LSR a Laird Business
ACCREDITED
TESTING CERT #1255.01
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TEST REPORT # 315381
LSR Job #: C-2400

Compliance Testing of:
OPTICOMGPS4 2.4 GHz RF Module with Dipole Antenna, Mobile Mark Antenna, Panorama Antenna & Laird PIFA Antenna

Test Date(s):
March 15-17, March 30, April 1-30, May 2-4, May 16-17, 2016

Prepared For:
Attn: Mark Schwartz
Global Traffic Technologies
7800 Third Street North
Saint Paul, MN 55128

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 247
Frequency Hopping Spread Spectrum (FHSS) Operating in the Frequency Band 2400-2483.5 MHz

This Test Report is issued under the Authority of:
Kimberly Bay, EMC Engineer

Signature: Date: 5/20/2016

Test Report Reviewed by:	Report by:
Adam Alger, Quality Systems Engineer – Test Services	Kimberly Bay, EMC Engineer
Signature: Date: 5-20-16	Signature: Date: 5/17/2016

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EXHIBIT 1. INTRODUCTION

1.1 –Scope

References:	FCC Part 15, Subpart C, Section 15.247, 15.209, 15.207, 15.205, 15.107 and 15.109, RSS 247 and ICES-0003
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.10 – American National Standard for Methods of Measurement of Unlicensed Wireless Devices ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

1.2 – Normative Reference

Publication	Year	Title
FCC CFR Parts 0-15	2016	Code of Federal Regulations – Telecommunications
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-247 Issue 1	2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License Exempt Local Area Network (LE-LAN) Devices
ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus

1.3 - LS Research, LLC Test Facility

TESTING CERT #1255.01

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) as conforming to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

1.4 – Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at LS Research, LLC:

Semi-Anechoic Chamber

1.5 – Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by a calibration laboratory accredited to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	Global Traffic Technologies
Address:	7800 Third Street North, Saint Paul, MN 55128
Contact Name:	Mark Schwartz

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	OPTICOMGPS4 RF Module
Model Number:	OPTICOMGPS4
Serial Number:	RK15450001, RK15450003, RK15450005, RK15450006, RK15450009

2.3 - Associated Antenna Description

There are four possible detachable antennas associated to the 2.4GHz radio. They are:

A.) HOW TSEN # S-00101 Dipole Antenna
B.) Mobile Mark #DM2-2400/1575Antenna
C.) Panorama #TRNBG-7-27
D.) Laird #MAF94192

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2401.02-2476.80 MHz
Minimum Conducted Output Power (dBm)	23.7 dBm
Maximum Conducted Output Power (dBm)	24.5 dBm
Minimum Power (in W)	0.234 W
Maximum Power (in W)	0.282 W
Occupied Bandwidth (20dB BW)	944 kHz
Type of Modulation	Filtered FSK
Emission Designator	944KF1D
Transmitter Spurious (worst case) at 3 meters	45.5 dBµV/m @ 3m
Receiver Spurious (worst case) at 3 meters	57.7 dBµV/m @ 3m
Receiver Bandwidth	1.1 MHz
Receiver Sensitivity	-86 dBm
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	OMAPL138BZCE3
Antenna Information	
Detachable/non-detachable	Detachable
Type	A.) HOW TSEN # S-00101 Dipole B.) Mobile Mark #DM2-2400/1575 C.) Panorama #TRNBG-7-24 D.) Laird #MAF94192
Gain (in dBi)	A.) 2.00 dBi B.) 2.50 dBi C.) 7.00 dBi D.) 3.50 dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	RSS 247
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

2.5 - Product Description

This module is a complete RF module with an integral reference oscillator. It is part of a GPS based priority control system and uses a proprietary 2.4 GHz FHSS/TDMA transceiver to transfer data between emergency vehicles and any traffic intersection controllers within radio range.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	20-25 ˚C
Humidity:	35-50 % R.H.

3.2 - Applicability & Summary of EMC Emission Test Results

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207, 15.107 IC: RSS GEN sect. 8.8	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247 (a)(1) IC: RSS 247 sect 5.1	20 dB Bandwidth	Yes
FCC : 15.247(b)(1) IC: RSS 247 sect 5.4	Maximum Output Power	Yes
FCC :15.247(d) IC: RSS 247 sect. 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(1) IC: RSS 247 sect. 5.1	Carrier Frequency Separation	Yes
FCC:15.247 (a)(1)(iii) IC: RSS 247 sect. 5.1	Number of hopping channels	Yes
FCC:15.247 (a)(1)(iii) IC: RSS 247 sect 5.1	Time of occupancy (Dwell Time)	Yes
FCC : 15.247(d) IC: RSS 247 sect 5.4	Transmitter Radiated Emissions	Yes

3.3 - Modifications Incorporated In the EUT for Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions from Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-247, Issue 1 (2015), Section 5 for Frequency Hopping Systems (FHSs).

Note: If some emissions are seen to be within 3 dB of their respective limits; as these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN, ANSI C63.10 and ANSI C63.4. For transmitter measurements, the EUT was placed on an 80cm (150cm above 1GHz) high non-conductive pedestal, centered on a flush mounted turntable inside a 3 meter semi-anechoic, FCC listed chamber. The EUT was operated in continuous modulated transmit mode for final testing using power as provided by a bench DC supply. For receiver measurements, the pedestal height remained at 80cm and the EUT was operated in continuous receive mode.

The applicable limits apply at a 3 meter distance. The calculations to determine these limits are detailed in the following pages. Refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2401.02 MHz), middle (2440.96 MHz) and high (2476.80 MHz) to comply with FCC Part 15.31(m). The channels and operating modes were controlled via laptop PC using Radio Module Controller Test Tool V 2.4.

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter semi-anechoic, FCC listed chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in a 3 meter semi-anechoic chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 200 MHz, and a Log Periodic Antenna was used to measure emissions from 200 MHz to 1000 MHz A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. A standard gain horn was used from 18 to 25 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height from 30-25000 MHz using both horizontal and vertical antenna polarities. For measurements above 1GHz, a tilting gear was used to maintain the EUT in the cone of radiation, and absorbers were placed on the ground plane.

The EUT was rotated along three orthogonal axes during the investigations to find the highest emission levels.

5.3 - Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a calibration laboratory accredited to ISO 17025, and are traceable to the SI standard. In addition, the connecting cables were measured for losses using a calibrated signal generator and an EMI receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI receiver database. As a result, the data taken from the EMI receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 1.2 MHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 3 MHz, with average measurements using 10 Hz).

5.4 - Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-247, Issue 1 (2015), for Frequency Hopping Systems (FHSS). The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 - Calculation of Radiated Emissions Limits

The maximum peak output power of an intentional radiator in the 2400 to 2483.5 MHz band, as specified in Title 47 CFR 15.247 and RSS 247 is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d) and RSS 247 shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and section 8.10 of RSS-GEN.

The following table depicts the general radiated emission limits above 30 MHz for both transmit and receive modes. These limits are obtained from Title 47 CFR, Part 15.209 &, for radiated emissions measurements for intentional radiators and Part 15.109 for unintentional radiators. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS-GEN sections 8.9 and 7.1.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
>960	500	54.0

Sample conversion of field strength (μV/m to dBμV/m):

$20 \log_{10} (100\ \mu V/m) = 40\ dB\mu V/m$ (from 30-88 MHz)

Sample Calculation using correction factors from the device:

Raw Receiver Data + Antenna Factor + Cable Factor + = Reported Value

Generic example of reported data at 258 MHz:

Reported Measurement data
= 20.7 (raw receiver measurement) + 12.9 (antenna factor) + 1.4 (cable factor)
= 35.0 dBμV

5.6 - Radiated Emissions Test Data Chart – Transmit Mode

Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Global Traffic Technologies					
Date(s) of Test:	March 15, April 6, 13-16, 18-22, 26-29, May 2-3, 2016					
Project Engineer:	Kimberly Bay					
Voltage:	3.3VDC					
Operation Mode:	Continuous transmit, modulated mode					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery	X	Other: Bench DC Supply		
EUT Placement:	X	80cm non-conductive table	X	1.5m non-conductive table		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	EUT Antenna
933.9	1.00	320.25	44.1	46.0	1.9	H	F	C
860.2	1.00	0.00	42.7	46.0	3.3	H	F	C
884.7	1.00	334.00	42.7	46.0	3.4	H	F	C
725.0	1.09	283.50	42.9	46.0	3.1	H	F	C
909.3	1.00	325.50	45.5	46.0	0.5	H	F	C
725.0	1.01	0.00	43.5	46.0	2.5	H	F	C
884.7	1.00	332.00	42.5	46.0	3.5	H	F	C
933.9	1.00	133.75	42.5	46.0	3.5	H	F	C
884.7	1.00	311.25	44.9	46.0	1.1	H	V	D
933.9	1.00	345.00	43.2	46.0	2.8	H	V	D
860.2	1.00	285.50	44.8	46.0	1.2	V	V	D
884.7	1.00	310.00	44.7	46.0	1.3	H	V	D
933.9	1.00	343.50	43.3	46.0	2.8	H	V	D
860.2	1.00	276.50	42.4	46.0	3.6	V	V	D
884.7	1.00	307.75	43.0	46.0	3.0	H	V	D
860.1	1.09	231.00	42.3	46.0	3.7	V	S	D
614.4	1.14	239.00	43.1	46.0	2.9	H	S	D
860.1	1.00	227.75	43.2	46.0	2.8	V	F	D
860.1	1.00	226.25	43.3	46.0	2.7	V	F	D
749.6	1.00	303.00	43.4	46.0	2.6	H	V	B
798.7	1.00	205.00	43.5	46.0	2.5	H	V	B
823.3	1.00	219.25	42.7	46.0	3.3	H	V	B

Notes: →Data tables show accumulation of worst-case emissions from all EUT setups, including the various antennas applicable.
→H: Horizontal, V: Vertical, S: Side, F: Flat
→ A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Duty-Cycle Adjusted Reading (dBµV/m) Peak-D.C. Relaxation Value	Average Limit (dBµV/m)	Avg. Margin (dB)	Antenna Polarity	EUT orientation	EUT Antenna
2366	1.01	273.00	57.8	27.8	54.0	26.2	V	V	B
2330	1.23	279.75	58.0	28.0	54.0	26.0	V	V	B
2290	1.05	284.50	57.6	27.6	54.0	26.4	V	V	B
2366	1.09	269.75	60.9	30.9	54.0	23.1	H	F	D
2366	3.15	176.50	59.3	29.3	54.0	24.7	V	F	D
2366	1.01	234.50	59.7	29.7	54.0	24.3	H	F	A
2330	1.73	247.50	59.1	29.1	54.0	24.9	H	F	A
2290	1.82	252.25	58.8	28.8	54.0	25.2	H	F	A

