15 = 10,6 H = 12 = 5,64 9 = 6,33
14 = 9,93 11 = 7,75 8 = 5,62
13 = 9,19 10 = 7,1 7 = 4,9
6 = 4,44

THOMSON TUBES ELECTRONIQUES

DEPARTEMENT TUBES et DISPOSITIFS HYPERFREQUENCES	**Référence** : CA 3759A-103	**Type** : **TH 3759A**
Service Assurance Qualité	**Edition du** : 22.10.90	**Page** : 1/15

SPECIFICATION FOR TH 3759A TWT

This specification is to be used jointly with the general specification NF C95 (equivalent to MIL-E-1), for all the parts thereof that are applicable.

The meaning of the symbols appears in paragraph 1.3.3.2 of the general specification.

The symbol * (when used) indicates that the actual value or text will be specified in a later issue of this specification.

The symbol vn refers to the nominal operating value of a parameter.

A synoptic table of standard symbols of French NF C95-201 and of MIL-E-1 is attached at the end of the text section of the present document.

As usual in English documentation :

- A decimal point is used to separate the fractional part of any number from the integer one (instead of a comma in the NF C95 general specification).
- The voltage standing wave ratio is referred to as VSWR (instead of ROS in the NF C95 general specification).

Voltages, unless otherwise specified, are referenced to cathode potential.

DEFINITION :

- Traveling-wave tube operating CW in the band 14.0 to 14.5 GHz
- Minimum output power : 300 W
- Gain greater than 50 dB for Ps ≥ 300 W
- Conduction cooling
- Periodic permanent magnet (ppm) beam focusing

WEIGHT : 5.2 kg approximately

DIMENSIONS AND CONNECTIONS : see drawing

	Réf. CA 3759A-	101	102	103	104	105	106	107	108	109	110
Histogramme	MOD			3401 3628							
	Visa										

ABSOLUTE RATINGS (see NF C95-201 - art. 1.3.2) :

Parameter	Vf	Ipdf	tk	Ih	Vcol	Vcol / Vh	Vcol to ground
Unit	V	A	s	mA	kV	-	kV
Maximum	6.35	2.5	-	10	4.9	0.55	-
Minimum	5.85	-	180	-	3.5	0.43	-6.0
Note	1 - 10	-	17	3 - 11	3 - 10 - 28	28	4 - 10

Parameter	Vh	Pe	Load reflected power	Storage temperature
Unit	kV	dBm	W	°C
Maximum	9	8	15	+ 85
Minimum	8.2	-	-	-40
Note	3 - 10	15	23 - 26	-

Parameter	Frequency	Distance from magnetic material	TWT baseplate temperature		RF output flange temperature
			tl	tcol	
Unit	GHz	cm	°C	°C	°C
Maximum	15.0	-	+ 95	+ 130	+ 100
Minimum	13.0	5	-40	-40	-
Note	7	6	8 - 27	8 - 27	24

LIMIT VALUES FOR CORRECT TUBE OPERATION :

The following table specifies the limiting values of the operating parameters not to be exceeded under permanent operation of the tube.

Parameter	Vf	Vcol	Vh	Load VSWR	TWT baseplate temperature	
					tl	tcol
Unit	V	kV	V	-	°C	°C
Maximum	6.25	Vh x 0.546	vn + 1%	1.3:1	+ 85	+ 120
Minimum	5.95	Vh x 0.44	vn -1%	-	-40	-40
Note	1 - 10	10	2 - 10 - 11	7 - 26	8 - 27	8 - 27

GENERAL TEST CONDITIONS : (see Notes 2, 10 and 22)

Parameter	Vf	tk	Vcol	Vh	Load VSWR	Pe
Unit	V	s	kV	kV	-	-
Value	6.1	180 min.	Vh x 0.45	vn	1.2:1 max.	vn
Note	1	-	-	2	-	2

Frequencies (± 10 MHz) :

f1 = 14.00 GHz
f2 = 14.25 GHz
f3 = 14.50 GHz

REFERENCE	Test Condition	Symbol	Limits min	Limits max	Unit
	QUALIFICATION TESTS :				
A.A.6.1	Shocks (tube non operating) Waveform : 1/2 sinus Acceleration : 15 g Duration : 11 ms ± 2 ms 3 shocks in both directions of the 3 axes (18 shocks) Post-test inspection : Output power f = f2	Ps	300	-	W
A.A.5.3	Vibrations (tube non operating) (Note 18) Waveform : sinus Duration : 45 mn on each of the 3 axes Levels and frequencies : 4 g 12 Hz to 500 Hz 1 g 500 Hz to 2000 Hz Post-test inspection : Output power f = f2	Ps	300	-	W
	Temperature and altitude (tube operating) 5 h cycle : Start the tube at -40°C ± 3°C 2 h at -40°C ± 3°C 1 h up to +65°C ± 2°C 2 h at +65°C ± 2°C 30 mn from +65°C to ambient temperature Altitude : 360 mbar (8000 m) Test inspection during and after the test : Output power f = f2	Ps	300	-	W

