Project 19703-15

Exhibit Set AZ489FT3844

Motorola Solutions Inc
CB200-M

MURS Paging Transmitter
151.820 to 154.600 MHz

Wireless Certification Report

FCC Part 95 MURS

Prepared for:

Motorola Solutions Inc
8000 W. Sunrise Blvd.
Ft. Lauderdale FL 33322
USA

By

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

9 Feb 2018

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
01	Final	9 Feb 2018

Errata:

None.

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Certificate of Compliance

FCC MRA Designation Number: US5270
NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification	
Motorola Solutions Inc	FCC ID:	AZ489FT3844
8000 W. Sunrise Blvd.	IC ID:	Not applicable.
Ft. Lauderdale FL 33322	Model(s):	CB200-M
Certificate Date: 23 Jan 2018	Laboratory Project ID:	19703-15

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
Paragraph & Parameter
§95.2725 MURS interference.
§95.2731 Permissible MURS uses.
§95.2733 Prohibited MURS uses.
§95.2741 MURS antenna height limit.
§95.2749 MURS network connection.
§95.2757 MURS duration of transmissions.
§95.2761 MURS transmitter certification.
§95.2763 MURS channels.
§95.2765 MURS frequency accuracy.
§95.2767 MURS transmitting power limit.
§95.2771 MURS emission types.
§95.2773 MURS authorized bandwidths.
§95.2775 MURS audio filter.
§95.2779 MURS unwanted emissions limits.
§15.109 Unintentional emissions
TIA/EIA-603-E Transient Frequency Behavior

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 requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

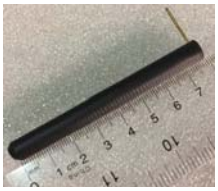
This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of North America.

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 methods of TIA/EIA-603 were applied unless specified otherwise in the associated agency rules and procedures.

1.2 EUT Description

Table 1.2.1 Equipment Under Test

Manufacturer & Description	Basic Properties	Photo
Motorola Solutions Inc Paging transmitter with user interface. Model CB200-M Serial Number: none	Dimensions ~19 x 11 x 3 cm. Typically wall mounted. Powered internally by six AA batteries in series/parallel to provide 4.5 VDC maximum; nominally 4.0 VDC in operation. Photo at right shown with cosmetic cover in place and battery holder partially removed at bottom end.	

Table 1.2.2 Antenna Description	Photo
Shortened/helical quarter-wave monopole soldered to circuit board. It is positioned near the bottom edge of circuit board and becomes oriented vertically when EUT is wall mounted. Antenna is fully contained in the enclosure and cannot be touched or modified by the user. Length ~7.7 cm. Gain 0 dBi.	

1.3 EUT Operation

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

Conducted measurements were taken on center-most channel for each modulation mode (narrow and wide).

Cabinet radiated measurements were taken for a wider frequency range that fully represents emissions for the contained and smaller MURS frequency range.

Table 1.3.1 Operating Frequency/Range; Narrow Mode 12.5 kHz			
Lowest Frequency	**Center Frequency**	**Highest Frequency**	**Total Frequency Range**
151.820 MHz	151.880 MHz	151.940 MHz	0.12 MHz
One channel tested per practice for a frequency range between under 1 MHz. Center channel selected for test.			

Table 1.3.2 Operating Frequency/Range; Wide Mode 25 kHz			
Lowest Frequency	**Center Frequency**	**Highest Frequency**	**Total Frequency Range**
154.57 MHz	N/A	154.600 MHz	0.03 MHz
One channel tested per practice for a frequency range between under 1 MHz. Highest channel selected for test.			

Table 1.3.3 Statements Regarding MURS Requirements	
Paragraph Reference	**Justification**
§95.2725 MURS interference.	The device first listens for an idle channel before transmitting.
§95.2731 Permissible MURS uses.	The device only transmits locally pre-recorded voice messages, and optionally with standard sub-audible coding.
§95.2733 Prohibited MURS uses.	The receiving function is limited to testing for channel activity only. It cannot function as a booster or as a store-and-forward device.
§95.2741 MURS antenna height limit.	The antenna is internal to the device. The device is used within or mounted to a wall of the hosting structure. It is not designed to be mounted on a mast or tower. There is no external antenna connector.
§95.2749 MURS network connection.	The device has no capability to connect to the PSTN.
§95.2757 MURS duration of transmissions.	The device total storage capacity is 20 seconds and has minimum delays programmed to listen for channel activity. Consequently the maximum transmit time is limited by design.
§95.2761 MURS transmitter certification.	This model is exclusively programmed and sold as a MURS device.
§95.2763 MURS channels.	This model can be programmed to operate on the following channels: 151.820, 151.880, 151.940, 154.570, and 154.600 MHz

1.4 Modifications to Equipment

A 0.015 µF capacitor was added across the microphone leads to suppress unwanted high audio frequencies to satisfy the 95.2775 audio response limits. Firmware version "u" was generated to select a programmed set of modulation filters to enhance suppression of modulation above 3 kHz.

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.

1.6 Applicable Documents

Table 1.6.1: Applicable Documents		
Document #	**Title/Description**	**Date**
47 CFR	FCC Part 95, FCC Part 2, with applicability to MURS devices.	
TIA/EIA-603-E	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services;	2015

2.0 Conducted Output Power

2.1 Procedure

The EUT is placed into continuous transmit mode without modulation for peak power measurement.

2.2 Criteria

Parameter	Section Reference	Date
Conducted Output Power	§95.2767 MURS transmitting power limit. 2.1046	22 Jan 2018

2.3 Results

EUT antenna port was directly coupled to the spectrum analyzer without a cable so power was read directly with no factors required.

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

Table 2.3.1 Power, Peak, Conducted

Frequency (MHz)	Power (dBm)	Power (mW)
151.880	25.38	345
154.600	25.33	341

3.0 Modulation

3.1 Procedure

Measure audio frequency response and compare to specific MURS attenuation curve. Measure modulation limiting response with a +20 dB step in modulation level.

3.2 Criteria

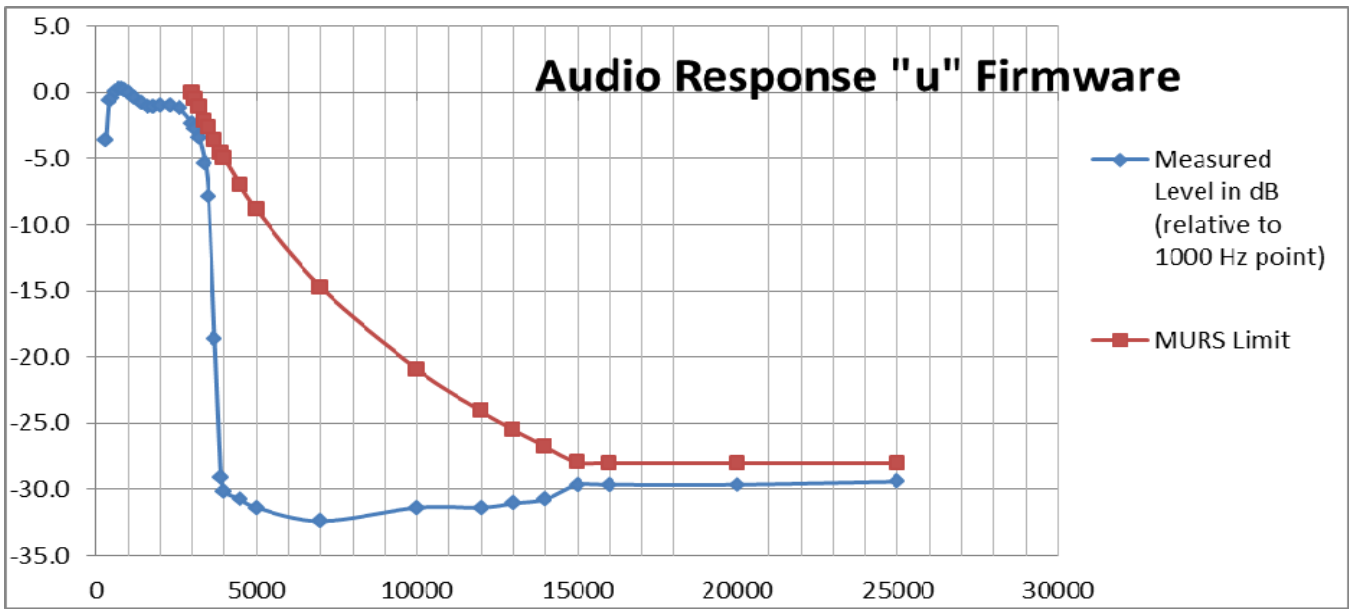
Parameter	Section Number	Date
Audio Frequency Response Modulation Limiting	§95.2775 MURS unwanted emissions limits. §2.1047	5 Jan 2018 8 Jan 2018

3.3 Results

The center most channel (151.94 MHz) was selected for this test with narrow channel spacing mode.

Reference point is 1000 Hz with deviation level of 60% or 1.5 kHz.

3.3.1 Audio Frequency Response



3.3.2 Modulation Limiting Response

Applied Modulation Frequency Hz	Measured Average Level kHz	Measured Peak Levels kHz
300	1.1	+2.2 & -2.1
1000	1.5	+2.5 & -2.4
1500	1.5	+2.7 & -2.7
3000	1.5	+2.5 & -2.4

4.0 Emission Mask

4.1 Procedure

Emissions are measured with peak detector with the mask superimposed on the graph.

4.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals Channel Mask Measurement	§95.2779 MURS unwanted emissions limits. §2.1047	22 Jan 2018

4.3 Results

4.3.1 Applicable Limits with Audio Filter 95.2779(b)3, 4, and 7

The device incorporates an audio filter that meets the requirement of 95.2775 making the following emission limits applicable:

25 dB on any frequency removed from the channel center frequency by more than 10 kHz, but not more than 20 kHz.

