1601 North A.W. Grimes Blvd., Suite B
Round Rock, TX 78665
e-mail: info@ptitest.com
(512) 244-3371 Fax: (512) 244-1846

April 16, 2015

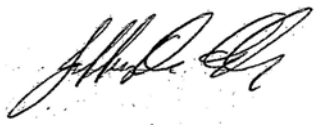
John Weber
Long Range Systems, LLC
4550 Excel Parkway Suite 200
Addison TX 75001

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 the requirements for wireless devices in North America.

If you have any questions, please contact me.

Sincerely,



Jeffrey A. Lenk
President

Attachment

Project 16332-15

TX-7470
LRS Paging Transmitter

Wireless Certification Report
Full Band Coverage

Prepared for:

Long Range Systems, LLC

By

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

April 16, 2015

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft for review.	April 15, 2015
01	Revised per internal and client review.	April 16, 2015

Table of Contents

Certificate of Compliance

Applicant	Device & Test Identification	
Long Range Systems LLC (John Weber)	FCC ID:	2AB6OTX7470
4550 Excel Parkway Suite 200	Industry Canada ID:	5501A-TX7470
Addison TX 75001	Model(s):	TX-7470, TX-7470-C232
Certificate Date: April 16, 2015	Laboratory Project ID:	16332-15

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)	
Section Reference FCC | IC	**Parameter**
90.210, 2.1046 | RSS 119 Issue 11, 5.4	Conducted Output Power
90.210, 2.1047| RSS 119 Issue 11, 5.8.3	Emission Mask D
90.210, 2.1051 | RSS 119 Issue 11, 5.8; RSS-Gen Issue 4	Conducted Spurious/Harmonic Emissions at Antenna Terminals
90.210, 2.1053 | RSS 119 Issue 11, 5.8	Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz
90.214, TIA/EIA-603C | RSS 119 Issue 11, 5.9	Transient Frequency Behavior
90.213, 2.1055 | RSS 119 Issue 11, 5.3	Frequency Stability
90.209, 2.1049 | RSS 119 Issue 11, 5.5	Occupied Bandwidth, 20 dB, < 11.5 kHz
15.109| RSS Gen Issue 4, ICES-003	Radiated Emissions 30 MHz – 6 GHz, Transmit & Receive
15.107| RSS Gen Issue 4, ICES-003	Mains Conducted Emissions, Class B
Reported separately.	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.

Eric Lifsey
EMC Engineer

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 rules listed above.

_____
Representative 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 and Canada.

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 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 & Description	Model	Serial #	Photo
Long Range Systems, LLC Paging transmitter	TX-7470	T7470-20243	

Table 1.2.2 Other Model(s) Represented by EUT

Manufacturer & Description	Model	Serial #	Photo
Long Range Systems, LLC Paging transmitter*	TX-7470-C232	N/A	

*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.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. The EUT is operable on selected frequencies in the band of 434.000 to 469.150 MHz which is configured at the factory.

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 11	2011
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: Section References for 47 CFR (USA) FCC, RSS IC (Industry Canada)	
Section Reference FCC | IC	**Parameter**
90.210, 2.1046 | RSS 119 Issue 11, 5.4	Conducted Output Power
90.210(d), 2.1047| RSS 119 Issue 11, 5.8.3	Emission Mask D
90.210, 2.1051 | RSS 119 Issue 11, 5.8; RSS-Gen Issue 4	Conducted Spurious/Harmonic Emissions at Antenna Terminals
90.210, 2.1053 | RSS 119 Issue 11, 5.8	Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz
90.214, TIA/EIA-603C | RSS 119 Issue 11, 5.9	Transient Frequency Behavior
90.213, 2.1055 | RSS 119 Issue 11, 5.3	Frequency Stability
90.209, 2.1049 | RSS 119 Issue 11, 5.5	Occupied Bandwidth, 20 dB, < 11.5 kHz
15.109| RSS Gen Issue 4, ICES-003	Radiated Emissions 30 MHz – 6 GHz, Transmit & Receive
15.107| RSS Gen Issue 4, ICES-003	Mains Conducted Emissions, Class B
Reported separately.	Maximum Permissible Exposure[1]

[1]Exposure is reported in a supplemental document.

3.0 Conducted Output Power

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

Parameter	Section Reference	Date(s)
Conducted Output Power	90.210, 2.1046 | RSS 119 Issue 11, 5.4	2015-02-26

3.3 Results

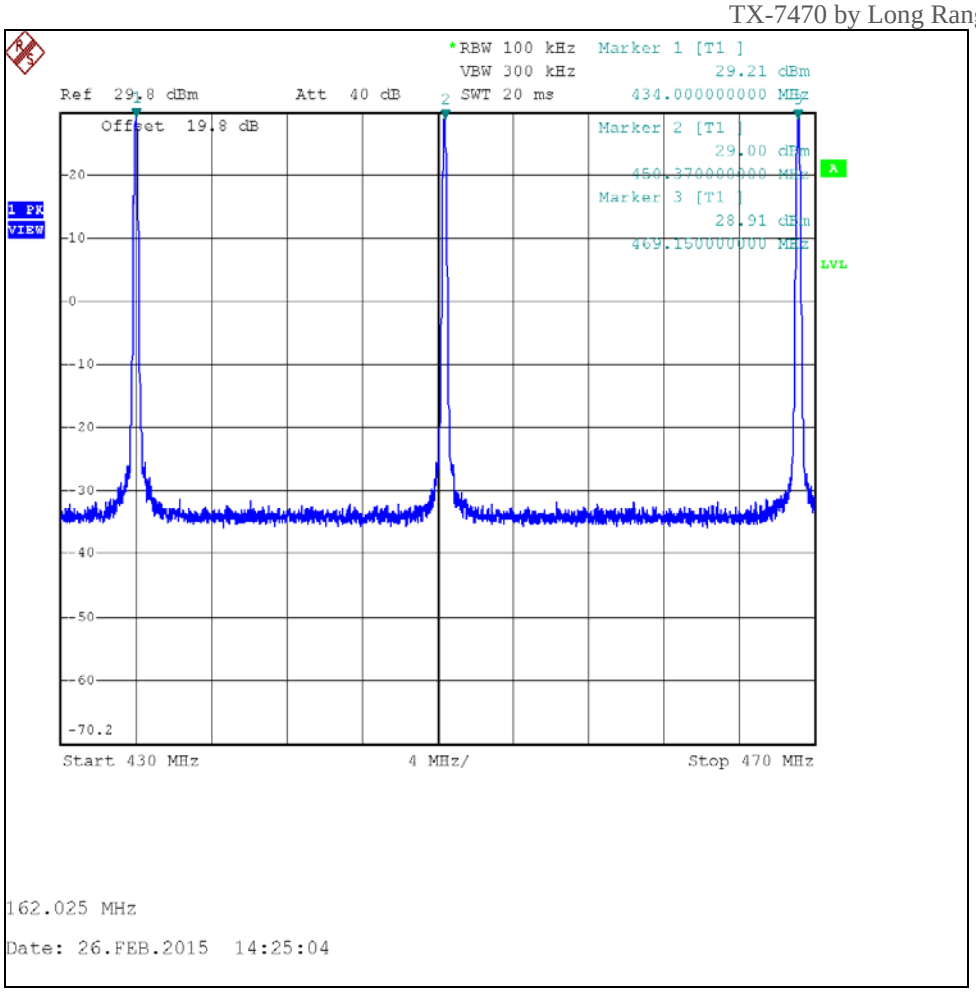
The EUT satisfied the requirement. Plotted and tabular results are presented below.

Table 3.3.1 Equipment List

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11

Table 3.3.2 Power, Conducted

Frequency (MHz)	Measured Level
434.000	29.21 dBm (834 mW)
450.370	29.00 dBm (794 mW)
469.150	28.91 dBm (778 mW)



Peak Power, Conducted

4.0 Emission Mask

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 peak 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

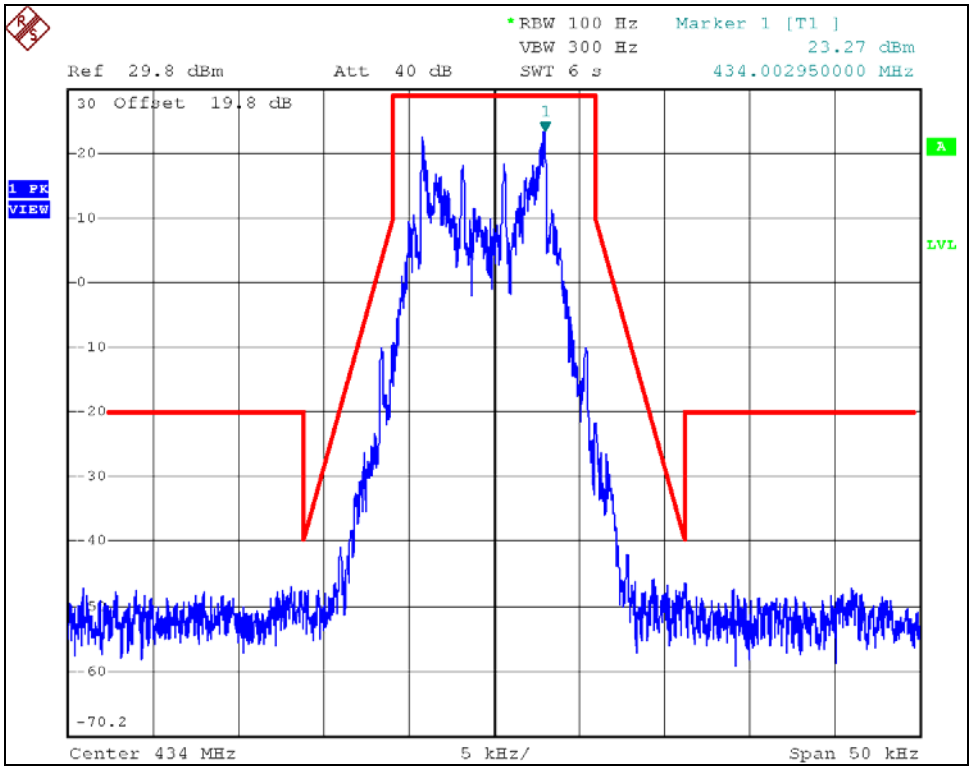
Guideline	Section Number	Date
Emissions at Antenna Terminals	90.210(d), 2.1047| RSS 119 Issue 11, 5.8.3	2015-02-26

4.3 Results

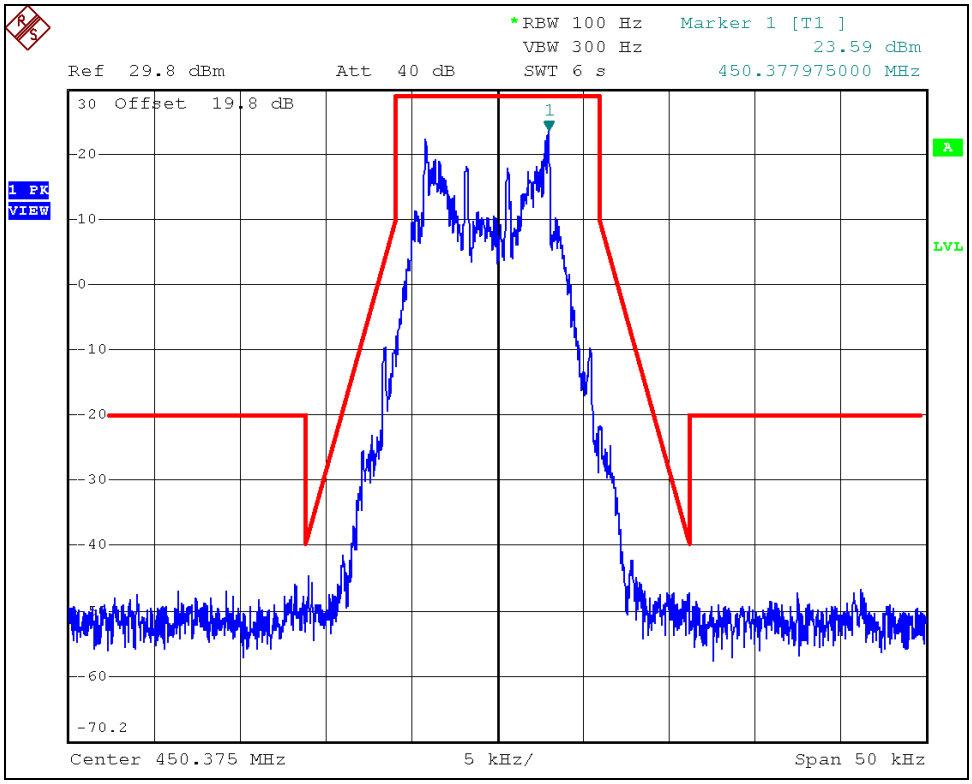
Table 4.3.1 Equipment List

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11

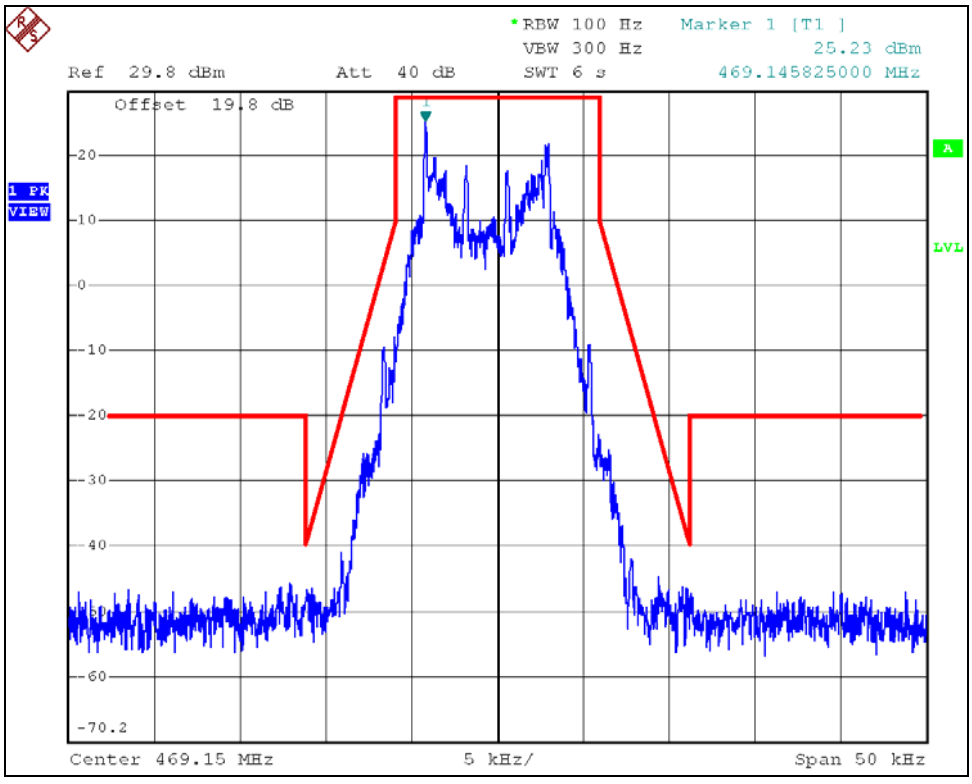
The emission measured within the mask as shown in the plot below. The EUT satisfied the requirement.