Notes: →Data tables show accumulation of worst-case emissions from all EUT setups, including the various antennas applicable.
→H: Horizontal, V: Vertical, S: Side, F: Flat
→Duty-Cycle Adjusted Reading = Peak – Duty-Cycle Correction Value; Margin Calculation: Margin = (Average Limit – Duty-Cycle Adjusted Reading); Justification in Appendix D.
→ A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

The following table depicts the level of significant spurious radiated RF emissions found:

The following table depicts the level of significant radiated harmonic emissions seen on Low Channel:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Duty-Cycle Adjusted Reading (dBµV/m) Peak-D.C. Relaxation Value	Avg Limit (dBµV/m)	Margin (dB) (Average Limit-Adjusted Reading)	Antenna Polarity	EUT orientation	EUT Antenna
4802	1.37	0	59.4	29.4	54	24.6	V	V	B
19208	2.18	329	51.9	21.9	54	32.1	H	V	D

The following table depicts the level of significant radiated harmonic emissions seen on Middle Channel:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Duty-Cycle Adjusted Reading (dBµV/m) Peak-D.C. Relaxation Value	Avg Limit (dBµV/m)	Margin (dB) (Average Limit-Adjusted Reading)	Antenna Polarity	EUT orientation	EUT Antenna
4882	1.31	330.50	56.6	26.6	54	27.4	V	V	C
7323	1.62	348.25	59.3	29.3	54	24.7	V	V	B
12205	1.34	0.00	55.5	25.5	54	28.5	V	V	D

RADIATED EMISSIONS DATA CHART (continued)

The following table depicts the level of significant radiated harmonic emissions seen on High Channel:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Duty-Cycle Adjusted Reading (dBµV/m) Peak-D.C. Relaxation Value	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	EUT Antenna
4953.6	2.09	330.00	62.8	32.8	54	21.2	V	V	C
7430	1.75	200.00	60.1	30.1	54	23.9	V	F	B
12384	1.65	24.25	58.1	28.1	54	25.9	H	S	D

Notes:

→Duty-Cycle Adjusted Reading = Peak – Duty-Cycle Correction Value; Margin Calculation: Margin = (Average Limit – Duty-Cycle Adjusted Reading); Justification in Appendix D.

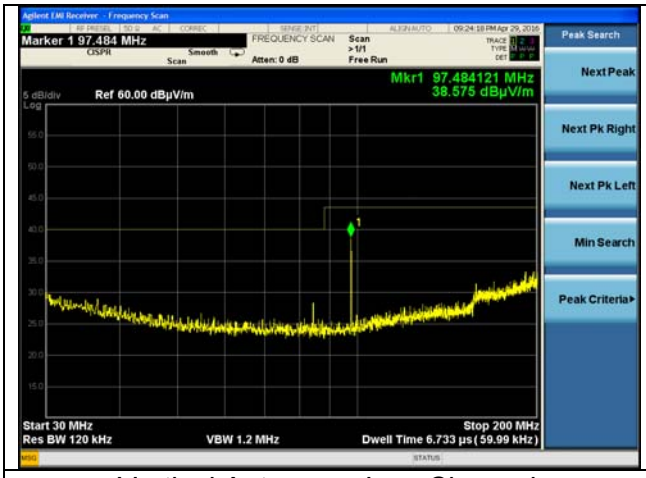
→A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

5.8 - Screen Captures – Transmit Mode

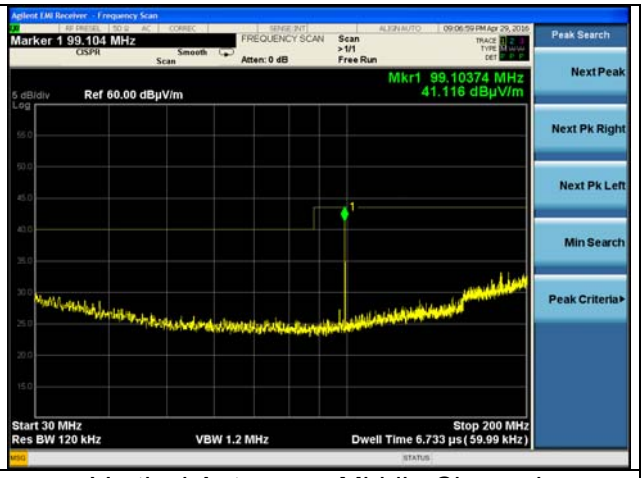
These screen captures represent peak emissions. For radiated emission measurements, a quasi-peak detector function is utilized when measuring frequencies below 1 GHz, and a peak detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 2401.02 MHz, 2440.96 MHz, or 2476.80 MHz, with the sense antenna in vertical or horizontal polarity for worst case presentations.

30-200 MHz



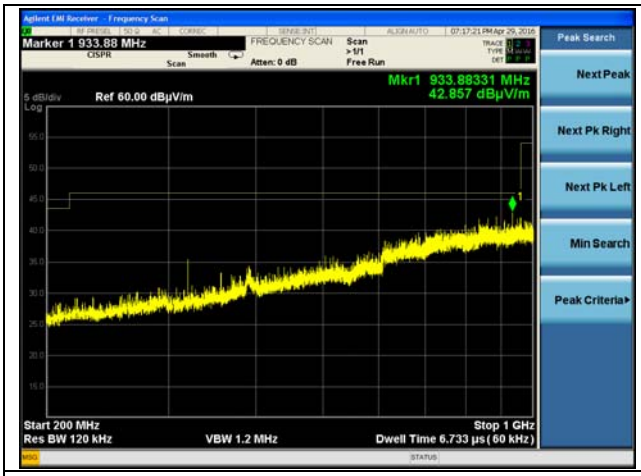
Vertical Antenna – Low Channel



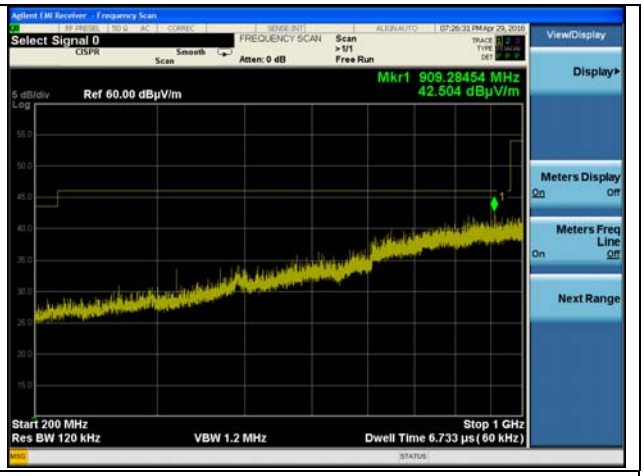
Vertical Antenna – Middle Channel

Screen Captures (continued)

200-1000 MHz

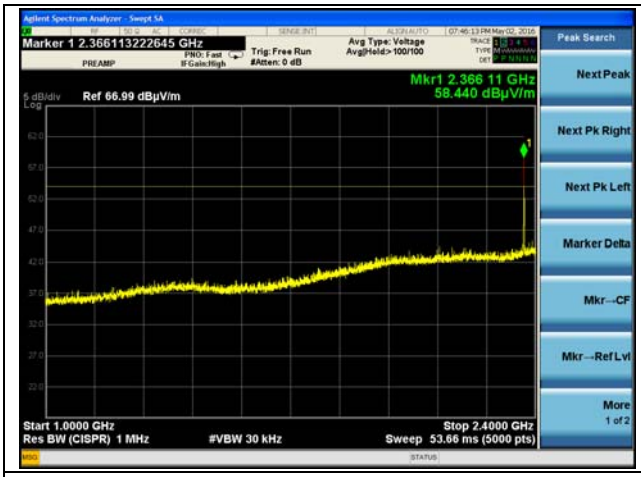


Horizontal Antenna – High Channel

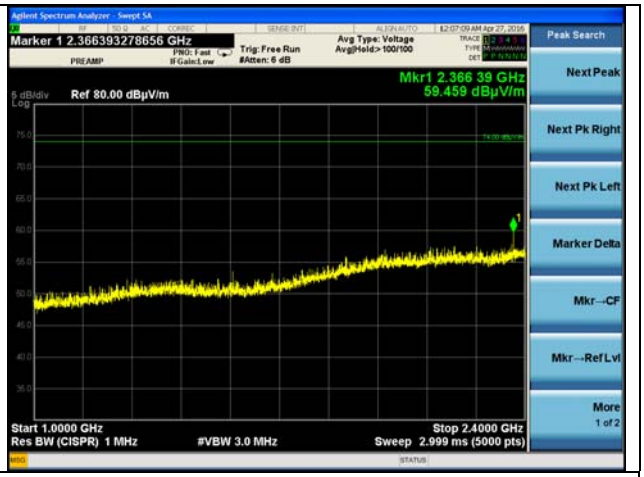


Vertical Antenna – High Channel

1000-2400 MHz



Horizontal Antenna – High Channel

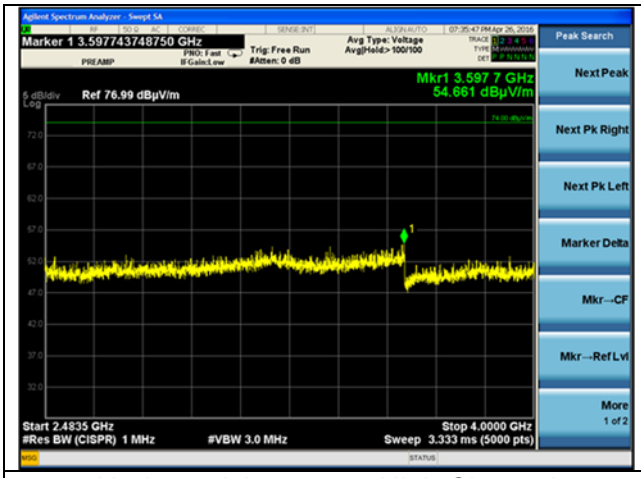


Horizontal Antenna – High Channel

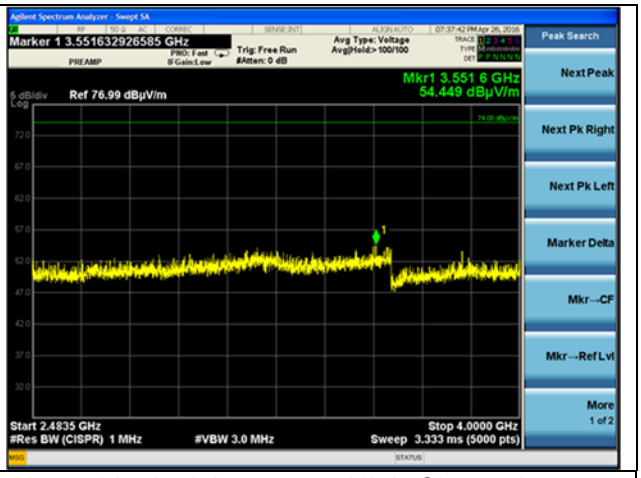
Note: The frequency range 2310-2390 MHz and 2483.5-2500.0 MHz is in the Restricted Band Band-Edge Measurements section (Exhibit 6).

