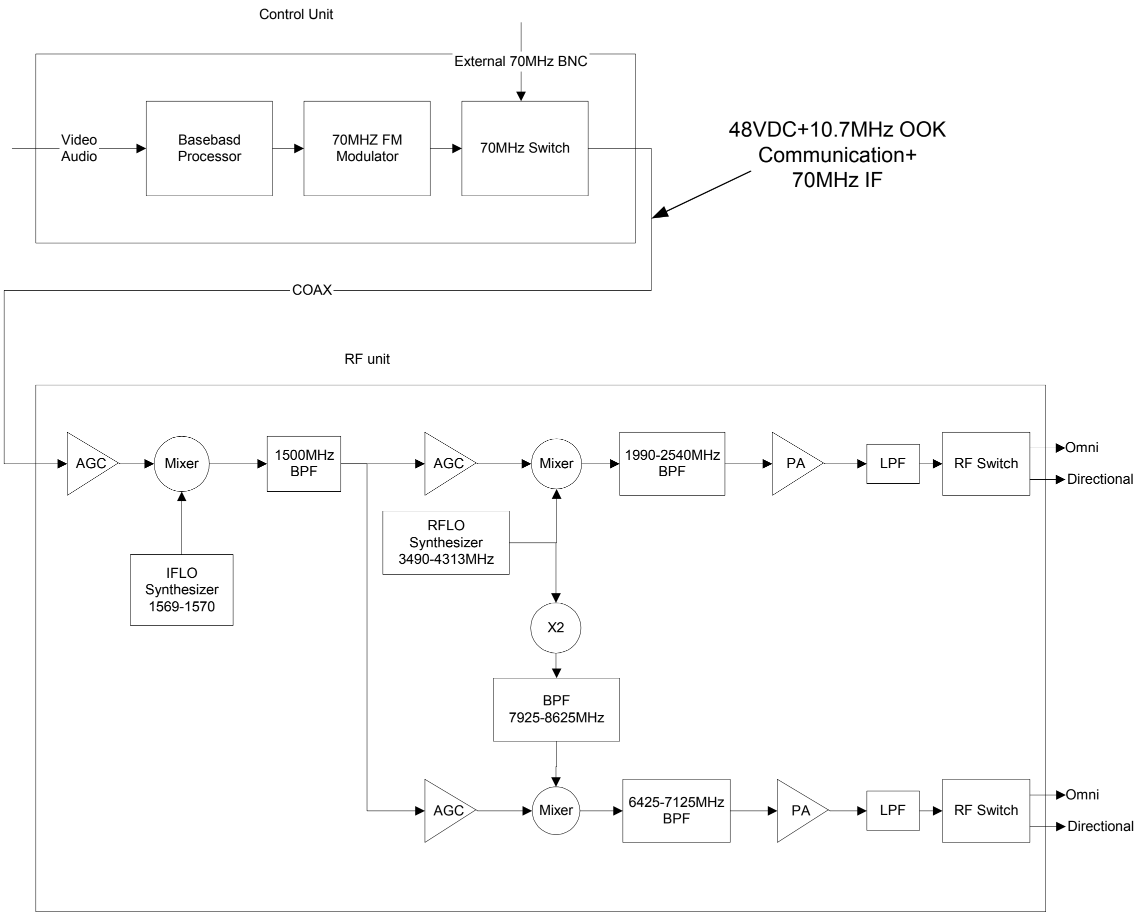
8) See the enclosed manual for operational detail. There is no external grounding requirements other than the earth ground center prong of the AC cord.

9)



15. Type of Emission, Frequency range of operation, Output power range and maximum output power:

For the 1990 to 2550 MHz band, the range of operating power is between 1.5 to 12Watts, with two selectable power output levels called “Low” and “High” and two operational modes called “Digital” and “Analog.” The following table outlines the respective power levels.

Mode	Nominal Power (Watts)	Minimum Power (Watts)
Analog High Power	**11.0**	**10.0**
Analog Low Power	**2.0**	**1.5**
Digital High Power	**4.0**	**3.0**
Digital Low Power	**1.0**	**0.75**

For the 6425 to 7125 MHz band, the range of operating power is between 1.5 to 12Watts, with two selectable power output levels called “Low” and “High” and two operational modes called “Digital” and “Analog.” The following table outlines the respective power levels.

Mode	Nominal Power (Watts)	Minimum Power (Watts)
Analog High Power	11.0	9.0
Analog Low Power	2.0	1.5
Digital High Power	4.0	3.0
Digital Low Power	1.0	0.75

The maximum power rating of 12 Watts is requested for service in Part 74, Subpart F, Television Auxiliary Broadcast Stations, Section 74.636 under the heading Power Limitations.

16. DC Voltages applied to and DC currents into the final RF stages of the transmitter:

The maximum DC voltage and DC currents into the last two stages of the driver and final amplifier for the maximum output are outlined in the following table. For both the Digital and Analog modes of operation the bias conditions on the amplifier are identical therefore only “High” and “Low” power conditions are shown.

