4. TEST REPORT

4.1 RF Power Measurements

Figure 4-1 shows the test equipment setup for the RF power measurements.

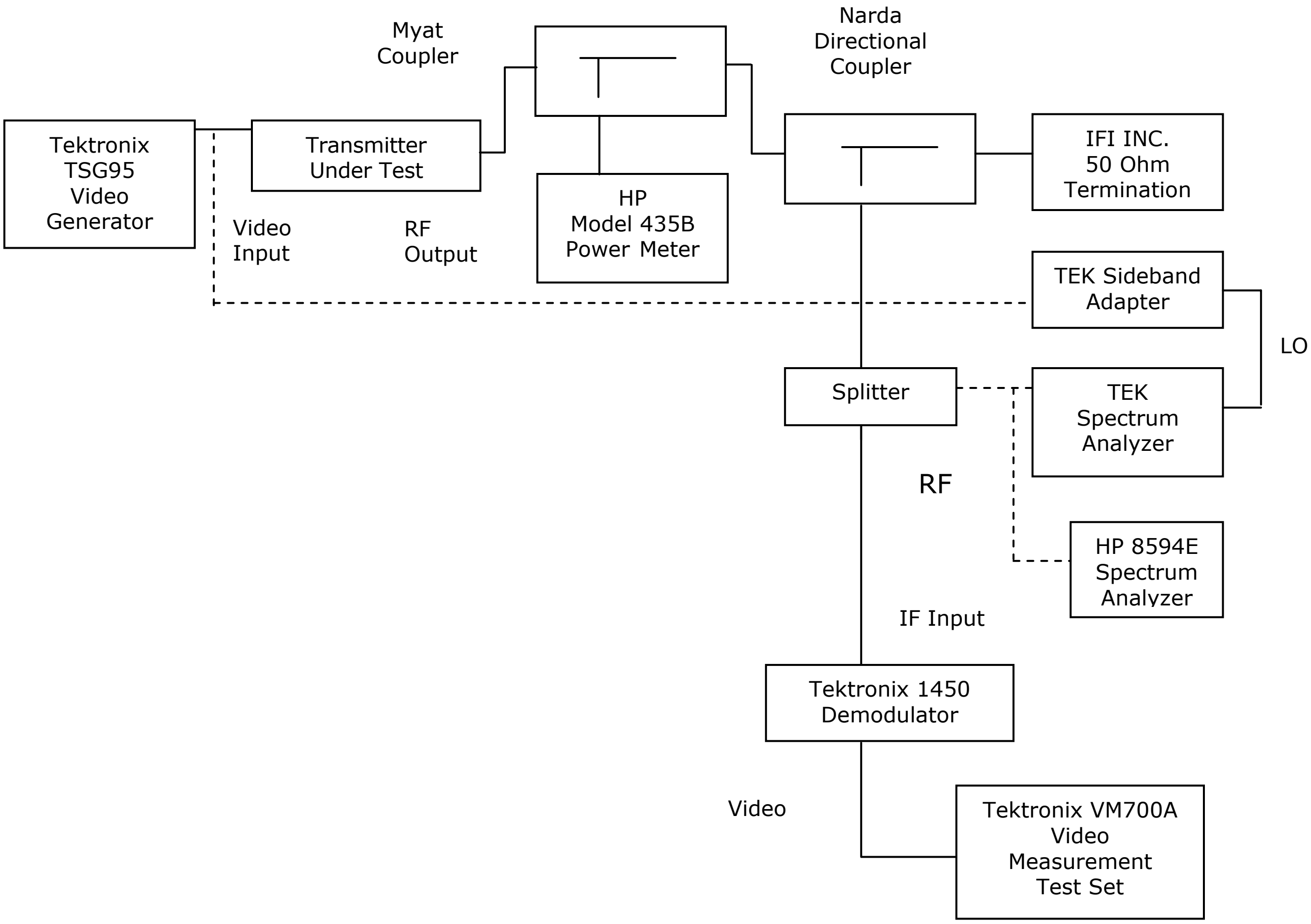

Figure 4-1. Test Equipment Setup for RF Power Measurements

The video modulation was adjusted for 25% with sync and blanking video signals and the aural power was turned off. The power was then adjusted to obtain 1200 watts of average visual RF output (2000 watts peak sync at the output connector). This level was used to establish a reference on the spectrum analyzer.

Next, the aural power was turned on and adjusted to 10 dB below the visual power. The following operating parameters were recorded:

Peak Visual Power: 100% = 2000 Watts
Aural Power: 100% = 200 Watts continuous wave (CW)
Reflected Power: <1%

4.2 Modulation Characteristics

4.2.1 Video Modulation

The test setup shown in Figure 4-1 was used to adjust the video signal to obtain a white picture level. Using the Tektronix 1450 demodulator chopper function, the modulation was accurately measured to be 87.5% while maintaining a depth of modulation at blanking.

