2) TEST REPORT

Certification Submission for the
Model TTU500FA
500 Watt UHF Transmitter
per Part 74, Subpart G,
of the FCC Rules and Regulations

EMCEE

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SECTION I

1.0 INTRODUCTION

1.1 General

This report contains data required for certification of the EMCEE Model TTU500FA UHF Low Power Television Transmitter. This internally diplexed unit, which will be manufactured in quantity, is rated to provide 500 watts peak visual and 25 watts average aural on any FCC specified UHF television channel extending from 470 to 806MHz (Ch.14 to Ch.69). The TTU500FA is completely solid state and comprised of five different assemblies. The RF sections begin with a standard television modulator which supplies diplexed visual and aural modulated IF carriers (45.75MHz visual/ 41.25MHz aural) to the EMEX1 2 Watt Exciter drawer. Here the carriers are converted to the desired UHF frequencies, filtered and amplified to the 100mW level. The television signal is then split into equal parts to drive two 300 Watt Power Amplifiers contained in a single 500 Watt Power Amplifier drawer. The output of the drawer is then connected to a six-section UHF Bandpass Filter where the unwanted products created by combined amplification are reduced to the appropriate levels. Other assemblies in the TTU500FA Transmitter include a Control/Metering panel to monitor the various transmitter circuits and an Ac Distribution panel to dispense power throughout the transmitter.

The data contained in this report was obtained from tests performed on an EMCEE production unit having an output frequency of UHF channel 56 (722-728MHz) using an SA6340 Modulator. However, to better serve our customers, EMCEE also wishes to use the EMCEE EM1 and RF Communications 2000 as appropriate substitutes for the SA6340. 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 X16 multiplier be used in the TTU500FA. This oscillator, replacing the standard synthesizer, will provide the customer with 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 TTU500FA 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 TTU500FA Transmitter and RF Communications 2000 Modulator Instruction Manuals. Information concerning the EM1 and SA6340 Modulators can be found in the previously submitted type acceptance report for the TTV1000ES (BMTTTV1000ES Grant 09-30-99).

1.2 Personnel Qualifications

The certification tests were conducted by Robert Nash, EMCEE VP/Director of Engineering. Mr. Nash has more than 25 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 3001-30, Narda
9. Diode Detector, 50 ohm, Model 423A, Hewlett Packard
10. Dummy Load, 50 ohm, 1000 Watt, Model 8833, Bird Electronic Corporation
11. Environmental Chamber, Tenny Jr., Tenny Engineering
12. Frequency Counter, Model 5386A, Hewlett Packard
13. Mixer, Model ZAD-2, 37023, Mini Circuits
14. Modulator, Model 6340, Scientific Atlanta
15. Multimeter, Digital, Model E2378A, Hewlett Packard
16. Power Meter, Model 435A, Hewlett Packard
17. NTSC Video Generator, Type 149A, Tektronix
18. Spectrum Analyzer, Model 8595E, Hewlett Packard
19. Video Measurement Set, Model VM700A, Tektronix
20. 500 Watt UHF Television Transmitter, Model TTU500FA, EMCEE

1.4 Active Device List

The following is a complete listing of all the active devices used in the EMCEE Model TTU500FA UHF 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/CONVERTER Schematic Diagram 40404021		
Integrated Circuit	AD603AR/U1	Variable Gain Amplifier
Integrated Circuit	SGA-3286/U8, U11, U20	RF Amplifier
PIN Diode	HSMP-3814/CR7-CR10	RF Attenuator
LINEARITY CORRECTOR Schematic Diagram 40404011		
Diode	HSMS-2812/CR1-CR4	RF Switch
Integrated Circuit	MAV-11SM/U1-U8	RF Amplifier
UHF SYNTHESIZER Schematic Diagram 30367094		
Integrated Circuit	3B160/U4	Reference Divider
Integrated Circuit	3B166/U2	Dual Prescaler
Integrated Circuit	3B161/U1	Synthesizer
Integrated Circuit	3B149/U3	Loop Filter
Integrated Circuit	3B141/U6	Feedback Amplifier
Integrated Circuit	3B151/U5	RF Amplifier
VCO	V707S001/G1	Oscillator
REFERENCE OSCILLATOR Schematic Diagram 10368037		
Integrated Circuit	3B130/U1	RF Amplifier
TCXO	RTX0771AD/G1	Oscillator
UHF BANDPASS FILTER Schematic Diagram 20404015		
Integrated Circuit	SGA-4286/U1	RF Amplifier

DEVICE	PART #/DESIGNATOR	FUNCTION
X16 MULTIPLIER (With Vectron Oscillator) Schematic Diagram 30367226		
Hybrid Circuit	SK2/A1, A2, A3	Frequency Doubler
Integrated Circuit	3B153/U1	RF Amplifier
Integrated Circuit	3B141/U2	RF Amplifier
Integrated Circuit	3B151/U3, U6	RF Amplifier
Integrated Circuit	2B131/U4	RF Amplifier
Integrated Circuit	2B130/U5	RF Amplifier
2 WATT UHF AMPLIFIER Schematic Diagram 30404029		
Integrated Circuit	SGA-4186/U1	RF Amplifier
Transistor	AH1/Q1	RF Amplifier
Transistor	PTF10027/Q2	RF Amplifier
300 WATT UHF POWER AMPLIFIER Schematic Diagram 40394135		
Transistor	PTF10027/Q1, Q3	RF Amplifier
Transistor	PTF10007/Q5, Q6	RF Amplifier
Transistor	PTF10159Q7-Q10	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 TTU500FA are true and correct to the best of my knowledge.

Robert G. Nash
VP/Director of Engineering

SECTION II
TEST PROCEDURES AND DATA

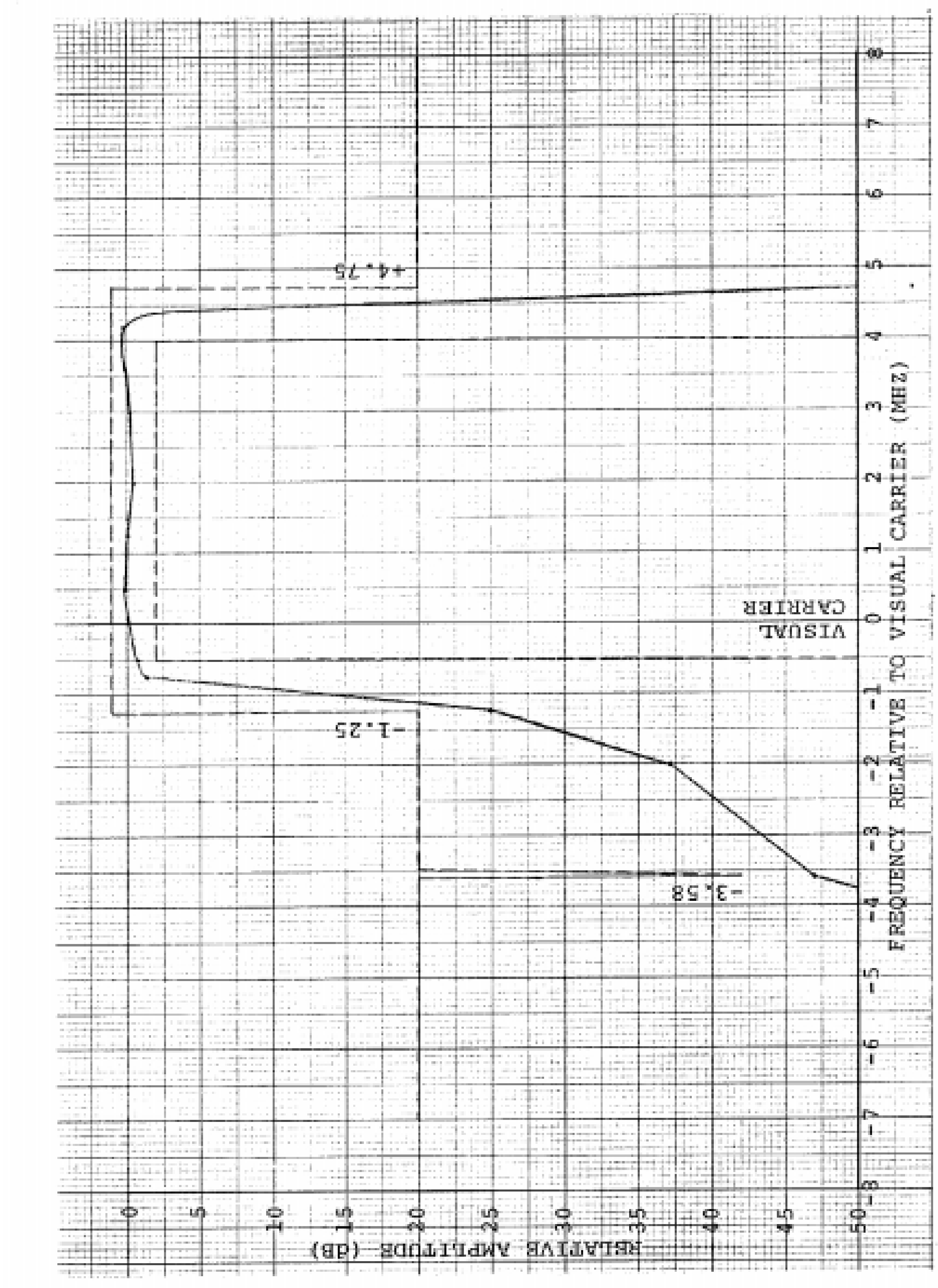
2.1 Frequency Response [73.687(a)(3)]

