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April 22, 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-7470 LRS Paging 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-7470 LRS Paging 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

April 22, 2014

Reviewed by

Larry Finn Regulatory Design Engineer Written by

Eric Lifsey Test Engineer

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Revision History

Revision Number	Description	Date
00	Initial draft for review.	April 22, 2014
01	Revised per Larry Finn review.	April 22, 2014

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NOTICE

- (1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST.
- (2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc.
- (3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Certificate of Compliance

Applicant: Long Range Systems, LLC (John Weber)

Applicant's Address: Long Range Systems, LLC

4550 Excel Parkway Suite 200

Addison, Texas 75001

FCC ID: 2AB6O7470

Model(s): TX-7470 and TX-7470-C232

Project Number: 15689-10

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

47 CFR, Part 90				
Clause Subject	Section References	Date		
Conducted Output Power	90.210, 2.1046	March 20, 2014		
Emission Mask	90.210, 2.1047	March 28, 2014		
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051	March 26, 2014		
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 2.1053	March 19, 24-26, 2014		
Transient Frequency Behavior	90.214, TIA/EIA-603C	March 21, 2014		
Frequency Stability	90.213, 2.1055	March 21, 2014		
Occupied Bandwidth, 20 dB	90.209, 2.1049	March 20, 2014		
Radiated Emissions 30MHz – 6 GHz	15.109, ICES-003	March 19, 26, 2014		
Mains Conducted Emissions, Class B	15.107, ICES-003	March 19, 2014		
Maximum Permissible Exposure	Reported separately.	April 13, 2014		

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

Jeffrey A. Lenk President

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

Representative of Long Range Systems, LLC

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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 a plastic enclosure with optional 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-7470	None	467.75 MHz paging transmitter		

Table 1.2.2 Other Model(s) Represented by EUT					
Manufacturer Model Serial # Description					
Long Range Systems, LLC*	TX-7470-C232	N/A	467.75 MHz paging transmitter		

^{*}This is a sub-equipped model with same RF characteristics as the EUT but is solely controlled by a serial port. It has no display or keypad.



Photograph 1.3.1: EUT TX-7470

1.3 EUT Operation

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

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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 RS-212, 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.

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2.0 Applicable Documents and Clauses

This device operates on frequencies assigned to the Iridium satellite communication services, as such 47 CFR, Part 25, applies as shown below.

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

Table 2.0.2: Applicable Clauses					
Clause Subject	Section References	Required?	Result		
Conducted Output Power	90.210, 2.1046	Yes	Pass		
Emission Mask	90.210, 2.1047	Yes	Pass		
Conducted Spurious/Harmonic	90.210, 2.1051	Voc	Docc		
Emissions at Antenna Terminals	90.210, 2.1051	Yes	Pass		
Field Strength of Radiated					
Spurious/Harmonic Emissions	90.210, 2.1053	Yes	Pass		
Fundamental to 5 GHz					
Transient Frequency Behavior	90.214, TIA/EIA-603C	Yes	Pass		
Frequency Stability	90.213, 2.1055	Yes	Pass		
Occupied Bandwidth, 20 dB	90.209, 2.1049	Yes	Pass		
Radiated Emissions 30MHz – 6 GHz ¹	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		

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.

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²Exposure is reported in a supplemental document.

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 spectrum analyzer amplitude is offset to compensate for the attenuator calibrated power loss. The connection is direct and no cables are used. Power is then measured directly with no additional calculation required.

3.2 Criteria

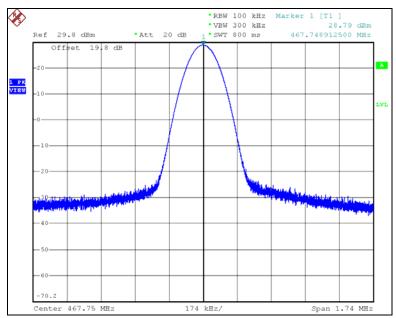
Section Reference	Parameter	Date(s)
90.205, 2.1046	Conducted Output Power	2014-03-20

3.3 Results

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

Table 3.3.1	Table 3.3.1 Equipment List					
Asset # Manufacturer Model # Description Calibration Due						
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29		
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16		

Table 3.3.2 Power, Conducted		
Frequency	Measured Level	
467.750 MHz	28.79 dBm (757 mW)	



Peak Power, Conducted

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4.0 Emission Mask [90.210(d)(1-3)]

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

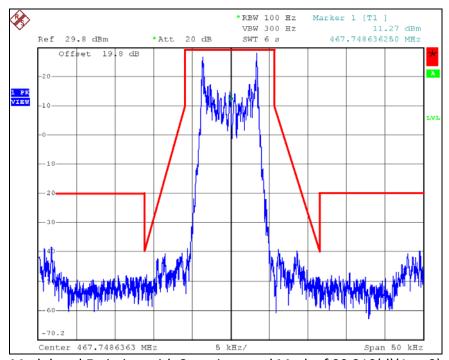
4.2 Criteria

Guideline	Section Number	Date
Emissions at Antenna Terminals	90.210(d)(1-3), 2.1051	2014-03-28

4.3 Results

Table 4.3.1	Table 4.3.1 Equipment List					
Asset # Manufacturer Model # Description Calibrat Due						
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29		
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16		

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



Modulated Emission with Superimposed Mask of 90.210(d)(1 to 3)

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5.0 Spurious Emissions at Antenna Terminals [90.210(e)(3)]

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 spectrum analyzer amplitude is offset to compensate for the attenuator calibrated power loss. 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	90.210(e)(3), 2.1051	2014-03-26
Antenna Terminals	90.210(e)(3), 2.1031	2014-05-20

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 90.210(e)(3) for emissions beyond 4.6 kHz from authorized bandwidth. (Note that paragraph 90.210(e)(3) selected as worse-case criteria for future bandwidth interest as the limit is 5 dB lower than section 90.210(e)(3).)

Per 90.210(e)(3) Attenuation_(dB) = $55 + \text{Log}_{10}(0.757 \text{ W}) = 54.88 \text{ dB}$

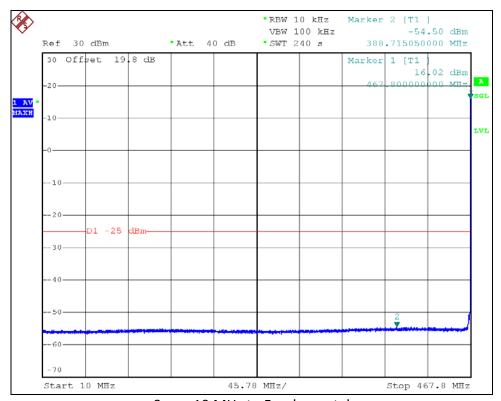
 $Limit_{(dBm)} = Fundamental_Power_{(dBm)} - Attenuation_{(dB)} = 28.79 dBm - 54.88 dB = -26.09 dBm$

5.3 Results

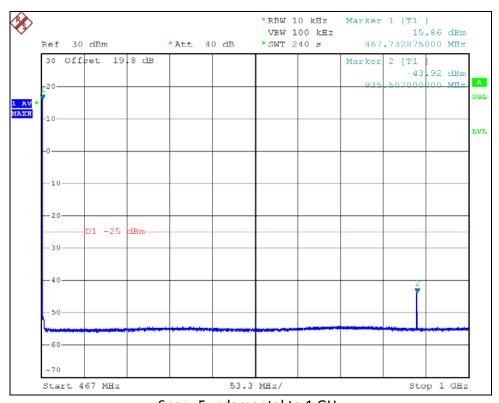
Table 5.3.1	Table 5.3.1 Equipment List									
Asset #	Asset # Manufacturer Model # Description									
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29						
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16						

Highest spurious emission was found to be in excess of 17 dB below the limit. The EUT was found to be in compliance with applicable requirements for both current operating bandwidth and the future operating bandwidth. Plotted results are presented below.

