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June 25, 2014

John Weber
Long Range Systems, LLC
4550 Excel Parkway Suite 200
Addison TX 75001

Dear John:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for Long Range Systems, LLC. Enclosed is the Wireless Certification Report for the TX-9601 Paging System Transmitter. This report can be used to demonstrate compliance with FCC requirements for wireless devices in the United States.

If you have any questions, please contact me.

Sincerely,

Jeffrey A. Lenk
President

Attachment

Project 15689-10

TX-9601 Paging System Transmitter

Wireless Certification Report

Prepared for:

Long Range Systems, LLC

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

June 25, 2014

Reviewed by



Larry Finn
Regulatory Design Engineer

Written by



Eric Lifsey
Test Engineer

Revision History

Revision Number	Description	Date
00	Reviewed and released.	June 25, 2014

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NOTICE:

(1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST.

(2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc.

(3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Certificate of Compliance

Applicant	Device & Test Identification
Long Range Systems, LLC (John Weber) 4550 Excel Parkway Suite 200 Addison, Texas 75001 Certificate Date: June 25, 2014	FCC ID: 2AB60TX9601 Model(s): TX-9601 Paging System Transmitter Part Number(s): N/A Laboratory Project #: 16005-15

The models listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR, Part 90	
Clause Subject	Section References
Conducted Output Power	90.210, 2.1046, 90.217(b)
Emission Mask	90.217(b), 2.1047
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.217(b), 2.1051
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.217(b), 2.1053
Frequency Stability	90.217(b), 2.1055
Occupied Bandwidth, 20 dB	90.209, 2.1049
Radiated Emissions 30MHz – 1 GHz, Class B	15.109, ICES-003
Mains Conducted Emissions, Class B	15.107, ICES-003
Maximum Permissible Exposure	Reported separately.

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures, have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Jeffrey A. Lenk
President

This report has been reviewed and accepted by Long Range Systems, LLC. The undersigned is responsible for ensuring that the model(s) listed above will continue to comply with the applicable rules.

Representative of Long Range Systems, LLC

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements.

1.2 EUT Description

The EUT transmits alert codes to receivers held by patrons at restaurants to page them to host for seating or similar purposes in the establishment.

The EUT is housed in an extruded aluminum enclosure with a small LCD display and integral keypad. It receives external power from an AC to DC adapter. The EUT employs a BNC connector where a quarter-wave antenna is attached and positioned vertically.

Table 1.2.1 Equipment Under Test			
Manufacturer	Model	Serial #	Description
Long Range Systems, LLC	TX-9601	None	467.75 MHz paging transmitter



Photograph 1.3.1: EUT

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

The EUT does not contain a receiver but was tested in both idle and transmit modes where applicable.

1.4 Modifications to Equipment

To reduce unwanted radiated emissions below 1 GHz a ferrite was added inside the EUT as a common-mode choke on the DC power line. Ferrite manufactured by Laird, part number 28A2025-0A2. To reduce unwanted conducted port harmonic emissions the output RF filter was modified by changing filter section capacitors.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

2.0 Applicable Documents and Clauses

Table 2.0.1: Applicable Documents		
Document #	Title/Description	Date
47 CFR	Part 90	
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment	2009
TIA/EIA-603C	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards	2004

Table 2.0.2: Applicable Clauses			
Clause Subject	Section References	Required?	Result
Conducted Output Power	90.210, 2.1046, 90.217(b)	Yes	Pass
Emission Mask ³	90.217(b), 2.1047	Yes	Pass
Conducted Spurious/Harmonic Emissions at Antenna Terminals ³	90.217(b), 2.1051	Yes	Pass
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz ³	90.217(b), 2.1053	Yes	Pass
Transient Frequency Behavior ³	90.214, TIA/EIA-603C	No ³	N/A
Frequency Stability ³	90.217(b), 2.1055	Yes	Pass
Occupied Bandwidth, 20 dB	90.209, 2.1049	Yes	Pass
Radiated Emissions 30MHz – 1 GHz ^{1, 3}	15.109, ICES-003	Yes	Pass
Mains Conducted Emissions, Class B ¹	15.107, ICES-003	Yes	Pass
Maximum Permissible Exposure ²	Reported separately.	Yes	Pass
Application Report Requirements	2.1033(c)	Yes	N/A
Exemption From Technical Standards ³	90.217(b)	Yes	Pass

¹This device generates and uses RF energy in the form of a switching power supply, such that 47 CFR, Part 15, applies. Therefore unintentional radiated and conducted emissions were measured to Part 15 limits.

²Exposure is reported in a supplemental document.

³The transmit power of this device is below 120 mW and as such the exemptions of 90.217 apply to the noted paragraphs.

3.0 Conducted Output Power [90.205]

3.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode without modulation. The connection is direct and no cables are used. Power is then measured directly with no additional calculation required.

3.2 Criteria

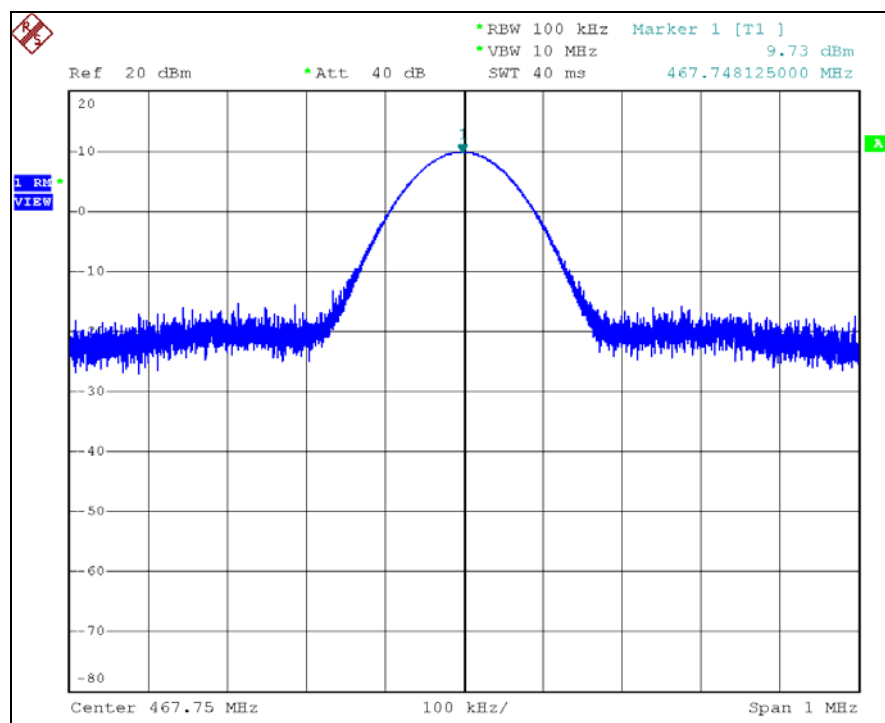
Section Reference	Parameter	Date(s)
90.205, 2.1046	Conducted Output Power	2014-06-13

3.3 Results

The EUT is in compliance with the applicable requirements. Plotted results are presented below.

