ENGINEERING TEST REPORT

TMS-100 VHF/AM Mobile Transceiver
Model: TIL-90-6R
FCC ID: IMA90-6R

Applicant:

Technisonic Industries Limited
240 Traders Blvd. E.
Mississauga, Ontario
Canada L4Z 1W7

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Parts 2 and 87 (Subpart D) – Aviation Services

UltraTech's File No.: TIL-074F87

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: April 13, 2012	
Report Prepared by: Dan Huynh Issued Date: April 13, 2012	Tested by: Wei Wu Test Dates: December 15 - 20, 2011 February 7 & 13, 2012 April 9, 2012

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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FCC	VCCI	Industry Canada Industrie Canada Approved Test Facility	NVLAP	BSMI	Korea KCC-RRL
91038	1309	46390-2049	NvLap Lab Code 200093-0	SL2-IN-E-1119R	CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 87
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication – Parts 2 & 87
Purpose of Test:	FCC Certification Authorization for Class II Permissive Change.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA-603-C – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2011	Code of Federal Regulations – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Technisonic Industries Ltd.
Address:	240 Traders Blvd. E. Mississauga, Ontario Canada L4Z 1W7
Contact Person:	Mr. Steve M^{c}Intosh Phone #: 905-890-2113 ext 205 Fax #: 905-890-5338 Email Address: stevem@til.ca

MANUFACTURER	
Name:	Technisonic Industries Ltd.
Address:	240 Traders Blvd. E. Mississauga, Ontario Canada L4Z 1W7
Contact Person:	Mr. Steve M^{c}Intosh Phone #: 905-890-2113 ext 205 Fax #: 905-890-5338 Email Address: stevem@til.ca

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Technisonic Industries Limited
Product Name:	TMS-100 VHF/AM Mobile Transceiver
Model Name or Number:	TIL-90-6R
Serial Number:	Test sample
External Power Supply:	External Power Supply
Transmitting/Receiving Antenna Type:	Non-integral
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Primary User Functions of EUT:	Communication from airport service vehicles

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, Industrial or Business
Power Supply Requirement:	13.75 VDC nominal
RF Output Power Rating:	10 W Conducted
Operating Frequency Range:	117.975 - 138 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	25.0 kHz, 8.33 kHz
Emission Designation*:	6K00A3E, 5K60A3E
Antenna Connector Type:	UHF Female

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

Calculation of Necessary Bandwidth for Telephony (Commercial Quality)

Telephony, double-sideband (single channel):

Bn = 2M

Where: Bn = necessary bandwidth in hertz
M = maximum modulation frequency in hertz

M = 3000Hz

Bn =2(3000) = 6000 Hz = 6.00 KHz

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	MIC/PTT	1	5-pin DIN	Shielded
2	Speaker/Phone	1	¼" headphone	Shielded
3	Antenna	1	UHF	Shielded
4	Power	1	2-pin circular	Non-shielded
5	USB	1	USB Type B	Shielded

EXHIBIT 3. EUT OPERATING CONDITION AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	10.8 - 30 VDC, with DC-DC converter 10.6 – 15 VDC (13.75 VDC nominal), without DC-DC converter

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ω Load.

Transmitter Test Signals	
Frequency Band(s):	117.975 - 138 MHz
Test Frequency(ies): (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	118, 128 and 138 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	8.34 W
▪ Normal Test Modulation:	AM
▪ Modulating signal source:	External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 87.131	RF Power Output	Yes
2.1047(a) & 87.141(f)	Modulation Characteristics - Audio Frequency Response	Yes
2.1047(b) & 87.141	Modulation Characteristics - Modulation Limiting	Yes
2.1049, 87.135 & 87.139	Occupied Bandwidth and Emission Limitations	Yes
2.1051, 2.1057 & 87.139,	Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057 & 87.139	Field Strength of Spurious Emissions	Yes
2.1055 & 87.133	Frequency Stability	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.107	AC Power Line Conducted Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. MEASUREMENTS DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 87.131]

5.1.1. Limits

The following table lists authorized emissions and maximum power. Power must be determined by direct measurement.

Class of station	Frequency band/ frequency	Authorized emission(s) [2]	Maximum power [1]
Aeronautical advisory	VHF	A3E	10 watts[3]
Aeronautical multicom	VHF	A3E	10 watts
Aeronautical search and rescue	VHF	A3E	10 watts
Aviation support	VHF	A3E	50 watts
Airport control tower	VHF	A3E	50 watts
Aeronautical utility mobile	VHF	A3E	10 watts
Aircraft	VHF	A3E	55 watts

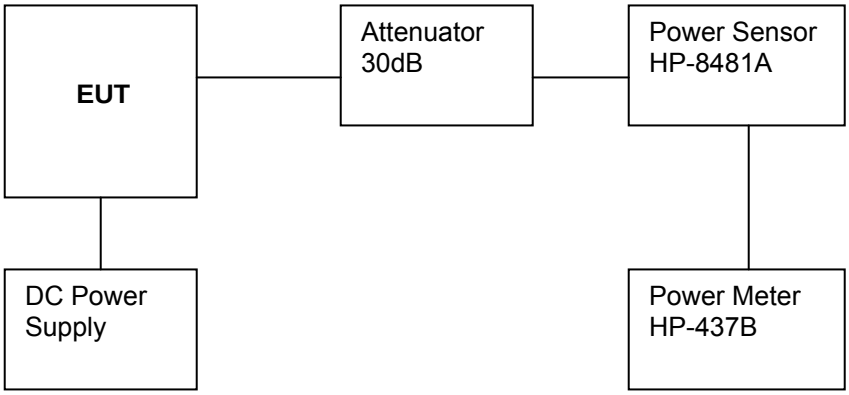
Notes:

(1) The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:
  (i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.
  (ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.
(2) Excludes automatic link establishment.
(3) Power is limited to 0.5 watt, but may not exceed 2 watts when station is used in an automatic unattended mode.

5.1.2. Method of Measurements

Refer to Exhibit 8, Section 8.1 of this report for measurement details.

5.1.3. Test Arrangement



5.1.4. Test Data

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured Mean Power @ Antenna Port (W)	Maximum Power Limit (W)
Lowest	118	8.34	10
Middle	128	6.52	10
Highest	138	6.67	10

5.2. MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE [§§ 2.1047(a) & 87.141(f)]

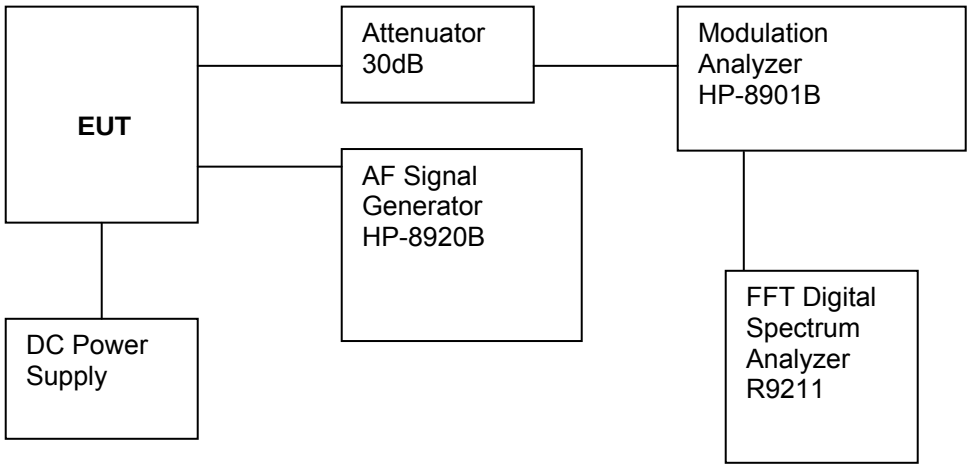
5.2.1. Limits

§ 87.141(f): Each frequency modulated transmitter equipped with a modulation limiter must have a low pass filter between the modulation limiter and the modulated stage. At audio frequencies between 3 kHz and 15 kHz, the filter must have an attenuation greater than the attenuation at 1 kHz by at least 40 $\log_{10}$ (f/3) db where ‘‘f’’ is the frequency in kilohertz. Above 15 kHz, the attenuation must be at least 28 db greater than the attenuation at 1 kHz.

5.2.2. Method of Measurements

The rated audio input signal was applied to the input of the audio lowpass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT (Audio) spectrum analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 kHz.

5.2.3. Test Arrangement



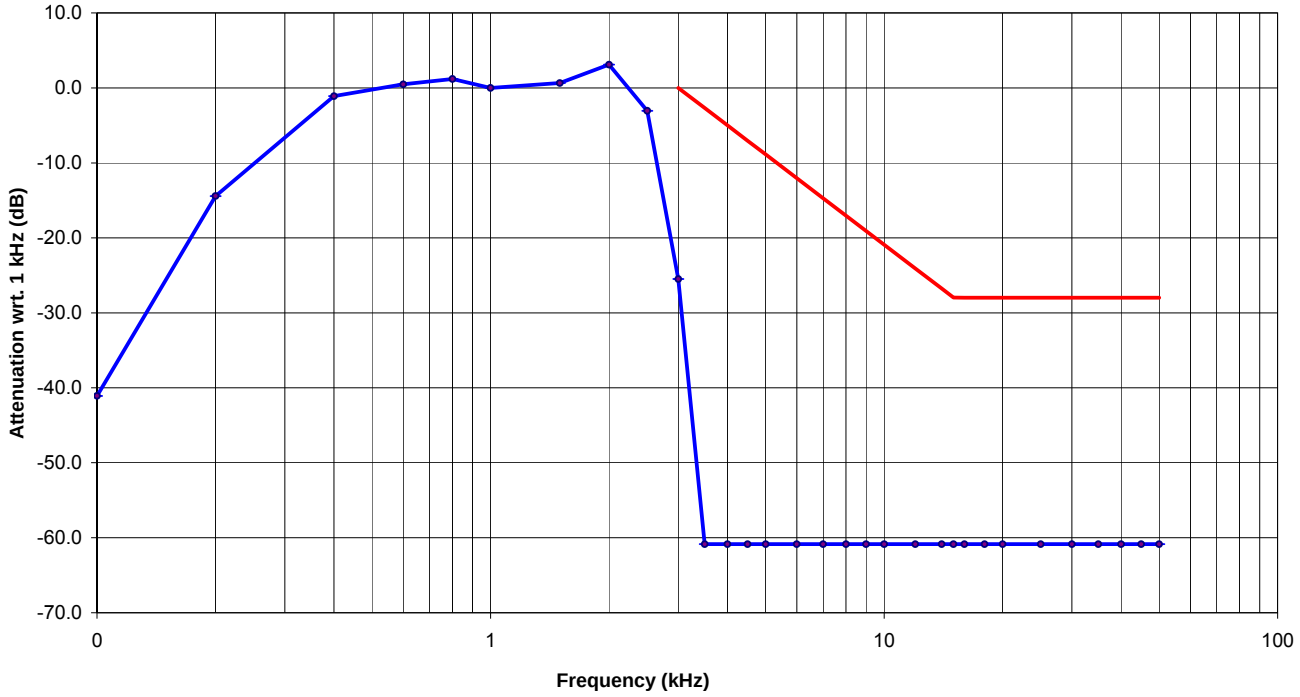
5.2.4. Test Data

Note: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States was performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio low-pass filter.