Test Equipment Setup	Figure 2–1A
Visual Output Power	500 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.

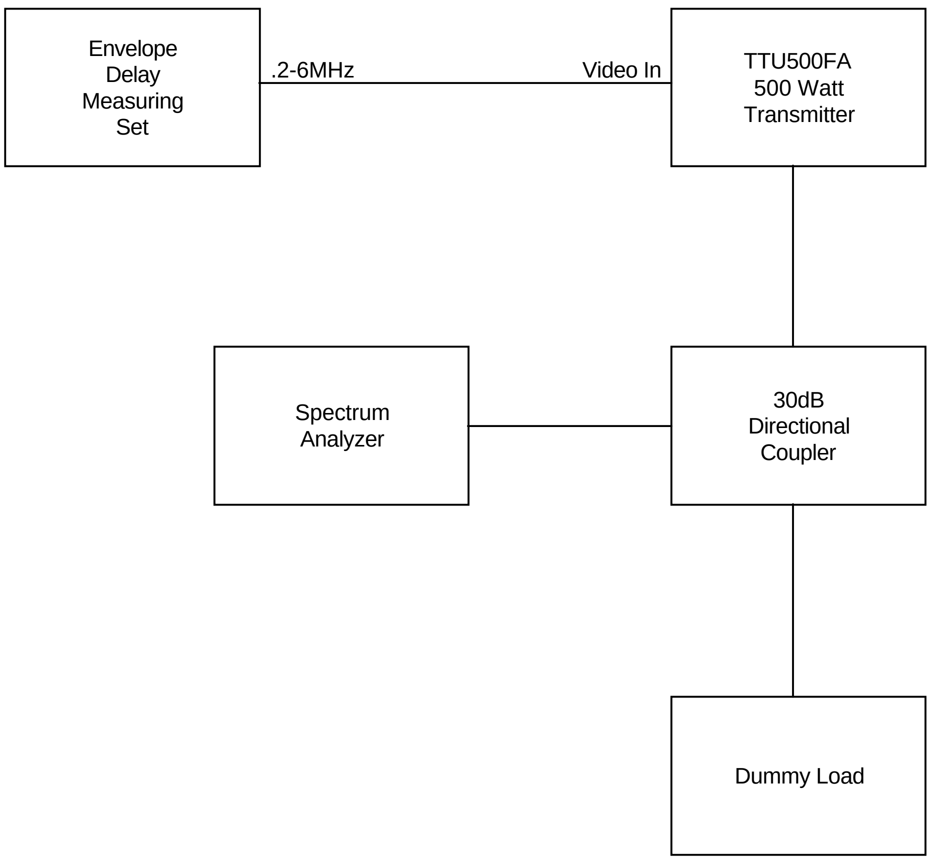
FREQUENCY RESPONSE DATA

REFERENCE LEVEL: 0dB = 200kHz sideband amplitude

OUTPUT FREQ. (MHz) CHANNEL 56	SIDEBANDS	RELATIVE OUTPUT (dB) CHANNEL 56
718.50	−4.75MHz	<−60.0
719.07	−4.18MHz	−57.0
719.67	−3.58MHz	−47.0
721.25	−2.00MHz	−37.0
722.00	−1.25MHz	−25.0
722.50	−750kHz	−1.5
722.75	−500kHz	− 0.8
723.25	VISUAL CARRIER	
723.45	REFERENCE SIDEBAND	0.0
723.75	+500kHz	0.2
724.50	+1.25MHz	0.0
725.25	+2.00MHz	−0.4
726.25	+3.00MHz	−0.1
726.83	+3.58MHz	+0.2
727.43	+4.18MHz	+0.3
728.00	+4.75MHz	−54.0



Amplitude Vs. Frequency Characteristics
Figure 2–1



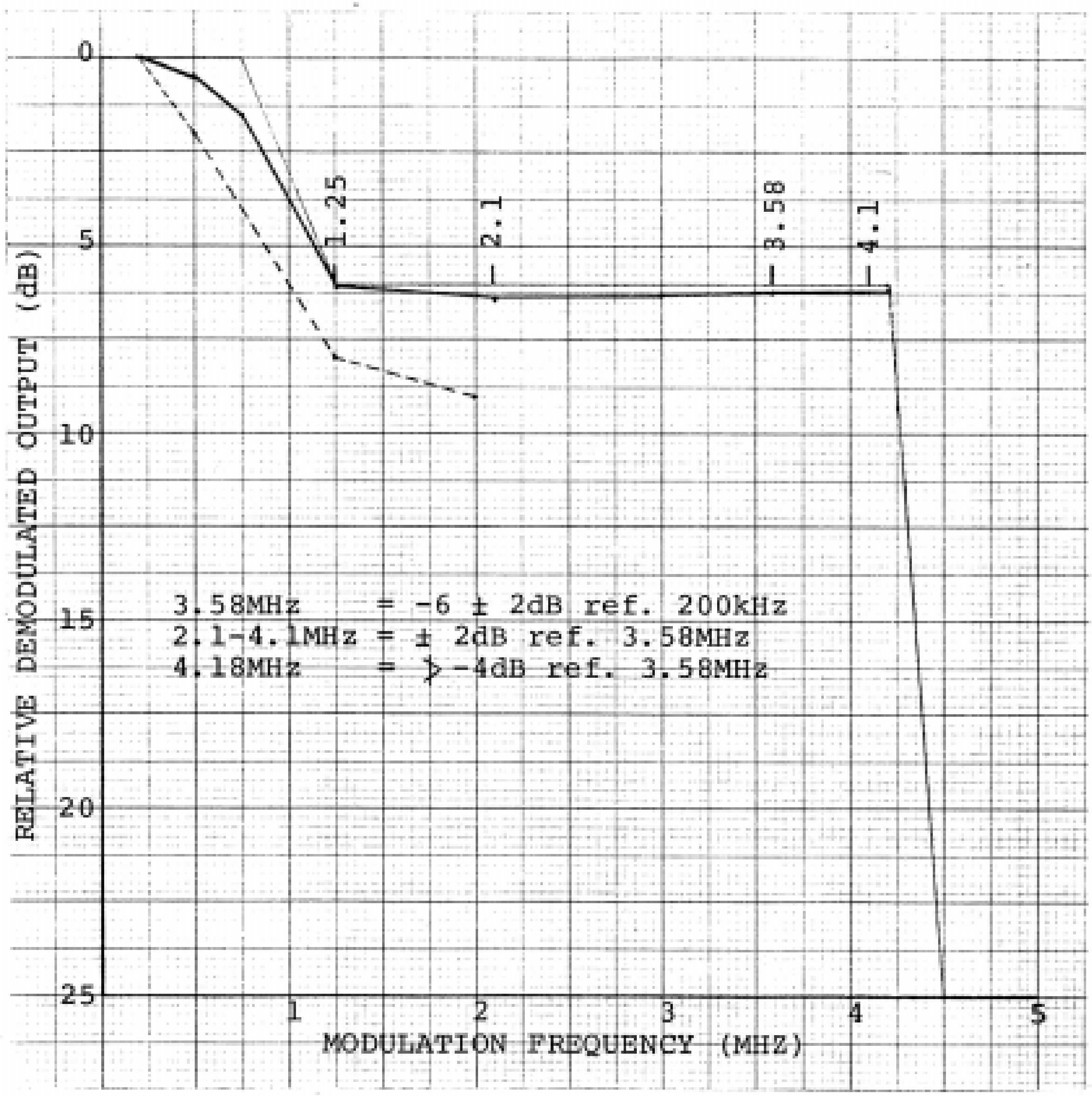
FREQUENCY RESPONSE TEST SETUP
Figure 2-1A

