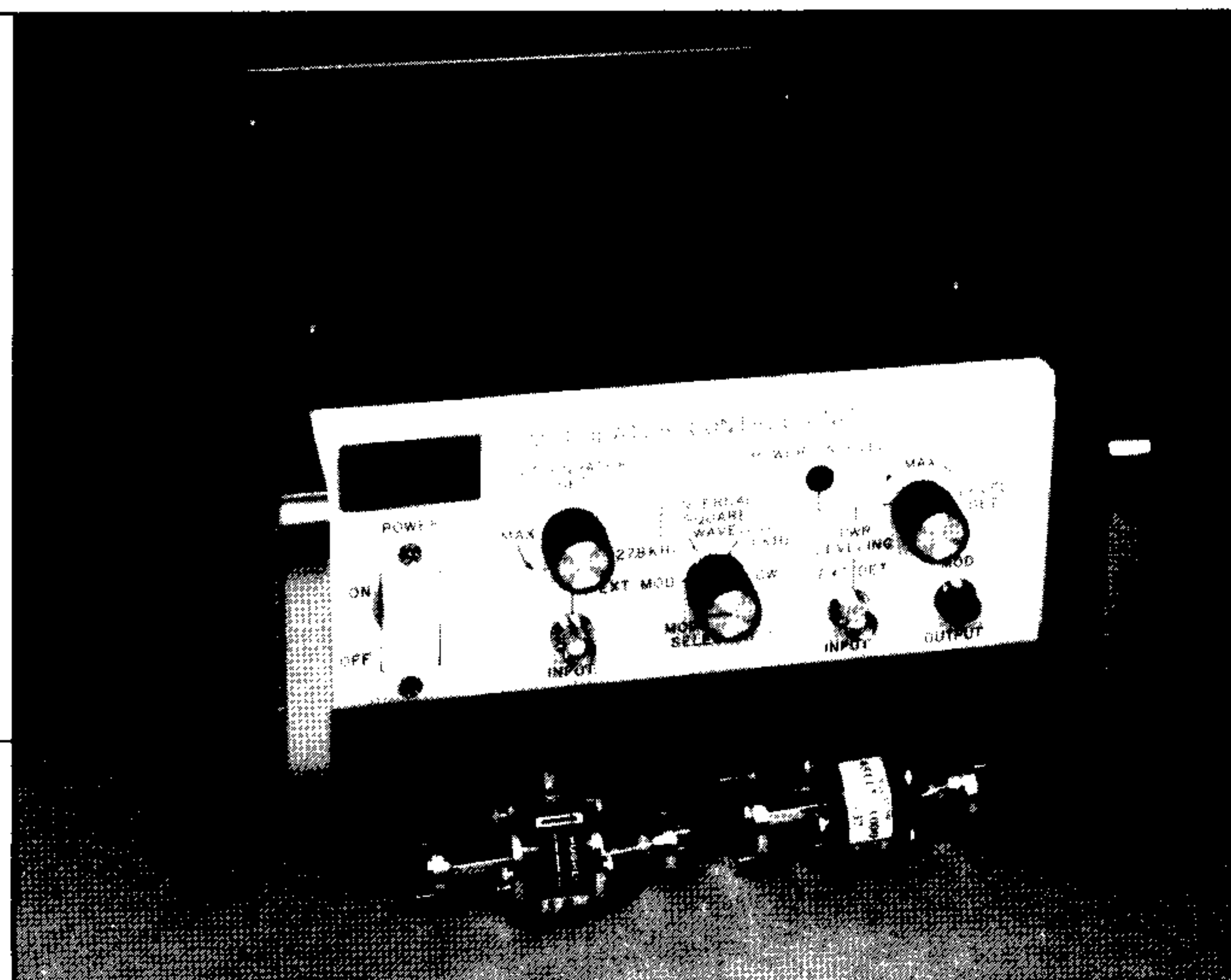


# Full Band Isolators and Modulators



Hughes 4511xH series of Millimeter-Wave Full Band Isolators and Hughes 4521xH series of Full Band Modulators are Faraday rotation type ferrite devices. They consist of a section of waveguide containing low loss ferrite material and impedance matching elements. An external magnetic bias field is supplied to the ferrite core by means of a permanent magnet for the isolator and a bifilar-wound solenoid for the modulator. The biasing current for the modulator passes through one arm of the solenoid driving the ferrite into a condition of minimum insertion loss. Current passing through the other arm biases the ferrite for maximum insertion loss.

