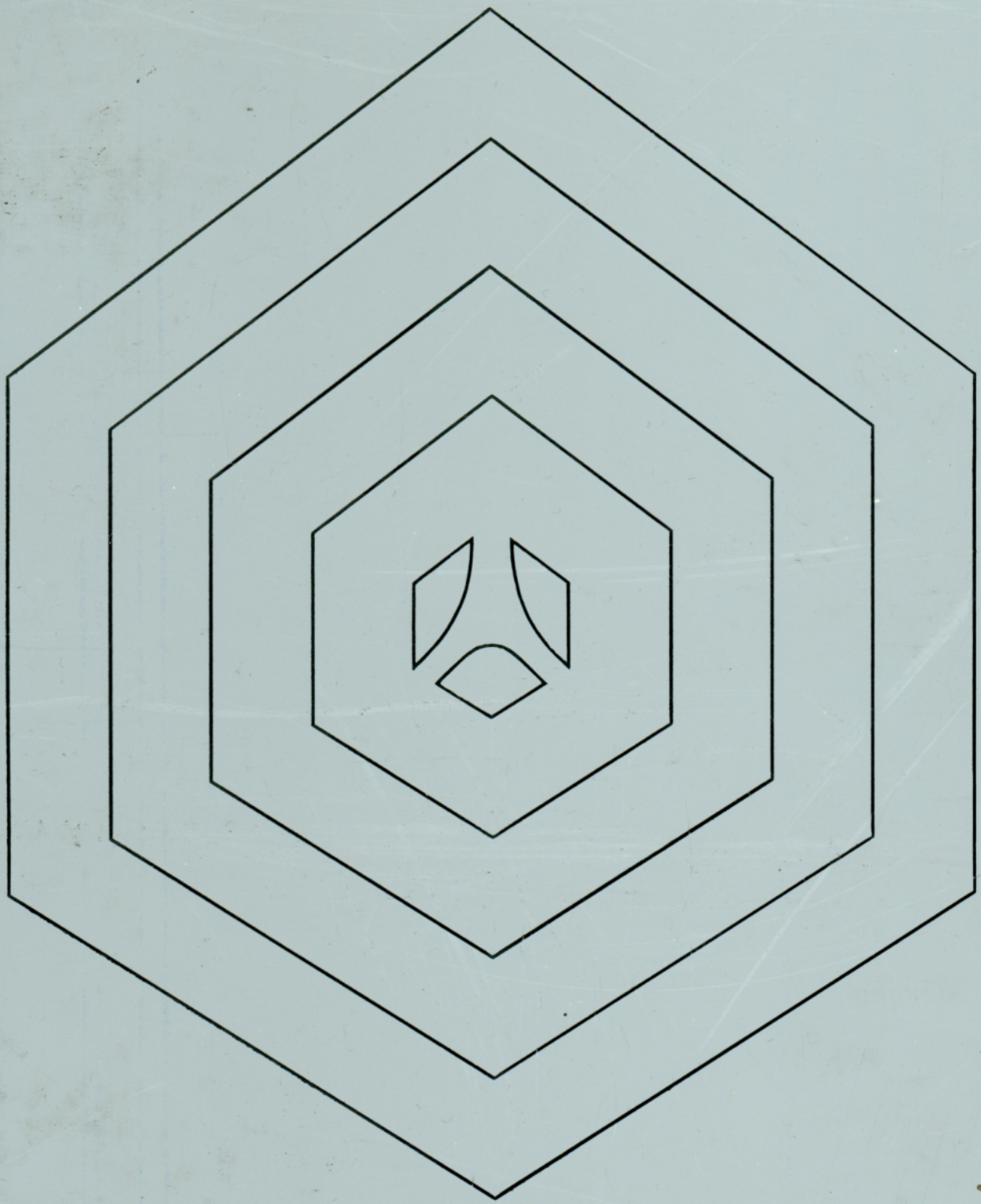


THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

TUBES ET DISPOSITIFS POUR HYPERFREQUENCES

INDEXED
FEBRUARY 76

THOMSON-CSF

TUBES ET DISPOSITIFS
POUR HYPERFREQUENCES
TOME 2

Exemplaire N° 0237

THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

June, 30, 1973

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MICROWAVE TUBES AND DEVICES

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TUBES ET DISPOSITIFS POUR HYPERFREQUENCES

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TUBES ET DISPOSITIFS POUR HYPERFREQUENCE
Microwave Tubes and Devices

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Vous trouverez
dans ce catalogue ...

2.1 MAGNETRONS

2.2 TUBES A ONDE PROGRESSIVE et AMPLIFICATEURS A TOP

2.3 TUBES A CHAMPS CROISES

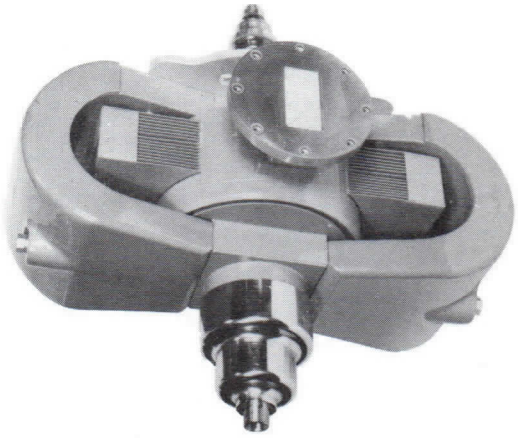
MAGNETRON TV 313

Le tube TV 313 est un magnétron coaxial fonctionnant dans la bande C, en régime d'impulsions.

Il fournit une puissance crête hyperfréquence de sortie supérieure à 1 MW avec un rendement minimum de 50%.

L'accord du tube peut se faire dans une large bande de fréquence, grâce à un dispositif mécanique à piston qui présente une grande sécurité de fonctionnement.

La sortie hyperfréquence est constituée par une fenêtre en céramique, très résistante aux TOS élevés et aux arcs dans le guide d'onde.



Grâce à son faible coefficient de poussée de fréquence, le TV 313 peut être utilisé avec des modulateurs fournissant des impulsions de formes très diverses, et de plus, le spectre obtenu est de bonne qualité.

Ce magnétron peut fonctionner dans les équipements radars fixes, mobiles ou aéroportés.

En résumé, les principales qualités de ce magnétron sont :

- puissance de sortie élevée,
- large bande d'accord,
- rendement élevé,
- sortie R.F. sur une fenêtre en céramique,
- faible coefficient d'entraînement de fréquence et de poussée de fréquence.

CARACTERISTIQUES GENERALES

Electriques

Fréquence (bande d'accord)	5450 à 5825 MHz
Tension de chauffage (au repos)	5 V -
Courant de chauffage (au repos)	19 A
Tension anodique crête	33,5 à 37,5 kV
Courant anodique crête	60 A
Puissance de sortie crête	min. 1 MW
Facteur d'utilisation	0.001
Rendement	min. 50%
Largeur d'impulsion	0,2 à 3 µs

Mécaniques

Dimensions	voir dessin page 4
Masse	23 kg environ
Position de fonctionnement préférentielle	indifférente
Refroidissement	par air forcé
Température de l'anode	max. 115°C
Sortie R.F.	s'adapte à la bride UG 148 B/U modifiée (trous taraudés remplacés par trous lisses)

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EXEMPLE DE FONCTIONNEMENT

Fréquence	5650	MHz
Tension anodique crête	37	kV
Courant anodique crête	60	A
Durée d'impulsion	1	µs
Facteur d'utilisation	0.001	
Puissance crête de sortie	1,1	MW
Rendement	54	%
Largeur de spectre	1,2	MHz
Rapport de lobe secondaire	12	dB
Coefficient d'entraînement de fréquence (TOS 1,5)	2	MHz
Coefficient de poussée de fréquence	50	kHz/A

CONSIGNES DE MISE EN SERVICE

Installation

1. Assurer la mise en place du magnétron. Pour le montage, utiliser des boulons et des outils non magnétiques.
2. Brancher les connexions d'amenée de courant au culot du magnétron, la connexion "cathode" étant reliée au conducteur portant un repère rouge.
3. Limiter le courant d'appel du chauffage filament à 25 ampères et laisser chauffer la cathode à la tension prescrite pendant 5 minutes au moins avant l'application de la haute tension.
4. Vérifier que la ventilation s'effectue normalement ; refroidir aussi le mécanisme (arbre flexible).
5. Pressuriser le guide de sortie ; cette pression dépend du gaz utilisé et du niveau de puissance demandé. Pour 1 MW crête par exemple et de l'air sec, la pression doit être de 3 bars absolus.
6. Appliquer la haute tension en impulsions négatives sur la cathode. Le plateau de fixation sert de contact de masse, l'anode du magnétron lui étant réunie par construction.

Dans les régimes normaux de fonctionnement, les formes d'impulsions observées devront correspondre aux caractéristiques suivantes :

Le taux de croissance de la tension devra être compris dans les limites suivantes :
90 à 120 kV/µs (pente de la tangente de plus forte pente au delà du point 70% d'amplitude sur l'impulsion de tension).

Toute pointe à l'avant de l'impulsion de tension devra être supprimée.

Toute suroscillation sur le plat de l'impulsion de tension ou de courant ne devra pas dépasser ± 10% de la valeur moyenne du maximum de l'impulsion.

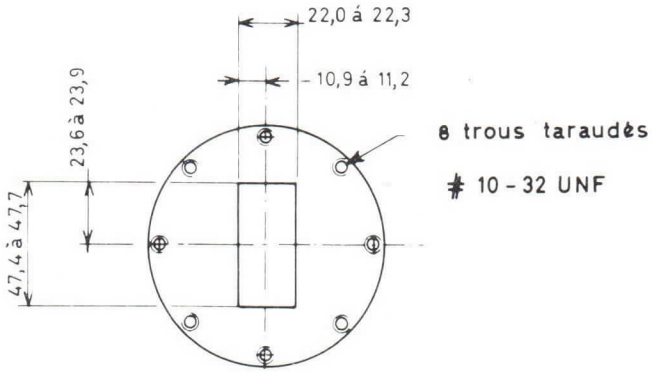
La tension inverse sur l'impulsion de tension ne devra pas dépasser 35% de l'impulsion appliquée.

Le temps de descente de l'impulsion de courant, mesuré entre 20 et 85% de la valeur crête de l'impulsion de courant, ne devra pas dépasser 0,35 µs.

Régler la tension d'entrée du modulateur jusqu'à ce que le courant magnétron ait atteint la valeur voulue.

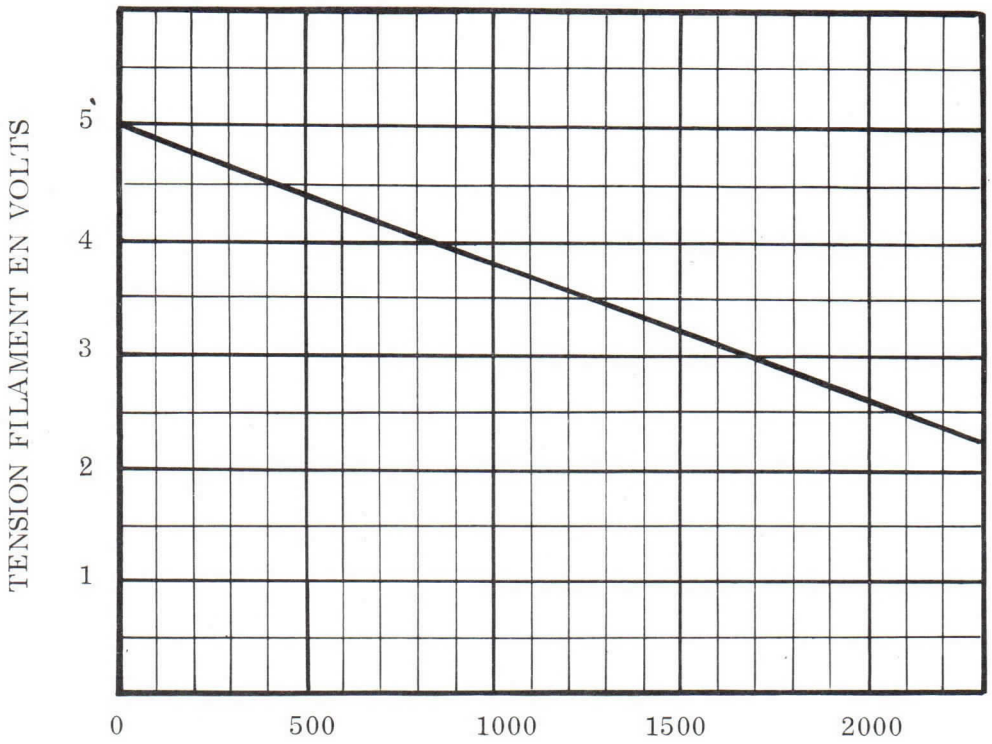
7. Réduire la tension de chauffage du magnétron en fonction de la puissance moyenne appliquée.
8. La fréquence de ce magnétron est réglable par rotation d'un pignon denté situé à la partie supérieure du tube. Il est important, au cours du fonctionnement, de ne jamais sortir des limites de fréquence indiquées. (5450 à 5825 MHz).

RACCORDEMENT DU TUBE



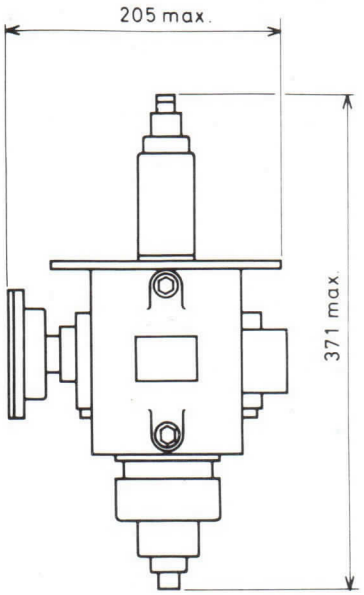
FLASQUE

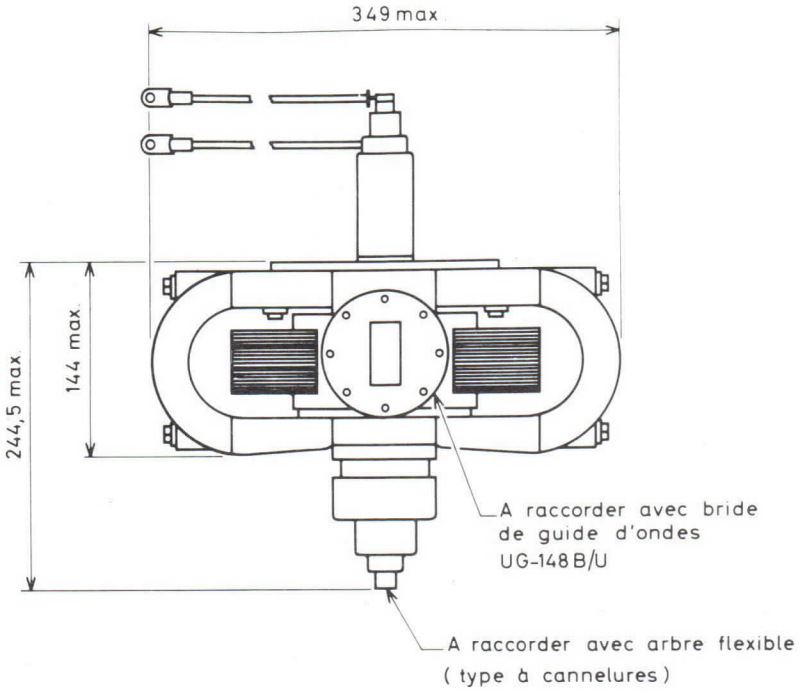
REDUCTION DE LA TENSION DE CHAUFFAGE EN FONCTION DE LA PUISSANCE D'ENTREE

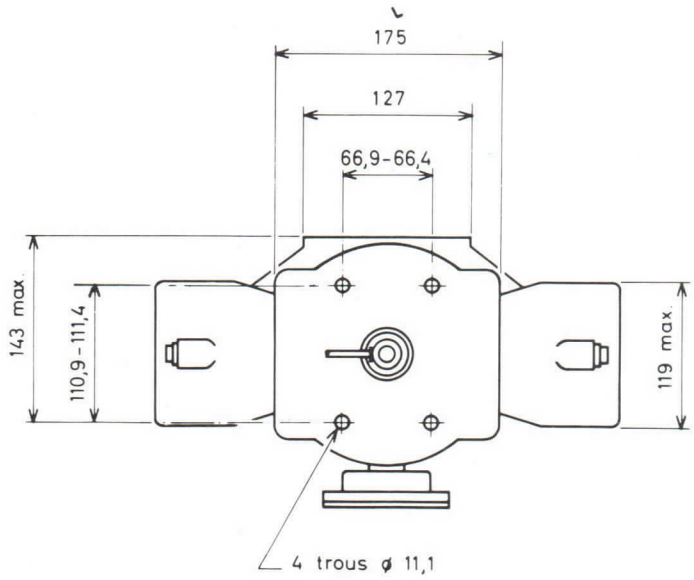


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COTES D'ENCOMBREMENT



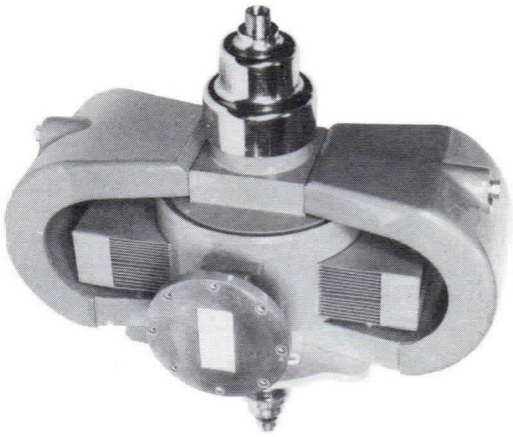




Cotes en mm.

TV 313 MAGNETRON

The TV 313 is a coaxial magnetron for pulsed operation in C-band. This tube delivers a peak power output of at least 1 MW with more than 50% efficiency; it is tunable by means of a reliable plunger system in the range 5 450 - 5 825 GHz.



The ceramic output window in standard waveguide offers added protection against damage by high VSWR or arcing.

Due to its low pulling factor, the TV 313 is used in modulators providing a great variety of pulse shape. It offers reliable performances in airborne and ground-based radars; it has the following features :

- high power output,
- wide tuning range,
- high efficiency,
- ceramic output window,
- low pulling and pushing factors.

GENERAL CHARACTERISTICS

Electrical

Frequency (tuning range)	5450	to	5825	MHz
Heater voltage (stand-by)		5		V
Heater current (stand-by)		19		A
Peak anode voltage	33. 5	to	37. 5	kV
Peak anode current		60		A
Peak power output	min.	1		MW
Duty cycle		.001		
Efficiency	min.	50		%
Pulse width	0. 2	to	3	µs

Mechanical

Dimensions	see drawing		
Weight, approximate	23		kg
Operating position	any		
Cooling	forced air		
Anode temperature	max.	115	°C
RF output	mates with UG 148 B/U flange modified (Tapped holes in place of smooth holes)		

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ABSOLUTE RATINGS

(non simultaneous)

	min.	max.	
Peak power input	-	2500	kW
Average power input	-	2500	W
Peak anode voltage	-	38	kV
Peak anode current	20	65	A
Duty cycle	-	.0011	
Pulse duration	0.2	3.0	μs
Rate of rise of voltage	-	120	kV/μs
Heater voltage	-	7.5	V
Anode block temperature	-	115	°C
Cathode bushing temperature	-	270	°C
Load VSWR	-	1.5:1	

TYPICAL OPERATION

Frequency	5650	MHz
Peak anode voltage	37	kV
Peak anode current	60	A
Pulse duration	1	μs
Duty cycle	.001	
Peak power output	1.1	MW
Efficiency	54	%
RF bandwidth	1.2	MHz
Side lobe level	12	dB
Pulling factor (VSWR = 1.5:1)	2	MHz
Pushing factor	50	kHz/A

OPERATING INSTRUCTIONS

1 - Installation : Use non magnetic tools and nuts for mounting. Connect the heater supply to the tube. The cathode connection is identified by a red mark.

2 - Application of heater voltage : Heater surge current should be limited to 50 amps. Allow at least 5 minutes for the cathode to warm-up before application of high voltage.

3 - Check that forced air is flowing. The tuning mechanism area should be cooled by the air flow.

4 - Pressurization of the output waveguide : The pressure depends on the gas being used and on the power level. For example, at 1 MW peak with dry air the pressure should be 45 psia.

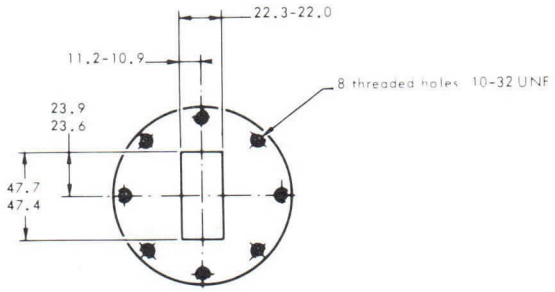
5 - Application of the high voltage : Apply the high voltage negative pulses to the cathode. Grounding of the mounting plate will insure adequate grounding of the tube.
In normal operating conditions, the pulse shape should correspond to the following characteristics :
- rate of rise of voltage within the limits : 90 to 120 kV/μs.
- any spike on the pulse front is to be cut out.
- the pulse level ripple should not exceed 10 % of the peak current average value.
- reverse voltage should not exceed 35 % of the applied pulse.
- the current pulse decrease, measured between 20 and 85% of the peak value, should not last more than 0.35 μs.

6 - Set the modulator input voltage to obtain the required anode current.

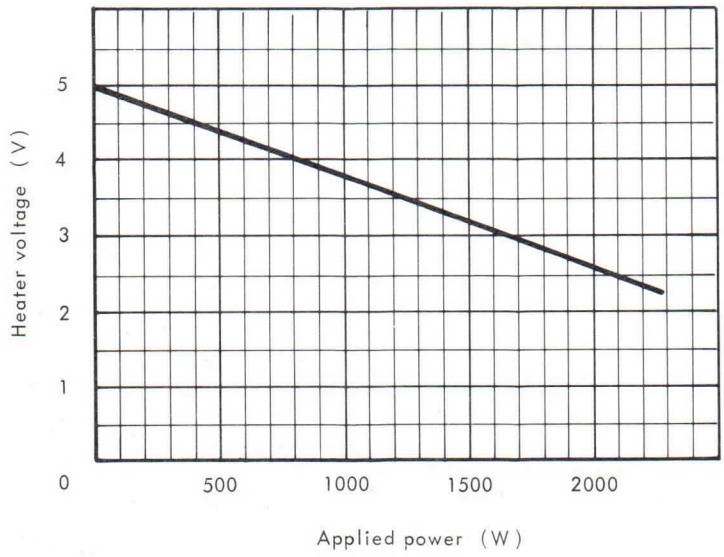
7 - The heater voltage should be adjusted with respect to the average applied power. (see curve).

8 - The frequency of the tube is tunable from 5450 to 5825 MHz. Do not attempt to tune over the frequency limits.

Tube connection



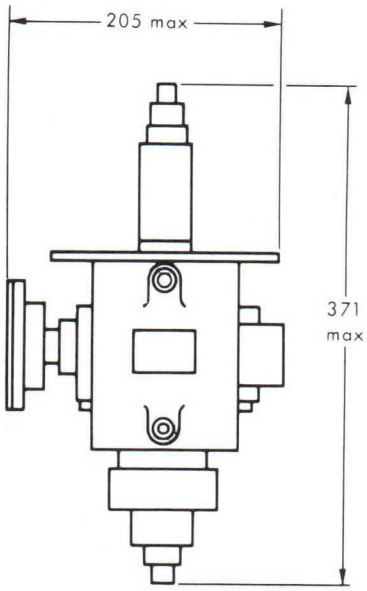
HEATER VOLTAGE ADJUSTMENT

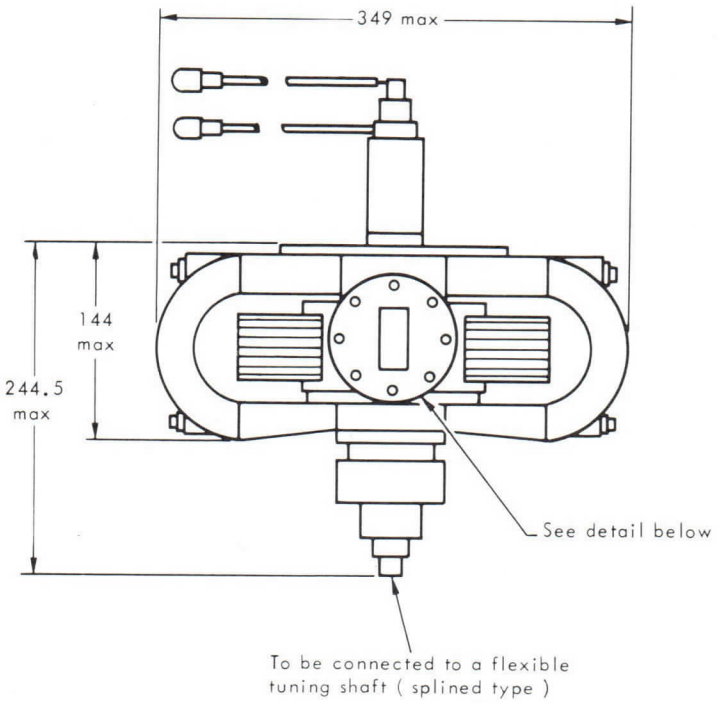


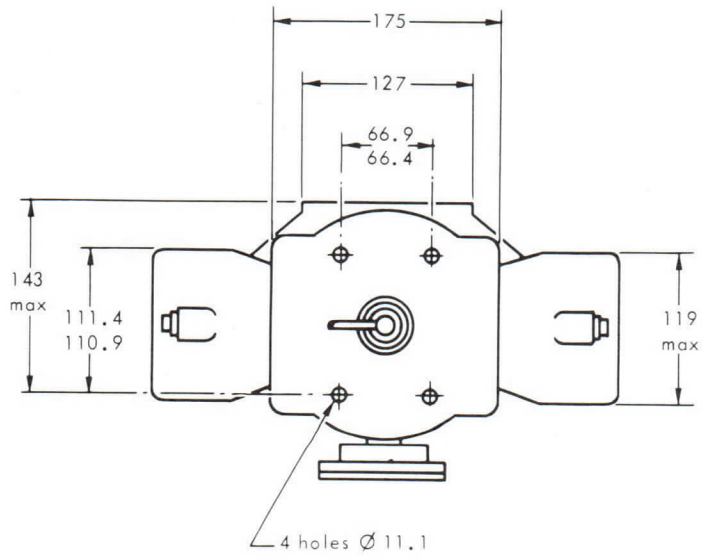
Dimensions in mm.

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OUTLINE DRAWING





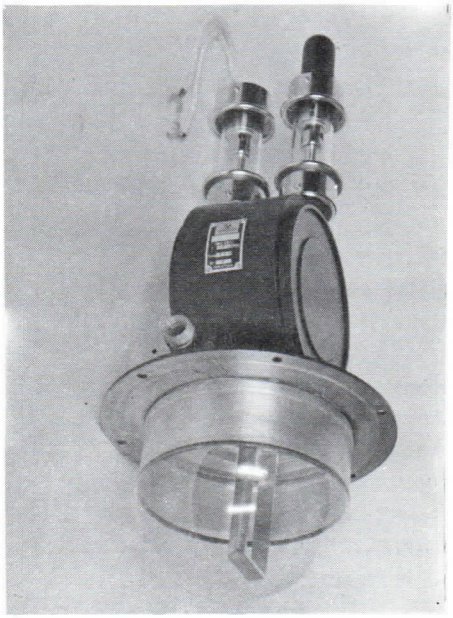


Dimensions in mm.

L-BAND MAGNETRONS-2.4MW
(1220 to 1370 MHz)

Magnetrons in the series are fixed frequency pulsed type oscillators, delivering a peak output power of at least 2.4 MW. Fifteen models are available between 1270 and 1370 MHz.

The magnetron output flange is designed for use with a circular to rectangular waveguide transition section.



Twelve tubes cover the frequency range :

F1088	*(MC.567A)*	*1275*	±	*5 MHz*
F1089	*(MC.567B)*	*1287*	±	*7 MHz*
F1090	*(MC.567C)*	*1300*	±	*5 MHz*
F1091	*(MC.567D)*	*1310*	±	*5 MHz*
F1092	*(MC.567E)*	*1320*	±	*5 MHz*
F1093	*(MC.567F)*	*1332*	±	*7 MHz*
F1094	*(MC.567G)*	*1345*	±	*5 MHz*
F1095	*(MC.567H)*	*1355*	±	*5 MHz*
F1096	*(MC.567J)*	*1365*	±	*5 MHz*
F1119		*1285*	±	*5 MHz*
F1120		*1315*	±	*5 MHz*
F1121		*1325*	±	*5 MHz*
MCF.1329		*1223*	±	*3 MHz*
MCF.1330		*1272*	±	*3 MHz*
MCF.1331		*1312*	±	*3 MHz*

GENERAL CHARACTERISTICS

Electrical

	min.		max.	
Heater voltage		20		V
Heater current	12		15	A
Anode voltage, peak	38		42	kV
Anode current, average		190		mA
Output power, peak		2.5		MW
Output power, average	3.0			kW

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Mechanical

Magnet	separate magnet
Output	circular waveguide
Weight (approximately)	10 kg
Mounting position	vertical, cathode and heater terminals up
Cooling	water

ABSOLUTE RATINGS
(non simultaneous values)

	min.	max.	
Heater voltage (1)	18	22	V
Heater surge current	-	50	A
Cathode warm-up time	5	-	mn
Load VSWR	-	1.5:1	
Magnetic field	900	1000	G
Anode voltage, peak	35	42	kV
Anode current, peak	-	152	A
Input power, peak	-	6.4	MW
Input power, average	-	8	kW
Duty cycle	-	0.0015	
Pulse length	-	5.0	µs
Rate of rise of voltage pulse	-	70	kV/µs
Anode temperature	-	80	°C
Cathode terminal temperature	-	165	°C
Water outlet temperature	-	80	°C
Water flow	1.7	-	l/mn

(1) Prior to the application of anode voltage, the cathode shall be heated to the required temperature by application of 20 volts to the heater, for at least 5 minutes. During high voltage operation it is essential to decrease the heater voltage according to the schedule page 3.

TYPICAL OPERATION

	OSC.1	OSC.2	
Heater voltage	0	0	V
Magnetic field	950	950	G
Anode current, average	190	190	mA
Anode voltage, peak	39	39	kV
Pulse length	1.5	4.0	µs
Duty cycle	0.00125	0.00125	
Rate of rise of voltage	60	60	kV/µs
Output power, average	3.25	3.25	kW
Output power, peak	2.6	2.6	MW

OPERATING INSTRUCTIONS

The cathode shall be heated to the required initial temperature by the application of 20 volts to the heater for at least 5 minutes.

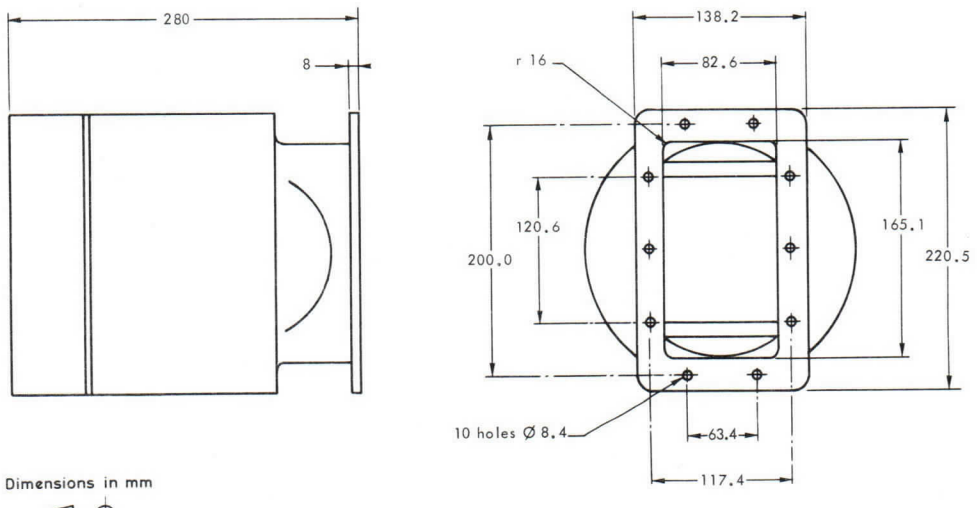
During high voltage operation it is essential to operate the heater according to the following schedule :

Mean input power (Watts)	Heater voltage (Volts)
less than 2000	20
2000 to 3000	15
3000 to 4000	10
4000 to 5000	5
more than 5000	0

The tube heater shall be protected against arcing by the use of a minimum capacitance of 0.004 μF shunted across the heater directly at the input terminals.

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless the tube is adequately shielded for X-rays radiation.

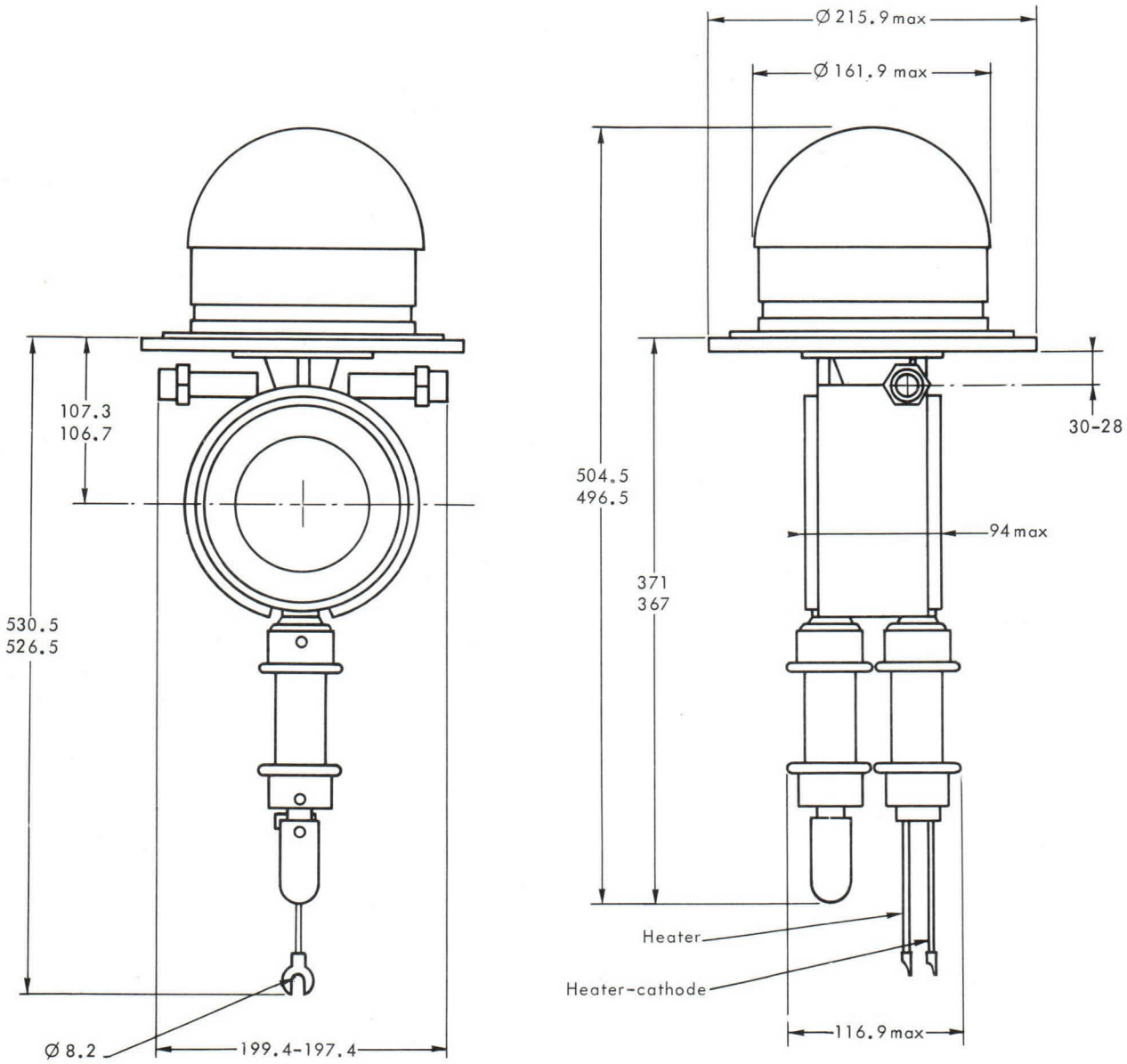
TRANSITION

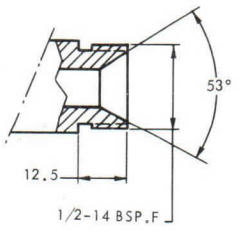


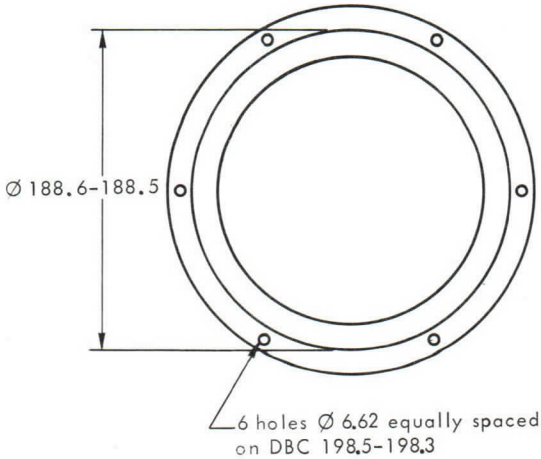
Dimensions in mm

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING







Dimensions in mm.

MAGNETRONS BANDE L - 2,4 MW
(de 1220 à 1370 MHz)



Les tubes de cette série sont des magnétrons à fréquence fixe fonctionnant en impulsions et pouvant fournir une puissance crête de sortie d'au moins 2, 4 MW. Les quinze tubes sont répartis dans la bande de fréquence de 1220 à 1370 MHz.

La puissance de sortie est transmise au circuit d'utilisation par l'intermédiaire d'une transition guide-circulaire-guide rectangulaire.

Le refroidissement est assuré par circulation d'eau.

F1088	*(MC. 567 A)*	*1275*	*±*	*5 MHz*
F1089	*(MC. 567 B)*	*1287*	*±*	*7 MHz*
F1090	*(MC. 567 C)*	*1300*	*±*	*5 MHz*
F1091	*(MC. 567 D)*	*1310*	*±*	*5 MHz*
F1092	*(MC. 567 E)*	*1320*	*±*	*5 MHz*
F1093	*(MC. 567 F)*	*1332*	*±*	*7 MHz*
F1094	*(MC. 567 G)*	*1345*	*±*	*5 MHz*
F1095	*(MC. 567 H)*	*1355*	*±*	*5 MHz*
F1096	*(MC. 567 J)*	*1365*	*±*	*5 MHz*
F1119		*1285*	*±*	*5 MHz*
F1120		*1315*	*±*	*5 MHz*
F1121		*1325*	*±*	*5 MHz*
MCF. 1329		*1223*	*±*	*3 MHz*
MCF. 1330		*1272*	*±*	*3 MHz*
MCF. 1331		*1312*	*±*	*3 MHz*

CARACTERISTIQUES GENERALES

Electriques

	min.		max.	
Tension de chauffage		20		V
Courant de chauffage	12		15	A
Tension d'anode crête	38		42	kV
Courant d'anode moyen		190		mA
Puissance de sortie crête		2, 5		MW
Puissance de sortie moyenne	3, 0			kW

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mecaniques

Aimant	aimant permanent (n'est pas fourni avec le tube)
Sortie RF	guide d'onde circulaire
Masse approximative	10 kg
Refroidissement	par circulation d'eau

VALEURS LIMITES D'UTILISATION

	min.	max.	
Tension de chauffage (1)	18	22	V
Courant de chauffage au démarrage	–	50	A
Temps de préchauffage	5	–	mn
TOS de la charge	–	1, 5	
Champ magnétique	900	1000	G
Tension d'anode crête	35	42	kV
Courant d'anode crête	–	152	A
Puissance appliquée crête	–	6, 4	MW
Puissance appliquée moyenne	–	8	kW
Facteur d'utilisation	–	0, 0015	
Durée d'impulsion	–	5	µs
Vitesse de croissance des impulsions	–	70	kV/µs
Température de l'anode	–	80	° C
Température de la sortie cathode	–	165	° C
Température de l'eau à la sortie	–	80	° C

(1) - La tension de chauffage de 20 volts doit être appliquée pendant au moins 5 minutes pour porter la cathode à la température requise avant d'appliquer la tension d'anode. Après application de la haute tension, la tension de chauffage doit être diminuée progressivement dans les proportions indiquées dans le paragraphe "consignes d'utilisation".

EXEMPLE DE FONCTIONNEMENT

	OSC . 1	OSC . 2	
Tension de chauffage	0	0	V
Champ magnétique	950	950	G
Courant d'anode moyen	190	190	mA
Tension d'anode crête	39	39	kV
Durée d'impulsions	1, 5	4, 0	µs
Facteur d'utilisation	0, 00125	0, 00125	
Vitesse de croissance des impulsions	60	60	kV/µs
Puissance de sortie moyenne	3, 25	3, 25	kW
Puissance de sortie crête	2, 6	2, 6	MW

CONSIGNES D'UTILISATION

La cathode du tube doit être portée à la température d'utilisation par l'application de la tension de préchauffage de 20 volts pendant une durée d'au moins cinq minutes.

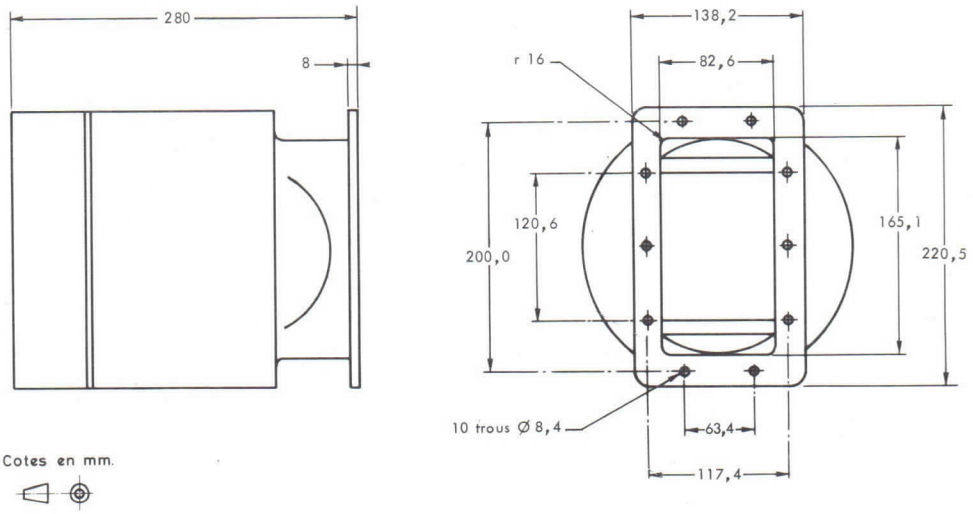
En fonctionnement normal, lorsque la haute tension est appliquée, la tension de chauffage doit prendre les valeurs suivantes :

Puissance d'entrée moyenne (Watts)	Tension de chauffage (Volts)
moins de 2000	20
2000 à 3000	15
3000 à 4000	10
4000 à 5000	5
plus de 5000	0

Pour protéger le tube en cas d'arcs ou flashs, un condensateur d'au moins 0, 004 μF doit être branché en parallèle sur le filament, directement sur les connexions de sortie.

Les magnétrons de grande puissance émettent un niveau important de rayons X dans la région de la cathode et du guide d'onde de sortie. Des blindages appropriés doivent être prévus pour la protection du personnel.

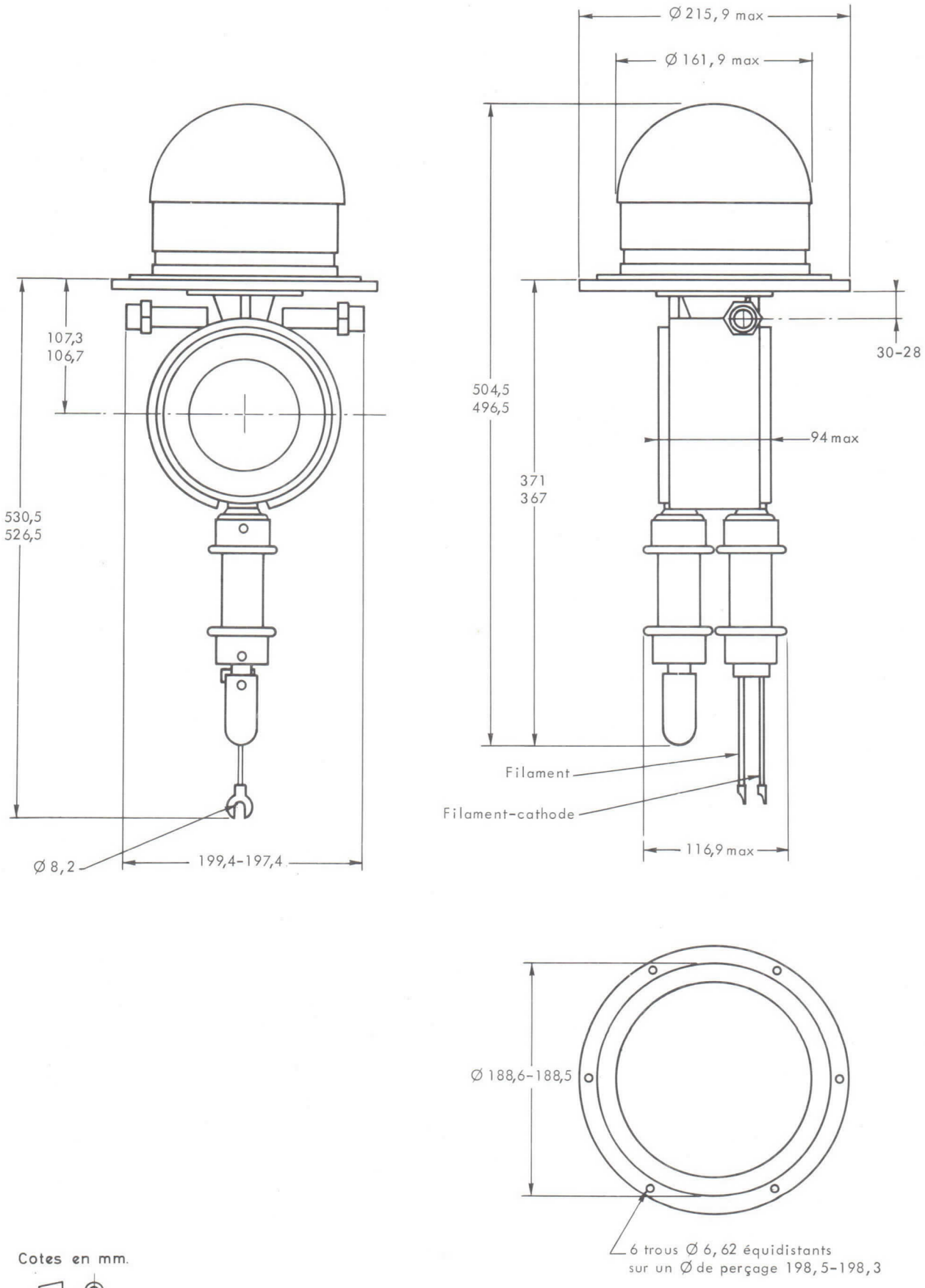
TRANSITION



Cotes en mm.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT



Cotes en mm.

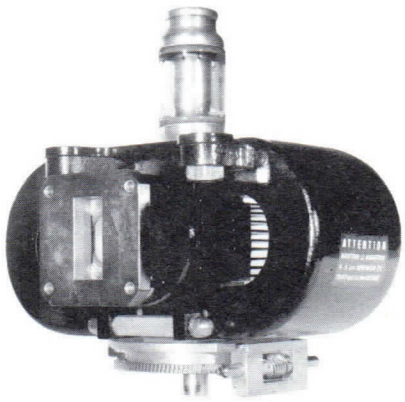
F 1025 MAGNETRON

The F 1025 is a tunable magnetron for pulse operation, it delivers a peak RF power output of at least 70 kW in the 8.5 - 9.6 GHz frequency range.

It features integral permanent magnets, forced air cooling, and RF output on standard waveguide.

The frequency is tunable from 8500 to 9600 MHz by means of an improved mechanical system.

The F 1025 magnetron is a replacement for the fixed frequency 4J 52, with a small size increase, due to the tuning system.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Frequency	8.5	–	9.6	GHz
Heater voltage (stand-by)	–	12.6	–	V
Heater current (stand-by)	2.0	–	2.4	A
Peak anode voltage	14	–	17	kV
Peak anode current	–	15	–	A
Peak power output	70	–	–	kW

Mechanical

Operating position	any	
Cooling	forced air	
Anode temperature, max.	140	°C
RF output, waveguide	RG 51/U	
RF output, flange	UG 52/AU	
Mechanical tuning :		
- number of tuner turns to cover the frequency range	7	
- tuner torque	0.29	mN
- tuner life duration (1 cycle = 8500 to 9600 to 8500 MHz)	10000	cycles
Tube weight, approximate	2.8	kg
Tube weight, with packing case	4.2	kg
Dimensions	see drawing	

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous)

	min.	max.	
Heater voltage	11.4	13.8	V
Warm-up time	3	–	mn
Duty cycle	–	0.002	
Anode average power	–	350	W
Peak anode current	–	20	A
Frequency	8.5	9.6	GHz

TYPICAL OPERATION

Heater voltage, stand-by	12.6	V
Heater voltage, in oscillation	7.5	V
Pulse duration	1 ± 10%	μs
Rate of rise of anode voltage	80	kV/μs
Duty cycle	0.001	
Peak anode current	15	A
Peak anode voltage	15	kV
Peak power output	80	kW
Operating frequency	8.5 to 9.6	GHz
Pulling	12	MHz

OPERATING INSTRUCTIONS

The following instructions are for installing and operating the F 1025 magnetron.

INSTALLATION

During mounting and handling of the magnetron, care should be taken to prevent shocks or strains especially on the output window. A minimum distance of 5 cm should be maintained between the tube and any magnetic material. Magnets should be kept away from the magnetron. Use non magnetic tools for installation.

ELECTRICAL CONNECTIONS

Connection of the base : The cathode of the magnetron is connected to the external ring of the base. The plug should not exercise any strain on the glass-to-metal seal.

To protect the heater, it is recommended to put an inductance (a few μH) in series with it and a shunt capacitor of about 20 000 pF between cathode and heater.

Apply heater voltage gradually. The heater surge current should not exceed 5 amperes. Allow at least 3 minutes for the cathode to warm-up before applying high voltage.

The tuning mechanism should be adjusted at the lower frequency position (8500 MHz).

Turn the tuning mechanism clockwise to lower the frequency. Operation at this frequency should be continued until the magnetron operates in a stable mode.

Check the efficiency of the cooling air flow.

Apply the high voltage negative pulses to the cathode. Grounding of the mounting plate will insure adequate grounding of the tube.

In normal operation, pulses should be according to the following characteristics :

The pulse level ripple must not exceed 10 % of the mean level.

Reverse voltage must not exceed 10 % of the applied pulse.

The pulse rise time should be limited according to the pulse width between 60 kV/μs for 2 μs and 100 kV/μs for 0. 5 μs.

The heater voltage should be reduced to 7.5 V as soon as the high voltage is applied and according to the following formula :

$$V_f = 11.6 - 0.17\ P_a \qquad \text{(PA = applied power)}$$

The tube should be tuned only through the specified tuning range.

STARTING A NEW TUBE

When a tube is new or has not been used for a long time, small quantity of gas can produce arcing when high voltage is applied. Generally, arcs are very short and high voltage and current may be increased. If instability occurs at any step, as evidenced by heavy arcing and erratic average anode current, the following procedure is to be observed :

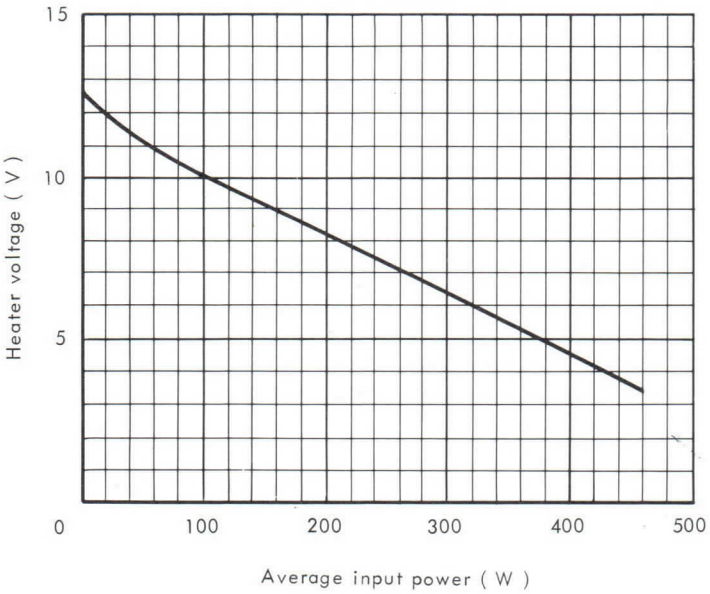
- turn the tuning mechanism clockwise to operate at the lowest frequency.
- allow at least 15 minutes for the tube to warm-up.
- gradually increase high voltage until average anode current instability appears.
- slightly reduce the high voltage and operate at this lower level during three minutes.
- tune the frequency at 8500 MHz.
- when the tube operates in a stable mode, increase gradually high voltage to reach normal operating value.
- the tube operating in a very stable way, frequency may be tuned slowly through the entire specified range (8500 to 9600 MHz).

Never exceed absolute ratings.

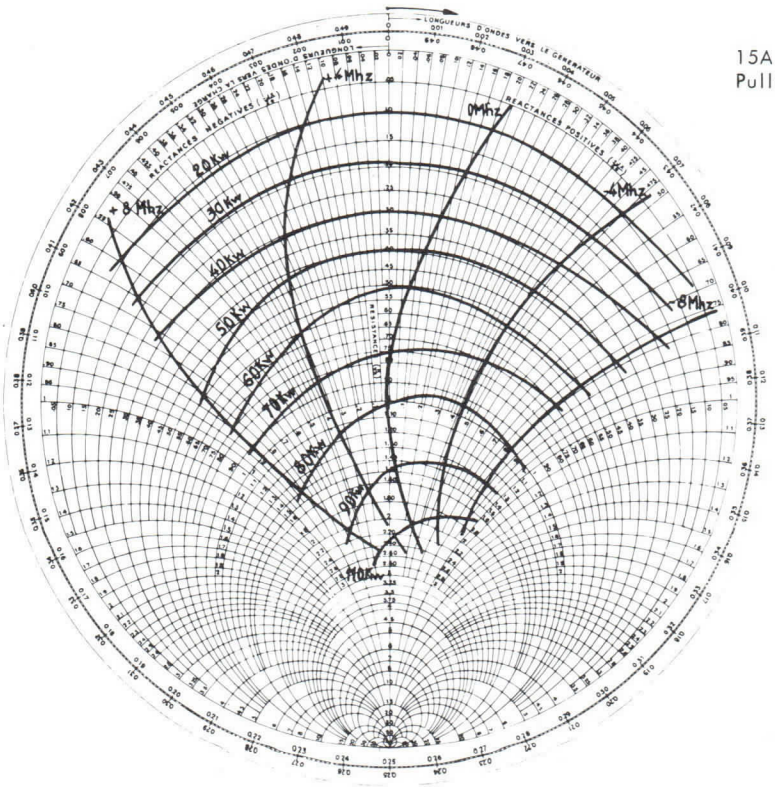
The load normally used should have a VSWR $< 1.3 : 1$. To avoid difficulties during starting of the tube, it is recommended to operate at the lowest possible VSWR.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

HEATER VOLTAGE ADJUSTMENT VERSUS INPUT POWER

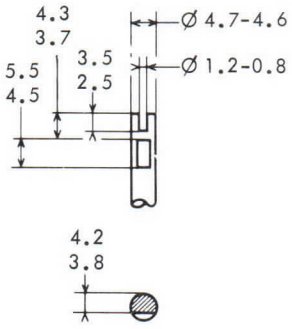


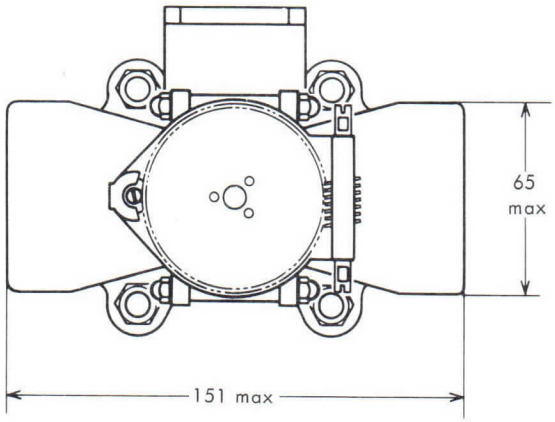
RIEKE DIAGRAM

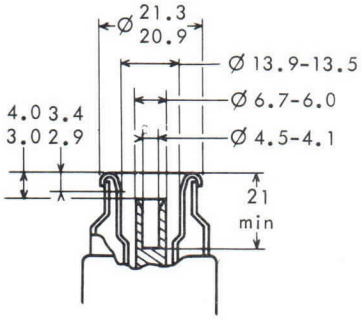


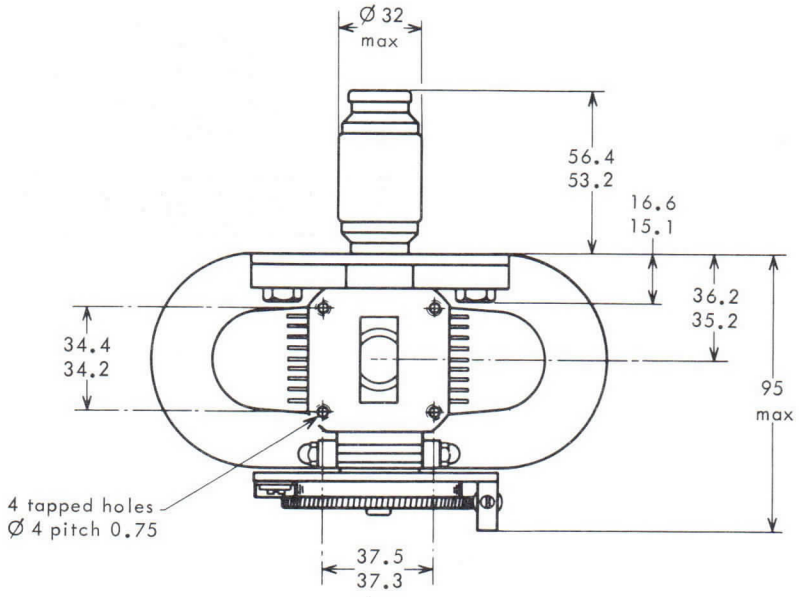
15A - 15kV
Pulling factor 9 MHz

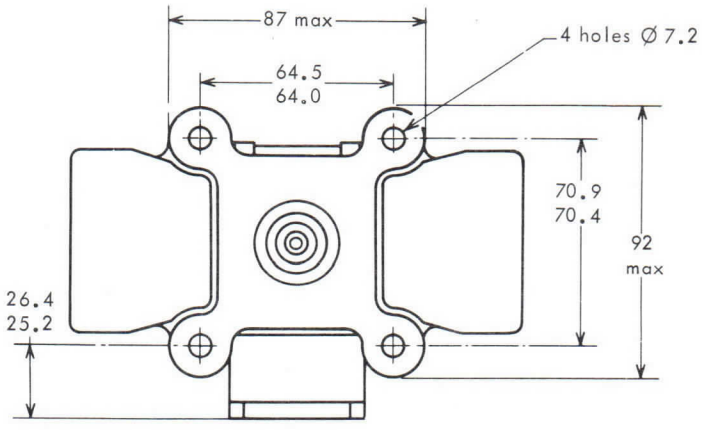
OUTLINE DRAWING



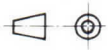








Dimensions in mm.



F 1025

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

THOMSON-CSF

MAGNETRON F 1025

Le tube F1025 est un magnétron accordable employé comme oscillateur hyperfréquence fonctionnant en régime d'impulsions. Il fournit une puissance RF de crête de 70 kW minimum entre 8,5 et 9,6 GHz.

Il comprend des aimants permanents incorporés au corps du tube. Le refroidissement se fait par air forcé. La sortie hyperfréquence est sur guide d'onde.

Un dispositif mécanique permet de régler la fréquence entre 8 500 et 9 600 MHz.

Le magnétron F1025 peut être utilisé à la place du magnétron à fréquence fixe 4J52 au prix d'un léger encombrement supplémentaire pour le système d'accord.



CARACTERISTIQUES GENERALES(1)

Electriques

	min.	nom.	max.	
Fréquence	8,5	-	9,6	GHz
Mode de chauffage	-	indirect	-	
Tension de chauffage (au repos)	-	12,6	-	V
Courant de chauffage (au repos)	2,0	-	2,4	A
Tension de crête d'anode	14	-	17	kV
Courant de crête d'anode	-	15	-	A
Puissance de crête de sortie	70	-	-	kW

Mécaniques

Position de fonctionnement : indifférente
Mode de refroidissement : air soufflé
Température maximale de l'anode : 140 °C
Sortie HF : guide d'onde : RG - 51/U
Sortie HF : bride : UG - 52/AU
Accord mécanique :
Nombre de tours maximale de la grande roue dentée pour couvrir la bande : 7
Rapport de démultiplication de la vis tangente : 116/4
Vitesse maximale d'entraînement du mécanisme d'accord (1 cycle = 1 aller et retour 8 500 - 9 600 - 8 500 MHz) : 1 cycle/minute
Couple : 300 g/cm
Nombre maximum de cycles admissibles : 10 000
Poids du tube net : 2,8 kg
Poids du tube sous emballage : 4,2 kg
Dimensions : voir dessin

(1) Ces caractéristiques sont données à titre indicatif seulement, voir spécifications pour caractéristiques de types.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION

(non simultanées)

	min.	max.	
Tension de chauffage	11,4	13,8	V
Temps de préchauffage	3	-	mn
Facteur d'utilisation	-	0,002	
Puissance moyenne d'anode	-	350	W
Courant de crête d'anode	-	20	A
Fréquence	8,5	9,6	GHz

EXEMPLE DE FONCTIONNEMENT

Tension filament - au démarrage	12,6	V
- en oscillation (voir courbe)	7,5	V
Durée de l'impulsion	1 ± 10 %	µs
Vitesse de croissance de la tension d'anode	80	kV/µs
Facteur d'utilisation	0,001	
Courant de crête d'anode	15	A
Tension de crête d'anode	15	kV
Puissance de crête de sortie	80	kW
Fréquence de fonctionnement	8,5 à 9,6	GHz
Entraînement de fréquence (pulling)	12	MHz

CONSIGNES DE MISE EN SERVICE

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes nécessaires par exemple pour l'établissement d'un matériel nouveau, peuvent être fournies sur demande.

Installation

1 - Assurer la mise en place du magnétron en prenant toutes précautions utiles.

a) N'utiliser pour le montage que des OUTILS NON MAGNETIQUES.

b) S'assurer au moment du serrage des vis, qu'aucune contrainte n'est exercée sur le tube et en particulier sur le pied de verre d'amenée de courant ainsi que sur le guide d'onde de sortie.

c) Aucun objet magnétique, ou ferromagnétique ne doit se trouver à MOINS DE 5 CM des aimants fixés au tube.

2 - Brancher les connexions d'amenée de courant au culot du magnétron. La cathode du magnétron est reliée par construction à la bague extérieure du culot. La fiche de connexion ne doit exercer aucune contrainte sur le scellement verre-métal. Pour cela le conducteur central de la fiche utilisée doit être souple tout en exerçant un contact parfait avec la douille centrale. Afin de protéger le filament, il est recommandé de mettre en série avec celui-ci, une self inductance de quelques microhenrys découplée à la connexion cathode par des condensateurs de 10 à 20 000 pF.

3 - Appliquer la tension de chauffage graduellement pour que le courant d'appel à la mise sous tension n'excède pas 5 ampères. Chauffer la cathode du magnétron à la tension prescrite. On observera que le temps de chauffage doit être au moins de 3 minutes avant l'application de la haute tension.

4 - S'assurer que l'axe d'entraînement du système d'accord est bien en position fréquence basse (8 500 MHz). Pour cela le tourner, jusqu'à la butée dans le sens de rotation des aiguilles d'une montre. En effet, il est recommandé de toujours démarrer ce magnétron sur la fréquence la plus basse, ce qui facilite en général le démarrage.

5 - Vérifier que la ventilation s'effectue normalement.

6 - Appliquer la haute tension en impulsions négatives sur la cathode. A noter que le plateau de fixation sert de contact de masse, l'anode du magnétron lui étant réunie par construction.

Forme des impulsions :

D'une manière générale, toute pointe ou suroscillation sur le plat d'une impulsion ne doit pas dépasser ± 10 % de la valeur moyenne de ce plat.

La tension inverse ne doit pas dépasser 10 % de l' impulsion appliquée. La vitesse de croissance doit être limitée en fonction de la largeur d' impulsion entre 60 kV/µs pour 2 µs et 100 kV/µs pour 0,5 µs.

7 - Réduire la tension de chauffage du magnétron à 7,5 volts immédiatement après l'application de la haute tension en fonction de la relation suivante :

$$V_f = 11,6 - 0,17\ P_a \qquad (P_a = \text{puissance appliquée})$$

8 - La fréquence de ce magnétron est accordable par la rotation d'un axe d'entraînement figuré sur le dessin. Il est important au cours du fonctionnement de ne pas sortir des limites de fréquences spécifiées 8 500 - 9 600 MHz.

Précautions importantes

FORMATION D'UN MAGNETRON NEUF :

Un magnétron qui est resté sans fonctionner depuis un certain temps peut contenir de petites traces de gaz. Ce gaz peut provoquer l'apparition d'arcs internes, dès l'application de la haute tension en impulsions négatives sur la cathode. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre contrôlant le courant moyen magnétron. Ils sont généralement de courte durée (inférieurs à 2 secondes). Dans ce cas la haute tension et le courant peuvent être montés sans hésitation. Quand les arcs ou "flashs" sont secs et répétés pendant plusieurs secondes (de l'ordre de 5 secondes et plus) et provoquent des fluctuations rapides et incontrôlées du milliampèremètre il devient essentiel d'appliquer la règle suivante :

a) Tourner l'axe d'entraînement du système d'accord dans le sens de rotation des aiguilles d'une montre jusqu'à la butée, pour régler ensuite la fréquence à 8 500 MHz.

b) Préchauffer le tube pendant 15 minutes.

c) Faire croître régulièrement la haute tension (impulsion de 0,5 µs de préférence) jusqu'à l'apparition d'instabilité du courant moyen magnétron.

d) Dès l'apparition d'instabilité du courant moyen magnétron réduire légèrement la haute tension pour faire disparaître cette instabilité et, laisser le magnétron fonctionner pendant 3 minutes.

e) Régler la fréquence à 8 500 MHz.

f) Aussitôt le courant stabilisé, augmenter progressivement la haute tension jusqu'à la valeur désirée (tenir compte du paragraphe d).

g) Le tube étant stabilisé au courant désiré, s'efforcer de couvrir la bande de 8 500 MHz vers 9 600 MHz.

En aucun cas les valeurs limites ne doivent être dépassées.

Le taux d'ondes stationnaires de la charge doit toujours être inférieur à 1,3. Un taux supérieur à cette valeur risque de perturber l'opération de démarrage.

Un mauvais fonctionnement du magnétron peut être dû à différentes causes, par exemple : Forme d'impulsions incorrecte, chauffage cathode anormal, T.O.S. trop élevé.

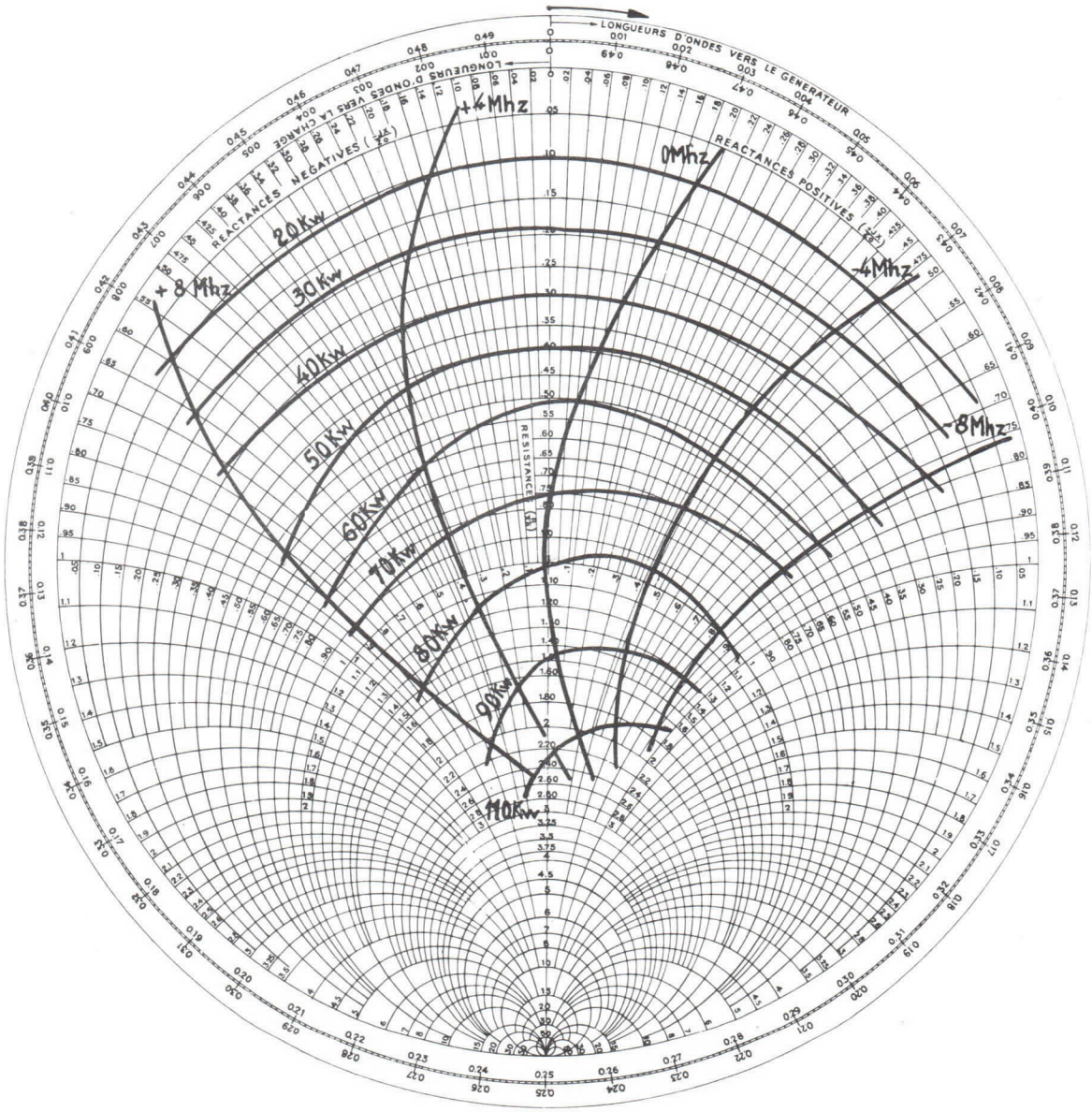
NOTA :

Au cours de la formation il est important d'ajuster la tension de chauffage en fonction du courant débité.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

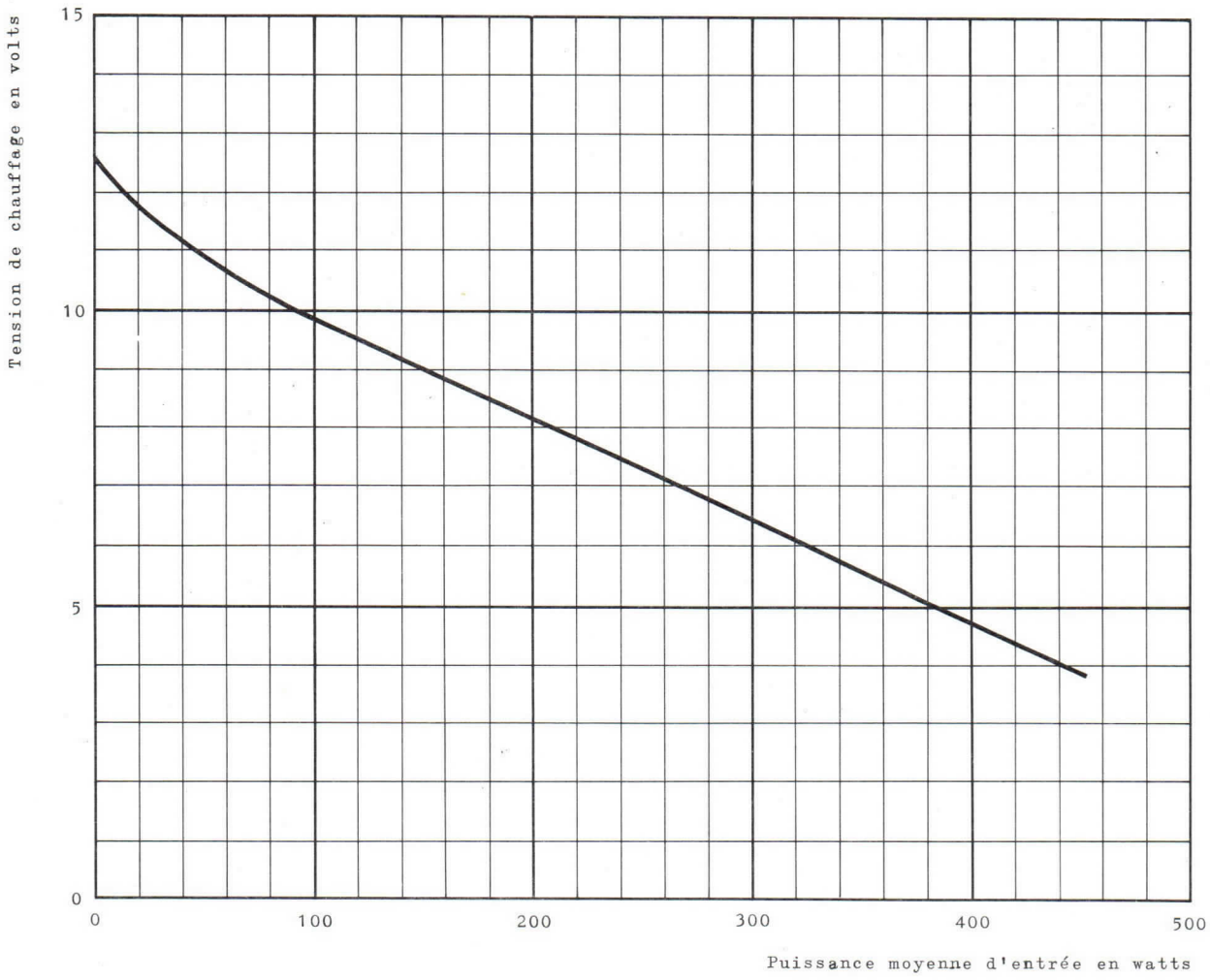
DIAGRAMME DE RIEKE

15 A - 15 kV
Entraînement de fréquence 9 MHz



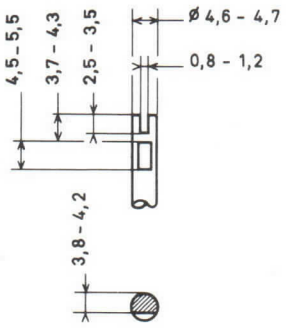
Nota : Ce diagramme est donné à titre indicatif seulement

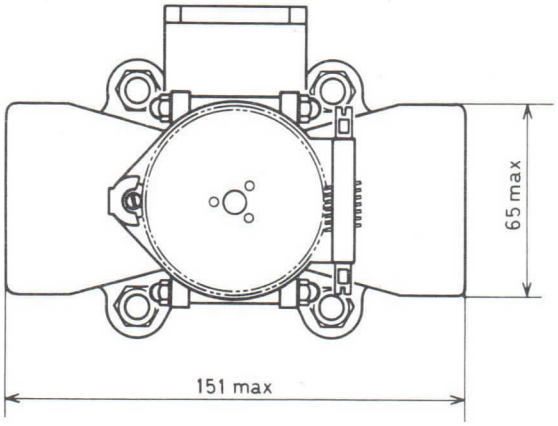
REDUCTION DE LA TENSION DE CHAUFFAGE EN FONCTION DE LA PUISSANCE D'ENTREE

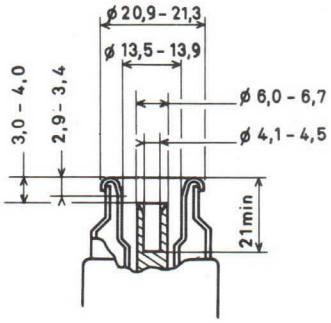


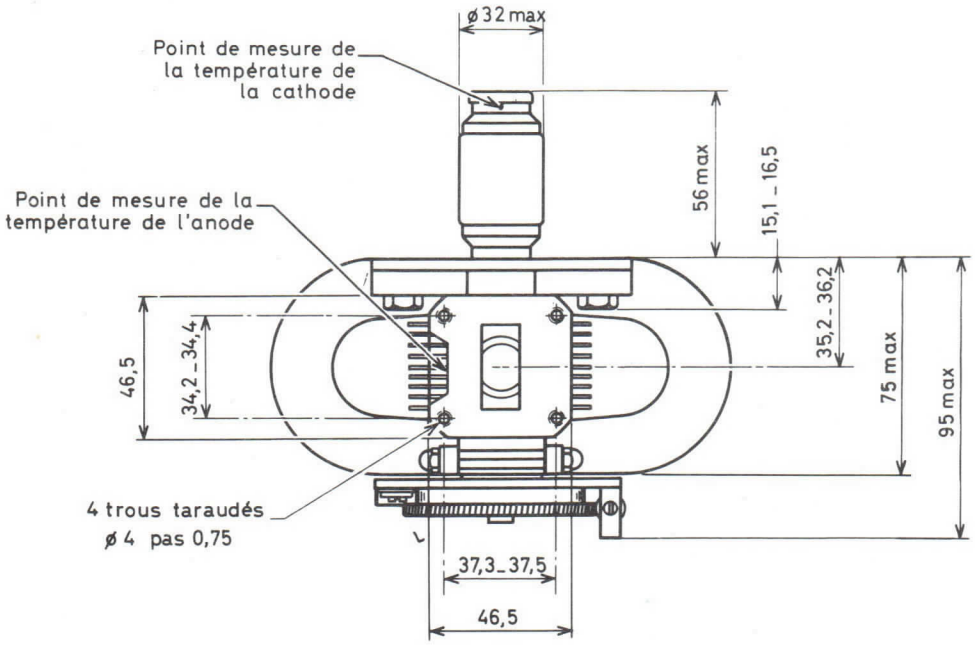
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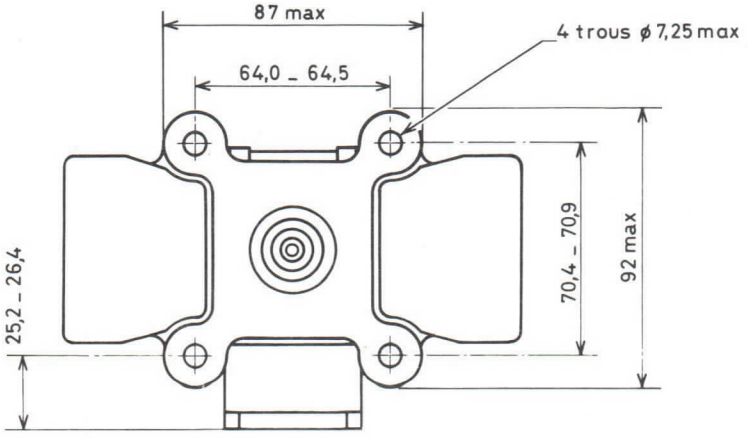
COTES D'ENCOMBREMENT





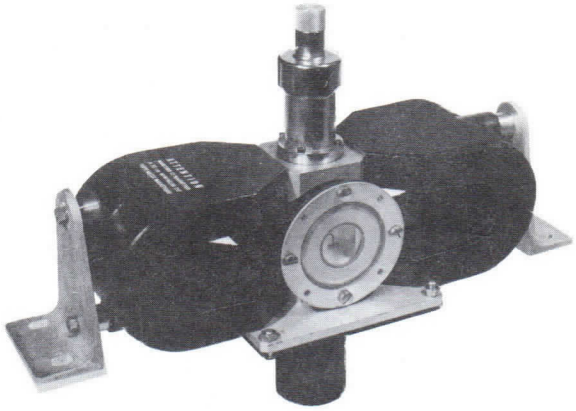






Cotes en mm

MAGNETRON F 1050



Le tube F 1050 est un magnétron accordable employé comme oscillateur hyperfréquence fonctionnant en régime d'impulsions. Il fournit une puissance RF crête de 250 kW minimale dans la bande 5450 à 5825 MHz.

Des aimants permanents sont incorporés au corps du tube. Le refroidissement se fait par air soufflé. La sortie hyperfréquence s'effectue sur guide d'onde bande C.

Un dispositif mécanique permet de régler la fréquence entre 5450 et 5825 MHz.

CARACTERISTIQUES GENERALES (1)

Eléctriques

	min.	nom.	max.	
Fréquence	5450	-	5825	MHz
Mode de chauffage		indirect		
Tension de chauffage	-	9,5	-	V
Courant de chauffage	5,0	-	6,0	A
Puissance de sortie crête	250	-	-	kW
Tension crête d'anode	23	-	26	kV
Courant crête d'anode	-	24	-	A

Mécaniques

Position de fonctionnement	indifférente
Mode de refroidissement	air soufflé
Sortie RF : guide d'onde	RG 49/U
bride à piège	UG 148 B/U
Masse du tube, environ	17 kg
Masse du tube sous emballage	25 kg
Dimensions	voir dessin

VALEURS LIMITES D'UTILISATION
(non simultanées)

	min.	max.	
Tension de chauffage	-	10,5	V
Durée d'impulsion	-	2,5	µs
Facteur d'utilisation	-	0,0012	
Puissance d'entrée moyenne	-	750	W
Puissance d'entrée crête	-	750	kW
Tension anodique de crête	-	28	kV
Courant anodique de crête	-	30	A
Dérive fréquence/température	-	0,2	MHz
Entraînement de fréquence	-	15	MHz
Temps de préchauffage	3	-	mn

(1) Ces caractéristiques sont données à titre indicatif seulement, voir spécifications pour caractéristiques de types.

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EXEMPLES DE FONCTIONNEMENT

	Oscillation 1	Oscillation 2	
Tension de chauffage au démarrage . . .	9,5	9,5	V
Tension de chauffage en oscillation . . .	5	6,3	V
Durée de l'impulsion	0,9 à 1,1	0,20 à 0,25	µs
Temps de croissance de la tension anodique.	0,15 à 0,20	0,15 à 0,20	µs
Facteur d'utilisation	0,001	0,00063	
Tension anodique de crête	23 à 26	23 à 26	kV
Courant anodique moyen	24	16	mA
Fréquence de fonctionnement	5450 à 5825	5450 à 5825	MHz
Variation de tension crête en fonction de l'augmentation de fréquence de 5450 à 5825 MHz	3	3	kV max
Puissance moyenne HF minimum	250	170	W

CONSIGNES DE MISE EN SERVICE

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes, nécessaires par exemple pour l'établissement d'un matériel nouveau, peuvent être fournies sur demande.

Installation

1 - Assurer la mise en place du magnétron, en prenant toutes précautions utiles.
   a) Utiliser pour le montage du tube des outils non magnétiques.
   b) S'assurer au moment du serrage des vis, qu'aucune contrainte n'est exercée sur le tube et en particulier sur le pied de verre d'amenée de courant ainsi que sur la fenêtre de sortie RF.
   c) Aucun objet magnétique, ou ferromagnétique ne doit se trouver à moins de 30 cm des aimants fixés au tube.

2 - Brancher les connexions d'amenée de courant aux deux cosses du magnétron, la cosse peinte en rouge étant reliée à la cathode.
   A titre de protection du filament, il est recommandé de mettre en série avec celui-ci une self inductance de quelques microhenrys découplée à la cathode par des condensateurs de 10 000 à 20 000 pF.

3 - Appliquer la tension de chauffage graduellement pour que le courant d'appel n'excede pas 18 ampères. Chauffer la cathode du magnétron à la tension prescrite pendant 3 minutes minimum avant l'application de la haute tension.

4 - Régler la fréquence du magnétron à 5500 MHz (environ). Pour cela tourner le système mécanique d'accord en fréquence dans le sens de rotation des aiguilles d'une montre. 13 tours environ suffisent pour couvrir la bande 5450 - 5825 MHz.

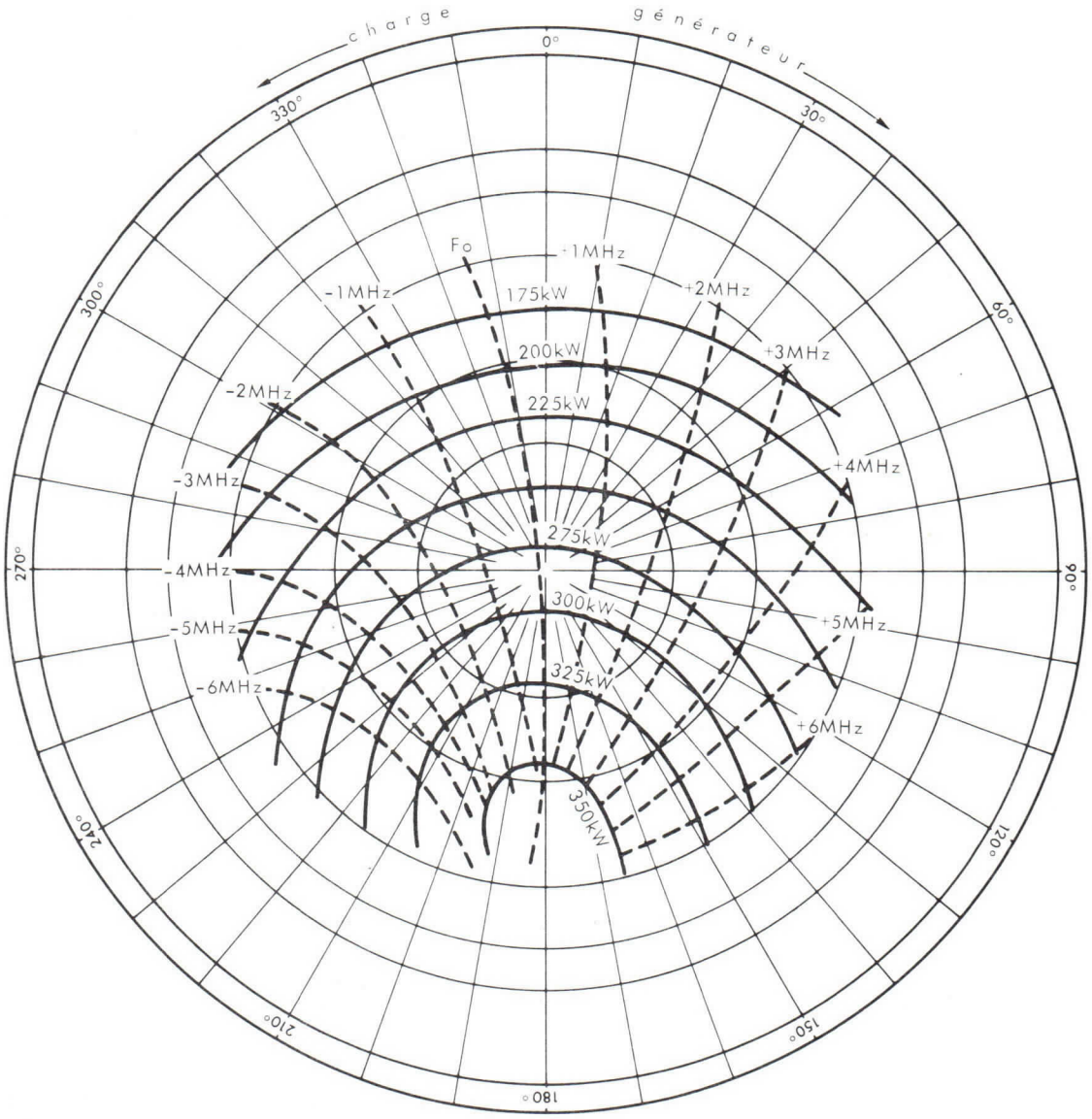
5 - Verifier que la ventilation s'effectue normalement.

6 - Appliquer la haute tension.
   Le plateau central doit être utilisé comme contact de masse, de préférence aux pattes de fixation. Dans les régimes normaux de fonctionnement, les formes d'impulsions observées devront correspondre aux caractéristiques suivantes :
   Temps de croissance de la tension (mesuré entre 20 et 85%) 0,15 à 0,20 µs.
   Toute pointe à l'avant de l'impulsion doit être supprimée. Toute suroscillation sur le plat de l'impulsion de courant ne doit pas dépasser 10% de la valeur moyenne du courant de crête. La tension inverse sur l'impulsion de tension ne doit pas dépasser 20% de l'impulsion appliquée.

7 - Réduire la tension de chauffage du magnétron en fonction de la puissance appliquée, conformément à la courbe.

8 - La fréquence de ce magnétron étant accordable, il est important au cours du fonctionnement de ne jamais sortir des limites de fréquences spécifiées (5450 - 5825 MHz).

DIAGRAMME DE RIEKE

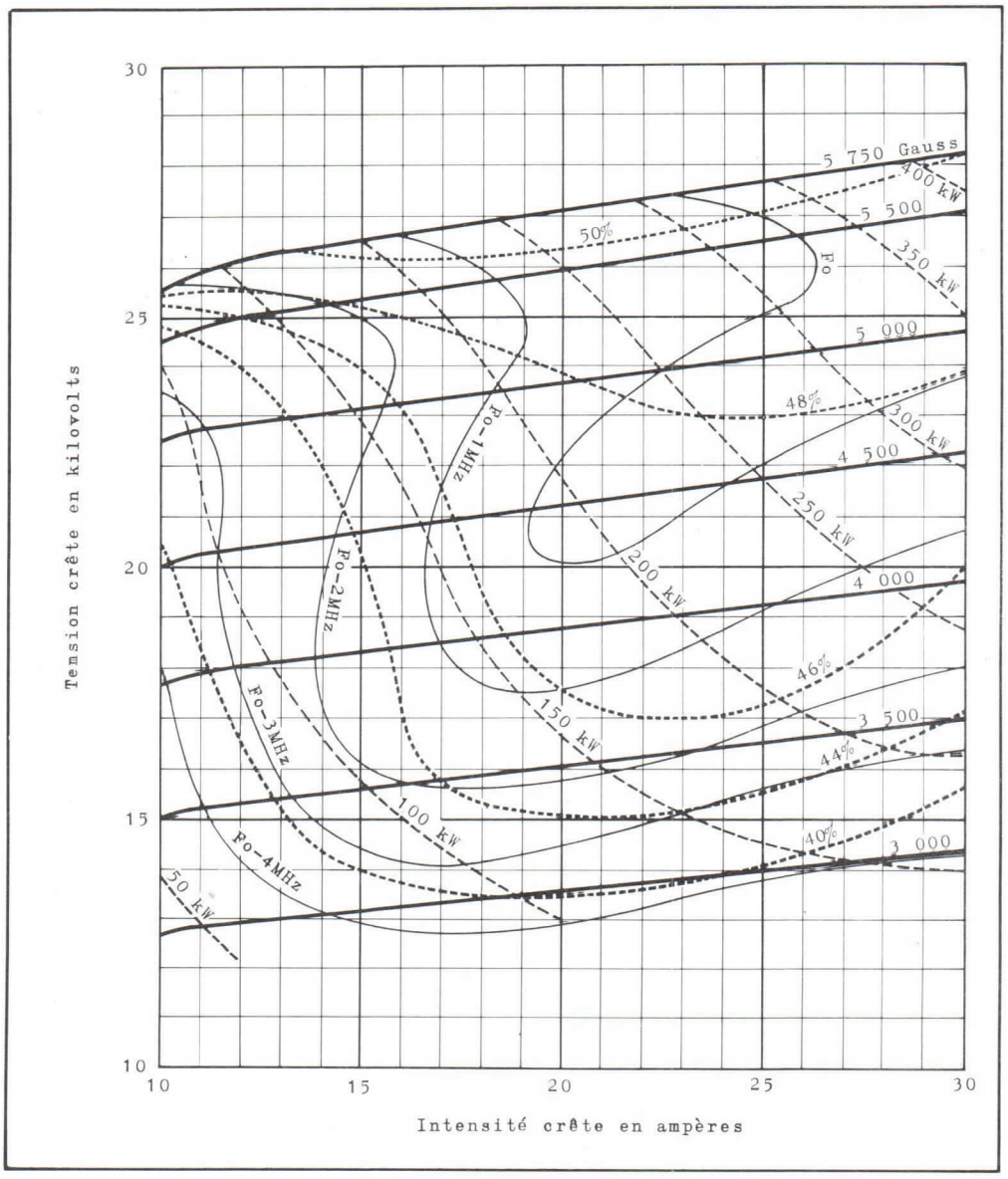


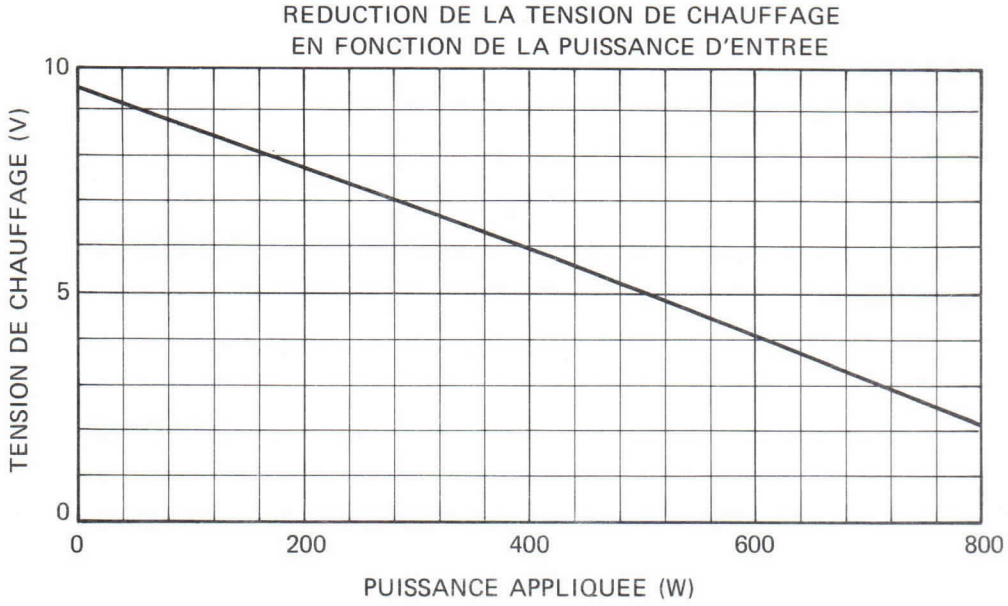
fo = 5650 MHz
Ic = 24 A
Fr = 400 Hz
τ = 1 µs
Vc = 24 à 25,5 kV

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GROUPEMENT TUBES ELECTRONIQUES

RESEAU CARACTERISTIQUE

Durée des impulsions :	1	µs
Fréquence de répétition :	500	Hz
Fréquence d'oscillation :	5 650	MHz
Entraînement de fréquence :	7,5	MHz





PRECAUTIONS IMPORTANTES

Formation d'un Magnétron neuf

Un magnétron qui est resté sans fonctionner depuis un certain temps peut présenter de petites traces de gaz, ce qui peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre de contrôle du courant moyen magnétron. Ils sont généralement de courte durée (inférieurs à 2 secondes). Dans ce cas la haute tension et le courant peuvent être montés sans hésitation. Quand les arcs ou "flahs" sont secs et répétés pendant plusieurs secondes (de l'ordre de 5 secondes et plus) et provoquent des fluctuations rapides du milliampèremètre il devient essentiel d'appliquer la règle suivante :

a) Former tout d'abord le tube dans le régime où la durée d'impulsion est la plus courte.
b) Tourner l'axe d'entrainement du système d'accord dans le sens de rotation des aiguilles d'une montre pour régler la fréquence aux environs de sa valeur minimale.
c) Préchauffer le tube pendant 15 minutes.
d) Faire croître régulièrement la haute tension jusqu'à l'apparition d'instabilité du courant moyen magnétron
e) Dès l'apparition d'instabilité du courant moyen magnétron réduire légèrement la haute tension pour faire disparaître cette instabilité et laisser le magnétron fonctionner pendant 3 minutes environ.
f) Régler ensuite la fréquence à la valeur la plus basse de la bande, soit 5450 MHz.
g) Aussitôt le courant stabilisé, augmenter progressivement la haute tension jusqu'à la valeur désirée (tenir compte du paragraphe d).
h) Le tube étant stabilisé au courant désiré, s'efforcer de couvrir la bande de 5450 vers 5825 MHz.
i) Si le tube doit fonctionner à différentes largeurs d'impulsions, faire la même reformation pour la durée d'impulsion la plus longue.

En aucun cas les valeurs limites ne doivent être dépassées.

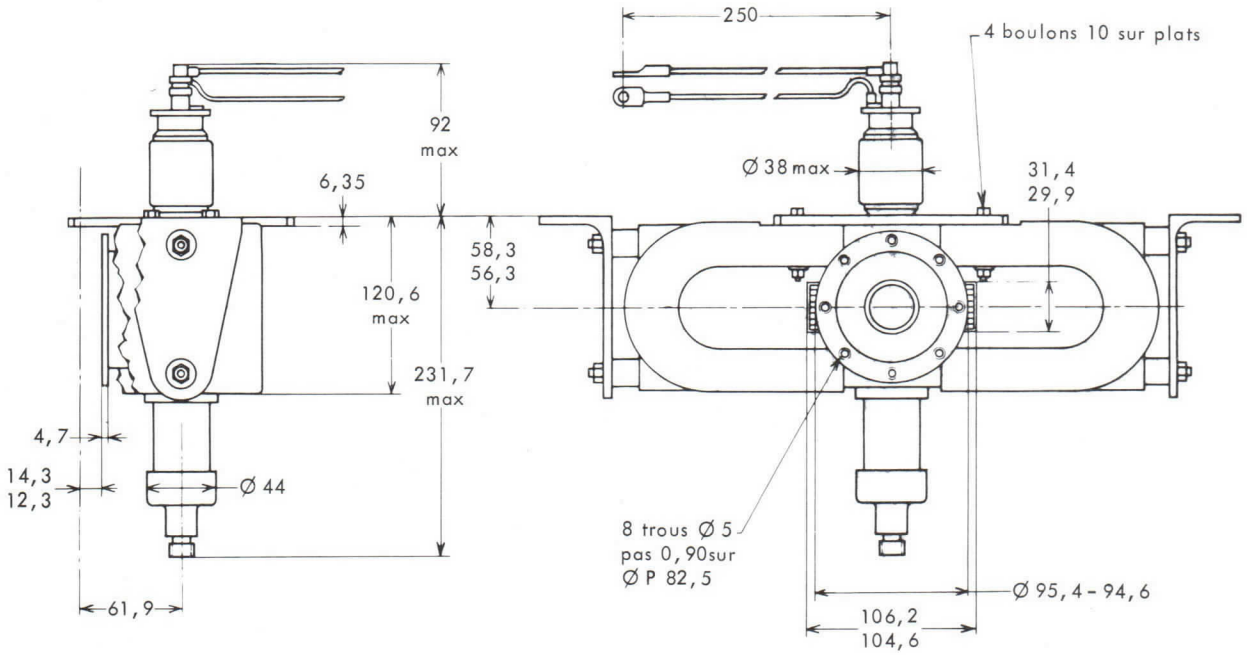
Le taux d'ondes stationnaires de la charge doit toujours être inférieur à 1,5. Un taux supérieur à cette valeur risque de perturber l'opération de démarrage.

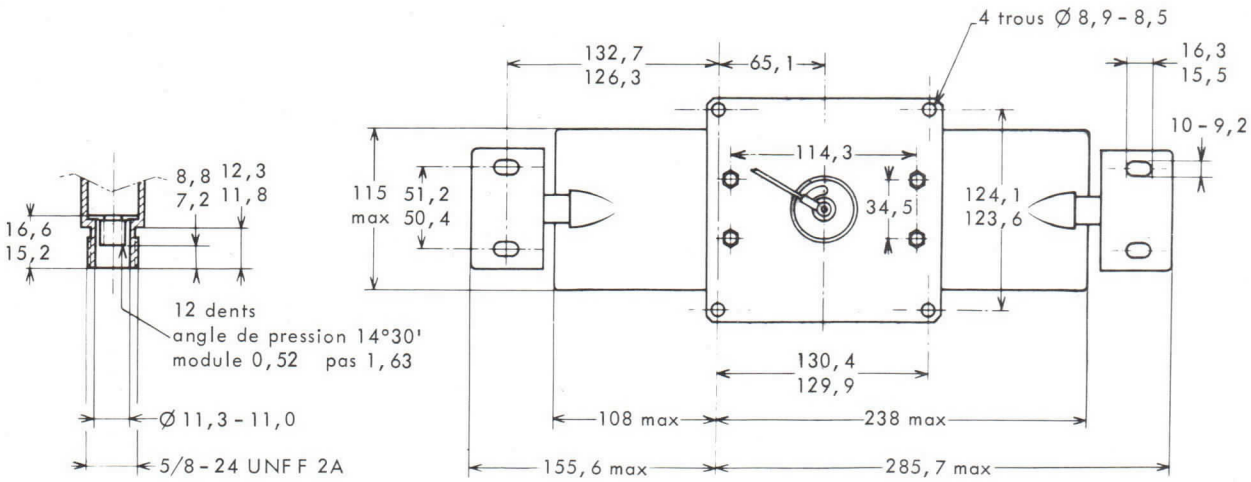
Un mauvais fonctionnement du magnétron peut être dû à différentes causes par exemple : Forme d'impulsion incorrecte, chauffage cathode anormal, TOS trop élevé.

NOTA: Au cours de la formation, il est important d'ajuster la tension de chauffage en fonction du courant débité.

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GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT

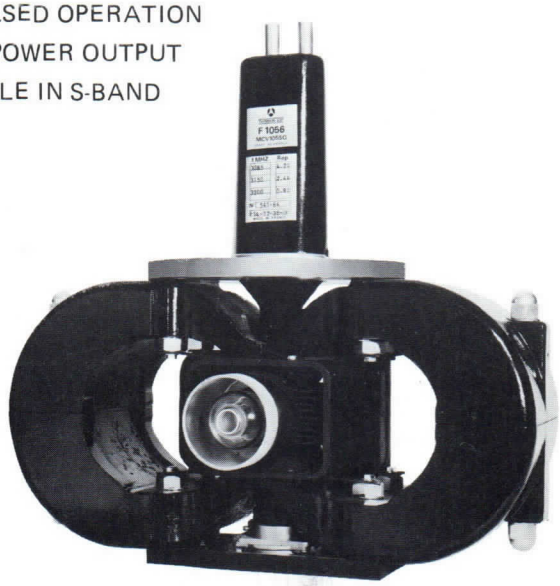




Cotes en mm.

MCV 1055 E, F, G MAGNETRONS

- MAGNETRONS FOR PULSED OPERATION
- 1 MW MINIMAL PEAK POWER OUTPUT
- FREQUENCY TUNABLE IN S-BAND



The MCV 1055 series of magnetrons deliver a peak output of at least 1 megawatt in S-Band, with a peak current of 60 amperes.

The RF output, under pressurization, is a 50 ohms standard coaxial line, which can be coupled to a rectangular waveguide through a suitable transition.

The cathode is of oxide type, indirectly heated.

GENERAL CHARACTERISTICS

Electrical

Ia avg. = 60 mA	Du = 0.001	t_{p1} = 4 ± 0.4 µs
E_f = 0 V	VSWR ⩽ 1.1 : 1	t_{p2} = 2 ± 2.2 µs
Warm-up :	E_f = 14 V	t = 240 s

		min.	max.	
Heater current (E_f = 14 V)		4.8	5.6	A
Peak anode voltage		27	33	kV
Average power output		1.0	–	kW
Frequency	MCV 1055 E	2900	3015	MHz
	MCV 1055 F	2985	3115	MHz
	MCV 1055 G	3085	3200	MHz
Radio frequency bandwidth (1)		–	2.5/t	MHz
Side lobe ratio (2)		6	–	dB
Stability (3)		–	1	%
Pushing (4)		–	0.1	MHz/A
Temperature coefficient (5)		–	0.15	MHz/°C
Pulling (6)		–	20	MHz
Anode-cathode capacitance		–	25	pF

(1) Measure at 1/4 of the maximum power on the principal lobe.

(2) Ratio between the maximum power of the principal lobe and the maximum power of the greatest secondary lobe.

(3) Missing pulses counted during the last five minutes of a fifteen minutes test.
A "missing pulse" is defined when its rf energy level is lower than 70 % of the rf energy level of pulses produced in the frequency range by normal oscillation of the tube.

(4) Measured between 50 and 65 A peak.

(5) Measured for a temperature variation of 30 °C ± 5 °C on the anode, according to note 12.

(6) Frequency deviation measured with a VSWR = 1.5 : 1 and the phase being cycled through 180°.

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GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous)

	min.	max.	
Warm-up time	240	–	s
Warm-up voltage	13	15	V
Heater voltage in operation	note 7		
Heater surge current (8)	–	15	A
Average anode current	–	70	mA
Duty cycle	–	0. 0011	
Peak anode current	–	65	A
Pulse duration (9)	0. 8	4. 4	µs
Rate of rise of current (10)	0. 15	0. 5	µs
Decay time (10)	–	0. 7	µs
Rate of rise of voltage (11)	70	100	kV/µs
VSWR	–	1. 5 : 1	
RF output pressurization (absolute)	2. 5	4	bar
Anode temperature (12)	–	120	°C

(7) After application of the anode voltage, the heater voltage should be set to a value given by the following formula :

$$E_f\,(Volt) = (14 - 0.0115 \times P_a) \pm 5\,\% \qquad P_a\,(watt) \leqslant 1200\ W$$
$$E_f = 0 \text{ for } P_a \geqslant 1200\ W \text{ or } P_a = 30 \times I_a\ avg\ (mA)$$

(8) Maximum current when applying heater voltage.
(9) Measured at the average half value point of current pulse.
(10) Measured between 10 and 90 % of the average peak value on the current pulse sides. Furthermore, the addition of the rise time and decay time should never exceeds 50 % of the pulse duration measured as indicated in note 9.
(11) Maximum slope of the voltage pulse front, measured above 80 % of the average peak value of the pulse.
(12) The measurement point is indicated on the outline drawing (junction between the central cooling fin and the rf output on the anode body).

TYPICAL OPERATION

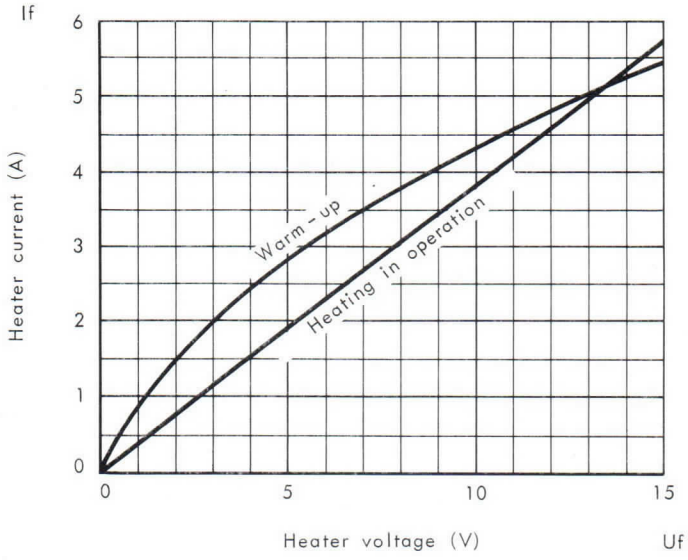
Pulse duration	1	4	µs
Duty cycle	.001	.001	
Peak anode current	60	60	A
Peak anode voltage	30	30	kV
Heater voltage	0	0	V
Peak RF power output	1. 1	1. 1	MW
Frequency pulling	14	14	MHz
Frequency pushing	.05	.05	MHz/A

HEATER VOLTAGE CHARACTERISTICS

These plots indicate the heater current versus heater voltage.

The warm-up plot corresponds to a tube in stand-by conditions (high voltage not applied).

The heater characteristics in normal operation correspond to a tube oscillating, the heater voltage being calculated by the formula given in note 7.

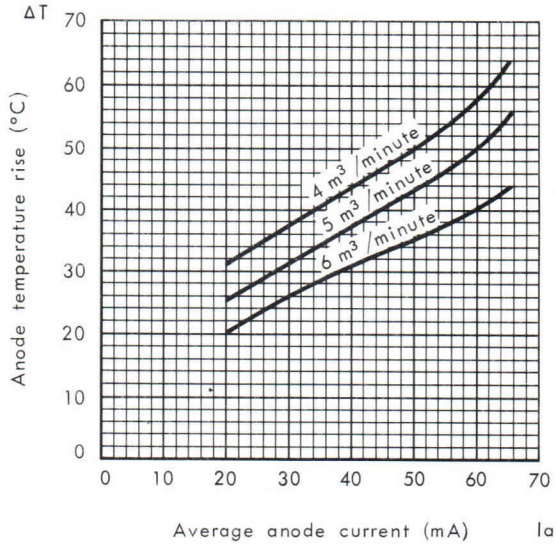


COOLING CHARACTERISTICS

The plots give the temperature rise of the anode from the ambient temperature, versus anode current, for the different values of cooling air flow.

Temperature 20 °C.

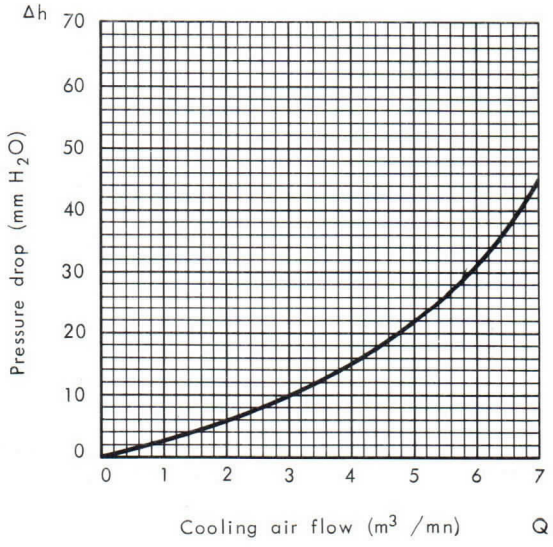
Normal atmospheric pressure.



The curve gives pressure drop in the air duct versus air flow.

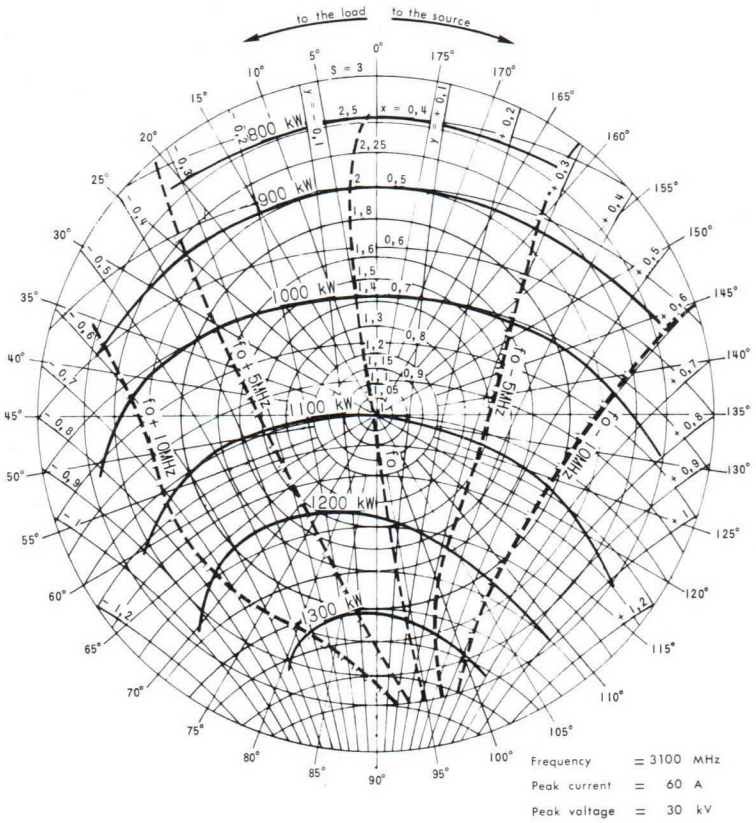
Ambient temperature 20 °C.

Normal atmospheric pressure.



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GROUPEMENT TUBES ELECTRONIQUES

RIEKE DIAGRAM



OPERATING INSTRUCTIONS

Heater

The heater should be protected against arcing (particularly when starting a new tube), a capacitor of about 10 000 pF should be placed at the heater connections, as close as possible to the tube.

Pulses

The ratings concerning the current and voltage pulses should be strictly observed :

- too long rise time or decay time makes the RF bandwidth worse.
- too short rise time produces instability.
- the ripple over the rop of the pulse should be as low as possible and never exceeds 8 % of the average value of the peak current pulse. The best performances are obtained with a current between 45 and 60 A.

For current values under 45 A, the RF bandwidth presents generally lower quality. For values higher than 65 A the tube stability decreases, as the pulse is wide.

RF output

To avoid arcing at the tube output, and consequently its destruction, it is necessary to provide dry air pressurization.

When the VSWR $\leqslant$ 1. 2 : 1 the minimum pressure is 2. 0 kg/cm^2
When the VSWR reaches 1. 5 : 1 the minimum pressure is 2. 8 kg/cm^2

Forced air cooling

Dimensions of the air channel should be convenient for the air inlet integral to the tube ; if not, turbulent flow does not insure satisfactory cooling.

The anode temperature (note 11) should never exceed 120 °C.

INSTALLATION AND STARTING OF A NEW TUBE

The tube should operate in vertical position, the heater connections being upside or down side.

Strains should not be applied to the RF output, the connection should be elastic enough to protect the glass part when heat expansion occurs.

The temperature rise at the central part of the output connector is approximately 250 °C for the following operating conditions :

I_a = 60 mA
D_u = 0. 001

Magnetic materials should be kept at least 30 cm away from the tube.

Mechanical stress should not be applied to the tuning mechanism either when setting the tube or when turning the tuning axis, particularly when reaching the stops.

Shocks and vibrations should be avoided.

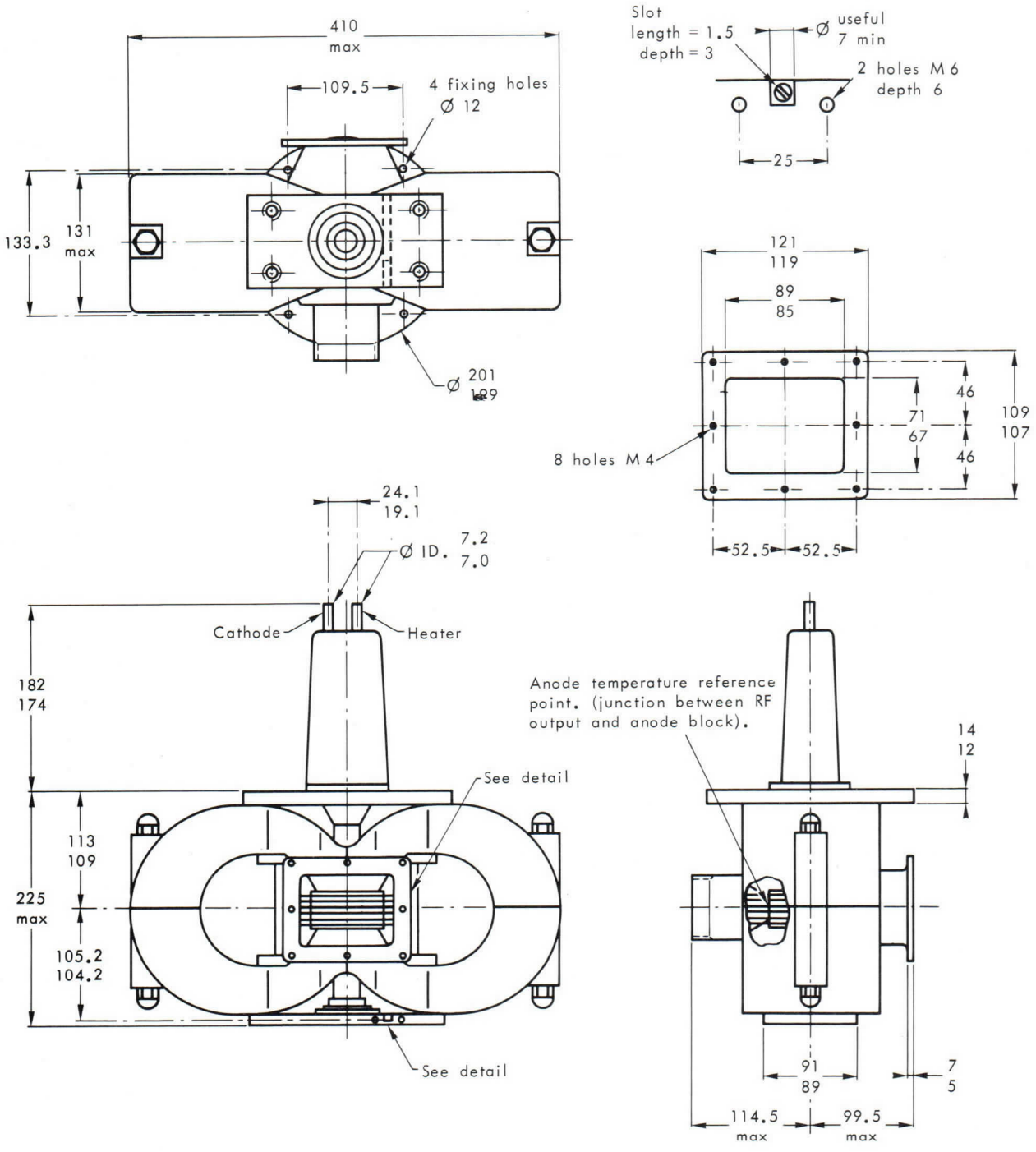
Before applying voltages, the tube should be tuned at the oscillation frequency required. If the frequency is to be changed during operation, the average current value should be brought down from 60 A to a value between 40 - 50 A, by decreasing the high voltage.

When a tube is new or has not been used for a long time, instability or arcing may occur, as evidenced by erratic average anode current. If the arcs are frequent, the magnetron should be progressively started in operation, the high voltage being rised slowly in order to limit arcing. After 20 minutes of operating at reduced voltage the tube is normally ready to operate without instability.

Heater voltage adjustment is very important during this procedure- see note 7.

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GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



Dimensions in mm.

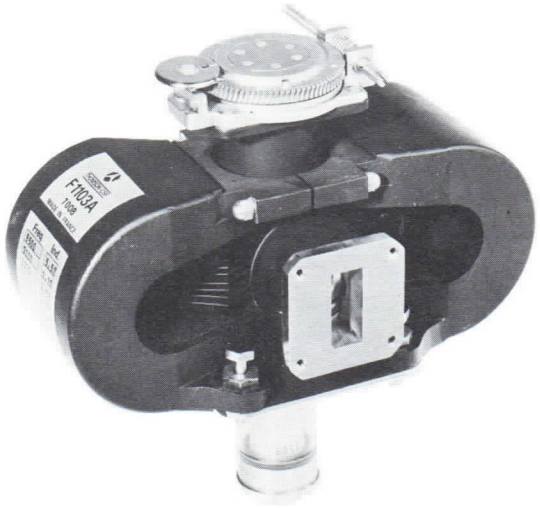
F 1103A (7008) MAGNETRON

The F 1103A (7008) is a magnetron capable of delivering a peak power output of at least 200 kW over the frequency range of 8. 5 to 9. 6 GHz.

It features an integral magnet and is cooled by forced air. The frequency is mechanically tunable.

The F 1103A (7008) has improved compact design and rugged construction making it extremely reliable under the most severe environmental conditions.

This magnetron is used in airborne and ground-based radars, such as F 104 Nasarr radars and Fledermaus and Superfledermaus fire control systems.



GENERAL CHARACTERISTICS

Electrical

	min.	nom.	max.	
Stand-by heater voltage	—	13. 75	—	V
Stand-by heater current	2. 9	—	3. 3	A
Heater voltage in operation (1)	—	—	0	V
Frequency range	8. 5	—	9. 6	GHz
Power output, peak	200	—	—	kW
Anode voltage, peak	20	—	23	kV
Pulling (VSWR = 1. 5 : 1)	—	—	13. 5	MHz
RF bandwidth (1 μs)	—	—	2. 5	MHz
Pushing	—	—	500	kHz/A
Side lobe level (1 μs)	9	—	—	dB
Stability, missing pulses (1 μs)	—	—	0. 25	%

Mechanical

Weight	5 kg
Dimensions	see drawing
Operating position	any
Cooling	forced air
Tuning characteristic	158 turns
Tuning torque	600 cm/g
Shaft rotation rate	1200 r/mn
RF output flange	mates with UG 52/U

(1) Average anode current = 27. 5 mA

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

	min.	max.	
Peak power input	–	630	kW
Average power input	–	630	W
Peak anode voltage	–	23	kV
Peak anode current	15	30	A
Duty cycle	–	0. 0011	
Pulse duration	0. 2	2. 5	µs
Anode temperature	– 55	+125	°C
Cathode bushing temperature	– 55	+165	°C
Load VSWR	–	1. 5 : 1	
Rate of rise of voltage	70	225	kV/µs
Heater surge current	–	12	A
Warm-up time	150	–	s
Cooling air flow	0. 70	–	kg/mn

NOTA

The heater voltage in operation should be set to the value given by the following formula :

$$V_f = 13.75 \left(1 - \frac{P_i}{450}\right) \quad \text{for } P_i = V_c \times I_{avg} \leqslant 450 \text{ W}$$

$V_f = 0$ when $P_i \geqslant 450$ W

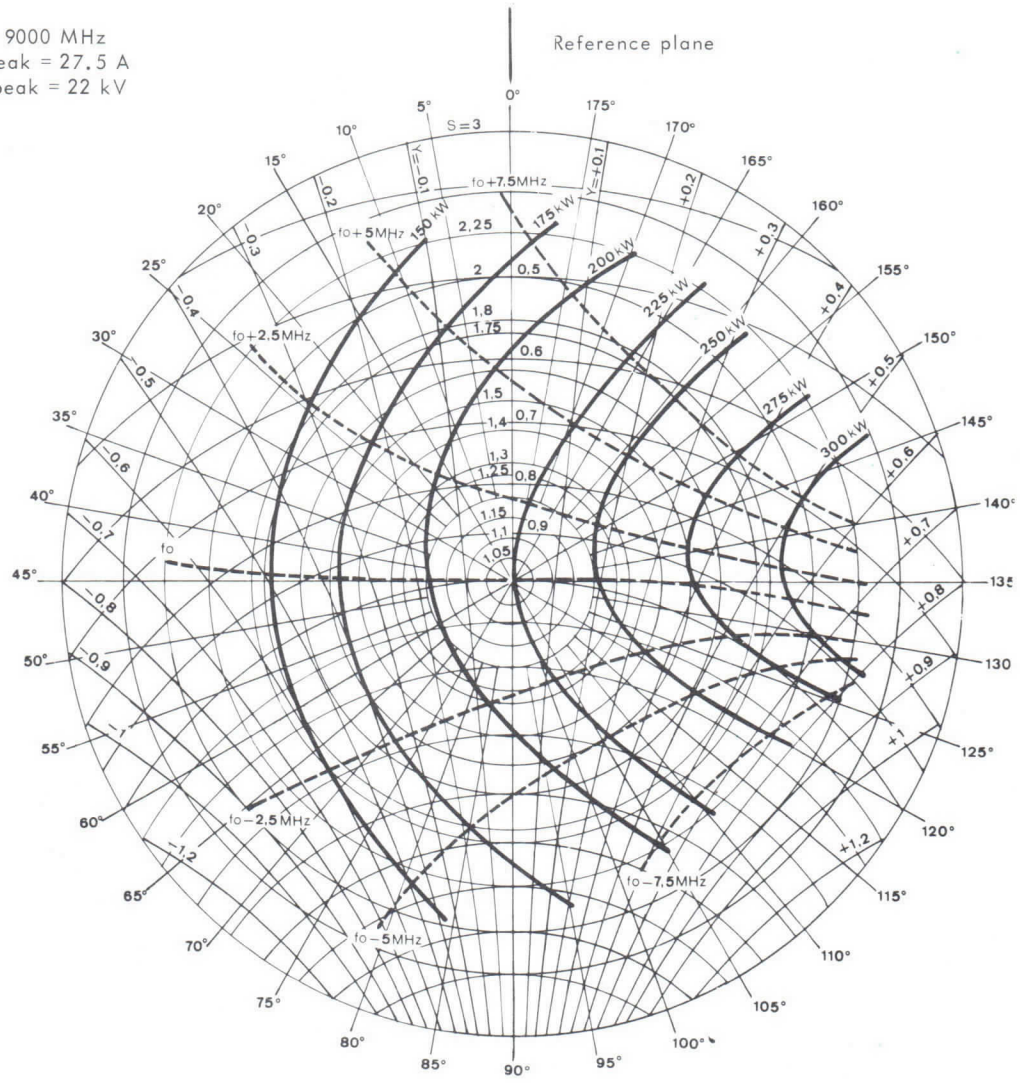
Pi being the average input power

TYPICAL OPERATION

Frequency range	8. 5 – 9. 6	9. 2 – 9. 55	9. 2 – 9. 55	GHz
Pulse duration	0. 37	0. 6	1. 4	µs
Duty cycle	0. 00063	0. 00077	0. 0009	
Stand-by heater voltage	13. 75	13. 75	13. 75	V
Stand-by heater current	3	3	3	A
Heater voltage in operation	4. 5	0	0	V
Anode current peak	26	27. 5	27. 5	A
Average current	16	21. 5	24. 5	mA
Anode voltage peak	22	23	23	kV
RF power output, peak	210	230	230	kW
Average power output	130	175	205	W
Side lobe level	10	10	9	dB
RF bandwidth	3. 3	2	0. 8	MHz
Pulling (VSWR 1. 5 : 1)	10	10	10	MHz
Load VSWR	1. 1 : 1	1. 1 : 1	1. 1 : 1	
Temperature coefficient	0. 25	0. 25	0. 25	MHz/°C
Rate of rise of voltage	170	180	180	kV/µs
Stability, missing pulses	< 0. 1	< 0. 1	< 0. 1	%

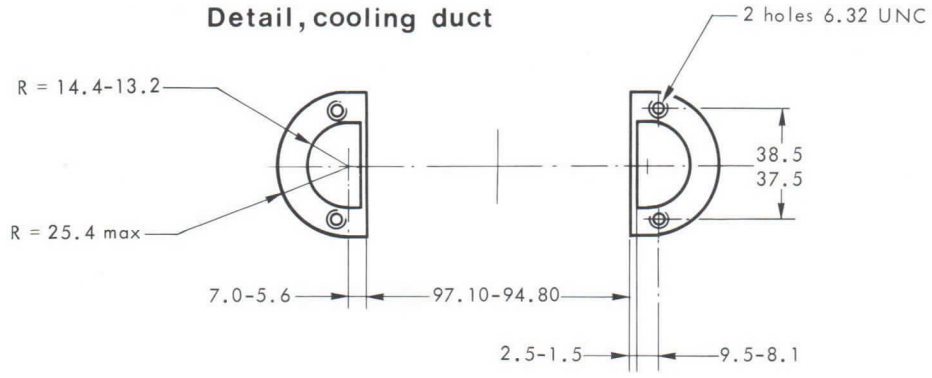
RIEKE DIAGRAM

fo = 9000 MHz
Ia peak = 27.5 A
Va peak = 22 kV

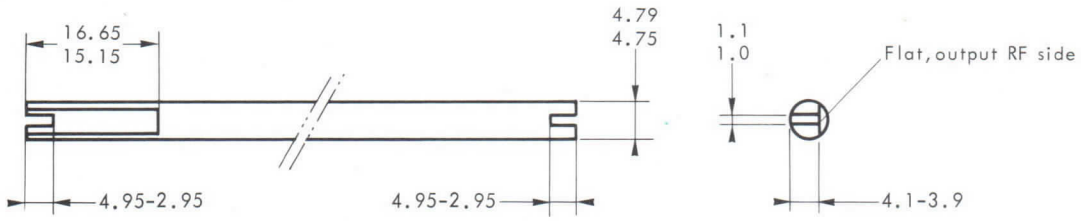


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GROUPEMENT TUBES ELECTRONIQUES

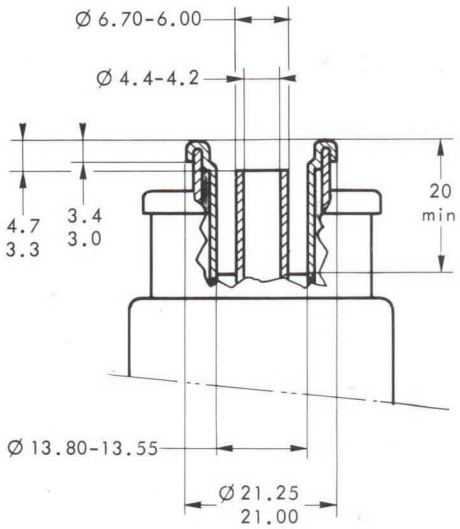
Detail, cooling duct



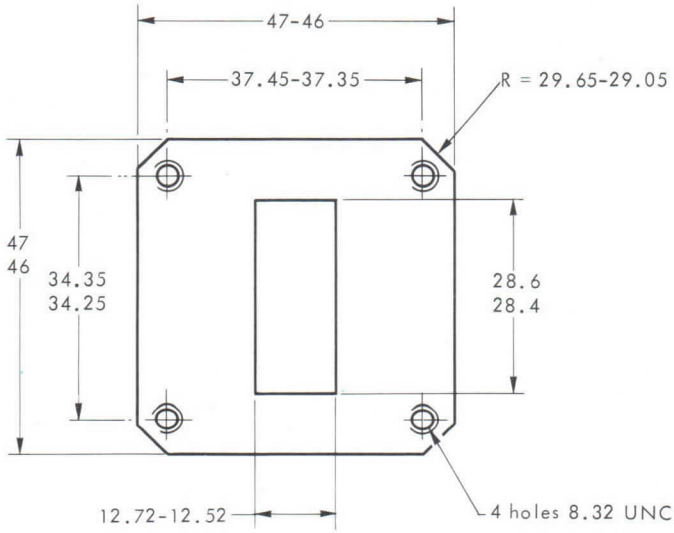
Detail, tuner shaft



Detail, input connection

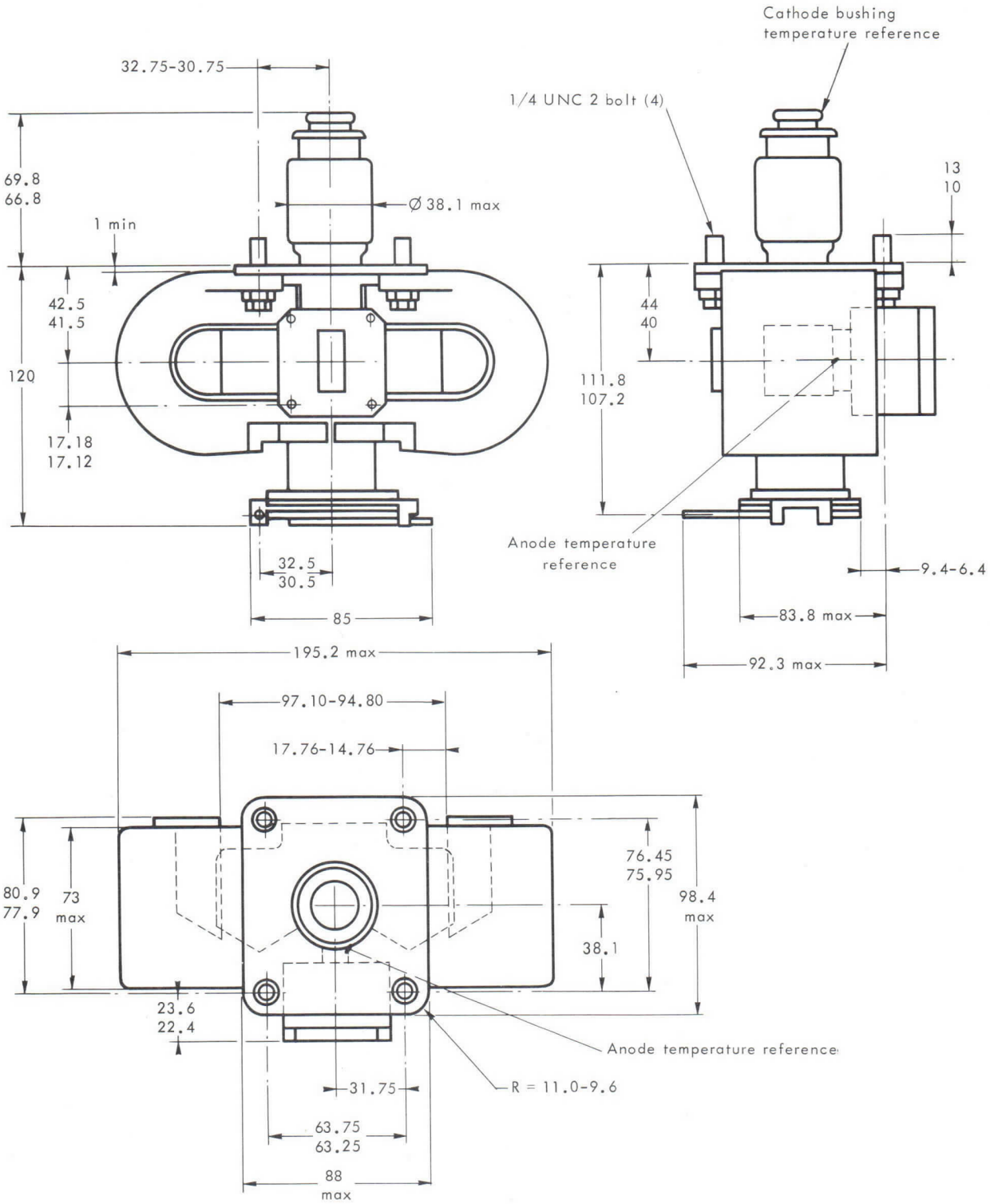


Output flange



Dimensions in mm.

OUTLINE DRAWING



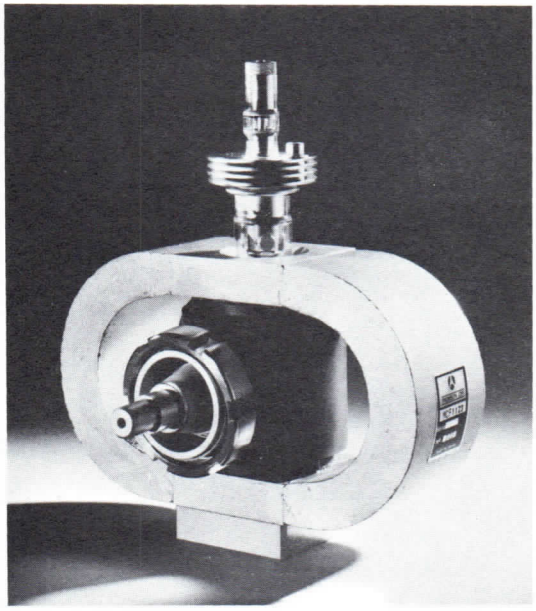
Dimensions in mm.

F 1103 A (7008)

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GROUPEMENT TUBES ELECTRONIQUES

THOMSON-CSF

F1123 MAGNETRON



The F 1123 is a magnetron designed specifically for industrial microwave heating or drying and food processing. between 2425 and 2475 MHz.

The tube, which features an impregnated type cathode, is usually built with an integral magnet ; it may be fitted with an electro-magnet for particular requirements.

The output connector allows easy coupling to the waveguide RG 112/U or RG 104/U, or coaxial 1" 5/8.

The F 1123 is used for applications suchas moisture removal, chemical changes, and biological changes in a growing number of industrial processes.

GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Frequency	2425	–	2475	MHz
CW power output	5	–	–	kW
Heater voltage (2)	14	15	16	V
Heater current	16	–	20	A
Cold resistance of the filament	–	0.1	–	Ω

Mechanical

Operating position	any
Overall dimensions	see outline drawing
Weight, approx.	6.5 kg
RF output	RG 112/U, or RG 104/U, or coaxial 1" 5/8

ABSOLUTE RATINGS (1)

	min.	max.	
Heater surge current	–	60	A
Heater voltage	–	16	V
Preheating time (2)	4	–	mn
Power output (3)	–	6.0	kW
Load VSWR (4)	–	3	
Average cathode current (5 - 6)	0.6	1.7	A
Peak cathode current (8)	–	4.0	A
Reflected power (7)	–	600	W

Cooling

		min.	max.	
TUBE BODY	Water flow	4	–	l/mn
	Input pressure	–	4	bar
	Body temperature	–	80	°C
CATHODE FINS	Temperature	–	180	°C
	Air flow	100	–	m^3/h

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GROUPEMENT TUBES ELECTRONIQUES

TYPICAL OPERATION

Heater voltage :		
- stand-by	15	V
- in operation (6)	0	V
Power output (3)	5.0	kW
Efficiency	60	%
Load VSWR	1.1	
Cathode voltage	5.2	kV
Average cathode current (5)	1.6	A
Peak cathode current	2.2	A

NOTES

1 - Non simultaneous values.

2 - Warm-up voltage is 15 ± 1 V during 4 minutes.

3 - Measured with a directional coupler inserted between the tube and the load.

4 - Intermittent operation is possible with a VSWR = 3 : 1. In case of continuous operation on a mismatched load, the VSWR should not exceed 2 : 1.

5 - Measured with a moving coil instrument.

6 - The heater voltage should be turned off when I_a avg. reaches 0.6 A.

7 - Measured with a directional coupler inserted between the mismatched load and the magnetron.

OPERATING INSTRUCTIONS

Handling and storage

The original packing should be used for transportation and storage of the tube. When the tube is unpacked, care should be taken that a minimum distance of 15 cm is maintained between all magnetic materials and the tube.

Non magnetic tools (screw drivers, wrenches, etc...) should be used for mounting to avoid any possible mechanical damage to ceramic and glass parts, as well as short-circuiting of the magnetic flux.

When connecting the magnetron, no significant stress should be placed on the output. Never lift the tube by the RF output.

Cooling

To avoid overheating during operation and stand-by, the following precautions should be taken :

- anode cooling by water flow according to the cooling diagram given below. If the anode cooling fails, the power should be switched off automatically by a safety device (thermoswitch). A place is provided, on the tube body, for the fixation of the Klixon thermoswitch (series 20700 "round eared flange"). The recommended opening temperature is 70 °C.
- input structure cooling by air flow, the air stream being directed towards the input connectors and perpendicular to the cathode axis. A safety device should prevent the temperature of the cathode heatsink to exceed 180 °C.

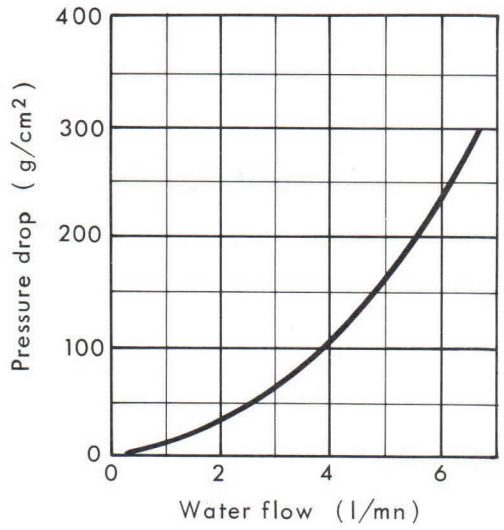
In case of operation under adverse environmental conditions, humidity, high VSWR, etc... RF output cooling by forced air is necessary. The air must be clean and dry to avoid arc-over.

Water and air flow rates are given in the paragraph "Absolute ratings".

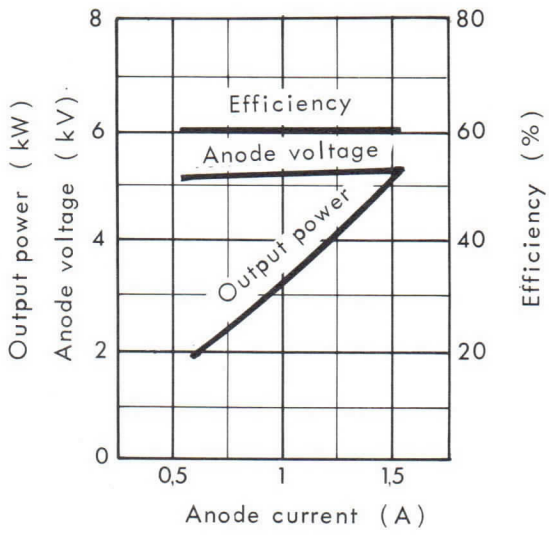
Shielding

RF radiations from the filament terminals may be reduced by external filtering and or shielding. THOMSON-CSF should be consulted for approbation of the system.

COOLING CHARACTERISTIC



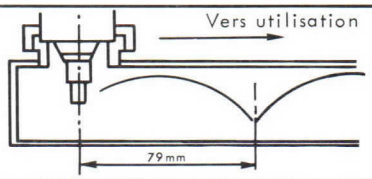
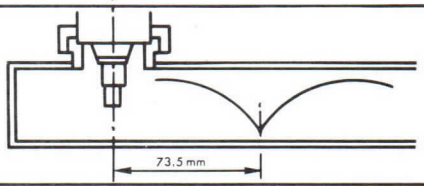
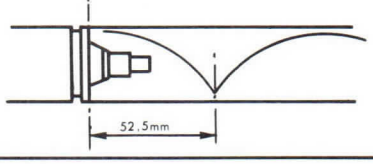
TYPICAL OPERATING CHARACTERISTICS



OPERATING ON A MISMATCHED LOAD

According to the VSWR phase, operating conditions are chosen on the Rieke diagram.

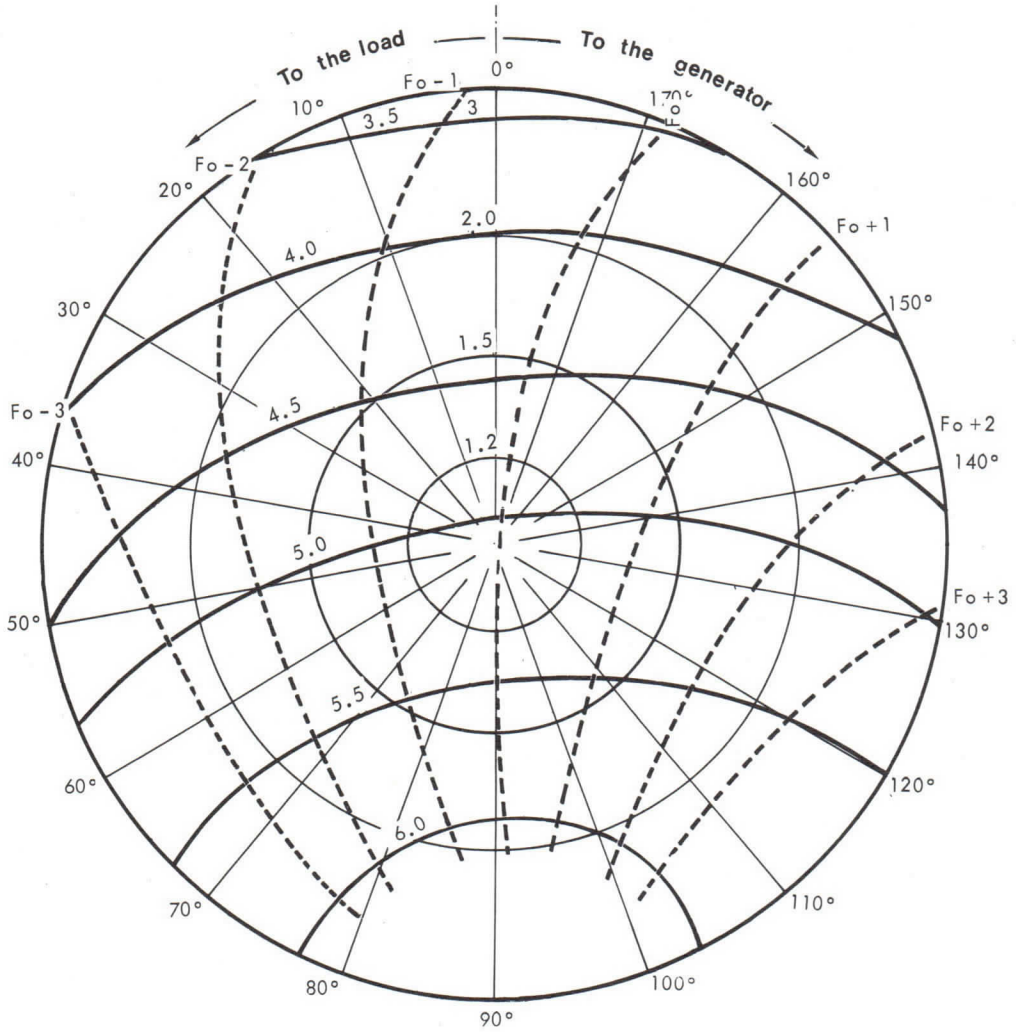
The condition for a maximum power output is reached when the distance A between the first voltage standing wave minimum and the reference plane of the magnetron corresponds to the table below :

	λg and λr	A mm	A°	REFERENCE PLANE
RG 112	173 mm	79	165	
RG 104	147 mm	73.5	180	
COAXIAL	122.5 mm	52.5	155	

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GROUPEMENT TUBES ELECTRONIQUES

RIEKE DIAGRAM

PROPAGATION

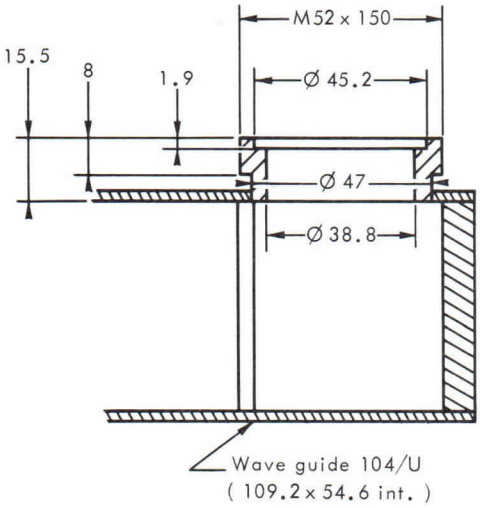


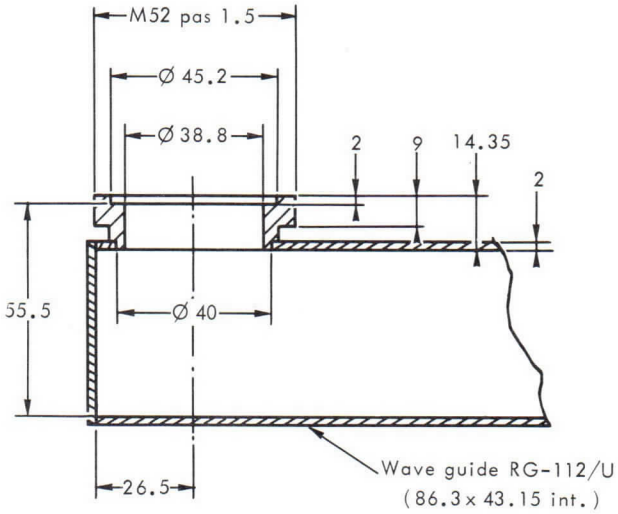
Mean cathode current	1.6 A
Mean cathode voltage	5.2 kV

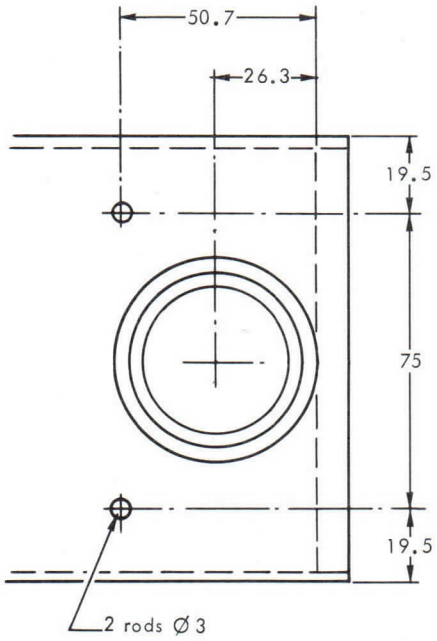
– – – – – – Frequency MHz

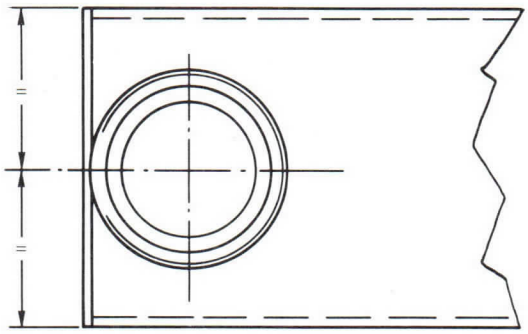
——————— Power kW

OUTPUT TRANSITIONS





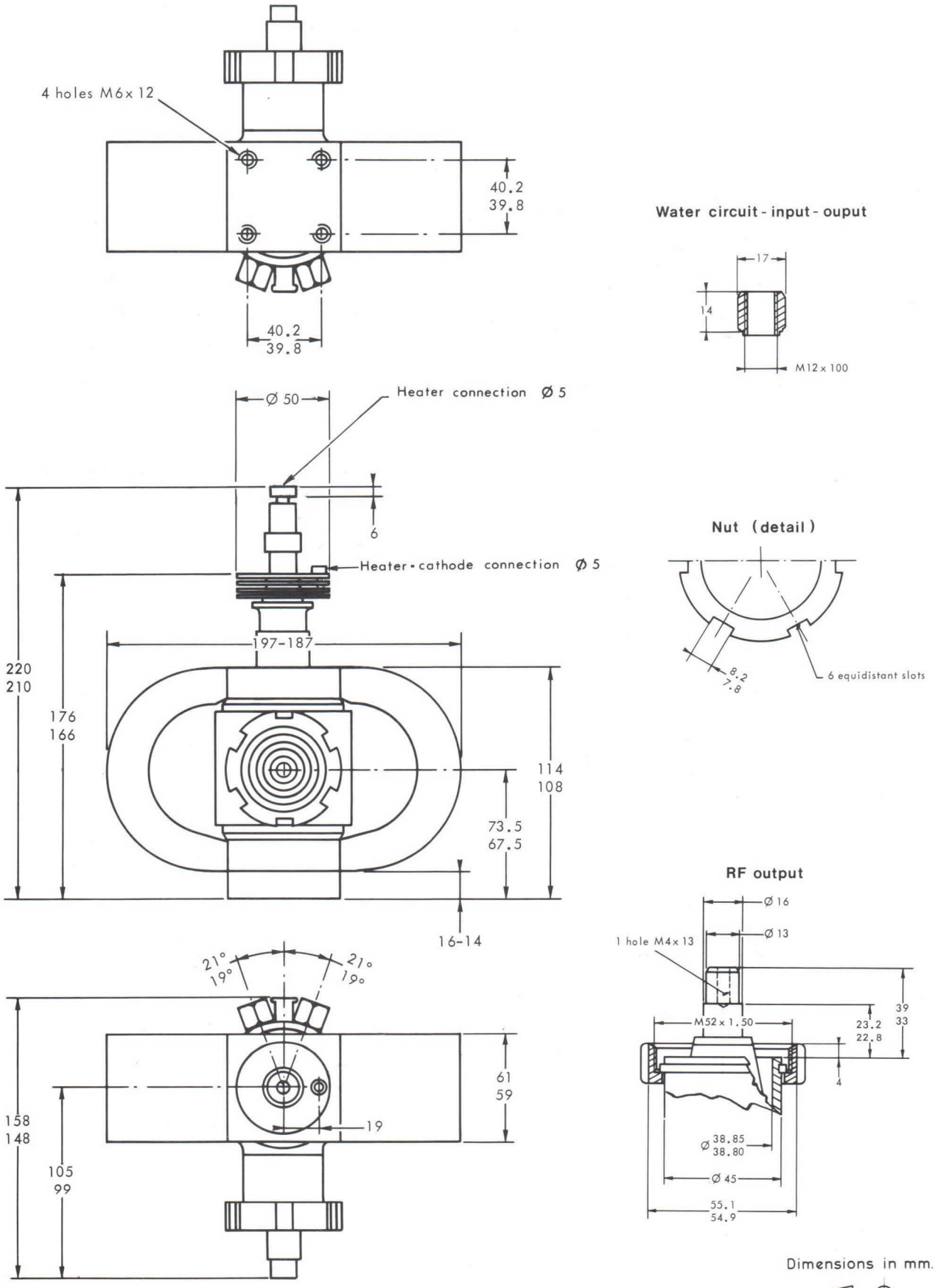




Dimensions in mm.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

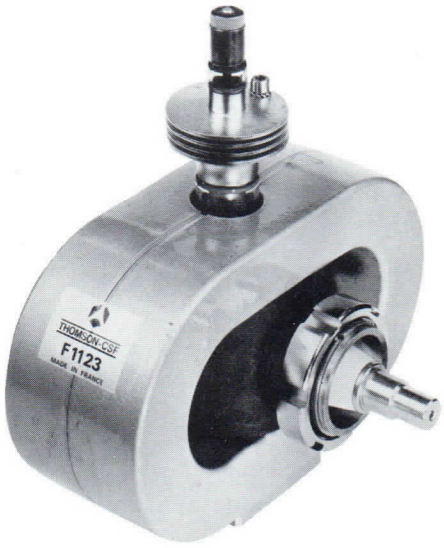
OUTLINE DRAWING



Dimensions in mm.

MAGNETRON F 1123

- **Réalisé spécialement pour les applications industrielles des micro-ondes.**
- **Aimant permanent incorporé.**
- **Cathode en tungstène imprégné, de longue durée.**
- **Rendement nominal d'au moins 60 %.**



Le magnétron F 1123 a été étudié spécialement pour équiper des générateurs industriels de micro-ondes. Il fonctionne dans la bande ISM (Applications Industrielles, Scientifiques et Médicales) à 2450 MHz ; c'est un oscillateur en onde entretenue extrêmement robuste, il peut fournir une puissance de sortie d'au moins 5 kW en continu ; son rendement, est supérieur à 60 % ce qui permet un fonctionnement particulièrement économique.

La cathode du F 1123, faite de tungstène imprégné est caractérisée par une très longue durée de vie. Le refroidissement du tube se fait par circulation d'eau. Le connecteur de sortie RF s'adapte aux guides d'ondes RG 112/U ou RG 104/U, ou au coaxial $1^{5/8''}$. Ce magnétron est livré équipé d'un aimant permanent.

THOMSON-CSF peut fournir avec le tube une alimentation et tous les circuits annexes nécessaires, cet ensemble forme un générateur micro-onde prêt à l'emploi, le GHF 1212, dont la description fait l'objet d'une notice séparée.

CARACTERISTIQUES GENERALES

Electriques

Fréquence	2450 ± 25	MHz
Puissance de sortie RF, min.	5000	W
Tension de chauffage	15	V
Courant de chauffage	16 à 20	A
Résistance du filament à froid	≃ 0, 1	Ω
Tension d'anode	5, 2	kV

Mécaniques

Position de fonctionnement	indifférente
Dimensions	voir dessin
Poids approximatif	6, 5 kg
Sortie RF adaptable sur :	guide d'onde RG 112/U ou RG 104/U ou coaxial $1^{5/8''}$

VALEURS LIMITES ABSOLUES (1)

	min.	max.	Unités
Courant de chauffage au démarrage	—	60	A
Tension de pré-chauffage	—	16	V
Temps de pré-chauffage	4	—	mn
Puissance de sortie	—	6	kW
ROS de la charge (2)	—	3	
Courant moyen d'anode (3)	0, 6	1, 7	A
Puissance réfléchie (4)	—	600	W
– REFROIDISSEMENT			
Corps du tube :			
- débit d'eau	4	—	l/mn
- pression à l'entrée	—	4	bar
- température du corps	—	80	°C
Ailettes de refroidissement :			
- débit d'air	100	—	m^3/h
- température	—	180	°C

EXEMPLE D'UTILISATION

Tension de chauffage en fonctionnement	0	V
Puissance de sortie	5	kW
Rendement	60	%
ROS de la charge	1. 1	
Tension d'anode	5, 2	kV
Courant moyen d'anode	1, 6	A

N O T E S

1 - Valeurs limites non simultanées, ne doivent être dépassées en aucun cas.

2 - Dans le cas d'un fonctionnement sur charge désadaptée il est recommendé de ne pas dépasser un ROS de 2.

Pour protéger le magnétron il est nécessaire d'utiliser un système de sécurité qui coupe automatiquement la haute tension en cas de ROS trop élevé (excédant 3).

3 - La tension de chauffage doit être coupée lorsque le courant moyen d'anode atteint 0, 6 A.

4 - Pour protéger le magnétron en cas de puissance réfléchie excessive, il est vivement conseillé de prévoir un circulateur entre la sortie RF du tube et la charge.

CONSIGNES D'UTILISATION

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes, nécessaires par exemple pour l'établissement d'un matériel nouveau, peuvent être fournies sur demande. Nos ingénieurs sont prêt à vous aider pour résoudre tous les problèmes d'installation que nos tubes pourraient vous poser.

STOCKAGE ET INSTALLATION

Les magnétrons doivent être stockés dans leur emballage d'origine, ou installés sur des bâtis prévus à cet effet. Durant le transport, ils doivent être correctement protégés par leur emballage contre les vibrations et les chocs.

La manutention des magnétrons doit se faire avec beaucoup de soins car un choc peut les mettre définitivement hors service. Les matériaux magnétiques tels que fer, nickel ou autres doivent être tenus à plus de 15 cm du tube, et seuls des outils amagnétiques doivent être utilisés pour le déballage et le montage, ainsi que pour le montage de pièces se trouvant à proximité du magnétron.

Les connexions électriques de la cathode et du filament doivent être bien fixées mais sans exercer de contraintes mécaniques, les sorties filament et cathode peuvent atteindre en fonctionnement des températures élevées, il faut donc tenir compte de la dilatation thermique. Le point chaud de la tension d'anode doit être connecté à la sortie cathode, pour éviter que le courant d'anode ou les régimes transitoires passent par le filament et l'endommagent.

La sortie RF ne doit pas subir de contraintes mécaniques, **il ne faut jamais soulever le tube par le connecteur de sortie RF.**

Le tube doit être fixé par 4 vis dans les filetages M6 profondeur 12 (voir encombrement) en aucun cas le tube ne doit être fixé et supporté uniquement par le connecteur de la sortie HF.

CONSIGNES DE REFROIDISSEMENT

Pour éviter toute surchauffe pendant le préchauffage ou le fonctionnement il est nécessaire de prendre les précautions suivantes :

1 - Le débit d'eau du circuit de refroidissement de l'anode doit être réglé en fonction de la courbe fig. 1.
Si le débit est insuffisant, la puissance d'alimentation doit être coupée automatiquement par un dispositif de sécurité (coupe-circuit thermique), réglé à 70 °C (valeur recommendée).
Il existe un emplacement sur le tube prévu pour ce dispositif*.

2 - Les connecteurs d'entrée sont refroidis par air soufflé dirigé perpandiculairement à l'axe de la cathode. Le flux d'air maximum doit être dirigé sur les ailettes.
Un dispositif de sécurité doit empêcher la température du radiateur de la cathode de dépasser 180 °C par contrôle du débit d'air.

3 - En cas de fonctionnement dans de mauvaises conditions d'humidité, de température, de ROS, etc. la sortie RF doit être refroidie par air forcé (propre et sec afin de ne pas provoquer d'arcs).

* Klixon (N° 20 700 "round-eared flange") ou équivalent.

APPLICATION DES TENSIONS

Il faut d'abord vérifier le bon état et mettre en marche le système de refroidissement par air.

La tension de chauffage doit être appliquée progressivement.

Le courant de pointe qui traverse le filament à froid ne doit pas dépasser 60 ampères. Le préchauffage de la cathode doit durer au moins 4 minutes. On peut alors appliquer la haute tension et réduire la tension de chauffage à zéro dès que le courant d'anode moyen atteint 0, 6 ampère.

DEMARRAGE D' UN MAGNETRON NEUF

Un magnétron neuf ou qui n'a pas été utilisé depuis longtemps peut contenir de petites traces de gaz. Ce gaz peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des fluctuations du courant d'anode. Afin de réduire ce phénomène au minimum, la haute tension doit être toujours appliquée graduellement.

PROTECTION CONTRE LES ARCS DANS LE GUIDE

Certaines matières traitées par le chauffage hyperfréquence dégagent des gaz pouvant être la cause de création d'arcs dans la zone utile. De même de petites particules ou poussières de divers matériaux (caoutchouc par exemple) peuvent créer le même effet. Etant donné le niveau de puissance ces arcs s'entretiennent et remontent inévitablement vers le magnétron pouvant entraîner la destruction du tube.

Il est nécessaire pour palier cet inconvénient d'utiliser une sécurité anti-arc composée par exemple d'une photo-diode associée à un relais permettant de couper la haute tension en cas de création d'arc dans le guide.

Il est possible de fournir le schéma détaillé de cette sécurité.

CONSIGNES DE SECURITE

- IMPORTANT

Tous les magnétrons fonctionnent avec une haute tension élevée. Des dispositifs doivent être mis en place pour protéger le personnel contre le danger d'être en contact avec cette tension.

– PERTES RF

Une quantité non négligeable de puissance RF peut être rayonnée par l'extrêmité cathode ou d'autres parties du tube. Ce rayonnement est dangereux pour l'homme, en particulier pour les yeux. Toutes les précautions doivent être prises pour éviter l'exposition à ce rayonnement et lors de la conception du matériel afin que ce rayonnement soit compatible avec les normes de sécurité.

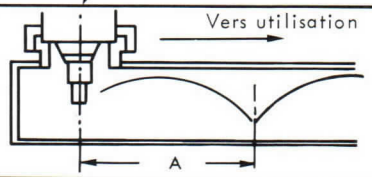
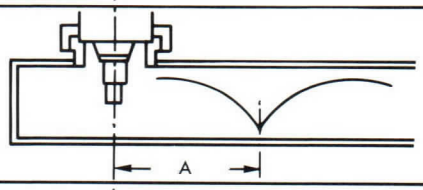
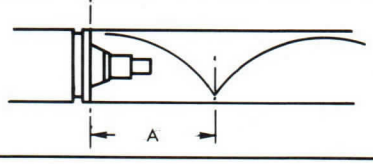
– RAYONS X

Les magnétrons de grande puissance sont générateurs de rayons X en particulier dans la région de la cathode et de la sortie RF. Le personnel doit être protégé par l'installation d'un blindage adéquat.

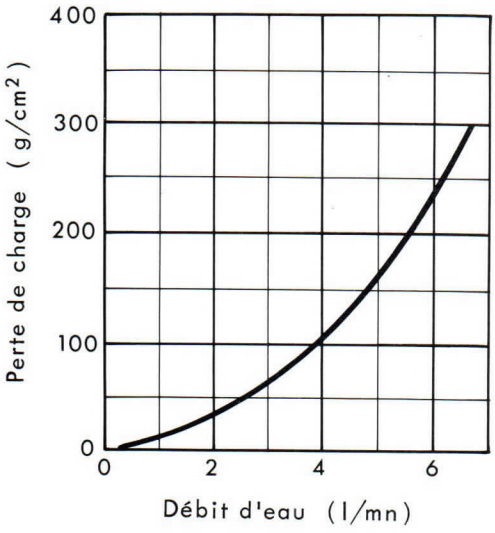
FONCTIONNEMENT SUR CHARGE DESADAPTEE

Suivant la phase du ROS, le point de fonctionnement du magnétron se déplace sur le diagramme de Rieke.