Table 3.3.1 Equipment List				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29

Table 3.3.2 Power, Conducted	
Frequency	Measured Level
467.750 MHz	9.73 dBm, 9.40 mW



Peak Power, Conducted

4.0 Emission Mask [90.217(b)]

4.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode with modulation. The connection is direct and no cables are used. Spurious signals are then measured directly with no additional calculation required. Emissions are measured with average detector. The frequency span is the inner mask area including the fundamental and out to ± 25 kHz from center frequency of signal. The mask was selected to match the emission bandwidth in use.

4.2 Criteria

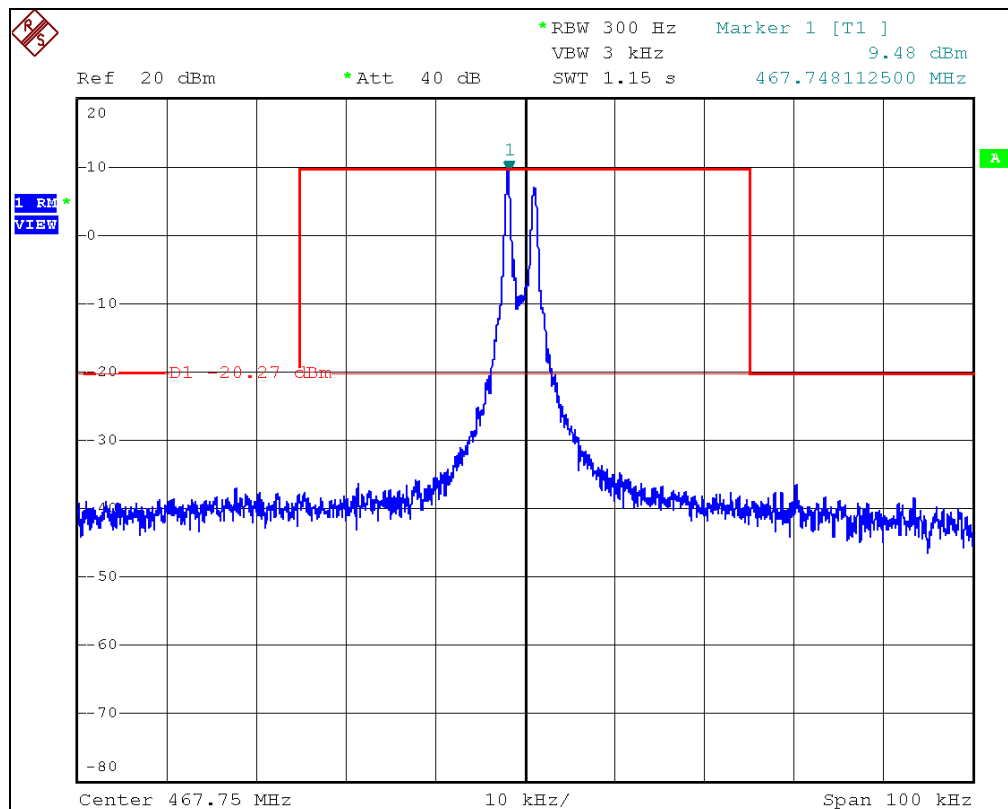
Guideline	Section Number	Date
Emissions at Antenna Terminals	90.217(b)*, 2.1051	2014-06-13

*Emission outside ± 25 kHz of allocated channel center must be 30 dB or more below the fundamental.

4.3 Results

Table 4.3.1 Equipment List				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29

The emission measured within the mask as shown in the plot below. The EUT satisfied the criteria.



Modulated Emission with Superimposed Mask of 90.217(b)

5.0 Spurious Emissions at Antenna Terminals [90.217(b)]

5.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode without modulation. The connection is direct and no cables are used. Spurious signals are then measured directly with no additional calculation required. Emissions are measured with average detector function from lowest operating frequency (12 MHz) to tenth harmonic (4.67750 GHz). Selected range is 10 MHz to 5 GHz in three sub-ranges.

5.2 Criteria

Guideline	Section Number	Date
Spurious/Harmonic Emissions at Antenna Terminals	90.217(b), 2.1051	2014-06-13

Per procedures of TIA/EIA-603, below 1 GHz measurement resolution bandwidth is 10 KHz with video bandwidth set higher at 100 kHz. Above 1 GHz measurement resolution bandwidth is 1 MHz with video bandwidth higher at 10 MHz.

Reference peak power level is 28.79 dBm. Limit is determined from 90.217(b) for emissions beyond 25 kHz from authorized bandwidth.

Per 90.217(b) $\text{Attenuation}_{(\text{dB})} = 30 \text{ dB}$

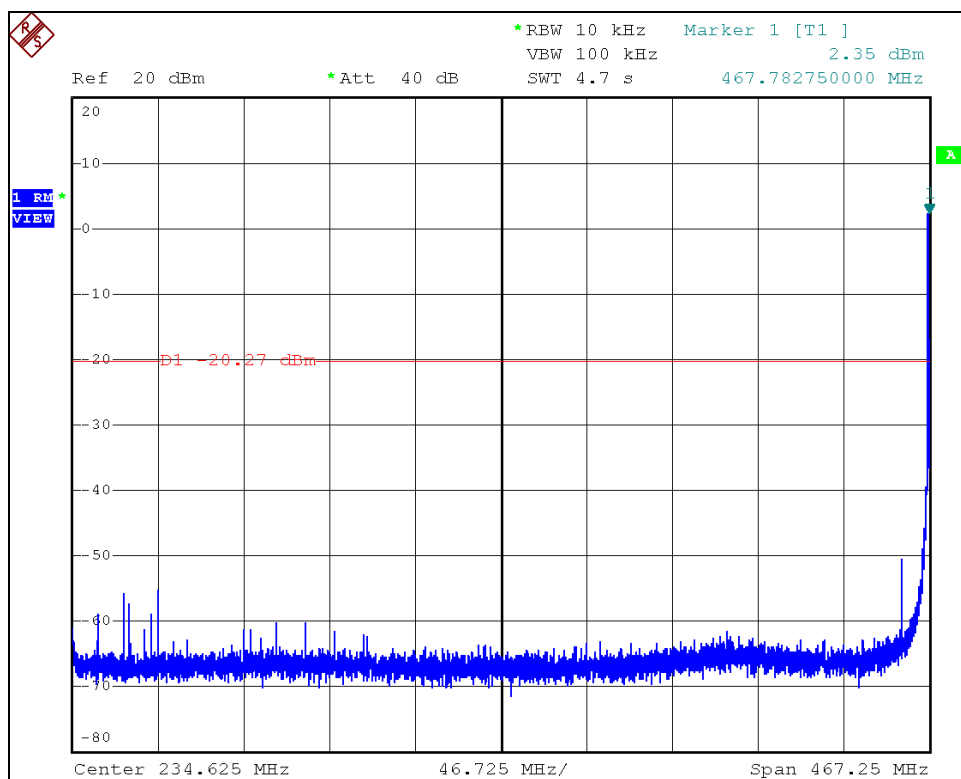
$\text{Limit}_{(\text{dBm})} = \text{Fundamental_Power}_{(\text{dBm})} - \text{Attenuation}_{(\text{dB})} = 9.73 \text{ dBm} - 30 \text{ dB} = -20.27 \text{ dBm}$