## FEATURES:

**27 dB Isolation**

## ELECTRICAL SPECIFICATIONS

	FREQUENCY BAND (GHz)									
	K (18-26.5)	Ka (26.5-40)	Q (33-50)	U (40-60)	V (50-75)	E (60-90)	W (75-110)	F (90-140)	D <sup>Ⓞ</sup> (110-170)	G <sup>Ⓞ</sup> (140-220)
<b>ISOLATORS</b>										
Insertion Loss (dB max)	1.5	1.5	1.5	1.7	1.8	2.0	2.5	3.0	3.5	4.5
Isolation (dB min)	25	27	27	27	27	27	27	20	20	20
Input/Output VSWR (max)	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1
Power Rating (W max)	2.0	2.0	1.5	1.5	1.0	1.0	1.0	.75	.75	.75
<b>STANDARD MODULATORS</b>										
Forward Insertion Loss (db max)	1.7	1.7	1.7	1.8	1.8	2.0	2.5	3.0	3.5	4.5
On-Off Ratio (dB min)	20	23	25	25	25	25	25	18	18	18
Rise Time (10-90%, μsec max)	250	3	3	3	3	3	3	3	3	3
Input/Output VSWR (max)	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Bias Current (mA max)	500	500	500	500	500	500	500	500	500	500
Coil Resistance (Ω typ)	25	2	2	2	2	2	2	2	2	2
Coil Inductance (mH typ)	7.9	0.056	0.048	0.041	0.034	0.027	0.021	0.013	0.015	0.015
Power Rating (W max)	2.0	2.0	1.5	1.5	1.0	1.0	1.0	.75	.75	.75
<b>LOW CURRENT MODULATORS</b>										
Forward Insertion Loss (dB max)		1.7	1.7	1.8	1.8	2.0	2.5			
On-Off Ratio (dB min)		20	20	20	20	20	20			
Rise Time (10-90% μ/sec max)		100	100	100	100	100	100			
Input/Output VSWR (max)		1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1			
Bias Current (mA max)		50	50	50	100	100	100			
Coil Resistance (typ)		10	10	10	5	5	5			
Coil Inductance (mH typ)		7.0	7.0	7.0	0.8	0.8	0.8			
Power Rating (W max)		2.0	1.5	1.5	1.0	1.0	1.0			

Ⓞ Specifications are typical values measured at Hughes selected frequency. Consult factory.

## HOW TO ORDER

Modulator Driver ..... 47530H-511x  
 Full Band Isolator ..... 4511xH-x000  
 Full Band Modulator ..... 4521xH-xx00

Frequency Band	<b>0:</b> K (1kHz units only)	<b>6:</b> W
	<b>1:</b> Ka	<b>7:</b> F
	<b>2:</b> Q	<b>8:</b> D
	<b>3:</b> U	<b>9:</b> G
	<b>4:</b> V	
	<b>5:</b> E	

AC Input Voltage	<b>1:</b> 110 VAC, 60 Hz
	<b>2:</b> 220 VAC, 50 Hz

Modulation Rate	<b>0:</b> Up to 1 kHz (available in K-band only)
	<b>1:</b> Up to 50 kHz (available in Ka- through G-bands only)
	<b>2:</b> Low current for Noise Source (available in Ka- through W-bands only)

Flange Type	<b>1:</b> Round (Ka- through G-bands only)
	<b>2:</b> Square (available in K and Ka-bands only)
	<b>3:</b> Pin Contact (available in F, D, and G-bands only)

Example: To order an E-Band modulator and driver capable of being used as a variable attenuator and of being modulated at a rate of 27.8 kHz, specify a 45215H-1100 modulator and a 47530H-5111 driver.