La distance A qu'il est nécessaire d'avoir entre le premier minimum de tension de l'onde stationnaire et le plan de référence du magnétron pour se trouver dans la zone de puissance maximale est donnée dans le tableau ci-dessous :

	λg en λr	A en mm	A en °	PLAN DE REFERENCE
RG 112	173 mm	79	165	
RG 104	147 mm	73.5	180	
COAXIAL	122.5 mm	52.5	155	

CARACTERISTIQUE DU CIRCUIT
de REFROIDISSEMENT



CARACTERISTIQUES
de FONCTIONNEMENT

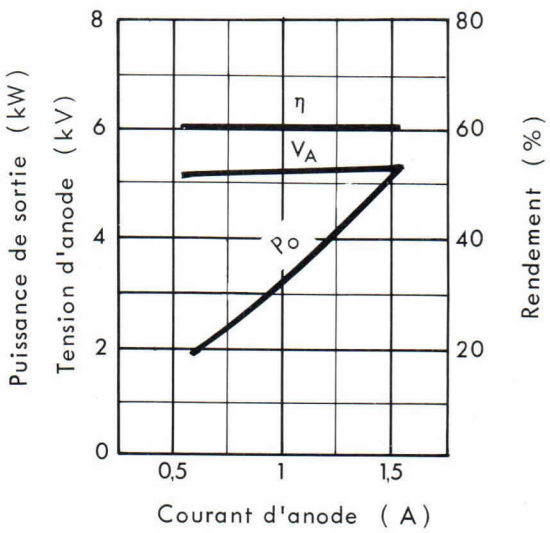
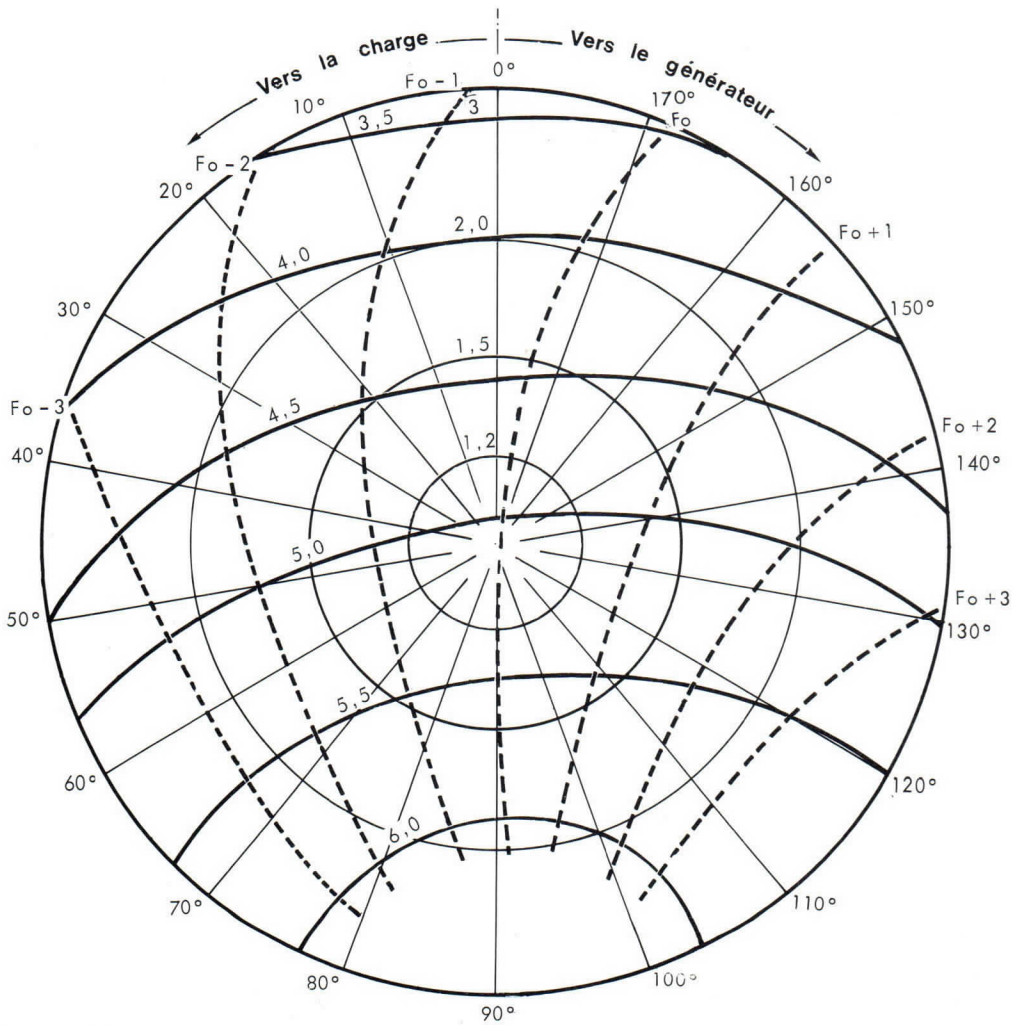


DIAGRAMME DE RIEKE

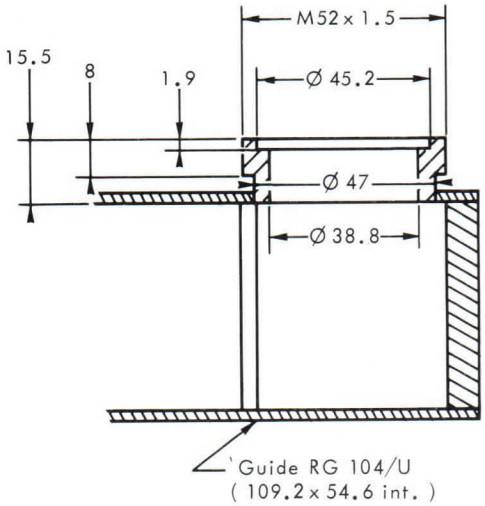
DEPLACEMENT

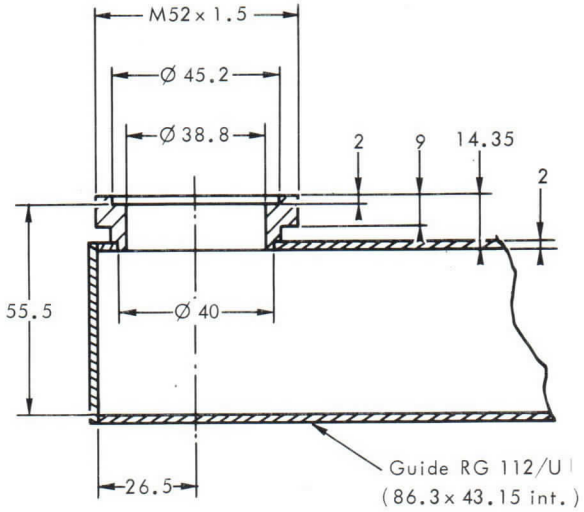


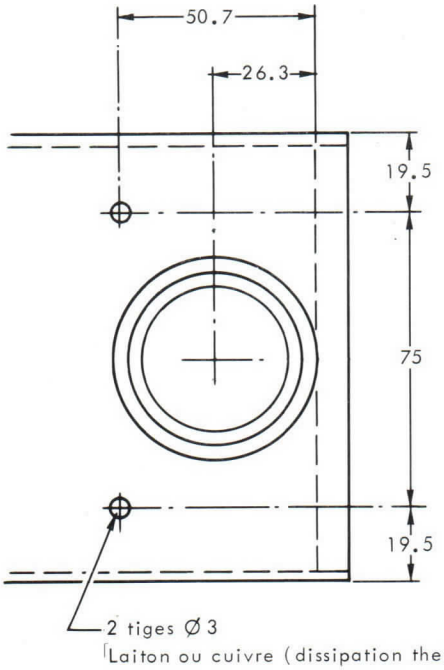
Courant cathodique moyen 1,6 A
Tension cathodique moyenne 5,2 kV

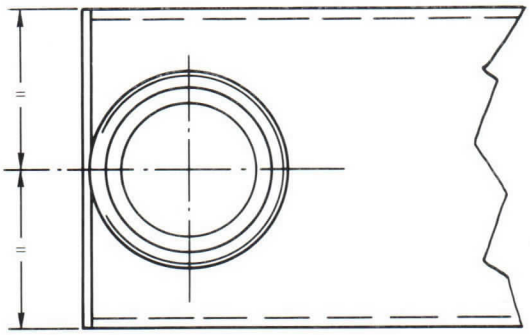
– – – – – Fréquence (MHz)
——— Puissance (kW)

TRANSITIONS DE SORTIE

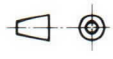




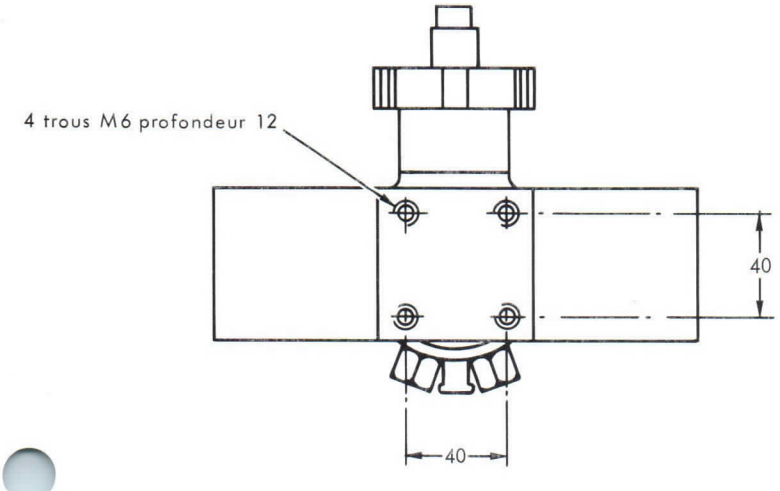




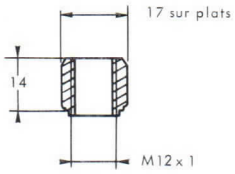
Cotes en mm.

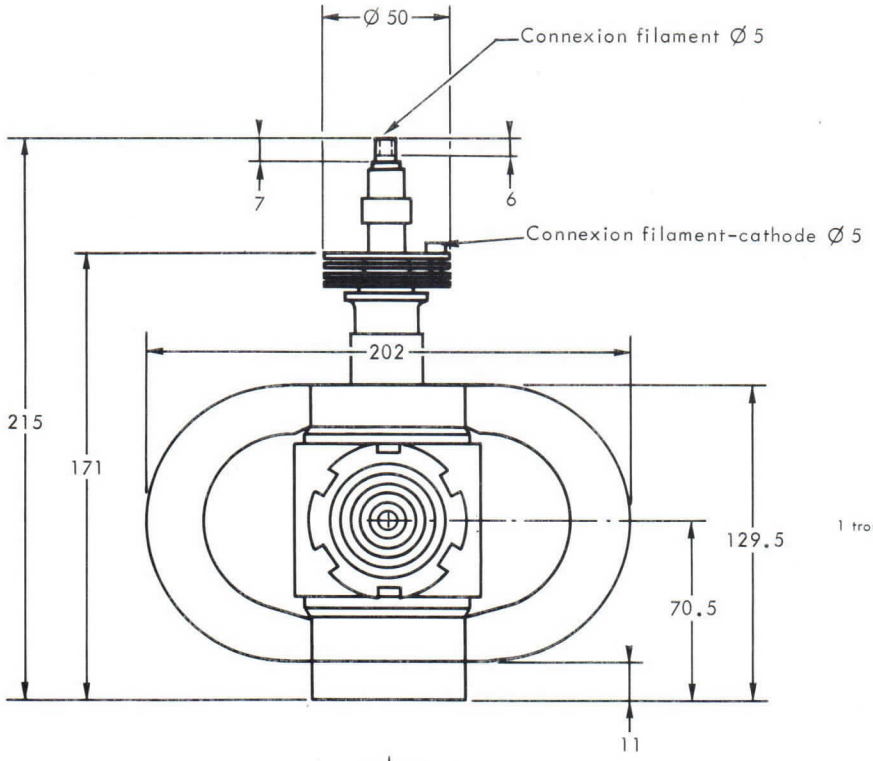


DESSIN D'ENCOMBREMENT

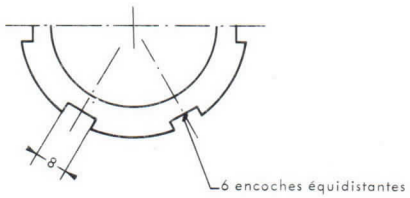


Détail entrée - sortie d'eau

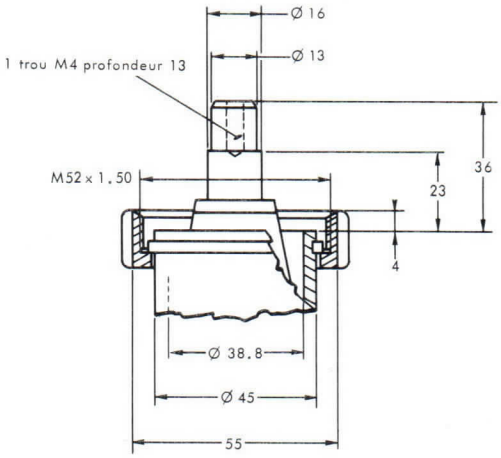


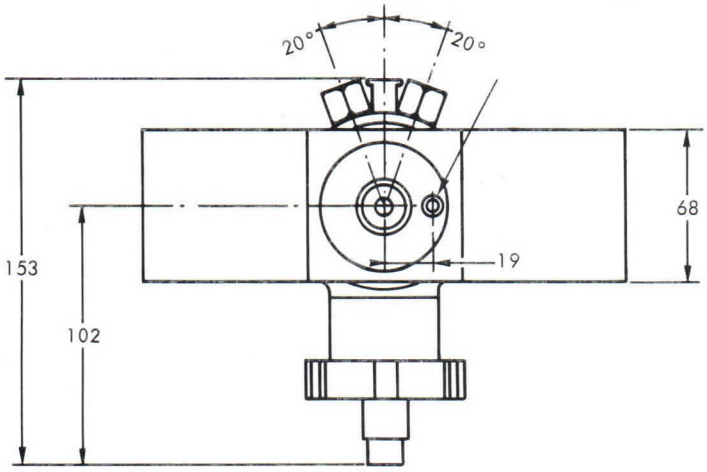


Détail écrou



Détail sortie RF





Cotes en mm.

F 1123

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

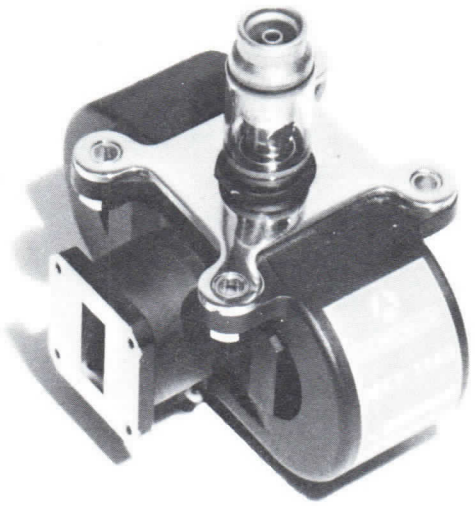
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Imprimé en France

MAGNETRON MCF 1145

Le tube MCF 1145 est un magnétron à fréquence fixe, fonctionnant en régime d'impulsions. Il fournit une puissance RF de crête minimale de 65 kW, dans la bande de fréquence 9, 225 à 9, 275 GHz.

Des aimants permanents sont incorporés au corps du tube. Le refroidissement se fait par inertie thermique. La sortie hyperfréquence est sur guide d'onde standard RG 51/U.



CARACTÉRISTIQUES GÉNÉRALES

Électriques

	min.	moy.	max.	
Fréquence	9, 225	–	9, 275	GHz
Mode de chauffage		indirect		
Tension de chauffage au repos	–	12, 6	–	V
Courant de chauffage au repos	2, 0	–	2, 4	A
Tension de crête d'anode	14	–	17	kV
Courant crête d'anode	–	15	–	A
Puissance crête de sortie	65	–	–	kW
Puissance moyenne appliquée	–	–	255	W

Mécaniques

Position de fonctionnement	indifférente
Mode de refroidissement	par inertie thermique
Température maximale de l'anode	150 °C
Température maximale de la cathode	220 °C
Sortie RF, guide d'onde	RG 51/U
Poids du tube	3, 250 kg
Dimensions	voir dessin

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GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION

(non simultanées)

	min.	max.	
Tension de chauffage	–	13, 5	V
Courant de chauffage de pointe, au démarrage	–	10	A
Temps de préchauffage	150	–	s
Facteur d'utilisation	–	0, 0012	
Durée d'impulsion	0, 4	2, 5	µs
Tension de crête d'anode	14	17	kV
Courant de crête d'anode	–	17	A
R.O.S. de la charge	–	1, 5	
Vitesse de croissance de la tension d'anode	70	150	kV/µs

EXEMPLE DE FONCTIONNEMENT

Tension de filament au démarrage	12, 6	V
- en oscillations (voir notes)	7, 8	V
Durée d'impulsion	0, 6	µs
Vitesse de croissance de la tension d'anode	150	kV/µs
Facteur d'utilisation	0, 001	
Courant moyen d'anode	15	mA
Puissance crête de sortie, min.	65	kW
Entraînement de fréquence, max.	15	MHz
Poussé de fréquence, max.	0, 6	MHz/A
R.O.S. de la charge	1, 1	

N O T E S

Chauffage

Le préchauffage s'effectue avec une tension filament de 12,6 V ± 5 %. La tension de chauffage doit être réduite dès l'application de la haute tension, à la valeur donnée par la formule suivante :

$$V_f = 11,6 - 0,017\ P_s$$

P_s = puissance appliquée en W

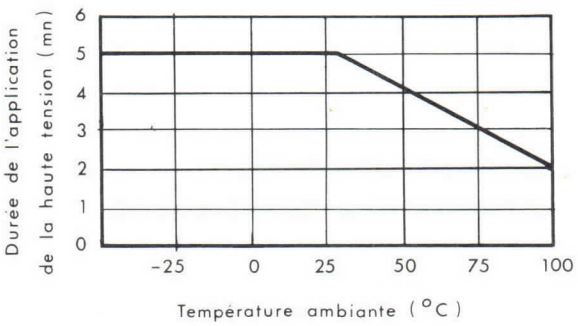
Pour le calcul de P_s on prendra V_a = 15 kV

Refroidissement

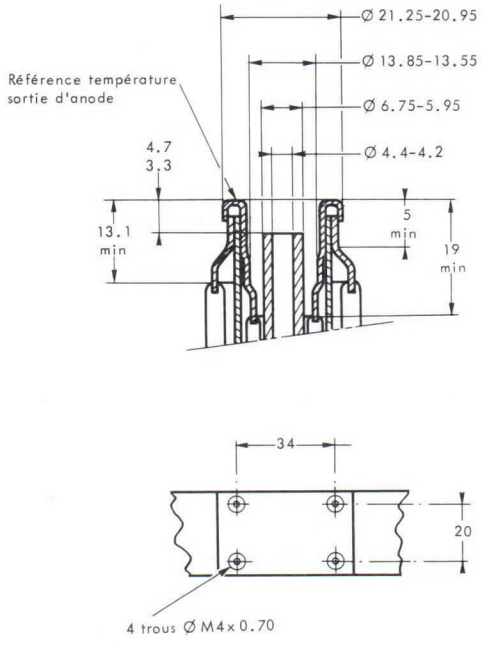
Le fonctionnement avec refroidissement par inertie thermique part d'un préconditionnement défini par la courbe ci-dessous.

La durée d'application de la H.T. est limitée et dépend de la température ambiante. La figure représente la durée maximale d'application de la H.T. en fonction de la température ambiante, pour la puissance appliquée nominale de 225 W.

On doit attendre que l'anode du magnétron ait repris la température ambiante avant d'appliquer la H.T. de nouveau.

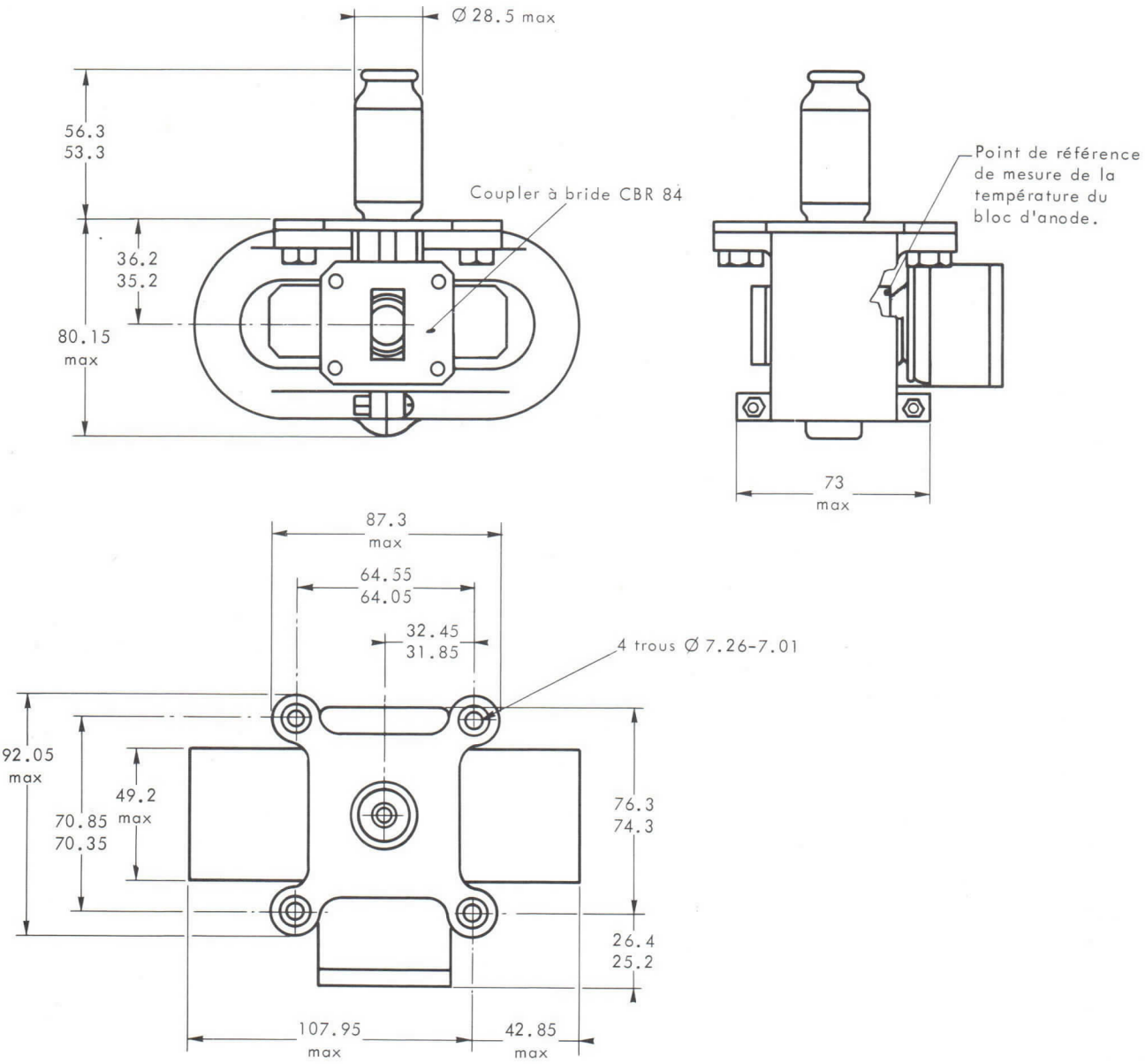


NOTA : *Pendant les essais, le refroidissement doit être réalisé par un soufflage d'air de 1000 l/mn pris aux conditions ambiantes normales, réparti dans l'espace compris entre la masse de refroidissement d'anode et les aimants.*



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT



Cotes en mm.

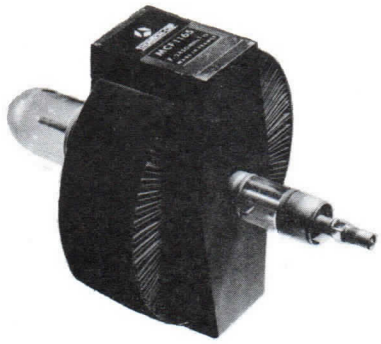
MCF. 1165 MAGNETRON

The MCF 1165 is a magnetron designed specifically for industrial microwave heating or drying, and food processing.

It delivers 1500 W C.W. output power at 2450 MHz.

The magnetic field is provided by a permanent magnet which is an integral part of the tube.

The MCF 1165 is forced air cooled. The cathode is of impregnated type, indirectly heated. The low heating power allows permanent warming of the cathode, making possible instantaneous starting of the microwave oscillation. The R.F. output mates either with a waveguide or with a cavity.



GENERAL CHARACTERISTICS

Electrical

	min.	nom.	max.	
Heater warm-up voltage	-	12	-	V
Heater warm-up current	2. 7	-	3. 3	A
Heater warm-up time (1)	3	-	-	mn
Heater voltage in operation	-	0	-	V
Anode voltage , peak	3. 5	-	3. 7	kV
Anode current , average	0. 2	-	0. 8	A
Output power	1. 2	-	-	kW
Frequency	2425	-	2475	MHz

(1) - not necessary, if the cathode preheating voltage has been applied after high voltage turned off.

Mechanical

Operating position	any
Weight	2. 3 kg
Dimensions	see drawing
Cooling	forced air

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous values)

	min.	max.			min.	max.	
Heater voltage (1)	–	13	V	Average applied power	0. 8	3. 0	kW
Heater surge current	–	10	A	Load VSWR	–	(2)	
Anode voltage, peak	–	3. 7	kV	Air flow (3)	150	–	m^3/h
Anode current, average	–	0. 85	A	Body temperature (4)	–	125	°C
Anode current, peak	–	3	A	Connections temperature	–	200	°C

(1) - Heater voltage should be adjusted according to the curves page 3.

(2) - In case of constant VSWR, the limit should be fixed to a maximum value of 3 : 1 for a minimum distance of the standing wave from the reference plane between 0. 23 λ and 0. 34 λ (see Rieke Diagramm). The maximum value of the VSWR is 4 : 1 for all other phases. When using in the cavity a device producing a periodic variation of the VSWR (preferred frequency = 100 to 120 Hz), the VSWR limitation is the same as above. Maximum instantaneous VSWR should not exceed 8 : 1.

(3) - With a mean VSWR of 3 : 1 and anode current : 0. 8 A - See curves page 3.

(4) - At the temperature measurement point, shown in drawing page 4.

TYPICAL OPERATION

Heater voltage	0	V	Output power	1. 6	kW
Anode voltage, peak	3. 6	kV	VSWR	1. 05 : 1	
Anode current, average	0. 75	A	Frequency :		
Applied power	2. 7	kW	(for VSWR 1 : 1)	2450	MHz

OPERATING INSTRUCTIONS

RF coupling

The MCF 1165 magnetron is designed for operation with a rectangular waveguide transition RG 112/U

The fixation ring should be tightened carefully.

For coupling into a circular waveguide or a cavity matching is obtained by means of a test probe adaptor especially designed to reproduce the magnetron RF output. (available on request).

Application of anode voltage

High voltage should be applied gradually until the average anode current reaches 0. 75 A. In case of full voltage application, a preliminary setting should prevent anode voltage from exceeding 0. 75 A.

When a magnetron that has been idle or stored for a period of time is taken into operation, the anode voltage should be rised slowly up to the nominal value.

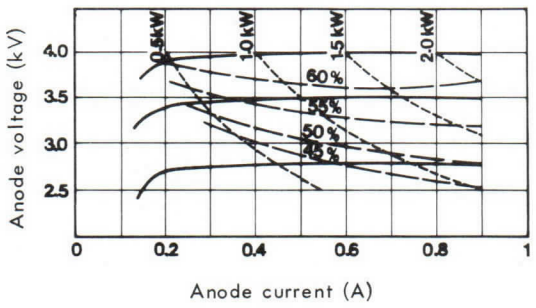
Cooling

Air circulation should be provided in the glass shell area under adverse environmental conditions (high ambient temperature, high output power, etc...).

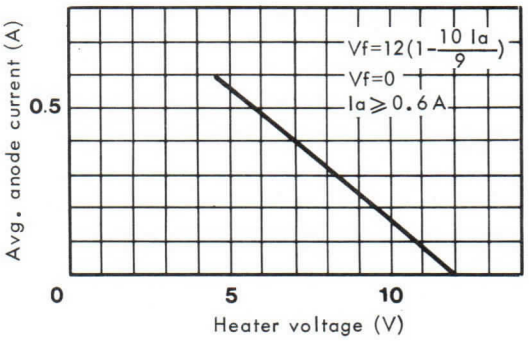
Handling

A minimun distance of 5 cm should be kept between the tube magnet and all other magnetic material.

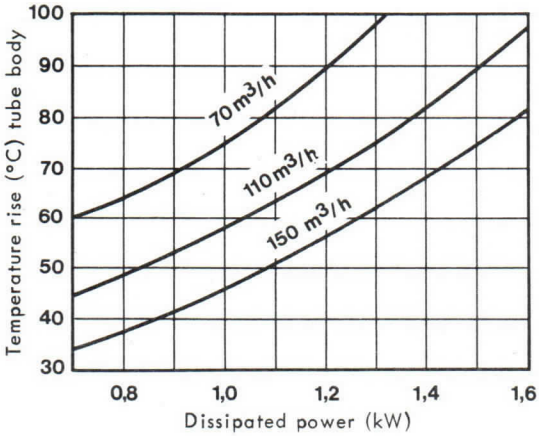
PERFORMANCE CHART

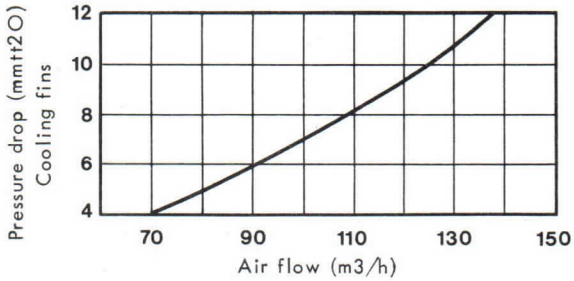


HEATER VOLTAGE ADJUSTEMENT

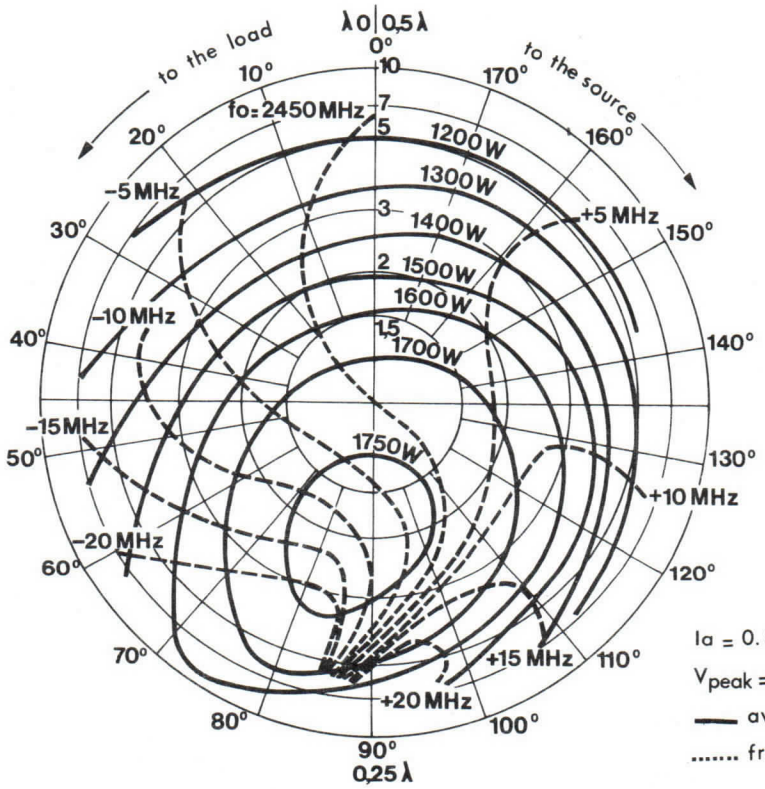


COOLING CHARACTERISTICS





Rieke diagramm



Ia = 0.8 A

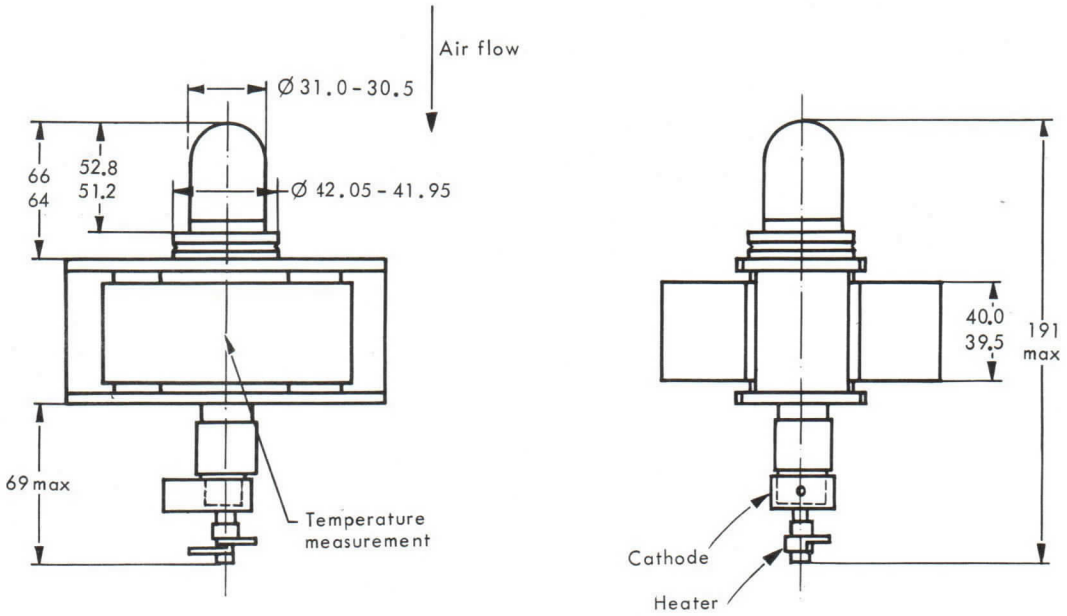
V_{peak} = 3650 V

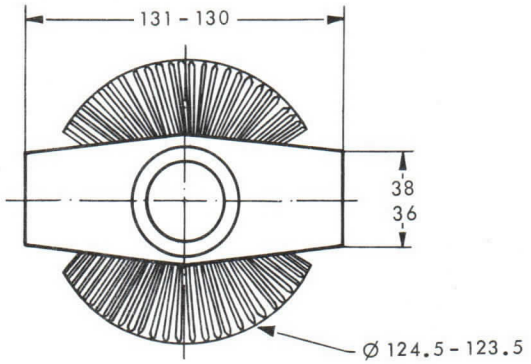
—— average output power

..... frequency

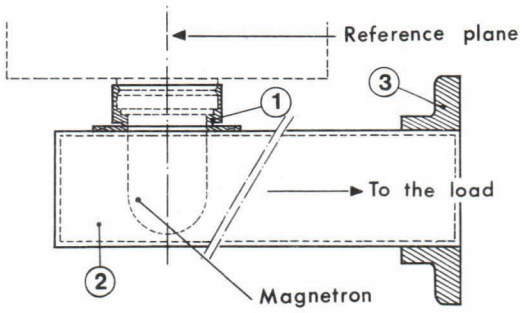
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





Transition



1 - Clamp : 321 38259

2 - Waveguide: RG 112/U

3 - Flange: UG 553/U

Dimensions in mm

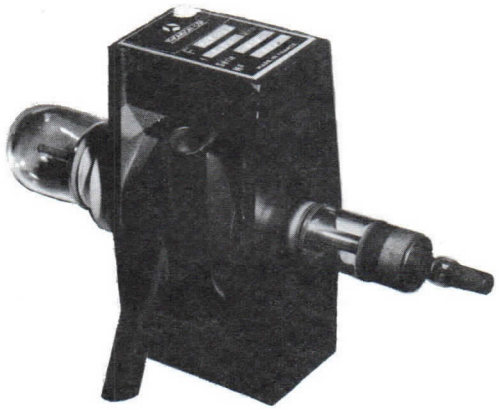
MCF. 1166 MAGNETRON

The MCF 1166 is a magnetron designed specifically for industrial microwave heating or drying, and food processing.

It delivers 1500 W C.W. output power at 2450 MHz.

The magnetic field is provided by a permanent magnet which is an integral part of the tube.

The MCF 1166 is cooled by water circulation. The cathode is of impregnated type indirectly heated. The low heating power allows permanent warming of the cathode, making possible instantaneous starting of the microwave oscillation. The R.F. output mates either with a waveguide or with a cavity.



GENERAL CHARACTERISTICS

Electrical

	min.	nom.	max.	
Heater warm-up voltage	-	12	-	V
Heater warm-up current	2.7	-	3.3	A
Heater warm-up time (1)	3	-	-	mn
Heater voltage in operation	-	0	-	V
Anode voltage, peak	3.5	-	3.7	kV
Anode current, average	0.2	-	0.8	A
Output power	1.2	-	-	kW
Frequency	2425	-	2475	MHz

(1) - not necessary, if the cathode preheating voltage has been applied after high voltage turned off.

Mechanical

Operating position	any
Weight	1.7 kg
Dimensions	see drawing
Cooling	water

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous values)

	min.	max.			min.	max.	
Heater voltage (1)	–	13	V	Average applied power .	0. 8	3. 0	kW
Heater surge current	–	10	A	Load VSWR	(2)	–	
Anode voltage, peak	–	3. 7	kV	Water flow (3)	2	–	l/mn
Anode current,average	–	0. 85	A	Body temperature (4) .	–	125	° C
Anode current peak	–	3	A	Connections temperature	–	200	° C

(1) - Heater voltage should be adjusted according to the curve page 3.

(2) - In case of constant VSWR, the limit should be fixed to a maximum value of 3 : 1 for a minimum distance of the standing wave from the reference plane between 0. 23 λ and 0. 34 λ (see Rieke Diagramm). The maximum value of the VSWR is 4 : 1 for all other phases. When using in the cavity a device producing a periodic variation of the VSWR (preferred frequency = 100 to 120 Hz), the VSWR limitation is the same as above. Maximum instantaneous VSWR should not exceed 8 : 1.

(3) - Whit a mean VSWR of 3 : 1 and anode current : 0. 8 A - See curves page 3.

(4) - At the temperature measurement point, shown in drawing page 4.

TYPICAL OPERATION

Heater voltage	0	V	Output power	1. 6	kW
Anode voltage, peak	3. 6	kV	VSWR	1. 05 : 1	
Anode current, average	0. 75	A	Frequency :		
Applied power	2. 7	kW	(for VSWR 1 : 1)	2450	MHz

OPERATING INSTRUCTIONS

RF coupling

The MCF 1166 magnetron is designed for operation with a rectangular waveguide transition RG 112/U

The fixation ring should be tightened carefully.

For coupling into a circular waveguide or a cavity matching is obtained by means of a test probe adaptor especially designed to reproduce the magnetron RF output. (available on request).

Application of anode voltage

High voltage should be applied gradually until the average anode current reaches 0. 75 A. In case of full voltage application, a preliminary setting should prevent anode voltage from exceeding 0. 75 A.

When a magnetron that has been idle or stored for a period of time is taken into operation, the anode voltage should be rised slowly up to the nominal value.

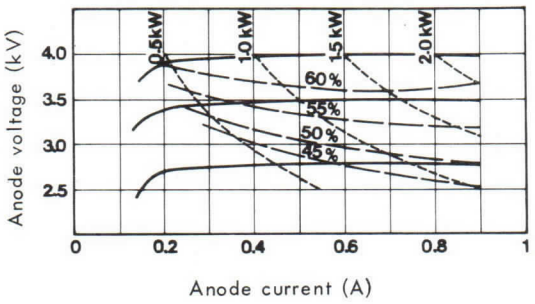
Cooling

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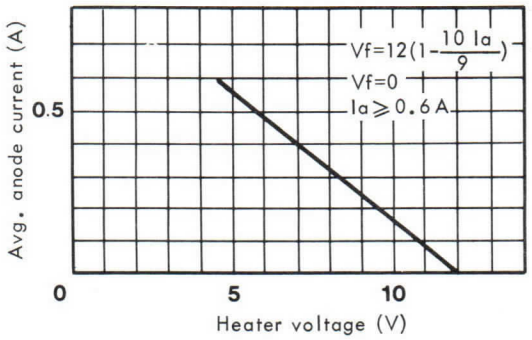
Handling

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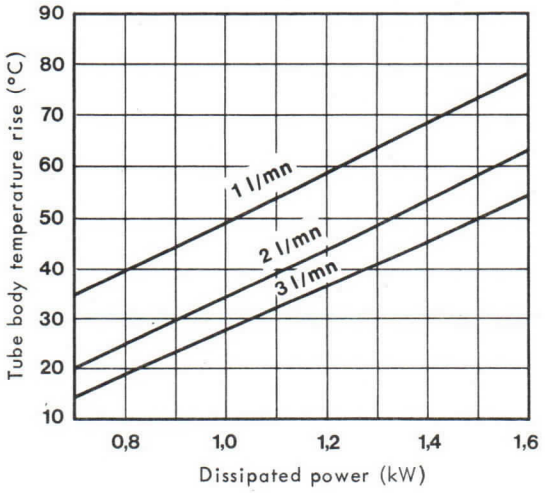
PERFORMANCE CHART

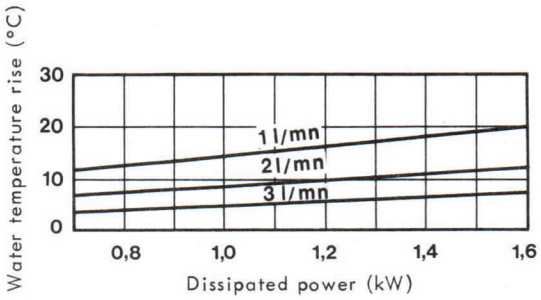


HEATER VOLTAGE ADJUSTEMENT

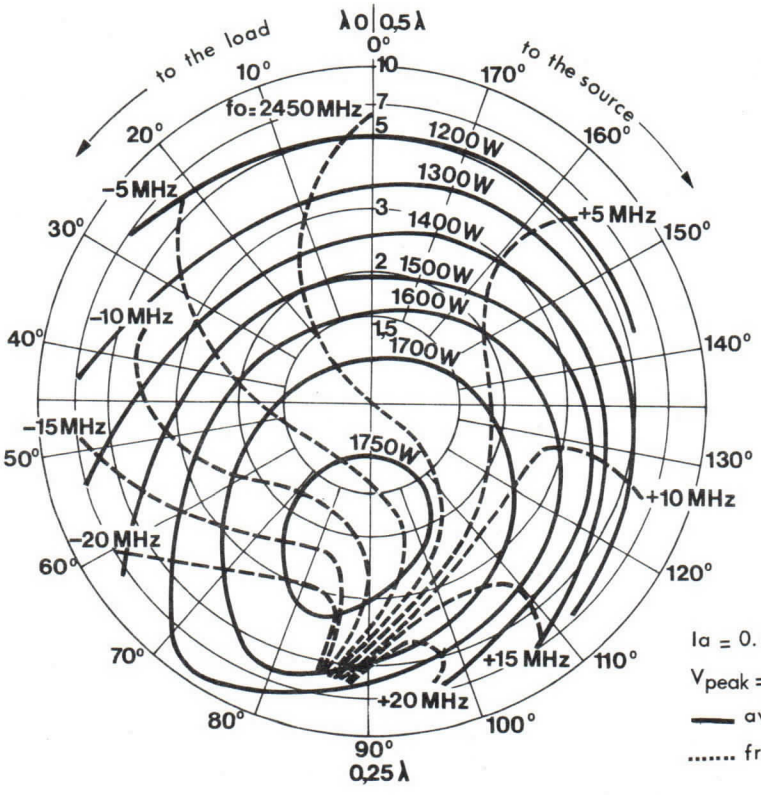


COOLING CHARACTERISTICS





Rieke diagramm



Ia = 0.8 A

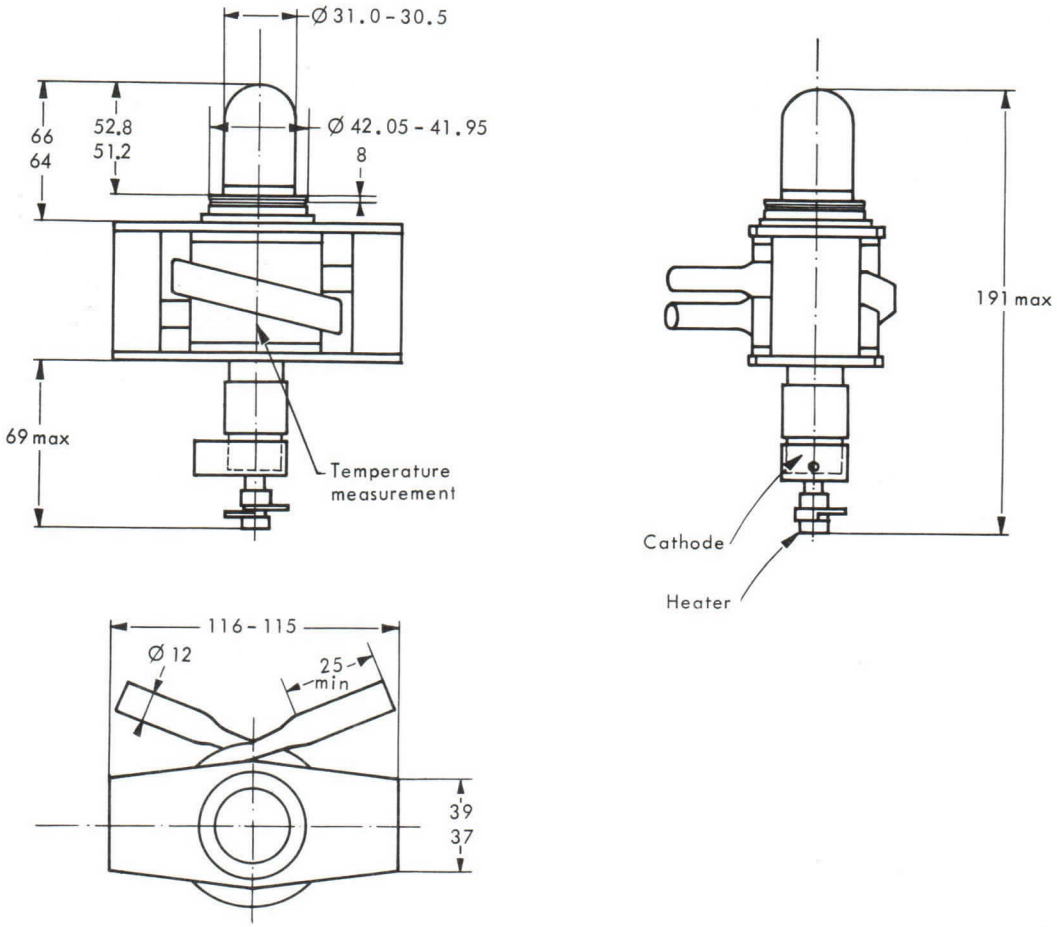
V_{peak} = 3650 V

—— average output power

..... frequency

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

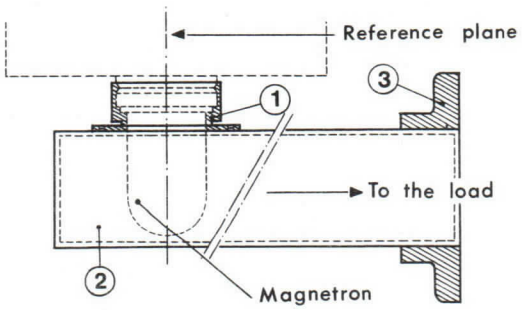


Transition

1 - Clamp : 321 38259

2 - Waveguide: RG 112/U

3 - Flange: UG 553/U



Dimensions in mm.

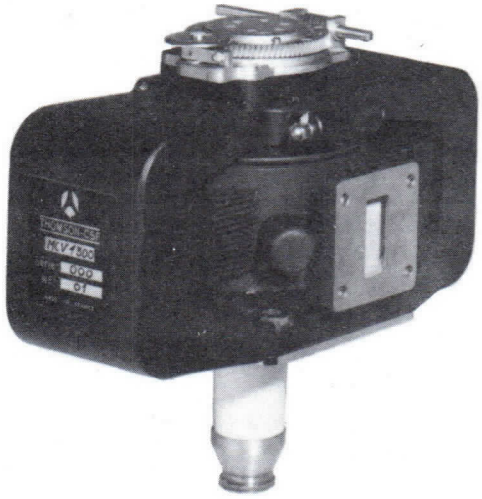
MCV 1300 MAGNETRON

The MCV.1300 is a coaxial magnetron capable of delivering a peak output power of at least 200 kW over the frequency range of 8. 5 to 9. 6 GHz.

It incorporates integral magnets and is cooled by forced air. The frequency is mechanically tunable.

The tube is extremely reliable under the most severe environmental conditions. With the new coaxial structure, radar applications have found improved frequency stability. The MCV.1300 is ideal for use in frequency adjustable systems, airborne and ground based radars.

This tube is a convenient replacement for 7008 and other conventional 200 kW magnetrons.



GENERAL CHARACTERISTICS

Electrical

	min.	nom.	max.	
Stand by heater warm-up voltage	-	13. 75	-	V
Stand by heater warm-up current	2. 9	-	3. 3	A
Heater voltage in operation (for Ia = 27, 5 A)	-	-	0	V
Frequency	8. 5	-	9. 6	GHz
Output power, peak	200	-	-	kW
Anode voltage	20	-	23	kV
Pulling (VSWR = 1. 5 : 1)	-	-	5	MHz
Pushing	-	-	100	KHz/A
RF Band width (VSWR = 1. 5 : 1)	-	-	2/tp	MHz
Side lobe level	9	-	-	dB
Stability, missing pulses	-	-	0. 25	%

Mechanical

Weight	7 kg
Dimensions	see drawing
Operating position	any
Cooling	forced air
Tuning torque	600 cm/g
Shaft rotation rate	1200 r/mn
RF output flange	mates with UG 52/U

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

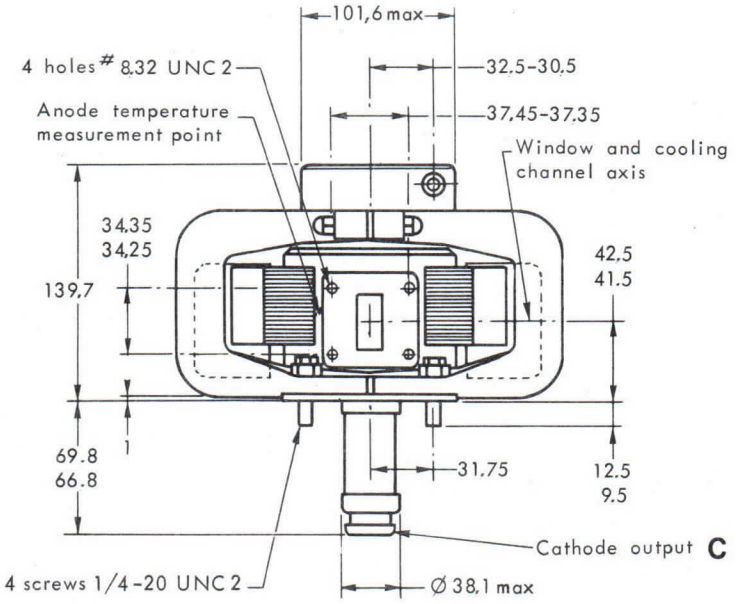
ABSOLUTE RATINGS

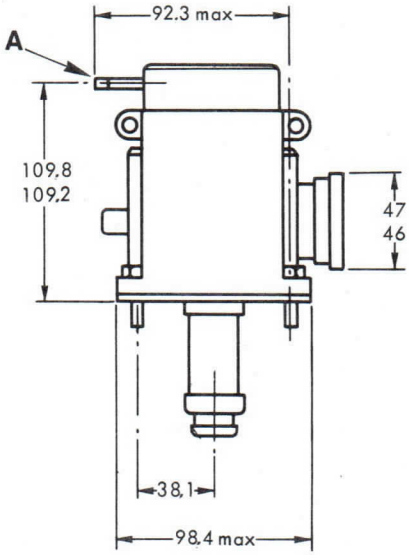
	min.	max.	
Applied power, peak	-	680	kW
Applied power, average	-	680	W
Anode voltage, peak	-	24	kV
Anode current, peak	15	30	A
Duty cycle	-	0. 0011	
Pulse duration, tp	0. 2	3	µs
Anode temperature	−55	+125	°C
Cathode bushing temperature	−55	+165	°C
Load VSWR	-	1. 5 : 1	
Rate of rise of voltage	90	170	kV/µs
Heater surge current	-	12	A
Cooling air flow (at 25 °C)	0. 70	-	kg/mn
Warm-up time	3	-	mn

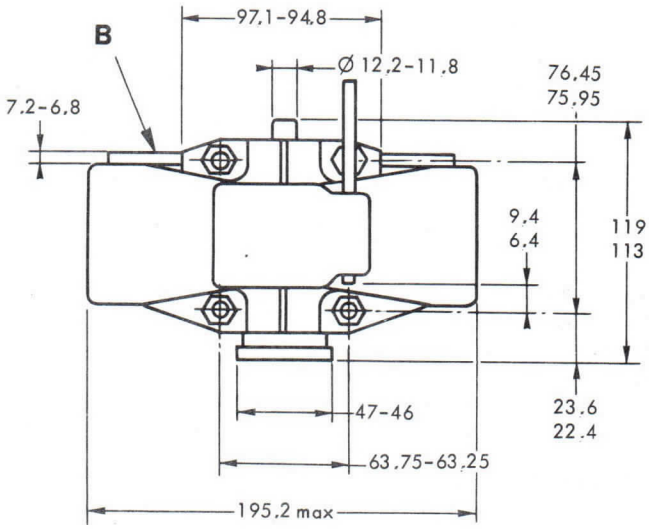
TYPICAL OPERATION

Pulse duration	1	µs
Duty cycle	0. 001	
Stand by heater warm-up voltage	13. 75	V
Stand by heater warm-up current	3	A
Anode current, peak	27. 5	A
Anode voltage, peak	23	kV
RF output power, peak	230	kW
Heater voltage in operation	0	V
Side lobe level	12	dB
RF band width	1. 2	MHz
Pulling (VSWR 1. 5 : 1)	3	MHz
Pushing	70	kHz/A
Load VSWR	1. 1 : 1	
Temperature coefficient	−0. 15	MH/°C
Rate of rise of voltage	150	kV/µs
Stability, missing pulses	< 0. 1	%

OUTLINE DRAWING





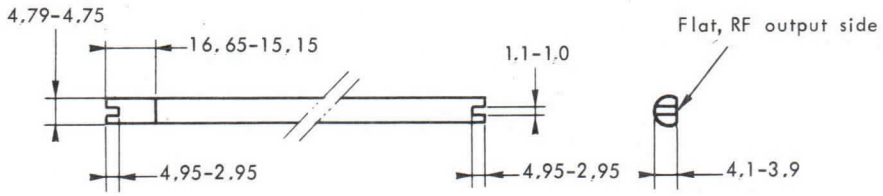


SEE DETAILS A,B,C, page 4

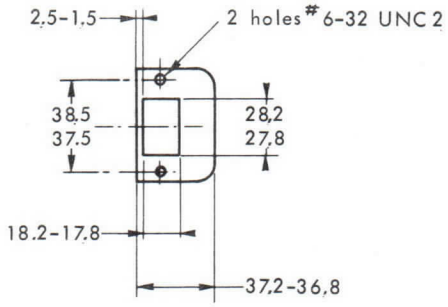
Dimensions in mm.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

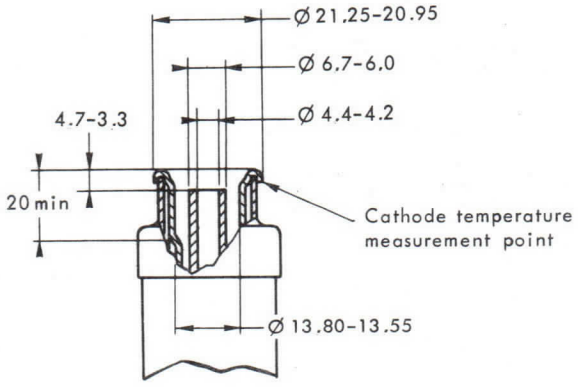
Details



DETAIL A



DETAIL B



DETAIL C

Dimensions in mm.

TUNABLE L-BAND MAGNETRONS
MCV 1352 - MCV 1353

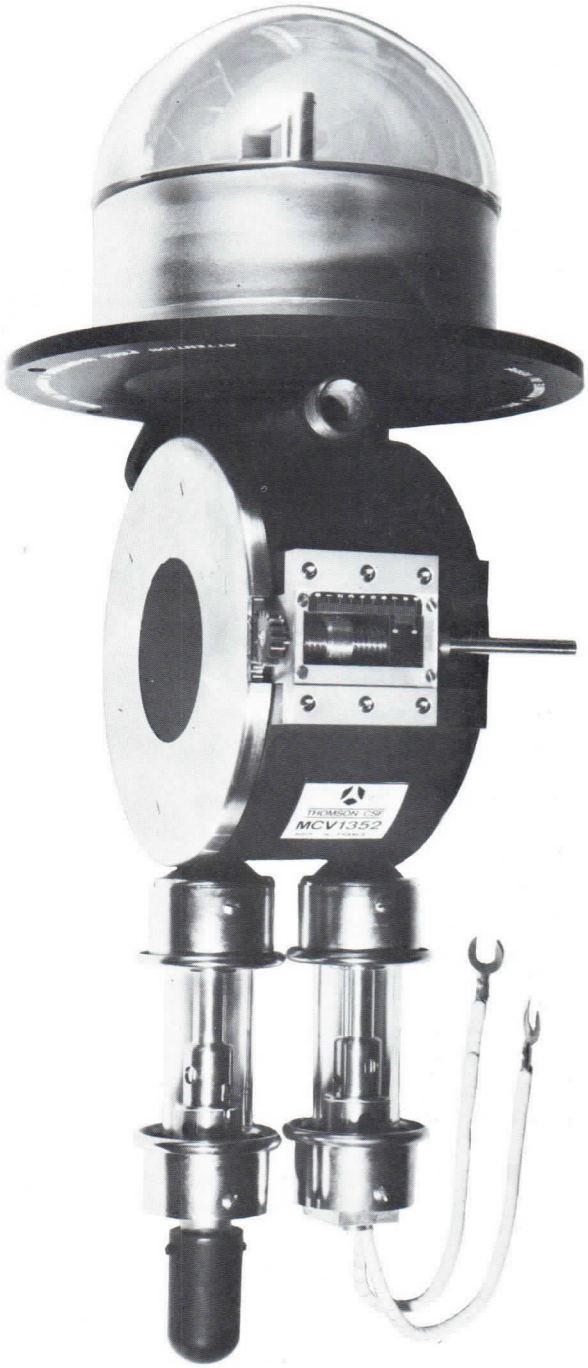
The MCV 1352 and MCV 1353 magnetrons are pulsed, high-power oscillators, each capable of delivering a minimum peak power output of 2.2 megawatts. Specifically designed to take the place of up to 15 ordinary fixed-frequency magnetrons, these two mechanically tuned tubes together cover the entire 1270 - 1370 MHz band. They are also mechanically and electrically interchangeable with the fixed-frequency models.

The MCV 1352 and MCV 1353 magnetrons find application in air-traffic-control (ATC) and other air-search radars, particularly for MTI systems requiring the generation of RF pulses largely free of time, amplitude or frequency jitter. Because they are tunable, these magnetrons have a major advantage in ATC - radar applications, i.e., their operating frequency can be easily shifted a few megahertz, up or down, to eliminate accidental jamming by other nearby radars. This feature is, of course, even more important in military use, where the jamming may be intentional.

A further advantage of these tunable L-band magnetrons is the way they simplify the spares support problem. For instance, in two-transmitter frequency-diversity operations, only one tunable magnetron need be kept on hand in spares storage to replace either of the operating tubes (as long as both frequencies used fall in either the 1270 - 1320 MHz band or in the 1315 to 1370 MHz band).

Having a circular-waveguide output, both the MCV 1352 and MCV 1353 are designed to be used with a circular-to-rectangular-waveguide transition (not furnished with the tube).

These magnetrons are each cooled by a simple circulating-water system, operating with ordinary tap water and requiring no complicated vapor-condensation system.



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

GENERAL CHARACTERISTICS

Electrical

Cathode	Indirectly heated
Heater voltage	20 V
Heater current	13 to 15 A
Peak anode voltage	38 to 42 kV
Peak anode current	155 A
Peak power output, typical	2. 3 MW
Average power output, minimum	2. 2 kW
Operating frequency :	
MCV 1352	1270 to 1320 MHz
MCV 1353	1315 to 1370 MHz

Mechanical

Mounting position	Vertical, cathode and heater terminals up
Dimensions	See the outline drawing
Weight (approximate)	13 kg
Tuner operating torque	2 cm/kg, nominal
Magnet	Separate permanent magnet (not supplied with the tube)
Cooling	By water circulation

MAXIMUM AND MINIMUM RATINGS
(non-simultaneous)

	Min.	Max.	Units
Heater voltage (1)	18	22	V
Heater starting-current surge	–	50	A
Warm-up time (1)	5	–	mn
Peak applied power	–	6. 4	MW
Average applied power	–	6. 4	kW
Peak anode voltage	35	42	kV
Peak anode current	–	160	A
Magnetic field	900	1000	G
Duty cycle	–	0. 15	%
Pulse length	–	5	μs
Rate of rise of voltage	–	60	kV/μs
Load VSWR	–	1. 5	
Cooling-water flow	1. 5	–	l/mn
Cooling-water outlet temperature	–	80	°C
Temperature at the cathode output	–	165	°C
Anode temperature	–	80	°C

(1) No anode voltage may be applied until the cathode has been warmed up. After application of high voltage to the anode, the heater voltage must be progressively reduced, as follows :

Average input power (watts)	Heater voltage
Less than 2000	20
2000 to 3000	15
3000 to 4000	10
4000 to 5000	5
More than 5000	0

TYPICAL OPERATION

Heater voltage	0	V
Magnetic field	950	G
Average anode current	155	mA
Peak anode voltage	39	kV
Pulse length	4	μs
Duty cycle	0. 1	%
Rate of rise of voltage	60	kV/μs
Average power output	2. 4	kW
Peak power output	2. 4	MW

STORAGE AND INSTALLATION

Stored magnetrons are much more likely to remain in a ready-to-operate condition if left in their original packing or placed in correctly designed storage racks. Whenever transported, they should be correctly packed to guard against subjecting the tube to undue vibration, shock or stress.

Care must be taken whenever handling these magnetrons ; they can be permanently damaged if subjected to rough handling. This is especially true when fitting the magnetron into its permanent magnet. Additionally, steel, nickel or any other magnetic materials must be kept from close contact with the magnet ; only non-magnetic tools should be employed during installation operations.

Electrical connections to the heater and cathode terminals should be tight, but not overly so. During tube operation, the heater and cathode terminals operate at high temperature, so provision must be made for thermal expansion. The anode voltage-supply return must be connected to the cathode terminal to prevent anode current and transients from passing through the heater and possibly causing burn out.

Never overstress the output section. Any mechanical pressure applied should be uniform, and a flexible-waveguide section should be inserted near the magnetron output.

STARTING A NEW MAGNETRON

When a new magnetron, or a magnetron that has been idle or stored for a while, is started up, some arcing and instability may occur. If instability is present, as evidenced by arcing or erratic anode current, the following procedure is recommended :

1 - After five minutes or warm-up, with 20 volts applied to the heater filament, raise the anode voltage gradually from zero (preferably at the shortest pulse duration) until one - half of the normal operating power is reached. The heater voltage must be progressively reduced as indicated in note (1) to the Maximum and Minimum Ratings table, page 2.

2 - As soon as the average anode current indicates stable operation, gradually increase the anode current until the normal operating conditions are reached. If arcing occurs, stop increasing anode current until the magnetron operation re-stabilizes. Be careful not to exceed any maximum ratings.

OPERATING ADVICE

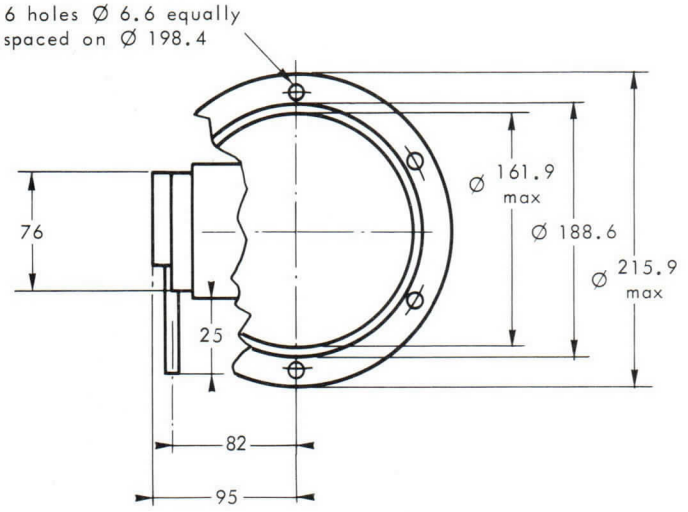
To protect the tube in case of arcing or flashover, a capacitor of at least 0.004 μF must be connected in parallel with the filament, directly across the output connections.

WARNING

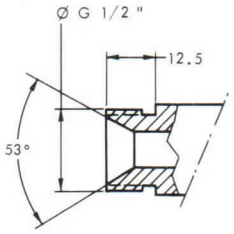
High power magnetrons emit a significant level of X-rays in the areas of the cathode and the RF output. Appropriate shielding should be installed to ensure protection of the operating personnel.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

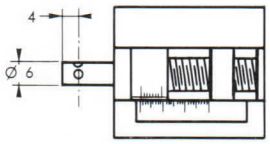
OUTLINE DRAWING

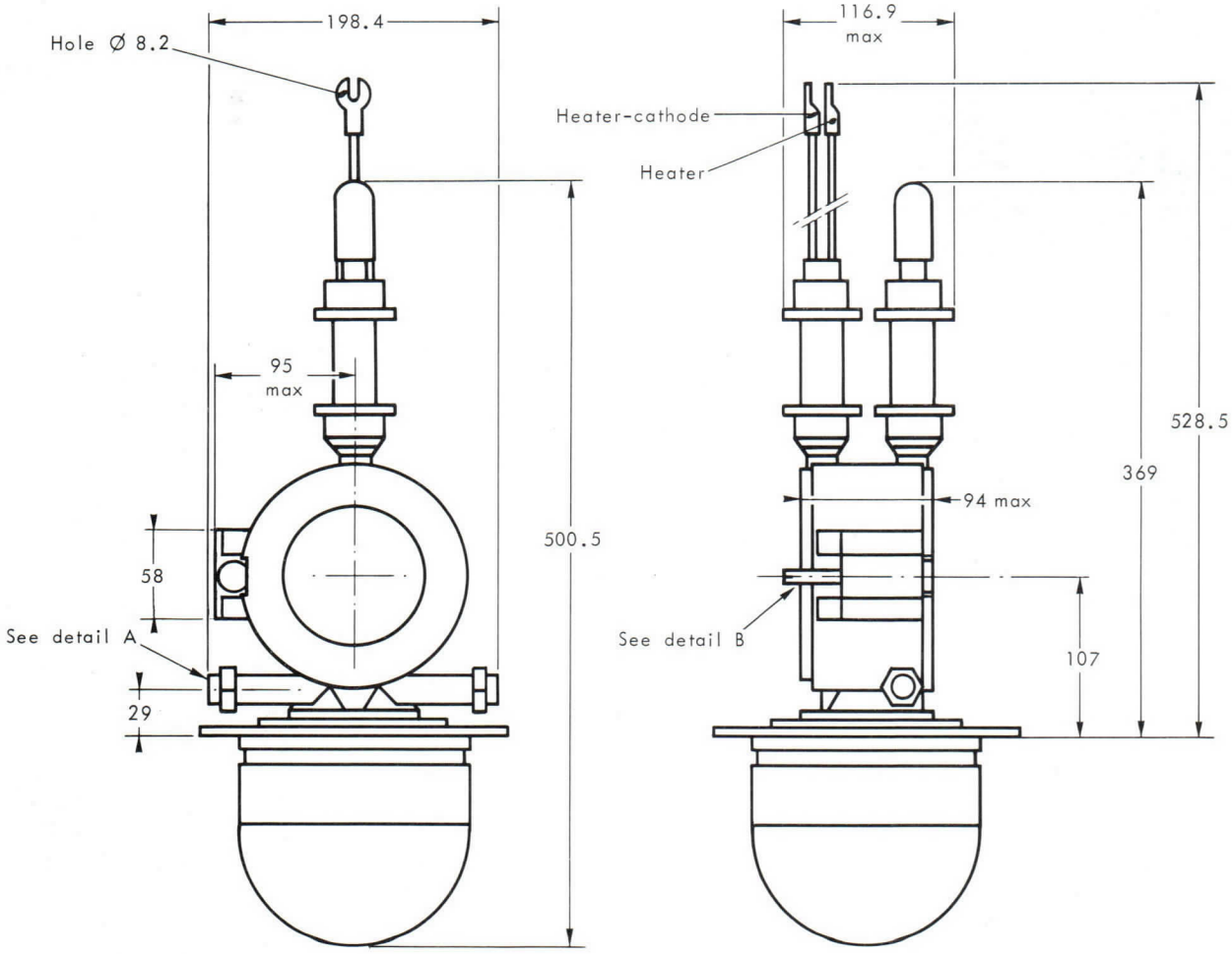


DETAIL A - Cooling water connection



DETAIL B - Tuning-system readout





Dimensions nominal, in mm.

Imprimé en France

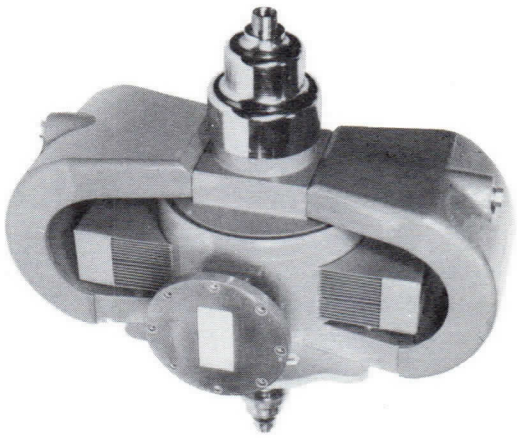
MCV 1420 COAXIAL MAGNETRON

The MCV 1420 is a coaxial magnetron designed for pulse operation at C band.

It delivers a peak RF power higher than 250 kW, with more than 50 % efficiency.

It finds applications in ground-based and airborne radar systems. Cooled by forced air and featuring an integral magnet, it offers the following advantages :

- wide tuning range,
- high efficiency,
- RF output with ceramic window,
- exceptional frequency stability.



GENERAL CHARACTERISTICS

Mechanical

Dimensions		see drawing page 3	
Weight	(approx.)	23	kg
Operating position		any	
Cooling		forced air	
Anode temperature	max.	120	°C
RF output temperature	max.	270	°C

Electrical

	min.	avg.	max.	
Frequency	5450	-	5825	MHz
Heater voltage	-	5	-	V
Peak anode voltage	23	-	36	kV
Peak anode current	-	24	-	A
Peak power output	250	-	-	W

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous)

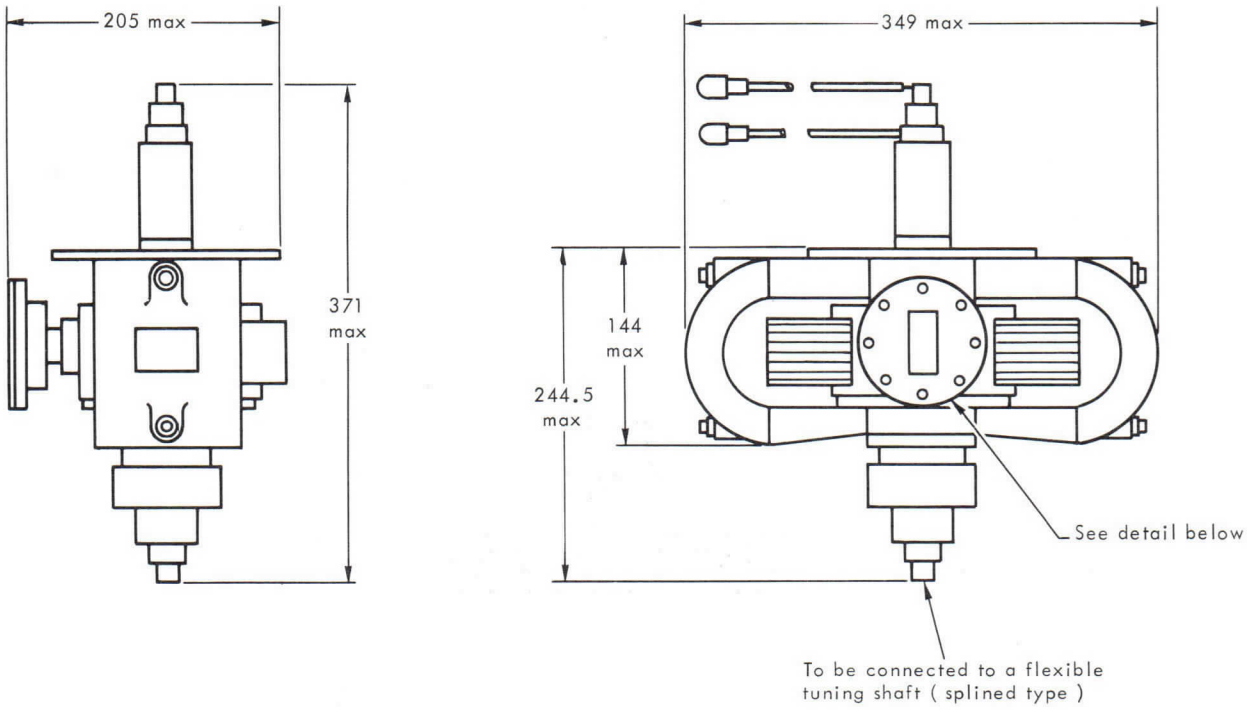
	min.	nom.	max.	
Warm-up voltage	-	7.5	-	V
Warm-up time	5	-	-	mn
Heater surge current	-	-	50	A
Peak anode current	-	30	-	A
Peak applied power	-	-	780	kW
Average applied power	-	-	780	W
Pulse width	0. 2	-	3	μs
Duty cycle	-	-	. 0011	
Rate of rise of voltage	-	-	120	kV/μs
Temperature of the anode	-	-	120	°C
Cathode bushing temperature	-	-	270	°C
Tuner torque	0. 35	-	1. 40	m.N

Remarks : *The heater voltage should not be reduced during operation . For other operating conditions, please, consult us.*

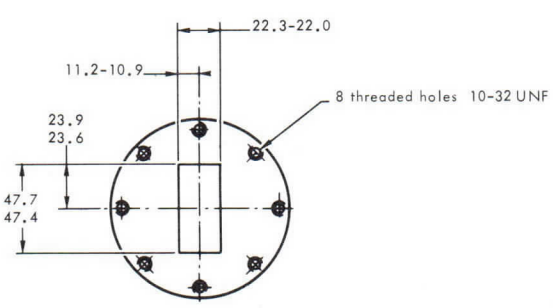
TYPICAL OPERATION

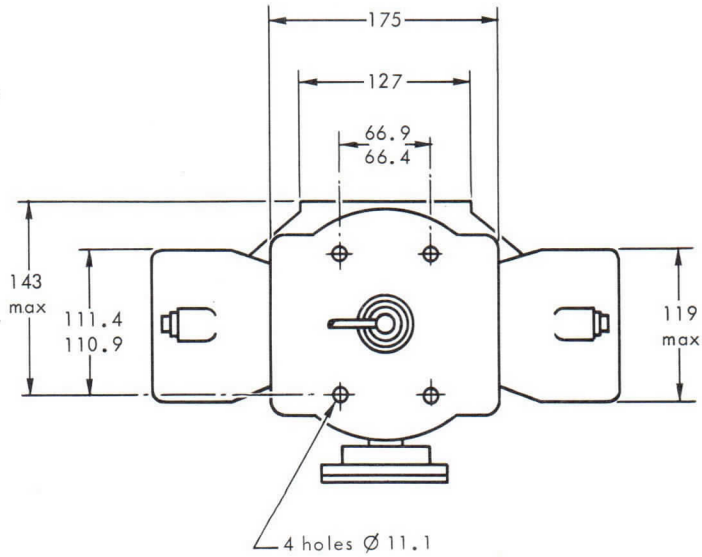
Frequency	5650	MHz
Heater voltage	5	V
Peak anode voltage	25	kV
Peak anode current	24	A
Pulse duration	1	μs
Duty cycle	. 001	
Efficiency	54	%
RF bandwidth	1. 2	MHz
Side lobe level	13	dB
Pulling (VSWR : 1. 5 : 1)	3	MHz
Pushing	30	kHz/A
Peak power output	310	kW

OUTLINE DRAWING



Tube connection





Dimensions in mm.

MCV 1420

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES



THOMSON-CSF

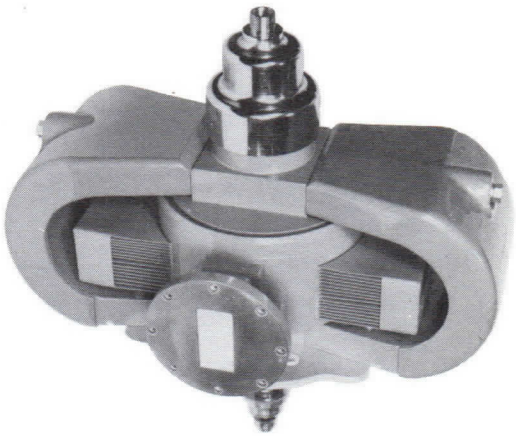
MAGNETRON MCV 1420

Le MCV.1420 est un magnétron coaxial fonctionnant dans la bande C en régime d'impulsions.

Il fournit une puissance crête hyperfréquence supérieure à 250 kW avec un rendement supérieur à 50 %.

Il peut équiper des radars fixes, mobiles ou aéroportés. Ses principales qualités sont :

- large bande d'accord ;
- rendement élevé ;
- sortie RF par fenêtre céramique ;
- stabilité de fréquence exceptionnelle.



CARACTERISTIQUES GENERALES

Mécaniques

Dimensions		voir dessin
Masse		23 kg environ
Position de fonctionnement		indifférente
Refroidissement		air forcé
Température d'anode	max.	120 °C
Sortie RF	max.	270 °C

Electriques

	min.	nom.	max.	
Fréquence	5450	-	5825	MHz
Tension de chauffage	-	5	-	V
Tension crête	23	-	36	kV
Courant crête	-	24	-	A
Puissance de sortie crête	250	-	-	kW

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION

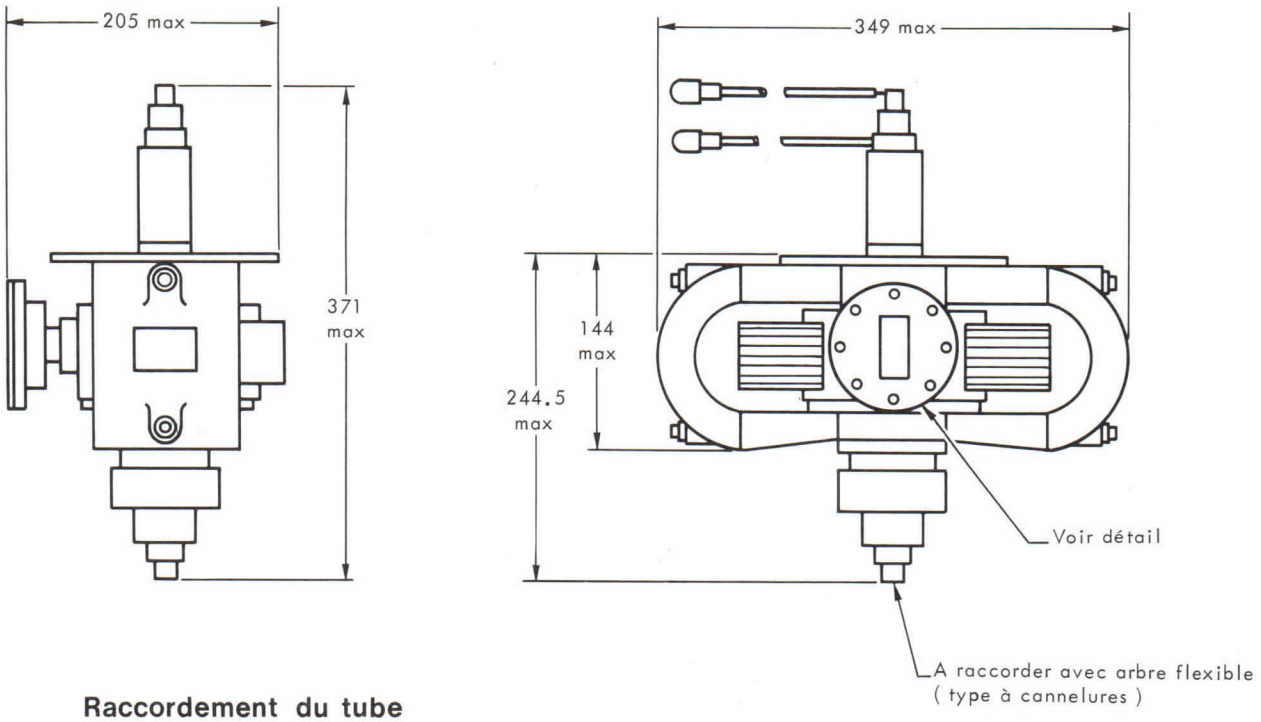
	min.	nom.	max.	
Tension de préchauffage	-	7, 5	-	V
Temps de préchauffage	300	-	-	s
Courant d'appel filament	-	-	50	A
Courant crête anodique	-	30	-	A
Puissance appliquée crête	-	-	780	kW
Puissance appliquée moyenne	-	-	780	W
Largeur d'impulsion	0, 2	-	3	μs
Facteur d'utilisation	-	-	0, 0011	-
Vitesse de croissance de la tension	-	-	120	kV/μs
Température du corps d'anode	-	-	120	°C
Température du pied cathode	-	-	270	°C
Couple nécessaire à l'entraînement du système d'accord	0, 35	-	1, 40	m.N

Note importante : *Il ne sera pas appliqué de réduction de chauffage en fonctionnement. Pour des conditions d'utilisation différentes, nous consulter.*

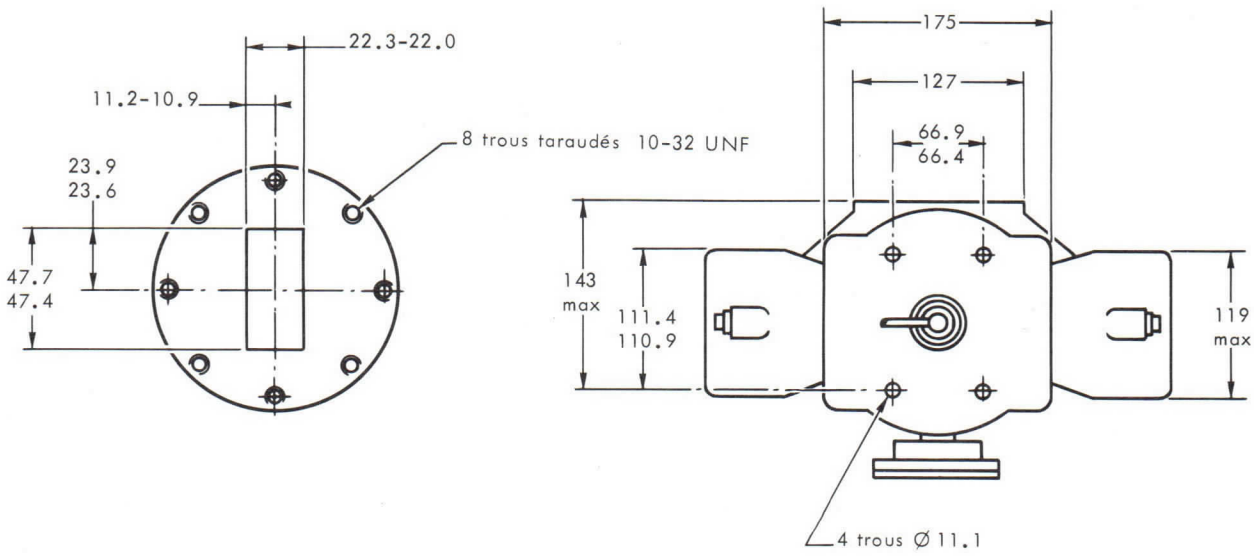
EXEMPLE DE FONCTIONNEMENT

Fréquence	5650	MHz
Tension de chauffage	5	V
Tension crête	25	kV
Courant crête	24	A
Durée d'impulsion	1	μs
Facteur d'utilisation	0, 001	
Rendement	54	%
Largeur de spectre (6 dB)	1, 2	MHz
Rapport de lobes	13	dB
Entraînement de fréquence (ROS 1,5)	3	MHz
Poussée de fréquence	30	kHz/A
Puissance de sortie crête	310	kW

DESSIN D'ENCOMBREMENT



Raccordement du tube



Cotes en mm.



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

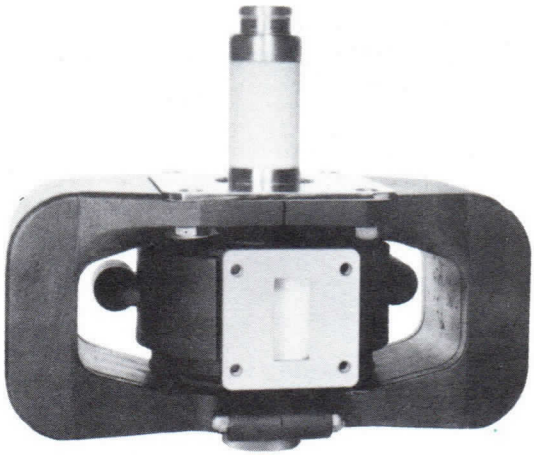
MCV. 1479 COAXIAL MAGNETRON

The MCV.1479 is a coaxial magnetron for use in airborne and ground-based radars. This tube delivers a peak output power of at least 200 kW over the frequency range of 8.5 to 9.6 GHz.

The MCV.1479 is mechanically tunable, the coaxial structure provides exceptional frequency stability, under the most severe environmental conditions.

This magnetron is liquid-cooled, incorporates integral magnets and features all metal and ceramic construction.

The MCV.1479 is ideal for frequency adjustable systems and is a direct replacement for the 4J50-TO and other conventional magnetrons.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Frequency	8.5	-	9.6	GHz
Heater voltage (warm-up)	-	9	-	V
Heater current (for $V_f = 9$ V)	2.4	-	2.9	A
Peak RF output power	200	-	-	kW
Average anode current	-	27.5	-	mA
Peak anode voltage	20	-	24	kV
RF bandwidth (1)	-	-	2/tp	MHz
Side lobe ratio (1)	9	-	-	dB
Stability, missing pulses (1)	-	-	1	%
Pulling (2)	-	-	5	MHz
Pushing	-	-	100	kHz/A
Temperature coefficient	-	-	0.25	MHz/°C

(1) At the worst phase of 1.5 : 1 VSWR.

(2) For VSWR = 1.5 : 1

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GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

	min.	max.	
Warm-up voltage	8	15	V
Heater surge current	-	15	A
Warm-up time	180	-	s
Peak anode current	17	30	A
Rate of rise of voltage	70	160	kV/μs
Peak anode power	-	660	kW
Load VSWR	-	1.5 : 1	
RF output pressurization (1)	-	3.0	bar
Cooling liquid pressure	-	5.0	bar
Anode temperature (2)	–40	+125	°C
Cathode connection temperature (2)	–40	+165	°C
Duty cycle	-	0.0011	
Pulse duration	-	2.5	μs

(1) See "Operating instructions".

(2) Measurement point indicated on drawing

TYPICAL OPERATION

(frequency 9 GHz)

Pulse duration	0.5	μs
Duty cycle	0.001	
Peak anode voltage	22	kV
Peak anode current	27.5	A
Heater voltage	0	V
Side lobe ratio	12	dB
Pulling	3	MHz
Peak RF power	225	kW
Cooling water flow	2	l/mn
Load VSWR	1.05 : 1	
RRV	150	kV/μs

OPERATING INSTRUCTIONS

Heater protection

The heater should be protected against arcing by a capacitor of at least 0.004 μF, connected in parallel on the heater and as close as possible from the output terminals.

Handling the tube

Do not exert any strains on the heater and cathode terminals.
Avoid shocks or stresses.
All magnetic materials should be kept away from the tube by at least 10 cm.

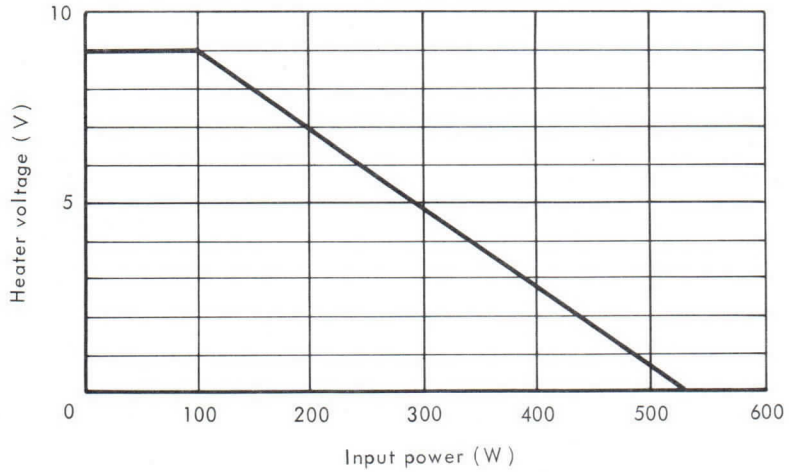
Pressurization

The MCV.1479 magnetron may be operated without breakdown in output at normal atmospheric pressure

- with dray air and perfectly clean output waveguides,
- VSWR less than 1.05 : 1
- peak output power less than 100 kW.

If all these conditions are not obtained, a minimum pressurization of 1.7 bar (absolute) is necessary.

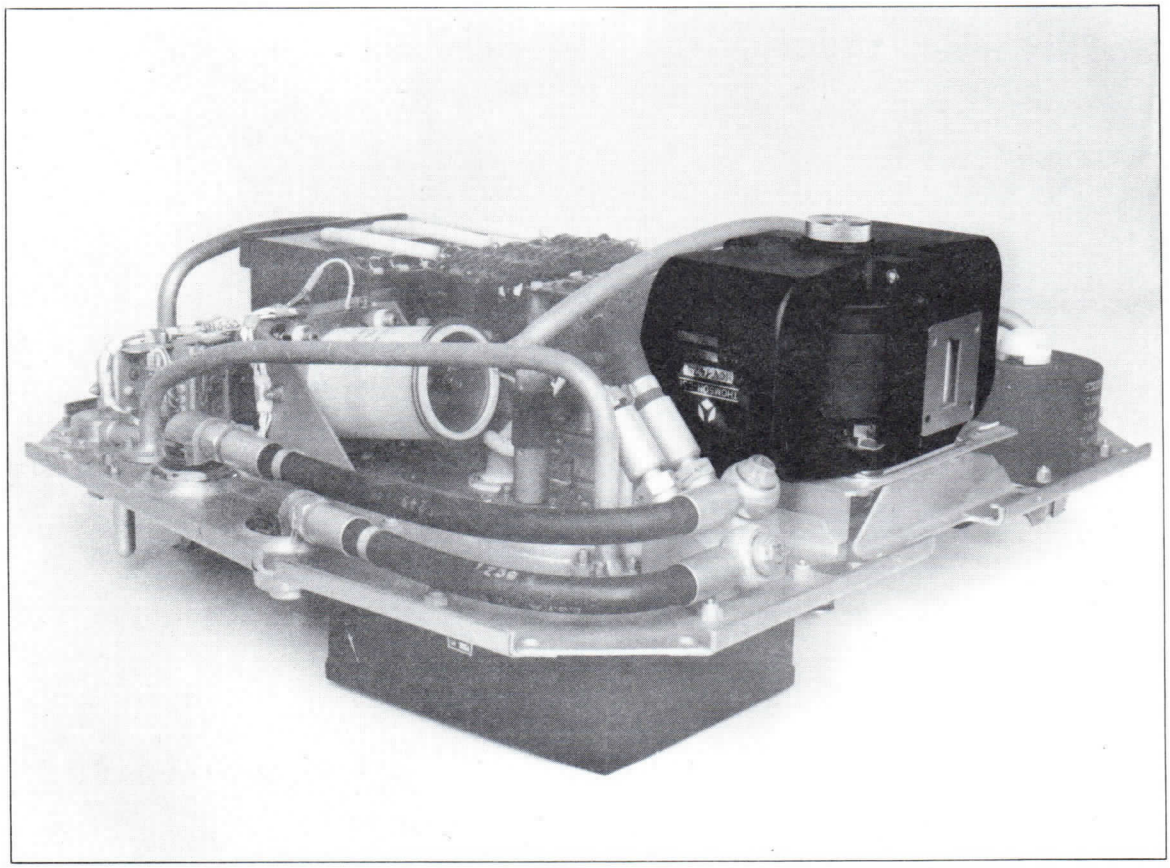
HEATER VOLTAGE ADJUSTMENT



$P_i < 100$ W $\quad V_F = 9$ V

$P_i > 525$ W $\quad V_F = 0$ V

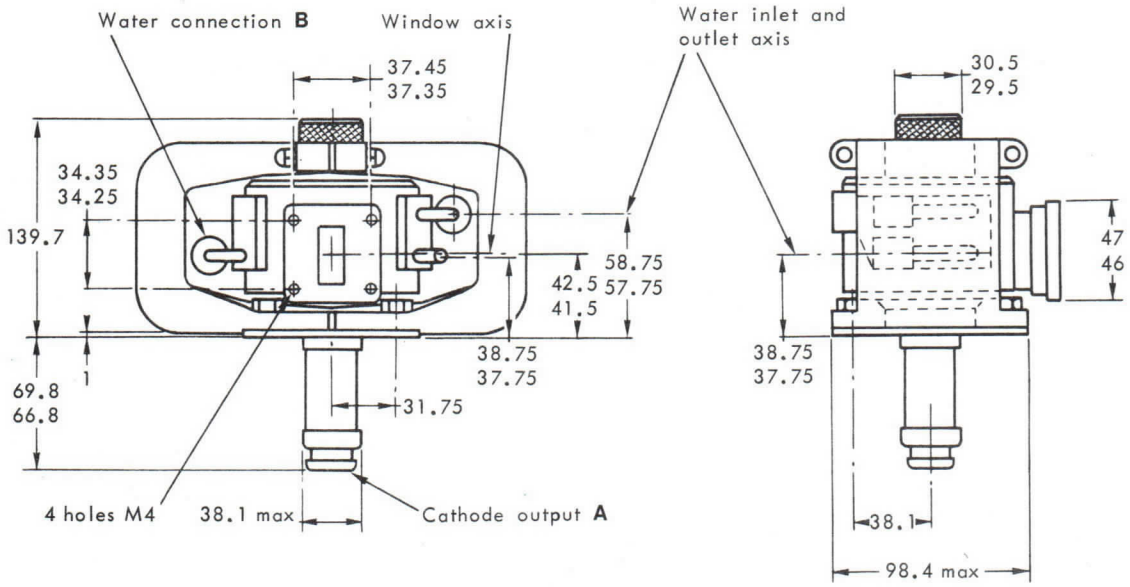
$100 \text{ W} \leqslant P_i \leqslant 525$ W $\quad V_F = 100 - 0.19\ P_i$ (W)

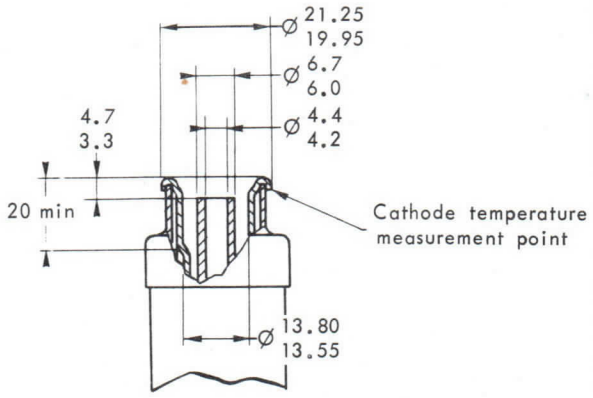


The MCV.1479 Magnetron is used in the "CYRANO" airborne radar.

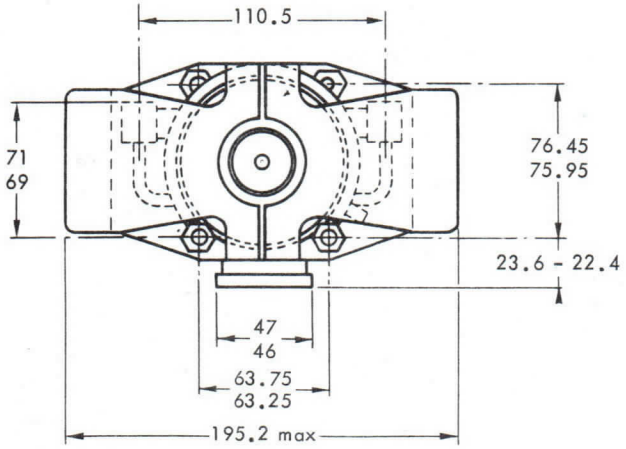
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

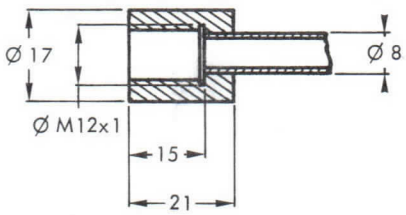
OUTLINE DRAWING





DETAIL A





DETAIL B

Dimensions in mm.

TH 3060B
TUNABLE HIGH-POWER S-BAND MAGNETRON

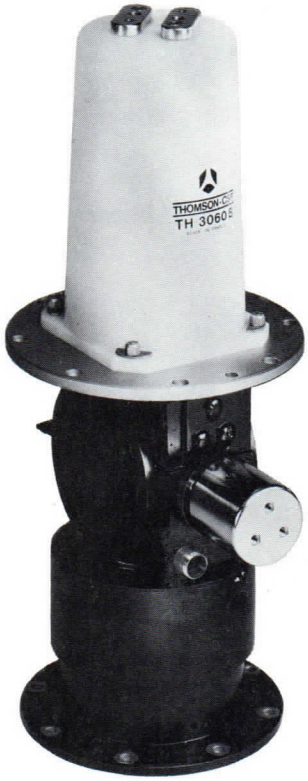
The TH 3060B magnetron is a pulsed, high-power oscillator, capable of delivering a minimum peak power output of 1.9 megawatts over its entire tunable band, 2992 to 3001 MHz.

Finding wide application in medical and industrial linear accelerators, the TH 3060B features a high-precision mechanical tuner and exceptional frequency stability. A particularly advantageous feature of this magnetron is that it can be rotated a full 360° about its long axis during operation, without disturbing the tube's correct operation.

Since it has an antenna output, this magnetron requires a special transition section, with a waveguide output, which can be furnished with the tube. (see drawing)

Long operating life is assured by the incorporation of an impregnated tungsten cathode.

The TH 3060B is cooled by demineralized water, or a water/ethylene glycol mixture, circulating through its integral water jacket, thus no complicated vapor-condensation system is needed.



GENERAL CHARACTERISTICS

Electrical

Operating frequency	2992 to 3001	MHz
Peak power output, typical	2.0	MW
Average power output, minimum	1.9	kW
Heating	indirect	
Cathode	impregnated tungsten	
Heater voltage (AC or DC)	14	V
Heater current	7 to 9	A
Peak anode voltage	36 to 46	kV

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GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Mounting position (1)	any	
Output (2)	see drawing	
Dimensions	see drawing	
Weight (approximate)	8.2	kg
Tuning (3)	mechanical	
Tuner operating torque, maximum	12	oz-in
Magnet	separate permanent magnet (not supplied with the tube)	
Cooling	by liquid circulation	

MAXIMUM AND MINIMUM RATINGS

(no single rating should be exceeded)

	min.	max.	units
Heater voltage (4)	13.3	14.7	V
Heater surge current	-	15	A
Warm-up time (4)	3	-	mn
Pulse length	-	4.5	μs
Duty cycle	-	0.0015	
Average applied power	-	5	kW
Peak anode voltage	35	47	kV
Peak anode current	-	110	A
Rate of rise of voltage	-	100	kV/μs
Load VSWR (5)	-	1.5 : 1	
Magnetic field	1350	1600	G
Coolant flow	1.06	-	gpm
Coolant outlet temperature	-	50	°C
Coolant pressure	-	100	psi
RF-output pressurization	-	45	psig

(1) In medical applications, where the magnetron is mounted with its long axis horizontal, it can be rotated 360° around that axis without disturbing its normal operation.

(2) The output RF power is sent to the waveguide via a special transition section, which must have a VSWR of less than 1.1 : 1, and be free of resonances in the 2,91 - 3.09 GHz band.

(3) The tube's entire frequency range is covered by approximately 4.5 turns of the mechanical-tuner shaft.

(4) No anode voltage may be applied until the cathode has been warmed up. During tube operation, the heater voltage must be adjusted according to the curve on page6, reducing the magnetron filament power as the average RF power is increased.

(5) For maximum tube operating life, the load VSWR should always be as low as possible.

TYPICAL OPERATION

Heater voltage	0	V
Pulse length	4	µs
Rate of rise of voltage	100	kV/µs
Duty cycle	0.001	
Peak anode current	100	A
Peak power output	2	MW
Load VSWR	1.1 : 1	
Magnetic field	1550	G
Coolant inlet temperature	40	°C
Coolant flow	1.5	gpm

ACCESSORIES

Output transition section	TV 19367 (see drawing)
Magnet	Separate permanent magnet, not supplied with the tube. Magnetic field : 1550 G (consult us for additional information).

APPLICATION NOTES

These application notes provide basic information concerning the storage, installation and operation of the TH 3060B magnetron. More complete information, required, for example, for the construction of a new type of of equipment, can be furnished upon request.

STORAGE AND INSTALLATION

Stored magnetrons are much more likely to remain in a ready-to-operate condition if left in their original packing or placed in correctly designed storage racks. Whenever transported, they should be correctly packed to guard against subjecting the tube to undue vibration, shock or tress.

Care must be taken whenever handling these magnetrons; they can be permanently damaged if subjected to rough handling. This is especially true when fitting the magnetron into its permanent magnet. Additionally, steel, nickel or any other magnetic materials must be kept from close contact with the magnet; only non-magnetic tools should be used during installation operations.

The following procedure is recommended for installating the TH 3060B magnetron :

1 - Verify the tube position with respect to the magnet. The tube must be mounted with its cathode side next to the magnet's north seeking pole.

2 - Install the magnetron, being sure not to subject the tube to shock or strain. Never overstress the glass-to-metal seal of the output section. Any mechanical pressure applied should be uniform, and a flexible waveguide section should be inserted near the magnetron output.

3 - Connect the current leads to the magnetron base. The cathode is connected to pin "C", identified on the protective cover. The electrical connections to the heater and cathode terminals should be tight but not overly so. During tube operation the heater and cathode terminals operate at high temperature, so provision must be made for thermal expansion.

4 - As a protective measure, the anode voltage-supply return must be connected to the cathode terminal to prevent anode current and transients from passing through the heater and possibly causing burn-out. Also, a non-inductive capacitor of at least 0.004 μF must be connected in parallel with the filament, directly across the heater terminals, to protect the tube in case of arcing or flashover.

5 - Apply the heater voltage gradually. The heater surge current must not exceed 15 amperes. Allow at least three minutes for the cathode to fully warm up before applying any high voltage to the tube.

6 - Verify that the cooling system is operating correctly.

7 - Apply the high voltage. The central plate must be used as the grounding contact. In the normal operating modes, the observed pulse forms must correspond to the following characteristics :

a) Any spike on the pulse front must be suppressed.

b) Any ripple on the top of the current pulses must not exceed 10% of the average value of the peak current.

8 - Reduce the heater voltage as the applied power is increased, according to the curve on page 6.

STARTING A NEW MAGNETRON

A new magnetron, or one that has been idle or stored for a while, may contain small traces of gas. This gas can cause internal arcing to occur when the high voltage is applied. These arcs are generally evidenced by flustuations of the average anode current, and are usually short (less than two-seconds long) and harmless.

When, however, these arcs or flashes are persistent or severe, causing rapid and uncontrolled fluctuations of the average anode current, the following procedure must be followed to avoid damaging the tube :

1 - Reduce the current to the level just below that at which arcing begins. Hold the current at this value for several minutes (about five).

2 - When the operation of the tube is stable, gradually increase the anode current.

3 - Repeat this procedure as often as necessary until stable operation at the desired operating voltage is achieved.

WARNING

All magnetrons operate with high anode potentials, which can cause lethal shocks to operating personnel Suitable safety interlocks must be provided to avoid this shock hazard.

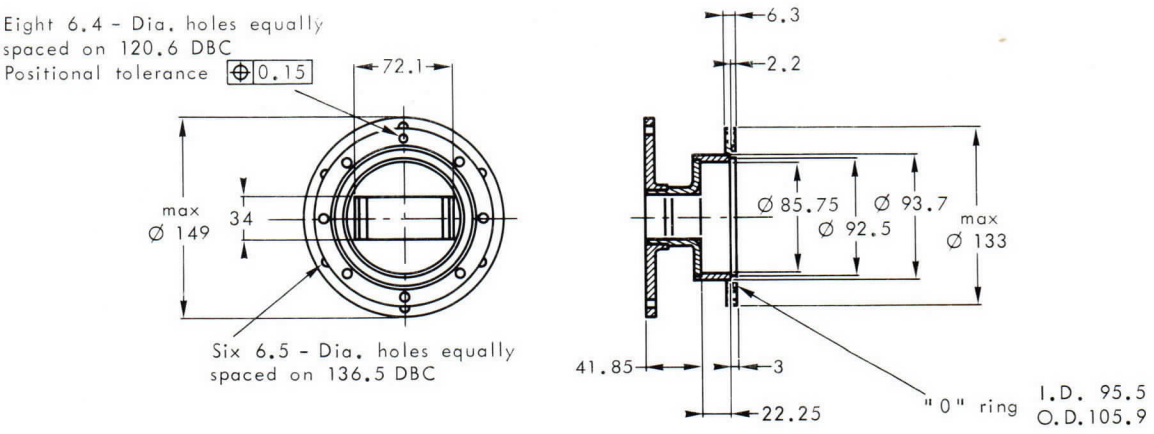
RF LEAKAGE

Sufficient RF power may be radiated through the cathode stem and other openings to interfere with adjacent circuit components. This radiation may be hazardous to human beings, especially to the eyes when arcing or the cathode temperature are being observed. Adequate precautions must be taken to guard against these hazards.

X-RAYS

High-power magnetrons emit a significant level of X-rays in the areas of the cathode and the RF output. Appropriate shielding should be installed to protect the operating personnel.

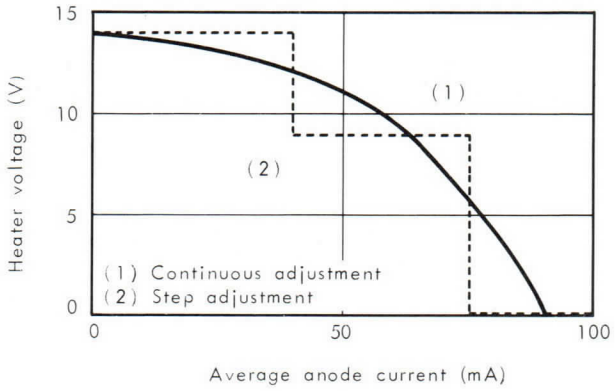
TRANSITION TV 19367



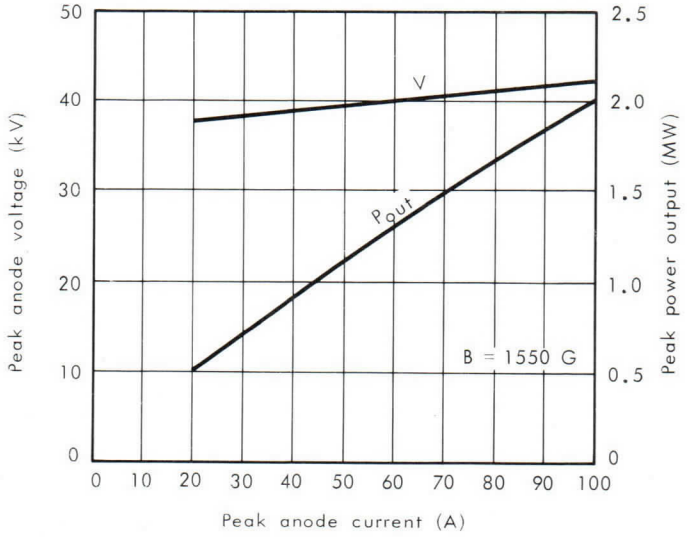
Dimensions in mm, nominal except for those marked "max"

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

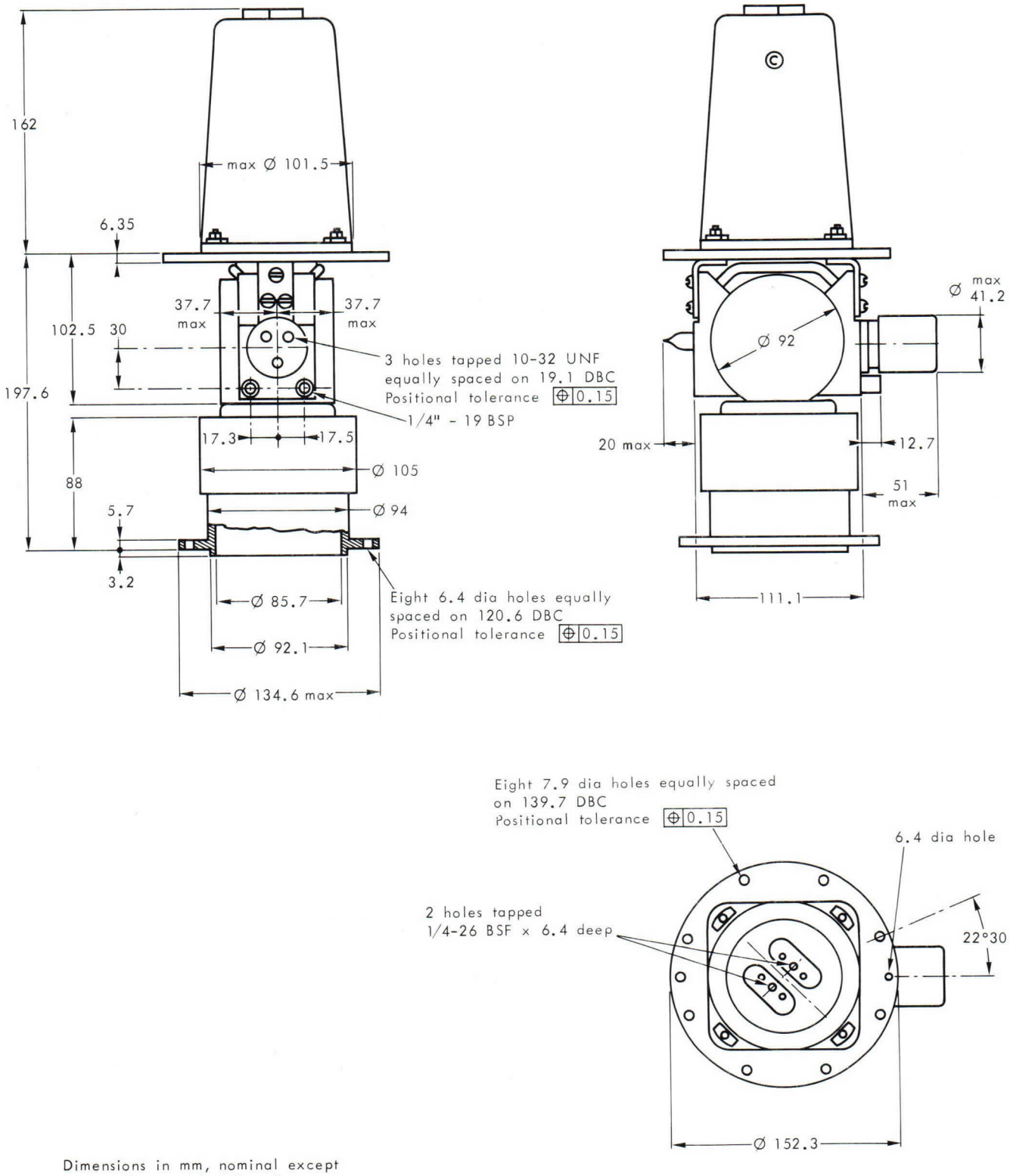
HEATER VOLTAGE ADJUSTMENT



PEAK ANODE VOLTAGE (V) AND PEAK POWER OUTPUT (P_{out})
AS A FUNCTION OF THE PEAK ANODE CURRENT



OUTLINE DRAWING



Dimensions in mm, nominal except those marked "max"

TH 3060B

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Imprimé en France

TH 3061 MAGNETRON

The TH 3061 is a tunable, L-band, high-power oscillator with external magnet.

This tube delivers a minimum peak output power of 500 kW at any operating frequency in the band 1220 to 1350 MHz.

An improved version of the well known and highly regarded 5J26 magnetron, the TH 3061 has been specially designed for long-life operation in MTI systems, while retaining the proven reliability and ease of operation of its predecessor.



GENERAL CHARACTERISTICS

Electrical

Frequency range	1220 to 1350	MHz
Peak output power, min. (average anode current 68 mA)	500	kW
Warm-up/standby heater voltage, nom.	23. 5	V
Warm-up/standby heater current	2. 0 to 2. 4	A
Heater voltage in operation (average anode current 68 mA)	0	V
Pulse duration, (1)	0. 7	µs
Duty cycle, (1)	0. 0012	
Anode voltage	33	kV
Magnetic field, (1)	1400	G

Mechanical

Operating position	Any
Cooling	Forced air
Anode temperature, max.	150 °C
RF output	1 5/8" coaxial line with special coupler (see drawing)
Net weight	18 lbs 8 kg

(1) For use with other pulse lengths, duty cycles or field strengths, consult THOMSON-CSF.

ABSOLUTE RATINGS (2)

	Min.	Max.	Units
Heater surge current	–	6	A
Heater voltage	23	24	V
Pulse duration	0. 5	1. 5	μs
Duty cycle	–	0. 00125	
Average input power	–	2450	W
Peak input power	–	2000	kW
Peak anode voltage	–	35	kV
Peak anode current	–	60	A
Rate of rise of voltage pulse (above 50 % amplitude)	–	120	kV/μs
Warm-up time	3	–	mn

(2) No single rating should be exceeded.

TYPICAL OPERATION

	Case 1	Case 2	Units
Pulse duration	0. 7	1. 5	μs
Operating frequency	1300	1300	MHz
Peak anode current	56	46	A
Average anode current	67	46	mA
Peak anode voltage	33	30	kV
Duty cycle	0. 00125	0. 001	
Rate of rise of voltage	100	100	kV/μs
Peak output power	580	500	kW
Average output power	690	500	W
Side-lobe level	11	11	dB
RF bandwidth	2. 0	0. 85	MHz
Pulling figure (VSWR 1. 5 : 1)	2. 5	2. 5	MHz

OPERATING INSTRUCTIONS

These instructions provide basic information for installing and operating the TH 3061 magnetron.

Installation

During mounting and handling the magnetron, care must be taken to prevent shocks or strains on the glass-to-metal seal of the output.

Use only non-magnetic tools during installation. The north pole of the magnet should be adjacent to the cathode and the tube should be located between the pole tips such that these are concentric with the axis of the tube.

A small deviation from this position may result in lower output power (see drawing, page 5).

Electrical Connections

The common cathode/heater terminal is located at the side of the magnetron which is provided with the tuning mechanism. It is, moreover, indicated by the inscription C on the insulator which protect the heater leads.

It is necessary to bypass the magnetron heater, directly across the heater terminals, with a capacitor having a minimum non-inductive capacitance of 4000 pF, rated for 1000 V.

In order to prevent heater burn-out the negative high-voltage pulse must be applied to the common cathode/heater terminal.

Application of Voltages

An adequate air flow should be directed along the cooling fins on the magnetron in order to keep the anode temperature below 150 °C.

Apply heater voltage gradually. The heater surge current should not exceed 6 A. Allow at least 3 minutes for the cathode to warm up before applying the high voltage.

Tune the magnetron to the higher frequency limit (1350 MHz). Clockwise rotation of the driving gear wheel of the tuning mechanism results in higher magnetron frequency.

After 3 minutes at full heater voltage, increase the anode voltage. The heater voltage must be reduced in accordance with the heater-voltage adjustment curve (see page 4).

The TH 3061 magnetron has been designed for operation under the following pulse conditions :

- pulse duration : 0. 5 μs to 1. 5 μs ± 10 %
- RRV : 100 kV/μs nominal

The spike on the top portion of the pulse must be kept as small as possible to avoid excessive peak pulse current.

The ripple over the top portion of the current pulse should not exceed ± 7 % of the average peak value of current. Inverse voltage should not exceed 35 % of the forward voltage. Post voltages should be held to a minimum as they may cause post-pulse noise or oscillation and increased leakage current.

Tuning

The tuning-gear assembly provides the variable frequency control of the magnetron.

The tuning assembly includes mechanical stops at each of the specified frequency extremes. Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

STARTING A NEW MAGNETRON

When a new magnetron, or a magnetron that has been idle or stored for a period of time, is put into operation, some sparking and instability may occur.

If instability occurs at any step, as evidenced by arcing or erratic average anode current, the following procedure is recommended :

- Adjust the tuning mechanism until the approximate highest frequency position is reached. (Clockwise rotation of the driving gear wheel of the tuning mechanism results in higher magnetron frequency).
- After a three minutes of warm-up with 23.5 V applied to the heater, raise the anode voltage gradually until one half of normal operating power is reached. The heater voltage must be reduced in accordance with the diagram, page 4.
- As soon as the average anode current indicates stable operation, gradually increase the anode voltage until the normal operating conditions are reached. If arcing occurs, stop until the magnetron operates stably again. Care should be taken that the maximum ratings are not exceeded.
- When stable operation at this frequency is reached, tune the magnetron to the lower frequency limit. Operate the magnetron at that frequency until it operates stably.
- After completing this procedure, the magnetron can be set for the normal operating conditions desired.

WARNING

All magnetrons operate with high anode potentials, which can cause lethal shocks to operating personnel. Suitable safety interlocks must be provided to avoid this shock hazard.

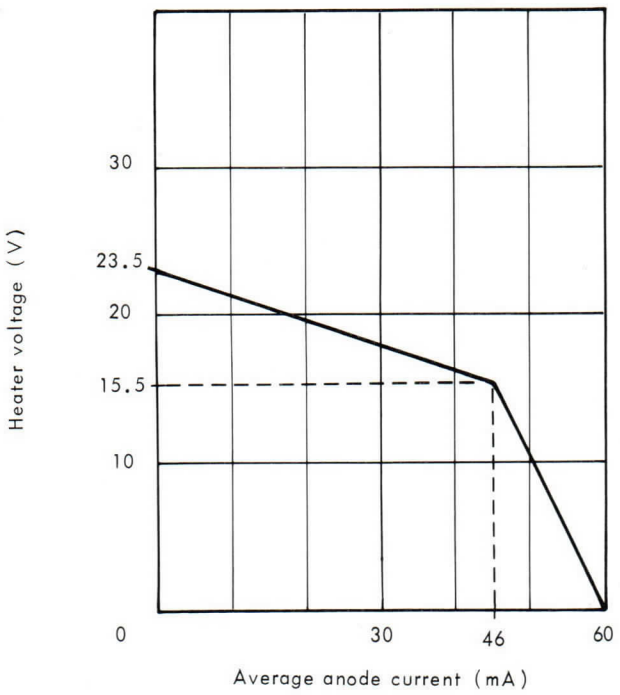
RF Leakage

Sufficient RF power may be radiated through the cathode stem and other openings to interfere with adjacent circuit components. This radiation may be hazardous to human beings, especially to the eyes when arcing or the cathode temperature are being observed. Adequate precautions must be taken to guard against these hazards.

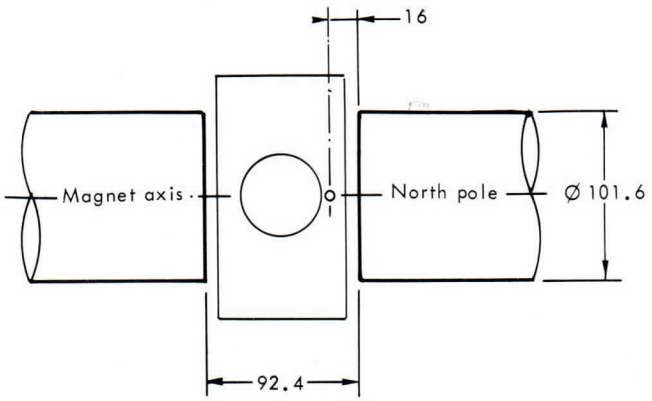
X-Rays

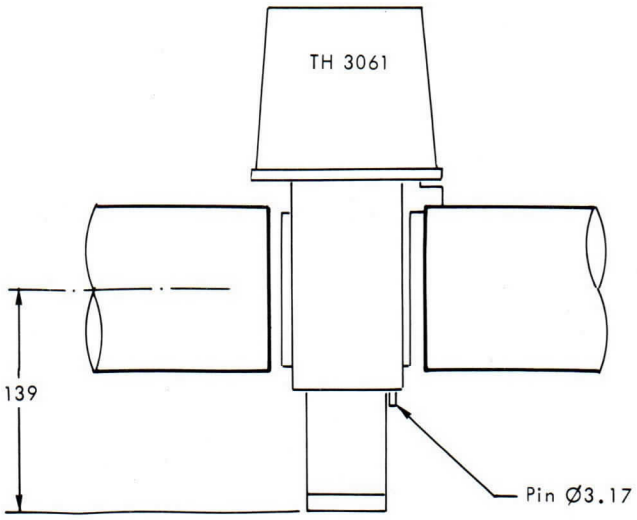
High power magnetrons emit a significant level of X-rays in the areas of the cathode and the RF output. Appropriate shielding should be installed to protect the operating personnel.

HEATER VOLTAGE ADJUSTMENT

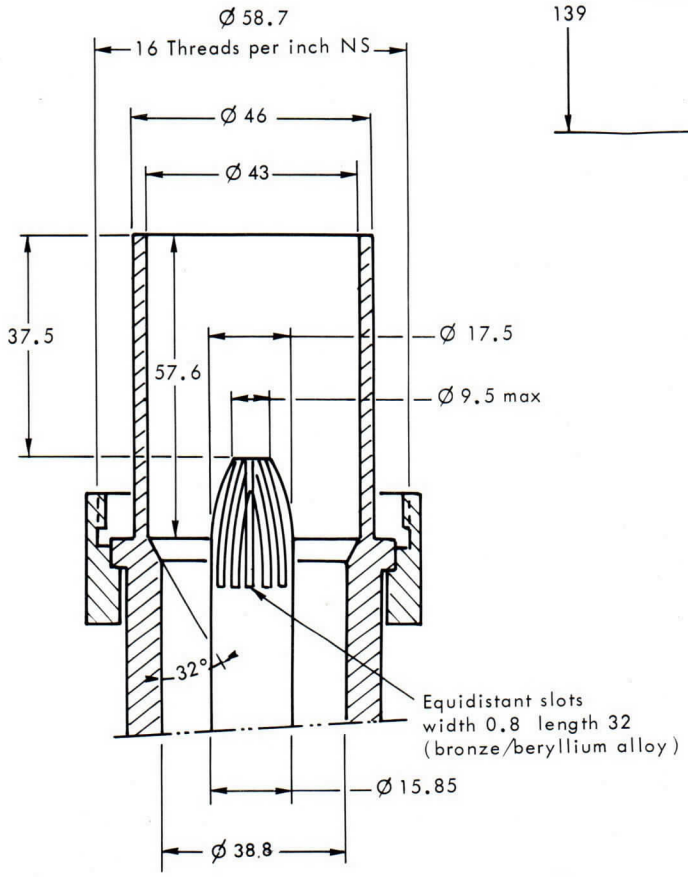


POSITION OF THE TUBE IN THE MAGNET



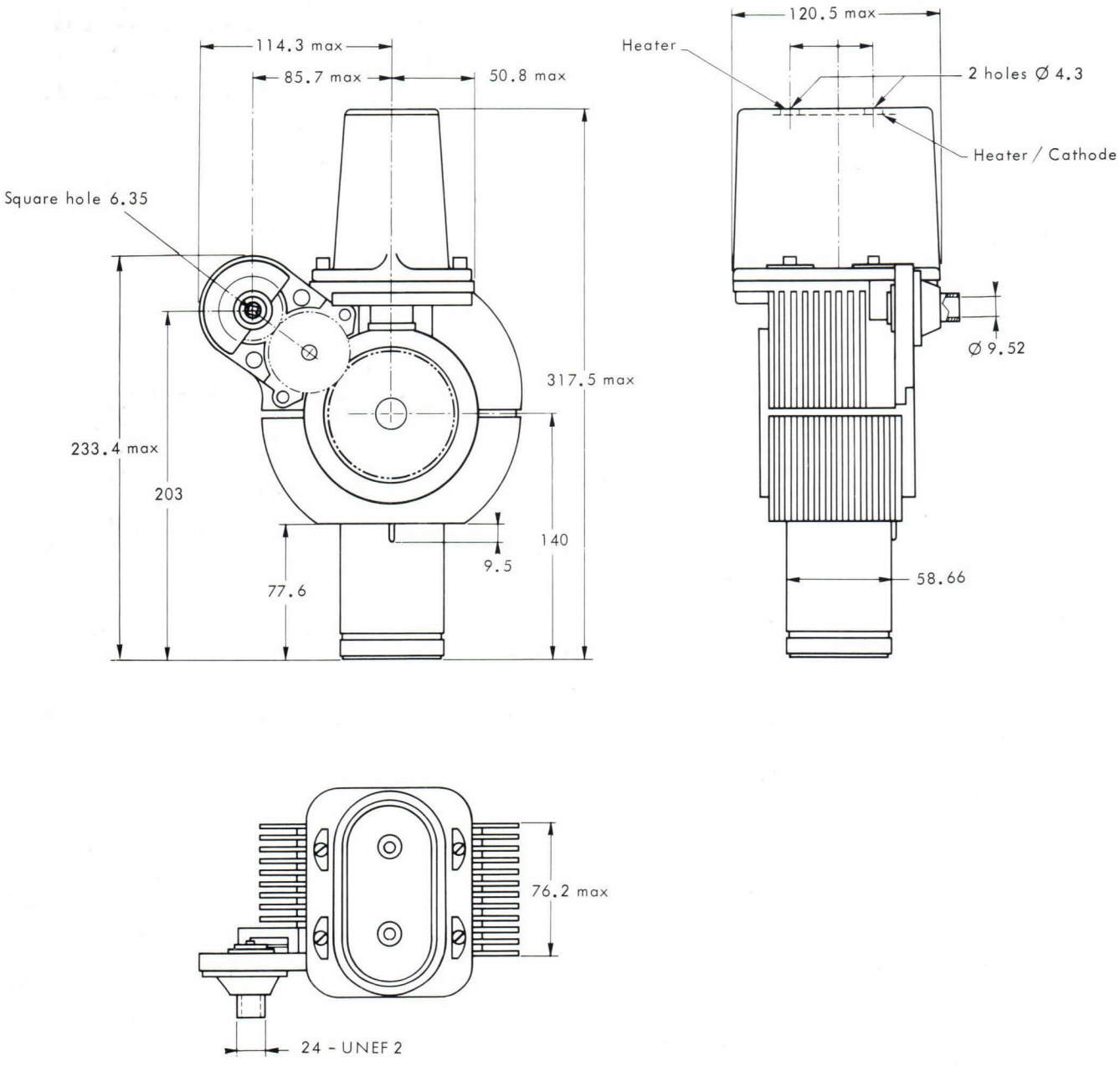


SPECIAL COUPLER



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



Dimensions in mm, nominal except for those market "max."

Imprimé en France

TH 3080 – TH 3081 MAGNETRONS

The TH 3080 and TH 3081 magnetrons are pulsed, high-power oscillators, each capable of delivering peak output power of one megawatt and an average power of two kilowatts.

Both of these tubes are mechanically tunable, from 2700 to 2800 MHz for the TH 3080 and from 2800 to 2900 MHz for the TH 3081, and both employ integral permanent magnets for electron-beam focusing.

These modern radar magnetrons are especially appropriate for use in MTI systems, where RF energy that is relatively free of time, frequency or amplitude jitter is required, and where low phase noise is also desirable.

Cooling of the TH 3080 and TH 3081 can either be all by forced air, or by a combination of forced air and circulating water, at the user's option.

GENERAL CHARACTERISTICS

Electrical

Frequency range TH 3080	2700 - 2800	MHz
TH 3081	2800 - 2900	MHz
Peak output power, typical	1.0	MW
Heater voltage (1)	8.5	V
Heater current, typical	9.0	A
Peak anode voltage	28 to 35	kV
Average anode current	150	mA

Mechanical

Mounting position	Vertical, cathode down
Tuning	Mechanical
Tuner turns to cover the frequency range, max.	220
Tuner torque, max.	50 oz - in (0.36 N.m)
Tuner rotation rate, max.	300 rpm
Weight, approx.	30 kg
Output :	
- waveguide	RG 48/U
- flange	Special (see outline drawing)
Coupler collar (2)	SARMA type C 6048/44 or equivalent

(1) See the Application Notes.

(2) Not supplied with the tube.

Limiting values for equipment design

Equipment-design values, **NOT** operating values. No one value ever to be exceeded, even under transient conditions, and operation at more than one limiting value at the same time may cause tube damage.

	Min.	Max.	Units
Heater voltage (3)	8. 1	8. 9	V
Heater starting current, peak	–	40	A
Cathode warm-up time	6	–	mn
Anode voltage, peak	28	35	kV
Anode current, peak	–	80	A
Input power, peak	–	2. 3	MW
Input power, mean	–	4. 6	kW
Duty cycle (4)	–	0. 002	
Pulse length (4)	0. 5	5. 0	µs
Rate of rise of voltage pulse	–	100	kV/µs
Anode temperature	–	140	°C
Cathode terminal temperature	–	160	°C
VSWR at the output coupler	–	1. 3 : 1	

Cooling

– MAGNETRON WAVEGUIDE - Forced air

	Rate of air flow	5. 0	–	ft^3/mn
		0. 09	–	m^3/mn

– MAGNETRON BODY - Two cooling possibilities :

1) FORCED AIR	Rate of air flow (at 35 °C)	200	–	ft^3/mn
		5. 7	–	m^3/mn
	Pressure drop (on water gauge)	–	2. 5	inches
		–	63. 4	mm
2) WATER	Rate of water flow	1. 5	–	l/mn
	Pressure drop	–	1	bar

(3) No anode voltage may be applied until the cathode has been warmed up. During tube operation, the heater voltage must be adjusted according to the schedule, page 3.

(4) Consult us for other operating conditions of duty cycle or pulse length.

Typical operation

Heater voltage	0	V
Anode current, peak	70	A
Pulse length	4. 0	µs
Pulse repetition rate	500	pps
Anode voltage,peak	33	kV
Output power, peak	1. 0	MW
Output power, average	2. 0	kW
Frequency pushing (at 70 A)	40	kHz/A

APPLICATIONS NOTES

These applications notes provide basic information concerning the storage, installation and operation of the TH 3080 and TH 3081 magnetrons. More complete information, required, for example, for the construction of a new type of equipment, can be furnished upon request.

STORAGE AND INSTALLATION

Stored magnetrons are much more likely to remain in a ready-to-operate condition if left in their original packing or placed in correctly designed storage racks. Whenever transported, they should be correctly packed to guard against subjecting the tube to undue vibration, shock or stress.

These magnetrons must be protected from mechanical strain by the use of a section of flexible waveguide between the magnetron and the waveguide system.

APPLYING VOLTAGES

1. Apply the heater voltage gradually. The heater surge current must not exceed 40 amperes. Allow at least six minutes for the cathode to fully warm up before applying any high voltage to the tube.
2. Verify that the cooling system is operating correctly.
3. Apply the high voltage. On the application of anode voltage the heater voltage must be reduced as follows :

Mean input power (kW)	Heater voltage (Vrms)
0 to 1	8.5
1 to 2	6.5
2 to 3	5.0
3 to 4	3.0
over 4	zero

The magnetron heater must be protected against arcing by the use of a minimum capacitance of 1.0 μF, shunted across the heater directly at the input terminals.

STARTING A NEW MAGNETRON

A new magnetron, or one that has been idle or stored for a while, may contain small traces of gas. This gas can cause internal arcing to occur when the high voltage is applied. These arcs are generally evidenced by fluctuations of the average anode current, and are usually short (less than two seconds long) and harmless.

When, however, these arcs or flashes are persistent or severe, causing rapid and uncontrolled fluctuations of the average cathode current, the following procedure must be followed to avoid damaging the tube :

1. Reduce the current to the level just below that at which arcing begins. Hold the current at this value for several minutes (about five).
2. When the operation of the tube is stable, gradually increase the anode current.
3. Repeat this procedure as often as necessary until stable operation at the desired operating current is achieved.

WARNING

All magnetrons operate with high anode potentials, which can cause lethal shocks to operating personnel. Suitable safety interlocks must be provided to avoid this shock hazard.

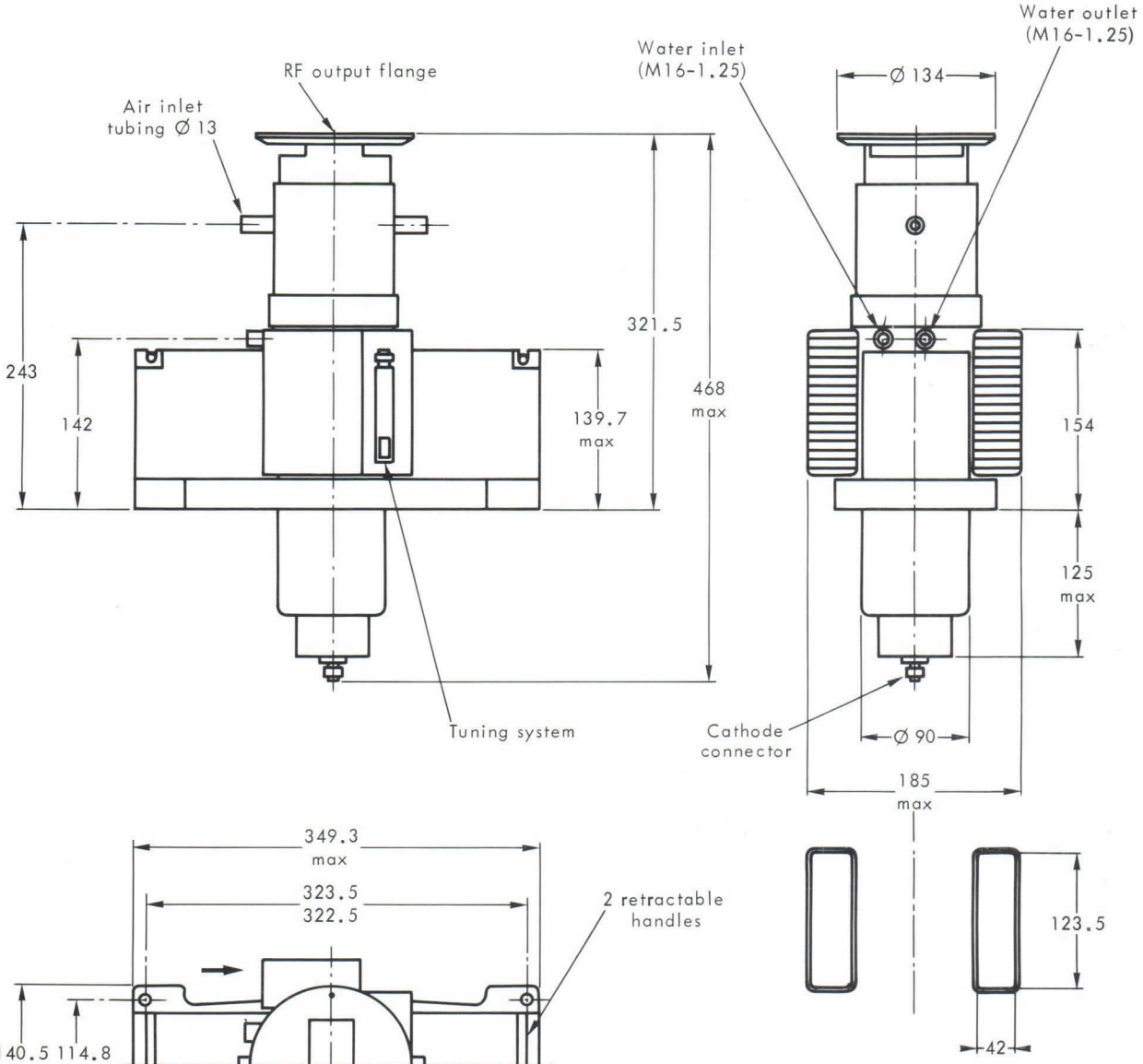
RF LEAKAGE

Sufficient RF power may be radiated through the cathode stem and other openings to interfere with adjacent circuit components. This radiation may be hazardous to human beings, especially to the eyes when arcing or the cathode temperature are being observed. Adequate precautions must be taken to guard against these hazards.

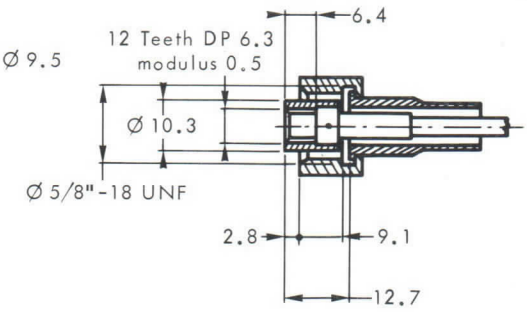
X-RAYS

High power magnetrons emit a significant level of X-rays in the areas of the cathode and the RF output. Appropriate shielding should be installed to protect the operating personnel.

OUTLINE DRAWING



DIMENSIONS OF BODY-COOLING AIR INLET



DIMENSIONS OF FREQUENCY-TUNER COUPLING

Dimensions in mm.

TV 1501 MAGNETRON

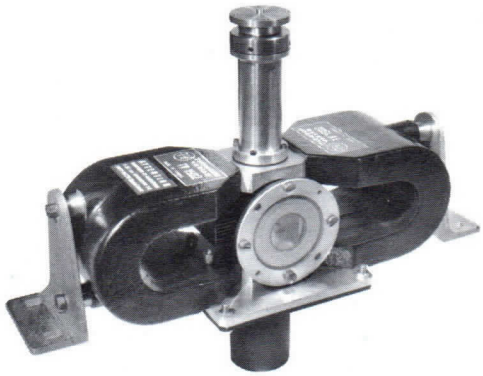
The TV 1501 mechanically-tuned magnetron is a high power pulsed oscillator, capable of more than 400 kW peak power output between 5.45 and 5.60 cm.

The tube includes an integral permanent magnet, and fins for forced air cooling.

RF output window mates with C band waveguide.

These magnetrons are extremely reliable for use in electromagnetic detection systems (radar).

The TV 1501 is mechanically tunable at any center frequency between 5350 and 5500 MHz.



GENERAL CHARACTERISTICS (1)

Electrical

Cathode	unipotential, oxide coated		
Heater	indirect		
Heater voltage		9.5	V
Heater current	4.5 to 6.5		A
Warm-up time	min.	3	mn

(1) Characteristics and operating values are given for information only and are not to be interpreted as specification limits. Performance limits are given on the tube Specification Sheet.

Mechanical

Mounting position	any		
Cooling	forced air		
Anode temperature	max.	120	°C
Cathode temperature	max.	270	°C
RF Output, waveguide	RG 49/U		
flange	modified UG 148 B/U		
Tuner torque	max.	19.1	N.cm
RF output pressurization	max.	1	bar
Weight, tube only		17	kg (approx.)
tube and packing case		25	kg
Dimensions	see drawing		

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MAXIMUM RATINGS

(non simultaneous)

Heater voltage		10.5	V
Pulse width	max.	2	µs
Duty cycle		0.0012	
Average input power		480	W
Peak input power		960	kW
Peak anode voltage		30	kV
Peak anode current		32	A
Frequency range	5350 to	5500	MHz
Frequency pulling		15	MHz

TYPICAL OPERATION

Starting heater voltage		9.5	V
Standby heater voltage		6.5	V
Pulse width		1 ± 0.1	µs
Anode voltage rise time		0.2	µs
Duty cycle		0.0005	
Peak anode voltage		26 to 30	kV
Average anode current		15	mA
Average RF power	min.	200	W
Operating frequency		5350 - 5500	MHz

OPERATING INSTRUCTIONS

The Data Sheet contains maximum ratings, operational data, and an outline drawing to be used with these instructions which provide the basic information for installing and operating the tube. For additional information, please address inquiries to Thomson-Varian.

Installation

1 - The following installation and operating precautions should be observed :
  a) - Use non-magnetic tools for mounting.
  b) - Do not stress the output connector and the output window.
  c) - Keep the tube at least 30 cm away from all magnetic material.

2 - Connect the power supply to the two plugs of the connector, the red one should be connected to the cathode.
To protect the heater, it is recommended to put in series with it an inductance (a few µH) and a capacitor of about 20 000 pF between cathode and heater.

3 - Gradually increase heater voltage so that the heater surge current never exceed 18 A.
Allow at least 3 minutes for cathode warm-up, before application of anode voltage.

4 - Tune frequency to approximately 5400 MHz.
To lower the frequency turn the tuning mechanism clockwise.

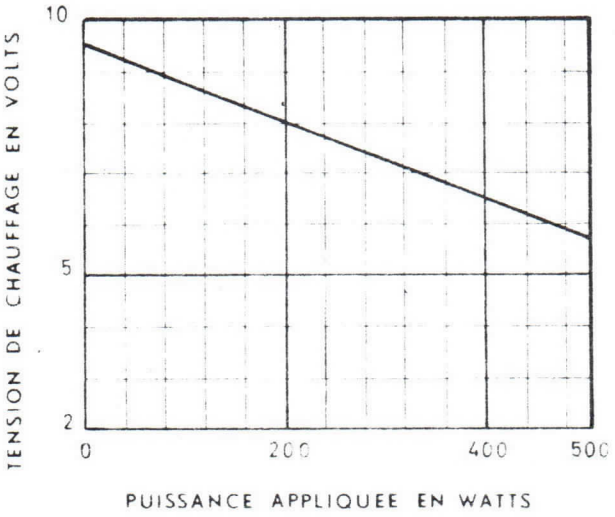
5 - Check the efficiency of the forced air cooling.

6 - Apply the high voltage negative pulses to the cathode. Grounding of the mounting plate will insure adequate grounding of the tube.
In normal operating conditions, pulses must be according to the following characteristics:
  - voltage rise time (between 20 and 85%) = 0.18 to 0.25 µs.
  - any spike on the pulse front must be cut out.
  - the pulse level ripple must not exceed 10% of the peak current average value.
  - reverse voltage must not exceed 20% of the applied pulse.

7 - The heater voltage must be reduced according to the input power.

8 - The tube should be tuned only through the specified tuning range (5350 - 5500 MHz).

HEATER VOLTAGE ADJUSTMENT



STARTING A NEW TUBE

When a tube is new, or has not been used for a long time, a quick preliminary check should be performed. Small quantity of gas can product arcing when high voltage is applied. Generally arcs are shorter than 2 seconds and high voltage and current may be increased. If instability occurs at any step, as evidenced by arcing of 5 seconds duration or more, and erratic average anode current, the following procedure is to be observed :

a) - Turn the tuning mechanism clockwise, to operate at low frequency (5400 MHz).

b) - Allow 15 minutes for the cathode to warm-up.

c) - Gradually increase high voltage until average anode current instability appears. Slightly reduce the high voltage and operate at this lower level during 3 minutes.

d) - Tune frequency at 5350 MHz.

e) - The tube operating stably, gradually increase high voltage to reach normal operating values (see § c).

f) - The magnetron operating in a very stable way, frequency may be tuned through the specified range (5350 - 5500 MHz).

NOTES

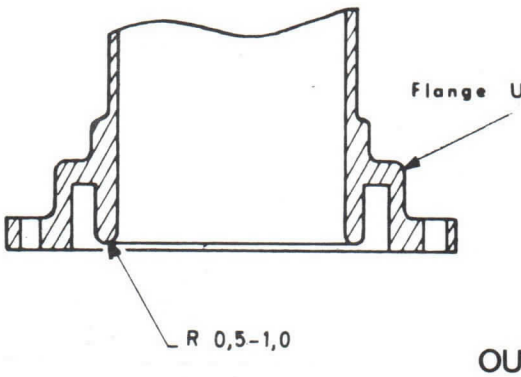
Never exceed absolute maximum ratings.

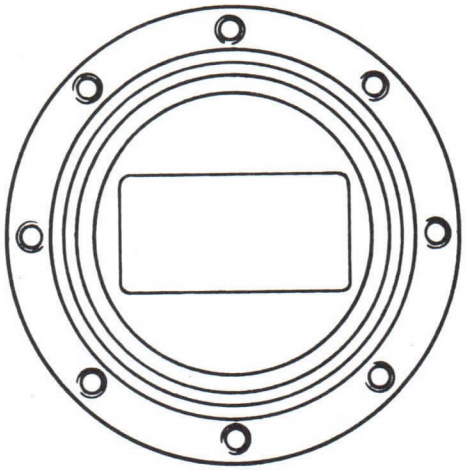
Heater voltage adjustment is very important when operating a new tube.

The load normally used should have a VSWR $<$ 1.5:1. To avoid difficulties of starting a new tube it is recommended to operate at the lowest possible standing wave ratio.

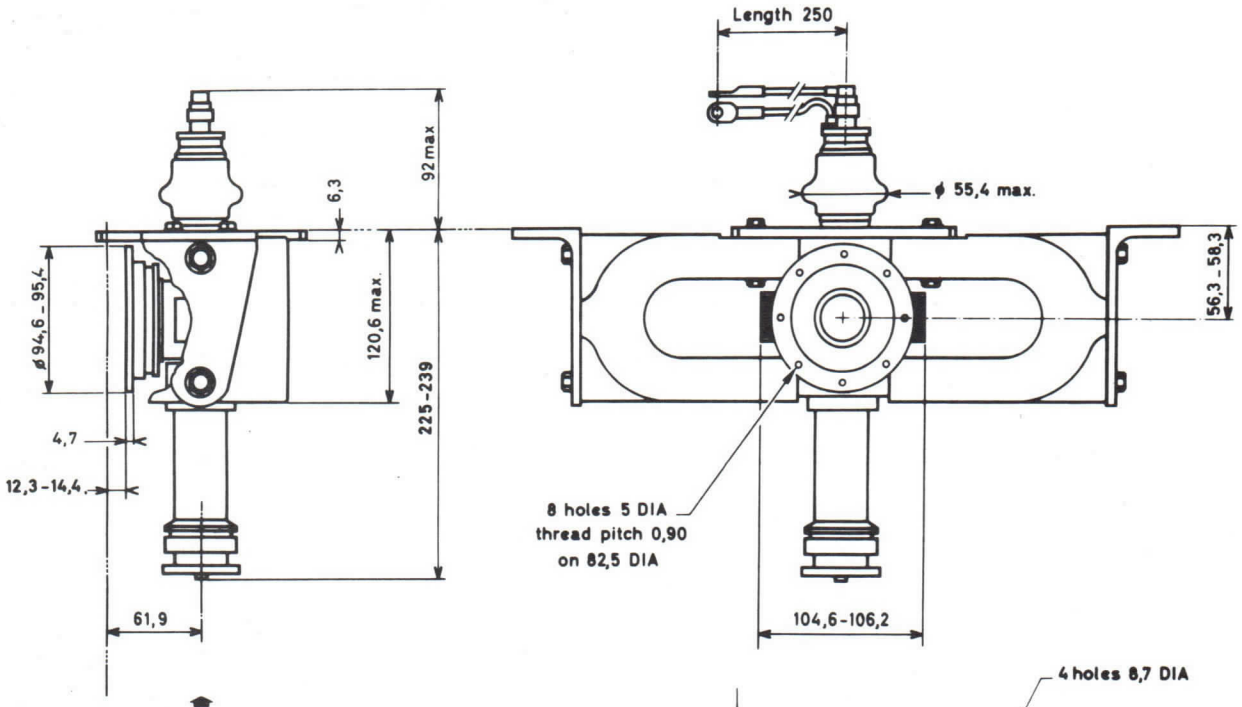
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UG 148 B/U FLANGE
(modified)



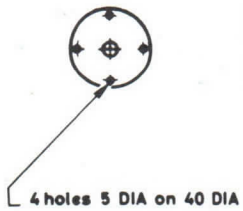


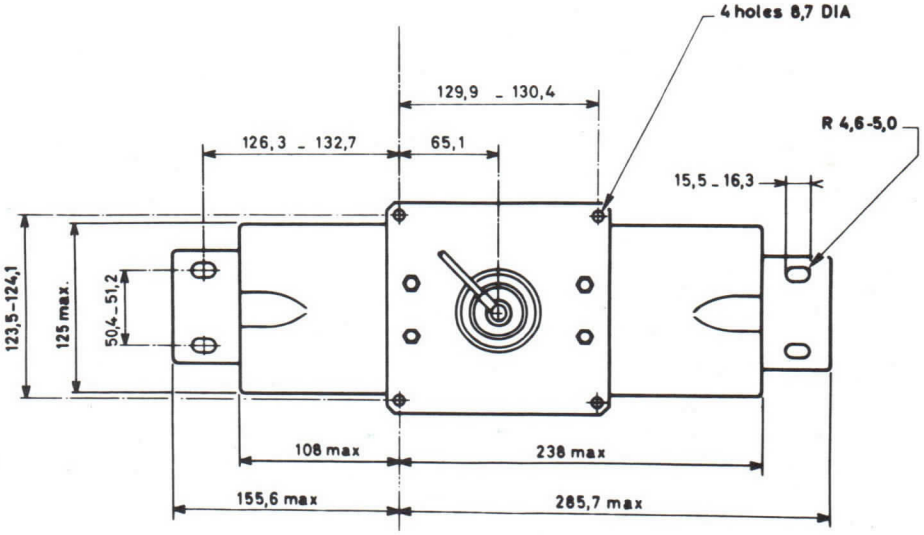
OUTLINE DRAWING



MECANISM
COUPLING FLANGE

VIEW AA





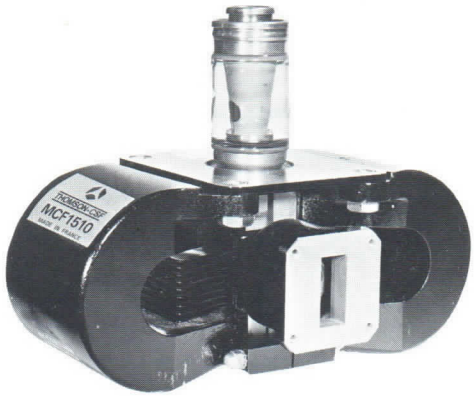
Dimensions in mm

MCF 1510 MAGNETRON

The MCF 1510 is a highly stable, fixed-tuned magnetron, designed for use as high power pulsed oscillator. This tube delivers a peak output power of a least 225 kW at a wavelength of about 3. 2 cm.

The MCF 1510 includes an integral permanent magnet; fins are provided for cooling by forced air. The RF output is a waveguide mating with a standard flange.

The MCF 1510 is an improved version of the 4J50 magnetron, designed for use under severe environmental conditions, particularly in airborne systems.



GENERAL CHARACTERISTICS

Electrical

Frequency (Note 1)		9375 ± 30	MHz
Pulse voltage (Note 1)		20 to 23	kV
Peak output power	min.	225	kW
Cathode		Impregnated, indirectly heated	
Heater voltage at switch-on		13. 75	V
Heater current (Note 2)		3 to 3. 5	A

Mechanical

Mounting position	Any
Cooling (Note 3)	By forced air
RF Output	Couples to a UG-52 A/U choke flange
Weight	4. 6 kg
Dimensions	See the Outline Drawing

ABSOLUTE RATINGS (Note 4)
(non-simultaneous)

	Min.	Max.	Units
Heater voltage at switch-on	–	15	V
Heater surge current	–	15	A
Heater warm-up time	180	–	s
Pulse duration (Note 5)	0. 2	6	µs
Duty cycle (Note 6)	–	0. 001	
Rate-of-rise of voltage (Note 7)	60	160	kV/µs
Repetition rate	160	5000	Hz
Peak input power	–	630	kW
Average input power	–	630	W
Peak anode voltage	–	23	kV
Peak anode current (Note 8)	–	27. 5	A
Load VSWR	–	1. 5 : 1	
Anode temperature (Note 9)	–	150	°C
Cathode temperature	–	165	°C
Output pressurization (Note 10)	–	0. 31	MPa

TYPICAL OPERATION

Operating Parameters

Pulse duration (Note 5)	0.5	μs
Duty cycle (Note 6)	0.001	
Rate-of-rise of voltage (Note 7)	160	kV/μs
Average anode current	27.5	mA
Heater voltage at switch-on	13.75	V
Heater warm-up time	180	s
Heater voltage in operation (Note 11)	6.6	V

Measured Values

Heater current (Note 2)	3.2	A
Frequency	9375	MHz
Peak anode voltage	22	kV
RF Output power, peak	235	kW
Pulling factor	13	MHz
RF Bandwidth	3	MHz
Side-lobe level	10	dB

NOTES

1 - For peak anode current = 27.5 A.
2 - After 180 seconds at V_f = 13.75 V.
3 - Cooling arrangements must be provided so that the anode temperature does not exceed 150 °C.
4 - No one value ever to be exceeded, even under transient conditions, and operation at more than one absolute rating at the same time may cause tube damage. Equipment must be designed so that these limits are never exceeded.
5 - Pulse duration at 50 % of pulse current.
6 - Duty cycle = Pulse duration (seconds) X Repetition rate (hertz).
7 - Rate-of-rise of voltage = Steepest tangent to the leading edge of the voltage pulse above 80 % amplitude.
8 - Peak anode current = Average anode current/Duty cycle.
9 - To be measured at the point specified on the Outline Drawing.
10 - Pressurization : Air at 20 °C.
11 - On the application of anode voltage, the heater voltage should be lowered in accordance with Figure 2.

OPERATING INSTRUCTIONS

These instructions provide basic information for installing and operating the MCF 1510 magnetron.

Installation

During mounting and handling the magnetron, care must be taken to prevent shocks or strains on the glass insulator and output waveguide.

A minimum distance of 5 cm should be maintained between tube and magnetic materials. Other magnets should be kept at least 15 cm away from the magnetron. Only non-magnetic tools should be used during installation.

Electrical Connections

The center terminal of the magnetron connector is the heater return and the outer terminal is the common heater-cathode connection.

The connector center terminal should be flexible enough to avoid stresses on the glass part.

In order to protect the heater, it is necessary to connect an inductor (a few μH) in series with it, bypassed to the cathode by capacitors of 10 000 to 20 000 pF.

Proper grounding, ensured by the mounting plate, is essential for satisfactory performance.

Application of Voltages

An adequate air flow should be directed along the cooling fins on the magnetron in order to keep the anode temperature preferably below 100 °C.

Apply heater voltage gradually. The heater surge current must not exceed 15 A. Allow at least 3 minutes for the cathode to warm-up before applying the high voltage.

After 3 minutes at full heater voltage, apply the high voltage negative pulses to the cathode. The heater voltage must be reduced in accordance with Figure 2.

The MCF 1510 magnetron has been designed for operation under the following pulse conditions :

- Any spike on the pulse front is to be clipped off.
- The ripple over the top portion of the current pulse must not exceed 7 % of the peak current average value.
- Reverse voltage must not exceed 20 % of the forward voltage.
- The load VSWR must not exceed 1. 5 : 1.

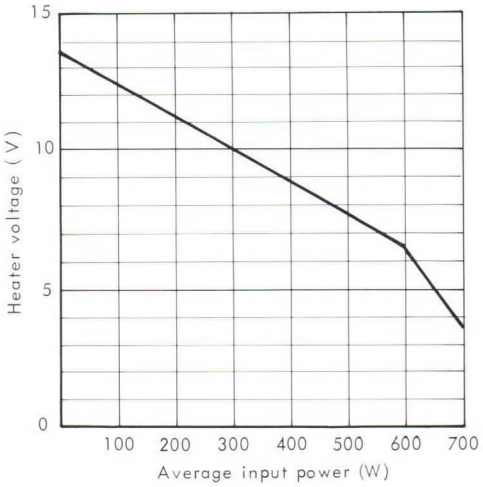
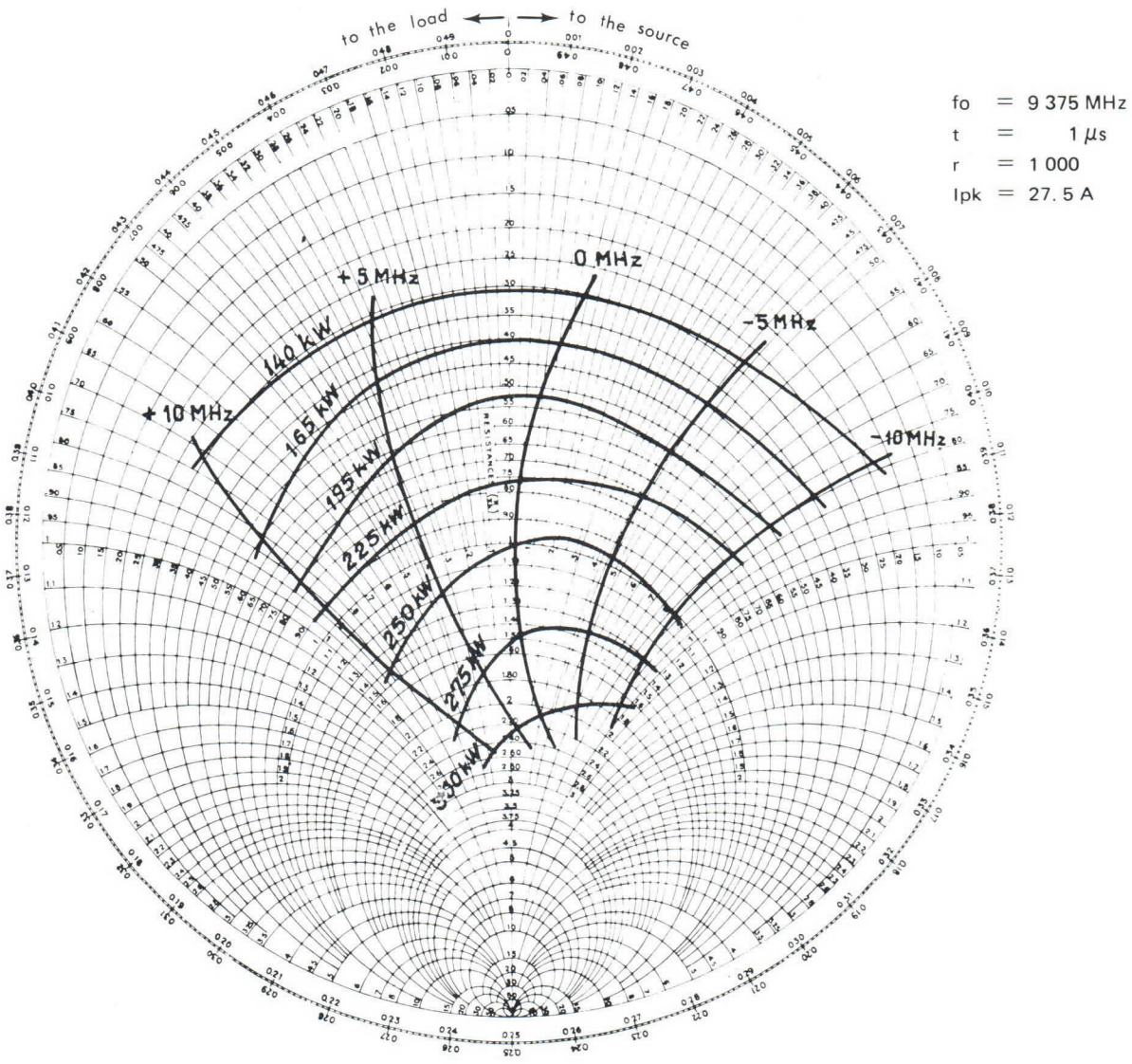


Figure 2 - Plot of heater voltage to apply versus average drive power.

Figure 1 - Rieke diagram for the MCF 1510.



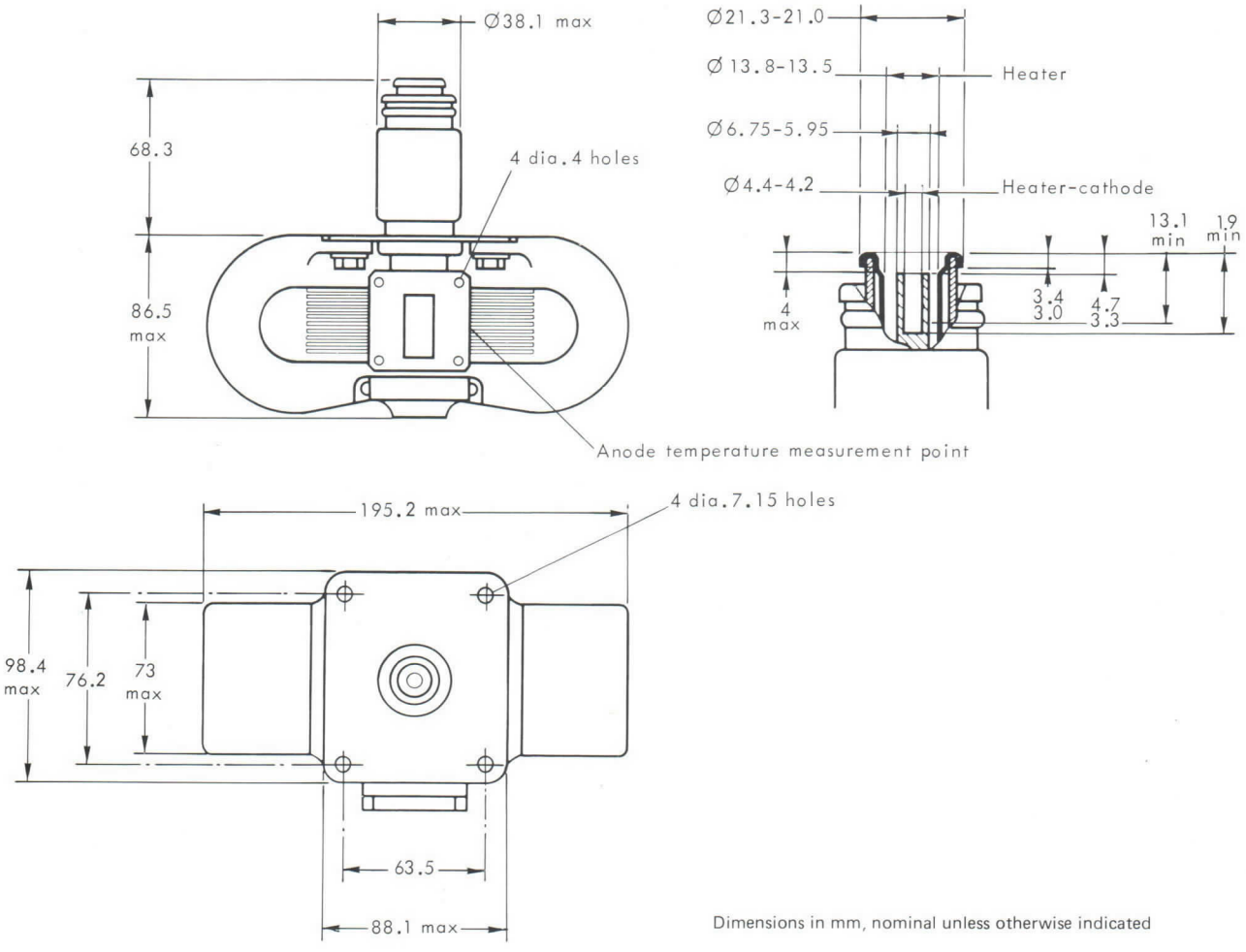
STARTING A NEW MAGNETRON

When a new magnetron, or a magnetron that has been idle or stored for a period of time, is put into operation, some sparking and instability may occur.

If instability occurs at any step, as evidenced by arcing or erratic average anode current, it is recommended that the magnetron be started up in the following way :

- After a warm-up time of three minutes at 13. 75 V, raise the anode voltage gradually (preferably at the shortest pulse duration) until one half of normal operating power is reached. The heater voltage must be reduced in accordance with the curve on Page 3.
- As soon as the average anode current indicates stable operation, gradually raise the anode current until the normal operating conditions are reached. If sparking occurs, stop raising anode current until the magnetron operates stably again. Care should be taken that the absolute ratings are not exceeded.

OUTLINE DRAWING



Dimensions in mm, nominal unless otherwise indicated

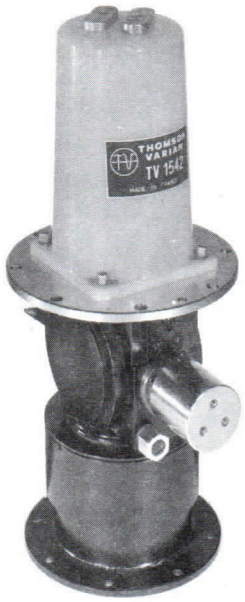
TV 1542 MAGNETRON

The TV 1542 is a non packaged magnetron capable of delivering at least 1.9 MW peak power output, in the 2992 - 3001 MHz range.

The RF output is on antenna. The power is fed into the waveguide by means of a transition section.

The tube is cooled by water flow. The mechanical tuner has been specifically designed to provide very sharp and easy tuning and exceptional frequency stability.

These features make this tube specially suitable to linear accelerator for medical purposes.



GENERAL CHARACTERISTICS

Electrical

Cathode	unipotential, oxide coated
Heating	indirect
Heater voltage (ac or dc)	8.5 V
Heater current	8 to 10 A
Warm-up time (1)	3 mn
Frequency	2992 to 3001 MHz

Physical

Mounting position (2)	any
Output (3)	waveguide and transition (see drawings)
Waveguide pressure	min. 1.5 bar dry air or nitrogen max. 2.5 (gauge)
Tuning (4)	mechanical
Tuner torque	11,5 cm.N
Cooling	water cooling
Weight	8.2 kg

(1) The heater voltage must be adjusted during operation according to the curve on page 3. The magnetron filament power is reduced as average RF power is increased.
(2) For medical application, the magnetron must rotate 360 degrees on its long axis during normal operation, the input and output parameters remain constant during rotation.
(3) The power is fed into the waveguide by means of a transition section which must have a VSWR better than 1.1/1 and be free of resonances over the range 9.7-10.3 cm.
(4) The tuning range specified is covered approximately by 4 turns of the tuner.

TYPICAL OPERATION

Magnetic field	1550 ± 25	G	Peak anode current	100	A
Pulse length	2	µs	Peak power	2	MW
Pulse repetition frequency	500	Hz	Water flow	5.7	l/mn
Peak anode voltage	43	kV	Water inlet temperature	40 ± 0.5	°C

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ABSOLUTE RATINGS

(non simultaneous)

Pulse length	max.	5	µs
Duty cycle.....	max.	0.0015	
Mean power input	max.	5	kW
Peak anode voltage.....	max.	47	kV
	min.	40	kV

Peak anode current	max.	110	A
	min.	75	A
Rate of rise of voltage ...	max.	100	kV/µs
VSWR (1).....	max.	1.5/1	
Outlet water temperature.	max.	50	°C
Heater current	max.	10	A

(1) For the most favourable life conditions, the tube should always be operated at the lowest possible standing wave ratio.

OPERATING INSTRUCTIONS

These operating instructions provide basic information for installating and operating the TV 1542 magnetron.

Installation

1 - During mounting and handling the magnetron, care must be taken to prevent shocks or strains on the glass-to-metal seal of the line output.
Use non magnetic tools for mounting.
Check the magnet position, the mounting position of the magnetron must be north pole on the side of the cathode.

2 - Connections of the base : The cathode is connected to the pin "C", which is noted on the protector cap.
To protect the heater it is recommended to put in series with it an inductance (a few µH) and a capacitor of about 20 000 pF between cathode and heater.

3 - Apply heater voltage gradually. The heater surge current should not exceed 15 A. Allow at least three minutes for the cathode to warm-up before applying the high voltage.

4 - Check the efficiency of the cooling.

5 - Apply the high voltage negative pulses to the cathode. Grounding of the mounting plate will insure adequate grounding of the tube.
Any spike on the pulse front is to be cut out.
The pulse level ripple must not exceed 10% of the peak current average value.

6 - The heater voltage must be reduced according to the power input.

STARTING A NEW TUBE

When a tube is new (or has not been used for a long time) a quick preliminary check should be performed. Small quantity of gas can product arcing when high voltage is applied. If instability occurs at any step, as evidenced by arcing or erratic average anode current, reduce the current and operate at this lower level until the tube operate stably. Then proceed to the next higher step.

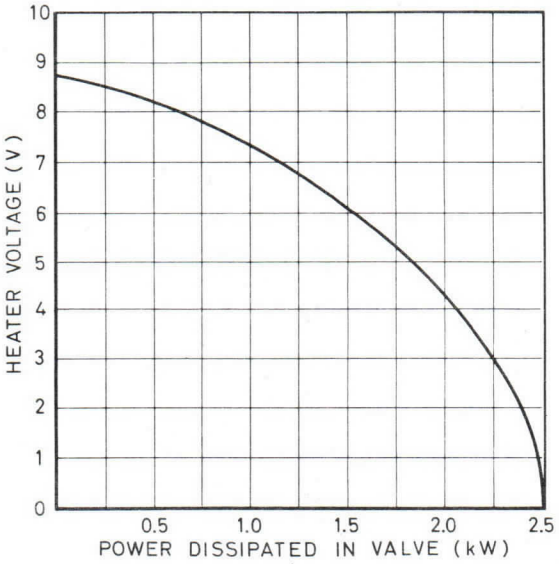
Repeat this procedure as required until stable operation at the desired operating voltage is achieved. If difficulties persist, it is sometimes desirable to operate the tube at reduced voltage until stable operation at full voltage is obtained.

To stabilize the operation, it is sometimes necessary to apply a current 2 or 3 mA higher during a few minutes. Then, the current reduced to the normal value, the magnetron should operate in a very stable way.

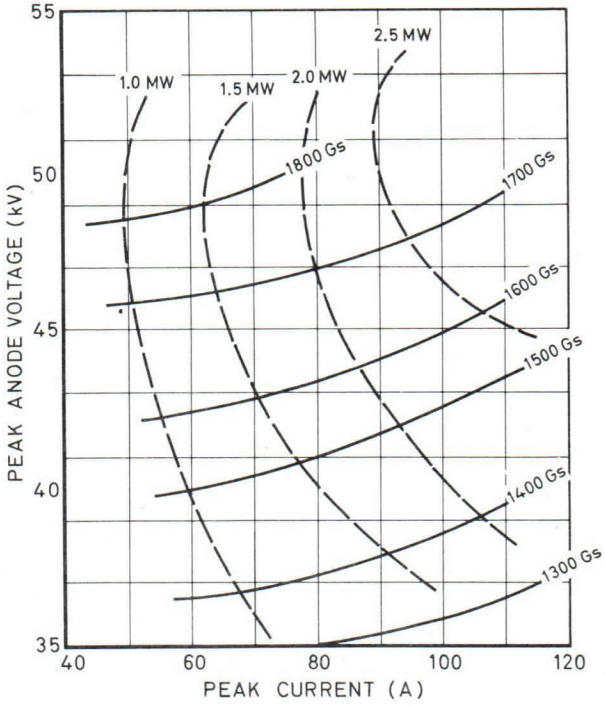
To avoid difficulties of starting a new tube it is recommended to operate on a matched load.

