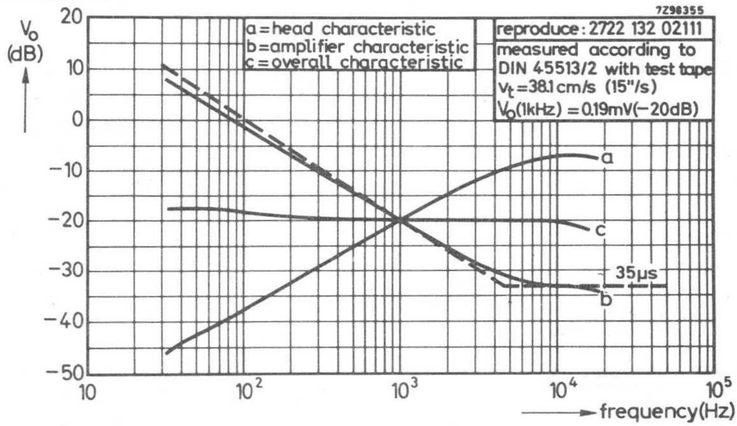
Dynamic performance

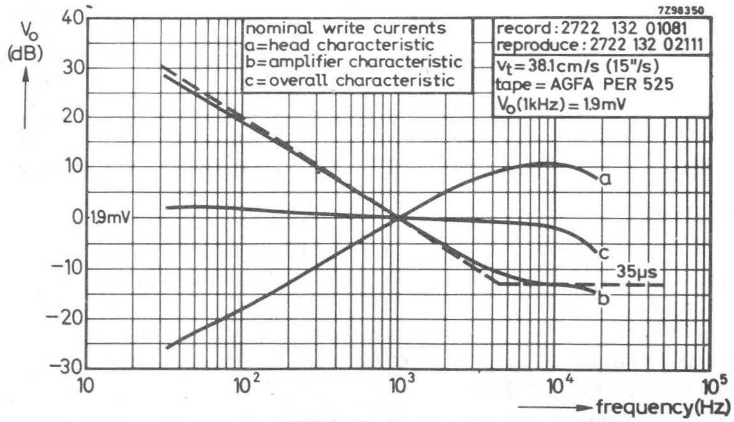
Test tape	BASF LGR
Tape velocity	19.05 cm/s (7.5 inch/s)
Tape tension	75 g

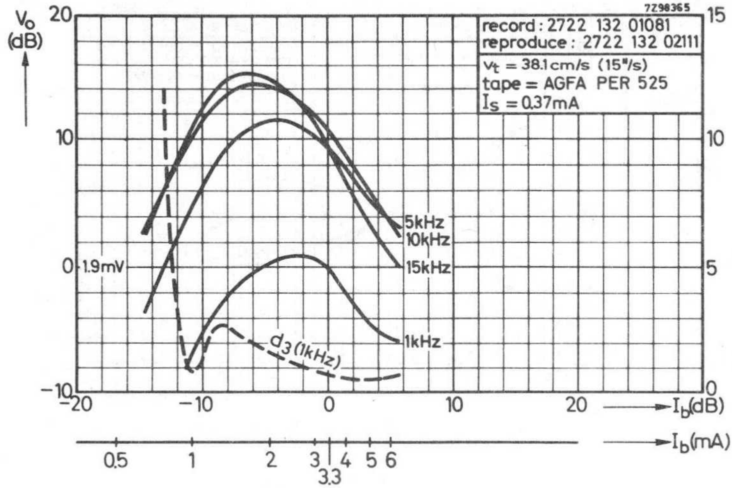
*) Measured at 100 mV, 100 kHz.
**) Measured at 80 mV, 10 kHz.

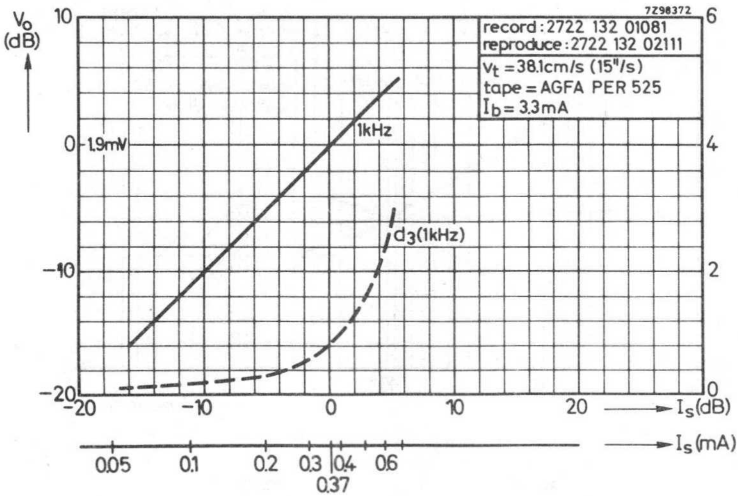
	erase head	record head	reproduce head
Erase current at 100 kHz	65 mA		
Erase efficiency (erasing a signal of 1 kHz with a 3% harmonic distortion)	≥ 74 dB		
Bias current at 100 kHz, optimal for 1 kHz		2.5 ±0.5 mA	
→ Signal current at 1 kHz for drive at 32 mMx/mm		0.46 ± 0.08 mA	
Output voltage at 1 kHz, 32 mMx/mm			1.9 ± 0.2 mV
Crosstalk (dynamically, 1 kHz) in combination with 2-track reproduce/ record head		< −57 dB	< −57 dB
Crosstalk (dynamically, 1 kHz) in combination with half-track reproduce/ record head		< −63 dB	< −60 dB

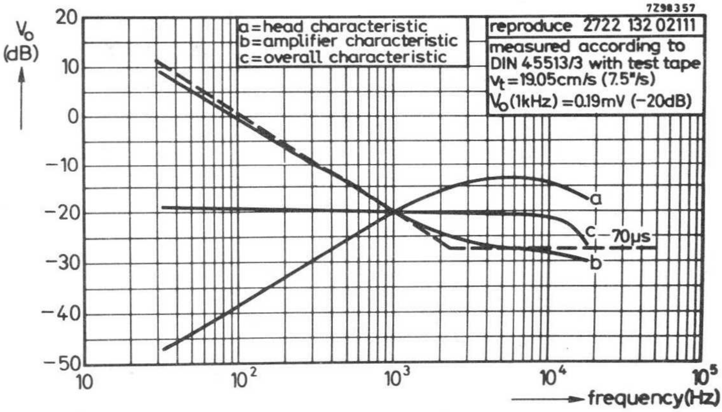
Typical curves

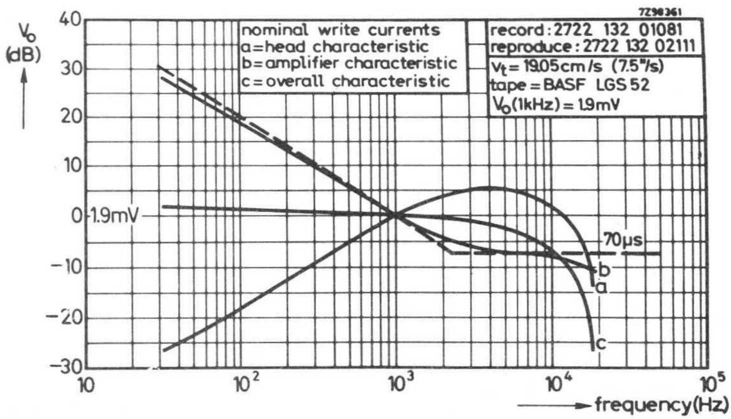


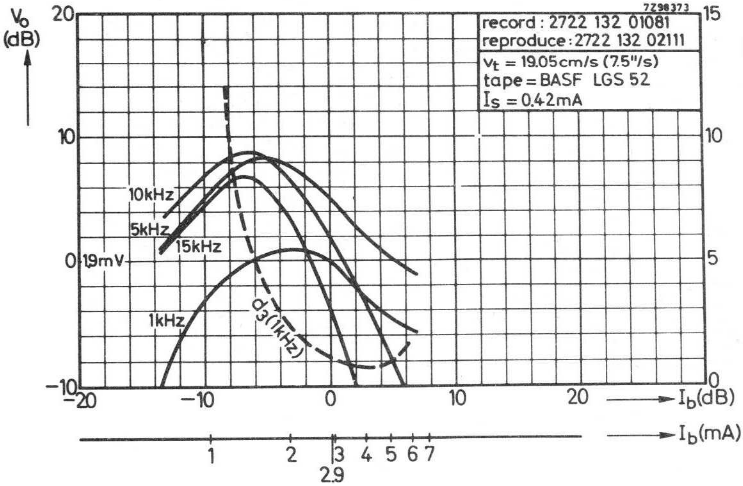


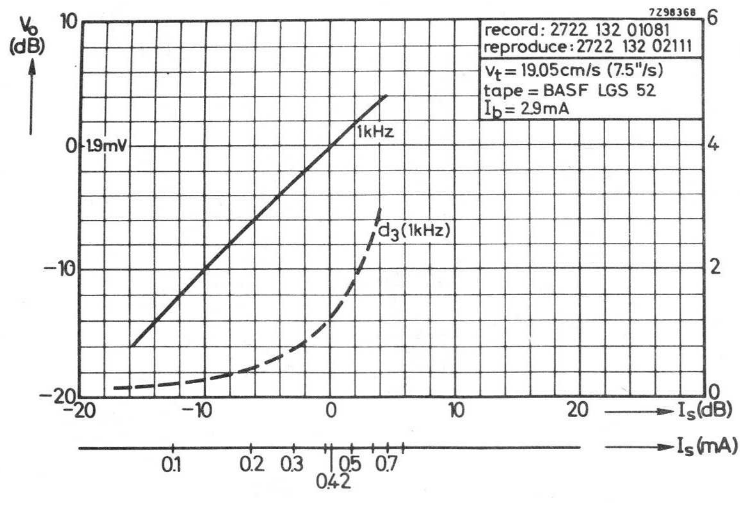

7Z98365
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_s = 0.37 mA
V_o (dB)
1.9 mV
5kHz
10kHz
15kHz
1kHz
d_3(1kHz)
I_b(dB)
I_b(mA)
3.3

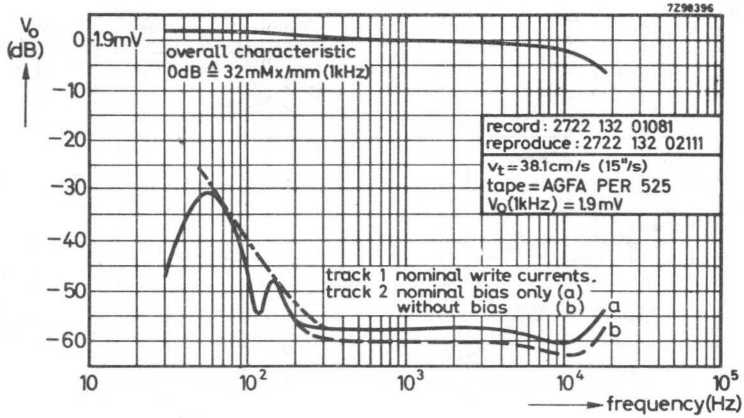

7Z98372
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_b = 3.3 mA
V_o (dB)
1.9 mV
1kHz
d_3(1kHz)
I_s(dB)
I_s(mA)
0.37

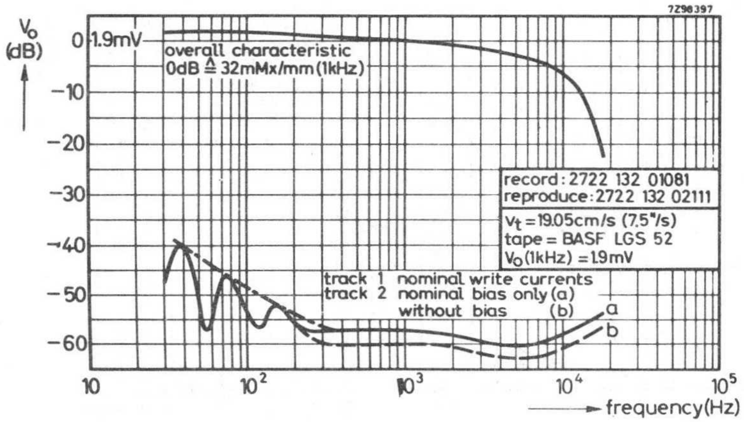

7Z98357
a=head characteristic
b=amplifier characteristic
c=overall characteristic
reproduce 2722 132 02111
measured according to
DIN 45513/3 with test tape
v_t=19.05cm/s (7.5"/s)
V_o(1kHz)=0.19mV (−20dB)
V_o
(dB)
20
10
0
−10
−20
−30
−40
−50
10
10^2
10^3
10^4
10^5
frequency(Hz)
a
c
70μs
b

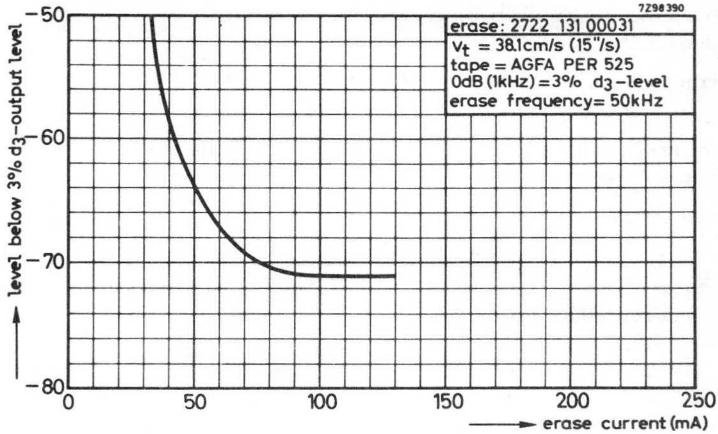

7Z98361
nominal write currents
a=head characteristic
b=amplifier characteristic
c=overall characteristic
record: 2722 132 01081
reproduce: 2722 132 02111
v_t= 19.05cm/s (7.5"/s)
tape = BASF LGS 52
V_o(1kHz) = 1.9mV
V_o
(dB)
40
30
20
10
0
1.9mV
−10
−20
−30
10
10^2
10^3
10^4
10^5
frequency(Hz)
70μs
b
a
c

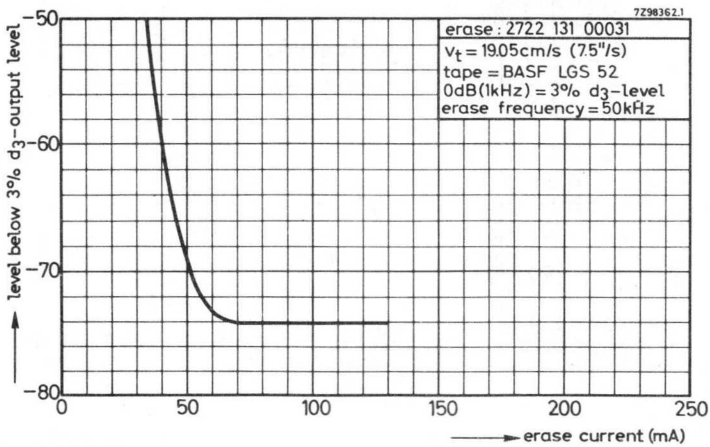

7Z98373
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
I_s = 0.42mA
V_o (dB)
d_3 (%)
10kHz
5kHz
15kHz
1kHz
1.9mV
d_3(1kHz)
I_b(dB)
I_b(mA)
2.9


7Z98368
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
I_b = 2.9mA
V_o (dB)
d_3 (%)
1kHz
1.9mV
d_3(1kHz)
I_s(dB)
I_s(mA)
0.42


7Z98396
V_o (dB)
0 1.9mV
overall characteristic
0dB ≙ 32mMx/mm (1kHz)
-10
-20
-30
-40
-50
-60
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 38.1cm/s (15"/s)
tape = AGFA PER 525
V_o(1kHz) = 1.9mV
track 1 nominal write currents.
track 2 nominal bias only (a)
without bias (b)
a
b
10
10^2
10^3
10^4
10^5
frequency(Hz)

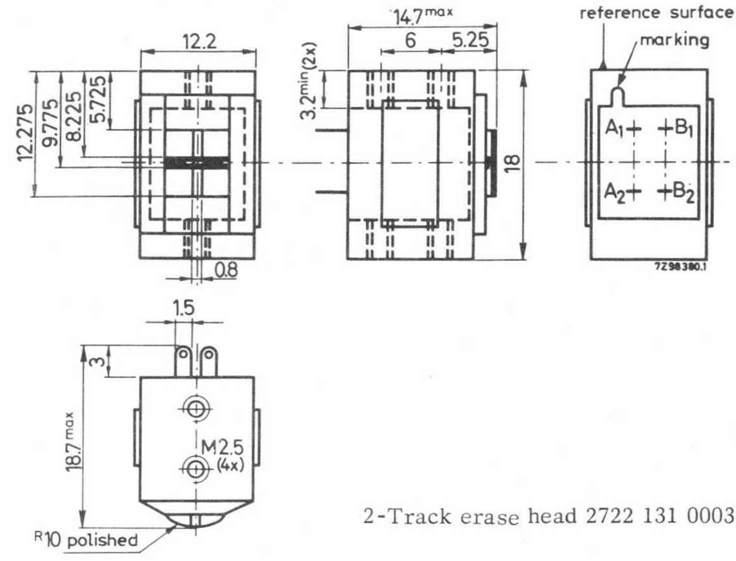

7Z98397
V_o (dB)
0 1.9mV
overall characteristic
0dB ≙ 32mMx/mm (1kHz)
-10
-20
-30
-40
-50
-60
record: 2722 132 01081
reproduce: 2722 132 02111
v_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
V_o(1kHz) = 1.9mV
track 1 nominal write currents
track 2 nominal bias only (a)
without bias (b)
a
b
10
10^2
10^3
10^4
10^5
frequency(Hz)


7Z98390
erase: 2722 131 00031
v_t = 38.1cm/s (15"/s)
tape = AGFA PER 525
0dB (1kHz) = 3% d_3-level
erase frequency = 50kHz
level below 3% d_3-output level
-50
-60
-70
-80
0
50
100
150
200
250
erase current (mA)

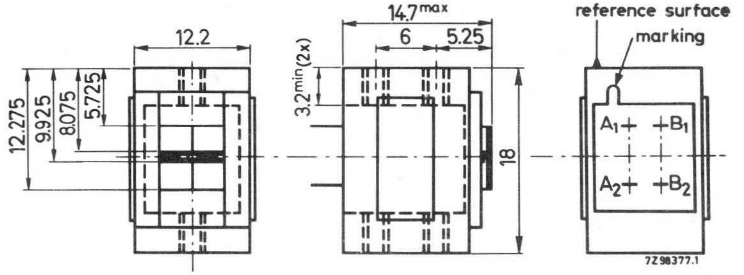

7Z98362.1
erase: 2722 131 00031
v_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
0dB (1kHz) = 3% d_3-level
erase frequency = 50kHz
level below 3% d_3-output level
-50
-60
-70
-80
0
50
100
150
200
250
erase current (mA)

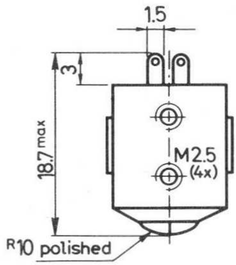
Mechanical data

Gap length	
erase head	2 x 0.1 mm
record head	7 μm
reproduce head	4 μm
Number of tracks	2
Track width	
erase head	2.5 $\pm$ 0.04 mm
record and reproduce heads	2.35 $\pm$ 0.04 mm
Centre track distance	4.2 mm
Azimuth	
erase head	< 5 minutes of arc
record and reproduce heads	< 2 minutes of arc
Tilt	< 3 minutes of arc
Gap scatter	< 2 μm

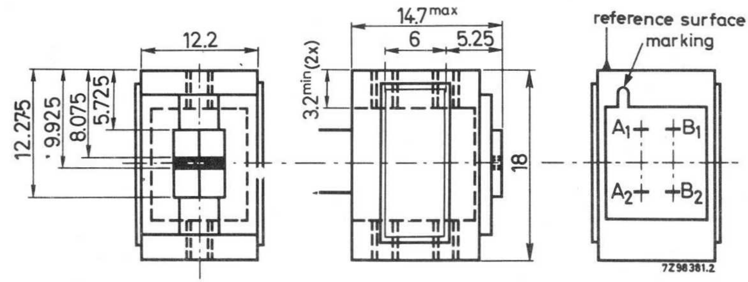


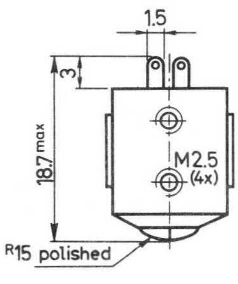
2-Track erase head 2722 131 00031





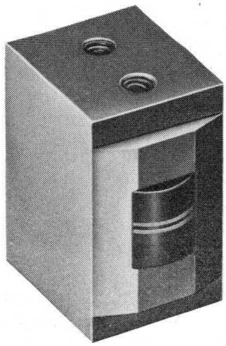
2-Track record head 2722 132 01081





2-Track reproduce head 2722 132 02111

AUDIO MAGNETIC HEADS
(studio)



A 51799-2

Audio magnetic head	2722 132 01091	record head
	2722 132 02121	reproduce head
Number of tracks		2
Tape width		$\frac{1}{4}$ inch

APPLICATION

For professional stereo sound recording and reproduction.
These heads generally will be used in combination with the full-track erase head, catalogue number 2722 131 00021. For data on this head see the relevant data sheets.

TECHNICAL PERFORMANCE

Electrical test specification

Static performance

	record head	reproduce head
L *)	7 ± 0.8 mH	75 ± 8 mH
Q *)	≥ 23	≥ 20
f_r	> 450 kHz	> 100 kHz
R_0	$6.0 \pm 0.8\ \Omega$	$68 \pm 9\ \Omega$
R_1, R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ

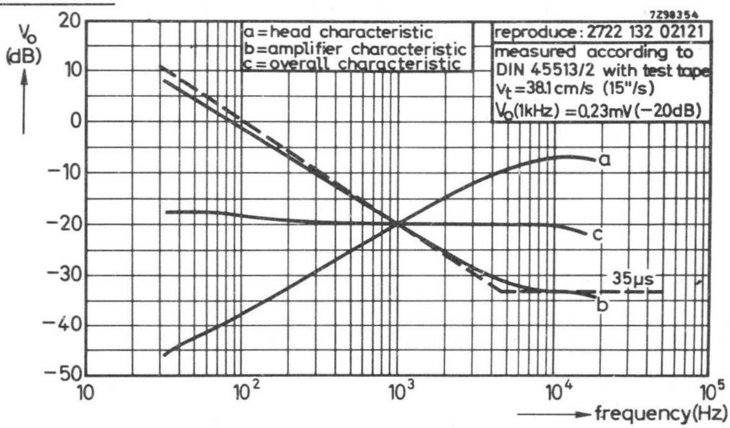
Dynamic performance

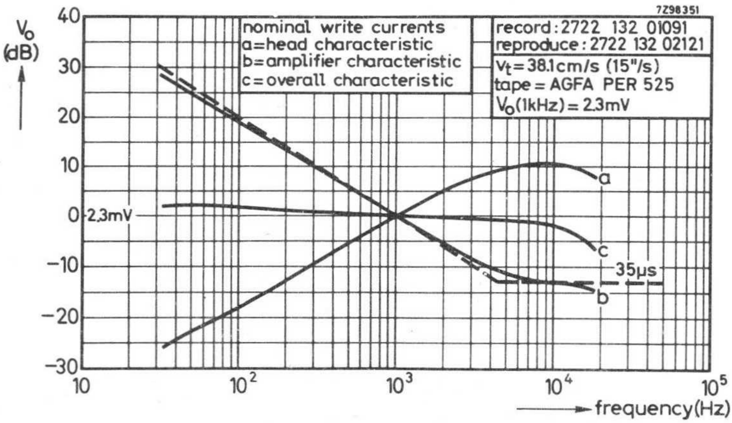
Test tape	BASF LGR
Tape velocity	19.05 cm/s (7.5 inch/s)
Tape tension	75 g

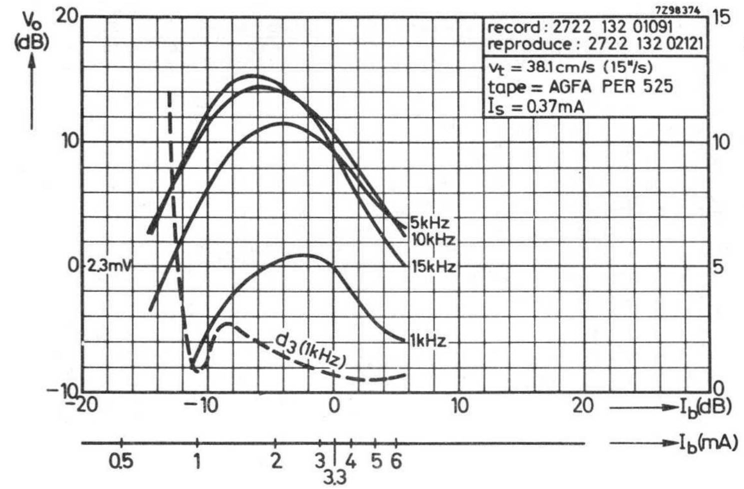
*) Measured at 80 mV, 10 kHz.

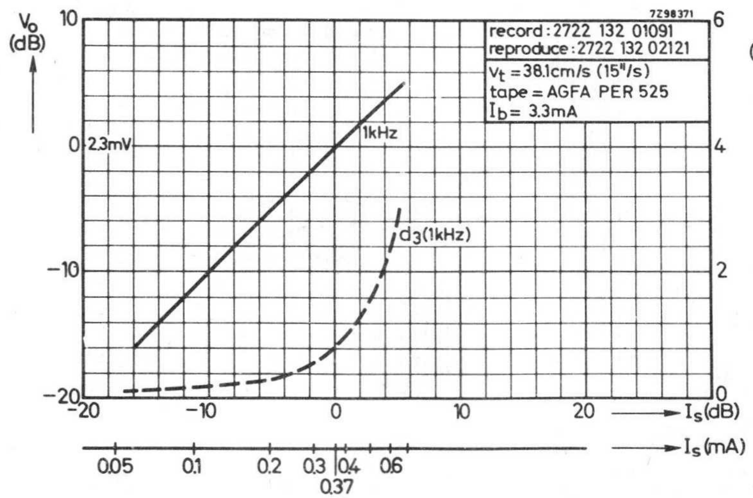
	record head	reproduce head
Bias current at 100 kHz, optimal for 1 kHz	2.5 ±0.5 mA	
Signal current at 1 kHz for drive at 25 mMx/mm	0.46 ±0.08 mA	
Output voltage at 1 kHz, 32 mMx/mm		2.3 ± 0.3 mV
Crosstalk (dynamically, 1 kHz) in combination with 2-track stereo reproduce/record head	< −43 dB	< −43 dB
Crosstalk (dynamically, 1 kHz) in combination with half-track reproduce/record head	< −49 dB	< −45 dB

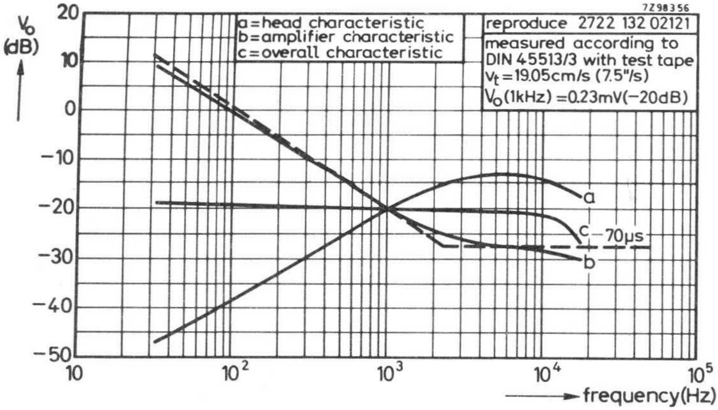
Typical curves

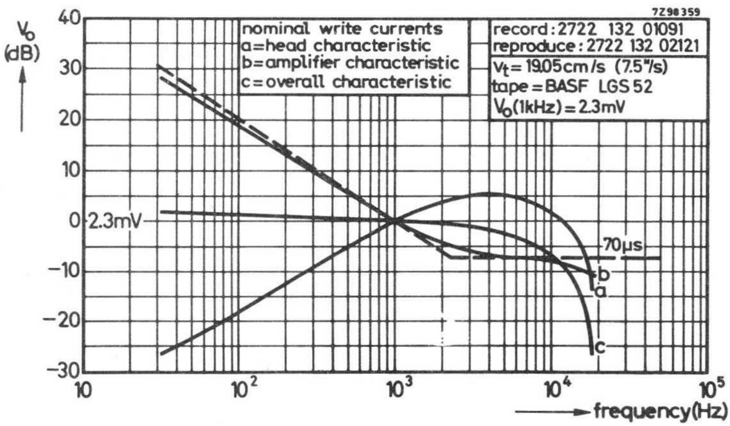


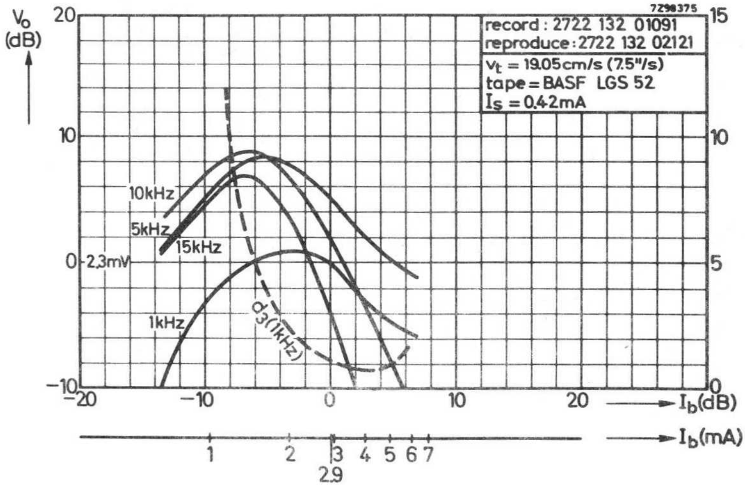


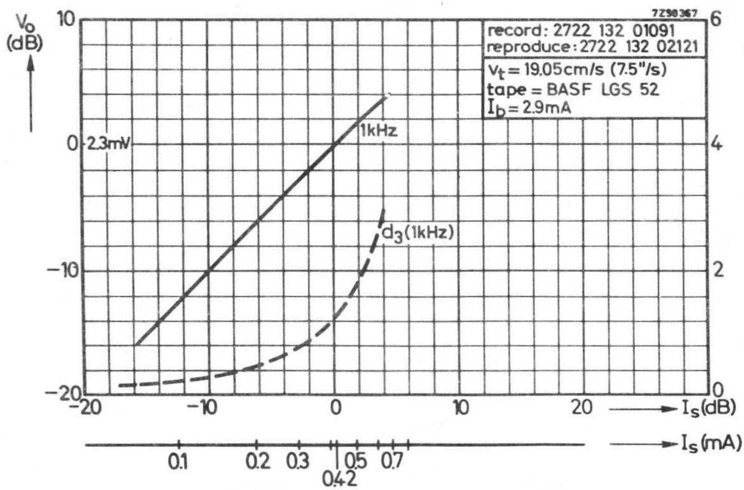

7Z98374
record : 2722 132 01091
reproduce : 2722 132 02121
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_s = 0.37 mA
V_o (dB)
d_3 (%)
2.3 mV
5 kHz
10 kHz
15 kHz
1 kHz
d_3 (1 kHz)
I_b (dB)
I_b (mA)
3.3

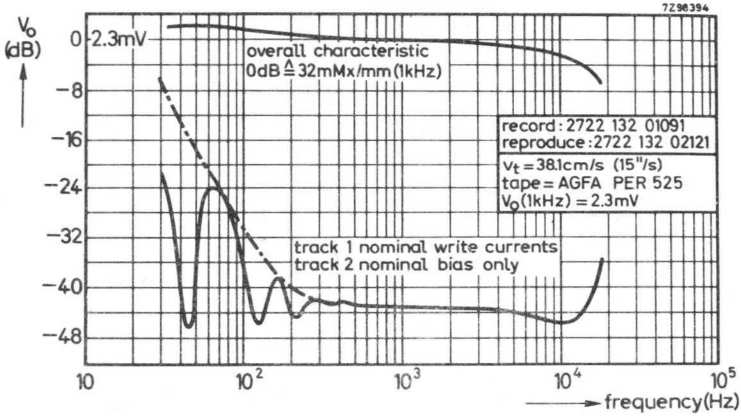

7Z98371
record : 2722 132 01091
reproduce : 2722 132 02121
v_t = 38.1 cm/s (15"/s)
tape = AGFA PER 525
I_b = 3.3 mA
V_o (dB)
d_3 (%)
2.3 mV
1 kHz
d_3 (1 kHz)
I_s (dB)
I_s (mA)
0.37

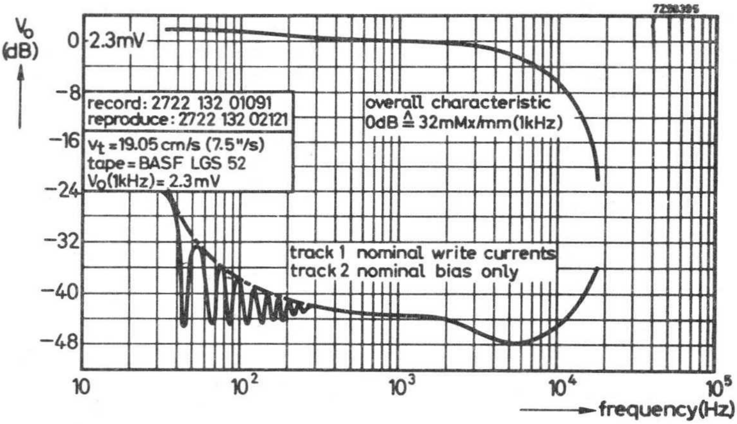

7Z98356
a = head characteristic
b = amplifier characteristic
c = overall characteristic
reproduce 2722 132 02121
measured according to DIN 45513/3 with test tape
V_t = 19.05cm/s (7.5"/s)
V_o(1kHz) = 0.23mV(−20dB)
V_o (dB)
20
10
0
−10
−20
−30
−40
−50
10
10^2
10^3
10^4
10^5
frequency(Hz)
a
b
c
70μs


7Z98359
nominal write currents
a = head characteristic
b = amplifier characteristic
c = overall characteristic
record: 2722 132 01091
reproduce: 2722 132 02121
V_t = 19.05cm/s (7.5"/s)
tape = BASF LGS 52
V_o(1kHz) = 2.3mV
V_o (dB)
40
30
20
10
0
2.3mV
−10
−20
−30
10
10^2
10^3
10^4
10^5
frequency(Hz)
a
b
c
70μs


7Z98375
record : 2722 132 01091
reproduce : 2722 132 02121
v_t = 19.05 cm/s (7.5"/s)
tape = BASF LGS 52
I_s = 0.42 mA
V_o (dB)
d_3 (%)
10kHz
5kHz
15kHz
1kHz
0 2.3mV
d_3(1kHz)
I_b(dB)
I_b(mA)
2.9

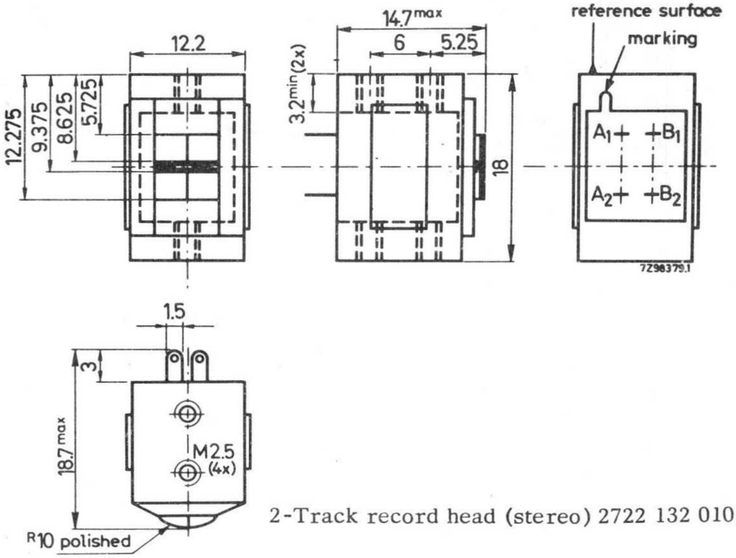

7Z98367
record: 2722 132 01091
reproduce: 2722 132 02121
v_t = 19.05 cm/s (7.5"/s)
tape = BASF LGS 52
I_b = 2.9 mA
V_o (dB)
d_3 (%)
1kHz
0 2.3mV
d_3(1kHz)
I_s(dB)
I_s(mA)
0.42


7Z98394
V_o (dB)
2.3mV
0
-8
-16
-24
-32
-40
-48
overall characteristic
0dB ≙ 32mMx/mm (1kHz)
record: 2722 132 01091
reproduce: 2722 132 02121
v_t = 38.1cm/s (15"/s)
tape = AGFA PER 525
V_o(1kHz) = 2.3mV
track 1 nominal write currents
track 2 nominal bias only
10
10^2
10^3
10^4
10^5
frequency (Hz)

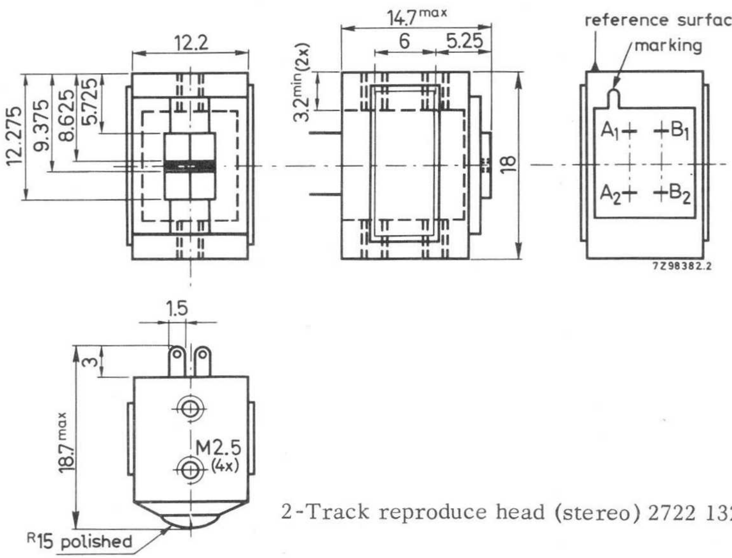

V_o (dB)
2.3mV
0
-8
-16
-24
-32
-40
-48
record: 2722 132 01091
reproduce: 2722 132 02121
v_t = 19.05 cm/s (7.5"/s)
tape = BASF LGS 52
V_o(1kHz) = 2.3mV
overall characteristic
0dB ≙ 32mMx/mm (1kHz)
track 1 nominal write currents
track 2 nominal bias only
10
10^2
10^3
10^4
10^5
frequency (Hz)

Mechanical data

Gap length	
record head	7 μm
reproduce head	4 μm
Number of tracks	2
Track width	2.9 $\pm$ 0.04 mm
Centre track distance	3.65 mm
Azimuth	< 2 minutes of arc
Tilt	< 3 minutes of arc
Gap scatter	< 2 μm

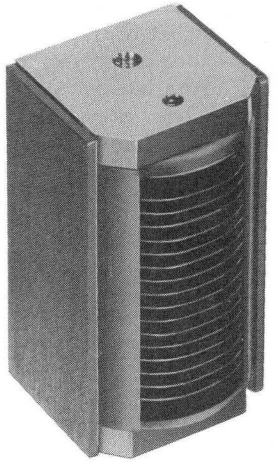


2-Track record head (stereo) 2722 132 01091



2-Track reproduce head (stereo) 2722 132 02121

AUDIO MAGNETIC HEADS
(Voice filing)



RZ 25044-8

INTRODUCTION

These audio magnetic heads have been designed for use in audio recorders for voice filing, where a high degree of information density is required to minimize the cost of investment in tape. For the track configuration is chosen the IRIG standard for 31 tracks on one inch tape, using a pair of interlaced heads. The same width and spacing of tracks is chosen for the other heads (1/4 and 1/2 inch).

These audio heads offer the following advantages:

- high number of tracks per unit tape width if using these heads interlaced viz. 7 tracks on 1/4 inch tape, 15 tracks on 1/2 inch tape and 31 tracks on 1 inch tape.
- with a tape speed as low as 15/16 in/s (2.38 cm/s) signal response up to 3 kHz is obtained. Together with the high track density mentioned above thus many hours of speech can be filed on a small amount of tape e.g. on 1080 meters (3600 feet) of 1/4" tape 7 x 12 hrs of speech can be recorded.
- low tape and head wear due to the very fine polished head surfaces and the hardness of ferrite and gap material
- small spread in mechanical parameters offering constant production quality and good compatibility between different tapes.

CONSTRUCTION

Starting from polished high density ferroxcube parts a multi-track head assembly is made. The separation between adjacent tracks is formed by non-magnetic ceramic material and a mu-metal shield. The assembly provided with coils is mounted in an aluminium housing. The datum surface of the housing is machined with respect to the gap lines and the front surface of the head.

TYPES

tape width	number of tracks in the head	number of tracks on the tape, using interlaced head pairs	type	catalog number
1/4 inch	4	7	record	2722 132 11001
1/4 inch	4	7	reproduce	2722 132 12001
1/2 inch	8	15	record	2722 132 11011
1/2 inch	8	15	reproduce	2722 132 12011
1 inch	17	31	record	2722 132 11021
1 inch	17	31	reproduce	2722 132 12021

TECHNICAL PERFORMANCE *)

Dynamic performance

Test conditions

Tape	BASF LGR unless otherwise specified
Tape tension	300 g/1 inch tape width
Bias frequency	25 kHz
Load resistor, reproduce head	10 kΩ
Wrap angle	2 x 6°

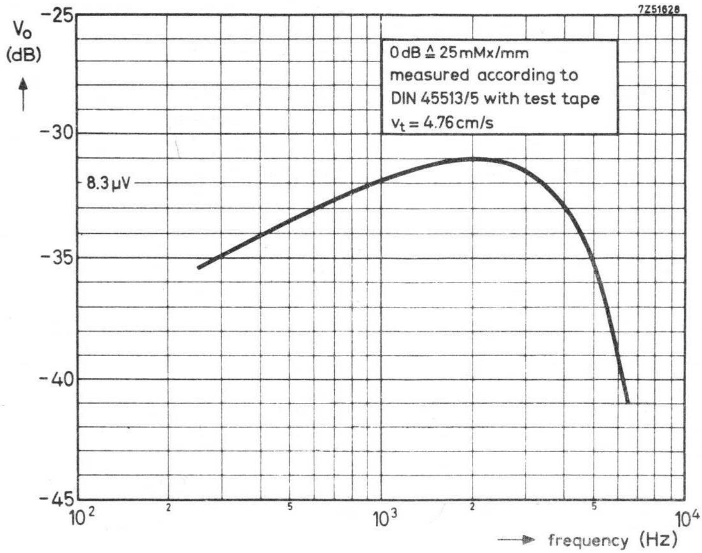
Dynamic crosstalk

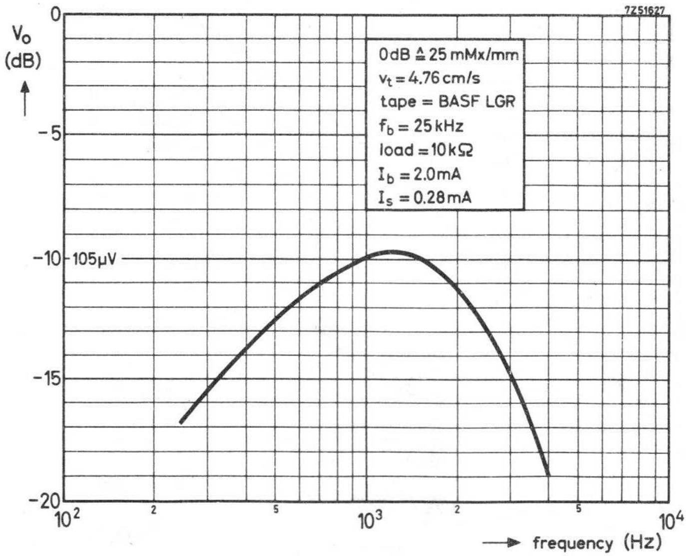
At a signal frequency of 1 kHz the dynamic crosstalk is better than 38 dB.

*) The figures and graphs given are valid for the following combinations of record - and reproduce heads: 2722 132 11001 with 2722 132 12001
2722 132 11011 with 2722 132 12011
2722 132 11021 with 2722 132 12021

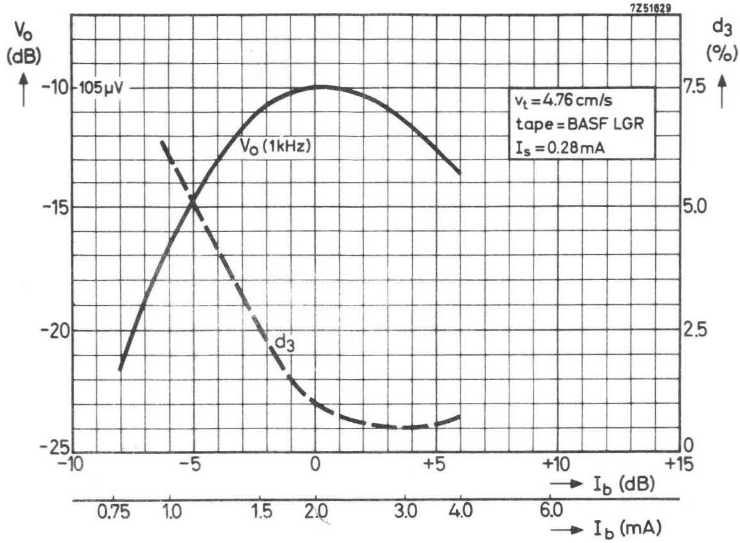
Characteristic curves

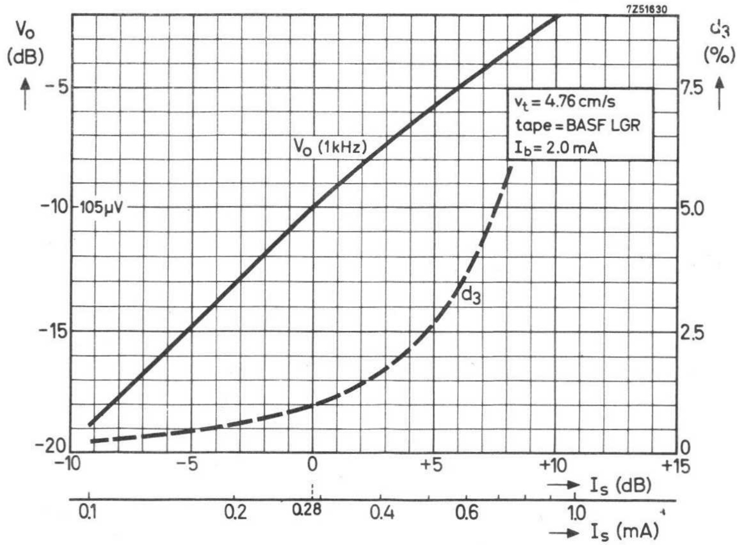
Tape speed = 4.76 cm/s ($1\,7/8$ inch/s)





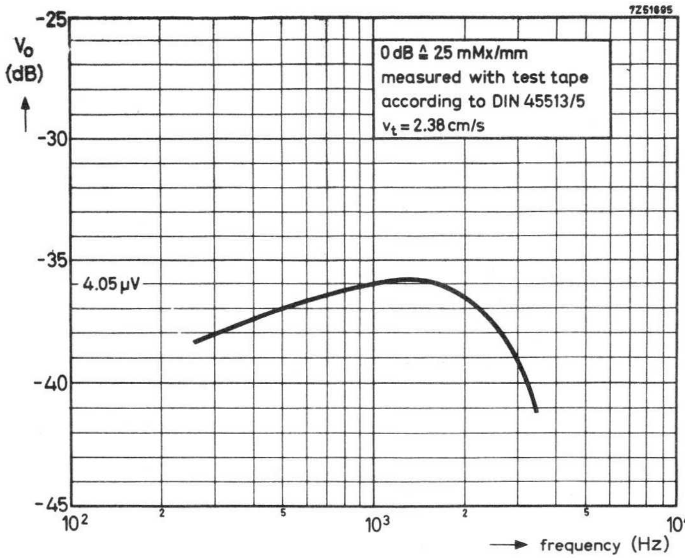
The distortion in the two following figures is presented without correction in contrary to what is normally done in the audio field.

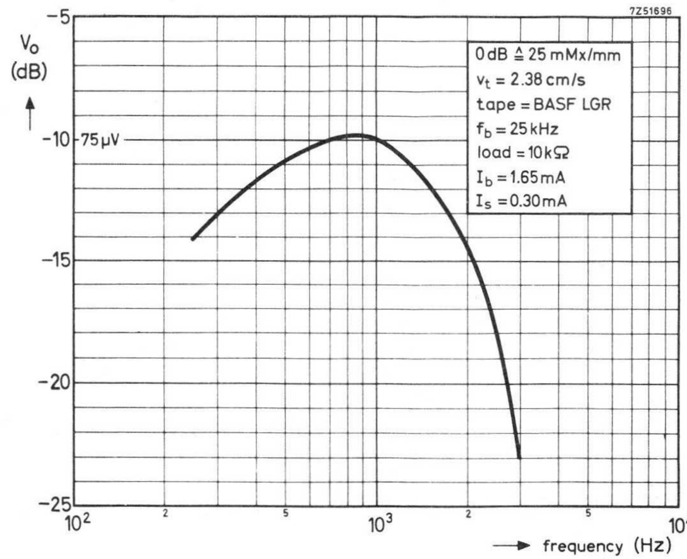




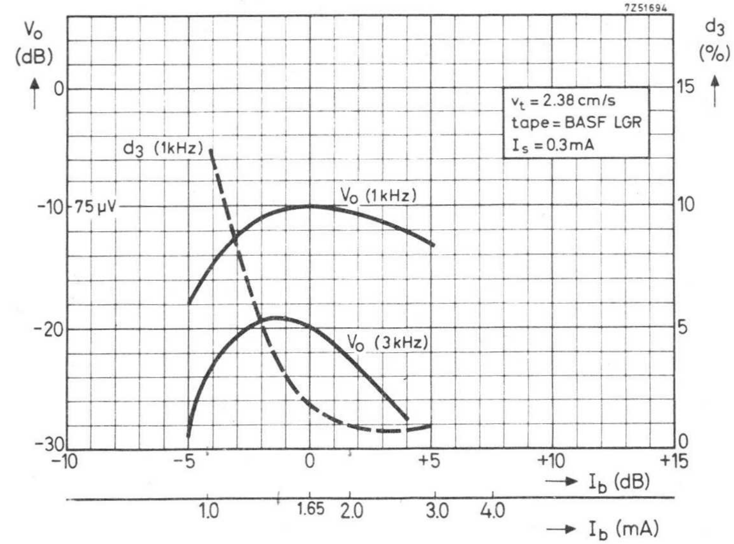
Tape speed = 2.38 cm/s (15/16 inch/s)

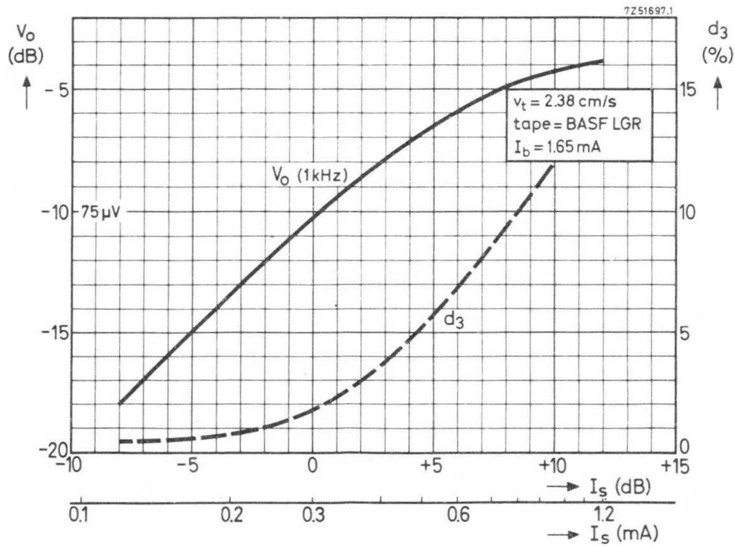
As for this tape speed no DIN test tape is available, the characteristic shown in the figure below is determined with test tape for a tape speed of 4.76 cm/s.





The distortion in the two following figures is presented without correction in contrary to what is normally done in the audio field.





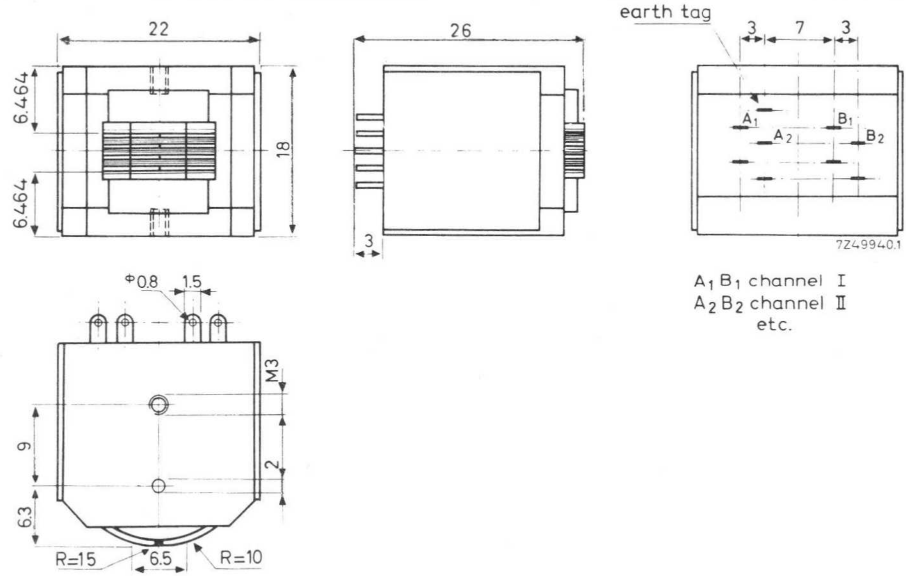
Static performance

Electrical data	record heads	reproduce heads
L *)	6 mH ± 10%	53 mH ± 15%
Q *)	≥ 7	≥ 8
f_r	≥ 500 kHz	≥ 100 kHz
R_0	25 ± 3 Ω	180 ± 20 Ω
R_1, R_2, R_3, R_4	1000 MΩ	
R_5	1 kΩ	

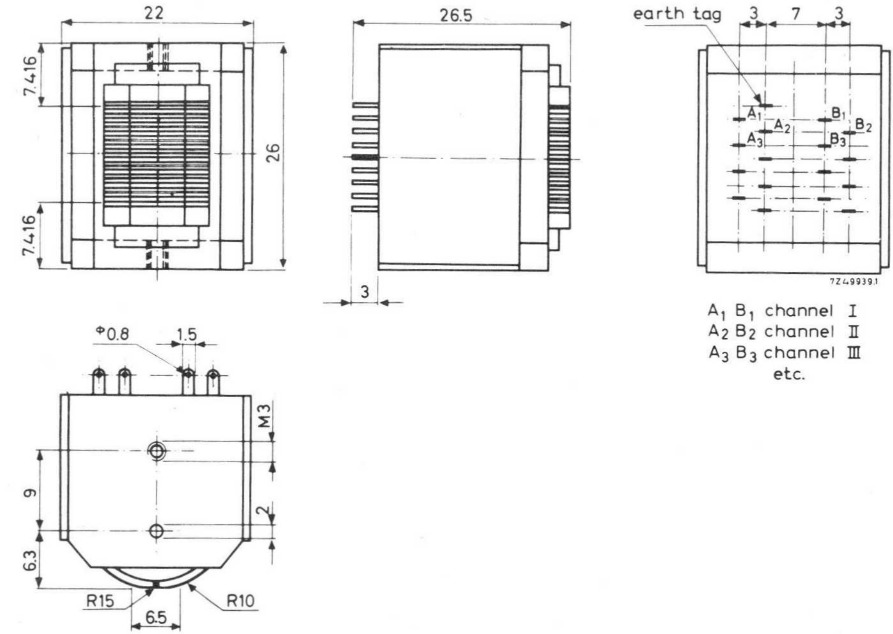
Mechanical data

Gap length	
for record heads	6 to 7 μm
for reproduce heads	3 to 4 μm
Track width	0.5 ± 0.04 mm
Centre to centre track distance	1.524 mm
Azimuth	
for 1/4 inch heads	< 5 minutes of arc
for 1/2 inch and 1 inch heads	< 1 minute of arc
Tilt	< 3 minutes of arc
Gap scatter	< 1 μm

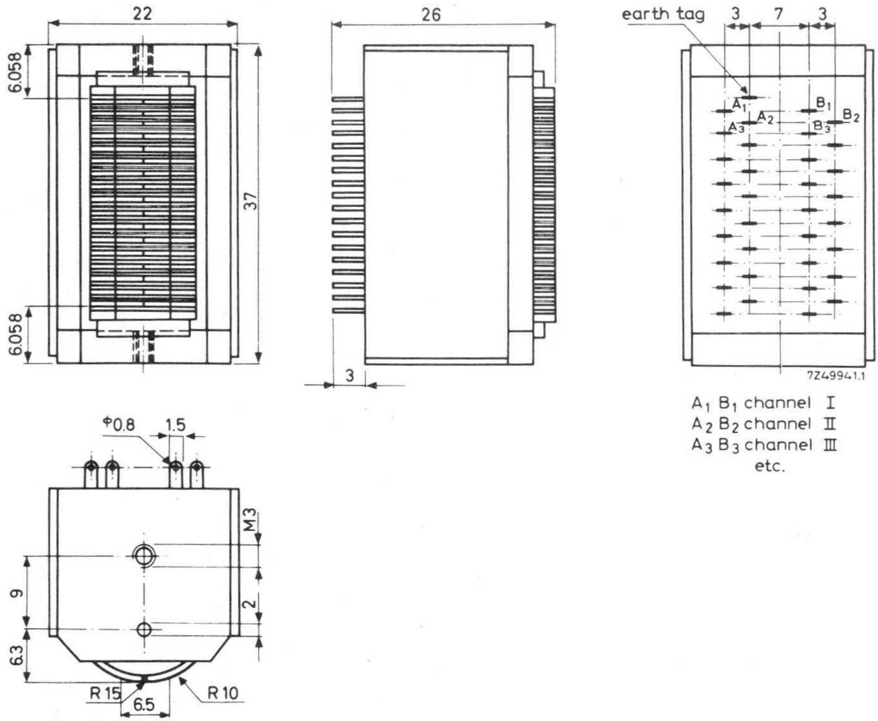
*) Measured at 80 mV, 1 kHz.



Audio heads (voice filing) 2722 132 11001 and 2722 132 12001. Dimensions in mm.

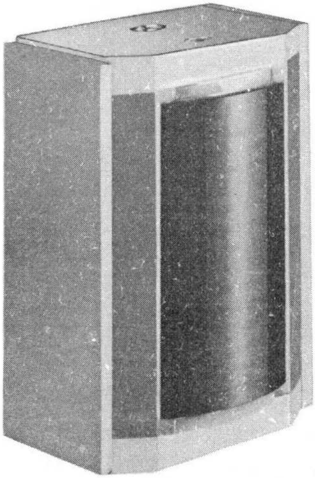


Audio heads (voice filing) 2722 132 11011 and 2722 132 12011. Dimensions in mm.

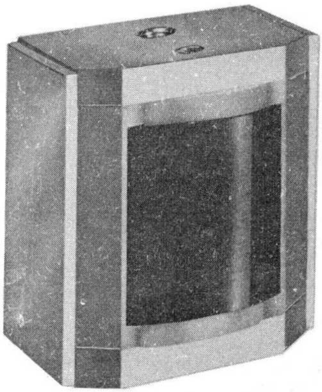


Audio heads (voice filing) 2722 132 11021 and 2722 132 12021. Dimensions in mm.

INSTRUMENTATION MAGNETIC HEADS



RZ 21953-1



RZ 21953-7

INTRODUCTION

These instrumentation magnetic heads in multi-track configuration have been designed for the recording and reproduction of analogue control and measurement data in industry, telemetry, airborne applications and research.
To achieve full compatibility and interchangeability between different systems, the generally accepted IRIG standard for track configuration on tape has been applied in the design of these heads.

The use of high density ferroxcube as the magnetic core material, together with the unique method of glass bonding employed results in the following features:

- low inherent core losses, especially advantageous for high frequency applications, thus requiring low bias and signal levels
- small spread in mechanical parameters, offering constant production quality and good compatibility between different tapes
- tight tolerance on gap scatter, inherently achieved by the closely controlled production technique
- low wear due to the hardness of core material, thus offering long head life and stable output characteristics.

CONSTRUCTION

Starting from polished high density ferroxcube parts a multi-track head assembly is made. The separation between adjacent tracks is formed by non-magnetic ceramic material and ferroxcube shielding. The complete head to tape contact area consists of wear resistant ceramics. The obtained assembly provided with coils is mounted in an aluminium housing. The datum surface of the housing is machined with respect to the gap lines and the front surface of the head.

TYPES

tape width	number of tracks (data + annotation)	type	catalog number
$\frac{1}{2}$ inch	3 + 1	record	2722 133 01001
$\frac{1}{2}$ inch	4	record	2722 133 01011
$\frac{1}{2}$ inch	3 + 1	reproduce	2722 133 02001
$\frac{1}{2}$ inch	4	reproduce	2722 133 02011
1 inch	7 + 1	record	2722 133 01021
1 inch	7 + 1	reproduce	2722 133 02021

TRACK CONFIGURATION

The interlaced track configuration for the heads is in accordance with the IRIG standard for direct and f.m. recording. This is illustrated schematically in following diagrams and the table below. Standard heads are equipped with annotation tracks (optional according to the IRIG Document, Number 106-60, revised June 1962).

For $\frac{1}{2}$ inch tape systems interlacing of tracks is achieved by mounting one 3 + 1 track head (3 data tracks + 1 annotation track) and one 4 track head on a flat mounting plate.

For 1 inch systems interlacing of tracks is achieved by mounting two identical 7 + 1 track heads (7 data tracks + 1 annotation track), one the opposite way up with respect to the other i.e. an annotation track appears at each edge of the tape.

	$\frac{1}{2}$ inch tape system	1 inch tape system
Number of data tracks	7 (3 + 4)	14 (7 + 7)
Width of data tracks	1.27 mm (0.05 inch)	1.27 mm (0.05 inch)
Number of annotation tracks	1	2 (1 + 1)
Width of annotation tracks		
in the head stacks	0.50 mm (0.020 inch)	0.50 mm (0.020 inch)
on the tape	0.13 mm (0.005 inch)	0.27 mm (0.010 inch)

Both heads mounted with earth tag nearest to base.

Thus one pair of heads gives 7 inter-laced tracks on the tape, according to the IRIG standard.

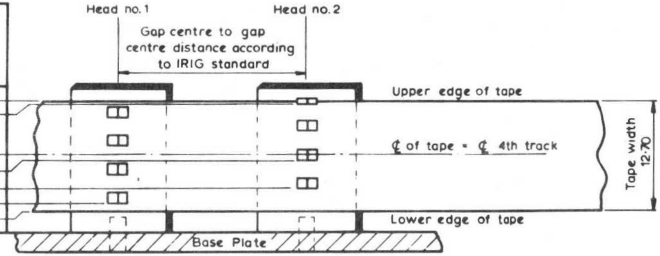
A denotes annotation track.

Catalog numbers:
4 tracks (no.1) { record : 2722 133 01011
reproduce: 2722 133 02011

3+1 tracks (no.2) { record : 2722 133 01001
reproduce: 2722 133 02001

Track position of 3+1 track and 4 track analogue heads on 1/2" tape

Tracks on tape	Distance to Base plate	Distance to Lower edge of tape
A	19·35	12·70
7	19·22	12·57
6		
5		
4	13·00	6·35
3		5·72
2	8·81	
1	7·03	0·38
	6·65	0·00



Head no.1 mounted with earth tag nearest to base

Head no.2 mounted with earth tag near upper edge of tape.

Thus one pair of identical heads gives 14 interlaced tracks on tape.

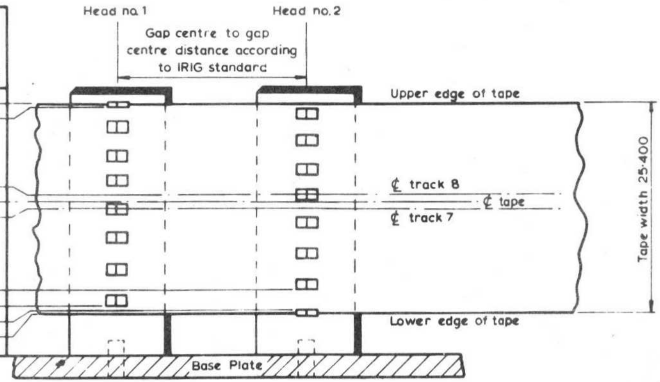
A and B denote annotation tracks.

Catalog numbers:
record : 2722 133 01021
reproduce: 2722 133 02021

All dimensions in mm

Track position of 7+1 track analogue heads on 1" tape

Tracks on tape	Distance to Base plate	Distance to Lower edge of tape
B	31·20	25·40
14	30·93	25·13
13		
12		
11		
10		
9	19·39	
8	18·50	12·70
7	17·61	
6		
5		
4		
3		
2	8·09	
1	6·31	0·51
A	6·07	0·27
	5·80	0·00



TECHNICAL PERFORMANCE *)

Dynamic performance

The information shown in the series of curves which follow has been obtained using the recommended measuring methods as set out in the IRIG Document 106-65 (issued November 1965) using instrumentation tape 3M 599, applying a wrap angle of 2 x 6^{o} and a tape tension of 300 g/inch tape width.

Direct recording

Record/reproduce parameters

In Table 1, the frequency ranges for low band and intermediate band as recommended by IRIG are given for the various tape speeds together with the number of appropriate curves showing the frequency response for these bands, and the influence of variations in bias and signal current on output and distortion for some discrete frequencies in every band.

Note

A typical example of how to set up normal bias and signal levels according to the IRIG standard is given below for a tape speed of 60 inch/s and low band.

1. A signal current (100 kHz) is set at a level −6 dB relative to the expected normal record signal level. The record bias current is adjusted for maximum reproduce output and then increased until an output level 3 dB below the maximum value is obtained (3 dB over-bias).
2. With the obtained bias current applied, the signal current (1 kHz) is set at a value which yields 1% third harmonic distortion from the tape, when measured at the output of the playback amplifiers during playback.
3. If there is a difference between the expected normal signal current mentioned in item 1 and the result of the measurements in item 2, steps 1 and 2 are repeated. The obtained values for bias and signal currents are the normal levels.

The above technique is employed to establish normal bias and signal levels. Graphs 6 and 7 illustrate percentage distortion and variation of output level when bias and signal current are varied.

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*) The figures and graphs given are valid for the following combinations of record - and reproduce heads: 2722 133 01001 with 2722 133 02001
2722 133 01011 with 2722 133 02011
2722 133 01021 with 2722 133 02021

Table 1

	tape speed (inch/s)	frequency band (kHz)	set frequency (kHz) for record bias current; see note on preceding page	set frequency (kHz) for record signal current; see note on preceding page	no. of graph showing output voltage versus frequency*	no. of graph showing output voltage and distortion versus bias current	no. of graph showing output voltage and distortion versus signal current
low band	120**	0.1-200	200	1	1	4	5
	60	0.1-100	100	1	1	6	7
	30	0.1- 50	50	1	1	8	9
	15	0.1- 25	25	1	1	10	11
	$7\frac{1}{2}$	0.1- 12	12	0.5	2	12	13
	3 3/4	0.1- 6	6	0.5	2	14	15
	1 7/8	0.1- 3	3	0.5	2	16	17
	15/16**	0.1- 1.5	1.5	0.25	3	18	19
intermediate band	120	0.3-500	500	1	20	23	24
	60	0.3-250	250	1	20	25	26
	30	0.2-125	125	1	20	27	28
	15	0.1- 60	60	1	20	29	30
	$7\frac{1}{2}$	0.1- 30	30	0.5	21	31	32
	3 3/4	0.1- 15	15	0.5	21	33	34
	1 7/8	0.1- 7.5	7.5	0.5	21	35	36
	15/16**	0.1- 3.5	3.5	0.25	22	37	38

* For diagramatic clarity, the low frequency response (i.e. below 1 kHz), shown in the curves, refers only to the lower speeds. The worst case low frequency response (i.e. for 120 inch/s) is shown in graph 39.

** These measurements were carried out in addition to the recommended IRIG measurements for added information.

Dynamic crosstalk

Table 2

	tape speed (inch/s)	minimum frequency (kHz)	maximum frequency (kHz)	crosstalk (dB) better than
low band	120	2	200	-40
	60	1 *	100	-45
	30	0.5 *	50	-45
	15	0.25 *	25	-45
	$7\frac{1}{2}$	0.125*	12	-45
	3 3/4	0.1	6	-45
	1 7/8	0.1	3	-45
	15/16	0.1	1.5	-45
intermediate band	120	2 *	500	-30
	60	1 *	250	-40
	30	0.5 *	125	-45
	15	0.25 *	60	-45
	$7\frac{1}{2}$	0.125*	30	-45
	3 3/4	0.1	15	-45
	1 7/8	0.1	7.5	-45
	15/16	0.1	3.75	-45

* Equivalent to maximum wave length on tape: 1.524 mm (= 0.060 inch).

F.M. recording

Record/ reproduce parameters

In Table 3 the frequency ranges, as recommended by IRIG, are given for the various tape speeds together with the number of the appropriate graph showing frequency response.

For the low band the record current has been optimised at the relevant centre frequencies, whereas for the intermediate and wide bands the record currents are optimised both for the centre frequencies (solid line) and for the maximum frequencies (broken line).

Table 3

	tape speed (inch/s)	carrier centre frequency (kHz)	carrier plus deviation (kHz)	carrier minus deviation (kHz)	modulation frequency range (kHz)	no. of graph
low band	120*	108	151.2	64.8	0 to 20	40
	60	54	75.6	32.4	0 to 10	
	30	27	37.8	16.2	0 to 5	
	15	13.5	18.9	8.1	0 to 2.5	
	$7\frac{1}{2}$	6.75	9.45	4.05	0 to 1.25	
	3 3/4	3.375	4.725	2.025	0 to 0.625	
	1 7/8	1.688	2.363	1.012	0 to 0.313	
	15/16*	0.844	1.182	0.506	0 to 0.157	
intermediate band	120	216	302.4	129.6	0 to 40	41
	60	108	151.2	64.8	0 to 20	
	30	54	75.6	32.4	0 to 10	
	15	27	37.8	16.2	0 to 5	
	$7\frac{1}{2}$	13.5	18.9	8.1	0 to 2.5	
	3 3/4	6.75	9.45	4.05	0 to 1.25	
	1 7/8	3.375	4.725	2.025	0 to 0.625	
	15/16*	1.688	2.363	1.012	0 to 0.313	
wide band	120	432	604.8	259.2	0 to 80	42
	60	216	302.4	129.6	0 to 40	
	30	108	151.2	64.8	0 to 20	
	15	54	75.6	32.4	0 to 10	
	$7\frac{1}{2}$	27	37.8	16.2	0 to 5	
	3 3/4	13.5	18.9	8.1	0 to 2.5	
	1 7/8*	6.75	9.45	4.05	0 to 1.25	
	15/16*	3.375	4.725	2.025	0 to 0.625	

* Tape speeds in addition to IRIG Document 106-65.

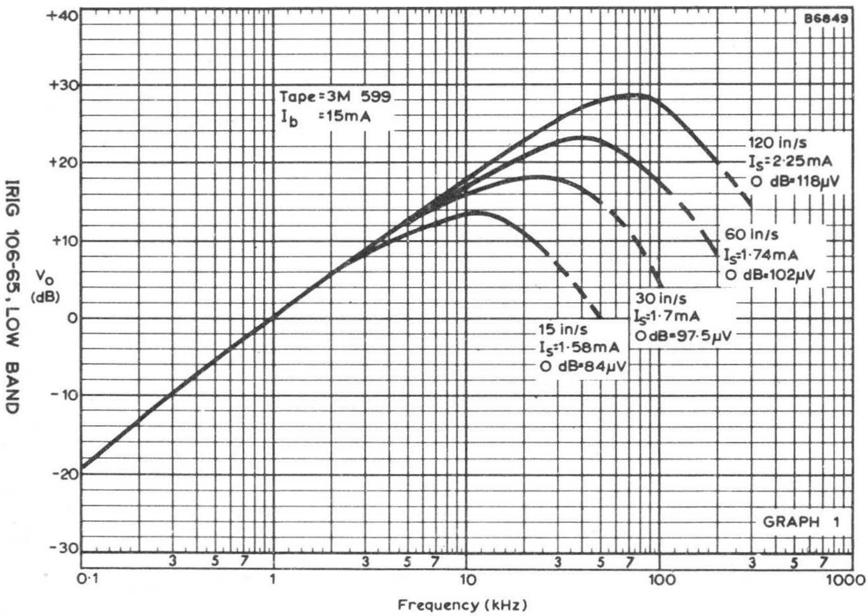
Dynamic crosstalk

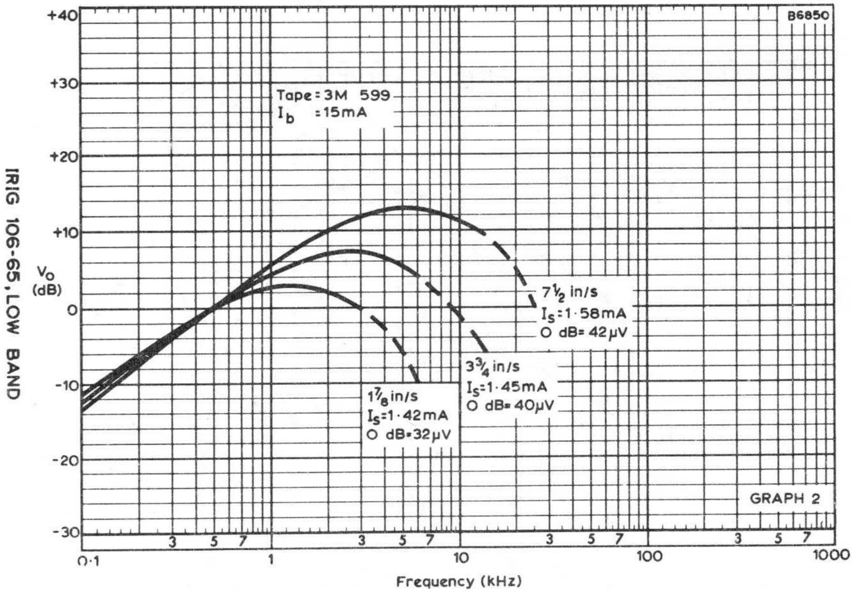
Over the frequency bands, mentioned in Table 3 the crosstalk is:

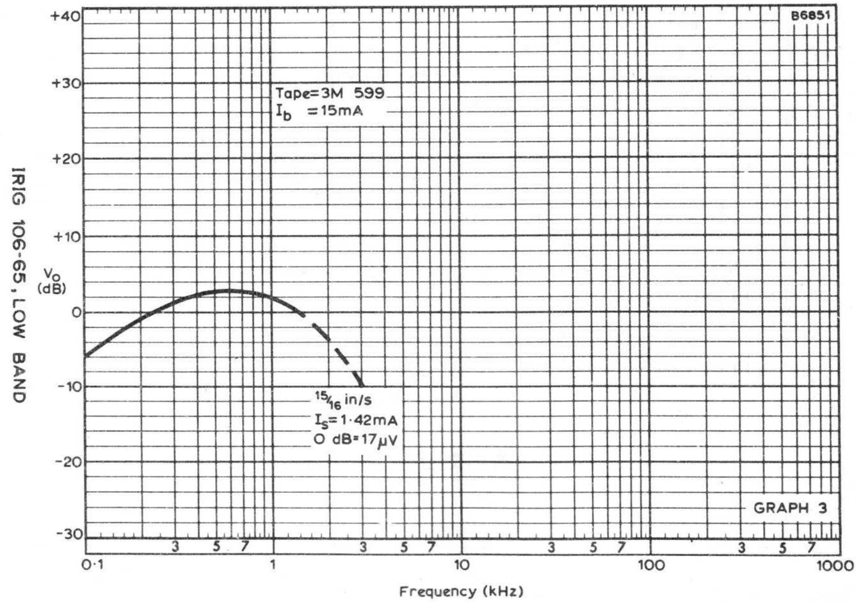
low band	< −45 dB
intermediate band	< −40 dB
wide band	< −35 dB

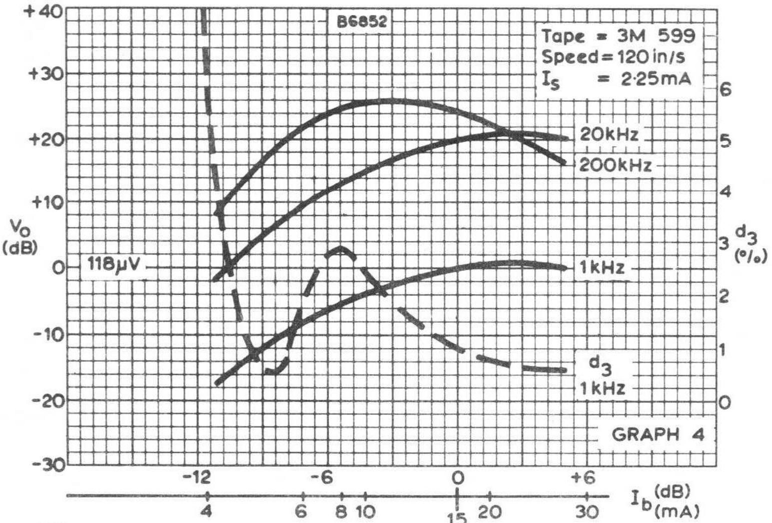
Characteristic curves

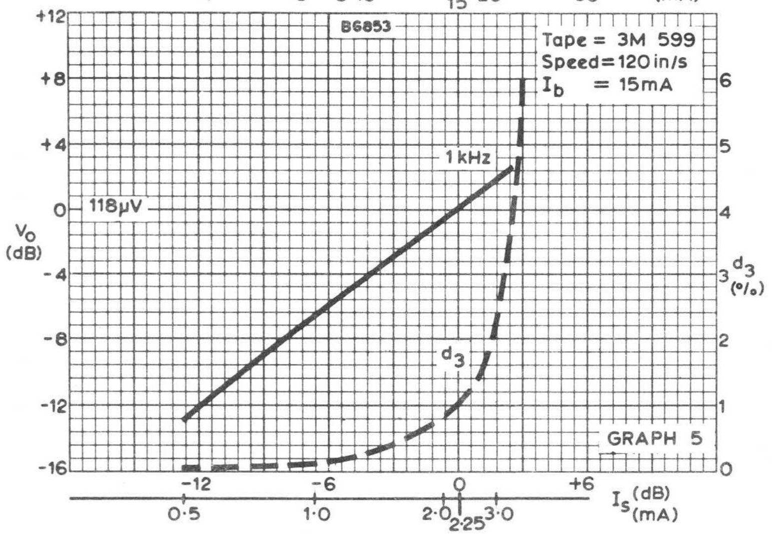
Direct recording



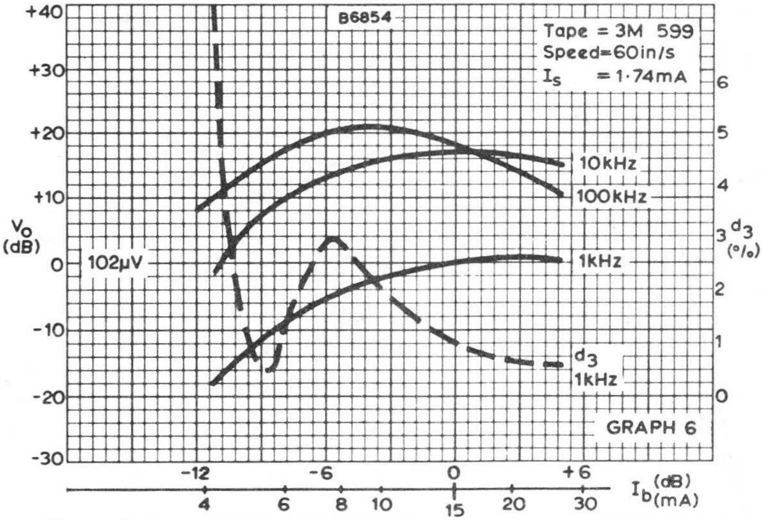

B6850
IRIG 106-65, LOW BAND
Tape: 3M 599
I_b = 15mA
$7\frac{1}{2}$ in/s
I_s = 1·58mA
0 dB = 42µV
$3\frac{3}{4}$ in/s
I_s = 1·45mA
0 dB = 40µV
$1\frac{7}{8}$ in/s
I_s = 1·42mA
0 dB = 32µV
V_o (dB)
Frequency (kHz)
GRAPH 2

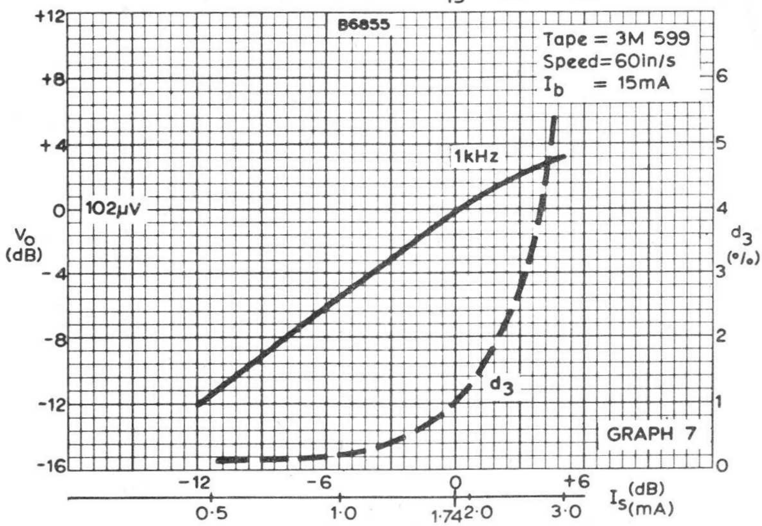

B6851
IRIG 106-65, LOW BAND
Tape = 3M 599
I_b = 15mA
$\frac{15}{16}$ in/s
I_s = 1·42mA
0 dB = 17µV
V_o (dB)
Frequency (kHz)
GRAPH 3



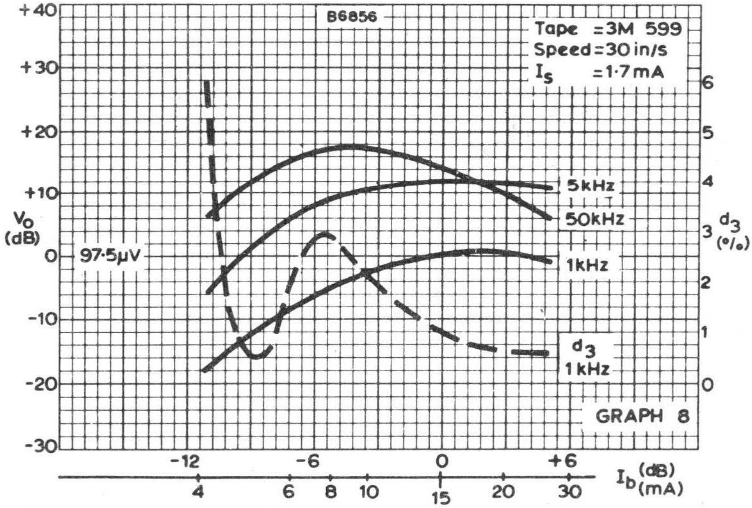


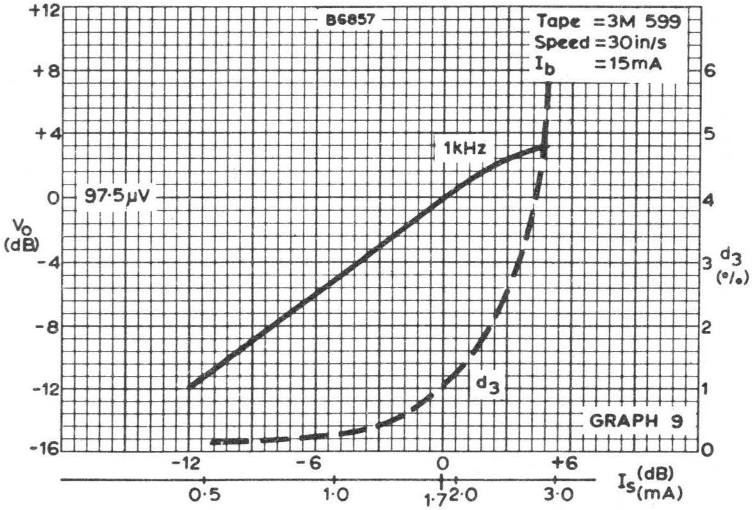
IRIG 106-65, LOW BAND



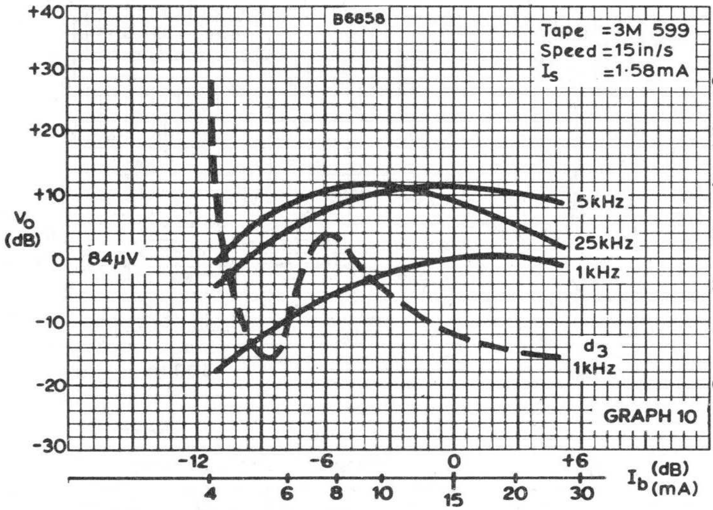


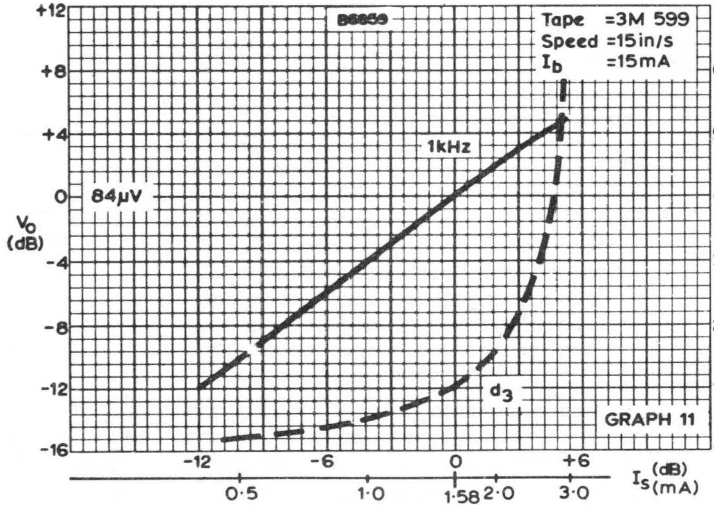
IRIG 106-65, LOW BAND



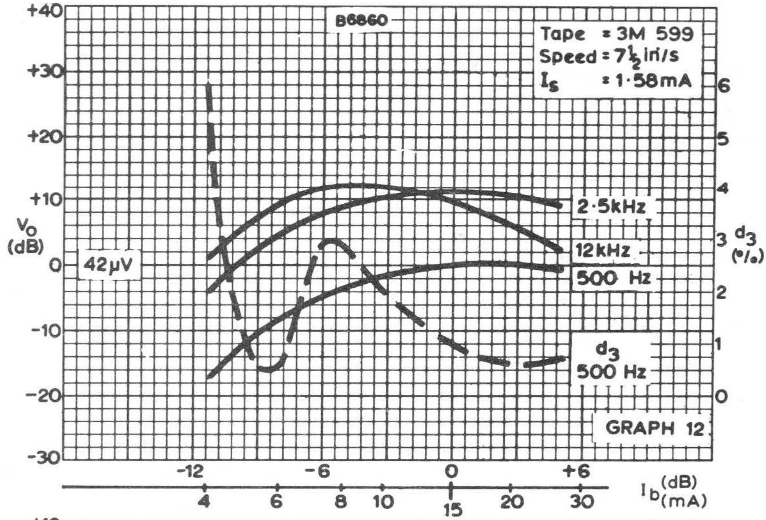


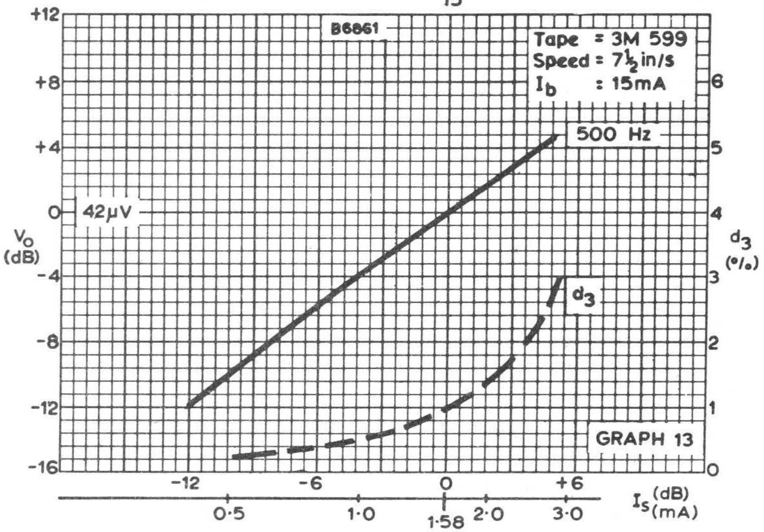
IRIG 106-65, LOW BAND



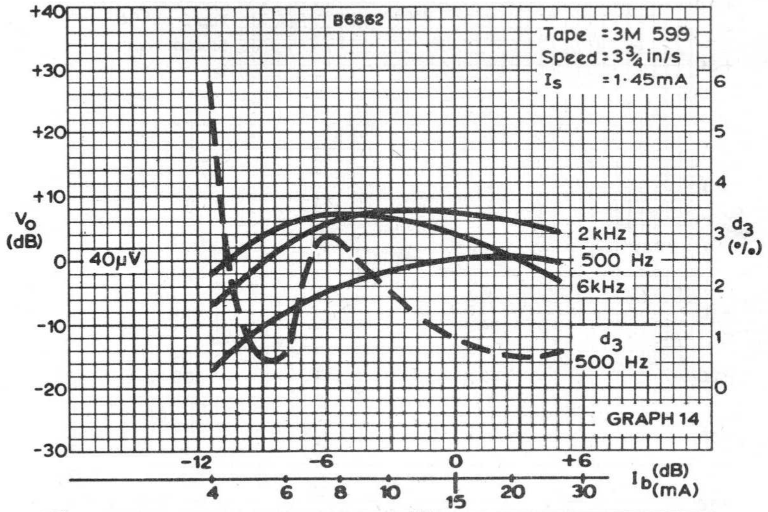


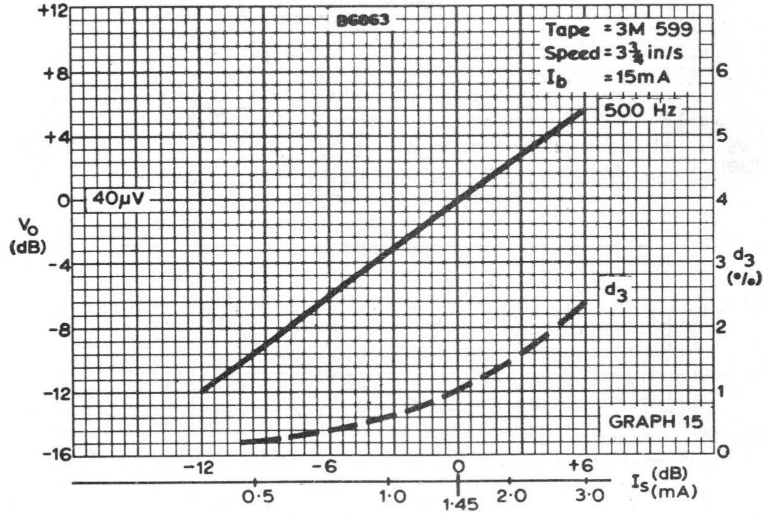
IRIG 106-65, LOW BAND



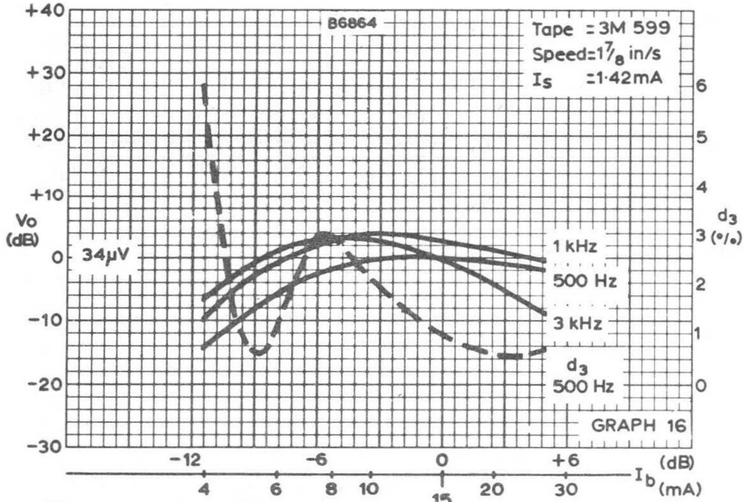


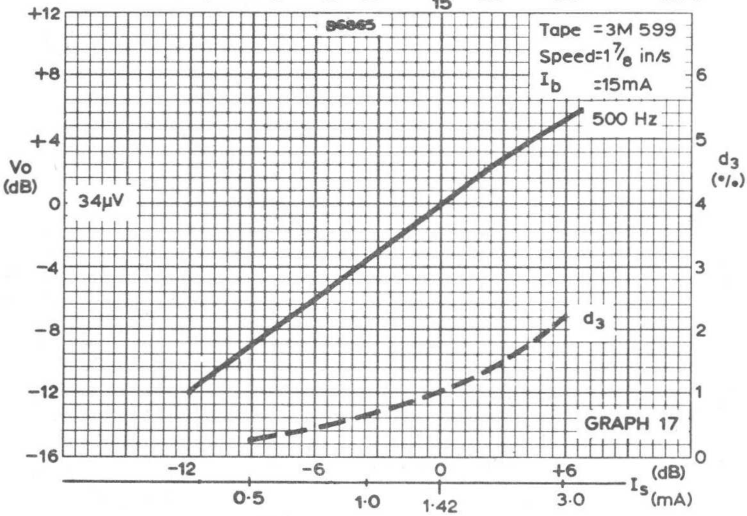
IRIG 106-65, LOW BAND



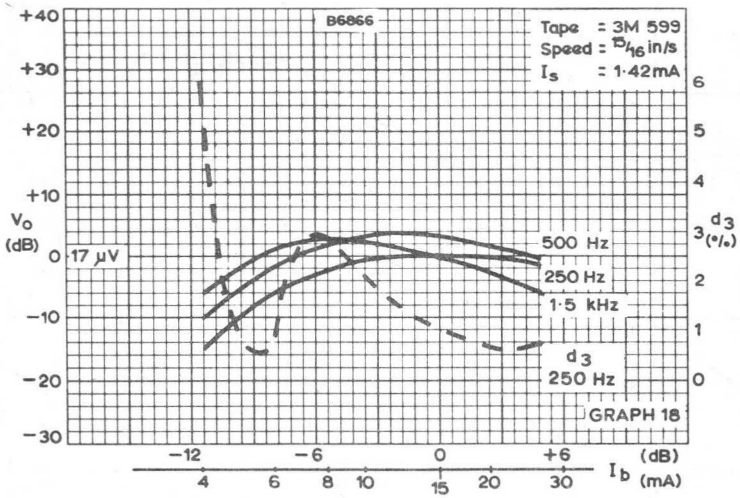


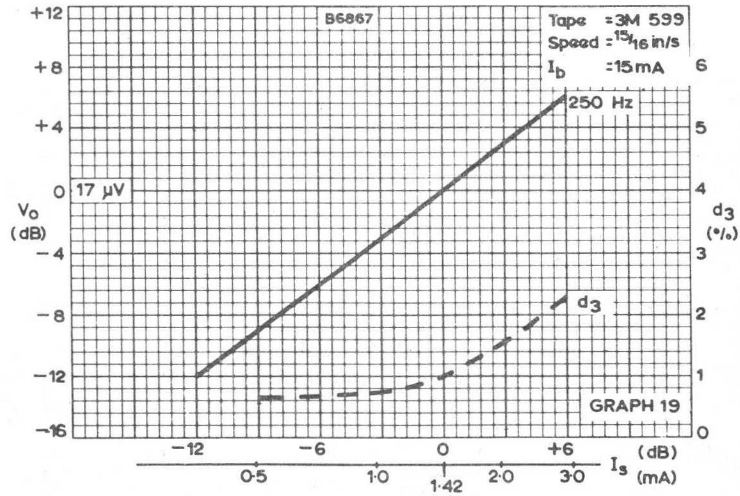
IRIG 106-65, LOW BAND



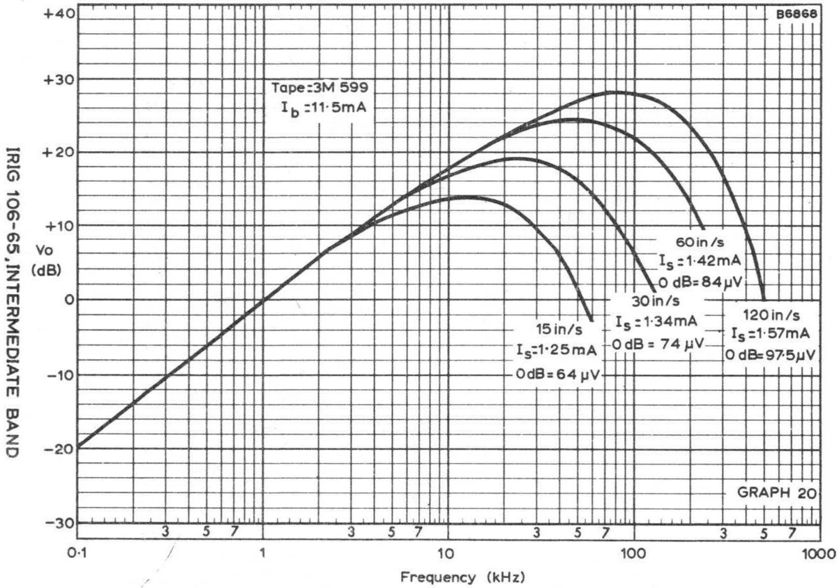


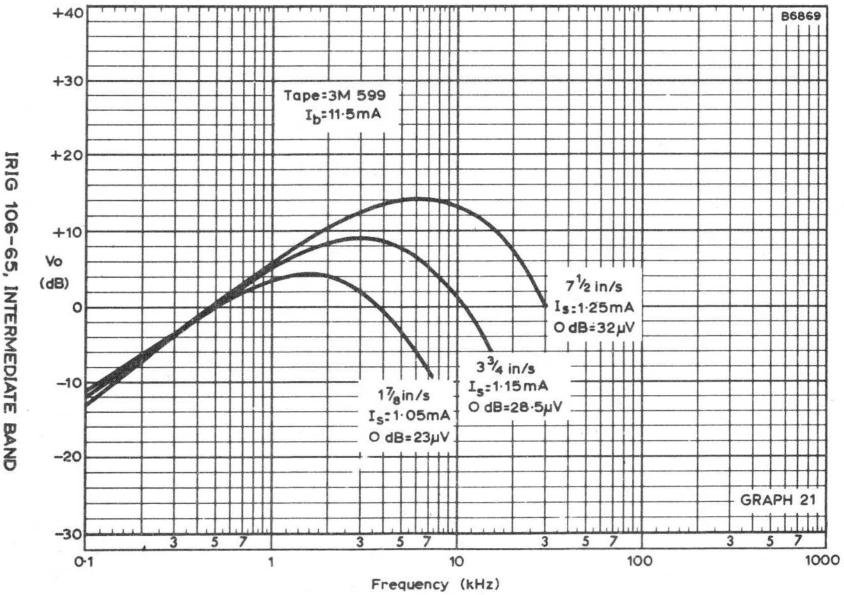
IRIG 106-65, LOW BAND

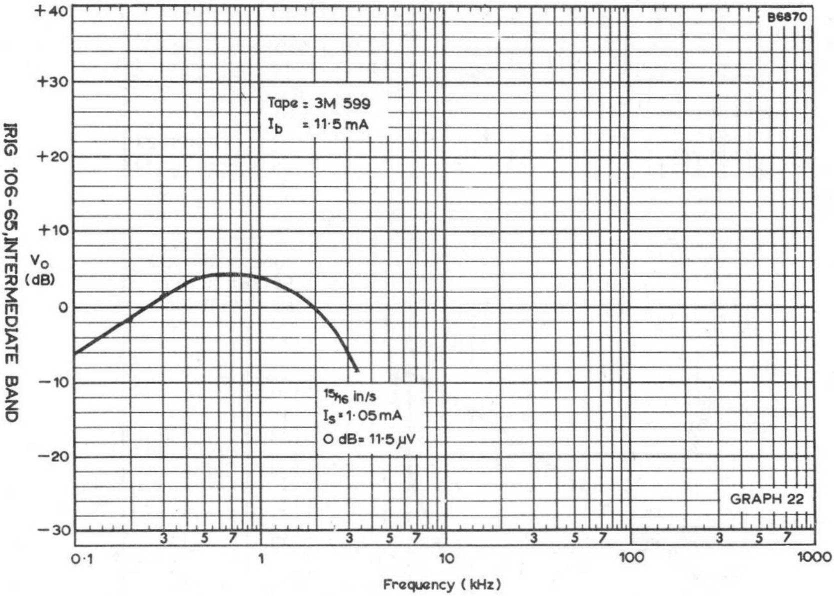


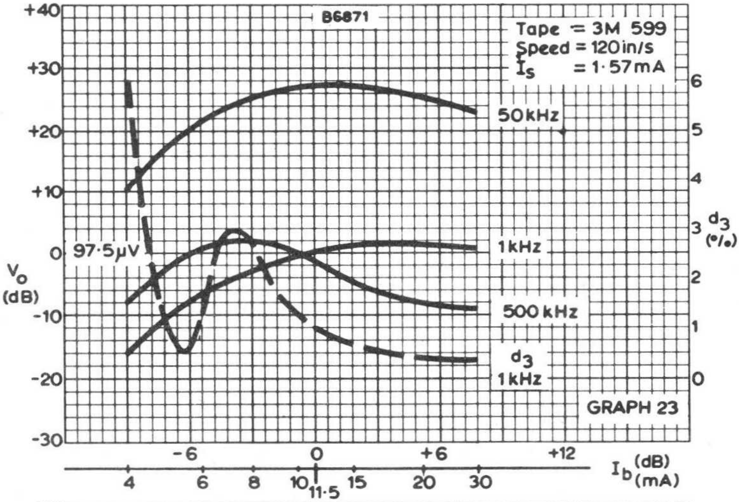


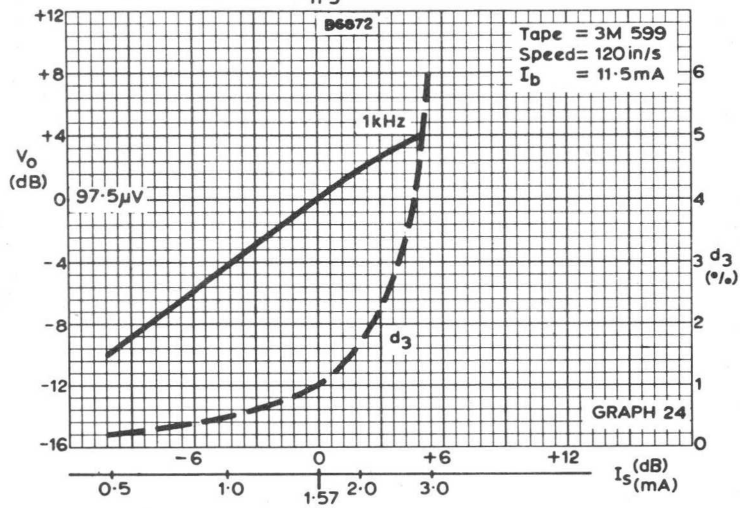
IRIG 106-65, LOW BAND


B6868
Tape: 3M 599
I_b = 11·5mA
IRIG 106-65, INTERMEDIATE BAND
Vo (dB)
+40
+30
+20
+10
0
−10
−20
−30
60 in/s
I_s = 1·42mA
0 dB = 84 μV
30 in/s
I_s = 1·34mA
0 dB = 74 μV
120 in/s
I_s = 1·57mA
0 dB = 97·5 μV
15 in/s
I_s = 1·25mA
0 dB = 64 μV
GRAPH 20
0·1
1
10
100
1000
Frequency (kHz)

