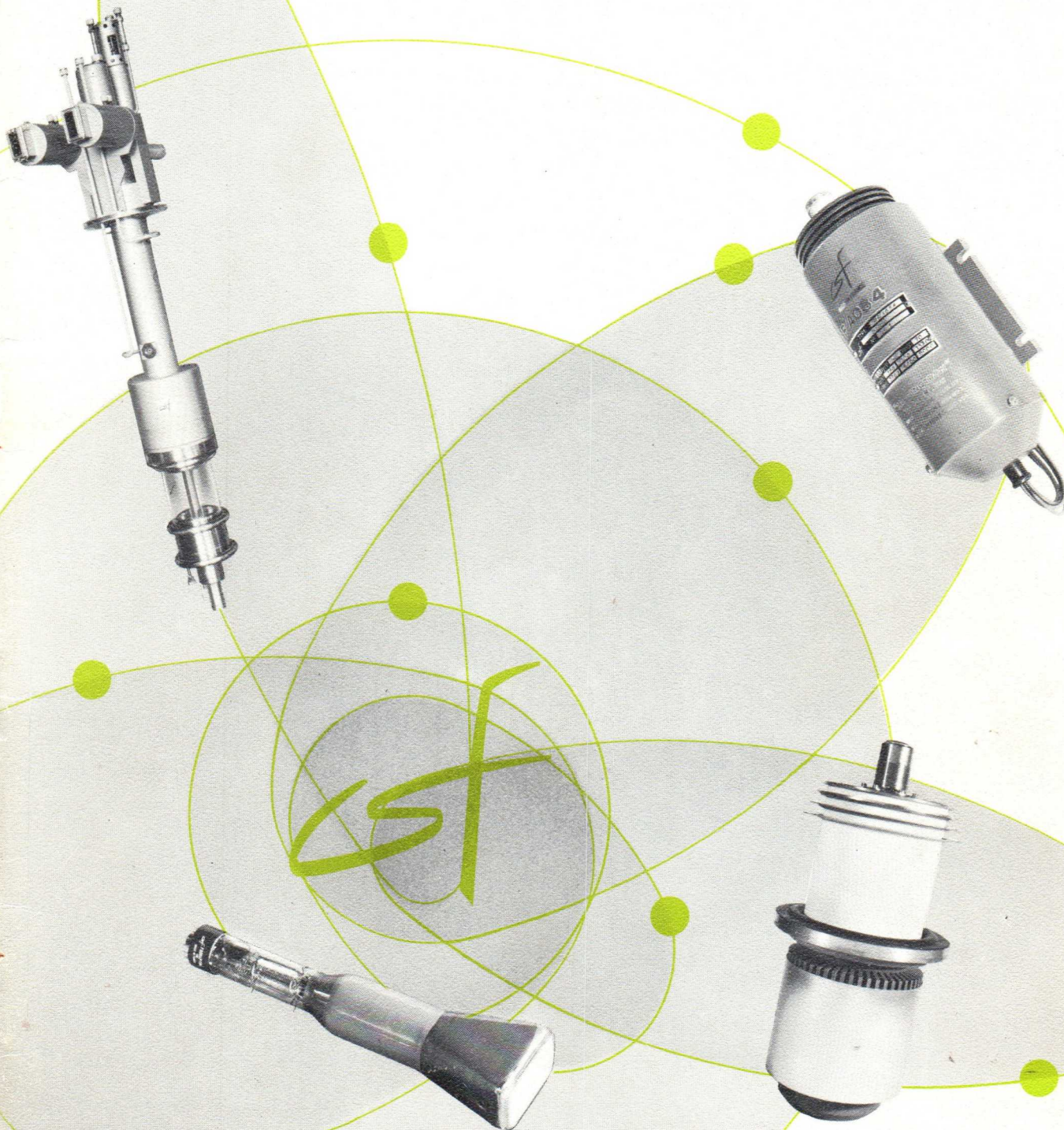


Bary Wade


Electronic tubes



CSF COMPAGNIE GÉNÉRALE DE TÉLÉGRAPHIE SANS FIL

GTE GROUPEMENT TUBES ÉLECTRONIQUES

55 RUE GREFFULHE - 92 - LEVALLOIS-PERRET - TÉLÉPHONE : 737.34.00



The "Groupement Tubes Electroniques" is the CSF (Compagnie Générale de Télégraphie Sans Fil) Division in charge of the study, development and production of Electronic Tubes. Its range of activities extends from the classical entertainment tubes to the more sophisticated ones such as gridded crossed field amplifier or storage viewing tubes.

The following applications have been found to its productions :

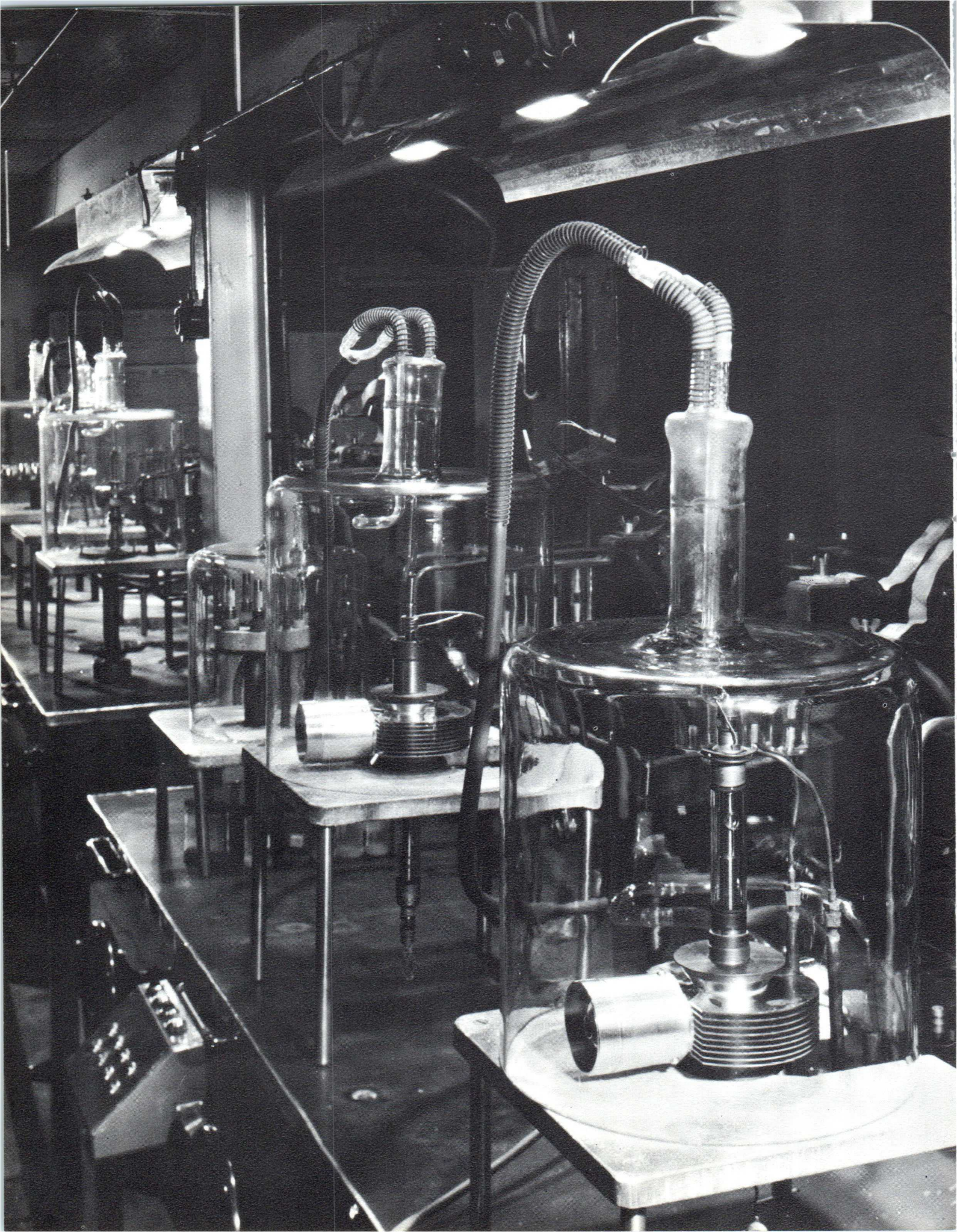
- airborne and ground radar : magnetrons, klystrons, O and M type travelling wave tubes, TR, ATR, thyratrons, diodes, cathode ray tubes, storage tubes.
- radio links : TWT, klystrons, solid state RF sources.
- electronic countermeasure systems : carcinotrons, noise generators, wide band amplifiers.
- (radio and TV) telecommunication transmitters, triodes, tetrodes, klystrons, TWT.
- measurement bench : carcinotrons, TWT, CRT.
- display devices : IR image converter, brightness amplifier, numerical readout, pick up tubes, storage viewing tubes, storage tubes.
- industrial heating process : triode.
- RF heating : magnetron.
- equipments : modulator hard tubes, for radar and linear accelerators.
- lasers : flash tube and detection cells.

Starting from an extensive background in vacuum and microwave techniques, the GTE has developed equipments for industries and laboratories such as : mass spectrometers, ultra high vacuum equipments, gas lasers, RF components, TWT packaged amplifier including power supply, TWT power supply...

These productions are listed in a second abridged catalogue.

CONTENTS

	Pages
MICROWAVE TUBES	4 5
● Power klystrons	6 7
● Reflex klystrons	8
● Travelling wave tubes	9 10 11
● Magnetrons	12 13
● "O" carcinotron tubes	14 15
● Crossed field noise generators ● Noise source for test equipment	16
● Duplexer tubes ● Neon tubes ● Spark-gaps	17
 TRANSMITTING TUBES	 18 19
● Triodes ● Tetrodes ● Pentodes	20 21
● Ceramic thyratrons	22
● Diodes and rectifiers ● Industrial purposes	23
 RECEPTION TUBES AND MISCELLANEOUS	 24 25
● "Miniatron" ● "Subnitron"	26 27
● Repeater tubes ● Thermal relays	28
● Gauges ● "Flash" tubes	29
 DISPLAY DEVICES	 30 31
● Cathode ray tubes	32 33 34
● Direct view storage tubes	35
● Scan conversion tubes	36
● Barrier grid storage tubes Brightness amplifiers ● Decoder tubes	37
● Display readout ● Image converter tube Photoelectric cells	38
 EQUIPMENT FOR THE LABORATORY AND FOR INDUSTRY	 39



MICROWAVE TUBES

The Laboratories of CSF have often been at the origin of microwave tubes, either magnetrons or klystrons for which their contribution was of prime importance, or the carcinotron which is a CSF invention.

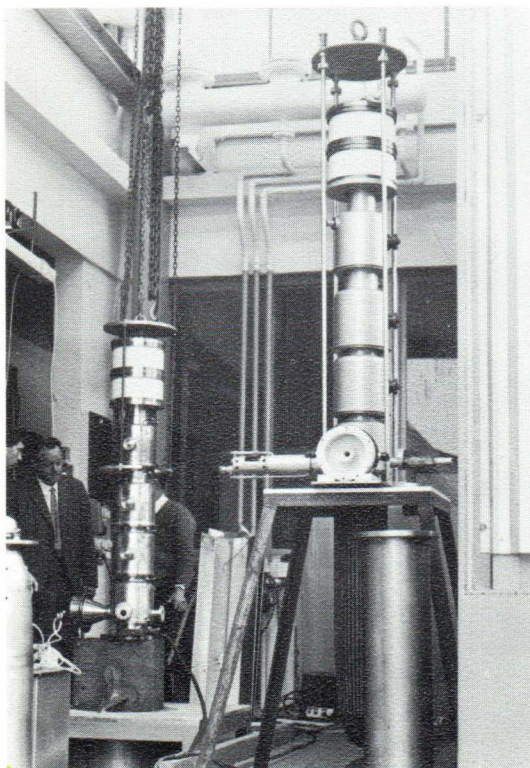
In this catalogue are offered a range of tubes which represent the outcome of continuous effort in research and improvement, both in performance and quality. Part of this research work has resulted in productions such as the M type Carcinotron and the M-type travelling wave tube (TPOM) both crossed-field tubes, the performances of which are generally "classified". On this account these tubes are not listed here. Information on these products can be furnished on a "need to know" basis.



POWER KLYSTRONS



"Argonac" welding of a F2008 klystron body on an automatic machine.



F2055 klystron testing room.

CW OPERATION

TYPE	Operat. frequency	Power	High voltage	Beam current	Gain	Focusing
	GHz	kW	kV	A	dB	
F 2047	1.428	10	13	2.8	40	electromagnetic
F 2008	0.47-0.65	30	18	4.8	30	electromagnetic
F 2048 [†]	0.47-0.64	50	23	6.0	40	electromagnetic
F 2009	0.59-0.83	30	17	3.8	40	electromagnetic

[†]Type under development.

CW Tubes :

The F2047 klystron is a 10 kW fixed frequency L band tube developed for the ELDO (European Launching Development Organization). This tube must be used in the guidance system of the satellite launcher "EUROPA".

Important efforts of production have been made to achieve the equipment of 18 French television emitters (ORTF). These emitters operate with 3 tubes F2008 or F2009, two in parallel for the image carrier, and one for the sound carrier.

These tubes at a nominal 30 kW power level can be pushed to 50 kW as in the derived model F2048. Good efficiency and high gain make these tubes suitable for power emitter realization. They can be cooled either with liquid or vapour. Some of them work in pulse condition at 100 kW peak 40 kW average power, as in the Bonn Synchrotron.

CW and pulsed tube :

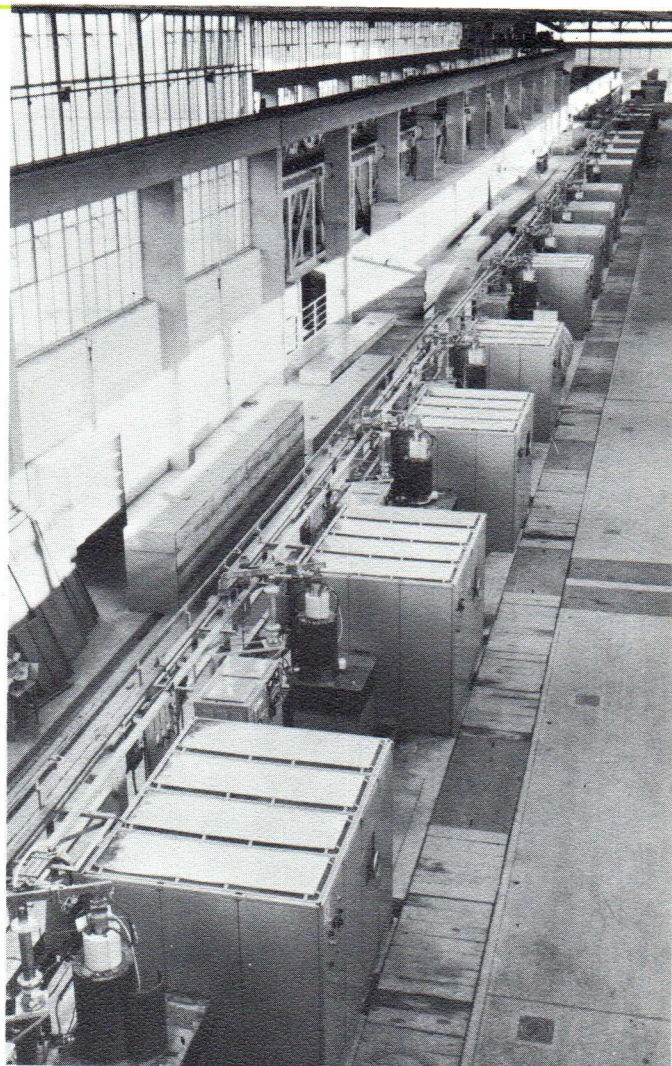
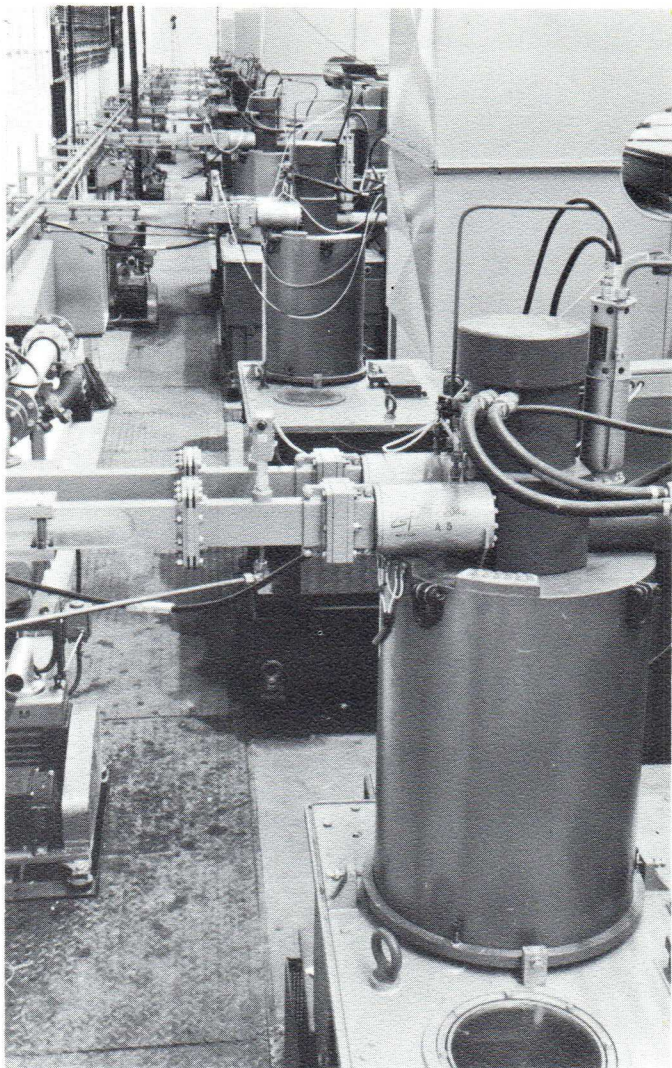
The F2055 klystron can operate at 500 MHz either in CW or pulsed conditions. In the 1st mode the objective is 250 kW CW. In the second, the objective is 500 kW peak, 250 kW average. This tube is developed for the DESY Synchrotron in Hamburg.

Pulsed tubes :

The production of high power pulsed tubes, as well as that of the other power klystrons, is achieved in the "Corbeville" Center. These tubes, widely used in CSF linear accelerators, feature high gain, high peak and average powers, and high efficiency; at the present, 63 tubes are in operation, two of these on the British Lineac "NINA".

Recent productions concern the F2042 klystron at a 30 MW peak 25 kW average power with two output windows, and the F2040 at a 25 MW peak 12 kW average power. CSF background in microwave tubes, and more specially in klystrons, is available to develop new tubes on requirements.

Besides, high stability klystrons for doppler applications are studied and developed at Corbeville but their characteristics are not available in this catalogue.



Linear accelerator constructed by CSF for MAYENCE University, fitted out with F2042 klystrons.

ORSAY linear accelerator fitted out with F2043 klystrons.

PULSE OPERATION

TYPE		Operat. frequency	Peak power	Mean power	High voltage	Beam current	Gain	Pulse duration	Focusing
"F"	"CSF"	GHz	MW	kW	kV	A	dB	μs	
F2011□	—	3.0	0.05	0.05	40	15 pA		10	electromagnetic
F2052□*	—	3.0	0.06	0.2	40	15 pA		10	electromagnetic
F2055▲*	—	0.499	0.5	250	47	26 pA	37	10 000	electromagnetic
F2015	KA435	3.0	5	5	125	105 pA	39	2.2	electromagnetic
F2043	KA436	3.0	20	2.5	250	230 pA	43	2.5	electromagnetic
F2040	KA438	3.0	25	12	285	265 pA	50	6	electromagnetic
F2042	KA437	3.0	30	25	310	280 pA	50	6	electromagnetic
F2049	—	2.856	30	25	300	280 pA	50	6	electromagnetic

□ Pilot klystron. * Type under development.

▲ This tube can operate in CW conditions, providing 250 kW CW output power.

REFLEX KLYSTRONS

TYPE		Heater		Frequency range	TYPICAL OPERATION						Electron tuning range
		Vf	If		Cavity voltage	Cavity current	Frequency	Reflector voltage	Grid voltage	Output power	
"F"	"CSF"	V	A	GHz	V	mA	GHz	V	V	W	MHz

WIDE ELECTRONIC TUNING BAND REFLEX KLYSTRONS, with external cavity. Natural air cooling.

6BL6	—	6.3	0.68	1.6-6.5	325	28	2.0	-140	0	0.200	6
					325	25	4.0	-300	0	0.150	6
5836*	—	6.3	0.68	1.6-6.5	325	25	2.0	-140	+10	0.200	6
					325	25	4.0	-300	+10	0.120	6
6BM6	—	6.3	0.68	0.55-3.0	300	18	1.15	-40	0	0.020	6
					325	22	2.2	-500	0	0.100	4
5837*	—	6.3	0.68	0.55-3.0	325	22	0.8	-50	+10	0.100	6

BUILT-IN CAVITY LOW NOISE REFLEX KLYSTRONS, for telecommunications. These tubes are used for CSF radio-link equipments.

WAVEGUIDE OUTPUT

F2021	KR.740**	6.3	1	2.90-3.50	1000	85	2.90	-230	—	1.3	25
					1000	85	3.20	-375	—	2.8	22
					1000	85	3.50	-570	—	3.0	17
					500	30	2.90	-375	—	0.4	10
F2022	KR.741***	6.3	1	3.45-3.75	500	30	3.20	-520	—	0.45	8
					500	30	3.50	-300	—	0.2	10
					850	67	3.50	-250	—	1.5	28
					850	67	3.70	-325	—	1.7	22
F2023	KR.742***	6.3	1	3.75-4.0	850	67	3.90	-330	—	1.7	21
					850	67	4.10	-450	—	1.5	16
					850	67	3.90	-230	—	1.5	26
F2024	KR.743***	6.3	1	4.0-4.25	850	67	4.10	-310	—	1.65	23
					850	67	4.30	-400	—	1.3	17
					850	67	4.30	-400	—	1.3	17

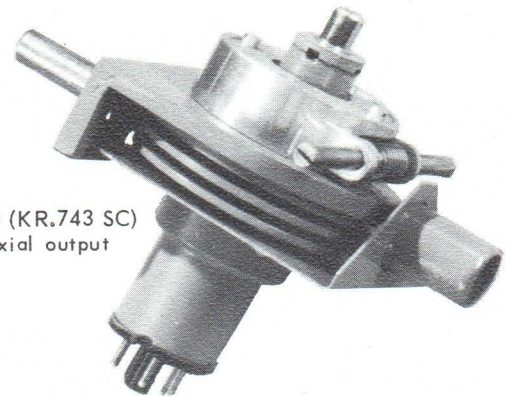
* Pulse operation or CW

** Output on CNET λ 7 waveguide

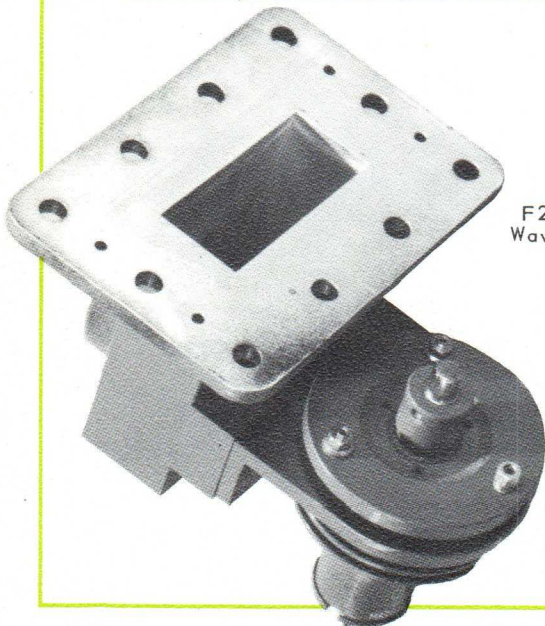
*** Output on CNET λ 6 waveguide.

COAXIAL OUTPUT

F2025	KR.740SC	Same characteristics as F2021, F2022, F2023 and F2024 but with output on coaxial line. Impedance 75 Ω and frequency adjustable by worm wheel and screw.
F2026	KR.741SC	
F2027	KR.742SC	
F2028	KR.743SC	



F2028 (KR.743 SC)
Coaxial output



F2024 (KR.743)
Waveguide output

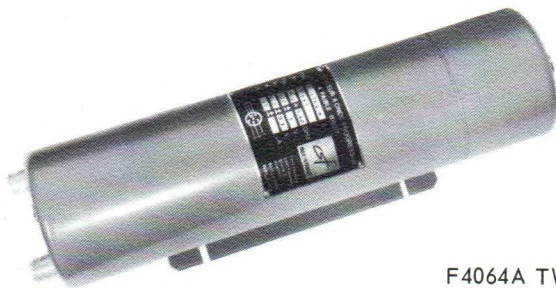
KLYSTRONS - TUBES FOR MAINTENANCE						Frequency range	Output power	
TYPE								
"F"	"CSF"	"F"	"CSF"	"F"	"CSF"	GHz	W	
				F2013	KR.117	2.75-3.65	0.380	
		KR.740SCA	F2030	KR.760		2.90-3.50	2.8	
		KR.741SCA	F2031	KR.761	F2037	KR.781	3.45-3.75	1.7
F2029	KR.742SCA	F2032	KR.762	F2038	KR.782	3.75-4.0	1.7	
		KR.743SCA	F2033	KR.763	F2039	KR.783	4.0-4.25	1.65

TRAVELLING-WAVE TUBES

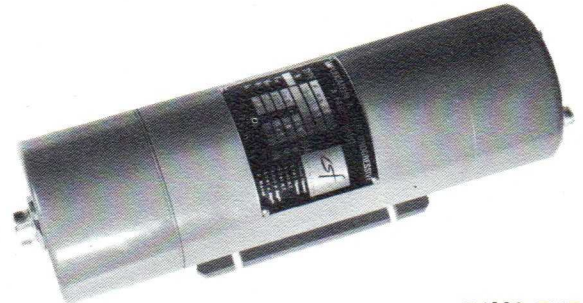
LOW NOISE T.W.T.

TYPE		Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
" F "	" CSF "	GHz	mW	dB	dB	V max	mA	kg	
F4064A	TPO.251A	1.2 - 1.4	0.15	>20	< 4.5	300	1.0	8.5	aimant permanent
F4129	—	2.9 - 3.1	1.5	> 25	< 5.6	450	0.5	7.3	aimant permanent
F4115*	—	28 - 34	< 50	> 20	< 15	2.500	7	8.0	aimant permanent

* Type under development.



F4064A TWT



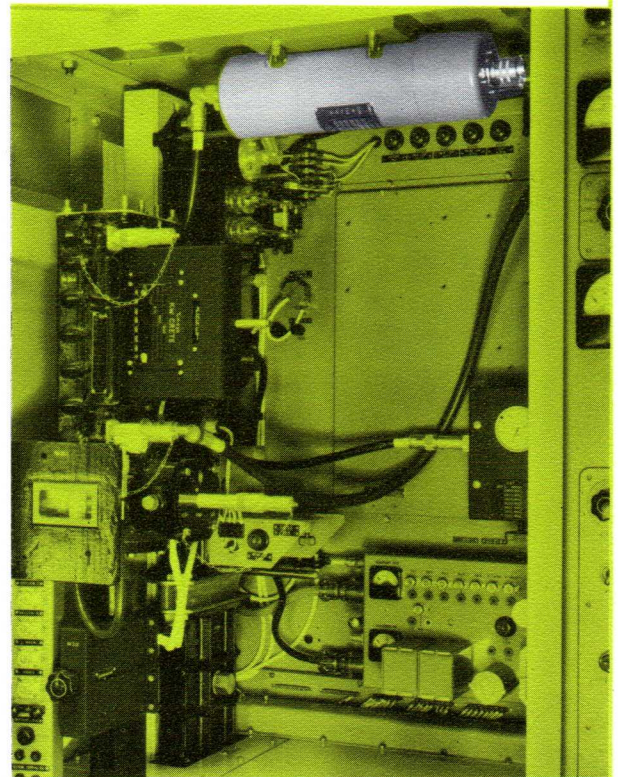
F4129 TWT

LOW-NOISE TRAVELLING WAVE TUBES

From the start, CSF laboratories have taken part in advances and improvements of travelling wave tubes. In this field, they have been concerned both with pulsed tubes and high-gain medium power tubes, or with low noise or very low noise tubes. In the latter field, operational tubes, such as the F4129 for S band and the F4064 for L band, improve signal to noise ratio on radars in which they are fitted. Spectacular range improvements were thus obtained. These tubes possess the property of saturating at a very low power level and are therefore able to protect and increase the life of mixer crystals in radar RF heads. They are focused by permanent magnets and require no cooling. They operate over a wide band and can thus be used in wide-band radar. Around 8 mm wavelength the F4115 tube is suitable for use in radiometry equipments which also operate over a wide band.

WIDE-BAND, MEDIUM NOISE TRAVELLING WAVE TUBE

These wide-band high-gain travelling wave tubes have a low noise figure which varies from 10 to 15 dB over the 1 to 18 Hz band (covered by 5 tubes). Developed for the military market, they feature low weight (1 kg, magnet included), high gain and octave bandwidth. They are intended for use in radar detection equipment and withstand severe environmental conditions. A series (B) is fitted with built-in divider bridges; the tubes are thus supplied only with one high voltage and the heater supply.

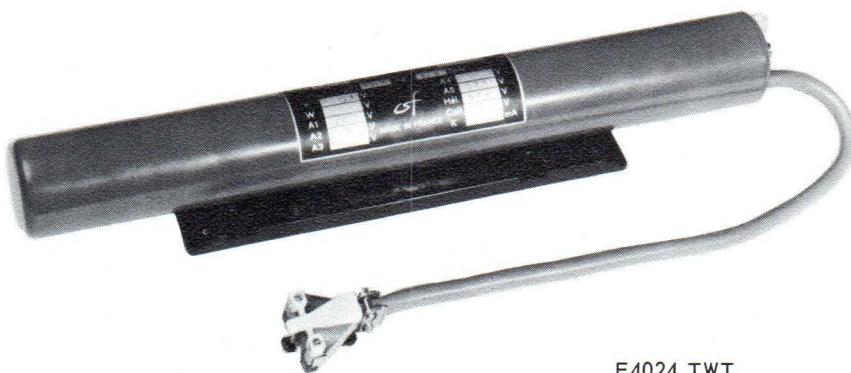


Adjunction of a F4129 TWT to a ER.437 radar.

WIDE-BAND, MEDIUM NOISE T.W.T.

TYPE	Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
" F "	GHz	mW	dB	dB	V max	mA	kg	
F4123B*	1.0 - 2.0	10	> 35	< 12	300	< 8	1	periodic magnets
F4100B*	2.0 - 4.0	40	> 35	< 12	700	< 10	1	periodic magnets
F4024	2.15 - 4.3	40	> 35	< 12	600	< 2	1	periodic magnets
F4025	4.0 - 7.0	30	> 35	< 13	850	< 1	1	periodic magnets
F4101B*	4.0 - 8.0	30	> 35	< 13	900	< 5	1	periodic magnets
F4026	6.9 - 11.1	10	> 35	< 14	1 000	< 1	1	periodic magnets
F4102B*	8.0 - 10.5	10	> 35	< 13.5	1 400	< 4	1	periodic magnets
F4156*	11.0 - 18.0	10	> 35	< 16	1 500	< 3	1	periodic magnets

* Built-in resistor bridge makes the unit adjustment-free and requiring only two input fixed voltages, for heating and high voltage.



F4024 TWT

MEDIUM POWER TRAVELLING WAVE TUBES

These tubes are designed for microwave links; they are mostly periodic permanent magnet focused like the F4017D and the F4059A. The F4056B (TPO 410) permanent magnet focused is used, for example, in school television transmission; it is also used to increase the power level of microwave links.

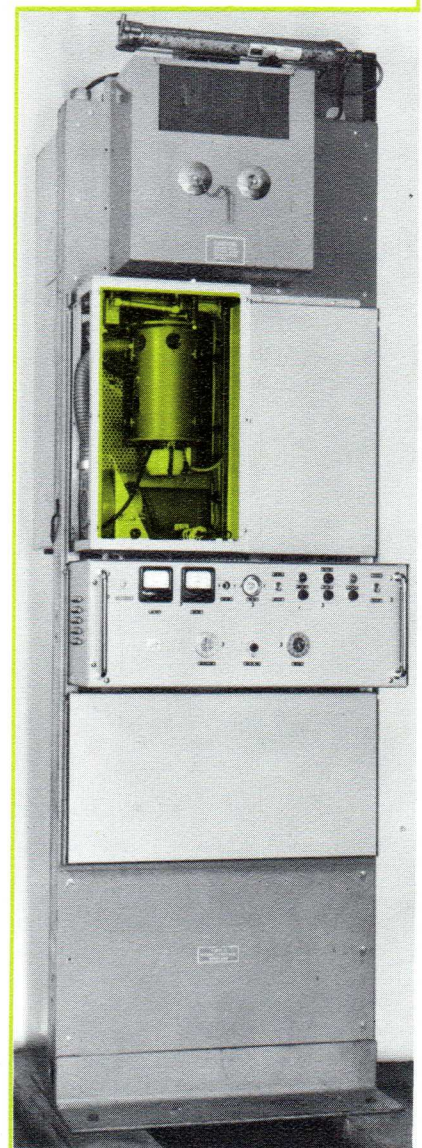
Other travelling wave tubes, with 1 to 10 W wide-band, and PPM focusing, are mainly intended for test instruments. They can be used also to increase power in microwave links.

Power supply packs have been developed at the GTE including tubes of these three families.

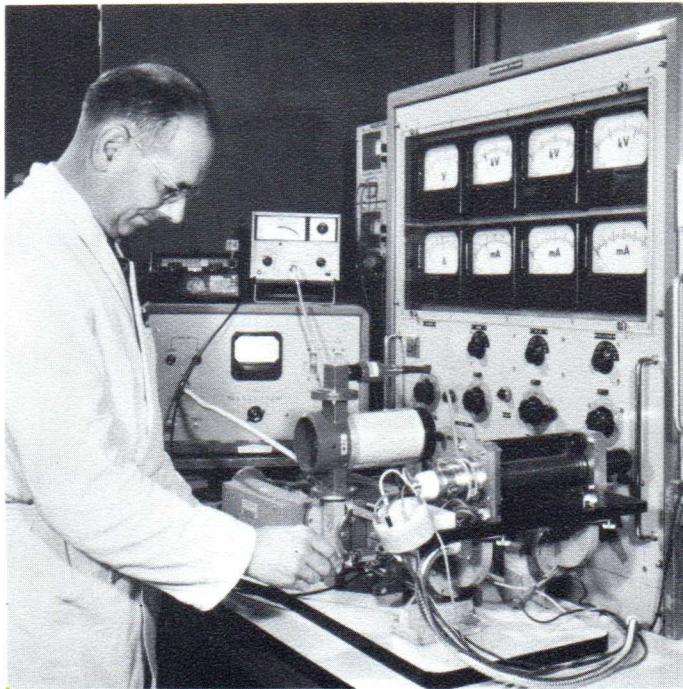
PULSE TRAVELLING WAVE TUBES

These tubes are used as pre-amplifiers in wide-band radar chains. Higher power tubes working on higher frequencies have been developed in the past, or are in development.

