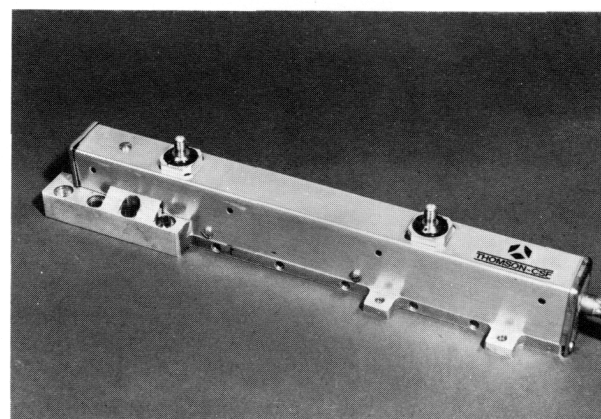


TOP 1369

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).

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
- The 3rd-order IM product's level, relative to either carrier is	- 17 dB	- 24 dB
AM/PM Transfer, at saturation	≤ 6	$^{\circ}/\text{dB}$
Small-signal to saturation phase shift, max.	40	$^{\circ}$
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	$^{\circ}\text{C}$
- Extreme (2)	- 15 to + 85	$^{\circ}\text{C}$

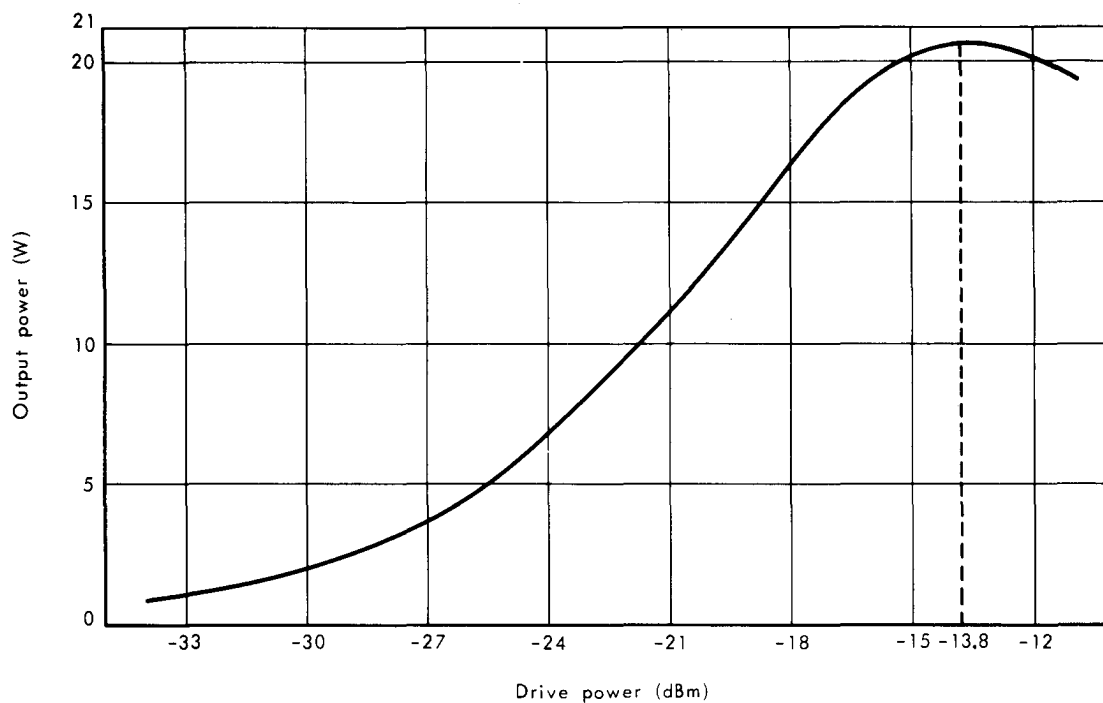
TYPICAL OPERATION

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	$^{\circ}/\text{dB}$
Output level below saturation	0 dB	- 3 dB
Phase shift	35 $^{\circ}$	12 $^{\circ}$
Variation of group-delay	0.5	ns

