Certification Submission for the
Model TTV1000ES
1000 Watt VHF Transmitter
per Part 74, Subpart G
of the FCC Rules and Regulations

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SECTION I

1.0 INTRODUCTION

1.1 General

This report contains data required for certification of the EMCEE Model TTV1000ES VHF Low Power Television Transmitter. This externally diplexed unit, which will be manufactured in quantity, is rated to provide 1000 watts peak visual and 100 watts average aural on any FCC specified VHF television channel extending from 54 to 216MHz (Ch.2 to Ch.13). The TTV1000ES is completely solid state and comprised of six different assemblies. The RF sections begin with a standard television modulator which supplies separate visual and aural modulated IF carriers (45.75MHz visual/41.25MHz aural) to the 2 watt Exciter drawer. Here the carriers are converted to the desired VHF frequencies, filtered and amplified to the 2W level. The television carriers are then sent to the Visual IPA/Aural Final Amplifier drawer where the signals are further amplified to the 50 watt visual and 160 watt aural levels. The 50 watt visual carrier is delivered to the Visual Final Amplifier drawer for final amplification while the 160 watt aural signal is brought to the Visual/Aural diplexer for combining with the 1000 watt visual output signal. Other assemblies in the TTV1000ES transmitter include the Power Supply/Control Status drawer which checks various transmitter circuits and distributes DC power throughout the transmitter. To separately supervise the output power of the visual and aural carriers, a Meter Panel is provided for monitoring and power calibration.

The data contained in this report was obtained from tests performed on an EMCEE production unit having an output frequency of VHF channel 10 (192-198MHz) using an EMCEE EM1 Modulator. However, to better serve our customers, EMCEE also wishes to use the Catel ATM1600 and the Scientific Atlanta 6340 as appropriate substitutes for the EM1. These modulator models, which also comply with Part 74, are used in all current EMCEE LPTV, MMDS and ITFS type accepted equipment requiring modulators. Also, we are requesting that the high stability (0.5PPM) Vectron CO-254D57 oscillator with a X2 or X4 multiplier be used in the TTV1000ES. This oscillator, replacing the standard synthesizer, will provide the customer with optional precision offset capability. Tests on both the oscillator and synthesizer are also found in this report.

In order to meet the requirements of Section 74.750(c)(5) of the FCC Rules, the TTV1000ES switches to a nonradiating condition in the absence of a modulating video signal. Additionally, an optional Code Identification Unit, capable of shifting the frequency of the transmitted carriers, may also be included to satisfy 74.750(c)(7) of the Rules.

A complete list of the test equipment utilized to obtain the certification data can be found in Section 1.3 of this report. Information relating to the description, operation and maintenance of the transmitter can be found in the TTV1000ES, EM1, ATM1600, and SA6340 Instruction Manuals.

1.2 Personnel Qualifications

The certification tests were conducted by Robert Nash, EMCEE VP/Director of Engineering. Mr. Nash has more than 23 years of experience in the development and testing of television transmitters and translators.

1.3 Test Equipment

1. Antenna, Adjustable Dipole Set, 30MHz to 1GHz, Model 3121, EMCO
2. Antenna, Conical Helix, 1-11GHz, Model ALN108B, AEL
3. Attenuator, 10dB, Model 766-10, Narda
4. Attenuator, 20dB, Model 766-20, Narda
5. Attenuator, 30dB, Model 766-30, Narda
6. Distortion Measurement Set, Model 339A, Hewlett Packard
7. Demodulator, Model 1450, Tektronix
8. Directional Coupler, 30dB, Model 3020-30, Narda
9. Diode Detector, 50 ohm, Model 423A, Hewlett Packard
10. Dummy Load, 50 ohm, 500 Watt, Model 785-30, Narda
11. Envelope Delay Measuring Set, Model 201/1, Shibasoku
12. Environmental Chamber, Tenny Jr., Tenny Engineering
13. Frequency Counter, Model 5386A, Hewlett Packard
14. Mixer, Model ZAD-2, 37023, Mini Circuits
15. Modulator, Model EM1, EMCEE
16. Multimeter, Digital, Model E2378A, Hewlett Packard
17. NTSC Vectorscope, Model 520, Tektronix
18. Power Meter, Model 435A, Hewlett Packard
19. NTSC Video Generator, Type 149A, Tektronix
20. Spectrum Analyzer, Model 8595E, Hewlett Packard
21. Waveform Monitor, Model 1485R, Tektronix
22. 1000 Watt VHF Television Transmitter, Model TTV1000ES, EMCEE

1.4 Active Device List

The following is a complete listing of all the active devices used in the EMCEE Model TTV1000ES VHF Television Transmitter. The devices are grouped together as seen on each specific schematic or interconnection diagram. Given with each device is its schematic designator, EMCEE part number and function.

DEVICE	PART #/DESIGNATOR	FUNCTION
IF AGC AMPLIFIER Schematic Diagram C331-37		
Diode	1B70/CR1, CR2, CR4, CR9	RF Attenuator
Diode	1B05/VR1	Voltage Regulator
Transistor	2B28/Q1	RF Amplifier
Transistor	2B06/Q2, Q3	RF Amplifier
LINEARIZER Schematic Diagram 30367078		
Diode	1B162/CR1-CR8	RF Switch
Transistor	2B08/Q2, Q4, Q5	RF Amplifier
Transistor	2B09/Q1, Q3	RF Amplifier
POWER ADJUST Schematic Diagram 10331255		
Diode	1B142/CR1, CR2, CR3	RF Attenuator
REFERENCE OSCILLATOR Schematic Diagram 10368037		
TCXO	RTX0771AD/G1	Oscillator
Integrated Circuit	3B130/U1	RF Amplifier

DEVICE	PART #/DESIGNATOR	FUNCTION
VHF SYNTHESIZER Schematic Diagram 30362427 (Band I)		
Integrated Circuit	3B160/U4	Reference Divider
Integrated Circuit	MC12028AD/U2	Dual Prescaler
Integrated Circuit	3B161/U1	Synthesizer
Integrated Circuit	3B149/U3	Loop Filter
Integrated Circuit	3B181/U6	Feedback Amplifier
Integrated Circuit	SNA586/U5	RF Amplifier
VCO	V110SC01/G1	Oscillator
VHF SYNTHESIZER Schematic Diagram 30362003 (Band III)		
Integrated Circuit	3B160/U4	Reference Divider
Integrated Circuit	3B190/U2	Dual Prescaler
Integrated Circuit	3B161/U1	Synthesizer
Integrated Circuit	3B149/U3	Loop Filter
Integrated Circuit	3B181/U6	Feedback Amplifier
Integrated Circuit	3B151/U5	RF Amplifier
VCO	V220S015/G1	Oscillator
X2 MULTIPLIER (With Vectron Oscillator - Band I) Schematic Diagram B280-35		
Integrated Circuit	3B09/LL1	Voltage Regulator
Transistor	2B03/Q1	RF Amplifier
Transistor	2B06/Q2	RF Amplifier
X4 MULTIPLIER (With Vectron Oscillator - Band III) Schematic Diagram C331-24		
Integrated Circuit	3B09/U1	Voltage Regulator
Transistor	2B03/Q1	RF Amplifier
Transistor	2B06/Q2, Q3	RF Amplifier

DEVICE	PART #/DESIGNATOR	FUNCTION
LO SPLITTER/AMPLIFIER Schematic Diagram 30362024		
Diode	SBL1-2MH/MX1, MX2	Mixer
Integrated Circuit	3B192/U3, U4	RF Amplifier
Integrated Circuit	3B185/U1, U2	RF Amplifier
2 WATT VHF AMPLIFIER Schematic Diagram 30362257		
Integrated Circuit	MAR7SM/U1	RF Amplifier
Integrated Circuit	MAV11SM/U2	RF Amplifier
Integrated Circuit	BGX885/U3	RF Amplifier
Transistor	MRF342/Q1	RF Amplifier
Transistor	MJE371/Q2	Current Regulator
50W VHF AMPLIFIER Schematic Diagram 30362252 (Band I) Schematic Diagram 30362046 (Band III)		
Transistor	DU28200M(2B146)/Q1	RF Amplifier
Transistor	MJE371(2B25)/Q2, Q3	Voltage Regulator
AURAL DRIVER AMPLIFIER Schematic Diagram 30362035		
Transistor	MRF173CQ/Q1	RF Amplifier
Transistor	2N3906/Q2	Voltage Regulator
AURAL FINAL AMPLIFIER Schematic Diagram 20362269 (Band I) Schematic Diagram 30362014 (Band III)		
Transistor	DU28200M(2B146)/Q1	RF Amplifier
300 WATT FINAL VISUAL AMPLIFIER Schematic Diagram 20362275 (Band I) Schematic Diagram 30362367 (Band III)		
Integrated Circuit	MC1723CD/U1	Voltage Regulator
Transistor	MRF151G/Q1, Q2	RF Amplifier

1.5 Certification of Data

Having supervised the tests and compilation of information in this report, I certify that all statements and test results submitted for certification of the EMCEE TTV1000ES are true and correct to the best of my knowledge.