Next, the video was adjusted for modulated staircase and the differential phase and gain were measured and recorded as follows:

- Differential phase: +/-.7°
- Differential gain : 3.5%

Figure 4-2 shows the substantially linear transfer characteristics of the transmitter as a demodulated video waveform.

Figure 4-2. Substantially Linear Transfer Characteristics of the Transmitter as a Demodulated Video Waveform

4.2.2 Video Envelope Delay

Using the test setup in Figure 4-1, the envelope delay was measured and the data recorded as shown in Table 4-1. A sinx/x test pattern was used.

Table 4-1. Envelope Delay Measurements

VIDEO FREQUENCY (kHz)	DELAY (ns)
200	-1
500	25
1000	19
1500	15
2000	-28
2500	-8
3000	-31
3500	-162
3580	-210
4000	-380
4180	-450

4.2.3 Video Noise

The test setup in Figure 4-1 was used to observe the video on the waveform monitor. The video was adjusted for sync-only, black picture. The 4.2 MHz low pass filter on the VM700 was enabled. The non-weighting function for video noise measurement was chosen. The video noise measured was –59 dB on the VM700 test set.

4.2.4 Video Frequency Response

The test setup shown in Figure 4-1 was used to record the detected video frequency response; the results are shown in Table 4-2 and Figure 4-3.

Note: For this test, the video signal was adjusted to provide a 50% average picture level and the video sweep signal level was set to cover the range from black to white picture.

Table 4-2. Detected Video Frequency Response

VIDEO FREQUENCY	RELATIVE RESPONSE
200 kHz	+2 dB
500 kHz	0 dB
750 kHz	0 dB
1.0 MHz	+0.2 dB
1.25 MHz	+0.1 dB
1.5 MHz	+0.1 dB
2.0 MHz	+0.4 dB
2.5 MHz	+0.4 dB
3.0 MHz	-.3 dB
3.5 MHz	0 dB
3.58 MHz	-.1 dB
4.1 MHz	0 dB
4.18 MHz	-1.0 dB
4.5 MHz	-20 dB
4.75 MHz	-35 dB
5.0 MHz	-42 dB

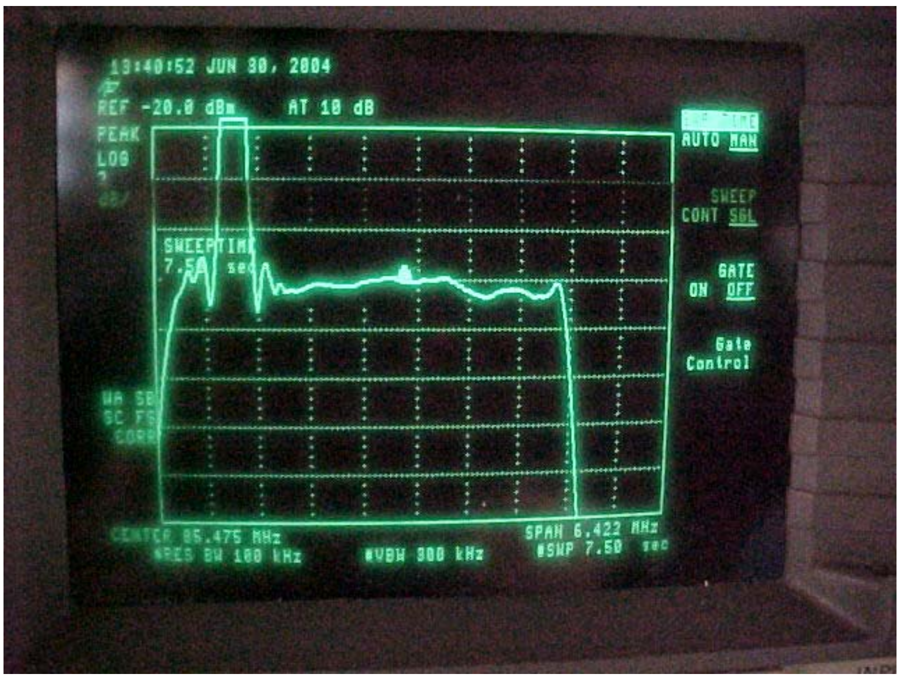

Figure 4-3. Graph of Detected Video Frequency Response

4.2.5 RF Sideband Response

The RF sideband response was recorded using the test setup shown in Figure 4-1. With the output power set to 2000 watts peak of sync, the Tektronix TSG95 video generator was adjusted to provide a cable sweep test signal and the RF sideband response was recorded. Data from this test is provided in Table 4-3.

Photographs of the spectrum analyzer results are shown in Figure 4-4.