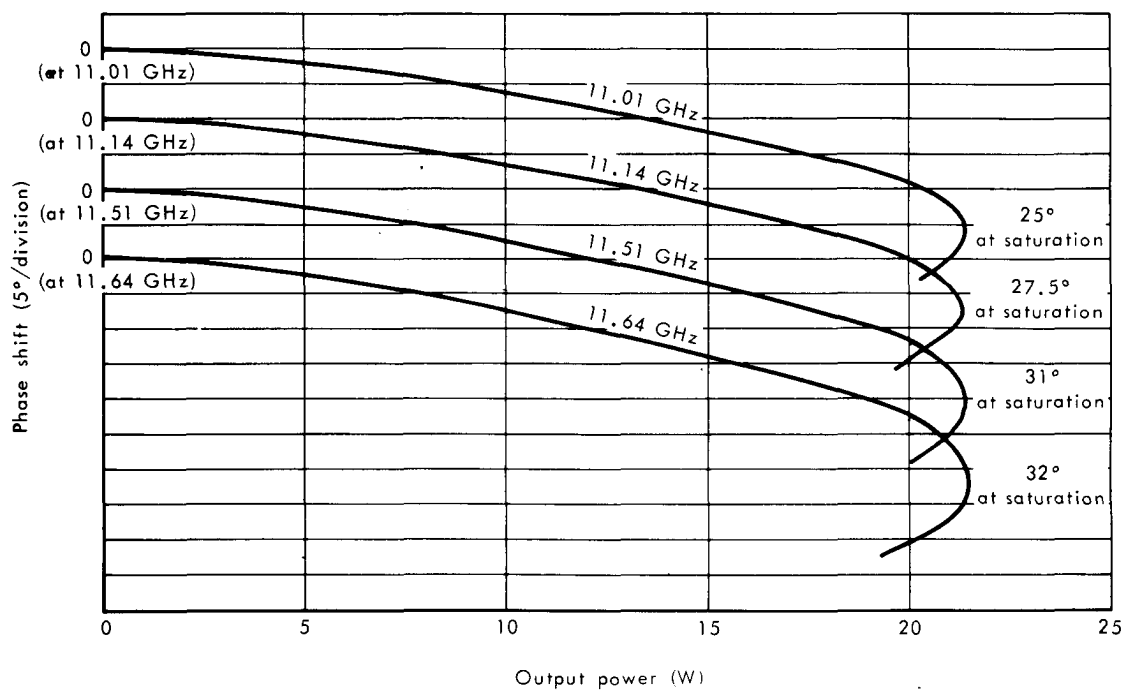
(1) The 10.95 - 11.70 GHz band has been allocated to Europe for satellite communications. The tube can be delivered in alternate versions, optimized for other frequency ranges and/or lower power levels.

(2) Characteristics not guaranteed.

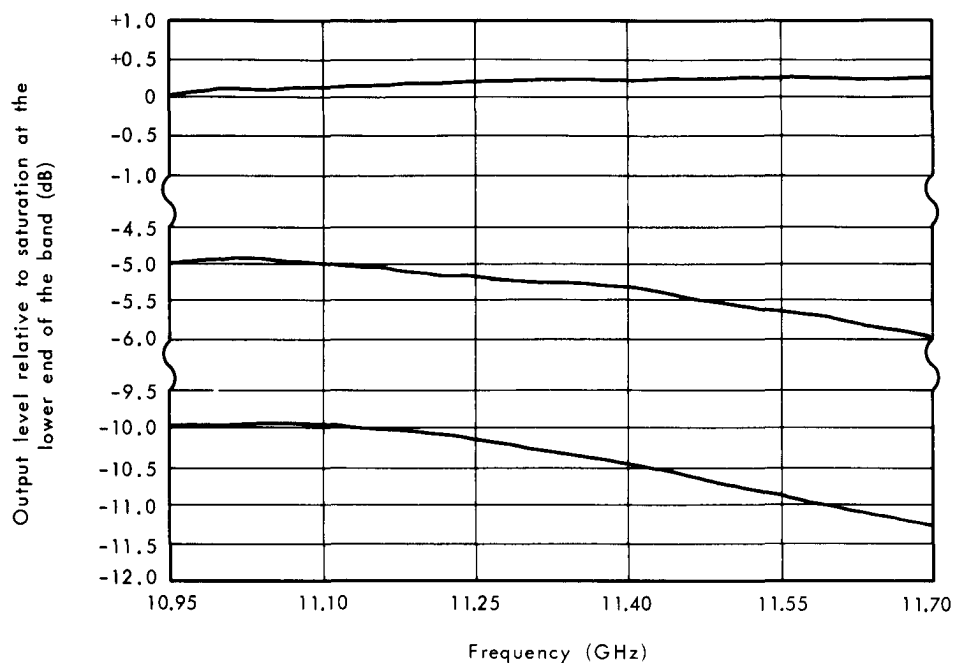
OUTPUT POWER VERSUS DRIVE POWER
(Typical curve)



