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

June 4, 2015

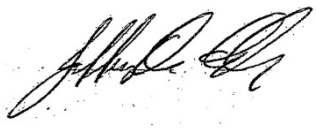
Gary Daniels
Garrock, LLC
49 W Henderson Rd
Columbus OH 43214

Gary:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for Garrock, LLC. Enclosed is the Wireless Certification Report for the RBM58FS. This report can be used to demonstrate compliance with requirements for wireless devices in North America.

If you have any questions, please contact me.

Sincerely,



Jeffrey A. Lenk
President

Attachment

Project 16946-15

Garrock, LLC
RBM58FS
5.8GHz RC MODULE

Wireless Certification Report

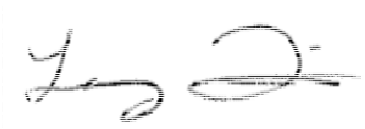
Prepared for:

Gary Daniels
Garrock, LLC
49 W Henderson Rd
Columbus OH 43214

By

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

June 4, 2015

Reviewed by	Written by
	
Larry Finn	Eric Lifsey
Chief Technical Officer	EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft for review.	1 June 2015
01	Revised for RSS-247 to include new standard clause citations.	4 June 2015

Table of Contents

Compliance Certificate

Applicant	Device & Test Identification	
Garrock, LLC (Gary Daniels)	FCC ID:	2ADVE-RBM58FS
49 W Henderson Rd	Industry Canada ID:	12612A-RBM58FS
Columbus OH 43214	Model(s):	RBM58FS
Certificate Date: 1 June 2015	Laboratory Project ID:	16946-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Standard	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.109, 15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document.

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

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the rules listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements.

1.2 EUT Description

Table 1.2.1: Equipment Under Test

Manufacturer	Model	Serial #	Description
Garrock, LLC	RBM58FS	None	Wireless transmitter/receiver for band 5725 to 5850 MHz.

This device is a wireless module and is intended for use in radio controlled aircraft. It operates on the upper portion of the 5.8 GHz band. It employs GFSK modulation on most channels, with DSSS modulation employed on the highest 4 channels.

The EUT measures approximately 85 x 55 x 28 cm plus mounting tabs. The module is constructed on a circuit board with the component side covered in a metal shield. The EUT is powered by a 3.6 Volt DC rechargeable battery. It is recharged by common USB power sources.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. This device is strictly battery powered cannot be powered from the AC mains during use. It employs two antenna ports using U.FL connectors. The 2 antennas are inside of the outer enclosure and not subject to user modification.

The EUT internal software operated the transmitter in a continuous modulated mode on channels selected manually.

1.4 Modifications to Equipment

No hardware modifications were made to the EUT during the performance of the test program. Power was adjusted to satisfy limits on power spectral density.

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 and Clauses

Table 1.6.1: Applicable Documents	
Document	**Title**
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

Table 1.6.2: Applicable Clauses		
Parameter	**FCC Part 15 Rule Paragraphs**	**IC RSS References**
Transmitter Characteristics	15.247	RSS-247; RSS Gen
Power	15.247(a)	RSS-247, 5.4
Power Spectral Density	15.247(e)	RSS-247, 5.2
Bandwidth	15.247(a)(2), 2.1049; KDB 558074 D01	RSS-247, 5.2; RSS-Gen
Unwanted Transmit Spurious	15.247(d), 15.209, 15.205	RSS-247, 5.5; RSS-Gen, 6.13
Unwanted Receive Spurious	15.109	RSS-Gen, 7.1
Band Edge	15.247(d), 15.205	RSS-247, 5.5; RSS-Gen, 8.10
Transmitter Duty Cycle	15.35(c)	RSS-Gen, 4.5
Antenna Requirement	15.203	RSS-247, 5.4; RSS-Gen

2.0 Fundamental Power, Conducted

2.1 Test Procedure

Bandwidth is first determined to select correct entire bandwidth for power measurement and the fundamental power is measured.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a) // RSS-247, 5.4	Fundamental Power Conducted Limit: 1 Watt	20 May 2015

2.3 Test Results

The EUT employs two antenna ports allowing for conducted measurement on each port. The EUT was connected to a spectrum analyzer directly for measurement; no loss factors were required and the measurement directly from the spectrum analyzer is correct.

