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THOMSON-CSF

DIVISION TUBES ELECTRONIQUES

DÉPARTEMENT TUBES et DISPOSITIFS HYPERFREQUENCES	Référence : CA 2095A-102	Type : TH 2095A
Service Assurance Qualité	Edition du : 19.06.85	Page : 1/11

DETAIL SPECIFICATION FOR KLYSTRON TH 2095A

This detail specification is to be used jointly with the general specification NF C95, for all the parts of the latter that are applicable.

The explanation of the symbols used is given in paragraph 1.3.3.2 of the general specification. For meaning of particular symbols see note 19.

The sign * (if used) indicates that the definitive value or text will be furnished separately.

At the end of this specification, correspondence between symbols of the NF C95 (French) and MIL-E-1 specifications is given.

DESCRIPTION :

Klystron amplifier :

- 5 integral cavities
- modulating anode
- solenoid focusing
- water cooling
- operating frequency 1300 MHz
- pulsed mode 6.5 MW peak, 45 kW average, 300 µs pulse duration.

WEIGHT : 160 kg approximately

MOUNTING POSITION : Vertical, cathode down.

PROTECTION AGAINST X - RAYS PRODUCED BY KLYSTRON : Required

DIMENSIONS AND CONNECTIONS : See drawing.

COOLING REQUIREMENTS : Body and collector : water (note 10)

Histogramme	Réf. CA 2095A-	101	102	103	104	105	106	107	108	109	110
	MOD		2419								
	Visa										

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ABSOLUTE RATINGS (see NF C95-201 - arr. 1.3.2) : (Note 1)

Parameter	Vf	Ipdf	tk	Vpi	Ipi	Ppi	Vkcr	Anode-cathode voltage Vakcr	Iacr
Unit	V	A	mn	kV	mA	W	kV	kV	A
Maximum	28	50	-	5.5	0.010	50	145	140	2
Minimum	-	-	15	4.5	-	-	-	-	-
Note	2 - 3	4	-	-	16	-	-	-	-

Parameter	Va	Pcolcr	Pcol	Pscr	Psmoy	tpV	tpf	Pecr	Pemoy
Unit	kV	MW	kW	MW	kW	µs	µs	kW	W
Maximum	28	18	140	6.5	50	310	310	0.5	15
Minimum	-	-	-	-	-	-	-	-	-
Note	-	-	-	-	-	5	-	6	-

Parameter	Load VSWR	Prcr	Pct	Isol	T water	P window	P water	Energy dissi-pation
Unit	-	MW	kW	A	°C	bar	bar relative	J
Maximum	1.5	0.6	6	65	50	3	6	20
Minimum	-	-	-	vn - 7.5%	-	-	-	-
Note	17	17	21	7	8 - 9	18	-	22

GENERAL TEST CONDITIONS :

- Preheating : Vf = vn (note 2) tk = 15 mn
- TH 2095A klystron must be used with TH 20277 focusing solenoid and its countercoil (notes 7 et 11) Iaol = vn
- fo = 1300 ± 1 MHz
- tpf = 250 ± 25 µs (note 12)
- Duty factor : 0.0075 max
- VSWR of water load : ≤ 1.2 : 1 (cold measurement) the output waveguide is filled with Freon 12 or SF6 at an absolute pressure of 1.5 bar.
- Vpi = 5 ± 0.5 kV
- body cooling water flow : J = 10 l/mn (note 10)
- collector " " " : J = 120 l/mn (note 10)
- Device for measuring the average power dissipated on the body : REGLINDEX DOP with 10°C full scale by BRION-LEROUX Cie, or equivalent.
- Pe = vn
- Vkcr = vn
- Vakcr = vn