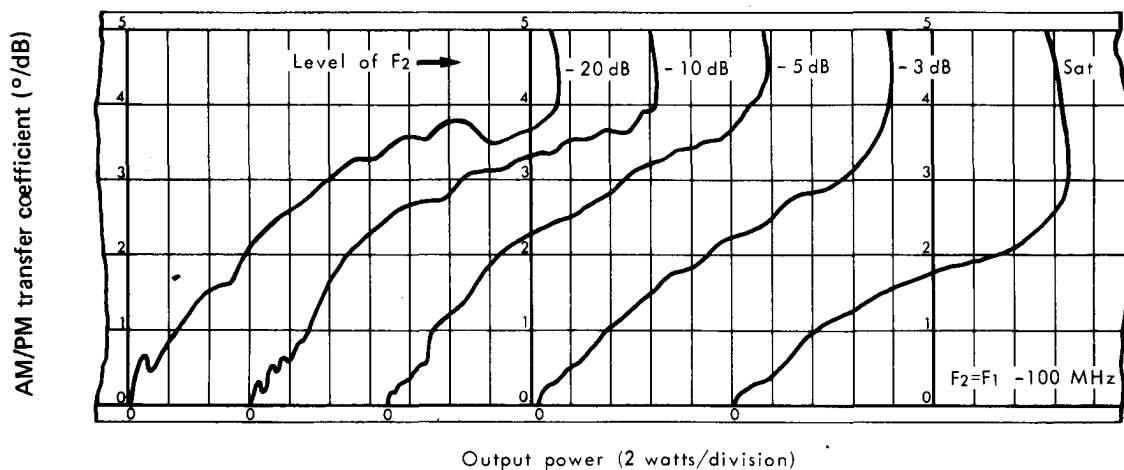
PHASE SHIFT VERSUS OUTPUT POWER
(Typical curves)



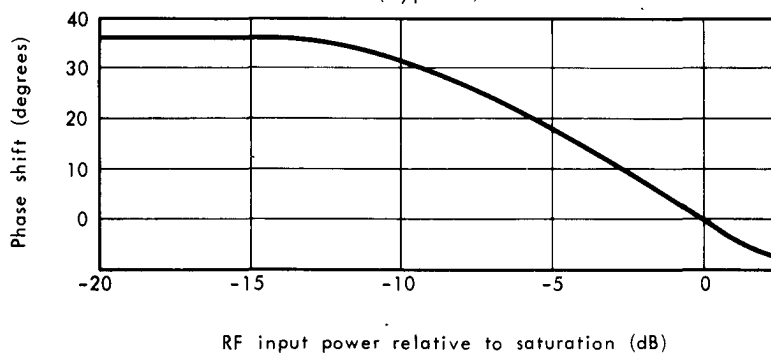
GAIN VERSUS FREQUENCY (Typical)