Table 2.3.1 Fundamental Power, Conducted

Frequency (MHz)	Port 1 Measured Peak Power (dBm)	Port 2 Measured Peak Power (dBm)
5728	13.14	12.93
5793	11.22	11.00
5846	10.03	9.90

Measured in 10 MHz RBW, 10 MHz VBW.

The EUT was found to be in compliance with the applicable criteria.

3.0 Power Spectral Density, Conducted

3.1 Test Procedure

The EUT is connected directly to a spectrum analyzer. The spectrum analyzer is then adjusted to measure the power spectral density in the prescribed resolution bandwidth with an extended sweep time.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247, 5.2	Power Spectral Density, Conducted Limit: 8 dBm / 3 kHz	20 May 2015

3.3 Test Results

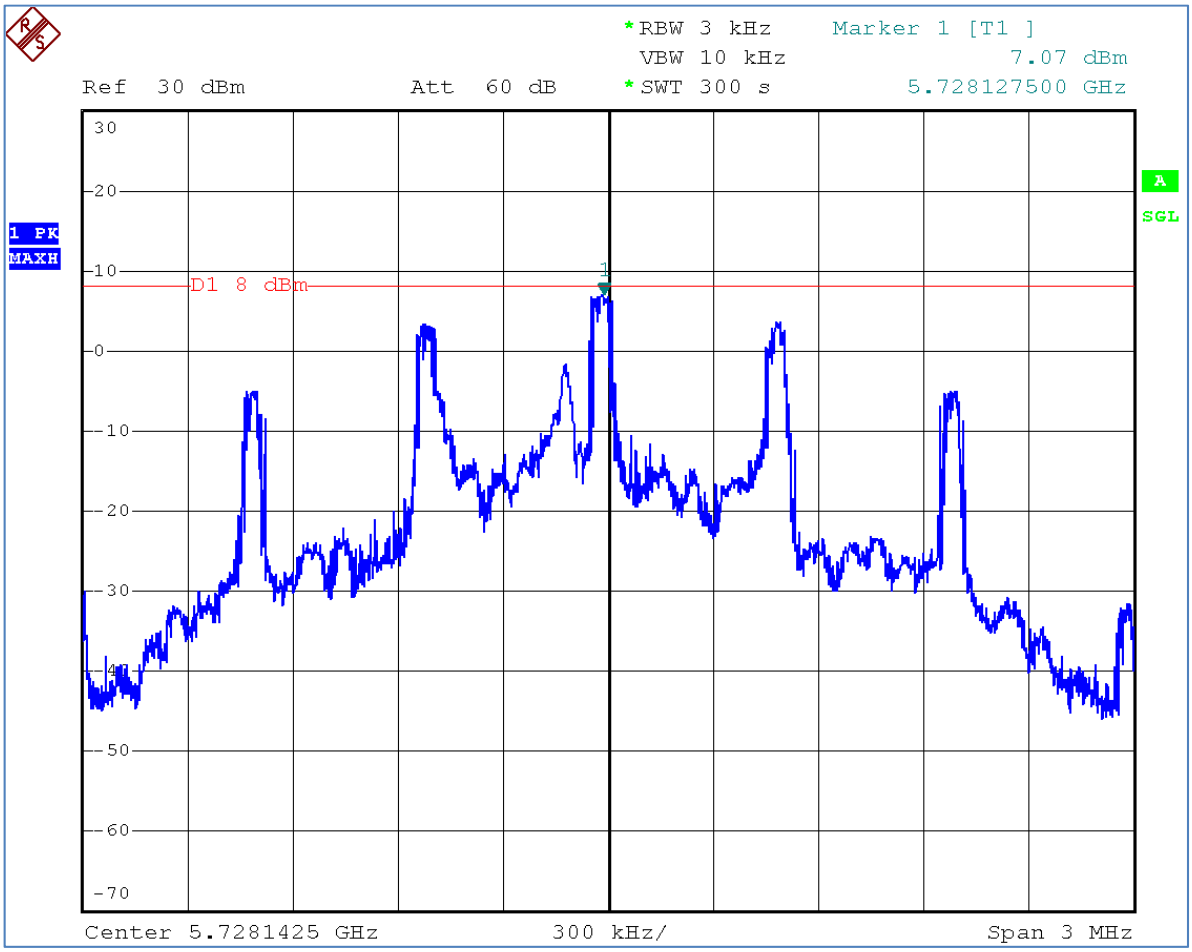
Table 3.3.1 Power Spectral Density		
Conducted Limit 8 dBm in 3 kHz		
Frequency MHz	Port 1 Corrected Measured Peak PSD (dBm)	Port 2 Corrected Measured Peak PSD (dBm)
5728	7.07	6.51
5793	4.17	2.97
5846	0.53	0.02