Robert G. Nash
VP/Director of Engineering

SECTION II
TEST PROCEDURES AND DATA

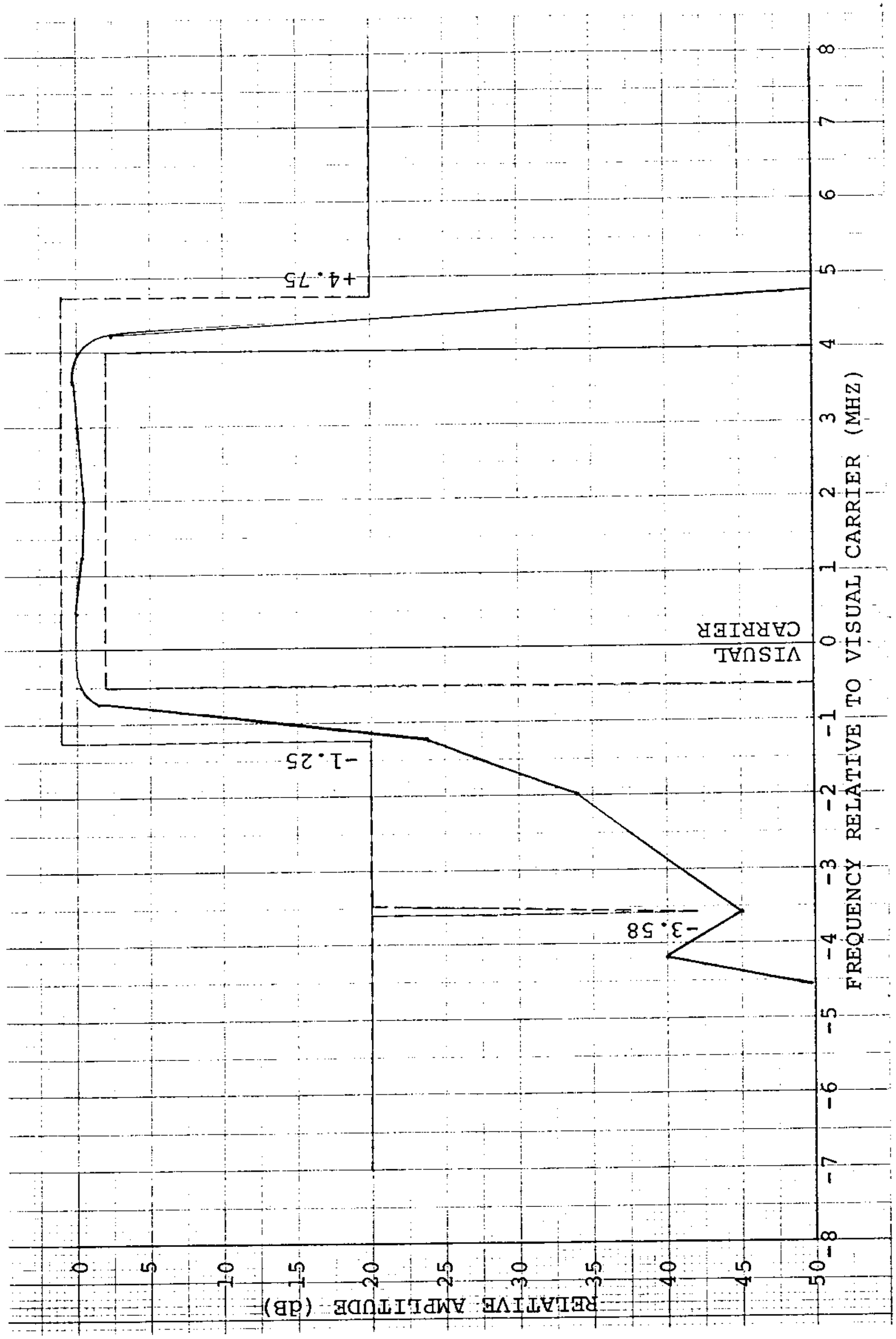
2.1 Frequency Response [73.687(a)(3)]

Test Equipment Setup	Figure 2–1A
Visual Output Power	1000 watts peak sync
% Video Modulation	87.5%
Type Video Modulation	Standard sync with a variable frequency sine wave occupying the interval between pulses. Sine-wave axis was maintained at 50% of the peak sync amplitude. Sine-wave amplitude was held constant at less than 75% of the peak output voltage.
Aural Output Power	0 watts
Method of Measurement	Sine-wave frequency was varied through the video range. The data recorded was relative to the 200kHz sideband amplitude designated as 0dB.

FREQUENCY RESPONSE DATA

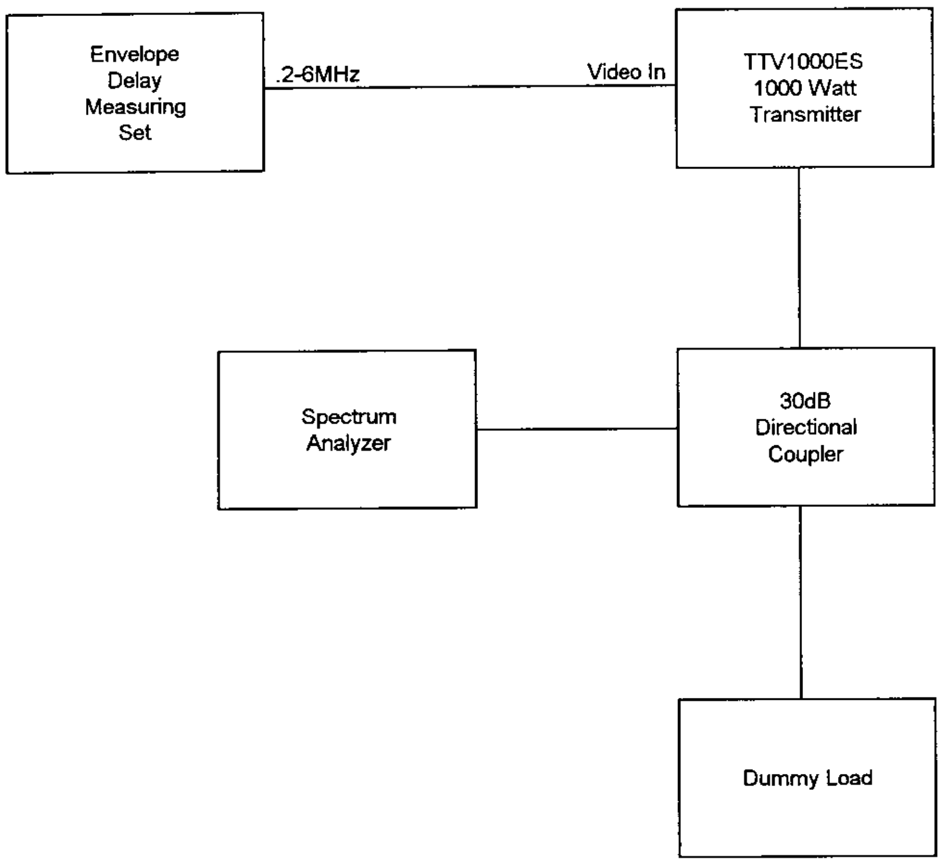
REFERENCE LEVEL: 0dB = 200kHz sideband amplitude

OUTPUT FREQ. (MHz) CHANNEL 10	SIDEBANDS	RELATIVE OUTPUT (dB) CHANNEL 10
188.50	-4.75MHz	-55.0
189.07	-4.18MHz	-40.0
189.67	-3.58MHz	-45.0
191.25	-2.00MHz	-34.0
192.00	-1.25MHz	-24.0
192.50	-750kHz	-1.5
192.75	-500kHz	-0.3
193.25	VISUAL CARRIER	
193.45	REFERENCE SIDEBAND	0.0
193.75	+500kHz	0.0
194.50	+1.25MHz	-0.4
195.25	+2.00MHz	-0.6
196.25	+3.00MHz	-0.1
196.83	+3.58MHz	+0.3
197.43	+4.18MHz	-2.4
198.00	+4.75MHz	-48.0



AMPLITUDE VS. FREQUENCY CHARACTERISTICS

Figure 2–1



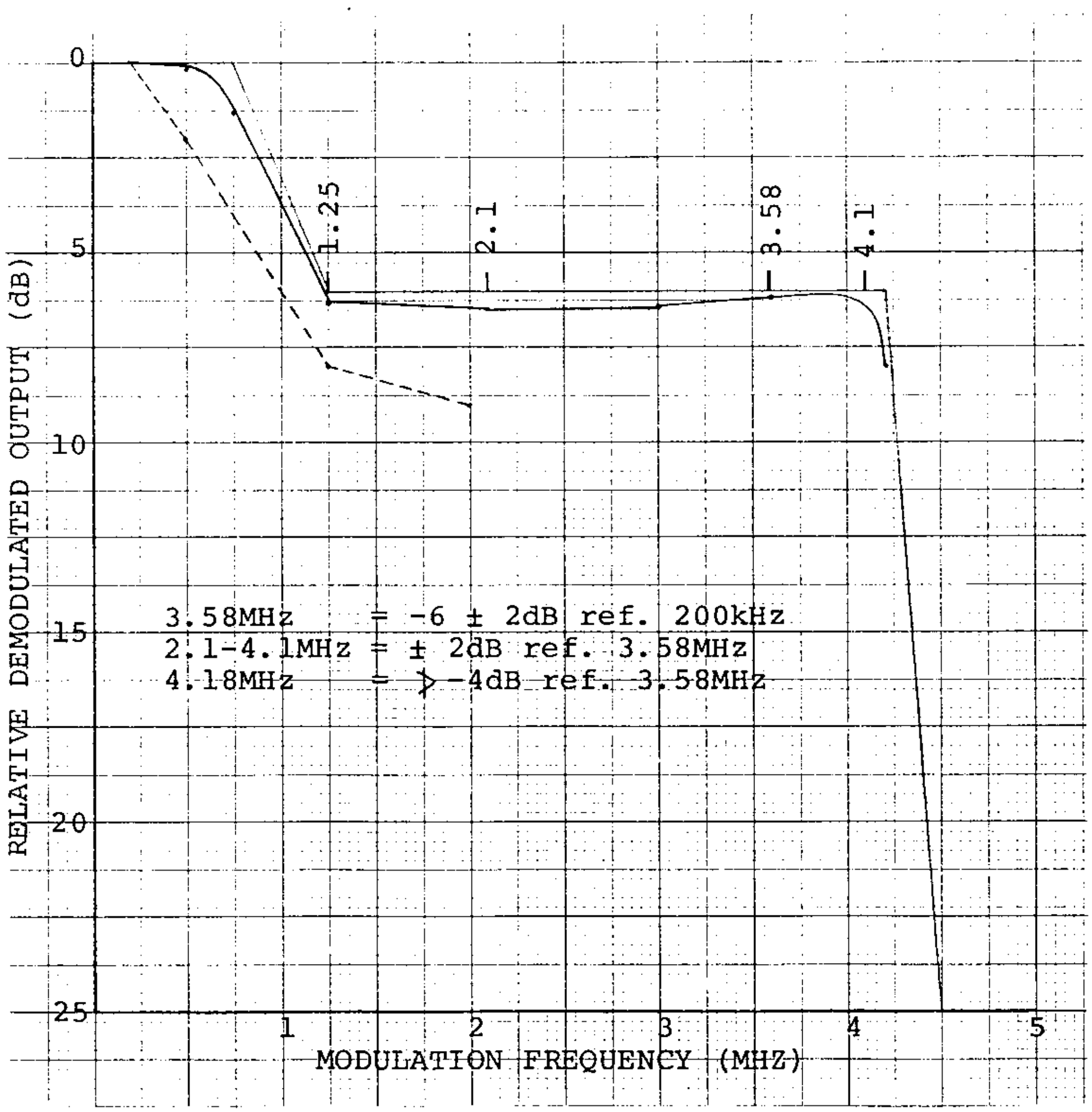
FREQUENCY RESPONSE TEST SETUP
Figure 2-1A

2.2 Attenuation Characteristics [73.687(a)(2)]

Test Equipment Setup	Figure 2-2A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard sync with a variable frequency sine wave occupying the interval between pulses. Sine-wave axis was maintained at 50% of the peak sync amplitude. Sine-wave amplitude was held constant at less than 75% of the peak output voltage.
Aural Output Power	0 watts
Method of Measurement	Sine-wave frequency was varied through the video range. The data recorded was relative to the 200kHz sideband amplitude designated as 0dB.

