ENGINEERING TEST REPORT

VHF LOW BAND RF MODULE
Model: T3100
FCC ID: IMA-T3100

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-102F90

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: August 19, 2013	
Report Prepared by: Dan Huynh Issued Date: August 19, 2013	Tested by: Mr. Hung Trinh Test Dates: July 9 - 11, 2013

- *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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

FCC	VCCI	Industry 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 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	2013	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:	VHF LOW BAND RF MODULE
Model Name or Number:	T3100
Serial Number:	12170
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Type of Power Source:	External DC supply from interface test jig
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:	28V DC
RF Output Power Rating:	1 or 10 Watts
Operating Frequency Range:	30 - 50 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	20 kHz
Modulation Employed:	FM Analog
Emission Designation:	16K0F3E
Antenna Connector Type:	OSMT

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	J16 Main Power, Audio and Control Interface	1	Header, Socket	Header, Plug,16 PINS, Male, 3 FT
2	P1 Remote Antenna Tuner Port	1	Hi Density D plug	HD D Female, 15 Pins.
3	ANT 1 Antenna Connector	1	Surface Mount OSMT,M	OSMT Female Plug Shielded, with BNC Female

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^{o}C
Humidity:	51%
Pressure:	102 kPa
Power input source:	28 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):	30 - 50 MHz
Test Frequency(ies):	30.6 MHz, 40.0 MHz and 49.6 MHz
Transmitter Wanted Output Test Signals:	
• Transmitter Power (measured maximum output power):	40.39 dBm
• Normal Test Modulation:	F3E
• 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 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: IMA-TDFM-7300 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]

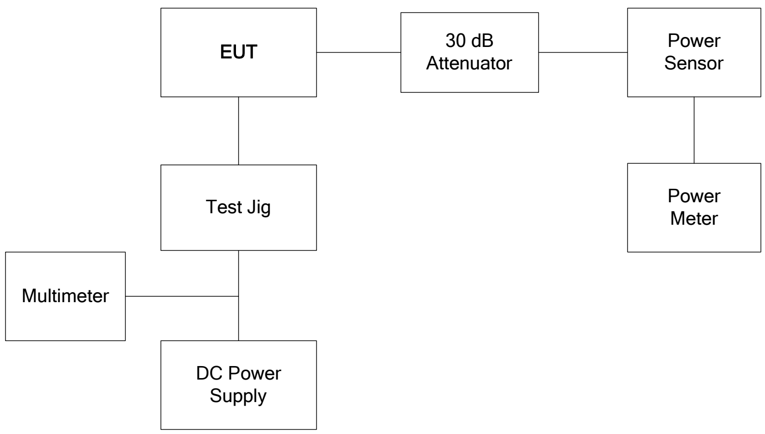
5.1.1. Limits

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

Conducted Output Power from EUT					
Power Setting	**Frequency**	**Measured Conducted Power Output**		**Power Output Rating**	
	(MHz)	**(dBm)**	**(W)**	**(dBm)**	**(W)**
High Power, 10 W	30.60	40.39	10.94	40	10
	40.00	40.34	10.81	40	10
	49.60	40.31	10.74	40	10
Low Power, 1 W	30.60	30.42	1.10	30	1
	40.00	30.37	1.09	30	1
	49.60	30.34	1.08	30	1

Conducted Power Verification of FCC ID: IMA-TDFM-7300 Certification and EUT			
Fundamental Frequency (MHz)	**Conducted Output Power from FCC ID: IMA-TDFM-7300 Certification (dBm)**	**Conducted Output Power Measured from EUT (dBm)**	**Power Rating (dBm)**
30	40.00	40.39 (at 30.60 MHz)	40
40	40.00	40.34	40
50	40.00	40.31 (at 49.60 MHz)	40
30	30.43	30.42 (at 30.60 MHz)	30
40	30.43	30.37	30
50	30.43	30.34 (at 49.60 MHz)	30