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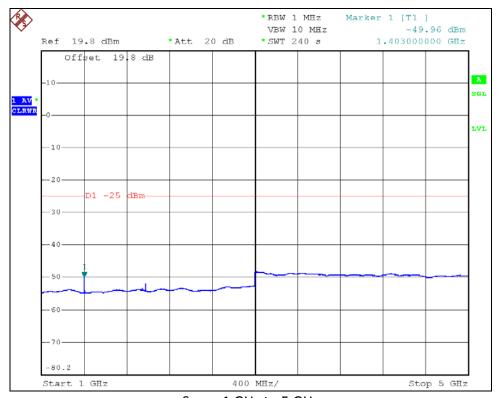


Span: 10 MHz to Fundamental (Fundamental visible on right edge of plot area.) (Red line at -25 dBm, limit is 1.1 dB lower at -26.09 dBm.)



Span: Fundamental to 1 GHz (Fundamental visible on left edge of plot.) (Red line at -25 dBm, limit is 1.1 dB lower at -26.09 dBm.)

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Span: 1 GHz to 5 GHz

(Red line at -25 dBm, limit is 1.1 dB lower at -26.09 dBm.)

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6.0 Field Strength of Radiated Unintentional Emissions – Receive 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 receive 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.

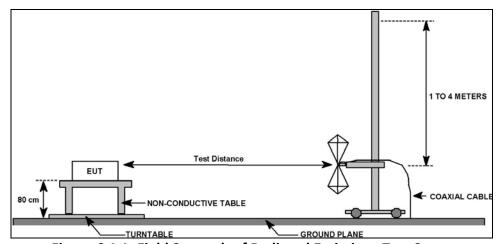


Figure 6.1.1: Field Strength of Radiated Emissions Test Setup

6.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated		
Unintentional Emissions	15.109	2014-03-19
30 MHz to 5 GHz		

6.3 Results

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Table 6.3.1: Equipment List

Professional Testing, EMI, Inc.									
Test Method:			oise Emissions from Low-Voltage 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):	3/19/2014	EUT Serial #:	1						
Customer:	Tenx Precision	EUT Part #:	None						
Project Number:	15689-10	Test Technician:	Larry Fuller						
Purchase Order #:		Supervisor:	Rob McCollough						
Equip. Under Test:	TX-7470	Witness' Name:	Jason Gossiaux						

Radiated Emissions Test Equipment List

Til	Tile! Software Version: 4.2.A, May 23, 2010, 08:38:52 AM								
	Test Profile: Radiated Emissions_Profile Version October 12, 2011								
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date				
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/29/2014				
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015				
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015				
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/29/2014				
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/26/2014				
1327	EMCO	1050	Controller, Antenna Mast	none	N/A				
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A				
1969	НР	11713A	Attenuator/Switch Driver	3748A04113	N/A				
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014				
2004	Miteq	AFS44-00101800- 2S-10P-44	Amplifier, 40dB, .1-18GHz	0	11/19/2014				
C030	N/A	0	Cable Coax, N-N, 30m none		9/26/2014				
Loaner-ETS	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	135203	1/14/2015				
1325	EMCO	1050			N/A				

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Table 6.3.2: Measurement Bandwidth

Professional Testing, EMI, Inc.									
Test Method:	ANSI C63.4–2003: "Metho	ds of Measurement of Radio-N	loise Emissions from Low-Voltage						
rest ivietilou.	Electrical and Electronic Ed	quipment 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):	3/19/2014	EUT Serial #:	1						
Customer:	Tenx Precision	EUT Part #:	None						
Project Number:	15689-10	Test Technician:	Larry Fuller						
Purchase Order #:		Supervisor:	Rob McCollough						
Equip. Under Test:	TX-7470	Witness' Name:	Jason Gossiaux						

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:

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^{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.

(MHz) (Meters) (Degrees) (Meters) Function (dBμV) (dBμV/m) (dBμV multiple (degrees)	Гable 6.3.3	3: Field Str	ength of S	.•	missions, B			Polarity		
Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38). FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits				Protes	sionai re	sting, Er	VII, Inc.			
In accordance with: FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits	Test Metho	d:							_	
Emissions limits	In accordan	co with:					•			
Test Date(s): 3/19/2014 EUT Serial #: 1		Ce with.		nits						
Tenx Precision EUT Part #: None		١.				ELIT Sorial	и.	4		
Test Technician: Larry Fuller Supervisor: Rob McCollough	•):	· ·	ion						
Purchase Order #: Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux		nber:		SIOII .				_	r	
Radiated Emissions Test Results Data Sheet Page: 1 of 1	-		15005 10							
Radiated Emissions Test Results Data Sheet Page: 1 of 1			TX-7470			•		_		
Frequency Test Distance (Meters) Detector (Meters) Test (Meters) Test (Meters) Test (Meters) (Meters) (Meters) Test Te	' '		Radiated Em	nissions Test	Results Data					of 1
Frequency Test Distance (Meters) Detector (Meters) Dete	EUT Li	ne Voltage:	: 12	20 VAC		EUT Pow	er Frequen	cy:	60 Hz	
Test EUT Direction Height (Meters) Detector Function (MHz) Detector (Meters) Direction (Meters) Detector Direction (Meters) Detector Direction (Meters) Detector Direction (Meters) Detector Direction (Meters) Detector	Antenna	Orientatio	n:	Vertic	al	Freque	ency Range:		30MHz to	1GHz
Measured (MHz)		EUT N	lode of Ope	eration:			R	leceive mo	de	
(МНz) (Meters) (Degrees) (Meters) (Овит)	-								_	Test Results
37.9823 10 35 1.61 Quasi-peak 38.8 23.381 29.5 -6.1 Pass 55.2732 10 256 3.74 Quasi-peak 46 25.209 29.5 -4.3 Pass 58.811 10 6 1.99 Quasi-peak 44.4 23.224 29.5 -6.3 Pass 65.3398 10 348 1.66 Quasi-peak 47.3 25.896 29.5 -3.6 Pass 225.01 10 270 1.23 Quasi-peak 44.2 28.644 35.6 -7.0 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Professional Testing and Distance 30MHz - 1GHz Vertical Polarity Measured Emissions 100	(MHz)	(Meters)	(Degrees)	(Meters)	Function	-	(dBµV/m)	(asµv/m)	(as)	
S5.2732 10 256 3.74 Quasi-peak 46 25.209 29.5 -4.3 Pass		10		1.42		36.9	23.332		-6.2	Pass
S8.811 10 6 1.99 Quasi-peak 44.4 23.224 29.5 -6.3 Pass							_			+
10 348 1.66 Quasi-peak 47.3 25.896 29.5 -3.6 Pass							_		_	-
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1 GHz Vertical Polarity Measured Emissions Output Description Output Outpu				7						
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Quasi-peak Limit Level Corrected Quasi-peak Re Peak Limit Level Corrected Peak Value Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions 100 100 100 100 100 100 100 100 100 1			_				_		+	+
Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Corrected Quasi-peak Re Peak Limit Level Corrected Peak Value PROFESSIONAL 100M 1G	225.01	10	270	1.23	Quasi-peak	44.2	28.644	35.6	-7.0	Pass
Field Strength (1987) And the strength of the	Radiated 30MHz -	l Emissions, 10	m Distance	ed Emissions			 	rrected Quasi- k Limit Level	peak Re	SIONAL
10 10 10 10 10 10 10 10 10 10 10 10 10 1	E ‡	M AM. NM		-						
Operator: Larry Fuller 2013 Rad Emissions_ClassB_020414_Run01. DUT Mode: Receive mode 03:12:39 PM, Wednesday, March 19, 2014 EUT Power: 120 VAc 60 Hz EUT: TX-7470 Project Number: 15689-10 EUT Power: 120 VAc 60 Hz Client: Tenx Precision	10 ± 0 0 30 M Operator 2013 Ra	d Emissions_C		Run01.DUT M	ode: Receive mode		Pi	•		1G