1990 MHz to 2550 MHz

Mode	Driver Stages	Final Stage
High Power	+10V@ 0.72A	+10V@ 4.0A
Low Power	+5V @ 0.45A	+5V @ 1.3A

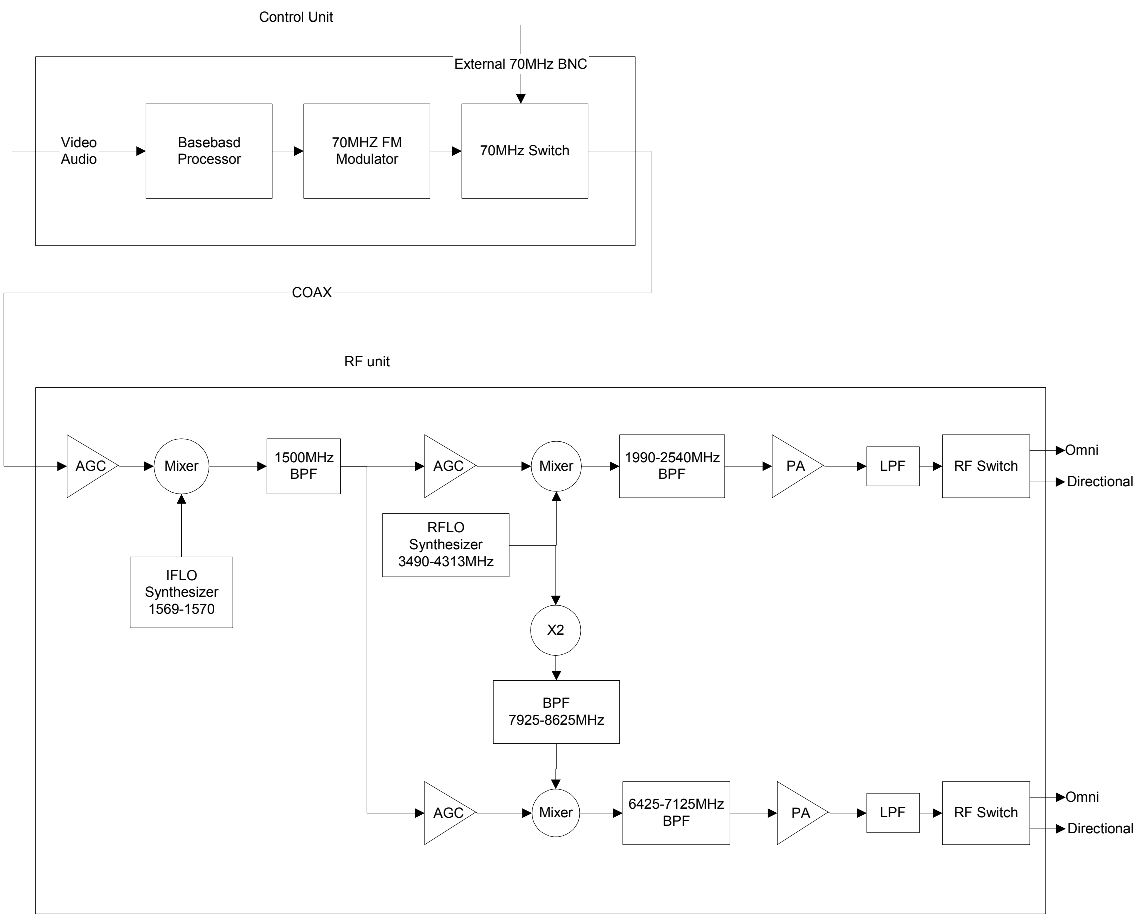
6425 MHz to 7125 MHz

Mode	Driver Stages	Final Stage
High Power	+10V@ 0.72A	+10V@ 4.0A
Low Power	+5V @ 0.45A	+5V @ 1.3A

17. Transmitter Tune Up procedure.
The 2/7NCVT1-LE06-1A2FK requires no tune-up over its operating range.

18) A description of circuits for determining and stabilizing frequency.
The following describes the operating principles of the various oscillator circuits employed in the 2/7NCVT1-LE06-1A2FK transmitter. Techniques used to stabilize the transmitter output frequency are also discussed.

System Architecture:
The 2/7NCVT1-LE06-1A2FK transmitter is a dual conversion transmitter. This is that the transmitter up converts a first IF frequency of 70MHz to 1500 MHz then a second up-conversion process is preformed to up-convert 1500MHz to the final RF output frequency. The transmitter has an internal 70MHz FM modulator but also has provisions to accept an external 70MHz.



Common PLL principles used on all the PLL's:
All the oscillators use a Phase Lock Loop to maintain their frequency. A sample of the oscillator output is divided down to a low reference frequency and compared to a crystal-controlled reference frequency inside the PLL IC. The PLL thus supplies an AFC voltage to the VCO assembly correcting any frequency error and holding the VCO on the selected frequency. In the event that the Phase-Locking process cannot be maintained, an alarm output from the PLL is sent to a local microprocessor that places the transmitter into "Standby" by shutting down all the voltages feeding the power amplifier preventing the radio from radiating. In this condition, a visual alarm appears on the front panel.