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

5.2.1. Limits

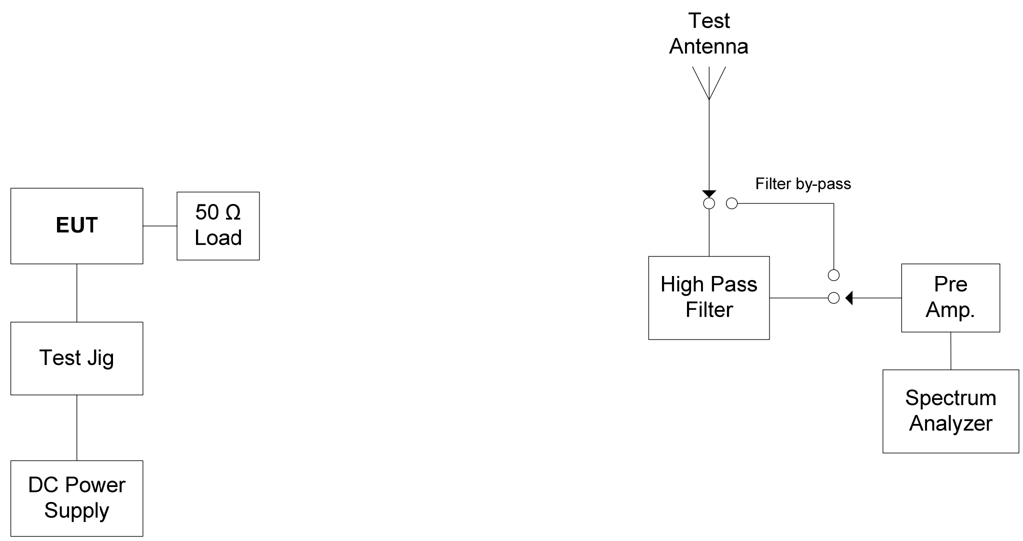
Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least 43 + 10 log(P) or -13 dBm

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.
- The radiated emissions were performed with high power setting (10 Watts) at 3 meters distance to represents the worst-case test configuration.

Test Frequency (MHz):	30.6					
Limit (dBm):	-13					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 1000	*	Peak	H/V	*	-13	*

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

Test Frequency (MHz):	40.0					
Limit (dBm):	-13					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 1000	*	Peak	H/V	*	-13	*

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

Test Frequency (MHz):	49.6					
Limit (dBm):	-13					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 1000	*	Peak	H/V	*	-13	*

* 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

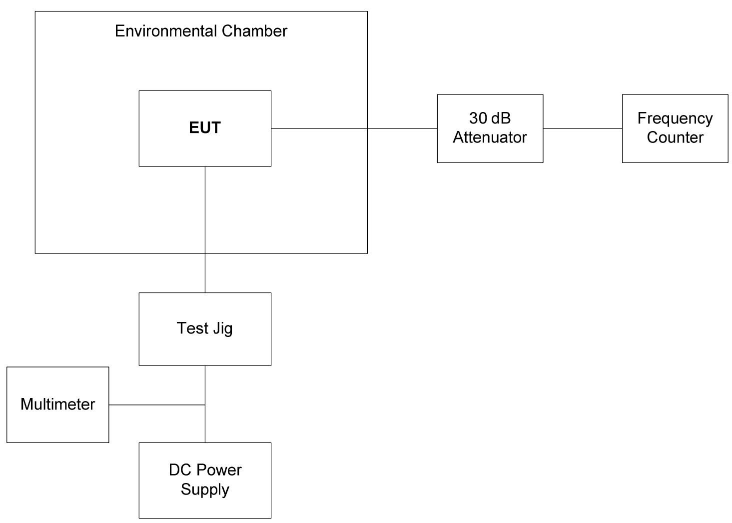
See § 90.213

Frequency Band	Minimum Frequency Stability (ppm)		
	Fixed and Base Stations	Mobile Stations	
		> 2 W	≤ 2 W
25-50	20	20	50

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:	30.6 MHz
Full Power Level:	10.94 W
Frequency Tolerance Limit (Worst Case):	±20 ppm or 612 Hz
Max. Frequency Tolerance Measured:	+61 Hz or 2.0 ppm
Input Voltage Rating:	28 VDC

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 28 VDC	**Supply Voltage (85% of Nominal) 23.8 VDC**	**Supply Voltage (115% of Nominal) 32.2 VDC**
-30	-40	--	--
-20	-33	--	--
-10	-25	--	--
0	-12	--	--
10	-5	--	--
20	+2	-42	+61
30	-27	--	--
40	-29	--	--
50	-31	--	--
60	-27	--	--

5.4. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091]

5.4.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

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: 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: 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.