Référence	Essai Condition particulière	Symbole	Limites min	Limites max	Unité
	QUALITY CONFORMANCE INSPECTION :				
A.B.2.1	Dimensions : see the outline drawing	-	-	-	-
A.D.1.1	Heater voltage (note 13)	Vf	20	28	V
A.C.4.1	Heater current (note 14)	If	17	28	A
A.D.1.1	Peak body-cathode voltage	Vkcr	-	135	kV
A.D.1.1	Peak anode-cathode voltage	Vakcr	-	130	kV
A.D.1.1	Peak body-anode voltage	Vbacr	4	-	kV
A.C.4.1	Peak cathode current	Ikcr	-	130	A
A.C.4.1	Peak anode current	Iacr	-	0,75	A
A.G.3	Peak output power	Pscr	6.25	-	MW
	Peak drive power (note 6)	Pecr	-	350	W
K.G.2.1	Gain	G	42	-	dB
	Efficiency (note 15)	η	42	-	%
	Bandwidth (- 1 dB)	ΔF	8	-	MHz
	Average body power (note 21)	Pct	-	5	kW
	Focusing coil current (note 7)	Isol	-	70	A
	Vacuum	Ipi	-	10	µA

Référence	Essai Condition particulière	Symbole	Limites min	Limites max	Unité
	Cooling circuits tests :				
	Pressure drop . Window and body circuit Flow = 10 l/mn	ΔP	-	5	bar
	. Collector circuit Flow = 120 l/mn	ΔP	-	2	bar
	Window pressure test (note 20) absolute pressure of air or nitrogen = 3 ± 0.2 bar	-	-	-	-
	Test duration : one hour with pressure drop to atmospheric pressure every 15 mn for 1 mn				
	END OF LIFE CONDITIONS :				
A.C.3	Peak output power Vker = 135 kV Vf ≤ 28 V (note 3) Pecr, Isol optimized	Pscr	5.5	-	MW

NOTES CONCERNING OPERATION AND TESTS

NOTE 1 - These limits should never be exceeded in continuous or transient operation.

Two or more absolute ratings must not be reached simultaneously.

NOTE 2 - In normal operation, the heater voltage should be held to within ± 2 % of the value specified by the manufacturer on the test sheet. If not, the tube might be damaged beyond repair.

NOTE 3 - During the life of the klystron and depending upon the evolution of its cathode, the manufacturer may request the user to adjust the filament voltage to a value outside the range defined by note 2 in order to optimize the tube operation.

NOTE 4 - The filament surge current (rms) after switching on the filament voltage should not exceed the specified value.

NOTE 5 - Voltage pulse duration measured at 75 % amplitude.

NOTE 6 - The drive power for tube saturation must not be exceeded by more than 3 dB and must be less than the maximum value specified.

NOTE 7 - The klystron must be operated in a model TH 20277 electromagnet. This electromagnet consists of a main coil, three trimming coils and two countercoils. By means of movable straps located on a terminal board, the profile of the magnetic field can be adjusted for optimum operation.

For each klystron, the tube's Test Report indicates the connections to be made on the TH 20277's terminal board and the optimum value of the coil current Isol.

The klystron can be irremediably damaged if the beam voltage is applied before the electromagnet current has been adjusted to the value given in the Test Report, or to a value compatible with the Absolute Ratings, set by the current Isol.

Isol must be adjusted to within ± 5 % of the value given in the Test Report (see note 21). The beam voltage can then be raised from zero to the value indicated, without any danger to the tube, whether or not RF drive is applied. On the other hand, it can be dangerous for the klystron to exceed the indicated beam-voltage value without increasing Isol accordingly.

NOTE 8 - Inlet water temperature.

NOTE 9 - Water quality
- dry residue : < 5 cg/l
- pH : 6.5 to 7.5
- (Ca + Mg) dissolved : < 2 cg/l

NOTE 10 - Minimum flow water cooling requirements and maximum pressure drop :

	Collector	Body	Unit
Minimum flow	120	10	l/mn
Maximum corresponding pressure drop	2	5	bar

NOTE 11 - Minimum water flow cooling requirement for the electromagnet :

8 dm3/mn with maximum inlet water temperature = 30°C

Maximum pressure drop for 8 l/mn = 2.2 bar

NOTE 12 - The RF pulse duration of the driver can be longer than tpf, but in this case it must be centered on the voltage pulse duration tpV.