Internal 70MHz FM Modulator

The 70MHZ FM Modulator consists of a 70MHz voltage-controlled oscillator (VCO) and a narrow loop PLL. The principle and alarm monitoring are the same as outline above. The FM modulator accepts a composite baseband signal from the baseband processor, where video signal is processed and the audio subcarriers are generated and combined with the video. This composite baseband signal frequency-modulates the VCO circuit, which is controlled by an error signal from the PLL.

Audio Subcarriers
Each audio signal is connected through a deviation adjustment potentiometer to one of the subcarrier generators, each of which consists of a PLL and VCO. The subcarrier synthesizers are each capable of operating from 4.83 to 8.3 MHz in 5KHz steps. The frequency of each is set through a menu on the front panel control. Each subcarrier VCO is directly modulated by the audio signal.

The Subcarrier Deviation is normally set to 75KHz peak, however, other deviations are possible. The output of each Subcarrier is buffered and summed with the video signal before it is applied to the70MHz modulator.

Subcarrier injection levels are normally set to -26 dBc, related to the 70MHz signal. Additionally, when the Audio Mode is switched to "Off", the corresponding subcarrier is turned off.

Circuitry used to suppress spurious radiation:
Circuitry used to suppress spurious out of band radiation is built into the final RF amplifier. Each amplifier, 2/2.5 GHz and 6/7GHz, contains a low-pass filter (LPF) following the final amplifier transistor prior to the output connector. This LPF is used to suppress any harmonic emissions above the band of interest.

In the first up-conversion process there is a 30MHz wide band pass filter at 1500MHz to eliminate the local oscillator image. This filter also functions to limit any unwanted or output of band signals present at 70MHz.

The second stage of up-conversion is followed by a 500MHz wide bandpass filter. This filter acts to eliminate the agile microwave oscillator signal from being radiated. This filter also acts to reduce and out of band mixing products.

The internal 70MHz FM modulator has an internal modulation control for adjustment of the video modulation. The industry standards for video modulation are observed when the units are tuned at the factory. A standard 1-Volt peak-to-peak video signal is set to produce a maximum carrier deviation of 8MHz peak-to-peak. In the audio portion of the subcarrier modulator the peak deviation is limited by the operation amplifiers.

The circuitry for limiting power in the RF output stage is primarily the regulated power supply voltage, which sets the saturated output power to 12Watts for the 2GHz band and 10Watts for the 6/7GHz band.

19) The 2/7NCVT1-LE06-1A2FK accept external modulators through a 70 MHZ input. This was designed to primarily accept DVB-T and DVB-S standards in accordance to EN 300 744 and EN 300 421 modulation formats respectively.

Data and Measurement Procedures:

All the measurements taken follow the guidelines set forth in sections 2.1041 through 2.1057.

2.1046 RF Output Power:

The transmitter was terminated through a 50 Ohm 30-dB pad. The data was measured on a 436A Hewlett-Packard power meter as shown in Figure 28.

Power Output Table: 1990-2500 MHz

		Analog Mode (Watts)		Digital Mode (Watts)	
Channel	Frequency (MHz)	High	Low	High	Low
1	1999.0	9.885	3.013	3.25	0.988
4	2050.5	9.908	3.076	3.147	0.946
7	2101.5	9.727	3.061	3.155	0.941
9	2475.5	9.162	2.944	2.798	0.901
10	2492.5	9.036	2.786	2.766	0.897

Power Output Table: 6425-7125 MHz

		Analog Mode (Watts)		Digital Mode (Watts)	
Channel	Frequency (MHz)	High	Low	High	Low
1	6887.5	8.609	2.766	3.076	1.264
4	6962.5	8.336	2.371	3.133	1.264
7	7037.5	7.834	1.282	3.033	1.213
9	7087.5	7.43	1.309	3.061	1.213
10	7112.5	7.261	1.513	3.041	1.199

2.1047 Modulation Characteristics:

1.Video Modulation:
Standard test signals were fed into the video input of 2/7NCVT1-LE06-1A2FK Transmitter from the Tektronix 1410 NTSC signal generator. The output of the transmitter was attenuated and then connected to a receiver. The video output of the receiver was connected to a Tektronix VM 700A Video Measurement Test Set.

Results:
As the modulation circuitry is common to both bands, 1999-2550 MHz and 6145-7125 MHz, and the data obtained was identical, only one set of data is given below. The Linearity waveform, as listed in the table below, demonstrates a substantially linear transfer function through the transmitter and the receiver.

Table of figures for Linearity Waveform

Band (GHz)	Freq. (MHz)	Fig. No. Demod Waveform	Fig. No. Diff. Gain	Diff. Gain	Fig. No. Diff. Phase	Diff. Phase (Deg)
2	2101.5	18,19	3	0.50%	4	0.3

Video Frequency Response:
The frequency is represented by the demodulated multiburst waveform, as listed and tabulated in the table. Since the modulation circuitry is common to each band and the data was identical, only one set of data is given below. Measurement were made to a tolerance of ±1/4 IRE (±0.025 dB).