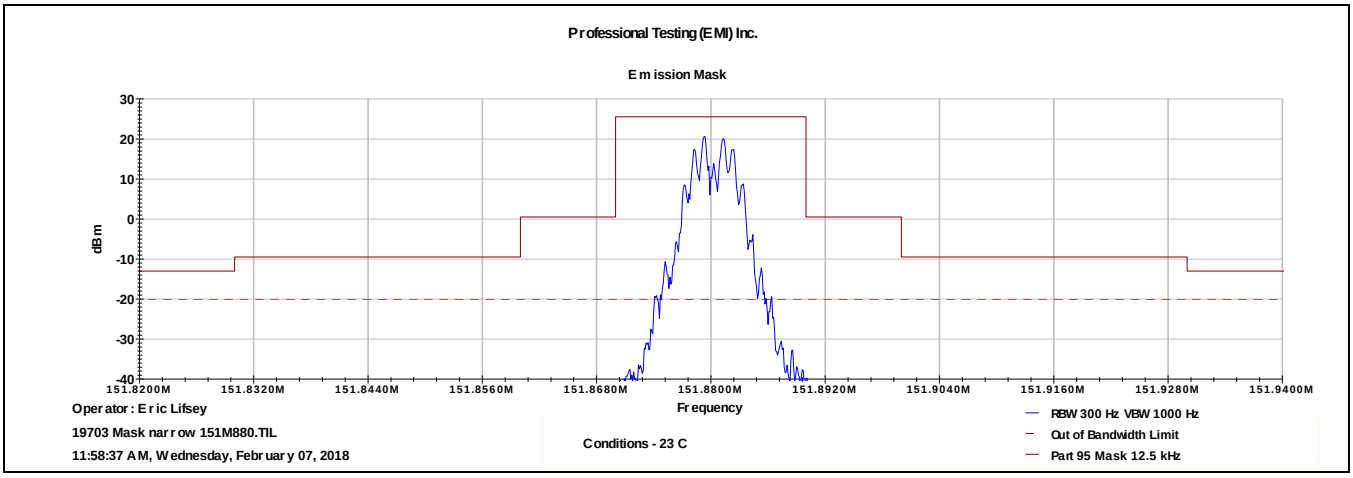
35 dB on any frequency removed from the channel center frequency by more than 20 kHz, but not more than 50 kHz.

43 + 10 log(P) dB on any frequency removed from the channel center frequency by more than 50 kHz.

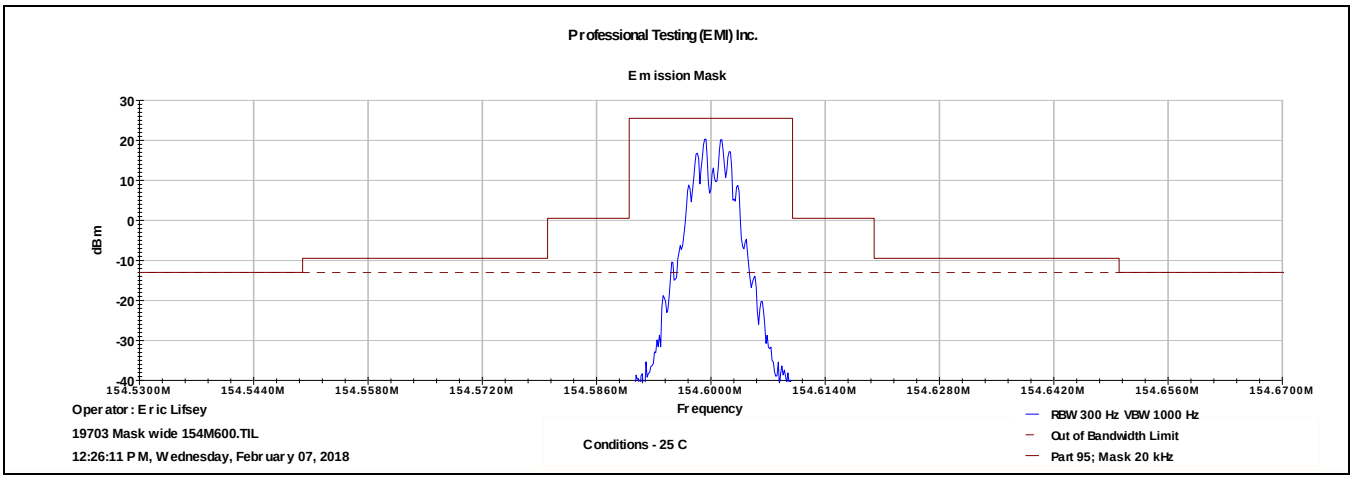
The emission was measured coupled directly to the analyzer without cabling.

The EUT satisfied the requirement. Measurements appear below.

4.3.2 12.5 kHz Mask (b)3, 4, 7



4.3.3 25 kHz Mask (b)3, 4, 7



5.0 Spurious Emissions at Antenna Terminals

5.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode without modulation. The connection is direct and no cables are used. Spurious signals are then measured directly with no additional calculation required. Emissions are measured with a peak detector function from 9 kHz to 5 GHz to include the tenth harmonic 4.75 GHz.

5.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals Spurious Emission	§95.2779 MURS unwanted emissions limits.	22 Jan 2018

Limit is determined from for emissions beyond the authorized bandwidth.

5.3 Results

Measurements were performed with a direct connection to the spectrum analyzer such that no external losses or gains would apply. Measurement bandwidth is detailed in the graphs provided.

Emission limit for spurious is -20 dBm.

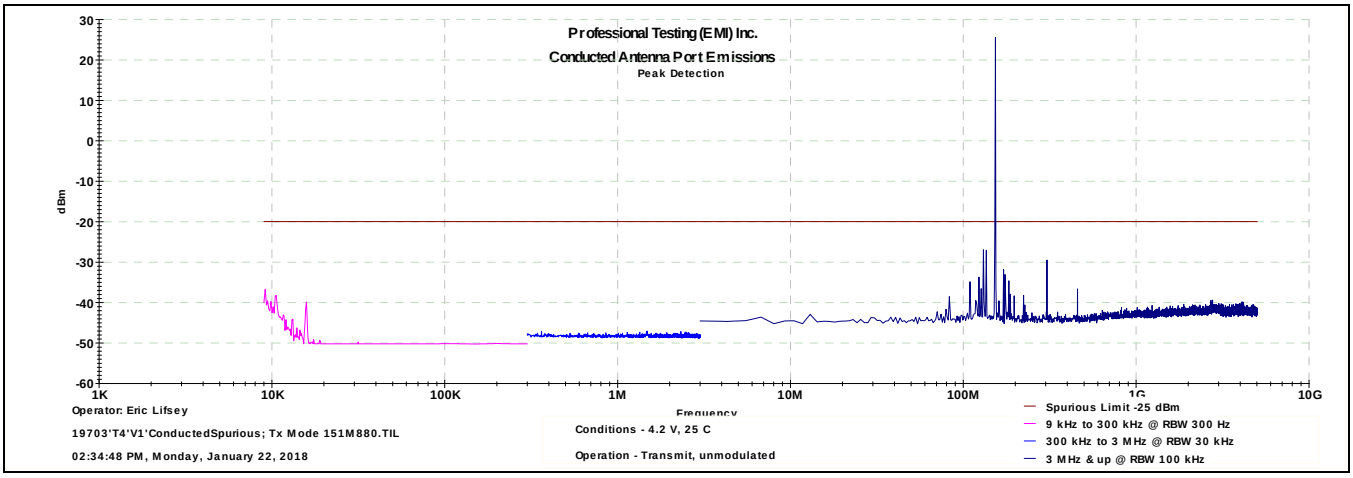
Emission limit per 15.111 applies to the receive mode.

Highest transmit harmonic spurious emission recorded: -29.48 dBm at 304.07 MHz.

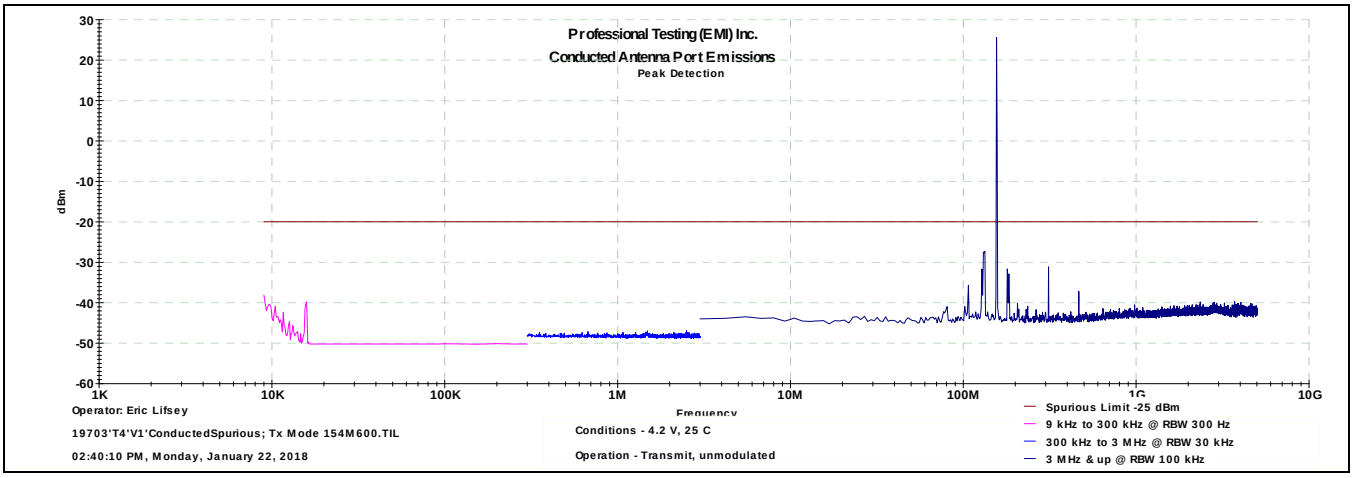
Highest transmit non-harmonic spurious emission recorded: -27.3 dBm at 132.92 MHz

The EUT satisfied the requirement. Measurements appear below.