Screen Captures (continued)

2500-4000 MHz

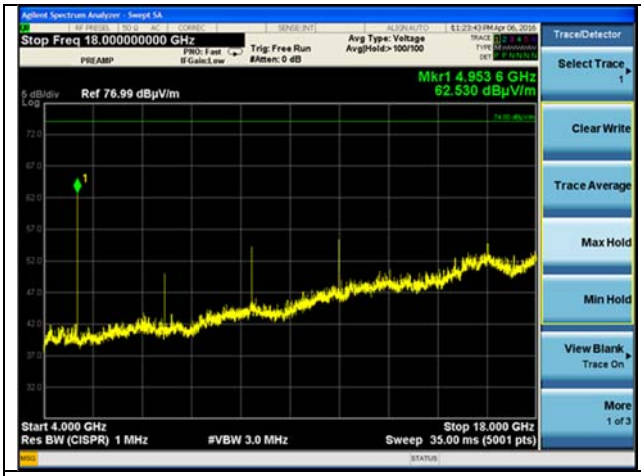


Horizontal Antenna – High Channel

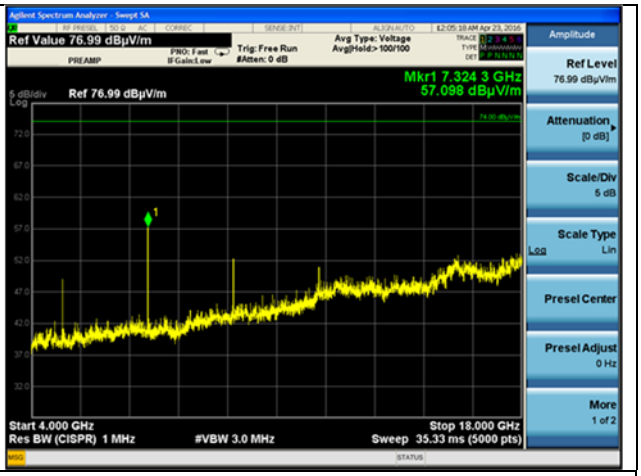


Vertical Antenna – High Channel

4000-18000 MHz



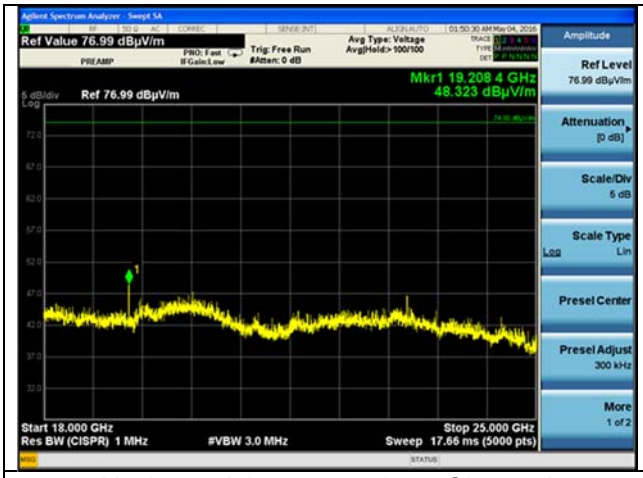
Vertical Antenna – High Channel



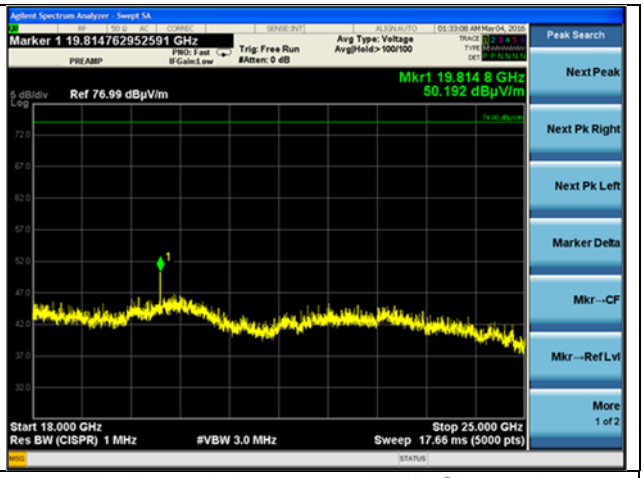
Vertical Antenna – Middle Channel

Screen Captures (continued)

18000-25000 MHz



Horizontal Antenna – Low Channel



Horizontal Antenna – High Channel

5.9 - Receive Mode Testing

Per the requirements of CFR 47 part 15, the EUT was placed in continuous receive mode and the radiated spurious emissions were measured and compared to the limits stated in RSS-GEN section 7 and CFR 47 15.109.

The test setup, procedure, and equipment utilized were identical to that described in sections 5.1, 5.2, and 5.3 of this document.

Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Global Traffic Technologies					
Date(s) of Test:	March 16-17, 30, April 4, 7,12-13, 15-16, 18-19, 21, 26, 28-30, May 3, 2016					
Project Engineer:	Kimberly Bay					
Voltage:	3.3VDC					
Operation Mode:	Continuous transmit, modulated mode					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery	X	Other: Bench DC Supply		
EUT Placement:	X	80cm non-conductive table		1.5m non-conductive table		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

Measurement data and screen captures from the receive tests are presented below:

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	EUT Antenna
725.0	1.00	344.00	42.39	46.0	3.6	V	V	D
749.7	1.00	238.75	42.1	46.0	3.9	H	V	A
724.9	1.00	229.50	40.38	46.0	5.6	H	V	A
872.5	1.00	134.00	40.33	46.0	5.7	H	V	A
749.6	1.00	235.75	39.65	46.0	6.4	H	V	A
749.6	1.00	238.25	40.54	46.0	5.5	H	V	A
724.9	1.11	225.25	41.37	46.0	4.6	H	V	A

Notes: →This table represents the highest receive mode emissions below 1 GHz.
→A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

Frequency (GHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Average Reading (dBµV/m)	Average Limit (dBµV/m)	Avg. Margin (dB)	Antenna Polarity	EUT orientation	EUT Antenna
2336	1.00	253.25	56.96	52.07	54.0	1.93	H	V	D
2336	1.00	306.50	57.16	53.04	54.0	0.96	V	V	D
2330	1.00	307.50	51.23	53.15	54.0	0.85	V	V	D
2290	1.04	253.25	57.22	52.70	54.0	1.30	H	V	D
2290	1.00	317.50	56.66	52.09	54.0	1.91	V	V	D
2290	1.00	199.75	57.74	53.72	54.0	0.28	H	S	D
2330	1.89	304.25	56.96	51.85	54.0	2.1	V	V	B
2366	1.01	258.50	56.49	51.76	54.0	2.2	H	S	C
4579	1.01	309.25	52.72	50.99	54.0	3.0	H	S	A

Notes*: →H: Horizontal, V: Vertical, S: Side, F: Flat*

→Data table shows accumulation of worst-case emissions above 1 GHz from all EUT setups.

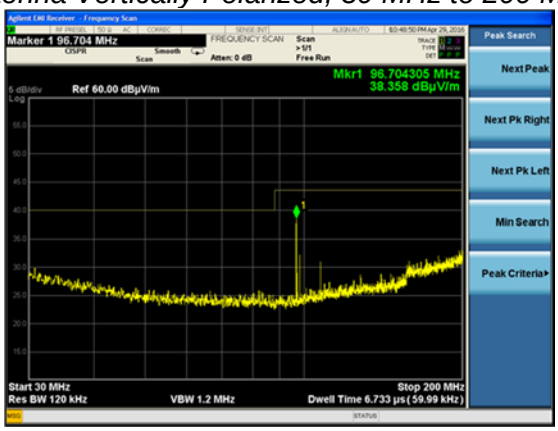
→A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

5.10 - Screen Captures - Receive Mode

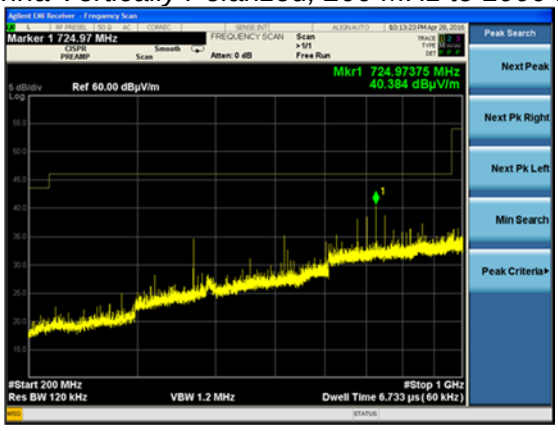
These screen captures represent peak emissions. For radiated emission measurements, a quasi-peak detector function is utilized when measuring frequencies below 1 GHz, and a peak detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 2401.02 MHz, 2440.96 MHz, or 2476.80 MHz, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Antenna Vertically Polarized, 30 MHz to 200 MHz

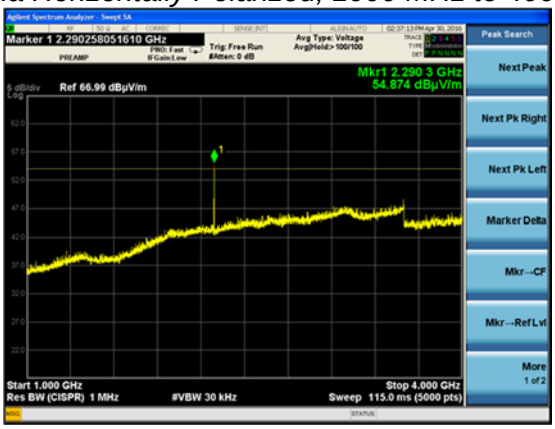


Antenna Vertically Polarized, 200 MHz to 1000 MHz



Screen Captures - Radiated Emissions Testing - Receive Mode (continued)

Antenna Horizontally Polarized, 1000 MHz to 4000 MHz



Antenna Horizontally Polarized, 4000 MHz to 18000 MHz

Antenna Horizontally Polarized, 18000 MHz to 25000 MHz

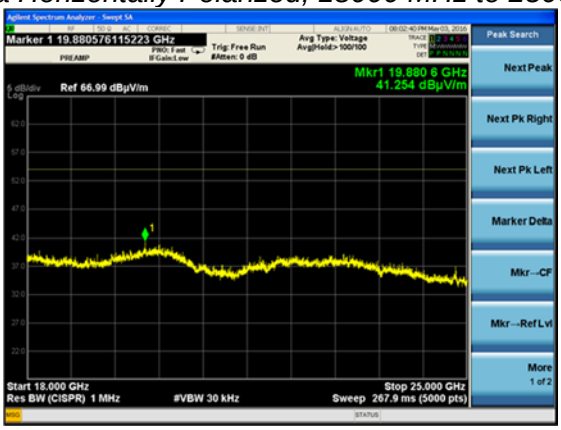


EXHIBIT 6. RESTRICTED-BAND BAND-EDGE MEASUREMENTS

6.1 - Method of Measurements

The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge. Measurements were taken with a peak detector. Average measurements were taken with a 1 MHz Resolution bandwidth and 10 Hz Video Bandwidth, and Peak measurements were taken with a 1 MHz Resolution Bandwidth and 3 MHz Video Bandwidth. Measurements were made in accordance with ANSI C63.10 section 6.10.5.2 measurement methodology for radiated measurements.