5.3 Results

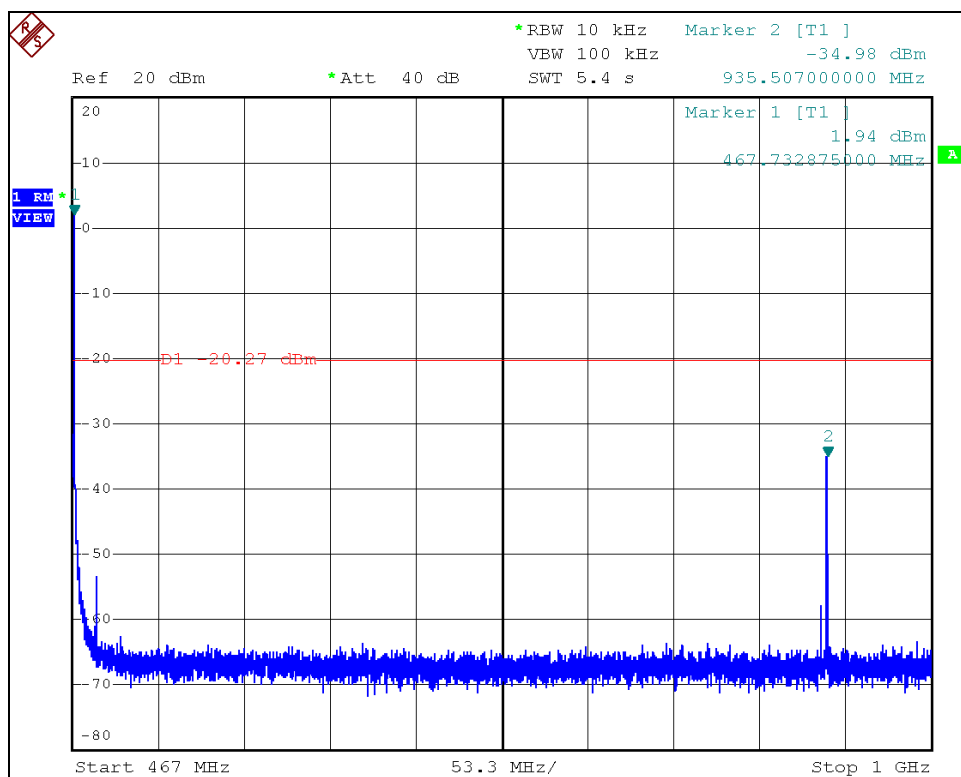
Table 5.3.1 Equipment List				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29

Measurements were performed with a direct connection to the spectrum analyzer such that no external losses or gains would apply.

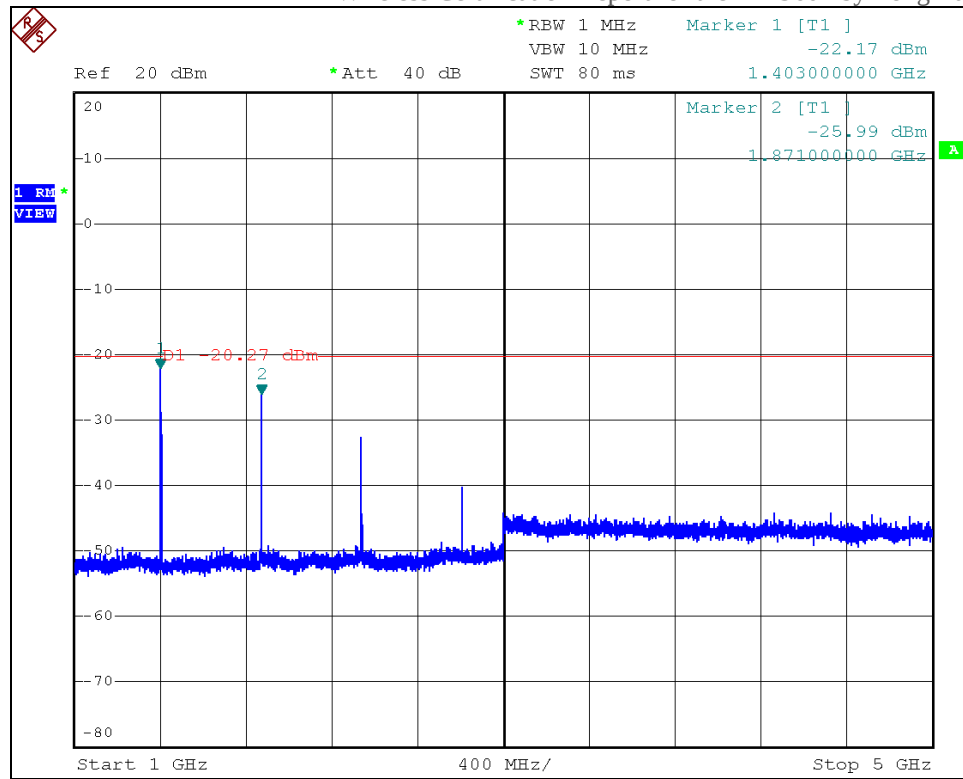
Highest spurious emission was found to be 1.9 dB below the limit at 1.403 GHz. The EUT was found to be in compliance with applicable requirements. Plotted results are presented below. In the plots the emission limit is marked with the red line at -20.27 dBm.



Span: 10 MHz to Fundamental
(Fundamental visible on right edge of plot area.)



Span: Fundamental to 1 GHz
(Fundamental visible on left edge of plot.)



6.0 Field Strength of Radiated Unintentional Emissions – Idle Mode [15.109]

6.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna. The EUT was placed into its idle mode with the antenna attached.

Spurious/harmonic emissions below 1 GHz were measured with quasi-peak detection at a distance of 10 meters. Spurious/harmonic emissions above 1 GHz peak were measured with average and peak detection with a resolution bandwidth of 1 MHz and measured at a distance of 3 meters. Average detection was used to determine compliance of the EUT if the peak did not meet the average limit. Non-harmonic emissions must satisfy the average limit and the peak limit (20 dB above average). A diagram showing the test setup is given as Figure 6.1.1.