8.33 kHz Channel Spacing, Frequency of All Modulation States

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation wrt. 1 kHz (dB)	Attenuation (dB)
0.1	-33.51	-50.21	-16.7	-41.1	--
0.2	-33.51	-23.56	10.0	-14.4	--
0.4	-33.51	-10.24	23.3	-1.1	--
0.6	-33.51	-8.64	24.9	0.5	--
0.8	-33.51	-7.94	25.6	1.2	--
1.0	-33.51	-9.13	24.4	0.0	--
1.5	-33.51	-8.47	25.0	0.7	--
2.0	-33.51	-6.02	27.5	3.1	--
2.5	-33.51	-12.19	21.3	-3.1	--
3.0	-33.51	-34.63	-1.1	-25.5	0
3.5	-33.51	-70.00	-36.5	-60.9	-3
4.0	-33.51	-70.00	-36.5	-60.9	-5
4.5	-33.51	-70.00	-36.5	-60.9	-7
5.0	-33.51	-70.00	-36.5	-60.9	-9
6.0	-33.51	-70.00	-36.5	-60.9	-12
7.0	-33.51	-70.00	-36.5	-60.9	-15
8.0	-33.51	-70.00	-36.5	-60.9	-17
9.0	-33.51	-70.00	-36.5	-60.9	-19
10.0	-33.51	-70.00	-36.5	-60.9	-21
12.0	-33.51	-70.00	-36.5	-60.9	-24
14.0	-33.51	-70.00	-36.5	-60.9	-27
16.0	-33.51	-70.00	-36.5	-60.9	-28
18.0	-33.51	-70.00	-36.5	-60.9	-28
20.0	-33.51	-70.00	-36.5	-60.9	-28
25.0	-33.51	-70.00	-36.5	-60.9	-28
30.0	-33.51	-70.00	-36.5	-60.9	-28
35.0	-33.51	-70.00	-36.5	-60.9	-28
40.0	-33.51	-70.00	-36.5	-60.9	-28
45.0	-33.51	-70.00	-36.5	-60.9	-28
50.0	-33.51	-70.00	-36.5	-60.9	-28

Audio Frequency Response
8.33 kHz Channel Spacing



5.3. MODULATION CHARACTERISTICS – MODULATION LIMITING [§§ 2.1047(b) & 87.141]

5.3.1. Limits

§ 87.141(a): When A3E emission is used, the modulation percentage must not exceed 100 percent. This requirement does not apply to emergency locator transmitters or survival craft transmitters.

§ 87.141(b): A double sideband full carrier amplitude modulated radiotelephone transmitter with rated carrier power output exceeding 10 watts must be capable of automatically preventing modulation in excess of 100 percent.

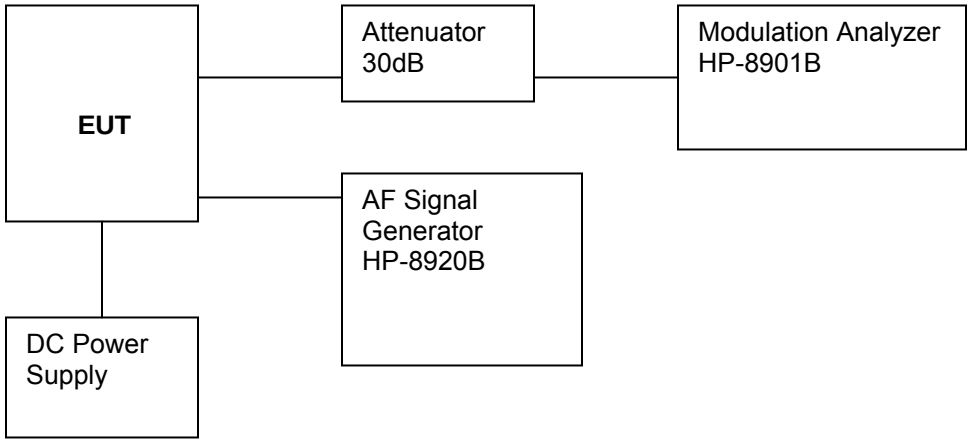
§ 87.141(c): If any licensed radiotelephone transmitter causes harmful interference to any authorized radio service because of excessive modulation, the Commission will require the use of the transmitter to be discontinued until it is rendered capable of automatically preventing modulation in excess of 100 percent.

5.3.2. Method of Measurements

For Audio Transmitter:- The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory: The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

5.3.3. Test Arrangement



5.3.4. Test Data

MODULATING SIGNAL LEVEL	Modulation (%) at the following modulating frequency:					MODULATION LIMIT (%)
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(%)
2	3.11	5.38	6.10	3.20	2.85	100
5	3.11	12.91	15.30	3.59	2.91	100
10	3.11	21.85	24.21	3.66	3.01	100
15	3.11	32.29	35.84	4.38	3.01	100
20	3.11	45.10	48.30	5.25	3.01	100
25	3.23	54.80	59.90	6.08	2.91	100
30	3.37	64.40	71.20	6.45	2.80	100
35	3.45	74.40	78.80	6.40	2.75	100
40	3.54	81.00	78.90	6.38	2.22	100
45	3.68	81.10	78.80	6.41	2.22	100
50	3.72	81.10	78.90	6.81	1.68	100
60	4.12	81.20	79.10	5.82	1.37	100
70	4.43	81.20	79.10	5.54	1.31	100
80	5.77	81.20	79.10	5.18	1.13	100
90	5.77	81.20	79.10	5.17	0.87	100
100	5.77	81.20	79.10	5.01	0.69	100
150	5.77	81.20	79.10	4.81	0.49	100

Voice Signal Input Level: 42.49 mVrms		
MODULATING FREQUENCY (KHz)	**MODULATION (%)**	**MODULATION LIMIT (%)**
0.1	5.71	100
0.2	28.90	100
0.4	70.90	100
0.6	85.10	100
0.8	86.00	100
1.0	79.10	100
1.2	72.10	100
1.4	74.50	100
1.6	86.90	100
1.8	93.90	100
2.0	95.60	100
2.5	55.80	100
3.0	4.81	100
3.5	1.25	100
4.0	0.90	100
4.5	1.24	100
5.0	0.49	100
6.0	0.99	100
7.0	0.81	100
8.0	0.83	100
9.0	1.78	100
10.0	0.73	100

5.4. OCCUPIED BANDWIDTH AND EMISSION LIMITATIONS [§§ 2.1049, 87.135 & 87.139]

5.4.1. Limits

§ 87.139(a) - Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the frequency bands 1435–1535 MHz and 2310–2390 MHz or digital modulation (G7D) for differential GPS, the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

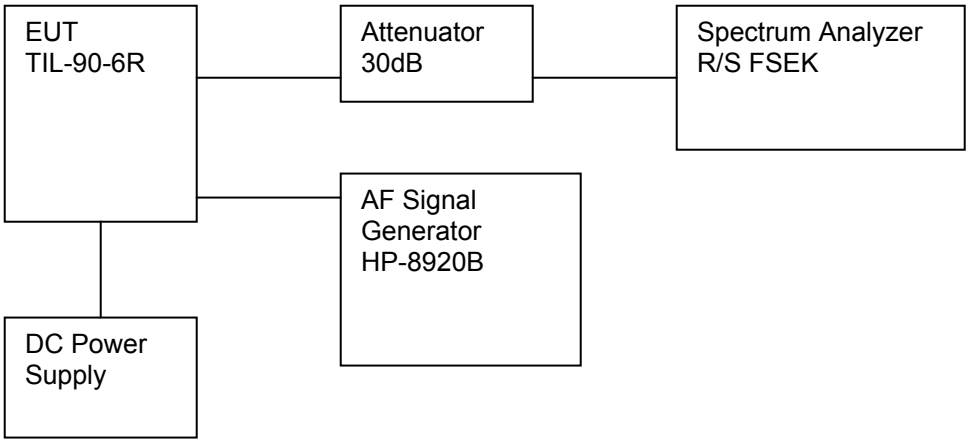
(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

5.4.2. Method of Measurements

Refer to Exhibit 8, Section 8.4 of this report for measurement details.

5.4.3. Test Arrangement



5.4.4. Test Data

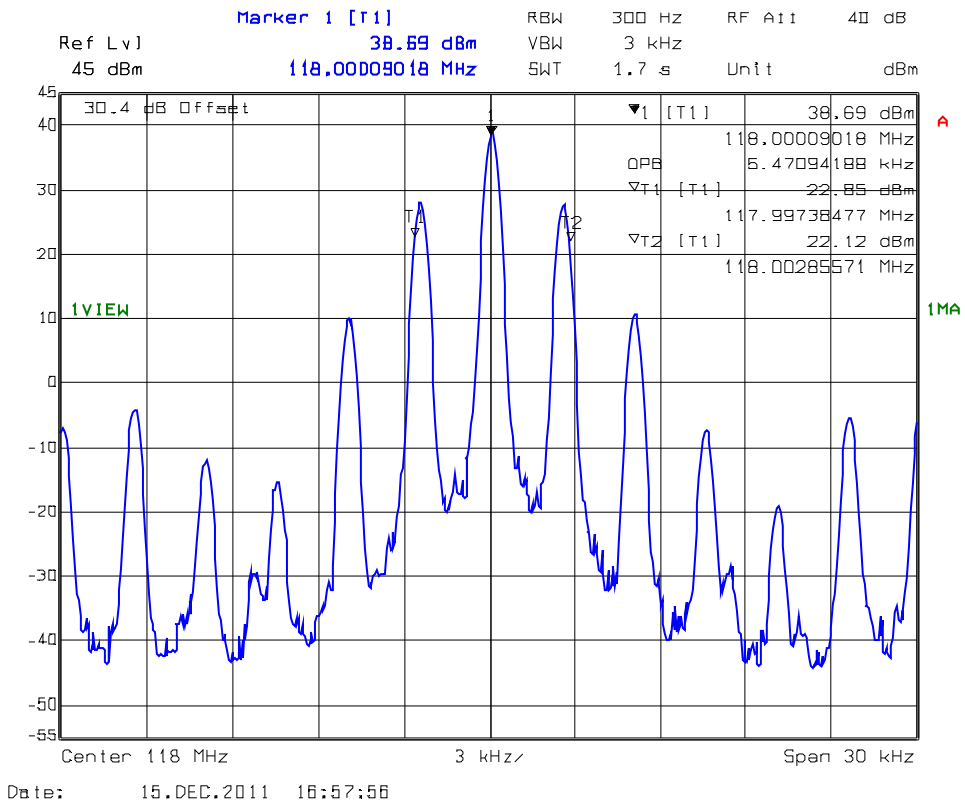
5.4.4.1. 99% Occupied Bandwidth

Frequency (MHz)	*Measured 99% OBW (kHz)	Authorized Bandwidth (kHz)
118	5.47	8.33
128	5.47	8.33
138	5.47	8.33

