

FCC Report of Measurements

FCC ID HTG3BPMTS10W

MTS10W

10 Watt AM Transmitter

Part 90.242

Travelers Information Station

Multi-Technical Services, Inc.
950 NC Highway 42 West
Clayton, NC 27520

February 21, 2012

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Modification Report

- 1. Cover:** modified to show new date
- 2. Table of contents:** modified page numbers and added additional menu items
- 3. 47 CFR 2.1051 Spurious emissions at antenna terminals :** changed photographs to show new data (pages 21 and 22)
- 4. 47 CFR 2.1057 Frequency spectrum investigated :** changed data and photographs to show data for new filters (pages 35 to 43)
- 5. 47 CFR 90.242 (B) (3) concerning leaky cable applications:** section added (page 57)
- 6. Measurement Equipment: Calibration column added (page 51-52)**

2.1046—RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § [2.1033](#)(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as follows. In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(6) Single-channel controlled-carrier transmitters in the A3 emission mode--by a 2500 Hz tone.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

Carrier Frequency: 530 KHz

Volts DC from point B to ground	5.09	VDC
Current measured at point A to B	2.69	A
RF Output Volts	22.65	V
RF Output Power	10.26	W

Carrier Frequency: 1120 KHz

Volts DC from point B to ground	4.99	VDC
Current measured at point A to B	2.73	A
RF Output Volts	22.7	V
RF Output Power	10.3	W

Carrier Frequency: 1690 KHz

Volts DC from point B to ground	5.43	VDC
Current measured at point A to B	2.41	A
RF Output Volts	22.1	V
RF Output Power	9.77	W

Carrier Frequency: 530 KHz with 2500 Hz tone

Volts DC from point B to ground	4.75	VDC
Current measured at point A to B	2.4	A
RF Output Volts	33.6	V
RF Output Power	31.93	W PEP

Carrier Frequency: 1120 KHz with 2500 Hz tone

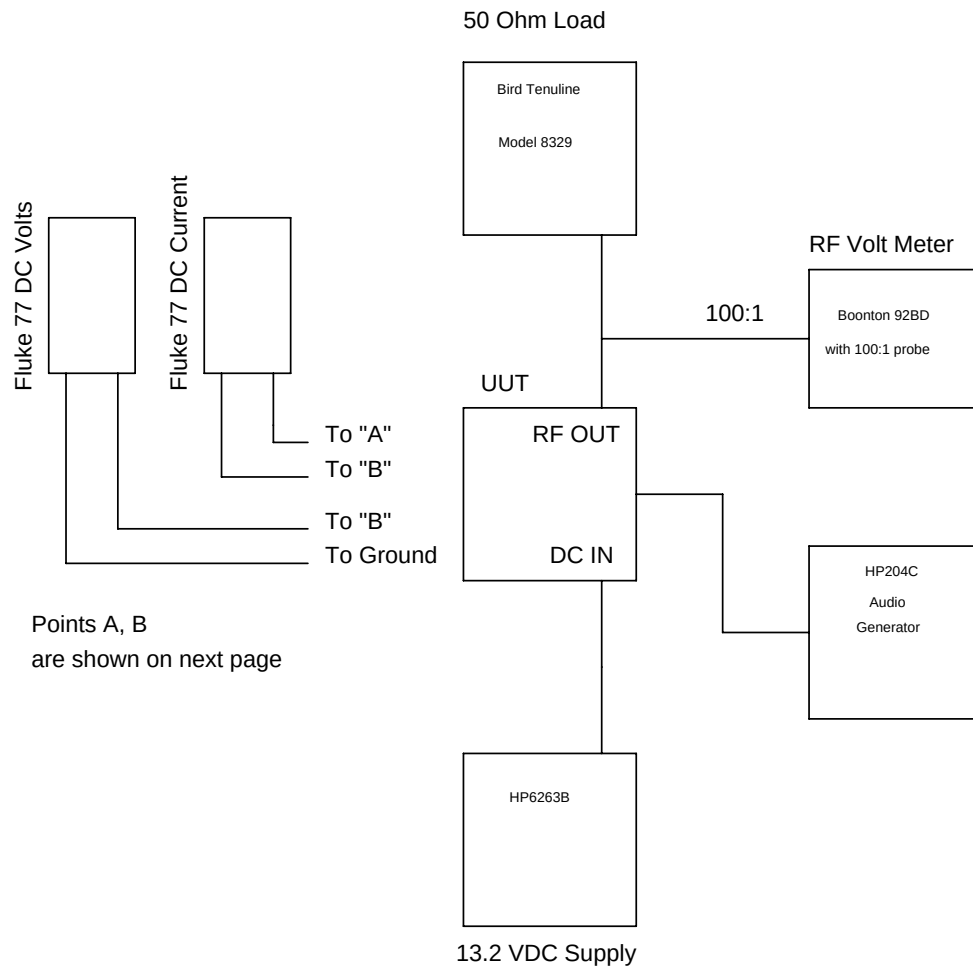
Volts DC from point B to ground	4.65	VDC
Current measured at point A to B	2.45	A
RF Output Volts	34.1	V
RF Output Power	32.88	W PEP

Carrier Frequency: 1690 KHz with 2500 Hz tone

Volts DC from point B to ground	4.96	VDC
Current measured at point A to B	2.14	A
RF Output Volts	33.4	V
RF Output Power	31.55	W PEP

POWER CALCULATIONS

$P = E^2 / R$ for carrier
carrier x 1.414 for PEP



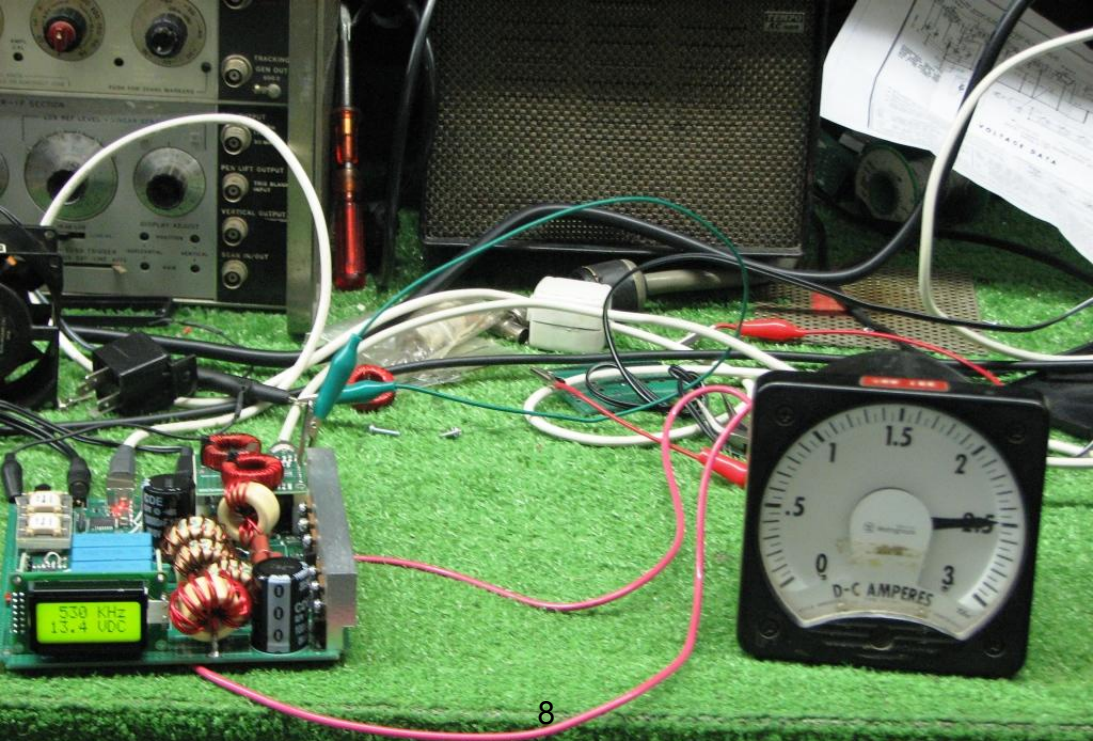
RF Power Table	
Watts	Rf Volts
0.1	2.23
0.5	5.0
1.0	7.07
2.0	10.0
5.0	15.81
7.5	19.36
10.0	22.36

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Test Setup : DC Input Power Measurement

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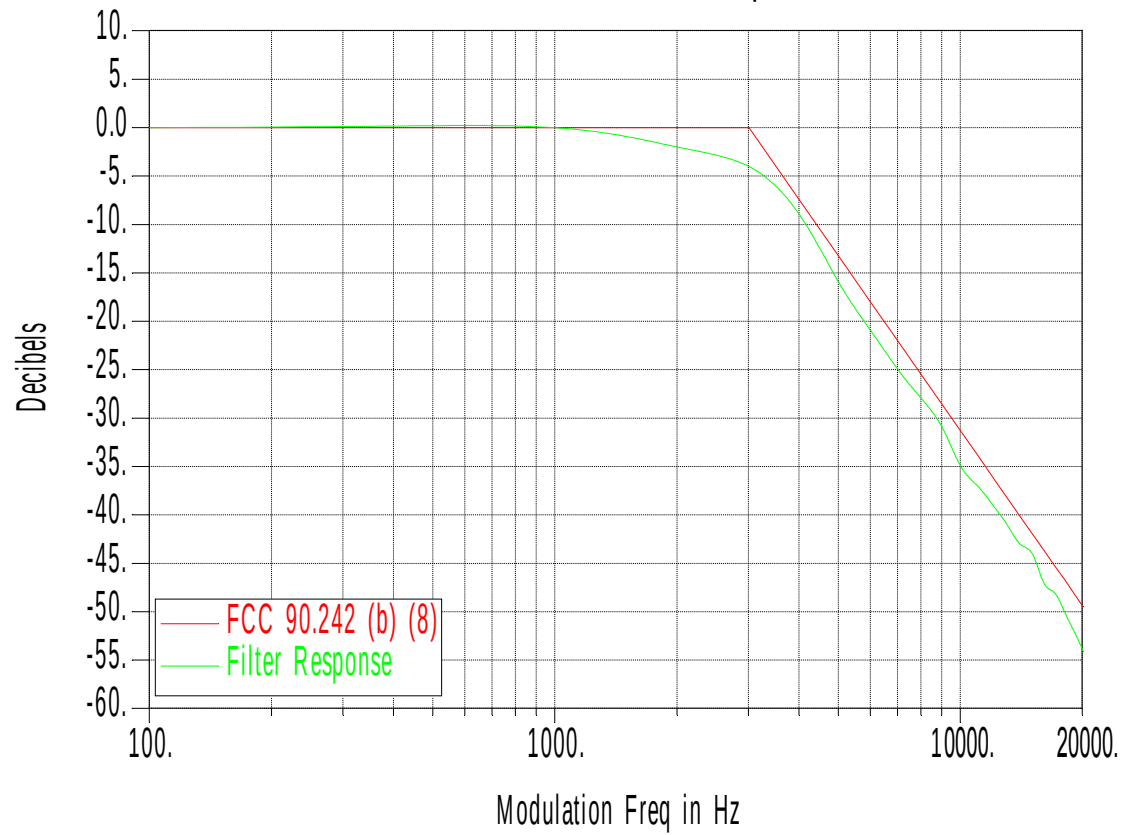