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

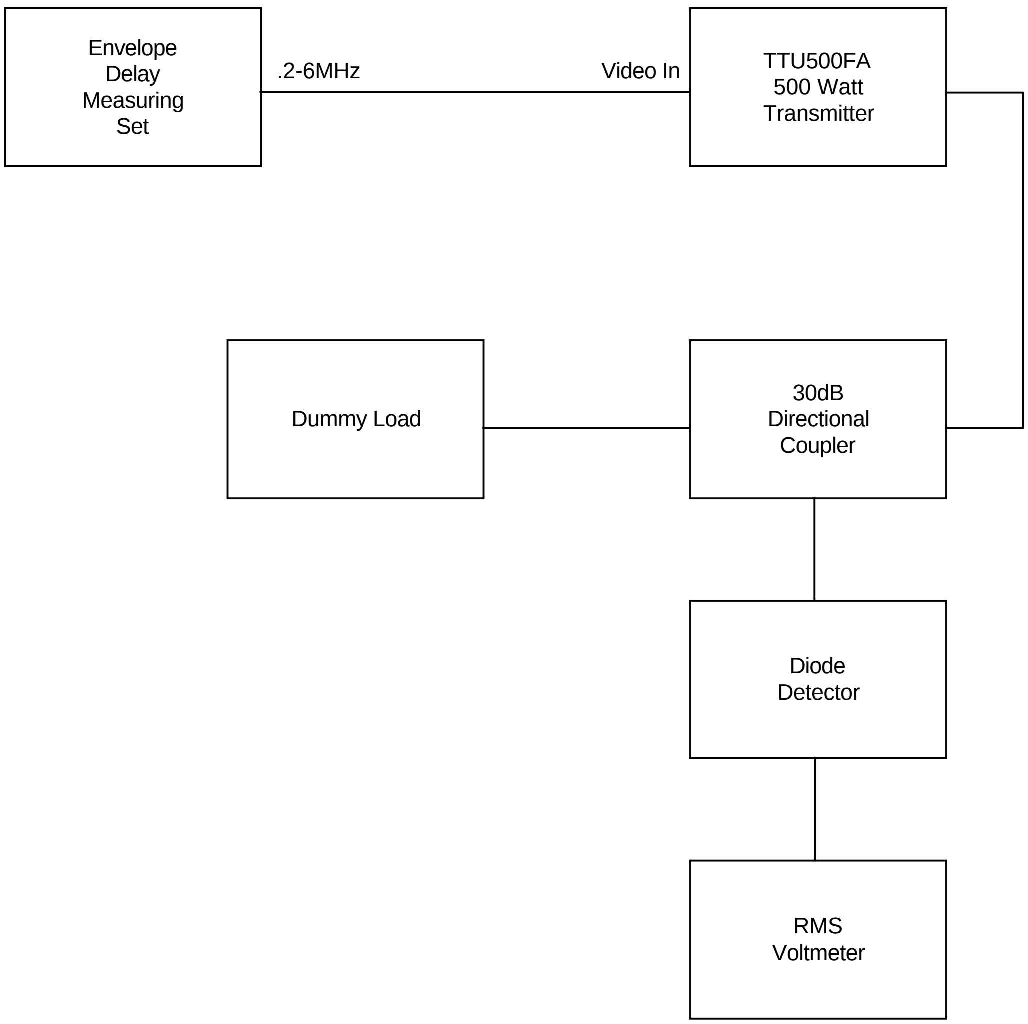
Test Equipment Setup	Figure 2–2A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard sync with a variable frequency sine wave occupying the interval between pulses. Sine-wave axis was maintained at 50% of the peak sync amplitude. Sine-wave amplitude was held constant 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	−0.5
0.75	−1.6
1.25	−6.1
2.10	−6.4
3.00	−6.3
3.58	−6.2
4.18	−6.2



Attenuation Characteristics Curve
Figure 2–2



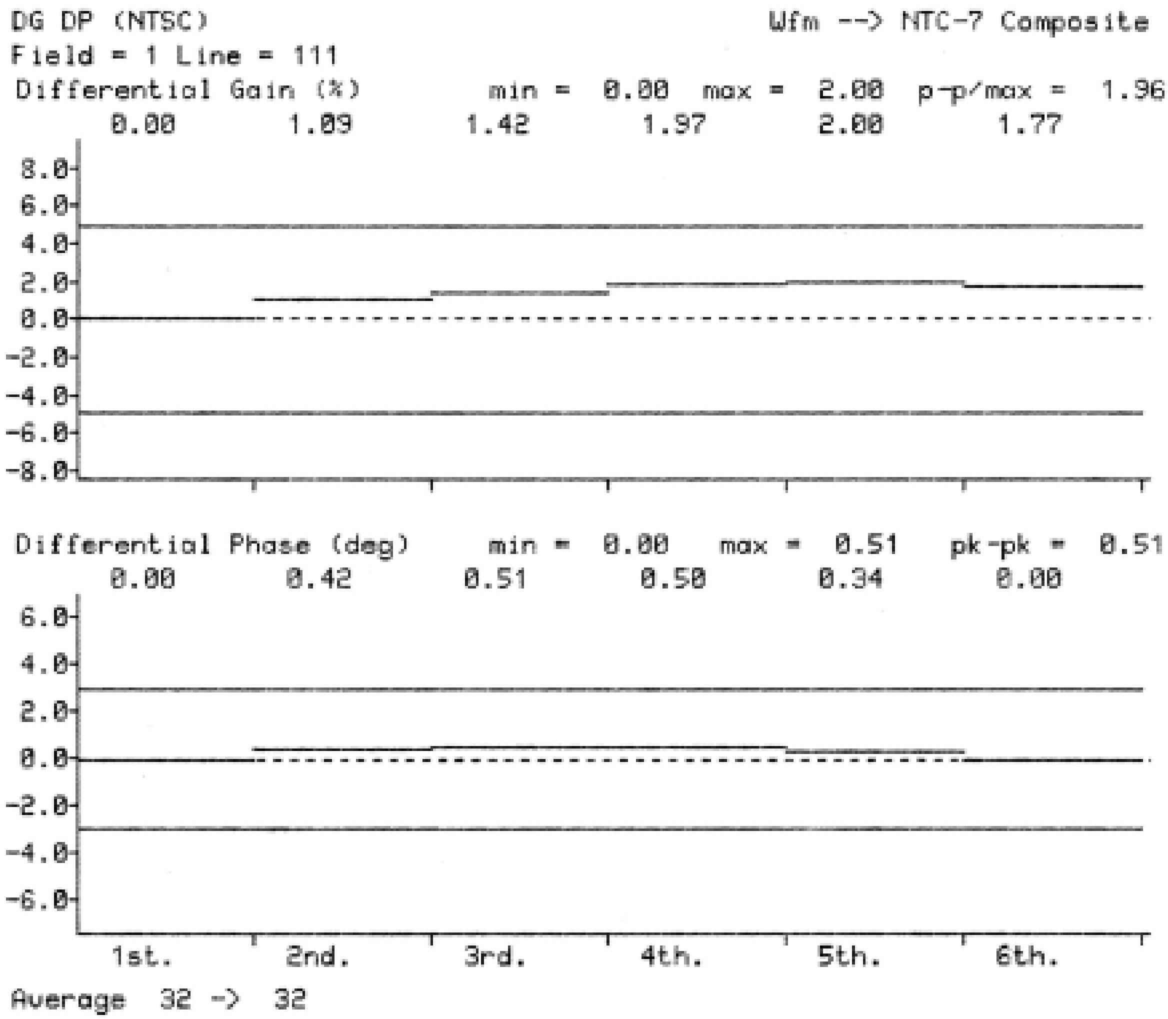
ATTENUATION CHARACTERISTICS TEST SETUP
Figure 2-2A