Type "O" and type "M" (crossed fields - TPOM on pulse or CW) tubes have given rise to important developments for "classified" applications in the field of radars and of counter-measures equipments.



Adjunction of a F4056 TWT and its supply to a "PHIL CO" type radio-link



F4181 TWT testing bench.



F4017D TWT
cooled by conduction

MEDIUM POWER T.W.T.

TYPE		Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
" F "	" CSF "	GHz	W	dB	dB	V max	mA	kg	
F4087	—	1.0 - 2.0	> 1	30	25	1 200	< 35	1.3	periodic magnets
F4134	—	1.0 - 2.0	> 10	30	25	1 600	< 50	1.3	periodic magnets
F4017D	—	1.7 - 2.7	> 7	30	25	2 000	< 55		periodic magnets
F4088	—	2.0 - 4.0	> 1	30	25	1 500	< 35	1.3	periodic magnets
F4135	—	2.0 - 4.0	> 10	30	25	2 000	< 75	1.3	periodic magnets
F4059A	—	5.9 - 6.5	> 12 □	36	23	3 900	< 55	0.5 + foc. 8.0	periodic magnets
F4181*	—	5.9 - 6.5	> 16 □	37	23	3 900	55	8.0	periodic magnets
F4056B	TPO.410	6.0 - 7.5	> 8	23	25	2 600	< 45	0.5 + foc. 11.0	permanent magnet
F4173*	—	8.2 - 12.4	> 3	35		2 500	20	0.5 + foc. 10.5	permanent magnet
F4185*	—	10.6 - 13.5	> 4	40		2 500	20		periodic magnets

* Types under development.

□ In linear operation.

PULSE OPERATION T.W.T.

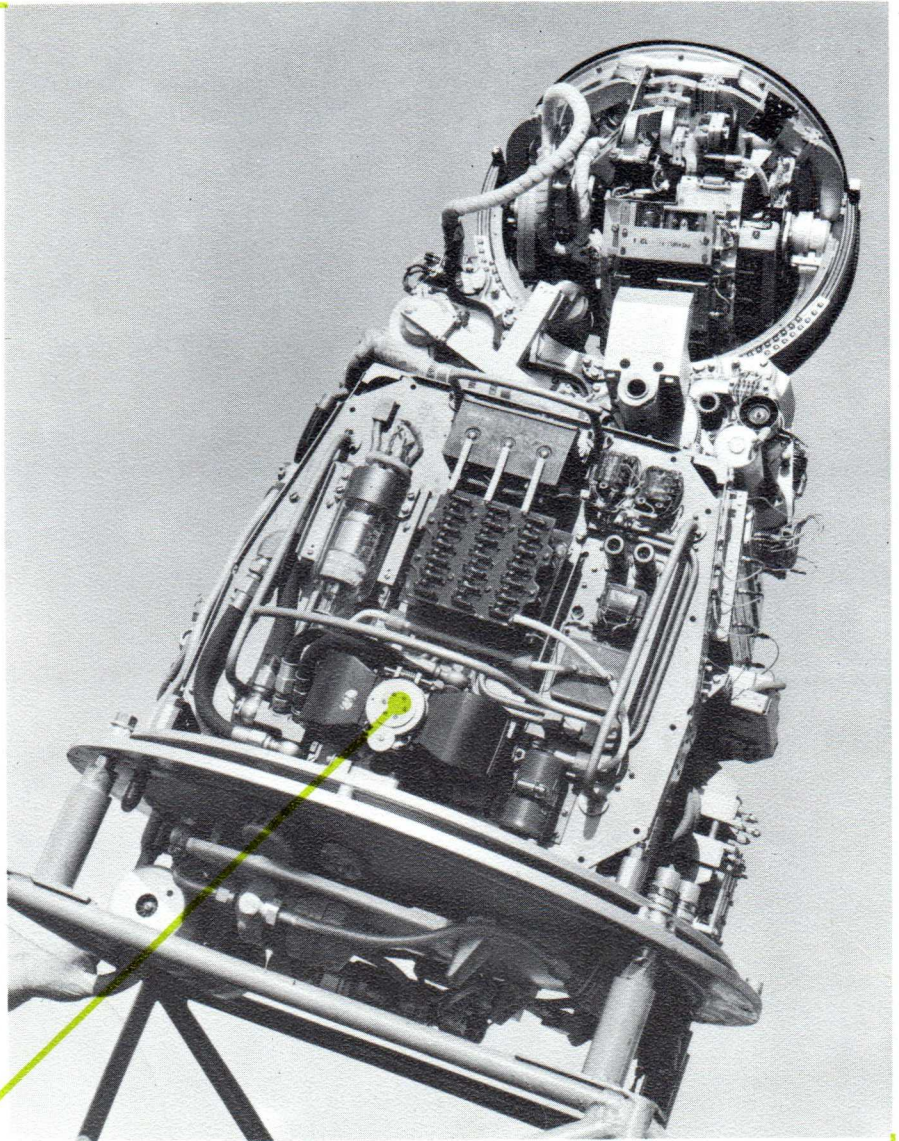
F4061	TPO.025	1.2 - 1.4	7.5	20	—	1 kV pk	100 mA pk	2.6	permanent magnet
F4063	TPO.125	1.2 - 1.4	> 3.5 kW	28	—	12 kV pk	4.5 A pk	5	periodic magnets

TUBES FOR MAINTENANCE

TYPE	" F "	F4017A	F4107C	F4107D	F4069	F4071	F4066	F4056D	F4017B
	" CSF "	—	—	—	TPO.851	TPO.921	TPO.430	—	—
Frequency range	GHz	1.7 - 2.0	2.9 - 3.2	2.9 - 3.5	3.6 - 4.1	3.8 - 4.2	3.8 - 4.2	6.5 - 7.5	1.7 - 2.7

X-band tubes are used in CSF aircraft radars. The 7008 and 7006 international versions were recently developed. More than two thousand MCV 1055 tubes are used in ER 37 S band transmitter-receivers. The MC 567 type is used in CSF air traffic control radars.

Recent developments have been concerned with continuous wave tubes delivering 1 to 5 kW at 2450 MHz, for heating purposes. Matched power supplies and microwave components have also been developed for the realization of domestic or industrial ovens.



F1103 (4J50TR) - Magnetron used in the "CYRANO" radar which equips the "MIRAGE III" airplane.



F1112 - Air-cooled magnetron for industrial heating.

MAGNETRONS

TYPE	Cooling ▲	Frequency range	Heating voltage	Heating current	Anode-cathode capacity	TYPICAL OPERATION				
						Anode peak voltage	Anode peak current	Filling percent	Pulse duration	Rated useful peak power
" F "	" CSF "	MHz	V	A	µF	V	A		µs	kW

X BAND

a) Fixed frequency

4J52A	—	2	9345 - 9405	12.6	2.2	13	15 000	15	0.001	1	75
4J50A		2	9345 - 9405	13.75	3.3	16	21 500	27.5	0.001	0.5	240

b) Tunable frequency

F1002	4J52T	2	8500 - 9600	12.6	2.2	12	15 000	15	0.001	1	70
F1097A	MCV602A	3	8500 - 9600	12.6	2.2	12	15 000	15	0.001	1	70
F1005	4J50TO	1	8500 - 9600	9	2.6	15	22 000	27.5	0.001	1	220
F1103	4J50TR	2	8500 - 9600	9	2.6	15	22 000	27.5	0.001	1	220
F1103A	(# 7008)	2	8500 - 9600	13.75	3.2	15	22 000	27.5	0.001	0.2 to 2.5	220
F1110A	(# 7006)	2	9000 - 9600	13.75	3.2	15	22 000	27.5	0.001	0.2 to 2.5	220

S BAND

a) Fixed frequency

F1030 ▲ F1044 □	MC1055A ▲ MC1055O	2	2897 - 3228	14	5.2	25	31 000	65	0.001	4,4 max.	1 200
--------------------	----------------------	---	-------------	----	-----	----	--------	----	-------	----------	-------

b) Tunable frequency

F1054	MCV1055E	2	2900 - 3015	14	5.2	—	30 000	65	0.001	4	1.1 MW
F1055	MCV1055F	2	2985 - 3115	14	5.2	—	30 000	65	0.001	4	1.1 MW
F1056	MCV1055G	2	3085 - 3200	14	5.2	—	30 000	65	0.001	4	1.1 MW

L BAND

a) Fixed frequency

F1088 ▲ F1096 □	MC567A ▲ J	1	1270 - 1370	20	13	—	40 000	152	0.00125	5	2 500
F1113	—		1200 - 1400	15	15	—	30 000	30	0.002	8	500

b) Tunable frequency

F1105	—	1	1200 - 1400	15	15	—	35 000	60	0.002	10	500
-------	---	---	-------------	----	----	---	--------	----	-------	----	-----

MAGNETRONS FOR INDUSTRIAL PURPOSES-CW

F1115	—	2	2425 - 2475	12	3	—	3 500	0.55	—	—	1.0
F1112	—	1	2425 - 2475	12	3	—	3 500	0.8	—	—	1.5
F1122	—	2	2425 - 2475	12	3	—	3 500	0.8	—	—	1.5
F1117*	—	1	2425 - 2475	15	5	—	4 600	1	—	—	2.5
F1123*	—	1	2425 - 2475	15	5	—	7 000	1.5	—	—	5.0

▲ 1. Water-cooled. - 2. Air cooled - 3. Cooled by inertia.
□ 15 Sub-ranges of 25 MHz * Types under development.

MAGNETRONS-TUBES FOR MAINTENANCE

TYPE	Fixed frequency		Tunable frequency						
	" F "	F1057 to F1077	—	—	F1098	F1099	F1100	F1101	F1118
	" CSF "	MC83 to MC103	MCV101A1	MCV101B1	MCV101C1	MCV101D1	MCV1053C	MCV1053D	MCV1055H
Frequency range (MHz)		2 925 to 3 525	2 900 to 3 000	3 100 to 3 200	3 300 to 3 400	3 500 to 3 600	2 900 to 3 025	3 025 to 3 150	2 975 to 3 025
Peak power (kW)		400	0.12	0.12	0.12	0.12	0.12	0.12	0.12

"O" CARCINOTRON TUBES

TYPE		Frequency range	Mean useful power min.-max.	Anode 1 voltage	Max. anode 2 voltage	Anode 2 current	Modulation sensitivity	Weight with permanent magnet	Remarks
"F"	"CSF"	GHz	mW	V	kV	mA	MHz/V	kg	
F4028E	CO.515E	0.98- 2.1	220-1 100	200	1.5	60	2.7 to 0.5	6	coax. output
F4005C	CO.210C	1.6 - 3.2	240-1 200	200	1.7	60	5.0 to 0.5	4.6	coax. output
F4029D	CO.127D	2.0 - 4.0	120- 750	200	1.7	50	5.0 to 0.6	4.6	coax. output
F4003C	CO.119C	2.4 - 4.7	100- 600	200	1.5	40	7.0 to 0.7	4.6	coax. output
F4187	—	3.0 - 6.0	50- 900	200	1.6	40	6.5 to 0.5	3.5	coax. output
F4006C	CO.94C	3.6 - 7.2	30- 300	200	1.5	40	8.0 to 1.0	3.5	coax. output
F4084	—	4.0 - 8.0	30- 240	200	1.5	35	7.5 to 1.9	3.5	coax. output
F4007C	CO.63C	4.8 - 9.6	20- 280	200	1.7	40	12.0 to 1.2	3.5	coax. output
F4008C	CO.43C	7.0 - 11.0	45- 200	150	1.46	35	7.1 to 2.1	3.5	coax. output
F4053	—	7.0 - 12.4	35- 140	250	1.5	25	13.0 to 1.0	2.5	coax. output
F4032B	CO.521B	8.0 - 16.0	15- 85	200	1.9	20	16.0 to 2.0	2.5	coax. output
F4171A*	—	12.4 - 18.0	25- 60	300	1.5	35	12.0 to 3.0	2.5	waveguide output RG91/U
F4033B	CO.2012B	15.5 - 24.0	35- 115	400	2.4	40	9.5 to 2.5	7.5	waveguide output RG53/U
F4034B	CO.1308B	23.5 - 37.5	22- 110	400	3.1	40	10.7 to 3.7	15	waveguide output RG96/U
F4143	CO.80	39 - 41	10 W - 20 W	2 000	6.0	85	1.5 to 0.7	16	waveguide output RG97/U
F4076	CO.40B	68 - 72	2 W - 10 W	1 800	6.0	70	2.0 to 1.2	16	waveguide output RG98/U
F4150	CO.40A	73 - 77	2 W - 10 W	1 800	6.0	70	2.0 to 1.2	16	waveguide output RG99/U
F4075	CO.20B	130 -142	100-1 000	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4146	CO.20A	140 -158	100-1 000	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4158*	CO.20-5	Δf 2 GHz** from 130 to 155	1 W - 5 W	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4074	CO.10	290 -320	5- 50	1 600	6.0	50	20.0 to 8.0	16	waveguide output RG138/U

* Types under development.

** Electronic tuning band over which the minimum power output can be provided, the mid-band frequency being adjusted at any value included between the 2 mentioned limits.



F4007C



F4171

"O" CARCINOTRON TUBES-TUBES FOR MAINTENANCE

TYPE	"F"	F4028A	F4028H	F4005A	4003A	F4007A	F4008B
	"CSF"	CO.515A	CO.515H	CO.210A	CO.119A	CO.63A	CO.43A
Frequency range	GHz	0.98-2.1	1.215-1.385	1.6-3.2	2.4-4.7	4.8-9.6	7.0-11.0

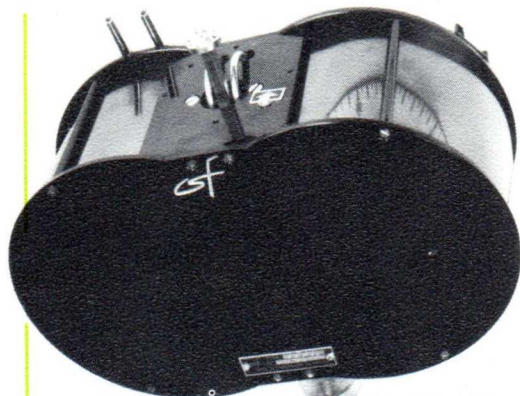
These electronically tuned, wide-band oscillators, invented in 1951, have established the prestige of CSF tubes.

They form three families :

- "M" Type power carcinotrons, developed for jamming equipments.
- "O" Type, low power, very wide band carcinotrons, used in test generators or military detection equipment, from 1000 to 37,500 MHz (30 to 0.8 cm).
- "O" Type millimetric carcinotrons, developed at Corbeville; these power sources cover continuously the 8 mm to 0.3 mm range. In addition to the spectacular aspect of world records attained (870 GHz), applications to physical instrumentation (plasmas in particular) have been found. Many CSF millimetric carcinotrons are in operation throughout the world.

A large number of "M" type carcinotrons for airborne application have been developed at Levallois. Recent studies have shown the interest for various applications of a driven version, the "carpitron", which combines the possibility of frequency versatility with high frequency stability.

The new centimetric carcinotron series features a high purity of the signal and a small size. Tubes F 4028 E - F 4029 D - F 4084 - F 4032 - 4033 and 4034 cover continuously the 1 to 37.5 GHz spectrum.

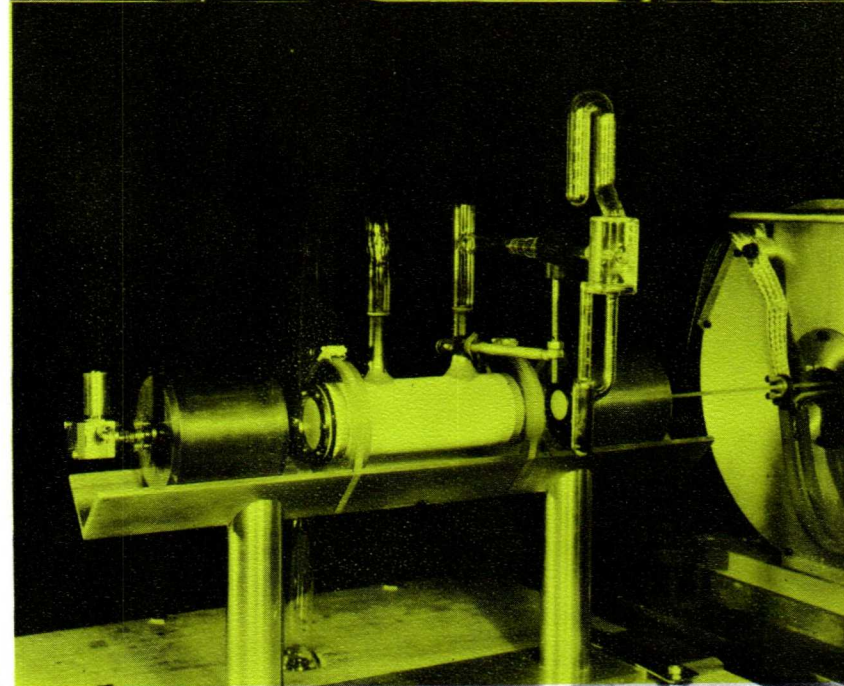


F4146 (CO.20A)

① "O carcinotron" assembly shop.

② Measurement of absorption line of the ammonia molecule by means of an "O" type carcinotron at 0,5 millimetre wavelength.

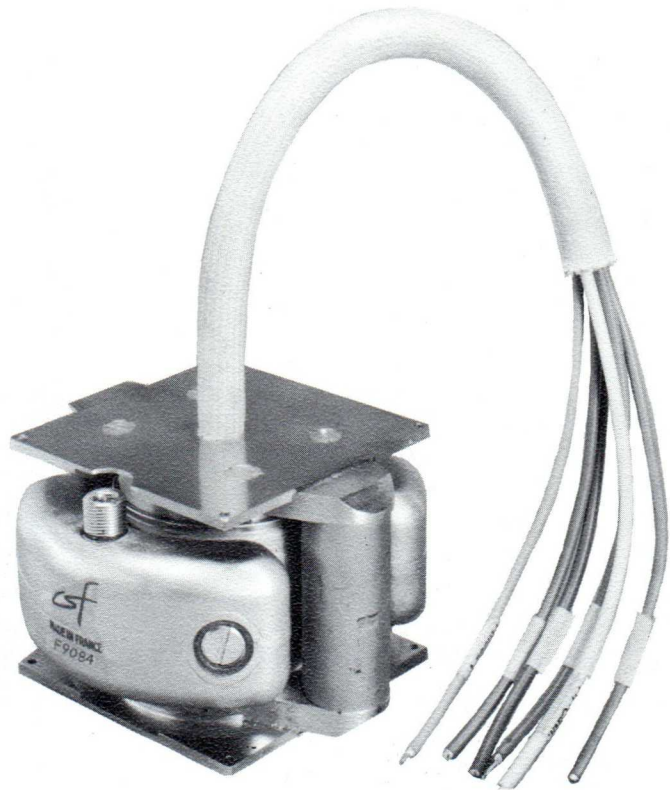
③ Carcinotron testing bench.



CROSSED FIELD NOISE GENERATORS

Noise generators are crossed-field power tubes. They have been the subject of many important recent developments. At levels of 10 watts to 1 kW, these small size tubes produce, without modulation, noise over a wide frequency band and may be tuned electronically. Other types of tubes developed in the CSF laboratories have higher performances than shown here, relating to available tubes.

TYPE	Frequency	Power	Max. voltage	Current
	MHz	W	V	A
F9076	200 - 400	40	1 500	0.2
F9084	450 - 750	100	2 200	0.35
F9091	1 250 - 1 350	60	1 700	0.4
F9099	2 700 - 3 300	400	5 000	0.8



F9084 noise generator.

NOISE SOURCE FOR TEST EQUIPMENT

TYPE		
" F "	" CSF "	
F9015	BG52-9	For noise measurement within 10 cm range
F9014	BG22-9	" " " " 9 cm "
F9016	BG65-9	" " " " 9 cm "
F9013	BG22-3	" " " " 3 cm "
F9093	-	" " " " 3 mm "

Low-power BG sources are test equipments for measuring the noise figure of receivers.

DUPLEXER TUBES

DUPLEXER TUBES FOR C AND S BAND RADARS

TYPE		Spécification	Frequency range	Max. useful power		Max. ins. loss	Max. deioniz. time attenuation 3 dB
" F "	" CSF "		GHz	MW pk	kW mean	dB	µS
F3024	AR434C	Spark gap	1.2-1.4	0.06	0.06	0.3	75
F3025	AR434E	Spark gap	1.2-1.4	0.06	0.06	0.3	75
F3027	AP433	Pre-TR window	1.2-1.4	3	3	0.6	50
F3023	AP623	Pre-TR window	1.2-1.4	8	6	0.6	75
F3004	AR414	Wide-band TR	2.9-3.23	0.03	0.03	0.9	40
F3003	AP413	Double Pre-TR	2.9-3.23	1.2	1.2	0.4	90



F3004 (AR.414)

TUBES FOR MAINTENANCE

TYPE		Spécification	Frequency range	Max. useful power
" F "	" CSF "		GHz	kW pk
F3031	ARL 133	Wide-band TR	1.20 - 1.4	500
F3026	AR2L 127	Double TR	2.90 - 3.26	1 100
F3022	AP427	Pre-TR	2.90 - 3.26	4 500
F3010	AR227	Tunable TR	2.91 - 3.55	500
F3009	AE227.5	A-TR	2.91 - 3.06	500
F3008	AE227.4		3.06 - 3.20	500
F3007	AE227.3		3.12 - 3.23	500
F3006	AE227.2		3.20 - 3.36	500
F3005	AE227.1		3.36 - 3.55	500



F3003 (AP.413)

NEON TUBES

Power indicators designed for instantaneous measurement of the peak power in a waveguide.

TYPE		
" F "	" CSF "	
F9017	IN10	400 to 1 600 kW - S Band
F9018	IN524	5 to 20 kW - X Band
F9019	IN663	2.5 MW - L Band



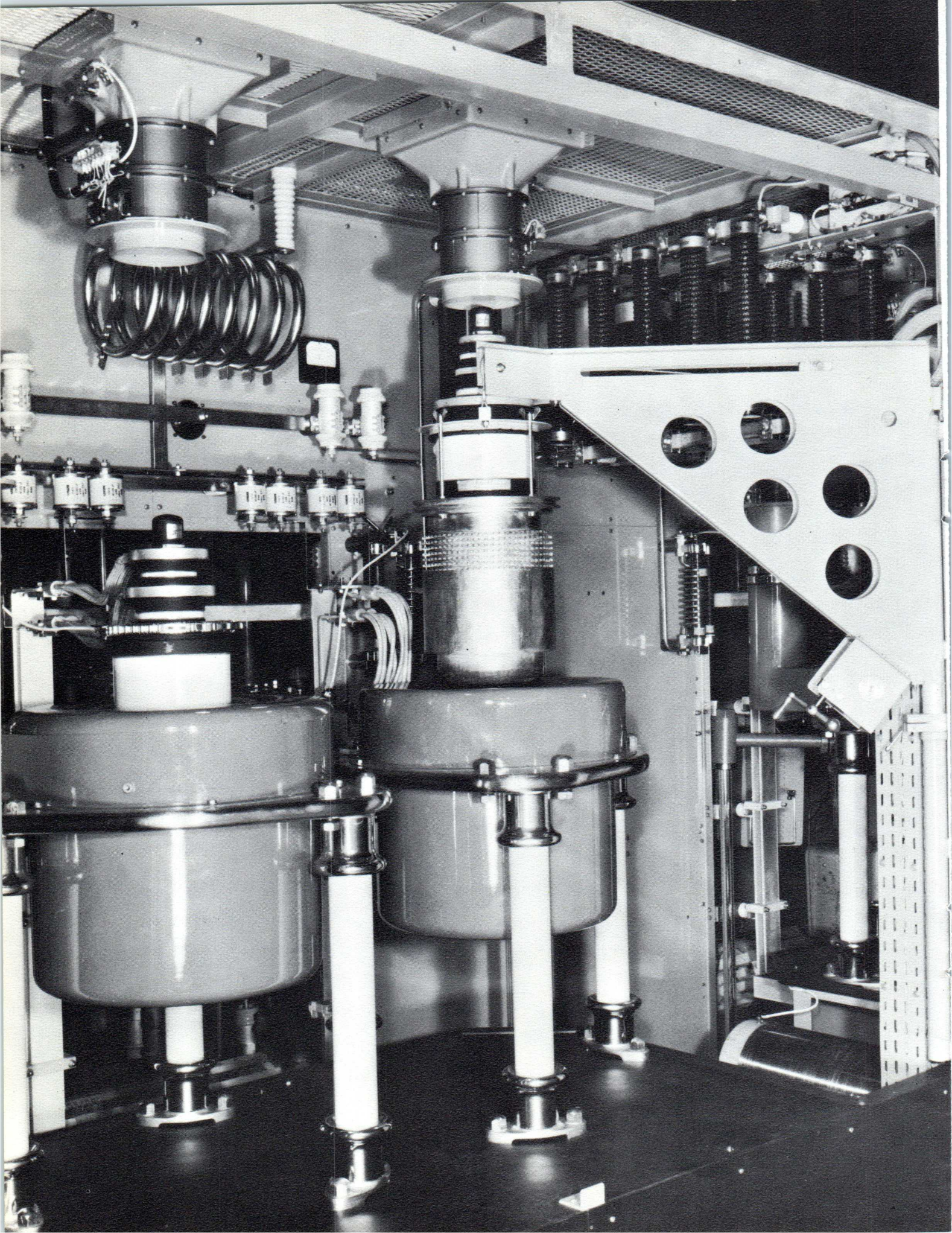
F3017 spark-gap.

SPARK-GAPS

To be used for passive protection of wide-band crystal detectors in radar equipments.

Type	Frequency range	Power supply				Max incident peak power	Total leakage power	Deioniz. time at 3 dB	Max. ins. loss
		Voltage	Current	Resistance transmitter side	Resistance receiver side				
	GHz	kV	mA	MΩ	MΩ	W	W	µs	dB
F3018 *F3028	2 - 4.6	-1.5	0.3	20	8.7	15	1	155	2.44
F3016 *F3029	4 - 7.3	-1.5	0.3	20	9.2	15	0.3	85	1
F3017 *F3030	6.7-10.7	-1.5	0.3	20	6	15	0.2	85	1.2

* RF connectors : type N.



TRANSMITTING TUBES

The first CSF productions in this domain date back to the time of the earliest telegraphy or radio transmitter. The G.T.E., with such antecedents, has followed up important efforts to develop power tubes for transmitters such as tubes operating in Radio Monte-Carlo or Radio-Luxembourg.

Alongside, its production and their applications have been diversified; thus, homogeneous series of high frequency tubes for industrial applications were realized, and hard tubes for high power radar or lineac modulators were developed.



TRIODES

TYPE		HEATER		Maximum ratings				Mean values		COOLING			
"F"	"CSF"	V _f V	I _f A	Fréq. MHz	V _a kV	I _k A	P _a kW	s mA/V	k	Natural	forced air	Water	Vapor

TÉLÉCOMMUNICATIONS

F6005	E1300	7.5	39	60	5	1.2	1.5	12	18	●			
F6052	E1566R	7.5	95	30	10	3.2	6	33	44		●		
F6043	ETR533	11	275	30	15	10	25	44	42		●		
F6051*	E1966R	11	275	30	15	10	25	44	42		●		
F6047	ETV561	12	480	30	18	30	150	135	50				●

* Vapor cooling is available for this tube. In that case, anode dissipation P_a = 100 kW.

HARD TUBES

F6086	—	8	320	—	25	100	20	43	26			●	Δ
F6046	—	12	480	—	40	300	150	135	50			●	Δ

Δ This tube can be oil-cooled.

VOLTAGE REGULATION

6080WA*	—	6.3	2.5	—	0.25	0.15	0.013	7	2	●			
6336A*	—	6.3	5.0	—	0.4	0.2	0.03	13	2.7	●			
F6025	—	10	10	—	4	0.6	0.5	> 7.5	11.5	●			
F6075	—	7.5	39	—	5	1.2	1.5	12	21	●			
F6073	—	7.5	100	—	3	3.2	5				●		

* Double triode, values per section.

TETRODES

TYPE		HEATER		Maximum ratings				Mean values		COOLING				
"F"	"CSF"	V _f V	I _f A	Fréq. MHz	V _a kV	V _{g2} V	I _a mA	P _a W	s mA/V	k'	Natural	forced air	Water	Vapor

TELECOMMUNICATIONS

F6078	—	12	320	30	15	2 000	2 000	30 000	55	3.3		●		
F6080	—	12	320	30	15	2 000	2 000	100 000	55	3.3				●
F6053	EG1566R	7.5	100	100	8	1 000	3 000	5 000	20	4		●		
F6054	EGR664	7.5	105	100	8	1 000	3 500	5 000	20	4		●		
F6065	EGV1566	7.5	100	100	8	1 000	3 000	10 000	20	4				●
5933S	—	6.3	0.9	125	0.6	300	120	25	5.5	7.5	●			
829B	—	6.3 12.6	2.25 1.125	200	0.75	225	240	40	7	11	●			
F6022	P2.40B	6.3 12.6	2.25 1.125	200	0.75	225	240	40	7	11	●			
8501	—	4.5	125	900	7	1 500	4 000	10 000		16		●		
7650	—	6.3	7	1 200	3	1 200	600	600	25	13		●		

PENTODES

F6010	P.1300	10	20	30	4	950	1 000	1 000	15	6.5	●			
F6003	P.600A	10	10	60	3	800	600	400	6.5	6.5	●			



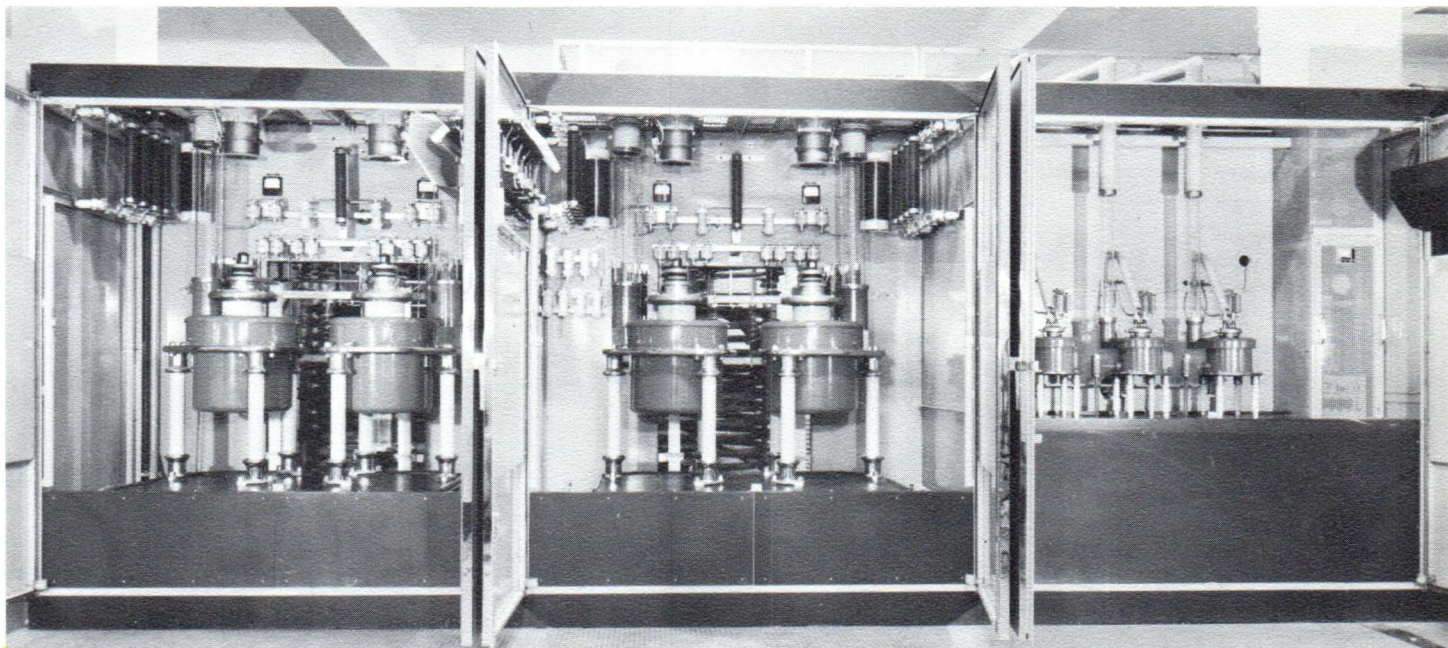
F6047



F6080



8501



Power stages of the 600 kW Radio-Luxembourg transmitter, fitted out with CSF F6047 (ETV.561) and F6065 (EGV.1566).

TUBES FOR MAINTENANCE

TRIODES

TYPE		Characteristics		
" F "	" CSF "	P _a kW	V _f V	V _a kV

TELECOMMUNICATIONS

F 6012	TAM10	0.012	12.6	0.2
F 6058	E600	0.375	7.5	2.5
F 6059	E1200	0.5	12	3.5
F 6006	E1556R	6.0	17.5	5.5
F 6055	GT20SD	12	20.4	17
F 6056	GT30ST	12	18.2	17
F 6030	E1801	16	30	12
F 6048	ETO578	16	8.5	15
F 6050	E1871R	17.5	7	12
F 6035	E1986R	25	11	15
F 6034	E1986	50	11	17
F 6037	E2006B	50	30	18
F 6040	E3056B	180	35	20
F 6041	E3056T	180	17	16

VOLTAGE REGULATION

6080S	-	0.013	6.3	0.25
-------	---	-------	-----	------

PENTODES

F 6015	P.40		6.3	
F 6060	P.200A	0.150	10	2.2
F 6070	P2.200A	0.300	10	4.4
F 6061	P.1200A	0.6	12.6	3.5
F 6062	P.1200M	0.7	12.6	3.5
F 6049	P.1806	20	22	18

In this chapter are many high-power tubes, covering from a few tens of watts to several hundred kilowatts.

According to their type they are used in many fields :

- broadcasting, television, telecommunication, modulators, etc...

They are used more particularly as ;

- high-frequency amplifiers (with or without grid current)
- audio-frequency amplifiers
- pulse modulators
- voltage regulators.

Among the latest, some tubes are more particularly designed :

- for television transmitters :

Ceramic envelope tubes 7650 (useful power 600 W at 1000 Mc/s) and 8051 (useful power 5 kW at 1000 Mc/s)

- for ISB telecommunication transmitters :

Tubes F 6053/EG 1566 R (useful power 5 kW)
 F 6051/E 1966 R (useful power 40 kW)
 and F 6080 (useful power 60 kW).