Table 4-3. RF Sideband Response

OUTPUT FREQUENCY (MHz)	VIDEO FREQUENCY	RESPONSES
83.24	Carrier	--
83.44	+200 kHz	0 (reference)
83.49	+250	-0.4
83.74	+500	-4.0
83.99	+750	-4.4
84.24	+1000	-4.0
85.24	+2000	-4.0
86.24	+3000	-4.4
87.24	+4000	-4.4
87.74	+4500	-8.5
87.99	+4750	-24
88.24	+5000	-44
82.99	-250	-1.0
82.74	-500	-4.0
82.49	-750	-6.0
82.24	-1000	-7.5
81.99	-1250	-22
81.74	-1500	-38
81.49	-1750	-36
81.24	-2000	-38
80.24	-3000	-54
79.66	-3580	-60
79.24	-4000	-60
78.24	-5000	-60
88.99	+5750	-56

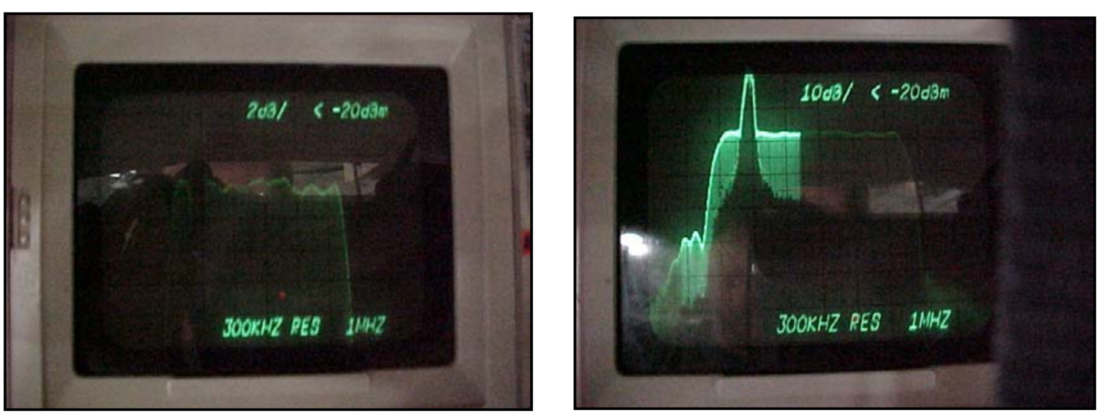

Figure 4-4. Spectrum Analyzer Results

4.2.6 Audio Modulation

The FM deviation and distortion was measured using the test setup shown in Figure 4-5.

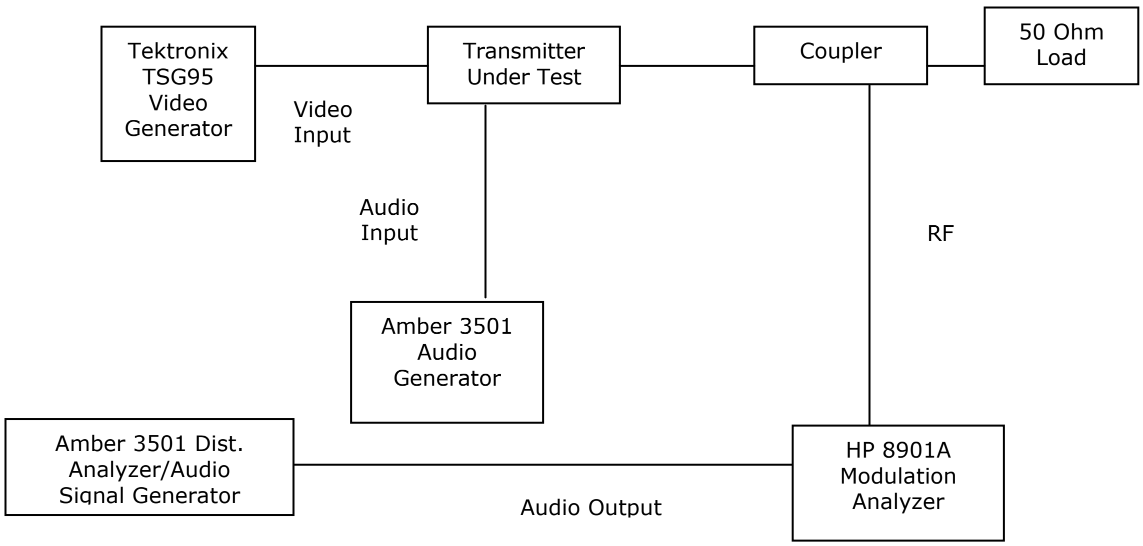

Figure 4-5. Test Setup for Measuring FM Deviation and Distortion

The results of measuring the FM deviation and distortion are shown in Table 4-4.

