Nucomm - FCC Certification Report

Newscaster VT2

Digital/Analog ENG/OB Van Transmitter

23NCVT2-L5-339-A2C2K

(Per CFR TITLE 47, PART 2, SUB-PART J)

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PROPRIETARY INFORMATION

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Specifications are subject to change in order to allow for the introduction of design improvements

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Table 1 Revision History

Date	Revision	Changed by	Reason for Change
11/11/05	1.0	George Williamson	Removed figure reference to figure 15, was redundant
11/14/05	1.1	John Odell	Update to reply to Retlif comments, added references to Modulation Characteristics pdf. Added new figures for test set ups.
12/8/05	1.2	John Odell	Added CW reference level signals to occupied bandwidth measurements including updating tables 12 & 13. Modified the Equipment ID to be I4U23VT2L.
1/16/05	1.3	John Odell	Updated occupied bandwidth measurements for 100Khz Res B.W. and 300Khz Video B.W and updating tables 12 & 13. Updated Spurious Emissions at Antenna Terminals measurements for 1 MHz Res B.W. and 3Mhz Video B.W. and correct Ref level. Changed RF Head picture to reflect changes to the unit.
1/23/06	1.4	John Odell	Re-measured antenna conducted on channel 10 in the FM high power mode. Re-measured all occupied bandwidth measurements at Retlif's request.
1/27/06	1.5	John Odell	Re-measured Occupied Bandwidth plots using a 1 to 3 ratio of RBW vs. VBW (Video Band Width) to adhere to the Industry standard of a 1 to 3 ratio. Corrected several typing errors.
4/6/06	1.6	George Williamson	Add BOM, pictures, equipment list and calibration dates as well as schematics (RF section) per Retlif request.

Nucomm - FCC Certification Report

~NCVT2~

(Per CFR TITLE 47, PART 2, SUB-PART J)

1 Applicants full name and address (1)

Full name and mailing address of the manufacturer of the device and the applicant for certification:

Name of Manufacturer/Applicant: Nucomm, Inc.

Address of Manufacturer/Applicant: 101 Bilby Road
Hackettstown, NJ 07840

2 FCC Identifier (2)

Equipment Identification: **FCC ID: I4U23VT2L**

3 Installation and operating instructions to be furnished by the user (3)

A copy of the Installation and operating instruction are provided under separate cover with the title of

4 Emission (4), Frequency range (5), & Range of operating power (6)

Values or specific operating power levels, and description of any means provided for variation of operating power.

For the 1990 to 2550 MHz band, the range of operating power is between 1.5 to 12 Watts, with two selectable power output levels called “Low” and “High” and two operational modes called “Digital” and “Analog.” The following table (Table 2) outlines the respective power levels.

Table 2: Analog and Digital 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	5.0	4.0
Digital Low Power	1.0	0.75

5 Maximum power rating as defined in the applicable part(s) of the rules (7)

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.

6 DC Voltages & Currents (8)

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 Table 3. 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

Table 3: Maximum DC voltage and currents

Mode	Driver Stages	Final Stage
High Power	+11V @ 0.72A	+11V @ 4.4A
Low Power	+11V @ 0.72A	+11V @ 4.4A

7 Tune-up procedure over the power range, or at specific operating power levels (9)

The 23NCVT2-L5-339-A2C2K requires no tune-up over its operating range.

8 Equipment Identification (11)

The following photograph figure (Figure 1: FCC Equipment Identification Plate) shows the FCC label which identifies the FCC ID, Manufactures name, part number, unit serial number and week of manufacture.

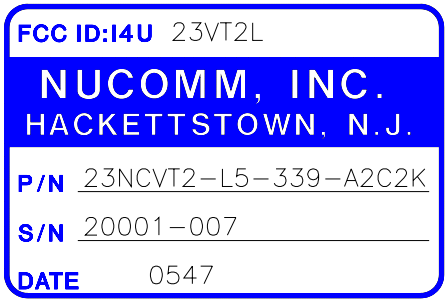


Figure 1: FCC Equipment Identification Plate

9 Photographs (8X10 inch) of the equipment (12).

Supply photographs of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Refer to addendum 1 (Radio and test Equipment Photographs) which is contained in a separate file associated with this report (NCVT2 Certification Report Addendum 1.doc).

