Project 16333-15

TX-14C LRS Paging Transmitter 457.525 MHz

Wireless Certification Report

Prepared for:

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

By

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

24 Aug 2015

Reviewed by

Larry Finn Chief Technical Officer me 7

Written by

Eric Lifsey EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft for review.	10 Aug 2015
01	Revised per review comments, final.	24 Aug 2015
01A	Delete IC ID references.	3 Sep 2015

Corrections

Where model is indicated as T14 or T14C the correct designation is TX-14C.

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	ix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty	
	Report	
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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	FCC ID:	2AB6OT14C
Addison TX 75001	Model(s):	TX-14C
Certificate Date: 24 Aug 2015	Laboratory Project ID:	16333-15

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR (USA) FCC, RSS IC(Industry Canada)			
Parameter	FCC	IC	
Conducted Output Power	90.210, 2.1046	RSS-119 Issue 12, 5.4	
Emission Mask C	90.210(c), 2.1047	RSS-119 Issue 12, 5.8.3	
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051	RSS-119 Issue 12, 5.8; RSS-Gen Issue 4	
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 15.209, 2.1053	RSS-119 Issue 12, 5.8	
Transient Frequency Behavior	90.214, TIA/EIA-603C	RSS-119 Issue 12, 5.9	
Frequency Stability	90.213, 2.1055	RSS-119 Issue 12, 5.3	
Occupied Bandwidth, 20 dB, < 11.5 kHz	90.209, 2.1049	RSS-119 Issue 12, 5.5	
Radiated Emissions 30 MHz – 5 GHz	15.109	RSS-Gen Issue 4, ICES-003	
Exemption For Power ≤ 120 mW	90.217(b)	RSS-119 5.10	
Mains Conducted Emissions, Class B	15.107	RSS-Gen Issue 4, ICES-003	
Maximum Permissible Exposure			

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above 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 the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

Representative of	of Applicant	

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 unless specified otherwise in TIA/EIA-603.

1.2 EUT Description

The EUT transmits alert codes to other associated wireless devices at restaurants for seating or similar purposes in the establishment. The EUT is housed in a plastic enclosure with a small LCD display and integral keypad. It receives power from an internal rechargeable battery. The EUT employs an inductively-loaded quarter-wave antenna soldered directly to the circuit board and is located entirely inside the plastic enclosure.

Table 1.2.1 Equipment Under Test				
Manufacturer & Description	Model	Serial #	Photo	
Long Range Systems, LLC Paging transmitter	TX-14C	Sample Unit 4	In Charger Base (left) and Not In Charger (right)	

1.3 EUT Operation

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

Operating Frequency List
457.525 MHz (Including ± 0.5 MHz as conventionally practiced.)

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

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 RSS-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	FCC Part 90	
IC RSS	RSS-119 Issue 12	2015
IC RSS	RSS-Gen Issue 4	2014
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			
Parameter	FCC	IC	
Conducted Output Power	90.210, 2.1046	RSS-119 Issue 12, 5.4	
Emission Mask C ¹	90.210(c), 2.1047	RSS-119 Issue 12, 5.8.3	
Conducted Spurious/Harmonic Emissions at	90.210, 2.1051	RSS-119 Issue 12, 5.8; RSS-	
Antenna Terminals	90.210, 2.1031	Gen Issue 4	
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 15.209, 2.1053	RSS-119 Issue 12, 5.8	
Transient Frequency Behavior ²	90.214, TIA/EIA-603C	RSS-119 Issue 12, 5.9	
Frequency Stability	90.213, 2.1055	RSS-119 Issue 12, 5.3	
Occupied Bandwidth, 20 dB, < 11.5 kHz	90.209, 2.1049	RSS-119 Issue 12, 5.5	
Radiated Emissions 30 MHz – 5 GHz	15.109	RSS-Gen Issue 4, ICES-003	
Exemption For Power ≤ 120 mW ²	90.217(b)	RSS-119 5.10	
Mains Conducted Emissions, Class B ³	15.107	RSS-Gen Issue 4, ICES-003	
Maximum Permissible Exposure ⁴	4	4	

¹Applies for equipment of this bandwidth and with transmit only functionality.

²Transmit power is below 120 mW which meets the requirement for exemption for this test.

³This device employs a charging accessory that 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.

⁴Exposure is reported in a separate supplement to this report.

3.0 Radiated Output Power

3.1 Procedure

The EUT contains an internal antenna and no external connector. The EUT is placed into continuous transmit mode without modulation and radiated emissions are measured. Field strength is recorded and converted by calculation to EIRP.

3.2 Criteria

Parameter	Section Reference	Date(s)
Conducted Output Power	90.210, 2.1046 RSS-119 Issue 12, 5.4	17 Jul 2015

3.3 Results

The EUT satisfied the requirement. Tabular results are presented below.

Table 3.3.1 Power, Radiated			
Frequency (MHz)	Polarity	Distance	Measured Level
457.525	Н	10 m	78.4 dBμV/m
457.525	V	10 m	74.3 dBμV/m

Table 3.3.2 Power of Maximum Radiated, Converted to EIRP			
Frequency (MHz)	Calculated EIRP dBm	Calculated EIRP mW	
457.525	-6.37	0.23	

4.0 Emission Mask

4.1 Procedure

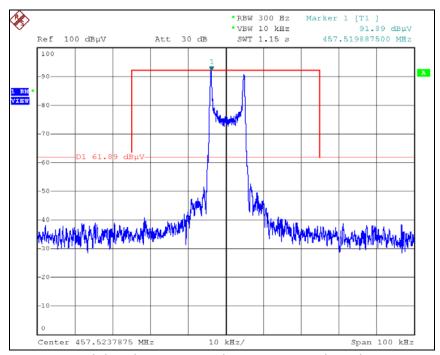
Emissions are measured with peak detector. The frequency span is the inner mask area including the fundamental and out to \pm kHz from center frequency of signal. The mask was selected to match the emission bandwidth in use and transmitter-only device type.

4.2 Criteria

Guideline	Section Number	Date
Emissions at Antenna Terminals	90.210(c), 2.1047 RSS-119 Issue 12, 5.8.3	3 Jun 2015

4.3 Results

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



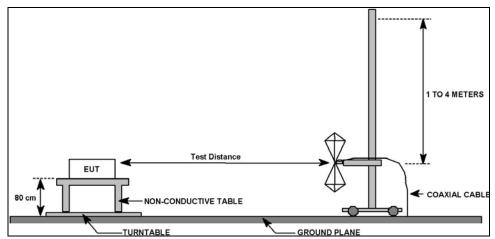
Modulated Emission with Superimposed Mask C

5.0 Field Strength of Radiated Spurious Emissions

5.1 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 removed and a resistive terminator substituted.

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 below.