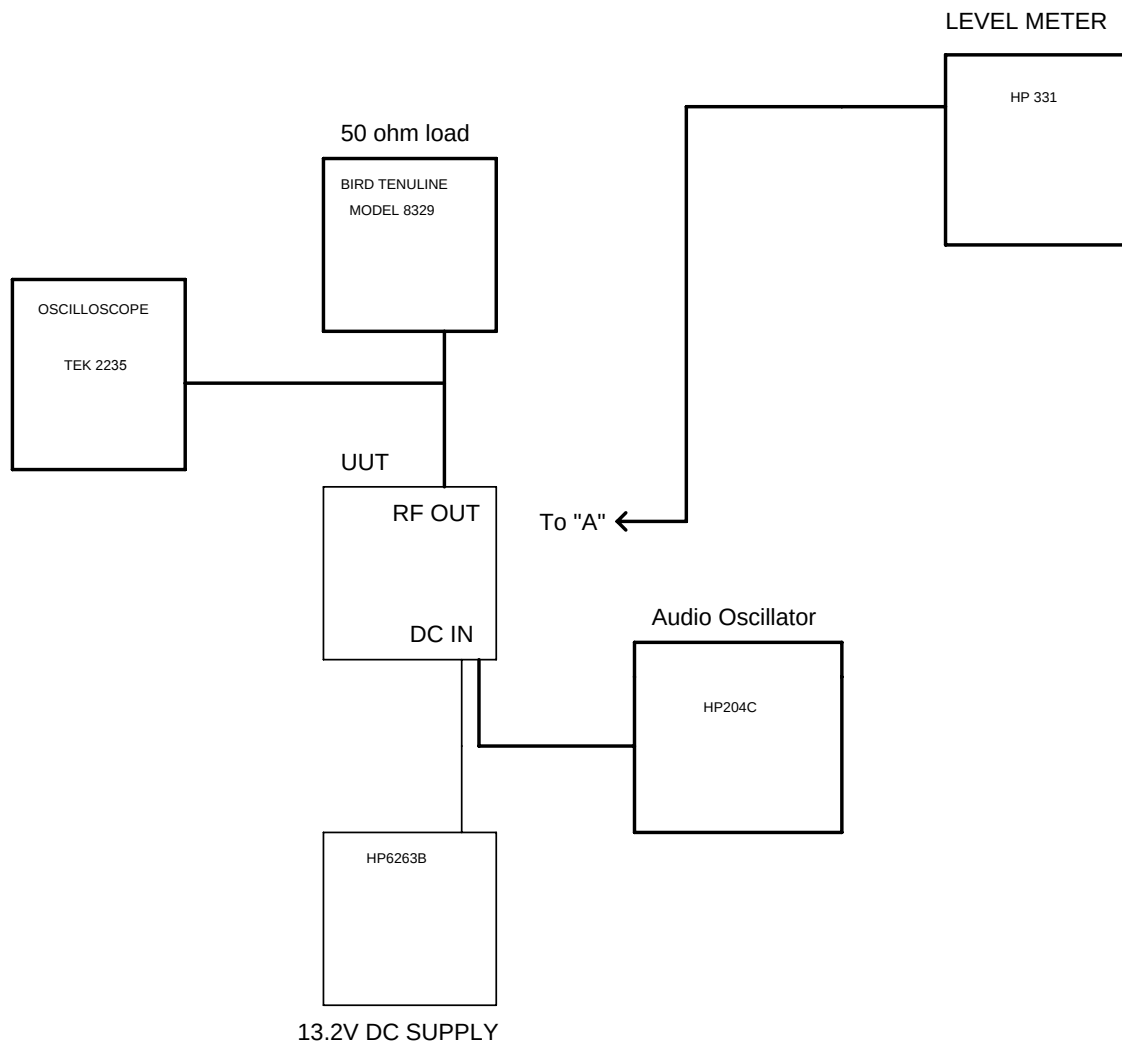
2.1047 Measurements required: Modulation characteristics.

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

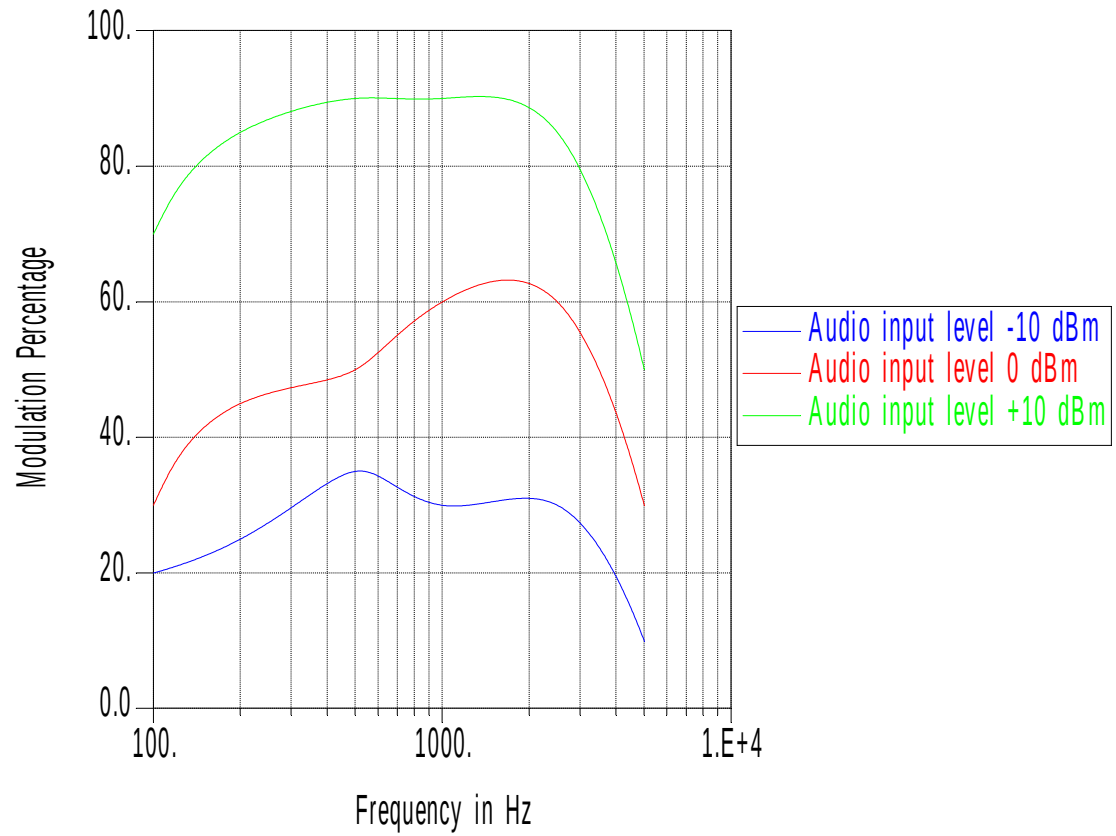
Modulation Filter Response

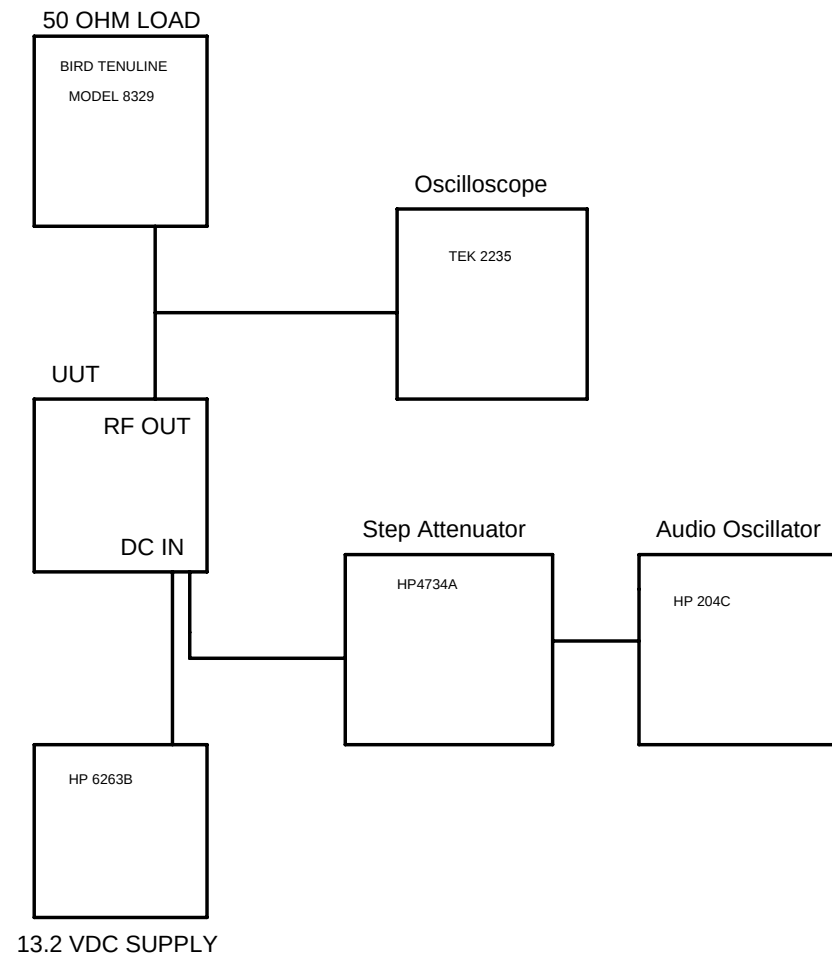




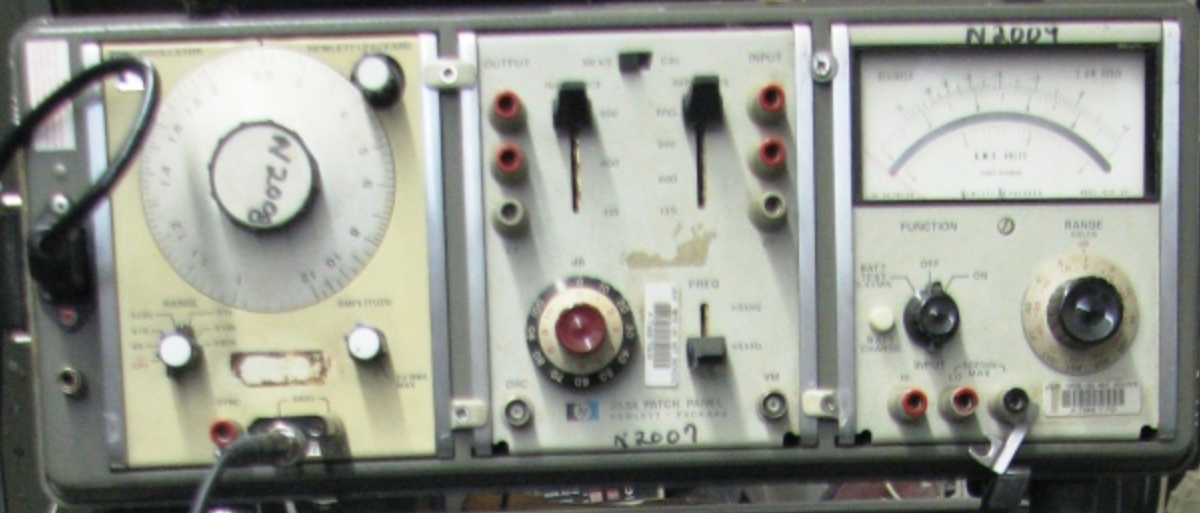
MULTI-TECHNICAL SERVICES, INC.		
Test Setup : Filter Response Test Setup		
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Modulation Characteristics





MULTI-TECHNICAL SERVICES, INC.	
Test Setup : Modulation Percentage Vs Input Level	
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2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal shall be 10 dB greater than that necessary to produce rated peak envelope power.

(1) Other than single sideband or independent sideband transmitters--when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