The load normally used should be replaced by a matched load with VSWR $<$1.3:1.

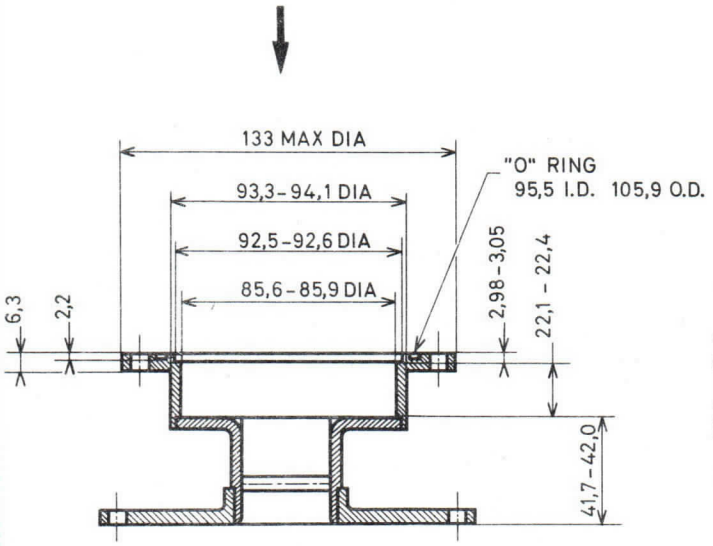
HEATER VOLTAGE ADJUSTMENT

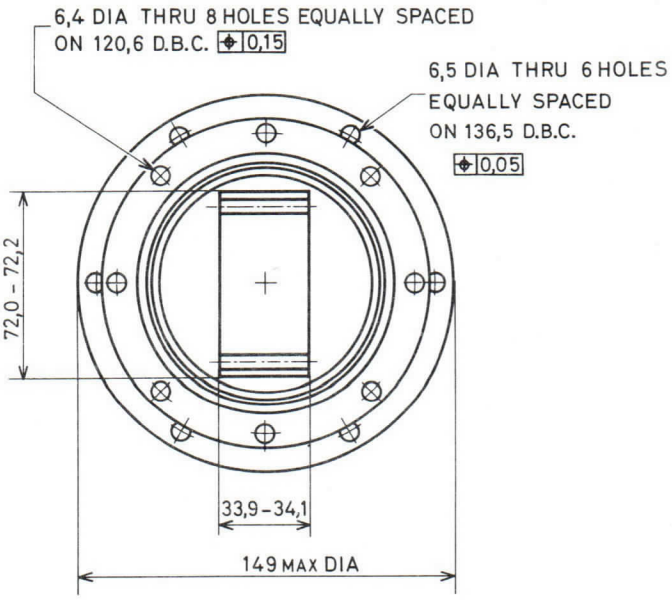


PERFORMANCE CHART



TRANSITION

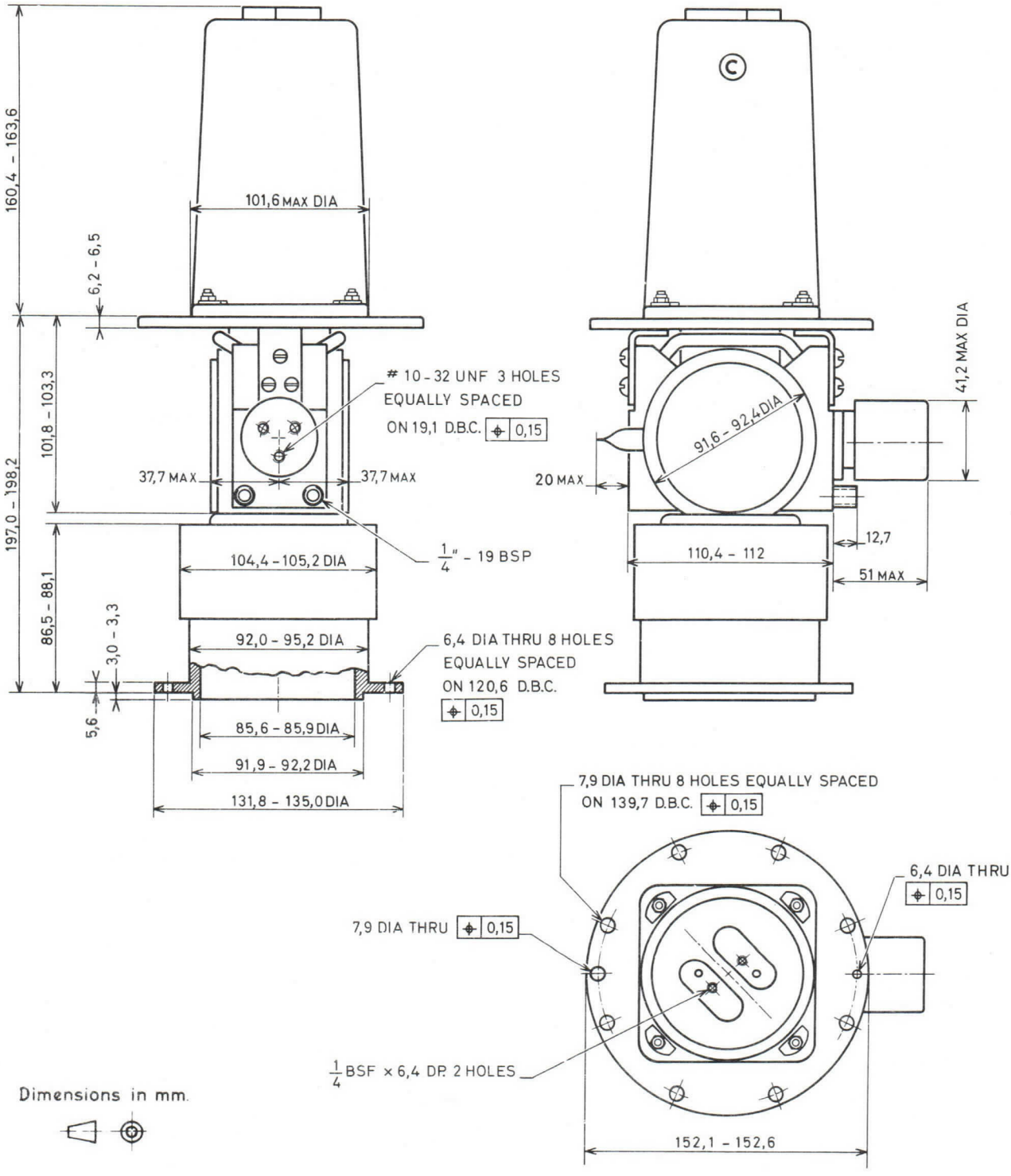




Dimensions in mm

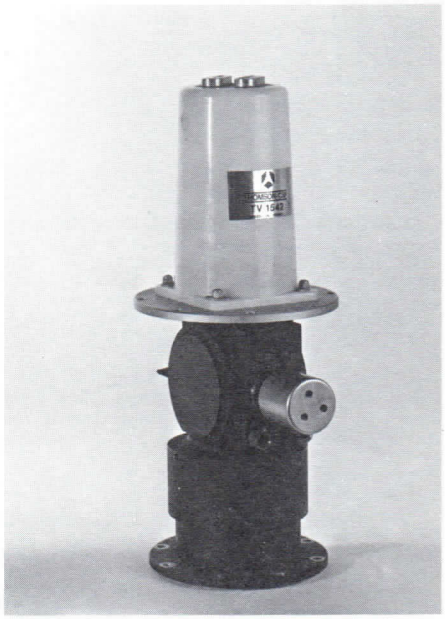
THOMSON-CSF
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OUTLINE DRAWING



Dimensions in mm.

MAGNETRON TV 1542



Le TV 1542 est un magnétron à fréquence ajustable, il fournit une puissance RF crête de 1,9 MW minimum, dans la bande 2992 à 3001 MHz.

La sortie hyperfréquence s'effectue par antenne ; une transition spéciale est nécessaire pour l'adaptation sur guide d'onde.

Le TV 1542 est refroidi par circulation d'eau. Le mécanisme d'accord de la fréquence a été étudié pour assurer une grande précision de réglage et une exceptionnelle stabilité de la fréquence. Ces caractéristiques font du magnétron TV 1542 un tube idéal pour les accélérateurs linéaires d'applications médicales.

CARACTERISTIQUES GENERALES

Electriques

Cathode	unipotentielle, à oxydes
Chauffage	indirect
Tension de chauffage (alternative ou continue)	8, 5 V
Courant de chauffage	8 à 10 A
Temps de préchauffage (1)	3 mn
Fréquence	2992 à 3001 MHz

Mécaniques

Position de fonctionnement	indifférente (2)
Sortie RF (3)	guide d'onde ou transition (voir dessin)
Pressurisation du guide de sortie	min. 1,5 bar (azote ou air sec) max. 2,5 bar
Système de réglage de la fréquence (4)	mécanique
Couple d'entraînement du système de réglage	0,115 m.N
Refroidissement	par circulation d'eau
Poids approximatif	8,5 kg

1 - En cours de fonctionnement la tension de chauffage doit être réglée conformément à la courbe page 3. La puissance de chauffage doit être réduite au fur et à mesure que la puissance RF augmente.

2 - Pour les applications médicales, le magnétron peut subir une rotation de 360° sur son axe longitudinal sans que le fonctionnement normal soit pertubé.

3 - La puissance RF de sortie est transmise au guide d'onde par l'intermédiaire d'une transition dont le TOS doit être inférieur à 1,1 et ne présentant pas de résonance dans la bande 9,7 à 10,3 cm.

4 - La bande de fréquence du tube est couverte par environ quatre tours du système d'accord.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

EXEMPLE DE FONCTIONNEMENT

Champ magnétique	1550 ± 25	G
Durée d'impulsion	2	µs
Fréquence de répétition	500	Hz
Tension crête d'anode	43	kV
Courant crête d'anode	100	A
Puissance crête de sortie	2	MW
Débit d'eau de refroidissement	5, 7	l/mn
Température de l'eau à l'entrée	40 ± 0, 5	°C

VALEURS LIMITES D'UTILISATION

(non simultanées)

	min.	max.	
Durée d'impulsion	-	5	µs
Facteur d'utilisation	-	0, 0015	
Puissance d'entrée moyenne	-	5	kW
Tension crête d'anode	40	47	kV
Courant crête d'anode	75	110	A
Vitesse de croissance de la tension d'anode	-	100	kV/µs
TOS (1)	-	1, 5	
Température de l'eau à la sortie	-	50	°C
Courant de chauffage	-	10	A

(1) Pour une durée de vie maximale, le TOS doit toujours être le plus faible possible.

CONSIGNES D'UTILISATION

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes nécessaires par exemple pour l'établissement d'un matériel nouveau peuvent être fournies sur demande.

INSTALLATION

1 - Assurer la mise en place du magnétron. Pour le montage n'utiliser que du matériel et des outils non magnétiques. Eviter au tube les chocs et les contraintes, particulièrement dans la région du scellement verre-métal de la sortie. Vérifier la position de l'aimant. Le pôle nord doit se trouver du côté de la cathode.

2 - Brancher les connexions d'amenée de courant au culot du magnétron, la cathode correspond à la broche "C", repérée sur le capot de protection. Pour protéger le filament, il est recommandé de mettre en série avec celui-ci une self inductance de quelques micro-Henrys et un condensateur d'environ 20 000 pF entre cathode et filament.

3 - Appliquer la tension de chauffage progressivement. Le courant d'appel ne doit pas dépasser 15 ampères. Chauffer la cathode du magnétron à la tension prescrite pendant au moins 3 minutes avant d'appliquer la haute tension.

4 - Vérifier que la circulation d'eau s'effectue normalement pour le refroidissement.

5 - Appliquer la haute tension. Le plateau central doit être utilisé comme contact de masse. Dans les régimes normaux de fonctionnement, les formes d'impulsions observées devront correspondre aux caractéristiques suivantes :
   - Toute pointe à l'avant de l'impulsion doit être supprimée.
   - Toute suroscillation sur le plat de l'impulsion de courant ne doit pas dépasser 10 % de la valeur moyenne du courant crête.

6 - La tension de chauffage doit être réduite en fonction de la puissance appliquée.

DEMARRAGE D'UN MAGNETRON NEUF

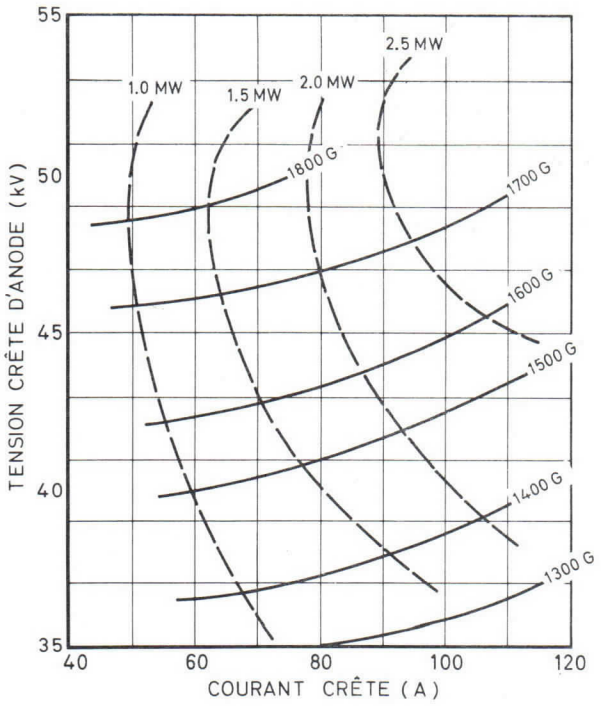
Un magnétron neuf ou qui est resté sans fonctionner depuis un certain temps peut contenir de petites traces de gaz. Ce gaz peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre contrôlant le courant moyen magnétron. Ils sont généralement de courte durée (inférieurs à deux secondes). Quand les arcs ou "flashs" sont secs et répétés pendant plusieurs secondes (de l'ordre de cinq secondes et plus) et provoquant des fluctuations rapides et incontrôlées du milliampèremètre, il devient essentiel d'appliquer la règle suivante :

- amener le courant au niveau immédiatement inférieur à la limite d'apparition des arcs. Maintenir le courant à cette valeur pendant quelques minutes ;
- lorsque le fonctionnement est stabilisé, augmenter progressivement la tension jusqu'à la valeur désirée.

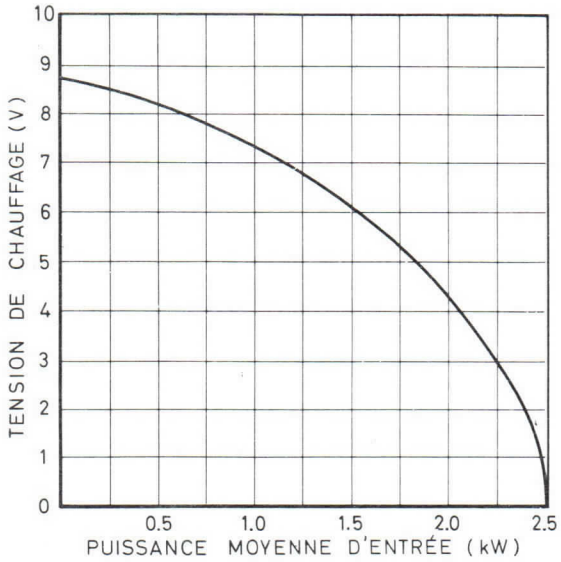
Pour faciliter l'opération de mise en route du magnétron, il est recommandé de le faire fonctionner sur une charge adaptée.

La charge adaptée qui remplacera la charge d'utilisation normale devra avoir un TOS inférieur à 1,3.

RÉSEAU CARACTERISTIQUE

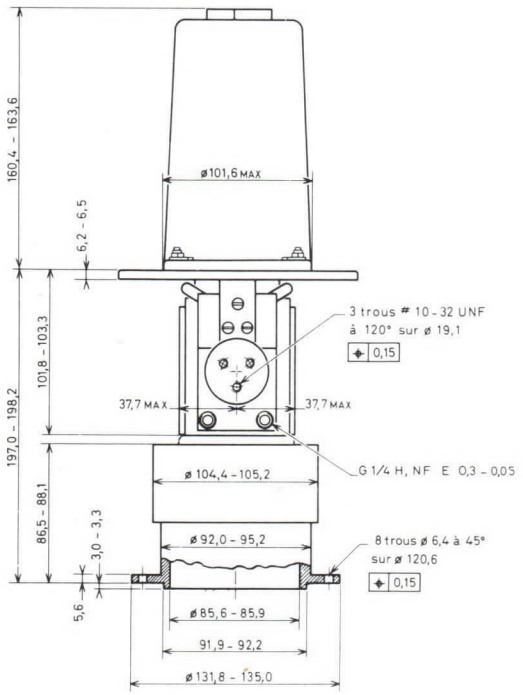


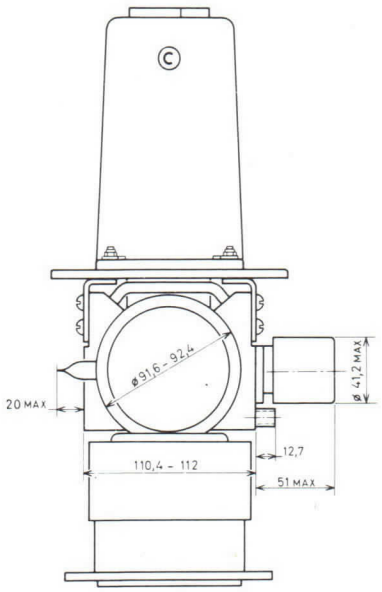
REDUCTION DE LA TENSION DE CHAUFFAGE EN FONCTION DE LA PUISSANCE D'ENTRÉE

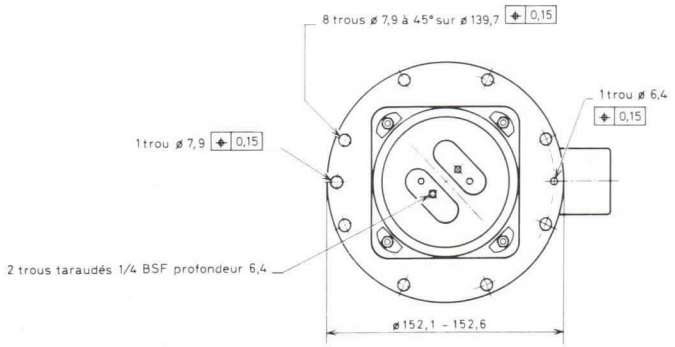


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

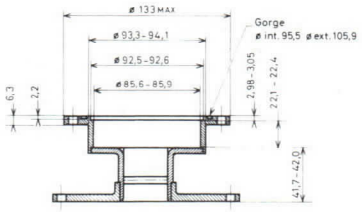
DESSIN D'ENCOMBREMENT

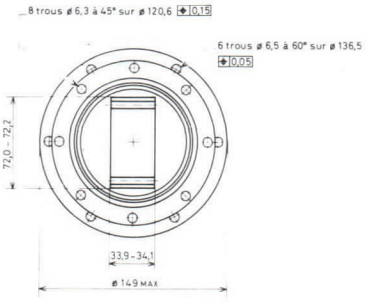






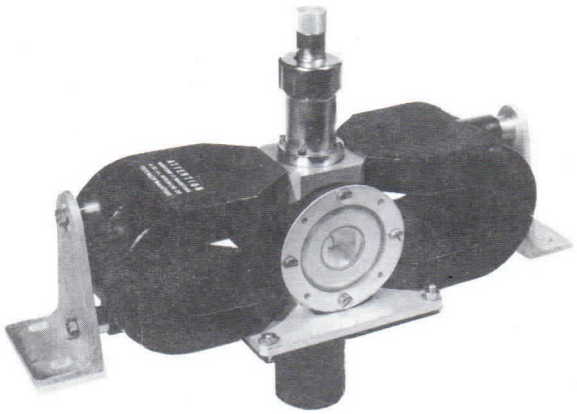
TRANSITION





Cotes en mm.

MAGNETRON TV 1546



Le tube TV 1546 est un magnétron accordable employé comme oscillateur hyperfréquence fonctionnant en régime d'impulsions. Il fournit une puissance RF crête de 250 kW minimale dans la bande 5450 à 5825 MHz.

Des aimants permanents sont incorporés au corps du tube. Le refroidissement se fait par air soufflé. La sortie hyperfréquence s'effectue sur guide d'onde bande C.

Un dispositif mécanique permet de régler la fréquence entre 5450 et 5825 MHz.

CARACTERISTIQUES GENERALES (1)

Eléctriques

	min.	nom.	max.	
Fréquence	5450	-	5825	MHz
Mode de chauffage		indirect		
Tension de chauffage	-	9,5	-	V
Courant de chauffage	5,0	-	6,0	A
Puissance de sortie crête	250	-	-	kW
Tension crête d'anode	23	-	26	kV

Mécaniques

Position de fonctionnement	indifférente
Mode de refroidissement	air soufflé
Sortie RF : guide d'onde	RG 49/U
bride à piège	UG 148 B/U
Masse du tube, environ	17 kg
Masse du tube sous emballage	25 kg
Dimensions	voir dessin

VALEURS LIMITES D'UTILISATION
(non simultanées)

	min.	max.	
Tension de chauffage	-	10,5	V
Durée d'impulsion	0,2	2,5	µs
Facteur d'utilisation	-	0,0012	
Puissance d'entrée moyenne	-	750	W
Puissance d'entrée crête	-	750	kW
Tension anodique de crête	-	28	kV
Courant anodique de crête	3	30	A
Dérive fréquence/température	-	0,2	MHz
Entraînement de fréquence	-	15	MHz
Temps de préchauffage	5	-	mn
Couple nécéssaire pour la variation de fréquence	0,60	-	m.N
Préssurisation dans la sortie RF	-	1	bar
Température maximale du bloc anode	-	120	°C
Température maximale du pied cathode	-	270	°C

(1) Ces caractéristiques sont données à titre indicatif seulement, voir spécifications pour caractéristiques de types.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

EXEMPLES DE FONCTIONNEMENT

	Oscillation 1	Oscillation 2	
Tension de chauffage au démarrage . . .	9,5	9,5	V
Tension de chauffage en oscillation . . .	8,2 à 6,5	9,0 à 4,0	V
Durée de l'impulsion	0,2	0,7	µs
Temps de croissance de la tension anodique.	0,15 à 0,20	0,15 à 0,20	µs
Facteur d'utilisation	0,00015 à 0,0006	0,000525 à 0,00105	
Tension anodique de crête	23 à 26	23 à 26	kV
Courant anodique moyen	3,6 à 14,4	1,26 à 25,2	mA
Fréquence de fonctionnement	5450 à 5825	5450 à 5825	MHz
Puissance crête RF minimale	250	250	kW
Puissance moyenne d'entrée	90 à 360	315 à 630	W

CONSIGNES DE MISE EN SERVICE

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes, nécessaires par exemple pour l'établissement d'un matériel nouveau, peuvent être fournies sur demande.

Installation

1 - Assurer la mise en place du magnétron, en prenant toutes précautions utiles.
   a) Utiliser pour le montage du tube des outils non magnétiques.
   b) S'assurer au moment du serrage des vis, qu'aucune contrainte n'est exercée sur le tube et en particulier sur le pied de verre d'amenée de courant ainsi que sur la fenêtre de sortie RF.
   c) Aucun objet magnétique, ou ferromagnétique ne doit se trouver à moins de 30 cm des aimants fixés au tube.

2 - Brancher les connexions d'amenée de courant aux deux cosses du magnétron, la cosse peinte en rouge étant reliée à la cathode.
A titre de protection du filament, il est recommandé de mettre en série avec celui-ci une self inductance de quelques microhenrys découplée à la cathode par des condensateurs de 10 000 à 20 000 pF.

3 - Appliquer la tension de chauffage graduellement pour que le courant d'appel n'excede pas 18 ampères. Chauffer la cathode du magnétron à la tension prescrite pendant 5 minutes minimum avant l'application de la haute tension.

4 - Régler la fréquence du magnétron à 5500 MHz (environ). Pour cela tourner le système mécanique d'accord en fréquence dans le sens de rotation des aiguilles d'une montre. 13 tours environ suffisent pour couvrir la bande 5450 - 5825 MHz.

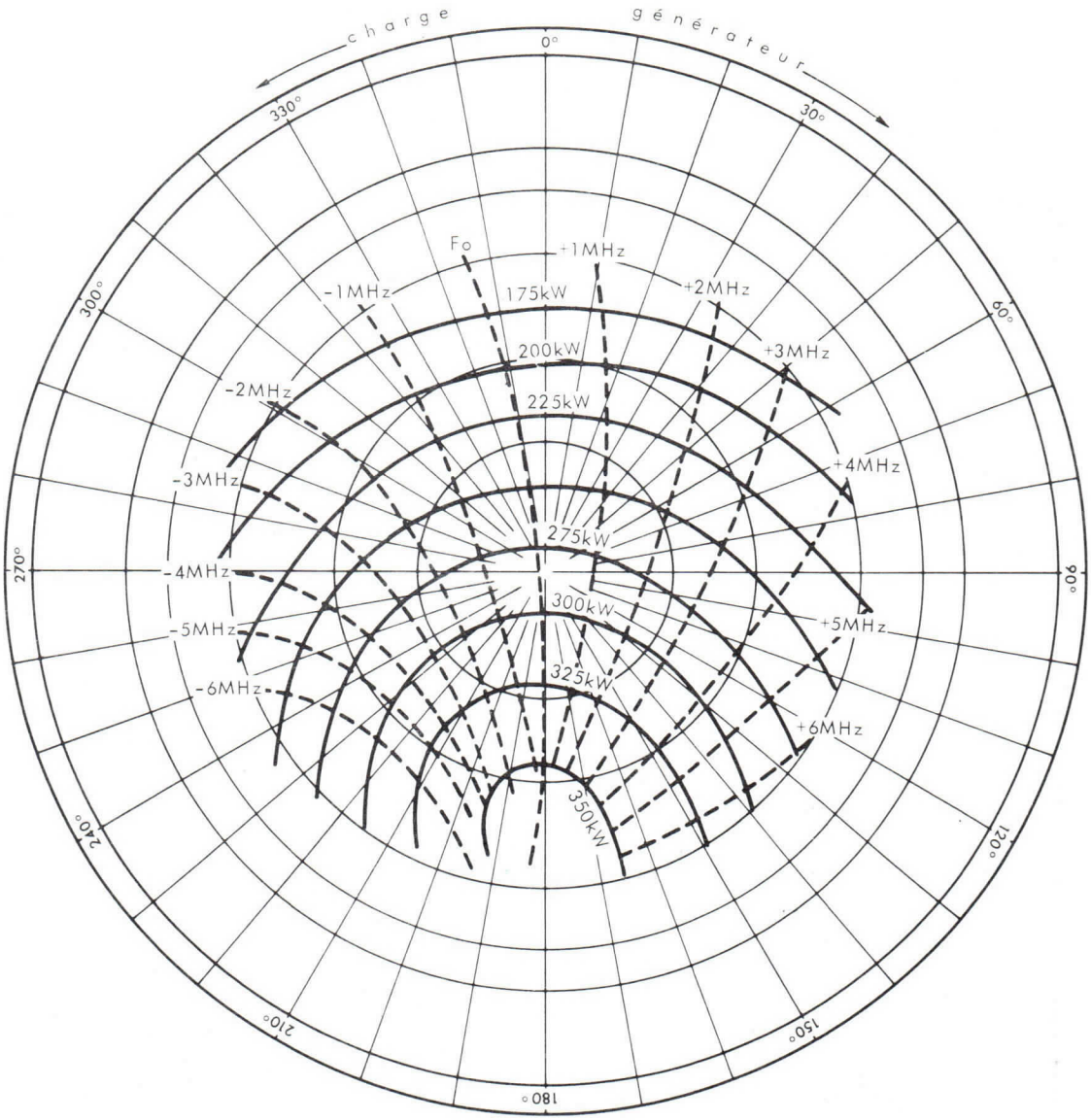
5 - Verifier que la ventilation s'effectue normalement.

6 - Appliquer la haute tension.
Le plateau central doit être utilisé comme contact de masse, de préférence aux pattes de fixation. Dans les régimes normaux de fonctionnement, les formes d'impulsions observées devront correspondre aux caractéristiques suivantes :
   Temps de croissance de la tension (mesuré entre 20 et 85%) 0,15 à 0,20 µs.
   Toute pointe à l'avant de l'impulsion doit être supprimée. Toute suroscillation sur le plat de l'impulsion de courant ne doit pas dépasser 10% de la valeur moyenne du courant de crête. La tension inverse sur l'impulsion de tension ne doit pas dépasser 20% de l'impulsion appliquée.

7 - Réduire la tension de chauffage du magnétron en fonction de la puissance appliquée, conformément à la courbe.

8 - La fréquence de ce magnétron étant accordable, il est important au cours du fonctionnement de ne jamais sortir des limites de fréquences spécifiées (5450 - 5825 MHz).

DIAGRAMME DE RIEKE

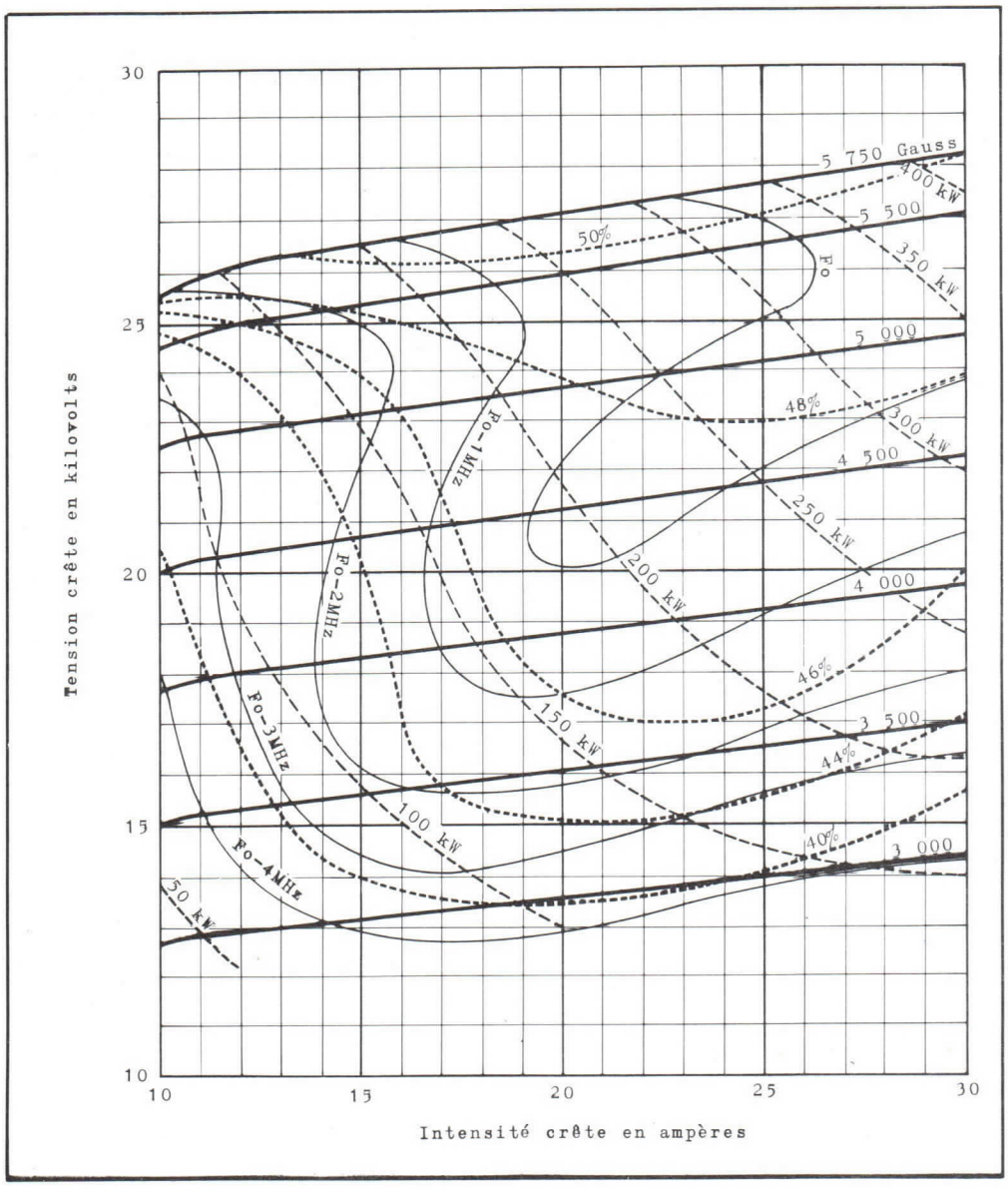


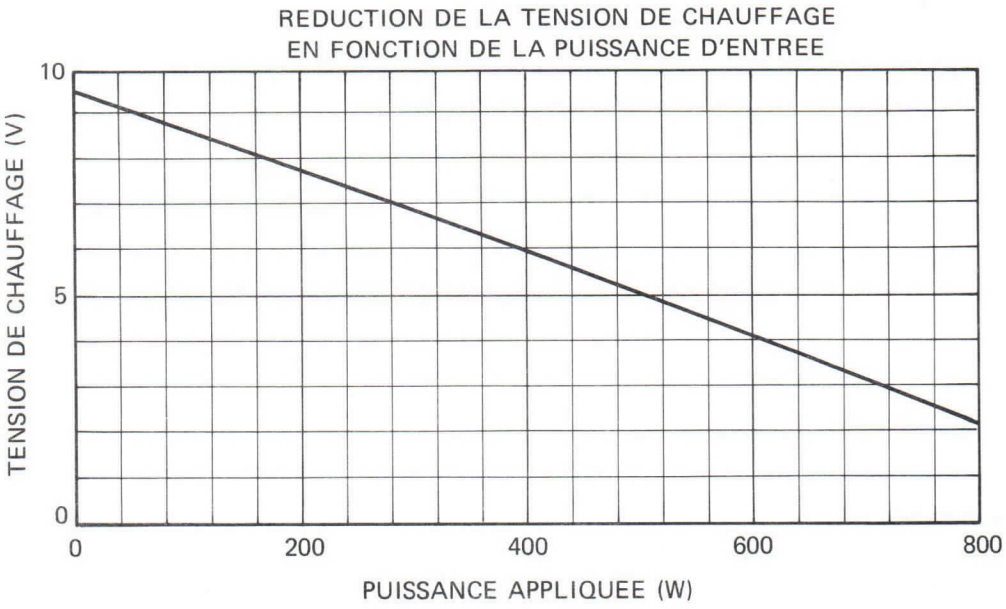
fo = 5650 MHz
Ic = 24 A
Fr = 400 Hz
τ = 1 µs
Vc = 24 à 25,5 kV

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

RESEAU CARACTERISTIQUE

Durée des impulsions :	1	µs
Fréquence de répétition :	500	Hz
Fréquence d'oscillation :	5 650	MHz
Entraînement de fréquence :	7,5	MHz





PRECAUTIONS IMPORTANTES

Formation d'un Magnétron neuf

Un magnétron qui est resté sans fonctionner depuis un certain temps peut présenter de petites traces de gaz, ce qui peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre de contrôle du courant moyen magnétron. Ils sont généralement de courte durée (inférieurs à 2 secondes). Dans ce cas la haute tension et le courant peuvent être montés sans hésitation. Quand les arcs ou "flahs" sont secs et répétés pendant plusieurs secondes (de l'ordre de 5 secondes et plus) et provoquent des fluctuations rapides du milliampèremètre il devient essentiel d'appliquer la règle suivante :

a) Former tout d'abord le tube dans le régime où la durée d'impulsion est la plus courte.
b) Tourner l'axe d'entrainement du système d'accord dans le sens de rotation des aiguilles d'une montre pour régler la fréquence aux environs de sa valeur minimale.
c) Préchauffer le tube pendant 15 minutes.
d) Faire croître régulièrement la haute tension jusqu'à l'apparition d'instabilité du courant moyen magnétron
e) Dès l'apparition d'instabilité du courant moyen magnétron réduire légèrement la haute tension pour faire disparaître cette instabilité et laisser le magnétron fonctionner pendant 3 minutes environ.
f) Régler ensuite la fréquence à la valeur la plus basse de la bande, soit 5450 MHz.
g) Aussitôt le courant stabilisé, augmenter progressivement la haute tension jusqu'à la valeur désirée (tenir compte du paragraphe d).
h) Le tube étant stabilisé au courant désiré, s'efforcer de couvrir la bande de 5450 vers 5825 MHz.
i) Si le tube doit fonctionner à différentes largeurs d'impulsions, faire la même reformation pour la durée d'impulsion la plus longue.

En aucun cas les valeurs limites ne doivent être dépassées.

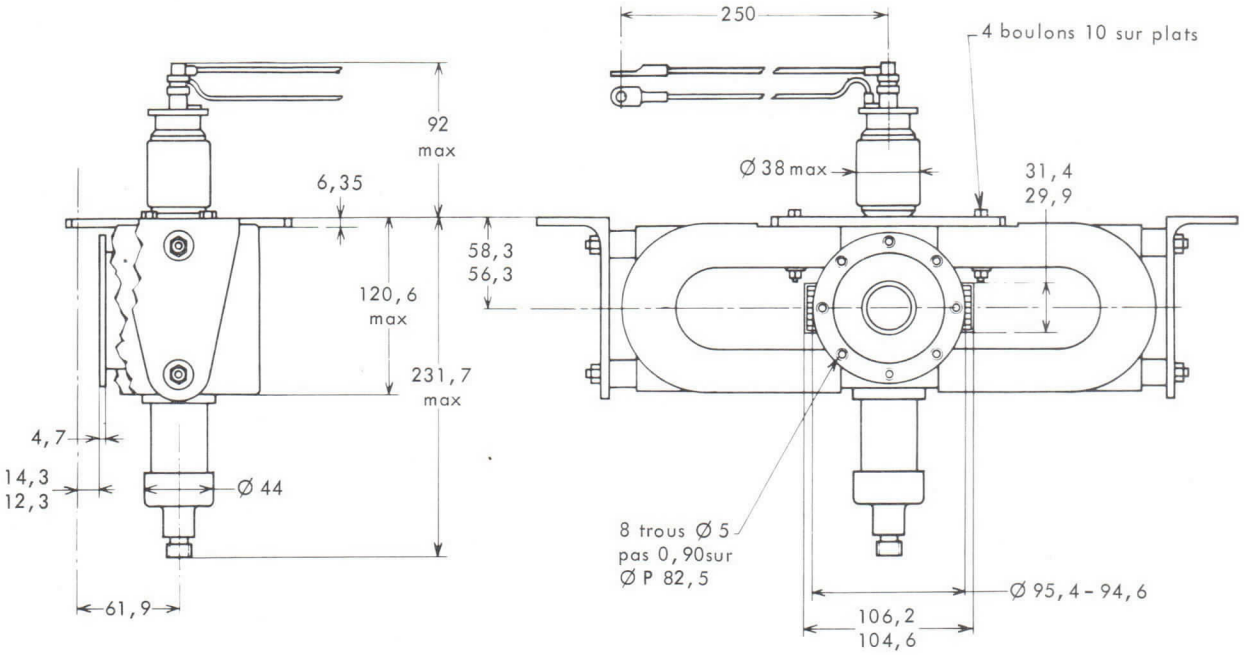
Le taux d'ondes stationnaires de la charge doit toujours être inférieur à 1,5. Un taux supérieur à cette valeur risque de perturber l'opération de démarrage.

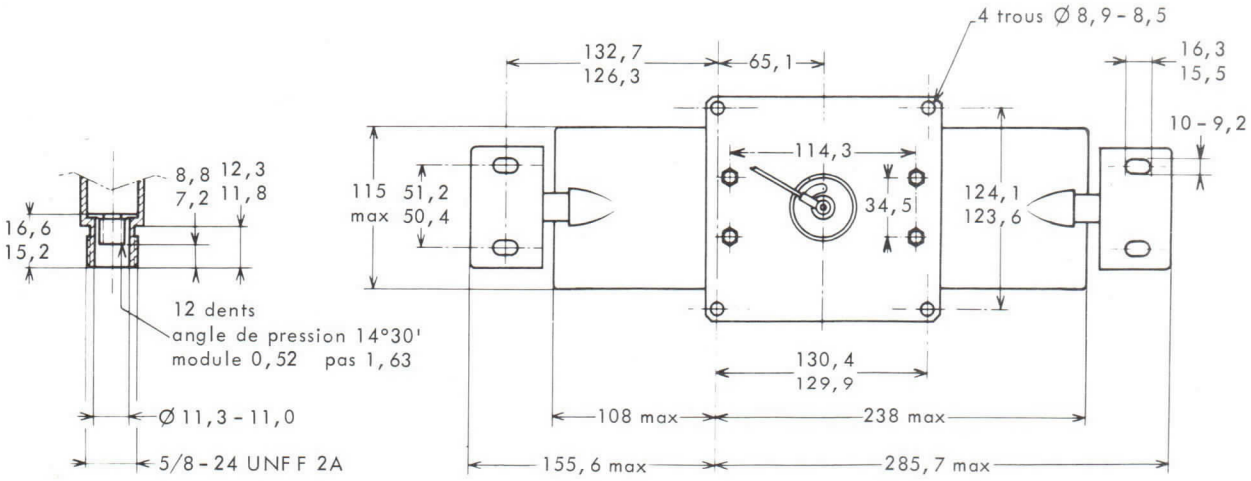
Un mauvais fonctionnement du magnétron peut être dû à différentes causes par exemple : Forme d'impulsion incorrecte, chauffage cathode anormal, TOS trop élevé.

NOTA: Au cours de la formation, il est important d'ajuster la tension de chauffage en fonction du courant débité.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT





Cotes en mm.

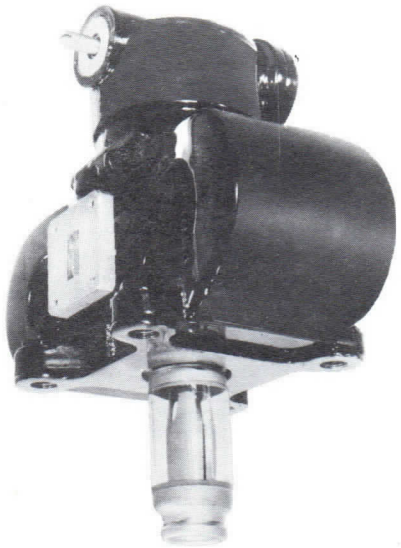
TV 1547 COAXIAL MAGNETRON

The TV 1547 is a coaxial magnetron designed for ground-based, transportable, and airborne radar systems. This tube delivers a minimum peak power output of 60 kW in the 16.0 - 17.0 GHz range.

The mechanical tuning system of the TV 1547 allows servo-tuned operation, with great reliability and easy frequency adjustment.

The TV 1547 offers the following advantages :

- exceptional frequency stability,
- rugged construction,
- extremely reliable under the most severe environmental conditions : vibrations : up to 5 g from 20 to 100 Hz, and 3 g from 100 to 500 Hz.
- long life.



GENERAL CHARACTERISTICS

Electrical

	min.	nom.	max.	
Frequency	16.0	–	17.0	GHz
Power output, peak	60	–	–	kW
Stand-by heater voltage	–	12.6	–	V
Stand-by heater current	–	2.4	–	A
Warm-up time	3	–	–	mn
Pulling (VSWR = 1.3 : 1)	–	–	8	MHz
Pushing	–	–	300	kHz/A
Cooling air flow	0.425	–	–	m^3/mn
Tuner rotation rate	–	–	600	r/mn
Tuner torque	–	–	0.113	N.m

Mechanical

Dimensions	see drawing
Weight, approx.	3.2 kg
Operating position	any
Cooling	forced air
Cathode connection	Jettron 90-006 or equivalent
Output flange	UG 541/U modified

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

TYPICAL OPERATION (1)

Power output, peak	75	kW
Anode voltage, peak	15. 5	kV
Anode current, peak	16. 0	A
Duty cycle	0. 0009	
Heater voltage	6. 9	V
Side lobe level	12	dB
Temperature coefficient	-0. 35	MHz/°C
Load VSWR	1. 05 : 1	

(1) For other operating conditions, (power, duty cycle, pulse duration, etc.) please consult us.

ABSOLUTE RATINGS

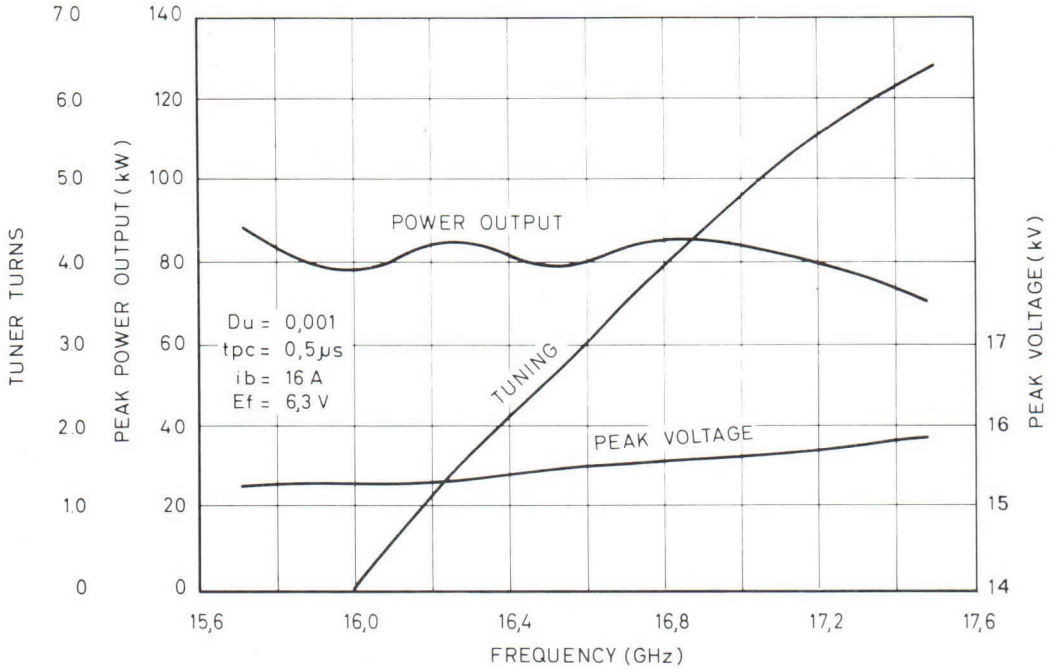
	min.	max.	
Power input, peak	–	288	kW
Power input, average	–	300	W
Peak anode voltage	–	17	kV
Peak anode current	11	18	A
Duty cycle	–	0. 001	(2)
Pulse duration	0. 25	2. 5	μs
Rate of rise of voltage	100	160	kV/μs
Heater voltage	–	14. 0	V
Body temperature	-55	+150	°C
Input bushing temperature	- 55	+175	°C
Load VSWR	–	1. 5 : 1	
Tuner torque	11. 3	35. 3	N.cm
Cooling air flow	0. 425	–	m^3/mn

(2) 0. 0015 max. for 0.35 μs $\leqslant \tau \leqslant$ 1 μs.

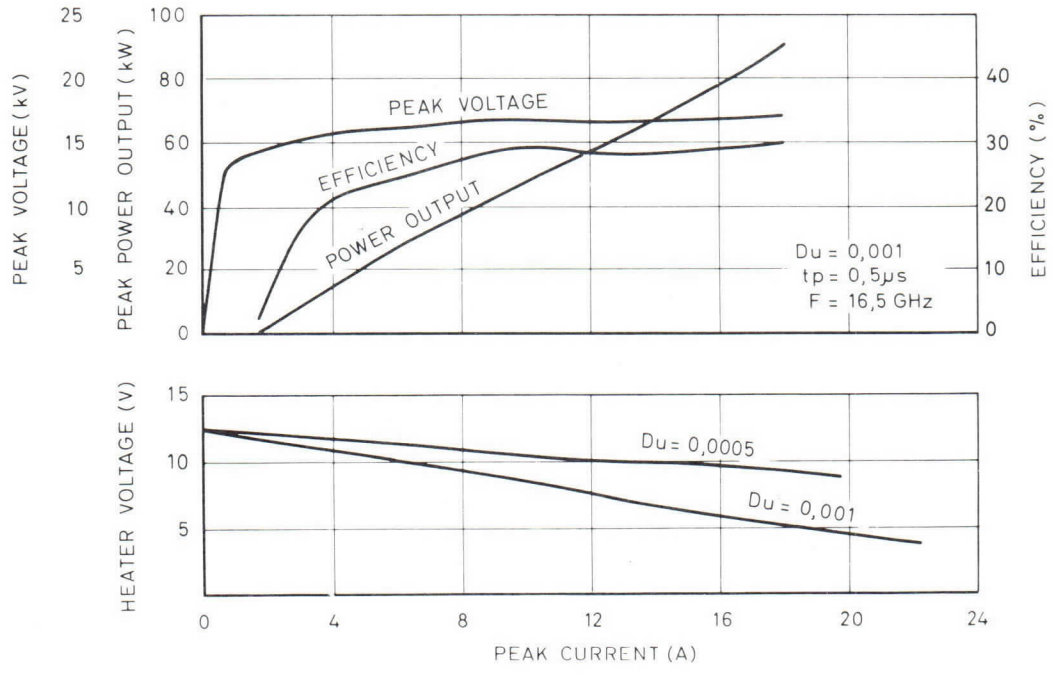
OPERATING INSTRUCTIONS

1 - When mounting the magnetron, use non magnetic tools and nuts.
2 - Connect the cathode connector.
3 - Apply heater voltage. The heater surge current should not exceed 10 A. Allow at least 3 minutes for the cathode warm-up, before application of anode voltage.
4 - Check the efficiency of the cooling air flow.
5 - Apply the negative high voltage pulses to the cathode. In normal operating conditions, pulses must be according to the following characteristics :
- rate of rise of voltage between 100 and 160 kV/μs
- any spike on the pulse front must be cut out.
- the pulse level ripple must not exceed 10 % of the peak current average value.
- reverse voltage must not exceed 35 % of the applied pulse.
6 - Adjust the modulator input voltage in order to reach the nominal value of the magnetron current.
7 - The heater voltage must be reduced depending on average input power.
8 - The magnetron frequency is tunable by means of a mechanical system. The tube should be tuned only within the specified tuning range.

FREQUENCY CHARACTERISTICS

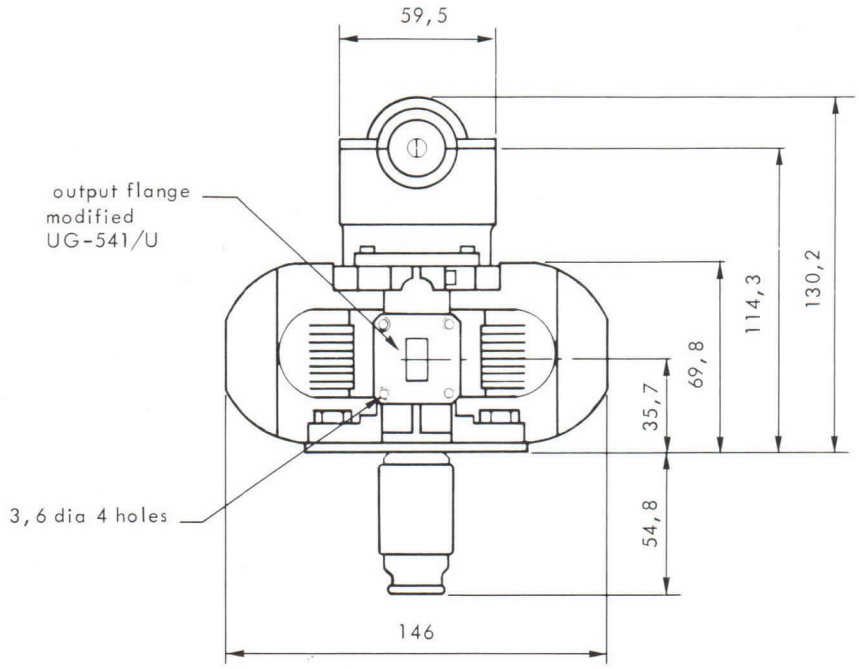


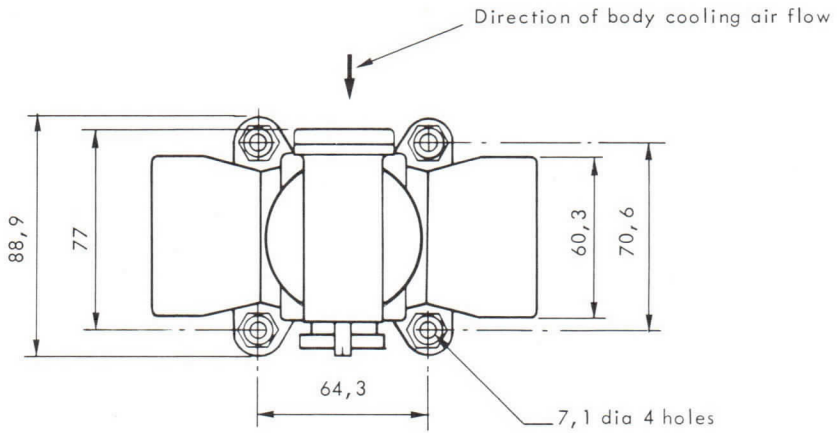
PERFORMANCE CHARACTERISTICS



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





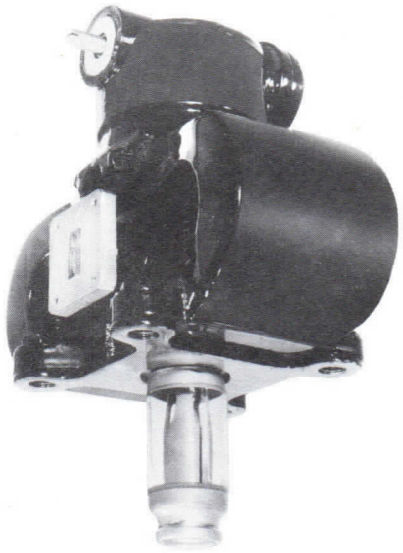
Dimensions in mm.

MAGNETRON TV 1547

Le TV 1547 est un magnétron coaxial destiné à être utilisé dans les équipements radars fixes, mobiles ou aéroportés. Ce tube fournit, en régime d'impulsions, une puissance crête de sortie supérieure à 60 kW dans la bande de fréquence comprise entre 16,0 et 17,0 GHz.

L'accord du tube se fait grâce à un dispositif de réglage qui peut être contrôlé par un servo-mécanisme, qui présente une grande sécurité de fonctionnement. En résumé, les principales qualités de ce magnétron sont :

- grande stabilité de fréquence,
- robustesse mécanique,
- bonne résistance aux vibrations :
  jusqu'à 5 G, de 20 à 100 MHz
  et 3 G, de 100 à 500 Hz,
- longue durée de vie.



CARACTERISTIQUES GENERALES

Electriques

	min.	nom.	max.	
Fréquence	16, 0	-	17, 0	GHz
Puissance de sortie crête	60	-	-	kW
Tension de chauffage au repos	-	12, 6	-	V
Courant de chauffage au repos	-	2, 4	-	A
Temps de préchauffage	180	-	-	s
Entraînement de fréquence (pour un TOS 1,3)	-	-	8	MHz
Coefficient de poussée	-	-	300	kHz/A
Refroidissement : débit d'air	0, 425	-	-	m^3/mn
Vitesse de rotation du mécanisme d'accord	-	-	600	t/mn
Couple résistant de l'axe d'entraînement	-	-	0, 113	N. m

Mécaniques

Dimensions	voir dessin
Masse	3, 2 kg
Position de fonctionnement	indifférente
Refroidissement	par air forcé
Connecteur de cathode	Jettron 90-006 ou équivalent
Bride de sortie	Bride UG-541/U modifiée

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

EXEMPLES DE FONCTIONNEMENT (1)

Puissance crête de sortie	75	kW
Tension anodique crête	15, 5	kV
Courant anodique crête	16, 0	A
Facteur d'utilisation	0, 0009	
Tension de chauffage	6, 9	V
Rapport du lobe secondaire	12	dB
Coefficient de température	–0, 35	MHz/°C
T.O.S. de la charge	1, 05	

(1) - Pour tout fonctionnement à des valeurs différentes de puissance, facteur d'utilisation ou de durée d'impulsion, nous consulter pour approbation.

VALEURS LIMITES D'UTILISATION

	min.	max.	
Puissance d'entrée crête	-	288	kW
Puissance d'entrée moyenne	-	300	W
Tension anodique crête	-	17	kV
Courant anodique crête	11	18	A
Facteur d'utilisation	-	0, 001	(2)
Durée d'impulsion	0, 25	2, 5	µs
Taux de croissance de la tension	100	160	kV/µs
Tension de chauffage	-	14, 0	V
Température du corps	–55	+150	°C
Température de l'enveloppe de cathode	–55	+175	°C
T.O.S. de la charge	-	1, 5	
Couple d'entraînement du système d'accord	11, 3	35, 3	N. cm
Débit d'air de refroidissement	0, 425	-	m^3/mn

(2) - 0,0015 max. pour 0,35 µs $\leqslant \tau \leqslant$ 1 µs

CONSIGNES DE MISE EN SERVICE

1 - Assurer la mise en place du magnétron. Pour le montage, utiliser des boulons et des outils non magnétiques.

2 - Brancher le connecteur au culot du magnétron.

3 - Limiter le courant d'appel du chauffage filament à 10 ampères et laisser chauffer la cathode à la tension prescrite pendant 3 minutes au moins avant l'application de la haute tension.

4 - Vérifier que la ventilation s'effectue normalement.

5 - Appliquer la haute tension en impulsions négatives sur la cathode. Dans les régimes normaux de fonctionnement, les formes d'impulsions devront correspondre aux caractéristiques suivantes :

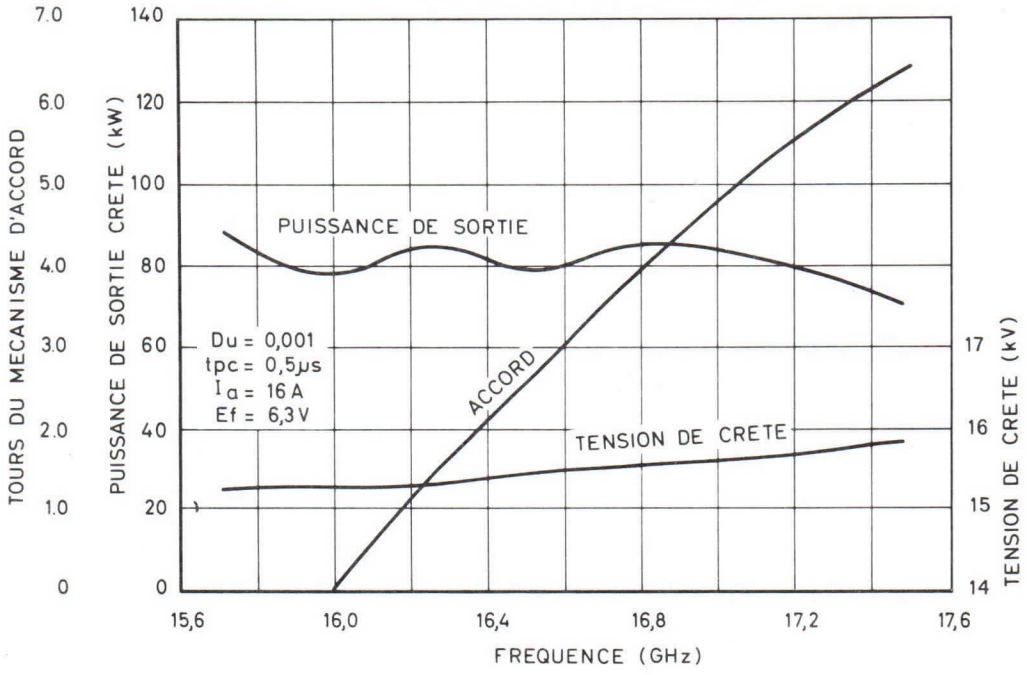
- Le taux de croissance de la tension devra être compris dans les limites suivantes : 100 à 160 kV/µs (pente de la tangente de plus forte pente au delà du point 70 % d'amplitude sur l'impulsion de tension).
- Toute pointe à l'avant de l'impulsion devra être supprimée.
- Toute suroscillation sur le plat de l'impulsion de tension ou de courant ne devra pas dépasser 10 % de la valeur moyenne du maximum de l'impulsion.
- La tension inverse sur l'impulsion de tension ne devra pas dépasser 35 % de l'impulsion appliquée.

6 - Régler la tension d'entrée du modulateur jusqu'à ce que le courant magnétron ait atteint la valeur nominale.

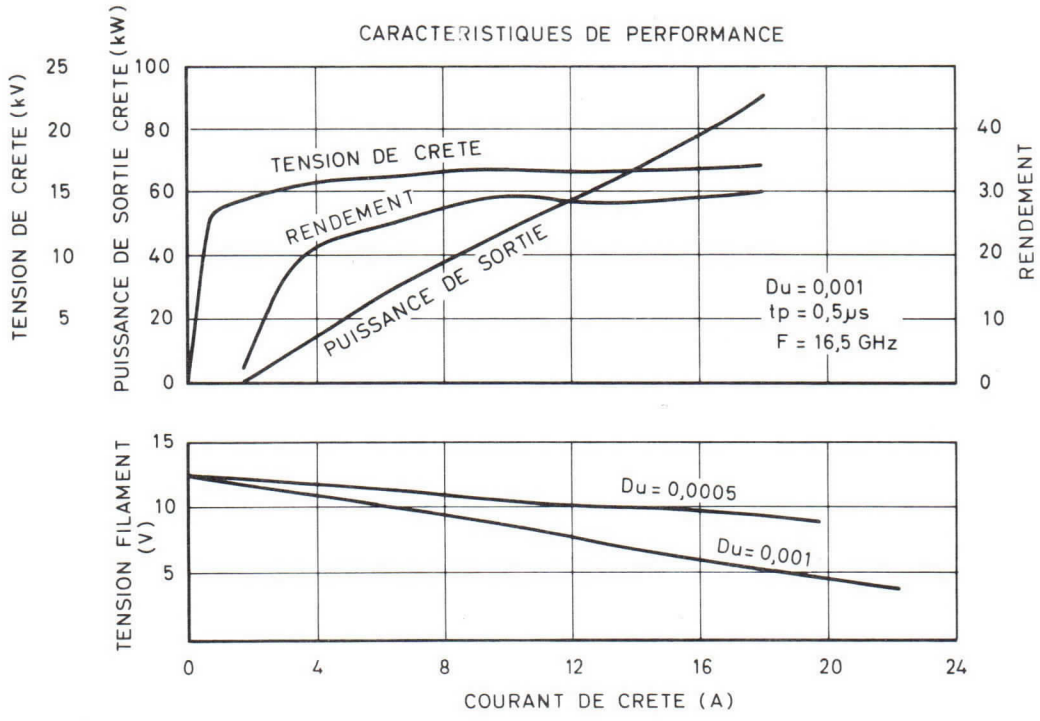
7 - Réduire la tension de chauffage du magnétron en fonction de la puissance moyenne appliquée.

8 - La fréquence de ce magnétron est réglable par rotation d'un axe de commande entraînant un pignon denté situé à la partie supérieure du tube. Il est important, au cours du fonctionnement, de ne jamais sortir des limites de fréquence indiquées.

CARACTERISTIQUES DE FREQUENCE

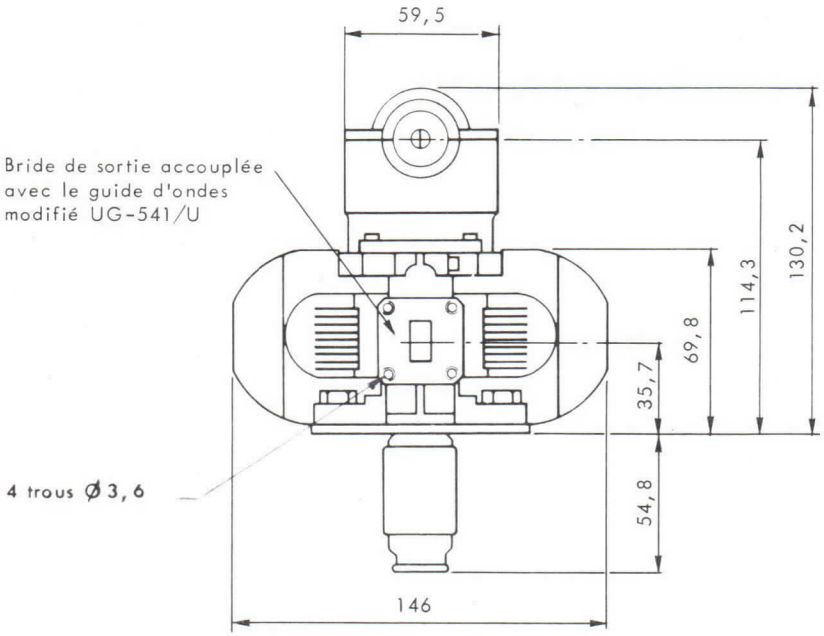


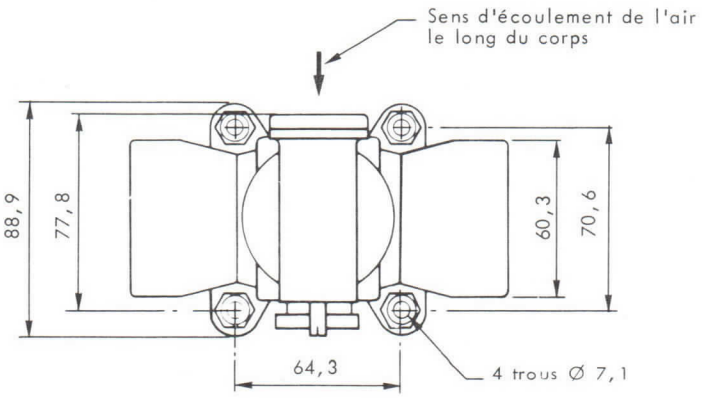
CARACTERISTIQUES DE PERFORMANCE



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT

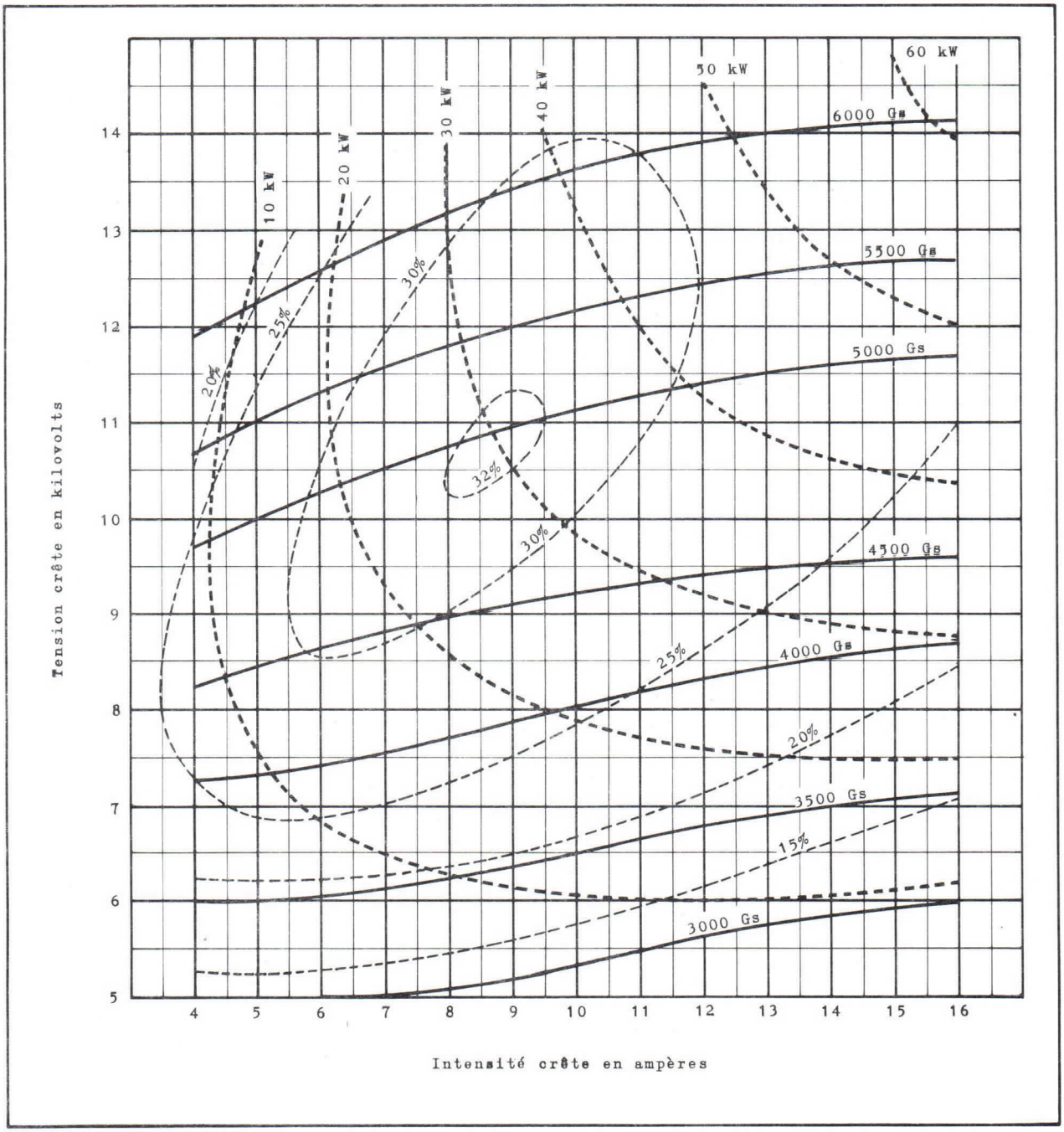




Cotes en mm

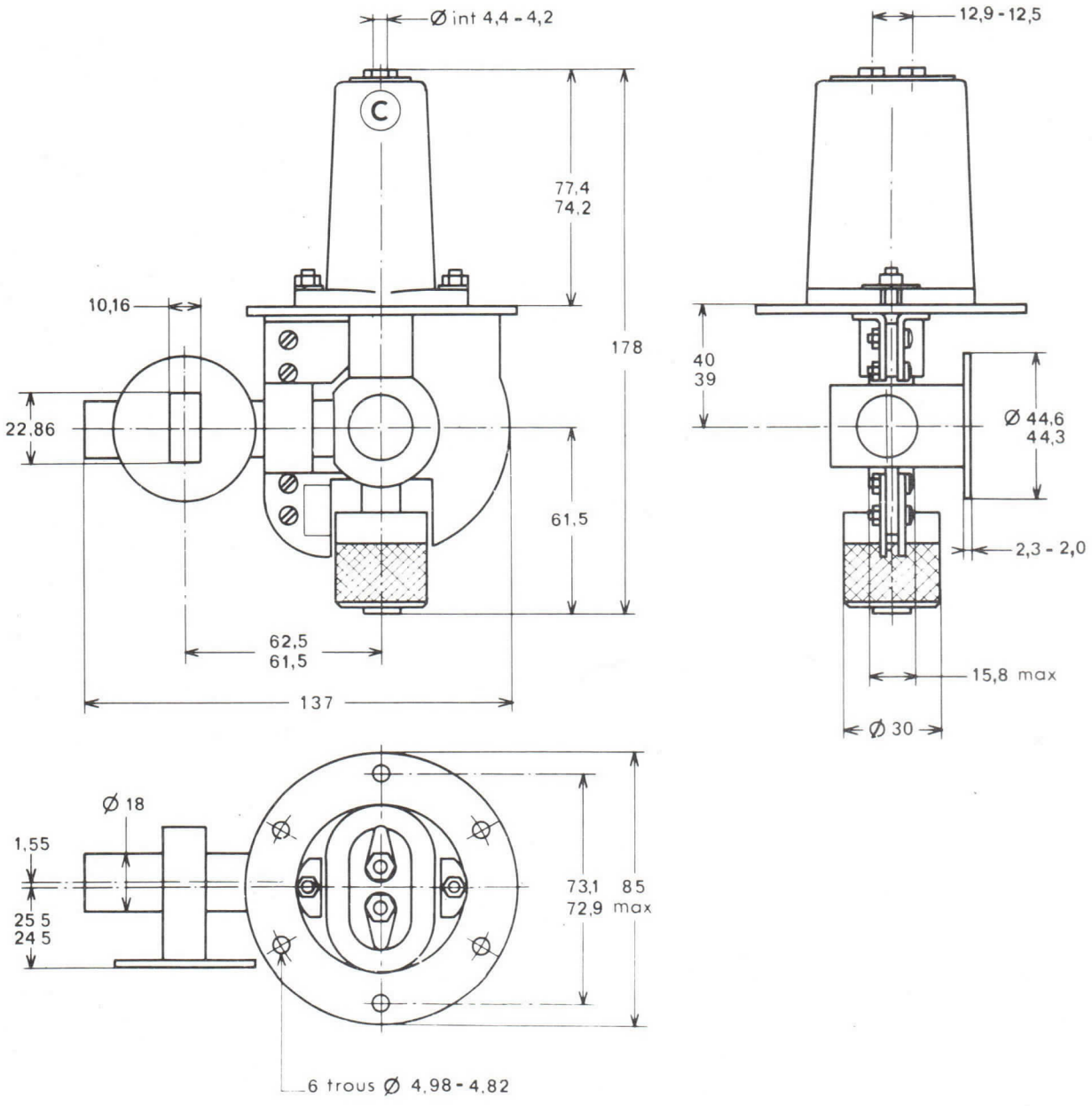
RESEAU CARACTERISTIQUE

Durée des impulsions	1 µs
Fréquence de répétition	1000 Hz
Entraînement de fréquence (Pulling)	11,4 MHz



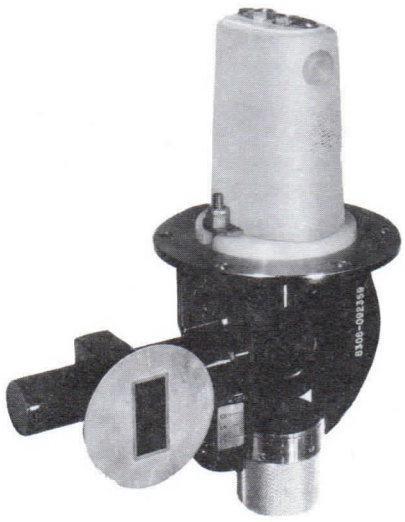
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GROUPEMENT TUBES ELECTRONIQUES

COTES D'ENCOMBREMENT



Cotes en mm

MAGNETRON TH 1725 B



Le tube TH 1725 B est un magnétron à fréquence ajustable, employé comme oscillateur hyperfréquence fonctionnant en régime d'impulsions. Il fournit une puissance RF crête de 40 kW minimum, dans la bande 9275 à 9475 MHz.

Des aimants permanents sont incorporés au corps du tube et des ailettes de refroidissement sont prévues pour recevoir un jet d'air soufflé. La sortie hyperfréquence est réalisée par un raccord coaxial-guide d'onde préréglé.

CARACTERISTIQUES GENERALES (1)

	min.	nom.	max.	
Eléctriques :				
Fréquence de fonctionnement ajustable de (2)	9275	-	9475	MHz
Mode de chauffage		indirect		
Tension de chauffage	-	6,3	-	V
Courant de chauffage	-	0,8	-	A
Tension anodique de crête	-	12,5	-	kV
Courant anodique de crête	-	12	-	A
Puissance de sortie crête	40	-	-	kW

Mécaniques :	
Position de fonctionnement	indifférente
Mode de refroidissement	air soufflé
Sortie RF : guide d'onde	RG 52/U
bride de raccordement extérieur	UG 40 A/U
Masse du tube, environ	750 g
Masse du tube sous emballage	1800 g
Dimensions	voir dessin
Système de réglage de fréquence	bouton molleté (voir dessin)
Nombre de tours du bouton de réglage	9

VALEURS LIMITES D'UTILISATION
(non simultanées)

	min.	max.	
Tension de chauffage	5,5	7,0	V
Temps de préchauffage	2	-	mn
Durée d'impulsion	-	2,5	µs
Facteur d'utilisation	-	0,001	
Puissance d'entrée moyenne	-	180	W
Puissance crête d'entrée	-	230	kW
Tension anodique de crête	-	16	kV
Courant anodique de crête	-	16	A
ROS de la charge	-	1,5	
Température maximale de l'anode	-	100	°C

(1) Ces caractéristiques sont données à titre indicatif seulement, voir spécifications pour caractéristiques de type.
(2) Il est à rappeler que ce magnétron est ajustable en fréquence et non accordable.

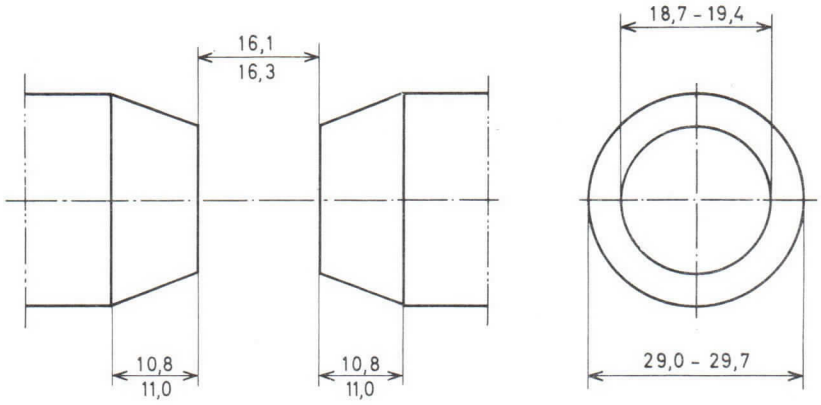
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

CARACTERISTIQUES DE FONCTIONNEMENT

Tension de chauffage au démarrage	6,3	V
Tension de chauffage en oscillation	voir courbe	page 4
Champ magnétique (1)	5400	Gs
Durée de l'impulsion	1	µs±10%
Facteur d'utilisation	0,001	
Tension anodique de crête	12,5	kV
Courant anodique de crête	12	A
Courant moyen	12	mA
Puissance d'entrée moyenne	150	W
Entraînement de fréquence (Pulling)	max. 15	MHz
Puissance HF de crête (à la fréquence milieu de la bande considérée)(2)	40	kW
Fréquence	9275 a 9475	MHz

(1) Aimant permanent MC 31S (5400 $\pm \begin{smallmatrix}100\\0\end{smallmatrix}$) gauss des Acieries et Forges d'Allevard.
(2) Aux extrémités de bande 36 kW minimum.

PIECES POLAIRES DE L'AIMANT



CONSIGNES DE MISE EN SERVICE

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes, necessaires par exemple pour l'établissement d'un materiel nouveau, peuvent être fournies sur demande.

Installations

1 - Assurer la mise en place du magnétron, le pôle nord de l'aimant étant côté cathode. Pour le montage du magnétron dans l'aimant utiliser des OUTILS NON MAGNETIQUES.

2 - Brancher les connexions d'amenée de courant au culot du magnétron, la connexion cathode étant reliee à la douille marquée C, solidaire du pot de protection des amenées de courant.
A titre de protection du filament, il est recommandé de mettre en série avec celui-ci une self inductance de quelques microhenrys, découplée à la connexion cathode par des condensateurs de 20 000 pF environ.

3 - Limiter le courant d'appel du chauffage filament à 3 ampères, et laisser chauffer la cathode a la tension prescrite pendant 2 minutes au moins avant l'application de la haute tension.

4 - Vérifier que la ventilation s'effectue normalement.

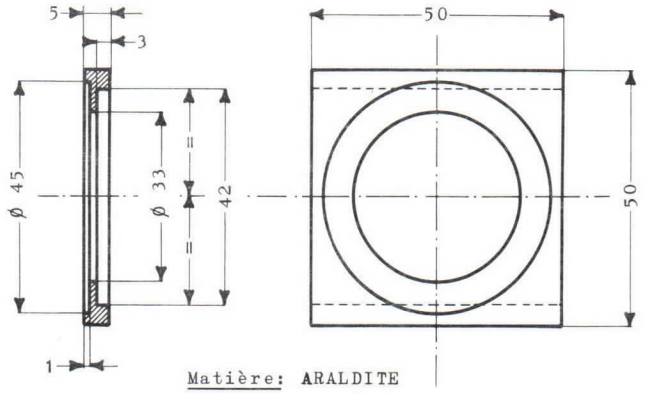
5 - Appliquer la haute tension en impulsions négatives sur la cathode. Le plateau de fixation sert de contact d'anode.
Dans les régimes normaux de fonctionnement les formes d'impulsions observées devront correspondre aux caractéristiques suivantes :

Temps de croissance de la tension (mesurée entre 20 et 85%)	0,1 à 0,2	µs
Temps de croissance de la tension (mesurée entre 0 et 85%)	0,4	µs max.

Toute pointe à l'avant de l'impulsion devra être supprimée. Toute suroscillation sur le plat de l'impulsion de courant ne devra pas dépasser 10% de la valeur moyenne du courant crête. La tension inverse sur l'impulsion de tension ne doit pas dépasser 20% de l'impulsion appliquée.

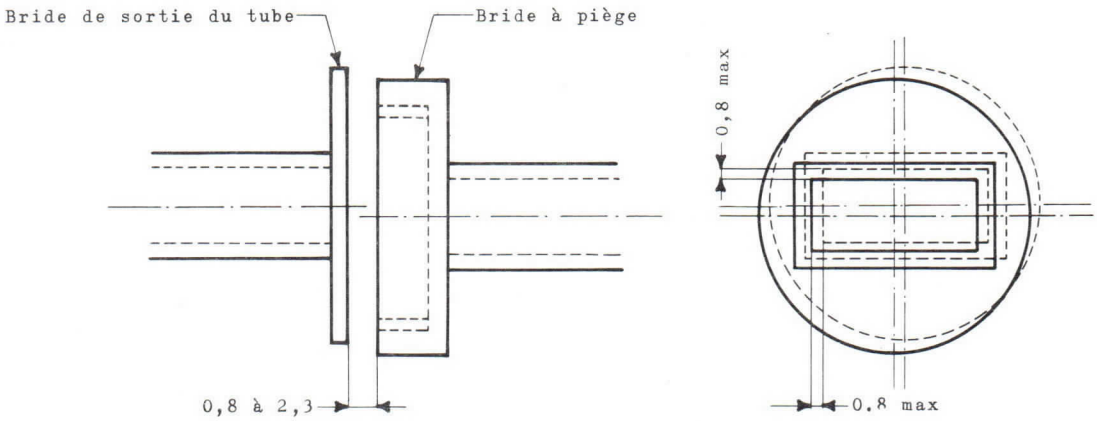
6 - Réduire la tension de chauffage du magnétron en fonction de la puissance appliquée (voir courbe page 4)

INTERCALAIRE RECOMMANDE
entre la bride du tube et la bride UG 40 A/U



Matière: ARALDITE

TOLERANCES DE MISE EN PLACE DU GUIDE D'UTILISATION



La bride à piège de raccordement doit se trouver face à face et parallèlement avec la bride du magnétron. Les limites d'écartement admissibles entre ces deux brides sont 0,8 mm minimum et 2,3 mm maximum.

Les ouvertures rectangulaires des deux brides placées en regard doivent être alignées, l'une par rapport à l'autre, à mieux que 0,8 mm pour tous les côtés des rectangles considerés.

Précautions importantes

REFORMATION D'UN MAGNETRON NEUF

Un magnétron qui est resté sans fonctionner depuis un certain temps peut contenir de petites traces de gaz. Ce gaz peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre contrôlant le courant moyen magnetron. Ils sont généralement de courte durée (inférieurs à 2 secondes). Quand les arcs ou "flashs" sont secs et repetés pendant plusieurs secondes (de l'ordre de 5 secondes et plus) et provoquent des fluctuations rapides et incontrôlées du milliampèremètre, il devient essentiel d'appliquer la règle suivante:

Amener le courant moyen au niveau immédiatement inférieur à la limite d'apparition des arcs ou sauts de l aiguille du milliampèremètre magnétron. Maintenir le courant à cette valeur pendant quelques minutes. Augmenter progressivement le courant pour atteindre la valeur désirée.

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GROUPEMENT TUBES ELECTRONIQUES

TENSION DE CHAUFFAGE
EN FONCTION DE LA PUISSANCE D'ENTREE

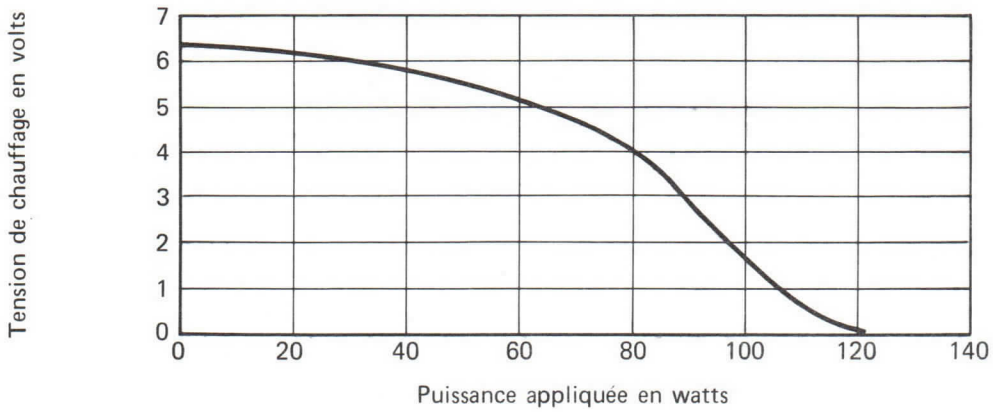
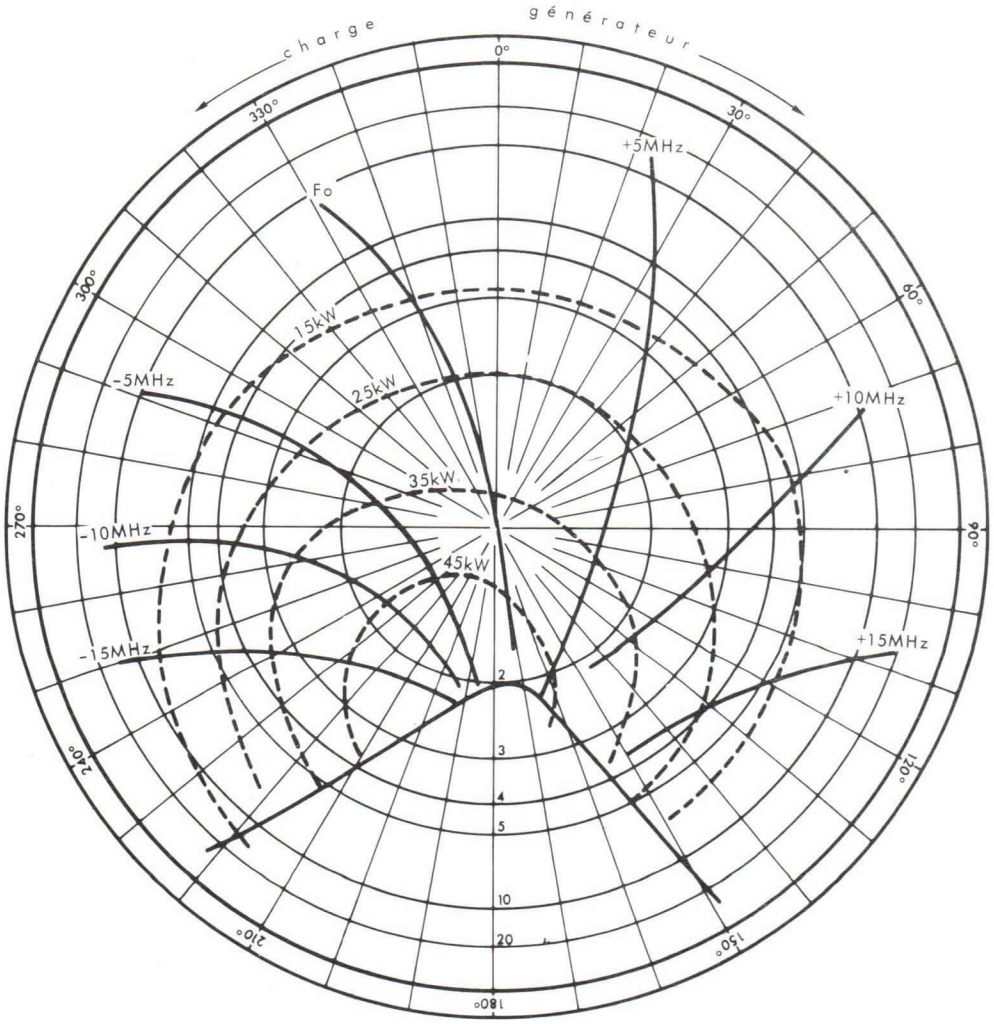


DIAGRAMME DE RIEKE

FREQUENCE Ic = 10 A
Fr = 1000 Hz
τ = 1 µs
H = 5400 Gs
Pf = 10,2 MHz

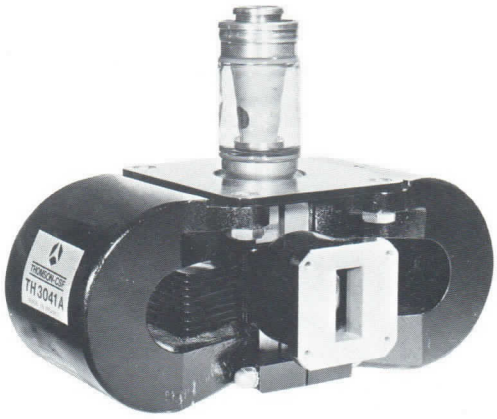


MAGNETRONS TH 3041A - TH 3041B

Les tubes TH 3041A et TH 3041B sont des magnétrons utilisés comme oscillateurs hyperfréquences à fréquence fixe fonctionnant en régime d'impulsions, ils fournissent une puissance crête de 200 kW à une fréquence comprise entre 9005 et 9055 MHz pour le TH 3041A, 9105 et 9155 MHz pour le TH 3041B.

Des aimants permanents sont incorporés aux corps des magnétrons. Le refroidissement se fait par air forcé. La sortie hyperfréquence peut être couplée directement à un guide d'onde rectangulaire RG-51/U.

La structure interne renforcée et la grande robustesse mécanique de ces tubes leur assurent une grande résistance aux chocs et vibrations et les désignent tout particulièrement aux matériels aéroportés.



CARACTERISTIQUES GENERALES (1)

Electriques

Fréquence :			
- TH 3041A		9005 à 9055	MHz
- TH 3041B		9105 à 9155	MHz
Tension de chauffage (2)		13, 75 ± 5%	V
Courant de chauffage		2, 9 à 3, 3	A
Tension d'anode crête		20 à 23	kV
Puissance de sortie crête	min.	200	kW
Puissance de sortie moyenne	min.	200	W
Facteur d'utilisation		0, 001	
Entraînement de fréquence	max.	15	MHz
Largeur de spectre	max.	2, 5/tp	MHz (3)
Rapport de lobes	min.	6	dB

Mécaniques

Dimensions	Voir dessin
Poids, environ	5 kg
Position de fonctionnement	Indifférente
Refroidissement	Air forcé
Bride de sortie	S'adapte sur bride UG-52/U

(1) Les valeurs et les caractéristiques indiquées dans cette notice sont susceptibles de modifications, dues à un complément d'informations ou à une amélioration du produit. La Division Tubes Electroniques de THOMSON-CSF doit être consultée pour l'utilisation de ces données en vue de la réalisation d'un équipement.

(2) La tension de chauffage doit être réduite dès l'application de la HT à la valeur donnée par la formule indiquée page 3.

(3) tp = durée d'impulsion.

VALEURS LIMITES D'UTILISATION (1)

(non-simultanées)

	Min.	Max.	Unité
Puissance crête appliquée	—	630	kW
Puissance moyenne appliquée	—	630	W
Tension de chauffage	—	15	V
Courant de chauffage au démarrage	—	12	A
Temps de préchauffage	3	—	mn
Tension d'anode crête	20	24	kV
Courant d'anode crête	—	30	A
ROS de la charge	—	1. 5	
Taux de monté de l'impulsion de tension	—	150	kV/µs

EXEMPLE DE FONCTIONNEMENT

Fréquence :		
- TH 3041A	9030	MHz
- TH 3041B	9130	MHz
Tension de chauffage	0	V
Courant d'anode moyen	27, 5	mA
Durée d'impulsion :		
- oscillation 1	0, 5	µs
- oscillation 2	1, 5	µs
Facteur d'utilisation	0, 001	

CONSIGNES DE MISE EN SERVICE

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement de ce type de magnétron. Des informations plus complètes par exemple pour l'étalissement d'un matériel nouveau, peuvent être fournies sur demande.

PRECAUTIONS IMPORTANTES

HAUTE TENSION

Le fonctionnement du magnétron nécessite l'utilisation de tensions élevées. Il faut prendre toutes précautions utiles pour prévenir les risques d'électrocution.

FUITES RF

Une quantité non négligeable de puissance RF peut être rayonnée par l'extrémité cathode ou d'autres parties du tube. Ce rayonnement est dangereux pour l'homme en particulier pour les yeux. Toutes les précautions nécessaires doivent être prises pour éviter l'exposition à ce rayonnement, lors de la conception des équipements.

INSTALLATION

Assurer la mise en place du magnétron en prenant toutes précautions utiles. N'utiliser pour le montage que des OUTILS NON MAGNETIQUES. S'assurer au moment du serrage des vis, qu'aucune contrainte n'est exercée sur le tube et en particulier sur le pied de verre d'amenée de courant ainsi que sur le guide d'onde de sortie. Aucun objet magnétique, ou ferromagnétique ne doit se trouver à moins de 5 cm des aimants fixés au tube.

CONNEXIONS ELECTRIQUES

Brancher les connexions d'amenée de courant au culot du magnétron. La cathode du magnétron est reliée par construction à la bague extérieure du culot. La fiche de connexion ne doit exercer aucune contrainte sur le scellement verre-métal. Afin de protéger le filament, il est recommandé de mettre en série avec celui-ci, une self inductance de quelques microhenrys découplée à la connexion cathode par un condensateur de 0, 004 µF minimum.

(1) Ces valeurs limites **NE SONT PAS** des valeurs de fonctionnement et ne doivent jamais être dépassées, même en régime transitoire. Chaque valeur extrême devant être considérée comme limitative en elle-même, deux ou plusieurs valeurs extrêmes ne doivent pas être atteintes simultanément. Les équipements devront être conçus de façon à protéger le tube de tout dépassement de ces valeurs.

FONCTIONNEMENT

1 - Appliquer la tension de chauffage graduellement pour que le courant d'appel à la mise sous tension n'excède pas 12 ampères. Chauffer la cathode du magnétrons à la tension prescrite. Le temps de pré-chauffage doit être au moins de 3 minutes avant l'application de la haute tension.

2 - Vérifier que la ventilation s'effectue normalement.

Les TH 3041A et TH 3041B sont refroidis par une circulation d'air forcé qui doit être répartie également entre les ailettes de refroidissement.

La température d'anode au point de référence (voir dessin) ne devra jamais excéder 140 °C. Pour plus de sécurité, il est recommandé de fonctionner aux environs de 100 °C seulement.

Pour la puissance appliquée nominale de 600 W, à la température ambiante de 25 °C, le débit d'air de refroidissement devra en tout cas être supérieur à 0, 70 kg/mn.

3 - Appliquer la haute tension

Réduire la tension de chauffage du magnétron immédiatement après l'application de la haute tension, en fonction de la relation suivante :

$$V_f = 13,75\left(1 - \frac{P_a}{450}\right) (P_a = \text{puissance appliquée}) \text{ pour } P_a \leqslant 450 \text{ W}$$

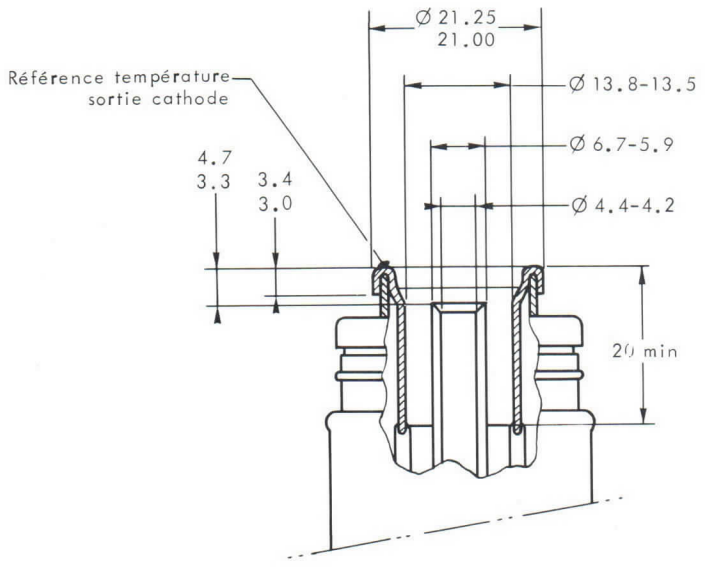
$$V_f = 0 \text{ pour } P_a > 450 \text{ W}$$

DEMARRAGE D'UN MAGNETRON NEUF

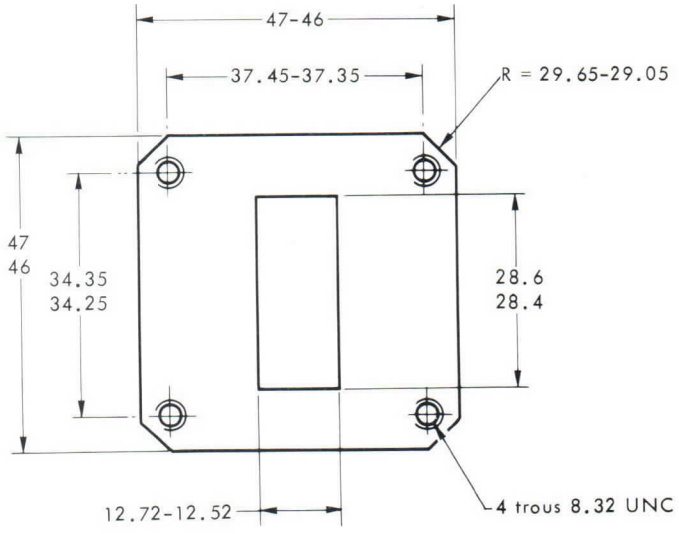
Un magnétron neuf ou qui est resté sans fonctionner depuis un certain temps peut contenir de petites traces de gaz. Ce gaz peut provoquer l'apparition d'arcs internes dès l'application de la haute tension. Ces arcs se manifestent généralement par des sauts de l'aiguille du milliampèremètre contrôlant le courant moyen magnétron. Ils sont généralement de courte durée (inférieurs à deux secondes). Quand les arcs ou "flashs" sont secs et répétés pendant plusieurs secondes (de l'ordre de cinq secondes et plus) et provoquant des fluctuations rapides et incontrôlées du milliampèremètre, il devient essentiel d'appliquer la règle suivante :

- amener le courant au niveau immédiatement inférieur à la limite d'apparition des arcs. Maintenir le courant à cette valeur pendant quelques minutes ;
- lorsque le fonctionnement est stabilisé, augmenter progressivement la tension jusqu'à la valeur désirée.

Détail sortie cathode

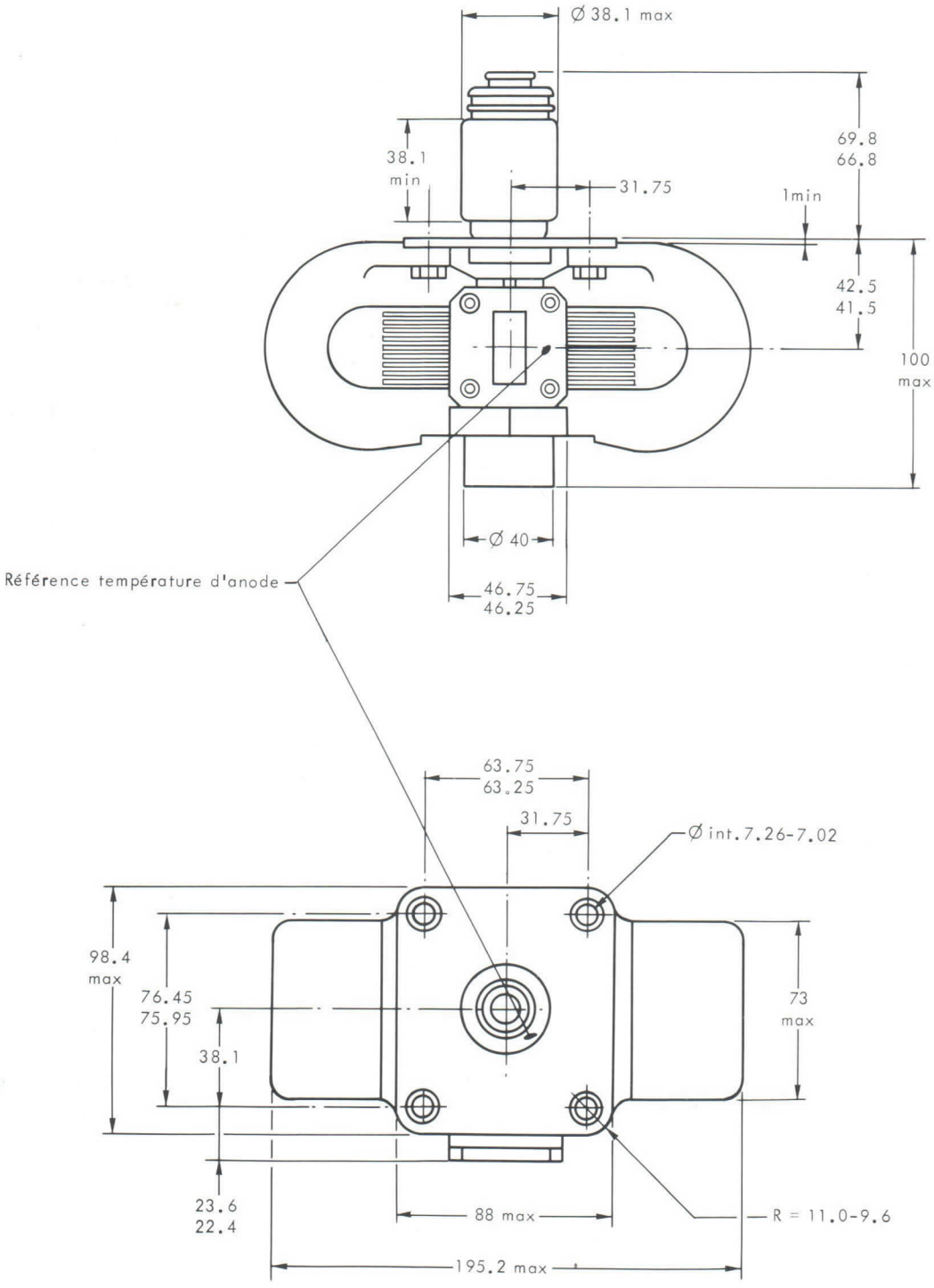


Bride de sortie



Cotes en mm.

DESSIN D'ENCOMBREMENT



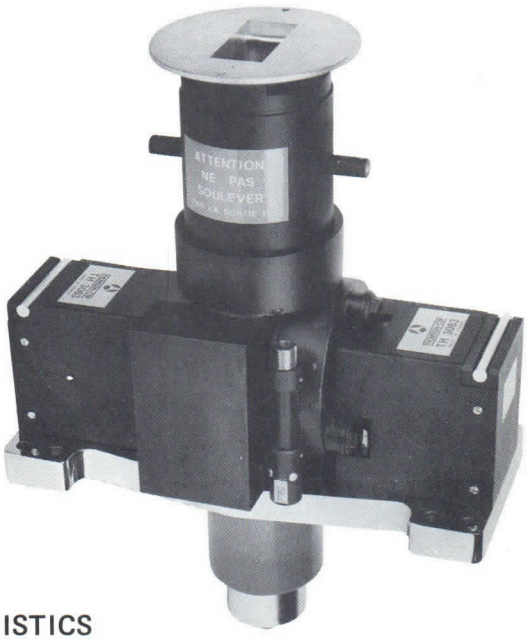
Cotes en mm.

TH 3062 - TH 3063 MAGNETRONS

The TH 3062 and TH 3063 magnetrons are pulsed, high-power oscillators, each capable of delivering peak output power of one megawatt and an average power of two kilowatts.

Both of these tubes are mechanically tunable, from 2900 to 3050 MHz for the TH 3062 and from 3050 to 3200 MHz for the TH 3063. Of the integral-magnet type, they also require forced-air cooling.

These modern radar magnetron are especially designed for use in MTI systems where RF energy that is relatively free of time, frequency or amplitude jitter is required, and where low phase noise is also desirable.



GENERAL CHARACTERISTICS

Electrical

Frequency range	TH 3062	2900 - 3050	MHz
	TH 3063	3050 - 3200	MHz
Peak output power, typical		1.0	MW
Heater voltage (1)		8.5	V
Heater current, typical		9.0	A
Peak anode voltage		30 to 36	kV
Average anode current		150	mA

Mechanical

Mounting position	Vertical, cathode down
Tuning	Mechanical
Tuner turns to cover the frequency range, max.	220
Tuner torque, max.	50 oz - in (0.36 N.m)
Tuner rotation rate, max.	300 rpm
Weight, approx.	30 kg
Output : Waveguide	RG 48/U
Flange	Special (see outline drawing)
Coupler collar (2)	SARMA type C 6048/44 or equivalent

(1) See the Application Notes.
(2) Not supplied with the tube.

Maximum ratings (no single rating should be exceed)

	MIN.	MAX.	UNITS
Heater voltage (1)	8.1	8.9	V
Heater starting current, peak	–	40	A
Cathode warm-up time	6	–	mn
Anode voltage, peak	30	36	kV
Anode current, peak	–	80	A
Input power, peak	–	2.3	MW
Input power, mean	–	4.6	kW
Duty cycle (2)	–	0.002	
Pulse length (2)	0.5	5.0	μs
Rate of rise of voltage pulse	–	100	kV/μs
Anode temperature	–	140	°C
Cathode terminal temperature	–	160	°C
VSWR at the output coupler	–	1.3:1	
Rate of air flow (at 35 °C)	200	–	ft^3/mn
	5.7	–	m^3/mn
Pressure drop (on water gauge)	–	2.5	inches
	–	63.4	mm
Rate of air flow into magnetron waveguide	5.0	–	ft^3/mn
	0.09	–	m^3/mn

(1) No anode voltage may be applied until the cathode has been warmed up. During tube operation, the heater voltage must be adjusted according to the schedule, page 3.

(2) Consult us for other operating conditions of duty cycle or pulse length.

Typical operation

Heater voltage	0	V
Anode current, peak	70	A
Pulse length	4.0	μs
Pulse repetition rate	500	pps
Anode voltage, peak	33	kV
Output power, peak	1.0	MW
Output power, average	2.0	kW
Frequency pushing (at 70 A)	40	kHz/A

APPLICATION NOTES

These applications notes provide basic information concerning the storage, installation and operation of the TH 3062 and TH 3063 magnetrons. More complete information, required, for example, for the construction of a new type of equipment, can be furnished upon request.

STORAGE AND INSTALLATION

Stored magnetrons are much more likely to remain in a ready-to-operate condition if left in their original packing or placed in correctly designed storage racks. Whenever transported, they should be correctly packed to guard against subjecting the tube to undue vibration, shock or stress.

These magnetrons must be protected from mechanical strain by the use of a section of flexible waveguide between the magnetron and the waveguide system.

APPLYING VOLTAGES

1. Apply the heater voltage gradually. The heater surge current must not exceed 40 amperes. Allow at least six minutes for the cathode to fully warm up before applying any high voltage to the tube.
2. Verify that the cooling system is operating correctly.
3. Apply the high voltage. On the application of anode voltage the heater voltage must be reduced as follows :

Mean input power (kW)	Heater voltage (Vrms)
0 to 1	8.5
1 to 2	6.5
2 to 3	5.0
3 to 4	3.0
over 4	zero

The magnetron heater must be protected against arcing by the use of a minimum capacitance of 1.0 μF, shunted across the heater directly at the input terminals.

STARTING A NEW MAGNETRON

A new magnetron, or one that has been idle or stored for a while, may contain small traces of gas. This gas can cause internal arcing to occur when the high voltage is applied. These arcs are generally evidenced by fluctuations of the average anode current, and are usually short (less than two seconds long) and harmless.

When, however, these arcs or flashes are persistent or severe, causing rapid and uncontrolled fluctuations of the average cathode current, the following procedure must be followed to avoid damaging the tube :

1. Reduce the current to the level just below that at which arcing begins. Hold the current at this value for several minutes (about five).
2. When the operation of the tube is stable, gradually increase the anode current.
3. Repeat this procedure as often as necessary until stable operation at the desired operating current is achieved.

WARNING

All magnetrons operate with high anode potentials, which can cause lethal shocks to operating personnel. Suitable safety interlocks must be provided to avoid this shock hazard.

RF LEAKAGE

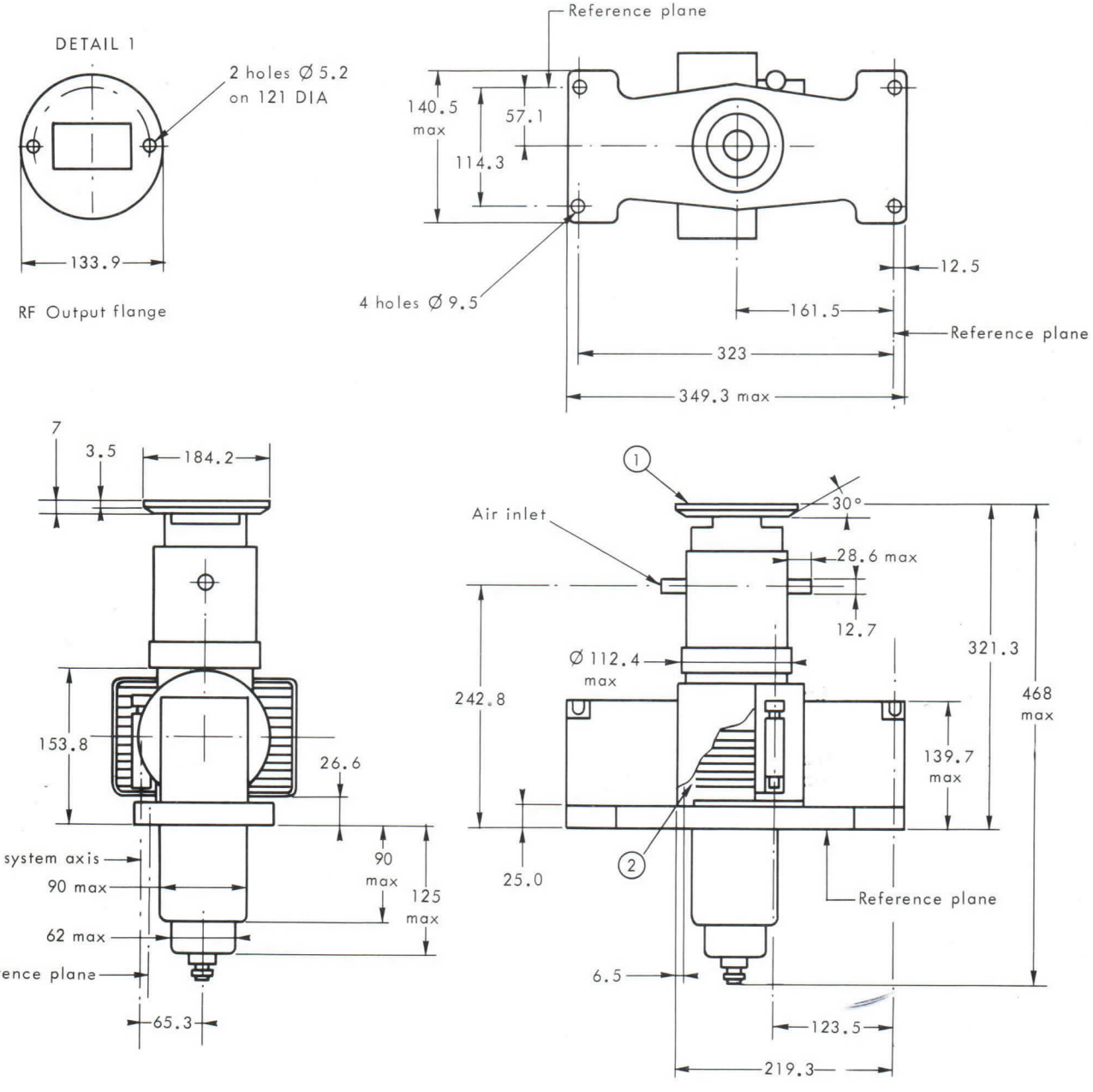
Sufficient RF power may be radiated through the cathode stem and other openings to interfere with adjacent circuit components. This radiation may be hazardous to human beings, especially to the eyes when arcing or the cathode temperature are being observed. Adequate precautions must be taken to guard against these hazards.

X-RAYS

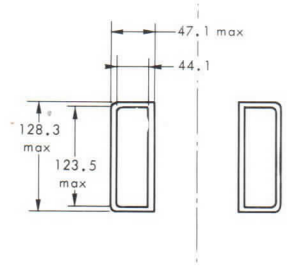
High power magnetrons emit a significant level of X-rays in the areas of the cathode and the RF output. Appropriate shielding should be installed to protect the operating personnel.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

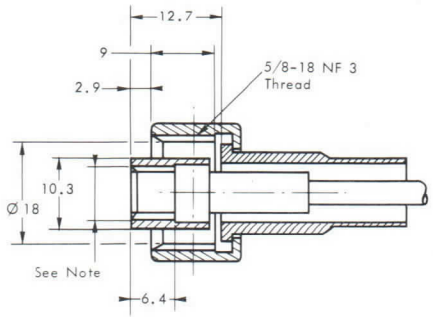
OUTLINE DRAWING



DETAIL 2



TUNING-CONTROL FLEXIBLE CONNECTOR

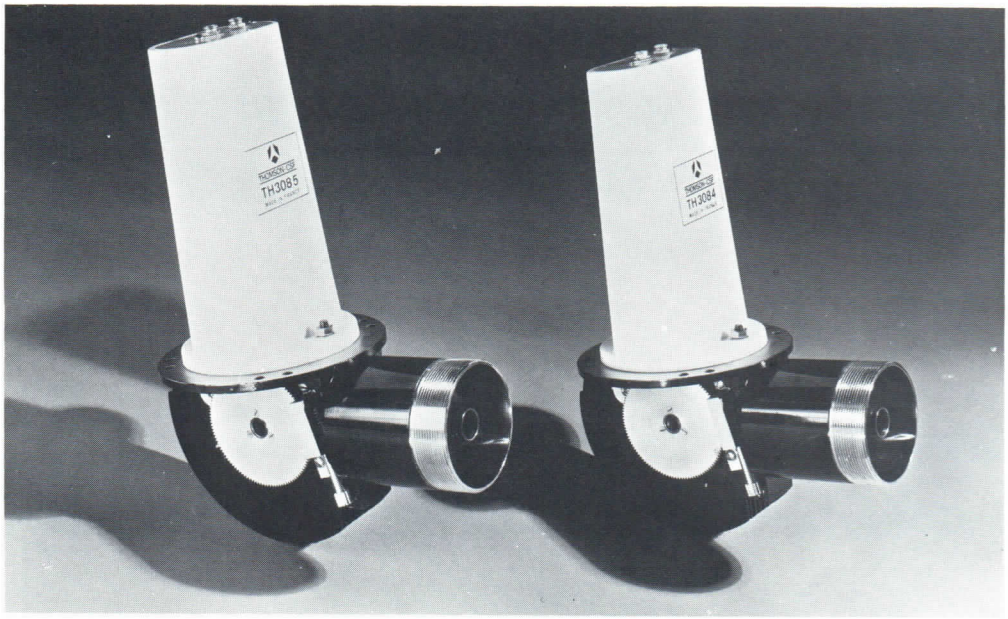


Dimensions in mm, nominal except for those marked "max".

Note : 12 teeth DP 6.3 - Modulus 0.5 - Pressure angle 14°30'

Imprimé en France

TH 3084 - TH 3085
TUNABLE HIGH-POWER S-BAND MAGNETRONS



The TH 3084 and TH 3085 magnetrons are pulsed, high-power oscillators, each capable of delivering peak output power of 800 kW. Of the external-magnet type, they are also mechanically tunable from 2700 to 2900 MHz for the TH 3085 and from 2900 to 3100 MHz for the TH 3084.

Both of these tubes are fitted with fins in the anode area for forced-air cooling. The RF output is designed for coupling to a standard coaxial transmission line, using a coaxial adapter.

The TH 3084 and TH 3085 are provided with loaded potting, to reduce the stray radiation emitted through the cathode stem.

GENERAL CHARACTERISTICS

Electrical

Frequency range		
TH 3084	2900 - 3100	MHz
TH 3085	2700 - 2900	MHz
Peak output power, min.	800	kW
Cathode	Indirectly heated oxide-coated type	
Warm-up/Standby heater voltage,	16	V
Warm-up/Standby heater current	2. 8 to 3. 4	A
Heater voltage in operation	See the schedule, page 6	
Pulse duration	1 to 2	µs
Duty cycle	0. 0005	
Frequency pulling, max.	15	MHz
Anode voltage	30	kV
Anode current	70	A
Magnetic field	2700	G

Mechanical

Dimensions	See the Outline Drawing
Operating position	Any
Cooling	Forced air
RF output	1 5/8" coaxial line (53. 4 Ω)with special coupler (See the Outline Drawing)
Net weight, approx.	3. 0 kg
Tube with packing	6. 0 kg
Tuner turns to cover the frequency range, (max.)	
TH 3085	150 turns
TH 3084	120 turns

ABSOLUTE RATINGS (1)

(non-simultaneous)

	Min.	Max.	Units
Warm-up time	2	–	mn
Heater voltage (2)	14. 4	17. 6	V
Heater starting current (peak)	–	15	A
Pulse duration	–	2. 5	µs
Duty factor	–	0. 001	
Average input power :			
TH 3085	–	1200	W
TH 3084	–	1300	W
Peak input power :			
TH 3085	–	2000	kW
TH 3084	–	2200	kW
Peak anode voltage :			
TH 3085	–	32	kV
TH 3084	–	32. 5	kV
Peak anode current	–	70	A
Load VSWR	–	1. 5 : 1	
RF output pressurization	–	3	bars
Anode temperature	–	100	°C
Cathode terminal temperature	–	100	°C

TYPICAL OPERATION

Heater voltage :		
- warm-up and standby	16	V
- in operation	8	V
Magnetic field	2700	gauss
Pulse duration	1	µs
Duty cycle	0. 0005	
Anode voltage, peak :		
TH 3085	29	kV
TH 3084	29. 5	kV
Anode current, peak	70	A
RF power, peak (3) min.	800	kW
Frequency pulling, max.	15	MHz

(1) Limiting values, **NOT operating values.** No one value ever to be exceeded, even under transient conditions, and operation at more that one limiting value at the same time may cause tube damage. Equipment must be designed so that these limits are never exceeded.

(2) See the schedule, page 6.

(3) Into a dissipating load presenting a VSWR lower than 1. 15 : 1.
The waveguide should be pressurized at high power level. Absolute pressure in the output waveguide = 3 bars.

Frequency	f_o	= 2800	MHz
	I_c	= 40	A
	B	= 2700	G
	f_r	= 500	Hz
	τ	= 1	μs

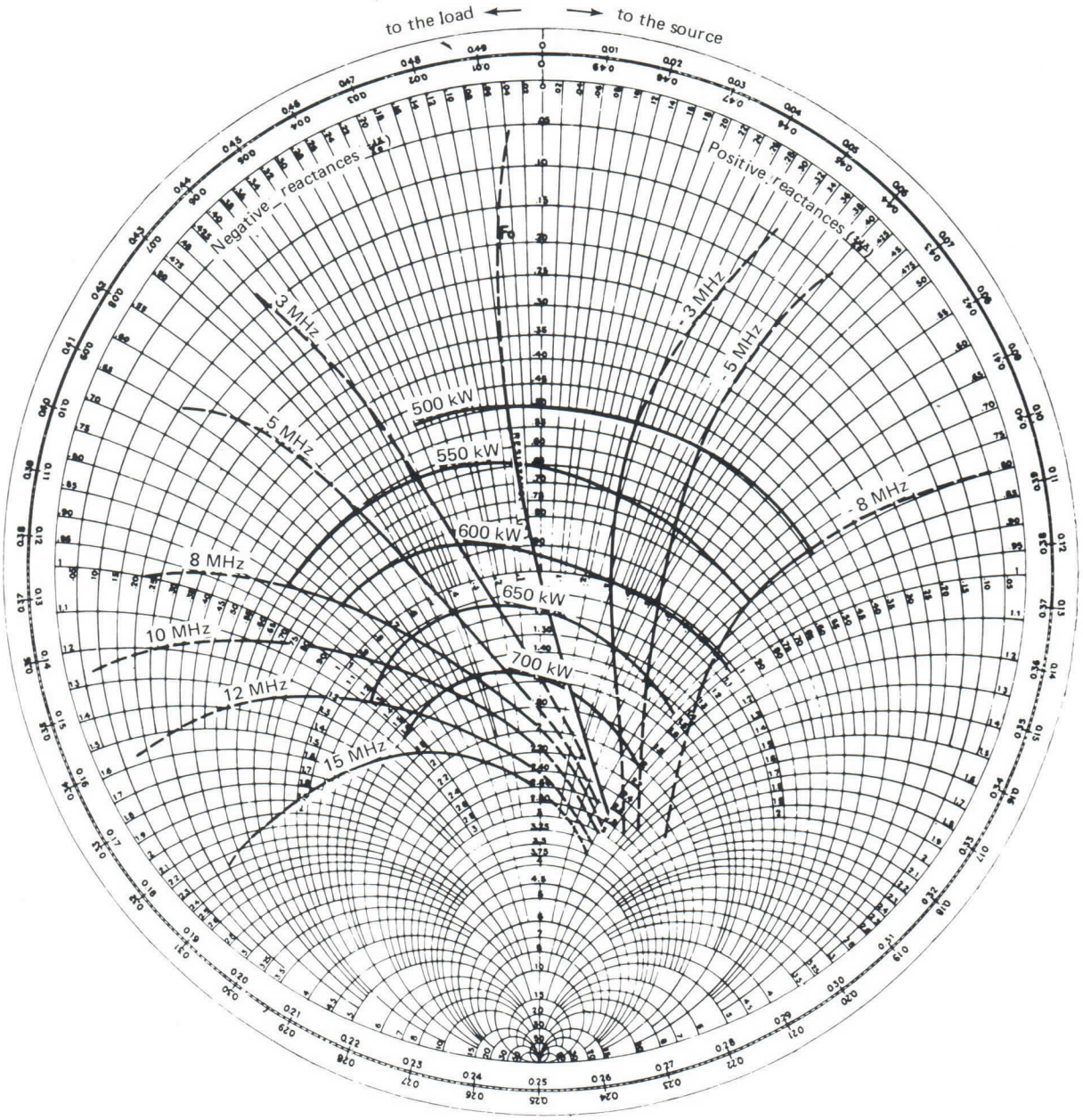


Figure 1 - Rieke diagram for the TH 3085.

Pulse duration :	1 μs
Repetition frequency :	500 Hz
Operating frequency :	2800 MHz
Frequency pulling :	10 MHz

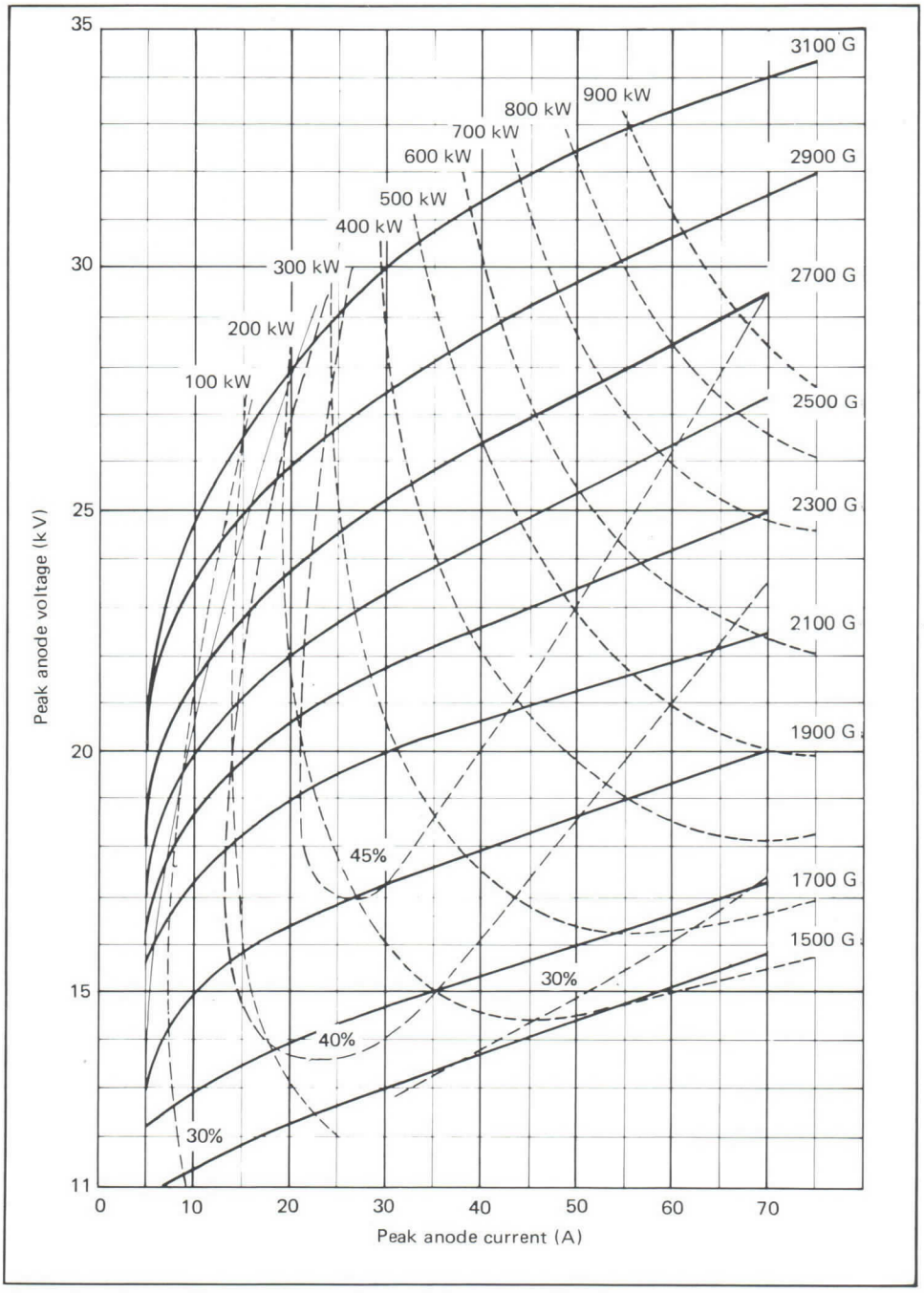


Figure 2 - Typical characteristic curves for the TH 3085.

OPERATING INSTRUCTIONS

These instructions provide basic information concerning the storage, installation and operation of the TH 3084 and TH 3085 magnetrons. More complete information, required, for example, for the design of a new type of equipment, can be furnished upon request.

WARNING

High Voltage

All magnetrons operate with high anode potentials, which can cause lethal shocks to operating personnel. Suitable safety interlocks must be provided to avoid this shock hazard.

RF Leakage

Sufficient RF power may be radiated through the cathode stem and other openings to interfere with adjacent circuit components. This radiation may be hazardous to human beings, especially to the eyes when arcing or the cathode temperature are being observed. Adequate precautions must be taken to guard against these hazards.

I - STORAGE and INSTALLATION

Stored magnetrons are much more likely to remain in a ready-to-operate condition if left in their original packing or placed in correctly designed storage racks. Whenever transported, they should be correctly packed to guard against subjecting the tube to undue vibration, shock or stress.

Care must be taken whenever handling these magnetrons ; they can be permanently damaged if subjected to rough handling. This is especially true when fitting the magnetron into its permanent magnet. Additionally, steel, nickel or any other magnetic materials must be kept from close contact with the magnet ; only non-magnetic tools should be used during installation operations.

The permanent magnet gap should correspond to the specifications ; a 50-mm field correction disk should be installed on the magnet's north-seeking pole.

Verify the tube position with respect to the magnet. The tube must be mounted with its cathode side next to the magnet's north-seeking pole, as follows (see Figure 3) :

1) Take off the No. 350 204 washer after having set the magnetic field at the rated value.
2) Place the washer No. 351 132, delivered with the tube, on the north-seeking pole of the magnet, and fasten it down with a brass countersunk-head screw.
3) The magnetron should be placed with its tuning system directed toward the south-seeking pole.

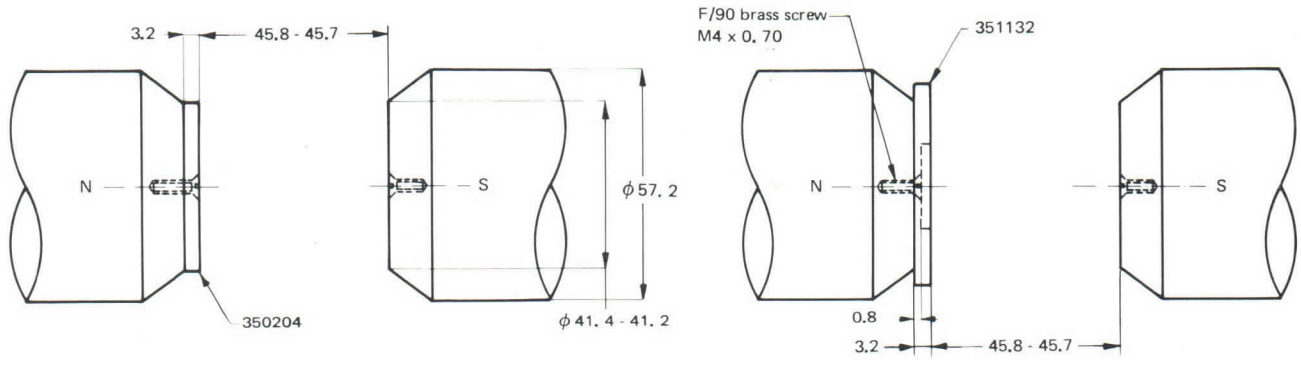


Figure 3

Checking the magnetic field :

a) The No. 350 204 washer being installed, set the magnetic field for 2700 gauss (measured in the middle of the gap).

b) Take off the No. 350 204 washer and put the No. 351 132 washer in its place for magnetron operation.

Connect the current leads to the magnetron base. The cathode is connected to pin "C", identified on the protective cover.

As a protective measure, the anode voltage-supply return must be connected to the cathode terminal to prevent anode current and transients from passing through the heater and possibly causing burn-out. Also, a non-inductive capacitor of at least 4, 000 pF must be connected in parallel with the filament, directly across the heater terminals, to protect the tube in case of arcing or flashover.

II - STARTING and OPERATING

Apply the heater voltage gradually. The heater surge current must not exceed 6 amperes. Allow at least two minutes for the cathode to fully warm up before applying any high voltage to the tube.

Always tune the magnetron to the higher frequency limit when starting (3100 MHz for the TH 3084, 2900 MHz for the TH 3085). Turn the tuning mechanism clockwise until the mechanical stop is reached to set the magnetron to its highest frequency.

Before applying the high voltage, verify that the air cooling system is operating correctly.

Apply the negative pulsed high voltage to the cathode. If arcing or fluctuations of the average anode current are observed, follow the procedure given in Section III. The mounting plate must be used as the grounding contact. In the normal operating modes, the observed pulse forms must correspond to the following characteristics :

Voltage rise time (measured between 20 % and 85 % of the peak voltage) = 0. 1 to 0. 2 μs.

Any ripple on the top of the current pulses must not exceed 10 % of the average value of the peak current. Inverse voltage must not exceed 20 % of the applied pulse.

The heater voltage must be reduced in accordance with the following schedule :

Average Input Power (W)	Heater Voltage (V)
1000 - 1200	8. 0
800 - 1000	10. 5
600 - 800	13
400 - 600	15
less than 400	16

The average input power is given by the following formula :

$P_{in} = I_{ap} \times V_{ap} \times D_u$

where P_{in} = average input power in watts
I_{ap} = peak anode current in amperes
V_{ap} = peak anode voltage in volts
and D_u = duty cycle

When tuning these magnetrons, care must be taken not to exceed the frequency limits specified (2700 -2900 MHz - for the TH 3085, 2900 - 3100 MHz for the TH 3084).

Particularly, operating beyond the lower frequency limit may cause oscillation or instability, and thus damage to the tube.

III - STARTING A NEW MAGNETRON

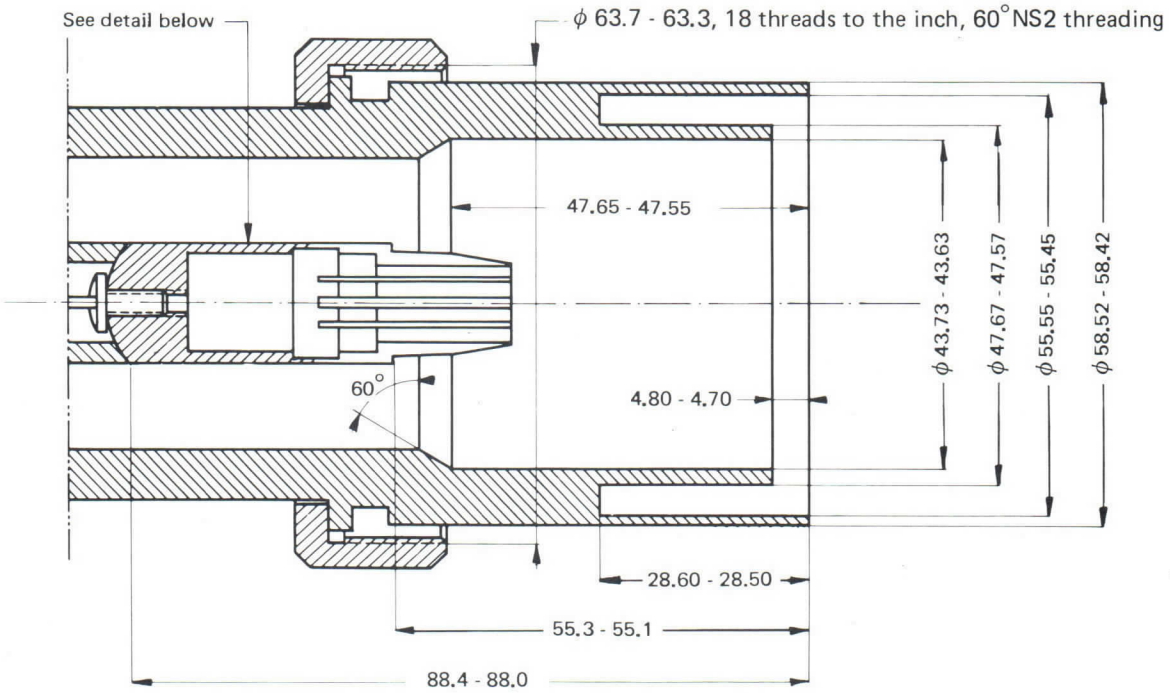
A new magnetron, or one that has been idle or stored for a while, may contain small traces of gas. This gas can cause internal arcing to occur when the high voltage is applied. These arcs are generally evidenced by fluctuations of the average anode current, and are usually short (less than two seconds long) and harmless.

When, however, these arcs or flashes are persistent or severe, causing rapid and uncontrolled fluctuations of the average cathode current, the following procedure must be followed to avoid damaging the tube :

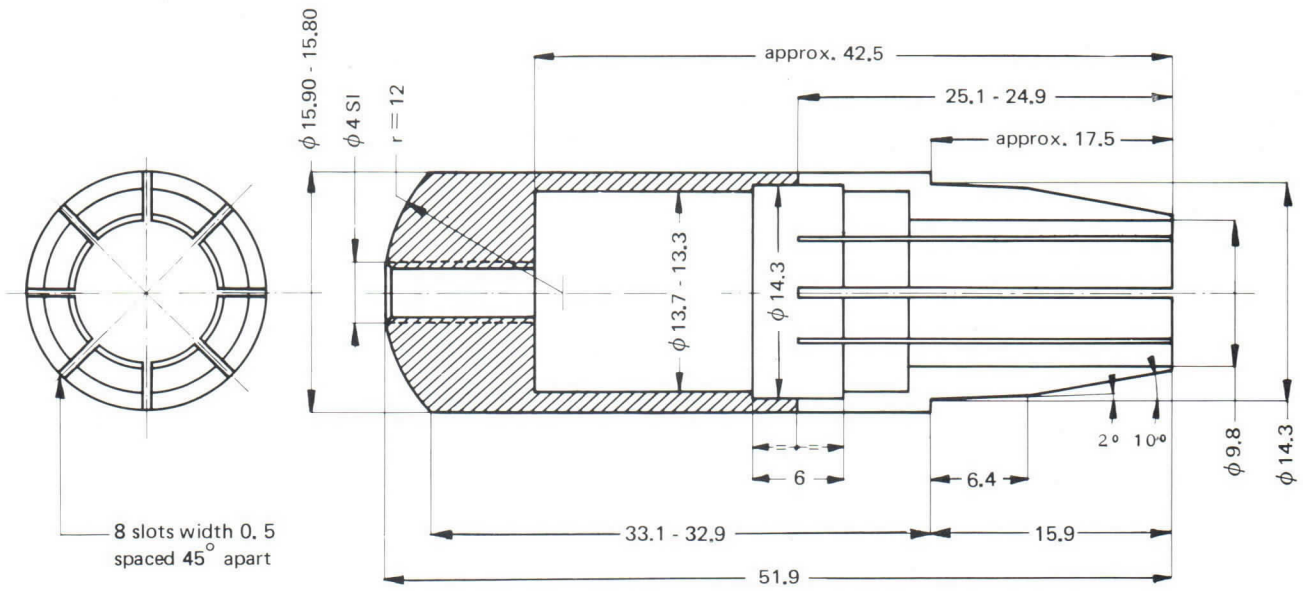
1 - Reduce the current to the level just below that at which arcing begins. Hold the current at this value for several minutes (about five).
When the operation of the tube is stable, gradually increase the anode current.
Repeat this procedure as often as necessary until stable operation at the desired operating current is achieved.

2 - To obtain stable operation of the magnetron, it may be necessary to maintain the anode current 2 or 3 mA higher than the normal value. This results in a very stable operation when the current is reduced to the initial value.

COAXIAL ADAPTER

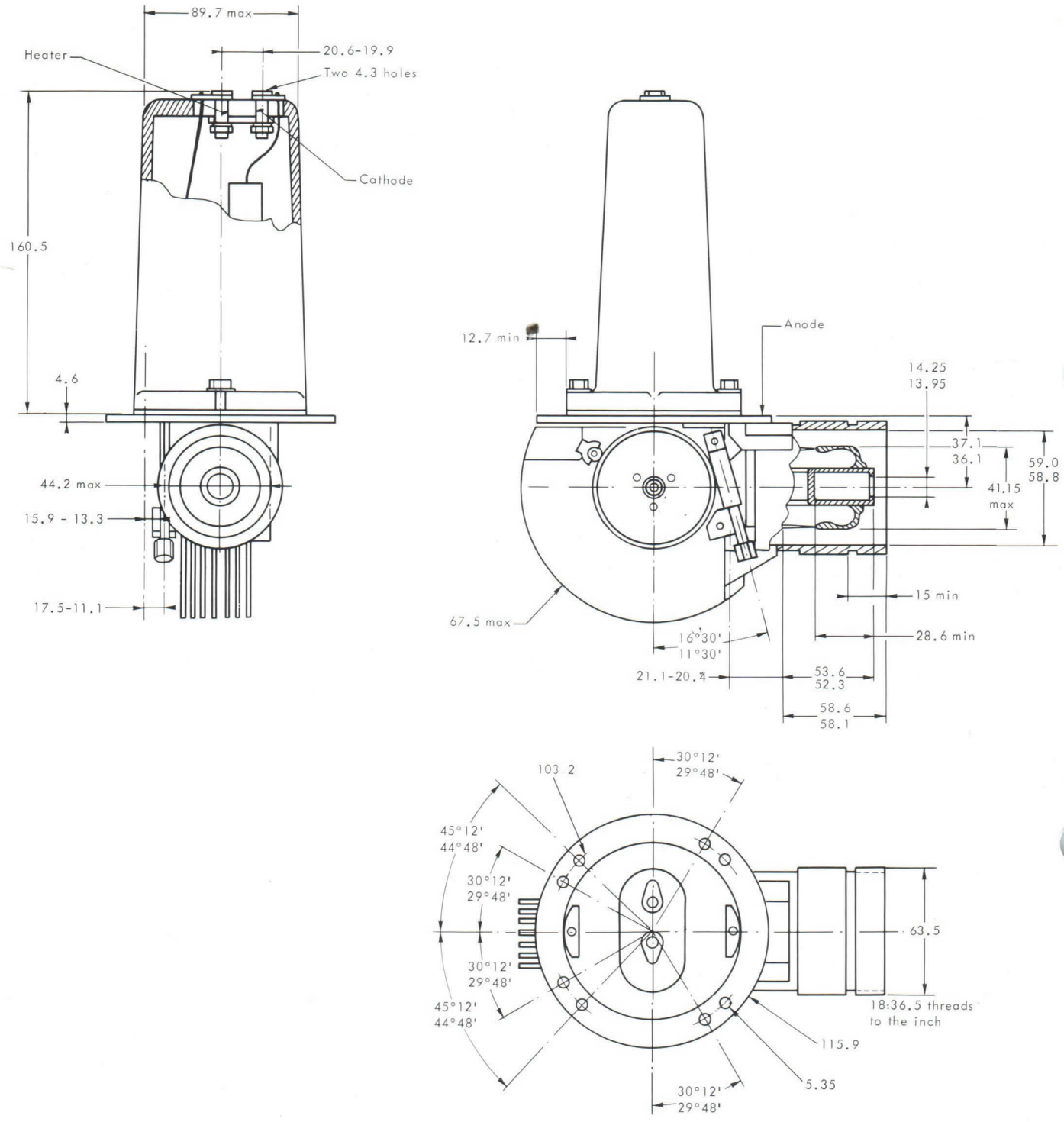


Detail



Dimensions in mm.

OUTLINE DRAWING



Dimensions in mm, nominal unless otherwise marked.

AMPLIFICATEURS UHF A TOP

UHF TRAVELING WAVE TUBE AMPLIFIERS

Large bande - Gain élevé - Faible bruit
Broad bandwidth - High gain - Low noise

Pour les mesures fines en laboratoire, dans le domaine UHF, telles que contrôle des performances des sources en modulation, en stabilité et en bruit, mesures de diagramme d'antenne, utilisation de wobulateur, THOMSON-CSF a étudié et développé une série d'amplificateurs couvrant la gamme de fréquence de 1 à 18 GHz, dont les caractéristiques propres ne risquent pas d'altérer les mesures à effectuer.

La totalité de la bande est couverte par deux coffrets alimentation associés à des tiroirs interchangeables comportant chacun un TOP. Le refroidissement est assuré par un système de ventilation incorporé aux coffrets alimentations.

Ces appareils sont réalisés dans le but de permettre une utilisation facile. Ils sont légers, peu encombrants et dotés de toutes les sécurités qui rendent quasi impossible une détérioration par accident de manipulation sur banc. La maintenance demeure très réduite voire inexistante car la réalisation est effectuée suivant les normes de haute fiabilité.

La série se présente de la façon suivante :

For delicate laboratory measurements in the UHF and SHF bands, such as checking RF sources for modulation, stability or noise , antenna-pattern measurements , wobbulating, and so on, THOMSON-CSF has designed and developed a series of amplifiers covering the 1 to 18 GHz frequency range. These amplifiers have been so designed that their own characteristics don't risk altering the results of the measurements being made.

The entire band is covered by only five amplifier units, each with its own TWT, which plug into one of only two different power-supply and support units, as illustrated below. Cooling is by a ventilation system built into the power units.

This equipment is designed for easy operation. Lightweight and compact, it includes a set of protection circuits that make it nearly impossible to damage the equipment in lab operating accidents. Maintenance has been reduced almost to the vanishing point, because of the high standards of reliability to which these TWTA's have been designed and built.

The series is a follows :

Alimentation *Power Supply*	Tiroir Amplificateur *Amplifier Unit*	Fréquence *Frequency* (GHz)
ALT 1410	AMP 1413	1 - 2
	AMP 1415	2 - 4
ALT 1411	AMP 1416	4 - 8
	AMP 1417	8 - 12, 4
	AMP 1418	12, 4 - 18



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ALIMENTATIONS ALT 1410 et ALT 1411
ALT 1410 and ALT 1411 POWER SUPPLIES

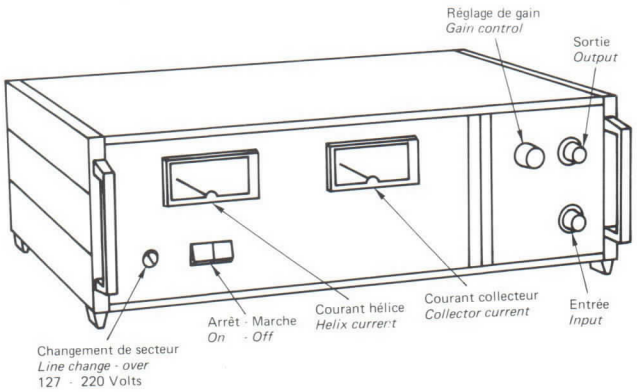
Caractéristiques électriques
Electrical characteristics



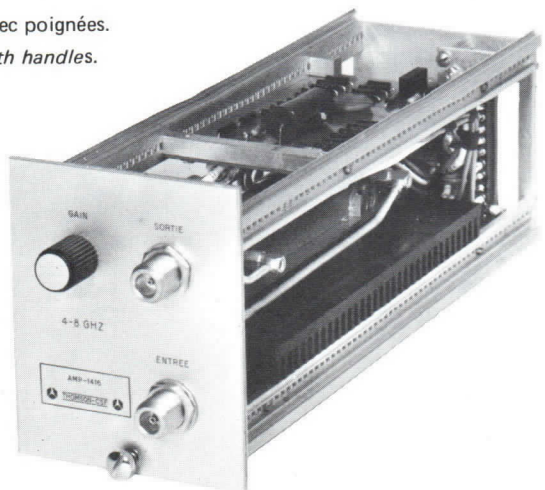
Réseau / *Mains Supply*	127 - 220 V ± 10 % / 50 - 60 Hz
Consommation / *Power use*	150 VA
Température d'utilisation / *Operating temperature*	+10 - +40
Sécurités / *Protection circuits*	de surintensité d'hélice, de température, de taux d'onde stationnaire / *helix overcurrent, overheating, VSWR*
Contrôles / *Meters*	du courant hélice, du courant collecteur / *helix current, collector current*
Réglage du gain / *Gain control*	par commande de la tension d'anode / *by anode voltage adjustment*

Caractéristiques mécaniques
Mechanical characteristics

	ALT 1410 AMP	ALT 1411 AMP
Poids approximatif / *Approximate weight*	16 kg	13 kg
Dimensions / *Dimensions* — Largeur / *Width*	445 mm	445 mm
Hauteur / *Height*	148 mm	148 mm
Profondeur * / *Depth* *	420 mm	320 mm



* Avec poignées.
* *With handles.*



Les tiroirs AMP sont équipés des TOP : *AMP units are equipped with TWT :*	
AMP 1413	TOP 1512
AMP 1415	TOP 1289
AMP 1416	TOP 1203
AMP 1417	F 4185
AMP 1418	TOP 1226

AMP 1413 1 - 2 GHz

Puissance nominale 10 W
Nominal output power 10 W

Caractéristiques Electriques
Electrical Characteristics

Fréquence - *Frequency*	1 - 2		GHz
Puissance de sortie - *Output power from*	1 - 1, 3	min. 4	W
	1, 3 - 2	min. 7, 5	W
Gain - *Gain*	1 - 1, 3	min. 28	dB
	1, 3 - 2	min. 33	dB
Facteur de bruit - *Noise factor*		26	dB
Bruit de modulation (1) - *FM Noise (1)*		< 70	dB
Puissance à l'entrée (2) - *Input power (2)*		max. 50	mW
Taux d'onde stationnaire (3) - *VSWR (3)*		max. 3	

Caractéristiques Mécaniques
Mechanical Characteristics

Masse approximative - *Approximate weight*	2, 6 kg
Dimensions - *Dimensions*	100 x 122 x 413 mm
Connecteur UHF entrée et sortie - *RF input and output connections*	coaxiales, type N, 50 ohms, femelle *50-ohm, female, type N coaxial connectors*

NOTES

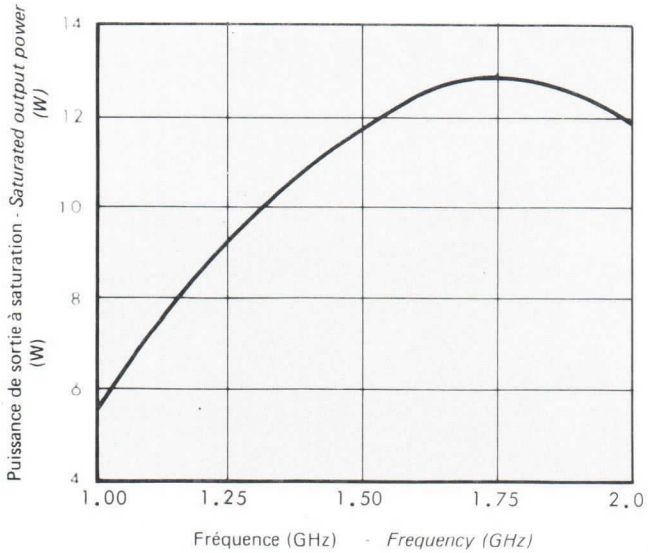
1 - Niveau de bruit mesuré dans une fenêtre de 4 kHz et rapporté à un signal de modulation de fréquence de référence de ± 280 kHz de déviation crête à crête.

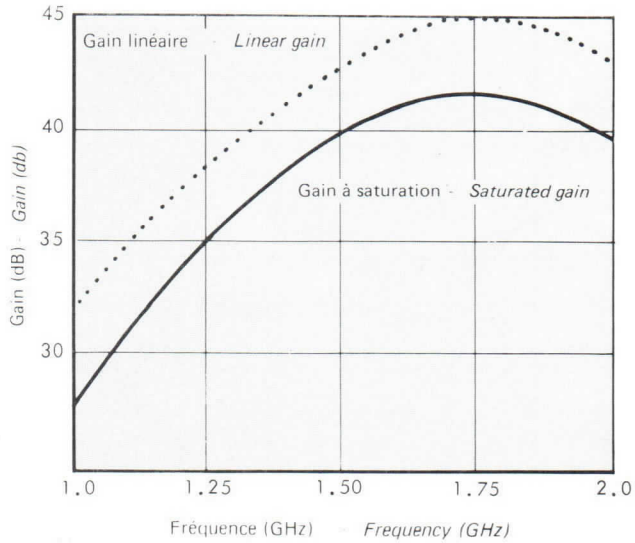
2 - 3 Un dispositif de sécurité entraîne l'arrêt de l'amplificateur en cas de surcharge.

1 - The FM noise measured in a 4-kHz window is referred to a FM reference signal of ± 280 kHz peak-to-peak deviation.

2 - 3 A protection device cuts off the supply voltages if the operating limits are exceeded.

Caractéristiques de fonctionnement - *Typical characteristics*





THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

AMP 1415 2 - 4 GHz

Puissance nominale 10 W
Nominal output power 10 W

Caractéristiques Electriques
Electrical Characteristics

Fréquence - *Frequency*		2–4	GHz
Puissance de sortie - *Output power from*	2 - 2, 2 GHz	min. 6, 5	W
	2, 2 - 4 GHz	min. 8, 5	W
Gain - *Gain*	2 - 2, 2 GHz	min. 31	dB
	2, 2 - 4 GHz	min. 33	dB
Facteur de bruit - *Noise factor*		26	dB
Bruit de modulation (1) - *FM Noise (1)*		< 70	dB
Puissance à l'entrée (2) - *Input power (2)*		max. 50	mW
Taux d'onde stationnaire (3) - *VSWR (3)*		max. 3	

Caractéristiques Mécaniques
Mechanical Characteristics

Masse approximative - *Approximate weight*	2, 6 kg
Dimensions - *Dimensions*	100 x 122 x 413 mm
Connecteur UHF entrée et sortie - *RF input and output connections*	coaxiales, type N, 50 ohms, femelle *50-ohm, female, type N coaxial connectors*

NOTES

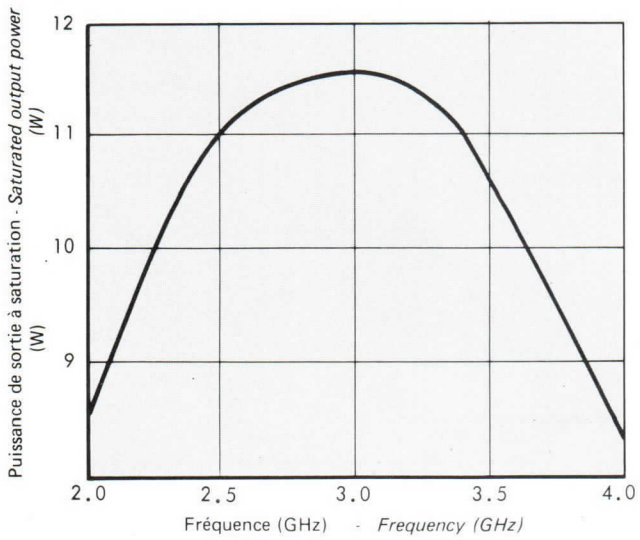
1 - Niveau de bruit mesuré dans une fenêtre de 4 kHz et rapporté à un signal de modulation de fréquence de référence de ± 280 kHz de déviation crête à crête.

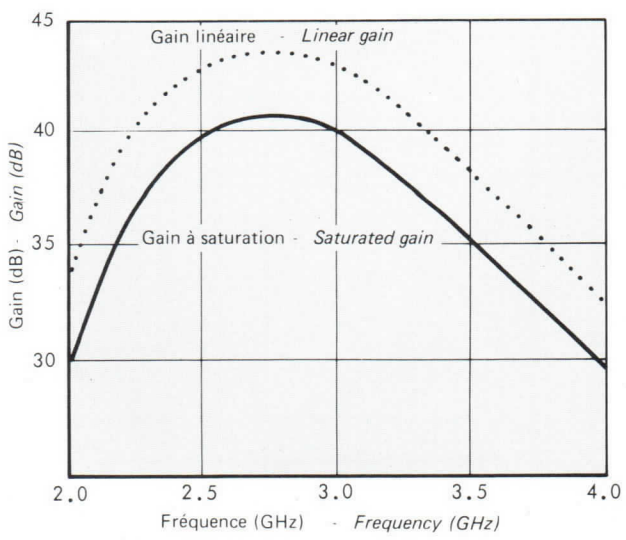
2 - 3 Un dispositif de sécurité entraîne l'arrêt de l'amplificateur en cas de surcharge.

1 - The FM noise measured in a 4-kHz window is referred to a FM reference signal of ± 280 kHz peak-to-peak deviation.

2 - 3 A protection device cuts off the supply voltages if the operating limits are exceeded.

Caractéristiques de fonctionnement - *Typical characteristics*





AMP 1416 4 - 8 GHz

Puissance nominale 7 W
Nominal output power 7 W

Caractéristiques Electriques
Electrical Characteristics

Fréquence - *Frequency*	4 - 8	GHz
Puissance de sortie - *Output power*	min. 6	W
Gain - *Gain*	min. 33	dB
Facteur de bruit - *Noise factor*	29	dB
Bruit de modulation (1) - - *FM Noise (1)*	< 70	dB
Puissance à l'entrée (2) - *Input power (2)*	max. 50	mW
Taux d'onde stationnaire (3) - *VSWR (3)*	max. 3	

Caractéristiques Mécaniques
Mechanical Characteristics

Masse approximative - *Approximate weight*	2, 2	kg
Dimensions - *Dimensions*	100 x 122 x 328	mm
Connecteur UHF entrée et sortie *RF input and output connections*	coaxiales, type N, 50 ohms, femelle *50-ohm , Female, type N coaxial connectors*	

NOTES

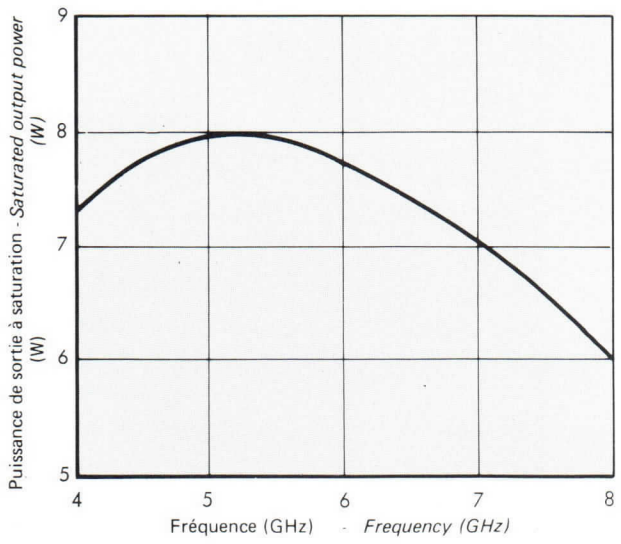
1 - Niveau de bruit mesuré dans une fenêtre de 4 kHz et rapporté à un signal de modulation de fréquence de référence de ± 280 kHz de déviation crête à crête.

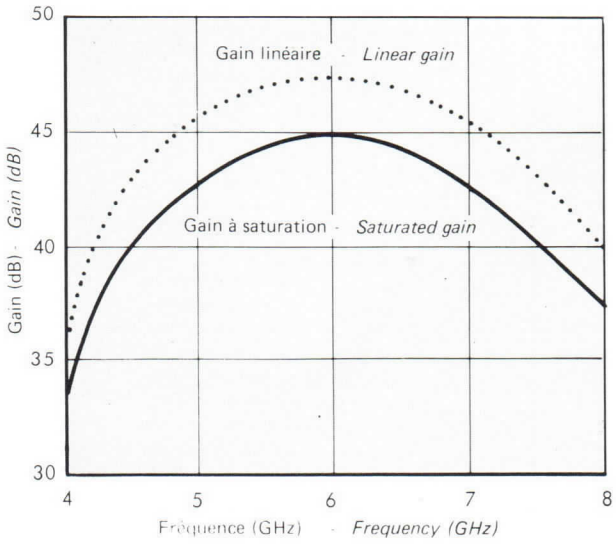
2-3 Un dispositif de sécurité entraîne l'arrêt de l'amplificateur en cas de surcharge.

1 - The FM noise measured in a 4-kHz window is referred to a FM reference signal of ± 280 kHz peak-to-peak deviation.

2-3 A protection device cuts off the supply voltages if the operating limits are exceeded.

Caractéristiques de fonctionnement - *Typical characteristics*





THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

AMP 1417 8 - 12,4 GHz

Puissance nominale 4 W
Nominal output power 4 W

Caractéristiques Electriques
Electrical Characteristics

Fréquence - *Frequency*		8 - 12,4	GHz
Puissance de sortie - *Output power*	min.	3,5	W
Gain - *Gain*	min.	38	dB
Facteur de bruit - *Noise factor*		29	dB
Bruit de modulation (1) - *FM Noise (1)*	<	70	dB
Puissance à l'entrée (2) - *Input power (2)*	max.	50	mW
Taux d'onde stationnaire - *VSWR*	max.	3	

Caractéristiques Mécaniques
Mechanical Characteristics

Masse approximative - *Approximate weight*	2,1 kg
Dimensions - *Dimensions*	100 x 122 x 328 mm
Connecteur UHF entrée et sortie *RF input and output connections*	coaxiales, type N, 50 ohms, femelle *50-ohm , Female, type N coaxial connectors*

NOTES

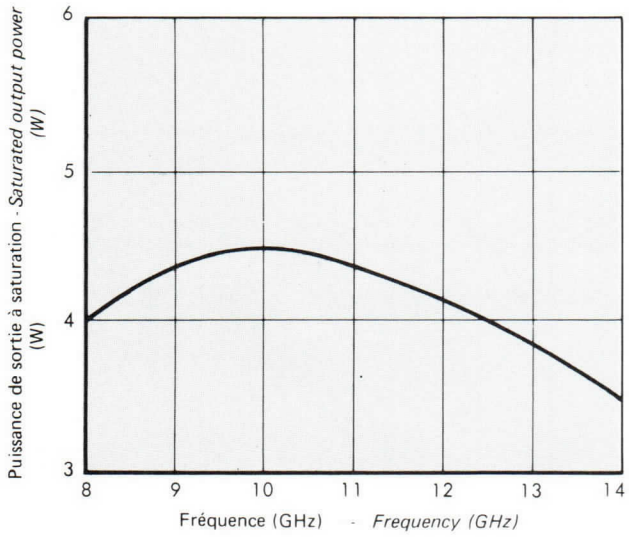
1 - Niveau de bruit mesuré dans une fenêtre de 4 kHz et rapporté à un signal de modulation de fréquence de référence de ± 280 kHz de déviation crête à crête.

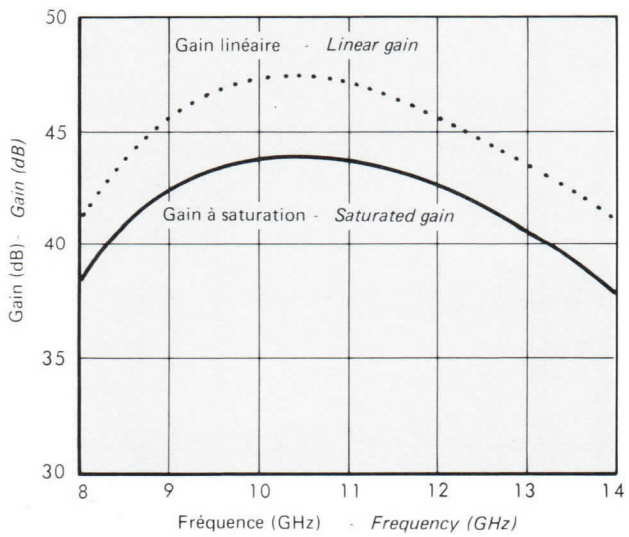
2 - Un dispositif de sécurité entraîne l'arrêt de l'amplificateur en cas de surcharge.

1 - The FM noise measured in a 4-kHz window is referred to a FM reference signal of ± 280 kHz peak-to-peak deviation.

2 - A protection device cuts off the supply voltages if the operating limits are exceeded.

Caractéristiques de fonctionnement - *Typical characteristics*





AMP 1418 12,4 - 18 GHz

Puissance nominale 2 W
Nominal output power 2 W

Caractéristiques Electriques
Electrical Characteristics

Fréquence - *Frequency*	12,4 -	18	GHz
Puissance de sortie - *Output power*	min.	1,5	W
Gain - *Gain*	min.	38	dB
Facteur de bruit - *Noise factor*		29	dB
Bruit de modulation (1) - *FM Noise (1)*	<	70	dB
Puissance à l'entrée (2) - *Input power (2)*	max.	50	mW
Taux d'onde stationnaire - *VSWR*	max.	3	

Caractéristiques Mécaniques
Mechanical Characteristics

Masse approximative - *Approximate weight*	2,1	kg
Dimensions - *Dimensions*	100 x 122 x 328	mm
Connecteur UHF entrée et sortie *RF input and output connections*	coaxiales, type N, 50 ohms, femelle *50-ohm , Female, type N coaxial connectors*	

NOTES

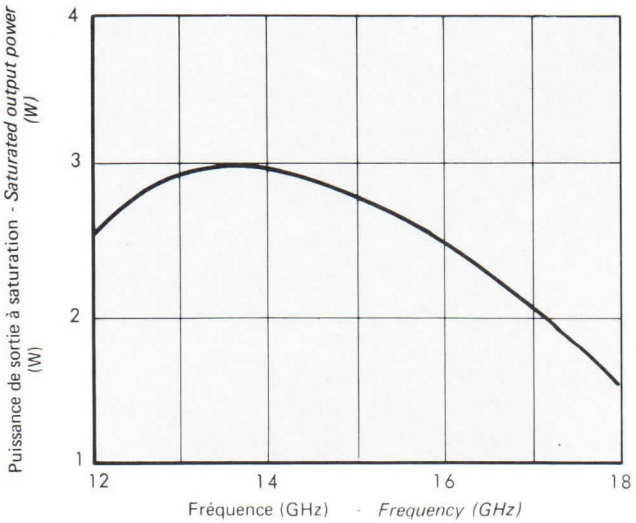
1 - Niveau de bruit mesuré dans une fenêtre de 4 kHz et rapporté à un signal de modulation de fréquence de référence de ± 280 kHz de déviation crête à crête.

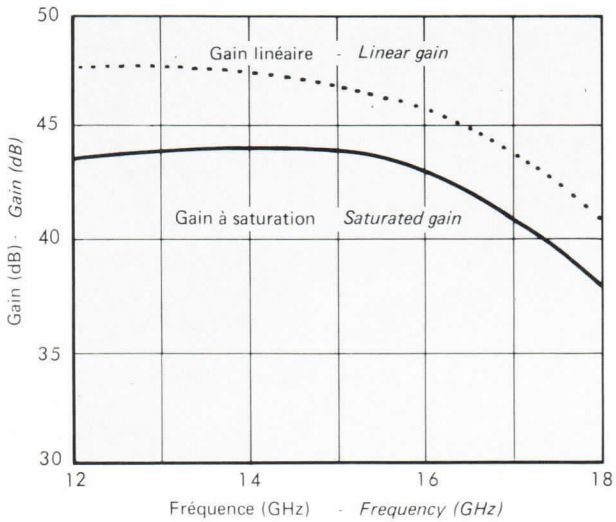
2 - Un dispositif de sécurité entraîne l'arrêt de l'amplificateur en cas de surcharge.

1 - The FM noise measured in a 4-kHz window is referred to a FM reference signal of ± 280 kHz peak-to-peak deviation.

2 - A protection device cuts off the supply voltages if the operating limits are exceeded.

Caractéristiques de fonctionnement - *Typical characteristics*





AMPLIFICATEURS U.H.F. A T.O.P.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

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GROUPEMENT TUBES ELECTRONIQUES

U.H.F. TRAVELING WAVE TUBE AMPLIFIERS

Broad bandwidth - High Gain - Medium power - Low noise

This TWTA series is designed by THOMSON-CSF for applications in laboratory fine measurements (control of noise, stability and modulation of RF sources, antenna pattern measurements, wobbulating etc ....)

THOMSON-CSF offers a complete line of TWTA's covering the entire frequency range from 1 to 18 GHz. Each model consists of a traveling wave tube associated to a power supply assembled within an enclosure forced air cooled by a self contained ventilating blower.

The six amplifiers unit listed are interchangeable in two power supplies, they offer the following characteristics :



Power Supply	Amplifier Unit	Frequency GHz	Gain dB	Minimum Output power* Watt
ALT 1410	AMP 1413	1 - 2	> 33	6
	AMP 1414	1.3 - 2.7	> 33	8.5
	AMP 1415	2 - 4	> 33	8.5
ALT 1411	AMP 1416	4 - 8	> 33	6
	AMP 1417	8 - 12.4	> 38	3.5
	AMP 1418	12.4 - 18	> 38	1.5

* *See curves on the individual data sheet of each AMP.*

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These equipments are designed for ease of operation. They feature small weight and dimensions. Protected against all sorts of mishandling by efficient safety circuits, and free of maintenance, they offer reliability, long life, handy operation and interchangeability.