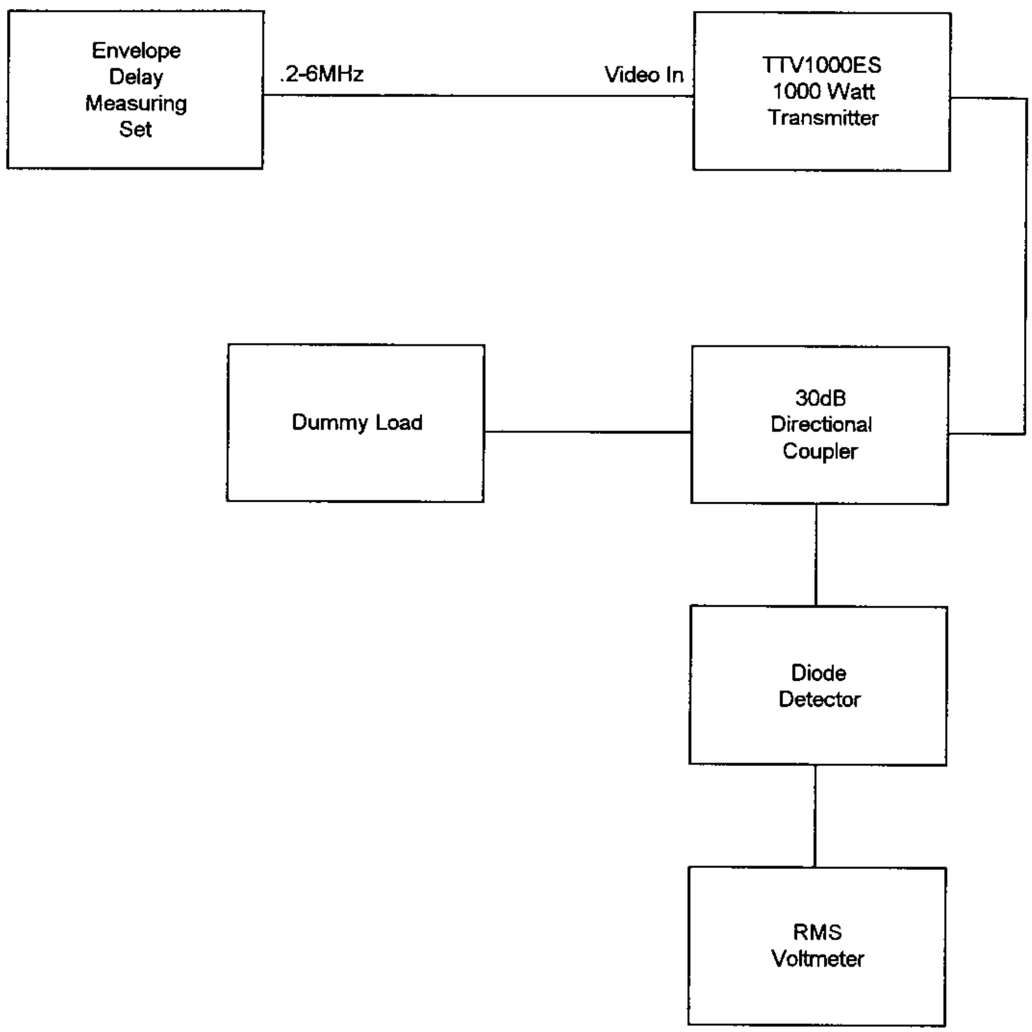
ATTENUATION CHARACTERISTICS DATA

MODULATION FREQ. (MHz)	RECTIFIED OUTPUT (dB)
0.20	0
0.50	-0.2
0.75	-1.3
1.25	-6.3
2.10	-6.6
3.00	-6.4
3.58	-6.2
4.18	-8.0



ATTENUATION CHARACTERISTIC CURVE

Figure 2–2



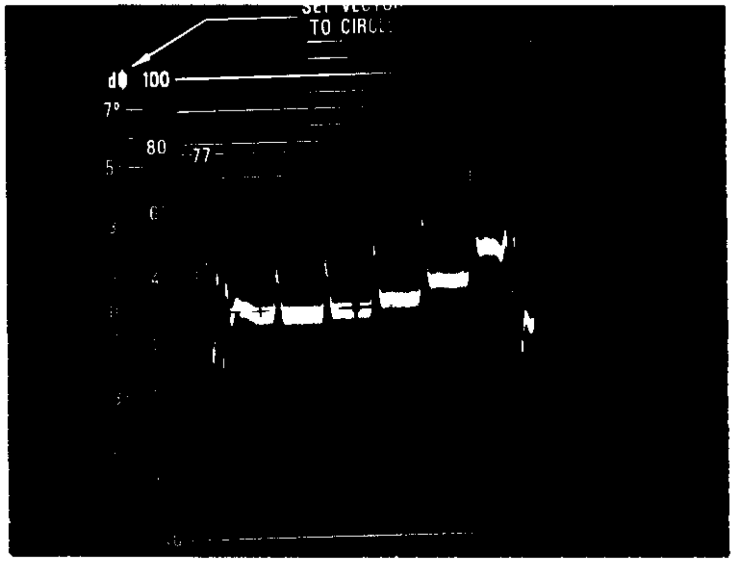
ATTENUATION CHARACTERISTICS TEST SETUP
Figure 2-2A

2.3 Differential Phase and Gain [73.682(a)(20)(vii)]

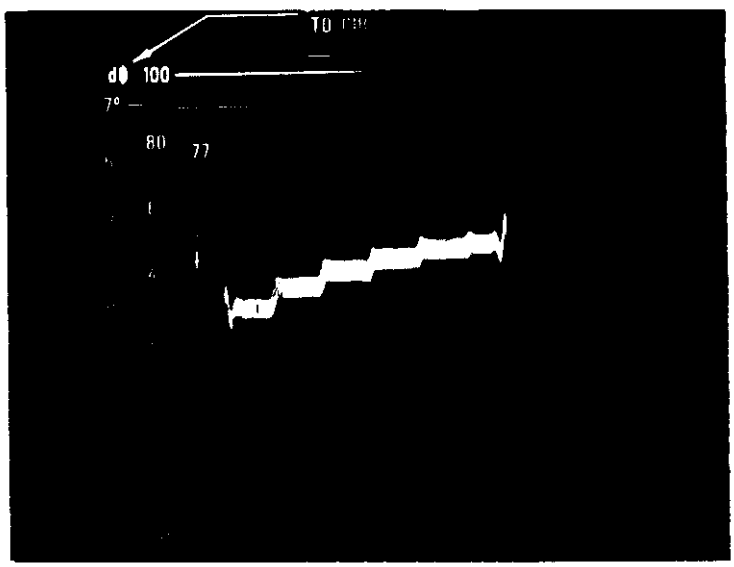
Test Equipment Setup	Figure 2–3A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 5-riser stairstep modulated with 3.58MHz color subcarrier
Aural Output Power	100 watts average
% Aural Modulation	0%
Method of Measurement	Data was taken from the demodulated output viewed on a vectorscope after passing through an internal chroma filter.