Both the isolators and modulators are available in full waveguide bandwidths between 18-220 GHz. The isolators provide greater than 25 dB isolation and can typically have 33 dB over most of the band. The modulators when switched between their high and low insertion loss states provide an on-to-off ratio greater than 20 dB. When biased in their low insertion loss state the modulators also provide an isolation of greater than 20 dB in the reverse direction. Three types of modulators are offered, a 50 kHz unit in Ka- through G-bands with switching speeds of 3  $\mu$ s, a 1 kHz unit in K-band with switching speeds of 250  $\mu$ s, and a low current type with switching speeds of 100  $\mu$ s.

The full waveguide bandwidth of these millimeter-wave iso-

lators and modulators makes them particularly useful in swept frequency applications. The modulators are very useful as unidirectional switches and can be used as electrically variable attenuators in conjunction with the Hughes Modulator Driver. The modulator driver contains all the electronic circuitry and power supplies required to bias the modulator coils. It has a built-in 1 kHz square wave generator that is tunable from 950 to 1050 Hz, and a 27.8 kHz one tunable from 26.4 to 29.2 kHz. A CW operation mode biases the modulator to its lowest loss state for use as an isolator. External modulation up to a 50 kHz rate may be applied to switch the modulator between its high and low insertion loss states, or optionally to vary the attenuation with the external voltage applied.