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

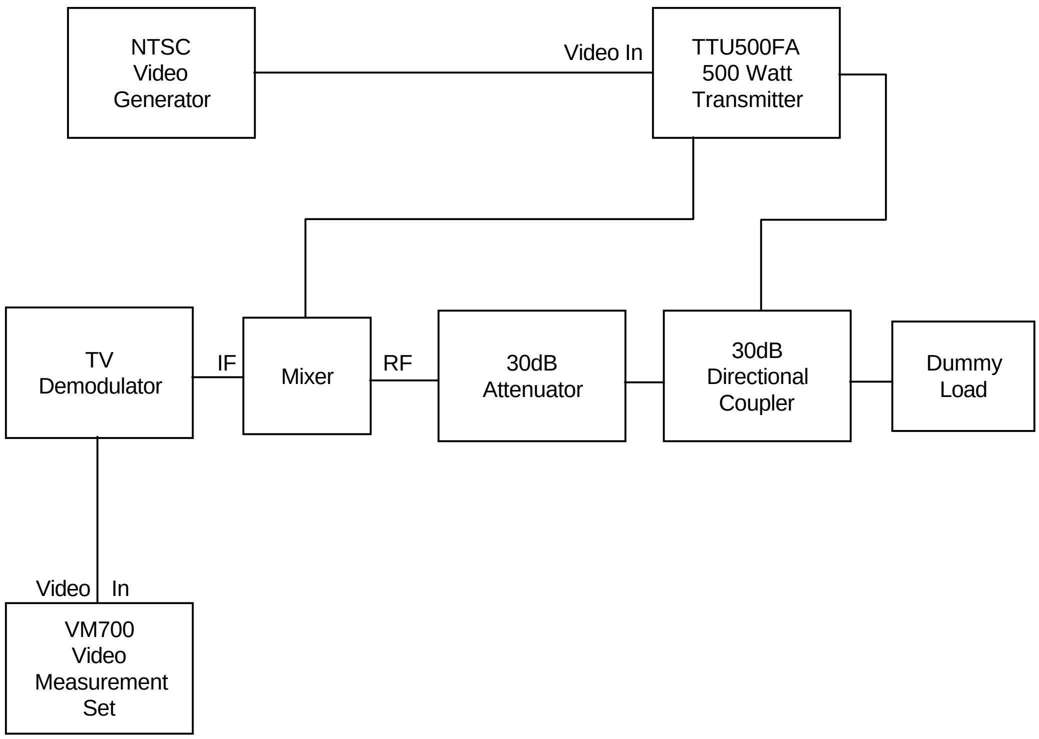
Test Equipment Setup	Figure 2–3A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 5-riser stairstep modulated with 3.58MHz color subcarrier
Aural Output Power	25 watts average
% Aural Modulation	0%
Method of Measurement	Data was taken from the demodulated output viewed on a vectorscope after passing through an internal chroma filter.

DIFFERENTIAL PHASE AND GAIN DATA

Differential Gain	=	+2.0%
Differential Phase	=	+0.5°



<u>Differential Gain/Differential Phase</u>
Figure 2–3



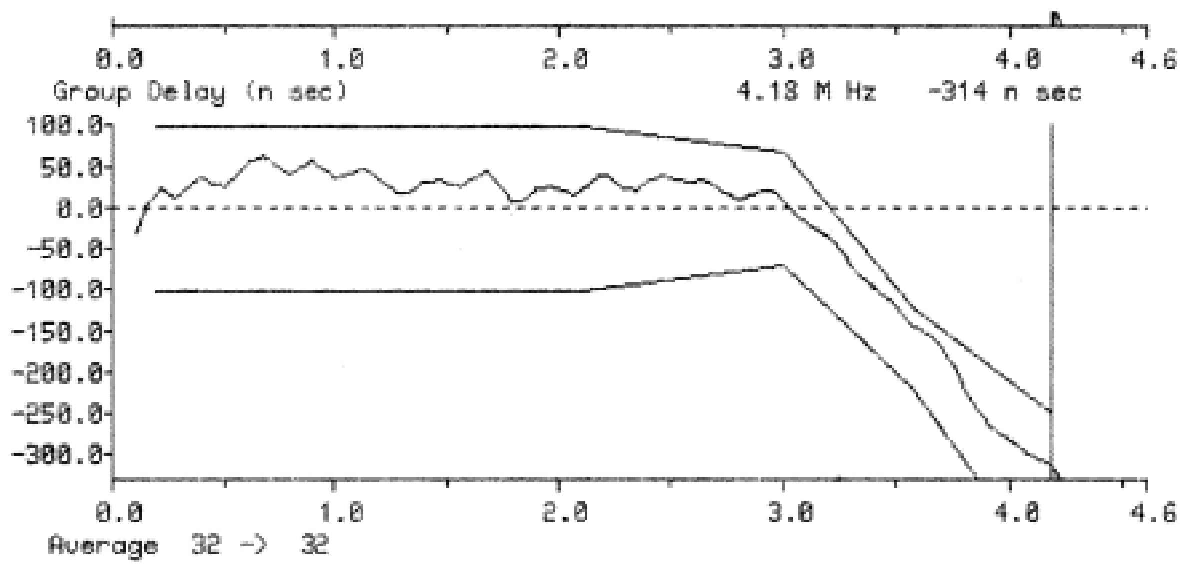
DIFFERENTIAL PHASE AND GAIN TEST SETUP
Figure 2-3A

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

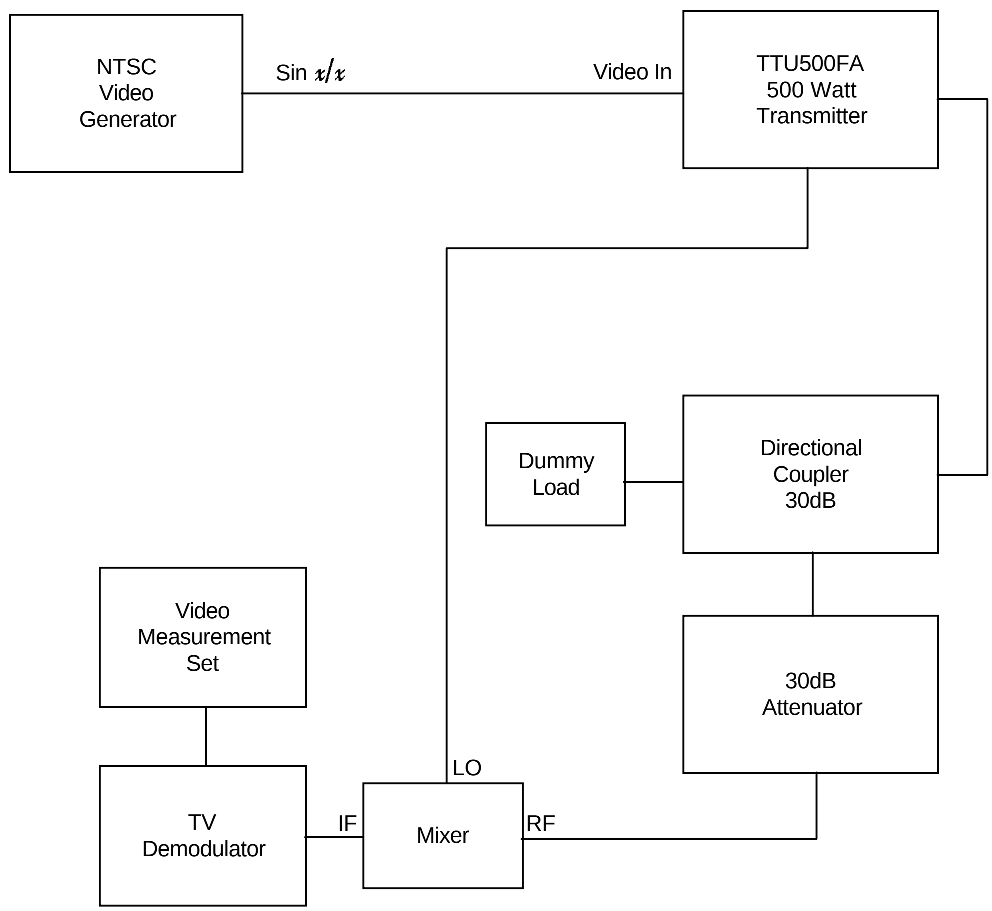
Test Equipment Setup	Figure 2–4A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	A variable frequency constant amplitude sine-wave with a 200kHz reference signal provided by the envelope delay test equipment
Aural Output Power	0 watts
Method of Measurement	The sine-wave 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	+30
1.0MHz	+40
1.5MHz	+30
2.1MHz	+10
2.5MHz	+40
3.0MHz	+5
3.2MHz	−50
3.4MHz	−100
3.58MHz	−150
4.0MHz	−275
4.18MHz	−320