6.2 – Limit

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels, in particular at the Band-Edges where the intentional radiator operates.

At the lower band-edge, 2310-2390 MHz, the average limit is 54 dBµV/m, peak limit is 74 dBµV/m.

At the upper band-edge, 2483.5-2500 MHz, the average limit is 54 dBµV/m, peak limit is 74 dBµV/m.

6.3 - Test Results

The EUT meets the requirements for spurious emissions at the band-edges.

6.4 – Data Table

Table shows the highest band edge emission for each antenna.

	Frequency (MHz)	Average Reading (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Peak Reading (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	EUT Antenna
Lower Band Edge	2377	45.8	54.0	8.2	58.2	74.0	15.8	A
	2376	45.6	54.0	8.4	58.5	74.0	15.5	B
	2377	46.2	54.0	7.8	58.4	74.0	15.6	C
	2377	41.8	54.0	12.2	59.0	74.0	15.0	D
Upper Band Edge	2484	47.6	54.0	6.4	60.6	74.0	13.4	A
	2484	46.4	54.0	7.6	58.8	74.0	15.2	B
	2484	47.8	54.0	6.2	62.0	74.0	12.0	C
	2484	47.1	54.0	6.9	61.4	74.0	12.6	D

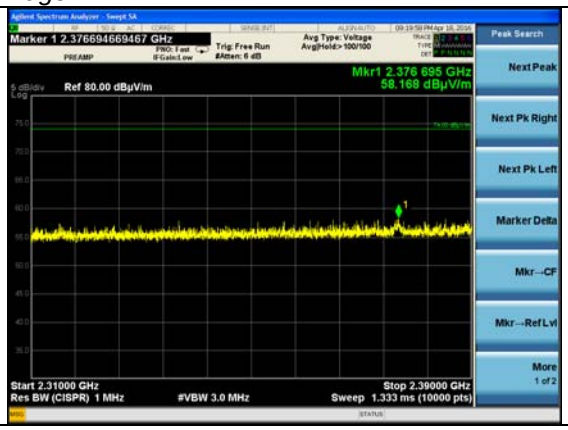
NOTE: → A: How Tsen dipole antenna; B: Mobile Mark antenna; C: Panorama antenna; D: Laird antenna

6.5 - Screen Captures

The scans shown here are from worst-case emissions.

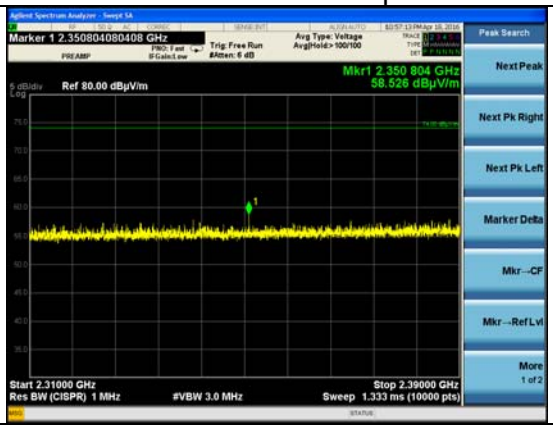
Lower Band-Edge

Average – How Tsen Dipole



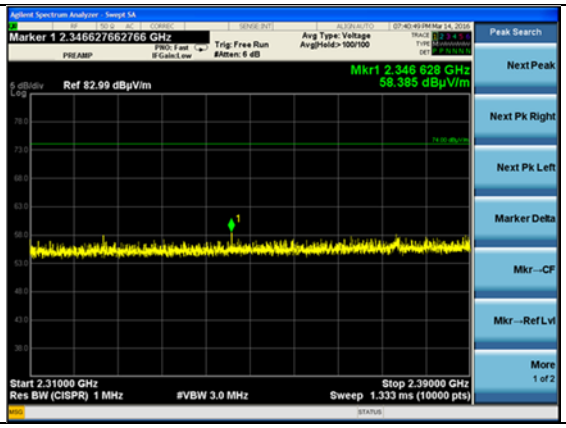
Peak – How Tsen Dipole

Average – Mobile Mark

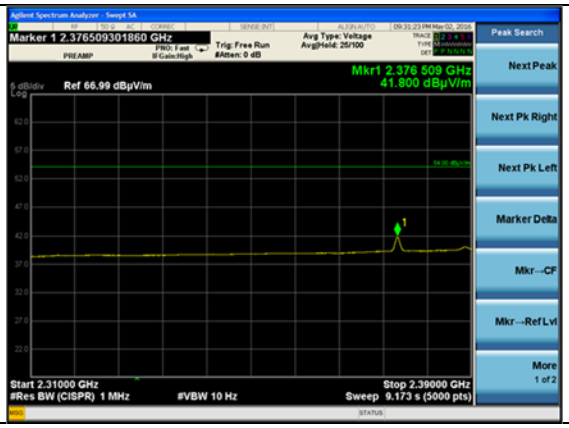
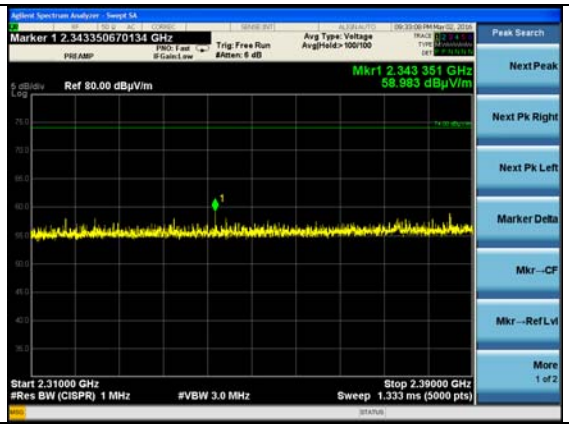


Peak – Mobile Mark

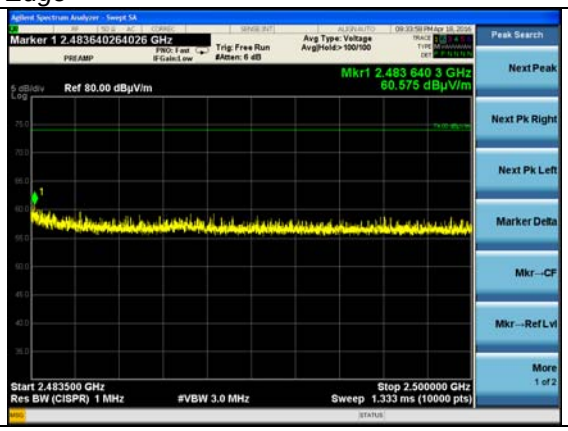
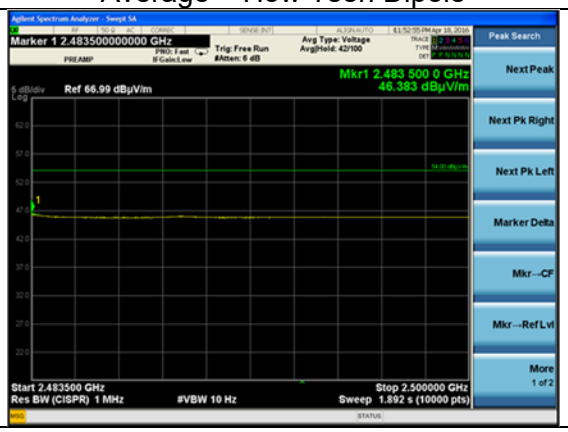
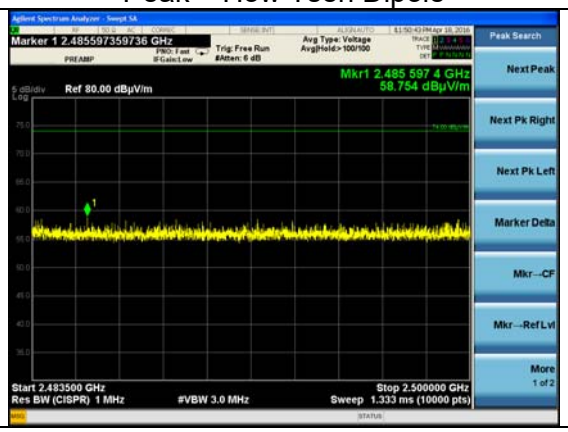
Average – Panorama