- for power output stages, RF and AF, of broadcasting or telecommunication transmitters, tubes of ceramic construction.

F 6080 (useful power 100 kW)
 and F 6047/ETV 561 (useful power 200 kW)

(The F6047 tube is used in the most recent 600 kW transmitters of Radio-Luxembourg and the 1200 kW transmitters of Monte-Carlo).

- for modulators in linear accelerators :

Tube F 6046 (12 MW peak - 150 kW mean)
 (The F 6084 tube is designed for 25 MW peak, 300 kW mean).

CERAMIC THYRATRONS

Developed under the sponsorship of the STTA (French Air Force) and suitable for use under difficult environmental conditions, these tubes are used increasingly in high-power radars and airborne radars.

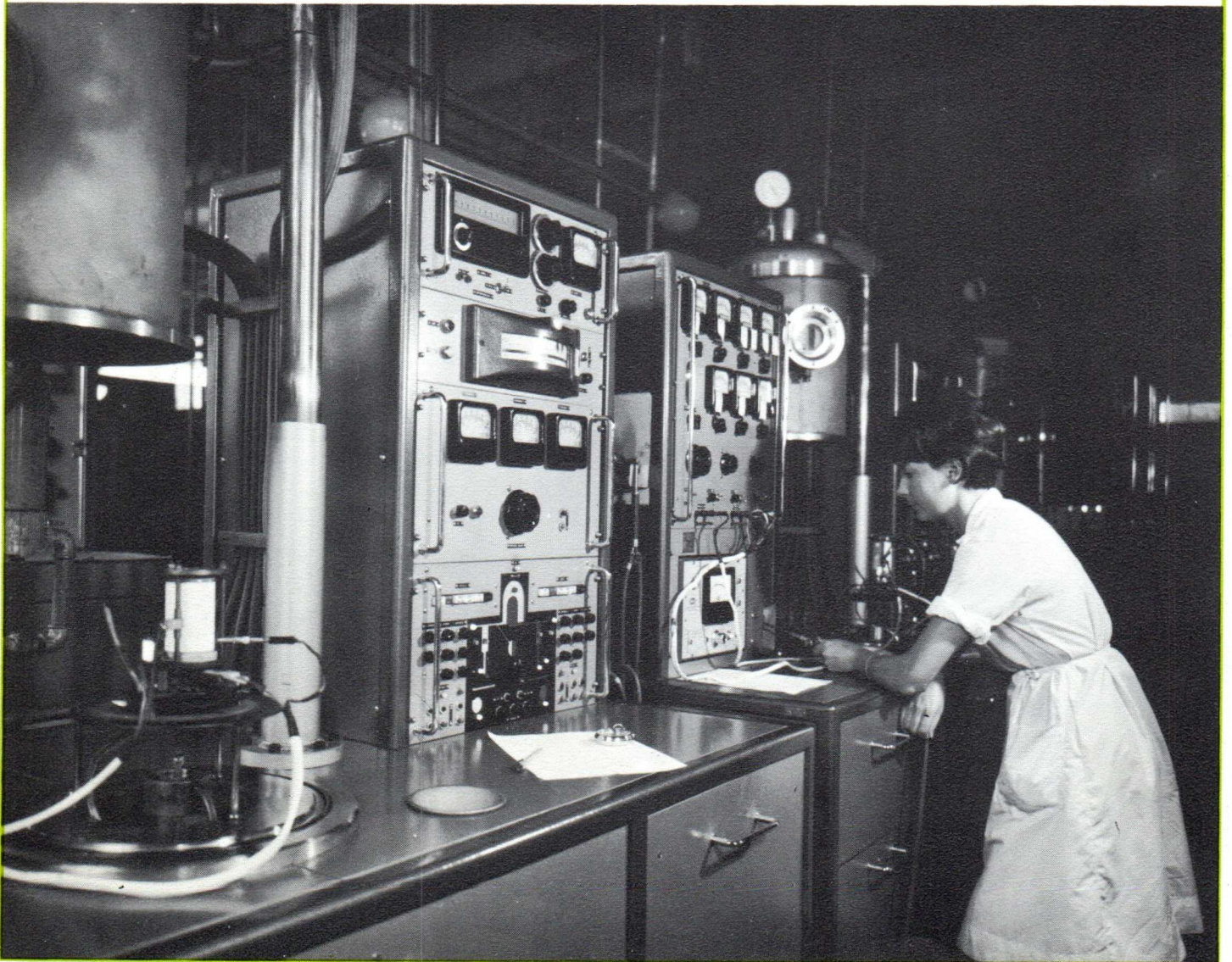


F5008B

V-810
F10-

TYPE	Limit operating conditions				
	pk V_a (kV)	inv. pk V_a (kV)	pk I_a (A)	mean I_a (mA)	min. pk V_g (V)
F5008A	16	16	150	450	200
F5008B	16	15	350	500	200
F5023	8	8	90	100	175
F5024	20	20	500	500	200

Ceramic thyratrons bench.



DIODES AND RECTIFIERS

TYPE		Filling	Limit amb. temp.	Max. inv. volt.		Max. peak current		Max. mean rect. cur.		Heating	
"F"	"CSF"			a	b	a	b	a	b	Vf	If
				°C	kV	kV	A	A	A	A	V

a) Hot cathode

F5004	V30*	vacuum	—	15	30	0.3	5	0.05	0.018	6.3	1.1
F5005	V35B*	vacuum	—	17	40	0.5	10	0.1	0.015	6.3	2
F5011 F5011A	VH8600 VH8600A	merc.	25to55	20 18		10		5	—	5	18
F5020	—	vacuum	—	25	25	10		2	—	7.5	58
8020*	—	vacuum	—	40	40	0.75	2.5	0.1	—	5	6

b) Cold cathode

F5019	AR64	merc.	5-45	16	—	33.6	—	5.6	—	liquid cathode	
-------	------	-------	------	----	---	------	---	-----	---	----------------	--

a = rectifier operation (with 0,1 μF filter input capacitance for tubes marked*).

b = pulse operation.



F5011A (VH.8600A)

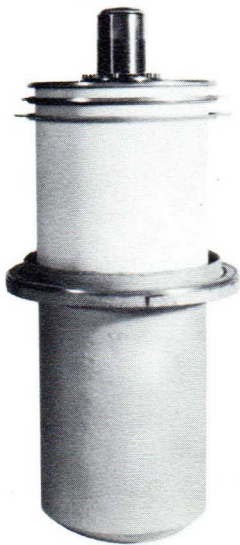
INDUSTRIAL APPLICATIONS

A complete series of tubes for industrial high-frequency applications have been developed; it covers a power range from 5 to 100 kW.

For the realisation of high frequency generators, up to 100 MHz, two tubes are especially suitable :

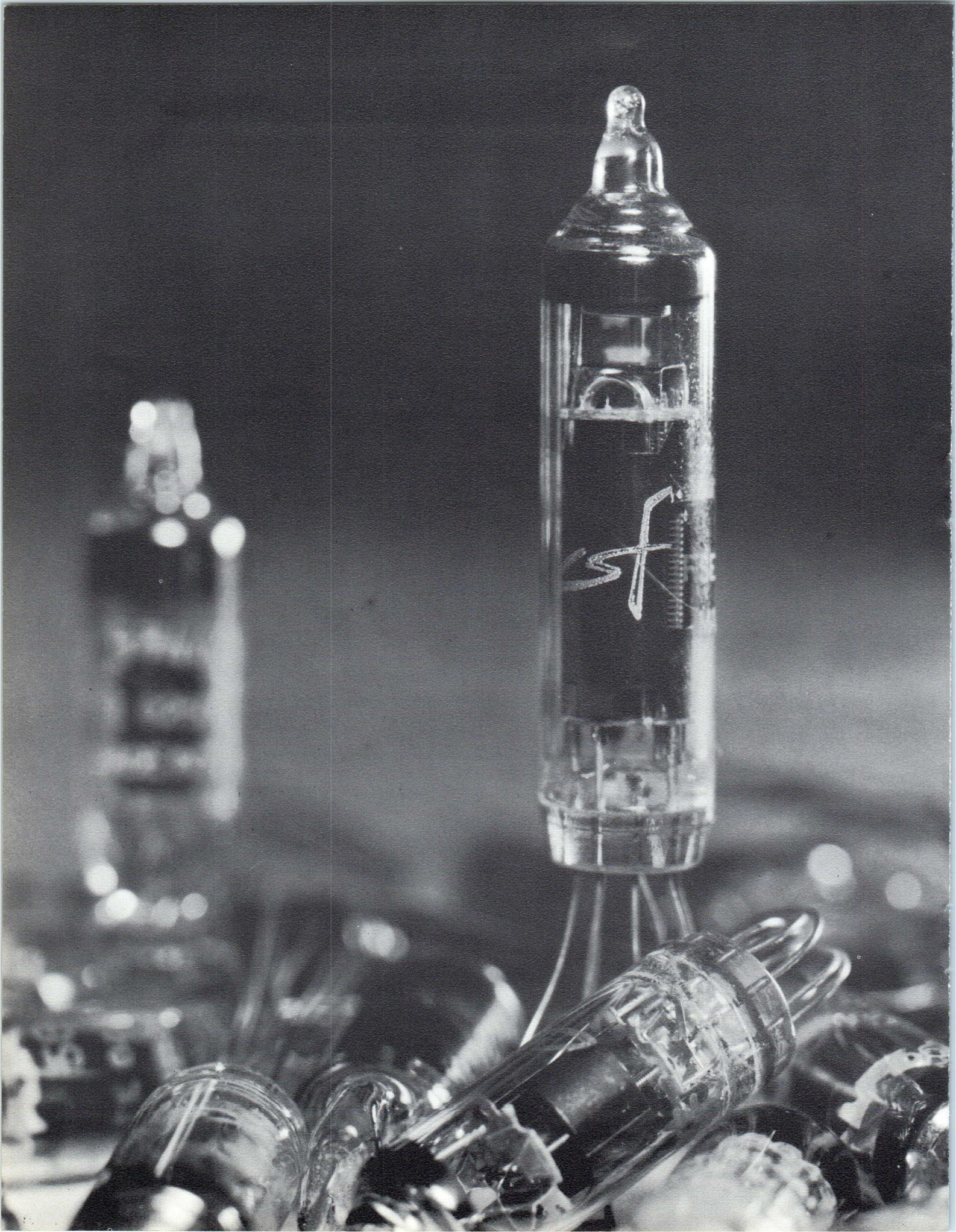
HFI 1016, ceramic envelope, 50 kW

HFI 1017, ceramic envelope, 100 kW



HFI.1017

TYPE	Purposes	Useful power	COOLING			
			Natural	Forced air	Water	Vapor
HFI.486	For HF generators.....	1 kW	•			
HFI.487	For HF generators.....	5 kW	•			
HFI.862	For HF generators.....	12 kW			•	
HFI.490	For HF generators.....	15 kW		•		
HFI.589	For HF generators.....	25 kW			•	
HFI.867	Low-frequency amplifiers for vibrating machine	25 kW			•	
HFI.863	For HF generators.....	40 kW			•	
HFI.1016	Ceramic envelope and coaxial output For 50 MHz generators.....	50 kW			•	
HFI.491	For HF generators.....	60 kW			•	
HFI.1017	Ceramic envelope and coaxial output For 50 MHz generators.....	100 kW			•	
HFI.1018	Ceramic envelope and coaxial output For HF generators.....	200 kW				•



RECEIVING TUBES AND MISCELLANEOUS

"Miniatron" and "Subnitron", are series of tubes used to solve problems of voltage and current amplification, as well as rectification and stabilisation problems which may arise for receivers and auxiliary circuits design, broadcasting and telecommunication transmitters, radars and practically all electronic equipments.



"MINIATRON"

TYPE	SPECIFICATION	HEATER		CHARACTERIS. absol. limit. values			TYPICAL OPERATION							Max. dimens.	
		V	A	V _a V	P _a W	P _{g2} W	V _a V	V _{g2} V	I _a mA	I _{g2} mA	R _k Ω	s mA/V	P kΩ	Max. length mm	Dia. mm

DIODES

1Z2	Half-wave rectifier	1.25	0.265	Anode maxim. inv. peak voltage 15,000 V									68.6	19.0
				Anode minimum resistance 300 kΩ										
				Anode max. peak current 8.5 mA										
				Max. mean rectif. cur. 1.5 mA										
5726(6AL5W)	RF twin-diode	6.3	0.3	Anode maxim. inv. peak voltage 360 V									45.3	19.0
				Anode minimum resistance 11 kΩ										
				Max. peak current per anode 60 mA										
				Max. rectified current per anode 9 mA										

TRIODES

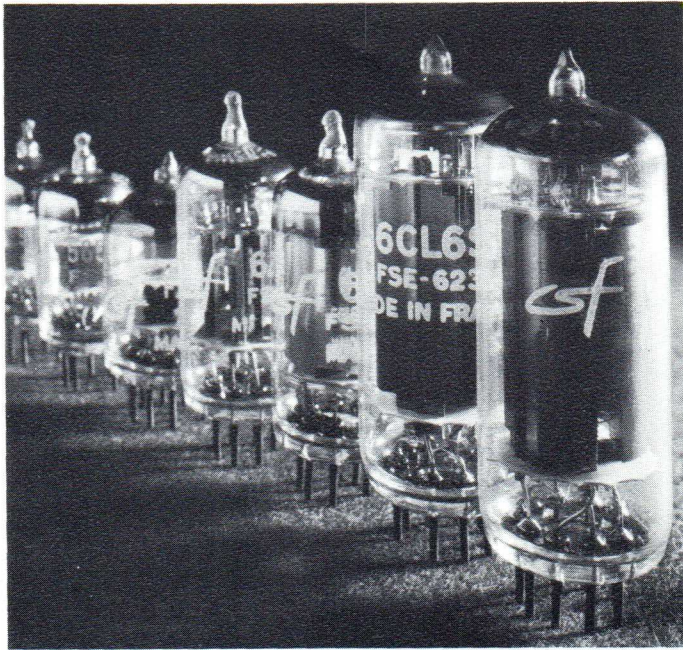
6J4S	UHF triode, grounded grid operation	6.3	0.4	165	2.2	—	100 150	—	10 15	—	100 100	11 12	5 4.5	54.8	19.0
6J4WA	UHF triode, grounded grid operation	6.3	0.4	150	2.25	—	150	—	13.5	—	100	11	5	54.8	19.0
6J6WA	Twin-triode	6.3	0.45	300	1.1	—	100	—	9	—	50	6	6.3	54.8	19.0
5687WA	Twin-triode	12.6 6.3	0.45 0.9	300	4.2	—	250	—	12.5	—	1 000	5.5	3	56.3	22.2
F7004(5842)	Low-noise triode	6.3	0.3	180	4.5	—	150	—	22	—	60	25	2	45.0	22.2
12AT7WA	Twin-triode	6.3 12.6	0.3 0.15	330	2.8	—	250	—	10	—	200	5.5	10.9	56.3	22.2
12AX7S	Twin-triode	6.3 12.6	0.3 0.15	300	1.0	—	250	—	1.25	—	—	1.6	6	56.3	22.2
6189(12AU7WA)	Twin-triode	6.3 12.6	0.3 0.15	300	2.7	—	250	—	10.5	—	1 000	2.2	7.7	56.3	22.2

TETRODES AND PENTODES

6AH6WA	Sharp cut-off RF pentode	6.3	0.45	330	3.2	0.45	300	150	10	2.5	160	9	500	54.8	19.0
6AM6S(6064)	Sharp cut-off RF pentode	6.3	0.3	550	3.0	0.9	250	250	9.8	2.6	160	7.6	1 000	54.8	19.0
6AN5WA	Video power pentode	6.3	0.45	135	4.6	1.5	120	120	34	11	125	8.5	—	54.8	19.0
6AU6WA	Sharp cut-off RF pentode	6.3	0.3	330	3.3	0.7	250	150	10.6	4.3	68	5.2	1 000	54.8	19.0
6AU6WB	Sharp cut-off RF pentode	6.3	0.3	330	3.3	0.7	250	150	10.6	4.3	68	5.2	1 000	54.8	19.0
6CL6S	Video power pentode	6.3	0.65	330	8.2	1.9	250	150	30	7	V _{g1} = -3V	11	150	67.5	22.2
6CQ6S	Remote cut-off RF pentode	6.3	0.2	300	3.0	0.7	200	200	8	2.1	240	2.5	400	54.8	19.0
5654(6AK5W)	Sharp cut-off RF pentode	6.3	0.175	200	1.65	0.55	120 180	120 120	7.5 7.7	2.5 2.4	180 180	5 5.1	300 500	45.3	19.0
5656	Power twin-tetrode	6.3	0.4	250	3.5	1.8	220	120	45	—	—	6	W _u = 4.5W	54.8	22.2
5686	Beam tetrode RF ampl. frequency multiplier	6.3	0.35	275	8.25	3.3	250	250	27	3.1	V _{g1} = -12.5V	3.1	45	56.3	22.2
5725(6AS6W)	Twin control grid RF pentode	6.3	0.175	200	1.65	0.55	120 120	120 120	5.2 3.6	3.5 4.8	V _{g1} V _{g3} -2 0 -3	S _{g1} = 3.2 S _{g1} = 1.8	S _{g3} = 0.5 S _{g3} = 0.8	45.3	19.0
5749(6BA6W)	Variable-μ RF pentode	6.3	0.3	330	3.3	0.7	100 250	100 100	10.8 11	4.4 4.2	68 68	4.3 4.4	250 1,000	54.8	19.0
6005(6AQ5W)	AF power beam tetrode	6.3	0.45	275	11	2.2	180 250	180 250	29 45	3 4.5	V _{g1} = 8.5 V _{g1} = 12.5	3.7 4.1	W _u 2W W _o 4.5W	67.5	19.0

VOLTAGE STABILISERS

OA2WA	Voltage stabiliser	Cold cathode	Min. supply voltage 185 V									67.5	19.0
			Operating voltage approx. 150 V										
			Regulation between 5 and 30 mA approx. 4 V										
			Cont. duty. current min. 5 mA max. 30 mA										
OB2WA	Voltage stabiliser	Cold cathode	Min. supply voltage 130 V									67.5	19.0
			Operating voltage approx. 108 V										
			Regulation between 5 and 30 mA approx. 3 V										
			Cont. duty. current min. 5 mA max. 30 mA										



These tubes are intended exclusively for use in professional equipment; they are tubes of very high reliability, their construction being subjected to controls at every stage; they meet the requirements of French Military Standards, as well as American or British Specifications.

"SUBNITRON"

"Miniatron" tubes.

TYPE	SPECIFICATION	CHARACTERI.		TYPICAL OPERATION										Max. dimens.	
		V _f V	I _f A	V _a V	P _a W	P _{g2} W	V _a V	V _{g2} V	I _a mA	I _{g2} mA or k	R _k Ω	S mA/V	ρ kΩ	length mm	Dia. mm

DIODE

5896	RF twin diode	6.3	0.3	Anode max. inverse peak voltage 460 V Max. peak current per anode 60 mA Max. rectified current per anode 10 mA										34.9	10.1
------	---------------	-----	-----	--	--	--	--	--	--	--	--	--	--	------	------

TRIODES

5703WB	UHF triode	6.3	0.2	200	1.35	—	120	—	9.4	k=25,5	220	5	5.1	38.1	10.1
5718	UHF triode	6.3	0.15	165	0.9	—	100	—	8.5	k=27	150	5.8	4.6	34.9	10.1
5719	AF triode	6.3	0.15	165	0.55	—	100	—	0.73	k=70	1.500	1.7	41	34.9	10.1
6021*	RF twin triode	6.3	0.3	165	1.1	—	100	—	6.5	k=35	150	5.4	6.5	34.9	10.1
6111*	RF twin triode	6.3	0.3	165	1.1	—	100	—	8.5	k=20	220	5	4	34.9	10.1
6533	Antimicrophonic AF triode	6.3	0.2	150	0.5	—	120	—	0.92	k=54	1.500	1.75	30	34.9	10.1

TETRODE AND PENTODES

5636	Twin-grid RF pentode mixer	6.3	0.15	165	1.1	0.7	100	100	5.6	4	150	3.2	110	34.9	10.1
5639	Video pentode	6.3	0.45	165	3.5	1	150	100	20	4	100	9.0	50	44.4	10.1
5840	Sharp cut-off RF pentode	6.3	0.15	165	0.9	0.35	100	100	7.5	2.4	150	5.0	260	34.9	10.1
5899	RF variable-mu pentode	6.3	0.15	165	1.1	0.35	100	100	7.2	2	120	4.5	260	34.9	10.1
5902	AF beam power tetrode	6.3	0.45	165	3.7	0.4	110	110	30	2.2	270	4.2	15	44.4	10.1

VOLTAGE STABILISER

5783WA	Voltage stabiliser		Cold cathode	Max. break down voltage 120 V Minimum current 1.5 mA Maximum current 3.5 mA Operating voltage 86 V approx. Input voltage 140 V min. Regulation between 1.5 and 3.5 mA 3 V approx.										38.1	10.1
--------	--------------------	--	--------------	--	--	--	--	--	--	--	--	--	--	------	------

THYRATRON

5643	Gas-filled tetrode thyatron	6.3	0.15	Anode max. peak voltage 500 V Anode max. inver. voltage 500 V Limit temperature 55 to 125° C Mean cathode current 16 mA max Maximum cathode peak current 100 mA										34.9	10.1
------	-----------------------------	-----	------	---	--	--	--	--	--	--	--	--	--	------	------

* Ratings per section. Length of leads : 38 mm min.

REPEATER TUBES

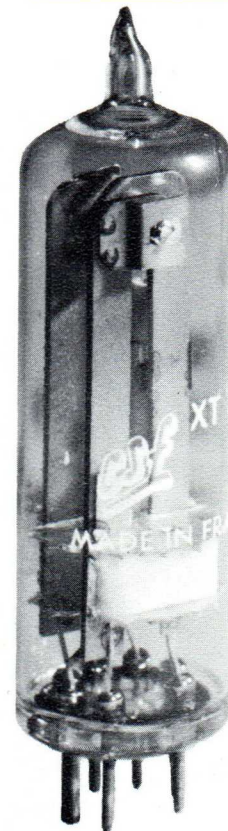
TYPE	SPECIFICATION	Heater		CHARACTERIS. Absolute max. values			TYPICAL OPERATION							Max. dim		CHARACTERISTIC FEATURES			
		V	A	V _a V	P _a W	P _{g2} W	V _a V	V _{g2} V	I _a mA	I _{g2} mA or k	R _k Ω	S mA/V	ρ kΩ	V _g	length mm	Dia. mm	Noise resist. at 1 Mc Ω	mA/V/pF	Life h
TRIODE																			
PTT.141	Low-noise triode	6.3	0.3	180	4.5	—	150	—	23	—	60	25	2	-1.4	45	22.2	150	—	8 000
TETRODE AND PENTODES																			
PTT.208P	Power amplifier pentode	18	0.140	225	3.6	0.7	200	200	18	3.6	200	6	140	-4.3	65	26.5	—	—	20 000
PTT.212P	Voltage amplifier pentode	18	0.11	225	2.4	0.6	200	200	10.5	2	125	8.5	500	-1.6	60	26.5	675	0.76	16 000
PTT.213P	Voltage amplifier pentode	6.3	0.31	225	2.4	0.6	200	200	10.5	2	125	8.5	500	-1.6	60	26.5	675	0.76	16 000
PTT.216	Noval pentode for IF wide-band amplifier	6.3	0.3	180	2.25	0.75	150	150	12.3	3.7	110	13.5	200	-1.75	45	22.2	185	1.2	16 000
PTT.244P	Wide-band amplifier tetrode	18	0.14	180	5.2	1.3	150	150	24	5	45	27	30	-1.5	60	26.5	300	1.7	8 000

THERMAL RELAYS

Single-Pole switches		Heater		Delay time			Characteristics
		Voltage	Current	Opening of contact 1	Closing of contact 2	Return to contact 1	
TYPE							
Officielle	"CSF"	V	A	s	s	s	
F9029A	XT20A	6.3	0.33	10	20	80	Contact rating : DC 115 V; 0.5 A. AC 250 V; 1 A Max. contact resist. : 0.05 Ω P in test voltage : 1 000 V rms across contacts Inter-pin insulation : 100 MΩ Max. dimens. : dia. 19 mm - h. 67 mm
F9030A	XT30A	6.3	0.33	13	30	85	
F9031A	XT45A	6.3	0.33	20	45	120	
F9032A	XT60A	6.3	0.33	25	60	130	
F9033A	XT75A	6.3	0.33	33	75	180	
F9034A	XT90A	6.3	0.33	38	90	190	
F9036A	YT15A	26.5	0.075	7	15	70	
F9037A	YT20A	26.5	0.075	10	20	80	
F9038A	YT30A	26.5	0.075	13	30	85	
F9039A	YT45A	26.5	0.075	20	45	120	
F9040A	YT60A	26.5	0.075	25	60	130	
F9041A	YT75A	26.5	0.075	33	75	180	
F9042A	YT90A	26.5	0.075	33	90	190	

TUBES FOR MAINTENANCE

TYPE	SPECIFICATION
PTT.241P	Power amplifier tetrode
PTT.243P	Wide-band amplifier tetrode

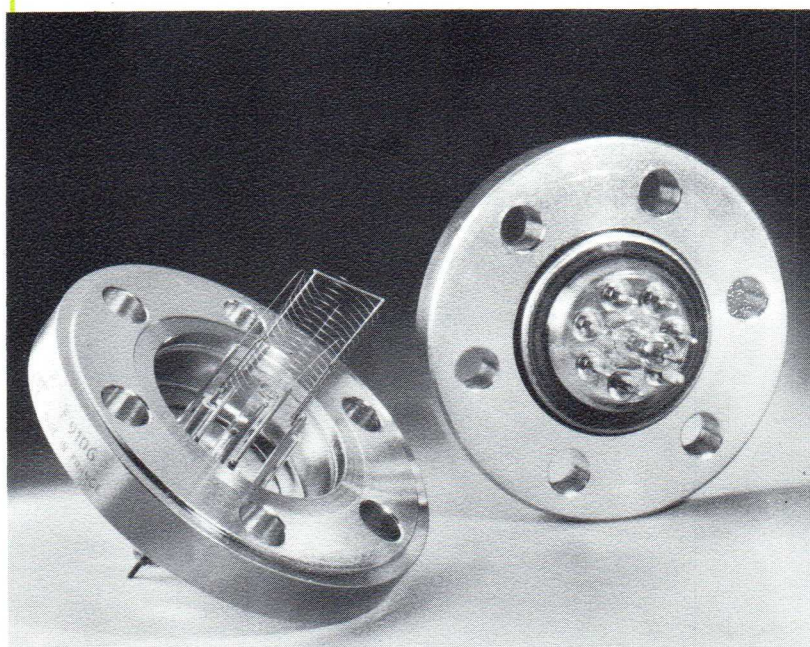


F9030A
(XT.30A)

GAUGES

TYPE		VACUUM GAUGES					
		Heater Voltage	Heater Current	Collector voltage	Grid voltage	Grid current	Limit vacuum
"F"	"CSF"	V	A	V	V	mA	mm of Hg
F9028	BA10	7	4	- 50	+150	10	10 ⁻¹⁰
F9012	-	electrically identical with the F9028 but with metal connecting flange, 100 mm DIA					
F9106	-	electrically identical with the F9028 but with metal connecting flange, 105 mm DIA					
F9130	-	Identical with the F9106 but with centring ring					

Note : The F9012, F9106 and F9130 types can be fitted with a modulating electrode.



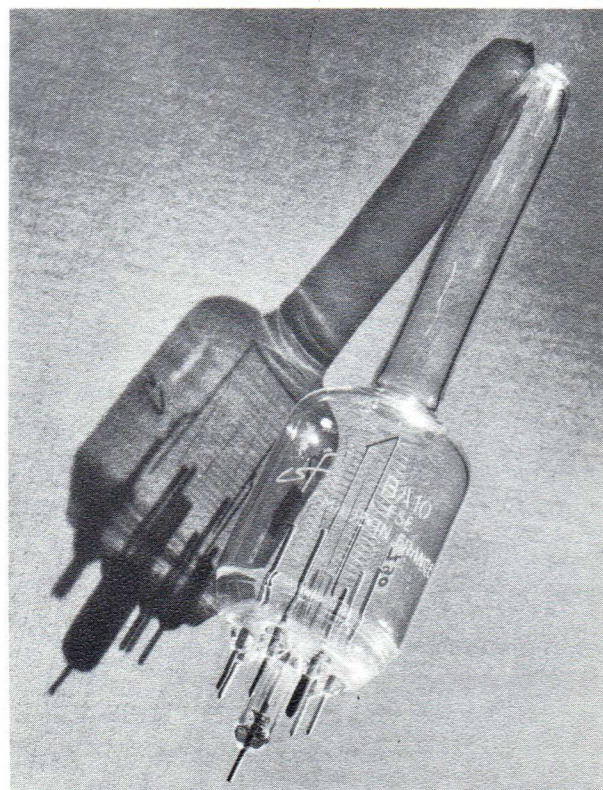
Insertable gauges F9106.

TUBES FOR MAINTENANCE

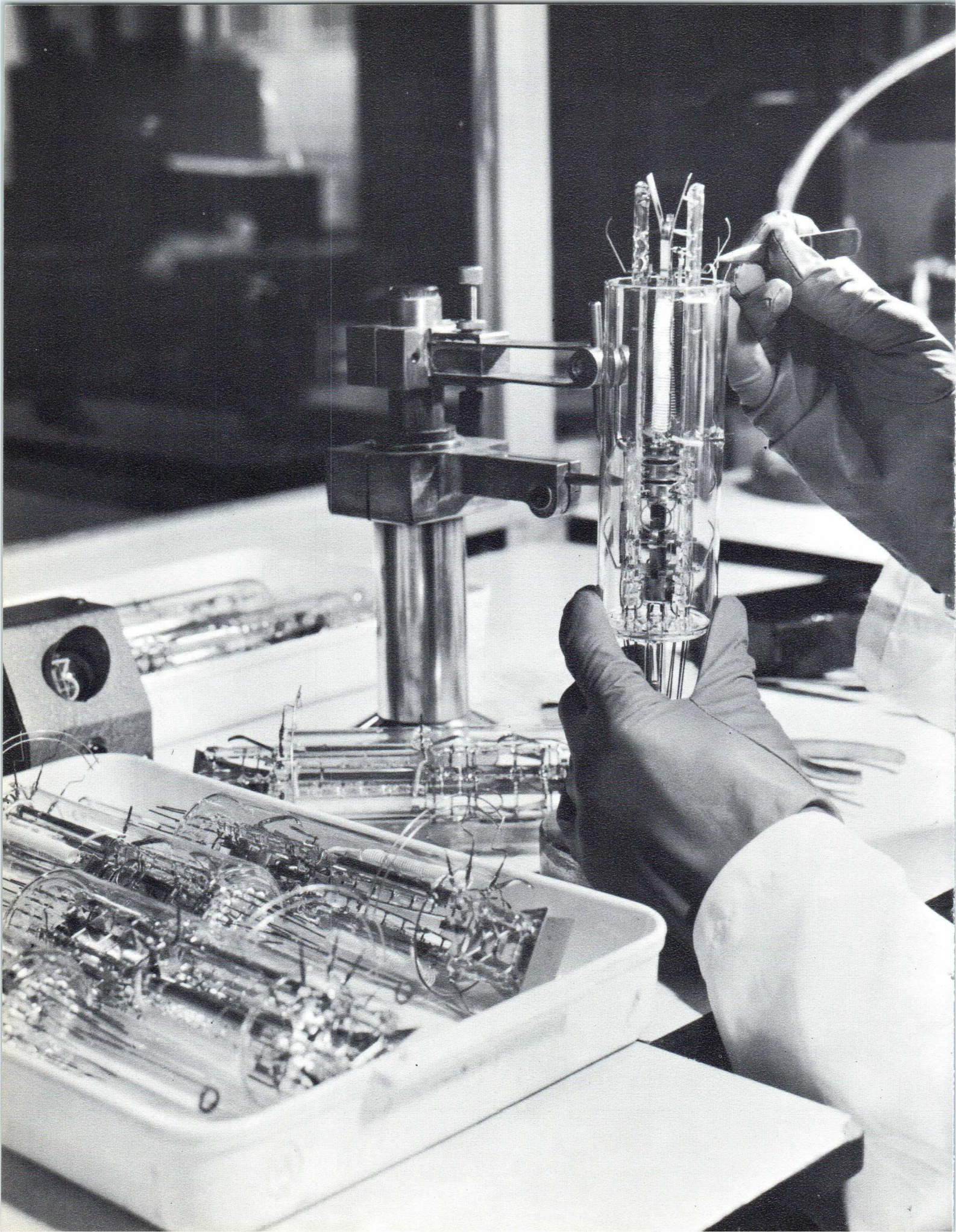
TYPE		Limit vacuum mm of Hg
"F"	"CSF"	
F9078	E4J	10 ⁻⁶
F9021	EJ1011	10 ⁻¹⁰

"FLASH" TUBES

TYPE		Characteristics	
"F"	"CSF"	Power J	Voltage kV
F9119	L 1122.B1	500	2,5
F9121	L 1259.A1	500	2,5
F9081	L 1159.A1	1 000	5
F9115	L 1082.B1	1 500	5
F9123	L 1223.B1	1 600	8
F9124	L 1240.B1	1 600	8
F9118	L 1089.C1	2 000	5
F9122	L 1218.B1	10 000	10
F9120	L 1185.B1	20 000	10



Weldable gauge F9028 (BA, 10).



DISPLAY DEVICES

Information at the output of an electronic system usually takes the form of electric signals. In order to be useful, they must be transformed into visual signals.

All components used to achieve this conversion are termed display devices.

The electric signals are either converted directly to light signals, or first transposed into different electric signals.

Similarly, these light signals are either directly utilisable or can be used after a change of wavelength or amplification.

The "Groupement Tubes Electroniques" has developed the following types :

- tubes for converting electric to light signals
- tubes for converting electric to electric signals
- tubes for converting light to light signals
- tubes for converting light to electric signals ;

they are listed below, with their principal characteristics.



CATHODE-RAY TUBES

" OSCILLOSCOPE " SERIES

ELECTROSTATIC FOCUSING AND DEFLECTION

These tubes display on a fluorescent screen, curves, relative to the variations of numerous parameters.

They feature a particularly sharp spot which has led to their adoption by oscilloscope manufacturers, and to their use in curve or network tracers.

These tubes cover the whole range of the most usual applications.

Screens are available in many different colours (P1 - P2 - P7 - P11 - P31), each type with a preferential one.

Several types are fitted with graticule screens to avoid the possibility of parallax error.

Lastly, have been developed tubes with a post-acceleration deflection grid (high sensitivity for use with transistor circuits - large useful screen surface for frequencies up to 100 MHz - rectangular front).