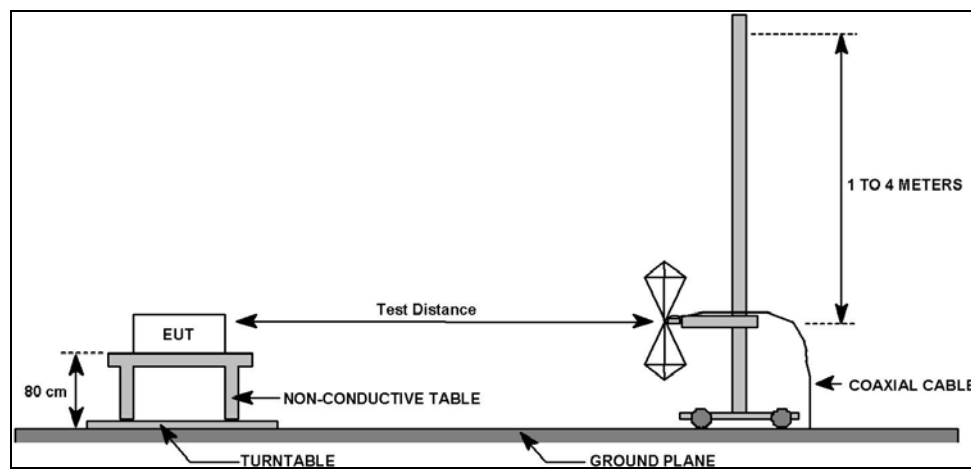


Figure 6.1.1: Field Strength of Radiated Emissions Test Setup

6.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Unintentional Emissions 30 MHz to 1 GHz	15.109	2014-06-13

6.3 Results

Note that the EUT is not totally idle, in that once per minute a brief transmission is made and can be seen in the recorded data.

Table 6.3.1: Equipment List

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).			
In accordance with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits			
Section:		15.109			
Test Date(s):		6/13/2014	EUT Serial #:	Sample B	
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601	
Project Number:		16005-15	Test Technician:	Eric Lifsey	
Purchase Order #:		N/A	Supervisor:	Rob McCollough	
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams	
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		Radiated Emissions_Profile Version October 12, 2011			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/29/2014
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/29/2014
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/26/2014
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A

Table 6.3.2: Measurement Bandwidth

Professional Testing, EMI, Inc.				
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,		
In accordance with:		Radiated Emissions Limits		
Section:		15.209		
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601
Project Number:		16005-15	Test Technician:	Eric Lifsey
Purchase Order #:		N/A	Supervisor:	Rob McCollough
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams
Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps
*Notes: 1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz. 4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz. 5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.				

Table 6.3.3: Field Strength of Spurious Emissions, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109							
Test Date(s):		6/13/2014			EUT Serial #:		Sample B		
Customer:		Long Range Systems LLC			EUT Part #:		TX-9601		
Project Number:		16005-15			Test Technician:		Eric Lifsey		
Purchase Order #:		N/A			Supervisor:		Rob McCollough		
Equip. Under Test:		TX-9601			Witness' Name:		Mike Williams		
Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:		120 VAC		EUT Power Frequency:		60 Hz			
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Idle, not transmitting				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
61.8263	10	319	1.57	Quasi-peak	33.9	12.483	29.5	-17.0	Pass
101.64	10	312	2.32	Quasi-peak	30.7	10.711	33.1	-22.4	Pass
120.54	10	215	1.35	Quasi-peak	51.3	30.363	33.1	-2.7	Pass
149.927	10	194	3.46	Quasi-peak	24.6	4.962	33.1	-28.1	Pass
192.039	10	30	1.2	Quasi-peak	26.6	9.04	33.1	-24.1	Pass
200.012	10	186	2.08	Quasi-peak	27.5	10.695	33.1	-22.4	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Vertical Polarity Measured Emissions

Quasi-peak Limit Level

Corrected Quasi-peak Re

Peak Limit Level

Corrected Peak Value

Operator: Eric Lifsey

16005 RE061314 Run03 Idle Mode w Ferrite til

01:09:52 PM, Friday, June 13, 2014

EUT SN: Sample A

EUT Power: 120 VAC 60Hz

EUT Mode: Idle, w Ferrite

EUT: TX-9601

Project Number: 16005-15

Client: Long Range Systems

≤ 1GHz Vertical Antenna Polarity Measured Emissions

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.4: Field Strength of Spurious Emissions, Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109							
Test Date(s):		6/13/2014			EUT Serial #:		Sample B		
Customer:		Long Range Systems LLC			EUT Part #:		TX-9601		
Project Number:		16005-15			Test Technician:		Eric Lifsey		
Purchase Order #:		N/A			Supervisor:		Rob McCollough		
Equip. Under Test:		TX-9601			Witness' Name:		Mike Williams		
Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:		120 VAC		EUT Power Frequency:		60 Hz			
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Idle, not transmitting				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
93.5082	10	268	3.7	Quasi-peak	30.8	10.102	33.1	-23.0	Pass
119.547	10	47	3.63	Quasi-peak	43	22.132	33.1	-11.0	Pass
150.17	10	323	3.67	Quasi-peak	22.9	3.258	33.1	-29.8	Pass
200.103	10	250	3.88	Quasi-peak	26.7	9.895	33.1	-23.2	Pass
216.066	10	215	3.58	Quasi-peak	29	12.942	35.6	-22.7	Pass
742.402	10	160	3.99	Quasi-peak	21.7	18.405	35.6	-17.2	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions

Quasi-peak Limit Level

Corrected Quasi-peak Re

Peak Limit Level

Corrected Peak Value

Operator: Eric Lifsey

16005'RE061314'Run03'IdleMode'wFerritefil

01:09:52 PM, Friday, June 13, 2014

EUTSN: Sample A

EUTPower: 120VAC 60Hz

EUTMode: Idle, wFerrite

EUT: TX-9601

Project Number: 16005-15

Client: Long Range Systems

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Field Strength of Radiated Spurious Emissions – Transmit Mode [90.217(b)]

7.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna. The EUT was placed into transmit mode with the antenna replaced by a non-radiating load.

Spurious/harmonic emissions below 1 GHz were measured with quasi-peak detection at a distance of 10 meters. Spurious/harmonic emissions above 1 GHz peak were measured with average and peak detection with a resolution bandwidth of 1 MHz and measured at a distance of 3 meters. Average detection was used to determine compliance of the EUT if the peak did not meet the average limit. Non-harmonic emissions must satisfy the average limit and the peak limit (20 dB above average). A high pass filter was employed to reduce the fundamental signal to allow measurement of the harmonics. A diagram showing the test setup is given as Figure 7.1.1.

