TAD Radio of Canada Inc.

Model M11

Application for Certification for equipment operating under FCC 47CFR Ch.I Part 90

Compliance Test Reports

Revision 1.3

Tested December 17, 2003

Revised February 26, 2004

Approval		
Checked by	**Robert Stirling, P.Eng.**	**Date**

Protocol Labs, Abbotsford BC, Canada
FCC Registration Number 96437
Industry Canada Registration Number IC3384

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Test Facilities

Protocol Labs
28945 McTavish Rd.
Abbotsford BC, Canada, V4X 2E7

FCC Registration Number 96437
Industry Canada Registration Number IC3384

Testing Details

TESTED BY: Robert Stirling/David Johanson

TEST CONDITIONS: Temperature and Humidity: 20 C, 35%

TEST VOLTAGE: 12VDC

Test Equipment List:

Device	Model Number	Serial No.	Last Cal.	Next Cal
Antenna	EMCO 3141 Bilog	1127	10/27/03	10/27/04
LISN	Solar 8012-50-R-24-BNC	863092	10/22/03	10/22/03
Spectrum Analyzer	Hewlett Packard 8566B	2241A02102	11/14/03	11/14/04
RF-Preselector	Hewlett Packard 85685A	3107A01222	01/16/03	01/16/04
Quasi-Peak Adapter	Hewlett Packard 85650A	2043A00240	01/16/03	01/16/04
Tower	Rhientech Labs	Custom		
Turntable	Protocol	Custom		

Company Tested:

COMPANY NAME:	TAD Radio of Canada Inc.
ADDRESS:	3663 Opie Crescent Prince George, BC V2N 1B9
CONTACT PERSON:	Mike Eaket, Manager
PHONE:	1-250-564-5517

Equipment Under Test:

THE TEST SYSTEM:

EUT	TAD Radio Model M11
Manufacturer	AZDEN CORPORATION Toyohiko Tokitomo, Osamu Yokoi
Product Number	66-514-01
Auxiliary Equipment	Palm Control Microphone
Manufacturer	AZDEN CORPORATION Toyohiko Tokitomo, Osamu Yokoi
Part Number	TAD DM3S

General Information & Technical Descriptions

TYPE OF EMISSION: Wideband Channel – 25kHz channel spacing: 13K6F3E
ALLOWED AUTHORIZED BANDWIDTH = 20kHz
Bn = 2M +2DK
M = 3000
D = 3800
K = 1
Bn = 2(3000) +2(3800) = 13K6

Narrowband Channel – 12.5kHz channel spacing: 9K48F3E
ALLOWED AUTHORIZED BANDWIDTH = 11.25kHz
Bn = 2M +2DK
M = 3000
D = 1740
K = 1
Bn = 2(3000) +2(1740) = 9K480

FREQUENCY RANGE: 138-174 Mhz

POWER RANGE & CONTROLS: There are no user Power controls.

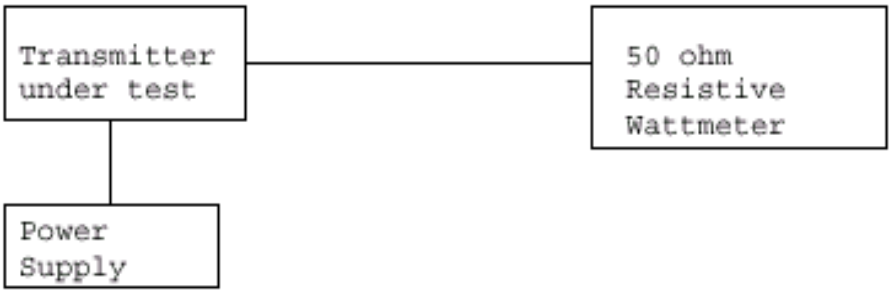
Note: in accordance with FCC Part 90.203 (e) and (g), the frequency and power of the Transmitter and Receiver is pre-programmed by the factory or authorized Dealer and assigned a Channel number of 01 to 99. The User then selects the Channel number as required and licensed for operations.

MAXIMUM OUTPUT POWER RATING:

RF power output is measured by connecting a 50 Ohm, resistance wattmeter to the RF output connector. With a nominal battery voltage of 12.0 VDC, and the transmitter properly adjusted the RF output measures.

Power Output – High power Channel 30 Watt;
Low power Channel 5 Watt

METHOD OF MEASURING RF POWER OUTPUT:



DC Voltages and Current into Final Amplifier:

Maximum POWER INPUT for 30 Watt rated output power
FINAL AMPLIFIER ONLY
Vce = 12.6VDC
IC = 7.07 A
P = 89.65 Watt

Complete circuit schematic and block diagrams:
- EXHIBIT 1 – (TADM11SCHEM.PDF)
- EXHIBIT 2 – (TADM11BLKDIA.PDF)

Function of each electron tube or semiconductor device or other active circuit device and parts list:
- EXHIBIT 3 – (TADM11PARTSLS.PDF)

Instruction and Users manual: - EXHIBIT 4 – (TADM11USERMAN.PDF)

Operational description of all circuitry and devices provided for determining and stabilizing frequency:
- EXHIBIT 5 – (TADM11OPDES.PDF)

Photographs of the equipment identification label:
- EXHIBIT 6 – (TADM11LABELLOC.PDF and TADM11LABELSMPL.PDF)

Tune-up procedures: - EXHIBIT 7 – (TADM11TUNPRO.PDF)

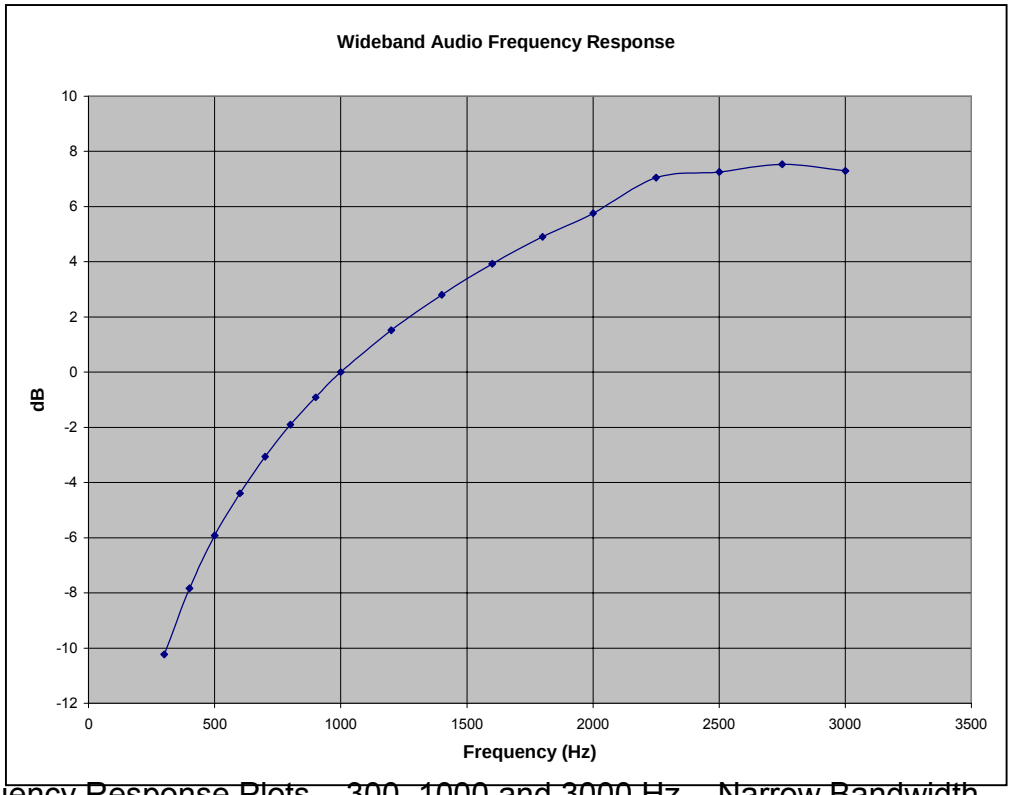
Photographs of the equipment to reveal clarity and per equipment construction, layout, label location and Test Setups:
- EXHIBIT 8 – (TADM11EXTPHO.PDF, TADM11INTPHO.PDF and TADM11TSUP)