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			•	missions, B sional Te		•			
Test Metho	d:		2003: "Metho	ds of Measuren e Range of 9 kH	nent of Radio-	Noise Emissic		_	
In accordan	ce with:	FCC Part 15.		Federal Regulat	ions Part 47, S	Subpart B - Un	intentional I	Radiators, Rad	iated
Section:		15.109					_		
Test Date(s):	3/19/2014			EUT Serial #	# :	1		
Customer:		Tenx Precis	sion		EUT Part #:		None		
Project Nur		15689-10			Test Techni	ician:	Larry Fulle		
Purchase O					Supervisor:		Rob McCo		
quip. Und	er Test:	TX-7470			Witness' Na	ame:	Jason Gos	siaux	
	F	Radiated En	nissions Test	t Results Data	a Sheet		Pa	age: 1	of 1
EUT Li	ne Voltage:	. 1	20 VAC		EUT Pow	er Frequen	cy:	60 Hz	
Antenna	Orientatio	n:	Horizor	ntal	Freque	ency Range:	;	30MHz to	1GHz
	EUT N	lode of Op	eration:			R	eceive mo	de	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Level	Margin (dB)	Test Results
31.0108	10	45	3.71	Quasi-peak	24.2	12.637	29.5	-16.9	Pass
40.3331	10	237	1.26	Quasi-peak	24.7	8.065	29.5	-21.4	Pass
97.7865	10	79	3.94	Quasi-peak	38.1	17.838	33.1	-15.3	Pass
112.893	10	262	3.83	Quasi-peak	38.7	18.166	33.1	-14.9	Pass
225.024	10	57	3.81	Quasi-peak	43.5	27.955	35.6	-7.6	Pass
887.466	10	38	3.53	Quasi-peak	21.4	20.82	35.6	-14.8	Pass
Radiated	ional Testing, 1 Emissions, 10 1 GHz Horizon	m Distance	sured Emissions	· 		 ∇ Co Pea 	asi-peak Limit rrected Quasi- k Limit Level rrected Peak V	peak Re	SIONAL
Field Strength (dBµV/m)					Y				
10#	Markha	A. MARYANA					Mary Mary Mary Mary Mary Mary Mary Mary	into tomp b	▼
2013 Ra		ClassB_020414 ay, March 19, 2	FIIT Do	Frequode: Receive mode wer: 120 VAc 60 l	uency Hz	Pr	UT: TX-7470 roject Number: lient: Tenx Pre		1G
		≤ 1G	Hz Horizont	tal Antenna P	olarity Mea	sured Emis	sions		

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			Profess	sional Te	sting, El	VII, Inc.			
Test Metho	od:			ds of Measure e Range of 9 kH				_	
n accordai	nce with:	FCC Part 15.2 Emissions Lir		ederal Regula	tions Part 47, 9	Subpart B - Ur	intentional R	adiators, Rad	iated
Section:	•	15.109			I		<u>r.</u>		
Test Date(s	s):	3/19/2014	.•		EUT Serial		1		
Customer: Project Nu	mh a ri	Tenx Precis 15689-10	sion		EUT Part #:		None		
urchase C		12093-10			Test Techni Supervisor:		Larry Fulle Rob McCo		
quip. Und		TX-7470			Witness' N		Jason Gos		
quip. Onu			nissions Test	: Results Dat	<u>.</u>	arrie.		ige: 1	of 1
EUT L	ine Voltage:	: 1	20 VAC		EUT Pow	ver Frequen		50 Hz	
Antenna	a Orientatio	n:	Vertic	al	Frequ	ency Range:	:	Above 1	GHz
	EUT N	lode of Ope	eration:			R	eceive mod	de	
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
1229.3	3	22	1	Average	33.8	21.385	54.0	-32.6	Pass
1322.3	3	53	1	Average	34.1	21.592	54.0	-32.4	Pass
2268.85	3	349	1	Average	35.1	26.252	54.0	-27.7	Pass
3194.61	3	13	1	Average	34	26.505	54.0	-27.5	Pass
5275.43	3	85	1	Average	32.2	28.757	54.0	-25.2	Pass
5683.38	3	179	1	Average	31.8	29.751	54.0	-24.2	Pass
Radiate 1-6GHz ∄	sional Testing, d Emissions, 3n Vertical Polarity	n Distance	ssio ns			 ∇ Co Pea 	erage Limit Le rrected Averag k Limit Level rrected Peak Re	e Readi	SIONAL
85 — (a) 75 ——									
Field Strength (dBµV/r									
⊕ ∰ 55									
## 45 —									
d St			1	The second se	والمرابع الماما المرابع والمرابع والمرابع	on the same of the same of the same of	Athern John Committee of the	and at the market of the state of	
를 35 	بغيبانيم بالتحياب البريميانييان				en de grange de production de la communicación de la communicación de la communicación de la communicación de l	the first of the party of the first of the f		7	abla
		▽		<u> </u>		— Y — —		'	
25 🚪 —	V								
25	Y								6G

