ENGINEERING TEST REPORT

UHF LO/UHF HI RF MODULE
Model No.: T3045
FCC ID: IMA-T3045

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 90

UltraTech's File No.: TIL-093F90

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: December 27, 2012	
Report Prepared by: Dan Huynh Issued Date: December 27, 2012	Tested by: Mr. Hung Trinh Test Dates: December 23, 25 & 27, 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.*

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FCC	VCCI	Industry Canada / Industrie Canada	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 90
Title:	Code of Federal Regulations (CFR), Title 47 –Telecommunication, Part 90 Private land mobile radio services
Purpose of Test:	To gain FCC Equipment Authorization for Radio operating in Part 90.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA-603-D – 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	2012	Code of Federal Regulations, Title 47 – 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 D	2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

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:	UHF LO/UHF HI RF MODULE
Model Name or Number:	T3045
Serial Number:	655CNP0989
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	7.5 VDC Nominal
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	RF Transceiver Module

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	7.5 VDC Nominal
RF Output Power Rating:	1 to 5 W
Operating Frequency Range:	380 – 406 MHz, 406.1 - 520 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	25 kHz,12.5 kHz, 6.25 kHz (2 SLOT TDMA)
Modulation Employed:	FM W/N, C4FM, CQPSK, 2 SLOT TDMA
Emission Designation:	11K0F3E, 8K10F1E, 8K10F1D, 8K10F1W
Antenna Connector Type:	MCX

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	J1 Main Audio and Control Interface	1	Molex Surface Mount FM	Molex, PCB Surface Mount, 60 Pins, Male
2	M101 DC Power Terminals	1	Custom Brass pins	PCB mounted pins
3	J101 Antenna Connector	1	Surface Mount MCX FM	MCX Male Plug Shielded

2.5. ANCILLARY EQUIPMENT

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	TECHNISONIC INDUSTRIES LIMITED
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

EXHIBIT 3. EUT OPERATING CONDITIONS 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:	7.5 VDC nominal

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:	Test Jig.
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ω Load.

Transmitter Test Signals	
Frequency Band(s):	380 - 406 MHz 406.1 - 520 MHz
Test Frequency(ies):	406.3 MHz, 450.1 MHz, 469.8 MHz and 519.8 MHz
Transmitter Wanted Output Test Signals:	
• Transmitter Power (measured maximum output power):	36.90 dBm
• Normal Test Modulation:	F3E and unmodulated
• Modulating signal source:	Internal

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.

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 EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 90.205	RF Power Output	Yes
2.1047(a)	Modulation Characteristics - Audio Frequency Response	Yes, See Note 1
2.1047(b)	Modulation Characteristics - Modulation Limiting	Yes, See Note 1
2.1049, 90.209 & 90.210	Occupied Bandwidth and Emission Limitations/Masks	Yes, See Note 1
2.1051, 2.1057 & 90.210	Spurious Emissions at Antenna Terminal	Yes, See Note 1
2.1053, 2.1057 & 90.210	Field Strength of Spurious Emissions	Yes
2.1055 & 90.213	Frequency Stability	Yes
1.1307, 1.1310 & 2.1091	RF Exposure Limit	Yes
15.107	AC Power Line Conducted Emissions	Yes

Note 1: See FCC ID: AZ489FT4906 test report

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 90.205]

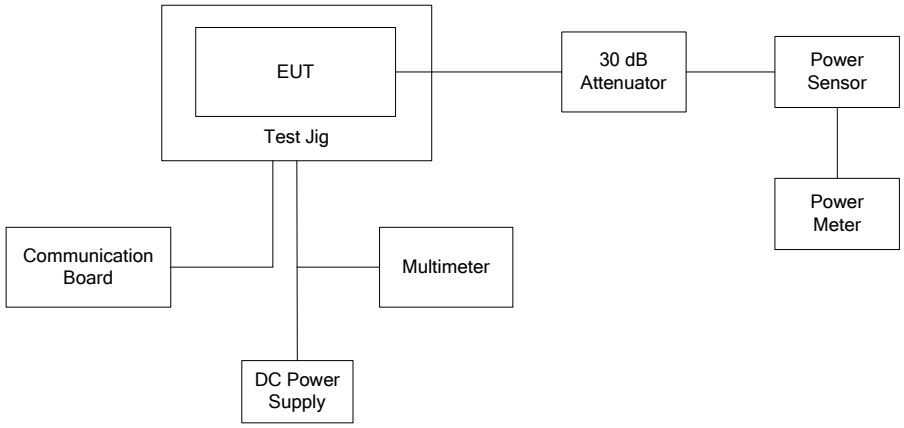
5.1.1. Limits

Please refer to FCC 47 CFR § 90.205 for specification details.