Table of Figures for Multiburst Waveform & Frequency Response

			Relative Response (MHz) in IRE units					
Band (GHz)	Freq. (MHz)	Fig. No.	0.5	1.25	2	3	3.58	4.1
2	2101.5	21	100	99.1	99.1	99	99	98.8

The video pre-emphasis circuit is designed in accordance with CCIR recommendation 405-1 (New Delhi, 1970) and has the insertion loss characteristic shown in Figure 31 and 32.

2. Audio Modulation:
The audio frequency response of the 2/7NCVT1-LE06-1A2FK was measured with the setup shown in Figure 29. The results are presented in the following table. These results were measured and found to be identical for the 2.0, 2.5, 6.5 and 7.0 GHz bands. Since the modulation circuitry is common to each band and the data was identical, only one set of data is given below.

Audio Frequency Response

Frequency (Hz)	Demodulated Relative Response (dB)	Measured Distortion
50	0.1	0.26%
100	0.03	0.26%
400	0	0.28%
1000	0	0.22%
5000	0	0.20%
10000	-0.2	0.40%
12000	-0.2	0.52%
15000	-0.2	0.55%
20000	-3.8	0.25%
30000	-16	x

See separate e-file named Modulation Characterics.pdf

<u>2.1049 Occupied Bandwidth</u>:

The Occupied Bandwidth is defined in Section 2.1049 as the frequency bandwidth, where the mean power radiated below its lower and above its upper frequency limits are each equal to 0.5 percent of the total mean radiated power. In other words, the Occupied Bandwidth contains 99% of the total mean radiated power.

For analog mode, the Linearity Stairstep (typical waveform representing Program video), Multiburst and Color bar signals from the Tektronix 147A NTSC signal generator along with two subcarriers of 4.83 MHz and 6.2 MHz were used as baseband input. For both analog and digital mode, 2/7NCVT1-LE06-1A2FK was set in the normal operational mode with maximum output power.

The spectrum analyzer parameters for the measurement of Digital Signal Bandwidth were as follows:

Resolution BW 10KHz
Video BW 10KHz
Span 50MHz
Sweep 0.5sec/div

In the case of Analog Signals, the spectrum changes substantially during the vertical interval and line by line through the picture. The display on the analyzer is the vector sum of these components that fall within the bandpass of the analyzer as it sweeps across the band. The accuracy of bandwidth measurement improves if the spectrum analyzer bandwidth is effectively narrow and effectively averaged. Also, the analyzer sweep should be slow enough to allow many TV fields to pass by for effective averaging of the changing sideband components. Taking these points into consideration, the spectrum analyzer was set to a resolution bandwidth of 10 kHz and swept slowly at the rate of 2 seconds per MHz across a 20 MHz span centered on the channel. The analyzer video filter was set to 1kHz to effectively average the display. The vertical scale was set to a logarithmic factor of 10 dB per division thus providing a power scale.

The Occupied Bandwidth measurement was done using a HP 8563E Spectrum analyzer, which has standard built-in bandwidth calculator (HP 8563E manual, Chapter 4 Key Function Description, page 192).

The table below shows the bandwidth occupied by Analog and Digital Signal for bands 1999-2550 and 6145-7125 MHz.

Occupied Bandwidth MHz				Frequency GHz
Figure No.	Analog (FM)	Figure No.	Digital (COFDM)	
10	10.37	1	7.580	2.4925
13	10.9	5	7.500	1.999
14	11.37	6	7.500	7.1125
17	11.27	9	7.500	6.887

See separate e-file named Occbw.pdf

2.1059 Spurious Emission at Antenna Terminals:

To be provided by Retlif Testing Laboratory.

2.1053Field Strength of Spurious Radiation:

To be provided by Retlif Testing Laboratory.

2.1055 Frequency Stability:

The transmitter was installed in a temperature test chamber and the output frequencies were measured at intervals of 10 ºC from +60 ºC to –10 ºC using the HP 5342A Frequency Counter.

Frequency vs. Temp 1999-2500 GHz

Channel	1	4	7	10
Temp ºC	Frequency Hz			
60	1,999,002,924	2,050,502,811	2,101,502,728	2,492,502,180
50	1,999,008,998	2,050,509,378	2,101,509,739	2,492,511,161
40	1,999,003,931	2,050,503,928	2,101,503,796	2,492,503,419
30	1,999,002,611	2,050,502,540	2,101,502,437	2,492,501,895
20	1,999,003,891	2,050,503,850	2,101,503,851	2,492,503,753
10	1,999,006,858	2,050,506,854	2,101,506,791	2,492,506,863
0	1,999,007,400	2,050,507,456	2,101,507,506	2,492,507,933
-10	1,999,010,910	2,050,511,011	2,101,511,088	2,492,511,907
-20	1,999,011,512	2,050,512,330	2,101,512,097	2,492,512,721
-30	1,999,010,885	2,050,511,924	2,101,511,756	2,492,511,880

Max Dev.	8,901	9,790	9,660	10,826
Max Dev. %	0.00045%	0.00048%	0.00046%	0.00043%

The maximum observed deviation was 10826 Hz, with carrier on Ch10.