NOTE 13 - Voltage indicated in the Test Report should be within specified limits.

NOTE 14 - With Vf equal to the value indicated in the Test Report, the filament current should be within specified limits after allowing 15 mn warm-up time.

NOTE 15 - a) - Efficiency is definid as the ratio :

$$\eta = \frac{Pscr\ (kW)}{Vkcr\ (kV) \times Ikcr\ (A)}$$

If an accurate measurement of Vkcr and Ikcr is impossible on the test equipment, use the efficiency formula defined by e).

b) - Peak RF output power output is calculated by multiplying the average output power by the duty factor $\frac{1}{D}$

c) - Duty factor is calculated by the following formula :

$$\frac{10^6}{tpf\ (\mu s) \times fr\ (Hz)} = \frac{1}{D}$$

Where : tpf is the detected RF pulse duration measured at
- 3 dB (Square law detector)
- fr is the repetition frequency.

d) - Average power dissipated on the water-cooled dummy load is given by the expression $Ps\ (kW) = \Delta T\ (°C) \times J\ (dm3/mn) \times \frac{4.18}{60}$

Where - ΔT is the water temperature increase
- J is the water flow.

e) - $$\eta = \frac{Pscr}{(Pcolcr + Pctcr) \text{ with } Pecr = 0}$$

In this case :

$$(Pcolcr + Pctcr) = \frac{10^6 \times (Pctmoy + Pcolmoy)}{tpV\ (\mu s) \times fr\ (Hz)}$$

NOTE 16 - A safety device must shut down the modulator when the ion-pump current exceeds the specified value.

NOTE 17 - If the VSWR cannot be maintained to less than 1.5 : 1 (due for instance to arcing in the R.F. load), there should be a protective circuit shutting down the RF power after the second pulse following reflected power exceeding 0.6 MW peak.

NOTE 18 - The output waveguide must be filled with gas at an absolute pressure of :

- 2.5 to 3.0 bar, if gas is dry air (normal value 2.75 bar)
- 1.05 to 3.0 bar, if gas is Freon 12 or SF6 (normal value 1.25 bar)

NOTE 19 - Ipi : ion-pump current
Isol : solenoid direct current
J : water flow
K : perveance
η : efficiency
Pcol or Pcolmoy : average power dissipated on the collector
Pcolcr : peak power dissipated on the collector
Pct or Pctmoy : average power dissipated on the body
Pctcr : peak power dissipated on the body
Pe or Pemoy : average drive power
Pecr : peak drive power
Ppi : average power input to the ion-pump
Prcr : reflected output power
Va : backswing voltage
vn : normal value given on the individual Test Report
Vpi : dc supply voltage for the ion-pump

NOTE 20 - This test will be made on the first tube only, without any voltage applied except Vpi.

NOTE 21 - The device for measuring and checking the power dissipated on the klystron body has a response time for cutting off the high voltage of 5 to 10 s. To prevent damaging the tube at the first application of voltage, it is necessary to adjust the focusing current beforehand to within better than ± 5 % of the value given on the tube's Test Report.

The klystron being in operation, adjust the focusing current for an optimum compromise between the efficiency, the gain, the stability and the power dissipated on the body, without the last notably exceeding the value indicated on the tube's Test Report. Adjust the protection threshold leading to high-voltage cutoff to a level 20 to 30 % higher than the optimum value determined as described above, without, however, exceeding the specified limit.

It should be remembered, in any case, that an adjustment of Isol yielding a low level of body power is favorable for a longer klystron operating life.

NOTE 22 - The power supply must imperatively be provided with a protection device (crow-bar or any equivalent system) to limit the energy discharge in the tube in case of arcing or too abrupt current surge to the specified value.