N.B. - In the denomination of the CRT listed hereunder, (first column), the suffix (P31, P2, P7...) is expressive of the standard phosphor used for each type of tube.

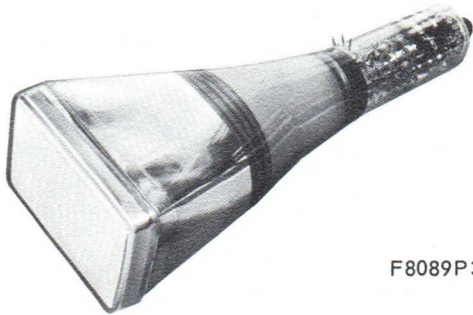
The diverse phosphors which may be supplied on request are registered in the last columns on right hand.

TYPE		Maximum operational frequency	Face dimensions	Useful screen	Mean sensitivity		Remarks	Typical operation				Phosphors which may be supplied on request				
" F "	" CSF "				X1X2	Y1Y2		Acceleration voltage	Geometry voltage	Concentration voltage	Grid cut-off voltage	P1	P2	P7	P11	P31
					V/cm	V/cm		V	V	V	V					
F8045P31	-	5 MHz	7 DIA	6.5x3.8	9	13.5	For transistorized devices Erasing electrode	4 000	700	0to270	-15to-25	•	•	•		
5ADP2 5ADP7	-	5 MHz	13 DIA	11 DIA	17.6	13.3		3 000	1 500	345to515	-34to-56	•		•		
F8030P2	-	5 MHz	13 DIA	11 DIA	17.6	13.3	Improved geometry	3 000	1 500	345to515	-34to-56	•	•	•		
F8065P11	-	5 MHz	13 DIA	10x10	26	²³ / ₅₀	2 pairs of Y plates	4 000	2 000	345to515	-34to-56					
F8042P7	OE1218PAR	5 MHz	18 DIA	15 DIA	18.5	16		4 000	2 000	460to690	-45to-75	•		•		
F8058P2 F8058P31	-	30 MHz	13 DIA	10x4	30.5	6.5	Improved astigmatism correction and geometry	10 000	1 670	180to590	-50to-80		•	•		
F8074P2 F8074P31	-	30 MHz	13 DIA	10x4 per gun	31	6.5	2 guns with X plates in common superimposition of traces	10 000	1 670	180to570	-50to-80	•		•		
F8089P2 F8089P31	-	30 MHz	12.5x8.5	10x6	11	4	Anti-compression grid gratulated screen Erasing electrode	10 000	1 000	0to300	-30to-80		•	•		
F8081P2A	-	50 MHz	13 DIA	10x6	20	7.5	Improved astigmatism correction and geometry + increased useful surface Graticulated screen	10 000	1 670	180to590	-50to-80		•	•		
F8084P2	-	50 MHz	13 DIA	10x10	20	12.5	□	10 000	1 670	180to590	-50to-80			•		
F8076P2	-	50 MHz	13 DIA	10x10	11	7	□ Very high sensitivity	15 000	2 000	180to590	-45to-85					
F8070P2 F8070P31	-	50 MHz	12.5x8.5	10x6	11	3	Anti-compression grid gratulated screen	15 000	1 670	180to590	-50to-90					
F8073P31A	-	100 MHz	13 DIA	10x4	20	5.5	For large range oscilloscope gratulated screen	10 000	1 670	200to600	-40to-70	•		•		
F8066P31	-	100 MHz	12.5x8.5	10x6	11	3	Anti-compression grid Very high sensitivity	15 000	1 670	180to590	-45to-85	•		•		

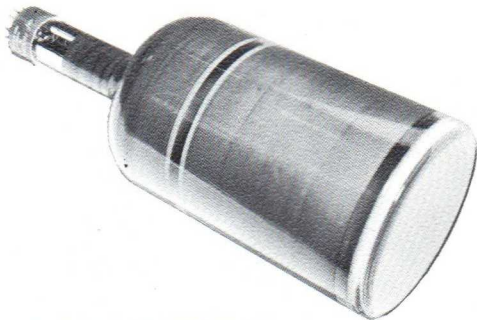
□ To be used when the same deflection is necessary on X and Y axis (Ex. : X-Y recorder).



F8073P31A



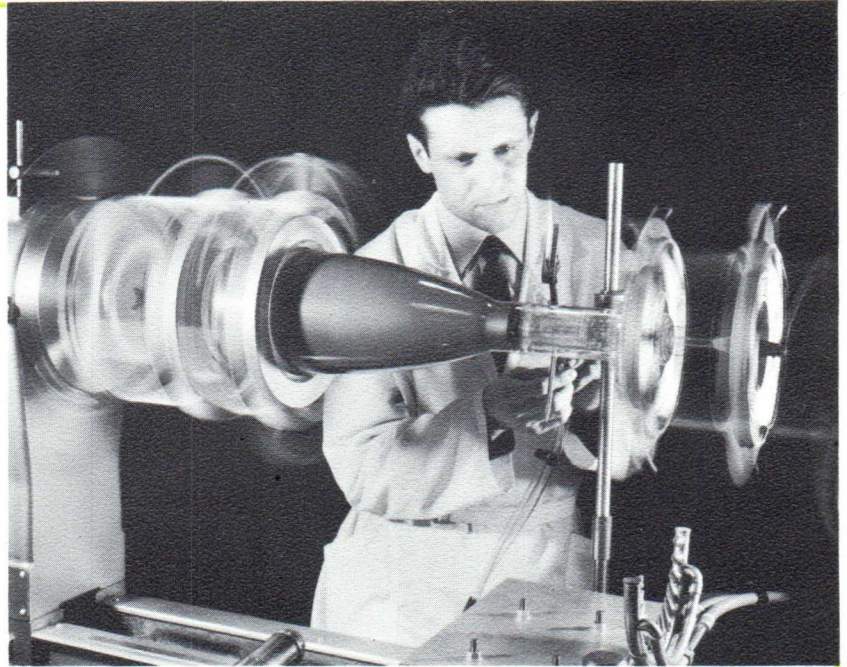
F8089P31



F8042P7 (OE1218PAR)



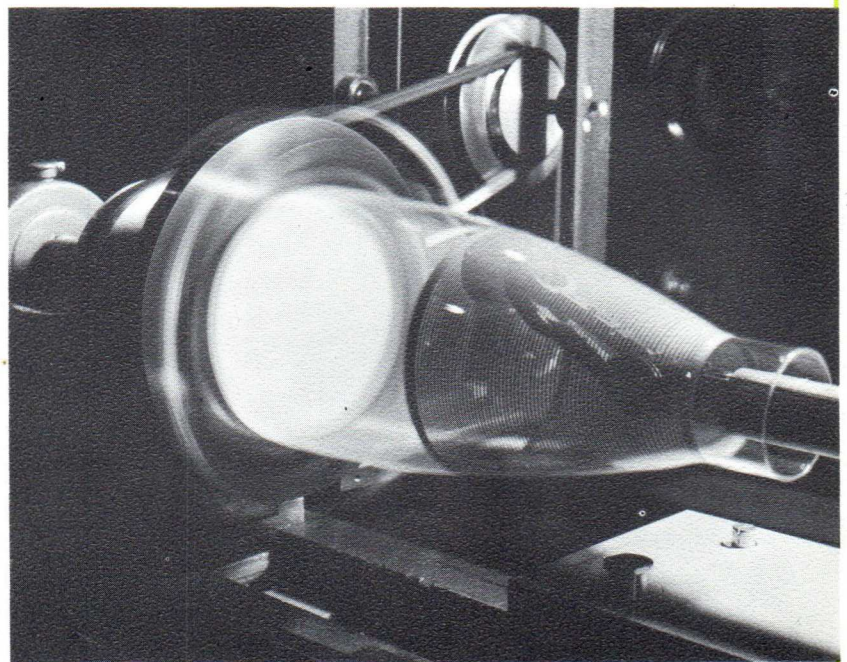
F8066P31



Assembly of the gun and the bulb of a cathode-ray tube.

TUBES FOR MAINTENANCE

TYPE		Maximum operational frequency	Face dim. cm	Useful screen cm	Phosphors which may be supplied on request		
" F "	" CSF "				P1	P7	P11
F8008AP1	OE407AV	800 kHz	7 DIA	6 DIA	●	●	●
F8009AP1 F8009AP11	OE407APAV OE407APAB	800 kHz	7 DIA	6 DIA	●	●	●
F8013AP1	OE411AV	800 kHz	11 DIA	9.5DIA	●	●	●
F8014AP1	OE411APAV	800 kHz	11 DIA	9.5DIA	●	●	●
F8018AP1	OE418AV	800 kHz	18 DIA	15 DIA	●	●	●
F8021AP7	OE418APAR	800 kHz	18 DIA	15 DIA	●	●	●



Realization of a post-accelerating electrode.

CATHODE-RAY TUBES

"RADAR INDICATOR" SERIES

These tubes mostly use electrostatic focusing and magnetic deflection for PPI scanning.

They are used extensively, both in civilian and military applications.

A few types are provided with magnetic focusing to obtain a very fine spot. They are used, particularly for monitoring purposes, in closed circuit television.

ELECTROSTATIC FOCUSING AND ELECTROMAGNETIC DEFLECTION

TYPE		Face dimensions	Useful screen	Remarks	Typical operation				Phosphors which may be supplied on request			
"F"	"CSF"				cm	cm	Acceleration voltage	Geometry voltage	Concentration voltage	Grid cut-off voltage	P2	P4
						V	V	V	V			
5AHP 19A	—	13 DIA	11 DIA	Low concentration voltage	5 000	300	0 to 250	-55				
7ABP 19A	—	19 DIA	15 DIA	Low concentration voltage	7 000	300	0 to 250	-28 to -72			•	
10WP 19A	—	27 DIA	23 DIA	Low concentration voltage	10 000	300	0 to 600	-33 to -77			•	
12ABP 19A	—	32 DIA	28 DIA	Low concentration voltage	10 000	300	0 to 300	-28 to -71				
F8031AP 19A	OM1138 AROA	38 DIA	33 DIA	Semi-Plane glass	15 000	300	0 to 600	-38 to -72	•	•		
F8038P7A	—	41 DIA	36.5 DIA	Metallic cone	12 000	300	135 to 400	-35 to -75	•	•		
F8038P 19A	—			Semi-plane glass								
F8064P4	—	15 × 12	12.5 × 9.5	Rectangular flat face (For view-finder, monitor).	9 000	450	0 to 300	-30 to -120			•	

ELECTROMAGNETIC FOCUSING AND DEFLECTION

TYPE		Face dimensions	Useful screen	Remarks	Typical operation			
"F"	"CSF"				cm	cm	Acceleration voltage	Concentration voltage
						V	V	V
10FP4-A	—	27 DIA	23 DIA	Semi-plane glass	10 000	250	-27 to -63	
F8048P 19A	OM726RO	27 DIA	23 DIA	Semi-plane glass	10 000	250	-27 to -63	



TUBES FOR MAINTENANCE

F8037AP 19A	(OM738ARO)	38 DIA
F8001AP 19A	(OM1038ARO)	38 DIA



Cathode-ray tubes packing shop at St-Egreve factory.



PICTURE STORAGE TUBES

As the remanence of conventional powders is not always adequate, picture storage tubes have been developed.

These cathode-ray tubes fitted with a storage grid, besides their conventional picture tube property, provide means for the direct study of fast random phenomena and, quite generally, of any phenomenon with a time of observation varying with the writing speed (from a few millimetres per microsecond to some hundred millimetres per microsecond, depending on the tube type).

These tubes are used in aircraft radar displays, such as in the Cyrano radar. A short type with magnetic deflection is used on radars carried on helicopters.

The last development concerns a two gun tube and a derived selective erasure tube.



F8055



The "Cyrano" radar set-up on the "Mirage III" airplane is fitted out with a CSF direct view storage tube.

TYPE		Useful dia	WRITING GUNS	Min. writing speed	Screen	Remarks
"F"	"CSF"					
F8006	-	92 mm	1 gun Static focusing and deflection	100 mm/ μ s	P20	
F8029	-	92 mm	1 gun Static focusing and deflection	5 mm/ μ s	P20	Designed for airborne equipments
F8036	-	92 mm	2 guns Static focusing and deflection	5 mm/ μ s	P20	Designed for airborne equipments
F8050	TEI.603	92 mm	1 gun Static focusing and deflection	100 mm/ μ s	P20	Designed for oscilloscopy of transients. Allow to see traces at writing speed up to 500 mm/ μ s
F8055	-	100 mm	1 gun Static focusing Magnetic deflection	10 mm/ μ s	P20	Low weight and dimensions (l = 200 mm). Designed for airborne equipments.
F8068	-	100 mm	1 gun Static focusing and deflection - writing gun		P20	Selective erasure, without magnetic shield
F8069	-		1 gun Static focusing and deflection - erasing gun			d ^o but with magnetic shield
F8086	-	100 mm	1 gun Static focusing Magnetic deflection	1 to 10 mm/ μ s	P20	magnetic shield

SCAN CONVERSION TUBES

Scan conversion tubes are more specially used in picture transformers to convert a PPI radar picture to a television one.

The latest types are characterised by small dimensions (the F8060/TMA weighs only 100 grams) and a high definition : 500 lines on the F8080/TMA 406.

These tubes comprise two guns on either side of a thin semi-conducting target.

The electric signals are deposited on the target by the writing gun and are restituted, in the form of electric signals, by the reading gun.

TYPE		WRITING GUN	READING GUN	Min. definition at 50 % mod.	Fast erasing	Remarks
"F"	"CSF"					
F8024	TMA403	Electrostatic focusing Magnetic deflection	Electrostatic focusing and deflection	140 circles	no	
F8041	TMA404	Electrostatic focusing Magnetic deflection	Electrostatic focusing and deflection	160 circles	yes	
F8080	TMA406	Electrostatic focusing Magnetic deflection	Electrostatic focusing Magnetic deflection	180 circles	yes	
F8060	TMA408	Electrostatic focusing Magnetic deflection	Magnetic focusing and deflection	140 circles	yes	Very light, and low overall dimensions
F8083	TMA409	Electrostatic focusing Magnetic deflection	Magnetic focusing and deflection	200 circles	yes	



Observation on a TV screen of a PPI aerial picture converted by means of a scan conversion tube, the remanence of which allows visual aircraft tracking.



Scan conversion tubes F8024 (TMA,403) and F8060 (TMA,408).

BARRIER-GRID STORAGE TUBE

Storage tubes of the TCM13 type are used in MTI processes.

These tubes are fitted with a storage grid. A single gun acts simultaneously as writing and reading gun.

They can store electric signals in the form of charges deposited on an insulating target and can reconstitute them in the form of electric signals.

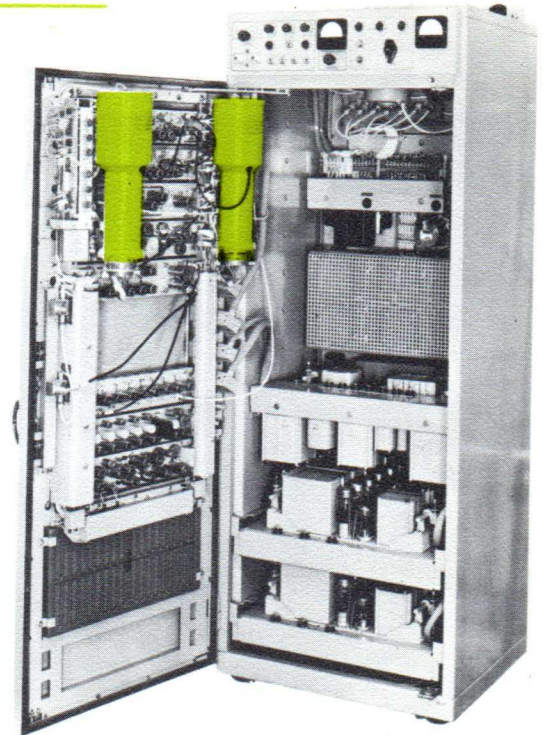
They can add or integrate several successive signals, or simultaneously write and read thanks to their collector screened from the target.

TYPE		Characteristics
" F "	" CSF "	
F8026	TCM13	Simultaneous writing and reading. Definition : 400 TV lines. Elimination rate : 20 dB.
F8085*	-	Miniaturized barrier grid storage tube.

* Under development.



F8026 (TCM.13)



Fixed target rejection filter MA.372 fitted with two CSF storage tubes F8026.

DECODER TUBES

TYPE	Characteristics	
F8082	Decoder tube fitted with 360 weldable terminals passing through the front glass; staggered arrangement on 2 concentric rings : outside ring DIA : 57 mm inside ring DIA : 55,5 mm	Electrostatic focusing and deflection
F8090	Binary coding according to GRAY code. 8 concentric rings connected to 8 terminals passing through the front glass : max. outside ring DIA : 80 mm approx. inside ring DIA : 40 mm	Electrostatic focusing magnetic deflection

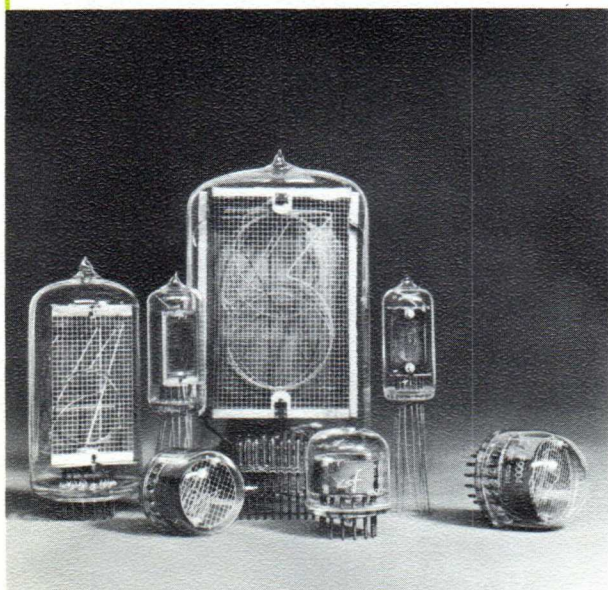
BRIGHTNESS AMPLIFIER

TYPE		Characteristics
" F "	" CSF "	
F8088	ABX	Brightness amplifier for X rays applications. Continuous electronic zoom effect. Input DIA 15 cm (5" 29/32) Output screen DIA 25 mm (1") Minimal contrast 4 %.



F8088 (ABX)

DISPLAY READOUT



Range of display tubes.

These cold cathode digital readout tubes display numbers or various signs.

By applying a continuous voltage on the selected cathode the corresponding figure lights up.

These tubes are used on digital voltmeters, frequency-meters, etc... where they give high reading precision compared to a pointer on a dial.

They are specially long life designed for transistor circuits. They can be supplied with orange coloured filters with improved contrast.

The control circuits are simplified by the use of the electro-mechanical decimal counter/driver which features ability for counting up to a rate of 50 c/s with display on a type F9080 tube.

TYPE		Figures	Height of figures mm	Voltage V	Current mA
"F"	"C.S.F."				
F9020A F9020AA	TA.543	Figures (0 to 9)	58	170 to 300	10 to 14
F9090A F9090AA	-	Figures (0 to 9)	40	170 to 300	5.8 to 8.2
F9057A F9057AA	-	Figures (0 to 9)	15.5	170 to 300	1.5 to 3
F9082A F9082AA	-	+ - $\sim \Omega$	15.5	170 to 300	1.5 to 3
F9080B F9080BA	-	Figures (0 to 9)	13	170 to 300	1.5 to 2.5
F9092A F9092AA	-	+ - $\sim \Omega$	13	170 to 300	1.5 to 2.5

"A" or "B" types : Glass colour filter coated.
"AA" or "BA" types : Glass without filter.

IMAGE CONVERTER TUBE

TYPE		Characteristics
"F"	"CSF"	
F9049	D.16	Designed for infra-red/visible image conversion; monovoltage type. HT 18 kV - Useful DIA 26 mm - S1 photocathode P20 or P11 phosphor - Resolution 60 line pairs/mm $0.7 \mu < \lambda < 0.9 \mu$.



F9049 (D16)

PHOTOELECTRIC CELLS



F9096 (DA-24-75)

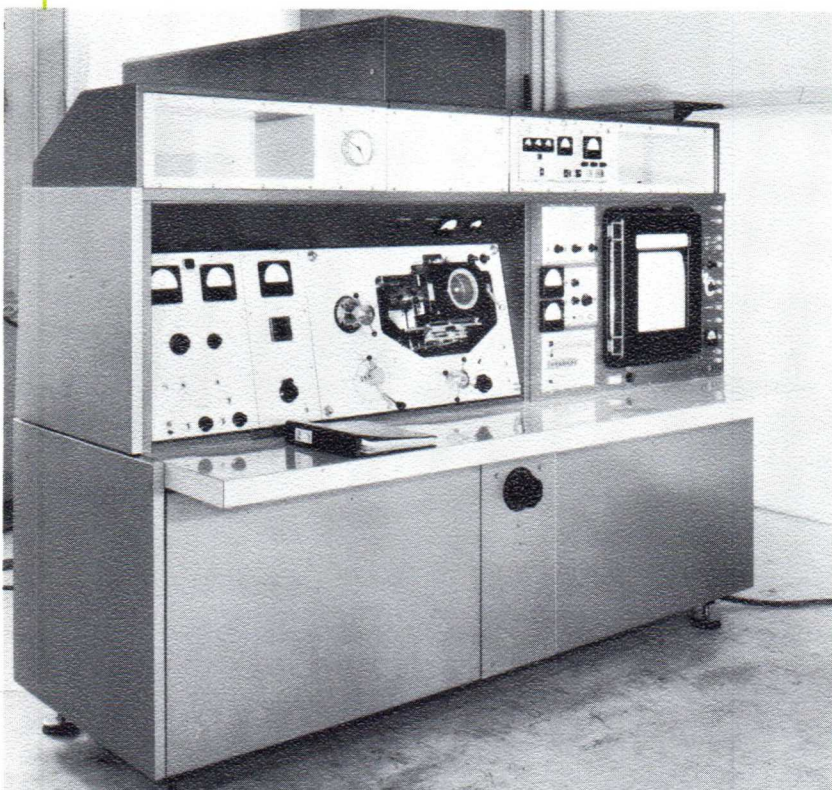


F9126

TYPE		Characteristics
"F"	"CSF"	
F9096*	DA-24-75	High-current, fast photoelectric cell - Coaxial Structure $0.3 \mu < \lambda < 1.2 \mu$ - designed for analysis of light intensities supplied by high - power lasers - Typical impedance : 75 Ω .
F9126**	DA-11-75	Ultra fast photoelectric cells, coaxial designed, specially intended for analysis of light beam generated by gas lasers in both infra red and visible spectrum. Average sensitivity 10 $\mu\text{A}/1\text{m}$ - S1 photocathode.
F9127**	DB-11-75	Identical with F9126 except : Average sensitivity 30 $\mu\text{A}/1\text{m}$ - S10 photocathode.
F9128**	DC-11-75	Identical with F9126 except : Average sensitivity 40 $\mu\text{A}/1\text{m}$ - S11 photocathode.
F9129**	DD-11-75	Identical with F9126 except : Average sensitivity 80 $\mu\text{A}/1\text{m}$ - S20 photocathode.

* The CA.2050 matched case, specially designed to be used with the F9096 cell can be supplied on request.
** The CA.2062 matched case specially designed to be used with the F9126, F9127, F9128 and F9129 cells, can be supplied on request.

EQUIPMENTS FOR LABORATORIES AND INDUSTRIES



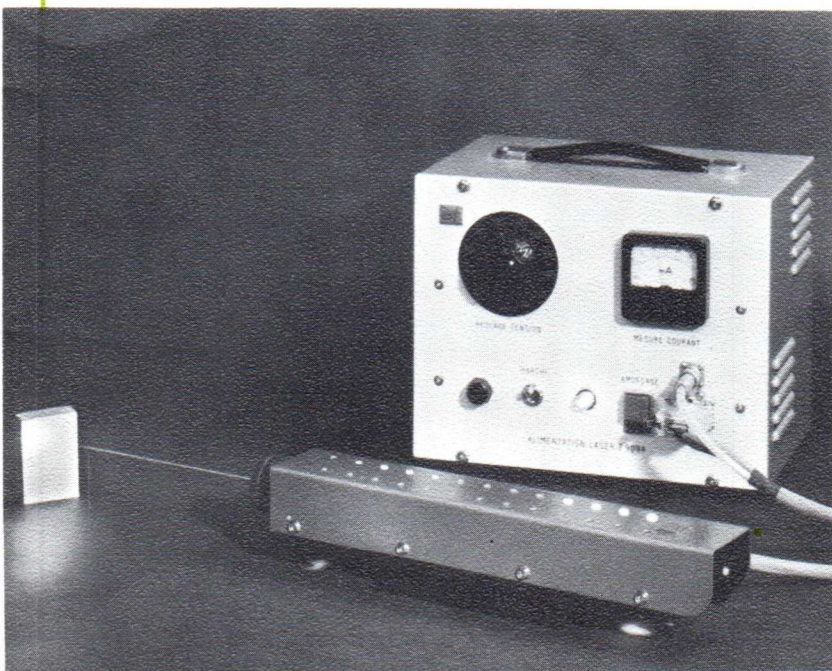
High-sensitivity mass spectrometer SM602 suitable for analysing traces of impurity in solids

VACUUM ENGINEERING

- Vacuum-tight bushings
- Windows
- Ionic pumps
- Gauge supplies
- Electron bombardment gun (under vacuum)
- Zone melting furnace

ANALYSIS

- Mass spectrometers
- Slow electron diffractograph
- Cinedensigraph
- Gaz lasers
- "Flash" tubes
- Electronic camera "Lallemand" type



CW miniature helium-neon laser F9094 providing an output power of 1 mW (uniphase wavefront) at 6328 Å

MEASUREMENTS

- TWT amplifiers
 - Stabilized power supplies
 - Wattmeters
 - Loads
 - Wavemeters
 - Directional couplers
 - Counter/driver for readout tubes
- } for microwave frequencies

INTERNATIONAL SALES

Algeria
S.F.R.A.
M. Champy
Alger 6, rue Guiauchain
T. 66.93.90 66.88.82 66.62.31
Télonde Alger

Argentina
CSF - Argentine
Sarmiento 1967, Oficina 29
Buenos-Aires, Argentine

Australia
Cavendish Pty Ltd
P.O. Box 86, Chatwood
Sydney (N.S.W.)

Pantechna
8/12 Easten Road
Melbourne
M. Weiner

Belgium
I.P.T.C.
18, avenue Franklin D. Roosevelt
Paris 8e

Brazil
CSF do Brasil
av. Ibirapuera 2572
Sao-Paulo
M. Lignon

Bulgaria
Sorice - M. Picard
50, rue Croix des Petits-Champs
Paris

Cambodia
M. Cros
P.O. Box 271
Pnom-Pnem

Cameroon
l'E.E.
M. Bruler
Douala (Cameroun)
B.P. 1074
T. 42.15
Télonde Douala

Canada
Emisco
850 Belfast Road
Ottawa
M. Mahoney

Chad
Seter
M. de Brisis
Fort Lamy
B.P. 66
Télex : " Tchator Lamy "

China
see Bulgaria

Columbia
E. Ramos-Esteban
Calle 13 n° 7/80 Office 661
Bogota

Comoro Islands
see Malagasy Republic

Congo Republic
CSF
Brazzaville (Congo)
av. du Gouverneur Gal Eboué
B.P. 199
T. 32.75
Télonde Brazzaville

Congo Republic Léopoldville
see Belgium

Czecho-Slovakia
see Bulgaria

Dahomey
see Ivory Coast

Denmark
Ferroperm
Vedbak
M. Svend Holm
Hans Buch and C°
6, Svanevej
Copenhague

East Germany
see Bulgaria

Ethiopia
Livierato
Addis Abeba
Ethiopian Shipping and
Forwarding Cor.
Addis Abeba

Finland
Parava Oy
Neitsytpolkn 1 A
Helsinki
M. Ulia

Gabon
CSF - M. Brand
Libreville (Gabon)
Quartier Jeanne et Blanche
B.P. 657
T. 27.32
Télonde Libreville

Greece
M. Bouensnard
22, rue Dragoumi
Athènes 612

Guatemala
José Goubaud
20 piso 5 Avda 10.58
Guatemala a Ciudad

Guinea
see Ivory Coast

Holland
CSF Nederland
16 Nassauplein
La Haye
M. Foppes

Hungary
see Bulgaria

India
M. SS. Tandon
Flat n° 3 Thapar House
124 Janpath
New-Delhi

Irak
see Lebanon

Iran
Iretelec
23/25 rue Pir Djamali
Route de Cheniran
Téhéran

Israel
Cidev
P.O. Box 2 24
Tel-Aviv

Italy
Mistral
Semonetta (Prov. de Latina)
M. Pressuti

M. Mazoyer
Via Nemoa
Rome

Ivory Coast
S.A.R.
M. Plumejeaud
Abidjan (Côte d'Ivoire)
Immeuble Borg
B.P. 1238
T. 28.02 37.20
Télonde Abidjan

Japan
Rikei Trading Co
Kosato Kaikan building
12-2 Chom, Shiba Tamuracho
Minato-Ku
Tokyo
M. Nakano

Jordan
see Lebanon

Koweit
see Lebanon

Lebanon
Emir Ernest A. Chehab
2, rue Maroun
Beyrouth
Liban

Malagasy Republic
S.M.E.
M. Forget
Tananarive (Madagascar)
20, av. de l'Indépendance
B.P. 477
T. 08.58
Télonde Tananarive

Mali
Socoram
M. Moricourt
Bamako
B.P. 154
T. 49.91

Mauritania
see Senegal

Mexico
Cegesa S.A.
Hamburgo 108 301
Mexico 6 D.F.

Morocco
S.F.R.M.
M. Belloteau
Casablanca 40, bd de la Résistance
T. 791.23 791.00
Télonde Casablanca

Mozambique
Agmel - Apartado 1362 Lisbonne 1

Nicaragua
J. Dreyfus y Cia Ltd
Apartado 89
Managua D.N.

Niger
see Ivory Coast

Norway
Sonnico
67/71 Munkodamov
Oslo

Pakistan
Humayun Ltd - Karachi (civil)
Savoy International France
32, avenue Kléber
Paris (militaire)

Poland
see Bulgaria

Reunion
see Malagasy Republic

Rumania
see Bulgaria

San Salvador
Pablo Block
San Salvador

Saudi Arabia
see Lebanon

Senegal
CSF
M. Marty
Dakar (Sénégal)
11, avenue Jean-Jaurès
B.P. 347
T. 365.31
Télonde Dakar

Spain
Praco S.A.
Serrano 92
Madrid 6

Sudan
National Electronic Ltd Khartoum
M. Nadler

Sweden
Sté Hans Puttgen
Grev Turegatan 73
Stockholm

Switzerland
Sté modulator A.S.
Blumensteinsstrasse 2
Berne

Syria
see Lebanon

Togo
see Ivory Coast

Tunisia
C.T.E.
M. Frémont
Tunis 63, rue Bélisaire
T. 244.511
Télonde Tunis

Turkey
Transturk Ltd Sirkoti
P.O. Box 823 Galata tunal Cad
Istanbul

Union of South Africa
Fuchs Electronics Pty Ltd
P.O. Box 57, Alberton Transval
Republic of South Africa

United Arab Republic
I.P.T.C.
18, avenue Franklin D. Roosevelt
Paris 8e

United Kingdom
CSF-UK
1, Cadogan Place
Londres

United States
A.R.C.
445, Park Avenue
New-York 10022
(212) Plaza 35 046
M. Savoyen

Welt
175 West Oakton Street
des Plaines
Illinois (U.S.A.)

Upper Volta
see Ivory Coast.

Uruguay
Murraciale Montevideo

Venezuela
Representaciones Industriales
Apartado 2648 - Caracas
(Frachot)

West Germany
Ditratherm
Ludmillastrasse 23/25
Landshut (Bavière)
M. Dorochevskyj

Neuberger
Fallstrasse 42
8 Munich 25
M. Beau

CSF - Verbindungstelle Bonn
Nordstrasse 6
53 Bonn
Dr Haczek

CSF - Direktion Deutschland
Palmengartenstrasse 6
6 Frankfurt-am-Main
Dipl. Ing. H. Vogel

Yugoslavia
Inimex M. Lederer
19, rue Michodière



CSF COMPAGNIE GÉNÉRALE DE TÉLÉGRAPHIE SANS FIL

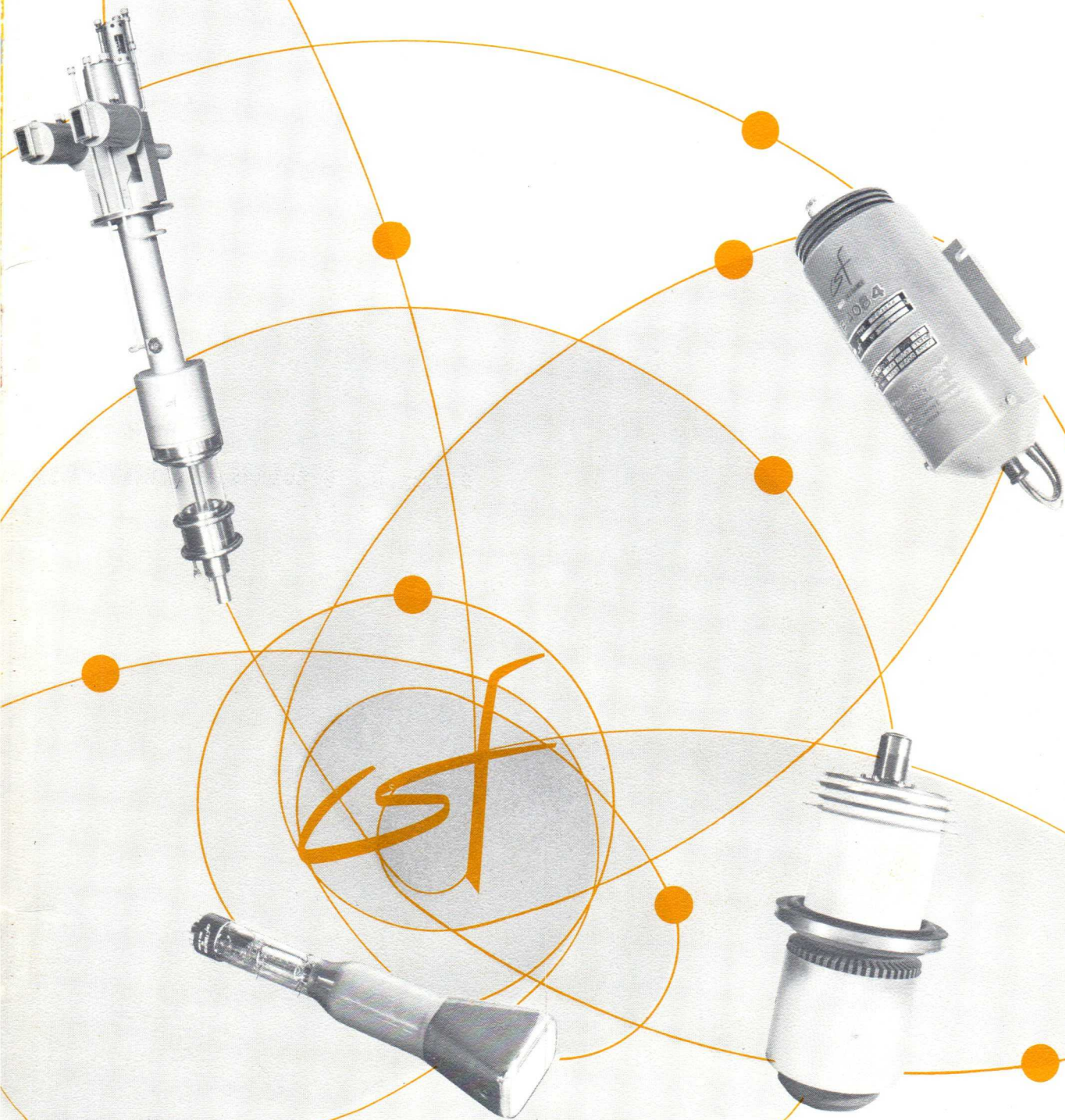
GTE GROUPEMENT TUBES ÉLECTRONIQUES

SALES IN FRANCE : 55, RUE GREFFULHE - 92 - LEVALLOIS-PERRET - TEL. 737.34.00

MARCH 1967

6703-D1-1/40


Electronic tubes



CSF COMPAGNIE GÉNÉRALE DE TÉLÉGRAPHIE SANS FIL

GTE GROUPEMENT TUBES ÉLECTRONIQUES

55 RUE GREFFULHE - 92 - LEVALLOIS-PERRET - TÉLÉPHONE : 737.34.00



The "Groupement Tubes Electroniques" is the CSF (Compagnie Générale de Télégraphie Sans Fil) Division in charge of the study, development and production of Electronic Tubes. Its range of activities extends from the classical entertainment tubes to the more sophisticated ones such as gridded crossed field amplifier or storage viewing tubes.

