

1601 North A.W. Grimes Blvd., Suite B

Round Rock, TX 78665 e-mail: info@ptitest.com

(512) 244-3371 Fax: (512) 244-1846

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

16005-15 Page 2 of 38

Revision History

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

16005-15 Page 3 of 38

Table of Contents

Revision History	3
Certificate of Compliance	5
1.0 Introduction	6
1.1 Scope	6
1.2 EUT Description	6
1.3 EUT Operation	6
1.4 Modifications to Equipment	7
1.5 Test Site	7
2.0 Applicable Documents and Clauses	8
3.0 Conducted Output Power [90.205]	9
3.1 Procedure	
3.2 Criteria	9
3.3 Results	9
4.0 Emission Mask [90.217(b)]	10
4.1 Procedure	10
4.2 Criteria	10
4.3 Results	10
5.0 Spurious Emissions at Antenna Terminals [90.217(b)]	11
5.1 Procedure	
5.2 Criteria	11
5.3 Results	11
6.0 Field Strength of Radiated Unintentional Emissions – Idle Mode [15.109]	14
6.1 Procedure	
6.2 Criteria	14
6.3 Results	14
7.0 Field Strength of Radiated Spurious Emissions – Transmit Mode [90.217(b)]	
7.1 Procedure	
7.2 Criteria	19
7.3 Results	19
8.0 Mains Conducted Emissions [15.107 Class B]	26
8.1 Procedure	
8.2 Criteria	
8.3 Results	27
9.0 Frequency Stability [90.217(b)]	
9.1 Procedure	
9.2 Criteria	
9.3 Results	31
10.0 Emission Bandwidth [90.210(d)]	
10.1 Procedure	34
10.2 Criteria	34
10.3 Results	34
Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty	
End of Report	

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.



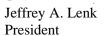
Certificate of Compliance

Applicant	Device & Test Identification	
Long Range Systems, LLC (John Weber)	FCC ID:	2AB6OTX9601
4550 Excel Parkway Suite 200	Model(s):	TX-9601 Paging System Transmitter
Addison, Texas 75001	Part Number(s):	N/A
Certificate Date: June 25, 2014	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.



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

16005-15 Page 5 of 38

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.

16005-15 Page 6 of 38

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.

16005-15 Page 7 of 38

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-	2009	
	Noise Emissions from Low Voltage Electrical and Electronic Equipment		
TIA/EIA-603C	Land Mobile FM or PM – Communications Equipment – Measurement	nt 2004	
HAY LIA-003C	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.

16005-15 Page 8 of 38

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

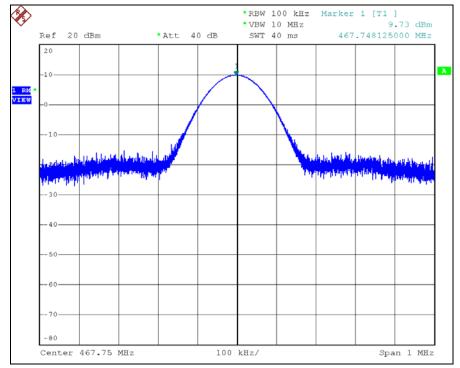
Section Reference	Parameter	Date(s)
90.205, 2.1046	Conducted Output Power	2014-06-13

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 Ca			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

16005-15 Page 9 of 38

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

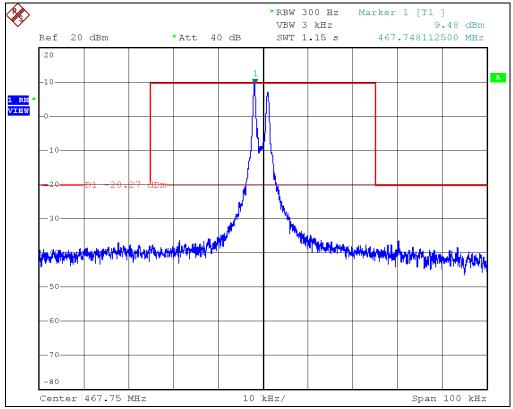
Guideline	Section Number	Date
Emissions at Antenna Terminals	90.217(b)*, 2.1051	2014-06-13