GENERAL CHARACTERISTICS

Mains Supply :	127 - 220 V ± 10 % 50 - 60 Hz
Consumption :	⩽ 150 VA
Safety circuits :	helix overcurrent temperature VSWR
Controls :	helix current collector current

ALT 1410 and ALT 1411 POWER SUPPLIES

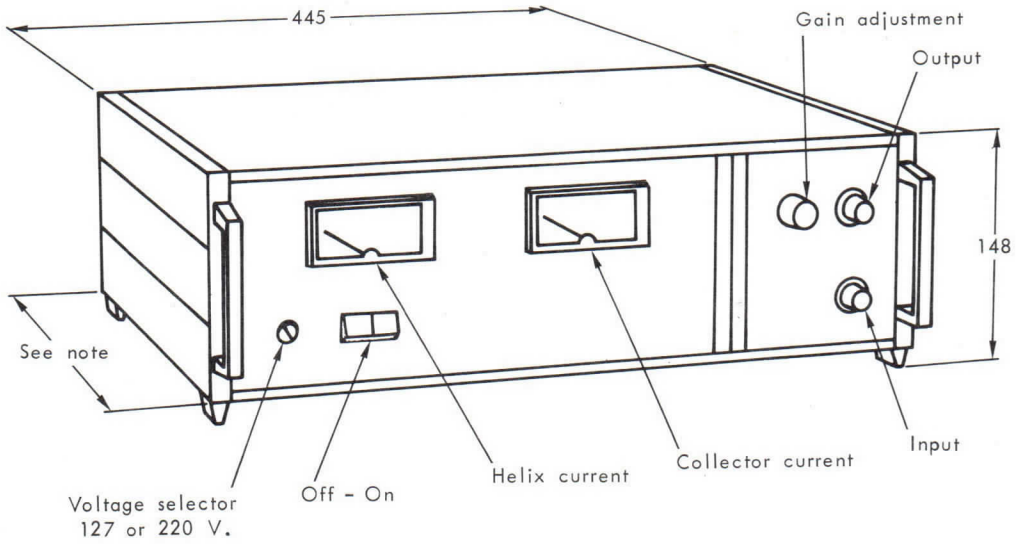
GENERAL CHARACTERISTICS

Mains Supply :	127 - 220 V ± 10% 50 - 60 Hz
Consumption :	150 VA
Operating temperature :	+10 to +40 °C
Safety circuits :	helix overcurrent overheating VSWR
Controls :	helix current collector current
Gain control :	by anode voltage adjustment



		ALT 1410 + AMP unit		ALT 1411 + AMP unit	
Approximate weight		13	kg	16	kg
Dimensions	Width	445	mm	445	mm
	Height	148	mm	148	mm
	Depth	420	mm	320	mm

OUTLINE DRAWING



NOTE : Depth of the unit ALT 1410 = 420 mm.
Depth of the unit ALT 1411 = 320 mm.

Dimensions in mm.

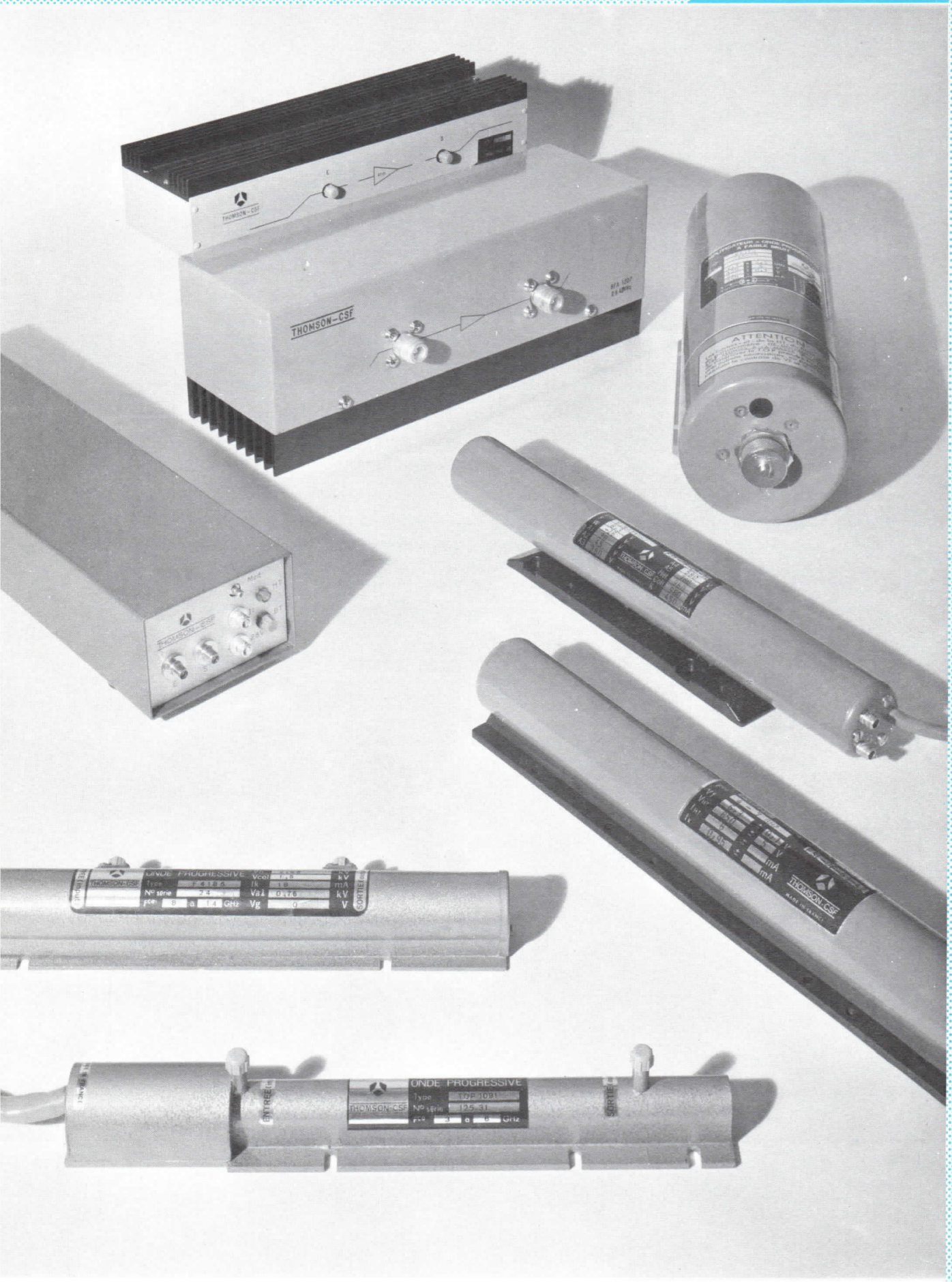
DATA TEH 4178

U.H.F. T.W.T AMPLIFIERS

January 1971

THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES



Some of the T.W.T. manufactured by **THOMSON-CSF**.

200-WATT CW TWT FAMILY

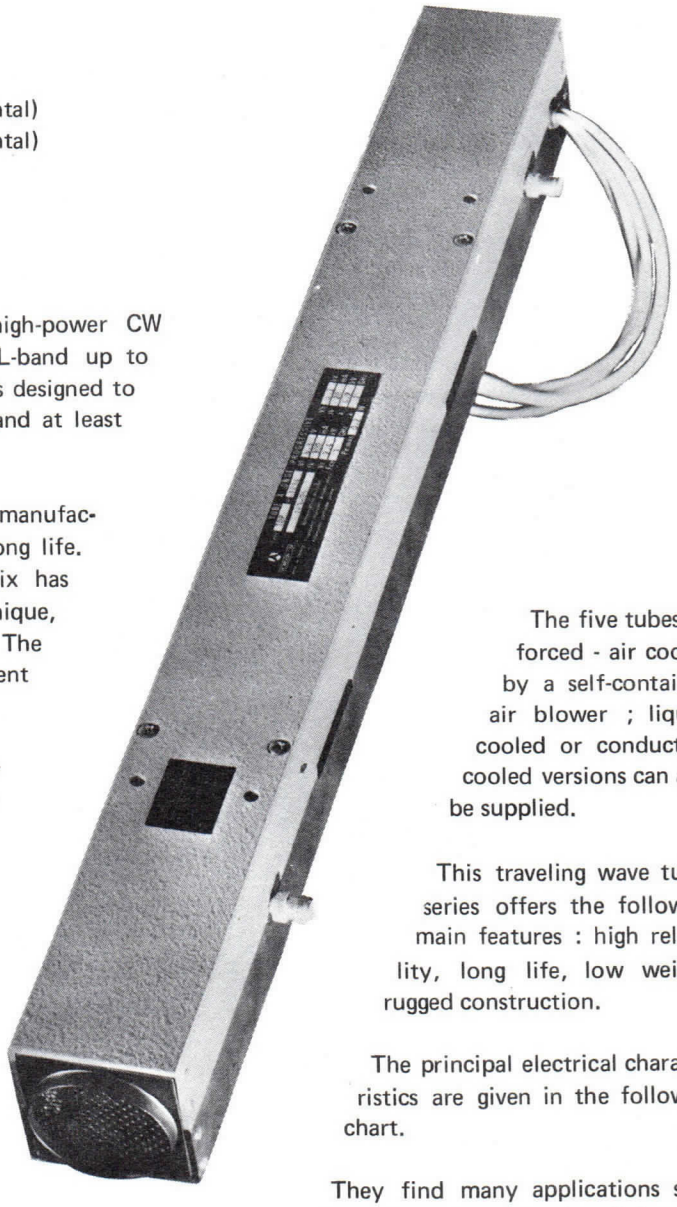
TOP. 1294	**1 - 2**	**GHz**	(available)
TOP. 1481	**2 - 4**	**GHz**	(objective)
TOP. 1432	**4 - 8**	**GHz**	(developmental)
TOP. 1334	**7 - 12.4**	**GHz**	(developmental)
TOP. 1482	**12.4-18**	**GHz**	(objective)

THOMSON-CSF is developing a high-power CW traveling wave tube family, ranging from L-band up to Ku-band. Each tube covers one octave and is designed to deliver 200 watts from L-band to X-band and at least 100 watts in Ku-band.

A new technology* of delay line manufacturing provides exceptional reliability and long life. The heat dissipation capability of the helix has been increased by a special brazing technique, resulting in lower operating temperature. The impregnated cathode, operating at low current density, provides longer life expectancy.

Collectors are insulated and depressed operation achieves high efficiency (25%). Upon request, they can be equipped with a low voltage control anode for pulse modulation.

* Patented



The five tubes are forced - air cooled by a self-contained air blower ; liquid-cooled or conduction cooled versions can also be supplied.

This traveling wave tubes series offers the following main features : high reliability, long life, low weight, rugged construction.

The principal electrical characteristics are given in the following chart.

They find many applications such as counter measures, data-link transmission, wideband communications,etc.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

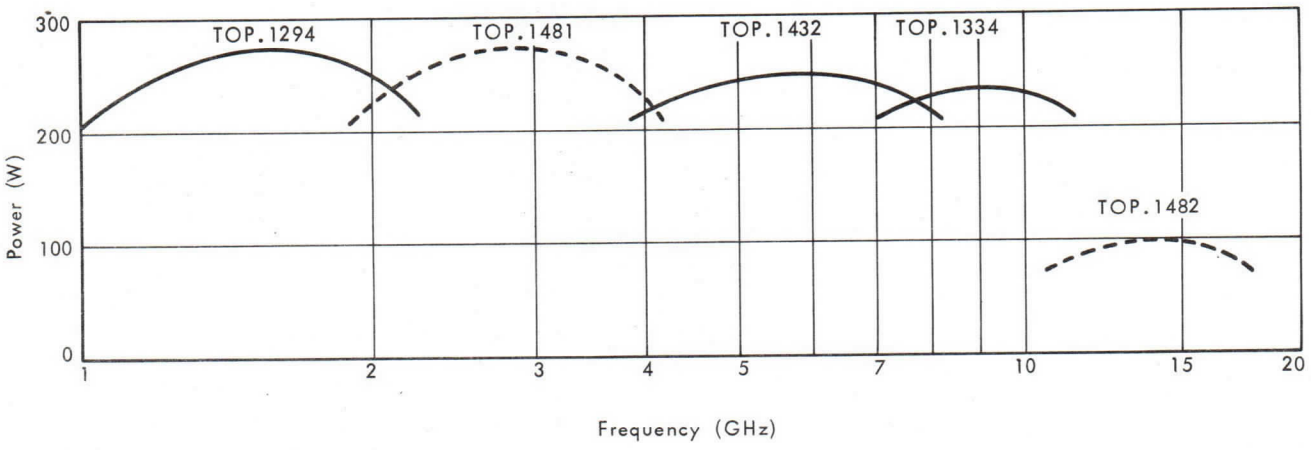
TOP. 1294	TOP. 1481	TOP. 1432	TOP. 1334	TOP. 1482

ELECTRICAL CHARACTERISTICS

Frequency	1 - 2 GHz	2 - 4 GHz	4 - 8 GHz	7 - 12. 4 GHz	12. 4 - 18 GHz
Output power	200 W	200 W	200 W	200 W	100 W
Gain	30 dB	30 dB	30 dB	30 dB	30 dB
Load VSWR	2. 5 : 1	2 : 1	1. 6 : 1	1. 8 : 1	

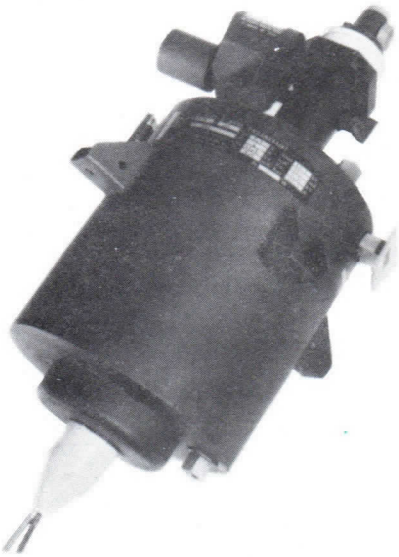
MECHANICAL CHARACTERISTICS

Operating position	any	any	any	any	any
Weight approximate	5 kg	3 kg	2. 1 kg	1. 9 kg	1. 6 kg
Cooling	forced air - 60 l/s	forced air - 60 l/s	forced air - 60 l/s	forced air - 60 l/s	forced air - 45 l/s
RF input connection	TNC	TNC	TNC	TNC	OSM
RF output connection	TNC	TNC	TNC	TNC	Waveguide



TOP. 117 TRAVELING WAVE TUBE

The TOP.117 is a traveling wave tube capable of delivering a CW power output in excess of 1 kW over a 25 % instantaneous bandwidth in the X-band region.



The tube is built with a severed circuit, consisting of two sections of helix delay line, both being terminated on internal matched loads. The tube interaction circuit is cooled by liquid circulation. Both helices are brazed on dielectric rods to evacuate the heat generated by electron bombardment and RF losses. Heat dissipation capability has been significantly increased by a special brazing technique, resulting in lower operating temperature and longer life expectancy.

Input and output ports are of the waveguide type. The output window is an original THOMSON-CSF development.

A solenoid focusing system has been chosen because of the importance of optimizing the beam transmission through the interaction circuit at this power level. The gun is of the convergent type and uses an impregnated cathode operating at low current density (1.4 amp/cm^2). An ion pump is permanently attached to the tube, and the tube technology is entirely metal-ceramic.

High voltage connections are flying leads and the gun insulator is potted in plastic.

Due to the wideband characteristics of the delay line, this tube is particularly well suited for military or civilian applications, such as satellite telecommunications, troposcatter or television broadcasting.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	typical	max.	
Frequency range		25 % at X-band		
Heater voltage	-	7	-	V
Heater current	-	4	-	A
Output power	1	-	-	kW
Small signal gain	-	35	-	dB
Helix voltage	10. 4	10. 9	11. 3	kV
Helix current	-	10	20	mA
Anode voltage	7. 0	7. 8	8. 5	kV
Anode current	-	0. 1	3. 0	mA
Collector voltage	10. 4	10. 9	11. 4	kV
Cathode current	-	760	850	mA

(1) All voltages are referenced to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight (approximate)	75 lbs
RF input and output waveguide	RG 52/U
RF input and output flange	UG 39/U
Electrical connections	flying leads
Cooling	water

ABSOLUTE RATINGS

	min.	max.	
Heater voltage (note 2)	−1.5	+1.5	%
Warm-up time	5	-	mn
Vibrations	-	25 Hz ± 40 mils	
Shocks	-	15 g 4 ms	
Water flow	5	-	gpm

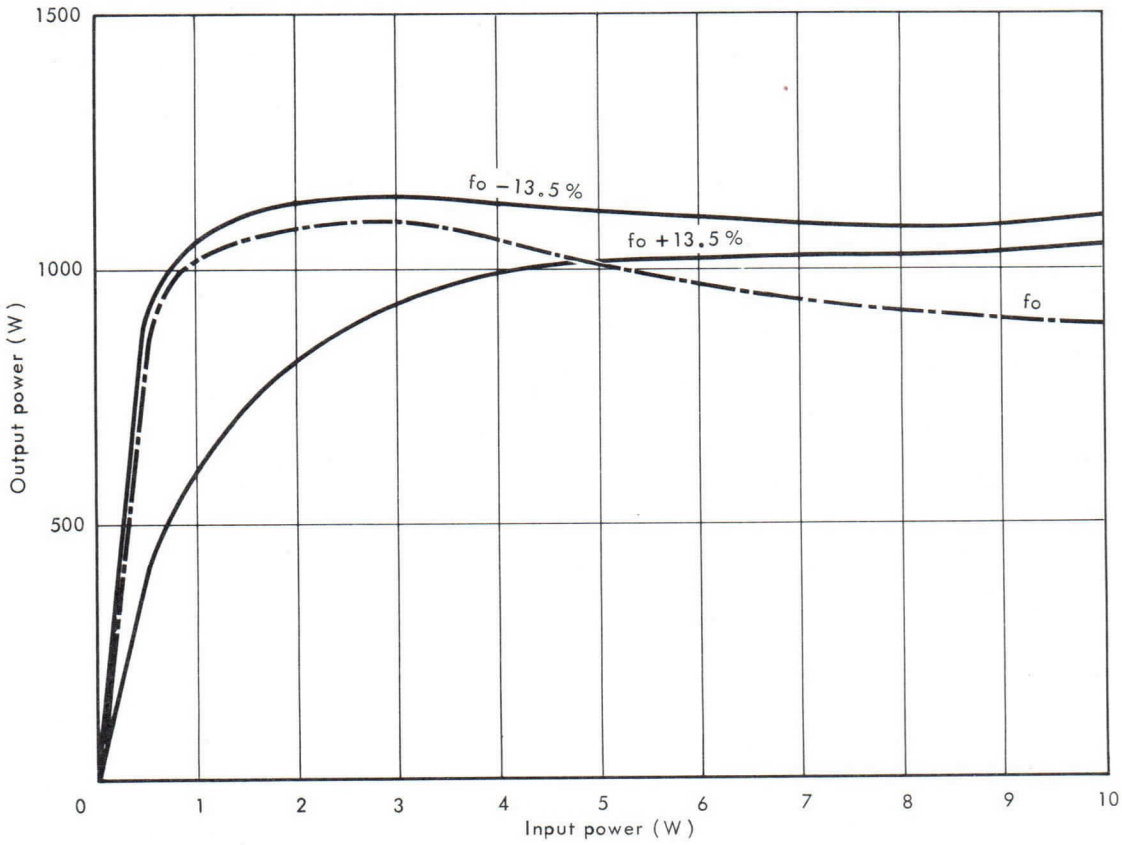
	min.	max.	
Helix voltage	10.4	11.4	kV
Helix current	-	20	mA
Anode voltage	7.2	8.5	kV
Anode current	-	3	mA
Collector voltage	10.4	11.4	kV
Cathode current	-	850	mA
Collector dissipation	-	9	kW
Drive power	-	6	W
Load VSWR	-	1.55 : 1	
Frequency range		30 % at X-band	

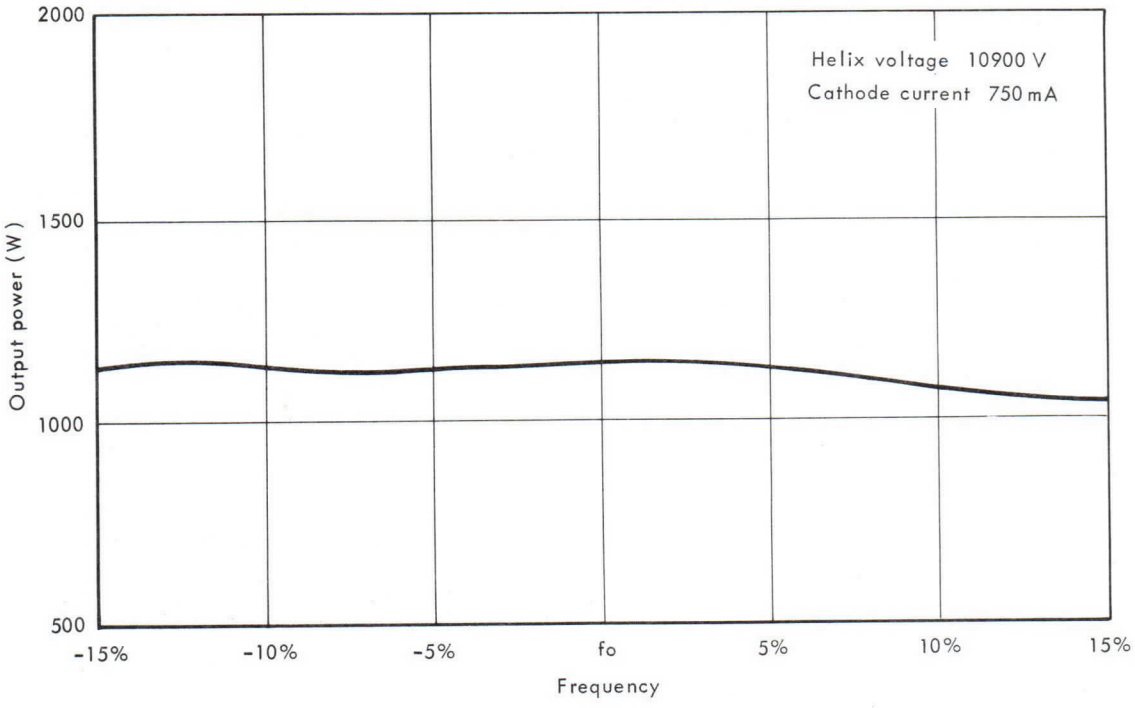
(2) of the value indicated in the Test Data Sheet.

TYPICAL OPERATION

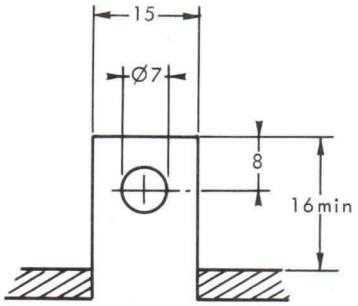
Frequency range	25 % at X-Band	
Heater voltage	7	V
Heater current	4	A
Output power	1150	W
Gain	See curve	
Helix voltage	10.9	kV
Helix current	10	mA
Anode voltage	7.8	kV
Anode current	0.1	mA
Cathode current	760	mA
Collector voltage	10.9	kV
Collector current	750	mA
Electromagnet current	39	A
Electromagnet voltage	41	V
Noise figure	35	dB
Ion pump voltage	4.5	kV
Ion pump current	1	μA

OPERATING CHARACTERISTICS

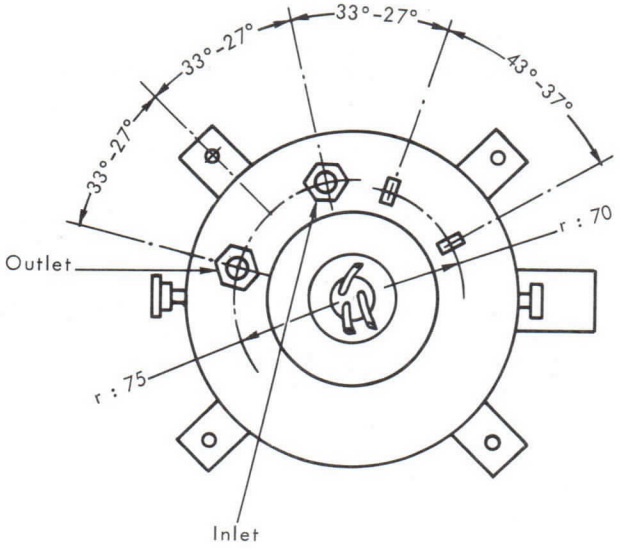




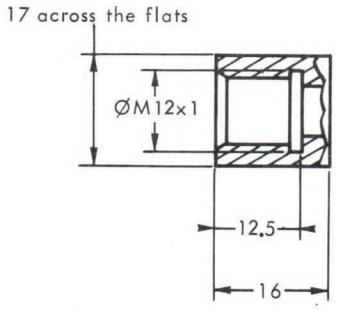
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES



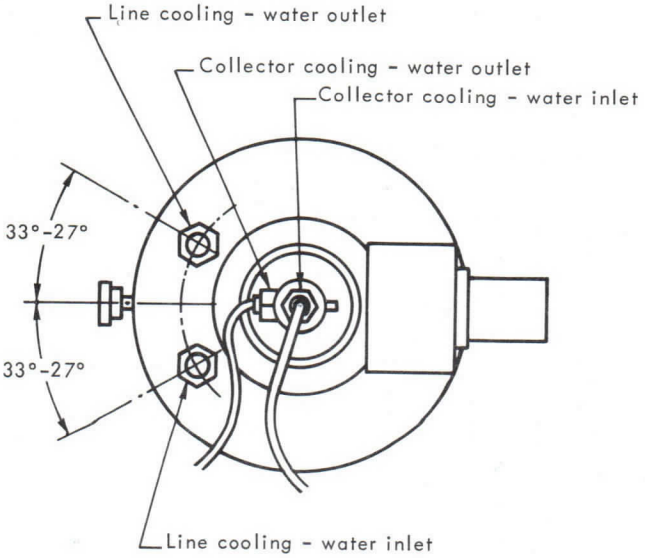
Focus connections



View A

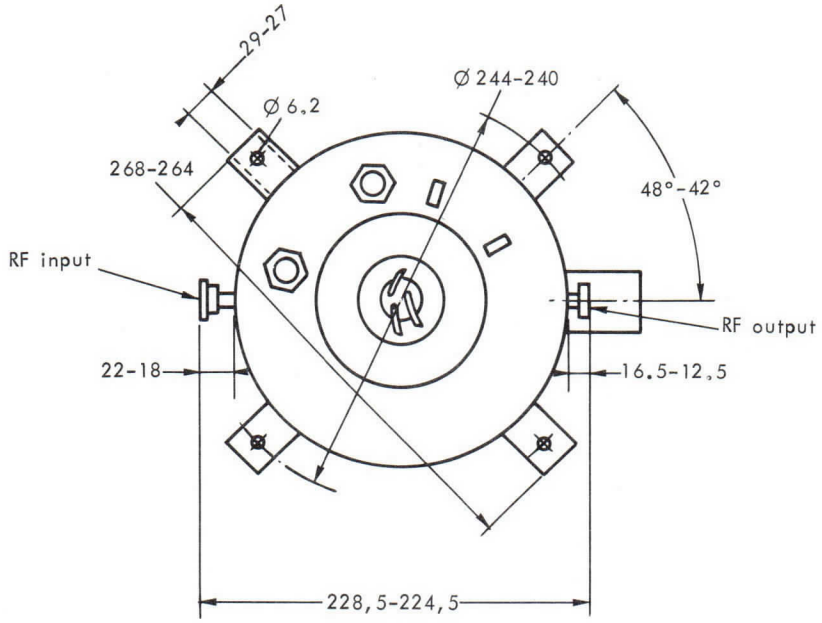


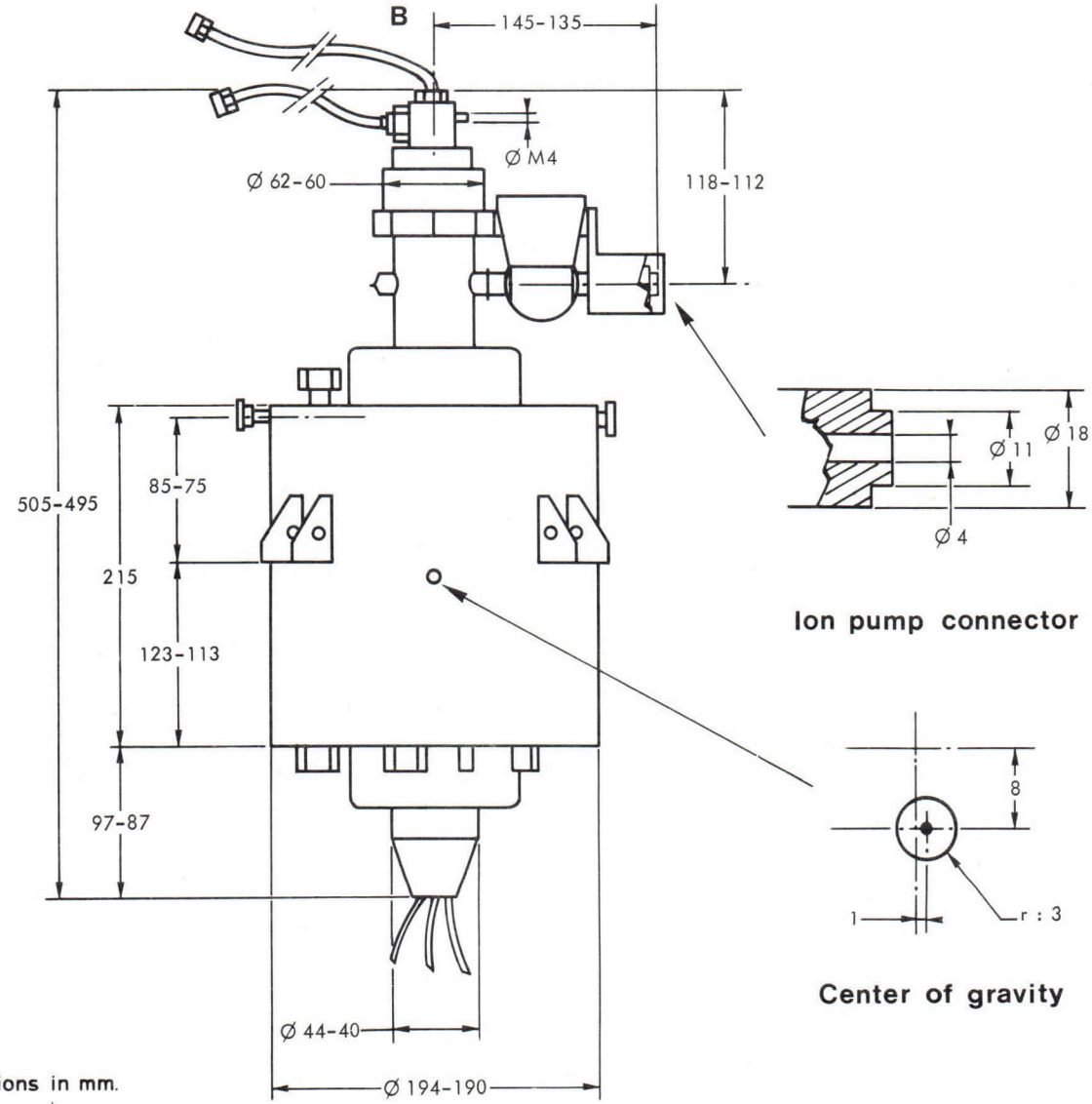
Water pipe union for collector



View B

OUTLINE DRAWING





Ion pump connector

Center of gravity

Dimensions in mm.



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

TOP. 1091 TRAVELING WAVE TUBE



The TOP.1091 traveling wave tube is a broadband amplifier capable of providing a minimum staurated output power of 3 W from 3. 0 to 6. 0 GHz. The saturation gain is more than 40 dB. Integral periodic permanent magnet focusing reduces the stray magnetic field and saves weight.

The TOP.1091 is cooled by natural convection and conduction. Because of its small size, light weight, and sturdy construction, this tube is especially attractive for transportable and airborne equipments.

A TWTA is available including TOP.1091 with its integral power supply :

The BFA.1298 is a small, light weight, compact, adjustment free microwave amplifier fitted with the TOP.1091, intended for airborne and transportable equipments, radio links and space communications. (See Data Sheet TEH 4076)

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Frequency	3		6	GHz
Heater voltage		4. 9		V
Heater current	0. 2		0. 3	A
Output power	3		—	W
Gain	40		—	dB
Helix voltage	1. 2		1. 6	kV
Helix current	—		2. 5	mA
Anode voltage	0. 8		1. 5	kV
Anode current	—		1. 0	mA
Collector voltage	0. 6		1. 0	kV
Cathode current	—		25	mA

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight (approx.)	400 g
RF connections	coaxial plugs OSM.202 (omni spectra)
Supply connections	flexible leads
Cooling	natural convection and conduction

ABSOLUTE RATINGS

(non simultaneous values)

	Min.	Max.	
Heater voltage	4. 3	5. 5	V
Heater surge current	–	0. 6	A
Warm-up time (1)	3	–	mn
Ambient temperature		100	°C
Vibrations		1 mm from 10 to 50	Hz
		10 g from 50 to 2000	Hz
Shocks		100 g – 11	ms
Helix voltage (2) nominal voltage	–200	+200	V
Helix current	–	3. 0	mA
Anode voltage (2) nominal voltage	–	+200	V
Anode current	–	2. 0	mA
Collector voltage (2) nominal voltage	–200	+200	V
Cathode current	–	30	mA
Load VSWR	–	3 : 1	

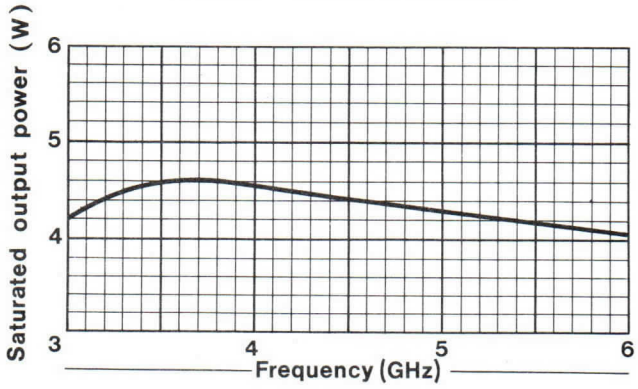
(1) - Not necessary if the heater supply is turned off for less than cinq seconds.

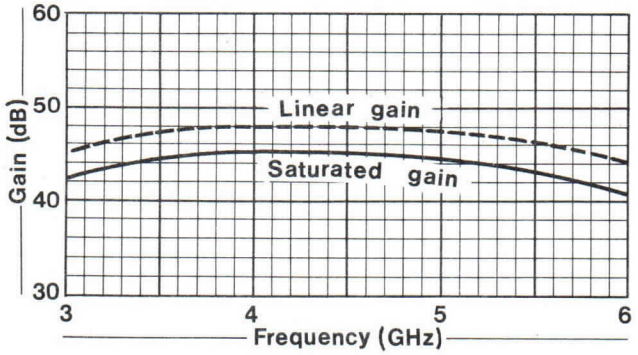
(2) - Nominal voltages are given on the label and on Test Data Sheet of each tube.

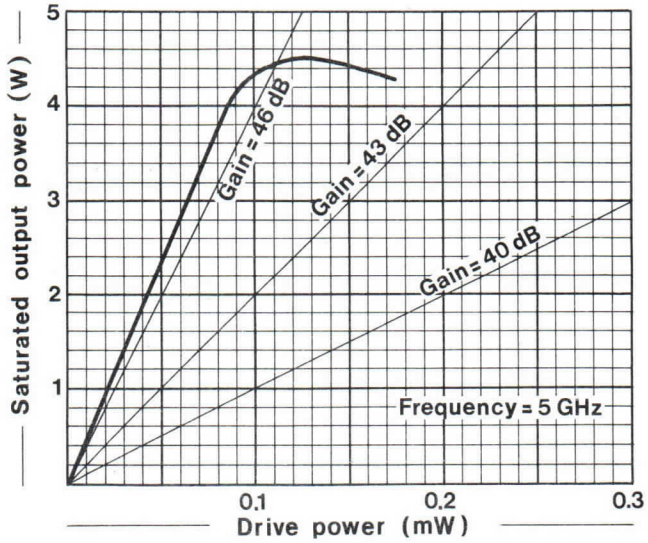
TYPICAL OPERATION

Frequency	5	GHz
Heater voltage	4. 9	V
Heater current	0. 23	A
Drive power	0. 1	mW
Output power	4. 2	W
Gain	45	dB
Helix voltage	1. 4	kV
Helix current	300	µA
Anode voltage	1. 4	kV
Anode current	0	
Cathode current	22	mA
Collector voltage	0. 6	kV

Typical characteristics

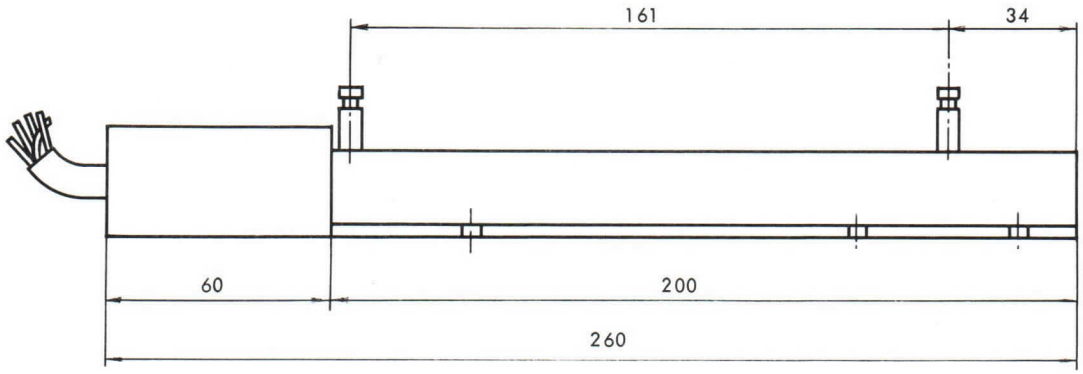




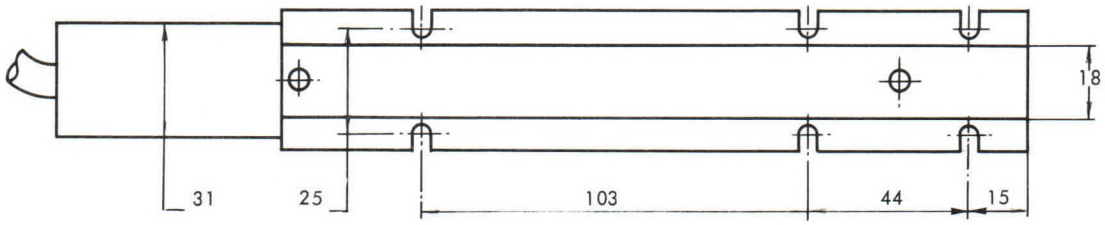


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

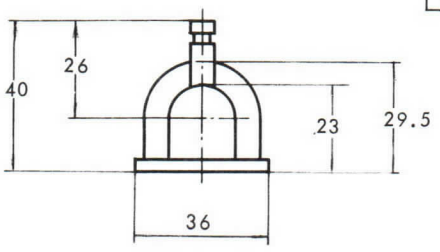
OUTLINE DRAWING



Fixing slots width : 4.5



Connections	
Brown	Heater-cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix



Dimensions in mm.

TOP 1487 - TOP 1487 B

TUBES A ONDE PROGRESSIVE DE GRANDE PUISSANCE EN REGIME CONTINU

- Etudié spécialement pour les stations au sol de communications par satellites.
- Puissance élevée en bande C : ce tube fournit une puissance de sortie à saturation supérieure à 1,2 kW (TOP 1487) ou 1,5 kW (TOP 1487 B).
- Gain élevé : au moins 34 dB à pleine puissance.
- Bobine de focalisation intégrée permettant une maintenance sans réglages.
- Tube et bobine de focalisation entièrement refroidis par air.
- Hélice brasée et construction métal/céramique assurant une fiabilité et une robustesse exceptionnelles.
- Cathode en tungstène imprégné et pompe ionique incorporée, permettant d'accroître la durée de vie. La pompe ionique ne nécessite aucune alimentation supplémentaire.
- Anode et hélice fonctionnant à partir d'une alimentation commune.



Le TOP 1487 et le TOP 1487 B sont des tubes à onde progressive de grande puissance, en bande C, conçus spécialement pour équiper les émetteurs des stations au sol de communications par satellites. Ils conviennent tout particulièrement aux stations de faible coût d'installation, et correspondent aux normes ICSC pour la transmission simultanée de voies téléphoniques, et voies de type SPADE, comme il est fait avec les satellites INTELSAT IV.

Ces tubes à large bande présentent un gain pratiquement constant, très peu de variation de temps de propagation de groupe, une très faible distortion de conversion AM/PM, et un bas niveau de produits d'intermodulation du troisième ordre.

Le TOP 1487 et le TOP 1487 B fonctionnent dans la bande 5925 - 6425 MHz, avec une puissance de sortie minimale à saturation de 1,2 et 1,5 kW respectivement. Le fonctionnement avec collecteur déprimé permet d'obtenir un rendement typique global de 25 %.

Grâce à une technologie particulière qui limite le courant d'anode à une valeur très faible, l'hélice et l'anode peuvent fonctionner à partir d'une alimentation haute tension commune. Un pont diviseur de tension à haute impédance est utilisé pour porter l'anode au niveau de haute tension nécessaire.

La longue durée de vie des tubes est dûe à la conception du canon électronique qui comporte une cathode en tungstène imprégnée. Cette cathode permet d'atteindre des densités de courant de l'ordre de 1 A/cm^2.

Le TOP et sa bobine de focalisation sont réglés en usine afin d'obtenir les meilleures performances de l'ensemble, de ce fait les réglages délicats et les pertes de temps qui en résultent sont épargnés à l'utilisateur. L'emploi de technologies nouvelles a permit de réaliser un ensemble tube-focalisateur allégé et de faible encombrement. Un système de ventilation débitant seulement 135 litres d'air par seconde (8,1 m^3/mn) suffit pour refroidir le TOP et sa bobine de focalisation.

CARACTERISTIQUES GENERALES

Electriques

	TOP 1487	TOP 1487 B	
Fréquence	5, 925 - 6, 425	5, 925 - 6, 425	GHz
Puissance de sortie à saturation	1, 2	1, 5	kW
Gain à 1500 W de puissance de sortie	$\geqslant$ 34	$\geqslant$ 35	dB
Rendement	25	25	%
Conversion AM/PM :			
P_s = 1200 W (TOP 1487) ou 1500 W (TOP 1487 B)	7	6	°/dB
P_s = 200 W	3	2	°/dB
Variation maximale de gain (P_s = 200 W)	0, 03	0, 03	dB/MHz
Tension de chauffage	6	6	V
Courant de chauffage	3, 25 - 4, 25	3, 25 - 4, 25	A
Tension d'anode	7 - 8, 5	7 - 8, 7	kV
Tension de collecteur	6, 5 - 8	6, 5 - 8	kV
Courant de cathode	0, 7 - 0, 95	0, 7 - 0, 95	A
Tension de focalisation	10	10	A
Courant de focalisation	250	250	V
Produit d'intermodulation du 3ème ordre pour deux porteuses de 75 W, avec écart de 5 MHz	–24	–26	dB

Mécaniques

Position de fonctionnement	verticale, collecteur vers le haut
Masse, focalisateur compris	30 kg
Entrée RF, coaxiale (1)	OSM ou RIM
Sortie RF, guide	RG 50
Connexions électriques	fils souples
Refroidissement	air forcé

VALEURS LIMITES DES CARACTERISTIQUES POUR PROJETS D'EQUIPEMENT (2)

(non simultanées)

	TOP 1487 et TOP 1487 B		
	Min.	Max.	
Courant de chauffage au démarrage	–	5	A
Tension de chauffage	5, 95	6, 05	V
Temps de préchauffage	5	–	mn
Fréquence	5, 85	6, 50	GHz
Puissance d'entrée	–	1, 5	W
Tension d'hélice	–	11	kV
Tension collecteur	–	8	kV
Dissipation collecteur	–	7	kW
Tension d'anode (3)	–	1, 025 V_a nom.	kV
ROS de la charge	–	1, 5	
Tension focalisateur	–	500	V
Courant focalisateur	–	10	A
Débit d'air	135	–	l/s
Température d'entrée d'air	–40	+ 55	°C
Distance des matériaux magnétiques	5	–	cm

(1) Peut être livré avec une entrée coaxiale TNC ou sur guide RG 50.

(2) Ces valeurs limites **NE SONT PAS** des valeurs de fonctionnement et ne doivent jamais être dépassées, même en régime transitoire. Chaque valeur extrême devant être considérée comme limitative en elle-même, deux ou plusieurs valeurs extrêmes ne doivent pas être atteintes simultanément.

(3) La tension d'anode doit toujours être inférieure ou au plus égale à la tension d'hélice moins 500 V.

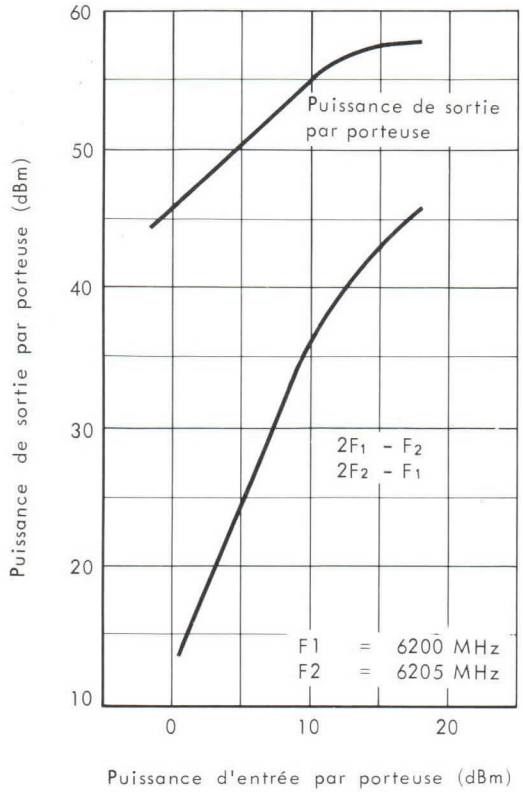
EXEMPLE D'UTILISATION

mono-porteuse

	TOP 1487	TOP 1487 B	
Fréquence	6, 2	6, 2	GHz
Puissance de sortie	1, 30	1, 60	kW
Gain	37	40	dB
Taux de conversion AM/PM	6	4	°/dB
Tension de chauffage	6	6	V
Courant de chauffage	3, 7	3, 7	A
Tension d'anode	7, 6	8, 1	kV
Courant de cathode	810	900	mA
Tension d'hélice	9, 7	9, 9	kV
Courant d'hélice	2	4	mA
Tension collecteur	6, 5	6, 5	kV
Tension de focalisation, env.	8, 5	8, 6	V
Courant de focalisation	180	190	A

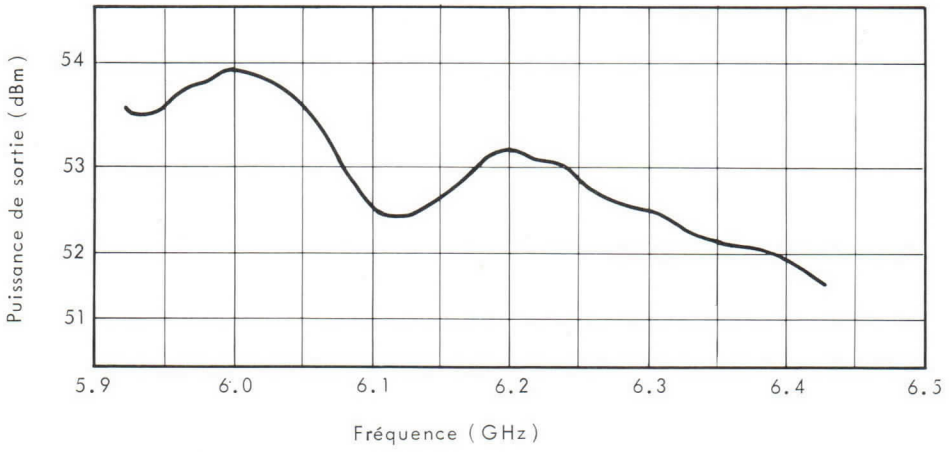
multi-porteuses

Intermodulation de troisième ordre :			
- pour deux porteuses de 75 W, avec écart de 5 MHz	−26	−28	dB
- pour deux porteuses de 125 W, avec écart de 5 MHz	−21	−23	dB
Taux de conversion AM/PM	2	<2	°/dB
Tension d'hélice	9, 7	9, 9	kV
Courant d'hélice	1	2	mA



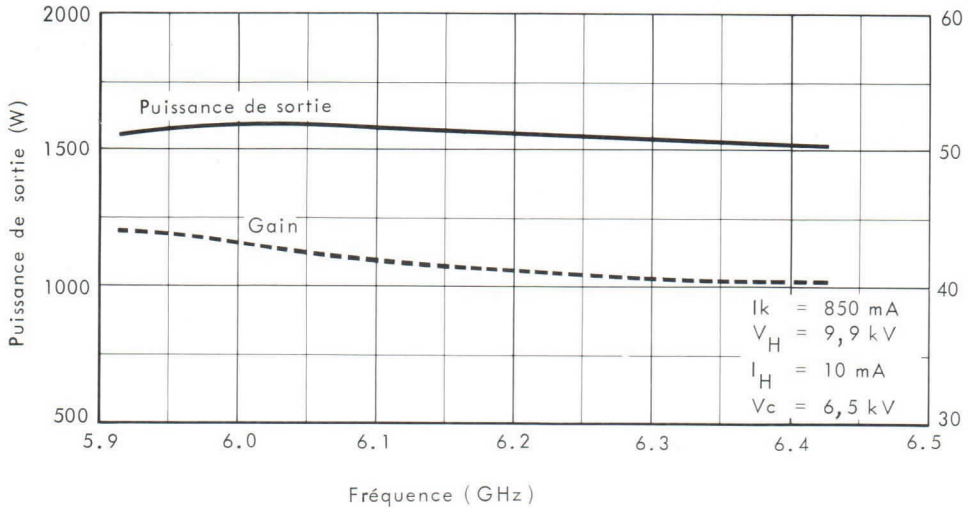
PRODUITS D'INTERMODULATION D'ORDRE 3

TOP 1487



VARIATIONS FINES DE GAIN
EN PETIT SIGNAL
Puissance d'entrée 5 mW

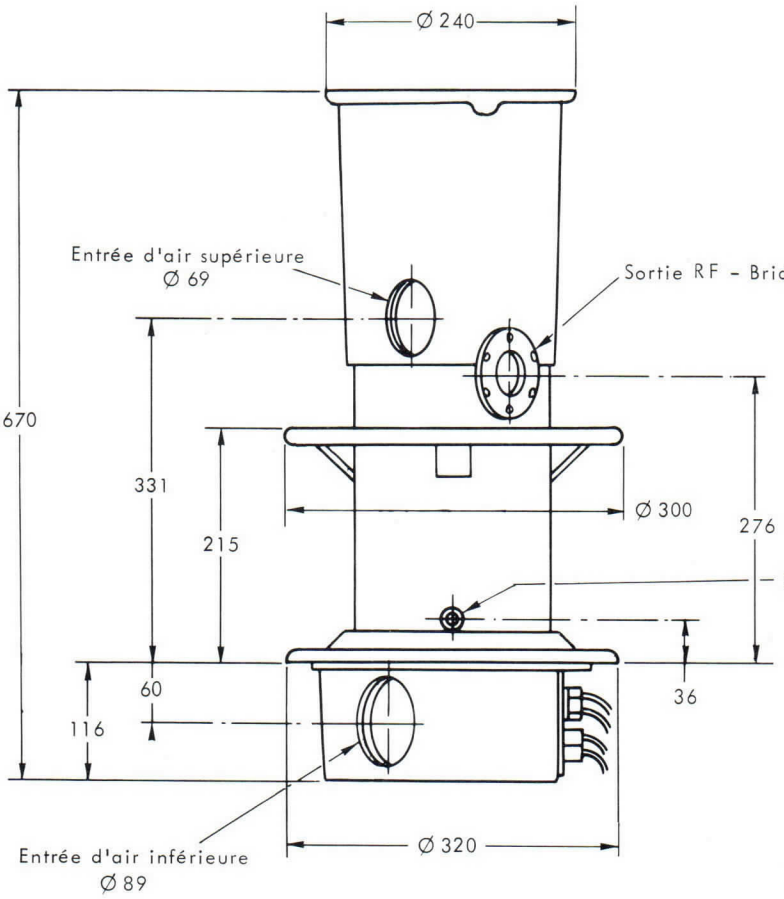
TOP 1487



PUISSANCE DE SORTIE ET
GAIN A SATURATION
(en fonction de la fréquence)

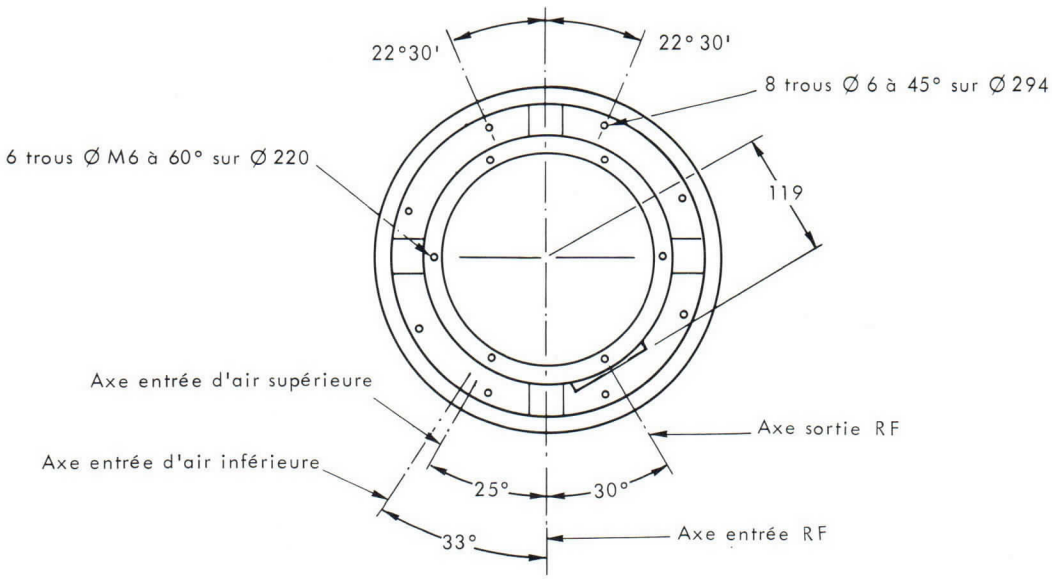
TOP 1487B

DESSIN D'ENCOMBREMENT



CONNEXIONS	
Filament	Brun
Filament-cathode	Jaune
Anode	Bleu
Collecteur	Rouge
Masse	Noir

Longueur des fils : de 300 à 400

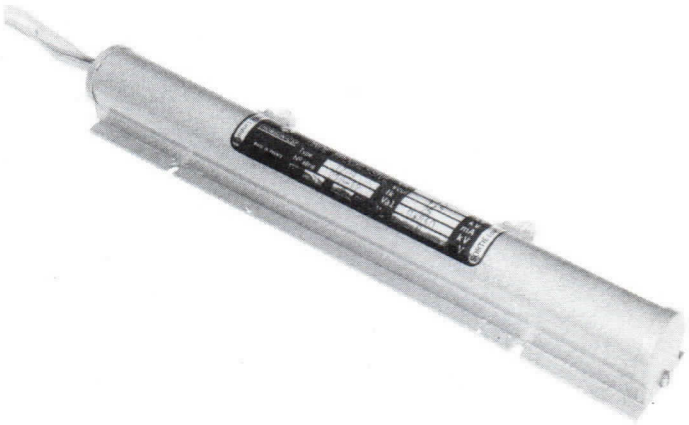


Cotes en mm.


THOMSON-CSF

TOP.1203
TRAVELING WAVE TUBE

The TOP1203 traveling wave tube is a broadband amplifier capable of providing a minimum saturated output power of 7 W from 4.0 to 8.0 GHz. The gain for an output power of 7 W is more than 35 dB. Integral periodic permanent focusing reduces the stray magnetic field and saves weight.



The TOP1203 is cooled by natural convection and conduction. Because of its small size, light weight, and sturdy construction this tube is especially attractive for transportable and airborne equipments.

The AMP.2077A amplifier, fitted with the TOP1203 traveling wave tube is ideal for laboratory measurements, wideband amplification for radars and communications, antenna pattern measurements etc.. This amplifier incorporates a power supply, a TOP1203 traveling wave tube with its permanent magnet, a modulating circuit and security devices.

A TWTA is available including TOP1203 with its integral power supply :

The BFA.1208 is a small, light weight, compact, adjustment free microwave amplifier fitted with the TOP1203 intended for airborne and transportable equipments, radio links and space communications. (see Data Sheet TEH 4081).

GENERAL CHARACTERISTICS (1)

Electrical

	min.	max.	
Frequency	4.0	8.0	GHz
Heater voltage	6.2	6.4	V
Heater current	0.3	0.6	A
Output power	7		W
Gain for an output power of 7 W	35		dB
Helix voltage	2.4	2.8	kV
Helix current		2.0	mA
Anode voltage	0.5	1.0	kV
Anode current		1.0	mA
Collector voltage	1.2	1.6	kV
Cathode current		26	mA

(1) All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight (approx).	600 g
RF connections	coaxial plugs OSM 202 (omni spectra)
Supply connections	flexible leads
Cooling	conduction

ABSOLUTE RATINGS

(non simultaneous values)

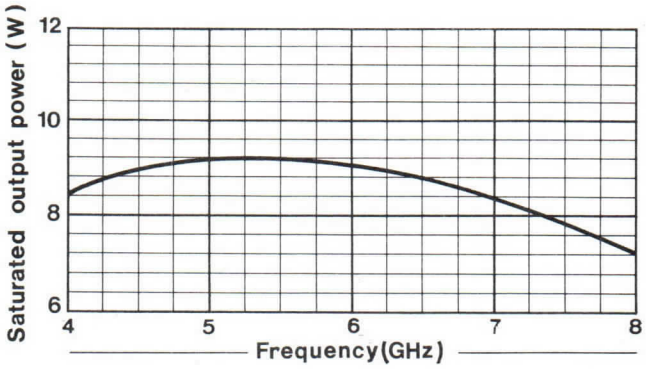
	min.	max.	
Heater voltage	6. 0	6. 6	V
Heater surge current	–	1. 2	A
Warm-up time	3	–	mn
Ambient temperature	–	100	°C
Vibrations	–	1 mm between 10 to 50	Hz
		10 g between 50 to 2000	Hz
shocks	–	100 g – 11	ms
Helix voltage (1) nominal voltage	–200	+200	V
Helix current	–	2. 5	mA
Anode voltage (1) nominal voltage	–	+200	V
Anode current	–	2. 0	mA
Collector voltage (1) nominal voltage	–200	+200	V
Cathode current		28	mA
Load VSWR	–	3 : 1	

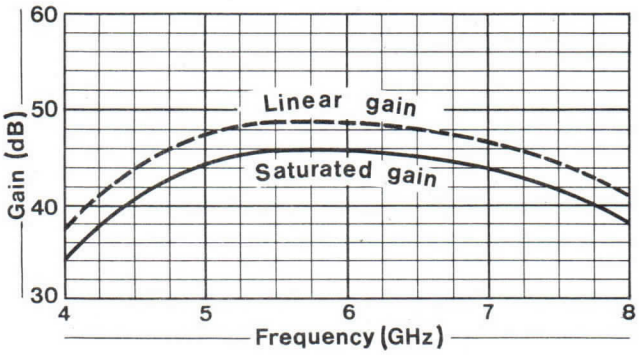
(1) The nominal voltage is indicated for each tube on the test Data Sheet.

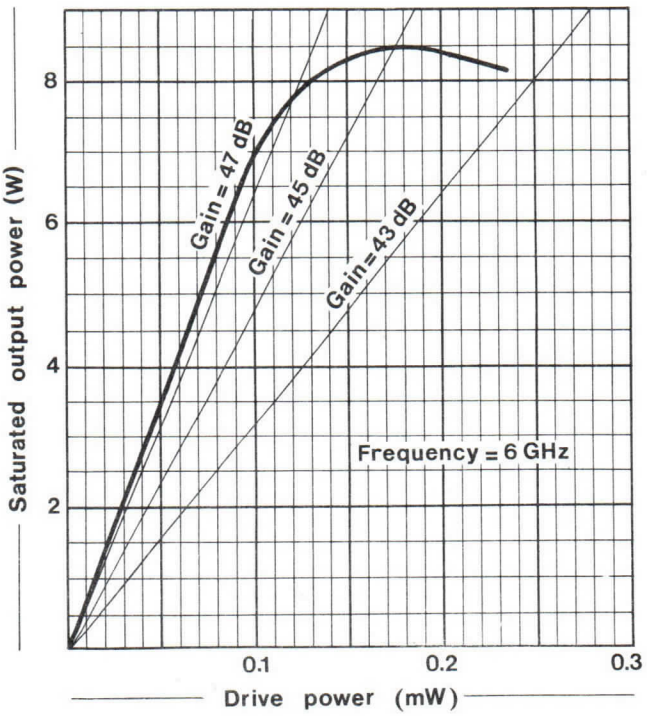
TYPICAL OPERATION

Frequency	6	GHz
Heater voltage	6. 3	V
Heater current	0. 48	A
Drive power	0. 15	mW
Output power	8. 2	W
Gain	45	dB
Helix voltage	2. 55	kV
Helix current	300	µA
Anode voltage	0. 85	kV
Anode current	0	
Cathode current	25	mA
Collector voltage	1. 5	kV

Typical characteristics

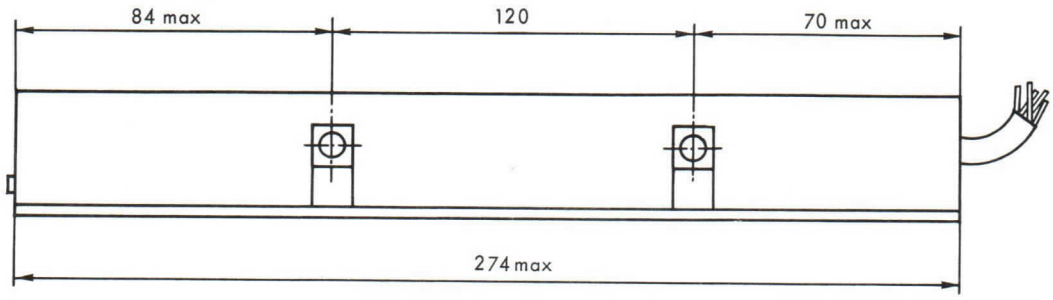


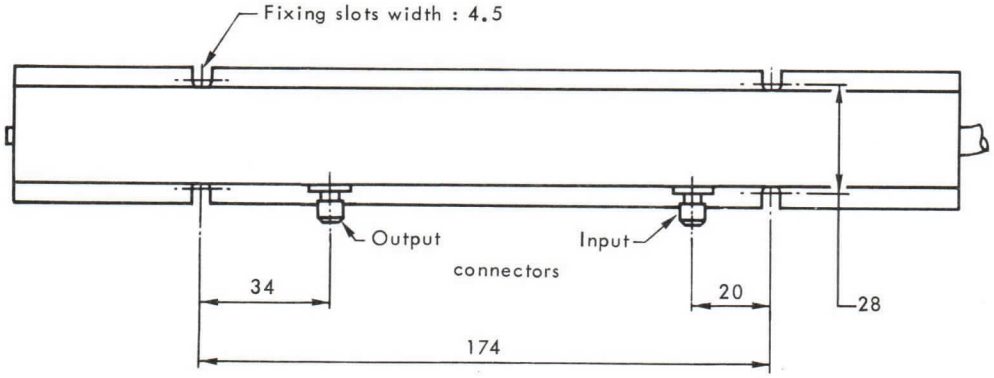


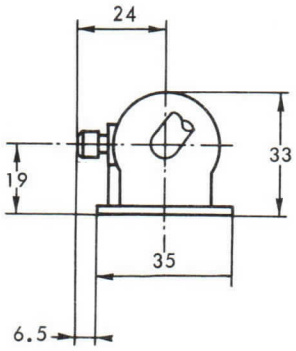


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING







Connections	
Brown	Heater-cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix

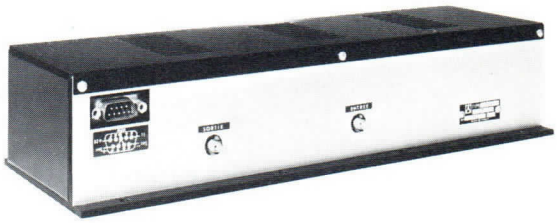
Dimensions in mm.

BFA 1208

TRAVELING-WAVE TUBE AMPLIFIER

The BFA 1208 is a small, lightweight, compact, adjustment-free microwave amplifier, which incorporates a traveling-wave tube, a solid-state power supply and protection devices.

This combination provides the best performances, the highest efficiency, the most reduced size and weight, and the lowest price for the TWTA.



The BFA 1208 operates from a DC power supply, regulated to within ± 1 %. Cooling is by conduction through the amplifier's base plate and convection. According to the cooling requirements, different types of heat radiators (not supplied) may be attached to the base plate to facilitate the convection process.

The principal characteristics of the BFA 1208 are :

Frequency range . . . . . 4 to 8 GHz
Output power, min. . . . . 7 W
Gain, min. . . . . 35 dB

GENERAL CHARACTERISTICS

Electrical

	Min.	Max.	
Frequency	4.0	8.0	GHz
Saturation gain	35	–	dB
Noise figure	–	28	dB
Output power	7	–	W
Gain variation	–	15	dB
Supply voltage	28 – 1 %	28 + 1 %	V
Power consumption	–	70	W

Mechanical

Input and output RF connections	SMA female
Power-supply and security-device connections	DEM 9 P connector
Cooling	By conduction and convection
Dimensions	328 x 115 x 70 mm
Weight	2.3 kg

ABSOLUTE RATINGS
(Non-simultaneous)

	Min.	Max.	
Storage temperature	–30	+60	°C
Operating temperature	0	+50	°C
VSWR of the load	–	3 : 1	
Supply voltage	27	29	VDC

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

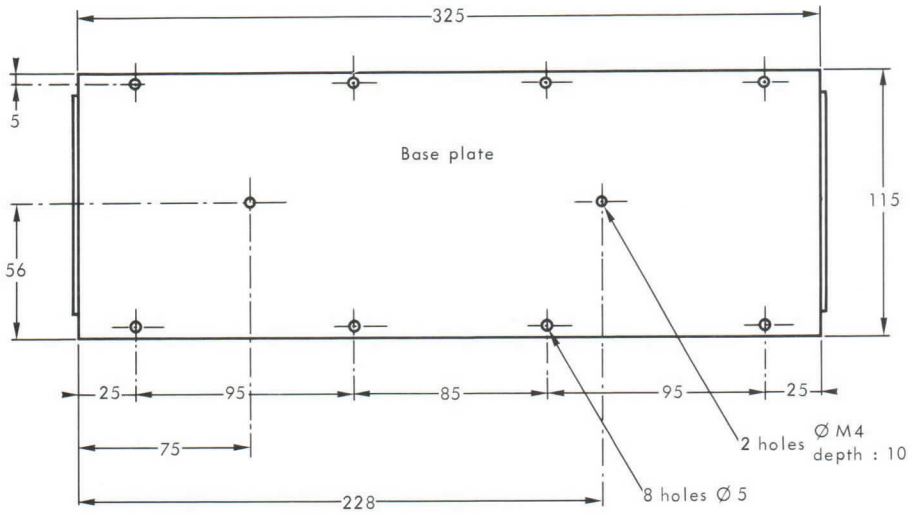
PROTECTION DEVICES AND CONTROL CIRCUITS INTEGRAL TO THE TWTA

Warm-up timing : Integral to the traveling-wave-tube amplifier and set for 180 seconds.

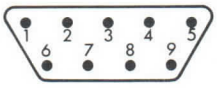
Helix current : Integral overcurrent security device, prevents the current from exceeding 2 mA. The same protection device may be controlled by an external signal (VSWR).

Collector current : A circuit is provided for checking the collector current value (approximately : 30 mA).

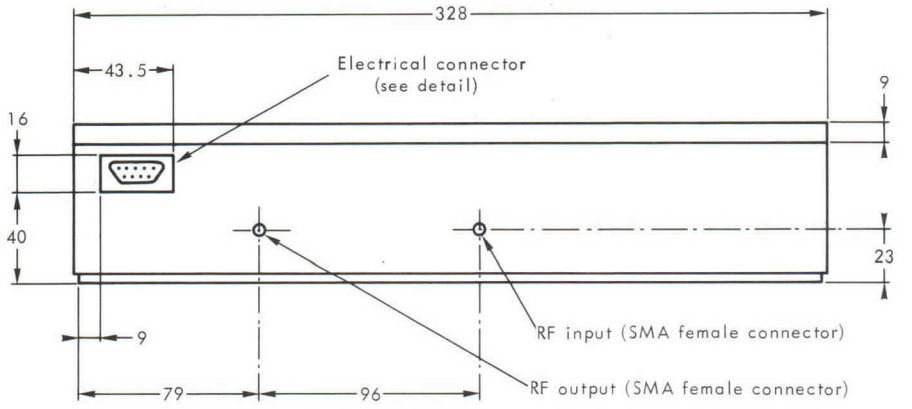
OUTLINE DRAWING

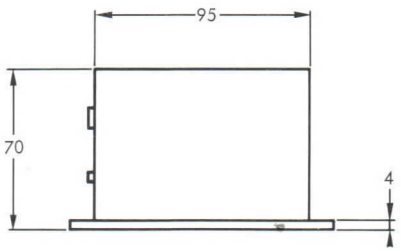


DEM-9-P 9-PIN CONNECTOR



PIN IDENTIFICATION	
1) 2	+ 28 V Power supply
3	Power-supply ground
4	Helix-voltage remote control
5	Collector-current measurement
6	VSWR protection circuit-positive input
7) 8	Power-supply ground
9	VSWR protection circuit-negative input





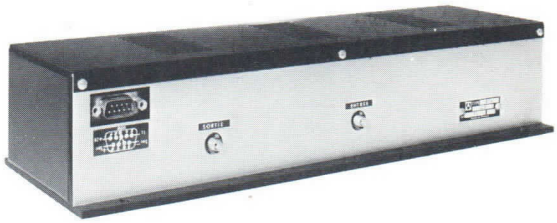
Dimensions nominal, in mm.

BFA 1209

TRAVELING-WAVE TUBE AMPLIFIER

The BFA 1209 is a small, lightweight, compact, adjustment-free microwave amplifier, which incorporates a traveling-wave tube, a solid-state power supply and protection devices.

This combination provides the best performances, the highest efficiency, the most reduced size and weight, and the lowest price for the TWTA.



The BFA 1209 operates from a DC power supply, regulated to within ± 1 %. Cooling is by conduction through the amplifier's base plate and convection. According to the cooling requirements, different types of heat radiators (not supplied) may be attached to the base plate to facilitate the convection process.

The principal characteristics of the BFA 1209 are :

Frequency range ..... **8.0 to 12.4 GHz**
Output power, min. ..... **4 W**
Gain, min. ..... **40 dB**

GENERAL CHARACTERISTICS

Electrical

	Min.	Max.	
Frequency	8.0	12.4	GHz
Saturation gain	40	–	dB
Noise figure	–	28	dB
Output power	4	–	W
Gain variation	–	10	dB
Supply voltage	28 – 1 %	28 + 1 %	V
Power consumption	–	70	W

Mechanical

Input and output RF connections ..... SMA female
Power-supply and security-device connections ..... DEM 9 P connector
Cooling ..... By conduction and convection
Dimensions ..... 328 x 115 x 70 mm
Weight ..... 2.3 kg

ABSOLUTE RATINGS

(Non-simultaneous)

	Min.	Max.	
Storage temperature	–30	+ 60	°C
Operating temperature	0	+ 50	°C
VSWR of the load	–	3 : 1	
Supply voltage	27	29	VDC

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

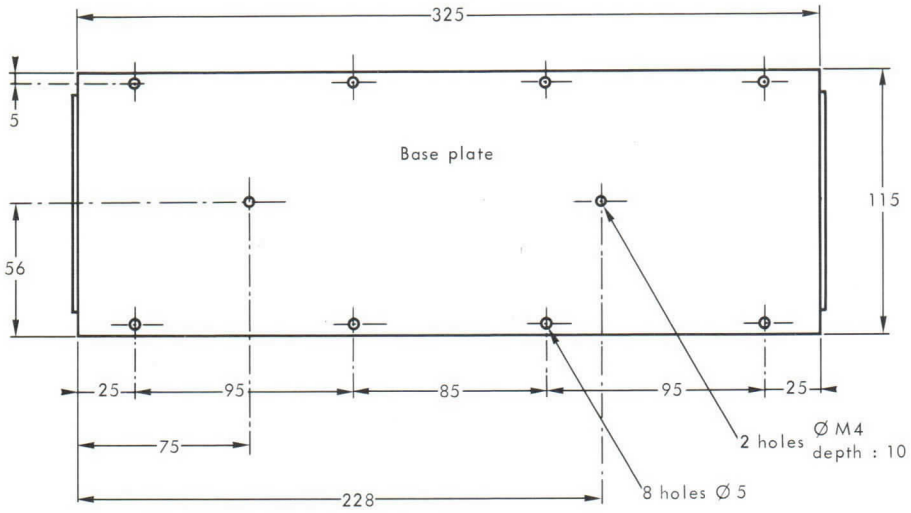
PROTECTION DEVICES AND CONTROL CIRCUITS INTEGRAL TO THE TWTA

Warm-up timing : Integral to the traveling-wave-tube amplifier and set for 180 seconds.

Helix current : Integral overcurrent security device, prevents the current from exceeding 2 mA. The same protection device may be controlled by an external signal (VSWR).

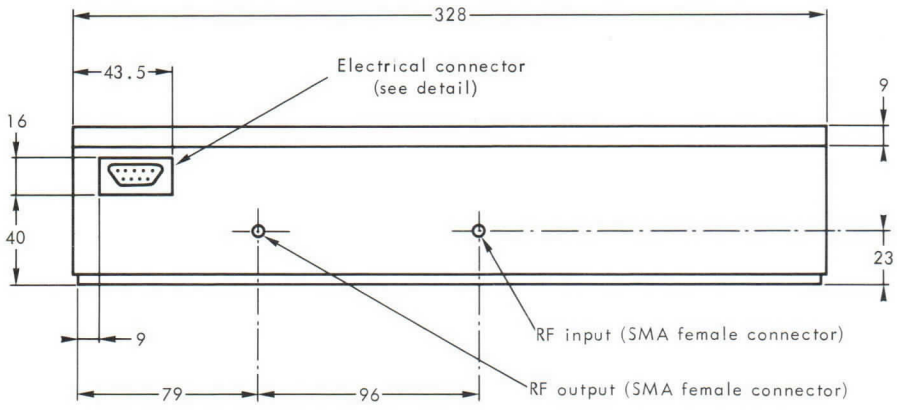
Collector current : A circuit is provided for checking the collector current value (approximately : 30 mA).

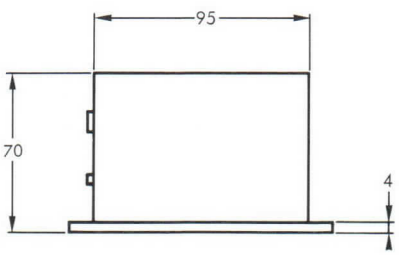
OUTLINE DRAWING





PIN IDENTIFICATION	
1, 2	+ 28 V Power supply
3	Power-supply ground
4	Helix-voltage remote control
5	Collector-current measurement
6	VSWR protection circuit-positive input
7, 8	Power-supply ground
9	VSWR protection circuit-negative input





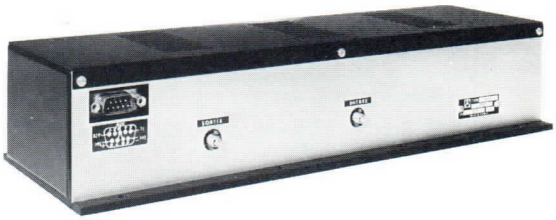
Dimensions nominal, in mm.

BFA 1210

TRAVELING-WAVE TUBE AMPLIFIER

The BFA 1210 is a small, lightweight, compact, adjustment-free microwave amplifier, which incorporates a traveling-wave tube, a solid-state power supply and protection devices.

This combination provides the best performances, the highest efficiency, the most reduced size and weight, and the lowest price for the TWTA.



The BFA 1210 operates from a DC power supply, regulated to within ± 1 %. Cooling is by conduction through the amplifier's base plate and convection. According to the cooling requirements,different types of heat radiators (not supplied) may be attached to the base plate to facilitate the convection process.

The principal characteristics of the BFA 1210 are :

Frequency range ..... 12.4 to 18 GHz
Output power, min. ..... 2 W
Gain, min. ..... 40 dB

GENERAL CHARACTERISTICS

Electrical

	Min.	Max.	
Frequency	12. 4	18	GHz
Saturation gain	40	–	dB
Noise figure	–	28	dB
Output power	2	–	W
Gain variation	–	15	dB
Supply voltage	28 – 1 %	28 + 1 %	V
Power consumption	–	70	W

Mechanical

Input and output RF connections	SMA female
Power-supply and security-device connections	DEM 9 P connector
Cooling	By conduction and convection
Dimensions	328 x 115 x 70 mm
Weight	2.3 kg

ABSOLUTE RATINGS
(Non-simultaneous)

	Min.	Max.	
Storage temperature	–30	+ 60	°C
Operating temperature	0	+ 50	°C
VSWR of the load	–	3 : 1	
Supply voltage	27	29	VDC

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

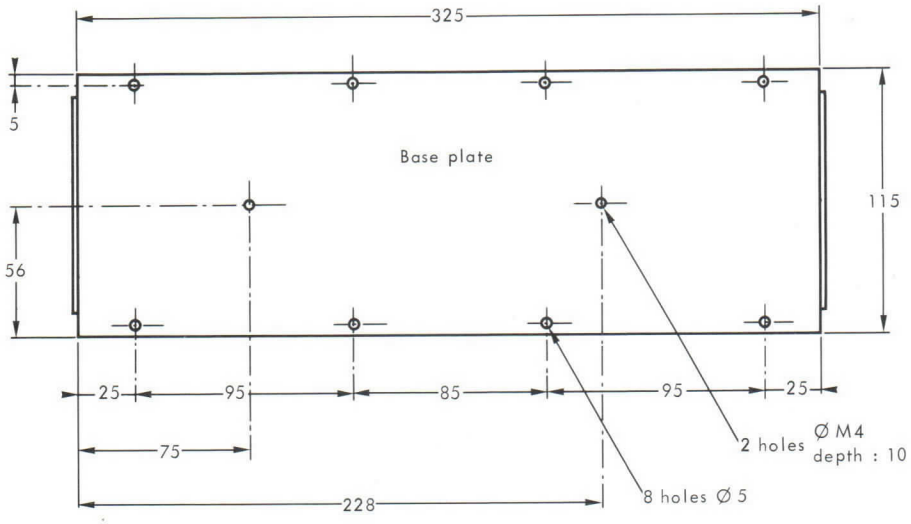
PROTECTION DEVICES AND CONTROL CIRCUITS INTEGRAL TO THE TWTA

Warm-up timing : Integral to the traveling-wave-tube amplifier and set for 180 seconds.

Helix current : Integral overcurrent security device, prevents the current from exceeding 2 mA. The same protection device may be controlled by an external signal (VSWR).

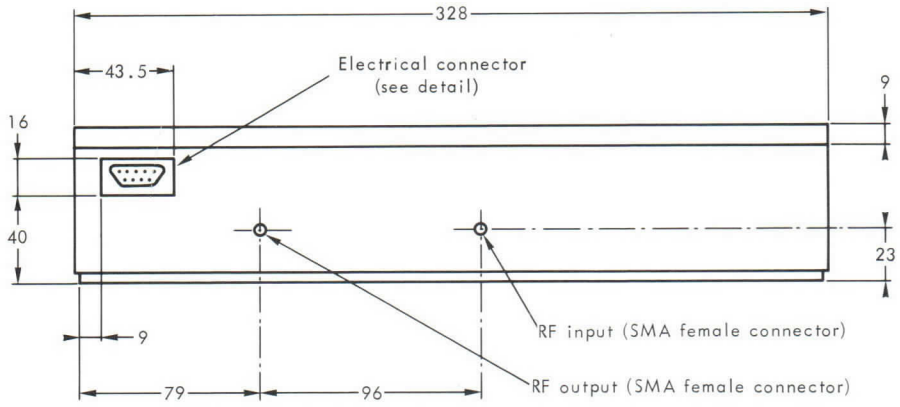
Collector current : A circuit is provided for checking the collector current value (approximately : 30 mA).

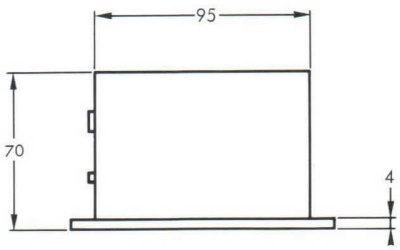
OUTLINE DRAWING





PIN IDENTIFICATION	
1) 2	+ 28 V Power supply
3	Power-supply ground
4	Helix-voltage remote control
5	Collector-current measurement
6	VSWR protection circuit-positive input
7) 8	Power-supply ground
9	VSWR protection circuit-negative input





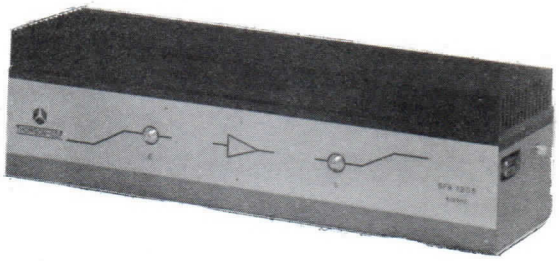
Dimensions nominal, in mm.

TRAVELING WAVE TUBE AMPLIFIERS

The BFA.1209 is a small, light weight, compact, adjustment free microwave amplifier, which incorporates a F.4185* traveling wave tube, a solid state power supply and security devices.

This combination provides the best performances, the highest efficiency, the most reduced size and weight, and the lowest price for the TWTA.

A d.c. power supply regulated within ± 1 % should be used. Convection cooling is achieved through a heat sink fastened tightly to the base plate of the amplifier. According to the cooling requirements different types of heat exchanger may be used.



In short, the principal features of the BFA.1209 are :

Frequency range		*8. 0 to 14*	*GHz*
Output power	*min .*	*4*	*W*
Gain	*min .*	*40*	*dB*

GENERAL CHARACTERISTICS

Electrical

	min.	max.	
Frequency	8. 0	14. 0	GHz
Saturation gain	40	-	dB
Noise figure	-	30	dB
Output power	4	-	W
Gain slope saturation	-	0. 01	dB/MHz
Voltage supply	28 – 1 %	28 +1 %	V
Power supply		50	W

Mechanical

Input and output RF connections		OSM plugs
Supply and security devices		DEM 9 S connector
Cooling		conduction or convection
Dimensions	with heat sink	315 x 95 x 85 mm
	without heat sink	315 x 95 x 60 mm
Weight, without heat sink		1. 8 kg
Heat sink weight		1. 0 kg

* *See Data Sheet TEH 4069*

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

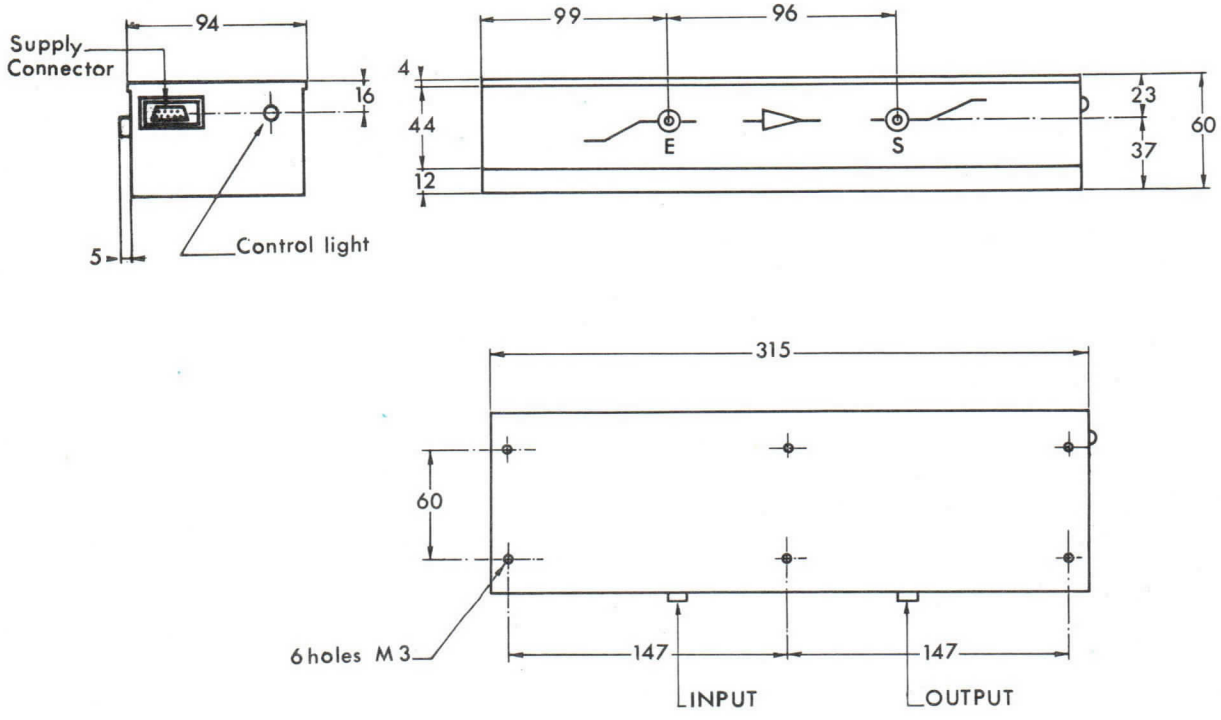
ABSOLUTE RATINGS

Operating temperature	−20	+85	°C
Shocks	-	100 g - 11 ms	
Vibration	-	1 mm between 10 to 50 Hz	
	-	10 g between 50 to 2000 Hz	
VSWR of the load	-	2: 1	

SECURITY DEVICES INTEGRAL TO THE TWTA AND CONTROL CIRCUITS

Warm-up timing : : integral to the traveling wave tube amplifier and set at 90 seconds.
Helix current : integral overcurrent security device, prevents the current from exceeding 2 mA. The same security device may be controlled by an external information (VSWR).
Cathode current : A circuit is provided for checking the cathode current value (approximately : 50 mA).

OUTLINE DRAWING



Dimensions in mm.

TOP.1223

TRAVELING WAVE TUBE



The TOP.1223 traveling wave tube is a broadband amplifier capable of providing a minimum saturated output power of 10 W from 5.0 to 11.0 GHz. The saturation gain is more than 30 dB. Integral periodic permanent focusing reduces the stray magnetic field and saves weight.

The TOP.1223 is cooled by natural convection and conduction Because of its small size, light weight, and sturdy construction this tube is especially attractive for transportable and airborne equipments.

A TWTA is available including TOP.1223 with its integral power supply :

The BFA.1274 is a small, light weight, compact, adjustment free microwave amplifier fitted with the TOP.1223 intended for airborne and transportable equipments, radio links and space communications. (see Data Sheet TEH 4083).

GENERAL CHARACTERISTICS (1)

Electrical

	min.	max.	
Frequency	5	11	GHz
Heater voltage	6. 2	6. 4	V
Heater current	0. 5	1. 1	A
Output power	10	–	W
Gain for an output power of 10 W	30	–	dB
Helix voltage	2. 7	3. 3	kV
Helix current	–	5	mA
Anode voltage	1. 0	1. 8	kV
Anode current	–	1. 0	mA
Collector voltage	1. 3	2. 0	kV
Cathode current	–	50	mA

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight (approx.)	700 g
RF connections	coaxial plugs OSM 202 (omni spectra)
Thermal switch connections	flexible leads
Supply connections	flexible leads
Cooling	conduction

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Heater voltage	6. 0	6. 6	V
Heater surge current	–	2. 2	A
Warm-up time	3	–	mn
Ambient temperature	–	100	°C
Base plate temperature (1)	–	120	°C
Vibrations		1 mm between 10 to 50 Hz 10 g between 50 to 2000 Hz	
Shocks		100 g – 11	ms

(1) - A thermal switch, can be used ro remove high voltage by openning the supply circuit if the base plate temperature exceeds 120° C.

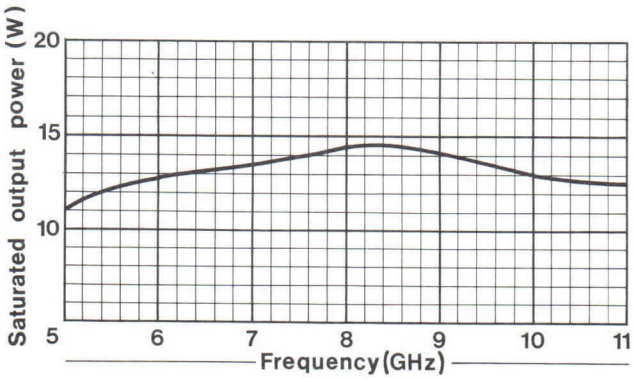
Helix voltage (1)	nominal voltage	– 200	+200	V
Helix current		–	5. 5	mA
Anode voltage (1)	nominal voltage	–	+200	V
Anode current		–	2. 0	mA
Collector voltage (1)	nominal voltage	2	+400	V
Cathode current		–	55	mA
Load VSWR		–	3 : 1	

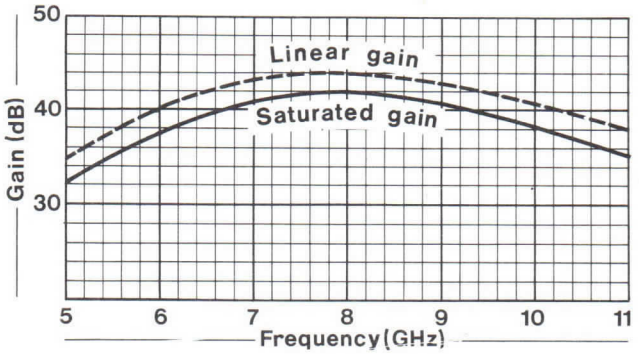
(1) - The nominal voltage is indicated for each tube on the Test Data Sheet.
(2) - The collector voltage may be adjusted to a value higher than the nominal voltage, within the indicated ratings, without degradation of characteristics.

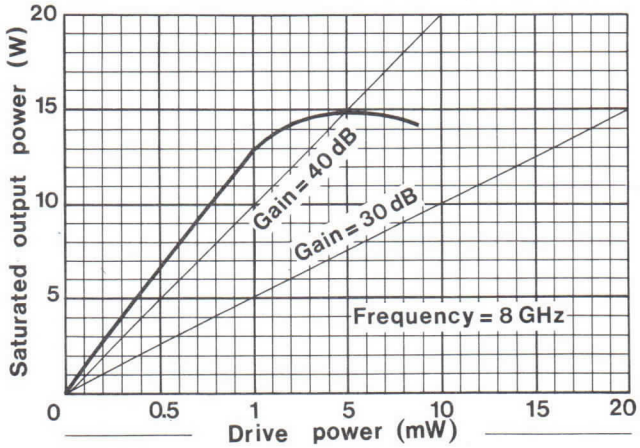
TYPICAL OPERATION

Frequency	8	GHz
Heater voltage	6. 3	V
Heater current	0. 940	mA
Drive power	1. 4	mW
Output power	14	W
Gain	40	dB
Helix voltage	3. 05	kV
Helix current	300	µA
Anode voltage	1. 5	kV
Anode current	0	
Cathode current	45	mA
Collector voltage	1. 5	kV

Typical characteristics

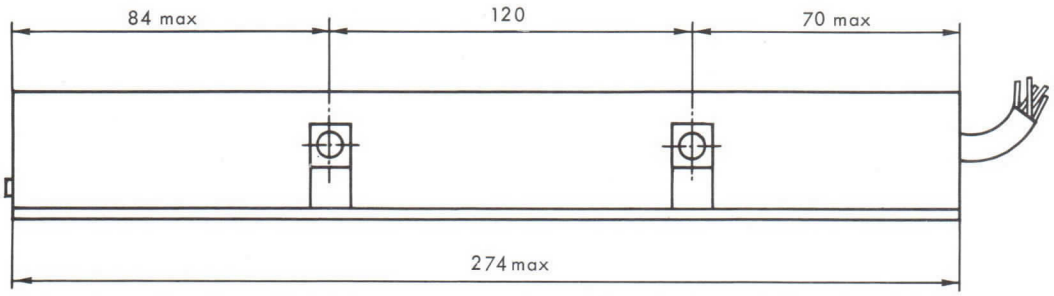


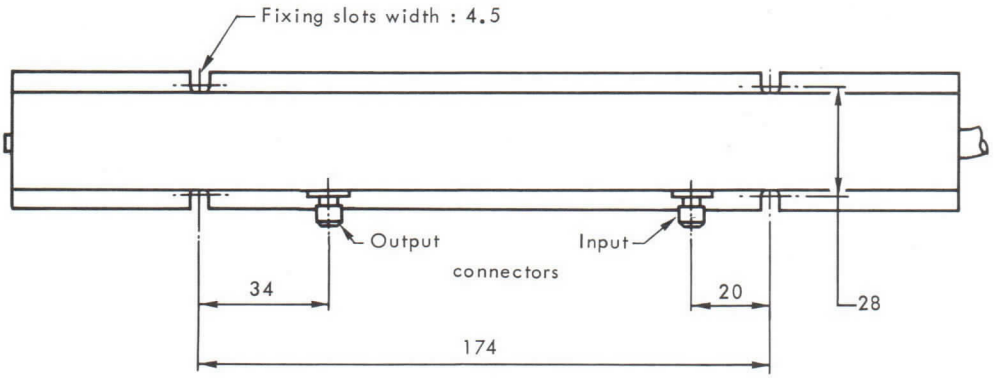


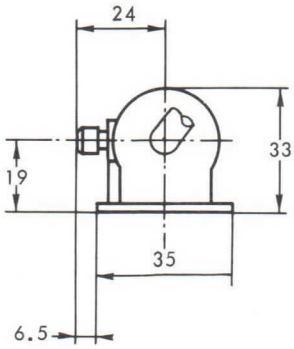


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING







Connections	
Brown	Heater-cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix

Dimensions in mm.

TOP 1226
TRAVELING WAVE TUBE



The TOP 1226 traveling wave tube is a broadband amplifier providing a minimum saturated output power of 2 W in the 12.4 to 18 GHz frequency range. Saturation gain is more than 40 dB. Integral periodic permanent focusing reduces the stray magnetic field and saves weight.

The TOP 1226 is cooled by natural convection and conduction. Its small size, light weight, and sturdy construction makes it especially attractive for transportable and airborne equipments.

Two packages using this TWT are also available :

- The BFA 1210 is a small, light weight, compact, adjustment free microwave amplifier fitted with the TOP 1226 intended for airborne and transportable equipments, radio links and space communications.
- The AMP 1418 amplifier fitted with the TOP 1226 is ideal for Laboratory measurements.

GENERAL CHARACTERISTICS (1)

Electrical

	min.	moy.	max.	
Frequency	12. 4	–	18	GHz
Heater voltage	–	6. 3	–	V
Heater current	0. 4	–	0. 8	A
Output power	2	–	–	W
Gain for an output power of 2 W	40	–	–	dB
Helix voltage	2. 3	–	2. 7	kV
Helix current	–	–	2. 0	mA
Anode voltage	0. 65	–	0. 95	kV
Collector voltage	1. 3	–	1. 55	kV
Cathode current	–	–	26	mA

(1) All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight, approximate	650 g
RF connections	coaxial plugs OSM 206/1 (omni spectra)
Supply connections	flying leads
Cooling	conduction

ABSOLUTE RATINGS

(non simultaneous values)

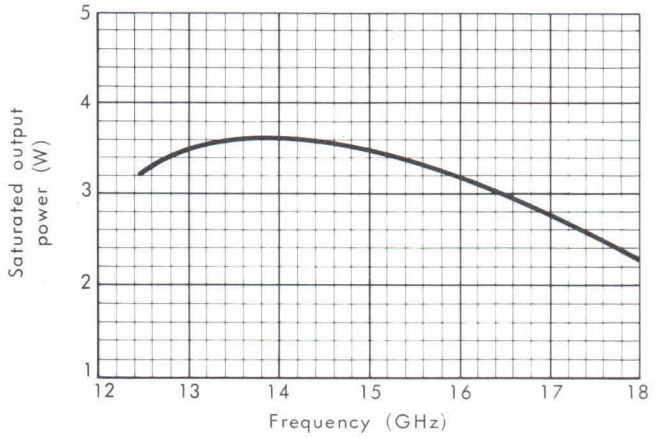
	min.	max.	
Heater voltage	6.0	6.6	V
Heater surge current	–	1.6	A
Warm-up time	3	–	mn
Ambient temperature	–	100	°C
Vibrations	–	2 mm between 5 to 50 Hz 20 g between 50 to 2000 Hz	
Shocks	–	100 g – 11 ms	
Helix voltage (1), nominal voltage	−200	+200	V
Helix current	–	2.0	mA
Anode voltage (1), nominal voltage	–	+200	V
Anode current	–	2.0	mA
Collector voltage (1), nominal voltage	−200	+200	V
Cathode current	–	28	mA
Load VSWR	–	3 : 1	

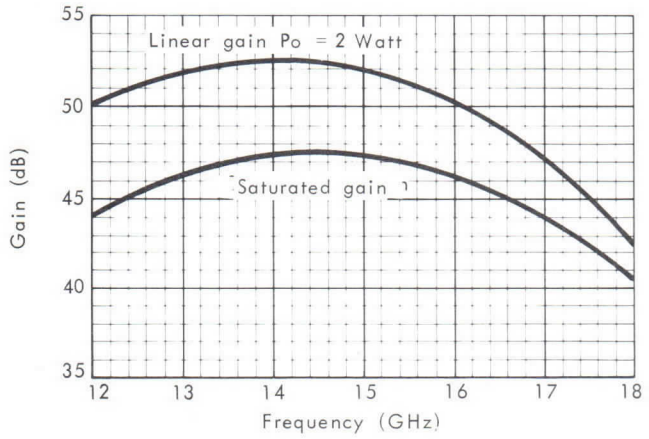
(1) The nominal voltage is indicated for each tube on the test Data Sheet.

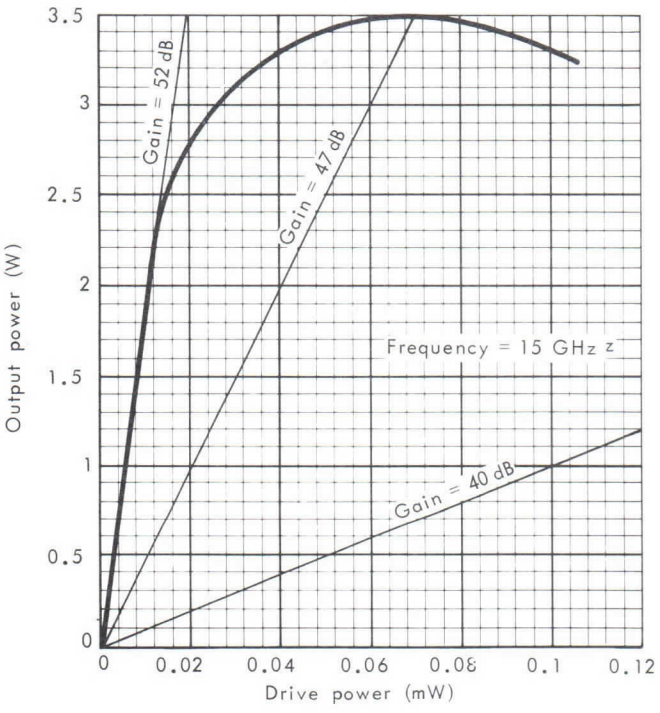
TYPICAL OPERATION

Frequency	15	GHz
Heater voltage	6.3	V
Heater current	0.48	A
Drive power	0.07	mW
Output power	3.5	W
Gain	47	dB
Helix voltage	2.55	kV
Helix current	0.30	mA
Anode voltage	0.8	kV
Anode current	0	
Cathode current	23	mA
Collector voltage	1.5	kV
Noise factor	30	dB

Typical characteristics

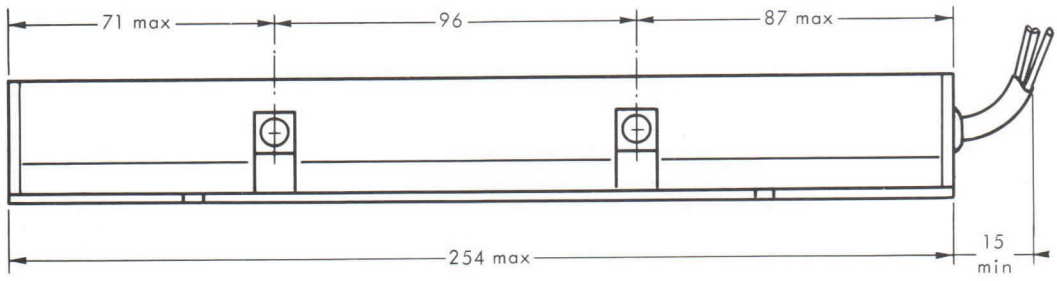


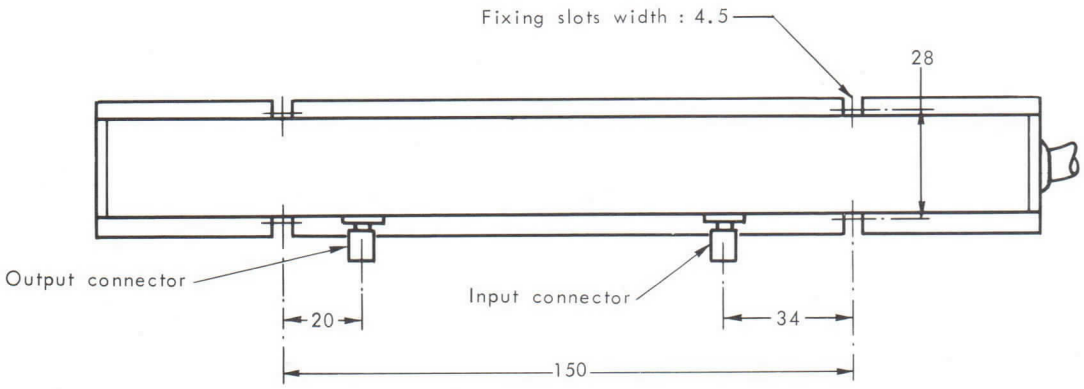


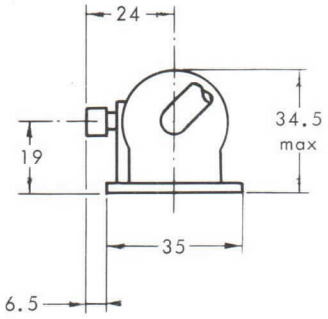


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





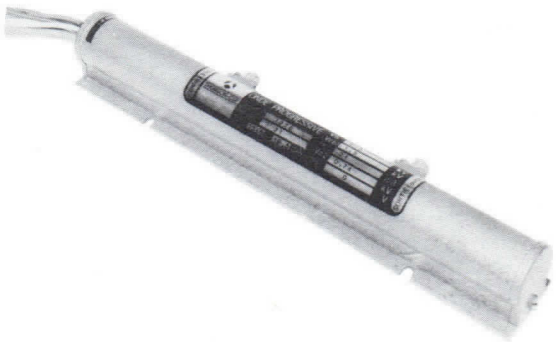


CONNECTIONS	
Brown	Heater-cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix
White	Thermal switch (isolated)
Grey	Thermal switch (ground)

Dimensions in mm.

TUBE A ONDE PROGRESSIVE TOP 1226

Le tube à onde progressive TOP 1226 est un amplificateur à large bande délivrant une puissance minimale à saturation de 2 watts, dans la bande de fréquence de 12,4 à 18 GHz. Le gain à saturation de ce tube est supérieur à 40 dB.



La focalisation est assurée par des aimants permanents à champ magnétique alterné, ce qui rend le tube léger et peu encombrant et réduit les fuites de champs magnétiques.

Le TOP 1226 est refroidi par convection et conduction. Son faible poids, sa robustesse et son volume réduit le destinent tout particulièrement aux équipements mobiles et aéroportés.

Un BLOC FONCTIONNEL AMPLIFICATEUR A TOP a été réalisé à partir d'un TOP 1226 associé à des circuits d'alimentation : le BFA 1210 est un amplificateur léger, compact, peu encombrant, sans nécessité de réglage, simplifiant les problèmes d'interface Matériel-Tube. Il trouve des applications multiples dans les équipements transportables, pour les communications terrestres et spatiales.

Le TOP 1226 équipe également un amplificateur de laboratoire : AMP 1418.

CARACTERISTIQUES GENERALES (1)

Electriques

	min.	moy.	max.	
Fréquence	12, 4	–	18	GHz
Tension de chauffage	–	6, 3	–	V
Courant de chauffage	0, 4	–	0, 8	A
Puissance de sortie	2	–	–	W
Gain, pour une puissance de 2 W	40	–	–	dB
Tension d'hélice	2, 3	–	2, 7	kV
Courant d'hélice	–	–	2, 0	mA
Tension d'anode	0, 65	–	0, 95	kV
Tension collecteur	1, 30	–	1, 55	kV
Courant de collecteur	–	–	26	mA

(1) Toutes les tensions sont mesurées par rapport à la cathode.

Mécaniques

Position de fonctionnement	indifférente
Masse, approximative	650 g
Connexion RF	fiches coaxiales OSM 206/1
Connexion d'alimentation	par fils souples
Refroidissement	par conduction

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION

(non simultanées)

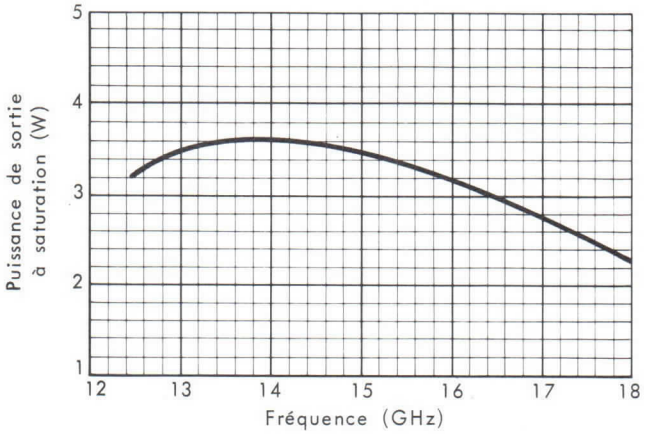
	min.	max.	
Tension de chauffage	6, 0	6, 6	V
Courant de pointe au démarrage = 2 I_f	–	1, 6	A
Temps de préchauffage	3	–	mn
Température de fonctionnement	– 50	+ 120	°C
Vibrations	2 mm entre	5 et 50	Hz
	20 g entre	50 et 2000	Hz
Chocs	–	100 *g* en 11 ms	
Tension d'hélice (1), nominale	– 200	+ 200	V
Courant d'hélice	–	2, 0	mA
Tension d'anode (1), nominale	–	+ 200	V
Courant d'anode	–	2, 0	mA
Tension collecteur (1), nominale	– 200	+ 200	V
Courant de collecteur	–	28	mA
TOS de la charge	–	3	

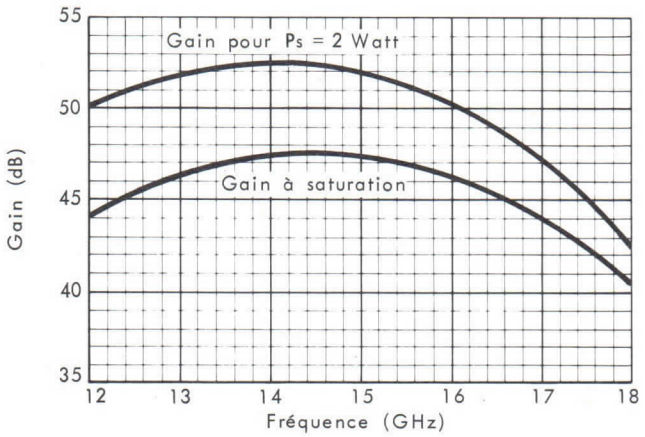
(1) - La tension nominale est précisée dans la fiche d'essais accompagnant chaque tube.

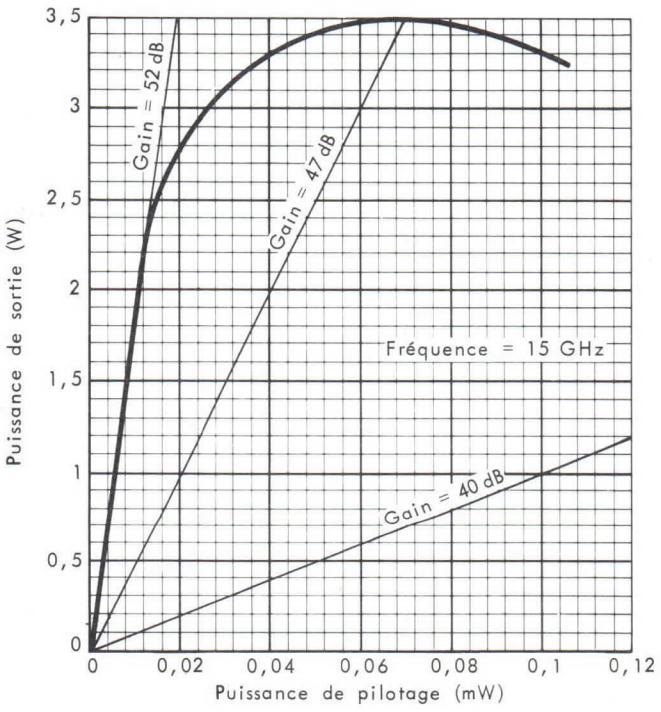
EXEMPLE DE FONCTIONNEMENT

Fréquence	15	GHz
Tension de chauffage	6, 3	V
Courant de chauffage	0, 48	A
Puissance de pilotage	0, 07	mW
Puissance de sortie	3, 5	W
Gain	47	dB
Tension d'hélice	2, 55	kV
Courant d'hélice	0, 30	mA
Tension d'anode	0, 8	kV
Courant d'anode	0	
Courant de collecteur	23	mA
Tension collecteur	1, 5	kV
Facteur de bruit	30	dB

Caractéristiques de fonctionnement

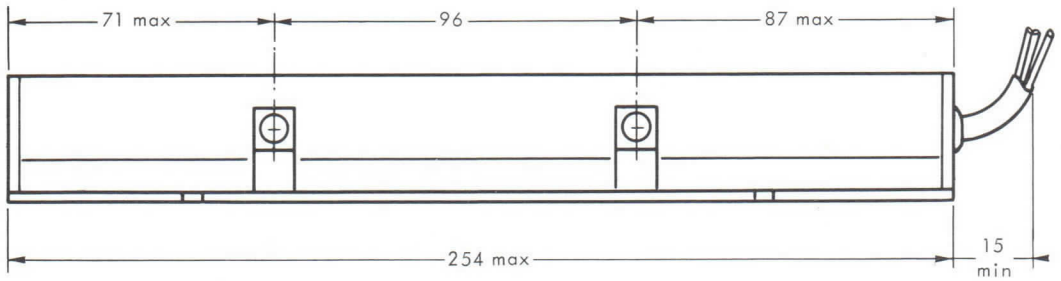


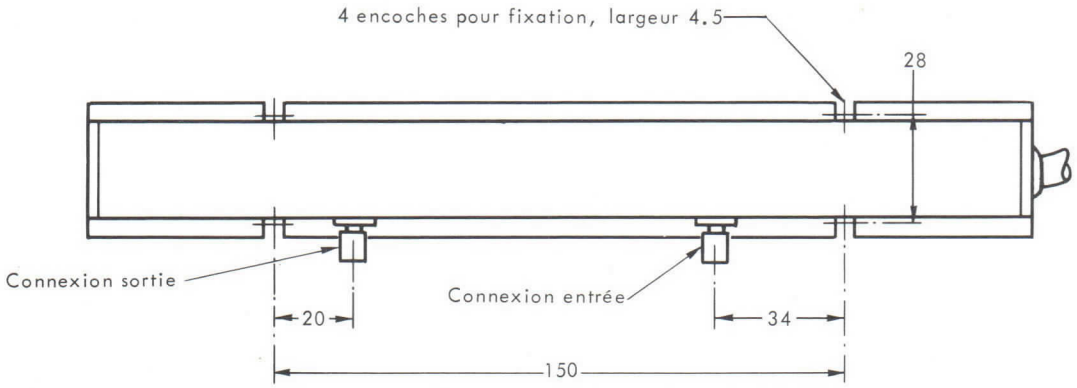


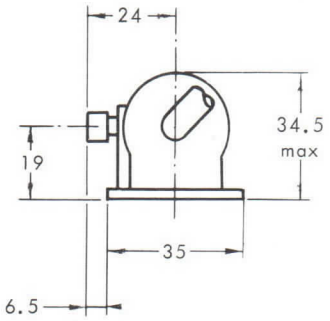


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT







CONNEXIONS	
Brun	Filament
Jaune	Cathode
Vert	Wehnelt
Bleu	Anode
Rouge	Collecteur
Orange	Masse-helice
Blanc	Vigitherme (isolé)
Gris	Vigitherme (masse)

Cotes en mm.

TRAVELING WAVE TUBE TOP 1289
TWTA's AMP 1415 and BFA 1298

The TOP 1289 traveling wave tube is a broadband amplifier providing a minimum saturated output power of 10 W from 2.2 to 4.0 GHz, and 8 W from 2.0 to 2.2 GHz. The gain exceeds 33 dB. Integral P.P.M focusing reduces the stray magnetic field and saves weight.



The TOP 1289 is cooled by natural convection and conduction. Because of its small size, light weight, and ruggedness, this tube is especially attractive for airborne and other mobile applications.

The AMP 1415 TWTA, equipped with the TOP 1289 traveling wave tube, is ideal for laboratory measurements, as a wideband amplifier in radar and communications equipment , and for antenna pattern measurements. In addition to the TWT, this amplifier incorporates a power supply, a modulating circuit and protection devices.

The BFA 1298 TWTA is a lightweight, compact, adjustment-free microwave amplifier, incorporating the TOP 1289. Of sturdy construction, it is intended for use in airborne and other mobile equipment, radio links and space communications.

GENERAL CHARACTERISTICS

Electrical (1)

Frequency	2.0	to	4.0	GHz
Heater voltage, typical		6.3		V
Heater current	0.2	to	0.5	A
Output power :				
- from 2.2 to 4.0 GHz, min.		10		W
- from 2.0 to 2.2 GHz, min.		8		W
Gain :				
- from 2.2 to 4.0 GHz (at 10 - W output), min.		35		dB
- from 2.0 to 2.2 GHz (at 8 - W output), min.		33		dB
Helix voltage	1.9	to	2.1	kV
Helix current	0	to	4	mA
Anode voltage	1.0	to	1.2	kV
Anode current	− 100	to	+100	μA
Collector voltage	1.0	to	1.2	kV
Collector current, max.		53		mA

(1) All voltages are referred to the cathode.

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GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	Any
Weight (approx.)	700 g
RF connections	OSM 206/1 (Omni-Spectra) coaxial connectors
Supply connections	Flying leads
Cooling	Natural conduction and convection

ABSOLUTE RATINGS

(non-simultaneous values)

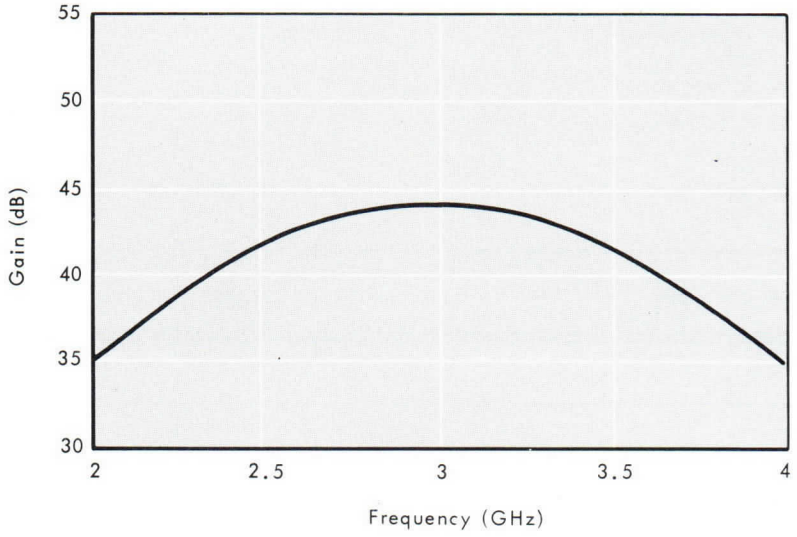
	Min.	Max.	Units
Heater voltage	6. 0	6. 6	V
Heater surge current	–	0. 55	A
Warm-up time	3	–	mn
Cathode current	–	60	mA
Helix voltage	1. 8	2. 2	kV
Helix current	–	6	mA
Anode voltage	–	1. 3	kV
Collector voltage	0. 9	1. 3	kV
Load VSWR	–	3 : 1	
Collector dissipation	–	70	W
Ambient temperature	– 40	+120	°C
Vibrations	–	1 mm between 10 and 50 Hz	

TYPICAL OPERATION

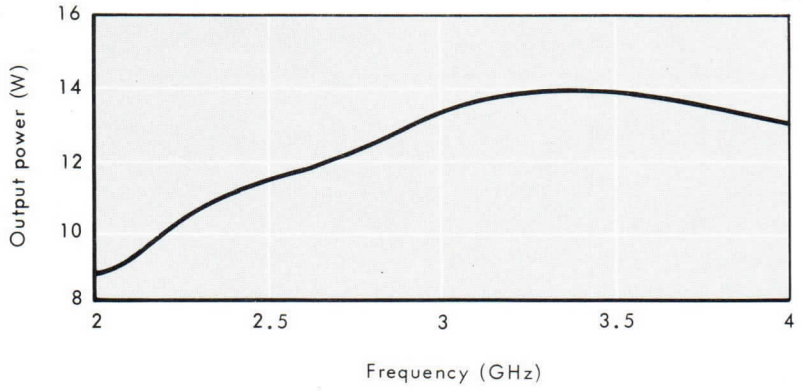
Frequency	3	GHz
Heater voltage	6. 3	V
Heater current	300	mA
Drive power	0. 45	W
Output power	14	W
Gain	45	dB
Helix voltage	1. 95	kV
Helix current	1. 5	mA
Anode voltage	1. 1	kV
Anode current	0	
Cathode current	46. 5	mA
Collector voltage	1. 2	kV
Collector current	45	mA

The Wehnelt must be connected to the heater-cathode terminal.

SATURATED GAIN

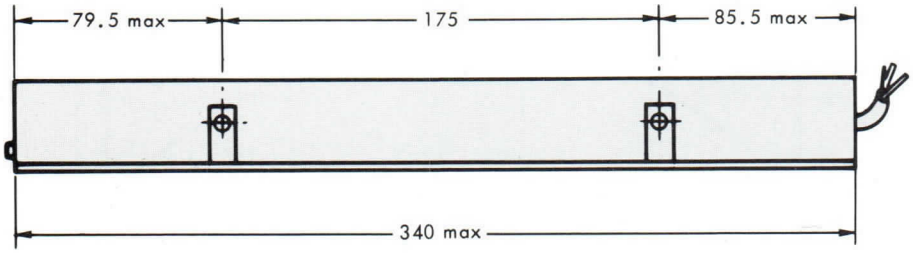


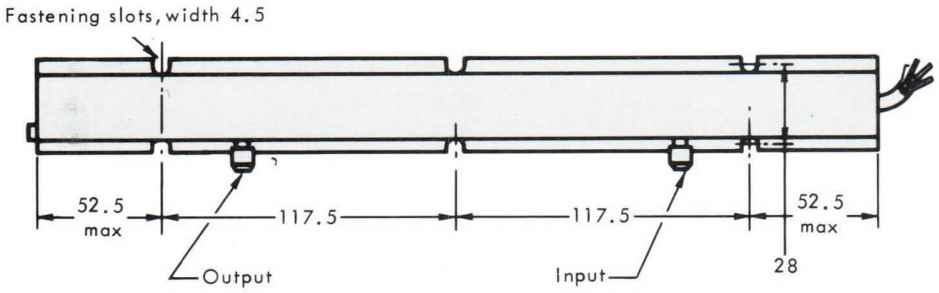
SATURATED OUTPUT POWER

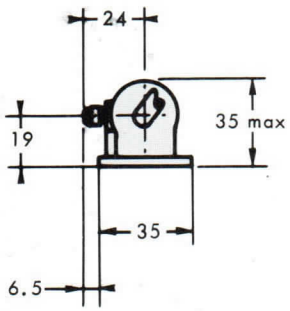


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GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING







CONNECTIONS	
Brown	Heater
Yellow	Heater-cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix
Grey	Thermal switch
White	Thermal switch (insulated wire)

(Wire lenght : 350 mm)

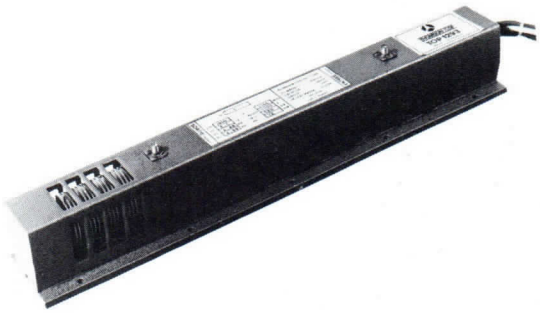
Dimensions in mm.

TOP 1293 TRAVELING WAVE TUBE

The TOP 1293 is a pulsed traveling wave tube operating in the frequency range from 2.9 to 3.1 GHz, delivering a peak power output of more than 300 watts, with a duty cycle of 0. 04.

This broadband amplifier features a saturated output gain of at least 43 dB.

The TOP 1293 uses periodic permanent magnet focusing and forced air cooling ; an internal thermal switch "Vigitherme" removes the supply voltages if the operating temperature exceeds 150 °C.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage (1)	–	6. 3	–	V
Heater current	1. 0	–	1. 5	A
Frequency	2. 9	–	3. 1	GHz
Collector voltage (1)	4. 75	–	5. 25	kV
Helix voltage (1)	4. 75	–	5. 25	kV
Peak cathode current	–	–	650	mA
Peak helix current	–	–	150	mA
Peak grid voltage	–	–	+175	V
Cut-off grid voltage	−110	–	−90	V
Peak power output	260	–	–	W
Input power	–	–	15	mW
Pulse duration	–	75	–	µs
Repetition frequency	–	500	–	Hz

Mechanical

Operating position	any
Dimensions	see drawing
RF input	OSM 206/1 coaxial connector
RF output	OSM 206/1 coaxial connector
Power supply connection	flying leads
Approximate weight	2. 5 kg
Cooling	forced air

(1) The exact value is given for each tube.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

	min.	max.	
Heater voltage	5. 9	6. 7	V
Heater surge current	–	2. 6	A
Warm-up time	3	–	mn
Collector voltage	–	6	kV
Helix voltage	–	6	kV
Peak helix current	–	180	mA
Peak grid voltage	– 300	+200	V
Peak power output	–	400	W
Input power	–	30	mW
Pulse duration	–	100	µs
Operating temperature (1)	–	150	°C
Duty cycle	–	0. 04	
Altitude	–	3000 10000	m feet

(1) Measured at the hotest point of the housing.

TYPICAL OPERATION

Heater voltage	6. 3	V
Peak power output	320	W
Average power output	12	W
Pulse duration	25	µs
Repetition frequency	1 500	Hz
Load VSWR	1. 2 : 1	
Saturated output gain	43	dB
Noise factor, max.	35	dB
Phase sensitivity, max.	1. 5	°/V

REMARKS

The TOP 1293 should be kept away from any magnetic or ferromagnetic materials.

When starting operation, voltages should be applied in the following order :

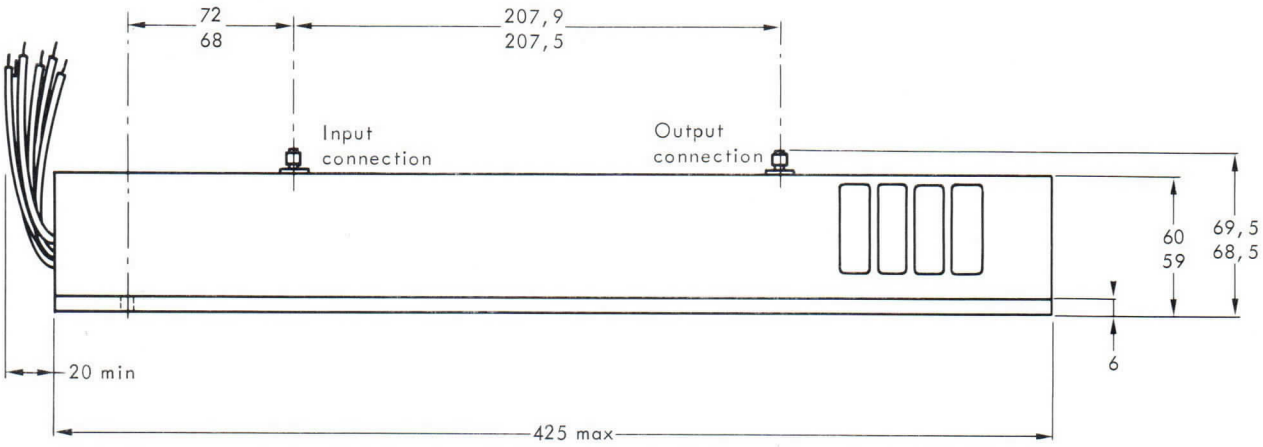
- heater (with a minimum warm-up time of three minutes), grid voltage (negative), helix voltage and collector voltage, positive grid voltage.

Voltages should be removed simultaneously by a relay or in the following order : positive grid voltage, helix and collector voltage.

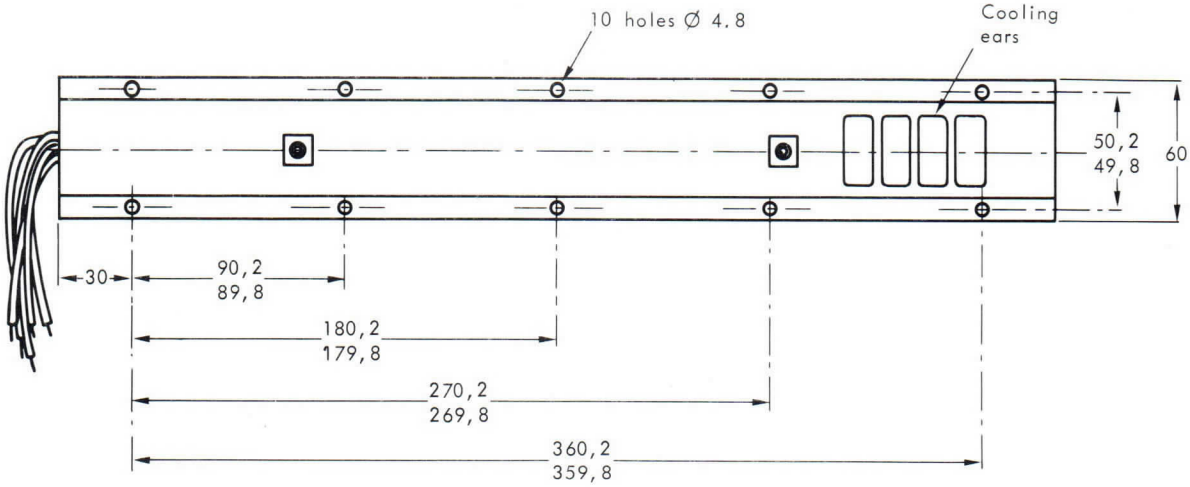
If the peak cathode current or the peak helix current exceeds the maximum rating, voltages should be automatically removed according to the above procedure.

OUTLINE DRAWING

Front view



Top view



CONNECTIONS	
Brown	Filament
Yellow	Cathode
Green	Grid
Orange	Ground-helix
Grey	Vigitherme
White	Vigitherme
	(isolated lead)

Nota : Minimum lead length for the Vigitherme and supply of the tube = 300 mm

Dimensions in mm.

TOP 1293

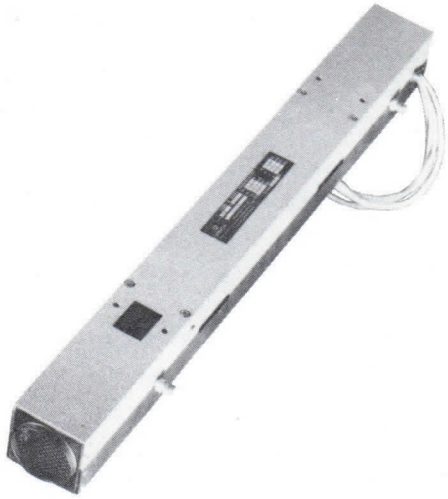
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GROUPEMENT TUBES ELECTRONIQUES

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TOP. 1294 TRAVELING WAVE TUBE

The TOP.1294 is a traveling wave tube capable of delivering more than 200 W in the frequency range from 1.0 to 2.0 GHz.

The tube is equipped with periodic permanent magnet and isolated collector. An all ceramic-and-metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions. The heat dissipation capability of the helix has been increased by a special brazing technique, resulting in lower operating temperature. The impregnated cathode, operating at low current density provides longer life expectancy. Depressed collector operation insures 25 % efficiency.



GENERAL CHARACTERISTICS

Electrical (1)

	min.	avg.	max	
Heater voltage	-	6.3	-	V
Heater current	2.55	-	2.85	A
Output power	200	-	-	W
Gain (saturated)	30	-	-	dB
Noise figure	-	-	36	dB
Helix voltage	4.0	-	4.4	kV
Helix current	-	-	50	mA
Anode voltage	3.8	-	4.4	kV
Anode current	-	-	4.5	mA
Collector voltage	2	-	4.4	kV
Cathode current	260	-	350	mA
Load VSWR	-	-	2.5 : 1	

(1) All voltages are referred to the cathode.

Mechanical

Operating position	any
Weight (approximate)	5 kg
RF input and output connections	TNC
Supply connections	flexible leads
Cooling	forced air
Dimensions	700 x 76 x 76 mm

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GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

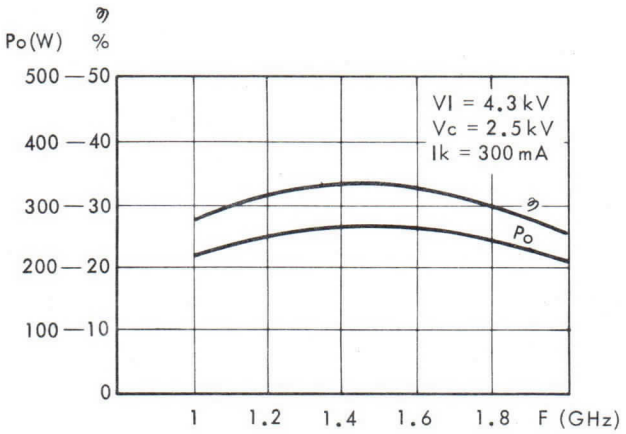
	min.	max.	
Heater voltage	5.7	6.9	V
Warm-up time	2	-	mn
Helix voltage	3.9	4.5	kV
Helix current	-	60	mA
Anode voltage	-	4.8	kV
Anode current	-	5	mA
Collector voltage	1.9	4.5	kV
Cathode current	-	360	mA
Collector dissipation	-	1.8	kW
Drive power	-	300	mW
Load VSWR	-	3 : 1	
Air flow (2)	60	-	l/s

(2) at atmospheric pressure, 1013 millibars.

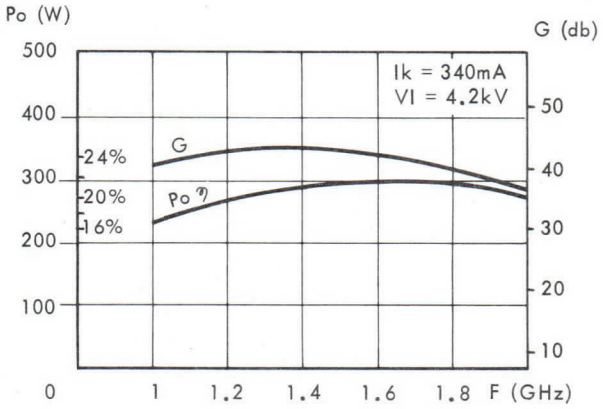
TYPICAL OPERATION

Frequency (see curves)	1.5	GHz
Heater voltage	6.3	V
Heater current	2.7	A
Drive power	11	mW
Output power (see curves)	275	W
Gain (saturated)	44	dB
Gain (small signal)	49	dB
Helix voltage	4.2	kV
Helix current	17	mA
Anode voltage	4.4	kV
Anode current	1	mA
Cathode current	340	mA
Collector voltage	4.2	kV
Collector current	322	mA
Noise figure	30	dB
AM/PM conversion	3.8	°/dB
Phase shift versus helix voltage	0.5	°/V

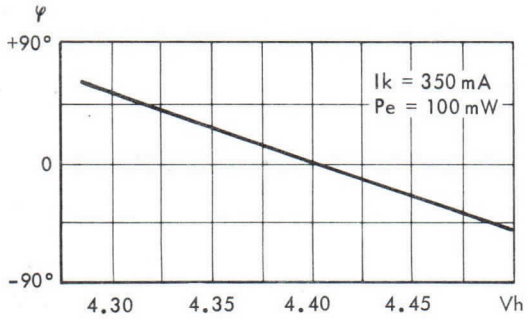
CHARACTERISTIC CURVES



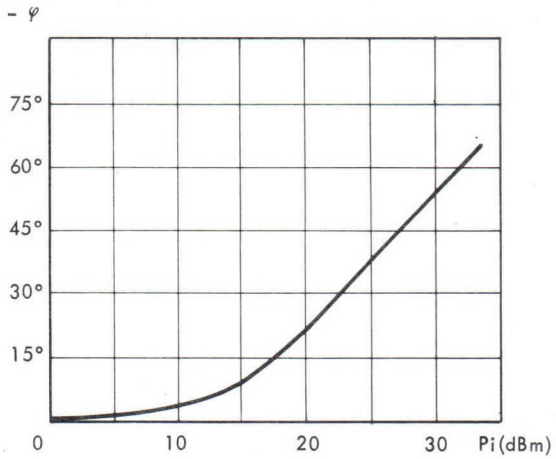
Output power (Po) and efficiency (η) versus frequency (depressed collector operation)



Output power (Po), efficiency (η), and gain (G) versus frequency



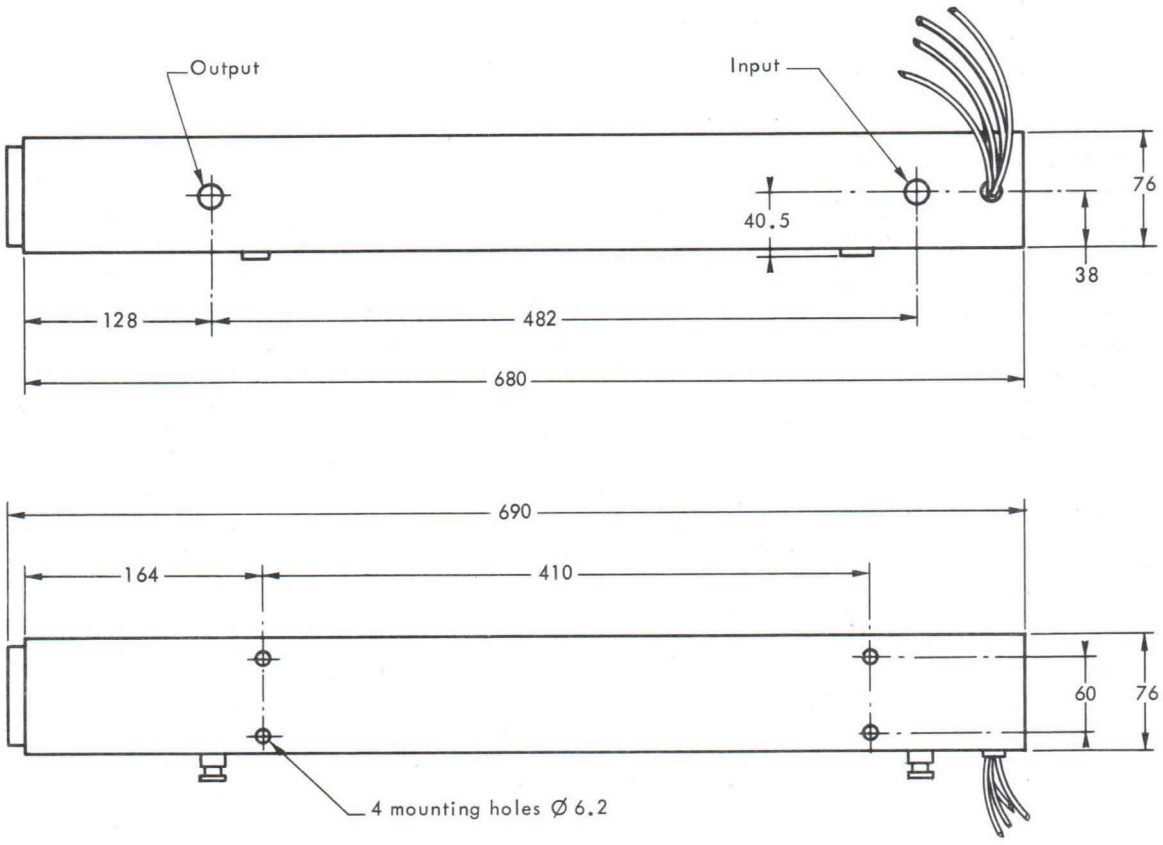
Phase shift (φ) versus helix voltage

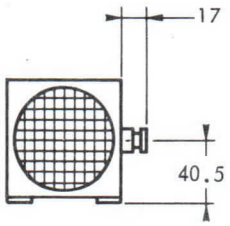


Phase shift (φ) versus input power (Pi) at 1.5 GHz

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GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





Dimensions in mm.

TUBE A ONDE PROGRESSIVE TOP 1294

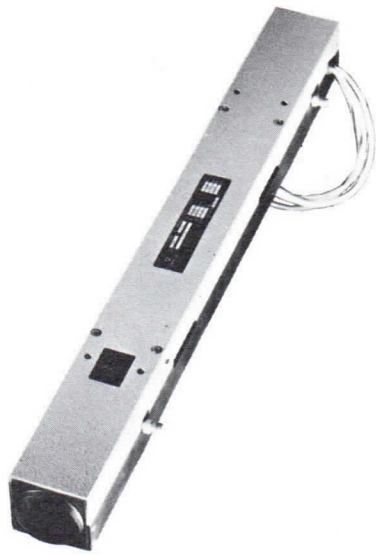
Le TOP 1294 est un tube à onde progressive à large bande fonctionnant dans la gamme de fréquence 1,0 à 2,0 GHz, et délivrant une puissance de 200 W continus.

Ce tube est focalisé par aimants périodiques alternés et refroidi par air; un système de ventilation est incorporé au tube. Sa construction métal-céramique en fait un tube particulièrement robuste et pouvant supporter les conditions d'environnement les plus rigoureuses.

Une nouvelle technologie appliquée à la conception de la ligne à retard permet d'obtenir une exceptionnelle fiabilité et une dirée de vie accrue.

La capacité de dissipation thermique de l'hélice a été augmentée par une nouvelle technique de brasure, qui permet d'abaisser la température de fonctionnement. La cathode imprégnée, à faible densité de courant, contribue à augmenter la durée de vie du tube. Le collecteur isolé, pouvant fonctionner en collecteur déprimé, garanti un rendement élevé, de l'ordre de 25 %.

Le TOP 1294 est destiné plus particulièrement aux télécommunications par faisceaux hertziens, aux équipements de contremesures, aux systèmes de communications à large bande, à la télémétrie et au guidage de missiles.



CARACTERISTIQUES GENERALES

Electriques (1)

	min.	moy.	max.	
Tension de chauffage	–	6, 3	–	V
Courant de chauffage	2, 3	–	2, 8	A
Puissance de sortie	200	–	–	W
Gain à saturation	30	–	–	dB
Facteur de bruit	–	–	36	dB
Tension d'hélice	4, 0	–	4, 4	kV
Courant d'hélice	–	–	50	mA
Tension d'anode	3, 8	–	4, 4	kV
Courant d'anode	–	–	4, 5	mA
Tension collecteur	2	–	4, 4	kV
Courant de cathode	260	–	350	mA
TOS de la charge	–	–	2, 5	

(1) Toutes les tensions sont mesurées par rapport à la cathode.

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GROUPEMENT TUBES ELECTRONIQUES

Mécanique

Position de fonctionnement	indifférente
Masse approximative	5 kg
Connexions d'entrée et de sortie RF	T N C
Connexions d'alimentation	par fils souples
Refroidissement	par air soufflé
Dimensions hors tout	700 x 76 x 76 mm

VALEURS LIMITES D'UTILISATION

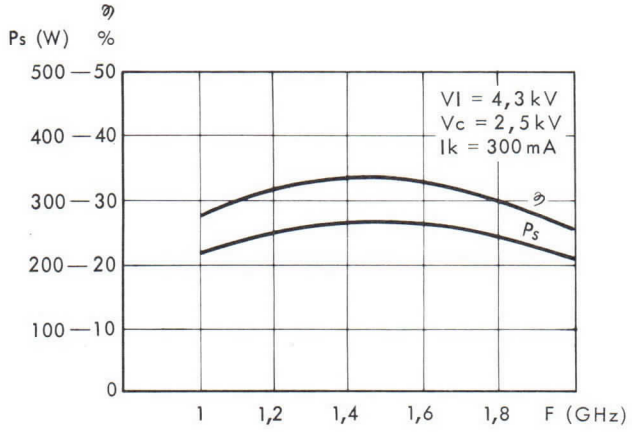
(NON SIMULTANEES)

	min.	max.	
Tension de chauffage	5, 7	6, 9	V
Temps de préchauffage	2	–	mn
Tension d'hélice	3, 9	4, 5	kV
Courant d'hélice	–	60	mA
Tension d'anode	–	4, 8	kV
Courant d'anode	–	5	mA
Tension de collecteur	1, 9	4, 5	kV
Courant de cathode	–	360	mA
Dissipation collecteur	–	1, 8	kW
Puissance de pilotage	–	300	mW
TOS de la charge	–	3 : 1	
Débit d'air (1)	60	–	l/s

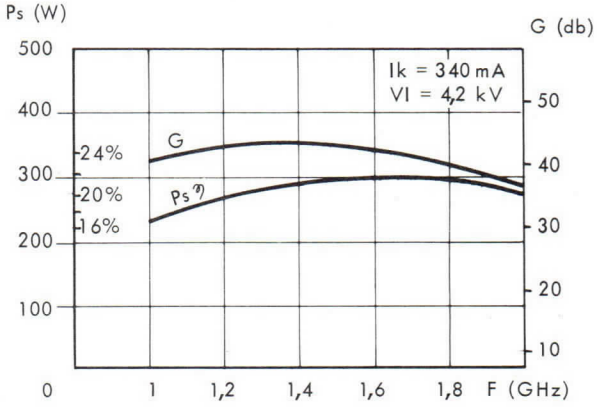
(1) A la pression atmosphèrique normale de 1013 millibars.

EXEMPLE DE FONCTIONNEMENT

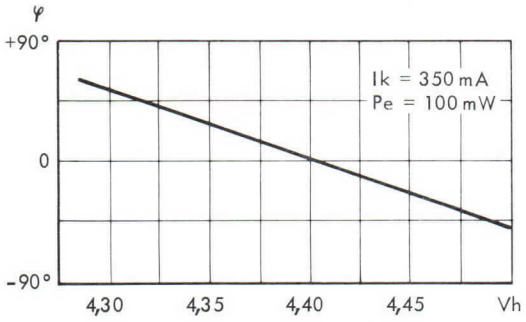
Fréquence (voir courbes)	1, 5	GHz
Tension de chauffage	6, 3	V
Courant de chauffage	2, 7	A
Puissance de pilotage	11	mW
Puissance de sortie (voir courbes)	275	W
Gain à saturation	44	dB
Gain, petits signaux	49	dB
Tension d'hélice	4, 2	kV
Courant d'hélice	17	mA
Tension d'anode	4, 4	kV
Courant d'anode	1	mA
Courant de cathode	340	mA
Tension collecteur	4, 2	kV
Courant collecteur	322	mA
Facteur de bruit	30	dB
Facteur de conversion AM/FM	3, 8	°/dB
Variation de phase en fonction de la tension d'hélice	0, 5	°/V



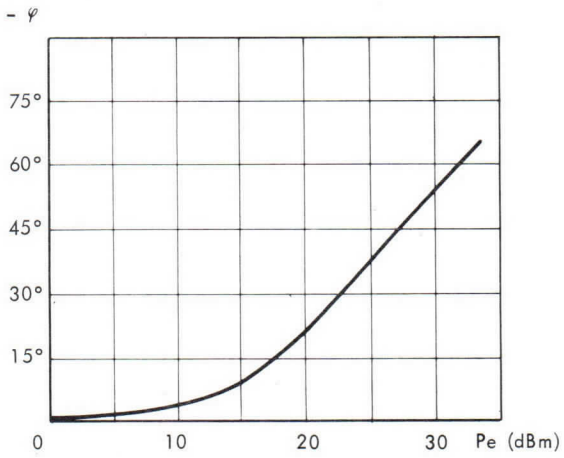
Puissance de sortie et rendement en fonction de la fréquence avec collecteur déprimé.



Puissance de sortie rendement et gain en fonction de la fréquence.



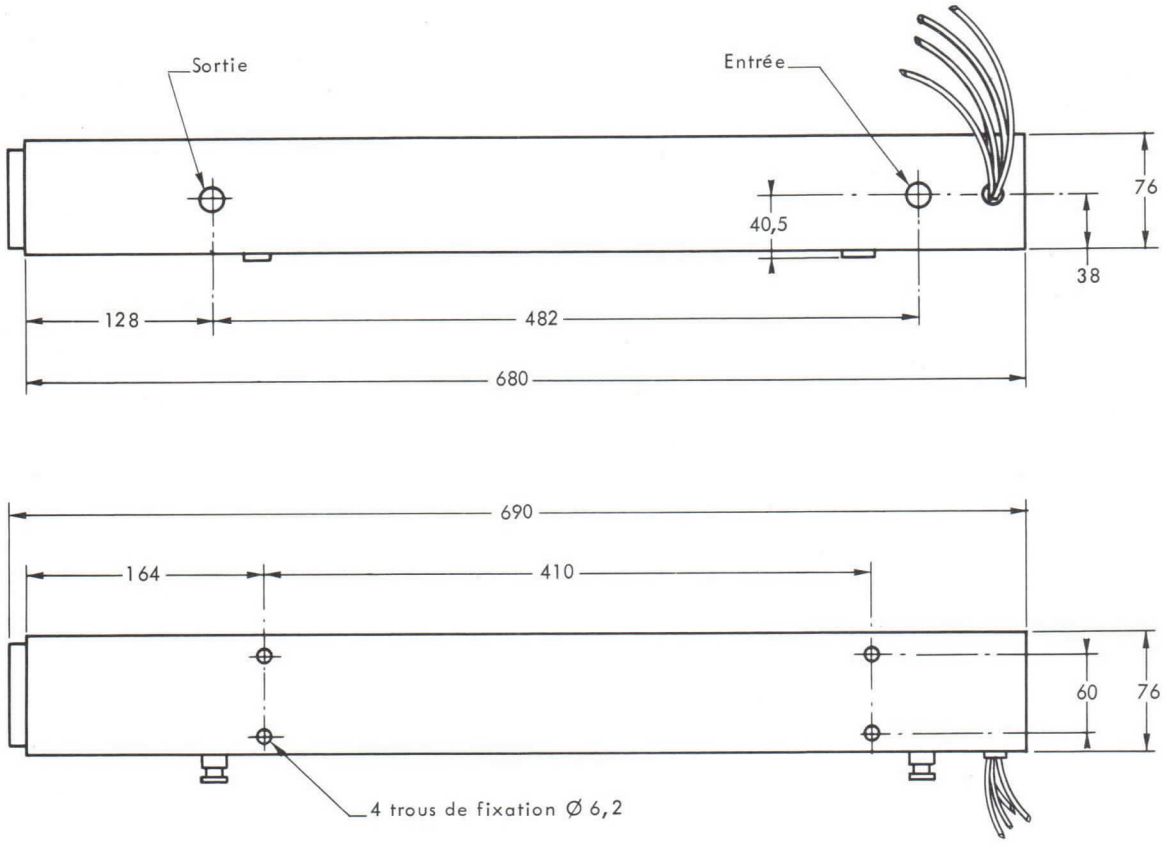
Rotation de la phase en fonction de la tension hélice

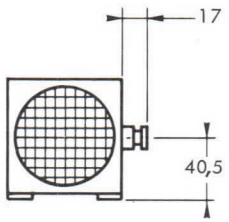


Rotation de la phase en fonction de la puissance d'entrée à 1,5 GHz

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DESSIN D'ENCOMBREMENT

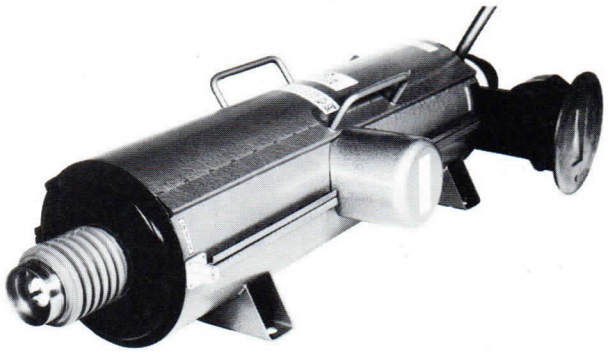




Cotes en mm.

TUBE A ONDE PROGRESSIVE TOP 1304

Le TOP 1304 est un tube à onde progressive modulable par la cathode, capable de délivrer une puissance crête minimale de 170 kW et une puissance moyenne minimale de 2,5 kW (1) en un point dans la bande 2850 - 3150 MHz. Son gain minimal est de 30 dB dans la bande. Ce tube, associé au TOP 1293 trouve son application dans les systèmes radars modernes.



Le TOP 1304, focalisé par un électroaimant, est équipé d'une pompe ionique. Il peut être refroidi par une circulation de coolanol.

Ses principales caractéristiques sont :

- faible poids : 35 kg focalisateur compris ;
- bon rendement : 35 %, fonctionnement possible en collecteur déprimé ;
- faible variation de gain dans la bande ;
- grande stabilité ;
- longue durée de vie grâce à une cathode du type imprégné.

CARACTERISTIQUES GENERALES

Electriques

	min.	max.	
Bande de fréquences	2850	3150	MHz
Puissance de sortie crête en un point de la bande	170	–	kW
Puissance de sortie moyenne en un point de la bande	2, 5	3	kW
Puissance de sortie crête dans la bande	135	–	kW
Largeur d'impulsion (2)	–	25	µs
Gain dans la bande à saturation	30	–	dB
Tension de chauffage	7	10	V
Courant de chauffage	10	11, 5	A
Tension focalisateur (3)	150	220	V
Courant focalisateur	9, 5	10, 5	A
Tension de pompe ionique	4	5, 5	kV
Courant de pompe ionique	–	200	µA
Tension ligne	45	48	kV
Courant ligne	–	5	A
Tension collecteur	28	48	kV
Courant cathode	15	18	A

(1) Pour des puissances moyennes supérieures, consulter le constructeur.
(2) Pour des largeurs d'impulsion supérieures, consulter le constructeur.
(3) La tension focalisateur et les caractéristiques hydrauliques sont mesurées lorsque la température du coolanol 35 est de l'ordre de 35 °C à l'entrée du tube.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mécaniques

Position de montage	indifférente		
Masse	35 kg		
Entrée RF	coaxiale, N, femelle		
Sortie RF	guide RG 48		
Refroidissement :	min.	max.	
Débit de refroidissement			
- corps du tube + focalisateur (3)	3, 5	—	l/mn
- collecteur (3)	7	—	l/mn
Pertes en charge			
- corps du tube + focalisateur (3)	1, 0	1, 5	bar
- collecteur (3)	1, 0	1, 5	bar

VALEURS LIMITES ABSOLUES

	min.	max.	
Tension de chauffage	7	—	V
Courant de chauffage	(4)	(4)	
Temps de préchauffage	5	—	mn
Débit de refroidissement corps + focalisateur (3)	3	—	l/mn
Débit de refroidissement collecteur (3)	6, 5	—	l/mn
Pression du réfrigérant	—	6	bar
Température maximale du réfrigérant à l'entrée du tube	—	50	°C
Tension collecteur	25	50	kV
Tension ligne	35	50	kV
ROS de la charge	—	1, 5	
Puissance d'entrée crête	—	200	W

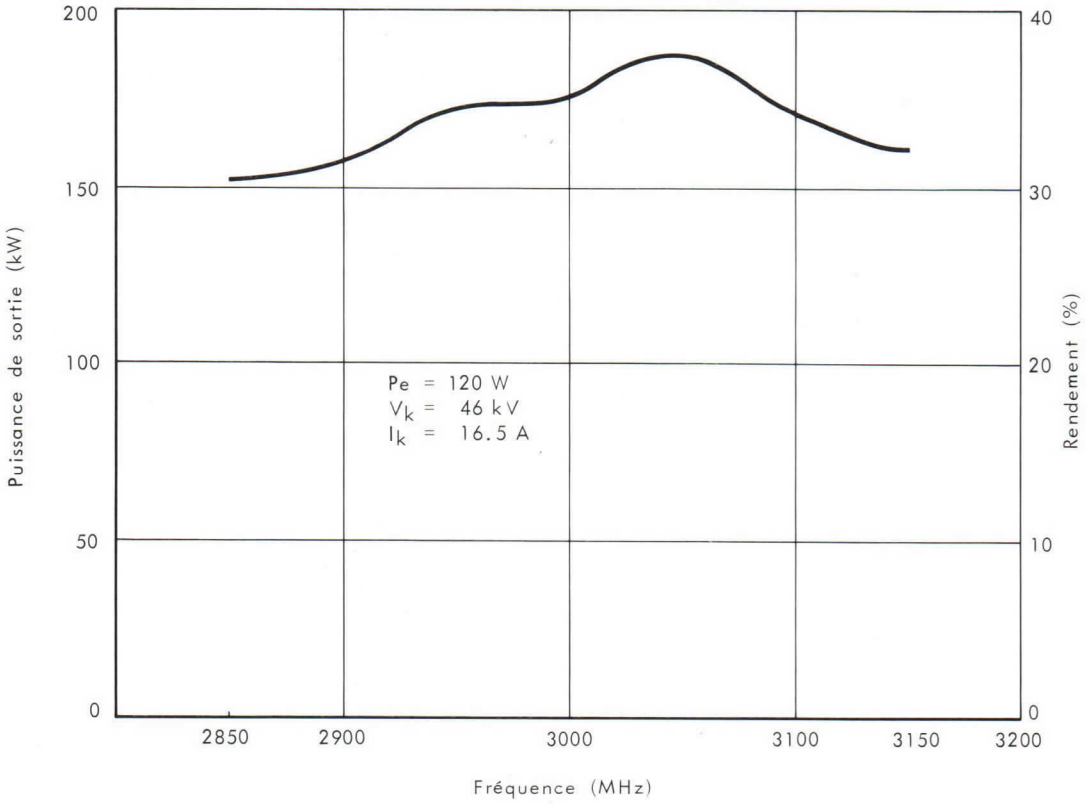
FONCTIONNEMENT TYPIQUE

Fréquence	3	GHz
Puissance de sortie crête	190	kW
Puissance de sortie moyenne	2, 4	kW
Largeur d'impulsion RF	25	µs
Gain à 160 kW crête	33	dB
Tension de chauffage	8, 2	V
Courant de chauffage	10, 6	A
Tension focalisateur	170	V
Courant focalisateur	9, 8	A
Tension ligne	46	kV
Courant ligne	2, 5	A
Tension collecteur	29	kV
Courant cathode	16, 5	A
Rotation de phase	0, 035	°/V
Refroidissement		
Température d'entrée du coolanol	35	°C
Débit du fluide de refroidissement :		
- corps + focalisateur	3, 75	l/mn
- collecteur	8, 5	l/mn

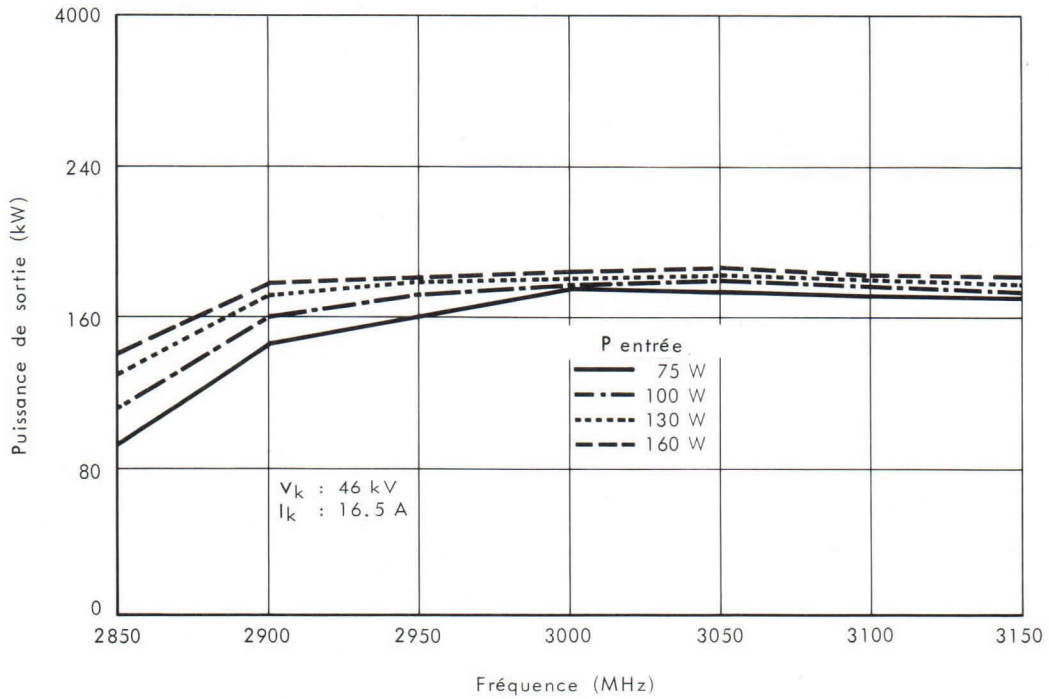
(3) La tension focalisateur et les caractéristiques hydrauliques sont mesurées lorsque la température du coolanol 35 est de l'ordre de 35 °C à l'entrée du tube.

(4) Le courant de chauffage doit être maintenu à ± 0, 2 A de la valeur nominale indiquée sur la feuille d'essai.

PUISSANCE DE SORTIE ET RENDEMENT

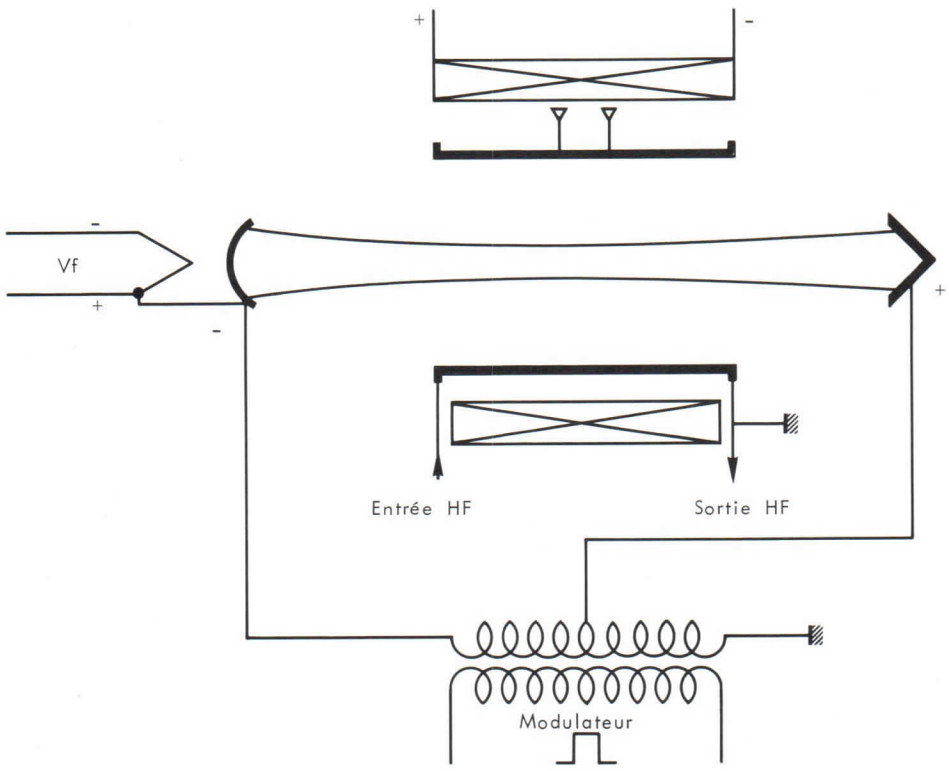


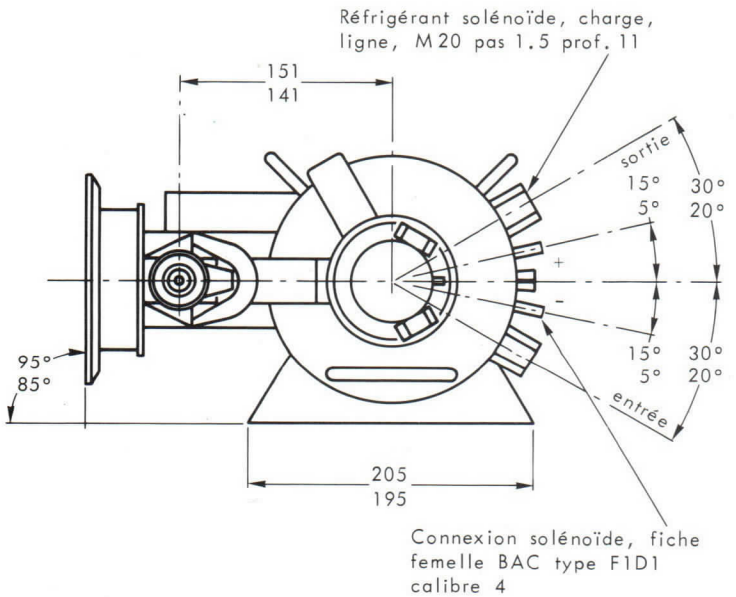
PUISSANCE DE SORTIE EN FONCTION DE LA PUISSANCE D'ENTREE ET DE LA FREQUENCE



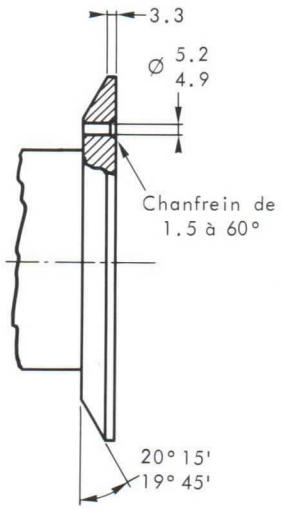
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

SCHEMA D'ALIMENTATION

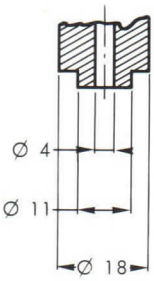




DETAIL SORTIE HF

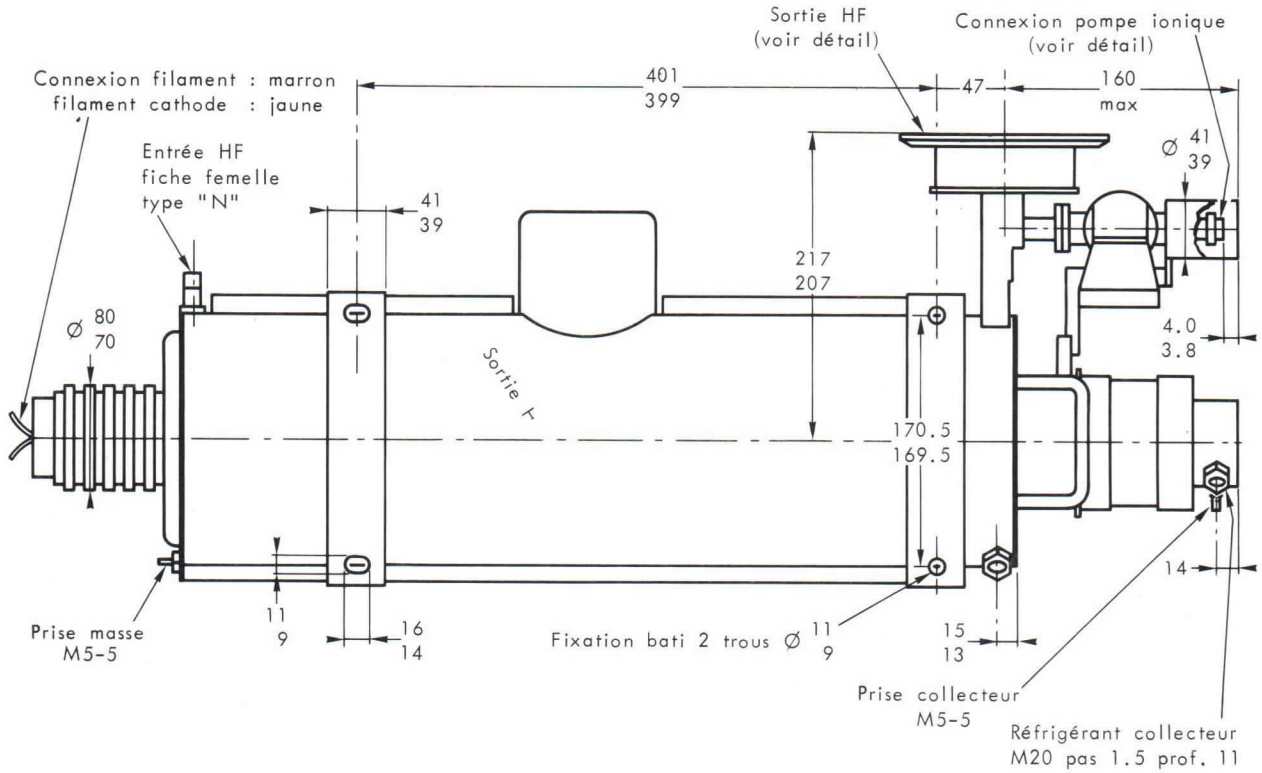


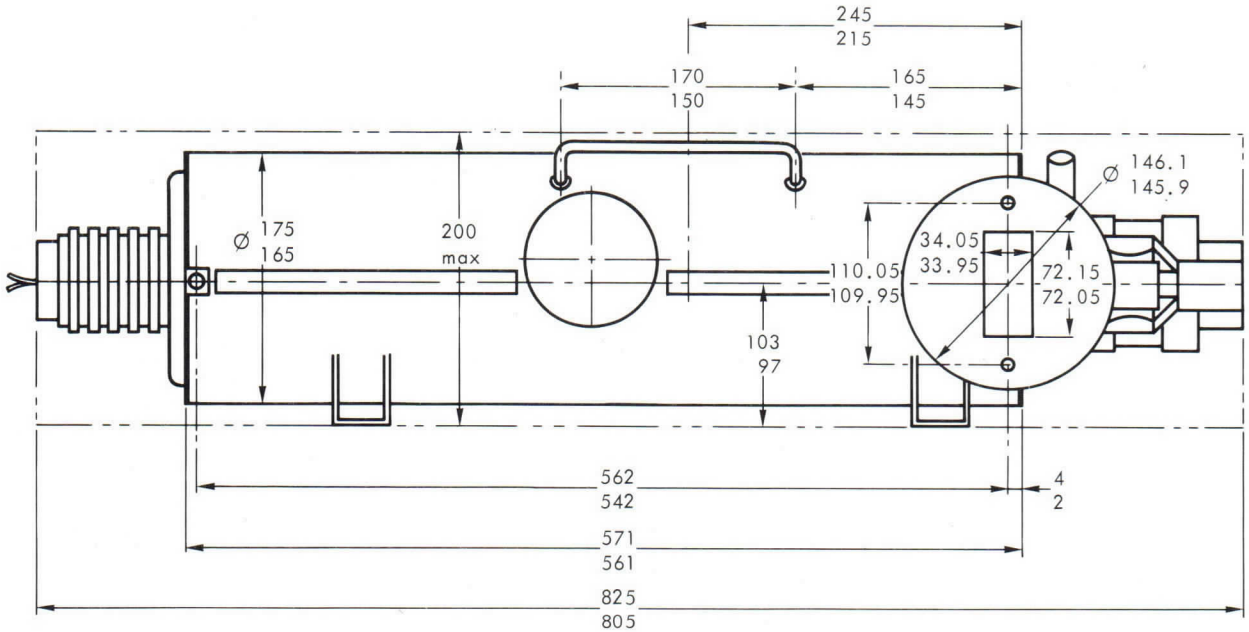
DETAIL CONNEXION POMPE IONIQUE



Cotes en mm.