5.1.2. Method of Measurements

Refer to Section 8.1 of this report for measurement details.

5.1.3. Test Arrangement



5.1.4. Test Data

Frequency	Measured Conducted Power Output		Power Output Rating	
(MHz)	(dBm)	(W)	(dBm)	(W)
406.3	36.90	4.90	37.56	5.0
450.1	36.87	4.86	37.56	5.0
469.8	36.80	4.79	37.56	5.0
519.8	36.75	4.73	37.56	5.0
406.3	30.43	1.10	30.00	1.0
450.1	30.37	1.09	30.00	1.0
469.8	30.30	1.07	30.00	1.0
519.8	30.27	1.06	30.00	1.0

Conducted Power Verification of FCC ID: AZ489FT4906 Certification and EUT			
Fundamental Frequency (MHz)	Conducted Output Power from FCC ID: AZ489FT4906 Certification (W)	Conducted Output Power Measured from EUT (W)	Power Rating (W)
425.025	5.7	4.90 (at 406.3 MHz)	5.0
485.025	5.7	4.79 (at 469.8 MHz)	5.0
425.025	1.0	1.10 (at 406.3 MHz)	1.0
485.025	1.0	1.07 (at 469.8 MHz)	1.0

5.2. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053 & 90.210]

5.2.1. Limits

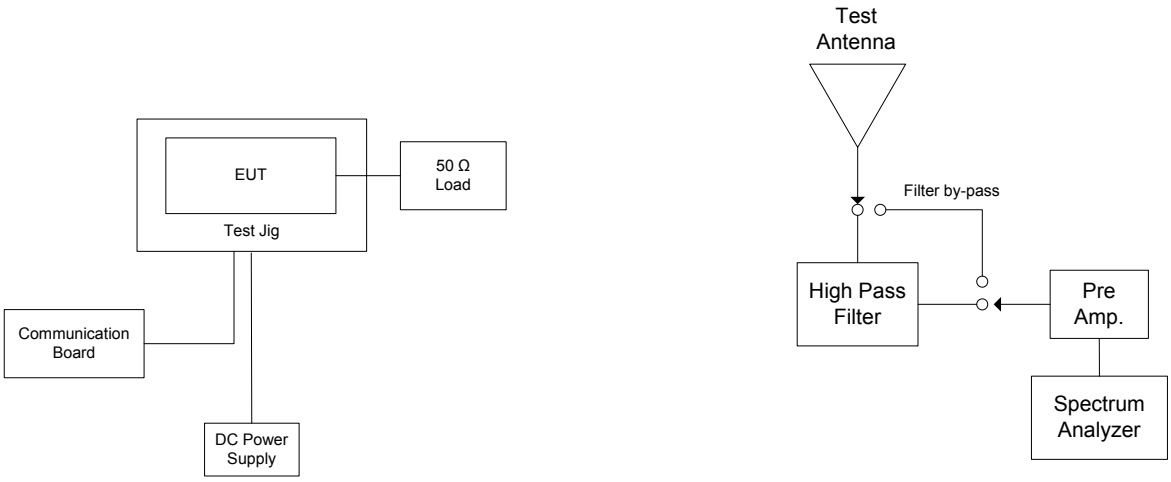
Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(d)	At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

5.2.2. Method of Measurements

See substitution test method specified in 8.2 of this report

5.2.3. Test Arrangement



5.2.4. Test Data

Remarks:

- The emissions were scanned from 30 MHz to 10th harmonics; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.
- Exploratory tests were conducted with modulations in the range of typical modes of operation to identify the worst-case modulation. There were no discernable differences detected. The high power setting was used to represents the worst-case test configuration for the final measurement.
- The more stringent limit will be applied for compliance.