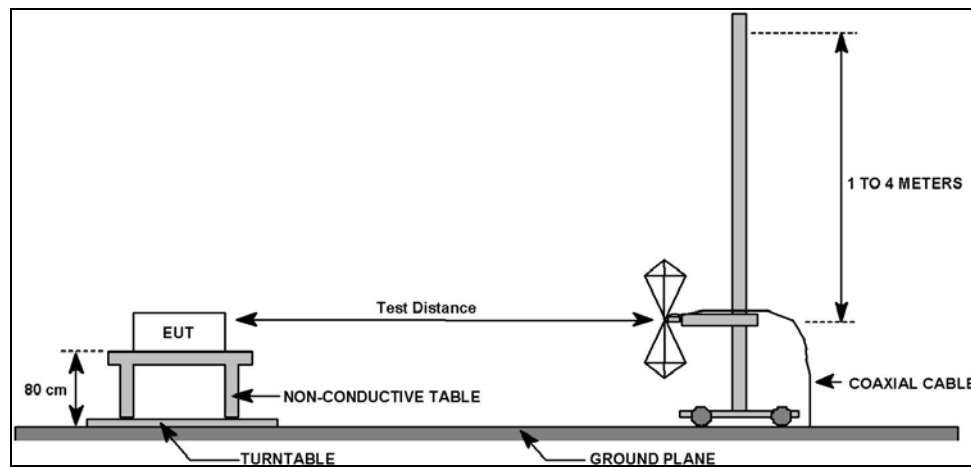


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

7.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.217(b)	2014-06-13 2014-06-25

7.3 Results

The EUT satisfied the requirements.

Table 7.3.1: Equipment List

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,			
In accordance with:		Radiated Emissions Limits			
Section:		15.209			
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)	
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601	
Project Number:		16005-15	Test Technician:	Eric Lifsey	
Purchase Order #:		N/A	Supervisor:	Rob McCollough	
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams	
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		Radiated Emissions_Profile Version October 12, 2011			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/29/2014
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/29/2014
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/26/2014
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	11/19/2014
C030	N/A	0	Cable Coax, N-N, 30m	none	9/26/2014
Loaner-ETS	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	135203	1/14/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A

Table 7.3.2: Measurement Bandwidth

Professional Testing, EMI, Inc.				
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,		
In accordance with:		Radiated Emissions Limits		
Section:		15.209		
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601
Project Number:		16005-15	Test Technician:	Eric Lifsey
Purchase Order #:		N/A	Supervisor:	Rob McCollough
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams
Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps
*Notes: 1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz. 4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz. 5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.				

Table 7.3.3: Field Strength of Spurious Emissions, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).			
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits			
Section:		15.209			
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)	
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601	
Project Number:		16005-15	Test Technician:	Eric Lifsey	
Purchase Order #:		N/A	Supervisor:	Rob McCollough	
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams	
Radiated Emissions Test Results Data Sheet					
			Page: 1 of 1		
EUT Line Voltage:		120	VAC	EUT Power Frequency: 60 Hz	
Antenna Orientation:		Vertical		Frequency Range: 30MHz to 1GHz	
EUT Mode of Operation:			Transmit		
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Corrected Quasi-peak Corrected Peak Value Limit 10m_90.217(b) PROFESSIONAL TESTING Operator: Eric Lifsey 16005'RE'061314'Run04'TxMode984'wFerrite.t 02:48:27 PM, Friday, June 13, 2014 EUT SN: Sample A EUT Power: 120VAC 60Hz EUT Mode: Tx984, wFerrite EUT: TX-9601 Project Number: 16005-15 Client: Long Range Systems					
≤ 1GHz Vertical Antenna Polarity Measured Emissions					

Note that the signal crossing the red limit line is the fundamental.

Table 7.3.4: Field Strength of Spurious Emissions, Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).			
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits			
Section:		15.209			
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)	
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601	
Project Number:		16005-15	Test Technician:	Eric Lifsey	
Purchase Order #:		N/A	Supervisor:	Rob McCollough	
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams	
Radiated Emissions Test Results Data Sheet					Page: 1 of 1
EUT Line Voltage:		120	VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:		Horizontal		Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:			Transmit		
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Horizontal Polarity Measured Emissions Corrected Quasi-peak Corrected Peak Value Limit_10m_90.217(b) PROFESSIONAL TESTING					
Operator: Eric Lifsey 16005'RE'061314'Run04'TxMode984'wFerrite.t 02:48:26 PM, Friday, June 13, 2014			EUT: TX-9601 Project Number: 16005-15 Client: Long Range Systems		
EUT SN: Sample A EUT Power: 120VAC 60Hz EUT Mode: Tx984, wFerrite					
≤ 1GHz Horizontal Antenna Polarity Measured Emissions					

Note that the signal crossing the red limit line is the fundamental.

Table 7.3.5: Field Strength of Spurious Emissions, 1 GHz to 5 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/25/2014	EUT Serial #:	None (Sample B)
Customer:	Long Range Systems LLC	EUT Part #:	TX-9601
Project Number:	16005-15	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Rob McCollough
Equip. Under Test:	TX-9601	Witness' Name:	N/A
Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit	
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6 GHz Vertical Polarity Measured Emissions Corrected Average E Corrected Peak Read Limit FCC90.217(b) Operator: Eric Lifsey 16005 RE'062514 Run05 Tx Mode 984 w Ferrite Shield 09:07:48 AM, Wednesday, June 25, 2014 EUT SN: Sample B EUT Power: 120 VAC 60 Hz EUT Mode: Tx984, w Ferrite EUT: TX-9601 Project Number: 16005-15 Client: Long Range Systems			
> 1GHz Vertical Antenna Polarity Measured Emissions			

Table 7.3.6: Field Strength of Spurious Emissions, 1 GHz to 5 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.											
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).									
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits									
Section:		15.209									
Test Date(s):		6/25/2014	EUT Serial #:	None (Sample B)							
Customer:		Long Range Systems LLC	EUT Part #:	TX-9601							
Project Number:		16005-15	Test Technician:	Eric Lifsey							
Purchase Order #:		N/A	Supervisor:	Rob McCollough							
Equip. Under Test:		TX-9601	Witness' Name:	N/A							
Radiated Emissions Test Results Data Sheet					Page: 1 of 1						
EUT Line Voltage:		120	VAC	EUT Power Frequency:	60 Hz						
Antenna Orientation:		Horizontal		Frequency Range:	Above 1GHz						
EUT Mode of Operation:			Transmit								
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6 GHz Horizontal Polarity Measured Emissions ▽ Corrected Average E — Corrected Peak Read — Limit_FCC90.217(b) PROFESSIONAL TESTING Operator: Eric Lifsey 16005 RE'062514 Run05 Tx Mode 984 w Ferrite Shield 09:07:48 AM, Wednesday, June 25, 2014 EUT SN: Sample B EUT Power: 120 VAC 60 Hz EUT Mode: Tx984, w Ferrite EUT: TX-9601 Project Number: 16005-15 Client: Long Range Systems <tr><td colspan="6">> 1GHz Horizontal Antenna Polarity Measured Emissions</td></tr>						> 1GHz Horizontal Antenna Polarity Measured Emissions					
> 1GHz Horizontal Antenna Polarity Measured Emissions											

8.0 Mains Conducted Emissions [15.107 Class B]

Measurements of mains conducted emissions were taken on the EUT to determine the compliance to CFR 47, Part 15.