DIFFERENTIAL PHASE AND GAIN DATA

Differential Phase	=	+2.5°
Differential Gain	=	+3.8%

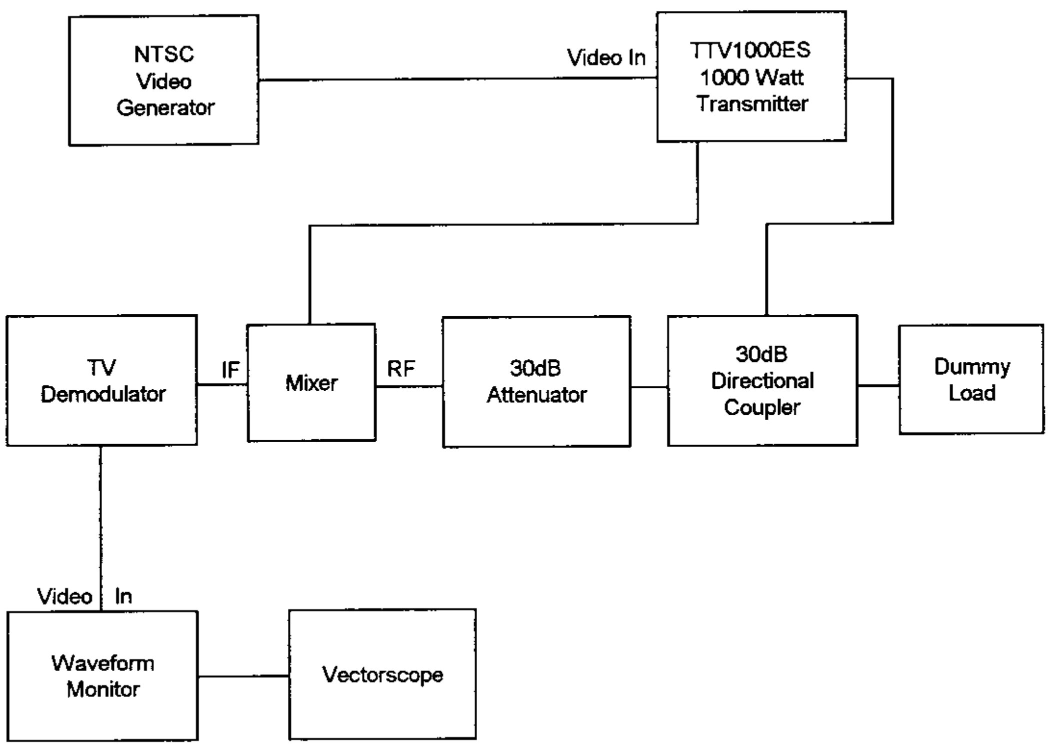


DIFFERENTIAL PHASE – +2.5°



DIFFERENTIAL GAIN – 3.8%

Figure 2–3



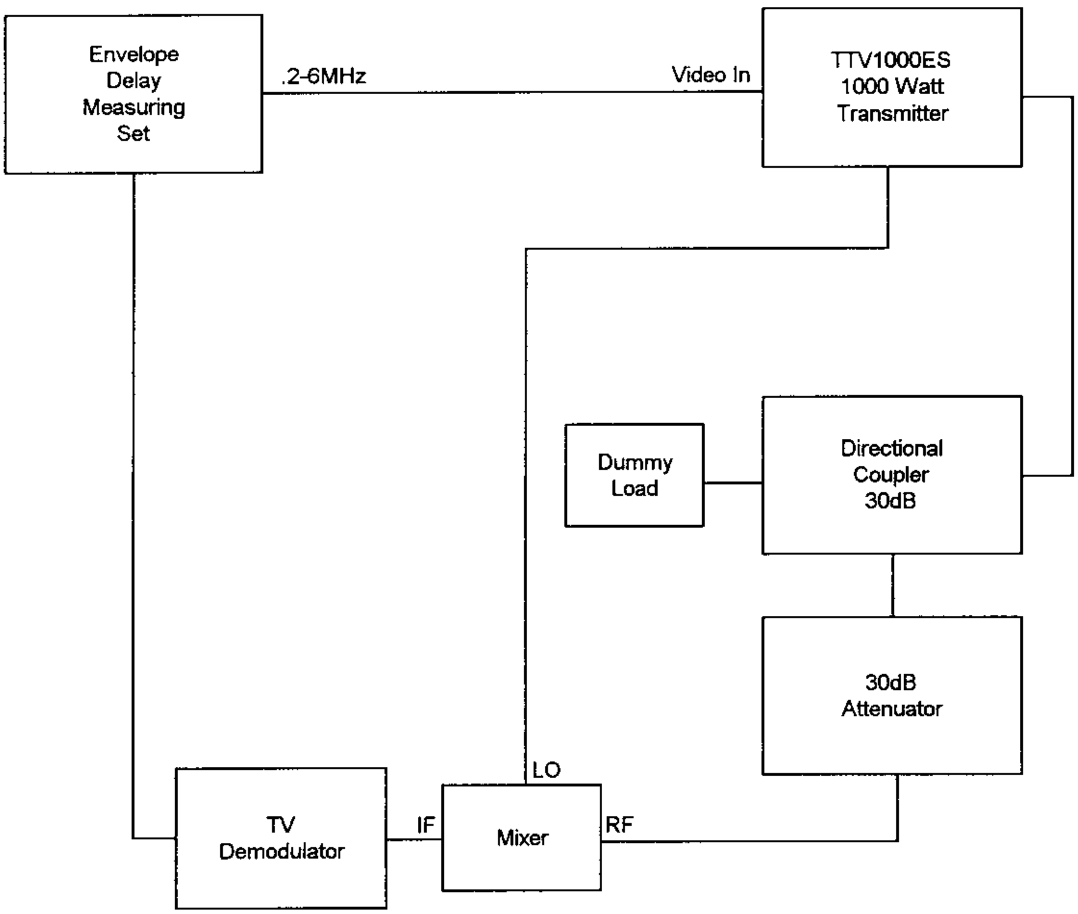
<u>DIFFERENTIAL PHASE AND GAIN TEST SETUP</u>
Figure 2-3A

2.4 Envelope Delay [73.687(a)(5)]

Test Equipment Setup	Figure 2–4A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	A variable frequency constant amplitude sine-wave with a 200kHz reference signal provided by the envelope delay test equipment
Aural Output Power	0 watts
Method of Measurement	The sine-wave was varied through the video range and the delay data was read from the CRT display of the Envelope Delay Measuring Set.

ENVELOPE DELAY VERSUS FREQUENCY DATA

FREQUENCY	ENVELOPE DELAY (ns)
200kHz	0
500kHz	-10
1.0MHz	-30
1.5MHz	-30
2.1MHz	-60
2.5MHz	-30
3.0MHz	-60
3.2MHz	-105
3.4MHz	-140
3.58MHz	-170
4.0MHz	-280
4.18MHz	-250



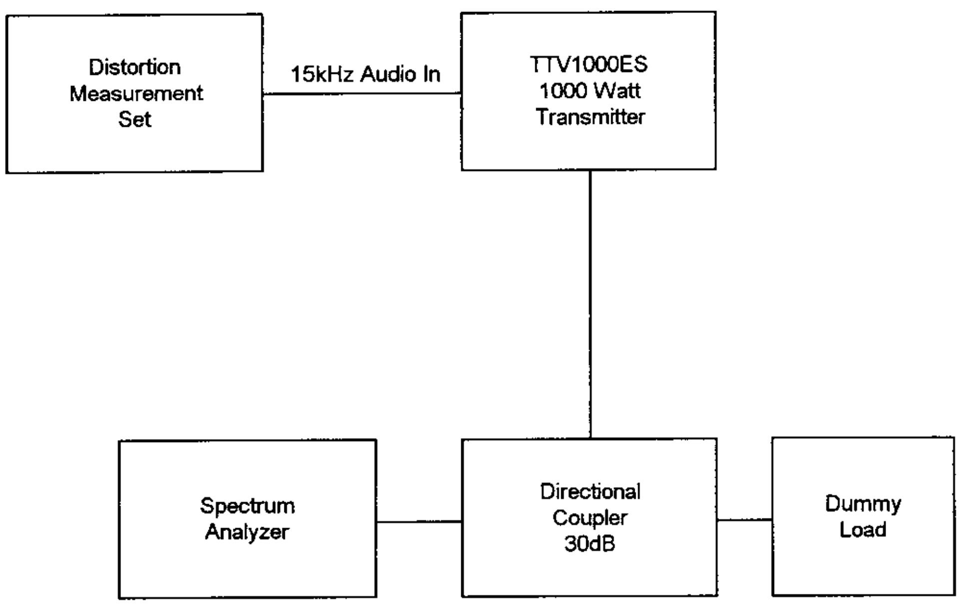
ENVELOPE DELAY TEST SETUP
Figure 2-4A

2.5 Aural Occupied Bandwidth [2.989(e)(5)]

Test Equipment Setup	Figure 2–5A
Visual Output Power	1000 watts peak
% Video Modulation	0%
Aural Output Power	100 watts average
% Aural Modulation	85% (21.25kHz)
Aural Modulation Signal	15kHz
Method of Measurement:	Spectrum Analyzer set at 3kHz resolution, 15kHz/division frequency span and 5ms/division sweep speed. Bandwidth was read at 0.5% (-23dB) of mean power.

AURAL OCCUPIED BANDWIDTH DATA

Bandwidth ≈ 90kHz



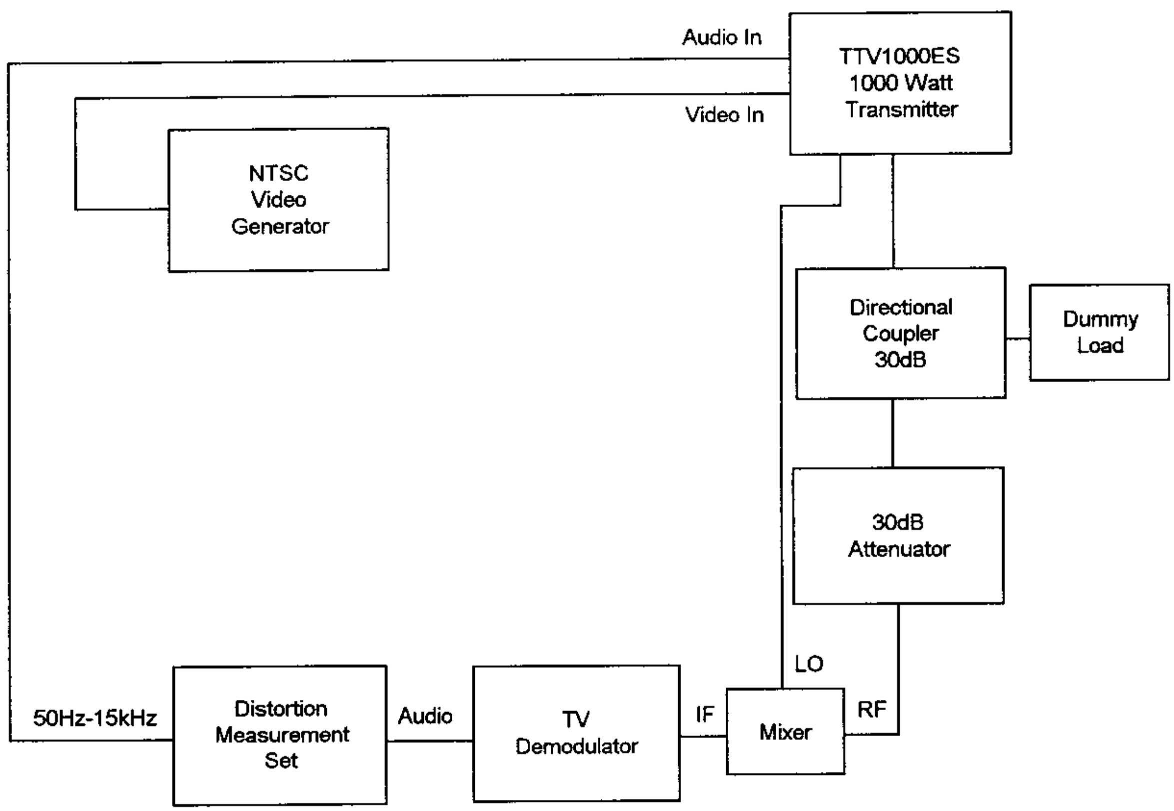
<u>AURAL OCCUPIED BANDWIDTH TEST SETUP</u>
Figure 2-5A

2.6 Aural Distortion [73.687(b)(3)]

Test Equipment Setup	Figure 2–6A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	100 watts average
% Aural Modulation	100%, 50%, 25%
Aural Modulation Signal	Variable audio sine-wave from 50Hz to 15kHz
Method of Measurement	The aural modulation frequency was varied at three different % modulation levels and a distortion measurement was noted for each frequency-modulation combination.