10 Digital modulation techniques (13)

A detailed description of the modulation system to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated.
The transmitter supports 2 forms of digital modulation VSB and COFDM (Coded Orthogonal Frequency Division Multiplexing). The VSB mode supports 2VSB, 4VSB, 8VSB, 8VSB with Trellis and 16VSB. These modes conform to the ATSC document A\53. The COFDM modulation conforms to DVB-T EN 300 744.

11 Data required by §§2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in *§2.1041* (14).

The following table (Table 4 - Test Equipment Used) identifies the equipment used to perform testing including the manufacturer, model number, serial number, calibration dates, frequency and thermo ranges. Images of the test equipment and set up are located in Addendum 1 section 1.2 (FCC Test Equipment Images).

Table 4 - Test Equipment Used

Manufacturer	Model #	Serial #	Calibration	Ranges
1. *Conducted Emissions Tests*				
Agilent	E4407B	MY45102094	5/1/05 due 6/1/06	9Khz to 26.5Ghz Spectrum Analyzer
Aeroflex Wienschel	46-30-34	BT6325	1/11/06 due 1/11/07	DC-18 Ghz, 25Watt, 30 dB Attenuator
2. *Output Power Tests*				
Hp/Agilent	437B	31254U11528	10-19-05 due 10-19-06	Power Meter
Hp/Agilent	8481A	2349A43226	12/12/05 due 12/12/06	Power Sensor 10 Mhz to 18 Ghz
Aeroflex Wienschel	46-30-34	BT6325	1/11/06 due 1/11/07	DC-18 Ghz, 25Watt, 30 dB Attenuator
3. *Occupied Bandwidth Tests*				
Agilent	E4407B	MY45102094	May 05 due May 06	Spectrum Analyzer 9Khz to 26.5 Ghz
Hp/Agilent	8481A	2349A43226	12/12/05 due 12/12/06	Microwave Power Sensor 10 Mhz to 18 GHz
Aeroflex Wienschel	46-30-34	BT6325	1/11/06 due 1/11/07	DC-18 GHz, 25Watt, 30 dB Attenuator
Narda	4226-20		N/A	20 dB Directional Coupler .5-18 GHz
4. *Frequency Stability Tests*				
Hewlett Packard	5342A	2542A 10570	10/24/05 due 10/24/06	Microwave Frequency Counter ,10 Hz to 18 Ghz
Tenney	BTL	23867-08.	N/A	Temperature Chamber

Manufacturer	Model #	Serial #	Calibration	Ranges
Fluke	54 II	90510039	3/29/05 due 3/29/06	Thermometer -200 C º to 1372 C º
5. *Video and Audio Modulation Tests*				
Tektronics	TG700	B011060	8/10/05 due 8/10/06	TV Signal Generator Platform, DC-10 MHz
Tektronics	VM700A	B021027	2/15/06 due 2/14/07	Video Measurement Set, DC-10 MHz
Audio Precision	ATS-2	11277	12/19/05 due 12/20/06	Audio Test Set System DC-100Khz
Hewlett Packard	8496B	3308A71159	N/A	Attenuator/110 dB DC-18 GHz
Hewlett Packard	8494B	2812A19146	N/A	Attenuator/11 dB DC-18 GHz

11.1 RF Power Output (2.1046)

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 2.

Figure 2 RF Power Output test set up

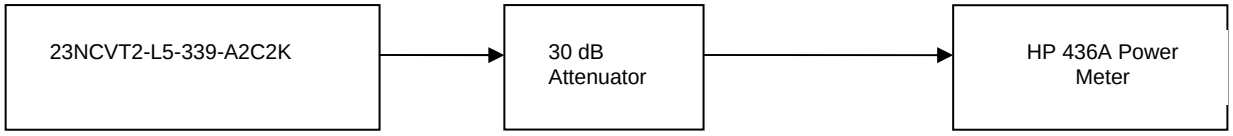


Table 5 Power Output: 1990-2500 MHz (current freqs)

		Analog Mode (Watts)		Digital Mode (Watts)	
Channel	Frequency (MHz)	High	Low	High	Low
1	1999.0	11.83	2.67	4.93	1.34
4	2050.5	11.90	2.86	4.99	1.4
7	2101.5	11.95	3.09	5.07	1.55
9	2475.5	10.46	2.67	4.00	1.36
10	2492.5	10.33	2.64	3.98	1.35

Table 6 Power Output: 2031.5-2500 MHz (BAS relo freqs)