Frequency vs. Temp 6145-7125 GHz

Channel	1	4	7	10
Temp ºC	Frequency Hz			
60	6,887,497,591	6,962,497,335	7,037,497,052	7,112,496,639
50	6,887,523,222	6,962,523,433	7,037,523,662	7,112,523,908
40	6,887,498,911	6,962,498,943	7,037,498,965	7,112,498,951
30	6,887,495,959	6,962,495,845	7,037,495,720	7,112,495,694
20	6,887,501,677	6,962,501,514	7,037,501,482	7,112,501,363
10	6,887,508,394	6,962,508,418	7,037,508,463	7,112,508,467
0	6,887,512,401	6,962,512,347	7,037,512,272	7,112,511,763
-10	6,887,523,173	6,962,523,197	7,037,523,224	7,112,523,247
-20	6,887,530,189	6,962,530,250	7,037,530,450	7,112,530,654
-30	6,887,532,560	6,962,532,640	7,037,532,482	7,112,532,854

Max Dev.	36,601	36,795	36,762	37,160
% Max Dev.	0.00053%	0.00053%	0.00052%	0.00052%

The maximum observed deviation was 37160 Hz, with carrier on Ch 10.

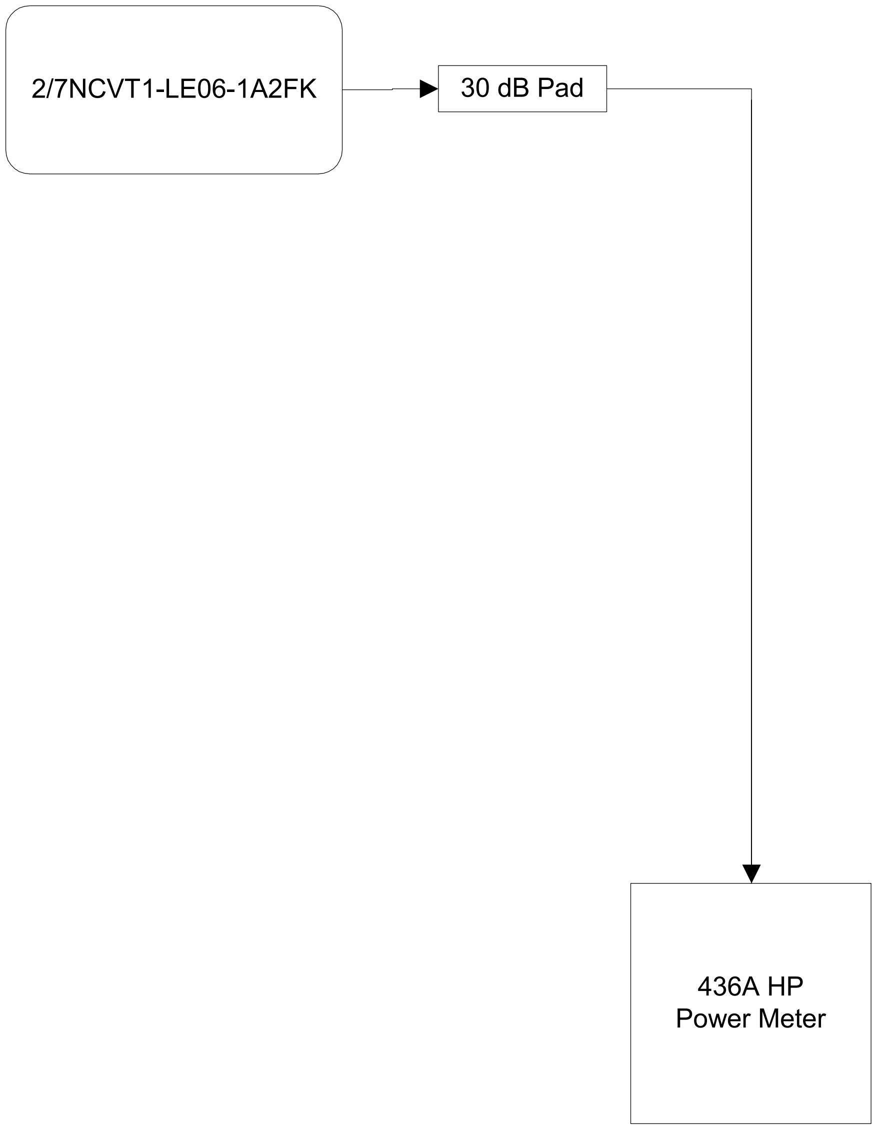


FIGURE 28

RF Output Power Measurement

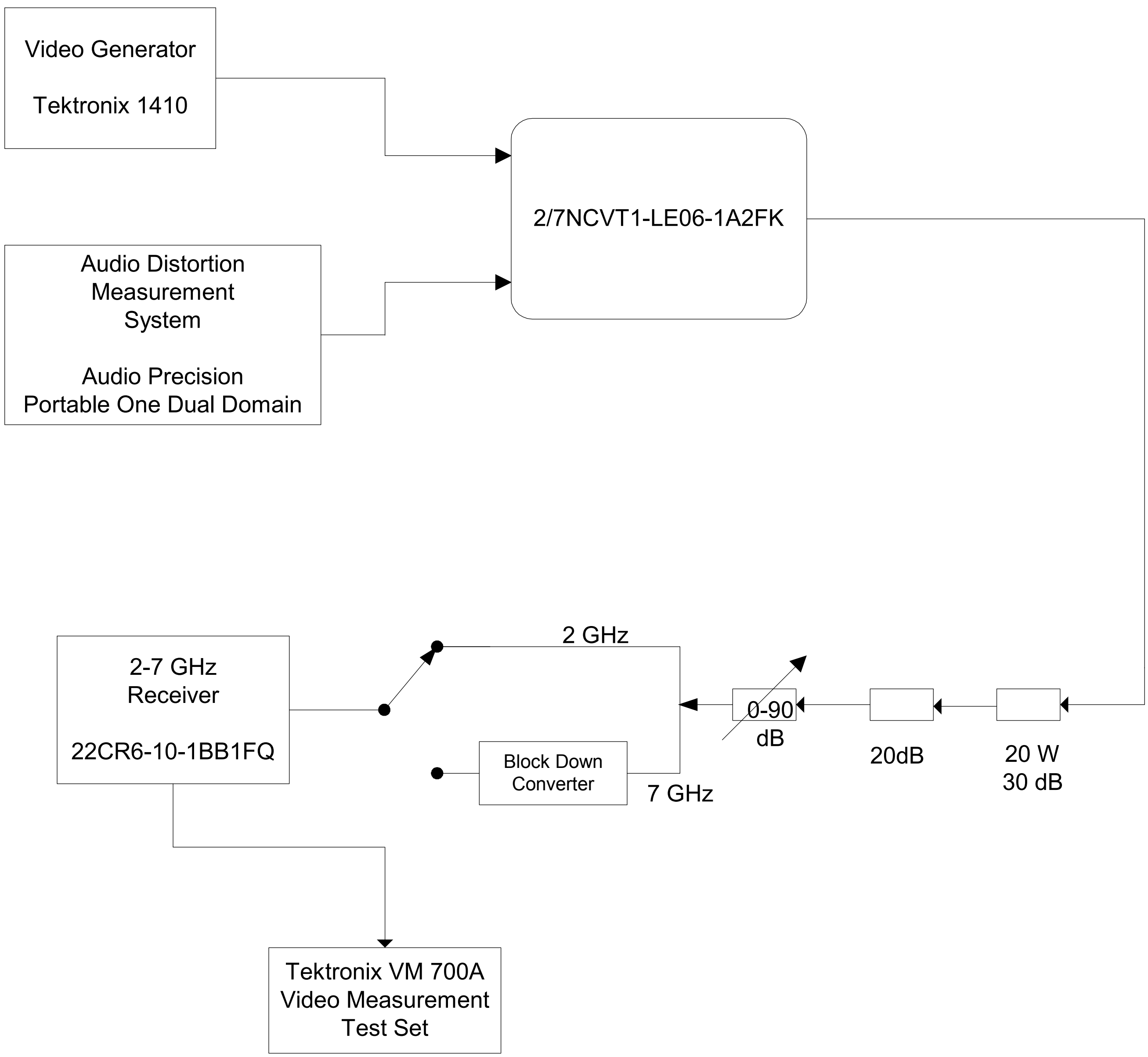


FIGURE 29

Video and Audio Response Test

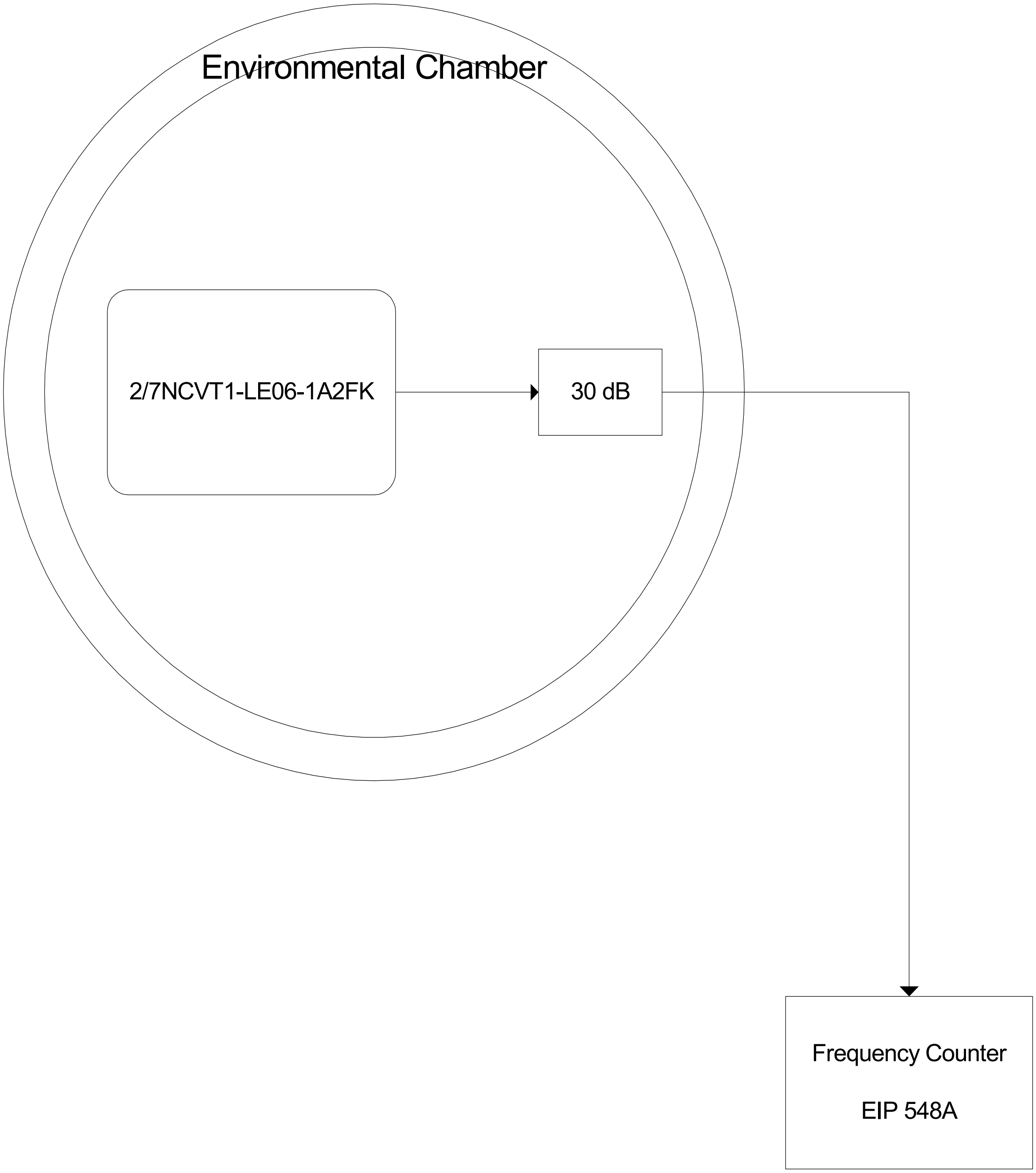
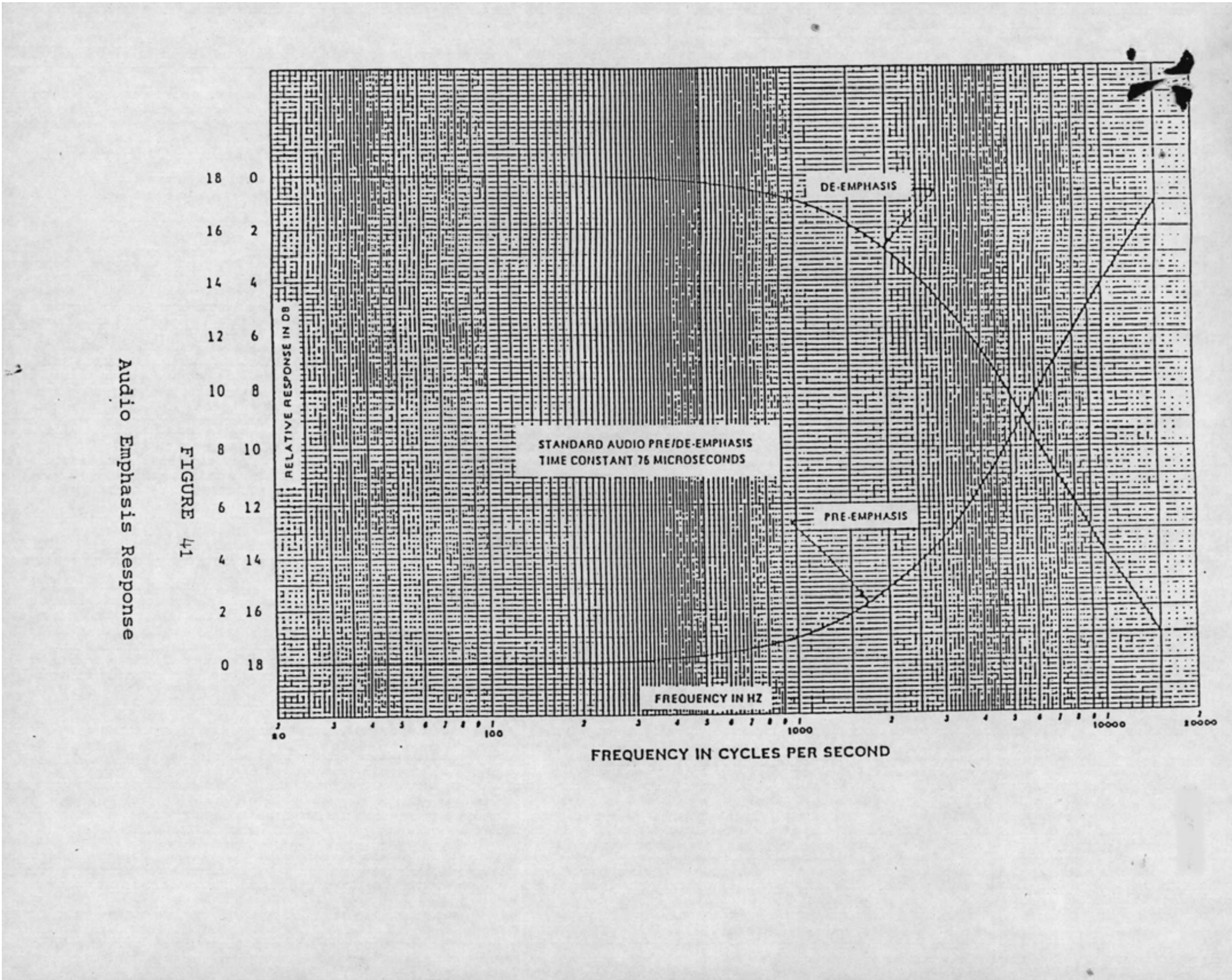