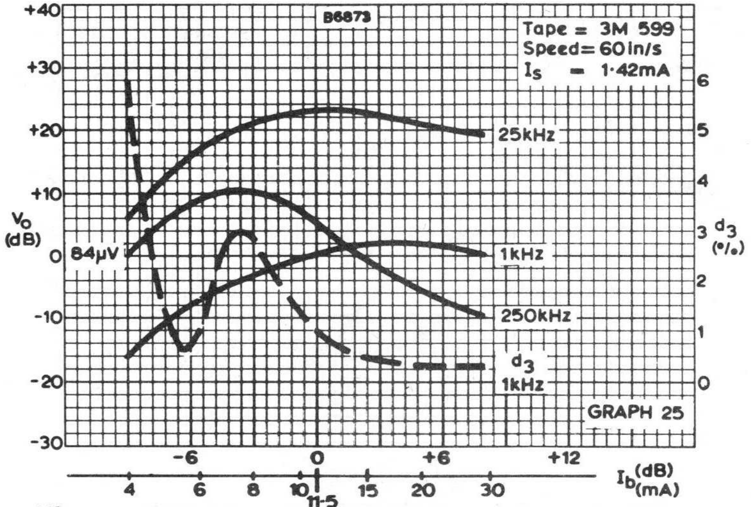

B6869
Tape: 3M 599
I_b = 11·5mA
IRIG 106-65, INTERMEDIATE BAND
Vo (dB)
+40
+30
+20
+10
0
−10
−20
−30
7½ in/s
I_s = 1·25mA
0 dB = 32 μV
3¾ in/s
I_s = 1·15mA
0 dB = 28·5 μV
1⅞ in/s
I_s = 1·05mA
0 dB = 23 μV
GRAPH 21
0·1
1
10
100
1000
Frequency (kHz)

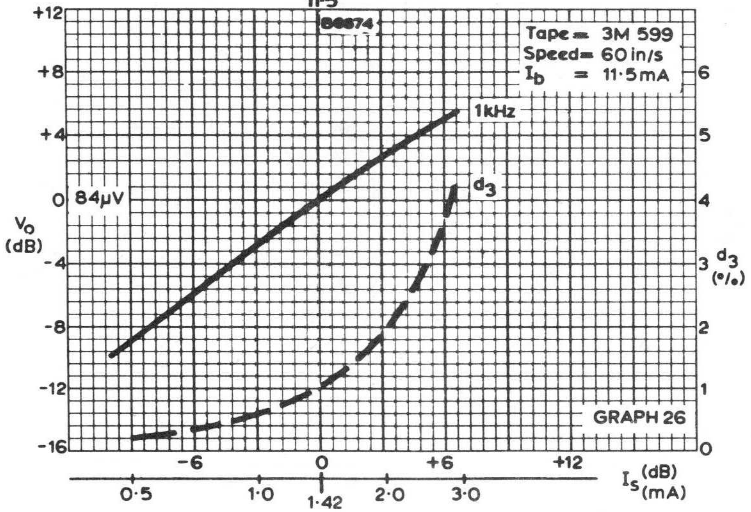

B6870
Tape = 3M 599
I_b = 11·5 mA
$^{15}/_{16}$ in/s
I_s = 1·05 mA
0 dB = 11·5 μV
GRAPH 22
IRIG 106-65, INTERMEDIATE BAND
V_o (dB)
+40
+30
+20
+10
0
−10
−20
−30
0·1
1
10
100
1000
Frequency (kHz)



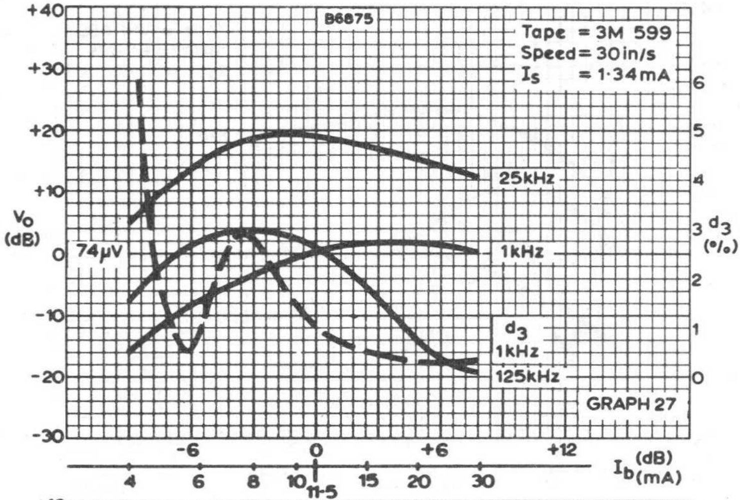


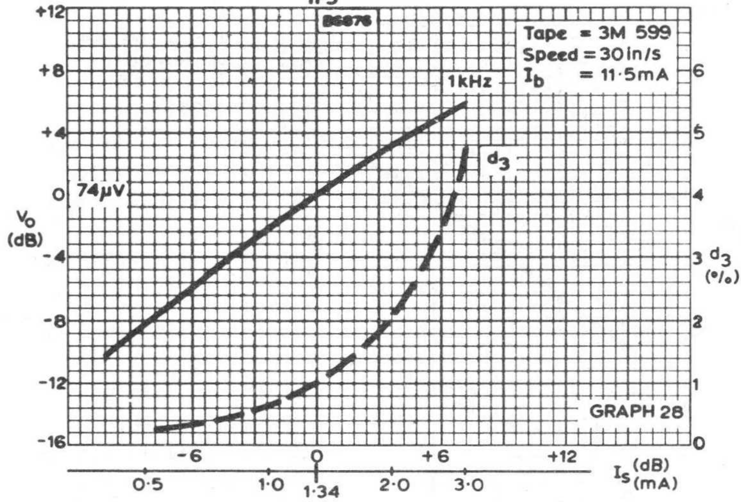
IRIG 106-65, INTERMEDIATE BAND



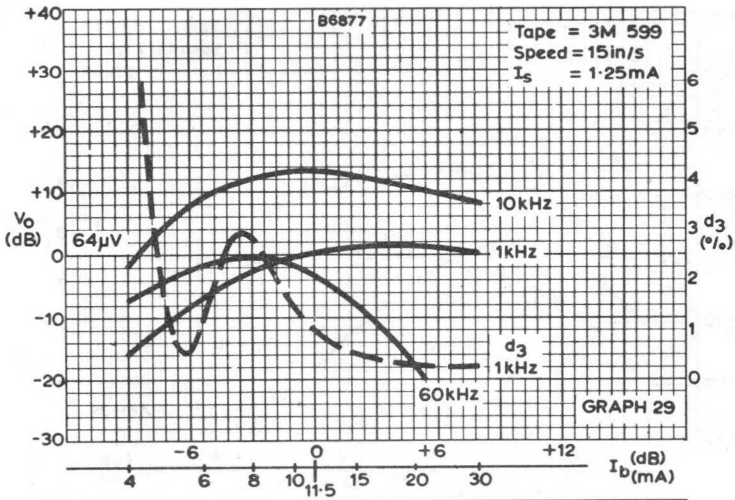


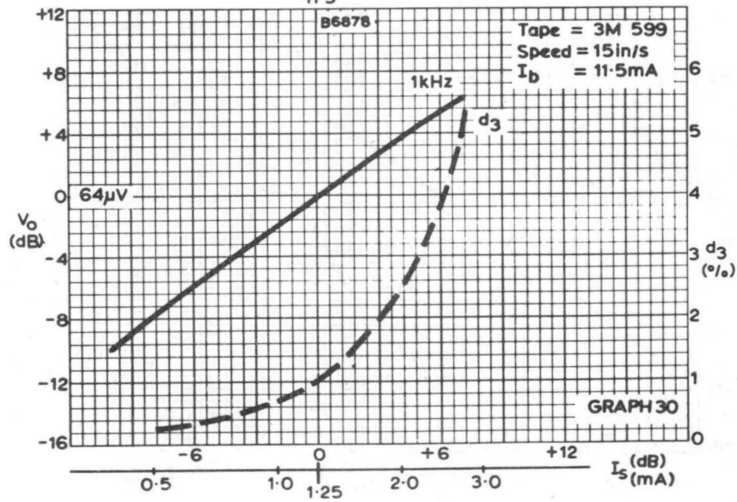
IRIG 106-65, INTERMEDIATE BAND



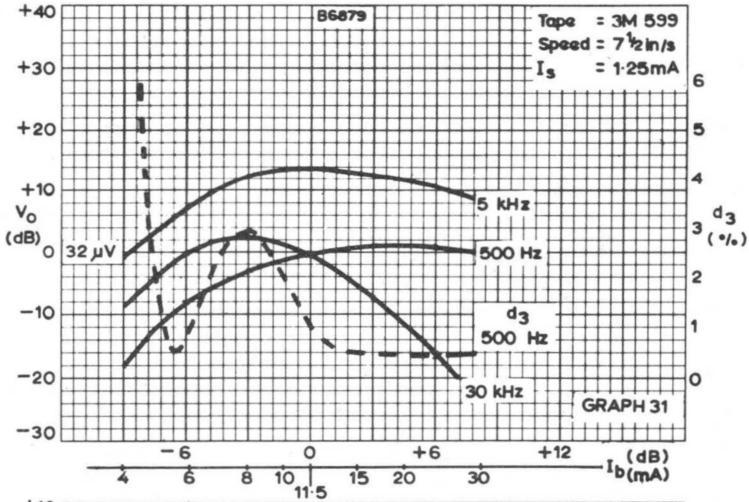


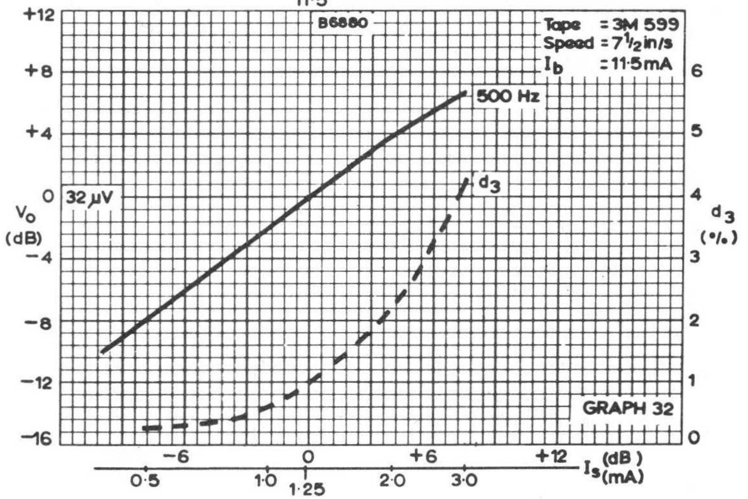
IRIG 106-65, INTERMEDIATE BAND



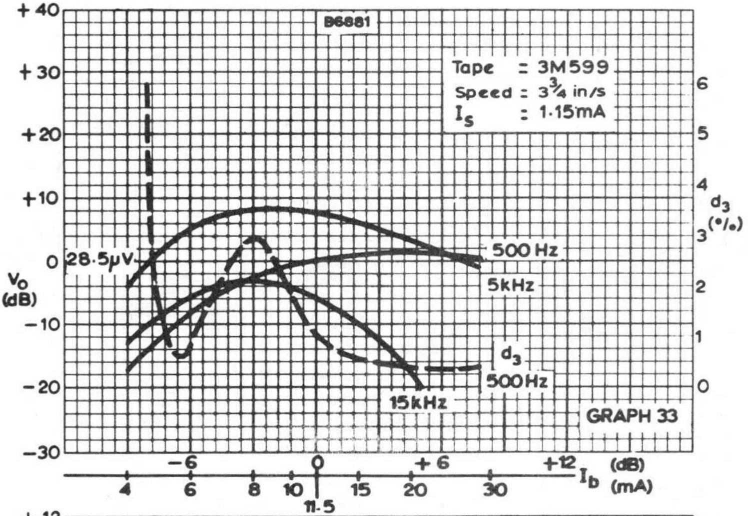


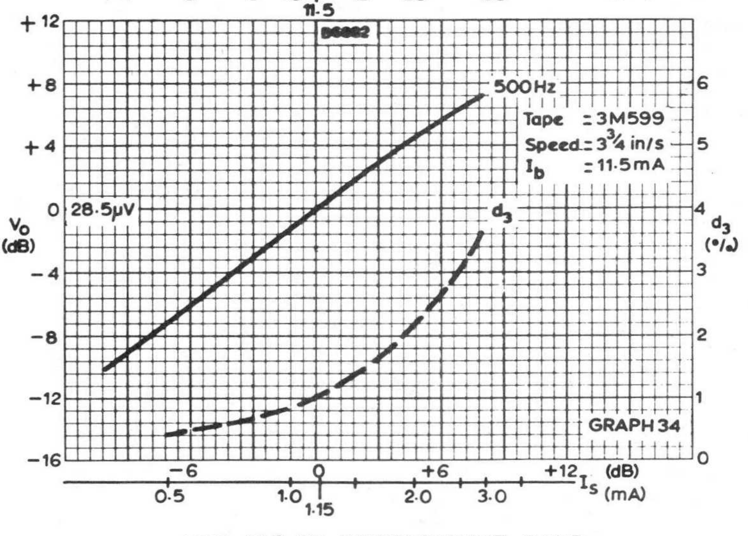
IRIG 106-65, INTERMEDIATE BAND



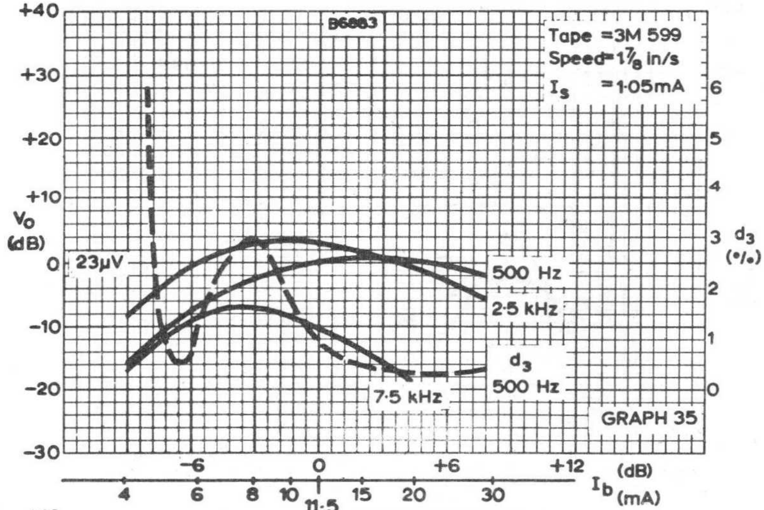


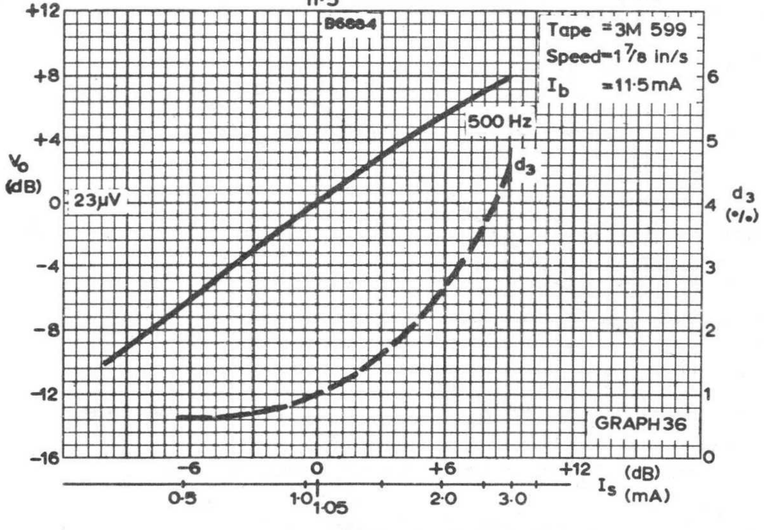
IRIG 106-65, INTERMEDIATE BAND



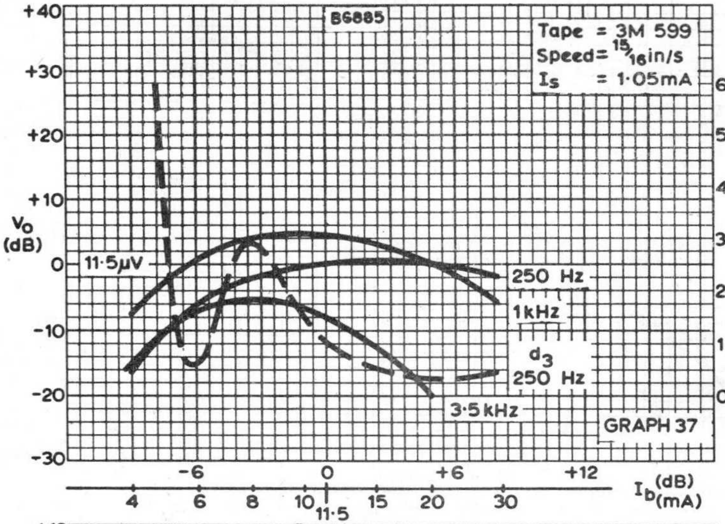


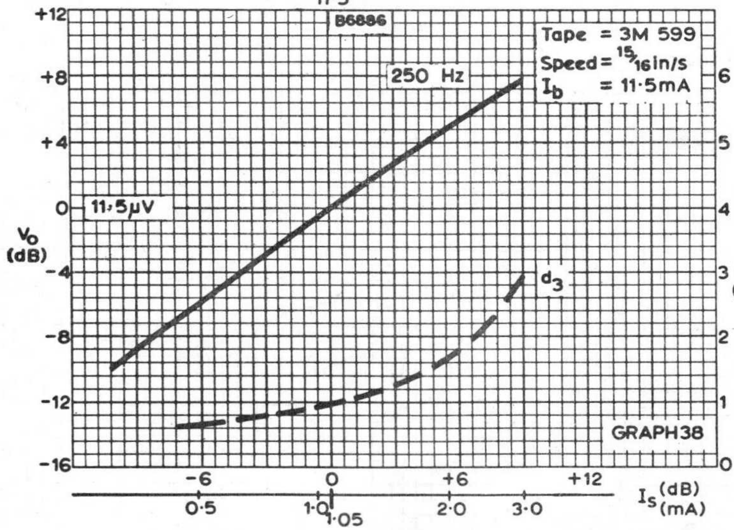
IRIG 106-65, INTERMEDIATE BAND



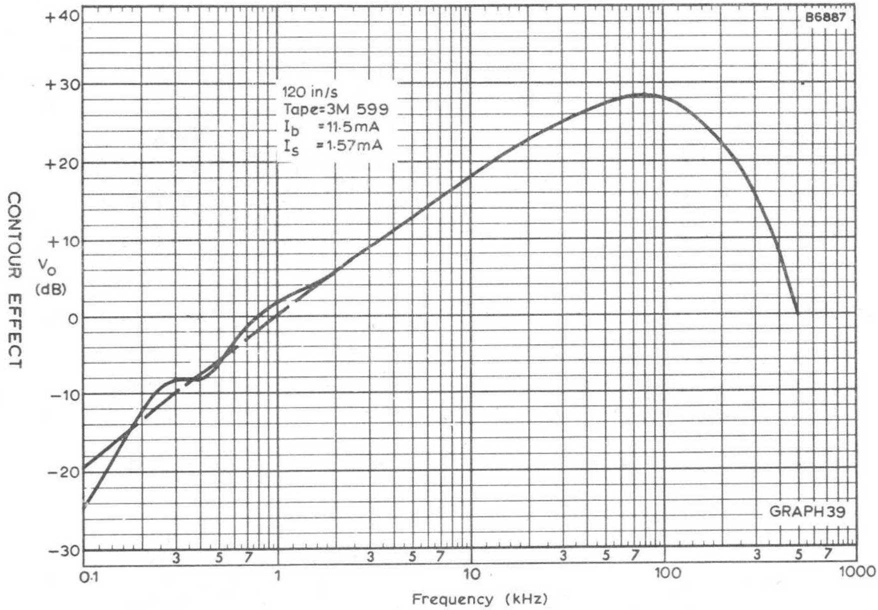


IRIG 106-65, INTERMEDIATE BAND

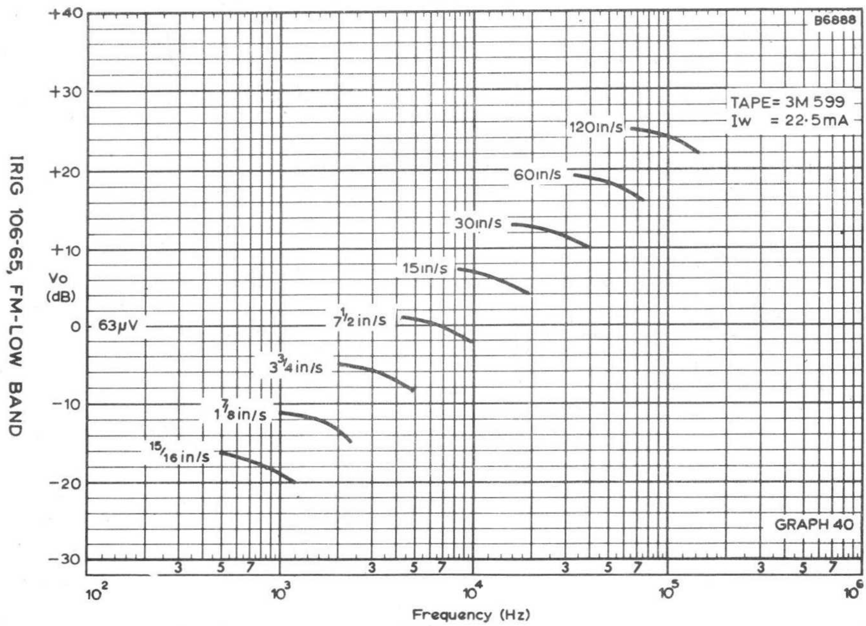


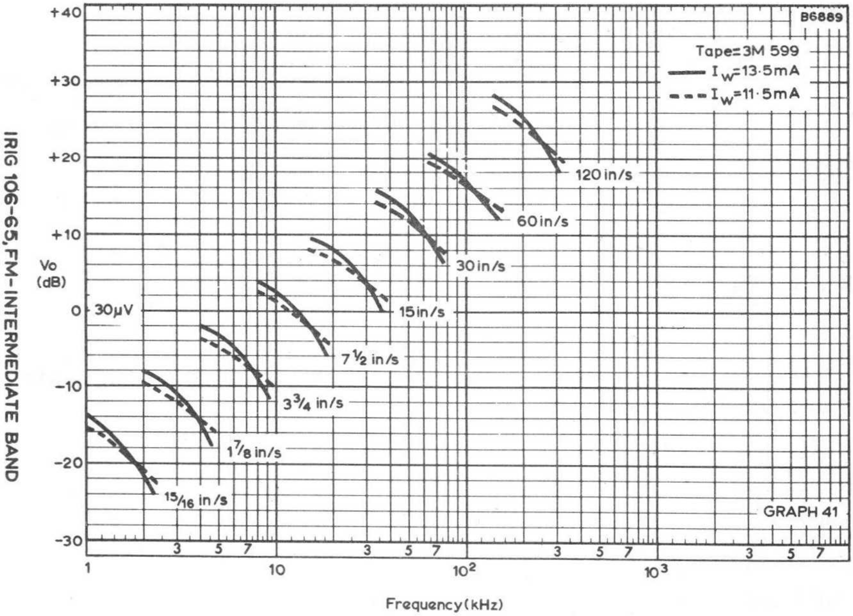


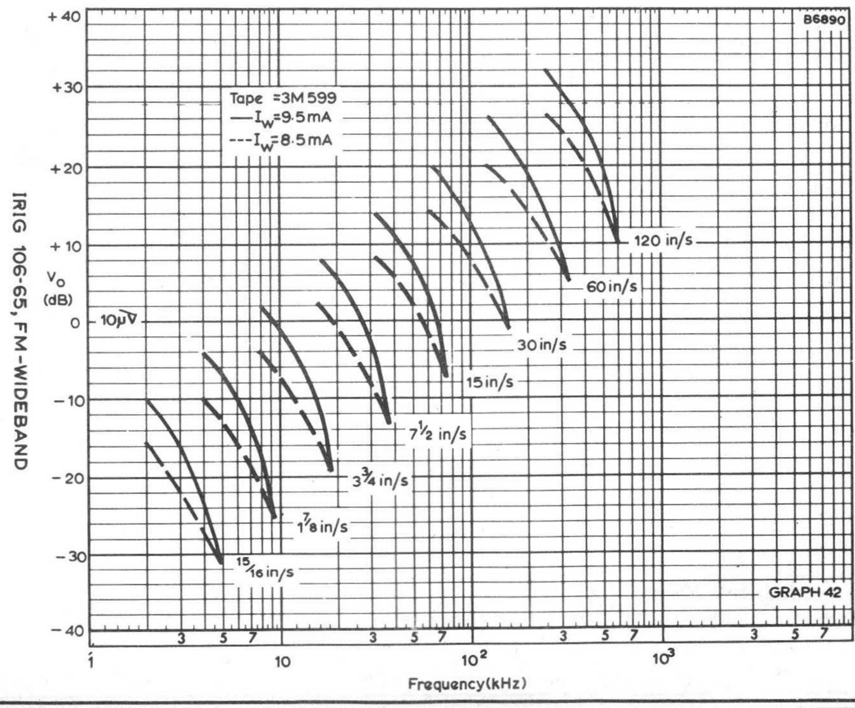
IRIG 106-65, INTERMEDIATE BAND



F.M. recording




B6889
Tape=3M 599
I_W=13.5mA
I_W=11.5mA
IRIG 106-65, FM-INTERMEDIATE BAND
Vo (dB)
30µV
120 in/s
60 in/s
30 in/s
15 in/s
7 1/2 in/s
3 3/4 in/s
1 7/8 in/s
15/16 in/s
GRAPH 41
Frequency (kHz)


B6890
Tape =3M 599
I_W=9.5mA
I_W=8.5mA
IRIG 106-65, FM-WIDEBAND
Vo (dB)
10µV
120 in/s
60 in/s
30 in/s
15 in/s
7 1/2 in/s
3 3/4 in/s
1 7/8 in/s
15/16 in/s
GRAPH 42
Frequency (kHz)

Static performance

Electrical data

	record heads	reproduce heads
L *)	0.1 mH ±15%	2.0 mH ±15%
Q *)	> 20	> 25
f_r	> 4.0 MHz	> 0.65 MHz
R_0	< 1 Ω	4 Ω ±15%
R_1, R_2, R_3, R_4	> 1000 MΩ	
R_5	< 100 MΩ	

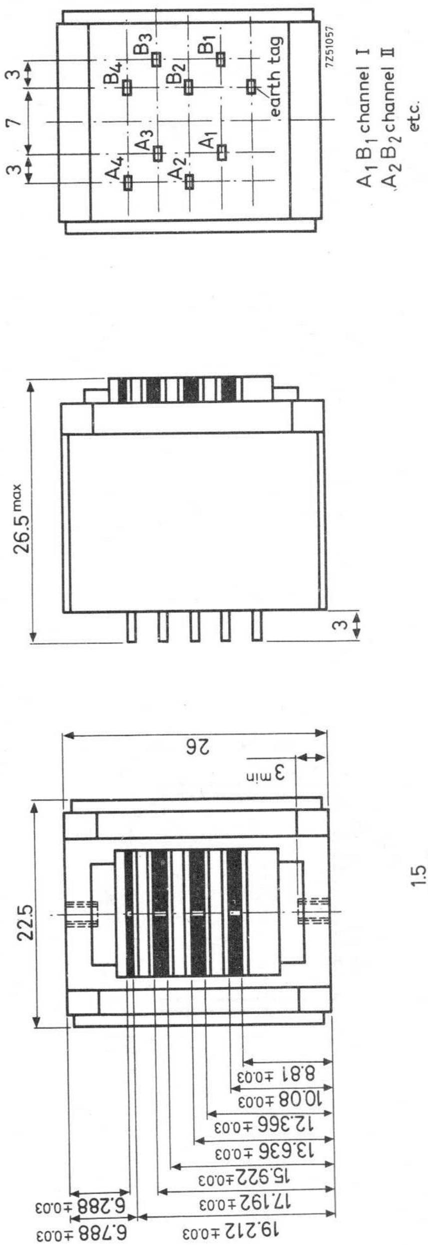
Note - Tolerances on inductance, quality factor and coil resistance do not hold for annotation tracks.

Mechanical data

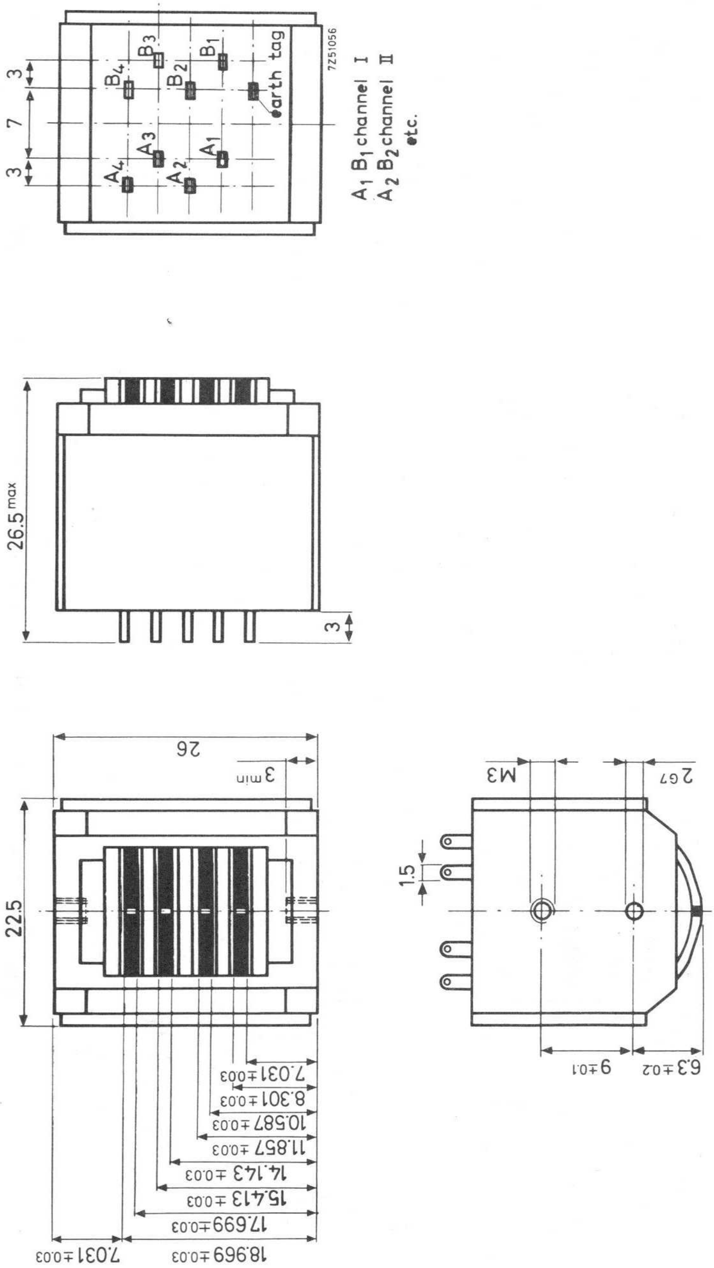
Gap length	
for record heads	3 to 4 μm
for reproduce heads	1.5 to 2.5 μm
Track width	
for instrumentation heads 2722 133 01021 and 2722 133 02021	7 x 1.27 mm and 1 x 0.5 mm
for instrumentation heads 2722 133 01001 and 2722 133 02001	3 x 1.27 mm and 1 x 0.5 mm
for instrumentation heads 2722 133 01011 and 2722 133 02011	4 x 1.27 mm
Azimuth	< 1 minute of arc **)
Tilt	< 3.0 minutes of arc **)
Gap scatter	< 1.0 μm

*) Measured with 100 mV, 100 kHz.

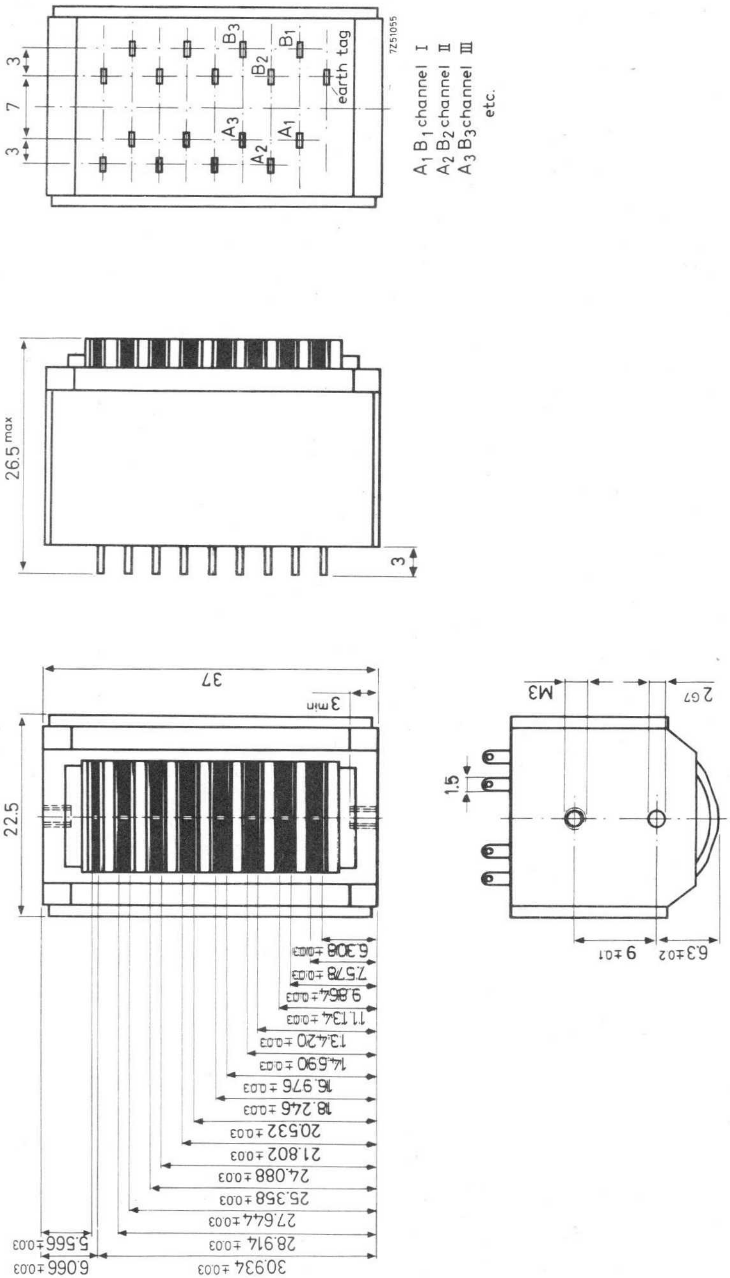
**) Magnetic heads with an azimuth < 0.5 minute of arc and a tilt < 1.5 minute of arc are available on request.



Instrumentation heads 2722 133 01001 and 2722 133 02001. Dimensions in mm.



Instrumentation heads 2722 133 01011 and 2722 133 02011. Dimensions in mm.



Instrumentation heads 2722 133 01021 and 2722 133 02021. Dimensions in mm.

INTRODUCTION

The standard range of digital magnetic heads consists of high quality dual gap and single gap ferroxcube write/read heads in multi-track configuration for writing and reading digital information on tape. Immediate read after write enables error detection circuits to be incorporated into the equipment.

The revolutionary manufacturing technique used has many advantages for fast digital tape systems:

- since small and sharply defined gaps can be made with the combination of high density ferroxcube and glass-bonding technique, high information densities on tape are achieved
- due to the high resistivity and low electrical losses of the applied ferroxcube, the heads can be operated at high bit rates
- due to closely controlled gap scatter, parallel alignment and azimuth, greater compatibility of tapes between different heads is achieved
- tests have shown, that the possibility of drop-outs is reduced to a minimum due to the chosen head contour and the applied method of construction, which eliminates resin glue lines at contact surfaces
- in addition the pre- and post-read effect has been reduced to a negligeable value by the applied head contour
- since all materials in contact with the tape (magnetic and non-magnetic ferrite and glass) are extremely wear resistant, the heads give a stable output/time characteristic over greatly extended periods of the life of the head.

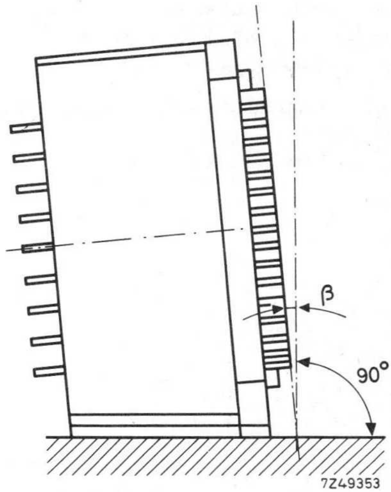
CONSTRUCTION

Starting from polished high density ferroxcube parts a multi-track head assembly is made. The separation between the adjacent tracks is formed by non-magnetic ceramic material bonded in glass. Thus the complete head to tape contact area consists only of wear resistant ceramics and glass. The obtained assembly, provided with screens and coils is mounted in an aluminium housing. The datum surface of the housing is machined with respect to the gap lines and the front surface of the head.

→ TYPES

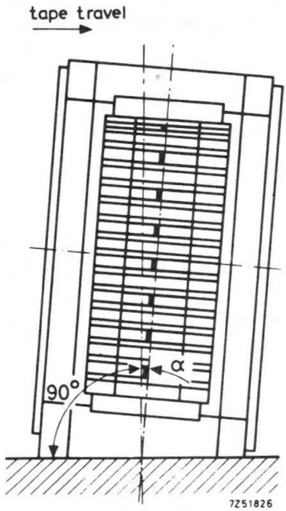
tape width	number of tracks		write to read gap separation	catalogue number
½ inch	7	dual gap	7.62 mm	2722 135 03041
½ inch	7	dual gap	7.62 mm	2722 135 03071
½ inch	9	dual gap	3.81 mm	2722 135 03091
½ inch	9	single gap	–	2722 135 03321
½ inch	7	single gap	–	2722 135 03331
½ inch	9	single gap	–	2722 135 03341
½ inch	7	single gap	–	2722 135 03351

DEFINITIONS



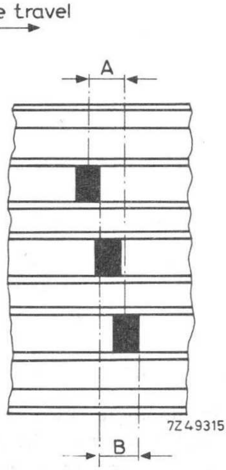
Tilt (β)

The tilt is the angle between the line through the centres of the gaps and the line perpendicular to the reference surface of the head in a plane perpendicular to the tangent plane on the head surface.



Azimuth (α)

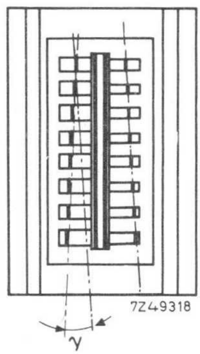
The azimuth is the angle between the line through the trailing edges of the write gaps and a line perpendicular to the reference surface of the head in the tangent plane on the head surface.



Gap scatter

For a write head stack the gap scatter is the distance which includes the trailing edges of the gaps (distance B).

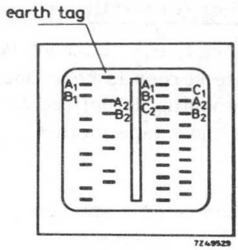
For a read head stack the gap scatter is the distance which includes the centre lines of the gaps (distance A).



Deviation of parallelness of gap lines (γ)

This is the angle between the centre line of the read gaps and the line through the trailing edges of the write gaps in the tangent plane on the head surface.

Note - To simplify the calculation of the maximum possible fault in bit position caused by gap scatter, azimuth deviation and unparallelness of gap lines the latter two are also given in units of length, calculated over the total width of the tracks.



A_1 B_1 read channel I
A_2 B_2 read channel II
etc.
A_1 C_1 B_1 write channel I
A_2 C_2 B_2 write channel II
etc.

Polarity

A positive current step into A of a write channel will produce a positive output pulse at A of the corresponding read channel. A positive current step into B of a write channel will produce a magnetic north pole furthest from the read section.

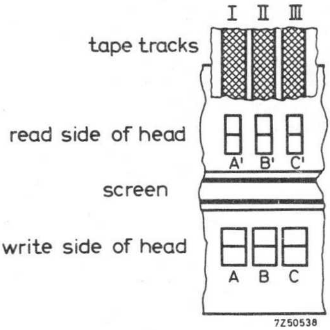
Crosstalk (write-write and read-read)

Crosstalk is the interference in a channel which has its origin in adjacent channels.

Tracks I and III are prerecorded in phase with the nominal write signal. Track II is left without signal. The ratio of the output voltage of channel B' (V_{II}) to the normal read signal (V_I) gives the crosstalk figure:

$$\frac{V_{II}}{V_I} \cdot 100\%.$$

This figure holds for prerecording tracks I and III with the coils of channel B either open or connected to the write amplifier and the coils of channels A' and C' loaded with the nominal load and with the external ferrite screen behind the tape. *)



*) For accurate positioning of this screen, see the data sheets of the relevant magnetic head.

Cross coupling (crosstalk write-read)

A write channel, e.g. channel B, is energised with the nominal signal and the external ferrite screen is positioned behind the tape. *)
The cross coupling is defined as the output voltage of the relevant read channel B', measured without tape motion.

Peak shift

The peak shift is the displacement of the peak of the output pulse with respect to the centre of 25% pulse levels.

Edge effect

The edge effect is the spurious signal from the tape originating from signal pick up by leading and trailing edges of the read track, related to nominal read signal.

Erase efficiency

This is the efficiency of erasing a 1010 pattern with nominal d.c. current through the write coils related to nominal read signal.

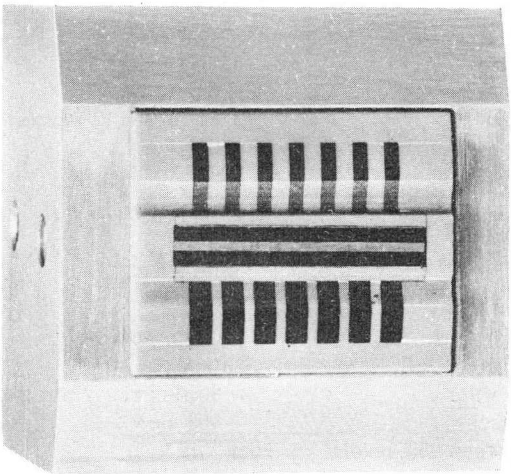
*) For accurate positioning of this screen, see the data sheets of the relevant magnetic head.

SYMBOLS AND TEST CONDITIONS

symbol	description	test condition
f_s	signal frequency in flux reversals per second (1 Hz = 2 flux rev./s)	
f_r *	resonance frequency of each coil	measured with an external capacitance of 10 pF
I_s	signal current	
L *	selfinductance of each coil	measured with 100 mV, 100 kHz
Q *	quality factor of each coil	measured with 100 mV, 100 kHz
R_0 *	d.c. resistance of each coil	
R_1	insulation resistance between two coils	at 200 V_{dc}
R_2	insulation resistance between each coil and housing	at 200 V_{dc}
R_3	insulation resistance between each coil and earth tag	at 200 V_{dc}
R_4	insulation resistance between housing and earth tag	at 200 V_{dc}
R_5	resistance between tape contact surface and earth tag	at 50 V_{dc}
V_o	output voltage of read head	
v_t	tape velocity	
t_r	rise time of the input pulse	measured from the 10% to the 90% points
t_f	fall time of the input pulse	measured from the 10% to the 90% points

* Refers to each half coil for centre tapped coils.

DIGITAL (tape) MAGNETIC HEAD



RZ 22435-2

Dual gap write/read head	
For use with tape	
Number of tracks	7
Tape width	$\frac{1}{2}$ inch

APPLICATION

This dual gap digital magnetic head is designed for writing and immediate reading after writing of digital signals on magnetic tape.

TECHNICAL PERFORMANCE

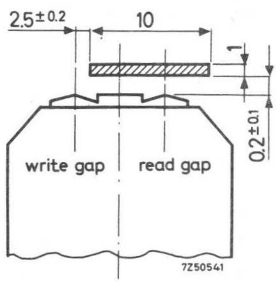
Electrical data

	write side	read side
L	30 μH ± 20%	330 μH ± 20%
Q	> 3	> 7
f_r	> 7 MHz	> 2 MHz
R_0	< 1.5 Ω	< 3.5 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ

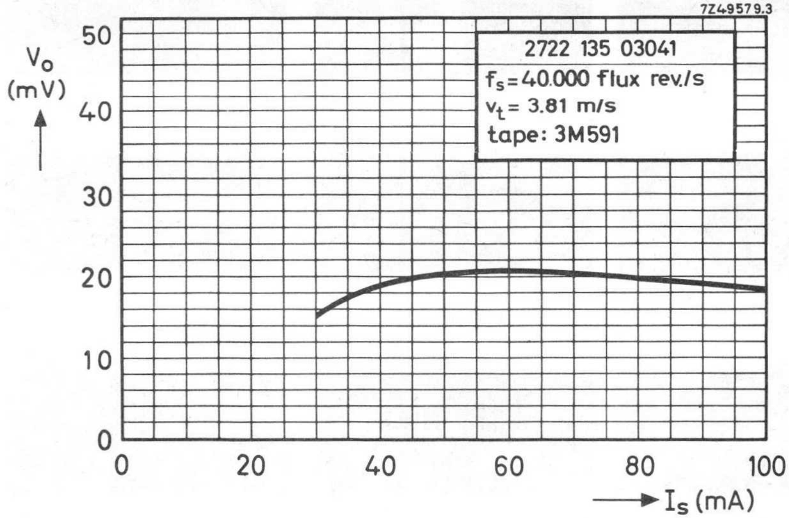
Test conditions

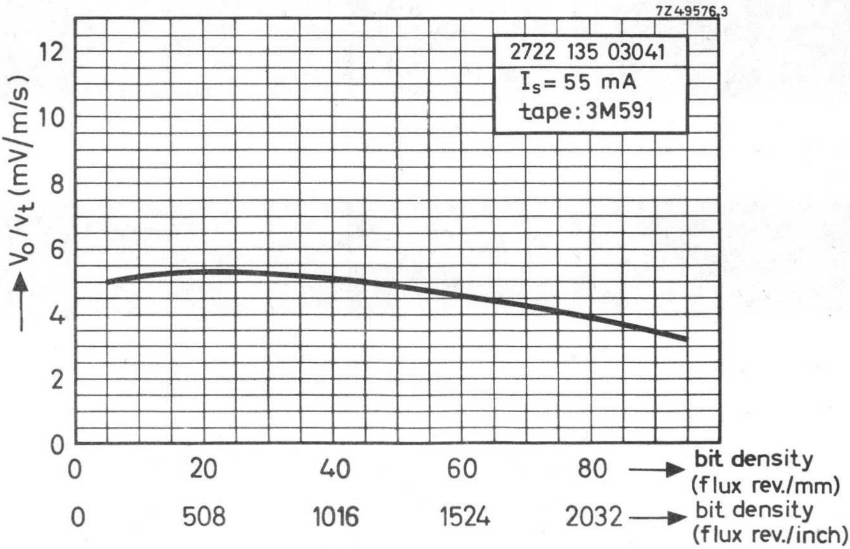
Tape used	3M591
Coating thickness	4.6 μm
Tape velocity	3.81 m/s (150 inch/s)
Tape tension	150 g
Wrap angle	7 ± 0.5^o
Signal frequency	40 000 flux rev./s
Duty cycle	50%
Signal current	55 mA
Pulse rise time = pulse fall time	1 μs
Load	2200 Ω, 200 pF
Output voltage (V_o)	23 mV_{p-p} ± 15%
−3 dB point (71%)	> 80 flux rev./mm (> 2000 flux rev./inch)
Output after 5 passes	> 95% of V_o
Pulse duration between 25% levels	≤ 7 μs
Peak shift	< 5%
Crosstalk (write-write and read-read)	≤ 4.5% (see Note)
Cross coupling	≤ 0.6 mV (see Note)
Pre-read edge effect	< 1.5%
Post-read edge effect	< 1.5%
Erase efficiency	> 99%

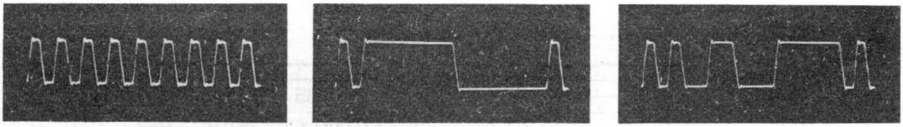
Note - Crosstalk and cross coupling are measured with an external ferroxcube screen behind the tape, positioned as given in the figure.



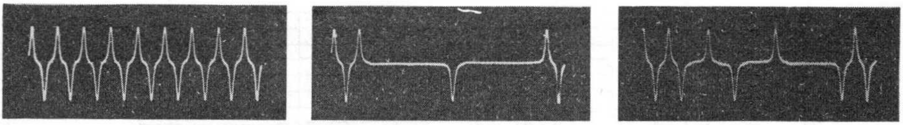
Dimensions of the screen: 25 x 10 x 1 mm
Ferroxcube grade: 8C1


7Z49579.3
2722 135 03041
f_s = 40.000 flux rev./s
v_t = 3.81 m/s
tape: 3M591
V_o (mV)
0
10
20
30
40
50
0
20
40
60
80
100
I_s (mA)

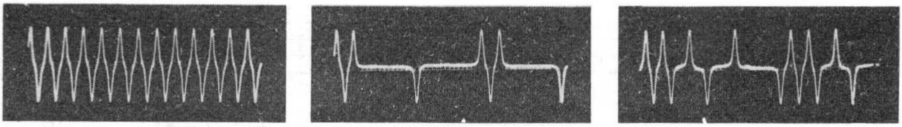

7Z49576.3
2722 135 03041
I_s = 55 mA
tape: 3M591
V_o/v_t (mV/m/s)
0
2
4
6
8
10
12
0
20
40
60
80
bit density (flux rev./mm)
0
508
1016
1524
2032
bit density (flux rev./inch)



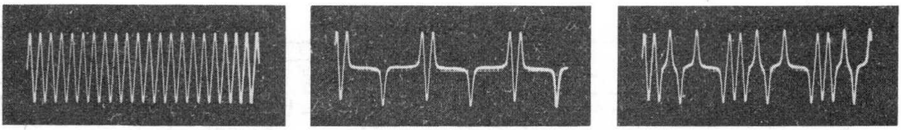
a. Input wave form



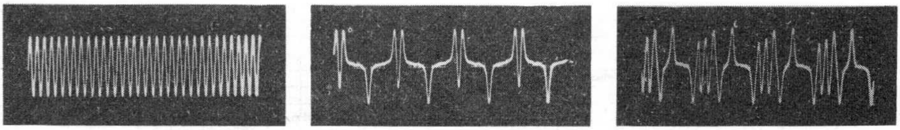
b. Output wave form at 22 bits/mm (556 bits/inch)



c. Output wave form at 32 bits/mm (800 bits/inch)



d. Output wave form at 52 bits/mm (1333 bits/inch)



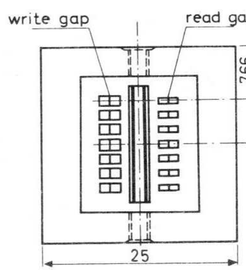
e. Output wave form at 80 bits/mm (2000 bits/inch)

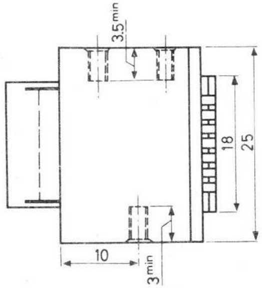
Typical response wave forms

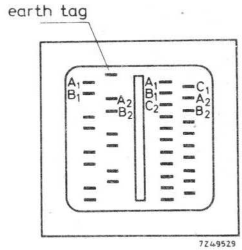
Conditions: tape 3M591, tape velocity = 3.81 m/s (150 inch/s), I_S: nominal, $t_r = t_f = 1\ \mu s$

Mechanical data

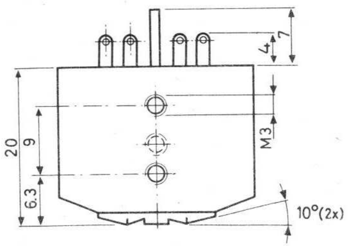
	write side	read side
Gap length	11 to 13 μm	5 to 6 μm
Track width	1.20 mm	0.74 mm
Number of tracks	7	
Centre track distance	1.78 mm	
Write to read gap separation	7.62 mm	
Azimuth	≤ 0.5 minute of arc (< 2μm)	
Tilt	≤ 3.0 minutes of arc	
Deviation of parallelness of gap lines	≤ 0.5 minute of arc (< 2μm)	
Gap scatter	≤ 1.0 μm	





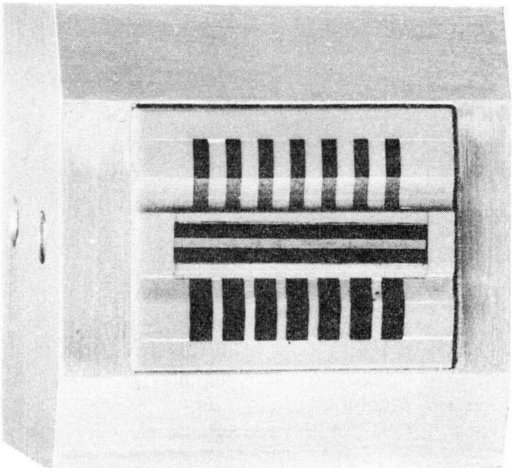


A_1 B_1 read channel I
A_2 B_2 read channel II
etc.
A_1 C_1 B_1 write channel I
A_2 C_2 B_2 write channel II
etc.



Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD



RZ 22435-2

Dual gap write/read head	
For use with tape	
Number of tracks	7
Tape width	$\frac{1}{2}$ inch

APPLICATION

This dual gap digital magnetic head is designed for writing and immediate reading after writing of digital signals on magnetic tape.

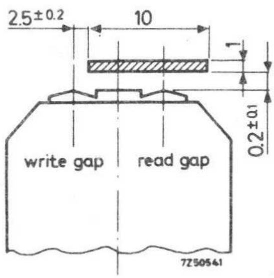
TECHNICAL PERFORMANCE

Electrical data	write side	read side
L	125 μH ± 15%	1 mH ± 15%
Q	≥ 4	≥ 9
f_r	≥ 2 MHz	≥ 1 MHz
R_0	< 3 Ω	< 7 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ

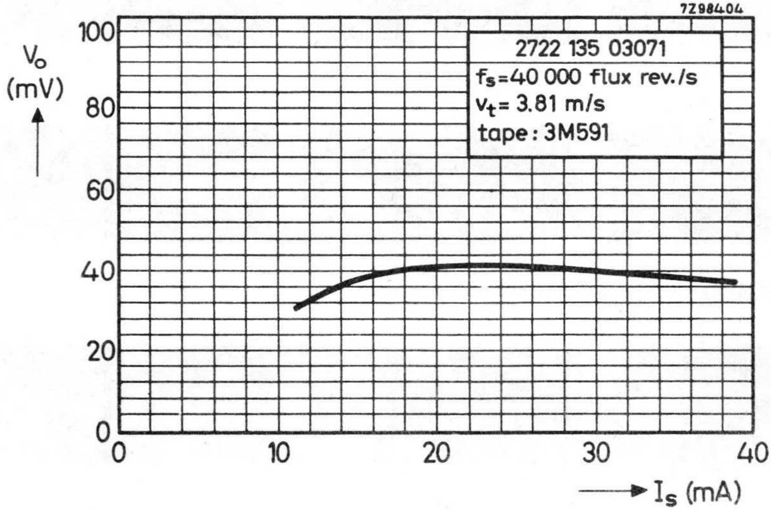
Test conditions

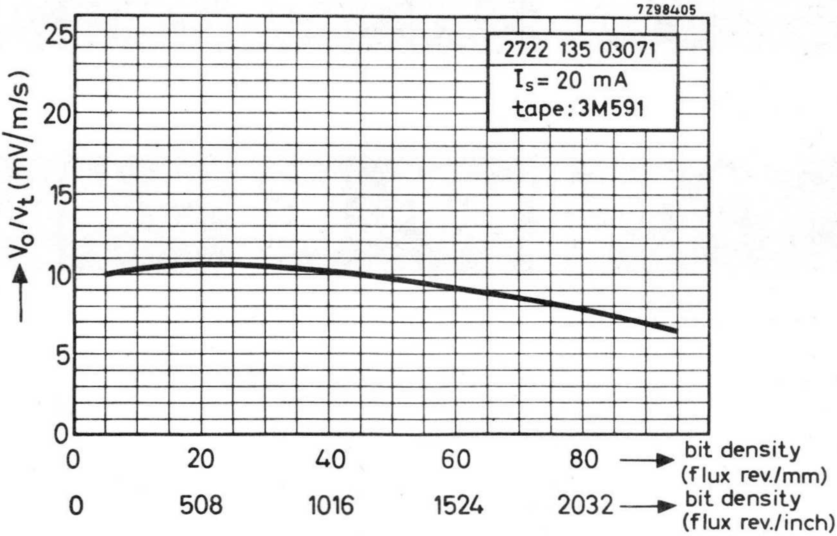
Tape used	3M591
Coating thickness	4.6 μm
Tape velocity	3.81 m/s (150 inch/s)
Tape tension	150 g
Wrap angle	7 ± 0.5°
Signal frequency	40 000 flux rev./s
Duty cycle	50%
Signal current	20 mA
Pulse rise time = pulse fall time	1 μs
Load	2200 Ω, 200 pF
Output voltage (V_o)	40 mV_{p-p} ± 15%
−3 dB point (71%)	> 80 flux rev./mm (>2000 flux rev./inch)
Output after 5 passes	> 95% of V_o
Pulse duration between 25% levels	≤ 7 μs
Peak shift	< 5%
Crosstalk (write-write and read-read)	≤ 4% (see Note)
Cross coupling	≤ 0.4 mV (see Note)
Pre-read edge effect	< 1.5%
Post-read edge effect	< 1.5%
Erase efficiency	> 99%

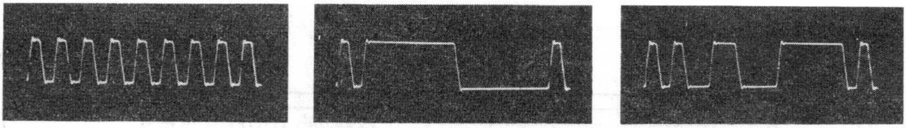
Note - Crosstalk and cross coupling are measured with an external ferroxcube screen behind the tape, positioned as given in the figure.



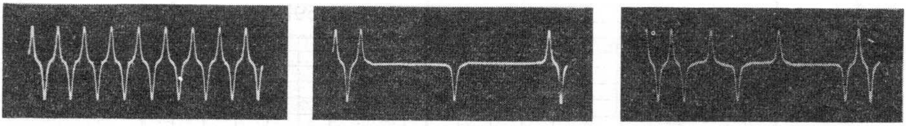
Dimensions of the screen: 25 x 10 x 1 mm
Ferroxcube grade: 8C1


7Z98404
2722 135 03071
f_s=40 000 flux rev./s
v_t= 3.81 m/s
tape: 3M591
V_o (mV)
I_s (mA)

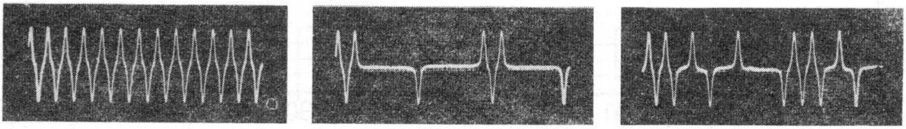

7Z98405
2722 135 03071
I_s= 20 mA
tape: 3M591
V_o/v_t (mV/m/s)
bit density (flux rev./mm)
bit density (flux rev./inch)



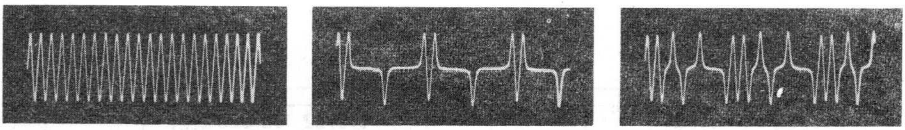
a. Input wave form



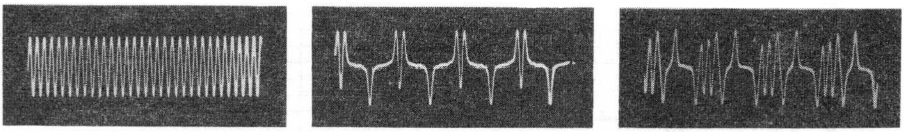
b. Output wave form at 22 bits/mm (556 bits/inch)



c. Output wave form at 32 bits/mm (800 bits/inch)



d. Output wave form at 52 bits/mm (1333 bits/inch)



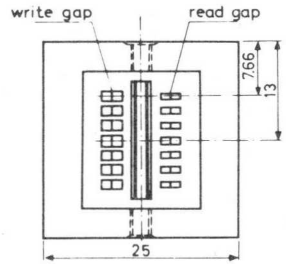
e. Output wave form at 80 bits/mm (2000 bits/inch)

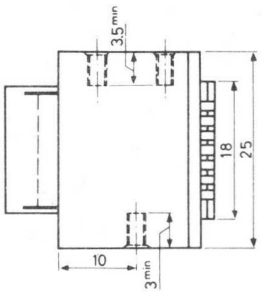
Typical response wave forms

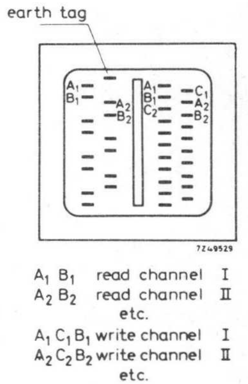
Conditions: tape 3M591, tape velocity = 3.81 m/s (150 inch/s), I_s: nominal, $t_r = t_f = 1\ \mu s$

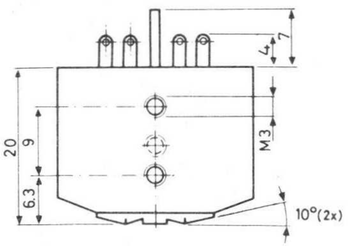
Mechanical data

	write side	read side
Gap length	11 to 13 μm	5 to 6 μm
Track width	1.20 mm	0.74 mm
Number of tracks	7	
Centre track distance	1.78 mm	
Write to read gap separation	7.62 mm	
Azimuth	$\leq$ 0.5 minute of arc (< 2 μm)	
Tilt	$\leq$ 3.0 minutes of arc	
Deviation of parallelness of gap lines	$\leq$ 0.5 minute of arc (< 2 μm)	
Gap scatter	$\leq$ 1.0 μm	



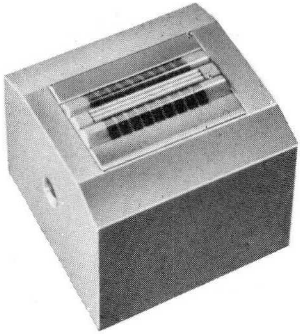






Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD



RZ 24239

Dual gap write/ read head for use with tape	
Number of tracks	9
Tape width	$\frac{1}{2}$ inch

APPLICATION

This dual gap digital magnetic head is designed for writing and immediate reading after writing of digital signals on magnetic tape.

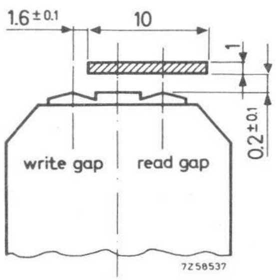
TECHNICAL PERFORMANCE

Electrical data	write side	read side
L	20 μH $\pm$ 15%	1.25 mH $\pm$ 15%
Q	$\geq$ 3	$\geq$ 7
f_r	$\geq$ 7 MHz	$\geq$ 1 MHz
R_0	$\leq$ 4 Ω	$\leq$ 9 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ	> 1000 MΩ

Test conditions

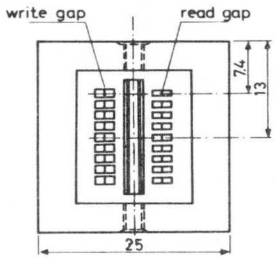
Tape used	3M8938
Coating thickness	max. 15.4 μm
Tape velocity	1.90 m/s (75 inch/s)
Tape tension	150 g
Wrap angle	10 $\pm$ 0.5°
Signal frequency	60 000 flux rev./s
Duty cycle	50%
Saturation current (o-p), per half coil	76 mA
Signal current (o-p), per half coil	114 mA
Pulse rise time = pulse fall time	1 μs
Load	5 kΩ, 100 pF
Output voltage (V_o)	18 mV_{p-p} $\pm$ 15%
Resolution (output at 800 bits/inch related to output at 200 bits/inch)	$\geq$ 80%
Output after 5 passes	$\geq$ 90% of V_o
Pulse duration between 25% levels (200 bits/inch)	$\leq$ 15 μs
Crosstalk (write-write and read-read)	$\leq$ 2.5% (see Note)
Cross coupling	$\leq$ 0.4 mV (see Note)
Pre-read edge effect (20 bits/inch)	$\leq$ 3%
Post-read edge effect (20 bits/inch)	$\leq$ 1%
Erase efficiency	$\geq$ 98%

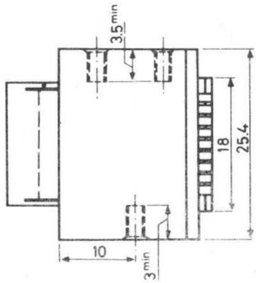
Note - Crosstalk and cross coupling are measured with an external ferroxcube screen behind the tape, positioned as given in the figure.

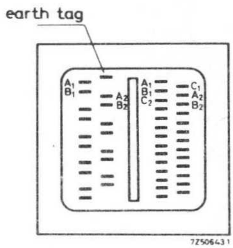


Dimensions of the screen: 25 x 10 x 1 mm
Ferroxcube grade: 8C1

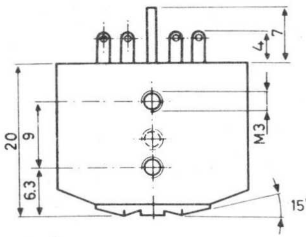
Mechanical data	write side	read side
Gap length	11 to 13 μm	5 to 6 μm
Track width	1.08 mm	0.98 mm
Number of tracks	9	
Centre track distance	1.397 mm	
Write to read gap separation	3.81 mm	
Azimuth	$\leq$ 0.5 minute of arc (< 2 μm)	
Tilt	$\leq$ 3.0 minutes of arc	
Deviation of parallelness of gap lines	$\leq$ 0.5 minute of arc (< 2 μm)	
Gap scatter	$\leq$ 1.0 μm	







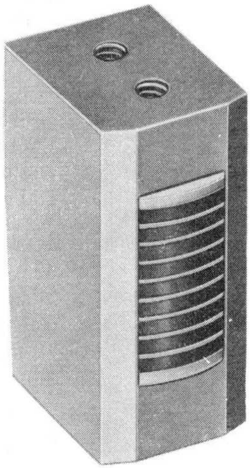
A_1 B_1 read channel I
A_2 B_2 read channel II
etc.
A_1 C_1 B_1 write channel I
A_2 C_2 B_2 write channel II
etc.



Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD

A 51799-4



Single gap write/read head for use with tape	
Number of tracks	9
Tape width	½ inch

APPLICATION

This single gap digital magnetic head is designed for writing or reading of digital signals on magnetic tape, not only at a tape speed of 76 cm/s with its high output voltage but also at lower speeds at which favourable output voltages are still obtainable.
Contrary to the dual gap heads this type does not enable immediate reading after writing; the tape has to pass a second time over the head if a check reading is required.

TECHNICAL PERFORMANCE

Electrical data

L *)	4 mH ± 15%
Q *)	> 5
f_r *)	> 0.2 MHz
R_0 *)	< 30 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ

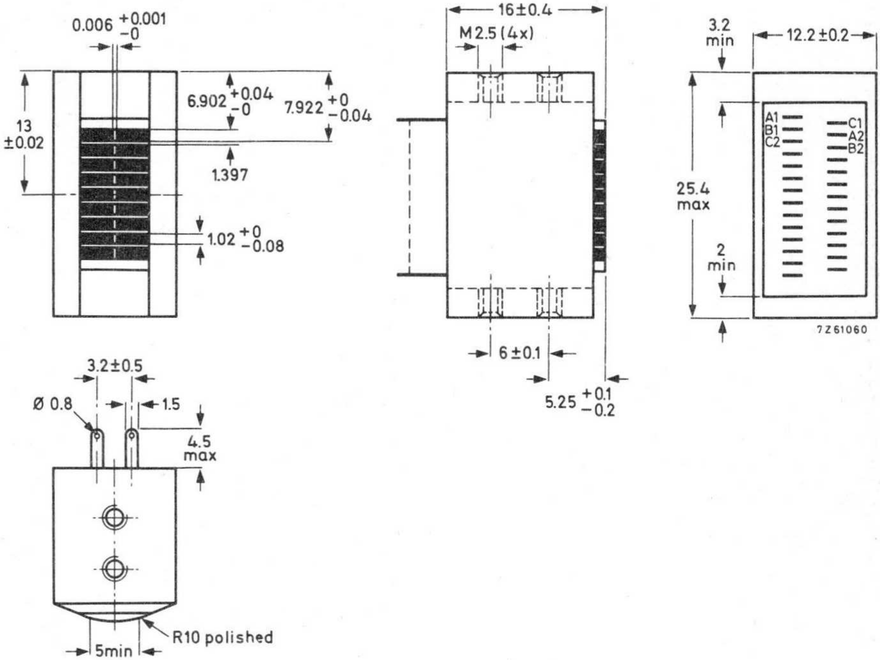
Test conditions

Tape used	3M8938
Coating thickness	15.4 μm max.
Tape velocity	76 cm/s (30 inch/s)
Tape tension	150 g
Wrap angle	7 ± 0.5°
Signal frequency (800 bits/inch)	24 000 flux rev./s
Duty cycle	50%
Saturation current (o-p), per half coil	6.7 mA
Signal current (o-p), per half coil	10 mA
Pulse rise time = pulse fall time	5 μs
Load	10 kΩ; 20 pF
Output voltage (V_o)	18 mV_{p-p} ± 15%
Resolution (output at 800 bits/inch related to output at 200 bits/inch)	≥ 80%
Output after 5 passes	≥ 90% of V_o
Pulse duration between 25% levels	≤ 60 μs
Peak shift	≤ 10%
Crosstalk	≤ 10%
Edge effect	≤ 1.5%
Erase efficiency	≥ 98%

*) Refers to each half coil.

Mechanical data

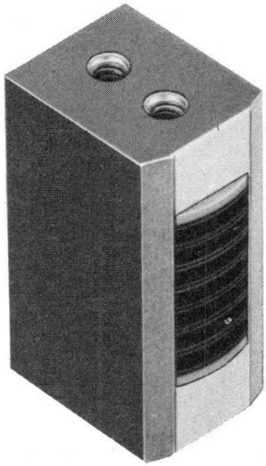
Gap length	6 μm
Track width	0.98 mm
Number of tracks	9
Centre track distance	1.397 mm
Azimuth	≤ 0.5 minute of arc (< 2 μm)
Tilt	≤ 3.0 minutes of arc
Gap scatter	≤ 1.0 μm



Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD

RZ 27851-3



Single gap write/read head for use with tape	
Number of tracks	7
Tape width	$\frac{1}{2}$ inch

APPLICATION

This single gap digital magnetic head is designed for writing or reading of digital signals on magnetic tape, not only at a tape speed of 76 cm/s with its high output voltage, but also at lower speeds at which favourable output voltages ate still obtainable.
Contrary to the dual gap heads this type does not enable immediate reading after writing; the tape has to pass a second time over the head if a check reading is required.

TECHNICAL PERFORMANCE

Electrical data

L [1] [2]	8 mH ± 15%
Q [1] [2]	> 5
f_r [1]	> 0.25 MHz
R_0 [1]	< 40 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ

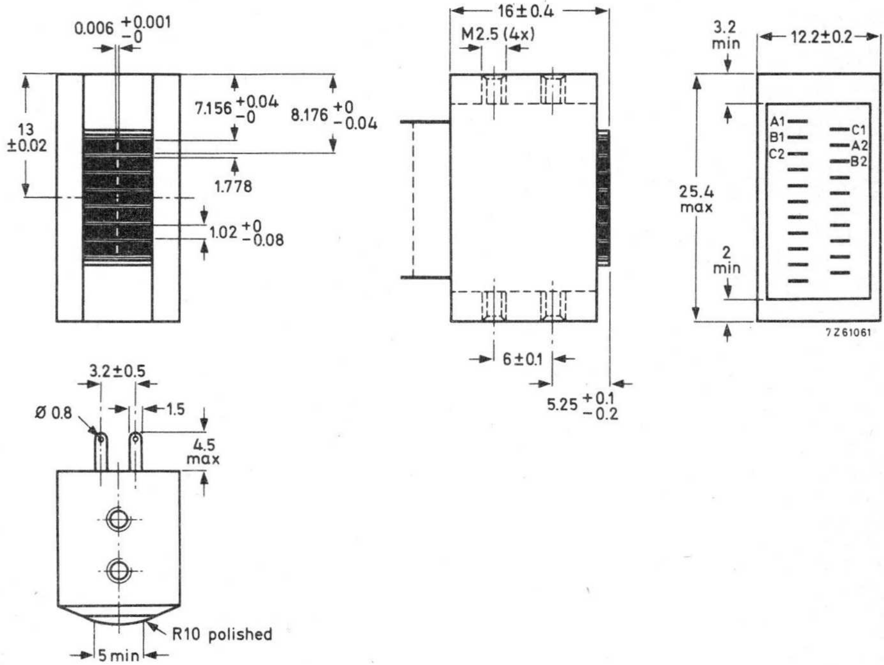
Test conditions

Tape used	3M8938
Coating thickness	15.4 μm max.
Tape velocity	76 cm/s (30 inch/s)
Tape tension	150 g
Wrap angle	$7 \pm 0.5^{\circ}$
Signal frequency (800 bits/inch)	24 000 flux rev./s
Duty cycle	50%
Saturation current (o-p), per half coil	3.4 mA
Signal current (o-p), per half coil	5 mA
Pulse rise time = pulse fall time	5 μs
Load	10 kΩ, 20 pF
Output voltage (V_o)	30 mV_{p-p} ± 15%
Resolution (output at 800 bits/inch related to output at 200 bits/inch)	≥ 80%
Output after 5 passes	≥ 90% of V_o
Pulse duration between 25% levels	≤ 60 μs
Peak shift	≤ 10%
Crosstalk	≤ 6%
Edge effect	≤ 1.5%
Erase efficiency	≥ 98%

[1] Refers to each half coil.
[2] Measured with 80 mV, 10 kHz.

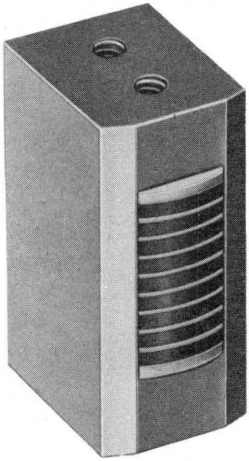
Mechanical data

Gap length	6 μm
Track width	0.98 mm
Number of tracks	7
Centre track distance	1.778 mm
Azimuth	≤ 0.5 minute of arc (< 2 μm)
Tilt	≤ 3.0 minutes of arc
Gap scatter	≤ 1.0 μm



Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD



A 51799-4

Single gap write/read head for use with tape	
Number of tracks	9
Tape width	$\frac{1}{2}$ inch

APPLICATION

This single gap digital magnetic head is designed for writing of digital signals on magnetic tape.
Contrary to the dual gap heads this type does not enable immediate reading after writing; the tape has to pass a second time over the head if a check reading is required.

TECHNICAL PERFORMANCE

Electrical data

L *)	1.45 mH ± 15%
Q *)	> 5
f_r *)	> 0.4 MHz
R_0 *)	< 7 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ

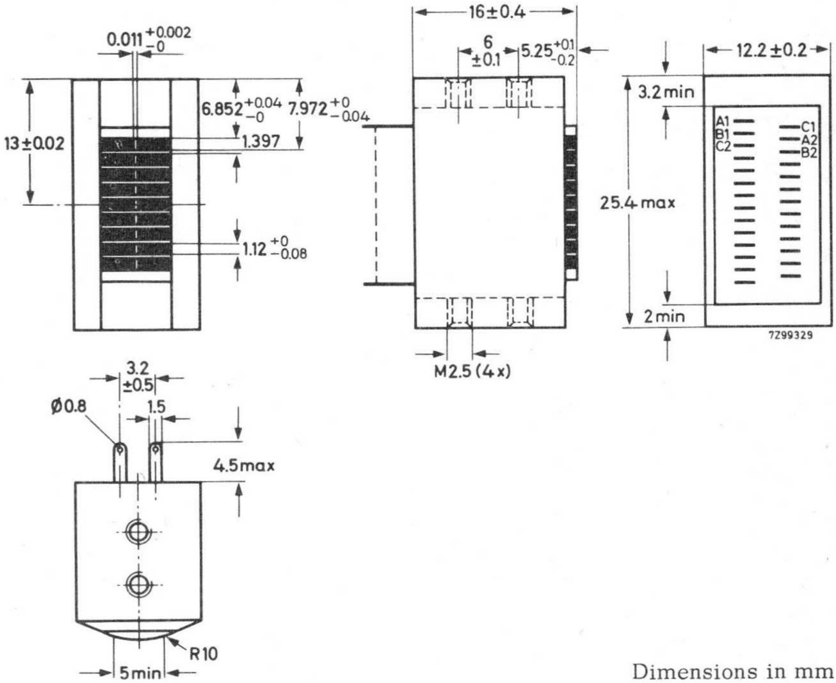
Test conditions

Tape used	3M8938
Coating thickness	15.4 μm max.
Tape velocity	76 cm/s (30 inch/s)
Tape tension	150 g
Wrap angle	7 ± 0.5°
Signal frequency (800 bits/inch)	24 000 flux rev./s
Duty cycle	50%
Saturation current (o-p), per half coil	20 mA
Signal current (o-p), per half coil	30 mA
Pulse rise time = pulse fall time	5 μs
Load	10 kΩ, 20 pF
Output voltage (V_o)	10.5 mV_{p-p} ± 15%
Resolution (output at 800 bits/inch related to output at 200 bits/inch)	≥ 80%
Output after 5 passes	> 90% of V_o
Pulse duration between 25% levels	≤ 60 μs
Peak shift	≤ 10%
Crosstalk	≤ 10%
Edge effect	≤ 1.5%
Erase efficiency	≥ 98%

*) Refers to each half coil.

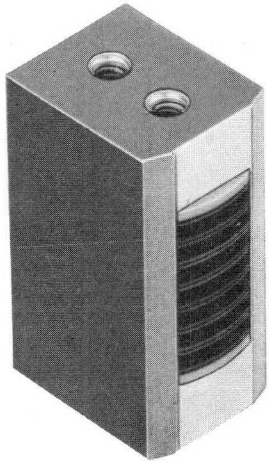
Mechanical data

Gap length	12 μm
Track width	1.08 mm
Number of tracks	9
Centre track distance	1.397 mm
Azimuth	$\leq$ 0.5 minute of arc (< 2 μm)
Tilt	$\leq$ 3.0 minutes of arc
Gap scatter	$\leq$ 1.0 μm



Dimensions in mm

DIGITAL (tape) MAGNETIC HEAD



RZ 27851-3

Single gap write/read head for use with tape	
Number of tracks	7
Tape width	$\frac{1}{2}$ inch

APPLICATION

This single gap digital magnetic head is designed for writing of digital signals on magnetic tape.
Contrary to the dual gap heads this type does not enable immediate reading after writing; the tape has to pass a second time over the head if a check reading is required.

TECHNICAL PERFORMANCE

Electrical data

→ L *)	0.55 mH ± 15%
→ Q *)	> 12
f_r *)	> 1 MHz
R_0 *)	< 5 Ω
R_1, R_2, R_3, R_4	> 1000 MΩ

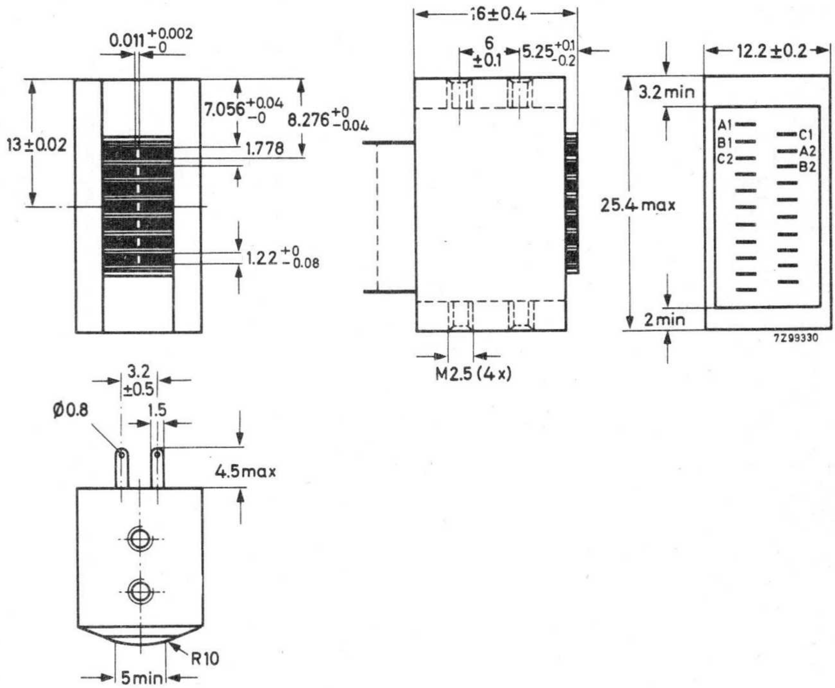
Test conditions

Tape used	3M8938
Coating thickness	15.4 μm max.
Tape velocity	76 cm/s (30 inch/s)
Tape tension	150 g
Wrap angle	7 ± 0.5°
Signal frequency (800 bits/inch)	24000 flux rev./s
Duty cycle	50%
Saturation current (o-p), per half coil	20 mA
Signal current (o-p), per half coil	30 mA
Pulse rise time = pulse fall time	5 μs
Load	10 kΩ, 20 pF
→ Output voltage (V_o)	9.5 mVp-p ± 15%
Resolution (output at 800 bits/inch related to output at 200 bits/inch)	≥ 80%
Output after 5 passes	> 90% of V_o
Pulse duration between 25% levels	≤ 60 μs
Peak shift	≤ 10%
Crosstalk	≤ 6%
Edge effect	≤ 1.5%
Erase efficiency	≥ 98%

*) Refers to each half coil.

Mechanical data

Gap length	12 μm
Track width	1.18 mm
Number of tracks	7
Centre track distance	1.778 mm
Azimuth	$\leq$ 0.5 minute of arc (< 2 μm)
Tilt	$\leq$ 3.0 minutes of arc
Gap scatter	$\leq$ 1.0 μm

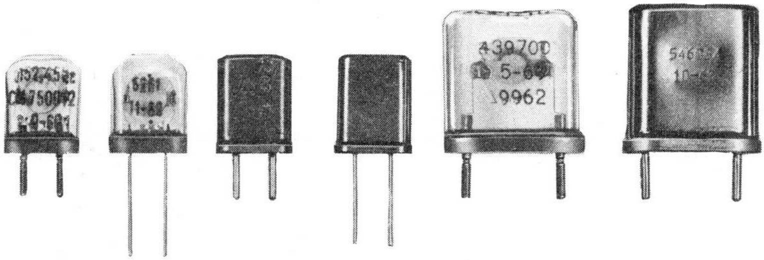


Dimensions in mm

Quartz crystal units and crystal filters

INTRODUCTION

RZ 29452-2



A quartz crystal unit consists of a quartz crystal element with electrodes, mounted in a glass or metal holder having connecting pins or leads.

In a quartz crystal unit the piezoelectric characteristics of quartz have been used to obtain a component that is equivalent to a stable resonance circuit with a very high Q-factor.

Crystal elements are normally in the form of plates or bars cut from the natural crystal. The dimensions of these elements and their orientation with respect to the axes of the natural crystal give the characteristics of the element. A number of orientations ("crystal cuts" XY, NT, and so forth) are favourable, e.g. in view of temperature dependence, for particular ranges of resonance frequency. The dimensions given to the crystal element are such that the mechanical resonance frequency equals the desired electrical resonance frequency as perfectly as possible. The crystal element may vibrate in the frequency of a fundamental mode of vibration, or in the third or fifth overtone of the fundamental frequency.

In the vicinity of resonance the electrical behaviour of a quartz crystal unit can be adequately described with reference to the simple equivalent circuit of Fig.1.

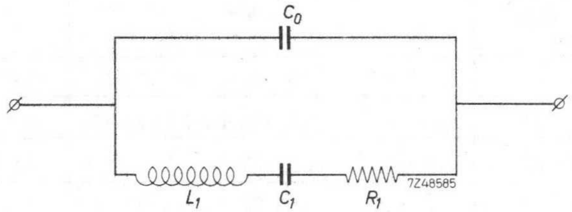


Fig.1

The inductance L_1, the capacitance C_1 and the resistance R_1 are piezoelectric phenomena, and are therefore said to form the motional branch of the unit. C_0 is the static capacitance between the electrodes.

SURVEY

On next pages can be found a survey of available types in order of type reference number, which is also the order of the data sheets.

→ Types for general frequency stabilisation

crystal cut	frequency range (MHz)	holder	type
AT (fundamental)	1.8 - 20	metal - HC-6/U, HC-17/U	4322 152
	7 - 20	metal - HC-18/U, HC-25/U	4322 153
	2.3 - 20	all-glass - HC-27/U	4322 154
	4.5 - 20	all-glass - HC-26/U, HC-29/U	4322 155
AT (third overtone)	10 - 61	metal - HC-6/U, HC-17/U	4322 157
	17 - 61	metal - HC-18/U, HC-25/U	4322 158
	10 - 61	all-glass - HC-27/U	4322 159
	10	all-glass - HC-27/U	4322 159 00001
	20 - 61	all-glass - HC-26/U, HC-29/U	4322 160
AT (fifth overtone)	50 - 87	metal - HC-6/U, HC-17/U	4322 163
	50 - 87	metal - HC-18/U, HC-25/U	4322 164
	50 - 87	all-glass - HC-27/U	4322 165
	50 - 87	all-glass - HC-26/U, HC-29/U	4322 166

→ Types for special applications

application	holder	data	crystal cut	for further data see type
steering of models	HC-6/U	27.125 MHz, 0/+60 °C total tolerance $\pm 1000 \times 10^{-6}$ series resonance	AT	4322 157 00010
		40.68 MHz, 0/+60 °C total tolerance $\pm 500 \times 10^{-6}$ series resonance	AT	4322 157 00020
		13.56 MHz, 0/+60 °C total tolerance $\pm 500 \times 10^{-6}$ C_L = 30 pF in parallel	AT	4322 152 01300
measuring equipment	HC-6/U	1 MHz 4.5 5.5 6.75 10.7 −20/+70 °C Total tol. $\pm 100 \times 10^{-6}$ C_L = 30 pF in parallel	AT	4322 152 01240 01280 01250 01290 01260

Fundamental and overtone AT-cut crystal units with an all-glass holder (2.3 - 87 MHz)

In the following respects the all-glass units show a better performance than those having a metal holder:

- Reduced liability to ageing effects.
  Changes in frequency as a result of ageing should be measured with the aid of equipment (test set and frequency-measuring outfit) having a "frequency-resetability accuracy" of better than 5×10^{-7}.
- Closer frequency tolerances at the nominal temperature can be achieved, if required. The total frequency tolerance and the accuracy of adjustment also include the permissible difference between test sets of the specified type. This means that if user and manufacturer agree on one single measuring instrument, even closer tolerances than those specified can be guaranteed.
- Lower series resistance, thanks to the crystal's working in vacuum.
  This is of consequence only when the working frequency should in the smallest possible degree be affected by electrical instabilities of oscillator components. In that case, the oscillator should be likewise designed to meet this requirements.