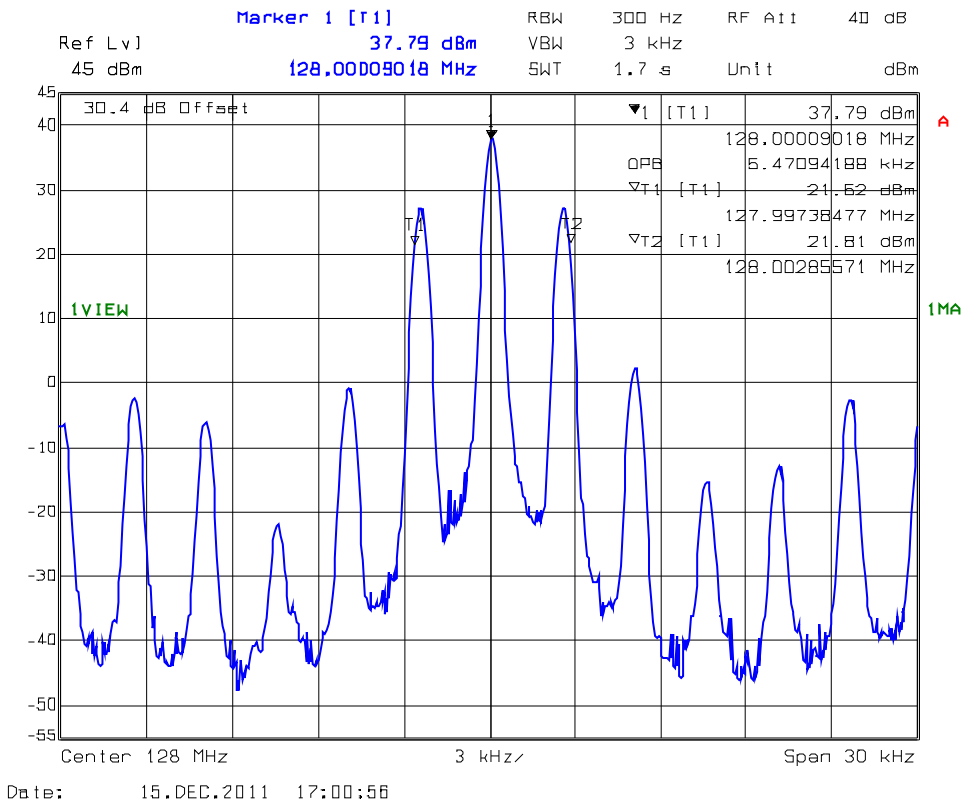
Note: 99% Occupied Bandwidth measurements were performed using the built-in auto function of the spectrum analyzer.

* See the following plots for details of measurements

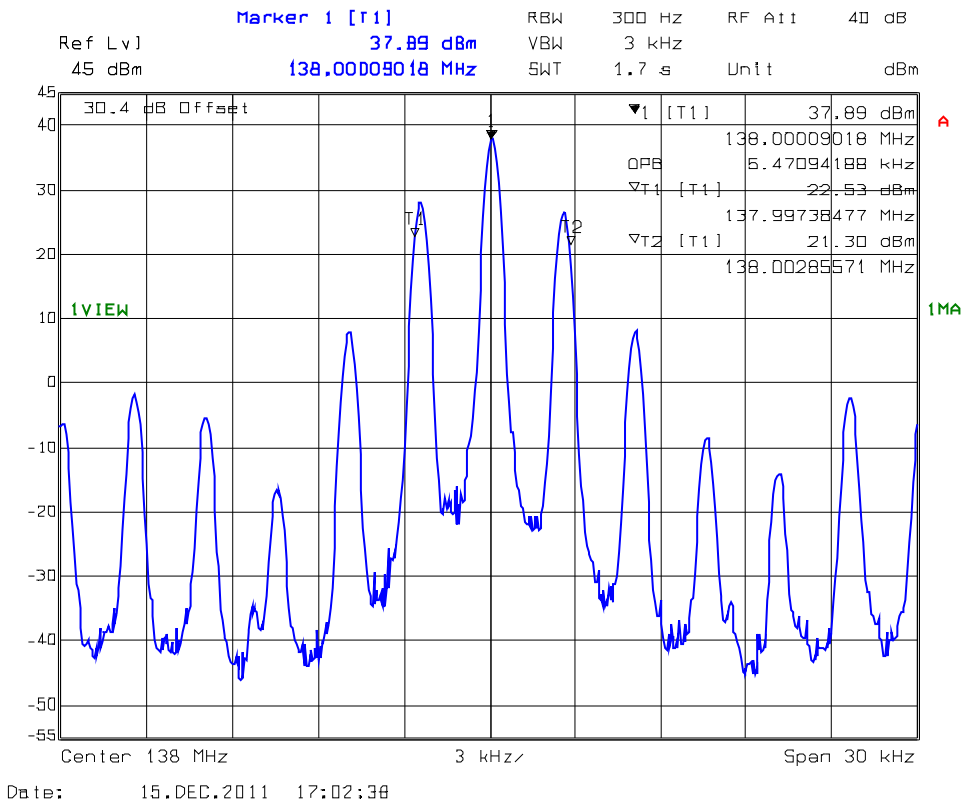
Plot 5.4.4.1.1. Occupied Bandwidth for 118 MHz, 8.33 kHz Channel Spacing



Plot 5.4.4.1.2. Occupied Bandwidth for 128 MHz, 8.33 kHz Channel Spacing

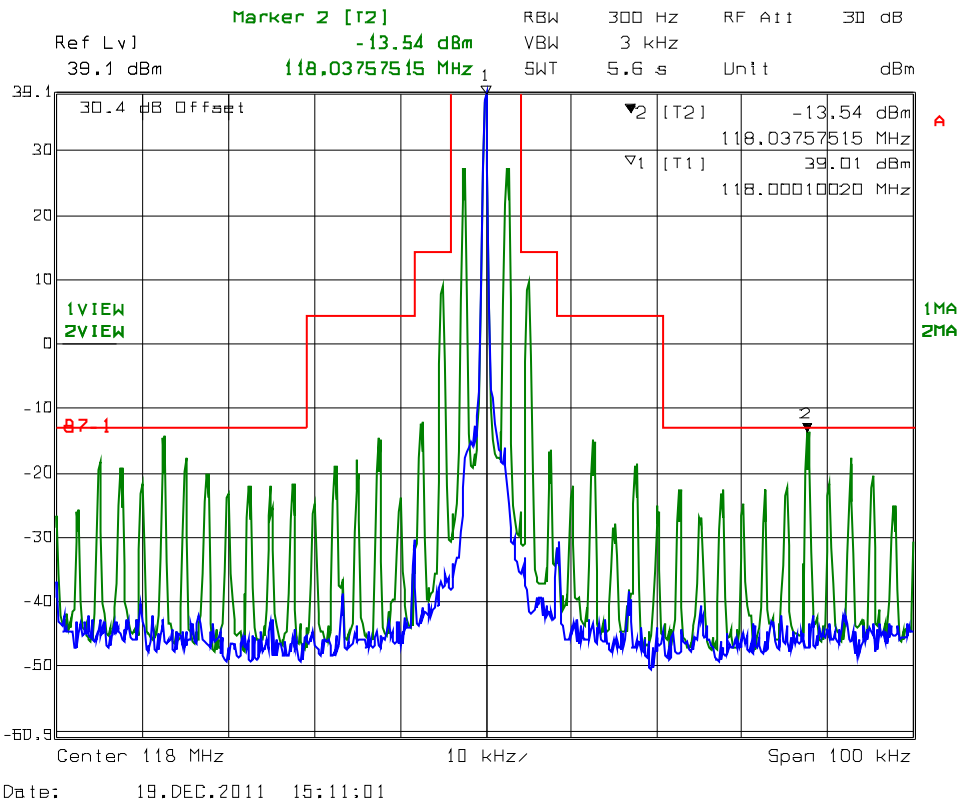


Plot 5.4.4.1.3. Occupied Bandwidth for 138 MHz, 8.33 kHz Channel Spacing

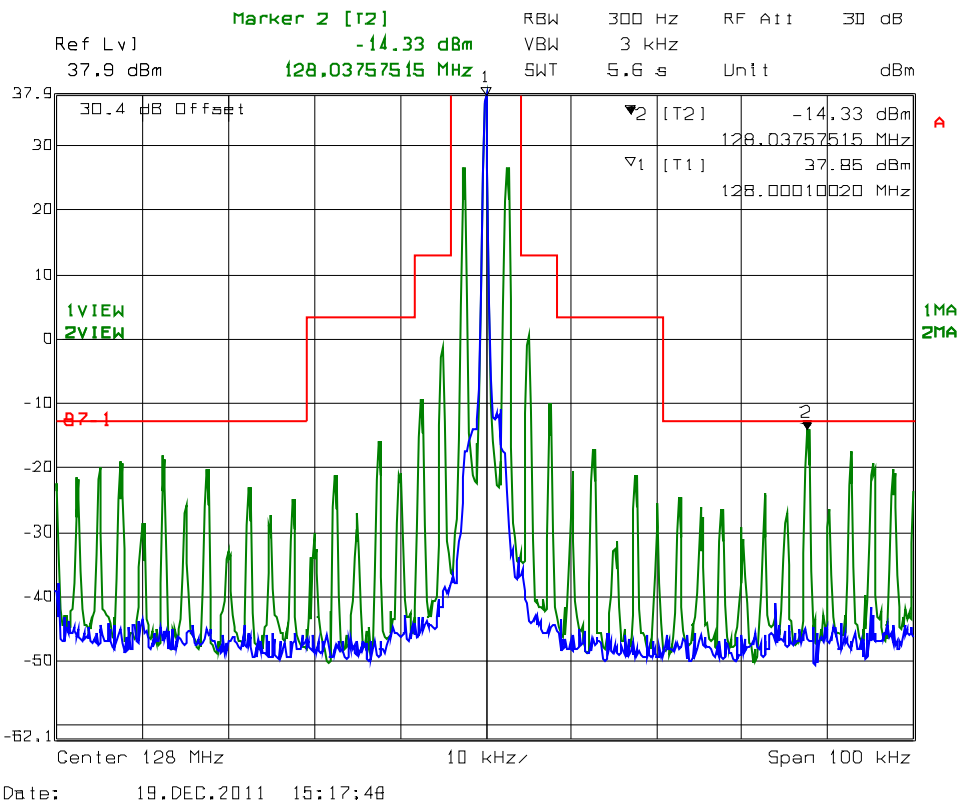


5.4.4.2. Emission Limitations

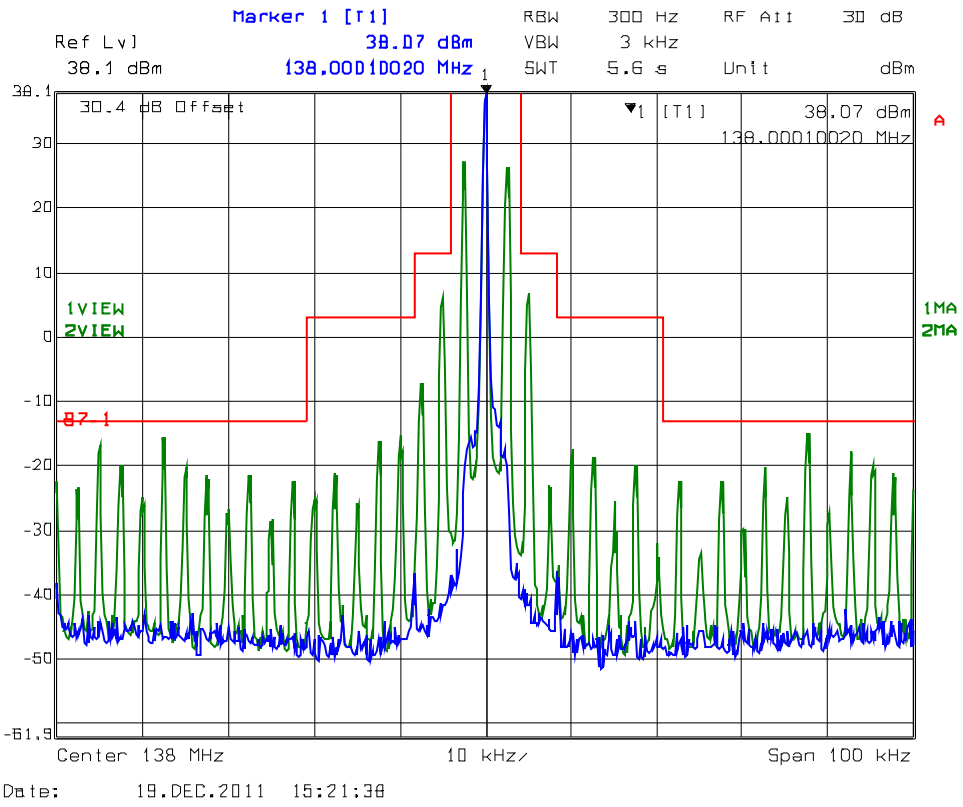
Plot 5.4.4.2.1. Emission Limitation for 118 MHz, 8.33 kHz Channel Spacing