Test Frequency (MHz):	406.3					
Limit (dBm):	-20					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 6000	*	Peak	H/V	*	-20	*

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

Test Frequency (MHz):	450.1					
Limit (dBm):	-20					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 6000	*	Peak	H/V	*	-20	*

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

Test Frequency (MHz):	469.8					
Limit (dBm):	-20					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 6000	*	Peak	H/V	*	-20	*

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

Test Frequency (MHz):	519.8					
Limit (dBm):	-20					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 6000	*	Peak	H/V	*	-20	*

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

5.3. FREQUECNY STABILITY [§§ 2.1055 & 90.213]

5.3.1. Limits

See § 90.213

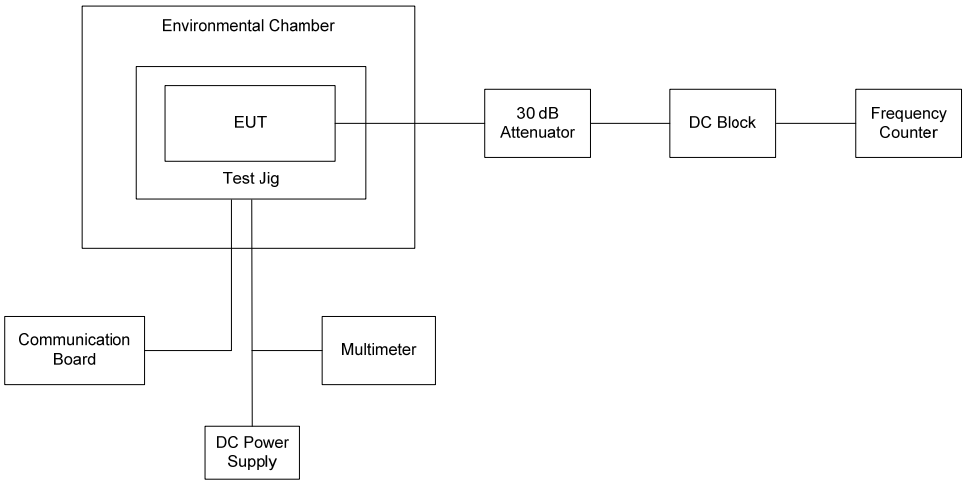
Frequency Band	Minimum Frequency Stability (ppm)		
	Fixed and Base Stations	Mobile Stations	
		> 2 W	≤ 2 W
421–512 MHz	[1,3,4]2 .5	[2]5	[2]5

[1] In the 421–512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
[2] In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
[3] Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150–174
[4] Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

5.3.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details

5.3.3. Test Arrangement



5.3.4. Test Data

Center Frequency:	406.3 MHz
Full Power Level:	4.90 W
Frequency Tolerance Limit (Worst Case):	±1.5 ppm or 609 Hz
Max. Frequency Tolerance Measured:	+87 Hz or 0.21 ppm
Input Voltage Rating:	7.5 VDC

Ambient Temperature (°C)	**Frequency Drift (Hz)**		
	Supply Voltage (Nominal) 7.5 VDC	**Supply Voltage (85% of Nominal) 6.375 VDC**	**Supply Voltage (115% of Nominal) 8.625 VDC**
-30	-51	--	--
-20	-43	--	--
-10	-51	--	--
0	-8	--	--
10	-25	--	--
20	-21	+30	+52
30	-11	--	--
40	+75	--	--
50	+87	--	--
60	+48	--	--

5.4. EXPOSURE OF HUMANS TO RF FIELD [[§§ 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.

5.4.1. Method of Measurements

See RSS-102 & FCC 47 CFR §§ 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements, 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

5.4.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
*Minimum calculated separation distance between antenna and persons required: **56 cm**	Manufacturer' instruction for separation distance between antenna and persons required: See the user's manual for information.
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

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

S = 380/1500 mW/cm^2
EIRP = 40 dBm = $10^{40/10}$ mW = 10000 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{10000}{4 \cdot \pi \cdot (380/1500)}} \approx 56.0cm$

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

5.5.1. Limits

The equipment shall meet the limits of the following table:

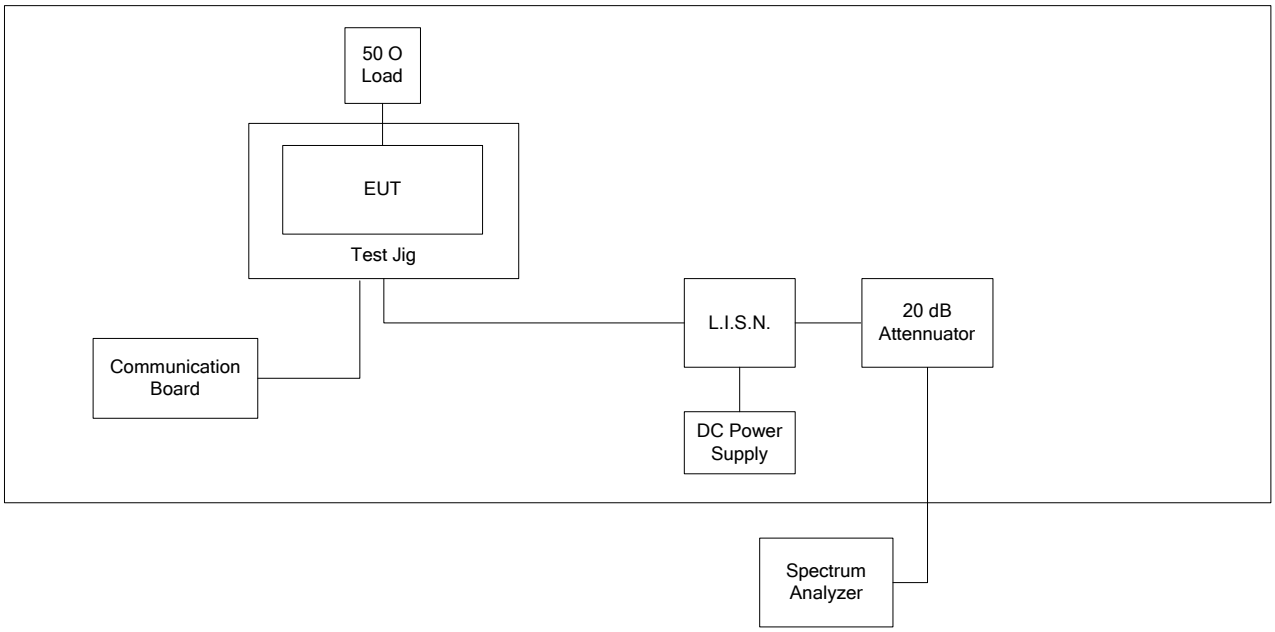
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

5.5.1.1. Method of Measurements

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

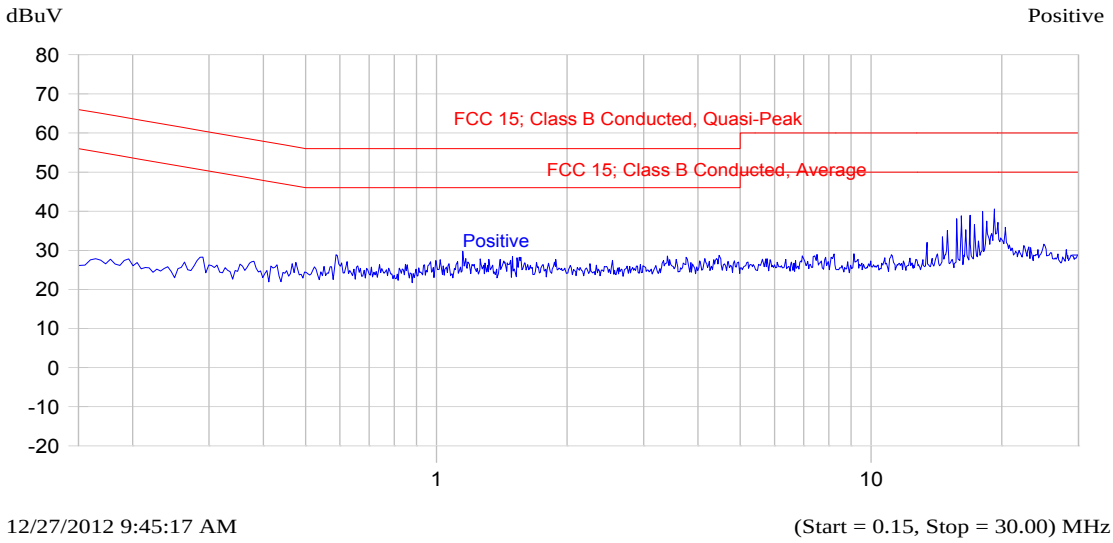
5.5.2. Test Arrangement



5.5.3. Test Data

Plot 5.5.3.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 7.5 VDC; Line Tested: Positive