Table 4-4. Results of FM Deviation and Distortion Measurements

AUDIO FREQUENCY	DEVIATION 6.25-KHz DISTORTION	DEVIATION 12.5-KHz DISTORTION	DEVIATION 25-KHz DISTORTION	DEVIATION 40-KHz DISTORTION
100 Hz	0.22%	0.10%	0.04%	0.04%
1000 Hz	0.24%	0.13%	0.05%	0.06%
5000 Hz	0.28%	0.15%	0.09%	0.07%
15000 Hz	0.37%	0.23%	0.23%	0.10%

While maintaining ±25-KHz deviation, the audio input frequency and level were varied and the response was recorded. The results are shown in Table 4-5.

Table 4-5. Results of Varying the Audio Input Frequency and Level

AUDIO FREQUENCY	RESPONSE (RELATIVE TO 100 Hz)
50 Hz	-0.1 dB
100 Hz	0.0
400 Hz	+0.2 dB
1000 Hz	+0.8 dB
2000 Hz	+2.8 dB
5000 Hz	+8.2 dB
10000 Hz	+13.6 dB
15000 Hz	+16.7 dB

Note: The HP modulation analyzer provides a calibrated audio output level that is suitable for determining the FM deviation. De-emphasis can be switched on or off for this measurement; it was switched off for the purposes of these tests. For the distortion measurements, the de-emphasis was switched on (pursuant to 73.687.b.3[I] of the FCC rules).

4.2.7 AM and FM Noise

The AM noise and the FM noise were recorded using the test setup shown in Figure 4-5.

Dotted lines were used for the AM tests and solid lines were used for the FM tests with the following results:

- AM noise: -56 dB
- FM noise: -70 dB

4.3 Occupied Bandwidth

Using the test setup in Figure 4-6, with the transmitter operating at maximum power, photographs of the transmitter-occupied bandwidth spectrum were taken and are shown in Figures 4-7 and 4-8.

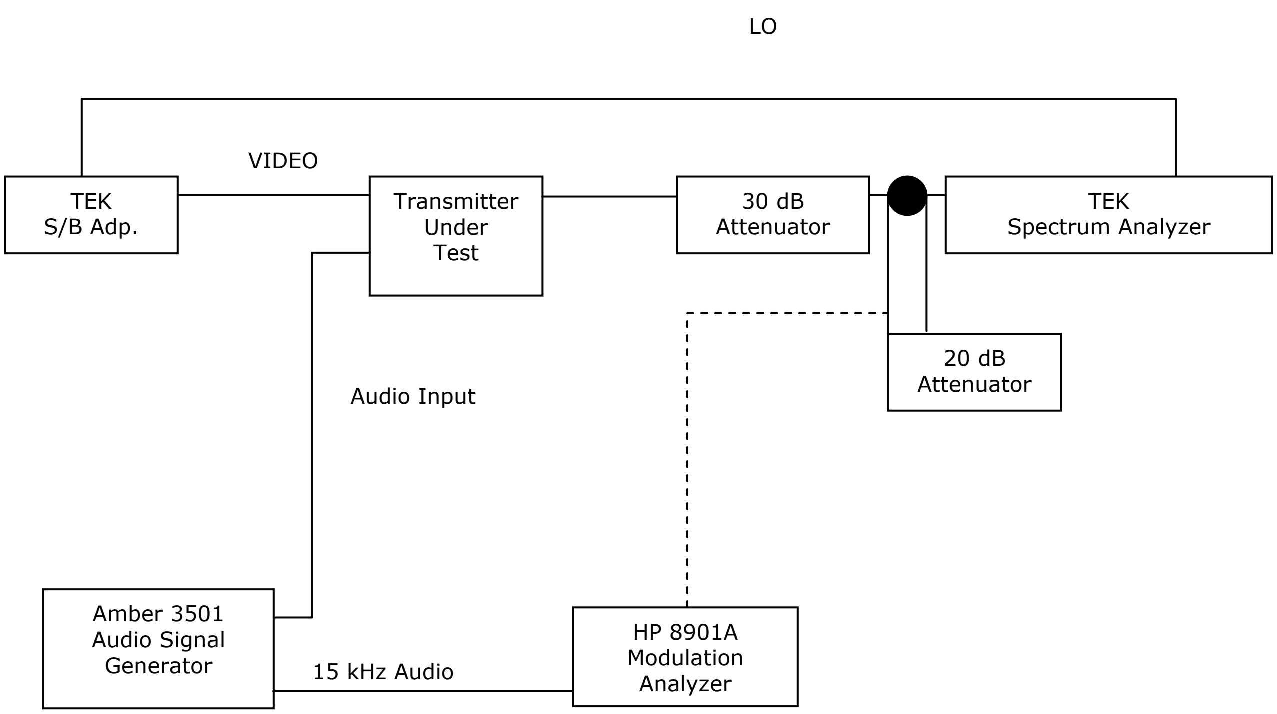

Figure 4-6. Test Setup for Occupied Bandwidth Spectrum Analysis

Note: Using the test setup shown in Figure 4-1, the visual modulation was adjusted to 87.5% at white with the modulated staircase waveform and the aural deviation adjusted to ±25 kHz (100%) with the 400-Hz audio tone.