Envelope Delay
Figure 2–4



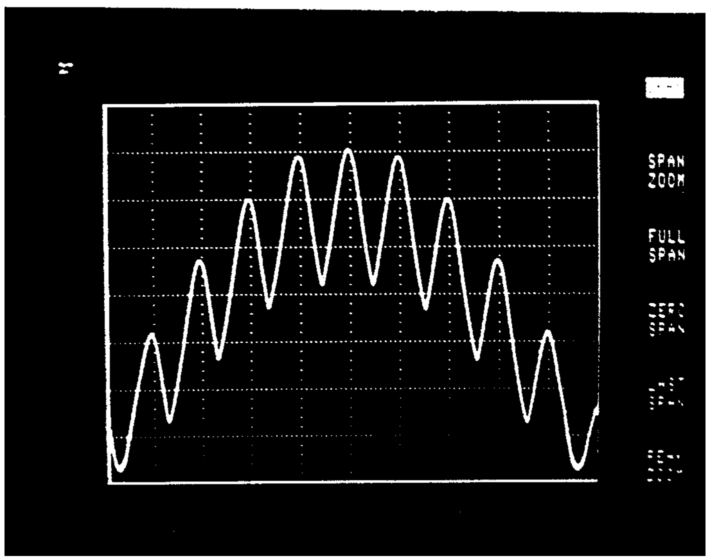
<u>ENVELOPE DELAY TEST SETUP</u>
Figure 2-4A

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

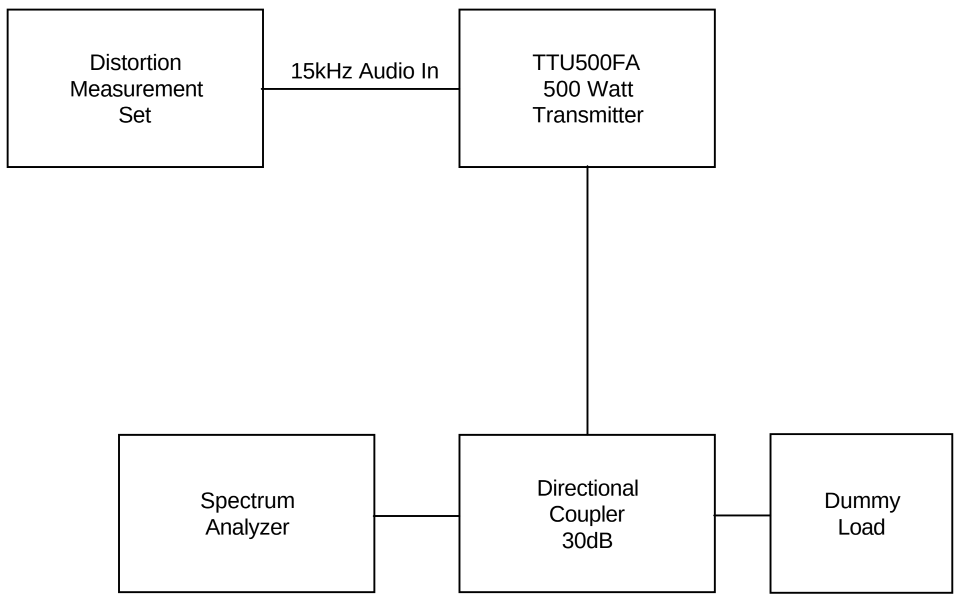
Test Equipment Setup	Figure 2–5A
Visual Output Power	500 watts peak
% Video Modulation	0%
Aural Output Power	25 watts average
% Aural Modulation	85% (21.25kHz)
Aural Modulation Signal	15kHz
Method of Measurement:	Spectrum Analyzer set at 3kHz resolution, 15kHz/division frequency span and 5ms/division sweep speed. Bandwidth was read at 0.5% (−23dB) of mean power.

AURAL OCCUPIED BANDWIDTH DATA

Bandwidth ≈ 90kHz



AURAL OCCUPIED BANDWIDTH
Figure 2–5



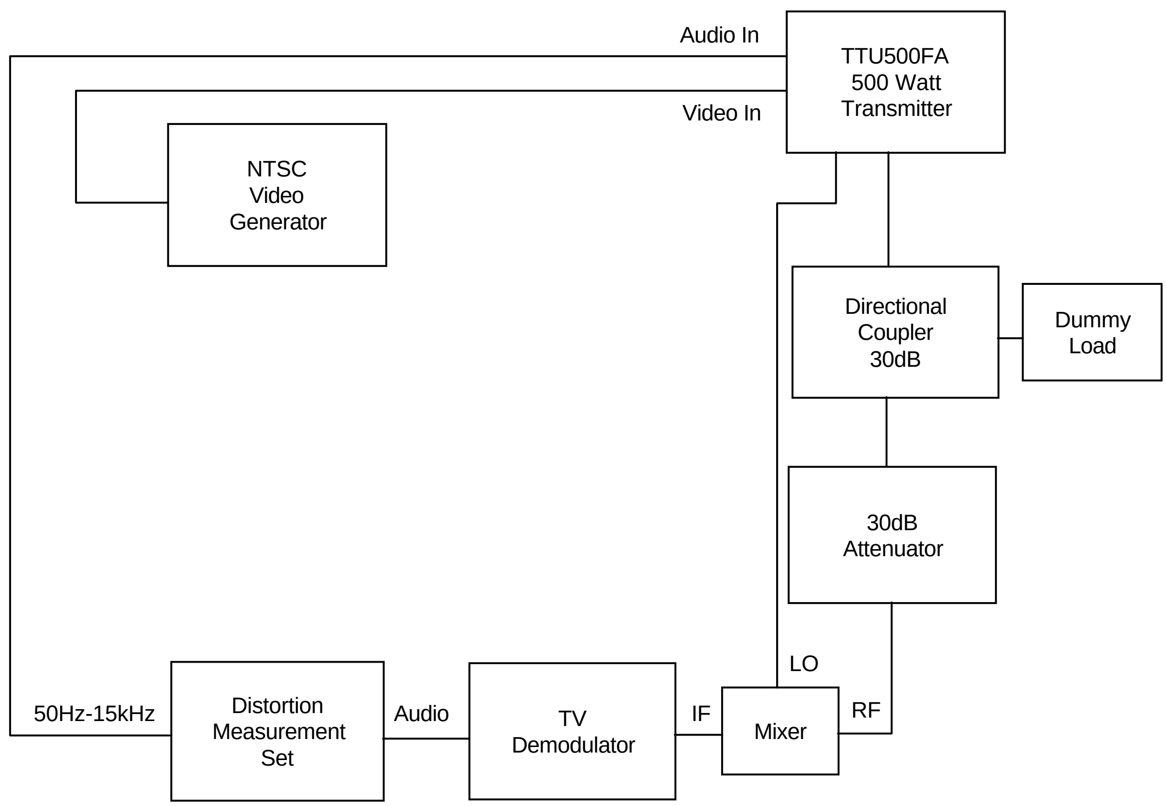
AURAL OCCUPIED BANDWIDTH TEST SETUP
Figure 2-5A

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

Test Equipment Setup	Figure 2–6A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	25 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 Hz	% DISTORTION 100% MOD	50% MOD	25% MOD
50	0.24	0.26	0.28
100	0.26	0.27	0.30
400	0.23	0.25	0.28
1,000	0.19	0.22	0.26
5,000	0.25	0.28	0.33
7,500	0.29	——	——
10,000	0.35	——	——
15,000	0.38	——	——