Field Strength of Radiated Emissions Test Setup

5.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Emissions	90.210, 15.209, 2.1053 RSS-119 Issue 12,	17 Jul 2015
30 MHz to 5 GHz	5.8; RSS-Gen Issue 4	17 Jul 2013

5.3 Results

The EUT is hand-held which called for 3 measurement orientations in transmit mode.

All peak levels were found to be in excess of 10 dB below the limit.

The EUT satisfied the requirement.

5.3.1 Transmit Mode

Table 5.3.1.1: Field Strength of Spurious Emissions, Upright, Below 1 GHz, Vertical Polarity

	Pı	rofessional To	esting, EMI, Ind	C .				
est Method:			ement of Radio-Noise Em kHz to 40 GHz" (incorpora			•	rical and	
n accordance with:	FCC Part 15.209 - Limits	Code of Federal Regul	ations Part 47, Subpart C	- Intention	al Radiators,	Radiate	d Emiss	ions
Section:	15.209							
est Date(s):	7/17/2015		EUT Serial #:	None				
Customer:	Long Range Sys	stems	EUT Part #:	Unit #	#4			
Project Number:	16333-15		Test Technician:	Eric Li	ifsey			
Purchase Order #:	NA		Supervisor:	Lisa A	rndt			
quip. Under Test:	T14		Witness' Name:	None				
F	Radiated Emissi	ons Test Results Da	ta Sheet		Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequ	iency:	0	N/A		
Antenna Orientatio	n:	Vertical	Frequency Ran	ige:	30N	/lHz to :	1GHz	
Professional Testing	FMI Inc		Transn	nit 457.52	25 MHz, Up	oright		
Professional Testing, Radiated Emissions, 10m Di 30MHz - 1GHz Vertical Polarity	stance		Transn	Corrected Po	eak Value	PROFESS	SIONAL N 6	
Radiated Emissions, 10m Di 30MHz - 1GHz Vertical Polarity	stance		Transn	Corrected Po	eak Value		SIONAL	
Radiated Emissions, 10m Di 30MHz-1GHz Vertical Polarity	stance		Transn	Corrected Po	eak Value		SIONAL	
Radiated Emissions, 10m Di 30MHz-1GHz Vertical Polarity 80 70 (m) 60 40 40 10 10 10 30M	stance	100M		Corrected Pospurious_Lin	eak Value		SIONAL N. 6	
Radiated Emissions, 10m Di 30MHz - 1GHz Vertical Polarity 80 70 60 60 60 60 60 60 60 60 60 60 60 60 60	stance Measured Emissions		requency	Corrected Pospurious_Lin	eak Value			

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Table 5.3.1.2: Field Strength of Spurious Emissions, Upright, Below 1 GHz, Horizontal Polarity

		Professional T	esting, EMI,	Inc.				
Test Method:		003: "Methods of Measu pment in the Range of 9				_	rical and	t
n accordance with:	FCC Part 15.20 Limits	9 - Code of Federal Regu	llations Part 47, Subpa	rt C - Intentiona	l Radiators,	Radiate	d Emiss	sion
Section:	15.209							
Test Date(s):	7/17/2015		EUT Serial #:	None				
Customer:	Long Range	Systems	EUT Part #:	Unit #	4			
Project Number:	16333-15		Test Technician:	Eric Li	fsey			
Purchase Order #:	NA		Supervisor:	Lisa A	rndt			
quip. Under Test:	T14		Witness' Name:	None				
	Radiated Emis	ssions Test Results D	ata Sheet		Page:	1	of	1
EUT Line Voltag	ge: 3.6	VDC	EUT Power Fr	requency:	0	N/A		
Antenna Orientat	ion:	Horizontal	Frequency	Range:	301	/lHz to	1GHz	
			Tra	nsmit 457.52	5 MHz, Up	right		
Professional Testing Radiated Emissions, 10m 30MHz-1GHzHorizontalPo	Distance			Corrected Pe Spurious_Lim		PROFESS T E S T	SIONAL N 6	
Eled of Strength (dB µV/m) 200	+++							
10 10 10 10 10 10 10 10 10 10 10 10 10 1	and a market all the same along	Carried Market M		A CONTRACTOR OF THE PARTY OF TH	A CONTRACTOR OF THE PARTY OF TH			
The state of the s	- THE	100M	+	+	-		1G	
30M Operator: Eric Lifsey				EUT: T14C				

Table 5.3.1.3: Field Strength of Spurious Emissions, Upright, 1 GHz to 5 GHz, Vertical Polarity

	Pı	rofessional Te	sting, EMI, Inc.				
Tact Mathad:			ment of Radio-Noise Emissic Hz to 40 GHz" (incorporated		U	cal and	ł
n accordance with:	C Part 15.209 - nits	Code of Federal Regulat	tions Part 47, Subpart C - Int	entional Radiators	, Radiated	l Emiss	ion
Section: 15	.209						
Test Date(s): 7/	17/2015		EUT Serial #:	None			
Customer: Lo	ng Range Sys	tems	EUT Part #:	Unit #4			
	333-15		Test Technician:	Eric Lifsey			
Purchase Order #: NA	4		Supervisor:	Lisa Arndt			
Equip. Under Test: T1	4		Witness' Name:	None			
Rad	iated Emission	ons Test Results Dat	a Sheet	Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequen	cy: 0	N/A		
Antenna Orientation:		Vertical	Frequency Range:	. Α	bove 1G	Hz	
			Transmit 4	457.525 MHz, U	pright		
Professional Testing, EM Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Er 90 80 (III) 70 40 90 90 90 90 90 90 90 90 90 90 90 90 90	è			rected Peak Reading	PROFESSI	ONAL N 6	
‡							
40 — — — — — — — — — — — — — — — — — — —	white a shake the state of the	in the same of	hand hare a second data of the lates of the	in all a second	a mileta Delega		
$30_{\mathbf{G}}^{\mathbf{I}}$		in the same of the latest transmitted to the same of t		HT TIAC	A Marian Mar	5G	
40	o525MHzUpPostil	Freq EUT Mode: Transmit 457.525MF	lucity	UT: T14C	d altim below	5G	

Table 5.3.1.4: Field Strength of Spurious Emissions, Upright, 1 GHz to 5 GHz, Horizontal Polarity