8.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive reference plane (wall). The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and software is employed to measure the radio frequency noise generated by the EUT.

8.2 Criteria

Clause Subject	Section Number	Date
Mains Conducted Emissions, Class B	15.107	2014-06-13

8.3 Results

Table 8.3.1: Mains Conducted Emissions, Equipment List

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits			
In accordance with:		Section: 15.107			
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)	
Customer:		Long Range Systems	EUT Part #:	N/A	
Project Number:		16005-15	Test Technician:	Eric Lifsey	
Purchase Order #:		N/A	Supervisor:	Rob McCollough	
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams	
Conducted Emissions Test Equipment List					
Tile! Software Version:		4.1.A.0, April 14, 2009, 11:01:00PM			
Test Profile:		Profile#: CE_2010.til, dated December 16, 2010			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spectrum Analyzer	2732A03633	6/17/2014
0045	HP	85662A	Spec Anal Dsply for AN1842	2816A16413	N/A
0990	HP	85685A	RF Preselector	3010A01119	8/29/2014
1281	HP	85650A	Quasi Peak Adapter	2043A00063	7/5/2014
1173	PTI	100k HPF	Filter, High Pass, 100kHz	none	10/30/2014
1086	PTI	PTI-ALF2	Attenuator Limiter Filter	none	5/7/2015
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	7/10/2014
C108	Pomona	RG-223	Cable 5.5 ft BNC RG-223 (black)	none	7/10/2014
0939	EMCO	3825/2	LISN, 10kHz-100MHz	9603-2521	10/31/2014
1132	AilTech	91550-1M	Probe, Current, 10kHz-100MHz	1856	1/8/2015
0936	FCC	FCC-TLISN-T2	TLISN-T2, 9kHz-30MHz, CISPR 22	20152	2/12/2015
0935	FCC	FCC-TLISN-T4	TLISN-T4, 9kHz-30MHz, CISPR 22	20153	2/12/2015
1683	Teseq	ISN T800	ISN-T8, Impedance Stabilization Network	27091	4/16/2015
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	10/31/2014

Table 8.3.2: Mains Conducted Emissions, Measurement Bandwidths

Professional Testing, EMI, Inc.				
Test Method:		ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits		
In accordance with:		15.107		
Section:		15.107		
Test Date(s):		6/13/2014	EUT Serial #:	None (Sample B)
Customer:		Long Range Systems	EUT Part #:	N/A
Project Number:		16005-15	Test Technician:	Eric Lifsey
Purchase Order #:		N/A	Supervisor:	Rob McCollough
Equip. Under Test:		TX-9601	Witness' Name:	Mike Williams
Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps
*Notes: 1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.				

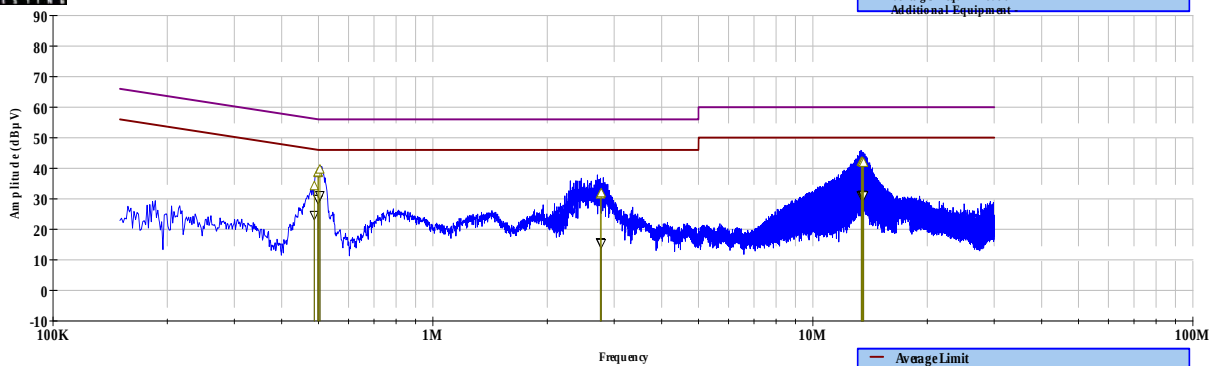
Table 8.3.3: Mains Conducted Emissions, Neutral Line

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4-2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits							
Section:		15.107							
Test Date(s):		6/13/2014			EUT Serial #:		None (Sample B)		
Customer:		Long Range Systems			EUT Part #:		N/A		
Project Number:		16005-15			Test Technician:		Eric Lifsey		
Purchase Order #:		N/A			Supervisor:		Rob McCollough		
Equip. Under Test:		TX-9601			Witness' Name:		Mike Williams		
Conducted Emissions Test Results Data Sheet - Neutral Lead								Page: 1 of 2	
EUT Line Voltage:		120		VAC		EUT Line Frequency:		60 Hz	
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.48719	36.1	34.1	56.2	-22.1	PASS	24.7	46.2	-21.5	PASS
0.498632	41.4	38.4	56	-17.6	PASS	29.9	46	-16.1	PASS
0.49878	40.2	38.6	56	-17.5	PASS	29.9	46	-16.1	PASS
0.504103	41.7	39.5	56	-16.5	PASS	31.2	46	-14.8	PASS
2.759	38.1	31.3	56	-24.7	PASS	15.8	46	-30.2	PASS
2.7717	38.4	31.8	56	-24.2	PASS	15.5	46	-30.5	PASS
13.4062	45.5	42	60	-18	PASS	31.2	50	-18.8	PASS
13.4648	46.1	42	60	-18	PASS	31.2	50	-18.8	PASS
13.5078	45.8	41.9	60	-18.1	PASS	31.3	50	-18.7	PASS
13.594	45.5	41.7	60	-18.3	PASS	31.2	50	-18.8	PASS



Professional Testing, EMI, Inc.
Conducted Emissions 150kHz to 30MHz
Neutral Graph

Company: - Long Range Systems
Model #: - TX-9601
Description -
Project #: - 16005-15
Voltage/Freq: - 120/60
Additional Equipment