CABLING:

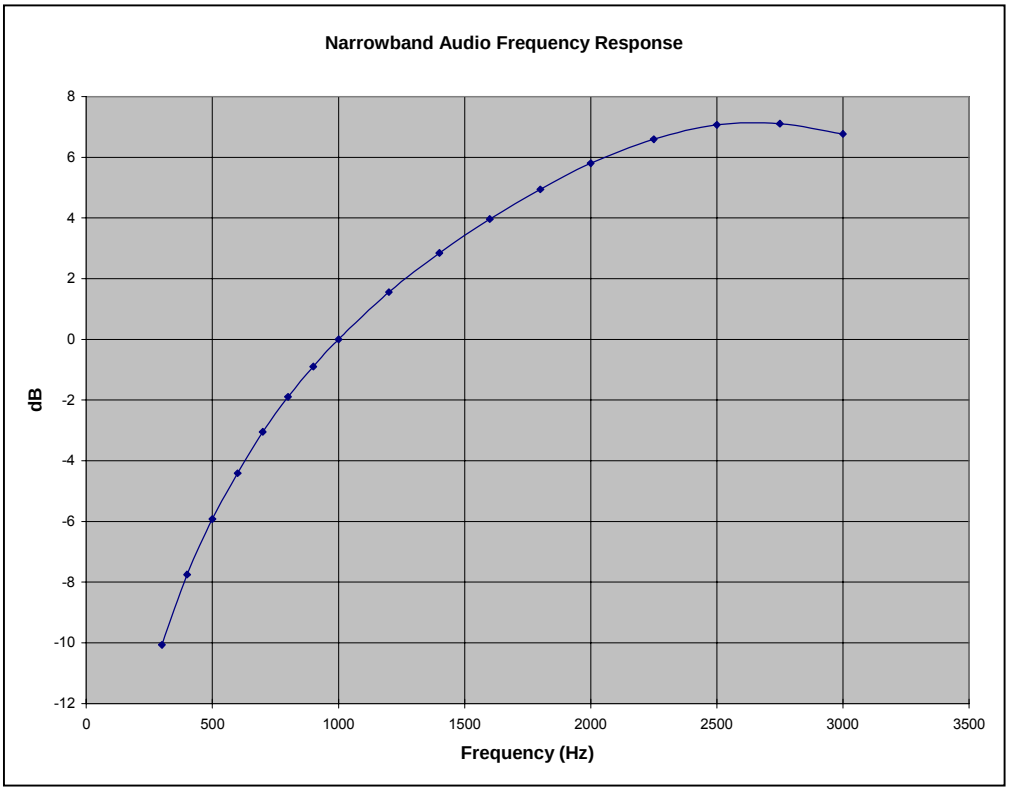
Cable	Voltage Source	Load/Termination	Ferrite	Shielded
Power Cable	12 Vdc	50 Ohm 100Watt	No	No

Voice Modulation Characteristics

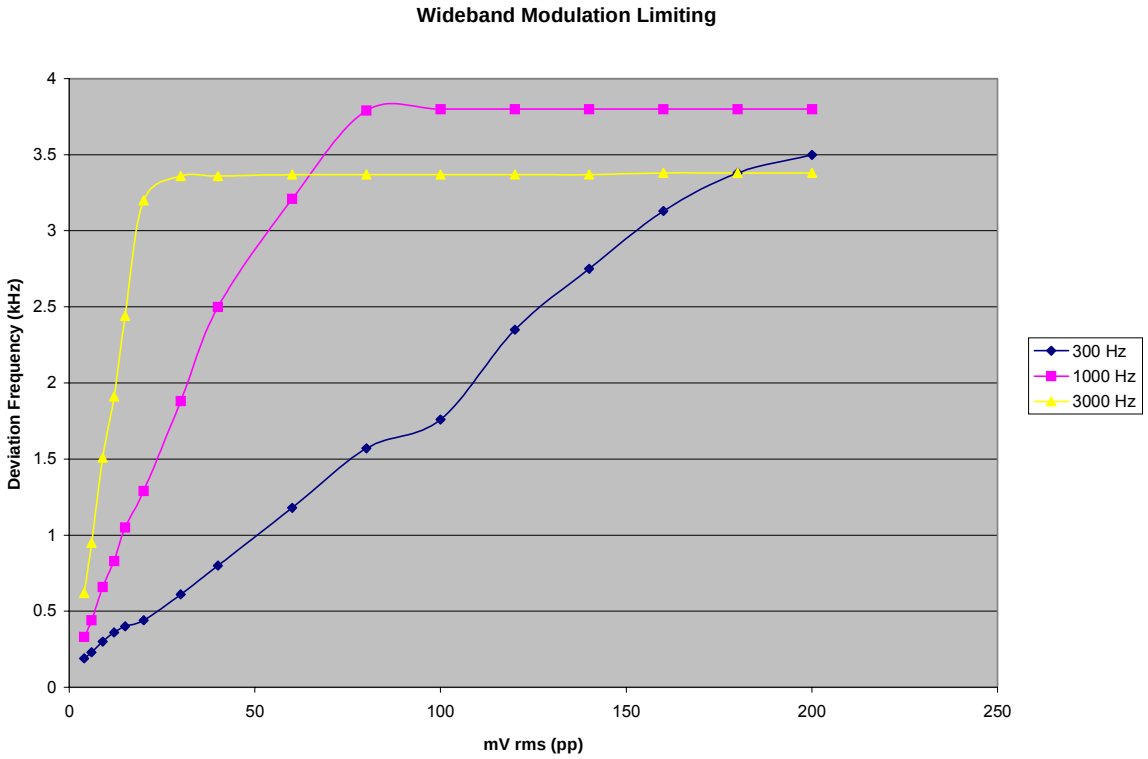
Audio Frequency Response Plots – 300, 1000 and 3000 Hz. - Wide Bandwidth