^{*}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)

16005-15 Page 10 of 38

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) Attenuation_(dB) = 30 dB

 $Limit_{(dBm)} = Fundamental_Power_{(dBm)} - Attenuation_{(dB)} = 9.73 dBm - 30 dB = -20.27 dBm$

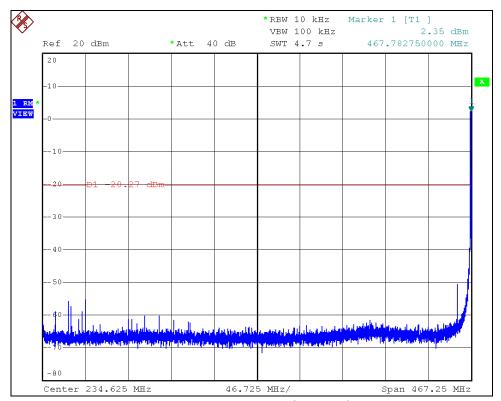
5.3 Results

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

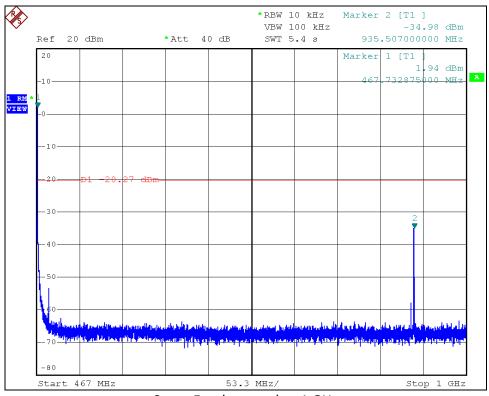
Measurements were performed with a direct connection to the spectrum analyzer such that no external losses or gains would apply.

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.

16005-15 Page 11 of 38

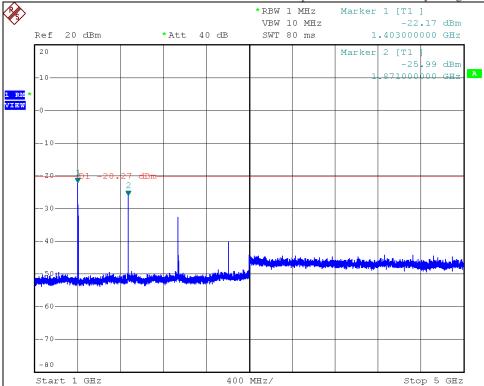


Span: 10 MHz to Fundamental (Fundamental visible on right edge of plot area.)



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

16005-15 Page 12 of 38



Span: 1 GHz to 5 GHz

16005-15 Page 13 of 38

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.

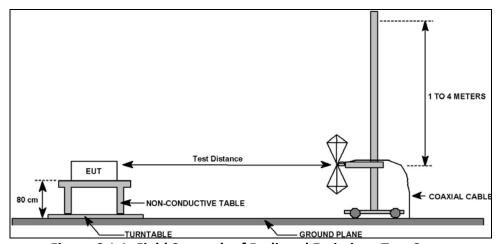


Figure 6.1.1: Field Strength of Radiated Emissions Test Setup

6.2 Criteria

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

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.