ÉRENCE	Test Condition	Symbol	Limits min	Limits max	Unit
A.3.1	Damp heat (tube operating) Ambient temperature : + 65°C ± 2°C Duration : 2 h Humidity : 95% Inspection during and after the test : Output power f = f2	Ps	300	-	W
A.3.1	Damp heat storage (tube non operating) Ambient temperature : + 40°C ± 2°C Duration : 10 days Humidity : 95% Post-test inspection : Output power f = f2	Ps	300	-	W
A.2.1	Cold and altitude storage (tube non operating) Cycle duration : 7 h From ambient temperature to -40°C ± 3°C : 30 mn -40°C ± 3°C : 6 h From -40°C to ambient temperature : 30 mn Pressure during the test : 121 mbar (15000 m) Post-test inspection : Output power f = f2	Ps	300	-	W

REFERENCE	Test Condition	Symbol	Limits min	Limits max	Unit
	Dry heat and altitude storage (tube non operating) Cycle duration : 7 h From ambient temperature to + 85°C ± 2°C : 30 mn + 85°C ± 2°C : 6 h From + 85°C to ambient temperature : 30 mn Pressure during the test : 121 mbar (15000 m) Post-test inspection :				
	Output power f = f2	Ps	300	-	W
	Noise power density (Note 21) from 10.5 GHz to 22.0 GHz	-	-	-70	$\frac{dBW}{4kHz}$
	Spurious (output power > 300 W) from 10.5 GHz to 22.0 GHz	-	-	-60	dBc
	Third-order intermodulation products (Note 12) f = f1, f2, f3	IM3	28	-	dB
	AM/PM conversion coefficient (Note 14) Large signal operation	-	-	6	°/dB
	Small signal operation (Note 13)	-	-	2	°/dB
	Stability over 24 h (Note 16) Power : f = f2 and Ps = 300 W	ΔPs	-	0.1	dB
	Gain (Note 13)	ΔG	-	± 0.25	dB

EFERENCE	Test Condition	Symbol	Limits min	Limits max	Unit
	Helix voltage sensitivity f = f2				
	Output phase	ΔΦ/ΔVh	-	1.4	°/V
	Output power	ΔPs/ΔVh	-	0.008	dB/V
	Small signal gain (Note 13)	ΔG/ΔVh	-	0.02	dB/V
	Collector voltage sensitivity f = f2				
	Output phase	ΔΦ/ΔVcol	-	0.02	°/V
	Output power	ΔPs/ΔVcol	-	0.001	dB/V
	Small signal gain (Note 13)	ΔG/ΔVcol	-	0.001	dB/V
	2nd harmonic level (Note 19)	-	-	44	dBm
	Radiation (Note 25)	-	-	-20	dBm
	Temperature gain sensitivity (Notes 13 and 20) Test temperature between -40°C and + 85°C	ΔG/Δt	-	0.01	dB/°C
	Group delay variation :				
	Linear :				
	Large signal operation	-	-	0.01	ns/MHz
	Small signal operation	-	-	0.01	ns/MHz
	Parabolic :				
	Large signal operation	-	-	0.01	ns/MHz²
	Small signal operation	-	-	0.01	ns/MHz²
	Ripple (peak-to-peak) :				
	Large signal operation	-	-	0.5	ns
	Small signal operation	-	-	0.5	ns
	Linear regime gain f > 18 GHz (measurement at f = 18 GHz)	G	-	*	dB
	Linear regime gain f > 10 GHz (measurement at f = 10 GHz)	G	-	*	dB