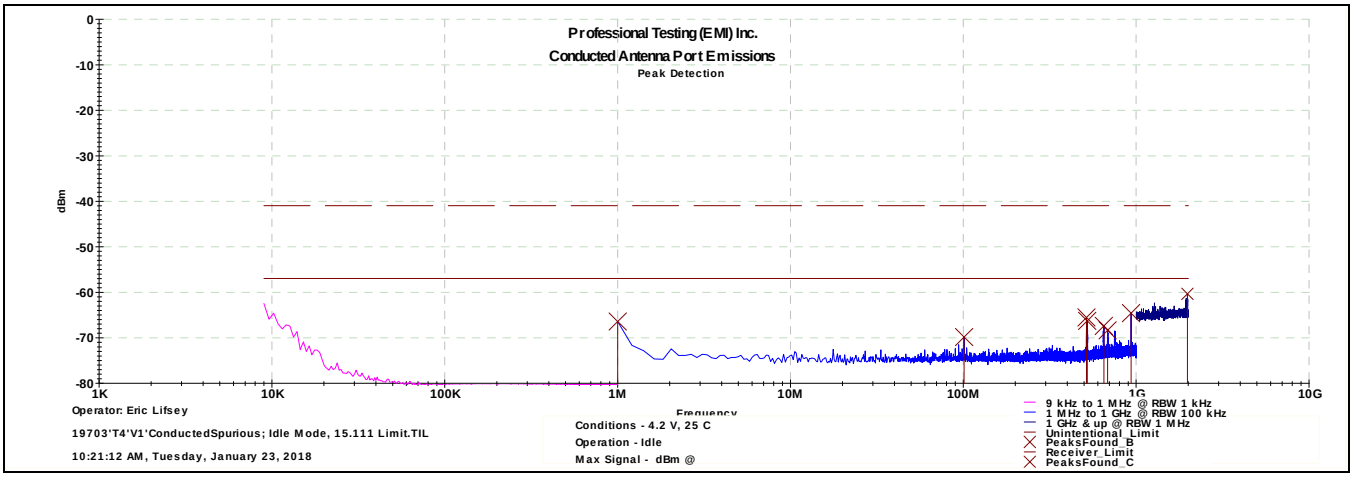
5.3.1 Transmit Mode, Narrow Mode, 151.880 MHz



5.3.2 Transmit Mode, Wide Mode, 154.600 MHz



5.3.3 Receive/Idle Mode

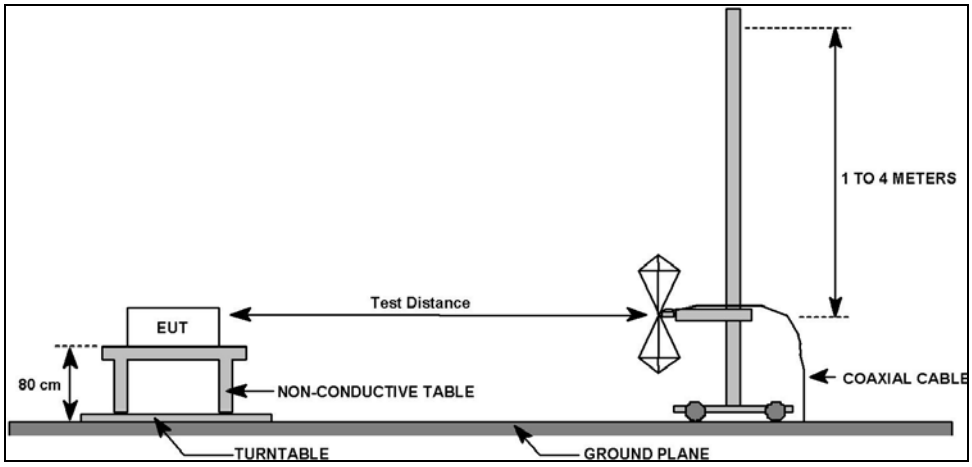


5.3.3.1 Table of Highest Recorded Peak Emissions	
Frequency	**Corrected Level**
MHz	**dBm**
1.000	-66.440
100.900	-69.870
515.069	-65.570
519.856	-66.310
648.685	-67.400
682.193	-68.390
931.735	-64.600
1973.750	-60.380

6.0 Field Strength of Radiated Spurious Emissions

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 transmit or receive mode with the antenna removed and a resistive terminator substituted.



Field Strength of Radiated Emissions Test Setup

6.2 Criteria

Parameter	Section Number	Date
Field Strength of Radiated Emissions 30 MHz to 5 GHz	§95.2779 MURS unwanted emissions limits. §2.1053	20 Sep 2017

6.3 Results

Conducted limit is -20 dBm.

Highest recorded transmit spurious emission: 37 dBµV/m @ 10 m on 452 MHz.

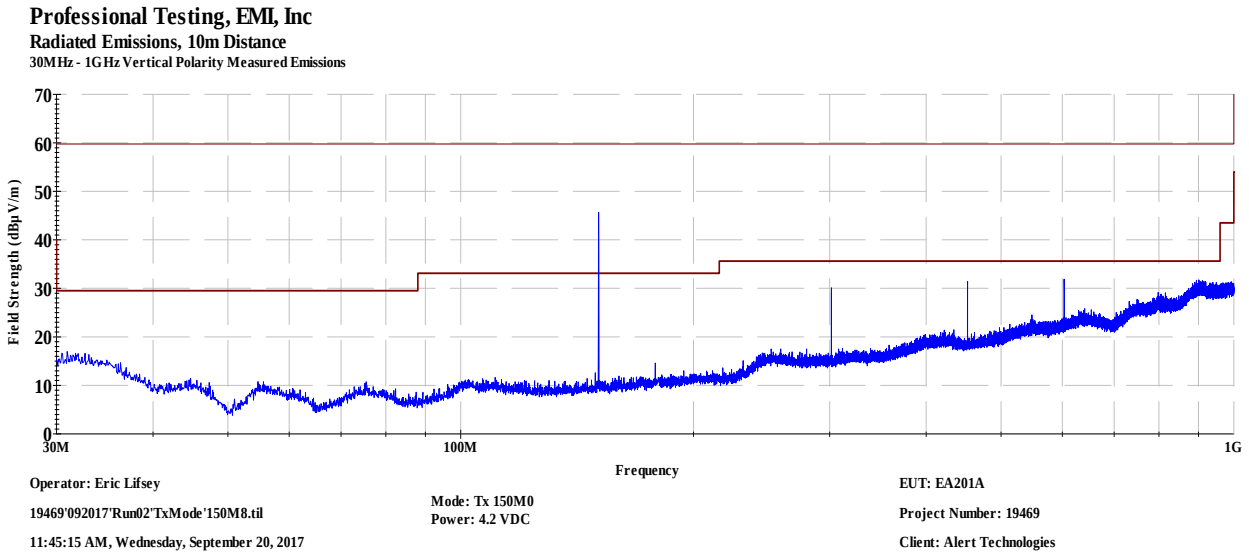
No emissions detected in receive mode.

The EUT satisfied the requirement. Measurements appear below.

6.3.1 Transmit Mode, Below 1 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	EUT Serial #:	None
Customer:	MSI	EUT Part #:	None
Project Number:	19469	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	CB200-M	Witness' Name:	None

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Bot Chan	



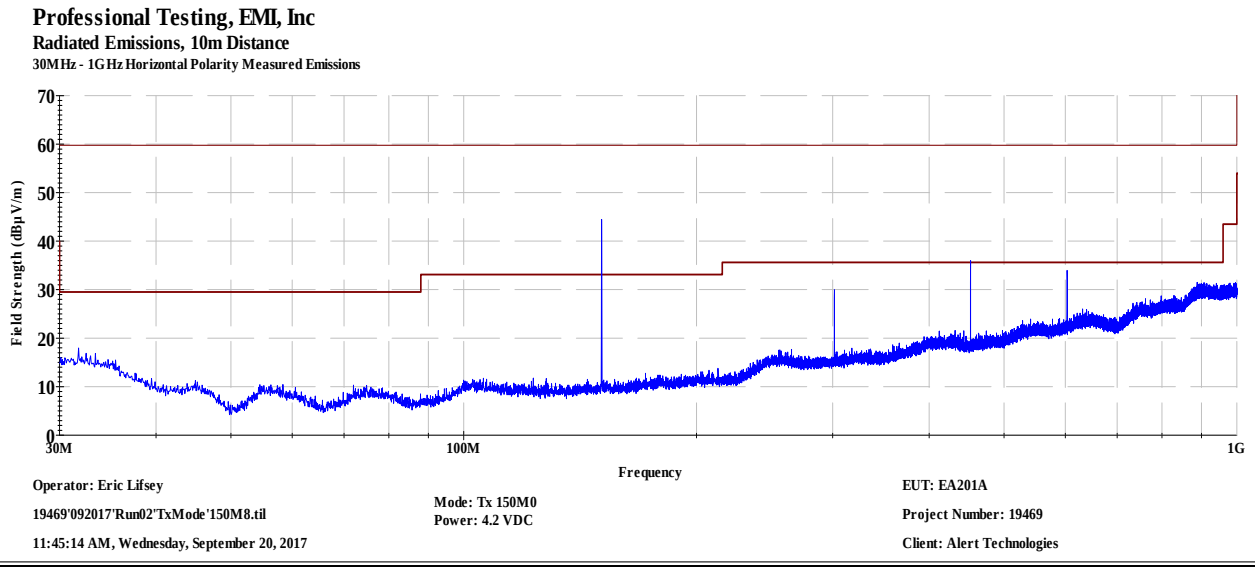
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19469	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB200-M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Bot Chan	