Low Channel; Modulated Emission with Superimposed Mask D



Middle Channel; Modulated Emission with Superimposed Mask D



High Channel; Modulated Emission with Superimposed Mask D

5.0 Spurious Emissions at Antenna Terminals, Transmit Mode

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 on each of the low, middle, and high channels. 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 (10 MHz) to tenth harmonic (4.67750 GHz). Selected range is 10 MHz to 5 GHz in three sub-ranges.

5.2 Criteria

Guideline	Section Number	Date
Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051 | RSS 119 Issue 11, 5.8; RSS-Gen Issue 4	2015-02-26

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 29.21 dBm. Limit is determined from 90.210(e)(3) for emissions beyond 4.6 kHz from authorized bandwidth. (Note that mask E selected as worse-case criteria for future bandwidth interest as the limit is 5 dB lower than mask D.)

Per 90.210(e)(3) $\text{Attenuation}_{(dB)} = 55 + \text{Log}_{10}(0.834\ W) = 54.92\ dB$

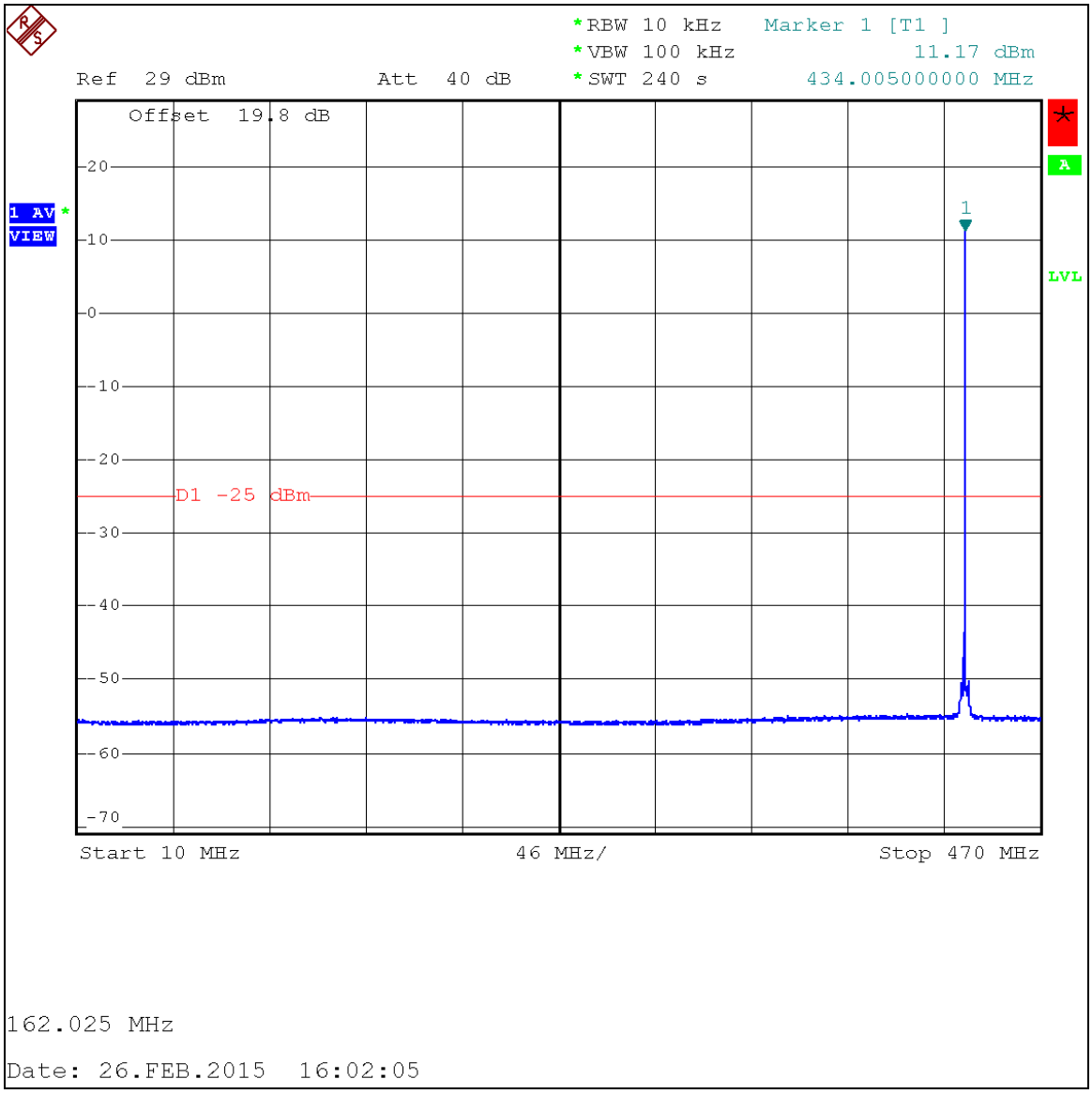
$\text{Limit}_{(dBm)} = \text{Fundamental\_Power}_{(dBm)} - \text{Attenuation}_{(dB)} = 29.21\ dBm - 54.92\ dB = -25.71\ dBm$

5.3 Results

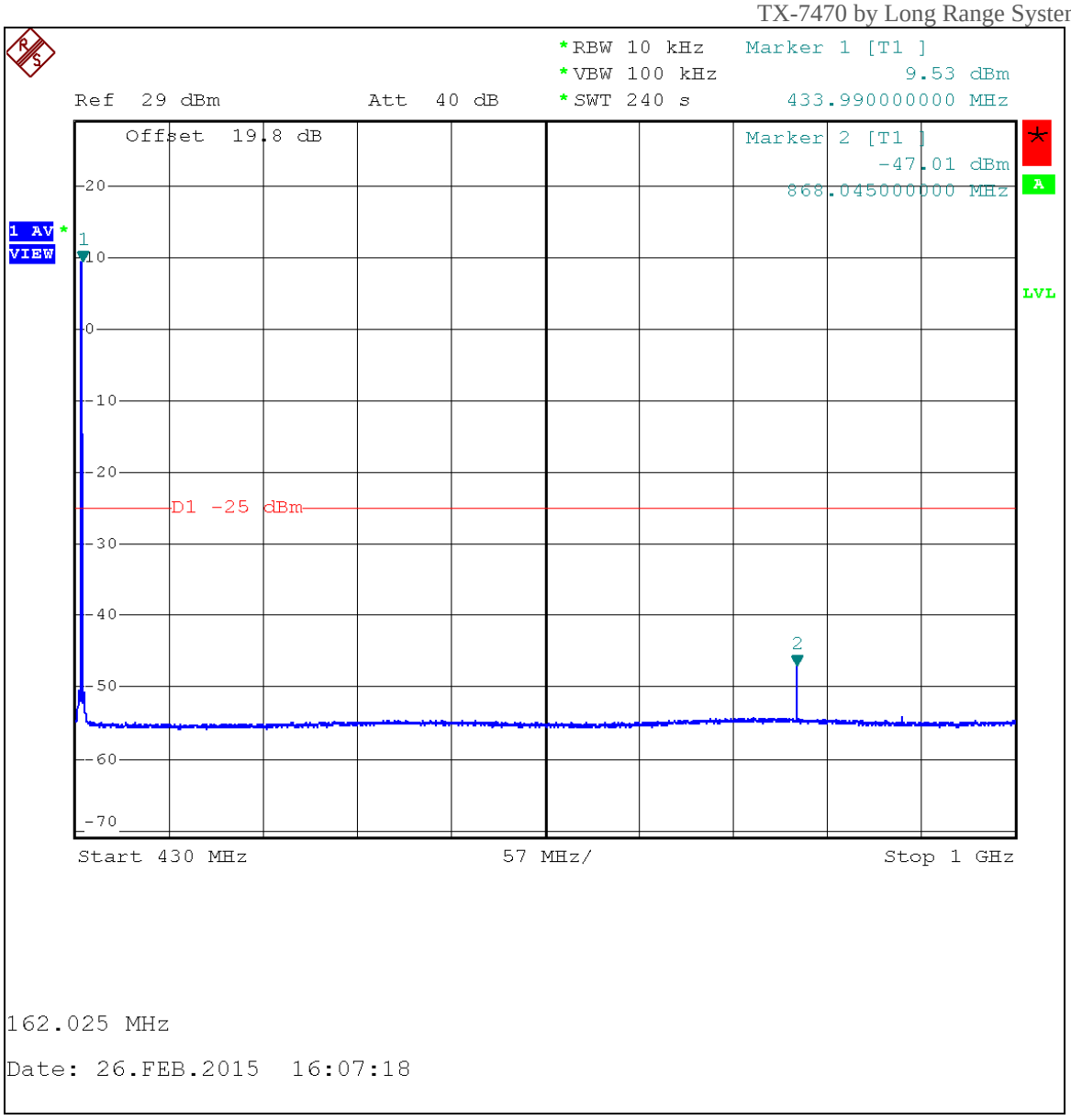
Table 5.3.1 Equipment List

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11

Highest spurious emission was found to be in excess of ~19 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.

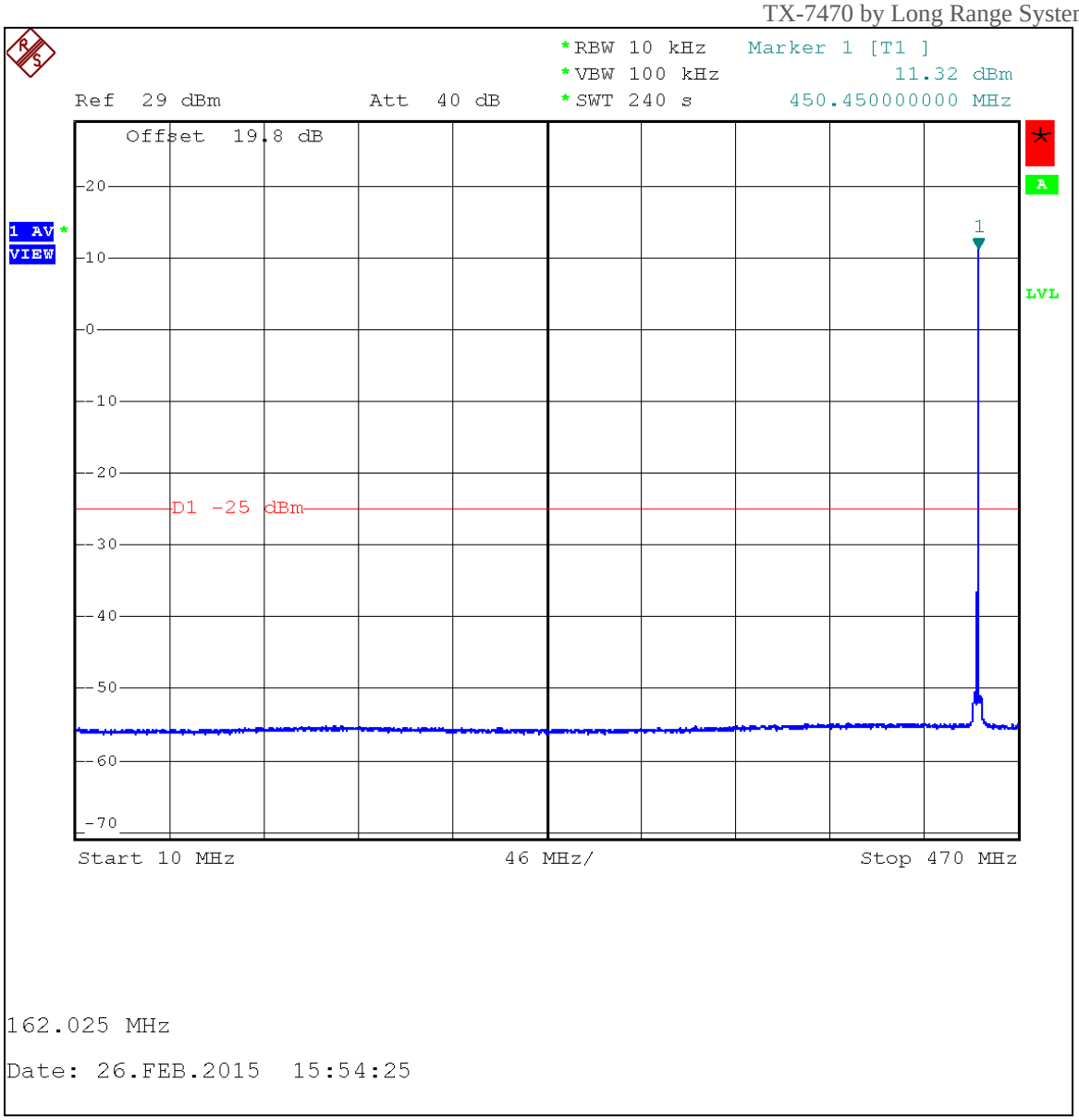


Low Channel Spurious Conducted, Span: 10 MHz to Fundamental
(Fundamental visible on right edge of plot area.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