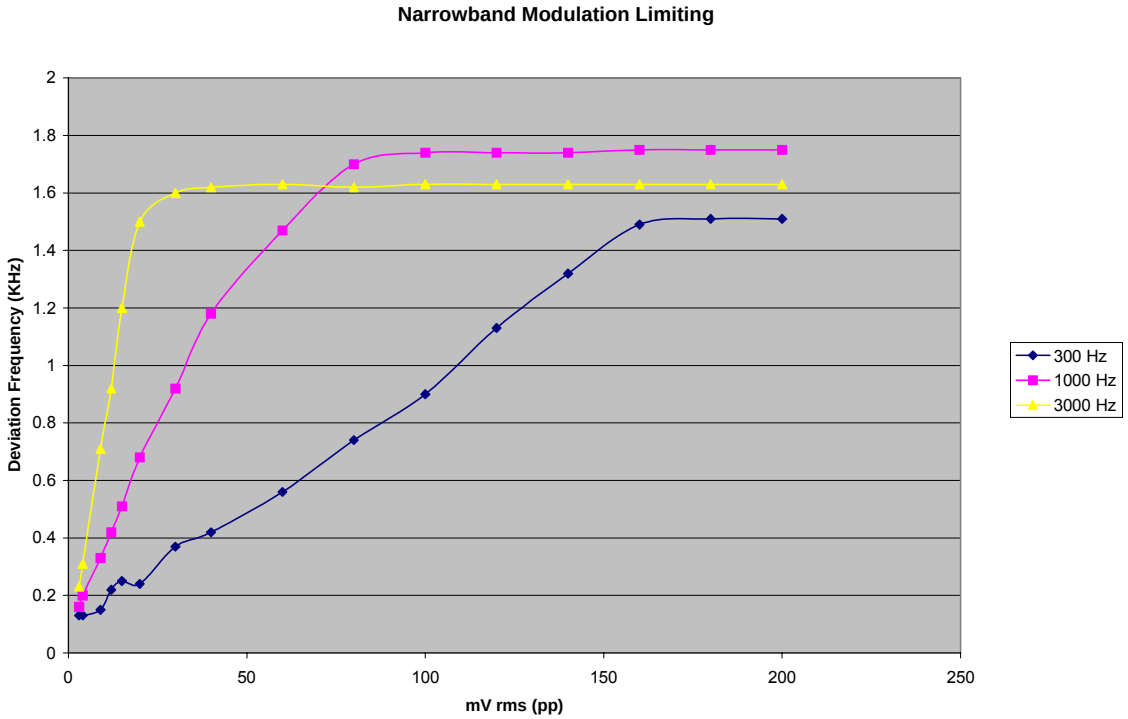
Audio Frequency Response Plots – 300, 1000 and 3000 Hz. - Narrow Bandwidth



Wideband Modulation Limiting Plots – 300, 1000 and 3000 Hz.



Narrowband Modulation Limiting Plots – 300, 1000 and 3000 Hz.



Occupied Bandwith

90.210(B) Emission Mask B – Audio Low Pass Filter; 25kHz channel bandwidth

For transmitters that are equipped with an audio low pass filter pursuant to S90.211(a), the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the assigned frequency by more then 50 percent, but not more then 100 percent of the authorized bandwidth: at least 25dB;

(2) On any frequency removed from the assigned frequency by more ten 100 percent, but not more then 250 percent of the authorized bandwidth: at least 35dB;

(3) On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 43 + 10 log (P) dB.

90.210(D) Emission Mask D – 12.5 kHz channel bandwidth equipment

For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

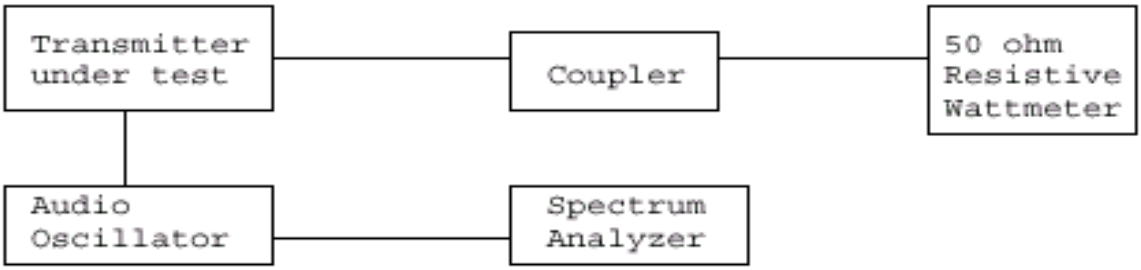
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 7.27(f_d - 2.88 kHz) dB

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Radiotelephone Transmitter with Modulation Limiter

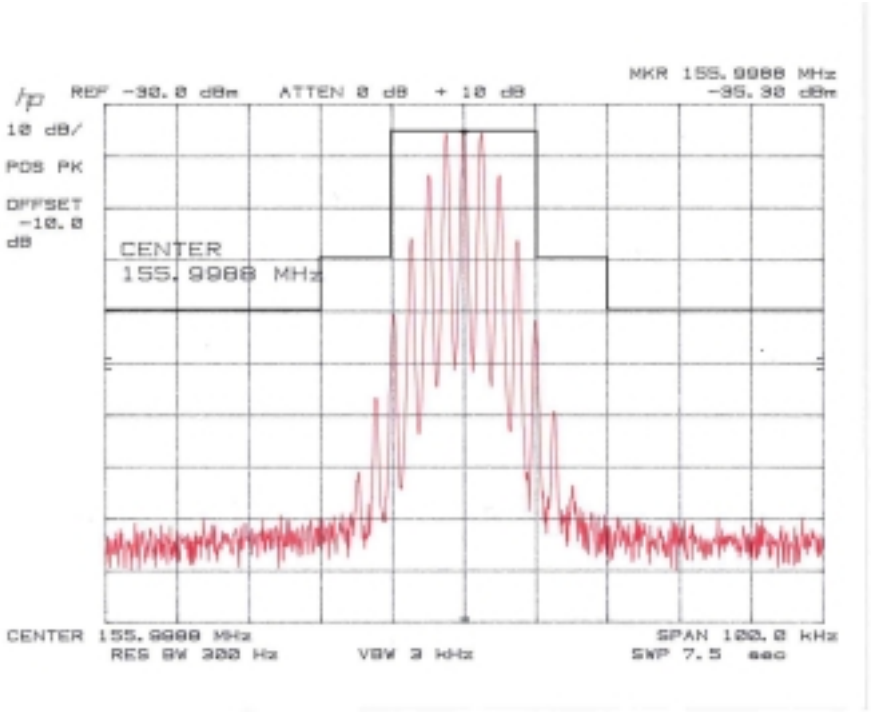
Test procedure: TIA/EIA-603-A paragraph 2.2.11.