Sweep time 300 seconds except highest channel 500 seconds. EUT power setting P-15.

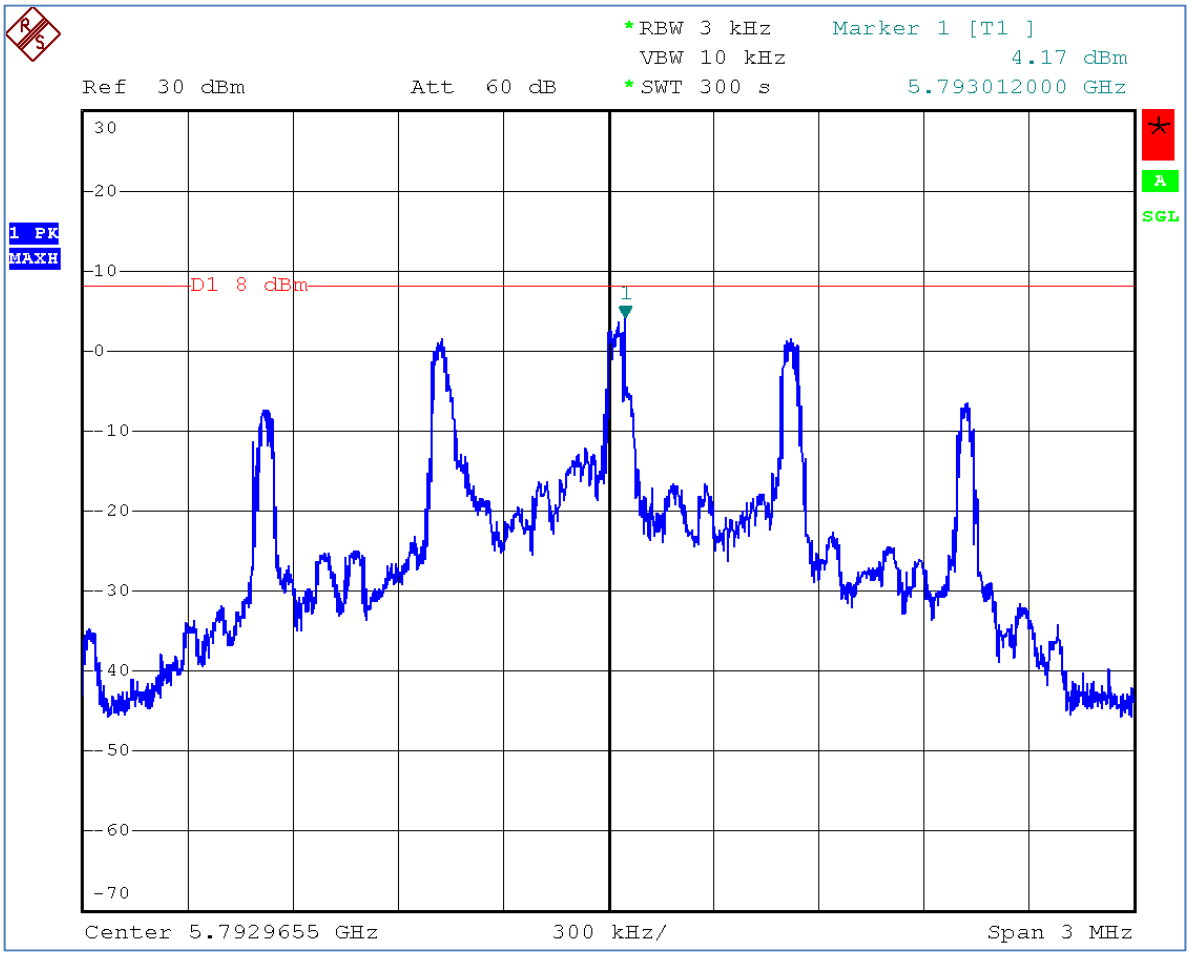
The EUT was found to be in compliance with the applicable criteria.