	P	rofessional Te	esting, EMI, Inc.				
Fest Method:			ement of Radio-Noise Emission Hz to 40 GHz" (incorporated		•	ical and	j
n accordance with:	FCC Part 15.209 - Limits	Code of Federal Regula	ations Part 47, Subpart C - Int	tentional Radiator	s, Radiate	d Emiss	ion
Section:	15.209						
Test Date(s):	7/17/2015		EUT Serial #:	None			
Customer:	Long Range Sys	stems	EUT Part #:	Unit #4			
Project Number:	16333-15		Test Technician:	Eric Lifsey			
Purchase Order #:	NA		Supervisor:	Lisa Arndt			
quip. Under Test:	T14		Witness' Name:	None			
	Radiated Emissi	ons Test Results Da	ta Sheet	Page:	1	of	1
EUT Line Voltage	e: 3.6	VDC	EUT Power Frequen	icy: 0	N/A		
Antenna Orientati	on:	Horizontal	Frequency Range	: <i>P</i>	bove 10	SHz	
			Transmit	457.525 MHz, U	pright		
Professional Testing Radiated Emissions, 3m Di 1-6GHz Horizontal Polarity Mo	istance			rrected Peak Reading	PROFESS	SIONAL I N 6	
Field Strength (dB µV/m)							
40 — — — —		intered white transport is the second of the			, literatura	lan principal	
		Fr	equency E	TUT: TI4C	- And the state of	56	

Table 5.3.1.5: Field Strength of Spurious Emissions, Side, Below 1 GHz, Vertical Polarity

	Pi	rofession	al Testing, EM	l, Inc.				
est Method:			leasurement of Radio-No e of 9 kHz to 40 GHz" (in			•	ical and	i
n accordance with:	CC Part 15.209 - imits	Code of Federal	Regulations Part 47, Sul	bpart C - Intentiona	al Radiators,	Radiate	d Emiss	ion
ection: 1	15.209							
est Date(s):	7/17/2015		EUT Serial #:	None				
Customer: L	ong Range Sys	tems	EUT Part #:	Unit #	‡ 4			
Project Number: 1	L6333-15		Test Technici	an: Éric Li	fsey			
urchase Order #:	NA		Supervisor:	Lisa A	rndt			
quip. Under Test: 1	Г14		Witness' Nan	ne: None				
Ra	ndiated Emissio	ons Test Resu	lts Data Sheet		Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Powe	r Frequency:	0	N/A		
Antenna Orientation	n:	Vertical	Frequen	ıcy Range:	30N	/IHz to :	1GHz	
				Transmit 457.5	525 MHz, S	Side		
Professional Testing, E Radiated Emissions, 10m Dist: 30MHz-1GHzVerticalPolarity Mo 80	ance			Corrected Pe Spurious_Lim		PROFESS T E S T	SIONAL I N 6	
70	-			-	_	 	+	
S 30 E 20 E	_							
Makeula	Andrew Control of the	a plate the second	والمالية المساولة المساولة المساولة المساولة	the state of the s				
10	a alambian and							
30M Operator: Eric Lifsey	. January	100M	'	EUT: T14C			1G	

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Table 5.3.1.6: Field Strength of Spurious Emissions, Side, Below 1 GHz, Horizontal Polarity

	P	rofessional T	esting, EMI, In	c.				
Fest Method:			rement of Radio-Noise Em kHz to 40 GHz" (incorpora			_	rical and	ł
n accordance with:	FCC Part 15.209	- Code of Federal Regu	lations Part 47, Subpart C	- Intentiona	I Radiators,	Radiate	d Emiss	ion
Section:	15.209							
Test Date(s):	7/17/2015		EUT Serial #:	None				
Customer:	Long Range Sy	stems	EUT Part #:	Unit #	4			
Project Number:	16333-15		Test Technician:	Eric Li	fsey			
Purchase Order #:	NA		Supervisor:	Lisa A	rndt			
Equip. Under Test:	T14		Witness' Name:	None				
	Radiated Emissi	ons Test Results Da	ata Sheet		Page:	1	of	1
EUT Line Voltag	ge: 3.6	VDC	EUT Power Freq	uency:	0	N/A		
Antenna Orientat	ion:	Horizontal	Frequency Rai	nge:	30N	/IHz to	1GHz	
			Tran	smit 457.5	25 MHz, 9	Side		
Professional Testin Radiated Emissions, 10m 30MHz-1GHzHorizontalPo	Distance			Corrected Pe		PROFES:	SIONAL	
(m/V 4 db) 40 4 40 4 40 4 40 4 40 4 40 4 40 4 40								
1/V4 20 1	And the second s	100M	Frequency	EUT: TI4C			16	

Table 5.3.1.7: Field Strength of Spurious Emissions, Side, 1 GHz to 5 GHz, Vertical Polarity

	Pi	rofessional Te	sting, EMI, Inc.				
Tact Mathad:			ment of Radio-Noise Emission Tale to 40 GHz" (incorporated		U	ical and	i
n accordance with:	CC Part 15.209 - mits	Code of Federal Regulat	tions Part 47, Subpart C - Int	tentional Radiators	, Radiate	d Emiss	ion
Section: 15	5.209						
Test Date(s): 7	/17/2015		EUT Serial #:	None			
Customer: Lo	ong Range Sys	tems	EUT Part #:	Unit #4			
	6333-15		Test Technician:	Eric Lifsey			
	IA		Supervisor:	Lisa Arndt			
Equip. Under Test: T	14		Witness' Name:	None			
Rac	diated Emission	ons Test Results Data	a Sheet	Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequen	cy: 0	N/A		
Antenna Orientation:	:	Vertical	Frequency Range	: А	bove 10	Hz	
			Transmi	t 457.525 MHz,	Side		
Radiated Emissions, 3m Distance						_	
1-6GHz Vertical Polarity Measured E				rrected Peak Reading rious_Limit_GHz	PROFESS	SIONAL	
1-6GHz Vertical Polarity Measured E	Emissions	Freq EUT Mode: Transmit 457.525 MH	— Spu	Ü	PROFESS	5G	

Table 5.3.1.8: Field Strength of Spurious Emissions, Side, 1 GHz to 5 GHz, Horizontal Polarity

	P	rofessional Te	esting, EMI, Inc.				
Test Method:			ement of Radio-Noise Emissi (Hz to 40 GHz" (incorporated		· ·	rical and	d
n accordance with:	FCC Part 15.209 - Limits	· Code of Federal Regula	ations Part 47, Subpart C - In	tentional Radia	tors, Radiate	d Emiss	sions
Section:	15.209						
Test Date(s):	7/17/2015		EUT Serial #:	None			
Customer:	Long Range Sys	stems	EUT Part #:	Unit #4			
Project Number:	16333-15		Test Technician:	Eric Lifsey			
Purchase Order #:	NA		Supervisor:	Lisa Arndt			
Equip. Under Test:	T14		Witness' Name:	None			
	Radiated Emissi	ons Test Results Da	ta Sheet	Pag	e: 1	of	1
EUT Line Voltage	e: 3.6	VDC	EUT Power Frequer	ncy: 0	N/A		
Antenna Orientati	ion:	Horizontal	Frequency Range	:	Above 10	GHz	
				it 457.525 MF	tz. Side		
Professional Testing Radiated Emissions, 3m D 1-6GHzHorizontal Polarity M 90 80 70 90 60 60 60 60 60 60 60 60 60 60 60 60 60	Distance			urious_Limit_GHz	PROFES	SIONAL	
40‡		Contracting and the state of th	A bounded to be the still or repeated the last of the state of the sta		And the state of t		