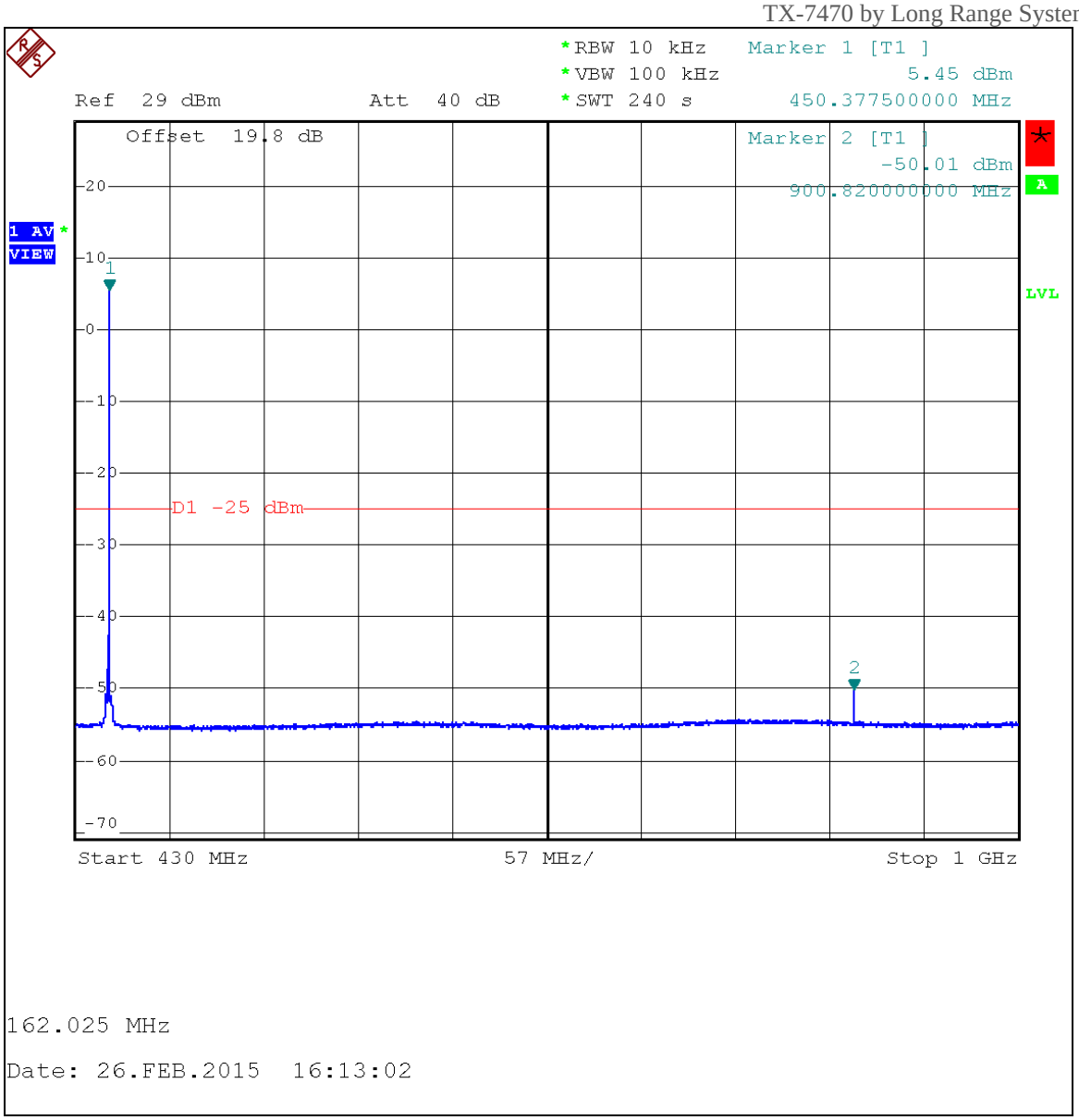


Low Channel Spurious Conducted, Span: Fundamental to 1 GHz
(Fundamental visible on left edge of plot.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

Low Channel Spurious Conducted, Span: 1 GHz to 5 GHz
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

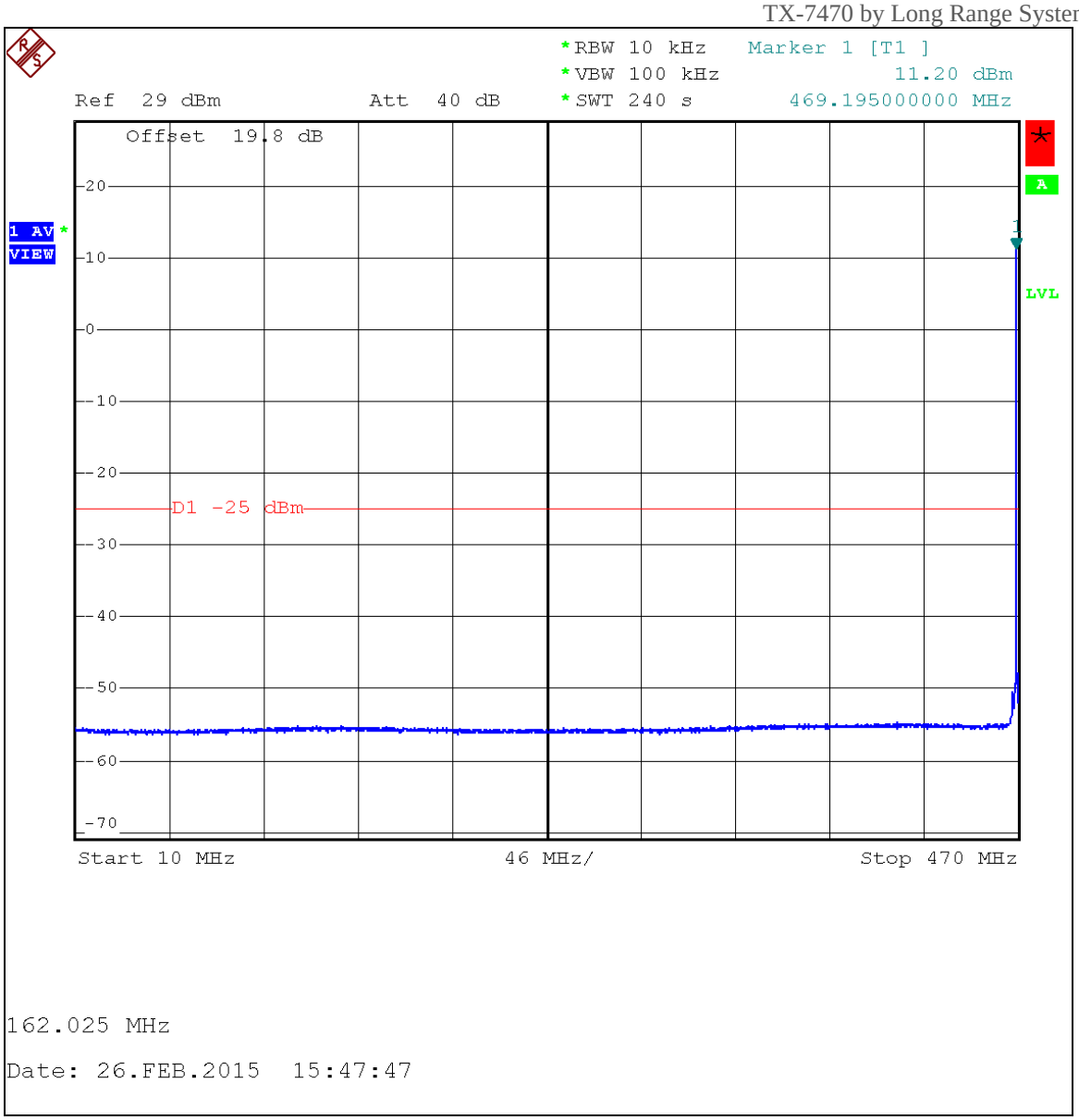


Mid Channel Spurious Conducted, Span: 10 MHz to Fundamental
(Fundamental visible on right edge of plot area.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

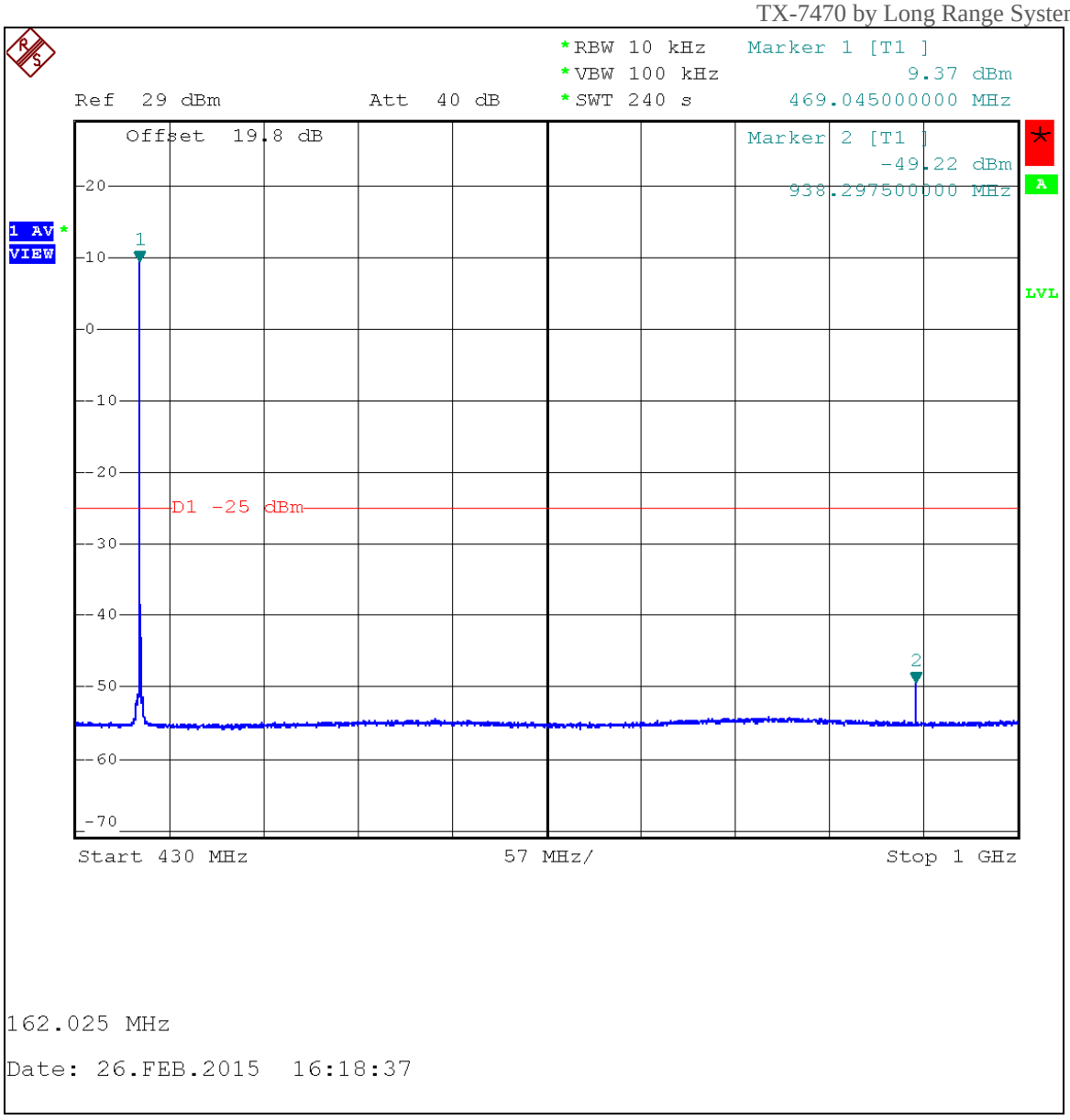


Mid Channel Spurious Conducted, Span: Fundamental to 1 GHz
(Fundamental visible on left edge of plot.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

Mid Channel Spurious Conducted, Span: 1 GHz to 5 GHz
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)



High Channel Spurious Conducted, Span: 10 MHz to Fundamental
(Fundamental visible on right edge of plot area.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)



High Channel Spurious Conducted, Span: Fundamental to 1 GHz
(Fundamental visible on left edge of plot.)
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

High Channel Spurious Conducted, Span: 1 GHz to 5 GHz
(Red line at -25 dBm, limit is 0.7 dB lower at -25.7 dBm.)

6.0 Spurious Emissions at Antenna Terminals, Receive Mode

6.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous receive mode on the middle channel. 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 peak detector function from lowest operating frequency (10 MHz) to include the tenth harmonic (4.67750 GHz). Selected range is 10 MHz to 5 GHz in two sub-ranges.