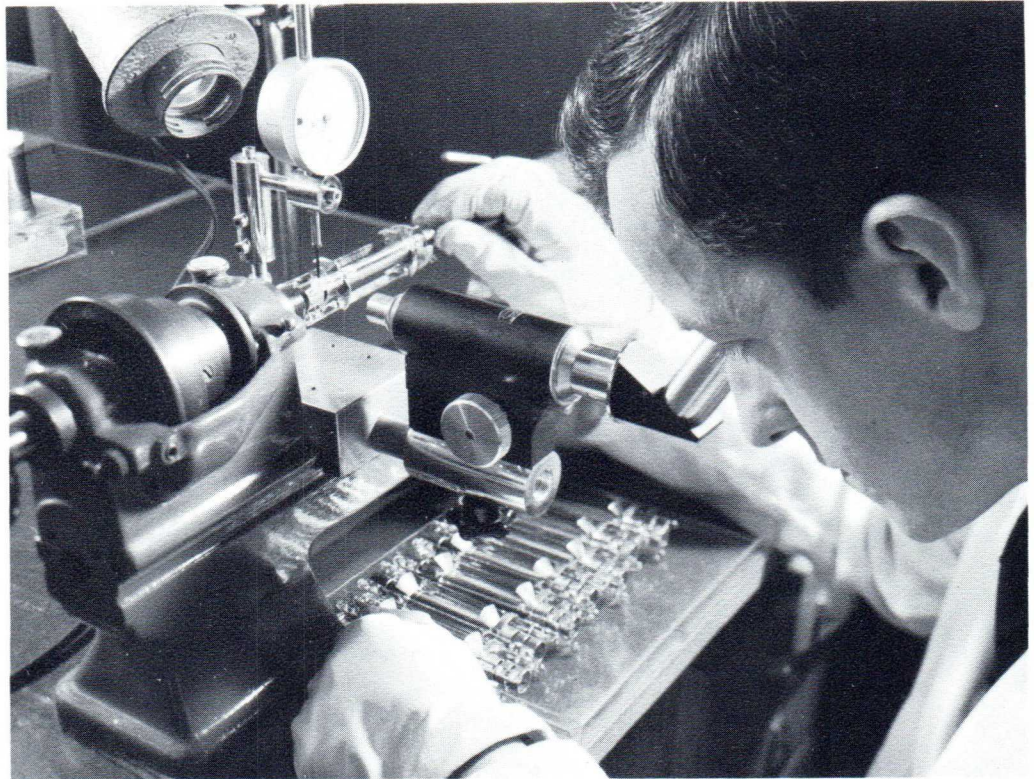
The following applications have been found to its productions :

- airborne and ground radar : magnetrons, klystrons, O and M type travelling wave tubes, TR, ATR, thyratrons, diodes, cathode ray tubes, storage tubes.
- radio links : TWT, klystrons, solid state RF sources.
- electronic countermeasure systems : carcinotrons, noise generators, wide band amplifiers.
- (radio and TV) telecommunication transmitters, triodes, tetrodes, klystrons, TWT.
- measurement bench : carcinotrons, TWT, CRT.
- display devices : IR image converter, brightness amplifier, numerical readout, pick up tubes, storage viewing tubes, storage tubes.
- industrial heating process : triode.
- RF heating : magnetron.
- equipments : modulator hard tubes, for radar and linear accelerators.
- lasers : flash tube and detection cells.

Starting from an extensive background in vacuum and microwave techniques, the GTE has also designed and constructed miscellaneous products such as gas lasers, ionic pumps and ultra-high vacuum equipments, TWT low noise and power amplifiers, microwave industrial ovens, power supplies, etc. The main features of these miscellaneous equipments are listed on page 39.

NEW DEVELOPMENTS

DISPLAY DEVICES



CRT gun centring test

CATHODE-RAY TUBES "OSCILLOSCOPE" SERIES

TYPE	Maximum operational frequency	Face dimensions cm	Useful screen cm	Mean sensitivity		Acceleration voltage V	Geometry voltage V	Grid cut-off voltage V	Phosphor
				X ₁ X ₂ V/cm	Y ₁ Y ₂ V/cm				
OEE.1107	General purpose TRC for AF operations; under development.								
	15 MHz	12.5×8.5	10×6	15	8	—	2500	-100	P.31 Other phosphors upon request
F8071	Low dimensioned tube for large range oscilloscope; graticulated screen; under development.								
	150 MHz	12.5×8.5	10×6	10	3.4	20000	2000		P.31 Other phosphors upon request

PICTURE STORAGE TUBES

TYPE	Useful dia	WRITING GUNS	Min. writing speed	Screen	Remarks
F8087	100 mm	2 guns; Electrostatic focusing and deflection; blanking grid.	100 mm/ μ s	P20	Under development
TEI.1114	100 mm	1 gun; Electrostatic focusing and deflection;	1 mm/ μ s	P20	Magnetic shield; for airborne equipment; under development.

COMPUTER CRT APPLICATIONS

TYPE	Collector voltage	Target voltage	Voltage required for scanning 1 symbol	
			Vertical	Horizontal
	V	V	V	V
OEE.1103	Monoscope picture generator			
	1203	1200	9	6.5

TYPE	Face dimensions	Typical operation			
		Acceleration voltage	Geometry voltage	Concentration voltage	Grid cut-off voltage
	cm	V	V	V	V
OME.1104	High resolution, rectangular face CRT				
	30 diag.	12 000	400	0 to 400	-30 to -70

SHUTTER TUBE

TYPE	Characteristics
OBD.1105	<p>Double deflection electronic shutter tube designed for photography of high speed phenomenon. It allows:</p> <ul style="list-style-type: none"> - ever photography of whole images in sequence Exposure time 10^{-8} s Shutter time between two exposures 5×10^{-8} s - or analysis of an image in movement through a slot



OBD.1105

TRAVELLING-WAVE TUBES

TYPE	Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Remarks
	GHz	mW	dB	dB	V max	mA	

WIDE-BAND, MEDIUM NOISE T.W.T.

TOP. 1109*	1.0 - 2.3	10	> 40	< 8	300	< 8	Uniform field magnet
TOP. 1110*	2.0 - 4.5	40	> 40	< 8	650	< 8	Uniform field magnet
TOP. 1111*	4.0 - 8.0	30	> 40	< 9	850	< 5	Uniform field magnet
TOP. 1112*	6.9 - 11.1	10	> 40	< 9	1050	< 3	Uniform field magnet

*Built-in resistor bridge makes the unit adjustment-free and requiring only two input fixed voltages, for heating and high voltage.

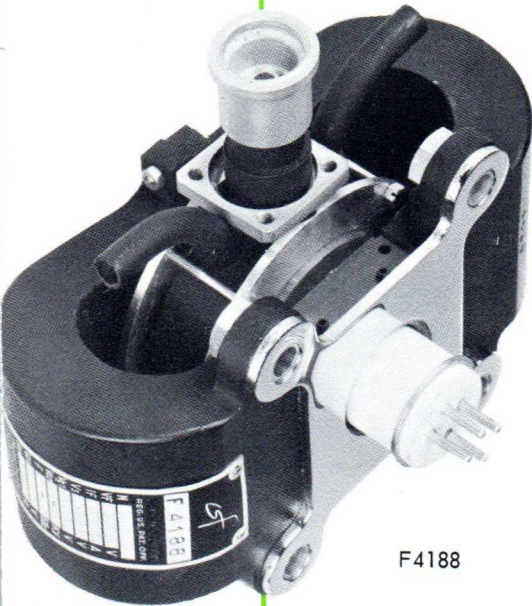
MEDIUM POWER T.W.T.

TOP. 1090	4.4 - 5.0	> 6W	> 33		1500	30 to 50	Periodic magnets
-----------	-----------	------	------	--	------	----------	------------------



TOP.1090

MICROWAVE TUBES



F4188

CARPITRONS

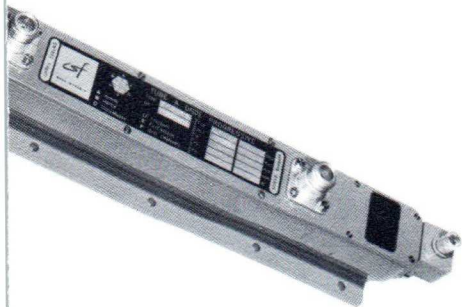
TYPE	Frequency range	Power	Anode 1 voltage	Anode 2 voltage	Anode 2 current	π
	MHz	W	kV	kV	mA	%
CMP.1115	5925-6425	> 500	< 1.8	< 4	< 600	35
F4188	5925-6425	> 200	< 1.6	< 3.5	< 300	35

POWER KLYSTRONS

CW OPERATION

TYPE	Frequency range	Power	High voltage	Beam current	Gain	Focusing
	GHz	kW	kV	A	dB	
F2057	0.59-0.83	50	22	5.8	42	Electromagnetic

MAGNETRONS



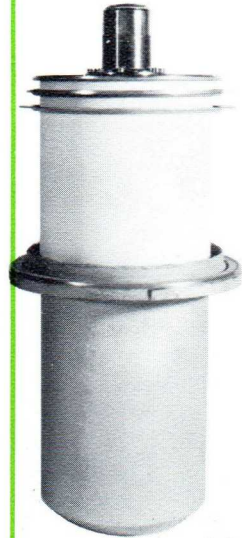
TYPE	Typical operation					
	Frequency range	Anode peak voltage	Anode peak current	Filling per cent	Pulse duration	Rated useful peak power
	GHz	kV	A		μ s	kW
MCV.1129*	2.90-3.05	30	65	0.002	6	1000
MCV.1130*	3.05-3.20	30	65	0.002	6	1000
7111	8.5 -9.6	22	27.5	0.001	1	220
MCV.1125▲	9.0 -9.6	22	27.5	0.001	0.5	220

*Tube under development.

▲Intended for applications with Doppler filtering. Tube under development.

TRANSMITTING TUBES

TRIODES



F6093

TYPE	HEATER		Maximum ratings				Mean values		COOLING			
	Vf V	If A	Fréq. .MHz	Va kV	Ik A	Pa kW	s mA/V	k	Natural	Forced air	Water	Vapor
Metal-ceramic triode - intended for high power telecommunication transmitters service.												
F6093	12	320	50	16	16	75	45	20			•	
Metal-ceramic triode - intended for high power generators service, either CW or pulse.												
ETO.1079	12	700		30	800	150	200	50			•	

INDUSTRIAL APPLICATIONS

TYPE	Purposes	Useful power	COOLING			
			Natural	Forced air	Water	Vapor
HFI.1106	Triode designed for LF linear amplifier	15 kW		•		

MISCELLANEOUS

ELECTRON MULTIPLIER



F9147

TYPE	Characteristics
F9147	Tubular electron multiplier designed for measurement of radiation intensity, either constituted by electrons, ions, particles or UV photons.

CSF COMPAGNIE GÉNÉRALE DE TÉLÉGRAPHIE SANS FIL

GTE GROUPEMENT TUBES ÉLECTRONIQUES

SALES IN FRANCE : 55, RUE GREFFULHE - 92 - LEVALLOIS-PERRET - TEL. 737.34.00



CONTENTS

MICROWAVE TUBES

- Power klystrons
- Reflex klystrons
- Travelling wave tubes
- Magnetrons
- "O" carcinotron tubes
- Carpitrons
- Crossed field noise generators ● Noise source for test equipment
- Duplexer tubes ● Neon tubes ● Spark-gaps

TRANSMITTING TUBES

- Triodes ● Tetrodes ● Pentodes
- Ceramic thyatrons
- Diodes and rectifiers ● Industrial purposes

RECEPTION TUBES AND MISCELLANEOUS

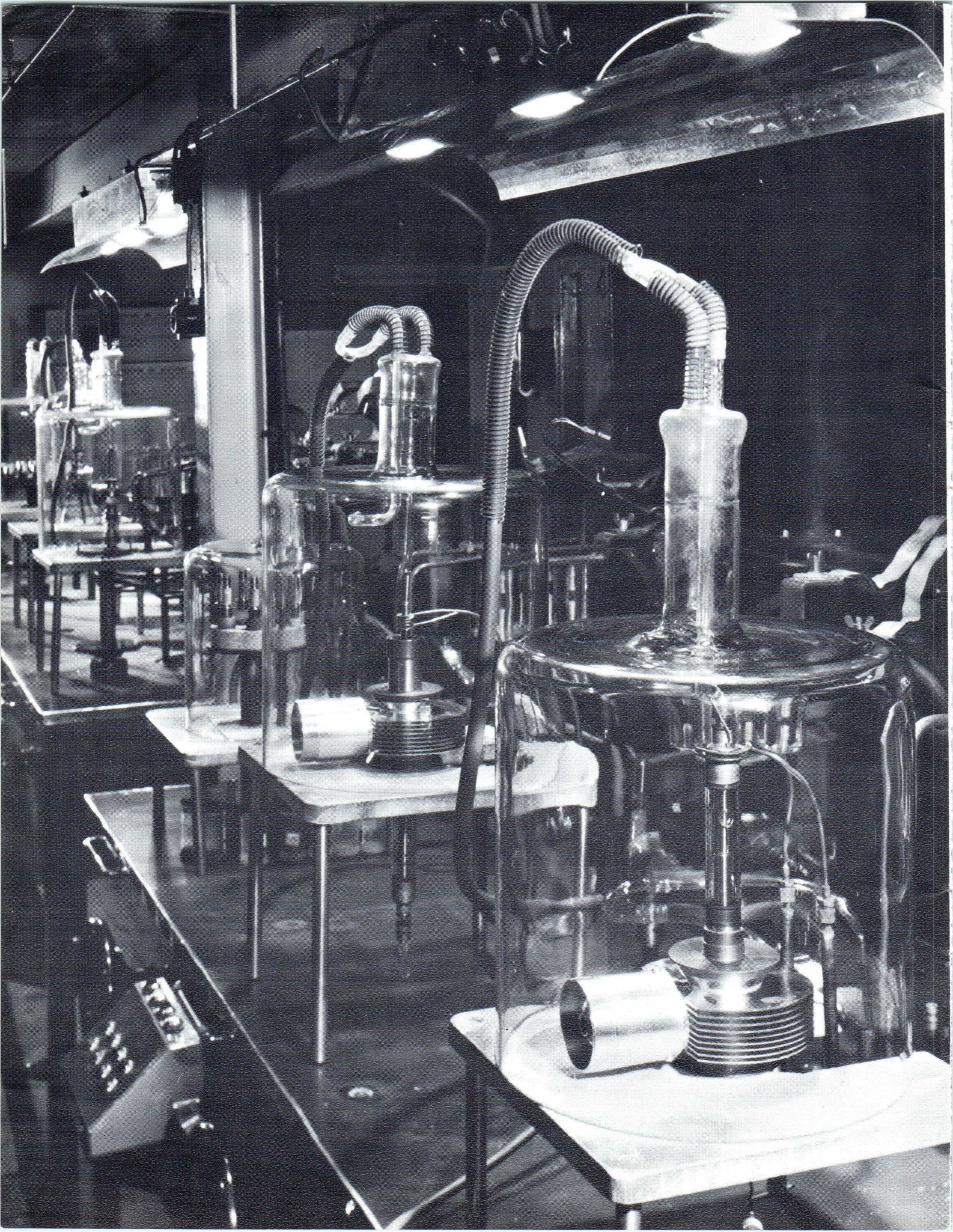
- "Miniatron" ● "Subnitron"
- Repeater tubes ● Thermal relays
- Gauges ● "Flash" tubes
- Electron multiplier

DISPLAY DEVICES

- Cathode ray tubes
- Direct view storage tubes
- Scan conversion tubes
- Barrier grid storage tubes ● Decoder tubes
- Shutter tube ● Computer CRT applications
- Display readout ● Image converter tube
Photoelectric cells

MISCELLANEOUS PRODUCTS

Catalogue	Suppl ^t
Pages	Pages
4 5	
6 7	3
8	
9 10 11	2
12 13	3
14 15	
	3
16	
17	
18 19	
20 21	4
22	
23	4
24 25	
26 27	
28	
29	
	4
30 31	
32 33 34	1
35	2
36	
37	
	2
38	
38 - 39	



MICROWAVE TUBES

The Laboratories of CSF have often been at the origin of microwave tubes, either magnetrons or klystrons for which their contribution was of prime importance, or the carcinotron which is a CSF invention.

In this catalogue are offered a range of tubes which represent the outcome of continuous effort in research and improvement, both in performance and quality. Part of this research work has resulted in productions such as the M type Carcinotron and the M-type travelling wave tube (TPOM) both crossed-field tubes, the performances of which are generally "classified". On this account these tubes are not listed here. Information on these products can be furnished on a "need to know" basis.



POWER KLYSTRONS

CW OPERATION

TYPE	Operat. frequency	Power	High voltage	Beam current	Gain	Focusing
	GHz	kW	kV	A	dB	
F2047	1.428	10	13	2.8	40	electromagnetic
F2008	0.47-0.65	30	18	4.8	30	electromagnetic
F2048*	0.47-0.64	50	23	6.0	40	electromagnetic
F2009	0.59-0.83	30	17	3.8	40	electromagnetic

*Type under development.

CW Tubes :

The F2047 klystron is a 10 kW fixed frequency L band tube developed for the ELDO (European Launching Development Organization). This tube must be used in the guidance system of the satellite launcher "EUROPA".

Important efforts of production have been made to achieve the equipment of 18 French television emitters (ORTF). These emitters operate with 3 tubes F2008 or F2009, two in parallel for the image carrier, and one for the sound carrier.

These tubes at a nominal 30 kW power level can be pushed to 50 kW as in the derived model F2048. Good efficiency and high gain make these tubes suitable for power emitter realization. They can be cooled either with liquid or vapour. Some of them work in pulse condition at 100 kW peak 40 kW average power, as in the Bonn Synchrotron.

CW and pulsed tube :

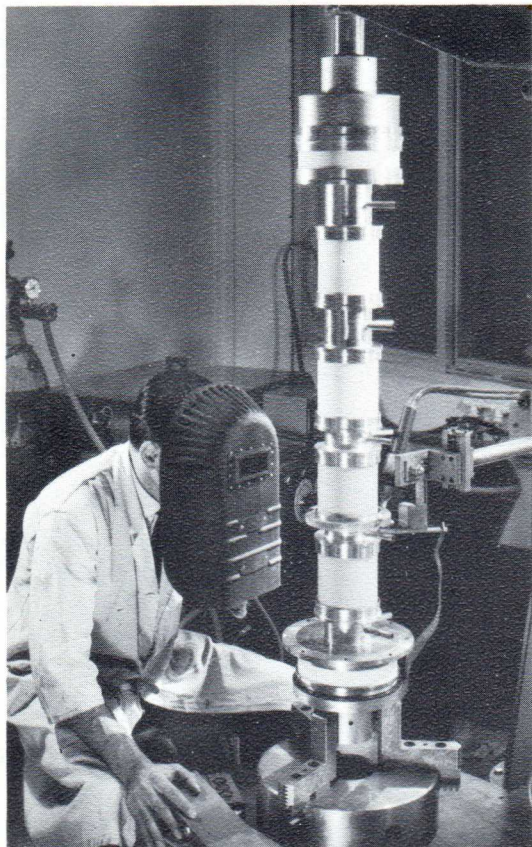
The F2055 klystron can operate at 500 MHz either in CW or pulsed conditions. In the 1st mode the objective is 250 kW CW. In the second, the objective is 500 kW peak, 250 kW average. This tube is developed for the DESY Synchrotron in Hamburg.

Pulsed tubes :

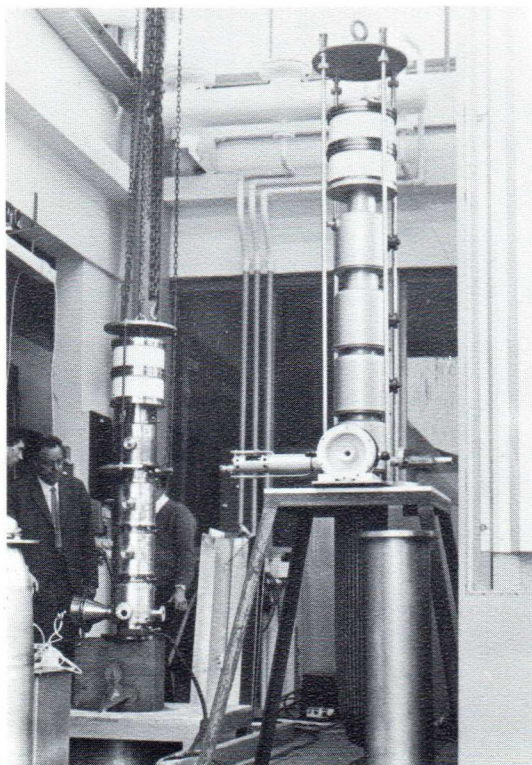
The production of high power pulsed tubes, as well as that of the other power klystrons, is achieved in the "Corbeville" Center. These tubes, widely used in CSF linear accelerators, feature high gain, high peak and average powers, and high efficiency; at the present, 63 tubes are in operation, two of these on the British Lineac "NINA".

Recent productions concern the F2042 klystron at a 30 MW peak 25 kW average power with two output windows, and the F2040 at a 25 MW peak 12 kW average power. CSF background in microwave tubes, and more specially in klystrons, is available to develop new tubes on requirements.

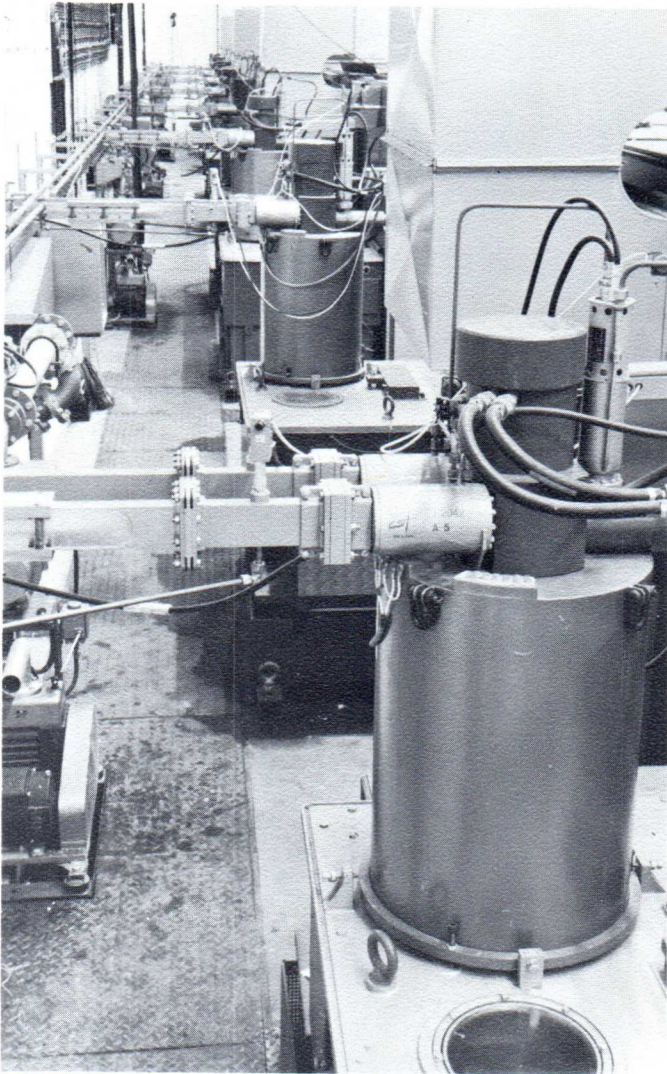
Besides, high stability klystrons for doppler applications are studied and developed at Corbeville but their characteristics are not available in this catalogue.



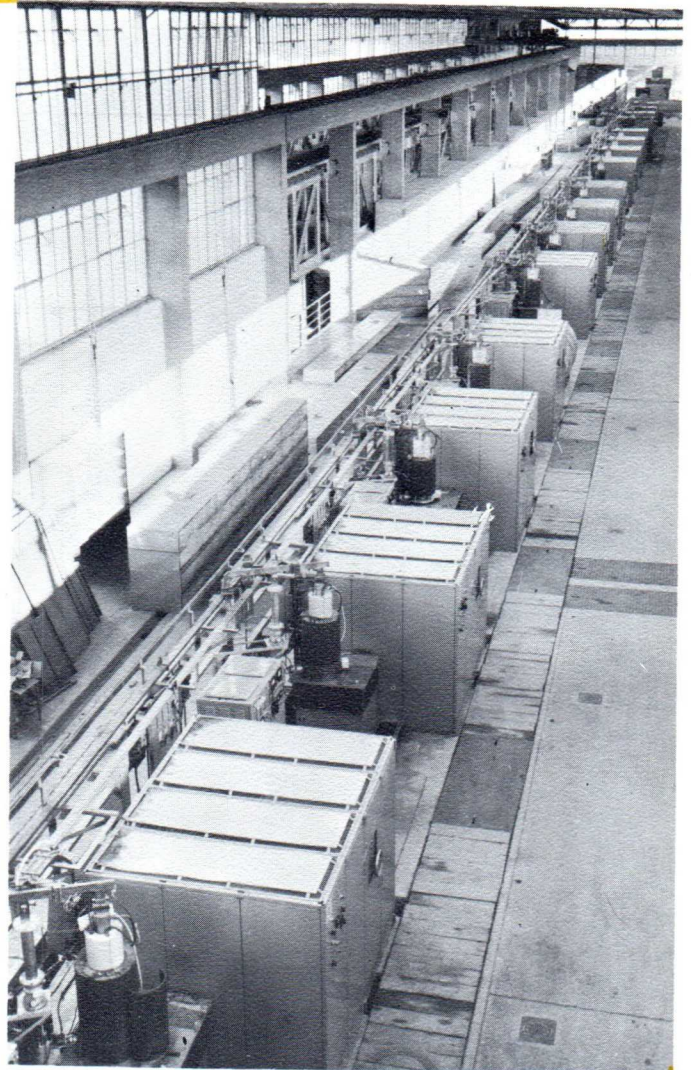
"Argonac" welding of a F2008 klystron body on an automatic machine.



F2055 klystron testing room.



Linear accelerator constructed by CSF for MAYENCE University, fitted out with F2042 klystrons.



ORSAY linear accelerator fitted out with F2043 klystrons.

PULSE OPERATION

TYPE		Operat. frequency	Peak power	Mean power	High voltage	Beam current	Gain	Pulse duration	Focusing
"F"	"CSF"	GHz	MW	kW	kV	A	dB	μs	
F2011□	—	3.0	0.05	0.05	40	15 pA		10	electromagnetic
F2052□*	—	3.0	0.06	0.2	40	15 pA		10	electromagnetic
F2055▲*	—	0.499	0.5	250	47	26 pA	37	10 000	electromagnetic
F2015	KA435	3.0	5	5	125	105 pA	39	2.2	electromagnetic
F2043	KA436	3.0	20	2.5	250	230 pA	43	2.5	electromagnetic
F2040	KA438	3.0	25	12	285	265 pA	50	6	electromagnetic
F2042	KA437	3.0	30	25	310	280 pA	50	6	electromagnetic
F2049	—	2.856	30	25	300	280 pA	50	6	electromagnetic

□ Pilot klystron. * Type under development.

▲ This tube can operate in CW conditions, providing 250 kW CW output power.

REFLEX KLYSTRONS

TYPE		Heater		Frequency range	TYPICAL OPERATION						Electron tuning range
		V _f	I _f		Cavity voltage	Cavity current	Frequency	Reflector voltage	Grid voltage	Output power	
"F"	"CSF"	V	A	GHz	V	mA	GHz	V	V	W	MHz

WIDE ELECTRONIC TUNING BAND REFLEX KLYSTRONS, with external cavity. Natural air cooling.

6BL6	—	6.3	0.68	1.6-6.5	325 325	28 25	2.0 4.0	-140 -300	0 0	0.200 0.150	6 6
5836*	—	6.3	0.68	1.6-6.5	325 325	25 25	2.0 4.0	-140 -300	+10 +10	0.200 0.120	6 6
6BM6	—	6.3	0.68	0.55-3.0	300 325	18 22	1.15 2.2	-40 -500	0 0	0.020 0.100	6 4
5837*	—	6.3	0.68	0.55-3.0	325	22	0.8	-50	+10	0.100	6

BUILT-IN CAVITY LOW NOISE REFLEX KLYSTRONS, for telecommunications. These tubes are used for CSF radio-link equipments.

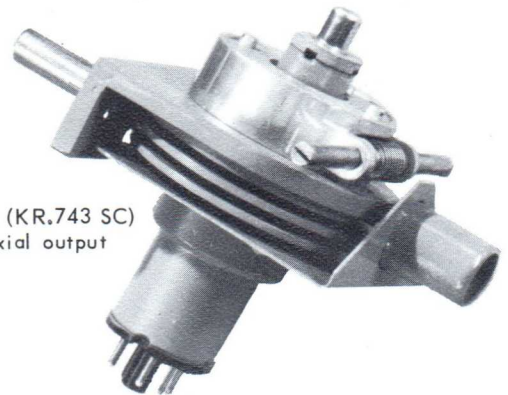
WAVEGUIDE OUTPUT

F2021	KR.740**	6.3	1	2.90-3.50	1000	85	2.90	-230	—	1.3	25
					1000	85	3.20	-375	—	2.8	22
					1000	85	3.50	-570	—	3.0	17
					500	30	2.90	-375	—	0.4	10
F2022	KR.741***	6.3	1	3.45-3.75	500	30	3.20	-520	—	0.45	8
					500	30	3.50	-300	—	0.2	10
					850	67	3.50	-250	—	1.5	28
					850	67	3.70	-325	—	1.7	22
F2023	KR.742***	6.3	1	3.75-4.0	850	67	3.90	-435	—	1.6	15
					850	67	3.70	-250	—	1.5	25
					850	67	3.90	-330	—	1.7	21
F2024	KR.743***	6.3	1	4.0-4.25	850	67	4.10	-450	—	1.5	16
					850	67	3.90	-230	—	1.5	26
					850	67	4.10	-310	—	1.65	23
					850	67	4.30	-400	—	1.3	17

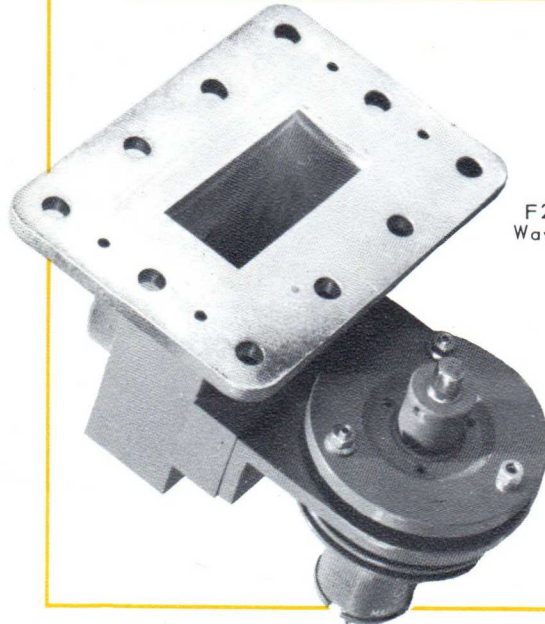
* Pulse operation or CW ** Output on CNET λ 7 waveguide *** Output on CNET λ 6 waveguide.

COAXIAL OUTPUT

F2025 KR.740SC Same characteristics as F2021, F2022, F2023 and F2024 but with output on coaxial line.
 F2026 KR.741SC
 F2027 KR.742SC Impedance 75 Ω and frequency adjustable by worm wheel and screw.
 F2028 KR.743SC



F2028 (KR.743 SC)
Coaxial output



F2024 (KR.743)
Waveguide output

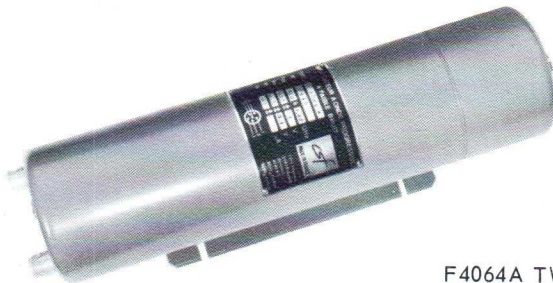
KLYSTRONS - TUBES FOR MAINTENANCE						Frequency range	Output power
TYPE							
"F"	"CSF"	"F"	"CSF"	"F"	"CSF"	GHz	W
				F2013	KR.117	2.75-3.65	0.380
	KR.740SCA	F2030	KR.760			2.90-3.50	2.8
	KR.741SCA	F2031	KR.761	F2037	KR.781	3.45-3.75	1.7
F2029	KR.742SCA	F2032	KR.762	F2038	KR.782	3.75-4.0	1.7
	KR.743SCA	F2033	KR.763	F2039	KR.783	4.0-4.25	1.65

TRAVELLING-WAVE TUBES

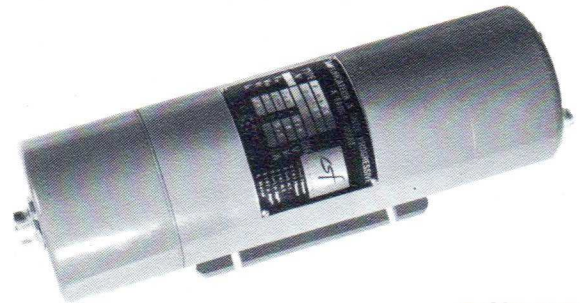
LOW NOISE T.W.T.