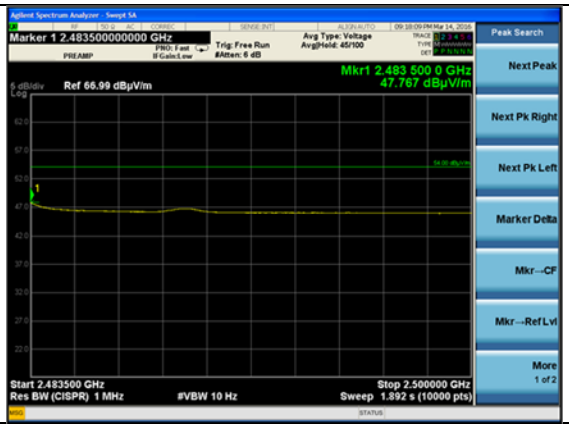


Peak - Panorama

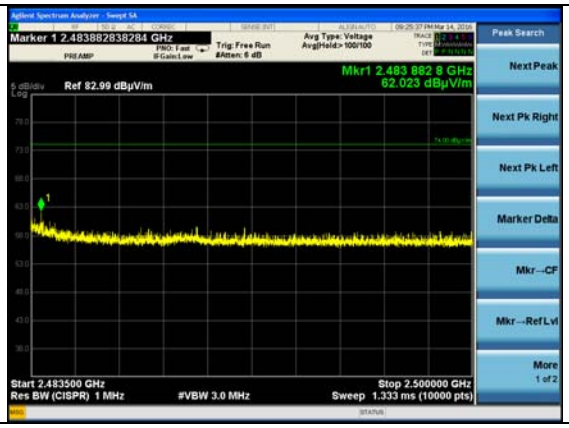
	
Average – Laird	Peak - Laird

Upper Band-Edge

	
Average – How Tsen Dipole	Peak – How Tsen Dipole
	
Average – Mobile Mark	Peak – Mobile Mark

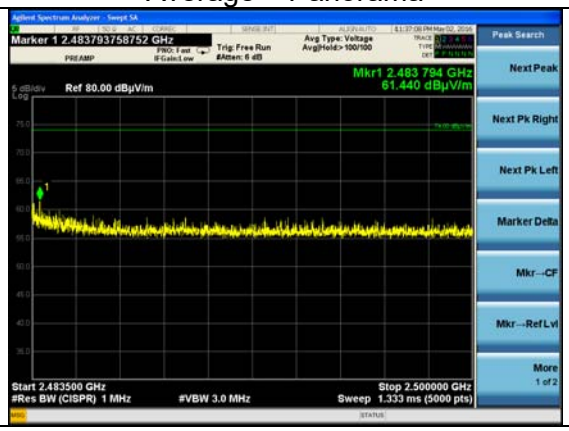


Average – Panorama



Average – Panorama

Average – Laird



Peak - Laird

EXHIBIT 7. CONDUCTED EMISSIONS TEST, AC POWER LINE

7.1 - Test Setup

The test area and setup are in accordance with FCC 15.107/15.207 and with Industry Canada RSS-247 and RSS-GEN. Measurements were made in accordance with ANSI C63.10 section 6.2 and ANSI C63.4 section 7.3 measurement methodology. The EUT was placed on an 80cm non-conductive pedestal. The EUT was powered through two AC to DC adapters, one providing 3.3VDC and the other 5.0VDC. Each adapter was attached to a separate 50Ω line impedance stabilization network (LISN).

After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to an EMI receiver System. First one of the two LISNs was used to test one of the EUT ac power lines, then the other LISN was connected to the EMI receiver to test the other ac power line. The LISNs used have the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

7.2 - Test Procedure

The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made for both transmit and receive modes of the EUT. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1-1, Section 6, Table 8, for quasi-peak and average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

7.3 - Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

7.4 - Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Parts 15.107 & 15.207 and RSS-247 and RSS-GEN for Conducted Emissions. See the Data Charts and Graphs for more details of the test results.

7.5 - Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

7.6 - Conducted Emissions Test Data Chart

Manufacturer:	Global Traffic Technologies					
Date(s) of Test:	May 4, 2016					
Project Engineer:	Kimberly Bay					
Test Engineer:	Kimberly Bay					
Voltage:	3.3/5.0 VDC					
Operation Mode:	Continuously Transmitting, Modulated; Continuously Receiving					
Environmental Conditions in the Lab:	Temperature: 73° F Relative Humidity: 40 %					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

			Quasi-Peak			Average		
EUT Voltage	Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
3.3 VDC	0.163	1	42.0	65.3	23.3	32.6	55.3	22.7
	0.226	1	39.8	62.6	22.8	31.5	52.6	21.1
	0.631	1	38.8	56.0	17.2	30.5	46.0	15.5
	0.172	2	46.7	64.8	18.1	35.8	54.8	19.0
	0.217	2	42.7	62.9	20.2	32.2	52.9	20.7
	0.609	2	40.2	56.0	15.8	31.3	46.0	14.7
5.0 VDC	0.155	1	48.4	65.8	17.4	33.1	55.8	22.7
	0.164	1	48.1	65.3	17.2	32.6	55.3	22.7
	0.177	1	46.0	64.6	18.6	33.5	54.6	21.1
	0.182	2	52.6	64.4	11.8	41.3	54.4	13.1
	0.226	2	46.6	62.6	16.0	35.8	52.6	16.8
	0.271	2	40.9	61.1	20.2	31.6	51.1	19.5

7.7 - Screen Captures – Conducted Emissions Test

These screen captures represent peak emissions. For conducted emission measurements, both a quasi-peak detector function and average detector function are utilized. The emissions must meet both the quasi-peak limit and average limits as described in 47 CFR 15.107/15.207 and RSS GEN.

3.3 VDC power adapter

	
Line 1	Line 2

5 VDC power adapter

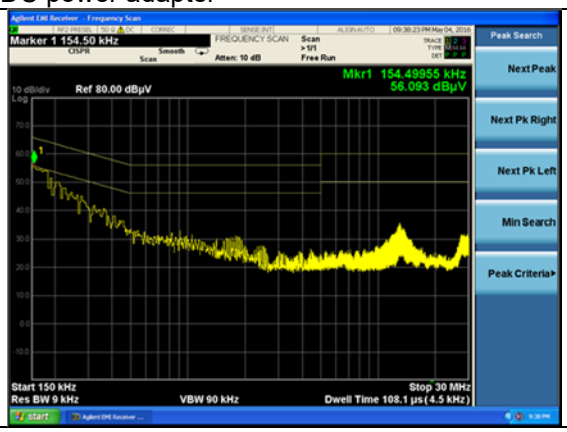
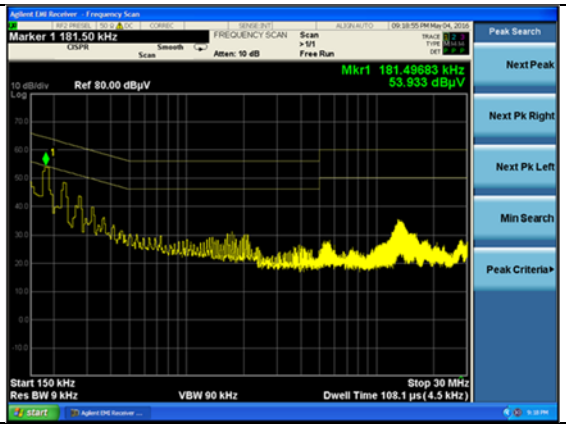
	
Line 1	Line 2

EXHIBIT 8. OCCUPIED BANDWIDTH

8.1 - Method of Measurements

The transmitter output was connected to a spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 10 kHz RBW and 30 kHz VBW. Measurements were made in accordance with ANSI C63.10 section 6.9.2 measurement methodology.

For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

8.2 - Limit

For a frequency hopping system in the 2400 to 2483.5 MHz band, channel separation shall be at minimum 25 kHz or the 20 dB bandwidth, for transmitters with a conducted power of greater than 0.125W. Therefore, the 20 dB bandwidth must be measured, to test channel separation requirement.

8.3 - Test Results

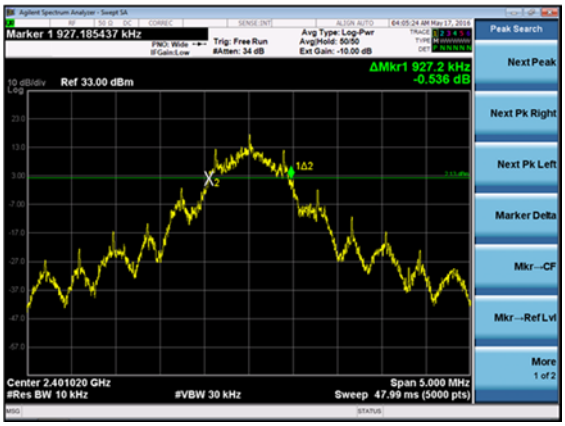
The EUT is compliant to channel separation requirements, therefore the 20 dB Occupied Bandwidth is sufficient.

8.4 - Test Data

Channel	Center Frequency (MHz)	Measured -20 dBc Occ. BW (kHz)
Low	2401.02	927
Middle	2440.96	924
High	2476.80	944

8.5 - Screen Captures

Low Channel -20 dBc Occupied Bandwidth



Middle Channel -20 dBc Occupied Bandwidth

High Channel -20 dBc Occupied Bandwidth

EXHIBIT 9. CONDUCTED BAND-EDGE MEASUREMENTS

9.1 - Method of Measurements

The test was conducted twice. Once with hopping mode turned on and once with hopping mode turned off. For hopping mode ON, the hopping sequence included both the lowest frequency (for lower band-edge) and the highest frequency (for upper band-edge). For hopping mode OFF, the EUT was operated at the lowest channel for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge. Measurements were taken with a peak detector using a resolution bandwidth of 100 kHz and video bandwidth of 300 kHz. Measurements were made in accordance with ANSI C63.10 section 6.10.4 measurement methodology.

9.2 – Limit

FCC 15.247(d) requires that in any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

9.3 - Test Results

The EUT meets the band-edges requirements.

9.4 - Screen Captures

Hopping Function ON

Lower Band Edge

Upper Band Edge

Hopping Function OFF

	
Lower Band Edge	Upper Band Edge

EXHIBIT 10: PEAK CONDUCTED OUTPUT POWER

10.1- Method of Measurements

The conducted RF output power of the EUT was measured, in accordance with ANSI C63.10 section 7.8.5 measurement methodology, at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution bandwidths set to 3 MHz and a span of 10 MHz, with measurements from a peak detector presented in the chart below.

10.2 - Limit

The limit for this test is 30.0 dBm.

10.3 - Test Results

The EUT meets the requirements for peak conducted output power.

10.4 - Test Data

CHANNEL	**CENTER FREQ (MHz)**	**LIMIT (dBm)**	**MEASURED POWER (dBm)**	**MARGIN (dB)**
LOW	2401.02	30.0	23.7	6.3
MIDDLE	2440.96	30.0	24.5	5.5
HIGH	2476.80	30.0	24.3	5.7

10.5 - Screen Captures

Low Channel – Peak Conducted Output Power

Middle Channel – Peak Conducted Output Power

High Channel – Peak Conducted Output Power

EXHIBIT 11. CONDUCTED SPURIOUS EMISSIONS

11.1 - Method of Measurement

For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct readings of the measurements made without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the test. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the charts below. Measurements were made in accordance with ANSI C63.10 section 7.8.8 measurement methodology.

11.2 – Limits

FCC Part 15.247(d) and IC RSS-247 section 5.5 both require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

11.3 – Results

Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured. The greatest measured value is -43.5 dBm, which is under the allowable limit.