## Full Waveguide Bandwidths

## 50 kHz Modulation Rates

### MECHANICAL SPECIFICATIONS

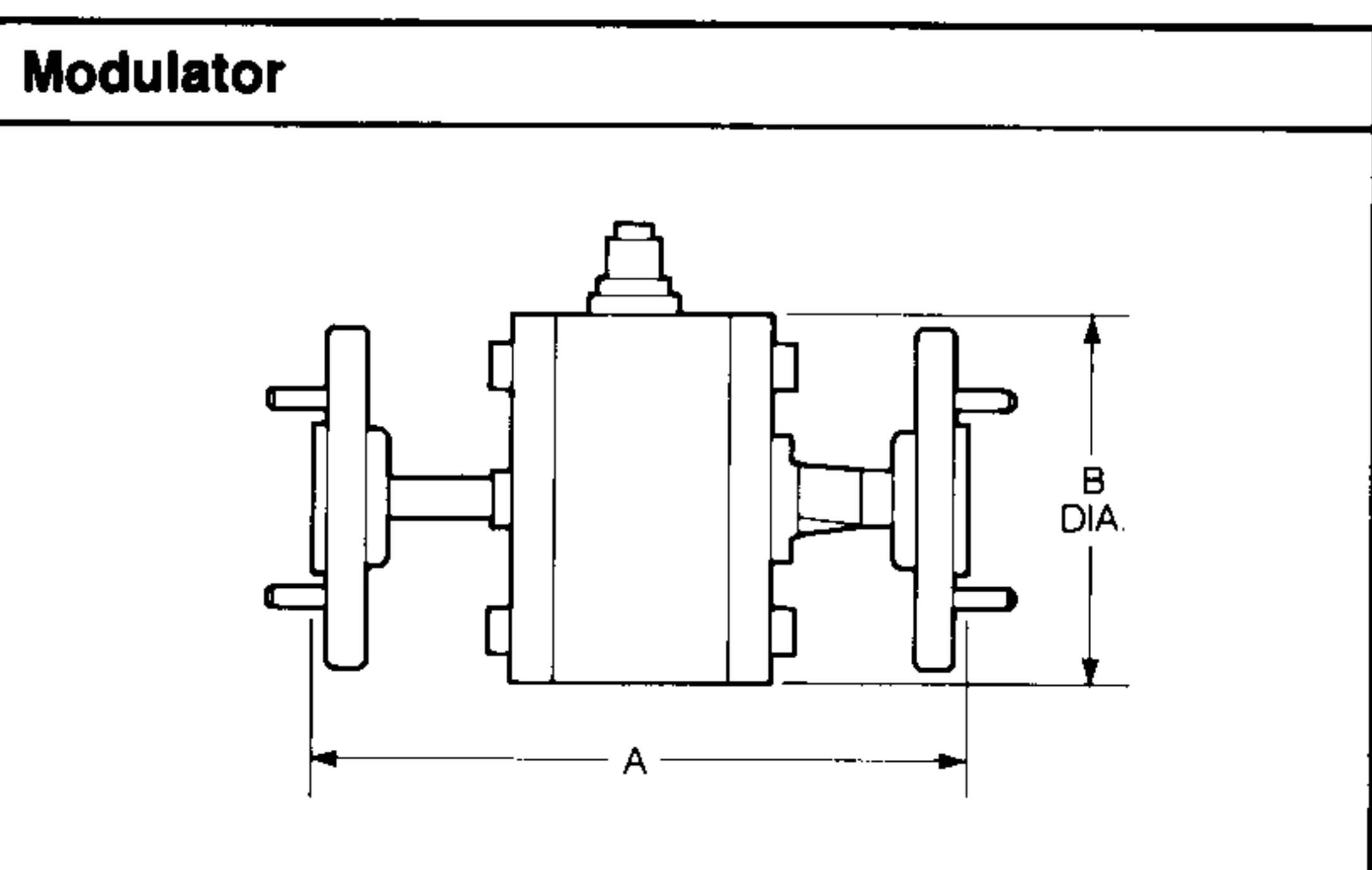
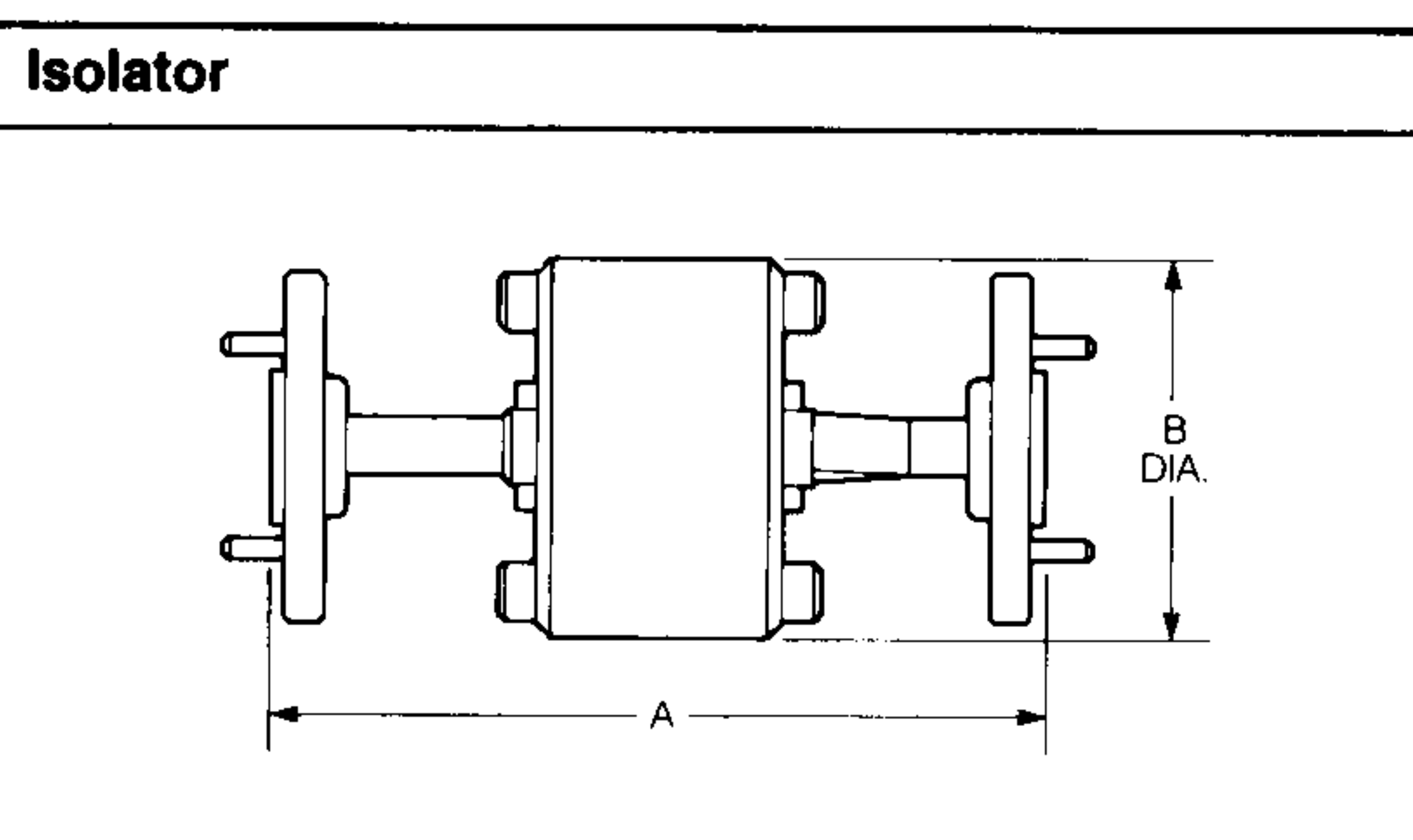
		Frequency Band (GHz)									
		K (18-26.5)	Ka (26.5-40)	Q (33-50)	U (40-60)	V (50-75)	E (60-90)	W (75-110)	F (90-140)	D (110-170)	G (140-220)
Modulator Dimensions (inches (cm))	A	4.23 (10.7)	3.85 (9.8)	3.27 (8.3)	3.14 (8.0)	2.68 (6.8)	2.58 (6.6)	2.48 (6.3)	2.48 (6.3)	2.48 (6.3)	2.48 (6.3)
	B	1.76 (4.5)	1.75 (4.5)	1.75 (4.5)	1.75 (4.5)	1.25 (3.2)	1.25 (3.2)	1.25 (3.2)	1.25 (3.2)	1.25 (3.2)	1.25 (3.2)
Isolator Dimensions (inches (cm))	A	4.34 (11.0)	3.28 (8.3)	2.69 (6.8)	2.62 (6.7)	2.56 (6.5)	2.51 (6.4)	2.46 (6.3)	2.34 (5.9)	2.31 (5.9)	2.29 (5.8)
	B	1.32 (3.4)	1.32 (3.4)	1.32 (3.4)	1.32 (3.4)	0.99 (2.5)	0.99 (2.5)	0.99 (2.5)	0.98 (2.5)	0.98 (2.5)	0.98 (2.5)
Waveguide Size <sup>①</sup>		WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-8	WR-6	WR-5
Waveguide Flange <sup>②</sup>		UG-595/U	UG-599/U <sup>③</sup>	UG-383/U	UG-383/U (mod)	UG-385/U	UG-387/U	UG-387/U (mod)	UG-387/U (mod)	UG-387/U (mod)	UG-387/U (mod)
			UG-381/U <sup>③</sup>						pin contact	pin contact	pin contact