		Analog Mode (Watts)		Digital Mode (Watts)	
Channel	Frequency (MHz)	High	Low	High	Low
1	2031.5	11.38	3.013	4.97	2.73
4	2067.5	11.45	3.076	5.08	2.50
7	2103.5	11.61	3.10	5.11	2.47
9	2475.5	10.48	2.70	4.00	1.38
10	2492.5	10.35	2.65	3.98	1.35

11.2 Modulation Characteristics (2.1047)

11.2.1 Video Modulation:

Standard test signals were fed into the video input of 23NCVT2-L5-339-A2C2K 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. A block diagram of the test setup is shown below

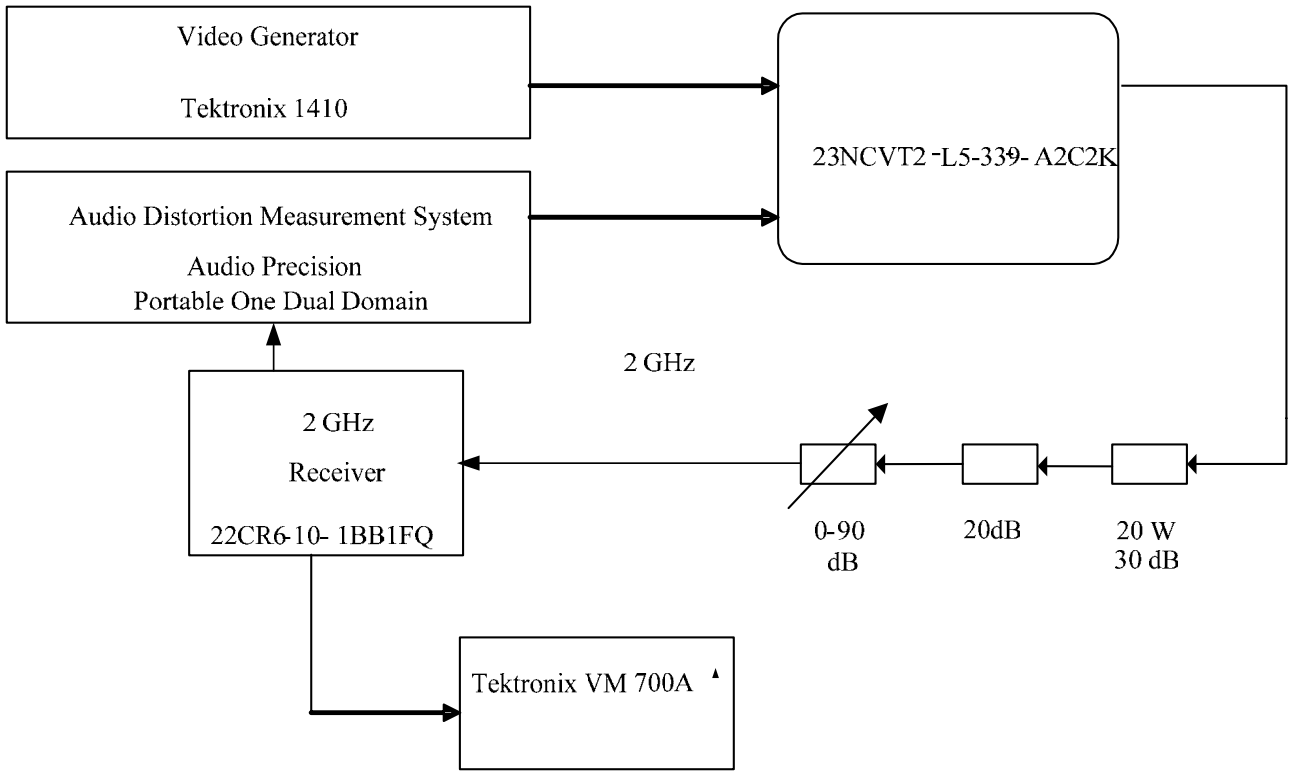


Figure 3 Video and Audio Modulation test setup

Results:

Since the modulation circuitry is common for all channels and the data 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 7: 17 MHz channel spacing with +/- 4 MHz FM deviation

Band (GHz)	Freq. (MHz)	Fig. No. Demod Waveform	Fig. No. Diff. Gain	Diff. Gain	Fig. No. Diff. Phase	Diff. Phase (Deg)
2	2101.5	3	4	2.97%	5	1.89

Table 8: 12 MHz channel spacing with +/- 3 MHz FM deviation (BAS relo frequencies)

Band (GHz)	Freq. (MHz)	Fig. No. Demod Waveform	Fig. No. Diff. Gain	Diff. Gain	Fig. No. Diff. Phase	Diff. Phase (Deg)
2	2031.5	6	7	2.20%	8	2.30

11.2.2 Video Frequency Response

The frequency is represented by the demodulated multi-burst 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. Measurements were made to a tolerance of ±1/4 IRE (±0.025 dB).