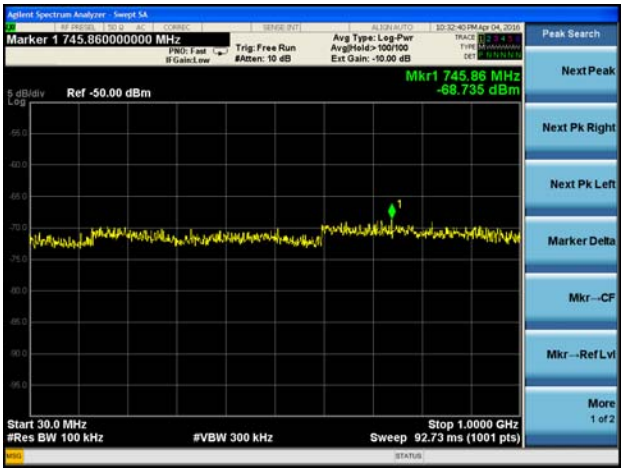
11.4 - Conducted Harmonic and Spurious RF Measurements

Conducted harmonics:

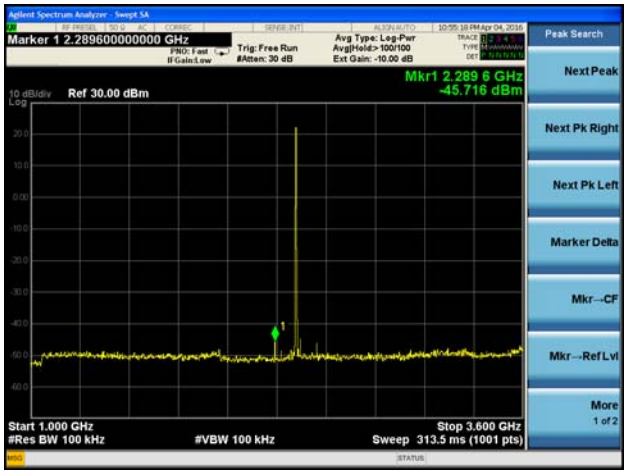
	fo = 2401 MHz			fo = 2440 MHz			fo = 2476.8 MHz		
harmonic	Measured (dBm)	Limit (dBm)	Margin (dBm)	Measured (dBm)	Limit (dBm)	Margin (dBm)	Measured (dBm)	Limit (dBm)	Margin (dBm)
2fo	-46.1	2.0	48.1	-44	5.0	49.0	-43.5	2.0	45.5
3fo	-57.3	2.0	59.3	-61.9	5.0	66.9	-59.7	2.0	61.7
4fo	-74.0	2.0	76.0	-64.2	5.0	69.2	-58.8	2.0	60.8

11.5 - Screen Captures[AA1]

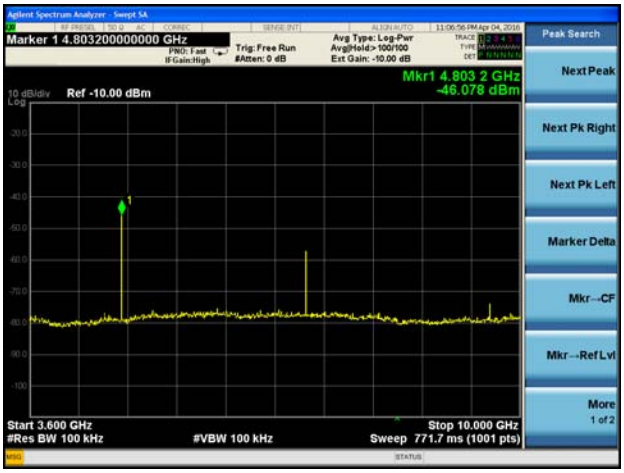
Low Channel



30 to 1000 MHz



1 to 3.6 GHz

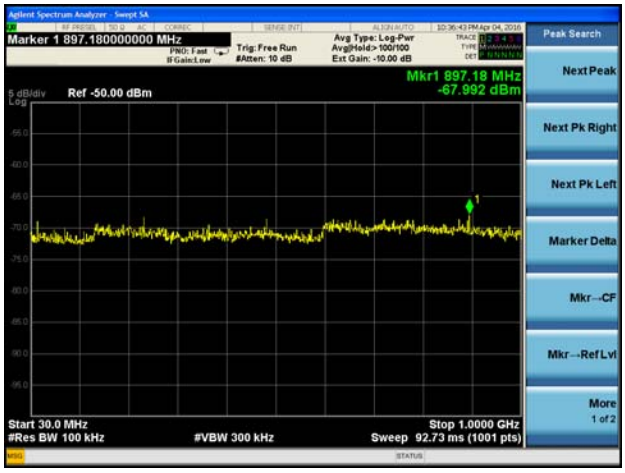


3.6 to 10 GHz

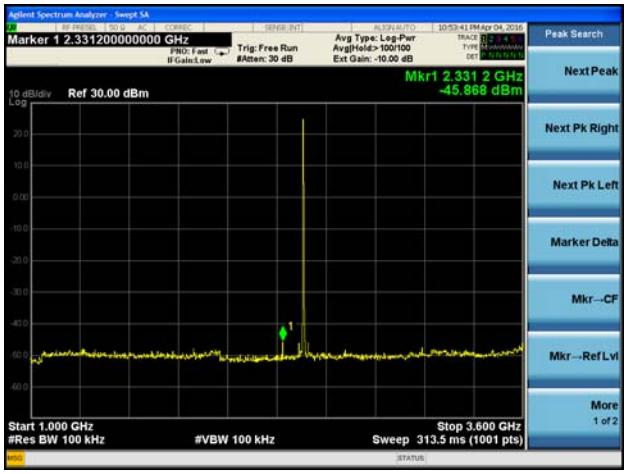
10 to 25 GHz

Spurious Conducted Emissions (continued)

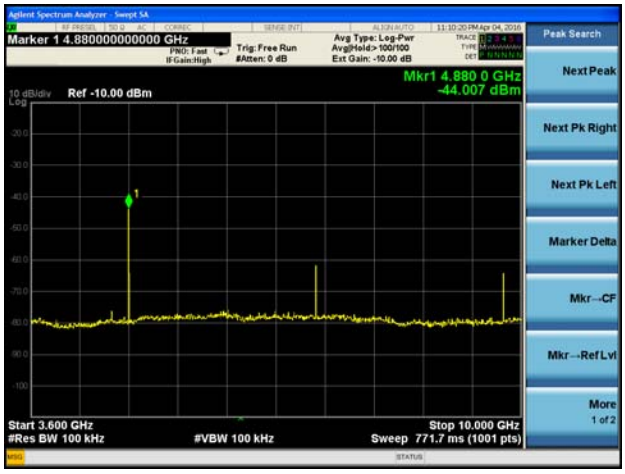
Middle Channel



30 to 1000 MHz



1 to 3.6 GHz

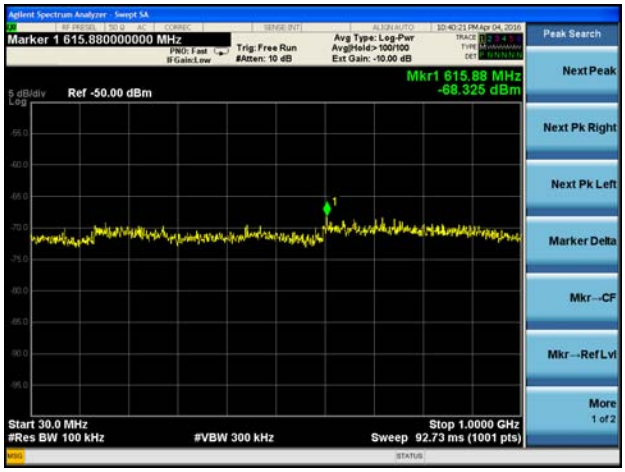


3.6 to 10 GHz

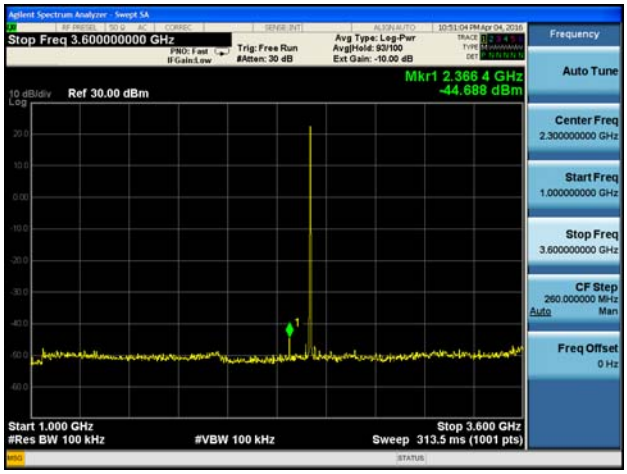
10 to 25 GHz

Spurious Conducted Emissions (continued)

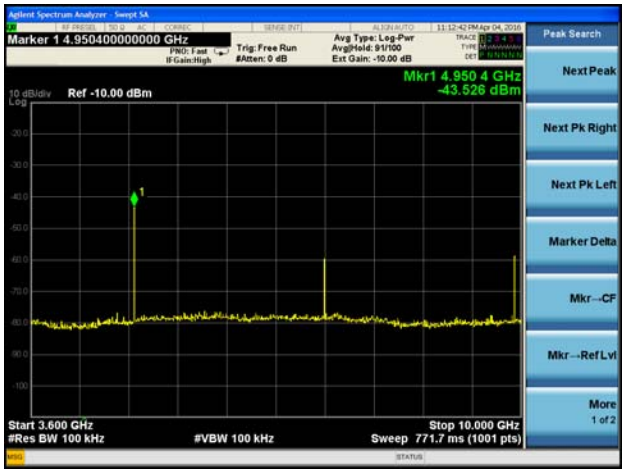
High Channel



30 to 1000 MHz



1 to 3.6 GHz



3.6 to 10 GHz

10 to 25 GHz

EXHIBIT 12. FREQUENCY STABILITY OVER VOLTAGE VARIATIONS

12.1 - Method of Measurement

For measurements of the frequency and power stability, the transmitter was powered by an external bench-type variable power supply. A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. Measurements were made in accordance with ANSI C63.10 section 6.8.2 measurement methodology.

12.2 - Test Results

The EUT meets the requirements of frequency and power stability over voltage variations. The maximum shift in frequency is 25 kHz which is much less than the 100 ppm variation allowed in the 2400 MHz to 2483.5 MHz band.

12.3 - Test Data

	2.8 VDC	3.3 VDC (nominal)	3.8 VDC	
Channel	Frequency (Hz)	Frequency (Hz)	Frequency (Hz)	Max Shift (kHz)
1	2401050000	2401032600	2401024300	17.4
40	2440993000	2440975000	2440950000	25.0
75	2476816000	2476792000	2476797000	24.0

EXHIBIT 13. CHANNEL PLAN AND SEPARATION

13.1 – Setup

A spectrum analyzer was used with a resolution bandwidth of 100 kHz to measure the channel separation of the EUT.