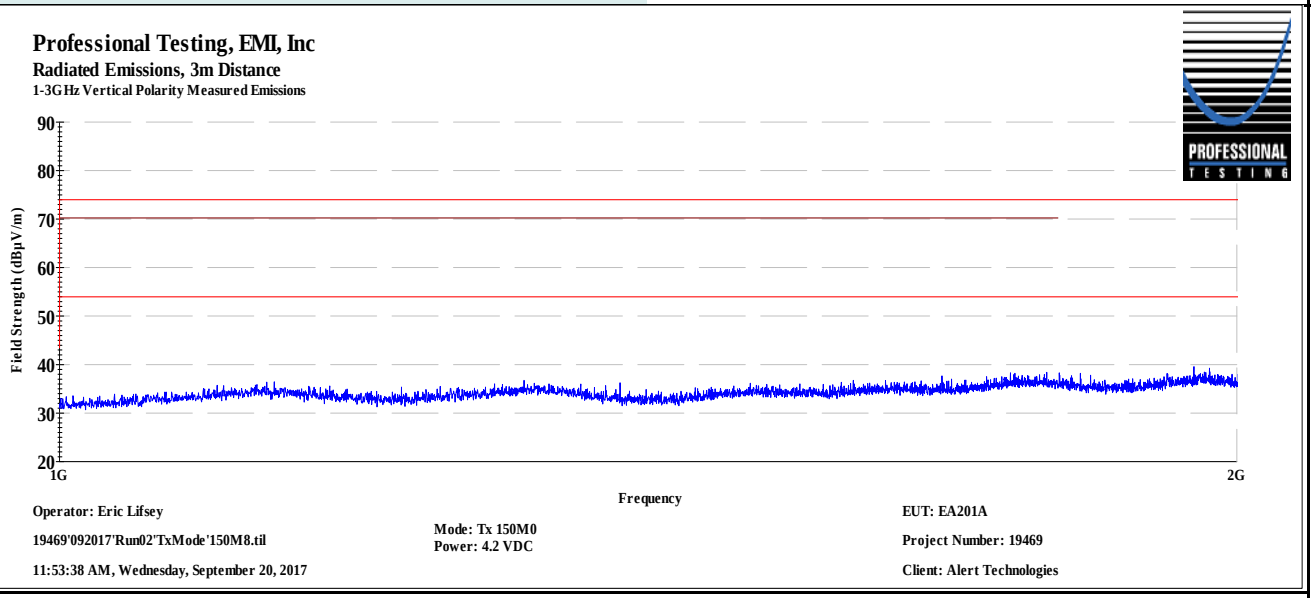


≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Transmit Mode, Above 1 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	EUT Serial #:	None
Customer:	MSI	EUT Part #:	None
Project Number:	19469	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	CB200-M	Witness' Name:	None

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit, Bot Chan	



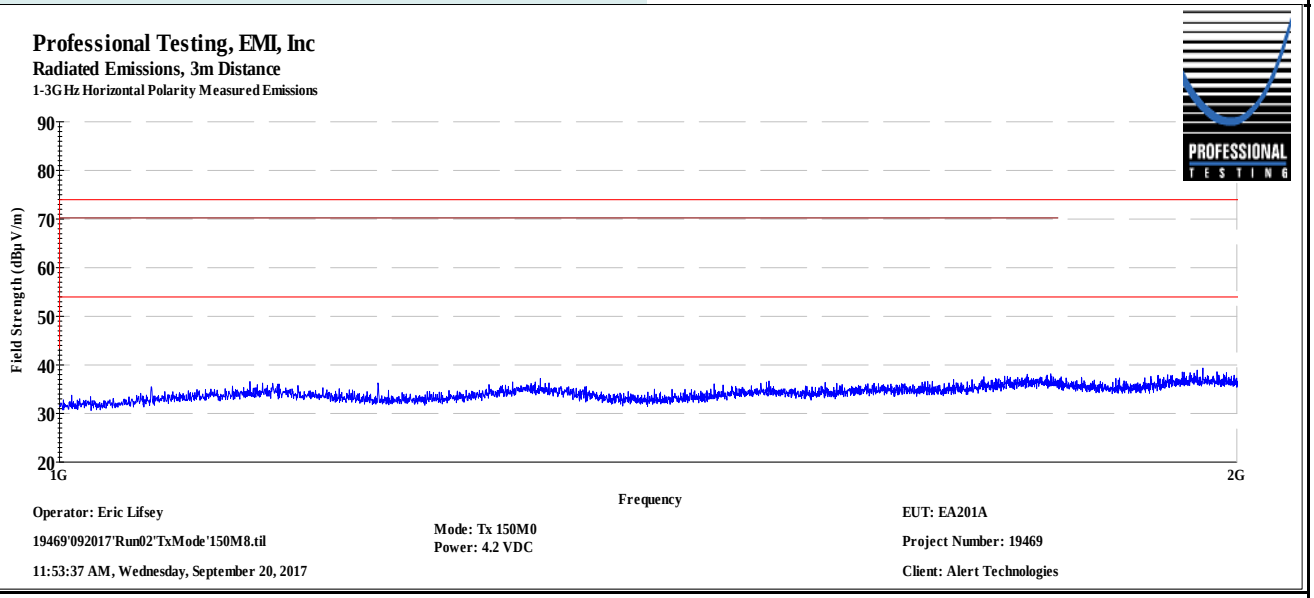
> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19469	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB200-M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit, Bot Chan	



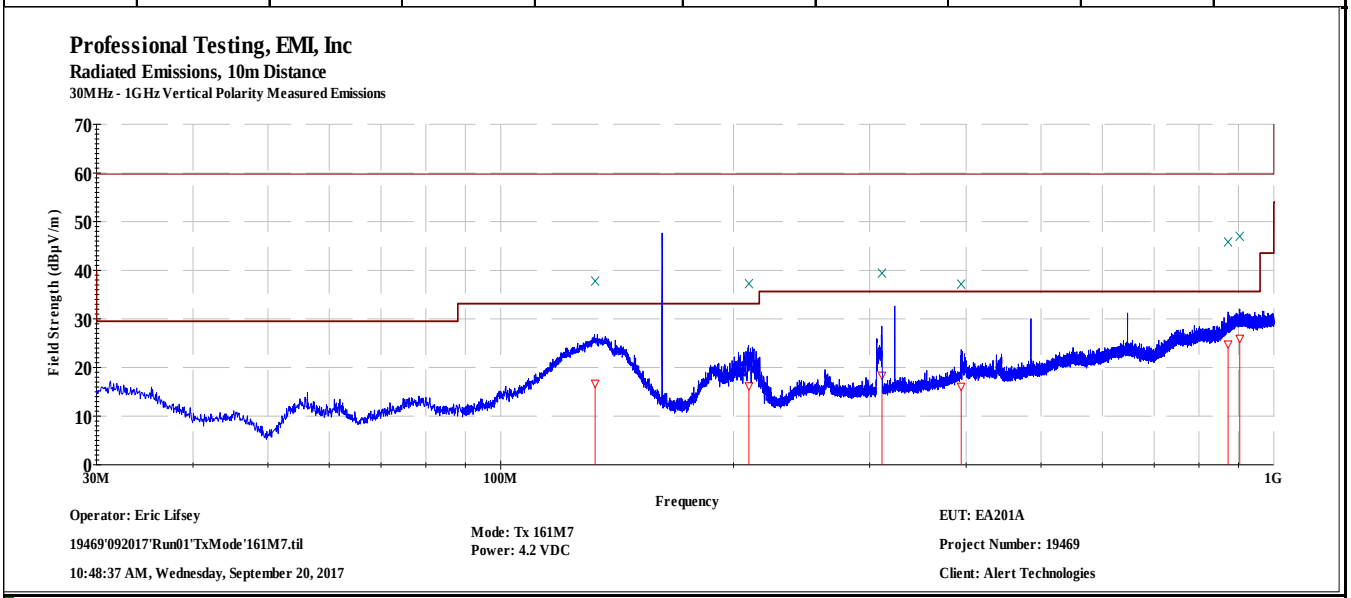
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Transmit Mode, Below 1 GHz, Top Channel

Professional Testing, EMI, Inc.			
Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	EUT Serial #:	None
Customer:	MSI	EUT Part #:	None
Project Number:	19469	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	CB200-M	Witness' Name:	None

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Top Chan	

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
132.49	10	227	1.25	Quasi-peak	34.1	16.739	33.0	-16.3	Pass
209.445	10	70	1.37	Quasi-peak	30.6	16.207	33.0	-16.8	Pass
311.27	10	133	1.62	Quasi-peak	28.5	18.386	35.6	-17.2	Pass
393.987	10	5	1.42	Quasi-peak	23.6	16.114	35.6	-19.5	Pass
872.526	10	138	4.07	Quasi-peak	21.3	24.805	35.6	-10.8	Pass
903.27	10	12	3.82	Quasi-peak	21.1	25.976	35.6	-9.6	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

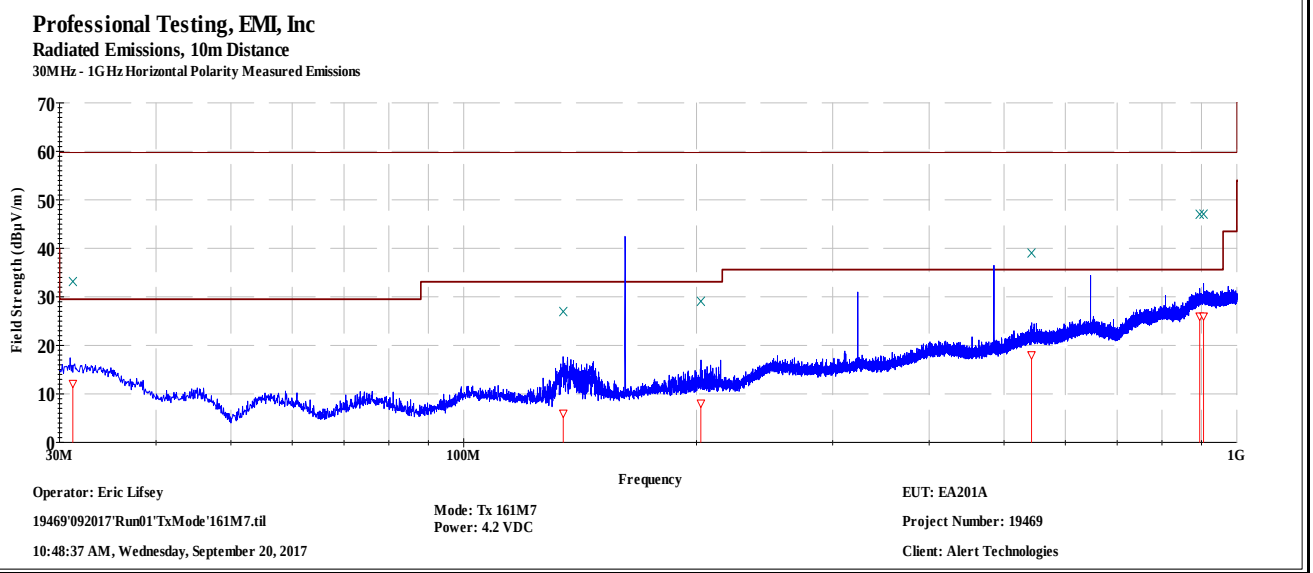
Professional Testing, EMI, Inc.

Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19469	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB200-M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Top Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.2278	10	155	2.93	Quasi-peak	24.1	12.139	29.0	-16.9	Pass
134.528	10	347	1.39	Quasi-peak	23.2	5.966	33.0	-27.0	Pass
202.69	10	354	1.13	Quasi-peak	22.4	8.069	33.0	-24.9	Pass
542.504	10	131	1.11	Quasi-peak	22.1	18.033	35.6	-17.6	Pass
895.438	10	43	1.14	Quasi-peak	21.3	26.008	35.6	-9.6	Pass
905.719	10	28	3.08	Quasi-peak	21.2	26.033	35.6	-9.6	Pass



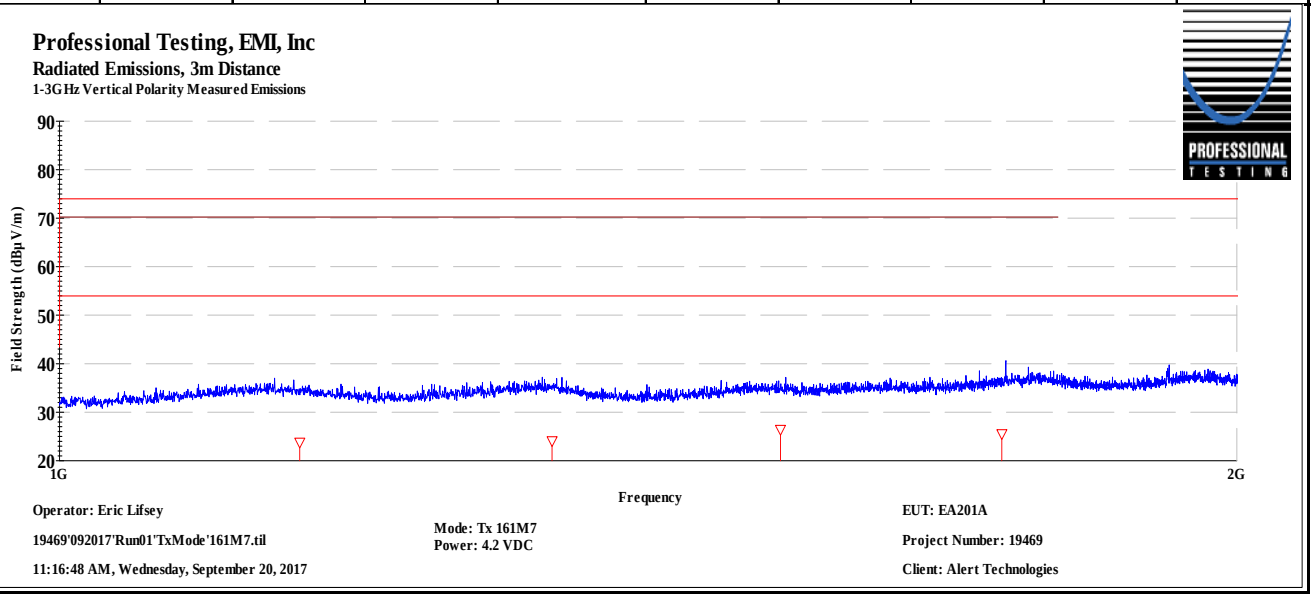
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.4 Transmit Mode, Above 1 GHz, Top Channel

Professional Testing, EMI, Inc.			
Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	EUT Serial #:	None
Customer:	MSI	EUT Part #:	None
Project Number:	19469	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	CB200-M	Witness' Name:	None

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit, Top Chan	

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
1151.96	3	218	2.69	Average	36.3	23.772	54.0	-30.2	Pass
1336.42	3	338	2.27	Average	36.1	24.092	54.0	-29.9	Pass
1528.73	3	12	3.83	Average	38.3	26.435	54.0	-27.6	Pass
1741.59	3	63	2.39	Average	35.5	25.513	54.0	-28.5	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

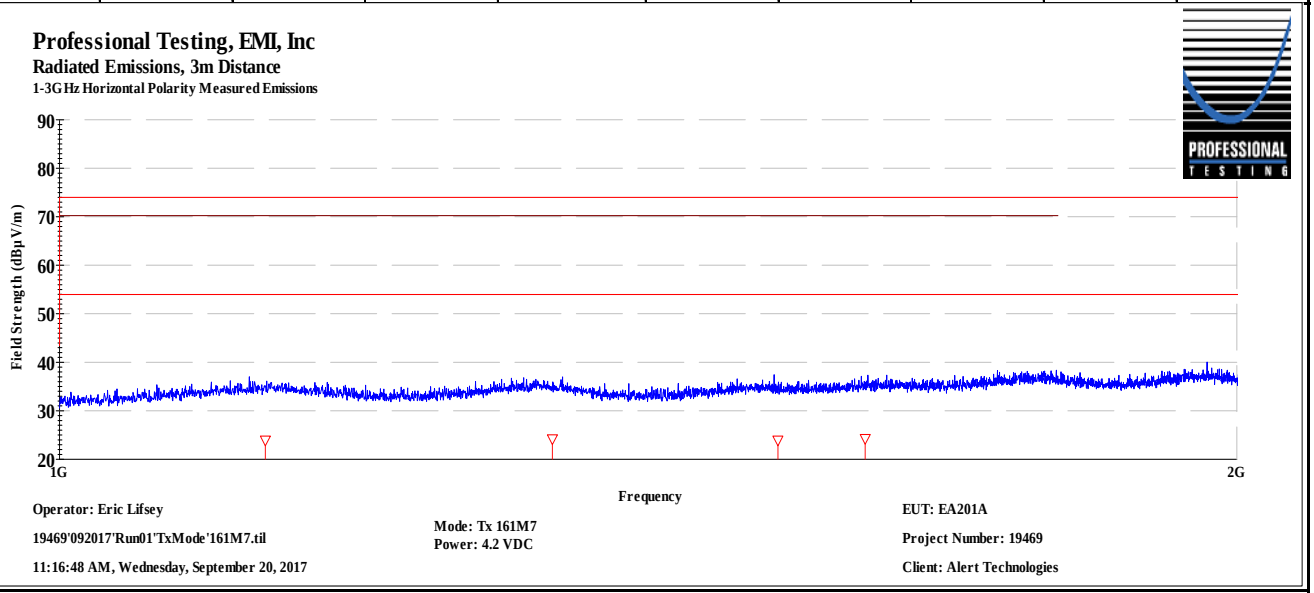
Test Method:	Part 95		
In accordance with:	Part 95		
Section:	Spurious cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19469	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB200-M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit, Top Chan	

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
1128.86	3	101	1.44	Average	36.6	23.926	54.0	-30.1	Pass
1336.7	3	119	1.14	Average	36.1	24.169	54.0	-29.8	Pass
1526.44	3	14	2.61	Average	35.8	23.906	54.0	-30.1	Pass
1606.93	3	344	3.77	Average	35.4	24.259	54.0	-29.7	Pass

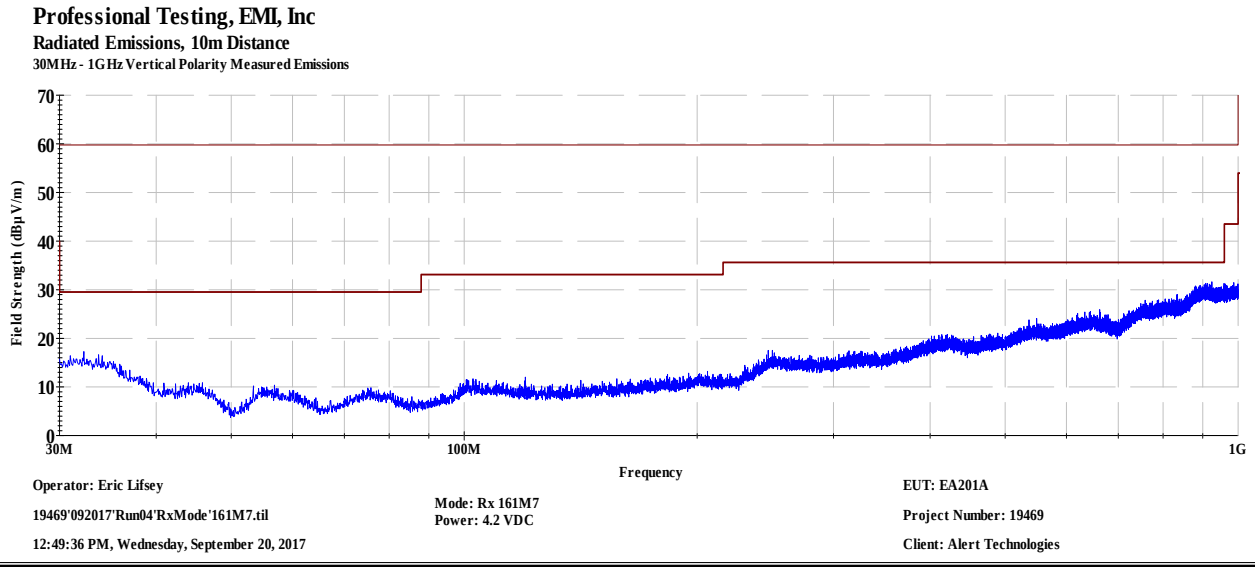


> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.5 Receive Mode

Professional Testing, EMI, Inc.			
Test Method:	Part 15		
In accordance with:	Part 15		
Section:	Cabinet radiated emissions		
Test Date(s):	9/20/2017	EUT Serial #:	None
Customer:	MSI	EUT Part #:	None
Project Number:	19372-15	Test Technician:	Eric Lifsey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	CB-200M	Witness' Name:	None