Table 5.3.1.9: Field Strength of Spurious Emissions, Flat, Below 1 GHz, Vertical Polarity

	Di	rofessional T	esting, EMI, I	Inc		-		
	F1	olessional i	estilig, Livii, i					
est Method:			ement of Radio-Noise kHz to 40 GHz" (incorp		· ·	•	rical and	t
n accordance with:	FCC Part 15.209 - Limits	Code of Federal Regu	lations Part 47, Subpar	t C - Intentiona	al Radiators,	Radiate	d Emiss	sion
ection:	15.209							
est Date(s):	7/17/2015		EUT Serial #:	None				
ustomer:	Long Range Sys	stems	EUT Part #:	Unit #	‡ 4			
roject Number:	16333-15		Test Technician:	Eric Li	ifsey			
urchase Order #:	NA		Supervisor:	Lisa A	rndt			
quip. Under Test:	T14		Witness' Name:	None				
	Radiated Emission	ons Test Results Da	ata Sheet		Page:	1	of	1
EUT Line Voltage	e: 3.6	VDC	EUT Power Fro	equency:	0	N/A		
Antenna Orientati	on:	Vertical	Frequency F	Range:	30N	1Hz to	1GHz	
			Tr	ansmit 457.	525 MHz, I	Flat		
Professional Testing Radiated Emissions, 10m I 30MHz-1GHzVerticalPolarity	Distance			Corrected PeSpurious_Lin		PROFESS	SIONAL	
80 70 70 70 70 70 70 70 70 70 70 70 70 70	The same of the sa	100M	requency.	EUT: T14C	ber: 16333-15		16	

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Table 5.3.1.10: Field Strength of Spurious Emissions, Flat, Below 1 GHz, Horizontal Polarity

	P	rofessional	Testing, EMI	, Inc.				
Test Method:			urement of Radio-No 9 kHz to 40 GHz" (inc				rical and	t
n accordance with:	FCC Part 15.209 Limits	- Code of Federal Reg	gulations Part 47, Sub	part C - Intentiona	I Radiators,	Radiate	d Emiss	sion
Section:	15.209							
Test Date(s):	7/17/2015		EUT Serial #:	None				
Customer:	Long Range Sy	stems	EUT Part #:	Unit #	4			
Project Number:	16333-15		Test Technicia	ın: Éric Li	fsey			
Purchase Order #:	NA		Supervisor:	Lisa A				
quip. Under Test:	T14		Witness' Nam	e: None				
	Radiated Emiss	ions Test Results [Data Sheet		Page:	1	of	1
EUT Line Voltag	ge: 3.6	VDC	EUT Power	Frequency:	0	N/A		
Antenna Orienta	tion:	Horizontal	Frequenc	cy Range:	30N	/IHz to	1GHz	
				Transmit 457.	525 MHz.	Flat		
Professional Testin Radiated Emissions, 10n 30MHz-1GHzHorizontalP 80 70 (iii / A	n Distance			Corrected Pe Spurious_Lim		PROFESS	SIONAL	
10 10 30M	Manager Manage	Market Company of the State of						
30M		100M	Frequency 25MHz	EUT: T14C	per: 16333-15		1G	ł

Table 5.3.1.11: Field Strength of Spurious Emissions, Flat, 1 GHz to 5 GHz, Vertical Polarity

	Pr	ofessional Te	sting, EMI, Inc.					
Fact Mathad:			ment of Radio-Noise Emissi Iz to 40 GHz" (incorporated			•	ical and	ł
n accordance with: Lim		Code of Federal Regulat	tions Part 47, Subpart C - In	tentiona	l Radiators,	Radiate	d Emiss	ions
Section: 15.	209							
Test Date(s): 7/1	17/2015		EUT Serial #:	None				
Customer: Lor	ng Range Sys	tems	EUT Part #:	Unit #	4			
Project Number: 163	333-15		Test Technician:	Eric Lif	sey			
Purchase Order #: NA			Supervisor:	Lisa Aı	ndt			
Equip. Under Test: T14	4		Witness' Name:	None				
Radi	ated Emission	ons Test Results Data	a Sheet		Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Freque	ncy:	0	N/A		
Antenna Orientation: Vertical Frequency Range:						ove 10	SHz	
			Transm	nit 457.5	25 MHz,	Flat		
Professional Testing, EM: Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Emi 90 80 (E/AT, 70 40 60 60 60 60 60 60 60 60 60 60 60 60 60	,			orrected Pe	J	PROFESS	SIONAL 1 N 6	
E E E E E E E E E E E E E E E E E E E		_					and the state of t	
<u> </u>	anital disease of the state of	Header to the second se	and the state of t	Mary Mary Carlot		I the same of the		

Table 5.3.1.12: Field Strength of Spurious Emissions, Flat, 1 GHz to 5 GHz, Horizontal Polarity

	P	rofessional	Testing, EM	II, Inc.				
est Method:			surement of Radio-No f 9 kHz to 40 GHz" (in			•	ical and	i
n accordance with:	FCC Part 15.209 Limits	- Code of Federal Re	gulations Part 47, Sul	bpart C - Intentio	nal Radiators,	, Radiate	d Emiss	sion
ection:	15.209							
est Date(s):	7/17/2015		EUT Serial #:	Non	е			
ustomer:	Long Range Sy	rstems	EUT Part #:	Unit	#4			
roject Number:	16333-15		Test Technici	an: Eric	Lifsey			
urchase Order #:	NA		Supervisor:		Arndt			
quip. Under Test:	T14		Witness' Nan	ne: Non	e			
	Radiated Emiss	ions Test Results	Data Sheet		Page:	1	of	1
EUT Line Voltag	e: 3.6	VDC	EUT Powe	r Frequency:	0	N/A		
Antenna Orientat	ion:	Horizontal	Frequer	ncy Range:	Al	bove 10	Hz	
				Transmit 457	.525 MHz,	Flat		
Professional Testing Radiated Emissions, 3m I 1-6GHz Horizontal Polarity M 90 80 80 70 80	Distance			CorrectedSpurious_L	Peak Reading imit_GHz	PROFESS	SIONAL	
Eidd Streng th (dB FV/III)	Milharia da de la companio della com	and the state of t	and the same of th	Angerty and the late of the la			56	

5.3.2 Idle Mode

Table 5.3.2.1: Field Strength of Spurious Emissions, Below 1 GHz, Vertical Polarity