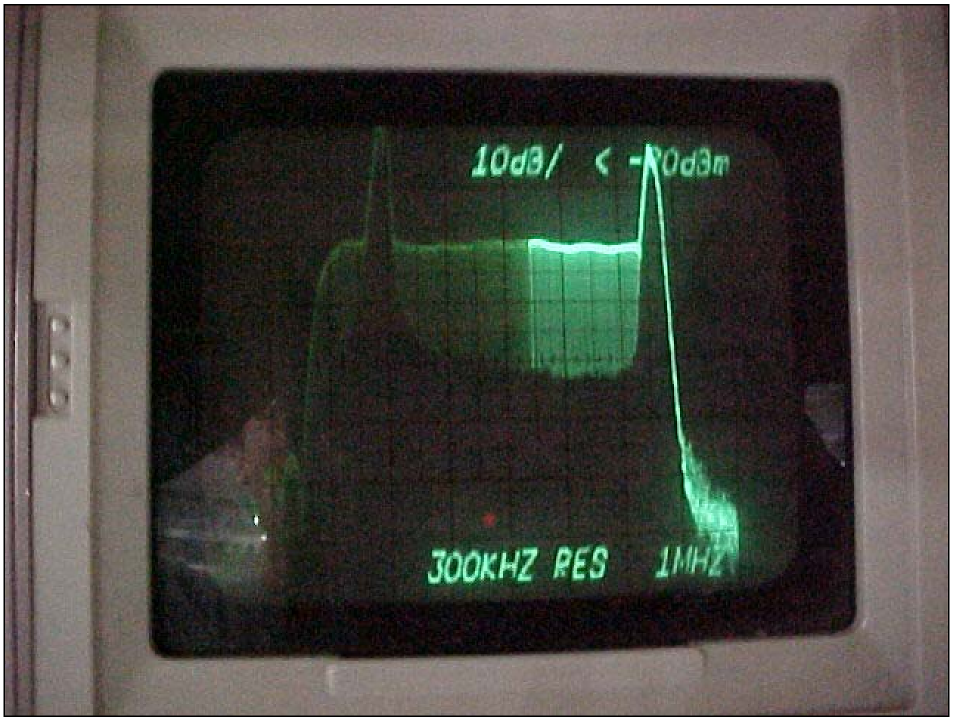

Figure 4-7. Channel-Occupied Bandwidth

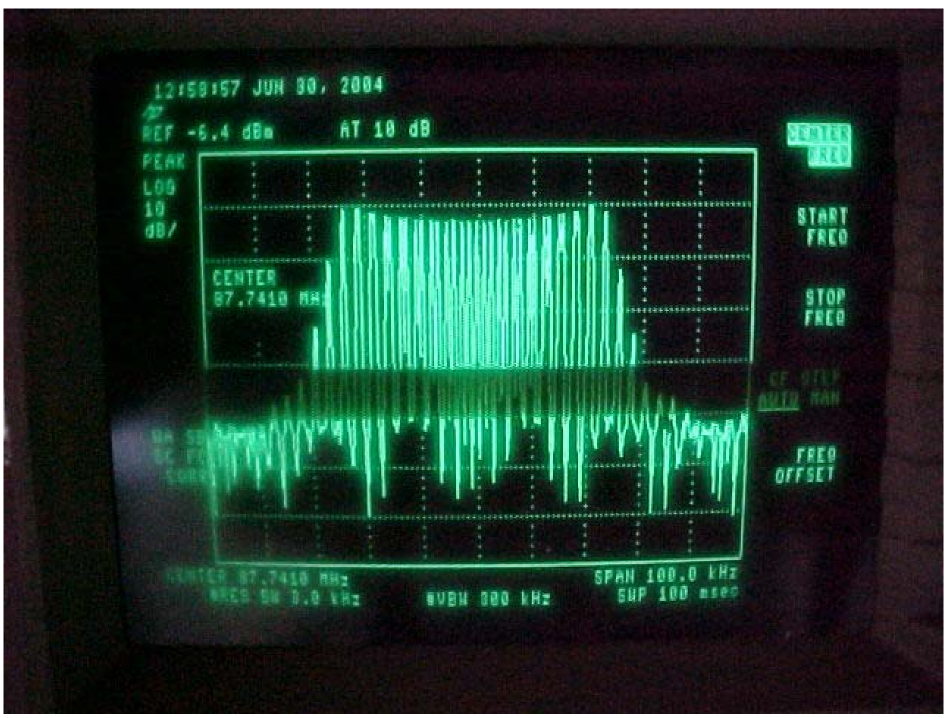

Figure 4-8. Aural Carrier-Occupied Bandwidth

4.4 Conducted Spurious Emissions

Using the test setup shown in Figure 4.1, the spectrum outside of the specified channel was observed and the data was recorded on all products above the 70-dB noise floor of the spectrum analyzer. This data is shown in Table 4-6 and is presented as graphs in Figures 4-9 and 4-10.

Table 4-6. Products Above the 70-dB Noise Floor of the Spectrum Analyzer

FREQUENCY (MHz)	SOURCE	PEAK LEVEL OBSERVED (dB)
174.74	Image Visual Carrier	None observed
170.24	Image Aural Carrier	None observed