16005-15 Page 14 of 38

Table 6.3.:	1: Equipment	List						
		Profes	sional Te	sting, 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:	15.1	09						
Test Date(s): 6/1	3/2014		EUT Serial #:	Sample B			
Customer:	Lon	g Range Systems Ll	_C	EUT Part #:	TX-9601			
Project Nur	mber: 160	05-15		Test Technician:	Eric Lifsey			
Purchase O				Supervisor:	Rob McCollough			
Equip. Und	er Test: TX-	9601		Witness' Name:	Mike Williams			
		Radiat	ed Emissions	Test Equipment List				
Til	e! Software Ver	ion: 4.2.A	, May 23, 201	.0, 08:38:52 AM				
	Test Profile:	Radia	ated Emission	s_Profile Version Octob	er 12, 2011			
Asset #	Manufacturer	Model	Equipm	nent Nomenclature	Serial Number	Calibration Due Date		
1509A	Braden	N/A	TDK 10M (Chamber, NSA < 1 GHz	DAC-012915-005	7/29/2014		
1890	НР	8447F	Preamp/	Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015		
1937	Agilent	Agilent E4440A Spectrum Analyzer, 3 Hz - 26.5 GHz		MY44303298	12/2/2015			
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz -		00135454	7/29/2014		
C027	N/A	RG214	Cable	Cable Coax, N-N, 25m		9/26/2014		
1327	EMCO	1050	Contro	ller, Antenna Mast	none	N/A		
0942	EMCO	11968D	Т	urntable, 4ft.	9510-1835	N/A		
1969	НР	11713A	Attenu	ator/Switch Driver	3748A04113	N/A		

Page 15 of 38 16005-15

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							
rest iviethou:	Electrical and Electronic Equip	ment in the Range of 9 kH	z 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:

16005-15 Page 16 of 38

^{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.

			•	sional Te	elow 1 GH sting. EN	•			
Test Metho	od:		2003: "Metho	ods of Measurer te Range of 9 kH	ment of Radio	-Noise Emissio		_	
In accordance with: FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits								iated	
Section:		15.109							
Test Date(s):	6/13/2014			EUT Serial	#:	Sample B		
Customer:		Long Rang	e Systems Ll	_C	EUT Part #:		TX-9601		
Project Nu		16005-15			Test Techn	ician:	Eric Lifsey		
Purchase C	Order #:	N/A			Supervisor:		Rob McCol		
Equip. Und	ler Test:	TX-9601			Witness' N	ame:	Mike Willia	ams	
	ı	Radiated En	nissions Tes	t Results Data	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage	: 1	20 VAC		EUT Pow	ver Frequen	icy: 6	0 Hz	
Antenn	a Orientatio	on:	Vertic	cal	Frequ	ency Range	•	30MHz to	1GHz
	EUT N	lode of Op	eration:			Idle,	not transm	itting	
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
Radiate 30MHz-1	sional Testing, ed Emissions, 10 GHzVerticalPolarity	m Distance	_			 ∇ Co Pe 	uasi-peak Limit orrected Quasi- ak Limit Level orrected Peak Va	peak Re	SIONAL
20									
Specific Street	harter gegen de geleigte de finishe de finis					thlus, a Labertaine	Alad	A second	
a £			100M						1G
0 ± 30M									
	Eric Lifsey			Freq	quency	E	CUT: TX-9601		

Page 17 of 38 16005-15

	4: Field St	engen or		sional Te				<u> </u>	
Test Metho	od:		-2003: "Metho	ods of Measurer te Range of 9 kH	ment of Radio	-Noise Emissic		_	
In accordance with: FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits								iated	
Section:		15.109							
Test Date(s	s):	6/13/2014	1		EUT Serial	#:	Sample B		
Customer:		Long Rang	e Systems LI	-C	EUT Part #:		TX-9601		
Project Nu		16005-15			Test Techn	ician:	Eric Lifsey		
Purchase C	Order #:	N/A			Supervisor:		Rob McCol		
Equip. Und	ler Test:	TX-9601			Witness' N	ame:	Mike Willia	ams	
	ı	Radiated Er	missions Tes	t Results Data	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage	: 1	.20 VAC		EUT Pow	ver Frequen	cy: 6	0 Hz	
Antenn	a Orientatio	n:	Horizo	ntal	Frequ	ency Range:		30MHz to	1GHz
	EUT N	/lode of Op	eration:			Idle,	not transm	itting	
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
Radiate	sional Testing, ed Emissions, 14 GHz Horizontal Polar	m Distance	ns			 ∇ Co Per 	nasi-peak Limit prected Quasi- ak Limit Level prected Peak Va	oeak Re	SIONAL
10	A PARTICIPATION OF THE PROPERTY OF THE PROPERT	Maria de la Caracteria de	1. m. 36 *** 1 *	Therefore the state of the Market					
10 0 30M Operator:	Eric Lifsey	A Pilation design patrick design and	100M	Free	juency	r r	UT: TX-9601		1G

Page 18 of 38 16005-15

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.