Test procedure diagram for occupied bandwidth measurement

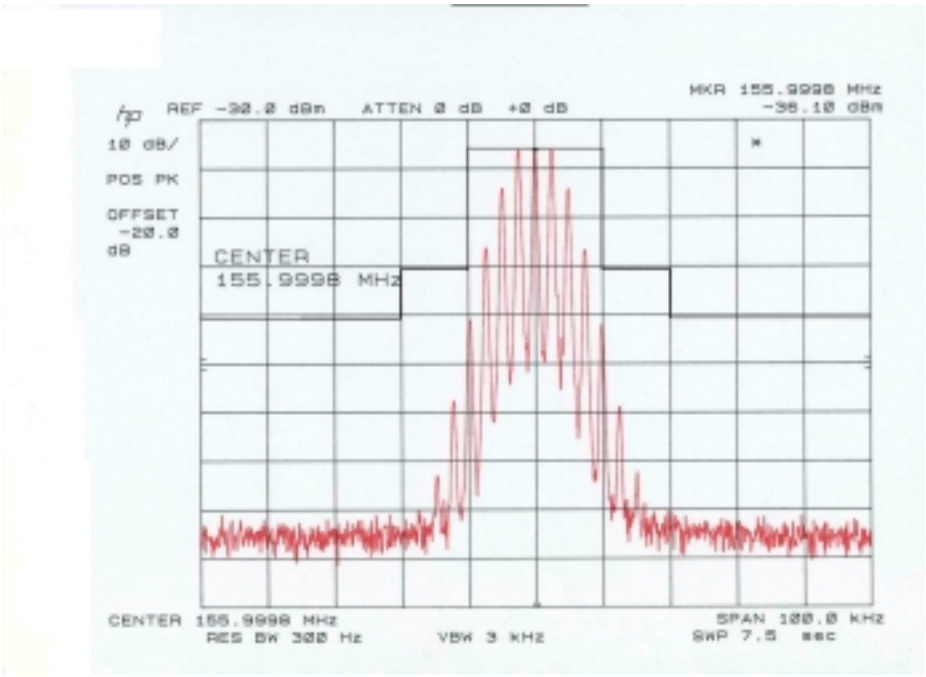


Occupied Bandwidth Plots

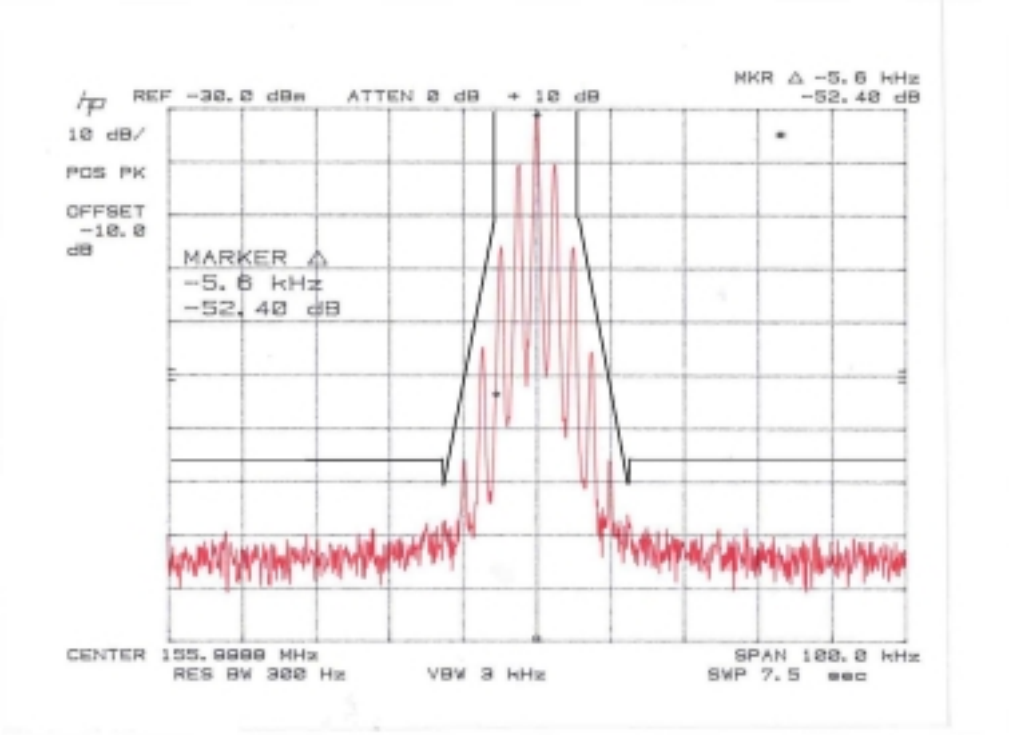
Occupied Bandwidth High Power (30W); Wide Bandwidth (25KHz); 156MHz Plot - F3E



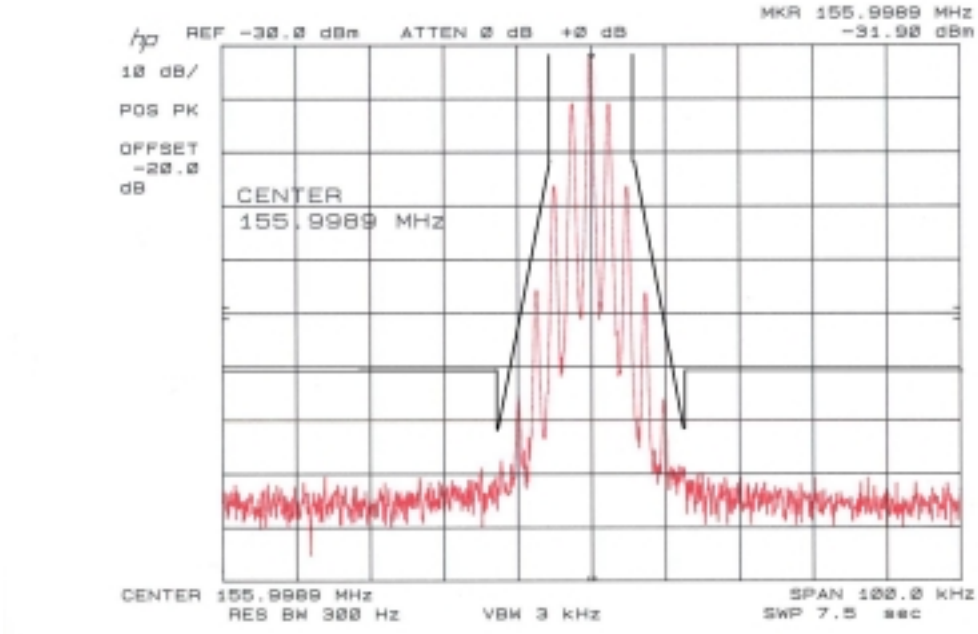
Occupied Bandwidth Low Power (5W); Wide Bandwidth (25KHz); 156MHz Plot - F3E