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Wireless Certification Report for the TX-7470 by Long Range Systems, LLC Field Strength of Spurious Emissions, 1 GHz to 5 GHz, Horizontal Polarity

			Profess	sional Te	sting, EN	VII, Inc.				
Test Metho	od:			ds of Measure e Range of 9 kH					•	
n accorda	nce with:	FCC Part 15.2 Emissions Lir		ederal Regula	tions Part 47, S	Subpart B - Ur	nintention	nal Rad	iators, Rad	iated
Section:		15.109					_			
Test Date(s):	3/19/2014			EUT Serial		1			
Customer:		Tenx Precis	sion		EUT Part #:	:	None			
Project Nu		15689-10			Test Techni		Larry Fu			
Purchase C		<u></u>			Supervisor:		Rob Mo			
quip. Und	ler Test:	TX-7470			Witness' N	ame:	Jason G	Gossia	ux	
	F	Radiated Em	issions Test	Results Dat	a Sheet			Page	: 1	of 1
EUT L	ine Voltage	: 1	20 VAC		EUT Pow	er Frequen	су:	60	Hz	
Antenn	a Orientatio	n:	Horizon	ntal	Freque	ency Range			Above 1	GHz
	EUT N	/lode of Ope	eration:			R	eceive r	mode		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Le		Margin (dB)	Test Result
1324.48	3	178	1	Average	34.7	22.204	54.0)	-31.8	Pass
2263.67	3	258	1	Average	34.7	25.801	54.0)	-28.2	Pass
3210.49	3	201	1	Average	34.3	26.724	54.0)	-27.2	Pass
4235.28	3	136	1	Average	33.8	28.42	54.0)	-25.5	Pass
5281.82	3	45	1	Average	32.2	28.727	54.0)	-25.2	Pass
5666.49	3	351	1	Average	31.8	29.619	54.0)	-24.3	Pass
Radiate	sional Testing, ed Emissions, 31 Horizontal Pola	n Distance	missions	L		 ∇ Co Pea 	erage Limi rrected Avo k Limit Le rrected Pea	erage Re evel		SIONAL
<u>a</u> 75										
Field Strength (dBµV)								na eta Albakira	مخدد المراب والمراب والمراب	- In a state of the state of th
Field 35	an in the first of the first blass				the last banks and the state of			∇		▽
25 -						_				
15 1G Operato	or: Larry Fuller			Freq	uency	E	UT: TX-74	170		6G
			D A4 ESTITUTE A	ode: Receive modo		TO.	roject Num	1 15/	00.10	

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7.0 Field Strength of Radiated Spurious Emissions – Transmit Mode [90.210(d)]

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.

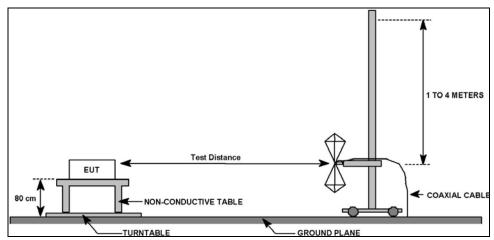


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

7.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated		
Spurious/Harmonic Emissions	90.210(d)	2014-03-24
Fundamental to 5 GHz		

7.3 Results

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Table 7.3.1: Equipment List

Table 7.5.	L: Equipment	LIST				
		Profes	sional Te	esting, EMI, Inc.		
Test Method	٦٠			surement of Radio-Noise in the Range of 9 kHz to		_
47 CFR Part 90 In accordance with:						
Section:	90.2	10				
Test Date(s)	: 3/2	5/2014		EUT Serial #:	1	
Customer:		x Precision		EUT Part #:	None	
Project Num	nber: 156	89-10		Test Technician:	Eric Lifsey	
Purchase Or				Supervisor:	Rob McCollough	
Equip. Unde	er Test: TX-7	7470		Witness' Name:	Jason Gossiaux	
		Radiate	ed Emissions	Test Equipment List		
Til	e! Software Vers		• •	.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	E4440A	Spectrum A	nalyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015
1926	ETS-Lindgren	3142D	Antenna, Bi	conilog, 26 MHz - 6 GHz	00135454	7/29/2014
C027	N/A	RG214	Cable	e Coax, N-N, 25m	none	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
1509B	Braden	N/A	TDK 10M C	hamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014

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Amplifier, 40dB, .1-18GHz

Cable Coax, N-N, 30m

Antenna, Double Ridged Guide

Horn, 1 - 18 GHz

Controller, Antenna Mast

0

none

135203

9003-1461

11/19/2014

9/26/2014

1/14/2015

N/A

AFS44-00101800-

2S-10P-44

0

3117

1050

2004

C030

Loaner-ETS

1325

Miteq

N/A

ETS-Lindgren

EMCO

Table 7.3.2: Measurement Bandwidth

	Professi	ional Testing, EMI, Inc	c.
Test Method:			loise Emissions from Low-Voltage z to 40 GHz" (incorporated by reference,
In accordance with:	47 CFR Part 90		
Section:	90.210		
Test Date(s):	3/26/2014	EUT Serial #:	1
Customer:	Tenx Precision	EUT Part #:	None
Project Number:	15689-10	Test Technician:	Eric Lifsey
Purchase Order #:		Supervisor:	Rob McCollough
Equip. Under Test:	TX-7470	Witness' Name:	Jason Gossiaux

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:

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^{1.} The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.

^{2.} The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.

^{3.} The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

^{4.} The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.

^{5.} The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

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

			Profes	sional Te	sting, EN	/II, Inc.					
Test Metho	d:		3.4–2003: "Met I and Electronic							_	ence,
In accordan	ce with:	47 CFR P	art 90								
Section:		90.210									
Test Date(s)	:	3/26/20	14		EUT Serial #:		1				
Customer:		Tenx Pre	cision		EUT Part #:		None				
Project Nun	nber:	15689-10)		Test Technic	ian:	Eric Lif				
Purchase O	rder #:				Supervisor:		Rob M	cCollough	1		
Equip. Und	er Test:	TX-7470			Witness' Na	me:	Jason (Gossiaux			
	R	Radiated	Emissions Test	Results Dat	a Sheet			Page:	1	of	1
EUT L	ne Voltage:		120 VAC		EUT Pow	er Frequen	су:	60	Hz		
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range		301	MHz to	1GHz	
	EUT N	lode of C	peration:			Tı	ransmi	t mode			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees	- 0	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit l (dBµV		/largin (dB)	Test Re	sult
935.495	10	170	2.96	Peak	47.6	47.6	59.	8 -	-12.2	Pas	SS
30MHz 110 Strength (dB LV/m) 100 100 100 100 100 100 100 100 100 100	or: Eric Lifse	ey 020414_Ru	n01_retest.FLIT	1(Iode: Transpri	DOM		EUT: TY	Number: 1	5689-15	SSIONAL WARREN TO THE PARTY OF	WR.
07:56:2	7 AM, Wedne	esday, Mar	ch 26, 201 HPF:	ower: 120 VAc F N001	160 Hz			Tenx Preci			