128.99	Local Oscillator	None observed
74.24	-9-MHz Product	None observed
78.74	-4.5-MHz Product	None observed
87.74	Aural Carrier	-10
83.24	Visual Carrier	0
90.44	+7.2-MHz Product	None observed
94.04	+10.8-MHz Product	None observed
92.24	+9-MHz Product	None observed
91.32	+8.08-MHz Product	None observed
88.66	+5.42-MHz Product	-50
79.66	-3.58-MHz Product	None observed
175.48	Second Harmonic-Aural Carrier	None observed
166.48	Second Harmonic-Visual Carrier	None observed
263.22	Third Harmonic-Aural Carrier	None observed
249.72	Third Harmonic-Visual Carrier	None observed

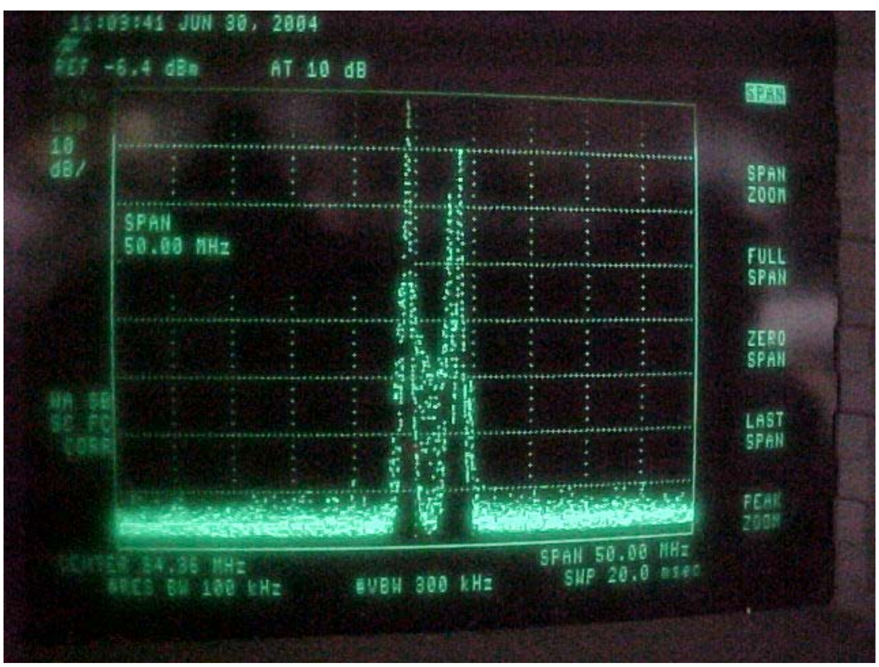

Figure 4-9. Products Above the 70-dB Noise Floor of the Spectrum Analyzer (1 of 2)