Occupied Bandwidth High Power (30W); Narrow Bandwidth (12.5KHz); 156MHz - F3E



Occupied Bandwidth Low Power (5W); Narrow Bandwidth (12.5KHz); 156MHz - F3E

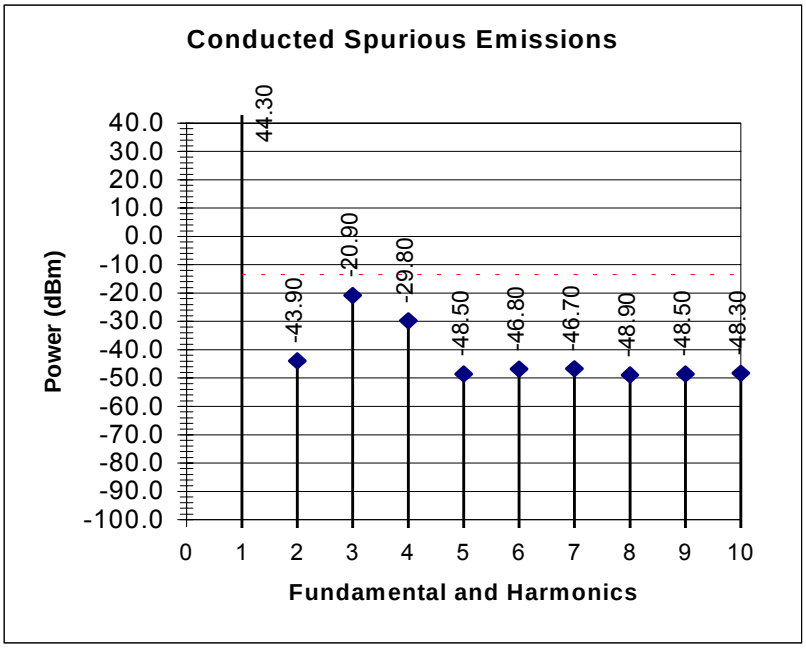


Conducted Spurious Emissions at Antenna terminals :

The following data charts the level of conducted spurious responses. The carrier, in this test, was modulated 100% using a 2.5 kHz tone. The spectrum was scanned from 0.4 to the 10th harmonic fundamental. The measurements were done in accordance with the TIA/EIA-603-A (2.2.13) Standard.

REQUIREMENTS: For 25 kHz Bandwidth High Power 43 + 10 log (30) = 43 + 14.8 = 57.8 dBc
25 kHz Bandwidth Low Power 43 + 10 log (5) = 43 + 7.0 = 50.0 dBc
12.5 kHz Bandwidth High Power 50 + 10 log (30) = 50 + 14.8 = 64.8 dBc
12.5 kHz Bandwidth Low Power 50 + 10 log (5) = 50 + 7.0 = 57.0 dBc

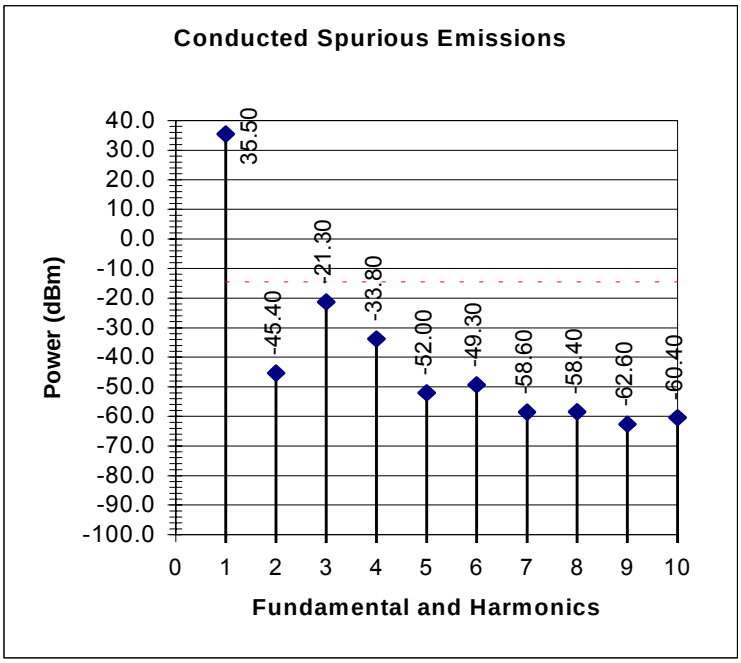
174MHz, High Power (30 W), Wide Band (25KHz)



Freq. (MHz)	Harmonic	Measured Signal (dBm)	Equipment Attenuation (dBm)	Signal (dBm)	Signal below Carrier (dBc)
174	1st	4.3	-40.0	44.3	NA
348	2nd	-83.9	-40.0	-43.9	-88.2
522	3rd	-60.9	-40.0	-20.9	-65.2
696	4th	-69.8	-40.0	-29.8	-74.1
870	5th	-88.5	-40.0	-48.5	-92.8
1044	6th	-86.8	-40.0	-46.8	-91.1
1218	7th	-86.7	-40.0	-46.7	-91.0
1392	8th	-88.9	-40.0	-48.9	-93.2
1566	9th	-88.5	-40.0	-48.5	-92.8
1740	10th	-88.3	-40.0	-48.3	-92.6

25 kHz Bandwidth High Power 43 + 10 log (30) = 43 + 14.8 = 57.8 dBc

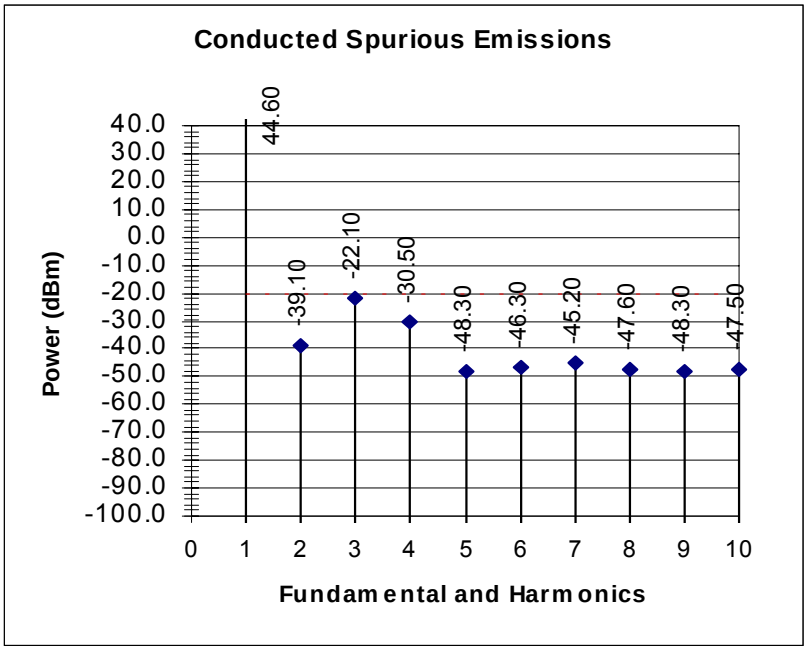
174MHz, Low Power (5W), Wide Band (25KHz)