TYPE		Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
" F "	" CSF "	GHz	mW	dB	dB	V max	mA	kg	
F4064A	TPO.251A	1.2 - 1.4	0.15	>20	< 4.5	300	1.0	8.5	aimant permanent
F4129	-	2.9 - 3.1	1.5	> 25	< 5.6	450	0.5	7.3	aimant permanent
F4115*	-	28 - 34	< 50	> 20	< 15	2.500	7	8.0	aimant permanent

* Type under development.



F4064A TWT



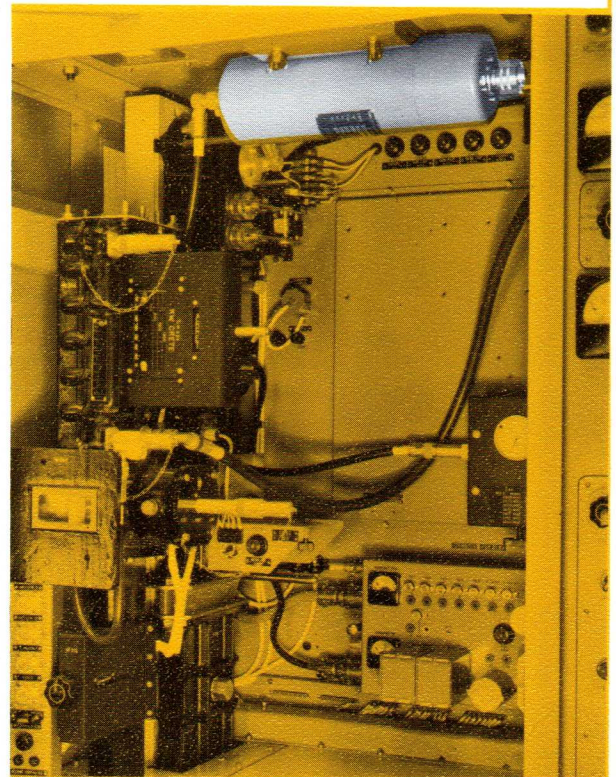
F4129 TWT

LOW-NOISE TRAVELLING WAVE TUBES

From the start, CSF laboratories have taken part in advances and improvements of travelling wave tubes. In this field, they have been concerned both with pulsed tubes and high-gain medium power tubes, or with low noise or very low noise tubes. In the latter field, operational tubes, such as the F4129 for S band and the F4064 for L band, improve signal to noise ratio on radars in which they are fitted. Spectacular range improvements were thus obtained. These tubes possess the property of saturating at a very low power level and are therefore able to protect and increase the life of mixer crystals in radar RF heads. They are focused by permanent magnets and require no cooling. They operate over a wide band and can thus be used in wide-band radar. Around 8 mm wavelength the F4115 tube is suitable for use in radiometry equipments which also operate over a wide band.

WIDE-BAND, MEDIUM NOISE TRAVELLING WAVE TUBE

These wide-band high-gain travelling wave tubes have a low noise figure which varies from 10 to 15 dB over the 1 to 18 Hz band (covered by 5 tubes). Developed for the military market, they feature low weight (1 kg, magnet included), high gain and octave bandwidth. They are intended for use in radar detection equipment and withstand severe environmental conditions. A series (B) is fitted with built-in divider bridges; the tubes are thus supplied only with one high voltage and the heater supply.



Adjunction of a F4129 TWT to a ER.437 radar.

WIDE-BAND, MEDIUM NOISE T.W.T.

TYPE	Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
" F "	GHz	mW	dB	dB	V _{max}	mA	kg	
F4123B*	1.0 - 2.0	10	> 35	< 12	300	< 8	1	periodic magnets
F4100B*	2.0 - 4.0	40	> 35	< 12	700	< 10	1	periodic magnets
F4024	2.15 - 4.3	40	> 35	< 12	600	< 2	1	periodic magnets
F4025	4.0 - 7.0	30	> 35	< 13	850	< 1	1	periodic magnets
F4101B*	4.0 - 8.0	30	> 35	< 13	900	< 5	1	periodic magnets
F4026	6.9 - 11.1	10	> 35	< 14	1 000	< 1	1	periodic magnets
F4102B*	8.0 - 10.5	10	> 35	< 13.5	1 400	< 4	1	periodic magnets
F4156*	11.0 - 18.0	10	> 35	< 16	1 500	< 3	1	periodic magnets

* Built-in resistor bridge makes the unit adjustment-free and requiring only two input fixed voltages, for heating and high voltage.



F4024 TWT

MEDIUM POWER TRAVELLING WAVE TUBES

These tubes are designed for microwave links; they are mostly periodic permanent magnet focused like the F4017D and the F4059A. The F4056B (TPO 410) permanent magnet focused is used, for example, in school television transmission; it is also used to increase the power level of microwave links.

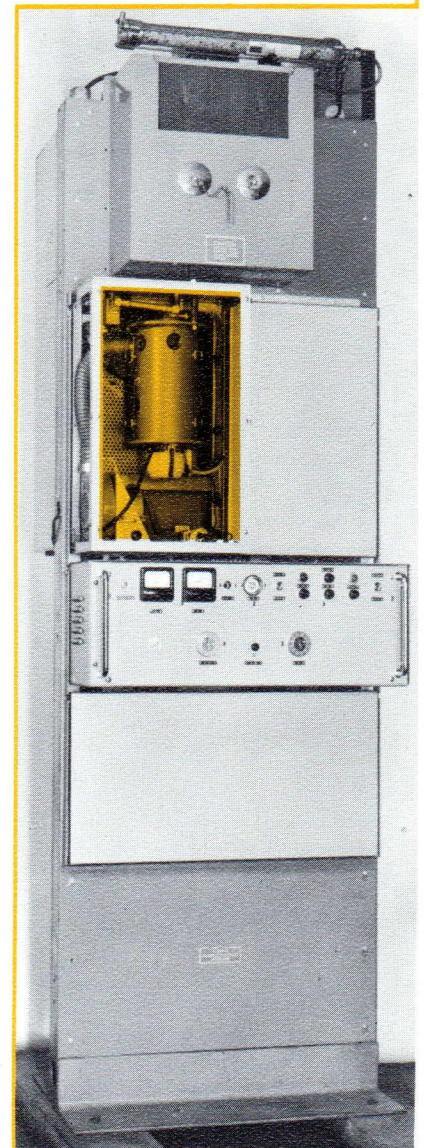
Other travelling wave tubes, with 1 to 10 W wide-band, and PPM focusing, are mainly intended for test instruments. They can be used also to increase power in microwave links.

Power supply packs have been developed at the GTE including tubes of these three families.

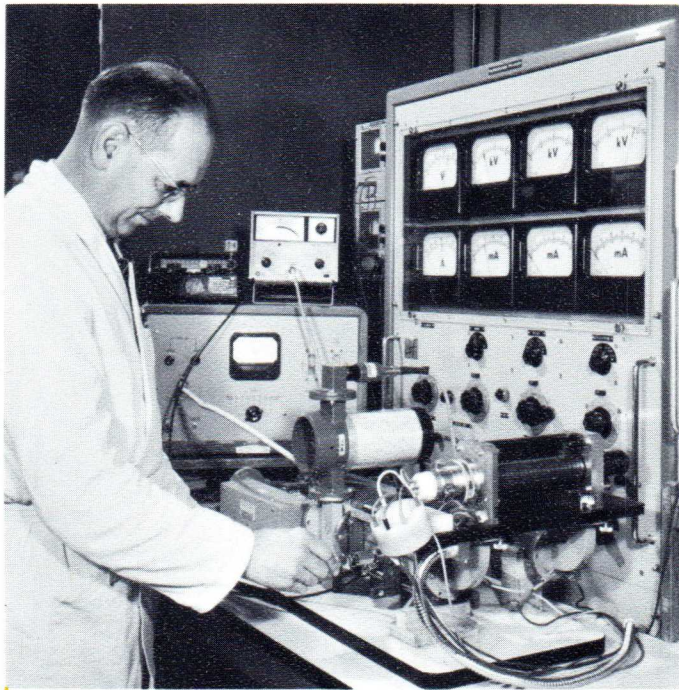
PULSE TRAVELLING WAVE TUBES

These tubes are used as pre-amplifiers in wide-band radar chains. Higher power tubes working on higher frequencies have been developed in the past, or are in development.

Type "O" and type "M" (crossed fields - TPOM on pulse or CW) tubes have given rise to important developments for "classified" applications in the field of radars and of counter-measures equipments.



Adjunction of a F4056 TWT and its supply to a "PHILCO" type radio-link



F4181 TWT testing bench.



F4017D TWT
cooled by conduction

MEDIUM POWER T.W.T.

TYPE		Frequency range	Useful power	Gain	Noise factor	High voltage	Current	Weight	Remarks
"F"	"CSF"	GHz	W	dB	dB	V max	mA	kg	
F4087	-	1.0 - 2.0	> 1	30	25	1 200	< 35	1.3	periodic magnets
F4134	-	1.0 - 2.0	> 10	30	25	1 600	< 50	1.3	periodic magnets
F4017D	-	1.7 - 2.7	> 7	30	25	2 000	< 55		periodic magnets
F4088	-	2.0 - 4.0	> 1	30	25	1 500	< 35	1.3	periodic magnets
F4135	-	2.0 - 4.0	> 10	30	25	2 000	< 75	1.3	periodic magnets
F4059A	-	5.9 - 6.5	> 12 □	36	23	3 900	< 55	0.5 + foc. 8.0	periodic magnets
F4181*	-	5.9 - 6.5	> 16 □	37	23	3 900	55	8.0	periodic magnets
F4056B	TPO.410	6.0 - 7.5	> 8	23	25	2 600	< 45	0.5 + foc. 11.0	permanent magnet
F4173*	-	8.2 - 12.4	> 3	35		2 500	20	0.5 + foc. 10.5	permanent magnet
F4185*	-	10.6 - 13.5	> 4	40		2 500	20		periodic magnets

* Types under development.
□ In linear operation.

PULSE OPERATION T.W.T.

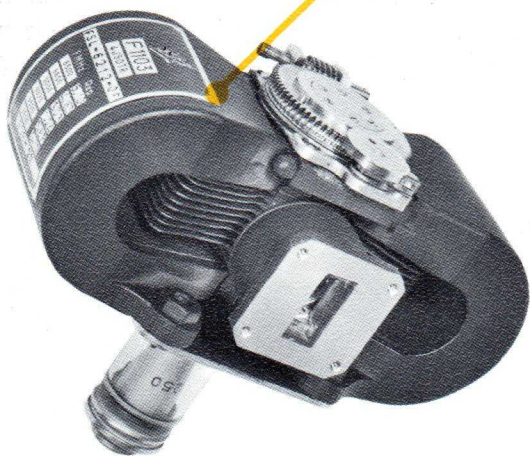
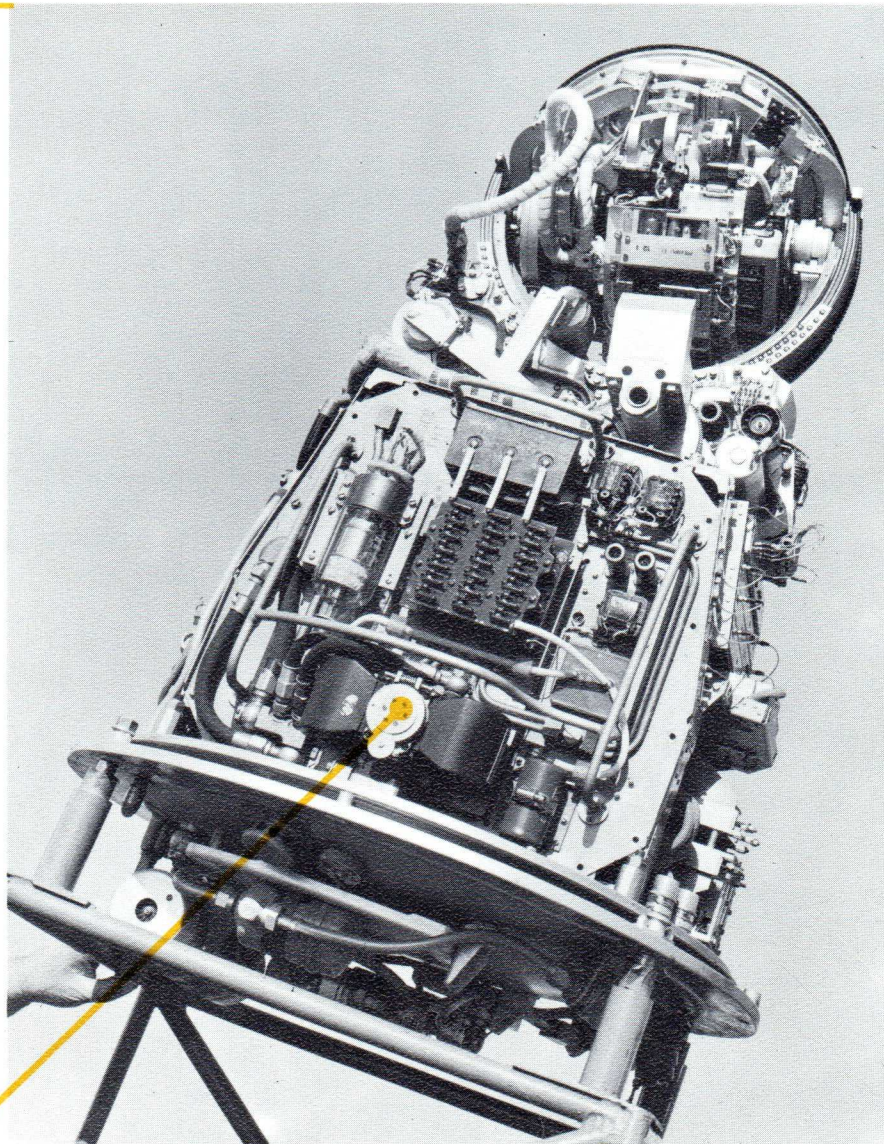
F4061	TPO.025	1.2 - 1.4	7.5	20	-	1 kV pk	100 mA pk	2.6	permanent magnet
F4063	TPO.125	1.2 - 1.4	> 3.5 kW	28	-	12 kV pk	4.5 A pk	5	periodic magnets

TUBES FOR MAINTENANCE

TYPE	"F"	F4017A	F4107C	F4107D	F4069	F4071	F4066	F4056D	F4017B
	"CSF"	-	-	-	TPO.851	TPO.921	TPO.430	-	-
Frequency range	GHz	1.7 - 2.0	2.9 - 3.2	2.9 - 3.5	3.6 - 4.1	3.8 - 4.2	3.8 - 4.2	6.5 - 7.5	1.7 - 2.7

X-band tubes are used in CSF aircraft radars. The 7008 and 7006 international versions were recently developed. More than two thousand MCV 1055 tubes are used in ER 37 S band transmitter-receivers. The MC 567 type is used in CSF air traffic control radars.

Recent developments have been concerned with continuous wave tubes delivering 1 to 5 kW at 2450 MHz, for heating purposes. Matched power supplies and microwaves components have also been developed for the realization of domestic or industrial ovens.



F1103 (4J50TR) - Magnetron used in the "CYRANO" radar which equips the "MIRAGE III" airplane.



F1112 - Air-cooled magnetron for industrial heating.

MAGNETRONS

TYPE		Cooling [▲]	Frequency range	Heating voltage	Heating current	Anode-cathode capacity	TYPICAL OPERATION				
							Anode peak voltage	Anode peak current	Filling percent	Pulse duration	Rated useful peak power
" F "	" CSF "		MHz	V	A	µF	V	A		µs	kW

X BAND

a) Fixed frequency

4J52A	—	2	9345 - 9405	12.6	2.2	13	15 000	15	0.001	1	75
4J50A	—	2	9345 - 9405	13.75	3.3	16	21 500	27.5	0.001	0.5	240

b) Tunable frequency

F1002	4J52T	2	8500 - 9600	12.6	2.2	12	15 000	15	0.001	1	70
F1097A	MCV602A	3	8500 - 9600	12.6	2.2	12	15 000	15	0.001	1	70
F1005	4J50TO	1	8500 - 9600	9	2.6	15	22 000	27.5	0.001	1	220
F1103	4J50TR	2	8500 - 9600	9	2.6	15	22 000	27.5	0.001	1	220
F1103A	(# 7008)	2	8500 - 9600	13.75	3.2	15	22 000	27.5	0.001	0.2 to 2.5	220
F1110A	(# 7006)	2	9000 - 9600	13.75	3.2	15	22 000	27.5	0.001	0.2 to 2.5	220

S BAND

a) Fixed frequency

F1030 [▲] F1044 [□]	MC1055A [▲] MC10550	2	2897 - 3228	14	5.2	25	31 000	65	0.001	4,4 max.	1 200
--	---------------------------------	---	-------------	----	-----	----	--------	----	-------	-------------	-------

b) Tunable frequency

F1054	MCV1055E	2	2900 - 3015	14	5.2	—	30 000	65	0.001	4	1.1 MW
F1055	MCV1055F	2	2985 - 3115	14	5.2	—	30 000	65	0.001	4	1.1 MW
F1056	MCV1055G	2	3085 - 3200	14	5.2	—	30 000	65	0.001	4	1.1 MW

L BAND

a) Fixed frequency

F1088 [▲] F1096	MC567A [▲] J	1	1270 - 1370	20	13	—	40 000	152	0.00125	5	2 500
F1113	—	—	1200 - 1400	15	15	—	30 000	30	0.002	8	500

b) Tunable frequency

F1105	—	1	1200 - 1400	15	15	—	35 000	60	0.002	10	500
-------	---	---	-------------	----	----	---	--------	----	-------	----	-----

MAGNETRONS FOR INDUSTRIAL PURPOSES-CW

F1115	—	2	2425 - 2475	12	3	—	3 500	0.55	—	—	1.0
F1112	—	1	2425 - 2475	12	3	—	3 500	0.8	—	—	1.5
F1122	—	2	2425 - 2475	12	3	—	3 500	0.8	—	—	1.5
F1117*	—	1	2425 - 2475	15	5	—	4 600	1	—	—	2.5
F1123*	—	1	2425 - 2475	15	5	—	7 000	1.5	—	—	5.0

▲ 1. Water-cooled. - 2. Air cooled - 3. Cooled by inertia.
□ 15 Sub-ranges of 25 MHz † Types under development.

MAGNETRONS-TUBES FOR MAINTENANCE

TYPE	Fixed frequency					Tunable frequency				
	" F "	F1057 to F1077	—	—	F1098	F1099	F1100	F1101	F1118	
	" CSF "	MC83 to MC103	MCV101A1	MCV101B1	MCV101C1	MCV101D1	MCV1053C	MCV1053D	MCV1055H	
Frequency range (MHz)		2 925 to 3 525	2 900 to 3 000	3 100 to 3 200	3 300 to 3 400	3 500 to 3 600	2 900 to 3 025	3 025 to 3 150	2 975 to 3 025	
Peak power (kW)		400	0.12	0.12	0.12	0.12	0.12	0.12	0.12	

"O" CARCINOTRON TUBES

TYPE		Frequency range	Mean useful power min.-max.	Anode 1 voltage	Max. anode 2 voltage	Anode 2 current	Modulation sensitivity	Weight with permanent magnet	Remarks
" F "	" CSF "	GHz	mW	V	kV	mA	MHz/V	kg	
F4028E	CO.515E	0.98- 2.1	220-1 100	200	1.5	60	2.7 to 0.5	6	coax. output
F4005C	CO.210C	1.6 - 3.2	240-1 200	200	1.7	60	5.0 to 0.5	4.6	coax. output
F4029D	CO.127D	2.0 - 4.0	120- 750	200	1.7	50	5.0 to 0.6	4.6	coax. output
F4003C	CO.119C	2.4 - 4.7	100- 600	200	1.5	40	7.0 to 0.7	4.6	coax. output
F4187	-	3.0 - 6.0	50- 900	200	1.6	40	6.5 to 0.5	3.5	coax. output
F4006C	CO.94C	3.6 - 7.2	30- 300	200	1.5	40	8.0 to 1.0	3.5	coax. output
F4084	-	4.0 - 8.0	30- 240	200	1.5	35	7.5 to 1.9	3.5	coax. output
F4007C	CO.63C	4.8 - 9.6	20- 280	200	1.7	40	12.0 to 1.2	3.5	coax. output
F4008C	CO.43C	7.0 - 11.0	45- 200	150	1.46	35	7.1 to 2.1	3.5	coax. output
F4053	-	7.0 - 12.4	35- 140	250	1.5	25	13.0 to 1.0	2.5	coax. output
F4032B	CO.521B	8.0 - 16.0	15- 85	200	1.9	20	16.0 to 2.0	2.5	coax. output
F4171A*	-	12.4 - 18.0	25- 60	300	1.5	35	12.0 to 3.0	2.5	waveguide output RG91/U
F4033B	CO.2012B	15.5 - 24.0	35- 115	400	2.4	40	9.5 to 2.5	7.5	waveguide output RG53/U
F4034B	CO.1308B	23.5 - 37.5	22- 110	400	3.1	40	10.7 to 3.7	15	waveguide output RG96/U
F4143	CO.80	39 - 41	10 W - 20 W	2 000	6.0	85	1.5 to 0.7	16	waveguide output RG97/U
F4076	CO.40B	68 - 72	2 W - 10 W	1 800	6.0	70	2.0 to 1.2	16	waveguide output RG98/U
F4150	CO.40A	73 - 77	2 W - 10 W	1 800	6.0	70	2.0 to 1.2	16	waveguide output RG99/U
F4075	CO.20B	130 - 142	100-1 000	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4146	CO.20A	140 - 158	100-1 000	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4158*	CO.20-5	Δf 2 GHz** from 130 to 155	1 W - 5 W	2 000	6.0	60	12.0 to 10.0	16	waveguide output RG138/U
F4074	CO.10	290 - 320	5- 50	1 600	6.0	50	20.0 to 8.0	16	waveguide output RG138/U

* Types under development.

** Electronic tuning band over which the minimum power output can be provided, the mid-band frequency being adjusted at any value included between the 2 mentioned limits.



F4007C



F4171

"O" CARCINOTRON TUBES-TUBES FOR MAINTENANCE

TYPE	" F "	F4028A	F4028H	F4005A	4003A	F4007A	F4008B
	" CSF "	CO.515A	CO.515H	CO.210A	CO.119A	CO.63A	CO.43A
Frequency range	GHz	0.98-2.1	1.215-1.385	1.6-3.2	2.4-4.7	4.8-9.6	7.0-11.0

These electronically tuned, wide-band oscillators, invented in 1951, have established the prestige of CSF tubes.

They form three families :

- "M" Type power carcinotrons, developed for jamming equipments.
- "O" Type, low power, very wide band carcinotrons, used in test generators or military detection equipment, from 1000 to 37,500 MHz (30 to 0.8 cm).
- "O" Type millimetric carcinotrons, developed at Corbeville; these power sources cover continuously the 8 mm to 0.3 mm range. In addition to the spectacular aspect of world records attained (870 GHz), applications to physical instrumentation (plasmas in particular) have been found. Many CSF millimetric carcinotrons are in operation throughout the world.

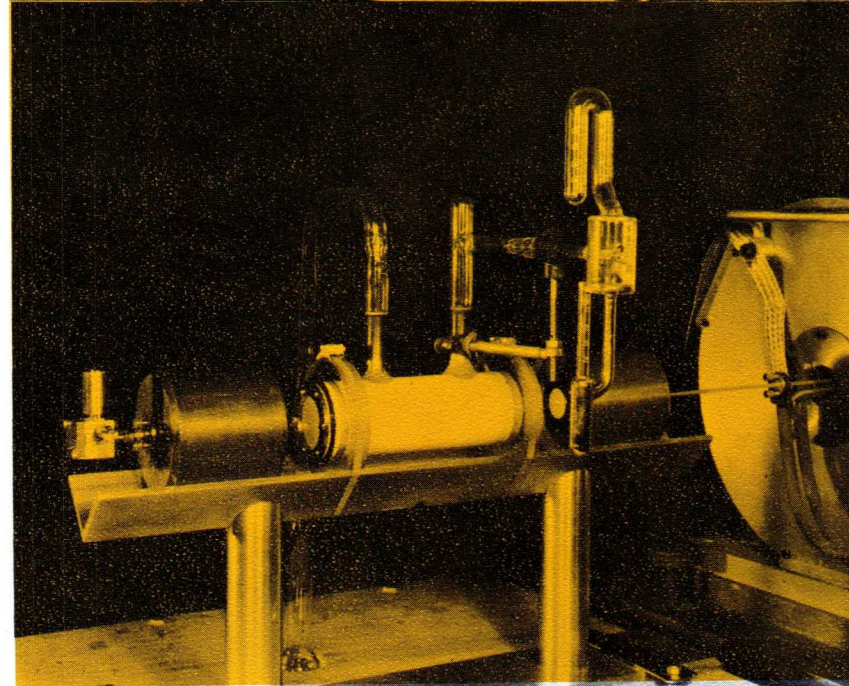
A large number of "M" type carcinotrons for airborne application have been developed at Levallois. Recent studies have shown the interest for various applications of a driven version, the "carpitron", which combines the possibility of frequency versatility with high frequency stability.

The new centimetric carcinotron series features a high purity of the signal and a small size. Tubes F 4028 E - F 4029 D - F 4084 - F 4032 - 4033 and 4034 cover continuously the 1 to 37.5 GHz spectrum.

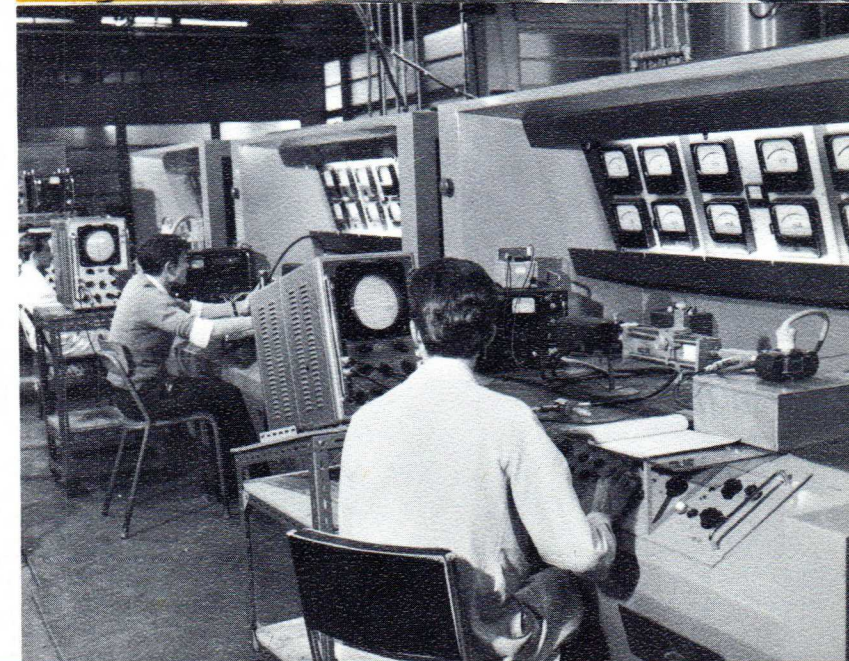
F4146 (CO.20A)



①



②



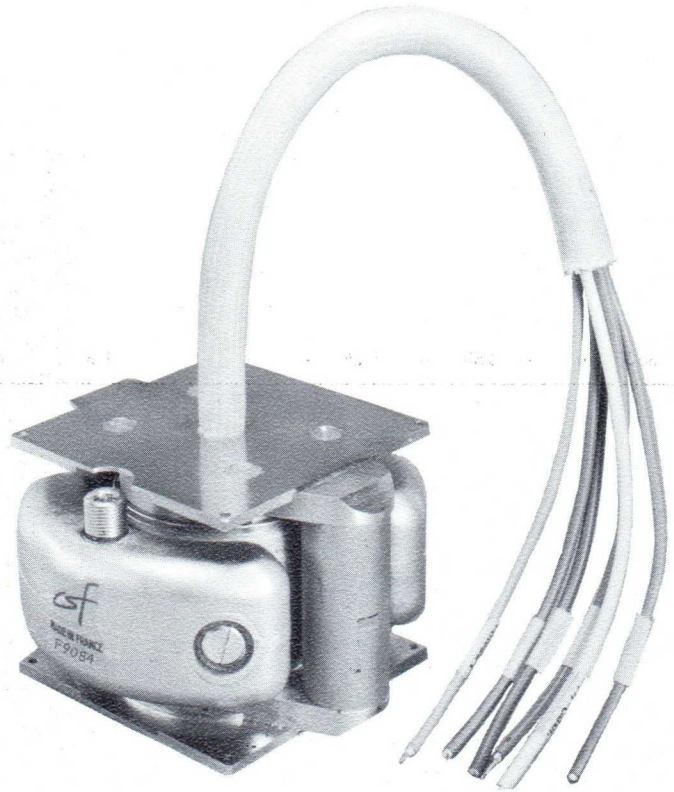
③

- ① "O" carcinotron " assembly shop.
- ② Measurement of absorption line of the ammonia molecule by means of an "O" type carcinotron at 0,5 millimetre wavelength.
- ③ Carcinotron testing bench.

CROSSED FIELD NOISE GENERATORS

Noise generators are crossed-field power tubes. They have been the subject of many important recent developments. At levels of 10 watts to 1 kW, these small size tubes produce, without modulation, noise over a wide frequency band and may be tuned electronically. Other types of tubes developed in the CSF laboratories have higher performances than shown here, relating to available tubes.

TYPE	Frequency	Power	Max. voltage	Current
	MHz	W	V	A
F9076	200 - 400	40	1 500	0.2
F9084	450 - 750	100	2 200	0.35
F9091	1 250 - 1 350	60	1 700	0.4
F9099	2 700 - 3 300	400	5 000	0.8



F9084 noise generator.

NOISE SOURCE FOR TEST EQUIPMENT

TYPE		
"F"	"CSF"	
F9015	BG52-9	For noise measurement within 10 cm range
F9014	BG22-9	" " " " 9 cm "
F9016	BG65-9	" " " " 9 cm "
F9013	BG22-3	" " " " 3 cm "
F9093	-	" " " " 3 mm "

Low-power BG sources are test equipments for measuring the noise figure of receivers.

DUPLEXER TUBES

DUPLEXER TUBES FOR C AND S BAND RADARS

TYPE		Spécification	Frequency range	Max. useful power		Max. ins. loss	Max. deioniz. time attenuation 3 dB
" F "	" CSF "			MW pk	kW mean		
F3024	AR434C	Spark gap	1.2-1.4	0.06	0.06	0.3	75
F3025	AR434E	Spark gap	1.2-1.4	0.06	0.06	0.3	75
F3027	AP433	Pre-TR window	1.2-1.4	3	3	0.6	50
F3023	AP623	Pre-TR window	1.2-1.4	8	6	0.6	75
F3004	AR414	Wide-band TR	2.9-3.23	0.03	0.03	0.9	40
F3003	AP413	Double Pre-TR	2.9-3.23	1.2	1.2	0.4	90



F3004 (AR.414)

TUBES FOR MAINTENANCE

TYPE		Spécification	Frequency range	Max. useful power
" F "	" CSF "			
F3031	ARL133	Wide-band TR	1.20 - 1.4	500
F3026	AR2L127	Double TR	2.90 - 3.26	1 100
F3022	AP427	Pre-TR	2.90 - 3.26	4 500
F3010	AR227	Tunable TR	2.91 - 3.55	500
F3009	AE227.5	A-TR	2.91 - 3.06	500
F3008	AE227.4		3.06 - 3.20	500
F3007	AE227.3		3.12 - 3.23	500
F3006	AE227.2		3.20 - 3.36	500
F3005	AE227.1		3.36 - 3.55	500



F3003 (AP.413)

NEON TUBES

Power indicators designed for instantaneous measurement of the peak power in a waveguide.

TYPE		
" F "	" CSF "	
F9017	IN10	400 to 1 600 kW - S Band
F9018	IN524	5 to 20 kW - X Band
F9019	IN663	2.5 MW - L Band



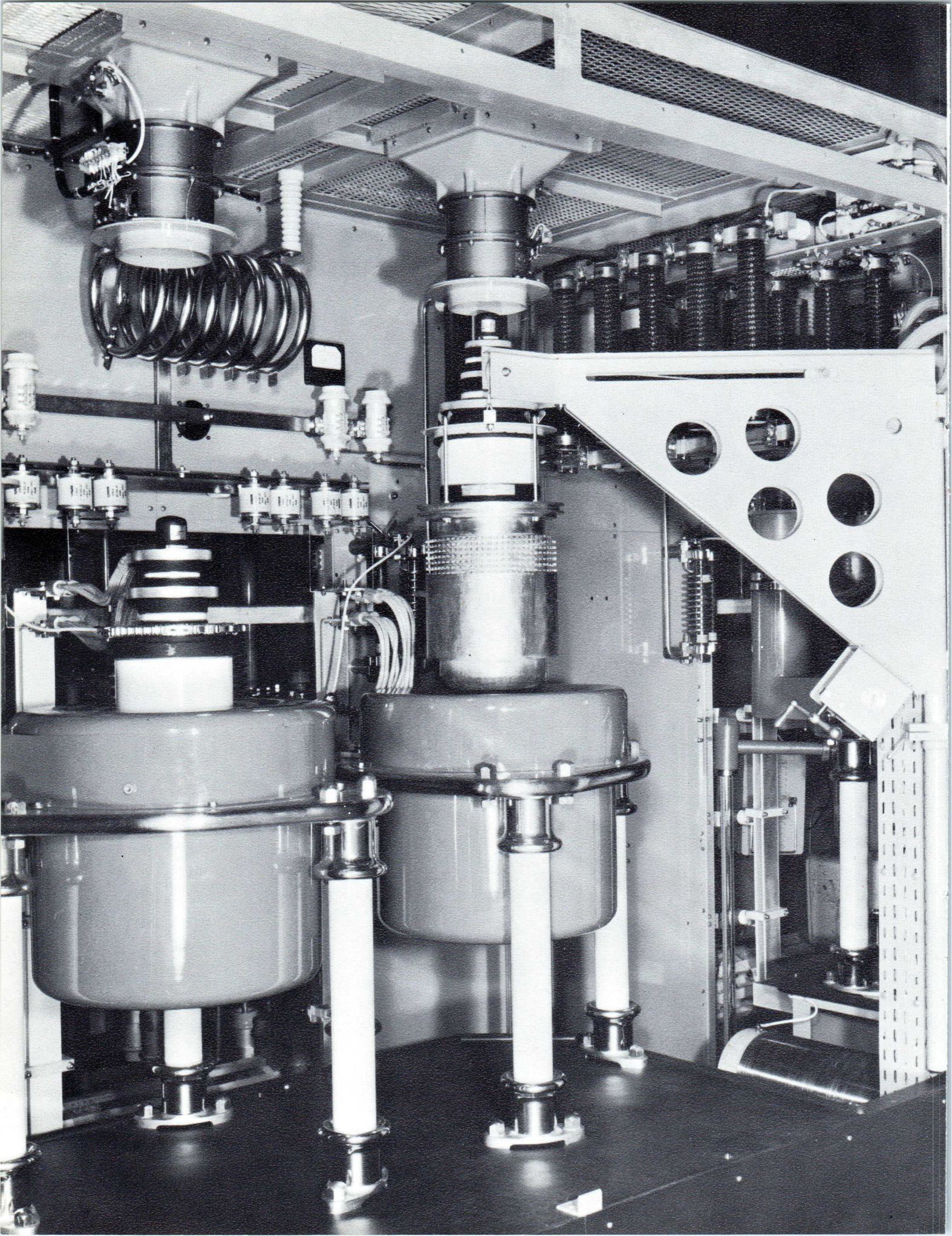
F3017 spark-gap.