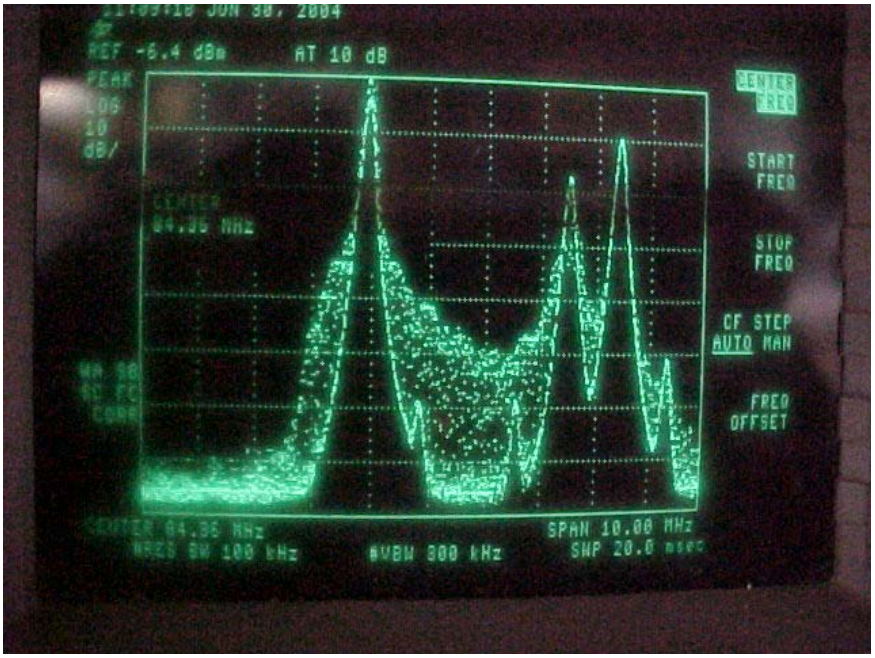

Figure 4-10. Products Above the 70-dB Noise Floor of the Spectrum Analyzer (2 of 2)

4.5 Radiated Emissions

Using the test setup shown in Figure 4-11, with the transmitter operating at full power, the spectrum analyzer was moved 20 meters from the transmitter and connected to a dipole antenna cut to 83 MHz. This antenna was oriented to maximize the received level and the data was recorded. The antenna was then cut to the local oscillator frequency and the second and third harmonic frequencies of the transmitter, and all of the signals received, were maximized by antenna orientation and their absolute levels were recorded.

With these various antennas, and with an adjustable length dipole for 40 to 300 MHz, the frequency spectrum from 40 MHz to 1,200 MHz was observed. The only measurable levels observed were at 83.24 MHz and 87.74 MHz. These levels are shown below in Table 4-8 and an analysis of the relative field and strength is provided in the following paragraphs.

Table 4-8. Measurable Levels Observed in Frequency Spectrum

FREQUENCY	**MEASURED LEVEL (INTO 50 Ω)**
83.24	-43 dBm
87.74	-52 dBm

The spectrum analyzer had a maximum sensitivity of -110 dBm during these tests.

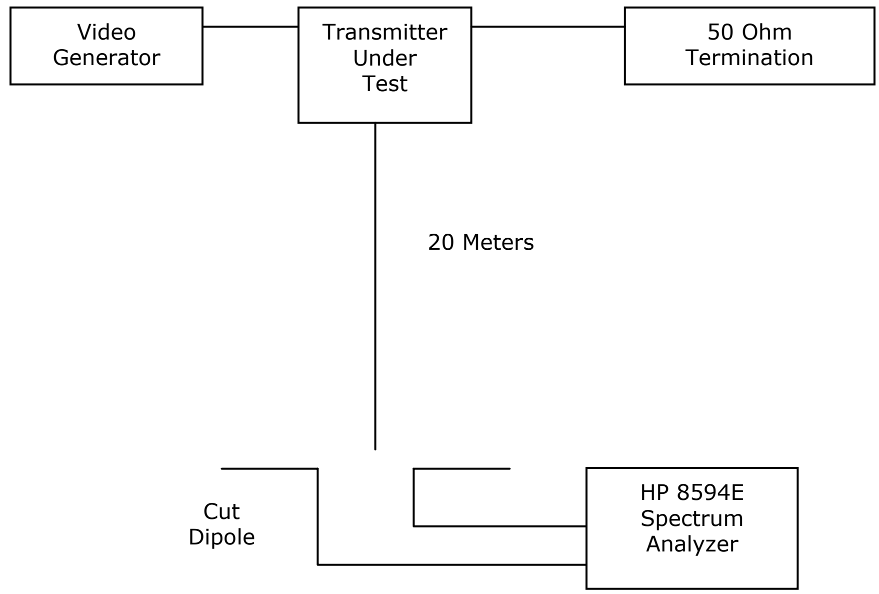

Figure 4-11. Test Setup for Measuring Radiated Emissions

Three levels were compared to the following reference level.

If all of the power of the transmitter was radiated by an isotropic radiator, the power density at 20 meters would be:

$$P = Pt/4\pi R^2 = 2000/4\pi \bullet (20)^2 = .4 \text{ w/m}^2$$

Using a dipole-transmitting antenna increases this by 1.64 to:

$$1.64 \times .4 = .66 \text{ w/m}^2$$

If a dipole-receive antenna (with a wavelength equal to the video carrier) is used to receive the signal, the area A of the antenna would be:

$$\text{where wavelength } \lambda = \frac{\text{(speed of light)}}{\text{(video carrier frequency)}} = \frac{3 \times 10^8}{83.24 \times 10^6} = 3.6 \text{ m}$$

$$A = \frac{1.64\lambda^2}{4\pi} = \frac{1.64(3.6)^2}{4\pi} = 1.69 \text{ m}^2$$

The received level would then be:

$$P_d \times A = .66 \text{ W/m}^2 \times 1.69 \text{ m}^2 = 1.1\text{W} = +30.5 \text{ dBm}$$

The receive levels at –43 dBm and –52 dBm were therefore at –73.5 dB and –82.5 dB relative to this level.