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	



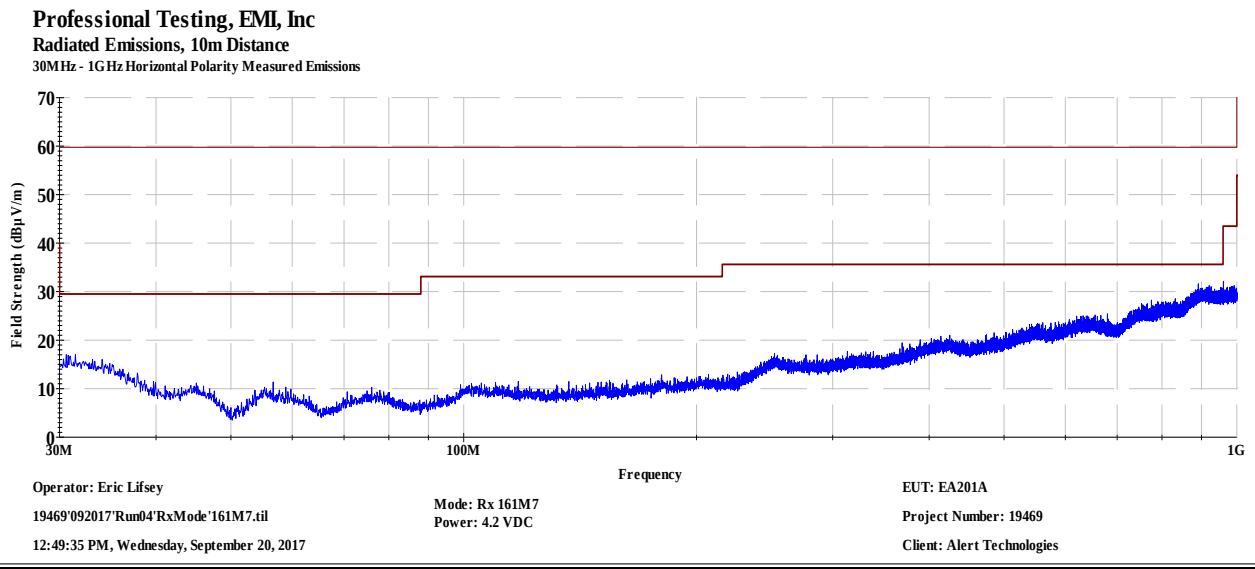
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	Part 15		
In accordance with:	Part 15		
Section:	Cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19372-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB-200M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	



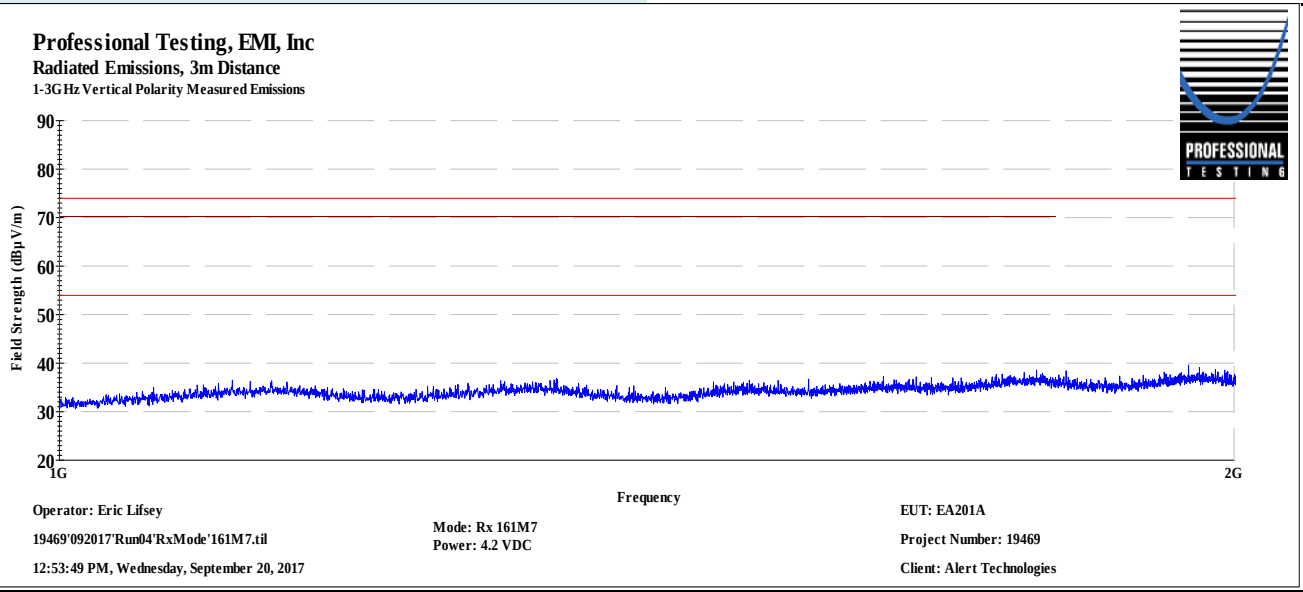
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	Part 15		
In accordance with:	Part 15		
Section:	Cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19372-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB-200M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Receive Mode	



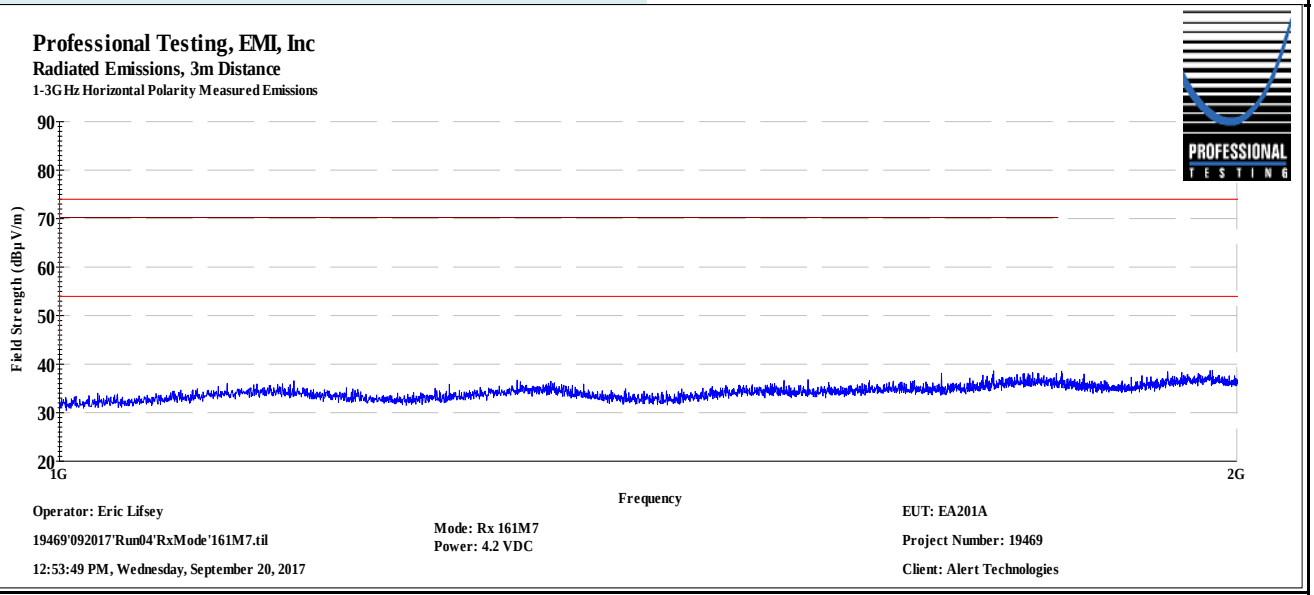
> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	Part 15		
In accordance with:	Part 15		
Section:	Cabinet radiated emissions		
Test Date(s):	9/20/2017	**EUT Serial #:**	None
Customer:	MSI	**EUT Part #:**	None
Project Number:	19372-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	N/A	**Supervisor:**	Lisa Arndt
Equip. Under Test:	CB-200M	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	4.2 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Receive Mode	



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Frequency Stability

7.1 Procedure

The EUT is placed into a temperature chamber with a cable coupling 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.

7.2 Criteria

Parameter	Section Number	Date
Frequency Stability Temperature, Voltage	§95.2765 MURS frequency accuracy.	21 Sep 2017

Table 6.2.1 Frequency Tolerance
± 2 ppm

Table 6.2.2 Operating Voltages		
Low	**Nominal**	**High**
3.3	**4.2**	**4.7**

The operating frequency shall remain within the required tolerance.

7.3 Results

The EUT satisfied the requirement. Measurements appear below.

7.3.1 Bottom Channel, Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	151.880000	151.880157	157
-20	151.880000	151.880105	105
-10	151.880000	151.880082	82
0	151.880000	151.880065	65
10	151.880000	151.880067	67
20	151.880000	151.880087	87
30	151.880000	151.880014	14
40	151.880000	151.880140	140
50	151.880000	151.880147	147
Max Deviation (Hz)			157
Min Deviation (Hz)			14

7.3.2 Bottom Channel, Operating Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	3.30	151.880000	151.880087	87
Nominal	4.20	151.880000	151.880097	97
High	4.70	151.880000	151.880105	105

7.3.3 Top Channel, Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	154.600000	154.600185	185
-20	154.600000	154.600120	120
-10	154.600000	154.600110	110
0	154.600000	154.600087	87
10	154.600000	154.600095	95
20	154.600000	154.600125	125
30	154.600000	154.600172	172
40	154.600000	154.600180	180
50	154.600000	154.600157	157
Max Deviation (Hz)			185
Min Deviation (Hz)			87

7.3.4 Top Channel, Operating Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	3.30	154.600000	154.600142	142
Nominal	4.20	154.600000	154.600140	140
High	4.70	154.600000	154.600135	135

8.0 Transient Frequency Behavior

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

The EUT is terminated with a suitable resistive attenuator 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.

8.1 Criteria

Parameter	Section Reference	Date
Transient Frequency Behavior	Procedure: TIA-603-E	11 Oct 2017

Table 7.1.1 Transient Frequency Limits

Time intervals[1,2]	Maximum frequency difference[3]	Frequency Range	
		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] t_{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.