2500 Hz tone 16 dB above 50% modulation

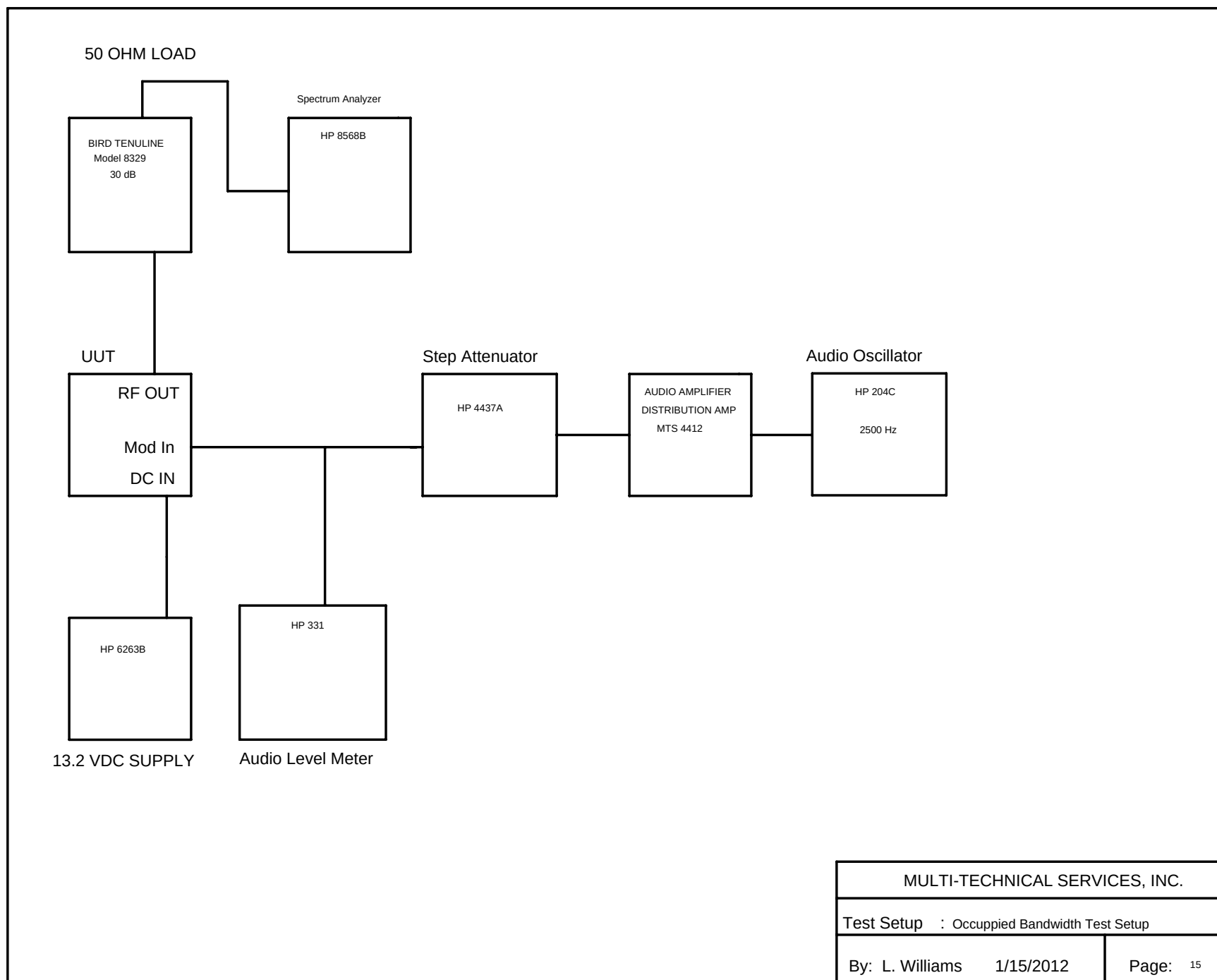
Audio Level 1.4 VAC rms

2500 Hz tone

Modulation percentage 98%

37.6 dBc

Occupied Bandwidth: 5 Kz



hp

REF 10.2 dBm

ATTEN 30 dB

MKR A 5.10 kHz

-37.60 dB

10 dB/

MARKER A
5.10 kHz
-37.60 dB

19

CENTER 1.69000 MHz

RES BW 100 Hz

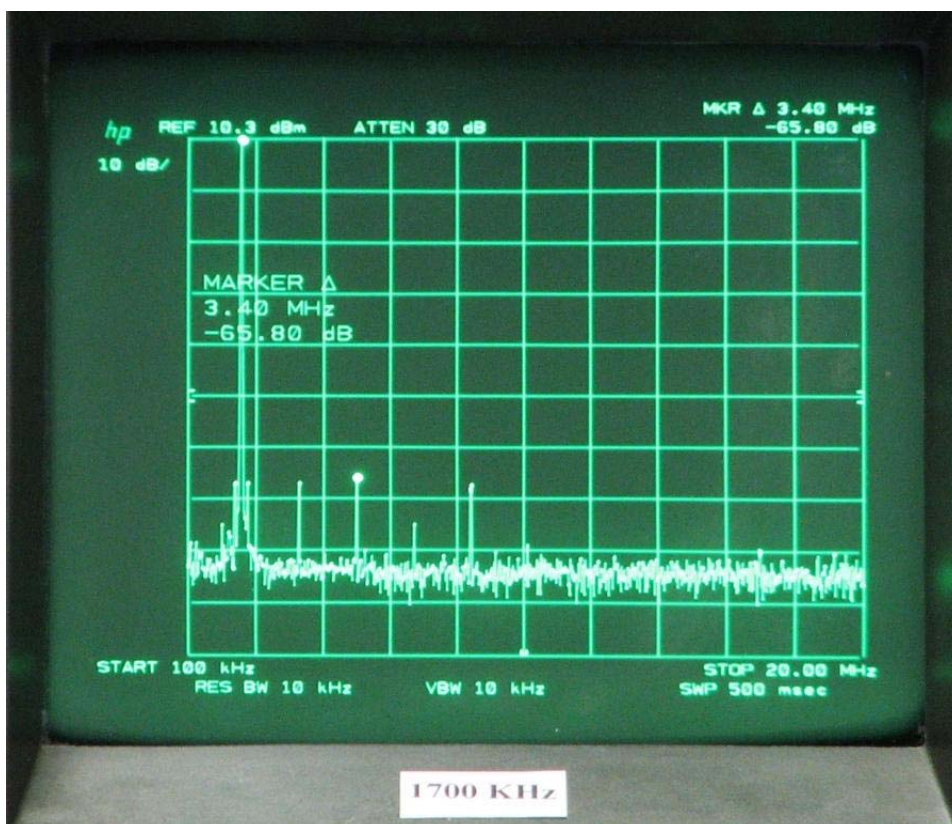
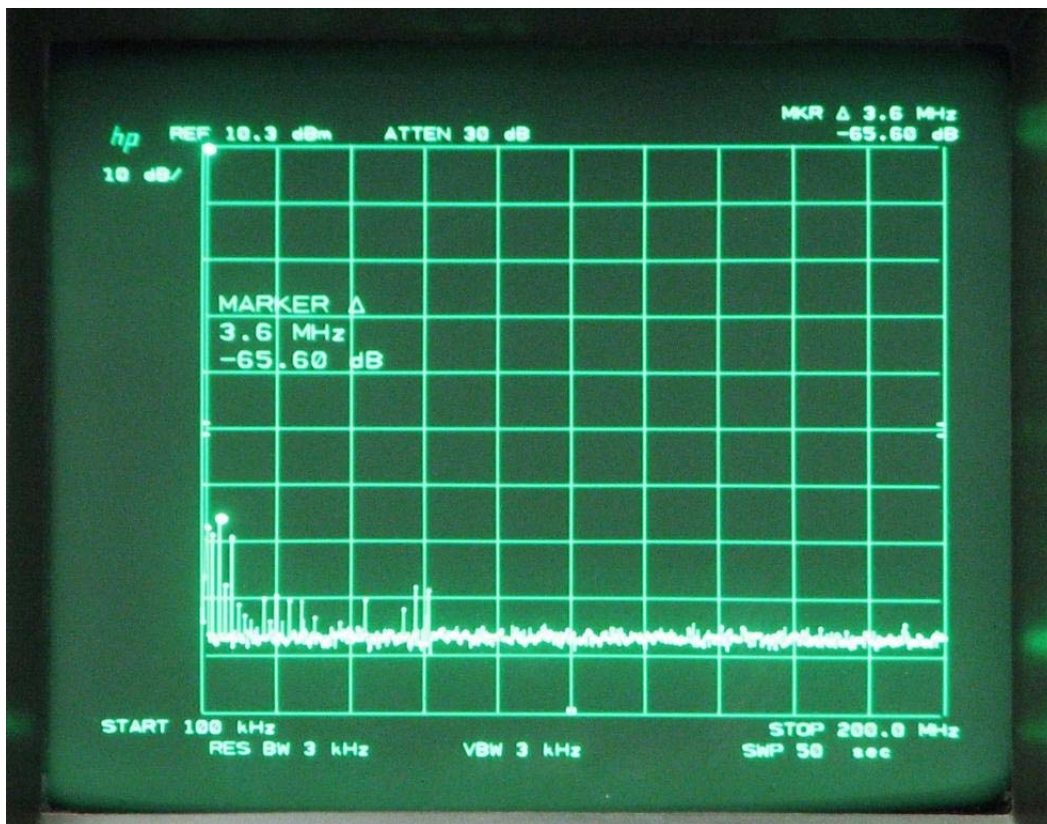
VBW 100 Hz

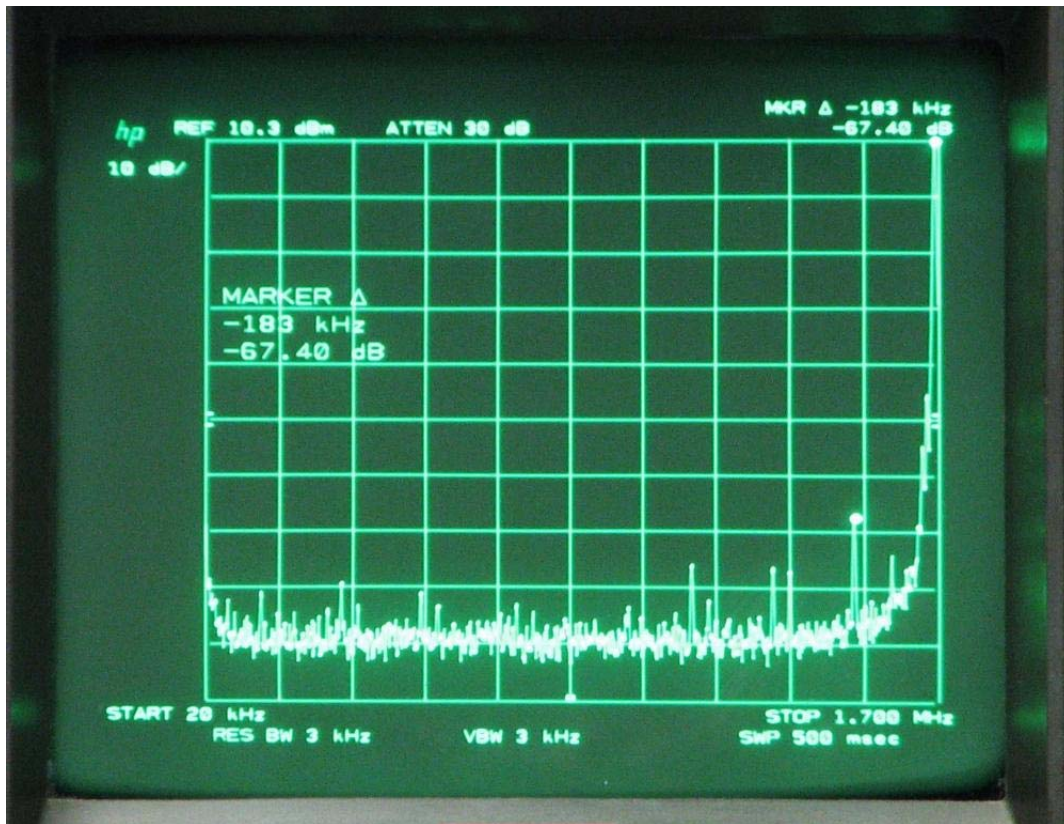
SPAN 25.00 kHz

SWP 7.5 sec

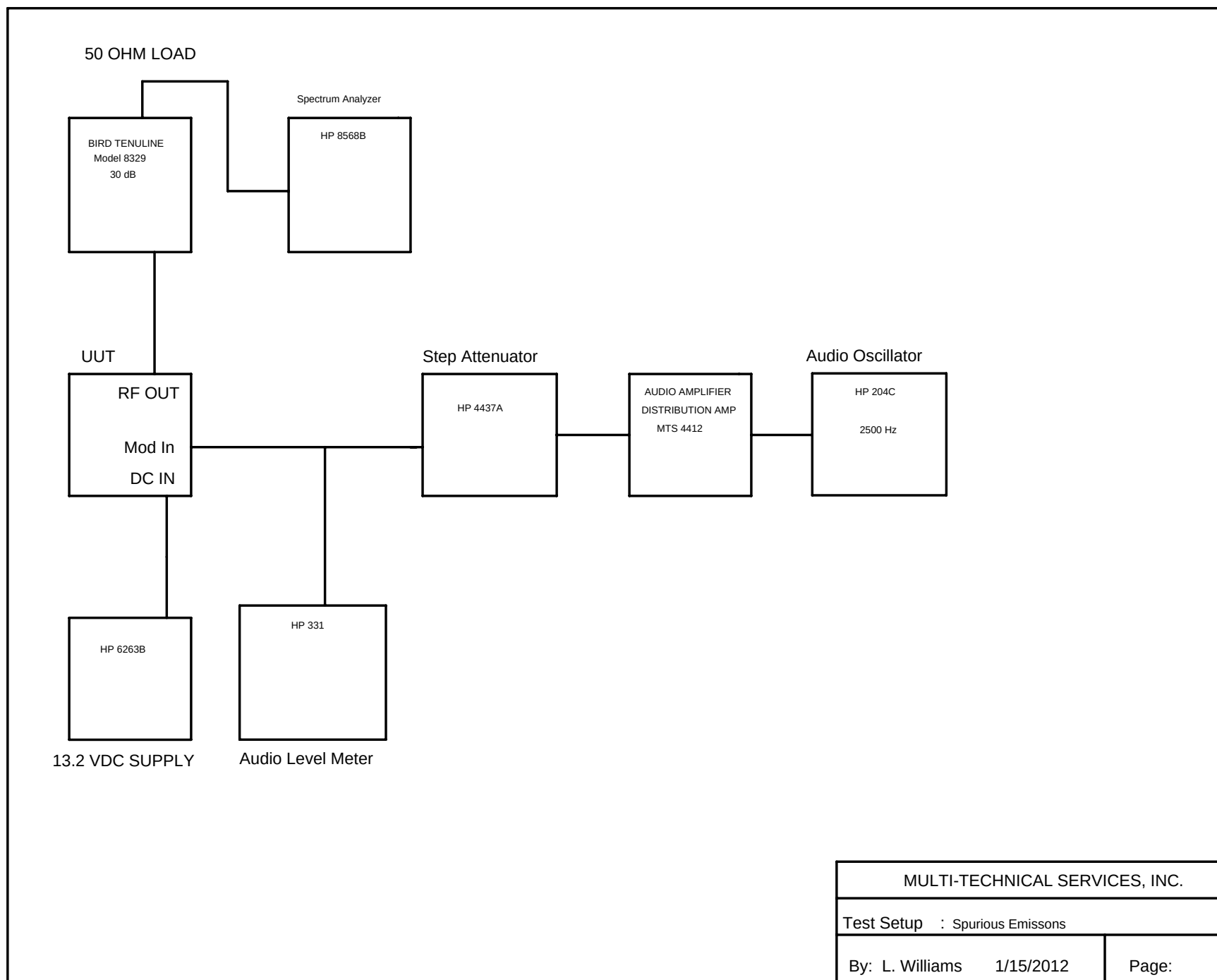
2.1051 Measurements required: Spurious emissions at antenna terminals.