6.2 Criteria

Guideline	Section Number	Date
Spurious/Harmonic Emissions at Antenna Terminals, Receive Mode	RSS-Gen Issue 4	2015-03-03

Receiver-spurious emissions at any discrete frequency shall not exceed:

2 nW in the band 30-1000 MHz, (-57 dBm) 120 kHz RBW QP Detector (used peak)
5 nW above 1000 MHz. (-53 dBm) 1 MHz RBW Average Detector (used peak)

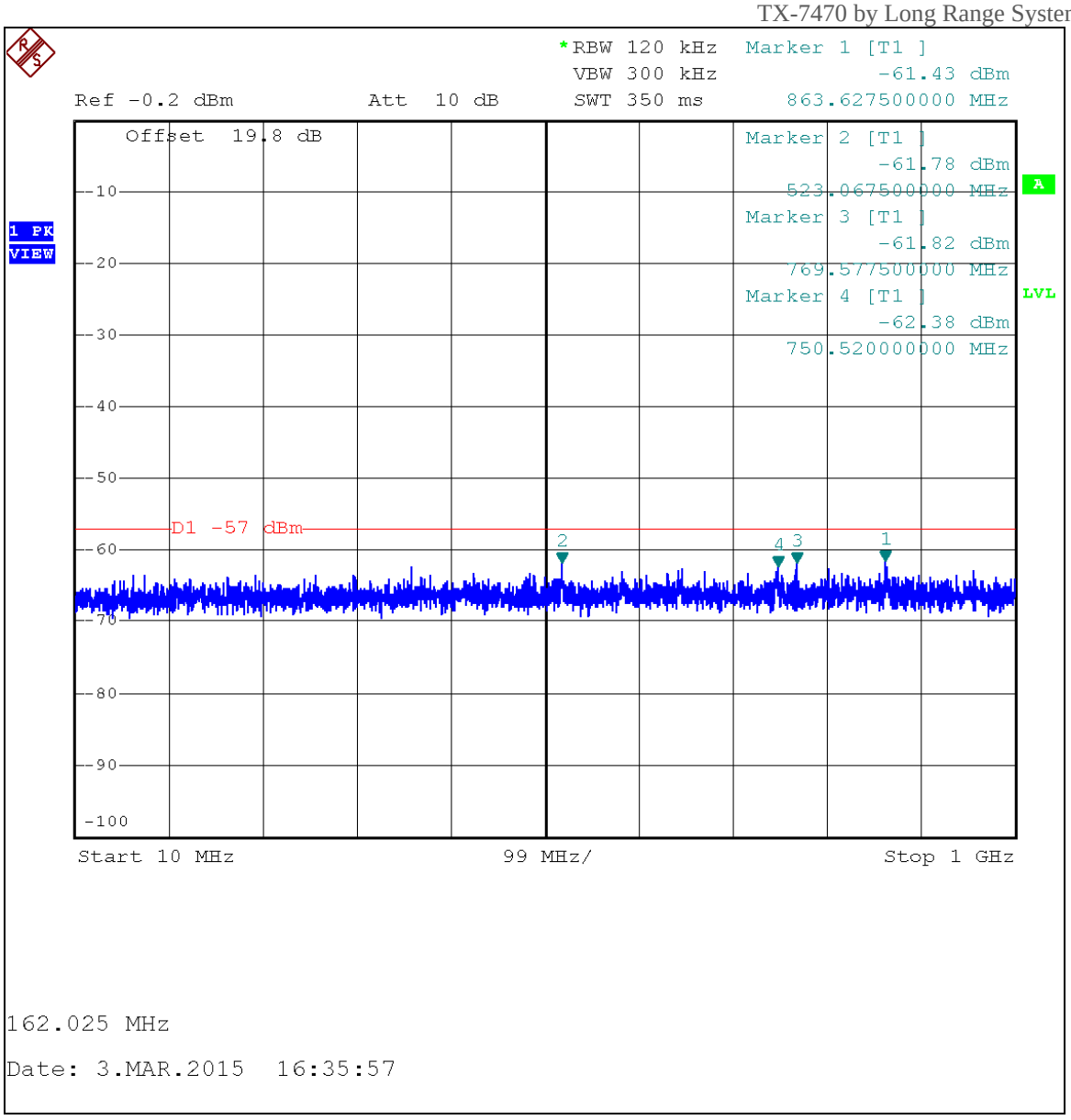
6.3 Results

Table 5.3.1 Equipment List

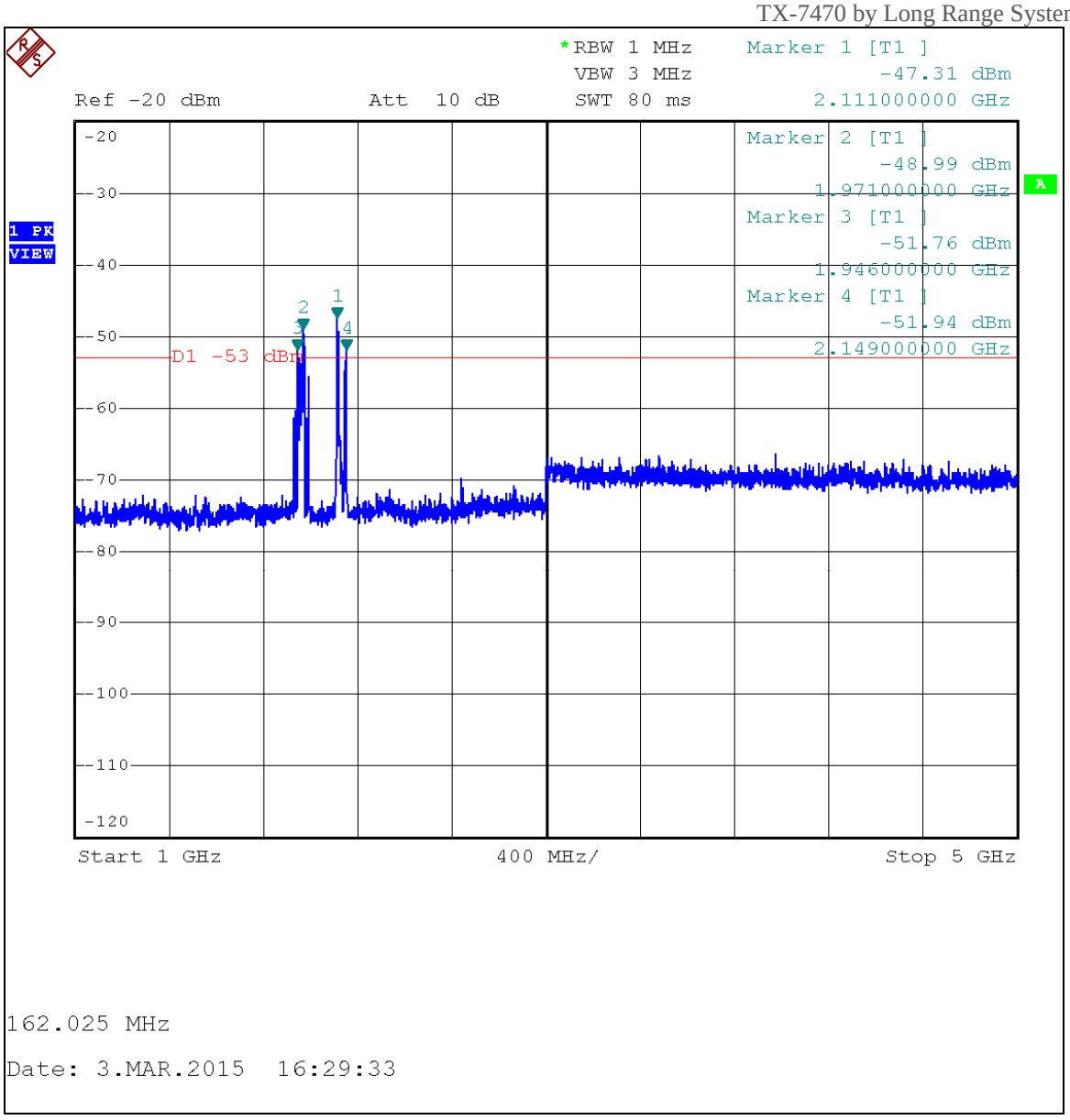
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11

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

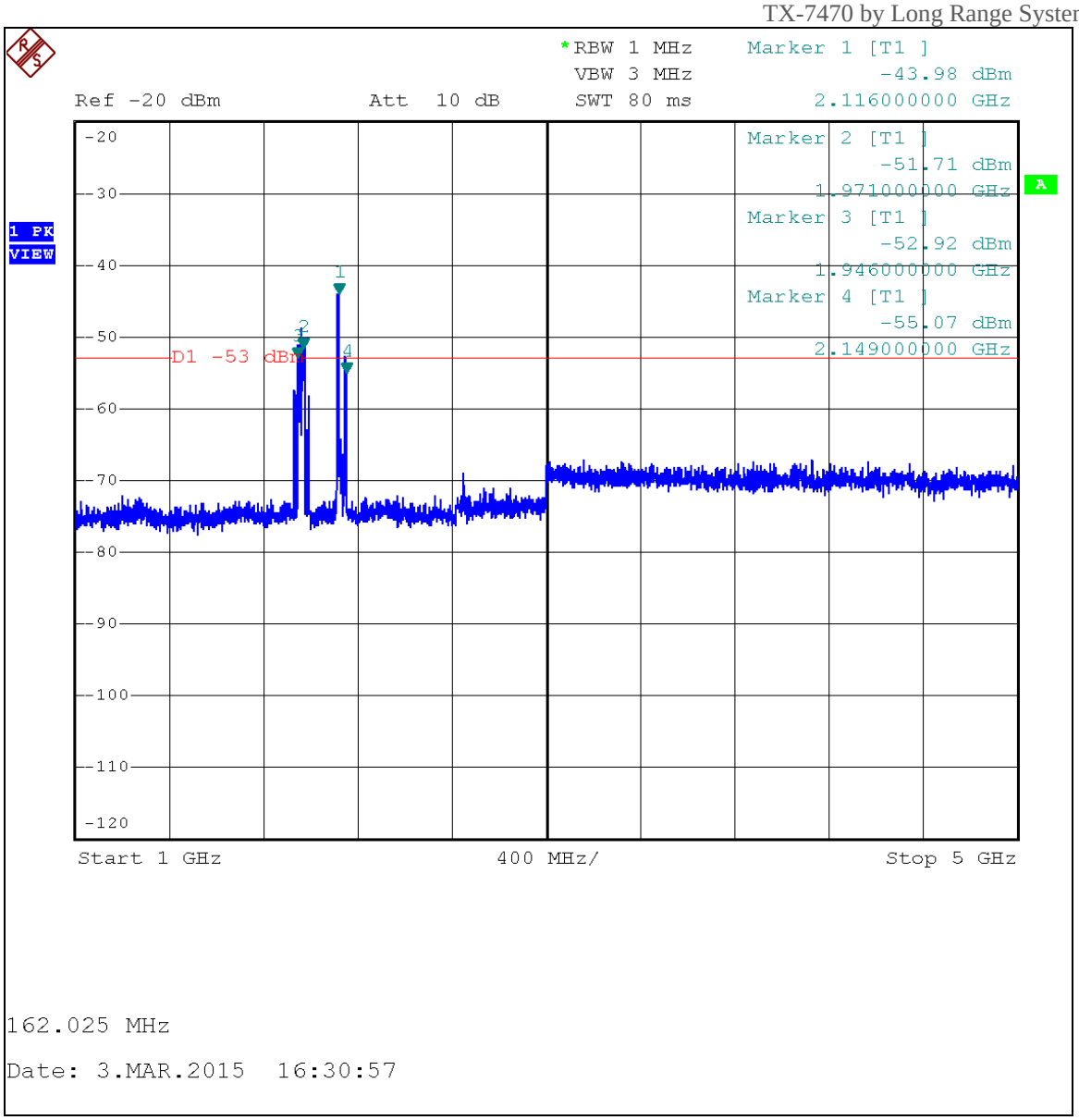
At these low levels ambient signals from local cellular systems were captured in the data. An additional sweep with the EUT switched off was performed to verify the signals were indeed ambient signals. The power attenuator was used below 1 GHz only. It was removed above 1 GHz to improve noise floor at the higher 1 MHz resolution bandwidth.



Receive Mode Spurious Conducted, 10 MHz to 1 GHz



Receive Mode Spurious Conducted, 1 GHz to 5 GHz
Marked Signals are Ambient (Confirmed on next plot.)



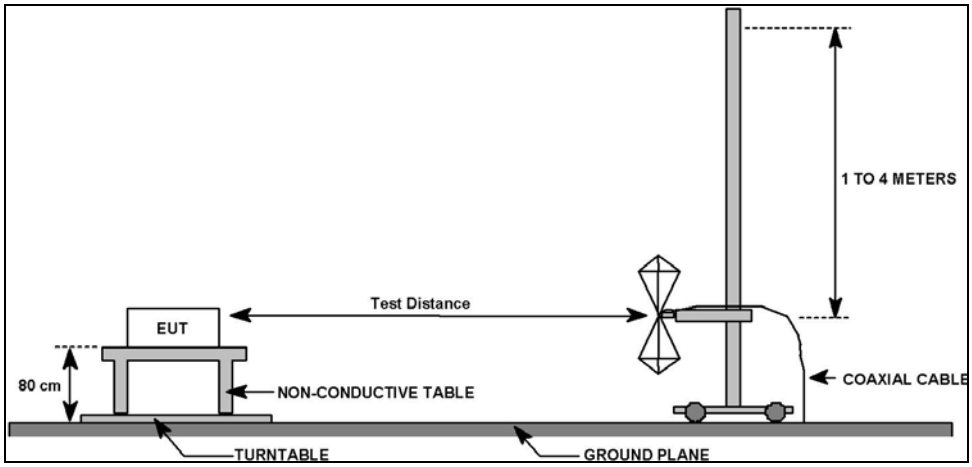
Check of Ambient Signals Conducted, EUT Connected and Powered Off

7.0 Field Strength of Radiated Spurious and Unintentional Emissions – Transmit Mode

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 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

7.2 Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Unintentional Emissions 30 MHz to 5 GHz	15.109| RSS Gen Issue 4, ICES-003	2015-03-16

7.3 Results

The EUT satisfied the requirement. Note that transmitter harmonics appearing the radiated measurements below were qualified by using direct conducted port measurement, the calculated radiated limit is shown as shorter limit lines. The long/bold limit lines are those of the general emission limits.