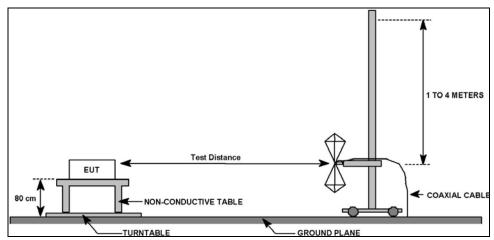


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

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.

16005-15 Page 19 of 38

11/19/2014

9/26/2014

1/14/2015

N/A

none

135203

9003-1461

C030

Loaner-ETS

1325

Miteq

N/A

ETS-Lindgren

EMCO

2S-10P-44

0

3117

1050

Table 7.3.	1: Equipment Li	ist				
		Profes	sional Te	esting, EMI, Inc.		
Test Metho	d. ANSI	C63.4-2003: "Meth	nods of Mea	surement of Radio-Noise	Emissions from Lo	w-Voltage
Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference						
	FCC P	art 15.209 - Code	of Federal Re	egulations Part 47, Subpa	art C - Intentional R	adiators,
n accordan		ted Emissions Limi	its			
Section:	15.20			T		
Test Date(s)				EUT Serial #:	None (Sample B)	
Customer:		Range Systems LLC		EUT Part #:	TX-9601	
Project Nun		5-15		Test Technician:	Eric Lifsey	
Purchase O Equip. Unde		.01		Supervisor: Witness' Name:	Rob McCollough Mike Williams	
Equip. Onde	er rest. TX-90				wike williams	
		Radiate	d Emissions	Test Equipment List		
Til	le! Software Version	on: 4.2.A,	May 23, 201	10, 08:38:52 AM		
	Test Profile:	Radia	ted Emission	ns_Profile Version Octob	er 12, 2011	
Asset #	Manufacturer	Model	Equipn	nent Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz		DAC-012915-005	7/29/2014
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB		3313A05298	1/22/2015
1937	Agilent	E4440A	Spectrum A	analyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015
1926	ETS-Lindgren	3142D	Antenna, Bi	iconilog, 26 MHz - 6 GHz	00135454	7/29/2014
C027	N/A	RG214	Cabl	e 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	НР	11713A	Attenuator/Switch Driver		3748A04113	N/A
1509B	Braden	N/A	TDK 10M C	hamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014
2004	Miteg	AFS44-00101800-	Amplif	ier, 40dB, .1-18GHz	0	11/19/2014

16005-15 Page 20 of 38

Amplifier, 40dB, .1-18GHz

Cable Coax, N-N, 30m

Antenna, Double Ridged Guide

Horn, 1 - 18 GHz

Controller, Antenna Mast

Table 7.3.2: Measurement Bandwidth

Professional Testing, EMI, Inc.						
Test Method:	ANSI C63.4–2003: "Methods o	f Measurement of Radio-N	oise Emissions from Low-Voltage			
rest ivictiou.	Electrical and Electronic Equip	ment in the Range of 9 kH:	z 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:

16005-15 Page 21 of 38

^{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.