The fundamental crystals are generally operated at parallel resonance, but they can also be obtained for series and antiresonance.

The overtone crystals are intended for operation at series resonance, however, for between 10 and 30 MHz they can also be obtained for antiresonance. In that case the series capacitance might have a standard value of 18 pF.

Fundamental AT-cut crystal units with a metal holder (1.8 - 20 MHz)

These crystal units are generally used at parallel resonance, the parallel capacitance being 20, 30, 32, 40 or 50 pF (in a few cases 100 pF at frequencies below 10 MHz). They can also be obtained for use at series or antiresonance.

Overtone AT-cut crystal units with a metal holder (10 - 87 MHz)

These crystal units are intended for operation at series resonance. For frequencies between 10 and 30 MHz they can also be obtained for use at antiresonance; in this case the series capacitance might have a value of 18 pF.

FREQUENCY DRIFT (Temperature dependence)

The frequency drift as a function of temperature can be represented by a graph, the TC curve or drift characteristic. In the case of AT cuts, the relation of drift and temperature is approximated by a cubic curve; the drift characteristic of the other cuts is parabolic in shape.

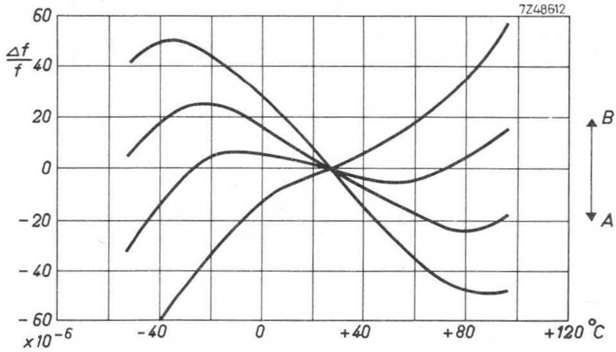


Fig.2

Fig.2 shows a number of frequency-temperature curves obtained from AT-cut crystals with various angles of cut (A stands for an increasing and B for a decreasing angle of cut). The curves are symmetric in respect of 27 °C, and it is not possible to shift this point. A temperature range which is fairly symmetric in respect of 27 °C (e.g. 0 - 60 °C) will, therefore, result in the smallest frequency drift possible in that range.

It will be evident that, for AT-cut crystals, the angle of cut and its accuracy are decisive for the frequency drift over a given temperature range.

→ FREQUENCY TOLERANCE

The frequency tolerance is an algebraic sum of the accuracy of adjustment, frequency drift and changes in frequency as a result of ageing effects.

In view of the tolerance on the angle of cut, rather than giving one single drift curve as a characteristic, it is more adequate to state the tolerance field. Fig.3 shows the tolerance field for an AT-cut type of crystal. The hatched surfaces represent the fields of tolerance resulting from drift. The dotted lines border the tolerance fields taking the accuracy of adjustment and the effect of ageing into account.

The tolerance field as per Fig.3 indicates that, for AT-cut crystals, the frequency drift as a function of temperature is next to symmetrical with regard to the working frequency at room temperature.

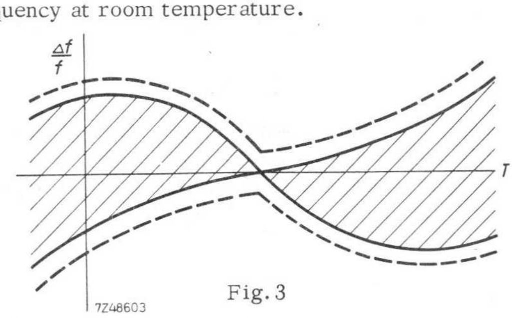


Fig.3

ACTIVITY

Activity is a qualitative term for comparing the stability of crystal units to oscillate under similar conditions. For quantitative comparisons, the Equivalent Series Resistance or the Equivalent Parallel Resistance must be measured.

AGEING

A non-reversible, mostly gradual change with time in resonance frequency is called (an effect of) ageing. Only where a very good long-term stability is required should ageing be of consequence. It should be borne in mind that (with a view to ageing only):

(a) crystal units having a glass holder are favourable compared with those having a metal holder;

(b) overtone crystals are favourable compared with fundamental crystals for the same frequency (or fifth overtone compared with third overtone crystals);

(c) low frequency crystals are favourable compared with high frequency crystals having the same crystal cut.

ADVANTAGES OF ALL-GLASS HOLDERS

Crystal units with glass and all-glass holders show the following advantages over those with metal holders:

(a) a lower series resistance, which also means a higher E.P.R. and Q-factor, thanks to the fact that glass holders are evacuated giving less mechanical damping;

(b) better performance under adverse climatic conditions;

(c) a higher frequency stability.

FREQUENCY PULLING

For the calculation of the degree of frequency pulling that is possible, it will be assumed that the loss resistance of the crystal unit is zero. This greatly simplifies the calculation and hardly influences the result. The thus simplified equivalent circuit is depicted in Fig. 4.

The reactance X of this circuit as a function of frequency is shown in Fig. 5.

When the crystal unit is connected in series to a capacitance C, the total impedance will be:

$$Z_S = jX + jX_C,$$

which means that series resonance ($Z_S = 0$) will occur at the frequency at which:

$$X = -X_C.$$

(It is assumed that this is the case in point A of Fig. 5.)

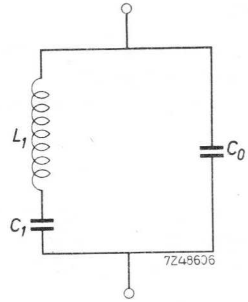


Fig. 4

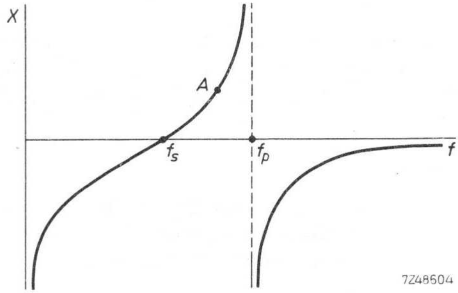


Fig. 5

When the crystal unit is connected in parallel to a capacitance C, the total impedance will be:

$$Z_p = \frac{jX \cdot jX_C}{jX + jX_C},$$

which means that parallel resonance (Z_p = infinite) will occur at the frequency at which:

$$jX + jX_C = 0 \text{ and, again, } X = -X_C,$$

(point A of Fig.5 for same value of C as in the first case).

It can be seen that the formula for the series resonance frequency (f_s') of the series combination will be identical to that for the parallel resonance frequency of the parallel combination (f_p').

This formula is most easily derived from the case of parallel resonance with a parallel capacitance C_L (at which Z_p = infinite), and reads:

$$(\omega_p')^2 = \frac{1}{L_1 C_1}\left(1 + \frac{C_1}{C_o + C_L}\right) = (\omega_s')^2 = \omega^2,$$

where C_L is also the external series capacitance.
Now the frequency change as a function of the external capacitance variation can be found. Differentiation gives:

$$2\,\omega \,.\, \Delta\omega = -\frac{1}{L_1 C_1} \cdot \frac{C_1}{(C_o + C_L)^2} \,.\, \Delta C_L,$$

and working out this equations results in

$$\Delta f = -\frac{1}{8\,\pi^2\, f L_1\, (C_o + C_L)^2} \,.\, \Delta C_L.$$

This formula can be used, without the introduction of appreciable errors, as long as ΔC_L is smaller than $0.1\ C_L$.

It can be seen that the change in frequency resulting from a capacitance decrease is larger than that resulting from an identical increase.

A suitable, though not quite exact formula for larger capacitance variations is the following:

$$f_2 - f_1 = - \frac{C_{L2} - C_{L1}}{8\pi^2 f L_1 (C_{L1} + C_o)(C_{L2} + C_o)} .$$

It should be recognised that changes in external capacitance are accompanied by two other effects: the E.P.R. or the E.S.R. will vary, and the current flowing through the crystal will vary.

Recommendation

We recommend you to consult I.E.C. publication 122-2, "Guide to the use of quartz oscillator crystals".

DEFINITIONS

Nominal frequency	The frequency assigned by the specification of the crystal unit.
Working frequency (f_w)	The frequency actually generated by the crystal unit forming part of an oscillator.
Frequency tolerance (total)	The maximum permitted deviation of the working frequency from the nominal frequency due to a number of causes such as accuracy of adjustment, ageing and temperature dependence.
Temperature range (Operating temperature range)	The range of temperature over which the crystal unit will function within the specified tolerances.
Nominal temperature (T_{nom})	The temperature specified for the crystal unit.
Frequency drift	The maximum permitted deviation of the working frequency from its value at nominal temperature as an exclusive result of temperature variation within the specified range.
Accuracy of adjustment	The tolerance that must be taken into account due to inaccuracy in manufacture including the permissible difference between test sets of the type specified for measuring the working frequency. The deviation is measured at the nominal temperature.
Parallel capacitance (C_o)	The "static" capacitance of the unit, C_o in the equivalent circuit (Fig.1).
Load capacitance (C_L)	The effective external capacitance associated with the crystal unit in an oscillator to obtain the working frequency.

Series resonance	Oscillation without an external capacitance, at the lower of the two frequencies at which the impedance of the unit is real.
Antiresonance (Series resonance with series capacitance)	Oscillation with a capacitance being in series with the crystal unit, at the lower of the two frequencies at which the impedance of the combination is real.
Parallel resonance	Oscillation with a capacitance being in parallel with the crystal unit, at the higher of the two frequencies at which the impedance of the combination is real.
Series resistance	The resistance of the unit at series resonance.
Equivalent series resistance (E.S.R.)	The impedance of the combination of the unit in series with a stated external capacitance or inductance at the lower of the two frequencies (in the vicinity of the nominal frequency) for which the electrical impedance of the combination is real.
Equivalent parallel resistance (E.P.R.)	The impedance of the combination of the unit in parallel with a stated external capacitance at the higher of the two frequencies (in the vicinity of the nominal frequency) for which the electrical impedance of the combination is real.
Inductance (L_1)	The inductance of the equivalent circuit (Fig.1)
Maximum permissible load	Maximum r.m.s. value of the current flowing through the crystal below which the crystal unit will function within the specified tolerances, and will not be damaged.

TEST CONDITIONS

PARAMETERS AND TEMPERATURE

All values given for parameters, such as inductance, series resistance, E.S.R. and E.P.R., apply to the entire temperature range.

SHOCK AND VIBRATION TESTS

When "MIL-C-3098B, par. 3.12" is referred to, after these tests the frequency and resistance of the crystal unit will comply with the data specified under "Frequency tolerance" and "Maximum series resistance".
When only "MIL-C-3098B" is referred to, the mechanical requirements as per MIL-C-3098 apply.

CLIMATIC TESTS

The climatic tests for quartz crystal units according to military specifications are described in the British spec RCS 271 and the USA spec MIL-C-3098B.
The climatic-proof qualities can be guaranteed only when use is made of a socket which causes no crack in the glass of the base when the unit is inserted. For that reason it is necessary to use sockets whose contact springs, after insertion of the crystal unit, do not jam in the surrounding insulating material of the socket. A socket will comply with this requirement if, after insertion of a calliper as per Fig.10 or 11, the calliper can still be moved to and fro slightly in the socket.

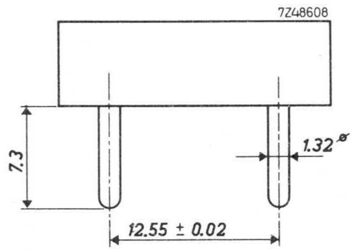


Fig.10

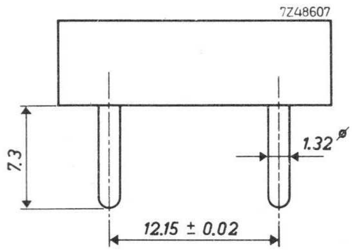


Fig.11

TEST SETS (Standard oscillators)

The working frequency of a quartz crystal unit depends on the combination of crystal and oscillator. Therefore, an exact specification of a crystal unit can only be given if the oscillator to be used is also completely specified. Furthermore, measurements made by user and manufacturer are identical only if both parties use identical test oscillators in the same manner.

Unless otherwise agreed, our quartz crystal units are measured with the test sets indicated below.

crystal	frequency range	test set	for operation at
fundamental up to 1 MHz	up to 1 MHz	TS-710/TSM	series resonance with or without series capacitance
fundamental AT-cut	1 - 20 MHz	TS-193/A	parallel resonance
	1 - 15 MHz 15 - 20 MHz	TS-330/TSM TS-683/TSM	series resonance with or without series capacitance
overtone AT-cut	10 - 87 MHz	TS-683/TSM	

The four test sets mentioned are used to meet military specifications and are also the most suitable for general use. For further details see "Measuring procedures".

MEASURING PROCEDURES

Unless differently specified, our quartz-crystal units are measured in one of the test sets and in the manner here described. The set to be used for a given kind of crystal, and data such as the load to be applied and the minimum crystal impedance, are specified on the relevant data sheet.

BRITISH TEST SET TS-193A

RZ 9607-1

The set (model QC57) is suitable for measuring the frequency and the equivalent parallel resistance of crystal units at frequencies of 1 - 20 MHz.
The measuring procedures are as follows.

Measuring the working frequency

1- Turn the "amplitude" knob completely to the left.

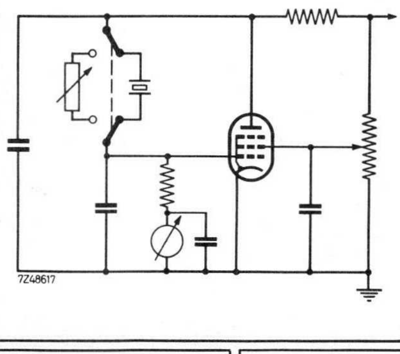
2- Switch the set on by putting the "on-off" switch in the on-position, and let it heat up for 15 minutes.

3- Set the arrow-shaped knob at the specified parallel capacitance.

4- Insert the crystal unit to be measured in the appropriate socket.

5- Turn the "amplitude" knob to the right until the microammeter indicates the specified grid current.

6- Measure the frequency.



Measuring the E.P.R.

Switch the set on and let it heat up, apply the specified parallel capacitance and insert the crystal unit to be measured as described above (points 1 - 4); then:

5- Turn the "amplitude" knob to the right until the microammeter indicates the specified grid current.

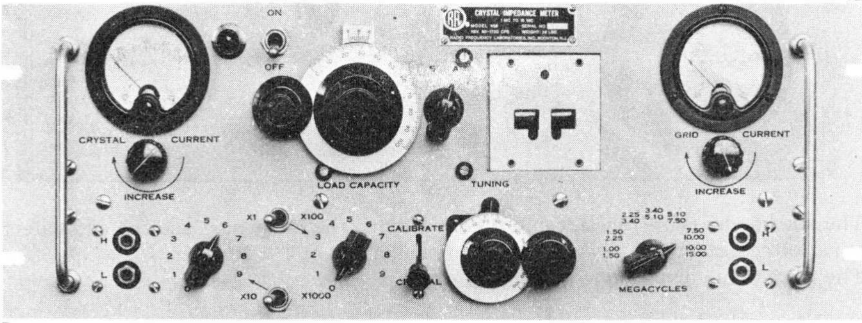
6- Put the arrow-shaped knob in position Z.

7- Turn the knob "E.P.R.-Z" until the microammeter again indicates the specified grid current.

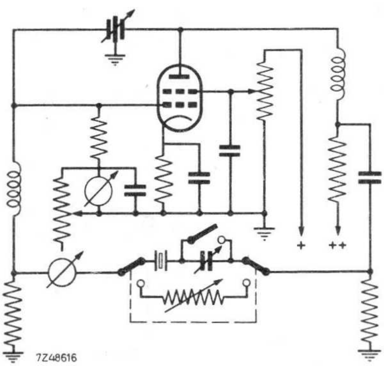
The number of kilohms now indicated by the dial of knob E.P.R.-Z represents the equivalent parallel resistance at the specified parallel capacitance.

U.S. TEST SET TS-330/TSM

RZ 9296-1



The set (model 459) is suitable for measuring the frequency and the equivalent series resistance of crystal units at frequencies of 1 - 15 MHz. Resistance decades are incorporated to replace the crystal impedance at series resonance, or the crystal impedance in series with a capacitive load at antiresonance.



Measuring procedure in the case of a series capacitance

1- Turn the "crystal current" and "grid current" knobs completely to the left.

2- Switch the set on by putting the "on-off" switch in the on-position, and let it heat up for 15 minutes.

3- Put the "calibrate-crystal" switch in the "crystal" position.

4- Set the "megacycles" switch at the required frequency range.

5- Put switch "S-A" in position S and apply the load (e.g. 32 pF) by means of the "load capacity" dial and the calibration chart which belongs to the set.

6- Place the tuning resistance (value specified on the relevant data sheet) into the crystal socket of the test set and connect the differential millivoltmeter (see the relevant section below).

7- Turn the "crystal current" knob somewhat to the right and adjust the tuning frequency (specified on the relevant data sheet) by means of the "tuning" knob, to be checked within ± 0.1 % with the aid of e.g. a decade counter-unit.

8- Adjust the tuning voltage (specified on the relevant data sheet) by means of the "crystal current" knob and the differential millivoltmeter.

9- Put the "calibrate-crystal" switch into the position "calibrate".

10- Dial the reject value of the crystal impedance (specified on the relevant data sheet) on the resistance decade, and tune the crystal frequency within ± 0.1 % by means of the "tuning" knob.

11- Bring the "grid current" meter up to an easily retainable value by means of the relevant knob.

12- Set switch "S-A" to position A and the "calibrate-crystal" switch to the "crystal" position.

13- Substitute the crystal unit to be measured for the tuning resistance and the differential voltmeter.

14- Units whose grid current exceeds the value to be retained according to 11, have a resistance smaller than the rejection value, and vice versa.

15- Measure the frequency.

Measuring procedure in the case of no series capacitance

The above procedure is modified as follows.

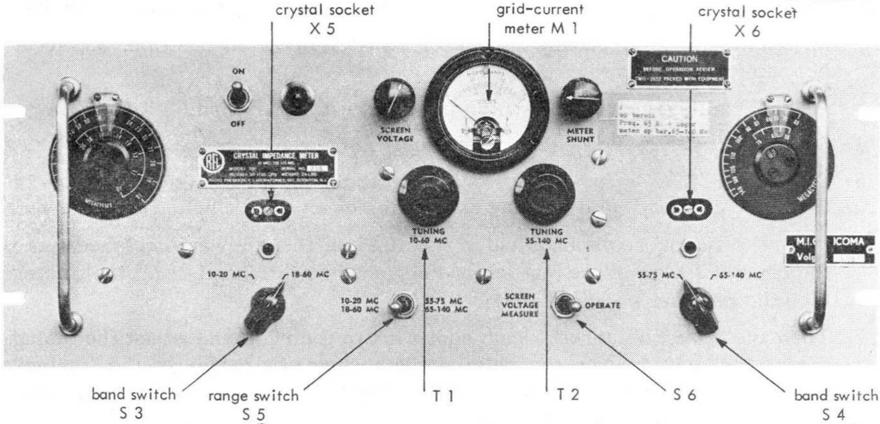
5- Set switch "S-A" to position S.

10- Dial the reject value of the crystal impedance (specified on the relevant data sheet) on the resistance decade, and tune the crystal frequency within ± 0.1 % by means of the "tuning" knob.

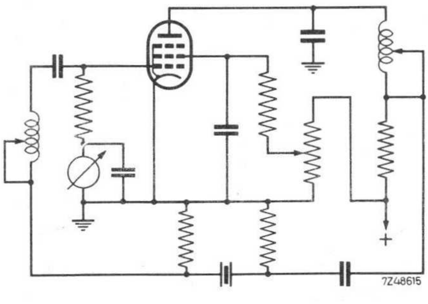
12- Put the "calibrate-crystal" switch into the "crystal" position.

U.S. TEST SET TS-683/TSM

RZ 9296-2



The set (model 531) is suitable for measuring the frequency and the equivalent series resistance of crystal units at frequencies of 10 - 140 MHz. Separate resistors are used to replace the crystal impedance.



Measuring procedure

1- Switch the set on by putting the "on-off" switch in the on-position, and let it heat up for 15 minutes.

2- Set range switch S5 to the position which covers the nominal frequency of the crystal unit.

3- Set band switch S3 or S4 to the same frequency range as switch S5.

Note: By agreement, frequencies between 55 and 65 MHz are measured in the range 55 - 75 MHz, and those of 65 MHz and higher in the range 65 - 140 MHz.

4- Set the tuning scale to the nominal frequency of the crystal unit by means of the knob "tuning, 10 - 60 Mc/s" (T1) or "tuning, 55 - 140 Mc/s" (T2).

5- Insert an intermediate socket (as described under "Differential millivoltmeter") which contains a resistor rated as specified on the relevant data sheet, in the crystal socket X5 or X6. X5 should be used when switch S5 is pointing to the left.

6- Insert the probe of the differential millivoltmeter in the intermediate socket.

7- Adjust the required voltage-drop across the resistor, by means of the "screen voltage" knob, to the value specified on the relevant data sheet.

8- Substitute the crystal unit to be measured for the probe and the intermediate socket.

9- Adjust the grid current by means of knob T1 or T2 so as to obtain the maximum deflection of the meter M1, and measure the frequency.

10- Replace the crystal unit by the intermediate socket with resistor prescribed under 5.

11- Tune with knob T1 or T2 so that the frequency to be measured differs no more than ±0.1 % from the frequency under 9.

12- Check the load and, if necessary, correct it according to 6 and 7.

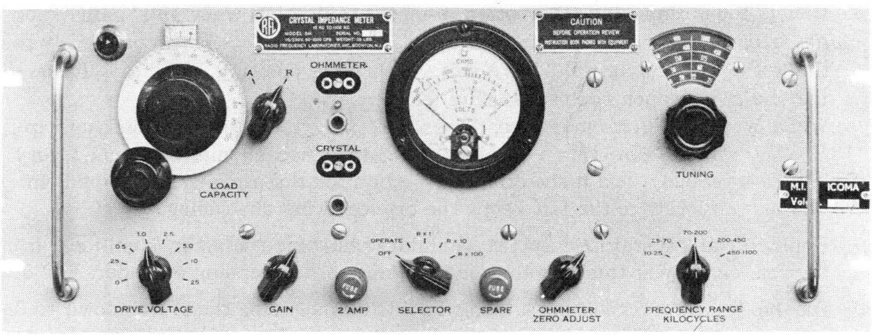
13- Set the deflection of meter M1 for the limit of rejection (resistance in accordance with the relevant data sheet) to a value easily borne in mind, by means of the "meter shunt" knob.

14- Substitute the crystal unit for the resistor and read the meter deflection. This should exceed the deflection for the resistance of rejection under 13.

15- Measure the frequency.

U.S. TEST SET TS-710/TSM

RZ 9607-2

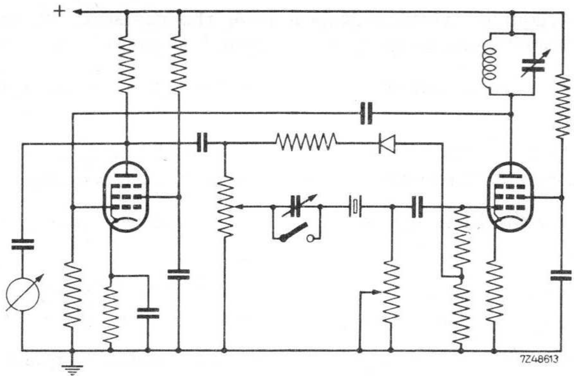


The set (model 541), which is based on the Heegner oscillator, is suitable for measuring the frequency and the equivalent series resistance of crystal units at frequencies of 10 - 1100 kHz.
Unless differently specified, the measuring procedure is as follows.

In the case of no series capacitance

1- Turn the "drive voltage" and "gain" knobs completely to the left.

2- Switch the set on by setting the "selector" switch to the "operate" position, and let it heat up for 15 minutes.



3- Set the "frequency range, kilocycles" switch to the position for the frequency range in question.

4- Put switch "A-R" at position R.

5- Insert the crystal unit to be measured in the "crystal" socket.

6- Put the "driving voltage" knob at position "0.25".

7- Turn the "gain" knob slowly to the right and meanwhile move the "tuning" knob back and forth through the nominal frequency value, until the maximum meter indication has been obtained by means of the "tuning" knob.

8- If it is found impossible to obtain a meter indication when the "gain" knob has been turned completely to the right, then rotate this knob completely to the left again and put the "drive voltage" knob at position "0.5" or a following one. Thereupon repeat as under 7.

Warning: Some units may start to oscillate sluggishly and then pick up rapidly. For this reason, the "gain" knob should be turned very slowly, and it should be borne in mind that turning this knob completely to the left keeps the crystal from shattering.

9- Replace the crystal unit by the variable-resistance adaptor supplied with the set, and adjust this adaptor for the same meter reading as under 7 or 8.

10- Put the "selector" knob in the position "Rx1" and bring the meter down to 0 ohms by means of the "ohmmeter zero adjust" knob.

11- Insert the adaptor in the "ohmmeter" socket and take a reading in ohms.

12- Take the required crystal-current intensity from the relevant data sheet.

13- Determine the drive voltage corresponding with the crystal current in question with the aid of the formula E = IR, where
E = the drive voltage in volts,
I = the crystal current in amps,
R = the reading in ohms found under 11.

14- Remove the adaptor from the "ohmmeter" socket and put the "selector" knob in the "operate" position.

15- Insert the crystal unit in the "crystal" socket again.

16- Turn the "drive voltage" and "gain" knobs until the meter indicates the drive voltage calculated under 13, and measure the frequency.

17- Once again, replace the crystal unit by the variable adaptor, put switch "A-R" to position R, and observe whether the meter indication is identical with that under 16. If not, adjust the adaptor.
If required, re-tune (within ± 0.1 %) by means of the "tuning" knob, to obtain the frequency found under 16.

18- Substitute the crystal unit for the adaptor, and put switch "A-R" in position A. The frequency now measured is the frequency at the calculated drive voltage.

19- Repeat steps 10 and 11.
The resistance now measured is the equivalent series resistance of the crystal unit under test. It should not exceed the maximum value specified on the relevant data sheet.

<u>In the case of a series capacitance</u>

The above procedure is modified as follows.

4- Set switch "A-R" to position A.
Set the "load capacity" dial to the value which corresponds with the relevant series capacitance and the calibration chart supplied with the test set.

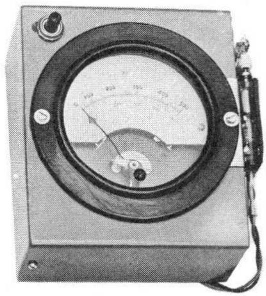
9- Set switch "A-R" to position R.
Replace the crystal unit by the variable-resistance adaptor that is supplied with the set, and adjust this adaptor for the same meter reading as under 7 or 8.

15- Set switch "A-R" to position A and substitute the crystal unit for the adaptor. The frequency now measured is the frequency at the calculated drive voltage.

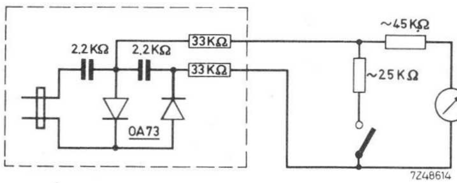
19- Not applicable.

DIFFERENTIAL MILLIVOLTMETER

C 65501



C 65495



With a view to present-day tolerances, it is impossible to obtain sufficiently comparable results with various oscillators if the level of drive of the crystal is not exactly known, even when the oscillators are built up quite identically.

In the specification MIL-C-3098B, the level of drive is specified in milliamps of crystal current at a given resistance, and also in milliwatts.

Particularly when the U.S. test set TS-330/TSM is used, it will be found that the reading of small crystal currents may give rise to appreciable inaccuracies resulting in frequency differences. Measuring the voltage with respect to earth at either side of the crystal in such a set appeared likewise to be inadequate in consequence of the self-inductances of the connecting leads.

For these reasons the differential millivoltmeter under discussion was designed to allow of measuring the voltage across the tuning resistor independently of earth. It is suitable for use in conjunction with both the U.S. test sets TS-330 and TS-683.

The HF part, indicated in the above diagram by a dotted line, is in the form of a probe. It comprises a diode circuit acting as a voltage doubler, and two 33-kΩ resistors, embedded in an epoxy resin by means of a mould. The base of holder type HC-6/U is employed for the terminals.

A number of intermediate sockets are utilized by way of shunts with various values for the rated level of drive to be measured. They are composed of a standard socket 88468/05, soldered on to another base HC-6/U, and a carbon resistor (e.g. 40 Ω) connected between the pins. The probe is inserted into one of these intermediate sockets and, by interchange of sockets having different resistance values, the shunt resistance most adequate for a given case can be applied very quickly.

A flex connects the d.c. side of the probe to the meter which, in our case, has a range of up to 10 μA and an internal resistance of 2000 Ω. In consequence of a series resistance of 45 kΩ, the full needle stroke corresponds to 500 mV. The measuring range can be extended to 1000 mV by applying a shunt resistance to the meter circuit with the aid of a push-button switch.

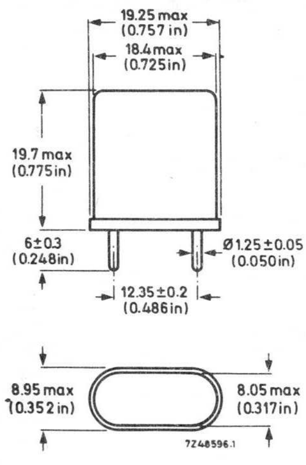
It goes without saying that the actual resistance values required are dependent on the diodes and, consequently, the probe may not be interchanged without re-calibrating the meter. For this reason, probe and meter are interconnected in a permanent manner.

The meter is calibrated in the conventional way by comparison with a HF volt-meter and a sine wave of about 1 MHz, whose amplitude is varied - one side may be earthed during the calibration. When calibrated at 1 MHz, the meter is correct for the frequency range covered by the quartz crystal units mentioned in the data sheets.

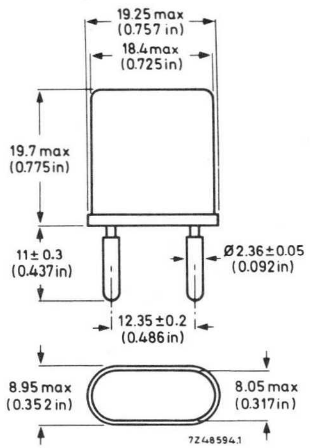
HOLDERS

METAL AND ALL-GLASS HOLDERS

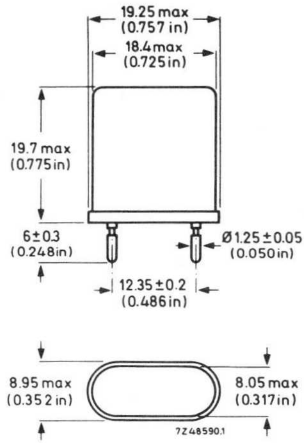
The following holders state the nominal frequency by means of 7 (or 8) figures on the top, in kHz in the case of fundamental crystals and in MHz in the case of overtone items.
The figures on one of the faces constitute registration numbers that relate to the date and series of manufacture.



HC-6/U (metal)

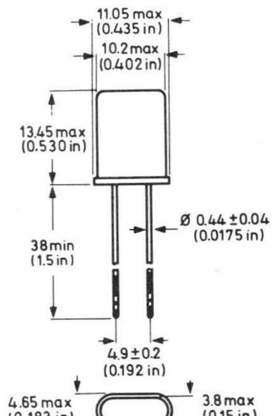


HC-17/U (metal)

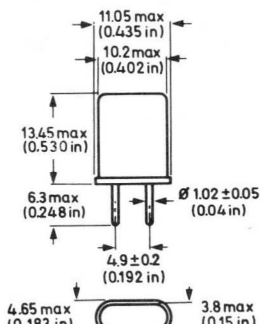


HC-27/U (glass)

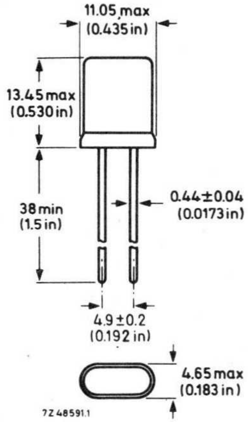
The four holders below state the nominal frequency on one of the faces, in kHz in the case of fundamental crystals and in MHz in the case of overtone items. The figures on the other faces constitute registration numbers that relate to the date and series of manufacture.



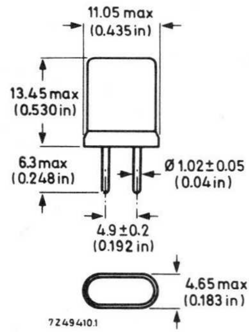
HC-18/U (metal)



HC-25/U (metal)



HC-26/U (glass)



HC-29/U (glass)

SOCKETS

The following ceramic sockets for quartz crystal units are available (only differences are given):

2422 518 00001 for HC-6/U, HC-13/U, HC-27/U, HC-28/U, conventional version.
2422 518 00002 for HC-6/U etc., printed-wiring version.

HOW TO ORDER

The quartz crystal units can be obtained in accordance with a specification of the (total) frequency tolerance or with a specification of the accuracy of adjustment and the frequency drift separately.

When applying for quotation or when ordering please state:

1. nominal frequency ... kHz, mode of vibration: fundamental / third / fifth
2. a. frequency tolerance ... x 10^{-6}, or

   b. accuracy of adjustment ... x 10^{-6}, and
   frequency drift ... x 10^{-6}.
3. temperature range
4. a. parallel resonance, capacitance parallel to unit: ... pF, or

   b. antiresonance, capacitance in series to unit: ... pF, or

   c. series resonance.
5. type of holder.

For non-listed types, please apply in the same manner and submit oscillator circuit with description.

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	1.8 - 20 MHz
Mode of vibration	fundamental
Type of holder	metal, HC-6/U (MIL) or HC-17/U (MIL) (non-preferred)

APPLICATION

These units are used for frequency stabilisation.
They are generally used in series or parallel resonance oscillators.

DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder, provided with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)

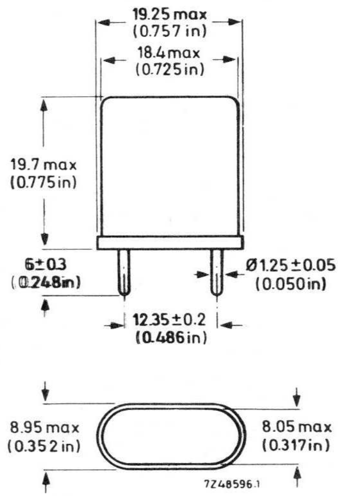


Fig. 1. HC-6/U

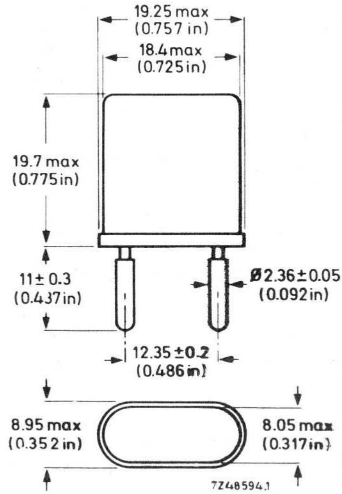


Fig. 2. HC-17U

Weight

With both types of holder approximately 4 g

Mounting

Holder type HC-6/U fits the socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to RCS271 and MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance, Table 1

frequency range	temperature range	frequency tolerance		
		class 0	class I	class II
1.8 - 20 MHz	-5/ +45 °C -10/ +50 °C -15/ +70 °C	$\pm 25 \times 10^{-6}$ $\pm 27.5 \times 10^{-6}$ $\pm 30 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$ $\pm 30 \times 10^{-6}$ $\pm 35 \times 10^{-6}$	$\pm 30 \times 10^{-6}$ $\pm 35 \times 10^{-6}$ $\pm 40 \times 10^{-6}$
1.8 - 2.3 MHz 2.3 - 4 MHz 4 - 20 MHz	-55/+105 °C -55/+105 °C -55/+105 °C	$\pm 50 \times 10^{-6}$ $\pm 52.5 \times 10^{-6}$ $\pm 45 \times 10^{-6}$	$\pm 55 \times 10^{-6}$ $\pm 55 \times 10^{-6}$ $\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$ $\pm 60 \times 10^{-6}$ $\pm 60 \times 10^{-6}$

Frequency drift, Table 2

frequency range	temperature range	frequency drift		
		class 0	class I	class II
1.8 - 20 MHz	-5/ +45 °C -10/ +50 °C -15/ +70 °C	$\pm 5 \times 10^{-6}$ $\pm 7.5 \times 10^{-6}$ $\pm 10 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$ $\pm 10 \times 10^{-6}$ $\pm 15 \times 10^{-6}$	$\pm 10 \times 10^{-6}$ $\pm 15 \times 10^{-6}$ $\pm 20 \times 10^{-6}$
1.8 - 2.3 MHz 2.3 - 4 MHz 4 - 20 MHz	-55/+105 °C -55/+105 °C -55/+105 °C	$\pm 30 \times 10^{-6}$ $\pm 32.5 \times 10^{-6}$ $\pm 25 \times 10^{-6}$	$\pm 35 \times 10^{-6}$ $\pm 35 \times 10^{-6}$ $\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$ $\pm 40 \times 10^{-6}$ $\pm 40 \times 10^{-6}$
1.8 - 20 MHz	$T_{nom} \pm 5$ °C	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment $\pm 20 \times 10^{-6}$ (to be combined with any of the frequency drift figures quoted)

Parallel capacitance	max. 7 pF
Max. permissible d.c. voltage between the pins	100 V

PARALLEL RESONANCE

Working frequency	to be measured with the British Military Test Set TS 193, the parallel capacitance being set at 30 pF and the grid current at 50 μA for the frequency range 1.8 - 15 MHz and at 20 μA for 15 - 20 MHz.
Minimum equivalent parallel resistance	
for 1.8 - 10 MHz	according to Fig.3, the parallel capacitance set at 30 pF and the grid current at 50 μA.
for 10 - 20 MHz	according to Fig.4, the parallel capacitance set at 20 pF and the grid current at 50 μA for 10 - 15 MHz, and at 20 μA for 15 - 20 MHz.

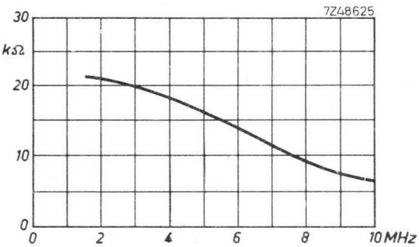


Fig.3

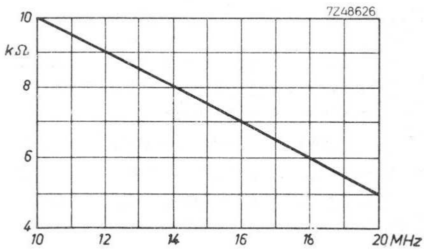


Fig.4

ANTI RESONANCE

Working frequency	to be measured with the American Military Test Sets TS-330/TSM for the frequency range 1.8 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz. The series capacitance to be set at 32 pF and the set being tuned in accordance with Table 3 or 4 (Table 4 applies to oven-controlled units).

Maximum equivalent
series resistance

at a series capacitance of 32 pF, and at

1.800000 - 1.999999 MHz	550 Ω
2.000000 - 2.249999 MHz	500 Ω
2.250000 - 2.999999 MHz	320 Ω
3.000000 - 3.749999 MHz	175 Ω
3.750000 - 4.749999 MHz	120 Ω
4.750000 - 5.999999 MHz	75 Ω
6.000000 - 7.499999 MHz	50 Ω
7.500000 - 9.999999 MHz	35 Ω
10.000000 - 20.000000 MHz	25 Ω

SERIES RESONANCE

Working frequency — to be measured with the American Military Test Sets TS-330/TSM for the frequency range 1.8 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz, without a series capacitance, the set to be tuned in accordance with Table 3 or 4, (Table 4 applies to oven-controlled units).

Maximum series resistance at

1.800000 - 1.999999 MHz	300 Ω
2.000000 - 2.249999 MHz	250 Ω
2.250000 - 3.749999 MHz	150 Ω
3.750000 - 4.999999 MHz	100 Ω
5.000000 - 6.999999 MHz	50 Ω
7.000000 - 9.999999 MHz	30 Ω
10.000000 - 20.000000 MHz	25 Ω

Tuning conditions for the test sets:

Table 3

test set	nominal frequency (MHz)	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	1.800000 - 2.259999	2	50	750	10 ± 2
	2.260000 - 3.409999	3	100	1000	10 ± 2
	3.410000 - 5.109999	nominal	45	675	10 ± 2
	5.110000 - 7.509999	nominal	25	500	10 ± 2
	7.510000 - 9.999999	nominal	16	400	10 ± 2
	10.000000 - 15.000000	nominal	13	260	5 ± 1
TS 683	15.000001 - 20.000000	nominal	22	330	5 ± 1

Table 4 (oven-controlled units)

test set	nominal frequency (MHz)	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	1.800000 - 2.259999	2	50	500	5 ± 1
	2.260000 - 3 409999	3	50	500	5 ± 1
	3.410000 - 5.109999	nominal	50	500	5 ± 1
	5.110000 - 7.509999	nominal	22	330	5 ± 1
	7.510000 - 9.999999	nominal	13	260	5 ± 1
	10.000000 - 15.000000	nominal	11	165	2.5 ± 0.5
TS 683	15.000001 - 20.000000	nominal	22	230	2.5 ± 0.5

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	7 - 20 MHz
Mode of vibration	fundamental
Type of holder	metal, HC-18/U (MIL) or HC-25/U (MIL)

APPLICATION

These units are used for frequency stabilisation.
They are generally used in series or parallel resonance oscillators.

DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder, provided with 2 connecting leads (HC-18/U) or 2 connecting pins (HC-25/U).

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)

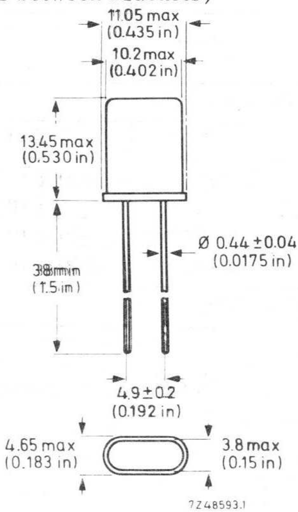


Fig. 1. HC-18/U

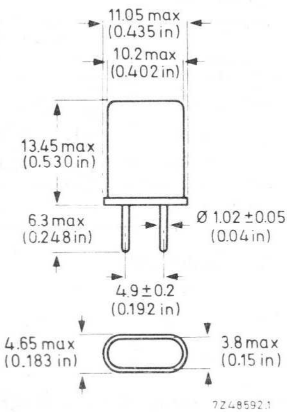


Fig. 2. HC-25/U

Weight

With both types of holder approximately 1 g

Mounting

Holder type HC-18/U fits a printed wiring board.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to RCS 271 and MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +45 °C	$\pm 25 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-10/ +50 °C	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
-15/ +70 °C	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
-55/+105 °C	$\pm 45 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +45 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +50 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-15/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
$T_{nom} \pm 5$ °C	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment	$\pm 20 \times 10^{-6}$ (to be combined with any of the frequency drift figures quoted)
Parallel capacitance	max. 7 pF
Maximum permissible d.c. voltage between the pins	100 V

PARALLEL RESONANCE

Working frequency — to be measured with the British Military Test Set TS-193, the parallel capacitance being set at 30 pF and the grid current at 50 μA for the frequency range 7 - 15 MHz and at 20 μA for 15 - 20 MHz.

Minimum equivalent parallel resistance

for 7 - 10 MHz — according to Fig.3, the parallel capacitance set at 30 pF, and the grid current at 50 μA

for 10 - 20 MHz — according to Fig.4, the parallel capacitance set at 20 pF, and the grid current at 50 μA for 10 - 15 MHz, and at 20 μA for 15 - 20 MHz.

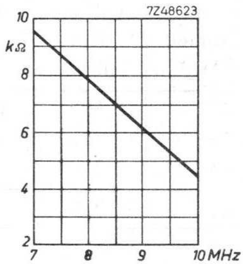


Fig.3

Fig.4

ANTIRESONANCE

Working frequency — to be measured with the American Military Test Sets TS-330/TSM for the frequency range 7 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz.
The series capacitance to be set at 32 pF and the set being tuned in accordance with Table 3 or 4, (Table 4 applies to oven-controlled units).

Maximum equivalent series resistance

at a series capacitance of 32 pF

7.000000 - 8.199999 MHz	60 Ω
8.200000 - 9.999999 MHz	45 Ω
10.000000 - 20.000000 MHz	35 Ω

SERIES RESONANCE

Working frequency: to be measured with the American Military Test Sets TS-330/TSM for the frequency range 7 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz, without a series capacitance.
The set to be tuned in accordance with table 3 or 4, (Table 4 applies to oven-controlled units).

Maximum series resistance at

7.000000 - 8.199999 MHz	40 Ω
8.200000 - 9.999999 MHz	30 Ω
10.000000 - 20.000000 MHz	25 Ω

Tuning conditions for the test sets:

Table 3

test set	nominal frequency (MHz)	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	7.000000 - 7.509999	nominal	25	500	10 ± 2
	7.510000 - 9.999999	nominal	16	400	10 ± 2
	10.000000 - 15.000000	nominal	13	260	5 ± 1
TS 683	15.000001 - 20.000000	nominal	22	330	5 ± 1

Table 4 (oven-controlled units)

test set	nominal frequency	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	7.000000 - 7.509999	nominal	25	350	5 ± 1
	7.510000 - 9.999999	nominal	16	300	5 ± 1
	10.000000 - 15.000000	nominal	13	180	2.5 ± 0.5
TS 683	15.000001 - 20.000000	nominal	22	235	2.5 ± 0.5

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	1.8 - 20 MHz
Mode of vibration	fundamental
Type of holder	
for 1.8 - 2.3 MHz	all glass/26 mm
2.3 - 20 MHz	all glass HC-27/U (MIL)

APPLICATION

These units are used for frequency stabilisation in circuits, in which a high stability and a low series resistance are required.
They are generally used in series or parallel resonance oscillators.
Example: oscillator circuits in communication equipment with narrow channel spacing.

DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed evacuated glass holder, provided with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA.

Dimensions in mm
(in inches between brackets)

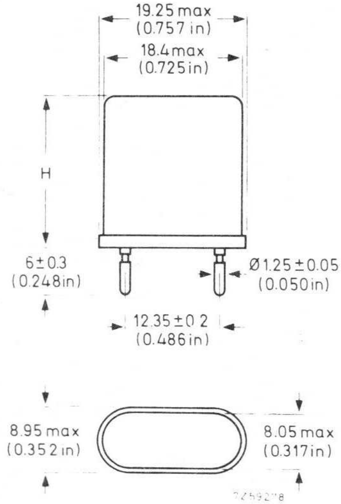


Fig. 1. For all glass/26 mm type
H = max. 26 mm (1.023 in)
for all glass HC-27/U
H = max. 19.7 mm (0.775 in)

Weight

Approximately 2.5 g

Mounting

Both types of holder fit the socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098E

Climatic tests

According to MIL-C-3098E.

ELECTRICAL DATA

Frequency tolerance, Table 1

frequency range	temperature range	frequency tolerance		
		class 0	class I	class II
1.8 - 20 MHz	-5/ +45 °C	$\pm$ 15 x 10^{-6}	$\pm$ 17.5 x 10^{-6}	$\pm$20 x 10^{-6}
	-10/ +50 °C	$\pm$ 17.5 x 10^{-6}	$\pm$ 20 x 10^{-6}	$\pm$25 x 10^{-6}
	-15/ +70 °C	$\pm$ 20 x 10^{-6}	$\pm$ 25 x 10^{-6}	$\pm$30 x 10^{-6}
1.8 - 2.3 MHz	-55/+105 °C	$\pm$ 40 x 10^{-6}	$\pm$ 45 x 10^{-6}	$\pm$50 x 10^{-6}
2.3 - 7 MHz	-55/+105 °C	$\pm$ 42.5 x 10^{-6}	$\pm$ 45 x 10^{-6}	$\pm$50 x 10^{-6}
7 - 20 MHz	-55/+105 °C	$\pm$ 35 x 10^{-6}	$\pm$ 40 x 10^{-6}	$\pm$50 x 10^{-6}

Frequency drift, Table 2

frequency range	temperature range	frequency drift		
		class 0	class I	class II
1.8 - 20 MHz	-5/ +45 °C	$\pm$ 5 x 10^{-6}	$\pm$ 7.5 x 10^{-6}	$\pm$10 x 10^{-6}
	-10/ +50 °C	$\pm$ 7.5 x 10^{-6}	$\pm$ 10 x 10^{-6}	$\pm$15 x 10^{-6}
	-15/ +70 °C	$\pm$ 10 x 10^{-6}	$\pm$ 15 x 10^{-6}	$\pm$20 x 10^{-6}
1.8 - 2.3 MHz	-55/+105 °C	$\pm$ 30 x 10^{-6}	$\pm$ 35 x 10^{-6}	$\pm$40 x 10^{-6}
2.3 - 7 MHz	-55/+105 °C	$\pm$ 32.5 x 10^{-6}	$\pm$ 35 x 10^{-6}	$\pm$40 x 10^{-6}
7 - 20 MHz	-55/+105 °C	$\pm$ 25 x 10^{-6}	$\pm$ 30 x 10^{-6}	$\pm$40 x 10^{-6}
1.8 - 20 MHz	$T_{nom} \pm 5$ °C		$\pm$ 2.5 x 10^{-6}	$\pm$ 5 x 10^{-6}

Accuracy of adjustment $\pm$ 10 x 10^{-6}

(to be combined with any of the frequency drift figures quoted)

Parallel capacitance C_0	max. 7 pF; typical values for 1.8 - 2.3 MHz are given in Fig.4.
Inductance L_1	typical values for 1.8 - 15 MHz are given in Figs.4 to 7
Dynamic capacitance C_1	typical values for 1.8 - 15 MHz are given in Figs.4 to 7
Change in frequency as a result of ageing	$-0.5/+1 \times 10^{-6}$, after 90 days at 85 ± 2 °C, non-operative.
Maximum permissible d.c.voltage between the pins	100 V

PARALLEL RESONANCE

Working frequency	measured with the British Military Test Set TS 193, the parallel capacitance being set at 30 pF and the grid current at 20 μA.
Minimum equivalent parallel resistance	
for 1.8 - 10 MHz	according to Fig.2, the parallel capacitance set at 30 pF, and the grid current at 20 μA.
for 10 - 20 MHz	according to Fig.3, the parallel capacitance set at 20 pF, and the grid current at 20 μA.

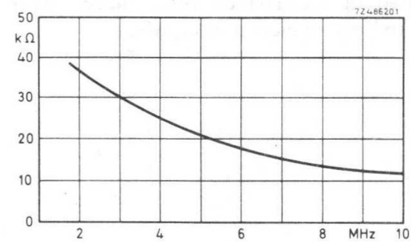


Fig. 2

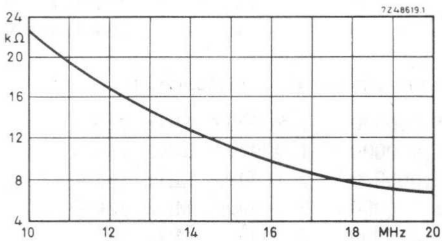


Fig. 3

ANTIRESONANCE

Working frequency	to be measured with the American Military Test Sets TS-330/TSM for the frequency range 1.8 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz The series capacitance to be set at 32 pF and the set being tuned in accordance with Table 3 or 4 (Table 4 applies to oven-controlled units).

Maximum equivalent series resistance

at a series capacitance of 32 pF :

1.800000 -	1.869999	MHz	300 Ω
1.870000 -	1.999999	MHz	290 Ω
2.000000 -	2.119999	MHz	270 Ω
2.120000 -	2.249999	MHz	245 Ω
2.250000 -	2.599999	MHz	195 Ω
2.600000 -	2.999999	MHz	150 Ω
3.000000 -	3.399999	MHz	110 Ω
3.400000 -	3.749999	MHz	90 Ω
3.750000 -	3.999999	MHz	75 Ω
4.000000 -	4.999999	MHz	60 Ω
5.000000 -	6.999999	MHz	35 Ω
7.000000 -	9.999999	MHz	24 Ω
10.000000 -	14.999999	MHz	22 Ω
15.000000 -	20.000000	MHz	20 Ω

SERIES RESONANCE

Working frequency

to be measured with the American Military Test Sets TS-330/TSM for the frequency range 1.8 - 15 MHz and TS-683/TSM for the frequency range 15 - 20 MHz, without a series capacitance.
The set to be tuned in accordance with Table 3 or 4 (Table 4 applies to oven-controlled units).

Maximum series resistance at

1.800000 -	1.869999	MHz	220 Ω
1.870000 -	1.999999	MHz	185 Ω
2.000000 -	2.119999	MHz	165 Ω
2.120000 -	2.249999	MHz	150 Ω
2.250000 -	2.599999	MHz	125 Ω
2.600000 -	2.999999	MHz	90 Ω
3.000000 -	3.399999	MHz	70 Ω
3.400000 -	3.749999	MHz	52 Ω
3.750000 -	3.999999	MHz	45 Ω
4.000000 -	4.999999	MHz	37 Ω
5.000000 -	6.999999	MHz	25 Ω
7.000000 -	9.999999	MHz	20 Ω
10.000000 -	14.999999	MHz	18 Ω
15.000000 -	20.000000	MHz	15 Ω

Tuning conditions for the test sets

Table 3

test set	nominal frequency (MHz)	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	1.800000 - 2.249999	nom.	50	750	10 ± 2
	2.250000 - 3.399999	nom.	40	600	10 ± 2
	3.400000 - 5.099999	nom.	25	500	10 ± 2
	5.100000 - 7.499999	nom.	14	350	10 ± 2
	7.500000 - 9.999999	nom.	11	330	10 ± 2
	10.000000 - 15.000000	nom.	13	260	5 ± 1
TS 683	15.000001 - 20.000000	nom.	10	220	5 ± 1

Table 4 (oven-controlled units)

test set	nominal frequency (MHz)	tuning frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	1.800000 - 2.249999	nom.	50	500	5 ± 1
	2.250000 - 3.399999	nom.	50	500	5 ± 1
	3.400000 - 5.099999	nom.	22	330	5 ± 1
	5.100000 - 7.499999	nom.	13	260	5 ± 1
	7.500000 - 9.999999	nom.	13	260	5 ± 1
	10.000000 - 15.000000	nom.	11	165	2.5 ± 0.5
TS 683	15.000001 - 20.000000	nom.	10	160	2.5 ± 0.5

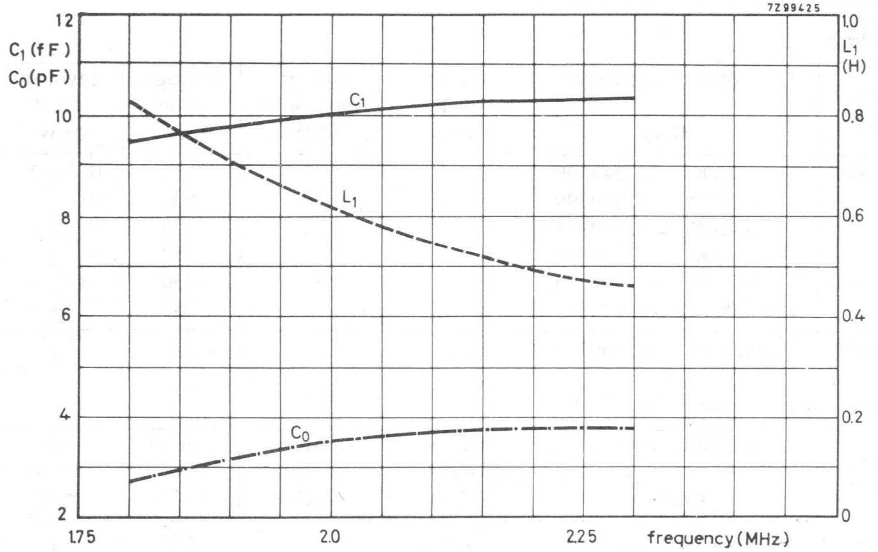


Fig. 4 Typical values for C_0, C_1 and L_1 for frequencies from 1.8 to 2.3 MHz

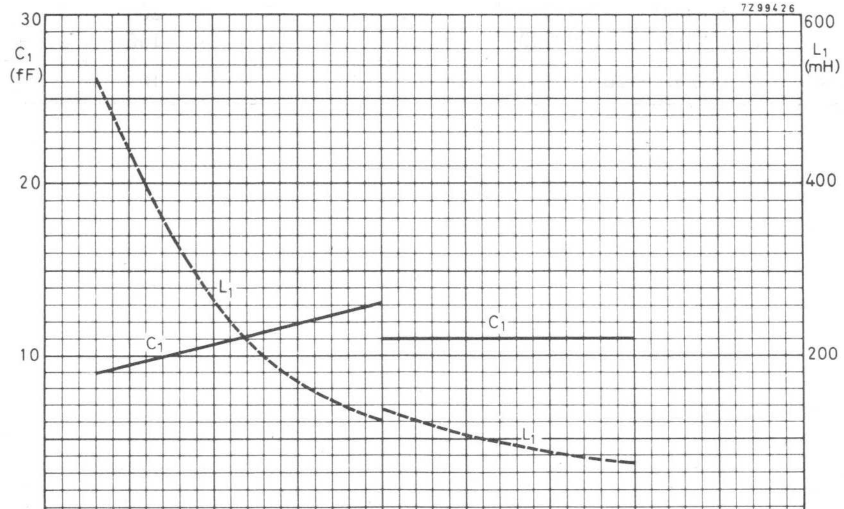


Fig. 5 Typical values for C_1 and L_1 for frequencies from 2.3 to 5.5 MHz

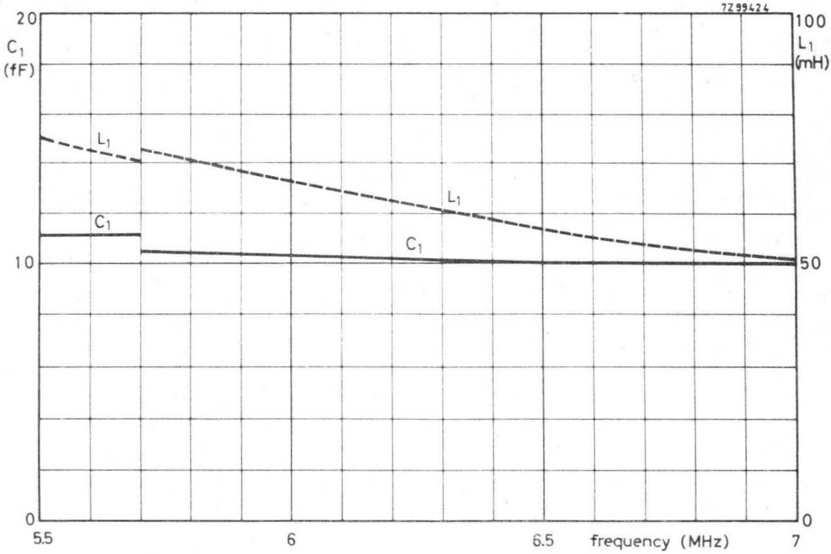


Fig. 6 Typical values for C_1 and L_1 for frequencies from 5.5 to 7 MHz

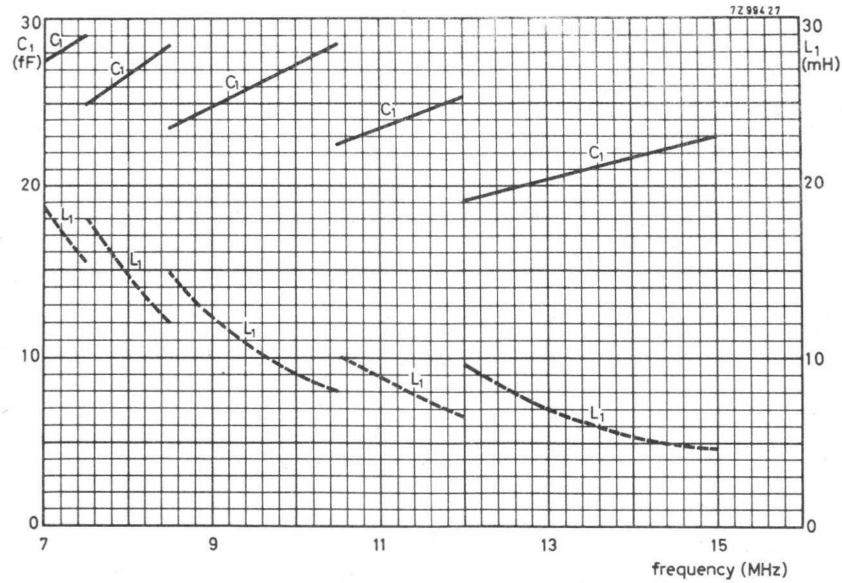


Fig. 7 Typical values for C_1 and L_1 for frequencies from 7 to 15 MHz

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	4.5 - 20 MHz
Mode of vibration	fundamental
Type of holder	all glass HC-26/U (MIL) or HC-29/U (MIL)

APPLICATION

These units are used for frequency stabilisation in circuits, in which a high stability and a low series resistance are required.
They are generally used in series or parallel resonance oscillators.
Example: oscillator circuits in communication equipment with narrow channel spacing.

DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed evacuated glass holder type HC-26/U provided with two connecting leads or type HC-29/U provided with two connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)

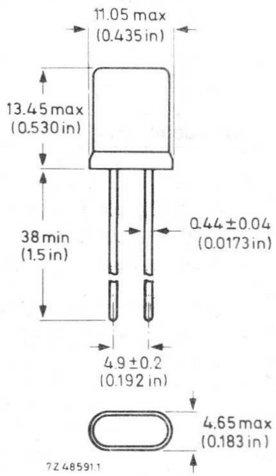


Fig. 1.

HC-26/U

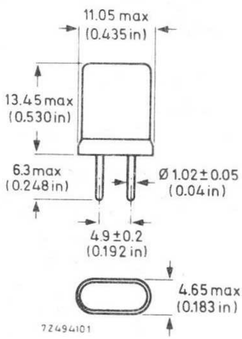


Fig. 2

HC-29/U

Weight

With both types of holder approximately 0.8 g

Mounting

Holder type HC-26/U fits a printed-wiring board.
Holder type HC-29/U fits a socket.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests: According to MIL-C-3098E

Climatic tests : According to MIL-C-3098E

ELECTRICAL DATA

Frequency tolerance

(Table 1)

frequency range	temperature range	frequency tolerance class 0	class I	class II
4.5 - 20 MHz	-5/+45 °C	± 15 x 10^{-6}	± 17.5 x 10^{-6}	± 20 x 10^{-6}
	-10/+50	± 17.5 x 10^{-6}	± 20 x 10^{-6}	± 25 x 10^{-6}
	-15/+70	± 20 x 10^{-6}	± 25 x 10^{-6}	± 30 x 10^{-6}
4.5 - 6 MHz	-55/+105 °C	± 40 x 10^{-6}	± 50 x 10^{-6}	± 60 x 10^{-6}
6 - 12 MHz	-55/+105	± 42.5 x 10^{-6}	± 45 x 10^{-6}	± 50 x 10^{-6}
12 - 20 MHz	-55/+105	± 35 x 10^{-6}	± 40 x 10^{-6}	± 50 x 10^{-6}

Frequency drift

(Table 2)

frequency range	temperature range	frequency drift class 0	class I	class II
4.5 - 20 MHz	-5/+45 °C	± 5 x 10^{-6}	± 7.5 x 10^{-6}	± 10 x 10^{-6}
	-10/+50	± 7.5 x 10^{-6}	± 10 x 10^{-6}	± 15 x 10^{-6}
	-15/+70	± 10 x 10^{-6}	± 15 x 10^{-6}	± 20 x 10^{-6}
4.5 - 6 MHz	-55/+105 °C	± 30 x 10^{-6}	± 40 x 10^{-6}	± 50 x 10^{-6}
6 - 12 MHz	-55/+105	± 32.5 x 10^{-6}	± 35 x 10^{-6}	± 40 x 10^{-6}
12 - 20 MHz	-55/+105	± 25 x 10^{-6}	± 30 x 10^{-6}	± 40 x 10^{-6}
4.5 - 20 MHz	Tnom. ± 5 °C		± 2.5 x 10^{-6}	± 5 x 10^{-6}

Accuracy of adjustment ± 10 x 10^{-6} (to be combined with any of the frequency drift figures quoted).

Parallel capacitance C_0 Inductance L_1 Dynamic capacitance C_1	typical values for 4.5 - 7 MHz: see Fig.6 7 - 20 MHz: see Fig.7
Change in frequency as a result of ageing	$-0.5/+1 \times 10^{-6}$, after 90 days at 85 ±2 °C, non-operative
Maximum permissible d.c. voltage between terminals	100 V

PARALLEL RESONANCE

Working frequency	measured with the British Military Test Set TS 193, the parallel capacitance being set at 30 pF and the grid current at 20 μA.
Minimum equivalent parallel resistance	
for 4.5 - 7 MHz	according to Fig.3, the parallel capacitance set at 30 pF and the grid current at 20 μA.
for 7 - 10 MHz	according to Fig.4, the parallel capacitance set at 20 pF and the grid current at 20 μA.
for 10 - 20 MHz	according to Fig.5, the parallel capacitance set at 20 pF and the grid current at 20 μA.

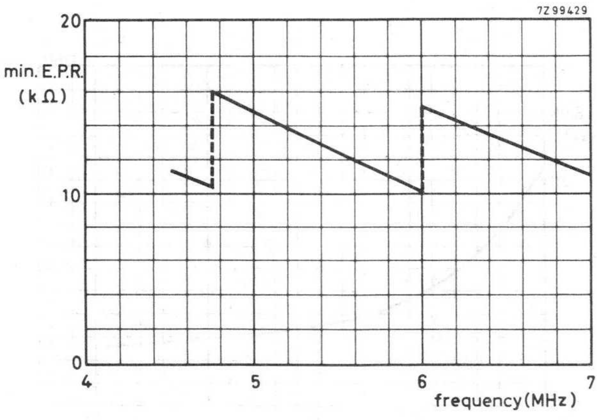


Fig. 3

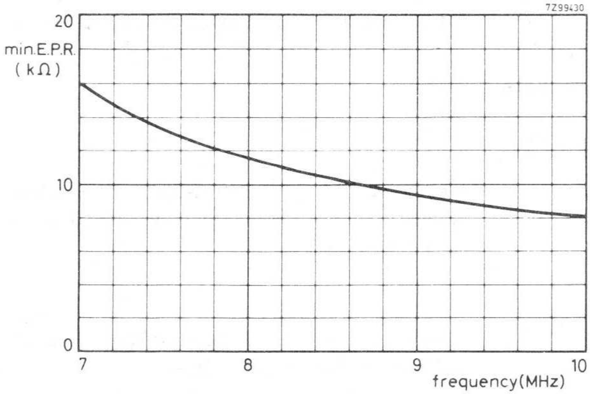

7Z99430
20
min.E.P.R.
(kΩ)
10
0
7
8
9
10
frequency(MHz)

Fig. 4

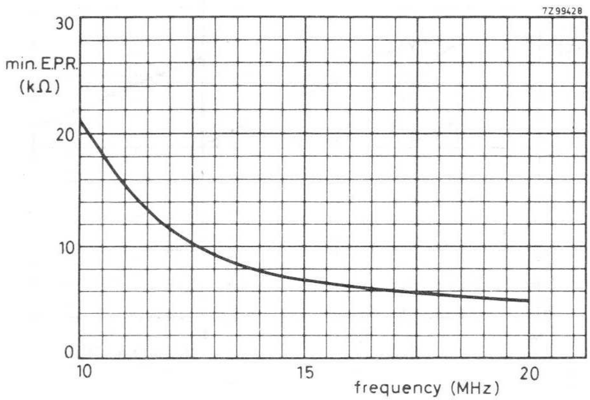

7Z99428
30
min. E.P.R.
(kΩ)
20
10
0
10
15
20
frequency (MHz)

Fig. 5

ANTIRESONANCE

Working frequency	to be measured with the American Military Test Sets TS 330/TSM for the frequency range 4.5 - 15 MHz, and TS 683/TSM for the frequency range 15 - 20 MHz, the series capacitance to be set at 30 pF and the set being tuned in accordance with table 3 or 4. (Table 4 applies to oven-controlled units).

Maximum equivalent series resistance

at a series capacitance of 30 pF, and at

4.500000 - 4.749999 MHz	120 Ω
4.750000 - 5.999999 MHz	75 Ω
6.000000 - 6.999999 MHz	50 Ω
7.000000 - 9.999999 MHz	30 Ω
10.000000 - 11.999999 MHz	30 Ω
12.000000 - 12.999999 MHz	30 Ω
13.000000 - 20.000000 MHz	25 Ω

Tuning conditions for the test sets:

Table 3

test set	nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	4.500000 - 5.099999	50	350	2.5 ± 0.5
	5.100000 - 6.999999	22	235	2.5 ± 0.5
	7.000000 - 7.499999	22	330	5 ± 1
	7.500000 - 15.000000	13	260	5 ± 1
TS 683	15.000001 - 20.000000	10	220	5 ± 1

Table 4 (oven-controlled units)

test set	nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	4.500000 - 5.099999	50	350	2.5 ± 0.5
	5.100000 - 6.999999	22	235	2.5 ± 0.5
	7.000000 - 7.499999	22	235	2.5 ± 0.5
	7.500000 - 15.000000	13	185	2.5 ± 0.5
TS 683	15.000001 - 20.000000	10	156	2.5 ± 0.5

SERIES RESONANCE

Working frequency: to be measured with the American Military Test Sets TS 330/TSM for the frequency range 4.5 - 15 MHz, and TS 683/TSM for the frequency range 15 - 20 MHz, without a series capacitance, the set to be tuned in accordance with Table 5 or 6. (Table 6 applies to oven-controlled units).

Maximum series resistance at

4.500000 - 4.749999 MHz	110 Ω
4.750000 - 5.999999 MHz	70 Ω
6.000000 - 6.999999 MHz	45 Ω
7.000000 - 9.999999 MHz	30 Ω
10.000000 - 14.999999 MHz	25 Ω
15.000000 - 20.000000 MHz	20 Ω

Tuning conditions for the test sets:

Table 5

test set	nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	4.500000 - 5.099999	50	350	2.5 ± 0.5
	5.100000 - 6.999999	22	235	2.5 ± 0.5
	7.000000 - 7.499999	25	350	5 ± 1
	7.500000 - 9.999999	16	288	5 ± 1
	10.000000 - 15.000000	13	260	5 ± 1
TS 683	15.000001 - 20.000000	12	240	5 ± 1

Table 6 (oven-controlled units)

test set	nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
TS 330	4.500000 - 5.099999	50	350	2.5 ± 0.5
	5.100000 - 6.999999	22	235	2.5 ± 0.5
	7.000000 - 7.499999	25	250	2.5 ± 0.5
	7.500000 - 9.999999	16	205	2.5 ± 0.5
	10.000000 - 15.000000	13	185	2.5 ± 0.5
TS 683	15.000001 - 20.000000	12	170	2.5 ± 0.5

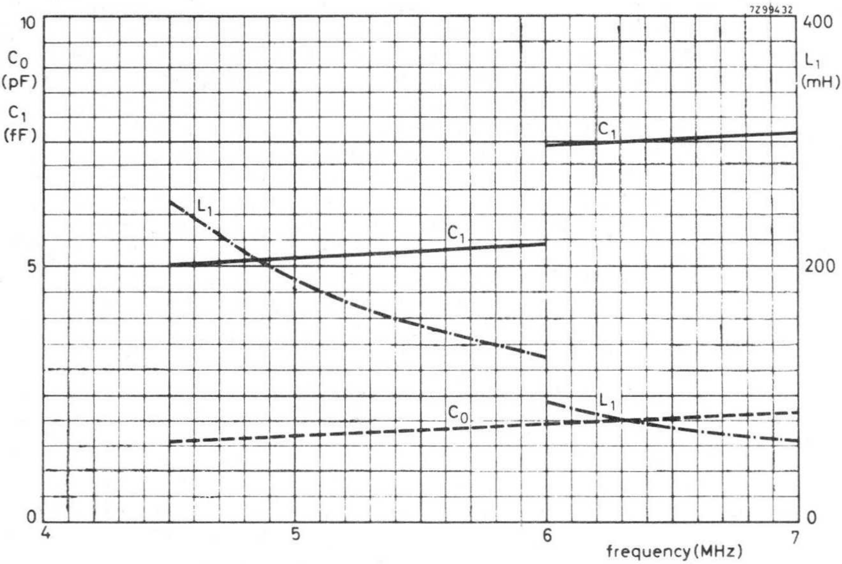


Fig. 6. Typical values of L_1, C_0 and C_1 for frequencies from 4.5 to 7 MHz.

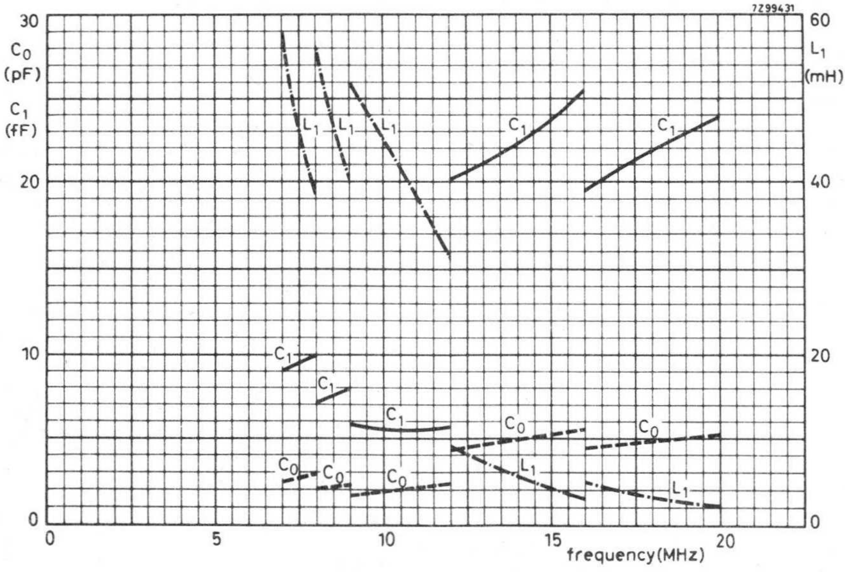


Fig. 7. Typical values of L_1, C_0 and C_1 for frequencies from 7 to 20 MHz.

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	10 - 61 MHz
Mode of vibration	third overtone
Type of holder	metal, HC-6/U (MIL) or HC-17/U (MIL) (non-preferred)

APPLICATION

These units are used for frequency stabilisation.
They are generally used at series resonance.

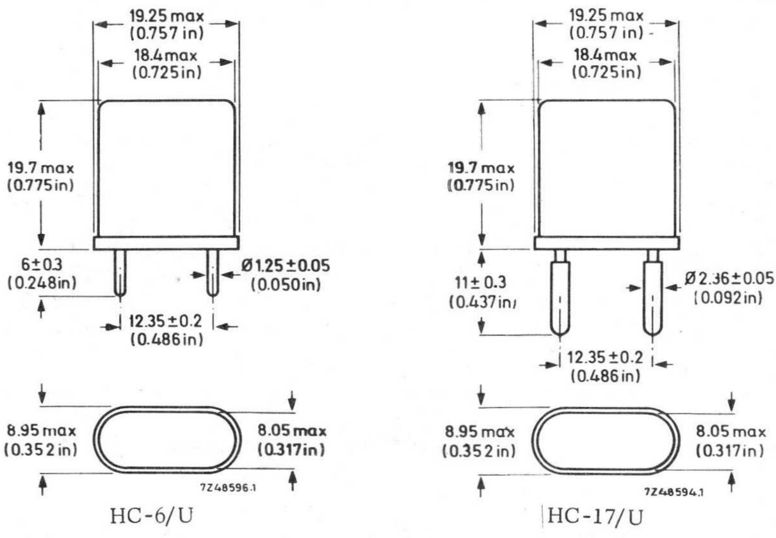
DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder, provided with two connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm

(in inches between brackets)



HC-6/U HC-17/U

Weight

Approximately 4 g

Mounting

Holder type HC-6/U fits a socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/+50 °C	$\pm 25 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-10/+60 °C	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
-20/+70 °C	$\pm 30 \times 10^{-6}$	$\pm 33 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
-55/+105 °C	$\pm 45 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/+50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/+60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/+70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
$T_{nom.} \pm 5\,^{o}C$	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment $\pm 20 \times 10^{-6}$ (to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance) — to be measured with the American Military Test Set TS-683/TSM without a series capacitance, the set being tuned in accordance with Table 3 or 4. (Table 4 applies to oven-controlled units).

Maximum series resistance

10-15 MHz	60 Ω
15-61 MHz	40 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
10.000000 - 14.999999	60	490	4 ± 0.8
15.000000 - 24.999999	40	400	4 ± 0.8
25.000000 - 61.000000	40	280	2 ± 0.4

Table 4 (oven-controlled units)

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
10.000000 - 14.999999	60	350	2 ± 0.4
15.000000 - 24.999999	40	280	2 ± 0.4
25.000000 - 61.000000	40	200	1 ± 0.2

Parallel capacitance — max. 7 pF

Maximum permissible d.c. voltage between the pins — 100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	17 - 61 MHz
Mode of vibration	third overtone
Type of holder	metal, HC-18/U (MIL)
	or HC-25/U (MIL)

APPLICATION

These units are used for frequency stabilisation.
They are generally used at series resonance.

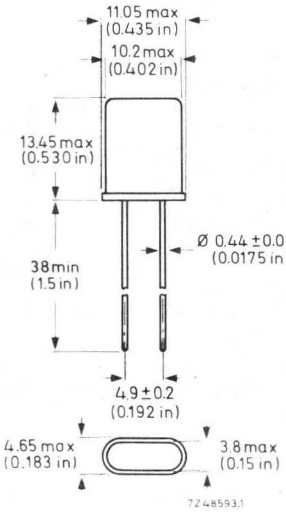
DESCRIPTION

The units consists of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder, provided with 2 connecting leads (HC-18/U) or pins (HC-25/U).

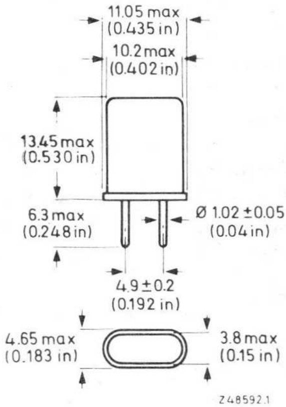
MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm

(in inches between brackets)



HC-18/U



HC-25/U

Weight

With both types of holder approximately 1 g.

Mounting

Holder type HC-18/U fits a printed wiring board.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm 25 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-10/ +60 °C	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
-20/ +70 °C	$\pm 30 \times 10^{-6}$	$\pm 33 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
-55/+105 °C	$\pm 45 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
$T_{nom} \pm 5$ °C	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment $\pm 20 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance) — to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3 or 4. (Table 4 applies to over-controlled units).

Maximum series resistance — 40 Ω

Tuning conditions of the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
17.000000 - 24.999999	40	400	4 ± 0.8
25.000000 - 61.000000	40	280	2 ± 0.4

Table 4 (oven-controlled units)

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
17.000000 - 24.999999	40	280	2 ± 0.4
25.000000 - 61.000000	40	200	1 ± 0.2

Parallel capacitance — max. 7 pF

Maximum permissible d.c. voltage between pins — 100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	10 - 61 MHz
Mode of vibration	third overtone
Type of holder	all glass, HC-27/U (MIL)

APPLICATION

These units are used for frequency stabilisation in circuits, in which a high stability and a low seires resistance are required.
They are generally used at series resonance.
Example: oscillator circuits in communication equipment with narrow channel spacing.

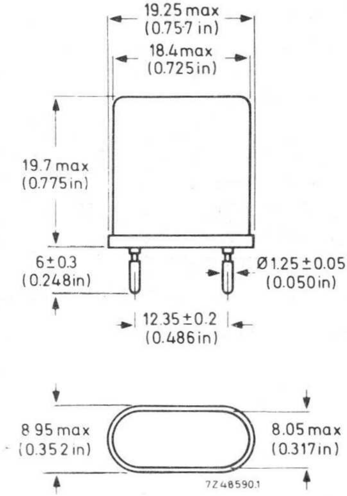
DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed, evacuated glass holder, provided with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm

(in inches between brackets)



Weight

Approximately 2.5 g.

Mounting

Holder type HC-27/U fits the socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098E.

Climatic tests

According to MIL-C-3098E.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm 15 \times 10^{-6}$	$\pm 17.5 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-10/ +60 °C	$\pm 17.5 \times 10^{-6}$	$\pm 20 \times 10^{-6}$	$\pm 25 \times 10^{-6}$
-20/ +70 °C	$\pm 20 \times 10^{-6}$	$\pm 23 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-55/+105 °C	$\pm 35 \times 10^{-6}$	$\pm 40 \times 10^{-6}$	$\pm 50 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
T_{nom} ± 5 °C		$\pm 2.5 \times 10^{-6}$	$\pm 5 \times 10^{-6}$

Accuracy of adjustment $\pm 10 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance) — to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3 or 4, (Table 4 applies to oven-controlled units).

Maximum series resistance

10 - 15 MHz	40 Ω
15 - 61 MHz	20 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
10.000000 - 14.999999	20	290	4 ± 0.8
15.000000 - 24.999999	10	200	4 ± 0.8
25.000000 - 61.000000	10	140	2 ± 0.4

Table 4 (oven-controlled units)

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
10.000000 - 14.999999	20	200	2 ± 0.4
15.000000 - 24.999999	10	140	2 ± 0.4
25.000000 - 61.000000	10	100	1 ± 0.2

Parallel capacitance — max. 7 pF

Change in frequency as a result of ageing — $-0.5/+1 \times 10^{-6}$, after 90 days at 85 ± 2 °C, non-operative

Maximum permissible d.c. voltage between the pins — 100 V

10 MHz, THIRD-OVERTONE QUARTZ CRYSTAL UNIT in all-glass holder HC-27/U

Application	in oscillators for SSB systems or secondary standards
Crystal cut	AT
Version	metal-plated

The crystal unit fulfils the following specification:

1) Nominal frequency — 10 MHz, third overtone.

2) Accuracy of adjustment — At a temperature of 70 °C ± 1 °C the accuracy of adjustment is better than $\pm 5.10^{-6}$ at a current of 1 mA and a series load capacitance (C_L) of 75 pF. The influence of the drive level on the frequency is $\leq 2.10^{-8}$ per dB. The working frequency can be adjusted to the nominal value by a variation of C_L by + 75 to − 25 pF.

3) Frequency drift — In the temperature range of +69 to +71 °C the frequency drift is $\leq \pm 0.3 \cdot 10^{-6}$ measured at series resonance.

4) Ageing — Frequency change due to ageing $< \pm 5.10^{-8}$/month.

5) Series resonance — < 40 Ω in the temperature range −40 to +75 °C, measured in test set TS-683/TSM according to MIL-C-3098B, CR-23/U.

6) Unwanted modes — In the temperature range −40 to 75 °C both the frequency and the series resistance as a function of the temperature do not show any discontinuities.

7) Holder — HC-27/U.

8) Mechanical tests — Shock and vibration according to MIL-C-3098C. The frequency change due to these tests is $< 3.10^{-6}$ and the change of the series resistance is < 15 %.

9) Oscillator circuit — The crystal unit can only prove its properties in a well designed circuit, such as that of Fig.1. Fig.2 gives a lay-out of this circuit on a p.w.-board.

Stability of oscillator

The stability of the oscillator frequency depends on the crystal oven used. A stability figure of 1.10^{-6} or even 1.10^{-7} can be achieved.

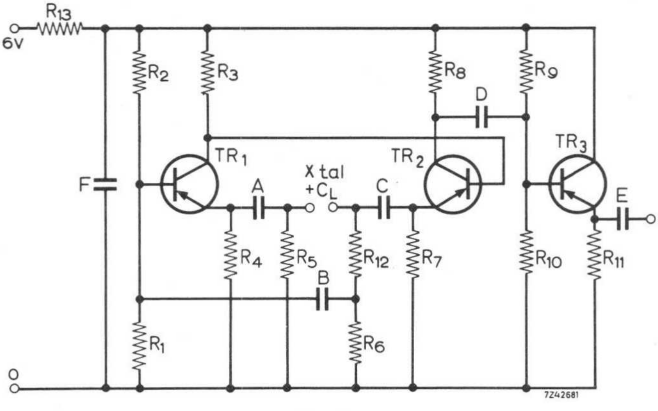


Fig.1

All resistors ±5 %

R_1 = 2000 Ω	R_8 = 180 Ω	C_A = 47 nF (n = 10^{-9})
R_2 = 3900 Ω	R_9 = 3900 Ω	C_B = 47 nF
R_3 = 820 Ω	R_{10} = 2000 Ω	C_C = 47 nF
R_4 = 820 Ω	R_{11} = 1800 Ω	C_D = 10 nF
R_5 = 68 Ω	R_{12} = 33 Ω	C_E = 47 nF
R_6 = 33 Ω	R_{13} = 22 Ω	C_F = 47 nF
R_7 = 1800 Ω	TR1, 2, 3 = AFZ12	

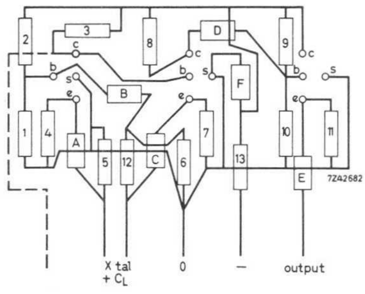
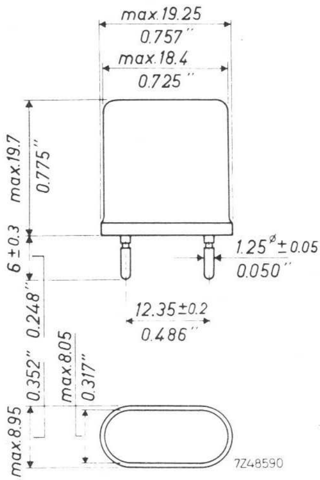


Fig.2


max.19.25
0.757"
max.18.4
0.725"
max.19.7
0.775"
6 ±0.3
0.248"
1.25 ø ±0.05
0.050"
12.35±0.2
0.486"
max.8.95
0.352"
max.8.05
0.317"
7Z48590

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	20 - 61 MHz
Mode of vibration	third overtone
Type of holder	all glass, HC-26/U (MIL)
	or HC-29/U (MIL)

APPLICATION

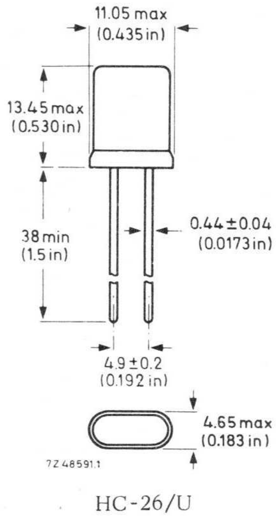
These units are used for frequency stabilisation in circuits, in which a high stability and a low series resistance are required.
They are generally used at series resonance.
Example: oscillator circuits in communication equipment with narrow channel spacing.

DESCRIPTION

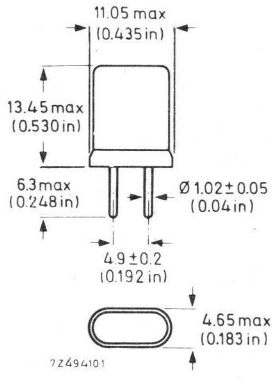
The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed, evacuated glass holder.
Holder type HC-26/U is provided with 2 connecting leads, type HC-29/U with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)



HC-26/U



HC-29/U

Weight

With both types of holder approximately 0.8 g

Mounting

Holder type HC-26/U fits a printed-wiring board, type HC-29/U fits a socket

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098C.

Climatic tests

According to MIL-C-3098C.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm$ 15 $\times 10^{-6}$	$\pm$ 17.5 $\times 10^{-6}$	$\pm$ 20 $\times 10^{-6}$
-10/ +60 °C	$\pm$ 17.5 $\times 10^{-6}$	$\pm$ 20 $\times 10^{-6}$	$\pm$ 25 $\times 10^{-6}$
-20/ +70 °C	$\pm$ 20 $\times 10^{-6}$	$\pm$ 23 $\times 10^{-6}$	$\pm$ 30 $\times 10^{-6}$
-55/+105 °C	$\pm$ 35 $\times 10^{-6}$	$\pm$ 40 $\times 10^{-6}$	$\pm$ 50 $\times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm$ 5 $\times 10^{-6}$	$\pm$ 7.5 $\times 10^{-6}$	$\pm$ 10 $\times 10^{-6}$
-10/ +60 °C	$\pm$ 7.5 $\times 10^{-6}$	$\pm$ 10 $\times 10^{-6}$	$\pm$ 15 $\times 10^{-6}$
-20/ +70 °C	$\pm$ 10 $\times 10^{-6}$	$\pm$ 13 $\times 10^{-6}$	$\pm$ 20 $\times 10^{-6}$
-55/+105 °C	$\pm$ 25 $\times 10^{-6}$	$\pm$ 30 $\times 10^{-6}$	$\pm$ 40 $\times 10^{-6}$
$T_{nom} \pm 5$ °C		$\pm$ 2.5 $\times 10^{-6}$	$\pm$ 5 $\times 10^{-6}$

Accuracy of adjustment $\pm 10 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance) — to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3.

Maximum series resistance — 30 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance Ω	voltage drop (mV)	level of drive (mW)
20.000000 - 61.000000	20	200	2 ± 0.4
oven-controlled units 20.000000 - 61.000000	20	140	1 ± 0.2

Parallel capacitance — max. 7 pF

Change in frequency as a result of ageing — $-0.5/+1 \times 10^{-6}$, after 90 days at 85 ± 2 °C, non-operative

Maximum permissible d.c.voltage between the pins — 100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	50 - 87 MHz
Mode of vibration	fifth overtone
Type of holder	metal, HC-6/U (MIL)
	or HC-17/U (MIL) (non-preferred)

APPLICATION

These units are used for frequency stabilisation.
They are generally used at series resonance.

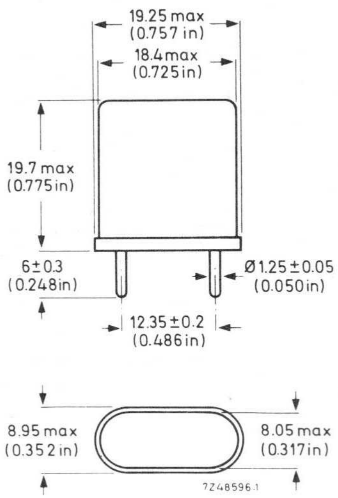
DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder, provided with 2 connecting pins.

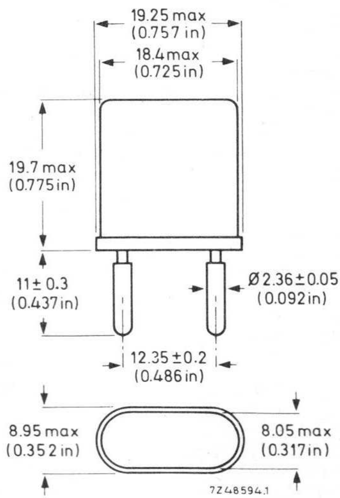
MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm

(in inches between brackets)



HC-6/U



HC-17/U

Weight

With both types of holder approximately 4 g.

Mounting

Holder type HC-6/U fits the socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm 25 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-10/ +60 °C	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
-20/ +70 °C	$\pm 30 \times 10^{-6}$	$\pm 33 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
-55/+105 °C	$\pm 45 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
T_{nom} ± 5 °C	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment $\pm 20 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance)	to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3.
Maximum series resistance	60 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
50.000000-87.000000	60	350	2 ± 0.4
oven-controlled units 50.000000-87.000000	60	240	1 ± 0.2

Parallel capacitance	max. 7 pF
Maximum permissible d.c. voltage between the pins	100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	50 - 87 MHz
Mode of vibration	fifth overtone
Type of holder	metal, HC-18/U (MIL) or HC-25/U (MIL)

APPLICATION

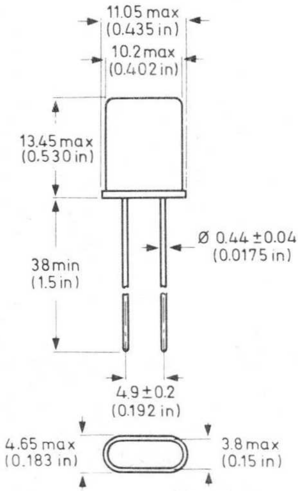
These units are used for frequency stabilisation.
They are generally used at series resonance.

DESCRIPTION

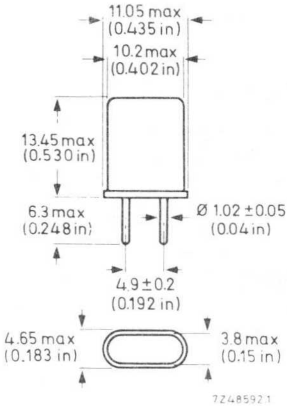
The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed metal holder.
Holder type HC-18/U is provided with 2 connecting leads, type HC-25/U with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)



HC-18/U



HC-25/U

Weight

With both types of holder approximately 1 g

Mounting

Holder type HC-18/U fits a printed-wiring board.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098B.

Climatic tests

According to MIL-C-3098B.

ELECTRICAL DATA

Frequency tolerance. Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm 25 \times 10^{-6}$	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-10/ +60 °C	$\pm 27.5 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
-20/ +70 °C	$\pm 30 \times 10^{-6}$	$\pm 33 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
-55/+105 °C	$\pm 45 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 60 \times 10^{-6}$

Frequency drift. Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
$T_{nom} \pm 5$ °C	$\pm 5 \times 10^{-6}$		

Accuracy of adjustment $\pm 20 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted).

Working frequency (series resonance)	to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3.
Maximum series resistance	60 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
50.000000 - 87.000000	60	350	2 ± 0.4
oven-controlled units 50.000000 - 87.000000	60	240	1 ± 0.2

Parallel capacitance	max. 7 pF
Maximum permissible d.c. voltage between the pins	100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	50 - 87 MHz
Mode of vibration	fifth overtone
Type of holder	all glass, HC-27/U

APPLICATION

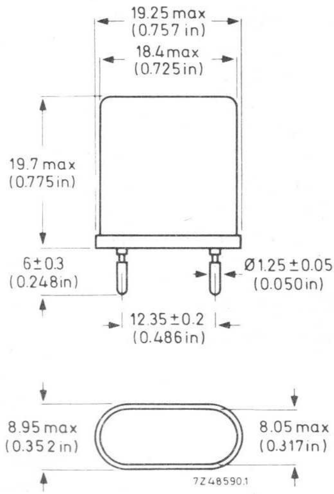
These units are used for frequency stabilisation in circuits, in which a high stability and a low series resistance are required.
They are generally used at series resonance.
Example: oscillator circuits in communication equipment with narrow channel spacing.

DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed, evacuated glass holder, provided with 2 connecting pins.

MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm
(in inches between brackets)



Weight

Approximately 2.5 g

Mounting

Holder type HC-27/U fits the socket catalogue number 2422 518 00001.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098C.