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Wireless Certification Report for the TX-7470 by Long Range Systems, LLC **Table 7.3.4: Field Strength of Spurious Emissions. Below 1 GHz. Horizontal Polarity**

			Profes	sional Te	sting, EN	/II, Inc.					
Test Metho	d:			hods of Meas Equipment i						•	ence
In accordan	ce with:	47 CFR Pa	t 90								
Section:		90.210									
Test Date(s)	:	3/26/2014			EUT Serial #:		1				
Customer:		Tenx Preci	sion		EUT Part #:		None				
Project Nun	nber:	15689-10			Test Technic		Eric Lifs	•			
Purchase O					Supervisor:		Rob Mc		1		
Equip. Unde	er Test:	TX-7470			Witness' Na	me:	Jason G	ossiaux			
	F	Radiated Er	nissions Test	Results Dat	a Sheet			Page:	1	of	1
EUT Li	ne Voltage	: 1	20 VAC		EUT Pow	er Frequen	су:	60	Hz		
Antenna	Orientation	n:	Horizor	ital	Freque	ency Range:		30	MHz to	1GHz	
	EUT N	lode of Op	eration:			Tı	ransmit	mode		•	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Le		/largin (dB)	Test R	esult
935.496	10	268	1.71	Peak	47.6	47.6	59.8	3	-12.2	Pa	SS
Profe Radiate 30MHz	essional Test ed Emissions, a - 1GHz Hor	sting, EM l 10m Distance izontal Pola	, Inc	Emissions	— N	Corrected Qua Corrected Pea MARKER_CO MARKER_SP	NDUCTE	D FUND	_PWR	PROFESSIONAL	2
Field Strength (dB µV/m) Field Strength (dB µV/m) 100 100 100 100 100 100 100 1	or: Eric Lifs	ey 020414 Run0	1 retest.FUT M	10 Iode: Transmit	10M		EUT: TX-		.5689-15	16	1

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Wireless Certification Report for the TX-7470 by Long Range Systems, LLC **Table 7.3.5: Field Strength of Spurious Emissions. 1 GHz to 5 GHz. Vertical Polarity**

Section: 90.210 Test Date(s): 3/26/2014 EUT Serial #: 1 Customer: Tenx Precision Project Number: 15689-10 Purchase Order #: Supervisor: Rob McCollough Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Frequency Measured Distance (Meters) Distance (Meters) Under Test Distance (Meters) Distance (Met					Profes	sional Te	sting, EN	/II, Inc.					
In accordance with: Section: 90.210 Test Date(s): 3/26/2014 EUT Serial #: 1 Customer: Tenx Precision EUT Part #: None Project Number: 15689-10 Test Technician: Eric Lifsey Purchase Order #: Supervisor: Rob McCollough Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test EUT Antenna Height (MHz) (Degrees) (Meters) Direction Height (Meters) Punction (Meters) (Degrees) (Meters) 1403 3 22 1 Peak 59 59 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions. 3m Distance 1-6GHz Vertical Polarity Measured Emissions Corrected Average Corrected Peak Rea Cor	Test Metho	ıd:										_	ence
Section: 90.210 Test Date(s): 3/26/2014 EUT Serial #: 1 Customer: Tenx Precision Project Number: 15689-10 Purchase Order #: Supervisor: Rob McCollough Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Frequency Measured Distance (Meters) Distance (Meters) Under Test Distance (Meters) Distance (Met	n accordan	nce with:						<u> </u>	<u></u>	(,	
Customer: Tenx Precision EUT Part #: None Project Number: 15689-10 Test Technician: Eric Lifsey Purchase Order #: Supervisor: Rob McCollough Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test Measured Distance (MHz) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees)			90.210)									
Project Number: 15689-10 Test Technician: Eric Lifsey Purchase Order #: Supervisor: Rob McCollough Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test EUT Antenna Distance (Meters) Distance (Meters) Distance (Meters) (Degrees) (Meters) Peak 59 59 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions 3m Distance 1-6GHz Vertical Polarity Measured Emissions Corrected Average Corrected Peak Reacons	Test Date(s):	3/26/2	2014			EUT Serial #:		1				
Purchase Order #: Equip. Under Test: TX-7470 Witness' Name: Jason Gossiaux Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test Distance (MHz) Direction (MHz) (Meters) Direction (MHz) (Meters) (Meters) (Meters) 1403 3 22 1 Peak 59 59 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Emissions Orientation: Vertical Frequency Range: Above 1GHz Transmit mode Corrected Amplitude (dBµV)m) (dB) Corrected Applitude (dBµV)m) (dB) Corrected Average Corrected Average Corrected Peak Read Peak Peak Peak Peak Peak Peak Peak Peak	Customer:		Tenx P	recisio	on		EUT Part #:		None				
Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Measured (MHz) Distance (Meters) (Degrees) (Meters) (Degrees) (Meters) Peak 59 59 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions 3 Distance 1-6GHz Vertical Polarity Measured Emissions Recorded Amplitude (dBμV/m)	Project Nur	nber:	15689-	-10			Test Technic	ian:	Eric Life	sey			
Radiated Emissions Test Results Data Sheet Page: 1 of 1 EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test Direction (Meters) Direction (Meters) (Degrees) (Meters) Peak Margin (Meters) (Meters) Peak S9 S9 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions Am Distance 1-GGHz Vertical Polarity Measured Emissions Orrected Average Peak Read Professional Testing (Meters) Peak Read Professional	Purchase O	rder #:					Supervisor:		Rob M	cCollou	gh		
EUT Line Voltage: 120 VAC EUT Power Frequency: 60 Hz Antenna Orientation: Vertical Frequency Range: Above 1GHz EUT Mode of Operation: Transmit mode Frequency Test Measured Distance (MHz) (Degrees) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Degree	Equip. Und	er Test:	TX-747	70			Witness' Na	me:	Jason (Gossiau	х		
Antenna Orientation: Vertical Frequency Range: Above 1GHz		R	Radiate	d Emi	ssions Test	Results Dat	a Sheet			Page	: 1	of	1
EUT Mode of Operation: Transmit mode Frequency Measured Distance (MHz) (Meters) (Degrees) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meter	EUT L	ine Voltage:		120	VAC		EUT Pow	er Frequen	icy:	60	Hz		
Frequency Test Distance Objection Height (Meters) Direction (Meters) Direction (Meters) Direction (Meters) Direction (Meters) Direction (Meters) Peak 59 59 70.2 -11.2 Pass Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Emissions Objector Function (Meters) Peak 59 59 70.2 -11.2 Pass Corrected Average Corrected Peak Rea Professional Testing, EMI, Inc Radiated Emissions Objector Function (Meters) Peak 59 59 70.2 -11.2 Pass Corrected Average Corrected Peak Rea Professional Testing, EMI, Inc Radiated Emissions Objector Function (Meters) Peak 59 59 70.2 -11.2 Pass Objector Function (Meters) Peak 59 59 70.2 -11.2 Pass	Antenn	a Orientatio	n:		Vertica	al	Freque	ency Range			Above 1	GHz	
Measured (MHz) Distance (Meters) Direction (Meters) Height (Meters) Function (MBμV) (MBμV/m) Margin (MBμV		EUT M	lode of	f Oper	ation:			Tı	ransmi	t mode			
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Emissions Corrected Peak Read Professional 15 C	Measured	Distance	Directi	ion	Height		Amplitude	Level	_		_	Test Re	esult
1-6GHz Vertical Polarity Measured Emissions Corrected Peak Read Professional September 155 15	1403	3	22		1	Peak	59	59	70.	.2	-11.2	Pas	S
Operator: Eric Lifsey 2013 Rad Emissions_020414_Run01_retest_Ell[InAtoide: Transmittmode	1-6GH (m/N dB dV/m) 35 45 45	essional Tes ed Emissions, z Vertical Pol	sting, E 3m Distan larity M	EMI, I	d Emissions								