Plot 5.4.4.2.2. Emission Limitation for 128 MHz, 8.33 kHz Channel Spacing



Plot 5.4.4.2.3. Emission Limitation for 138 MHz, 8.33 kHz Channel Spacing



5.5. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§§ 2.1051 & 87.139]

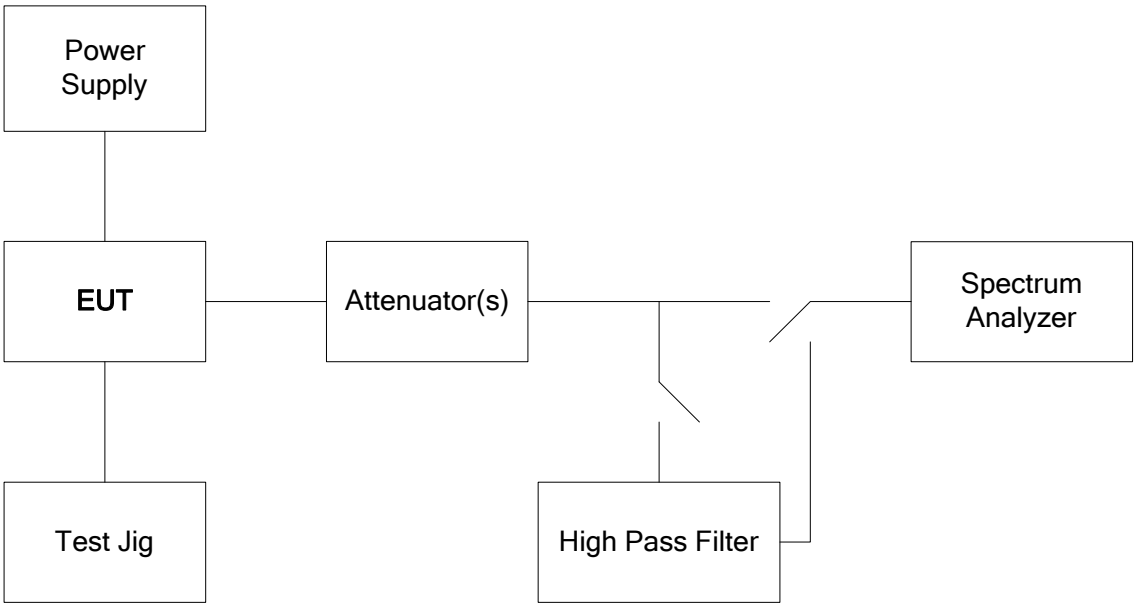
5.5.1. Limits

§ 87.139(a)(3): When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 $\log_{10}$ pY dB.

5.5.2. Method of Measurements

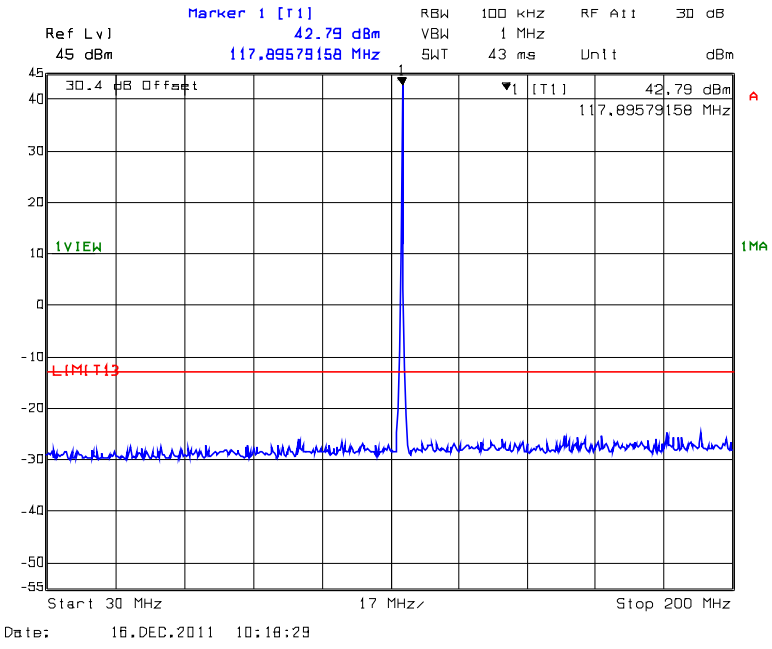
Refer to Exhibit 8 Section 8.5 of this report for measurement details

5.5.3. Test Arrangement

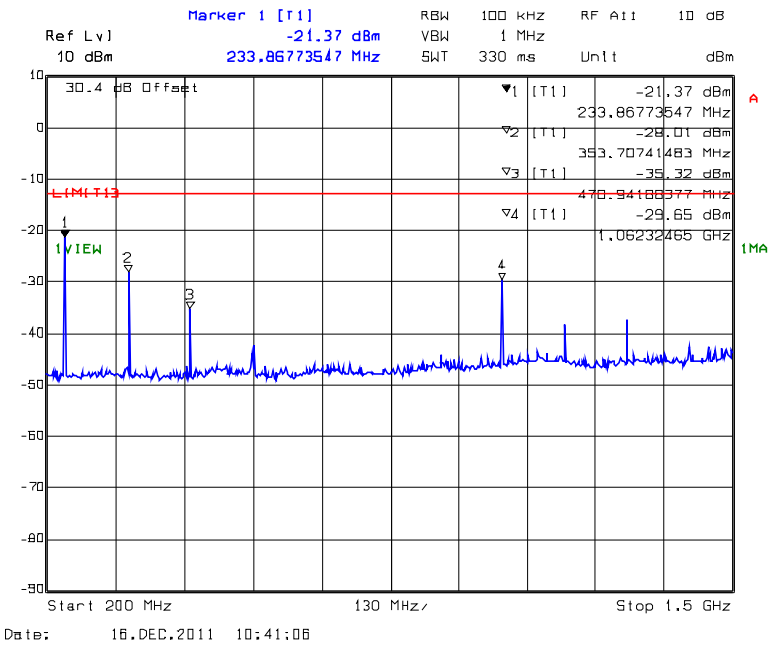


5.5.4. Test Data

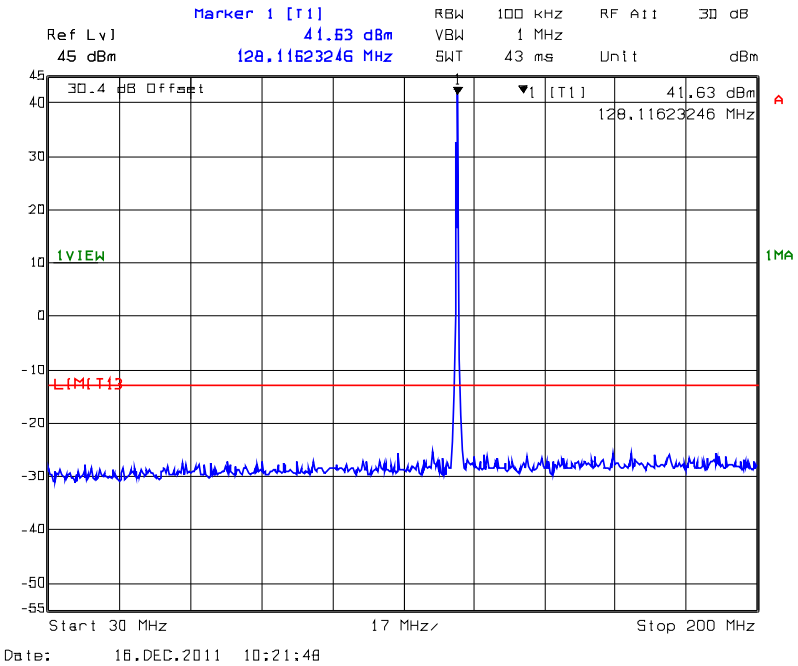
Plot 5.5.4.1. Spurious Emissions at Antenna Terminals, 118 MHz, 8.33 kHz Channel Spacing, 30 MHz - 200 MHz



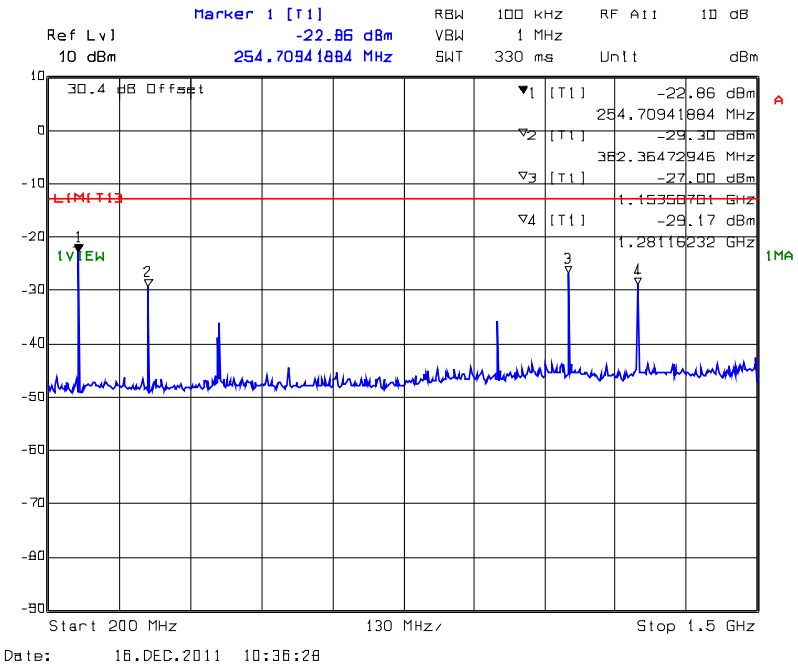
Plot 5.5.4.2. Spurious Emissions at Antenna Terminals, 118 MHz, 8.33 kHz Channel Spacing, 200 MHz - 1.5 GHz