DESSIN D'ENCOMBREMENT





Cotes en mm.

TOP 1304

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GROUPEMENT TUBES ELECTRONIQUES

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GROUPEMENT TUBES ELECTRONIQUES

Imprimé en France

TOP 1334 TRAVELING WAVE TUBE

The TOP 1334 is a traveling wave tube capable of delivering more than 150 W in the 7.0 to 11 GHz frequency range.

The tube is equipped with periodic magnet and isolated collector. An all ceramic metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions. The heat dissipation capability of the helix has been increased by a special brazing technique, resulting in lower operating temperature. The impregnated cathode, operating at low current density provides longer life expectancy. Depressed collector operation insures 25 % efficiency. Upon request, it can be equiped with a low voltage control anode for pulse modulation.



This traveling wave tube offers the following main features :

- high reliability,
- long life,
- low weight,
- rugged construction.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	avg.	max.	
Frequency	7. 0	–	11	GHz
Heater voltage	–	6. 3	–	V
Heater current	–	2. 7	–	A
Output power	150	–	–	W
Gain	30	–	–	dB

(1) All voltages are referred to the cathode.

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	min.	avg.	max.	
Helix voltage	–	6. 3	–	kV
Helix current	–	–	25	mA
Anode current	–	–	0. 5	mA
Cathode current	–	180	–	mA
Load VSWR	–	–	1. 2 : 1	

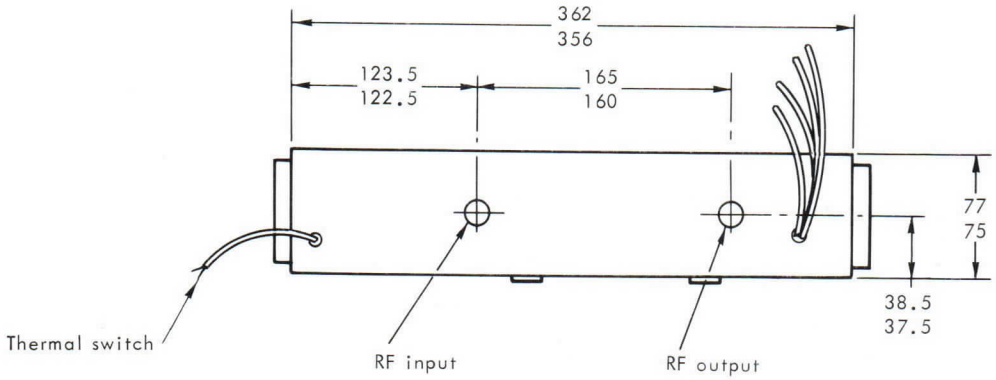
Mechanical

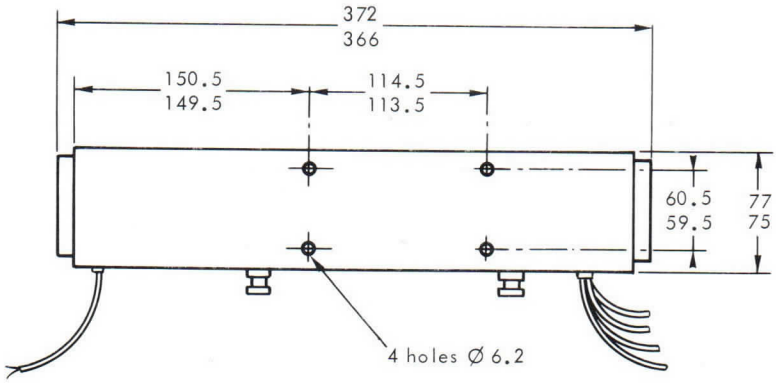
Operating position	any
Weight (approximate)	2. 3 kg
RF input and output connections	T N C
Supply connections	flexible leads
Cooling	forced air

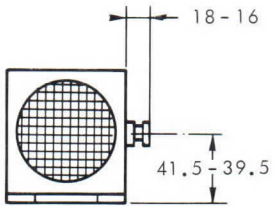
ABSOLUTE RATINGS

	min.	max.	
Heater current	2. 4	3. 0	A
Heater voltage	6. 2	6. 4	V
Warm-up time	3	–	mn
Helix voltage	6. 1	6. 9	kV
Helix current	–	20	mA
Anode voltage	6. 0	6. 6	kV
Anode current	–	5	mA
Cathode current	–	210	mA
Collector dissipation	–	1600	W
Drive power	–	150	mW
Load VSWR	–	2 : 1	
Cooling air flow	60	–	l/s

OUTLINE DRAWING







Dimensions in mm.

TOP 1334

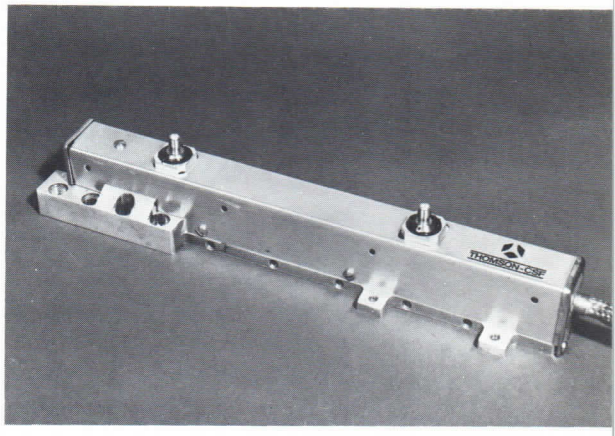
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TOP 1369

HIGH-GAIN 11–GHz TWT FOR COMMUNICATIONS SATELLITES

FEATURES



- **Specifically developed for use in communications-satellite transponders.**
- **Unusually high gain** : at least 55 dB at saturation and over 60 dB under small-signal conditions.
- **Powerful** : over 20 watts of saturated output power available.
- **Linear transmission characteristics** : small-signal to saturation phase shift limited to 40 ° , maximum.
- **Lightweight, compact and extremely rugged** : to withstand all the rigors of launching and the space environment.
- **Exceptional reliability** : designed to operate at least seven full years in space, with an MTTF of at least 500, 000 hours (60 % confidence level). Long-life impregnated-tungsten cathode.

DESCRIPTION

The TOP 1369 high-gain traveling-wave tube has been developed to meet the severe requirements of in-space operations in communications-satellite transponders. Delivering more than 20 watts of output power at saturation, in the 10.95 to 11.70-GHz frequency band (1), this lightweight, compact tube is rugged enough to withstand the severe environmental conditions encountered in launching, orbital insertion, and operation in space.

Paired with a highly efficiency solid-state power supply (2), the TOP 1369 provides the very small fine-grain small-signal gain variations and flat gain characteristics needed in satellite-transponder service.

Since a transponder TWT must normally perform simultaneous amplification of several carriers, linearity of its transmission characteristics is extremely important. This is expressed by a limiting value being set on the phase variation between small-signal and large-signal operation. In the TOP 1369, this phase shift does not exceed a maximum of 40°.

Featuring PPM focusing, this tube is cooled by simple conduction alone, through its base plate.

Presently undergoing qualification for the European Space Research Organization (ESRO), the TOP 1369 is manufactured to the very strict quality-assurance standards for space tubes, and is designed to provide at least seven years of continuous in-space operation. It is estimated that the improved impregnated-tungsten cathode will have a useful operating life of more than 200,000 hours.

Variants of this TWT are available for operation in other frequency ranges and/or at lower power levels. The Electron Tube Group of THOMSON-CSF welcomes the opportunity to discuss your specific requirements with you.

(1) The band allocated for the European satellite-communications system.
(2) Developed by CGE-FIAR (Italy).

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CHARACTERISTICS

Performances

Frequency range (Note 1)	10.95 to 11.70 GHz
Single-carrier saturated output power, min.	20 W
Gain at saturation, min.	55 dB
Small-signal gain, min.	60 dB
Noise figure, max.	28 dB
Nominal input and output impedance	50 Ω
VSWR, input and output :	
- hot, max.	1.5 : 1
- cold, max.	1.3 : 1
Frequency response in any 125 MHz channel :	
- Gain ripple at saturation	± 0.1 dB
- Gain ripple below saturation	± 0.2 dB
- Gain slope at saturation	± 0.005 dB/MHz
- Gain slope below saturation	± 0.01 dB/MHz
Third-order intermodulation products :	
- With 2 equal-amplitude carriers driving the TWT to saturation	< − 10 dB, relative to either carrier's output level

- With each carrier output at a level, relative to the single-carrier saturation level, of	− 6 dB	− 9 dB	− 13 dB
- The 3rd-order IM product's level, relative to either carrier is	− 17 dB	− 24 dB	− 33 dB

AM/PM Transfer, at saturation	⩽ 6 °/dB
Small-signal to saturation phase shift, max.	40°
Group-delay variation at saturation,	0.5 ns
Overall efficiency (DC to saturated RF),	30 %

Mechanical

Weight, approx.	650 grams
Dimensions	See Outline Drawing
RF Connections	Female SMA type
Power-supply connections	Flying leads
Cooling	By conduction
Operating-temperature range (base plate) :	
- Normal	− 5 to + 70 °C
- Extreme (2)	− 15 to + 85 °C

TYPICAL OPERATION

Single-carrier saturated output power	+ 13.2 dBW
Gain at saturation	57 dB
Small-signal gain	62 dB
Noise figure	26 dB
Input and output VSWR	As specified
Frequency response	As specified
Third-order intermodulation products	As specified
AM/PM Transfer, at saturation	5 °/dB

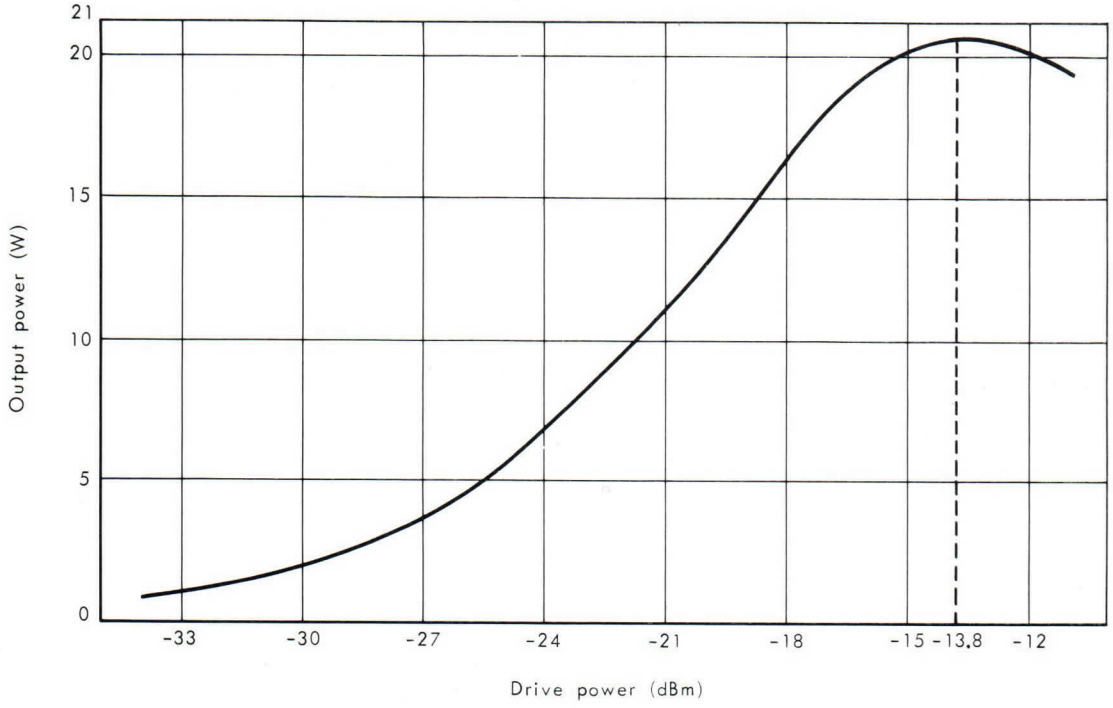
Output level below saturation	0 dB	− 3 dB	− 6 dB	− 10 dB
Phase shift	35°	12°	6°	3°

Variation of group-delay	0.5 ns

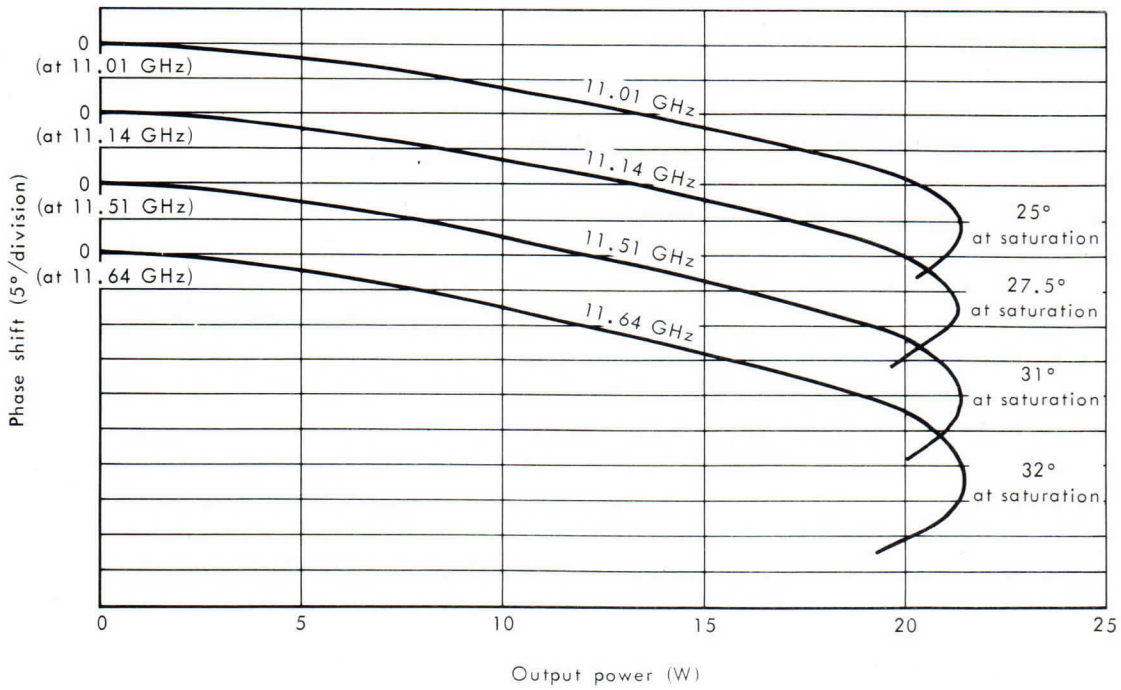
(1) The 10.95 - 11.70 GHz band has been allocated to Europe for satellite communications. The tube can be delivered in alternate versions, optimized for other frequency ranges and/or lower power levels.

(2) Characteristics not guaranteed.

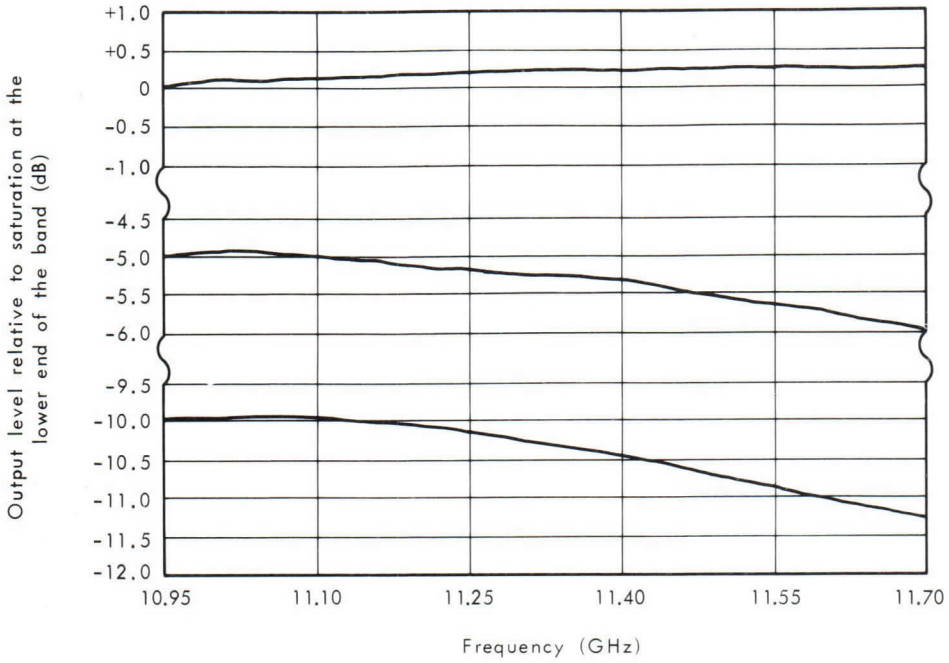
OUTPUT POWER VERSUS DRIVE POWER
(Typical curve)



PHASE SHIFT VERSUS OUTPUT POWER
(Typical curves)

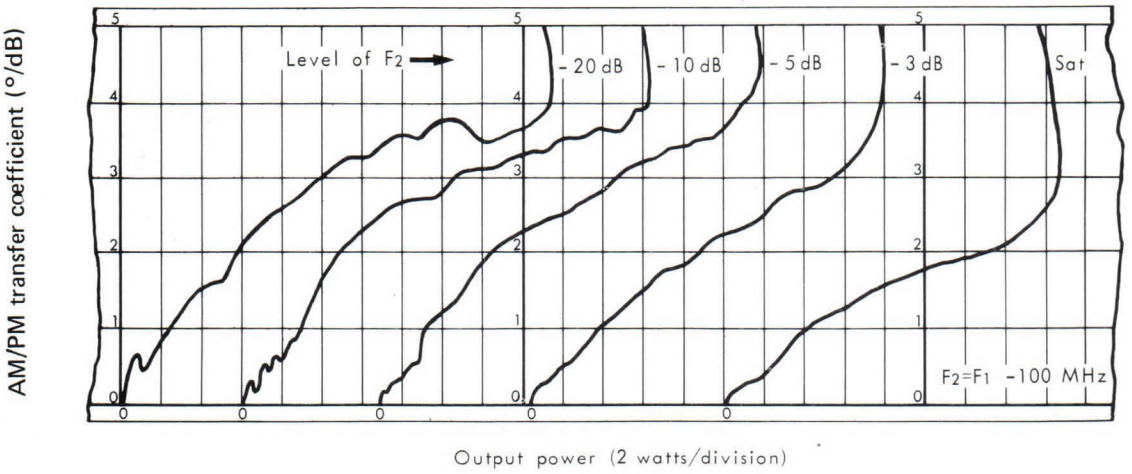


GAIN VERSUS FREQUENCY (Typical)



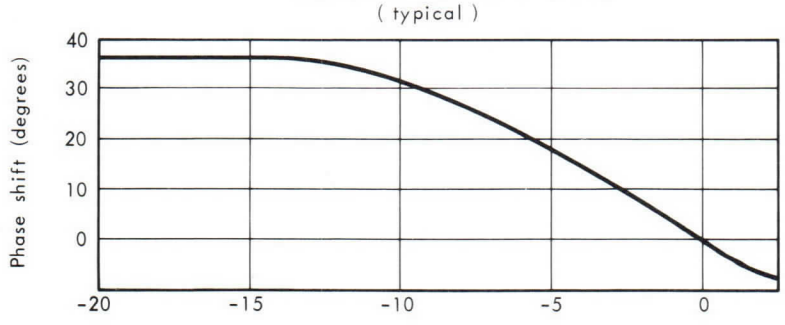
AM/PM TRANSFER COEFFICIENT VERSUS OUTPUT POWER (Typical)

(level of F1 held constant while level of F2 is varied)



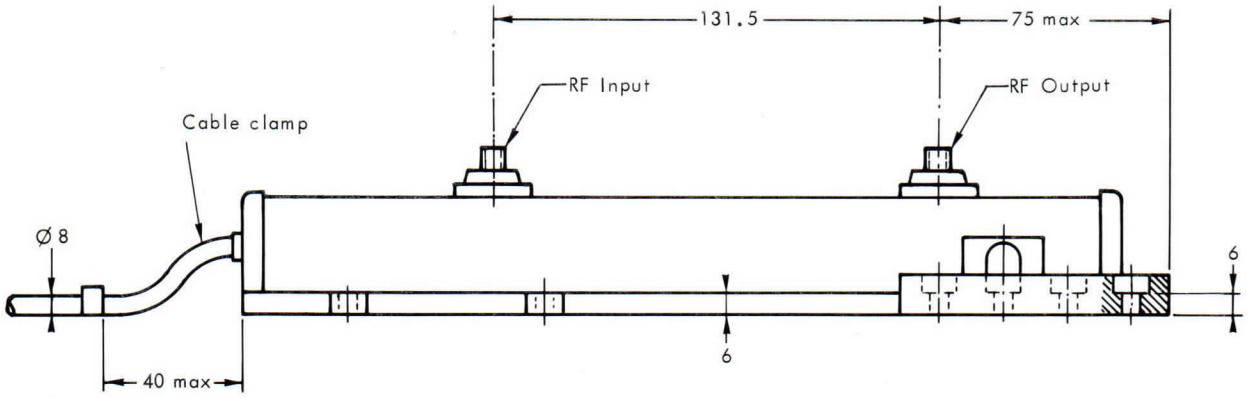
PHASE SHIFT VERSUS RF DRIVE

(typical)

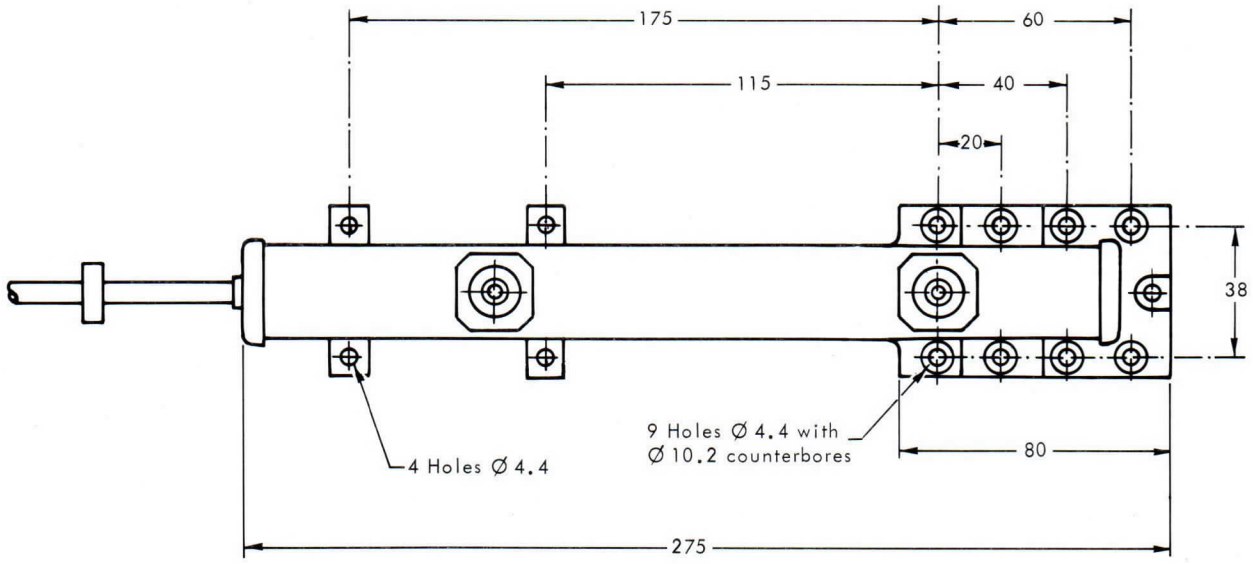


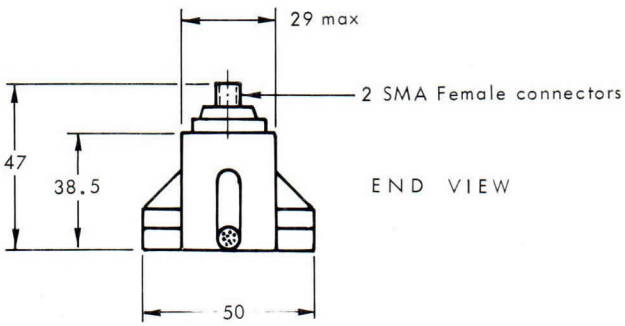
OUTLINE DRAWING

SIDE VIEW



TOP VIEW





END VIEW

Dimensions in mm, nominal except for those market "max."

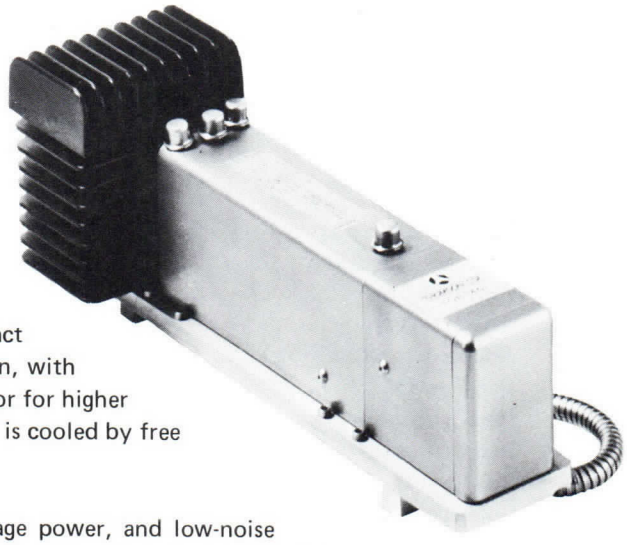
TOP 1369

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Imprimé en France

TOP 1401
25 W PPM-FOCUSED TWT



The TOP 1401 is a medium-power, helix-type, wideband traveling-wave tube, well-suited for pre-amplifier or power amplifier use in the earth stations of satellite communications systems. Operating in C band, in the range 5.9 to 6.5 GHz, it delivers more than 25 watts of CW power at the output, with minimum small-signal gain equal to 35 dB.

A periodic permanent magnet beam-focusing assembly is an integral part of the TOP 1401. This compact and lightweight TWT may be mounted in any orientation, with no degradation in performance. Using a depressed collector for higher efficiency and reduced power consumption, the TOP 1401 is cooled by free convection alone.

Its wideband, helical slow-wave circuit, good average power, and low-noise characteristics make the TOP 1401 also an excellent choice for microwave radio-link applications.

Based on extensive actual operating experience, a useful operating life of 30,000 hours or more can be expected from this TWT.

GENERAL CHARACTERISTICS

Electrical

Frequency range	5.925 to 6.425		GHz
Output power, at saturation	⩾	25	W
Gain at rated power	⩾	35	dB
Efficiency	⩾	20	%
Noise figure		28	dB
Heater current	0.8 to	1.2	A
Anode voltage, maximum		1.80	kV
Helix voltage	3.60 to	3.95	kV
Collector voltage	2.30 to	2.40	kV
Collector current	45 to	55	mA

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Mechanical

Operating position	Any
Dimensions	See outline drawing
Weight (approx.)	8 kg
RF Connections	UG 344/U Flanges
Power supply connections	Flying leads
Cooling	By convection

ABSOLUTE RATINGS

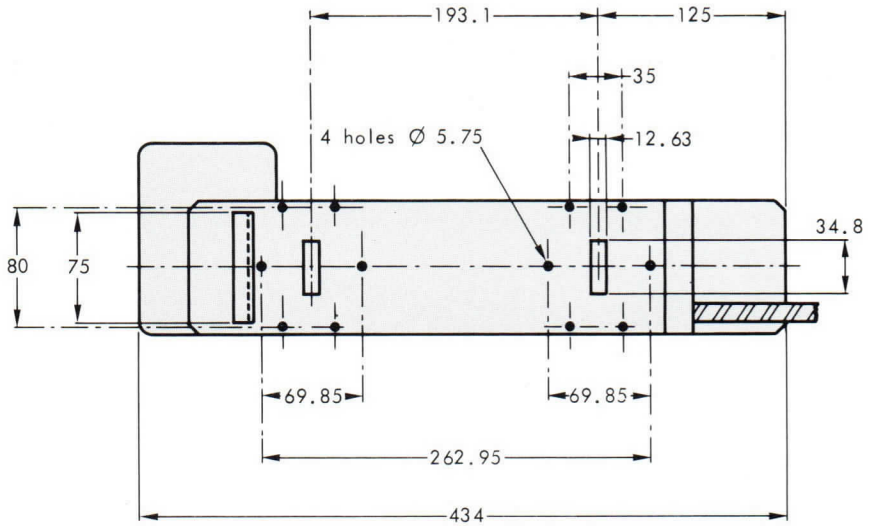
(non-simultaneous)

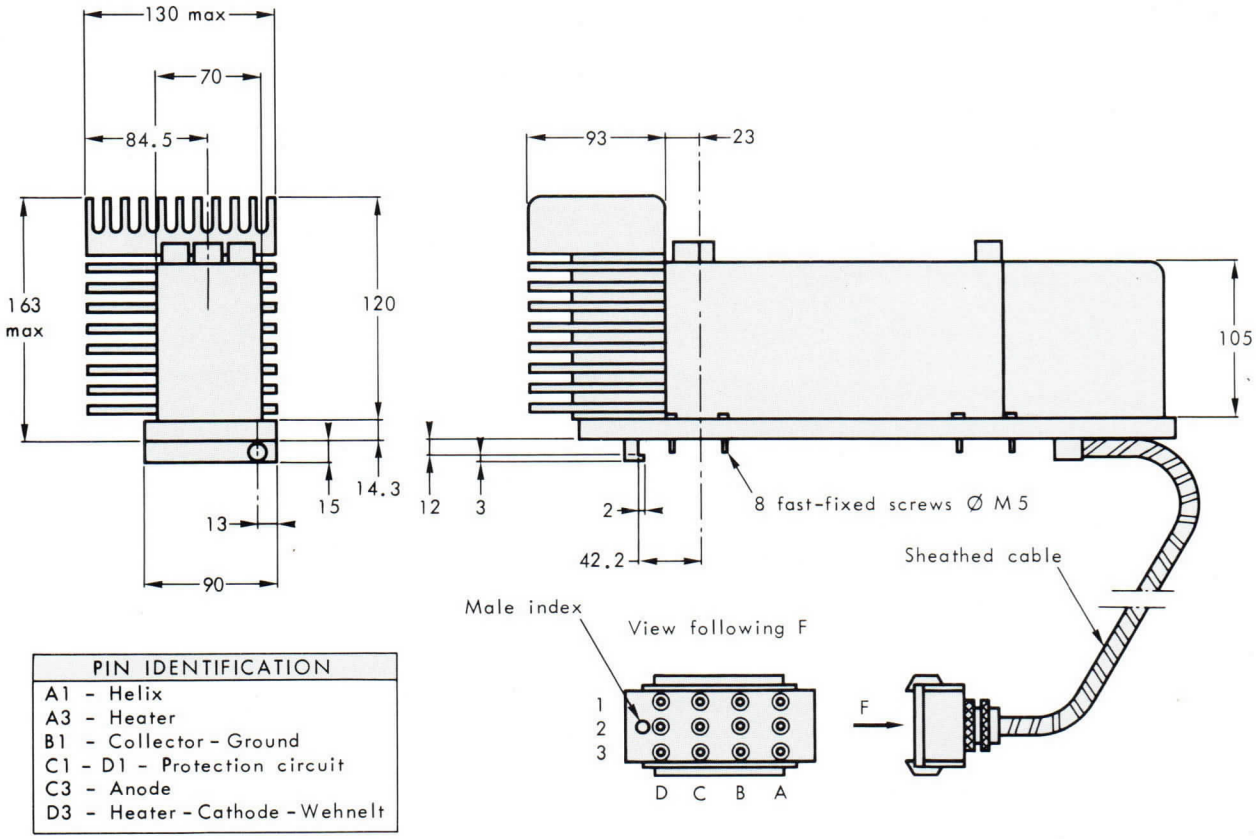
	Min.	Max.	Units
Heater voltage	6. 2	6. 6	V
Heater surge current	–	2. 0	A
Warm-up time	3	–	mn
Anode voltage	–	2. 0	kV
Anode current	– 1	+ 1	mA
Drive power	–	10	mW
Helix voltage	3. 5	4. 0	kV
Helix current	–	4	mA
Collector voltage	2. 2	2. 7	kV
Collector current	–	60	mA
Collector dissipation	–	140	W
Ambient temperature	– 10	+ 50	°C
Load VSWR	–	2 : 1	

TYPICAL OPERATION

Frequency	6	GHz
Output power	25	W
Gain	38	dB
Anode voltage	1. 55	kV
Anode current	0	mA
Helix voltage	3. 85	kV
Helix current	0. 6	mA
Collector voltage	2. 30	kV
Collector current	50	mA

OUTLINE DRAWING





PIN IDENTIFICATION
A1 - Helix
A3 - Heater
B1 - Collector - Ground
C1 - D1 - Protection circuit
C3 - Anode
D3 - Heater - Cathode - Wehnelt

Dimensions nominal, in mm.

TOP 1401

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GROUPEMENT TUBES ELECTRONIQUES

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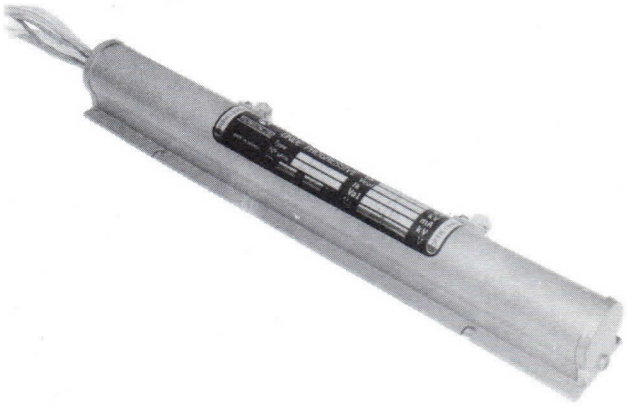
Imprimé en France

TOP.1409 TRAVELING WAVE TUBE

The TOP.1409 traveling wave tube is a medium power amplifier, used in telecommunication systems. This tube is capable of providing a minimum output power of 20 watts in the frequency range from 3300 to 4200 megahertz (for an input power of 3. 2 milliwatts) and a saturated output power of at least 25 watts.

Depressed collector operation reduces power supply requirements.

The TOP.1409 traveling wave tube is cooled by conduction and focused by a permanent magnet.



GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.			min.	max.	
Frequency	3300	4200	MHz	Helix current	-	3	mA
Heater voltage	6. 2	6. 4	V	Anode voltage	2. 3	-	kV
Heater current	0. 9	1. 3	A	Anode current	–0. 5	+0. 5	mA
Saturated output power	25	-	W	Collector voltage	1. 2	1. 8	kV
Gain	38	-	dB	Collector current	-	70	mA
Helix voltage	2. 3	2. 6	kV	Noise factor	-	30	dB

(1) All voltages are referred to the cathode.

Mechanical

Operating position	horizontal or vertical
Approximate weight	550 g
RF connexions	OSM plug 206/1
Supply connections	flexible leads
Cooling	conduction

ABSOLUTE RATINGS
(non simultaneous.)

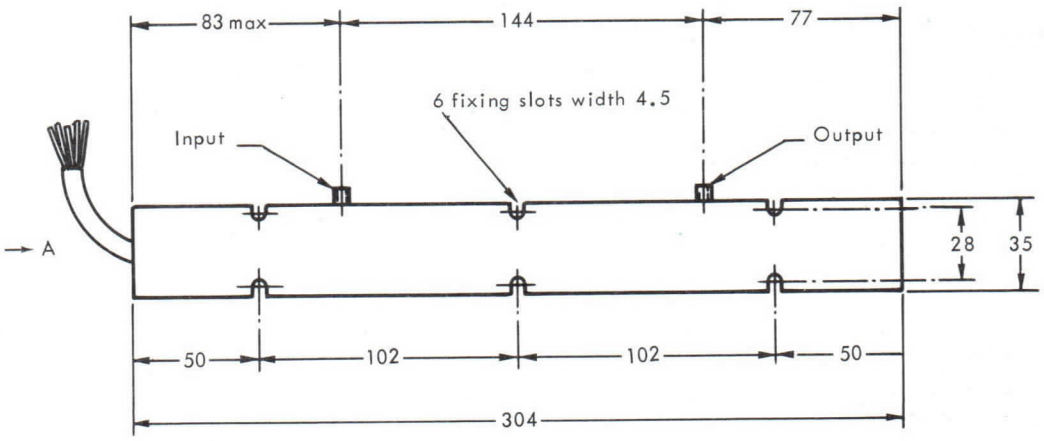
	min.	max.			min.	max.	
Heater voltage	6. 0	6. 6	V	Anode current	–1	+1	mA
Heater current	-	1. 5	A	Collector voltage	1. 1	2. 0	kV
Temperature limits	–10	+50	°C	Collector current	-	80	mA
Helix voltage	2. 2	2. 8	kV	Collector dissipated power	-	130	W
Helix current	-	4	mA	Output power	-	30	W
Anode voltage	-	2. 4	kV	Load VSWR	-	2 : 1	

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

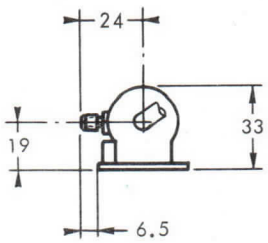
TYPICAL OPERATION

Frequency	3.7	GHz	Helix voltage	2.45	kV
Heater voltage	6.3	V	Helix current	0.7	mA
Heater current	1.0	A	Anode voltage	2	kV
Saturated output power	32	W	Anode current	0	mA
Gain for $P_o = 20$ W	40	dB	Collector voltage	1.5	kV
			Collector current	65	mA

OUTLINE DRAWING



A VIEW



CONNECTIONS	
Brown	Heater
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground - helix

Dimensions in mm

TOP 1432 TRAVELING WAVE TUBE

The TOP 1432 is a traveling wave tube operating in the 4. 0 to 8. 0 GHz frequency range, delivering a 200 W CW output power, p.p.m. focused and using an isolated collector. An all ceramic-metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions. The heat dissipation capability of the helix has been increased by a special brazing technique, resulting in lower operating temperature. The impregnated cathode, operating at low current density provides longer life expectancy. Depressed collector operation insures 25 % efficiency.



This traveling wave tube offers the following main features :

- high reliability,
- long life,
- low weight,
- rugged construction.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	avg.	max.	
Frequency	4. 0	–	8. 0	GHz
Heater voltage	–	6. 3	–	V
Heater current	–	2. 45	–	A
Output power	200	–	–	W
Gain	30	–	–	dB
Helix voltage	–	5. 6	–	kV
Helix current	–	–	30	mA
Anode voltage	–	4. 8	–	kV
Anode current	–	–	0. 5	mA
Cathode current	–	270	–	mA
Load VSWR	–	–	1. 2 : 1	

Mechanical

Operating position	any
Weight (approximate)	2. 4 kg
RF input and output connections	T N C
Supply connections	flexible leads
Cooling	forced air

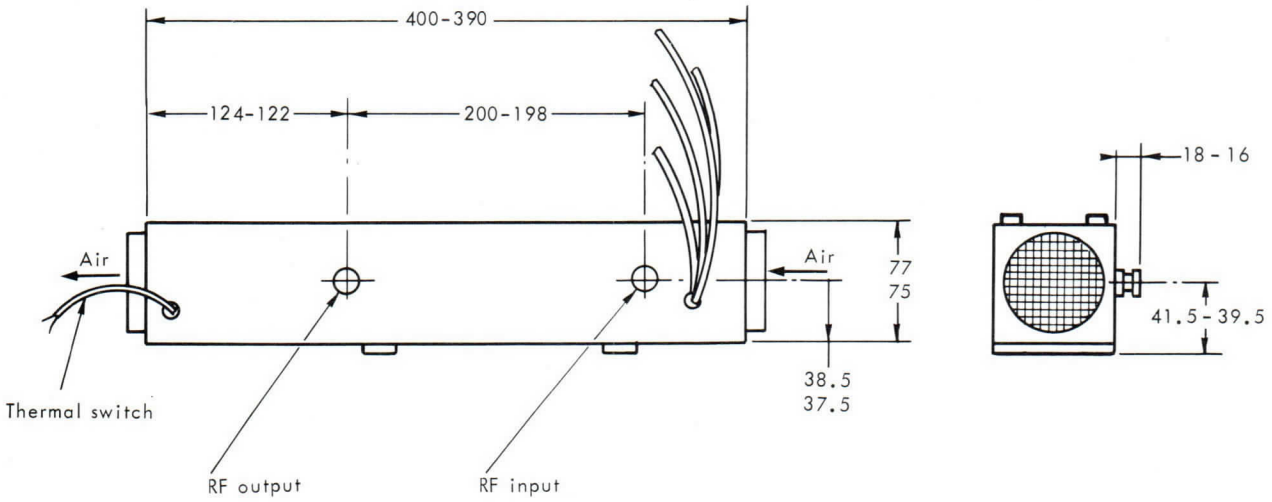
(1) All voltages are referred to the cathode.

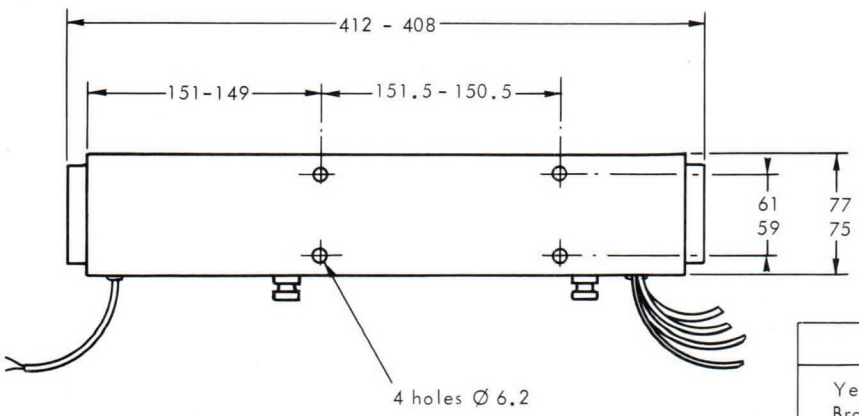
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater current	2. 3	2. 7	A
Heater voltage	6. 2	6. 4	V
Warm-up time	3	–	mn
Helix voltage	5. 3	5. 9	kV
Helix current	–	40	mA
Anode voltage	4. 0	5. 0	kV
Anode current	–	5	mA
Cathode current	–	300	mA
Collector dissipation	–	1. 7	kW
Drive power	–	300	mW
Load VSWR	–	2. 5 : 1	
Cooling flow	60	–	l/s

OUTLINE DRAWING





Dimensions in mm.

CONNECTIONS	
Yellow	Heater-cathode
Brown	Heater
Blue	Anode
Ground	Helix and tube body
Red	Collector

TUBE A ONDE PROGRESSIVE TOP 1432

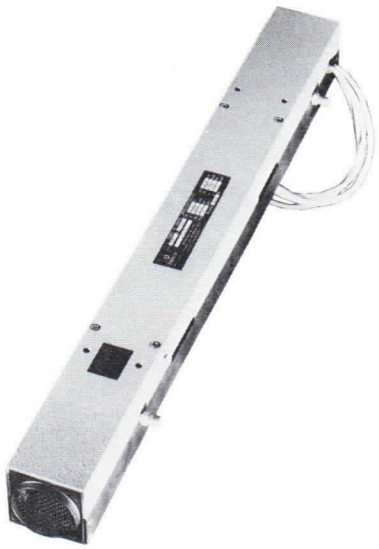
Le TOP 1432 est un tube à onde progressive à large bande fonctionnant dans la gamme de fréquence 4.0 à 8.0 GHz, et délivrant une puissance de 200 W continus.

Ce tube est focalisé par aimants périodiques alternés et refroidi par air; un système de ventilation est incorporé au tube. Sa construction métal-céramique en fait un tube particulièrement robuste et pouvant supporter les conditions d'environnement les plus rigoureuses.

Une nouvelle technologie appliquée à la conception de la ligne à retard permet d'obtenir une exceptionnelle fiabilité et une durée de vie accrue.

La capacité de dissipation thermique de l'hélice a été augmentée par une nouvelle technique de brasure, qui permet d'abaisser la température de fonctionnement. La cathode imprégnée, à faible densité de courant, contribue à augmenter la durée de vie du tube. Le collecteur isolé, pouvant fonctionner en collecteur déprimé, garanti un rendement élevé, de l'ordre de 22 %.

Le TOP 1432 est destiné plus particulièrement aux télécommunications par faisceaux hertziens, aux équipements de contremesures, aux systèmes de communications à large bande, à la télémétrie et au guidage de missiles.



CARACTERISTIQUES GENERALES

Electriques (1)

	min.	moy.	max.	
Fréquence	4,0	–	8,0	GHz
Tension de chauffage	–	6,3	–	V
Courant de chauffage	–	2,5	–	A
Puissance de sortie	200	–	–	W
Gain	30	–	–	dB
Tension d'hélice	–	5,6	–	kV
Courant d'hélice	–	–	30	mA
Tension d'anode (2)	–	4,8	–	kV
Courant d'anode	–	–	0,5	mA
Courant cathode	–	270	–	mA
TOS de la charge	–	–	1,2	

(1) Toutes les tensions sont mesurées par rapport à la cathode.

(2) La tension d'anode doit toujours être plus élevée que la tension d'hélice d'au moins 150 volts.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mécaniques

Position de fonctionnement	indifférente	
Masse approximative	2, 5	kg
Connexions d'entrée et de sortie RF	T N C	
Connexions d'alimentation	par fils souples	
Refroidissement	par air soufflé	

VALEURS LIMITES D'UTILISATION

(NON SIMULTANEES)

	min.	max.	
Tension de chauffage	5, 7	6, 9	V
Courant de chauffage	2, 3	2, 7	A
Temps de préchauffage	3	–	mn
Tension d'hélice	5, 3	5, 9	kV
Courant d'hélice	–	40	mA
Tension d'anode	4, 2	4, 8	kV
Courant d'anode	–	5	mA
Courant de cathode	–	300	mA
Dissipation collecteur	–	1, 7	kW
Puissance de pilotage	–	300	mW
TOS de la charge	–	2	
Débit d'air	60	–	l/s

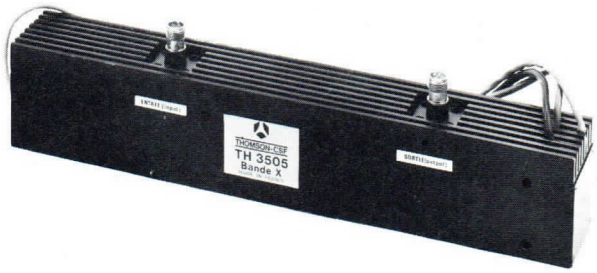
TH 3505

X-BAND TRAVELING WAVE TUBE

The TH 3505 is a pulsed traveling-wave tube operating in X band, which provides a peak output of 1250 watts or more, with a duty factor of 0.015. The minimum saturated gain of this amplifier is 35 dB.

In ECM applications, the sturdy PPM-focused TH 3505 is ideal for high-power jammer use, especially in naval and ground-transportable types. It may also be used as a radar-transmitter preamplifier.

This tube is particularly rugged because of its all metal-ceramic construction. Cooling is either by conduction or forced air ; an internal thermal switch cuts off the supply voltage if the temperature exceeds 130 °C.



GENERAL CHARACTERISTICS

Electrical

Heater voltage	6. 3	V
Heater current	1. 6	A
Frequency	7 - 11	GHz
Collector voltage	10 - 11. 4	kV
Helix voltage	10 - 11. 4	kV
Peak cathode current, max.	2	A
Peak helix current	0. 5	A
Peak grid voltage	250	V
Grid cut-off voltage	− 90	V
Peak output power, min.	1250	W
Saturated gain, min.	35	dB
Duty factor	0. 015	
Pulse duration	10	µs

Mechanical

Dimensions	See the Outline Drawing
Operating position	Any
Approximate weight	2. 5 kg
RF input and output	Female TNC coaxial connectors
Power-supply connections	Flying leads

ABSOLUTE LIMITS (1)

	Min.	Max.	Units
Heater voltage	6. 1	6. 6	V
Warm-up time	3	–	mn
Heater surge current	–	2. 5	A
Collector voltage	–	12	kV
Helix voltage	–	12	kV
Peak helix current	–	0. 7	A
Peak grid voltage	– 300	+ 300	V
Pulse duration	–	25	µs
Duty factor	–	0. 02	
Collector dissipation	–	160	W
Load VSWR	–	2 : 1	
Operating temperature (2)	–	130	°C

(1) Limiting values, **NOT** operating values. No one value ever to be exceeded even under transient conditions, and operation at more than one limiting value at the same time may cause tube damage. Equipment must be designed so that these limits are never exceeded.

(2) Measured on the hottest point of the housing. A "Vigitherme" thermal switch cuts off the supply voltages if the temperature exceeds 130 °C.

OPERATING NOTES

For optimum performance, the TH 3505 should be operated at the values determined at the factory and shown on the tube label for these parameters : heater voltage, helix voltage, collector voltage, grid current, and peak cathode current. The positive grid voltage is defined to correspond to the value of cathode current specified on the label.

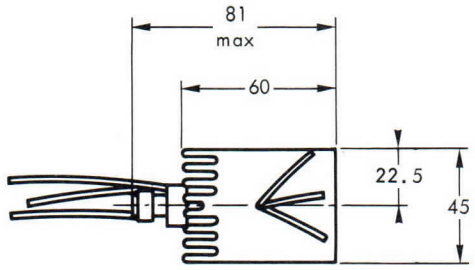
Voltages should be applied in the following order : heater (allow at least 3 minutes for the cathode to warm up), negative grid voltage, helix voltage and collector voltage.

In the case of brief power outages (less than 5 seconds), voltages may be reapplied immediately, without waiting for the cathode to warm up again.

If a dc heater supply is used, the positive side of the supply must be connected to the common heater-cathode lead.

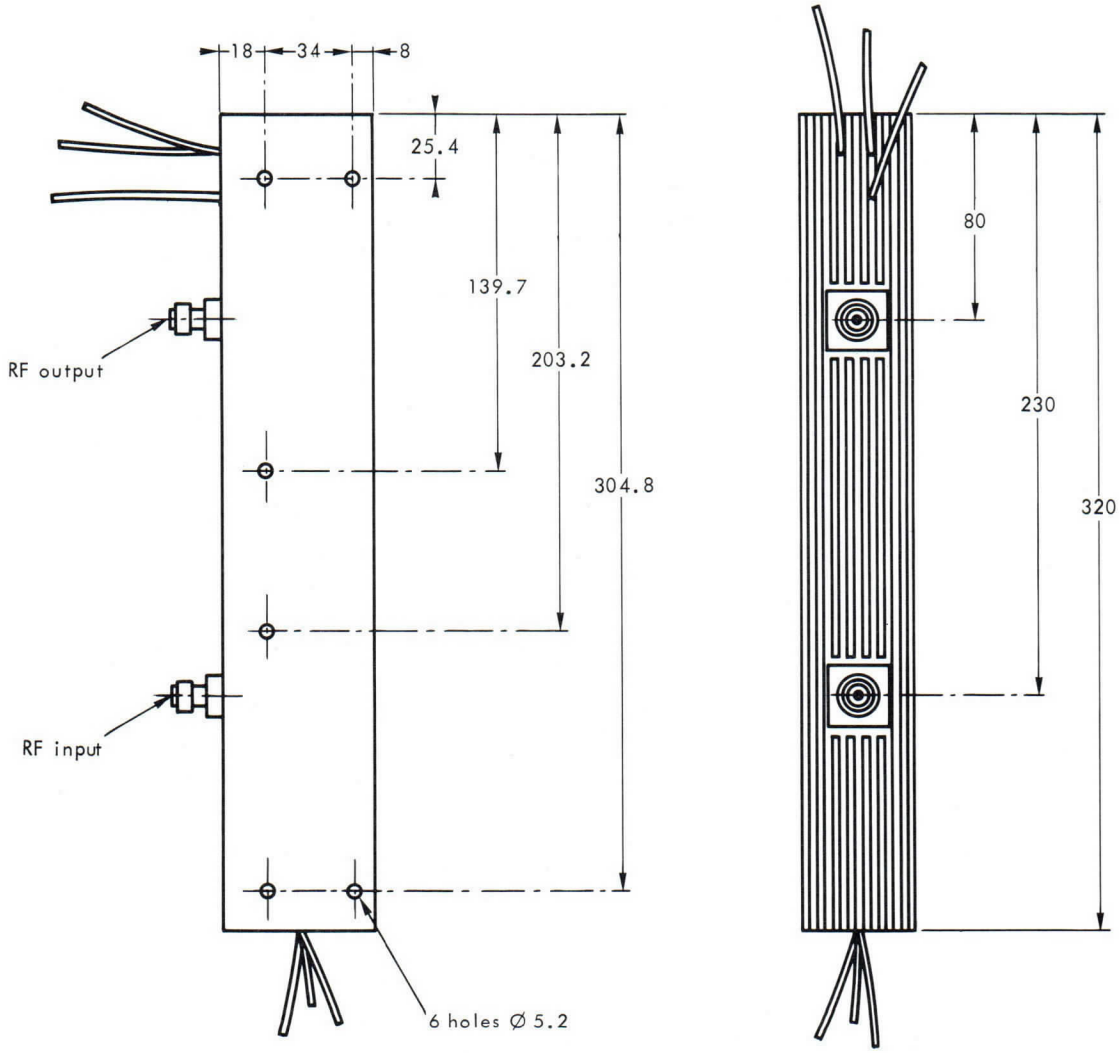
An overcurrent relay should be installed to cut off voltages if the peak cathode current or the helix current exceeds the maximum rating. Voltages should be cut off simultaneously or preferably in the following order : positive grid voltage, helix voltage and collector voltage.

OUTLINE DRAWING



CONNECTIONS	
Brown	Heater
Yellow	Cathode
Green	Grid
Black	Ground-helix
Red	Collector
Grey-White	"Vigitherme" (insulated leads)

Minimum lead length = 300 mm.



All dimensions in mm, nominal unless otherwise marked.



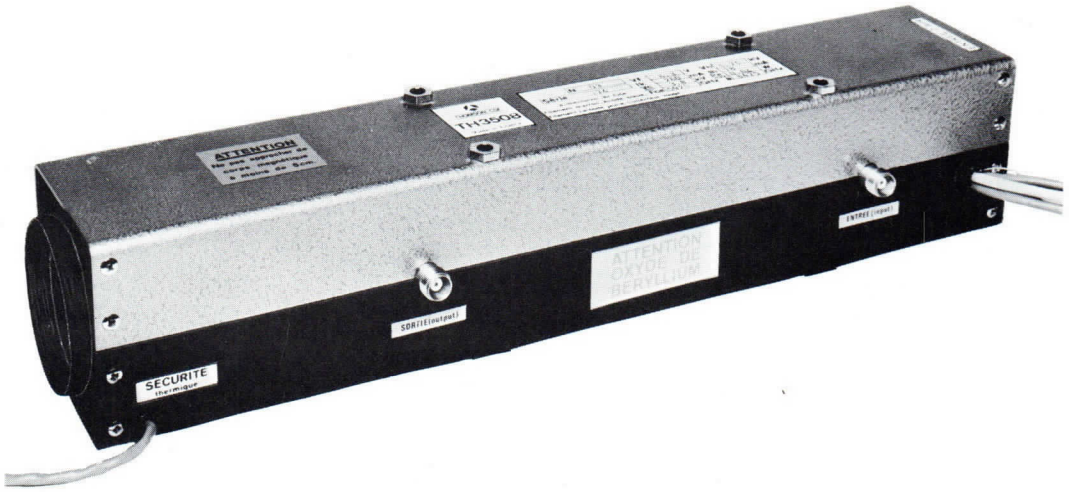
THOMSON-CSF

DIVISION TUBES ELECTRONIQUES

TH 3508
250 W CW TRAVELING WAVE TUBE

Features

- Specially designed for communications-satellite earth stations
- More than 250 Watts of CW power in C Band
- PPM-focused, for reduced power consumption and simple forced-air cooling
- Rugged all metal-and-ceramic construction, with a copper helix brazed to berylium-oxide support rods
- Compact and light weight
- Highly reliable and offers long tube life.



The TH 3508 is a high-gain, medium-power traveling-wave tube, designed for transmitter use in satellite-communications-system earth stations operating in the 5. 925 to 6. 425 GHz band.

Featuring a brazed copper helix slow-wave structure, the TH 3508 is especially well-suited for multicarrier operation in low-cost, smaller capacity INTELSAT IV-type earth stations, either fixed or transportable. Careful matching of its coupling elements and lossy sections has resulted in a TWT providing wideband operation with nearly flat gain, very low group-delay distortion and small AM/PM conversion distortion.

If operated in the normal depressed-collector configuration, the TH 3508 has a minimum overall efficiency of 25 %, with typical efficiency on the order of 30 %.

Air-cooled, the TH 3508 requires a minimum cooling-air flow of only 47 liters a second (100 cu.ft./min.).

The dispenser-type cathode, made of specially treated barium-impregnated tungsten, ensures long tube life. In addition, tube life can be further prolonged because the electron-gun design allows readjusting the cathode current as the tube ages, without changing the helix voltage.

Presently in use in the French earth station at Pleumeur-Bodou, the TH 3508 has already achieved several thousands of hours of successful operation.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

GENERAL CHARACTERISTICS

Electrical

Frequency range	5. 925 to	6. 425	GHz
Output power, at saturation	⩾	250	W
Efficiency (depressed collector)	⩾	25	%
Gain, at rated power	⩾	35	dB
Gain slope, small signal	⩽	0. 05	dB/MHz
AM/PM Conversion	⩽	8	°/dB
Noise figure		30	dB
Noise measured in a 4 KHz window	⩽	− 35	dBm
Heater voltage		6. 3	V
Heater current	2. 3 to	2. 6	A
Cathode current	240 to	300	mA
Anode voltage	4. 4 to	5. 4	kV
Collector voltage	2. 8 to	4. 0	kV

Mechanical

Operating position	Any
Dimensions	See outline drawing
Weight, approximate	2. 5 kg
RF connections	Coaxial, TNC female
Power-supply connections	Flying leads
Thermal-switch connections	Flying leads
Cooling	Forced air

ABSOLUTE RATINGS
(non-simultaneous)

	Min.	Max.	Units
Heater surge current	−	5	A
Heater voltage	6. 2	6. 4	V
Warm-up time	3	−	mn
Anode voltage	−	1. 1 V_a (nom)	kV
Anode current	− 1	+ 3	mA
Drive power	−	P_d (nom.) + 3 dB	mW
Helix voltage	−	V_h (nom.) + 0. 1	kV
Helix current	−	1. 5 I_h (nom.)	mA
Load VSWR	−	2. 5 : 1	
Collector voltage	See note (1)	4. 5	kV
Collector dissipation	−	1. 2	kW
Cooling air flow (2)	47	−	l/s
Inlet cooling air temperature	− 40	+ 50	°C
Distance from magnetic materials	5	−	cm

(1) The difference between the helix voltage and the collector voltage shall not exceed 5 kV.

(2) At normal atmospheric pressure : 1013 millibars.

TYPICAL OPERATION

Single-carrier mode

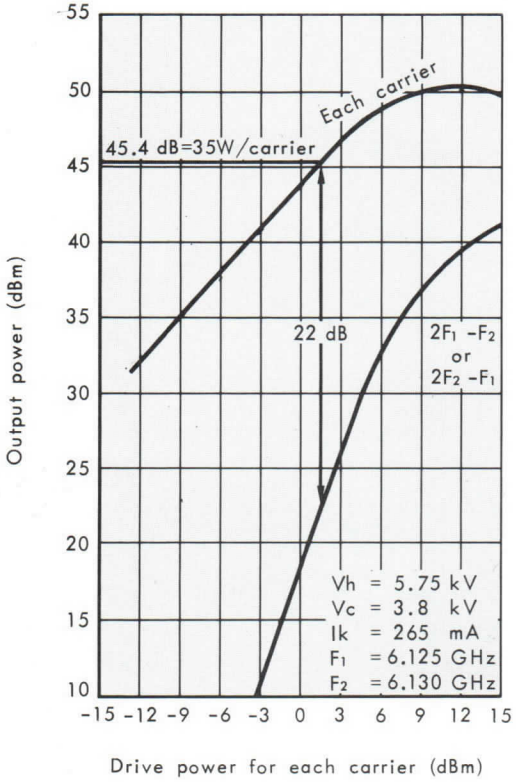
Frequency	6. 175	GHz
Drive power	11	mW
Output power	280	W
Gain :		
- saturated	44	dB
- small signal	48	dB
Efficiency	30	%
Maximum gain variation over the band, saturated	1	dB
Gain slope, maximum	0. 02	dB/MHz
Noise measured in a 4 - kHz window	− 60	dBm
Heater voltage	6. 3	V
Heater current	2. 42	A
Cathode current	260	mA
Anode voltage	4. 7	kV
Anode current	0	mA
Helix voltage	5. 75	kV
Helix current	20	mA
Collector voltage	3. 8	kV
Collector current	240	mA

Multi-carrier mode

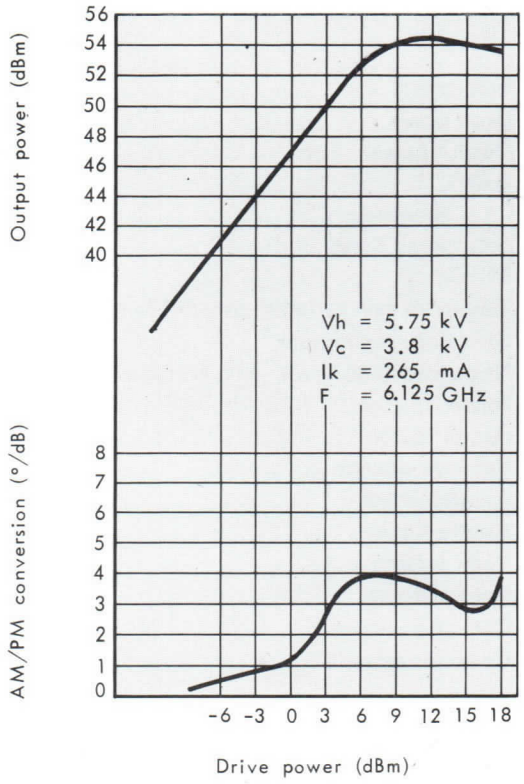
First carrier frequency, F_1	6. 125	GHz
Second carrier frequency, F_2	6. 130	GHz
Drive power, per carrier	0. 5	mW
Output power, per carrier	35	W
Intermodulation products	$\leqslant$ − 22	dB
AM/PM conversion	$\leqslant$ 1. 3	°/dB
Maximum gain variation over the band, small signal	1	dB

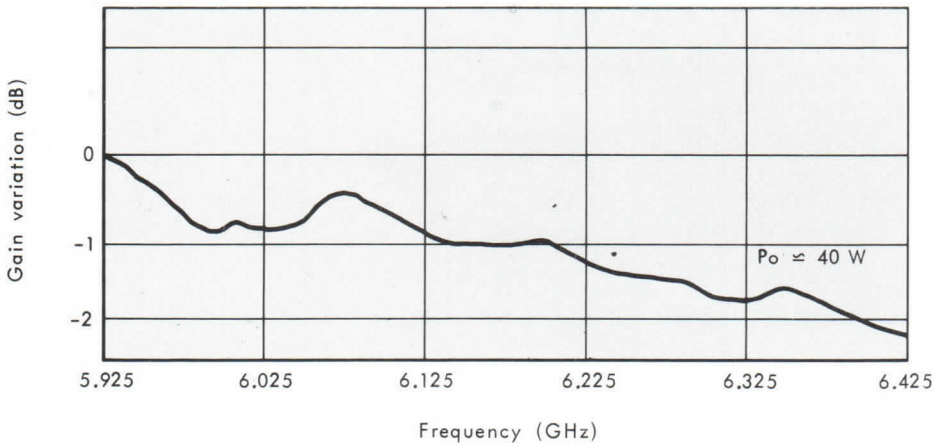
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

THIRD - ORDER
INTERMODULATION PRODUCTS

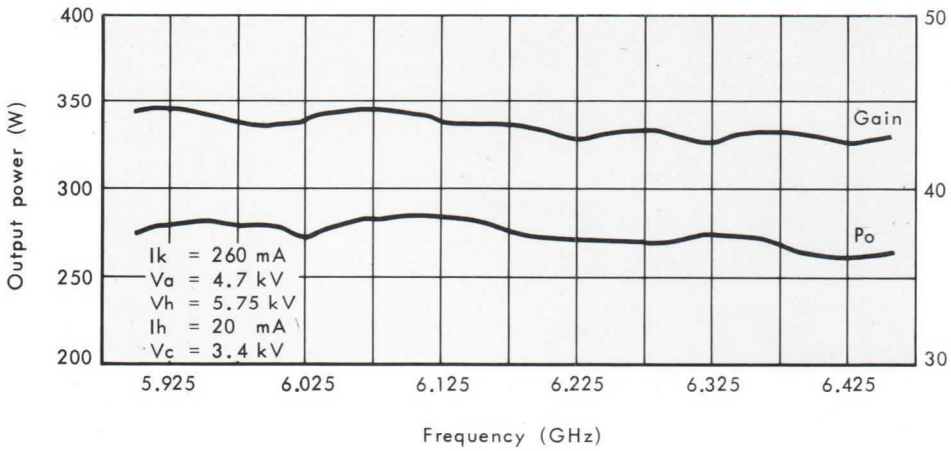


OUTPUT POWER AND AM/PM CONVERSION
VERSUS DRIVE POWER



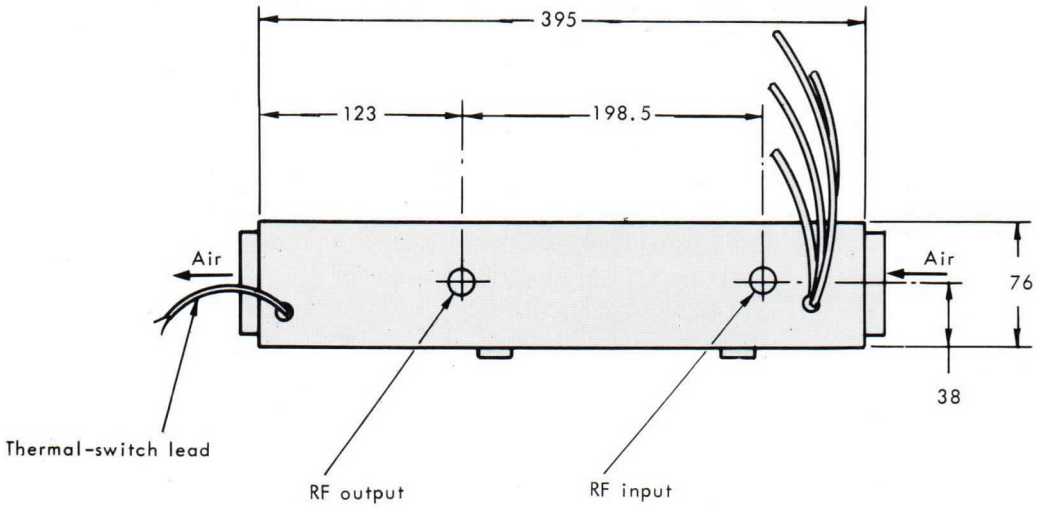


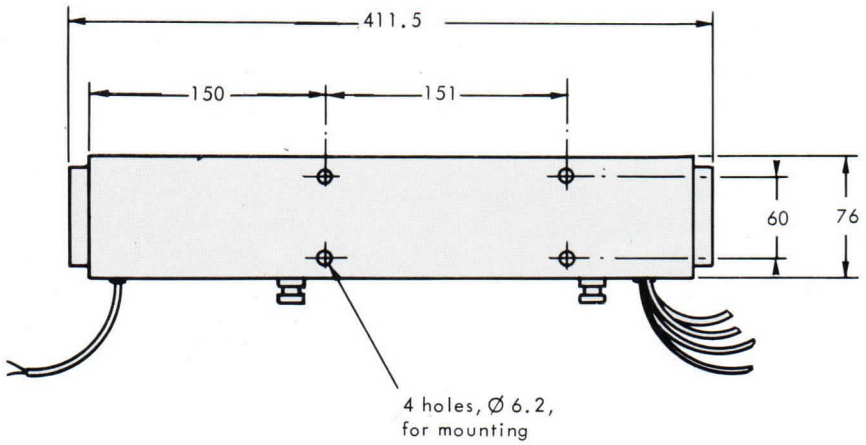
SMALL - SIGNAL GAIN
VARIATIONS
(Drive power = 0.85 mW)

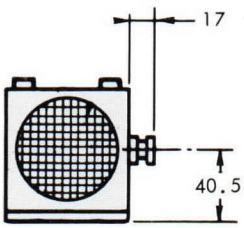


OUTPUT POWER
AND
SATURATED GAIN
VERSUS FREQUENCY

OUTLINE DRAWING







LEADS	
Yellow	Heater-cathode
Brown	Heater
Blue	Anode
Ground	Helix and tube body
Red	Collector

Dimensions nominal, in mm.

TH 3508

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

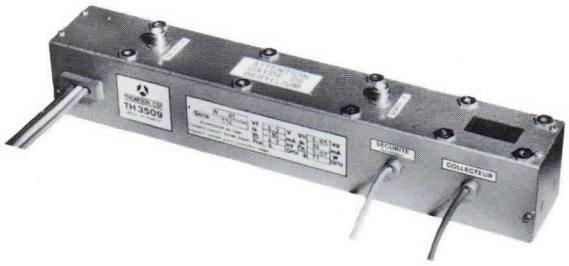
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Imprimé en France

TOP 3509 TRAVELING WAVE TUBE

Features :

- High reliability ;
- Long life ;
- Low weight ;
- Rugged construction.



The TH 3509 is a traveling wave tube delivering more than 150 W in the 7.0 to 11 GHz frequency range, which has been specially designed for ECM systems.

Featuring PPM focusing and all ceramic-metal construction, this tube is highly rugged and operates under the most severe environmental conditions. The TH 3509 is available in conduction-cooled configuration (cooled through the plate).

GENERAL CHARACTERISTICS

Electrical (1)

	min.	avg.	max.	
Frequency	7.0	—	11	GHz
Heater voltage	—	6.3	—	V
Heater current	2.4	—	2.9	A
Output power	150	—	—	W
Gain	30	—	—	dB
Efficiency (saturated output)	20	—	—	%
Collector voltage - nominal value (2)	− 0.1	—	helix voltage	kV
Helix voltage - nominal value (2)	− 0.2	—	+ 0.1	kV
Anode voltage - nominal value (2)	—	—	+ 0.1	kV
Helix current - nominal value (2)	—	—	± 50	%
Anode current	− 1.0	—	+ 4.5	mA
Cathode current	—	—	200	mA
Load VSWR	—	—	1.2 : 1	

Mechanical

Operating position	any
Weight, approximate	1.75 kg
RF input and output connections	TNC
Supply connections	flying leads
Cooling	conduction

(1) All voltages are referred to the cathode.
(2) Tolerances with respect to the nominal value given on the individual test sheet of each tube.

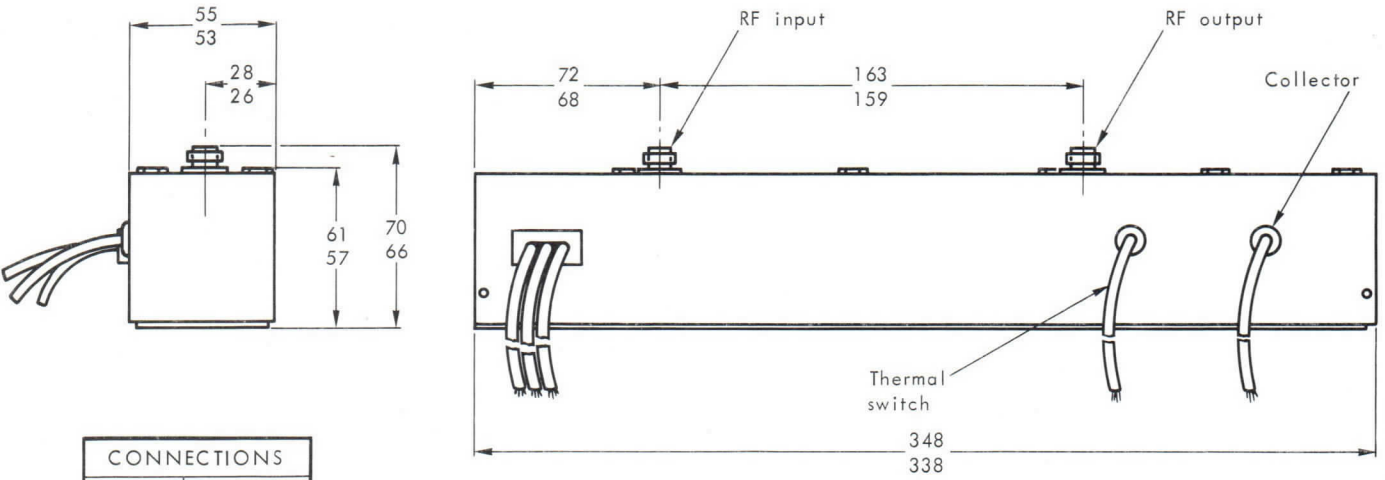
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

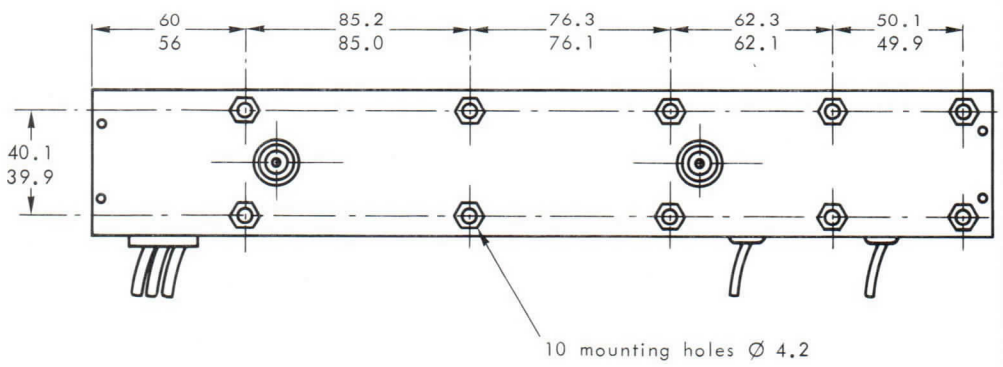
	min.	max.	
Surge heater current	–	5. 0	A
Heater voltage	6. 0	6. 6	V
Warm-up time	3	–	mn
Collector voltage	2. 9	helix voltage	kV
Helix voltage	5. 8	6. 5	kV
Helix current	–	35	mA
Anode voltage	4. 5	5. 5	kV
Anode current	–	5	mA
Cathode current	–	210	mA
Collector dissipation	–	1200	W
Drive power	–	0. 07	W
Load VSWR	–	2. 1 : 1	
Heat sink temperature	–	110	°C

NOTE - Voltages should be applied in the following order : heater, collector, helix and anode.
Anode voltage should never be applied to the tube if any one of the other voltages is not applied.

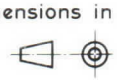
OUTLINE DRAWING



CONNECTIONS	
Yellow	Heater-Cathode
Brown	Heater
Blue	Anode
Red	Collector



Dimensions in mm.



TUBE A ONDE PROGRESSIVE

TH 3513

Le TH 3513 est un tube à onde progressive fonctionnant en Bande Ku dans la gamme de fréquence 12,7 à 13,25 GHz, et fournissant une puissance de sortie minimale de 2 W. Le gain de cet amplificateur est de 40 dB minimum.

Le TH 3513 est refroidi par convection naturelle. Sa focalisation est assurée par des aimants permanents à champ magnétique alterné.

Ce tube robuste, de faible encombrement est conçu pour équiper des matériels aéroportés. Un bloc fonctionnel amplificateur à TOP a été étudié à partir du TH 3513 associé à des circuits d'alimentation : Le TH 20057 est un amplificateur compact et léger, ne nécessitant pas de réglage, étudié pour les équipements transportables et aéroportés, les télécommunications spatiales et par faisceaux hertziens.



CARACTERISTIQUES GENERALES (1)

Electriques

	min.	max.	
Fréquence	12, 70	13, 25	GHz
Tension de chauffage	6, 2	6, 4	V
Courant de chauffage	0, 3	–	A
Puissance de sortie	2	–	W
Gain	40	45	dB
Tension d'hélice	2, 5	3, 0	kV
Courant d'hélice	–	2, 0	mA
Tension d'anode	650	950	V
Courant d'anode	−0, 1	+0, 1	mA
Tension collecteur	1, 3	1, 55	kV
Courant collecteur	–	20	mA

Mécaniques

Position de fonctionnement	indifférente
Masse approximative	650 g
Connexions r.f.	fiches coaxiales OSM 206/1
Connexions d'alimentation	par fils souples
Refroidissement	par conduction

(1) - Toutes les tensions sont mesurées par rapport à la cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION

(non simultanées)

	min.	max.	
Tension de chauffage	6, 0	6, 6	V
Courant de pointe au démarrage	–	1, 0	A
Temps de préchauffage	3	–	mn
Température de stockage	– 60	+ 60	°C
Température ambiante de fonctionnement	– 10	+120	°C
Tension d'hélice (1) - tension nominale	–200	+200	V
Courant d'hélice	–	2, 0	mA
Tension d'anode (1) - tension nominale	–	+200	V
Courant d'anode	–	2, 0	mA
Tension de collecteur (1) - tension nominale	– 200	+200	V
Courant collecteur	–	22	mA
TOS de la charge	–	3	
Puissance d'entrée	–	50	mW
Altitude	–	28000	m
Puissance dissipée sur le collecteur	–	35	W

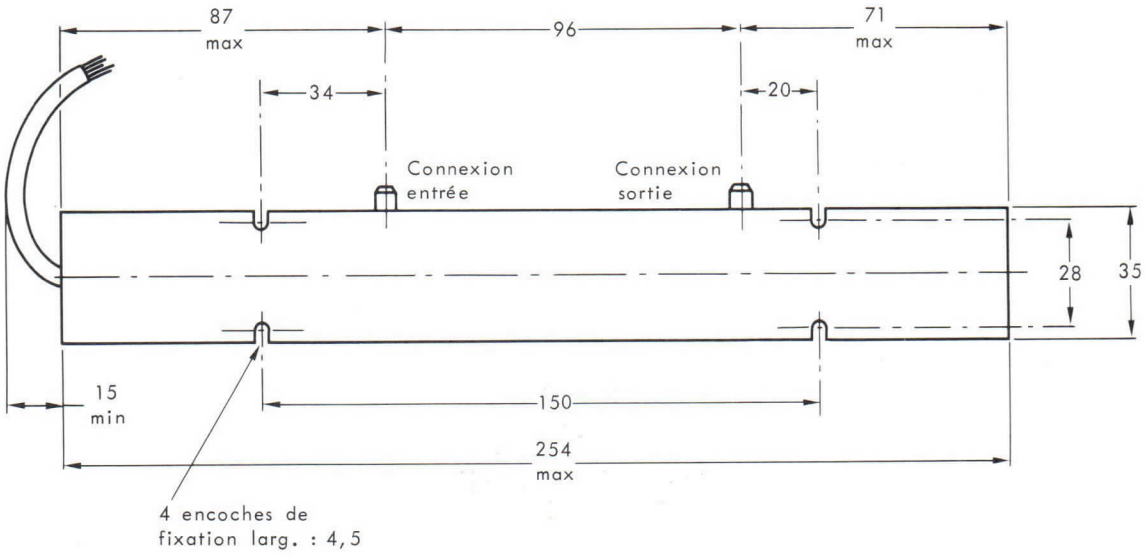
(1) - La tension nominale est indiquée sur la fiche d'essais de chaque tube.

EXEMPLE D'UTILISATION

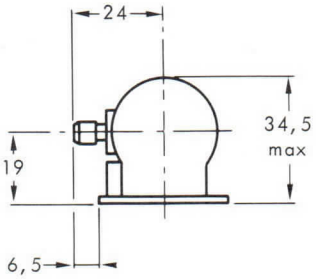
Fréquence	13	GHz
Tension de chauffage	6, 3	V
Puissance d'entrée	0, 15	mW
Puissance de sortie	3	W
Gain	43	dB
Facteur de bruit max.	28	dB
Tension d'hélice	2, 80	kV
Courant d'hélice	0, 6	mA
Tension d'anode	720	kV
Courant d'anode	0	mA
Courant collecteur	18	mA
Tension collecteur	1, 5	kV

DESSIN D'ENCOMBREMENT

Vue de dessous



Vue de coté



CONNEXIONS	
Marron	Filament cathode
Jaune	Cathode
Vert	Wehnelt
Bleu	Anode
Rouge	Collecteur
Orange	Masse hélice
Gris	Vigitherme
Blanc	Vigitherme (fil isolé)

Nota : A la sortie du tube, la longueur minimale des fils :

- d'alimentation du TOP est de 350 mm
- du vigitherme est de 450 mm

Cotes en mm.

TH 3513

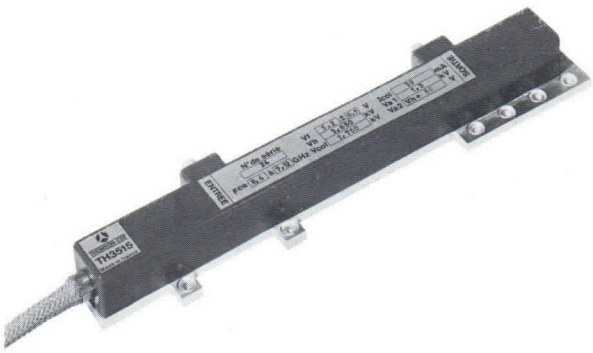
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

THOMSON-CSF

TH 3515
HIGH-PERFORMANCE C-BAND TRAVELING-WAVE TUBE

FEATURES :

- **Designed specifically for tomorrow's line-of-sight microwave links,** carrying up to 2700 telephone channels.
- **Exceptional linearity and noise characteristics.**
- **Delivers a minimum of 20** W of carrier power at saturation.
- **Incorporates long-life space-TWT technology** and gives high efficiency.
- **PPM - focused and cooled by simple conduction.**



Description

The TH 3515 traveling-wave tube has been developed to serve as the power amplifier in new, high-capacity microwave links over line-of-sight routes. Able to amplify a signal carrying up to 2700 telephone channels, or television or high bit-rate data, this TWT is designed to operate in the 6.4 to 7.2-GHz band. It's minimum output power at saturation is 20 watts, and its minimum gain 33 dB. The operating band can be appreciably enlarged with a small output power reduction.

An important feature of this new tube is its low noise factor, which does not exceed 24 dB. Further, as shown in Figure 1, it easily meets a stringent specification concerning the admissible minimum signal-to-noise ratio. Even more important, this superior noise performance is achieved with an impregnated-tungsten cathode, of the type developed for our satellite-carried TWT's. The consequences for the expected reliability and long-life capacity of the TH 3515 are obvious.

Designed to operate with its collector depressed about two kilovolts below the helix, the tube has a typical efficiency of 25 %. It also has a nearly flat gain characteristic (Figure 3) and very low AM/PM conversion. Employing PPM beam focusing (Ticonal ^{TM} 1500), the TH 3515 is fully cooled by simple conduction alone.

This state-of-the-art TWT is also available with a matched solid-state power supply, in a compact, adjustment-free TWTA configuration, eliminating all tube/power-supply interface problems for the equipment designer. Contact THOMSON-CSF for more information.

GENERAL CHARACTERISTICS

Electrical (1)

Operating-frequency range		6.4 - 7.2	GHz
Output power at saturation	min.	20	W
Gain	min.	33	dB
Noise factor	max.	24	dB
AM/PM Conversion	max.	5	°/dB
Input/output cold VSWR		1.7 : 1	
Heater voltage		5 - 6	V
Heater current		0.5 - 0.8	A
Helix voltage		3.6 - 3.9	kV
Helix current		2	mA
Anode 1 voltage		1.8	kV
Anode 2 voltage		Vh + (50 to 150)	V
Anode current		− 0.5 to + 0.5	mA
Collector voltage		1.7 - 2.0	kV

(1) All voltages referred to the cathode.

Mechanical

Operating position	Any
Dimensions	See Outline Drawing
Weight, approx.	700 grams
RF Connections	OSM
Power-supply connections	Shielded cable
Cooling	By conduction

ABSOLUTE RATINGS (2)

	Min.	Max.	Units
Heater voltage	4.8	6.5	V
Heater surge current	−	1	A
Warm-up time	3	−	mn.
Ambient temperature	− 10	+ 50	°C
Helix voltage	3.5	4.0	kV
Helix current	−	3	mA
Anode 1 voltage	−	2	kV
Anode current	− 1	+ 1	mA
Collector voltage	1.6	2.5	kV
Collector current	−	55	mA
Collector dissipation	−	130	W
Drive power	−	100	mW
Load VSWR	−	2 : 1	

(2) No single rating is to be exceeded.

TYPICAL OPERATION

Operating frequency	7	GHz	Anode 1	1.5	kV
Drive power	5	mW	Anode 2	Vh+50	V
Output power	21	W	Helix voltage	3.75	kV
Gain	35	dB	Helix current	0.6	mA
Heater voltage	5.5	V	Collector voltage	1.75	kV
Heater current	0.65	A	Collector current	45	mA

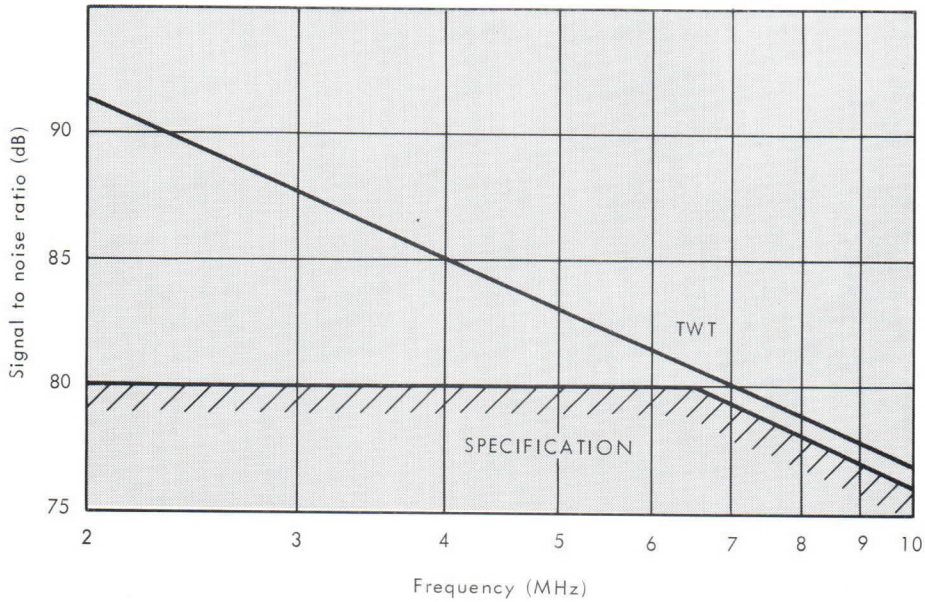


FIGURE 1 - Noise measured in a 4 kHz window, with respect to a signal causing a 140 kHz rms excursion of the carrier frequency.

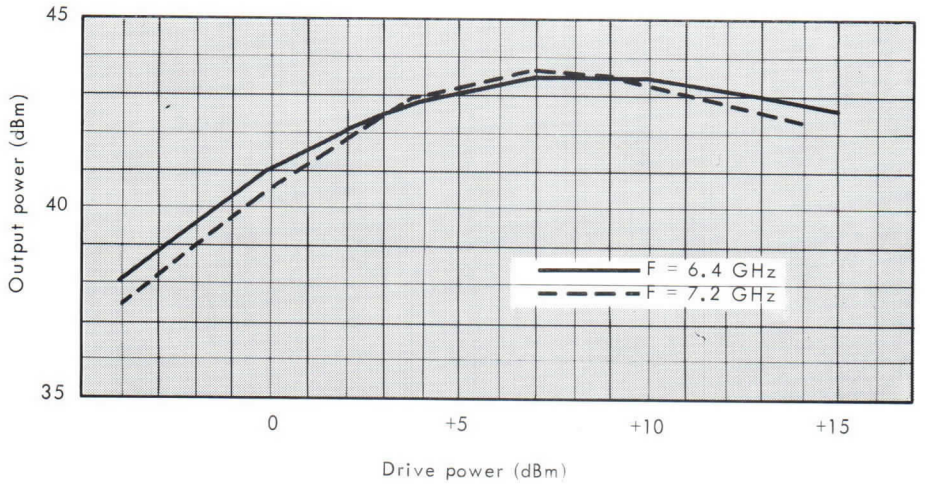


FIGURE 2 - RF Transfer curves at each end of the band.

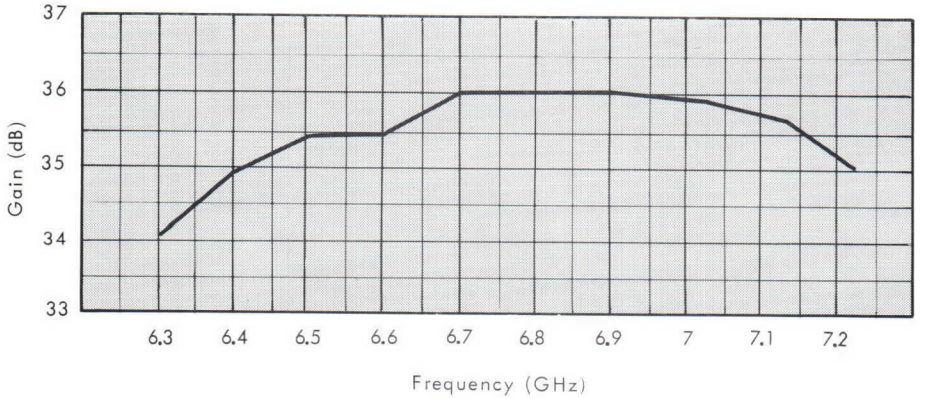
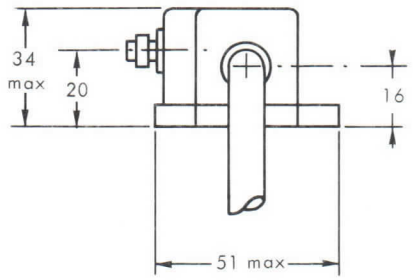


FIGURE 3 - Gain flatness at saturation.

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OUTLINE DRAWING

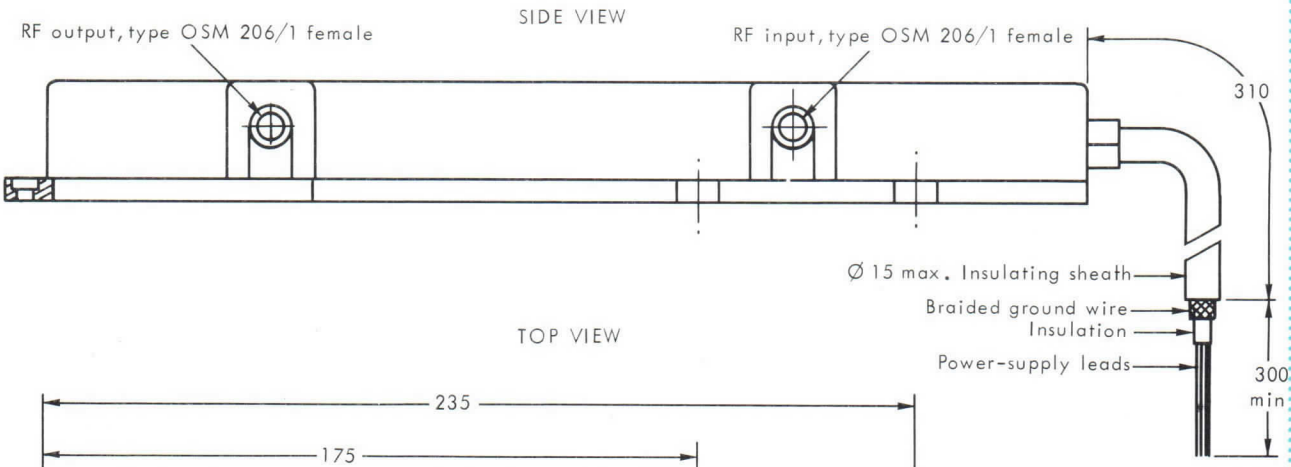
RIGHT VIEW



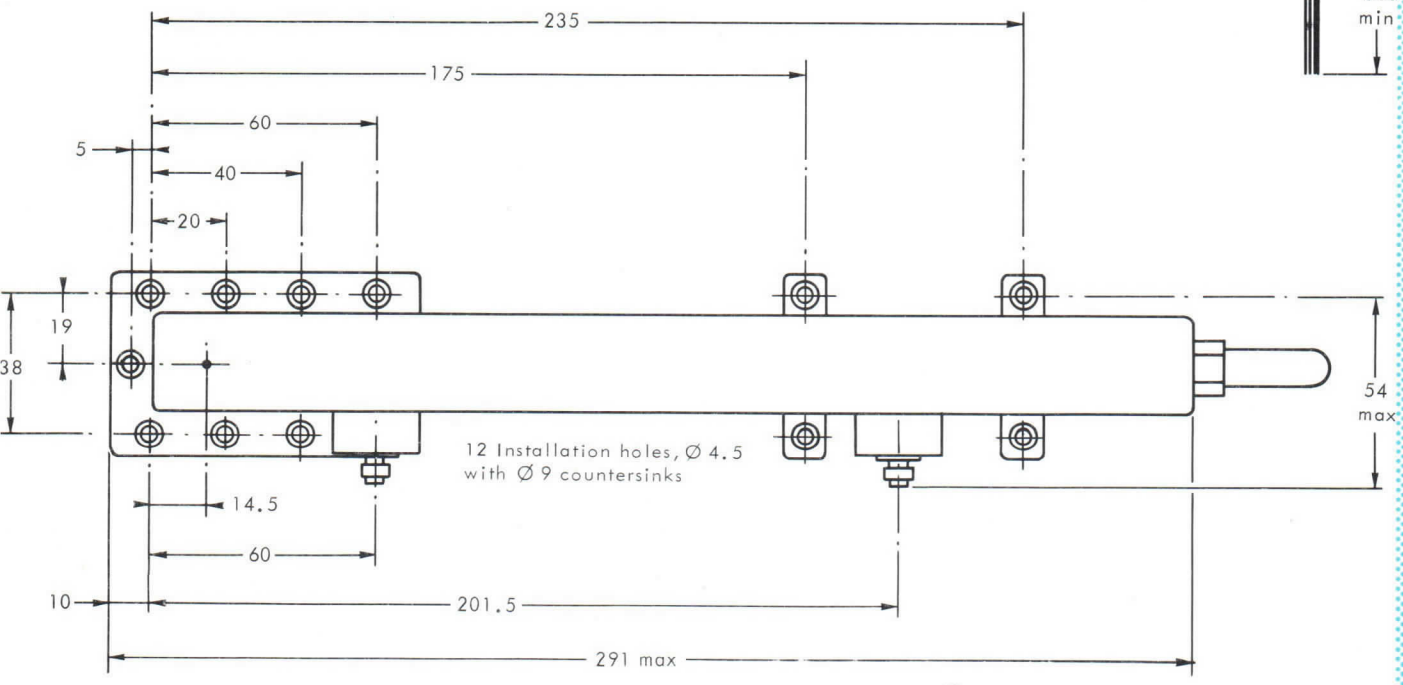
POWER-SUPPLY LEAD COLOR CODE

Filament	Brown
Filament-cathode	Yellow
Anode 1	Blue
Anode 2	Green
Helix-ground	Orange
Collector	Red

SIDE VIEW



TOP VIEW



Dimensions in mm, nominal except those marked " max " or " min ".

Imprimé en France

TH 3517

HIGH-POWER 14-GHZ TWT FOR ADVANCED SATELLITE-COMMUNICATIONS STATIONS



The TH 3517 represents a major advance in the state of the art of traveling-wave tubes. **Cooled by forced air alone,** this exceptional new coupled-cavity TWT will generate at least 2 kW of RF output power all across its 500-MHz bandwidth. It is designed to operate in the band allocated by the ITU for uplink communications in the next generation of satellite-communications earth stations, 14 to 14. 5 GHz.*

Designed to meet or surpass the provisions of the ICSC requirements for simultaneous transmission of multiple telephone carriers and SPADE carriers, this broadband TWT has very low distortion due to AM/PM transfer, group-delay variations and third-order intermodulation.

Due to a design that limits the anode current to an especially small value, the slow-wave structure and the anode can operate from a common high-voltage power supply. A high-impedance voltage-divider network is used to tap off that portion of the high voltage that is to be applied to the anode.

Long tube life is ensured by the design of the electron gun, featuring a dispenser-type cathode of specially treated impregnated tungsten. An added long-life factor is the integral ion pump, self-powered between the collector and ground. Finally, during long periods of standby operation the filament voltage can be reduced, to further prolong the TH 3517's life expectancy.

The TWT and its focusing electromagnet are factory-adjusted for optimum performance as a unit, thus no delicate and time-consuming field adjustments are necessary. Advanced design concepts have resulted in a more compact, lighter-weight TWT/electromagnet assembly. Complete air cooling of both the tube and its electromagnet requires only one blower, providing a minimum flow of only 10 kg/minute.

* **Note** - This TWT is able to deliver 2. 3 kW of RF power in the 14. 095 to 14. 365 GHz range.

A gain equalizer, specially designed for this tube, may be connected at the RF input to minimize the gain variation.

The TH 3517 can be driven by the TH 3523 TWT, a new helix tube using much of the proven technology of THOMSON-CSF's well-known 12-GHz space tubes. In small-signal operation (this case), the TH 3523's gain variation does not exceed ± 0. 3 dB over any 100-MHz sub-band in the 14 to 14. 5-GHz range.

GENERAL CHARACTERISTICS

Electrical

Frequency range	14. 0 to 14. 5	GHz
Output power at saturation (min.)	2	kW
Gain at rated power	31	dB
Overall efficiency, typical	27	%
AM/PM conversion :		
- at P_o = 2 kW	7	°/dB
- at P_o = 250 W	4	°/dB
Gain slope, small-signal	0. 05	dB/MHz
Heater voltage	6	V
Heater current	3. 5 to 4	A
Cathode current	0. 750 to 0. 900	A
Anode voltage	7 to 8. 5	kV
Beam voltage	12. 5 to 14. 0	kV
Body current (with RF) max.	20	mA
Collector voltage (min.) (1)	8. 6	kV
Electromagnet current, max.	12. 5	A
Electromagnet voltage, max.	300	V
Third-order intermodulation (two 125 W carriers)	27	dB

Mechanical

Operating position	Vertical, collector up
Weight, with electromagnet (approximate)	40 kg
RF input and output waveguide	RG-91/U
RF input and output flange	UG-419/U
Power-supply connections	Flying leads
Cooling	Forced air

LIMITING VALUES FOR EQUIPMENT DESIGN (2)

(non-simultaneous)

	Min.	Max.	Units
Heater surge current	–	8	A
Heater voltage	5. 9	6. 1	V
Warm-up time	4	–	mn
Frequency	13. 975	14. 525	GHz
Anode voltage	–	V (nom) + 0. 2	kV
Drive power	–	P_d (nom) + 2	dB
Beam voltage	–	16	kV
Body current	–	25	mA

	Min.	Max.	Units
Load VSWR	—	1. 5 : 1	
Collector voltage	—	11	kV
Collector dissipation	—	10	kW
Electromagnet current	—	14	A
Electromagnet voltage	—	320	V
Cooling-air flow	10	—	kg/mn
Inlet cooling-air temperature	− 20	+40	°C
Distance from magnetic material	5	—	cm

(1) The collector voltage must be between 8. 6 and 10. 6 kV. The minimum air flow rate is a function of the maximum collector voltage.

(2) Equipment-design values, NOT operating values. No one value ever to be exceeded even under transient conditions, and operation at more than one limiting value at the same time may cause tube damage.

TYPICAL OPERATION

Single-carrier

Frequency	14. 2	GHz
Output power	2. 5	kW
AM-PM conversion	4	°/dB
Gain	35	dB
Gain variation (in 500 MHz)	3. 0	dB
Gain slope (small-signal)	0. 02	dB/MHz
Heater voltage	6	V
Heater current	3. 75	A
Cathode current	850	mA
Anode voltage	7. 2	kV
Beam voltage	13. 0	kV
Body current (saturation)	8	mA
Collector voltage	9. 3	kV
Electromagnet current	10. 1	A
Electromagnet voltage (approximate)	200	V
Noise figure	30	dB

Multi-carrier

Frequency	14. 2	GHz
Third order intermodulation :		
- for two 200 watt carriers, 10 MHz apart	27	dB
- for two 125 watt carriers, 10 MHz apart	30	dB
AM-PM conversion	< 2	°/dB
Beam voltage	13. 0	kV
Body current	1	mA
Gain	38	dB

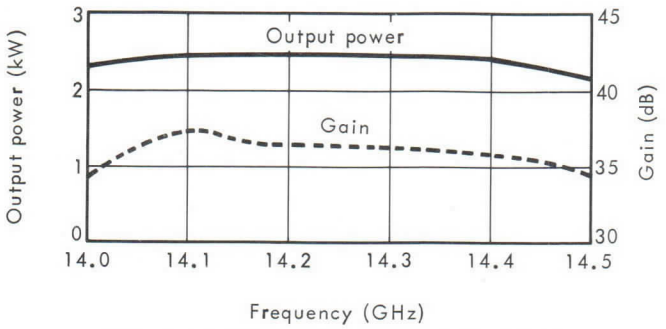


Fig. 1 - Typical curves of output power and gain over the band.

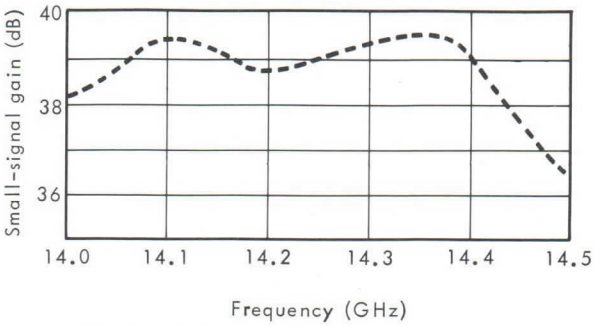


Fig. 2 - Variations of small-signal gain versus frequency (typical).

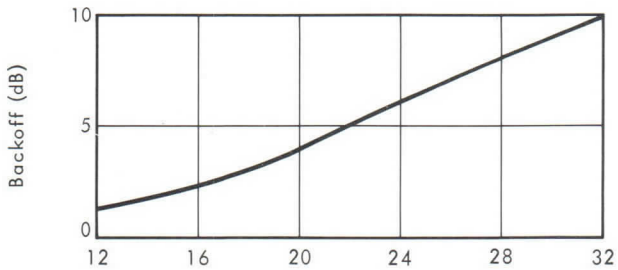


Fig. 3 - Backoff required for desired values of 3rd-order intermodulation.

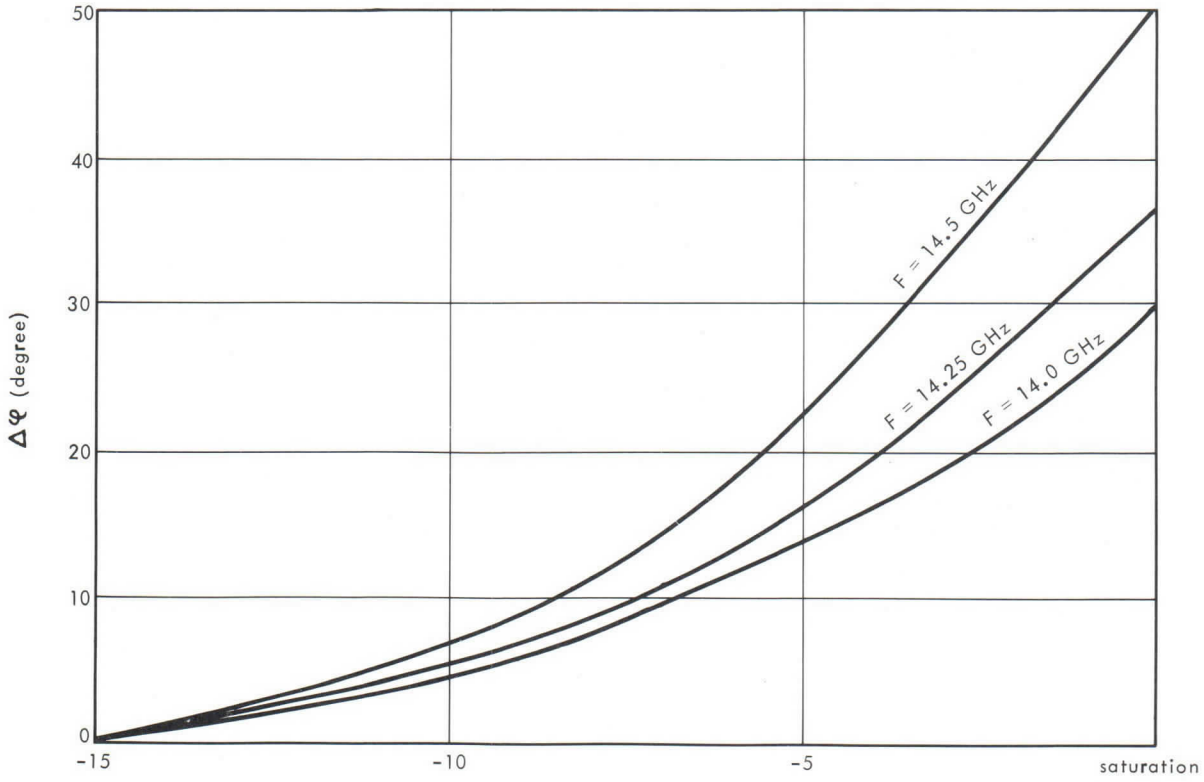
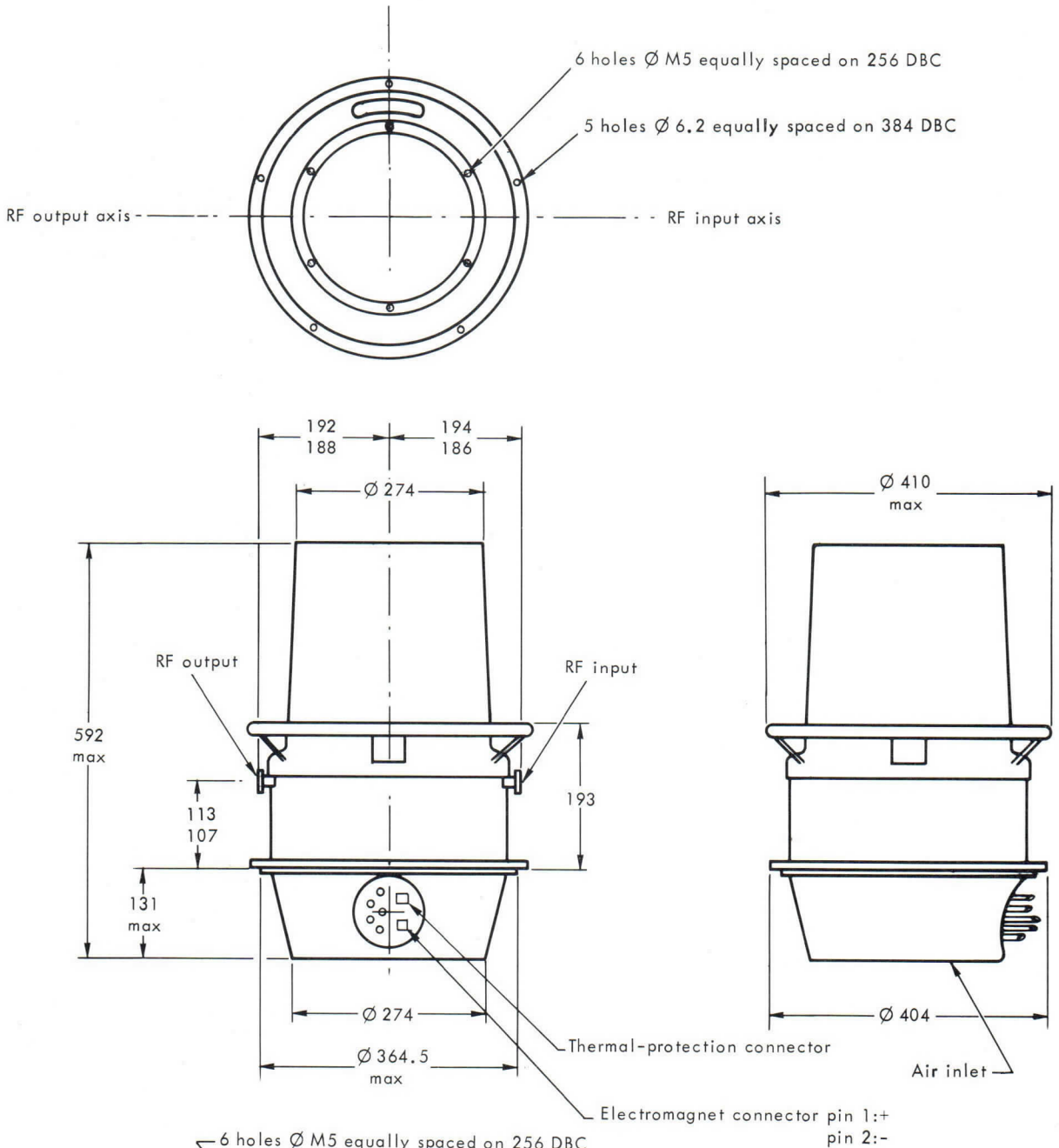


Fig. 4 - Phase shift versus drive at the top of the band, at center band, at the bottom of the band.

OUTLINE DRAWING



All dimensions in mm, nominal except for those marked "max"

POWER-SUPPLY LEAD COLOR CODE	
Filament	Brown
Filament-cathode	Yellow
Anode	Blue
Collector	Red
Ground	Black

Length : 300 to 400

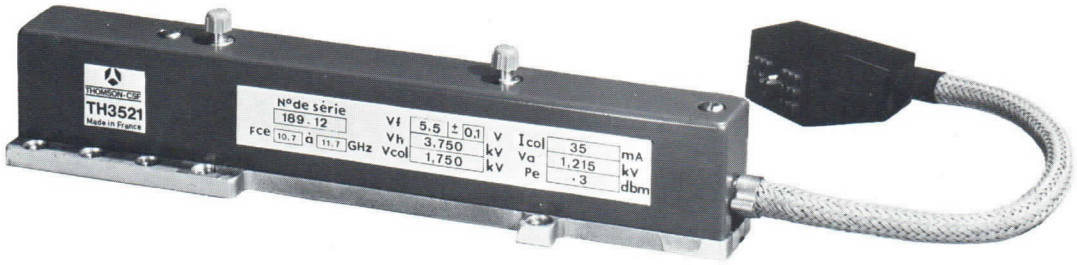


THOMSON-CSF

DIVISION TUBES ELECTRONIQUES

TH 3521
TRAVELING WAVE TUBE

- Designed for advanced line-of-sight microwave links, carrying up to 1800 telephone channels
- Flat gain/frequency curve
- Exceptional noise characteristics
- Delivers 20 W of carrier power with 3 dBm drive power
- Incorporates long-life space-TWT technology and gives high efficiency
- PPM-focused and cooled by simple conduction



Description

The TH 3521 traveling wave tube has been developed to serve as the power amplifier in new, high-capacity microwave links over line-of-sight routes. Able to amplify a signal carrying up to 1800 telephone channels, television, or high bit-rate data, this TWT is designed to operate in the 10.7 - 11.7 GHz band. Its nominal output power is 20 watts, and its nominal drive power 3 dBm. The operating band can be appreciably enlarged with a small output power reduction.

An important feature of this new tube is its low noise figure, which does not exceed 27 dB. This superior noise performance is achieved with an impregnated-tungsten cathode, of the type developed for our satellite-carried TWT's. The consequences for the expected reliability and long-life capability of the TH 3521 are obvious.

It also has a nearly flat gain characteristic and a very low AM/PM conversion coefficient (4 °/dB). Employing PPM beam focusing, the TH 3521 is fully cooled by simple conduction alone.

Adjustment of the electrical parameters of this TWT is made extremely simple ; the heater, helix and collector voltages and the drive power level being fixed. Only the anode voltage is changed to obtain the desired output-power level, by varying the cathode current. Consequently, TWT installation or replacement is easy to accomplish.

This state-of-the-art TWT is also available with a matched solid-state power supply in a compact, adjustment-free TWTA configuration, the TH 21521, eliminating all tube/power supply interface problems for the equipment designer. Contact THOMSON-CSF, Electron Tube Division for more information.

GENERAL CHARACTERISTICS (1)

Electrical (2)

Operating frequency range	10. 7 - 11. 7	GHz
Output power	20	W
Drive power	3	dBm
Noise factor, max.	27	dB
AM/PM conversion coefficient, max.	4	°/dB
Heater voltage	5. 5	V
Helix voltage	3. 75	kV
Anode 0 voltage	1. 3	kV
Anode 1 voltage	Vh + 50	V
Collector voltage	1. 75	kV

Mechanical

Operating position	Any
Dimensions	See the Outline Drawing
Weight, max.	700 g
RF connections.	SMA connectors
Power-supply connections.	Shielded cable
Cooling	By conduction

ABSOLUTE RATINGS (3)

(non-simultaneous)

	Min.	Max.	Units
Heater voltage	5. 3	5. 7	V
Heater current	0. 4	0. 8	A
Heater surge current	–	1	A
Warm-up time	3	–	mn
Helix voltage	3. 5	4. 0	kV
Helix current	–	2. 5	mA
Anode 0 voltage	–	1. 4	kV
Anode 1 voltage	–	Vh + 0. 1	kV
Anode 1 current	− 1	+ 1	mA
Anode 0 current	− 0. 5	+ 0. 5	mA
Collector voltage	1. 6	2. 0	kV
Collector current	–	50	mA
Collector dissipation	–	90	W
Drive power	–	20	mW
Load VSWR	–	2 : 1	
Operating temperature	− 20	+ 100	°C
Storage temperature	− 40	+ 70	°C

(1) Values based on performance tests and may be modified without notice due to product improvement or later information. THOMSON-CSF, Electron Tube Division, should be consulted prior to making use of this information for equipment design.

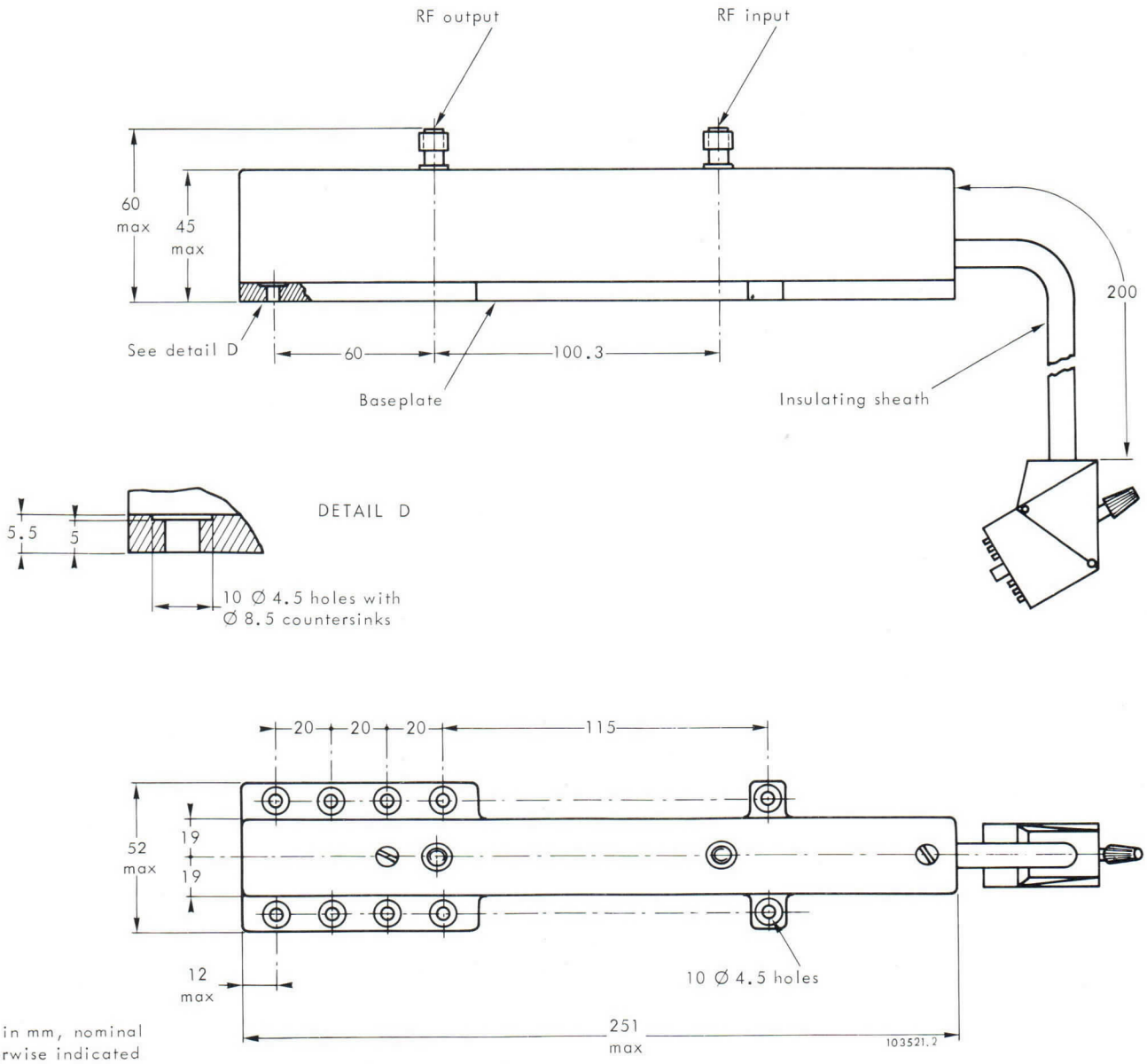
(2) All voltages referred to the cathode.

(3) No one value ever to be exceeded, even under transient conditions, and operation at more than one absolute rating at the same time may cause tube damage. Equipment must be designed so that these limits are never exceeded.

TYPICAL OPERATION

Operating frequency	11. 2	GHz
Drive power	3	dBm
Output power	20	W
Gain	40	dB
Anode 0 voltage	1. 2	kV
Anode 1 voltage	3. 8	kV
Helix voltage	3. 75	kV
Helix current	1	mA
Collector voltage	1. 75	kV
Collector current	35	mA
Noise factor	25	dB
AM/PM conversion coefficient	2. 5	°/dB

OUTLINE DRAWING



Dimensions in mm, nominal unless otherwise indicated



THOMSON-CSF

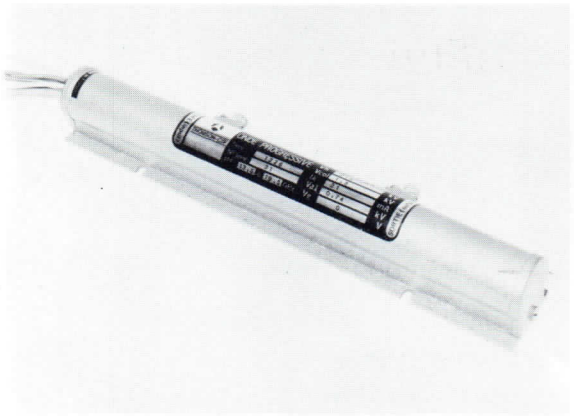
DIVISION TUBES ELECTRONIQUES

TH 3522
TRAVELING WAVE TUBE

The TH 3522 is a medium-power, traveling wave tube designed for microwave radio-link applications. Operating in C band, in the range 5.9 to 7.2 GHz, it delivers more than 7 watts of CW power at the output with minimum gain equal to 30 dB.

A periodic permanent magnet beam-focusing assembly is an integral part of the TH 3522. This compact and lightweight TWT is cooled by conduction alone.

The TH 3522 TWT is used in the TH 20034, a lightweight, compact, adjustment-free microwave amplifier. Of sturdy construction, it is intended for use in airborne and other mobile equipment, and in microwave radio links.



GENERAL CHARACTERISTICS

Electrical

Frequency range	5.9 to 7.2	GHz
Output power , min	7	W
Gain at rated power, min.	30	dB
Gain ripple, max.	± 0.5	dB
Gain slope, max.	± 0.02	dB/MHz
Efficiency, min.	16	%
Noise figure, max.	28	dB
Output hot VSWR, max.	2.5 : 1	
AM/PM conversion, max.	4	°/dB
Heater current	0.3 - 0.6	A
Anode voltage	0.6 - 1.2	kV
Helix voltage	2.7 - 3.2	kV
Collector voltage	1.3 - 1.55	kV
Collector current, max.	28	mA

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	Any
Dimensions	See outline drawing
Weight (approx.)	650 g
RF connections	OSM 206/1
Power-supply connections	Flying leads
Cooling	By conduction

ABSOLUTE RATINGS

(non-simultaneous)

	Min.	Max.	Units
Heater voltage	6.0	6.6	V
Heater surge current	-	1.2	A
Warm-up time	3	-	mn
Anode voltage	-	V_a (nom) +200	V
Anode current	-	2	mA
Drive power	-	50	mW
Helix voltage (1)	V_h -250	V_h +250	V
Helix current	-	2	mA
Collector voltage (2)	V_c -200	V_c +200	V
Collector current	-	28	mA
Collector dissipation	-	45	W
Ambient temperature	-10	+120	°C
Load VSWR	-	2.5 : 1	

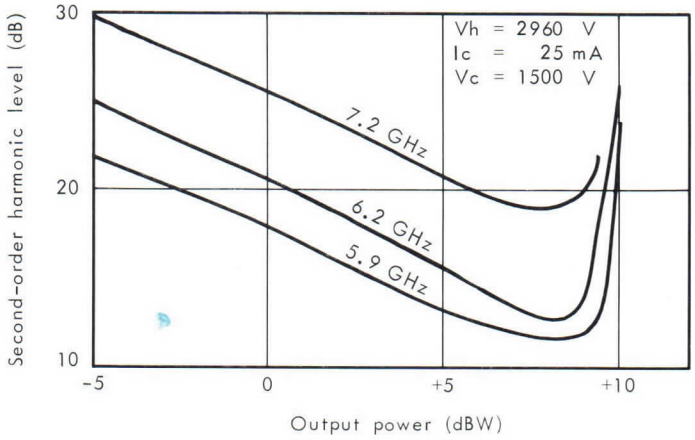
(1) V_h = nominal helix voltage, as per each tube's data sheet.

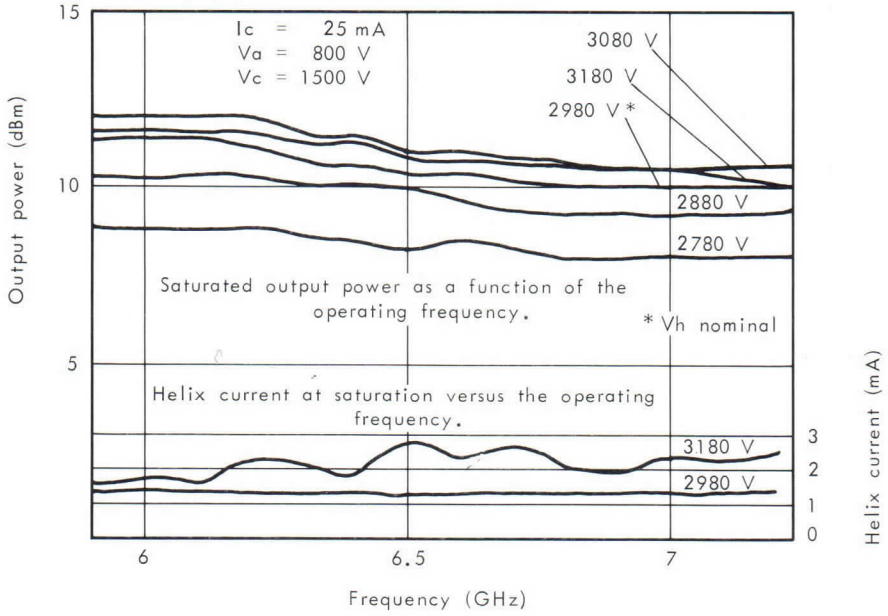
(2) V_c = nominal collector voltage, as per each tube's data sheet.

TYPICAL OPERATION

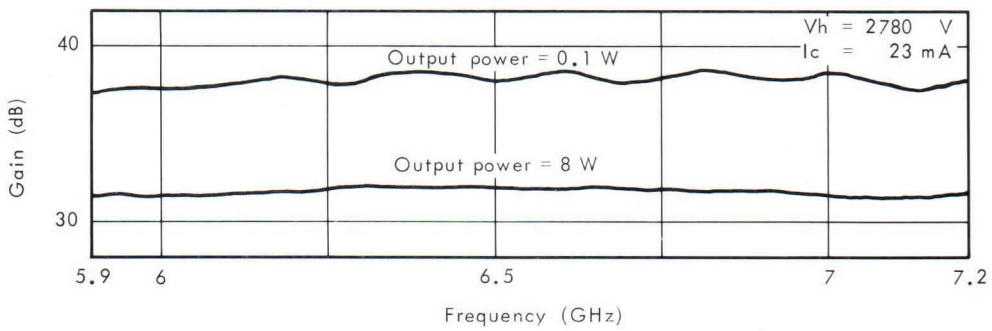
Frequency	6.7	GHz
Output power	9.2	W
Input power	5.2	mW
Gain	32.5	dB
Heater voltage	6.3	V
Heater current	0.42	A
Cathode current	25	mA
Anode voltage	810	V
Anode current	0	mA
Helix voltage	2.86	kV
Helix current	0.70	mA
Collector voltage	1.5	kV

Second-order harmonics versus output power



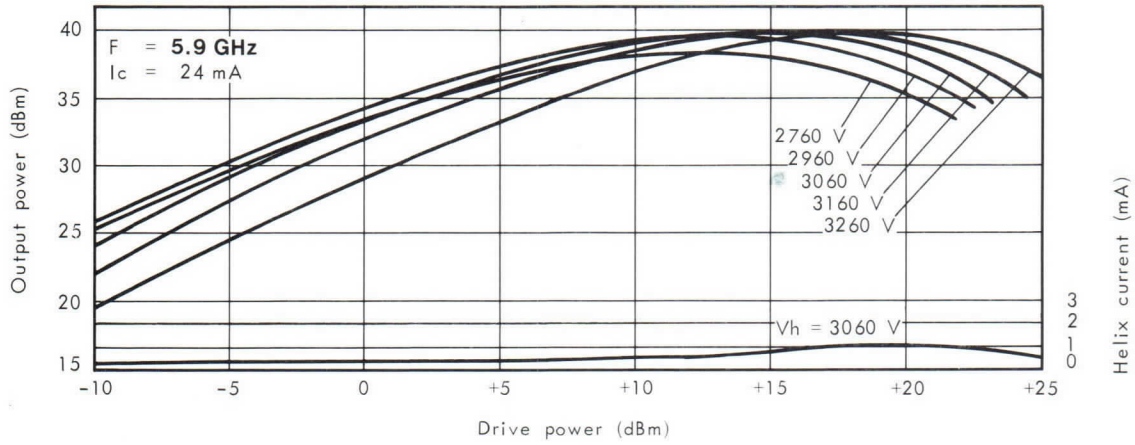


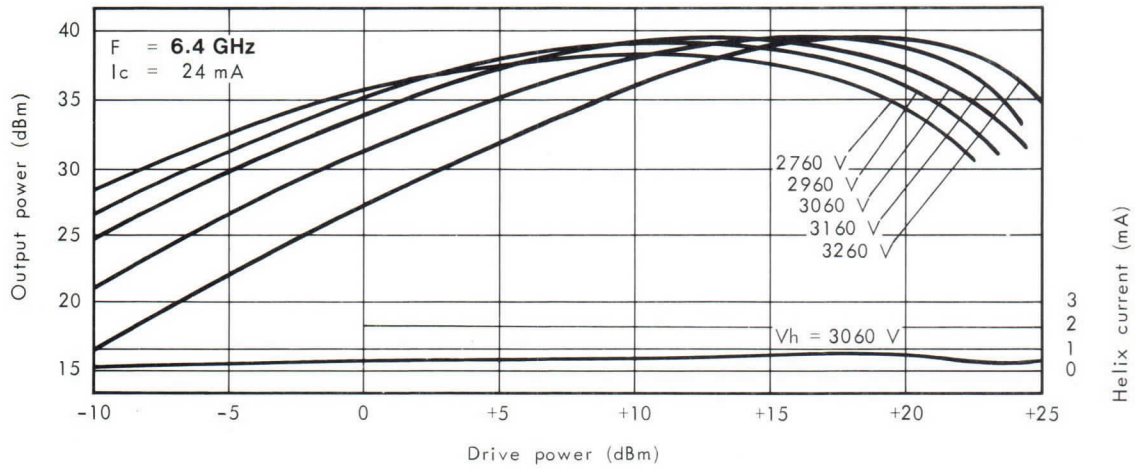
Gain flatness at two different output-power levels.

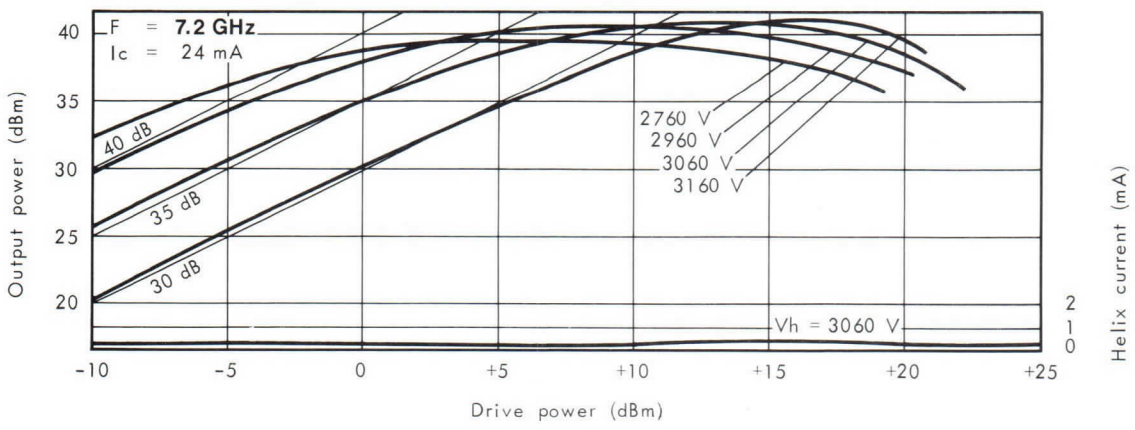


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

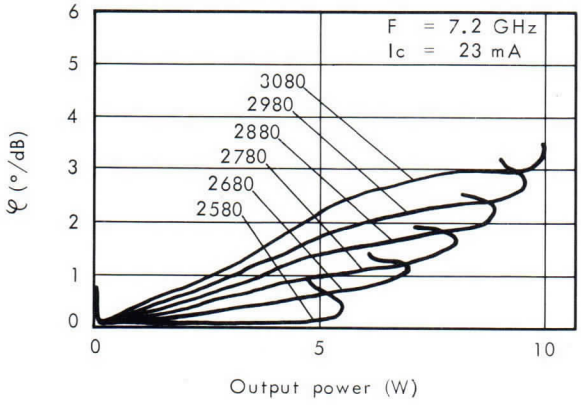
OUTPUT POWER AND HELIX CURRENT
AS A FUNCTION OF DRIVE POWER,
WITH A CONSTANT HELIX VOLTAGE

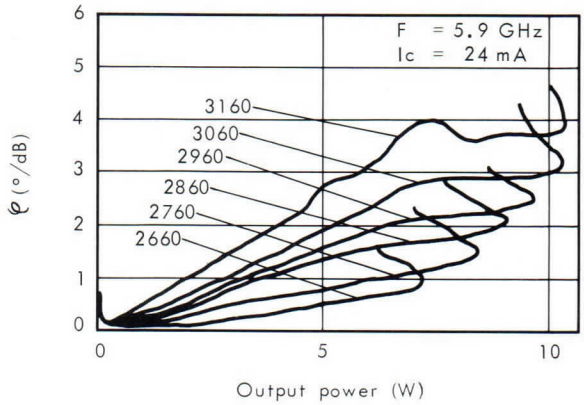




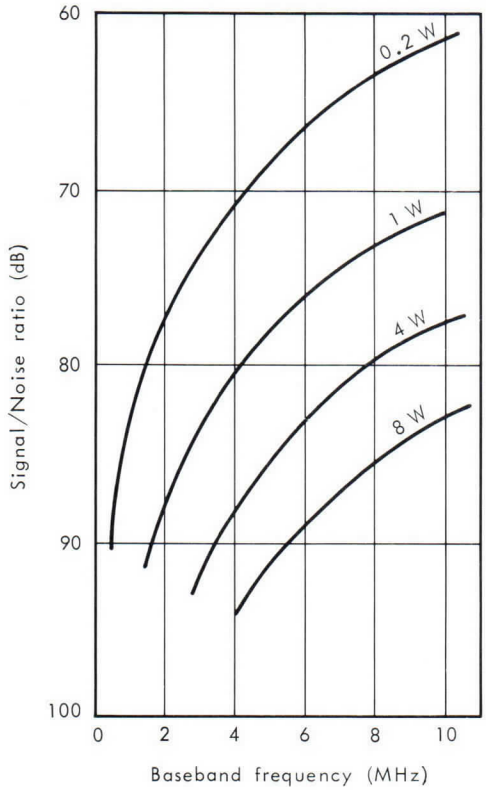


AM/PM CONVERSION (φ)

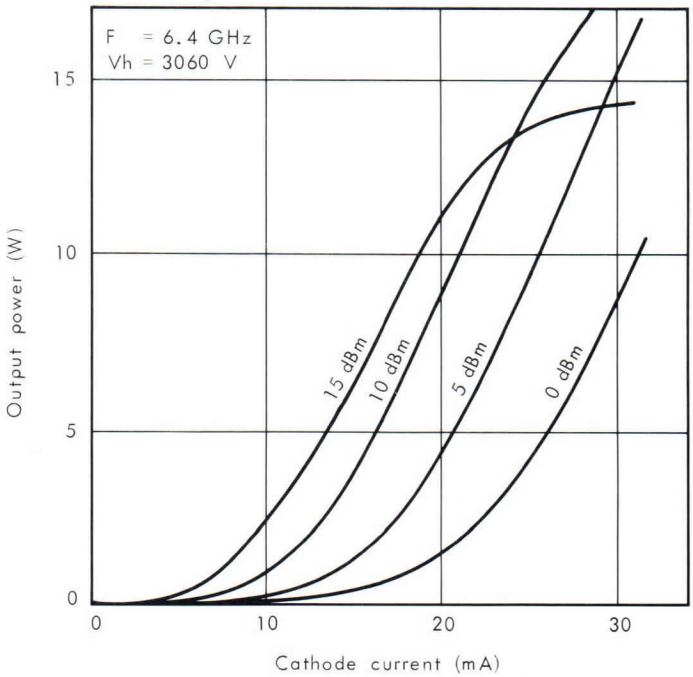




FM Signal-to-noise ratio
(carrier frequency = 6 GHz) in a 4-kHz
window as a function of the baseband frequency

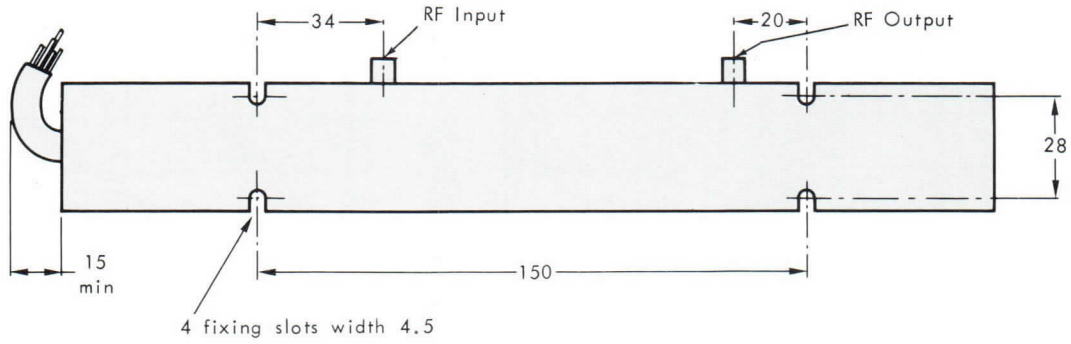


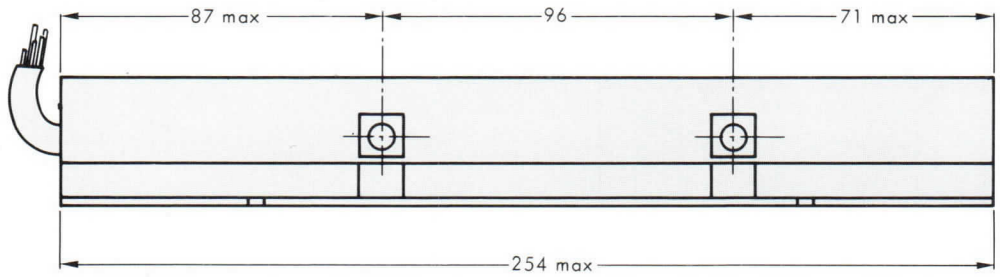
Output power as a function of the cathode current,
with a constant drive-power level.



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

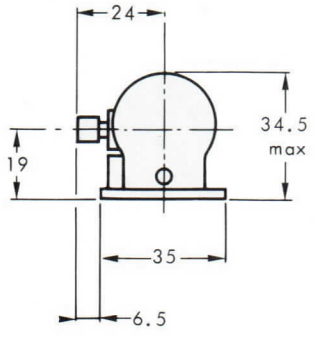
OUTLINE DRAWING





Note - The minimum length of the flying leads is :

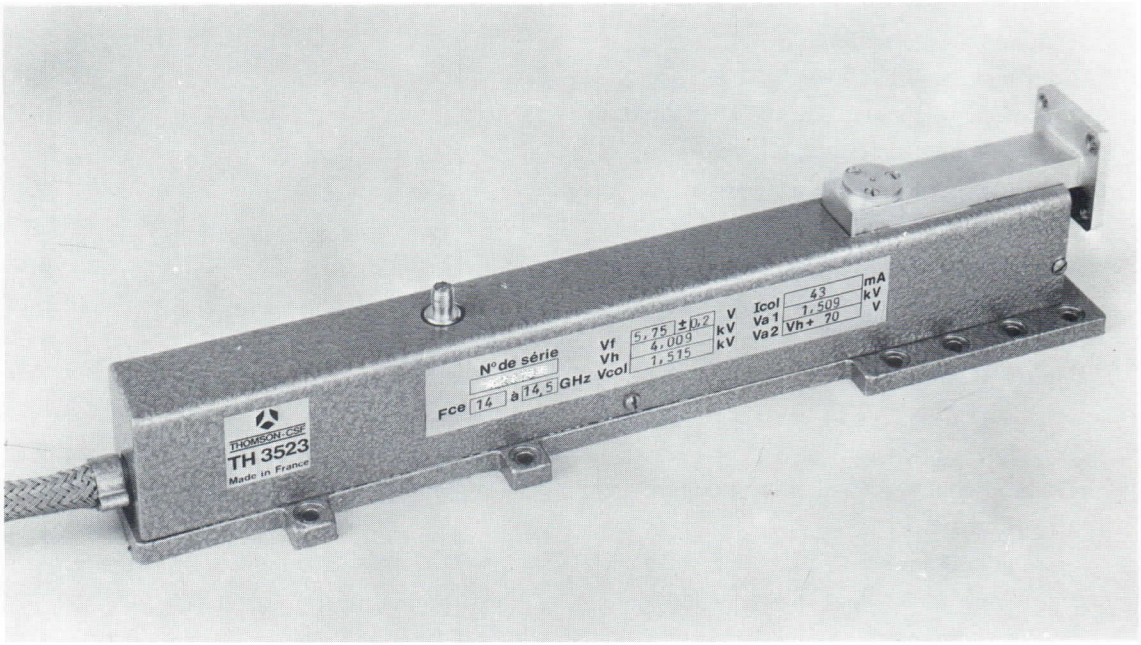
- for the TWT supply = 350 mm
- for the thermal protection ("Vigitherme") = 450 mm



LEADS IDENTIFICATION	
Brown	Heater cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Helix Ground
Grey	"Vigitherme"
White	"Vigitherme" (isolated)

All dimensions nominal (except limiting values), in mm.

TH 3523
HIGHLY LINEAR 14-GHz TWT
FOR SATELLITE-COMMUNICATIONS EARTH STATIONS



The TH 3523 traveling-wave tube (TWT) can be used either as a medium-power amplifier, delivering a minimum output power at saturation of 20 watts, or as a driver for the high-power TH 3517 TWT, to form a 2-kW uplink transmitter for next-generation satellite-communications earth stations. Operating in the 14-GHz band, but using much of the proven technology of THOMSON-CSF's well-known 12-GHz space tubes, the TH 3523 represents the latest advance in the helix-TWT state of the art.

Having extraordinary linearity of transmission characteristics when used as a driver (small-signal operation), the TH 3523 TWT is ideal for the first stage of a multicarrier transmitter. Its gain variation in small-signal operation will not exceed ± 0.3 dB over any 100-MHz sub-band within the 500-MHz operating bandwidth.

By retaining the proven electron-gun cathode and collector designs of our space tube, the TH 3523 is assured of long operating life and exceptional reliability. At the same time, the redesigned helix reflects a cost-effective solution for operation of an earth-based tube in the 14 to 14.5 GHz range. The RF input of the tube is coaxial, while the output is via waveguide.

The TH 3523 can be delivered with a matched solid-state power supply, designed to power and protect the tube with high reliability. For more details, refer to the Data Sheet for the TWT + power supply combination, known as the TH 20133 TWT amplifier. The TWTA operates from non-regulated 36 - 72 Vdc supply.

GENERAL CHARACTERISTICS

Electrical

Operating frequency range	14 - 14.5	GHz
Heater voltage	5.50	V
Heater current	0.65	A
Anode voltage	1300 ± 300	V
Helix voltage	3950 ± 150	V
Collector voltage	1500	V
Cathode current	45 ± 5	mA
Output power at saturation, min.	20	W
Gain with an output power of 2 W	55 to 61	dB
Frequency response in any 100-MHz sub-band :		
- gain ripple at saturation, max.	± 0.1	dB
- gain ripple in small-signal, max.	± 0.3	dB
- gain slope at saturation	⩽ 0.005	dB/MHz
- gain slope in small-signal operation	⩽ 0.02	dB/MHz
Noise factor	< 28	dB
AM/PM Conversion	< 4	°/dB
Input and output VSWR :		
- cold	< 1.5 : 1	
- hot	< 2 : 1	

Third-order intermodulation products (two equal-amplitude carriers, at least 10 MHz apart) :

- at saturation	< −10 dB, relative to either carrier's output level	
- with total input power relative to single-carrier input power for tube saturation of	− 6 dB	− 15 dB
- the 3rd-order IM level is at least (below either carrier's output power)	− 15 dB	− 20 dB

Mechanical

Weight, approx.	850 grams
Dimensions	291 x 50 x 65 mm
RF Connections :	
- input	Female SMA type
- output	RG 91/U waveguide UG 419/U flange
Power-supply connections	Flying leads
Cooling	By conduction

ABSOLUTE RATINGS

(Non-simultaneous)

	Min.	Max.	Units
Heater surge current	–	1	A
Heater voltage	$V_f - 0.2$	$V_f + 0.2$	V
Warm-up time	180	–	s
Frequency	12.4	16	GHz
Anode current	−1	+1	mA
Drive power	–	−5	dBm
Helix voltage, V_H nominal	−250	+250	V
Load VSWR	–	2 : 1	
Collector voltage	1400	1850	V
Collector dissipation	–	130	W
Baseplate temperature	−45	+85	°C
Helix current	–	2.0	mA
Collector current	–	55	mA

TYPICAL OPERATION

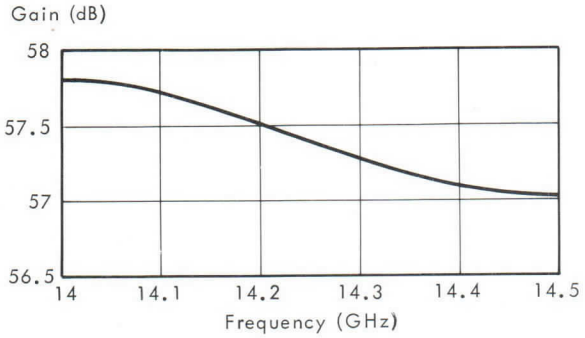
Frequency	14.2	GHz
Output power	22	W
AM/PM Conversion	3	°/dB
Gain, at saturation	52	dB
Maximum gain variation at saturation over the 500-MHz bandwidth	< 0.1	dB
Small-signal gain, 10-dB backoff	58	dB
Maximum small-signal gain variation over the whole band, 10-dB backoff	0.8	dB
Heater voltage	5.5	V
Heater current	0.64	A
Cathode current	47	mA
Anode voltage	1370	V
Helix voltage	3900	V
Helix current	1	mA
Collector voltage	1500	V

Third-order intermodulation products :

- with 2 equal-amplitude carriers driving the TWT to saturation ..... < −10 dB, relative to either carrier's output level

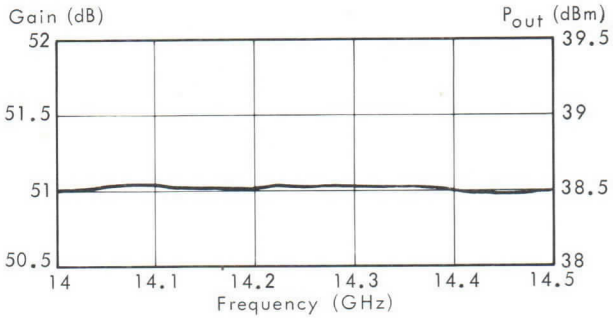
SMALL SIGNAL GAIN
P_{in} = -30 dBm (constant)

Vh = 3900 V
Va = 1370 V

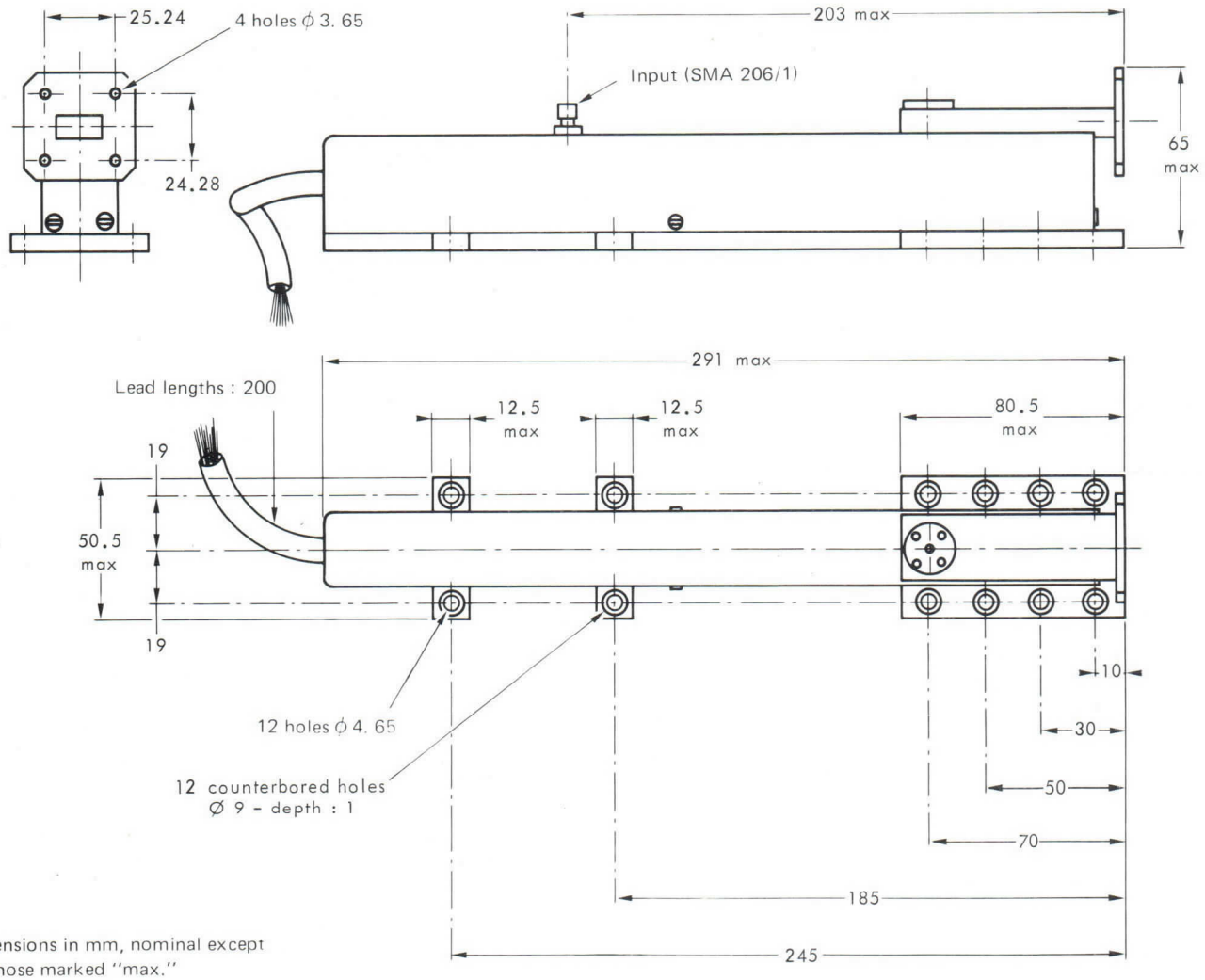


POWER AND GAIN, AT SATURATION
P_{in} = -12.5 dBm (constant)

Vc = 1500 V
Ic = 47 mA



OUTLINE DRAWING

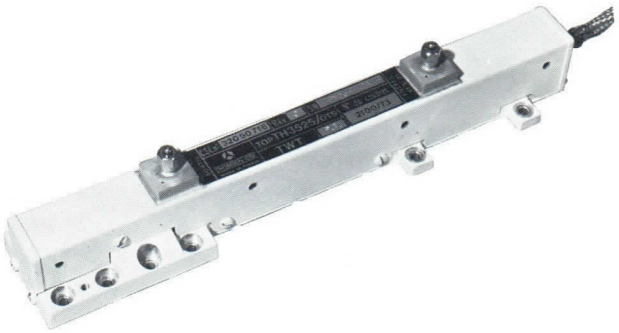


Dimensions in mm, nominal except for those marked "max."

TH 3525

HIGH-EFFICIENCY 11-12 GHz TWT FOR COMMUNICATIONS SATELLITES

FEATURES



- **Specifically developed for use in communications-satellite transponders.**
- **Exceptional efficiency**, due to a two-stage collector. A minimum overall tube efficiency of 40 % is guaranteed.
- **Stable thermal dissipation**, regardless of drive level, also thanks to the two-stage collector.
- **High gain** : at least 55 dB at saturation and over 60 dB under small-signal conditions.
- **Powerful** : over 20 watts of saturated output power available.
- **Linear transmission characteristics** : small-signal to saturation phase shift limited to 40°.
- **Lighweight, compact, and extremely rugged**, to withstand all the rigors of launching and the space environment .
- **Extremely reliable** : designed to operate at least seven full years in space, with an MTTF of at least 500000 hours. Long life impregnated-tungsten cathode.

DESCRIPTION

The TH 3525 high-gain, high-efficiency traveling-wave tube has been developed to meet the exacting requirements of in-space operation in communications-satellite transponders. Delivering more than 20 watts of output power at saturation, in the 10.95 - 11.70 GHz frequency band (1), this lightweight, compact tube is rugged enough to withstand the severe environmental conditions encountered in launching, orbital insertion and operation in space,

A two-stage collector is used to enable recovery of most of the residual beam energy, thus significantly increasing the tube's efficiency, up to a typical 43 %, and greatly reducing primary-power consumption. Simultaneously, this collector solves another major problem for communications-satellite designers, by making the thermal dissipation essentially independent of the RF input level.

The TH 3525 also features the very small fine-grain small-signal gain variations and flat gain characteristics needed in satellite-transponder service.

Since a TWT in this application must normally perform simultaneous amplification of several carriers, the linearity of its transmission characteristics is extremely important. This is expressed by the setting of a limit value for the phase variation between small-signal and large-signal operation. In ordinary TWT's, optimizing the efficiency and the phase characteristics at the same time is not possible. By using a tapered helix in the TH 3525, though, the total phase shift has been held to a maximum of 40°, while the operating efficiency has been raised to at least 40 %, guaranteed. At the same time, none of the tube's other electrical characteristics have been degraded, as compared to a non-tapered-helix tube.

(1) - The band allocated for the European satellite-communications system.

Featuring PPM focusing, this tube is cooled by simple conduction alone, through its baseplate.

Having completed qualification for the European Space Research Organization (ESRO), the TH 3525 is manufactured to the very strict quality-assurance standards for spaces tubes, and is designed to provide at least seven years of continuous in-space operation. It is estimated that the improved impregnated-tungsten cathode will have a useful operating life of more than 200 000 hours.

Variants of this TWT are available for operation in other frequency ranges and/or at lower power levels. The Electron Tube Division of THOMSON-CSF welcomes the opportunity to discuss your specific requirements with you.

SPECIFICATIONS

Performance

Frequency range (Note 2)		10. 95 to 11. 70 GHz
Single-carrier saturated output power, min.		13 dBW (20 W)
Saturation gain, min.		55 dB
Overall electrical efficiency, min.		40 %
Small-signal gain, min.		60 dB
Noise figure, max.		27 dB
Frequency response (in any 125-MHz channel)		
Gain ripple, max.	at saturation	± 0. 1 dB
	small-signal	± 0. 2 dB
Gain slope, max.	at saturation	± 0. 005 dB/MHz
	small-signal	± 0. 01 dB/MHz
Third-order intermodulation products		
With 2 equal-amplitude carriers driving the TWT to saturation		< – 10 dB, relative to either carrier's output level
With each carrier output at a level, relative to single carrier saturation level, of		– 6 dB – 9 dB – 13 dB
the 3rd-order IM product's level, relative to either carrier is		– 17 dB – 24 dB – 33 dB
AM/PM Transfer		
Two carriers driving the TWT to saturation		⩽ 4. 5°/dB
Below saturation		⩽ 6°/dB
AM/PM Conversion, all input levels up to saturation		6°/dB
Small-signal to saturation phase shift, max.		40 °
Group delay variation at saturation, max.		0. 5 ns
Total harmonic power, relative to the single carrier saturation level, max.		– 15 dB

Normal load operation : TWT meets all specifications when operating into a load having an in-band VSWR of 1. 1 : 1, max.

Mismatch operation : TWT can stand up to 24 hours of operation into a load with a 2. 5 : 1 VSWR.

Overdrive operation : TWT can operate up to 24 hours with an input 10 dB above saturation drive, without switchoff.

(2) The 10. 95 - 11. 70 GHz range has been allocated to Europe for satellite communications. Other frequency ranges and/or lower output levels are quite envisageable.

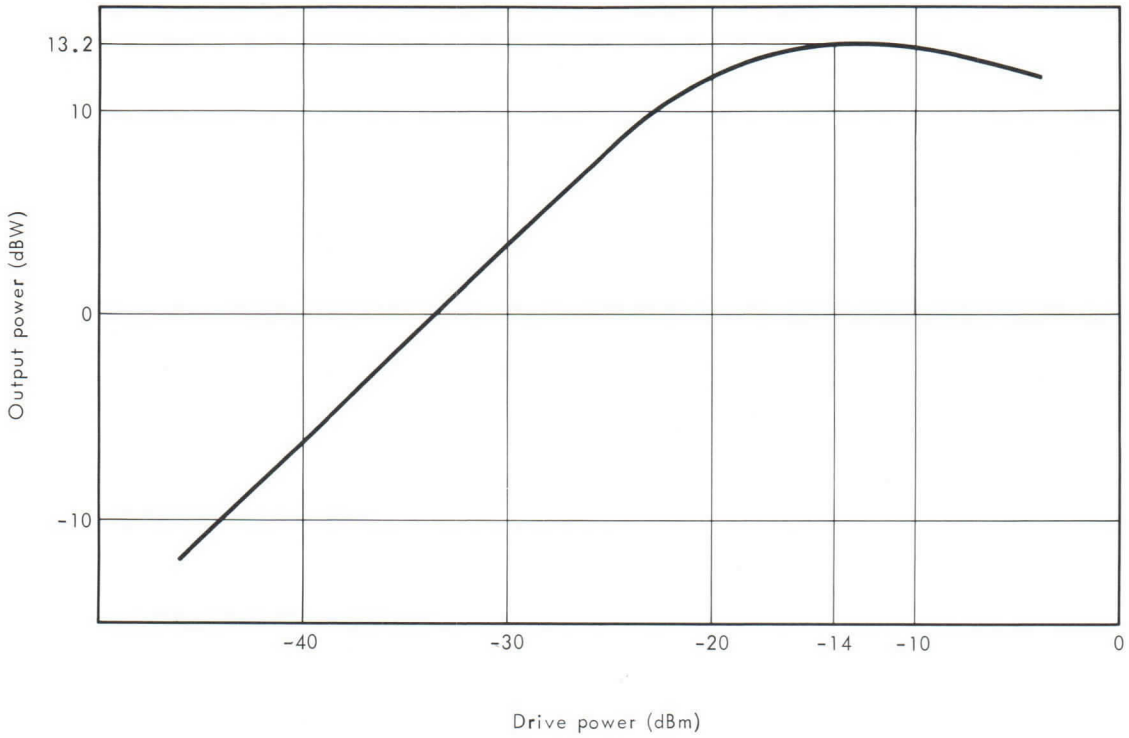
Mechanical

Weight, approx.	650 g
Dimensions	See the Outline Drawing
RF connections	Female SMA type
Power supply connection	Flying leads or other termination on request
Cooling	By conduction
Operating temperature range (baseplate)	
- Normal	-5° C to $+70^{\circ}$ C
- Extreme	-15° C to $+85^{\circ}$ C
Thermal flux (TWT to baseplate)	$\leqslant 1.5$ W/cm^2
Ambient pressure for satisfactory operation	>500 mm Hg or $< 10^{-4}$ mm Hg

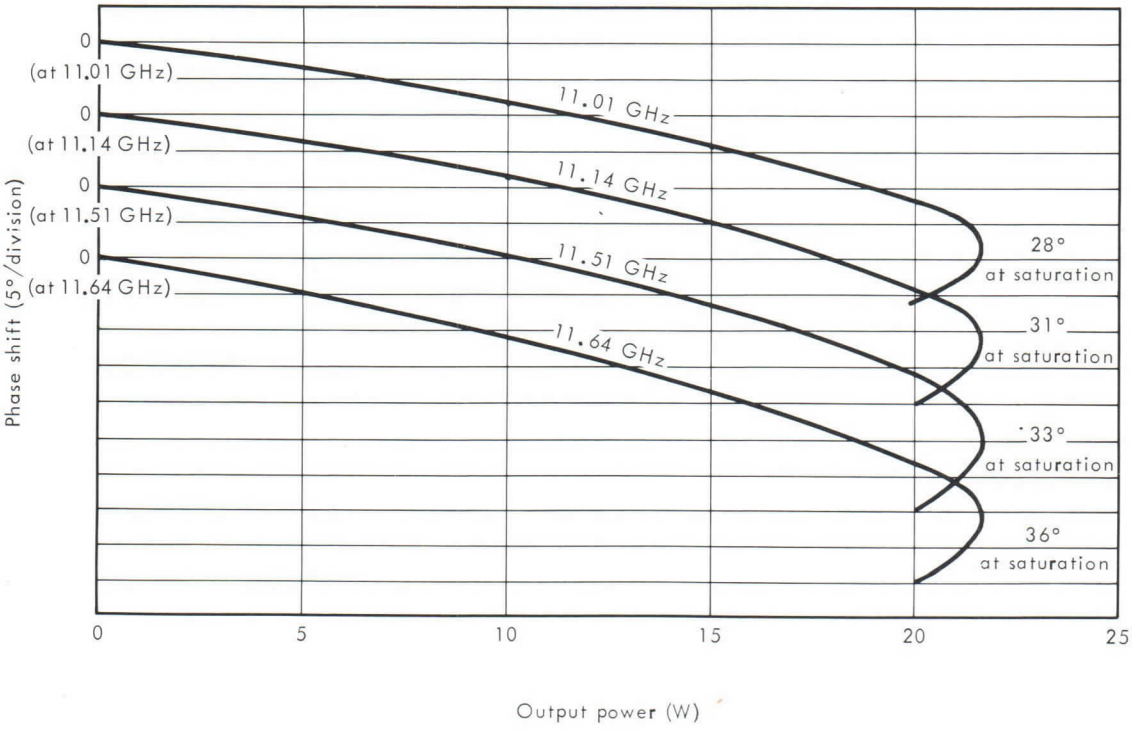
TYPICAL OPERATION

Single-carrier saturated output power				+ 13. 2 dBW
Saturated gain				57 dB
Small-signal gain				62 dB
Noise figure				26 dB
VSWR input and output				As specified
Frequency response				As specified
Third-order intermodulation products				As specified
AM/PM Transfer and conversion				As specified
Output level below saturation	0 dB	− 3 dB	− 6 dB	− 10 dB
Phase shift at 11. 7 GHz	36°	12°	6°	3°
Variation of group delay				As specified
Harmonic power				As specified

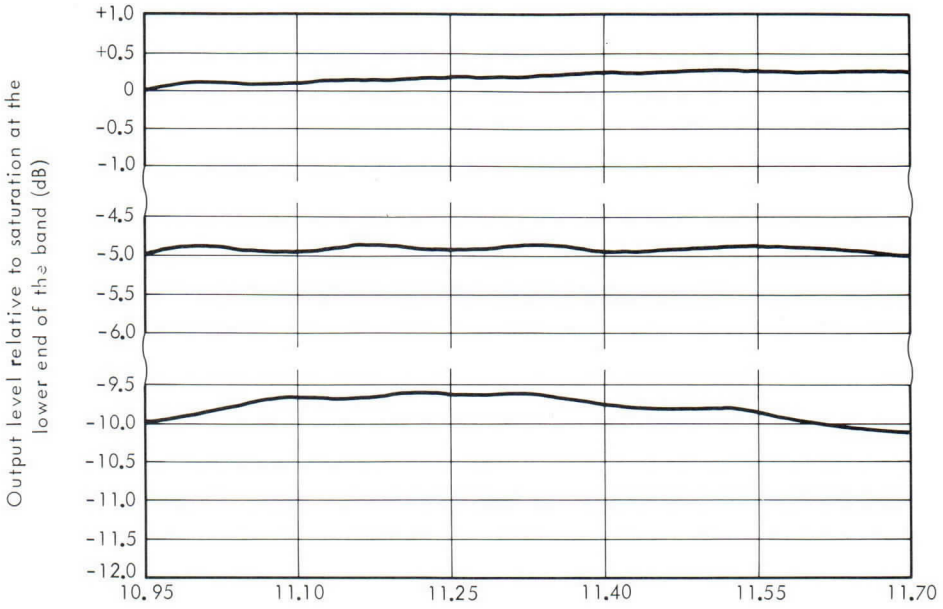
OUTPUT POWER VERSUS DRIVE POWER



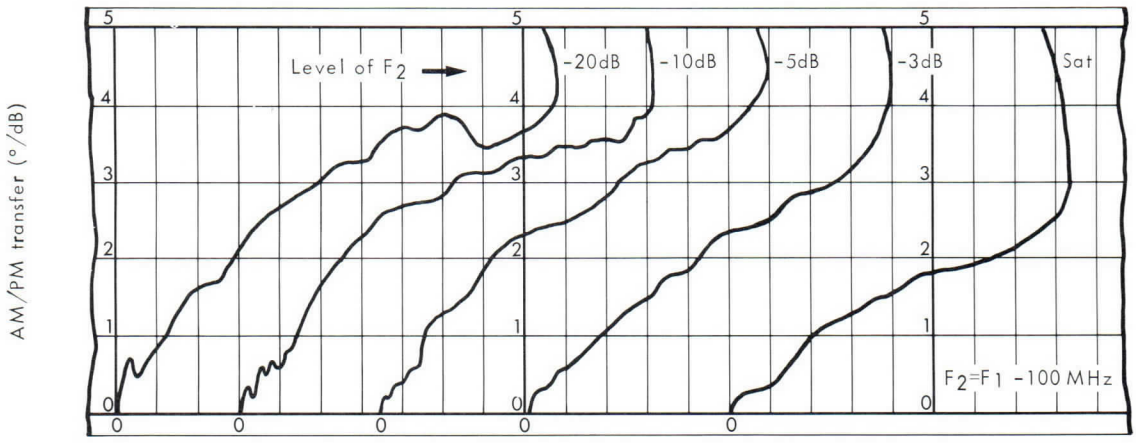
PHASE SHIFT VERSUS OUTPUT POWER
(Typical curves)



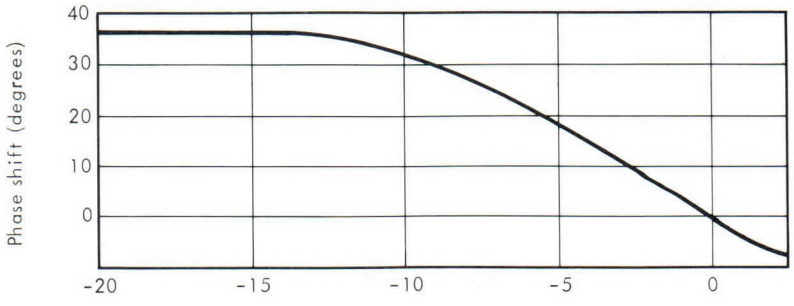
GAIN FLATNESS VERSUS FREQUENCY



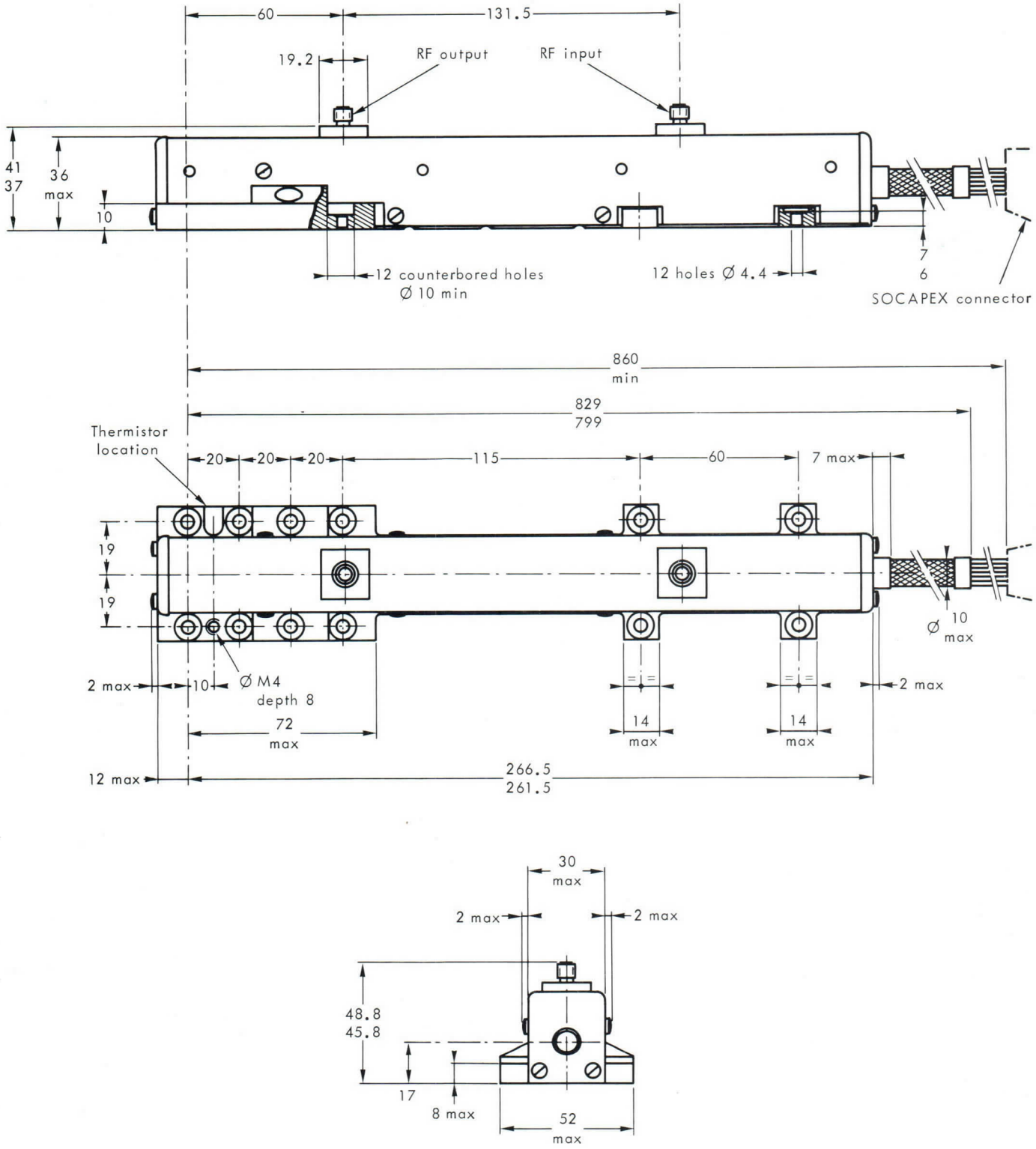
AM/PM TRANSFER VERSUS OUTPUT POWER
(level of F_1 held constant while level of F_2 is varied)



PHASE SHIFT VERSUS RF DRIVE
(Typical)



OUTLINE DRAWING

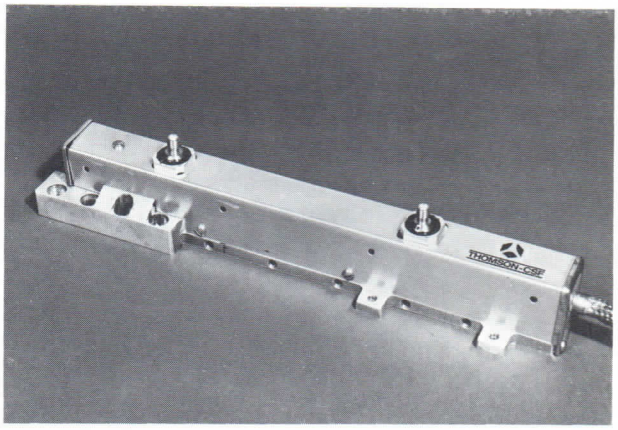


Dimensions in mm, nominal unless otherwise marked.