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Wireless Certification Report for the TX-7470 by Long Range Systems, LLC **Table 7.3.6: Field Strength of Spurious Emissions, 1 GHz to 5 GHz, Horizontal Polarity**

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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	2014-03-19

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8.3 Results

ı. ANSI (Profes	sional Testing, EMI, Inc.		
. ANSI (5.6.1.d. 1.654.1.g, 2.11.1, 11.16.		
	C63.4-2009: Meth	ods of Measurement of Radio-Noise	Emissions from Lov	w-Voltage
Electr				
	art 15.107 - Code	of Federal Regulations Part 47, Subp	art B - Unintention	al Radiators,
		mits		
			_	
	-10			
	70	Witness' Name:		
		ed Emissions Test Equipment List		
e! Software Versio	n: 4.1.A	.0, April 14, 2009, 11:01:00PM		
Test Profile:	Profi	e#: CE_2010.til, dated December 16	, 2010	
Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
НР	8568B	Spectrum Analyzer	2732A03633	5/17/2014
НР	85662A	Spec Anal Dsply for AN1842	2816A16413	N/A
НР	85685A	RF Preselector	3010A01119	8/29/2014
НР	85650A	Quasi Peak Adapter	2043A00063	6/5/2014
PTI	100k HPF	Filter, High Pass, 100kHz	none	10/30/2014
PTI	PTI-ALF3	Attenuator Limiter Filter	none	5/6/2014
Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	7/10/2014
Pomona	RG-223	Cable 5.5 ft BNC RG-223 (black)	none	7/10/2014
EMCO	3825/2	LISN, 10kHz-100MHz	9603-2521	10/31/2014
C109 HP		Cable 19 inch BNC (grey)	none	7/10/2014
EMCO	2025/2		1225	10/31/2014
	Electr FCC P Ee with: Condu 15.10 S 3/19/ Tenx I ber: 15689 der #: r Test: TX-74 e! Software Version Test Profile: HP HP HP HP HP PTI PTI Pomona Pomona EMCO	Electrical and Electronic FCC Part 15.107 - Code te with: Conducted Emissions Li 15.107 : 3/19/2014 Tenx Precision ber: 15689-10 der #: r Test: TX-7470 Conduct el Software Version: 4.1.A Test Profile: Profil Manufacturer Model HP 8568B HP 85662A HP 85662A HP 85660A HP 85685A HP 85650A PTI 100k HPF PTI PTI-ALF3 Pomona RG-223 Pomona RG-223 EMCO 3825/2 HP none	Electrical and Electronic Equipment in the Range of 9 kHz to FCC Part 15.107 - Code of Federal Regulations Part 47, Subp te with: Conducted Emissions Limits 15.107 By 3/19/2014 EUT Serial #: Tenx Precision EUT Part #: Ber: 15689-10 Test Technician: Ber: Supervisor: Test: TX-7470 Witness' Name: Conducted Emissions Test Equipment List Ele Software Version: 4.1.A.0, April 14, 2009, 11:01:00PM Test Profile: Profile#: CE_2010.til, dated December 16, Manufacturer Model Equipment Nomenclature HP 8568B Spectrum Analyzer HP 85662A Spec Anal Dsply for AN1842 HP 85662A RF Preselector HP 85650A Quasi Peak Adapter PTI 100k HPF Filter, High Pass, 100kHz PTI PTI-ALF3 Attenuator Limiter Filter Pomona RG-223 Cable 9 ft BNC RG-223 (black) Pomona RG-223 Cable 5.5 ft BNC RG-223 (black) EMCO 3825/2 LISN, 10kHz-100MHz HP none Cable 19 inch BNC (grey)	Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporal FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentions to the with: Conducted Emissions Limits 15.107

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Table 8.3.2: Mains Conducted Emissions, Measurement Bandwidths

	Profession	onal Testing, EMI, Inc	2.					
Test Method:	ANSI C63.4–2009: Methods	s of Measurement of Radio-No	ise Emissions from Low-Voltage					
rest ivictiou.	Electrical and Electronic Ec	quipment in the Range of 9 kH	z to 40 GHz (incorporated by reference,					
	FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators,							
In accordance with:	with: Conducted Emissions Limits							
Section:	15.107							
Test Date(s):	3/19/2014	EUT Serial #:	1					
Customer:	Tenx Precision	EUT Part #:	None					
Project Number:	15689-10	Test Technician:	Larry Fuller					
Purchase Order #:		Supervisor:	Rob McCollough					
Equip. Under Test:	TX-7470	Witness' Name:	Jason Gossiaux					

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:

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^{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.

 $^{3.\,} The\ measurement\ receiver\ resolution\ bandwidth\ setting\ was\ 9\ kHz\ for\ quasi-peak\ measurements\ from\ 0.15-30\ MHz.$