13.2 – Limits

The minimum channel separation limit as stated in FCC CFR 47 15.247 and IC RSS-247 is 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

The minimum number of channels as stated in FCC CFR 47 15.247 and IC RSS-247 is 15 channels.

13.3 - Data Summary

This EUT uses 75 channels and has a minimum and maximum channel-separation measured for this device as 0.95 MHz and 1.08 MHz respectively. The maximum occupied bandwidth of the device, as reported in Exhibit 7 of this report is 944 kHz.

13. 4 – Results

The EUT meets the requirements for channel plan and separation.

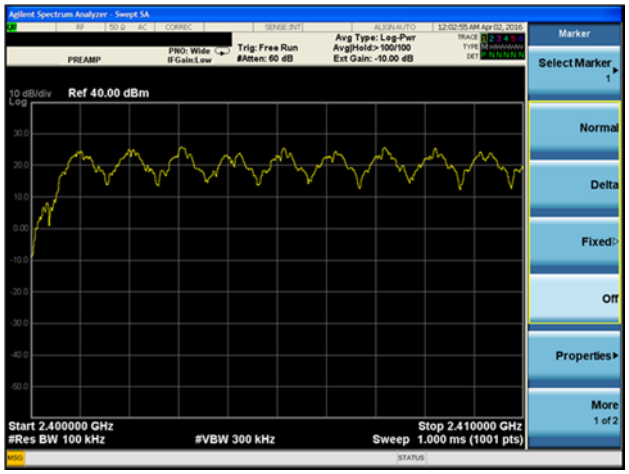
13.5 - Data and Plots

The following plots describe this spacing, and also establish the channel separation and plan.

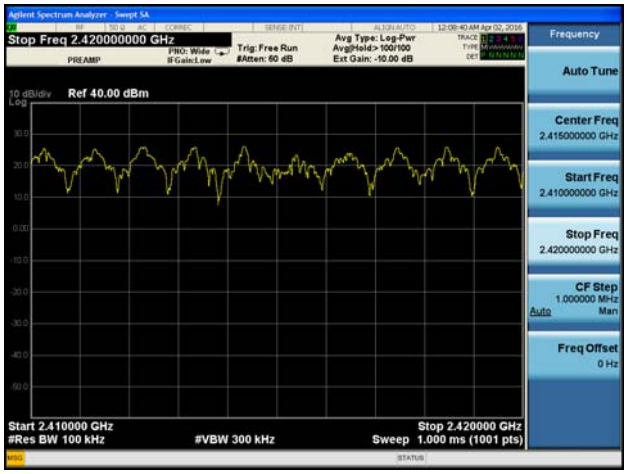
RANGE (MHz)	Max separation (MHz)
2400-2410	1.06
2410-2420	1.10
2420-2430	1.05
2430-2440	1.06
2440-2450	1.08
2450-2460	1.08
2460-2470	1.08
2470-2483.5	1.06

Total Channels	75
Max separation (MHz)	1.08
Min Separation (MHz)	0.95

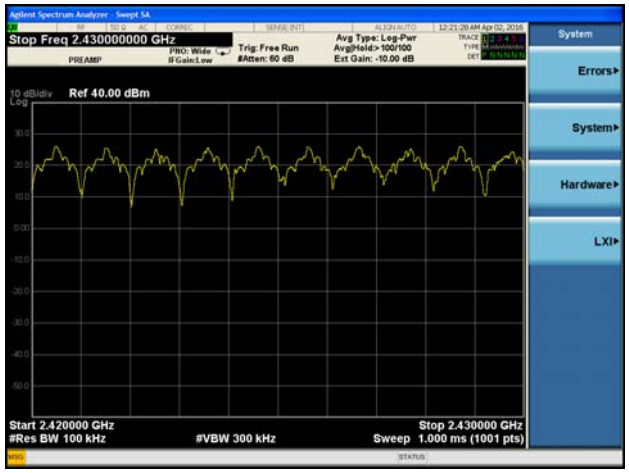
Screen Captures – Channel Separation



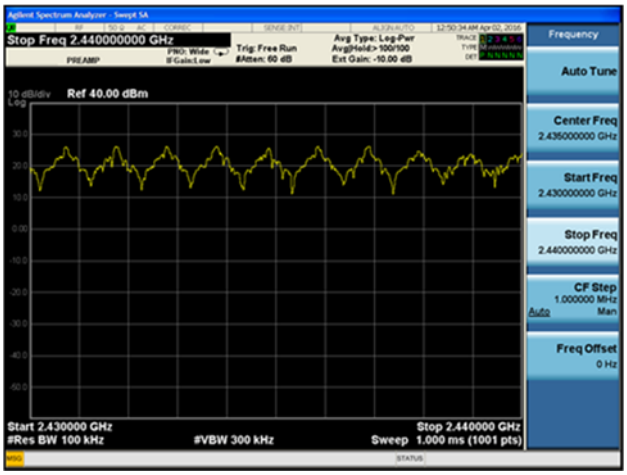
Channels 1 through 9



Channels 10 through 19

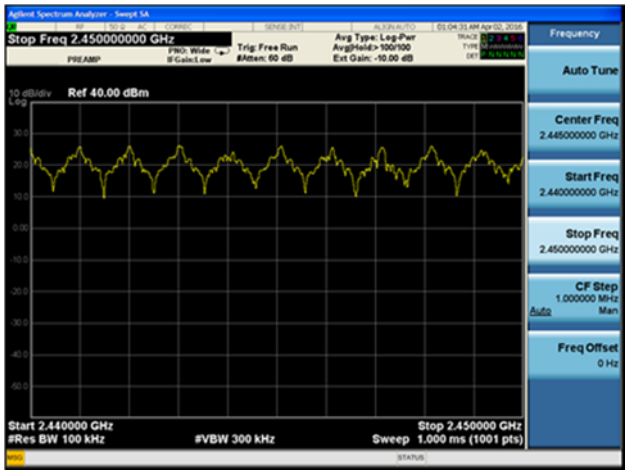


Channels 20 through 29

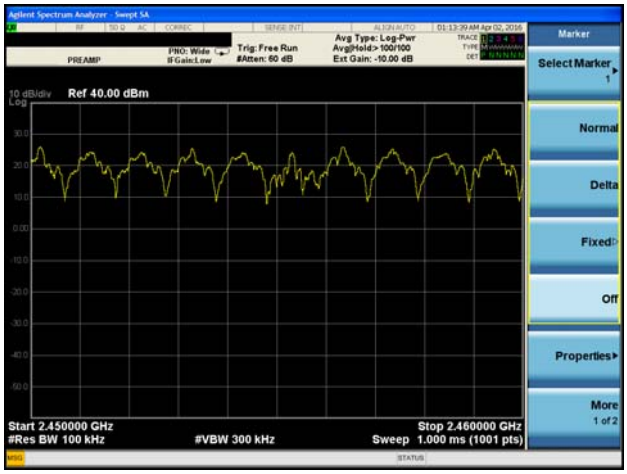


Channels 30 through 39

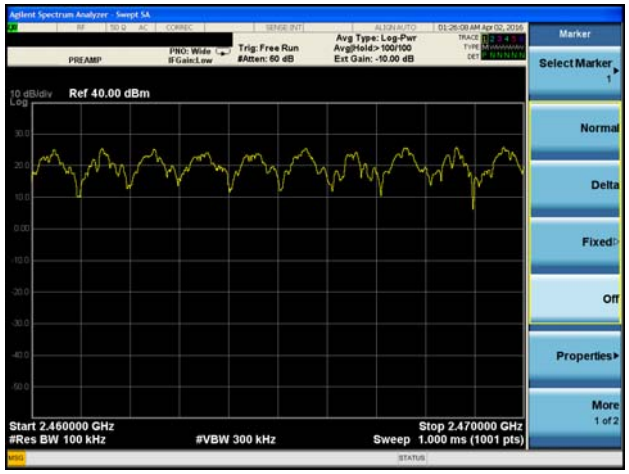
Screen Captures – Channel Separation (continued)



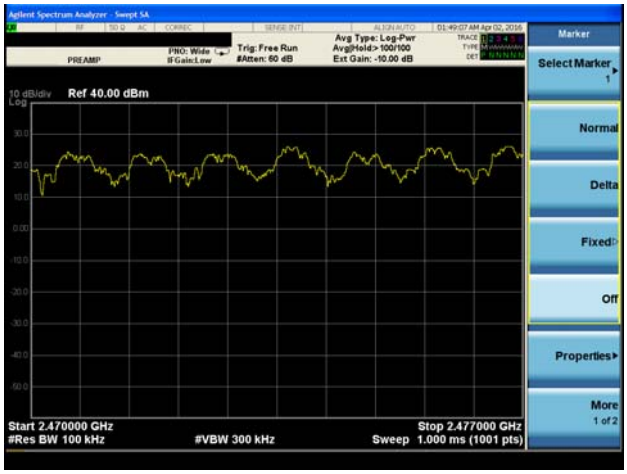
Channels 39 through 48



Channels 49 through 58



Channels 59 through 68



Channels 69 through 75

EXHIBIT 14. CHANNEL OCCUPANCY

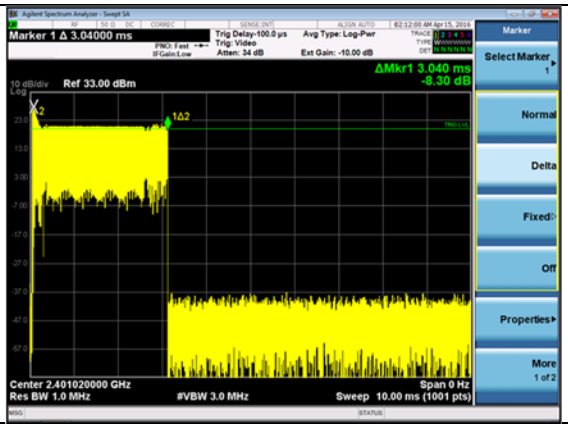
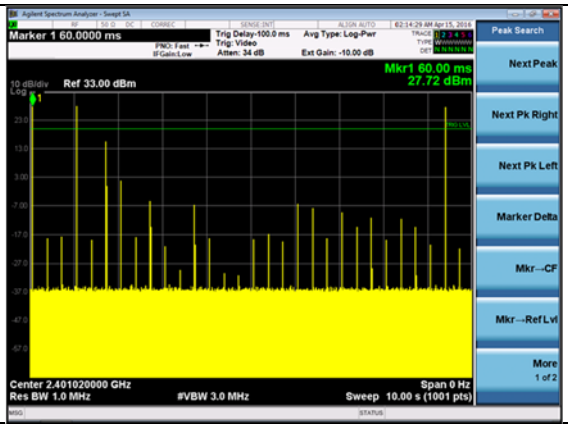
Part 15.247(a) (1) requires a channel occupancy, for this device, of no more than 400 milliseconds in a 30 second window. The channel occupancy for this EUT was measured using a spectrum analyzer, set to zero-span at the frequency of interest. With the analyzer in peak-hold mode, the transmission lengths can be measured by adjusting the sweep rate of the analyzer. A suitable sweep rate was used to measure the channel occupancy at the low, mid and high channels.