Wireless Certification Report for the TX-9601 by Long Range Systems, LLC **Table 7.3.3: Field Strength of Spurious Emissions. Below 1 GHz. Vertical Polarity**

	Pr	ofessiona	l Testing, E	MI, Inc.				
Test Method:				o-Noise Emissions f " (incorporated by r		_	rical and	i
In accordance with:	CC Part 15.209 - (imits	Code of Federal R	egulations Part 47	, Subpart C - Intenti	onal Radiators,	Radiate	d Emiss	ions
Section: 1	.5.209							
Test Date(s):	5/13/2014		EUT Seria	l #: No	ne (Sample B	5)		
Customer: L	ong Range Syst	ems LLC	EUT Part	#:TX-	-9601			
Project Number: 1	16005-15		Test Tech	nician: Eri	c Lifsey			
Purchase Order #:	N/A		Superviso	r: Ro	b McCollough	า		
Equip. Under Test: 1	X-9601		Witness'	Name: Mi	ke Williams			
Ra	diated Emissio	ns Test Results	Data Sheet		Page:	1	of	1
EUT Line Voltage:	120	VAC	EUT Po	wer Frequency:	60	Hz		
Antenna Orientation	ı:	Vertical	Freq	uency Range:	30N	/IHz to :	1GHz	
EUT Mo	ode of Operation	n:		Tr	ansmit			
Professional Test Radiated Emissions, 10 30MHz-1GHzVerticalPo	ing, EMI, Inc Im Distance larity Measured Emiss	ions		— Corr	rected Quasi-pe rected Peak Val it_10m_90.217(1	ı	SIDNAL	
Field Strength (d B w Vm) 20 20 20 20 20 20 20 20 20 20 20 20 20			 - 					
30								
10	Were water the first the second secon				<u>Landon</u>			
0 10 M Operator: Eric Lifsey 16005 RE'061314 Run04	"Tx M o de 984 'w Ferrito e 13,2014	atEUT SN: Sample A	100M Frequency	Proje	TX-9601 ect Number: 16005 t: Long Range Sys		10	Ĵ

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

16005-15 Page 22 of 38 Wireless Certification Report for the TX-9601 by Long Range Systems, LLC **Table 7.3.4: Field Strength of Spurious Emissions. Below 1 GHz. Horizontal Polarity**

	P	rofessional	Testing, EN	/II, Inc.				
Test Method:		3: "Methods of Meas nent in the Range of				•	ical and	i
In accordance with:	FCC Part 15.209	- Code of Federal Re	gulations Part 47, S	ubpart C - Intention	al Radiators,	Radiate	d Emiss	ions
Section:	15.209							
Test Date(s):	6/13/2014		EUT Serial #	EUT Serial #: None (S				
Customer:	Long Range Sy	stems LLC	EUT Part #:	TX-96	01			
Project Number:	16005-15		Test Techni	cian: Eric Li	fsey			
Purchase Order #:	N/A		Supervisor:	Rob N	/lcCollough			
Equip. Under Test:	TX-9601		Witness' Na	me: Mike	Williams			
	Radiated Emissi	ons Test Results	Data Sheet		Page:	1	of	1
EUT Line Voltage	: 120	VAC	EUT Pow	er Frequency:	60	Hz		
Antenna Orientation	on:	Horizontal	Freque	ency Range:	30M	Hz to 1	LGHz	
EUT I	Mode of Operat	ion:		Tran	smit			
Professional Te Radiated Emissions, 30MHz - 1 GHz Ho rizon	sting, EMI, Inc 10m Distance tal Polarity Measured	Emissions		— Correct	ed Quasi-pea ed Peak Valu 0m_90.217(b		SIONAL I N G	
60			+ +	_	_	+ +-		
8 50					_ _ _			
nd 10 10 10 10 10 10 10 10	<u> </u>	+ + +	- -		- - -	+ +-		
ੜ੍ਹ 30 <u> </u>						+ +		
Eield Strength (d Bµ V m) 30 20 20 20 20 20 20 20 20 20 20 20 20 20	<u> </u>			_				
10		The state of the s	A Part of the last					
0 10M Operator: Eric Lifsey			100M Frequency	EUT: TX	-9601 umber: 16005-		10	j

