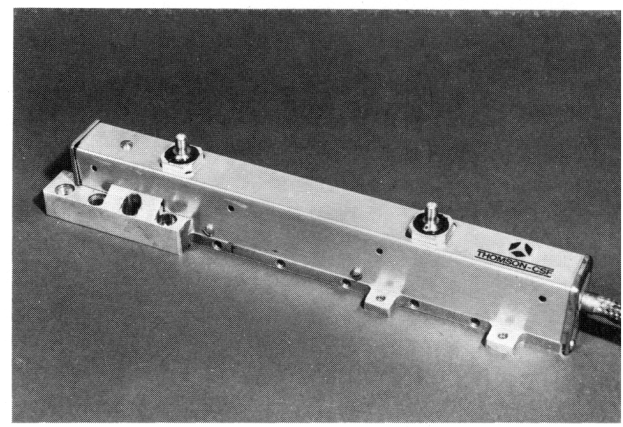
TH 3529

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.

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

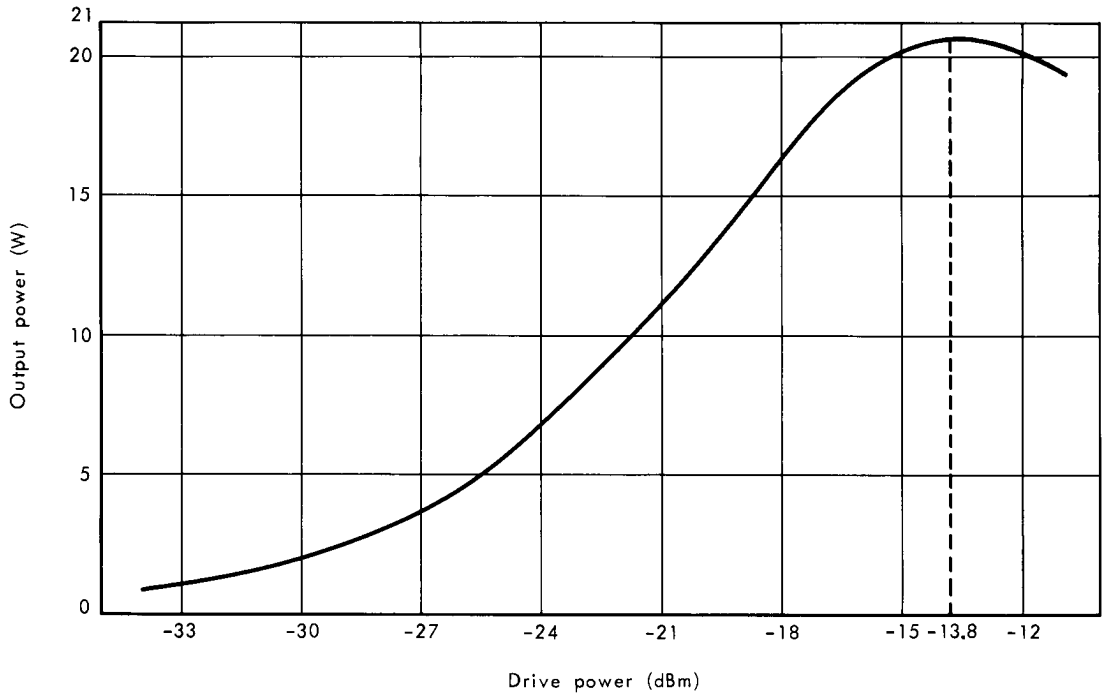
TYPICAL OPERATION

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

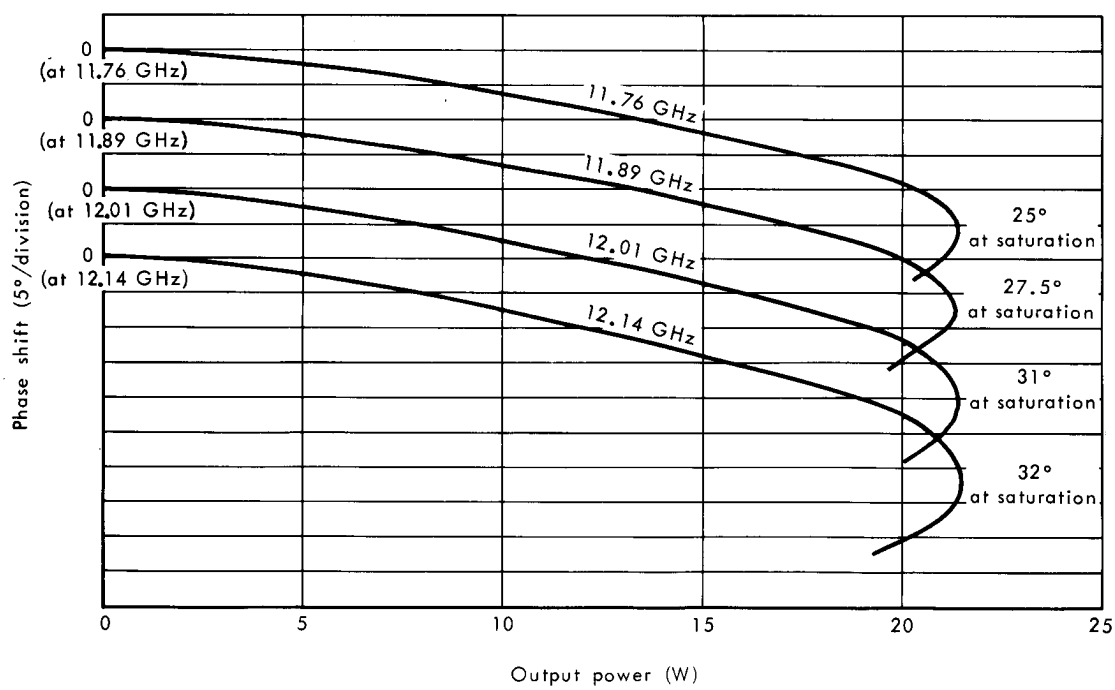
(2) The 11.7 to 12.2-GHz band has been allocated for national communications-satellite systems. This tube can be delivered in alternate versions, optimized for operation in other frequency ranges and/or at lower power levels.