Climatic tests

According to MIL-C-3098C.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm$ 15 x 10^{-6}	$\pm$ 17.5 x 10^{-6}	$\pm$ 20 x 10^{-6}
-10/ +60 °C	$\pm$ 17.5 x 10^{-6}	$\pm$ 20 x 10^{-6}	$\pm$ 25 x 10^{-6}
-20/ +70 °C	$\pm$ 20 x 10^{-6}	$\pm$ 23 x 10^{-6}	$\pm$ 30 x 10^{-6}
-55/+105 °C	$\pm$ 35 x 10^{-6}	$\pm$ 40 x 10^{-6}	$\pm$ 50 x 10^{-6}

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm$ 5 x 10^{-6}	$\pm$ 7.5 x 10^{-6}	$\pm$ 10 x 10^{-6}
-10/ +60 °C	$\pm$ 7.5 x 10^{-6}	$\pm$ 10 x 10^{-6}	$\pm$ 15 x 10^{-6}
-20/ +70 °C	$\pm$ 10 x 10^{-6}	$\pm$ 13 x 10^{-6}	$\pm$ 20 x 10^{-6}
-55/+105 °C	$\pm$ 25 x 10^{-6}	$\pm$ 30 x 10^{-6}	$\pm$ 40 x 10^{-6}
$T_{nom} \pm 5$ °C		$\pm$ 2.5 x 10^{-6}	$\pm$ 5 x 10^{-6}

Accuracy of adjustment $\pm$ 10 x 10^{-6}

(to be combined with any of the frequency drift figures quoted).

Working frequency (series resonance)	to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3.
Maximum series resistance	50 Ω
Tuning conditions for the test set:	

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
50.000000 - 87.000000	60	350	2 ± 0.4
oven-controlled units 50.000000 - 87.000000	60	240	1 ± 0.2

Parallel capacitance	max. 7 pF
Change in frequency as a result of ageing	$-0.5/+1 \times 10^{-6}$, after 90 days at 85 ± 2 °C, non-operative
Maximum permissible d.c.voltage between the pins	100 V

QUARTZ CRYSTAL UNITS

QUICK REFERENCE DATA	
Frequency range	50 - 87 MHz
Mode of vibration	fifth overtone
Type of holder	all glass, HC-26/U (MIL) or HC-29/U (MIL)

APPLICATION

These units are used for frequency stabilisation in circuits, in which a high stability and a low series resistance are required.
They are generally used at series resonance.
Example: oscillator circuits in communication equipment with narrow channel spacing.

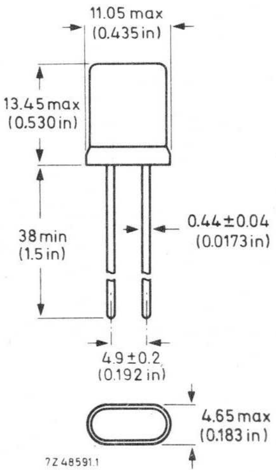
DESCRIPTION

The units consist of a metal plated AT-cut quartz plate, mounted in a hermetically sealed evacuated glass holder.
Holder type HC-26/U is provided with 2 connecting leads, type HC-29/U with 2 connecting pins.

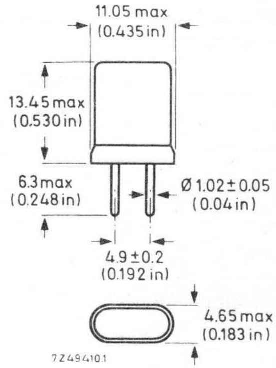
MECHANICAL AND ENVIRONMENTAL DATA

Dimensions in mm

(in inches between brackets)



HC-26/U



HC-29/U

Weight

With both types of holder approximately 0.8 g.

Mounting

Holder type HC-26/U fits a printed-wiring board, type HC-29/U fits a socket.

Marking

If a special marking is not requested, marking will be done as stated under "Holders" in the general section.

Shock and vibration tests

According to MIL-C-3098C.

Climatic tests

According to MIL-C-3098C.

ELECTRICAL DATA

Frequency tolerance, Table 1

temperature range	frequency tolerance		
	class 0	class I	class II
-5/ +50 °C	$\pm 15 \times 10^{-6}$	$\pm 17.5 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-10/ +60 °C	$\pm 17.5 \times 10^{-6}$	$\pm 20 \times 10^{-6}$	$\pm 25 \times 10^{-6}$
-20/ +70 °C	$\pm 20 \times 10^{-6}$	$\pm 23 \times 10^{-6}$	$\pm 30 \times 10^{-6}$
-55/+105 °C	$\pm 35 \times 10^{-6}$	$\pm 40 \times 10^{-6}$	$\pm 50 \times 10^{-6}$

Frequency drift, Table 2

temperature range	frequency drift		
	class 0	class I	class II
-5/ +50 °C	$\pm 5 \times 10^{-6}$	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$
-10/ +60 °C	$\pm 7.5 \times 10^{-6}$	$\pm 10 \times 10^{-6}$	$\pm 15 \times 10^{-6}$
-20/ +70 °C	$\pm 10 \times 10^{-6}$	$\pm 13 \times 10^{-6}$	$\pm 20 \times 10^{-6}$
-55/+105 °C	$\pm 25 \times 10^{-6}$	$\pm 30 \times 10^{-6}$	$\pm 40 \times 10^{-6}$
T_{nom} ±5 °C		$\pm 2.5 \times 10^{-6}$	$\pm 5 \times 10^{-6}$

Accuracy of adjustment $\pm 10 \times 10^{-6}$
(to be combined with any of the frequency drift figures quoted)

Working frequency (series resonance)	to be measured with the American Military Test Set TS-683/TSM, without a series capacitance, the set being tuned in accordance with Table 3.
Maximum series resistance	50 Ω

Tuning conditions for the test set:

Table 3

nominal frequency (MHz)	tuning resistance (Ω)	voltage drop (mV)	level of drive (mW)
50.000000-87.000000	60	350	2 ± 0.4
oven-controlled units 50.000000-87.000000	60	240	1 ± 0.2

Parallel capacitance	max. 7 pF
Change in frequency as a result of ageing	$-0.5/+1 \times 10^{-6}$, after 90 days at 85 ± 2 °C, non-operative.
Maximum permissible d.c. voltage between the pins	100 V

SURVEY

SELECTION GUIDE

10.7 MHz - 90 dB types

channel spacing (kHz)	pass-band width (kHz)	terminating impedances (Ω // pF)	dimensions 1) (mm)	catalog number	page
±50	±15 at 3 dB	2000//25	36x27x19	9573 136 20000	C95
		2000//25	40x18x19	9573 136 70000	C96
		910//25	36x27x19	9573 136 80000	C97
		910//25	40x18x19	9573 136 90000	C98
±25	±7.5 at 3 dB	910//25	36x27x19	9573 136 22000	C99
			40x18x19	9573 136 72000	C100
±20	±6 at 3 dB	825//25	36x27x19	9573 136 78000	C101
	±6 at 6 dB	825//25	40x18x19	9573 136 87000	C102
±12.5	±3.75 at 3 dB	560//25	36x27x19	9573 136 82000	C103
			40x18x19	9573 142 00000	C104

11.5 MHz - 80/90 dB types

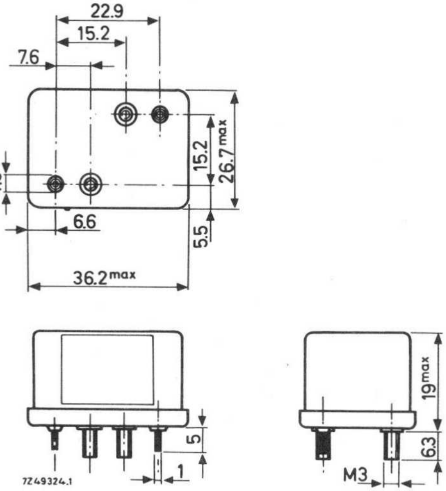
±50	±17.5 at 3 dB	2200//20	40x18x19	9573 136 19000	C105
		2700//41	36x27x19	9573 136 21000	C106

1) Size of can without stud and pins

TYPES (in order of catalogue number)

	page		page
9573 136 19000 (YL3619)	C105	9573 136 78000 (YL3678)	C101
20000 (YL3620)	C95	80000 (YL3680)	C97
21000 (YL3621)	C106	82000 (YL3682)	C103
22000 (YL3622)	C99	87000 (YL3687)	C102
70000 (YL3670)	C96	90000 (YL3690)	C98
72000 (YL3672)	C100	9573 142 00000 (YL4200)	C104

10.7 MHz CRYSTAL FILTER
for 50 kHz channel spacing

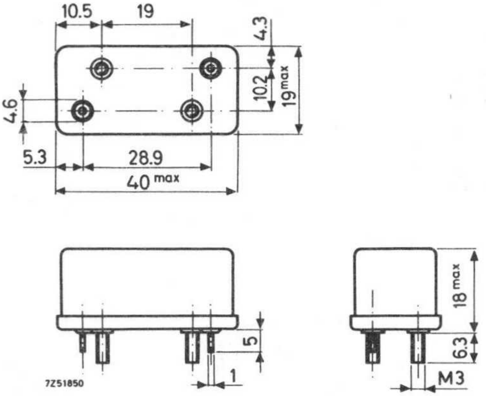


mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 4.5 dB
Min. pass-band width (3 dB)	± 15 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 35 kHz, > 90 dB at ± 50 kHz maintained over at least ± 300 kHz
Terminating impedances	2 kΩ ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF.5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 50 kHz channel spacing

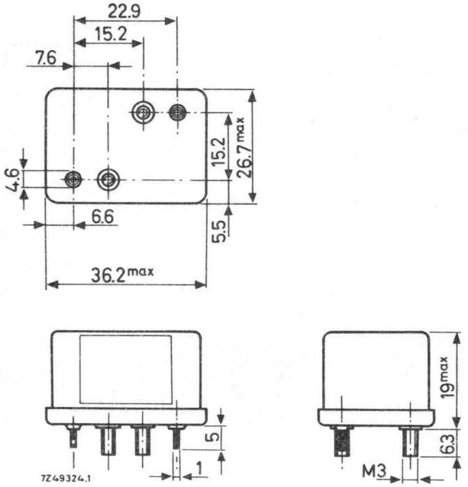


mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 4.5 dB
Min. pass-band width (3 dB)	± 15 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 35 kHz
	> 90 dB at and beyond ± 50 kHz
Terminating impedances	2 kΩ ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER for 50 kHz channel spacing

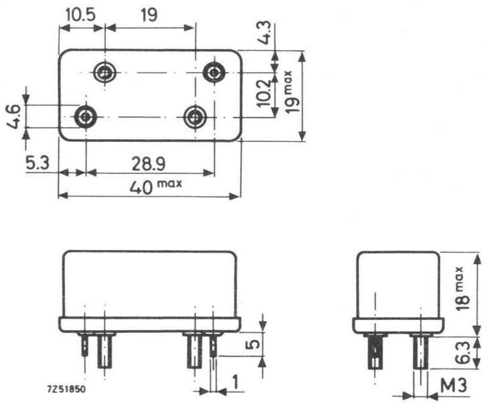


mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 4.5 dB
Min. pass-band width (3 dB)	± 15 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 35 kHz, > 90 dB at and beyond ± 50 kHz
Terminating impedances	910 Ω ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF.5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 50 kHz channel spacing

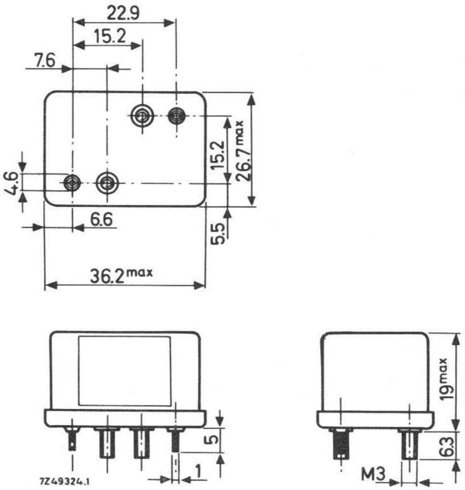


mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 4.5 dB
Min. pass-band width (3 dB)	± 15 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 35 kHz
	> 90 dB at and beyond ± 50 kHz
Terminating impedances	910 Ω ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	−40 to + 80 °C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 25 kHz channel spacing

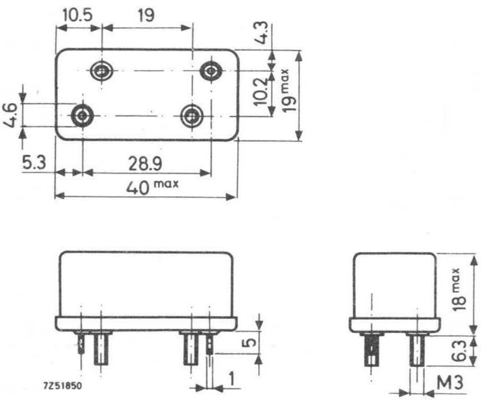


mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 3.5 dB
Min. pass-band width (3 dB)	± 7.5 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 17.5 kHz
	> 90 dB at ± 25 kHz
	maintained over at least ± 300 kHz
Terminating impedances	910 Ω ± 15% in parallel with 25 pF ±1.5 pF
Maximum input level	10 mW
Operating temperature range	−40 to +80 °C
Environment specification	DEF.5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 25 kHz channel spacing

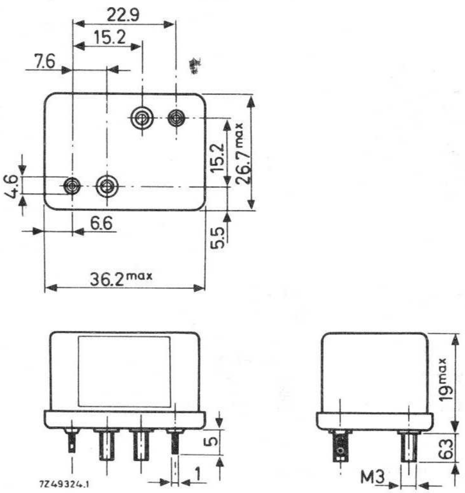


Dimensions in mm

mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Mid-band frequency	10.7 MHz
Insertion loss	< 3.5 dB
Min. pass-band width (3 dB)	± 7.5 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ±17.5 kHz,
	> 90 dB at and beyond ±25 kHz
Terminating impedances	910 Ω ±15% in parallel with 25 ±1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER for 20 kHz channel spacing

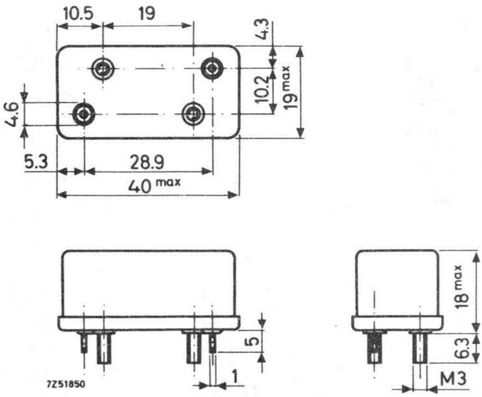


mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 2.5 dB
Min. pass-band width (6 dB)	± 6 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 15 kHz, > 90 dB at and beyond ± 18 kHz
Terminating impedances	825 Ω ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF.5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 20 kHz channel spacing

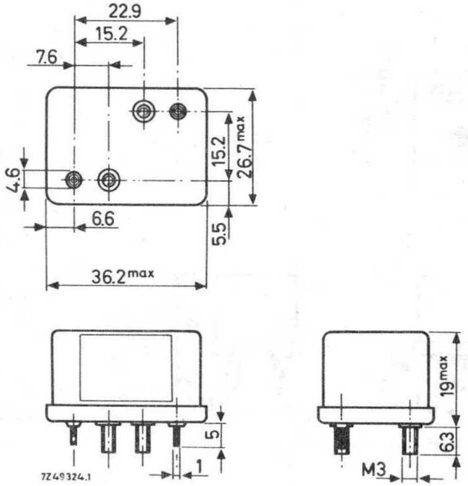


mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 2.5 dB
Min. pass-band width (3 dB)	$\pm$ 6 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at $\pm$ 15 kHz
	> 90 dB at and beyond 18 kHz
Terminating impedances	825 $\Omega \pm$ 15% in parallel with 25$\pm$1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to + 80 ^{o}C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER for 12.5 kHz channel spacing

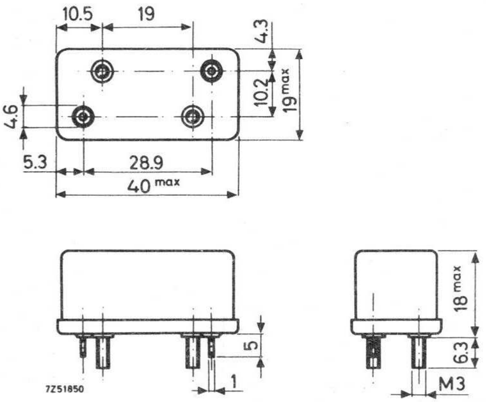


mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 2.5 dB
Min. pass-band width (3 dB)	± 3.75 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ± 8.75 kHz,
	> 90 dB at and beyond ± 12.5 kHz
Terminating impedances	560 Ω ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 ^{0}C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tinned dipped
Earth connection	through the studs

10.7 MHz CRYSTAL FILTER
for 12.5 kHz channel spacing

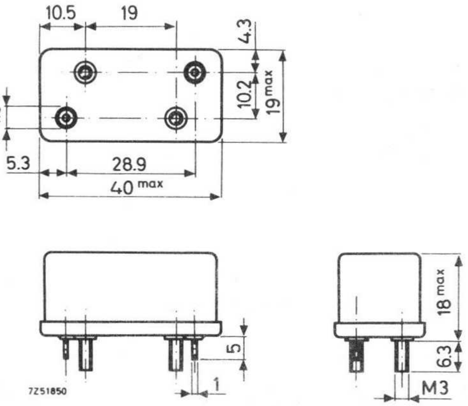


mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Dimensions in mm

Mid-band frequency	10.7 MHz
Insertion loss	< 2.5 dB
Min. pass-band width (3 dB)	± 3.75 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 70 dB at ±8.75 kHz, > 90 dB at and beyond ± 12.5 kHz
Terminating impedances	560 Ω ± 15% in parallel with 25 ± 1.5 pF
Maximum input level	10 mW
Operating temperature range	-40 to +80 °C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tinned dipped
Earth connection	through the studs

11.5 MHz CRYSTAL FILTER for 50 kHz channel spacing

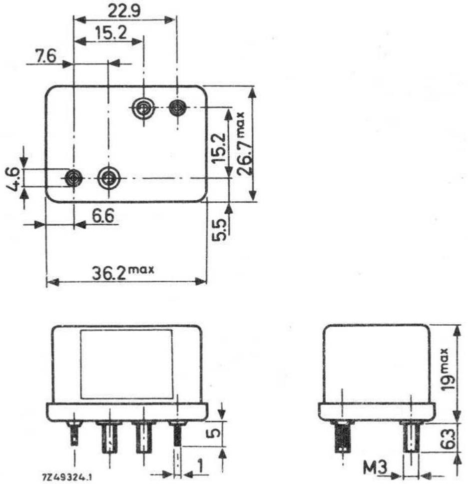


mm	inches
1	0.04
4.3	0.17
4.6	0.18
5	0.2
5.3	0.21
6.3	0.25
10.2	0.400
10.5	0.41
18	0.71
19	0.75
28.9	1.140
40	1.57

Dimensions in mm

Mid-band frequency	11.5 MHz
Insertion loss	< 3 dB
Min. pass-band width (3 dB)	± 17.5 kHz
Pass-band ripple	< 2 dB
Stop-band discrimination	> 50 dB at ± 30 kHz
	> 90 dB at ± 50 kHz maintained over at least ± 300 kHz
Terminating impedances	2.2 kΩ ± 10% in parallel with 20 ± 1 pF
Maximum input level	10 mW
Operating temperature range	-40 to + 80 °C
Environment specification	DEF. 5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

11.5 MHz CRYSTAL FILTER
for 50 kHz channel spacing



mm	inches
1	0.04
4.6	0.18
5	0.2
5.5	0.22
6.3	0.25
6.6	0.26
7.6	0.300
15.2	0.600
19	0.75
22.9	0.900
26.7	1.05
36.2	1.42

Dimensions in mm

Mid-band frequency	11.5 MHz
Insertion loss	< 3 dB
Min. pass-band width (3 dB)	± 17.5 kHz
Pass-band ripple	< 2.5 dB; < 2 dB at room temperature
Stop-band discrimination	> 60 dB at ± 30 kHz
	> 85 dB at ± 50 kHz
	> 80 dB over + 50 to + 300 kHz and over − 50 to − 300 kHz
Terminating impedances	2.7 kΩ in parallel with 41 pF
Maximum input level	10 mW
Operating temperature range	−45 to + 80 °C
Environment specification	DEF.5011/H6 and G.P.3
Finish	hot-tin dipped
Earth connection	through the studs

Microwave devices

SURVEY

WAVEGUIDE ISOLATORS

frequency	catalogue number
3.65 - 3.95 GHz	2722 161 01011
3.8 - 4.2 GHz	01081
3.8 - 4.2 GHz	01071
3.9 - 4.2 GHz	01021
4.2 - 4.6 GHz	01091
4.6 - 5.0 GHz	01101
5.925- 6.425 GHz	01191
6.425- 7.150 GHz	01251
6.825- 7.425 GHz	01231
7.125- 7.750 GHz	01291
7.125- 7.750 GHz	01281
7.25 - 7.75 GHz	01241
7.400- 8.025 GHz	01151
7.7 - 8.5 GHz	01161
7.7 - 8.5 GHz	01051
8.5 - 9.6 GHz	01211
8.5 - 9.6 GHz	01221
8.5 - 9.6 GHz	01261
8.5 - 9.6 GHz	01271
10.7 -11.7 GHz	01171
12.5 -13.5 GHz	01181

COAXIAL ISOLATORS

frequency	catalogue number
0.740- 0.810 GHz	2722 162 02001
0.890- 0.970 GHz	02011
1.48 - 1.95 GHz	02041
2.96 - 3.22 GHz	02021
3.56 - 3.90 GHz	02031

WAVEGUIDE 3 PORT CIRCULATORS

frequency	catalogue number
3.4 - 3.7 GHz	2722 161 02031
3.6 - 3.9 GHz	02041
3.6 - 4.2 GHz	02001
3.6 - 4.2 GHz	02011
5.925- 6.425 GHz	02051
5.925- 6.425 GHz	02101
6.425- 7.125 GHz	02081
7.125- 7.750 GHz	02091
7.7 - 8.5 GHz	02021

WAVEGUIDE 4 PORT CIRCULATORS

frequency	catalogue number
5.925- 6.175 GHz	2722 161 03081
6.125- 6.425 GHz	03091
6.575- 6.875 GHz	03031
6.825- 7.125 GHz	03011
7.125- 7.425 GHz	03001
7.425- 7.725 GHz	03041
10.700-11.700 GHz	03061
12.500-13.500 GHz	03051

COAXIAL 3 PORT CIRCULATORS

frequency	catalogue number
170- 200 MHz	2722 162 01191
200- 230 MHz	01201
370- 402 MHz	01221
406- 470 MHz	01051
406- 470 MHz	01151
445- 485 MHz	01231
450- 550 MHz	01091
470- 600 MHz	01061
470- 600 MHz	01121
590- 720 MHz	01131
590- 720 MHz	01071
590- 720 MHz	01171
608- 783 MHz	01101
710- 860 MHz	01081
710- 860 MHz	01141
710- 860 MHz	01181
710- 860 MHz	01241
1900-2300 MHz	01001
2500-4000 MHz	01211
3600-4300 MHz	01111

On the following pages the various components are arranged according to catalogue numbers.

INTRODUCTION

An isolator is a passive non-reciprocal device which permits microwave energy to pass through it in one direction whilst absorbing energy in the reverse direction.

In the forward direction, that is the direction in which the energy is passed, the insertion loss is usually 0.3 to 0.5 dB in the frequency range for which the isolator has been designed. In the opposite direction the isolation is normally 30 dB but for certain applications isolation can be made as high as 55 to 60 dB.

In the field displacement type of isolator, which is described underneath, a ferrite bar is mounted in a waveguide and biassed by a magnetic field. The non-reciprocal behaviour of this type of isolator is produced by gyromagnetic effects which occur between the high frequency magnetic field and the electrons in the ferrite.

For the coaxial isolators in this section, which are coaxial 3-port circulators with a matched load on one port, we refer to section "Circulators, general".

APPLICATION

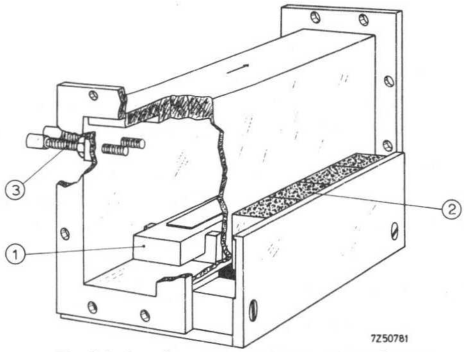
The main application of an isolator is to improve the behaviour of klystrons, magnetrons or travelling wave tubes by isolating the source from the load. The main factor is that an antenna or amplifier can not be ideally matched to the preceding function over the required frequency range so that energy would be reflected back into the tube and upset the frequency stability. The isolator will absorb this reflected energy so that the tube is effectively protected from these disturbing influences.

The isolators, provided with matching screws, offer the possibility to match the isolator so that over a certain frequency range the VSWR is minimum. It is therefore possible to optimise the efficiency of waveguide runs by matching the isolator to minimum reflection. This means that long line effects can be drastically reduced.

CONSTRUCTION

Waveguide isolator

In the fig. below a field displacement isolator is shown. In the waveguide the ferrite bar (1) can be seen, flanked by two sets of magnets (2) outside the waveguide. These magnets bias the ferrite bar.



Field displacement type of isolator

The screws (3) protruding into the waveguide are used to match the isolator for minimum voltage standing wave ratio.

Coaxial isolator

For construction and mounting see section "Circulators, general" at Fig.8.

TERMS AND DEFINITIONS

Frequency range is the range within which the isolator meets the guaranteed specification.
Outside this range the electrical properties deteriorate rapidly.

Isolation is the ratio, expressed in dB, of the input power to the output power in the reverse direction, measured with matched source and matched load.

Insertion loss is the attenuation resulting from the insertion of an isolator into a transmission system, expressed in dB, of the power delivered to a matched load before insertion of the isolator, to the power delivered to that load after insertion of the isolator.

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along the line.

Typical data. These data are derived by taking the mean measured values of several production runs of the component.

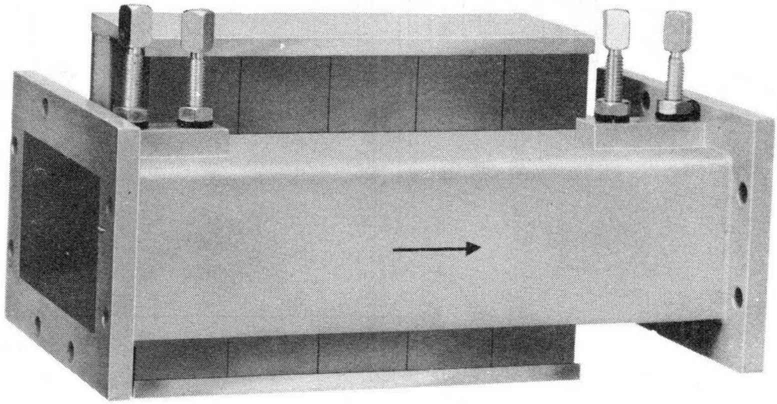
Maximum power is the largest power that may be passed through the isolator in forward direction into a load with a VSWR of 2. **This power value should under no circumstances be exceeded.**

Temperature range is the ambient temperature range within which the isolators function to specification.
The isolator will continue to function outside the given temperature range, but some of its characteristics may change.
The storage temperature of the isolators may be from $-40\ ^{o}C$ to $+125\ ^{o}C$.

CAUTION

The isolators have rather strong internal magnetic fields which are carefully adjusted for optimal operation. They are not to be subjected to strong external magnetic fields.

ISOLATOR



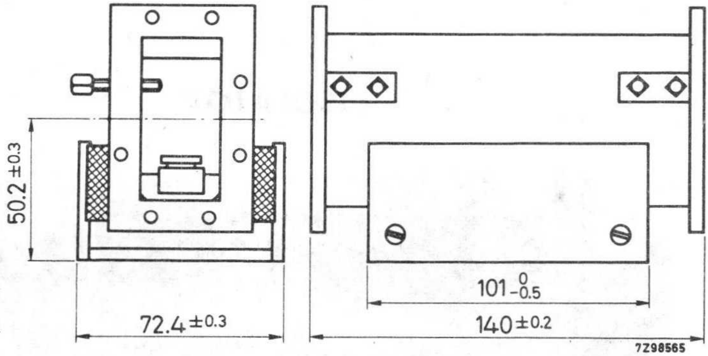
RZ 21478-5

ELECTRICAL DATA

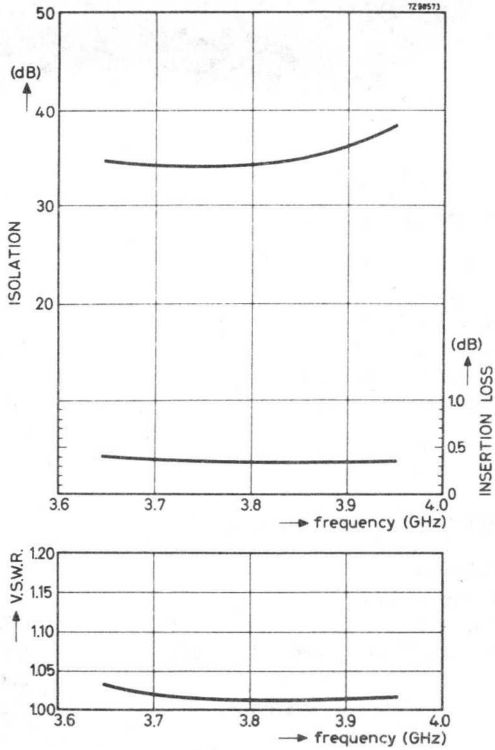
Frequency range	3.65-3.95 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	15 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R40 (I.E.C.)
Flange type	UER40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat

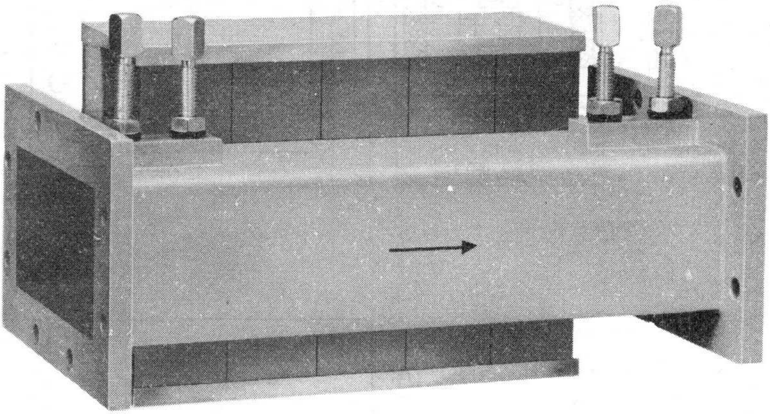


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



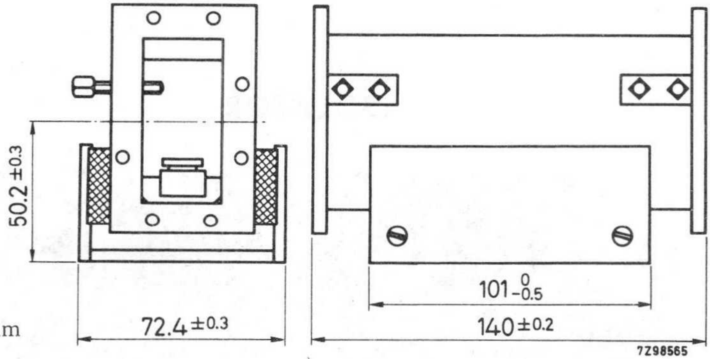
RZ 21478-5

ELECTRICAL DATA

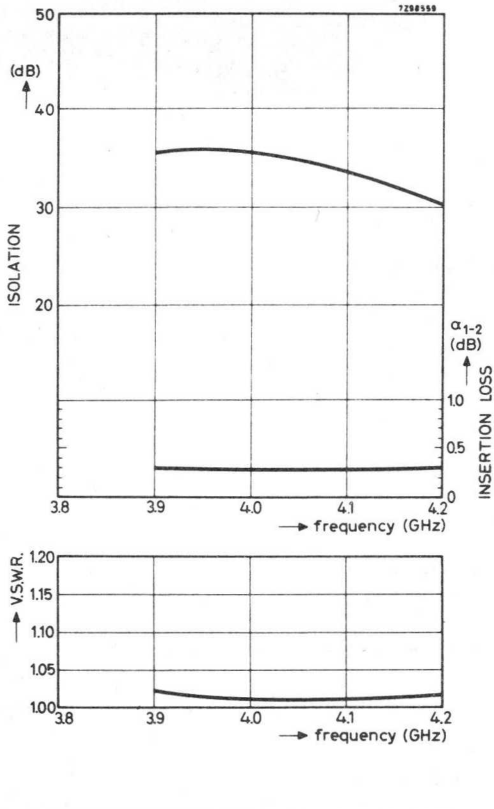
Frequency range	3.9-4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	15 W
Temperature range	+10 to +80 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R40 (I.E.C.)
Flange type	UER40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

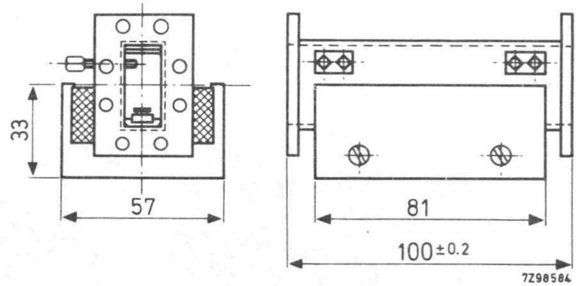
RZ 25233-3

ELECTRICAL DATA

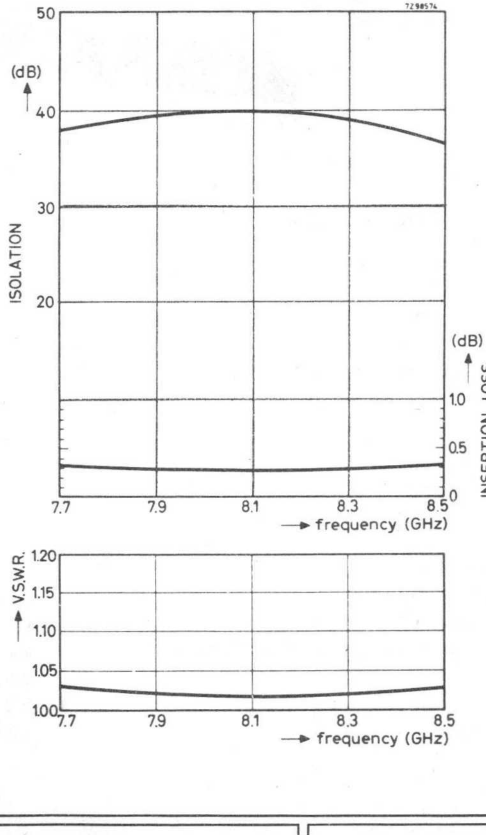
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UER84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g



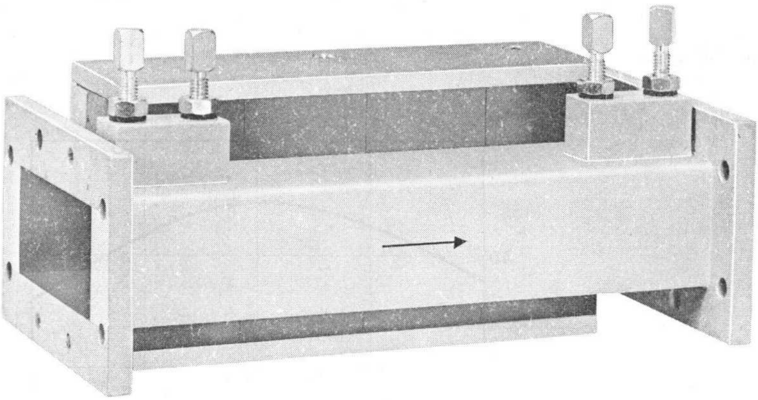
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

RZ 21478-21

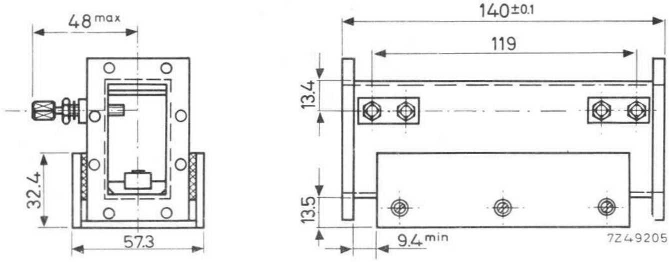


ELECTRICAL DATA

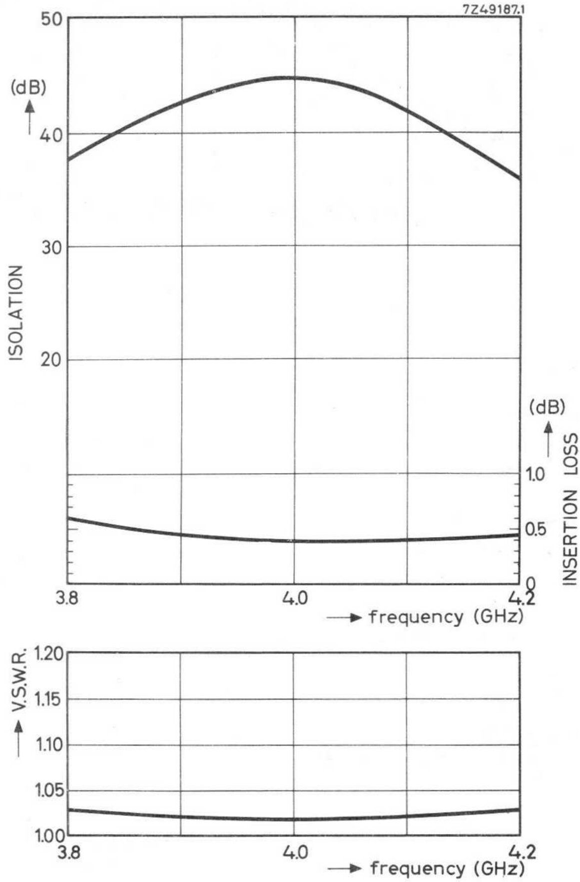
Frequency range	3.8 - 4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1700 g



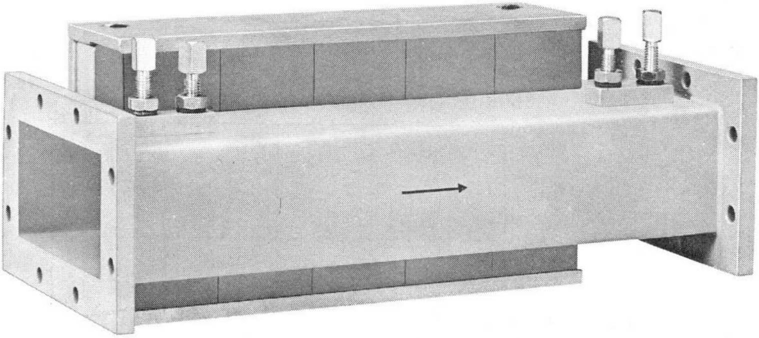
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

RZ 21478-22

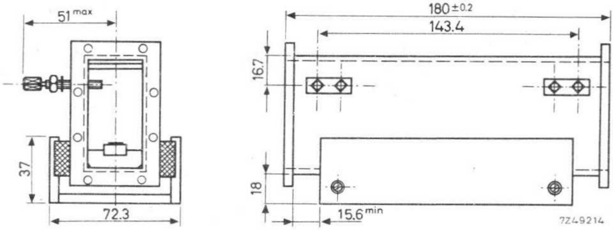


ELECTRICAL DATA

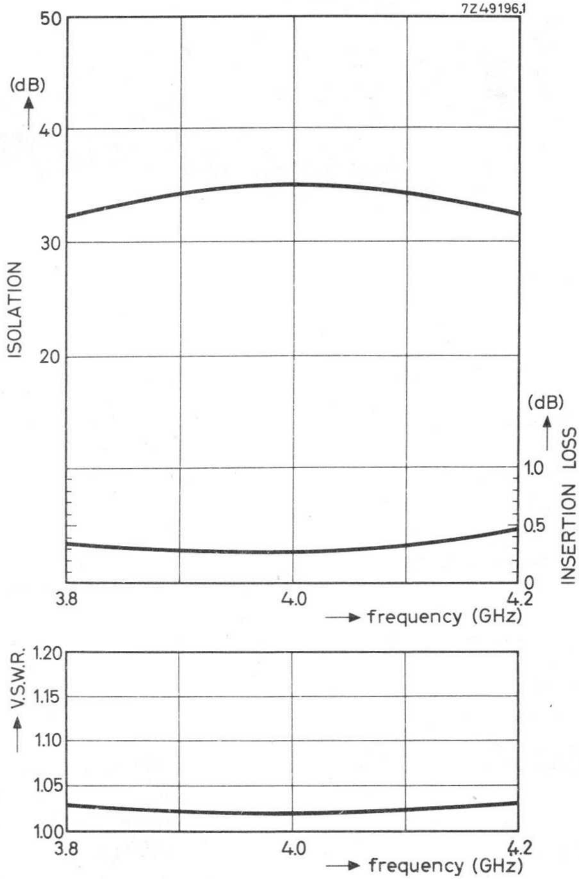
Frequency range	3.8 - 4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 80 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 40 (I.E.C.)
Flange type	UER 40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	2450 g



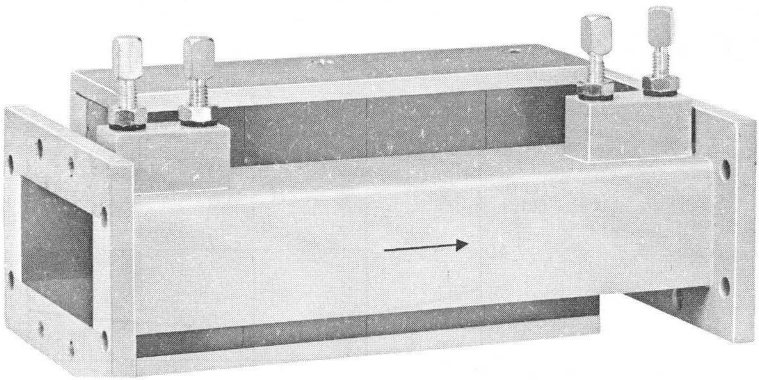
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

RZ 21478-21

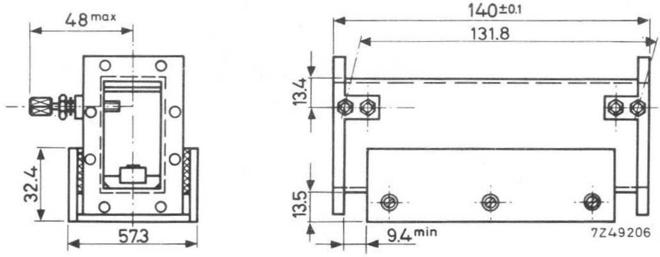


ELECTRICAL DATA

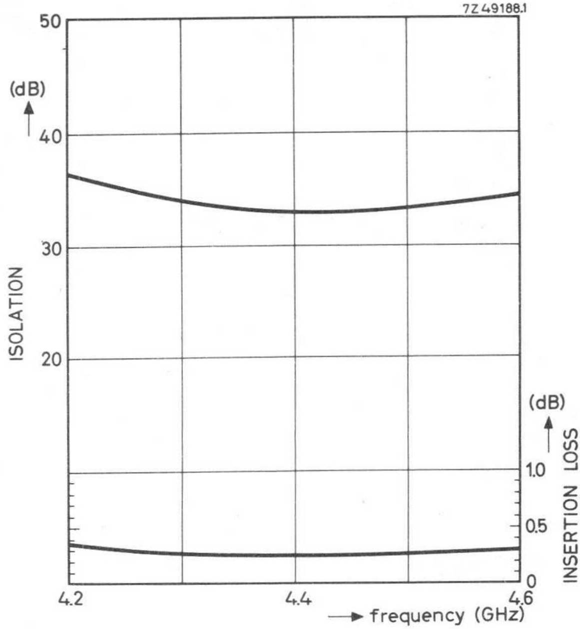
Frequency range	4.2 - 4.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C For other temperature ranges please inquire

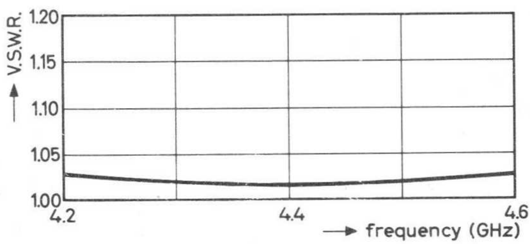
MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g



Dimensions in mm.

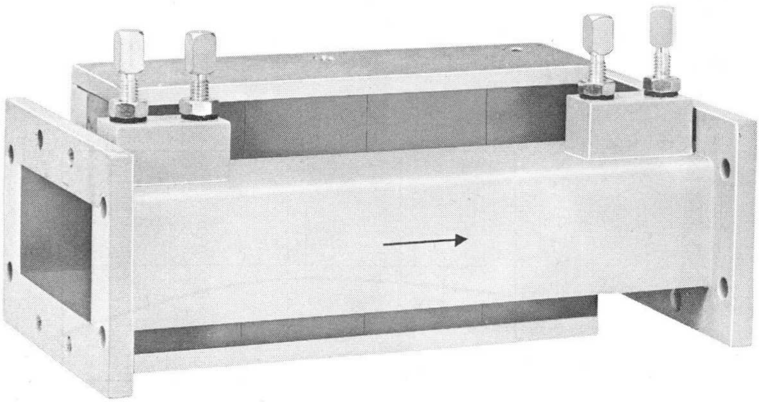




Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

RZ 21478-21

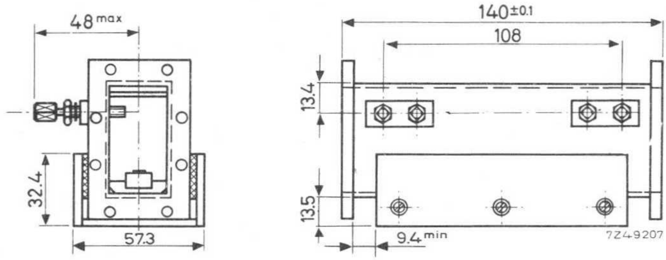


ELECTRICAL DATA

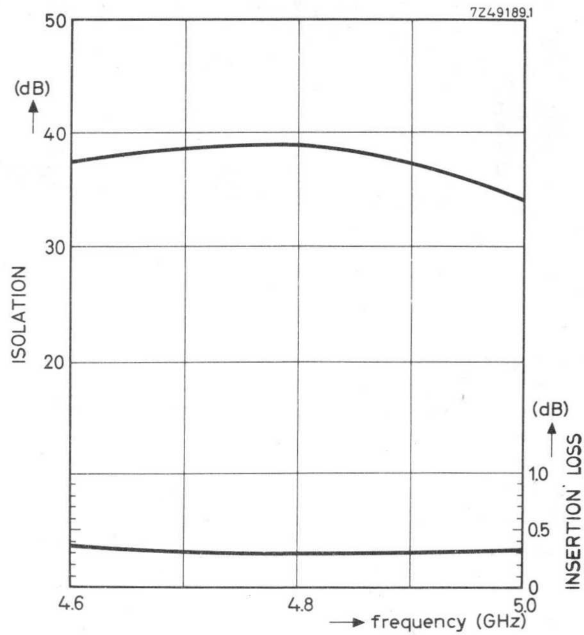
Frequency range	4.6 - 5.0 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C For other temperature ranges please inquire

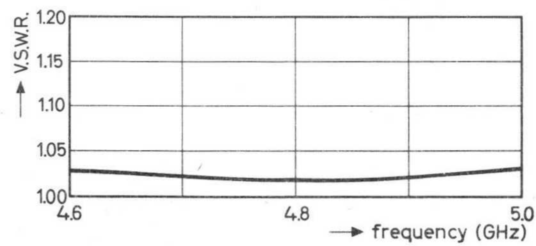
MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g



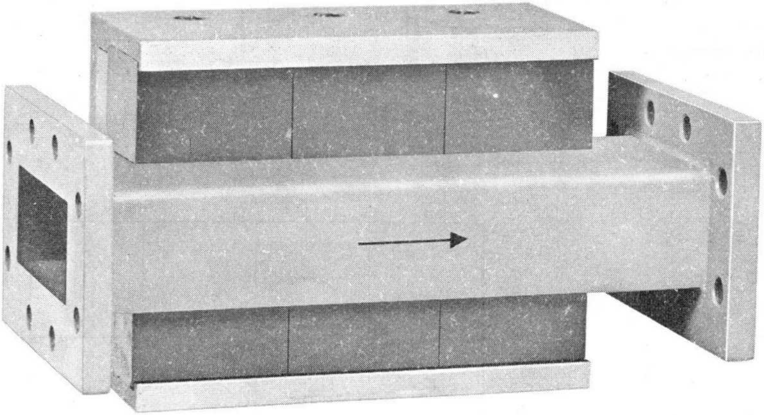
Dimensions in mm.





Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



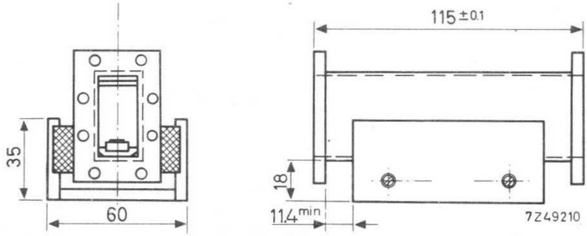
RZ 21478-16

ELECTRICAL DATA

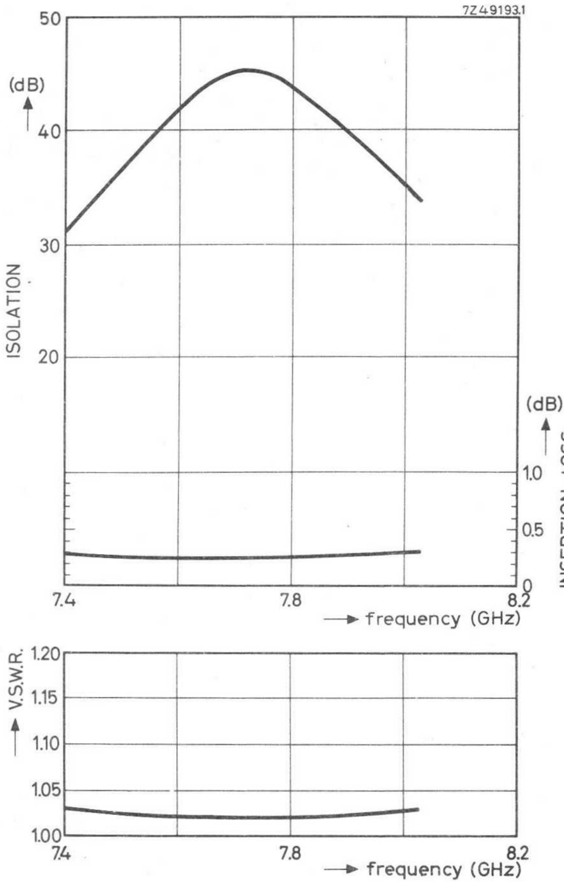
Frequency range	7.4-8.025 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

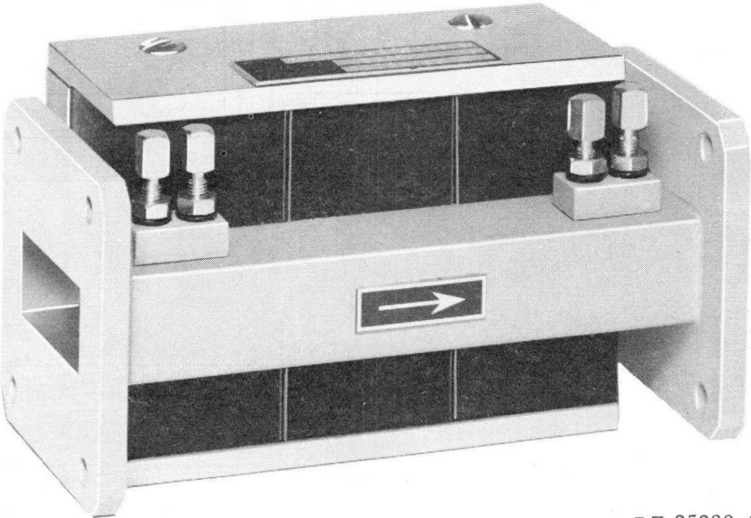


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

ISOLATOR



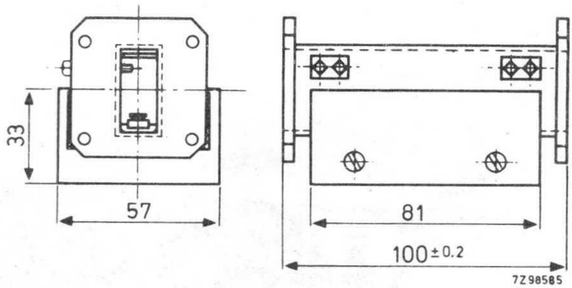
RZ 25233-12

ELECTRICAL DATA

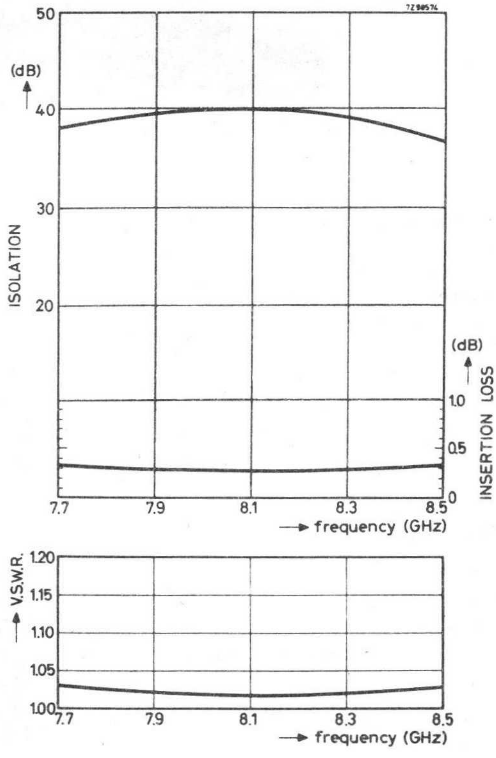
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UBR84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g

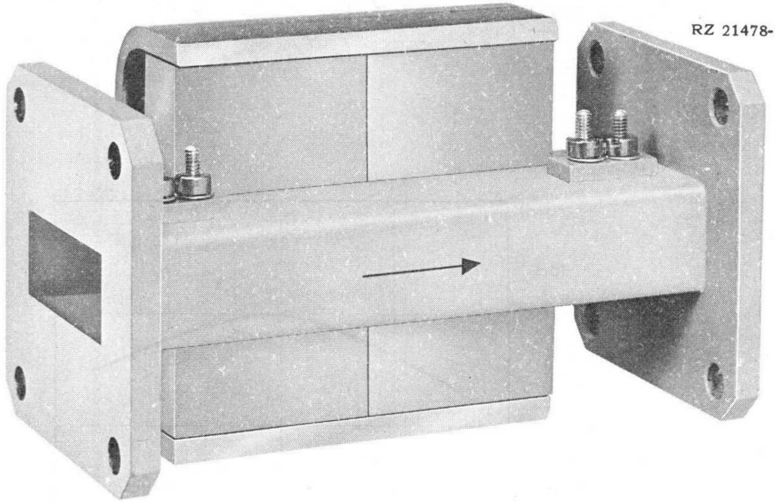


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



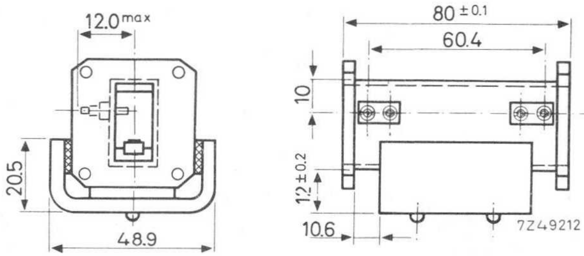
RZ 21478-17

ELECTRICAL DATA

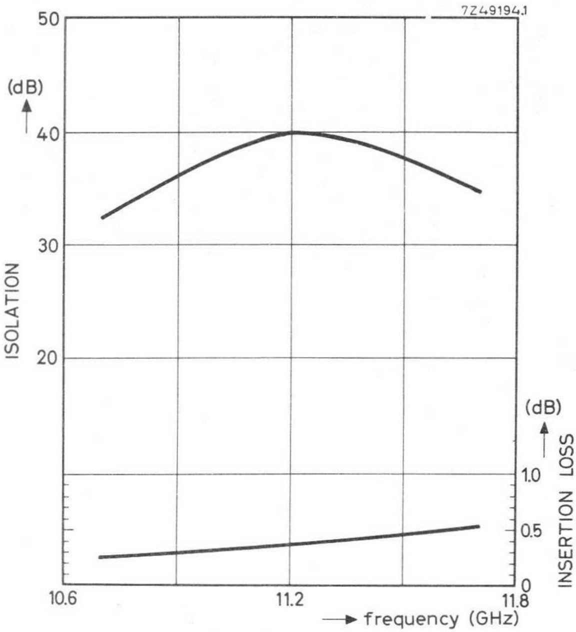
Frequency range	10.7 - 11.7 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	5 W
Temperature range	+ 10 to +70 °C For other temperature ranges please inquire

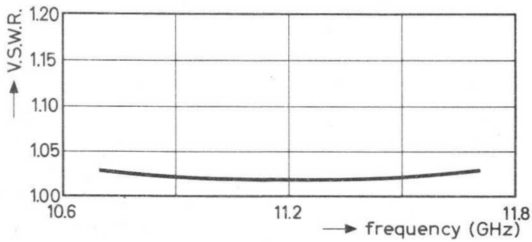
MECHANICAL DATA

Material	brass
Waveguide type	R 100 (I.E.C.)
Flange type	UBR 100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	430 g



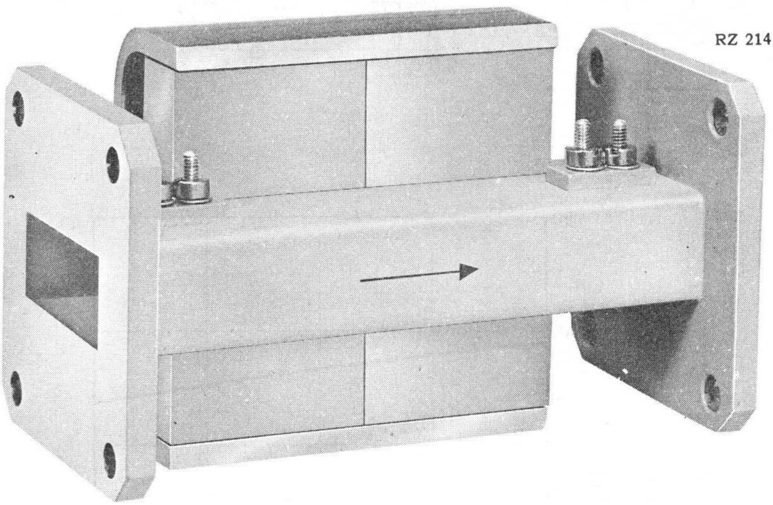
Dimensions in mm.





Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



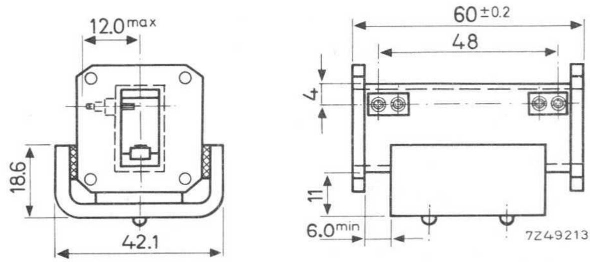
RZ 21478-17

ELECTRICAL DATA

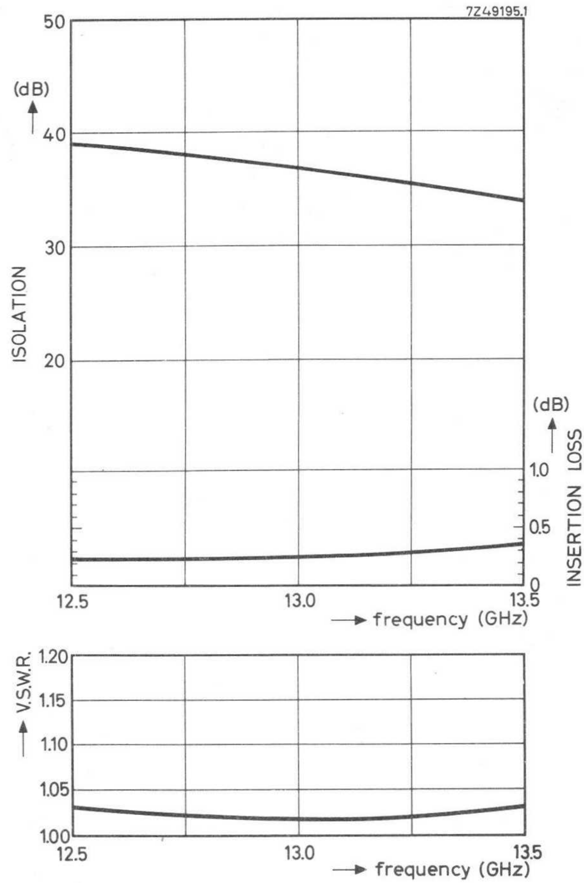
Frequency range	12.5 - 13.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 140 (I.E.C.)
Flange type	UBR 140 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	220 g

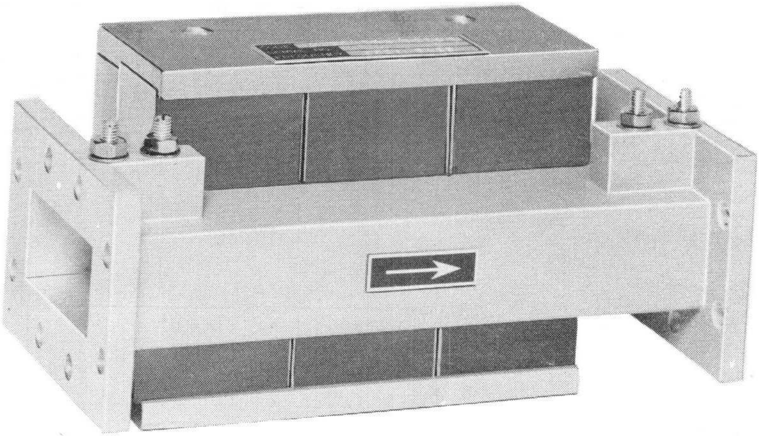


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



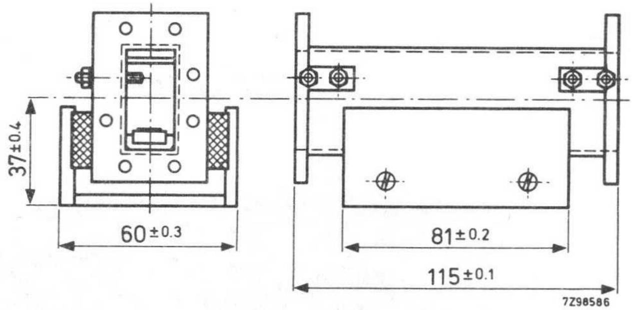
RZ 25233-15

ELECTRICAL DATA

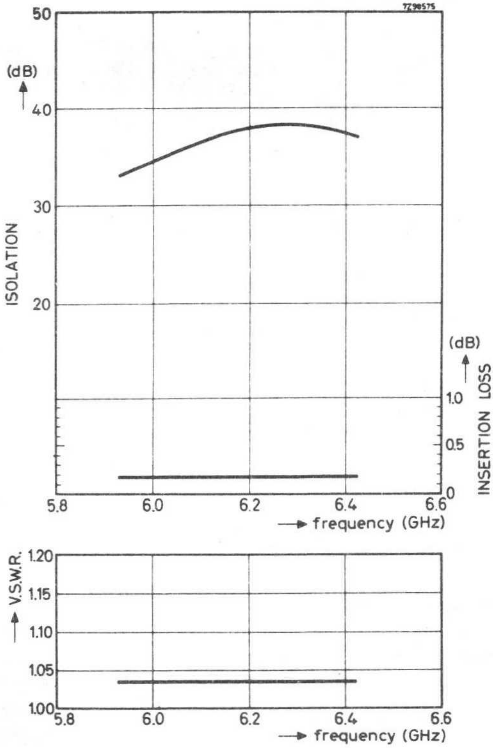
Frequency range	5.925-6.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

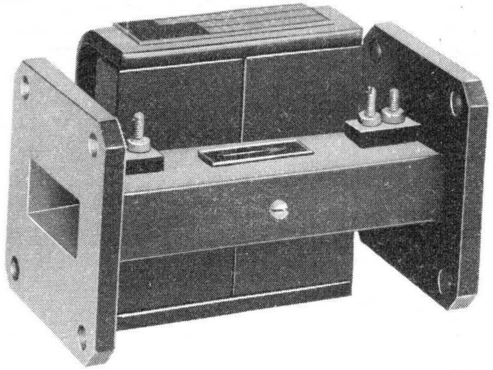


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



RZ 25233-11

ELECTRICAL DATA

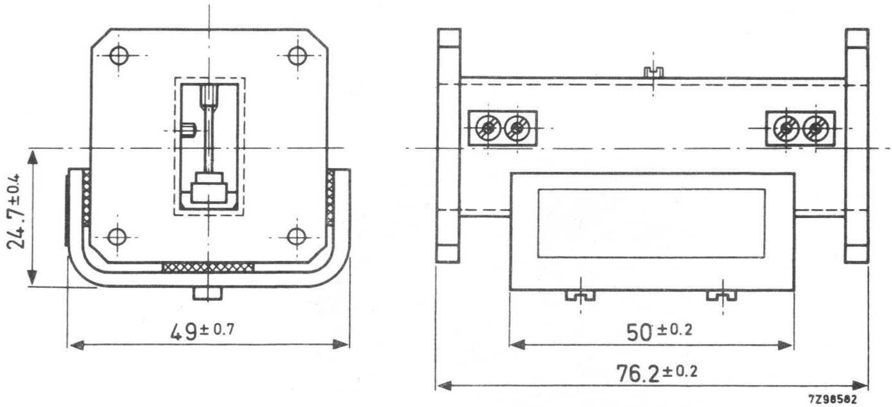
Frequency range	8.5-9.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

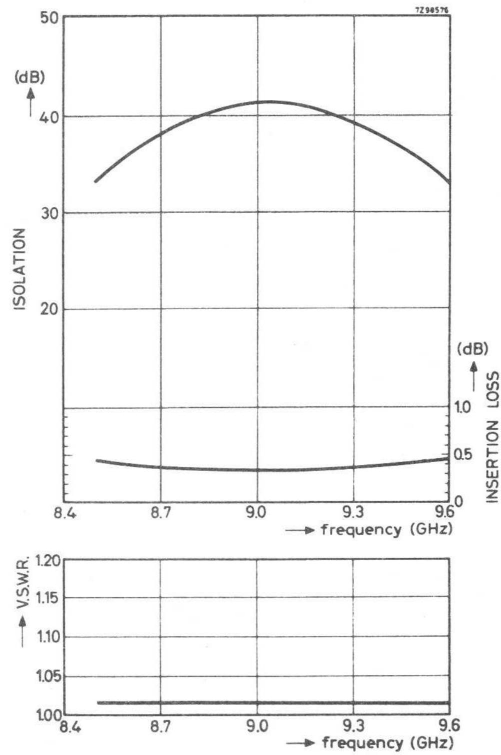
Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	420 g

ENVIRONMENTAL DATA

The isolator withstands the following environmental tests of MIL-STD-202C:
Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

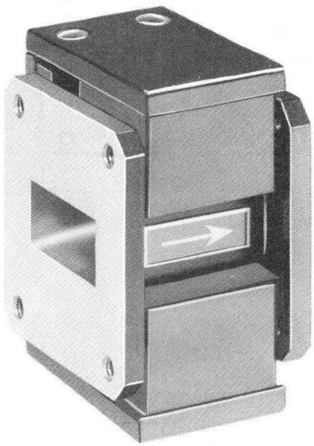


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

ISOLATOR



RZ 25233-6

ELECTRICAL DATA

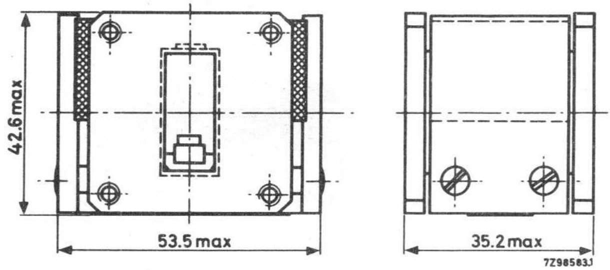
Frequency range	8.5-9.6 GHz
Isolation	> 15 dB
Insertion loss	< 0.6 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	1 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

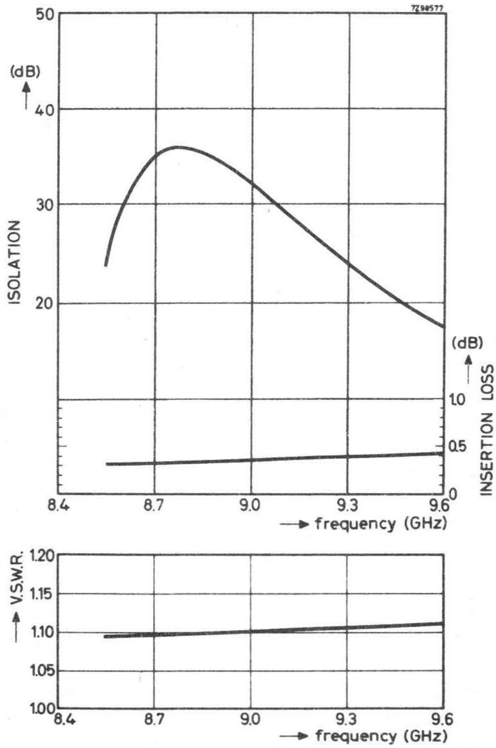
Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	400 g

ENVIRONMENTAL DATA

The isolator withstands the following environmental tests of MIL-STD-202C:
Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

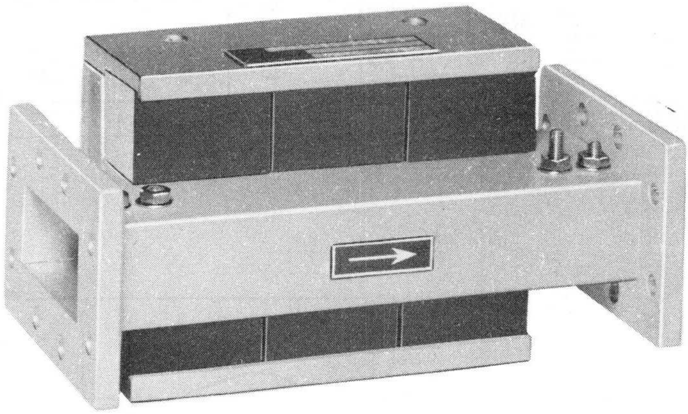


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



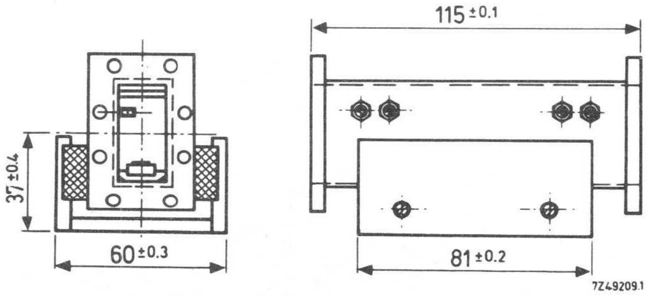
RZ 25233-16

ELECTRICAL DATA

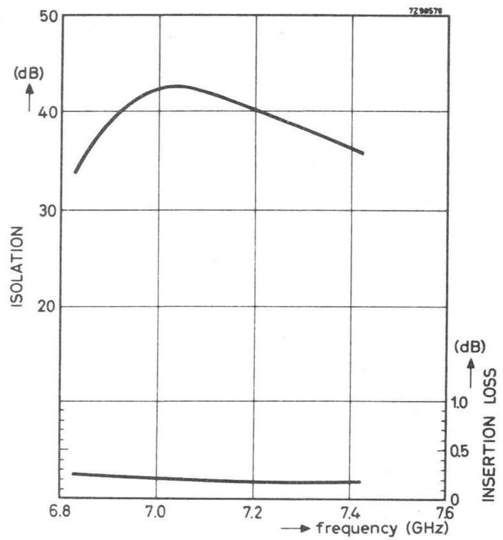
Frequency range	6.825-7.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

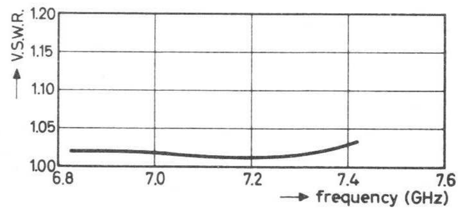
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

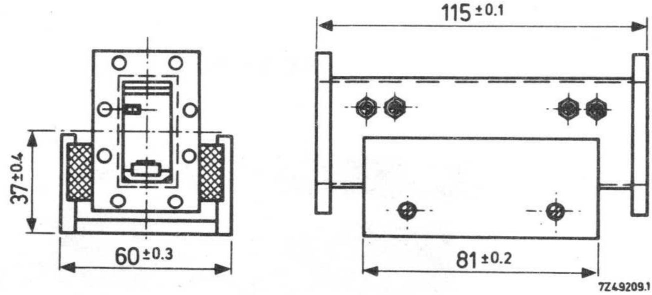
RZ 25233-16

ELECTRICAL DATA

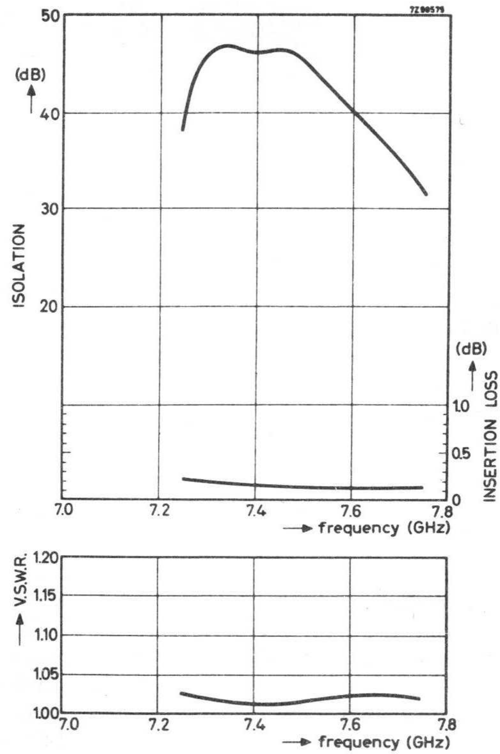
Frequency range	7.25-7.75 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

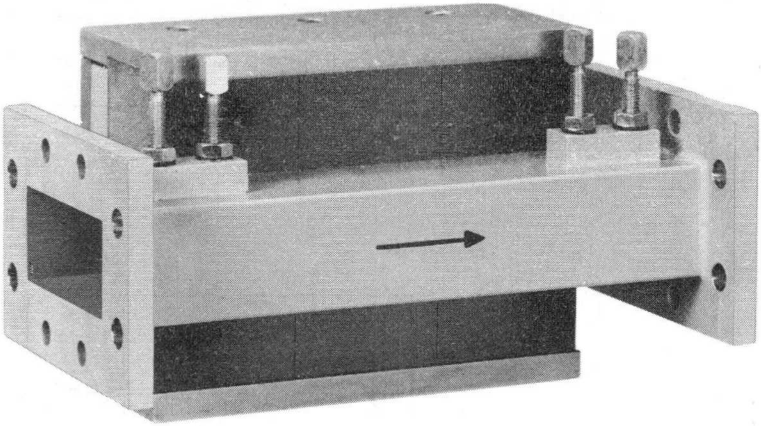


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR



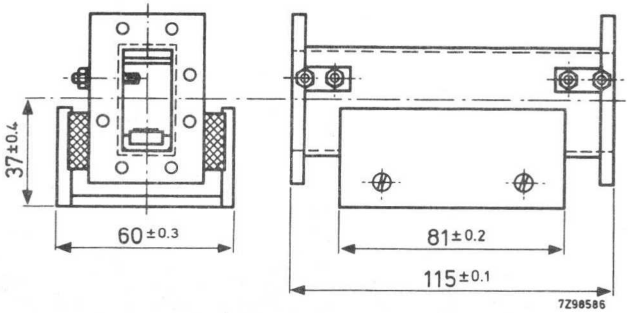
RZ 21478-11

ELECTRICAL DATA

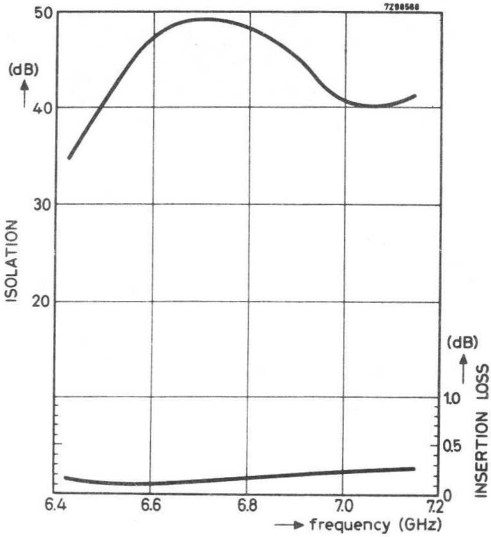
Frequency range	6.425-7.150 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

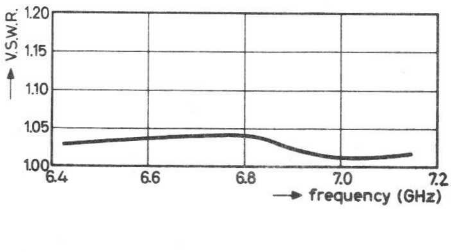
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

WAVEGUIDE ISOLATOR

Frequency 8.5 to 9.6 GHz

DIMENSIONS (in mm)

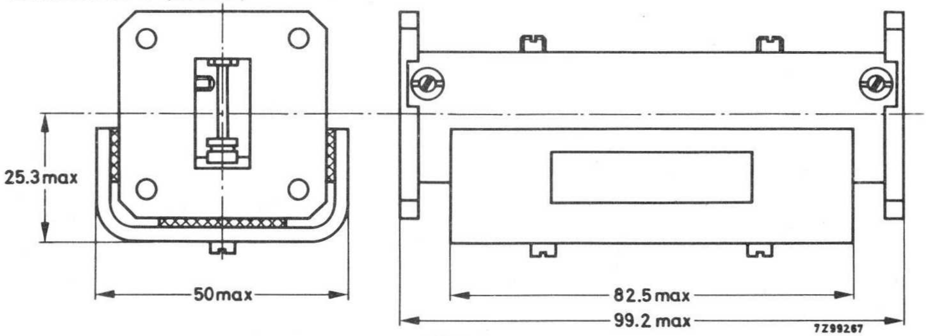


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	8.5 to 9.6 GHz
Isolation	> 55 dB
Insertion loss	< 1.2 dB
V.S.W.R.	< 1.2
Maximum power	10 W
Temperature range	−10 to +70 $^{\circ}$C For other temperature ranges please inquire.

MECHANICAL DATA

Material of waveguide and flange	brass
Mating flange type	154 IEC-UER 100
Finish of flanges	nickel plated
Colour	black
Weight	600 g.

Typical performance as a function of frequency at an operating temperature of 20 °C.

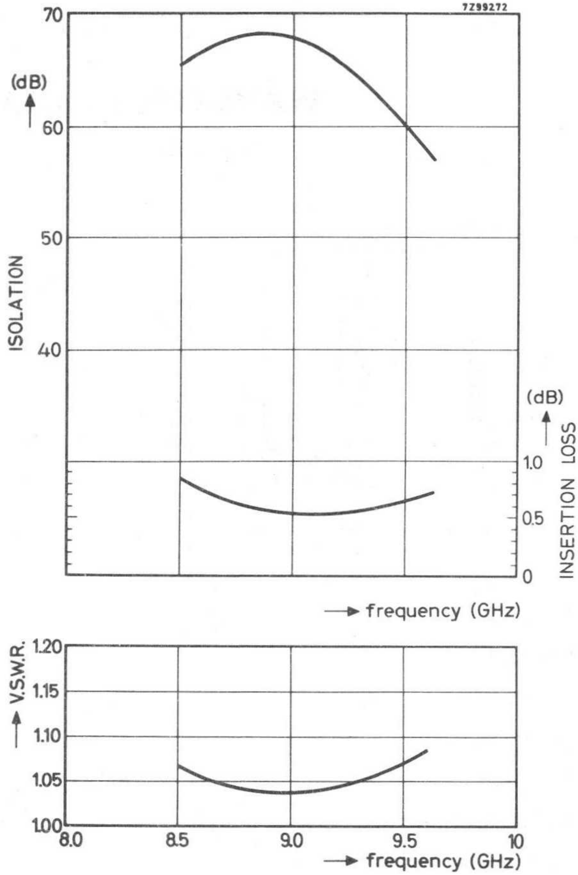


Fig.2

ENVIRONMENTAL TESTS

The isolator withstands the following environmental tests of MIL-STD-202C

Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

WAVEGUIDE ISOLATOR

Frequency 8.5 to 9.6 GHz

DIMENSIONS (in mm)

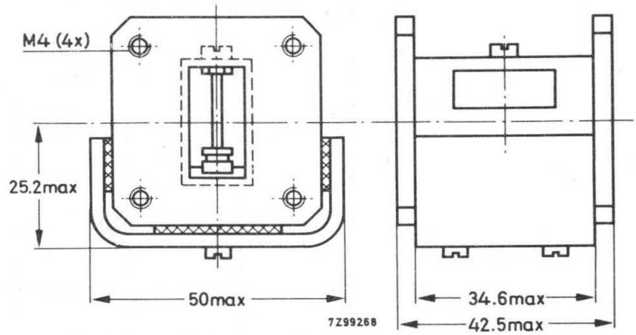


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	8.5 to 9.6 GHz
Isolation	> 20 dB
Insertion loss	< 1 dB
V.S.W.R.	< 1.15
Maximum power	10 W
Temperature range	-10 to +70 °C For other temperatures please inquire

MECHANICAL DATA

Material of waveguide and flange	brass
Mating flange type	154 IEC-UBR 100
Finish of flanges	nickel plated
Colour	black
Weight	300 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

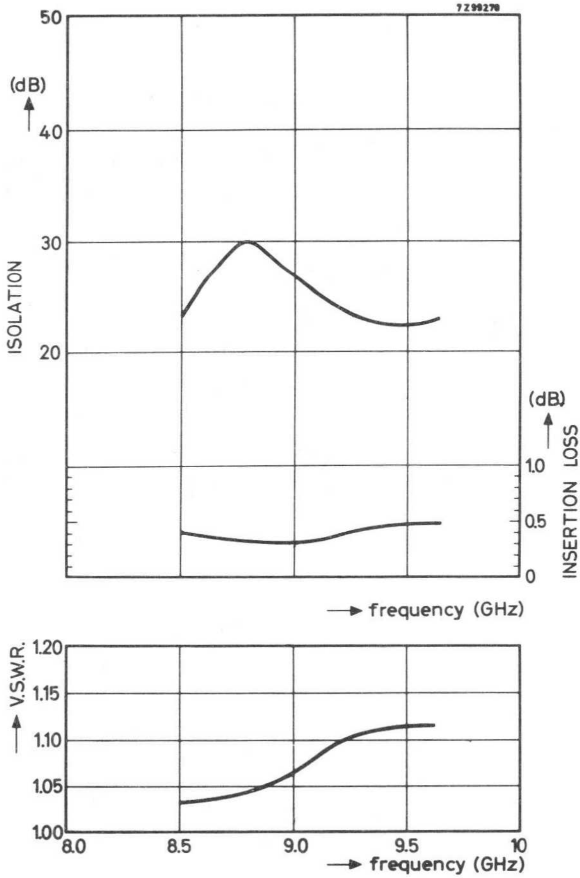


Fig.2

ENVIRONMENTAL TESTS

The isolator withstands the following environmental tests of MIL-STD-202C

Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

WAVEGUIDE ISOLATOR

Frequency 7.125 to 7.750 GHz

DIMENSIONS (in mm)

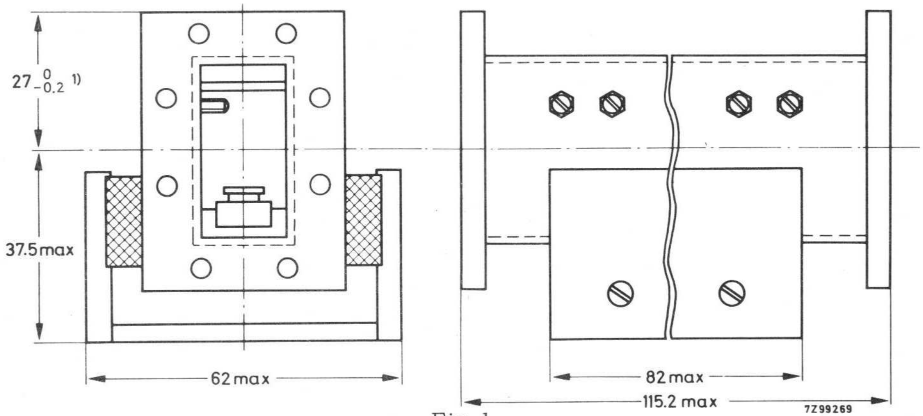


Fig. 1

ELECTRICAL DATA (See also Fig. 2)

Frequency range	7.125 to 7.750 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Maximum power	20 W
Temperature range	-10 to +70 °C For other temperatures please inquire

MECHANICAL DATA

Material of waveguide and flange	brass
Mating flange type	154 IEC-UER 70 [1])
Finish of flanges	gold plated
Colour of waveguide	grey
magnets	black
magnet yoke	nickel
Weight	1450 g

[1]) The flange of this isolator is a standard flange except for the dimension indicated with [1]) (2 mm shorter)

Typical performance as a function of frequency at an operating temperature of 20 °C.

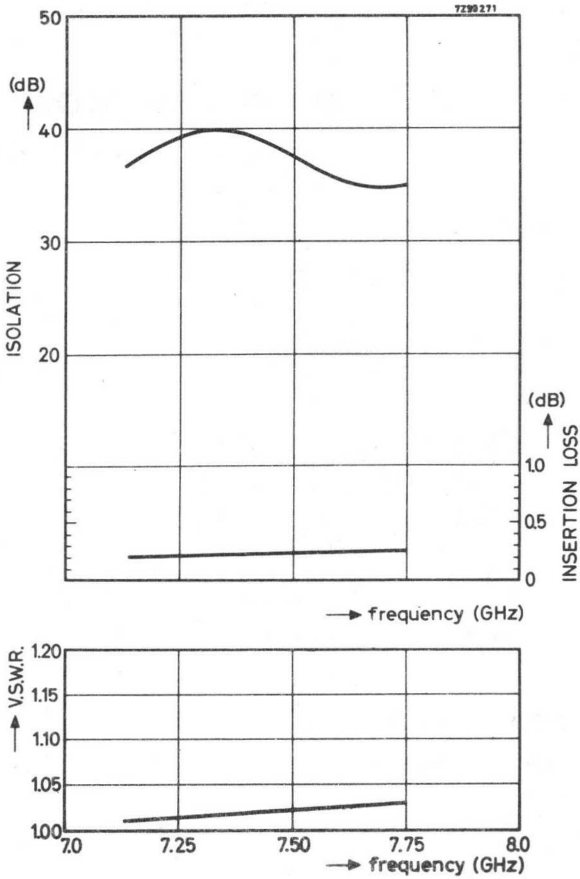


Fig. 2

ISOLATOR

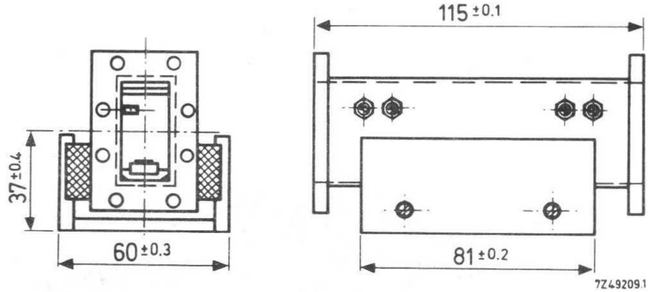
RZ 25233-16

ELECTRICAL DATA

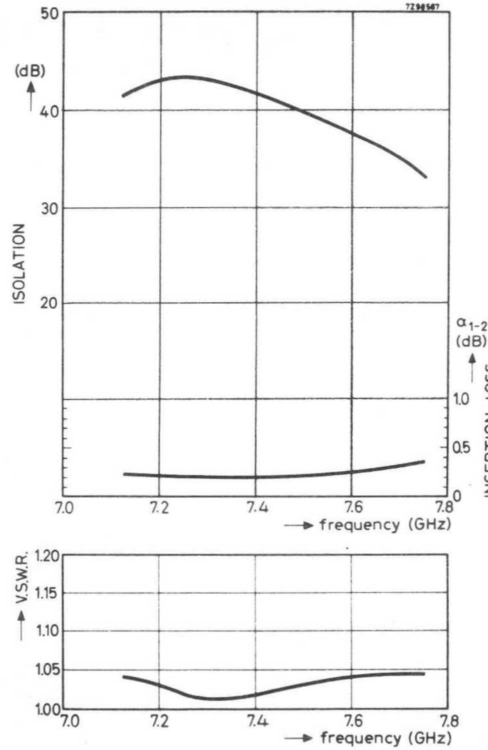
Frequency range	7.125-7.750 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

COAXIAL ISOLATOR

Frequency 740 to 810 MHz

DIMENSIONS (in mm)

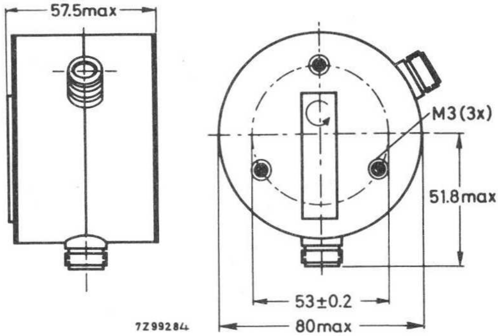


Fig. 1

ELECTRICAL DATA

Frequency range	740 to 810 MHz
Isolation	> 22 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	1200 g

COAXIAL ISOLATOR

Frequency 890 to 970 MHz

DIMENSIONS (in mm)

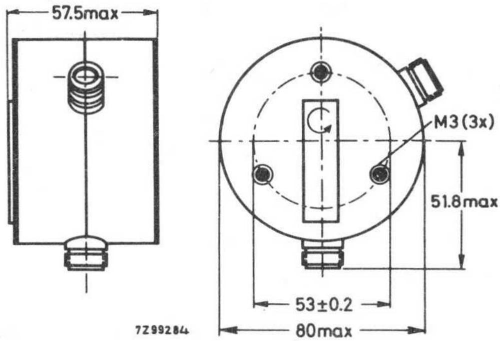


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	890 to 970 MHz
Isolation	> 22 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver coloured
top and bottom face	black
Weight	1200 g

Typical performance as a function of frequency at an operating temperature of 20 °C

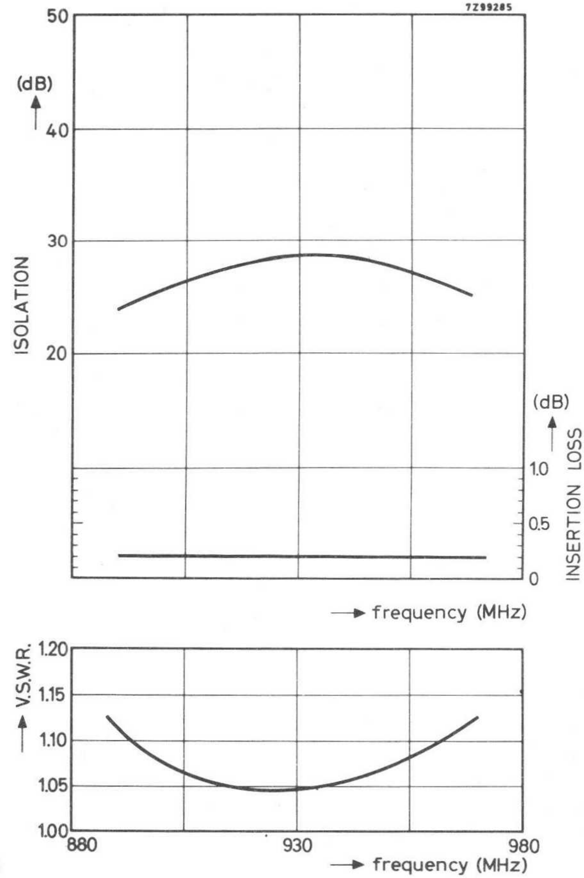


Fig.2

COAXIAL ISOLATOR

Frequencie 2.96 to 3.22 GHz

DIMENSIONS (in mm)

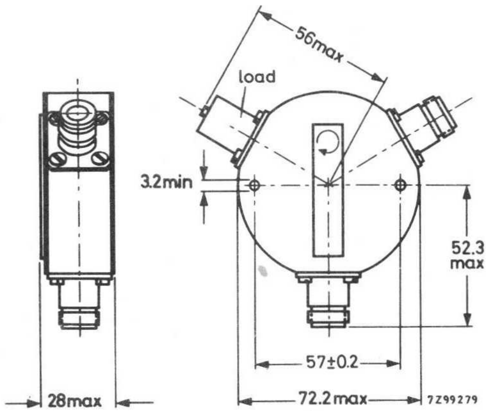


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	2.96 to 3.22 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	550 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

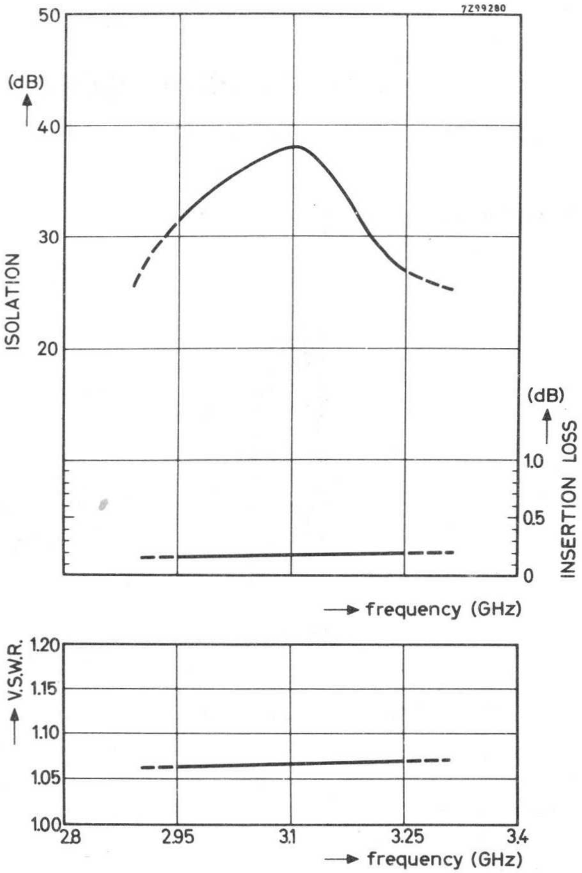


Fig.2

COAXIAL ISOLATOR

Frequency 3.56 to 3.90 GHz

DIMENSIONS (in mm)

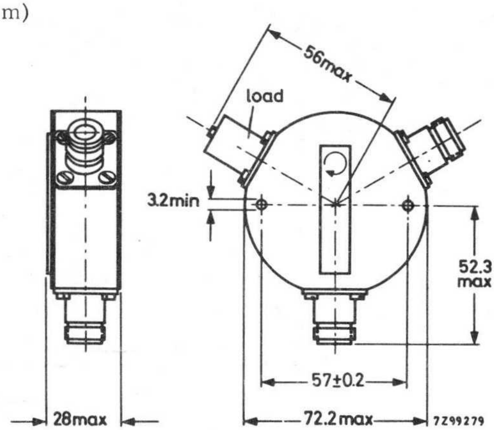


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequeny range	3.56 to 3.90 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	550 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

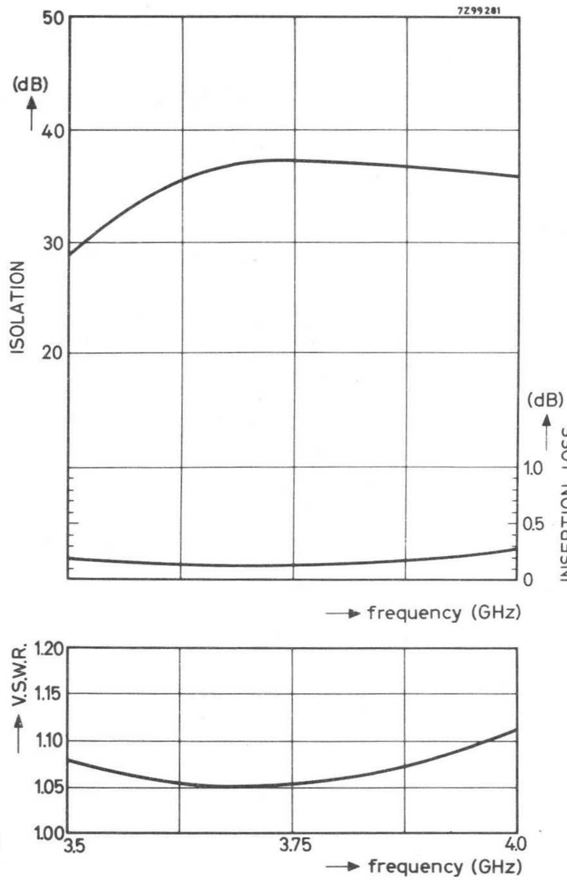


Fig.2

COAXIAL ISOLATOR

Frequency 1.48 to 1.95 GHz

DIMENSIONS (in mm)

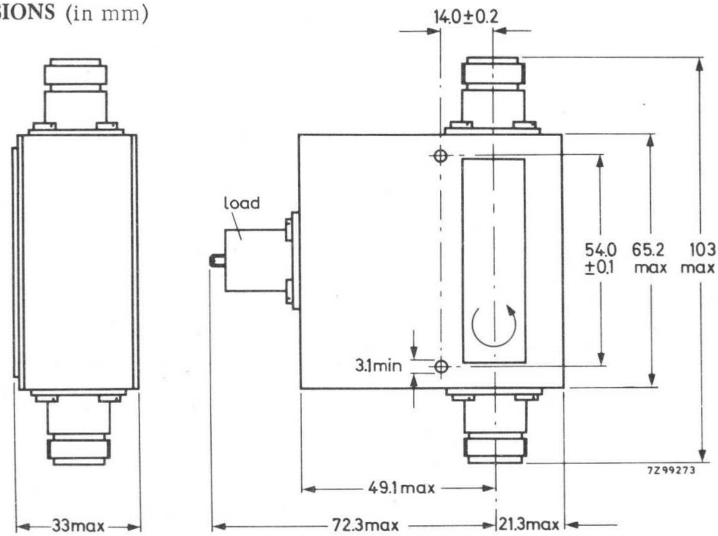


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	1.48 to 1.95 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	50 W
Maximum permissible reflected power	2 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire.