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

16005-15 Page 23 of 38

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

	Pr	ofessional Te	esting, EMI, Inc.	•				
Test Method:			ment of Radio-Noise Emiss Hz to 40 GHz" (incorporate			•	rical and	t
In accordance with: FCC		Code of Federal Regula	tions Part 47, Subpart C - I	ntentiona	Radiators,	Radiate	d Emiss	sion
Section: 15.2	209							
Test Date(s): 6/2	25/2014		EUT Serial #:	None	Sample B)		
Customer: Lor	ng Range Syst	tems LLC	EUT Part #:	TX-960)1			
Project Number: 160	005-15		Test Technician:	Eric Lif	sey			
Purchase Order #: N//	A		Supervisor:	Rob M	cCollough)		
Equip. Under Test: TX-	-9601		Witness' Name:	N/A				
Radi	ated Emissio	ons Test Results Dat	a Sheet		Page:	1	of	1
EUT Line Voltage:	120	VAC	EUT Power Freque	ency:	60	Hz		
Antenna Orientation:		Vertical	Frequency Rang	e:	Ab	ove 10	GHz	
EUT Mod	e of Operation	on:		Trans	mit			
Professional Testing Radiated Emissions, 3m I 1-6GHz Vertical Polarity Mea	g, EN11, Inc Distance sured Emissions			Correcte	d Average l d Peak Rea CC90.217(b)		SIONAL	
⊋ 80‡								
Strength (dBµV/m) 80 40 40 40 40 40 40 40 40 40 40 40 40 40								
и/ _Л п д р) ч			Markett and has been a second life to an analysis of the second life to an	the Market Annie of the Control		Jahren er		

16005-15 Page 24 of 38

Wireless Certification Report for the TX-9601 by Long Range Systems, LLC **Table 7.3.6: Field Strength of Spurious Emissions, 1 GHz to 5 GHz, Horizontal Polarity**

			Pr	ofes	sio	nal	Te	sting	, EM	I, Inc	.				
Test Method:												n Low-Volta rence, see	_		t
In accordance with:	FCC Pa		:09 - C	ode of	Fede	ral Re	gulat	ions Pa	rt 47, Sul	bpart C -	Intentiona	al Radiators	, Radiate	ed Emiss	sior
Section:	15.20	9													
Test Date(s):	6/25	6/25/2014				EUT S	erial #:		None	(Sample E	3)				
Customer:	Long	Range	Syst	ems L	LC			EUT P	art #:		TX-96	01			
Project Number:	1600	5-15						Test T	echnici	an:	Eric Li	fsey			
Purchase Order #:	N/A							Super	visor:		Rob N	/lcColloug	h		
Equip. Under Test:	TX-96	501						Witne	ss' Nan	ne:	N/A				
	Radiat	ed Em	issio	ns Tes	st Re	sults	Data	Shee	t			Page:	1	of	:
EUT Line Voltage	e:	12	<u>2</u> 0	VAC				EU'	Γ Powe	r Frequ	ency:	60	Hz		
Antenna Orientati	on:		ŀ	Horizo	ntal			F	requen	ıcy Ran	ge:	A	bove 1	GHz	
EUT I	Mode (of Ope	ratio	n:							Trans	smit			
Professional Te Radiated Emissions, 1-6 GHz Horizontal Pok	SUMG, 3m Dis arity Mea	EIVII, tance sured Em	1NC nissions	l							Correct	ed Average ed Peak Rea CC90.217(b	ac	SSIONAL T I N G	
80															
Field Strength (d B v/m) 70 60 60 60 60 60 60 60 60 60 60 60 60 60		<u> </u>													
50 St.															
<u>:</u>					المال المالية والمالة					Charles Harris			Harris Marie		
40	The state of the s	MIT						0 G	3.4G	3.	 				