①Refer to page 157 for specifications and MIL specifications cross reference ②Square flange ③Round flange

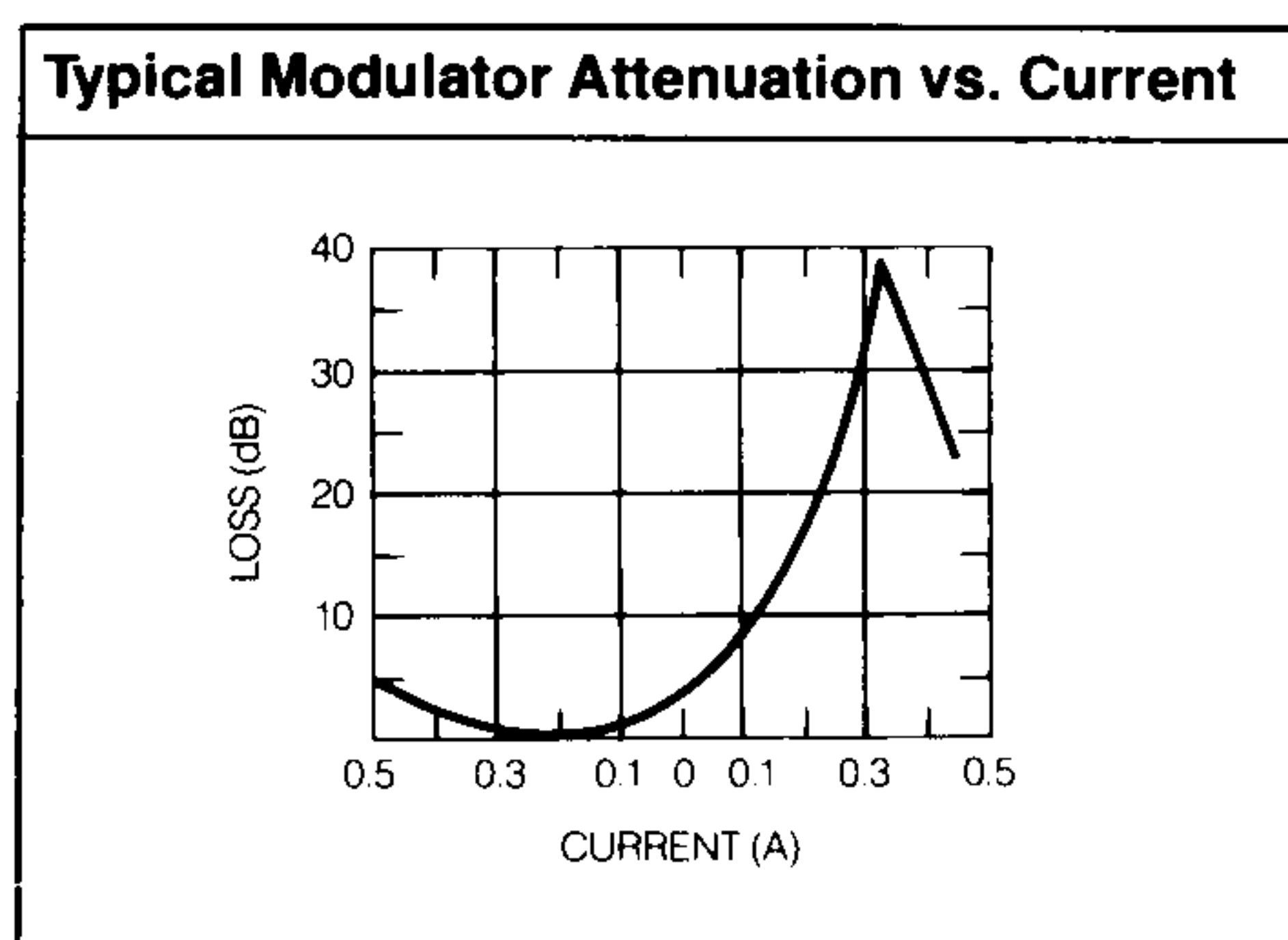
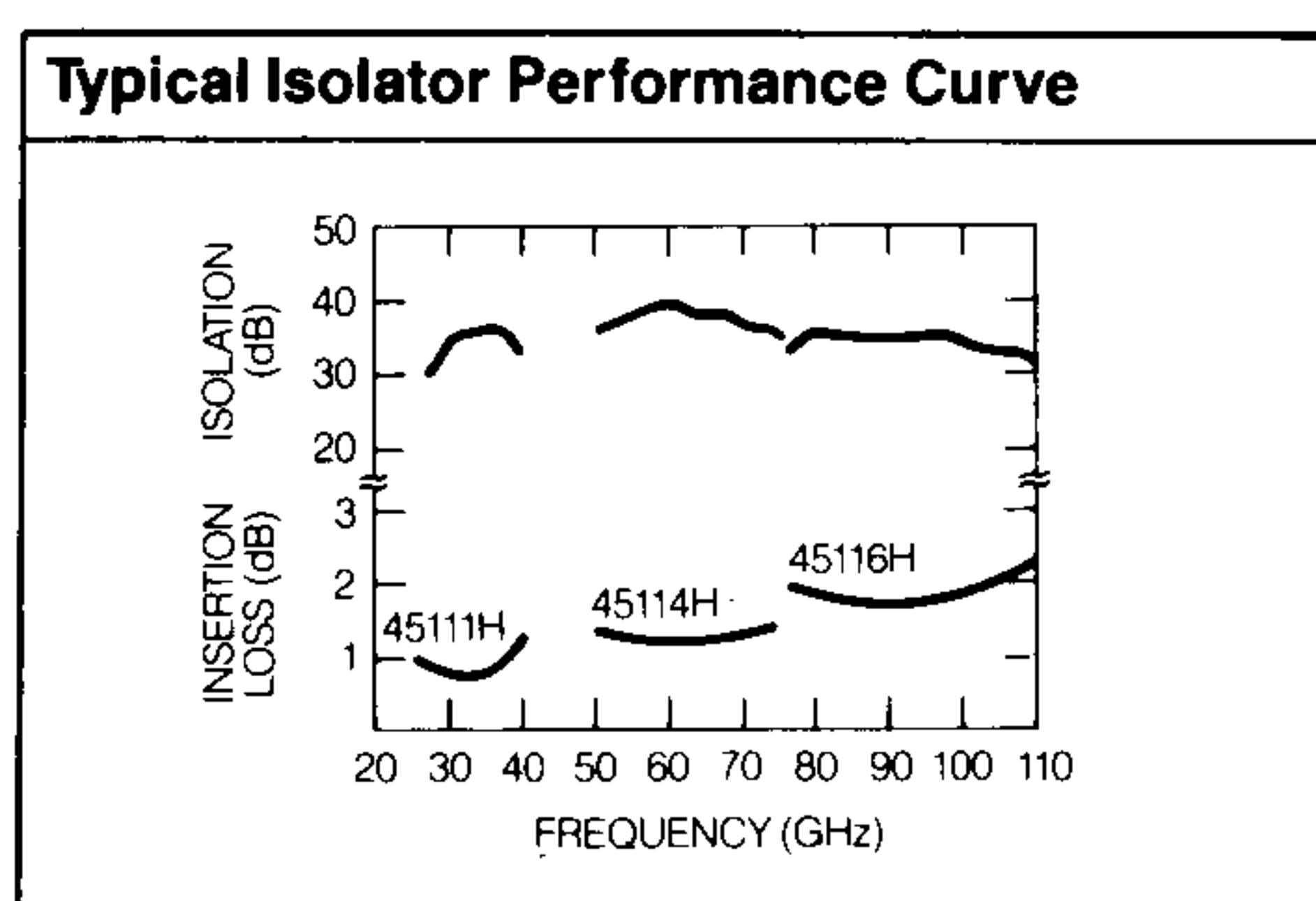
### MODULATOR DRIVER SPECIFICATIONS FOR MODEL 47530H-511x

Square-Wave Modulation Frequency (tunable)	1 kHz $\pm$ 5% and 27.8 kHz $\pm$ 5%
Switching Voltage for External Modulation	0 to +5V
Input Voltage for Variable Attenuation	0 to +10V
AC Input Voltages	110 V, 60 Hz
	220 V, 50 Hz
Size	3.6" (9.15 cm) x 9.4" (23.9 cm) x 15.6" (39.6 cm)

### OUTLINE DRAWINGS



### TYPICAL DATA



### PANEL VIEW OF MODULATOR DRIVER