				Profes	sional Te	sting, El	VII, Inc.			
Test I	Metho	d:			ods of Measurer e Range of 9 kH				•	
		ice with:	Emissions Li		Federal Regulat	ions Part 47, S	Subpart B - Ur	nintentional F	Radiators, Rad	iated
Section			15.109							
	Date(s	s):	7/22/2015			EUT Serial		None		
	mer:		Long Rang	e Systems		EUT Part #:		Unit #4		
	ct Nur		16333-15			Test Techn		Eric Lifsey		
		rder #:	NA			Supervisor:		Lisa Arndt		
quip	. Und	er Test:	T14C			Witness' N	ame:	None		
		F	Radiated En	nissions Test	t Results Data	Sheet		Pa	age: 1	of 1
	EUT Li	ne Voltage	: 3	3.6 VDC		EUT Pow	er Frequen	су:	0 N/A	
Ar	ntenna	orientation	n:	Vertic	al	Frequ	ency Range	:	30MHz to	1GHz
								ldle, Uprigh	nt	
Frequ Meas (M	sured	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
33.4	1924	10	113	1.28	Quasi-peak	23.5	11.979	29.5	-17.5	Pass
89.5	194	10	20	3.11	Quasi-peak	29	9.358	33.1	-23.7	Pass
549.	.854	10	294	2.78	Quasi-peak	22	18.666	35.6	-16.9	Pass
670	.466	10	239	2.52	Quasi-peak	21.9	19.807	35.6	-15.8	Pass
903	.585	10	213	2.31	Quasi-peak	21.2	26.452	35.6	-9.1	Pass
931	.002	10	351	1.87	Quasi-peak	21.1	26.097	35.6	-9.5	Pass
	Radiated 30MHz - 80	sional Testing, Emissions, 10m D 1GHz Vertical P	istance	Emissions			— Qu	asi-peak Limit Lo rrected Quasi-peak Limit Level rrected Peak Val rified Low-PRF (evel ak Readin ue JP Readin	SSIONAL
Field Strength (dBμV/m)	70 60 50 40 30	Manual .					A part of the black			
Field	10	The last of the la			AND REAL PROPERTY.	Principal Inglished .				
	0 30M Operator	: Eric Lifsey	p525MHz'Idle'Upl	100M Pos.til EUT Mo	Freo ode: Idle on 457.525 wer: 3.6V Battery	pency MHz		EUT: T14C Project Number:	16333-15	1G

TX-14C by Long Range Systems, LLC

Table 5 3 2 2: Field Strength of Spurious Emissions, Below 1 GHz, Horizontal Polarity

			Profes	sional Te	sting, EN	MI, Inc.			
Test Metho	d:			ds of Measurer e Range of 9 kH				•	
n accordar	ce with:	FCC Part 15. Emissions Li		Federal Regulat	ions Part 47, S	Subpart B - Un	intentional R	adiators, Radi	iated
Section:		15.109			1		,		
est Date(s):	7/22/2015			EUT Serial		None		
ustomer:		Long Rang	e Systems		EUT Part #:		Unit #4		
roject Nur		16333-15			Test Techni		Eric Lifsey		
urchase O		NA			Supervisor:		Lisa Arndt		
quip. Und	er Test:	T14C			Witness' N	ame:	None		
	F	Radiated Er	nissions Test	t Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage	:	3.6 VDC		EUT Pow	ver Frequen	cy:	0 N/A	
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range:		30MHz to	1GHz
						1	dle, Uprigh	t	
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
31.6875	10	214	2.74	Quasi-peak	24.1	12.664	29.5	-16.8	Pass
547.168	10	94	1.39	Quasi-peak	22.1	18.582	35.6	-17.0	Pass
633.912	10	174	3.59	Quasi-peak	22	20.363	35.6	-15.2	Pass
757.218	10	290	1.27	Quasi-peak	21.6	22.534	35.6	-13.1	Pass
887.166	10	214	1.5	Quasi-peak	21.4	26	35.6	-9.6	Pass
932.027	10	81	1.5	Quasi-peak	21.2	26.217	35.6	-9.4	Pass
Radiated 30MHz - 80	ional Testing, Emissions, 10m D 1GHz Horizontal	istance	red Emissions			— Co	asi-peak Limit Le rrected Quasi-pea ak Limit Level rrected Peak Valu rified Low-PRF ()	ie 💮	SIONAL
Field Strength (dBµV/m) 70 20 20 20 20 20 20 20 20 20 20 20 20 20	mayber of block of the			Physical Disease May of the Control		alonilly documents to the three beautiful to the second se			
	: Eric Lifsey 'Run01'T14C'457	n525MHz'Idle'Un	100M	Fred ode: Idle on 457.525	nency		EUT: T14C Project Number: 1	6333.15	1G

				Pro	fess	ional Te	sting, EN	MI. Inc.						
		ANSI C				ds of Measurer			ns fron	n Low-\	/oltage	Flect	rical and	d
Test Metho	od:					Range of 9 kH					_		i i cai ai i	-
In accordar	nce with:		rt 15.10 ons Limi		de of F	ederal Regulat	tions Part 47, S	Subpart B - Un	intenti	onal Ra	diator	s, Radi	ated	
Section:		15.109												
Test Date(s	s):	7/22/					EUT Serial		None					
Customer:			Range	Syste	ms		EUT Part #:		Unit					
Project Nui		16333	3-15				Test Techn		Eric L					
Purchase C		NA					Supervisor:		Lisa A					
Equip. Und	er Test:	T14C					Witness' N	ame:	None					
	F	Radiate	ed Emis	ssion	s Test	Results Data	a Sheet			Pag	e:	1	of	1
EUT L	ine Voltage	:	3.6	5	VDC		EUT Pow	ver Frequen	су:	0		N/A		
Antenna	a Orientatio	n:		\	/ertica	al	Frequ	ency Range:	:		Abo	ove 10	GHz	
								ı	ldle, U	pright				
Frequency	Test	EL	JT	Ante	nna		Recorded	Corrected						
Measured	Distance	Direc	tion	Heig	ght	Detector	Amplitude	Level	_	Level	Ma	_	Test R	esult
(MHz)	(Meters)	(Deg	rees)	(Met	ers)	Function	(dBµV)	(dBµV/m)	(dBµ	v/m)	(d	в)		
1438.6	3	4	4	1		Average	36	24.587	54	.0	-29	9.4	Pa	iss
1945.97	3	6	1	1		Average	39.3	30.27	54	.0		3.7	Pa	iss
2437.49	3	14		1		Average	34.6	26.12		.0		7.8	Pa	iss
2939.64	3	20)5	1		Average	34.4	27.658	54	.0	-20	5.3	Pa	iss
Radiated	sional Testing, Emissions, 3m Dis Vertical Polarity	tance						– Pea	ik Limit I	nit Level verage Re Level eak Readin V_PKk		PROFES	SIONAL I N 6	
Field Strength														
Str													ابد بر د	
9 40		Mar Davidson	والمراجع والماراة		a del chi del del del		the state of the s				addinal district	January Community		
30		A CONTRACTOR OF THE PARTY OF TH	through salary completely	taka erekalah karpaya	<u> </u>									
20		Y	7			7	Ţ							
-	: Eric Lifsey L'Run01'T14C'457p	o525MHz'	Idle'UpPos			Freq le: Idle on 457.5251 er: 3.6V Battery	quency MHz		UT: T140	mber: 163	333-15	•	6G	ŗ