Table 9: 17 MHz channel spacing with +/- 4 MHz FM deviation

			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	9a,9b	100.02	100.02	99.91	99.98	99.95	98.94

Table 10: 12 MHz channel spacing with +/- 3 MHz FM deviation (BAS relo frequencies)

			Relative Response (MHz) in IRE units					
Band (GHz)	Freq. (MHz)	Fig. No.	0.5	1.25	2	3	3.58	4.1
2	2031.5	10a,10b	99.99	99.87	99.70	99.37	99.34	99.12

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 11 and 12.

11.2.3 Audio Modulation

The audio frequency response of the 23NCVT2-L5-339-A2C2K was measured with the setup shown Below (Figure 4).

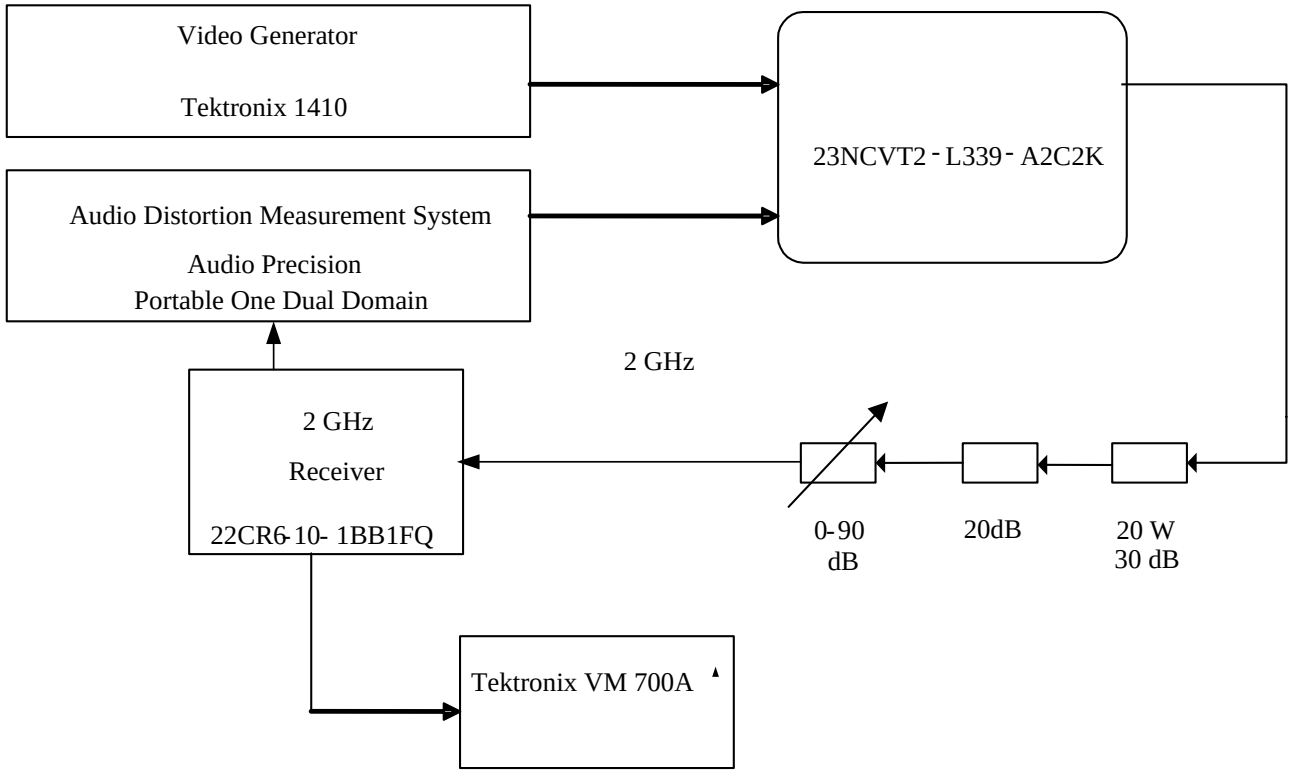


Figure 4 Video and Audio Modulation test setup

Results:

The results are presented in the following table. These results were measured and found to be identical for all channels. Since the modulation circuitry is common to each channel and the data was identical, only one set of data is given below.