REFERENCE	Test Condition	Symbol	Limits min	Limits max	Unit
	QUALITY CONFORMANCE INSPECTION : (Note 9)				
A.B.1.1	Visual inspection				
A.B.2.1	Dimensions : see drawing				
A.C.4.1	Heater current	If	-	1.5	A
A.D.1.1	Helix voltage (Note 2)	Vh	8.3	8.9	kV
A.D.1.2	Helix current (Note 3)	Ih	-	8	mA
A.D.1.2	Cathode current (Note 2)	Ik	-	250	mA
K.G.2.1	Gain for Ps ≥ 300 W from f1 to f3	G	50	-	dB
A.G.3	Output power from f1 to f3 (Note 22)	Ps	300	-	W
	Output power variation Pe = vn	ΔPs	-	1	dB
	Power slope Pe = vn	ΔPs/Δf	-	0.02	dB/MHz
	Output power variation within any 80 MHz band	ΔPs	-	0.5	dB
K.G.2.1	Small signal gain (Note 13)	G	-	62	dB
	Small signal gain variation (Note 13)	ΔG	-	2	dB
	Gain slope (Note 13)	ΔG/Δf	-	0.02	dB/MHz
	Small signal gain variation within any 80 MHz band (small signal operation) (Note 13)	ΔG	-	1	dB
1.5.1.1	Thermal switch inspection (vigitherme) At room temperature the contacts are normally closed, TWT non operating				
	END OF LIFE CRITERION :				
A.G.3	Output power at f1, f2 and f3 Pe ≤ 5 dBm (Note 22)	Ps	240	-	W

NOTES CONCERNING OPERATION AND TESTS

NOTE 1 - If a DC heater supply is used, the filament-cathode wire (yellow) must be connected to the positive terminal of that supply. The tolerances indicated in the "Limit Values for Correct Tube Operation" table should be complied with to get optimal operating life of the TWT.

Vf tolerance includes supply instability.

NOTE 2 - The nominal operating values (vn) are indicated for each tube.

NOTE 3 - The power supply must be designed in such a way that if one of the limiting values is reached during tube operation, the total energy dissipated during transient, between the defect and the instant when the helix voltage reaches 500 V, shall not exceed 5 J on the helix.

Irrespective of the switch-on sequence used, the switch-on transient duration should not exceed 30 ms. The transient duration is defined as the time interval from the moment when the cathode voltage reaches 50 V to the moment when all voltages : Vh and Vcol are within ranges of values given under **ABSOLUTE RATINGS**.

During the 30 ms switch-on transient the peak value of the helix current may possibly reach 70 mA.

NOTE 4 - Without helix-cathode voltage applied, the maximum collector to ground voltage should never exceed the maximum specified value (even during transient conditions).

NOTE 5 - Intentionally blanked.

NOTE 6 - During operation magnetic material should be kept at least 5 cm away from the tube's outer surface.

The magnetic induction at any point inside the volume occupied by the tube should not exceed 0.0005 T, the measurement being made with the tube removed from its support.

NOTE 7 - The tube is stable, for any combination of input and output mismatches, any phase, with no drive power.

NOTE 8 - Baseplate and collector temperature reference areas are shown on the drawing. The temperatures shall be within the indicated limits.

NOTE 9 - Values given in individual data sheet must be within specified limits.

NOTE 10 - The TWT operation should be started according to the following sequence :

- apply heater voltage Vf (Note 1)
- wait for preheating period
- simultaneously or in following order, apply Vcol and Vh in accordance with Notes 3 and 4.
- If the collector voltage is not applied simultaneously with the cathode-helix voltage, it must be applied in such a way that the induced cathode/ground voltage is never greater than 500 V.
- The collector/ground insulation resistance is greater than 30 MΩ.
- The cathode/ground insulation resistance is greater than 40 MΩ.

NOTE 11 - Absolute value of TWT negative impedance for the normal operating values of Vf, Va and Vcol is not less than :

50 kΩ for Vh = vn ± 100 V
30 kΩ for Vh = vn ± 500 V

NOTE 12 - The third-order intermodulation products are measured using a spectrum analyzer.

The intermodulation products are measured with two carriers at the output level of 20 W each for f = f1, f2, f3 and separated in frequency by 10 MHz. The level of intermodulation products should be at least 28 dB lower than each of the two carriers.

NOTE 13 - The output power is adjusted to 15 W at f1.

NOTE 14 - The tests are performed at f1, f2, f3.

NOTE 15 - The RF drive power must be switched-off within less than 1 s if Pe reaches the maximum value.

NOTE 16 - All parameters should be maintained constant (voltages, reflection coefficient of the RF output load in value and phase, frequency and power of the RF drive signal, ambient and cooling support temperatures).

NOTE 17 - The preheating time is defined as the interval from the instant when heater voltage reaches 90% of its normal value to the instant of application of collector and helix voltage to the tube.

NOTE 18 - The RF input and output circuitry shall not produce resonance on the RF input and output of the TWT.

NOTE 19 - This measurement shall be made by substitution at the water load (with or without an harmonic filter).

NOTE 20 - The temperature of the tube is stabilized prior to achieve this small signal gain measurement.