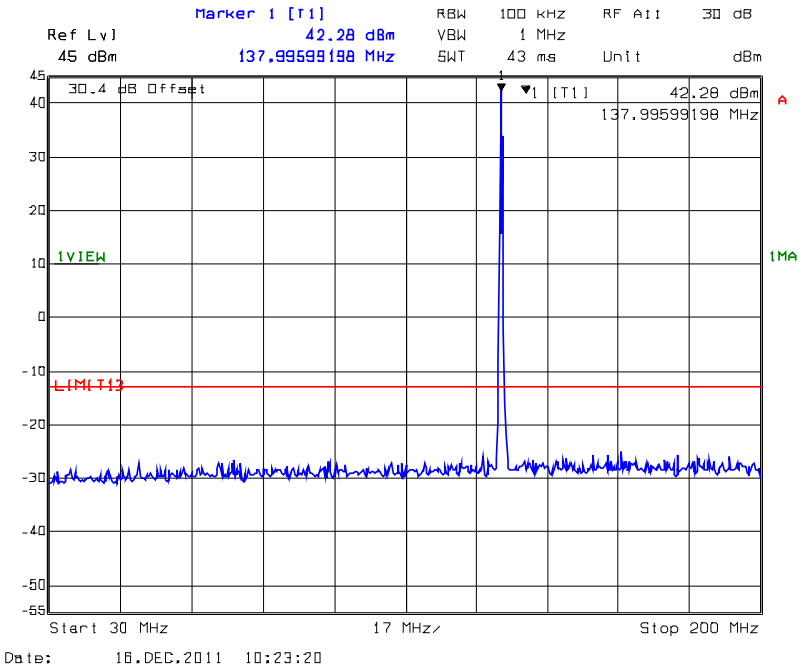
Plot 5.5.4.3. Spurious Emissions at Antenna Terminals, 128 MHz, 8.33 kHz Channel Spacing, 30 MHz - 200 MHz



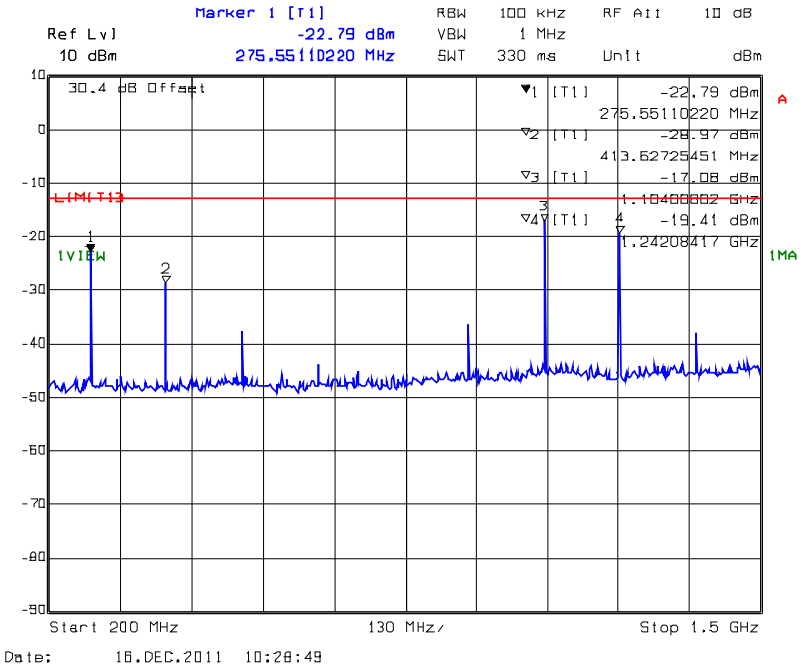
Plot 5.5.4.4. Spurious Emissions at Antenna Terminals, 128 MHz, 8.33 kHz Channel Spacing, 200 MHz - 1.5 GHz



Plot 5.5.4.5. Spurious Emissions at Antenna Terminals, 138 MHz, 8.33 kHz Channel Spacing, 30 MHz - 200 MHz



Plot 5.5.4.6. Spurious Emissions at Antenna Terminals, 138 MHz, 8.33 kHz Channel Spacing, 200 MHz - 1.5 GHz



5.6. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053 & 87.139]

5.6.1. Limits

§ 87.139(a)(3): When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 $\log_{10}$ pY dB.

5.6.2. Method of Measurements

Refer to Exhibit 8 Section 8.2 of this report for measurement details.

5.6.3. Test Data

Remarks:

- The radiated emissions were performed with the EUT operating at 8.33 kHz channel spacing at 3 m distance.
- The emissions were scanned from 30 MHz to 2 GHz; all significant emissions were recorded.

Carrier Frequency:	118 MHz
Power:	8.34 W
Limit:	-13 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 2000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:	128 MHz
Power:	6.52 W
Limit:	-13 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 2000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:	138 MHz
Power:	6.67 W
Limit:	-13 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 2000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.7. FREQUENCY STABILITY [§§ 2.1055 & 87.133]

5.7.1. Limits

§ 87.133 The carrier frequency of each station must be maintained within the tolerance in the following table:

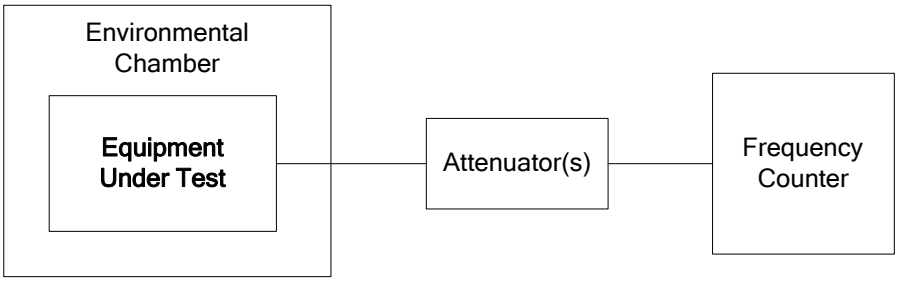
Frequency band (lower limit exclusive, upper limit inclusive), and categories of station	Tolerance (ppm)
(5) Band - 108 to 137 MHz: Aircraft and other mobile stations in the Aviation Services.	*30

* For emissions G1D and G7D, the tolerance is 5 parts per 10^6.

5.7.2. Method of Measurements

Refer to Exhibit 8, Section 8.3 of this report for measurement details

5.7.3. Test Arrangement



5.7.4. Test Data

Center Frequency:	118 MHz
Full Power Level:	8.34 W
Frequency Tolerance Limit:	30 ppm or 3540 Hz (Manufacturer's rating: ± 1 ppm)
Max. Frequency Tolerance Measured:	+89 Hz or 0.75 ppm
Input Voltage Rating:	13.75 Vdc (nominal)

Ambient Temperature (°C)	**Frequency Drift (Hz)**		
	Supply Voltage (Nominal) 13.75 Vdc	**Supply Voltage (85% of nominal) 11.69 Vdc**	**Supply Voltage (115% of nominal) 15.81 Vdc**
-40	+89	--	--
-30	+40	--	-
-20	+11	--	--
-10	+5	--	--
0	-4	--	--
+10	-6	--	--
+20	+1	+2	+2
+30	+14	--	--
+40	+24	--	--
+50	+38	--	--
+55	+40	--	--

5.8. RF EXPOSURE REQUIRMENTS [§§ 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.8.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.8.2. RF Evaluation

EVALUATION OF RF EXPOSURE COMPLIANCE REQUIREMENTS	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***89.1 cm**	Manufacturer' instruction for separation distance between antenna and persons required: **90 cm.**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

RF EXPOSURE DISTANCE LIMITS

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

P = 40 dBm
G = 3 dBi (Maximum antenna gain to be used with this device as declared by the manufacturer)
S = 0.2 mW/cm^2
EIRP = 43 dBm = $10^{43/10}$ mW = 19952.6 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{19952.6}{4 \cdot \pi \cdot (0.2)}} \approx 89.1cm$

5.9. POWER LINE CONDUCTED EMISSIONS [§ 15.107(a)]

5.9.1. Limits

The equipment shall meet the limits of the following table:

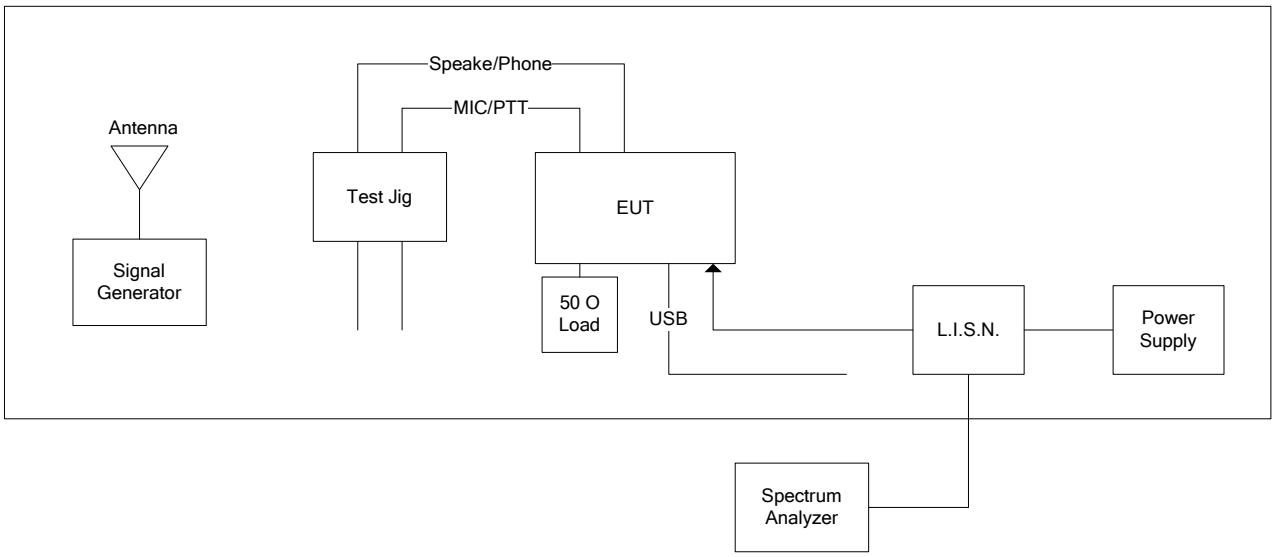
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

5.9.1.1. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4-2009 for method of measurements.

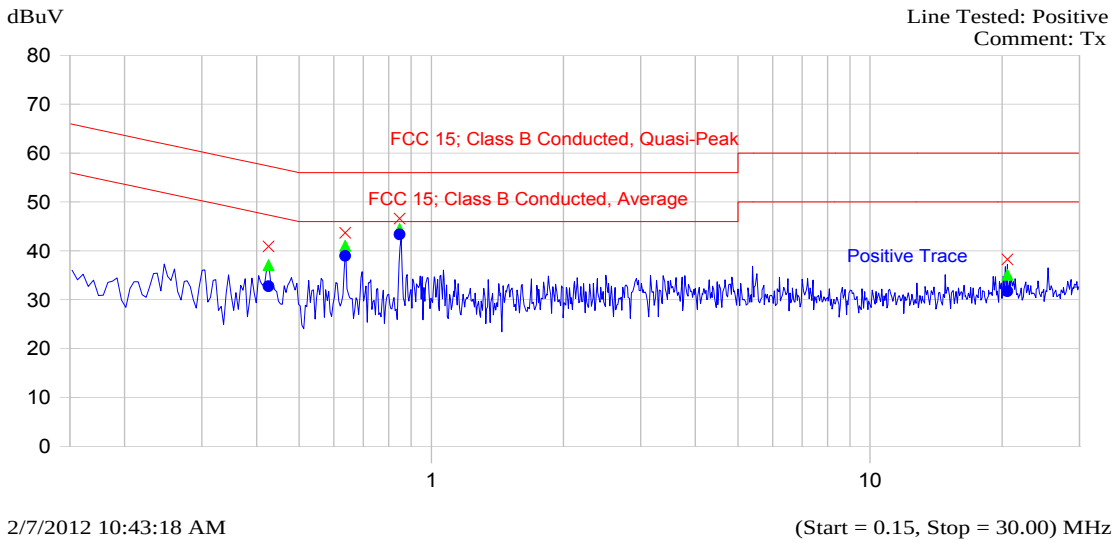
5.9.2. Test Arrangement



5.9.3. Test Data

Plot 5.9.3.1. Power Line Conducted Emissions, EUT with DC – DC Converter (Tx Mode)
Line Voltage: 30 VDC; Line Tested: Positive