Audio Frequency Response:

Table 11: 17 MHz channel spacing with +/- 4 MHz FM deviation

Frequency (Hz)	Demodulated Relative Response (dB)	Measured Distortion
50	.15	0.154
100	.15	0.144%
400	.17	0..138%
1000	.12	0.128%

Frequency (Hz)	Demodulated Relative Response (dB)	Measured Distortion
5000	.08	0.152%
10000	-0.31	0.264%
12000	-0.38	0.219%
15000	-0.58	0.277%
20000	-7.35	03.01%
30000	-60	x

Table 12: 12 MHz channel spacing with +/- 3 MHz FM deviation (BAS relo frequencies)

Frequency (Hz)	Demodulated Relative Response (dB)	Measured Distortion
50	-1.82	0.154
100	-1.83	0.144%
400	-1.94	0.138%
1000	-2.06	0.128%
5000	-2.06	0.152%
10000	-2.06	0.264%
12000	-2.06	0.219%
15000	-2.06	0.277%
20000	-8.75	03.01%
30000	-60	x

See separate e-file named Modulation Characterics.pdf.

11.3 Occupied bandwidth (2.1049)

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.

Color bar signals along with two sub-carriers of 4.83 MHz and 6.2 MHz were used as baseband input. For both analog and digital mode, 23NCVT2-L5-339-A2C2K was set in the normal operational mode with maximum output power.

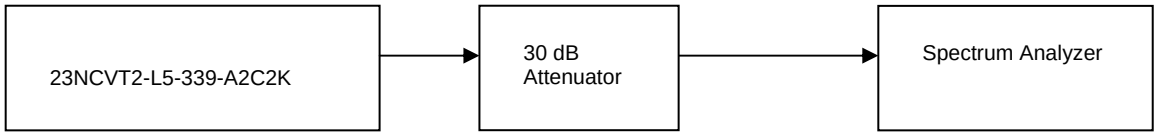
The spectrum analyzer parameters for the measurement of Digital Signal Bandwidth were as follows:

- Resolution BW 3KHz
- Video BW 3KHz
- Span 30MHz

- Sweep 4.295sec

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 band pass 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, several analyzer sweeps should be averaged 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 100 kHz and swept slowly at the rate of 1 second across a 50 MHz span centered on the channel. The analyzer video bandwidth was set to 100 kHz and 20 averages were taken 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 an Agilent E4407B Spectrum analyzer, which has standard built-in bandwidth calculator. The test set up is shown in Figure 5.

Figure 5 Occupied Bandwidth test set up



The table below shows the bandwidth occupied by Analog and Digital Signal for the current 17 MHz channel spacing (Table 13) and the new 12 MHz channel spacing BAS relo frequencies (Table 14).

Table 13: Occupied Bandwidth Figure Reference (17 MHz spacing)

Occupied Bandwidth MHz				Frequency GHz
Figure No.	Analog (FM)	Figure No.	Digital (COFDM)	
23	12.795	13	7.689	1.999
26	12.594	16	7.698	2050.5
28	12.729	18	7.660	2084.5
32	12.838	22	7.698	2492.5

See separate e-file named Occbw_17Mhz_channels.pdf.

Table 14: Occupied Bandwidth figure reference (12 MHz spacing)

Occupied Bandwidth MHz				Frequency GHz
Figure No.	Analog (FM)	Figure No.	Digital (COFDM)	
37	10.877	33	7.590	2031.5
38	11.198	34	7.528	2043.5
39	11.396	35	7.516	2091.5
40	10.704	36	7.515	2103.5

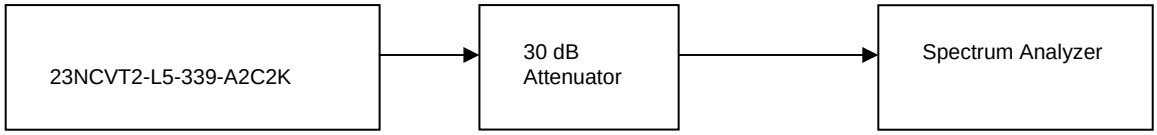
See separate e-file named Occbw_BAS_relo_freq.pdf.