Plotted measurements appear below.

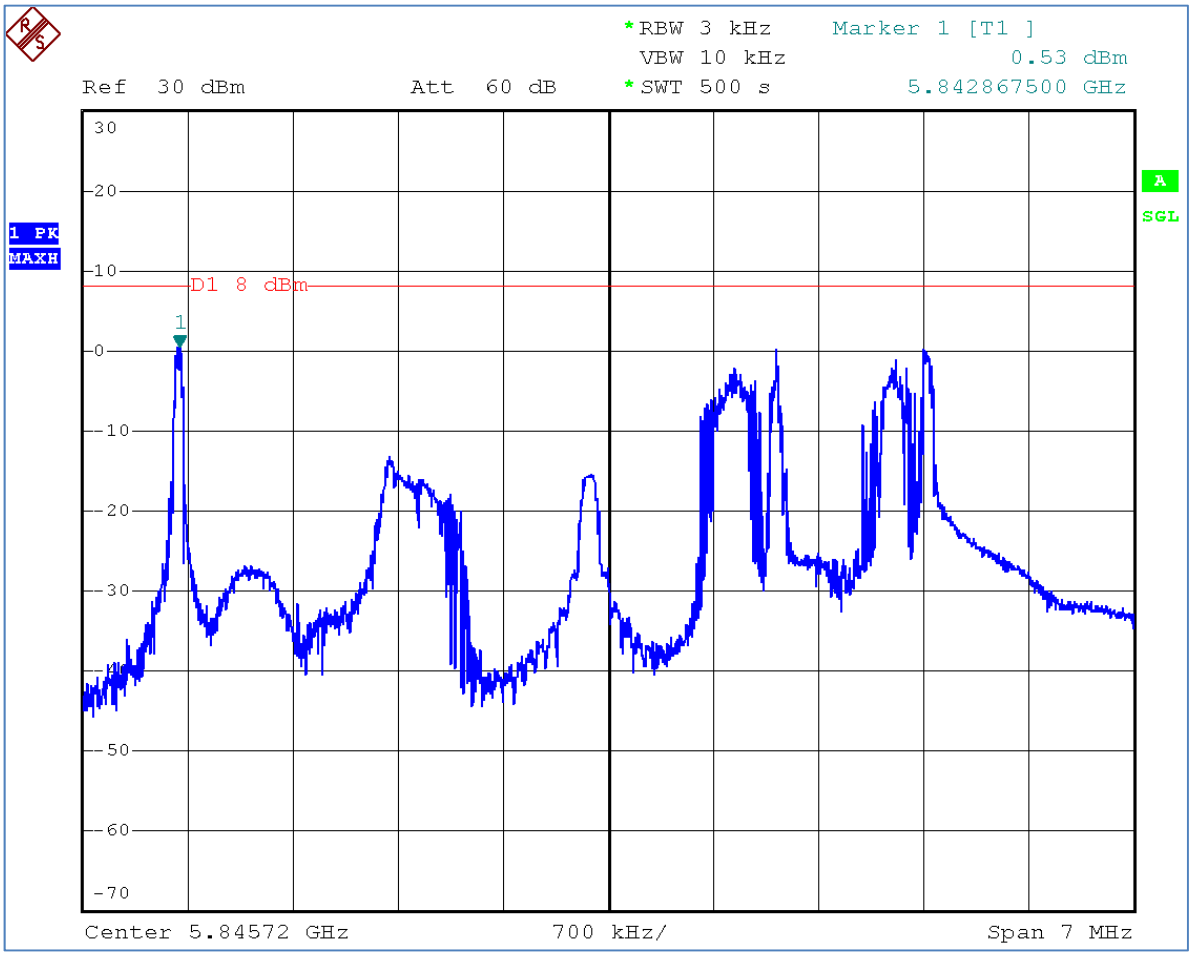
3.3.1 Port 1, Low Channel



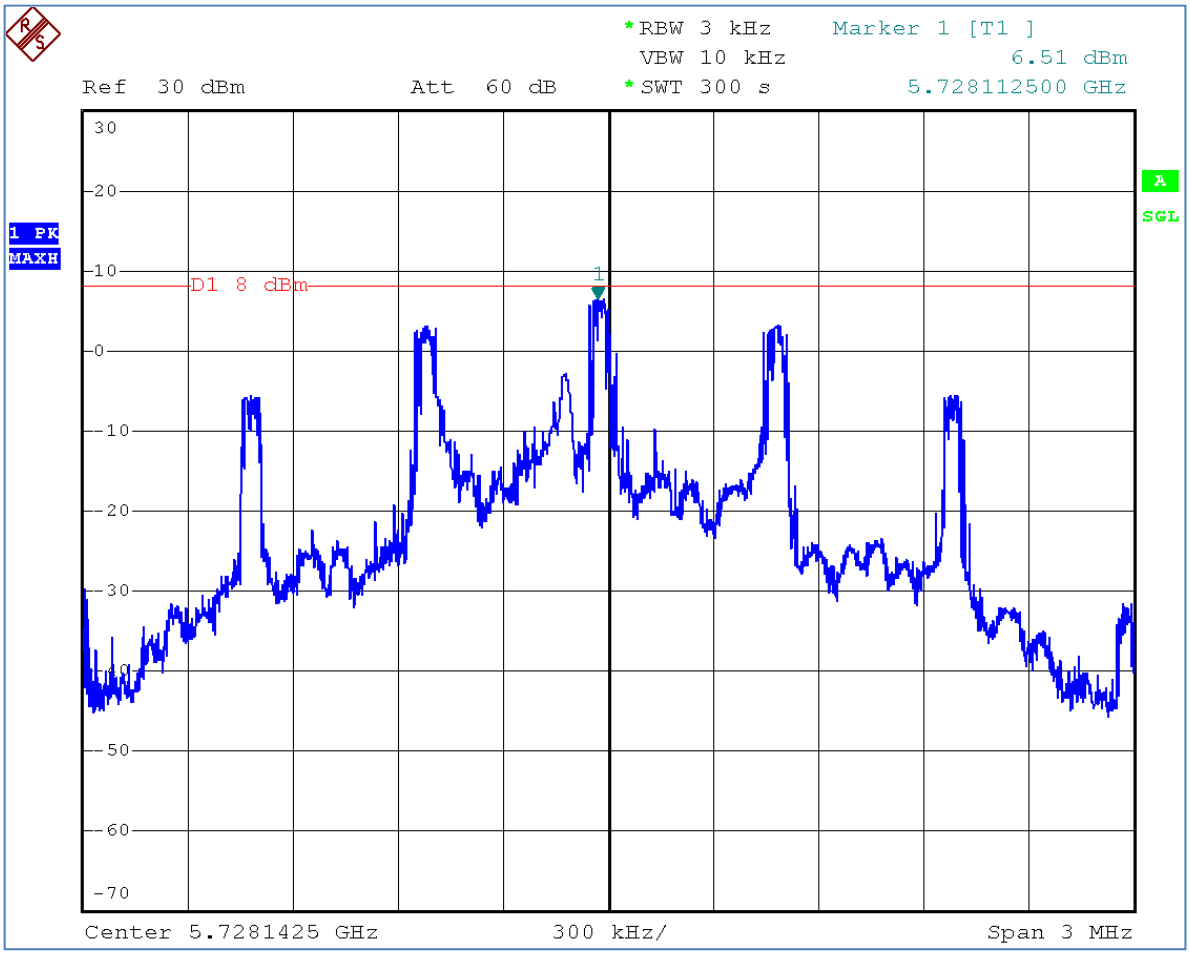
3.3.2 Port 1, Middle Channel



3.3.3 Port 1, High Channel

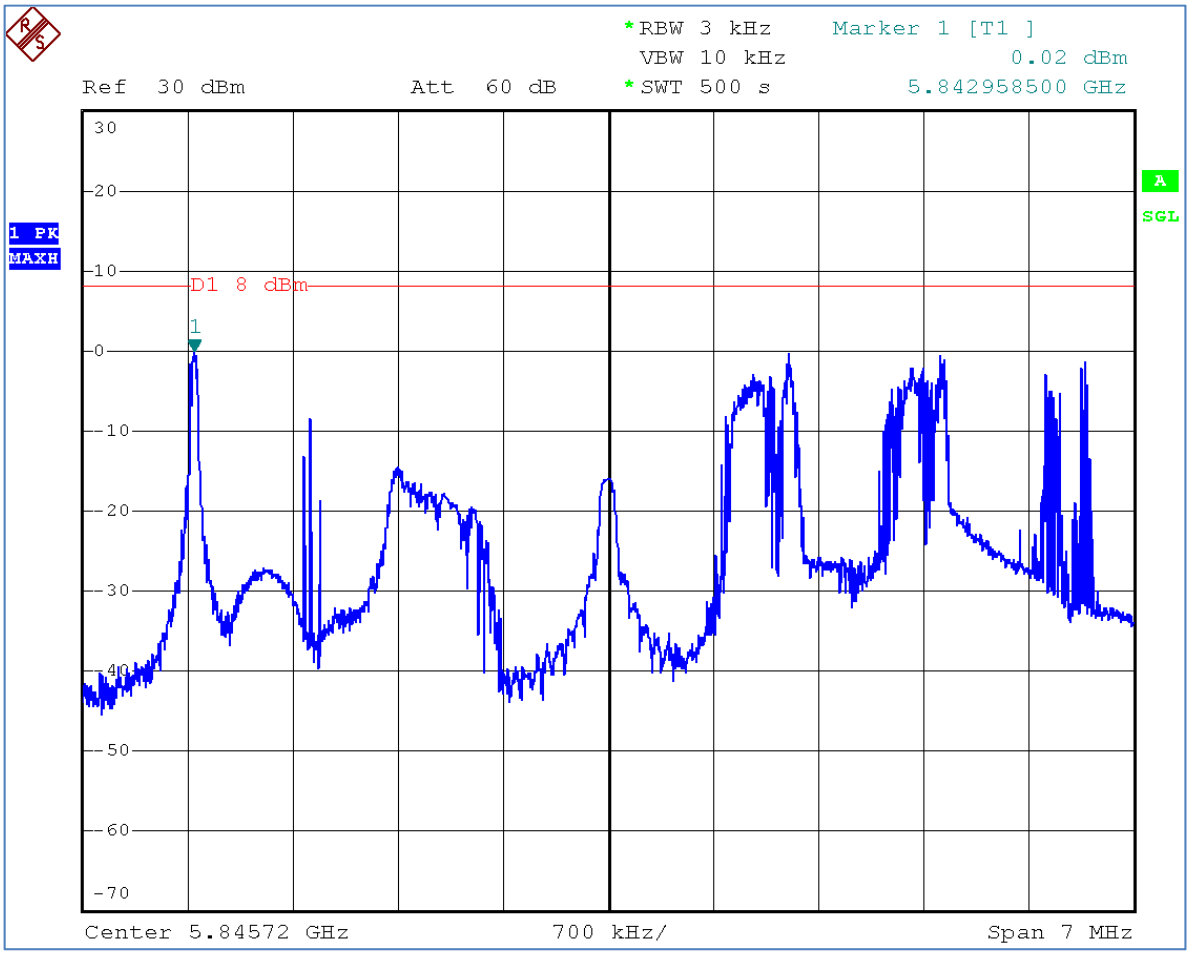