Current Graph

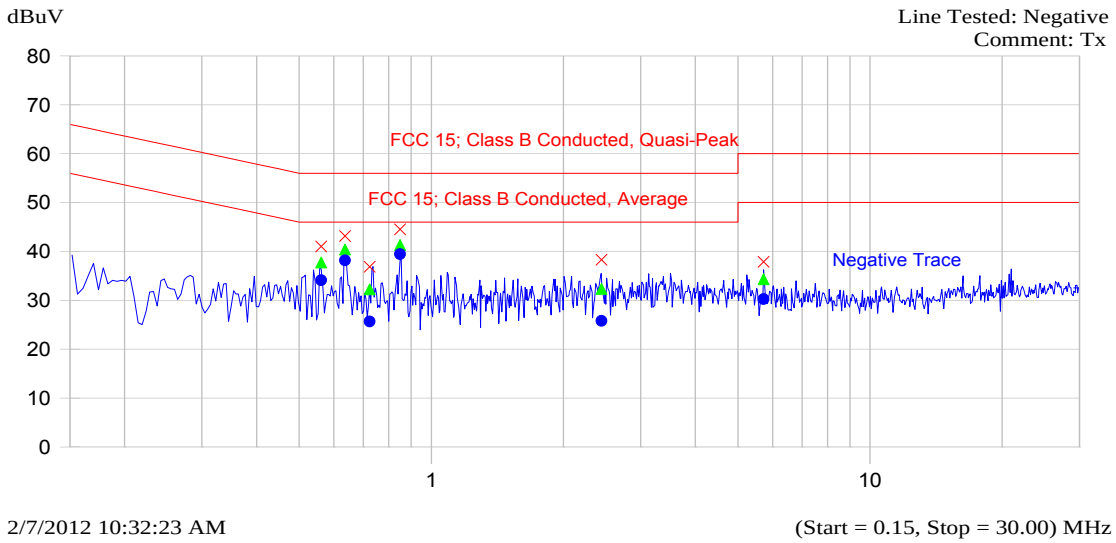


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.426	40.9	37.1	-21.0	32.8	-15.3	Positive Trace
0.636	43.7	41.0	-15.0	39.0	-7.0	Positive Trace
0.847	46.6	44.5	-11.5	43.4	-2.6	Positive Trace
20.556	38.3	35.1	-24.9	31.7	-18.3	Positive Trace

Plot 5.9.3.2. Power Line Conducted Emissions, EUT with DC – DC Converter (Tx Mode)
Line Voltage: 30 VDC; Line Tested: Negative

Current Graph

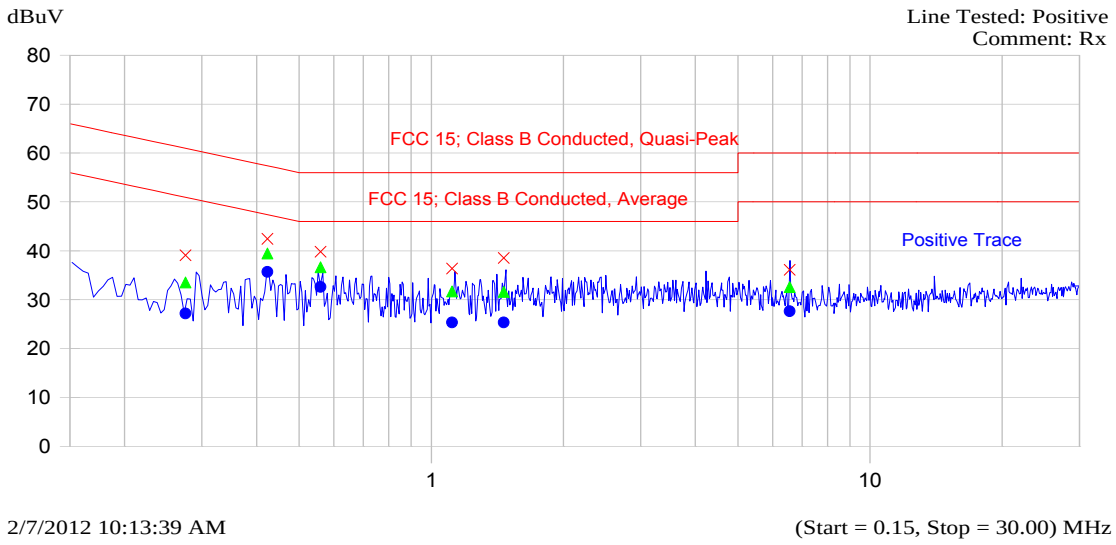


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.561	41.0	37.7	-18.3	34.1	-11.9	Negative Trace
0.636	43.2	40.4	-15.6	38.2	-7.8	Negative Trace
0.724	36.9	32.3	-23.7	25.7	-20.3	Negative Trace
0.849	44.5	41.3	-14.7	39.5	-6.5	Negative Trace
2.444	38.3	32.4	-23.6	25.8	-20.2	Negative Trace
5.720	37.9	34.3	-25.7	30.3	-19.7	Negative Trace

Plot 5.9.3.3. Power Line Conducted Emissions, EUT with DC – DC Converter (Rx Mode)
Line Voltage: 30 VDC; Line Tested: Positive

Current Graph

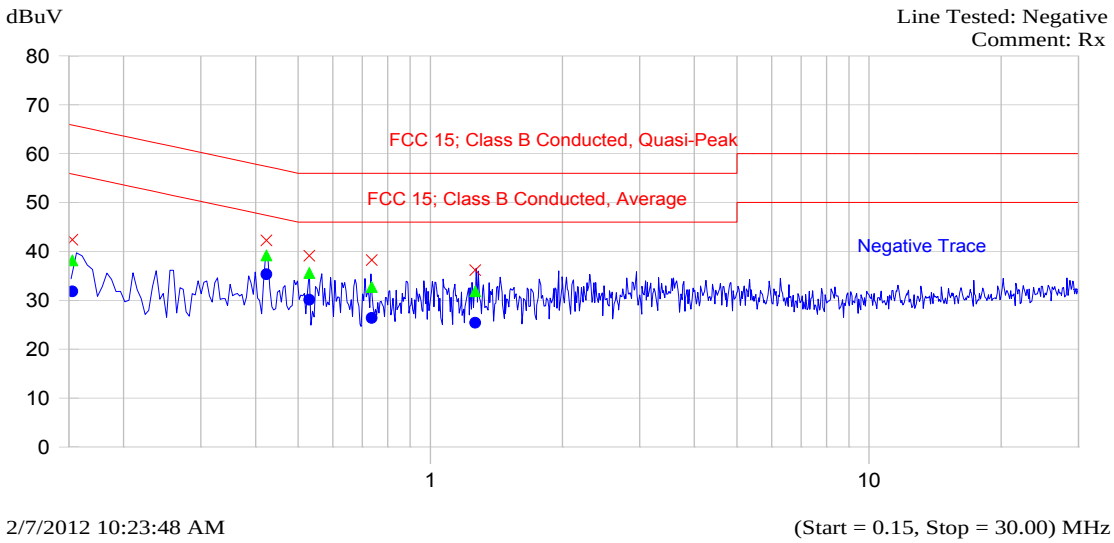


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.275	39.1	33.5	-28.8	27.2	-25.1	Positive Trace
0.423	42.4	39.5	-18.7	35.7	-12.4	Positive Trace
0.559	39.8	36.6	-19.4	32.6	-13.4	Positive Trace
1.115	36.4	31.7	-24.3	25.3	-20.7	Positive Trace
1.463	38.5	31.6	-24.4	25.4	-20.6	Positive Trace
6.558	36.1	32.6	-27.4	27.6	-22.4	Positive Trace

Plot 5.9.3.4. Power Line Conducted Emissions, EUT with DC – DC Converter ((Rx Mode)
Line Voltage: 30 VDC; Line Tested: Negative

Current Graph

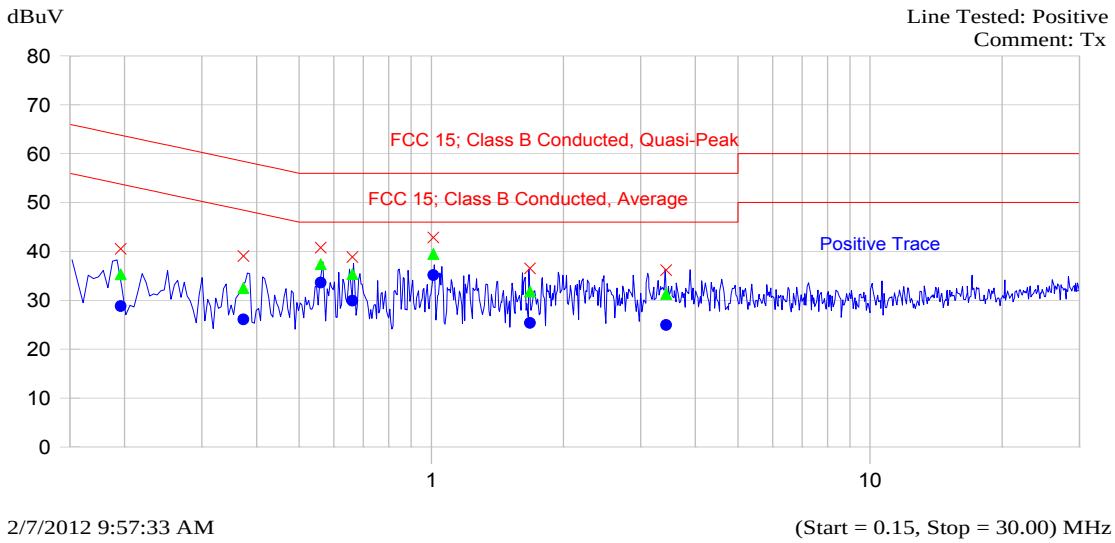


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.153	42.4	38.2	-27.7	31.8	-24.1	Negative Trace
0.423	42.3	39.2	-19.0	35.3	-12.8	Negative Trace
0.530	39.1	35.6	-20.4	30.1	-15.9	Negative Trace
0.735	38.2	32.8	-23.2	26.4	-19.6	Negative Trace
1.266	36.2	31.9	-24.1	25.4	-20.6	Negative Trace

Plot 5.9.3.5. Power Line Conducted Emissions, EUT with DC – DC Converter (Tx Mode)
Line Voltage: 10.8 VDC; Line Tested: Positive