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

Table 8.3.3	3: Mains C	Conducted			fication Repo ine	ort for the T	X-7470 by L	ong Range S	ystems, LLO
			Profess	sional Te	esting, EN	ЛI, Inc.			
Test Metho	d:				ent of Radio-No z (incorporated			age Electrical a	nd Electronic
In accordan	ce with:	FCC Part 15.10 Limits	07 - Code of Fe	deral Regulation	ons Part 47, Su	bpart B - Unin	tentional Radia	tors, Conducte	d Emissions
Section:		15.107							
Test Date(s)):	3/19/2014			EUT Serial #	:	1		
Customer:		Tenx Precisi	on		EUT Part #:		None		
Project Num		15689-10			Test Technic	cian:	Larry Fuller		
Purchase O		TV 7470			Supervisor:		Rob McColl		
Equip. Unde	er Test:	TX-7470			Witness' Na	me:	Jason Gossi	aux	
	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
0.41796	46.8	46.5	57.5	-11	PASS	45.3	47.5	-2.2	PASS
0.43759	47.8	47.6	57.1	-9.5	PASS	46.4	47.1	-0.7	PASS
0.43763	47.9	47.6	57.1	-9.5	PASS	46.5	47.1	-0.6	PASS
0.500019	38.4	37.9	56	-18.1	PASS	36.7	46	-9.3	PASS
0.9223	37.4	37	56	-19	PASS	35.7	46	-10.3	PASS
1.2866	36.6	36.4	56	-19.6	PASS	35	46	-11	PASS
20.3943	42.2	39.5	60	-20.5	PASS	33.3	50	-16.7	PASS
20.4003	43.2 41.9	38.6 38.6	60 60	-21.4 -21.4	PASS PASS	32 32.9	50 50	-18 -17.1	PASS PASS
21.4028	42.1	37.8	60	-22.2	PASS	32.1	50	-17.9	PASS
PROFESSIONA	⊒ E AL				sting, EMI, I s 150kHz to 30M		Company: - Ten Model#: - TX-74 Description - Project #: - 1568 Voltage/Freq: - 1 Additional Equip	70 9-10 20 VAc60 Hz	
80									
70 -	 								
€ 60									
(ag 50		₩ Ŷ							
(And G) 50 - 40 - 40 - 40 - 40 - 40 - 40 - 40 -						WWW	Mary Mary Mary	TIL TIL THE	er gett der Pettendig
0 -	· '				F 7				
-10 150	0K	1 11	1	M		<u> </u>	10M	Щ	30M
					P		- Average Lim	it	2 3 111

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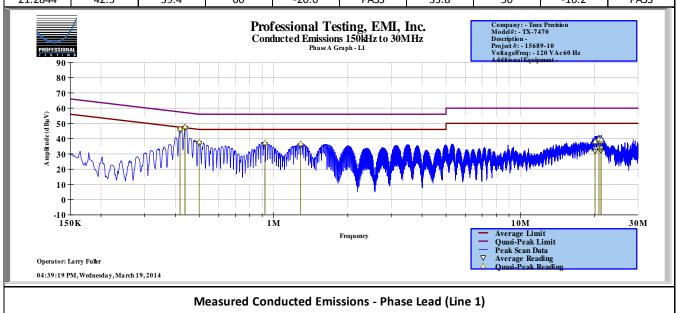
Measured Conducted Emissions - Neutral Lead

Frequency

Operator: Larry Fuller

04:17:54 PM, Wednesday, March 19, 2014

Wireless Certification Report for the TX-7470 by Long Range Systems, LLC Fable 8.3.4: Mains Conducted Emissions, Phase Line									
			Profes	sional Te	esting, EN	VII, Inc.			
Test Method: ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).							nd Electronic		
In accordan	ce with:	FCC Part 15.10 Limits	07 - Code of Fe	deral Regulati	ons Part 47, Su	bpart B - Unin	tentional Radia	itors, Conducte	d Emissions
Section:		15.107							
Test Date(s)	:	3/19/2014			EUT Serial #	:	1		
Customer:		Tenx Precisi	on		EUT Part #:		None		
Project Nun	nber:	15689-10			Test Technic	cian:	Larry Fuller		
Purchase O	rder #:				Supervisor:		Rob McColl	ough	
Equip. Unde	er Test:	TX-7470			Witness' Na	me:	Jason Gossi	aux	
Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) Page: 2 of 2									
EU	T Line Volta	ge:	120	VAC	EUT Line Frequency:		60	Hz	
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.4185	47.1	46.6	57.5	-10.9	PASS	45.3	47.5	-2.1	PASS
0.43801	48.1	47.9	57.1	-9.2	PASS	46.9	47.1	-0.2	PASS
0.43828	48.2	47.9	57.1	-9.2	PASS	46.8	47.1	-0.3	PASS
0.500045	38.5	38	56	-18	PASS	36.9	46	-9.1	PASS
0.9231	37.7	37.5	56	-18.5	PASS	36.3	46	-9.7	PASS
1.2879	37	36.8	56	-19.2	PASS	35.4	46	-10.6	PASS
20.1039	41.5	38.2	60	-21.8	PASS	31.6	50	-18.4	PASS
20.82	42.7	39.7	60	-20.3	PASS	33.8	50	-16.2	PASS
21.254	42.7	38.5	60	-21.5	PASS	32	50	-18	PASS
21.2844	42.5	39.4	60	-20.6	PASS	33.8	50	-16.2	PASS
Professional Testing, EMI, Inc. Conducted Emissions 150kHz to 30MHz Phase A Graph · L1 Phase A Graph · L1 Company: - Tenx Precision Model#: - IX-7470 Description - Project #: - 15689-10 Voltagefreq: - 120 VAc60 Hz Additional Equipment -									
80									



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9.0 Frequency Stability [90.213]

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 \pm 5 ppm of the assigned channel.

9.3 Results

Table 9.3.1 Equipment List						
Asset #	Manufacturer	nrer Model # Description		Calibration Due		
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29		
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16		
2087	Fluke	189	DMM	2015-03-06		
0428	Powerstat	146	Variac, 120V 30A	Not Required		
	Tenny		Temperature Chamber	2014-11-19		

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	<u> </u>						
Professional Testing, EMI, Inc.							
TIA-603-C-2004 Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards						nt and	
Section:	3	.2.2 [FCC 2.1055(a)(1)]		EUT Typical (Operation Mode: 0	Continuous	
Test Date(s):		/21/2014		EUT Serial #:	N	lone	
Customer:	Т	enx Precision (for LRS)		EUT Part #:	N	lone	
Project Numb	er: 1	5689-15		Test Technic	ian: E	ric Lifsey	
Purchase Orde	er#: N	I/A		Supervisor	R	ob McCollough	
Equipment Un	der Test: 7	470		Witness' Nar	ne: J	ustin Gossiaux	
Mobile Criteri	a: +/- 5 ppm						
Condition		Frequency			Deviation	Soak	Time
Temperature (C)	Reference Frequency (MHz)	Measured Frequency (MHz)		lculated ation (Hz)	Calculated Deviation (ppm)	Power-Off (min)	Power-On (min)
-30	467.750000	467.749341250	-658.	750000014	-1.408337787	20	12
-20	467.750000	467.750612750	612.7	750000016	1.309994655	20	7
-10	467.750000	467.750989625	989.6	524999988	2.115713522	20	6
0	467.750000	467.750830625	830.6	524999992	1.775788348	20	7
10	467.750000	467.750299250	299.2	250000012	0.639764832	20	9
20	467.750000	467.749843250	-156.	749999974	-0.335114912	20	11
30	467.750000	467.749604750	-395.	249999997	-0.845002672	20	8
40	467.750000	467.749596100	-403.	899999981	-0.863495457	20	6
50	467.750000	467.750307500	307.5	500000019	0.657402459	20	11
Condition		Frequency			Deviation	Vol	tage
Voltage Extreme	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)		Calculated Deviation (ppm)	Measured Voltage (V AC)	
-15%	467.750000	467.749688000	-312.	80000000	-0.667022982	97	.61
Nominal	467.750000	467.749642250	-357.	749999978	-0.764831641	115	5.00
+15%	467.750000	467.749625375			-0.800908605	0908605 143.95	

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

Final tolerance displayed was +/- 1.77 ppm.