Table 7.3.1: Equipment List

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,**		
In accordance with:	**FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits**		
Section:	**15.209**		
Test Date(s):	**3/16/2015**	**EUT Serial #:**	**0**
Customer:	**Long Range Systems**	**EUT Part #:**	**0**
Project Number:	**16332-15**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**TX-7470**	**Witness' Name:**	**None**

Radiated Emissions Test Equipment List	
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**
Test Profile:	**Radiated Emissions_Profile Version October 12, 2011**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	3/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/26/2016
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	HP	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
Loaner-10	EMCO	3115	Antenna, Horn, DRG, 1-18GHz	9010-3578	7/31/2015
F001	Mini-Circuits	SHP-1000	Filter, High Pass, 1GHz	9707	CBU

Table 7.3.2: Measurement Bandwidth

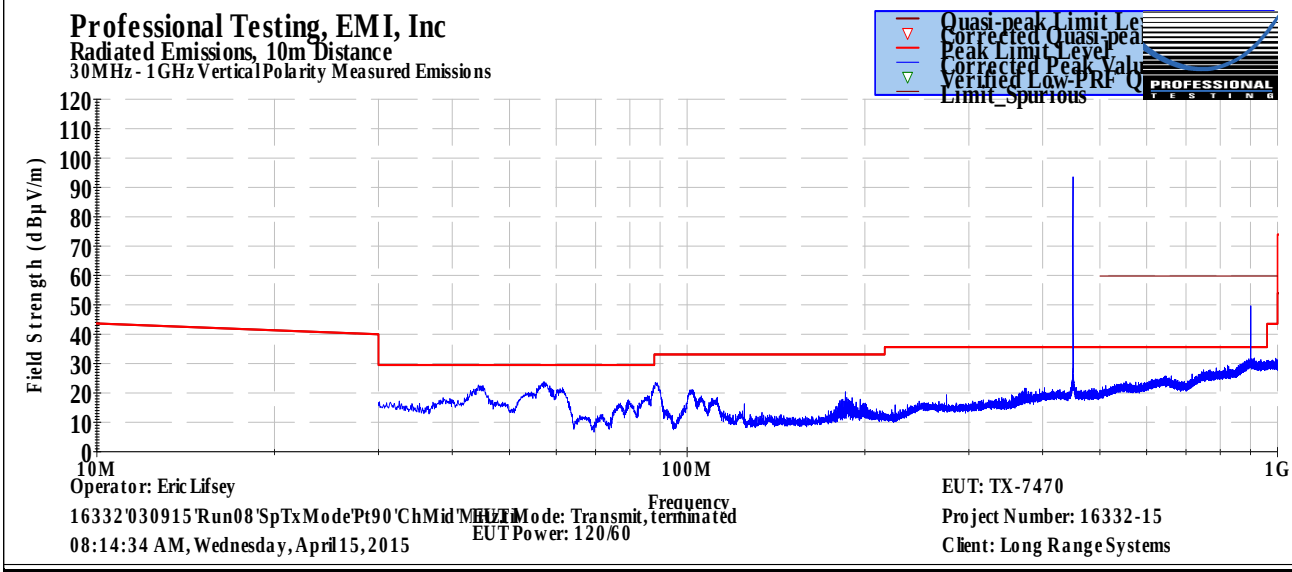
Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

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

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	4/15/2015	EUT Serial #:	0
Customer:	Long Range Systems	EUT Part #:	0
Project Number:	16332-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	TX-7470	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	120	VAC	EUT Power Frequency:	60	Hz
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz	
EUT Mode of Operation:			Transmit, Middle Channel, Unmodulated		



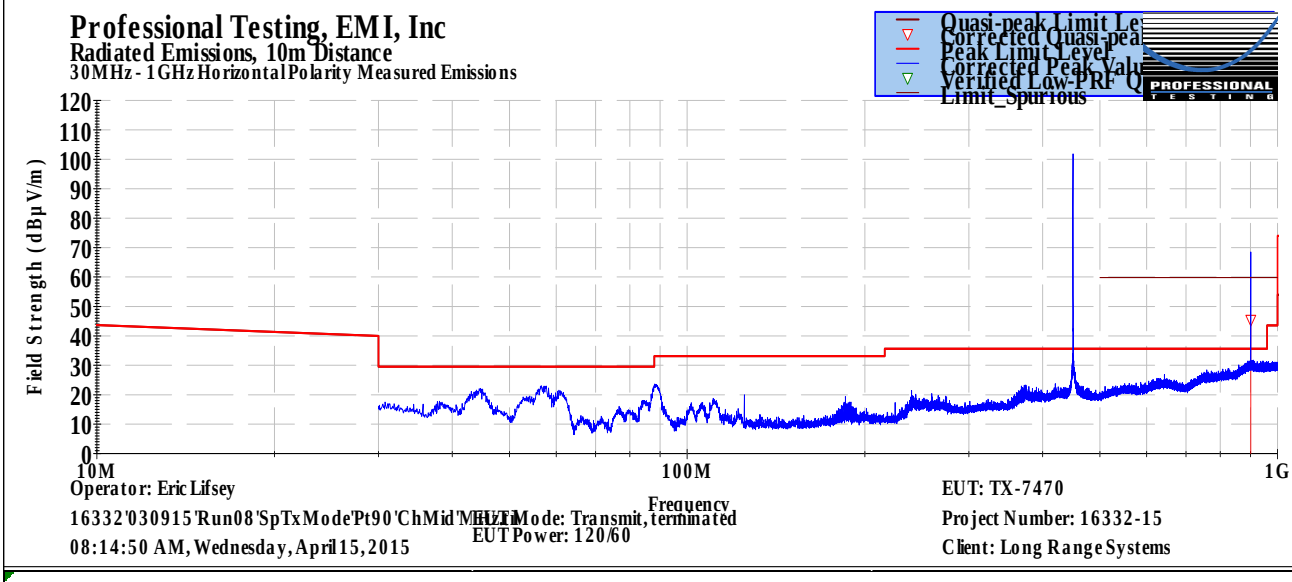
≤ 1GHz Vertical Antenna Polarity Measured Emissions

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

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	4/15/2015	EUT Serial #:	0
Customer:	Long Range Systems	EUT Part #:	0
Project Number:	16332-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	TX-7470	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Middle Channel, Unmodulated	

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
900.7569	10	0	4	Quasi-peak	45.42	45.42	59.9	-14.4	Pass

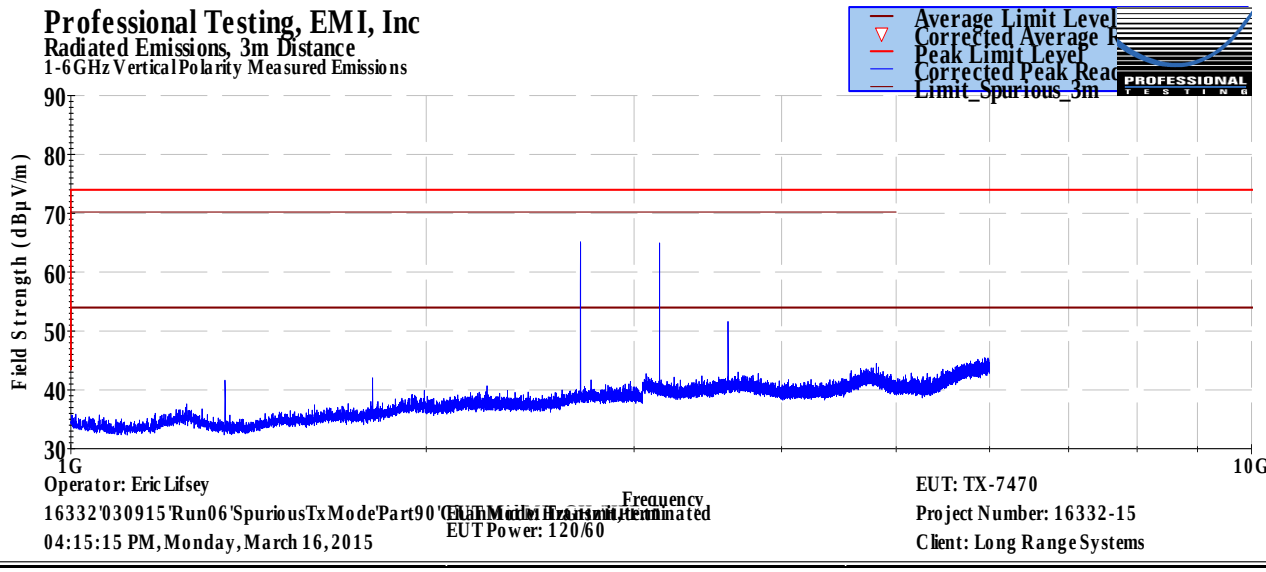


≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Note that the system pre-amp was briefly overloaded during this measurement resulting in the 900.7569 MHz 2nd harmonic appearing to fail the Part 90 limit. The 900 MHz signal was re-measured individually with care to avoid overload and found to be below the Part 90 limit as shown in the tabular result and by the triangular marker.

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

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	EUT Serial #:	0
Customer:	Long Range Systems	EUT Part #:	0
Project Number:	16332-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	TX-7470	Witness' Name:	None
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, Middle Channel	

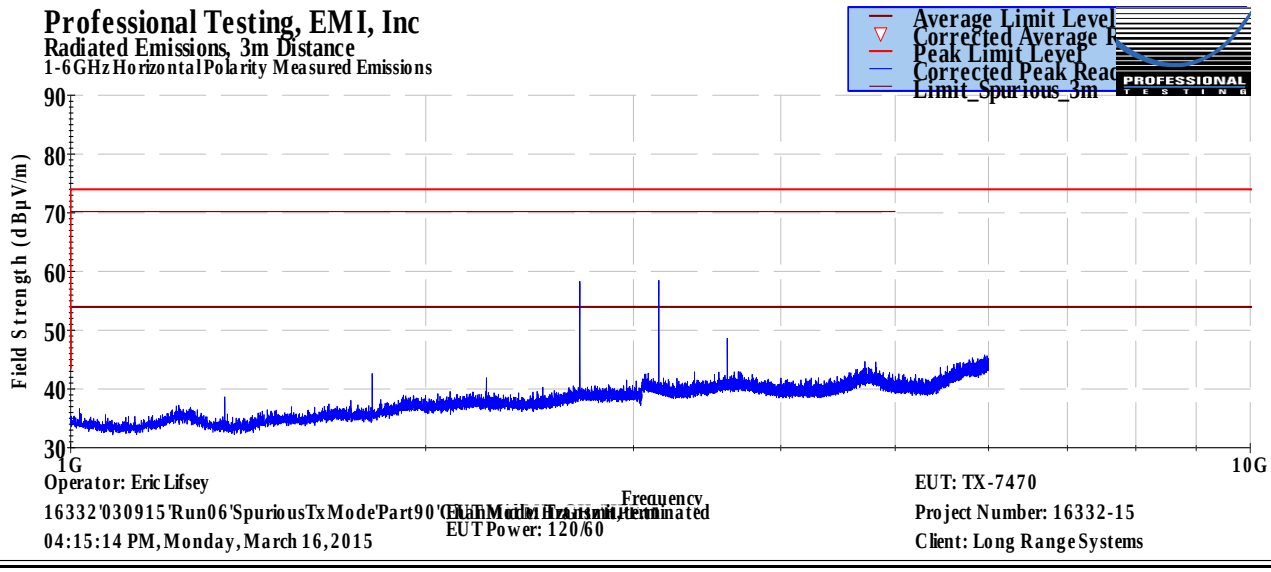


> 1GHz Vertical Antenna Polarity Measured Emissions

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

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	EUT Serial #:	0
Customer:	Long Range Systems	EUT Part #:	0
Project Number:	16332-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	TX-7470	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	120	VAC	EUT Power Frequency:	60	Hz
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz	
EUT Mode of Operation:	Transmit, Middle Channel				

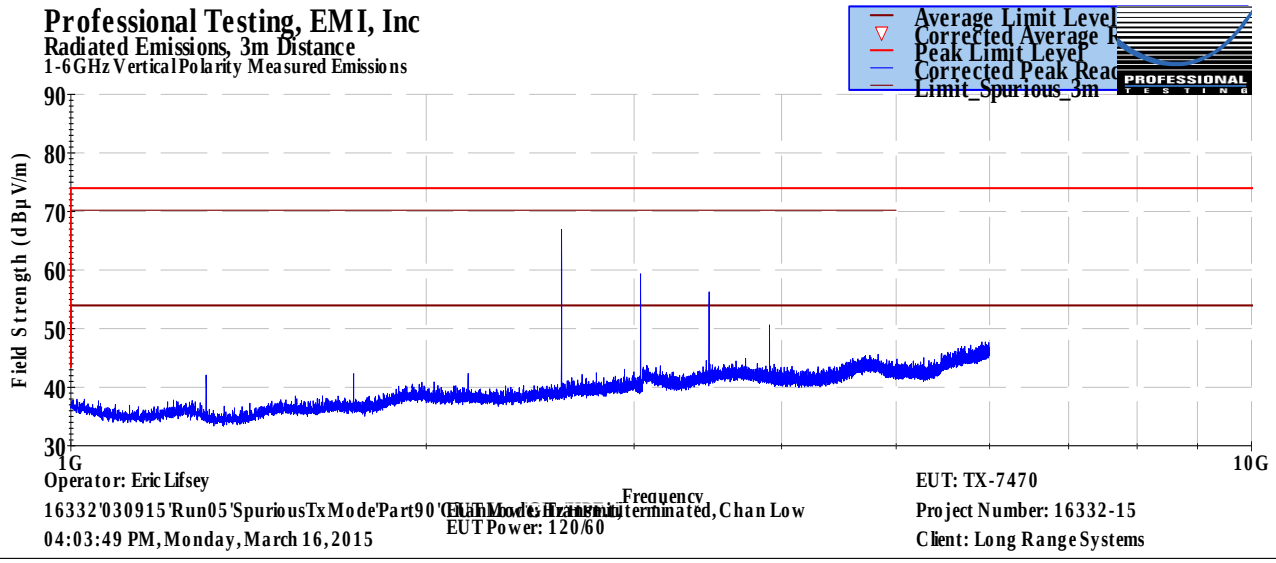


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.7: Field Strength of Spurious Emissions, Low Channel, 1 GHz to 5 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	**EUT Serial #:**	0
Customer:	Long Range Systems	**EUT Part #:**	0
Project Number:	16332-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	TX-7470	**Witness' Name:**	None