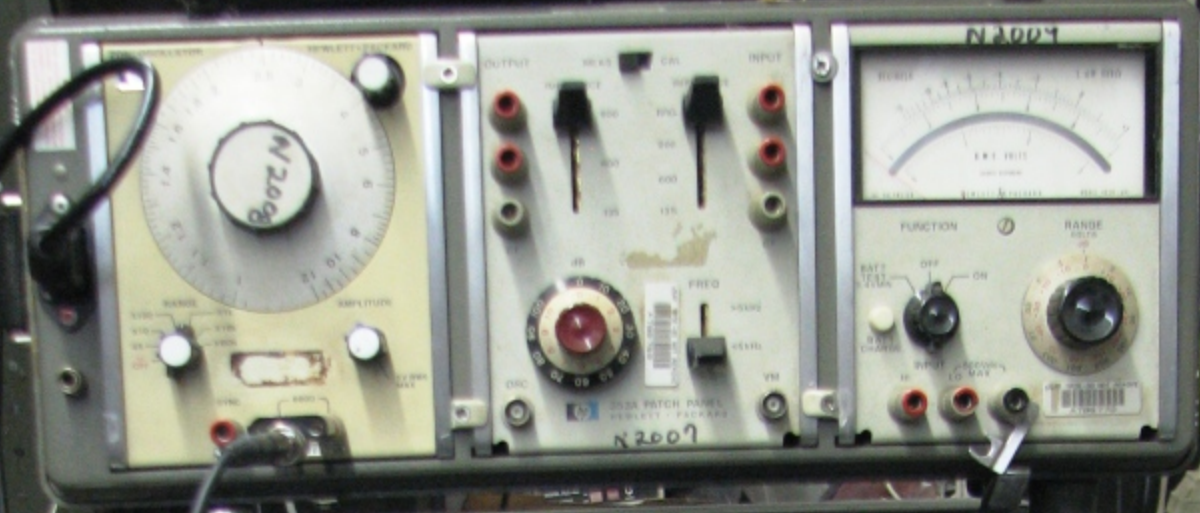
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.





No spurious emission within 20dB of the allowable -40 dBc.





2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30DEG to +50DEG centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10DEG centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0DEG centigrade and +30DEG centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10DEG centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

Temperature stabilization time at component surface temperature for each measurement was 10 minutes.

Temperature probe attached to printed circuit board surface 0.5" below TCXO

Supply voltage 13.2 Volts DC

Tolerance Requirement: 47CFR 90.242 (b) (2): A frequency tolerance of 100 Hz shall be maintained.

Temperature Range: 47CFR 2.1055 (a) (1) From: -30 degrees C to +50 degrees C

Temperature Interval: 47CFR 2.1055 (b) at the extremes of the specified temperature range and at intervals of not more than 10 degrees C through the range.

Carrier Frequency at 20 degrees C = 530.000 KHz at 10 watts

Degrees C	Carrier frequency in KHz	Time / Date
-30	530.000	3:32/3:42 10-27-2011
-20	530.000	4:39/4:49 10-27-2011
-10	530.001	11:35/11:46 10-28-2011
0	530.000	1:50/2:01 10-28-2011
10	530.000	3:13/3:23 10-28-2011
20	530.000	4:14/4:25 10-28-2011
30	530.001	10:49/11:02 10-31-2011
40	530.000	11:52/12:03 10-31-2011
50	530.001	1:43/1:56 10-31-2011

Carrier Frequency at 20 degrees C = 1120.000 KHz at 10 watts

Degrees C	Carrier frequency in KHz	Time / Date
-30	1120.001	3:45/3:55 10-27-2011
-20	1120.001	4:52/5:03 10-27-2011
-10	1120.001	11:50/12:00 10-28-2011
0	1120.000	2:05/2:11 10-28-2011
10	1120.001	3:25/3:35 10-28-2011
20	1120.000	4:30/4:41 10-28-2011
30	1120.001	11:05/11:17 10-31-2011
40	1120.000	12:45/12:55 10-31-2011
50	1120.001	1:59/2:11 10-31-2011

Carrier Frequency at 20 degrees C = 1700.000 KHz at 10 watts

Degrees C	Carrier frequency in KHz	Time / Date
-30	1700.001	3:20/3:30 10-27-2011
-20	1700.000	4:27/4:37 10-27-2011
-10	1700.001	11:10/11:20 10-28-2011
0	1700.001	1:35/1:45 10-28-2011
10	1700.001	3:00/3:12 10-28-2011
20	1700.000	4:00/4:11 10-28-2011
30	1700.001	10:30/10:42 10-31-2011
40	1700.001	11:40/11:51 10-31-2011
50	1700.000	1:30/1:41 10-31-2011

Requirement: vary primary supply voltage from 85 to 115 % of the nominal supply voltage as measured at the power supply.

Nominal Supply Voltage = 13.2 VDC

Ambient Temperature = 22 degrees C

Range = 11.2 to 15.8 VDC in .2 VDC increments

Carrier Frequency = 530.000 KHz

Supply Voltage	Carrier frequency in KHz
11.200	530.000
11.400	530.001
11.600	530.000
11.800	530.000
12.000	530.000
12.200	530.000
12.400	530.000
12.600	530.000
12.800	530.000
13.000	530.000
13.200	530.000
13.400	530.000
13.600	530.000
13.800	530.000
14.000	530.000
14.200	530.000
14.400	530.000
14.600	530.000
14.800	530.000
15.000	530.000
15.200	530.000
15.400	530.000
15.600	530.000
15.800	530.000

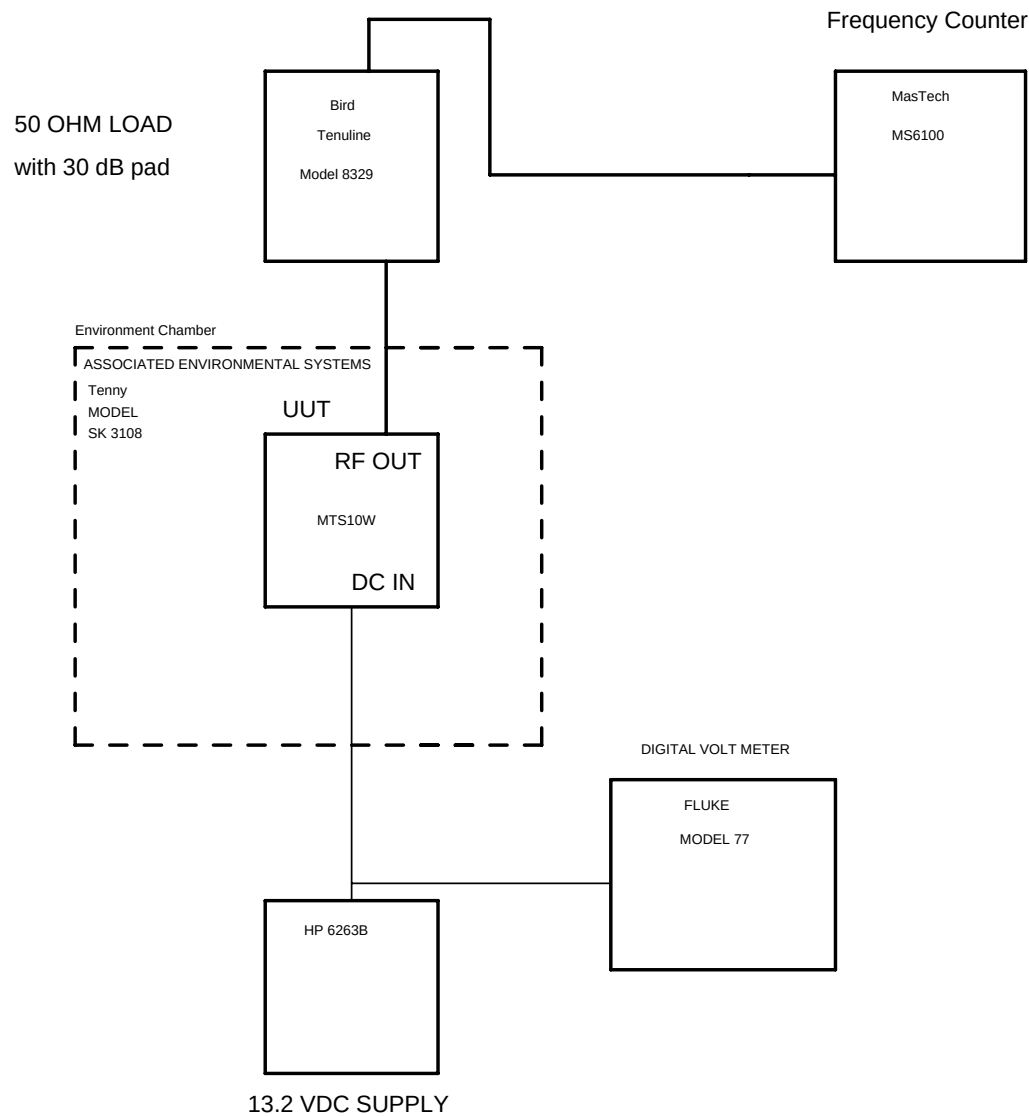
Carrier Frequency = 1120.000 KHz

Supply Voltage	Carrier frequency in KHz
11.200	1120.001
11.400	1120.000
11.600	1120.000
11.800	1120.000
12.000	1120.000
12.200	1120.000
12.400	1120.001
12.600	1120.000
12.800	1120.000
13.000	1120.000
13.200	1120.000
13.400	1120.000
13.600	1120.000

13.800	1120.000
14.000	1120.000
14.200	1120.001
14.400	1120.000
14.600	1120.000
14.800	1120.000
15.000	1120.000
15.200	1120.001
15.400	1120.000
15.600	1120.000
15.800	1120.000

Carrier Frequency = 1700.000 KHz

Supply Voltage	Carrier frequency in KHz
11.200	1700.000
11.400	1700.000
11.600	1700.001
11.800	1700.001
12.000	1700.000
12.200	1700.000
12.400	1700.000
12.600	1700.001
12.800	1700.000
13.000	1700.000
13.200	1700.000
13.400	1700.001
13.600	1700.000
13.800	1700.000
14.000	1700.001
14.200	1700.000
14.400	1700.000
14.600	1700.000
14.800	1700.001
15.000	1700.000
15.200	1700.000
15.400	1700.000
15.600	1700.001
15.800	1700.000



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Test Setup : Frequency Stability		
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MTS10W in test chamber



Test equipment setup



Test equipment setup 2

2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in § § 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

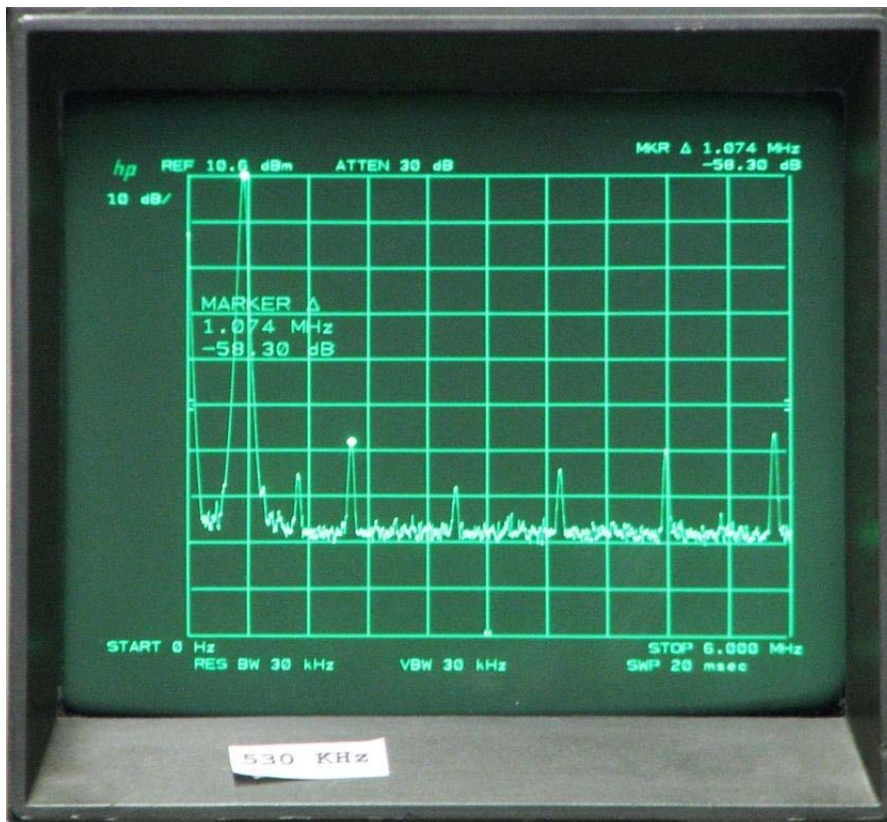
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