AURAL DISTORTION DATA

FREQUENCY	% DISTORTION		
Hz	100% MOD	50% MOD	25% MOD
50	0.37	0.40	0.44
100	0.33	0.34	0.38
400	0.29	0.31	0.33
1,000	0.25	0.29	0.28
5,000	0.24	0.32	0.38
7,500	0.30	—	—
10,000	0.37	—	—
15,000	0.44	—	—



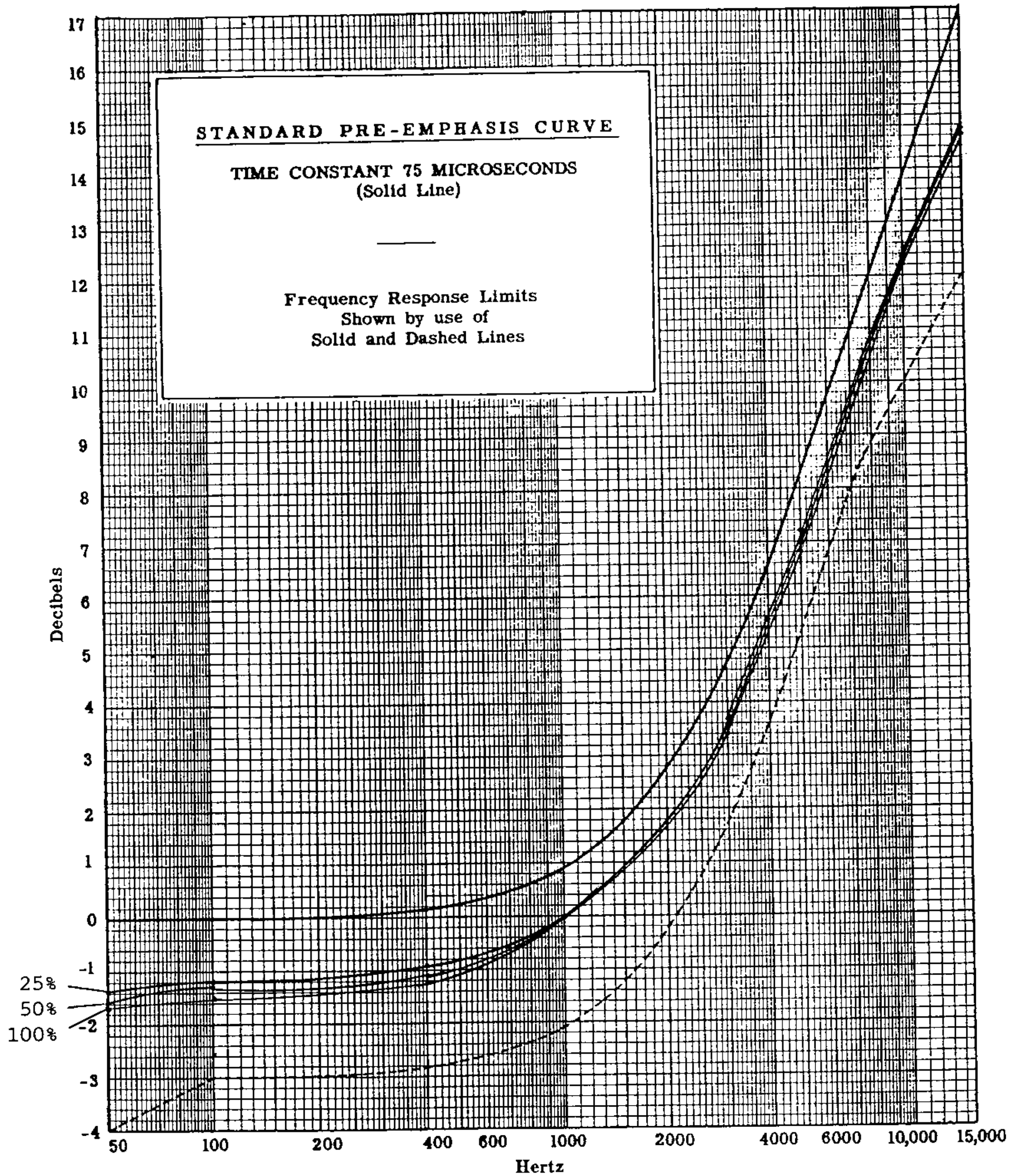
<u>AURAL DISTORTION TEST SETUP</u>
Figure 2-6A

2.7 Aural Frequency Response [73.687(b)(2)]

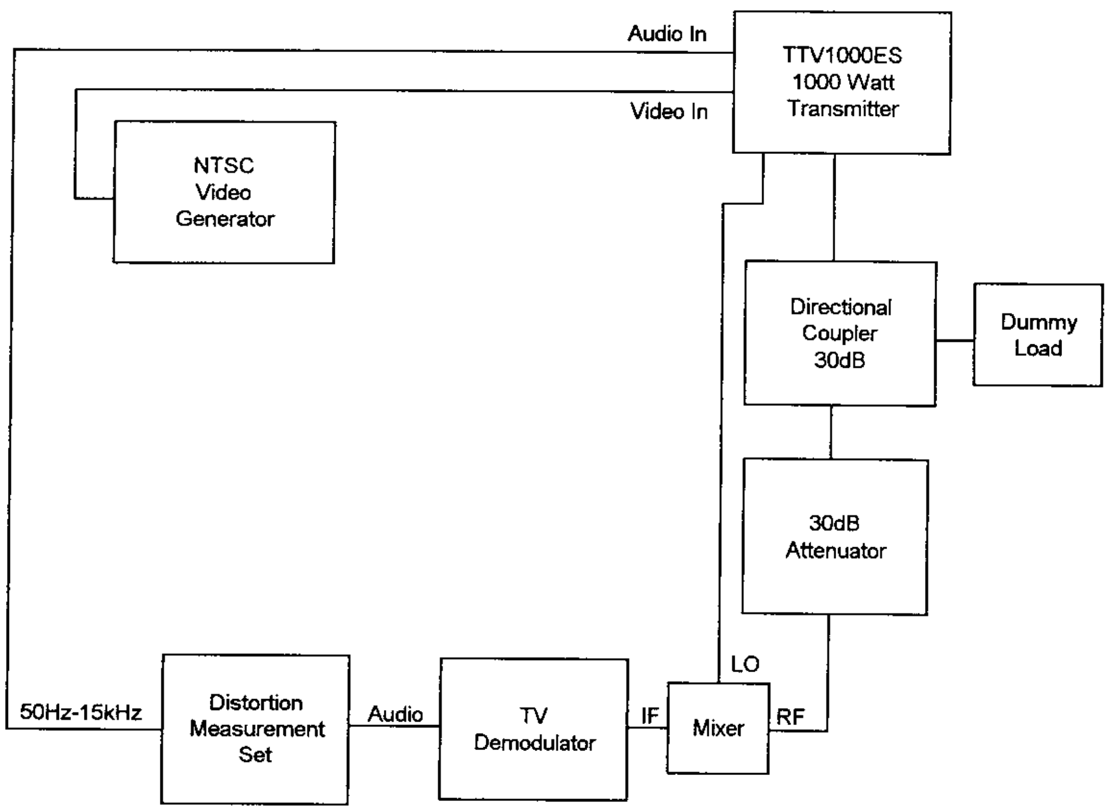
Test Equipment Setup	Figure 2–7A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	100 watts average
% Aural Modulation	100%, 50%, 25%
Aural Modulation Signal	50 to 15,000Hz
Method of Measurement	The audio input was adjusted at each audio frequency to maintain a constant modulation level. Modulation input variations were plotted directly from the dB scale of the Distortion Test Set Meter.

AURAL FREQUENCY RESPONSE DATA

FREQUENCY	OUTPUT LEVEL RELATIVE TO 1000Hz (dB)		
Hz	100% MOD	50% MOD	25% MOD
50	-1.7	-1.6	-1.4
100	-1.5	-1.3	-1.2
400	-1.2	-1.1	-0.9
1000	0	0	0
3000	+3.4	+3.6	+3.7
5000	+6.8	+7.0	+7.2
7500	+10.0	+10.2	+10.4
10000	+12.2	+12.3	+12.5
15000	+14.6	+14.7	+14.8



AURAL FREQUENCY RESPONSE
Figure 2–7



AURAL PREEMPHASIS TEST SETUP
Figure 2-7A

2.8 Amplitude Modulation Noise [73.687(b)(5)]

Test Equipment Setup	Figure 2–8A
Visual Output Power	0 watts
Aural Output Power	100 watts average
% Aural Modulation	100%
Aural Modulation Signal	400Hz
Method of Measurement	AC RMS and DC readings were taken to compute the signal to noise ratio shown below. An RC network was used with the RMS voltmeter to roll off noise above 15kHz.

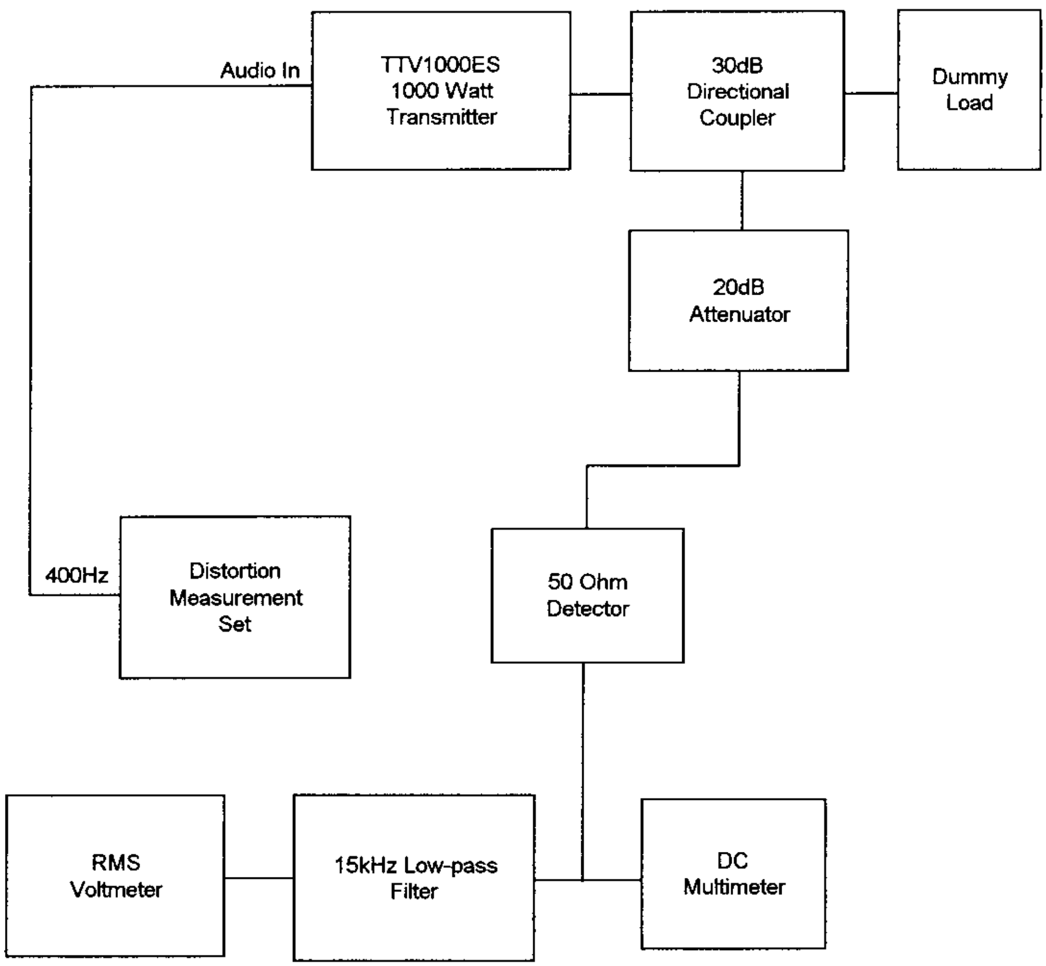
AM NOISE DATA

AC Output = 3.3mV

DC Output = 2.5V

$$\text{AM Noise} = 20 \log \frac{\text{AC Output}}{\text{DC Output}} = \frac{.0033\text{V}}{2.5\text{V}}$$

AM Noise = -57.6dB



AM NOISE TEST SETUP
Figure 2-8A

2.9 Frequency Modulation Noise [73.687(b)(4)]

Test Equipment Setup	Figure 2–9A
Visual Output Power	0 watts
Aural Output Power	100 watts average
% Aural Modulation	100% and 0%
Aural Modulation Signal	400Hz
Method of Measurement	With aural modulation applied, a reading was obtained from the Distortion Measurement Set RMS voltmeter. With modulation removed, a new reading was recorded. The signal to noise calculation was checked against the dB scale of the RMS voltmeter.