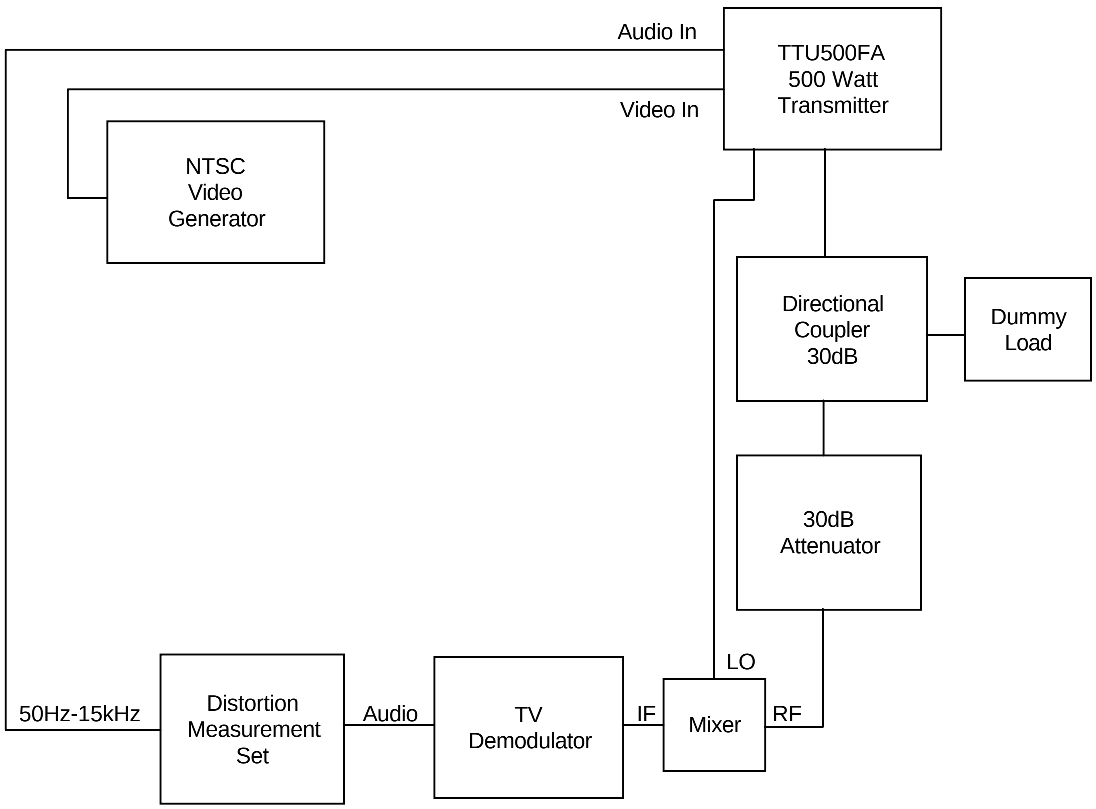
AURAL DISTORTION TEST SETUP
Figure 2-6A

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

Test Equipment Setup	Figure 2–7A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	25 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	−1.8	−2.0	−1.9
100	−1.4	−1.6	−1.5
400	−1.2	−1.3	−1.2
1000	0	0	0
3000	+3.2	+3.3	+3.5
5000	+6.6	+6.8	+7.0
7500	+9.8	+10.0	+10.2
10000	+11.9	+12.0	+12.1
15000	+14.6	+14.8	+15.0



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	25 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.

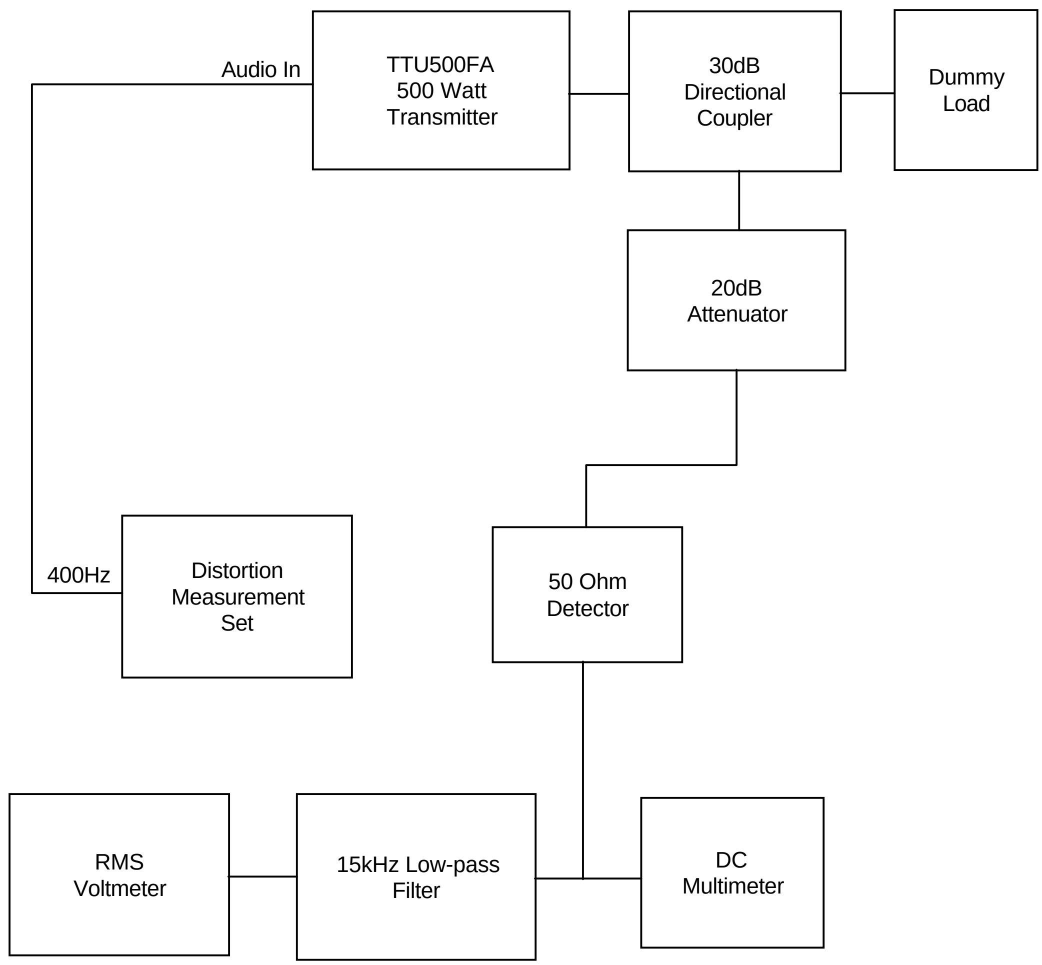
AM NOISE DATA

AC Output = 2.1mV

DC Output = 2.5V

$$\text{AM Noise} = 20 \log \frac{\text{AC Output}}{\text{DC Output}} = \frac{.0021\text{V}}{2.5\text{V}}$$

AM Noise = −61.5dB



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	25 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.

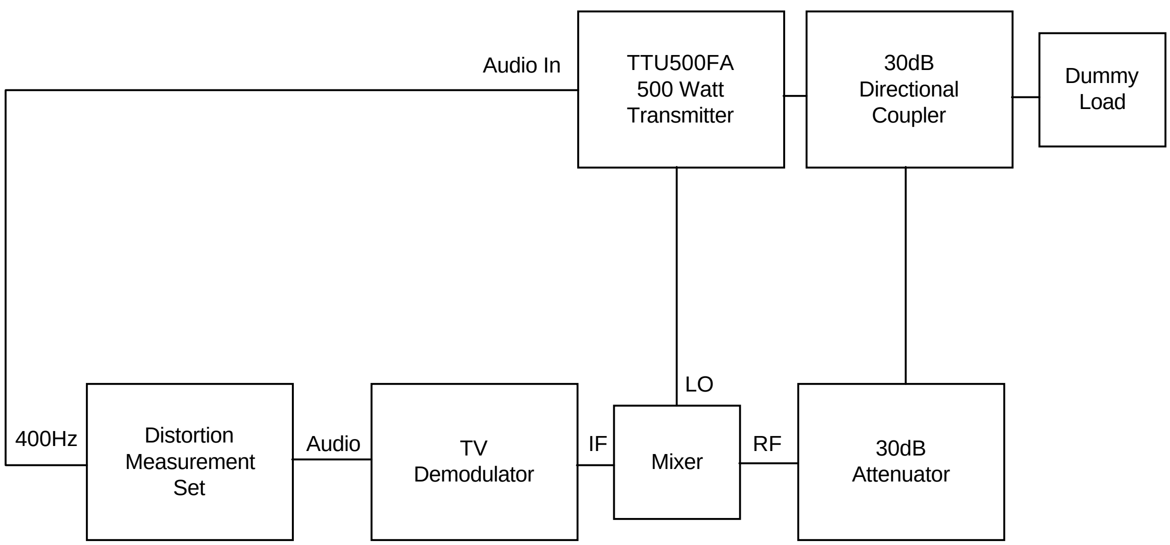
FM NOISE DATA

Detected Output w/o modulation = 1.5mV

Detected Output w/modulation = 3.2V

$$\text{FM Noise} = 20 \log \frac{\text{Output w/o modulation}}{\text{Output w/modulation}} = \frac{.0015\text{V}}{3.2\text{V}}$$