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	grey
top and bottom face	black
Weight	500 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

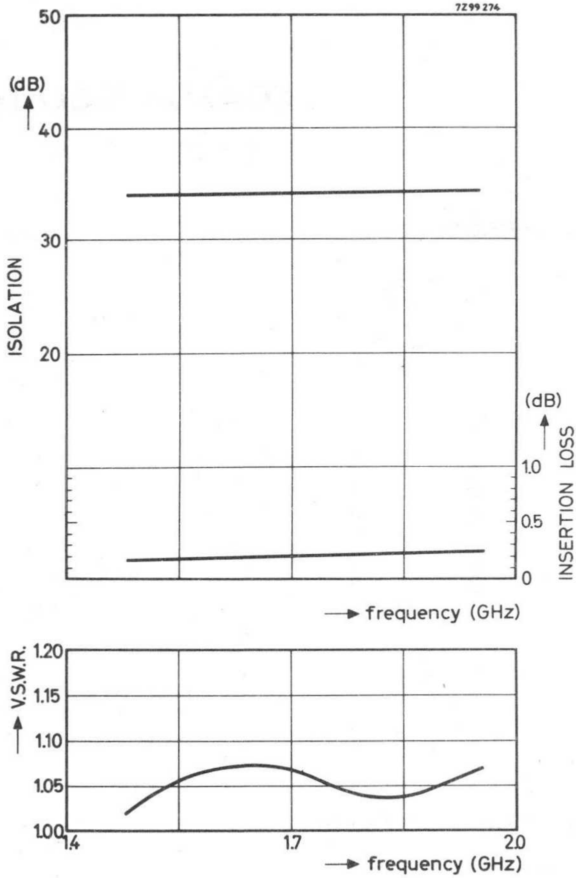
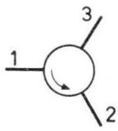


Fig. 2

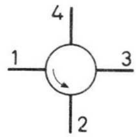
INTRODUCTION

A circulator is a passive non-reciprocal device with three or more ports. It contains a core of ferrite material in which energy introduced into one port is transferred to an adjacent port, the other ports being isolated.

Although circulators can be made with any number of ports, the most commonly used are 3 ports and 4 ports, the symbols of which are given in Fig.1 and 2.



symbols



3 port circulator
Fig.1

4 port circulator
Fig.2

Energy entering into port 1 emerges from port 2, energy entering into port 2 emerges from port 3, and so on in cyclic order. In this direction of circulation an ideal circulator would have no losses, but in practical constructions there are some losses.

In an ideal circulator no energy would flow in the direction opposite to the circulation direction. Again in practice this isolation is in the order of 20 to 30 dB, in very narrow bands even higher.

The non-reciprocal behaviour of circulators is the result of gyromagnetic effects in the ferrite when this is biased with a magnetic field.

APPLICATION

The main application of circulators is duplexing of systems for simultaneous transmission and reception in low and medium power telecommunication equipment as illustrated in Fig.3 and 4.

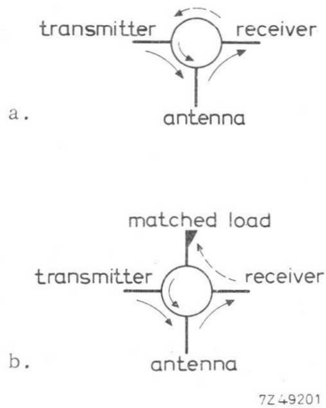


Fig.3
Duplexing of one receiver and one transmitter

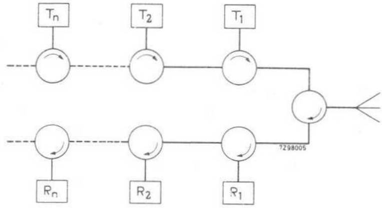


Fig.4
Duplexing of a number of transmitters and receivers

R = receiver; T = transmitter

The reasons that both 3 port and 4 port circulators are used are:

a. a 3 port circulator usually has a wider bandwidth than a 4 port circulator,
b. a 4 port circulator (of which the fourth port is provided with a matched load, see Fig.3b), however, does not require a very accurately matched receiver so that a much simpler filter can be used on the receiver input.

A 3 port circulator can also be used as an isolator by putting a matched load on one port, Fig.5. Particularly at lower frequencies the characteristics of a circulator as to decoupling of functions are superior to those of an isolator. Decoupling can be increased by cascading circulators, see Fig.6. The decoupling is directly proportional to the number of circulators; so is the insertion loss.

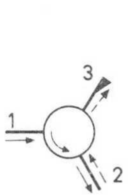


fig.5

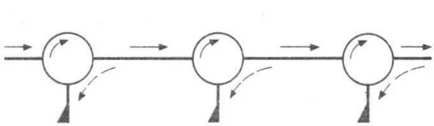
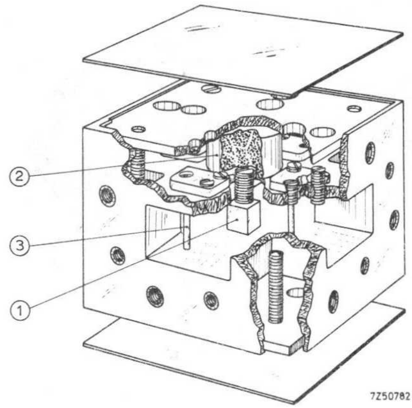


fig.6

CONSTRUCTION

As for the construction of the circulators two types may be distinguished, the waveguide circulators and the coaxial circulators. Both are junction types.

Waveguide circulators



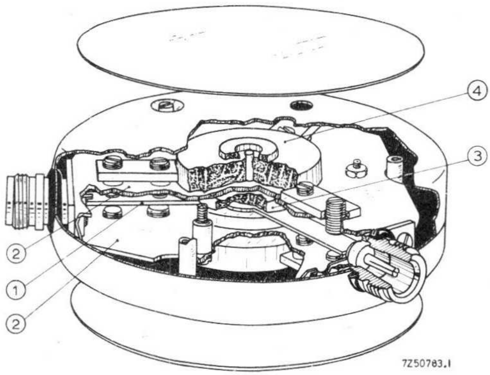
Construction of a waveguide circulator
Fig.7

In this type three or four waveguides intersect each other at 120° or 90° angles. In Fig.7 a 4-port waveguide circulator of the junction type is shown. Exactly in the centre of the intersection a piece of ferrite (1) is located between two magnets (2).

In the waveguide some posts (3) are placed which are required to achieve a good match.

Coaxial circulators

In Fig.8 a coaxial circulator of the junction type is shown. Three copper strips (1) intersect at an angle of 120° in the centre of the circulator, thus forming a Y-arrangement [1]). These strips are mounted between two earth plates (2), in this way forming a matched high frequency conductor. In the exact centre of the circulator two ferrite discs (3) and magnets (4) are mounted.



Construction of a coaxial circulator
Fig.8

Mounting

Mounting of a coaxial circulator can be done by removing the three screws in the cover plates. The screw size is 3 x 10 mm metric. The circulator can then be placed directly against a metal support and be secured by the three screws.

TERMS AND DEFINITIONS

Frequency range is the range within which the circulator meets the guaranteed specification.
Outside this range the electrical properties deteriorate rapidly. The circulator will not be damaged, however, if erroneously subjected to frequencies outside the range.

Isolation is the ratio, expressed in dB, of the energy entering into a port to the energy scattered into the adjacent port on the side opposite to normal circulation. It is measured with a matched source and all other ports correctly terminated.
The isolation α_{1-3}, i.e. the isolation between ports 1 and 3, is equal to α_{3-2} and α_{2-1}. (See Fig.1).

[1]) A T-arrangement can be made on request.

Insertion loss is the attenuation resulting from the insertion of a circulator into a transmission system, expressed in dB, of the power delivered to a matched load before insertion of the circulator, to the power delivered to that load after insertion of the circulator.

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along the line. It is measured with all other ports terminated with a matched load.
The coaxial circulators are designed with a characteristic impedance of 50 ohms.

Typical data. These data are derived by taking the mean measured values of several production runs of the component.

Maximum power is the largest power that a circulator can handle when one port is terminated with a mismatch of VSWR = 2, whilst the next port is matched with VSWR $\leq$ 1.2. This power value should under no circumstances be exceeded.

Temperature range is the ambient temperature range within which the circulators will function to specification.
(When necessary special temperature compensation is built in.)

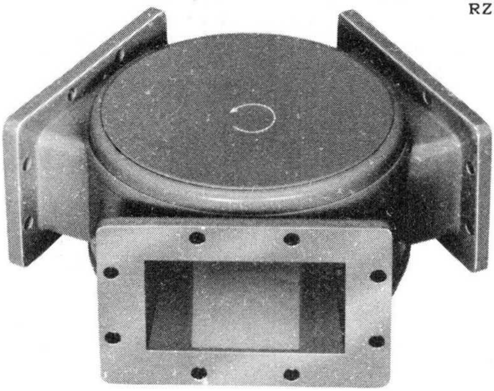
CAUTION

a. The circulators have rather strong internal magnetic fields which are carefully adjusted for optimal operation,

b. They are not to be subjected to strong external magnetic fields.

CIRCULATOR

RZ 21604-1

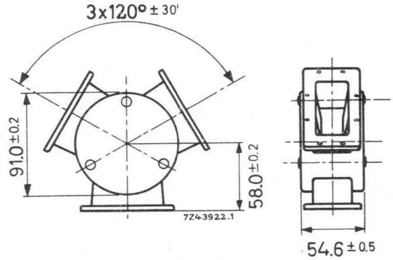


ELECTRICAL DATA

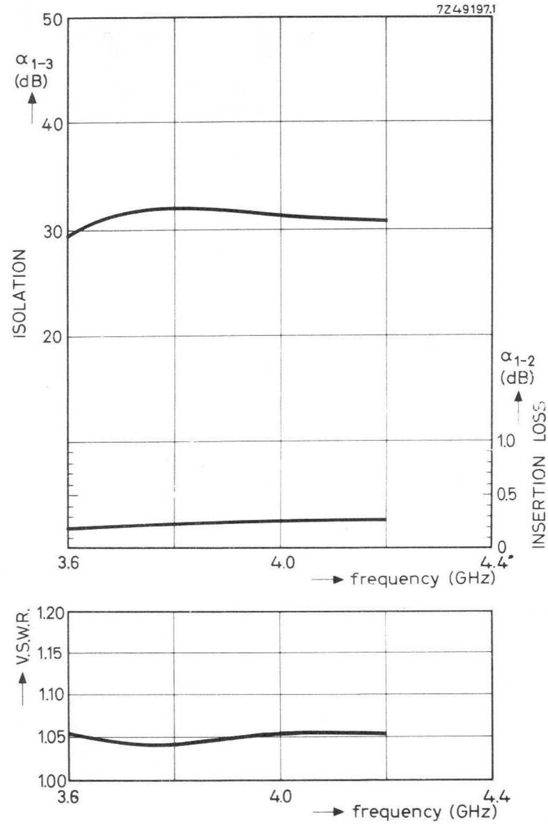
Frequency range	3.6-4.2 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.12
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 3 port
Material	aluminium
Flange type	UER 40 (I.E.C.)
Finish	iridium flashed, covers enamelled grey



Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 3.6 to 4.2 GHz

DIMENSIONS (in mm)

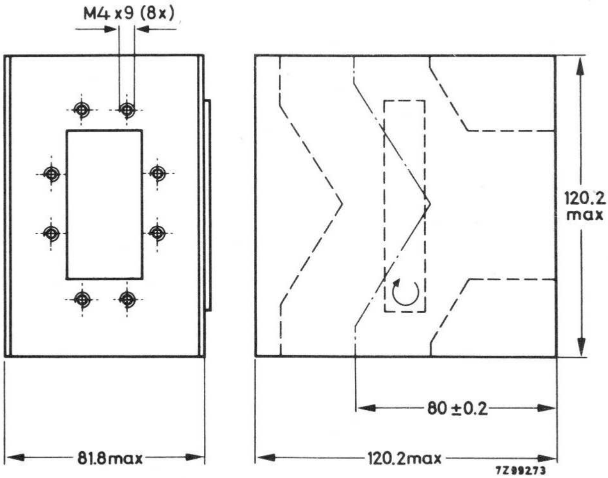


Fig.1

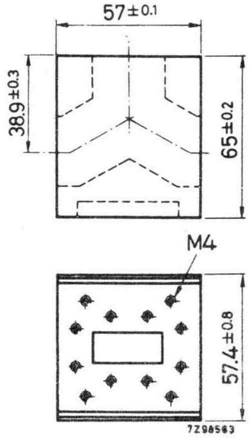
ELECTRICAL DATA

Frequency range	3.6 to 4.2 GHz
Isolation α_{1-3}	> 28 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Maximum power	50 W
Temperature range	0 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Material of waveguide and flanges	aluminium
Mating flange type	154 IEC-UER 40
Finish of flanges	alodine
Colour of top and bottom face	grey
Weight	2900 g

CIRCULATOR



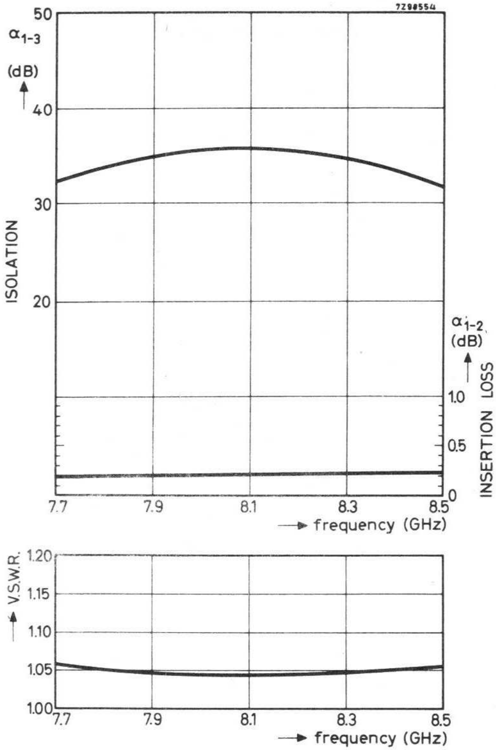
Dimensions in mm

ELECTRICAL DATA

Frequency range	7.7-8.5 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range	+10 to +40 °C For other temperature ranges please inquire

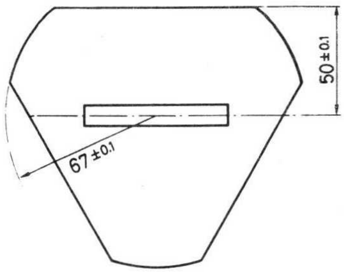
MECHANICAL DATA

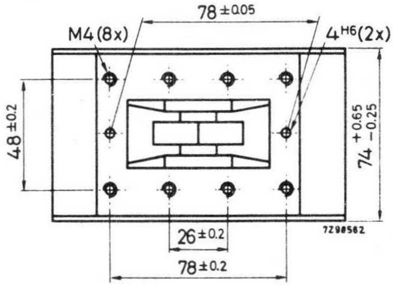
Construction	waveguide 3 port
Material	brass
Flange type	UER84/UBR84 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR





Dimensions in mm

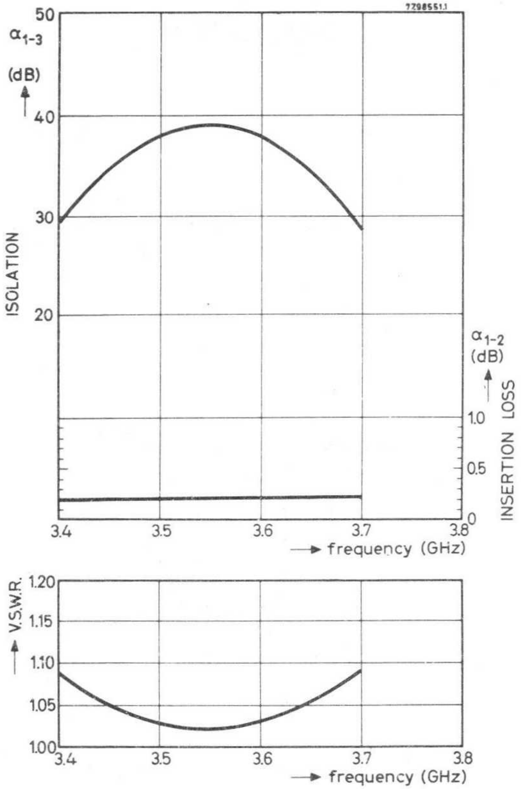
ELECTRICAL DATA

Frequency range	3.4-3.7 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range	+5 to +45 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

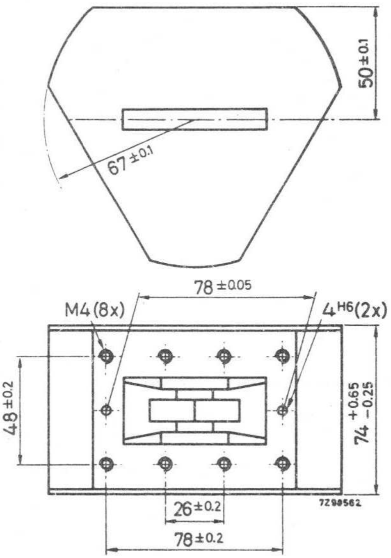
Construction	waveguide 3 port
Material	aluminium
Flange type	C.C.T.U. No.6 *)
Finish	alodine outside enamelled grey

*) UER40 available on request



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



Dimensions in mm

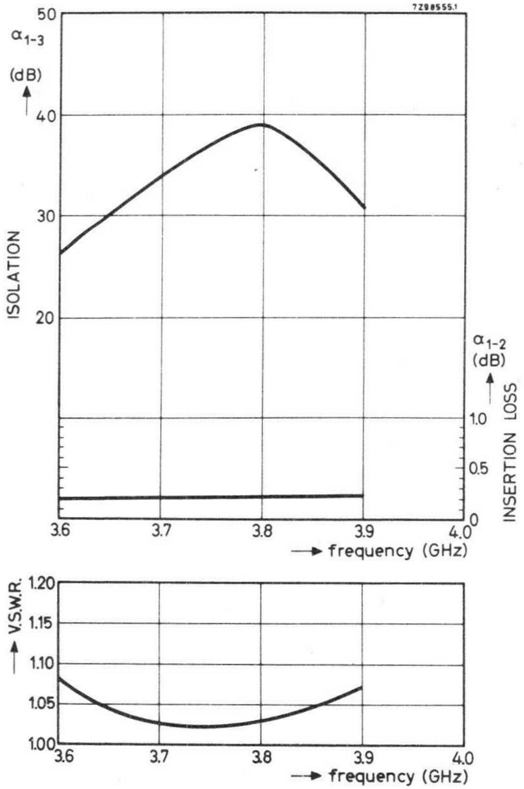
ELECTRICAL DATA

Frequency range	3.6-3.9 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range	+5 to +45 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

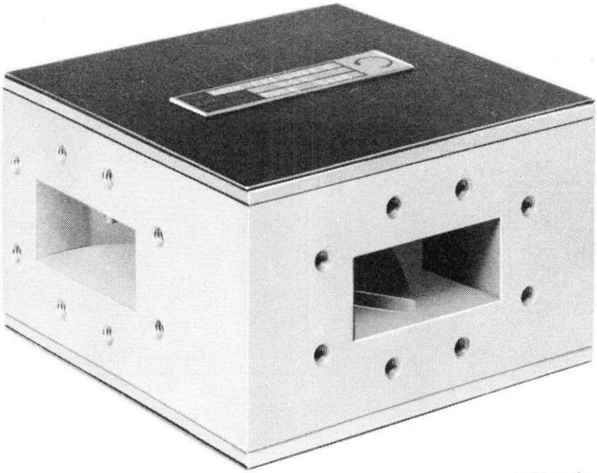
Construction	waveguide 3 port
Material	aluminium
Flange type	C.C.T.U. No.6 *)
Finish	alodine, outside enamelled grey

*) UER40 available on request



Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

CIRCULATOR



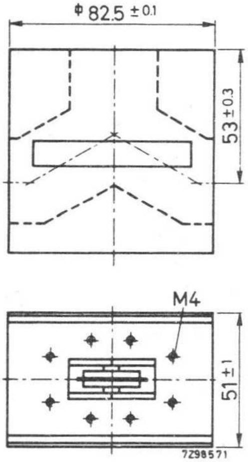
RZ 25233-2

ELECTRICAL DATA

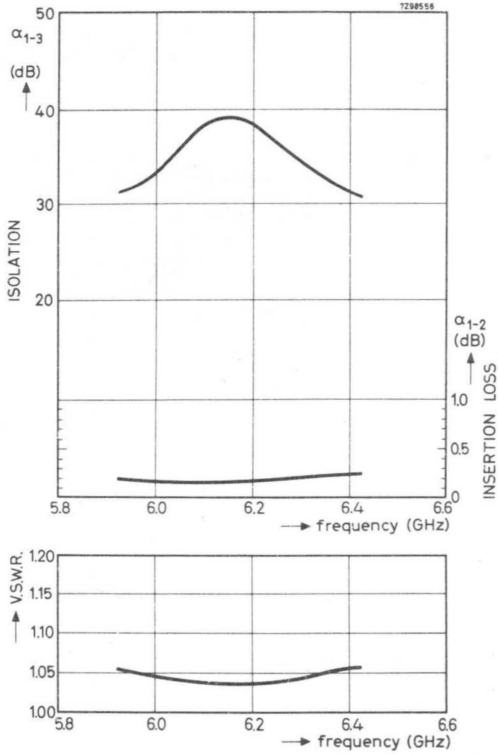
Frequency range	5.925-6.425 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.12
Nominal power (c.w.)	100 W
Temperature range	+10 to +40 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 3 port
Material	aluminium
Flange type	UER70 (I.E.C.)
Finish	alodine, covers black
Weight	950 g



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 6.425 to 7.125 GHz

DIMENSIONS (in mm)

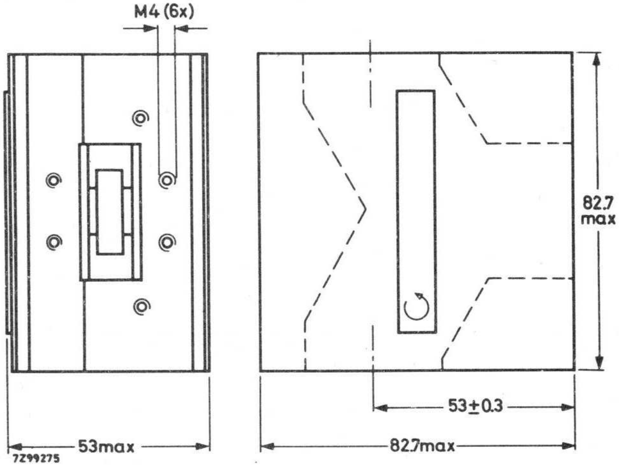


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	6.425 to 7.125 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.15 dB
V.S.W.R.	< 1.07
Maximum power	100 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Material of waveguide and flanges	aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	950 g

Typical performance as a function of frequency at an operating temperature of 20 $^{\circ}$C

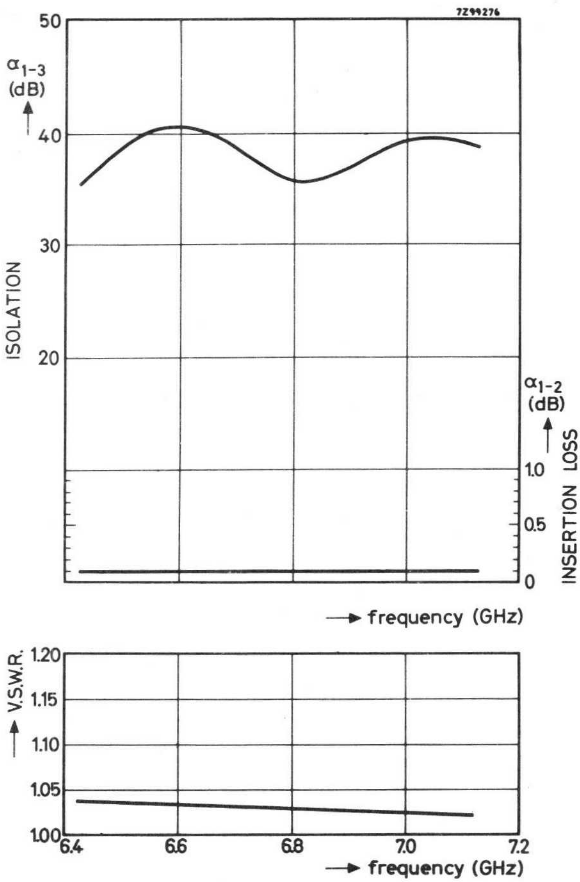


Fig.2

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 7.125 to 7.750 GHz

DIMENSIONS (in mm)

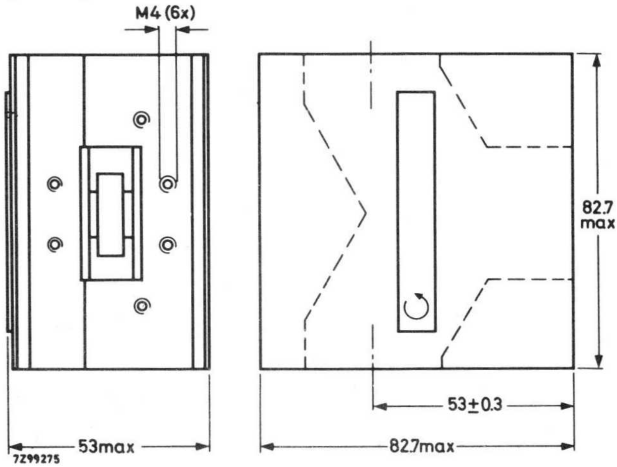


Fig.1

ELECTRICAL DATA (see also Fig.2)

Frequency range	7.125 to 7.750 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.2 dB
V.S.W.R.	< 1.06
Maximum power	100 W
Temperature range	-10 to $+70\,^{o}C$ For other temperature ranges please inquire

MECHANICAL DATA

Material of waveguide and flanges	aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	950 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

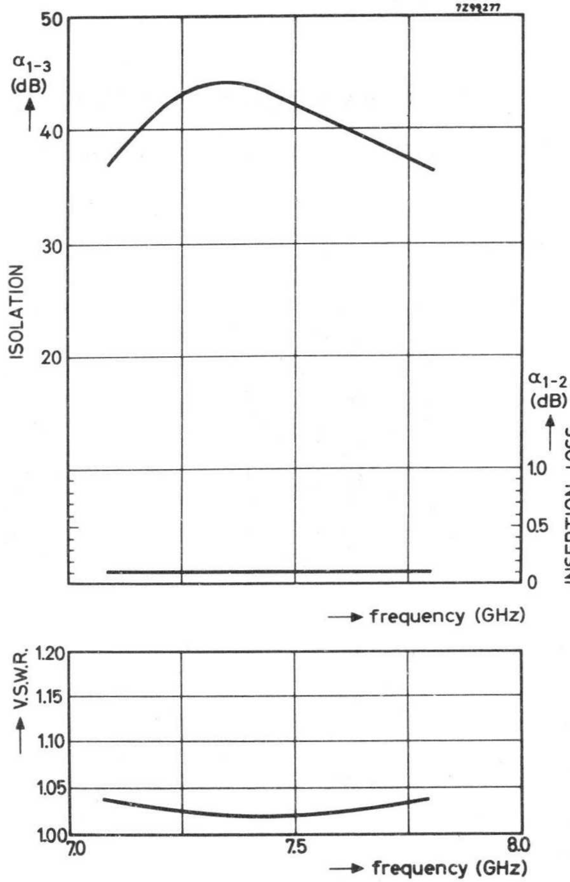


Fig.2

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 5.925 to 6.425 GHz

DIMENSIONS (in mm)

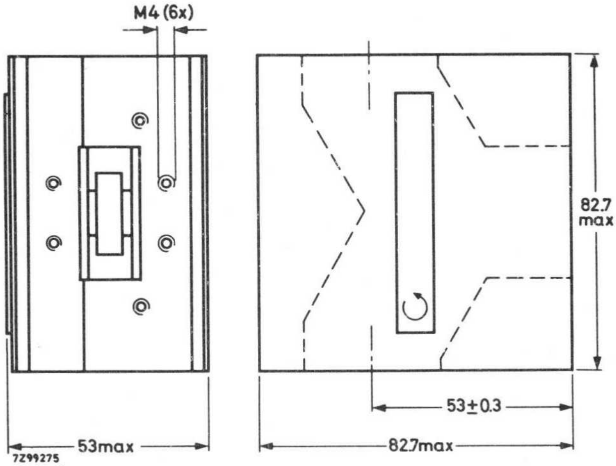


Fig.1

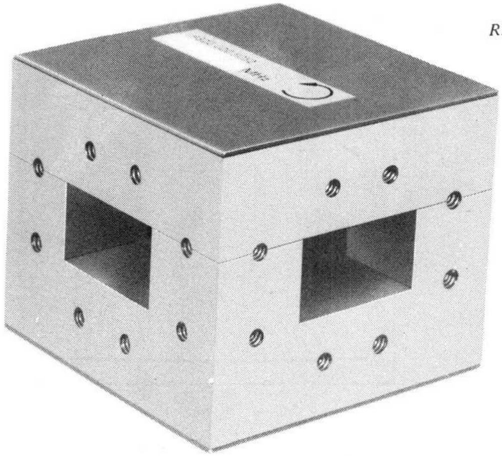
ELECTRICAL DATA

Frequency range	5.925 to 6.425 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.2 dB
V.S.W.R.	< 1.06
Maximum power	100 W
Temperature range	$-10\,^{o}C$ to $+70\,^{o}C$ For other temperature ranges please inquire

MECHANICAL DATA

Material of waveguide and flanges	Aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	approx 950 g

CIRCULATOR



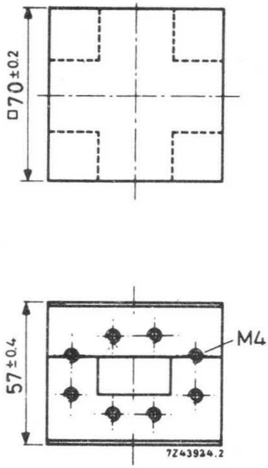
RZ 21478-1.1

ELECTRICAL DATA

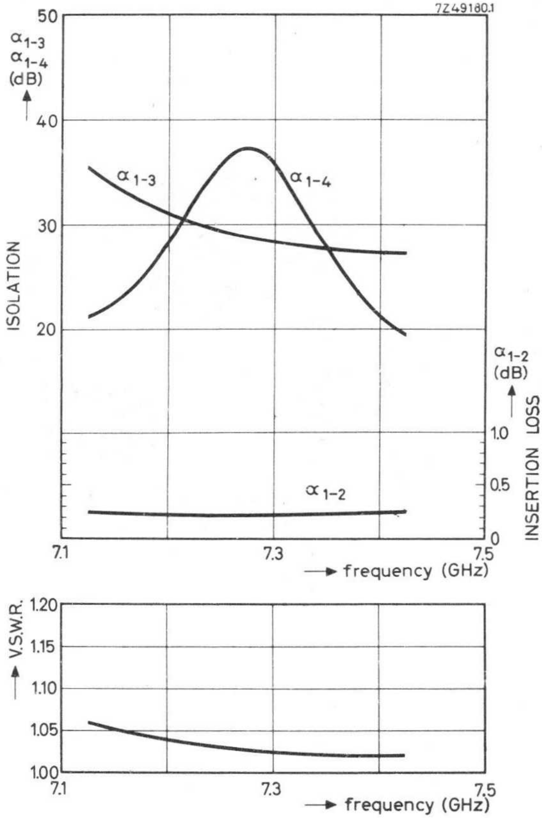
Frequency range	7.125-7.425 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



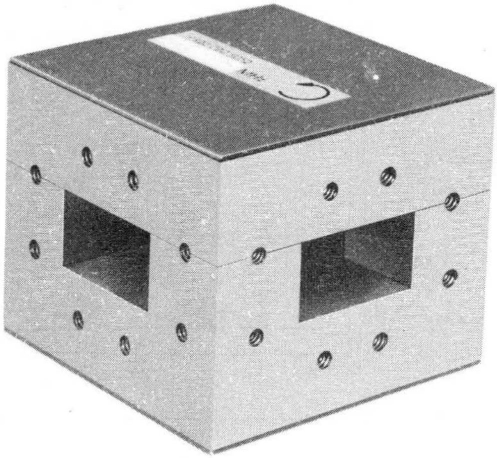
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-1.1

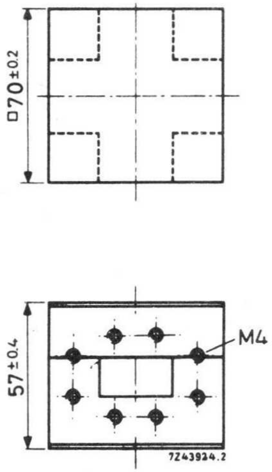


ELECTRICAL DATA

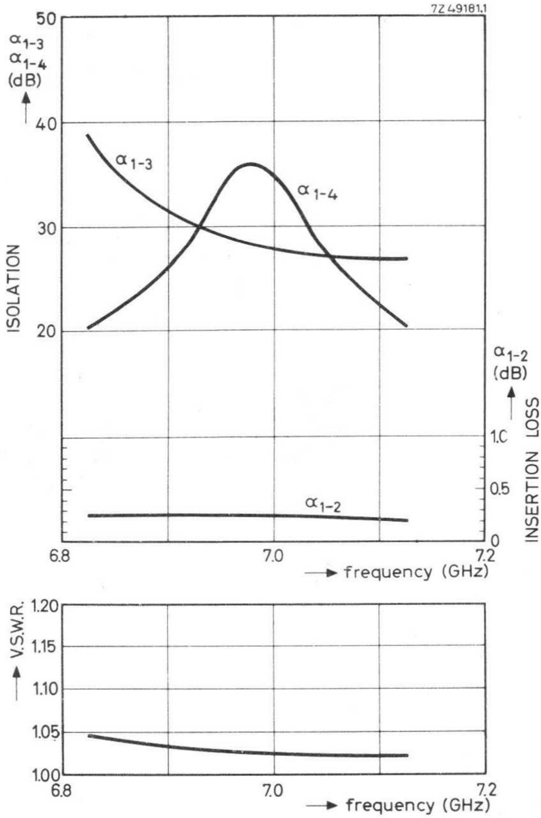
Frequency range	6.825-7.125 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.4
V.S.W.R.	< 1.08
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 $^{\circ}$C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



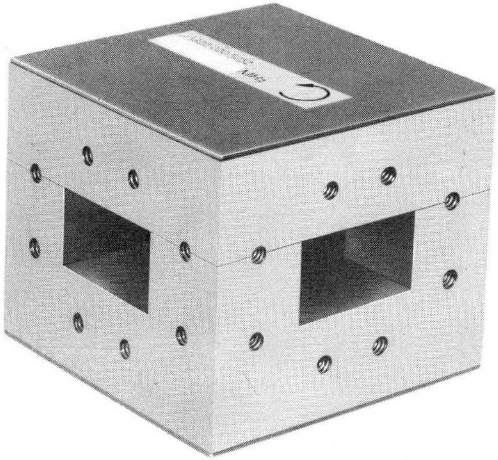
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-1.1

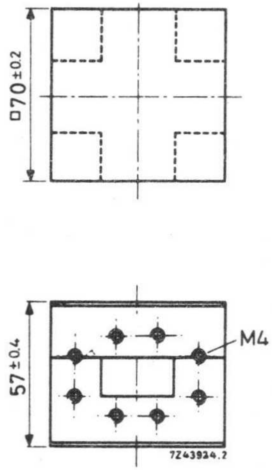


ELECTRICAL DATA

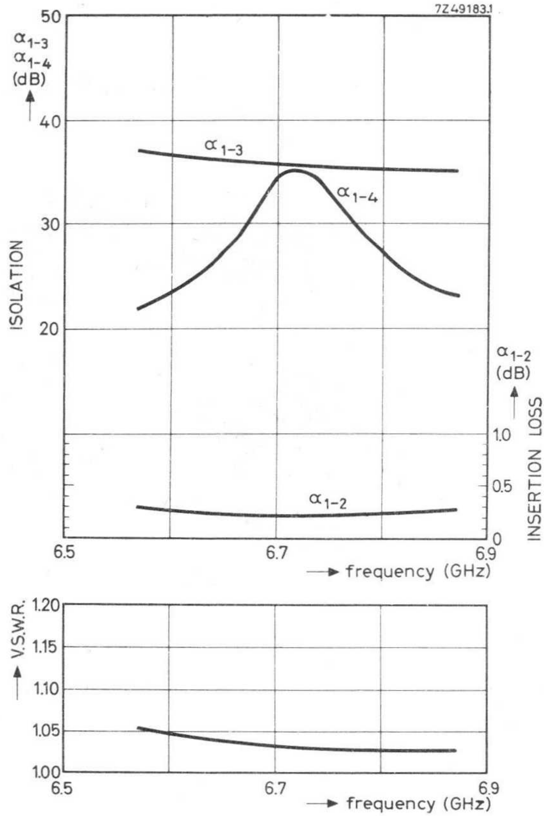
Frequency range	6.575-6.875 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



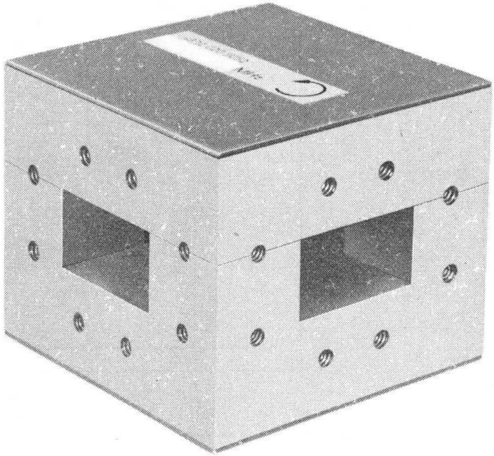
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-1.1

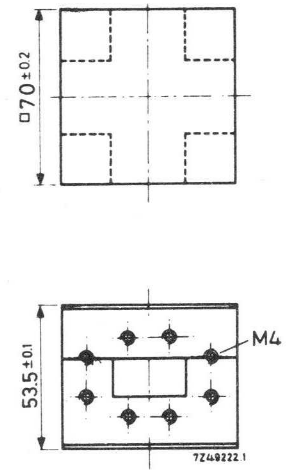


ELECTRICAL DATA

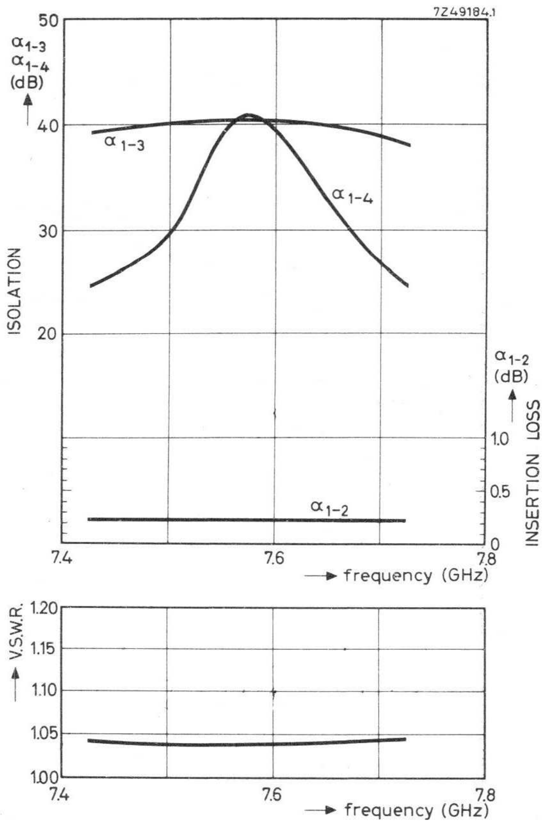
Frequency range	7.425-7.725 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



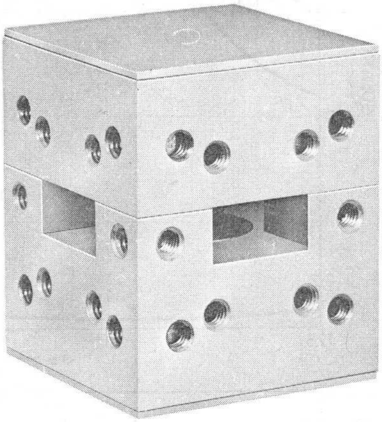
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-3

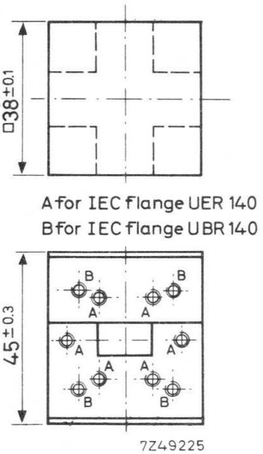


ELECTRICAL DATA

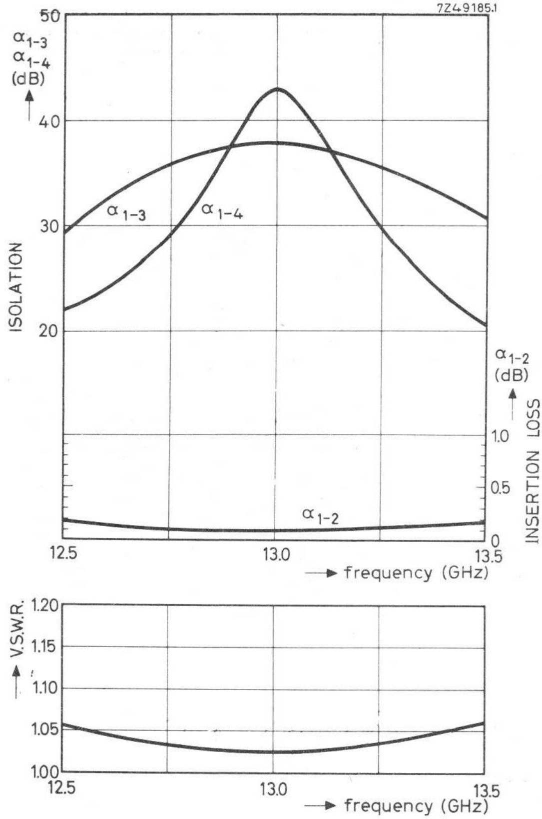
Frequency range	12.5 - 13.5 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+ 10 to + 60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER140 and UBR140 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey
Weight	320 g

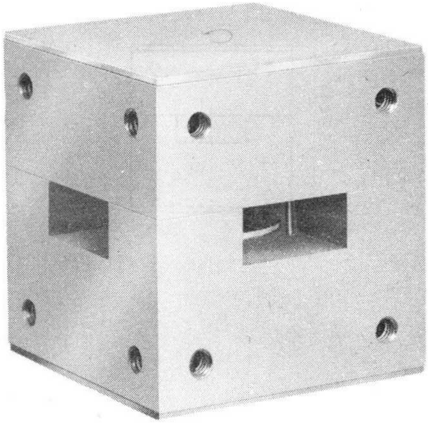


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

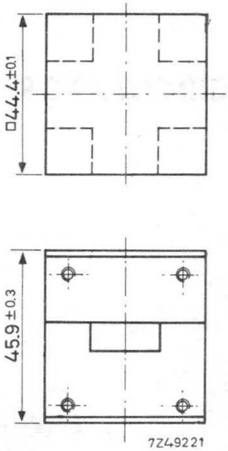


ELECTRICAL DATA

Frequency range	10.7-11.7 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

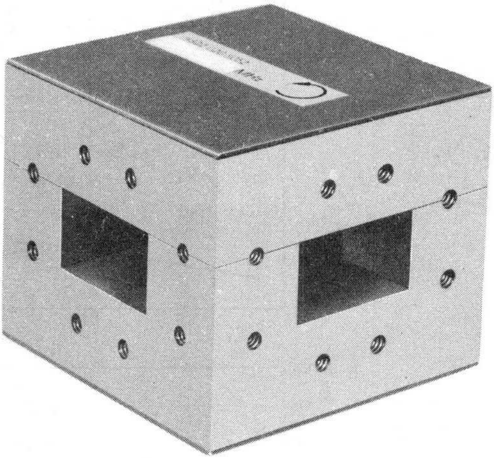
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UBR 100 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey
Weight	390 g



Dimensions in mm.

CIRCULATOR



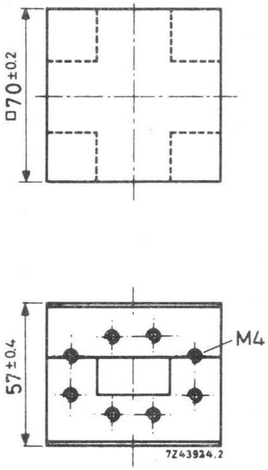
RZ 21478-1.1

ELECTRICAL DATA

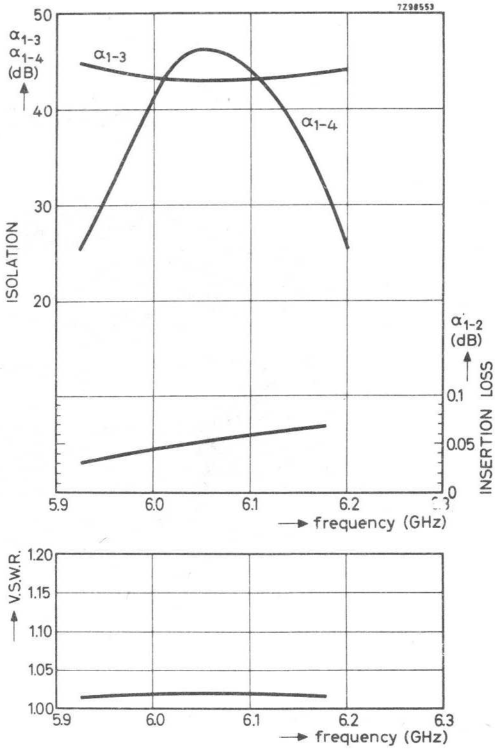
Frequency range	5.925–6.175 GHz
Isolation α_{1-3}	> 33 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

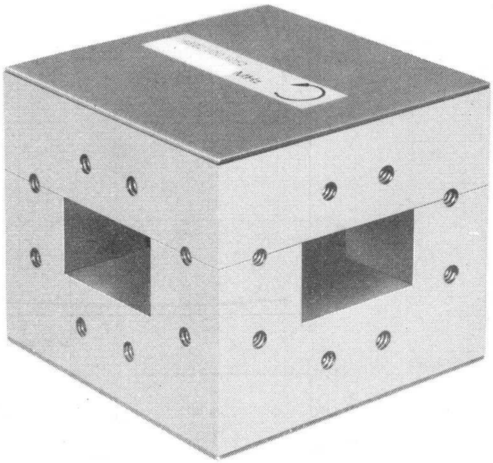


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



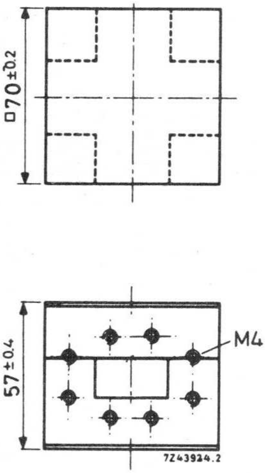
RZ 21478-1.1

ELECTRICAL DATA

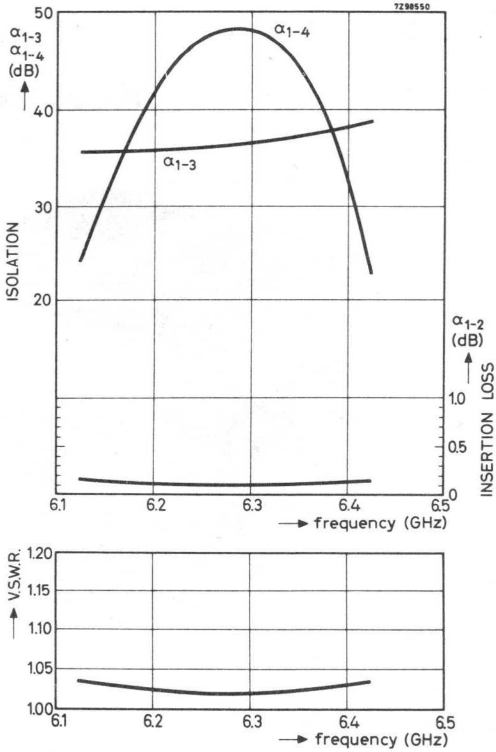
Frequency range	6.125-6.425 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.06
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



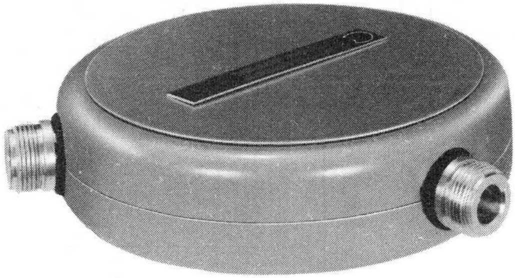
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-9

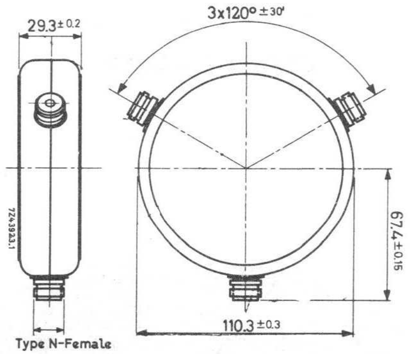


ELECTRICAL DATA

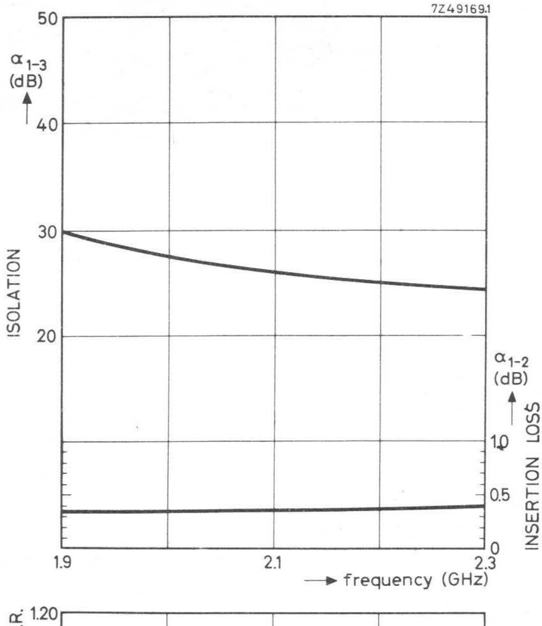
Frequency range	1.9-2.3 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.75 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	50 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

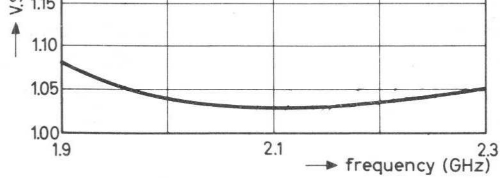
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	600 g



Dimensions in mm

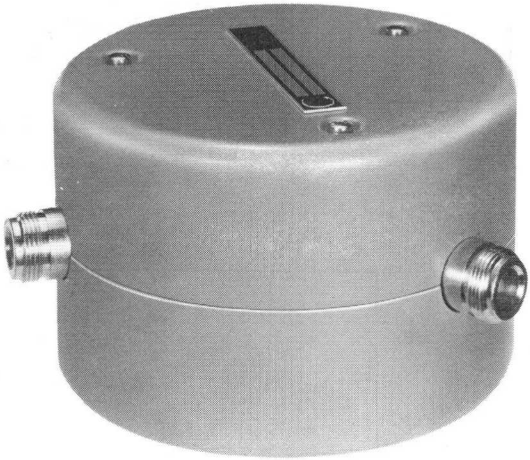




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-8

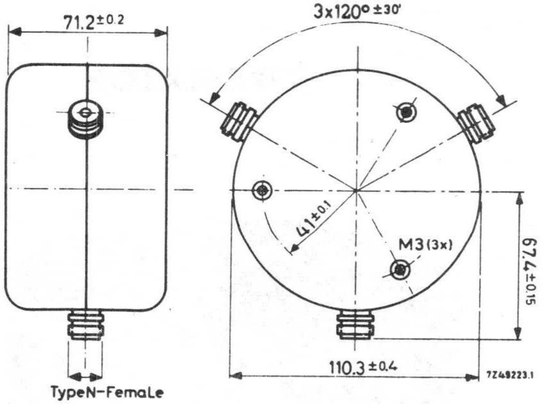


ELECTRICAL DATA

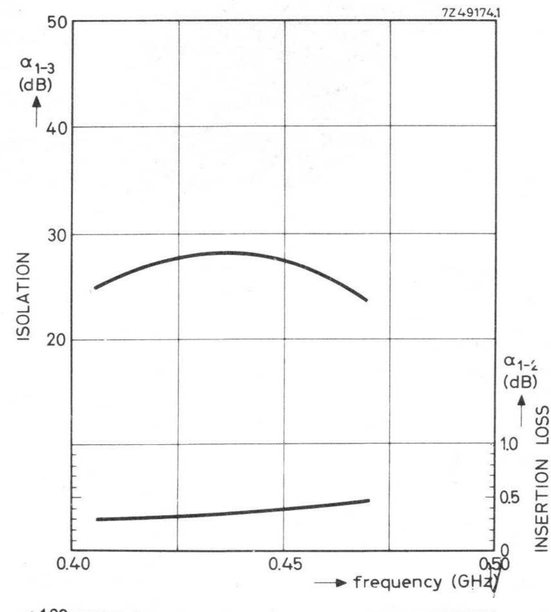
Frequency range	0.406-0.470 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C
	For other temperature ranges please inquire

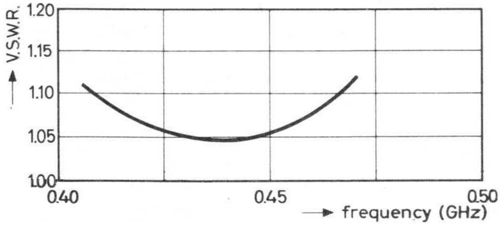
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g



Dimensions in mm

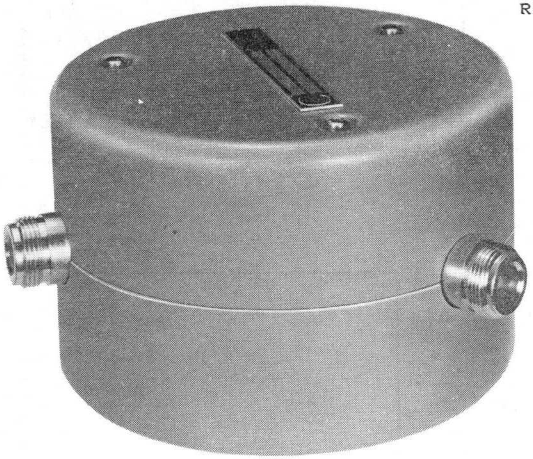




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-8

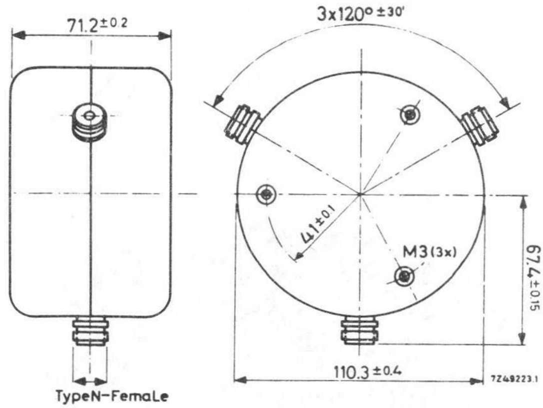


ELECTRICAL DATA

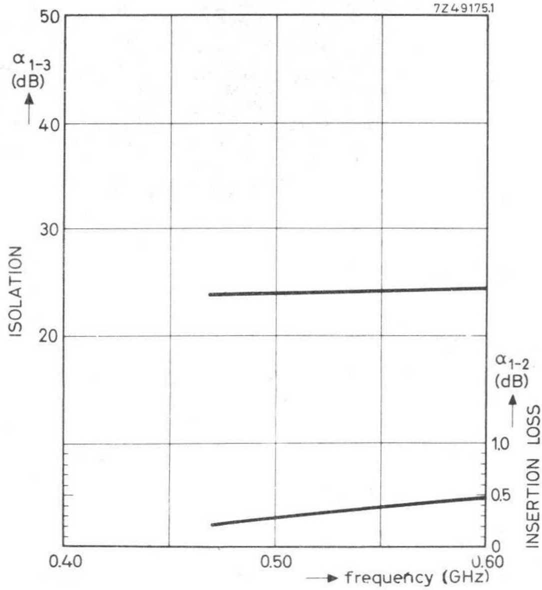
Frequency range	0.47-0.60 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

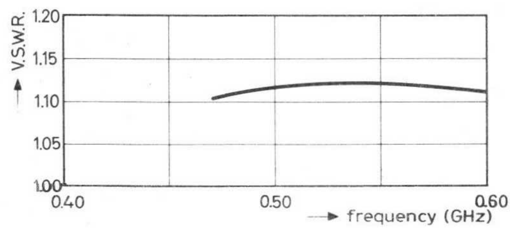
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g



Dimensions in mm

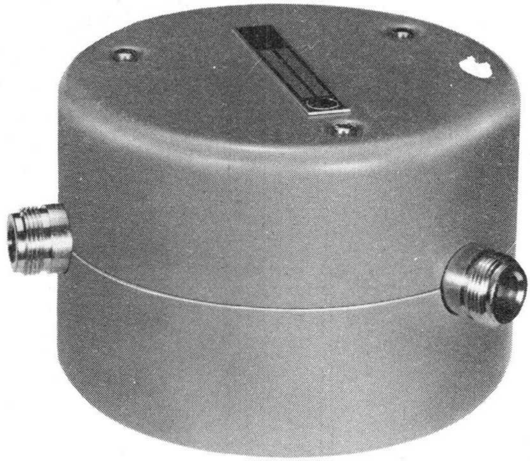




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-8

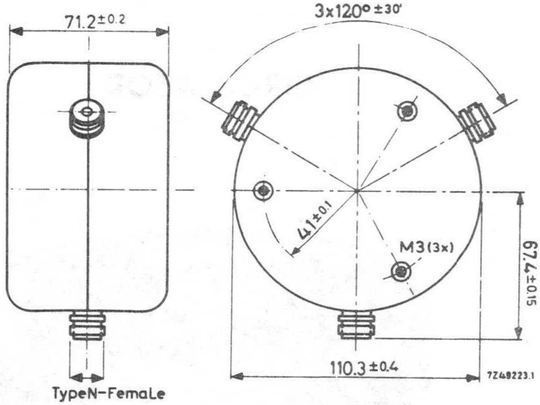


ELECTRICAL DATA

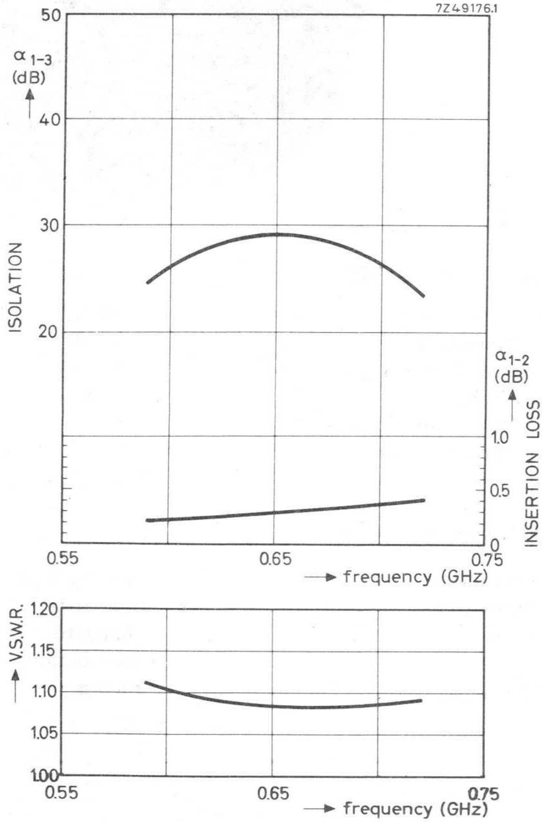
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g



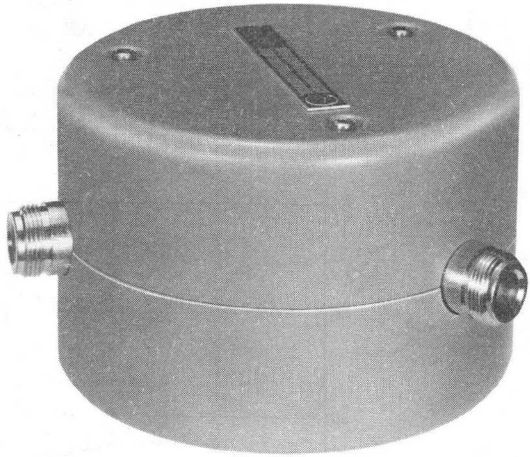
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-8

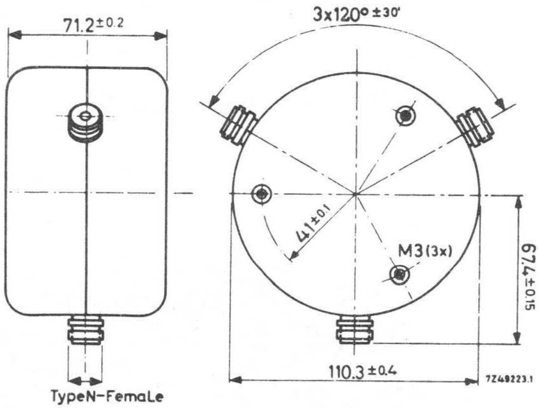


ELECTRICAL DATA

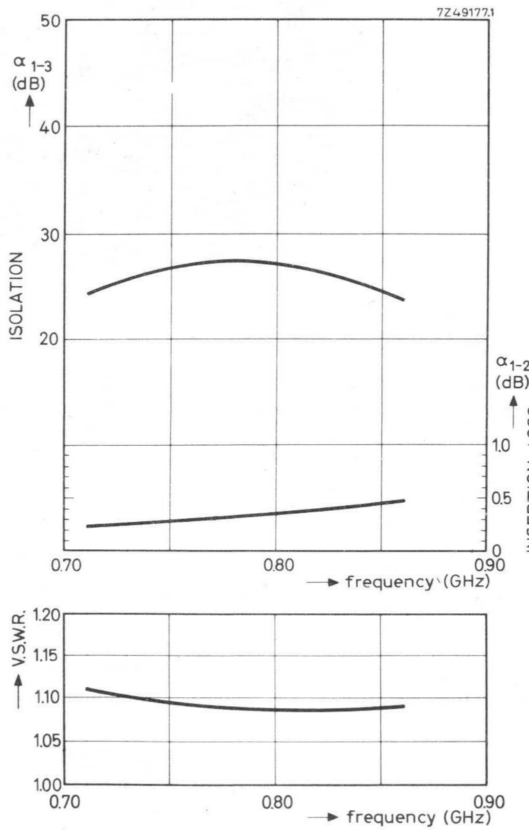
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g



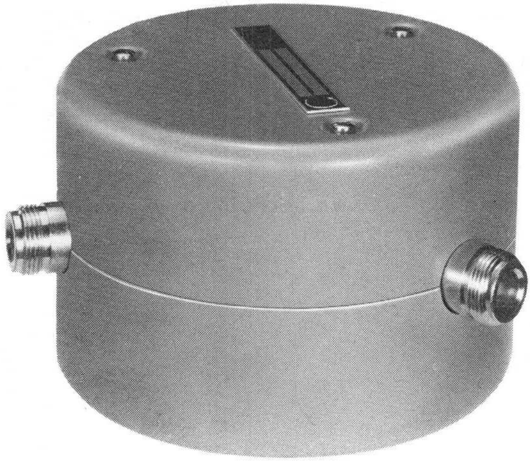
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

RZ 21478-8

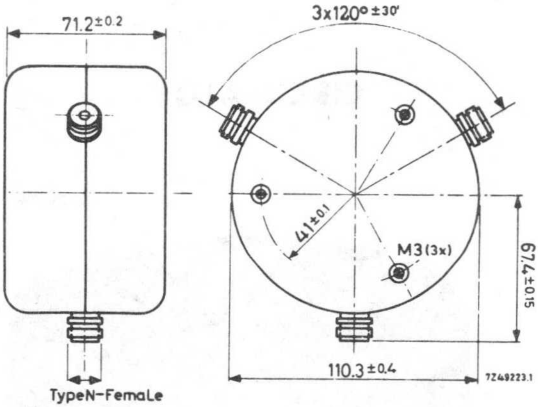


ELECTRICAL DATA

Frequency range	0.45-0.55 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

MECHANICAL DATA

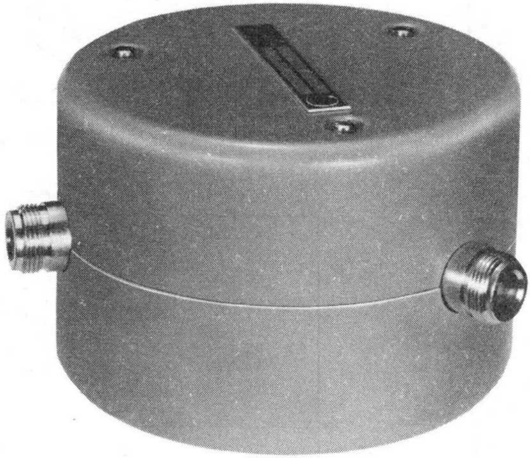
Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g



Dimensions in mm

CIRCULATOR

RZ 21478-8

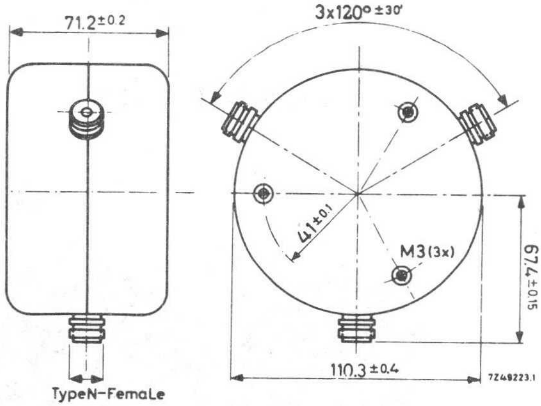


ELECTRICAL DATA

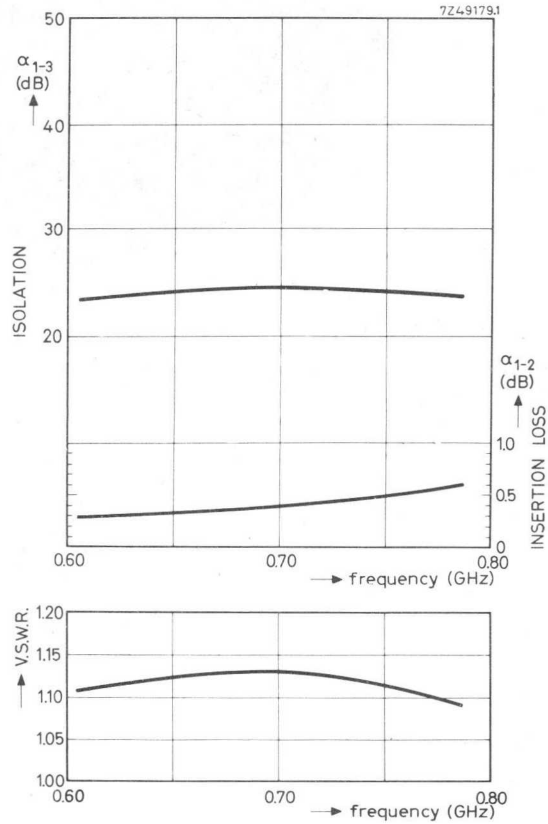
Frequency range	0.608-0.783 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.75 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated body outside enamelled grey
Weight	2080 g

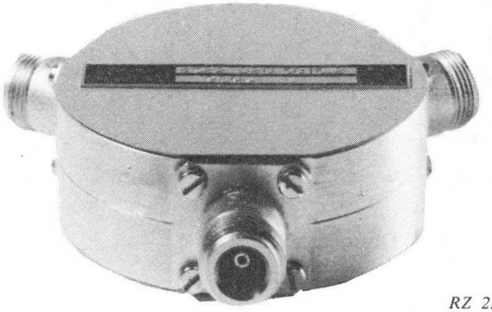


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



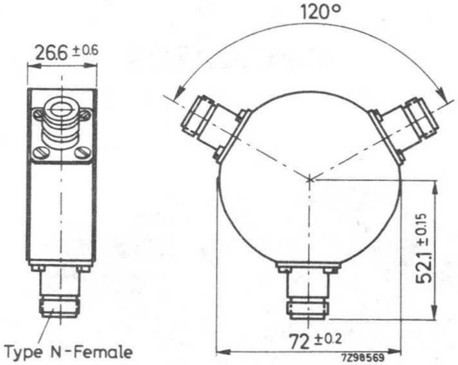
RZ 22967-1

ELECTRICAL DATA

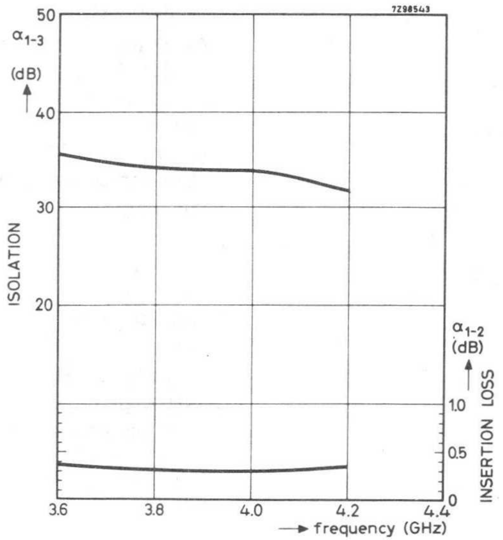
Frequency range	3.6-4.2 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.5 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	50 W
Temperature range	+10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Material	brass
Terminations	type N-female
Finish	silverplated, top and bottom cover black
Weight	550 g

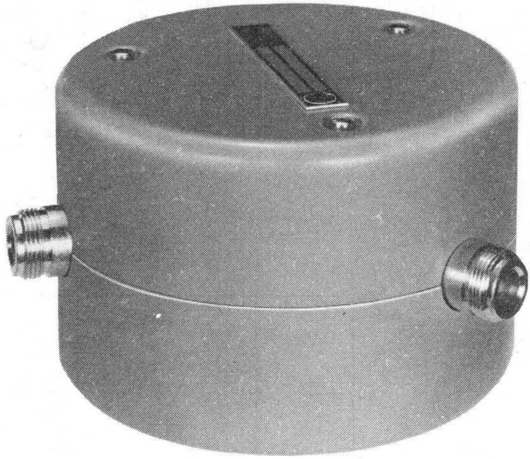


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C

CIRCULATOR



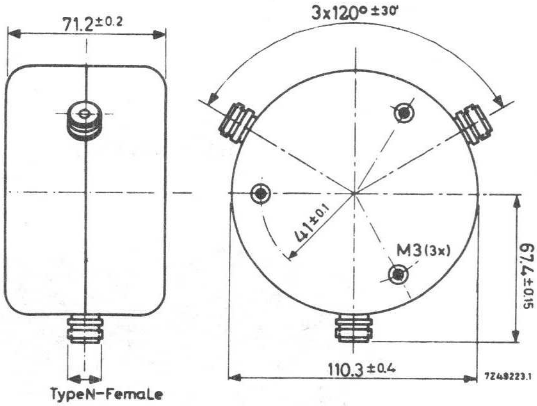
RZ 21478-8

ELECTRICAL DATA

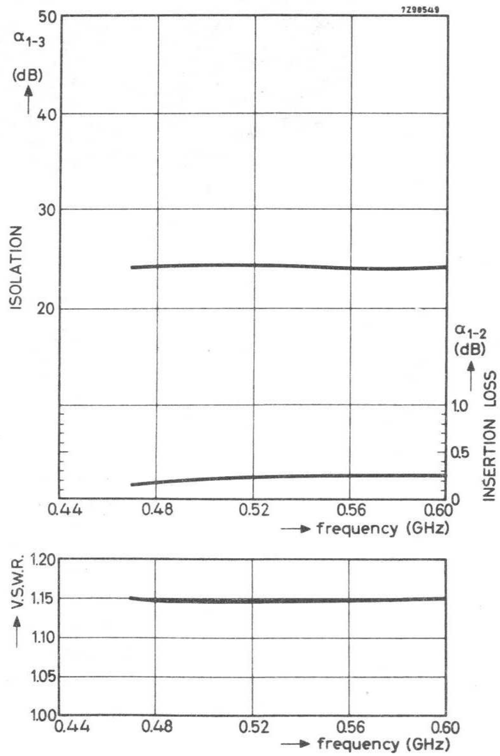
Frequency range	0.47-0.60 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

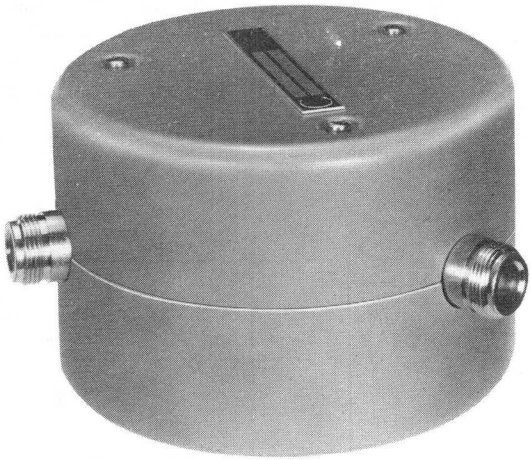


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



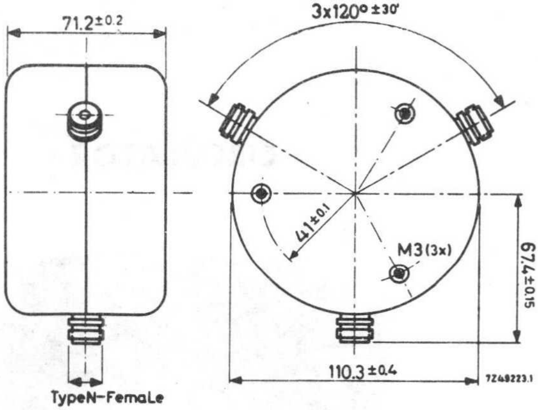
RZ 21478-8

ELECTRICAL DATA

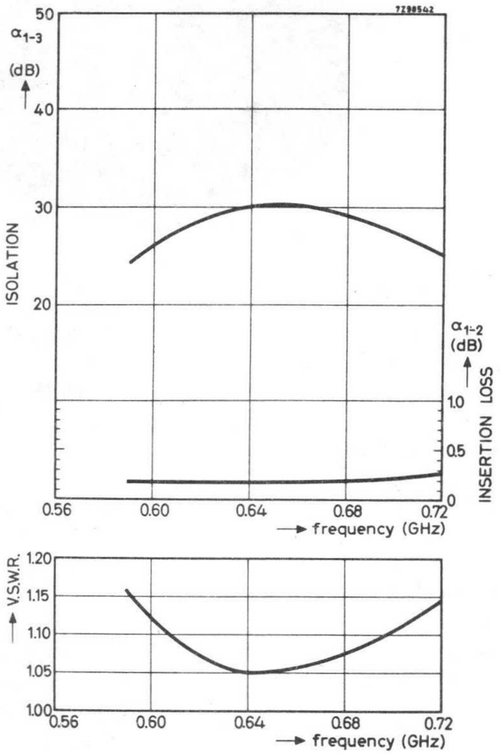
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 $^{\circ}$C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

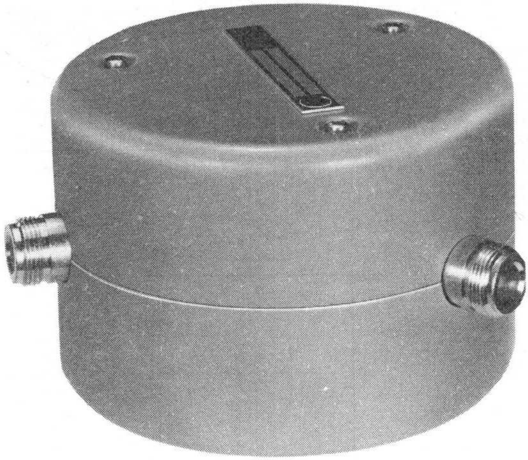


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



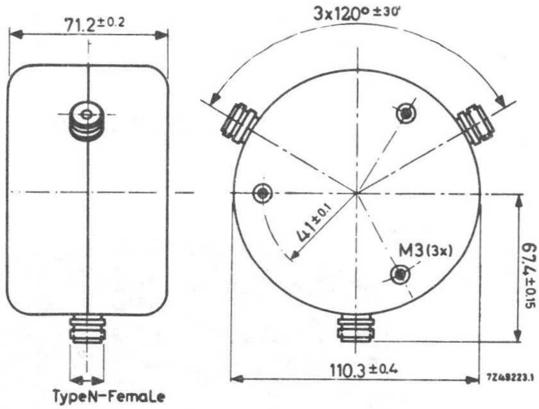
RZ 21478-8

ELECTRICAL DATA

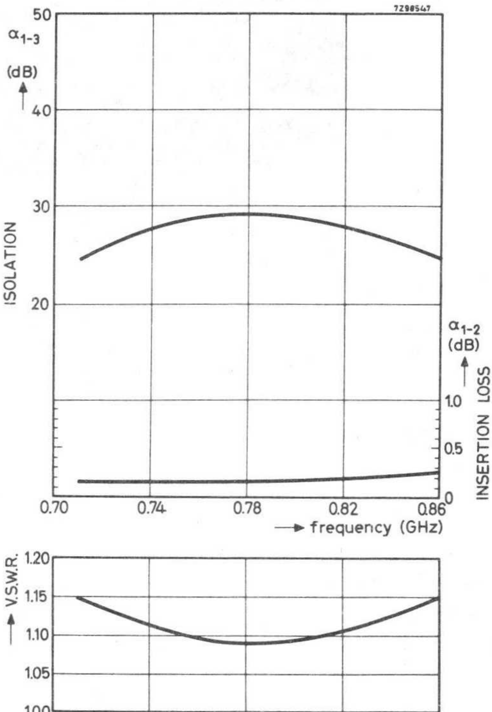
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

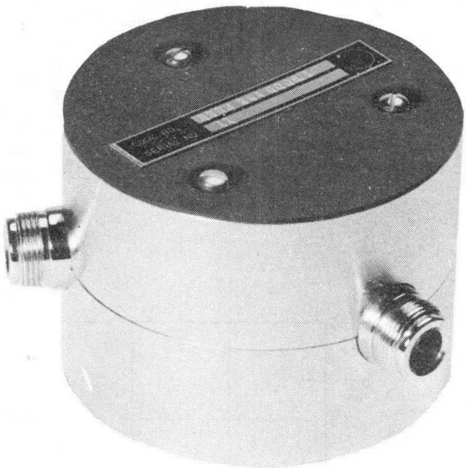


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



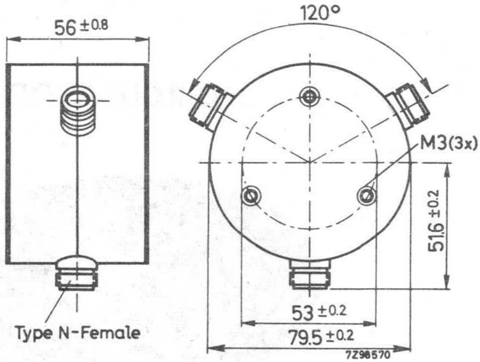
RZ 24733-1

ELECTRICAL DATA

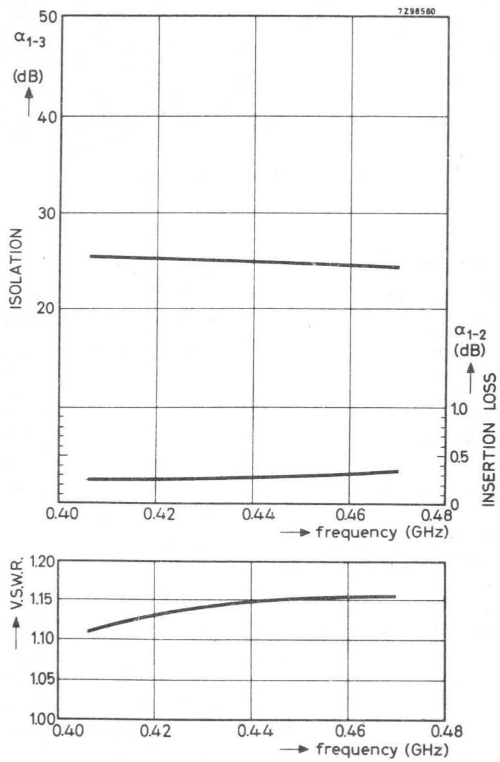
Frequency range	0.406-0.470 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g

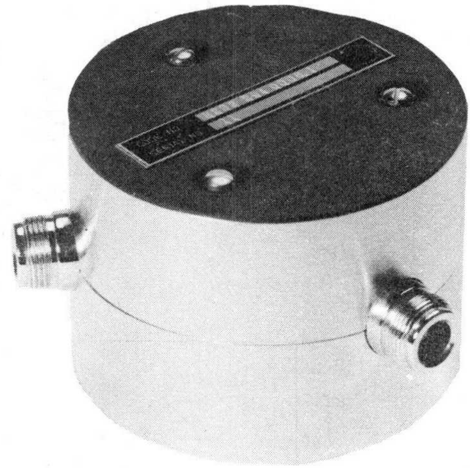


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



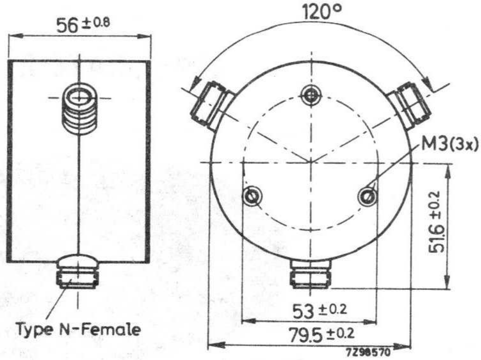
RZ 24733-1

ELECTRICAL DATA

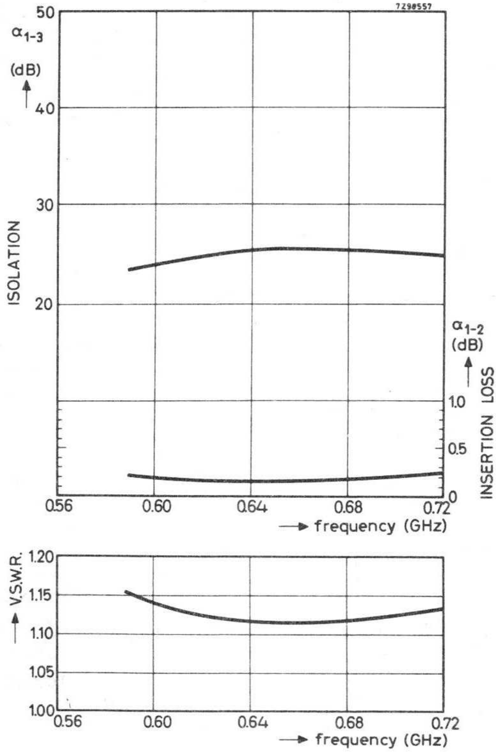
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 $^{\circ}$C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g

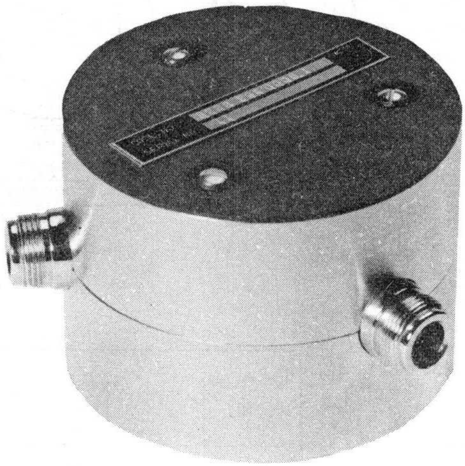


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



RZ 24733-1

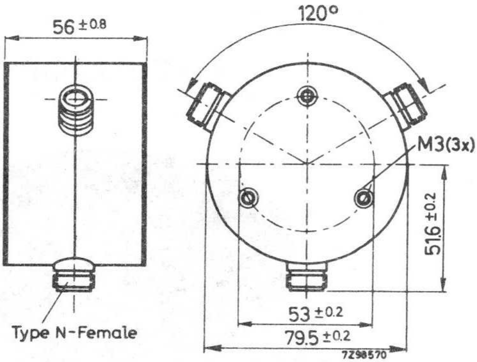
ELECTRICAL DATA

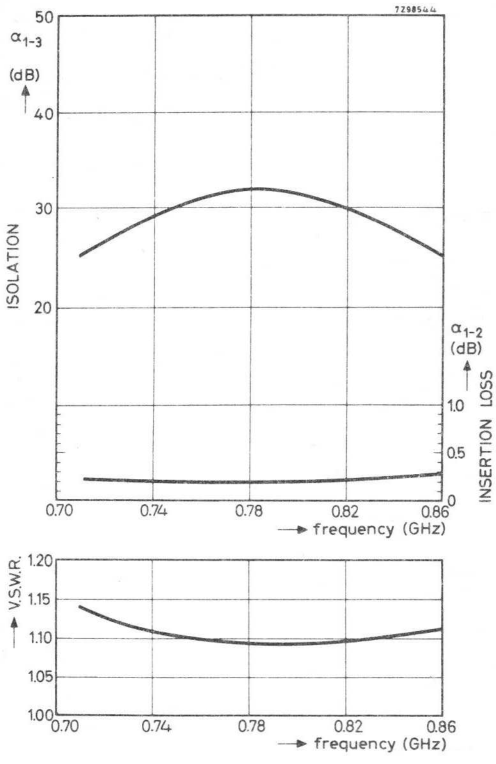
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g

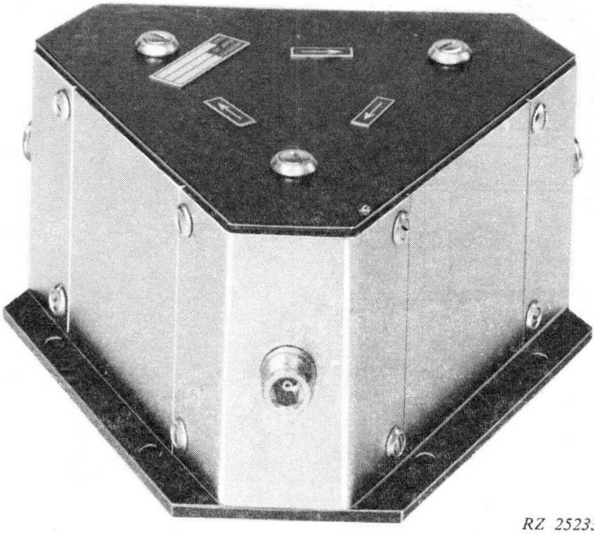
Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



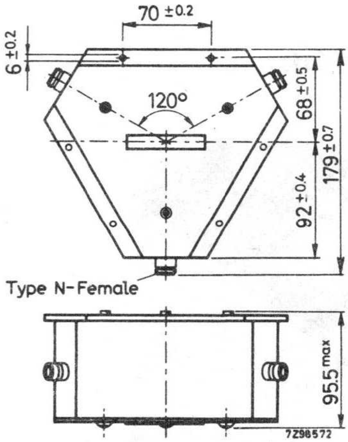
RZ 25233-1

ELECTRICAL DATA

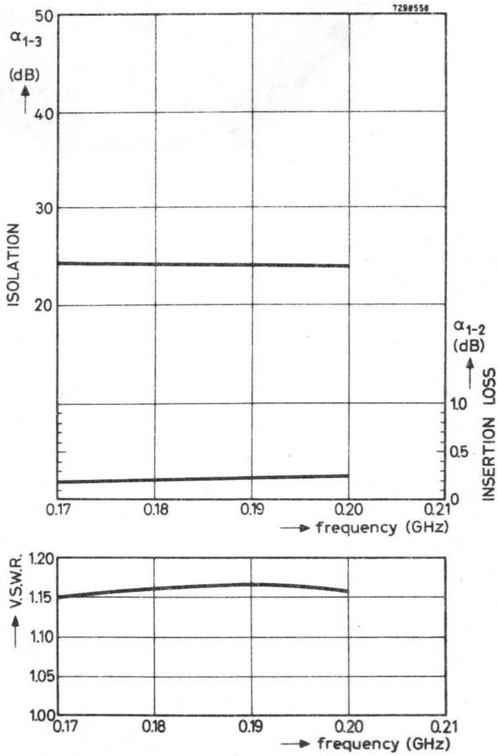
Frequency range	0.17-0.20 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	+10 to +100 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	body nickelplated connectors silverplated top and bottom cover black
Weight	6400 g

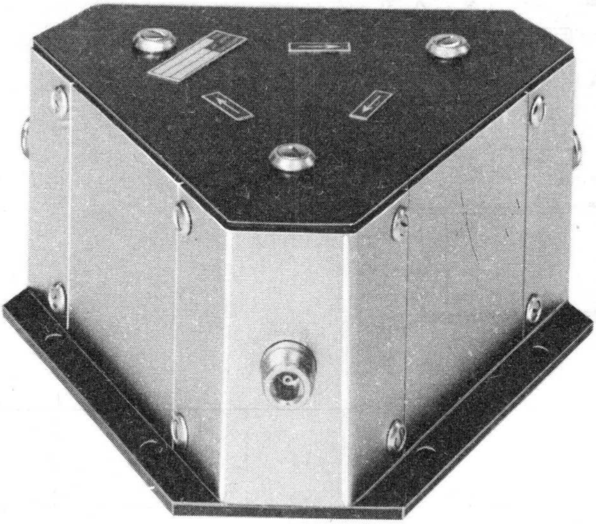


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR



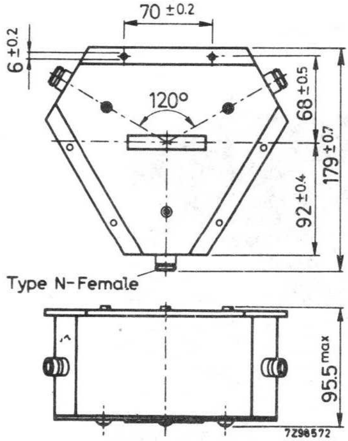
RZ 25233-1

ELECTRICAL DATA

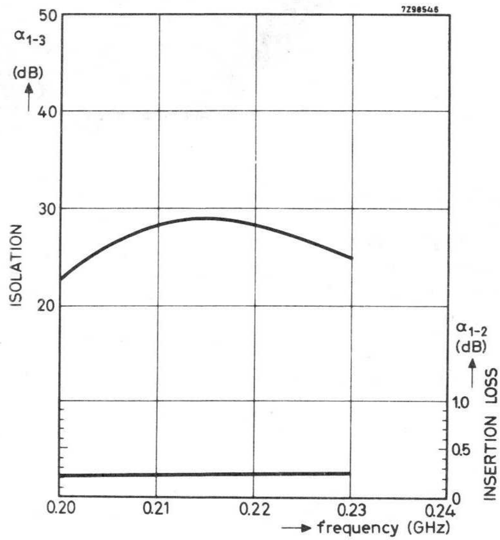
Frequency range	0.20-0.23 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	+10 to +100 °C For other temperature ranges please inquire

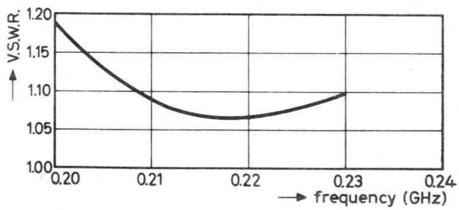
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	body nickelplated connectors silverplated top and bottom cover black
Weight	6400 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

COAXIAL 3-PORT CIRCULATOR

Frequency 370 to 402 MHz

DIMENSIONS (in mm)

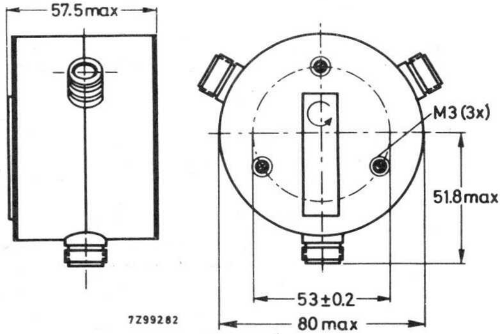


Fig.1

ELECTRICAL DATA

Frequency range	370 to 402 MHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Temperature range	−10 to +70 °C. For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	1200 g

Typical performance as a function of frequency at an operating temperature of 20 °C

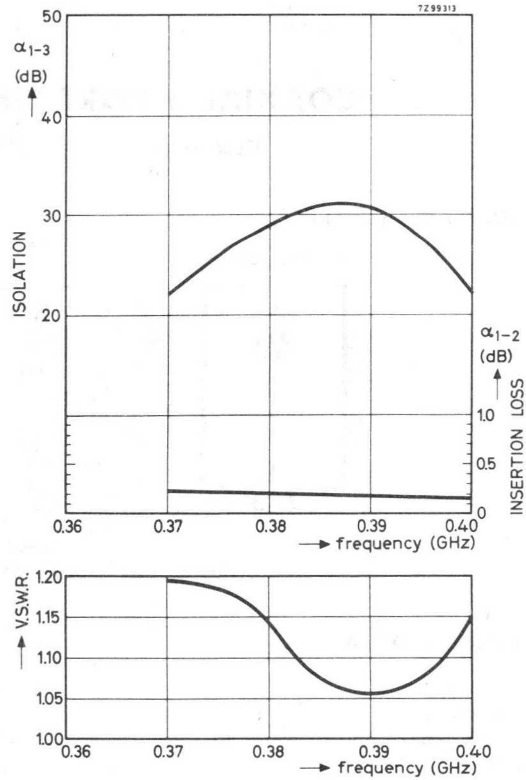


Fig. 2

COAXIAL 3-PORT CIRCULATOR

Frequency 445 to 485 MHz

DIMENSIONS (in mm)

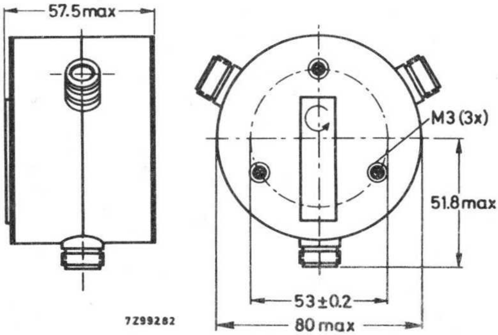


Fig. 1

ELECTRICAL DATA

Frequency range	445 to 485 MHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	1200 g

COAXIAL 3-PORT CIRCULATOR

Frequency 710 to 860 MHz

DIMENSIONS (in mm)

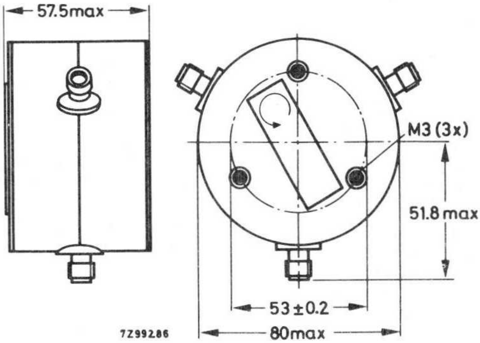


Fig. 1

ELECTRICAL DATA

Frequency range	710 to 860 MHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Connector type	TNC female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	1200 g

Variable mains transformers

For survey, see pages E4 and E5

INTRODUCTION

APPLICATION

The main fields of our variable transformers are:

distortion free voltage control for
- measuring equipment
- voltage stabilisers etc.

power control for
- electric heating
- heat sealing of plastics
- motor speed

current control for
- galvanising plants

light control in
- hotels, cinema's, homes

ventilation control in
- buildings, live stock houses, green houses, etc.