TH 3529

HIGH-GAIN 12-GHz TWT FOR COMMUNICATIONS SATELLITES

FEATURES



- **Specifically developed for use in communications-satellite transponders.**
- **Unusually high gain** : at least 55 dB at saturation and over 60 dB under small-signal conditions.
- **Powerful** : over 20 watts of saturated output power available.
- **Linear transmission characteristics** : small-signal to saturation phase shift limited to 40°, max.
- **Lightweight, compact and extremely rugged** ; to withstand all the rigors of launching and the space environment.
- **Exceptional reliability** : designed to operate at least seven full years in space, with an MTTF of at least 500,000 hours (60 % confidence level). Long-life impregnated-tungsten cathode.

DESCRIPTION

The TH 3529 high-gain traveling-wave tube has been developed to meet the severe requirements for in-space operation in communications-satellite transponders. Delivering more than 20 watts of output power at saturation, in the 11.7 to 12.2-GHz frequency band (1), this lightweight, compact tube is rugged enough to withstand the extreme environmental conditions encountered in launching, orbital insertion and operation is space.

Since a transponder TWT must normally perform simultaneous amplification of several carriers, it is extremely important that its transmission characteristics be very linear. This is expressed quantitatively by setting a limiting value on the phase variation between small-signal and large-signal operation. In the TH 3529, that phase shift does not exceed a maximum of 40°.

This advanced traveling-wave tube also provides the very small fine-grain small-signal gain variations and flat gain characteristics needed in satellite-transponder service. Incorporating PPM focusing, the TH 3529 is cooled by simple conduction alone, through its base plate.

Manufactured to the very strict quality-assurance standards for space tubes, this TWT is designed to provide at least seven years of continuous in-space operation. It is estimated that its improved impregnated-tungsten cathode will have a useful operating life of more than 200,000 hours.

Variants of the TH 3529 are available for operation in other frequency ranges and/or at lower power levels. The Electron Tube Group of THOMSON-CSF welcomes the opportunity to discuss your specific requirements with you.

(1) The band allocated for national communications-satellite systems.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

CHARACTERISTICS

Performance

Frequency range (Note 2)	11. 7 to 12. 2	GHz
Single-carrier saturated output power, min.	20	W
Gain at saturation, min.	55	dB
Small-signal gain, min.	60	dB
Noise figure, max.	28	dB
Nominal input and output impedance	50	Ω
VSWR, input and output : hot, max.	1. 5 : 1	
VSWR, input and output : cold, max.	1. 3 : 1	
Frequency response in any 125 MHz channel :		
- Gain ripple at saturation	± 0. 1	dB
- Gain ripple below saturation	± 0. 2	dB
- Gain slope at saturation	± 0. 005	dB/MHz
- Gain slope below saturation	± 0. 01	dB/MHz
Third-order intermodulation products :		
- With 2 equal-amplitude carriers driving the TWT to saturation	< − 10 dB, relative to either carrier's output level	

- With each carrier output at a level, relative to the single-carrier saturation level of	− 6 dB	− 9 dB	− 13 dB
- the third-order IM product's level, relative to either carrier is	− 17 dB	− 24 dB	− 33 dB

AM/PM Transfer, at saturation	⩽ 6 °/dB
Small-signal to saturation phase shift, max.	40 °
Group-delay variation at saturation, typ.	0. 5 ns
Overall efficiency (DC to saturated RF), typical	30 %

Mechanical

Weight, approx.	650 g
Dimensions	See Outline Drawing
RF Connections	Female SMA type
Power-supply connections	Flying leads
Cooling	By conduction
Operating-temperature range (base plate) :	
Normal	− 5 to +70 ° C
Extreme (Note 3)	− 15 to +85 ° C

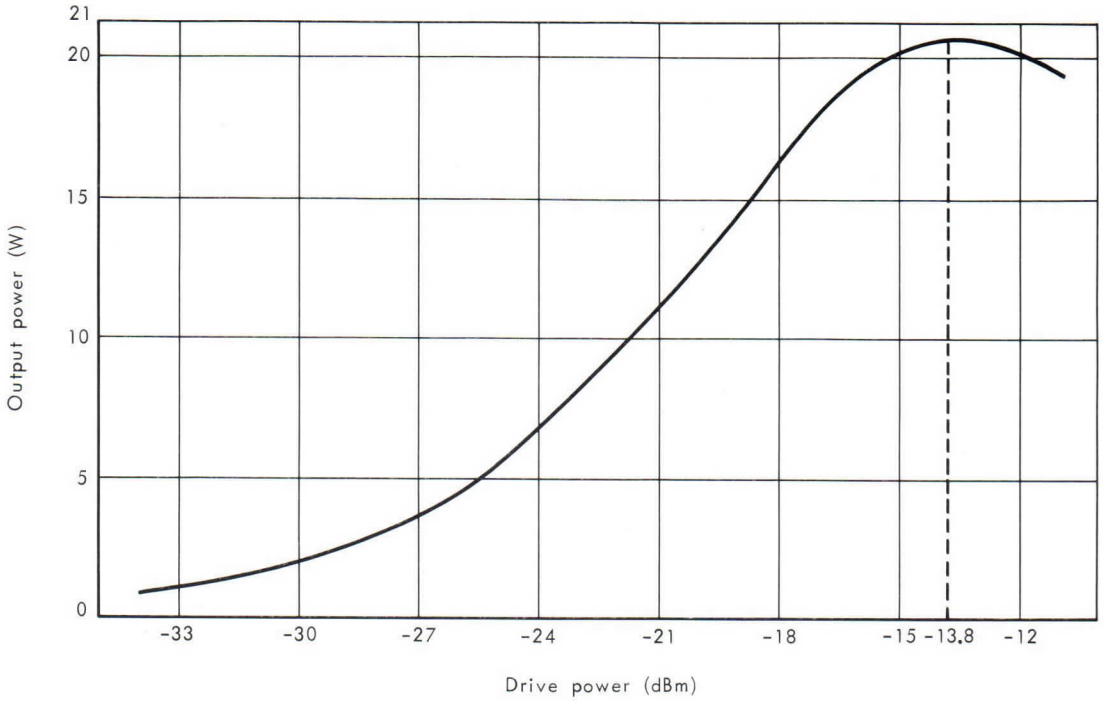
TYPICAL OPERATION

Single-carrier saturated output power				+ 13. 2 dBW
Gain at saturation				57 dB
Small-signal gain				62 dB
Noise figure				26 dB
Input and output VSWR				As specified
Frequency response				As specified
Third-order intermodulation products				As specified
AM/PM Transfer, at saturation				5 °/dB
Output level below saturation	0 dB	− 3 dB	− 6 dB	− 10 dB
Phase shift	35 °	12 °	6 °	3 °
Variation of group delay				0. 5 ns

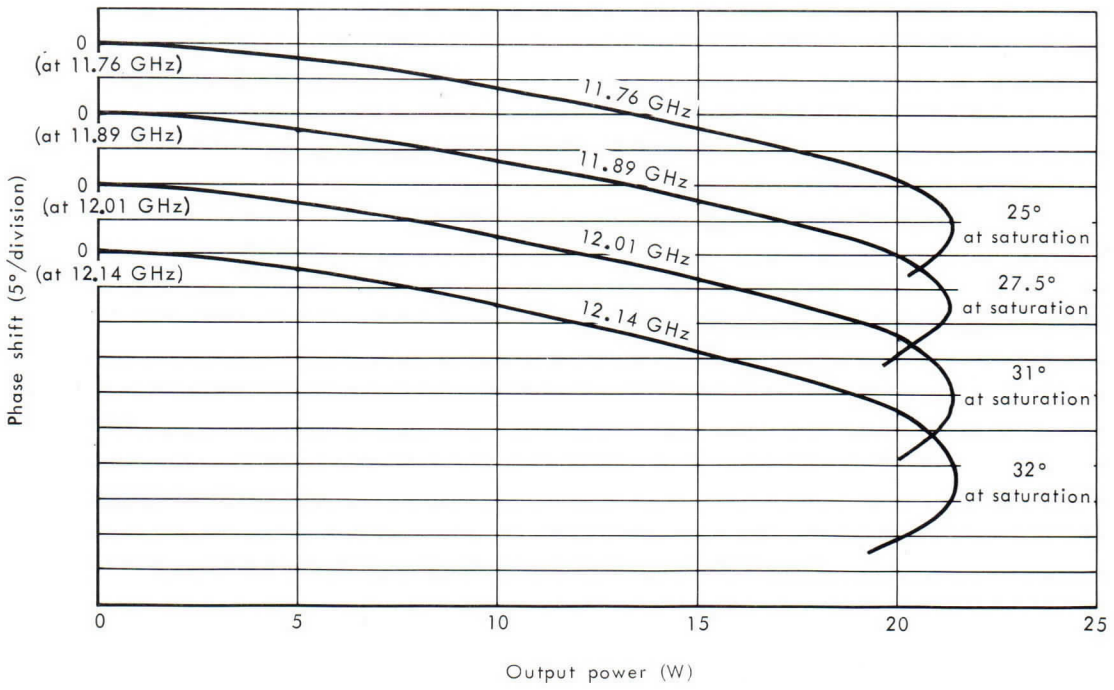
(2) The 11.7 to 12.2-GHz band has been allocated for national communications-satellite systems. This tube can be delivered in alternate versions, optimized for operation in other frequency ranges and/or at lower power levels.

(3) Characteristics not guaranteed.

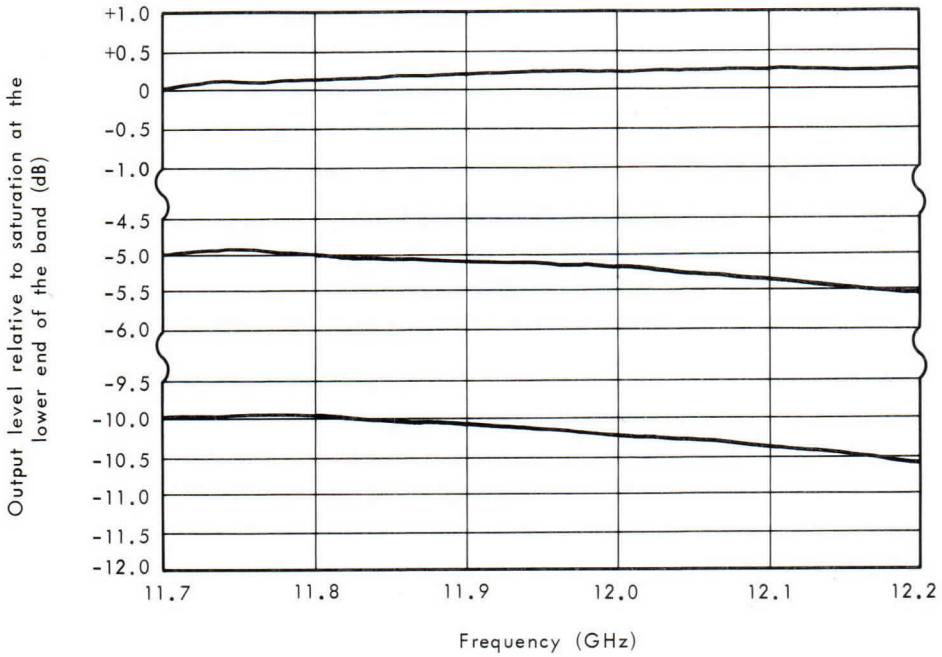
OUTPUT POWER VERSUS DRIVE POWER
(Typical curve)



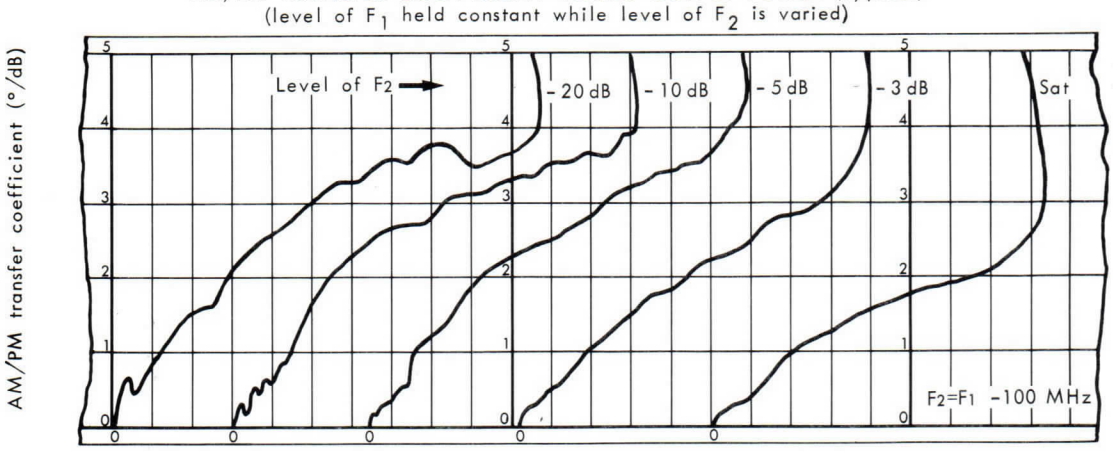
PHASE SHIFT VERSUS OUTPUT POWER
(Typical curves)



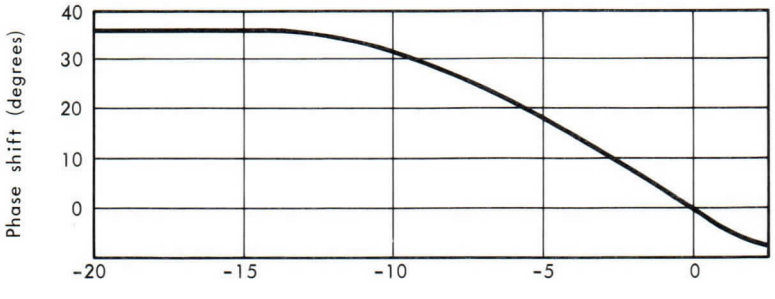
GAIN VERSUS FREQUENCY (Typical)



AM/PM TRANSFER COEFFICIENT VERSUS OUTPUT POWER (Typical)
(level of F_1 held constant while level of F_2 is varied)

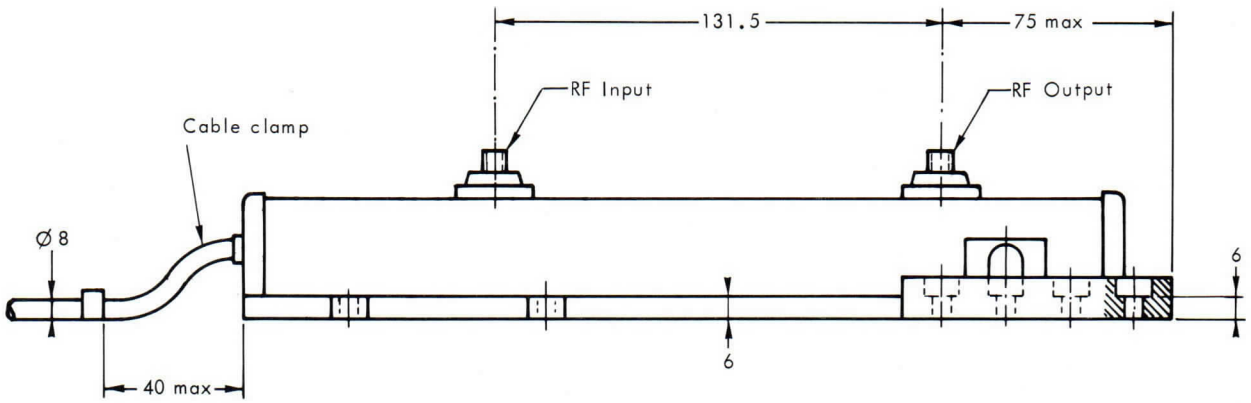


PHASE SHIFT VERSUS RF DRIVE
(typical)

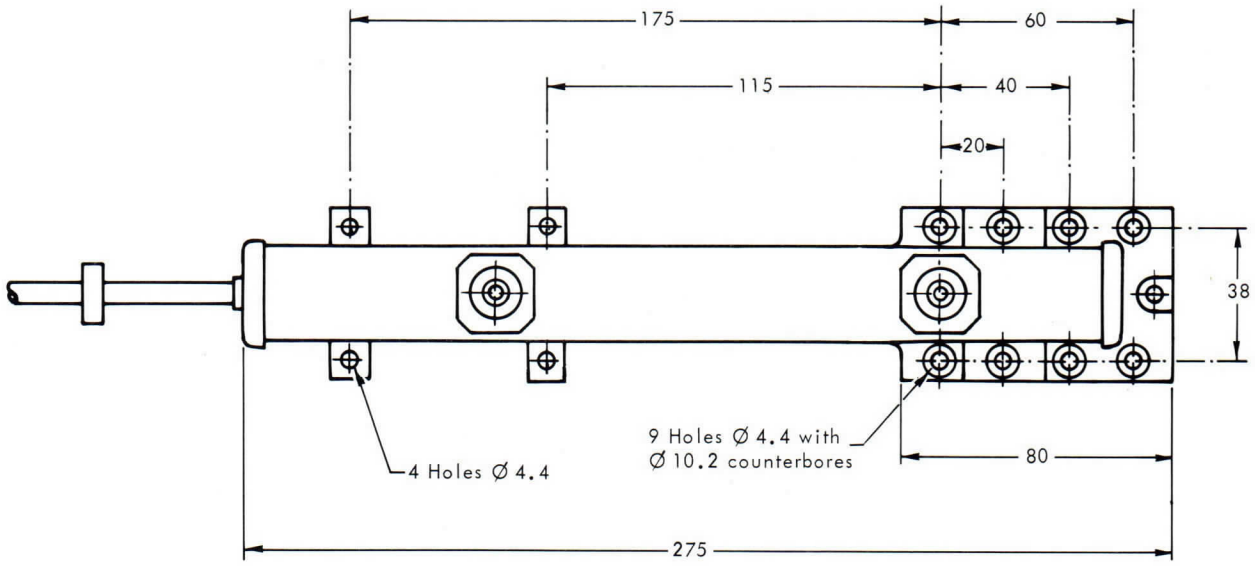


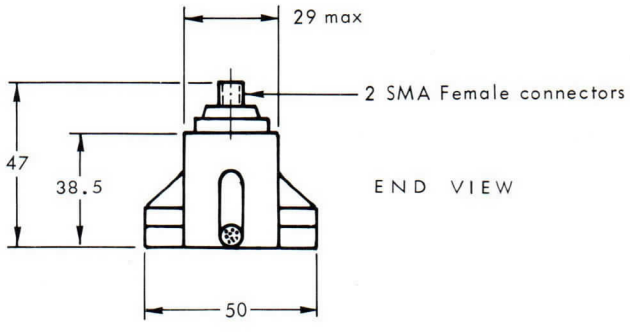
OUTLINE DRAWING

SIDE VIEW



TOP VIEW





END VIEW

TH 3529

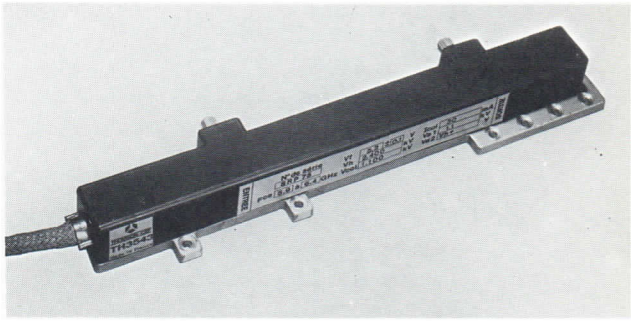
THOMSON-CSF
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Imprimé en France

TH 3543
TRAVELING - WAVE TUBE
11 W - 5.9 - 6.4 GHz

- **Designed specifically for advanced line-of-sight microwave links,** carrying up to 1800 telephone channels.
- **Exceptional linearity and noise characteristics.**
- **Delivers 40.5 dBm** of carrier power.
- **Incorporates long-life space-TWT technology** and has high efficiency.
- **PPM-focused and cooled by simple conduction.**



Description

The TH 3543 traveling-wave tube has been developed to serve as the power amplifier in new, high-capacity microwave links over line-of-sight routes. Able to amplify a signal carrying up to 1800 telephone channels, or television or high bit-rate data, this TWT is designed to operate in the 5.9 to 6.4-GHz band and deliver an output power of 40.5 dBm, with an input power of 1.5 dBm. The operating band can be appreciably enlarged with a small output power reduction.

An important feature of this new tube is its low noise factor, which does not exceed 24 dB. Further, it easily meets a stringent specification concerning the admissible minimum signal-to-noise ratio. Even more important, this superior noise performance is achieved with an impregnated-tungsten cathode, of the type developed for our satellite-carried TWT's. The consequences for the expected reliability and long-life capacity of the TH 3543 are obvious.

Adjustment of this tube's electrical parameters has been made extremely simple. Only the anode voltage is adjustable, the heater, helix and collector voltages all being fixed, as is the drive-power level. To obtain the specified 40.5 dBm output (Fig. 1), it suffices to adjust the cathode current by changing the anode voltage applied to the tube. Because of this simplified procedure, TWT replacement is also easy to accomplish.

Designed to operate with its collector depressed about 50 % below the helix, the TH 3543 has a typical efficiency of 28 %. It also has a nearly flat gain characteristics (Fig. 2) and very low AM/PM conversion factor (Fig. 3). Employing PPM beam focusing, the TH 3543 is fully cooled by simple conduction alone.

This state-of-the-art TWT is also available with a matched solid-state power supply, in a compact, adjustment-free TWTA, the TH 20139, which eliminates all tube/power-supply interface problems for the equipment designer. Contact THOMSON-CSF for more information.

GENERAL CHARACTERISTICS

Electrical (1)

Operating-frequency range	5. 925 - 6. 425	GHz
Output power, min.	40. 5 dBm (11. 2 W)	
Drive power	1. 5 dBm (1. 4 mW)	
Noise factor, max.	24	dB
AM/PM Conversion factor, max.	4	°/dB
Input/output cold VSWR	1. 7 : 1	
Heater voltage	5. 5	V
Heater current	0. 5 - 0. 7	A
Helix voltage	2. 5	kV
Helix current	2	mA
Anode voltage, max.	1. 5	kV
Anode current	− 0. 1 to + 0. 1	mA
Collector voltage	1. 2	kV
Collector current , max.	40	mA

(1) All voltages referred to the cathode.

Mechanical

Operating position	Any
Dimensions	See Outline Drawing
Weight, approx.	700 grams
Power-supply connections	Shielded cable
Cooling	By conduction

LIMITING VALUES FOR EQUIPMENT DESIGN (2)

(non-simultaneous)

	Min.	Max.	Units
Heater voltage	5. 3	5. 7	V
Heater surge current	−	1	A
Warm-up time	3	−	mn
Ambient temperature	− 10	+ 50	°C
Helix voltage	2. 3	2. 8	kV
Helix current	−	3	mA
Anode voltage	−	1. 8	kV
Anode current	− 1	+ 1	A
Collector voltage	1	2	kV
Collector current	−	40	mA
Collector dissipation	−	80	W
Drive power	−	10	mW
Load VSWR	−	2 : 1	

(2) Equipment-design values, **NOT** operating values. No one value ever to be exceeded, even under transient conditions, and operation at more than one limiting value at the same time may cause tube damage.

TYPICAL OPERATION

Operating frequency	6	GHz	Helix voltage	2. 5	kV
Drive power	1. 4	mW	Helix current	0. 4	mA
Output power	40. 5	dBm	Collector voltage	1. 2	kV
Heater voltage	5. 5	V	Collector current	32	mA
Heater current	0. 65	A	Harmonic level max.	31	dBm
Anode voltage	1. 16	kV	Efficiency	26	%

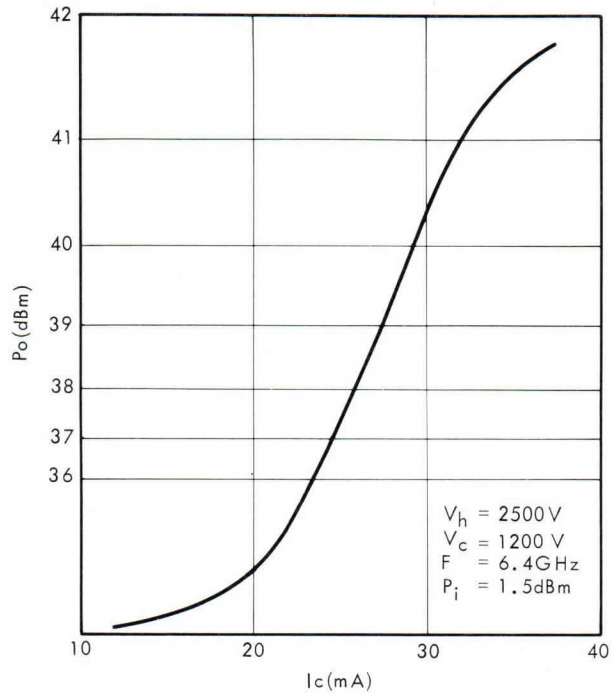


FIGURE 1 - Output power versus collector current

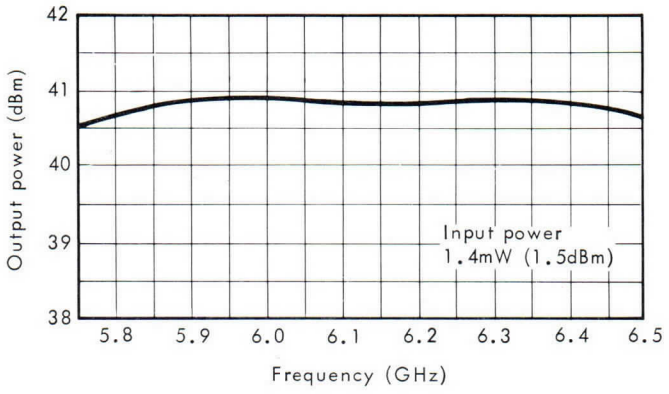


FIGURE 2 - Frequency response

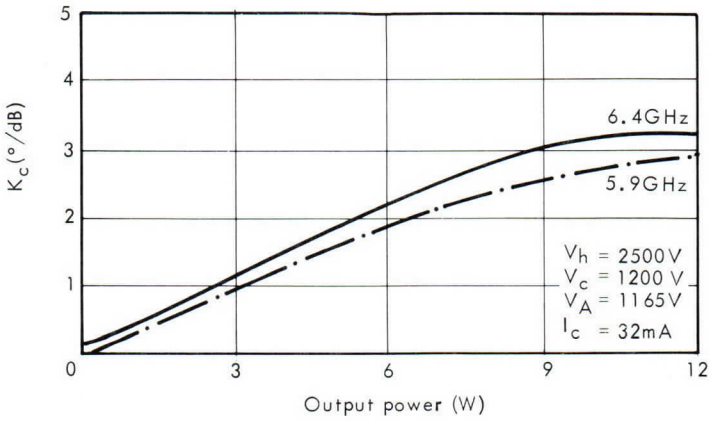
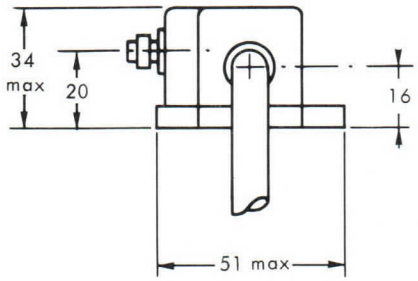


FIGURE 3 - AM-PM conversion cœfficient versus output power with constant collector current

OUTLINE DRAWING

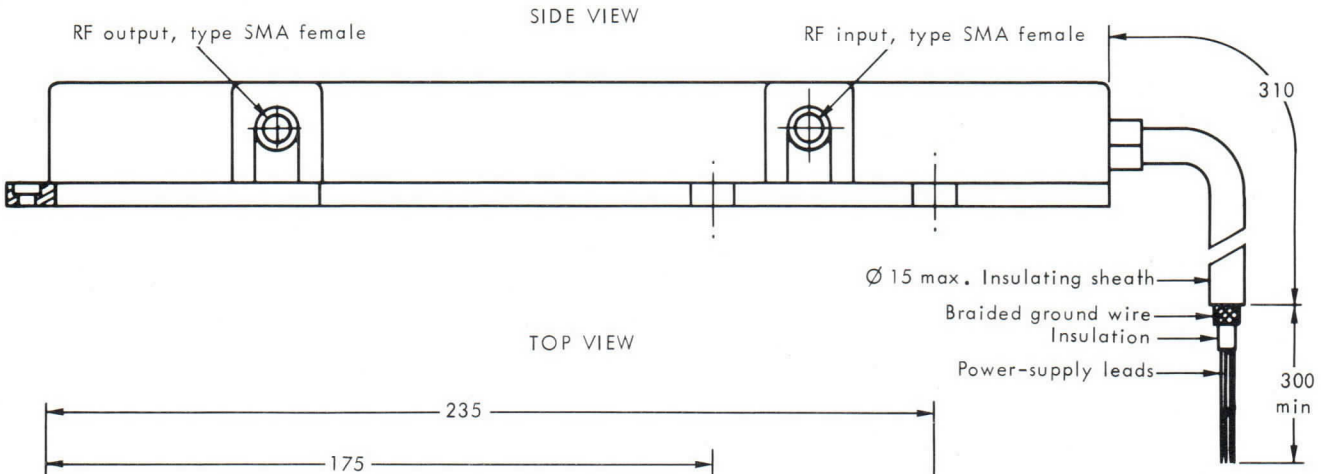
RIGHT VIEW



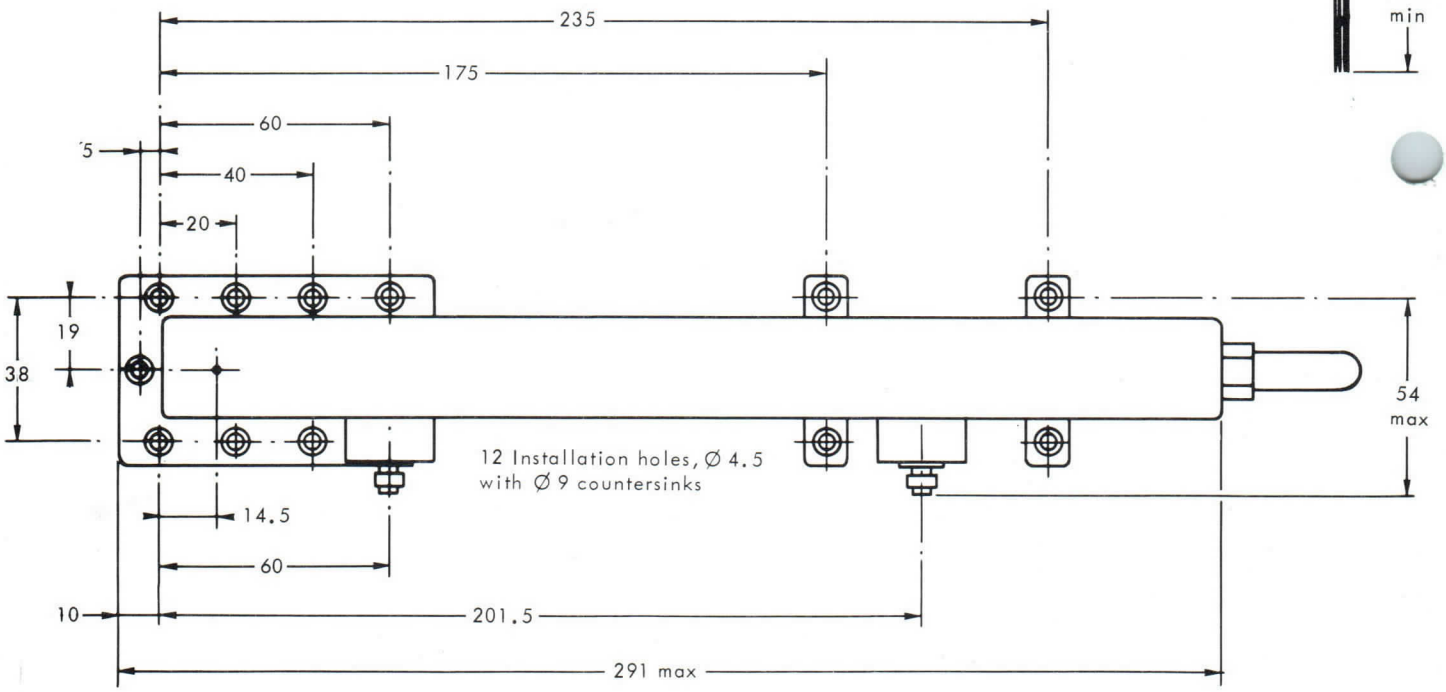
POWER-SUPPLY LEAD COLOR CODE

Filament	Brown
Filament-cathode	Yellow
Anode	Blue
Helix-ground	Orange
Collector	Red

SIDE VIEW



TOP VIEW

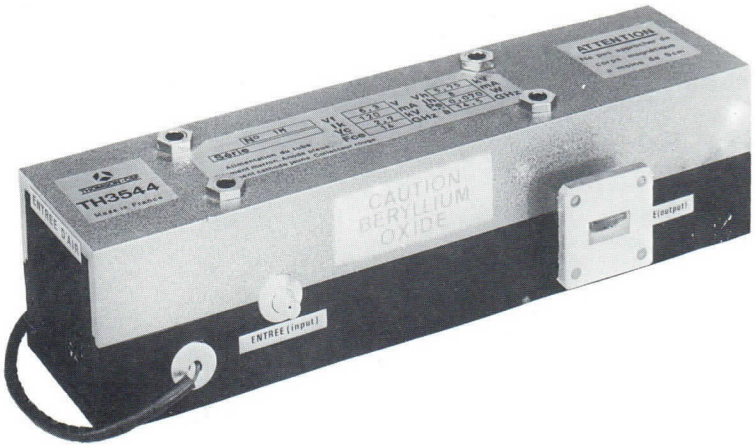


Dimensions in mm, nominal except those marked " max " or " min ".

TH 3544
125 W CW TRAVELING-WAVE TUBE

Features

- Specially designed for communications-satellite earth stations.
- More than 125 watts CW in Ku-Band.
- PPM-focused, for reduced power consumption and simple forced-air cooling.
- Rugged all metal-and-ceramic construction, with a copper helix brazed to berylium-oxide support rods.
- Compact and lightweight.
- Highly reliable and offers long tube life.



The TH 3544 is a high-gain, medium-power traveling-wave tube, designed for transmitter use in satellite-communications-system earth stations operating in the 14 to 14. 5 GHz band.

Featuring a brazed copper helix slow-wave structure, the TH 3544 is especially well-suited for multicarrier operation in low-cost, small capacity INTELSAT-V or OTS-type earth stations, either fixed or transportable. Careful matching of its coupling elements and lossy sections has resulted in a TWT providing wideband operation with nearly flat gain, very low group-delay distortion and small AM/PM conversion distortion.

If operated in the normal depressed-collector configuration, the TH 3544 has a minimum overall efficiency of 25 %, with typical efficiency on the order of 30 %.

Air-cooled, the TH 3544 requires a minimum cooling-air flow of only 30 liters a second (60 cu.ft/min.).

The dispenser-type cathode, made of specially treated barium-impregnated tungsten, ensures long tube life. In addition, tube life can be further prolonged because the electron-gun design allows readjusting the cathode current as the tube ages, without changing the helix voltage.

A power supply, specially designed for the TH 3544, can be delivered on order.

THOMSON-CSF
DIVISION TUBES ELECTRONIQUES

GENERAL CHARACTERISTICS

Electrical

Frequency range	14 - 14. 5	GHz
Output power, at saturation	⩾ 125	W
Efficiency (depressed collector)	⩾ 30	%
Gain, at rated power	⩾ 50	dB
Gain variation over the band	⩽ 1. 5	dB
Gain slope, small-signal	⩽ 0. 03	dB/MHz
AM/PM conversion	⩽ 6	°/dB
Noise figure	⩽ 35	dB
Noise measured in a 4 kHz window	⩽ – 42	dBm
Heater voltage	7	V
Heater current	1 to 1. 1	A
Cathode current	110 to 130	mA
Helix voltage	5. 4 to 5. 8	kV
Cathode current	110 to 130	mA
Anode voltage	4. 7 to 5. 2	kV
Collector voltage	2. 8 to 3. 5	kV
Load VSWR (max.)	1. 2 : 1	

Mechanical

Operating position	Any
Dimensions	334 mm x 87 mm x 65 mm
Weight, approximate	1. 5 kg
RF Connections	Input : coaxial 3 mm female
	Output waveguide : WR-75
Power-supply connections	Flying leads
Thermal-switch connections	Flying leads
Cooling	Forced air

LIMITING VALUES FOR EQUIPMENT DESIGN*

(non-simultaneous)

	Min.	Max.	Units
Heater surge current	–	2	A
Heater voltage	6. 8	7. 2	V
Warm-up time	3	–	mn
Anode voltage	–	V_a (nom) + 0. 1	kV
Anode current	–1	+ 1	mA
Drive power	–	5 dB above P_d (nom)	mW
Helix voltage	V_h (nom) – 0. 1	V_h (nom) + 0. 1	kV
Helix current	–	12	mA
Load VSWR	–	2 : 1	
Collector voltage	–	3. 8	kV
Cooling air flow	30	–	g/s
Inlet cooling air temperature	– 40	+ 60	°C
Distance from magnetic materials	5	–	cm

* Equipment-design values, NOT operating values. No one value ever to be exceeded, even under transient conditions, and operation at more than one limiting value at the same time may cause tube damage.

TYPICAL OPERATION

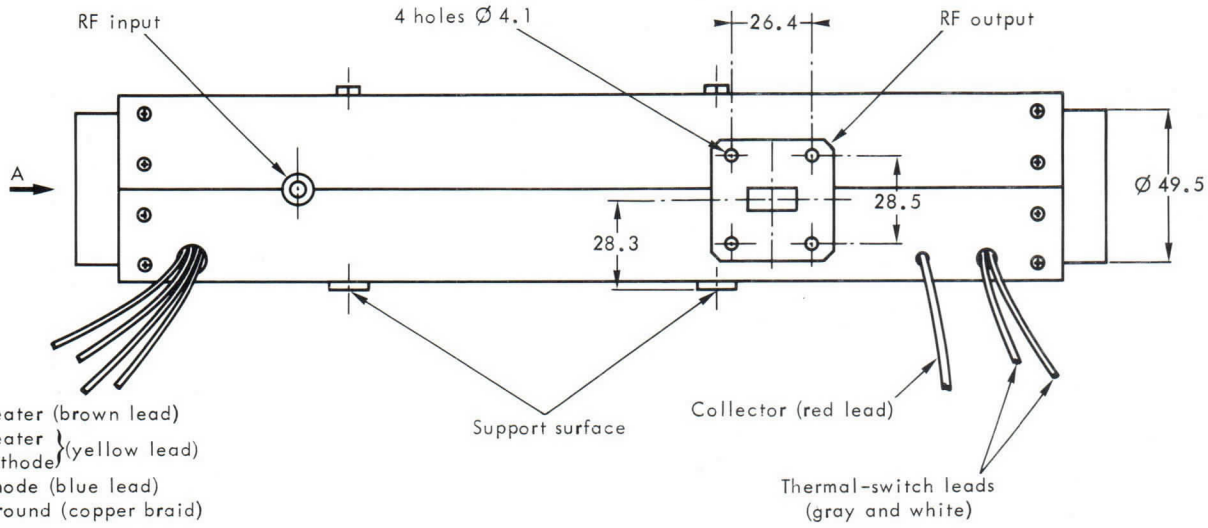
Single-carrier mode

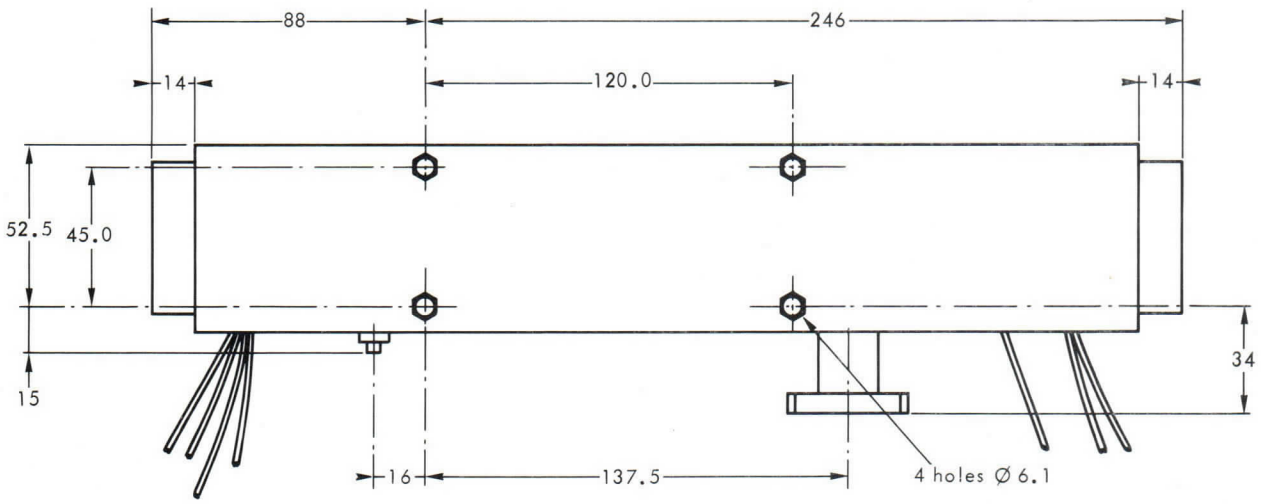
Frequency	14 - 14. 5	GHz
Output power	150	W
Gain :		
- saturated	55	dB
- small-signal	60	dB
Efficiency	35	%
Maximum gain variation over the band, P_{out} = 150 W	0. 3	dB
Gain slope, maximum	0. 02	dB/MHz
Noise measured in a 4-kHz window	– 48	dBm
Heater voltage	7	V
Heater current	1	A
Cathode current	130	mA
Anode voltage	4. 9	kV
Anode current	0	mA
Helix voltage	5. 75	kV
Helix current	5	mA
Collector voltage	3	kV
Collector current	115	mA
AM/PM conversion	5	°/dB

Multi-carrier mode

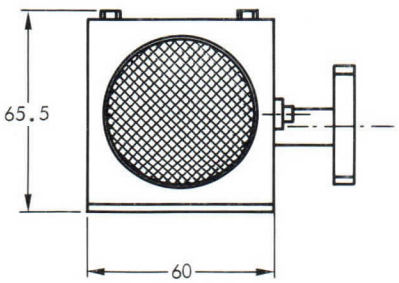
First carrier frequency, F_1	14. 24	GHz
Second carrier frequency, F_2	14. 26	GHz
Output power, per carrier	15	W
Intermodulation products	– 26	dB
AM/PM conversion	2	°/dB
Maximum gain variation over the band, small-signal	1	dB

OUTLINE DRAWING





View in the direction of A



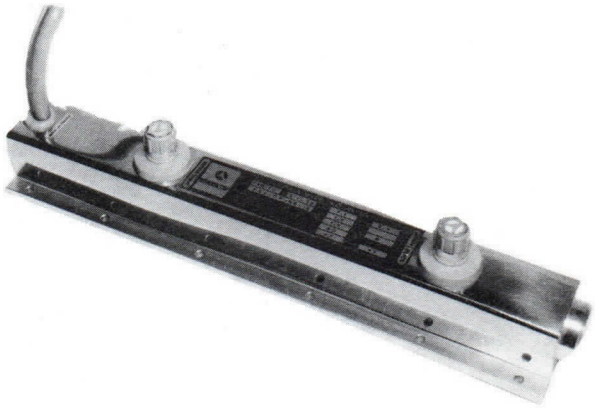
All dimensions nominal in mm

F4017D
TRAVELING WAVE TUBE

The F4017D traveling wave tube is a broadband amplifier capable of providing a minimum saturated output power of 7 W from 1.7 to 2.7 GHz. The saturation gain is more than 30 dB and the small signal gain is more than 35 dB.

Integral periodic permanent magnet focusing reduces the stray magnetic field and saves weight.

The F4017D is cooled by conduction. Because of its small size, light weight and rugged construction, this tube is ideal for use in mobile radio link communications systems.



GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Frequency	1.7	2.7	GHz
Heater voltage	6.3		V
Heater current	1.1	1.5	A
Output power	7	–	W
Gain saturation	30	–	dB
Gain small signal	35	–	dB
Helix voltage	1.5	1.9	kV
Helix current	–	3	mA
Anode voltage	0.8	1.5	kV
Anode current	–1	+3	mA
Collector voltage	1.5	1.9	kV
Cathode current	–	53	mA

Mechanical

Operating position	any
Weight (approx.)	1.7 kg
RF connections	coaxial, N type, UG 58 A/U
Supply connections	flexible leads
Cooling	conduction

(1) All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Heater voltage	6.0	6.6	V
Heater surge current	–	3.0	A
Warm-up time (1)	3	–	mn
Ambient temperature	–	60	°C
Vibrations	–	0.5 mm from 10 to 55	Hz
		0.05 mm from 55 to 100	Hz
Shocks	–	40 g - 6 ms	
Helix voltage nominal voltage (2)	–200	+200	V
Helix current	–	3.5	mA
Anode voltage nominal voltage (2)	–	+200	V
Anode current	–	3	mA
Collector voltage nominal voltage (2)	–200	+200	V
Cathode current	–	55	mA
Collector dissipation	–	100	W
Drive power	–	100	mW
Pressure	0.6	2	bar (3)
Load VSWR	–	2:1	

(1) Not necessary if the supply is cut off for less than 5 seconds.
(2) Indicated on the Test Data Sheet of each tube.
(3) 1 bar = approx. 15 psi.

TYPICAL OPERATION

Frequency	2.2	GHz
Heater voltage	6.3	V
Heater current	1.3	A
Drive power	7	mW
Output power, saturation	10	W
Gain, saturation	32	dB
Helix voltage	1.76	kV
Helix current	0.9	mA
Anode voltage	1.14	kV
Anode current	0	mA
Cathode current	43	mA
Collector voltage	1.76	kV
Collector current	42	mA

OPERATING INSTRUCTIONS

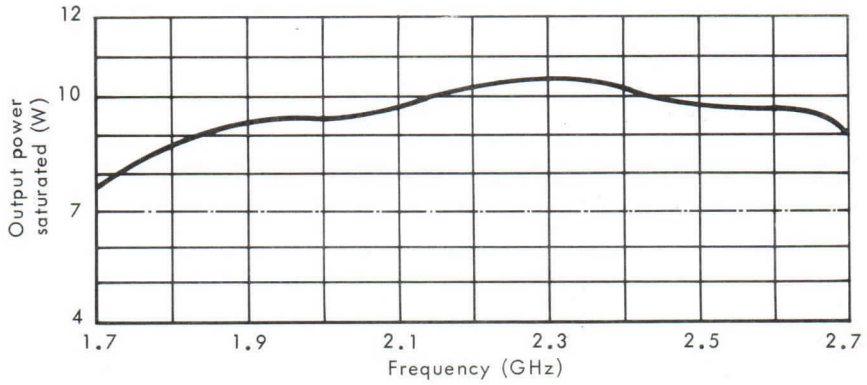
Application of voltages

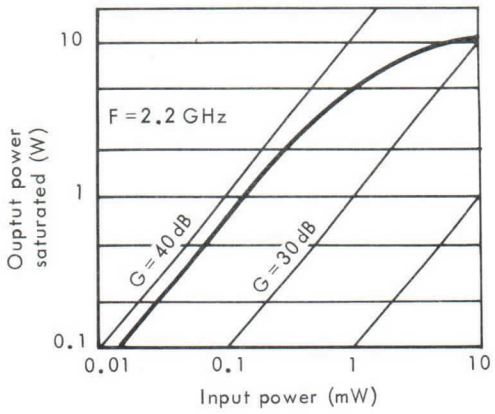
Voltages should be applied in the following order :

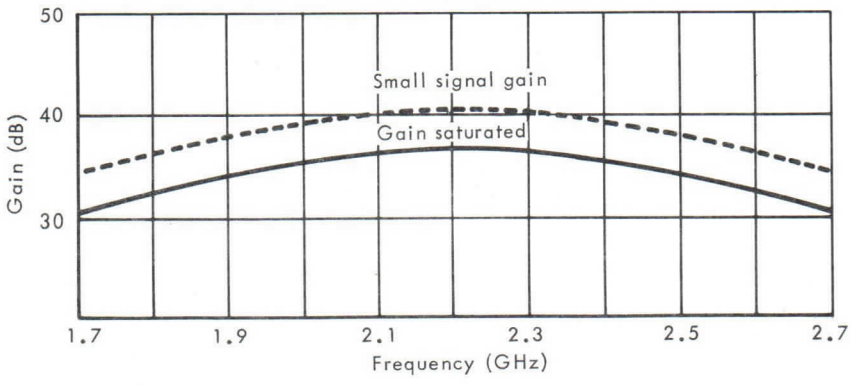
- Heater, allow three minutes for cathode warm-up,
- Grid,
- Helix,
- Collector,
- Anode.

Anode voltage should not be applied if other voltages are applied or if the hermal safety relay is open.

CHARACTERISTIC CURVES

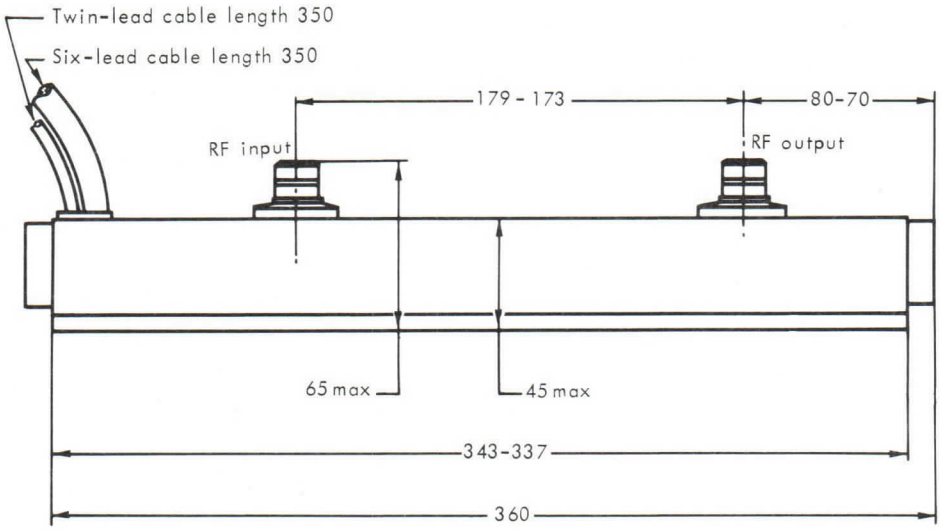


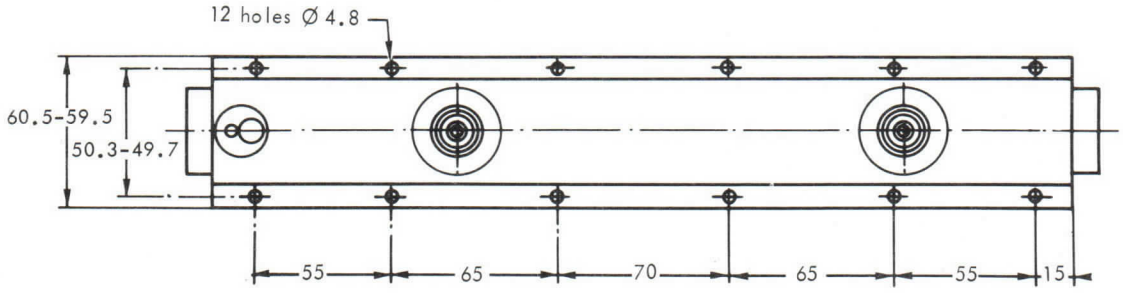




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





CONNECTIONS	
Blue	Anode
Orange	Helix
Red	Collector-ground
Brown	Heater
Yellow	Heater-cathode
Green	Wehnelt
White	Protection circuit
Grey	Protection circuit

Dimensions in mm.

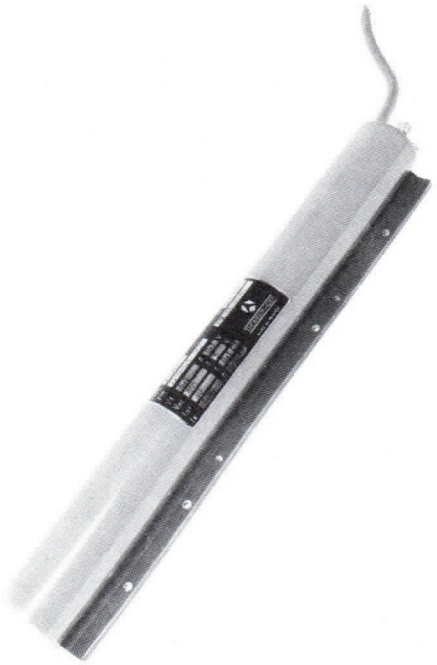
F4024B TRAVELING WAVE TUBE

The F4024B is a wide band, low noise, high gain, traveling wave tube which provides a saturated power output of 30 to 60 mW, from 2.15 to 4.30 GHz.

The typical noise figure is 9 dB and the small signal gain at least 40 dB.

The F4024B features periodic permanent magnet focusing, small size, light weight. Specifically intended for military airborne applications, an all ceramic and metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions.

The F4024B traveling wave tube incorporates a voltage distributing network preset at the factory for optimum combination of noise figure and gain. Furthermore, power supply voltage requirements are reduced to heater voltage and high voltage.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage	-	6.3	-	V
Heater current	0.4	-	0.6	A
High voltage supply	-	650	-	V
Current supply	6	-	12	mA
Small signal gain (1)	35	-	-	dB
Saturated power output	30	-	60	mW
Insertion loss	70	-	-	dB
Input VSWR (2)	-	-	1.8 : 1	
Output VSWR (2)	-	-	2.0 : 1	
Stray magnetic field at 2 m	-	-	4	γ

(1) For $P_i = -45$ dBm

(2) Tube not supplied.

Mechanical

RF connections	ATI coaxial socket, mini-ultra ref : 2008
Supply connections	DEUTSCH connector RSM 07.12.14.P.A.520
Operating position	any
Weight	1.5 kg

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater voltage	6. 2	6. 4	V
High voltage supply			
- for the rated performances	645	655	V
- for tube life	600	700	V
Peak input power (3)	-	1	kW
Average input power	-	0. 1	W
Warm-up time	120	-	s
Ambient temperature	–55	+110	°C
Depression	3	-	bar

(3) with pulse duration ⩽ 50 µs.

TYPICAL OPERATION

Heater voltage			6. 3	V
Heater current			0. 4	A
High voltage supply			650	V
Current supply			10	mA
Cathode current			1630	µA
Collector current			1610	µA
Frequency	2. 15	3. 3	4. 3	GHz
Noise figure	9. 2	9. 6	9. 2	dB
Small signal gain (4)	38	41	39	dB
Saturated power output	31	39	28	mW
Input VSWR	1. 22 : 1	1. 20 : 1	1. 40 : 1	
Output VSWR	1. 20 : 1	1. 24 : 1	1. 60 : 1	

(4) For $P_i = -45$ dBm

OPERATING INSTRUCTION

Electro-magnet

The F4024B is focused by an integral periodic permanent magnet. Before applying voltages, check that environmental magnetic field is less than 10 gauss, if not, tube performances are not guaranteed.

Helix grounding

After installation, the tube helix should be connected to ground by means of a DC short or a crystal rectifier.

Application of voltages

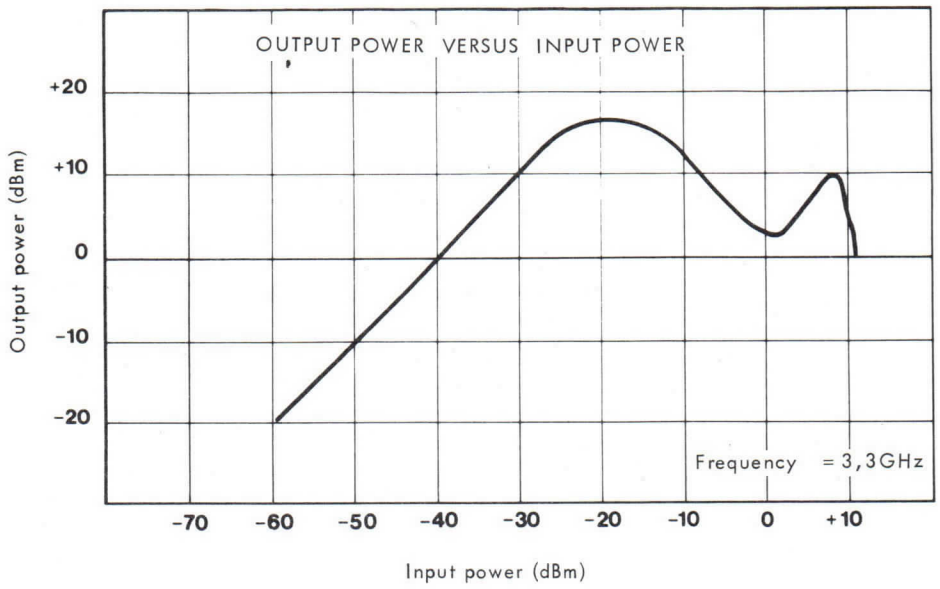
Before applying voltages, check that high voltage and heater voltage delivered by the supply unit are within the specified values indicated on the tube label. The meters used for this control should present an isolation from ground of at least 1000 V and accuracy of at least ± 1 %.

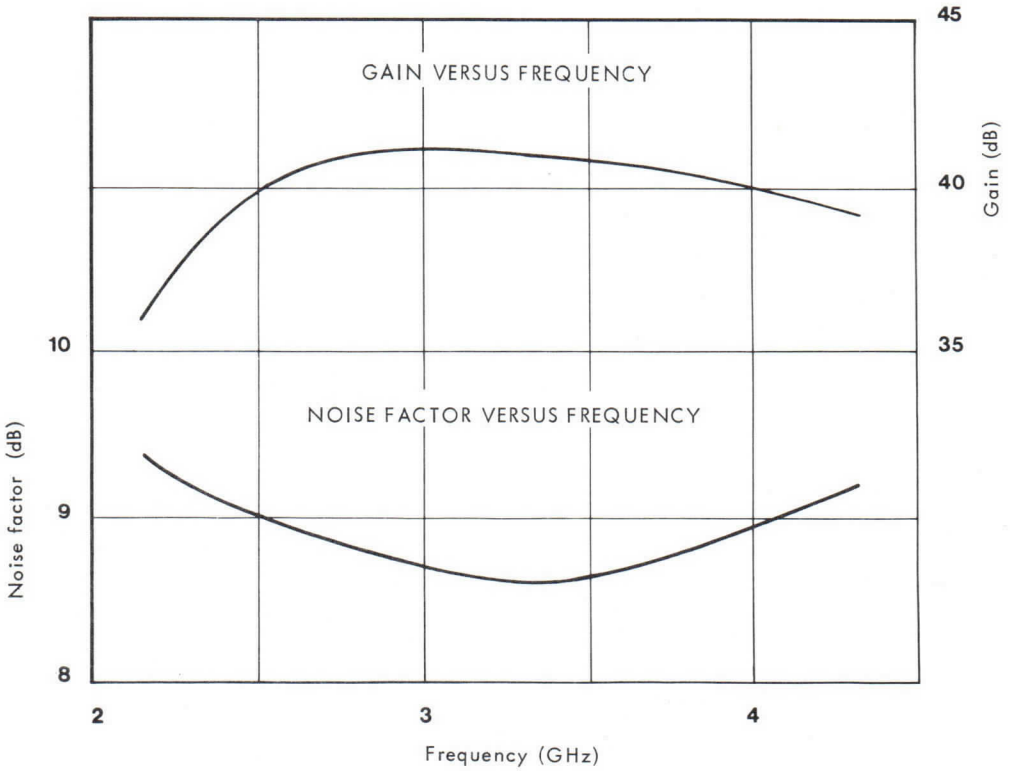
After applying heater voltage wait two minutes before applying the high voltage. A micro-ammeter connected according to the diagramm given page 3 indicates if the tube is operating correctly, with respect to the values specified on the tube label. This meter should feature : full scale deviation : 2000 µA - internal resistance ⩽ 1000 Ω - isolation : 1000 V dc operating voltage.

Input power

The tube helix can be damaged if the input power (peak and average values) exceeds the limits given in the paragraph "Absolute Ratings".

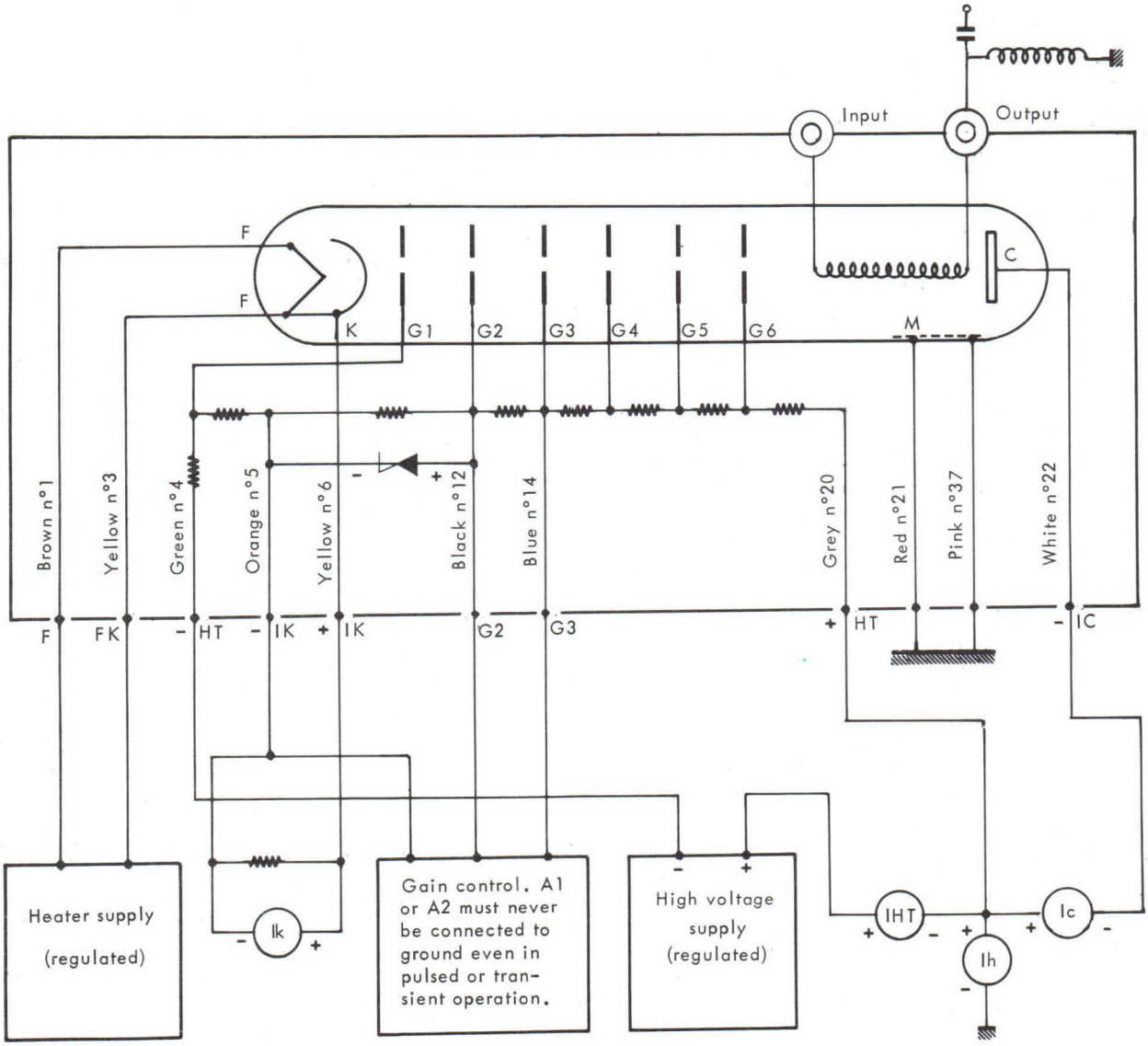
CHARACTERISTIC CURVES

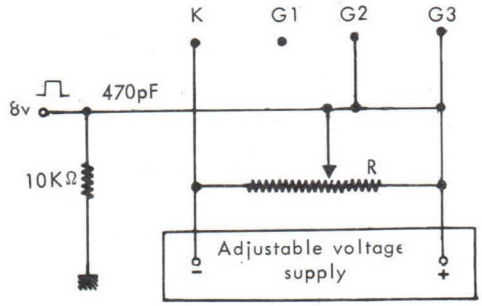




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

SUPPLY DIAGRAM

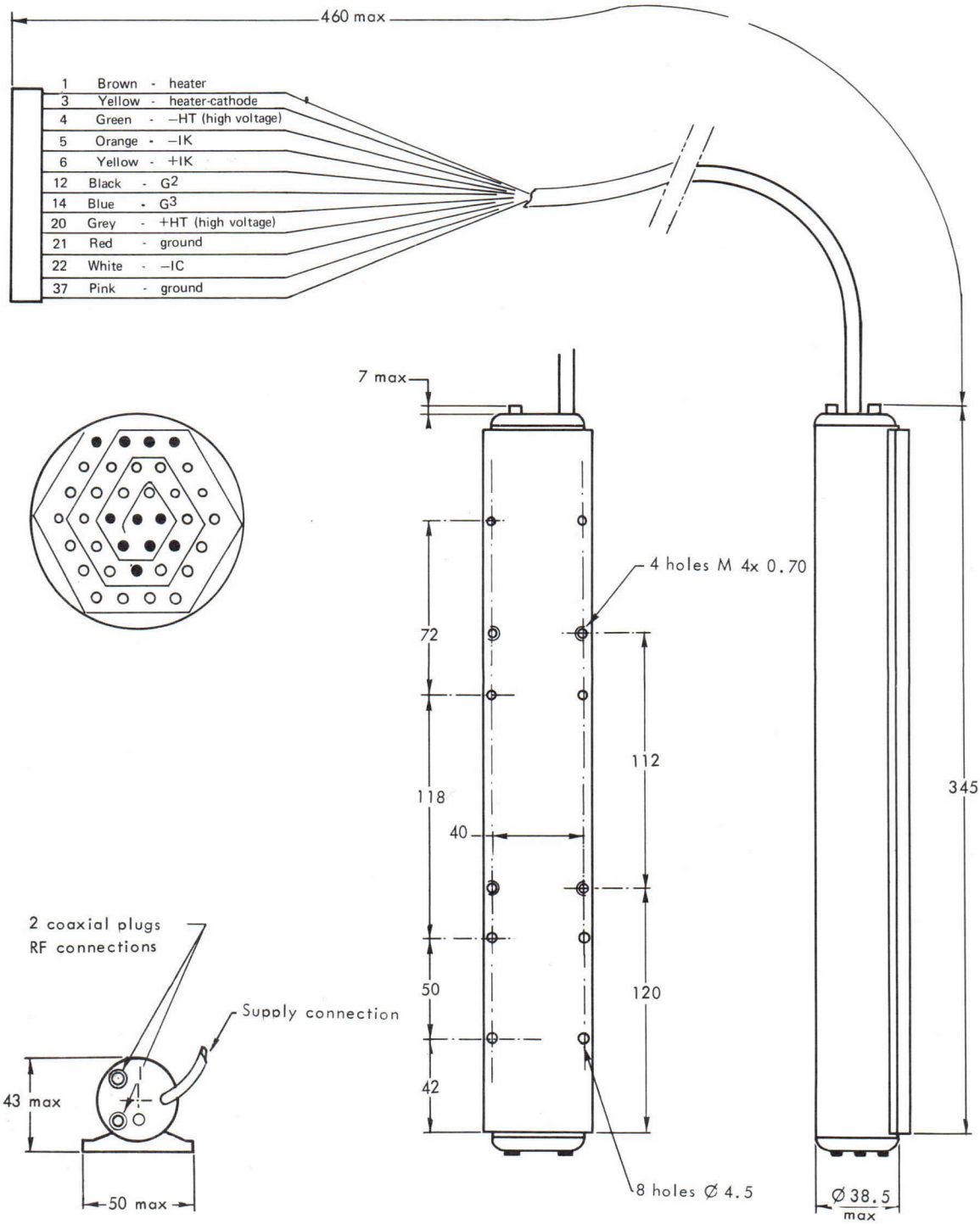




PULSE OPERATION

- The control pulse is applied to G2 through the 470pF capacitor..
- The TWT cut off conditions are G2 and G3 voltage decreased to 0 volt in a constant ratio fixed by R and given by the nominal values.

OUTLINE DRAWING



Dimensions in mm.

THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

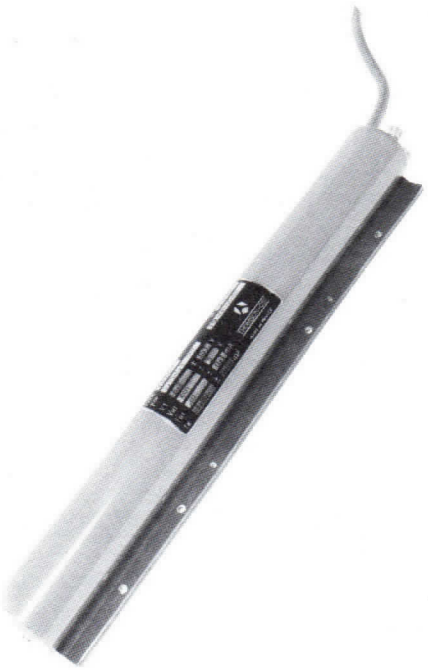
F4025B TRAVELING WAVE TUBE

The F4025B is a wide band, low noise, high gain, traveling wave tube which provides a saturated power output of 20 to 40 mW, from 4 to 7 GHz.

The typical noise figure is 10 dB and the small signal gain at least 40 dB.

The F4025B features periodic permanent magnet focusing, small size, light weight, Specifically intended for military airborne applications, an all ceramic and metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions.

The F4025B traveling wave tube incorporates a voltage distributing network preset at the factory for optimum combination of noise figure and gain. Furthermore, power supply voltage requirements are reduced to heater voltage and high voltage.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage	-	6.3	-	V
Heater current	0.4	-	0.6	A
High voltage supply	-	850	-	V
Current supply	3	-	7	mA
Small signal gain (1)	35	-	-	dB
Saturated power output	20	-	40	mW
Insertion loss	70	-	-	dB
Input VSWR (2)	-	-	1.8 : 1	
Output VSWR (2)	-	-	2 : 1	
Stray magnetic field at 2 m	-	-	4	γ

(1) For $P_i = -45$ dBm
(2) Tube not supplied.

Mechanical

RF connections	ATI coaxial socket, mini-ultra ref : 2008
Supply connections	DEUTSCH connector RSM 07.12.14.P.A.5205
Operating position	any
Weight	1.5 kg

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater voltage	6. 2	6. 4	V
High voltage supply			
- for the rated performances	845	855	V
- for tube life	800	900	V
Peak input power (3)	-	1	kW
Average input power	-	0. 1	W
Warm-up time	120	-	s
Ambient temperature	–55	+110	°C
Depression	3	-	bar

(3) with pulse duration ⩽ 50 µs.

TYPICAL OPERATION

Heater voltage			6. 3	V
Heater current			0. 4	A
High voltage supply			850	V
Current supply			6	mA
Cathode current			900	µA
Collector current			890	µA
Frequency	4. 2	5. 7	6. 9	GHz
Noise figure	10. 8	10. 5	10. 5	dB
Small signal gain (4)	39	42	39	dB
Saturated power output	22	30	20	mW

(4) For $P_i = -45$ dBm.

OPERATING INSTRUCTION

Electro-magnet

The F4025B is focused by an integral periodic permanent magnet. Before applying voltages, check that environmental magnetic field is less than 10 gauss, if not, tube performances are not guaranteed.

Helix grounding

After installation, the tube helix should be connected to ground by means of a DC short or a crystal rectifier.

Application of voltages

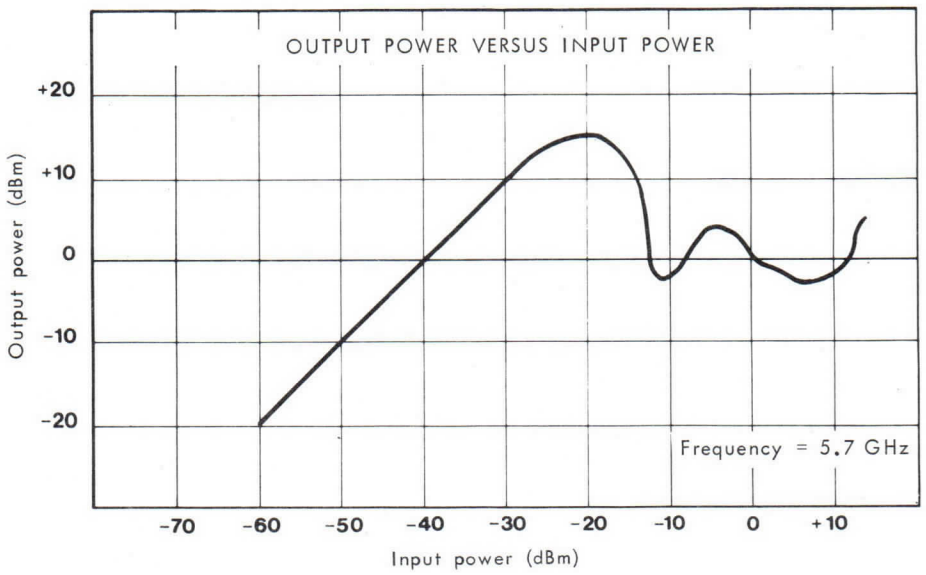
Before applying voltages, check that high voltage and heater voltage delivered by the supply unit are within the specified values indicated on the tube label. The meters used for this control should present an isolation from ground of at least 1000 V and accuracy of at least ± 1 %.

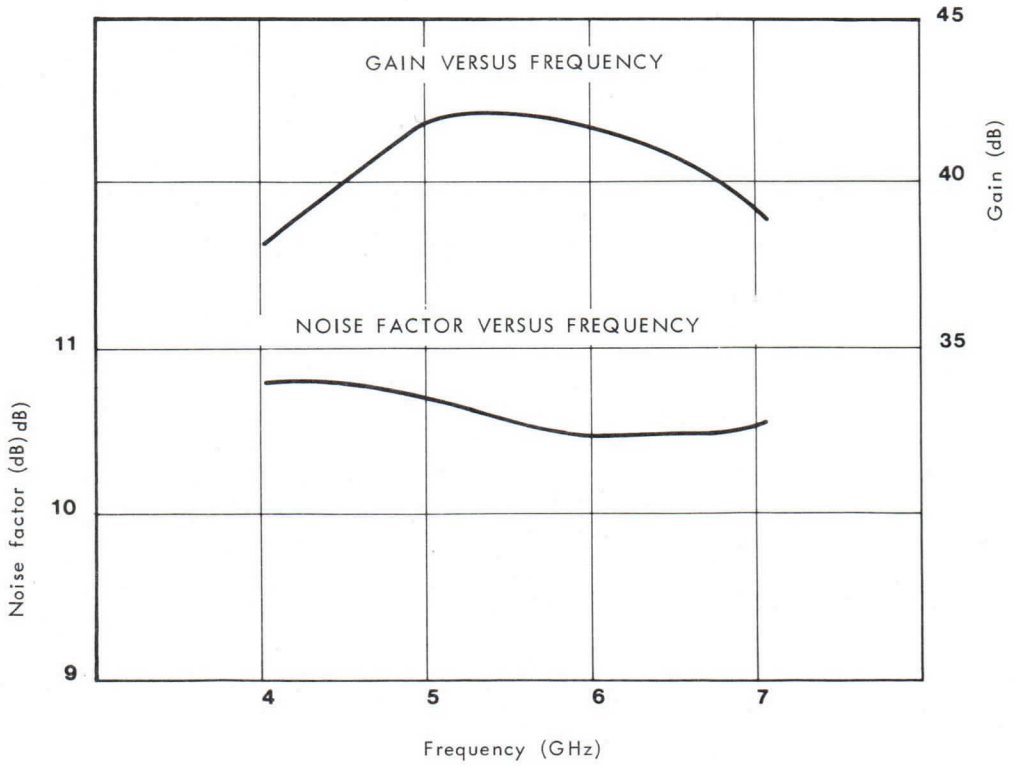
After applying heater voltage wait two minutes before applying the high voltage. A micro-ammeter connected according to the diagramm given page 3 indicates if the tube is operating correctly, with respect to the values specified on the tube label. This meter should feature : full scale deviation : 1000 µA
internal resistance ⩽1000 Ω
isolation : 1000 V dc operating voltage.

Input power

The tube helix can be damaged if the input power (peak and average values) exceeds the limits given in the paragraph "Absolute Ratings".

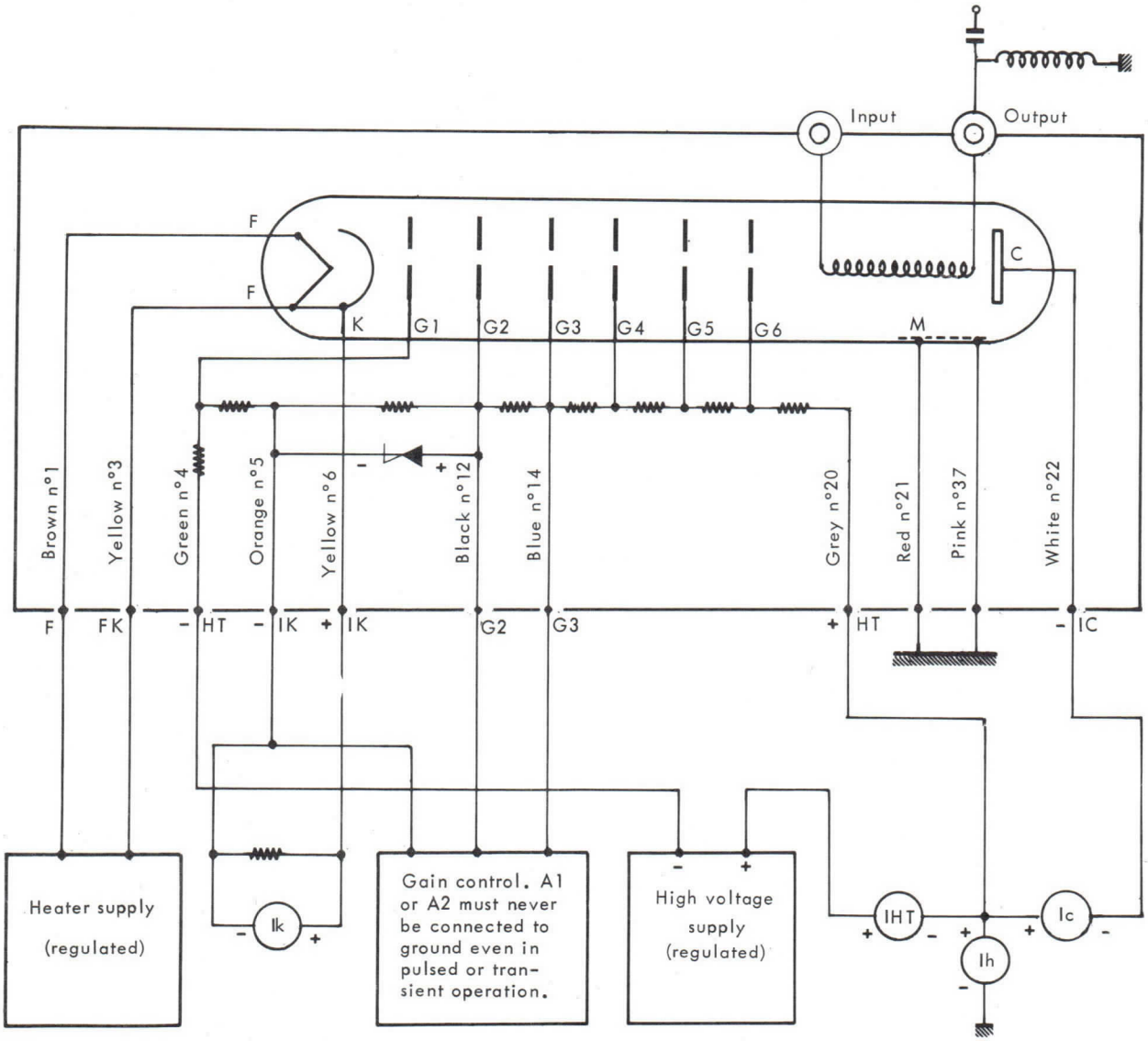
CHARACTERISTIC CURVES

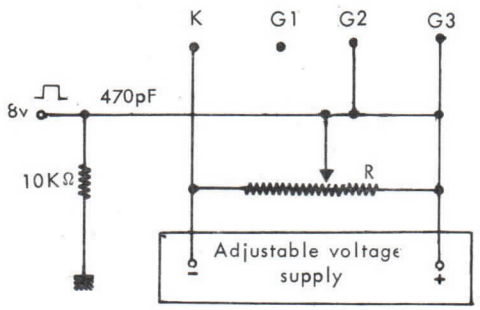




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

SUPPLY DIAGRAM

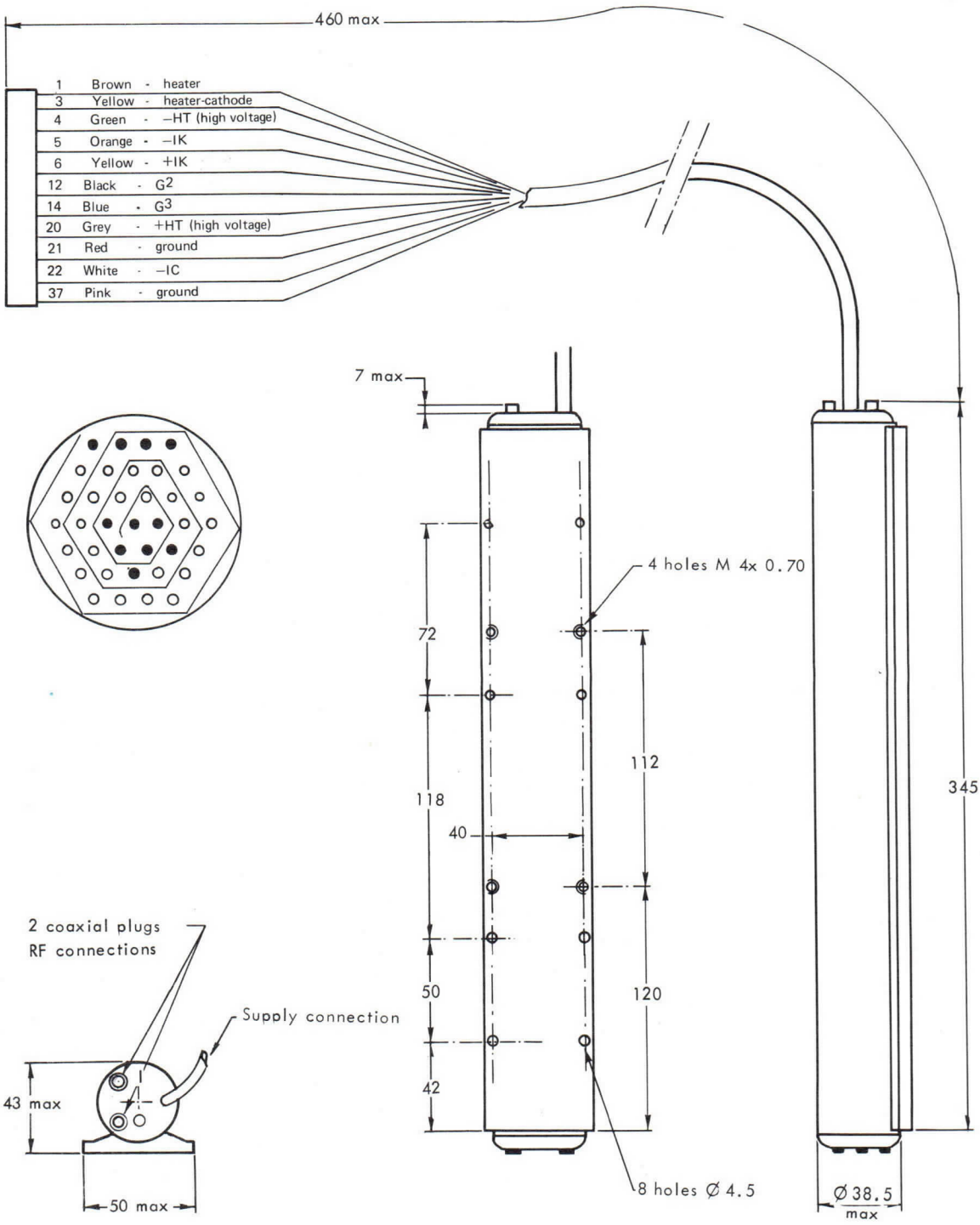




PULSE OPERATION

- The control pulse is applied to G2 through the 470pF capacitor..
- The TWT cut off conditions are G2 and G3 voltage decreased to 0 volt in a constant ratio fixed by R and given by the nominal values.

OUTLINE DRAWING



Dimensions in mm.



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

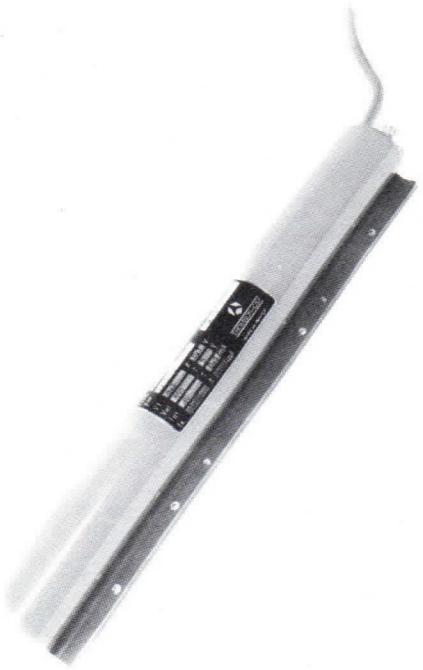
F4026B TRAVELING WAVE TUBE

The F4026B is a wide band, low noise, high gain, traveling wave tube which provides a saturated power output of 10 to 30 mW, from 6.9 to 11.1 GHz.

The typical noise figure is 12 dB and the small signal gain at least 40 dB.

The F4026B features periodic permanent magnet focusing, small size, light weight. Specifically intended for military airborne applications, an all ceramic and metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions.

The F4026B traveling wave tube incorporates a voltage distributing network preset at the factory for optimum combination of noise figure and gain. Furthermore, power supply voltage requirements are reduced to heater voltage and high voltage.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage	-	6.3	-	V
Heater current	0.4	-	0.6	A
High voltage supply	-	1200	-	V
Current supply	3	-	7	mA
Small signal gain (1)	35	-	-	dB
Saturated power output	10	-	30	mW
Insertion loss	70	-	-	dB
Input VSWR (2)	-	-	1.8 : 1	
Output VSWR (2)	-	-	2.0 : 1	
Stray magnetic field at 2 m	-	-	4	γ

(1) For $P_i = -45$ dBm
(2) Tube not supplied.

Mechanical

RF connections	ATI coaxial socket, mini-ultra ref : 2008
Supply connections	DEUTSCH connector RSM 07.12.14.P.A.5205
Operating position	any
Weight	1.5 kg

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater voltage	6. 2	6. 4	V
High voltage supply			
- for the rated performances	1190	1210	V
- for tube life	1100	1300	V
Peak input power (3)	-	1	kW
Average input power	-	0. 1	W
Warm-up time	120	-	s
Ambient temperature	–55	+110	°C
Depression	3	-	bar

(3) with pulse duration ⩽ 50 µs.

TYPICAL OPERATION

Heater voltage			6. 3	V
Heater current			0. 42	A
High voltage supply			1200	V
Current supply			3. 5	mA
Cathode current			510	µA
Collector current			460	µA
Frequency	6. 9	9. 4	11. 1	GHz
Noise figure	12. 3	11. 0	11. 0	dB
Small signal gain (4)	40	43	40	dB
Saturated power output	10	15	10. 5	mW
Input VSWR	1. 30 : 1	1. 40 : 1	1. 70 : 1	
Output VSWR	1. 40 : 1	1. 22 : 1	1. 65 : 1	

(4) For $P_i = -45$ dBm

OPERATING INSTRUCTION

Electro-magnet

The F4026B is focused by an integral periodic permanent magnet. Before applying voltages, check that environmental magnetic field is less than 10 gauss, if not, tube performances are not guaranteed.

Helix grounding

After installation, the tube helix should be connected to ground by means of a DC short or a crystal rectifier.

Application of voltages

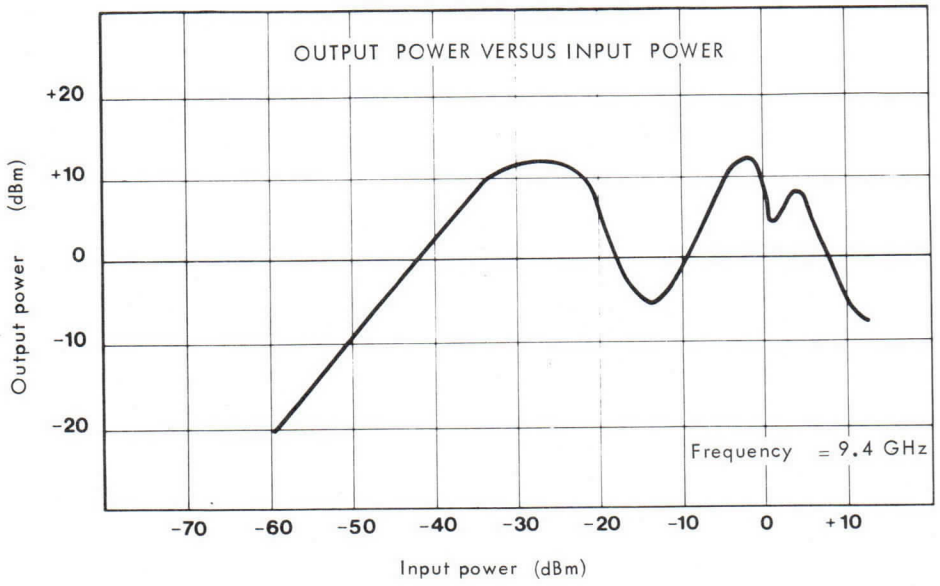
Before applying voltages, check that high voltage and heater voltage delivered by the supply unit are within the specified values indicated on the tube label. The meters used for this control should present an isolation from ground of at least 1500 V and accuracy of at least ± 1 %.

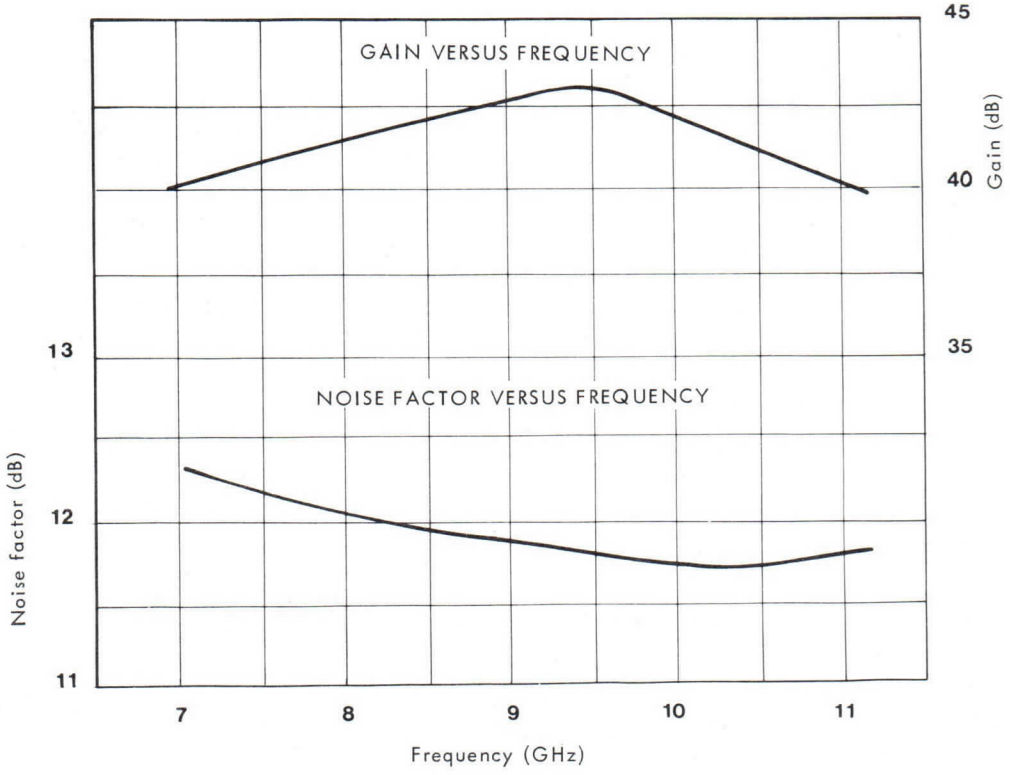
After applying heater voltage wait two minutes before applying the high voltage. A micro-ammeter connected according to the diagramm given page 3 indicates if the tube is operating correctly, with respect to the values specified on the tube label. This metter should feature : full scale deviation : 1000 µA
internal resistance ⩽ 1000 Ω
isolation : 1500 V dc operating voltage.

Input power

The tube helix can be damaged if the input power (peak and average values) exceeds the limits given in the paragraph "Absolute Ratings".

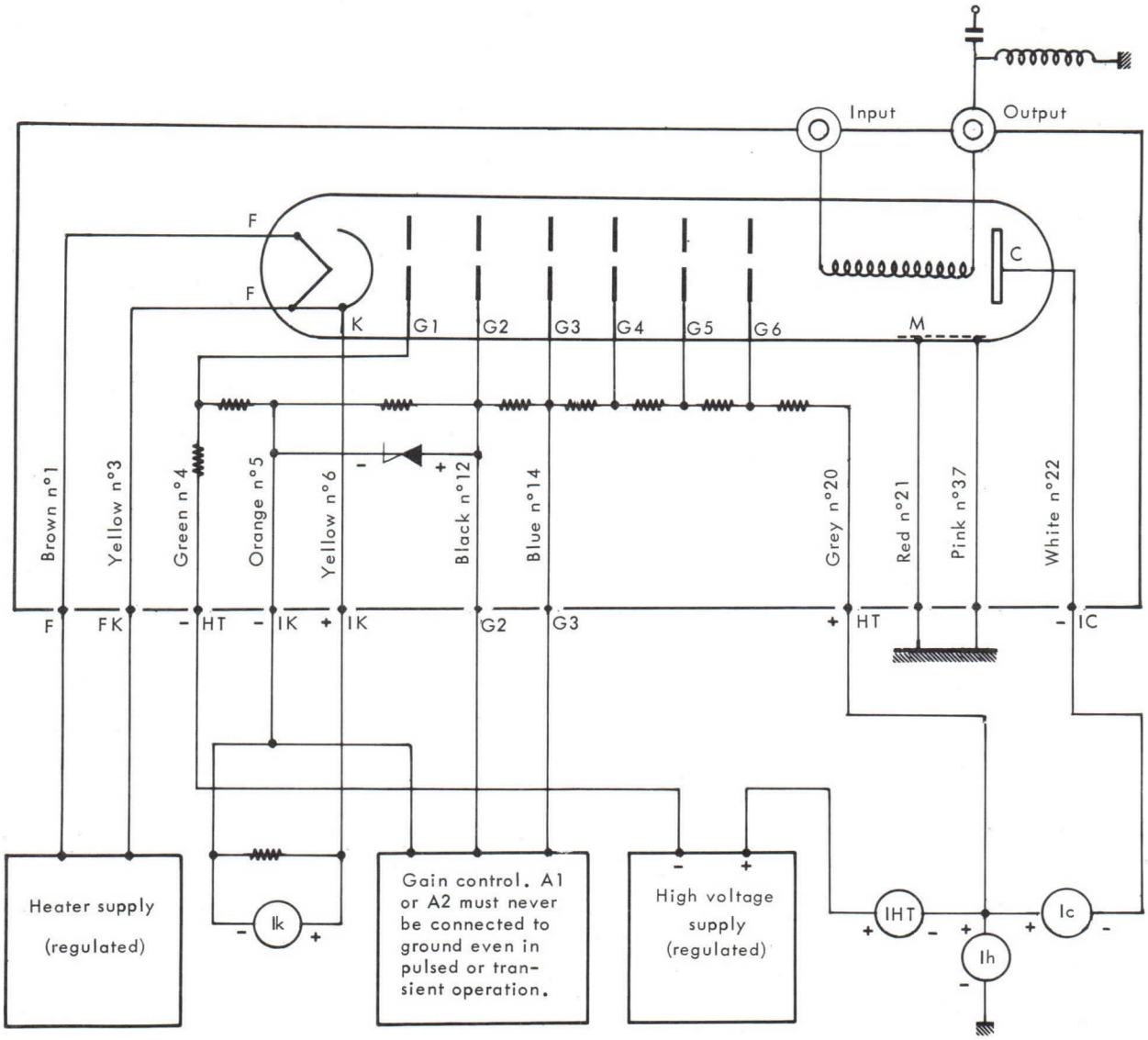
CHARACTERISTIC CURVES

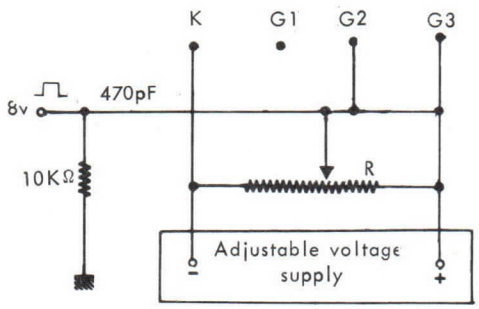




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

SUPPLY DIAGRAM

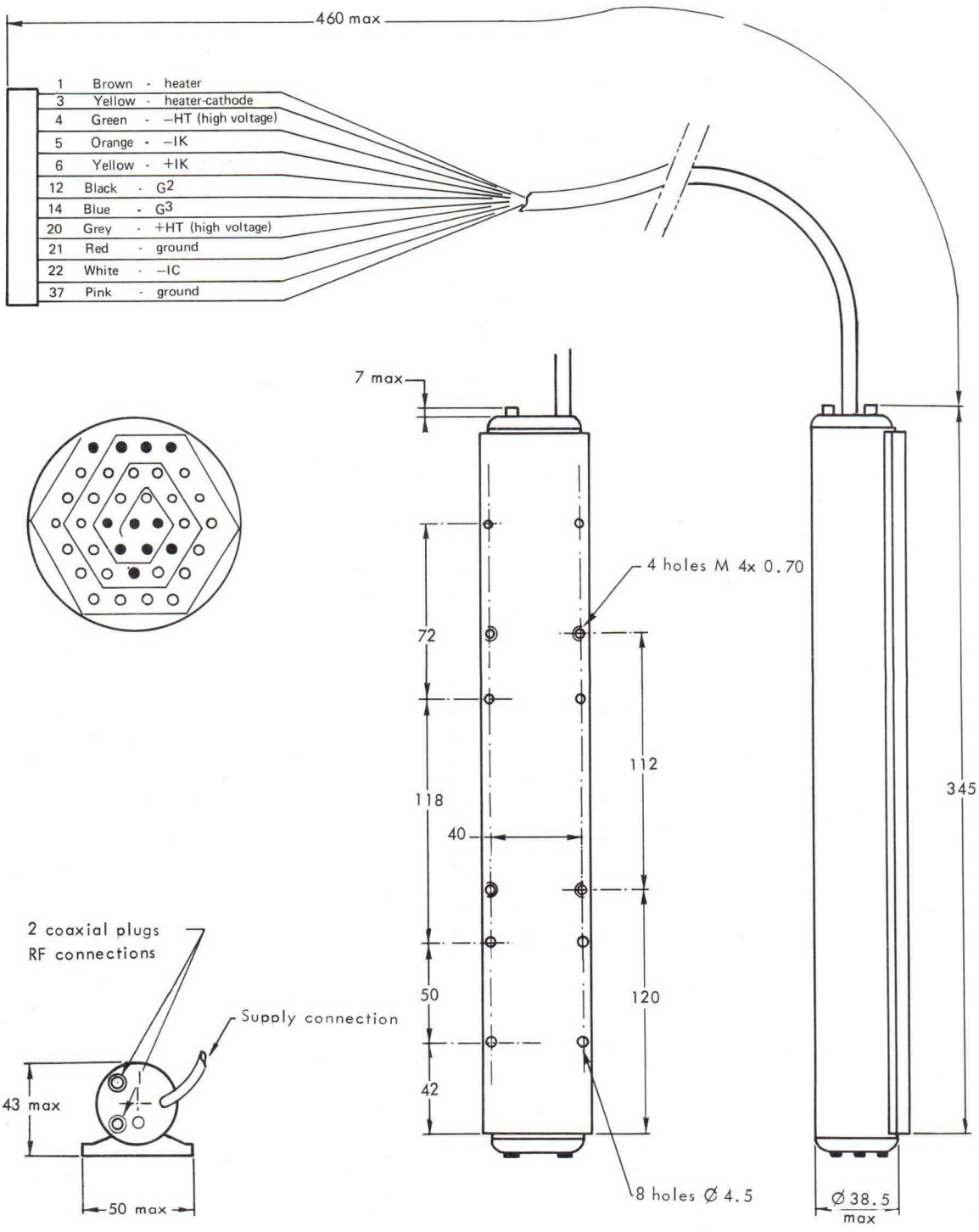




PULSE OPERATION

- The control pulse is applied to G2 through the 470pF capacitor..
- The TWT cut off conditions are G2 and G3 voltage decreased to 0 volt in a constant ratio fixed by R and given by the nominal values.

OUTLINE DRAWING



Dimensions in mm.



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

F4064A
TRAVELING WAVE TUBE



The F4064A is a low noise traveling wave tube amplifier. It delivers a saturated output power of at least 0.08 mW from 1.2 to 1.4 GHz. The nominal gain is 25 dB at small signal level.

The F4064A uses integral permanent magnet focusing and natural conduction and convection cooling.

A voltage divider integral to the tube and preset for optimum noise performance permits operation with only two voltage supplies.

The F4064A finds applications in telecommunication systems.

The AMP.2023 low noise amplifier manufactured by Thomson CSF is provided with the F4064A low noise traveling wave tube. Designed for transportable equipment, focusing with a permanent magnet saves weight and eliminates adjustments. Installation or replacement of the tube are simplified.

The AMP.2023 amplifier features increased ruggedness and reliability. It is particularly suitable in industry or university laboratories use and in all applications where accuracy, stability and low noise are required.

GENERAL CHARACTERISTICS

Electrical

Heater voltage		6.3	V
Heater current		0.3 to 0.6	A
Beam voltage		300	V
Beam current		4.0 to 8.0	mA
Noise figure			
1.2 - 1.4 GHz band	max.	4.5	dB
1.25 - 1.35 GHz band	max.	4.0	dB
Gain, small signal (– 45 dBm)			
1.2 - 1.4 GHz band	min.	25	dB
Saturated power		0.08 to 0.5	mW
Attenuation	min.	50	dB
Input VSWR	max.	1.7 : 1	
Output VSWR	max.	2.0 : 1	

Mechanical

RF connections (input and output)	type "N"
Power supply connector	Jaeger n° 536756
Coupling to type (supplied with the tube)	Jaeger n° 532356
Mounting position	any
Weight	11 kg

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Typical operation

Frequency	1. 20	1. 30	1. 40	GHz
Beam voltage	300	300	300	V
Beam current	70	70	70	μA
Noise figure	4. 0	3. 8	4. 0	dB
Gain, small signal (–45 dBm)	27. 5	28. 5	28. 0	dB
Saturated power	0. 19	0. 17	0. 14	mW
Input VSWR	1. 40 : 1	1. 20 : 1	1. 40	
Output VSWR	1. 35 : 1	1. 10 : 1	1. 40	
Attenuation	55	60	65	dB
Peak power output (1)	-	0. 13	-	mW
Variation of noise figure versus VSWR seen from input connector				
VSWR = 1. 25 : 1	±0. 1	± 0. 1	±0. 08	dB
VSWR = 1. 5 : 1	±0. 2	±0. 15	±0. 13	dB
VSWR = 2. 0 : 1	±0. 3	±0. 25	±0. 22	dB

(1) For a peak drive power of 0. 5 kW

Absolute ratings

	min.	max.	
RF drive power (peak)	-	500	W
RF drive power (average)	-	0. 5	W
Filament voltage	6. 2	6. 4	V
Beam voltage :			
for guaranteed performance	297	303	V
for life of the tube	270	315	V
Warm-up time	3	-	mn
Ambient temperature	–40	+70	°C
Altitude without pressurization	-	3000	m

OPERATING INSTRUCTIONS

FOCUSING

Disturbance of the magnetic field by external means may seriously affect tube performance (gain and noise figure) without change on the cathode current, and in extreme cases, may destroy the tube. All wrenches and screw-drivers used to mount the tube must be non-magnetic. Magnetic materials (such as permanent magnets, transformers, etc..) should be kept away from the tube. In case of such a failure, the tube should be returned to the factory for a check-up.

POWER SUPPLIES

Heater and beam voltage should be checked to ensure they have proper stabilization. Supplies must be isolated from ground by at least 500 Vdc.

SECURITY DEVICES

An interlock should prevent the application of beam voltage before the heater voltage has been applied for a least 3 minutes.

A meter is necessary to adjust the cathode current to the value specified on the Test Data Sheet provided with each tube. This microammeter should present the following characteristics :

Full scale deviation	100	μA	
Internal resistance	1000	Ω	max.
Insulation	500	V	d c

DRIVE POWER

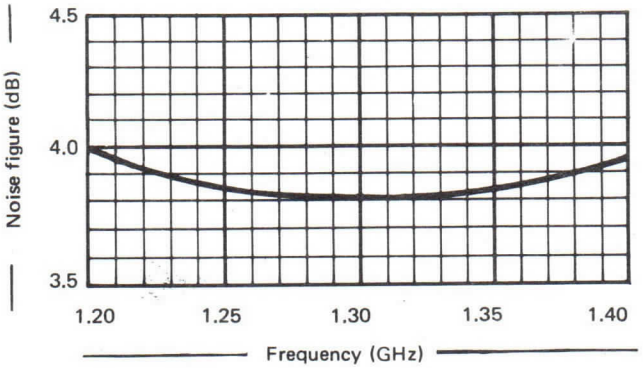
The TWT helix could be damaged by an excess of either peak or average drive power and it is important to keep the latter within ratings.

INPUT VSWR

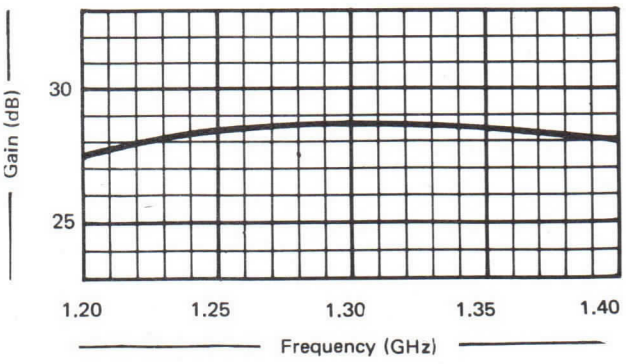
In case the input VSWR should exceed 1. 5 : 1 a low loss circulator could be inserted to limit the noise figure increase.

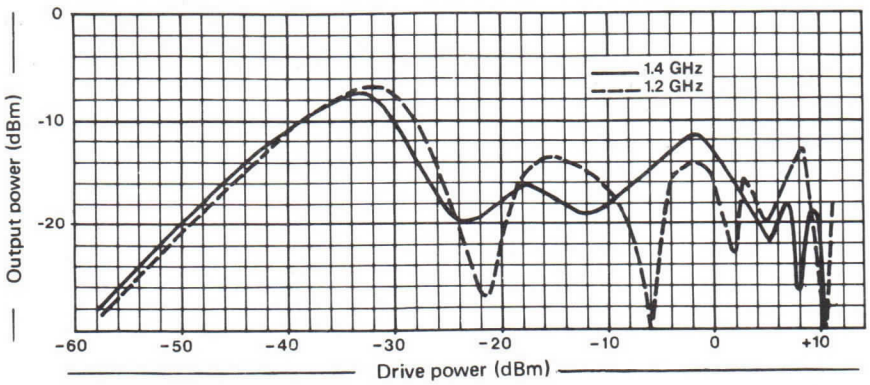
TYPICAL CHARACTERISTICS

Noise figure



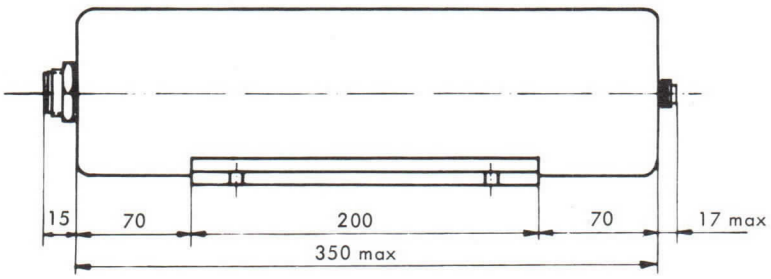
Gain

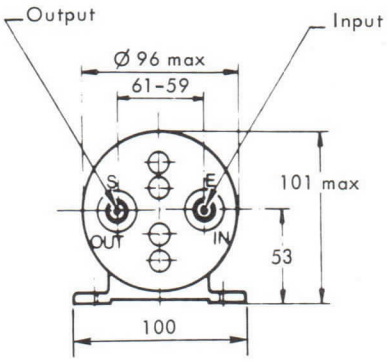


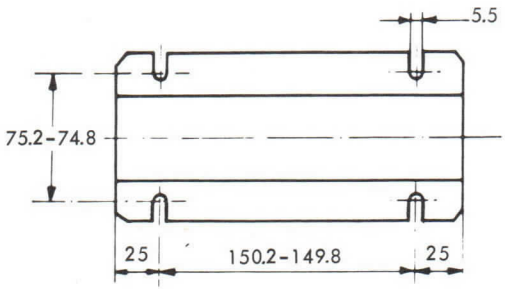


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



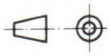






1 - Heater
2 + Heater
4 + HT
3 - HT
3 - Microammeter
5 + Microammeter
6 Ground

Dimensions in mm



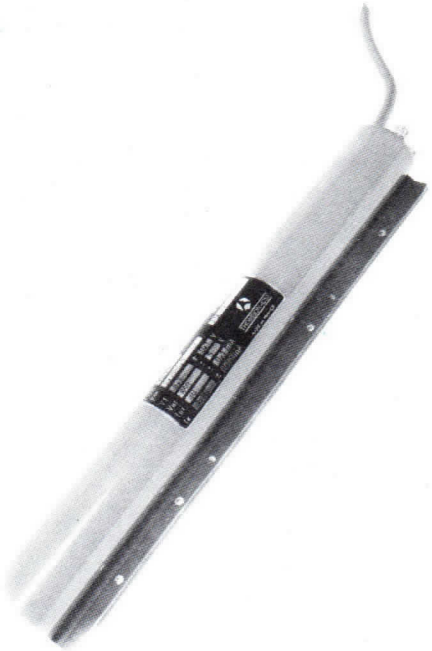
F4156 TRAVELING WAVE TUBE

The F4156 is a wide band, low noise, high gain, traveling wave tube which provides a saturated power output of 0.6 to 20 mW, from 11 to 18 GHz.

The typical noise figure is 14 dB and the small signal gain at least 39 dB.

The F4156 features periodic permanent magnet focusing, small size, light weight. Specifically intended for military airborne applications, an all ceramic and metal construction makes it highly rugged and ensures satisfactory operation under the most severe environmental conditions.

The F4156 traveling wave tube incorporates a voltage distributing network preset at the factory for optimum combination of noise figure and gain. Furthermore, power supply voltage requirements are reduced to heater voltage and high voltage.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage	-	6.3	-	V
Heater current	0.3	-	0.8	A
High voltage supply	-	1500	-	V
Current supply	3.5	-	-	mA
Small signal gain (1)	0.6	-	20	dB
Insertion loss	70	-	-	dB
Input VSWR (2)	-	-	2 : 1	
Output VSWR (2)	-	-	2.2 : 1	
Stray magnetic field at 2 m	-	-	4	γ

(1) For $P_i = -45$ dBm
(2) Tube not supplied.

Mechanical

RF connections	ATI coaxial socket, mini-ultra ref : 2008
Supply connections	DEUTSCH connector RSM 07.12.14.P.A.5205
Operating position	any
Weight	1.5 kg

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater voltage	6. 2	6. 4	V
High voltage supply			
- for the rated performances	1490	1510	V
- for tube life	1400	1600	V
Peak input power (3)	-	1	kW
Average input power	-	0. 1	W
Warm-up time	120	-	s
Ambient temperature	−55	+110	°C
Depression	3	-	bar

(3) with pulse duration ⩽ 50 µs.

TYPICAL OPERATION

Heater voltage			6. 3	V
Heater current			0. 42	A
High voltage supply			1500	V
Current supply			3	mA
Cathode current			430	µA
Collector current			420	µA
Frequency	11	15	18	GHz
Noise figure	15. 3	13. 2	13. 2	dB
Small signal gain (4)	38	40	36	dB
Saturated power output	12	5. 4	1. 4	mW
Input VSWR	1. 4 : 1	1. 3 : 1	1. 8 : 1	
Output VSWR	1. 4 : 1	1. 6 : 1	2. 0 : 1	

(4) For $P_i = -45$ dBm

OPERATING INSTRUCTION

Electro-magnet

The F4156 is focused by an integral periodic permanent magnet. Before applying voltages, check that environmental magnetic field is less than 10 gauss, if not, tube performances are not guaranteed.

Helix grouding

After installation, the tube helix should be connected to ground by means of a DC short or a crystal rectifier.

Application of voltages

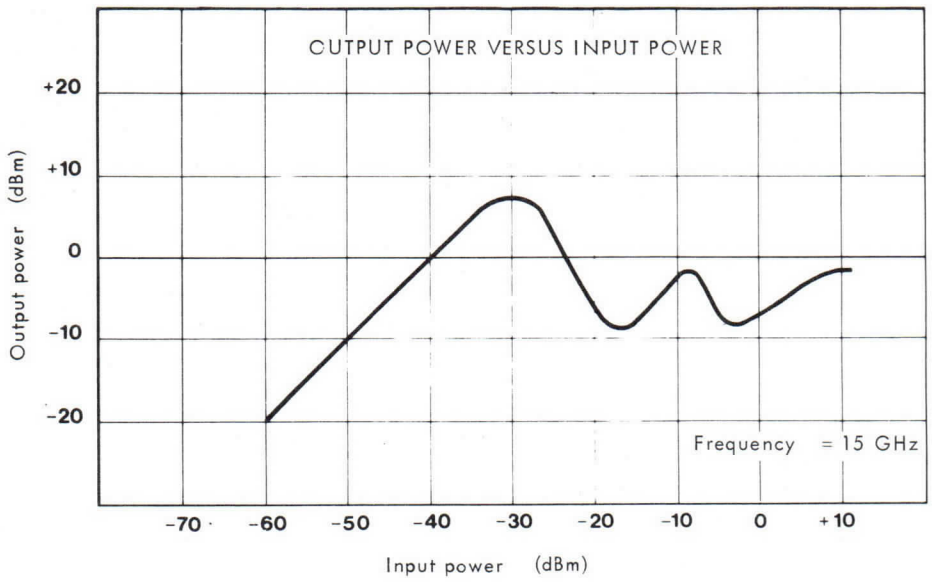
Before applying voltages, check that high voltage and heater voltage delivered by the supply unit are within the specified values indicated on the tube label. The meters used for this control should present an isolation from ground of at least 2000 V and accuracy of at least ± 1 %.

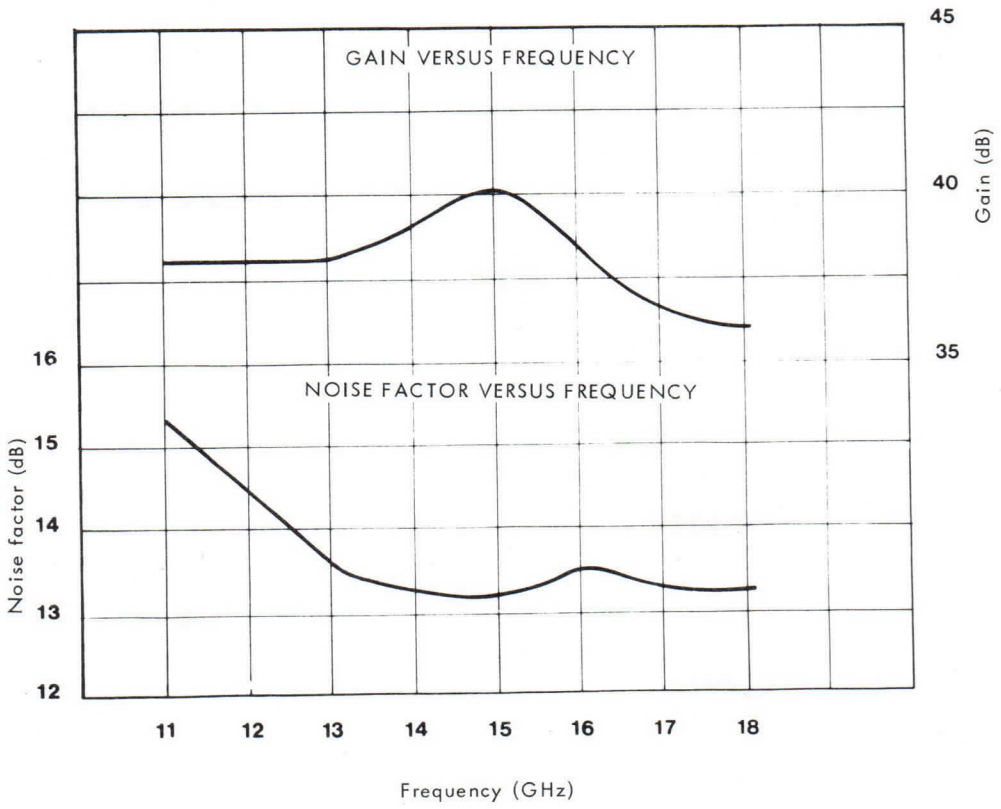
After applying heater voltage wait two minutes before applying the high voltage. A micro-ammeter connected according to the diagramm given page 3 indicates if the tube is operating correctly, with respect to the values specified on the tube label. This meter should feature : full scale deviation : 1000 µA-internal resistance ⩽ 1000 Ω - isolation : 2000 V dc operating voltage.

Input power

The tube helix can be damaged if the input power (peak and average values) exceeds the limits given in the paragraph "Absolute Ratings".

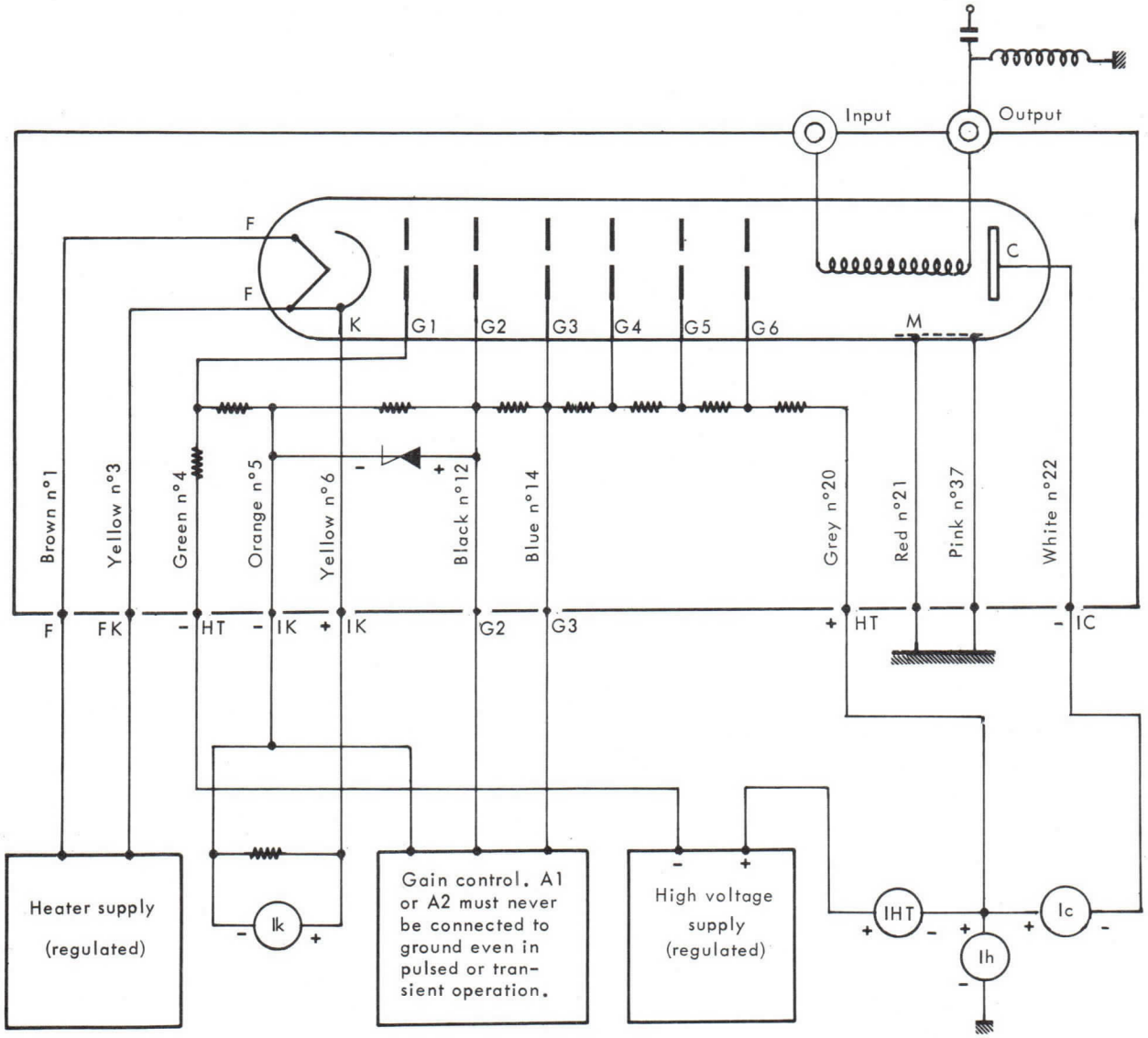
CHARACTERISTIC CURVES

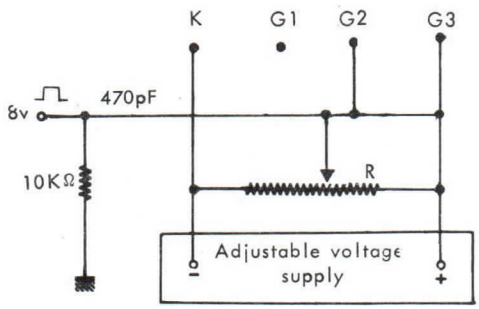




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

SUPPLY DIAGRAM

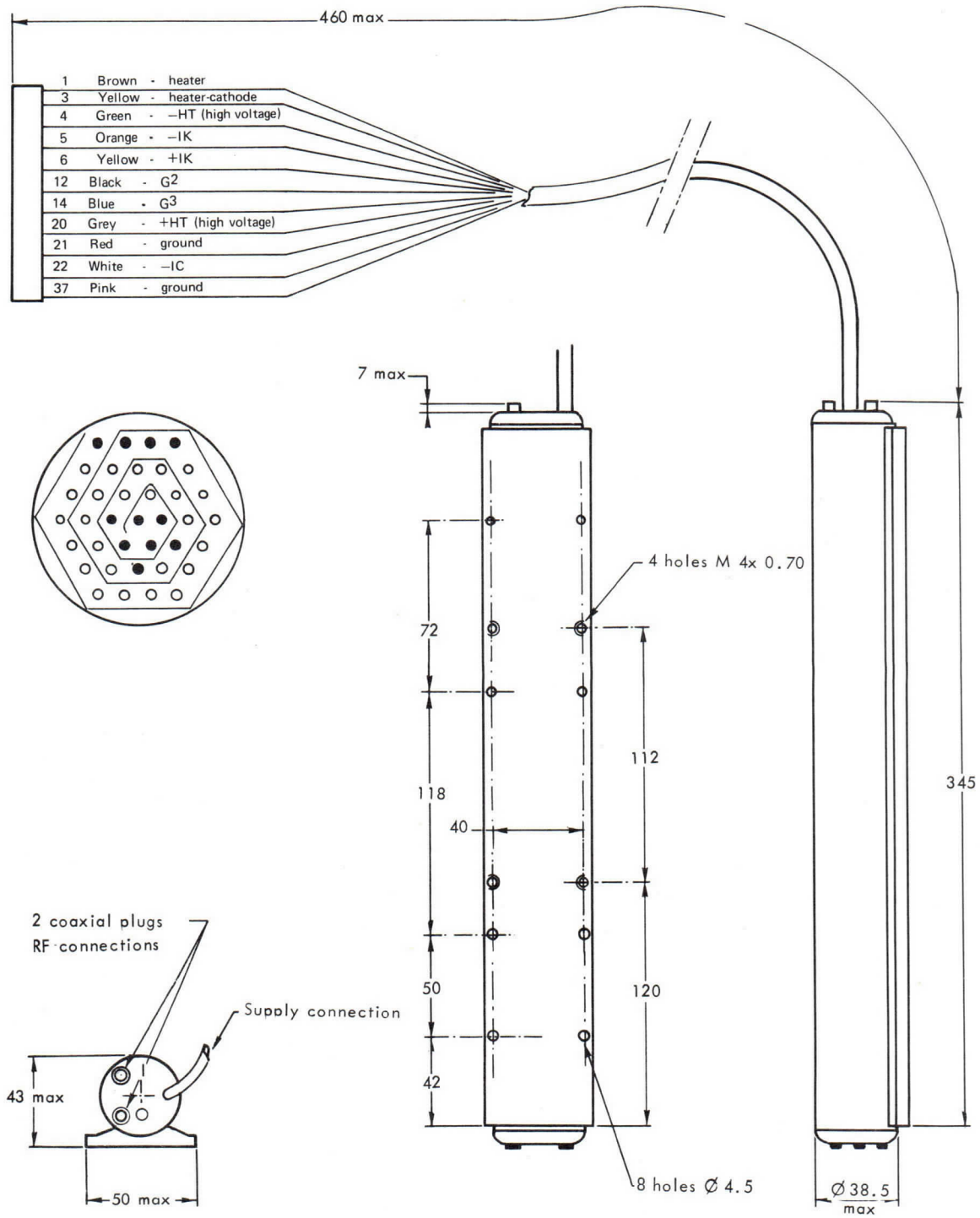




PULSE OPERATION

- The control pulse is applied to G2 through the 470pF capacitor..
- The TWT cut off conditions are G2 and G3 voltage decreased to 0 volt in a constant ratio fixed by R and given by the nominal values.

OUTLINE DRAWING



Dimensions in mm.



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

F4181

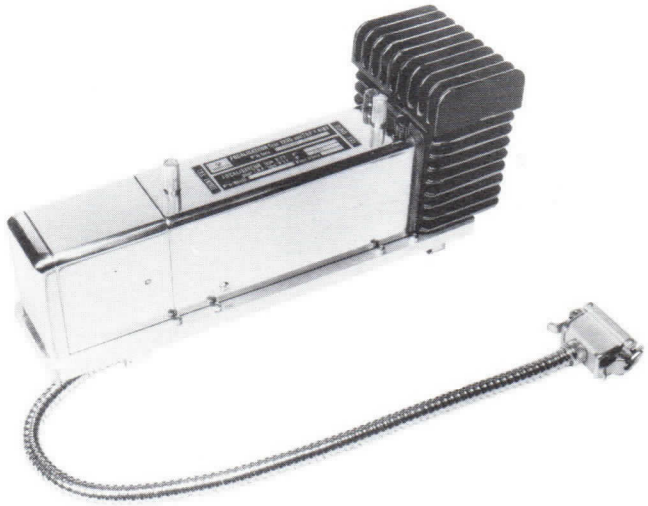
TRAVELING WAVE TUBE

The F4181 traveling wave tube is a medium power amplifier for radio link communications systems. This tube delivers at least 16 W from 5925 to 6425 MHz, with a gain greater than 37 dB. The saturated output power is more than 25 W.

Depressed collector operation reduces power consumption.

The tube and its permanent magnet are cooled by conduction and may be used either in horizontal or vertical position.

The F4181 is easily interchangeable in the permanent magnet (FOC.1235) ; the tube should be inserted in the magnet and properly centered with respect to the positioning marks. When electrical connections are made, final alignment is provided by means of 2 knobs, to obtain correct focusing. This mechanical adjustment optimizes the collector position in the magnet. Furthermore, the F4181 allows optimization of input and output VSWR.



GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Frequency	5.925	6.425	GHz
Heater voltage	6.2	6.4	V
Heater current	0.8	1.1	A
Output power, saturation	25	—	W
Gain	37	42	dB
Helix voltage	3.55	3.85	kV
Helix current	—	2	mA
Anode voltage	—	1.80	kV
Anode current	−0.5	+0.5	mA
Collector voltage	2.20	2.40	kV
Noise factor	—	30	dB

(1) All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	horizontal or vertical
Weight (approx.)	8 kg
RF connections	UG 344/U flanges
Supply connections	Souriau plug ref. 8540-400-261
Cooling	conduction

ABSOLUTE RATINGS

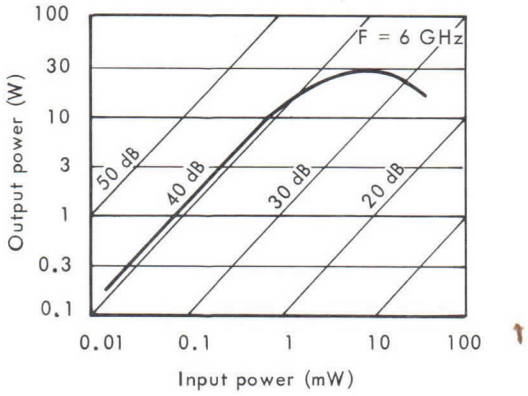
(non simultaneous values)

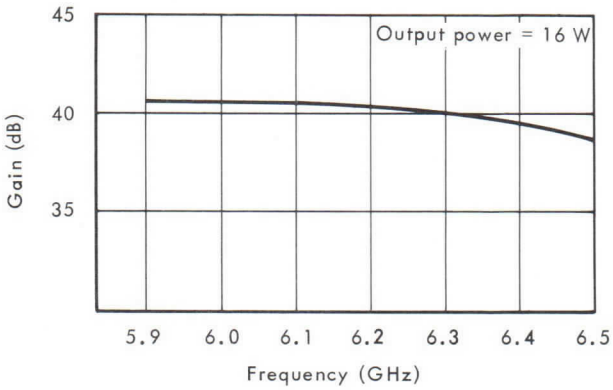
	min.	max.	
Heater voltage	6. 0	6. 6	V
Heater surge current	–	2. 0	A
Warm-up time	–	3	mn
Ambient temperature	–10	+50	°C
Helix voltage	3. 5	4. 0	kV
Helix current	–	3	mA
Anode voltage	–	2. 0	kV
Anode current	–1	+1	mA
Collector voltage	2. 0	2. 5	kV
Collector current	–	60	mA
Collector dissipation	–	130	W
Drive power	–	10	mW
Output power	–	30	W
Load VSWR	–	2: 1	

TYPICAL OPERATION

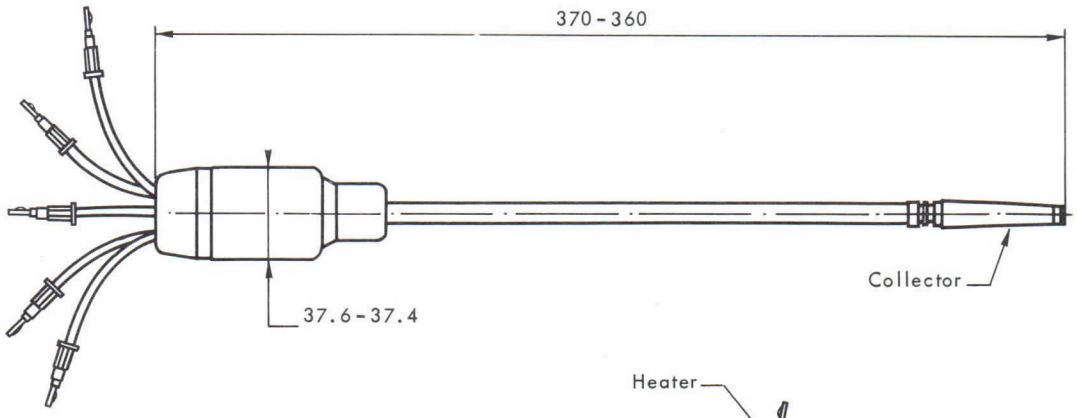
Frequency	6	GHz
Heater voltage	6. 3	V
Heater current	0. 95	A
Drive power	1. 6	mW
Output power	16	W
Gain	40	dB
Helix voltage	3. 60	kV
Helix current	0. 6	mA
Anode voltage	1. 55	kV
Anode current	0	mA
Collector voltage	2. 30	kV
Collector current	50	mA

CHARACTERISTIC CURVES

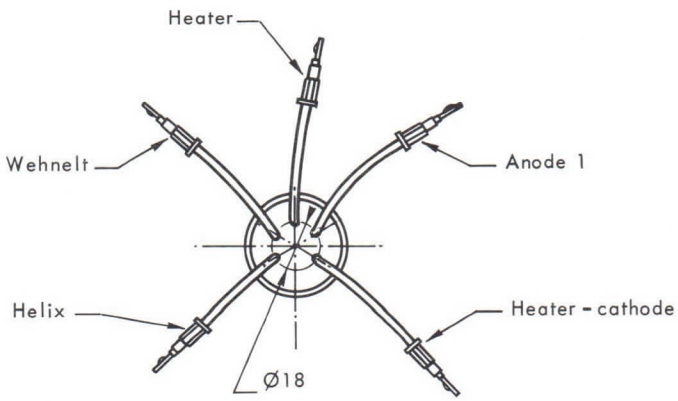




OUTLINE DRAWING

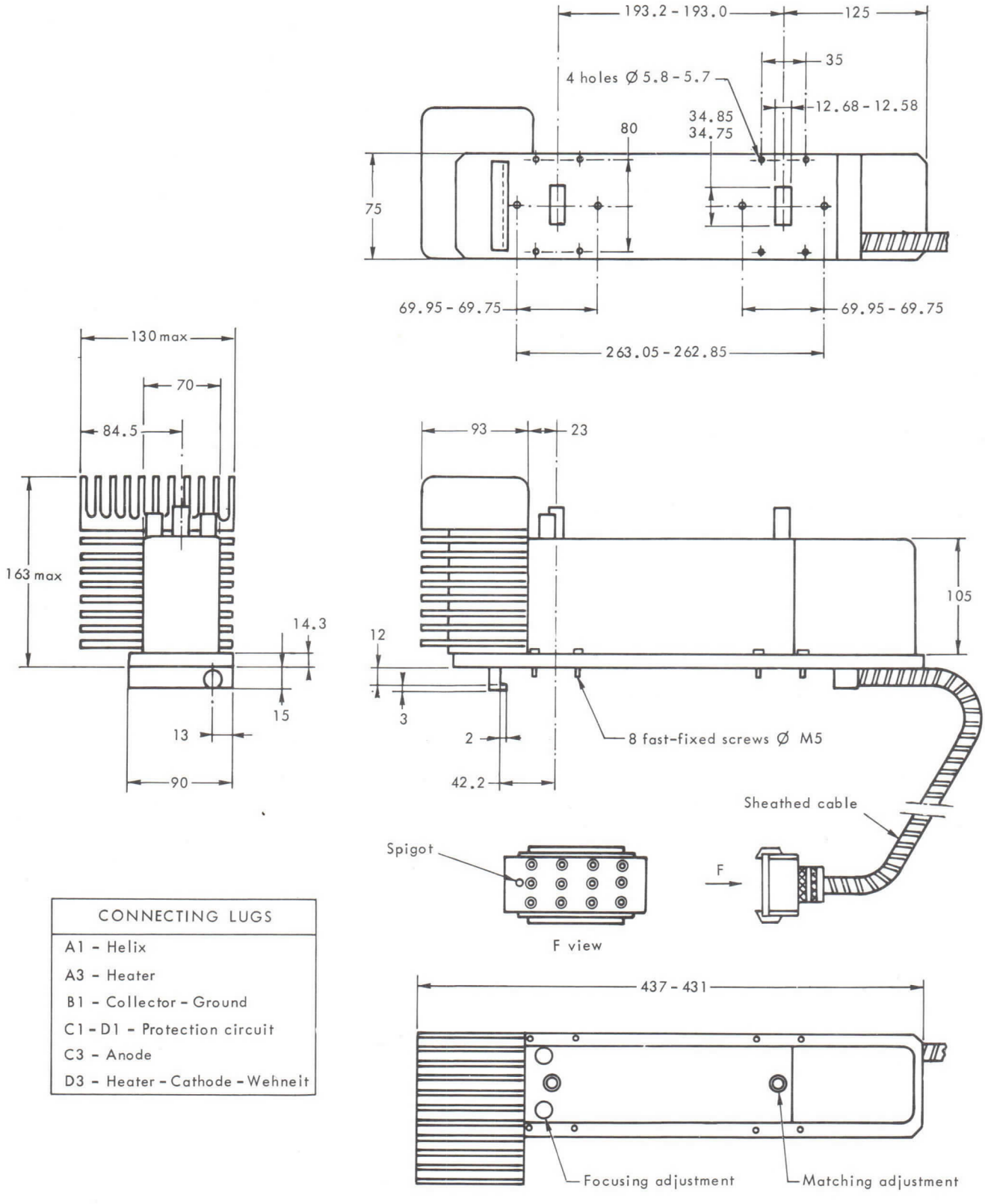


Lead connections	
Brown	Heater
Yellow	Heater-cathode
Blue	Anode
Green	Wehnelt
Orange	Helix



THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

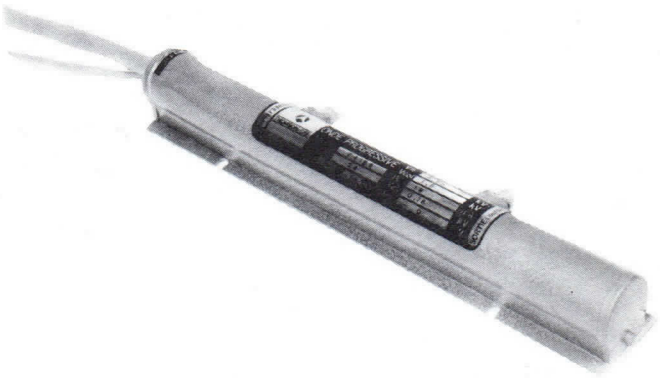


CONNECTING LUGS
A1 - Helix
A3 - Heater
B1 - Collector - Ground
C1 - D1 - Protection circuit
C3 - Anode
D3 - Heater - Cathode - Wehneit

Dimensions in mm.

F4185 TRAVELING WAVE TUBE

The F4185 traveling wave tube is a broadband amplifier capable of providing a minimum saturated output power of 4 W from 8.0 to 14.0 GHz. The saturation gain is more than 40 dB. Integral periodic permanent focusing reduces the stray magnetic field and saves weight.



The F4185 is cooled by natural convection and conduction. Because of its small size, light weight, and sturdy construction this tube is especially attractive for transportable and airborne equipments.

The AMP.2078A amplifier, fitted with the F4185 traveling wave tube is ideal for laboratory measurements, wideband amplification for radars and communications, antenna pattern measurements etc.. This amplifier incorporates a power supply, a F4185 traveling wave tube with its permanent magnet, a modulating circuit and security devices.

A TWTA is available including F4185 with its integral power supply :

The BFA.1209 is a small, light weight, compact, adjustment free microwave amplifier fitted with the F4185 intended for airborne and transportable equipments, radio links and space communications. (see Data Sheet TEH 4068)

GENERAL CHARACTERISTICS

Electrical

Frequency		8.0 to 14.0	GHz
Heater voltage		6.3	V
Heater current		0.3 to 0.6	A
Output power		4	W
Gain for an output power of 4 W	min.	40	dB
Helix voltage		2.4 to 2.8	kV
Helix current	max.	2.0	mA
Anode voltage		0.5 to 1.0	kV
Anode current	max.	1.0	mA
Collector voltage		1.2 to 1.6	kV
Cathode current	max.	25	mA

(1) All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Mechanical

Operating position	any
Weight (approx.)	600 g
Rf connections	coaxial plugs OSM 202 (omni spectra)
Supply connections	flexible leads
Cooling	conduction

Absolute ratings

(non simultaneous values)

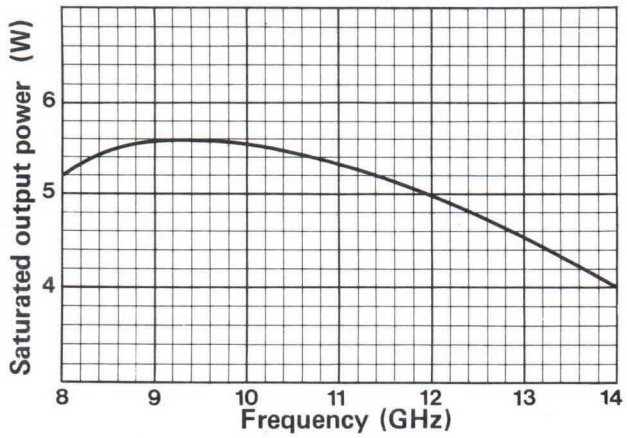
		min.	max.	
Heater voltage		6. 0	6. 6	V
Heater surge current		–	1. 2	A
Warm-up time		3	–	mm
Ambient temperature			100	°C
Vibrations			1 mm between 10 to 50	Hz
			10 g between 50 to 2000	Hz
Shocks			100 g –11 ms	
Helix voltage (1)	nominal voltage	– 200	+ 200	V
Helix current		–	2. 5	mA
Anode voltage(1)	nominal voltage		+ 200	V
Anode current			2. 0	mA
Collector voltage(1)	nominal voltage	– 200	+ 200	V
Cathode current			28	mA
Load VSWR		–	3 :1	

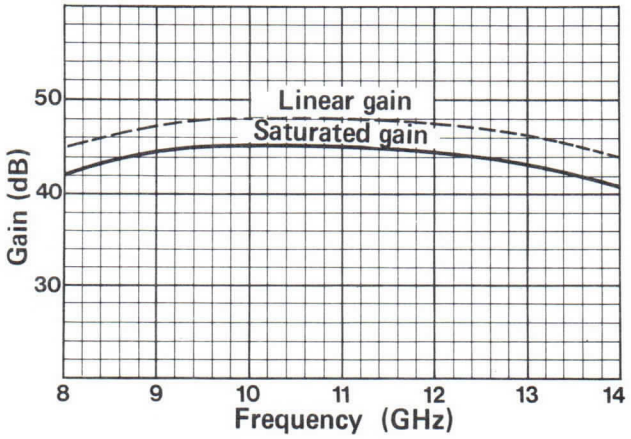
Typical operation

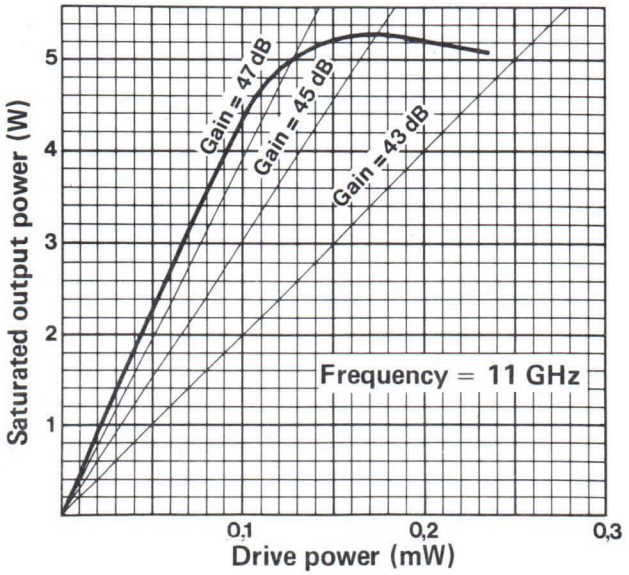
Frequency	11	GHz
Heater voltage	6. 3	V
Heater current	0. 48	mA
Drive power	0. 15	mW
Output power	5.2	W
Gain	45	dB
Helix voltage	2. 55	kV
Helix current	0. 30	mA
Anode voltage	0. 8	kV
Anode current	0	
Cathode current	23	mA
Collector voltage	1. 5	kV

(1) The nominal operating value is indicated on the label and on the test Data Sheet of each tube.

Typical characteristics

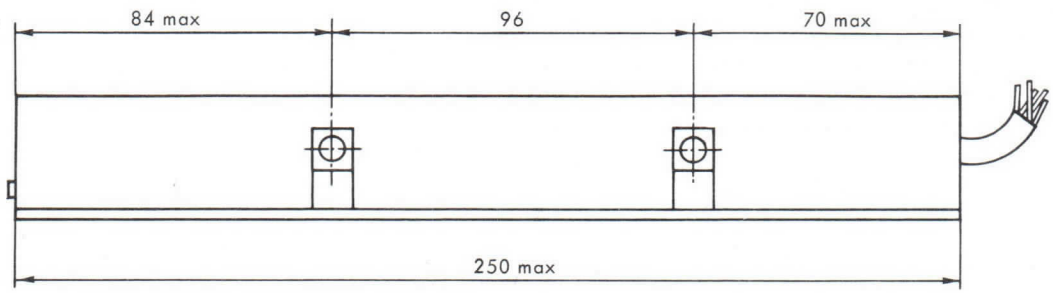


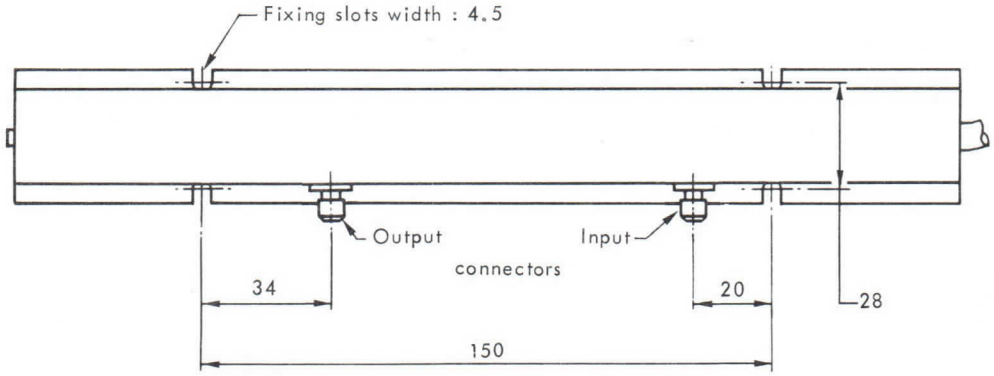


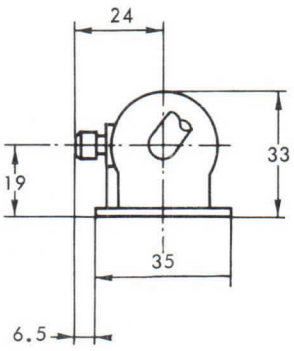


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING







Connections	
Brown	Heater-cathode
Yellow	Cathode
Green	Wehnelt
Blue	Anode
Red	Collector
Orange	Ground-helix

Dimensions in mm.

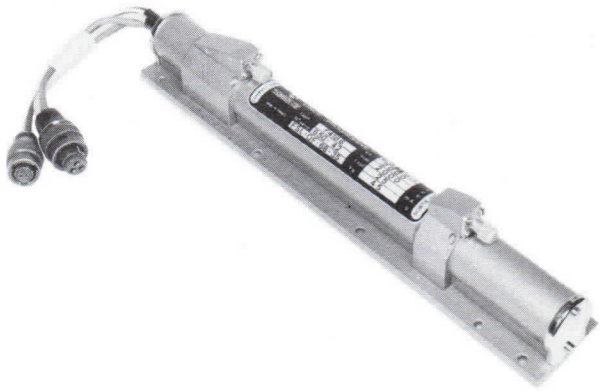
F4186
TRAVELING WAVE TUBE

The F4186 is a wideband, high gain, traveling wave tube amplifier, specially designed for counter-measures systems.

The saturation output power is about 2 to 3 W, and the gain is at least 50 dB.

This tube has a control grid which permits easy modulation, furthermore, the helix is isolated from ground, which simplifies serrodyne operation.

Periodic permanent magnet focusing reduces size and weight. The tube and magnet are cooled by conduction.



GENERAL CHARACTERISTICS

Electrical

	min.	max.	
Frequency	5	11	GHz
Heater voltage	—	6.3 —	V
Heater current	0.8	1.0	A
Output power, saturation	2.0	—	W
Gain	50	—	dB
Noise factor	—	30	dB
Grid voltage (2)	— 100	+ 60	V
Helix voltage	1.90	2.10	kV
Helix current	—	4	mA
Serrodyne voltage	— 150	+ 150	V
Grid current	—	5	mA
Collector voltage	1.90	2.10	kV
Collector current	—	30	mA

(1) - All voltages are referred to the cathode.

(2) - The grid should always be in cut-off condition when the high voltage is not applied.

Mechanical

Operating position	any
Weight (approx.)	800 g
RF connections	coaxial plugs, OSM 202
Supply connections	flexible leads
Cooling	conduction

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous values)

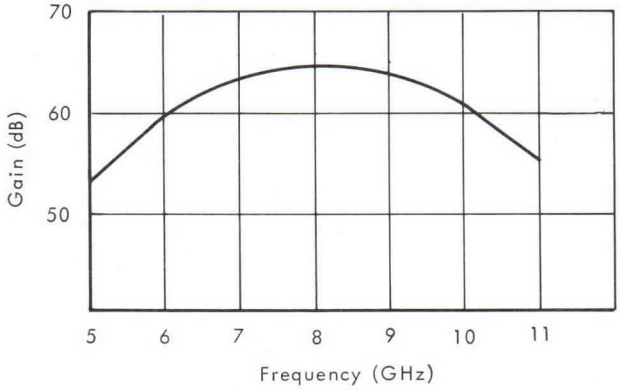
	min.	max.	
Heater voltage	6. 0	6. 6	V
Heater surge current	–	2. 0	A
Warm-up time	90	–	s
Ambient temperature	– 40	+100	°C
Vibrations	1 mm between 10 to 50		Hz
	10 g between 50 to 2000		Hz
Shocks		100 g – 11	ms
Helix voltage	1. 75	2. 25	kV
Helix current (1)	–	5	mA
Grid voltage	– 150	+ 70	V
Grid current	–	6	mA
Collector voltage	1. 80	2. 20	kV
Cathode current	–	40	mA
Serrodyne voltage	– 175	+175	V
Drive power	–	1	mW
Altitude without pressurization		25 000	m
Load VSWR	–	3 : 1	

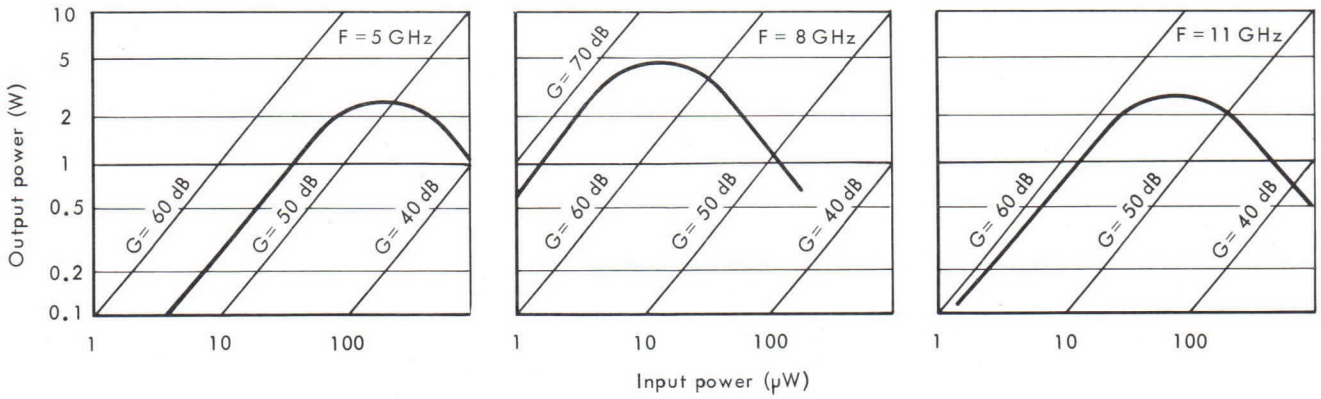
(1) - Overcurrent interlock should be provided to remove helix, collector and grid voltages if the helix current exceeds 5 mA.

TYPICAL OPERATION

Frequency	8	GHz
Heater voltage	6. 3	V
Heater current	0. 95	A
Drive power	1. 1	µW
Output power	3. 5	W
Gain	6. 5	dB
Helix voltage	1. 98	kV
Helix current	1	mA
Grid voltage	40	V
Grid current	3	mA
Collector voltage	1. 98	kV
Collector current	25	mA

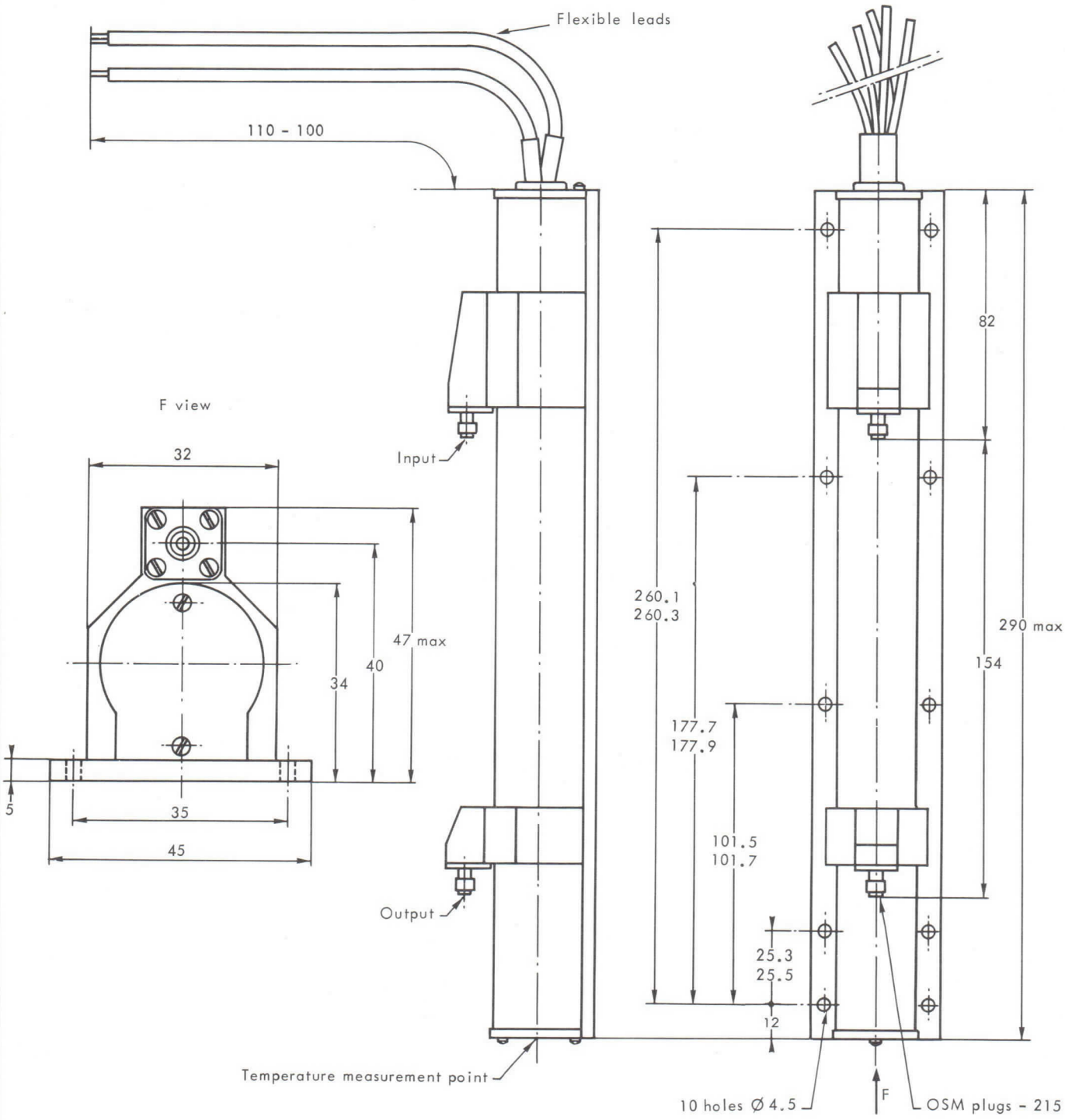
CHARACTERISTIC CURVES





THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



Dimensions in mm.

F4189

TRAVELING WAVE TUBE



The F4189 traveling wave tube is a broadband amplifier capable of providing a minimum saturated output power of 10 W from 1. 3 to 2. 1 GHz. The saturation gain is more than 30 dB and the small signal gain is more than 35 dB.

Integral periodic permanent magnet focusing reduces the stray magnetic field and saves weight.

The F4189 is cooled by forced air. Because of its small size, light weight and rugged construction, this tube is ideal for use in mobile radio link communications systems.

The AMP.2070 amplifier, fitted with the F4189 traveling wave tube is ideal for laboratory measurements, wideband amplification for radars and communications, antenna pattern measurements etc... This amplifier incorporates a power supply, a F4189 traveling wave tube with its permanent magnet, a modulating circuit and security devices.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Frequency	1. 3		2. 1	GHz
Heater voltage		6. 3		V
Heater current	1. 1		1. 5	A
Output power	10			W
Gain saturation	30			dB
Gain small	35			dB
Helix voltage	1. 2		1. 6	kV
Helix current			5	mA
Anode voltage	0. 8		1. 5	kV
Anode current	−1		+3	mA
Collector voltage	1. 2		1. 6	kV
Cathode current			55	mA

(1) - All voltages are referred to the cathode.

Mechanical

Operating position	any
Weight (approx.)	1. 7 kg
RF connections	coaxial N type, UG 58 A/U
Supply connections	flexible leads
Cooling	forced air, 400 1/mn

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Heater voltage	6.0	6.6	V
Heater surge current	–	3.0	A
Warm-up time (1)	3	–	mn
Ambient temperature	–	60	°C
Vibrations	–	0.5 mm from 10 to 55	Hz
		0.05 mm from 55 to 100	Hz
Shocks		40 g – 6 ms	
Helix voltage (2) ..... nominal voltage.	– 200	+ 200	V
Helix current	–	5.5	mA
Anode voltage (2) ..... nominal voltage	–	+ 200	V
Anode current		3	mA
Collector voltage (2) ..... nominal voltage	– 200	+ 200	V
Cathode current	–	57	mA
Collector dissipation	–	100	W
Drive power	–	100	mW
Pressure	0.6	2	bar(3)
Load VSWR	–	2:1	

(1) - Not necessary if the supply is shut off for less than 5 seconds.

(2)- Indicated on the Test Data Sheet of each tube.

(3) - 1 bar = approx. 15 psi.

TYPICAL OPERATION

Frequency	1.7	GHz
Heater voltage	6.3	V
Heater current	1.25	A
Drive power	7	mW
Output power saturation	11.5	W
Gain saturation	32	dB
Helix voltage	1.48	kV
Helix current	0.9	mA
Anode voltage	1.02	kV
Anode current	0	mA
Cathode current	46	mA
Collector voltage	1.48	kV
Collector current	45	mA

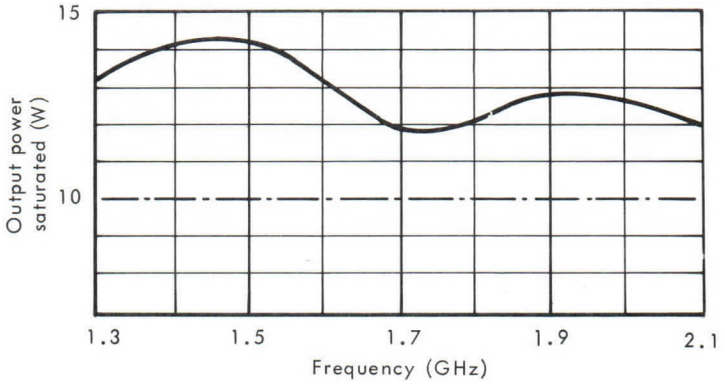
OPERATING INSTRUCTIONS

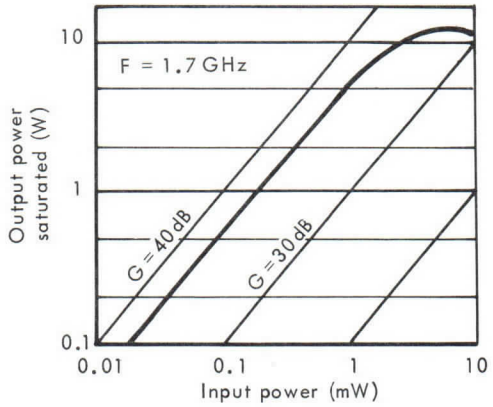
Application of voltages

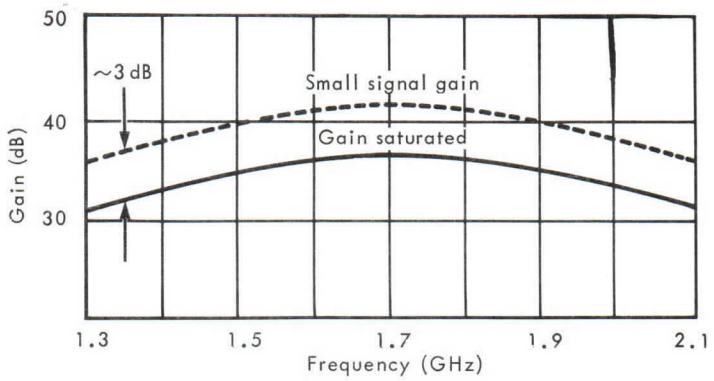
Voltages should be applied in the following order :

- Heater, allow three minutes for cathode warm-up.
- Grid,
- Helix,
- Collector,
- Anode, (Anode voltage should not be applied if other voltages are not applied or if the thermal safety relay is open).

CHARACTERISTIC CURVES

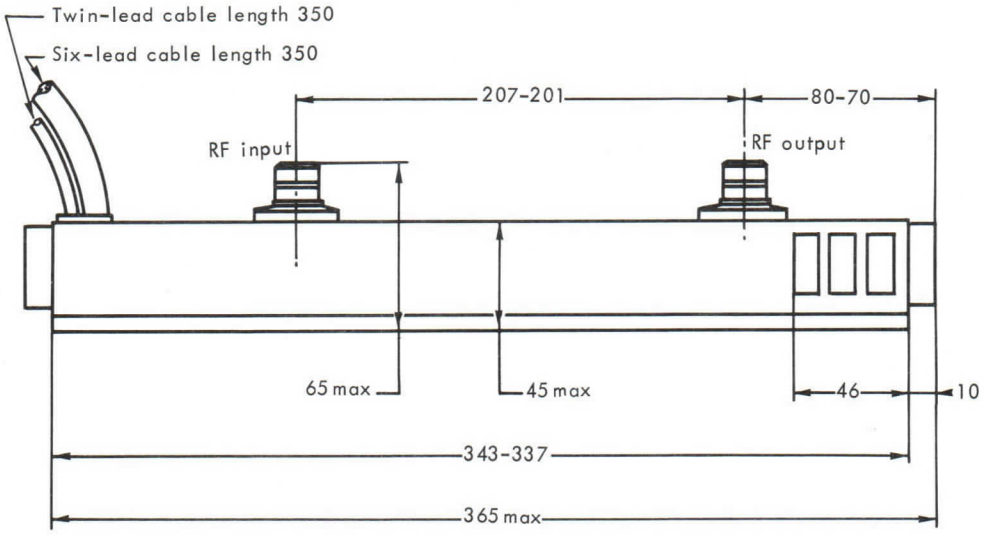


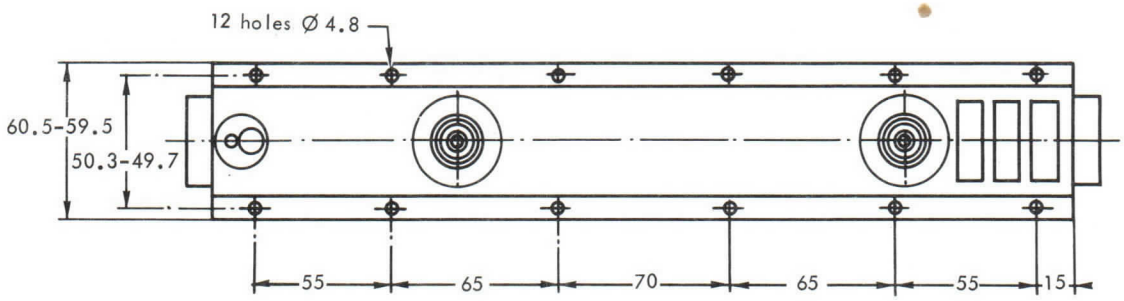




THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





CONNECTIONS	
Blue	Anode
Orange	Helix
Red	Collector-ground
Brown	Heater
Yellow	Heater-cathode
Green	Wehnelt
White	Protection circuit
Grey	Protection circuit

Dimensions in mm.