5.4.2. Method of Measurements

Calculation Method of RF Safety Distance:

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

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

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

5.4.3. Evaluation of RF Exposure Compliance Requirements

Maximum RF Power conducted, **$P_{conducted}$[dBm]:**	40.39
Maximum Antenna Gain, **G[dBi]**:	3
Maximum EIRP, **P_{EIRP}[dBm]**:	43.39
MPE Limit for General Population/Uncontrolled Exposure, $S_{uncontrolled}$[mW/cm^2]:	0.2
Calculated RF Safety Distance for General Population/Uncontrolled Exposure, **$r_{safety\_controlled}$[cm]**:	93.19

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

5.5.1. Limits

The equipment shall meet the limits of the following table:

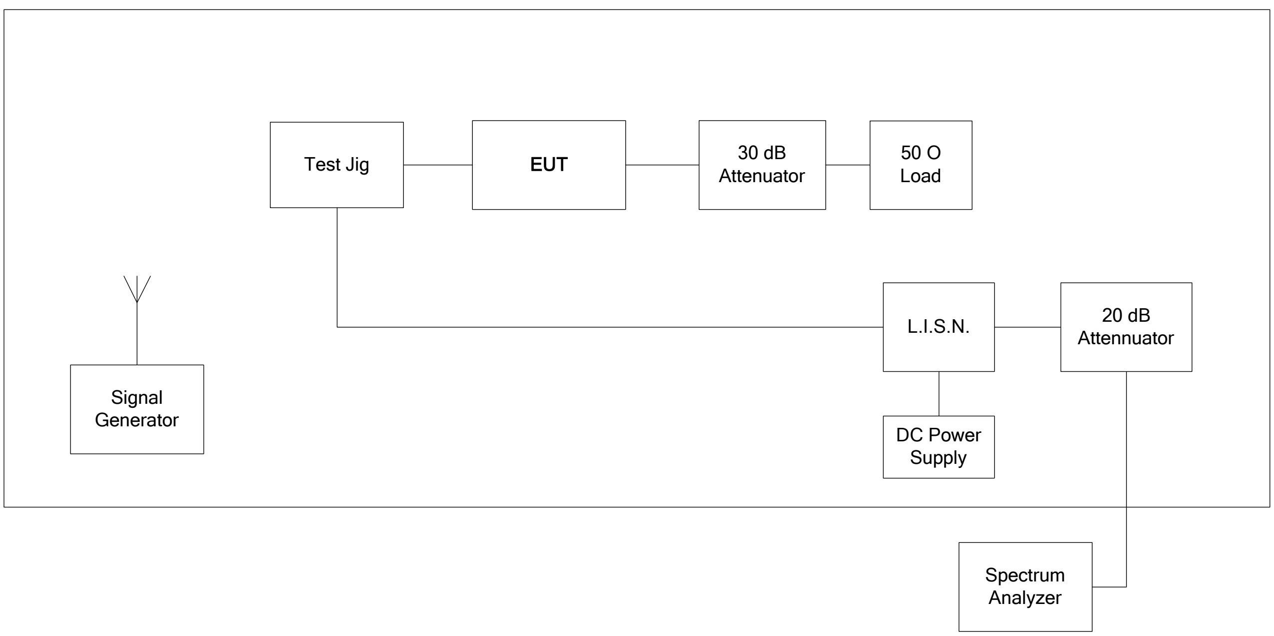
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*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.