Freq. (MHz)	Harmonic	Measured Signal (dBm)	Equipment Attenuation (dBm)	Signal (dBm)	Signal below Carrier (dBc)
174	1st	-4.5	-40.0	35.5	NA
348	2nd	-85.4	-40.0	-45.4	-80.9
522	3rd	-61.3	-40.0	-21.3	-56.8
696	4th	-73.8	-40.0	-33.8	-69.3
870	5th	-92.0	-40.0	-52.0	-87.5
1044	6th	-89.3	-40.0	-49.3	-84.8
1218	7th	-98.6	-40.0	-58.6	-94.1
1392	8th	-98.4	-40.0	-58.4	-93.9
1566	9th	-102.6	-40.0	-62.6	-98.1
1740	10th	-100.3	-40.0	-60.3	-95.8

25 kHz Bandwidth Low Power 43 + 10 log (5) = 43 + 7.0 = 50.0 dBc

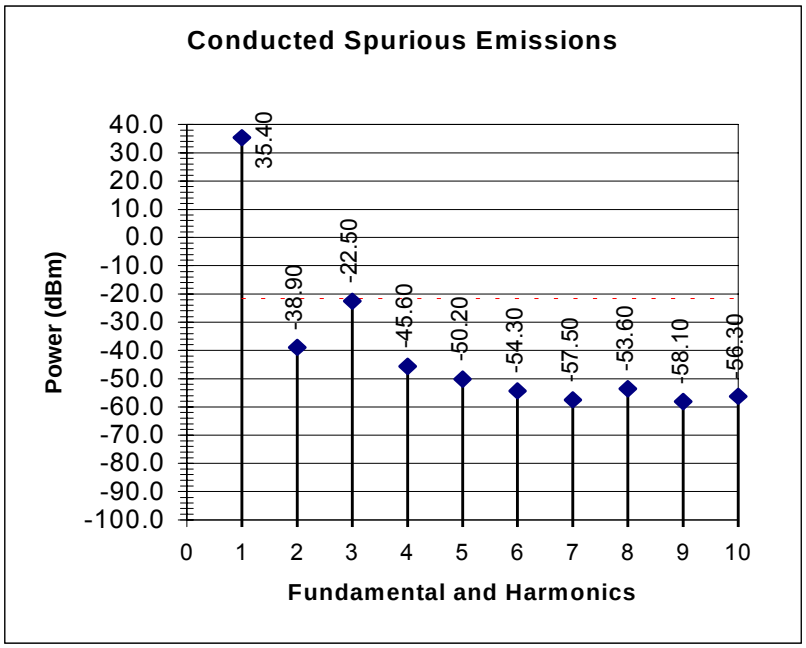
174MHz, High Power (30W) Narrow Band (12.5kHz)



Freq. (MHz)	Harmonic	Measured Signal (dBm)	Equipment Attenuation (dBm)	Signal (dBm)	Signal below Carrier (dBc)
174	1st	4.6	-40.0	44.6	NA
348	2nd	-79.1	-40.0	-39.1	-83.7
522	3rd	-62.1	-40.0	-22.1	-66.7
696	4th	-70.5	-40.0	-30.5	-75.1
870	5th	-88.3	-40.0	-48.3	-92.9
1044	6th	-86.3	-40.0	-46.3	-90.9
1218	7th	-85.2	-40.0	-45.2	-89.8
1392	8th	-87.6	-40.0	-47.6	-92.2
1566	9th	-88.3	-40.0	-48.3	-92.9
1740	10th	-87.5	-40.0	-47.5	-92.1

12.5 kHz Bandwidth High Power 50 + 10 log (30) = 50 + 14.8 = 64.8 dBc

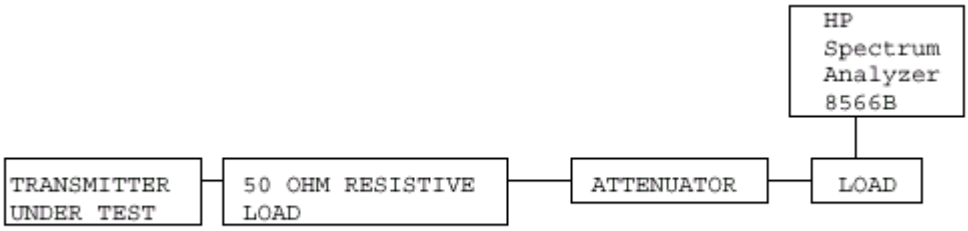
174MHz, Low Power (5W), Narrow Band (12.5kHz)



Freq. (MHz)	Harmonic	Measured Signal (dBm)	Equipment Attenuation (dBm)	Signal (dBm)	Signal below Carrier (dBc)
174	1st	-4.6	-40.0	35.4	NA
348	2nd	-78.9	-40.0	-38.9	-74.3
522	3rd	-62.5	-40.0	-22.5	-57.9
696	4th	-85.6	-40.0	-45.6	-81.0
870	5th	-90.2	-40.0	-50.2	-85.6
1044	6th	-94.3	-40.0	-54.3	-89.7
1218	7th	-97.5	-40.0	-57.5	-92.9
1392	8th	-93.6	-40.0	-53.6	-89.0
1566	9th	-98.1	-40.0	-58.1	-93.5
1740	10th	-96.3	-40.0	-56.3	-91.7

12.5 kHz Bandwidth Low Power 50 + 10 log (5) = 50 + 7.0 = 57.0 dBc

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was the TIA/EIA-603-A STANDARD without any exceptions. An audio generator is connected to EUT through a dummy microphone circuit and the output of the transmitter is then connected to a standard load to a pre-selected filter of the spectrum analyzer. The spectrum is scanned from 30 MHz to a minimum of the tenth harmonic of the fundamental using a HP model 8566B spectrum analyzer.

Radiated Spurious Emissions

REQUIREMENTS:

For 25 kHz Bandwidth High Power 43 + 10 log (30) = 43 + 14.8 = 57.8 dBc
25 kHz Bandwidth Low Power 43 + 10 log (5) = 43 + 7.0 = 50.0 dBc
12.5 kHz Bandwidth High Power 50 + 10 log (30) = 50 + 14.8 = 64.8 dBc
12.5 kHz Bandwidth Low Power 50 + 10 log (5) = 50 + 7.0 = 57.0 dBc