Operator: Eric Lifsey
05:12:58 PM, Friday, June 13, 2014

Sample B
Sample E power supply

— Average Limit
— Quasi-Peak Limit
— Peak Scan Data
▽ Average Reading
▲ Quasi-Peak Reading

Measured Conducted Emissions - Neutral Lead

Measured Conducted Emissions - Neutral Lead

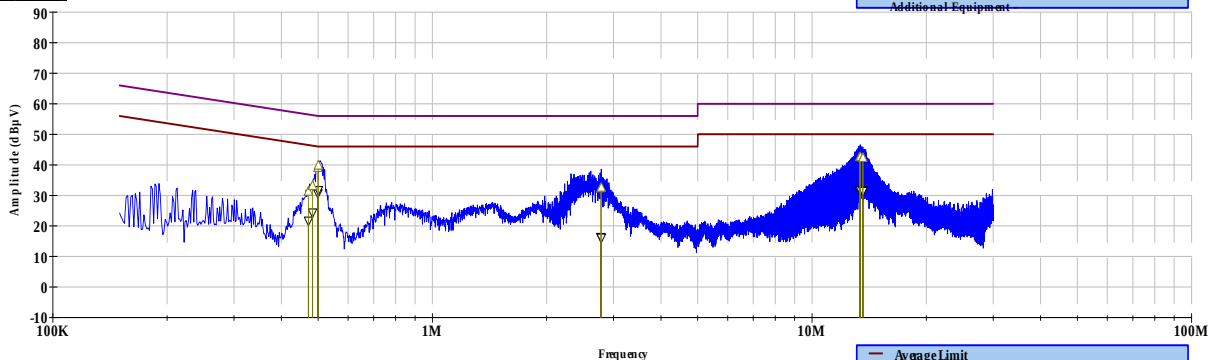
Table 8.3.4: Mains Conducted Emissions, Phase Line

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4-2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits							
Section:		15.107							
Test Date(s):		6/13/2014			EUT Serial #:		None (Sample B)		
Customer:		Long Range Systems			EUT Part #:		N/A		
Project Number:		16005-15			Test Technician:		Eric Lifsey		
Purchase Order #:		N/A			Supervisor:		Rob McCollough		
Equip. Under Test:		TX-9601			Witness' Name:		Mike Williams		
Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1)								Page: 2 of 2	
EUT Line Voltage:			120 VAC		EUT Line Frequency:			60 Hz	
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.47148	33.9	31.2	56.5	-25.2	PASS	21.7	46.5	-24.8	PASS
0.48306	34.7	33.1	56.3	-23.2	PASS	24.4	46.3	-21.9	PASS
0.49893	41	39	56	-17	PASS	30.7	46	-15.4	PASS
0.500725	42.3	39.8	56	-16.2	PASS	31.7	46	-14.3	PASS
2.7762	38.6	32.3	56	-23.7	PASS	16.3	46	-29.7	PASS
2.7839	39.6	32.5	56	-23.5	PASS	16.2	46	-29.8	PASS
13.3414	46.3	42.5	60	-17.5	PASS	31.6	50	-18.4	PASS
13.4023	46.5	42.6	60	-17.4	PASS	31.7	50	-18.3	PASS
13.5965	46.2	42.2	60	-17.8	PASS	31.7	50	-18.3	PASS
13.6154	46.5	42.2	60	-17.8	PASS	31.4	50	-18.6	PASS



Professional Testing, EMI, Inc.
Conducted Emissions 150kHz to 30MHz
Phase A Graph - L1

Company: - Long Range Systems
Model #: - TX-9601
Description -
Project #: - 16005-15
Voltage/Freq: - 120/60
Additional Equipment



Operator: Eric Lifsey
05:34:43 PM, Friday, June 13, 2014

Sample B
Sample E power supply

Average Limit
Quasi-Peak Limit
Peak Scan Data
Average Reading
Quasi-Peak Reading

Measured Conducted Emissions - Phase Lead (Line 1)

Measured Conducted Emissions - Phase Lead (Line 1)

9.0 Frequency Stability [90.217(b)]

The EUT operating frequency is measured under conditions of ambient operating temperatures, then for conditions of operating mains voltage.

9.1 Procedure

The EUT is placed into a temperature chamber with a small dipole to pass the transmitted signal to a spectrum analyzer. On reaching each set point temperature, the EUT is allowed to soak at least 20 minutes without power applied. After soak time was satisfied, the EUT is powered on in transmit mode and the frequency is observed until it becomes stable; then the measurement of frequency is taken. The time required to become stable is also recorded.

Operating voltage stability was also measured for extremes of +/- 15% from nominal. In this case the power source is the AC mains.

9.2 Criteria

The operating frequency shall remain within +/- 25 kHz of the assigned channel.

9.3 Results

Table 9.3.1 Equipment List				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29
2087	Fluke	189	DMM	2015-03-06
0428	Powerstat	146	Variac, 120V 30A	Not Required
0881	Thermotron	S-1.2C	Temperature Chamber	2014-09-13
C144	Unspecified	RG-223	Coaxial Cable, Double Shielded	Not Required

Professional Testing, EMI, Inc.

Test Method: TIA-603-C-2004 Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards

Section:	3.2.2 [FCC 2.1055(a)(1)]	EUT Typical Operation Mode:	Unmod. TX, FSK Shifted Down
Test Date(s):	6/18/2014	EUT Serial #:	None
Customer:	Long Range Systems	EUT Part #:	TX-9601
Project Number:	16005-15	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor	Rob McCollough
Equipment Under Test:	TX-9601	Witness' Name:	None

Mobile Criteria (per exemption paragraph): +/- 25 kHz at -30 dBc

Condition	Frequency		Deviation		Soak Time	
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Deviation Increased by 50% of Channel BW (Hz)	Power-Off (min)	Power-On (min)
-30	467.750000	467.742640000	-7360.0000000	-13610.00000001	15	10
-20	467.750000	467.745420000	-4580.0000000	-10829.99999998	15	5
-10	467.750000	467.747060000	-2940.0000000	-9190.00000002	15	5
0	467.750000	467.747840000	-2160.0000000	-8410.00000000	15	4
10	467.750000	467.748060000	-1940.0000000	-8189.99999999	15	4
20	467.750000	467.748020000	-1980.0000000	-8230.00000000	15	4
30	467.750000	467.748300000	-1700.0000000	-7950.00000003	15	5
40	467.750000	467.748840000	-1160.0000000	-7410.00000003	15	5
50	467.750000	467.749640000	-360.0000000	-6610.00000000	15	15

EUT lower FSK frequency spur measured. EUT plus worse case channel BW remained within 25 kHz of center frequency.

Professional Testing, EMI, Inc.