(3) Characteristics not guaranteed.

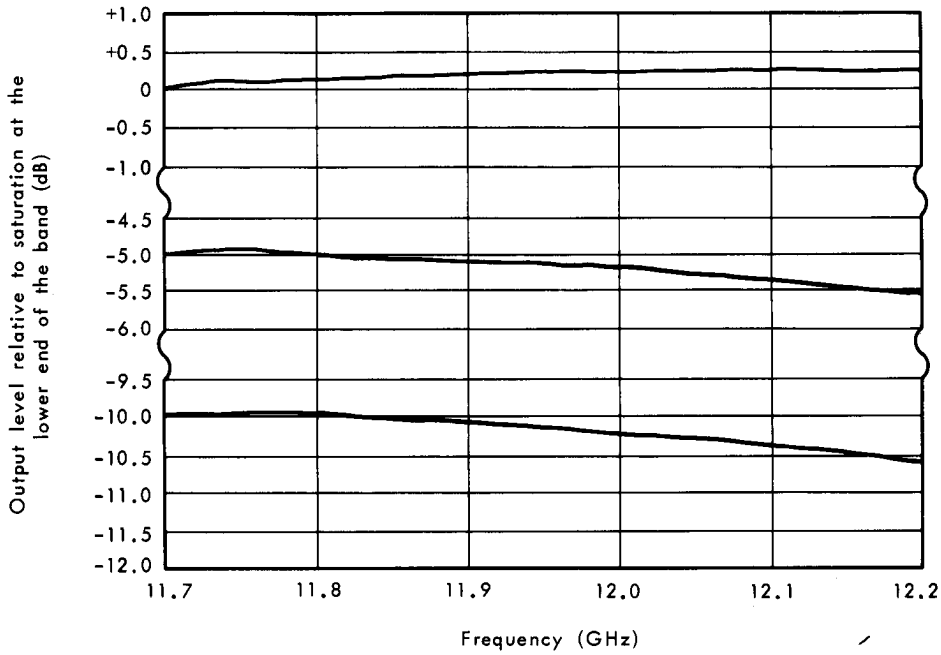
OUTPUT POWER VERSUS DRIVE POWER
(Typical curve)



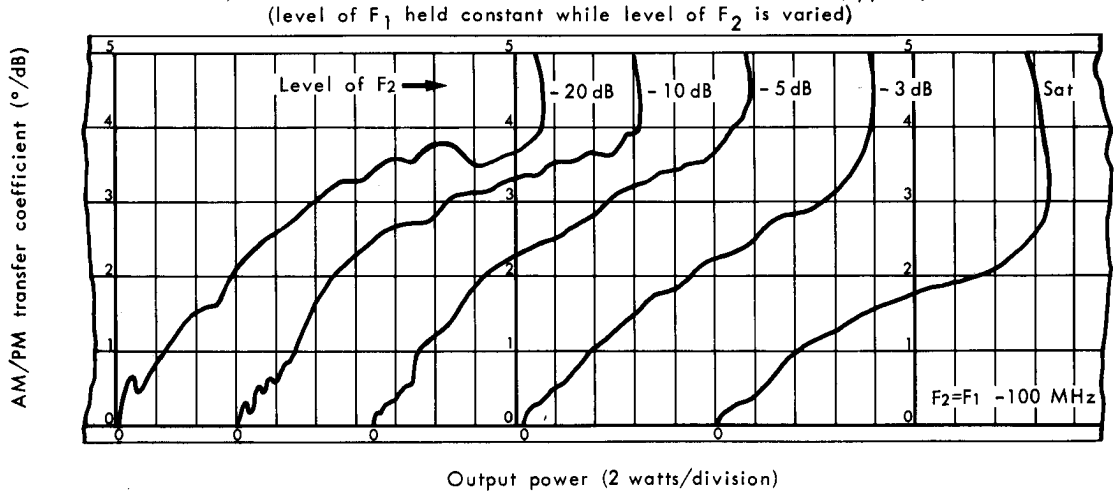
PHASE SHIFT VERSUS OUTPUT POWER
(Typical curves)