SPARK-GAPS

To be used for passive protection of wide-band crystal detectors in radar equipments.

Type	Frequency range	Power supply					Max incident peak power	Total leakage power	Deioniz. time at 3 dB	Max. ins. loss
		Voltage	Current	Resistance transmitter side	Resistance receiver side					
	GHz	kV	mA	MΩ	MΩ	W	W	μs	dB	
F3018 *F3028	2 - 4.6	-1.5	0.3	20	8.7	15	1	155	2.44	
F3016 *F3029	4 - 7.3	-1.5	0.3	20	9.2	15	0.3	85	1	
F3017 *F3030	6.7-10.7	-1.5	0.3	20	6	15	0.2	85	1.2	

* RF connectors : type N.



TRANSMITTING TUBES

The first CSF productions in this domain date back to the time of the earliest telegraphy or radio transmitter. The G.T.E., with such antecedents, has followed up important efforts to develop power tubes for transmitters such as tubes operating in Radio Monte-Carlo or Radio-Luxembourg.

Alongside, its production and their applications have been diversified; thus, homogeneous series of high frequency tubes for industrial applications were realized, and hard tubes for high power radar or lineac modulators were developed.



TRIODES

TYPE		HEATER		Maximum ratings				Mean values		COOLING			
" F "	" CSF "	Vf V	If A	Fréq. MHz	Va kV	Ik A	Pa kW	s mA/V	k	Natural	forced air	Water	Vapor

TÉLÉCOMMUNICATIONS

F6005	E1300	7.5	39	60	5	1.2	1.5	12	18	●			
F6052	E1566R	7.5	95	30	10	3.2	6	33	44		●		
F6043	ETR533	11	275	30	15	10	25	44	42		●		
F6051*	E1966R	11	275	30	15	10	25	44	42		●		
F6047	ETV561	12	480	30	18	30	150	135	50				●

* Vapor cooling is available for this tube. In that case, anode dissipation $P_a = 100$ kW.

HARD TUBES

F6086	—	8	320	—	25	100	20	43	26				● Δ
F6046	—	12	480	—	40	300	150	135	50				● Δ

Δ This tube can be oil-cooled.

VOLTAGE REGULATION

6080WA*	—	6.3	2.5	—	0.25	0.15	0.013	7	2	●			
6336A*	—	6.3	5.0	—	0.4	0.2	0.03	13	2.7	●			
F6025	—	10	10	—	4	0.6	0.5	> 7.5	11.5	●			
F6075	—	7.5	39	—	5	1.2	1.5	12	21	●			
F6073	—	7.5	100	—	3	3.2	5				●		

* Double triode, values per section.

TETRODES

TYPE		HEATER		Maximum ratings				Mean values		COOLING				
" F "	" CSF "	Vf V	If A	Fréq. MHz	Va kV	Vg2 V	Ia mA	Pa W	s mA/V	k'	Natural	forced air	Water	Vapor

TELECOMMUNICATIONS

F6078	—	12	320	30	15	2 000	2 000	30 000	55	3.3		●		
F6080	—	12	320	30	15	2 000	2 000	100 000	55	3.3				●
F6053	EG1566R	7.5	100	100	8	1 000	3 000	5 000	20	4		●		
F6054	EGR664	7.5	105	100	8	1 000	3 500	5 000	20	4		●		
F6065	EGV1566	7.5	100	100	8	1 000	3 000	10 000	20	4				●
5933S	—	6.3	0.9	125	0.6	300	120	25	5.5	7.5	●			
829B	—	6.3 12.6	2.25 1.125	200	0.75	225	240	40	7	11	●			
F6022	P2,40B	6.3 12.6	2.25 1.125	200	0.75	225	240	40	7	11	●			
8501	—	4.5	125	900	7	1 500	4 000	10 000		16		●		
7650	—	6.3	7	1 200	3	1 200	600	600	25	13		●		

PENTODES

F6010	P.1300	10	20	30	4	950	1 000	1 000	15	6.5	●			
F6003	P.600A	10	10	60	3	800	600	400	6.5	6.5	●			



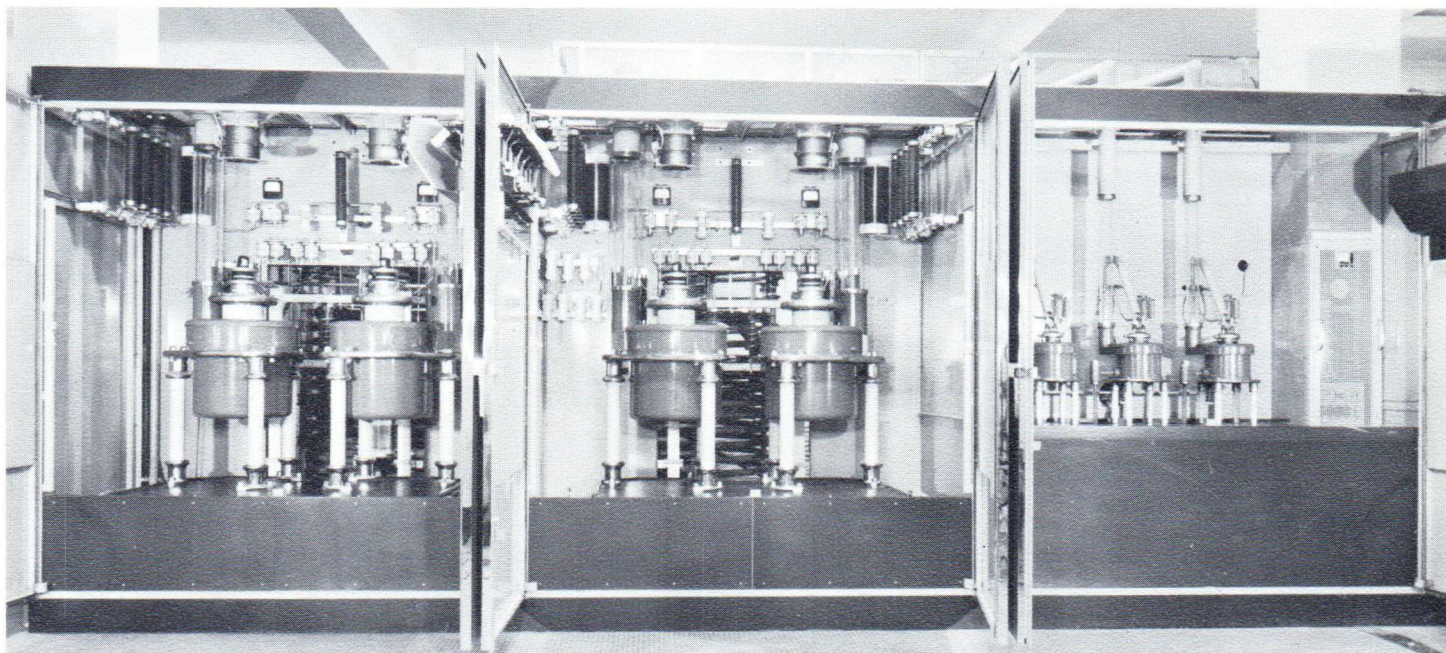
F6047



F6080



8501



Power stages of the 600 kW Radio-Luxembourg transmitter, fitted out with CSF F6047 (ETV.561) and F6065 (EGV.1566).

TUBES FOR MAINTENANCE

TRIODES

TYPE		Characteristics		
" F "	" CSF "	Pa kW	Vf V	Va kV

TELECOMMUNICATIONS

F6012	TAM10	0.012	12.6	0.2
F6058	E600	0.375	7.5	2.5
F6059	E1200	0.5	12	3.5
F6006	E1556R	6.0	17.5	5.5
F6055	GT20SD	12	20.4	17
F6056	GT30ST	12	18.2	17
F6030	E1801	16	30	12
F6048	ETO578	16	8.5	15
F6050	E1871R	17.5	7	12
F6035	E1986R	25	11	15
F6034	E1986	50	11	17
F6037	E2006B	50	30	18
F6040	E3056B	180	35	20
F6041	E3056T	180	17	16

VOLTAGE REGULATION

6080S	-	0.013	6.3	0.25
-------	---	-------	-----	------

PENTODES

F6015	P.40		6.3	
F6060	P.200A	0.150	10	2.2
F6070	P2.200A	0.300	10	4.4
F6061	P.1200A	0.6	12.6	3.5
F6062	P.1200M	0.7	12.6	3.5
F6049	P.1806	20	22	18

In this chapter are many high-power tubes, covering from a few tens of watts to several hundred kilowatts.

According to their type they are used in many fields :

- broadcasting, television, telecommunication, modulators, etc...

They are used more particularly as ;

- high-frequency amplifiers (with or without grid current)
- audio-frequency amplifiers
- pulse modulators
- voltage regulators.

Among the latest, some tubes are more particularly designed :

- for television transmitters :

Ceramic envelope tubes 7650 (useful power 600 W at 1000 Mc/s) and 8051 (useful power 5 kW at 1000 Mc/s)

- for ISB telecommunication transmitters :

Tubes F 6053/EG 1566 R (useful power 5 kW)
F 6051/E 1966 R (useful power 40 kW)
and F 6080 (useful power 60 kW).

- for power output stages, RF and AF, of broadcasting or telecommunication transmitters, tubes of ceramic construction.

F 6080 (useful power 100 kW)
and F 6047/ETV 561 (useful power 200 kW)
(The F6047 tube is used in the most recent 600 kW transmitters of Radio-Luxembourg and the 1200 kW transmitters of Monte-Carlo).

- for modulators in linear accelerators :

Tube F 6046 (12 MW peak - 150 kW mean)
(The F 6084 tube is designed for 25 MW peak, 300 kW mean) .

CERAMIC THYRATRONS

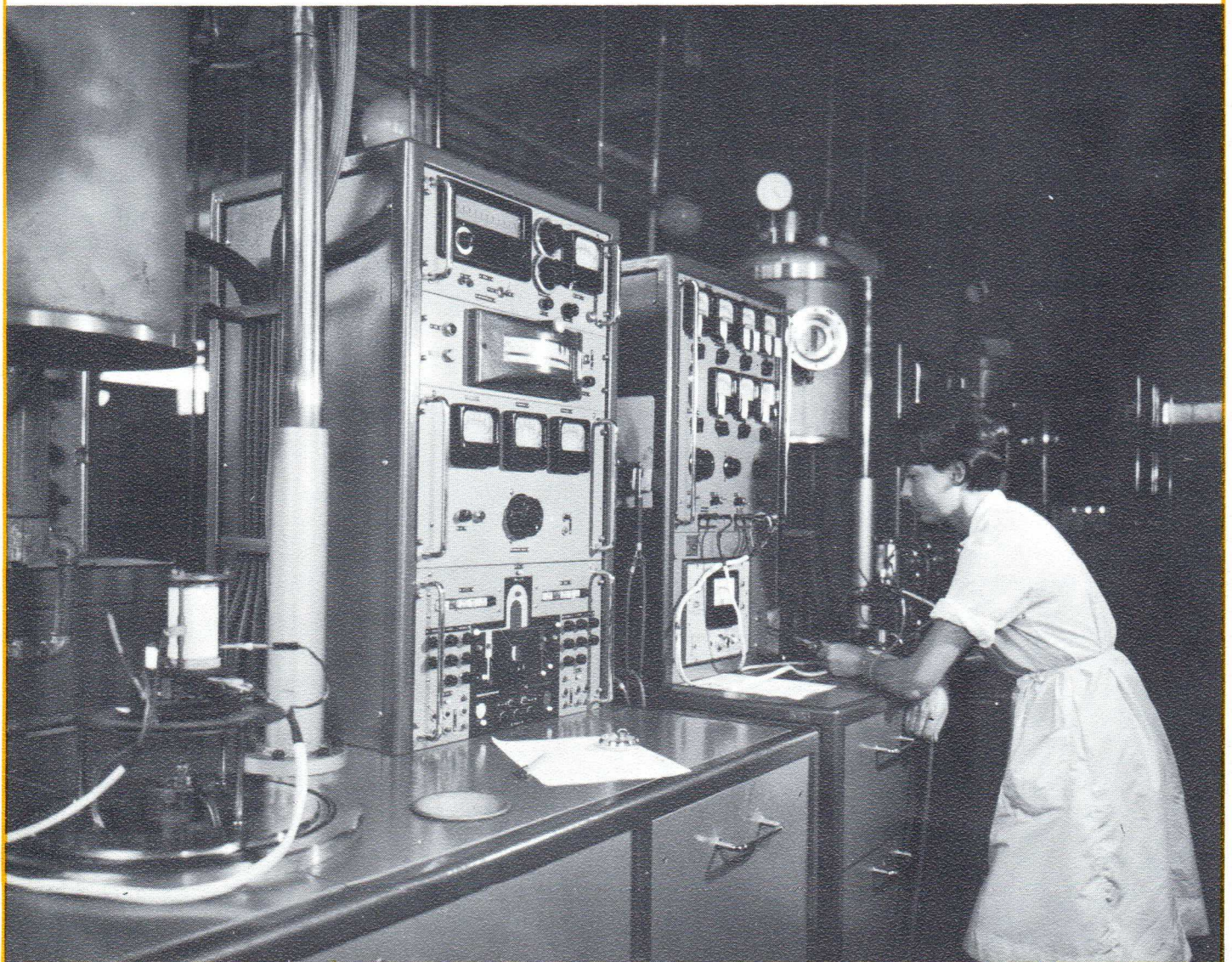
Developed under the sponsorship of the STTA (French Air Force) and suitable for use under difficult environmental conditions, these tubes are used increasingly in high-power radars and airborne radars.



F5008B

TYPE	Limit operating conditions				
	pk V_a (kV)	inv. pk V_a (kV)	pk I_a (A)	mean I_a (mA)	min. pk V_g (V)
F5008A	16	16	150	450	200
F5008B	16	15	350	500	200
F5023	8	8	90	100	175
F5024	20	20	500	500	200

Ceramic thyratrons bench.



DIODES AND RECTIFIERS

TYPE		Filling	Limit amb. temp.	Max. inv. volt.		Max. peak current		Max. mean rect. cur.		Heating	
"F"	"CSF"			a	b	a	b	a	b	Vf	If
				°C	kV	kV	A	A	A	A	V

a) Hot cathode

F5004	V30*	vacuum	—	15	30	0.3	5	0.05	0.018	6.3	1.1
F5005	V35B*	vacuum	—	17	40	0.5	10	0.1	0.015	6.3	2
F5011 F5011A	VH8600 VH8600A	merc.	25to55	20 18		10		5	—	5	18
F5020	—	vacuum	—	25	25	10		2	—	7.5	58
8020*	—	vacuum	—	40	40	0.75	2.5	0.1	—	5	6

b) Cold cathode

F5019	AR64	merc.	5-45	16	—	33.6	—	5.6	—		liquid cathode
-------	------	-------	------	----	---	------	---	-----	---	--	----------------

a = rectifier operation (with 0,1 µF filter input capacitance for tubes marked*).

b = pulse operation.



F5011A (VH.8600A)

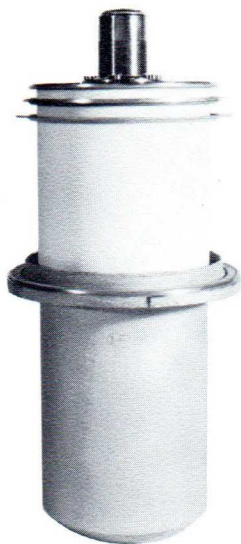
INDUSTRIAL APPLICATIONS

A complete series of tubes for industrial high-frequency applications have been developed; it covers a power range from 5 to 100 kW.

For the realisation of high frequency generators, up to 100 MHz, two tubes are especially suitable :

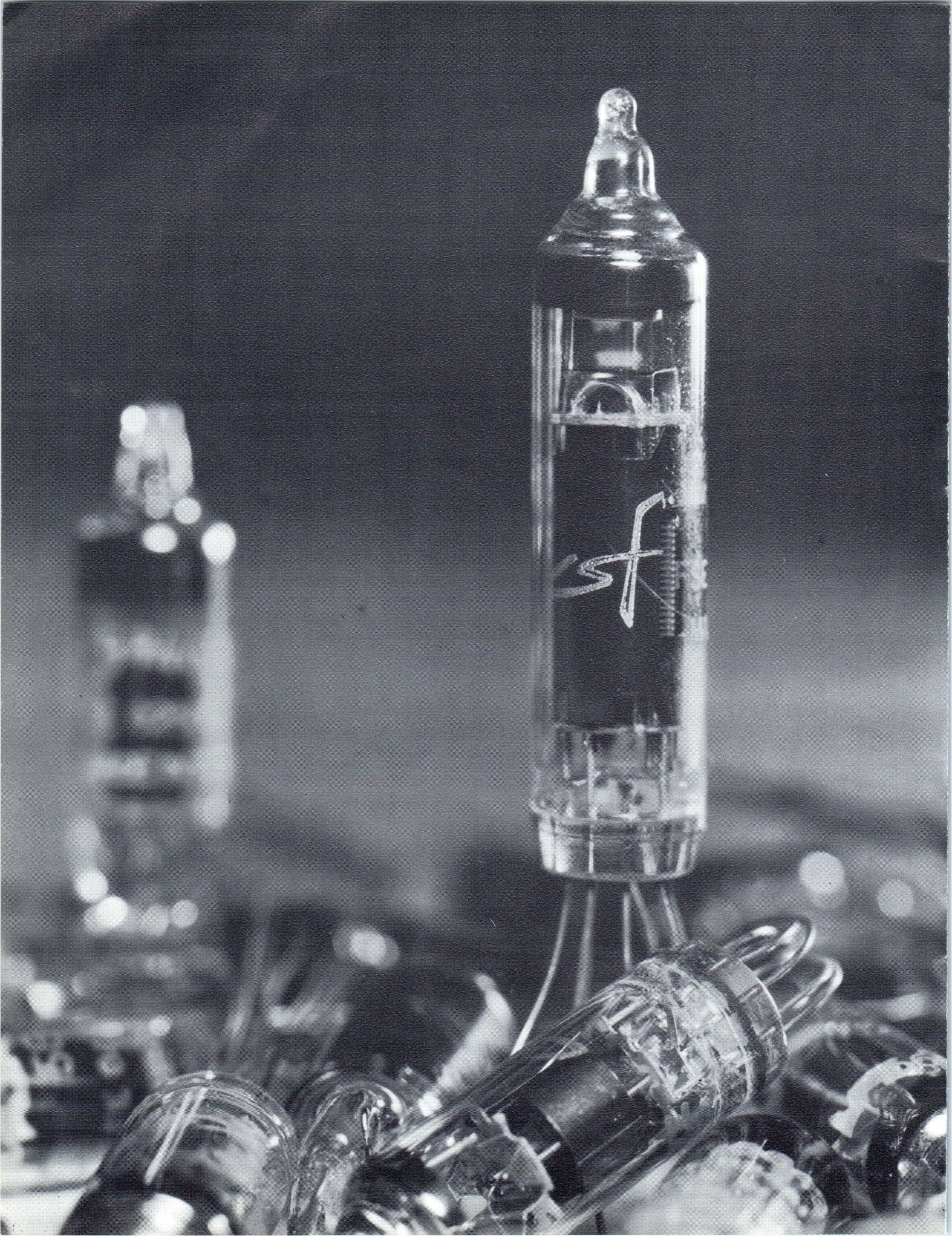
HFI 1016, ceramic envelope, 50 kW

HFI 1017, ceramic envelope, 100 kW



HFI.1017

TYPE	Purposes	Useful power	COOLING			
			Natural	Forced air	Water	Vapor
HFI.486	For HF generators.....	1 kW	•			
HFI.487	For HF generators.....	5 kW	•			
HFI.862	For HF generators.....	12 kW			•	
HFI.490	For HF generators.....	15 kW		•		
HFI.589	For HF generators.....	25 kW			•	
HFI.867	Low-frequency amplifiers for vibrating machine	25 kW			•	
HFI.863	For HF generators.....	40 kW			•	
HFI.1016	Ceramic envelope and coaxial output For 50 MHz generators.....	50 kW			•	
HFI.491	For HF generators.....	60 kW			•	
HFI.1017	Ceramic envelope and coaxial output For 50 MHz generators.....	100 kW			•	
HFI.1018	Ceramic envelope and coaxial output For HF generators.....	200 kW				•



RECEIVING TUBES AND MISCELLANEOUS

"Miniatron" and "Subnitron", are series of tubes used to solve problems of voltage and current amplification, as well as rectification and stabilisation problems which may arise for receivers and auxiliary circuits design, broadcasting and telecommunication transmitters, radars and practically all electronic equipments.



"MINIATRON"

TYPE	SPECIFICATION	HEATER		CHARACTERIS. absol. limit. values			TYPICAL OPERATION							Max. dimens.	
		V	A	V _a V	P _a W	P _{g2} W	V _a V	V _{g2} V	I _a mA	I _{g2} mA	R _k Ω	s mA/V	Ω k	Max. length mm	Dia. mm

DIODES

1Z2	Half-wave rectifier	1.25	0.265	Anode maxim. inv. peak voltage 15,000 V Anode minimum resistance 300 kΩ Anode max. peak current 8.5 mA Max. mean rectif. cur. 1.5 mA							68.6	19.0
5726(6AL5W)	RF twin-diode	6.3	0.3	Anode maxim. inv. peak voltage 360 V Anode minimum resistance 11 kΩ Max. peak current per anode 60 mA Max. rectified current per anode 9 mA							45.3	19.0

TRIODES

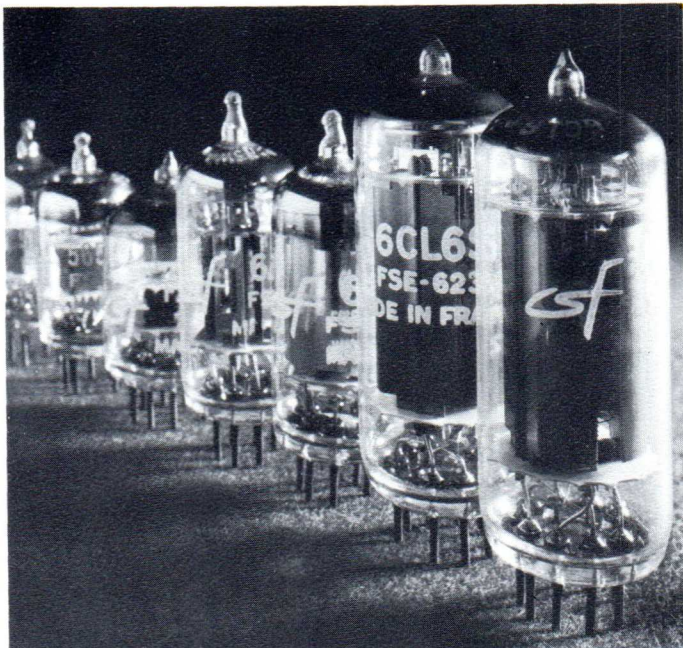
6J4S	UHF triode, grounded grid operation	6.3	0.4	165	2.2	—	100 150	—	10 15	—	100 100	11 12	5 4.5	54.8	19.0
6J4WA	UHF triode, grounded grid operation	6.3	0.4	150	2.25	—	150	—	13.5	—	100	11	5	54.8	19.0
6J6WA	Twin-triode	6.3	0.45	300	1.1	—	100	—	9	—	50	6	6.3	54.8	19.0
5687WA	Twin-triode	12.6 6.3	0.45 0.9	300	4.2	—	250	—	12.5	—	1 000	5.5	3	56.3	22.2
F7004(5842)	Low-noise triode	6.3	0.3	180	4.5	—	150	—	22	—	60	25	2	45.0	22.2
12AT7WA	Twin-triode	6.3 12.6	0.3 0.15	330	2.8	—	250	—	10	—	200	5.5	10.9	56.3	22.2
12AX7S	Twin-triode	6.3 12.6	0.3 0.15	300	1.0	—	250	—	1.25	—	—	1.6	6	56.3	22.2
6189(12AU7WA)	Twin-triode	6.3 12.6	0.3 0.15	300	2.7	—	250	—	10.5	—	1 000	2.2	7.7	56.3	22.2

TETRODES AND PENTODES

6AH6WA	Sharp cut-off RF pentode	6.3	0.45	330	3.2	0.45	300	150	10	2.5	160	9	500	54.8	19.0
6AM6S(6064)	Sharp cut-off RF pentode	6.3	0.3	550	3.0	0.9	250	250	9.8	2.6	160	7.6	1 000	54.8	19.0
6AN5WA	Video power pentode	6.3	0.45	135	4.6	1.5	120	120	34	11	125	8.5	—	54.8	19.0
6AU6WA	Sharp cut-off RF pentode	6.3	0.3	330	3.3	0.7	250	150	10.6	4.3	68	5.2	1 000	54.8	19.0
6AU6WB	Sharp cut-off RF pentode	6.3	0.3	330	3.3	0.7	250	150	10.6	4.3	68	5.2	1 000	54.8	19.0
6CL6S	Video power pentode	6.3	0.65	330	8.2	1.9	250	150	30	7	V _{g1} = -3V	11	150	67.5	22.2
6CQ6S	Remote cut-off RF pentode	6.3	0.2	300	3.0	0.7	200	200	8	2.1	240	2.5	400	54.8	19.0
5654(6AK5W)	Sharp cut-off RF pentode	6.3	0.175	200	1.65	0.55	120 180	120 120	7.5 7.7	2.5 2.4	180 180	5 5.1	300 500	45.3	19.0
5656	Power twin-tetrode	6.3	0.4	250	3.5	1.8	220	120	45	—	—	6	W _u = 4.5W	54.8	22.2
5686	Beam tetrode RF ampl. frequency multiplier	6.3	0.35	275	8.25	3.3	250	250	27	3.1	V _{g1} = -12.5V	3.1	45	56.3	22.2
5725(6AS6W)	Twin control grid RF pentode	6.3	0.175	200	1.65	0.55	120 120	120 120	5.2 3.6	3.5 4.8	V _{g1} V _{g3} -2 0 -3 -3	S _{g1} = 3.2 S _{g1} = 1.8	S _{g3} = 0.5 S _{g3} = 0.8	45.3	19.0
5749(6BA6W)	Variable-mu RF pentode	6.3	0.3	330	3.3	0.7	100 250	100 100	10.8 11	4.4 4.2	68 68	4.3 4.4	250 1,000	54.8	19.0
6005(6AQ5W)	AF power beam tetrode	6.3	0.45	275	11	2.2	180 250	180 250	29 45	3 4.5	V _{g1} = 8.5 V _{g1} = 12.5	3.7 4.1	W _u = 2W W _o = 4.5W	67.5	19.0

VOLTAGE STABILISERS

OA2WA	Voltage stabiliser	Cold cathode	Min. supply voltage 185 V Operating voltage approx. 150 V Regulation between 5 and 30 mA approx. 4 V Cont. duty. current min. 5 mA max. 30 mA	67.5	19.0
OB2WA	Voltage stabiliser	Cold cathode	Min. supply voltage 130 V Operating voltage approx. 108 V Regulation between 5 and 30 mA approx. 3 V Cont. duty. current min. 5 mA max. 30 mA	67.5	19.0



These tubes are intended exclusively for use in professional equipment; they are tubes of very high reliability, their construction being subjected to controls at every stage; they meet the requirements of French Military Standards, as well as American or British Specifications.

"SUBNITRON"

"Miniatron" tubes.

TYPE	SPECIFICATION	CHARACTERI. Absolute max. values		TYPICAL OPERATION										Max. dimens.	
		Vf V	If A	Va V	Pa W	Pg2 W	Va V	Vg2 V	Ia mA	Ig2 mA or k	Rk Ω	S mA/V	ρ kΩ	length mm	Dia. mm

DIODE

5896	RF twin diode	6.3	0.3	Anode max. inverse peak voltage 460 V Max. peak current per anode 60 mA Max. rectified current per anode 10 mA										34.9	10.1
------	---------------	-----	-----	--	--	--	--	--	--	--	--	--	--	------	------

TRIODES

5703WB	UHF triode	6.3	0.2	200	1.35	—	120	—	9.4	k=25,5	220	5	5.1	38.1	10.1
5718	UHF triode	6.3	0.15	165	0.9	—	100	—	8.5	k=27	150	5.8	4.6	34.9	10.1
5719	AF triode	6.3	0.15	165	0.55	—	100	—	0.73	k=70	1.500	1.7	41	34.9	10.1
6021*	RF twin triode	6.3	0.3	165	1.1	—	100	—	6.5	k=35	150	5.4	6.5	34.9	10.1
6111*	RF twin triode	6.3	0.3	165	1.1	—	100	—	8.5	k=20	220	5	4	34.9	10.1
6533	Antimicrophonic AF triode	6.3	0.2	150	0.5	—	120	—	0.92	k=54	1.500	1.75	30	34.9	10.1

TETRODE AND PENTODES

5636	Twin-grid RF pentode mixer	6.3	0.15	165	1.1	0.7	100	100	5.6	4	150	3.2	110	34.9	10.1
5639	Video pentode	6.3	0.45	165	3.5	1	150	100	20	4	100	9.0	50	44.4	10.1
5840	Sharp cut-off RF pentode	6.3	0.15	165	0.9	0.35	100	100	7.5	2.4	150	5.0	260	34.9	10.1
5899	RF variable-mu pentode	6.3	0.15	165	1.1	0.35	100	100	7.2	2	120	4.5	260	34.9	10.1
5902	AF beam power tetrode	6.3	0.45	165	3.7	0.4	110	110	30	2.2	270	4.2	15	44.4	10.1

VOLTAGE STABILISER

5783WA	Voltage stabiliser			Cold cathode	Max. break down voltage 120 V Minimum current 1.5 mA Maximum current 3.5 mA Operating voltage 86 V approx. Input voltage 140 V min. Regulation between 1.5 and 3.5 mA 3 V approx.										38.1	10.1
--------	--------------------	--	--	--------------	--	--	--	--	--	--	--	--	--	--	------	------

THYRATRON

5643	Gas-filled tetrode thyatron	6.3	0.15	Anode max. peak voltage 500 V Anode max. inver. voltage 500 V Limit temperature 55 to 125° C Mean cathode current 16 mA max Maximum cathode peak current 100 mA										34.9	10.1
------	-----------------------------	-----	------	---	--	--	--	--	--	--	--	--	--	------	------

* Ratings per section.

Length of leads : 38 mm min.

REPEATER TUBES

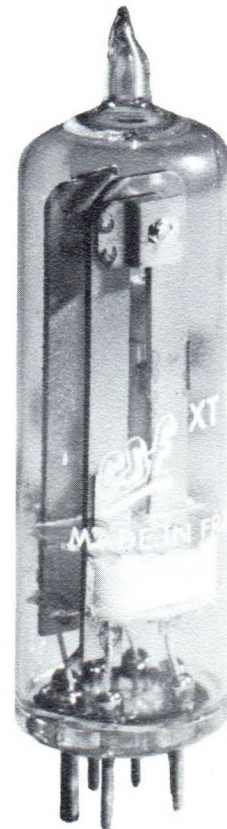
TYPE	SPECIFICATION	Heater		CHARACTERIS. Absolute max. values			TYPICAL OPERATION							Max. dim		CHARACTERISTIC FEATURES			
		V	A	V _a V	P _a W	P _{g2} W	V _a V	V _{g2} V	I _a mA	I _{g2} mA or k	R _k Ω	S mA/V	ρ kΩ	V _g	length mm	Dia. mm	Noise resist. at 1 Mc Ω	mA/V/pF	Life h
TRIODE																			
PTT.141	Low-noise triode	6.3	0.3	180	4.5	—	150	—	23	—	60	25	2	-1.4	45	22.2	150	—	8 000
TETRODE AND PENTODES																			
PTT.208P	Power amplifier pentode	18	0.140	225	3.6	0.7	200	200	18	3.6	200	6	140	-4.3	65	26.5	—	—	20 000
PTT.212P	Voltage amplifier pentode	18	0.11	225	2.4	0.6	200	200	10.5	2	125	8.5	500	-1.6	60	26.5	675	0.76	16 000
PTT.213P	Voltage amplifier pentode	6.3	0.31	225	2.4	0.6	200	200	10.5	2	125	8.5	500	-1.6	60	26.5	675	0.76	16 000
PTT.216	Noval pentode for IF wide-band amplifier	6.3	0.3	180	2.25	0.75	150	150	12.3	3.7	110	13.5	200	-1.75	45	22.2	185	1.2	16 000
PTT.244P	Wide-band amplifier tetrode	18	0.14	180	5.2	1.3	150	150	24	5	45	27	30	-1.5	60	26.5	300	1.7	8 000

THERMAL RELAYS

Single-Pole switches		Heater		Delay time			Characteristics
		Voltage	Current	Opening of contact 1	Closing of contact 2	Return to contact 1	
TYPE							
Officielle	" CSF "	V	A	s	s	s	
F9029A	XT20A	6.3	0.33	10	20	80	Contact rating : DC 115 V ; 0.5 A, AC 250 V ; 1 A Max. contact resist. : 0.05 Ω Pin test voltage : 1 000 V rms across contacts Inter-pin insulation : 100 MΩ Max. dimens. : dia. 19 mm - h. 67 mm
F9030A	XT30A	6.3	0.33	13	30	85	
F9031A	XT45A	6.3	0.33	20	45	120	
F9032A	XT60A	6.3	0.33	25	60	130	
F9033A	XT75A	6.3	0.33	33	75	180	
F9034A	XT90A	6.3	0.33	38	90	190	
F9036A	YT15A	26.5	0.075	7	15	70	
F9037A	YT20A	26.5	0.075	10	20	80	
F9038A	YT30A	26.5	0.075	13	30	85	
F9039A	YT45A	26.5	0.075	20	45	120	
F9040A	YT60A	26.5	0.075	25	60	130	
F9041A	YT75A	26.5	0.075	33	75	180	
F9042A	YT90A	26.5	0.075	33	90	190	

TUBES FOR MAINTENANCE

TYPE	SPECIFICATION
PTT.241P	Power amplifier tetrode
PTT.243P	Wide-band amplifier tetrode

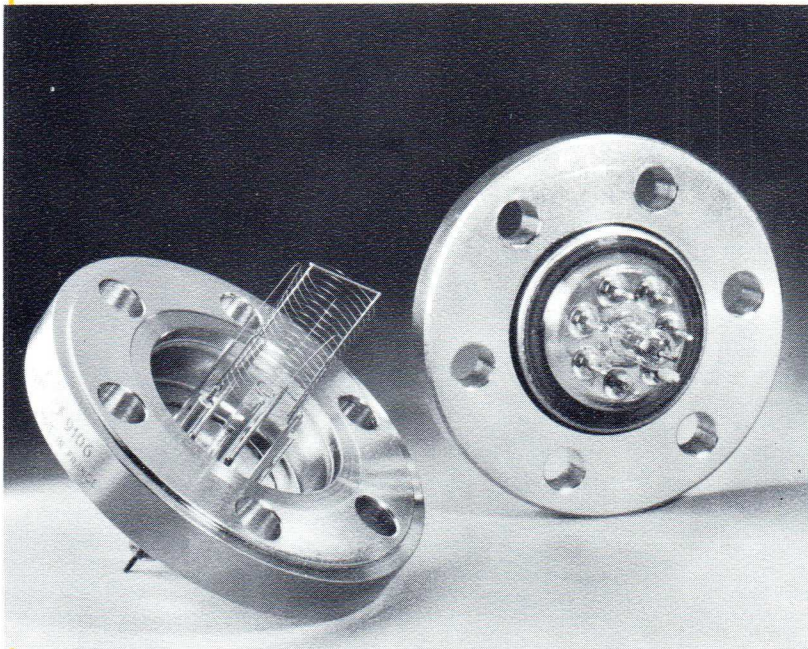


F9030A
(XT.30A)

GAUGES

TYPE		VACUUM GAUGES					
		Heater Voltage	Heater Current	Collector voltage	Grid voltage	Grid current	Limit vacuum
"F"	"CSF"	V	A	V	V	mA	mm of Hg
F9028	BA10	7	4	-50	+150	10	10 ⁻¹⁰
F9012	-	electrically identical with the F9028 but with metal connecting flange, 100 mm DIA					
F9106	-	electrically identical with the F9028 but with metal connecting flange, 105 mm DIA					
F9130	-	Identical with the F9106 but with centring ring					

Note : The F9012, F9106 and F9130 types can be fitted with a modulating electrode.