Current Graph

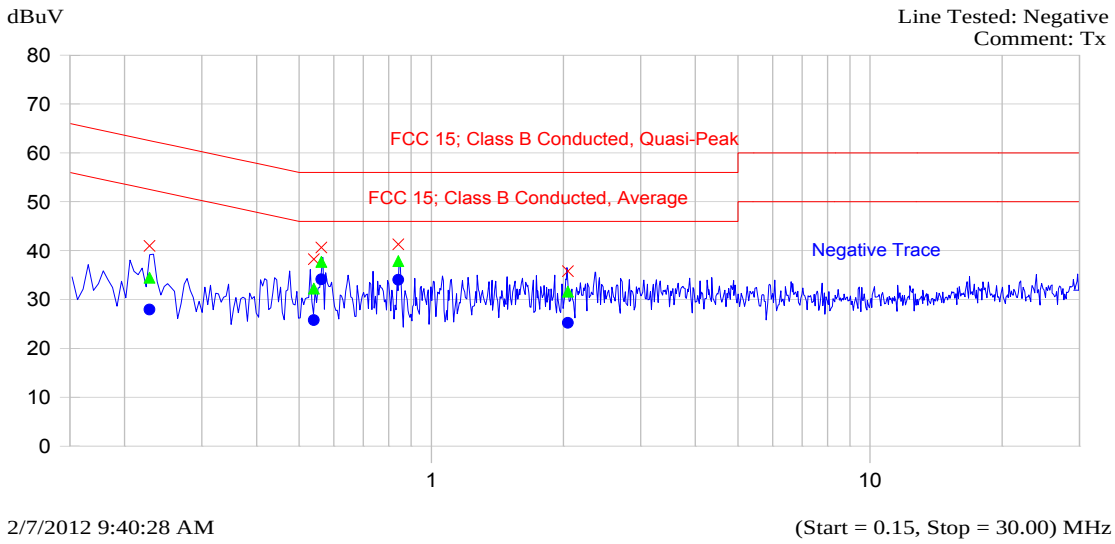


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.196	40.5	35.3	-29.3	28.8	-25.8	Positive Trace
0.373	39.1	32.5	-27.0	26.1	-23.4	Positive Trace
0.560	40.8	37.4	-18.6	33.6	-12.4	Positive Trace
0.661	38.8	35.4	-20.6	29.9	-16.1	Positive Trace
1.011	42.9	39.5	-16.5	35.2	-10.8	Positive Trace
1.679	36.5	31.8	-24.2	25.4	-20.6	Positive Trace
3.430	36.2	31.3	-24.7	25.0	-21.0	Positive Trace

Plot 5.9.3.6. Power Line Conducted Emissions, EUT with DC – DC Converter (Tx Mode)
Line Voltage: 10.8 VDC; Line Tested: Negative

Current Graph

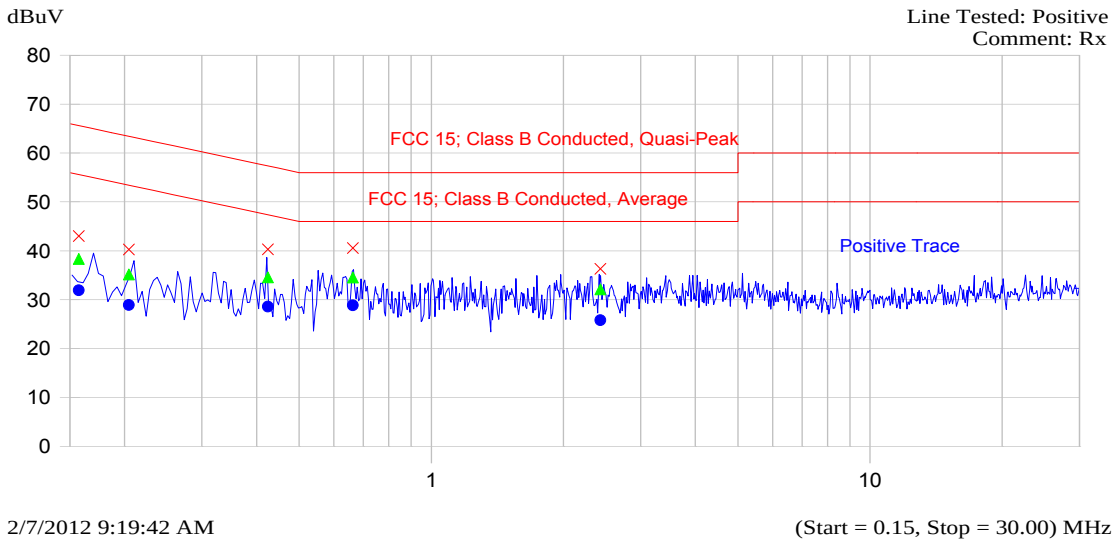


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.228	41.0	34.4	-29.3	27.9	-25.8	Negative Trace
0.540	38.2	32.2	-23.8	25.8	-20.2	Negative Trace
0.562	40.6	37.7	-18.3	34.1	-11.9	Negative Trace
0.841	41.3	37.9	-18.1	34.0	-12.0	Negative Trace
2.048	35.8	31.6	-24.4	25.2	-20.8	Negative Trace

Plot 5.9.3.7. Power Line Conducted Emissions, EUT with DC – DC Converter (Rx Mode)
Line Voltage: 10.8 VDC; Line Tested: Positive

Current Graph

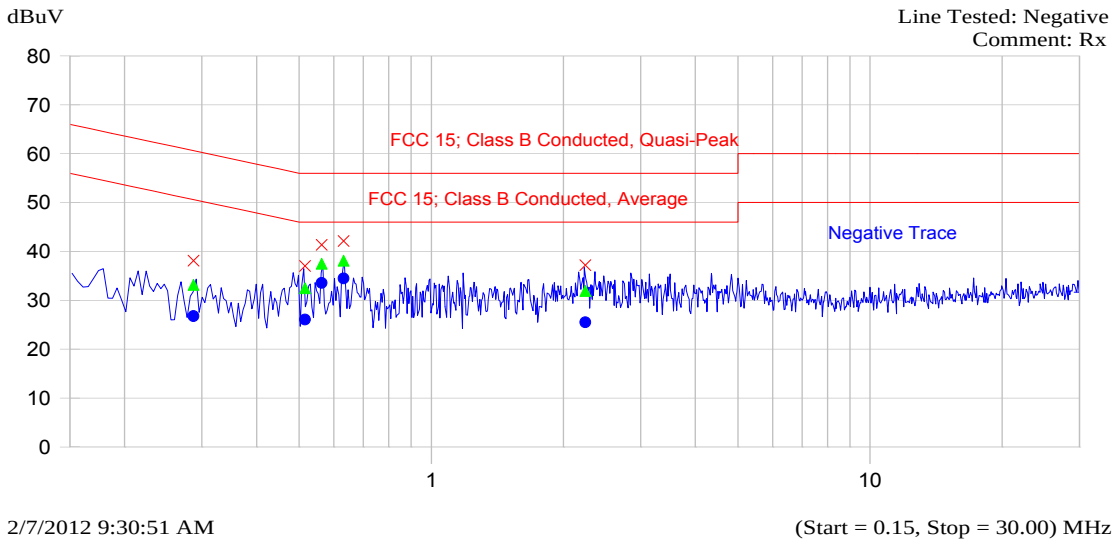


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.157	43.0	38.4	-27.4	31.9	-23.9	Positive Trace
0.204	40.3	35.2	-29.2	28.9	-25.5	Positive Trace
0.424	40.3	34.6	-23.5	28.6	-19.5	Positive Trace
0.663	40.6	34.5	-21.5	28.8	-17.2	Positive Trace
2.428	36.3	32.1	-23.9	25.8	-20.2	Positive Trace

Plot 5.9.3.8. Power Line Conducted Emissions, EUT with DC – DC Converter (Rx Mode)
Line Voltage: 10.8 VDC; Line Tested: Negative

Current Graph

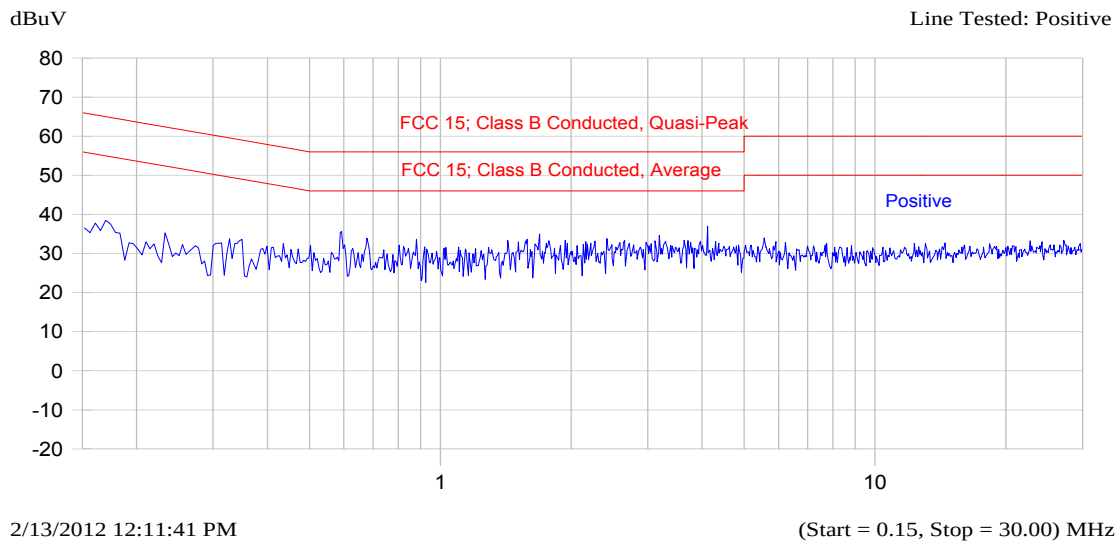


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.287	38.1	33.2	-28.9	26.8	-25.2	Negative Trace
0.515	37.0	32.5	-23.5	26.1	-19.9	Negative Trace
0.562	41.4	37.5	-18.5	33.6	-12.4	Negative Trace
0.631	42.2	38.1	-17.9	34.5	-11.5	Negative Trace
2.245	37.2	31.9	-24.1	25.5	-20.5	Negative Trace

Plot 5.9.3.9. Power Line Conducted Emissions, EUT without DC – DC Converter (Tx Mode)
Line Voltage: 13.75 VDC; Line Tested: Positive

Current Graph

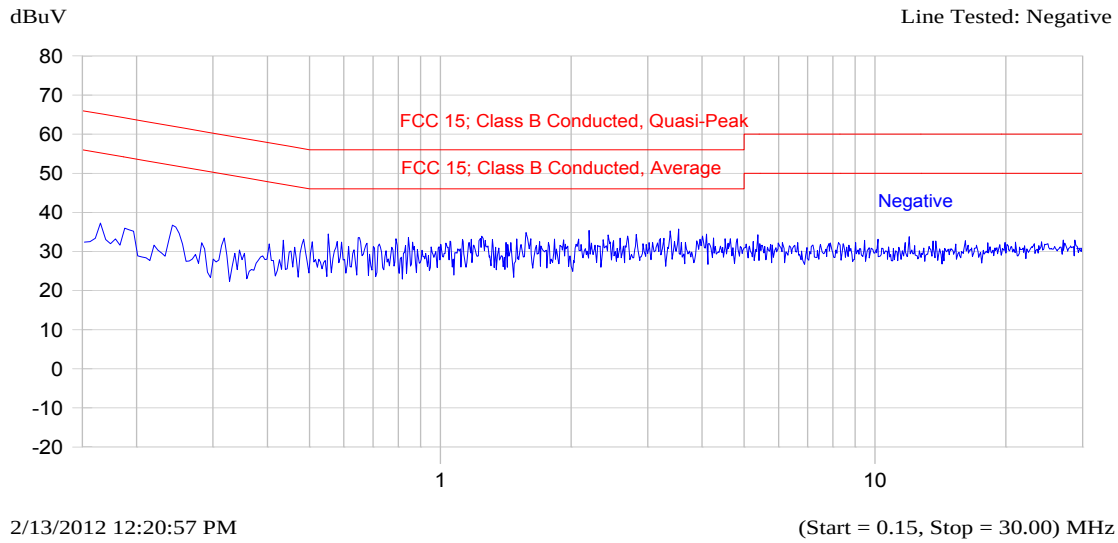


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
4.133	35.1	30.1	-25.9	23.9	-22.1	Positive