FM Noise = −66.6dB



FM NOISE TEST SETUP
Figure 2-9A

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

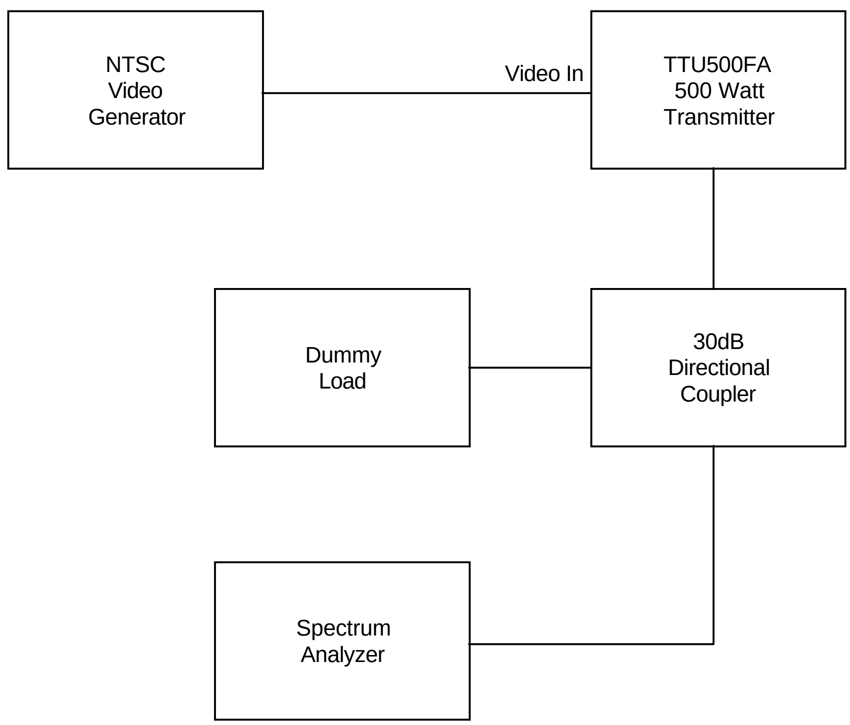
Test Equipment Setup	Figure 2–10A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	25 watts average
% Aural Modulation	0%
Method of Measurement	The spectrum analyzer display was adjusted for a zero reference level at the visual carrier using the following settings:

Frequency Span/Division	–	1MHz
Resolution Bandwidth	–	30kHz
Time/Division	–	20ms
Input Attenuation	–	30dB
Reference Level	–	−3dBm
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)	
723.25	0dB	Visual Carrier
727.75	−13dB	Aural Carrier
718.75	−68dB	Visual Carrier −4.5MHz
732.25	−76dB	Aural Carrier +4.5MHz
714.25	———	Visual Carrier −9.0MHz
736.75	———	Aural Carrier +9.0MHz
769.00	———	Visual Carrier +45.75MHz
1446.50	−78dB	Visual 2nd Harmonic
1455.50	———	Aural 2nd Harmonic



ANTENNA TERMINAL RF VOLTAGE TEST
Figure 2-10A

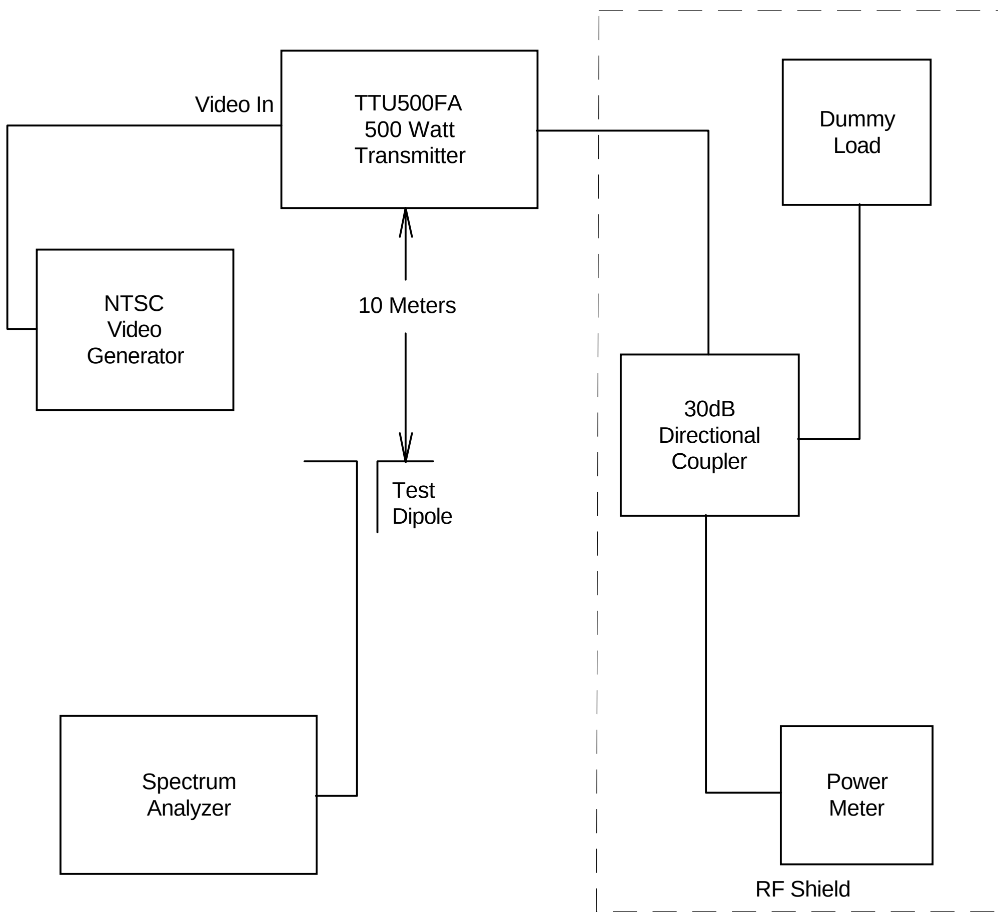
2.11 Spurious Radiation Field Strength [2.993]

Test Equipment Setup	Figure 2–11A
Visual Output Power	500 watts peak
% Video Modulation	87.5%
Type Video Modulation	Standard 10-riser stairstep
Aural Output Power	25 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

$$E\ Output = \sqrt{49.2P}/R = \sqrt{(49.2)(500)}/10 = 15.7\text{Volts/Meter}$$

FREQUENCY (MHz)		POWER MEASURED (dBm)	EQUIVALENT FIELD STRENGTH (VOLTS/METER)	RELATIVE FIELD STRENGTH (dB)
Visual	723.25	−53	9.2×10^{-3}	−64.6dB
Aural	727.75	−67	1.8×10^{-3}	−78.6dB
LO	769.00	Not Visible	————	———
2nd Harmonic	1446.50	Not Visible	————	———