CORRESPONDENCE BETWEEN SYMBOLS
OF NF C95 (French) AND
MIL-E-1 SPECIFICATIONS (WHEN SYMBOLS ARE DIFFERENT)

NF C95	MIL-E-1
Ce	Cin
Cs	Cout
D	Du
dB	dB
f	F
FB	NF
fr	prr
Ia1	Ib1
Ia2	Ib2
Iacr	ib
Ifk	Ihk
Ig	Ic
Ig1	Ic1
Ig2	Ic2
Igcr	ic
Ih	Iw
Ikcr	ik
Ipdf	If (surge)
Pa	Pp
Pcol	Pp
Pe	Pi
Pecr	pi
PSa	Pi
Ps	Po

NF C95	MIL-E-1
Pscr	po
ROS	VSWR
Ta	TA
tcV	trv
tdV	tfv
TOP	TWT
Va	Eb
Vacr	eb
Vbloc	Eco
Vcol	Eb
vcV	tarv
Vf	Ef
Vfk	Ehk
Vgcr	egy
Vg1	Ec1
Vgr	Ec2
Vgicr	egx
Vgkcr	egk
Vpi	Eip
Vr	Er
Vres	Eres
Vrs	Ers
Vsa	Ebb
Vsol	Esol

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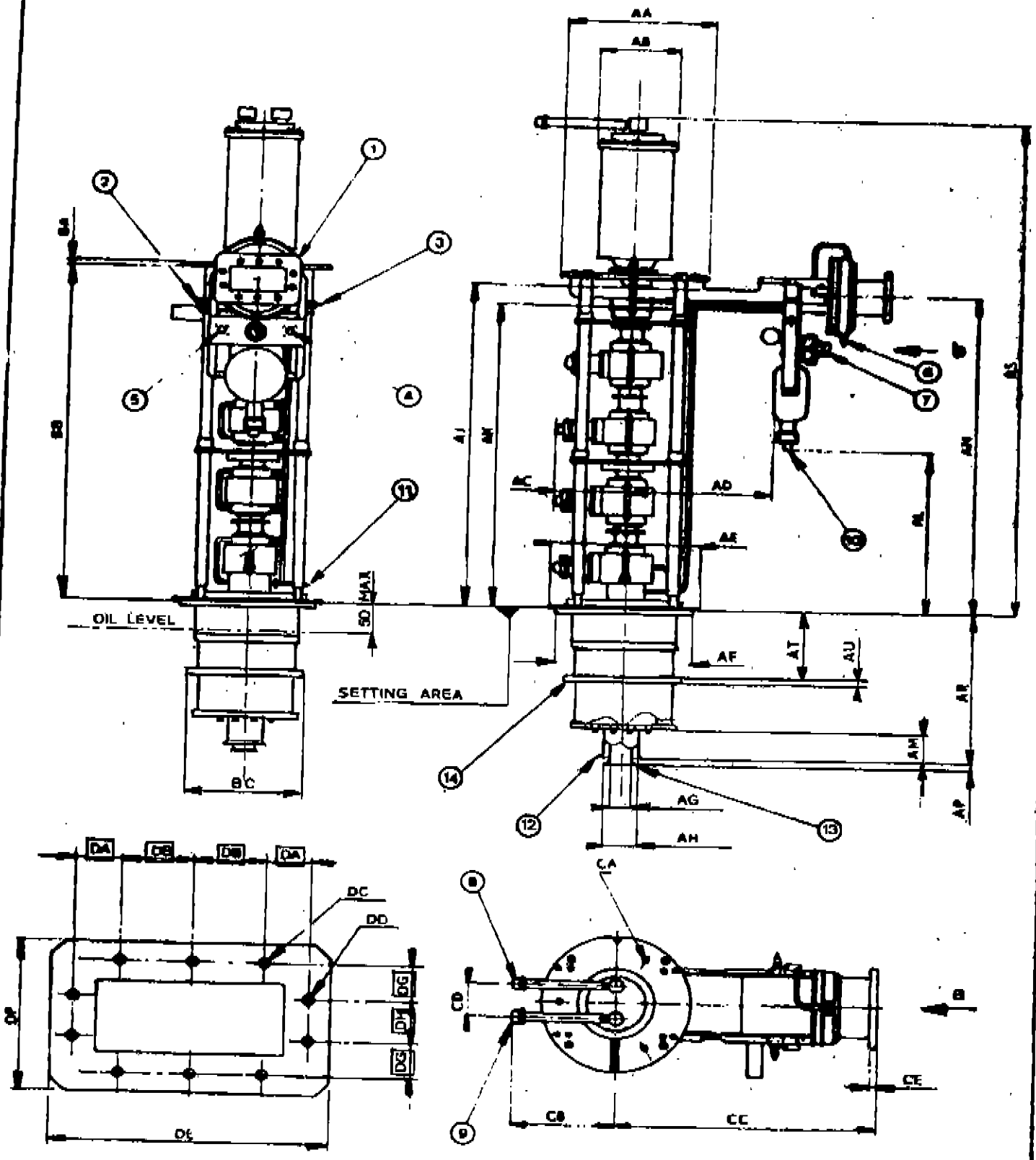