TX-14C by Long Range Systems, LLC

Table 5 3 2 4: Field Strength of Spurious Emissions 1 to 6 GHz Horizontal Polarity

Full Line Voltage: 3.6 VDC EUT Power Frequency: 0 N/A	Гаble 5.3.2	2.4: Field \$	Streng	th of	Spurious	Emissions,	1 to 6 GHz	, Horizont	al Pola	arity			
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					Profess	ional Te	sting, El	VII, Inc.					
In accordance with: Emissions Limits Section: 15.109 Test Date(s): 7/22/2015 EUT Serial #: None Customer: Long Range Systems EUT Part #: Unit #4 Project Number: 16333-15 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arnot Equip. Under Test: T14C Witness' Name: None Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 3.6 VDC EUT Power Frequency: 0 N/A Antenna Orientation: Horizontal Frequency Range: Above 1GHz Idle, Upright Frequency Test Distance (Meters) (Degrees) (Meters) (Test Metho	od:									•		d
Test Date(s):	In accordan	ice with:				ederal Regulat	ions Part 47, S	Subpart B - Un	intentio	nal Rac	diators, Radi	iated	
Customer: Long Range Systems EUT Part #: Unit #4 Project Number: 16333-15 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: T14C Witness' Name: None Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 3.6 VDC EUT Power Frequency: 0 N/A Antenna Orientation: Horizontal Frequency Range: Above 1GHz Tequency Test Distance (Meters) Direction Height (Meters) Direction (Meters) Direction (Meters) (Meters) Direction (Meters) Direction (Meters) 1450.84 3 39 1 Average 36 24.57 54.0 -29.4 Pass 1945.06 3 177 1 Average 34.7 25.67 54.0 -29.4 Pass 2440.77 3 148 1 Average 34.6 26.128 54.0 -27.8 Pass 2956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 3 30 30 1 Average 34.4 27.734 54.0 -26.2 Pass 3956.83 30 30 30 30 30 30 30 30 30 30 30 30 30	Section:												
Project Number: 16333-15 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: T14C Witness' Name: None Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 3.6 VDC EUT Power Frequency: 0 N/A Antenna Orientation: Horizontal Frequency Range: Above 1GHz Idle, Upright Frequency Distance (Meters) Distance (Meters) Distance (Meters) (Meters) Punction (Meters) Level (dBµV/m) (dBµV/m) (dB) 1450.84 3 39 1 Average 36 24.57 54.0 -29.4 Pass 1945.06 3 1777 1 Average 34.7 25.67 54.0 -28.3 Pass 1945.06 3 1777 1 Average 34.6 26.128 54.0 -27.8 Pass 2956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass 1961.84 Distance Level (Bluby) Results of the Meters of the M	Test Date(s	s):	_						_				
Purchase Order #: NA Supervisor: Lisa Arndt					Systems				_				
Radiated Emissions Test Results Data Sheet Page: 1 of 1			_	3-15					_				
Radiated Emissions Test Results Data Sheet							•			ndt			
EUT Line Voltage: 3.6 VDC EUT Power Frequency: 0 N/A	Equip. Und	er Test:	T14C				Witness' N	ame:	None				
Antenna Orientation: Horizontal Frequency Range: Above 1GHz		F	Radiate	ed Em	issions Test	Results Data	Sheet			Page	e: 1	of	1
Test EUT Antenna Detector Function (Meters) Direction (Meters) Direction (Meters) (Meters) Direction (Meters) (Meters) (Meters) Direction (Meters) (Me	EUT Li	ne Voltage	:	3.	6 VDC		EUT Pow	er Frequen	су:	0	N/A		
Test Measured Distance (MHz) Direction Height (Degrees) Height (Degrees) Height (Meters) Detector Function Height (Meters) Detector Function (Meters) Height (Meters) H	Antenna	Orientatio	n:		Horizon	tal	Frequ	ency Range:			Above 1	GHz	
Measured (Meters) Direction (Meters) Direction (Meters) Detector Function (Meters) Detector Function (Methy) Detector (Methy) De								ı	dle, Up	right			
1945.06 3 1.77 1 Average 34.7 25.67 54.0 -28.3 Pass 2440.77 3 148 1 Average 34.6 26.128 54.0 -27.8 Pass 2956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1.6GHz Horizontal Polarity Measured Emissions	Measured	Distance	Direc	tion	Height		Amplitude	Level	_			Test R	esult
2440.77 3 148 1 Average 34.6 26.128 54.0 -27.8 Pass 2956.83 3 30 1 Average 34.4 27.734 54.0 -26.2 Pass Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1.6GHz Horizontal Polarity Measured Emissions	1450.84	3	39	9	1	Average	36	24.57	54.0	0	-29.4	Pa	ISS
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Horizontal Polarity Measured Emissions 90 100 100 100 110 110 110 110	1945.06	3	17	7	1	Average	34.7	25.67	54.0	0	-28.3	Pa	ISS
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Horizontal Polarity Measured Emissions 90 70 70 10 10 10 10 10 10 10 1		3	14	8	1	Average	34.6	26.128	54.0	0	-27.8	Pa	ISS
Radiated Emissions, 3m Distance 1-GHz Horizontal Polarity Measured Emissions 90 70 60 Operator: Eric Lifsey 16333'RE'Rum01'T14C'457p525MHz'Idle'UpPos.til EUT Mode: Idle on 457.525MHz EUT Mode: Idle on 457.525MHz EUT Mode: Idle on 457.525MHz EUT Power: 3 6V Bottery Frequency EUT Power: 3 6V Bottery For equency EUT Power: 3 6V Bottery Poset Life on 457.525MHz Project Number: 16333-15	2956.83	3	30)	1	Average	34.4	27.734	54.0	0	-26.2	Pa	ISS
1G 6G Operator: Eric Lifsey Frequency EUT: T14C 16333'RE'Run01'T14C'457p525MHz'Idle'UpPos.til EUT Mode: Idle on 457.525MHz Project Number: 16333-15 EIT Power: 3 6V Battery	Radiated 1-6GHz I 90	Emissions, 3m Dis	tance		ions				rected Ave k Limit Le rected Pea	rage Rea vel k Readin	α ====	SIONAL	
Operator: Eric Lifsey Frequency 16333'RE'Run01'T14C'457p525MHz'Idle'UpPos.til EUT Mode: Idle on 457.525MHz FIT Power: 3 6V Bottery EUT: T14C Project Number: 16333-15	20												<u> </u>
03:37:45 PM, Wednesday, July 22, 2015 Pos: Upright Client: Long Range Systems	Operator 16333'RE	'Run01'T14C'457 _I		•	EUT Pow	le: Idle on 457.525 er: 3.6V Battery	puency MHz	P	roject Num			0 G	

Table 7.3.13: Measurement Bandwidth

Radiat	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.