High Power Channel

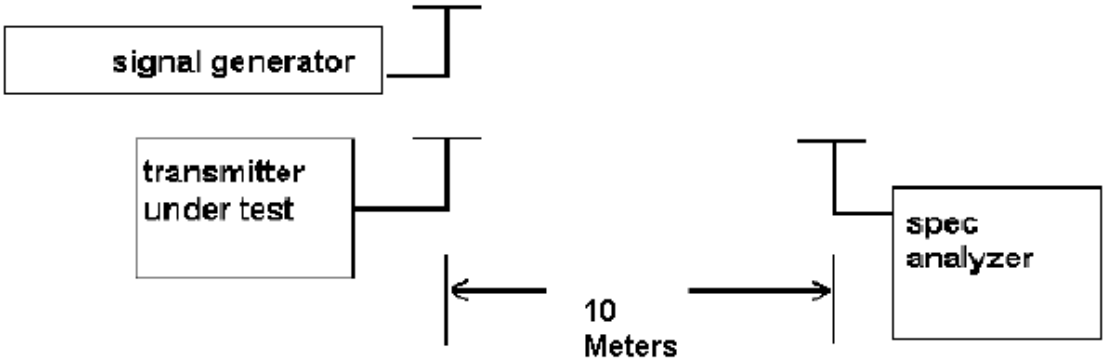
Emission Frequency (MHz)	Antenna Factor (dB)	Cable Losses (dB)	substitution power with cable loss (dBm)	high power reading at 10m (dBuV)	Antenna Polarity	true direct power w/o cable loss (dBm)	direct power after A.F. correction (dBm)	Spurious Emission below Carrier (dBc)
156							44.8	N/A
314	15.0	3.6	-15.3	53.2	H	-18.9	-33.9	78.7
472	17.2	3.9	-11.0	59.9	H	-14.9	-32.1	76.9
630	19.2	4.6	4.1	67.9	H	-0.5	-19.7	64.5
788	21.1	5.2	-8.7	50.7	H	-13.9	-35.0	79.8
946	23.3	5.4	-7.0	37.2	V	-12.4	-35.7	80.5
1104	26.9	6.1	-18.0	28.4	V	-24.1	-51.0	95.8
1262	26.5	6.3	-28.6	20.4	H	-34.9	-61.4	106.2
1420	26.9	6.8	-33.0	17.3	V	-39.8	-66.7	111.5
1578	27.3	7.0	-38.0	12.9	V	-45.0	-72.3	117.1

Low Power Channel

Emission Frequency (MHz)	Antenna Factor (dB)	Cable Losses (dB)	substitution power with cable loss (dBm)	low power reading at 10m (dBuV)	Antenna Polarity	true direct power w/o cable loss (dBm)	direct power after A.F. correction (dBm)	Spurious Emission below Carrier (dBc)
156							37.0	N/A
314	15.0	3.6	-9.8	58.7	H	-13.4	-28.4	65.4
472	17.2	3.9	-12.2	58.2	H	-16.1	-33.3	70.3
630	19.2	4.6	-11.2	55.7	H	-15.8	-35.0	72.0
788	21.1	5.2	-23.8	32.6	H	-29.0	-50.1	87.1
946	23.3	5.4	-12.6	32.6	V	-18.0	-41.3	78.3
1104	26.9	6.1	-32.0	15.4	H	-38.1	-65.0	102.0
1262	26.5	6.3	-48.0	7.9	H	-54.3	-80.8	117.8
1420	26.9	6.8	-43.0	6.9	H	-49.8	-76.7	113.7
1578	27.3	7.0	-39.0	13.3	V	-46.0	-73.3	110.3

METHOD OF MEASUREMENTS:

This test was conducted per TIA/EIA STANDARDS 603-A using the substitution method. The spectrum was scanned from 30 MHz to a minimum of the tenth harmonic of the fundamental. Measurements were made in an open field test site. The receiving Antenna was located at 10m for “worst case” reading results.



Frequency Stability

Temperature and voltage tests were performed to verify that the frequency remains within the specified 0.0005%, 5 PPM specification limit for 25kHz spacing on the High Power transmission channel.

For the Temperature tests, the transmitter was placed in the temperature chamber at 25 degrees C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -30 degrees C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed on for one minute, and again frequency readings were noted at 15 second intervals. The worst case number was used for temperature plotting. This procedure was repeated in 10 degree increments up to + 50 degrees C.

For the Voltage tests, readings were also taken at Plus 15% (15.64VDC) and Minus 15% (11.56VDC) of the battery voltage of 13.6VDC as specified by the manufacturer, which can be viewed as the battery endpoints.

Measurement Data

PPM	Temperature ^{0}C
-0.85	-30
-0.34	-20
-0.50	-10
-0.88	0
-0.81	10
0.00	20
0.91	30
1.07	40
0.71	50

Input +/- 15% Battery End-Points VDC (11.56 – 15.64): no detectable change in frequency.

Results of Measurement:
The maximum frequency variation over the temperature range was: +1.07/-0.88 PPM.

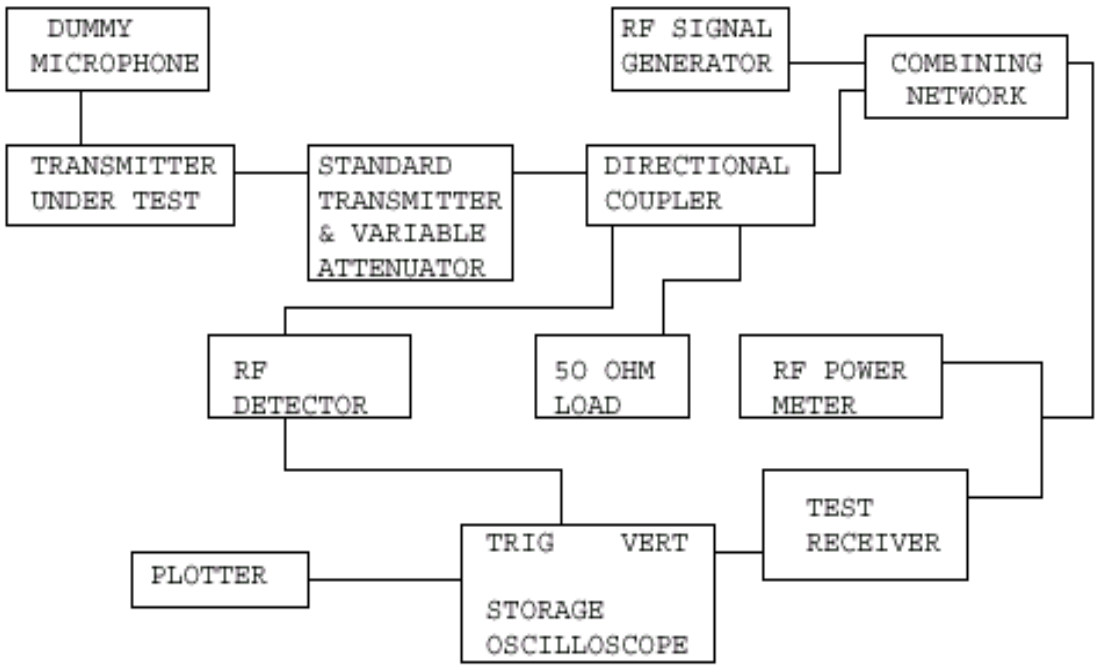
Transient Frequency Behavior

REQUIREMENTS: In the 150-174 MHz frequency band, transient frequency must be within requency difference limits during the time interval indicated below for 25 kHz channels.