11.4 Spurious Emission at Antenna Terminals (2.1059)

Measurement Procedure:

The RF output of the transmitter was directly coupled through attenuators to the input of a spectrum analyzer. With the transmitter on, the spectrum analyzer was swept from 30 MHz to 26.5 GHz. It was verified that all emissions not associated with the fundamental transmission were at least 43 +10 log (P) down from the fundamental transmit power level (P). The test set up is depicted in Figure 6 below.

Figure 6 Spurious emission at antenna terminals test set up



The results for the above test are submitted as a separate attachment named AntCe.pdf.

11.5 Field strength of spurious radiation (2.1053)

To be provided by Retlif Testing Laboratory.

11.6 Frequency stability (2.1055)

The transmitter was installed in a temperature test chamber per Figure 7 below.

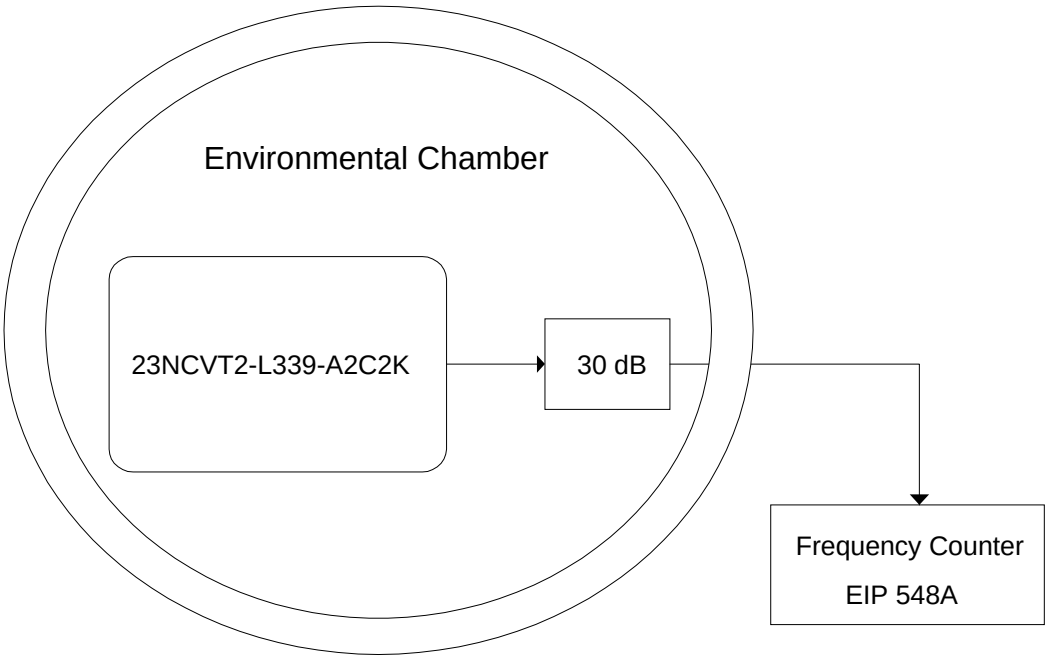


Figure 7 Frequency stability test set-up

The output frequencies were measured at intervals of 10 ºC from +60 ºC to –30 ºC using the HP 5342A Frequency Counter. Table 15 and Table 16 summarize the measured frequency vs. temperature.

Table 15: Frequency vs. Temp: 1990-2055 GHz (current freqs)

Channel	1	4	7	10
Temp ºC		Frequency Hz		
60	1,999,000,271	2,050,500,961	2,101,500,786	2,492,500,815
50	1,999,000,598	2,050,500,725	2,101,500,480	2,492,500,653
40	1,999,000,471	2,050,500,565	2,101,500,344	2,492,500,532
30	1,999,000,871	2,050,501,002	2,101,500,515	2,492,500,637
20	1,999,001,005	2,050,501,030	2,101,500,963	2,492,501,430
10	1,999,000,497	2,050,500,901	2,101,500,844	2,492,501,213
0	1,999,000,367	2,050,500,538	2,101,500,243	2,492,501,212
-10	1,999,000,256	2,050,500,485	2,101,500,307	2,492,500,897
-20	1,999,000,216	2,050,500,375	2,101,500,152	2,492,500,710
-30	1,998,999,696	2,050,499,856	2,101,499,997	2,492,500,610

Max Dev.	1,005	1030	963	1,430
Max Dev. %	0.000050%	0.000050%	0.000046%	0.000057%

The maximum observed deviation was 1430 Hz, with carrier on Ch10.