The longest time any transmission will occur on a single channel is 3.045 milliseconds. In a 30 second window, each channel has 9-15 transmission cycles. The maximum occupancy in a 30 second window is calculated by multiplying the number of transmission cycles by 3.045 milliseconds transmission duration per cycle, to arrive at the total channel occupancy.

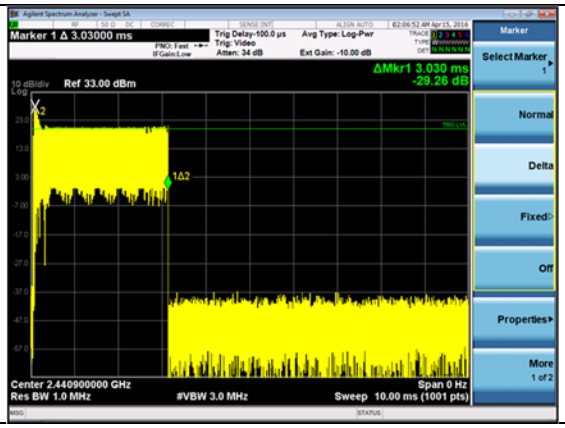
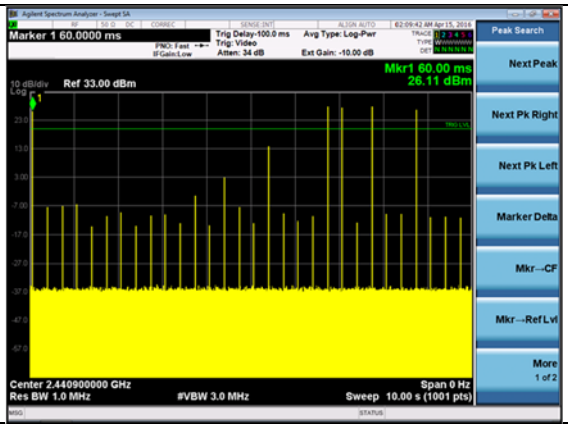
Channel	Frequency (MHz)	Total Occupancy in 30 seconds (ms)	Occupancy in 10 ms window (ms)
Low	2401.02	48.48	12.16
Middle	2440.96	45.45	15.15
High	2476.80	27.42	9.14

Plots of Channel Occupancy

Low Channel Occupancy

<table>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td>10 ms window</td>
<td>10 second window</td>
</tr>
</table>

Middle Channel Occupancy

	
10 ms window	10 second window

Channel High Occupancy

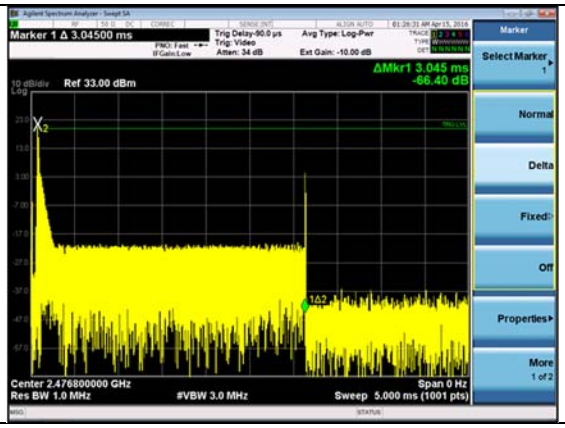
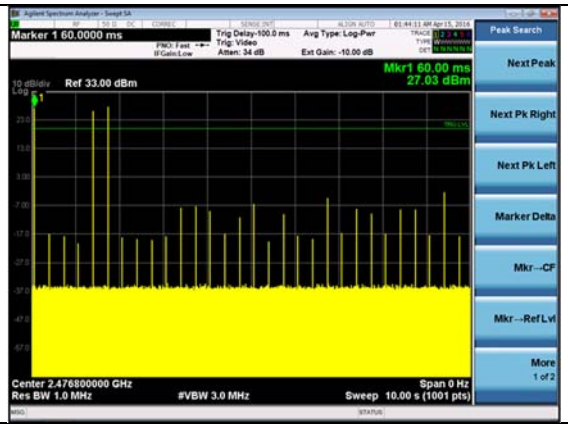
	
5 ms window	10 second window

EXHIBIT 15. EQUAL CHANNEL USAGE AND PSEUDORANDOM HOPPING SEQUENCE

A new hop channel is selected every 333ms.

2	50	58
4	52	6
8	60	10
48	42	12
46	44	40
62	38	64
14	16	66
18	32	20
68	22	30
72	1	74
34	36	24
28	26	3
70	53	5
55	59	9
49	7	47
51	11	45
61	13	63
41	39	15
43	65	19
37	67	69
17	21	73
31	29	33
71	75	27
35	25	23
56	57	54

Note: The information in this section is provided by the manufacturer.

EXHIBIT 16. RECEIVER SYNCHRONIZATION AND RECEIVER INPUT BANDWIDTH

The receiver input bandwidth is 1.1 MHz.

The receiver is a dual conversion design with a FSK discriminator based demodulator. The discriminator output is connected to an A/D converter.

Note: The information in this section is provided by the manufacturer.

APPENDIX A – Test Equipment List

LSR
a Laird Business

Date: 16-Feb-2016 Type Test: Conducted RF Job #: C-2400

Prepared By: Kim Bay Customer: GTT Quote #: 315381

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	CC 000181C	Arb Wave F. Generator	HP	33120A	US36013549	10/26/2015	10/26/2016	Active Calibration
2	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
3	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System
4	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/26/2017	Active Calibration

LSR
a Laird Business

Date: 16-Feb-2016 Type Test: Conducted AC Mains Job #: C-2400

Prepared By: Kim Bay Customer: GTT Quote #: 315381

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	EE 960162	LISN - 15A	COM-POWER	LI-215A	191969	7/24/2015	7/24/2016	Active Calibration
3	EE 960089	LISN - 15A	COM-POWER	LI-215A	191943	3/8/2016	3/8/2017	Active Calibration
4	EE 960054	Multimeter	HP	971A	JP40011152	4/13/2016	4/13/2017	Active Calibration

LSR
a Laird Business

Date: 16-Feb-2016 Type Test: Radiated Emissions Job #: C-2400

Prepared By: Kim Bay Customer: GTT Quote #: 315381

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	2/4/2016	2/4/2017	Active Calibration
3	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	40201429	2/4/2016	2/4/2017	Active Calibration
4	AA 960153	2.4GHz High Pass Filter	KWM	HPF-L-14186	7272-04	4/29/2016	4/29/2017	Active Calibration
5	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	2/1/2016	2/1/2017	Active Calibration
6	AA 960004	Log Periodic Antenna	EMCO	93146	9512-4276	8/18/2015	8/18/2016	Active Calibration
7	RE 16001	AH Horn 18-40 GHz Rental	AH	SAS-574	193	11/30/2015	11/30/2016	Active Calibration
8	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System
9	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/26/2017	Active Calibration
10	AA 960171	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-6	386	3/31/2016	3/31/2017	Active Calibration
11	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	3/7/2016	3/7/2017	Active Calibration

Project Engineer: Kimberly B Bay Quality Assurance: Adam O Alger

APPENDIX B – Test Standards Publication Dates

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2014		
ANSI C63.10	2013		
RSS 247	2015		
RSS GEN	2014		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2016		

APPENDIX C - Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	*Particular Configuration*	*Uncertainty Values*
Radiated Emissions	*3 – Meter chamber, Biconical Antenna*	*4.82 dB*
Radiated Emissions	*3-Meter Chamber, Log Periodic Antenna*	*4.88 dB*
Radiated Emissions	*3-Meter Chamber, Horn Antenna*	*4.85 dB*
Radiated Emissions	*10-Meter OATS, Biconical Antenna*	*4.32 dB*
Radiated Emissions	*10-Meter OATS, Log Periodic Antenna*	*3.63 dB*
Absolute Conducted Emissions	*Agilent PSA/ESA Series*	*1.38 dB*
AC Line Conducted Emissions	*Shielded Room/EMCO LISN*	*3.20 dB*
Radiated Immunity	*3 Volts/Meter in 3-Meter Chamber*	*2.05 Volts/Meter*
Conducted Immunity	*3 Volts level*	*2.33 V*
EFT Burst, Surge, VDI	*230 VAC*	*54.4 V*
ESD Immunity	*Discharge at 15kV*	*3200 V*
Temperature/Humidity	*Thermo-hygrometer*	*0.64° / 2.88 %RH*

APPENDIX D – Duty-Cycle Justification

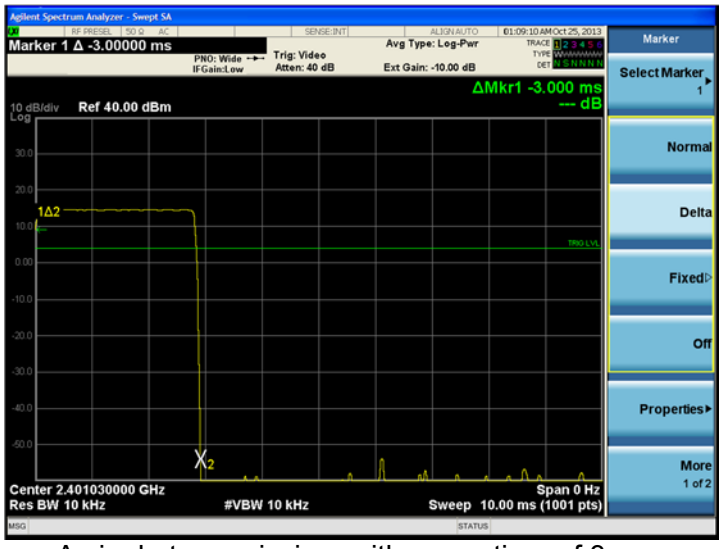
Average (Relaxation) Factor

Average Factor = 20* Log_{10} (Worst Case EUT On-time over _X_ ms time window)

The transmit packet occupies 3 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20* Log_{10} (3 / 100 ms) = - 30.46

A relaxation factor of 30.46 dB would be allowable for this product.



A single transmission, with an on-time of 3 ms.

Period greater than 100 ms demonstrated.