They have the following features:

continuous voltage control

small dimensions and high efficiency by using core material of high quality

very low stray losses by using toroid coil shape and specially treated contact surface with low and stable contact resistance between brush and contact surface resulting in low losses at the most critical place

corrosion proof

long life carbon brushes and smooth contact surface

simple coupling in parallel or three-phase combinations

adjustable spindle length

low coil resistance

high overload characteristics.

SURVEY

Conventional types (core sizes C1-C6)

nom. input voltage (V)	no-load output voltage (V)	nom. output current (A)	$I_{max.}$ (A)	core size	catalogue number 2422 530 ..... bench model with knob	panel model without knob	laboratory model with terminals	laboratory model with socket	page
130	0-150	2.5	3.2	C1		02306			E29
		5	6.3	C2		03306			
		10	12.6	C3		04306			
220	0-220	6.5	7.5	C3		14406			E29
		10	12	C4		15406			E29
		15	18	C5		16407			E39
220	0-260	1	1.4	C1	02401	02406			E29
		2.5	3.2	C2	03401	03406		03405	
		5	6.3	C3	04401	04406	04404	04405	
		8.5	11.2	C4	05401	05406	05404	05405	
		12	15	C5		06407			E39
		23	30	C6	07401	07406			E45
240	0-270	1	1.4	C1	02501	02506			E29
		2.5	3.2	C2	03501	03506			
		5	6.3	C3	04501	04506			
		8.5	11.2	C4	05501	05506			
		12	15	C5		06507			E39
	0-260	23	30	C6	07501	07506			E45

→

core size designation	core diameter (mm)	core height (mm)
E1	85	45
E2	85	58
E3	85	77.5
E4	107	86
C1	106	110
C2	127	112
C3	158	117
C4	185	120
C5	200	116
C6	314	141

Encapsulated types (core sizes E1-E4)

nom. input voltage (V)	no-load output voltage (V)	nom. output current (V)	Imax. (A)	core size	catalogue number 2422 530	page
60	0-60	1.2	1.32	E1	00007	E13
220 or 240	110-220 or 0-110 or 120-240 or 0-120	0.5	0.55	E1	00407	
70	0-70	5.5	5.5	E4	13707	E25
115 or 130	0-130	1.2 1.4	1.4 1.7	E2	01607 11607	E17
220	0-220	0.83 1.4 2.5	1 1.7 3	E2 E3 E4	11407 18407 13407	E17 E21 E25
220 or 240	0-240	0.7	0.83	E2	01407	E17
220 or 260	0-260	1.2 2	1.4 2.4	E3 E4	08407 03407	E21 E25
240 or 260	0-260	2	2.4	E4	03507	E25

Types with separate windings

nom. input voltage (V)	no-load output voltage (V)	nom. output current (A)	core size	catalogue number 2422 529 ..... bench	catalogue number 2422 529 ..... panel	page
220	0-250	3	C4	00005	00006	E79

OPERATIONAL NOTES

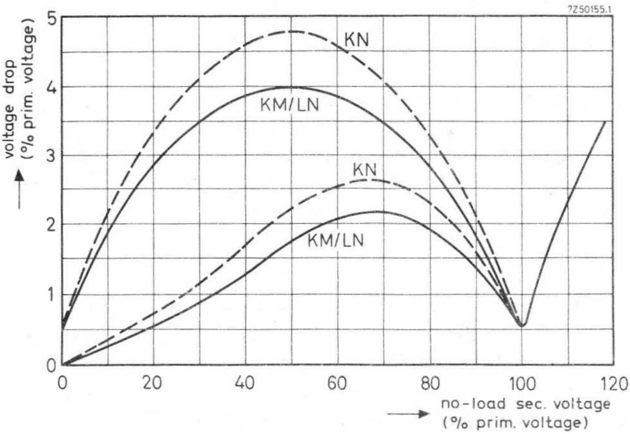
Voltage drop

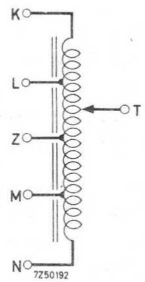
Due to copper losses and brush losses the secondary voltage will drop proportionally to the value of the secondary current drawn.

The graphs show the voltage drop as a function of the secondary voltage for 0.7 A to 2.5 A transformers, and for 5 A to 23 A transformers respectively.

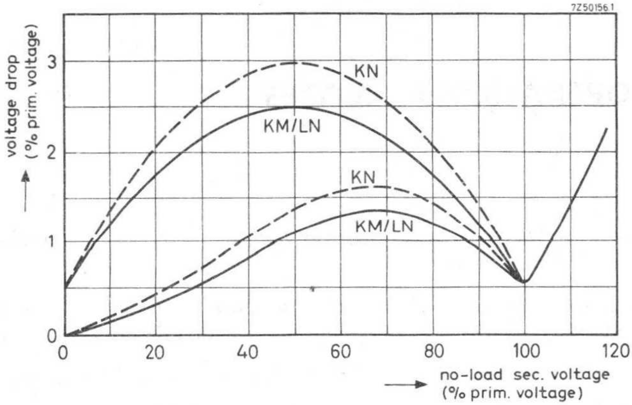
All the graphs apply to the rated output current, the full lines to overvoltage connection and the broken lines to 0-100% connection.

Each lower pair of graphs apply to a constant impedance load.





Transformers 0.7 A to 2.5 A



Transformers 5 A to 23 A

Overload protection and inrush current

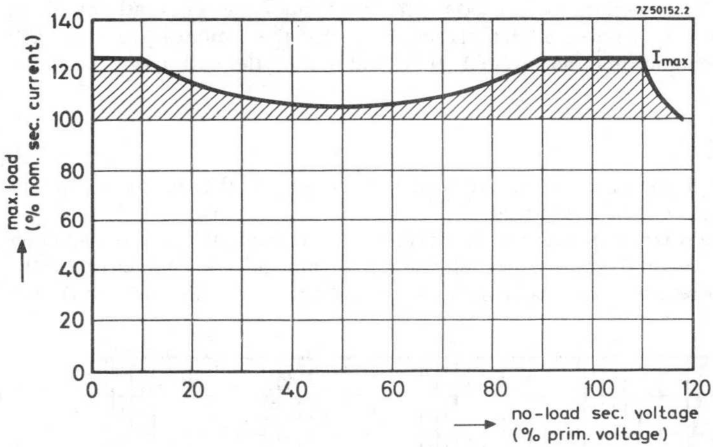
Protection of the transformer can be effected by inserting appropriate overload protection in the output line.
Due to the high permeability of the core material, high inrush currents (up to 20 times the nominal current) may occur. Although these phenomena last only a few cycles, and will not damage the transformer, primary fuses may be blown. It is therefore necessary to employ delayed fuses or other delayed protection devices. In general a delayed fuse of min. $2xI_{max}$ will do.

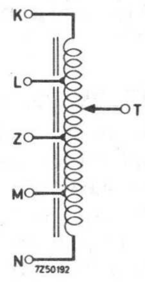
Continuous overload (Imax.)

In an autotransformer the distribution of the currents, and consequently the copper losses and heat generation in the windings, depends on the brush position. The nominal continuous current is defined by the most unfavourable brush position (corresponding to 50% of the input voltage) and the cooling capacity of the transformer. Starting from that cooling capacity it is obvious that the secondary current value may be adapted to the brush position. Measurements on the 220 V/240 V types have shown that a certain overload is permissible within 15 V from the primary tappings. For the 130 V types the ratings are proportional. Ambient temperature is 40 ^{o}C.

In the graphs the maximum load is plotted as a function of the no-load secondary voltage which corresponds with the brush position. For the values of primary voltage, nominal secondary current and "I_{max}" see under Electrical Data in the data sheets.

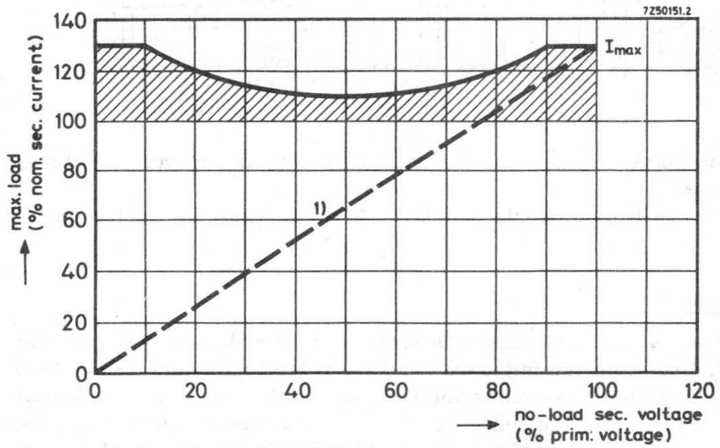
KM/LN connections

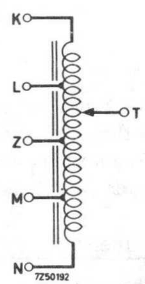




When the ends of the winding are connected to the mains, an even higher overload is permitted. Ambient temperature is 40 °C.

KN connection

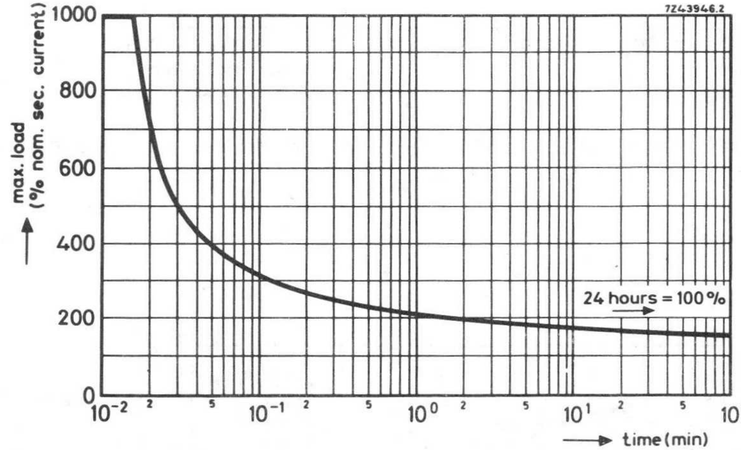




If any doubt arises as to the cooling, do not overload the transformer. A considerable overload can be tolerated if the transformer, and especially the brush track contact is artificially cooled or immersed in oil. Since this depends greatly on given circumstances, the only hard-and-fast directive is that the temperature rise (ΔT) of the brush track contact may not exceed 90 ^{o}C and that of the coil may not exceed 50 ^{o}C.

Momentary overloads

Due to the improved construction of the brush track and of the brush gear, high momentary overloads can be permitted.
The curve gives the relation between max. permissible load and time. It is based on the maximum permissible temperature of the brush and on the unfavourable 50% brush position. Therefore, after occasional overloading, no cooling of the transformer is required.



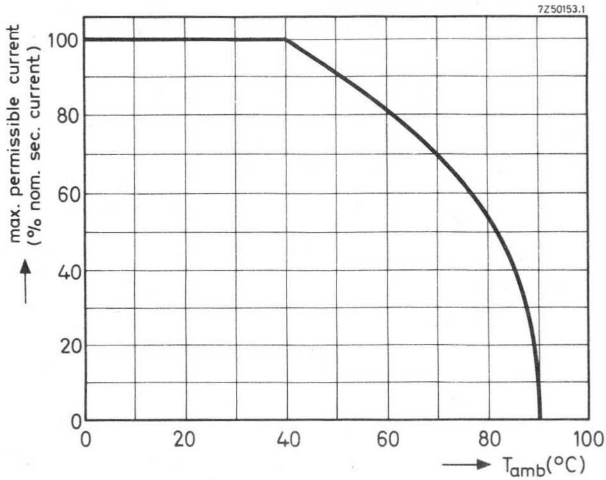
For other secondary voltages the curve can be combined with the overload curves of the preceding pages.
To avoid damage to the brush and the track the absolute limit for instantaneous loads is 1000%.

Influence of the frequency

The core material has a practically constant specific no-load loss for frequencies of 50 to 400 Hz. The values given in the data sheets, refer to a mains frequency of 50 Hz. For lower frequencies the mains voltage must be decreased proportionally to avoid saturation of the core, and hence excessive core losses. Theoretically, the mains voltage can be increased for higher frequencies. However, the brush losses, being related to the voltage per winding, would cause overheating of the brush contact point. For this reason it is not advisable to increase the input voltage.

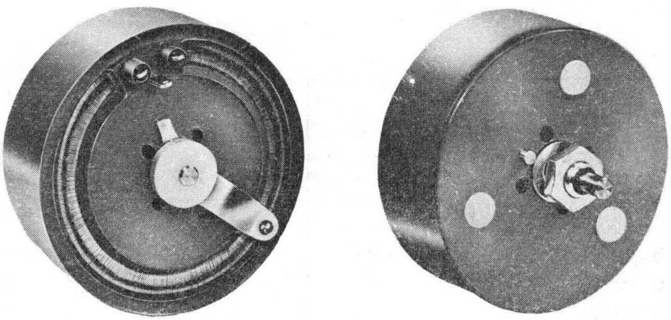
Derating for higher ambient temperatures

The nominal data refer to a maximum ambient temperature of 40 °C.
For higher temperatures the current must be derated in conformity with the figure below.



This curve is also based on the 50% brush position and should be combined with figures of preceding pages for different conditions.

MOULDED VARIABLE MAINS TRANSFORMERS
0.5 A , 1.2 A



Input voltage	60 V, 240 V
Output voltage	0-60 V, 0-240 V

APPLICATION

These variable transformers will find their main application in those cases, where up till now inefficient load potentiometers or adjustable series resistors are used. Besides, they can succesfully replace tapped transformers in some types of inductive voltage control.

CONSTRUCTION

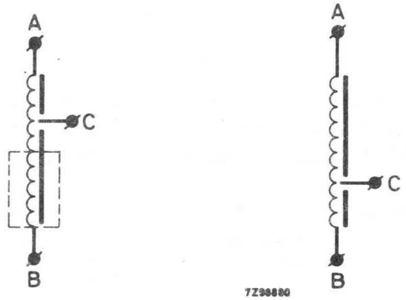
A length of enamelled copper wire is wound on an insulated ring-shaped core of high-permeability laminations. A brush track is then formed by partly removing the wire insulation, after which the transformer is encapsulated in reinforced polyester resin.
The moulding protects the winding and improves the cooling capacity.
The coils of the 220 V/240 V types are wound in two layers. The upper layer forms the brush track, so that the brush sweeps half the total winding.

ELECTRICAL DATA

Frequency range	50 - 400 Hz
Insulation resistance between winding	
and spindle	> 10^4 MΩ
after climate test	> 5 MΩ
Climatic robustness	conform I.E.C. 68, test C, 21 days
Test voltage for 1 min	2 kV, 50 Hz

input voltage (V)	output voltage (V)	direction of rotation *)	output connections	output current (A)		max. voltage drop at 50% position (V)	no-load losses (mW)
				I_{nom}	I_{max}		
catalog number 2422 530 00407							
220	110 - 220	CW	CB	0.5	0.55	20	< 800
	0 - 110	CCW	CA				
240	120 - 240	CW	CB				
	0 - 120	CCW	CA				
catalog number 2422 530 00007							
60	0 - 60	CW	CB	1.2	1.32	6	< 600
		CCW	CA				

2422 530 00407 2422 530 00007



*) Seen from extending spindle end,
CW = clockwise, CCW = counter clockwise

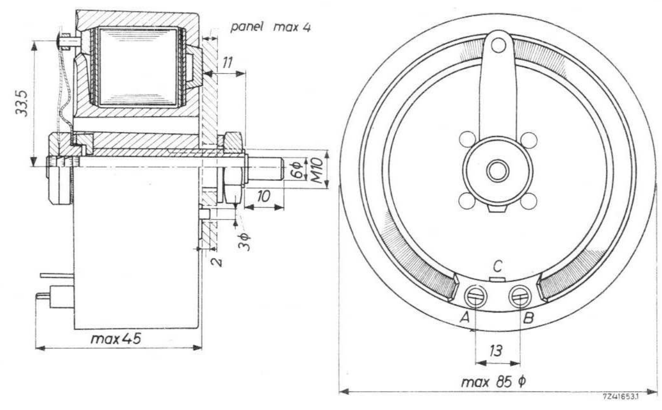
Note

If it is necessary to earth the output circuit, an isolating transformer must be connected between the mains and the variable transformer, so as to prevent short circuits.

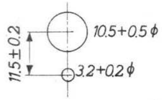
MECHANICAL DATA

Core size	E 1
Life	> 100 000 complete rotations
Life of all tested samples	> 250 000 complete rotations
Operating torque	0.03-0.07 Nm (0.3-0.7 kgcm)
Max. torque against endstop	1 Nm (10 kgcm)
Weight	700 g
Mounting	by means of threaded bush

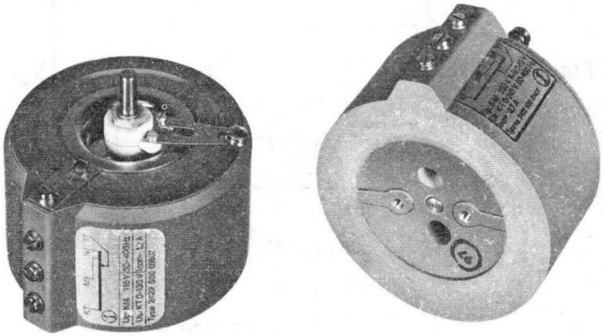
Dimensions in mm



Mounting holes



MOULDED VARIABLE MAINS TRANSFORMERS
0.7A, 0.83A, 1.2A, 1.4A



RZ 24762-4A

transformer	input voltage	output voltage	nominal output current
2422 530 01407	220 V/240 V	0-240 V	0.7 A
2422 530 11407	220 V	0-220 V	0.83 A
2422 530 01607	115 V/130 V	0-130 V	1.2 A
2422 530 11607	115 V	0-115 V	1.4 A

APPLICATION

These variable transformers will find their main application in those cases, where up till now inefficient load potentiometers or adjustable series resistors are used.
Besides they can succesfully replace tapped transformers in some types of inductive voltage control.

CONSTRUCTION

The transformers are moulded in reinforced polyester resin. The construction is rugged and professional.
The mounting hole pattern is simple, the support area is relatively wide, and the transformers are light enough to be mounted on thin chassis or panels.
The spindle is adjustable in length protruding at both sides. A different spindle of suitable length can be fitted.

ELECTRICAL DATA

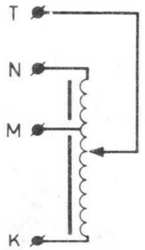


Fig.1

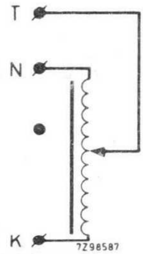


Fig.2

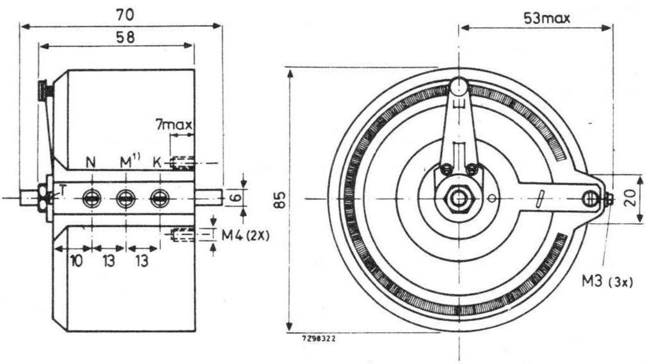
	2422 530 01407	2422 530 11407	2422 530 01607	2422 530 11607
Circuit diagram	Fig.1	Fig.2	Fig.1	Fig.2
Input voltage K-M	220 V +5%	-	115 V +5%	-
Input voltage K-N	240 V +5%	220 V +5%	130 V +5%	115 V +5%
Output voltage K-T	0-240 V	0-220 V	0-130 V	0-115 V
Nominal output current over the whole range, I_{nom}	0.7 A	0.83 A	1.2 A	1.4 A
Max. output current for constant impedance load, I_{max}	0.83 A	1.0 A	1.4 A	1.7 A
Voltage per turn of winding	0.242 V	0.23 V	0.195 V	0.186 V

Frequency range	50 - 400 Hz
Insulation resistance between winding and spindle	$> 10^4$ MΩ
No-load losses	2 W
Test voltage for 1 min	2000 V, 50 Hz
Temperature range (without derating)	−15 to +40 °C
Maximum permissible temperature rise at any point	70 °C
Climatic category (I.E.C. 68)	15/040/21

MECHANICAL DATA

Max. thickness of mounting panel	4 mm
Life	> 100 000 complete rotations
Life of all tested samples	> 250 000 complete rotations
Operating torque	0.03-0.07 Nm (0.3-0.7 kgcm)
Max. torque against endstop	1 Nm (10 kgcm)
Weight	1200 g
Colour	grey

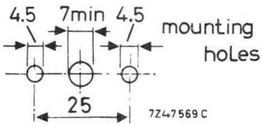
Dimensions in mm



1) Not on 2422 530 11407 and 11607

Mounting

The transformers can be mounted on chassis or panels by means of 2 screws M4. The mounting hole pattern is given in the figure below.



Control knobs

Any control knob suitable for 6 mm spindles can be used.

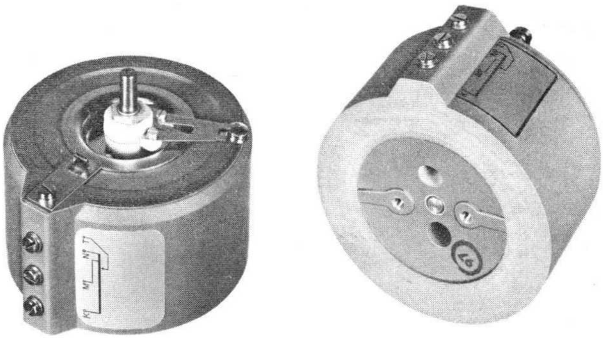
Special control knobs with dial attached are:
catalog number 2922 511 90044: with scale 0 - 115%
catalog number 2922 511 90046: with scale 0 - 100%

Carbon brushes

Spare carbon brushes, already mounted in the contact arm, complete with heat sink, can be supplied under catalog number 4322 026 16310.

MOULDED VARIABLE MAINS TRANSFORMERS

1.2 A, 1.4 A



RZ 24762-4B

Input voltage	
transformer 2422 530 08407	220 V or 260 V
transformer 2422 530 18407	220 V
Output voltage	
transformer 2422 530 08407	0-260 V
transformer 2422 530 18407	0-220 V

APPLICATION

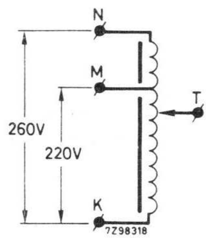
These transformers have been designed to meet the growing market for low priced variable transformers used as power or voltage controls in mass produced apparatus, such as air heaters, ventilator controls, etc.

CONSTRUCTION

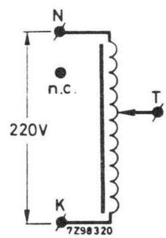
The transformers are moulded in reinforced polyester resin. The construction is rugged and professional.
The mounting hole pattern is simple, the support area is relatively wide and therefore the transformers can be mounted on thin chassis or panels.
The spindle is adjustable in length protruding at both sides. A different spindle of suitable length can be fitted. A special heat-sink construction keeps the brush temperature low.

ELECTRICAL DATA

	catalog number 2422 530 08407	catalog number 2422 530 18407
Input voltage K-M	220 V +5%	-
Input voltage K-N	220 V +5%	220 V +5%
Output voltage K-T	0-260 V	0-220 V
Nominal output current over the whole range, I_{nom}	1.2 A	1.4 A
Max. output current for constant impedance load, I_{max}	1.4 A	1.7 A
Voltage per turn of winding	0.39 V	0.36 V
Frequency range	50-400 Hz	
Insulation resistance between winding and spindle	> 10^4 MΩ	
No-load losses	3 W	
Test voltage for 1 min	2000 V, 50 Hz	
Temperature range (without derating)	-15 to +40 °C	
Maximum permissible temperature rise at any point	70 °C	
Climatic category (I.E.C. 68)	15/040/21	



Electrical diagram of the transformer 2422 530 08407

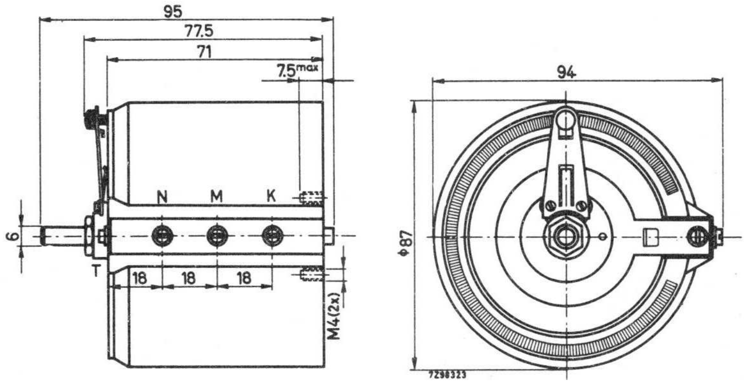


Electrical diagram of the transformer 2422 530 18407

MECHANICAL DATA

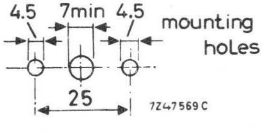
Core size	E 3
Life	> 100 000 complete rotations
Life of all tested samples	> 250 000 complete rotations
Operating torque	0.03-0.07 Nm (0.3-0.7 kgcm)
Max. torque against endstop	1 Nm (10 kgcm)
Weight	1800 g
Moulding colour	grey

Dimensions in mm



Mounting

The transformers can be mounted on chassis or panels by means of 2 screws M4. The mounting hole pattern is given in the figure below.



Carbon brushes

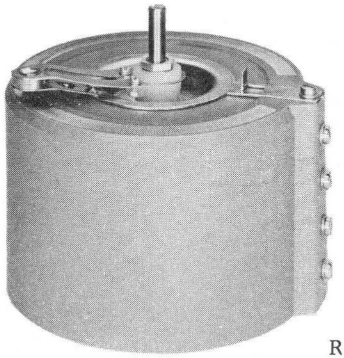
Spare carbon brushes, already mounted in the contact arm, complete with heat sink, can be supplied under catalog number 4322 026 16310.

Control knobs

Any control knob suitable for 6 mm spindles can be used.

Special control knobs with dial attached are:
catalog number 2922 511 90043 : with scale 0-260 V
catalog number 2922 511 90046 : with scale 0-100 %

MOULDED VARIABLE MAINS TRANSFORMERS
2 A, 2.5 A, 5.5 A



RZ 22644-2

transformer	input voltage	output voltage	nominal output current
2422 530 03407	220 V/260 V	0-260 V	2 A
2422 530 03507	240 V/260 V	0-260 V	2 A
2422 530 13407	220 V	0-220 V	2.5 A
2422 530 13707	70 V	0- 70 V	5.5 A

APPLICATION

These transformers have been designed to meet the growing market for low priced variable transformers used as power or voltage controls in mass produced apparatus, such as air heaters, ventilator controls, etc.

CONSTRUCTION

The transformers are moulded in reinforced polyester resin. The construction is rugged and professional.
The mounting hole pattern is simple, the support area is relatively wide and therefore the transformers can be mounted on thin chassis or panels.
The spindle is adjustable in length protruding at both sides. A different spindle of suitable length can be fitted. A special heat-sink construction keeps the brush temperature low.

Ganging

The transformer can be ganged by standard Ganging Units, see relevant section.

Moter drive

An additional adaptor to accept 6 and 8 mm spindles enables the use of all standard motor drive accessories. Catalog number of the adaptor is 4322 026 68990.

ELECTRICAL DATA

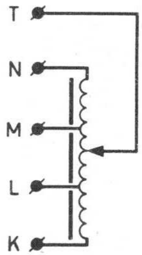


Fig.1

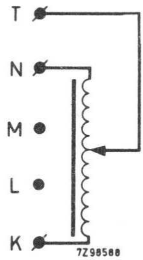


Fig.2

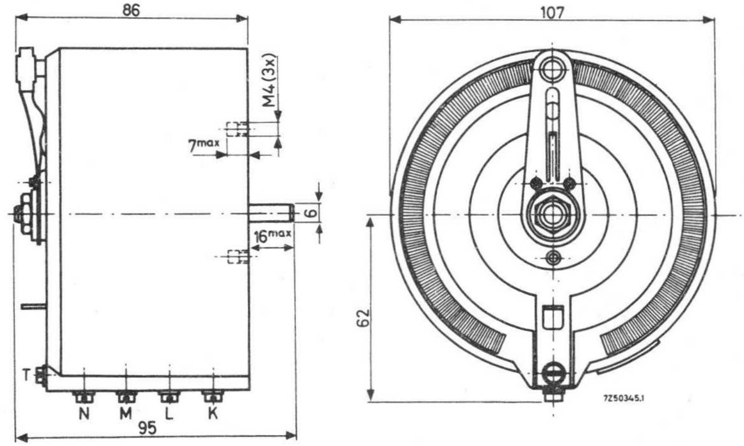
	2422 530 03407	2422 530 03507	2422 530 13407	2422 530 13707
Circuit diagram	Fig.1	Fig.1	Fig.2	Fig.2
Input voltage K-M or L-N	220 V +5%	240 V +5%	-	-
Input voltage K-N	260 V +5%	260 V +5%	220 V +5%	70 V +5%
Output voltage K-T	0-260 V	0-260 V	0-220 V	0-70 V
Nominal output current over the whole range, I_{nom}	2 A	2 A	2.5 A	5.5 A
Max. output current for constant-impedance load, I_{max}	2.4 A	2.4 A	3 A	5.5 A
Voltage per turn of winding	0.488 V	0.488 V	0.478 V	0.35 V

Frequency range	50-400 Hz
Insulation resistance between winding and spindle	$> 10^4$ MΩ
No-load losses	4.5 W
Test voltage for 1 mm	2000 V, 50 Hz
Temperature range (without derating)	−15 to +40 °C
Maximum permissible temperature rise at any point	70 °C
Climatic category (I.E.C. 68)	15/040/21

MECHANICAL DATA

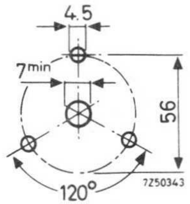
Core size	E 4
Life	> 100 000 complete rotations
Life of all tested samples	> 250 000 complete rotations
Operating torque	0.05-0.1 Nm (0.5-1 kgcm)
Max. torque against endstop	1 Nm (10 kgcm)
Weight	3100 g
Colour	grey

Dimensions in mm



Mounting

The transformers can be mounted on chassis or panels by means of 3 screws M4. The mounting hole pattern is given in the figure below.



Carbon brushes

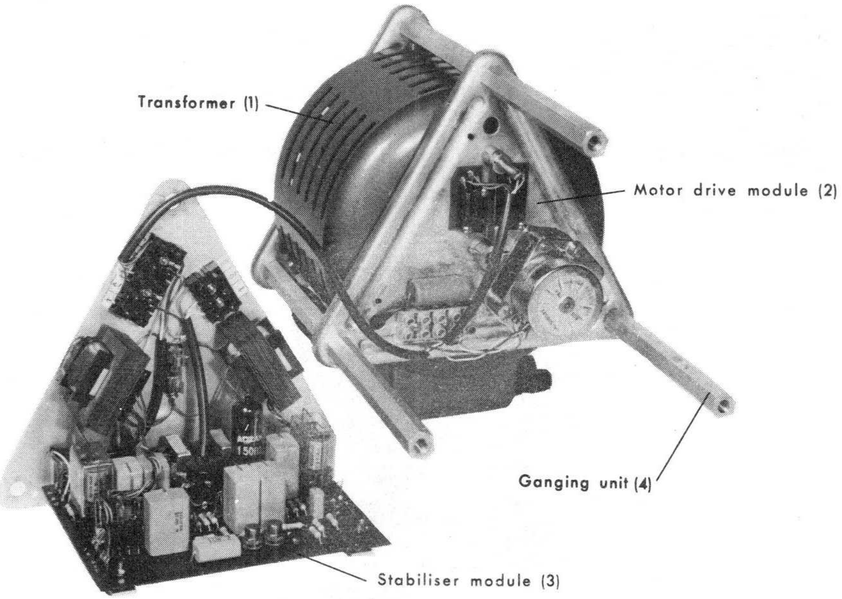
Spare carbon brushes, already mounted in the contact arm, complete with heat sink, can be supplied under catalog number 4322 026 65540.

Control knobs

Any control knob suitable for 6 mm spindles can be used.

Special control knobs with dial attached are:
catalog number 2922 511 90043 : with scale 0-260 V
catalog number 2922 511 90046 : with scale 0-100 %

A.C. STABILISER MODULE
BEY 801



54791

APPLICATION

The unit is capable of stabilising voltages to a value set by means of a control potentiometer. The accuracy of stabilisation is ± 1 volt, and the voltage to be stabilised can vary between -15 % and $+10$ % of the desired value.
It is suitable to be used in all cases where one wants to be safeguarded against possible effects of voltage variations as in laboratories and other research institutions, in measuring set-ups which are sensitive to voltage variations, in test arrangements left unattended for long periods, and so on.

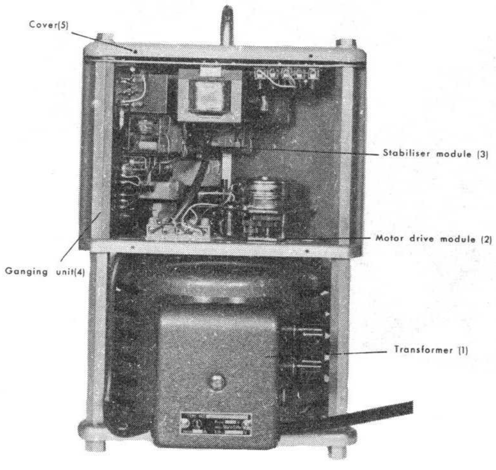
CONSTRUCTION

The photo's illustrate how the stabiliser unit and the motor drive unit, all made up of standard component parts and forming the transformer-control system, are mounted on the variable transformer.

The a.c. stabiliser is available as an assembly kit, easily to mount by the user himself on an already existing combination of gearbox and motor drive module.

A complete a.c. stabiliser consists of the following parts:

1. transformer(s), bench or panel model
2. motor drive module with a rotation time of 15 seconds minimum
3. stabiliser module BEY 801, excluding
   - wire potentiometer k_1, 20 000 Ω (2 W), for input voltage of 220 V
   - voltmeter 0-250 V
4. ganging unit to fix stabiliser to transformer catalog number 2422 532 00028



54790

TECHNICAL PERFORMANCE

A reference voltage derived from a voltage stabilising tube type 150B2 (which is supplied from the non-stabilised input voltage) is applied via a control potentiometer to a comparator, where it is compared with a rectified voltage from the secondary of the transformer. Any difference voltage exceeding 1 volt is amplified and then used to energize one of the control relays switching the drive motor.

The relay releases - and the motor stops - when the difference voltage underpasses 1 volt again.

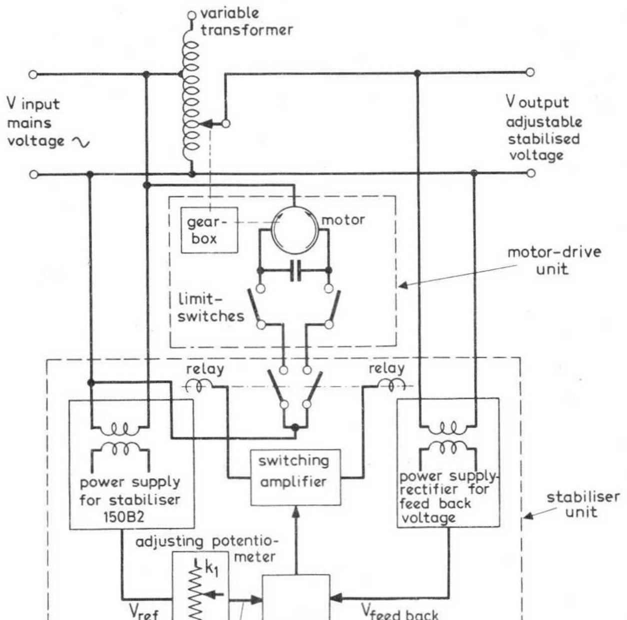
At a rotation time of 15 seconds the stabilisation rate is approximately 10 % of the input voltage per second.

The stabiliser module comprises 2 parts, a triangular metal plate for the supply transformers, and a printed-wiring board carrying the fully transistorised control system, the relays and the reference-voltage circuit. The control potentiometer can be fitted either on the stabiliser, or mounted separately.

A cover is available for modules mounted on bench transformers.

For mounting the two parts on the drive system an instruction sheet is supplied.

Using a combination of 2 or 3 transformers, one may control a higher power.



VARIABLE MAINS TRANSFORMERS
with separate windings

A 51753

Transformer 2422 529 00005, bench model
2422 529 00006, panel model

APPLICATION

As variable isolating transformers in radio and television repair shops and in laboratories.
Very low coil impedance (3.7 Ω).

ELECTRICAL DATA

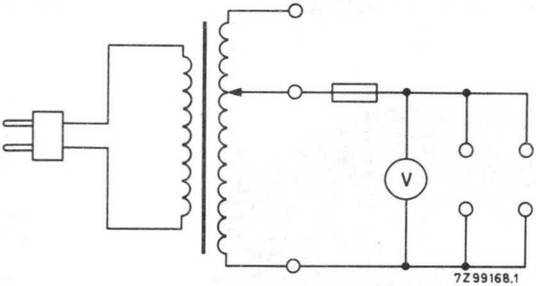


Diagram of bench model

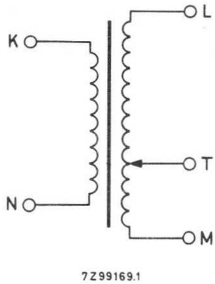


Diagram of panel model

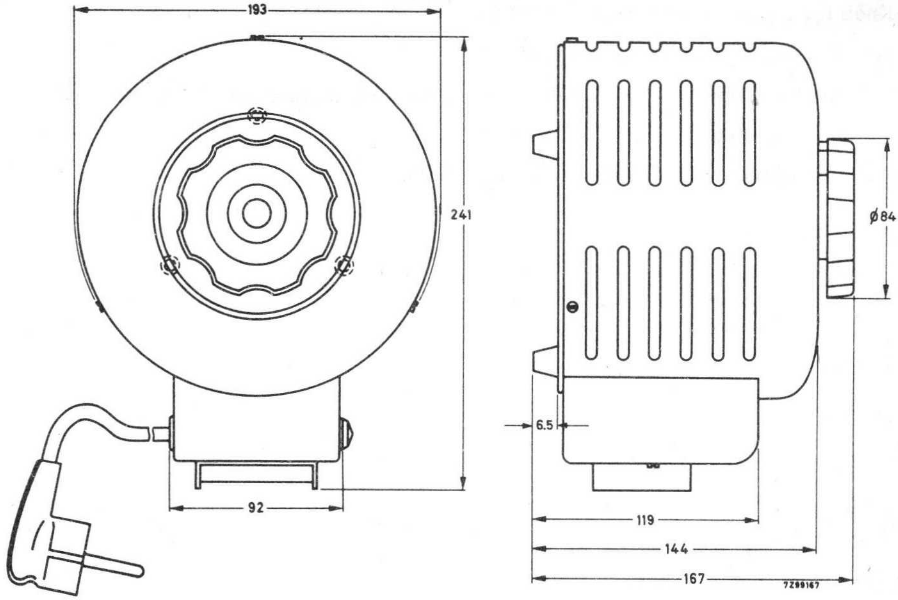
Input voltage	220 V
Output voltage at I_{nom}	0-237 V
No-load output voltage	0-248 V
Nominal output current I_{nom}	3 A
No-load losses	< 8.5 W

MECHANICAL DATA

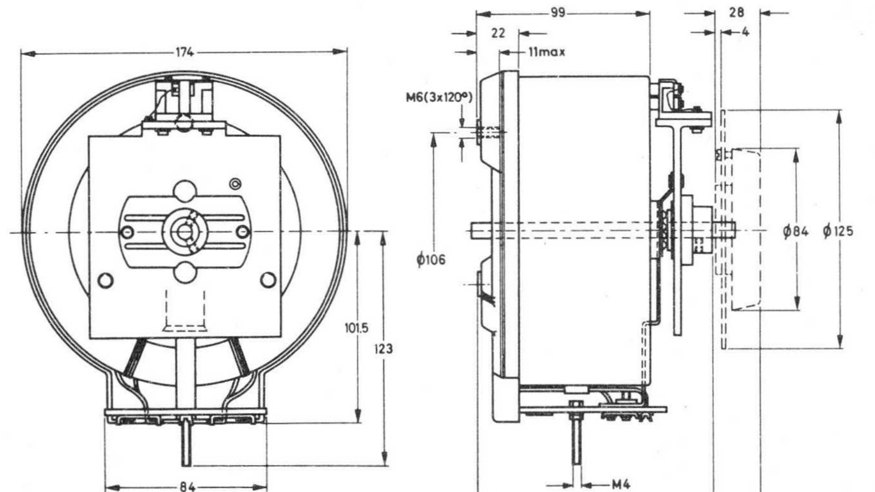
Core size	C4
Operating torque	0.15-0.3 Nm (1.5-3 kg cm)
Max. torque against end stop	4 Nm (40 kg cm)
Weight, bench model	9.6 kg
panel model	8.5 kg

[1]) For inductive loads it may be necessary to replace the fuse by one which can stand high transient currents.

MECHANICAL DATA (Dimensions in mm)



Bench model



Panel model

ACCESSORIES

- Knob for panel model : 2922 511 90056
- Spare brushes : 4322 026 69320
- Ganging Units for series, parallel and 3 phase connection: see "Accessories"
- Motor drive module, see "Accessories"
- A.C. Stabilizer Module BEY: see "Accessories"

Electro-mechanical components

2.54 mm (0.1 in) PITCH PRINTED-WIRING CONNECTORS

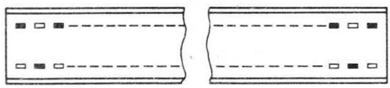
QUICK REFERENCE DATA	
Contact pitch	2.54 mm (0.1 in)
Number of connections	4 to 39
Board thickness	1.6 mm
Terminations	solder tags, dipsolder pins or pins for wire wrapping
Category	25/085/21

DESCRIPTION

The connectors have a body of black tropic proof thermosetting phenolic resin, available with either moulded brackets or in open ended form.
The contact springs are of phosphor bronze wire, with mating faces. The opposite contacts are bridged to provide a fourfold contact.
The contact faces are gold plate on nickel plate.

TECHNICAL DATA

Dimensions (in mm)



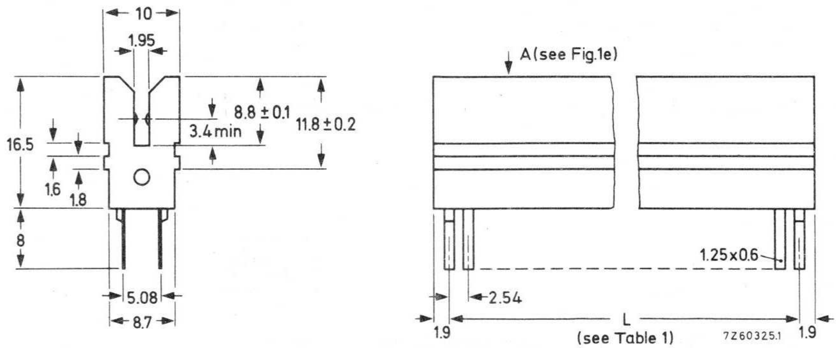


Fig. 1a. Connector with dipsolder pins, open ended, 2422 021 4....

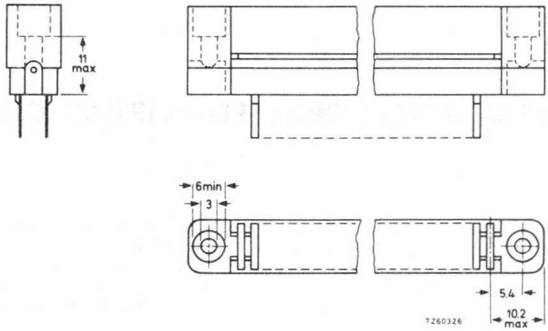


Fig. 1b. Connector with dipsolder pins, with integral mounting brackets, 2422 021 3....
Dimensions not shown are identical with those in Fig. 1a.

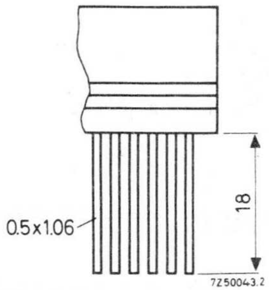


Fig. 1c.
Connector with pins for wire wrapping, open ended, 2422 022 4....

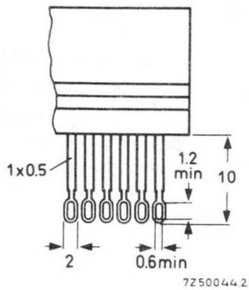


Fig. 1d.
Connector with solder tags, open ended, 2422 023 4....

For piercing diagrams see Figs. 6 and 7 under "Mounting".

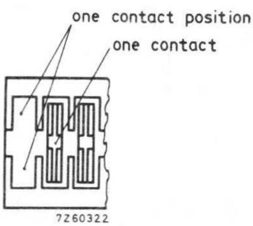


Fig. 1e. Diagrammatic part view in the direction of arrow A (see Fig. 1a)

Table 1

n number of contact positions	L *) (mm)	approx. weight **) (g)	
		versions with dipsolder pins	versions with solder tags or with pins for wire wrapping
06	12.70	8.2	5
07	15.24	9.4	5.5
08	17.78	10.6	6
09	20.32	11.8	6.5
10	22.86	13.0	7
11	25.40	14.2	8
12	27.94	15.4	8.5
13	30.48	16.6	9.5
14	33.02	17.8	10
15	35.56	19.0	10.5
16	38.10	20.2	11
17	40.64	21.4	12
18	43.18	22.6	13
19	45.72	23.8	14
20	48.26	25.0	15
21	50.80	26.2	15.5
22	53.34	27.4	16
23	55.88 ±0.2	28.6	17
24	58.42	29.8	17.5
25	60.96	31.0	18
26	63.50	32.2	19
27	66.04	33.4	19.5
28	68.58	34.6	20
29	71.12	35.8	20.5
30	73.66	37.0	21
31	76.20	38.2	22
32	78.74	39.4	22.5
33	81.28	40.6	23
34	83.82	41.8	23.5
35	86.36	43.0	24
36	88.90	44.2	24.5
37	91.44	45.4	25
38	93.98	46.6	25.5
39	96.52	47.8	26

*) $L_{nom} = (n-1)\ 2.54$ mm

**) For connectors with integral mounting brackets, the values have to be increased by 1.5 g.

Contact pitch	2.54 mm (0.1 in)
Number of connections	4 to 39
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig. 8)
Mechanical endurance	≥ 300 insertions
Ambient temperature range	−25 to +85 °C
Connector body, material	tropic proof phenolic resin
Contact springs, material	phosphor bronze
shape	mating faces
finish of faces	5 μm nickel plate, 1 μm (min. 0.8 μm) gold plate
contact force for 1.6 mm board	
initially	≥ 1 N (0.1 kg)
after mech. endurance	≥ 1 N (0.1 kg)
type of terminations	solder tag, dipsolder pin or pin for wire wrapping
finish of terminations	tinned
Maximum current at $T_{amb} \leq 65$ °C	4A
at $T_{amb} > 65$ °C	see Fig. 2
Creepage distance between two adjacent contacts	≥ 1.3 mm
Maximum r.m.s. voltage (I.E.C. publ. 130.1)	100 V
Test voltage for 1 min	
between adjacent contacts	700 V, 50 Hz
between a contact and a metal mountingplate	700 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, ≤ 20 mV, 1 kHz	
initially	≤ 10 mΩ *) typ. 7.7 mΩ at T_{amb} = 23 °C typ. 7.8 mΩ at T_{amb} = 85 °C
after damp heat test (I.E.C. 68, test Ca)	≤ 12 mΩ *)
Insulation resistance	
initially	> 10^4 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^2 MΩ
Capacitance between adjacent contacts	2 pF

*) For versions with pins for wire wrapping (2422 022 .....): ≤ 12 mΩ (initially)
≤ 14 mΩ (after damp heat test)

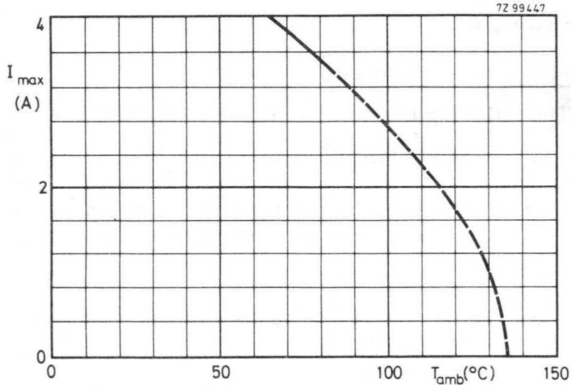


Fig. 2. Derating of maximum current with ambient temperature

The following tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95 % R.H., 21 days)
rapid change of temperature	test Na (−25 °C/+85 °C, 5 cycles)
soldering	test T

AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

2422 ... .

021 dipsolder pins
022 pins for wire wrapping
023 solder tags

16 double sided bridged
18 double sided bridged, minus one contact at either end

number of contact positions, see Table 1

3 with integral mounting brackets (only for connectors without contact at either end)
4 open ended

For ordering purposes please quote the catalogue number.
For example: a connector with solder tags, with integral mounting brackets and 22 contact positions (20 contacts), should be ordered as 2422 023 32218.

MOUNTING

Mounting accessories

The following mounting accessories are available:

- metal bracket for rail or panel mounting, catalogue number 4332 026 00750, Fig. 3a
- metal bracket for panel mounting, catalogue number 4332 026 00760, Fig. 4a
- metal bracket for panel mounting of connectors in series, catalogue number 4332 026 00730, Fig. 5a and metal bracket, catalogue number 4332 026 00720, Fig. 5b.

Note - The mounting accessories can only be used with connectors without contacts at both ends.

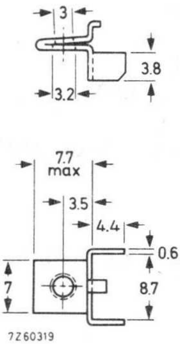


Fig. 3a. Metal mounting bracket 4332 026 00750

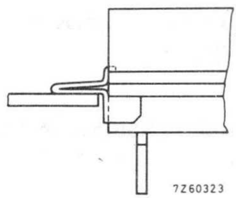


Fig. 3b. Part view, showing mounting bracket in position

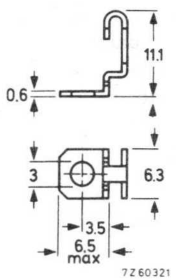


Fig. 4a. Metal mounting bracket 4332 026 00760

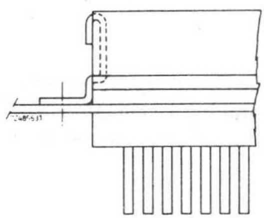


Fig. 4b. Part view, showing mounting bracket in position

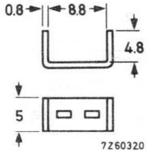
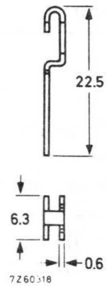


Fig. 5a. Metal mounting bracket
4332 026 00730

Fig. 5b. Metal mounting bracket
4332 026 00720



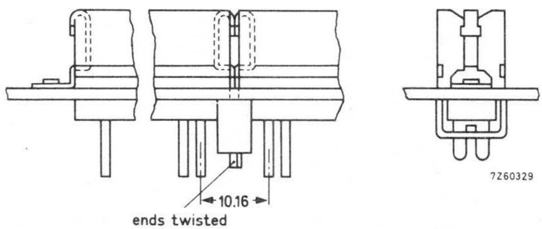


Fig. 5c. Part view, showing mounting
brackets in position

Mounting methods

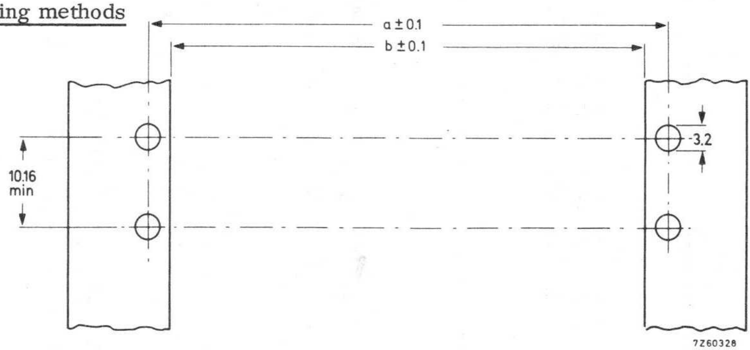


Fig. 6. Rail mounting; for dimensions a and b, see Table 2.

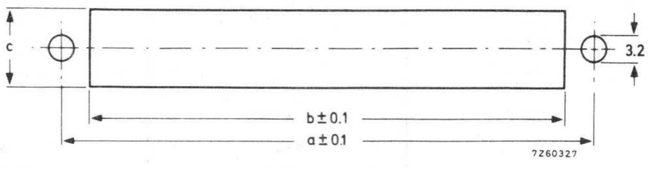


Fig. 7. Panel mounting; for dimensions a and b, see Table 2.
c = 10.5 ± 0.15 mm, when bracket 4332 026 00750 is used,
= 9 ± 0.15 mm, when bracket 4332 026 00760 is used.

Table 2

n number of contact positions	dimensions (mm) a (L_{nom} + 10.8)	for mounting with 4332 026 00750 b (L_{max} + 5.6)	for mounting with 4332 026 00760 or integral mounting brackets b (L_{max} + 4.2)
06	23.50	18.50	17.10
07	26.04	21.04	19.64
08	28.58	23.58	22.18
09	31.12	26.12	24.72
10	33.66	28.66	27.26
11	36.20	31.20	29.80
12	38.74	33.74	32.34
13	41.28	36.28	34.88
14	43.82	38.82	37.42
15	46.36	41.36	39.96
16	48.90	43.90	42.50
17	51.44	46.44	45.04
18	53.98	48.98	47.58
19	56.52	51.52	50.12
20	59.06	54.06	52.66
21	61.60	56.60	55.20
22	64.14	59.14	57.74
23	66.68	61.68	60.28
24	69.22	64.22	62.82
25	71.76	66.76	65.36
26	74.30	69.30	67.90
27	76.84	71.84	70.44
28	79.38	74.38	72.98
29	81.92	76.92	75.52
30	84.46	79.46	78.06
31	87.00	82.00	80.60
32	89.54	84.54	83.14
33	92.08	87.08	85.68
34	94.62	89.62	88.22
35	97.16	92.16	90.76
36	99.70	94.70	93.30
37	102.24	97.24	95.84
38	104.78	99.78	98.38
39	107.32	102.32	100.92

Table 3

n number of contact positions	dimensions (mm)			
	for mounting with brackets 4332 026 00750 or 4332 026 00760		for mounting with integral mounting brackets	
	$d(L_{nom} - 5.08)$	$W(L_{min} - 0.4)$	$d(L_{nom} - 5.08)$	$W(L_{min} - 1.5)$
06	7.62	12.10	7.62	11.00
07	10.16	14.64	10.16	13.54
08	12.70	17.18	12.70	16.08
09	15.24	19.72	15.24	18.62
10	17.78	22.26	17.78	21.16
11	20.32	24.80	20.32	23.70
12	22.86	27.34	22.86	26.24
13	25.40	29.88	25.40	28.78
14	27.94	32.42	27.94	31.32
15	30.48	34.96	30.48	33.86
16	33.02	37.50	33.02	36.40
17	35.56	40.04	35.56	38.94
18	38.10	42.58	38.10	41.48
19	40.64	45.12	40.64	44.02
20	43.18	47.66	43.18	46.56
21	45.72	50.20	45.72	49.10
22	48.26	52.74	48.26	51.64
23	50.80	55.28	50.80	54.18
24	53.34	57.82	53.34	56.72
25	55.88	60.36	55.88	59.26
26	58.42	62.90	58.42	61.80
27	60.96	65.44	60.96	64.34
28	63.50	67.98	63.50	66.88
29	66.04	70.52	66.04	69.42
30	68.58	73.06	68.58	71.96
31	71.12	75.60	71.12	74.50
32	73.66	78.14	73.66	77.04
33	76.20	80.68	76.20	79.58
34	78.74	83.22	78.74	82.12
35	81.28	85.76	81.28	84.66
36	83.82	88.30	83.82	87.20
37	86.36	90.84	86.36	89.74
38	88.90	93.38	88.90	92.28
39	91.44	95.92	91.44	94.82

POLARIZATION

A metal key (Fig. 8) fitted over a contact spring ensures that a printed-wiring board is correctly polarized in its connector. A slot must be made in the printed-wiring board to receive the key (Fig. 9).
The same key is also recommended for positioning of the board when using connectors mounted e.g. with brackets 4332 026 00750 (open end mounting).

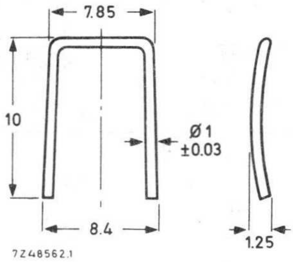


Fig. 8. Polarizing key, catalogue number 4332 026 00770

PRINTED-WIRING BOARD RECOMMENDATIONS

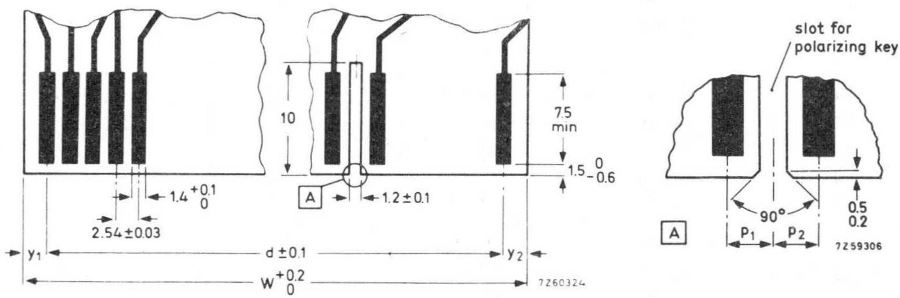


Fig. 9. For the dimensions d and W, see Table 3
$y_1 = y_2$ with a tolerance of ± 0.1 mm
$p_1 = p_2$ with a tolerance of ± 0.1 mm

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

5.08 mm (0.2 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	5.08 mm (0.2 in)
Number of connections	
single sided	1 to 54
double sided	2 to 108
Board thickness	1.6 or 2.4 mm
Terminations	solder tags or pins for wire wrapping
Category (I.E.C.publ.68)	25/085/21

DESCRIPTION

The connectors have a moulded body of black, tropic proof thermosetting phenolic resin.
The contact springs are of phosphor bronze; they are bifurcated to provide a double contact. The contact springs of the connectors with solder tags are removable.
The contact faces are gold plate on nickel plate.

For batches of 500 or more special contact configurations and markings are obtainable.

TECHNICAL DATA

Dimensions (in mm)

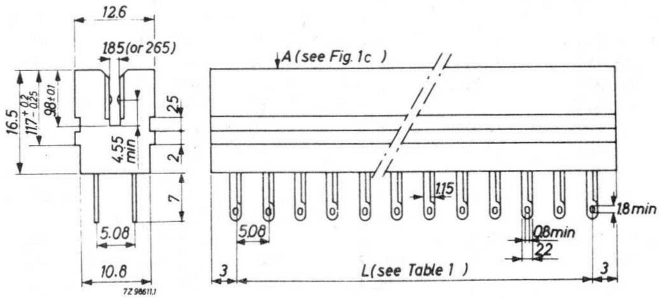


Fig.1a. Connector with solder tags 2422 020 5....

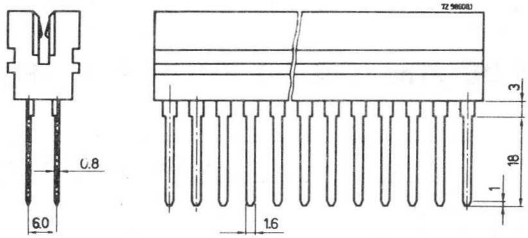


Fig. 1b.
Connector with pins for wire wrapping 2422 035 5....
Dimensions not shown are identical with those in Fig. 1a.

For piercing diagrams see Figs. 7 and 8 under "Mounting".

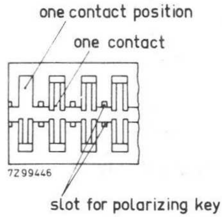


Fig. 1c.
Diagrammatic part view in the direction of arrow A (see Fig. 1a)

Table 1

n number of contact positions, single sided	L*) (mm)		approx. weight**) (g) versions with tags	versions with pins	n number of contact positions single sided	L*) (mm)		approx. weight**) (g) versions with tags	versions with pins
03	10.16		4.6	6.0	29	142.24		35.8	50.3
04	15.24		5.8	7.7	30	147.32		37.0	52.0
05	20.32		7.0	9.4	31	152.40		38.2	53.7
06	25.40		8.2	11.1	32	157.48	±0.4	39.4	55.4
07	30.48	±0.2	9.4	12.8	33	162.56		40.6	57.1
08	35.56		10.6	14.5	34	167.64		41.8	58.8
09	40.64		11.8	16.2	35	172.72		43.0	60.5
10	45.72		13.0	17.9	36	177.80		44.2	62.2
11	50.80		14.2	19.6	37	182.88		45.4	63.9
12	55.88		15.4	21.3	38	187.96		46.6	65.6
13	60.96		16.6	23.0	39	193.04		47.8	67.3
14	66.04		17.8	24.7	40	198.12		49.0	69.0
15	71.12		19.0	26.4	41	203.20		50.2	70.7
16	76.20	±0.3	20.2	28.1	42	208.28		51.4	72.4
17	81.28		21.4	29.9	43	213.36		52.6	74.1
18	86.36		22.6	31.6	44	218.44		53.8	75.8
19	91.44		23.8	33.3	45	223.52	±0.5	55.0	77.5
20	96.52		25.0	35.0	46	228.60		56.2	79.2
21	101.60		26.2	36.7	47	233.68		57.4	80.9
22	106.68		27.4	38.4	48	238.76		58.6	82.6
23	111.76		28.6	40.1	49	243.84		59.8	84.3
24	116.84		29.8	41.8	50	248.92		61.0	86.0
25	121.92		31.0	43.5	51	254.00		62.2	87.7
26	127.00	±0.4	32.2	45.2	52	259.08		63.4	89.4
27	132.08		33.4	46.9	53	264.16		64.6	91.1
28	137.16		34.6	48.6	54	269.24		65.8	92.8

*) $L_{nom} = (n-1)\ 5.08$ mm

**) For double sided connectors

Contact pitch	5.08 mm (0.2 in)
Number of connections, single sided	1 to 54
double sided	2 to 108
Board thickness	1.4 to 1.8 mm or 2.2 to 2.6 mm
Polarization	by means of a polarizing key (Fig. 9)
Mechanical endurance	$\geq$ 300 insertions [1]
Ambient temperature range	-25 to +85 ^{o}C
Connector body, material	tropic proof phenolic resin
Contact springs, material	phosphor bronze
shape	bifurcated
finish of faces	1 μm (min. 0.75 μm) gold plate, 5 μm nickel plate, or 0.4 μm (min. 0.2 μm) gold flash, 3 μm nickel plate
contact force for 1.6 mm board	
initially	$\geq$ 1 N (0.1 kg)
after mech. endurance	$\geq$ 0.8 N (0.08 kg)
type of terminations	solder tag or pin for wire wrapping
material of terminations	
solder tags	phosphor bronze
pins for wire wrapping	brass
finish of terminations	gold flash
Maximum current at $T_{amb} \leq 58\ ^{o}C$	5 A
at $T_{amb} > 58\ ^{o}C$	see Fig.2
Clearance between two opposite contacts	$\geq$ 0.5 mm
Creepage distance between two adjacent or opposite contacts	$\geq$ 2.6 mm
Maximum r.m.s. voltage (I.E.C.publ.130.1)	250 V
Test voltage for 1 min	
between contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, $\leq$ 20 mV, 1 kHz	
initially	$\leq$ 12 mΩ typ. 9.5 mΩ at T_{amb} = 23 ^{o}C typ. 9.6 mΩ at T_{amb} = 85 ^{o}C
after damp heat test (I.E.C.68, test Ca)	$\leq$ 14 mΩ
Insulation resistance	
initially	> 10^4 MΩ
after damp heat test (I.E.C.68, test Ca)	> 10^2 MΩ
Capacitance between adjacent contacts	1 pF
between opposite contacts	1 pF

[1]) For versions with min. 0.2 μm gold flash on contact faces, the mechanical endurance is $\geq$ 100 insertions.

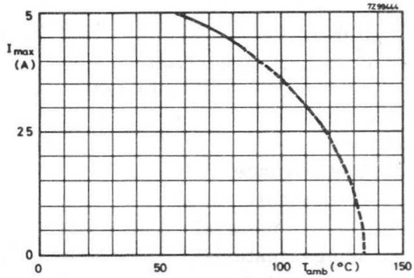


Fig. 2. Derating of maximum current with ambient temperature

The following tests are carried out by frequent inspections:

vibration	I.E.C.68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95 % R.H., 21 days)
rapid change of temperature	test Na (-25 °C/+85 °C, 5 cycles)
soldering	test T

→ AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

2422 ... 5 ....

020 solder tags (Fig. 1a)
035 pins for wire wrapping (Fig. 1b)

number of contact positions, single sided (see Table 1)

02	single sided	for a board thickness of 1.6 mm; ≥ 0.75 μm gold plate on contact face
12	double sided	
04	single sided, minus one contact at either end	
14	double sided, minus two contacts at either end	
22	single sided	for a board thickness of 2.4 mm; ≥ 0.75 μm gold plate on contact face
32	double sided	
24	single sided, minus one contact at either end	
34	double sided, minus two contacts at either end	
42	single sided	for a board thickness of 1.6 mm; ≥ 0.2 μm gold flash on contact face
52	double sided	
44	single sided, minus one contact at either end	
54	double sided, minus two contacts at either end	
62	single sided	for a board thickness of 2.4 mm; ≥ 0.2 μm gold flash on contact face
72	double sided	
64	single sided, minus one contact at either end	
74	double sided, minus two contacts at either end	

For ordering purposes please quote the catalogue number.
For example: a double sided connector with solder tags, 22 contact positions single sided, and 40 contacts (i.e. 2 contact positions at either end not provided), min. 0.75 μm gold plate on contact face, suitable for a board thickness of 1.6 mm, should be ordered as 2422 020 52214

MOUNTING

Mounting accessories

The following types of mounting accessories are available:

- thermoplastic bracket for rail or panel mounting (catalogue number 4332 026 11110), Fig.3a
- metal bracket for rail or panel mounting (catalogue number 4332 026 04760), Fig.4a
- metal bracket for panel mounting (catalogue number 4332 026 04750), Fig.5a
- metal bracket for panel mounting (catalogue number 4332 026 04630) in combination with end piece (catalogue number 4332 026 04770), Fig.6
- nickel plated brass bolt M 2.5 x 6, catalogue number 2522 001 08776
- cadmium plated steel bolt M 2.5 x 6, catalogue number 2522 004 02137, for use in mounting chassis
- chromium plated steel bolt M 2.5 x 6, catalogue number 2522 004 03137, for use in mounting chassis
- spring washer for the bolts mentioned above, catalogue number 2522 600 17013

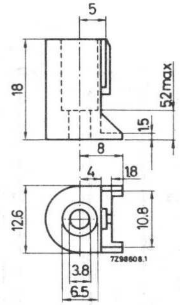


Fig.3a. Thermoplastic mounting bracket 4332 026 11110

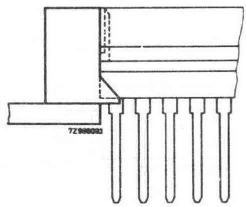


Fig.3b. Part view, showing mounting bracket in position

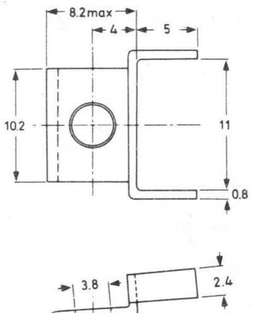


Fig.4a. Metal mounting bracket 4332 026 04760

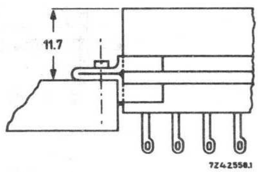


Fig.4b. Part view, showing mounting bracket in position

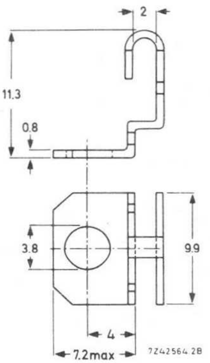


Fig.5a. Metal mounting bracket
4332 026 04750 *)

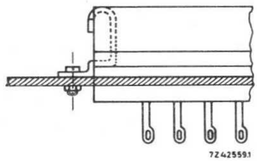


Fig.5b. Part view, showing mounting bracket in position

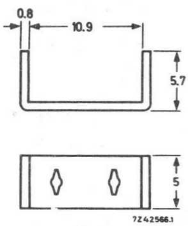


Fig.6a. Metal mounting bracket
4332 026 04630 *)

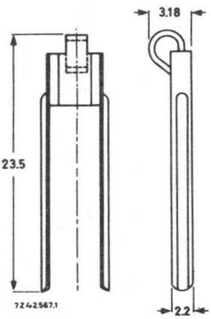


Fig.6b. End piece 4332 026 04770 *)

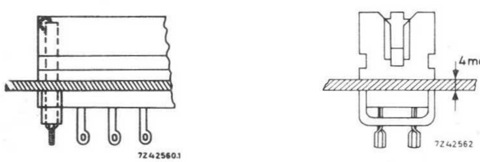


Fig.6c. Part views, showing mounting bracket and end piece in position.

*) For use with connectors of which the contact positions at either end are not provided.

Mounting methods

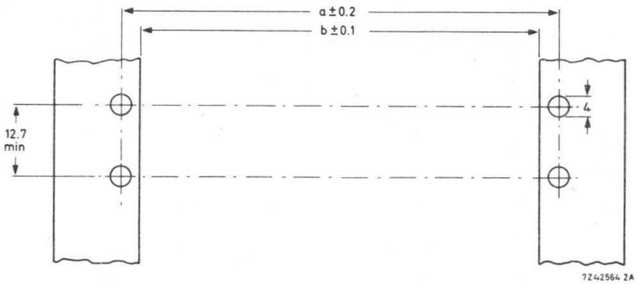


Fig. 7. Rail mounting; for dimensions a and b, see Table 2.

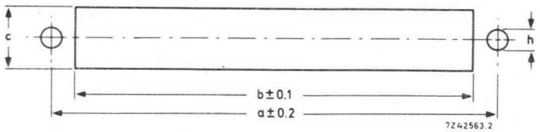


Fig. 8. Panel mounting; for dimensions a and b, see Table 2.

mounting accessory	see Fig.	c (mm)	h (mm)
4332 026 11110	3	$11^{+0.2}_{-0}$	4
4332 026 04760	4	$12.8^{+0.2}_{-0}$	4
4332 026 04750	5	$11^{+0.2}_{-0}$	4
4332 026 04630 4332 026 04770	6	$11^{+0.2}_{-0}$	not required

Table 2

number of contact positions, single sided n	dimensions (mm) a ($L_{nom}+14$)	for mounting with bracket 4332 026 04760 b ($L_{max.}+7.8$)	for mounting with other parts b ($L_{max}+6.2$)
03	24.16	18.16	16.56
04	29.24	23.24	21.64
05	34.32	28.32	26.72
06	39.40	33.40	31.80
07	44.48	38.48	36.88
08	49.56	43.56	41.96
09	54.64	48.64	47.04
10	59.72	53.72	52.12
11	64.80	58.90	57.30
12	69.88	63.98	62.38
13	74.96	69.06	67.46
14	80.04	74.14	72.54
15	85.12	79.22	77.62
16	90.20	84.30	82.70
17	95.28	89.38	87.78
18	100.36	94.46	92.86
19	105.44	99.54	97.94
20	110.52	104.62	103.02
21	115.60	109.70	108.10
22	120.68	114.78	113.18
23	125.76	119.86	118.26
24	130.84	125.04	123.44
25	135.92	130.12	128.52
26	141.00	135.20	133.60
27	146.08	140.28	138.68
28	151.16	145.36	143.76
29	156.24	150.44	148.84
30	161.32	155.52	153.92
31	166.40	160.60	159.00
32	171.48	165.68	164.08
33	176.56	170.76	169.16
34	181.64	175.84	174.24
35	186.72	180.92	179.32
36	191.80	186.10	184.5[illegible]
37	196.88	191.18	189.58
38	201.96	196.26	194.66
39	207.04	201.34	199.74
40	212.12	206.42	204.82
41	217.20	211.50	209.90
42	222.28	216.58	214.98
43	227.36	221.66	220.06
44	232.44	226.74	225.14
45	237.52	231.82	230.22
46	242.60	236.90	235.30
47	247.68	241.98	240.38
48	252.76	247.06	245.46
49	257.84	252.14	250.54
50	262.92	257.22	255.62
51	268.00	262.30	260.70
52	273.08	267.38	265.78
53	278.16	272.46	270.86
54	283.24	277.54	275.94

dimensions (mm)							
for mounting with bracket 4332 026 04760		for mounting with bracket 4332 026 11110		for mounting with bracket 4332 026 04750		for mounting with bracket 4332 026 04630 and end piece 4332 026 04770	
$d(L_{nom})$	$W(L_{min} + 5.5)$	$d(L_{nom})$	$W(L_{min} + 1.9)$	$d(L_{nom} - 10.16)$	$W(L_{min} - 0.1)$	$d(L_{nom} - 10.16)$	$W(L_{min} - 0.15)$
10.16	15.46	10.16	11.86	–	9.86	–	9.81
15.24	20.54	15.24	16.94	5.08	14.94	5.08	14.89
20.32	25.62	20.32	22.02	10.16	20.02	10.16	19.97
25.40	30.70	25.40	27.10	15.24	25.10	15.24	25.05
30.48	35.78	30.48	32.18	20.32	30.18	20.32	30.13
35.56	40.86	35.56	37.26	25.40	35.26	25.40	35.21
40.64	45.94	40.64	42.34	30.48	40.34	30.48	40.29
45.72	51.02	45.72	47.42	35.56	45.42	35.56	45.37
50.80	56.00	50.80	52.40	40.64	50.40	40.64	50.35
55.88	61.08	55.88	57.48	45.72	55.48	45.72	55.43
60.96	66.16	60.96	62.56	50.80	60.56	50.80	60.51
66.04	71.24	66.04	67.64	55.88	65.64	55.88	65.59
71.12	76.32	71.12	72.72	60.96	70.72	60.96	70.67
76.20	81.40	76.20	77.80	66.04	75.80	66.04	75.75
81.28	86.48	81.28	82.88	71.12	80.88	71.12	80.83
86.36	91.56	86.36	87.96	76.20	85.96	76.20	85.91
91.44	96.64	91.44	93.04	81.28	91.04	81.28	90.99
96.52	101.72	96.52	98.12	86.36	96.12	86.36	96.07
101.60	106.80	101.60	103.20	91.44	101.20	91.44	101.15
106.68	111.88	106.68	108.28	96.52	106.28	96.52	106.23
111.76	116.96	111.76	113.36	101.60	111.36	101.60	111.31
116.84	121.94	116.84	118.34	106.68	116.34	106.68	116.29
121.92	127.02	121.92	123.42	111.76	121.42	111.76	121.37
127.00	132.10	127.00	128.50	116.84	126.50	116.84	126.45
132.08	137.18	132.08	133.58	121.92	131.58	121.92	131.53
137.16	142.26	137.16	138.66	127.00	136.66	127.00	136.61
142.24	147.34	142.24	143.74	132.08	141.74	132.08	141.69
147.32	152.42	147.32	148.82	137.16	146.82	137.16	146.77
152.40	157.50	152.40	153.90	142.24	151.90	142.24	151.85
157.48	162.58	157.48	158.98	147.32	156.98	147.32	156.93
162.56	167.66	162.56	164.06	152.40	162.06	152.40	162.01
167.64	172.74	167.64	169.14	157.48	167.14	157.48	167.09
172.72	177.82	172.72	174.22	162.56	172.22	162.56	172.17
177.80	182.80	177.80	179.20	167.64	177.20	167.64	177.15
182.88	187.88	182.88	184.28	172.72	182.28	172.72	182.23
187.96	192.96	187.96	189.36	177.80	187.36	177.80	187.31
193.04	198.04	193.04	194.44	182.88	192.44	182.88	192.39
198.12	203.12	198.12	199.52	187.96	197.52	187.96	197.47
203.20	208.20	203.20	204.60	193.04	202.60	193.04	202.55
208.28	213.28	208.28	209.68	198.12	207.68	198.12	207.63
213.36	218.36	213.36	214.76	203.20	212.76	203.20	212.71
218.44	223.44	218.44	219.84	208.28	217.84	208.28	217.79
223.52	228.52	223.52	224.92	213.36	222.92	213.36	222.87
228.60	233.60	228.60	230.00	218.44	228.00	218.44	227.95
233.68	238.68	233.68	235.08	223.52	233.08	223.52	233.03
238.76	243.76	238.76	240.16	228.60	238.16	228.60	238.11
243.84	248.84	243.84	245.24	233.68	243.24	233.68	243.19
248.92	253.92	248.92	250.32	238.76	248.32	238.76	248.27
254.00	259.00	254.00	255.40	243.84	253.40	243.84	253.35
259.08	264.08	259.08	260.48	248.92	258.48	248.92	258.43
264.16	269.16	264.16	265.56	254.00	263.56	254.00	263.51
269.24	274.24	269.24	270.64	259.08	268.64	259.08	268.59

POLARIZATION AND POSITIONING

A thermoplastic key (Fig. 9) inserted in a slot between any two adjacent contacts (see Fig. 1c) ensures that a printed-wiring board is correctly polarized in its connector. This method involves no loss of contacts. A slot must be made in the printed-wiring board to receive the key (Fig. 10).

The same key is also recommended for positioning of the board when using connectors with more than 35 contact positions, single sided.
In this case the slot in the printed-wiring board should be near the centre.

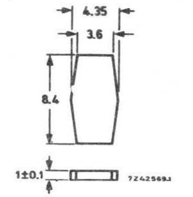


Fig. 9. Polarizing key, 4332 026 04740

PRINTED-WIRING BOARD RECOMMENDATIONS

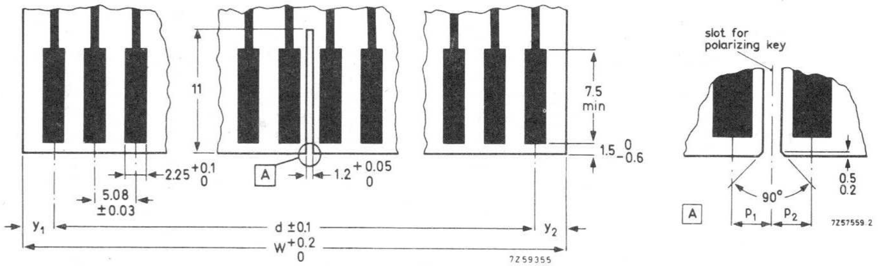


Fig. 10. For the dimensions d and W, see Table 2.
$y_1 = y_2$ with a tolerance of ± 0.1 mm
$P_1 = P_2$ with a tolerance of ± 0.1 mm

MARKING

For batches of 500 or more, the contacts can be marked either with letters or numbers, or any combination of the two.

PACKAGING

The package is marked with: Name of component
Catalogue number
Number of pieces
Reference number of manufacture

3.81 mm (0.15 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.81 mm (0.15 in)
Number of connections	
single sided	4 to 45
double sided	8 to 90
Board thickness	1.6 mm
Terminations	solder tags dipsolder pins
Category (I.E.C.publ.68)	25/085/21

DESCRIPTION

The connectors have a moulded body of black, tropic proof thermosetting phenolic resin.

The contact springs are of phosphor bronze; they are bifurcated to provide a double contact and are easily removable.

The contact faces are gold plate on nickel plate.

For batches of 500 or more special contact configurations and marking are obtainable.

TECHNICAL DATA

Dimensions (in mm)

Fig. 1 a.
Connector with solder tags,
2422 036 6....

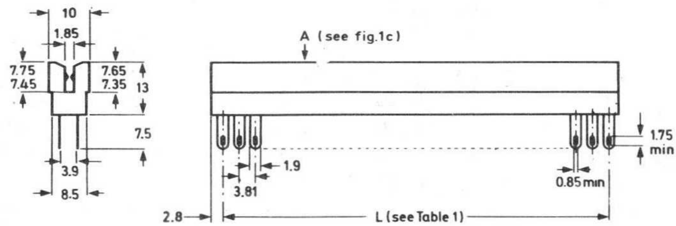
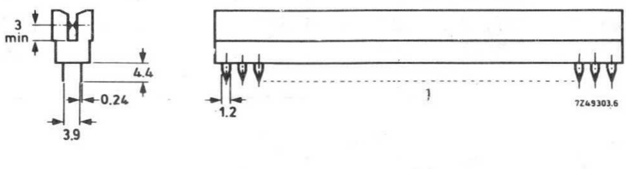


Fig. 1 b.
Connector with dipsolder pins,
2422 042 6....
Dimensions not shown are identical with those in Fig. 1a.



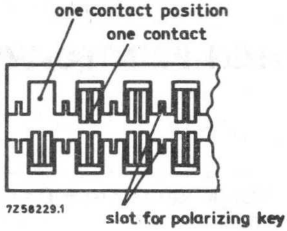


Fig. 1c. Diagrammatic part view in the direction of arrow A (see Fig. 1a).

For piercing diagrams see Figs. 5, 6 and 7 under "Mounting".

Table 1

n number of contact positions, single sided	L*) (mm)	approx. weight **) (g)	n number of contact positions, single sided	L*) (mm)	approx. weight **) (g)
06	19.05 ± 0.15	4.5	26	95.25 ± 0.20	16
07	22.86 ± 0.15	5	27	99.06 ± 0.20	16.5
08	26.67 ± 0.15	6	28	102.87 ± 0.20	17
09	30.48 ± 0.15	6.5	29	106.68 ± 0.20	18
10	34.29 ± 0.15	7	30	110.49 ± 0.20	18.5
11	38.10 ± 0.20	8	31	114.30 ± 0.20	19
12	41.91 ± 0.20	8.5	32	118.11 ± 0.20	19.5
13	45.72 ± 0.20	9	33	121.92 ± 0.20	20
14	49.53 ± 0.20	10	34	125.73 ± 0.20	20.5
15	53.34 ± 0.20	10.5	35	129.54 ± 0.20	21
16	57.15 ± 0.20	11	36	133.35 ± 0.30	21.5
17	60.96 ± 0.20	11.5	37	137.16 ± 0.30	22
18	64.77 ± 0.20	12	38	140.97 ± 0.30	22.5
19	68.58 ± 0.20	12.5	39	144.78 ± 0.30	23
20	72.39 ± 0.20	13	40	148.59 ± 0.30	23.5
21	76.20 ± 0.20	13.5	41	152.40 ± 0.30	24
22	80.01 ± 0.20	14	42	156.21 ± 0.30	25
23	83.82 ± 0.20	14.5	43	160.02 ± 0.30	26
24	87.63 ± 0.20	15	44	163.83 ± 0.30	27
25	91.44 ± 0.20	15.5	45	167.64 ± 0.30	28

*) $L_{nom} = (n-1)\ 3.81$ mm
**) For double sided connectors

Contact pitch	3.81 mm (0.15 in)
Number of connections, single sided	4 to 45
double sided	8 to 90
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig. 8)
Mechanical endurance	≥ 300 insertions [1])
Ambient temperature range	−25 to +85 °C
Connector body, material	phosphor bronze
shape	bifurcated
finish of faces	1 μm (min. 0.8 μm) gold plate, 5 μm nickel plate, or 0.4 μm (min. 0.2 μm) gold flash, 3 μm nickel plate
contact force for 1.6 mm board	
initially	≥ 1 N (0.1 kg)
after mech. endurance	≥ 0.8 N (0.08 kg)
type of terminations	solder tag or dipsolder pin
finish of terminations	gold flash
Maximum current at $T_{amb} \leq 43$ °C	3 A
at $T_{amb} > 43$ °C	see Fig. 2
Clearance between two opposite contacts	≥ 0.4 mm
Creepage distance between two adjacent or opposite contacts	≥ 1.8 mm
Maximum r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min	
between contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, ≤ 20 mV, 1 kHz	
initially	< 10 mΩ typ. 5.9 mΩ at T_{amb} = 23 °C typ. 6.0 mΩ at T_{amb} = 85 °C
after damp heat test (I.E.C. 68, test Ca)	< 12 mΩ
Insulation resistance	
initially	> 10^4 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^2 MΩ
Capacitance between adjacent contacts	2 pF
between opposite contacts	2 pF

[1]) For versions with min. 0.2 μm gold flash on contact faces, the mechanical endurance is ≥ 100 insertions.

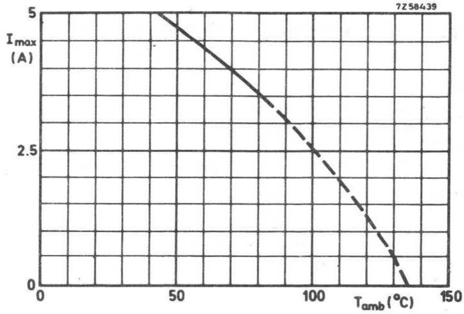


Fig. 2. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C.68	test F/VI
shock		test Ea
damp heat		test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature		test Na (−25 °C/+85 °C, 5 cycles)
soldering		test T

→ AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

2422 ... 6 ....

036 solder tags (Fig. 1a)
042 dipsolder pins (Fig. 1b)

number of contact positions, single sided (see Table 1)

02 single sided
12 double sided
04 single sided, minus one contact at either end
14 double sided, minus two contacts at either end
} ≥0.8 μm gold plate on contact face

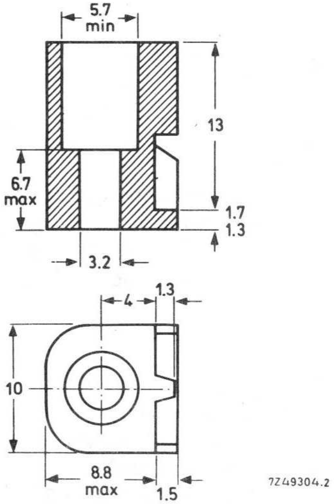
42 single sided
52 double sided
44 single sided, minus one contact at either end
54 double sided, minus two contacts at either end
} ≥0.2 μm gold flash on contact face

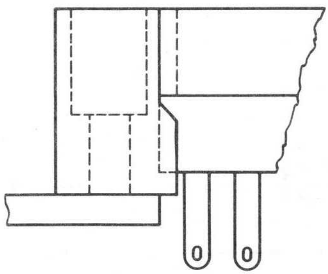
For ordering purposes please quote the catalogue number.
For example: a double sided connector with dipsolder pins, 22 contact positions single sided, and 40 contacts (i.e. 2 contact positions at either end not provided), min. 0.8 μm gold plate on contact face, should be ordered as 2422 042 62214.

MOUNTING

Mounting accessories

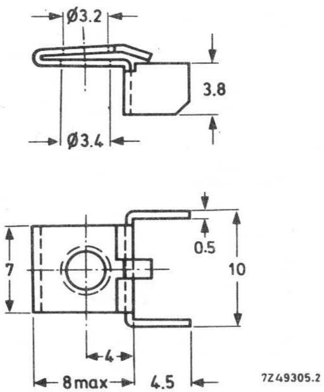
Two types of mounting brackets are available:
- thermoplastic brackets, catalogue number 4332 026 06560 (Fig.3) and
- metal brackets, catalogue number 4332 026 06540 (Fig.4).

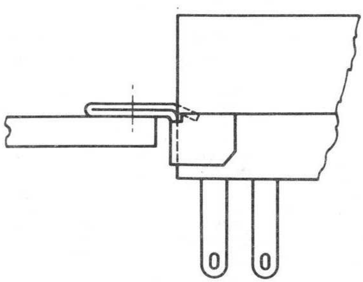




Part view, showing mounting bracket in position

Fig. 3. Thermoplastic mounting bracket
4332 026 06560





Part view, showing mounting bracket in position

Fig. 4. Cadmium plated steel mounting bracket
4332 026 06540

Mounting method

Brackets, if used, are fastened with 3 mm (M3) screws and washers.

- For connectors with solder tags (2422 036)

  Hole configurations required for bracket mounting on rails and panels are shown in Figs 5 and 6 respectively.

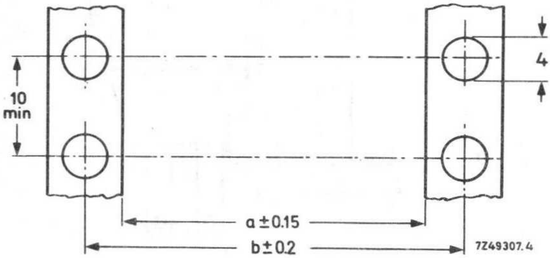


Fig. 5. Hole configuration for rail mounting, for dimensions a and b see Table 2

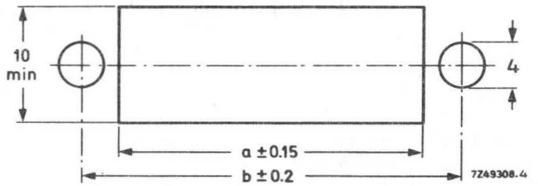


Fig. 6. Hole configuration for panel mounting, for dimensions a and b see Table 2

- For connectors with dipsolder pins (2422 042)

  This version is intended for dipsolder mounting on printed-wiring boards with a thickness of maximum 2.4 mm and a hole pitch of 0.15 inch. The thermoplastic mounting bracket (Fig. 3) can be employed for greater stability.

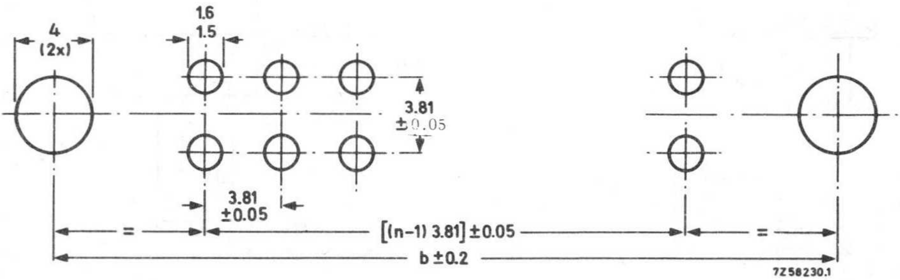


Fig. 7. Piercing diagram for double sided connectors; for dimension b see Table 2.
$(n-1)3.81 = L_{nom}$, see Table 1.

Table 2

number of contact positions, single sided	dimensions			number of contact positions, single sided	dimensions		
	Fig. 5, 6	Fig. 5, 6, 7	Fig. 9		Fig. 5, 6	Fig. 5, 6, 7	Fig. 9
n	a	b	W	n	a	b	W
06	26.20	32.45	21.65	26	102.45	108.65	97.85
07	30.01	36.26	25.46	27	106.26	112.46	101.66
08	33.82	40.07	29.27	28	110.07	116.27	105.47
09	37.63	43.88	33.08	29	113.88	120.08	109.28
10	41.44	47.69	36.89	30	117.69	123.89	113.09
11	45.30	51.50	40.70	31	121.50	127.70	116.90
12	49.11	55.31	44.51	32	125.31	131.51	120.71
13	52.92	59.12	48.32	33	129.12	135.32	124.52
14	56.73	62.93	52.13	34	132.93	139.13	128.33
15	60.54	66.74	55.94	35	136.74	142.94	132.14
16	64.35	70.55	59.75	36	140.65	146.75	135.95
17	68.16	74.36	63.56	37	144.46	150.56	139.76
18	71.97	78.17	67.37	38	148.27	154.37	143.57
19	75.78	81.98	71.18	39	152.08	158.18	147.38
20	79.59	85.79	74.99	40	155.89	161.99	151.19
21	83.40	89.60	78.80	41	159.70	165.80	155.00
22	87.21	93.41	82.61	42	163.51	169.61	158.81
23	91.02	97.22	86.42	43	167.32	173.42	162.62
24	94.83	101.03	90.23	44	171.13	177.23	166.43
25	98.64	104.84	94.04	45	174.94	181.04	170.24

POLARIZATION AND POSITIONING

A thermoplastic key (Fig. 8) inserted in a slot between any two adjacent contacts (see Fig. 1c) ensures that a printed-wiring board is correctly polarized in its connector. This method involves no loss of contacts. A slot must be made in the printed-wiring board to receive the key (Fig. 9).

The same key is also recommended for positioning to avoid misalignment arising from (a) cumulative tolerances in the case of long connectors (with more than 35 contacts, single sided) and (b) open-end mounting.
For case (a) the slot in the printed-wiring board should be near the centre.
Positioning is not required if a connector with no more than 35 contacts (single sided) is used together with thermoplastic brackets.