NOTE 21 - TWT's RF input and output are connected to loads with VSWR < 1.25 during the measurement which is performed without RF drive.

NOTE 22 - The RF output power is measured at the TWT's RF output flange.

NOTE 23 - The load reflected power is the power reflected to the tube on the drive frequency. The output harmonic power may be entirely reflected to the tube.

NOTE 24 - The RF output is normally cooled. Nevertheless, it is advisable to limit the thermal transfer from the equipment-side microwave circuit toward the tube flange.

NOTE 25 - Measurement performed with a coaxial-to-waveguide transition type HEWLETT-PACKARD P281B placed 15 cm away from the tube envelope.

NOTE 26 - Outside the band, the load VSWR should be :

less than 2:1 for 13.0 GHz < f < 15 GHz

and may take any value over 15 GHz and below 13 GHz

NOTE 27 - The tube base plate should be coated with silicone grease and bolted on a heat exchanger. The contact face of the heat exchanger should be rigid and free from surface irregularities greater than 0.15 mm, peak to peak.

NOTE 28 - The Vcol/Vh rate is to be complied with for any value of collector voltage (including the specified limit values).

Correspondance between
Symbols of NF-C95 (French) and MIL-E-1 Specification
("-" : no specified symbol by MIL-E-1)

e	Capacité d'entrée	Cin	Input capacitance
ga	Capacité entre grille et anode	-	Grid-anode capacitance
gk	Capacité entre grille et cathode	-	Grid-cathode capacitance
s	Capacité de sortie	Cout	Output capacitance
	Facteur d'utilisation	Du	duty cycle, product of pulse length by repetition rate
P	Perte d'insertion	Li	Insertion loss
	Fréquence RF	F	RF frequency
3	Facteur de bruit	NF	Noise figure
	Fréquence de répétition	prr	Pulse recurrence (repetition) rate
	Gain	G	Gain
ı,lactu	Courant (continu) d'anode	Ia	Anode current or dc anode current
ıcr	Courant crête d'anode	ib	Peak anode current, excluding spike
:ol	Courant (continu) de collecteur	Ib	dc collector current
:olcr	Courant crête de collecteur	ib	Peak collector current
:t	Courant continu de corps	-	dc body current
:tcr	Courant crête de corps	-	Peak body current
	Courant de chauffage, filament	If	Filament or heater current
fk	Courant de fuite filamt-cathode	Ihk	Heater-cathode leakage current
foc	Courant de bobine focalisateur	-	dc solenoid current
g, lg1	Courant continu de grille, de grille 1	Ig	dc/rms value of ac component of grid current, grid 1
gcr	Courant crête de grille	ic	Peak grid current
h,ll	Tension continue d'hélice,ligne	Iw	dc helix current
hcr,llcr	Tension crête d'hélice, de ligne	iw	Peak helix current
k	Courant continu de cathode	Ik	dc cathode current
kcr	Courant crête de cathode	ik	Peak cathode current
M3	Rapport d'intermodulation	-	Intermodulation ratio
pdf	Cour.de pointe démarrage filamt.	If(surge)	Peak filament or heater current
pi	Courant conti. de pompe ionique	-	dc ion-pump current
	Débit fluide de refroidissement	-	Coolant flow
<	Pervéance	-	Perveance
ɔ,pa	Pression, pression ambiante	-	Pressure, ambient pressure
Pa	Puissance moy. dissipée d'anode	Pp	Average anode power dissipation
Pa,Pamoy	Puissance moyenne de faisceau	-	Average beam power
Pacr	Puissance crête d'anode	-	Peak anode power dissipation
Pacr	Puissance crête de faisceau	-	Peak beam power
Pcol, Pcolmoy	Puissance moyenne collecteur	Pp	Average collector power dissipation
Pcolcr	Puissance crête sur collecteur	-	Peak collector power dissipation
Pct	Puissance moyenne sur le corps	-	Average body power dissipation
Pctcr	Puissance crête sur le corps	-	Peak body power dissipation
Pe,Pemoy	Puissance d'entrée moyenne ou puissance moyenne de pilotage	Pd,Pi(rf)	Average drive power or average input RF power
Pecr	Puissance RF crête d'entr.	pd,pi(rf)	Peak drive (or input) power
Pg	Puissance dissipée de grille	-	Grid power dissipation
Ppi	Puissance sur pompe ionique	-	Ion-pump power input dissipation
Prcr	Puissance réfléchie par la charge	-	Load reflected power
Ps,Psmoy	Puissance de sortie moyenne	P_o	Average output power
Pscr	Puissance de sortie crête	po	Peak output power
Rfk	Résistance filament-cathode	-	Heater-cathode resistance
ROS	Rapport d'ondes stationnaires	VSWR	Voltage standing wave ratio
T	Couple (mécanique)	-	Torque (mechanical)
t, t1...	Durée ou temps	-	Duration (or length) or time
Ta, ta	Température ambiante (normale ou spécifiée)	TA	Ambient temperature (normal or specified)
tci	Temps de croissance du courant (magnetron)	trc	Time of rise of current pulse (magnetron)
tcV	Temps de croissance de tension	trv	Time of rise of voltage pulse
td	Temps de démarrage	-	Start-up period
tdi	Temps de recouvrement.(désio.)	-	Recovery time
tdi	Temps de décroissance du courant	tfc	Time of fall of current pulse
tdV	Temps de décroissance de tension	tfv	Time of fall of voltage pulse
Te, te	Tempér. au point spécifié ou le plus chaud d'enceinte, de bride	TE, TF	Envelope or flange temperature at the specified or hottest point
tk	Durée de préchauffage cathode	tk	Cathode preheating time
tp	Durée d'une impulsion	tp	Pulse duration
tpI	Durée de l'impulsion de courant	tpc	Current pulse duration (or length)
tpRF	Durée de l'impulsion RF	trf	RF pulse duration (or length)
tpV	Durée de l'impulsion de tension	-	Voltage pulse duration (or length)
Va	Tension continue d'anode	Eb	dc anode voltage
Vacr	Tension crête d'anode	eb	Peak anode voltage
Vcol	Tension continue collecteur	Ece	dc collector voltage
Vcolcr	Tension crête de collecteur	eb	Peak collector voltage
Vct	Tension continue de corps	-	dc body voltage
Vctcr	Tension crête de corps	-	Peak body voltage
vcV	Vit.de croiss. impuls.de tension	rrv	Rate of rise of voltage pulse
Vf	Tension filament, de chauffage	Ef	Filament or heater voltage
Vfk	Tension filament-cathode	Ehk	Heater-cathode voltage
Vfoc	Tension continue de focalisateur	Esol	dc solenoid voltage
Vg, Vg1	Tension ctue. de grille, de grille 1	Ec, Ec1	dc grid voltage, grid 1
Vgb	Tension de grille de blocage	Eco	dc cut-off grid voltage
Vgcr	Tension crête de grille	egy	Peak grid voltage
Vh,Vl	Tension ctue. d'hélice, de ligne	ew	Peak helix voltage
Vhcr,Vlcr	Tension crête d'hélice, de ligne	Ew	dc helix voltage
Vi	Tension électrode d'ionisation	-	Ignitor voltage
Vj	Tension d'ouverture volets (TR)	-	Monitoring voltage
Vk	Tension continue de cathode	-	dc cathode voltage
Vkcr	Tension crête de cathode	-	peak cathode voltage
Vpi	Tension continue, pompe ionique	Eip	dc ion-pump voltage
Vr	Tension réflecteur	Er	Reflector voltage
W	Energie	-	Energy