6.0 Mains Conducted Emissions

6.1 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.

6.2 Criteria

Clause Subject	Section Number	Date
Mains Conducted Emissions, Class B	15.107 RSS-Gen Issue 4, ICES-003	21 Jul 2015

6.3 Results

The EUT is inhibited from operating when in charge mode; and more than half of the keypad is not accessible when in the charger base.

The EUT satisfied the requirement. Tabular and plotted measurements appear below.

Table 8.3.1: Mains Conducted Emissions, Neutral Line

	Professio	nal Testing, EMI, Inc	с.
Test Method:		easurement of Radio-Noise Emiss to 40 GHz (incorporated by refere	ions from Low-Voltage Electrical and Electronic ence, see §15.38).
In accordance with:	FCC Part 15.207 - Code of Federa Limits	l Regulations Part 47, Subpart C - I	Intentional Radiators, Conducted Emissions
Section:	15.207		
Test Date(s):	7/21/2015	EUT Serial #:	None
Customer:	Long Range Systems	EUT Part #:	Unit #4
Project Number:	16333-15	Test Technician:	Dave Kohutek
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T14C	Witness' Name:	None

	Conduct	ed Emissions	s Test Result	s Data Sheet	- Neutral Le	ad	Pa	ge: 1	of 2
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	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
0.48752	38.2	35.3	56.2	-20.9	PASS	16	46.2	-30.2	PASS
0.499337	44.2	40.2	56	-15.8	PASS	20.6	46	-25.5	PASS
0.499686	43.4	40.2	56	-15.8	PASS	20.8	46	-25.2	PASS
0.500512	44.2	40.5	56	-15.5	PASS	21.3	46	-24.7	PASS
2.795	30.1	19.7	56	-36.3	PASS	1.2	46	-44.8	PASS
2.9542	29.8	20.2	56	-35.8	PASS	2.5	46	-43.5	PASS
16.8402	41	34.7	60	-25.3	PASS	13.3	50	-36.7	PASS
16.8945	41.1	34.8	60	-25.2	PASS	13.2	50	-36.8	PASS
17.0596	41.2	34.7	60	-25.3	PASS	13.2	50	-36.8	PASS
17.074	41.5	34.8	60	-25.2	PASS	13.3	50	-36.7	PASS

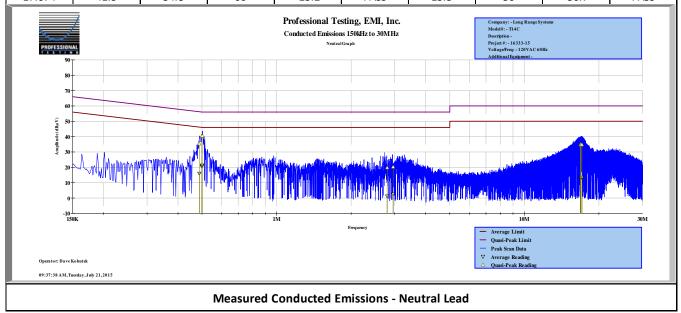


Table 8.3.2: Mains Conducted Emissions. Phase Line

	Profession	nal Testing, EMI, Inc	c .
Test Method:	ANSI C63.4–2009: Methods of Mo Equipment in the Range of 9 kHz		ions from Low-Voltage Electrical and Electronic nce, see §15.38).
In accordance with:	FCC Part 15.207 - Code of Federal Limits	Regulations Part 47, Subpart C - I	ntentional Radiators, Conducted Emissions
Section:	15.207		
Test Date(s):	7/21/2015	EUT Serial #:	None
Customer:	Long Range Systems	EUT Part #:	Unit #4
Project Number:	16333-15	Test Technician:	Dave Kohutek
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T14C	Witness' Name:	None

	Conducted	Emissions 16	est Results D	ata Sneet - P	nase Lead (L	ine 1)	Pa	ge: Z	OT Z
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	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
0.47585	35.6	31.2	56.4	-25.2	PASS	11.6	46.4	-34.8	PASS
0.49897	43.4	40.3	56	-15.7	PASS	20.7	46	-25.3	PASS
0.499098	44	40.2	56	-15.8	PASS	20.7	46	-25.3	PASS
0.504092	44.2	41	56	-15	PASS	22.1	46	-23.9	PASS
2.9934	30.6	20.7	56	-35.3	PASS	2.6	46	-43.4	PASS
3.0412	29.9	21	56	-35	PASS	2.1	46	-43.9	PASS
16.9539	41.9	35.6	60	-24.4	PASS	14.2	50	-35.8	PASS
17.0033	42.3	35.6	60	-24.4	PASS	14.2	50	-35.8	PASS
17.1232	42.2	35.5	60	-24.5	PASS	14.1	50	-35.9	PASS
17.1852	41.7	35.1	60	-24.9	PASS	13.8	50	-36.2	PASS

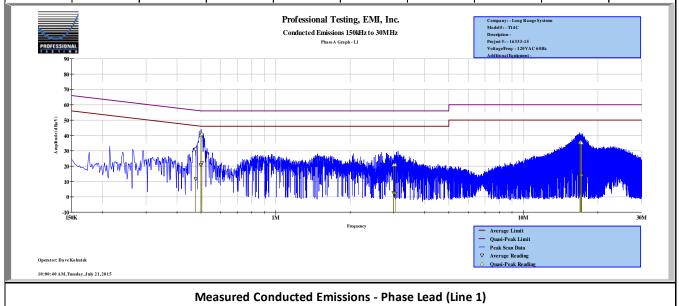


Table 8.3.4: Mains Conducted Emissions, Measurement Bandwidths

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time						
Frequency Band Start (MHz) Frequency Band Stop (6 dB Bandwidth Number of Ranges Used 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.

7.0 Frequency Stability

7.1 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 10 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 nominally 3.6 VDC.

7.2 Criteria

The operating frequency shall remain within +/- 25 kHz of the assigned channel. The measurement is performed for lowest, middle, and highest operating frequency.

7.3 Results

The EUT satisfied the requirement.