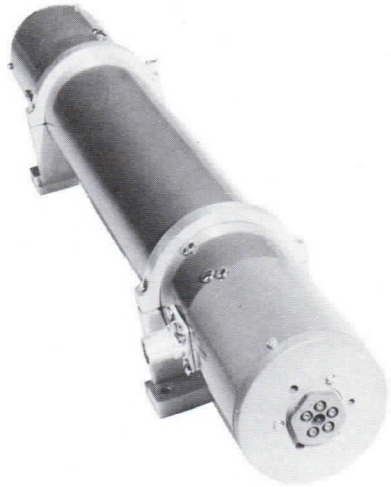
T.O.P 8232

Le tube 8232 est un amplificateur du type à onde progressive utilisable dans la bande 2,7 à 3,6 GHz.

Il fonctionne en régime d'impulsions et fournit une puissance de 5 kW crête dans les conditions de saturation. C'est un amplificateur caractérisé par une large bande (environ 900 MHz) couverte sans modification de réglages électriques ou mécaniques.

Outre cet avantage, il faut ajouter :

- la focalisation par aimants permanents qui évite l'utilisation d'une source d'alimentation pour les bobines de focalisation.
- la modulation en impulsions avec une faible puissance de commande grâce à l'emploi d'une grille de commande.
- le refroidissement par air forcé qui permet l'emploi de ce tube dans des équipements compacts avec le minimum de servitude.



CARACTERISTIQUES GENERALES

Electriques

	min.	moy.	max.	
Gamme de fréquence	2,7	-	3,6	GHz
Tension continue de faisceau	13	-	15	kV
Courant crête de faisceau	-	-	4	A
Tension de chauffage (alternative ou continue)	-	7,5	-	V
Courant de chauffage	1,75	-	2,25	A
Puissance de sortie	5	-	-	kW
Capacité grille - autres électrodes	-	-	25	pF

Mécaniques

Dimensions	voir dessin
Poids approximatif	7 kg
Position de montage	indifférente
Connecteurs RF	UG 571/U
Connexions d'alimentation	Winchester PM6S
Refroidissement	air forcé
Température ambiante de fonctionnement	–20 à +40 °C

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

VALEURS LIMITES D'UTILISATION
(non simultanées)

	min.	max.	
Puissance de pilotage	-	15	W
Tension continue de faisceau	-	16	kV
Courant crête de faisceau	-	4, 5	A
Polarisation de grille	−100	−300	V
Tension crête de grille par rapport à la cathode	-	+500	V
Facteur d'utilisation	-	0, 003	
Durée d'impulsion	-	15	µs
Temps de préchauffage	3	-	mn
Tension de chauffage	7	8	V
Courant de chauffage au démarrage	-	5	A
T.O.S. de la charge	-	2	
Température d'utilisation	−20	+55	°C

EXEMPLE DE FONCTIONNEMENT

Fréquence	3	GHz
Tension de chauffage (alternative ou continue)	7, 5	V
Courant de chauffage	2, 0	A
Puissance crête de sortie	7	kW
Puissance moyenne de sortie	15	W
Puissance crête d'entrée	5	W
Tension de faisceau	14, 5	kV
Courant crête de faisceau	3	A
Polarisation de grille	−150	V
Tension crête de grille par rapport à la cathode	+326	V
Facteur d'utilisation	0, 002	
Durée d'impulsion	10	µs
T.O.S. de la charge	1. 2 : 1	

CONSIGNES D'UTILISATION

Ces instructions donnent les informations essentielles sur l'installation et le fonctionnement du tube à onde progressive 8232. Des informations plus complètes nécessaires par exemple pour l'établissement d'un matériel nouveau peuvent être fournies sur demande.

I - Précautions importantes

Ce tube doit fonctionner dans un ensemble muni des systèmes de sécurité décrits ci-dessous. De plus, des précautions doivent être prises à l'installation et à la mise sous tension, et les valeurs maximales ne doivent pas être dépassées.

HAUTE TENSION

Les tensions utilisées pour l'alimentation de ce TOP sont extrêmement dangereuses. L'installation devra être munie de circuits de sécurité afin d'éliminer les risques d'électrocution.

RAYONNEMENT HYPERFREQUENCE

Il faut prendre les précautions nécessaires pour éviter l'exposition du personnel au puissant rayonnement produit par le tube ; en particulier, les connexions d'entrée et de sortie RF doivent être réalisées avec beaucoup de soin pour éviter les fuites.

TENSION DE CHAUFFAGE

La tension de chauffage doit être appliquée au moins 3 minutes avant la tension de faisceau. Le courant de pointe au démarrage ne doit pas dépasser 5 ampères.

TENSION DE FAISCEAU

Un relais de sécurité ou tout autre dispositif doit être prévu dans le circuit d'alimentation pour empêcher la tension de faisceau de dépasser 16 kV. Des systèmes de verrouillage doivent rendre impossible l'application de la tension de faisceau avant la tension de polarisation de la grille.

COURANT DE FAISCEAU

Un relais de sécurité doit être prévu dans l'installation pour empêcher le courant de faisceau d'atteindre la valeur limite d'utilisation. Il doit couper la tension de faisceau si le courant de faisceau atteint et dépasse 12 mA.

TENSION GRILLE

L'alimentation de la grille doit présenter une faible impédance au circuit grille, ceci afin d'éviter un emballement du tube ou des oscillations parasites dans le cas ou la grille aurait une impédance négative vis à vis du circuit de modulation en impulsion.

Le générateur des impulsions de modulation doit être muni d'un dispositif limitant la durée des impulsions à 15 μs. De plus, un système de sécurité (par exemple un éclateur) doit limiter la différence de potentiel entre grille et cathode à 500 volts maximum.

II - Refroidissement

Ce tube est refroidi par circulation d'air. Pour des conditions normales de température et de pression atmosphérique, un minimum de 0,45 m^3 /mn doit être dirigé sur le tube avec une pression d'environ 4 g/cm^2.

III - Installation

Le tube peut être monté dans n'importe quelle position ; se reporter au dessin d'encombrement pour le mode de fixation.

Le conduit d'arrivée d'air se fixe au tube, il doit avoir un diamètre intérieur de 5,6 cm environ et se monte du côté du collecteur.

CONNEXIONS ELECTRIQUES

Le schéma de branchement du tube le plus habituel, c'est-à-dire le corps du tube et le pôle positif de l'alimentation faisceau au potentiel de la masse, est donné figure 1. Les alimentations du filament et de la grille doivent être isolées de manière à pouvoir supporter la totalité de la tension faisceau.

Les tensions d'alimentation se répartissent sur un connecteur de type Winchester PM6S qui s'adapte à la fiche Winchester PM6P. Les connexions sont indiquées figure 1.

Les connecteurs RF d'entrée et de sortie s'adaptent à des fiches coaxiales 50 ohms type C, UG 573 A/U, ou équivalentes.

IV - Fonctionnement

Vérifications à effectuer avant d'appliquer les tensions :

- branchement de connecteurs d'alimentation et d'entrée et sortie RF ;
- ventilation en ordre de marche ;
- bon fonctionnement des circuits de sécurité ;
- TOS de la charge inférieur à 2,0 dans toute la bande de fréquence.

Les tensions doivent être appliquées au tube dans l'ordre suivant :

- appliquer la tension de chauffage et attendre 3 minutes ;
- appliquer la tension de polarisation de la grille, la tension de faisceau et les impulsions de modulation en respectant les valeurs données sur la feuille d'essais particulière du tube afin d'obtenir la valeur correcte du courant crête de faisceau.
- appliquer la puissance RF de pilotage et régler pour obtenir la puissance de sortie désirée.

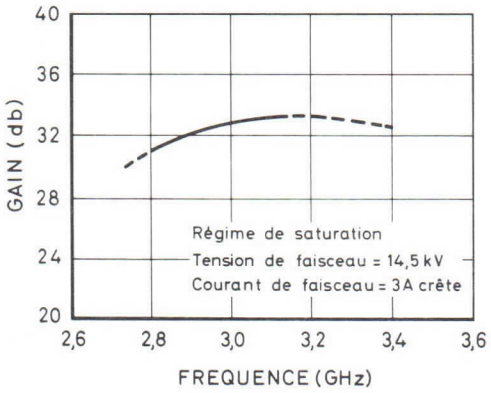
La tension de polarisation de la grille ne doit pas être coupée tant que les impulsions de modulation et la tension de faisceau sont appliquées au tube.

La tension de polarisation de la grille et la tension de chauffage seront coupées simultanément.

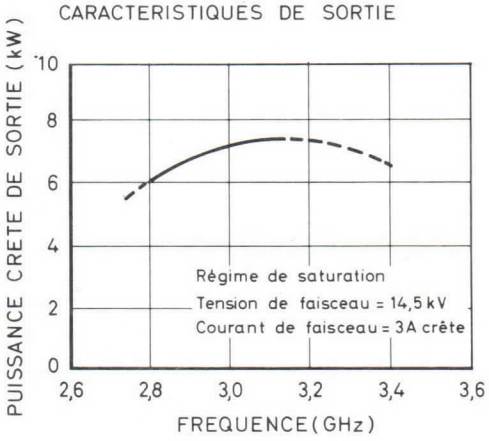
V - Manutention et stockage

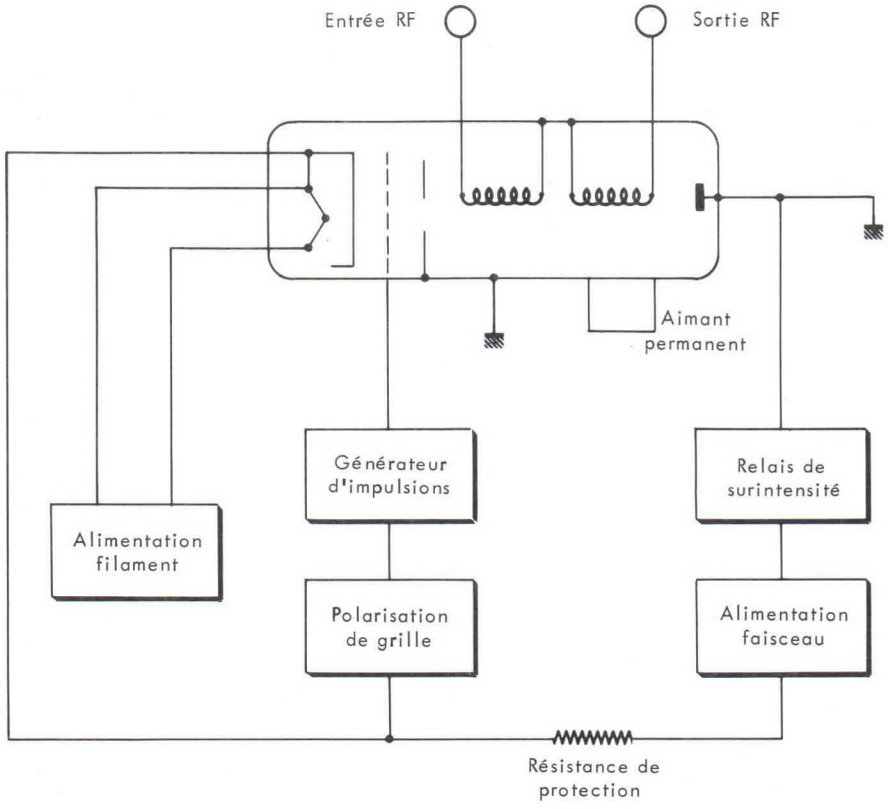
Le tube doit toujours être transporté dans son emballage d'origine. S'il n'est pas utilisé il doit également être conservé dans le container spécial.

CARACTERISTIQUES DE GAIN



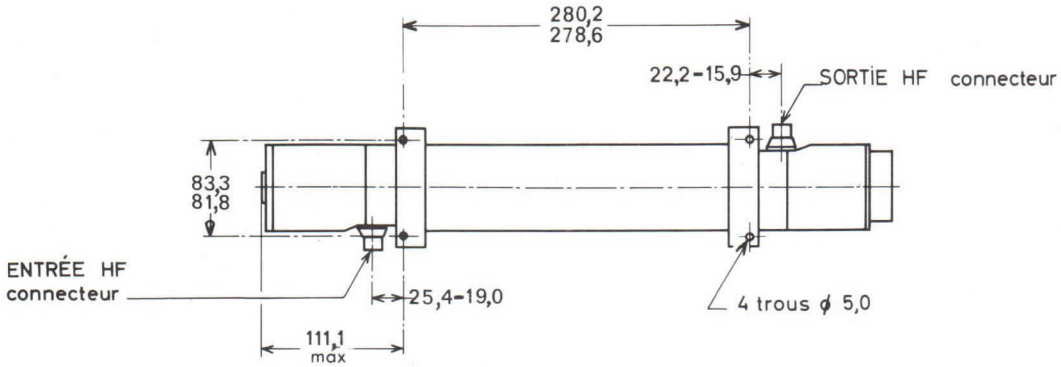
CARACTERISTIQUES DE SORTIE

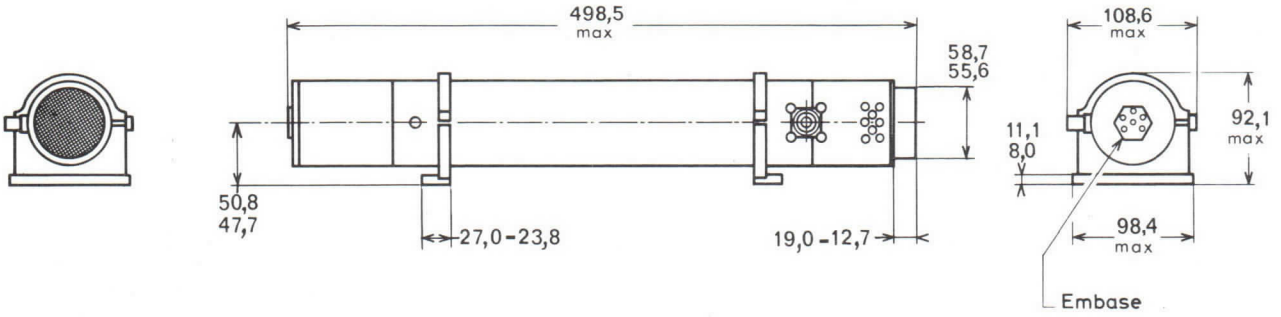




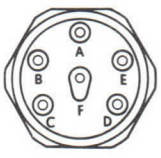
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT



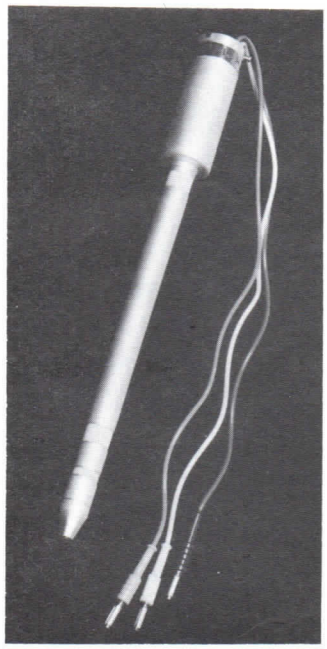


CONNEXIONS
A CATHODE
B non connecté
C Filament cathode
D Filament
E non connecté
F Grille



Cotes en mm.

TH 9121 A TRAVELING WAVE TUBE



The TH 9121 A is a traveling wave tube of metal-ceramic construction designed for pulsed wave operation. This power amplifier is designed for S band and can provide a minimum of 30 W in the frequency range of 2700 to 3300 MHz.

Due to its ruggedness, the TH 9121 A is designed to operate under severe environmental conditions.

The R.F. input and output fittings mate with N type coaxial connectors or flat waveguides.

The TH 9121 A requires the use of the TH 19 603 B electromagnet for focusing.

GENERAL CHARACTERISTICS

Electrical

Cathode	unipotential, oxide coated	
Heating	indirect	
Heater voltage (1)	5.8	V
Heater current	1	A
Warm-up time	5	mn
Frequency range	2700 to 3300	MHz

(1) The exact heater voltage is given on the Test Data Sheet of each tube. This voltage is to be observed within ± 5%.

Mechanical

Envelope	ceramic-metal	
Operating position	any	
Cooling	forced-air	
Weight (tube)	300	g
Dimensions	see drawings	
Connections	flexible leads	

ABSOLUTE RATINGS
(non simultaneous)

	min.	max.	
Heater surge current		2	A
Heater voltage	5	6.6	V
Heater current		1.5	A
Warm-up time	300		s
Negative grid bias	- 10	- 100	V
Grid power		300	mW
Beam voltage	2.0	2.6	kV
Helix current, average		5	mA

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

	min.	max.	
Cathode current peak		200	mA
Peak grid voltage		150	V
Pulse width		1000	µs
Duty factor		0.1	
Collector temperature		160	°C
Grid bias supply resistance		10	kΩ
Body temperature		70	°C
Cooling air flow	0.5		m^3/mn
Load VSWR		1.5:1	
Focus coil current		2	A
Focus coil voltage		60	V

TYPICAL OPERATION

Beam voltage	2300	V
Cathode current, peak	150	mA
Grid bias	- 20	V
Peak grid voltage	+ 40	V
Pulse width	10	µs
Duty factor	0.1	
Power output, saturated	45	W
Gain at saturated power output	33	dB
Small signal gain	36	dB
Frequency range	2700 - 3300	MHz
Focus applied power	90	W

TH 19603 B FOCUS COIL

Cooling	forced air	
Weight, approximate	12	kg
Dimensions	see drawings	
Power supply connections	pigmy PT 02A84P	
Focus coil voltage	60	V
Focus coil current	2	A

OPERATING INSTRUCTIONS

These operating instructions provide basic information for installing and operating the TH 9121 A pulsed traveling wave tube amplifier. Supplementary information is given in the Test Performance Sheet which contains test results at specific frequencies for individual tube.

I - Protective measures

This tube should be used in equipment which provides protection as described below. In addition, installation and operating precautions should be observed, and ratings should not be exceeded.

- High voltage

Voltages required for operation of this tube are extremely dangerous ; equipment should be designed with protective interlock circuits to make physical contact with these voltages impossible.

- Heater voltage

Heater voltage given on the Test Data Sheet should be applied for at least 5 minutes before applying beam voltage. Heater surge current should never exceed 2 amperes.

- Beam voltage

An overvoltage relay should be provided to limit the beam voltage to 2.6 kV dc. A device should be provided to cut-off the grid voltage and the beam voltage if the helix current exceeds the maximum rating.

- Grid power supply

The grid power supply should present a low impedance to the grid circuit. This will prevent runaway conditions and oscillations in the grid power supply wiring due to the possibility of the grid presenting a negative resistance to the gating circuit.

The grid gate generator should have a protective circuitry to prevent the pulse duration from exceeding 1 ns. In addition, a suitable protective device (e.g. a spark gap) should be provided to limit the potential difference between grid and cathode to a maximum of 150 volts.

II - Absolute ratings

Ratings should not be exceeded under continuous or transient conditions. A single rating may be the limitation and simultaneous operation at more than one rating may not be possible. Equipment design should allow for voltage and environment variations so that ratings will never be exceeded.

III - Mounting

The tube can be mounted in any position. See the outline drawing page 4 for details.

- Mounting the tube in the TH 19603 B electromagnet.

During handling and storage the electromagnet should be kept at least 10 cm away from all magnetic material and 30 cm away from magnet.

- Unscrew the ring of the magnet.
- Carefully guide the tube into the electromagnet, without any side stress, slightly rotate the tube clockwise, until it is seated properly into its normal operating position.
- Insets of the tube and electromagnet cover should be coincident with the matching slot of the electromagnet.
- Bolt the ring to lock in place the tube and cover.

- Electrical connections

The connections are made by flexible leads, and FRB plugs, type RCA 2F2.

- Heater : brown
- Heater-cathode : yellow
- Grid : green

The R.F. input and output connectors are coaxial type "N" or flat waveguides.

IV - Operation

Check the following conditions before applying voltages to the tube :

- R.F. connectors are connected properly to their mating parts.
- Tube body is grounded by means of the D plug of the electromagnet socket.
- The collector (C plug) is isolated from ground.
- All supplies are connected.
- R.F. load is connected.
- Cooling air is flowing.
- All protective circuits are operating correctly.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

Applications of voltages (see test performance sheet)

1 - Apply focus coils current.

2 - Apply heater and allow at least 5 minutes for cathode warm-up.

3 - Apply beam voltage, step by step, (at least for the first time).

4 - Apply voltage to the grid, and at the same time :

5 - Adjust the electromagnet focusing.

Electromagnet adjustment :

The four setting mechanism are located under a protective plate, upon the electromagnet. Non magnetic tools should be used.

With the gate voltage applied to the grid, adjust the four setting mechanism to obtain minimum helix current for the given value of the collector current.

A first approximate adjustment is obtained with a reduced collector current. Repeat the operation with gradually increased values of the collector current, until the normal operating current is reached.

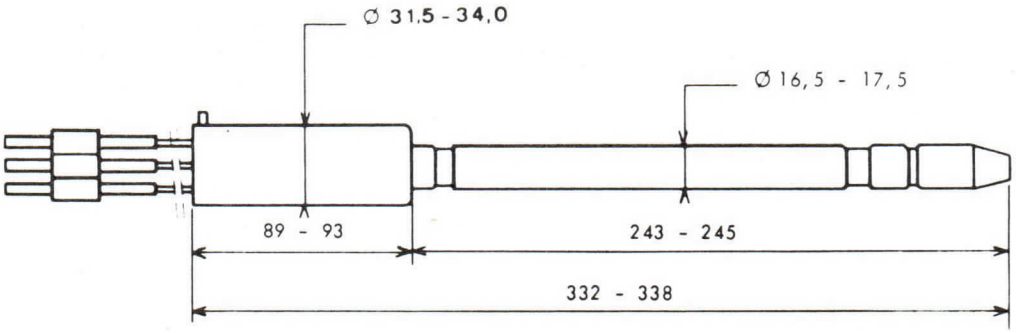
6 - Apply R.F. drive power.

V - Storing precautions

The tube should be handled and stored in its original shipping crate, it should be kept sheltered from bad weather, at ambient temperature and non corrosive atmosphere.

After a six months storage, a periodical check should be performed. The tube is unpacked and tested in the TH 19 603 B electromagnet according to the operating instructions and Test Data Sheet. The performance of the tube should be compared to the values given on the Test Data Sheet of each tube.

OUTLINE DRAWING

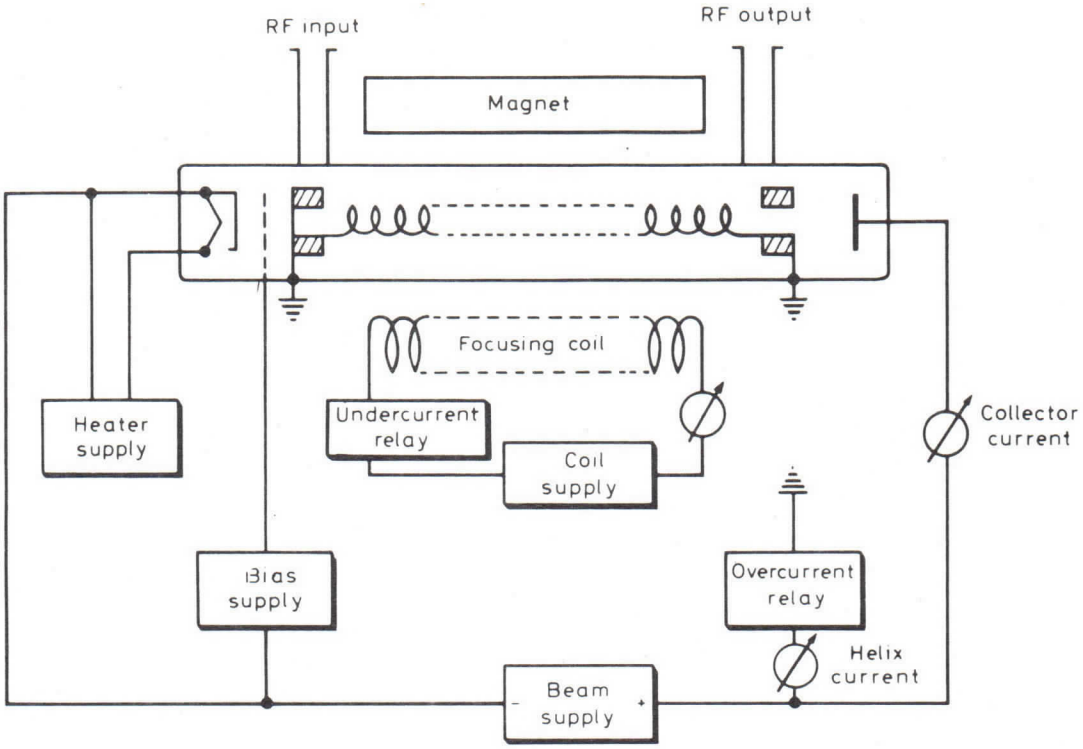


CONNECTIONS	
Brown	Heater
Yellow	Cathode-heater
Green	Grid

Dimensions in mm

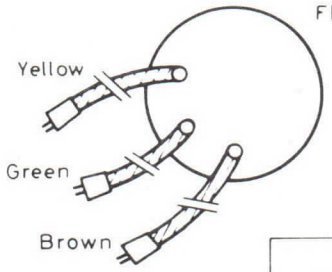
CIRCUIT CONNECTIONS

TUBE AND ELECTROMAGNET



TUBE CONNECTIONS

flexible leads and FRB plugs (RCA 2F2)



CONNECTIONS	
Brown	Heater
Yellow	Cathode-heater
Green	Grid

FOCALIZER SOCKET
Pygmy PT 02A8 4P

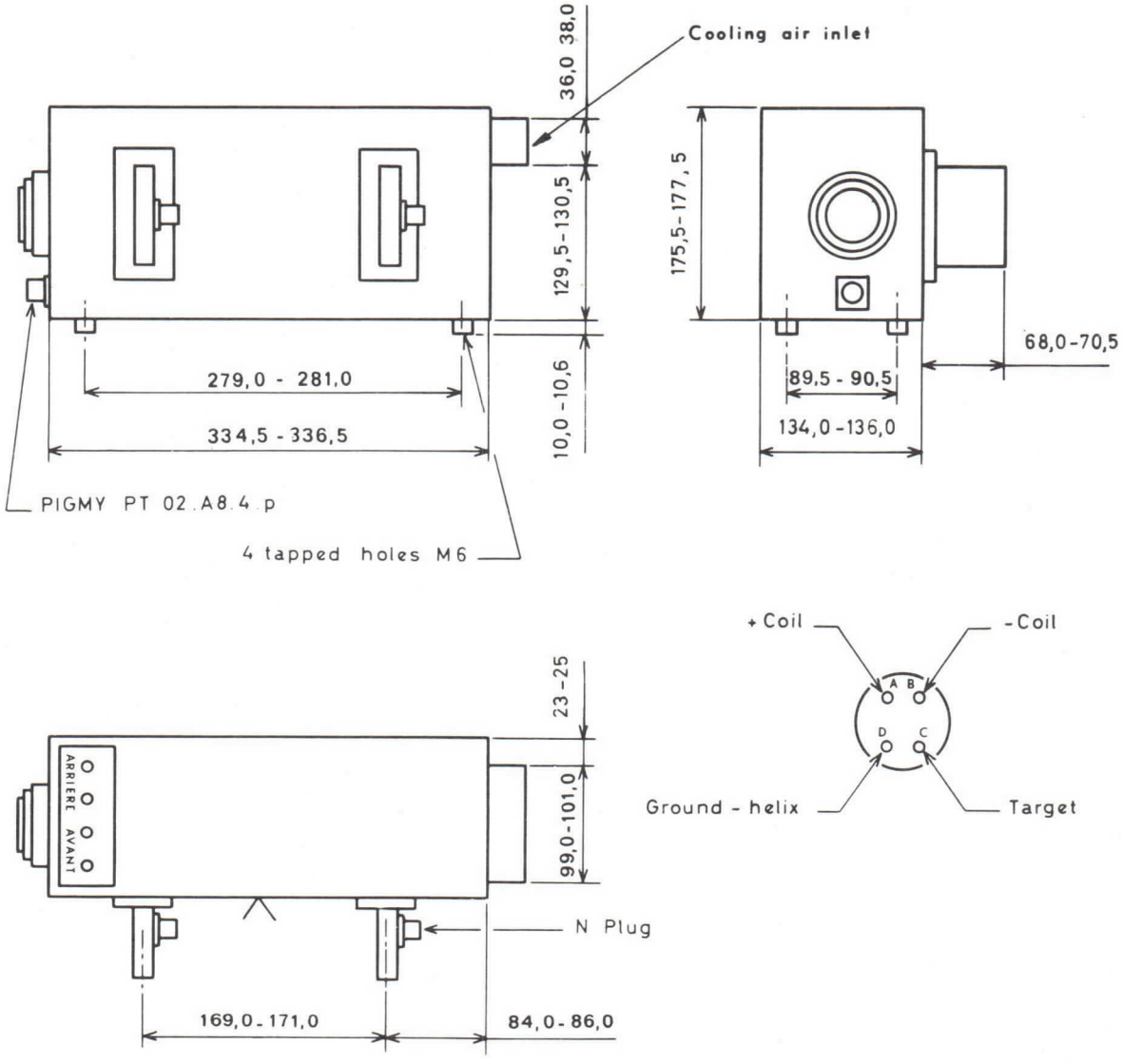


A	Focusing coil +
B	Focusing coil -
C	Collector
D	Helix-ground

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GROUPEMENT TUBES ELECTRONIQUES

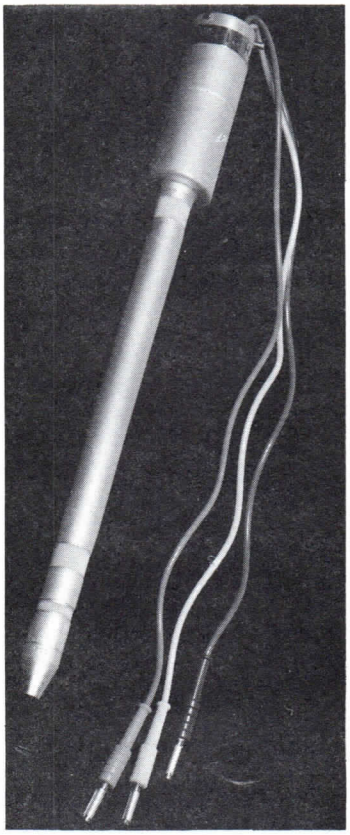
OUTLINE DRAWING

TH 19603 B Electromagnet



Dimensions in mm.

TH 9131 TRAVELING WAVE TUBE



The TH 9131 is a traveling wave tube of metal-ceramic construction designed for continuous wave operation. This power amplifier is designed for S band and can provide a minimum of 6 W in the frequency range of 2670 to 3280 MHz.

Due to its ruggedness, the TH 9131 is designed to operate under severe environmental conditions.

The R.F. input and output fittings mate with N type coaxial connectors or flat waveguides.

The TH 9131 requires the use of the TH 19 603 B electromagnet for focusing.

GENERAL CHARACTERISTICS

Electrical

Type of cathode	unipotential oxide coated	
Heating	indirect	
Heater voltage	5.8	V (1)
Heater current	1	A
Preheating time	300	s
Frequency range	2670 - 3280	MHz

(1) The exact heater voltage is given on the Test Data Sheet of each tube. This voltage is to be observed within ± 5%.

Mechanical

Envelope	metal ceramic
Connections	flexible leads
Mounting position	any
Weight (approx.)	300 g
Cooling	forced air
Dimensions	see drawings

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Heater voltage	5.0	6.6	V
Heater current (surge)		2	A
Grid bias	- 100	+ 100	V
Grid power		500	mW
Helix and anode voltage	1900	2500	V
Collector current		100	mA
Helix and anode current		7	mA
Cathode current		120	mA
Collector temperature		160	°C
Preheating time	300		s

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

TYPICAL OPERATION

Helix voltage	2100	V
Cathode current	57	mA
Grid bias	+ 17	V
Saturated power output	8	W
Gain at saturated power output	23	dB
Frequency range	2670 - 3280	MHz
Focusing power	85	W

TH 19603 B FOCUS COIL

Cooling	forced air	
Approx. weight	12	kg
Dimensions	see drawing	
Focus coil voltage	60	V
Focus coil current	2	A

OPERATING INSTRUCTIONS

These operating instructions provide basic information for installing and operating the TH 9131 C.W. traveling wave tube amplifier. Supplementary information is given in the Test Performance sheet which contains test results at specific frequencies for individual tube.

I - Protective measures

This tube should be used in equipment which provides protection as described below. In addition, installation and operating precautions should be observed, and ratings should not be exceeded.

HIGH VOLTAGE

Voltages required for operation of this tube are extremely dangerous ; equipment should be designed with protective interlock circuits to make physical contact with these voltages impossible.

HEATER VOLTAGE

Heater voltage given on the Test Data Sheet should be applied for at least 5 minutes before applying beam voltage. Heater surge current should never exceed 2 amperes.

BEAM VOLTAGE

An overvoltage relay should be provided to limit the beam voltage to 2.5 kV dc. Positive grid voltage may be applied when the normal beam voltage is reached.

A device should be provided to cut off the grid voltage and the beam voltage if the helix current exceeds the maximum rating.

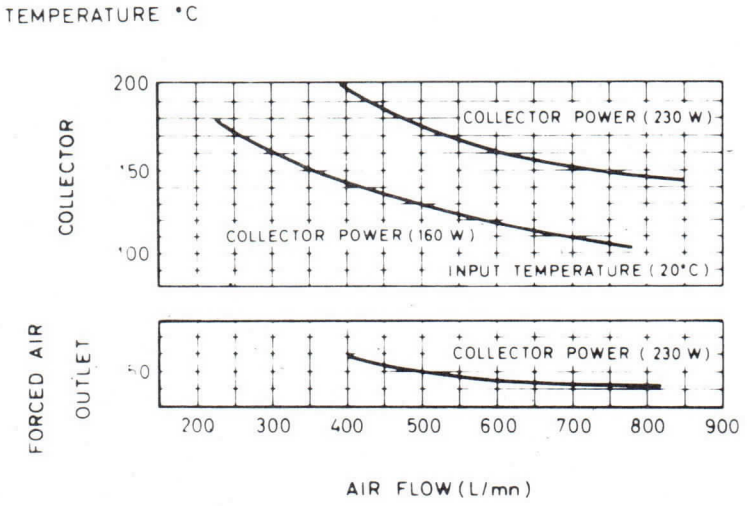
II - Absolute ratings

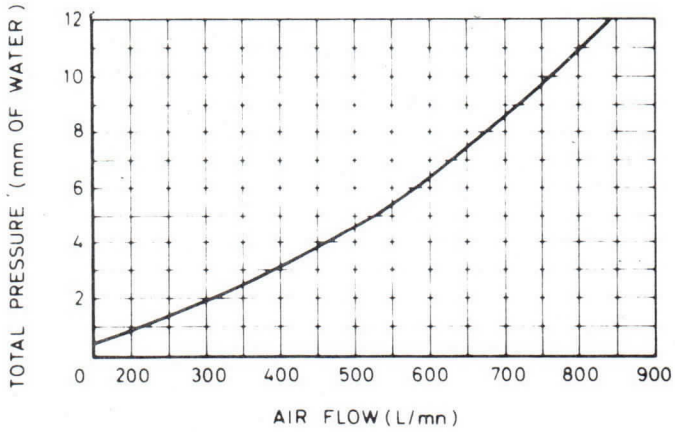
Ratings should not be exceeded under continuous or transient conditions. A single rating may be the limitation and simultaneous operation at more than one rating may not be possible. Equipment design should allow for voltage and environmental variations so that ratings will never be exceeded.

	min.	max.	
Beam voltage	1.9	2.5	kV
Helix current		7	mA
Grid voltage		+100	V
Grid power		500	mW
Cathode current		120	mA
Collector current		100	mA
Heater voltage	5.0	6.6	V
Heater current		2	A
Collector temperature		160	°C
Focus coil current		2	A
Focus coil voltage		60	V
Cathode warm up time	5		mn.
Load V.S.W.R		1.5:1	

III - Cooling

The tube is forced air cooled. Temperature and air flow characteristics are given in the following chart.





IV - Mounting

See the outline drawing for details.

- Mounting the tube in the TH 19603 B electromagnet.

During handling and storage the electromagnet should be kept at least 10 cm away from all magnetic material and 30 cm away from magnet.

- Unscrew the ring of the magnet.
- Carefully guide the tube into the electromagnet, without any side stress, slightly rotate the tube clockwise, until it is seated properly into its normal operating position.
- Insets of the tube and electromagnet cover should be coincident with the matching slot of the electromagnet.
- Bolt the ring to lock in place the tube and cover.

- Electrical connections

The connections are made by flexible leads, and FRB plugs type RCA 2F2.

- Heater : brown
- Heater-cathode : yellow
- Grid : green

The R.F. input and output connectors are coaxial type "N" or flat waveguides.

V - Operation

Check the following conditions before applying voltages to the tube :
- R.F. connectors are connected properly to their mating parts.
- Tube body is grounded by means of the D plug of the electromagnet socket.
- The collector (C plug) is isolated from ground.
- All supplies are connected.
- R.F. load is connected.
- Cooling air is flowing.
- All protective circuits are operating correctly.

Applications of voltages

1 - Apply focus coils current.

2 - Apply heater voltage (the exact value is given on the Test Performance Sheet of each tube and should not be exceeded) and allow at least 5 minutes for cathode warm-up.

3 - Apply beam voltage, step by step, (at least for the first time).

4 - Apply voltage to the grid, and at the same time :

5 - Adjust the electromagnet focusing.

- Electromagnet adjustment :

The four setting mechanisms are located under a protective plate, upon the electromagnet. Non magnetic tools should be used.

With the gate voltage applied to the grid, adjust the four setting mechanisms to obtain minimum helix current for the given value of the collector current.

A first approximate adjustment is obtained with a reduced collector current. Repeat the operation with gradually increased values of the collector current, until the normal operating current is reached.

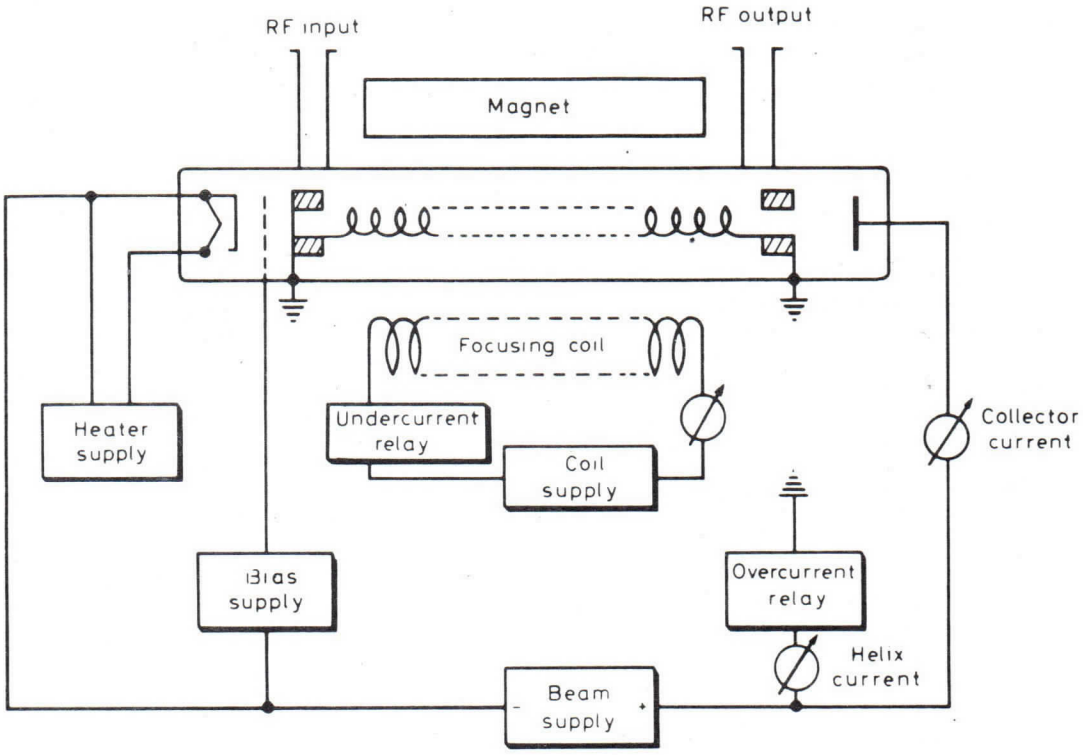
6 - Apply RF drive power.

VI - Storing precautions

The tube should be handled and stored in its original shipping crate, it should be kept sheltered from bad weather, at ambient temperature and non corrosive atmosphere.

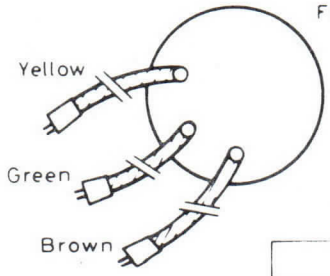
After a six months storage, a periodical check should be performed. The tube is unpacked and tested in the TH 19603 B electromagnet according to the operating instructions and Test Data Sheet. The performance of the tube should be compared to the values given on the Test Data Sheet of each tube.

CIRCUIT CONNECTIONS



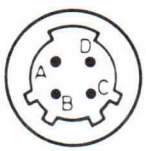
TUBE CONNECTIONS

flexible leads and FRB plugs (RCA 2F2)



CONNECTIONS	
Brown	Heater
Yellow	Cathode-heater
Green	Grid

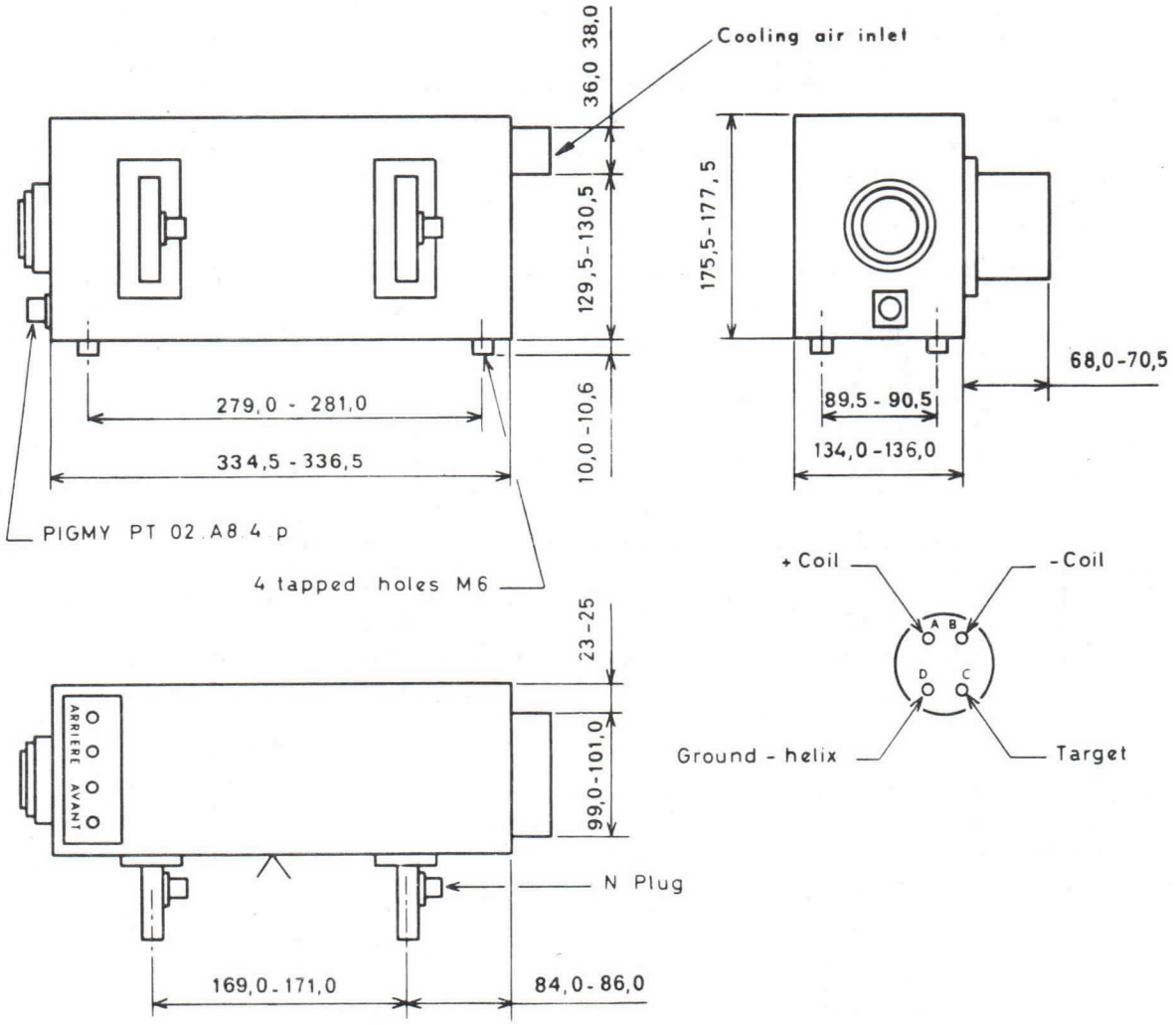
FOCALIZER SOCKET
Pygmy PT 02A8 4P



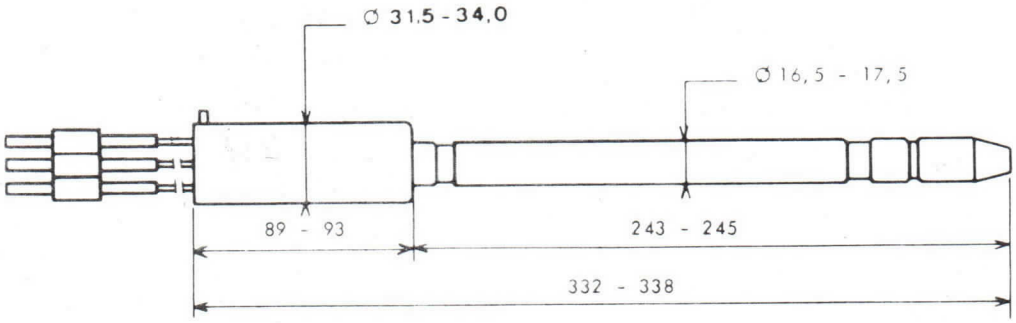
A	Focusing coil +
B	Focusing coil -
C	Collector
D	Helix-ground

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

TH 19603 B ELECTROMAGNET



OUTLINE DRAWING



CONNECTIONS	
Brown	Heater
Yellow	Cathode-heater
Green	Grid

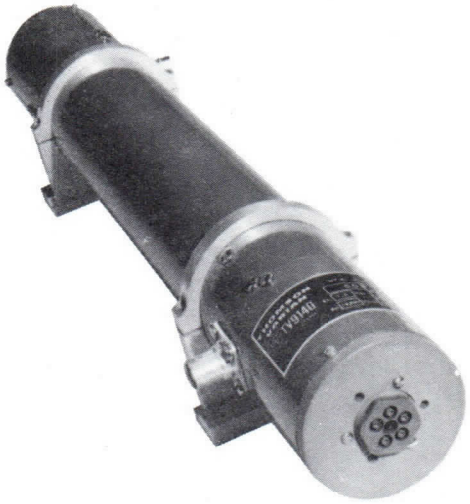
TV 9140 TRAVELING WAVE TUBE

The TV 9140 is a traveling wave pulse amplifier which delivers 6 to 10 kilowatts peak output between 2. 8 and 3. 15 gigahertz, under saturation conditions.

It is a broadband driver for multimegawatt amplifiers. The tube includes a control grid to permit low voltage beam switching.

The tube offers the following main features :

- Periodic permanent magnet focusing - Needs no magnet power supply.
- Broadband - High power - Amplifies pulses within its 350 MHz bandwidth without adjustment for change of frequency.
- Control grid. Permits low voltage beam pulsing.
- Forced air cooled - Permits compact equipment design : no heat exchanger or interconnecting hoses required.



GENERAL CHARACTERISTICS

Electrical

	min.	avg.	max.	
Heater voltage	–	7. 5	–	V
Heater current	1. 75	–	2. 25	A
Frequency	2. 8	–	3. 15	GHz
Beam voltage	13	–	15	kV
Peak beam current	–	–	4	A
Output power	6	–	–	kW
Capacitance grid to all other electrodes	–	–	25	pF

Physical

Dimensions	see outline drawing page 6
Weight, approximate	7 kg
Mounting position	any
RF connectors	UG 571/U
Supply connection	Winchester PM6S
Cooling	Forced air

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

ABSOLUTE RATINGS

	min.	max.	
Drive power	–	15	W
Beam voltage	–	16	kV
Peak beam current	–	4	A
Grid bias voltage	–100	–300	V
Peak grid voltage, above cathode	–	+500	V
Duty cycle	–	0. 003	
Pulse duration	–	15	µs
Heater warm up time	3	–	mn
Heater voltage	7	8	V
Heater surge current	–	5	A
Load VSWR	–	2. 0 : 1	
Operating temperature	–20	+55	°C

TYPICAL OPERATION

Frequency	3	GHz
Heater voltage	7. 5	V
Heater current	2. 0	A
Peak input power	5	W
Peak output power	7	kW
Average output power	15	W
Beam voltage	14. 5	kV
Peak beam current	3	A
Grid bias voltage	–150	V
Peak grid voltage, above cathode	+326	V
Duty cycle	0. 002	
Pulse duration	10	µs
Load VSWR	1. 2 : 1	

OPERATING INSTRUCTIONS

These operating instructions provide basic information for installing and operating the TV 9140 pulsed traveling wave tube amplifier. Supplementary information is given in the Test Performance sheet which contains test results at specific frequencies for individual tube.

1 - PROTECTIVE MEASURES

This tube should be used in equipment which provides protection as described below. In addition, installation and operating precautions should be observed, and ratings should not be exceeded.

High voltage

Voltages required for operation of this tube are extremely dangerous ; equipment should be designed with protective interlock circuits to make physical contact with these voltages impossible.

Microwave radiations

Precautions should be taken to prevent exposure of personnel to the strong microwave fields generated by this tube. Microwave radiation due to leakage at the coaxial connectors should be prevented by making tight R.F. input and output connections.

Heater voltage

Specified heater voltage should be applied for at least 3 minutes before applying beam voltage. Heater surge current should never exceed 5 amperes.

Beam voltage

Interlocks should be provided to prevent the application of beam voltage before the grid bias voltage is applied. An overvoltage relay should be provided to limit the beam voltage to 16 kV dc.

Grid power supply

The grid power supply should present at low impedance to the grid circuit. This will prevent runaway conditions and oscillations in the grid power supply wiring due to the possibility of the grid presenting a negative resistance to the gating circuit.

The grid gate generator should have a protective circuitry to prevent the pulse duration from exceeding 15 μs. In addition, suitable protective device (e.g. a spark gap) should be provided to limit the potential difference between grid and cathode to a maximum of 500 volts.

Beam current

A peak current sensing device should be employed which will limit the peak beam current to 4 A maximum, and an overcurrent relay to remove the high voltage and gate pulse if the average beam current exceeds 12 mA.

2 - COOLING

The tube is forced air cooled. At least 0. 45 m^3/mn of cooling air should be provided for adequate cooling at sea level and normal room temperature. This air flow must be supplied against a back pressure of about 4 g/cm^2.

3 - MOUNTING

The tube can be mounted in any position. See the outline drawing for details.

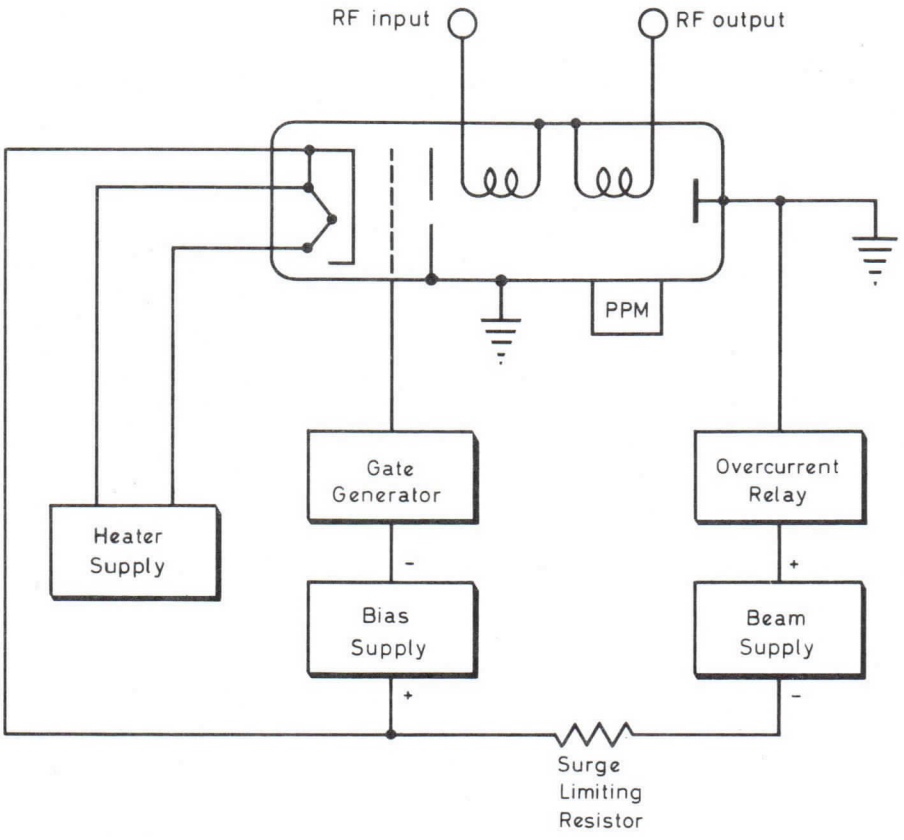
Attached the forced air cooling ducts to the tube. The air duct should have an inside diameter of about 5. 6 cm and should connect to the collector end of the tube.

Electrical connections

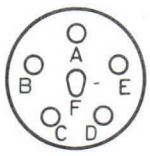
Electrical connections to the tube should be made as shown in Fig. 1. This diagram shows the tube body and the positive side of the beam power supply at ground potential. With this arrangement, the heater and grid power supply must be insulated to withstand the full beam voltage.

The power connector on the tube is a Winchester PM6S receptacle which mates with a Winchester plug, type PM6P. The pin connections are shown in Fig. 1.

The R.F. input and output connectors mates with a 50 - Ohms coaxial, type "C", UG-573A/U plug or equivalent.



SUPPLY CONNECTOR



CONNECTIONS	
A-C	Cathode-heater
B	No connection
D	Heater
E	No connection
F	Grid

FIGURE 1

4 - OPERATION

Check the following conditions before applying voltages to the tube :

- Winchester socket and R.F.connectors are connected properly to their mating parts and tube body grounded.
- Air duct is attached securely and cooling air is flowing.
- All protective circuits are operating correctly.
- VSWR of load is no more than 2. 0 : 1 throughout the operating frequency range.

5 - APPLICATIONS OF VOLTAGES

Voltages should be applied in the following order :

- Apply heater voltage and allow at least 3 minutes for cathode warm-up.
- Apply grid bias, beam and gate voltages specified on the Test Performance Sheet may be adjusted (within their maximum ratings) to obtain the desired peak beam current.
- Apply R.F. drive power and adjust to obtain desired R.F. output.

Removal of voltages

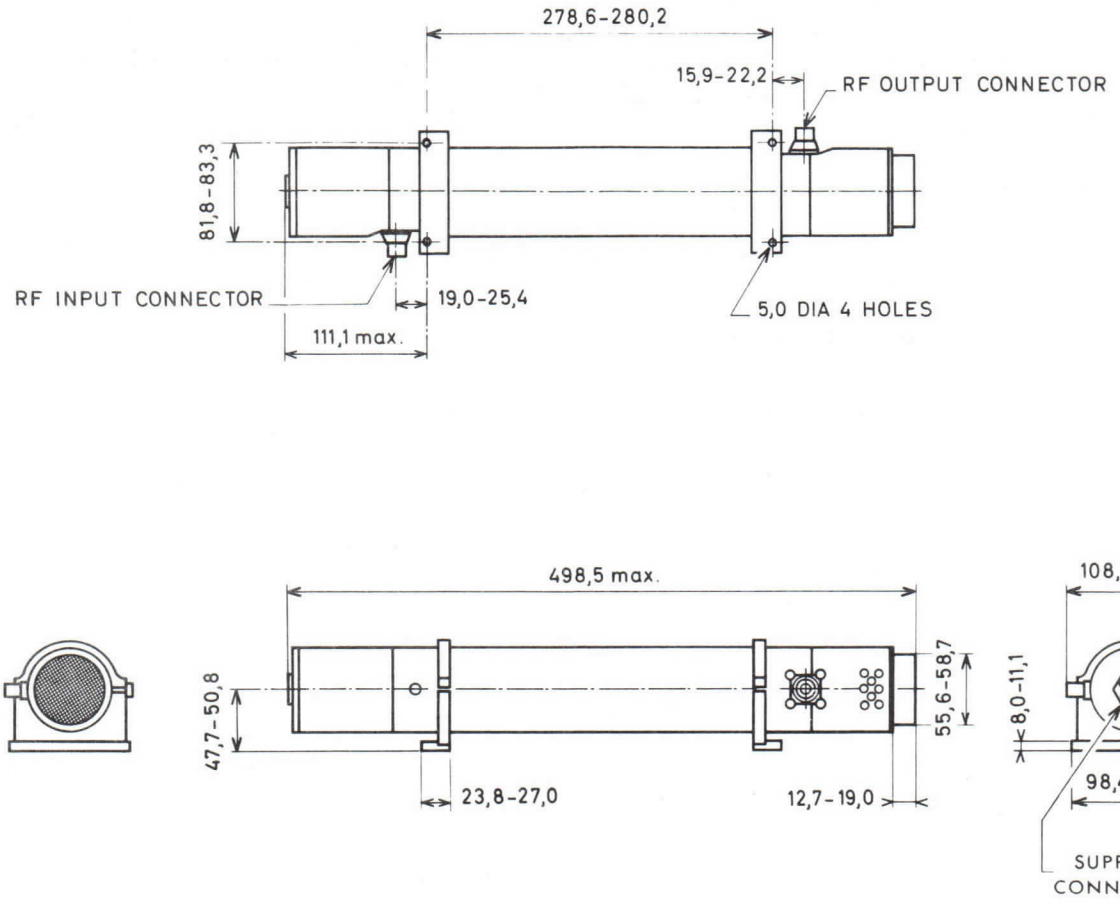
Grid bias voltage must not be removed until both the gate and beam voltages have reached zero. Grid bias and heater voltages may be removed simultaneously.

6 - TRANSPORTATION AND STORAGE

Use the packing case for transportation and storage of the tube when it is not in service.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



Dimensions in mm.

TH 20036
TRAVELING-WAVE-TUBE AMPLIFIER
5.925 – 6.425 GHz/4 Watts

Features

- Specially designed for use in satellite-communications earth stations.
- Includes a TWT and its matched solid-state power supply, in a single compact, lightweight package.
- Low power consumption.
- Built-in protection devices.
- Rugged construction.



The TH 20036 is a C-band traveling-wave-tube amplifier, specially designed for use as a CW preamplifier in the earth stations of modern satellite-communications systems. It delivers a minimum or four watts of output power, at saturation, in the 5.925 to 6.425 GHz band. Small-signal gain is factory adjustable in the range 27 - 30 dB, according to the gain desired by the user.

The incorporated TWT, a TH 3507, features PPM focusing, a helical slow-wave structure for better wideband performance, and entirely metal and ceramic construction for great ruggedness. With its associated solid-state power supply, the tube provides high operating reliability and uniform performance in any orientation.

Designed to withstand shock, vibration and severe environmental conditions, the TH 20036 is ideal for use in low-cost, ground-transportable earth stations. Power consumption is typically 60 watts or less, and cooling is natural (a heat radiator, not supplied, must be attached to the amplifier's baseplate).

The TH 20036 incorporates several protection devices for increased operating reliability. These include a collector-current monitoring circuit and remote control of the helix voltage. Additionally, the signal from an external reflected-power sensor can be applied to the amplifier to cause quick power-supply switch-off.

GENERAL CHARACTERISTICS

Electrical

Frequency range	5.925 to 6.425 GHz
Output power, at saturation	⩾ 4 W
Small-signal gain	27 to 30 dB
Noise figure, max.	26 dB
Gain slope variation	0.02 dB/MHz
Power-supply voltage	28 VDC (± 1 %)
Power consumption, typical	60 W

Mechanical

Dimensions	See the Outline Drawing
Operating position	Any
Weight, approximate	2. 3 kg
RF connections	SMA Female
Power-supply connections	Souriau 9-pin connector (DEM-9-P)
Cooling	By conduction and convection

ABSOLUTE RATINGS (1)

(Non-simultaneous)

	Min.	Max.	Units
Warm-up time	3	–	mn
Ambient temperature (operating)	0	+50	°C
Storage temperature	– 30	+60	°C
Input power	–	50	mW
Load VSWR	–	3 : 1	
Power-supply voltage	27	29	Vdc

TYPICAL OPERATION

Frequency	6. 175	GHz
Small-signal gain	28	dB
Output power at saturation	5	W
Noise figure	24	dB

(1) Limiting values, NOT operating values. No one value ever to be exceeded, even under transient conditions, and operation at more than one limiting value at the same time may cause amplifier damage. Equipment must be designed so that these limits are never exceeded.

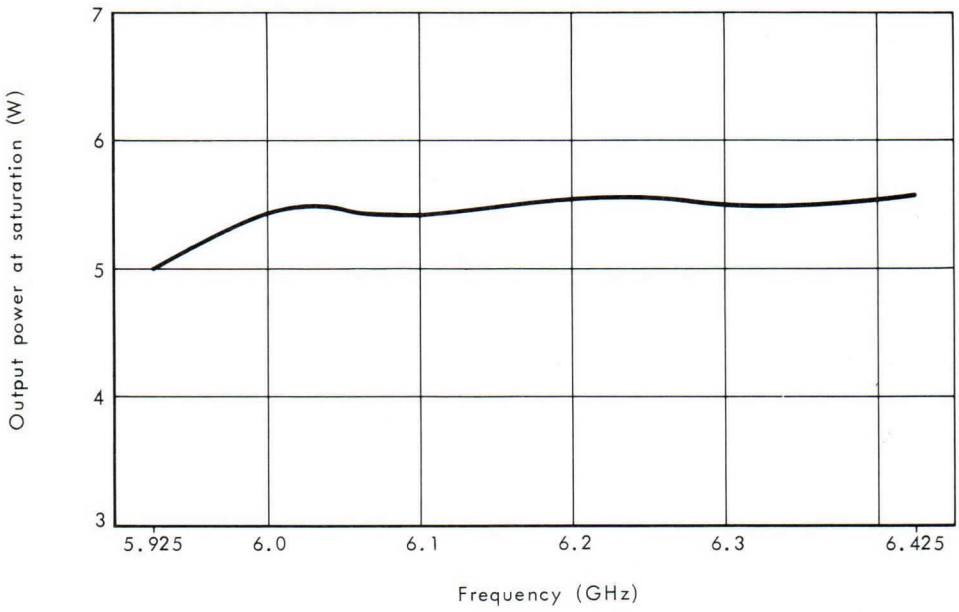


Figure 1 - Typical variation of output power across the uplink band.

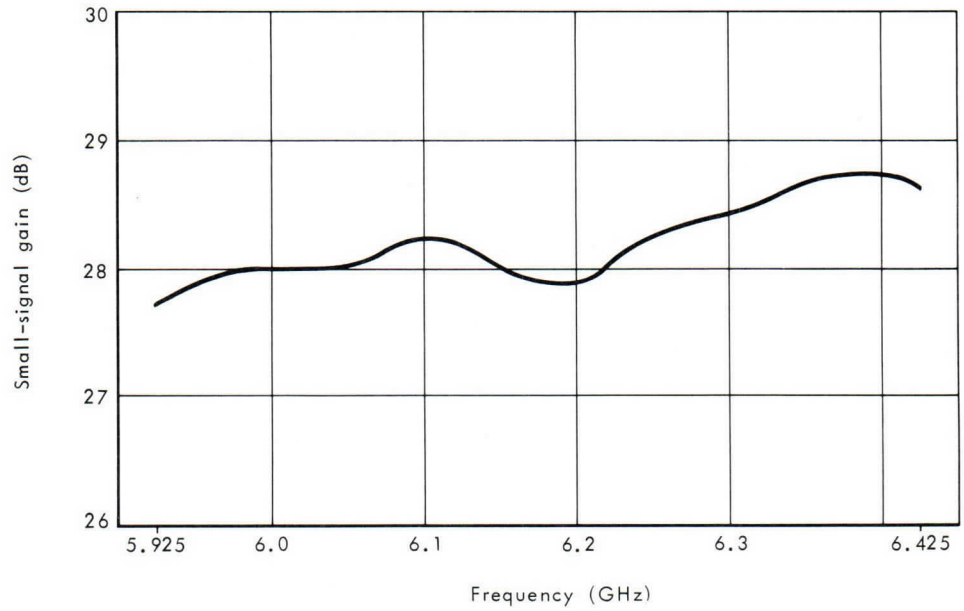
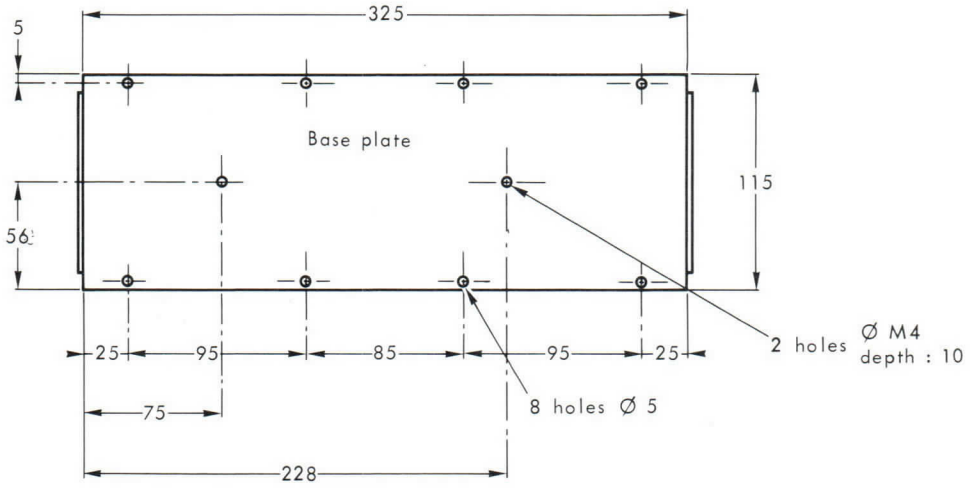
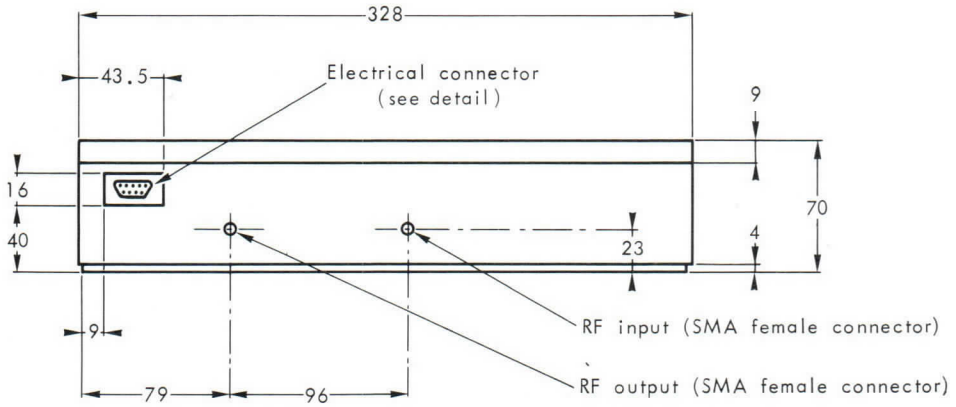
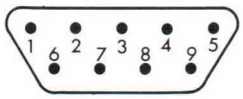


Figure 2 - Typical small-signal gain variations in the band
(TWTA set for 28 dB gain).

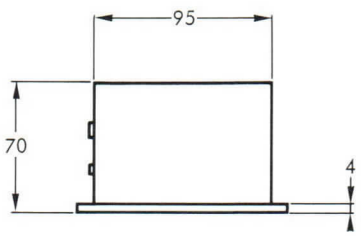
OUTLINE DRAWING







DEM-9-P 9-PIN CONNECTOR

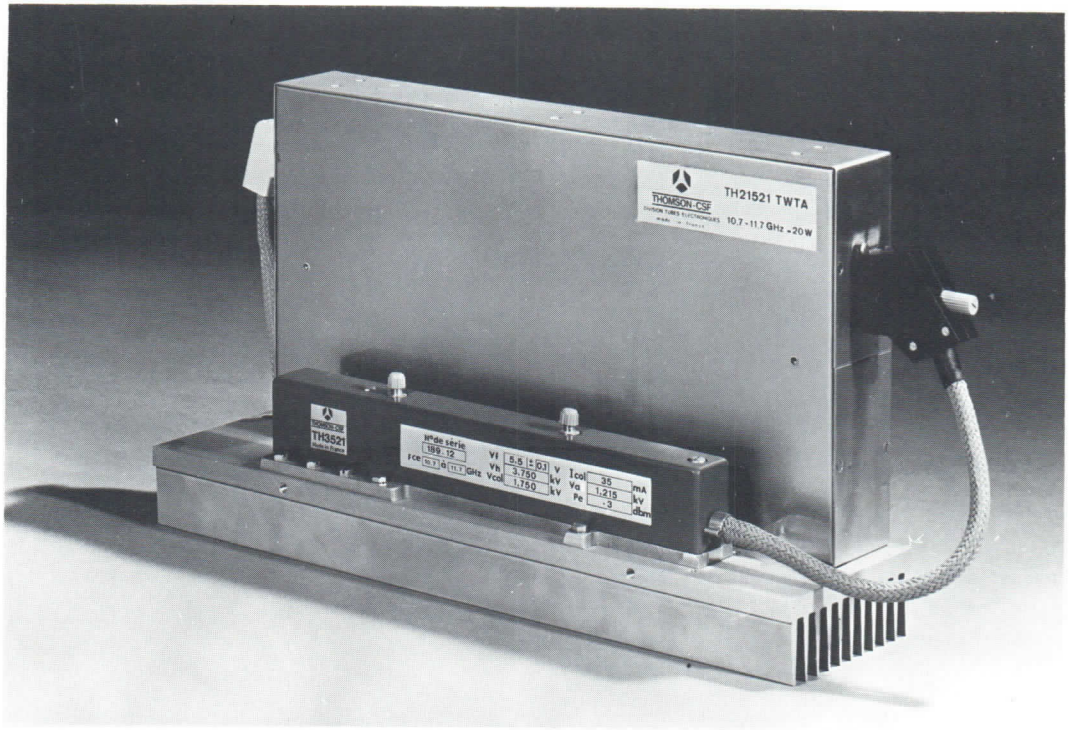


PIN IDENTIFICATION	
1 } 2 }	+28 V Power supply
3	-28 V
4	VSWR protection circuit, negative input
5	Collector - current measurement (common)
6	Collector - current measurement (output)
7	Collector - current measurement (meter)
8 } 9 }	Power-supply ground

Dimensions nominal, in mm.

TH 21521 TWTA

FOR LINE-OF-SIGHT MICROWAVE LINKS
10.7 - 11.7 GHz / 20 W



The TH 21521 traveling-wave tube amplifier (TWTA) consists of a high-efficiency, chopper-type power supply and a TH 3521 traveling-wave tube (TWT), operating in the 10.7 - 11.7 GHz band. The TH 21521 is designed for use in wideband line-of-sight microwave links, carrying up to 1800 telephone channels, and delivers an output power of 20 watts.

Of modern conception, the dc/dc power supply employs high-frequency chopping (at 20 kHz) to ensure high conversion efficiency and to enable the supply to take the form of a light, compact package.

The TH 3521 TWT is derived from a THOMSON-CSF satellite-transponder tube. It has kept much of the technology of the "space" tube, in particular the impregnated cathode and the depressed collector, for an assurance of long life and exceptional reliability.

The RF input and output are via coaxial connectors.

GENERAL CHARACTERISTICS

TWTA Input

Electrical supply dc (1) (2)	24 V ± 2 %
Maximum power use	100 W
Typical power use	85 W

The TWTA's line input is floating, thus the user can connect either the positive or the negative pole to ground, at his preference.

Mechanical Characteristics

Total weight	< 3. 5 kg (incl. 700 g tube)
Overall dimensions :	
- power supply	325 x 180 x 50 mm
- tube	251 x 52 x 60 mm
Power-supply input	DA 15P (15-pin) CANNON connector or equivalent
Tube RF input and output	Female SMA connectors

Environmental Characteristics

Type of cooling	Conduction
Normal operating-temperature range (characteristics guaranteed)	0 to 45 °C
Extreme operating-temperature range	−10 to + 50 °C
Storage temperature range	−40 to + 70 °C
Maximum relative humidity	95 % at 40 °C

(Temperature measured on the tube or power-supply baseplates).

TWT Electronic Characteristics

Frequency range	10. 7 - 11. 7 GHz
Input power	3 dBm (2 mW)
Nominal output power	43 dBm (20 W)
Noise figure	27 dB
AM/PM conversion coefficient, max.	4 °/dB
TWTA efficiency	22 %

Particular Protection and Dispositions

Time Delay

A built-in time delay provides a delay of approximately three minutes between the application of power of the TWTA and the application of high voltage to the tube. During this delay, only the filament voltage is applied to the TWT. At the end of the delay, the high voltages are simultaneously and automatically applied.

Helix Protection

In cause of helix overcurrent, the high voltages are interrupted, then automatically reapplied after several seconds, for up to five times in a row. In case of prolonged malfunction, resetting is no longer automatic, but must be accomplished by turning the TWTA (or the equipment) off, then on again, or by using the reset system, via remote control (accessible on LV connector).

High-Voltage Protection

If the tube is disconnected, the high-voltage supply is automatically turned off for equipment and personnel protection.

Indication

The TWTA delivers a dc signal (12 V or 6 mA) during warm-up and in case of HV trip-out. This signal may be used, for example, to light a luminescent diode.

(1) Upon request, the amplifier can be delivered set to operate from any line voltage between 18 and 48 Vdc.

(2) As an option, a pulse-width modulation (PWM) regulator can be included in the power supply. This regulator produces an intermediate voltage of 24 V ± 1 % , when operating from any line voltage from 36 to 72 Vdc.

OPTIONS

1 - On order, the TWTA can be mounted in a 2-unit high 19" rack drawer, and an ac/dc converter can be added to power the TWTA from a 110/220 Vac, 50/60 Hz line supply.

2 - The TWTA can be delivered with a heat sink mounted, in case natural cooling is to be used.

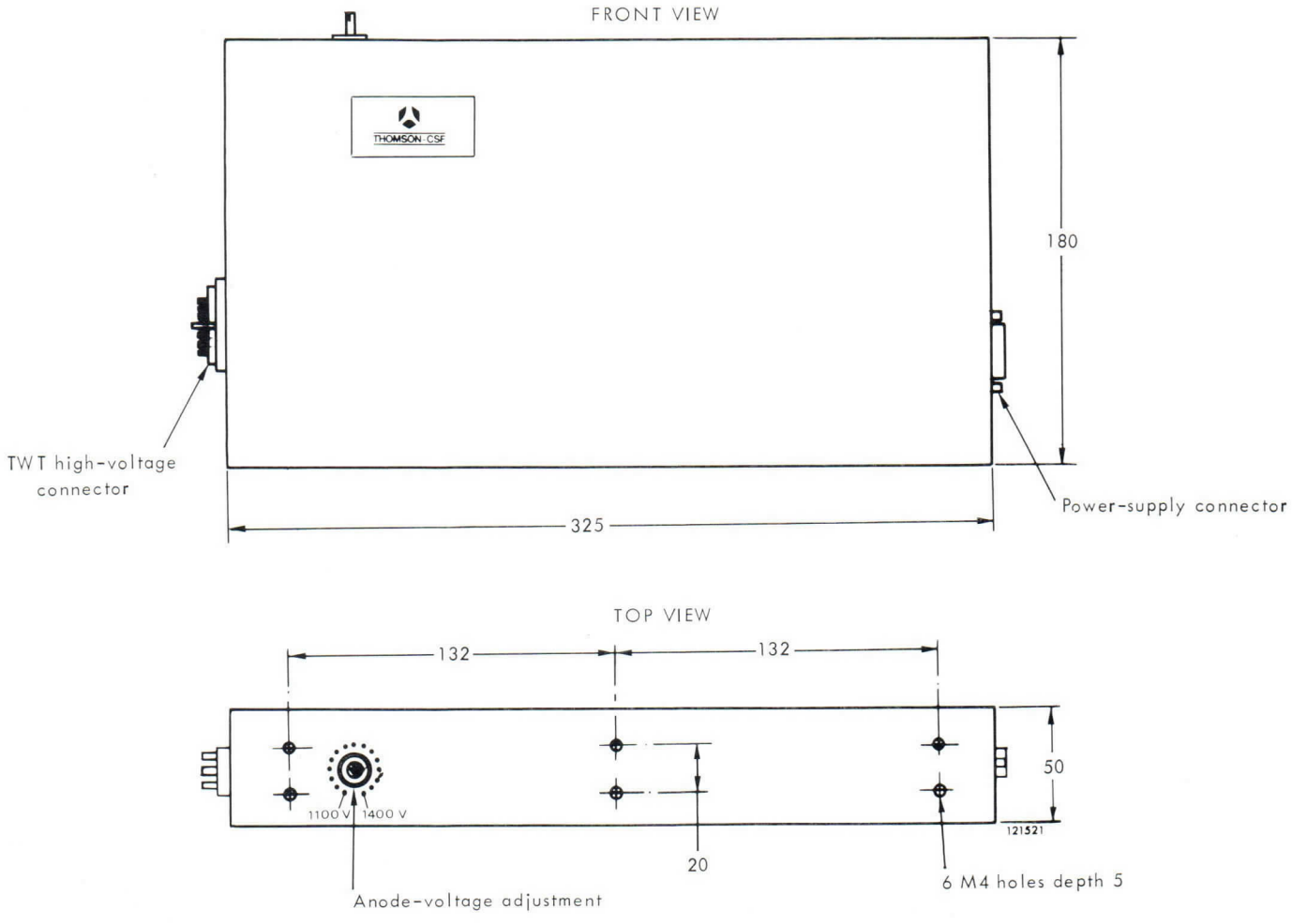
In both cases, the equipment may be provided with TWTA indicating lamps, a cathode-current and helix-current monitoring output and a RESET push button.

INSTALLATION AND MAINTENANCE

The TWT's and their power supplies are interchangeable. The TWT is connected to the power supply via an HV connector. TWT replacement is a very simple operation ; only the anode voltage need be adjusted to obtain the desired output-power level. The anode voltage is adjusted by means of a precalibrated control knob on the power supply housing. In case of disconnection of the HV connector, the equipment is automatically switched off to ensure protection of the personnel and equipment.

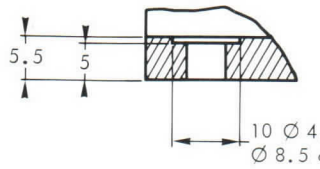
OUTLINE DRAWING

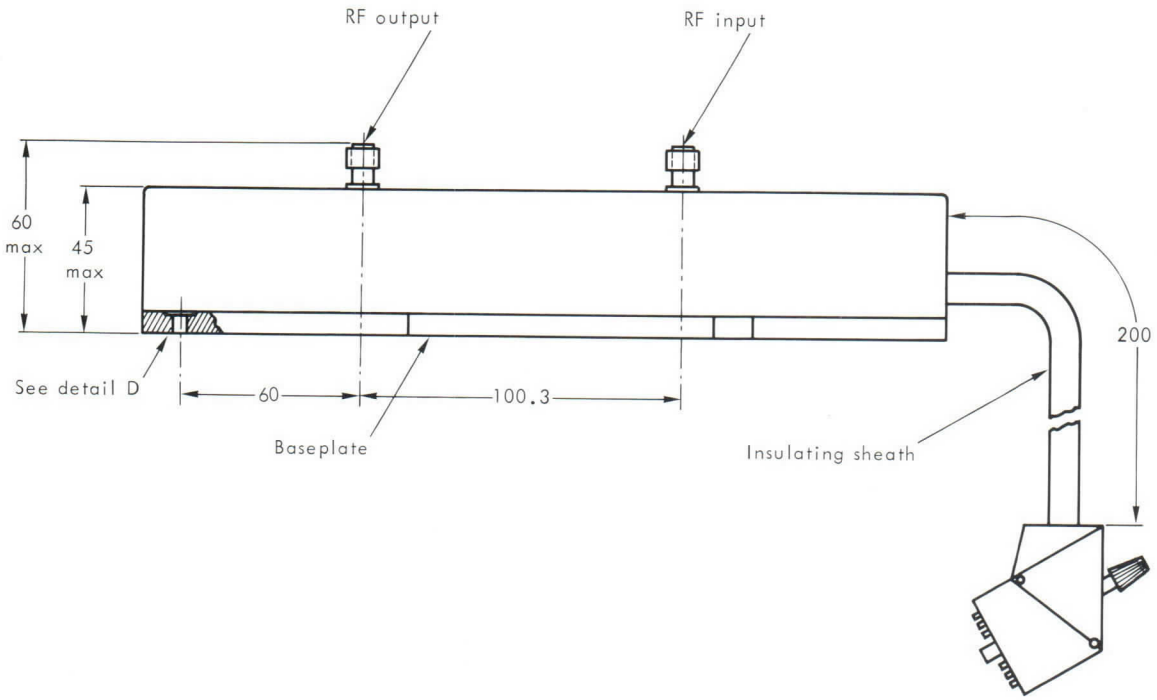
POWER SUPPLY

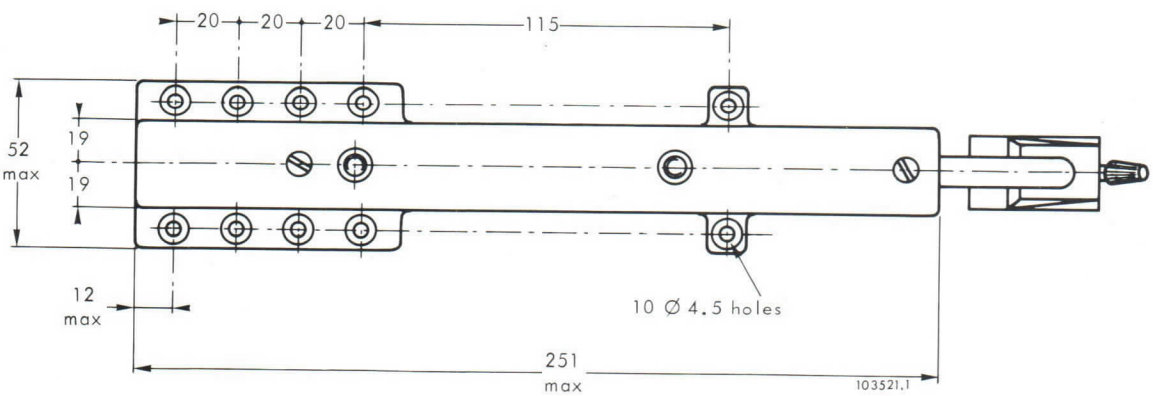


Dimensions in mm

OUTLINE DRAWING
TWT



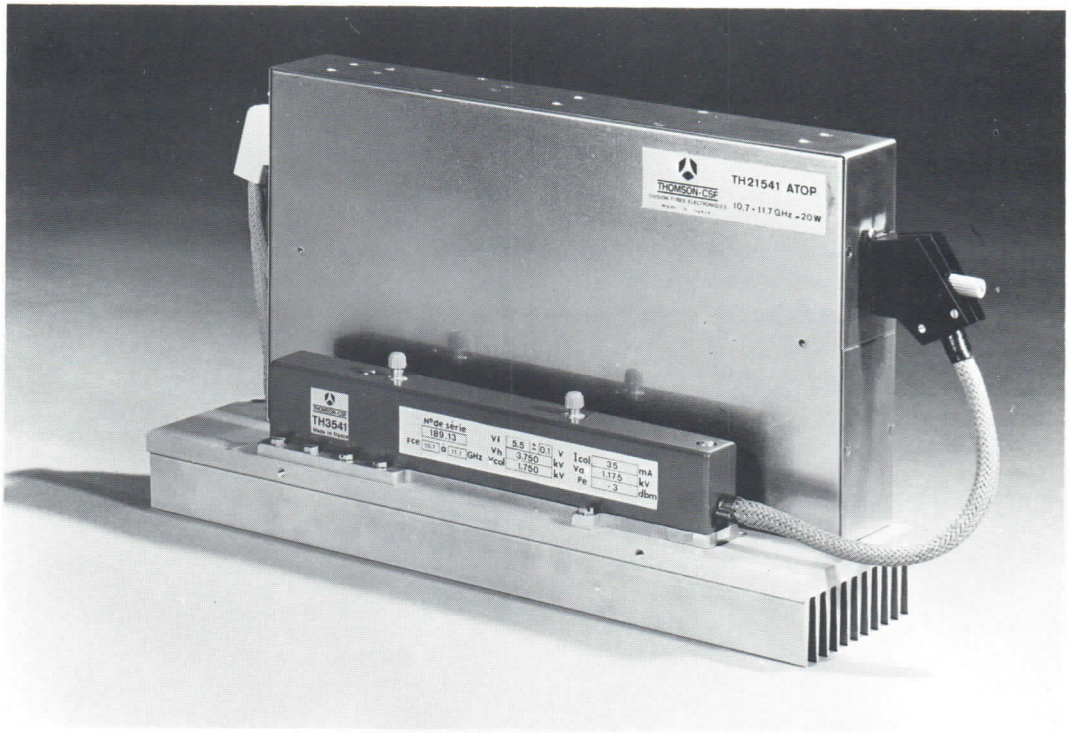




Dimensions in mm, nominal
unless otherwise indicated

AMPLIFICATEUR A TOP TH 21541

10, 7 - 11, 7 GHz - 20 W
POUR FAISCEAUX HERTZIENS EN VISIBILITE DIRECTE



L'amplificateur à TOP TH 21541 est constitué :

- d'une alimentation modulaire à découpage, à haut rendement,
- d'un tube à onde progressive, TH 3541, fonctionnant dans la bande 10, 7 - 11, 7 GHz.

Il est prévu pour équiper des liaisons par faisceaux hertziens à visibilité directe à large bande, pouvant transmettre 1800 voies téléphoniques, et délivre une puissance de sortie de 20 W.

L'alimentation est du type continu-continu. Le découpage se fait à fréquence élevée (20 kHz) assurant ainsi un haut rendement avec un faible poids et des dimensions réduites.

Le TH 3541, dérivé des tubes spatiaux étudiés par la Division Tubes Electroniques THOMSON-CSF, bénéficie d'une technologie d'avant garde, notamment le canon à électrons avec sa cathode imprégnée ainsi que le collecteur déprimé, ce qui lui assure une durée de vie et une fiabilité exceptionnelles.

L'entrée et la sortie RF du tube se font sur des fiches coaxiales.

CARACTERISTIQUES GENERALES

Caractéristiques d'entrée de l'ATOP

Tension d'alimentation, continu (1) (2)	24 V ± 2 %
Puissance consommée maximale	100 W
Puissance consommée typique	85 W

L'entrée réseau de l'ATOP est flottante ; de ce fait, l'utilisateur peut indifféremment relier le pôle positif ou le pôle négatif à la masse.

Caractéristiques mécaniques

Poids : (alimentation + tube)	< 3, 5 kg dont tube = 0. 7 kg
Dimensions hors tout :	
- alimentation	325 x 180 x 50 mm
- tube	251 x 52 x 60 mm
Connexion d'alimentation	Connecteur DA 15 P(15 broches) CANNON ou équivalent
Entrée et sortie RF	Connecteurs SMA

Caractéristiques d'environnement

Type de refroidissement	Conduction
Température de fonctionnement avec toutes les performances garanties	0 à + 45 °C
Température de fonctionnement possible	–10 à + 50 °C
Température de stockage	–40 à + 70 °C
Humidité (maximale)	95 % à + 40 °C

(Les températures s'entendent mesurées sur les plaques de base du tube ou de l'alimentation).

Caractéristiques électriques

Bande de fréquence	10, 7 - 11, 7 GHz
Puissance d'entrée	3 dBm (2 mW)
Puissance de sortie nominale	43 dBm (20 W)
Facteur de bruit, max.	27 dB
Conversion amplitude/phase AM/PM, max.	4 °/dB
Rendement de l'ATOP	22 %

Sécurités prévues dans l'ATOP

Temporisation

Une temporisation interne déclenche l'application des hautes tensions environ trois minutes après la mise sous tension du réseau. Durant cette période, seule la tension de chauffage est appliquée au TOP. Les hautes tensions sont ensuite appliquées simultanément et automatiquement.

Protection Helice

En cas de surintensité hélice, les hautes tensions sont coupées. Le redémarrage s'effectue automatiquement, sans intervention, après quelques secondes, cinq fois de suite. Si le défaut se prolonge il y a un arrêt général de l'ATOP. Le réarmement s'effectue alors par coupure et remise en marche du réseau alimentant l'ATOP ou en utilisant le dispositif de réarmement par télécommande accessible sur le connecteur BT.

Sécurité haute tension

Lorsque le tube est déconnecté, la haute tension se trouve automatiquement coupée pour la protection du personnel et du matériel.

Signalisation

L'ATOP délivre un signal continu (12 V ou 6 mA) pouvant alimenter un diode électroluminescente durant le temps de préchauffage et en cas de disjonction.

(1) Sur demande, d'autres valeurs fixes de tension réseau peuvent être prévues dans une gamme comprise entre 18 et 48 volts.

(2) En option, un régulateur à modulation de largeur d'impulsion peut être prévu à l'intérieur de l'alimentation. Il produit une tension intermédiaire de 24 V regulée à ± 1 % à partir d'un réseau pouvant varier entre 36 et 72 V.

OPTIONS

1 - Sur demande, l'ATOP peut être monté dans un tiroir de rack 19" de deux unités de hauteur, avec possibilité d'y adjoindre un convertisseur ac/dc pour alimentation par réseau 110/220 V alternatif, 50/60 Hz.

2 - L'ATOP peut être également livré avec un radiateur, dans le cas d'un refroidissement naturel.

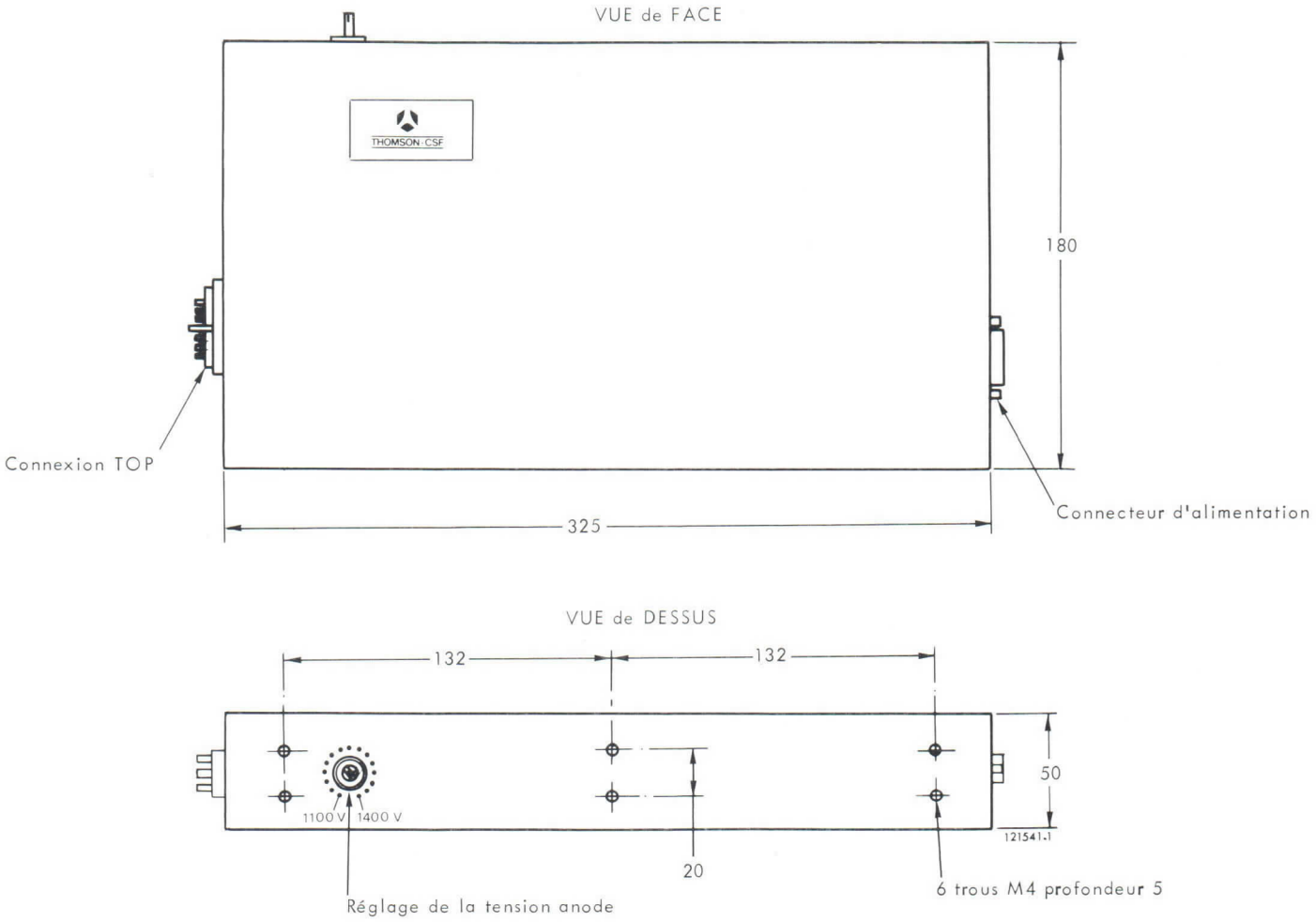
Dans ces deux cas, le matériel peut être munis de voyants indiquant le fonctionnement de l'ATOP, de prise de télémétrie de courant cathode et de courant hélice et d'un bouton de réarmement.

INSTALLATION ET MAINTENANCE

Les TOP et leurs alimentations sont parfaitement interchangeables entre eux. Le raccordement de l'un et l'autre se fait par l'intermédiaire d'un connecteur HT rendant l'opération très simple. Le changement de TOP ne nécessite pas d'autre réglage que celui de la tension d'anode par un commutateur pré-étalonné accessible à l'extérieur du boîtier d'alimentation. En cas de fausse manœuvre ou d'ouverture du connecteur HT l'appareil disjoncte automatiquement et s'autoprotège.

DESSIN D'ENCOMBREMENT

ALIMENTATION



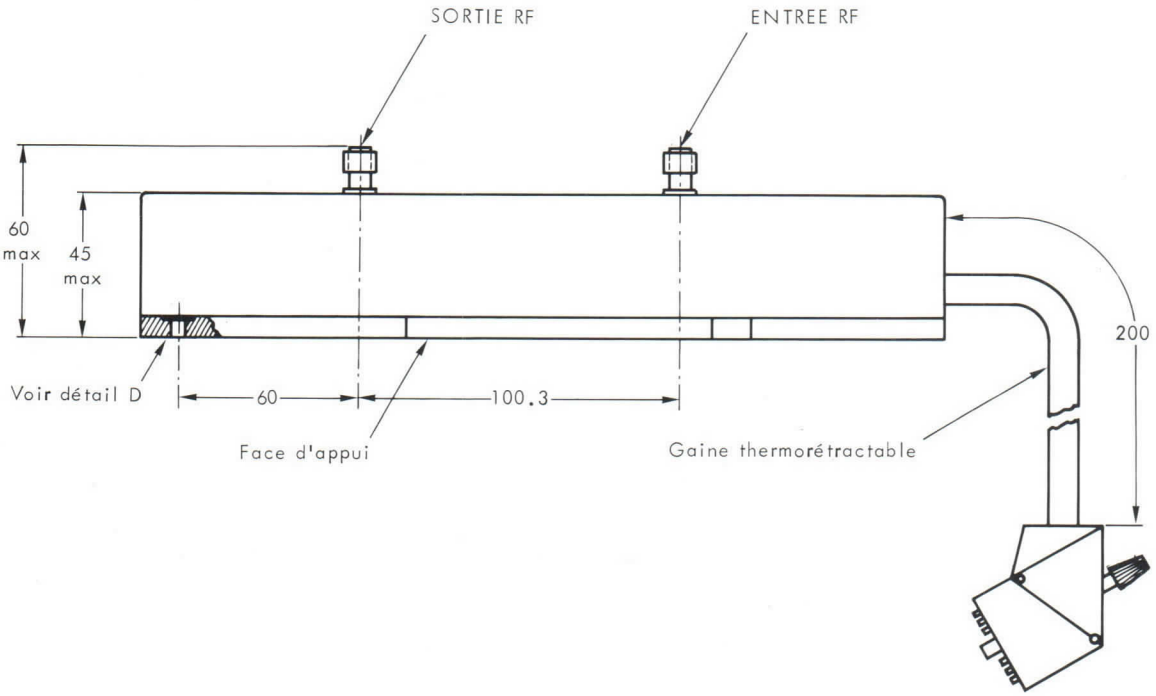
Cotes en mm.

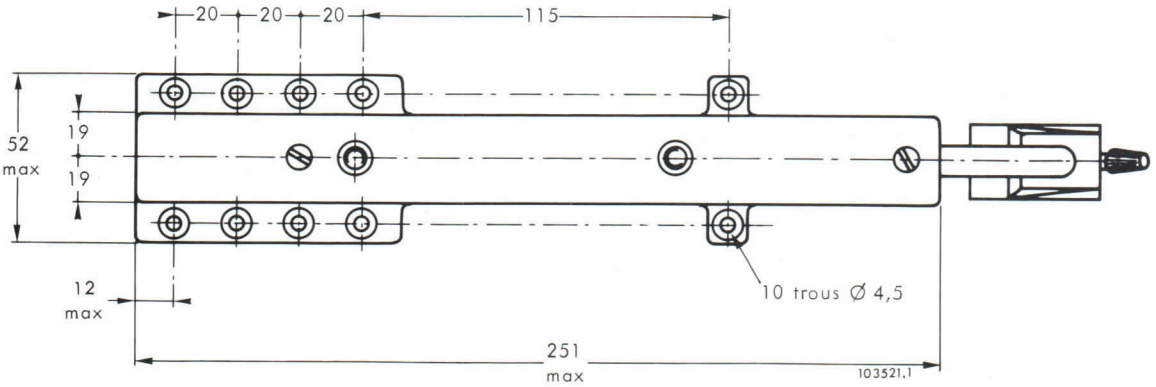
THOMSON-CSF
DIVISION TUBES ELECTRONIQUES

DESSIN D'ENCOMBREMENT

TOP



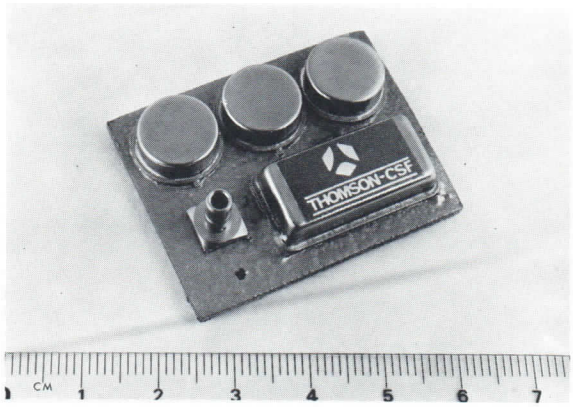




Cotes en mm.

OSCILLATEURS ACOUSTO-HYPERFREQUENCE

- **Grande stabilité**
- **Faible bruit et grande pureté spectrale** obtenue sans multiplication de fréquence.
- **Large gamme de fréquences disponibles** (fréquences de 100 à 2000 MHz en génération directe et jusqu'à 10 GHz par multiplication).
- **Grande souplesse d'adaptation** à tous les types d'équipements.
- **Faible poids et encombrement extrêmement réduit.**
- **Robustesse exceptionnelle.**



Description et principe de fonctionnement

Dans le domaine en rapide évolution des composants acousto-hyperfréquence ou elle occupe une place de tout premier plan, la Division Tubes Electroniques de THOMSON-CSF produit maintenant une nouvelle famille de dispositifs : des oscillateurs fonctionnant jusqu'à 800 MHz (les derniers modèles à l'étude doivent permettre d'obtenir directement des fréquences à 2 GHz). Ils présentent les excellentes caractéristiques de bruit et de stabilité propres aux circuits résonnants à quartz sans être limités en fréquence. Ces oscillateurs représentent l'un des derniers perfectionnements de la technologie acousto-hyperfréquence. En les associant à un simple circuit de multiplication de fréquence on peut réaliser un ensemble dont la fréquence de fonctionnement peut atteindre 10 GHz, avec des caractéristiques de stabilité et de bruit exceptionnelles.

Comme le montre la Figure 1, le principe de l'oscillateur acousto-hyperfréquence consiste à reboucler une ligne à retard sur un amplificateur (de telle sorte que le gain total soit supérieur à 1) et non pas à utiliser un élément résonnant comme le quartz dans les oscillateurs conventionnels.

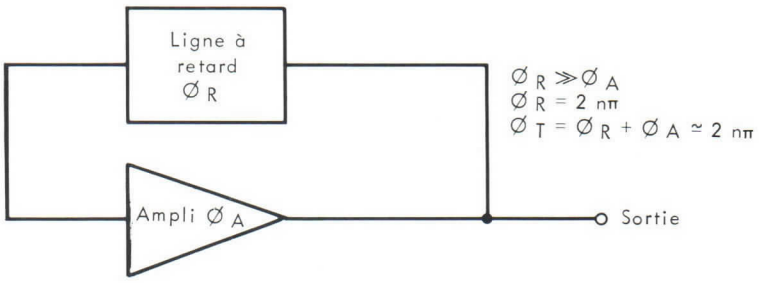


Figure 1 - Diagramme de l'oscillateur et relations de phase.

Le retard et la bande passante de la ligne à retard sont choisis pour sélectionner une raie spectrale particulière. La fréquence est déterminée par la géométrie des transducteurs, déposés sur un substrat piézoélectrique par photolitographie (ce procédé permet de réaliser facilement des oscillateurs correspondant à la demande de l'utilisateur).

Pour obtenir les meilleures conditions de stabilité et de bruit FM par rapport à la fréquence fondamentale, un retard important est généralement utilisé pour obtenir un coefficient de surtension, Q, le plus élevé possible, sans introduire de pertes excessives.

La Figure 2 montre que les circuits électroniques associés à l'oscillateur acoustique ne sont pas très sensibles à la température , leur loi de variation étant pratiquement linéaire. La sensibilité à la température de la ligne à retard variant de façon quasiment parabolique, l'oscillateur acoustique présente par conséquent, une sensibilité du type parabolique avec une variation globale de 60 ppm sur 50 °C de la fréquence en fonction de la température.

CARACTERISTIQUES GENERALES

	Actuelles	Prévisibles
Fréquence centrale (F_o)	100 - 800 MHz	100 MHz - 2 GHz
Stabilité à court terme	< 1 pour 10^{-9} /s	< 1 pour 10^{-10} /s
Stabilité à long terme	< 1 pour 10^{-5} /an	< 1 pour 10^{-6} /an
Stabilité en température (pour une plage de 50 °C)	$< 3 .10^{-5}$/°C	$\leqslant 1. 10^{-6}$ /°C
Puissance de sortie	0 à 20 dBm	—
Bruit à 2 kHz de la porteuse F_o	−120 dB/Hz	−120 dB/Hz
Modulation	—	Possibilité de modulation de fréquence
Dimensions	63 x 63 x 17 mm	—

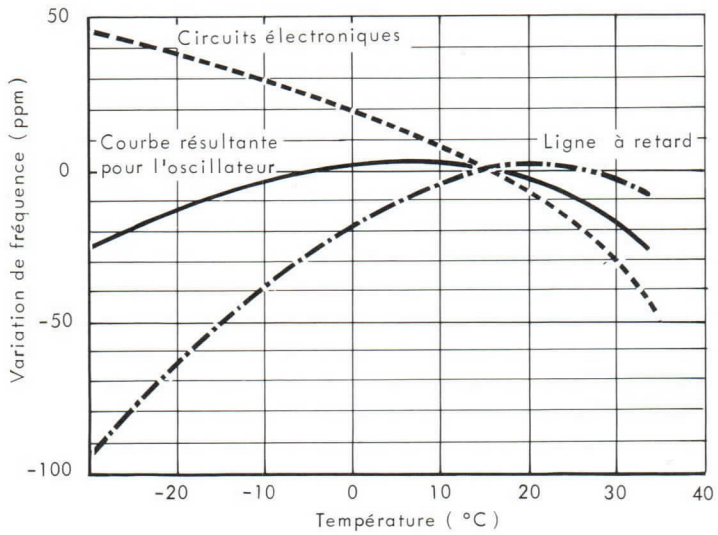
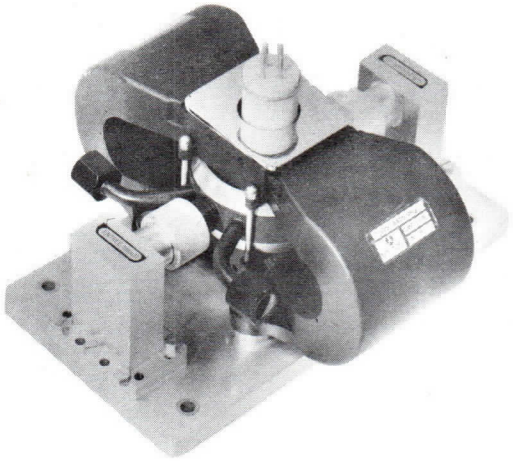


Figure 2 - Variations typiques de la fréquence en fonction de la température pour un oscillateur acousto-hyperfréquence à 500 MHz .

CMP.1115 CARPITRON

The CMP.1115 CARPITRON, a crossed field tube with built-in magnet, delivers a 500 W minimum CW output power over an instantaneous bandwidth of some tens of MHz (according to the input level). Electronically tunable in the telecommunications frequency range 5925 to 6425 MHz., the tube is liquid cooled.

This tube meets the COMSAT requirements concerning transmission of telephony and television for Intelsat III and Intelsat IV satellites.



The principal features of the CMP.1115 are :

- Low size
- Low weight
- High efficiency
- High CW power level.

GENERAL CHARACTERISTICS

ELECTRICAL (1) :

Cathode	Impregnated, indirectly heated	
Heater voltage (a - c)	6.3 ± 2 %	V
Heater current	2.5 to 3.5	A
Sole voltage	−600 to −1800	V
Grid 1 voltage	−100 to − 800	V
Anode 1 voltage	500 to 1800	V
Anode 2 voltage	2.5 to 3.7	kV
Sole current	− 35 to + 3	mA
Grid 1 current	− 3 to + 3	mA
Anode 1 current	− 3 to + 3	mA
Anode 2 current	600	mA

(1) - The voltages are specified with respect to the cathode.

MECHANICAL

Weight	5.7 kg
Mounting position	any
Ambient temperature	− 40 to + 110 °C
Connections :	
- RF connections :	waveguide RG 50/U mates with CMR. 137 flange
- DC connections :	refer to drawing

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Cooling

Liquid cooling		
Water flow (2)	4	l/mn
Outlet temperature, maximum	80	° C

(2) - Please, consult us for other coolants.

Typical operation *(3)*

Frequency	6064	MHz	Grid 1 voltage	−600	V
Instantaneous bandwidth	40	MHz	Anode 1 voltage	1500	V
Output power	600	W	Anode 2 voltage	3300	V
Gain	17	dB	Sole voltage	−900	V
			Anode 2 current	475	mA

Absolute ratings *(3)*

(non simultaneous)

Heater voltage	6 .3 ± 5%	V	Sole voltage	min.	−600	V
Heater current	4	A		max.	−1800	V
Grid 1 voltage *(4)*	± 100	V	Anode 2 current *(4)*	max.	+ 50	mA
Anode 1 voltage *(4)*	max. + 200	V	Temperature of the coolant at			
Anode 2 voltage	max. 3800	V	the output of the cooling circuit		80	° C

(3) - The voltages are specified with respect to the cathode.

(4) - Operating voltages and currents are given for each tube in particular data sheets. The above-mentionned values are tolerances on these voltages.

Operating instructions

The CARPITRON is a locked backward wave oscillator.

For a given adjustment of the supply voltages and a given input power level, the locking can be achieved if the driver frequency is in a so-called " locking bandwidth".

It must be noticed that :

a - Control of the anode 2 current and therefore RF power is achieved by the anode 1 voltage.

b - The operating frequency is fixed by the line to sole voltage ; the frequency adjustment is achieved by varying the sole to cathode voltage and does not need any power consumption.

APPLICATION OF VOLTAGES

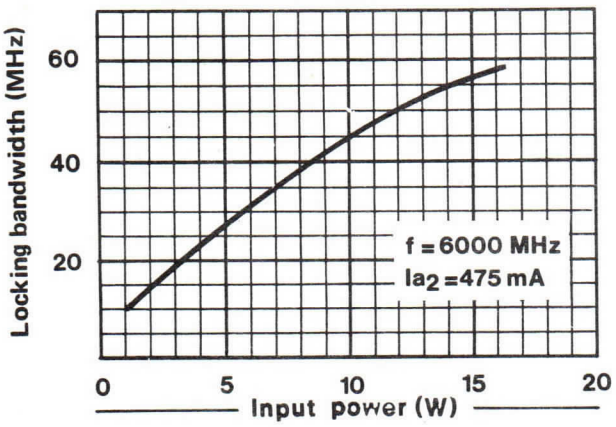
Apply voltages in the following order : Heater, grid 1, sole, anode 2, anode 1.

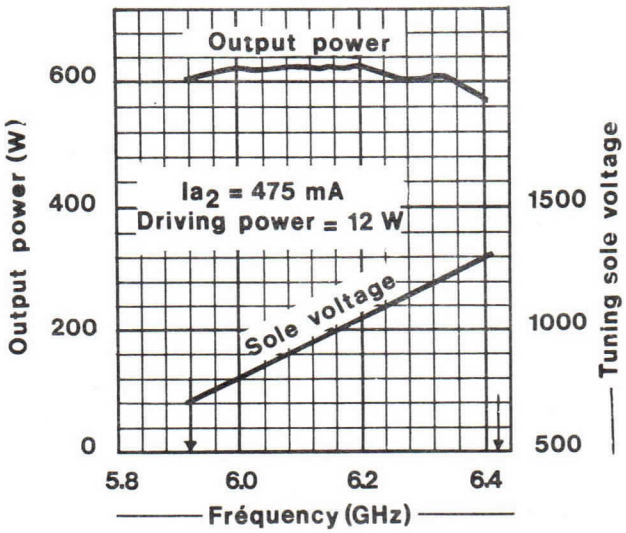
The grid 1 voltage must never be positive.

The anode 2 voltage must always be greater than anode 1 voltage.

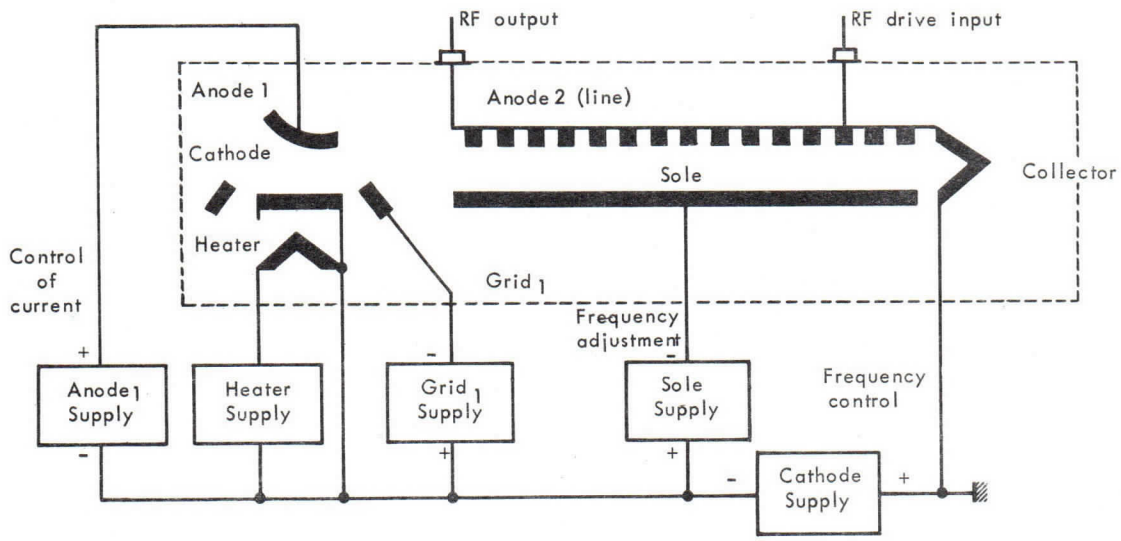
The grid 1 must not be used for modulation.

Characteristics curves



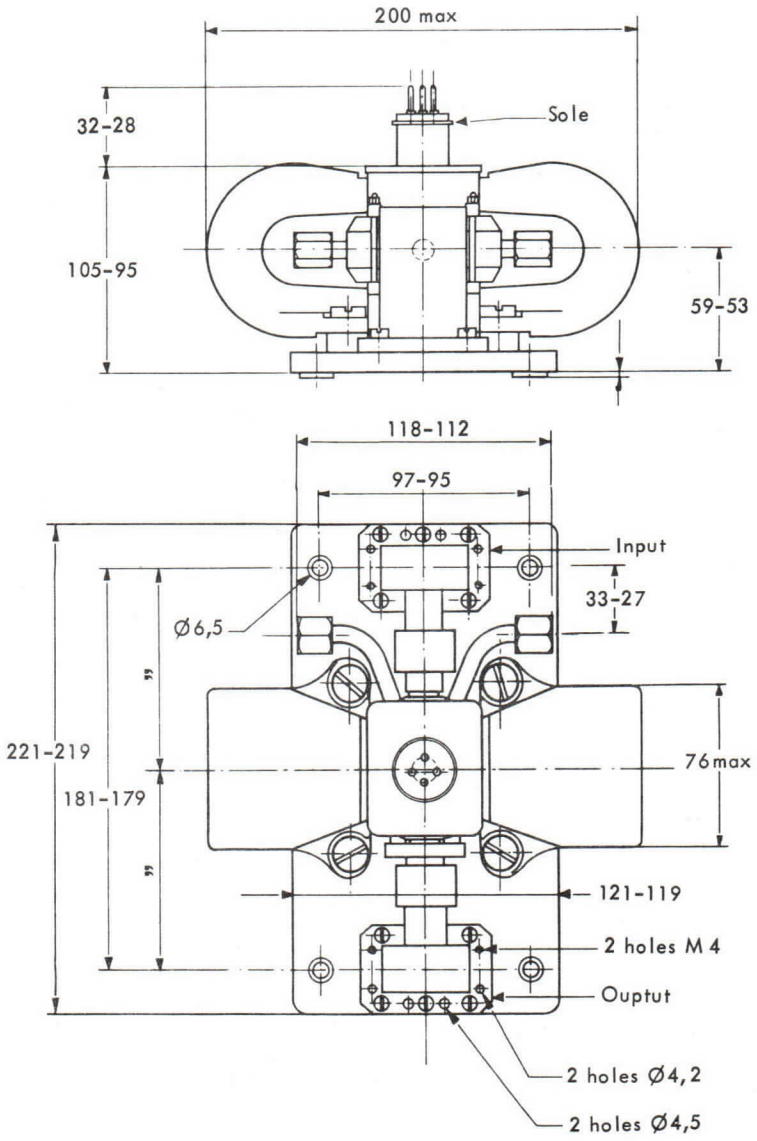


Supply diagram

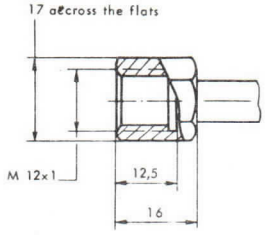


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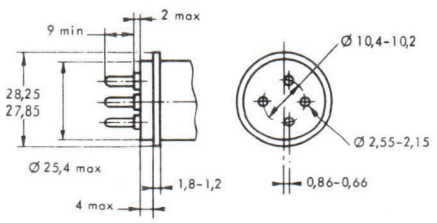
OUTLINE DRAWING



Water outlet hexagonal nut



Pin arrangement



The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0,3 mm.

Dimensions in mm.

CMA 1231 CARCINOTRON



The CMA.1231 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 250 W over the frequency range of 0. 52 to 0. 67 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1231 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage		6. 3	V
Heater current	3. 5	6. 0	A
Output power	250	–	W
Frequency range	0. 52	0. 67	GHz
Interelectrodes capacitances :			
Sole to all other electrodes	–	105	pF
Anode to all other electrodes	–	22	pF
Line to all other electrodes	–	125	pF
Sole voltage	–0. 5	–1. 5	kV
Sole current	–80	0	mA
Grid voltage	–0. 1	–1. 0	kV
Grid current	–	1. 0	mA
Anode voltage	–	2. 0	kV
Anode current	–0. 25	+2. 0	mA
Line voltage	1. 5	5. 0	kV
Line current		350	mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	22. 5 kg
RF output connector	coaxial

(1) - All voltages are referred to the cathode.

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GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 07	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	2. 7	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 55	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	2. 7	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	5	—	mn
Heater voltage	6. 1	6. 6	V
Heater surge current	—	10	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	–40	+110	° C
Vibration :			
5 to 15 Hz	—	0. 5 g	
15 to 500 Hz	—	2 g	

	min.	max.	
Sole voltage (3)	–50	+50	V
Grid voltage	0	–1. 1	kV
Anode voltage	—	2. 2	kV
Line voltage	—	5. 2	kV
Line current	—	375	mA
Acceleration	—	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	0. 52	0. 67	GHz
Heater current	4. 5	A				
Sole voltage	–0. 9	kV	Anode voltage	0. 89	0. 90	kV
Grid voltage	–0. 3	kV	Line voltage	2. 60	4. 55	kV
Grid current	0	mA	Sole current	–15	–30	mA
Line current	350	mA	Output power	280	350	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least five minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

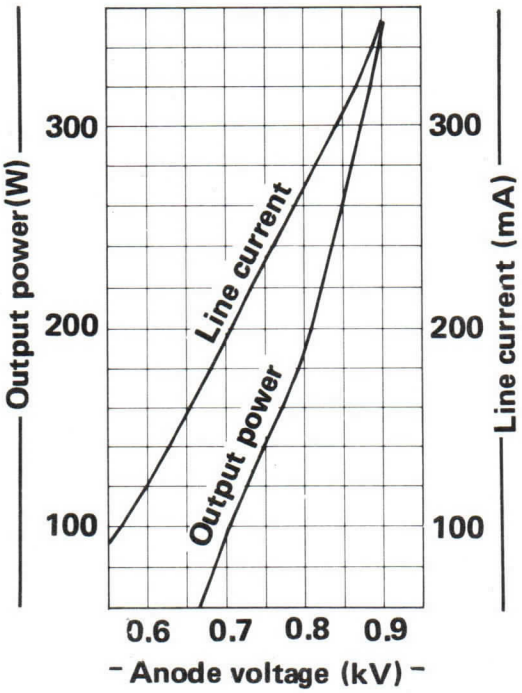
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

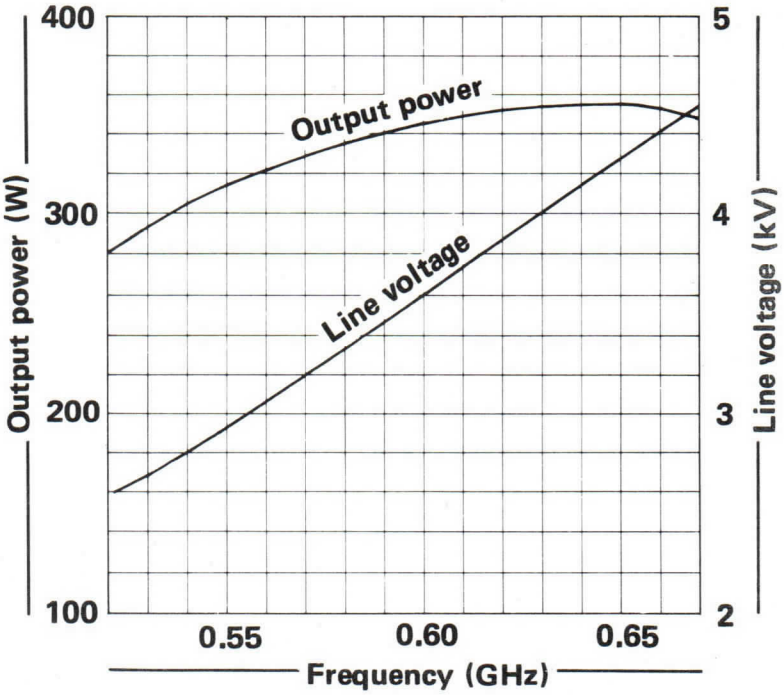
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

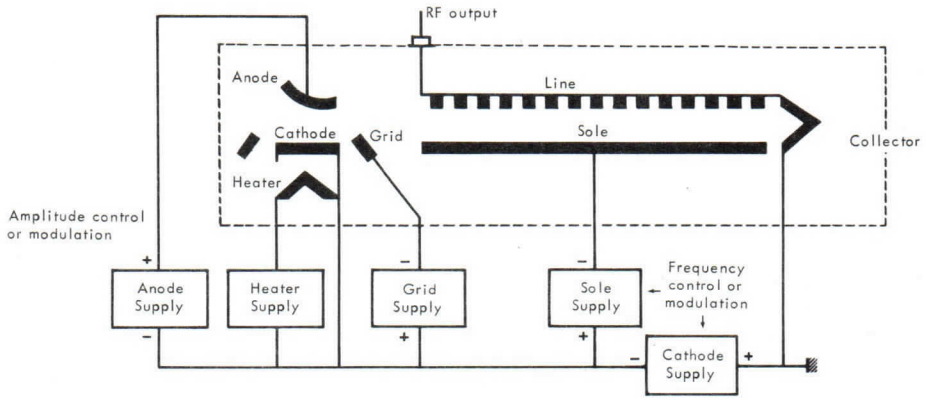
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



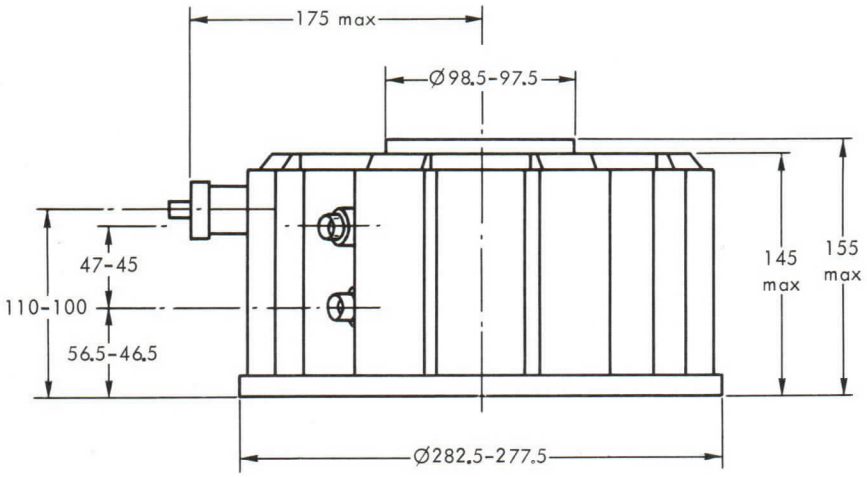


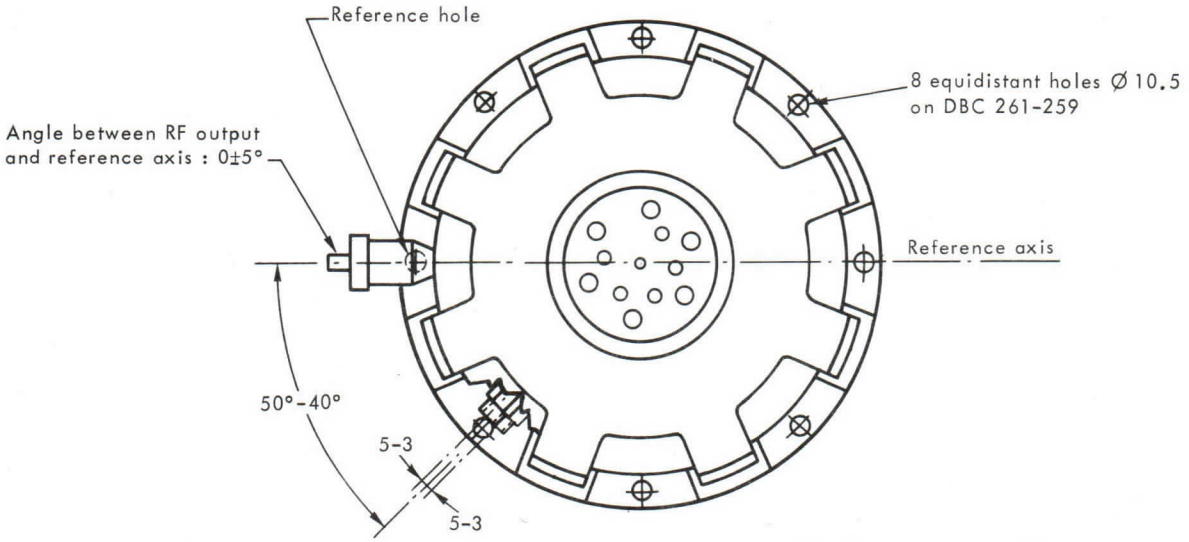
Supply diagram



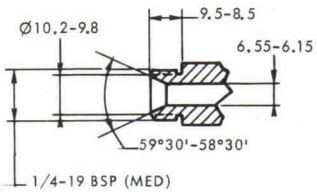
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OUTLINE DRAWING

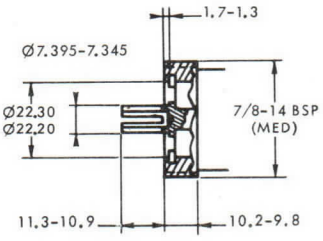




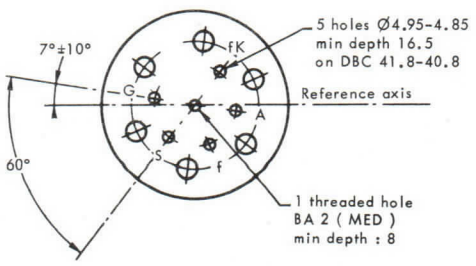
Water connection



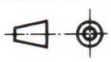
RF output



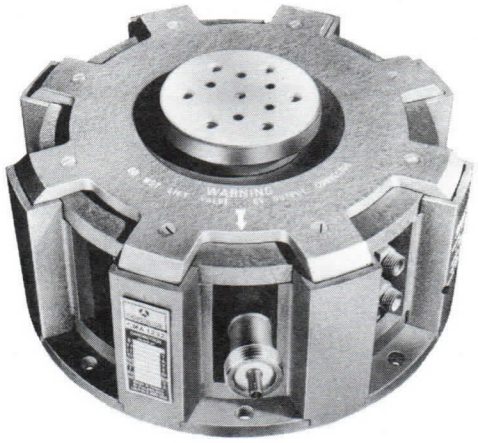
Connector



Dimensions in mm.



CMA 1232 CARCINOTRON



The CMA.1232 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 250 W over the frequency range of 0. 66 to 0. 86 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1232 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	3. 5	6. 6	A
Output power	250	–	W
Frequency range	0. 66	0. 86	GHz
Interelectrodes capacitances :			
Sole to all other electrodes	–	105	pF
Anode to all other electrodes	–	22	pF
Line to all other electrodes	–	125	pF
Sole voltage	–0. 5	–1. 5	kV
Sole current	–80	0	mA
Grid voltage	–0. 1	–1. 0	kV
Grid current	–	1	mA
Anode voltage	–	2. 0	kV
Anode current	–0. 25	+2. 0	mA
Line voltage	1. 5	5. 0	kV
Line current		350	mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	21. 5 kg
RF output connector	coaxial

(1) - All voltages are referred to the cathode.

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COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 065	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	2. 7	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 30	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	2. 7	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	5	—	mn
Heater voltage	6. 1	6. 6	V
Heater surge current	—	10	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	— 40	+110	° C
Vibration :			
5 to 15 Hz	—	0. 5 g	
10 to 500 Hz	—	2 g	

	min.	max.	
Sole voltage (3)	—50	+50	V
Grid voltage	0	—11	kV
Anode voltage	—	2. 2	kV
Line voltage	—	5. 2	kV
Line current	—	375	mA
Acceleration		15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	0. 66	0.8 6	GHz
Heater current	4. 5	A				
Sole voltage	—0. 9	kV	Anode voltage	0. 90	0. 91	kV
Grid voltage	—0. 6	kV	Line voltage	2. 50	4. 55	kV
Grid current	0	mA	Sole current	—15	—40	mA
Line current	350	mA	Output power	300	430	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least five minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

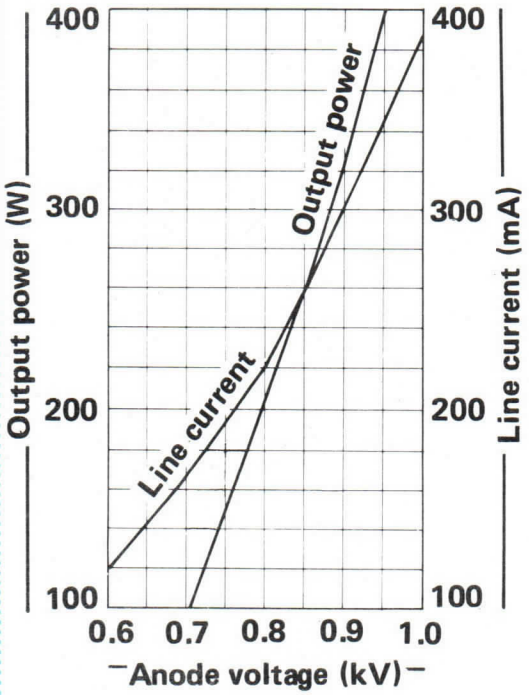
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

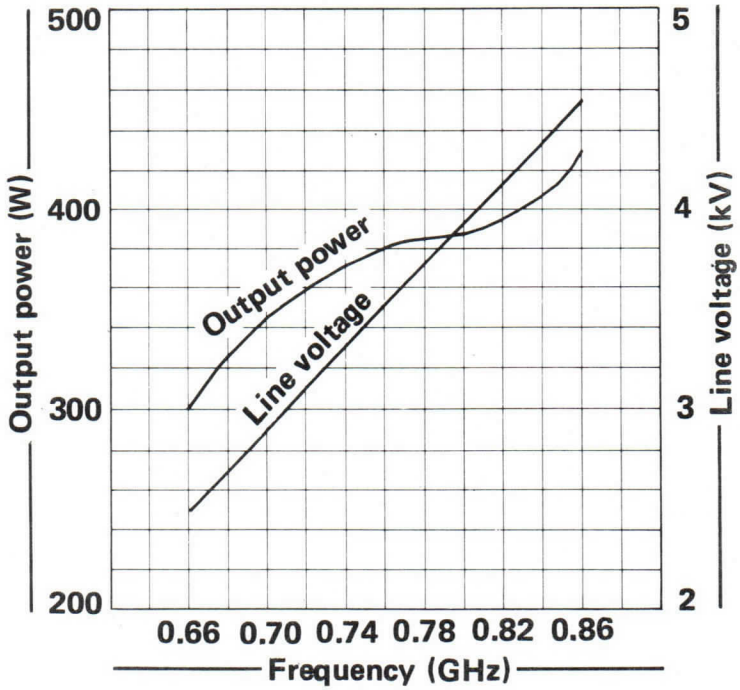
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

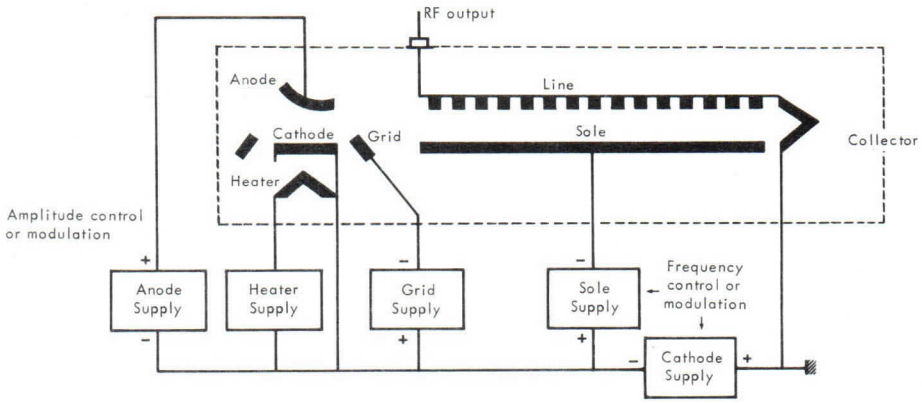
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



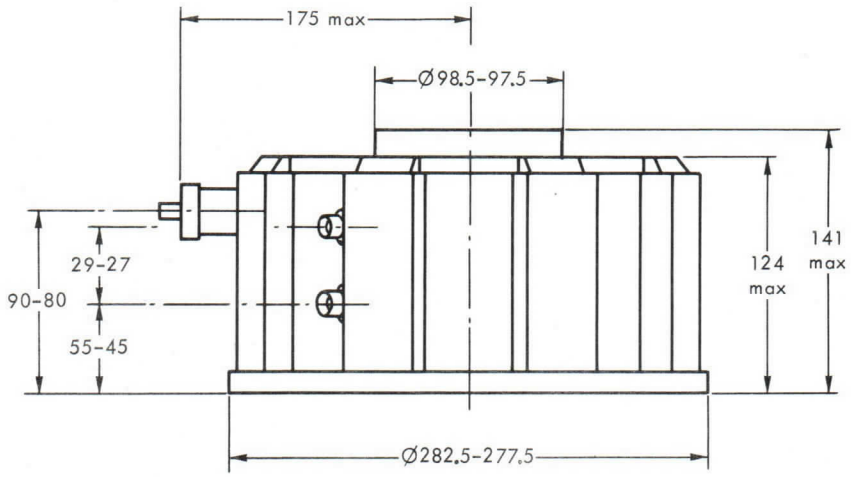


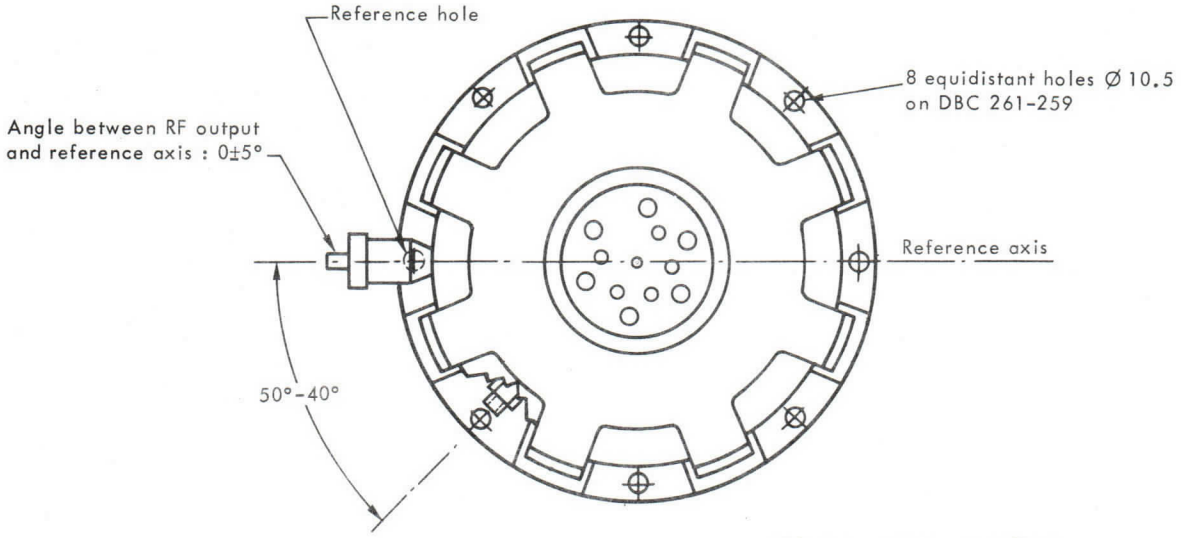
Supply diagram



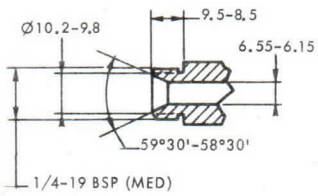
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

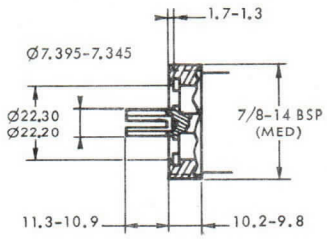




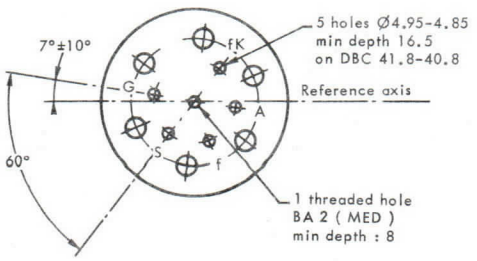
Water connection



RF output

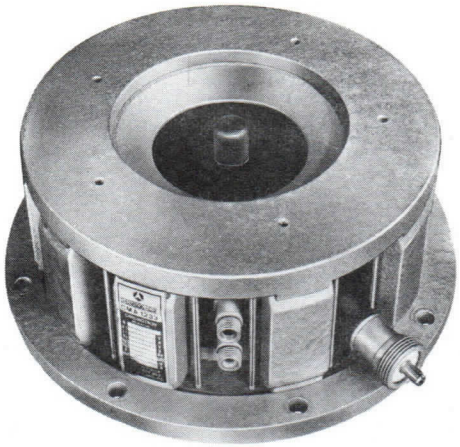


Connector



Dimensions in mm.

CMA 1233 CARCINOTRON



The CMA.1233 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 250 W over the frequency range of 0. 85 to 1. 1 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1233 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	3. 5	6. 0	A
Output power	250	-	W
Frequency range	0. 85	1. 1	GHz
Interelectrodes capacitances :			
Sole to all other electrodes	-	105	pF
Anode to all other electrodes	-	18	pF
Line to all other electrodes	-	105	pF
Sole voltage	−0. 5	−1. 5	kV
Sole current	−80	0	mA
Grid voltage	−0. 1	−1. 0	kV
Grid current	-	1	mA
Anode voltage	-	2. 0	kV
Anode current	−0. 25	+2. 0	mA
Line voltage	1. 5	5. 0	kV
Line current	350		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	17 kg
RF output connector	coaxial

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0.05	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	2.7	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0.25	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	2.7	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	5	-	mn
Heater voltage	6.1	6.6	V
Heater surge current	-	10	A
Load VSWR (2)		3:1	
Ambient temperature	−40	+110	°C
Vibration : 5 to 15 Hz	-	0.5	g
15 to 500 Hz	-	2	g

	min.	max.	
Sole voltage (3)	−50	+50	V
Grid voltage	0	−1.1	kV
Anode voltage	-	2.2	kV
Line voltage	-	5.2	kV
Line current	-	375	mA
Acceleration	-	15	g

TYPICAL OPERATION

Heater voltage	6.3	V	Oscillating frequency :	0.85	1.10	GHz
Heater current	5.0	A				
Sole voltage	−1.1	kV	Anode voltage	1.26	1.25	kV
Grid voltage	−0.3	kV	Line voltage	2.60	4.75	kV
Grid current	0	mA	Sole current	−15	−60	mA
Line current	350	mA	Output power	370	570	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least five minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

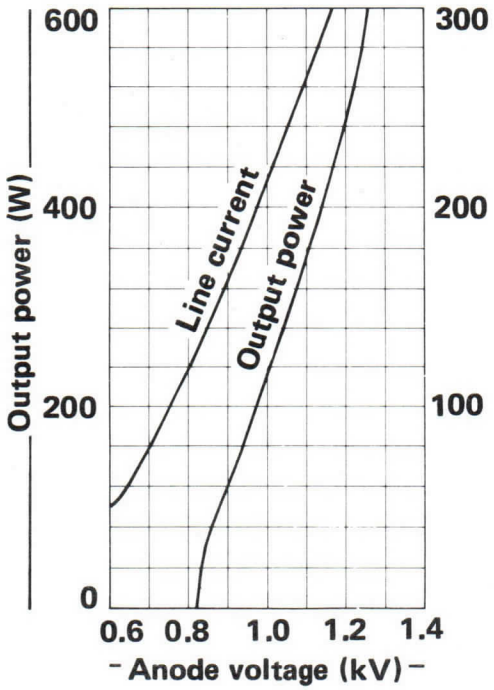
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

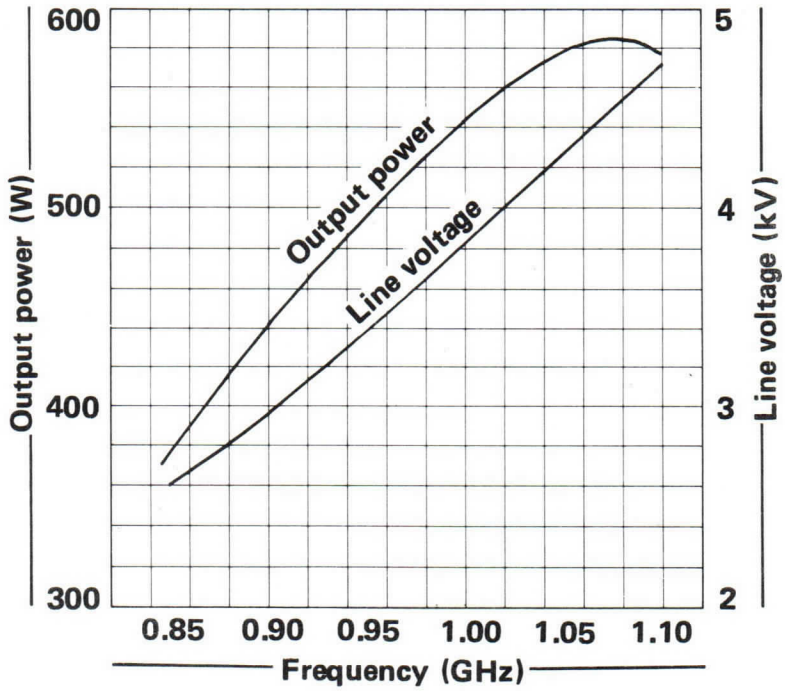
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

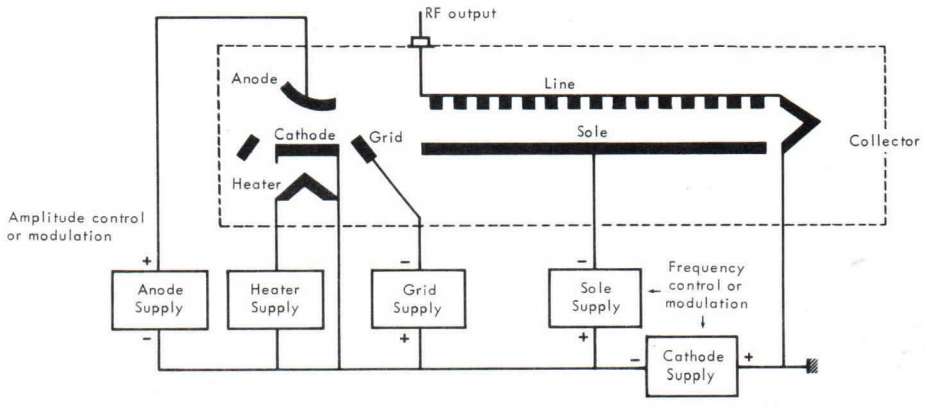
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1.5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



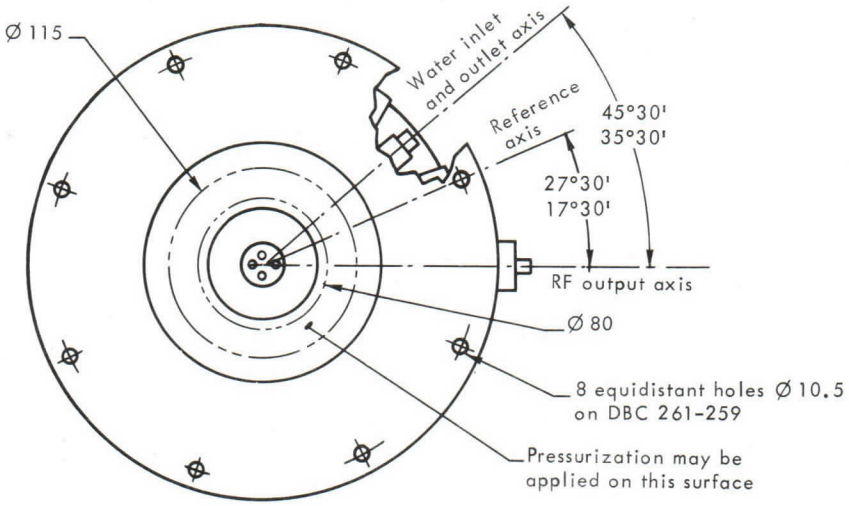


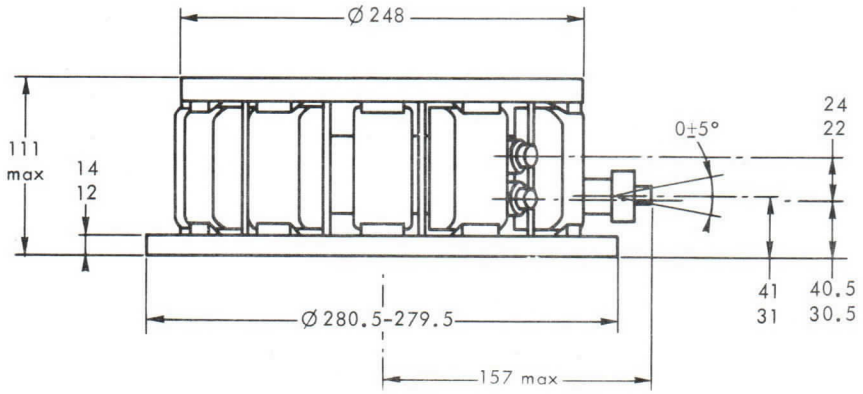
Supply diagram



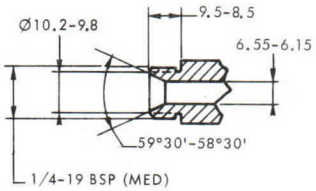
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

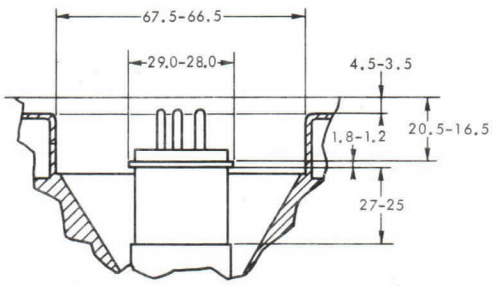




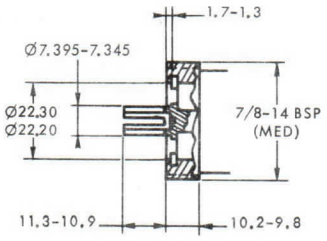
Water connection

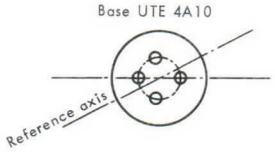


Pin arrangement



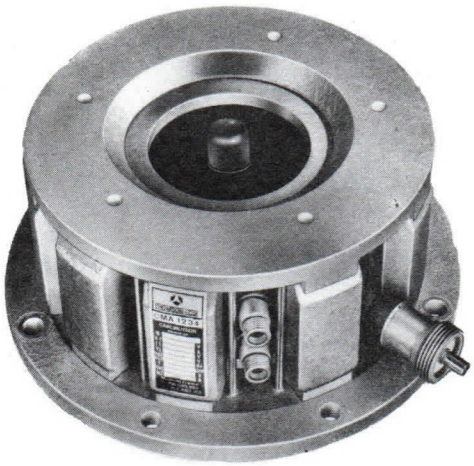
RF output





Dimensions in mm

CMA.1234 CARCINOTRON



The CMA.1234 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 250 W over the frequency range of 1. 06 to 1. 37 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1234 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	3. 5		6. 0	V
Output power	250		-	W
Frequency range	1. 06		1. 37	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	-		105	pF
Anode to all other electrodes	-		18	pF
Line to all other electrodes	-		105	pF
Sole voltage	–0. 5		–1. 5	kV
Sole current	–80		0	mA
Grid voltage	–0. 1		–1. 0	kV
Grid current	-		1. 0	mA
Anode voltage	-		2. 0	kV
Anode current	–0. 25		+2. 0	mA
Line voltage	1. 5		5. 0	kV
Line current		350		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	13 kg
RF output connector	coaxial

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 25	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	2. 7	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 85	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	2. 7	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	5	-	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	-	6. 0	A
Load VSWR (2)		3: 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz		0. 5 g	
15 to 500 Hz		2 g	

	min.	max.	
Sole voltage	–500	–2100	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	-	+200	V
Line voltage	-	+5. 2	kV
Line current	-	440	mA
Acceleration	-	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V
Heater current	4. 5	A
Sole voltage	–0. 9	kV
Grid voltage	–0. 4	kV
Grid current	0	mA
Line current	350	mA

Oscillating frequency :	1. 06	1. 37	GHz
Anode voltage	970	960	V
Line voltage	2. 55	4. 75	kV
Sole current	15	60	mA
Output power	310	540	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least five minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

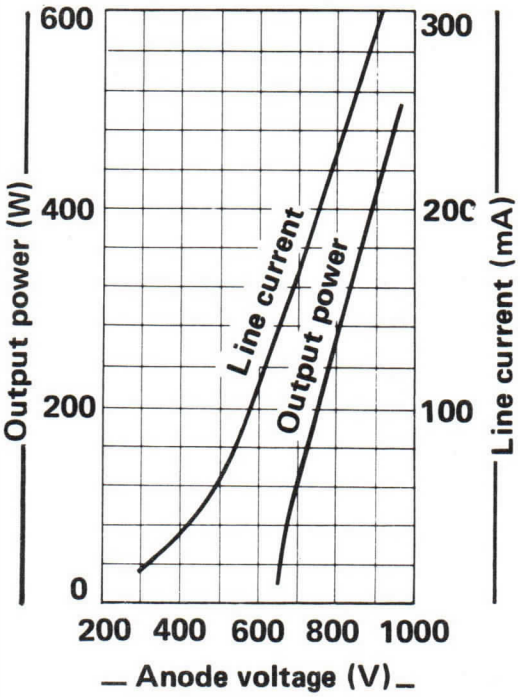
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

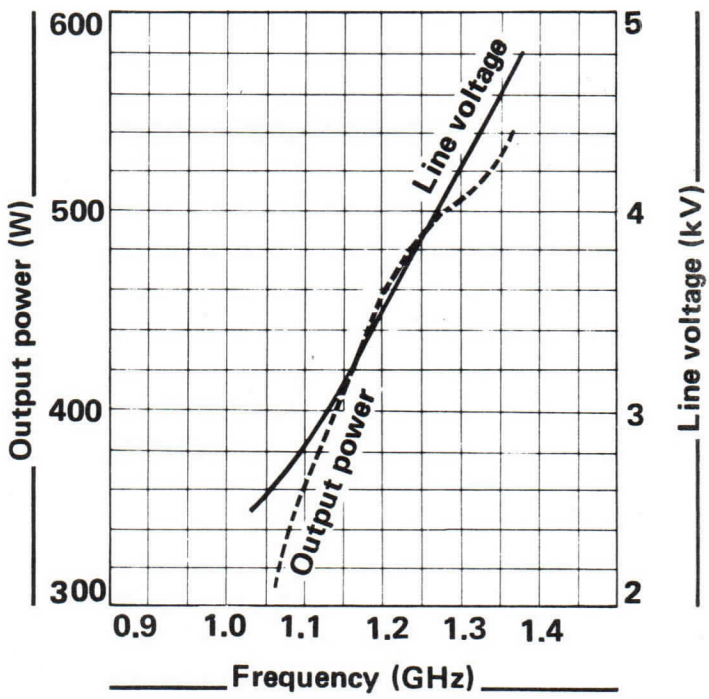
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

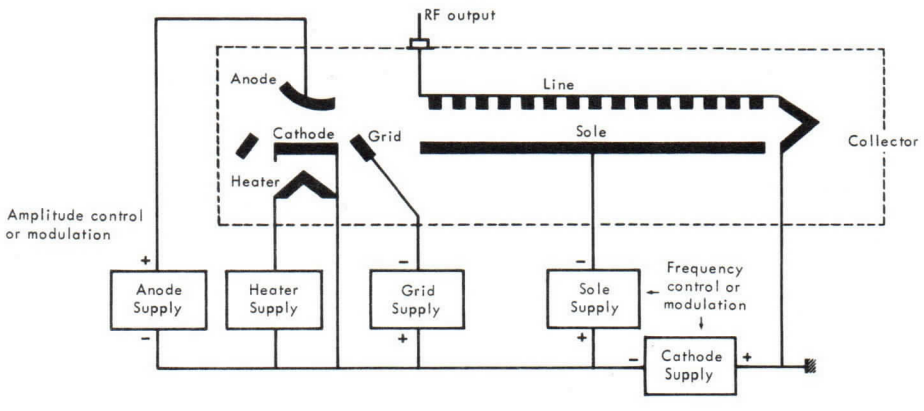
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



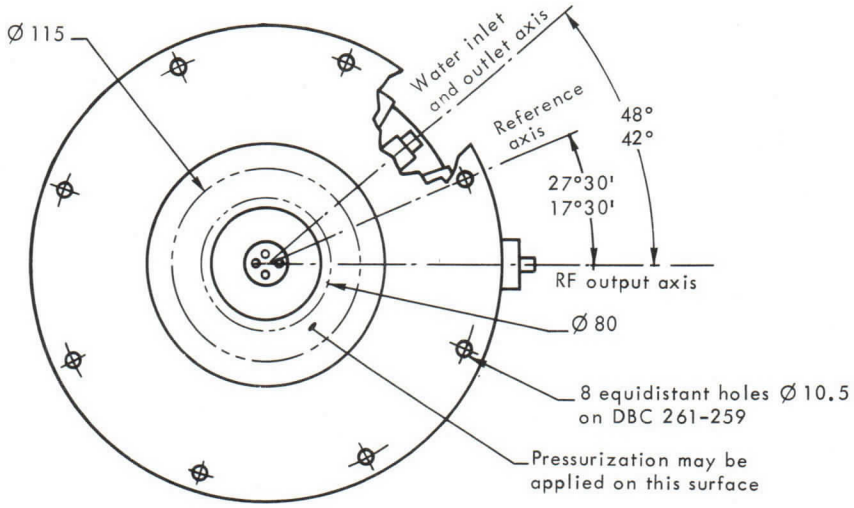


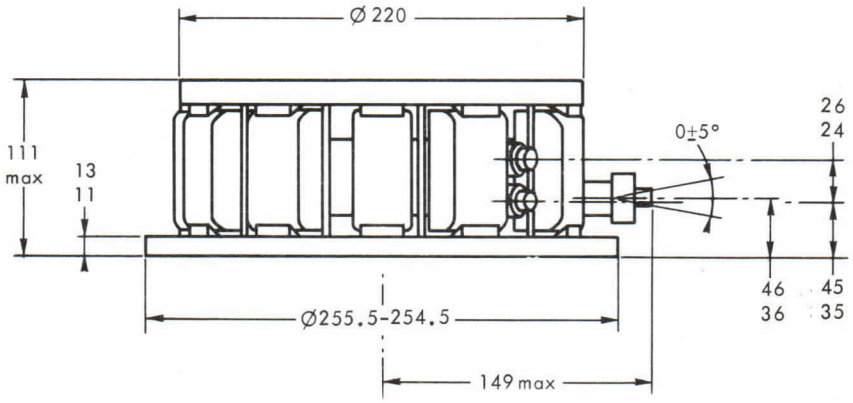
Supply diagram



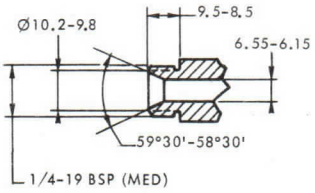
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

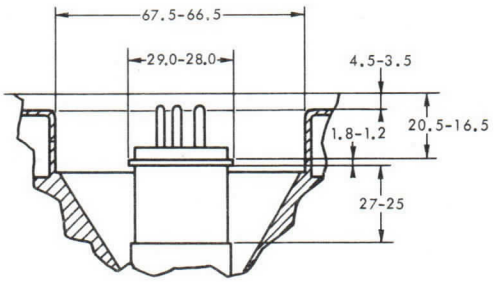




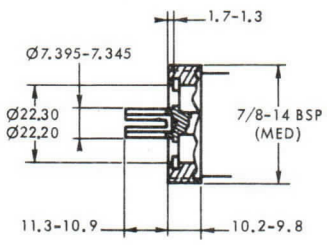
Water connection

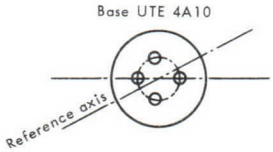


Pin arrangement

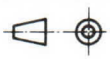


RF output





Dimensions in mm

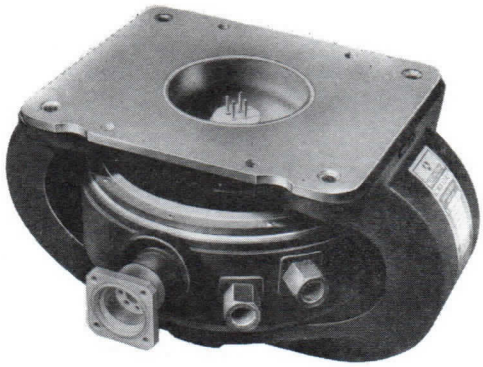


CMA.1241 CARCINOTRON

The CMA.1241 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 750 W over the frequency range of 0. 80 to 1. 06 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.



The CMA.1241 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 5		6. 0	A
Output power	750		–	W
Frequency range	0. 80		1. 06	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		125	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		125	pF
Sole voltage	–0. 7		–1. 6	kV
Sole current	–150		+10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	–3		+3	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		6. 0	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	14 kg
RF output connector	coaxial UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	4	l/mn
Pressure drop (1)	max.	0. 2	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	4	bar

COOLANOL 35

Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0. 25	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	—	12	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz		± 1 mm	
15 to 500 Hz		2 g	

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	—	200	V
Line voltage	—	6. 2	kV
Line current	—	650	mA
Acceleration		15	g

TYPICAL OPERATION

Heater voltage	6. 3	V
Heater current	5. 3	A
Sole voltage	–1. 0	kV
Grid voltage	–0. 4	kV
Grid current	0	mA
Line current	600	mA

Oscillating frequency :	0. 80	1. 06	GHz
Anode voltage	1. 60	1. 65	kV
Line voltage	3. 1	5. 8	kV
Sole current	–40	–110	mA
Output power	850	1000	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

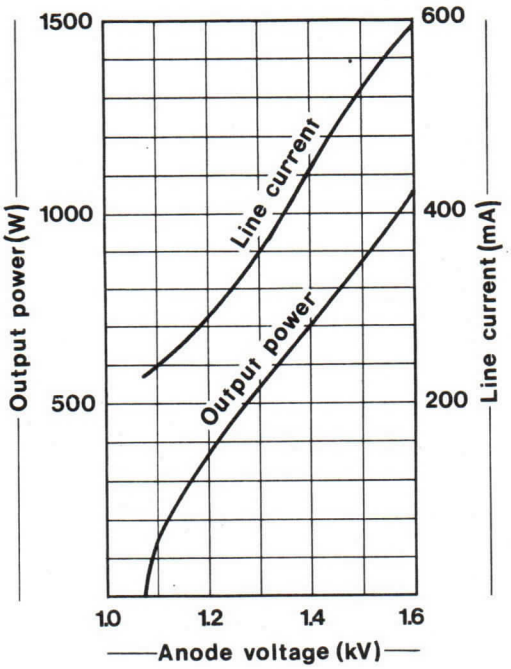
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

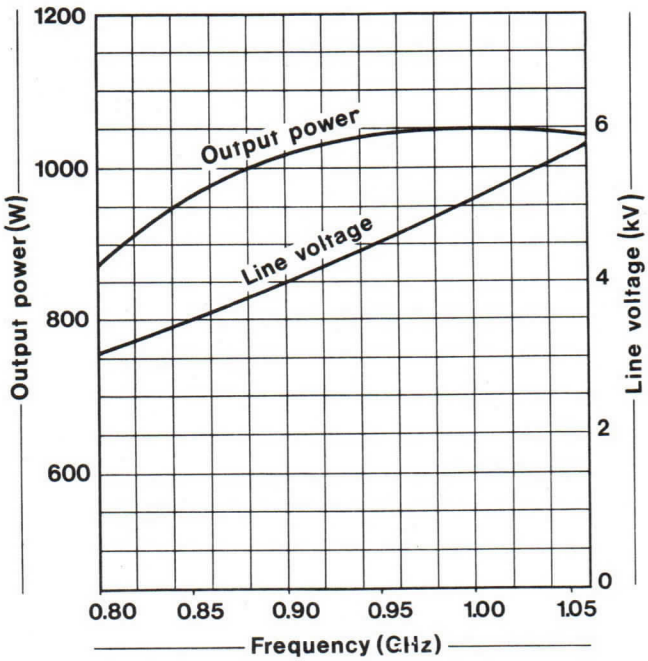
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

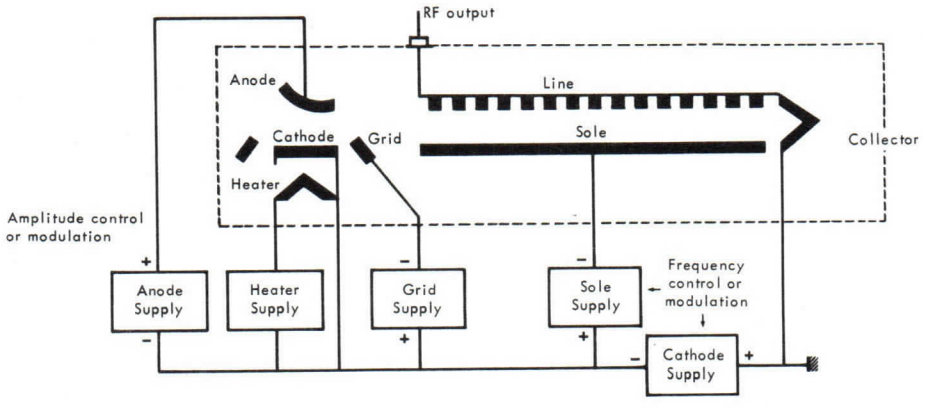
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



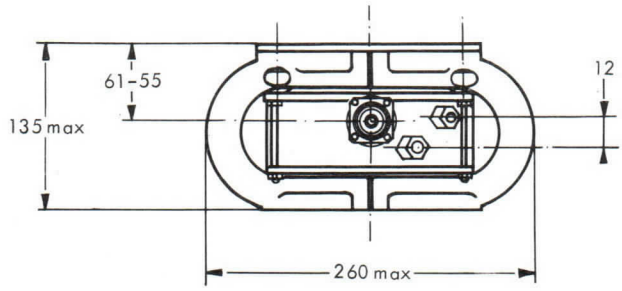


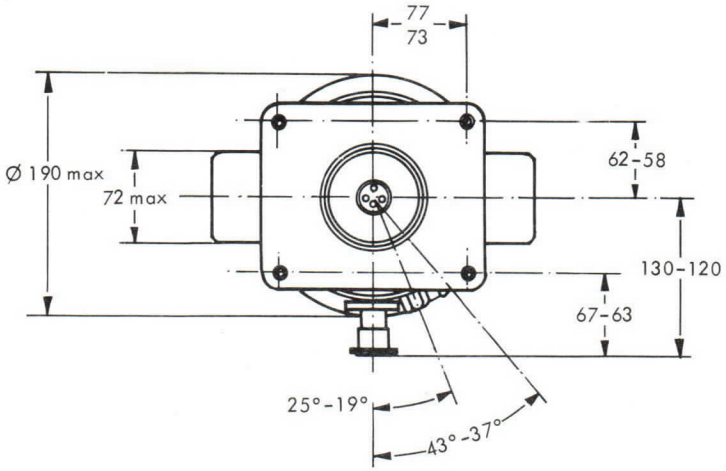
Supply diagram



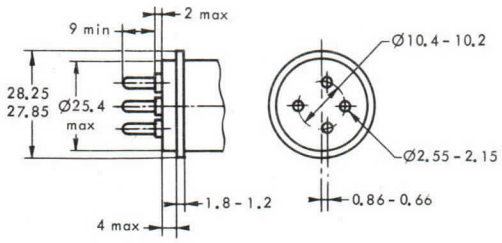
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





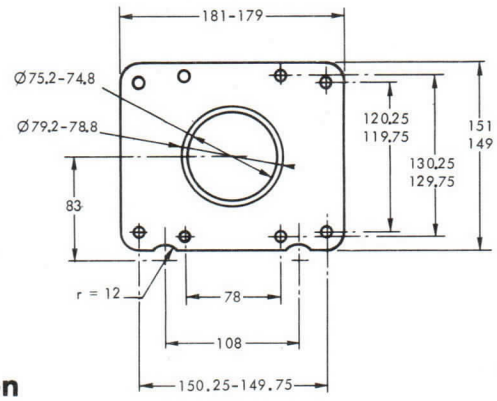
Pin arrangement



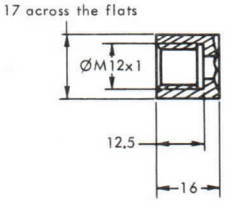
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Pressurization flange



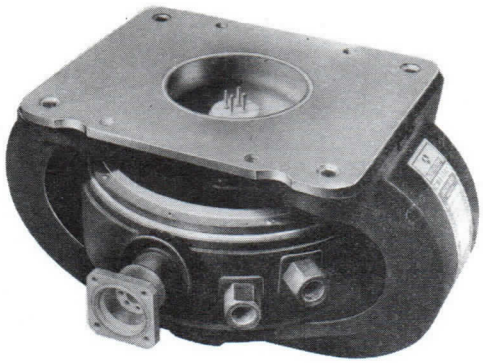
Water connection



Dimensions in mm.