16005-15 Page 25 of 38

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

16005-15 Page 26 of 38

8.3 Results

Table 8.3.	1: Mains Condu	cted Emissions,	, Equipment List		
		Profes	sional Testing, EMI, Inc.		
Test Metho	ANSI (C63.4–2009: Metho	ods of Measurement of Radio-Noise	Emissions from Lov	w-Voltage
Test Metho	Electr		Equipment in the Range of 9 kHz to		
		art 15.107 - Code o	of Federal Regulations Part 47, Subp	art B - Unintention	al Radiators,
In accordan		ucted Emissions Li	mits		
Section:	15.10		leuro : L#	AL (C. 1.D)	
Test Date(s			EUT Serial #:	None (Sample B)	
Customer: Project Nun		Range Systems	EUT Part #: Test Technician:	N/A Eric Lifsey	
Purchase O)-13	Supervisor:	Rob McCollough	
Equip. Und		01	Witness' Name:	Mike Williams	
			ed Emissions Test Equipment List		
Ti	le! Software Version	on: 4.1.A.	0, April 14, 2009, 11:01:00PM		
	Test Profile:	Profil	e#: CE_2010.til, dated December 16,	2010	
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	НР	8568B	Spectrum Analyzer	2732A03633	6/17/2014
0045	НР	85662A	Spec Anal Dsply for AN1842	2816A16413	N/A
0990	НР	85685A	RF Preselector	3010A01119	8/29/2014
1281	НР	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

Page 27 of 38 16005-15

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,						
In accordance with:	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				

C	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:

16005-15 Page 28 of 38

^{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.

			Profes	sional Te	sting, EN	ЛI, Inc.			
Test Method	d:				nt of Radio-No (incorporated		from Low-Volt , see §15.38).	age Electrical a	and Electronic
n accordanc	ce with:	FCC Part 15.10	07 - Code of Fe	deral Regulation	ons Part 47, Sul	bpart B - Unin	tentional Radia	ators, Conducto	ed Emissions
Section:		15.107							
Test Date(s)	:	6/13/2014			EUT Serial #	:	None (Sam	ole B)	
Customer:		Long Range	Systems		EUT Part #:		N/A	- ,	
Project Num	ber:	16005-15			Test Technic	ian:	Eric Lifsey		
Purchase Or	der #:	N/A			Supervisor:		Rob McColl	ough	
quip. Unde	r Test:	TX-9601			Witness' Na	me:	Mike Willia	ms	
	Conduct	ed Emissions	Test Result	s Data Sheet	- Neutral Le	ad	Pa	ge: 1	of 2
EU.	T Line Volta	ge:	120	VAC	EUT	Line Freque	ency:	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
PROFESSIONA 90 T			P	Conducted Emissi	sting, EMI, Incons 150kHzto 30	C. OMHz	Company: - Long Modd #: - TX-960 Description - Project #: - 16005- VoltageFreq: - 126 Additional Equipm	15 0/60	
80- 70- (a fd g) 30 p mill d ww 30- 30- 20-	~n,/h/h/	Phylindra Marie Carlotte							
10- 0-	Į.	* "Wyy	Mar,		V 17 1/1 1/1 1/1 1/1 1/1 1/1 1/1 1/1 1/1				
-10+ 100 Operator: Eric		4		Sample B Sample E power supply	Frequency	10M	— Average Limit — Quasi-Peak Limit — Peak Scan Data ∇ Average Reading A Quasi-Peak Readin		100M