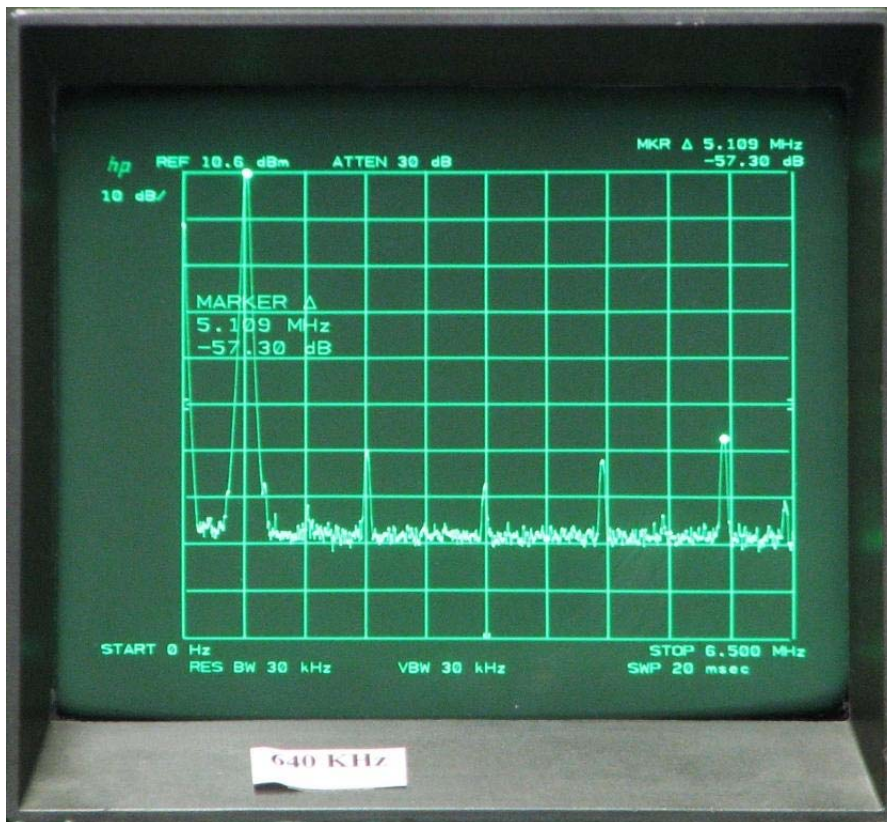
Frequency 530 KHz

2 nd harmonic	-66.5	dBc
3 rd harmonic	-58.3	dBc
4 th harmonic	n/a	dBc
5 th harmonic	-68.3	dBc
6 th harmonic	n/a	dBc
7 th harmonic	-64.9	dBc
8 th harmonic	n/a	dBc
9 th harmonic	-60.1	dBc
10 th harmonic	-74.4	dBc



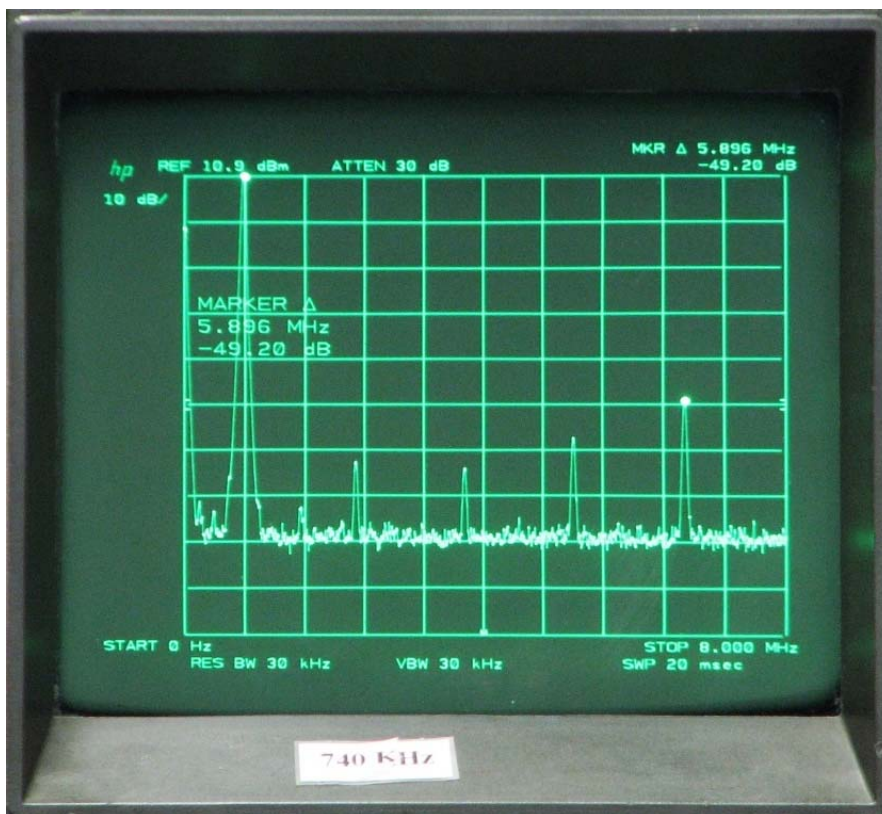
Frequency 640 KHz

2 nd harmonic	-72.2	dBc
3 rd harmonic	-60	dBc
4 th harmonic	-76.9	dBc
5 th harmonic	-67.9	dBc
6 th harmonic	n/a	dBc
7 th harmonic	-62.6	dBc
8 th harmonic	-74.2	dBc
9 th harmonic	-57.3	dBc
10 th harmonic	-70.6	dBc



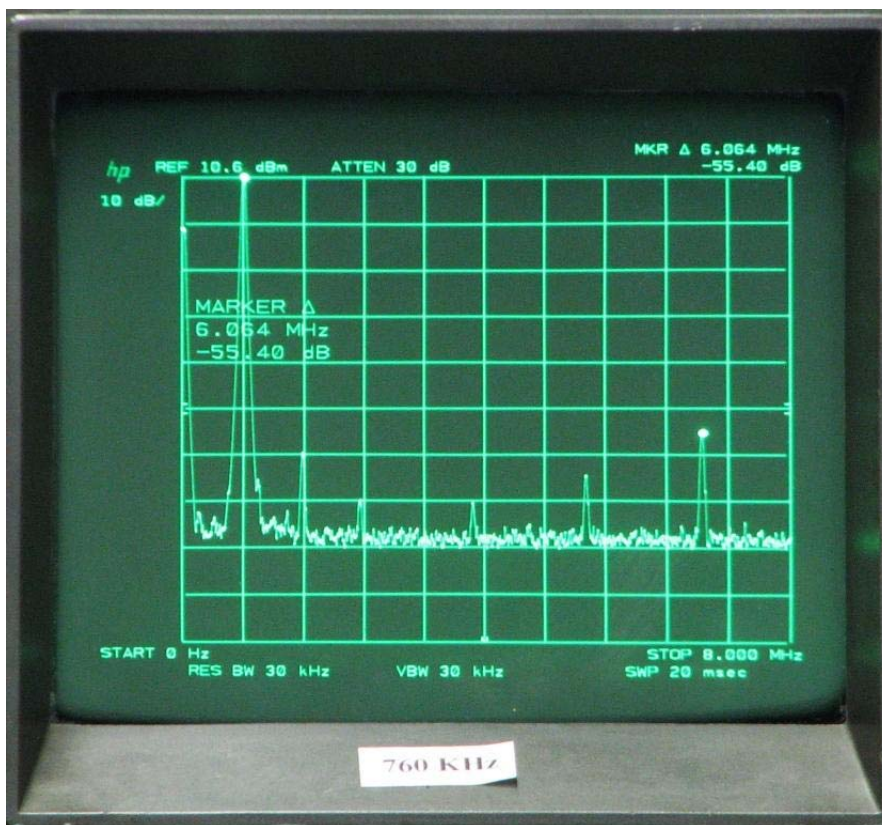
Frequency 740 KHz

2 nd harmonic	-72.7	dBc
3 rd harmonic	-62.7	dBc
4 th harmonic	-76.3	dBc
5 th harmonic	-64.2	dBc
6 th harmonic	-75	dBc
7 th harmonic	-57.4	dBc
8 th harmonic	n/a	dBc
9 th harmonic	-49.2	dBc
10 th harmonic	-75.4	dBc



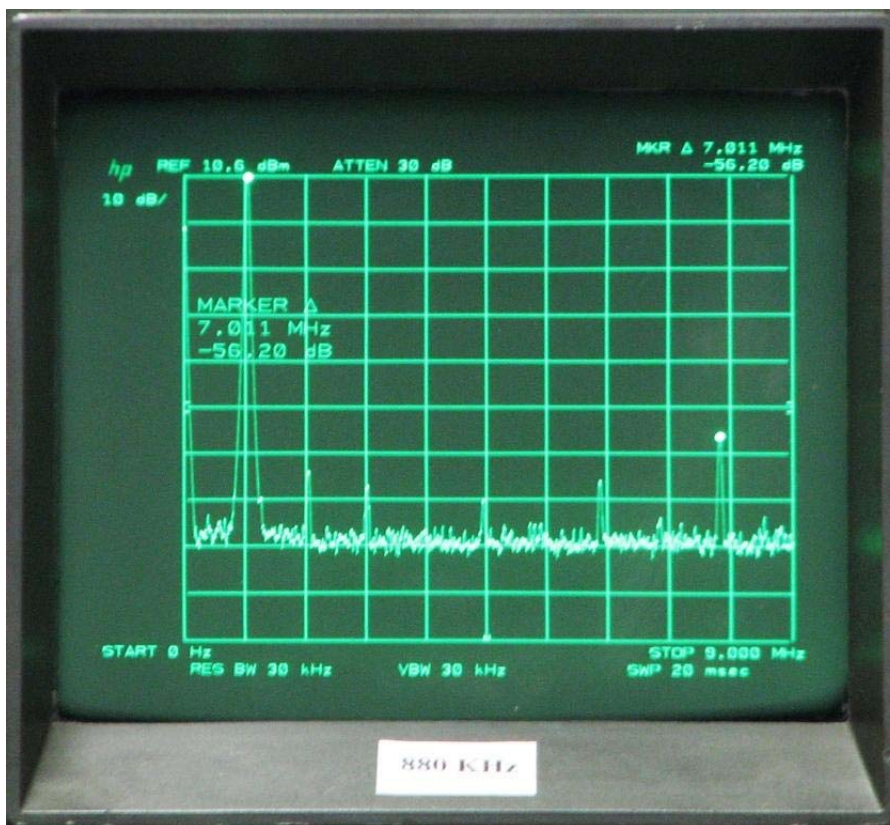
Frequency 760 KHz

2 nd harmonic	-59.9	dBc
3 rd harmonic	-70.7	dBc
4 th harmonic	n/a	dBc
5 th harmonic	-70.5	dBc
6 th harmonic	-76.2	dBc
7 th harmonic	-64.7	dBc
8 th harmonic	-76.3	dBc
9 th harmonic	-55.4	dBc
10 th harmonic	n/a	dBc



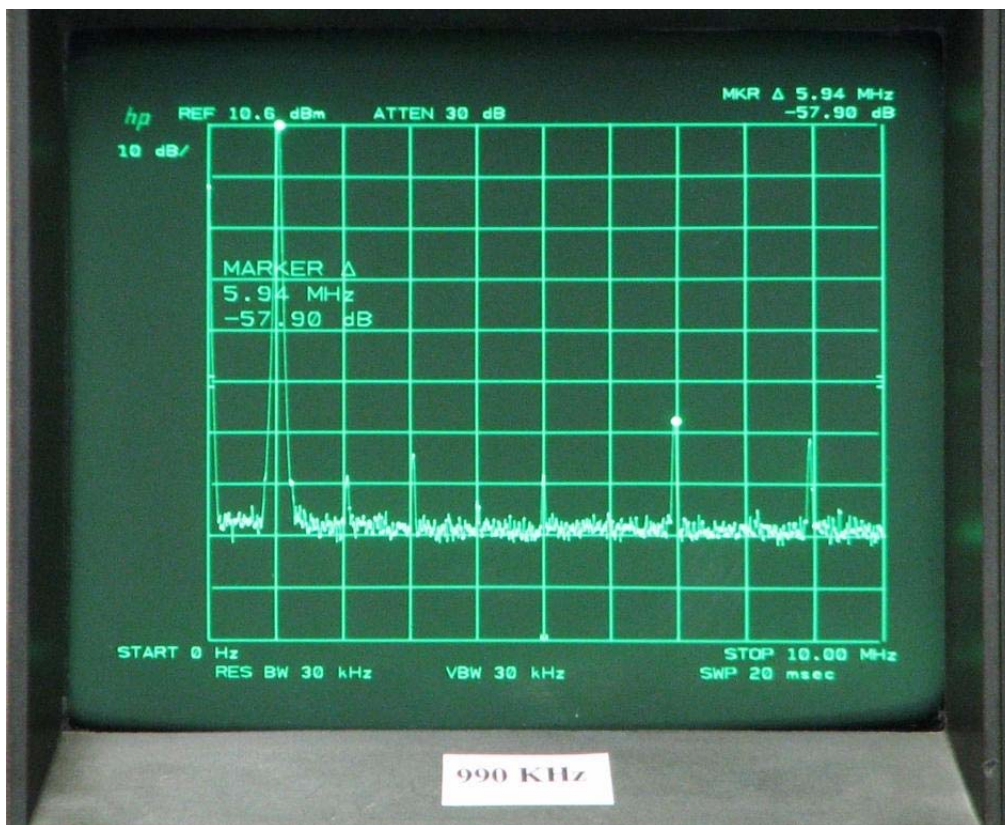
Frequency 880 KHz

2 nd harmonic	-64.6	dBc
3 rd harmonic	-67.1	dBc
4 th harmonic	-77.2	dBc
5 th harmonic	-70.6	dBc
6 th harmonic	-75.6	dBc
7 th harmonic	-66	dBc
8 th harmonic	-73.9	dBc
9 th harmonic	-56.2	dBc
10 th harmonic	-75.6	dBc