CMA.1242 CARCINOTRON

The CMA.1242 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 750 W over the frequency range of 1. 06 to 1. 37 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1242 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 5		6. 0	A
Output power	750		–	W
Frequency range	1. 06		1. 37	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–0. 7		–1. 6	kV
Sole current	–150		+10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	– 3		– 3	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		6. 0	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	13. 5 kg
RF output connector	UG 46/U coaxial

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	4	l/mn
Pressure drop (1)	max.	0. 15	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	4	bar

COOLANOL 35

Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0. 2	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	—	12	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	–40	110	° C

Vibration :

5 to 15 Hz ± 1 mm
15 to 500 Hz 2 g

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	– 50	+ 50	V
Anode voltage (3)	—	+200	V
Line voltage	—	6. 2	kV
Line current	—	650	mA
Acceleration	—	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V
Heater current	4. 6	A
Sole voltage	–1. 1	kV
Grid voltage	–0. 5	kV
Grid current	0	mA
Line current	600	mA

Oscillating frequency :	1. 06	1. 37	GHz
Anode voltage	1. 60	1. 62	kV
Line voltage	3. 0	5. 5	kV
Sole current	–30	–80	mA
Output power	850	1250	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

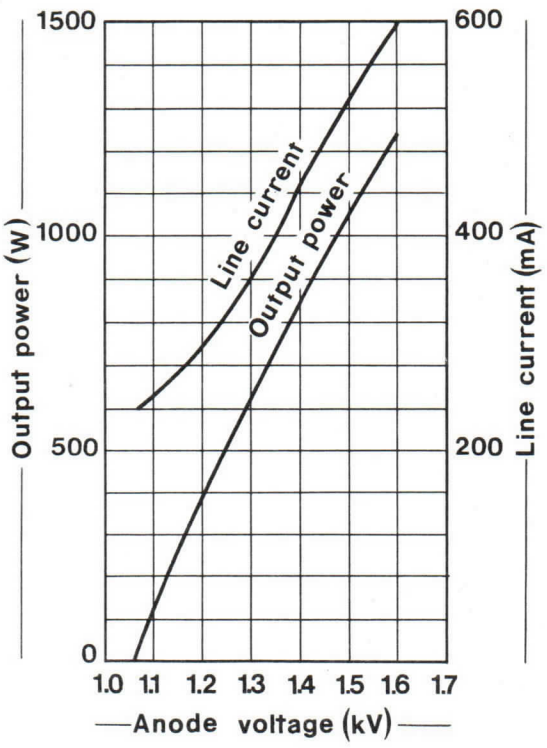
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Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

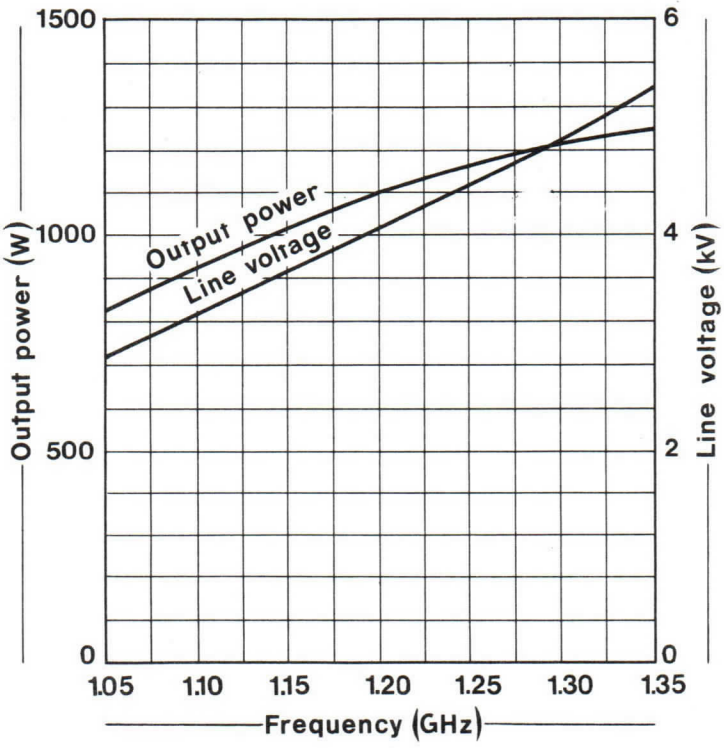
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

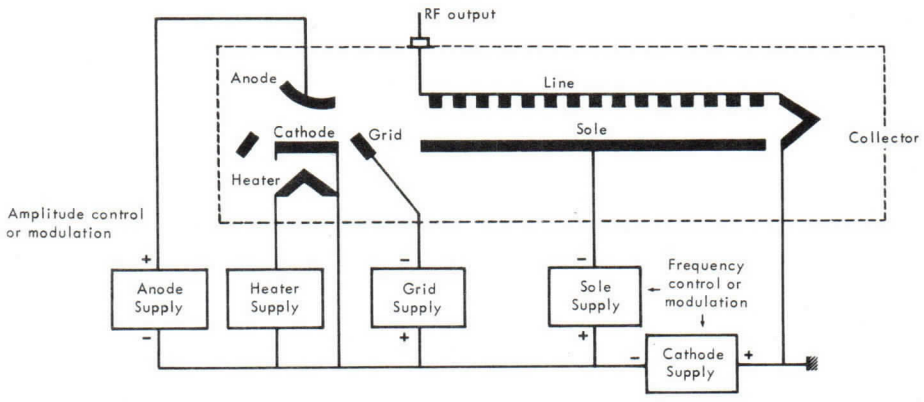
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



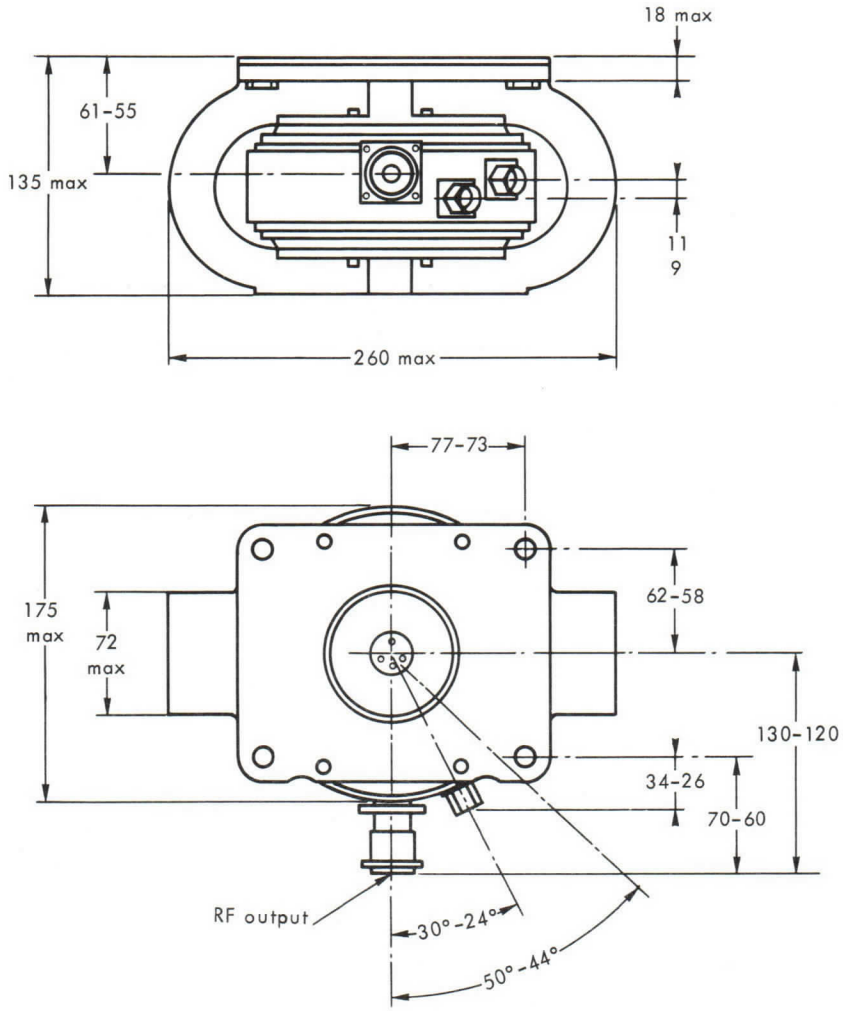


Supply diagram

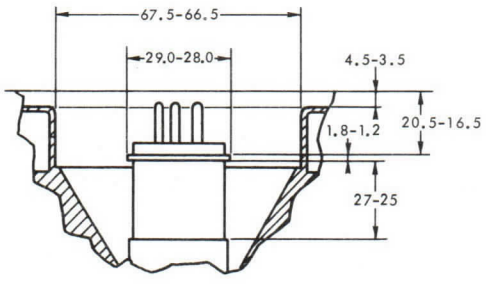


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

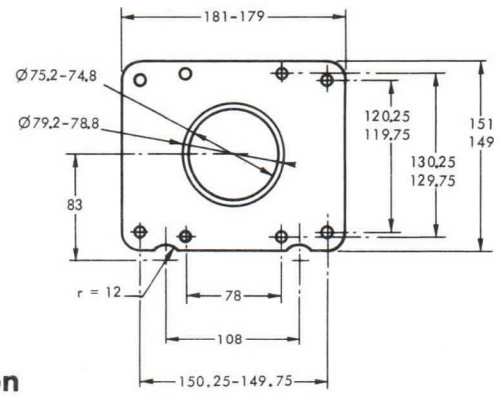
OUTLINE DRAWING

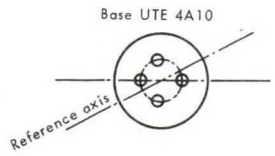


Pin arrangement

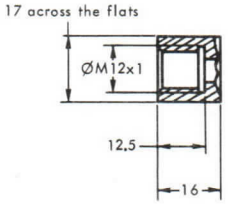


Pressurization flange



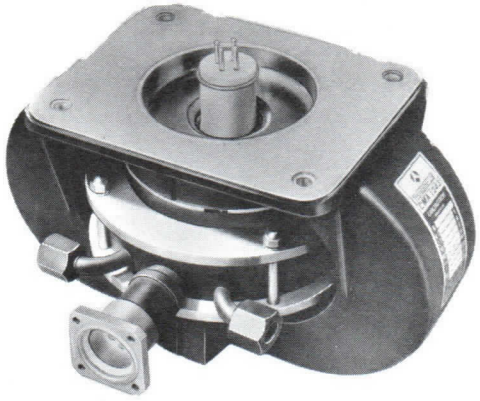


Water connection



Dimensions in mm.

CMA.1243 CARCINOTRON



The CMA.1243 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 750 W over the frequency range of 1. 34 to 1. 70 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1243 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 0		5. 5	A
Output power	750		–	W
Frequency range	1. 34		1. 70	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–0. 7		–2. 0	kV
Sole current	–150		+10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	–5		+5	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		5. 8	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	10 kg
RF output connector	UG 46 /U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER				COOLANOL 35			
Water flow	min.	4	l/mn	Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0. 25	bar	Pressure drop (1)	max.	0. 55	bar
Coolant temperature . .	max.	80	°C	Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	4	bar	Absolute inlet pressure .	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	–	mn	Sole voltage (3).	–200	+200	V
Heater voltage	6. 0	6. 6	V	Grid voltage (3).	–100	+100	V
Heater surge current . .	–	10	A	Anode voltage (3)	–	+200	V
Load VSWR (2).	–	3 : 1		Line voltage	–	6. 2	kV
Ambient temperature .	–40	+110	°C	Line current	–	650	mA
Vibration : 5 to 15 Hz ± 1 mm				Acceleration.	–	15	g
15 to 500 Hz 2 g							

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	1. 34	1. 70	GHz
Heater current	3. 3	A				
Sole voltage	–1. 2	kV	Anode voltage	1. 52	1. 50	kV
Grid voltage	–0. 5	kV	Line voltage	3. 2	5. 7	kV
Grid current	0	mA	Sole current	–20	–70	mA
Line current	600	mA	Output power	850	1250	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

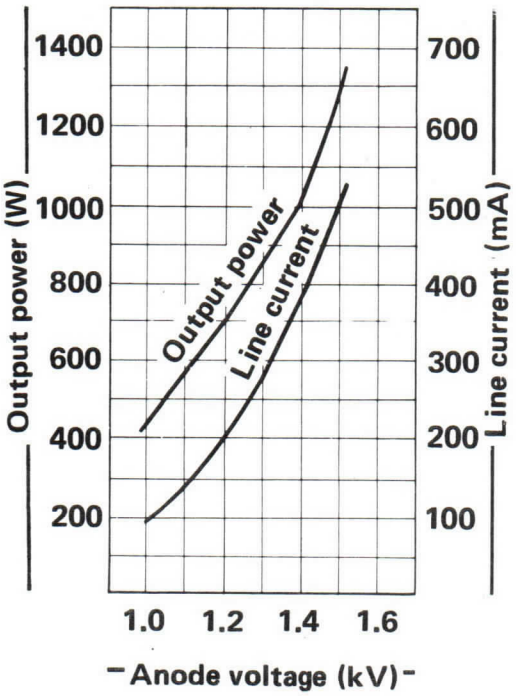
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

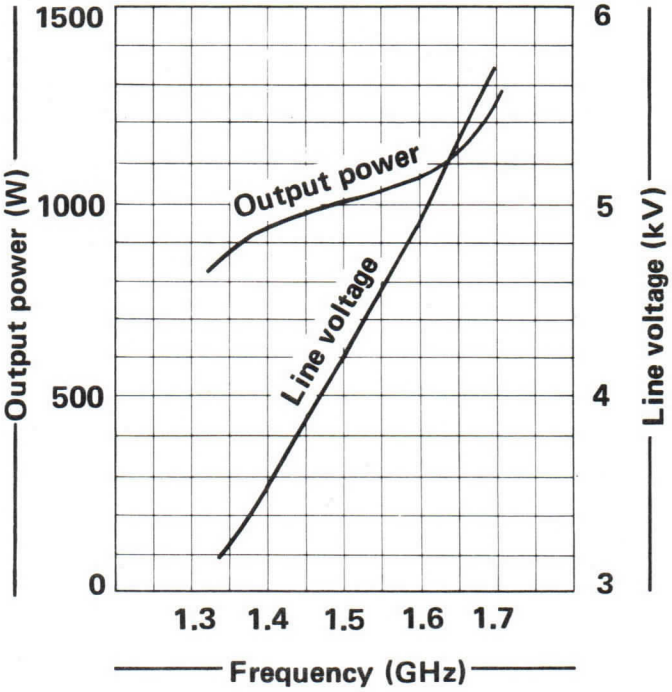
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

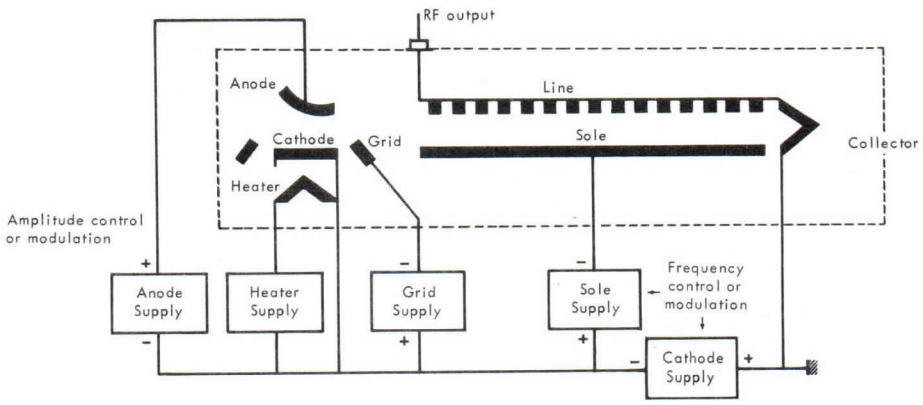
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



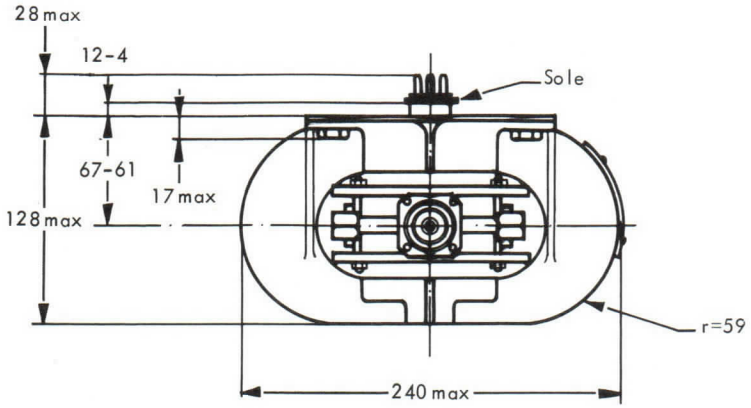


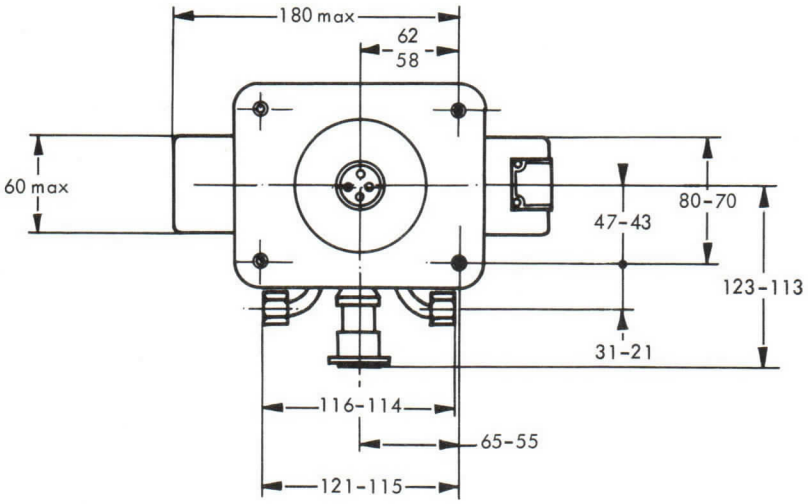
Supply diagram



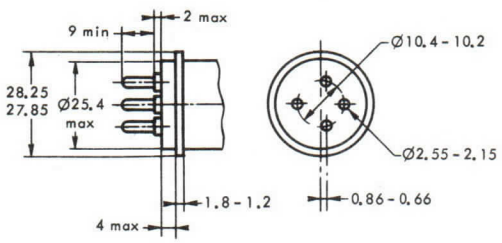
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





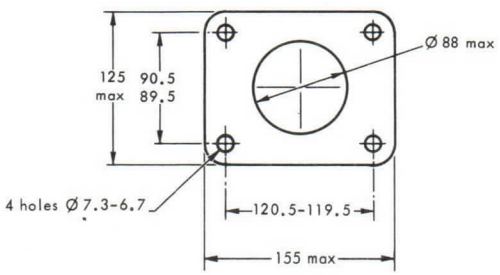
Pin arrangement



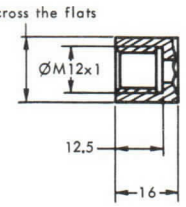
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection: 0.3 mm.

Mounting flange

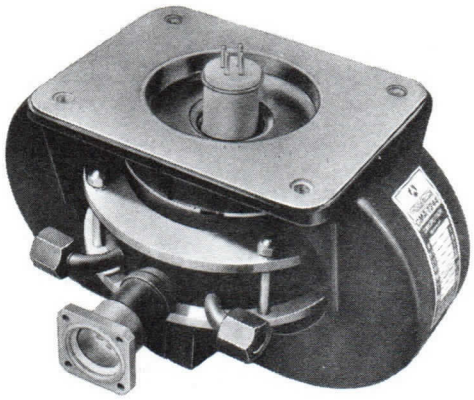


Water connection



Dimensions in mm.

CMA.1244 CARCINOTRON



The CMA.1244 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 700 W over the frequency range of 1. 65 to 2. 10 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1244 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 0		5. 5	A
Output power	700		–	W
Frequency range	1. 65		2. 10	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–0. 7		–2. 0	kV
Sole current	–150		+ 10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	–5		+5	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		5. 8	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	10 kg
RF output connector	UG 46/U coaxial

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER				COOLANOL 35			
Water flow	min.	4	l/mn	Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0. 25	bar	Pressure drop (1)	max.	0. 55	bar
Coolant temperature	max.	80	°C	Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar	Absolute inlet pressure	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	–	mn	Sole voltage (3)	–200	+200	V
Heater voltage	6. 0	6. 6	V	Grid voltage (3)	–100	+100	V
Heater surge current	–	10	A	Anode voltage (3)	–	+200	V
Load VSWR (2)	–	3 : 1		Line voltage	–	6. 2	kV
Ambient temperature	–40	+110	°C	Line current	–	650	mA
Vibration : 5 to 15 Hz		± 1 mm		Acceleration	–	15	g
15 to 500 Hz		2 g					

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	1. 65	2. 10	GHz
Heater current	3. 3	A				
Sole voltage	–1. 1	kV	Anode voltage	1. 28	1. 30	kV
Grid voltage	–0. 4	kV	Line voltage	3. 30	5. 70	kV
Grid current	0	mA	Sole current	–30	–70	mA
Line current	600	mA	Output power	800	1050	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

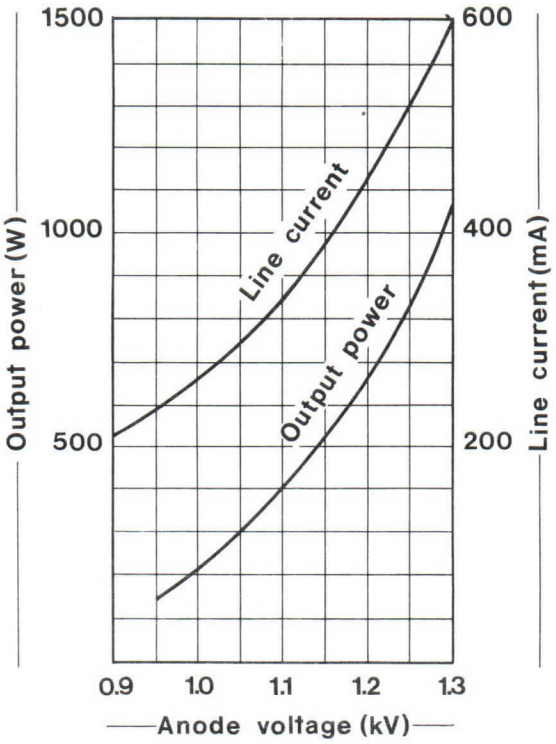
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Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

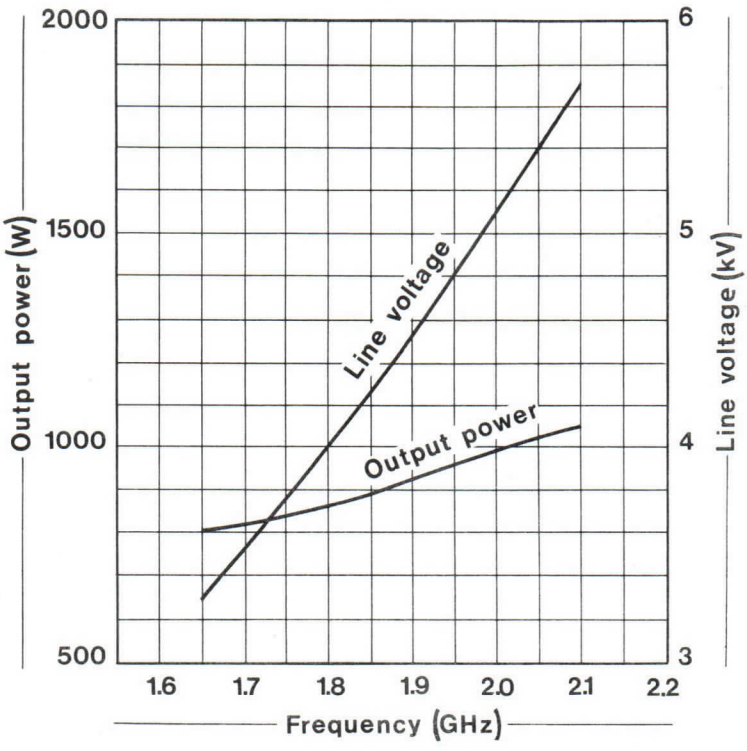
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

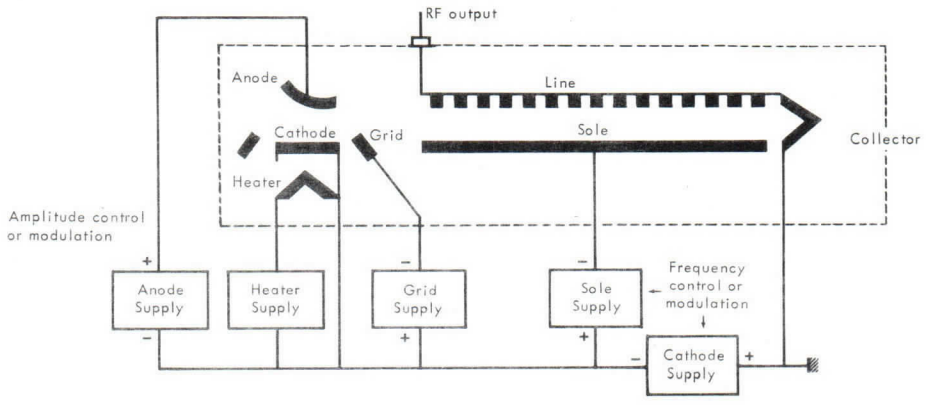
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



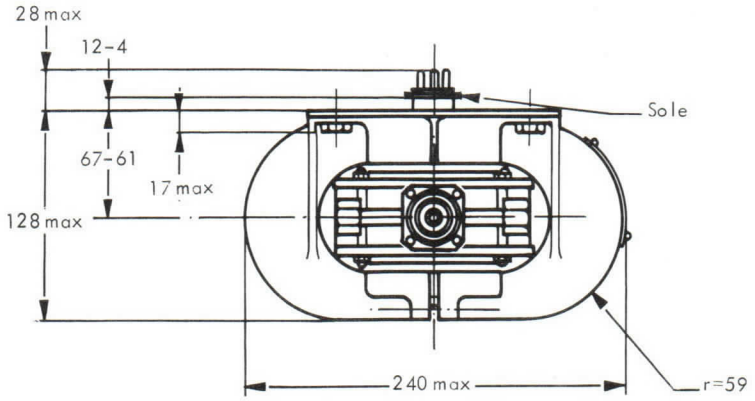


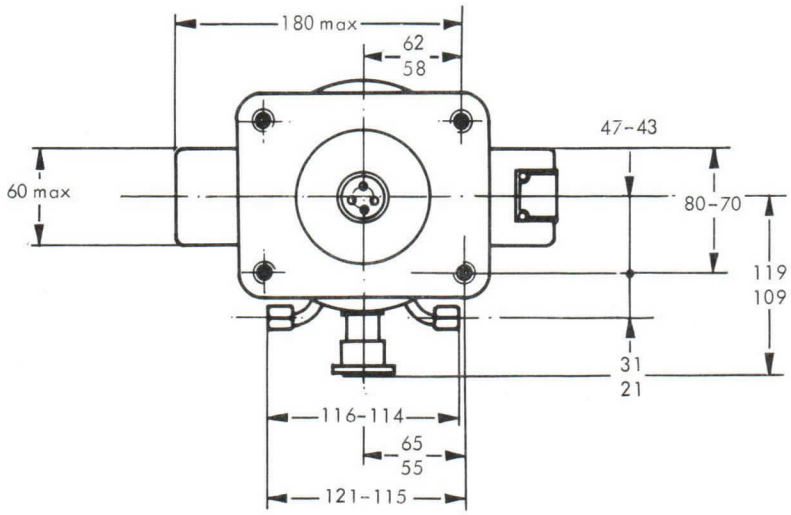
Supply diagram



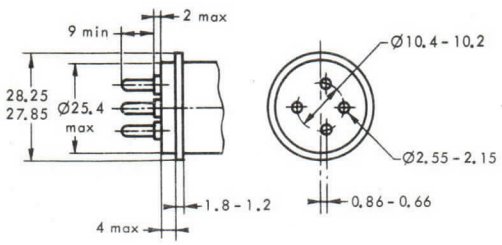
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





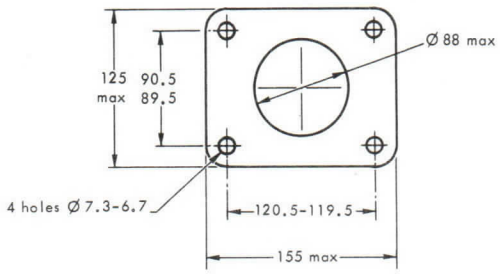
Pin arrangement



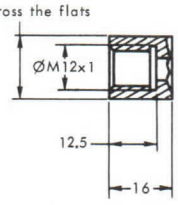
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection: 0.3 mm.

Mounting flange

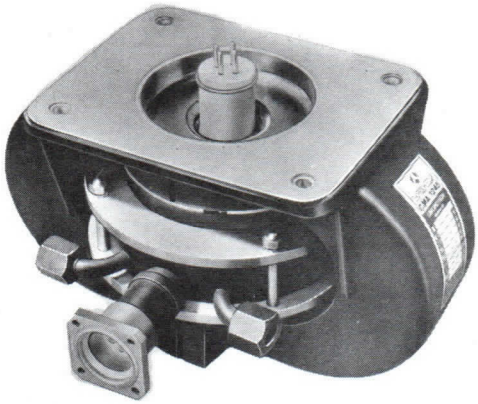


Water connection



Dimensions in mm.

CMA.1245 CARCINOTRON



The CMA.1245 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 600 W over the frequency range of 2. 05 to 2. 65 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1245 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 0		5. 5	A
Output power	600		–	W
Frequency range	2. 05		2. 65	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–0. 7		–2. 0	kV
Sole current	–150		+10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	–5		+5	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	3. 3		5. 8	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	9 kg
RF output connector	UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	4	l/mn
Pressure drop (1)	max.	0.3	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar

COOLANOL 35

Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0.75	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	–	mn	Sole voltage (3)	–200	+200	V
Heater voltage	6.0	6.6	V	Grid voltage (3)	–100	+100	V
Heater surge current	–	10	A	Anode voltage (3)	–	+200	V
Load VSWR (2)	–	3 : 1		Line voltage	–	6.2	kV
Ambient temperature	–40	+110	°C	Line current	–	650	mA
Vibration : 5 to 15 Hz	± 1 mm			Acceleration	–	15	g
15 to 500 Hz	2 g						

TYPICAL OPERATION

Heater voltage	6.3	V	Oscillating frequency :	2.05	2.65	GHz
Heater current	3.6	A				
Sole voltage	–1.0	kV	Anode voltage	1.58	1.56	kV
Grid voltage	–0.2	kV	Line voltage	3.3	5.8	kV
Grid current	0	mA	Sole current	–25	–80	mA
Line current	600	mA	Output power	750	950	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

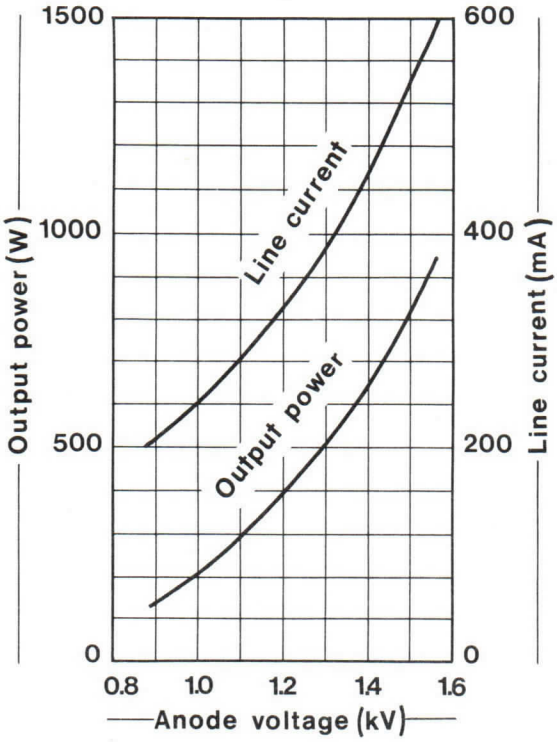
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

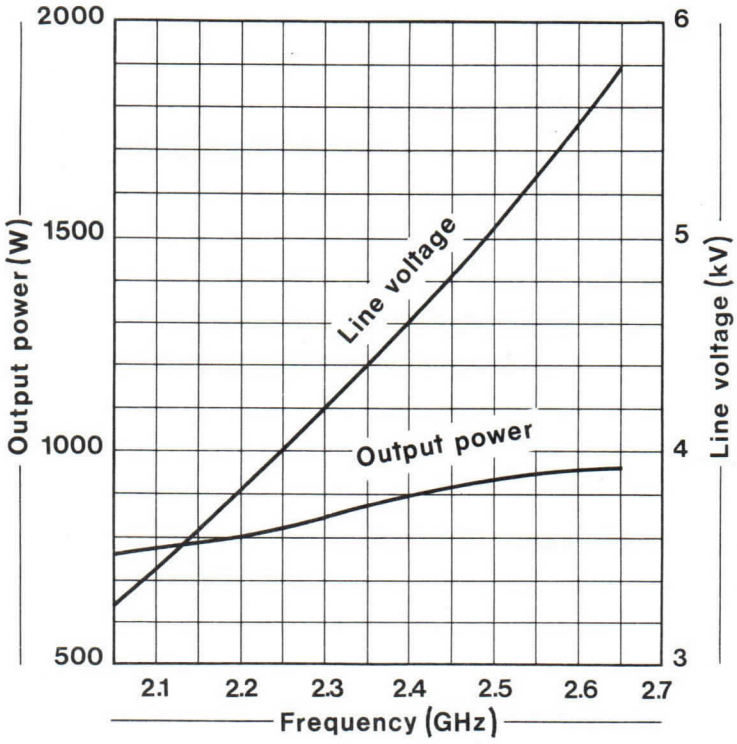
Caution

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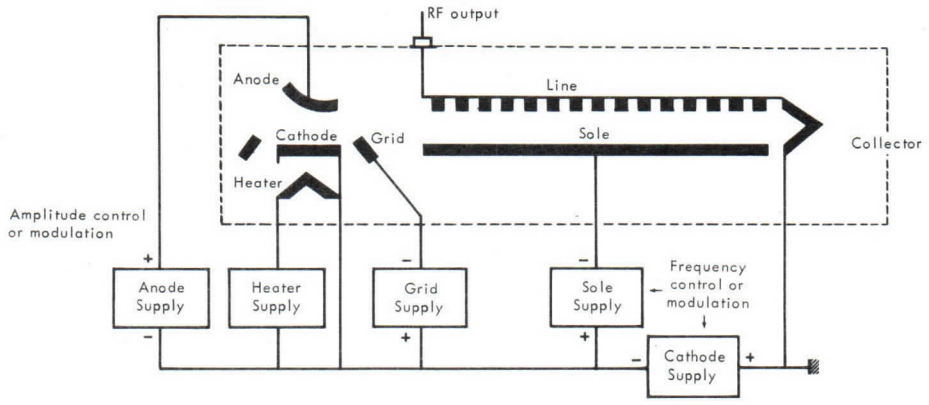
(1) - 1 bar = approximately 15 psi.
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Characteristic curves



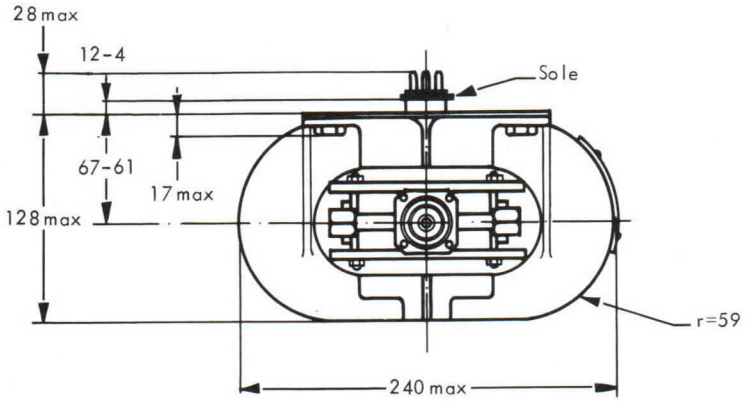


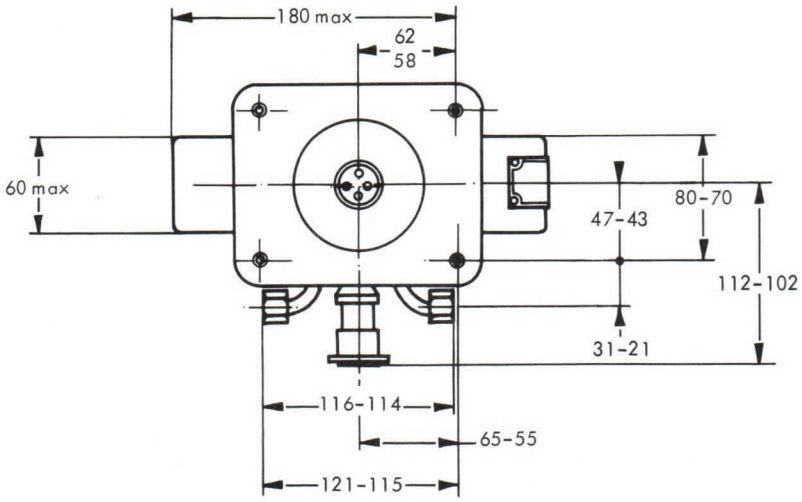
Supply diagram



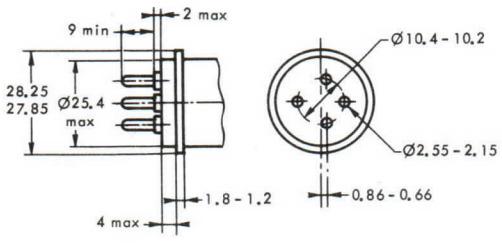
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





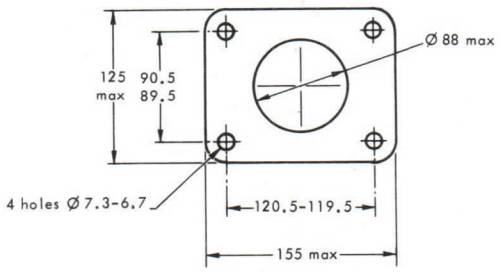
Pin arrangement



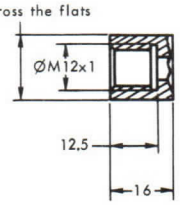
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Mounting flange

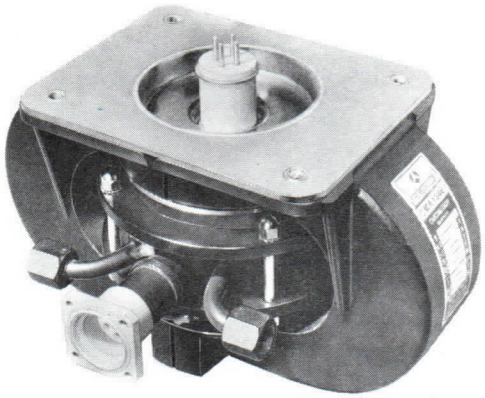


Water connection



Dimensions in mm.

CMA 1246 CARCINOTRON



The CMA.1246 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 500 W over the frequency range of 2. 60 to 3. 40 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1246 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 0		5. 5	A
Output power	500		–	W
Frequency range	2. 60		3. 40	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–2000		–700	V
Sole current	–150		+10	mA
Grid voltage	–800		0	V
Grid current	–5		+5	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		5. 8	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	8 kg
RF output connector	UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	4	l/mn
Pressure drop (1)	max.	0. 25	bar
Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	4	bar

COOLANOL 35

Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	0. 3	bar
Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6. 0	6. 6	V
Heater surge current . .	—	7. 5	A
Load VSWR (2).	—	3: 1	
Ambient temperature .	–40	+110	°C
Vibration : 5 to 15 Hz	±4 mm		
15 to 400 Hz	5 g		

	min.	max.	
Sole voltage (3).	–200	+200	V
Grid voltage (3).	–50	+50	V
Anode voltage (3)	—	+200	V
Line voltage	—	6	kV
Line current	—	650	mA
Acceleration.	—	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	2. 60	3. 40	GHz
Heater current	3. 0	A				
Sole voltage	–1. 0	kV	Anode voltage	1. 40	1. 38	kV
Grid voltage	–0. 2	kV	Line voltage	3. 20	5. 70	kV
Grid current	0	mA	Sole current	–20	–70	mA
Line current	600	mA	Output power	690	680	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

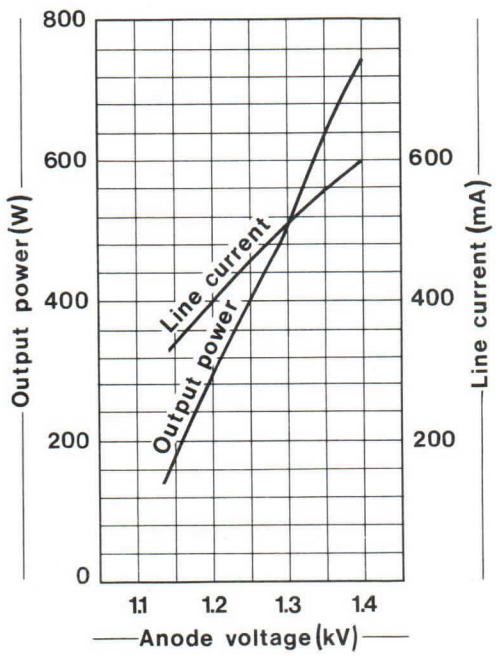
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

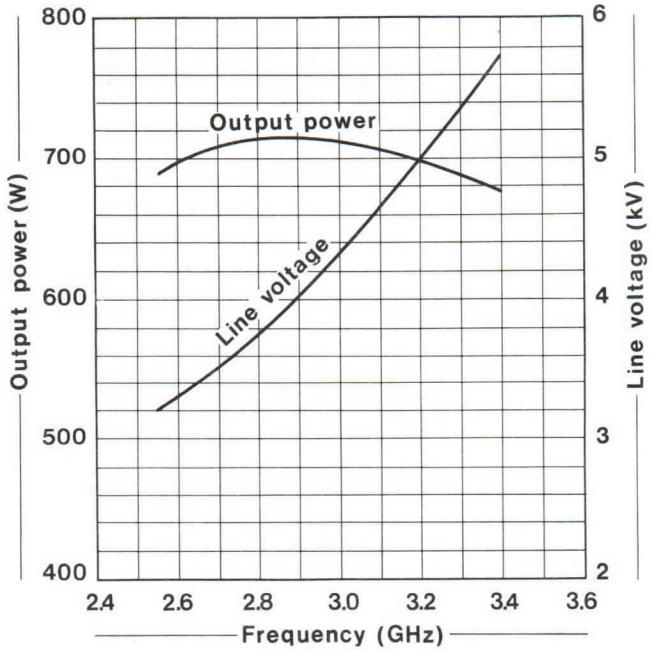
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

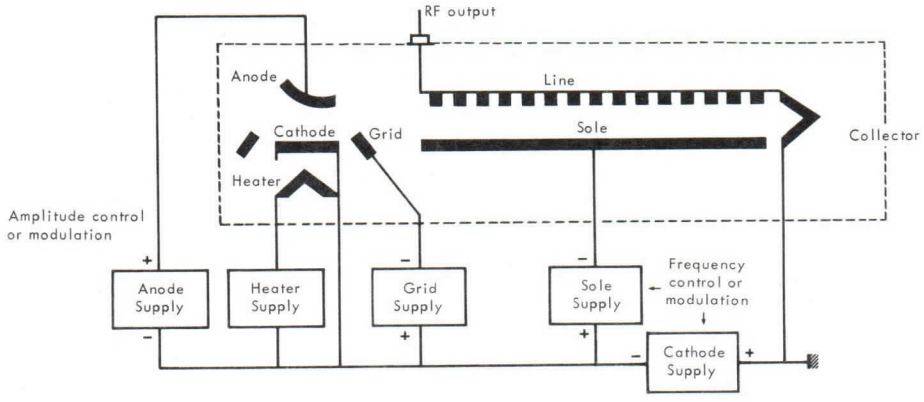
(1) - 1 bar = approximately 15 psi.
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Characteristic curves



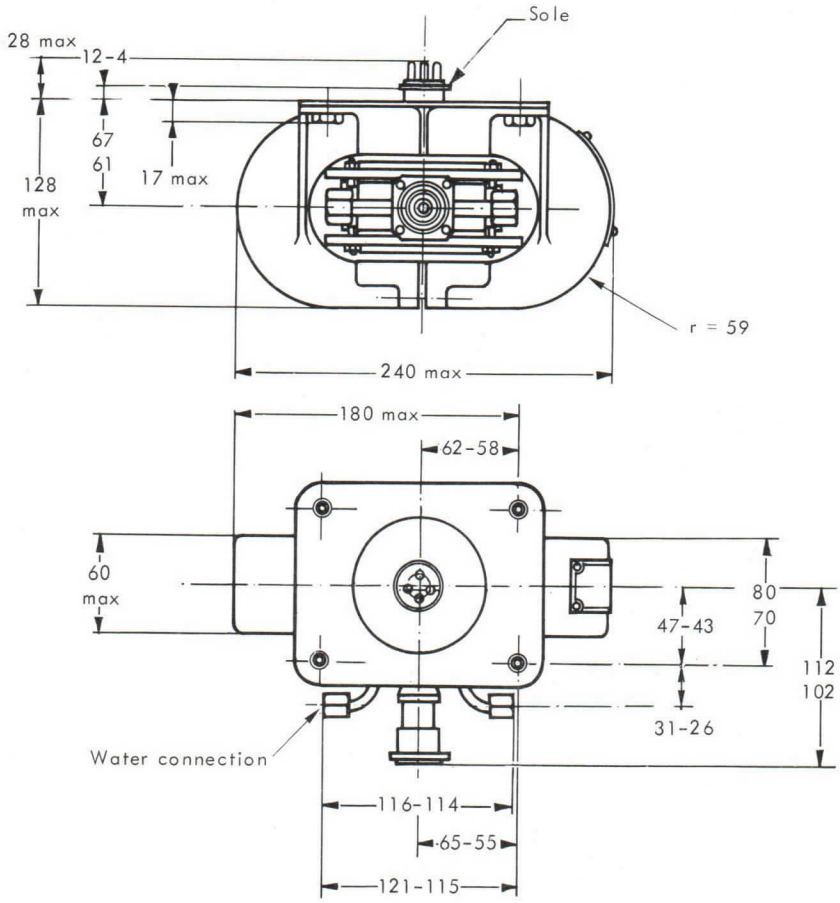


Supply diagram

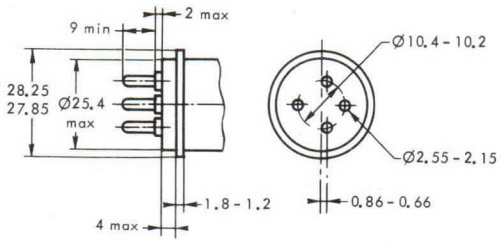


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING



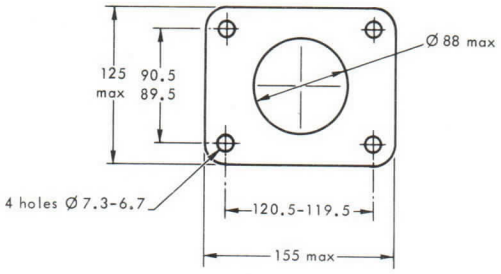
Pin arrangement



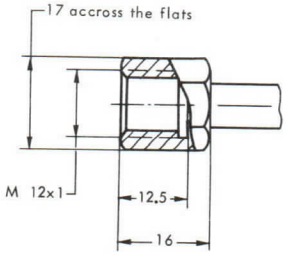
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Mounting flange

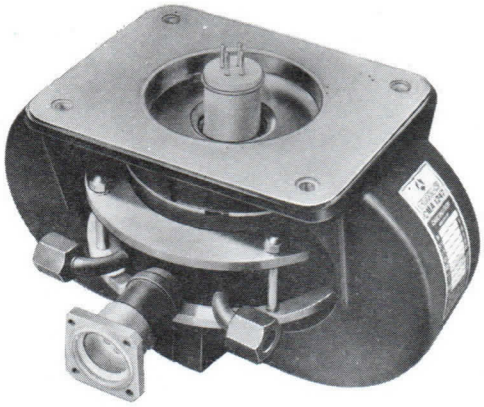


Water connection



Dimensions in mm

CMA.1247 CARCINOTRON



The CMA.1247 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 500 W over the frequency range of 3. 2 to 4. 1 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1247 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 0		5. 5	A
Output power	500		–	W
Frequency range	3. 2		4. 1	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		90	pF
Anode to all other electrodes	–		20	pF
Line to all other electrodes	–		100	pF
Sole voltage	–0. 7		–2. 0	kV
Sole current	–150		+10	mA
Grid voltage	–0. 1		–0. 8	kV
Grid current	–5		+5	mA
Anode voltage	–		2. 0	kV
Anode current	–3		+3	mA
Line voltage	2. 5		5. 8	kV
Line current		600		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	8. 5 kg
RF output connector	UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	4	l/mn
Pressure drop (1)	max.	0. 35	bar
Coolant temperature . .	max.	80	° C
Absolute inlet pressure .	max.	4	bar

COOLANOL 35

Liquid flow	min.	6	l/mn
Pressure drop (1)	max.	8. 5	bar
Coolant temperature . .	max.	80	° C
Absolute inlet pressure .	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6. 0	6. 6	V
Heater surge current . .	—	10	A
Load VSWR (2).	—	3 : 1	
Ambient temperature .	− 40	+110	°C
Vibration : 5 to 15 Hz	± 1 mm		
15 to 500 Hz	2 g		

	min.	max.	
Sole voltage (3).	−200	+200	V
Grid voltage (3).	−100	+100	V
Anode voltage (3)	—	+200	V
Line voltage	—	6. 2	kV
Line current	—	650	mA
Acceleration.	—	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	3. 2	4. 1	GHz
Heater current	3. 3	A				
Sole voltage	−1. 1	kV	Anode voltage	1. 49	1. 50	kV
Grid voltage	−0. 2	kV	Line voltage	3. 3	5. 6	kV
Grid current	0	mA	Sole current	−15	−60	mA
Line current	600	mA	Output power	650	1000	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

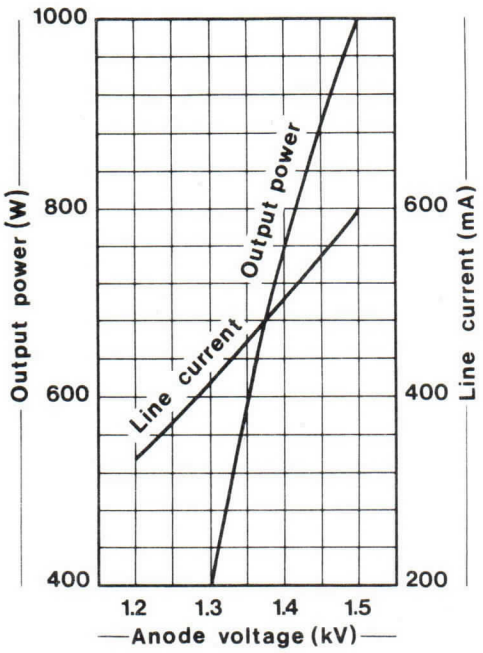
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Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

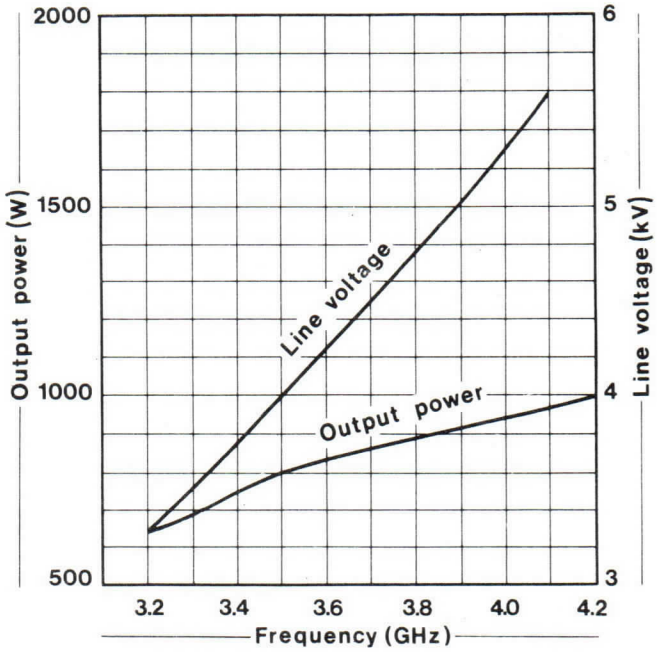
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

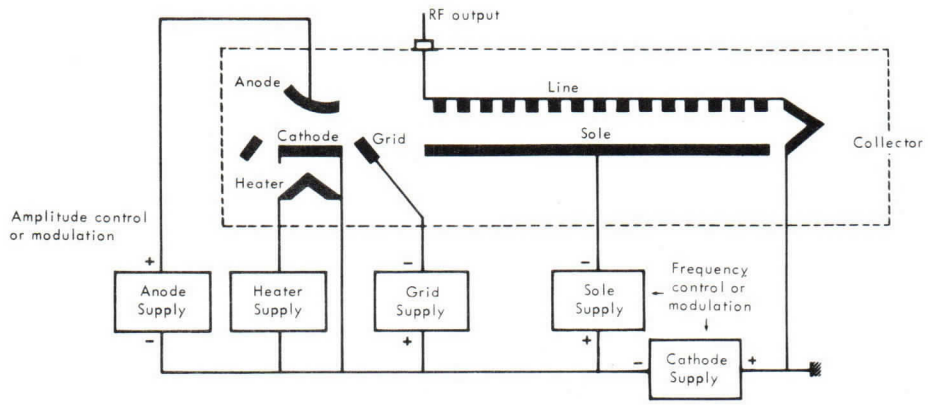
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Characteristic curves



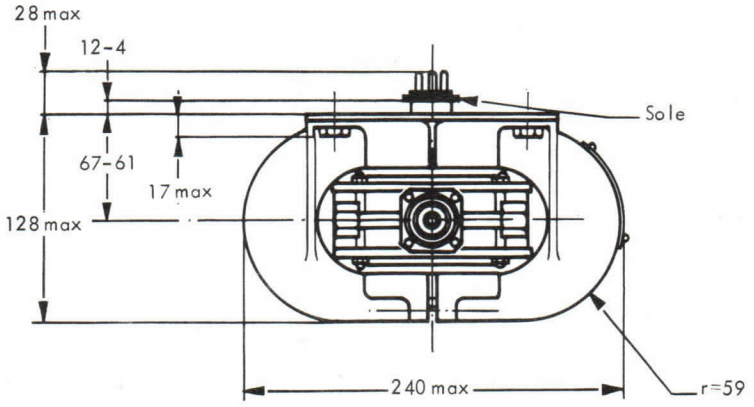


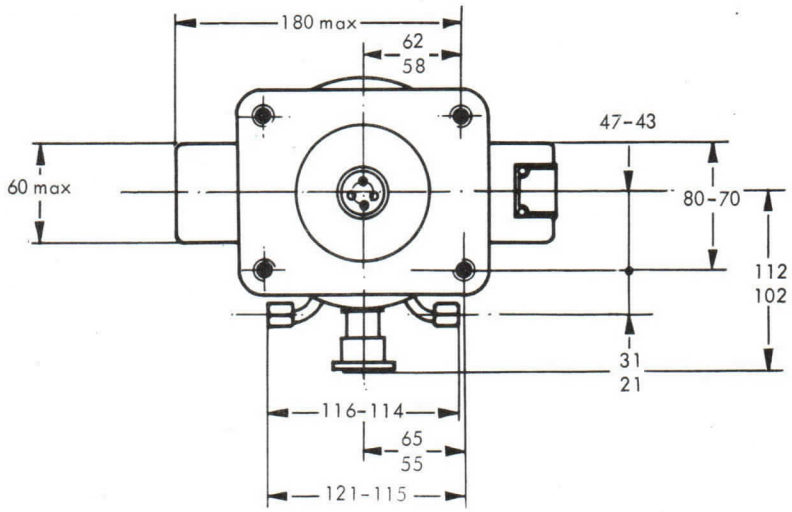
Supply diagram



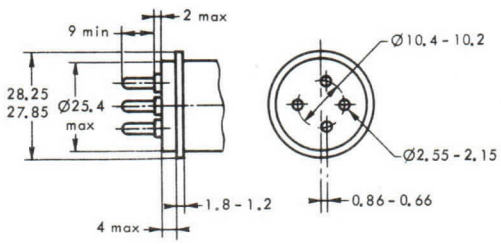
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





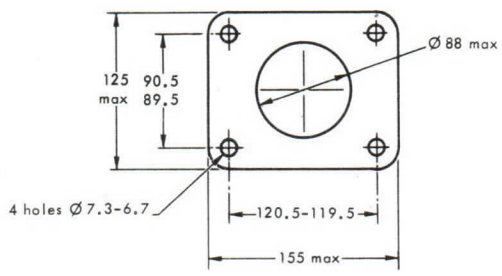
Pin arrangement



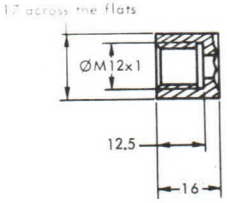
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

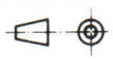
Mounting flange



Water connection

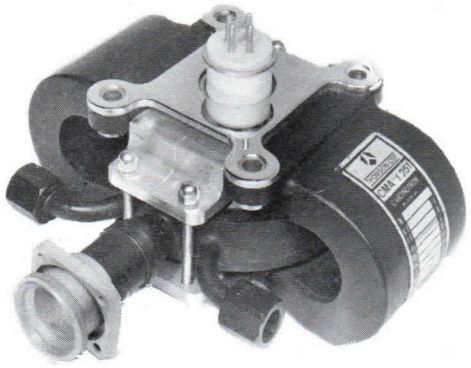


Dimensions in mm



CMA.1251 CARCINOTRON

The CMA.1251 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 300 W over the frequency range of 2. 10 to 2. 65 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1251 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	2. 4		4. 0	A
Output power	300		–	W
Frequency range	2. 10		2. 65	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		50	pF
Anode to all other electrodes	–		15	pF
Line to all other electrodes	–		50	pF
Sole voltage	–0. 7		–1. 8	kV
Sole current	–50		+5	mA
Grid voltage	–0. 1		–0. 7	kV
Grid current	–3		+3	mA
Anode voltage	0. 7		2. 0	kV
Anode current	–3		+3	mA
Line voltage	1. 9		5. 0	kV
Line current		350		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3. 5 kg
RF output connector	UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 05	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 25	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	–	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	–	6	A
Load VSWR (2)	–	3 : 1	
Ambient temperature	– 40	+110	°C
Vibration : 5 to 15 Hz		± 1 mm	
15 to 500 Hz		2 g	

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	–	+200	V
Line voltage	–	5. 2	kV
Line current	–	370	mA
Acceleration	–	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V
Heater current	3. 5	A
Sole voltage	–1. 1	kV
Grid voltage	–0. 3	kV
Grid current	0	mA
Line current	350	mA

Oscillating frequency :	2. 10	2. 65	GHz
Anode voltage	1. 12	1. 10	kV
Line voltage	2. 78	4. 00	kV
Sole current	2. 5	–30	mA
Output power	350	475	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

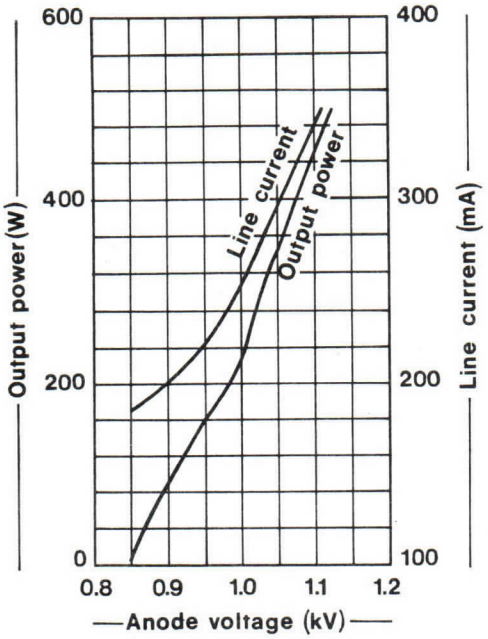
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

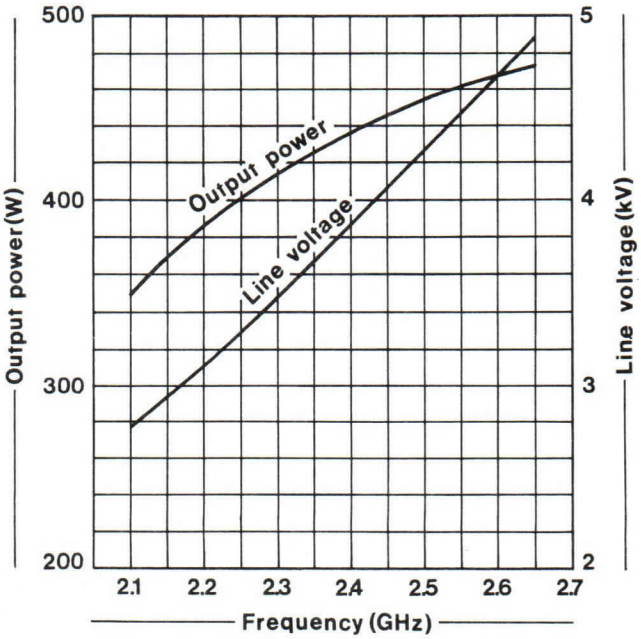
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

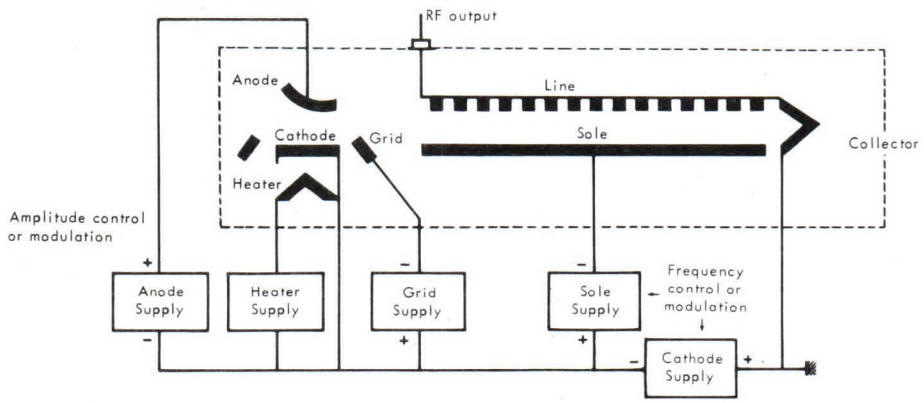
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



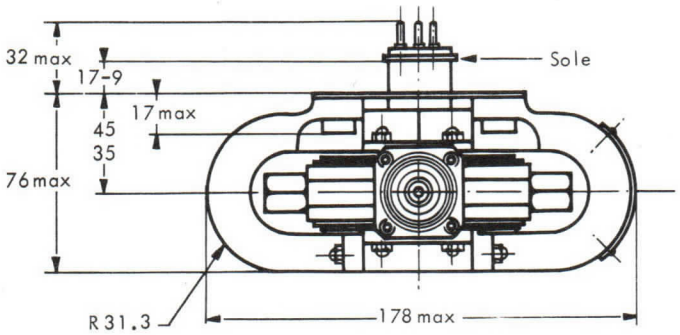


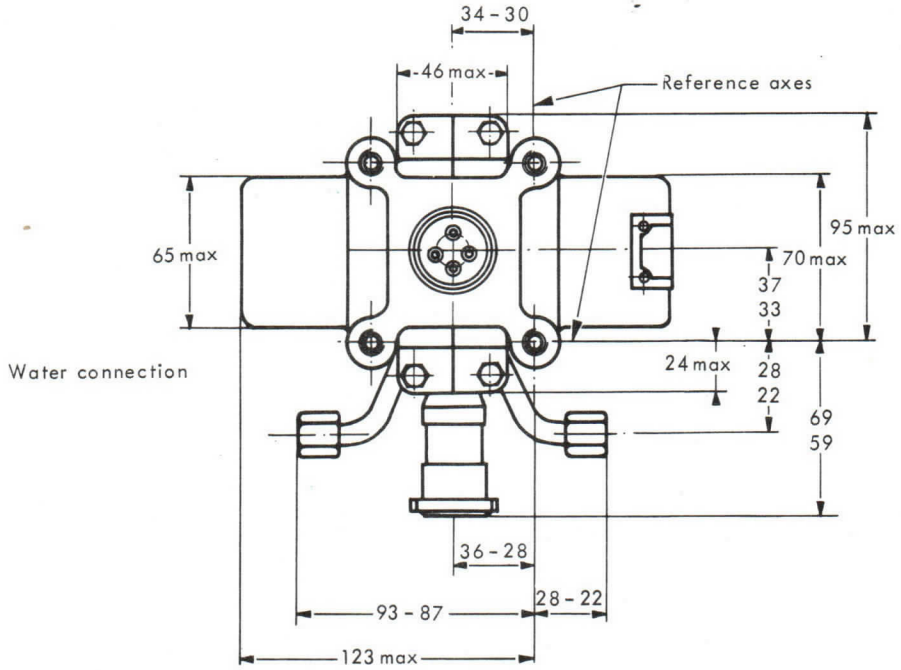
Supply diagram



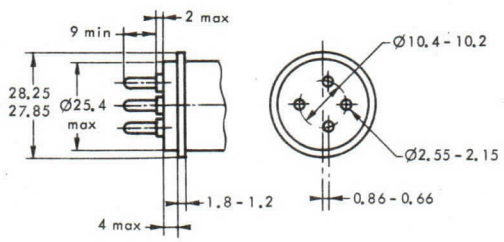
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





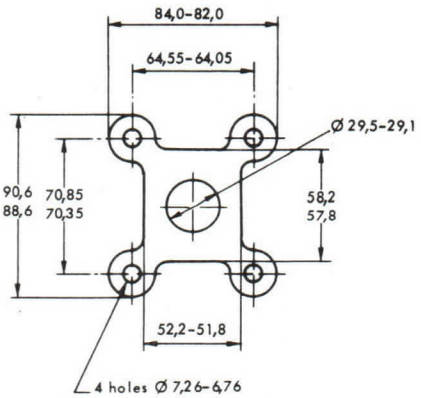
Pin arrangement



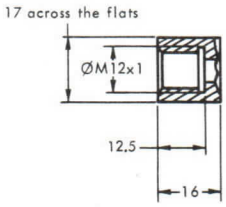
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

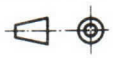
Mounting flange



Water connection



Dimensions in mm.

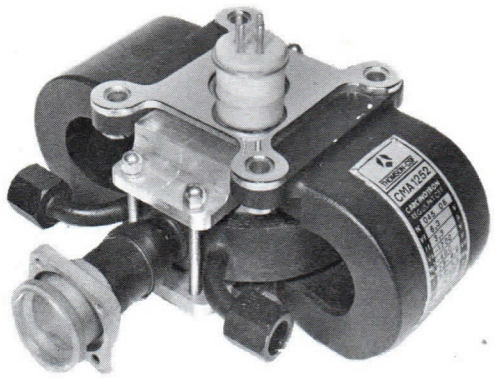


CMA.1252 CARCINOTRON

The CMA.1252 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 200 W over the frequency range of 2. 6 to 3. 4 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.



The CMA.1252 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

Heater voltage		6. 3		V
Heater current	2. 5		4. 0	A
Output power	200		–	W
Frequency range	2. 6		3. 4	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	–		50	pF
Anode to all other electrodes	–		15	pF
Line to all other electrodes	–		50	pF
Sole voltage	–0. 7		–1. 8	kV
Sole current	–40		+ 5	mA
Grid voltage	–0. 1		0. 7	kV
Grid current	–3		+ 3	mA
Anode voltage	0. 7		2. 0	kV
Anode current	– 3		+ 3	mA
Line voltage	1. 9		5. 0	kV
Line current		350		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3. 5 kg
RF output connector	coaxial U/G 46 U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0.05	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0.30	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	–	mn
Heater voltage	6.0	6.6	V
Heater surge current	–	6	A
Load VSWR (2)	–	3 : 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz	–	1	mm
15 to 500 Hz	–	2	g

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	–	+200	V
Line voltage	–	5.2	kV
Line current	–	370	mA
Acceleration	–	15	g

TYPICAL OPERATION

Heater voltage	6.3	V
Heater current	3.25	A
Sole voltage	–1.4	kV
Grid voltage	–0.2	kV
Grid current	0	mA
Line current	350	mA

Oscillating frequency :	2.6	3.4	GHz
Anode voltage	1.035	1.01	kV
Line voltage	2.64	4.98	kV
Sole current	– 3	–30	mA
Output power	380	350	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

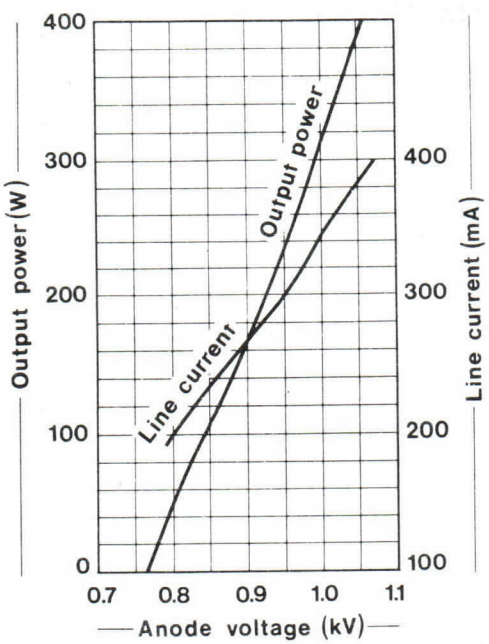
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

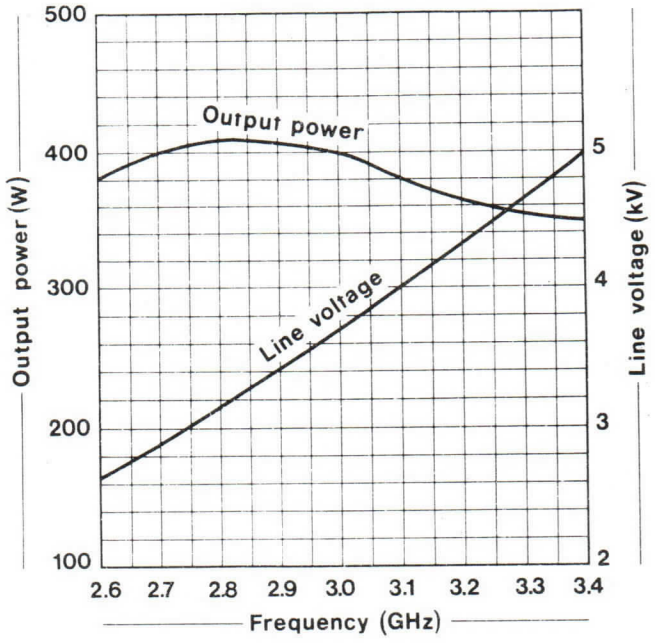
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

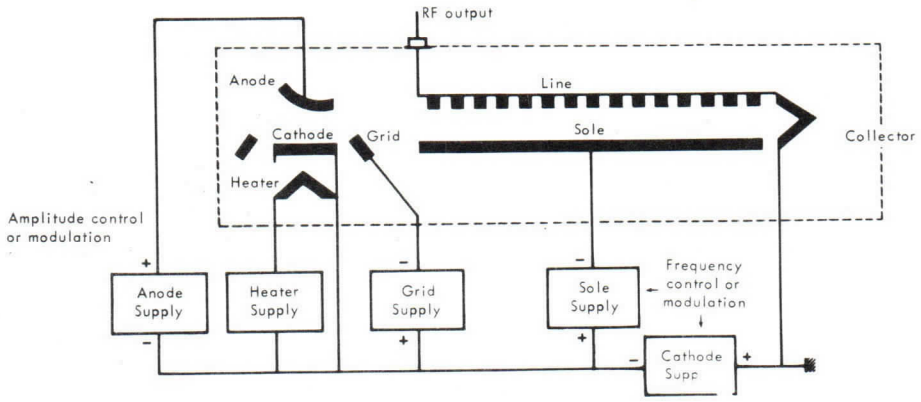
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1.5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



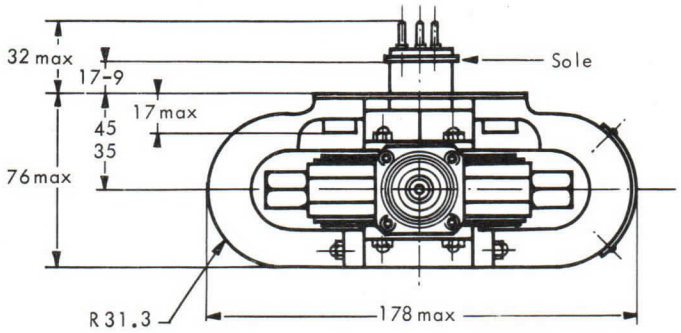


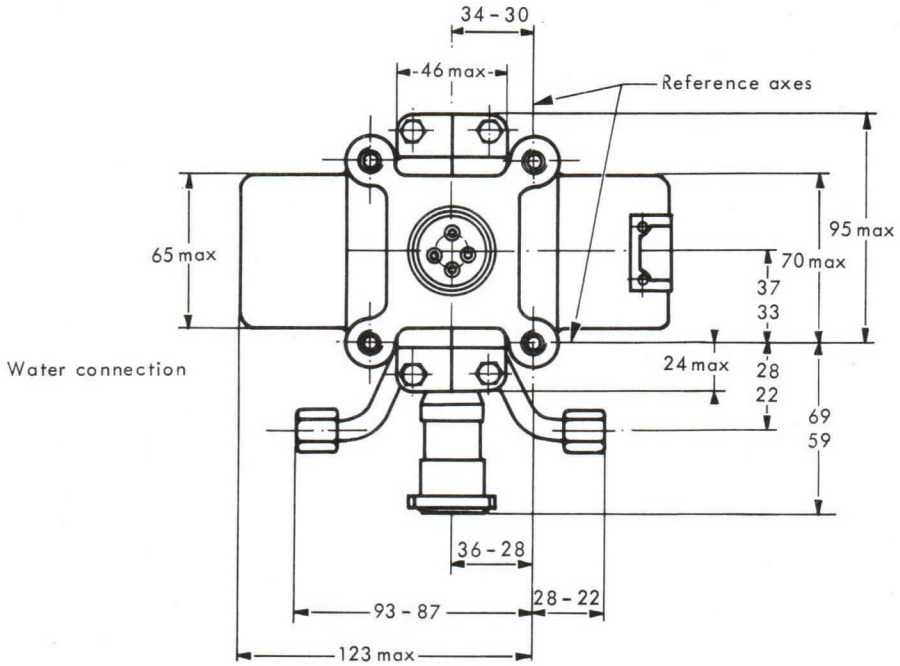
Supply diagram



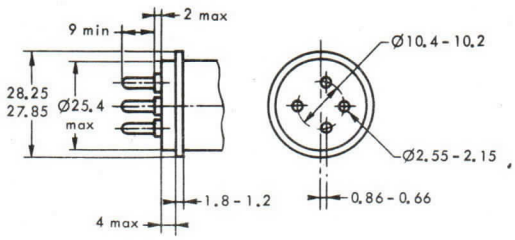
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





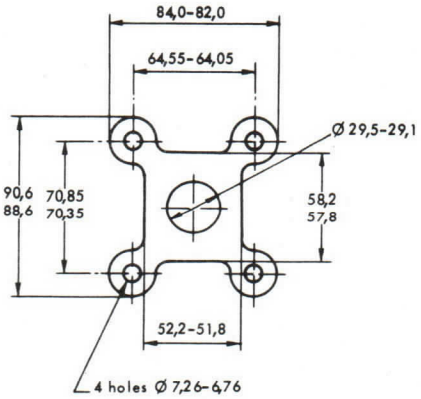
Pin arrangement



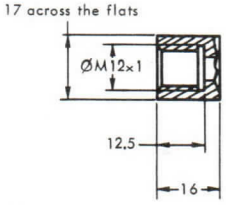
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

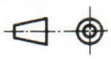
Mounting flange



Water connection

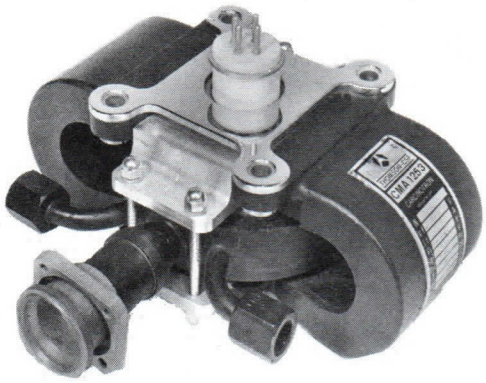


Dimensions in mm.



CMA.1253 CARCINOTRON

The CMA.1253 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 200 W over the frequency range of 3.2 to 4.0 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1253 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6.3		V
Heater current	2.5		4.0	A
Output power	200		-	W
Frequency range	3.2		4.0	GHz
Interelectrodes capacitances :				
Sole to all other electrodes	-		50	pF
Anode to all other electrodes	-		15	pF
Line to all other electrodes	-		50	pF
Sole voltage	−0.7		−1.8	kV
Sole current	−40		+5	mA
Grid voltage	−0.1		−0.7	kV
Grid current	−3		+3	mA
Anode voltage	0.7		2.0	kV
Anode current	−3		+3	mA
Line voltage	1.9		5.0	kV
Line current		350		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3.5 kg
RF output connector	coaxial UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 07	bar
Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 4	bar
Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	-	mn
Heater voltage	6. 0	6. 6	V
Heater surge current . .	-	6	A
Load VSWR (2).	-	3: 1	
Ambient temperature .	–40	+110	°C
Vibration : 5 to 15 Hz		- 1 mm	
15 to 500 Hz		- 2 g	

	min.	max.	
Sole voltage (3).	–200	+200	V
Grid voltage (3).	–100	+100	V
Anode voltage (3)	-	+200	V
Line voltage	-	5. 2	kV
Line current	-	370	mA
Acceleration.	-	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	3. 2	4. 0	GHz
Heater current	3. 2	A				
Sole voltage	–1. 5	kV	Anode voltage	1. 12	1. 10	kV
Grid voltage	–0. 3	kV	Line voltage	2. 95	4. 95	kV
Grid current	0	mA	Sole current	–2. 4	–2. 6	mA
Line current	350	mA	Output power	345	310	

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

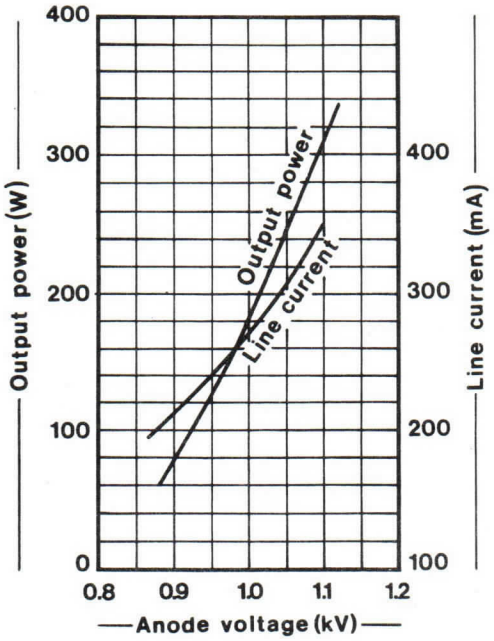
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

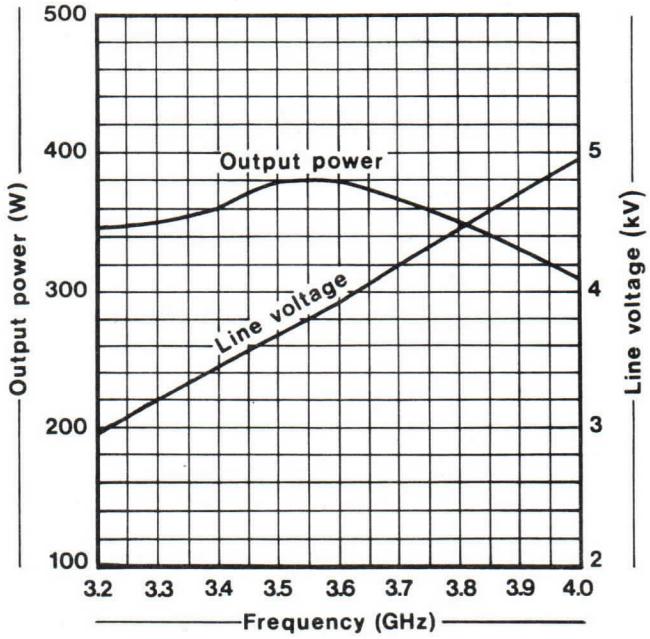
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

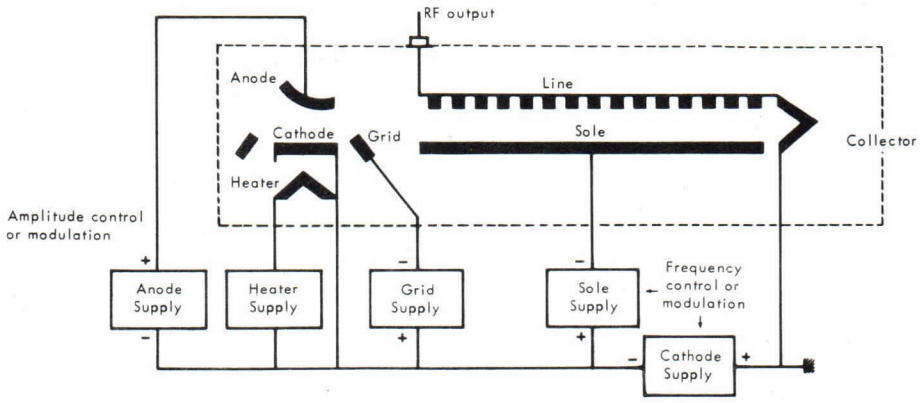
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



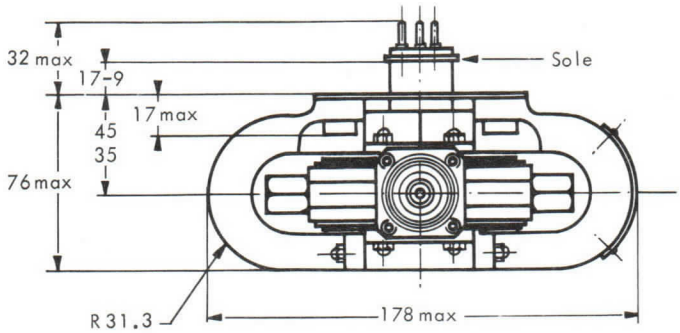


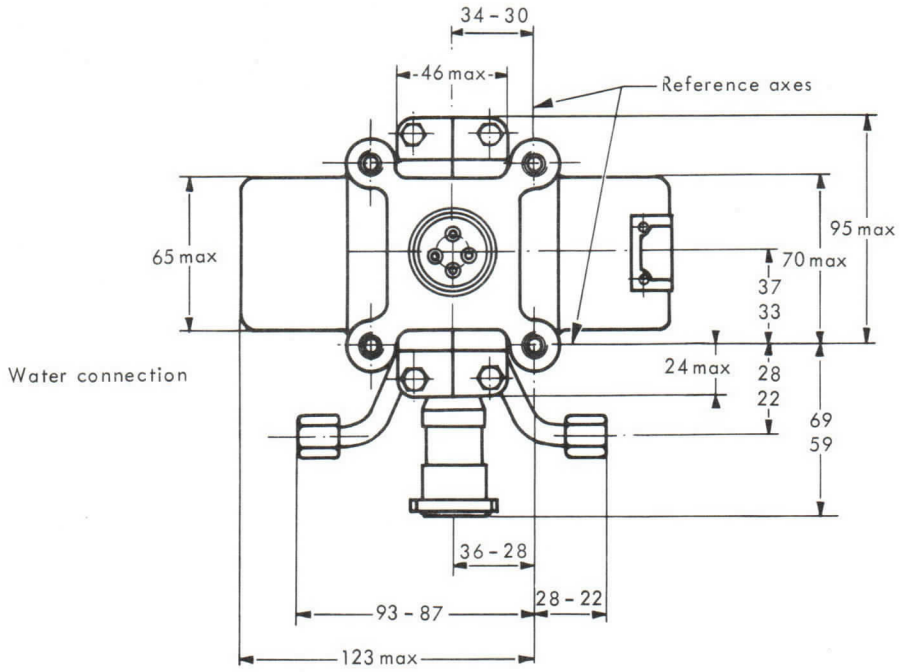
Supply diagram



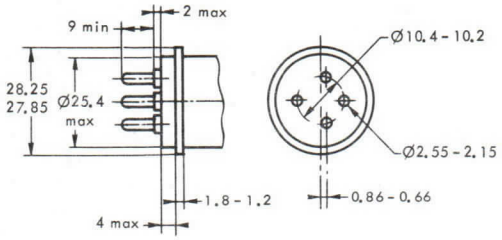
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

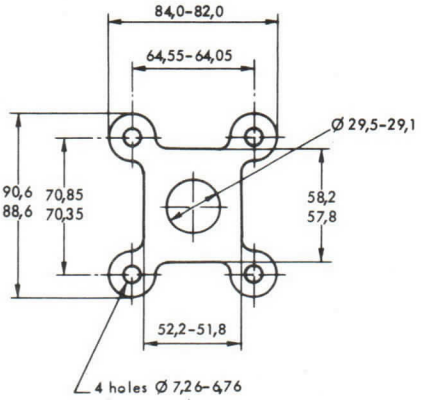




Pin arrangement



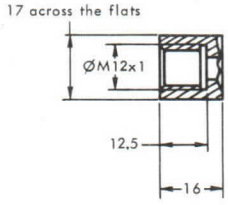
Mounting flange



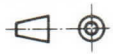
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Water connection

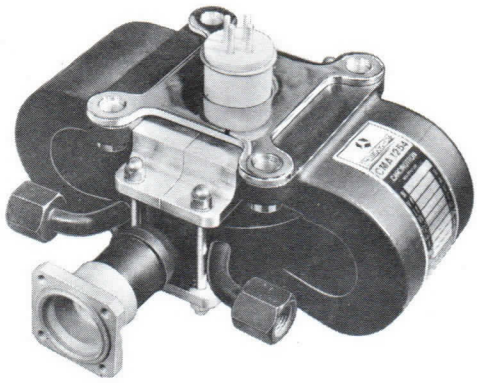


Dimensions in mm.



CMA.1254 CARCINOTRON

The CMA.1254 is a rugged, compact, electronically tunable, crossfied, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 150 W over the frequency range of 3. 9 to 4. 9 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1254 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	1. 6	3. 0	A
Output power	150	–	W
Frequency range	3. 9	4. 9	GHz
Interelectrodes capacitances :			
Sole to all other electrodes	–	50	pF
Anode to all other electrodes	–	15	pF
Line to all other electrodes	–	50	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–50	+5	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	– 3	+ 3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current	300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3. 5 kg
RF output connector	UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER				COOLANOL 35		
Water flow	min.	2	l/mn	Liquid flow	4	l/mn
Pressure drop (1)	max.	0. 07	bar	Pressure drop (1)	0. 4	bar
Coolant temperature . .	max.	80	°C	Coolant temperature . .	80	°C
Absolute inlet pressure .	max.	6	bar	Absolute inlet pressure .	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	–	mn	Sole voltage (3).	–200	+200	V
Heater voltage	6. 0	6. 6	V	Grid voltage (3).	–100	+100	V
Heater surge current . .	–	6	A	Anode voltage (3)	–	+200	V
Load VSWR (2).	–	3 :1		Line voltage	–	5. 2	kV
Ambient temperature .	–40	+110	°C	Line current	–	320	mA
Vibration : 5 to 15 Hz ± 1 mm				Acceleration.	–	15	g
15 to 500 Hz 2 g							

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	3. 9	4. 9	GHz
Heater current	2. 6	A				
Sole voltage	–1. 4	kV	Anode voltage	1. 17	1. 16	kV
Grid voltage	–0. 5	kV	Line voltage	2. 83	4. 71	kV
Grid current	0	mA	Sole current	–4. 0	–8. 5	mA
Line current	300	mA	Output power	240	210	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

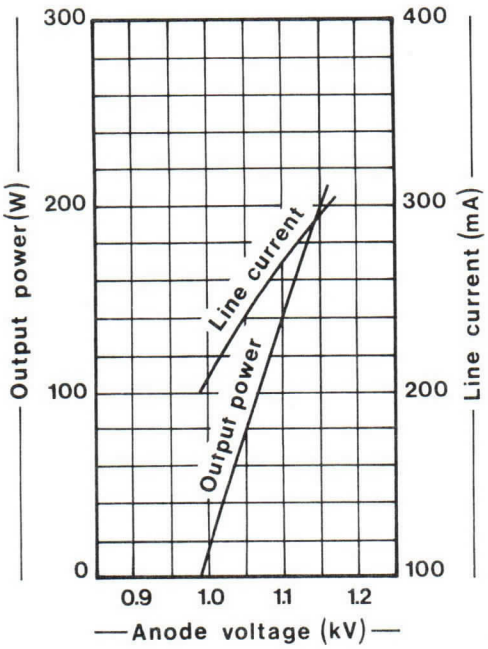
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

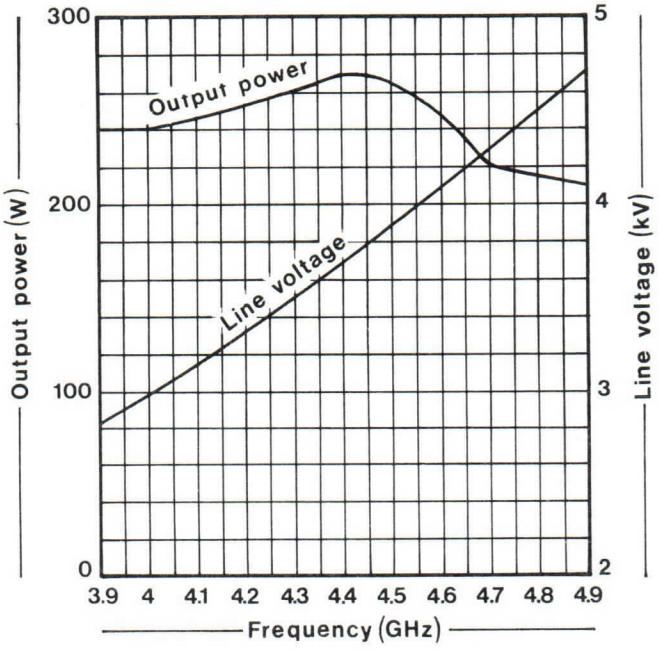
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

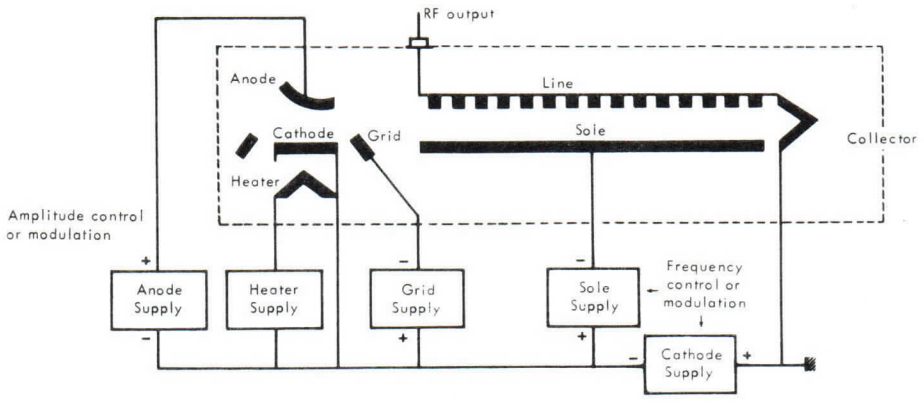
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



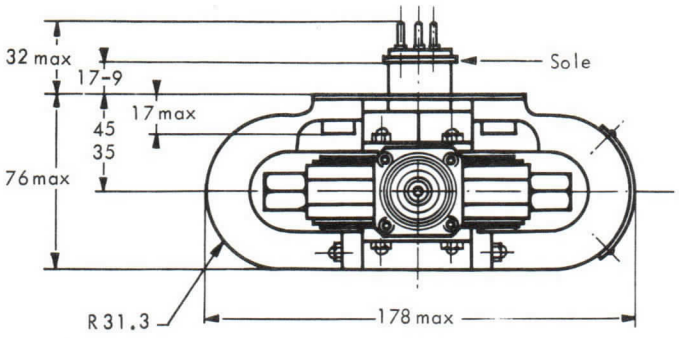


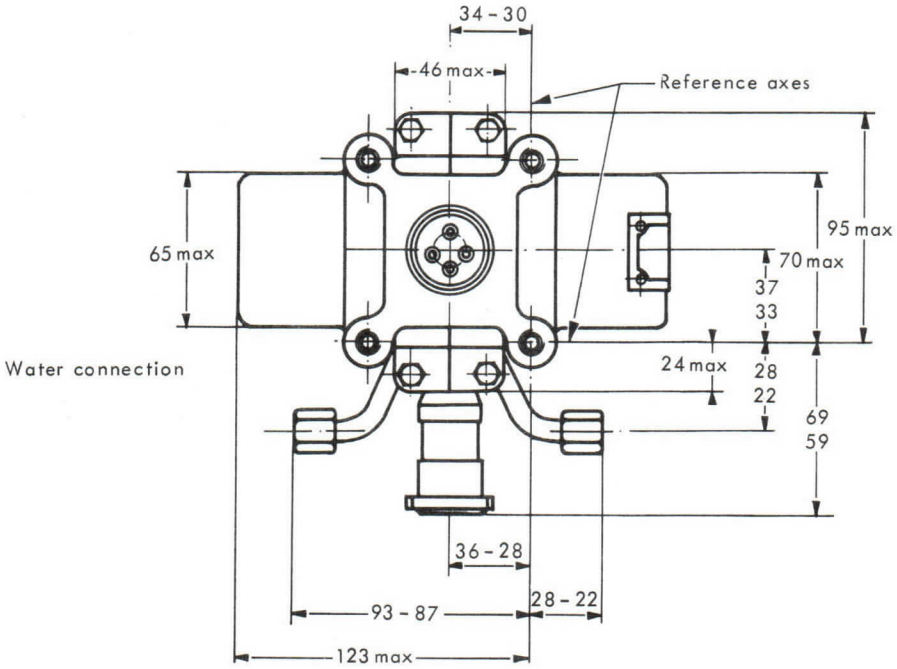
Supply diagram



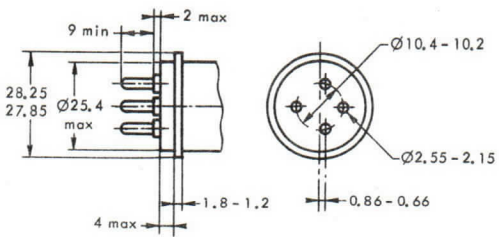
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





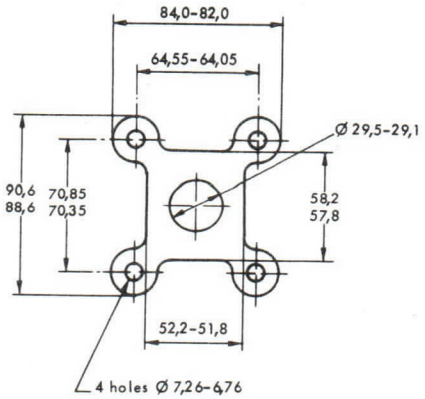
Pin arrangement



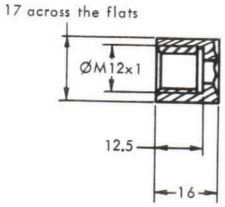
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection: 0.3 mm.

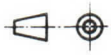
Mounting flange



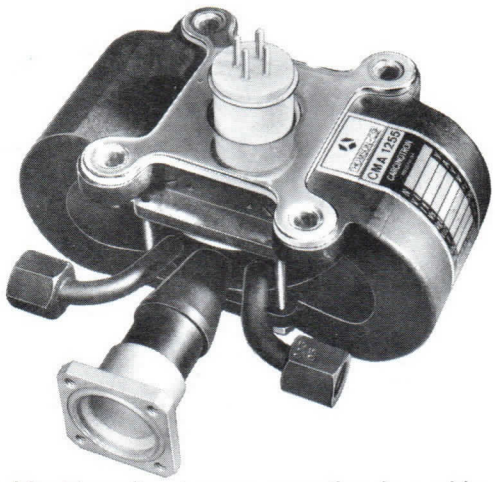
Water connection



Dimensions in mm



CMA 1255 CARCINOTRON



The CMA.1255 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 150 W over the frequency range of 4. 8 to 6. 0 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1255 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	1. 8	2. 8	A
Output power	150	–	W
Frequency range	4. 8	6. 0	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	35	pF
Anode to all other electrodes	–	10	pF
Line to all other electrodes	–	30	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–25	+5	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current	300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	2. 5 kg
RF output connector	coaxial UG 46/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0.08	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0.4	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	–	mn
Heater voltage	6.0	6.6	V
Heater surge current	–	6	A
Load VSWR (2)	–	3 : 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz		± 1 mm	
15 to 500 Hz		2 g	

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	–	+200	V
Line voltage	–	5.2	kV
Line current	–	320	mA
Acceleration	–	15	g

TYPICAL OPERATION

Heater voltage	6.3	V
Heater current	2.0	A
Sole voltage	–1.0	kV
Grid voltage	–0.5	kV
Grid current	0	mA
Line current	300	mA

Oscillating frequency :	4.8	6.0	GHz
Anode voltage	1.31	1.36	kV
Line voltage	2.72	4.30	kV
Sole current	–9	–13	mA
Output power	290	270	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

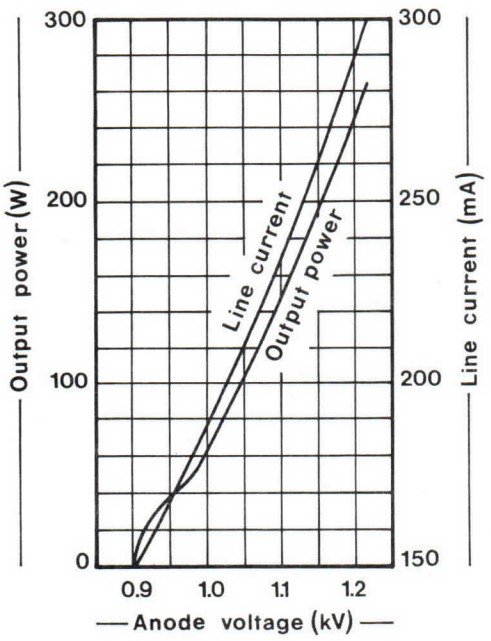
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

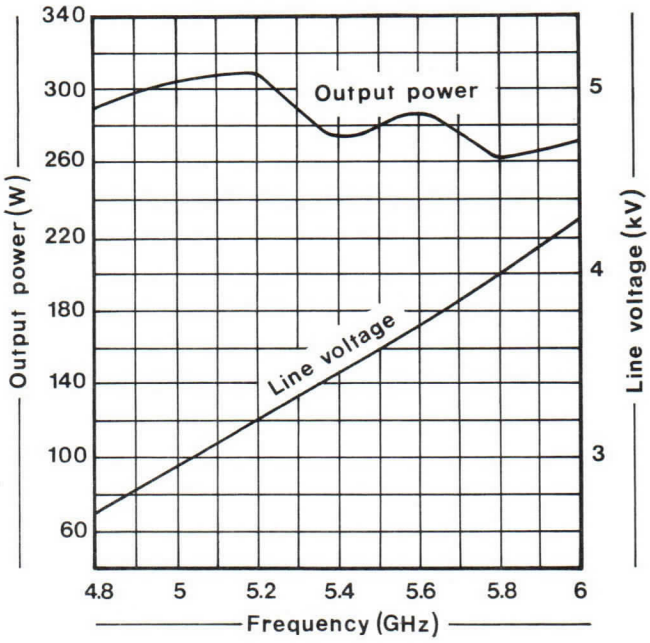
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

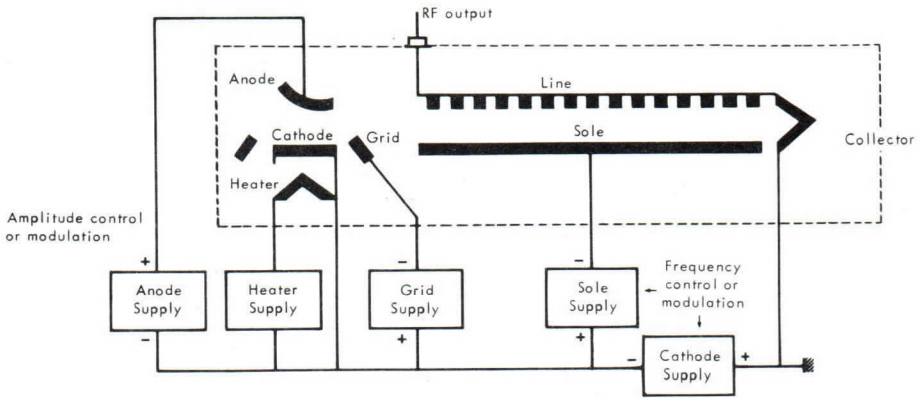
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1.5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristics curves



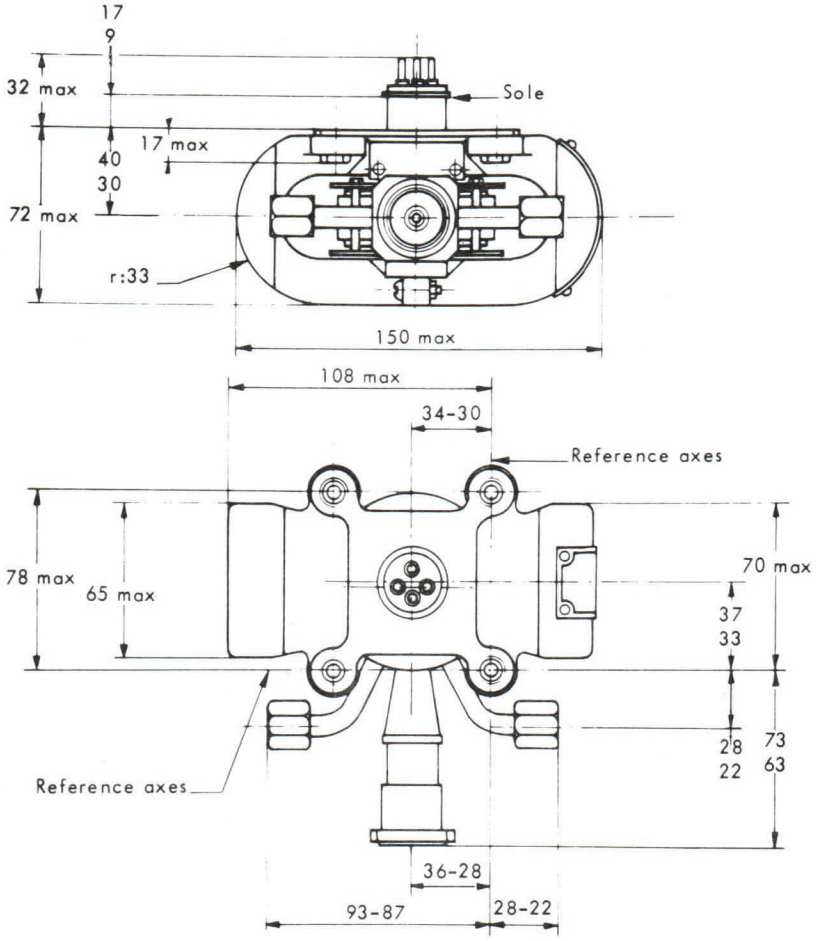


Supply diagram

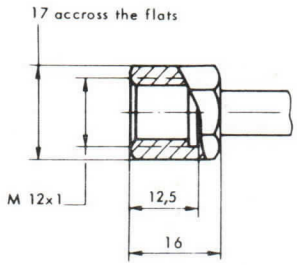


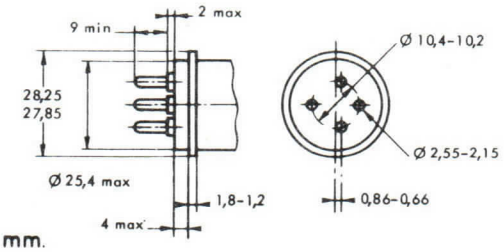
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

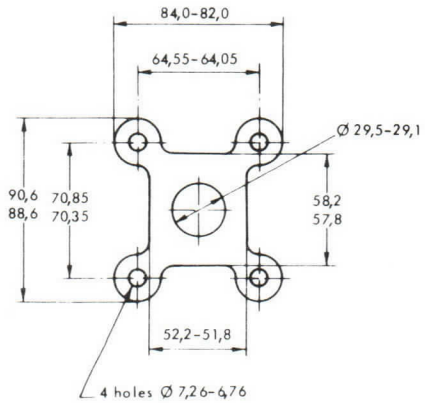


Water outlet hexagonal nut





Mounting flange



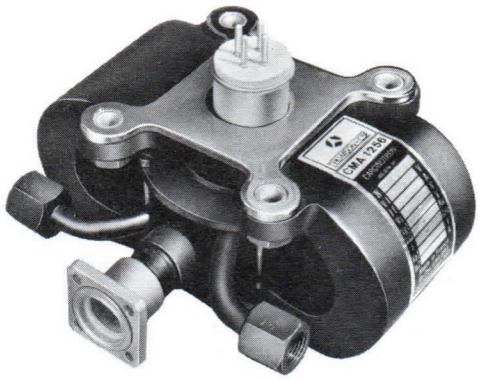
Pin arrangement

The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Dimensions in mm.

CMA 1256 CARCINOTRON



The CMA.1256 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 150 W over the frequency range of 5. 9 to 7. 3 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1256 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	1. 8	3. 2	A
Output power	150	–	W
Frequency range	5. 9	7. 3	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	45	pF
Anode to all other electrodes	–	15	pF
Line to all other electrodes	–	45	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–40	+ 5	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current	300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	2. 5 kg
RF output connector	UG 141/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 08	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 4	bar
Coolant temperature	max.	80	° C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	—	6	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	–40	+110	° C
Vibration : 5 to 15 Hz	± 1 mm		
15 to 500 Hz	2 g		

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	—	+200	V
Line voltage	—	5. 2	kV
Line current	—	320	mA
Acceleration	—	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V
Heater current	2. 3	A
Sole voltage	–1. 1	kV
Grid voltage	–0. 5	kV
Grid current	0	mA
Line current	300	mA

Oscillating frequency :	5. 90	7. 30	GHz
Anode voltage	1. 34	1. 31	kV
Line voltage	2. 65	4. 25	kV
Sole current	–4	–25	mA
Output power	270	290	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

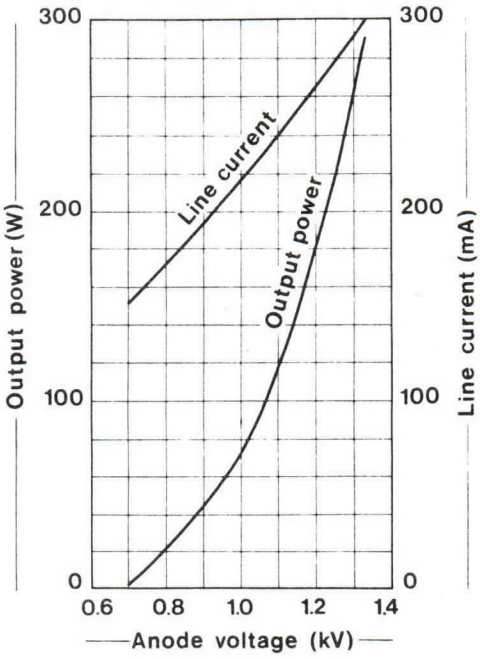
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

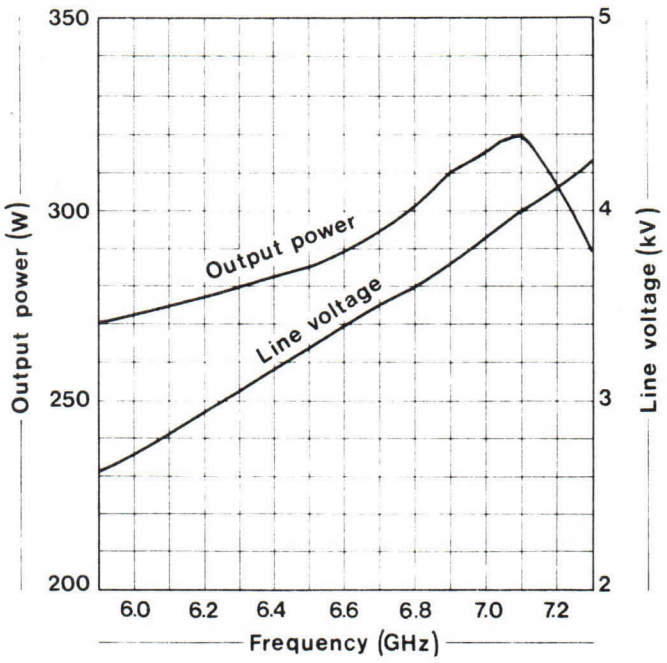
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

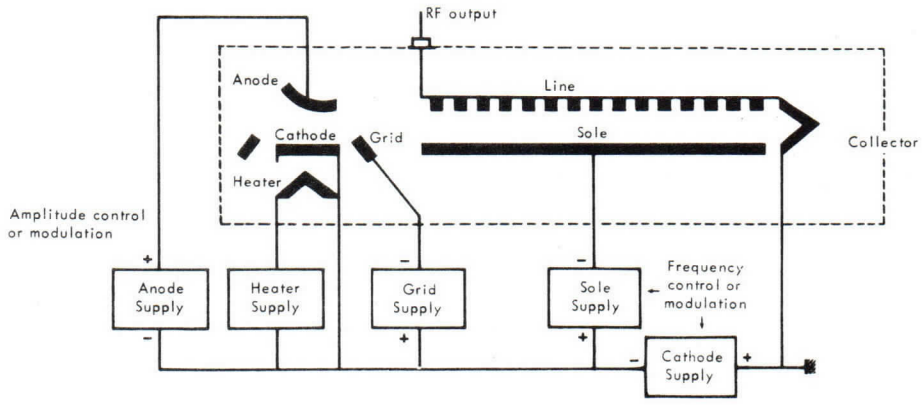
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



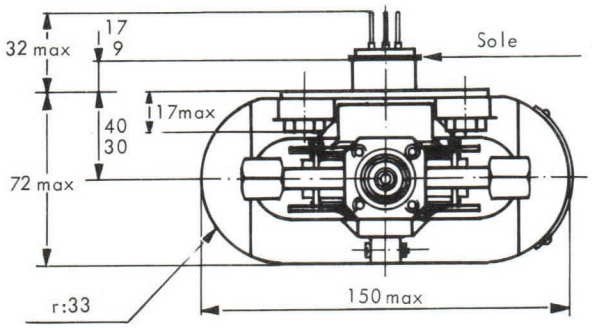


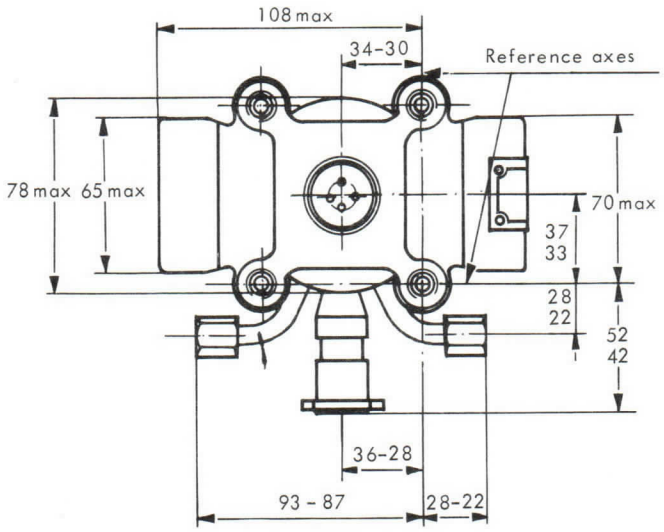
Supply diagram



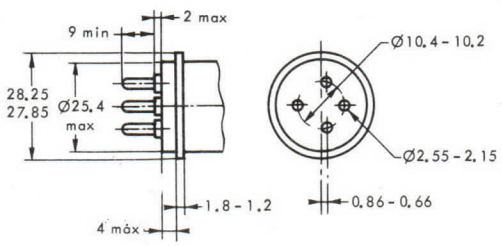
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





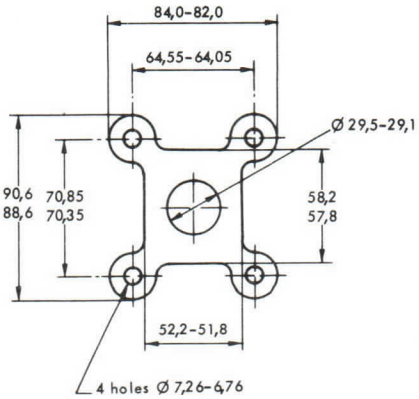
Pin arrangement



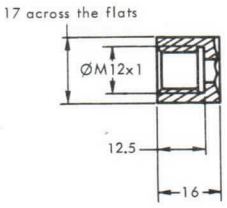
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

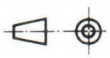
Mounting flange



Water connection

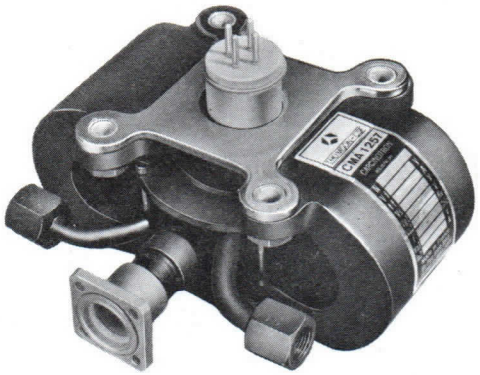


Dimensions in mm



CMA 1257 CARCINOTRON

The CMA.1257 is a rugged, compact electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 150 W over the frequency range of 7. 2 to 8. 7 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1257 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	1. 5	3. 0	A
Output power	150	–	W
Frequency range	7. 2	8. 7	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	45	pF
Anode to all other electrodes	–	15	pF
Line to all other electrodes	–	45	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–30	+10	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current	300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	2. 5 kg
RF output connector	UG 141/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 1	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 6	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	–	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	–	6	A
Load VSWR (2)	–	3 : 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz	± 1 mm		
15 to 500 Hz	2 g		

	min.	max.	
Sole voltage (3)	–200	+200	V
Grid voltage (3)	–100	+100	V
Anode voltage (3)	–	+200	V
Line voltage	–	5. 2	kV
Line current	–	320	mA
Acceleration	–	15	g

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	7. 2	8. 7	GHz
Heater current	1. 7	A				
Sole voltage	–1. 2	kV	Anode voltage	1. 36	1. 34	kV
Grid voltage	–0. 4	kV	Line voltage	2. 70	4. 26	kV
Grid current	0	mA	Sole current	–2	+14	mA
Line current	300	mA	Output power	205	235	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

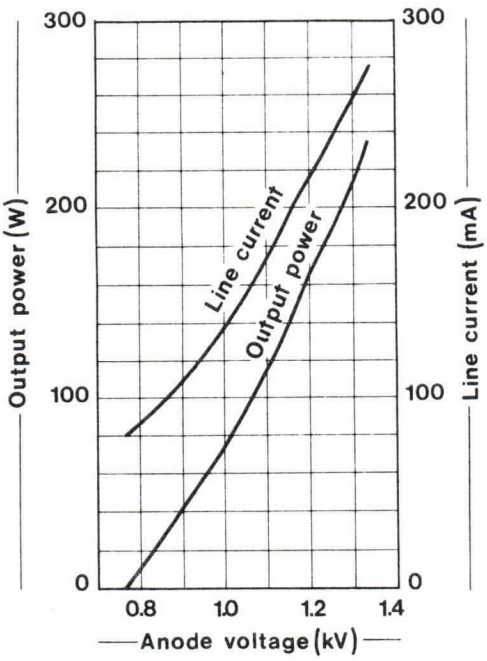
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

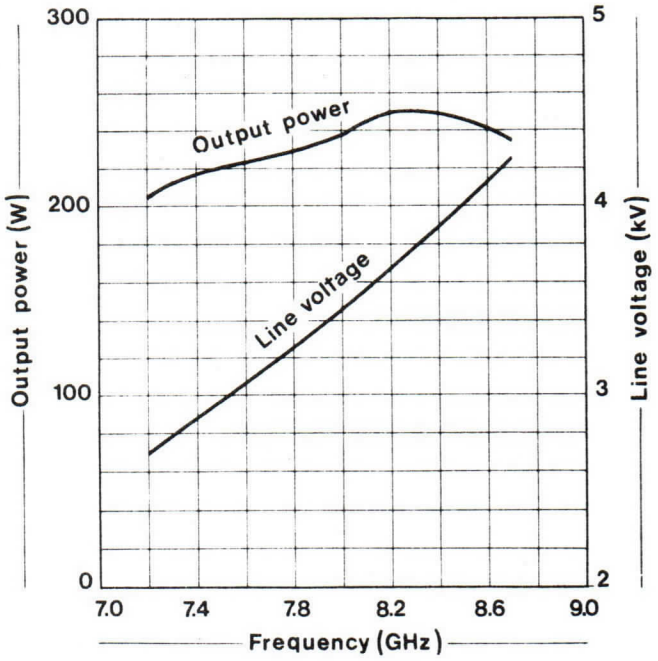
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

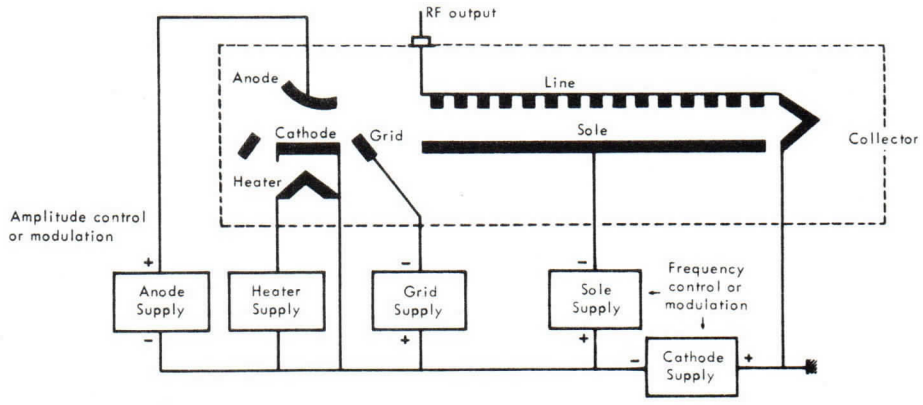
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



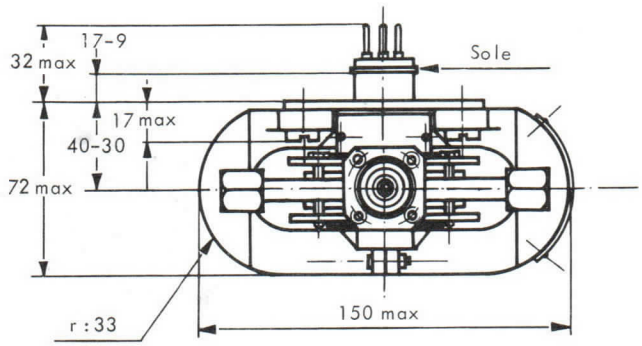


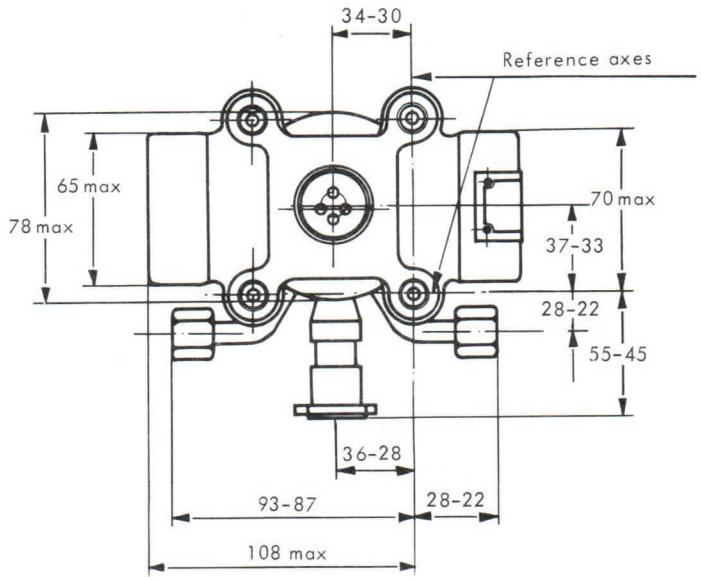
Supply diagram



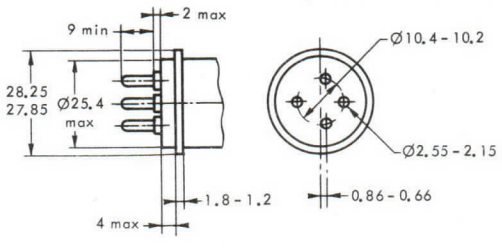
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





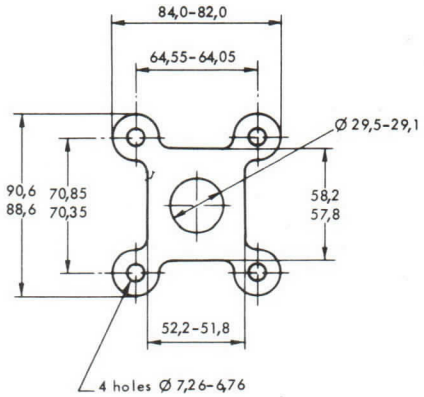
Pin arrangement



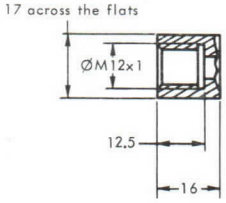
The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

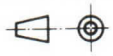
Mounting flange



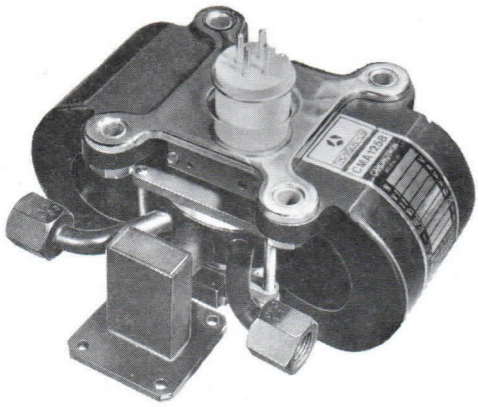
Water connection



Dimensions in mm



CMA 1258 CARCINOTRON



The CMA.1258 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 150 W over the frequency range of 8. 0 to 10. 5 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1258 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage		6. 3	V
Heater current	1. 4	2. 5	A
Output power	–	150	W
Frequency range	8. 0	10. 5	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	35	pF
Anode to all other electrodes	–	10	pF
Line to all other electrodes	–	25	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–25	+5	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current		300	mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	2. 5 kg
RF output connector	coaxial UG 39/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER				COOLANOL 35			
Water flow	min.	2	l/mn	Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0.05	bar	Pressure drop (1)	max.	0.28	bar
Coolant temperature	max.	80	°C	Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar	Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	—	mn	Sole voltage (3)	−200	+200	V
Heater voltage	6.0	6.6	V	Grid voltage (3)	−100	+100	V
Heater surge current	—	6	A	Anode voltage (3)	—	+200	V
Load VSWR (2)	—	3 : 1		Line voltage	—	5.2	kV
Ambient temperature	−40	+110	°C	Line current	—	320	mA
Vibration : 5 to 15 Hz	± 1 mm			Acceleration	—	15	g
15 to 500 Hz	2 g						

TYPICAL OPERATION

			Oscillating frequency :	8.0	10.5	GHz
Heater voltage	6.3	V				
Heater current	1.7	A				
Sole voltage	−1.2	kV	Anode voltage	1.30	1.28	kV
Grid voltage	−0.4	kV	Line voltage	2.67	4.96	kV
Grid current	0	mA	Sole current	−1.8	−12	mA
Line current	300	mA	Output power	180	185	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

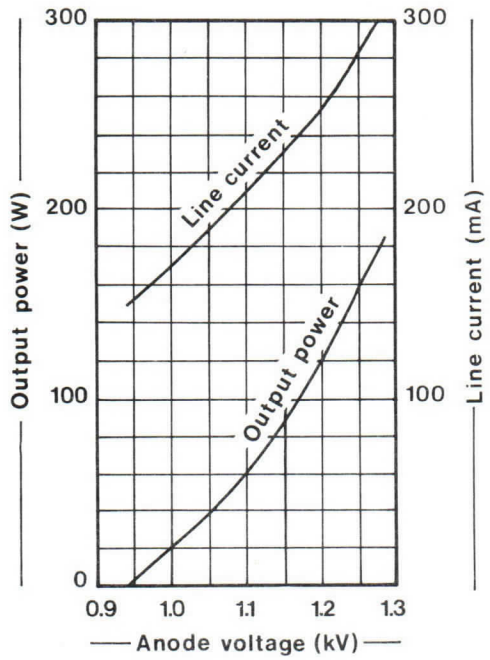
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

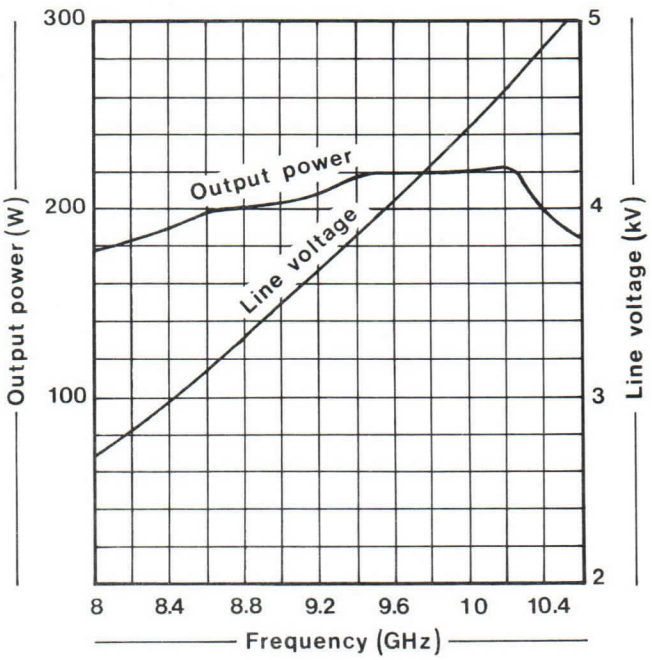
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

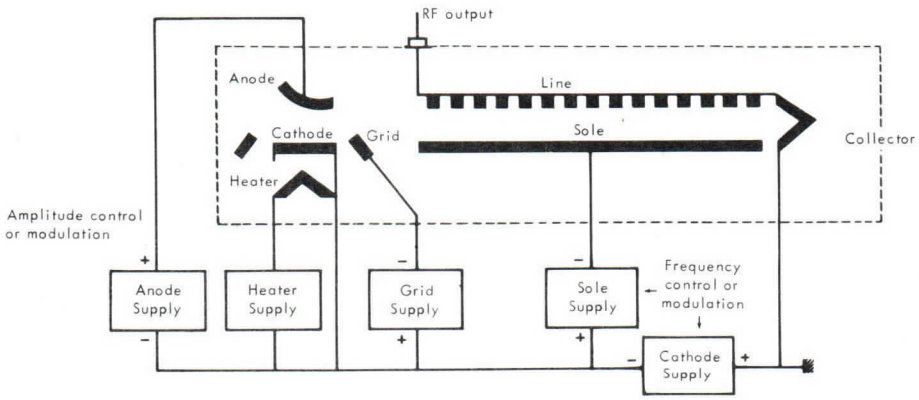
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1.5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves





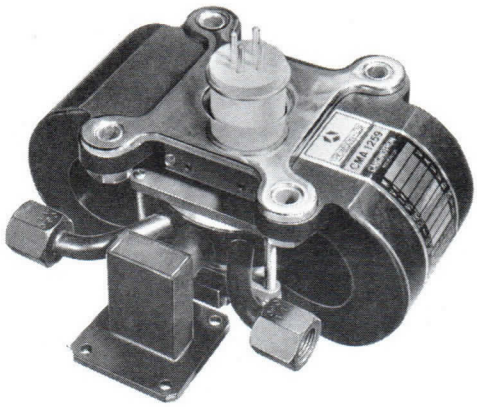
Supply diagram



THOMSON-CSF

GROUPEMENT TUBES ELECTRONIQUES

CMA 1259 CARCINOTRON



The CMA.1259 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 100 W over the frequency range of 10. 4 to 12. 5 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1259 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage	6. 3		V
Heater current	1. 2	2. 1	A
Output power	100	–	W
Frequency range	10. 4	12. 5	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	35	pF
Anode to all other electrodes	–	10	pF
Line to all other electrodes	–	30	pF
Sole voltage	–0. 7	–1. 8	kV
Sole current	–10	+3	mA
Grid voltage	–0. 1	–0. 7	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 9	5. 0	kV
Line current	300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	2. 5 kg
RF output connector	coaxial UG 39/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0.08	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0.8	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	6	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	—	mn
Heater voltage	6.0	6.6	V
Heater surge current	—	6	A
Load VSWR (2)	—	3 : 1	
Ambient temperature	−40	+110	°C
Vibration : 5 to 15 Hz	± 1 mm		
15 to 500 Hz	2 g		

	min.	max.	
Sole voltage (3)	−200	+200	V
Grid voltage (3)	−100	+100	V
Anode voltage (3)	—	+200	V
Line voltage	—	5.2	kV
Line current	—	320	mA
Acceleration	—	15	g

TYPICAL OPERATION

Heater voltage	6.3	V
Heater current	1.5	A
Sole voltage	−1.5	kV
Grid voltage	−0.4	kV
Grid current	0	mA
Line current	300	mA

Oscillating frequency :	10.4	12.5	GHz
Anode voltage	1.78	1.80	kV
Line voltage	2.20	3.56	kV
Sole current	0	4	mA
Output power	135	135	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

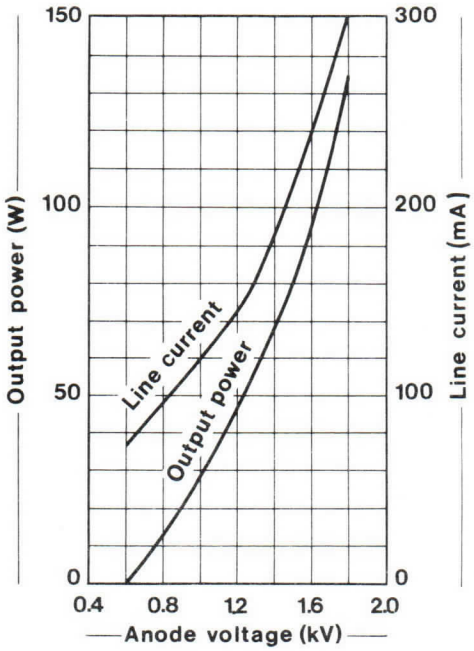
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

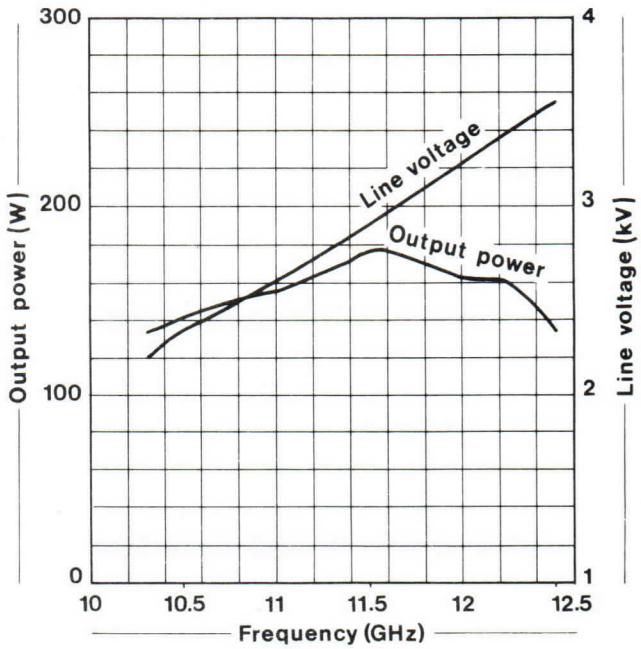
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

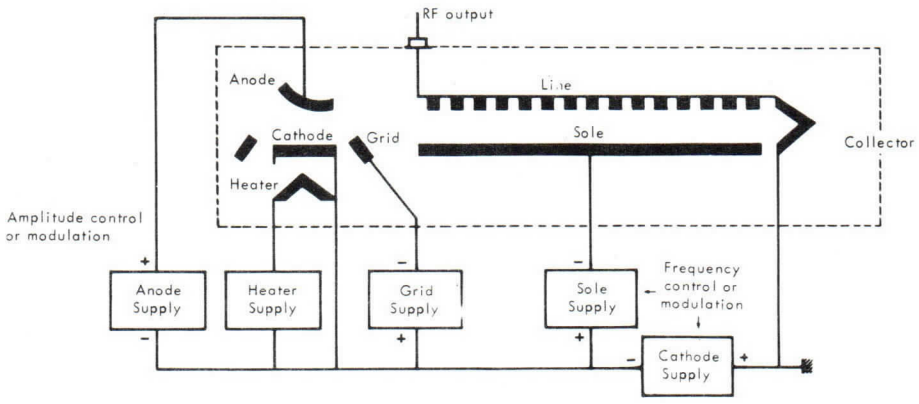
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1.5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



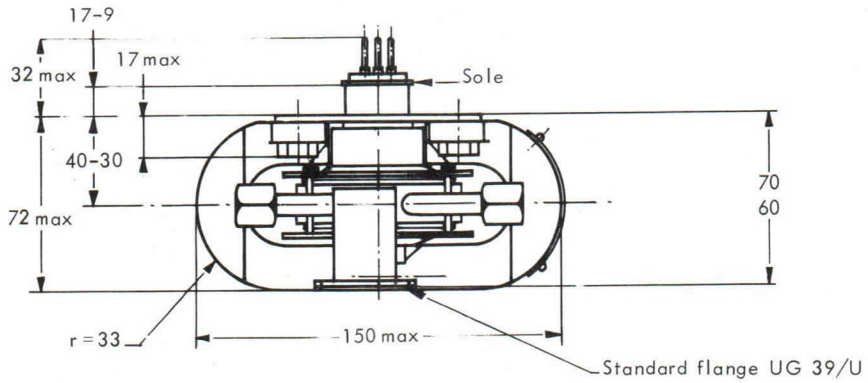


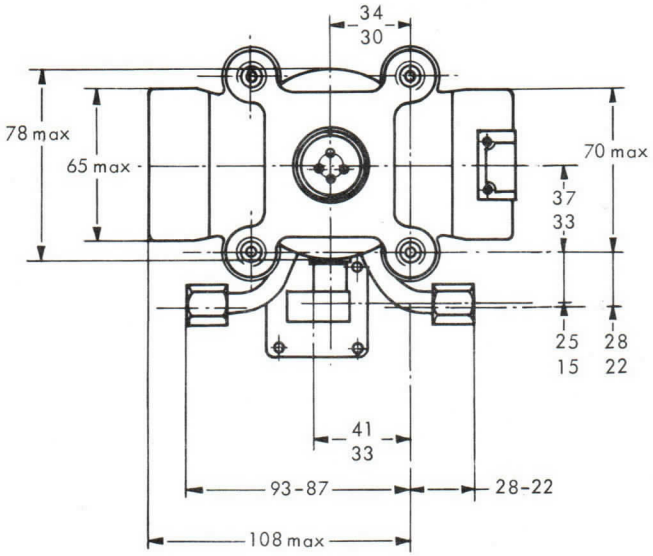
Supply diagram



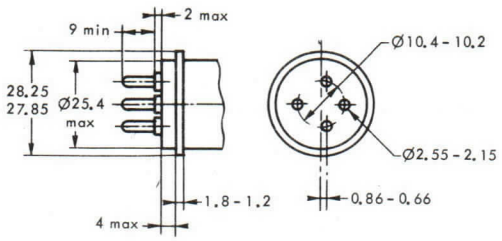
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

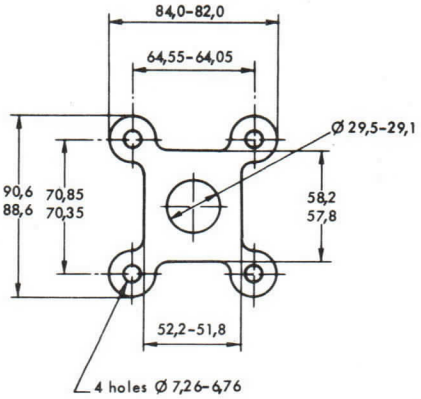
OUTLINE DRAWING



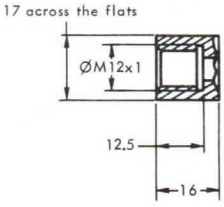


Pin arrangement





Water connection

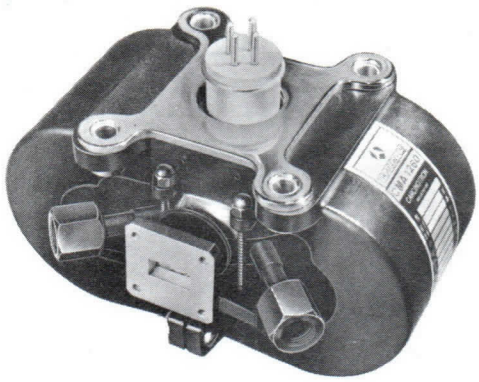


The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

Dimensions in mm.

CMA 1260 CARCINOTRON



The CMA.1260 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.

This M type carcinotron provides an output of at least 80 W over the frequency range of 12. 3 to 14. 8 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1260 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.	max.	
Heater voltage		6. 3	V
Heater current	1. 0	2. 0	A
Output power	80	–	W
Frequency range	12. 3	14. 8	GHz
Interelectrode capacitances :			
Sole to all other electrodes	–	30	pF
Anode to all other electrodes	–	10	pF
Line to all other electrodes	–	30	pF
Sole voltage	–0. 7	–2. 0	kV
Sole current	–20	+5	mA
Grid voltage	–0. 1	–1. 0	kV
Grid current	–3	+3	mA
Anode voltage	0. 7	2. 0	kV
Anode current	–3	+3	mA
Line voltage	1. 5	5. 0	kV
Line current		300	mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3. 6 kg
RF output connector	coaxial UG 419/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER

Water flow	min.	2	l/mn
Pressure drop (1)	max.	0. 085	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar

COOLANOL 35

Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 4	bar
Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.	
Warm-up time	3	–	mn
Heater voltage	6. 0	6. 6	V
Heater surge current	–	6	A
Load VSWR (2)	–	3 : 1	
Ambient temperature	–40	+110	°C
Vibration : 5 to 15 Hz		± 1 mm	
15 to 500 Hz		2 g	

	min.	max.	
Sole voltage (3)	–100	+100	V
Grid voltage (3)	–50	+50	V
Anode voltage (3)	–	+200	V
Line voltage	–	5. 2	kV
Line current	–	310	mA
Acceleration	–	15	g

TYPICAL OPERATION

Heater voltage	6. 2	V	Oscillating frequency :	12. 3	14. 8	GHz
Heater current	1. 6	A				
Sole voltage	–1. 3	kV	Anode voltage	1. 24	1. 23	kV
Grid voltage	0. 8	kV	Line voltage	2. 20	3. 48	kV
Grid current	0	mA	Sole current	–0. 2	–0. 5	mA
Line current	300	mA	Output power	120	125	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

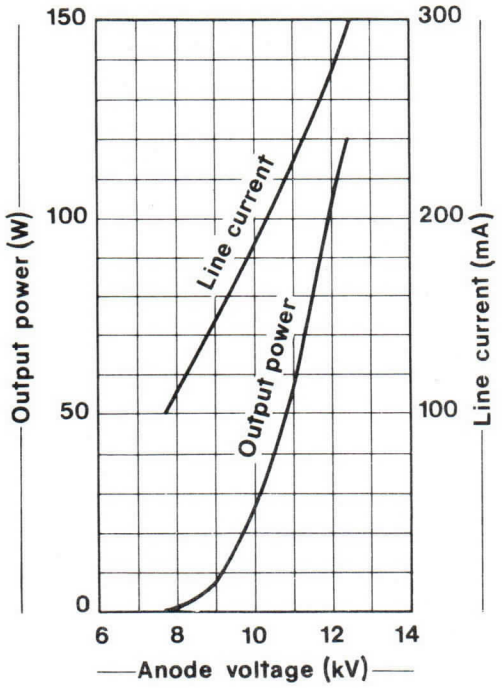
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

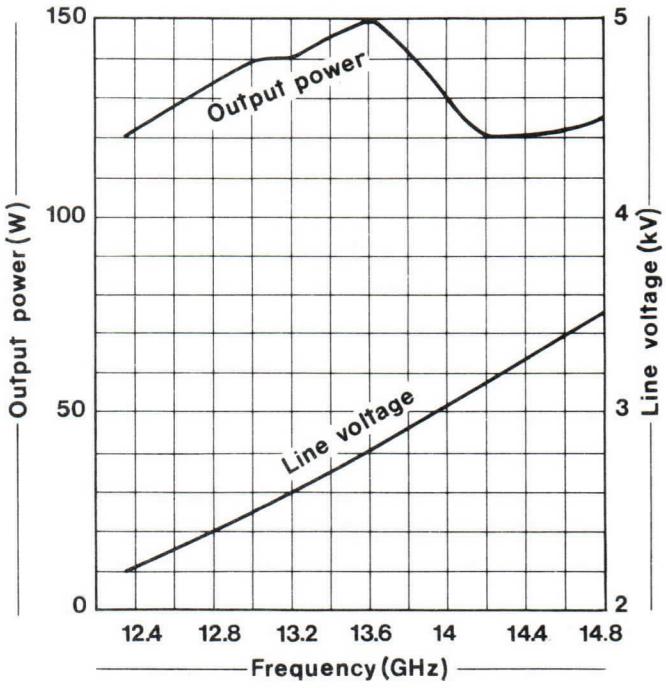
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

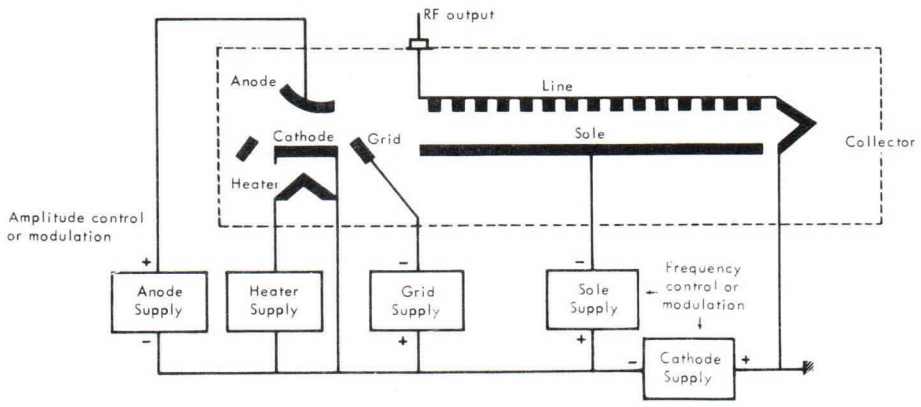
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



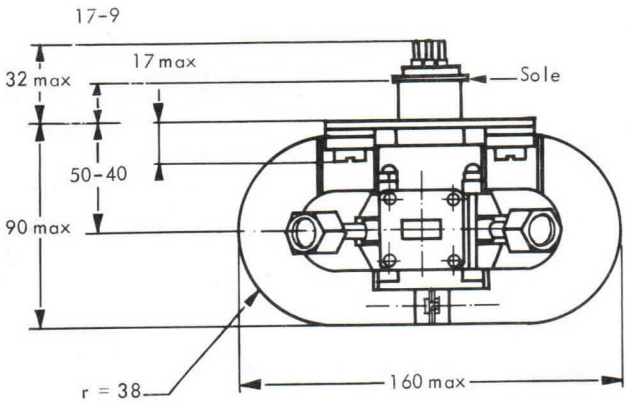


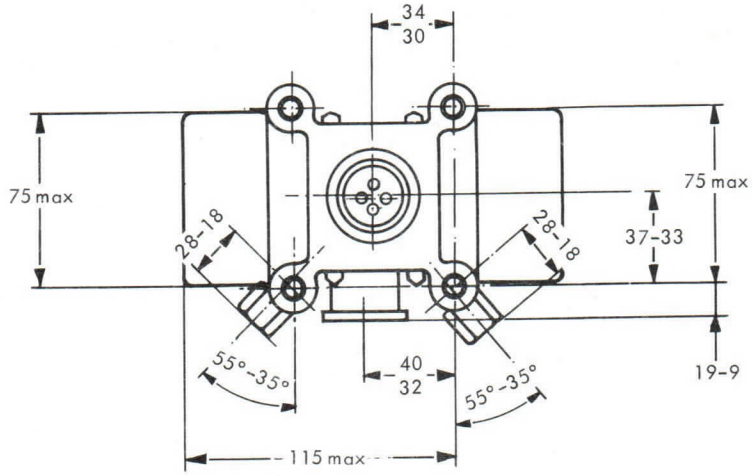
Supply diagram



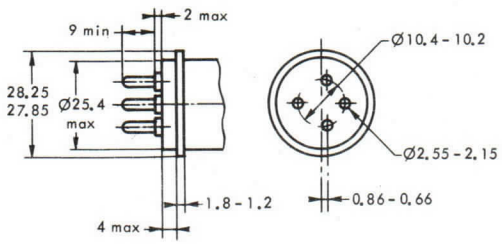
THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

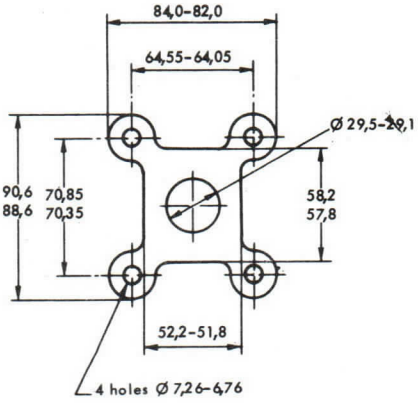
OUTLINE DRAWING





Pin arrangement

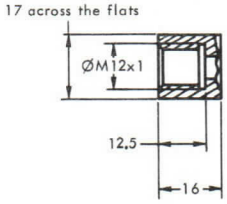




The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection: 0.3 mm.

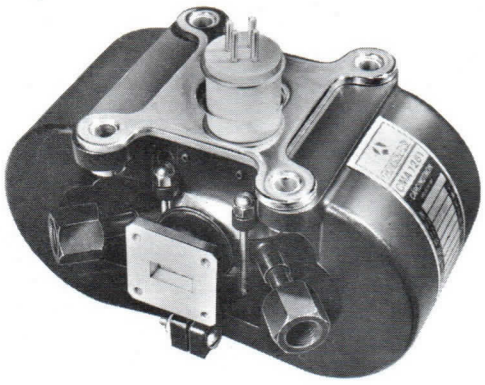
Water connection



Dimensions in mm.

CMA 1261 CARCINOTRON

The CMA.1261 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 80 W over the frequency range of 14. 5 to 17. 5 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA.1261 uses integral permanent magnet focusing. Liquid cooling insures operation in a wide temperature range.

GENERAL CHARACTERISTICS

Electrical (1)

	min.		max.	
Heater voltage		6. 3		V
Heater current	1. 0		2. 0	A
Output power	80		–	W
Frequency range	14. 5		17. 5	GHz
Interelectrode capacitances :				
Sole to all other electrodes	–		30	pF
Anode to all other electrodes	–		10	pF
Line to all other electrodes	–		30	pF
Sole voltage	–0. 7		–2. 0	kV
Sole current	–20		+5	mA
Grid voltage	–0. 1		–1. 0	kV
Grid current	–3		+3	mA
Anode voltage	0. 7		0. 2	kV
Anode current	–3		+3	mA
Line voltage	1. 5		5. 0	kV
Line current		300		mA

Mechanical

Operating position	any
Dimensions	see drawing
Weight	3. 6 kg
RF output connector	UG 419/U

(1) - All voltages are referred to the cathode.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

WATER				COOLANOL 35			
Water flow	min.	2	l/mn	Liquid flow	min.	4	l/mn
Pressure drop (1)	max.	0. 08	bar	Pressure drop (1)	max.	0. 4	bar
Coolant temperature . .	max.	80	°C	Coolant temperature . .	max.	80	°C
Absolute inlet pressure .	max.	4	bar	Absolute inlet pressure .	max.	4	bar

ABSOLUTE RATINGS

(non simultaneous values)

	min.	max.			min.	max.	
Warm-up time	3	—	mn	Sole voltage (3).	−100	+100	V
Heater voltage	6. 0	6. 6	V	Grid voltage (3).	−50	+50	V
Heater surge current . .	—	6	A	Anode voltage (3)	—	+200	V
Load VSWR (2).	—	3 : 1		Line voltage	—	5. 2	kV
Ambient temperature .	−40	+110	°C	Line current	—	310	mA
Vibration : 5 to 15 Hz ±1 mm				Acceleration.	—	15	g
15 to 500 Hz 2 g							

TYPICAL OPERATION

Heater voltage	6. 3	V	Oscillating frequency :	14. 5	17. 5	GHz
Heater current	1. 5	A				
Sole voltage	−1. 3	kV	Anode voltage	1. 61	1. 60	kV
Grid voltage	−0. 7	kV	Line voltage	2. 10	3. 35	kV
Grid current	0	mA	Sole current	−10	−0. 4	mA
Line current	300	mA	Output power	110	160	W

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least three minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

Removal of voltages

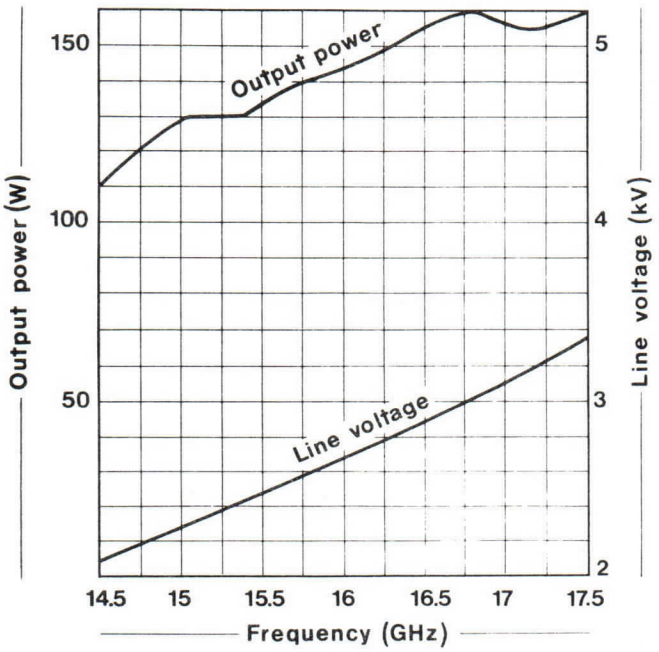
First remove the modulation voltages.
Remove anode voltage.
Remove line voltage.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

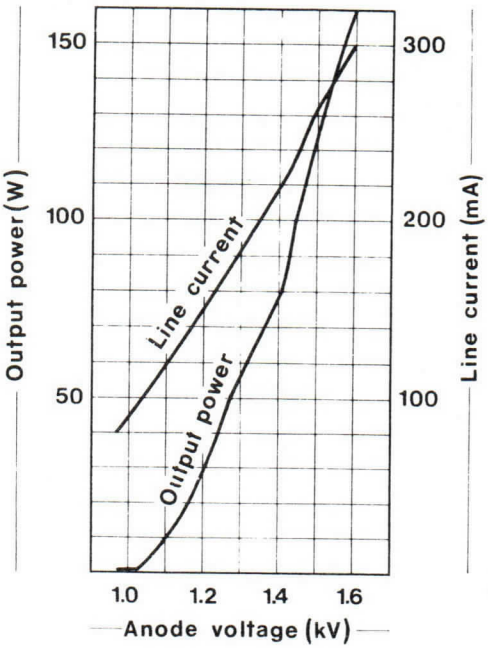
Caution

Minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

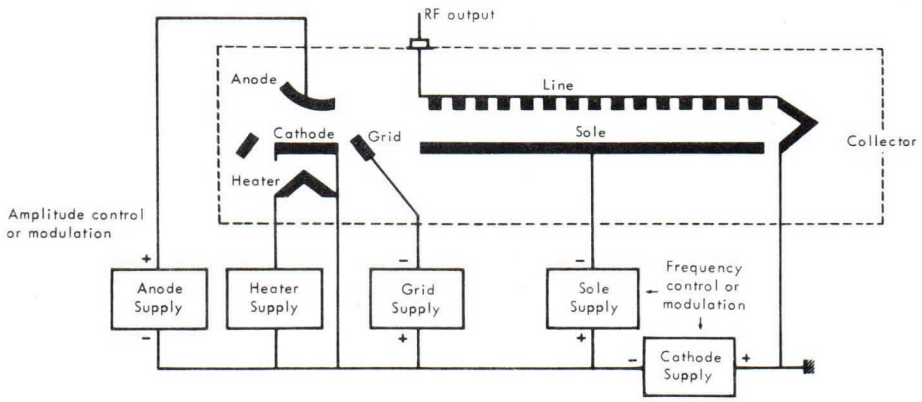
(1) - 1 bar = approximately 15 psi.
(2) - The tube may require a load isolator at load VSWR exceeding 1. 5 : 1 to maintain the tube performances.
(3) - These minimum and maximum ratings are the allowable deviation from the nominal value given for each tube.

Characteristic curves



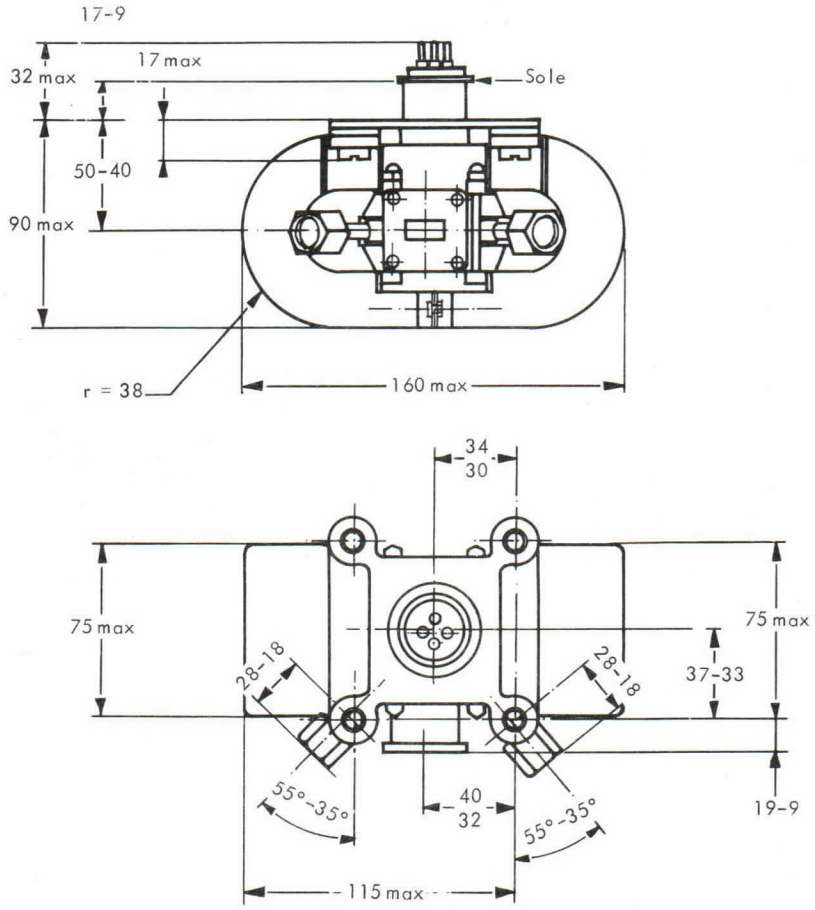


Supply diagram

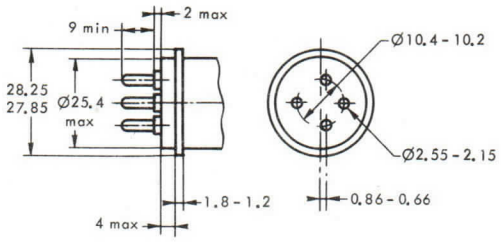


THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING

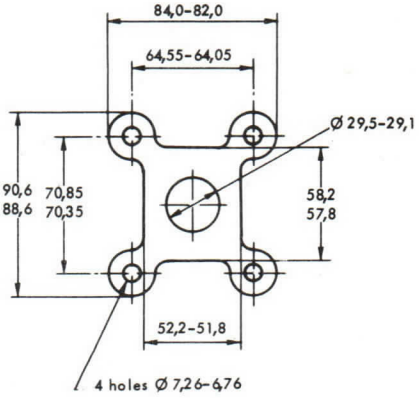


Pin arrangement

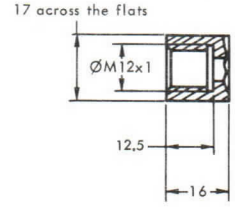


The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0,3 mm.



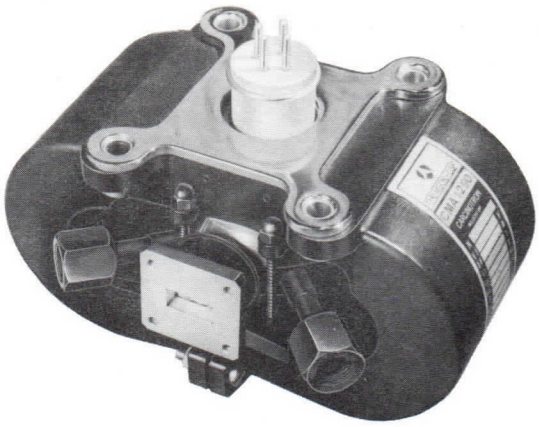
Water connection



Dimensions in mm.

CMA 1290 CARCINOTRON

The CMA 1290 is a rugged, compact, electronically tunable, crossfield, backward wave oscillator. Its light weight makes it suitable for airborne equipments. Sturdy metal-ceramic construction insures reliable performance in spite of severe environmental conditions.



This M type carcinotron provides an output of at least 100 W over the frequency range of 15.4 to 17.6 GHz. The tube tunes over the entire frequency range by changing the line or sole voltage.

It can be amplitude modulated through its anode. Frequency modulation can be obtained by line or sole voltage variations.

The CMA 1290 uses integral permanent magnet focusing. Liquid cooling insures reliable operation in a wide temperature range.

In short, the principal features of the CMA 1290 are :

- Wide tuning range	15.4 to 17.6	GHz
- Nominal output power	130	W
- Light weight	3.6	kg

GENERAL CHARACTERISTICS

Electrical

Heater voltage	6.3	V
Heater current	1.5	A
Warm-up time	3	mn
Interelectrode capacitances :		
- Sole to other electrodes	30	pF
- Anode to other electrodes	10	pF
- Line to other electrodes	30	pF
- Frequency range	15.4 to 17.6	GHz

Mechanical

Operating position	any	
RF output connector	UG 419/U	
Weight	3.6 kg	
Dimensions	see drawing	
Ambient temperature	−40 to +110	°C
Acceleration	15 g	
Vibration	5 to 15 Hz	2 mm
	15 to 500 Hz	2 g

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

COOLING

Water				Coolanol 35			
Water flow	min.	2	l/mn	Liquid flow	min.	4	l/mn
Pressure drop	max.	0.08	bar	Pressure drop	max.	0.4	bar
Coolant temperature	max.	80	°C	Coolant temperature	max.	80	°C
Absolute inlet pressure	max.	4	bar	Absolute inlet pressure	max.	4	bar

TYPICAL OPERATION (1)

Heater voltage	6.3	V	Oscillating frequency	15.4 to 17.6	GHz
Heater current	1.5	A			
Sole voltage	−1.3	kV	Anode voltage	1.61 to 1.60	kV
Grid voltage	−0.7	kV	Line voltage	2.10 to 3.35	kV
Grid current	0	mA	Sole current	−1.0 to −0.4	mA
Line current	300	mA	Output power	110 to 160	W

ABSOLUTE RATINGS (1)

	min.	max.			min.	max.	
Warm-up time	3	-	mn	Sole current	−20	+5	mA
Heater voltage	6.2	6.4	V	Grid current	−3	+3	mA
Heater current	1.2	2.0	A	Line current	-	300	mA
Sole voltage	−1.28	−2.0	kV	Anode current	−3	+3	mA
Grid voltage	−0.3	−0.8	kV	Output power	100	-	W
Anode voltage	1.0	2.1	kV	Load VSWR (2)		1.2 : 1	
Line voltage	2.2	4.17	kV	Spurious oscillations	-	−20	dB

(1) All voltages are referred to the cathode.

(2) The tube may require a load isolator at load VSWR values above 1.5 : 1 to maintain the tube performances. The tube may be damaged when the mismatch corresponds to a VSWR exceeding 3 : 1.

OPERATING INSTRUCTIONS

Application of voltages

Before applying any voltages to the tube, check the coolant flow.
Apply the heater voltage and allow at least 3 minutes for the cathode to warm-up.
Apply grid and sole voltages.
Apply line voltage. The minimum value of the line voltage given on the tube label is for operating at the lower frequency ; when starting the tube, the voltage applied should be slightly higher.
Apply reduced anode voltage. Increase the voltage slowly and simultaneously check the line voltage, which should not decrease.
Adjust the voltages for each particular operation.
Apply modulation voltages.

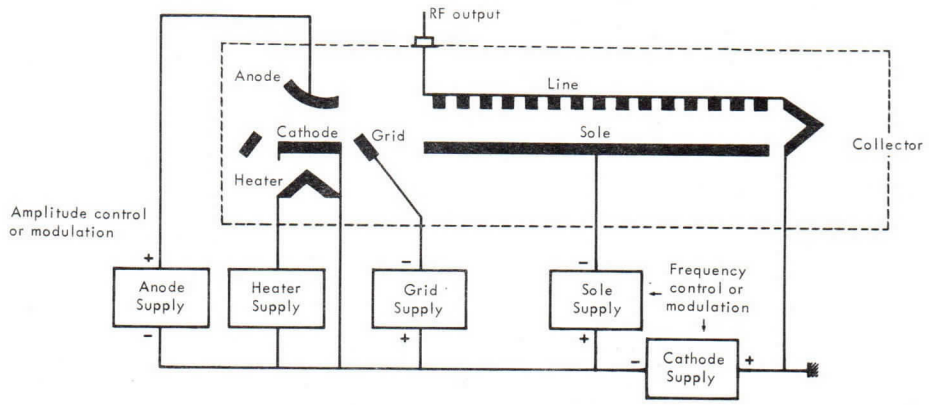
Removal of voltages

First remove the modulation voltages.
Remove simultaneously the anode and line voltages.
Remove sole, grid and heater voltages.
Turn off coolant supply to the tube.

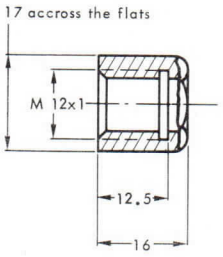
Caution

A minimum distance of 15 cm should be kept between the tube and all other magnetic materials.

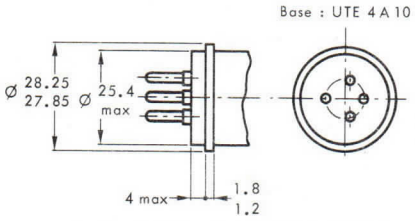
SUPPLY DIAGRAM



WATER CONNECTION



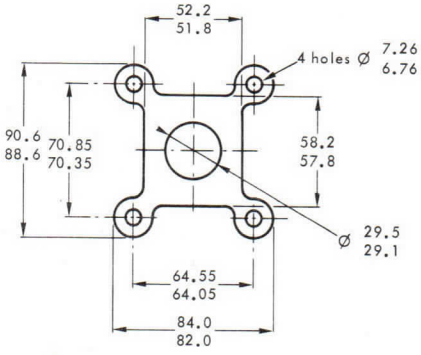
PIN ARRANGEMENT



The pin position with respect to the tube axes is determined within 10°

Maximum base eccentricity with respect to the sole connection : 0.3 mm.

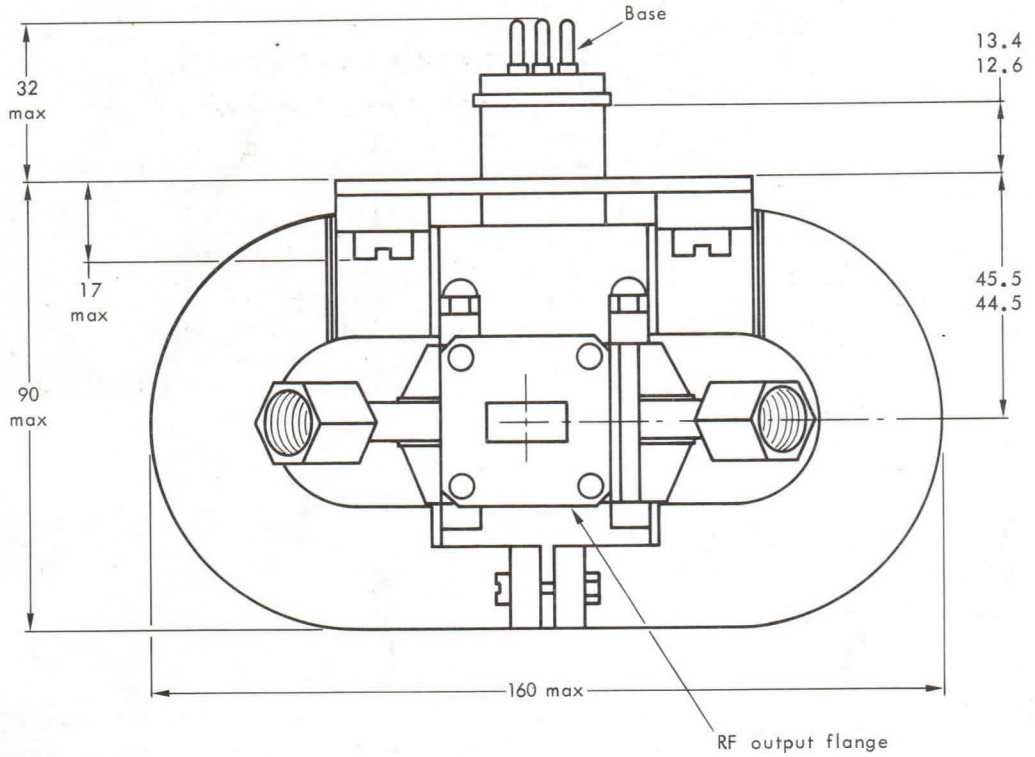
MOUNTING FLANGE

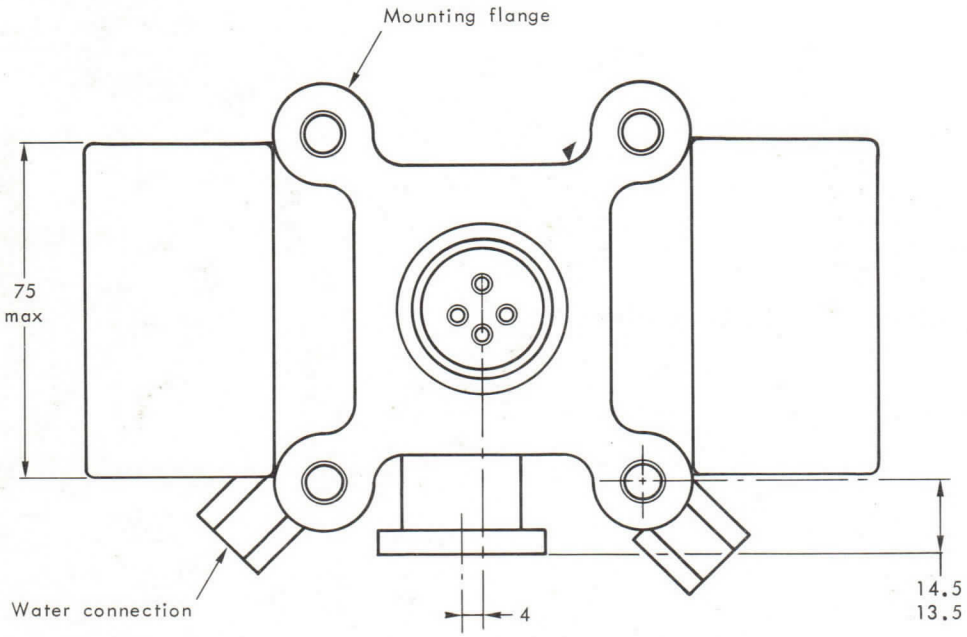


Dimensions in mm.

THOMSON-CSF
GROUPEMENT TUBES ELECTRONIQUES

OUTLINE DRAWING





Dimensions in mm.