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10.0 Transmit Transient [90.214]

The EUT was tested for transient frequency behavior using the test method outlined in TIA/EIA-603C paragraph 2.2.19.3 Alternate Method of Measurement (Using a Test Receiver). The 12.5 kHz requirement applies.

10.1 Procedure

Refer to diagram of TIA-603-C page 99 and the procedure of 2.2.19.3.

The EUT is terminated in a resistive attenuator of 20 dB with the output connected to a forward power coupler. The coupler forward output (-10 dB) is run through a detector diode then to the trigger input port of a digital oscilloscope. The RF pass-through output of the coupler is then run to a 3 port resistive power combining network; the #2 port of the combiner is connected to the output of a RF signal generator, the #3 port is used as output and connected to a test receiver (modulation analyzer). The detected output of the modulation analyzer is connected to the vertical input of the digital oscilloscope.

The RF generator is set to the fundamental operating frequency, set to modulate with a 1 kHz tone at +/-25 kHz FM deviation, and at a relatively low but usable level where the modulation analyzer is able to demodulate the signal. The modulation analyzer is configured to use the high and low pass filter settings as called out in the TIA-603-C procedure. The modulation analyzer is then dialed via front panel keypad to the fundamental operating frequency for best sensitivity.

The transmitter is keyed as needed and adjustments are made to the instruments to trigger appropriately and render the measurement as required by the TIA-603-C standard. The essential technique is the signal generator provides a reference frequency captured by the modulation analyzer. When the EUT is keyed, at many dB above the signal generator level, the modulation analyzer locks to the EUT signal and deviation from center frequency can be observed and recorded on the digital oscilloscope.

10.2 Criteria

Transmitters for 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

	Maximum	All equ	ipment		
Time intervals ^{1,2}	frequency difference ³	150 to 174 MHz	421 to 512 MHz		
Transient Frequ	ency Behavior for Equi	pment Designed to Operate on 25	kHz Channels		
${t_1}^4$	±25.0 kHz	5.0 ms	10.0 ms		
t_2	±12.5 kHz	20.0 ms	25.0 ms		
t_3^4	±25.0 kHz	5.0 ms	10.0 ms		
Transient Freque	ency Behavior for Equip	oment Designed to Operate on 12.5	5 kHz Channels		
${\mathsf t_1}^4$	±12.5 kHz	5.0 ms	10.0 ms		
t_2	±6.25 kHz	20.0 ms	25.0 ms		
t_3^4	±12.5 kHz	5.0 ms	10.0 ms		
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels					
t_1^4	±6.25 kHz	5.0 ms	10.0 ms		

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t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3^4	±6.25 kHz	5.0 ms	10.0 ms

¹_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t₃ is the time period from the instant when the transmitter is turned off until t_{off}.

t_{off} is the instant when the 1 kHz test signal starts to rise.

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 t_1 is the time period immediately following t_{on} .

 t_2 is the time period immediately following t_1 .

²During the time from the end of t_2 to the beginning of t_3 , the frequency difference must not exceed the limits specified in §90.213.

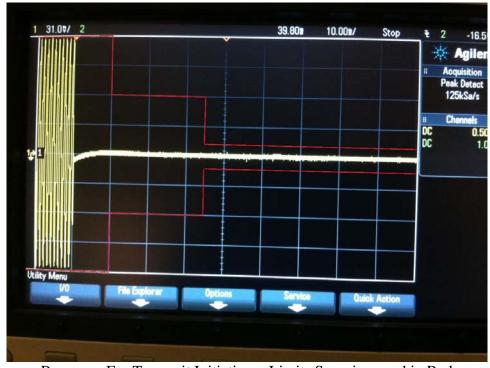
³Difference between the actual transmitter frequency and the assigned transmitter frequency.

⁴If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

10.3 Results

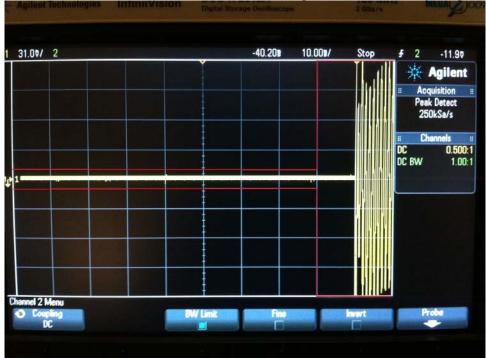
Transient frequency behavior was found to be in compliance with applicable requirements.

Table 9.3.1 Equipment List						
Asset #	Manufacturer	Model #	Model # Description			
1924	Agilent	DSO X-2012	Oscilloscope, Digital	2015-06-11		
0718	HP	8656A	Signal Generator	2014-09-18		
0637	НР	8901A	Modulation Analyzer	Not Required		
0835	Narda	3293-1	Forward Power Coupler	Not Required		
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16		
A100	Narda	94455-1	Diode Detector	Not Required		



Response For Transmit Initiation – Limits Superimposed in Red

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Response For Transmit Cessation – Limits Superimposed in Red

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11.0 Emission Bandwidth [90.210(d)]

11.1 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.

11.2 Criteria

Clause Requirement	Section Number	Date
90.210(d) Bandwidth < 12. 5 kHz	90.210(d)(1), 2.1051	2014-03-20

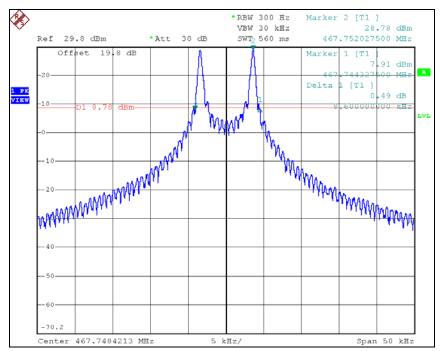
11.3 Results

Table 11.3.1 Equipment List						
Asset #	Manufacturer	Model #	Model # Description			
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29		
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2014-04-16		

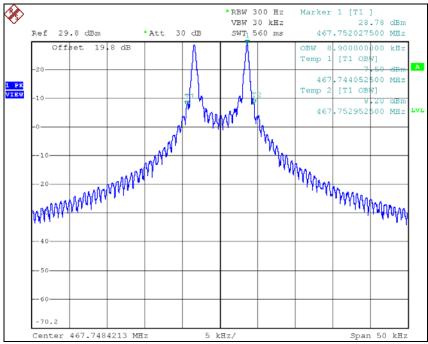
Table 11.3.2 Bandwidth					
Bandwidth Measurement Method	Measured Bandwidth				
20 dB	8.6 kHz				
OBW Instrument Measurement	8.9 kHz				

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

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Bandwidth, 20 dB, 8.6 kHz



Bandwidth, OBW 8.9 kHz

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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.

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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 Emissions	1 to 18 GHz	3 m	5.7

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End of Report

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