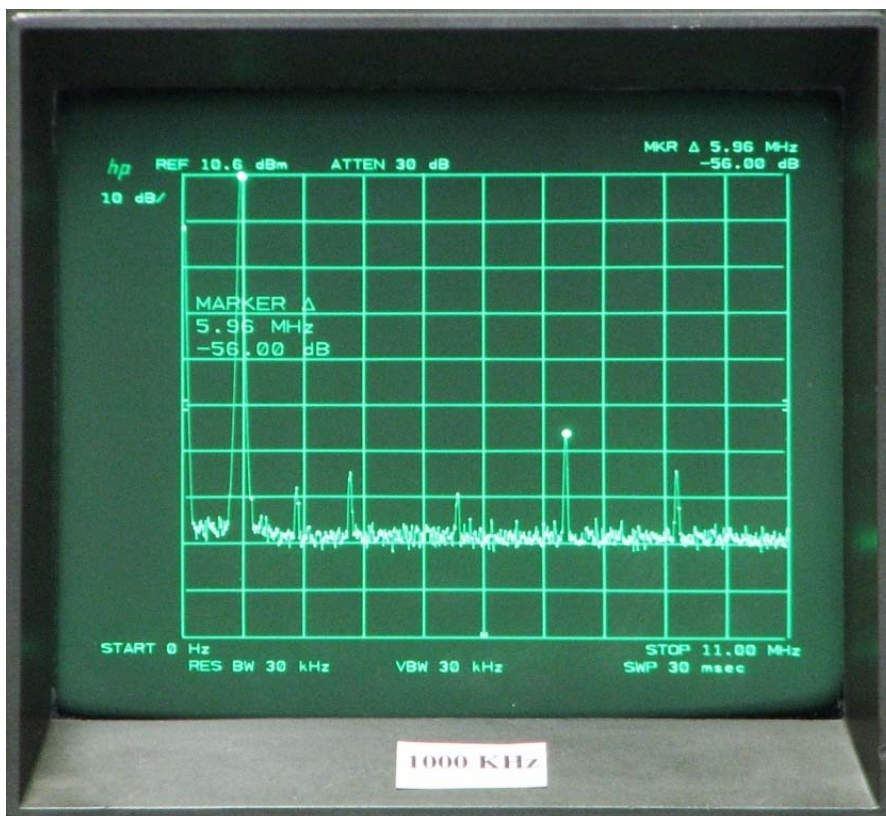
Frequency 990 KHz

2 nd harmonic	-69.7	dBc
3 rd harmonic	-64.8	dBc
4 th harmonic	-73.7	dBc
5 th harmonic	-69.6	dBc
6 th harmonic	-77.6	dBc
7 th harmonic	-57.9	dBc
8 th harmonic	-75.2	dBc
9 th harmonic	-62.1	dBc
10 th harmonic	n/a	dBc



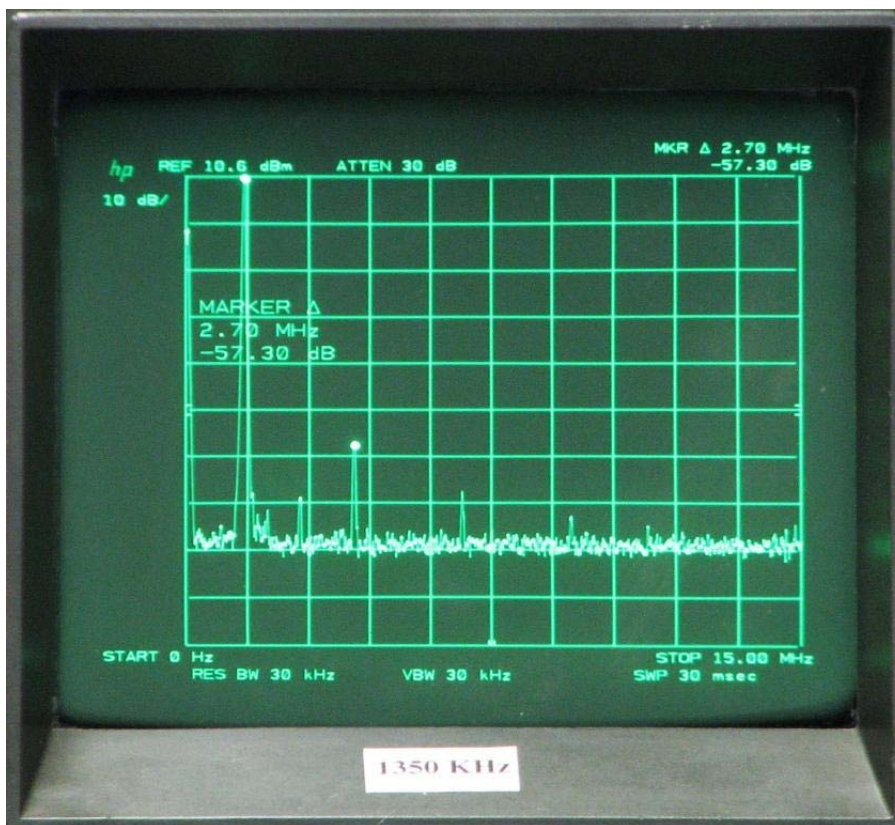
Frequency 1000 KHz

2 nd harmonic	-68	dBc
3 rd harmonic	-64.5	dBc
4 th harmonic	n/a	dBc
5 th harmonic	-64.9	dBc
6 th harmonic	-75.4	dBc
7 th harmonic	-56	dBc
8 th harmonic	-75	dBc
9 th harmonic	-64.3	dBc
10 th harmonic	n/a	dBc



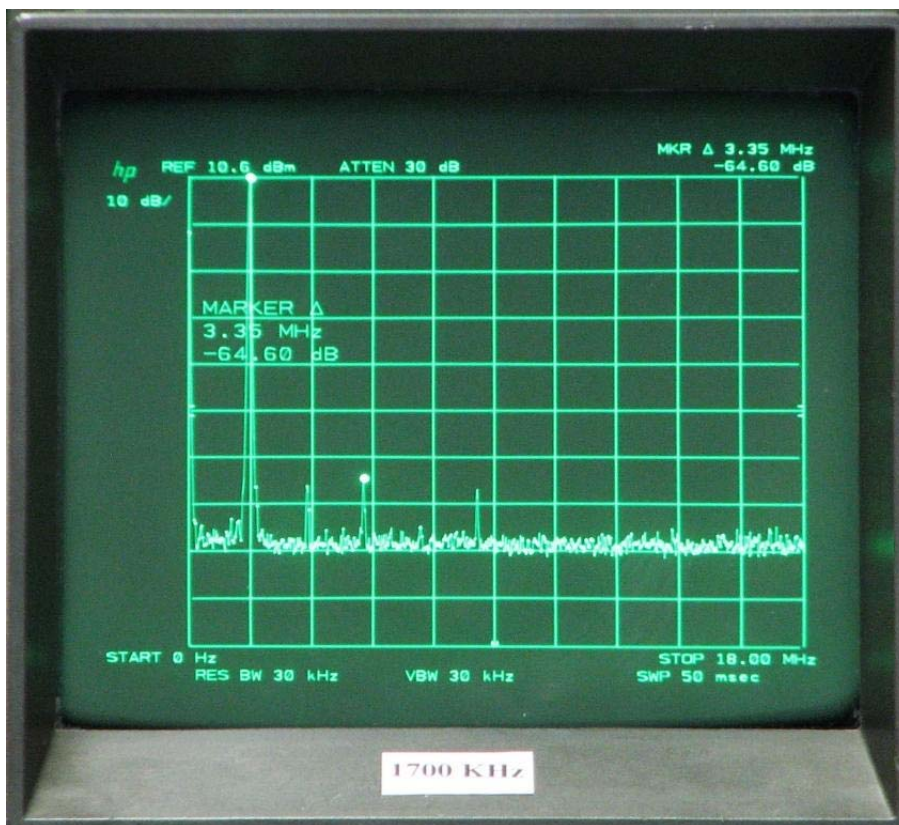
Frequency 1350 KHz

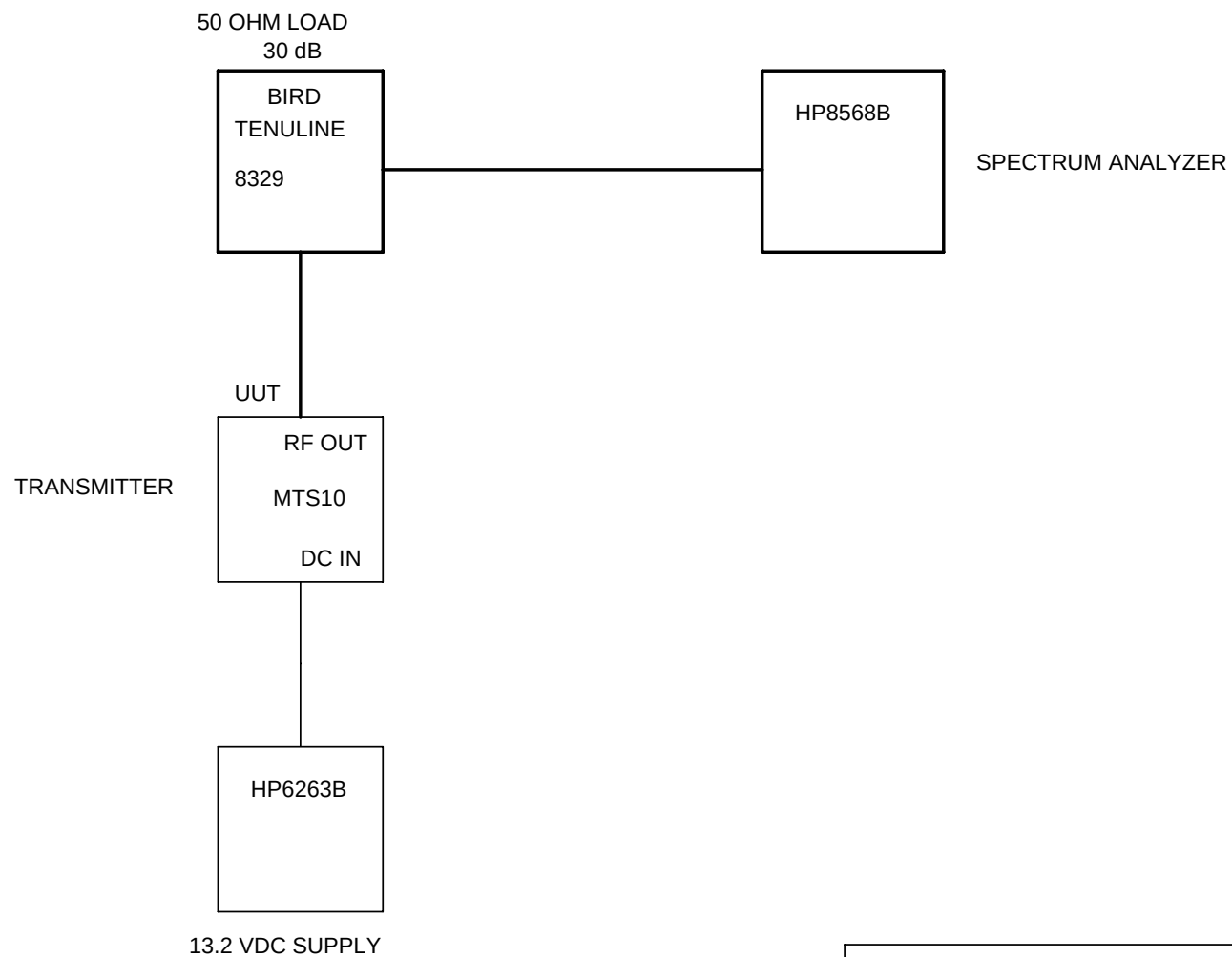
2 nd harmonic	-69.3	dBc
3 rd harmonic	-57.3	dBc
4 th harmonic	-75.8	dBc
5 th harmonic	-67.3	dBc
6 th harmonic	n/a	dBc
7 th harmonic	-72.6	dBc
8 th harmonic	-74.6	dBc
9 th harmonic	n/a	dBc
10 th harmonic	n/a	dBc