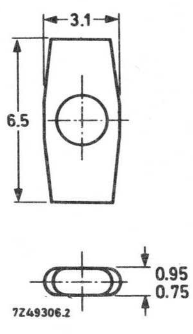
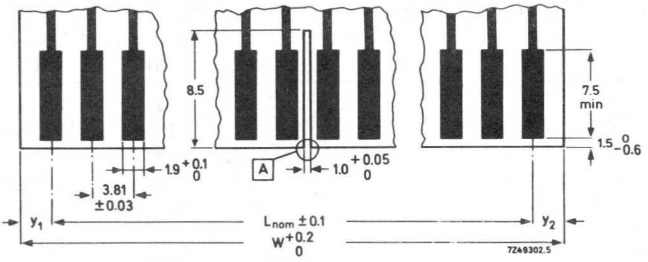


Fig. 8. Polarizing key, 4332 026 06550

PRINTED-WIRING BOARD RECOMMENDATIONS



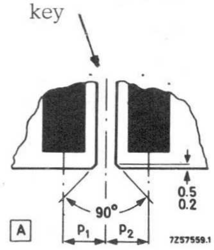


Fig. 9. For the dimensions L_{nom} and W, see Tables 1 and 2 respectively.
$y_1 = y_2$ with a tolerance of ±0.1 mm
$p_1 = p_2$ with a tolerance of ±0.1 mm

MARKING

For batches of 500 or more, the contacts can be marked either with letters or numbers, or any combination of the two.

PACKAGING

The package is marked with: Name of component
Catalogue number
Number of pieces
Reference number of manufacture

3.96 mm (0.156 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18 and 22
double sided	12, 20, 30, 36 and 44
Board thickness	1.6 mm
Terminations	solder tags
MIL specification	C-21097-1

DESCRIPTION

The connectors have a moulded body of a blue tropic proof glass fibre filled diallyl-phthalate resin.
The contact springs are of phosphor bronze, they are bifurcated to provide a double contact. The contact springs are easily removable.
The contact faces are gold plate on nickel plate.

TECHNICAL DATA Dimensions in mm

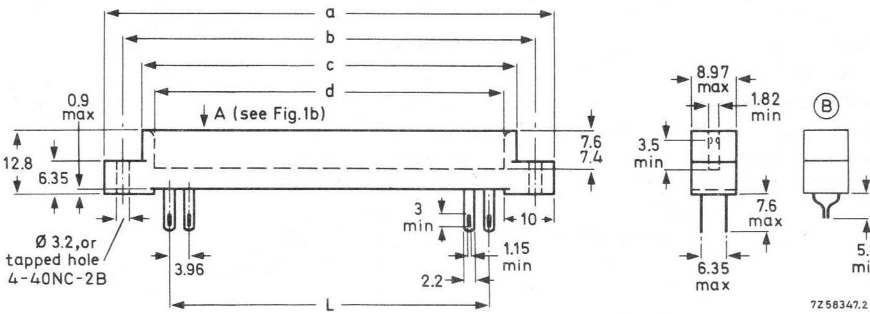


Fig. 1a. Outline drawing of a double sided connector with insert (B) for type with bridged opposite terminations.

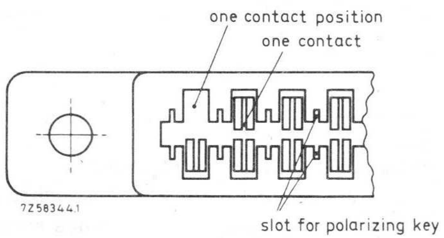


Fig. 1b. Diagrammatic part view in the direction of arrow A (see Fig. 1a)

number of connections single sided	number of connections double sided	dimensions (mm) L 1)		a_{max}	b		c_{max}	d	approx. weight 2) double sided (g)
6	12	19.80	+0.2 -0.1	47.34	38.91	±0.2	32.56	27.94±0.15	6.8
10	20	35.64		63.19	54.76		48.43	43.79±0.15	10
15	30	55.44		83.00	74.62		68.27	63.60±0.15	14
18	36	67.32		94.89	86.51		80.18	75.49±0.15	16.4
→ 22	44	83.16		110.74	102.41		96.16	91.34±0.20	19.6

Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18 and 22
double sided	12, 20, 30, 36 and 44
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig.3)
Insertion force 3)	
12 contacts	≤ 27 N (2.7 kg)
20 contacts	≤ 45 N (4.5 kg)
30 contacts	≤ 60 N (6.0 kg)
36 contacts	≤ 70 N (7.0 kg)
44 contacts	≤ 80 N (8.0 kg)
Withdrawal force per contact 3)	> 0.2 N (20 g)
Mechanical endurance	≥ 250 insertions
Ambient temperature range	−65 to +125 °C
Connector body, material	glass fibre filled diallylphthalate
Contact springs, material	phosphor bronze
shape	bifurcated
finish of faces	min.3 μm copper plate, min. 5 μm nickel plate, min. 1.3 μm or min. 2.5 μm gold plate
contact force	
initially	1.0 N (0.1 kg)
after mech. endur.	0.8 N (0.08 kg)
type of terminations	solder tag with eyelet
finish of terminations	gold flash on nickel plate

1) $L_{nom} = (n-1)\ 3.96$ mm
2) For connectors with plain holes
For connectors with threaded bushes 2 g to be added
3) Measured with mechanical gauge according to MIL-C-21097-1

Maximum current at $T_{amb} \leq 85\,^{o}C$	5 A
$T_{amb} > 85\,^{o}C$	see Fig. 2
Clearance between two opposite contacts	$\geq$0.4 mm
Creepage distance between two adjacent or opposite contacts	$\geq$1.9 mm
Max. r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min (MIL-STD202, method 301)	
between adjacent contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, $\leq$20 mV, 1 kHz	
initially	< 7 mΩ, typ. 5.4 mΩ at T_{amb} = 23 °C typ. 5.6 mΩ at T_{amb} = 125 °C
after damp heat test (I.E.C. 68, test Ca)	< 7 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	2 pF
between opposite contacts	2 pF

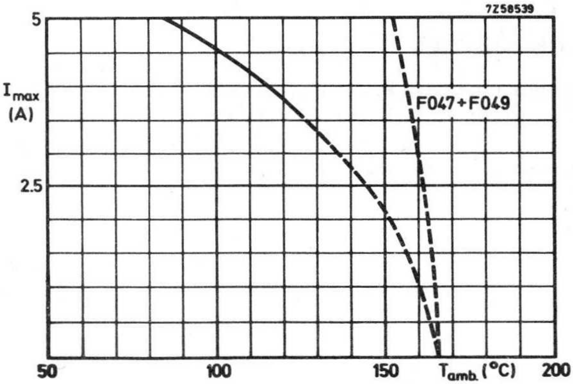


Fig. 2. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
mould growth	test J
soldering	test T
salt mist	test Ka

AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

For ordering purposes please quote the catalogue number.

2422 037 .....

4 threaded fixing bushes } ≥ 2.5 μm gold plate
5 plain fixing holes } on contact face
6 threaded fixing bushes } ≥ 1.3 μm gold plate
7 plain fixing holes } on contact face

number of contacts,
counted single sided (06, 10, 15, 18 or 22)

02 single sided
12 double sided
16 double sided bridged

MOUNTING

The connectors with plain fixing holes can be mounted bv means of two M3 screws, or two screws according to MIL 21097-1, with nuts and washers to match, the connectors with threaded bushes by means of two screws according to MIL 21097-1 and washers to match.

POLARIZATION

A thermoplastic key (Fig.3), inserted in a slot between any two adjacent contacts (see Fig.1 b) ensures that a printed-wiring board is correctly polarized in its connector. This method involves no loss of contacts. A slot must be made in the printed-wiring board to receive the key (Fig.4)

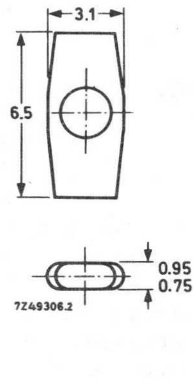
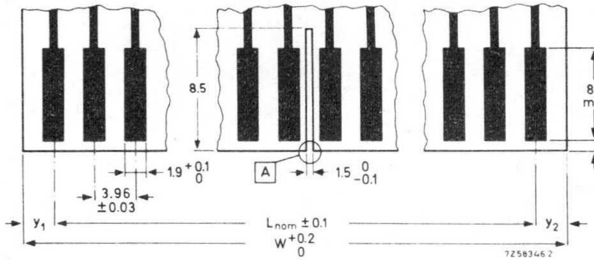


Fig. 3. Polarizing key,
cat. no. 4332 026 06550

PRINTED-WIRING BOARD RECOMMENDATIONS



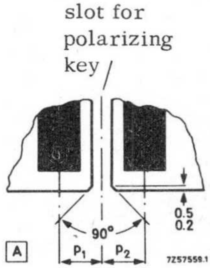


Fig. 4. $y_1 = y_2$ with a tolerance of ±0.1 mm
$p_1 = p_2$ with a tolerance of ±0.1 mm

number of connections, single sided	L_{nom} (mm)	W (mm)	
6	19.80	27.58	27,65±0,1
10	35.64	43.43	43,55±0,1
15	55.44	63.24	63,35±0,1
18	67.32	~~75.13~~	75,25±0,1
22	83.16	90.93	91,05±0,1

MARKING

The individual positions are marked with figures and letters according to MIL-C-21097-1.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

3.96 mm (0.156 in) PITCH PRINTED-WIRING INTERCONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22
double sided	12, 20, 30, 36, 44
Board thickness	1.6 mm
Terminations	solder tags with open eyelet
Category (I.E.C.publ.68)	65/125/21

DESCRIPTION

These interconnectors have a blue glass fibre filled diallylphthalate body, according to MIL specification C-21097-1.
The contact springs are of phosphor bronze; they are easily removable.
The finish of the contact faces is rolled gold; the contact tags are gold flashed.
The interconnectors mate with the printed-wiring connectors F 047 and F 053.

TECHNICAL DATA

Dimensions (in mm)

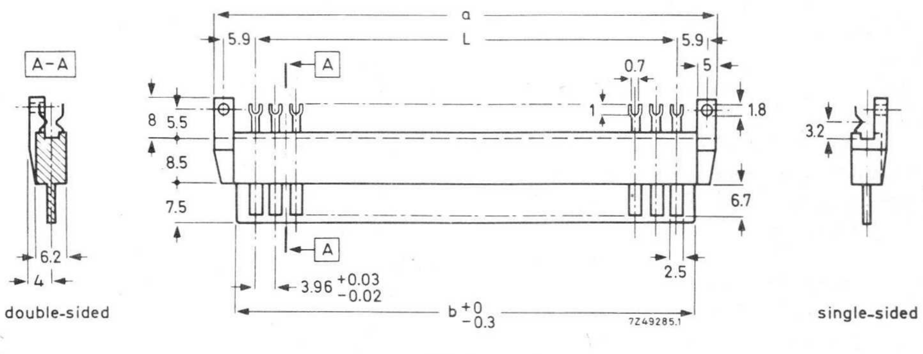


Fig. 1

Table 1

number of connections		L *) (mm)		a_{max} (mm)	b (mm)	approx. weight (g)	
single sided (n)	double sided					single sided	double sided
6	12	19.80	+0.15 −0.1	37.45	27.74	5.0	6.0
10	20	35.64	+0.2 −0.1	53.34	43.58	7.5	8.0
15	30	55.44	+0.2 −0.1	73.14	63.40	9.0	10.5
18	36	67.32	+0.2 −0.1	85.02	75.30	10.0	12.0
22	44	83.16	+0.2 −0.1	100.86	91.10	12.5	15.0

Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22
double sided	12, 20, 30, 36, 44
Board thickness	1.4 to 1.8 mm
Mechanical endurance	≥ 300 insertions
Ambient temperature range	−65 to +125 °C
Connector body, material	glass fibre filled diallylphthalate
Contacts, material	phosphor bronze
finish of faces	5 μm (min. 3 μm) rolled gold
type of terminations	solder tag with open eyelet
finish of terminations	gold flash
Maximum current at $T_{amb} \leq 80$ °C	5 A
at $T_{amb} > 80$ °C	see Fig.2
Creepage distance between two adjacent or opposite contacts	≥ 1.25 mm
Max. r.m.s. voltage (I.E.C.publ.130.1)	250 V
Test voltage for 1 min between adjacent contacts	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, ≤ 20 mV, 1 kHz	
initially	≤ 8 mΩ typ. 4.6 mΩ at T_{amb} = 23 to 125 °C
after damp heat test (I.E.C.68, test Ca)	≤ 10 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C.68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	≤ 1.5 pF
between opposite contacts	≤ 2.0 pF

*) L_{nom} = (n-1) 3.96 mm

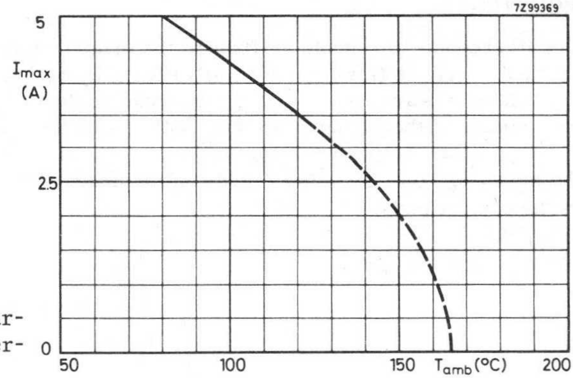


Fig. 2. Derating of maximum current with ambient temperature

The following tests are carried out by frequent inspections:

vibration	I.E.C.68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
mould growth	test J
soldering	test T
salt mist	test Ka

AVAILABLE VERSIONS

Table 2

version	number of connections	catalogue number
single sided	6	2422 025 89033
	10	89034
	15	89035
	18	89036
	22	89037
double sided	12	2422 025 89038
	20	89039
	30	89041
	36	89042
	44	89043

MOUNTING

The interconnector should be fixed to the printed-wiring board by means of screws or tubular rivets (max. ϕ 1.7 mm), after positioning the board in such a way that the solder tags are opposite the corresponding contact pads of the board. To improve the rigidity of the fixing a washer with a diameter of 4.5 mm and a hole of 1.8 ± 0.1 mm should be placed under the screw or rivet and soldered to the copper isle of the mounting hole. See also Fig.3. Subsequently the solder tags should be soldered to the contact pads.

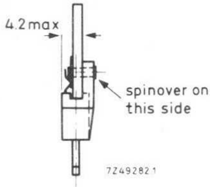


Fig.3

PRINTED-WIRING BOARD RECOMMENDATIONS

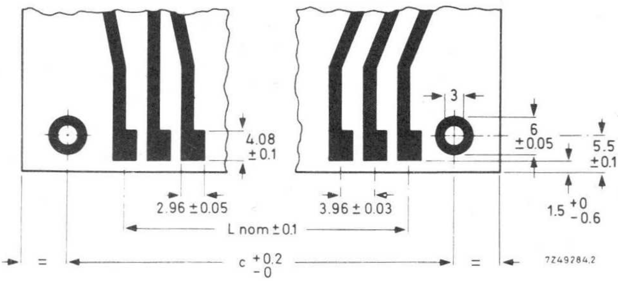


Fig.4

number of connections		L_{nom}	c
single sided(n)	double sided	(n-1) 3.96 (mm)	(n+2) 3.96 (mm)
6	12	19.80	31.68
10	20	35.64	47.52
15	30	55.44	67.32
18	36	67.32	79.20
22	44	83.16	95.04

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

3.96 mm (0.156 in) PITCH MULTI-PIN CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	6, 10, 12, 15, 18, 22
Terminations	straight or hooked solder tags
Category (I.E.C. publ.68) for versions with hooked terminations	65/125/21
MIL specification for versions with straight terminations	C-21097-7

DESCRIPTION

These multi-pin connectors have a blue glass fibre filled diallylphthalate body.
The contact springs are of nickel plated brass; they are easily removable.
The contact faces are gold plated; the contact terminations are gold flashed.
The multi-pin connectors mate with the printed-wiring connectors F047 and F053.

TECHNICAL DATA

Dimensions (in mm)

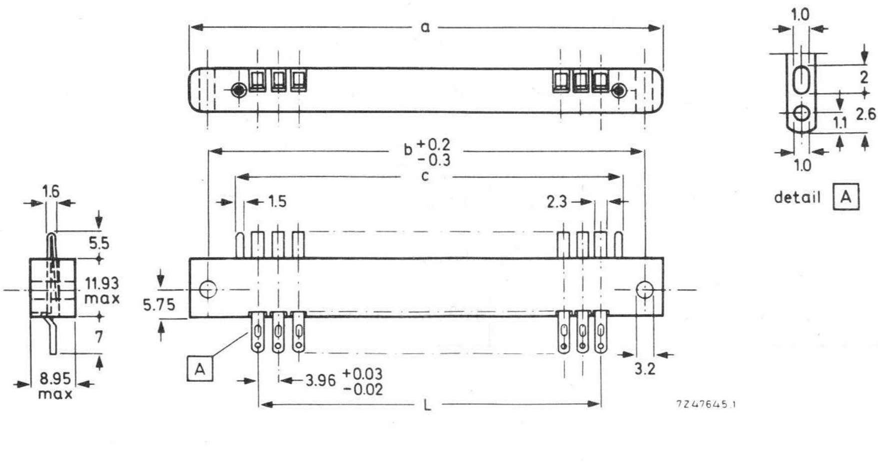


Fig.1.Connector with straight terminations

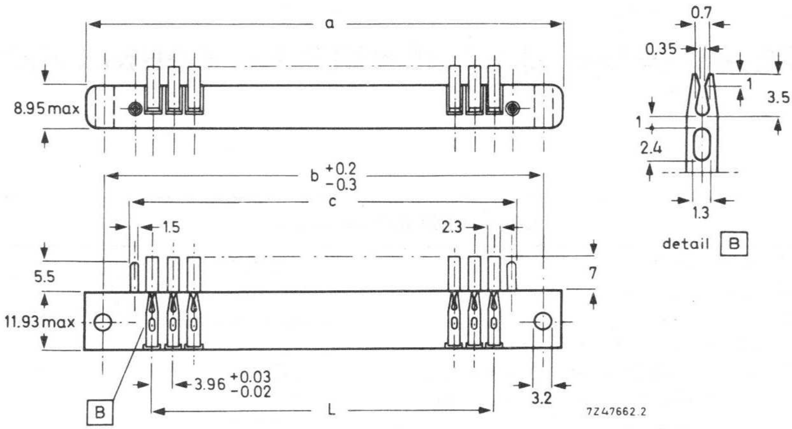


Fig.2. Connector with hooked terminations

Table 1

number of connections (n)	L *) (mm)	a_{max} (mm)	b (mm)	c_{max} (mm)	approx. weight (g) versions with straight terminations	approx. weight (g) versions with hooked terminations
6	19.80 +0.18 −0.16	47.0	38.94	27.73	11.0	12.0
10	35.64 +0.19 −0.15	62.9	54.77	43.63	15.0	16.0
12	43.56 +0.20 −0.15	70.7	62.74	51.56	17.0	18.0
15	55.44 +0.21 −0.14	82.5	74.65	63.47	20.0	22.0
18	67.32 +0.21 −0.13	94.5	86.56	75.35	24.0	26.0
22	83.16 +0.22 −0.12	110.5	102.43	91.23	28.0	31.0

*) L_{nom} = (n-1) 3.96 mm

Contact pitch	3.96 mm (0.156 in)
Number of connections	6, 10, 12, 15, 18, 22
Mechanical endurance	**≥ 300 insertions**
Ambient temperature range	−65 to +125 °C
Connector body, material	glass fibre filled diallylphthalate
Contact springs, material	brass
shape	knife
finish of faces	
versions with straight terminations	min. 5 μm nickel plate min. 1.3 μm gold plate
versions with hooked terminations	min. 4 μm nickel plate, 1 μm (min. 0.55 μm) gold plate
type of terminations	straight or hooked solder tag with eyelets (see Figs. 1 and 2)
finish of terminations	gold flash on nickel plate
Maximum current	5 A
Creepage distance between two adjacent contacts	≥ 1.44 mm
Max. r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min	
between adjacent contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, ≤ 20 mV, 1 kHz	
initially	≤ 4 mΩ typ. 1.8 mΩ *) at T_{amb} = 23 to 125 °C
after damp heat test (I.E.C. 68, test Ca)	≤ 6 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	< 1 pF

The following tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
mould growth	test J
soldering	test T
salt mist	test Ka

*) Measured with F047, double sided bridged version.

AVAILABLE VERSIONS

Table 2

version	number of connections	catalogue number
with straight terminations *)	6	2422 025 89002
	10	89003
	12	89004
	15	89005
	18	89006
	22	89007
with hooked terminations	6	2422 025 89026
	10	89027
	12	89028
	15	89029
	18	89031
	22	89032

MOUNTING

The connectors can be mounted by means of two screws and nuts M3.

MARKING

The contact positions are marked with capitals.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

*)According to MIL specification C-21097-7

3.96 mm (0.156 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18 and 22
double sided	12, 20, 30, 36 and 44
Board thickness	1.6 mm
Terminations	solder tags
Category (I.E.C.publ.68)	65/125/21

DESCRIPTION

The connectors have a moulded body of a green tropic proof glass fibre filled polyester resin.
The contact springs are of phosphor bronze, they are bifurcated to provide a double contact. The contact springs are easily removable.
The contact faces are gold plate on nickel plate.

TECHNICAL DATA Dimensions in mm

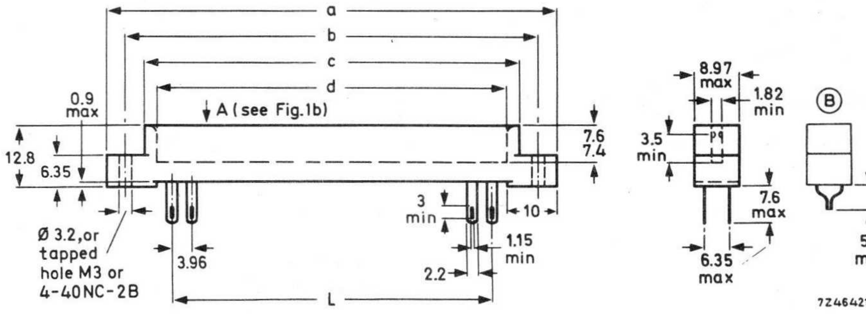


Fig. 1a. Outline drawing of a double sided connector with insert (B) for type with bridged opposite terminations.

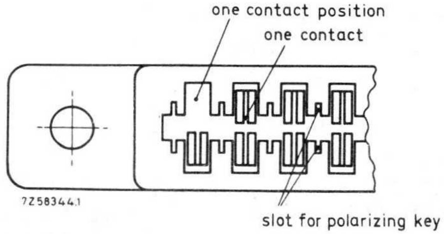


Fig. 1b. Diagrammatic part view in the direction of arrow A (see Fig. 1a)

number of connections single sided	number of connections double sided	dimensions (mm) L [1]		a_{max}	b		c_{max}	d	approx. weight [2] double sided (g)
6	12	19.80	+0.2 / -0.1	47.34	38.91	±0.2	32.56	27.94±0.15	6.8
10	20	35.64		63.19	54.76		48.43	43.79±0.15	10
15	30	55.44		83.00	74.62		68.27	63.60±0.15	14
18	36	67.32		94.89	86.51		80.18	75.49±0.15	16.4
→ 22	44	83.16		110.74	102.41		96.16	91.34±0.20	19.6

Contact pitch	3.96 mm (0.156 in)
Number of connections, single sided	6, 10, 15, 18 and 22
double sided	12, 20, 30, 36 and 44
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig.3)
Insertion force [3]	
12 contacts	≤ 27 N (2.7 kg)
20 contacts	≤ 45 N (4.5 kg)
30 contacts	≤ 60 N (6.0 kg)
36 contacts	≤ 70 N (7.0 kg)
44 contacts	≤ 80 N (8.0 kg)
Withdrawal force [3]	> 0.2 N (20 g)
Mechanical endurance	≥ 250 insertions [4]
Ambient temperature range	-65 to +125 °C
Connector body, material	glass fibre filled polyester
Contact springs, material	phosphor bronze
shape	bifurcated
finish of faces	min. 3 μm nickel plate, 0.4 μm (min. 0.2 μm) gold flash, or min. 5 μm nickel plate, 5 μm (min. 2.5 μm) gold plate, or min. 5 μm nickel plate, 2.5 μm (min. 1.3 μm) gold plate
contact force	
initially	1.0 N (0.1 kg)
after mech. endurance	0.8 N (0.08 kg)
type of terminations	solder tag with eyelet
finish of terminations	gold flash on nickel plate

1) $L_{nom} = (n-1)\ 3.96$ mm
2) For connectors with plain holes; for connectors with threaded bushes 2 g to be added.
3) Measured with mechanical gauge according to MIL-C-21097-1.
4) For versions with min. 0.2 μm gold flash on contact faces, the mechanical endurance is ≥ 100 insertions.

Maximum current at $T_{amb} \leq 85\ ^oC$	5 A
at $T_{amb} > 85\ ^oC$	see Fig. 2
Clearance between two opposite contacts	$\geq$0.4 mm
Creepage distance between two adjacent or opposite contacts	$\geq$1.9 mm
Max. r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min	
between adjacent contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, $\leq$20 mV, 1 kHz	
initially	< 10 mΩ typ. 5.4 mΩ at T_{amb} = 23 ^oC typ. 5.6 mΩ at T_{amb} = 125 ^oC
after damp heat test (I.E.C. 68, test Ca)	< 12 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	2 pF
between opposite contacts	2 pF

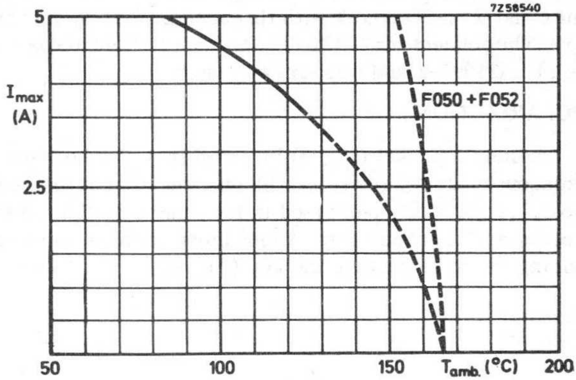


Fig. 2. Derating of maximum current with ambient temperature.

The follo ing tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40^{o}C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
soldering	test T

AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

For ordering purposes please quote the catalogue number.

2422 037 . . . . .

- First digit:
  - 0 plain fixing holes, 1 threaded fixing bushes: $\geq 0.2\,\mu m$ gold flash on contact face
  - 2 plain fixing holes, 3 threaded fixing bushes: $\geq 2.5\,\mu m$ gold plate on contact face
- Next two digits: number of contacts counted single sided (06, 10, 15, 18 or 22)
- Last two digits:
  - 02 single sided
  - 12 double sided
  - 16 double sided bridged

2422 040 . . . . .

- First digit:
  - 0 plain fixing holes, 1 threaded fixing bushes acc.to MIL-C-21097-1: $\geq 1.3\,\mu m$ gold plate on contact face
- Next two digits: number of contacts counted single sided (06, 10, 15, 18 or 22)
- Last two digits:
  - 02 single sided
  - 12 double sided
  - 16 double sided bridged

MOUNTING

The connectors with plain fixing holes can be mounted by means of two M3 screws, nuts and washers, those with threaded bushes by means of two M3 screws and washers. The connectors 2422 040 1.... can be mounted by means of two screws according to MIL-21097-1 and washers to match.

POLARIZATION

A thermoplastic key (Fig.3) inserted in a slot between any two adjacent contacts (see Fig.1b) ensures that a printed-wiring board is correctly polarized in its connector. This method involves no loss of contacts. A slot must be made in the printed-wiring board to receive the key (Fig.4).

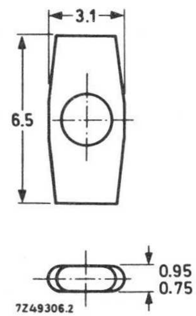
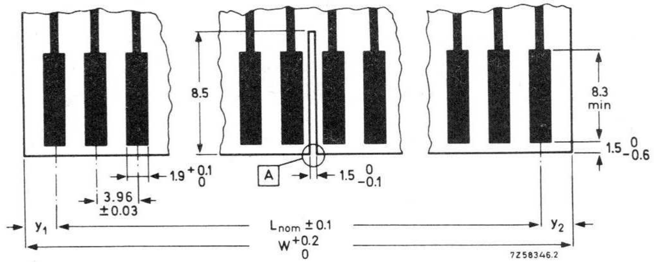


Fig.3. Polarizing key, cat.no. 4332 026 06550

PRINTED-WIRING BOARD RECOMMENDATIONS



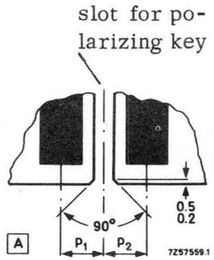


Fig. 4. $y_1 = y_2$ with a tolerance of ±0.1 mm
$p_1 = p_2$ with a tolerance of ±0.1 mm

number of connections, single sided	L_{nom} (mm)	W (mm)
6	19.80	27.58
10	35.64	43.43
15	55.44	63.24
18	67.32	75.13
22	83.16	90.93

MARKING

The individual positions are marked with figures and letters according to MIL-C-21097-1.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

3.96 mm (0.156 in) PITCH PRINTED-WIRING INTERCONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22
double sided	12, 20, 30, 36, 44
Board thickness	1.6 mm
Terminations	solder tags with open eyelet
Category (I.E.C. publ. 68)	65/125/21

DESCRIPTION

These interconnectors have a body of green glass fibre filled thermosetting material.
The contact springs are of phosphor bronze; they are easily removable.
The finish of the contact faces is rolled gold; the contact tags are gold flashed.
The interconnectors mate with the printed-wiring connectors F050 and F053.

TECHNICAL DATA

Dimensions (in mm)

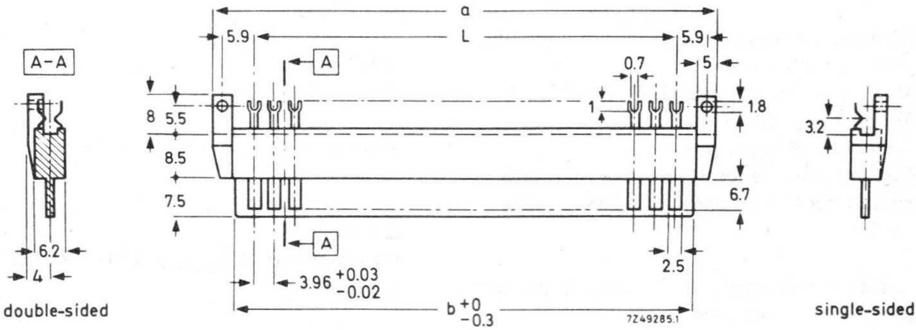


Fig. 1

Table 1

number of connections					approx. weight (g)	
single sided(n)	double sided	L *) (mm)	a_{max} (mm)	b (mm)	single sided	double sided
6	12	19.80 $^{+0.15}_{-0.1}$	37.45	27.74	5.0	6.0
10	20	35.64 $^{+0.2}_{-0.1}$	53.34	43.58	7.5	8.0
15	30	55.44 $^{+0.2}_{-0.1}$	73.14	63.40	9.0	10.5
18	36	67.32 $^{+0.2}_{-0.1}$	85.02	75.30	10.0	12.0
22	44	83.16 $^{+0.2}_{-0.1}$	100.86	91.10	12.5	15.0

Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22
double sided	12, 20, 30, 36, 44
Board thickness	1.4 to 1.8 mm
Mechanical endurance	$\geq$ 300 insertions **)
Ambient temperature range	−65 to +125 ^{o}C
Connector body, material	thermosetting glass fibre filled
Contact springs, material	phosphor bronze
finish of faces	5 μm (min. 3 μm) rolled gold or min. 0.2 μm gold flash
type of terminations	solder tag with open eyelet
finish of terminations	gold flash
Maximum current at $T_{amb} \leq 80\,^{o}$C	5 A
at $T_{amb} > 80\,^{o}$C	see Fig.2
Creepage distance between two adjacent or opposite contacts	$\geq$1.25 mm
Max. r.m.s. voltage (I.E.C.publ.130.1)	250 V
Test voltage for 1 min between adjacent contacts	1000 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, $\leq$ 20 mV, 1 kHz	
initially	$\leq$ 8 mΩ typ. 4.6 mΩ at T_{amb} = 23 to 125 ^{o}C
after damp heat test (I.E.C.68, test Ca)	$\leq$ 10 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C.68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	$\leq$ 1.5 pF
between opposite contacts	$\leq$ 2.0 pF

*) L_{nom} = (n−1) 3.96 mm.

**) For versions with min. 0.2 μm gold flash on contact faces, the mechanical endurance is $\geq$ 100 insertions.

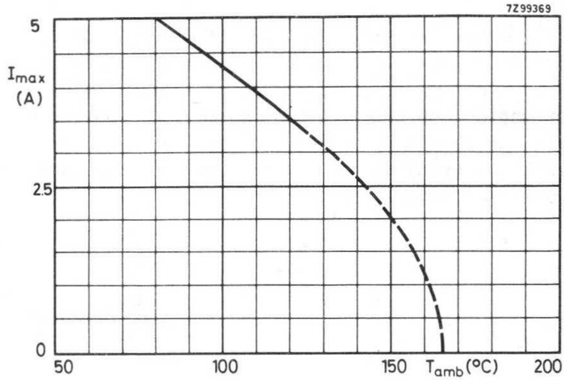


Fig. 2. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C 68	test F/VI
shock		test Ea
damp heat		test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature		test Na
mould growth		test J
soldering		test T
salt mist		test Ka

AVAILABLE VERSIONS

Table 2

version	number of connections	catalogue number
single sided	6	2422 025 89·71
	10	89·72
	15	89·73
	18	89·74
	22	89·75
double sided	12	2422 025 89·76
	20	89·77
	30	89·78
	36	89·79
	44	89·81

0 = ≥ 3 μm rolled gold } finish of faces
2 = ≥ 0.2 μm gold flash } finish of faces

MOUNTING

The interconnector should be fixed to the printed-wiring board by means of screws or tubular rivets (max. ϕ 1.7 mm), after positioning the board in such a way that the solder tags are opposite the corresponding contact pads of the board. To improve the rigidity of the fixing a washer with a diameter of 4.5 mm and a hole of 1.8 ± 0.1 mm should be placed under the screw or rivet and soldered to the copper isle of the mounting hole. See also Fig. 3. Subsequently the solder tags should be soldered to the contact pads.

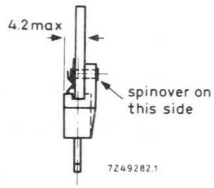


Fig. 3

PRINTED-WIRING BOARD RECOMMENDATIONS

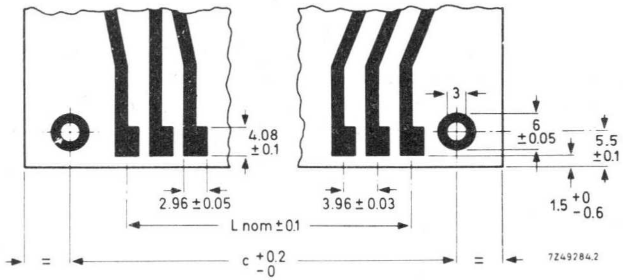


Fig. 4

number of connections		L_{nom} (n-1)3.96 (mm)	c (n+2)3.96 (mm)
single sided	double sided		
6	12	19.80	31.68
10	20	35.64	47.52
15	30	55.44	67.32
18	36	67.32	79.20
22	44	83.16	95.04

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

3.96 mm (0.156 in) PITCH MULTI-PIN CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	6, 10, 12, 15, 18, 22
Terminations	solder tags
Category (I.E.C. publ. 68)	65/125/21

DESCRIPTION

These multi-pin connectors have a green glass fibre filled polyester body.
The contact springs are of nickel plated brass; they are easily removable.
The contact faces are gold plated; the contact terminations are gold flashed.
The multi-pin connectors mate with the printed-wiring connectors F050 and F053.

TECHNICAL DATA

Dimensions (in mm)

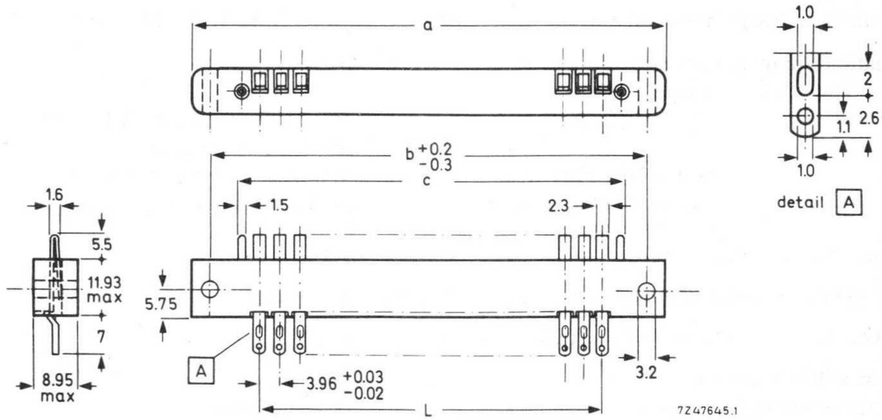


Fig.1

Table 1

number of connections (n)	L*) (mm)	a_{max} (mm)	b (mm)	c_{max} (mm)	approx. weight (g)
6	$19.80^{+0.18}_{-0.16}$	47.0	38.94	27.73	11.0
10	$35.64^{+0.19}_{-0.15}$	62.9	54.77	43.63	15.0
12	$43.56^{+0.20}_{-0.15}$	70.7	62.74	51.56	17.0
15	$55.44^{+0.21}_{-0.14}$	82.5	74.65	63.47	20.0
18	$67.32^{+0.21}_{-0.13}$	94.5	86.56	75.35	24.0
22	$83.16^{+0.22}_{-0.12}$	110.5	102.43	91.23	28.0

Contact pitch	3.96 mm (0.156 in)
Number of connections	6, 10, 12, 15, 18, 22
Mechanical endurance	$\geq$ 250 insertions
Ambient temperature range	−65 to +125 °C
Connector body, material	glass fibre filled polyester
Contact springs, material	brass
shape	knife
finish of faces	min. 3 μm nickel plate, 0.4 μm (min. 0.2 μm) gold plate
type of terminations	solder tag with two eyelets
finish of terminations	gold flash on nickel plate
Maximum current	5 A
Creepage distance between two adjacent contacts	$\geq$ 1.4 mm
Max. r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min	
between adjacent contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz

*) L_{nom} = (n-1) 3.96 mm.

Contact resistance (inclusive material resistance) at 10 mA, $\leq$ 20 mV, 1 kHz	
initially	$\leq 4\ m\Omega$ typ. 1.8 $m\Omega$*) at T_{amb} = 23 to 125 °C
after damp heat test (I.E.C. 68, test Ca)	$\leq 6\ m\Omega$
Insulation resistance	
initially	$> 10^5\ M\Omega$
after damp heat test (I.E.C.68, test Ca)	$> 10^3\ M\Omega$
Capacitance between adjacent contacts	< 1 pF

The following tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
soldering	test T

AVAILABLE VERSIONS

Table 2

number of connections	catalogue number
6	2422 025 89084
10	89085
12	89086
15	89087
18	89088
22	89089

MOUNTING

The connectors can be mounted by means of two screws and nuts M3.

MARKING

The contact positions are marked with capitals.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

*) Measured with F050, double sided bridged version.

3.96 mm (0.156 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22, 28, 36 and 43
double sided	12, 20, 30, 36, 44, 56, 72 and 86
Board thickness	1.6 mm
Terminations	mini wire wrap or dipsolder
Category (I.E.C. publ. 68)	40/125/21

DESCRIPTION

The connectors have a moulded body of a red tropic proof glass fibre filled polycarbonate resin.

The contact springs are of phosphor bronze, they are bifurcated to provide a double contact. The contact springs are easily removable.

The contact faces are gold plate on nickel plate.

TECHNICAL DATA Dimensions in mm

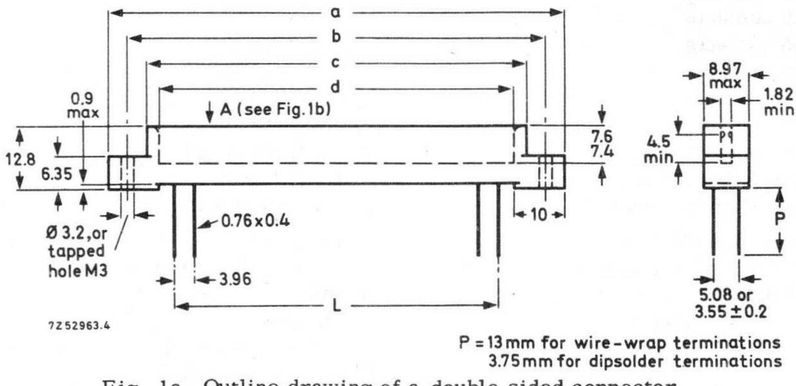


Fig. 1a. Outline drawing of a double sided connector.

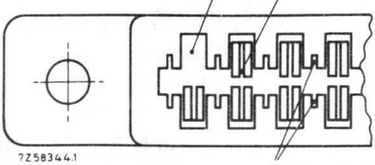


Fig. 1b. Diagrammatic part view in the direction of arrow A (see Fig. 1a).

A piercing diagram for dipsolder version is given in Fig. 3 under "Mounting".

Table 1

number of connections single sided	number of connections double sided	dimensions (mm) L [1]		a_{max}	b	c_{max}	d	approx. weight [2] double sided(g)
6	12	19.80	+0.2 / −0.1	47.34	38.91±0.2	32.56	27.94±0.15	6.8
10	20	35.64		63.19	54.76±0.2	48.43	43.79±0.15	10
15	30	55.44		83.00	74.62±0.2	68.27	63.60±0.15	14
18	36	67.32		94.89	86.51±0.2	80.18	75.49±0.15	16.4
→ 22	44	83.16		110.74	102.41±0.2	96.16	91.34±0.20	19.6
28	56	106.92		134.21	126.09±0.4	118.97	115.11±0.25	24.4
36	72	138.60		166.19	157.99±0.4	150.67	146.76±0.25	30.8
43	86	166.32		193.82	185.47±0.4	178.61	174.55±0.25	36.4

Contact pitch	3.96 mm (0.156 in)
Number of connections	
single sided	6, 10, 15, 18, 22, 28, 36 and 43
double sided	12, 20, 30, 36, 44, 56, 72 and 86
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig.4)
Insertion force [3]	
12 contacts	≤ 27 N (2.7 kg)
20 contacts	≤ 45 N (4.5 kg)
30 contacts	≤ 60 N (6.0 kg)
36 contacts	≤ 70 N (7.0 kg)
44 contacts	≤ 80 N (8.0 kg)
56 contacts	≤ 100 N (10.0 kg)
72 contacts	≤ 120 N (12.0 kg)
86 contacts	≤ 140 N (14.0 kg)
Withdrawal force per contact [3]	> 0.2 N (20 g)
→ Mechanical endurance	≥ 250 insertions [4]
Ambient temperature range	−40 to +125 °C
Connector body, material	glass fibre filled polycarbonate
Contact spings, material	phosphor bronze
shape	bifurcated
finish of faces	min. 5 μm nickel plate, 2.5 μm (min. 1.3 μm) gold plate, or min. 3 μm nickel plate, 0.4 μm (min. 0.2 μm) gold flash
contact force	
initially	1.0 N (0.1 kg)
after mech. endurance	0.8 N (0.08 kg)
type of terminations	mini wire wrap or dipsolder
finish of terminations	goldflash on nickel plate

1) Lnom = (n-1) 3.96 mm.

2) For connectors with plain holes; for connectors with threaded bushes 2 g to be added.

3) Measured with mechanical gauge according to MIL-C-21097-1.

4) For versions with min. 0.2μm gold flash on contact faces, the mechanical endurance is ≥ 100 insertions.

Maximum current at $T_{amb} \leq 65\ ^{o}C$	5 A
at $T_{amb} > 65\ ^{o}C$	see Fig. 2
Clearance between two opposite contacts	$\geq$ 0.4 mm
Creepage distance between two adjacent or opposite contacts	$\geq$ 2.1 mm
Max. r.m.s. voltage (I.E.C. publ. 130.1)	250 V
Test voltage for 1 min	
between adjacent contacts	1000 V, 50 Hz
between a contact and a metal mounting plate	1000 V, 50 Hz
Contact resistance (incl. material resistance) at 10 mA, $\leq$ 20 mV, 1 kHz	
initially	< 18 mΩ
	typ. 9.5 mΩ at T_{amb} = 23 ^{o}C
	typ. 9.7 mΩ at T_{amb} = 125 ^{o}C
after damp heat test (I.E.C. 68, test Ca)	< 20 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	2 pF
between opposite contacts	2 pF

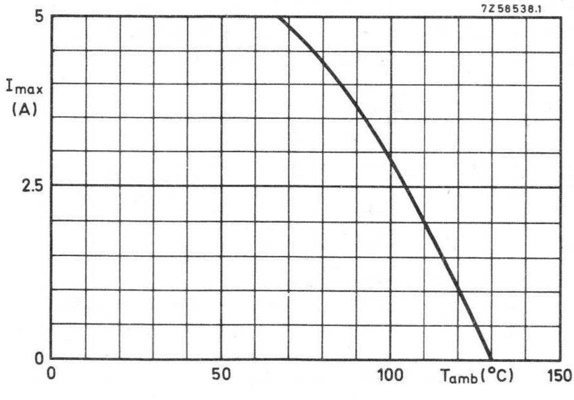


Fig. 2. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C. 68 test F/VI
shock	test Ea
damp heat	test Ca (40 ^{o}C, 90-95% R.H., 21 days)
rapid change of temperature	test Na
mould growth	test J
soldering (type 2422 044 only)	test T

AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

For ordering purposes please quote the catalogue number.

2422 ... .

039 wire wrap terminations (length 13 mm)
044 dipsolder terminations (length 3.75 mm)

02 single sided } ≥ 1.3 μm gold plate
12 double sided } on contact face
42 single sided } ≥ 0.2 μm gold flash
52 double sided } on contact face

number of contacts, counted single sided (06, 10, 15, 18, 22, 28, 36 or 43)

0 plain fixing holes } pitch of opposite
1 threaded fixing bushes } terminations 5.08 mm

4 plain fixing holes } pitch of opposite
5 threaded fixing bushes } terminations 3.55 mm

MOUNTING

The wire wrap connectors must be fixed with two M3 screws.
If required the same screws can be used to secure the dipsolder connectors. The relevant piercing diagram is shown in Fig.3.

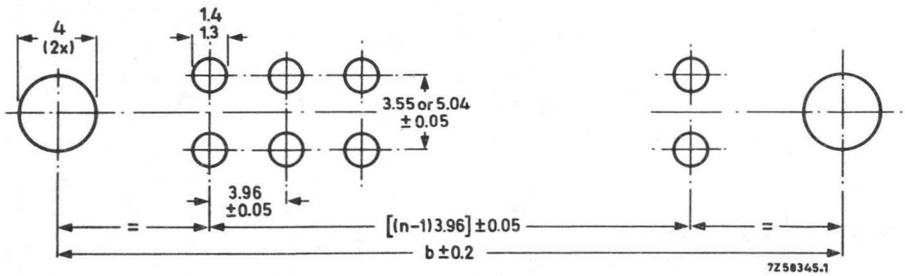


Fig.3. Piercing diagram for double sided connectors with dip-solder pins. $(n-1)3.96 = L_{nom}$. For b and L_{nom} see Table 1.

POLARIZATION

A thermoplastic key (Fig.4), inserted in a slot between any two adjacent contacts (see Fig.1) ensures that a printed-wiring board is correctly polarized in its connector. This method involves no loss of contacts. A slot must be made in the printed-wiring board to receive the key (Fig.5).

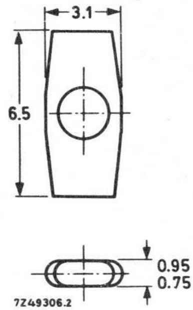


Fig.4. Polarizing key cat. no. 4332 026 06550

PRINTED-WIRING BOARD RECOMMENDATIONS

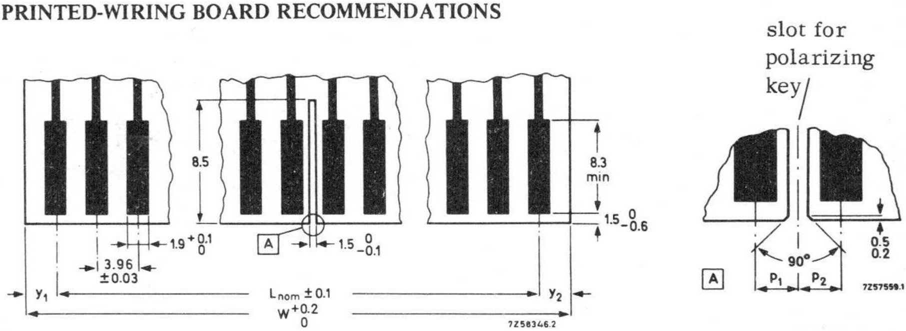


Fig.5. $y_1 = y_2$ with a tolerance of ± 0.1 mm
$p_1 = p_2$ with a tolerance of ± 0.1 mm

number of connections, single sided	L_{nom} (mm)	W (mm)
6	19.80	27.58
10	35.64	43.43
15	55.44	63.24
18	67.32	75.13
22	83.16	90.93
28	106.92	114.65
36	138.60	146.30
43	166.32	174.09

MARKING

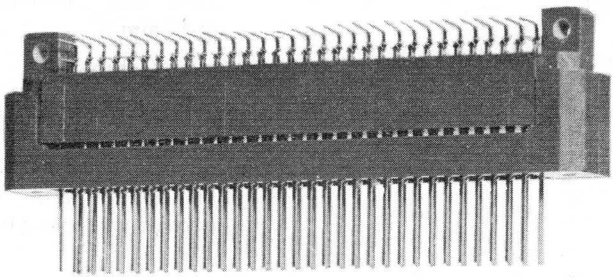
The individual positions are marked with figures and letters according to MIL-C-21097-1.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

0.1" PRINTED-WIRING CONNECTORS

RZ 23456-2



Composed of a male part and a female part

Contact pitch	0.1" (2.54 mm)
Contact termination of the male part	for mini wire-wrap connection
Number of connections	32, 48, 64 (double sided)
Maximum thickness	9.6 mm

GENERAL

These printed-wiring connectors will find application in electronic and electrical equipment, where high demands are made on the quality and the reliability of the connection and the possibility of a quick exchange of printed-wiring boards is required. They are very suited to be used in multi-layer technics.

The connectors are composed of a male part and a female part, which are supplied separately.

By soldering the right-angled contact pins of the female part to the copperclad pads of the printed-wiring board, good and sturdy connections are obtained. The gold-plated contacts of the female part form with those of the male part connections of high quality.

The male parts 2422 025 89118, 2422 025 89124 and 2422 025 89129 are suited for mounting on a panel by means of dipsoldering.

CONSTRUCTION

Material of connector bodies	glass fibre filled diallyl phthalate, colour green
Material of contact springs	phosphor-bronze, 4 μm rolled goldplating on contact area
Contact termination of the male part	mini wire-wrap pins, which permit at least 3 wire-wrap connections using a wire of max. 0.25 mm ∅.
Contact pitch	0.1" (2.54 mm)
Board thickness	max. 1/16" (1.4-1.8 mm)
Number of contacts	32, 48, 64 (double sided)
Polarisation	insertion of male part in female part is only possible in one way.

Dimensions in mm

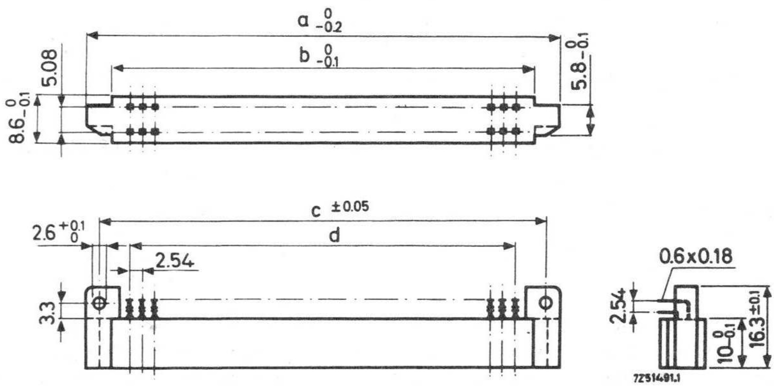


Fig.1 Female part

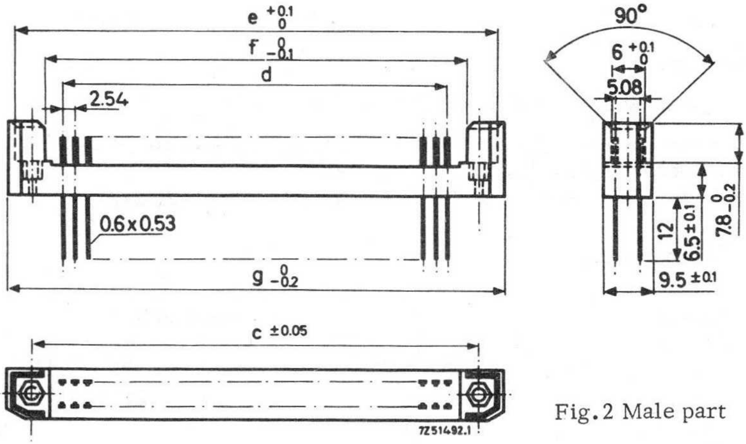


Fig. 2 Male part

number of connections	a	b	c	d	e	f	g
32	54.5	43.8	48.3	38.10	55.2	44.0	58.3
48	74.8	64.1	68.6	58.42	75.5	64.3	78.6
64	95	84.4	88.9	78.74	95.8	84.6	98.9

TECHNICAL PERFORMANCE

Maximum current	1.5 A
Ambient temperature range	-65 to +125 °C
Contact resistance [1] (inclusive material resistance)	
initially	≤ 14 mΩ
after damp heat test (I.E.C. 68, test C, 21 days)	≤ 17 mΩ
Insulation resistance between adjacent contacts and between a contact spring and the mounting chassis	
initially	> 10^5 MΩ
after damp heat test (I.E.C. 68, test C, 21 days)	> 10^3 MΩ
Air- and creepage distance between two adjacent or opposite contacts	≥ 0.8 mm
Contact force	
initially	≤ 90 g
after 300 insertions/withdrawals	≥ 50 g

[1]) Measured between two contacts, 2 mm from the body of the moulding part.

Insertion force ≤ 6 kg

Withdrawal force ≥ 1 kg

The printed-wiring connector meets the following tests:

- vibration test according to MIL-STD-202C, method 204A, condition B
- shock test according to MIL-STD-202C, method 202B
- long term damp heat test according to I.E.C. 68, test C, 21 days.

AVAILABLE VERSIONS

number of connections	catalogue number	
	male part	female part
32	2422 025 89117	2422 025 89114
48	89123	89115
64	89128	89116
32	89118 for panel mounting	89114
48	89124 for panel mounting	89115
64	89129 for panel mounting	89116

MOUNTING

The printed-wiring board should be apertured as shown in Fig.3, to pass the contact pins of the female part. This part should be fitted to the printed-wiring board by means of rivets or screws.
Subsequently the pins must be soldered to the pads of the board.*)
The male parts 2422 025 89128 and 2422 025 89129 may be mounted in a miniature mounting chassis 4322 026 38250 and 4322 026 38280 respectively. These chassis can accommodate up to 41 printed-wiring connectors.

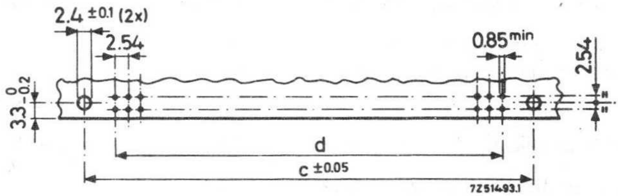


Fig.3

*) Experimenters' printed-wiring boards are available under catalogue number 4322 026 39880 and 4322 026 39890.

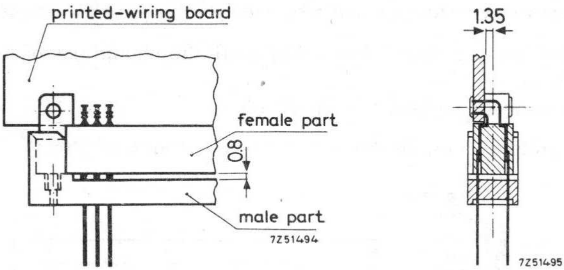


Fig.4

For mounting the male parts suited for panel mounting, on a panel pay attention to the following. Both rows of pins of the male part are at one side terminated by a comb (a, Fig.5). The wire-wrap pins are aligned by means of a polyester strip (b). Be careful to keep this strip in the same position during mounting.

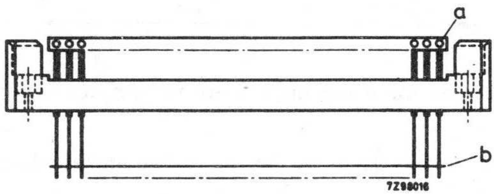


Fig.5

The mounting procedure is as follows:

1. Apply the hole pattern in the panel as given in Fig.6.

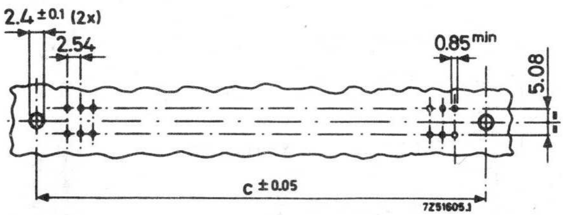


Fig.6

2. Insert the wire-wrap terminations row by row into the holes of the panel (see Fig.7). This may be achieved by approaching the panel under slight angle. The terminations should be inserted until the polyester strip touches the panel.

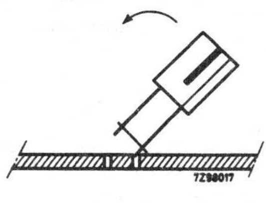


Fig.7

3. Turn the strip in vertical position by means of a pair of tweezers and remove it.
4. Push by hand on the edge of a comb until the shoulders of the wire-wrap pins touch the panel.
   Repeat this procedure with the other comb.
5. Press the combs firm with the aid of the tool shown in Fig.8.

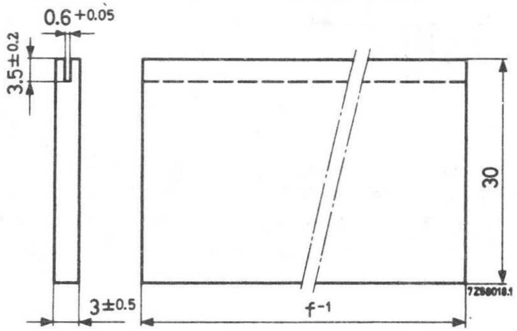


Fig.8

6. Push the male part on the panel until there is no space between panel and male part.
7. Fit the male part to the panel by means of two nickel-plated screws and nuts.
8. Solder the connections. During this dipsoldering procedure a pressure on both combs must be applied to prevent movement.
9. Remove the combs with the aid of the tool shown in Fig.8, by bending this tool from the vertical position to the outside of the connector.

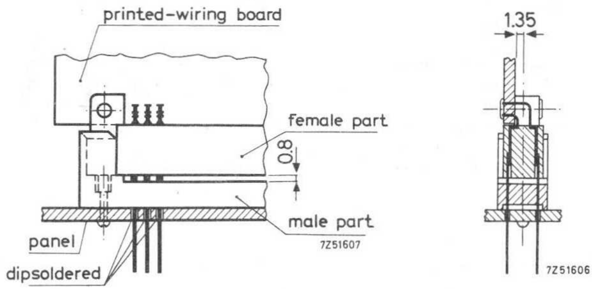


Fig.9

1.27 mm (0.05 in) PITCH TWO-PART PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	1.27 mm (0.05 in)
Number of connections	48, 84 and 116
Terminations	solder and/or dipsolder pins
Category (I.E.C. publ.68)	65/125/21

DESCRIPTION

These connectors consist of a part to be fitted to a printed-wiring board (board part) and another part to be mounted on a chassis or back panel (panel part).
Both parts have a blue glass fibre filled diallylphthalate body.
The contact springs are of phosphor bronze. The contact faces are rolled gold on nickelplating. No special provisions are required for positioning.

TECHNICAL DATA

Dimensions (in mm)

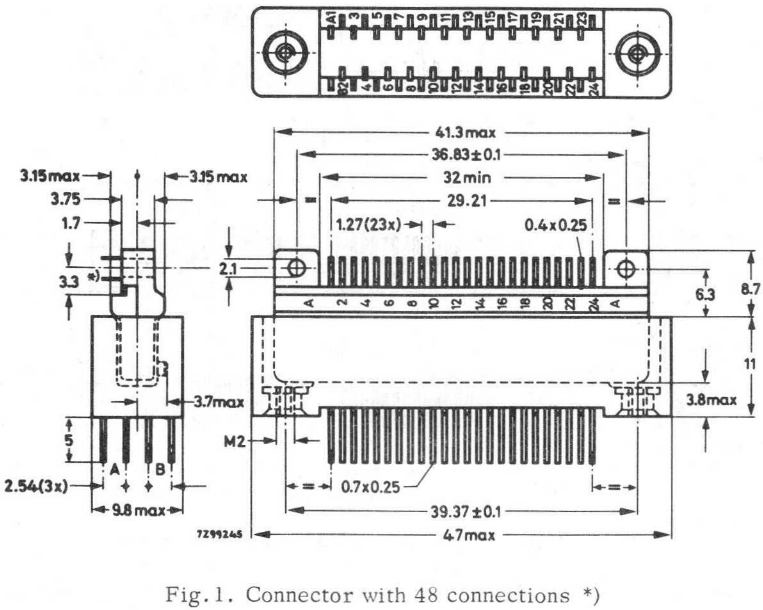


Fig. 1. Connector with 48 connections *)

*) See also Figs. 5 to 8 for the various terminal configurations (with dimensions) of the board part. For piercing diagrams, see Figs. 9 to 23.

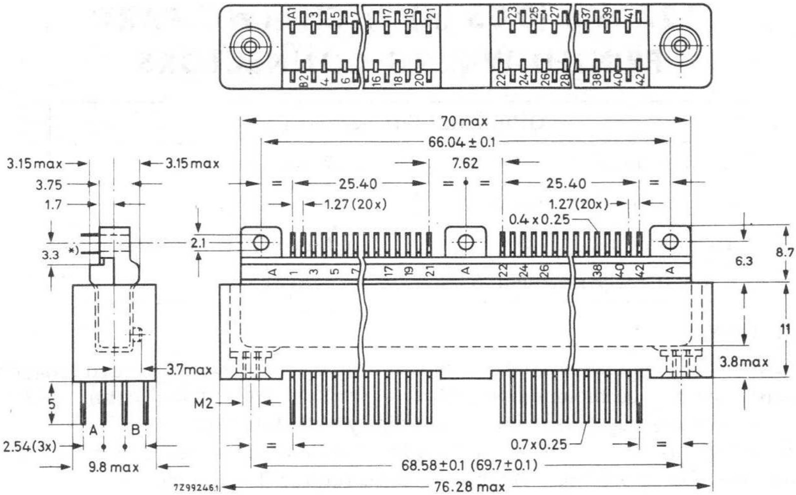


Fig. 2 Connector with 84 connections *)

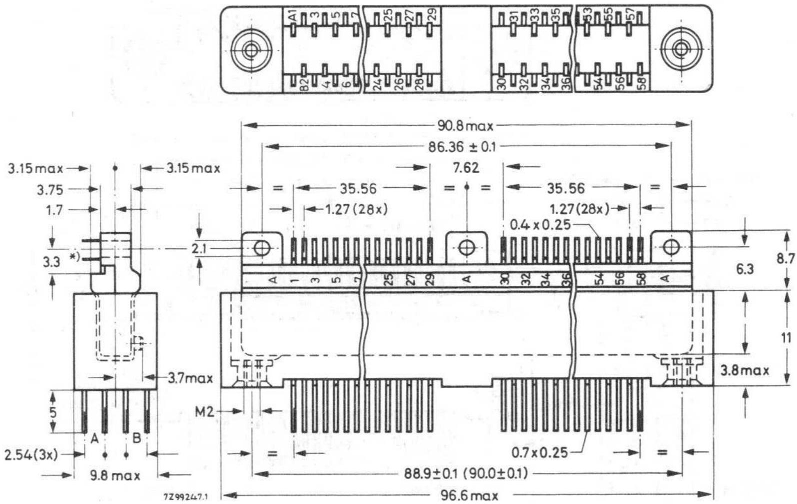


Fig. 3 Connector with 116 connections *)

*) See also Figs. 5 to 8 for the various terminal configurations (with dimensions) of the board part. For piercing diagrams, see Figs. 9 to 23.
In future the connectors will be manufactured to meet the latest I.E.C. specifications. This means that the centre distance of the mounting holes of the panel part will be as shown between brackets.

Weight	board part	panel part
48 connections	approx. 4.3 g	approx. 6.1 g
84 connections	approx. 7.2 g	approx. 10 g
116 connections	approx. 9.4 g	approx. 13 g

Contact pitch	1.27 mm (0.05 in)
Number of contacts	48, 84 and 116
Positioning	board part has been provided with two guiding protrusions, preventing incorrect insertion
Insertion force	
48 connections	< 30 N (3 kg)
84 connections	< 40 N (4 kg)
116 connections	< 50 N (5 kg)
Withdrawal force	
48 connections	between 10 N (1 kg) and 30 N (3 kg)
84 connections	between 10 N (1 kg) and 40 N (4 kg)
116 connections	between 10 N (1 kg) and 50 N (5 kg)
Mechanical endurance	$\geq$ 300 insertions
Ambient temperature range	-65 to +125 ^{o}C
Connector body, material	glass fibre filled diallylphthalate
Contact springs, material	phosphor bronze
shape	single face
finish of faces	5 μm (min. 4 μm) rolled gold on nickel-plating
contact force	
initially	0.45 N (0.045 kg)
after mech. endurance	0.35 N (0.035 kg)
type of terminations	
board part	solder and/or dipsolder pins
panel part	dipsolder pins
finish of terminations	goldflash
configuration of terminations	
board part	hooked and/or double hooked and/or staggered; see Figs.5 to 8
panel part	staggered
Maximum current at $T_{amb} \leq 65\ ^{o}C$	2 A
at $T_{amb} > 65\ ^{o}C$	see Fig.4
Clearance between two opposite contacts	$\geq$ 0.7 mm
Creepage distance between two adjacent or opposite contacts	$\geq$ 0.55 mm

Maximum r.m.s. voltage (I.E.C. publ. 130.1)	100 V
Test voltage for 1 min	
between adjacent contacts	700 V, 50 Hz
between a contact and a metal mounting plate	700 V, 50 Hz
Contact resistance (inclusive material resistance) at 10 mA, < 20 mV, 1 kHz	
initially	< 30 mΩ
	typ. 26.0 mΩ at T_{amb} = 23 °C
	typ. 26.6 mΩ at T_{amb} = 125 °C
after damp heat test (I.E.C.68, test Ca)	< 32 mΩ
Insulation resistance	
initially	> 10^5 MΩ
after damp heat test (I.E.C.68, test Ca)	> 10^3 MΩ
Capacitance between adjacent contacts	1.5 pF
between opposite contacts	1.5 pF

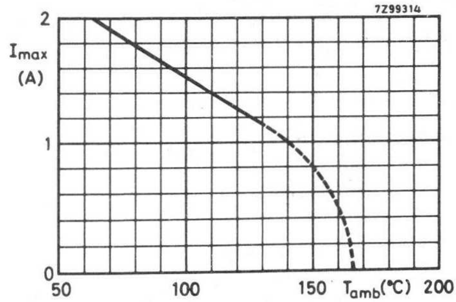


Fig.4. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C.68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90 - 95% R.H., 21 days)
rapid change of temperature	test Na (−65 °C/+125 °C, 5 cycles)
soldering	test T
salt mist	test Ka

AVAILABLE VERSIONS

number of connections	terminal configuration of the board part according to	catalogue number 2422 025 89... board part	catalogue number 2422 025 89... panel part
48	Fig. 5	136	139
	Fig. 6	137	
	Fig. 7	142	
	Fig. 8	167	
84	Fig. 5	157	162
	Fig. 6	158	
	Fig. 7	161	
	Fig. 8	169	
116	Fig. 5	147	152
	Fig. 6	148	
	Fig. 7	151	
	Fig. 8	172	

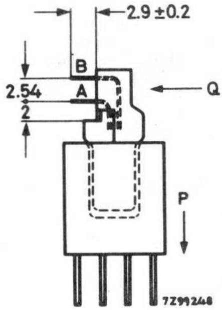


Fig. 5 *)

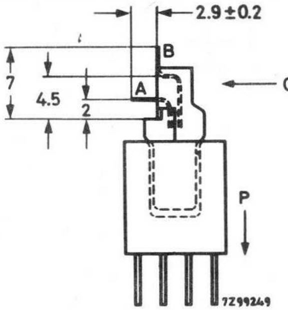


Fig. 6 *)

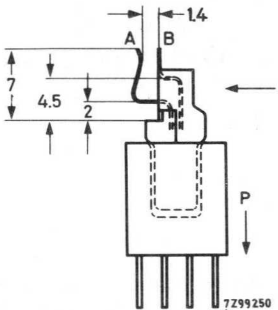


Fig. 7 *)

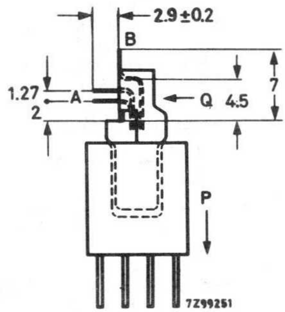


Fig. 8 *)

*) Catalogue numbers for ordering are given in the table.
Arrows Pand Q have been drawn for the sake of clarity: they indicate the directions of viewing when making the piercing diagrams (Figs. 9 to 23).

MOUNTING

Piercing diagrams for the panel part

The figures below give a view on the back panels (or chassis) in the direction of arrow P (Figs. 5 to 8).

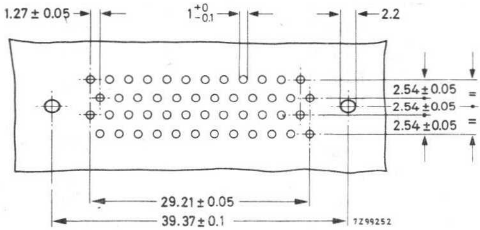


Fig. 9 For 48 connections

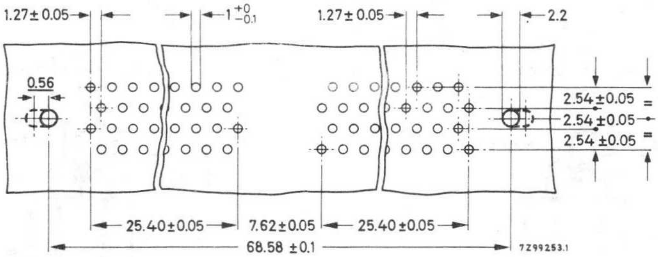


Fig. 10 For 84 connections *)

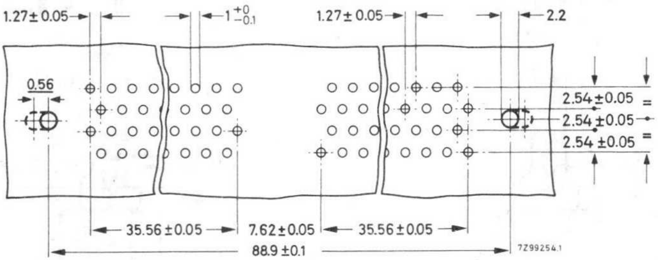


Fig. 11 For 116 connections *)

*) In future the connectors will be manufactured to meet the latest I.E.C. specifications. This will mean that the centre distance of the mounting holes for the panel part will be about 1 mm longer. Customers are recommended to make provisions for this change by using elongated mounting holes as shown in the piercing diagram in dashed lines. All other dimensions and distances remain the same.

Piercing diagrams for the board part

The figures below give a view on the printed-wiring boards in the direction of arrow Q (Figs. 5 to 8).

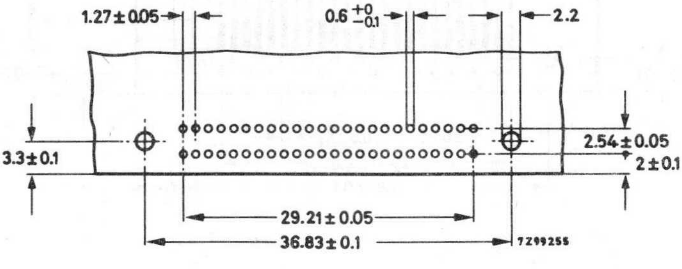


Fig. 12. For 48 connections; terminal configuration according to Fig.5.

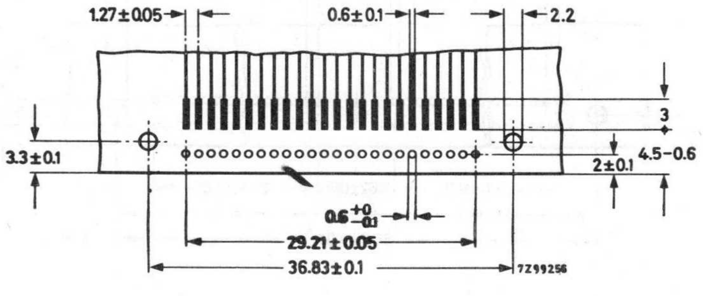


Fig.13. For 48 connections; terminal configuration according to Fig.6.

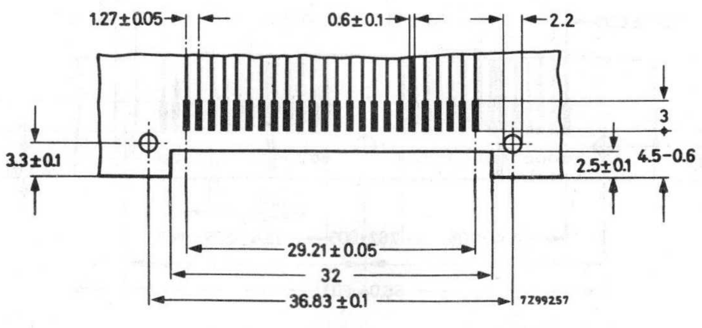


Fig.14. For 48 connections; terminal configuration according to Fig.7.

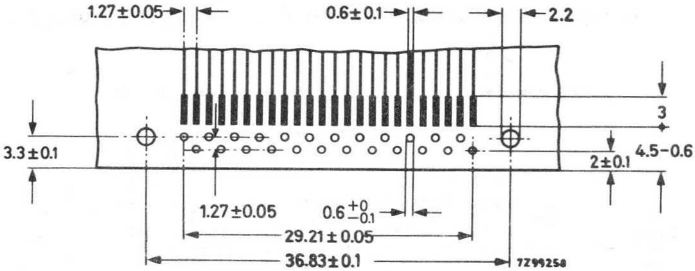


Fig.15. For 48 connections; terminal configuration according to Fig.8.

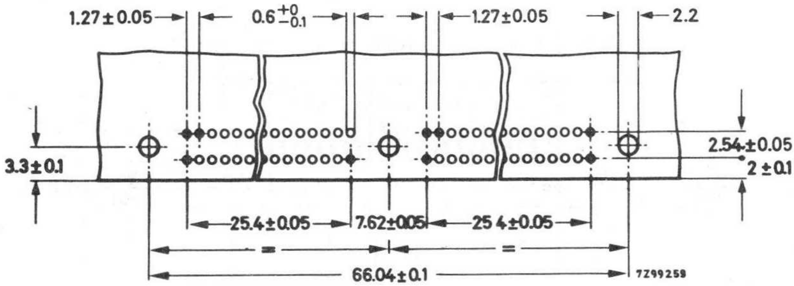


Fig.16. For 84 connections; terminal configuration according to Fig.5.

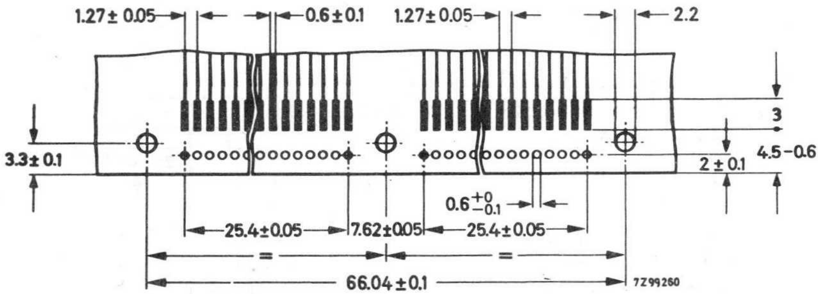


Fig.17. For 84 connections; terminal configuration according to Fig.6.

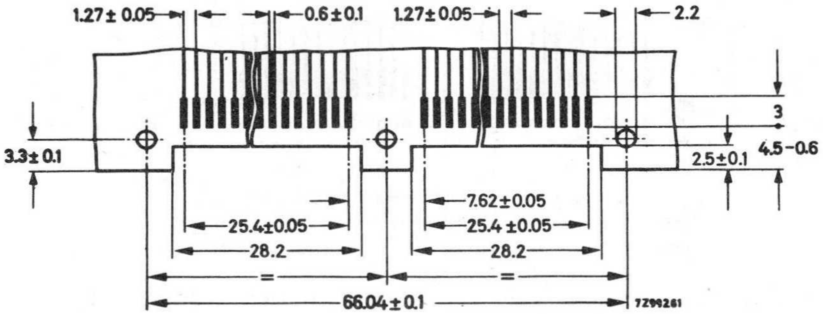


Fig.18. For 84 connections; terminal configuration according to Fig.7.

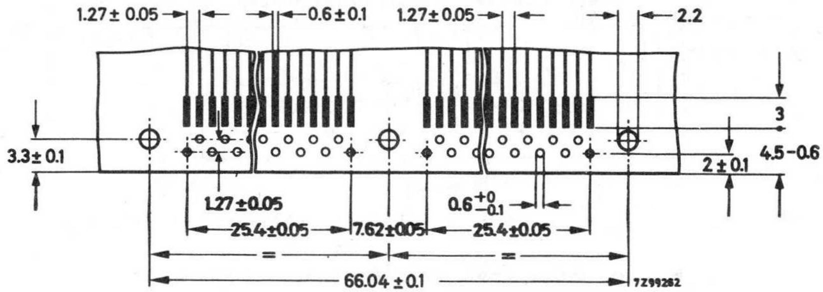


Fig.19. For 84 connections; terminal configuration according to Fig.8.

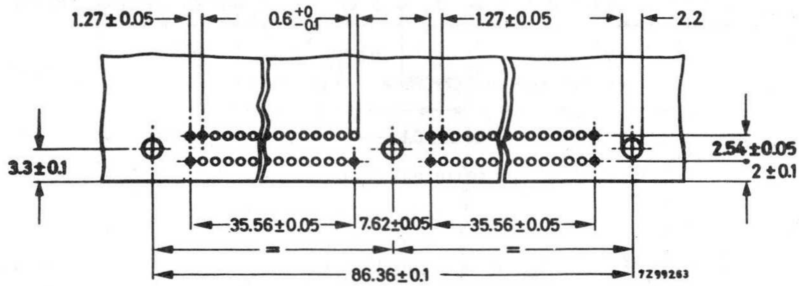


Fig.20. For 116 connections; terminal configuration according to Fig.5.

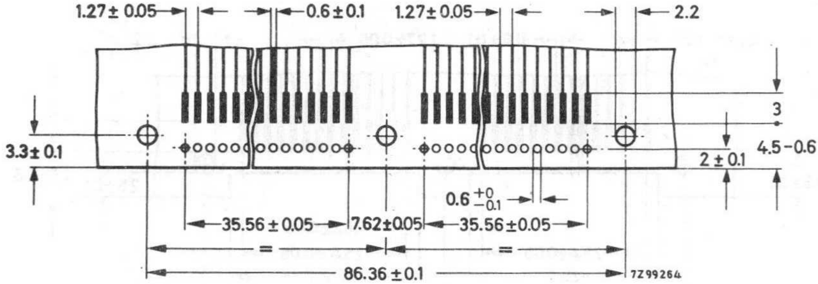


Fig. 21. For 116 connections; terminal configuration according to Fig. 6.

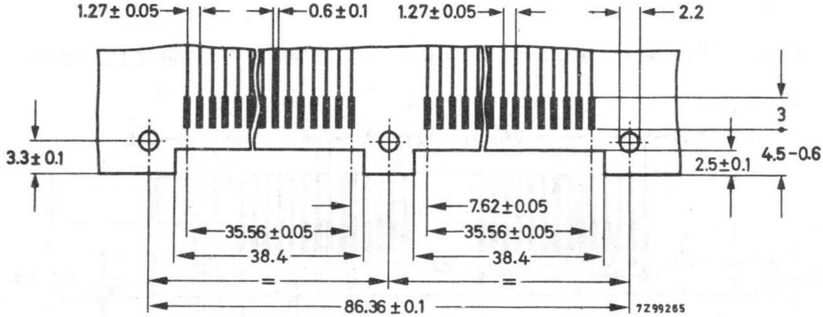


Fig. 22. For 116 connections; terminal configuration according to Fig. 7.

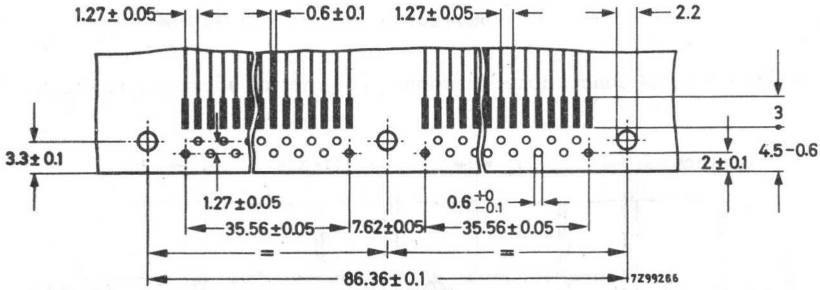


Fig. 23. For 116 connections; terminal configuration according to Fig. 8.

MARKING

The panel part and the board part are marked 1 A to 24 A and 1 B to 24 B for 48 connections, 1 A to 42 A and 1 B to 42 B for 84 connections, and 1 A to 58 A and 1 B to 58 B for 116 connections.

2.54 mm (0.1 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	2.54 mm (0.1 in)
Number of connections	
single sided	4 to 45
double sided	8 to 90
Board thickness	1.6 mm
Terminations	solder tags
Category (I.E.C.publ.68)	40/125/21

DESCRIPTION

The connectors have a moulded body of black, tropic proof thermosetting phenolic resin.
The contact springs are of phosphor bronze; they are bitongued (see Fig. 2) to provide a double contact and a large creepage distance. The contact springs are easily removable.
The contact faces are gold plated.

TECHNICAL DATA

Dimensions (in mm)

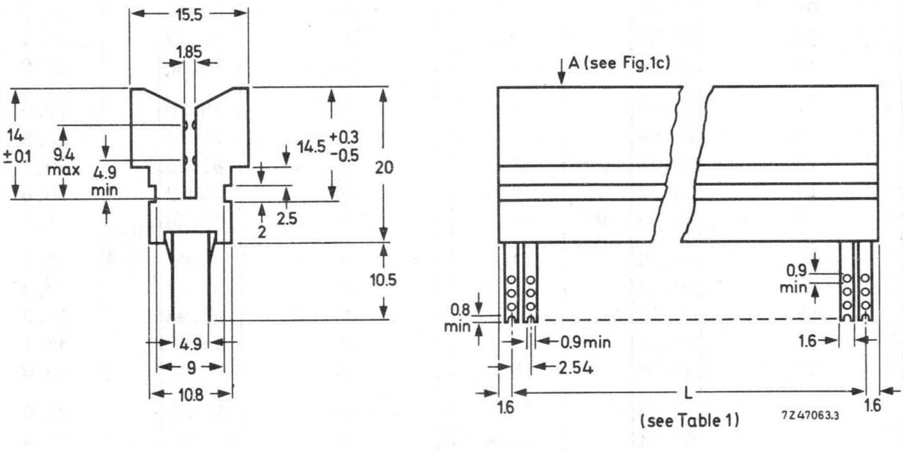


Fig. 1a. Double sided connector (open ended).

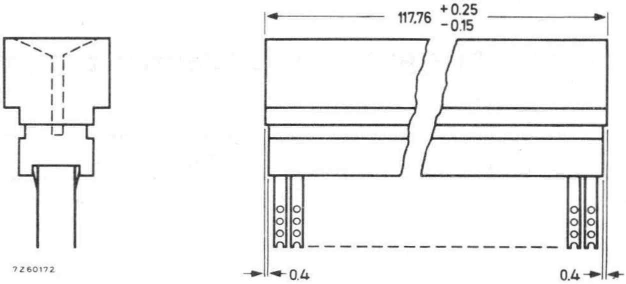


Fig. 1b. **Double sided connector (closed ends) with 90 contact positions.**
Dimensions not shown are identical with those in Fig. 1a.

For piercing diagrams see Figs. 5 and 6 under "Mounting".

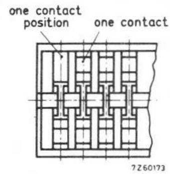


Fig. 1c.
Diagrammatic part view in the direction of arrow A (see Fig. 1a).

Table 1

number of contact positions, single sided (n)	L 1) (mm)	approx. weight 2) (g)	number of contact positions, single sided (n)	L 1) (mm)	approx. weight 2) (g)
06	12.70	5.4	26	63.50	23.4
07	15.24	6.3	27	66.04	24.3
08	17.78	7.2	28	68.58	25.2
09	20.32	8.1	29	71.12	26.1
10	22.86	9.0	30	73.66	27.0
11	25.40	9.9	31	76.20	27.9
12	27.94	10.8	32	78.74	28.8
13	30.48	11.7	33	81.28	29.7
14	33.02	12.6	34	83.82	30.6
15	35.56 ±0.1 −0.2	13.5	35	86.36 ±0.1 −0.2	31.5
16	38.10	14.4	36	88.90	32.4
17	40.64	15.3	37	91.44	33.3
18	43.18	16.2	38	93.98	34.2
19	45.72	17.1	39	96.52	35.1
20	48.26	18.0	40	99.06	36.0
21	50.80	18.9	41	101.60	36.9
22	53.34	19.8	42	104.14	37.8
23	55.88	20.7	43	106.68	38.7
24	58.42	21.6	44	109.22	39.6
25	60.96	22.5	45	111.76	40.5

1) Lnom = (n − 1) 2.54 mm
2) For double sided connectors

Contact pitch	2.54 mm (0.1 in)
Number of connections, single sided	4 to 45
double sided	8 to 90
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig. 7)
Mechanical endurance	$\geq$ 300 insertions
Ambient temperature range	-40 to +125 ^{o}C
Connector body, material	tropic proof phenolic resin
Contact springs, material	phosphor bronze
shape	bitongued, see Fig. 2

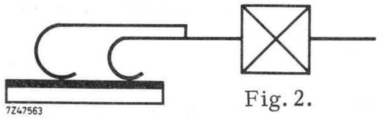


Fig. 2.

finish of faces	2 μm (min. 1.6 μm) gold plate
contact force	
initially	$\geq$ 1 N (0.1 kg)
after mech. endurance	$\geq$ 1 N (0.1 kg)
type of terminations	solder tag
finish of terminations	gold flash
Maximum current at $T_{amb} \leq 100\ ^{o}C$	5 A
at $T_{amb} > 100\ ^{o}C$	see Fig. 3
Clearance between two opposite contacts	$\geq$ 0.5 mm
Creepage distance between two adjacent or opposite contacts	$\geq$ 0.77 mm
Maximum r.m.s. voltage (I.E.C. publ. 130.1)	100 V
Test voltage for 1 min	
between adjacent contacts	700 V, 50 Hz
between a contact and a metal mounting plate	2260 V, 50 Hz
Contact resistance (inclusive material resistance)	
at 10 mA, $\leq$ 20 mV, 1 kHz	
initially	$\leq$ 10 mΩ
	typ. 8.6 mΩ at $T_{amb} = 23\ ^{o}C$
	typ. 8.8 mΩ at $T_{amb} = 125\ ^{o}C$
after damp heat test (I.E.C. 68, test Ca)	$\leq$ 12 mΩ
Insulation resistance	
initially	> 10^{4} MΩ
after damp heat test (I.E.C. 68, test Ca)	> 10^{2} MΩ
Capacitance between adjacent contacts	1.5 pF
between opposite contacts	1.5 pF

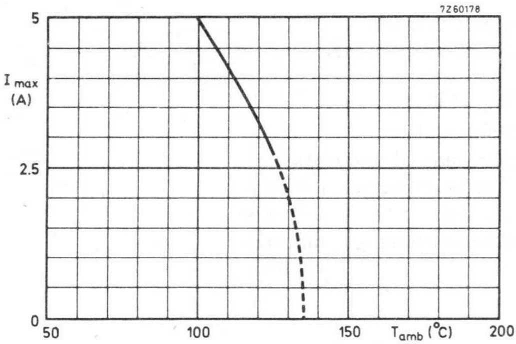


Fig. 3. Derating of maximum current with ambient temperature

The following tests are carried out by frequent inspections:

vibration	I.E.C.68	test F/VI
shock		test Ea
damp heat		test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature		test Na (−40 °C/+125 °C, 5 cycles)
soldering		test T

AVAILABLE VERSIONS AND COMPOSITION OF THE CATALOGUE NUMBER

2422 023 1. . . .

number of contact positions, single sided (see Table 1)

02 single sided connector
12 double sided connector
04 single sided connector, minus one contact at either end
14 double sided connector, minus two contacts at either end

For ordering purposes please quote the catalogue number.

Note: All connectors are open ended, except those with 45 (single sided) and 90 (double sided) connections.

MOUNTING

Mounting accessory

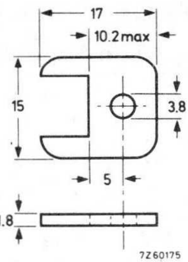


Fig. 4a. Metal mounting bracket 4332 026 11290 for rail or panel mounting

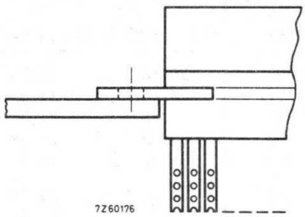


Fig. 4b. Part view, showing mounting bracket in position

Mounting methods

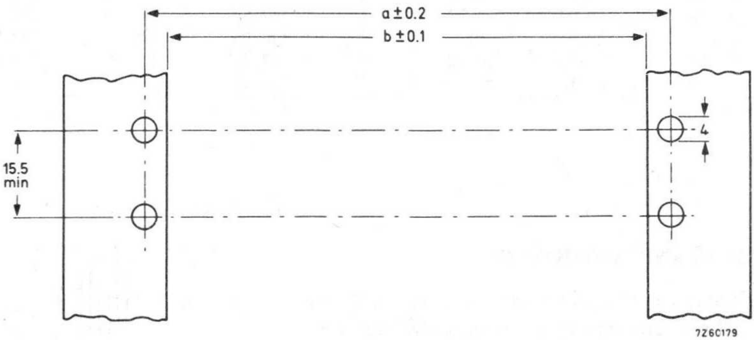


Fig. 5. Rail mounting; for dimensions a and b, see Table 2.

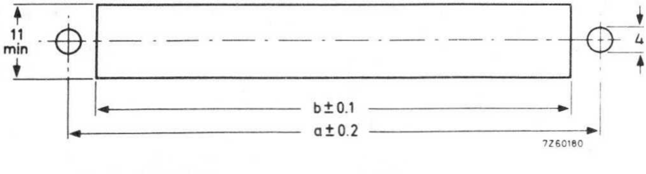


Fig. 6. Panel mounting; for dimensions a and b, see Table 2.

Table 2

number of contact positions, single sided	dimensions Fig. 5, 6 a (L_{nom} + 13.4)	Fig. 5, 6 b (L_{max} + 3.5)	Fig. 8 W (L_{nom} + 2.4)	number of contact positions, single sided	dimensions Fig. 5, 6 a (L_{nom} + 13.4)	Fig. 5, 6 b (L_{max} + 3.5)	Fig. 8 W (L_{nom} + 2.4)
06	26.10	16.30	15.10	26	76.90	67.10	65.90
07	28.64	18.84	17.64	27	79.44	69.64	68.44
08	31.18	21.38	20.18	28	81.98	72.18	70.98
09	33.72	23.92	22.72	29	84.52	74.72	73.52
10	36.26	26.46	25.26	30	87.06	77.26	76.06
11	38.80	29.00	27.80	31	89.60	79.80	78.60
12	41.34	31.54	30.34	32	92.14	82.34	81.14
13	43.88	34.08	32.88	33	94.68	84.88	83.68
14	46.42	36.62	35.42	34	97.22	87.42	86.22
15	48.96	39.16	37.96	35	99.76	89.96	88.76
16	51.50	41.70	40.50	36	102.30	92.50	91.30
17	54.04	44.24	43.04	37	104.84	95.04	93.84
18	56.58	46.78	45.58	38	107.38	97.58	96.38
19	59.12	49.32	48.12	39	109.92	100.12	98.92
20	61.66	51.86	50.66	40	112.46	102.66	101.46
21	64.20	54.40	53.20	41	115.00	105.20	104.00
22	66.74	56.94	55.74	42	117.54	107.74	106.54
23	69.28	59.48	59.28	43	120.08	110.28	109.08
24	71.82	62.02	60.82	44	122.62	112.82	111.62
25	74.36	64.56	63.36	45	125.16	115.36	114.16

POLARIZATION AND POSITIONING

A thermoplastic key (Fig. 7) inserted in two opposite contact positions, ensures that a printed-wiring board is correctly positioned and polarized in its connector. A slot must be made in the printed-wiring board to receive the key (Fig. 8).

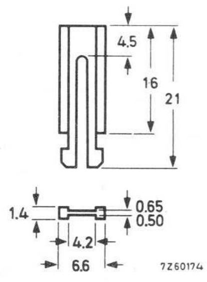


Fig. 7. Polarizing key, 4332 026 10550

PRINTED-WIRING BOARD RECOMMENDATIONS

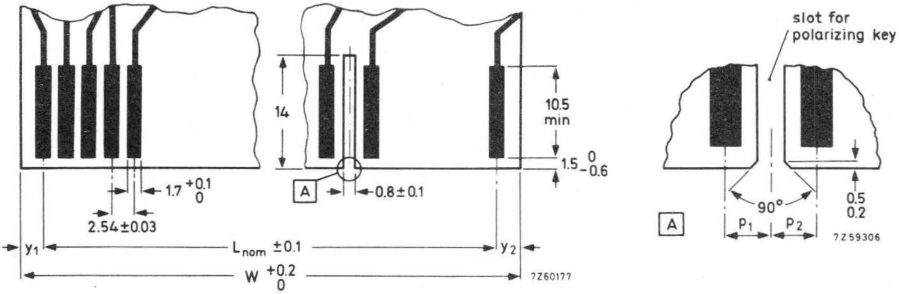
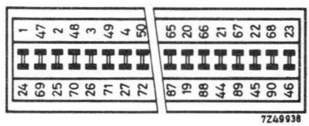


Fig. 8. For the dimension W, see Table 2.
$y_1 = y_2$ with a tolerance of ± 0.1 mm
$p_1 = p_2$ with a tolerance of ± 0.1 mm

MARKING

The contact positions are marked according to Fig. 9.

Fig. 9. Marking of the connector with closed ends.



PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

2.54 mm (0.1 in) PITCH PRINTED-WIRING CONNECTORS

QUICK REFERENCE DATA	
Contact pitch	2.54 mm (0.1 in)
Number of connections	39
Board thickness	1.6 mm
Terminations	solder pins pins for wire wrapping
Category (I.E.C.publ.68)	40/085/21

DESCRIPTION

The connectors have a moulded body of black, tropic proof thermosetting phenolic resin.

The contact springs are of phosphor bronze wire, double face shaped. The opposite contacts are bridged to provide a fourfold contact.

The contact faces are gold plate on nickel plate.