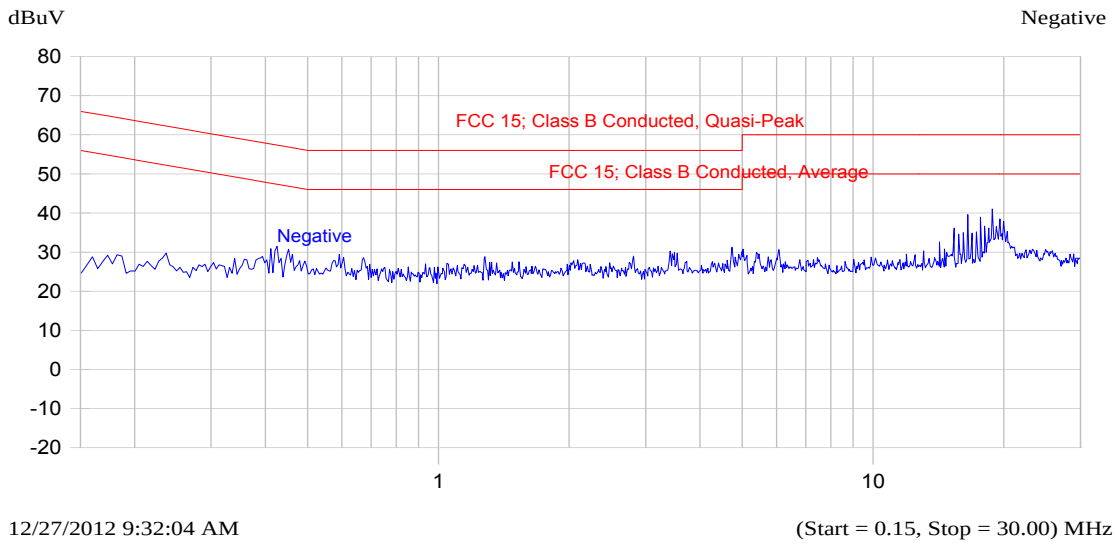
Current Graph



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.590	27.2	22.1	-33.9	14.9	-31.1	Positive
1.148	27.7	20.0	-36.0	12.7	-33.3	Positive
19.205	41.4	38.3	-21.7	36.0	-14.0	Positive

Plot 5.5.3.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 7.5 VDC; Line Tested: Negative

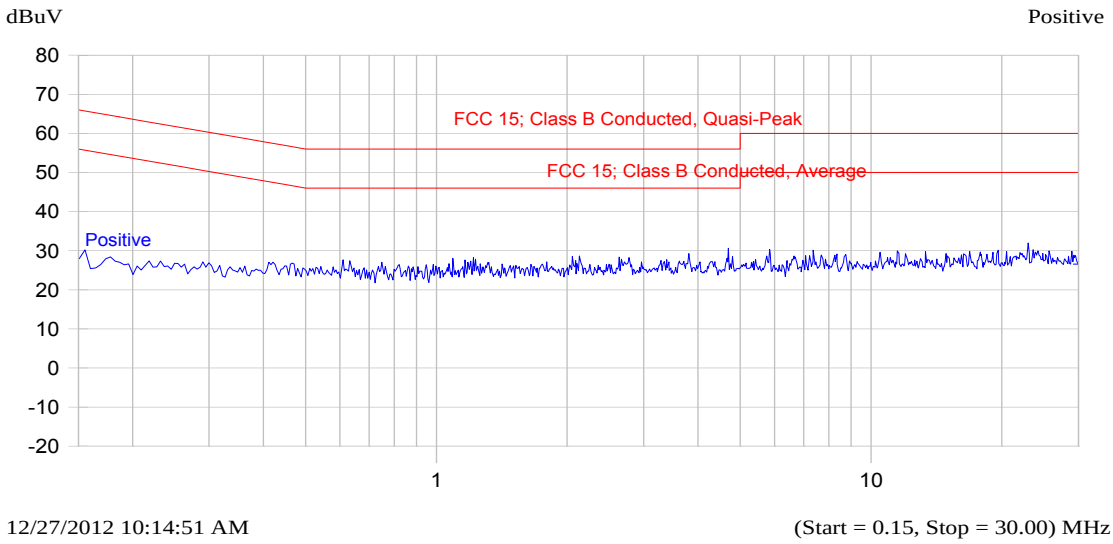
Current Graph



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.419	28.1	21.0	-37.3	14.3	-34.0	Negative
4.726	27.3	20.3	-35.7	13.2	-32.8	Negative
18.826	41.2	38.5	-21.5	33.6	-16.4	Negative