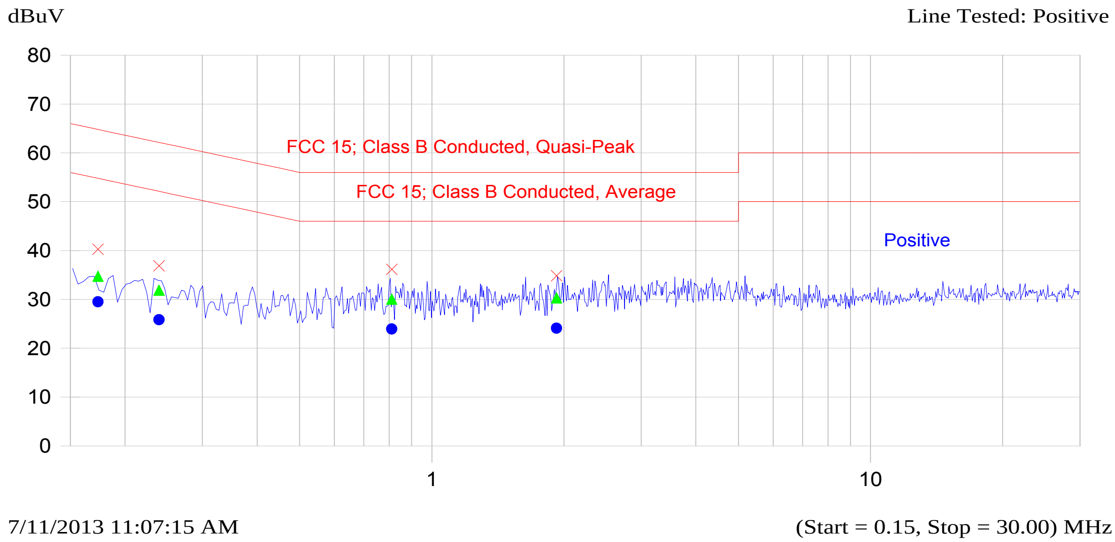
5.5.2. Test Arrangement



5.5.3. Test Data

Plot 5.5.3.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 28 VDC; Line Tested: Positive

Current Graph

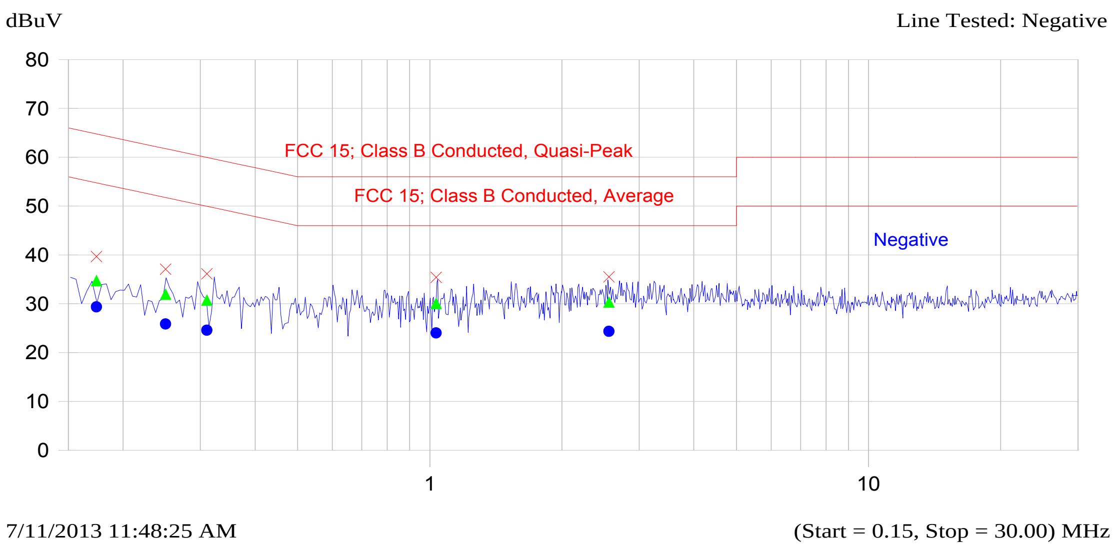


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.174	40.3	34.7	-30.6	29.5	-25.8	Positive
0.239	36.9	31.9	-31.5	25.8	-27.6	Positive
0.811	36.2	30.1	-25.9	23.9	-22.1	Positive
1.926	34.8	30.3	-25.7	24.1	-21.9	Positive