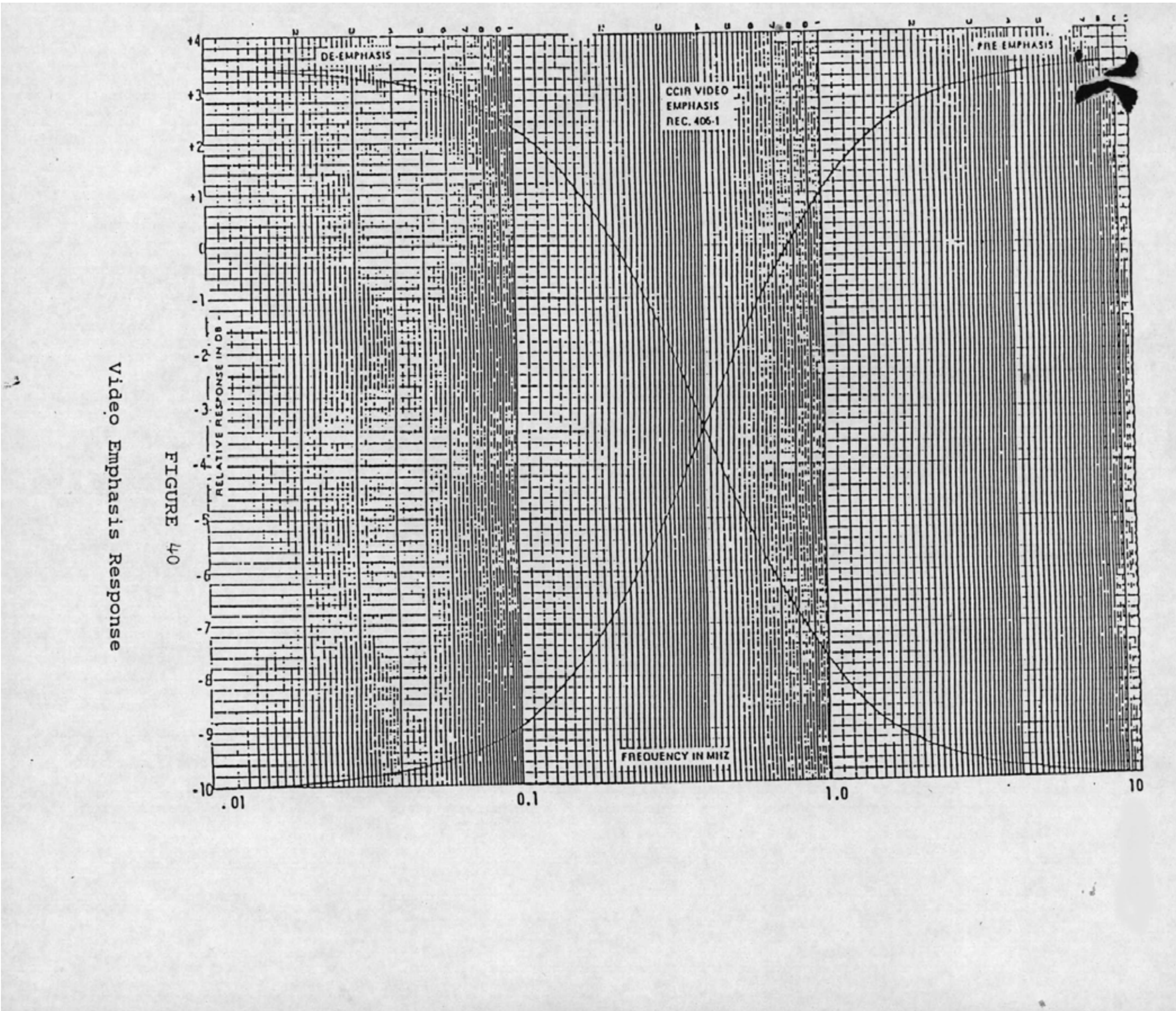
FIGURE 30

Frequency Stability Measurement



Audio Emphasis Response

Figure 31



Video Emphasis Response

Figure 32