Plot 5.5.3.3. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 7.5 VDC; Line Tested: Positive

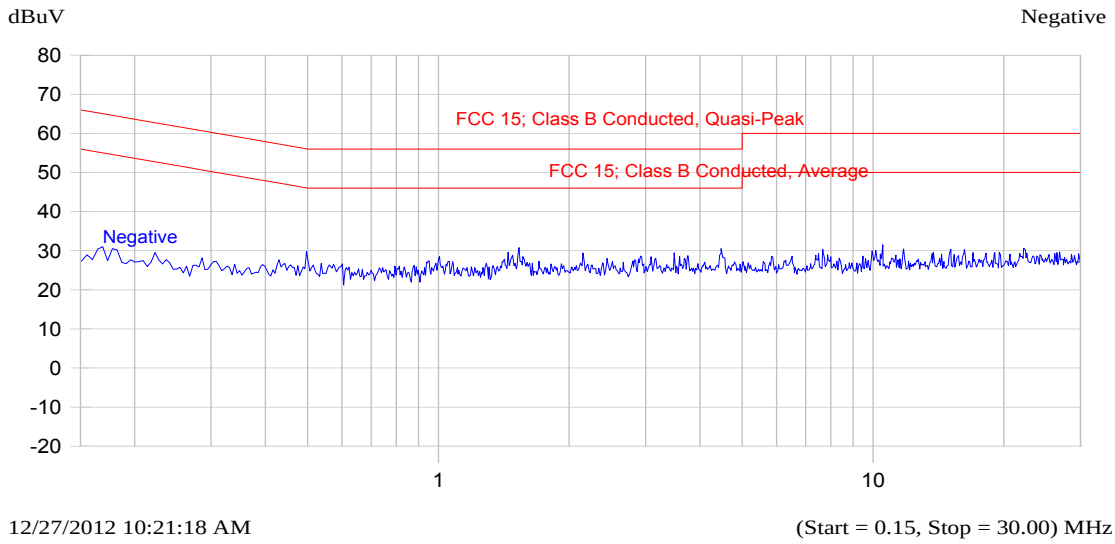
Current Graph



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
4.688	24.8	20.1	-35.9	12.7	-33.3	Positive
22.983	26.9	21.2	-38.8	14.6	-35.4	Positive

Plot 5.5.3.4. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 7.5 VDC; Line Tested: Negative

Current Graph



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.487	26.7	20.4	-36.0	14.2	-32.2	Negative
1.528	27.3	22.9	-33.1	18.5	-27.5	Negative
10.523	28.4	19.6	-40.4	12.7	-37.3	Negative

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Power Meter	Hewlett Packard	436A	2016A07747	10 MHz – 18 GHz	13 Dec 2013
Power Sensor	Hewlett Packard	8481A	2237A33409	10 MHz – 18 GHz	13 Dec 2013
Attenuator	Weinschel	48-30-34	BM5354	DC – 18 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
DC Power Supply	Tenma	72-7295	490300297	1 – 40 Vdc	Cal on use
Multimeter	Extech Instruments	EX530	12070737	0.01mV - 1kV	05 Dec 2013
Frequency Counter	EIP	545A	02683	10Hz–18 GHz	01 Mar 2013
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 °C	16 Aug 2013
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	02 Nov 2013
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 – 26.5 GHz	06 Aug 2013
Dipole Antenna	EMCO	3121C-B3&B4	434	140–1000 MHz	06 Jan 2014
Biconi-Log Antenna	ETS Lindgren	3142B	1575	26 – 3000 MHz	04 May 2013
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	02 Apr 2013
Horn Antenna	EMCO	3155	5061	1 – 18 GHz	25 Jan 2013
High Pass Filter	Mini-Circuits	SHP-800	10425	Cut off 400 MHz	Cal. on use
High Pass Filter	Mini-Circuits	SHP-300	10427	Cut off 200 MHz	Cal. on use
Spectrum Analyzer	Agilent	E7401A	US40240432	9 kHz–1.5 GHz	01 May 2013
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	09 Jan 2013
L.I.S.N	EMCO	3825/2	8907-1531	10 kHz -100 MHz	05 Apr 2013

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**

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

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).