TECHNICAL DATA

Dimensions (in mm)

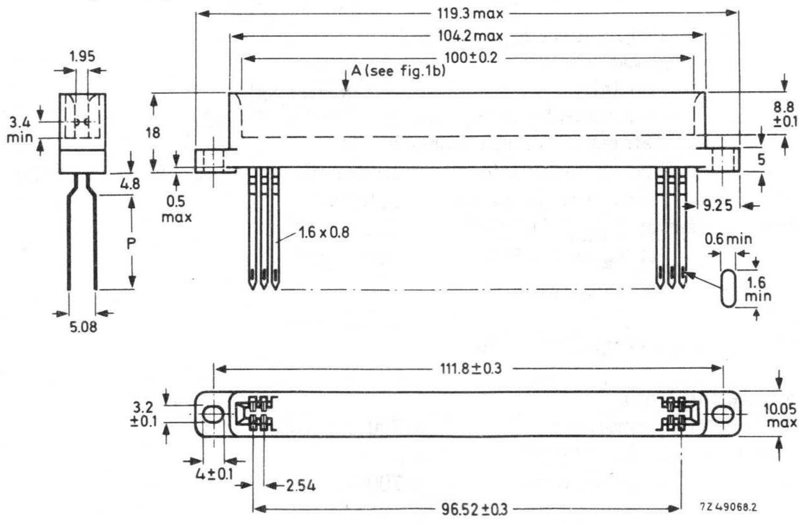


Fig.1a. P = 4.6 mm for solder pins
= 19.6 mm for pins for wire wrapping

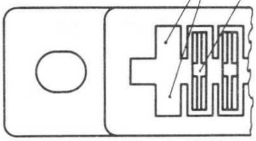


Fig. 1b. Diagrammatic part view in the direction of arrow A (see Fig. 1a).

Weight	
versions with solder pins	approx. 33 g
versions with pins for wire wrapping	approx. 39 g
Contact pitch	2.54 mm (0.1 in)
Number of connections	39
Board thickness	1.4 to 1.8 mm
Polarization	by means of a polarizing key (Fig. 3)
Insertion force	$\leq$ 70 N (7 kg)
Withdrawal force	$\geq$ 20 N (2 kg)
Mechanical endurance	$\geq$ 300 insertions
Ambient temperature range	−40 to +85 °C
Connector body, material	tropic proof phenolic resin
Contact springs, material	phosphor bronze
shape	double face
finish of faces	1 μm (min. 0.75 μm) goldplate, 5 μm nickel plate
contact force for 1.6 mm board	
initially	$\geq$ 1 N (0.1 kg)
after mech. endurance	$\geq$ 0.8 N (0.08 kg)
material of terminations	brass
type of terminations	solder pin or pin for wire wrapping
finish of terminations	goldflash
Maximum current at $T_{amb} \leq 65$ °C	4 A
at $T_{amb} > 65$ °C	see Fig. 2
Creepage distance between two adjacent contacts	$\geq$ 0.75 mm
Maximum r.m.s. voltage (I.E.C. publ. 130.1)	100 V
Test voltage for 1 min	
between adjacent contacts	700 V, 50 Hz
between a contact and a metal mounting plate	700 V, 50 Hz

Contact resistance (inclusive material resistance) at 10 mA, ≤ 20 mV, 1 kHz	
initially	≤ 10 mΩ typ. 7.7 mΩ at T_{amb} = 23 °C typ. 7.8 mΩ at T_{amb} = 85 °C
after damp heat test (I.E.C.68, test Ca)	≤ 12 mΩ
Insulation resistance	
initially	> 10^4 MΩ
after damp heat test (I.E.C.68, test Ca)	> 10^2 MΩ
Capacitance between adjacent contacts	2 pF

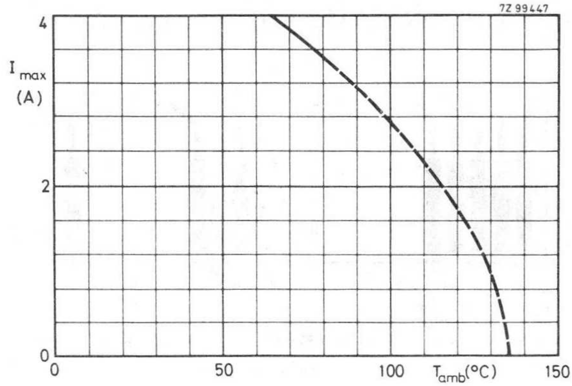


Fig. 2. Derating of maximum current with ambient temperature.

The following tests are carried out by frequent inspections:

vibration	I.E.C.68 test F/VI
shock	test Ea
damp heat	test Ca (40 °C, 90-95% R.H., 21 days)
rapid change of temperature	test Na (-40 °C/+85 °C, 5 cycles)
soldering	test T

AVAILABLE VERSIONS

Version with pins for wire wrapping, catalogue number 2422 022 03916
Version with pins for soldering, catalogue number 2422 023 03916

MOUNTING

The connectors can be mounted by means of two M3 screws, nuts and washers.

POLARIZATION

A metal key (Fig.3) fitted over a contact spring ensures that a printed-wiring board is correctly polarized in its connector. A slot must be made in the printed-wiring board to receive the key (Fig.4).

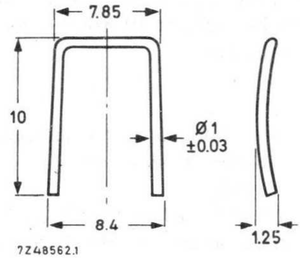


Fig.3. Polarizing key, catalogue number 4332 026 00770

PRINTED-WIRING BOARD RECOMMENDATIONS

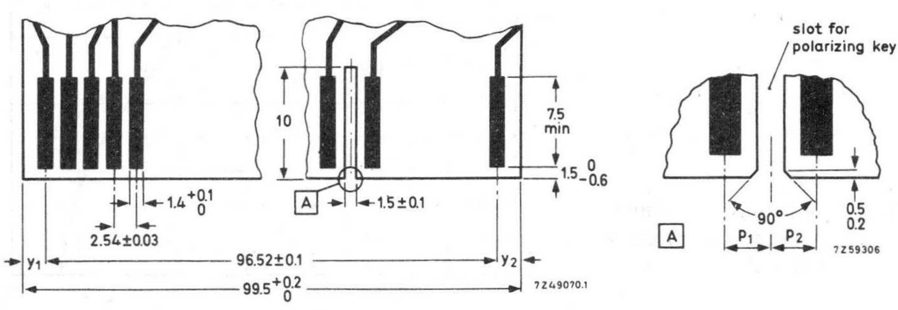


Fig. 4

$y_1 = y_2$ with a tolerance of $\pm$ 0.1 mm

$p_1 = p_2$ with a tolerance of $\pm$ 0.1 mm

MARKING

The contact positions are marked 1 to 39.

PACKAGING

The package is marked with: name of component
catalogue number
number of pieces
reference number of manufacture

SURVEY OF CHASSIS FOR PRINTED-WIRING BOARDS

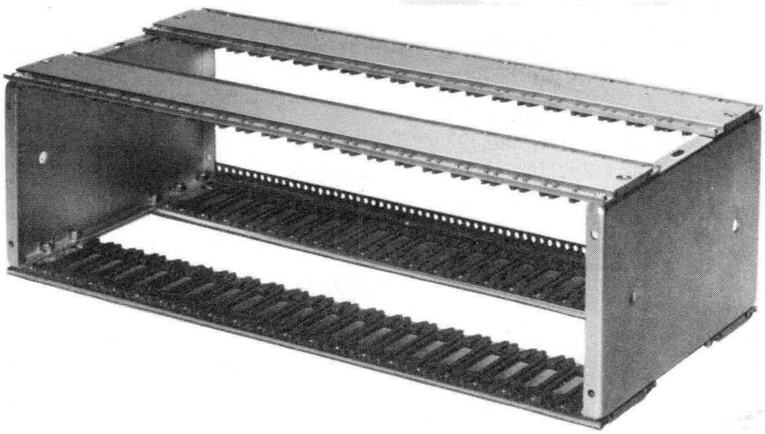
All chassis are metal frames which can be mounted in standard 19 inch racks. Board thickness always 1.6 ± 0.2 mm.

connectors				printed-wiring boards			
type	contact pitch (mm)	number of contacts	method of connection	dimensions h x l (mm)	min. pitch in chassis (mm)	max. number	chassis (catal. No.)
F054 1)	2.54	2x32	mini wire-wrap back panel dip soldering	116.8x98	10.16	41	4322 026 38250 4322 026 38280
F047 or F050 F053	3.96	1 or 2x22	hand soldering mini wire-wrap	116.8x110	10.16	41	4322 026 38310 2)
F047 or F050	3.96	1 or 2x22	hand soldering	121.8x204	19.35 12.9	21 30	4322 026 38230 4322 026 38260
F053	3.96	1 or 2x22	mini wire-wrap	121.8x204	19.35 12.9	21 30	4322 026 38230 4322 026 38260
special F045	5.08	1 or 2x23	hand soldering or wire-wrap	121.8x 204 or 180	19.35 12.9	21 30	4322 026 38240 4322 026 38270

1) Using F054 connectors the boards are to be provided with metallized contact holes, instead of the usually expensive contact pads. The female part of the two-part F054 connector has right-angled pins which are to be soldered into the holes.

2) Data sheets will be issued separately.

MOUNTING CHASSIS
for printed-wiring boards



RZ 21804-1

QUICK REFERENCE DATA	
Dimensions (assembled)	133 x 216 x 444
Max. housing capacity	
of chassis 4322 026 38230	21 boards, 21 connectors
of chassis 4322 026 38260	30 boards, 30 connectors
Size of printed-wiring board	121.8 x 204.2 x 1.6 mm
Required connectors	type F047, F050 or F053 (22 or 2 x 22 contacts at 0.156 inch)
Mounting	in standard 19 inch rack
Climatic category (I.E.C. 68)	25/085/21
Delivery	in kit form, without connectors

APPLICATION

Accommodation for printed-wiring boards standardized for any series of Circuit Blocks and for 60-series Norbits, as well as for other printed-wiring boards which have the required dimensions and are suitable for our 0.156 inch connectors.

MECHANICAL AND ENVIRONMENTAL DATA

Description

The mounting chassis consists of 4 profile strips, 2 side plates, 2 connector rails and a number of snap-in board guides, screws, nuts and washers. The delivery is in kit form [1]), without connectors. The board guides have recessed holes for colour coding.

Housing capacity of 4322 026 38230	up to 21 standard printed-wiring boards
of 4322 026 38260	up to 30 standard printed-wiring boards
Distance between boards (centre to centre) in 4322 026 38230	19.35 mm or 19.35 + n x 6.45 mm
in 4322 026 38260	12.9 mm or 12.9 + n x 6.45 mm
Material	Anodized aluminium conforming to MIL-A-8625 type II
Weight	3 kg approx.

Vibration test

Frequency: 20 Hz, amplitude: 0.5 mm in three perpendicular directions.
Chassis filled with 21 printed-wiring boards which are loaded with 400 g each.

Humidity test

Conforming to I.E.C. 68, test C: 21 days at 40 °C and a R.H. of 90% to 95%.

Ambient temperature: operating: −25 to +85 °C
storage : −55 to +85 °C.

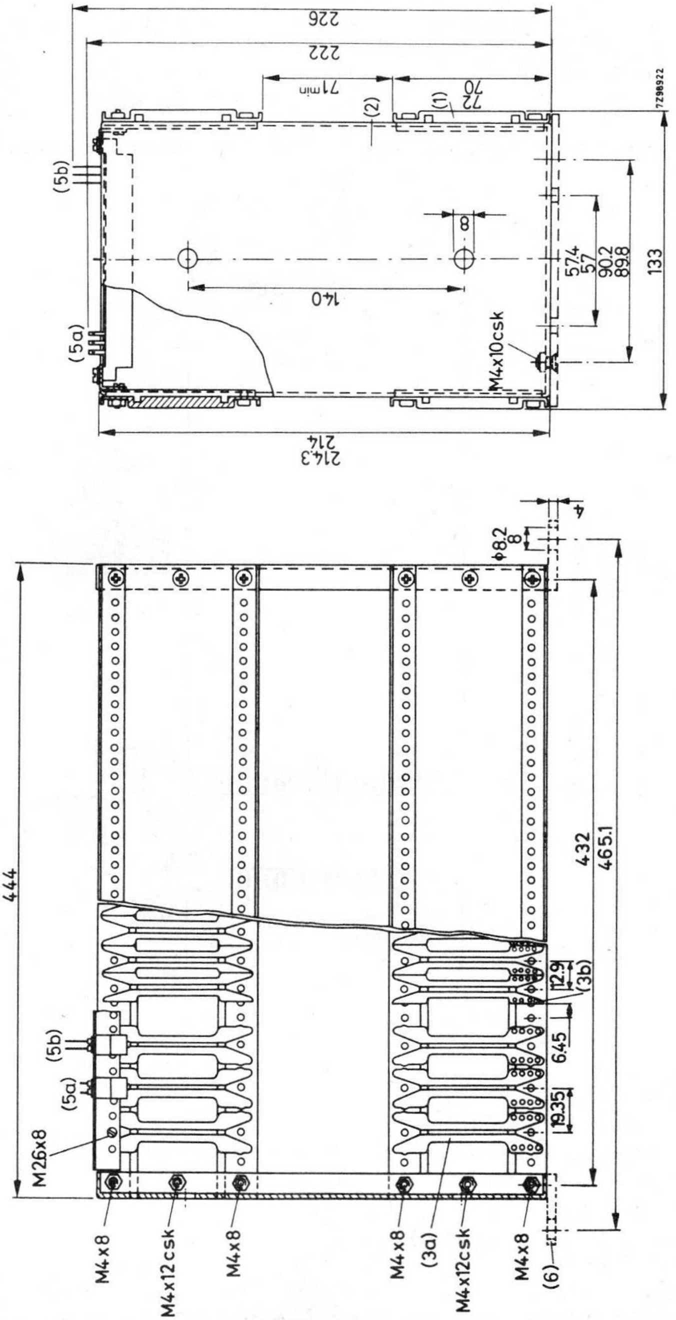
Required printed-wiring connectors

Standard 0.156 inch printed-wiring connectors fit in the chassis: type F047, F050 or F053 connectors possessing threaded mounting bushes and 1 x 22 or 2 x 22 contacts, see relevant data sheets.
For fixing the F047 connectors use screws UNC No.4 x $\frac{1}{4}$", catal.No. 2522 085 02005 and washers 2522 600 11013, for the F050 and F053 connectors use screws M3 x 6 (mm) and washers.

After assembly of the chassis the connectors should be positioned with respect to the printed-wiring boards. This can be achieved by using a dummy printed-wiring board.

[1]) Loose side plates and rails are available in multiples of 100, profile strips of 200 and guides of 1000.

Assembly Drawing (Fig.1; dimensions in mm)



(1)= profile strip; (2) = side panel; (3a) = board guide of kit 38230; (3b) = board guide of kit 38260; (4) = connector rail; (5a) = F047 or F050 connector; (5b) = F053 connector; (6) = mounting flange, see section Accessories.

Printed-wiring board requirements

Thickness: 1.6 ± 0.2 mm

Outline : Fig.5

Contacts : 22 or 2 x 22 pitch 0.156 inch (to fit the connectors mentioned above).

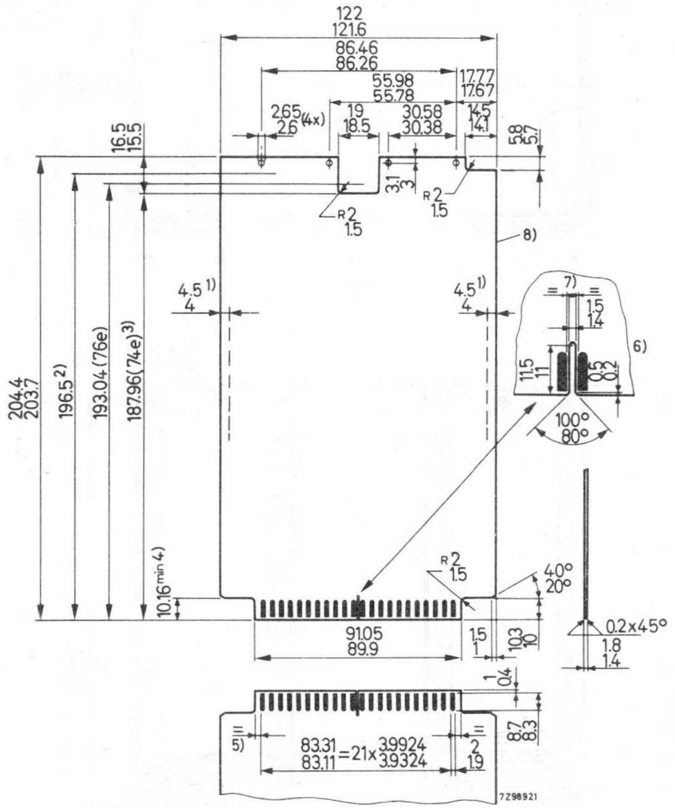


Fig.5

1) Keep clear of copper.

2) No copper allowable outside this area.

3) No components allowable outside this area. e = 2.54 mm (0.1 inch).

4) Keep clear of components.

5) Eccentricity factor 0.6.

6) Slot for polarizing key (optional).

7) Eccentricity factor 0.4.

8) Upper edge of board.

ACCESSORIES

Aligning kit

Use of the kit is preferable, but not essential if only one chassis is to be assembled; if 2 or more chassis are to be assembled in stack formation, use of the aligning kit is essential.

The kit includes 4 aligning pins
1 aligning plate
1 dummy printed-wiring board

Catalogue number of the kit: 4322 026 38430.

Number strips

Set of 10 number strips (blank) + number strip holders
for one chassis : 4322 026 38410
for between two chassis: 4322 026 38420.

Mounting flanges

Set of 2 lacquered mounting flanges, 4 countersunk screws M4 x 10 and 4 nuts M4, for mounting one chassis to a 19 inch rack.

Catalogue number of set: 4322 026 38450.

Extractor

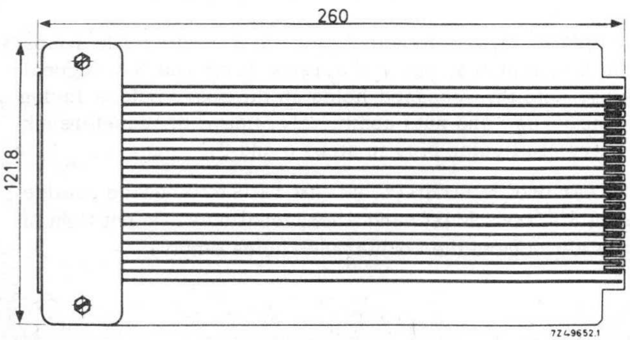
This extractor facilitates the locking and extracting of p.w. boards with the dimensions given in Fig.5. It consists of:

1 holder	4322 026 32860
1 text strip	4322 026 45860
1 locking lever	4322 026 32880
1 spring	4322 026 32870
4 rivets	2522 642 08085

Catalogue number of a set for 25 extractors: 4322 026 38400

Extender board

This board facilitates the testing of printed-wiring assemblies functioning outside the chassis. It is provided with an F047 connector. The board material is glass-epoxy.



Contacts:
2 x 22, gold plated;
pitch 0.156 inch

Catalogue number:
4322 026 44290

PARTS LIST

A kit for a mounting chassis includes the following parts:

2 side plates	4322 026 44370
4 profile strips	4322 026 32500
84 board guides	4322 026 32680 (kit 38230)
120 board guides	4322 026 70060 (kit 38260)
2 connector rails	4322 026 44380
8 countersunk screws M4x12	2522 023 05065
16 screws M4x8	2522 012 06068
12 screws M2.6x8	2522 004 02014
24 nuts M4	2522 418 01002
12 nuts M2.6	2522 418 01107

ASSEMBLY INSTRUCTIONS

1. Tools to be used:
   Aligning kit 4322 026 38440
   Screw driver for pan-head screws
   Spanner with 7 mm jaw.
   Two 15 cm long pins of 2.6 mm diameter.

2. Snap the board guides into the desired positions on each profile strip. The guides have recessed holes for colour coding; on the front profile strip these holes must face outwards (see Assembly Drawing). To obtain a symmetrical layout, do not use the first holes in the profile strips.
   This procedure and the next one can be delayed until after step 9.

3. Attach a connector rail to each rear profile strip by means of 6 equidistant screws and nuts M2.6x8 (see Fig.9). Do not tighten the screws earlier then step 10.

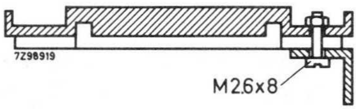


Fig.9. Connector rail attached to profile strip with board guides.

4. With the flanges of the side plates facing inwards, join the 2 front profile strips to the top and bottom of the 2 side plates, using 8 screws M4x8 and 8 hexagonal nuts (see Assembly Drawing; note the recessed holes in the board guides facing outwards). Do not tighten the screws and nuts completely. Leave the countersunk holes empty to allow for entry of aligning pins in steps 6 and 8.

5. Similarly, assemble the 2 rear profile strips (connector rails to be on the outside edge of the assembly), using 8 screws M4x8, and 8 hexagonal nuts. Do not tighten the screws and nuts completely. Leave the countersunk holes empty.

6. With the chassis in normal horizontal position, insert the four aligning pins in the empty countersunk holes and place the aligning plate to fit over the aligning pins (see Fig.10).
7. Tighten the 8 screws and nuts at the side of the aligning plate. Remove the aligning plate and the aligning pins.
8. Invert the chassis and repeat the steps 6 and 7.

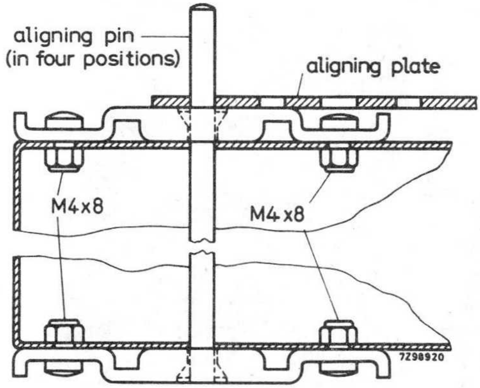
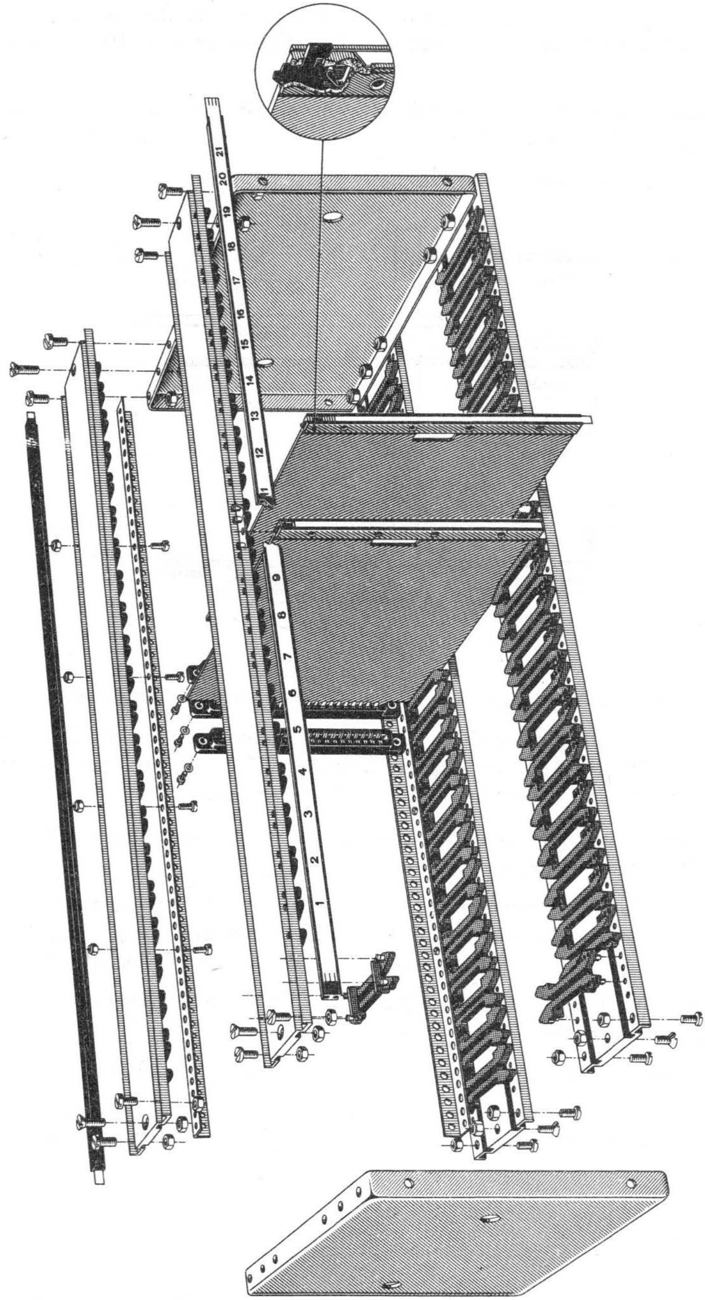


Fig.10. Aligning

9. Insert and tighten the eight M4x12 countersunk screws (see Assembly Drawing).
10. Align the connector rails: Stick two 15 cm long pins of 2.6 mm diameter through holes near the first and last M2.6 screws, pull each rail outwards (they may move part of 1 mm) and then tighten the twelve screws.
11. Insert the dummy printed-wiring board at three or four places in the chassis to check that it slides properly.
12. Place the chassis in vertical position. Insert the dummy printed-wiring board in the highest board guides, but do not fully insert it. Take a connector, bring it in-line with the dummy board and push the dummy board into the connector.
13. Fix the connector to the connector rails with two appropriate screws and washers and tighten the screws.
14. Repeat steps 12 and 13 for the next lower position until all connectors are fixed.
15. If required, 19 inch rack-mounting flanges can be attached to the side plates by using M4x12 countersunk head screws and hexagonal nuts (see Assembly Drawing).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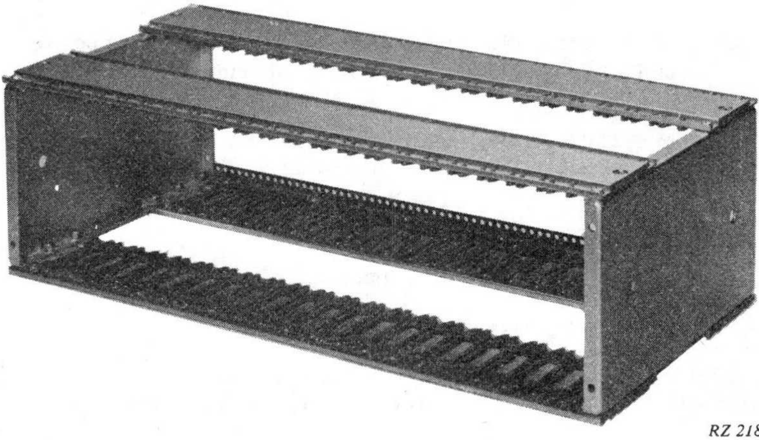
MOUNTING CHASSIS
for printed-wiring boards



RZ 21804-1

QUICK REFERENCE DATA	
Dimensions (assembled)	133 x 216 x 444
Max. housing capacity	
of chassis 4322 026 38240	21 boards, 21 connectors
of chassis 4322 026 38270	30 boards, 30 connectors
Size of printed-wiring board	121.8 x 204.2 x 1.6 mm or 121.8 x 180.3 x 1.6 mm
Required connectors	special type F045 (23 or 2 x 23 contacts at 0.2 in)
Mounting	in standard 19 in rack
Climatic category (I.E.C. 68)	25/085/21
Delivery	in kit form, without connectors

APPLICATION

Accomodation for printed-wiring boards standardised for any series of Circuit Blocks and for 60-series Norbits, as well as for other printed wiring boards which have the required dimensions and are suitable for F045 connectors.

MECHANICAL AND ENVIRONMENTAL DATA

Description

The mounting chassis consists of 4 profile strips, 2 side plates, 2 connector rails and a number of snap-in board guides, screws, nuts and washers. The delivery is in kit form [1]), without connectors. The kit can be assembled to a Long-Board Version or to a Short-Board Version. The board guides have recessed holes for colour coding.

Housing capacity of 4322 026 38240	up to 21 standard printed-wiring boards
of 4322 026 38270	up to 30 standard printed-wiring boards
Distance between boards (centre to centre) in 4322 026 38240	19.35 mm or 19.35 + n x 6.45 mm
in 4322 026 38270	12.9 mm or 12.9 + n x 6.45 mm
Material	Anodised aluminium conforming to MIL-A-8625 type II
Weight	3 kg approx.

Vibration test

Frequency: 20 Hz, amplitude: 0.5 mm in three perpendicular directions.
Chassis filled with 21 printed-wiring boards which are loaded with 400 g each.

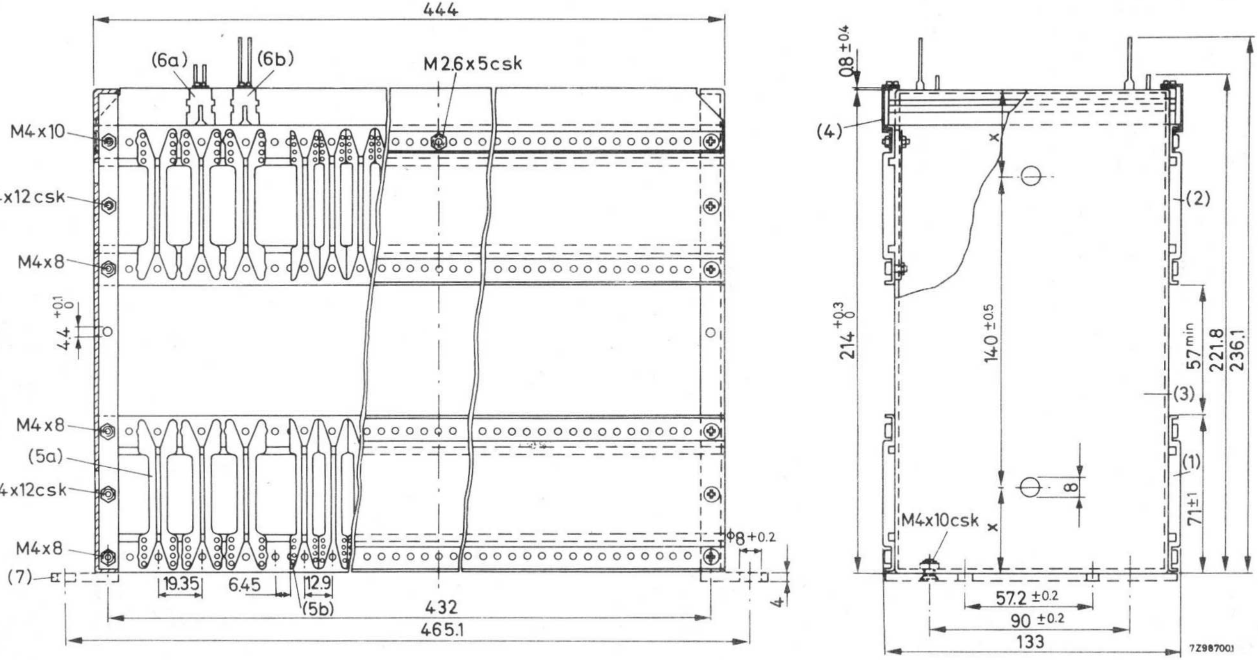
Humidity test

Conforming to I.E.C. 68, test C: 21 days at 40 °C and a R.H. of 90% to 95%.

Ambient temperature: operating: −25 to +85 °C
storage : −55 to +85 °C

[1]) Loose side plates and rails are available in multiples of 100, profile strips of 200 and guides of 1000.

Assembly Drawing (Fig.1. Long-Board version; dimensions in mm)



(1) = front profile strip; (2) = rear profile strip; (3) = side panel; (4) = connector rail; (5a) = board guide of kit 38240; (5b) = board guide of kit 38270; (6a) and (6b) = F045 connectors; (7) = mounting flange, see section Accessories.

Required printed-wiring connectors

The following special F045 printed-wiring connectors fit in the chassis:

pitch	number of contacts	catalogue No. of connector	
		with lugs	with wire wrap pins
0.2 in	1x23	2422 020 52592	2422 035 52592
0.2 in	2x23	2422 020 52591	2422 035 52591

The fixing holes in the connectors are threaded M2.6. Two screws M2.6x6 (catal. No. 2522 004 02013) and two washers (catal. No. 2522 600 17013) are necessary for fitting each connector into the chassis.*)
After assembly of the chassis the connectors should be positioned with respect to the printed-wiring boards. This can be achieved by using a polarizing key 4322 026 04740 and a dummy printed-wiring board.

Technical data of the F045 connectors

Construction

Material of connector body	black synthetic resin (moulded)
Material of contact springs	phosphor bronze, 5 μm nickelplating, 1 μm acid hard goldplating
Shape of contact springs	bifurcated springs
Termination	soldering lugs (Fig.2), wire-wrap pins (Fig.2)

Dimensions in mm

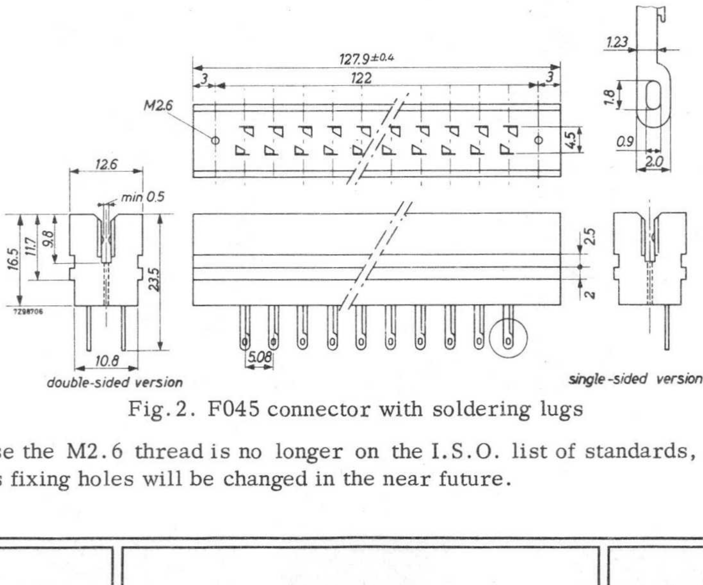


Fig. 2. F045 connector with soldering lugs

*) Because the M2.6 thread is no longer on the I.S.O. list of standards, the screw and its fixing holes will be changed in the near future.

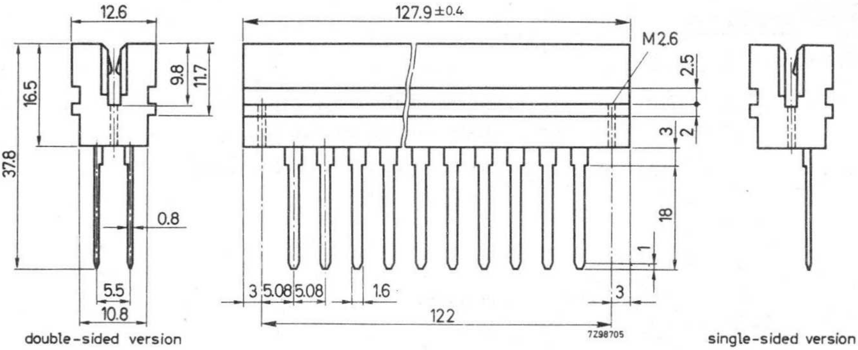


Fig.3. F045 connector with wire-wrap pins

Technical performance

Maximum voltage between	
adjacent contacts	145 V_{rms}
any contact and metal mounting part	250 V_{rms}
Test voltage between	
adjacent contacts	800 V, 50 Hz
any contact and metal mounting part	1000 V, 50 Hz
Maximum current	5 A
Ambient temperature range	-40 to $+85$ ^{o}C
Contact resistance (inclusive material resistance)	< 10 mΩ
Insulation resistance, initially	> 10^5 MΩ
Max. number of insertions/withdrawals of the printed-wiring board	300

Polarization

Polarizing keys, made of an insulating material, can be obtained under catalogue number 4332 026 04740. These keys fit into the slots provided between the contact chambers, so that their use does not involve the loss of any contact position. Polarization is achieved by providing one or more slots with a key, in an asymmetrical arrangement, and making slots in the printed-wiring board (Fig.7) to accept the keys.

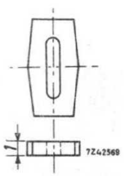


Fig.4. Polarizing key

Printed-wiring board requirements

Thickness: 1.6 ± 0.2 mm

Outline : Fig.5 and 7 for long boards with the Extractor mentioned below.
Fig.6 and 7 for short boards without extractor.

Contacts : 23 or 2 x23, pitch 0.2 in (to fit the F045 connectors).

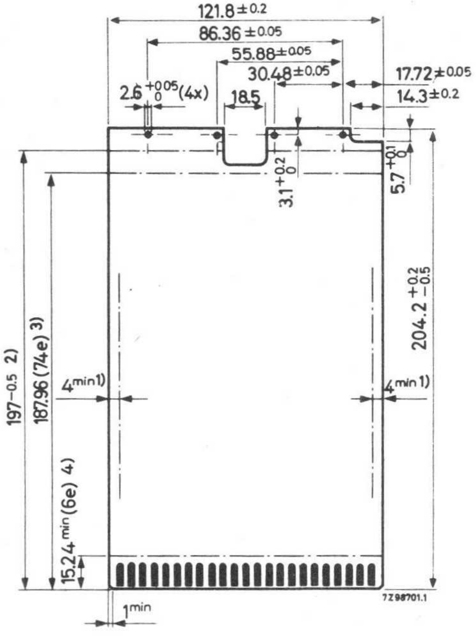


Fig.5

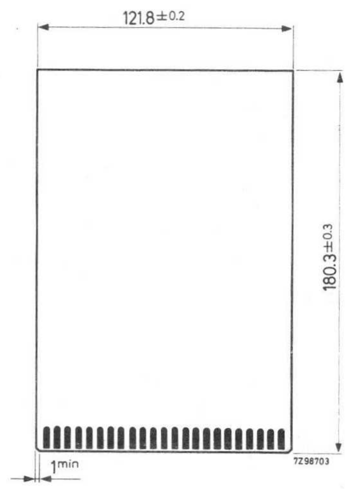


Fig.6

1) Keep clear of copper.
2) No copper allowable outside this area.
3) No components allowable outside this area. e = 2.54 mm (0.1 in).
4) Keep clear of components.

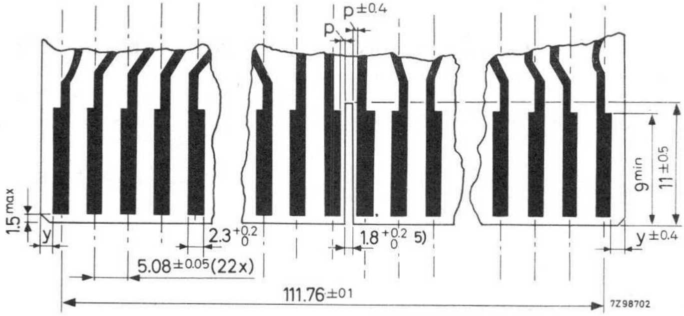


Fig.7

ACCESSORIES

Aligning kit

Use of the kit is preferable, but not essential if only one chassis is to be assembled; if 2 or more chassis are to be assembled in stack formation, use of the aligning kit is essential.

The kit includes 4 aligning pins
1 aligning plate
1 dummy printed-wiring board

Catalogue number of the kit: 4322 026 38440

Number strips

Set of 10 number strips (blank) + number strip holders
for one chassis : 4322 026 38410
for between two chassis: 4322 026 38420.

Mounting flanges

Set of 2 lacquered mounting flanges, 4 countersunk screws M4x10 and 4 nuts M4, for mounting one chassis to a 19 in rack.

Catalogue number of set: 4322 026 38450.

5) Slot for polarizing key (optional).

Extractor

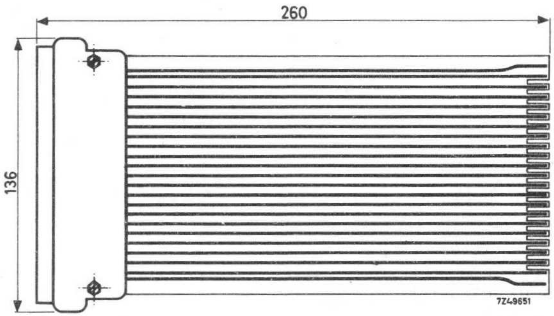
This extractor facilitates the locking and extracting of p.w. boards with the dimensions given in Fig.4a. It consists of:

1 holder	4322 026 32860
1 text strip	4322 026 45860
1 locking lever	4322 026 32880
1 spring	4322 026 32870
4 rivets	2522 642 08085

Catalogue number of a set for 25 extractors: 4322 026 38400

Extender board

This board facilitates the testing of printed-wiring assemblies functioning outside the chassis. It is provided with an F045 connector. The board material is glass-epoxy.



Contacts:
2 x 23, gold plated;
pitch 0.2 in

Catalogue number:
4322 026 03910

Fig.8

PARTS LIST

A kit for a mounting chassis includes the following parts:

2 side plates	4322 026 44400
2 front profile strips	4322 026 32500
2 rear profile strips	4322 026 46800
84 board guides	4322 026 32680 (kit 38240)
120 board guides	4322 026 70060 (kit 38270)
2 connector rails	4322 026 46610
8 countersunk screws M4x12	2522 023 05065
4 screws M4x10	2522 012 06069
12 screws M4x8	2522 012 06068
2 countersunk screws M2.6x5	2522 018 01012
24 nuts M4	2522 418 01002
2 nuts M2.6	2522 401 04007
2 washers 2.8x7	2522 600 16014

ASSEMBLY INSTRUCTIONS

1. Tools to be used:
   Aligning kit 4322 026 38440
   Polarizing keys 4322 026 04740 1)
   Screw driver for pan-head screws
   Spanner with 7 mm jaw.

2. Attach a connector rail to each rear profile strip by means of a countersunk screw M2.6x5, washer and nut in the countersunk centre hole (see Fig. 9; only two profile strips possess a countersunk centre hole; these are the rear profile strips).

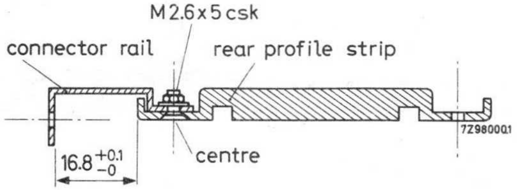


Fig.9

3. Snap the board guides into the desired positions on each profile strip. The guides have recessed holes for colour coding if required; these holes must face outwards (see Assembly Drawing). To obtain a symmetrical layout, do not use the first holes in the profile strips. Never use the centre holes.
   This procedure can be delayed until after step 9.

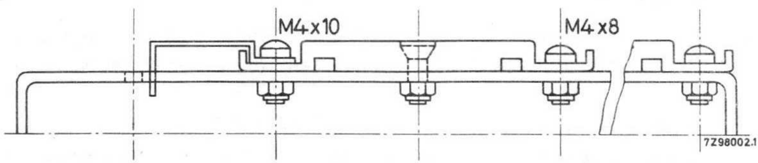


Fig.10. Short-Board Version; position of rear profile strips on side plates (Step 5)

4. With the flanges of the side plates facing inwards, join the 2 front profile strips to the top and bottom of the 2 side plates, using 8 screws M4x8 and 8 hexagonal nuts (see Assembly Drawing; note the recessed holes in the board guides facing outwards). Do not tighten the screws and nuts completely. Leave the countersunk holes empty to allow for entry of aligning pins in steps 6 and 8.

1) Because this part is very small and may get lost during use, it is recommended to order more than one polarizing key (see also step 11).

5. Similarly, assemble the 2 rear profile strips (connector rails to be on the outside edge of the assembly), using 4 screws M4x8, 4 screws M4x10 and 8 hexagonal nuts. Do not tighten the screws and nuts completely. Leave the countersunk holes empty. For the Short-Board Version see Fig.10.

6. With the chassis in normal horizontal position, insert an aligning pin in the empty countersunk holes and place the aligning plate to fit over the aligning pins (see Fig.11).

7. Tighten the 8 screws and nuts at the side of the aligning plate. Remove the aligning plate and the aligning pins.

8. Invert the chassis and repeat the steps 6 and 7.

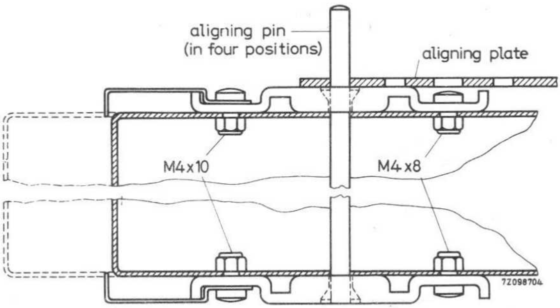


Fig.11. Aligning. (Short-Board Version is represented by dashed lines.)

9. Insert and tighten the eight M4x12 countersunk screws (see Assembly Drawing).

10. Insert the dummy printed-wiring board at 3 or 4 places in the chassis to check that it slides properly.

11. If the dummy printed-wiring board from the aligning kit is to be used, insert one polarization key in each printed-wiring connector, between contacts 11 and 12.

12. Place the chassis in vertical position and pile up 8 connectors in the slots between the connector rails. These are the connectors to be fixed last.

13. Insert the dummy printed-wiring board in the highest board guides, but do not fully insert it. Take a connector (not yet one of the eight mentioned in step 12), bring it in-line with the dummy board and push the dummy board into the connector.

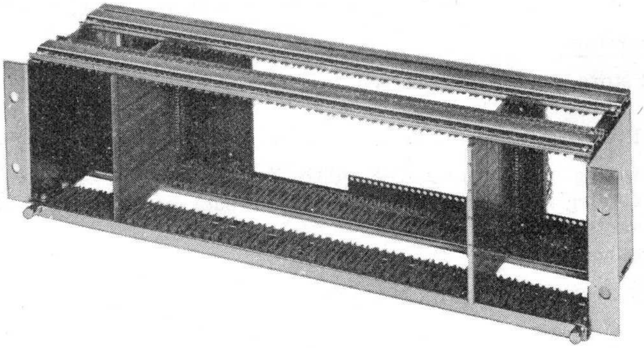
14. Fix the connector to the connector rails with two screws M2.6x6 and washers and tighten the screws.

15. Repeat steps 13 and 14 for the next lower position until all connectors are fixed, also the 8 mentioned in step 12.

16. Remove the polarizing keys from the connectors.

17. If required, 19 in rack-mounting flanges can be attached to the side plates by using M4x12 countersunk head screws and hexagonal nuts (see Assembly Drawing).

MINIATURE MOUNTING CHASSIS
for printed-wiring boards



RZ 24885-3

For mounting in a 19" rack
Maximum capacity: 41 printed-wiring boards

APPLICATION

Accommodation of printed-wiring boards intended for miniature components and Dual-In-Line packages.

MECHANICAL AND ENVIRONMENTAL DATA

Description

The chassis 4322 026 38250 and 4322 026 38280 have been designed to be used in 19" racks and to be equipped with 0.1" printed-wiring connectors F054BC/032 (catalog number 2422 025 89082) and F054BP/032 (catalog number 2422 025 89083), respectively.
The chassis can contain 41 printed-wiring boards, measuring 98.2 x 116.8 mm, pitch of 0.4" (10.16 mm). Each board may accommodate 4 x 9 = 36 Dual-In-Line packages, consequently 41 x 36 = 1476 circuits can be accommodated in one mounting chassis.
The chassis are delivered in kit form.

Material	: steel, nickel-chromium plated.
Outer dimensions	: 436 x 130 x 123 mm.
Weight	: approximately 2 kg.

Vibration test

Frequency: 10 to 55 Hz, amplitude: 0.76 mm in three perpendicular directions, according to MIL-STD-202C, method 201A. Chassis completely filled with printed-wiring boards which are loaded with 40 g each. The printed-wiring boards are secured by a metal strip at the front.

Humidity test

According to I.E.C. 68, test C, during 21 days and a R.H. of 95% at 40 °C.

Ambient temperature

Operating and storage temperature: −65 to +125 °C.

SUITABLE PRINTED-WIRING CONNECTORS

0.1" printed-wiring connectors F054BC/032, catalog number 2422 025 89082 and F054BP/032, catalog number 2422 025 89083 (for back-panel mounting); maximum number of contacts: 64.
See also the relevant data.

PRINTED-WIRING BOARD REQUIREMENTS

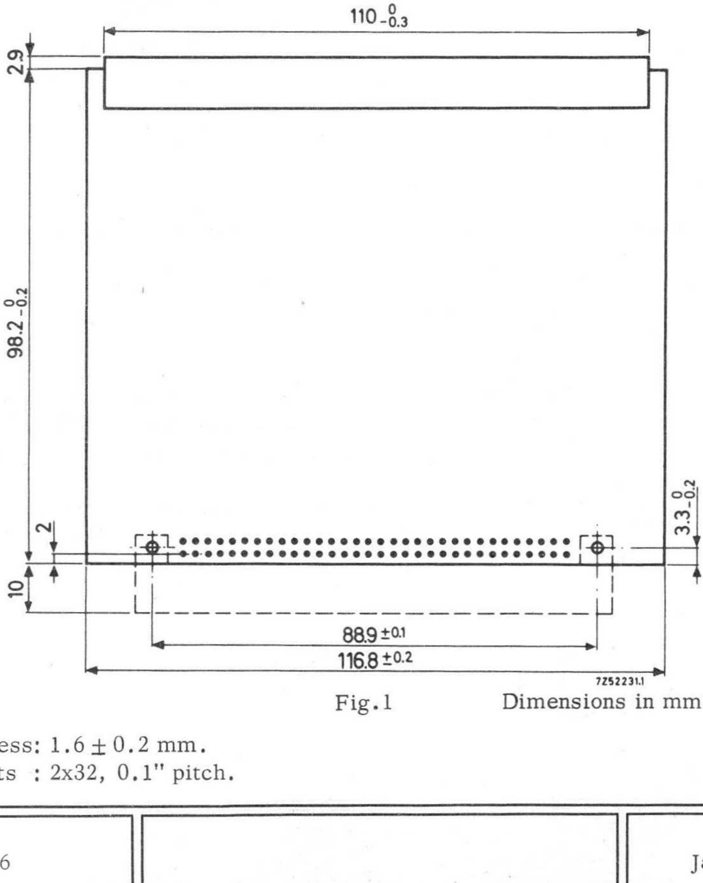


Fig.1 Dimensions in mm

Thickness: 1.6 ± 0.2 mm.
Contacts : 2x32, 0.1" pitch.

ASSEMBLING INSTRUCTIONS

The kit for assembling the miniature mounting chassis includes the following parts:

description	number	catalog number
side plates	2	4322 026 70070
profile strips	4	4322 026 70050
board guides	164	4322 026 70040
connector rails	2	4322 026 70080, for chassis 4322 026 38250 only
panel rails	2	4322 026 70180, for chassis 4322 026 38280 only
bracket	1	4322 026 70090
bracket	1	4322 026 70100
locking strip	1	4322 026 70110
knurled screw	2	4322 026 70140
screws M3 x 5	16	
screws M3 x 8	4	
nuts M3	4	

Loose parts, screws and nuts excluded, are available in multiples of 100 pieces. On request, identification rails with marking strips are available in multiples of 100 pieces.

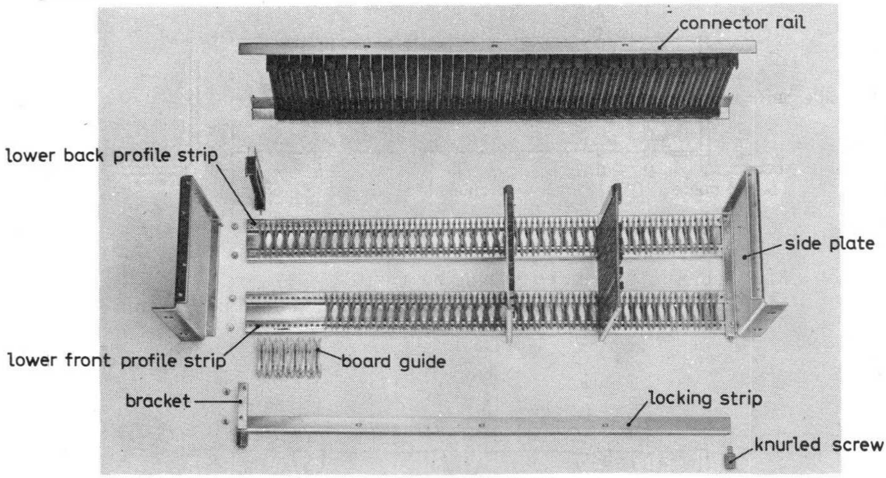


Fig.2

RZ 23732-4

1. Snap the board guides into the desired holes of the 4 profile strips. For pitches between the printed-wiring boards of 0.4", 0.5", 0.6", 0.7" and 0.8", refer to Figs.3 to 7. Pay attention to the asymmetrical shape of the board guides.

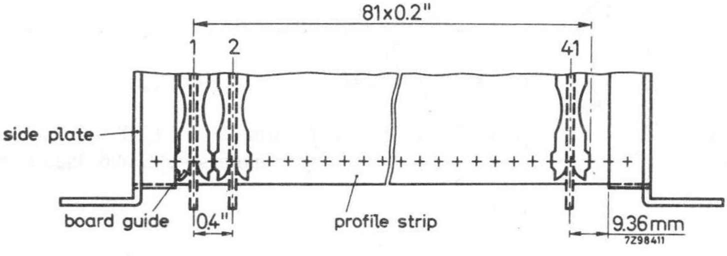


Fig.3

Max. number of printed-wiring boards: 41

Max. height of components on printed-wiring boards: 6 mm

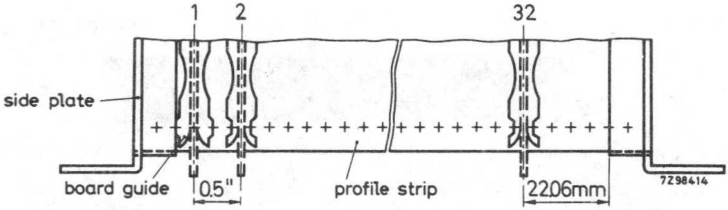


Fig.4 (Only for back-panel mounting)

Max. number of printed-wiring boards: 32

Max. height of components on printed-wiring boards: 8.54 mm

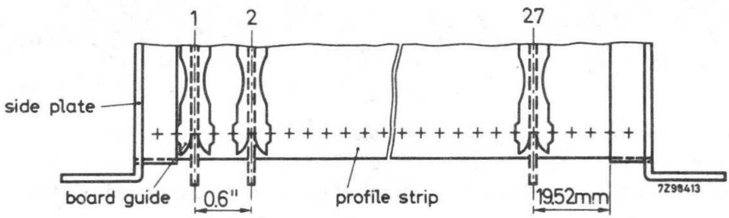


Fig.5

Max. number of printed-wiring boards: 27

Max. height of components on printed-wiring boards: 11.08 mm

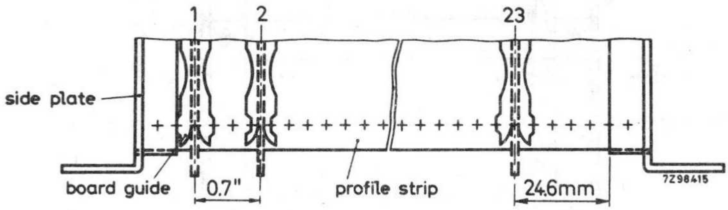


Fig.6 (Only for back-panel mounting)

Max. number of printed-wiring boards: 23
Max. height of components on printed-wiring boards: 13.62 mm

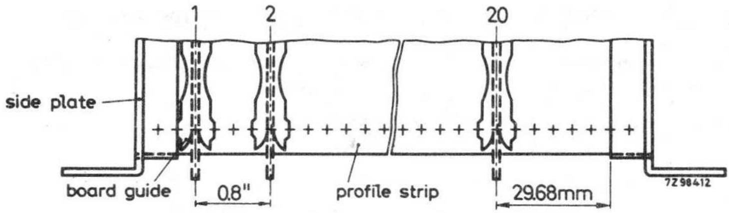


Fig.7

Max. number of printed-wiring boards: 20
Max. height of components on printed-wiring boards: 16.16 mm

2. Attach both side plates to the profile strips by means of 12 screws M3x5 (2 back strips plus upper front strip) and 4 screws M3x8 (lower front strip). See Figs.8 and 9.

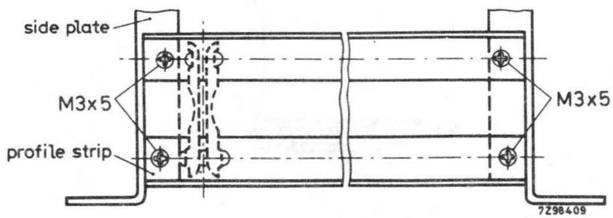


Fig.8
Attachment of side plates to upper profile strips (top view)

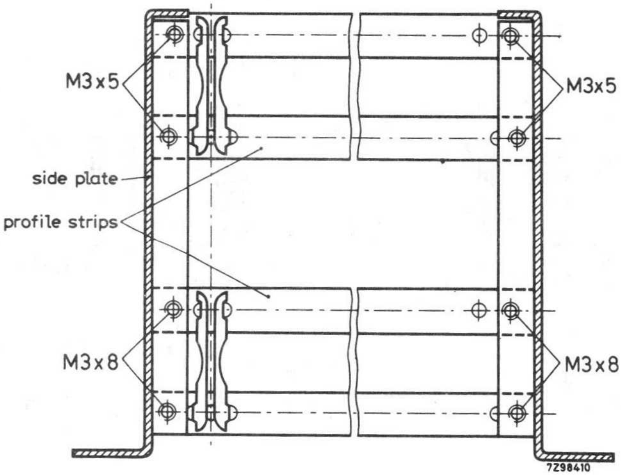


Fig.9. Attachment of side plates to lower profile strips (top view)

3. Attach the two connector rails *) to the side plates with 4 screws M3x5; do not tighten the screws (Fig.10).

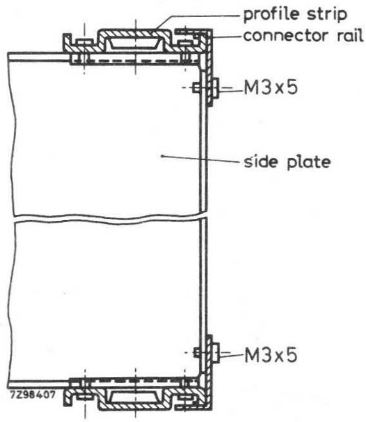


Fig.10

*) When using connectors for back-panel mounting (catalog number 2422 025 89083) read "panel rails" instead of "connector rails".

4. When mounting chassis 4322 026 38250:

   a. Attach the male part F054MP/032 of the connector F054BC/032 to the connector rails by means of two screws and nuts (M2). Do not yet tighten the screws, as the connector has to be aligned first, see item b.

   b. Place a printed-wiring board with the female part F054FP/032 of the connector fitted to it in the board guides and push the board firmly in, as far as it will go, making sure that the two parts of the connector are linked properly.

   c. Tighten the fixing screws of the connector rails.

   d. Tighten the fixing screws of the printed-wiring connector.

   e. Mount the other printed-wiring connectors.

4. When mounting chassis 4322 026 38280:

   Connect a back panel, with the male parts F054MB/032 of the connectors F054BP/032 fitted to it, to the panel rails by means of screws (M2.6). Tighten all screws, after aligning the back panel.

Warning: The following instructions should not be carried out with the chassis resting on its back, that is, on the connector pins. These might be bent or otherwise damaged.

5. Attach the two brackets for mounting the locking strip to the side plates by means of 4 nuts M3 (on screws M3x8). The short sides of the brackets must point downwards. Do not tighten the nuts (Fig.11).

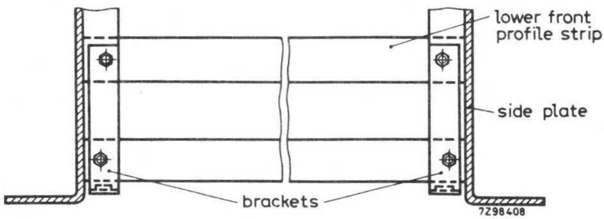


Fig.11

6. Attach the locking strip to the brackets by means of the two knurled nuts; tighten these nuts.

7. Pull the brackets to their foremost position by the 2 knurled nuts until the 3 punched notches on the locking strip touch the inside of the "front leg" of the front profile strip *) (Fig.12). Tighten the fixing nuts of the brackets.

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*) For mounting chassis 4322 026 38280 a distance of approximately 1 mm between the notches and the inside of the "front leg" should be maintained.

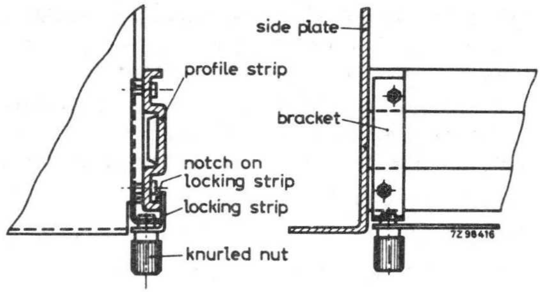


Fig.12

Note - Before placing the printed-wiring boards, the locking strip has to be removed. After placing the boards fasten the locking strip again.

SURVEY

Abbreviations: exp. = experimenters' p.w. board
univ. = p.w. board universal for the given series of circuit blocks
gl. = glass epoxy
ph. = phenolic resin bonded paper

	to fit chassis 4322 026	ma-terial	con-tacts	cat.number 4322 026	page
For general purposes					
exp., 0.1 in grid	38230	gl.	2x22	38640	F133
exp., 0.1 in grid	38240	gl.	2x23	38650	F135
exp., 0.2 in grid		ph.	2x38	34900	F125
exp., 0.2 in grid		ph.	4x38	34910	F125
exp., 0.2 in grid	38240	ph.	1x23	34940	F127
exp., 0.2 in grid	38230	ph.	2x22	38620	F129
exp., 0.2 in grid	38240	ph.	2x23	38630	F131
exp., 0.2 in grid	38240	gl.	2x23	38690	F131
exp.		ph.	2x10	73780	F141
exp.		gl.	2x35	74670	F143
exp. 1)	38250 38280	gl.	2x32	39880	F137
exp. 2)	38250 38280	gl.	2x32	39890	F137
For ZM1000		ph.		39960	F139
For 100 kHz- and 1-Series (0.2 in grid)					
exp.		ph.	2x38	34900	F125
exp.		ph.	4x38	34910	F125
exp.	38230	ph.	2x22	38620	F129
exp.	38240	ph.	2x23	38630	F131
exp.	38240	gl.	2x23	38690	F131
exp.	38240	ph.	1x23	34940	F127
univ.	38240	ph.	1x23	34920	3)

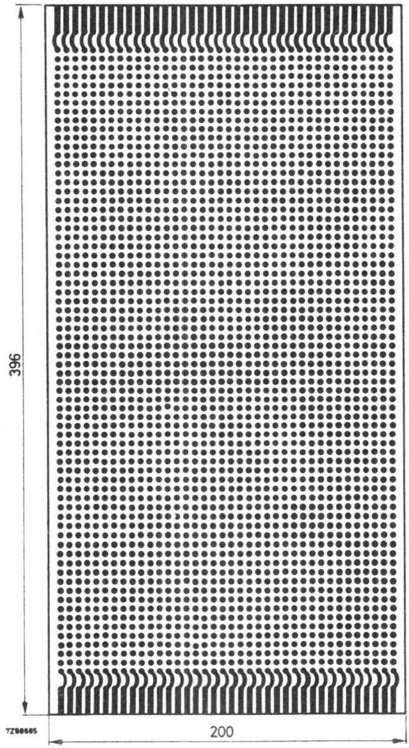
1) For dual-in-line packages with 2x7 pins.
2) For dual-in-line packages with a different number of pins.
3) See Data Handbook "Components and Materials", Part 1.

	to fit chassis 4322 026	ma-terial	con-tacts	cat.number 4322 026	page
univ. (8 blocks)	38240	ph.	1x23	34960	1)
univ.	38240	ph.	1x23	36310	
for 4 blocks PA 1	38240	gl.	1x23	33630	
for 4 blocks PD 1	38240	gl.	1x23	34710	
For 10-Series (0.1 in grid)					
exp. (20 blocks)	38240	gl.	2x23	38600	1)
exp. (20 blocks)	38240	ph.	2x23	38610	
exp. (10 low cases)	38240	ph.	2x23	36270	
univ. (8 blocks)	38240	ph.	1x23	34950	
for 4 blocks PA 10	38240	gl.	2x23	38680	
of assembly DCA 10	38240	gl.	2x23	38700	
of assembly 2.DCA 11	38240	gl.	2x23	38710	
of assembly 2.DCA 12	38240	gl.	2x23	38720	
of assembly BCA 10	38240	gl.	2x23	38730	
of assembly 2.SRA 10	38240	gl.	2x23	38740	
of assembly RSR 10	38240	gl.	2x23	38750	
For 60-Series Norbits					
exp.	38240	gl.	2x23	38600	1)
exp.	38240	ph.	2x23	38610	
exp.	38230	gl.	2x22	38790	
exp.	38230	ph.	2x22	38800	
exp.	38240	gl.	2x23	38810	
exp.	38240	ph.	2x23	38820	
univ.	38250	gl.	2x32	38780	
univ.	38330	gl.		73750	

1) See Data Handbook "Components and Materials", Part 1.

EXPERIMENTERS' PRINTED–WIRING BOARDS

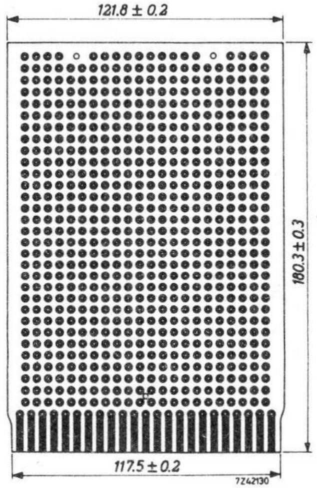
These experimenters' printed-wiring boards are very suitable for circuit blocks of the 100 kHz- and 1-Series.



Material	copper-clad phenolic resin bonded paper	
Grid pitch	5.08 mm (0.2 inch)	
Contacts	gold plated, pitch 0.2 inch	
	single sided 2 x 38	double sided 4 x 38
Holes	with holes	–
Catalogue number	4322 026 34900	4322 026 34910

EXPERIMENTERS' PRINTED-WIRING BOARD

To fit chassis 4322 026 38240.

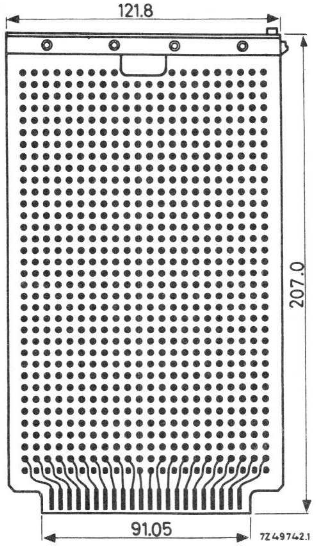


This printed-wiring board is very suitable for circuit blocks of the 100 kHz- and 1-Series.

Material	copper-clad phenolic resin bonded paper with punched holes
Grid pitch	5.08 mm (0.2 inch)
Hole diameter	1.3 mm
Contacts	1x23, gold plated, pitch 0.2 inch

EXPERIMENTERS' PRINTED—WIRING BOARD

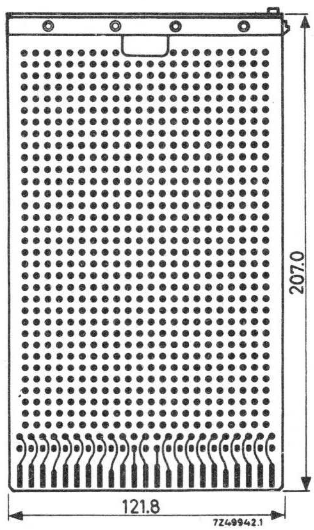
This experimenters' printed-wiring board (with extractor) is very suitable for circuit blocks of the 100 kHz- and 1-Series.
It fits the mounting chassis 4322 026 38230.



Material	phenolic resin bonded paper with holes; on both sides are copper lands around each hole
Grid pitch	5.08 mm (0.2 inch)
Hole diameter	1.3 mm
Contacts	2 x 22, gold plated, pitch 0.156 inch

EXPERIMENTERS' PRINTED-WIRING BOARDS

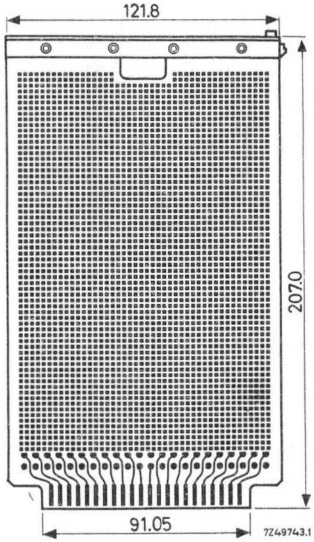
These experimenters' printed-wiring boards (with extractor) are very suitable for circuit blocks of the 100 kHz- and 1-Series.
They fit the mounting chassis 4322 026 38240.



Catalogue number	4322 026 38630	4322 026 38690
Material	phenolic resin bonded paper	glass epoxy
Grid pitch	5.08 mm (0.2 inch)	
Holes	diameter 1.3 mm; on both sides of the board are copper lands around each hole	
Contacts	2 x 23, gold plated, pitch 0.2 inch	

EXPERIMENTERS' PRINTED-WIRING BOARD

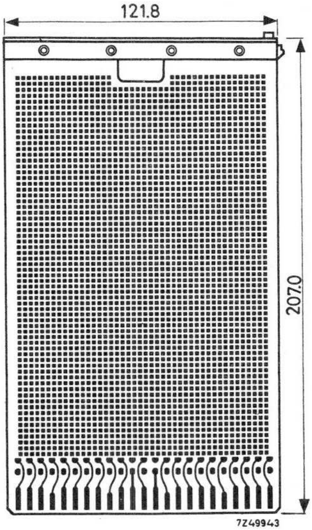
This experimenters' printed-wiring board (with extractor) is intended for quick mounting of discrete components and integrated circuits.
It fits the mounting chassis 4322 026 38230.



Material	glass epoxy with plated-through holes of 0.8 mm diameter
Grid pitch	2.54 mm (0.1 inch)
Contacts	2 x 22, gold plated, pitch 0.156 inch

EXPERIMENTERS' PRINTED-WIRING BOARD

This experimenters' printed-wiring board (with extractor) is intended for quick mounting of discrete components and integrated circuits.
It fits the mounting chassis 4322 026 38240.



Material	glass epoxy with plated-through holes of 0.8 mm diameter
Grid pitch	2.54 mm (0.1 inch)
Contacts	2 x 23, gold plated, pitch 0.2 inch

EXPERIMENTERS' PRINTED-WIRING BOARDS

for integrated circuits in dual-in-line package

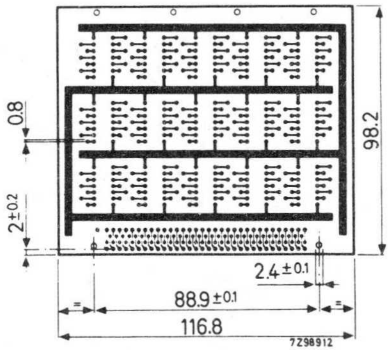
These printed-wiring boards have been designed for dual-in-line packages; the packages are connected with each other and with the connector by means of insulated wires. The packages are mounted perpendicular to the connector, so the wires to the connector can run parallel to the rows of pins of the packages, instead of between the pins.

The board 4322 026 39880 is intended for dual-in-line packages with two rows of seven pins (code XG 14), to a maximum of 15 (three rows of five packages each). Two holes for each package have been connected to supply tracks.

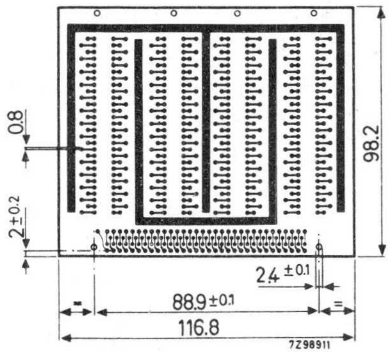
The board 4322 026 39890 is intended for dual-in-line packages with a different number of pins. The maximum number of packages which can be mounted is given below.

number of pins of the package	max. number of packages per board
2 x 7	16
2 x 8	12
2 x 9	12
2 x 10	8
2 x 11	8

Both types of printed-wiring board can be used in the miniature mounting chassis 4322 026 38250 and 4322 026 38280. In that case the boards have to be provided with an extractor and a female part of the 0.1 inch printed-wiring connector F 054 (catalogue number 2422 025 89116).



Printed-wiring board
4322 026 39880



Printed-wiring board
4322 026 39890

Material	glass epoxy
Board thickness	1.6 mm
Holes	plated-through, 0.8 mm diameter, provided with soldering lands

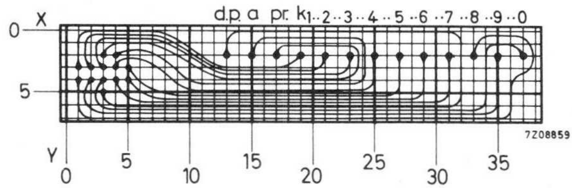
Note

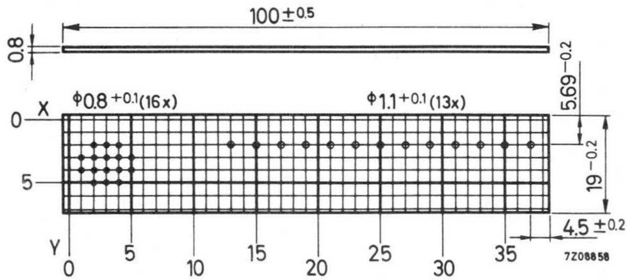
Printed-wiring boards similar to the 4322 026 39880 and 4322 026 39890, however provided with an extractor and a connector for use in the miniature mounting chassis can be delivered under catalogue number 4322 026 38760 and 4322 026 38770, respectively.

PRINTED-WIRING BOARD

Printed-wiring board to which the ZM1000 can be soldered after which the combination can be connected to a vertical printed-wiring board which contains, e.g., the drive unit.

Dimensions in mm



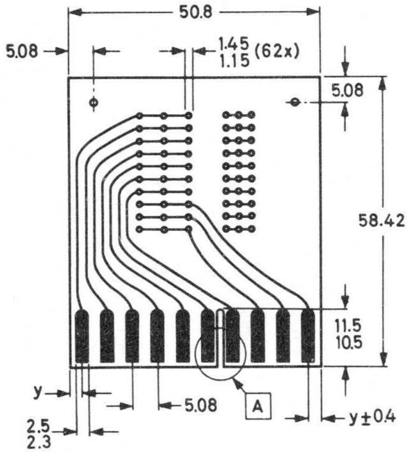


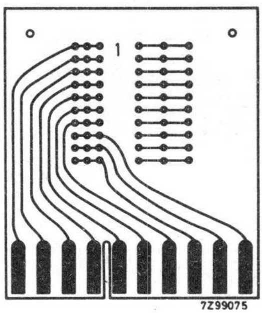
Material	copper-clad phenolic resin bonded paper, 0.8 mm
Holes	0.8 mm Ø on 2.54 mm (0.1 inch) pitch for soldering the ZM1000, soldering lands 2-0.1 mm Ø
	1.1 mm Ø on 5.08 mm (0.2 inch) pitch for connections, soldering lands 3±0.1 mm Ø
Creepage distance	min. 0.35 mm
Track width	min. 0.35 mm

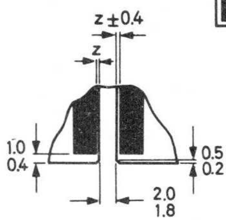
EXPERIMENTERS' PRINTED-WIRING BOARD

for one integrated circuit in dual in-line package or one thin film circuit

Double-sided printed-wiring board for one dual in-line package with maximum 2 x 10 pins or one thin film circuit with maximum 2 x 10 terminals at a pitch of 3e to 9e (e = 0.1 inch = 2.54 mm).







A

Material of the board	phenolic resin bonded paper
of tracks and contact pads	copper, min. 6 μm nickel plated, 2.5 μm gold plated
Board thickness	1.6 mm
Holes	plated-through, 20 μm copper plated, 0.5-2.5 μm gold plated; provided with soldering lands
Number of contact pads	2 x 10
Mating connector	0.2 inch printed-wiring connector F 045 (e.g. catalogue number 2422 020 51214)

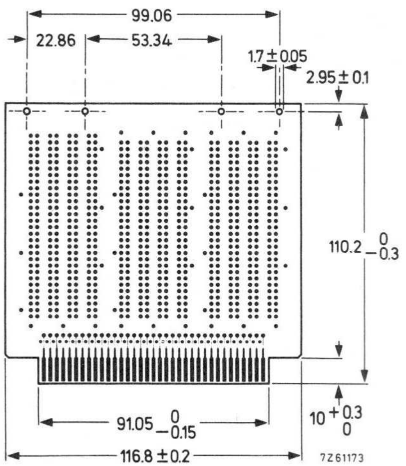
EXPERIMENTERS' PRINTED-WIRING BOARD

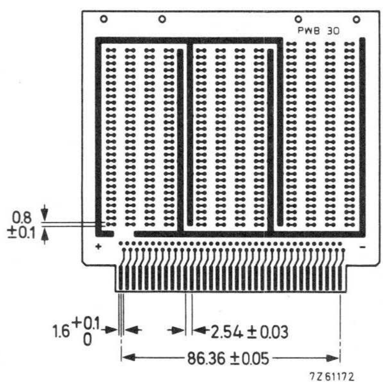
for integrated circuits in dual-in-line package

This printed-wiring board has been designed for dual-in-line packages with a different number of pins; the packages are connected with each other and with the connector by means of insulated wires. The packages are mounted perpendicular to the connector, so the wires to the connector can run parallel to the rows of pins of the packages, instead of between the pins.
The maximum number of packages which can be mounted is given below:

number of pins of the package	max. number of packages per board
2 x 7	24
2 x 8	18
2 x 9	18
2 x 10	12
2 x 11	12

The board can be used in the miniature mounting chassis 4322 026 38310 *) with the 2.54 mm (0.1 in) pitch printed-wiring connector F061 *).





*) Data sheets will be issued separately.

Material	glass epoxy
Board thickness	1.6 mm
Holes	plated-through, 0.8 mm diameter, provided with soldering lands
Contact pads	2 x 35, gold plated

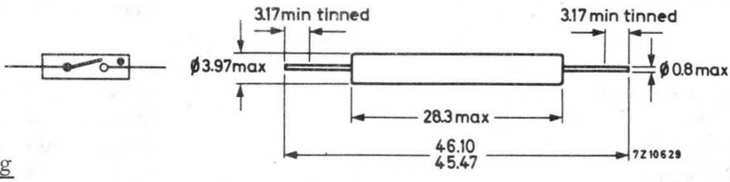
DRY REED SWITCH

Miniature dry reed switch hermetically sealed in a gas-filled glass capsule. Single-pole, single-throw type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by means of either an electromagnet or a permanent magnet or combinations of both. The switch is intended for use in telephone equipment and other applications where exceptional reliability is required.

QUICK REFERENCE DATA	
Contact	S.P.S.T. normally open
Switched power	5 W
Switched voltage	50 V
Switched current	100 mA
Failure rate	$< 5 \times 10^{-8}$

MECHANICAL DATA Dimensions in mm

Contact material	gold
Contact arrangement	normally open
Terminal finish	tinned
Resonant frequency of single reed	approx. 1650 Hz
Net weigth	approx. 0.6 g
Mounting position	any



Mounting

The leads should not be bent nearer than 2 mm to the glass-to-metal seals.
Stress on the glass-to-metal seals should be avoided.
The robustness of terminations is tested according to IEC Publication 68-2-1. test Ua (load 3 kg), Ub (load 1 kg, 4 bends) and Uc.
Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions.

Data based on pre-production devices.

Soldering

The switch may be soldered direct into the circuit but heat conducted to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt.

Dip-soldering is permitted to a minimum of 4 mm from the seals at a solder temperature of 240 °C during maximum 10 s.

Solderability

Solderability is tested according to IEC Publication 68-2-20, test T, solder globule method.

CHARACTERISTICS

Non-operative

Breakdown voltage		min.	1000	V
Insulation resistance, initial (V = 100 V)		min.	10^5	MΩ
Capacitance	without test coil		0.70	pF
	with earthed test coil		0.35	pF
Non-operative ampere turns		max.	30	A.T. [1]

Operative

Operating ampere turns	max.	58	A.T. [1]
Operating time, including bounce	av.	0.6	ms [1][2]
	max.	1.0	ms [1][2]
Switched current	max.	100	mA

Hold

Hold ampere turns	min.	27	A.T. [1]
Current through closed contacts	max.	1	A
Contact resistance, initial	min.	60	mΩ [1][3]
	max.	150	mΩ [1][3]

Release

Release ampere turns	max.	15	A.T. [1]
Release time	max.	50	μs [1][2]
Switched current	max.	100	mA
Switched power	max.	5	W

[1]) Measured in a standard coil of 5000 turns of 42 SWG single enamelled copper wire on a coil former of 25.4 mm winding length and a core diameter of 8.75 mm.

[2]) Measured with 80 A.T.

[3]) Measured with 40 A.T.

LIMITING VALUES (Absolute max. rating system)

See also "Life expectancy and reliability"

Switched power	max.	5	W
Switched voltage	max.	65	V
Switched current	max.	100	mA
surge (T = max. 100 ns)	max.	1.5	A
Temperature, operating	min.	−55	°C
	max.	+80	°C

LIFE EXPECTANCY AND RELIABILITY

End of life is assumed to be reached when:
a) the contact resistance exceeds 1 Ω for no load conditions or 2.5 Ω for loaded conditions
b) the release time exceeds 1.5 ms (latching or contact sticking)

No load conditions

Life expectancy min. 10^7 operations with a failure rate of less than 5.5×10^{-9} with 90% confidence level.

Loaded conditions

Life expectancy min. 5×10^6 operations with a failure rate of less than 10^{-8} with 90% confidence level.

If inductive loads are to be interrupted, contact protection is recommended (diode or RC network).

Reliability - testing conditions

Capacitive loading resulting in a peak current of 1.4 A, $i_1/i_2 = 1.4$, T = 80 ns to 100 ns, see Fig. 1. Nominal switched voltage 50 V, nominal switched current 100 mA.

Under these conditions a life of more than 5×10^6 operations can be reached with a failure rate of less than 8.5×10^{-9}.

Remark

Higher loads may be switched if a reduced life expectancy and reliability are acceptable. The manufacturer should be consulted before doing so.

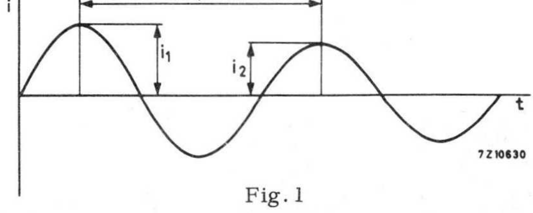


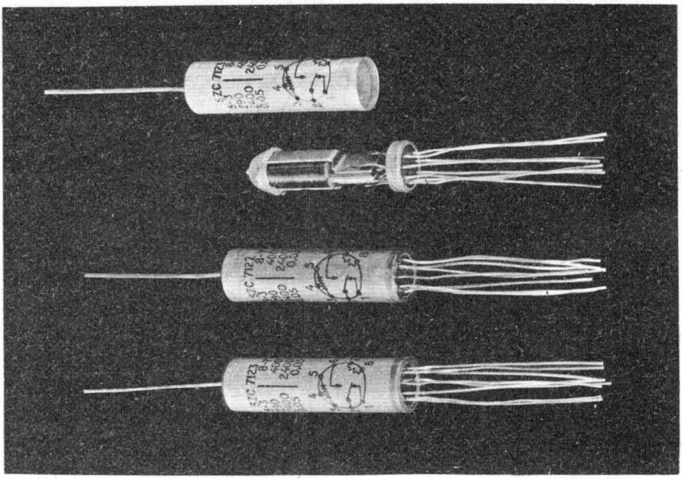
Fig. 1

SHOCK AND VIBRATION

Impact : Acceleration 50 g during 11 ms, due to a force perpendicular to the flat sides of the reeds.
Such an impact will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 A.T. coil to open.

Vibration: Frequency range 50 Hz to 1500 Hz, acceleration 20 g due to a force perpendicular to the flat side of the reed.
Such a vibration will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 A.T. coil to open:

MINIATURE POLARISED RELAYS



APPLICATION

These relays have been designed for applications which require:

- small dimensions
- high reliability
- long life
- low power
- short switching times
- good shock- and vibration properties

They are suitable for use in :

- telephone systems
- computers
- remote control
- data switching systems
- telegraph systems
- measuring apparatus
- logic circuits
- television

CIRCUIT DATA

Two versions are available:

SZC 7122, bistable polarised relay with two stable positions and one change-over contact. No energy is required for holding the contact closed in either position.
When the relay is energised as shown in Fig. 1 contact 2-6 is closed, when energised in opposite direction contact 2-1 is closed.

SZC 7123, monostable polarised relay with one stable position and one change-over contact. To hold the make-contact closed, the relay must be energised. When the relay is energised as shown in Fig. 1 contact 2-6 is closed. In its normal position (if not energised or energised in opposite direction) contact 2-1 is closed.

The windings I and II can be energised either connected in series or in separate circuits.

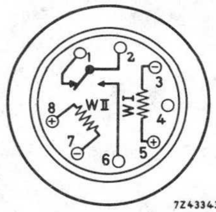


Fig. 1

Winding data

winding	terminals begin	terminals end	number of turns	wire diameter	resistance at 25 °C
I	5	3	2400	0.05 mm	290 Ω ± 15 %
II	8	7	2400	0.05 mm	400 Ω ± 15 %

CONSTRUCTION

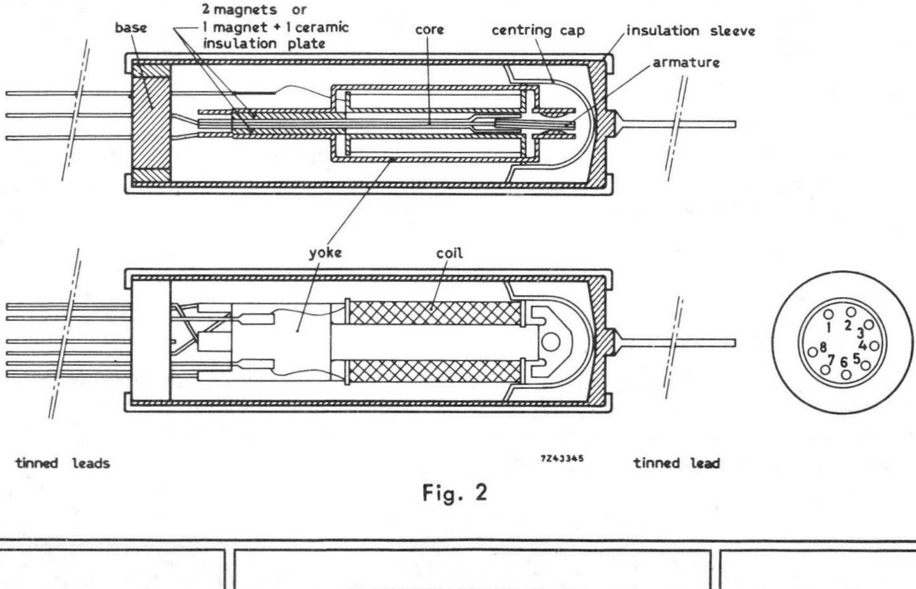


Fig. 2

The magnetic paths of the relays consist of a core (of the coil), to which the armature is flexibly attached by means of the armature spring, and two yokes. The core is electrically separated from the yokes by means of a ferroxdure magnet at each side in the bistable relay, and at one side and an insulating plate at the other side in the monostable relay. The yokes, which besides form the two fixed contact springs, and the armature plates are gold-alloy coated to form a change-over contact.

The contacts are protected by a plastic centring cap.
The relays are housed in a hermetically sealed metal can after being thoroughly degassed, and dried in an oven.
Type SZC 7122 is provided with a transparent blue insulating sleeve
Type SZC 7123 is provided with a transparent red insulating sleeve

Dimensions in mm

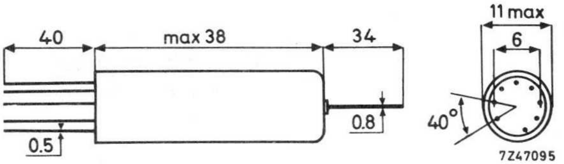


Fig. 3

Weight: approximately 7 g.

Marking: The can is marked with the type number of the relay, the terminal numbers of the coils, followed by the rèsistance values, the numbers of turns, the wire diameters, and the circuit diagram as shown in Fig. 1.

TECHNICAL PERFORMANCE

Contact rating

- The contacts are rated to switch a maximum d.c. voltage of 60 V or a maximum direct current of 200 mA provided the applied values of voltage and current do not exceed those given by line A B C D in Fig. 4.
- The contacts are rated for a maximum steady-state d.c. voltage of 120 V and a maximum steady-state direct current of 1 A.
- The contacts withstand a maximum switching-on surge (as a result of wiring capacitance) of 2 A, provided this decays to a maximum of 200 mA within 6 µs. For optimum reliability it is recommended to "wet" the contacts from a source of at least 6 V (see Figs 5 and 6).

Expected life of contacts

- At least 10^9 operations, if contacts are switched unloaded. In this case the contact may be loaded after closing and should be unloaded before opening it.
- As given in Fig. 4, if contacts are switched loaded and are provided with a suitable spark quenching circuit.

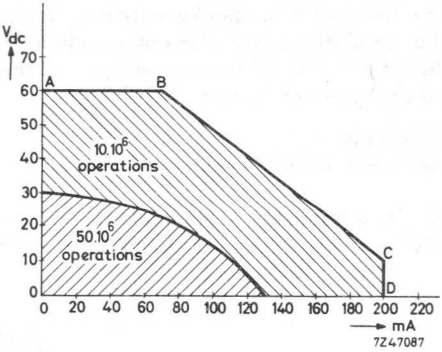


Fig. 4

Inductive circuit

Purpose: Switching the coil of a relay

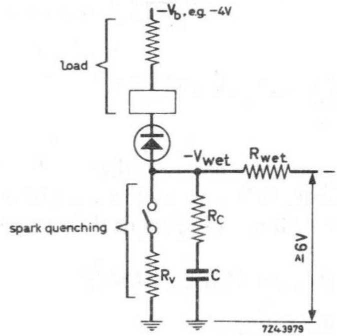


Fig. 6

Resistive circuit

Purpose: Square voltage of 3V

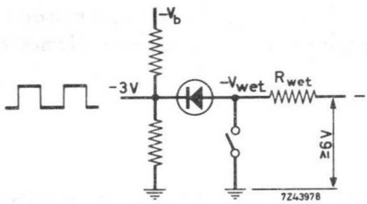


Fig. 5

If in Fig. 5 the tap voltage and in Fig. 6 V_b is 6V or higher the wetting circuits are superfluous.

Contact resistance

The contact resistance of the relay including lead resistance of 150 mΩ, is 300 mΩ or less, measured at a distance of 10 mm from the base.

Ampere turns

	bistable relay	monost. relay
operate	35 AT	45 AT
release	-	6 AT
non operate	10 AT	20 AT
hold	-	22 AT

A safety factor of at least 1.5 should be applied.

Permissible temperature range
- 20 to +70 °C

Maximum permissible coil dissipation
- Continuous energising: The coil dissipation must be kept below the values indicated in Fig. 7.
- Intermittent energising:

a. for temperarily energising of maximum 10 minutes the temperature rise ΔT is given in Fig. 8. The permissible dissipation is determined by the sum of room temperature and ΔT (max. 70 °C)

b. when using a series of pulses of relatively high frequency, the mean coil dissipation must be kept below the values indicated in Fig. 7

c. when using a series of pulses of relatively low frequency, ΔT can be determined by plotting the temperature gradient during the pulse series with the aid of Figs 8 and 9. The permissible dissipation is determined by the sum of room temperature and ΔT (max. 70 °C)

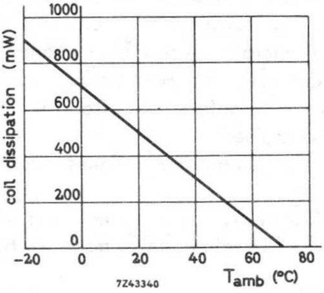


Fig. 7

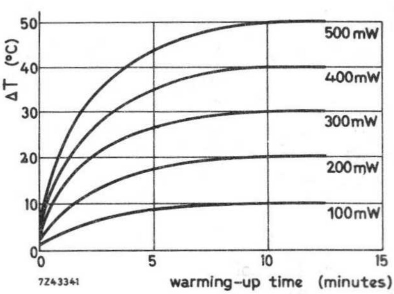


Fig. 8

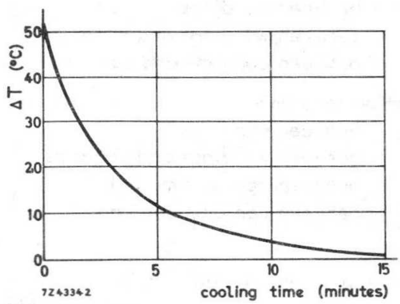


Fig. 9

Switching times

- Operate break time. This time depends on the energising AT, operate AT and the total power in the energising circuit and may vary from
  0.3 - 1.5 ms (monostable)
  0.15 - 0.6 ms (bistable)
  e.g.:

circuit dissipation	500 mW	100 mW
$\frac{\text{energising AT}}{\text{operate AT}}$	2	1.1
monostable	~ 0.3 ms	~ 1.5 ms
bistable	~ 0.15 ms	~ 0.6 ms

- Change-over time. This time also depends on the energising AT, operate AT and the total power in the energising circuit and lies between 0.25 and 0.6 ms.
- Operate make time = operate break time + change-over time.
- Release break time and release make time (only for monostable relay). These times depend on the nature of the electrical circuit which remains in parallel to the coil after being de-energised.
  Value for guidance: the release break time for a non retarded relay is approximately 0.3 ms.
- Bounce time of bistable relay : < 0.3 ms } for 90% of all relays
  of monostable relay: < 0.4 ms } (statistical evaluation)

Switching frequency
maximum 200 Hz

Maximum permissible working voltage
- between windings
- between windings and contacts
- between contacts and can

} 200 V_{dc}

Insulation resistance
- between windings
- between windings and contacts
- between contacts mutually
- between contacts and can

} > 100 MΩ

Capacitance

- between the contacts	2-1	~ 21 pF
	2-6 (bistable relay)	~ 21 pF
	2-6 (monostable relay)	~ 6.5 pF

Spark quenching

If the voltage to be switched exceeds 12V a spark quenching should be applied, in particular when a long life and the highest reliability are required. If the voltage exceeds 60V due to switching off an inductive circuit, spark quenching is absolutely necessary.
In Fig. 10 a suitable RC spark quenching circuit is shown in which R_V acts as a limitation for the discharge current of the wiring capacitance. This circuit gives optimum result if

$$R_V = \frac{8}{I}\ \Omega \text{ (I in amperes)}$$

$$C = 1.25\ I\ \mu F$$

$$R_C = 0\ \Omega$$

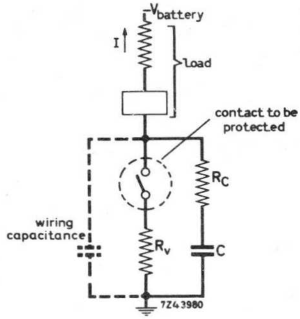


Fig. 10

When R_V in this case exceeds the maximum permissible resistance value in the switching circuit, the calculated value of R_V can be spread over R_V and R_C. Because then the result will not be optimum, it is recommended to keep R_V as large as possible.

$$\text{minimum } R_V = \frac{V\text{battery}}{2}\ \Omega \text{ (V in volts)}$$

$$R_C = \frac{8}{I} - R_V\ \ \Omega$$

R_V must be placed as close as possible to the switch contact.

Climat

The relays are suitable for use in all climats.

Vibration

The relays satisfy the requirements of RCS 165 test 11.10.

Shock

The relays can withstand shocks of 20g without contact interruption.

Acceleration

The relays meet the requirement of RCS 165 test 11.12.5 (acceleration 60g).

MOUNTING

The relays can be mounted in any position.
If more relays must be mounted close together they must be placed in the same radial position, i.e. with connection 4 at the top as shown in Fig. 11.
They fit the tube socket type B1 506 70.

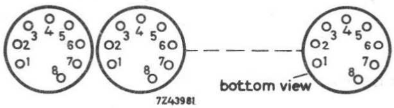


Fig. 11

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