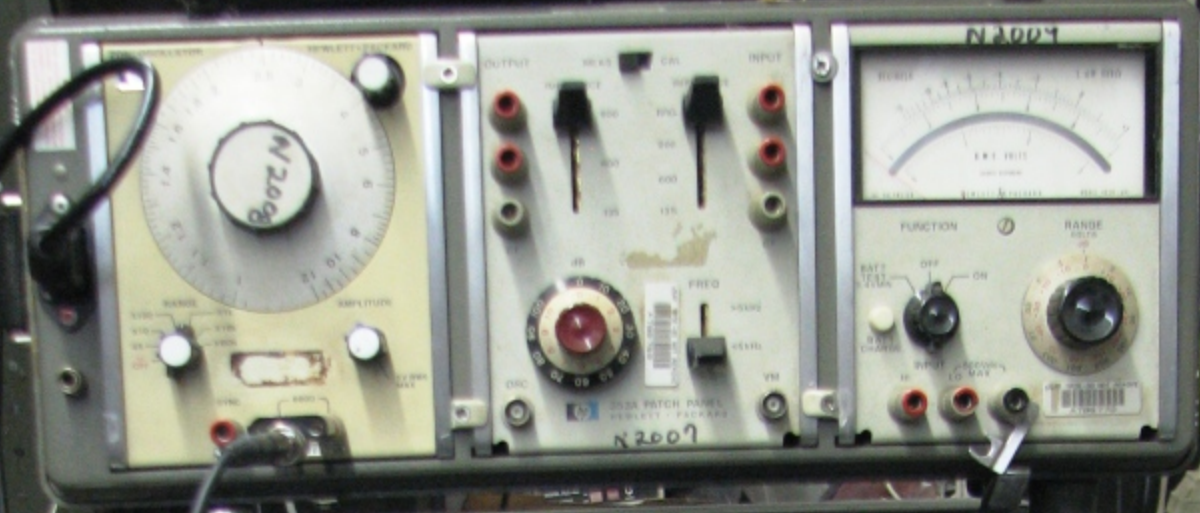
Frequency 1700 KHz

2 nd harmonic	-66.6	dBc
3 rd harmonic	-64.6	dBc
4 th harmonic	-75.1	dBc
5 th harmonic	-67.1	dBc
6 th harmonic	-78.2	dBc
7 th harmonic	n/a	dBc
8 th harmonic	n/a	dBc
9 th harmonic	n/a	dBc
10 th harmonic	n/a	dBc

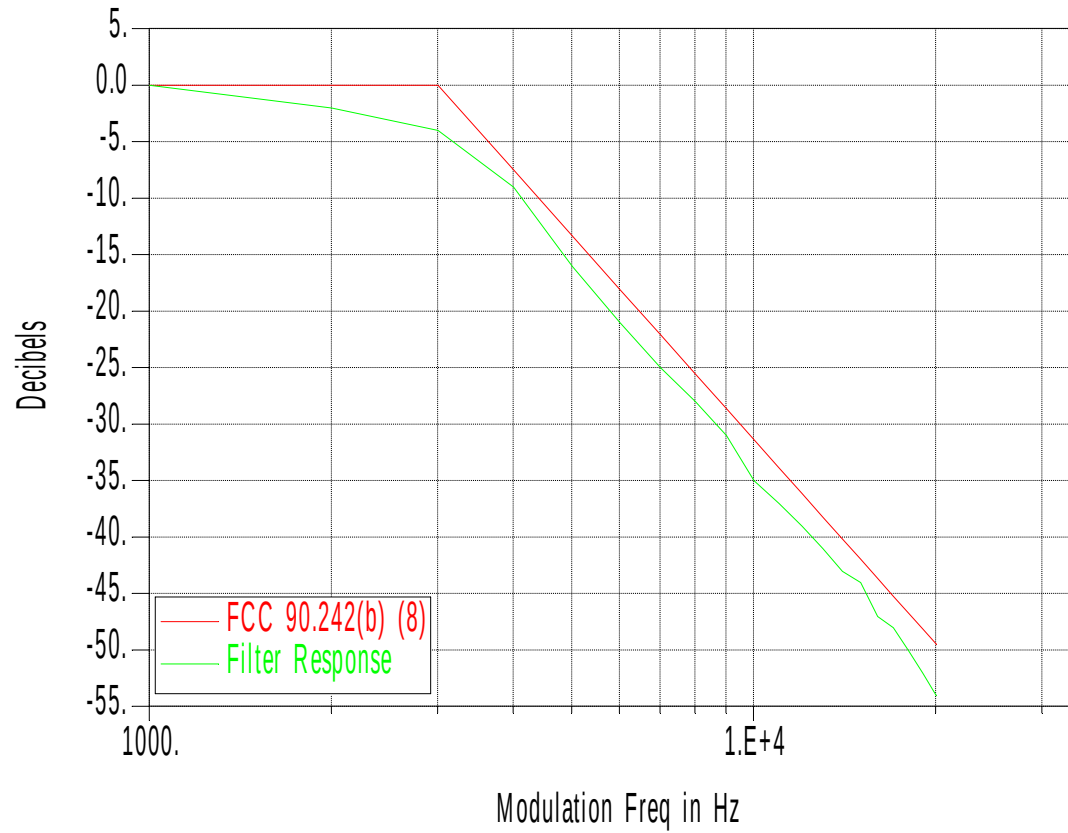


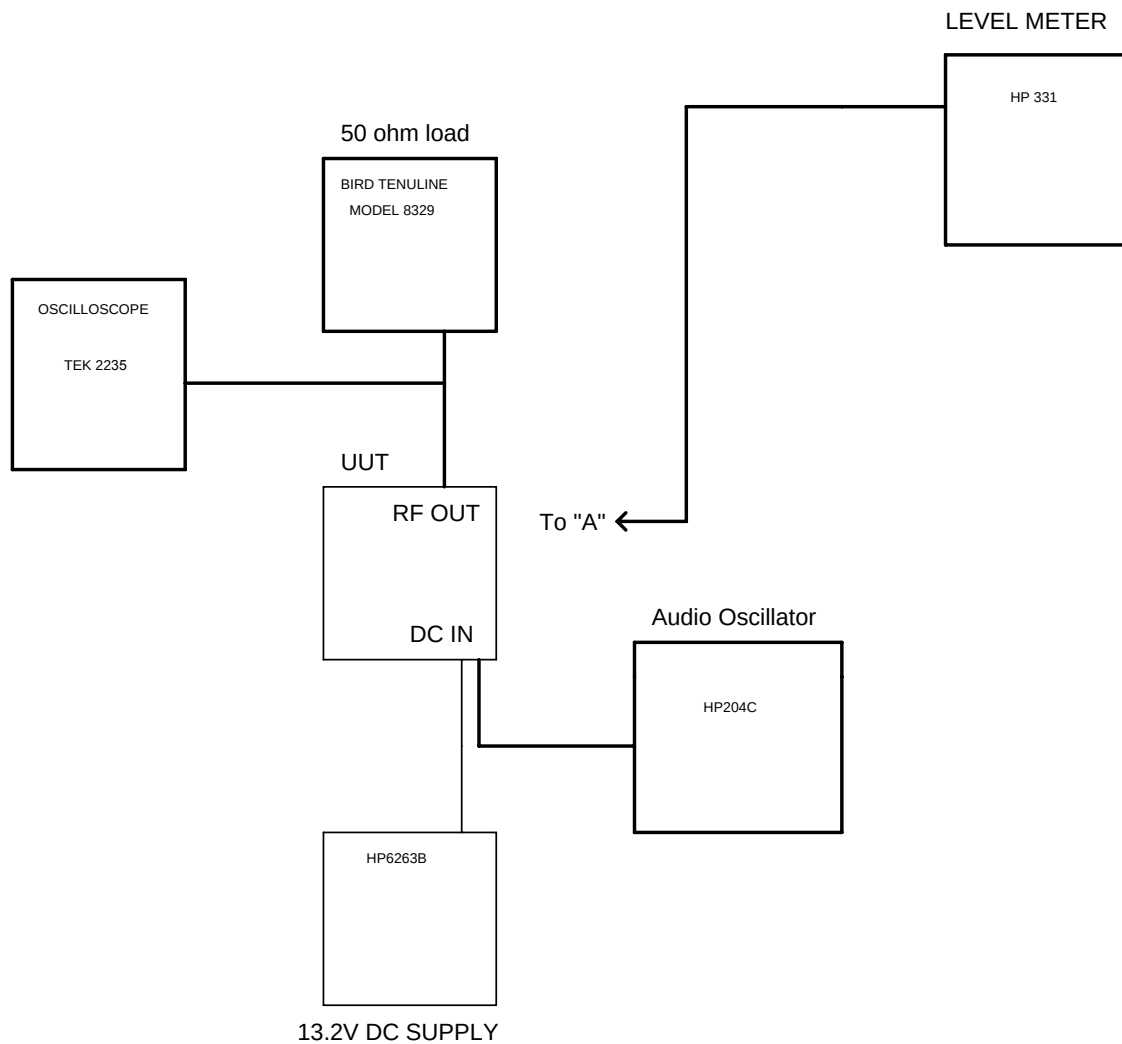


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Test Setup : Harmonic and Spurious Content		
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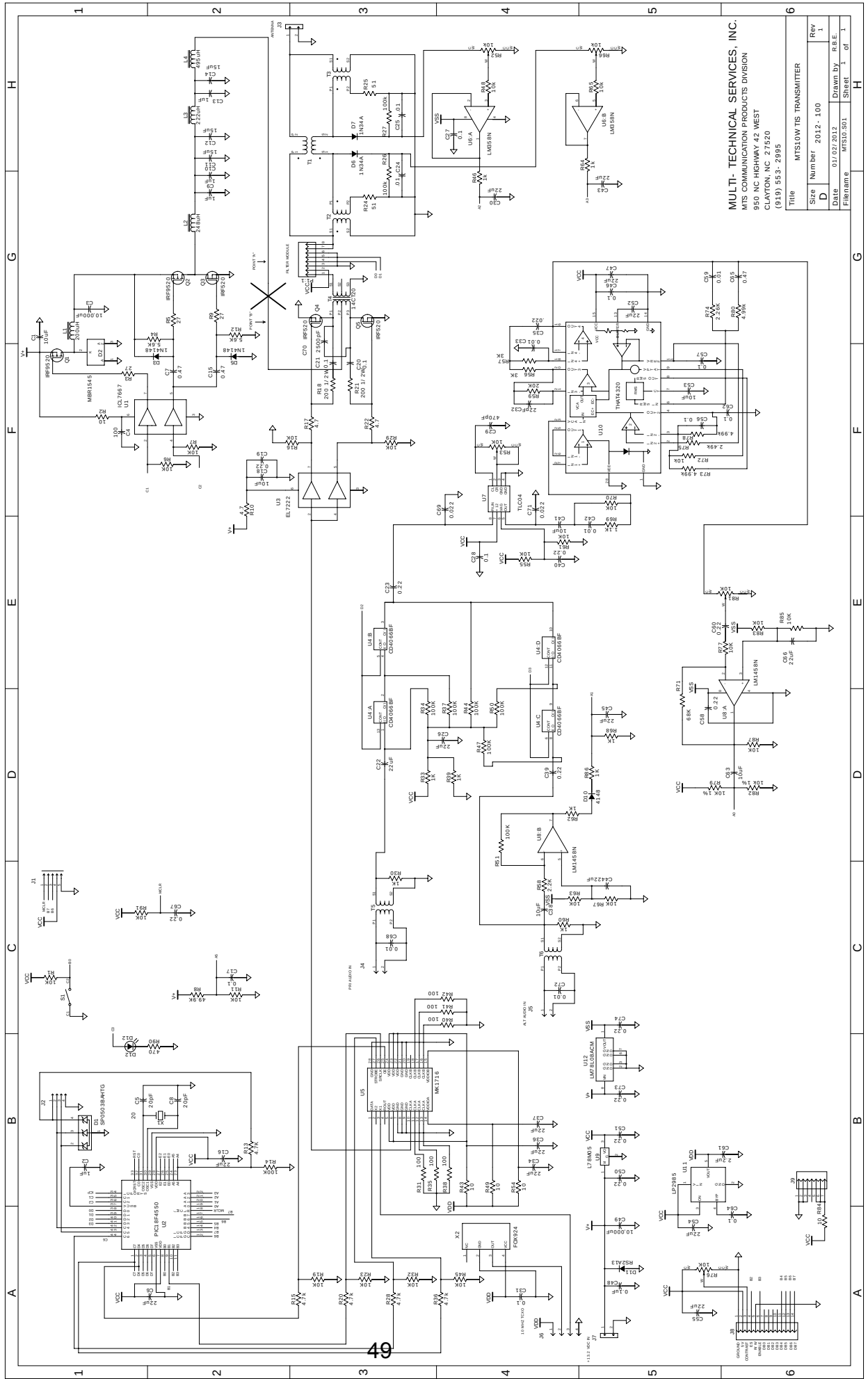


Modulation Filter Response





MULTI-TECHNICAL SERVICES, INC.		
Test Setup : Filter Response Test Setup		
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MULTI-TECHNICAL SERVICES, INC.
 MTS COMMUNICATION PRODUCTS DIVISION
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 (919) 553-2995

Title MTS10W TS TRANSMITTER			
Size	Number	2012-100	Rev
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DATE	01/27/2012	Drawn by	R.B.E.
Filename	MTS10.S01	Sheet	1 of 1

Citation: 90.242 (b) (8)

Each transmitter in a Travelers Information Station shall be equipped with an audio low-pass filter. Such filter shall be installed between the modulation limiter and the modulated stage. At audio frequencies between 3 kHz and 20 kHz this filter shall have an attenuation greater than the attenuation at 1 kHz by at least:

$60 \log_{10} (f/3)$ decibels.

where f is the audio frequency in kHz. At audio frequencies above 20 kHz, the attenuation shall be at least 50 decibels greater than the attenuation at 1 kHz.