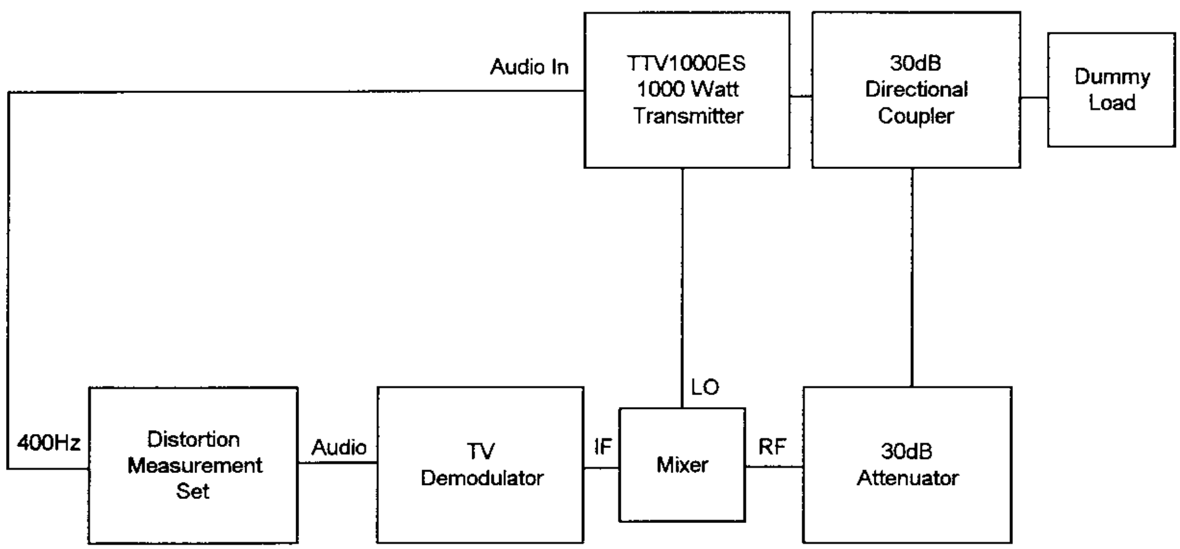
FM NOISE DATA

Detected Output w/o modulation = 1.6mV

Detected Output w/modulation = 2.4V

$$\text{FM Noise} = 20 \log \frac{\text{Output w/o modulation}}{\text{Output w/modulation}} = \frac{.0016\text{V}}{2.4\text{V}}$$

FM Noise = -63.5dB



FM NOISE TEST SETUP
Figure 2-9A

2.10 Antenna Terminal Radio Frequency Voltage [74.936(c)(iii)]

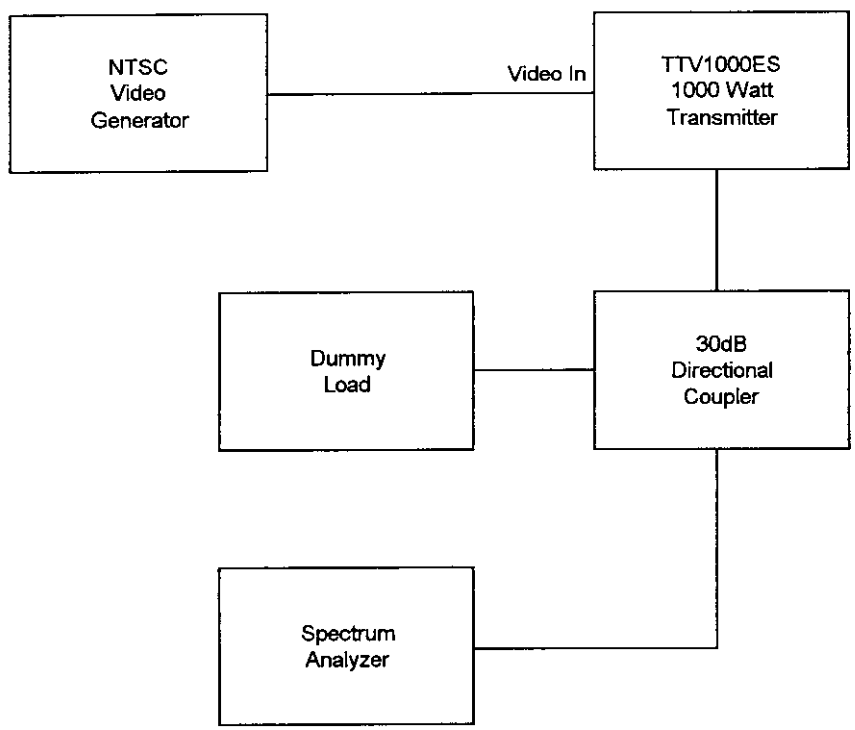
Test Equipment Setup	Figure 2–10A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	100 watts average
% Aural Modulation	0%
Method of Measurement	The spectrum analyzer display was adjusted for a zero reference level at the visual carrier using the following settings:

Frequency Span/Division	–	1MHz
Resolution Bandwidth	–	30kHz
Time/Division	–	20ms
Input Attenuation	–	30dB
Reference Level	–	-1dBm
Video Filter	–	Off

All emissions were checked relative to peak sync from 0 to 10.0GHz. Those emissions below -80dB were not noted.

ANTENNA TERMINAL RF VOLTAGE DATA

FREQUENCY (MHz)	LEVEL (dB relative to peak visual)	
193.25	0dB	Visual Carrier
197.75	-10dB	Aural Carrier
188.75	-65dB	Visual Carrier -4.5MHz
202.25	-72dB	Aural Carrier +4.5MHz
184.25	-78dB	Visual Carrier -9.0MHz
206.75	———	Aural Carrier +9.0MHz
239.00	-68dB	Visual Carrier +45.75 (LO)
386.50	-64dB	Visual 2nd Harmonic
395.50	-70dB	Aural 2nd Harmonic



ANTENNA TERMINAL RF VOLTAGE TEST
Figure 2-10A

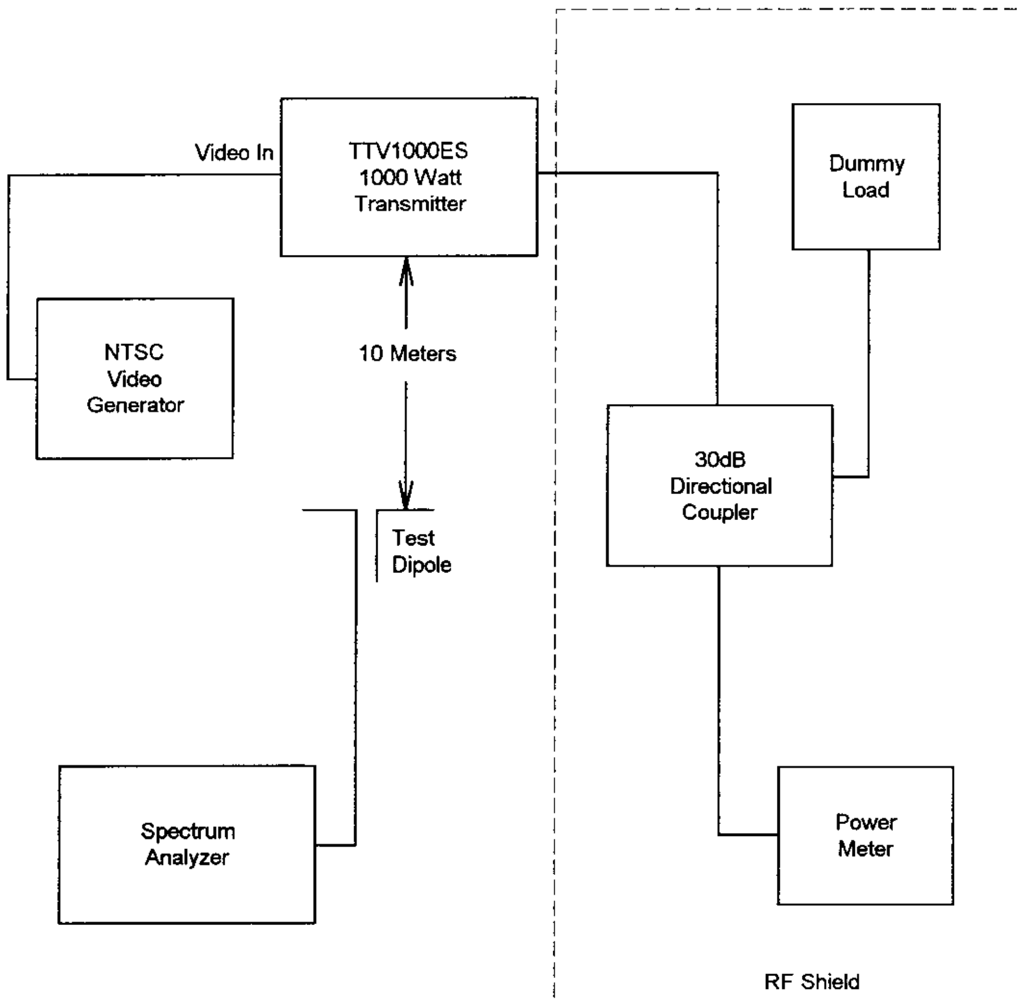
2.11 Spurious Radiation Field Strength [2.993]

Test Equipment Setup	Figure 2–11A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	100 watts average
% Aural Modulation	0%
Method of Measurement	The broadband receive antennas were moved horizontally and vertically around the unit to maximize receive level. Absolute power level of each spurious radiation was measured on a calibrated spectrum analyzer and converted to an equivalent field strength by finding the power density (absolute power divided by the antenna area). The relative field strength of the spurious radiation was then calculated with respect to the unit's rated output power. The field strength of the rated output was found using $\sqrt{49.2P}/R$ (P = rated output, R = distance). All emissions were assumed to be radiated from half-wave dipoles. Frequencies scanned extended from 20MHz to 10.0GHz.

