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

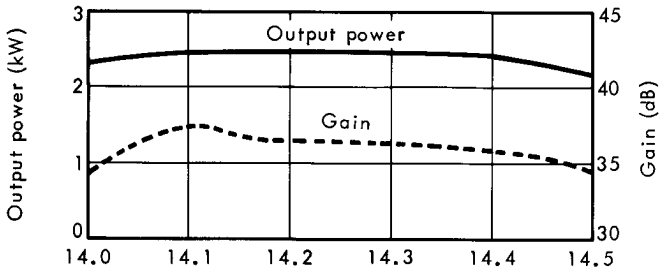


Fig. 1 - Typical curves of output power and gain over the band.

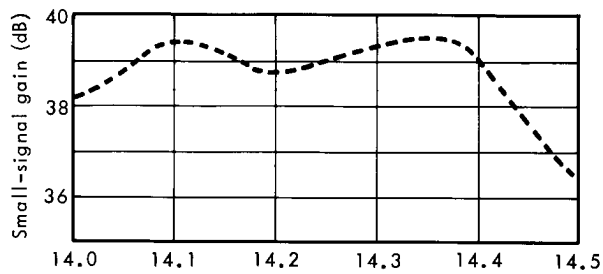


Fig. 2 - Variations of small-signal gain versus frequency (typical).

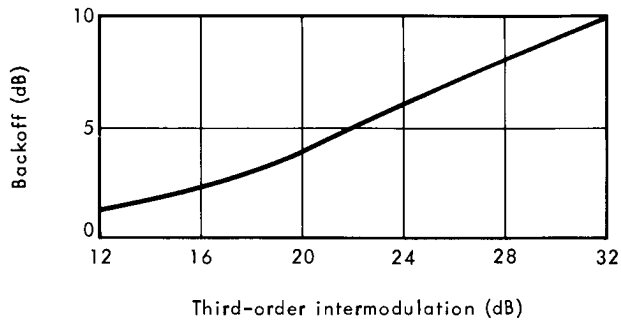


Fig. 3 - Backoff required for desired values of 3rd-order intermodulation.