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, Low Channel				

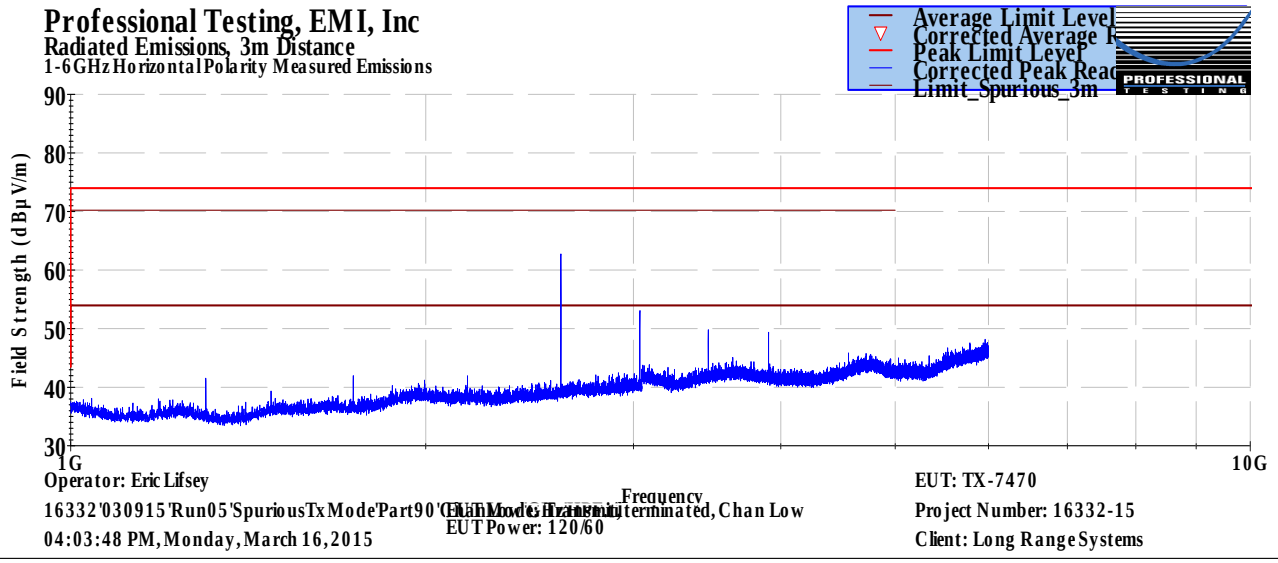


> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.8: Field Strength of Spurious Emissions, Low Channel, 1 GHz to 5 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	**EUT Serial #:**	0
Customer:	Long Range Systems	**EUT Part #:**	0
Project Number:	16332-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	TX-7470	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	120	VAC	**EUT Power Frequency:**	60	Hz
Antenna Orientation:	Horizontal		**Frequency Range:**	Above 1GHz	
EUT Mode of Operation:	Transmit, Low Channel				

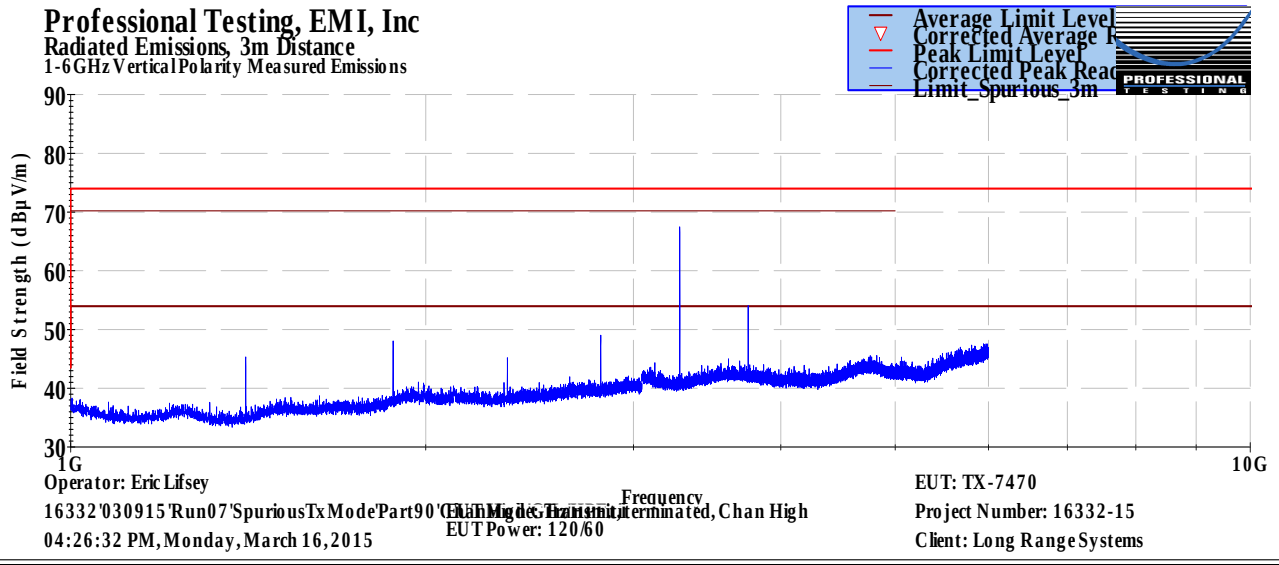


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.9: Field Strength of Spurious Emissions, High Channel, 1 GHz to 5 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	EUT Serial #:	0
Customer:	Long Range Systems	EUT Part #:	0
Project Number:	16332-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	TX-7470	Witness' Name:	None

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, High Channel				

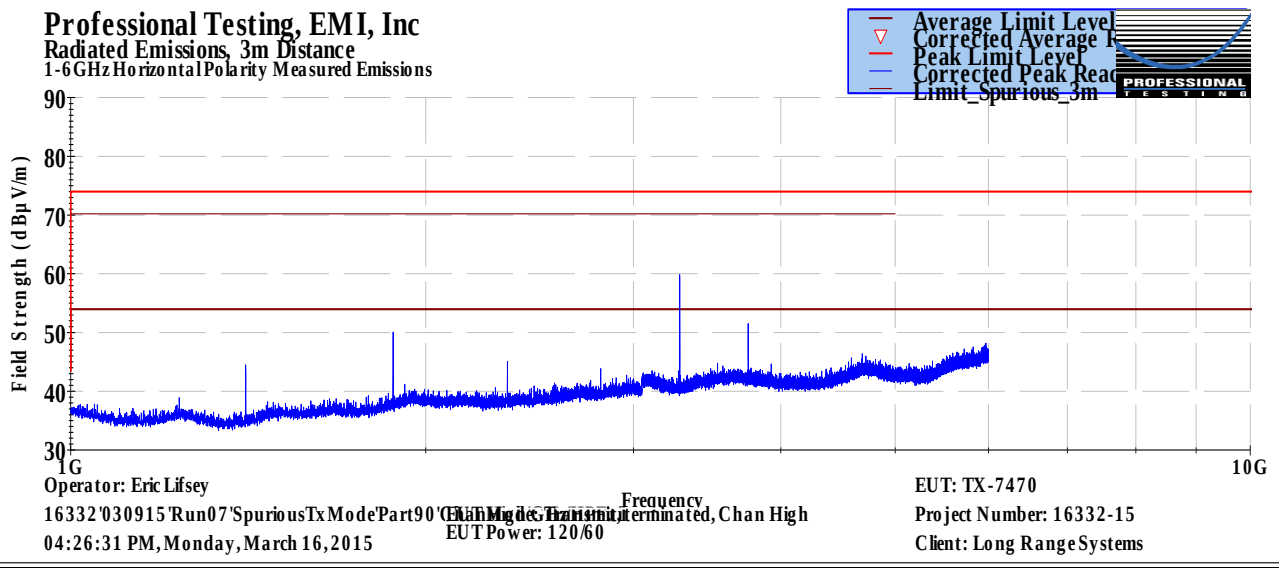


> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.10: Field Strength of Spurious Emissions, High Channel, 1 GHz to 5 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	3/16/2015	**EUT Serial #:**	0
Customer:	Long Range Systems	**EUT Part #:**	0
Project Number:	16332-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	TX-7470	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	120	VAC	**EUT Power Frequency:**	60	Hz
Antenna Orientation:	Horizontal		**Frequency Range:**	Above 1GHz	
EUT Mode of Operation:	Transmit, High Channel				



> 1GHz Horizontal Antenna Polarity Measured Emissions

8.0 Mains Conducted Emissions

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 | RSS Gen Issue 4, ICES-003	2014-03-19

8.3 Results

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

Table 8.3.1: Mains Conducted Emissions, Equipment List

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference,**		
In accordance with:	**FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits**		
Section:	**15.107**		
Test Date(s):	**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**

Conducted Emissions Test Equipment List	
Tile! Software Version:	**4.1.A.0, April 14, 2009, 11:01:00PM**
Test Profile:	**Profile#: CE_2010.til, dated December 16, 2010**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spectrum Analyzer	2732A03633	5/17/2014
0045	HP	85662A	Spec Anal Dsply for AN1842	2816A16413	N/A
0990	HP	85685A	RF Preselector	3010A01119	8/29/2014
1281	HP	85650A	Quasi Peak Adapter	2043A00063	6/5/2014
1173	PTI	100k HPF	Filter, High Pass, 100kHz	none	10/30/2014
1087	PTI	PTI-ALF3	Attenuator Limiter Filter	none	5/6/2014
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	7/10/2014
C108	Pomona	RG-223	Cable 5.5 ft BNC RG-223 (black)	none	7/10/2014
0939	EMCO	3825/2	LISN, 10kHz-100MHz	9603-2521	10/31/2014
C109	HP	none	Cable 19 inch BNC (grey)	none	7/10/2014
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	10/31/2014

Table 8.3.2: Mains Conducted Emissions, Measurement Bandwidths

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps

*Notes:
1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

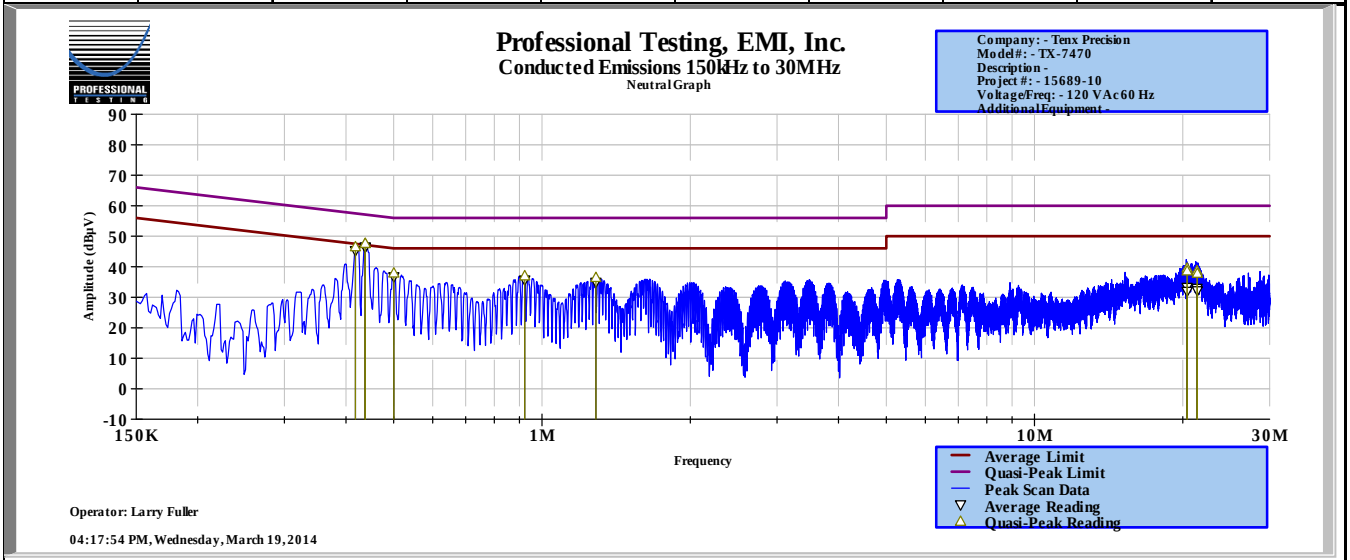
Table 8.3.3: Mains Conducted Emissions, Neutral Line

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits		
Section:	15.107		
Test Date(s):	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

Conducted Emissions Test Results Data Sheet - Neutral Lead **Page: 1 of 2**

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.41796	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	38.6	60	-21.4	PASS	32	50	-18	PASS
21.3661	41.9	38.6	60	-21.4	PASS	32.9	50	-17.1	PASS
21.4028	42.1	37.8	60	-22.2	PASS	32.1	50	-17.9	PASS



Measured Conducted Emissions - Neutral Lead

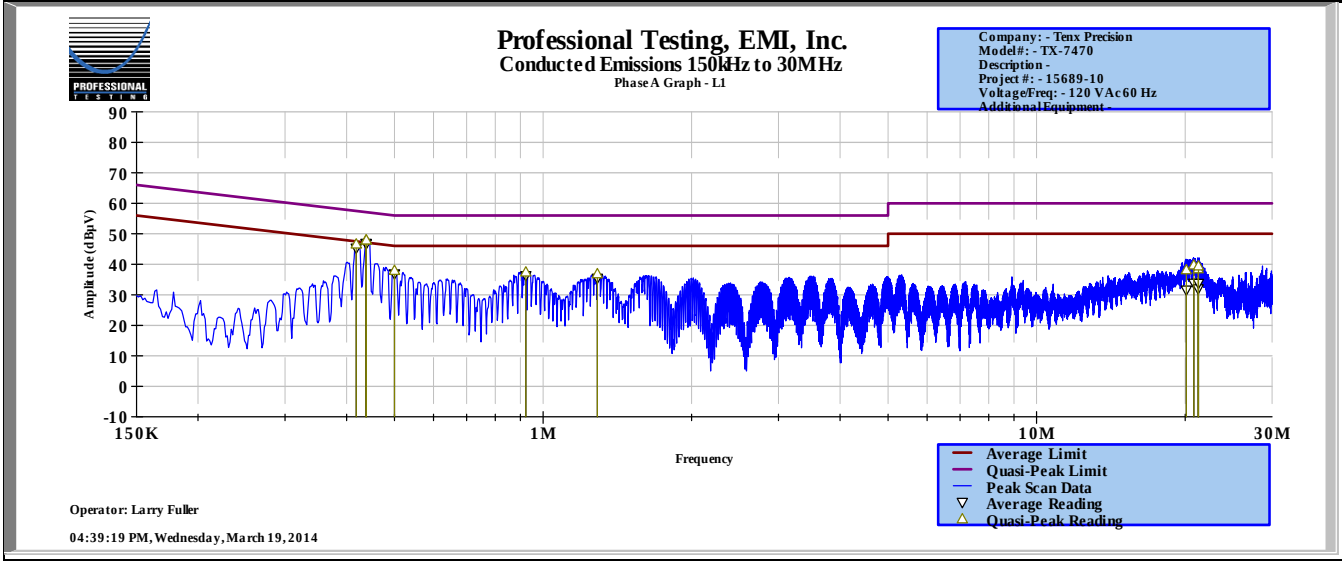
Table 8.3.4: Mains Conducted Emissions, Phase Line

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits		
Section:	15.107		
Test Date(s):	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

Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) **Page: 2 of 2**

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.4185	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



Measured Conducted Emissions - Phase Lead (Line 1)

9.0 Frequency Stability

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 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 +/- 15% from nominal. In this case the power source is the AC mains.