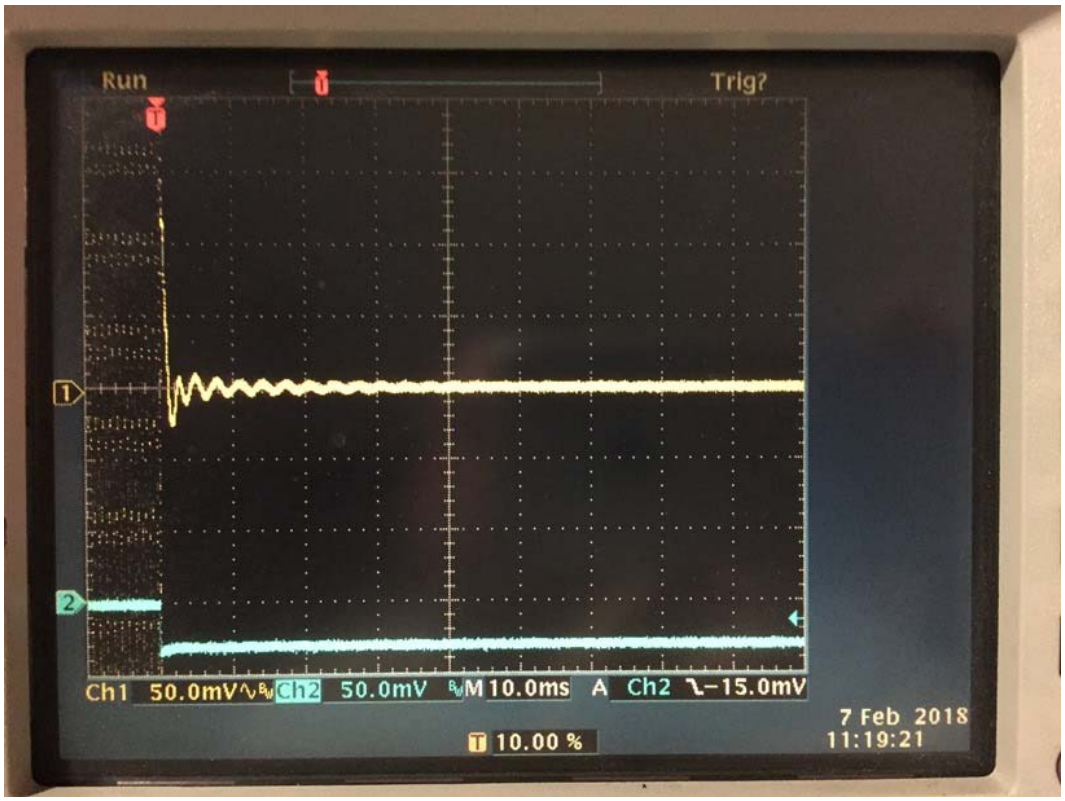
The measurement is performed for the lowest and highest operating frequency.

8.2 Results

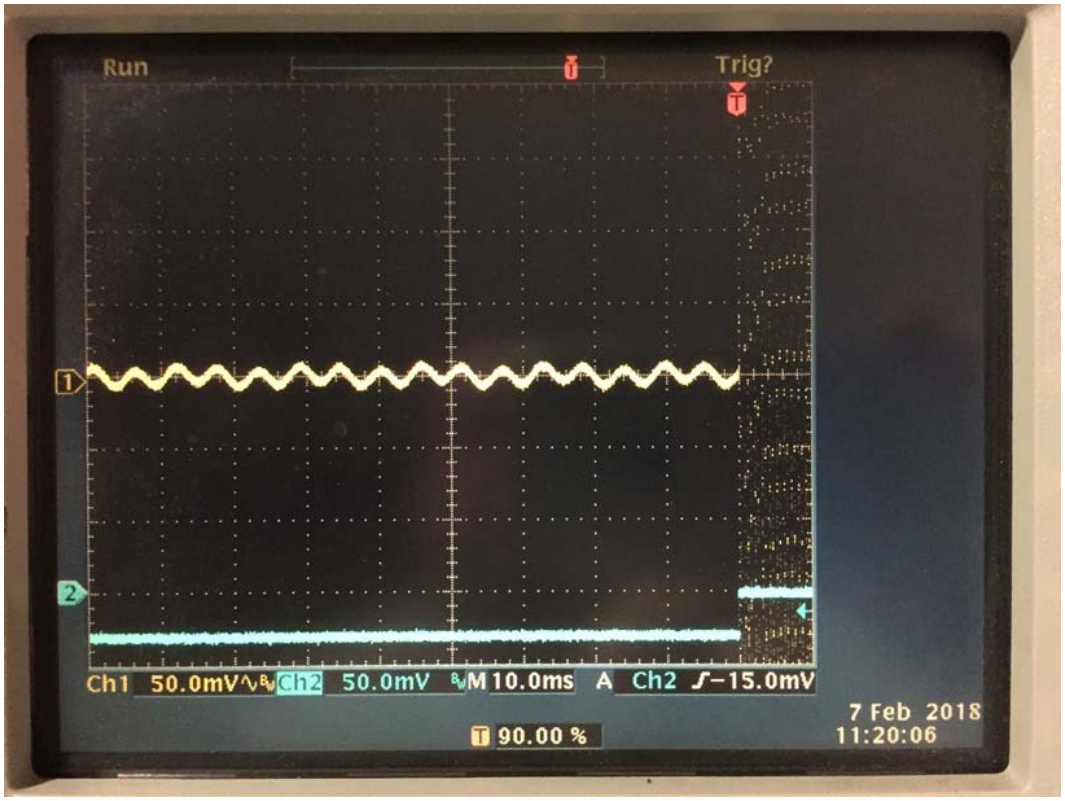
Plotted measurements appear on the following pages. The limits were not superimposed on the plots as the transmitter performance was clearly in compliance for any allowed channel scheme and for either 25 kHz or 12.5 kHz channel spacing.

The EUT satisfied the requirement. Measurements appear below.

8.2.1 Narrow Channel 151.880 MHz

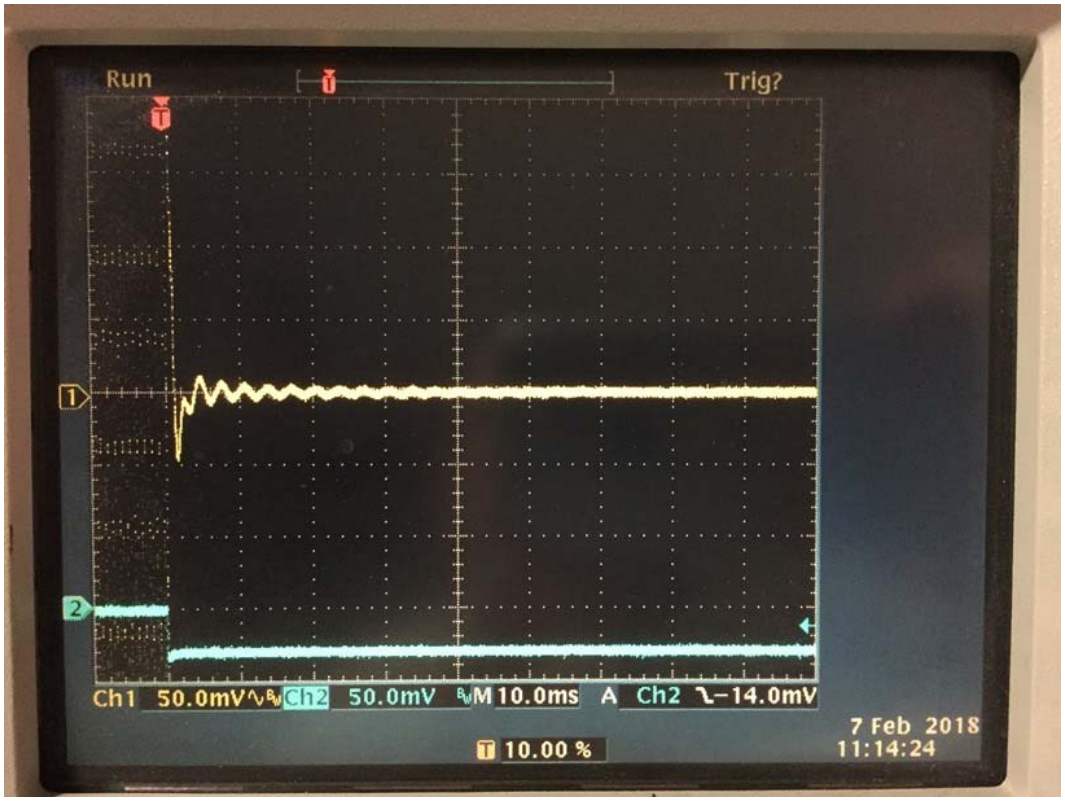


Attack

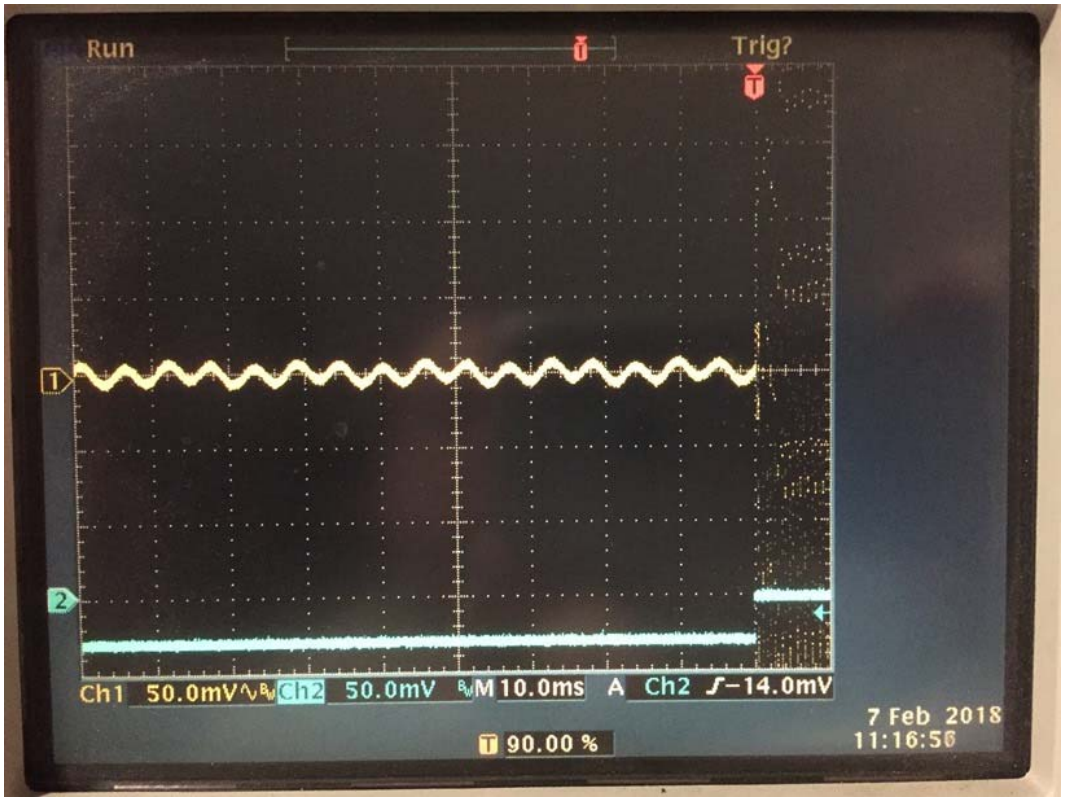


Release

8.2.2 Wide Channel 154.600 MHz



Attack



Release

9.0 Emission Bandwidth

9.1 Procedure

The EUT antenna port is coupled direct to the spectrum analyzer for measurement with attenuation if required.