Test Method: TIA-603-C-2004 Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards

Section:	3.3.1 [FCC 2.1055(d)(1)]	EUT Typical Operation Mode:	Unmod. TX, FSK Shifted Down
Test Date(s):	6/18/2014	EUT Serial #:	None
Customer:	Long Range Systems	EUT Part #:	TX-9601
Project Number:	16005-15	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor	Rob McCollough
Equipment Under Test:	TX-9601	Witness' Name:	None

Condition	Frequency			Deviation	Voltage
Voltage Extreme	Reference Frequency (MHz)*	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Measured Voltage (V AC)
-15%	467.748320	467.748300000	-20.000000006	-0.042758037	106.26
Nominal	467.748320	467.748320000	0.000000000	0.000000000	125.20
+15%	467.748320	467.748280000	-39.999999956	-0.085516074	143.75

Note that the +15% mains voltage was calculated from a nominal assumed as 125 VAC.

10.0 Emission Bandwidth [90.210(d)]

10.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode with modulation. The connection is direct and no cables are used. The modulated signal is then measured directly in a manner consistent with power measurement. Resolution bandwidth is typically ~1-3 percent of the bandwidth of ~12 kHz max where that range is 120 Hz to 360 Hz; 300 Hz RBW is selected for measurement.

10.2 Criteria

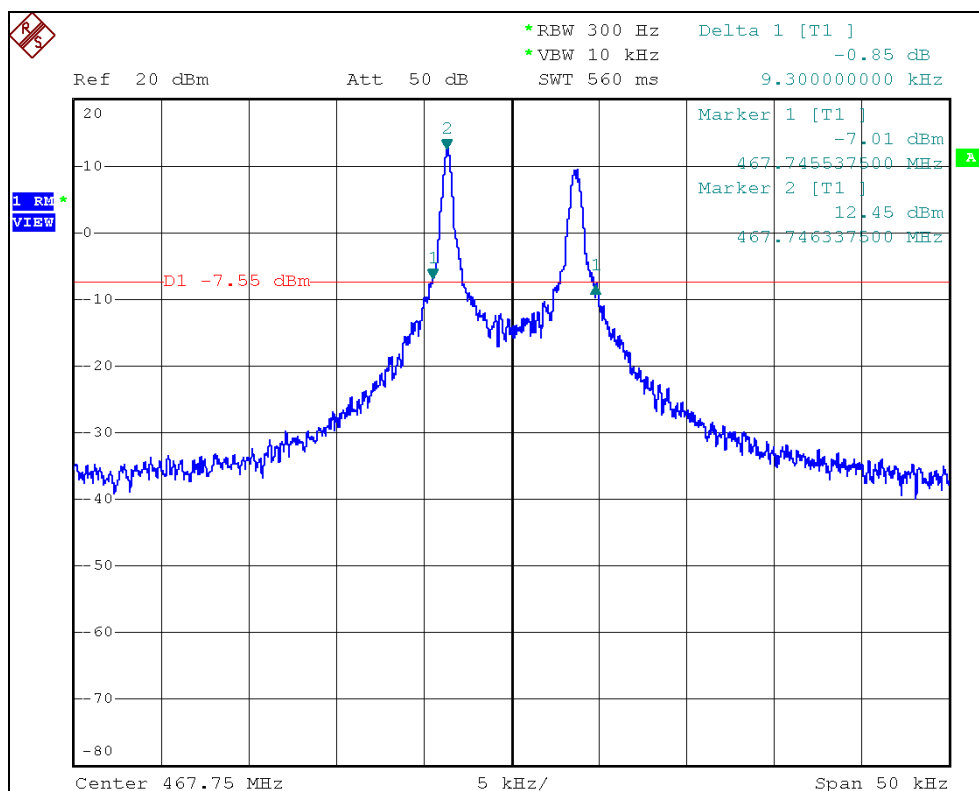
Clause Requirement	Section Number	Date
90.210(d) Bandwidth < 12.5 kHz	90.210(d)(1), 2.1051	2014-06-13

10.3 Results

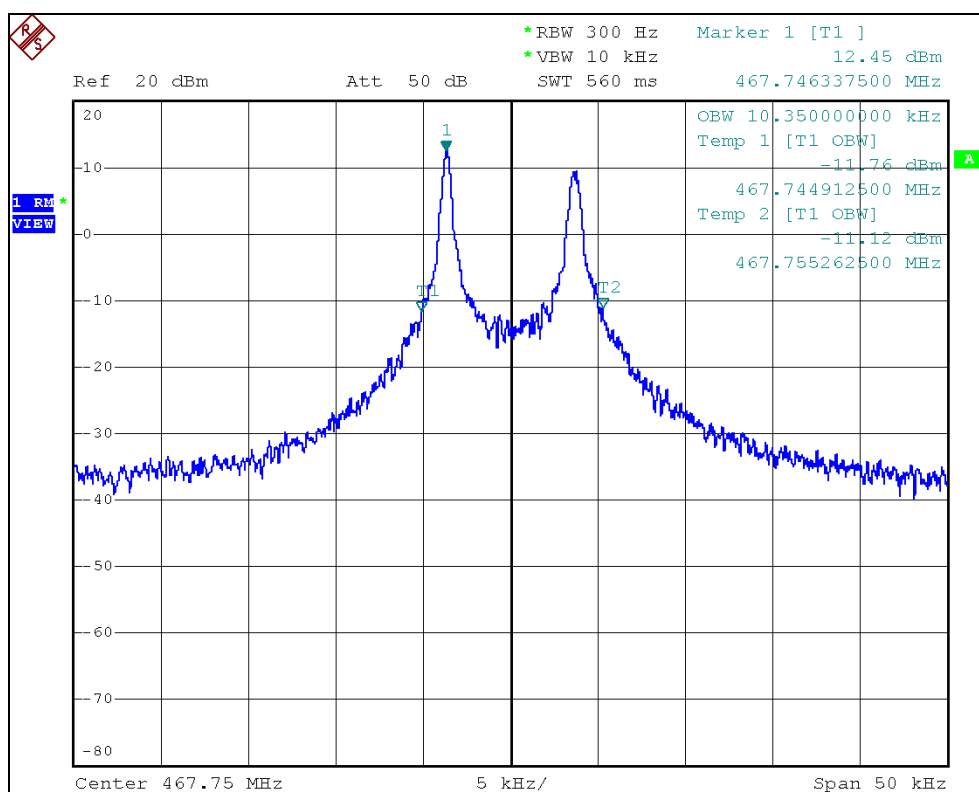
Table 11.3.1 Equipment List				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29

Table 11.3.2 Bandwidth	
Bandwidth Measurement Method	Measured Bandwidth
20 dB	9.3 kHz
OBW Instrument Measurement	10.35 kHz

The emission satisfies the bandwidth criteria. Plotted results appear below.



Bandwidth, 20 dB



Bandwidth, OBW

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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