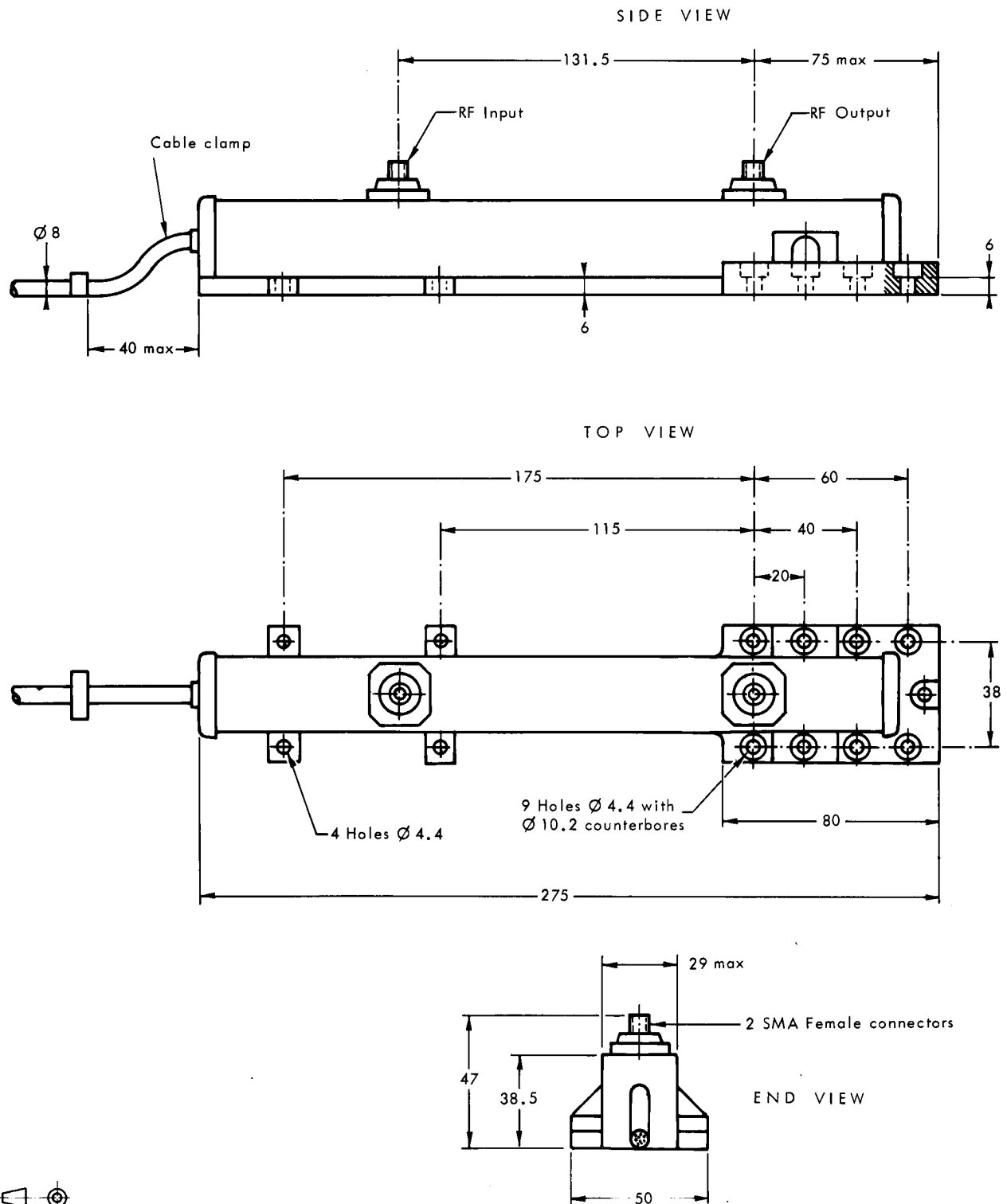
AM/PM TRANSFER COEFFICIENT VERSUS OUTPUT POWER (Typical)
(level of F1 held constant while level of F2 is varied)



PHASE SHIFT VERSUS RF DRIVE
(typical)



OUTLINE DRAWING



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



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