Time Interval	Maximum Frequency	Portable Radio 150-174 MHz
T1	+25 kHz	5.0 ms
T2	+ 12.5 kHz	20.0 ms
T3	+25 kHz	5.0 ms

TIA/EIA TS-603-A PARAGRAPH 2.2.19 - TEST PROCEDURE:

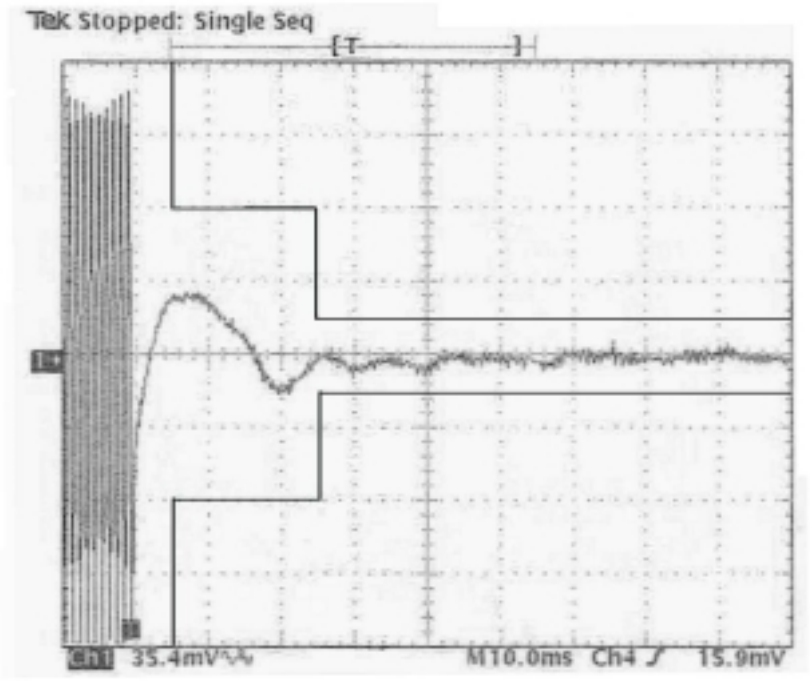
(1) Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level , then the transmitter was turned off.
(2) With the transmitter off, the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
(3) Reduce the attenuation between the transmitter and the RF detector by 30dB.
(4) With the levels set as above the transient frequency behavior was observed and recorded.



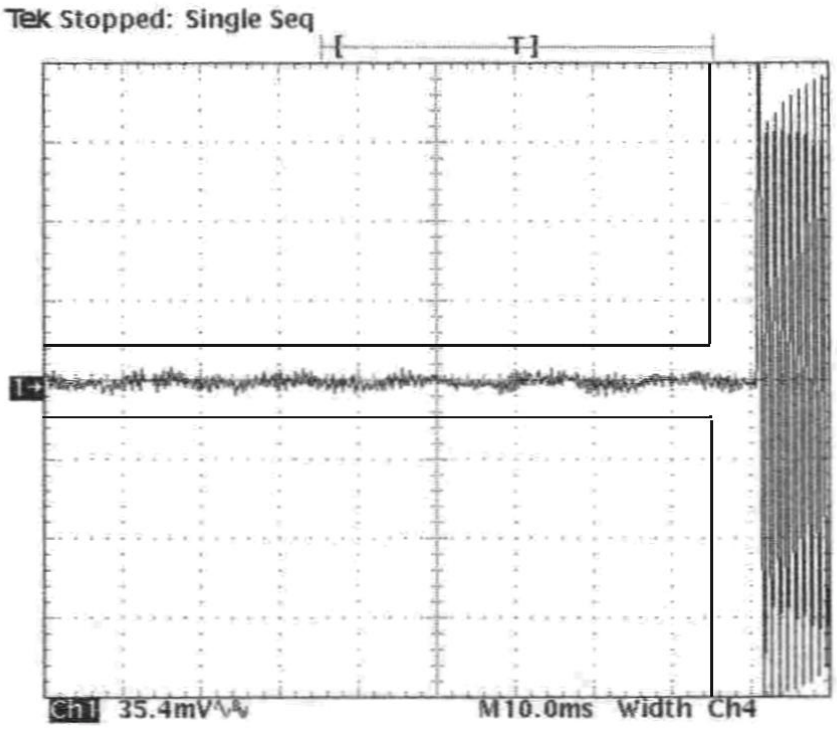
Transient Frequency Response Plots

Transient Frequency Response Plots - 25 kHz

Key Switch On



Key Switch Off



MPE Calculation

The EUT is classified as a Mobile device in accordance with 47CFR CH.I 2.1091. W= 30Watts maximum power.

This product can be attached to various antenna configurations. Calculations are for worst case Power and 3 Antenna's as specified by Manufacturer.

W = 30 (power in Watts)	Wexp = W*D* (E/U)
D = 1 [Duty Factor in Decimal % (1 = 100 %)]	Wexp = 30*1*(15/30)
E = 15 min	Wexp = 30*0.5
U = 30	Wexp = 15W

$Gn = 10^{G/10}$	If G = 1	If G = 5	If G = 7
G = Antenna Gain (dBi)	$Gn = 10^{1/10}$	$Gn = 10^{5/10}$	$Gn = 10^{7/10}$
	$Gn = 10^{0.1}$	$Gn = 10^{0.5}$	$Gn = 10^{0.7}$
	Gn = 1.259	Gn = 3.162	Gn = 5.012

Antenna Gain	G = 1	G = 3	G = 7
Po = 15000 mW	$R = \sqrt{\frac{Po*Gn}{4*3.14*S}}$	$R = \sqrt{\frac{Po*Gn}{4*3.14*S}}$	$R = \sqrt{\frac{Po*Gn}{4*3.14*S}}$
Freq. = 156.0MHz	$R = \sqrt{\frac{15000*1.259}{4*3.14*0.2}}$	$R = \sqrt{\frac{15000*3.162}{4*3.14*0.2}}$	$R = \sqrt{\frac{15000*5.012}{4*3.14*0.2}}$
If S = 0.2 (uncontrolled)	$R = \sqrt{\frac{18885}{2.512}}$	$R = \sqrt{\frac{47430}{2.512}}$	$R = \sqrt{\frac{75180}{2.512}}$
	R = √ 7517.9	R = √ 18881.4	R = √ 29928.3
Safe Distance at 30W:	R = 86.71cm or 34.1in	R = 137.4cm or 54.1in	R = 173.0cm or 68.11in
If S = 1.0 (controlled)	$R = \sqrt{\frac{15000*1.259}{4*3.14*1.0}}$	$R = \sqrt{\frac{15000*3.162}{4*3.14*1.0}}$	$R = \sqrt{\frac{15000*5.012}{4*3.14*1.0}}$
Po = 15000 mW	$R = \sqrt{\frac{18885}{12.56}}$	$R = \sqrt{\frac{47430}{12.56}}$	$R = \sqrt{\frac{75180}{12.56}}$
Freq. = 156.0MHz			
	R = √ 1503.58	R = √ 3776.27	R = √ 5985.67
Safe Distance at 30W:	R = 38.78cm or 15.27in	R = 61.45cm or 24.19in	R = 77.37cm or 30.46in