9.2 Criteria

The operating frequency shall remain within +/- 5 ppm of the assigned channel. The measurement is performed for lowest, middle, and highest operating frequency.

9.3 Results

The EUT satisfied the requirement.

Table 9.3.1 Equipment List

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	1/29/2016
2134	Tenny	TPS	Temperature Chamber	10/15/2015
A105	Narda		20 W 20 dB N-N Attenuator	10/11/2015
C286	Unknown	RG type	Coaxial Cable	CNR
0355	Powerstat	3PN236B	Variable transformer	CNR
1777	B&K	2408	DMM	4/8/2015

Table 9.3.2: Frequency Stability, Temperature

Mobile Criteria: +/- 5 ppm						3/10/2015
Condition	**Frequency**			**Deviation**	**Soak Time**	
Temperature (C)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Power-Off (min)	Power-On (min)
-30	434.000000	433.99817	-1830	-4.216590	10	10
-20	434.000000	433.99974	-260	-0.599078	10	10
-10	434.000000	434.00044	440	1.013825	10	10
0	434.000000	434.00056	560	1.290323	10	10
10	434.000000	434.00032	320	0.737327	10	10
20	434.000000	433.99978	-220	-0.506912	10	10
30	434.000000	433.99946	-540	-1.244240	10	10
40	434.000000	433.99929	-710	-1.635945	10	10
50	434.000000	433.99953	-470	-1.082949	10	10

Condition	**Frequency**			**Deviation**	**Soak Time**	
Temperature (C)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Power-Off (min)	Power-On (min)
-30	450.375000	450.37345	-1550	-3.44157646	NA	+5
-20	450.375000	450.37484	-160	-0.35525951	NA	+5
-10	450.375000	450.37548	480	1.06577852	NA	+5
0	450.375000	450.37558	580	1.28781571	NA	+5
10	450.375000	450.37530	300	0.66611157	NA	+5
20	450.375000	450.37474	-260	-0.57729670	NA	+5
30	450.375000	450.37442	-580	-1.28781571	NA	+5
40	450.375000	450.37428	-720	-1.59866778	NA	+5
50	450.375000	450.37492	-80	-0.17762975	NA	+7

Condition	**Frequency**			**Deviation**	**Soak Time**	
Temperature (C)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Power-Off (min)	Power-On (min)
-30	469.150000	469.14864	-1360	-2.89885964	NA	+5
-20	469.150000	469.14990	-100	-0.21315144	NA	+5
-10	469.150000	469.15052	520	1.10838751	NA	+5
0	469.150000	469.15061	610	1.30022381	NA	+5
10	469.150000	469.15026	260	0.55419375	NA	+5
20	469.150000	469.14973	-270	-0.57550890	NA	+5
30	469.150000	469.14935	-650	-1.38548439	NA	+5
40	469.150000	469.14929	-710	-1.51337525	NA	+5
50	469.150000	469.14999	-10	-0.02131514	NA	+5

Result				
		Worse case negative deviation	-4.216589862	ppm
		Worse case positive deviation	1.300223809	ppm

Table 9.3.3: Frequency Stability, Voltage

Mobile Criteria: +/- 5 ppm					3/11/2015
Condition	**Frequency**			**Deviation**	**Voltage**
Voltage Extreme	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Measured Voltage (V AC)
-15%	434.00000	433.99976	-240.000000019	-0.552995392	97.30
Nominal	434.00000	433.99982	-180.000000000	-0.414746544	115.00
+15%	434.00000	433.99977	-229.999999988	-0.529953917	132.60

Condition	**Frequency**			**Deviation**	**Voltage**
Voltage Extreme	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Measured Voltage (V AC)
-15%	450.37500	450.37479	-209.999999981	-0.466278102	97.30
Nominal	450.37500	450.37480	-200.000000007	-0.444074382	115.00
+15%	450.37500	450.37476	-240.000000019	-0.532889259	132.60

Condition	**Frequency**			**Deviation**	**Voltage**
Voltage Extreme	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	Calculated Deviation (ppm)	Measured Voltage (V AC)
-15%	469.15000	469.14978	-219.999999956	-0.468933177	97.30
Nominal	469.15000	469.14981	-189.999999975	-0.404987744	115.00
+15%	469.15000	469.14971	-289.999999950	-0.618139188	132.60

Result			
	Worse case negative deviation	-0.618139188	ppm
	Worse case positive deviation	-0.404987744	ppm

Ambient:	
21.2	C
40	% RH

10.0 Transmit Transient

10.1 Procedure

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.

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:

Time intervals[1,2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment 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 Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
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
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.

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

t_2 is the time period immediately following t_1.

t_3 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.

[2]During 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.

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

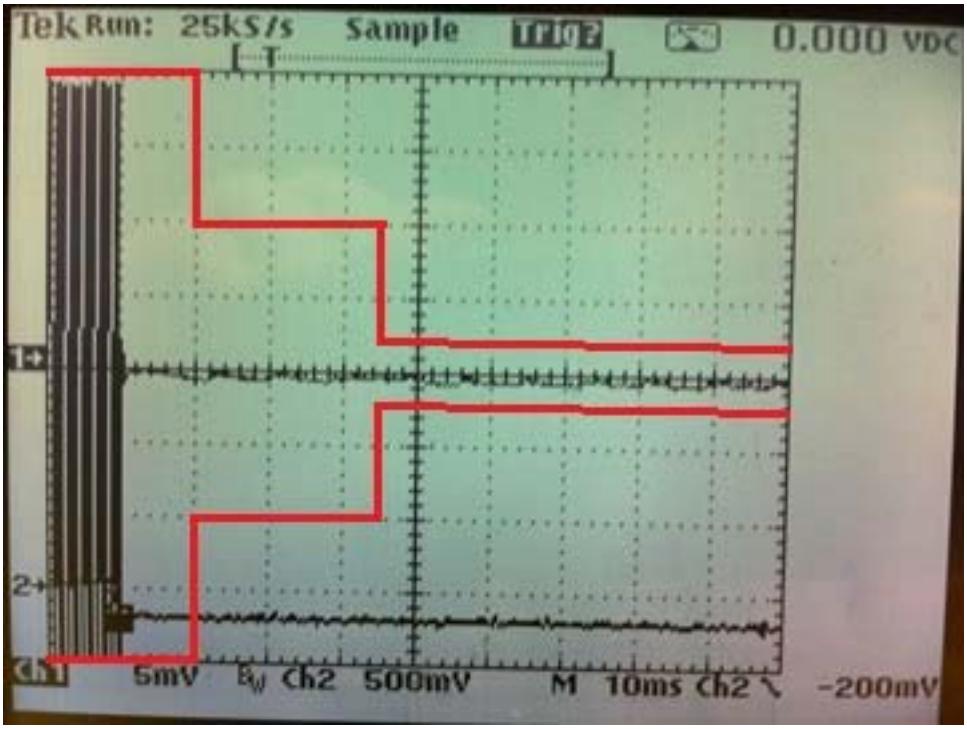
[4]If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

The measurement is performed for the lowest, middle, and highest operating frequency.

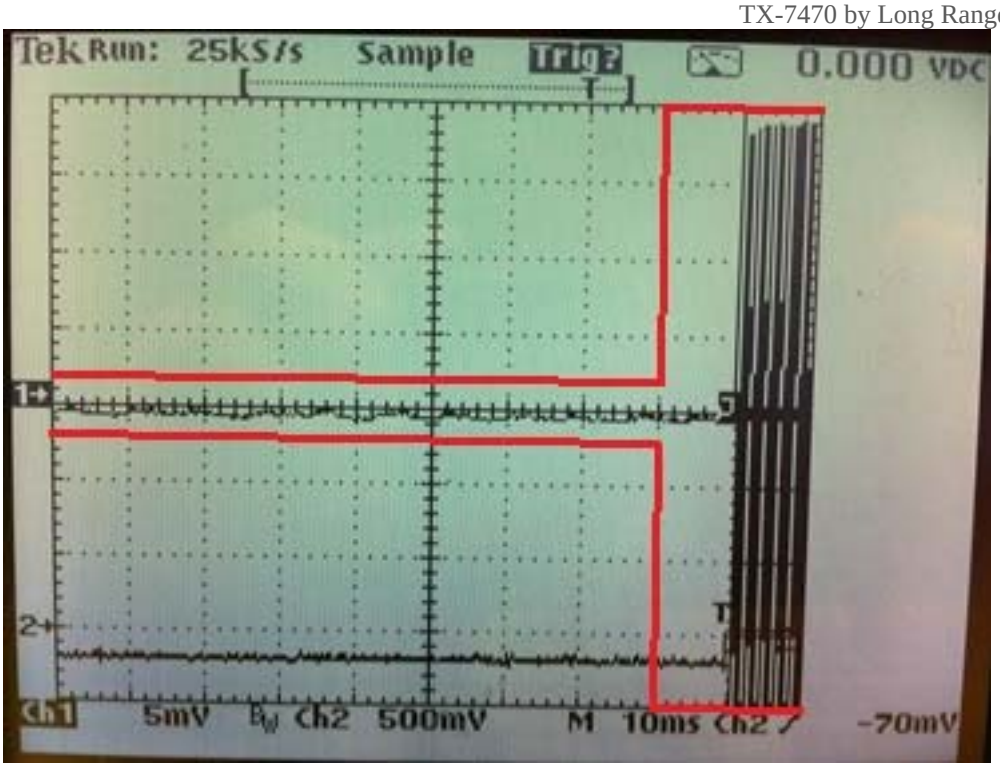
10.3 Results

The EUT satisfied the requirement.

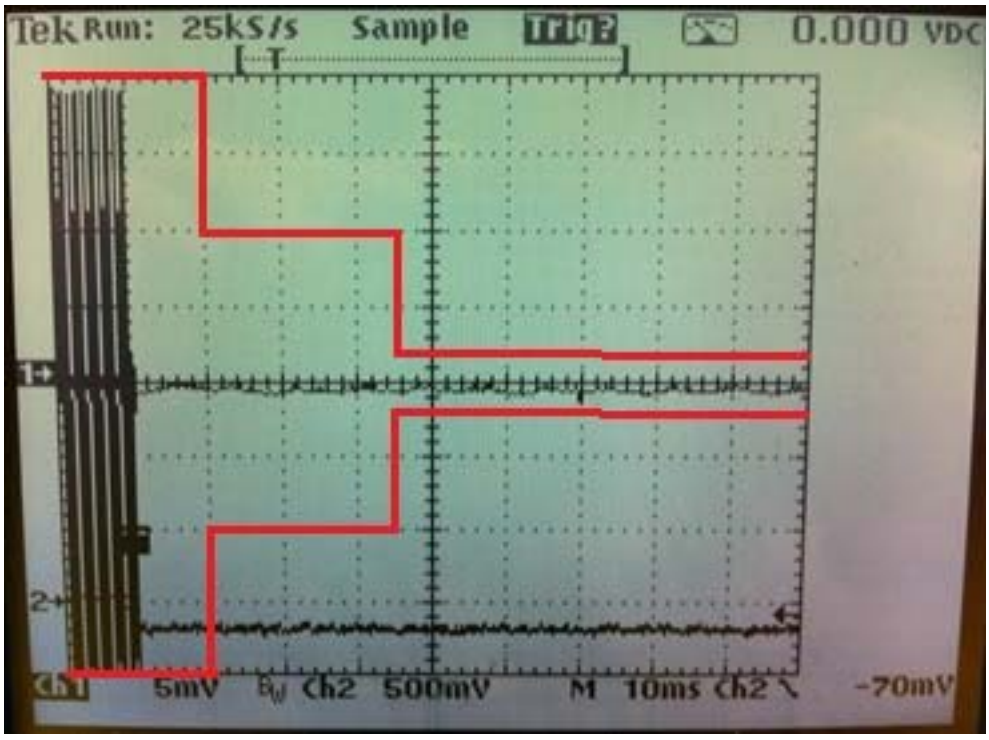
Table 9.3.1 Equipment List				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
0472	Tektronix	THS730A	Oscilloscope, Digital	2015-09-29
0718	HP	8656A	Signal Generator	2014-09-18
0637	HP	8901A	Modulation Analyzer	Not Required
0835	Narda	3293-1	Forward Power Coupler	Not Required
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11
A100	Narda	94455-1	Diode Detector	Not Required