<u>SPURIOUS CABINET RADIATION TEST SETUP</u>
Figure 2-11A

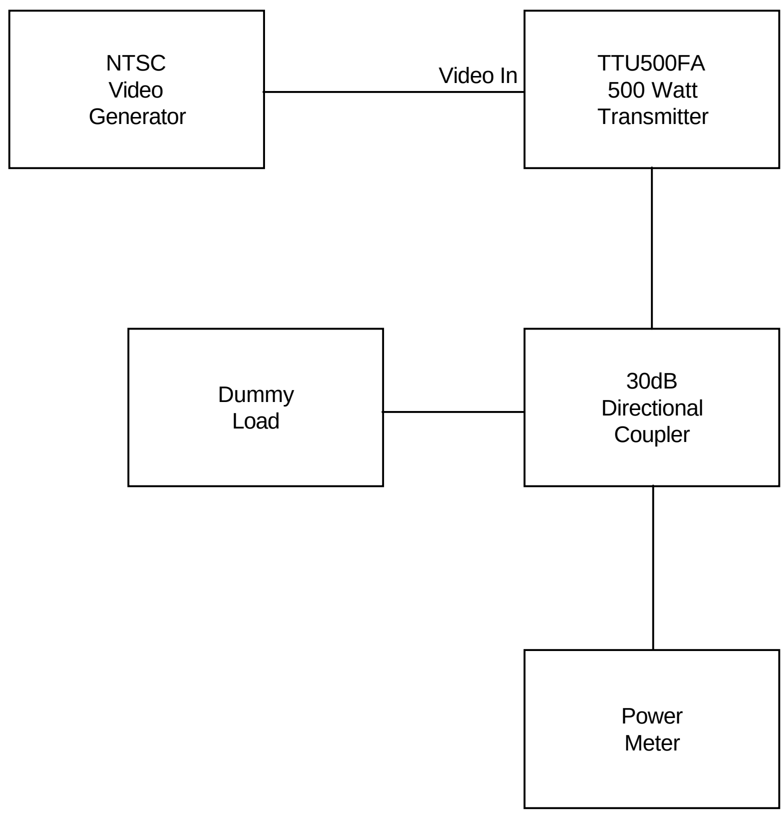
2.12 Power Output Meter Calibration [2.985]

Test Equipment Setup	Figure 2–12A
Visual Output Power	500 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	25 watts average
% Aural Modulation	0%
Method of Measurement	The 2W Exciter was adjusted to obtain a 298mW average visual reading from the TTU500FA Transmitter. This power level corresponds to 500 watts peak power when using the factor of 1.68 and compensating for the output attenuation as shown:

$$\underset{\text{meter reading}}{[298\text{mW}]} \times \underset{\text{attenuation}}{[10^3]} \times \underset{\text{power factor}}{[1.68]} = 500\text{W}$$

The modulator's aural level was then adjusted to obtain a 323mW indication on the external power meter (298W average visual + 25W average aural −30dB = 323mW).

The FWD control of the Metering Detector, located through an access hole on the transmitter Control/Metering panel, was adjusted to provide a 100% indication on the RF POWER meter with the meter switch set to FWD. The RF POWER meter and meter switch are also located on the Control/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 UHF 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	769.000086	+86
115	769.000085	+85
135	769.000087	+87

TEMP C°	EMCEE FREQUENCY SYNTHESIZER	CHANNEL ERROR (Hz)
+50	768.999829	−171
+40	768.999892	−108
+30	768.999974	−26
+20	769.000082	+82
+10	769.000158	+158
0	769.000223	+223
−10	769.000287	+287
−20	769.000368	+368
−30	769.000454	+454

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 X16 Multiplier will be used as a direct replacement for the EMCEE UHF synthesizer in the TTU500FA Transmitter.

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

LINE VOLTAGE	EMCEE OSCILLATOR (MHz)	X16 MULTIPLIER (MHz)	CHANNEL ERROR (Hz)
95	48.062505	769.000080	+80
115	48.062504	769.000064	+64
135	48.062504	769.000064	+64

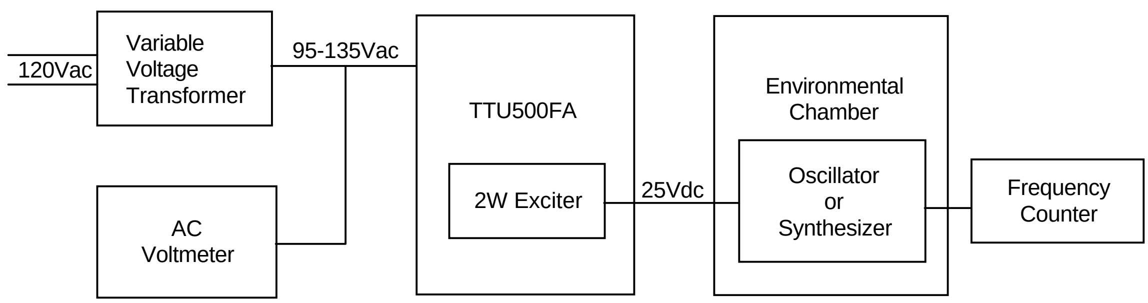
TEMP C°	EMCEE OSCILLATOR (MHz)	X16 MULTIPLIER (MHz)	CHANNEL ERROR (Hz)
+50	48.062489	768.999824	−176
+40	48.062488	768.999808	−192
+30	48.062498	768.999968	−32
+20	48.062501	769.000016	+16
+10	48.062505	769.000080	+80
0	48.062511	769.000176	+176
−10	48.062514	769.000224	+224
−20	48.062509	769.000144	+144
−30	48.062521	769.000336	+336

Test Equipment Setup	Figure 2–13B
Method of Measurement	The Scientific Atlanta 6340 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.

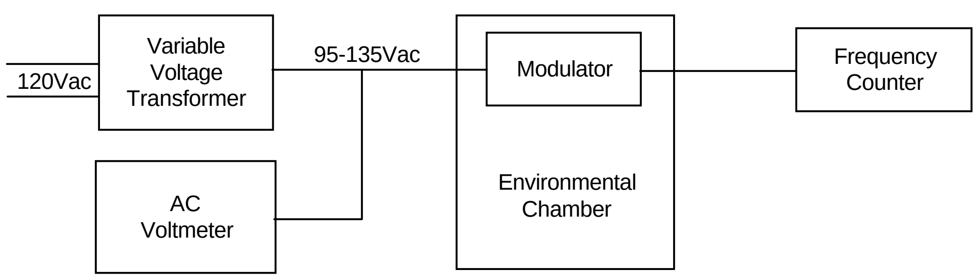
LINE VOLTAGE	VISUAL CARRIER (MHz)	AURAL CARRIER (MHz)	4.5MHz ERROR (Hz)	CHANNEL ERROR (Hz)
95	45.750014	41.250056	−42	+14
115	45.750014	41.250057	−43	+14
135	45.750013	41.250058	−45	+13

TEMP C°	VISUAL CARRIER (MHz)	AURAL CARRIER (MHz)	4.5MHz ERROR (Hz)	CHANNEL ERROR (Hz)
+50	45.749888	41.249915	−27	−112
+40	45.749901	41.249929	−28	−99
+30	45.749976	41.250008	−32	−24
+20	45.750015	41.250050	−35	+15
+10	45.750103	41.250130	−27	+103
0	45.750185	41.250207	−22	+185
−10	45.750256	41.250275	−19	+256
−20	45.750332	41.250343	−11	+332
−30	45.750397	41.250402	−5	+397

Adding the worst instances of frequency variations for the modulator and UHF Synthesizer, the TTU500FA 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 X16 Multiplier, the TTU500FA 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

TCXOs (50 kHz to 140 MHz)

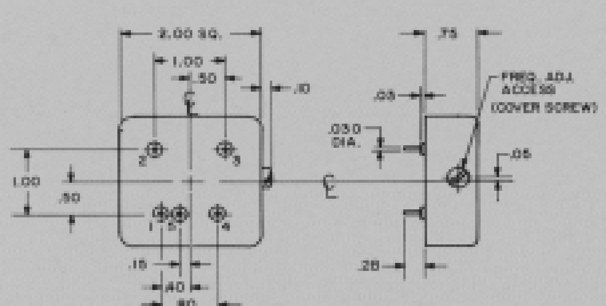
Series CO-252 and CO-254 offer the highest stability alternatives and broadest range of options within Vectron's line of TCXOs. The TCXOs on the adjacent pages are more limited in input/output alternatives and other options, but are smaller in size.

		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 15 MHz HCMOS: 20.01 MHz to 50 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	

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

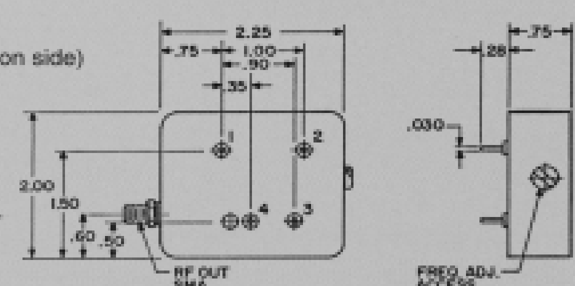
*Internally connected (except pin 5 is not internally connected with sine output in CO-252 series)

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.