Plot 5.9.3.10. Power Line Conducted Emissions, EUT without DC – DC Converter (Tx Mode)
Line Voltage: 13.75 VDC; Line Tested: Negative

Current Graph

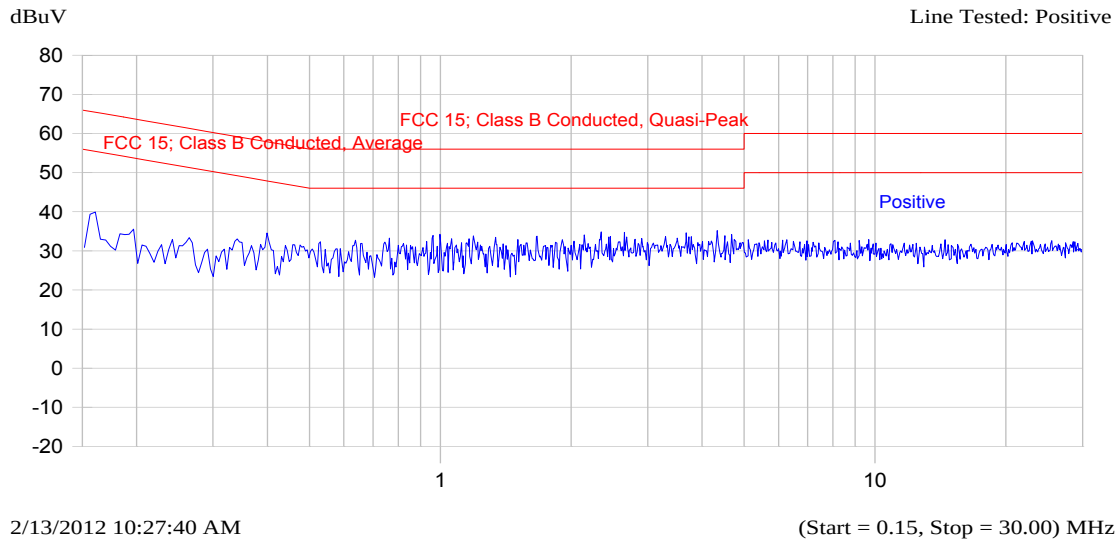


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.236	39.2	34.3	-29.2	28.4	-25.1	Negative

Plot 5.9.3.11. Power Line Conducted Emissions, EUT without DC – DC Converter (Rx Mode)
Line Voltage: 13.75 VDC; Line Tested: Positive

Current Graph

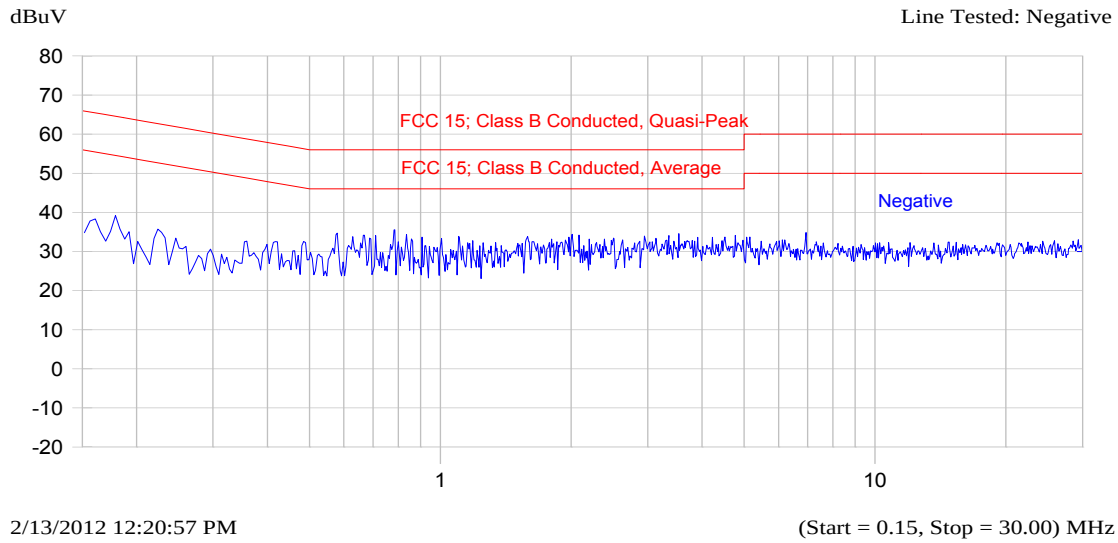


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.159	42.4	36.8	-28.9	31.3	-24.5	Positive

Plot 5.9.3.12. Power Line Conducted Emissions, EUT without DC – DC Converter ((Rx Mode)
Line Voltage: 13.75 VDC; Line Tested: Negative

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.187	40.3	35.7	-29.2	30.1	-24.8	Negative

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Frequency Counter	EIP	545A	2683	10Hz - 18 GHz	31 Jan 2012*
Combiner	Mini Circuit	ZFSC-3-4	15542	1MHz - 1GHz	Cal. on use.
RF Detector	Pasternack	PE8000-50	--	10M--1G Hz	Cal. on use.
Infinium Digital Oscilloscope	Hewlett-Packard	54801A	US38380192	DC--500M Hz 1G sampling	07 Jun 2012
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	11 Aug 2012
RF Synthesized signal Generator	HP	8648C	3343U00391	100K-3200M Hz AM/ FM/ PM	14 Dec 2012
Power supply	Tenma	72-7295	490300297	1-40V DC 5A	Cal. on use.
FFT Digital Spectrum Analyzer	Advantest	R9211E	8202336	10mHz--100KHz	14 Dec 2012
RF Communication Test Set	Hewlett Packard	8920B	US39064699	30MHz-1GHz	27 Oct 2012
Horn antenna	ETS-LINDGREN	3117	119425	1-18GHz	15 Feb 2012
Preamplifier	Hewlett Packard	8449B	3008A00769	1-26.5GHz	17 Feb 2012
High Pass Filter	Mini Circuit	SHP 600	--	Cut off 560 MHz	Cal. on use.
Power supply	XANTREX	XKW 60-50	26509	0-60V 0-50A DC	Cal. on use.
High Pass Filter	Mini Circuit	BHP-200	--	Cut off 200 MHz	Cal. on use.
Attenuator	Aeroflex/ Weinschel	23-20-34	BH7876	DC-18 GHz	Cal. on use.
Log-periodic Antenna	ETS	93148	1101	200-2000 MHz	04 Jan 2012*
Biconical Antenna	ETS	3110B	3379	30-300MHz	04 Jan 2012*
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3710A00223	9 kHz – 22 GHz	25 Apr 2012
L.I.S.N.	Schwarzbeck	NSLK8127	8127276	10 kHz – 30 MHz	07 Apr 2012
Transient Limiter	Pasternack	PE7010-20	--	DC – 2 GHz 20 dB attenuation	9 Jan 2013
Highpass Filter	Telemeter Electronics	MTA-HPF-150	2110465-007	9 kHz – 250 MHz Barrier Frequency: 150 kHz	17 Aug 2013
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	11 Aug 2012
Frequency Counter	EIP	545A	02683	10Hz - 18 GHz	01 Mar 2013

* This equipment was used during the period of December 15 - 20, 2011.

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.57**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.14**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- If the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

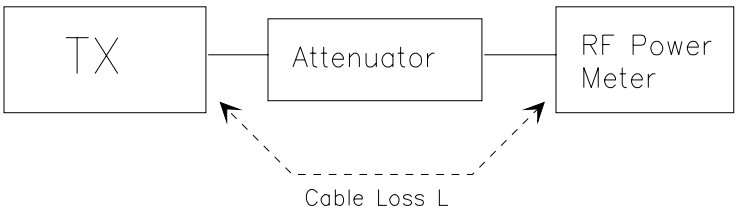
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions Using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

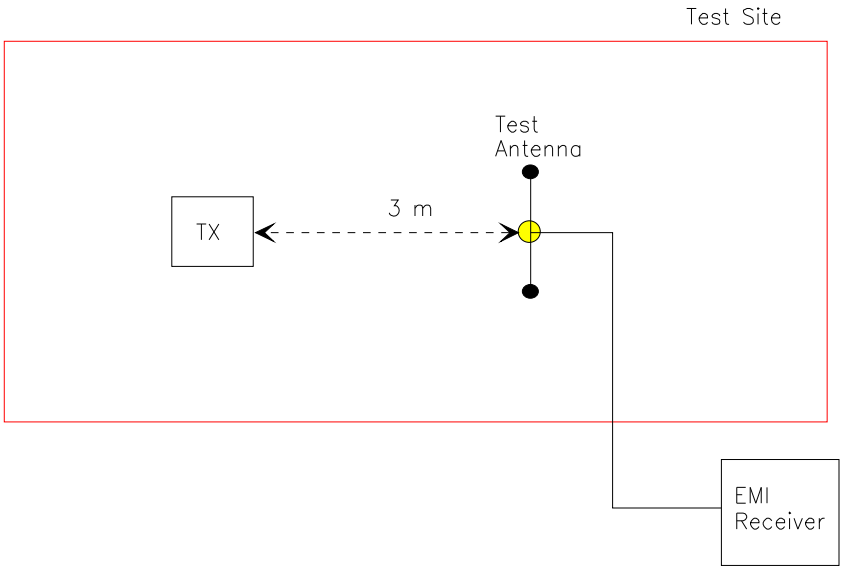
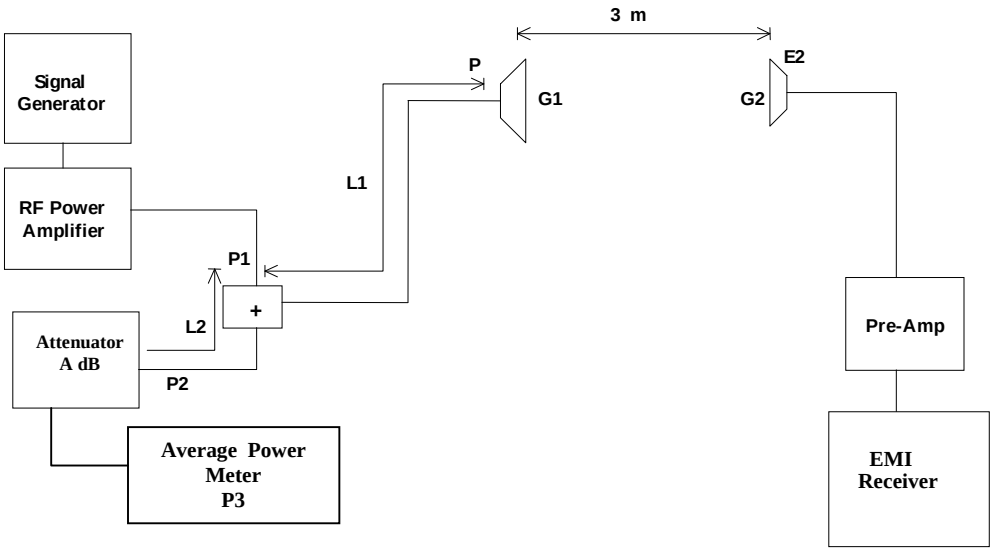


Figure 3



All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 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 stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply 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.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide 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.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION LIMITATIONS

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

(1) For 25 kHz Channel Spacing: RBW = 300 Hz
(2) For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.1051 - Spurious Emissions at Antenna Terminal:- 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 the 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.