Table 16: Frequency vs. Temp 2031.5-2492.5 GHz (BAS freqs)

Channel	1	4	7	10
Temp ºC		Frequency Hz		
60	2031,501,073	2067,500,770	2103,500,535	2492,500,515
50	2031,500,892	2067,500,770	2103,500,399	2492,500,394
40	2031,501,346	2067,501,047	2103,500,570	2492,500,499
30	2031,501,480	2067,501,075	2103,501,018	2492,501,292
20	2031,500,972	2067,500,946	2103,500,899	2492,501,075
10	2031,500,842	2067,500,583	2103,500,478	2492,501,074
0	2031,500,731	2067,500,530	2103,500,362	2492,500,759
-10	2031,500,691	2067,500,420	2103,500,207	2492,500,572
-20	2031,500,171	2067,499,901	2103,500,052	2492,500,472
-30	2031,500,475	2067,500,045	2103,500,055	2492,499,862

Max Dev.	1,480	1,075	1,018	1,292
% Max Dev.	0.000073%	0.000052%	0.000048%	0.000052%

The maximum observed deviation was 1480 Hz, with carrier on Ch 1.

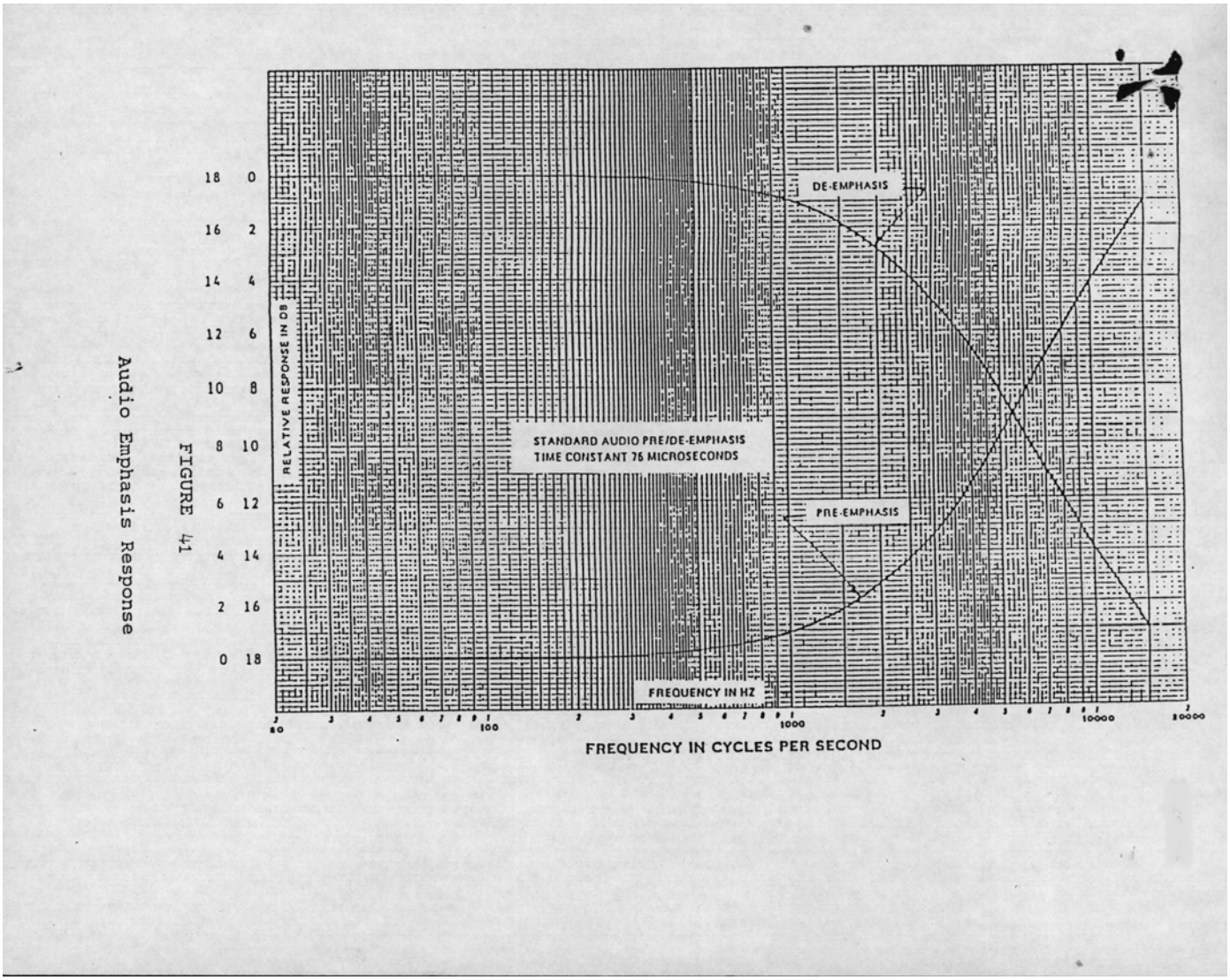


Figure 8: Audio Emphasis Response

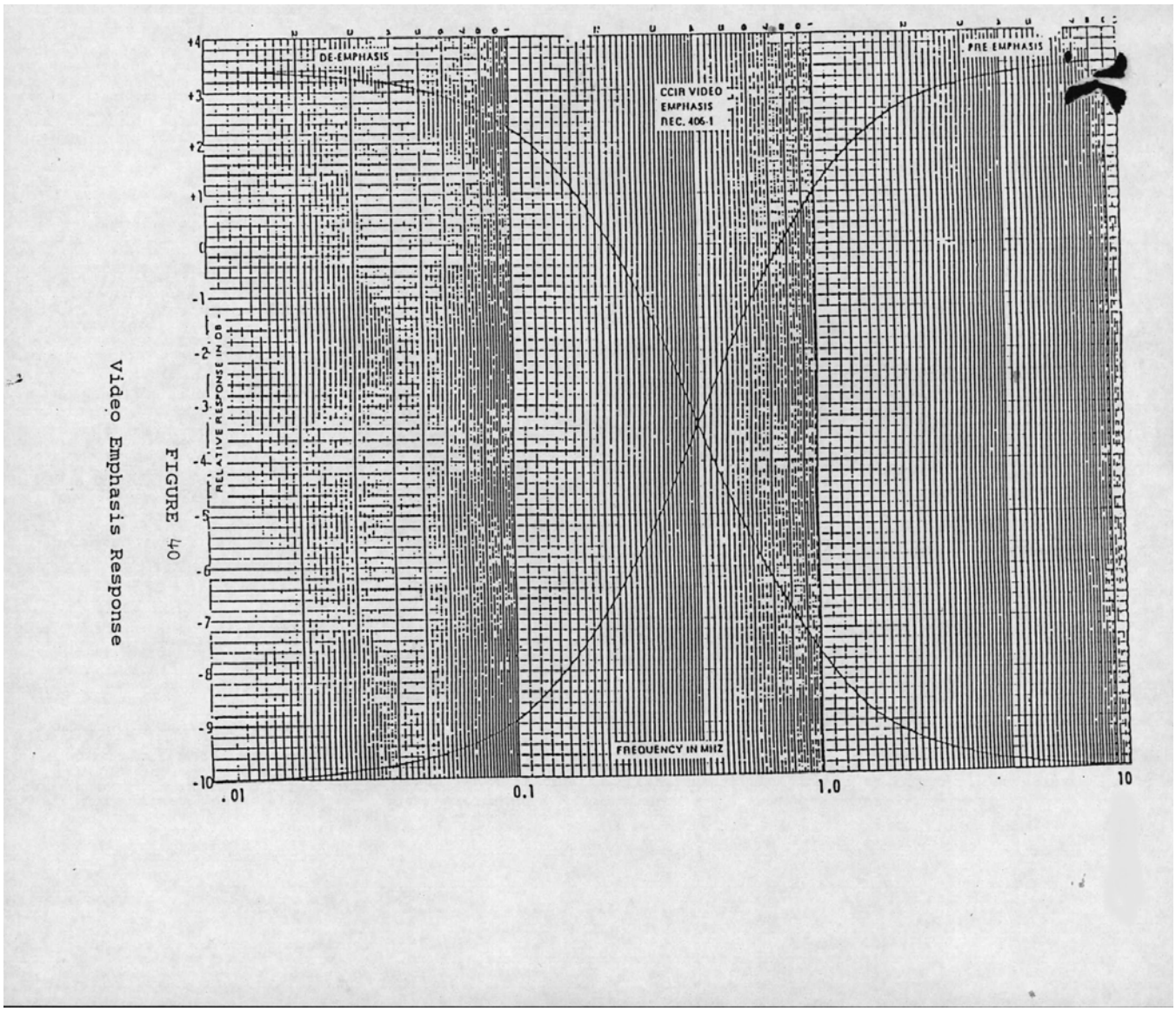


Figure 9 - Video Emphasis Response