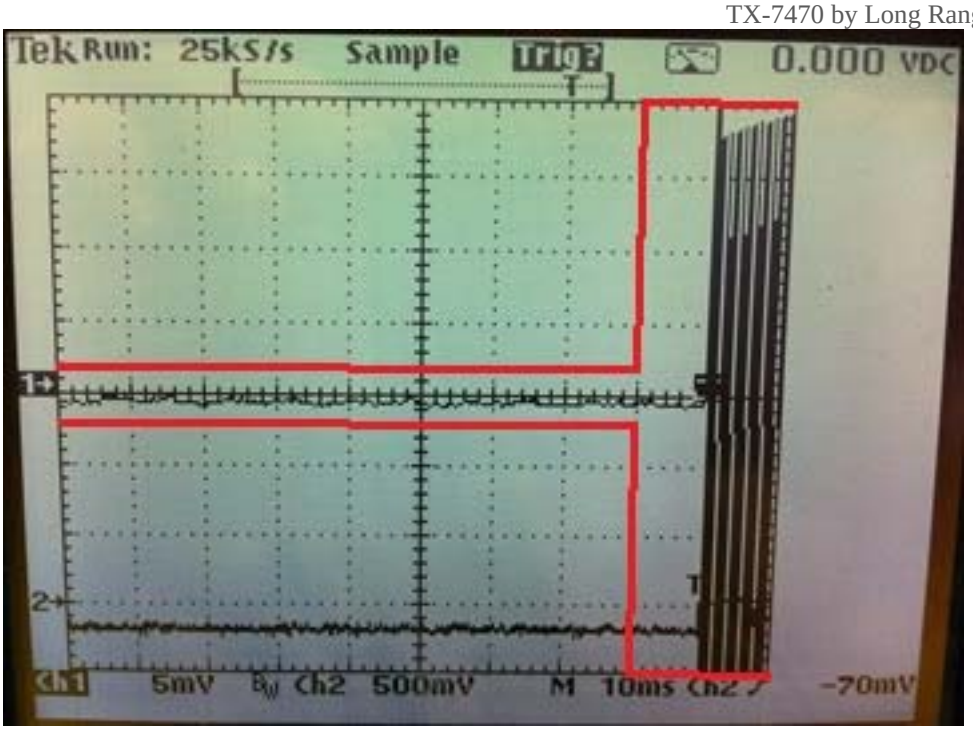
Low Channel; Response For Transmit Initiation – Limits Superimposed in Red



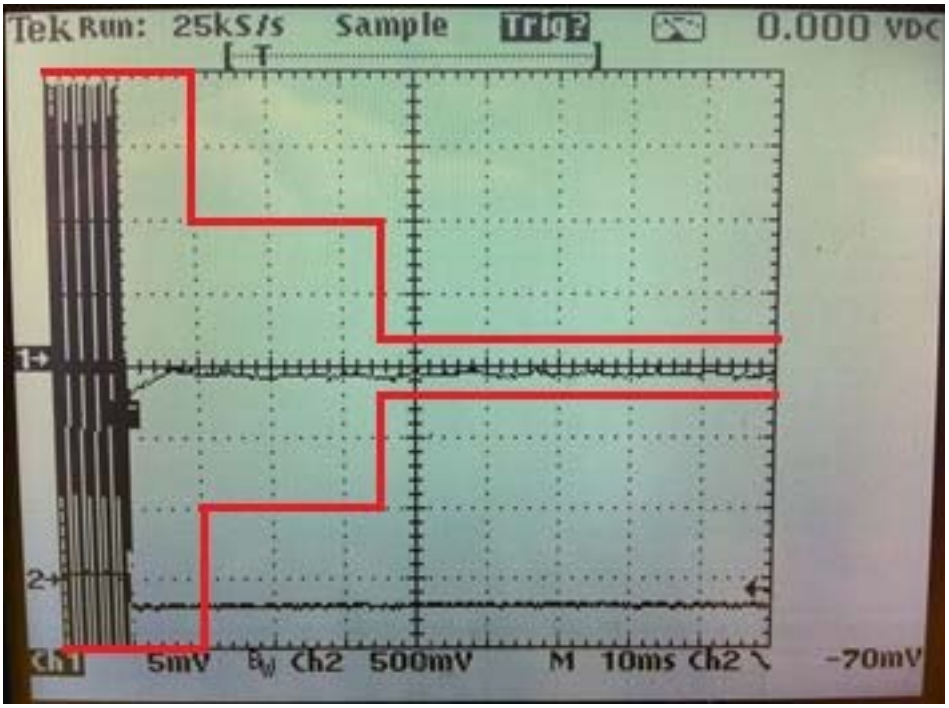
Low Channel; Response For Transmit Cessation – Limits Superimposed in Red



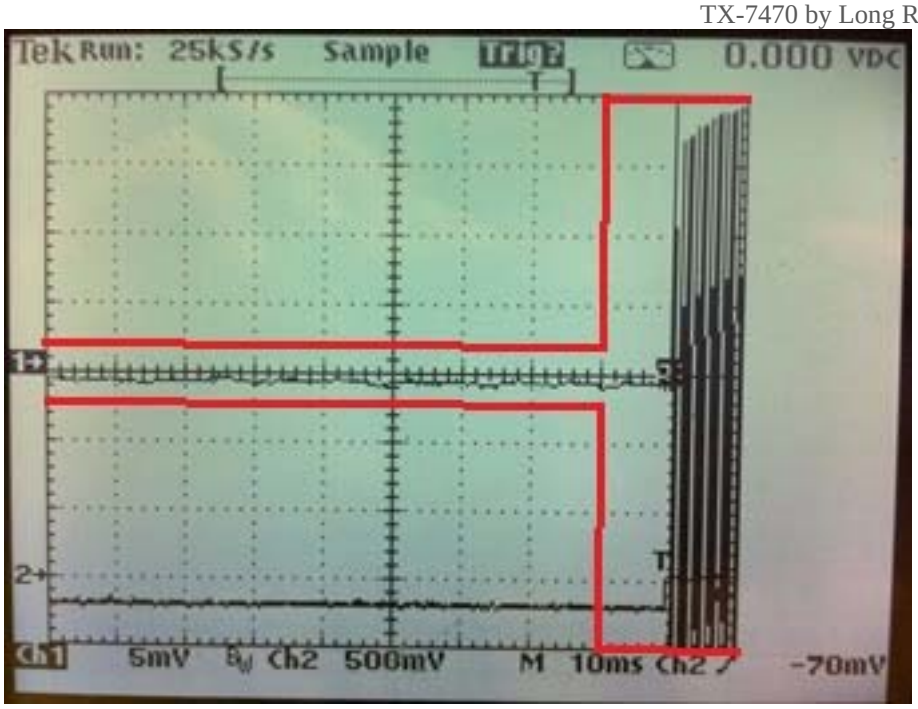
Mid Channel; Response For Transmit Initiation – Limits Superimposed in Red



Mid Channel; Response For Transmit Cessation – Limits Superimposed in Red



High Channel; Response For Transmit Initiation – Limits Superimposed in Red



High Channel; Response For Transmit Cessation – Limits Superimposed in Red

11.0 Emission Bandwidth

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	90.209, 2.1049 | RSS 119 Issue 11, 5.5	2015-02-26

11.3 Results

Table 11.3.1 Equipment List

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
A105	Narda	768A-20	20 Watt 20 dB Attenuator, DC to 11 GHz	2015-10-11

Table 11.3.2a Bandwidth, Low Channel

Bandwidth Measurement Method	Measured Bandwidth
20 dB	9.30 kHz

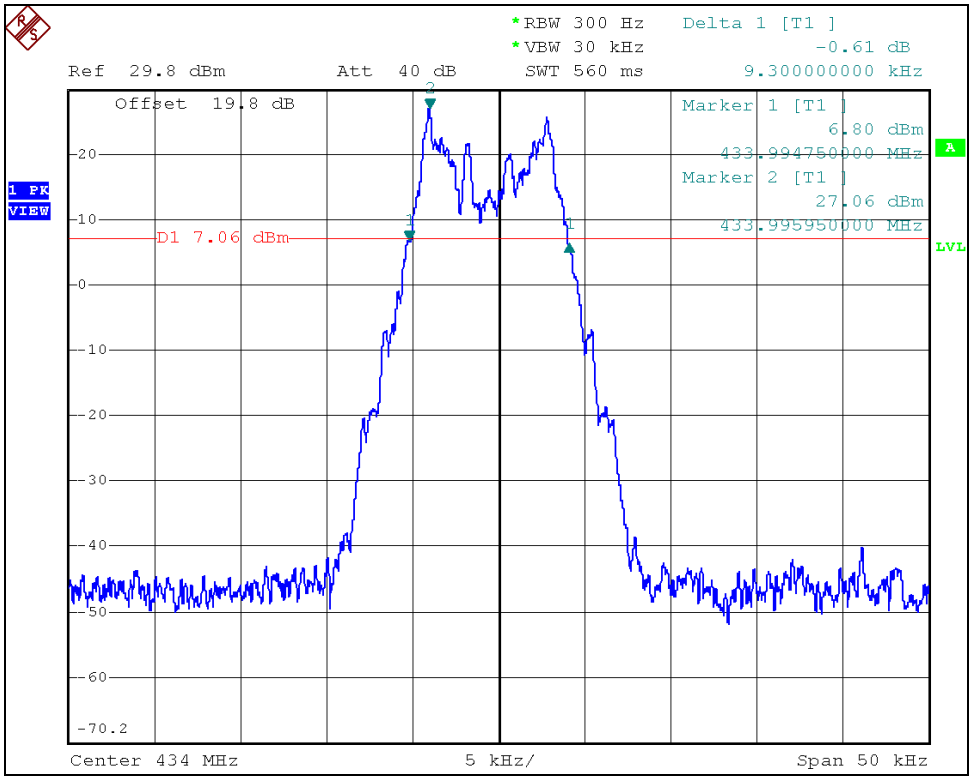
Table 11.3.2b Bandwidth, Middle Channel

Bandwidth Measurement Method	Measured Bandwidth
20 dB	9.20 kHz

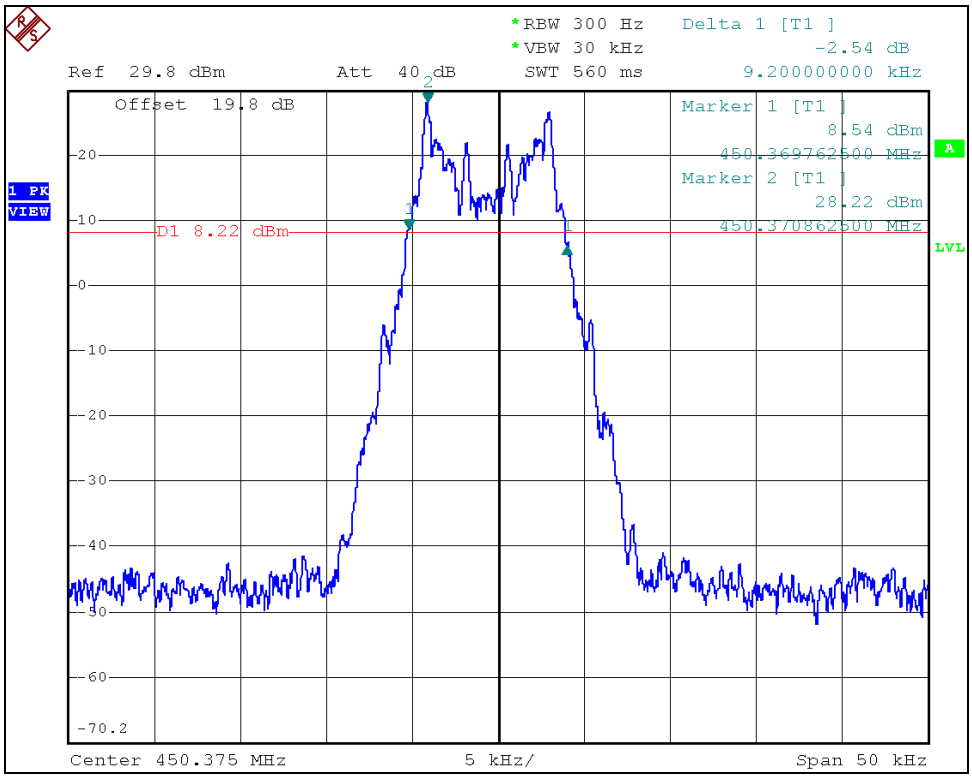
Table 11.3.2c Bandwidth, High Channel

Bandwidth Measurement Method	Measured Bandwidth
20 dB	9.20 kHz

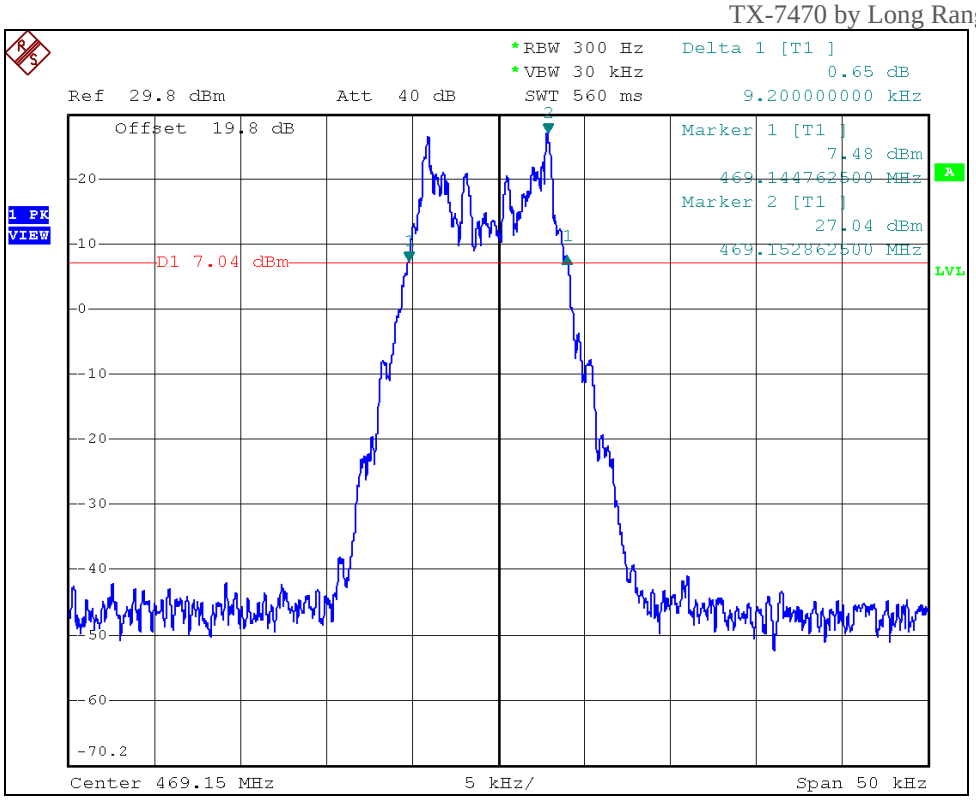
The emission satisfies the bandwidth criteria. Plotted results appear below.



Low Channel; Bandwidth, 20 dB



Mid Channel; Bandwidth, 20 dB



High Channel; Bandwidth, 20 dB

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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