SPURIOUS RADIATION FIELD STRENGTH DATA

E Output = $\sqrt{49.2P}/R = \sqrt{(49.2)(1000)}/10$ = 22.2Volts/Meter

FREQUENCY (MHz)		POWER MEASURED (dBm)	EQUIVALENT FIELD STRENGTH (VOLTS/METER)	RELATIVE FIELD STRENGTH (dB)
Visual	193.25	-46	5.47×10^{-3}	-72.2dB
Aural	197.75	-54	2.24×10^{-3}	-79.9dB
LO	233.00	Not Visible	————	———
2nd Harmonic	374.50	Not Visible	————	———



SPURIOUS CABINET RADIATION TEST SETUP
Figure 2-11A

2.12 Power Output Meter Calibration [2.985]

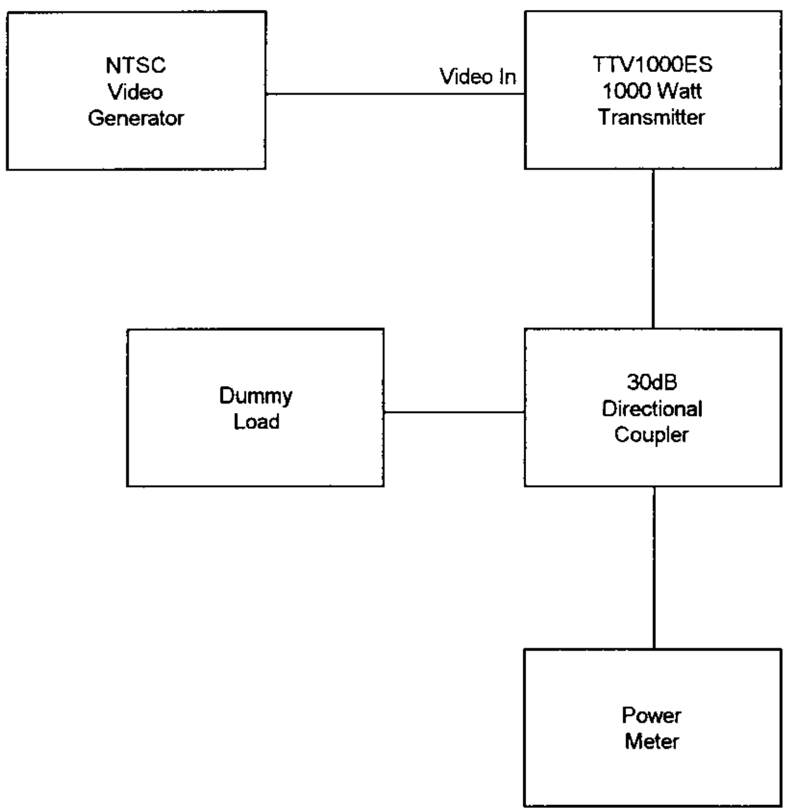
Test Equipment Setup	Figure 2–12A
Visual Output Power	1000 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard sync with blanking level set at 75% of peak sync and maintained through the interval between pulses (0% APL).
Aural Output Power	100 watts average
% Aural Modulation	0%
Method of Measurement	The 2W Exciter was adjusted to obtain a 595mW average visual reading from the transmitter. This power level corresponds to 1000 watts peak power when using the factor of 1.68 and compensating for the output attenuation as shown:

$$\underset{\text{meter reading}}{[595\text{mW}]} \times \underset{\text{attenuation}}{[10^3]} \times \underset{\text{power factor}}{[1.68]} = 1000\text{W}$$

The FWD control of the VISUAL Metering Detector, located behind an access hole on the transmitter Metering Panel, was adjusted to provide a 100% indication on the VISUAL % POWER meter with the meter switch set to FWD. The % POWER meter and meter switch are also located on the Metering Panel.

The Exciter's aural level was then adjusted to obtain a 695mW indication on the external power meter (595W average visual +100W average aural -30dB = 695mW).

The FWD control of the AURAL Metering Detector, located behind an access hole on the transmitter's Metering Panel, was adjusted to provide a 100% indication on the AURAL % POWER meter with its meter switch set to FWD. The % POWER meter and meter switch are also located on the Metering Panel.



POWER OUTPUT METER CALIBRATION SETUP
Figure 2-12A

2.13 Frequency Stability [2.995]

Test Equipment Setup — Figure 2–13A

Method of Measurement — The EMCEE VHF Synthesizer, with its B+ lines intact, was removed from the transmitter and placed in an environmental chamber. The synthesizer's stability was first tested with ±15% variations in the AC line voltage. The chamber's internal temperature was then changed and the oscillator frequency was noted at every 10°C increment. The results of both tests are shown in the following tables.

LINE VOLTAGE	EMCEE FREQUENCY SYNTHESIZER	CHANNEL ERROR (Hz)
95	239.000055	+55
115	239.000054	+54
135	239.000056	+56

TEMP C°	EMCEE FREQUENCY SYNTHESIZER	CHANNEL ERROR (Hz)
+50	238.999937	-63
+40	238.999986	-14
+30	239.000029	+29
+20	239.000055	+55
+10	239.000067	+67
0	239.000089	+89
-10	239.000110	+110
-20	239.000143	+143
-30	239.000171	+171

Test Equipment Setup — Figure 2–13A

Method of Measurement — To provide the customer with our optional precision offset, the Vectron CO-254D57 oscillator with an EMCEE X2 or X4 Multiplier will be used as a direct replacement for the EMCEE VHF synthesizer in the TTV1000ES Transmitter.

The Vectron CO-254D57 oscillator was tested using the same method as for the EMCEE synthesizer.

LINE VOLTAGE	EMCEE OSCILLATOR (MHz)	X4 MULTIPLIER (MHz)	CHANNEL ERROR (Hz)
95	59.750008	239.000032	+32
115	59.750009	239.000036	+36
135	59.750009	239.000036	+36

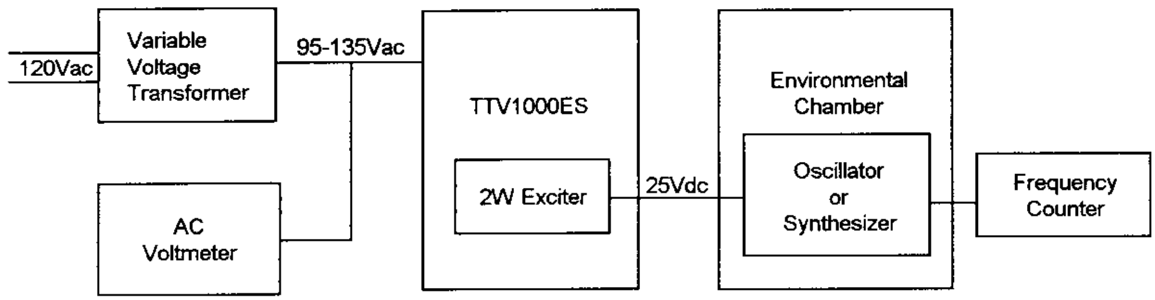
TEMP C°	EMCEE OSCILLATOR (MHz)	X4 MULTIPLIER (MHz)	CHANNEL ERROR (Hz)
+50	59.749979	238.999916	-84
+40	59.749995	238.999980	-20
+30	59.750002	239.000008	+8
+20	59.750011	239.000044	+44
+10	59.750015	239.000060	+60
0	59.750022	239.000088	+88
-10	59.750031	239.000124	+124
-20	59.750042	239.000168	+168
-30	59.750055	239.000220	+220

Test Equipment Setup	Figure 2–13B
Method of Measurement	The EMCEE EM1 Modulator was placed in an environmental chamber and the frequency stability of the visual and aural carriers was monitored during variations in line voltage and ambient temperature. The results of both tests are recorded in the tables below.

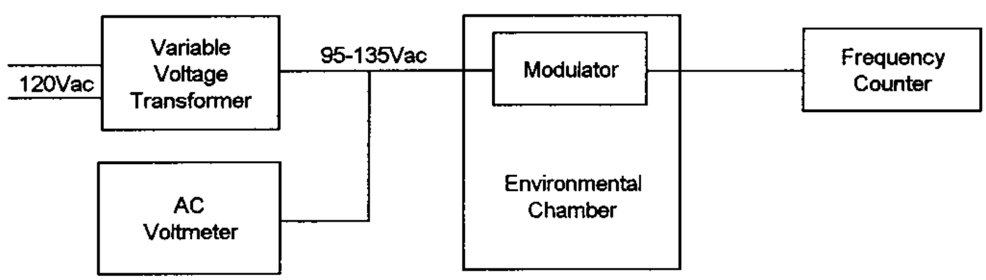
LINE VOLTAGE	VISUAL CARRIER (MHz)	AURAL CARRIER (MHz)	4.5MHz ERROR (Hz)	CHANNEL ERROR (Hz)
95	45.750064	41.250076	-12	+64
115	45.750064	41.250077	-13	+64
135	45.750063	41.250078	-15	+ 63

TEMP C°	VISUAL CARRIER (MHz)	AURAL CARRIER (MHz)	4.5MHz ERROR (Hz)	CHANNEL ERROR (Hz)
+50	45.749888	41.249920	-32	-112
+40	45.749901	41.249929	-28	-99
+30	45.749976	41.249998	-22	-24
+20	45.750065	41.250080	-15	+ 65
+10	45.750123	41.250130	-7	+123
0	45.750185	41.250180	+ 5	+185
-10	45.750256	41.250249	+ 7	+256
-20	45.750332	41.250321	+11	+332
-30	45.750297	41.250288	+ 9	+297

Adding the worst instances of frequency variations for the modulator and VHF Synthesizer, the TTV1000ES carrier frequencies are well within the .002% FCC specifications for Low Power Television Transmitters and within the ±1kHz requirement for zero frequency offset . When using the Vectron high stability CO254D57 oscillator and X2 or X4 Multiplier, the transmitter's frequency stability also falls within the ±1000Hz necessary for ±10kHz precision offset.



FREQUENCY STABILITY TEST SETUP
Figure 2-13A



FREQUENCY STABILITY TEST SETUP
Figure 2-13B

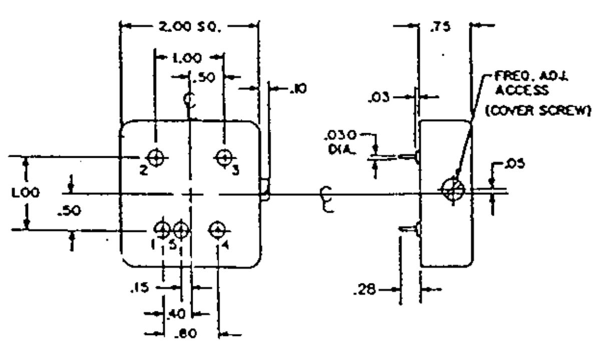
Series CO-252 and CO-254 offer the highest stability alternatives and broadest range of options within Vectron's line of TCXOs. The TCXOs on the adjacent pages are more limited in input/output alternatives and other options, but are smaller in size.