9.2 Criteria

Parameter	Section Number	Date
Occupied Bandwidth for Reporting	§95.2773 MURS authorized bandwidths. §2.1049	5 Feb 2018

9.3 Results

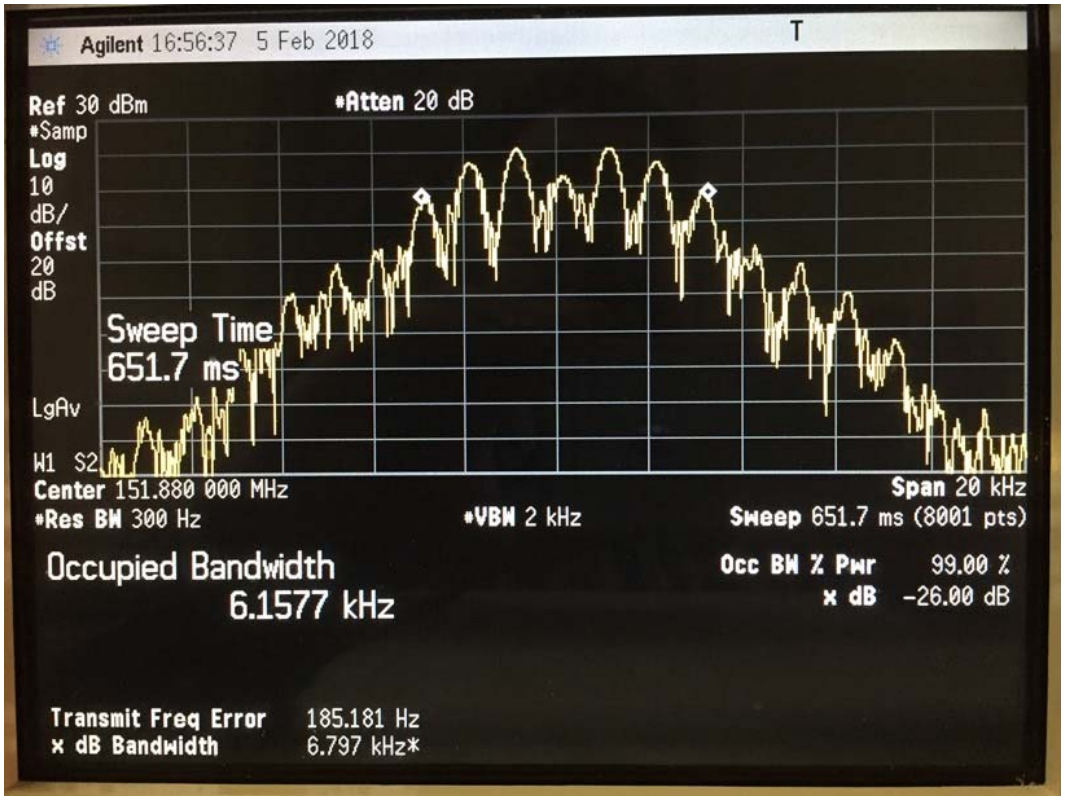
Table 8.3.1 Bandwidth 99%, 12.5 kHz Channel Spacing	
Frequency	**Measured Bandwidth**
151.88 MHz	6.16 kHz

Table 8.3.2 Bandwidth 99%, 25 kHz Channel Spacing	
Frequency	**Measured Bandwidth**
154.60 MHz	6.15 kHz

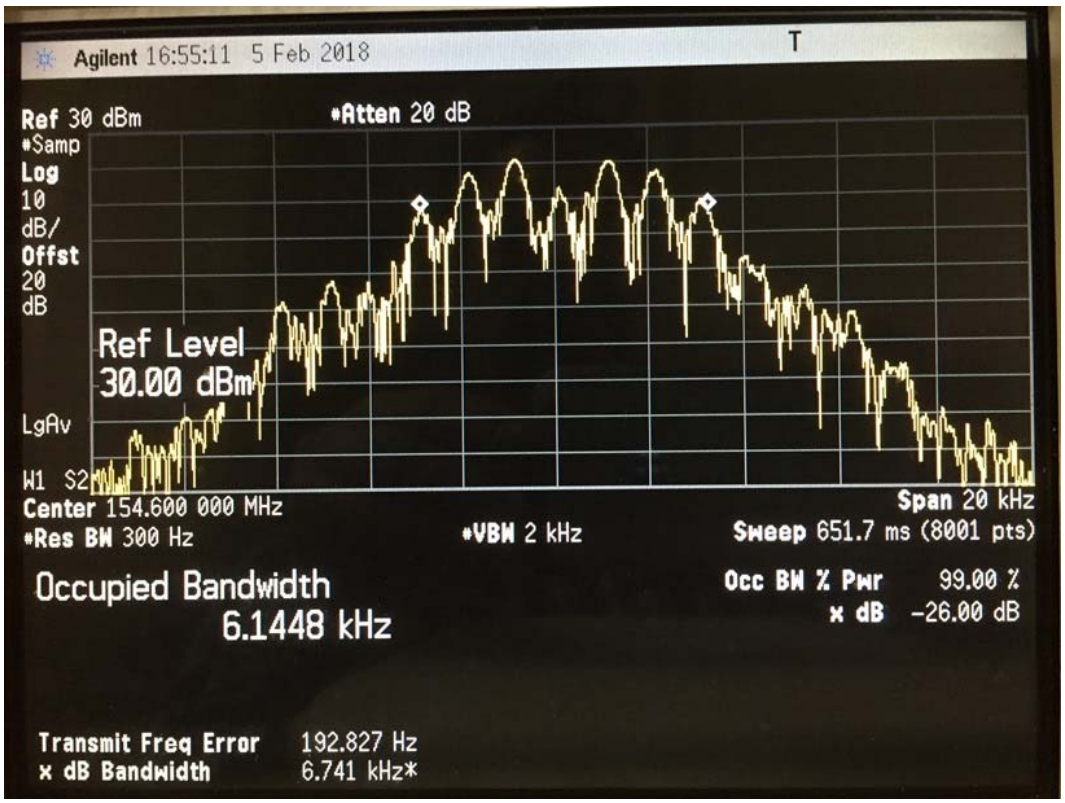
The EUT satisfied the channel usage requirement.

Measurements appear below.

9.3.1 12.5 kHz Channel Spacing



9.3.2 25 kHz Channel Spacing



10.0 Equipment Lists

10.1 Conducted Power, Conducted Spurious, and Mask

Asset #	Manufacturer	Model #	Description	Calibration Due
2216	HP	8593E	Spectrum Analyzer	18 Jan 2019
2134	Tenny	TPS T2C	Temperature Chamber	12 Oct 2017
C241	Pasternack	RG type	Coaxial Cable, Low Loss, ~5m	21 Jan 2018
0472	Tektronix	THS730A	Scope/DMM	15 Nov 2017
1831	HP	6622A	DC Power Supply	CIU
A105	Narda		20 dB 20 W attenuator	5 Oct 2018

10.2 Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	19 Dec 2018
A105	Narda	TPS T2C	20 dB 20 W attenuator	5 Oct 2018
1831	HP	6622A	DC Power Supply	CIU

10.3 Frequency Stability

Asset #	Manufacturer	Model #	Description	Calibration Due
2216	HP	8593E	Spectrum Analyzer	18 Jan 2019
2134	Tenny	TPS	Temperature Chamber	12 Oct 2017
C247	Pasternack	RG type	Coaxial Cable, double shielded	CNR
0472	Tektronix	THS730A	Scope/DMM	15 Nov 2017
1831	HP	6622A	Adjustable DC Power Supply	CIU

10.4 Frequency Behavior

Asset #	Manufacturer	Model #	Description	Calibration Due
2228	Tektronix	TDS3034	Oscilloscope, Digital	19 Jul 2018
1816	Agilent	N5181A	Signal Generator	7 Nov 2018
0742	HP	355C	Step Attenuator	CNR
0637	HP	8901A	Modulation Analyzer	10 Nov 2018
None	Mini-Circuits	ZFRSC-43	3 Port Resistive Divider/Combiner SMA	CNR
0835	Narda	3293-1	Forward Power Coupler	CNR
0856	Narda	702-60	70 dB Step Attenuator	CNR
A100	Narda	94455-1	Diode Detector	CNR
1831	HP	6622A	Adjustable DC Power Supply	CIU
None	Various	None	RG Type coaxial cables	CNR

10.5 Modulation Frequency and Limiting

Asset #	Manufacturer	Model #	Description	Calibration Due
2228	Tektronix	TDS3034	Oscilloscope, Digital	19 Jul 2018
0637	HP	8901A	Modulation Analyzer	10 Nov 2018
None	Pasternack	Unknown	10 dB SMA-SMA attenuator	CNR
1678	HP	8921A	Cell Site Tester (as audio signal generator)	CIU
1831	HP	6622A	Adjustable DC Power Supply	CIU
None	ETS/EMCO	5211	Shielded foam-lined shielded enclosure	CNR

10.6 Radiated Spurious Transmit Mode and Receive Mode

Radiated Emissions Test Equipment List					
Tile! Software Version:		**4.2.A, May 23, 2010, 08:38:52 AM**			
Test Profile:		**2016 RE_ClassA - Boresite+Mast_LowPRF_030617.til or 2016 RE_ClassB - Boresite+Mast_LowPRF_030617.til**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2019
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/1/2018
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
C027D	PTI	None	Relay	none	N/A
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	TDK 10M	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/23/2019
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m, 30 MHz - 18GHz	none	9/28/2018
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019

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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