Measurement Facilities Report

Scope

This document contains the description, location, and calibration information of the engineering laboratory at Multi-Technical Services, Inc.

Location

The engineering laboratory is located at the primary Multi-Technical Services facility located at 950 NC Highway 42 West, Clayton, NC 27520.

Physical Description

The structure at 950 NC Highway 42 West is a single story steel and brick structure. All test measurements for FCC measurement reports are conducted in the engineering lab.

Supporting Structures

The engineering work bench, a wooden structure approximately 1 meter high and 4.9 meters long, is the non-conductive support structure.

Measurement Equipment

The following test equipment is maintained at Multi-Technical Services, Inc., in the engineering lab. Each piece has been calibrated within the previous six months. All calibration procedures are the manufacturers' recommended procedures.

Device	Manufacturer	Model	Serial Number	Calibration
DVM	Fluke	77	37653186-----	6-23-2011/6-23-2012
DVM	Fluke	77	37653227-----	
RF Osc	HP	8651A	1116J00124---	6-17-2011/6-17-2012
Sig Gen	HP	8640B	2153A18338--	
Track Gen	HP	8443A	1049AQ00481	
Spec Analyzer	HP	141T	1377A-----	
RF Head	HP	8553B	954-00199----	
IF Head	HP	8552B	971-00114----	6-18-2011/6-18-2012
RF Head	HP	8554B	1245A01183---	
Attenuator	HP	4437A	1250J01629---	
Audio Osc	Eico	378	-----	6-21-2011/6-21-2012
RF Voltmeter	Boonton	92BD	1870---	
Counter	Systron Donner	6016	09012-4-----	6-15-2011/6-15-2012
Power Meter	HP	435A	1810A06428--	
Distort Analyzer	HP	330B	246-09720-----	
VTVM	HP	400L	313-25869-----	
Sig Gen	HP	606A	038-02024-----	
Audio Osc	HP	200CDR	005-26991-----	6-20-2011/6-20-2012
Audio Osc	HP	200CDR	1065-----	
Q-Meter	Boonton	160A	3753-----	
Amplifier	HP	461A	0946A07025--	
Watt meter	Bird	43	129425-----	
Counter	B&K	1827	42-03787-----	
C-Meter	Doric	130A	71759-----	
Camera	Tek	C12	021168-----	
Oscilloscope	Tek	2235	B077850-----	
Plug-In	Tek	7A12	B102838-----	
Plug-In	Tek	7A24	B061513-----	6-21-2011/6-21-2012
Plug-In	Tek	7B53A	B185489-----	
RF Load	Bird	8329	892----	6-17-2011/6-17-2012
If Head	HP	8552B	1410A06482--	
Multi-Meter	Ballantine	3025B	024-0007-----	
LF Head	HP	8556A	163A02862----	
AC Voltmeter	Ballantine	3045A	021-949-----	
VTVM	HP	400LR	313-28078-----	
RX Meter	Boonton	250A	2617-----	
Q-Meter	Boonton	190A	2218-----	
Oscilloscope	HP	1740A	1914A09014---	
FM Meter	Radio Spec	1163	3406-----	
RF Load	Bird	8340-200	1040-----	
Temp Meter	TES	TES1320	95060035-----	

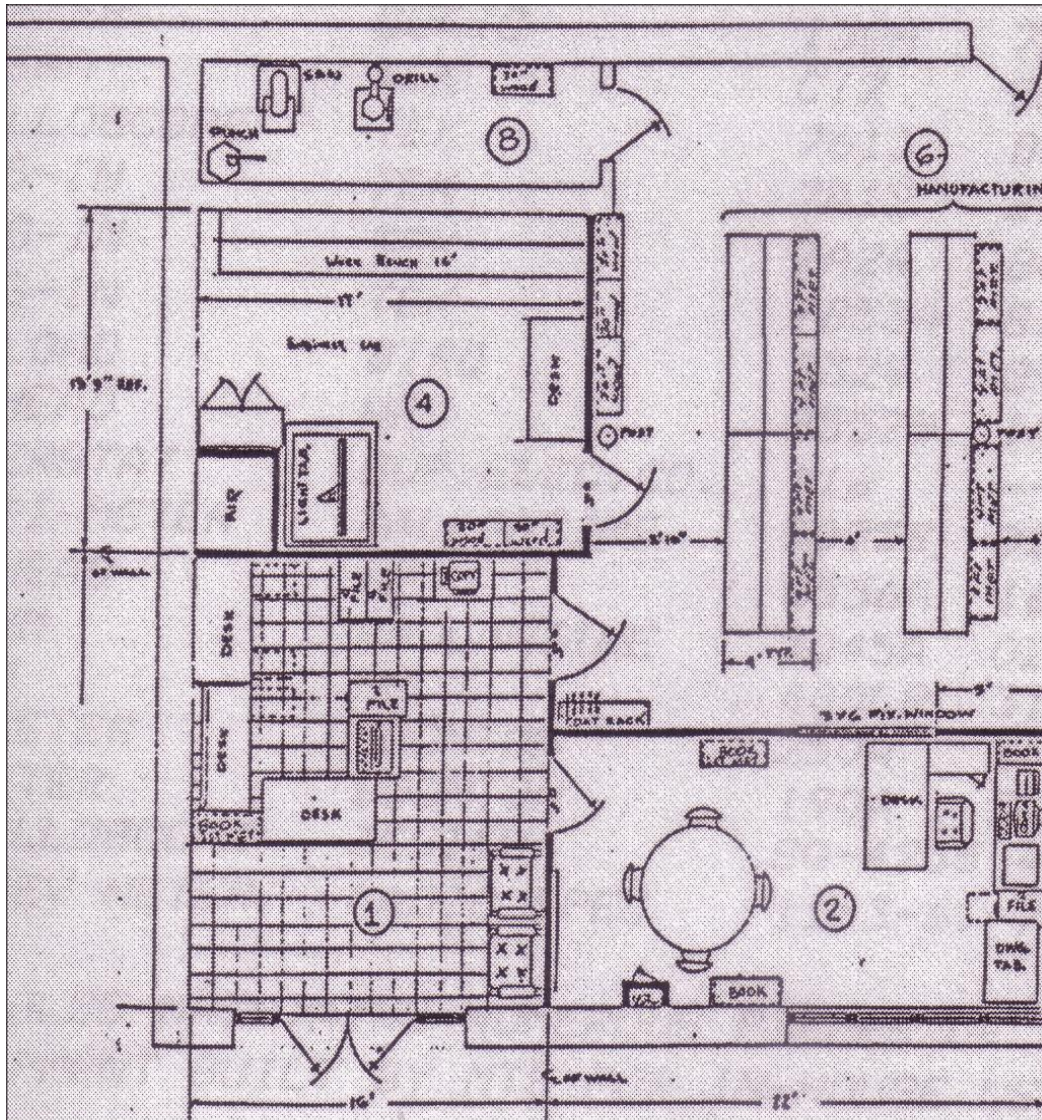
Envir Chamber	Ass.Evn.Sys	SK3108	5406-----	8-20-2011/8-20-2012
Power Supply	HP	6274B	1029A00275-----	
Power Supply	HP	6205B	7L3245-----	
Spectrum Analyzer	HP	8568B	-----	6-19-2011/6-19-2012
Sig Gen	HP	8656A	-----	6-17-2011/6-17-2012
Sig Gen	HP	8640B	-----	
Sig Gen	HP	8640B	-----	
Spectrum Analyzer	HP	8568A	-----	
Distribution Amp	MTS	4412	-----	
Freq Counter	MasTech	MS6100	-----	8-20-2011/8-20-2012
Signal Generator	HP	8656B	-----	
Signal Generator	HP	8656B	-----	
Signal Generator	HP	8656B	-----	
Signal Generator	HP	8657A	-----	
Signal Generator	HP	8658A	-----	
Power Supply	HP	6263B	-----	6-15-2011/6-15-2012
Distort Analyzer	HP	331A	0995A04910-----	6-15-2011/6-15-2012
Oscillator Test Set	HP	204C	0964A09747-----	6-17-2011/6-17-2012
Patch Panel	HP	353A	0964A09747-----	
Ammeter	Westing House	KX241	68351 -----	8-20-2011/8-20-2012

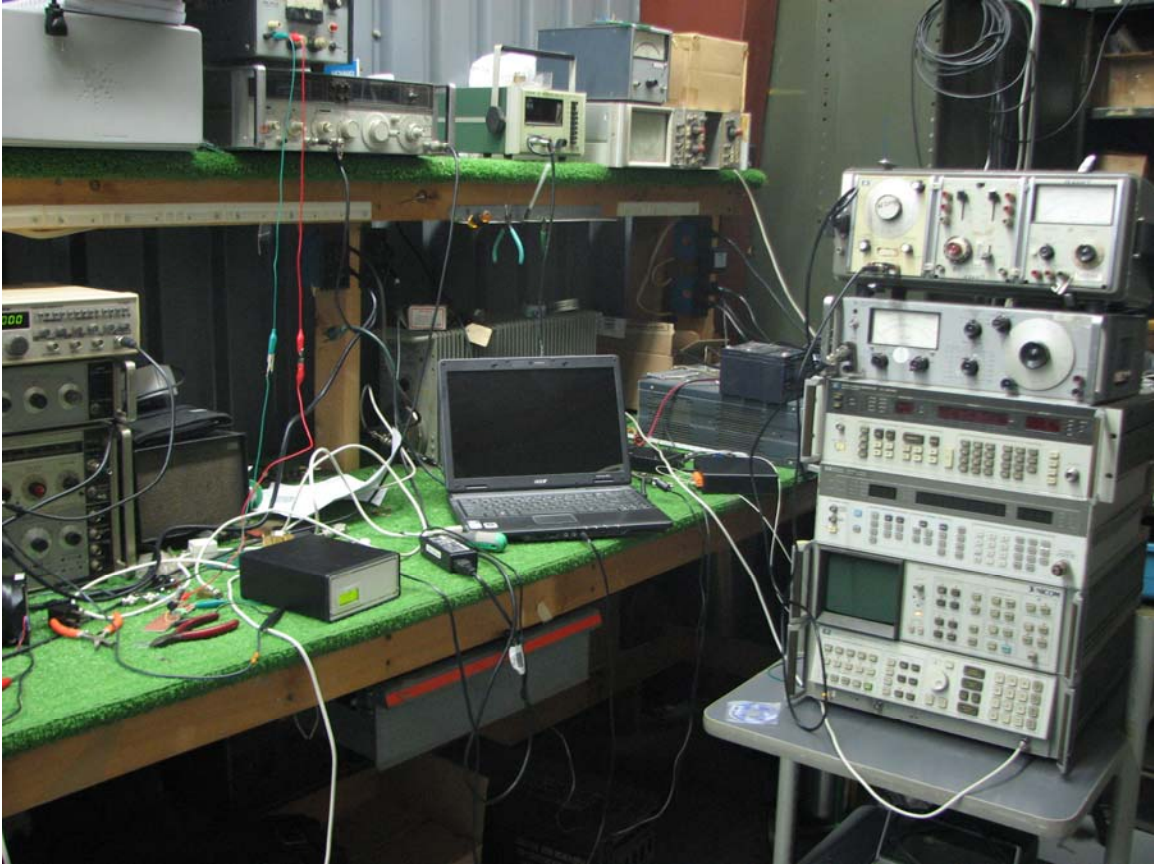
Measurement Facility Statement

MTS Chief Engineer Lynwood A. Williams holds numerous FCC licenses including a current and valid General Radio Telephone and Amateur Extra Class Licenses. Lynwood has participated in numerous FCC applications for Grant of Equipment Authorization over the past 25 years, including several similar transmitters also designed and operated under Part 90.242.

The engineering, test, and production facilities at Multi-Technical Services, Inc., are available for contract work. For details contact: Lyn Williams, Technical Director, at 919-553-2995.

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Photograph of Engineering Lab during testing phase of the MTS10W



Temperature Test Facilities at MTS as setup for MTS10W Testing

Statement per 47 CFR 90.242 (B) (3) concerning leaky cable applications:

The MTS10W is not intended for application in 'leaky cable antenna' installations. The MTS10W is intended for conventional vertical antenna installations.