Table 9.3.2: Frequency Stability, Temperature

Date: 5 Jun 2015

Condition	Fred	juency	Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	457.525000	457.524070	-930
-20	457.525000	457.526300	1300
-10	457.525000	457.527000	2000
0	457.525000	457.526690	1690
10	457.525000	457.525820	820
20	457.525000	457.524740	-260
30	457.525000	457.524270	-730
40	457.525000	457.523570	-1430
50	457.525000	457.523390	-1610

Table 9.3.3: Frequency Stability, Voltage

Date: 5 Jun 2015

Condition	Frequency			Deviation	Voltage
Voltage Extreme	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Measured Voltage (V DC)
-15%	457.525000	457.525000000	0	0.000000000	3.06
Nominal	457.525000	457.525100000	100	0.218567291	3.60
+15%	457.525000	457.525200000	200	0.437134583	4.14

8.0 Transmit Transient

8.1 Procedure - Exempt

Transmit power under 120 mW exempts this test.

9.0 Emission Bandwidth

9.1 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 spectrum analyzer amplitude is offset to compensate for the attenuator calibrated power loss. 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.

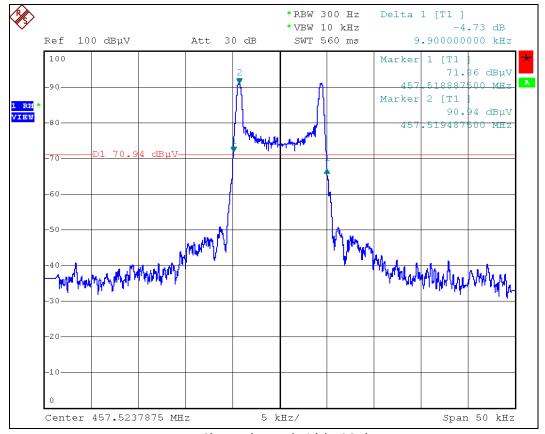
9.2 Criteria

Clause Requirement	Section Number	Date
90.210(c) Bandwidth < 12. 5 kHz	90.209, 2.1049 RSS-119 Issue 12, 5.5	3 Jun 2015

9.3 Results

Table 9.3.2 Bandwidth			
Bandwidth Measurement Method Measured Bandwidth			
20 dB	9.9 kHz		

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



Low Channel; Bandwidth, 20 dB

10.0 Equipment Lists

10.1 Bandwidth

Table 10.1 Equipment List; Bandwidth					
Asset # Manufacturer Model # Description Calibrat Due					
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	29 Jan 2016	

10.2 Frequency Stability

Table 10.2 Equipment List; Frequency Stability						
Asset #	set # Manufacturer Model # Description		Calibration Due			
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	29 Jan 2016		
2134	Tenny	TPS	Temperature Chamber	31 Oct 2015		
C235	235 Unknown RG type Coaxial Cable, double shielded		CNR			
1778	B&K	2408	DMM	20 Apr 2016		
none	PTI	none	Sense Antenna, sleeve dipole	CNR		

10.3 Radiated Spurious and Fundamental Power

10.3 K	adiated Spurio	us and Fundan	nental Power		
		Profes	sional Testing, EMI, Inc.		
T 1 0 0 - 1 -	. ANSI	C63.4–2003: "Meth	nods of Measurement of Radio-Noise	Emissions from Lo	w-Voltage
Test Metho	a:		Equipment in the Range of 9 kHz to		_
			of Federal Regulations Part 47, Subpa		
In accordan	ce with: Radia	ted Emissions Limi	ts		
Section:	15.20	9			
Test Date(s): 7/17/	'2015	EUT Serial #:	None	
Customer:	Long	Range Systems	EUT Part #:	Unit #4	
Project Nur	nber: 16333	3-15	Test Technician:	Eric Lifsey	
Purchase O	rder #: NA		Supervisor:	Lisa Arndt	
Equip. Und	er Test: T14		Witness' Name:	None	
		Radiate	d Emissions Test Equipment List		
Ti	le! Software Version	on: 4.2.A,	May 23, 2010, 08:38:52 AM		
	Test Profile:	Radia	ted Emissions_Profile Version Octob	er 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	2/5/2016
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	9/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027	PTI	None	Relay	none	N/A
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 Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800- 2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	none	none	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

Horn, 1 - 18 GHz

10.4 Radiated Spurious Idle Mode

	Profession	nal Testing, EMI, Inc	C.	
Test Method:	ANSI C63.4–2003: "Methods	of Measurement of Radio-N	oise Emissions from Low-Voltage	
rest Method.	Electrical and Electronic Equ	ipment in the Range of 9 kH	z to 40 GHz" (incorporated by reference,	
	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators,			
In accordance with:	Radiated Emissions Limits			
Section:	15.109			
Test Date(s):	7/22/2015	EUT Serial #:	None	
Customer:	Long Range Systems	EUT Part #:	Unit #4	
Project Number:	16333-15	Test Technician:	Eric Lifsey	
Purchase Order #:	NA	Supervisor:	Lisa Arndt	
Equip. Under Test:	T14C	Witness' Name:	None	

Radiated Emissions Test Equipment List

Tile! Software Version: 4.2.A, May 23, 2010, 08:38:52 AM

	Test Profile:	Radia	ted Emissions_Profile Version Octob	er 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	2/5/2016
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	8/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027	N/A	RG214	Cable Coax, N-N, 25m	none	10/22/2015
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 Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800- 2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	N/A	0	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

10.5 Mains Conducted Emissions

Professional Testing, EMI, Inc.					
Test Method:			oise Emissions from Low-Voltage z to 40 GHz (incorporated by reference,		
In accordance with:	FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits				
Section:	15.207				
Test Date(s):	7/21/2015	EUT Serial #:	None		
Customer:	Long Range Systems	EUT Part #:	Unit #4		
Project Number:	16333-15	Test Technician:	Dave Kohutek		
Purchase Order #:	NA	Supervisor:	Lisa Arndt		
Equip. Under Test:	T14C	Witness' Name:	None		

Conducted Emissions Test Equipment List

Tile! Software Version: 4.1.A.0, April 14, 2009, 11:01:00PM

Test Profile: Profile#: CE_2014_R3.TIL, dated May 1, 2014

	Test Profile: Profile#: CE_2014_R3.11L, dated May 1, 2014						
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date		
1842	НР	8568B	Spectrum Analyzer	2732A03633	10/1/2015		
2113	НР	85662A	Spec Anal Dsply for A/N 1842	2403A07470	N/A		
0990	НР	85685A	RF Preselector	3010A01119	9/30/2016		
1281	НР	85650A	Quasi Peak Adapter	2043A00063	N/A		
1173	НР	6214B	Power Supply, DC, 12V 1A	2617A11110	N/A		
1087	PTI	PTI-ALF3	Attenuator Limiter Filter	none	4/28/2016		
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	8/11/2015		
C108	НР	11170 C	Cable 5 ft BNC (Grey)	none	8/11/2015		
C109	НР	none	Cable 19 inch BNC (grey)	none	8/11/2015		
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	11/11/2015		

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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