16005-15 Page 29 of 38

Measured Conducted Emissions - Neutral Lead

			Profes	sional Te	esting, EN	∕II, Inc.			
est Metho	d:				ent of Radio-No z (incorporated		from Low-Volta see §15.38).	age Electrical a	ınd Electron
n accordan	ce with:	FCC Part 15.10 Limits	07 - Code of Fe	deral Regulation	ons Part 47, Su	bpart B - Unin	tentional Radia	tors, Conduct	ed Emission
ection:		15.107							
est Date(s)):	6/13/2014			EUT Serial #	:	None (Samp	ole B)	
ustomer:		Long Range	Systems		EUT Part #:		N/A		
roject Nun	nber:	16005-15			Test Technic	cian:	Eric Lifsey		
urchase O	rder #:	N/A			Supervisor:		Rob McColl	ough	
quip. Unde	er Test:	TX-9601			Witness' Na	me:	Mike Willia	ms	
		Emissions Te	est Results D	ata Sheet - P	hase Lead (L	ine 1)	Pa	ge: 2	of 2
EU	T Line Volta	ıge:	120	VAC	EUT	Line Freque	ency:	60	Hz
	Peak	Quasi-peak	Quasi-peak	Quasi-peak	Quasi-peak	Average	Average	Average	Averag
Frequency	Detector	Detector	Detector	Detector	Detector	Detector	Detector	Detector	Detecto
Measured	Reading	Reading	Limit	Margin	Test	Reading	Limit	Margin	Test
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	Results	(dBµV)	(dBµV)	(dB)	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
PROFESSION				onducted Emissi	sting, EMI, Incons 150kHz to 30		Company: - Long Modd #: - TX-9601 Description - Project #: - 16005-1 Voltage Freq: - 120 Additional Equipm	l 15 /60	
80- 70- (A ng p) 50- miji du uv 40- 30-		AM MOUNTAIN			1		Manual Ma		
20- 10-									
20-									

16005-15 Page 30 of 38

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 \pm 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	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						

16005-15 Page 31 of 38

	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	serumental report for the 171 you						
	Professiona	l Testing, EMI, Inc.						
TIA-603-C-2004 Land Mobile FM or PM - Communications Equipment - Measurement and								
Test Method: 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.

16005-15 Page 32 of 38

Wireless Certification Report for the TX-9601 by Long Range Systems, LLC						
Professional Testing, EMI, Inc.						
TIA-603-C-2004 Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards				nt - Measurement and		
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		X-9601		Witness' Name: None		lone
Condition		Frequency			Deviation	Voltage
Voltage Extreme	Reference Frequency (MHz)*	Measured Frequency (MHz)		Iculated ation (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	-39.99999956		-0.085516074	143.75

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

16005-15 Page 33 of 38

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

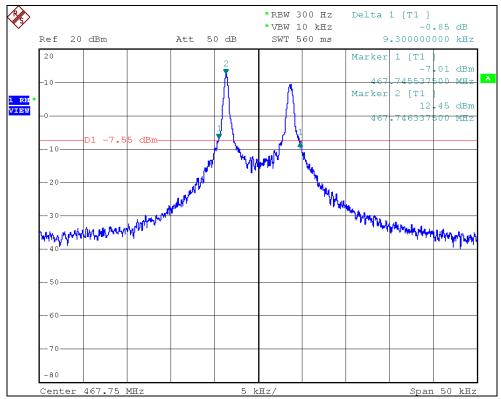
10.3 Results

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

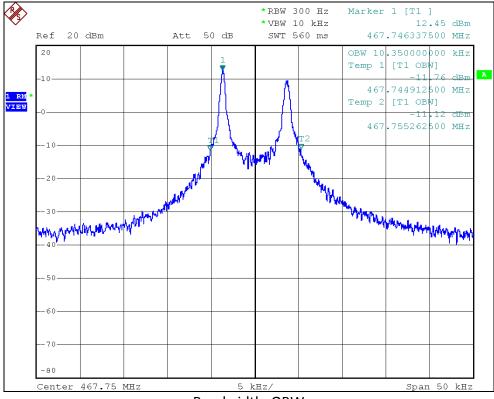
Table 11.3.2 Bandwidth				
Bandwidth Measurement Method	Measured Bandwidth			
20 dB	9.3 kHz			
OBW Instrument Measurement	10.35 kHz			

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

16005-15 Page 34 of 38



Bandwidth, 20 dB



Bandwidth, OBW

16005-15 Page 35 of 38

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.

16005-15 Page 36 of 38

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
Radiated Ellissions	1 to 18 GHz	3 m	5.7

16005-15 Page 37 of 38

End of Report

(This page intentionally left blank.)

16005-15 Page 38 of 38