Plot 5.5.3.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 28 VDC; Line Tested: Negative

Current Graph

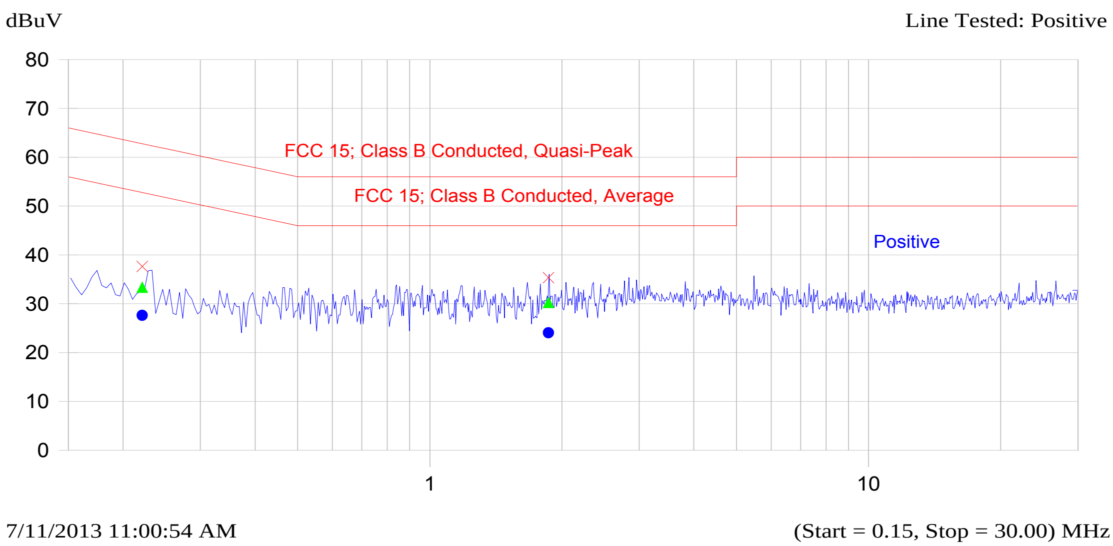


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.174	39.7	34.7	-30.6	29.4	-25.9	Negative
0.250	37.1	31.9	-31.1	25.8	-27.2	Negative
0.311	36.1	30.7	-30.6	24.6	-26.8	Negative
1.034	35.4	30.1	-25.9	24.0	-22.0	Negative
2.562	35.5	30.3	-25.7	24.4	-21.6	Negative

Plot 5.5.3.3. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 28 VDC; Line Tested: Positive