- I f 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.

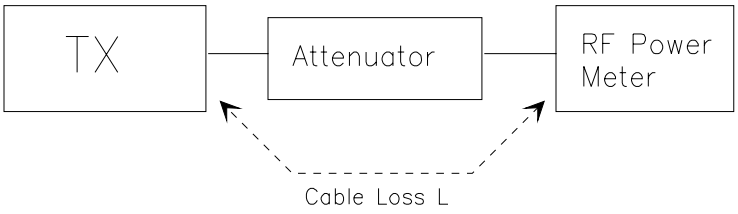
Step 2: Calculation of Average EIRP. See Figure 1

- 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:	100 kHz
Video BW:	VBW > RBW
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

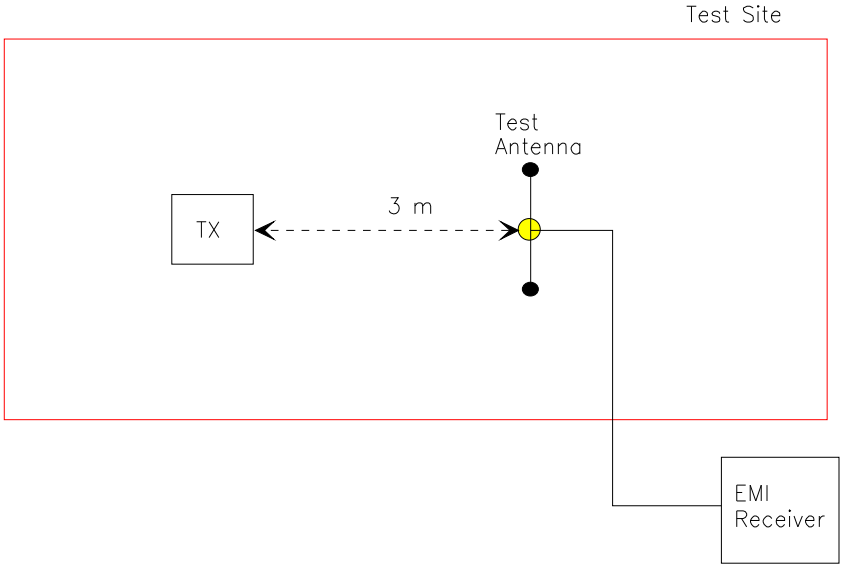
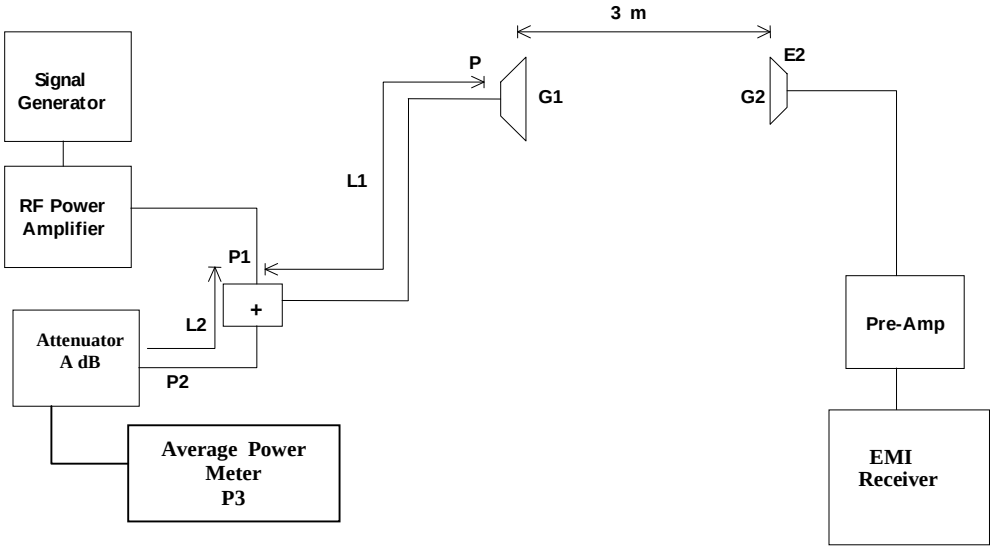


Figure 3



8.3. FREQUENCY STABILITY

Refer to § 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).