The receive levels were therefore at the relative levels shown in Table 4-9.

Table 4-9. Receive Levels

FREQUENCY	(REF = +30.5 dBm) RELATIVE MEASURED LEVEL
83.24	-73.5 dB
87.74	-82.5 dB

With the receive dipole antenna cut to 83.24 MHz, the cabinet radiation was also checked, within very close proximity to the trays of the transmitter, and the received level that was recorded, and is shown below, did not exceed a power density above -20 dBm:

$$Pr/A = 0.001 \ mw/cm^2$$

This level is far less than the current or proposed standard for safe radiation levels.

4.6 Frequency Stability

The output carrier frequencies are determined by the IF crystal oscillator, IF aural oscillator, and the crystal oscillator/multiplier of the exciter. Because the IF aural oscillator at 4.5 MHz is phase locked to the IF crystal oscillator at 45.75 MHz, the error in visual/aural separation is very small.

All three oscillators and the related phase-locked loop circuitry were placed in a temperature-controlled chamber and the temperature was varied from –30° C to +50° C. The chamber was slowly heated and the frequency was measured at 10° C increments up to +50° C. The oscillators were allowed to stabilize at each temperature before measurements were recorded.

Tables 4-10, 4-11, and 4-12 provide data on the individual oscillator frequencies; a calculation of the output frequency error indicates that the output frequency of the transmitter is well within the FCC tolerance for this service.

Table 4-10. Oscillator Data

TEMP (°C)	45.75-MHz CRYSTAL OSCILLATOR	4.5-MHz AURAL OSCILLATOR (PHASE LOCKED TO 45.75 MHz)	OVEN-CONTROLLED EXCITER CRYSTAL OSCILLATOR (MHz)	VISUAL/ AURAL FREQUENCY SEPARATION (MHz)
-30	45.750100	4.500011	81.124932	4.500011
-20	45.750061	4.500006	81.124968	4.500006
-10	45.750057	4.500006	81.124969	4.500006
0	45.750043	4.500005	81.124975	4.500005
10	45.750023	4.500003	81.124986	4.500003
20	45.750000	4.500000	81.125000	4.500000
30	45.749974	4.499998	81.125031	4.499998
40	45.749945	4.499994	81.125057	4.499994
50	45.749917	4.499996	81.125070	4.499996

Table 4-11. Calculated Frequency Errors

TEMP (°C)	45.75-MHz OVEN OSCILLATOR ERROR Δ kHz	DUAL OVEN OSCILLATOR ERROR Δ^1 KHz	TOTAL OUTPUT ERROR (kHz)
-30	0.1	-0.068	-0.644
-20	0.061	-0.032	-0.371
-10	0.057	-0.031	-0.305
0	0.043	-0.025	-0.243
10	0.023	-0.014	-0.135
20	0.0	0.0	0.0
30	-0.026	0.031	0.274
40	-0.055	0.057	0.511
50	-0.083	0.070	0.643

Table 4-12. Frequency Stability Versus Line Voltage

LINE VOLTAGE	45.75-MHz OSCILLATOR	4.5-MHz OSCILLATOR	OSCILLATOR (MHz)	TOTAL OUTPUT ERROR kHz
95V	45.750007	4.5000007	81.125000	0.01
115V	45.750007	4.5000007	81.125000	0.01
135V	45.750007	4.5000007	81.125000	0.01

4.7 Test Equipment

The test equipment that was used to analyze the Axcera-334B system is listed in Table 4-13.

Table 4-13. Test Equipment

MODEL	MANUFACTURER	DESCRIPTION	SERIAL #
TSG95	Tektronix	Video Generator	10242
1450-1	Tektronix	Demodulator	10028
435B	Hewlett-Packard	Power Meter	20151
DL271-2.5kW 8251	IFI INC.	50 Ω Termination	D129-1100
5253B	Hewlett-Packard	Frequency Counter	716-18295
VM-700A	Tektronix	Delay and Test Set	10808
ZFM-15	Mini-Circuits	Mixer	
3501	Amber	Distortion Analyzer	20014
1405	Tektronix	Sideband Adapter	20159
7623A	Tektronix	Spectrum Analyzer	20092
8901A	Hewlett-Packard	Modulation Analyzer	00553
8594E	Hewlett-Packard	Spectrum Analyzer	10118