DIMENSIONS IN MM

REF.	-	MIN	MAX	OBSERVATIONS
AA	DIA	4.80	5.20	⌖ Ø 0.2 Ⓜ 16 HOLES
AB	-	46.40		
AC	-		8.20	
AD	-	18.20	18.80	
AE	-	76.20		
AF	-	76.20		
AG	-	63.50		
AH	-	44.50		
AJ	-	31.80		
AK	-	28.60		
AL	-	28.60		
AM	-	43.50	45.50	
BA	-		65	
BB	-		437	
CA	-		78	
CB	-		39	
CC	-		55	
CD	-	269	299	
CE	-		119	
CF	-		154	
CG	-		424	
CH	-	3.50	4.50	
DA	-		75	
DB	-		65	
DC	-		8	
DD	-	65.50	68.50	
EA	DIA	12	14	⇨ 8 HOLES
EB	-		29	

NOTES :

(1) RF OUTPUT R120 WAVEGUIDE (WR75)

(2) RF INPUT - FEMALE SMA COAXIAL CONNECTOR

(3) HEATER - CATHODE - YELLOW - LENGTH 1000 mm $^{+200}_{-0}$

(4) HEATER - BROWN " "

(5) GROUND - BLACK " "

(6) COLLECTOR - RED " "

(7) THERMAL SWITCH - GREY/WHITE " "

(8) BASE PLATE LINE TEMPERATURE CHECK POINT

(9) COLLECTOR TEMPERATURE CHECK POINT