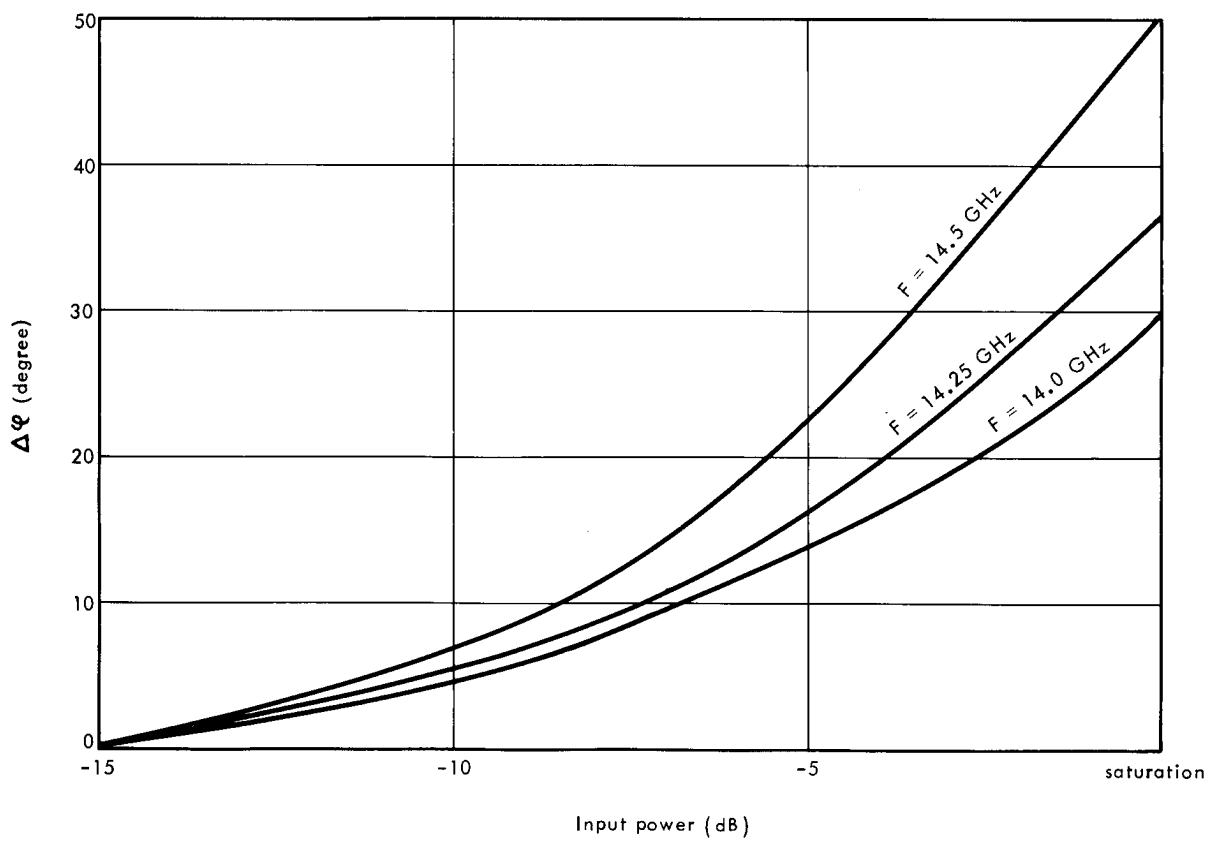
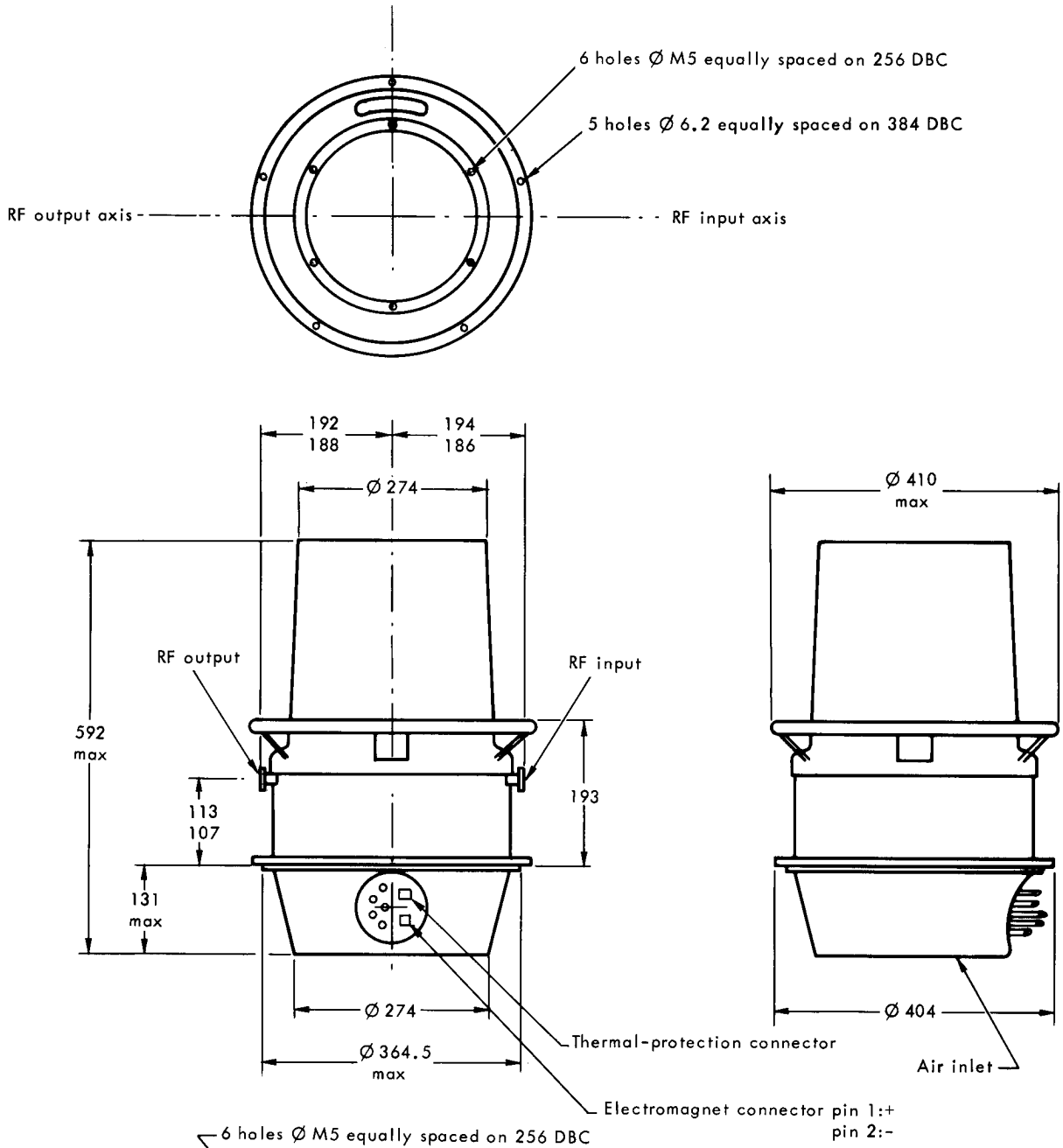


Fig. 4 - Phase shift versus drive at the top of the band, at center band, at the bottom of the band.

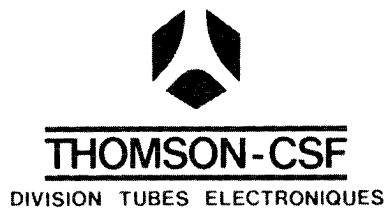
OUTLINE DRAWING



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