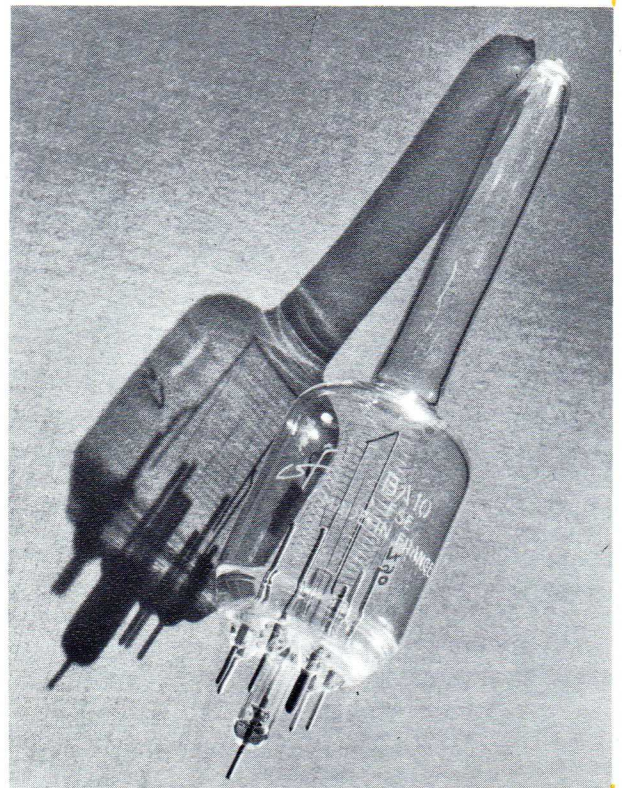
Insertable gauges F9106.

TUBES FOR MAINTENANCE

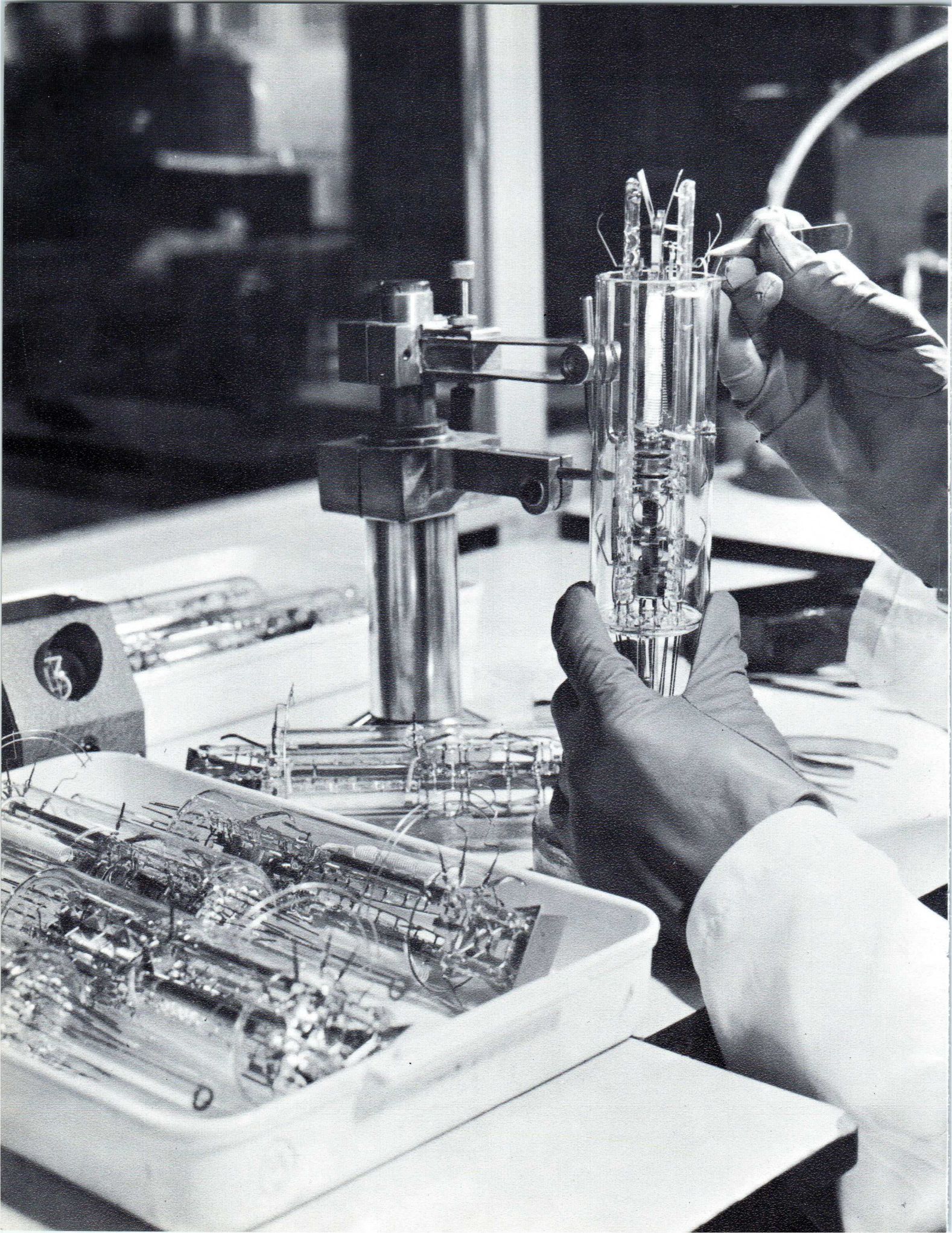
TYPE		Limit vacuum mm of Hg
"F"	"CSF"	
F9078	E4J	10 ⁻⁶
F9021	EJ1011	10 ⁻¹⁰

"FLASH" TUBES

TYPE		Characteristics	
"F"	"CSF"	Power J	Voltage kV
F9119	L1122.B1	500	2,5
F9121	L1259.A1	500	2,5
F9081	L1159.A1	1 000	5
F9115	L1082.B1	1 500	5
F9123	L1223.B1	1 600	8
F9124	L1240.B1	1 600	8
F9118	L1089.C1	2 000	5
F9122	L1218.B1	10 000	10
F9120	L1185.B1	20 000	10



Weldable gauge F9028 (BA.10).



DISPLAY DEVICES

Information at the output of an electronic system usually takes the form of electric signals. In order to be useful, they must be transformed into visual signals.

All components used to achieve this conversion are termed display devices.

The electric signals are either converted directly to light signals, or first transposed into different electric signals.

Similarly, these light signals are either directly utilisable or can be used after a change of wavelength or amplification.

The "Groupement Tubes Electroniques" has developed the following types :

- tubes for converting electric to light signals
- tubes for converting electric to electric signals
- tubes for converting light to light signals
- tubes for converting light to electric signals ;

they are listed below, with their principal characteristics.



CATHODE-RAY TUBES

" OSCILLOSCOPE " SERIES

ELECTROSTATIC FOCUSING AND DEFLECTION

These tubes display on a fluorescent screen, curves, relative to the variations of numerous parameters.

They feature a particularly sharp spot which has led to their adoption by oscilloscope manufacturers, and to their use in curve or network tracers.

These tubes cover the whole range of the most usual applications.

Screens are available in many different colours (P1 - P2 - P7 - P11 - P31), each type with a preferential one.

Several types are fitted with graticule screens to avoid the possibility of parallax error.

Lastly, have been developed tubes with a post-acceleration deflection grid (high sensitivity for use with transistor circuits - large useful screen surface for frequencies up to 100 MHz - rectangular front).

N.B. - In the denomination of the CRT listed hereunder, (first column), the suffix (P31, P2, P7...) is expressive of the standard phosphor used for each type of tube.

The diverse phosphors which may be supplied on request are registered in the last columns on right hand.

TYPE		Maximum operational frequency	Face dimensions	Useful screen	Mean sensitivity		Remarks	Typical operation				Phosphors which may be supplied on request						
" F "	" CSF "				X1	X2		Y1	Y2	Acceleration voltage	Geometry voltage	Concentration voltage	Grid cut-off voltage	P1	P2	P7	P11	P31
					cm	cm		V/cm	V/cm	V	V	V	V					
F8045P31	-	5 MHz	7 DIA	6,5×3,8	9	13,5	For transistorized devices Erasing electrode	4 000	700	0 to 270	-15 to -25		●	●	●			
5ADP2 5ADP7	- -	5 MHz	13 DIA	11 DIA	17,6	13,3		3 000	1 500	345 to 515	-34 to -56	●			●			
F8030P2	-	5 MHz	13 DIA	11 DIA	17,6	13,3	Improved geometry	3 000	1 500	345 to 515	-34 to -56	●		●	●			
F8065P11	-	5 MHz	13 DIA	10×10	26	$\frac{23}{50}$	2 pairs of Y plates	4 000	2 000	345 to 515	-34 to -56							
F8042P7	OE1218PAR	5 MHz	18 DIA	15 DIA	18,5	16		4 000	2 000	460 to 690	-45 to -75	●			●			
F8058P2 F8058P31	- -	30 MHz	13 DIA	10×4	30,5	6,5	Improved astigmatism correction and geometry	10 000	1 670	180 to 590	-50 to -80			●	●			
F8074P2 F8074P31	- -	30 MHz	13 DIA	10×4 per gun	31	6,5	2 guns with X plates in common superimpression of traces	10 000	1 670	180 to 570	-50 to -80	●			●			
F8089P2 F8089P31	- -	30 MHz	12,5×8,5	10×6	11	4	Anti-compression grid graticulated screen Erasing electrode	10 000	1 000	0 to 300	-30 to -80			●	●			
F8081P2A	-	50 MHz	13 DIA	10×6	20	7,5	Improved astigmatism correction and geometry + increased useful surface Graticulated screen	10 000	1 670	180 to 590	-50 to -80			●	●	●		
F8084P2	-	50 MHz	13 DIA	10×10	20	12,5	□	10 000	1 670	180 to 590	-50 to -80				●			
F8076P2	-	50 MHz	13 DIA	10×10	11	7	□ Very high sensitivity	15 000	2 000	180 to 590	-45 to -85							
F8070P2 F8070P31	- -	50 MHz	12,5×8,5	10×6	11	3	Anti-compression grid graticulated screen	15 000	1 670	180 to 590	-50 to -90							
F8073P31A	-	100 MHz	13 DIA	10×4	20	5,5	For large range oscilloscope graticulated screen	10 000	1 670	200 to 600	-40 to -70			●	●			
F8066P31	-	100 MHz	12,5×8,5	10×6	11	3	Anti-compression grid Very high sensitivity	15 000	1 670	180 to 590	-45 to -85			●	●			

□ To be used when the same deflection is necessary on X and Y axis (Ex. : X-Y recorder).

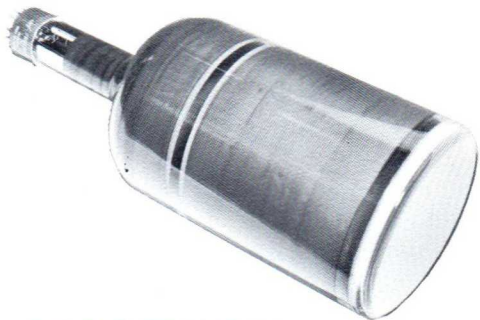
F8073P31A



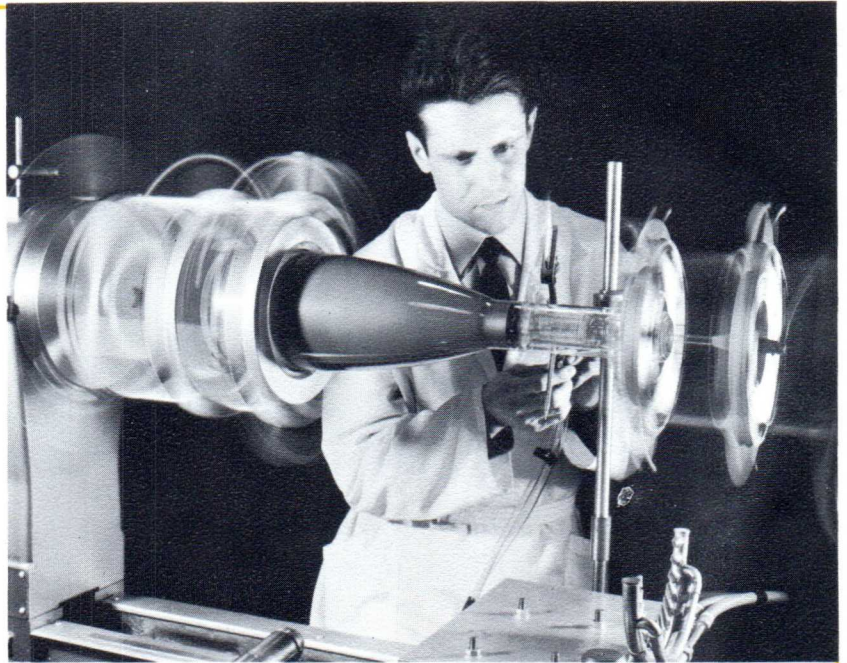
F8089P31



F8042P7 (OE1218PAR)



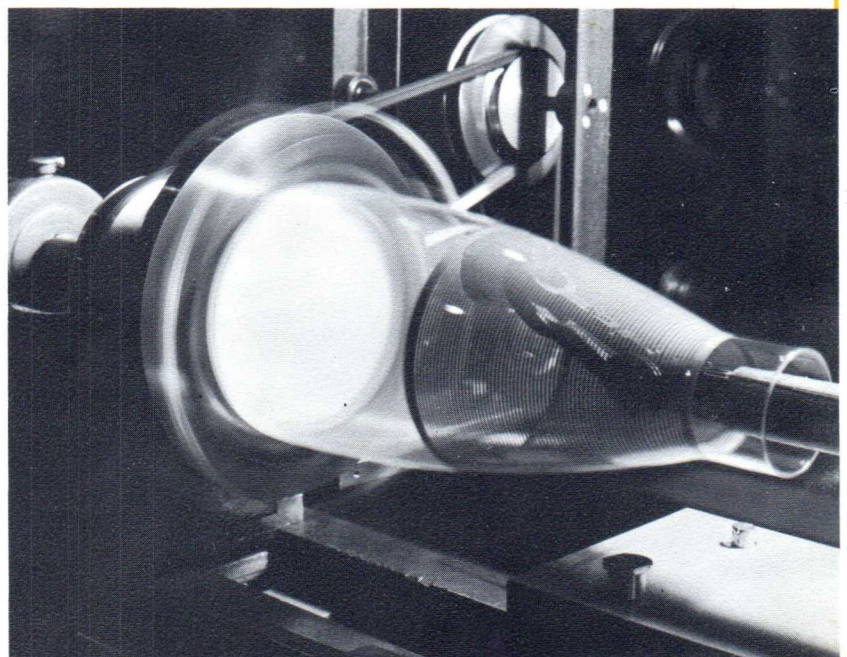
F8066P31



Assembly of the gun and the bulb of a cathode-ray tube.

TUBES FOR MAINTENANCE

TYPE		Maximum operational frequency	Face dim. cm	Useful screen cm	Phosphors which may be supplied on request		
" F "	" CSF "				P1	P7	P11
F8008AP1	OE407AV	800 kHz	7 DIA	6 DIA		●	●
F8009AP1 F8009AP11	OE407APAV OE407APAB	800 kHz	7 DIA	6 DIA		●	
F8013AP1	OE411AV	800 kHz	11 DIA	9.5DIA		●	●
F8014AP1	OE411APAV	800 kHz	11 DIA	9.5DIA		●	●
F8018AP1	OE418AV	800 kHz	18 DIA	15 DIA		●	●
F8021AP7	OE418APAR	800 kHz	18 DIA	15 DIA	●		●



Realization of a post-accelerating electrode.

CATHODE-RAY TUBES

"RADAR INDICATOR" SERIES

These tubes mostly use electrostatic focusing and magnetic deflection for PPI scanning.

They are used extensively, both in civilian and military applications.

A few types are provided with magnetic focusing to obtain a very fine spot. They are used, particularly for monitoring purposes, in closed circuit television.

ELECTROSTATIC FOCUSING AND ELECTROMAGNETIC DEFLECTION

TYPE		Face dimensions	Useful screen	Remarks	Typical operation				Phosphors which may be supplied on request		
"F"	"CSF"				Acceleration voltage	Geometry voltage	Concentration voltage	Grid cut-off voltage	P2	P4	P7
		cm	cm		V	V	V	V			
5AHP 19A	—	13 DIA	11 DIA	Low concentration voltage	5 000	300	0 to 250	-55			
7ABP 19A	—	19 DIA	15 DIA	Low concentration voltage	7 000	300	0 to 250	-28 to -72			•
10WP 19A	—	27 DIA	23 DIA	Low concentration voltage	10 000	300	0 to 600	-33 to -77			•
12ABP 19A	—	32 DIA	28 DIA	Low concentration voltage	10 000	300	0 to 300	-28 to -71			•
F8031AP 19A	OM1138 AROA	38 DIA	33 DIA	Semi-Plane glass	15 000	300	0 to 600	-38 to -72	•	•	
F8038P7A	—	41 DIA	36.5 DIA	Metallic cone	12 000	300	135 to 400	-35 to -75	•	•	
F8038P 19A	—	41 DIA	36.5 DIA	Semi-plane glass	12 000	300	135 to 400	-35 to -75	•	•	
F8064P4	—	15 x 12	12.5 x 9.5	Rectangular flat face (For view-finder, monitor).	9 000	450	0 to 300	-30 to -120			•

ELECTROMAGNETIC FOCUSING AND DEFLECTION

TYPE		Face dimensions	Useful screen	Remarks	Typical operation		
"F"	"CSF"				Acceleration voltage	Concentration voltage	Grid cut-off voltage
		cm	cm		V	V	V
10FP4-A	—	27 DIA	23 DIA	Semi-plane glass	10 000	250	-27 to -63
F8048P 19A	OM726RO	27 DIA	23 DIA	Semi-plane glass	10 000	250	-27 to -63



TUBES FOR MAINTENANCE

F8037AP 19A	(OM738ARO)	38 DIA
F8001AP 19A	(OM1038ARO)	38 DIA



Cathode-ray tubes packing shop at St-Egreve factory.



PICTURE STORAGE TUBES

As the remanence of conventional powders is not always adequate, picture storage tubes have been developed.

These cathode-ray tubes fitted with a storage grid, besides their conventional picture tube property, provide means for the direct study of fast random phenomena and, quite generally, of any phenomenon with a time of observation varying with the writing speed (from a few millimetres per microsecond to some hundred millimetres per microsecond, depending on the tube type).

These tubes are used in aircraft radar displays, such as in the Cyrano radar. A short type with magnetic deflection is used on radars carried on helicopters.

The last development concerns a two gun tube and a derived selective erasure tube.



F8055



The "Cyrano" radar set-up on the "Mirage III" airplane is fitted out with a CSF direct view storage tube.

TYPE		Useful dia	WRITING GUNS	Min. writing speed	Screen	Remarks
"F"	"CSF"					
F8006	—	92 mm	1 gun Static focusing and deflection	100 mm/μs	P20	
F8029	—	92 mm	1 gun Static focusing and deflection	5 mm/μs	P20	Designed for airborne equipments
F8036	—	92 mm	2 guns Static focusing and deflection	5 mm/μs	P20	Designed for airborne equipments
F8050	TEI.603	92 mm	1 gun Static focusing and deflection	100 mm/μs	P20	Designed for oscilloscopy of transients. Allow to see traces at writing speed up to 500 mm/μs
F8055	—	100 mm	1 gun Static focusing Magnetic deflection	10 mm/μs	P20	Low weight and dimensions (l = 200 mm). Designed for airborne equipments.
F8068	—	100 mm	1 gun Static focusing and deflection - writing gun		P20	Selective erasure, without magnetic shield
F8069	—		1 gun Static focusing and deflection - erasing gun			d ^o but with magnetic shield
F8086	—	100 mm	1 gun Static focusing Magnetic deflection	1 to 10 mm/μs	P20	magnetic shield

SCAN CONVERSION TUBES

Scan conversion tubes are more specially used in picture transformers to convert a PPI radar picture to a television one.

The latest types are characterised by small dimensions (the F8060/TMA weighs only 100 grams) and a high definition : 500 lines on the F8080/TMA 406.

These tubes comprise two guns on either side of a thin semi-conducting target.

The electric signals are deposited on the target by the writing gun and are restituted, in the form of electric signals, by the reading gun.

TYPE		WRITING GUN	READING GUN	Min. definition at 50 % mod.	Fast erasing	Remarks
" F "	" CSF "					
F8024	TMA403	Electrostatic focusing Magnetic deflection	Electrostatic focusing and deflection	140 circles	no	
F8041	TMA404	Electrostatic focusing Magnetic deflection	Electrostatic focusing and deflection	160 circles	yes	
F8080	TMA406	Electrostatic focusing Magnetic deflection	Electrostatic focusing Magnetic deflection	180 circles	yes	
F8060	TMA408	Electrostatic focusing Magnetic deflection	Magnetic focusing and deflection	140 circles	yes	Very light, and low overall dimensions
F8083	TMA409	Electrostatic focusing Magnetic deflection	Magnetic focusing and deflection	200 circles	yes	



Observation on a TV screen of a PPI aerial picture converted by means of a scan conversion tube, the remanence of which allows visual aircraft tracking.

Scan conversion tubes F8024 (TMA.403) and F8060 (TMA.408).

BARRIER-GRID STORAGE TUBE

Storage tubes of the TCM13 type are used in MTI processes.

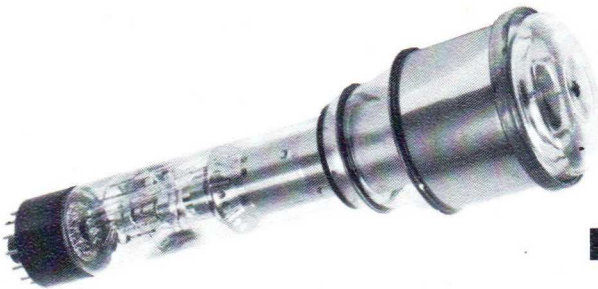
These tubes are fitted with a storage grid. A single gun acts simultaneously as writing and reading gun.

They can store electric signals in the form of charges deposited on an insulating target and can reconstitute them in the form of electric signals.

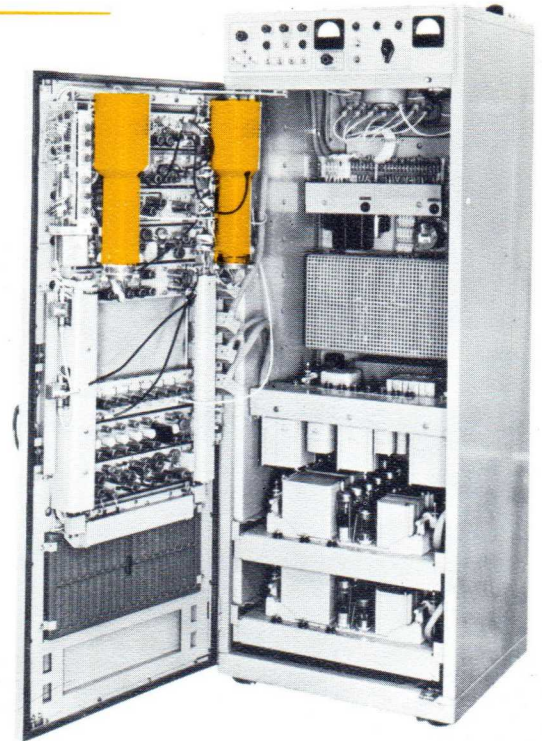
They can add or integrate several successive signals, or simultaneously write and read thanks to their collector screened from the target.

TYPE		Characteristics
"F"	"CSF"	
F8026	TCM13	Simultaneous writing and reading. Definition: 400 TV lines. Elimination rate: 20 dB.
F8085*	-	Miniaturized barrier grid storage tube.

* Under development.



F8026 (TCM13)



Fixed target rejection filter MA.372 fitted with two CSF storage tubes F8026.

DECODER TUBES

TYPE	Characteristics	
F8082	Decoder tube fitted with 360 weldable terminals passing through the front glass; staggered arrangement on 2 concentric rings: outside ring DIA: 57 mm inside ring DIA: 55.5 mm	Electrostatic focusing and deflection
F8090	Binary coding according to GRAY code. 8 concentric rings connected to 8 terminals passing through the front glass: max. outside ring DIA: 80 mm approx. inside ring DIA: 50 mm	Electrostatic focusing, magnetic deflection



F9126

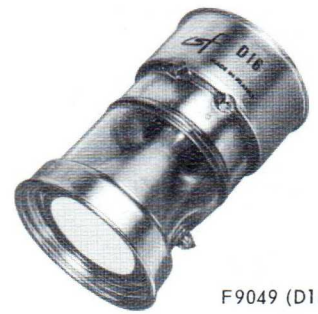
PHOTOELECTRIC CELLS

TYPE		Characteristics
"F"	"CSF"	
F9096*	DA-24-75	High-current, fast photoelectric cell - Coaxial Structure $0.3 \mu < \lambda < 1.2 \mu$ - designed for analysis of light intensities supplied by high - power lasers - Typical impedance: 75 Ω .
F9126**	DA-11-75	Ultra fast photoelectric cells, coaxial designed, specially intended for analysis of light beam generated by gas lasers in both infra red and visible spectrum. Average sensitivity 10 $\mu\text{A}/1\text{m}$ - S1 photocathode.
F9127**	DB-11-75	Identical with F9126 except Average sensitivity 30 $\mu\text{A}/1\text{m}$ - S10 photocathode
F9128**	DC-11-75	Identical with F9126 except Average sensitivity 40 $\mu\text{A}/1\text{m}$ - S11 photocathode
F9129**	DD-11-75	Identical with F9126 except Average sensitivity 80 $\mu\text{A}/1\text{m}$ - S20 photocathode

*The CA. 2050 matched case is specially designed to be used with this cell.

**The CA. 2062 matched case is specially designed to be used with this cell.

IMAGE CONVERTER TUBE



F9049 (D16)

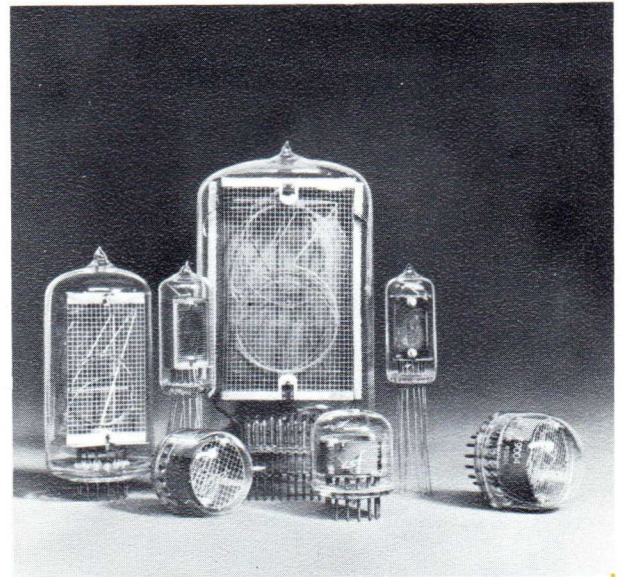
TYPE		Characteristics
"F"	"CSF"	
F9049	D.16	Designed for infra-red/visible image conversion; monovoltage type. HT 18 kV - Useful DIA 26 mm - S1 photocathode P20 or P11 phosphor - Resolution 60 line pairs/mm $0.7 \mu < \lambda < 0.9 \mu$.

DISPLAY READOUT

These tubes are direct view digital display tubes. They consist of 10 cathodes appearing as superimposed figures and one anode. Figure display is obtained by applying a suitable voltage to the corresponding cathode.

FIGURES FROM 0 to 9

TYPE	Height of the figures (mm)	Mechanical features	Current (mA) for V = 170 V to 300 V	Connections
F9080B F9080BA	13	Miniature bulb. Side display	1.5 à 2.5	Flexible leads
F9057A F9057AA	15.5	Cylindrical bulb. Frontal display	1.5 à 3.0	Direct plug-in
F9138A F9138AA	15.5	Rectangular bulb. Frontal display	1.5 à 3.0	Direct plug-in
F9090A F9090AA	40	Cylindrical bulb. Side display	5.8 à 8.2	Direct plug-in

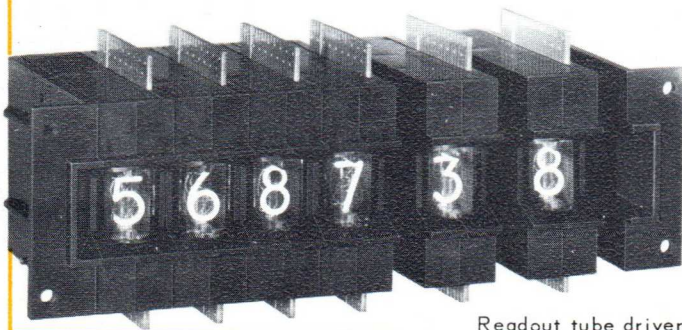


Sample of readout tubes

Index "A" or "B" : Colour filter on the bulb
Index "AA" or "BA" : Without filter

OTHER TYPES

TYPE	CHARACTERISTICS
F9082	Identical with F9057 except for symbols + - ∞ Ω
F9092	Identical with F9080 except for symbols + - ∞ Ω
F9152	Identical with F9138 except for symbols + - ∞ Ω



Readout tube driver

LUMIPLAQUES

The "LUMIPLAQUES" are electroluminescent panels. Schematically, an electroluminescent cell can be compared to a planar capacitor converting electric power into luminous energy without any overheating.

The "LUMIPLAQUES" enable to solve cheaply and easily innumerable problems of display operations such as :

Signal operations, visual indicator, luminescent test material, control panel markerlight, night light, advertising, staircase switch... etc.

READOUT TUBE DRIVERS

- 1 - ELECTROMECHANICAL READOUT COUNTER - Type "EM"
Stepping rate : 50 Hz
- 2 - ELECTRONIC READOUT COUNTER - type "EL"
Bidirectional - counter } Stepping rate : 250 kHz
decoder

MISCELLANEOUS PRODUCTS

GAS LASERS



XENON FLASHLAMPS
for ruby crystal lasers

Large variety of
shapes and powers

● Hélium-néon lasers

Type	F9094	LHN. 1097	F9136
Output power	1mW	Single mode 15mW	60mW

● Argon lasers

Type	LGA. 1098	LGA. 1099	LGA. 1100
Output power	150mW	Single mode 1W	5W

● CO² lasers

Type	LGC. 1101	LGC. 1120
Output power	Single mode	
	5W	
	Multimode	
	10W	120W

(Other types to
special order)

T.W.T. POWER AMPLIFIERS

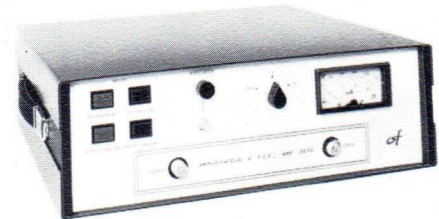
Type	Frequency range
------	-----------------

● Low noise amplifiers

AMP.2023	1.2 - 1.4 GHz
AMP.2024	2.7 - 3.5 GHz

● Power amplifiers

Built-in T.W.T.	AMP.2070	1.0 - 2.0 GHz
	AMP.2054	2.0 - 4.0 GHz
T.W.T. in individual unit	AMP.2077	4.9 - 9.0 GHz
	AMP.2078	8.0 - 12.0 GHz



AMP.2070

Supplies

- for travelling wave tube
- for carcinotrons
- for wattmeter

Microwave equipments

Wattmeters, loads, wavemeters, directional couplers, (any UHF equipment on request)

MICROWAVE OVENS



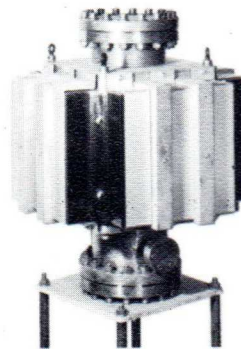
FDC.1124

Type	Application	Output power
FD.6065-1	Oven for laboratory	1200W
FDC.1124	Microwave conveyor	10kW

Power supplies
for ion pumps

Waveguide windows
Glass,
quartz,
sapphire

ION PUMPS



F9132

Type	Pumping rate
F9111	50 l/s
F9125	100 l/s
F9112	200 l/s
F9132	400 l/s

Vacuum feed-throughs

Alumine/ metal (titanium, stainless steel, inconel, niobium)