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Dimensions in mm

Ref.	-	min	max	Observations
AA	DIA	379.2	380.1	
AB	DIA	-	200	
AC	-	-	190	
AD	-	355	-	
AE	DIA	379	380.1	
AF	DIA	369.4	370.2	
AG	DIA	46.5	47.5	on 20 mm length (Heater connection)
AH	DIA	83	84	on 30 mm length (Cathode heater)
AJ	-	-	868.5	
AK	-	795	-	
AL	-	400	-	
AM	-	72.5	75.5	
AN	-	840	850	
AP	-	8	13	
AR	-	465	471	
AS	-		1340	
AT		218.5	222.5	
AU		23.5	25.5	
BA	-	14.5	15.5	
BB	-	868.8	871.2	
BC	DIA	297.5	299.5	
CA	DIA	-	-	3 HOLES M14 at 120° / DIA 280
CB	-	245	260	
CC	-	637	650	
CD	-	88	92	
CE	-	13	20	
DA	-	39.7		
DB	-	60.3		
DC	DIA	8.4	8.6	6 HOLES ⌖ Ø 0.4 M
DD	DIA	8.25	8.35	4 HOLES ⌖ Ø 0.25 M
DE	-	219.5		
DF	-	137.3		
DG	-	26.96		
DH	-	63.46		

Waveguide WR 650

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Connections, accessory and divers

Ref.	Designation	Observations
1	Output flange	Waveguide WR 650
2	Drain connector	Staubli connector mates with TH 20066
3	Water outlet (Body-Window)	Staubli connector mates with TH 20204
4	RF input	UG 22 D/U mates with UG 21 D/U
5	Thermometric resistances socket	SOCAPEX socket mates with FFD 17 P Plug
6	Water inlet (Body-Window)	Staubli connector mates with TH 20204
7	Shock detector	OMNIG calibrated 15 g
8	Water outlet	Connectors mates with TH 20089
9	Water inlet	
10	Ion pump input	UG 61 D/U mates with UG 59 D/U
11	Body water circuit drain	
12	Heater-cathode connection	
13	Heater connection	
14	Anode connection	

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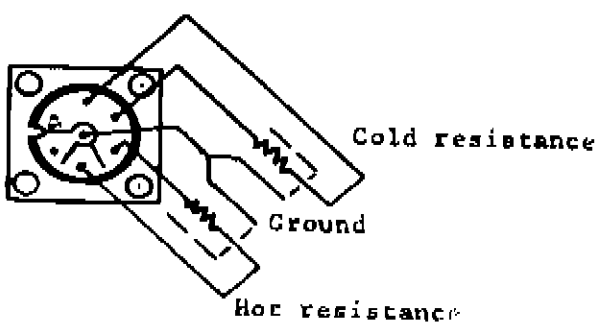

Socket SOCAPEX EM 17 P