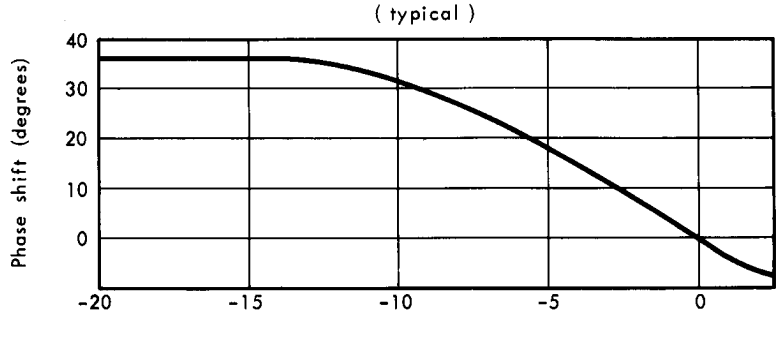
GAIN VERSUS FREQUENCY (Typical)



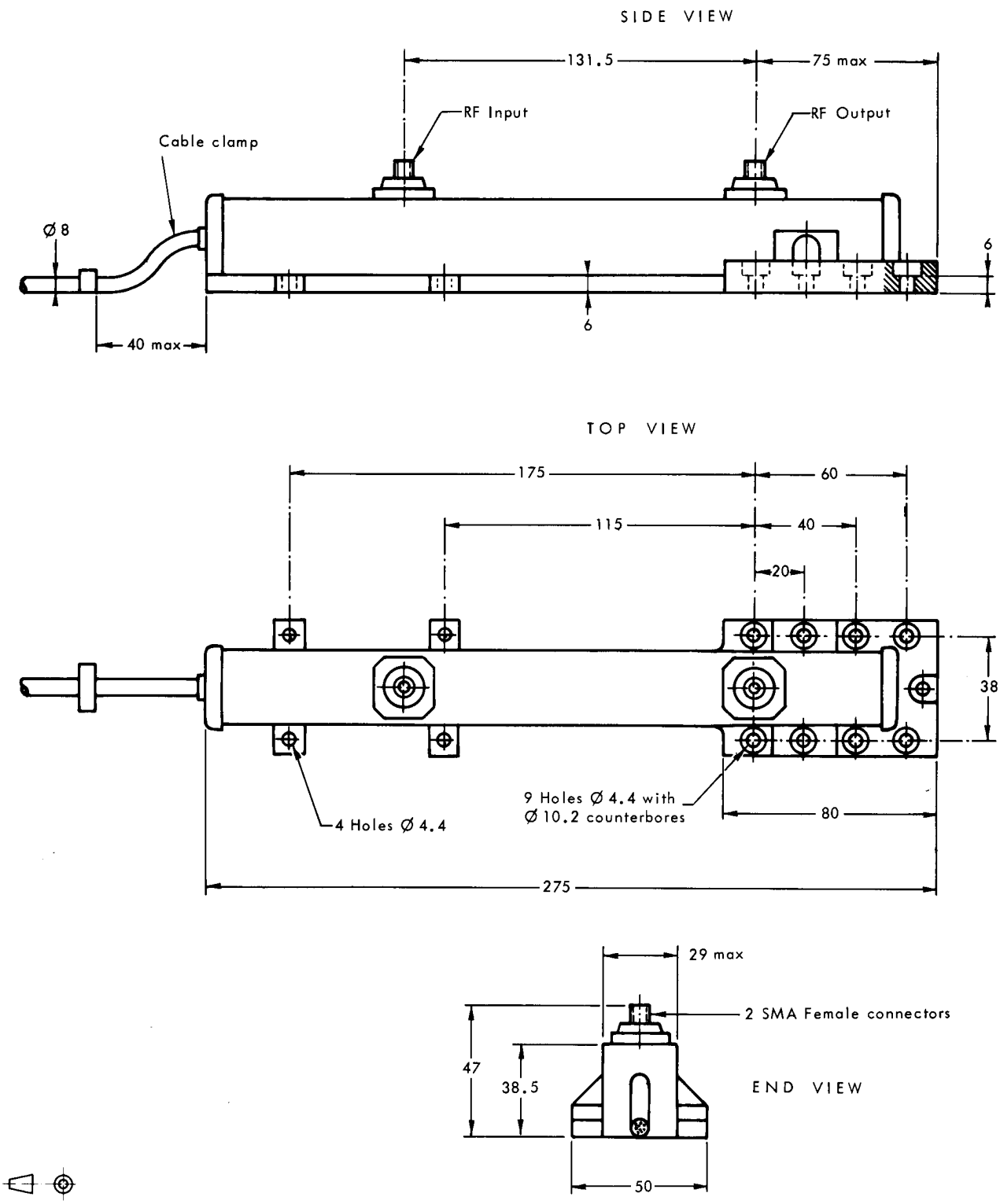
AM/PM TRANSFER COEFFICIENT VERSUS OUTPUT POWER (Typical)
(level of F_1 held constant while level of F_2 is varied)



PHASE SHIFT VERSUS RF DRIVE
(typical)



OUTLINE DRAWING



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