		50 kHz to 20 MHz CO-252 SERIES	20.1 MHz to 140 MHz CO-254 SERIES
FREQUENCY		Sine: 1 MHz to 20 MHz TTL: 200 kHz to 20 MHz CMOS: 50 kHz to 15 MHz HCMOS: 50 kHz to 20 MHz	Sine: 20.01 MHz to 140 MHz TTL: 20.01 MHz to 100 MHz CMOS: 20.01 MHz to 50 MHz HCMOS: 20.01 MHz to 140 MHz ECL: 20.01 MHz to 140 MHz
STABILITY	Temperature (Temp. Range A) +15°C to +35°C:	CO-252A17: $\pm 1 \times 10^{-7}$ CO-252A58: $\pm 5 \times 10^{-8}$	CO-254A57: $\pm 5 \times 10^{-7}$ CO-254A17: $\pm 1 \times 10^{-7}$
	(Temp. Range B) 0°C to +50°C:	CO-252B57: $\pm 5 \times 10^{-7}$ CO-252B27: $\pm 2 \times 10^{-7}$ CO-252B17: $\pm 1 \times 10^{-7}$	CO-254B16: $\pm 1 \times 10^{-6}$ CO-254B57: $\pm 5 \times 10^{-7}$ CO-254B27: $\pm 2 \times 10^{-7}$
	(Temp. Range C) 0°C to +70°C:	CO-252C16: $\pm 1 \times 10^{-6}$ CO-252C57: $\pm 5 \times 10^{-7}$ CO-252C37: $\pm 3 \times 10^{-7}$	CO-254C36: $\pm 3 \times 10^{-6}$ CO-254C16: $\pm 1 \times 10^{-6}$ CO-254C37: $\pm 3 \times 10^{-7}$
	(Temp. Range D) −20°C to +70°C:	CO-252D16: $\pm 1 \times 10^{-6}$ CO-252D57: $\pm 5 \times 10^{-7}$	CO-254D56: $\pm 5 \times 10^{-6}$ CO-254D16: $\pm 1 \times 10^{-6}$ CO-254D57: $\pm 5 \times 10^{-7}$ ←
	(Temp. Range E) −40°C to +75°C:	CO-252E56: $\pm 5 \times 10^{-6}$ CO-252E26: $\pm 2 \times 10^{-6}$ CO-252E16: $\pm 1 \times 10^{-6}$	CO-254E56: $\pm 5 \times 10^{-6}$ CO-254E26: $\pm 2 \times 10^{-6}$ CO-254E16: $\pm 1 \times 10^{-6}$
	(Temp. Range F) −55°C to +85°C:	CO-252F56: $\pm 5 \times 10^{-6}$ CO-252F26: $\pm 2 \times 10^{-6}$ CO-252F16: $\pm 1 \times 10^{-6}$	CO-254F56: $\pm 5 \times 10^{-6}$ CO-254F26: $\pm 2 \times 10^{-6}$ CO-254F16: $\pm 1 \times 10^{-6}$
	(Temp. Range G) −55°C to +105°C:	CO-252G56: $\pm 5 \times 10^{-6}$	CO-254G56: $\pm 5 \times 10^{-6}$
	(Temp. Range H) −55°C to +125°C:	CO-252H15: $\pm 1 \times 10^{-5}$	CO-254H15: $\pm 1 \times 10^{-5}$
	Aging Rate	≤5 MHz: 5×10^{-7}/year (3×10^{-9}/day avg) >5 MHz: 1×10^{-6}/year (5×10^{-9}/day avg)	
	Short Term (Allan Variance)	1×10^{-9}/second under constant conditions	
	Frequency vs Supply	2×10^{-8} per percent in supply with 10 to 28 Vdc input; 1×10^{-7} per percent change in supply for 5 to 9 Vdc input	

OUTLINE/INSTALLATION DRAWINGS

CO-252, CO-254 SERIES

PCB mount (standard)



Pin	WITH SINGLE SUPPLY No "V" Option	WITH SINGLE SUPPLY "V" Option	WITH SEPARATE TTL SUPPLY No "V" Option	WITH SEPARATE TTL SUPPLY "V" Option
1	Output	Output	Output	Output
2	Supply (+)	Supply (+)	Supply (+)	Supply (+)
3	0 Volt/case	0 Volt/case	*0 Volt/case	*0 Volt/case
4	0 Volt/case	VCXO in	+5V	VCXO in
5	*rf return	*rf return	*rf return	+5 Vdc

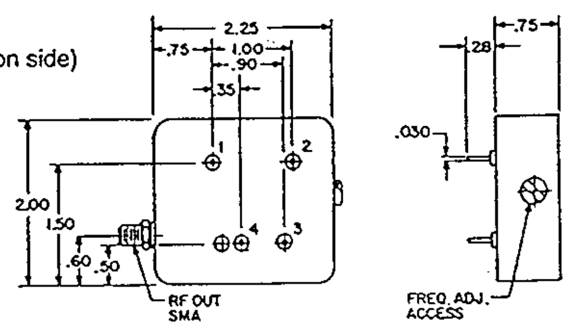
*Internally connected (except pin 5 is not internally connected with sine output in CO-252 series)

RF Connector options

Option SW
(SMA connector on side)

Pin	Function
1	Supply (+)
2	0 volts, case
*3	Case
4	Case

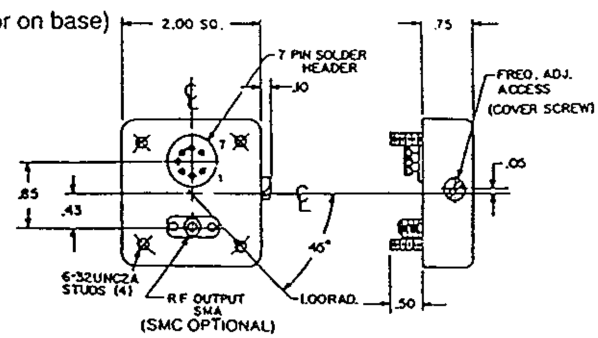
*In units with electronic tuning ("V" option), control voltage is applied from pin 3 to pin 2.



Option W
(SMA connector on base)

Pin	Function
1	Supply (+)
2	N/C
3	0 volts, case
4	N/C
5	Case
6	N/C
*7	N/C

*In units with electronic tuning ("V" option), control voltage is applied from pin 7 to pin 3.



2.14 Certification Identification Label [2.1003]

The certification identification label for the aforementioned transmitter is shown below. This label shall be displayed conspicuously on the transmitter's front panel.

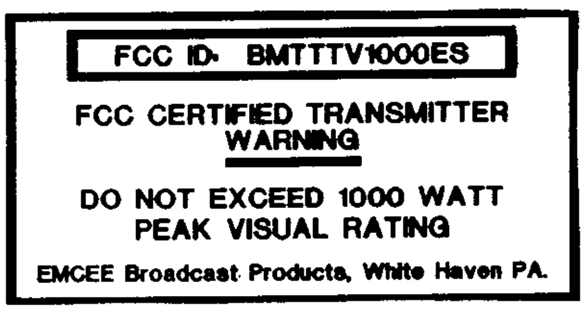
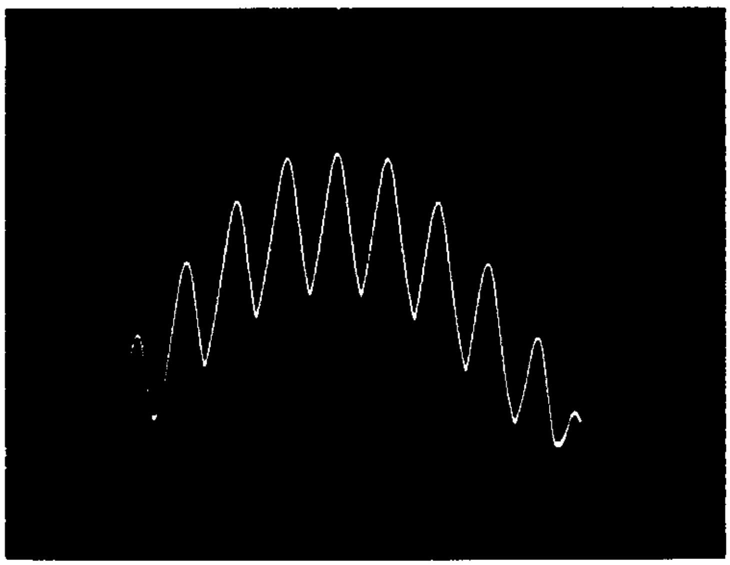


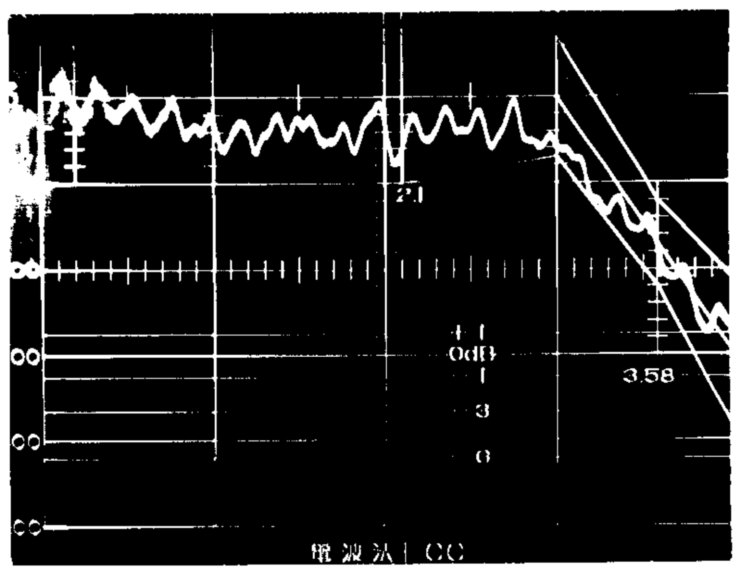
Figure 2–14

2.15 Photographs [2.983 (g)]

The following photographs will be used as part of the TTV1000ES Instruction Manual.



AURAL OCCUPIED BANDWIDTH
Figure 2–5



ENVELOPE DELAY

Figure 2–4