Current Graph

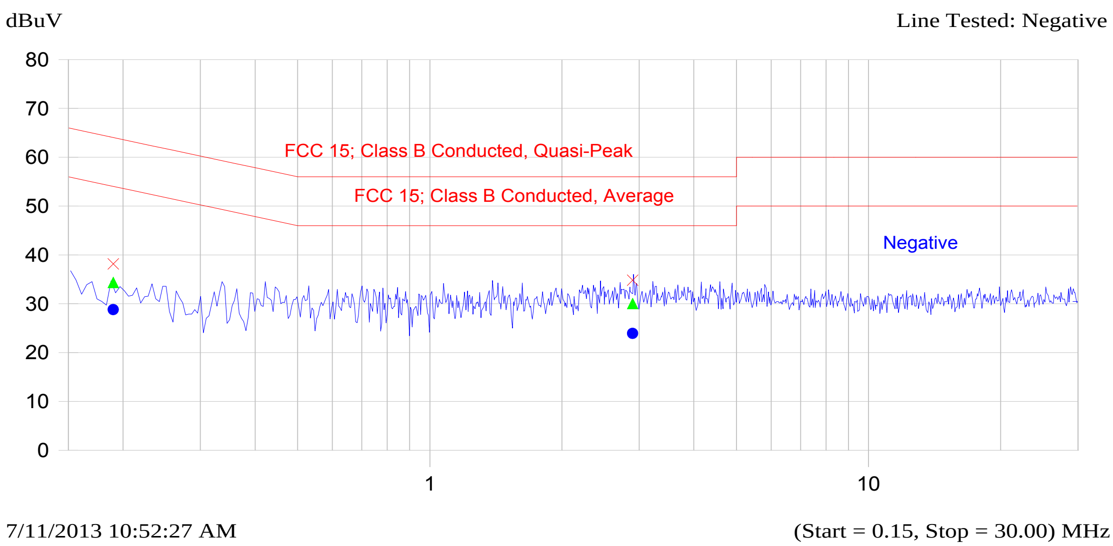


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.221	37.6	33.4	-30.5	27.6	-26.3	Positive
1.864	35.3	30.3	-25.7	24.0	-22.0	Positive

Plot 5.5.3.4. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 28 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
0.190	38.1	34.4	-30.5	28.8	-26.0	Negative
2.899	34.8	30.0	-26.0	23.9	-22.1	Negative

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK	834157/005	9 kHz - 40G	30 Jul 2014
Attenuator (30dB)	Aeroflex/Weinschel	46-30-34	BR9127	DC-18 GHz	Cal. on use
Power Sensor	Hewlett Packard	8482A	US37295944	0.1 - 4 GHz	28 Feb 2014
Power Meter	Hewlett Packard	438A	3008A06729	100K--50G sensor dependent	25 Mar 2014
Power Supply	Tenma	72-7295	490300297	1-40V DC 5A	Cal on use
Multi-meter	Tenma	72-6202	2080027	DC 0-1000V, AC 0-750V	28 Aug 2013
High Pass Filter	Mini Circuit	BHP 100	--	Cut off 90 MHz	Cal. on use
High Pass Filter	Mini Circuit	SHP 50	--	Cut off 41 MHz	Cal. on use
Preamplifier	Hewlett Packard	8449B	3008A00769	1 - 26.5GHz	01 Dec 2013
Frequency Counter	EIP	545A	2683	10Hz - 18 GHz	25 Mar 2014
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	16 Apr 2014
RF Synthesized Signal Generator	HP	8648C	3343U00391	100K-3200M Hz AM/ FM/ PM	03 Jan 2014
RF Communication Test Set	Hewlett Packard	8920B	US39064699	30MHz-1GHz	17 Jan 2015
Horn antenna	ETS-LINDGREN	3117	119425	1 - 18GHz	25 Apr 2014
Attenuator	Aeroflex/Weinschel	23-20-34	BH7876	DC-18 GHz	Cal on use
Antenna	ETS	3148	1101	200 - 2000 MHz	22 Mar 2014
Antenna	EMCO	3142B	1575	26 - 3000MHz	26 Jun 2014
EMI Receiver	Rohde & Schwarz	ESU 40	100037	20 Hz - 40 GHz	07 Mar 2014
Preamplifier	AH System	PAM-0118	225	20 MHz - 18 GHz	25 Mar 2014
Antenna	EMCO	3115	9701-5061	1 - 18GHz	18 Feb 2014
Spectrum Analyzer	Hewlett Packard	8593EM	3710A00223	9 kHz – 22 GHz	06 Feb 2014
Attenuator	Pasternack	PE7010-20	--	DC - 2 GHz	11 Jan 2014
LISN	EMCO	3825/2	8907-1531	10 kHz – 30 MHz	14 May 2014

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 (9 kHz – 30 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	± 1.44	± 1.8
U	**Expanded uncertainty U:** $U = 2u_c(y)$	± 2.89	± 3.6

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured (dB)	Limit (dB)
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:** $U = 2u_c(y)$	± 4.79	± 5.2

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured (dB)	Limit (dB)
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 (dB)	Limit (dB)
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).

- 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.

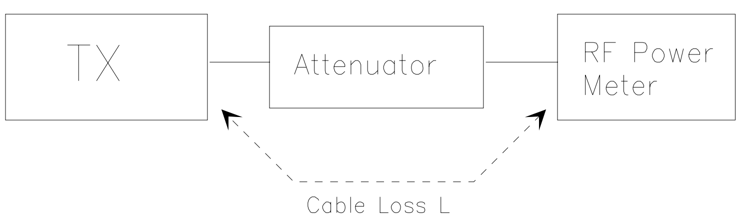
Step 2: Calculation of Average EIRP. See Figure 1

- 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° 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^o 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:

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

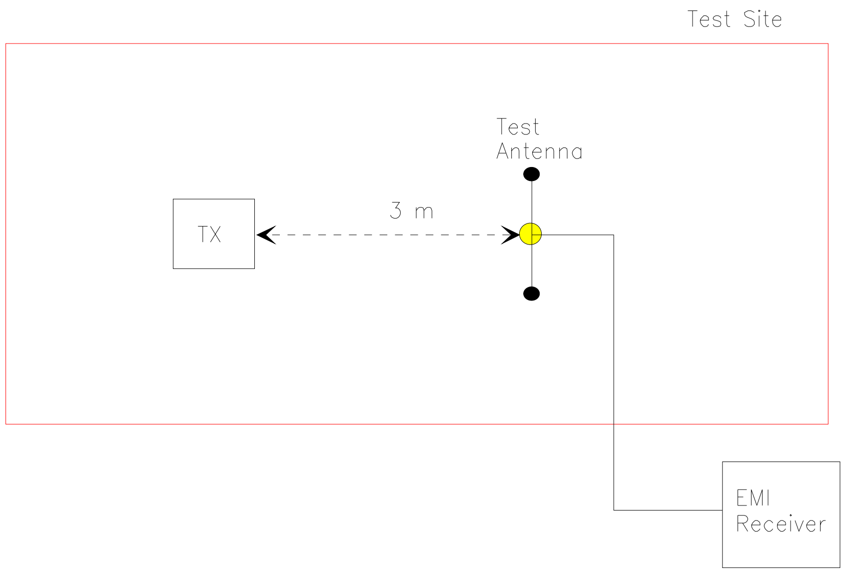
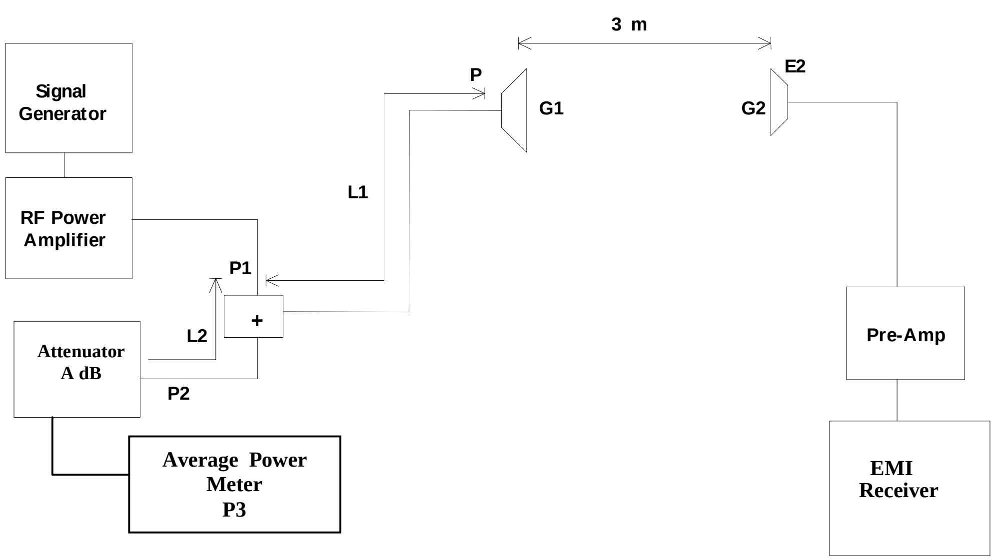


Figure 3



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).