3.3.4 Port 2, Low Channel



3.3.5 Port 2, Middle Channel

3.3.6 Port 2, High Channel



4.0 Transmitter Duty Cycle

4.1 Test Procedure

EUT is placed into normal transmit operation to observe and record transmitter time domain performance.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.35(c) // RSS-Gen, 4.5	Averaging of Pulsed Transmissions	20 May 2015

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. For permissible exposure the calculation is based on power and no limit applies to the result. This is not a pass/fail measurement.

4.3 Test Results

Table 4.3.1 Duty Cycle Results

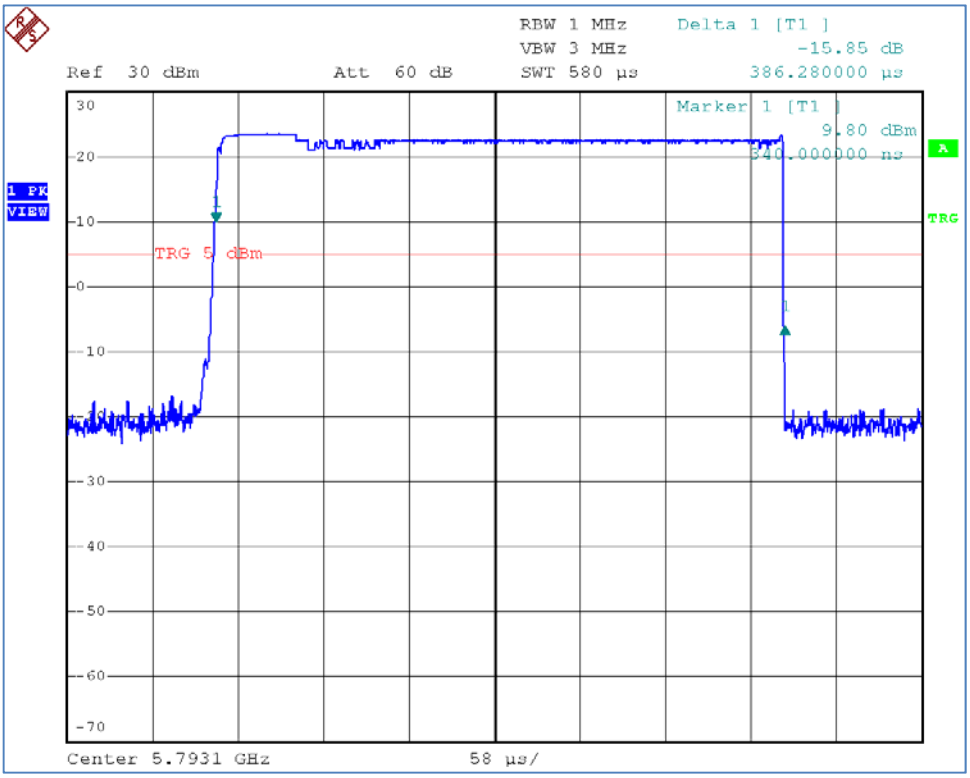
Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.38628	7.033	= 20 * Log_{10} (0.38628 msec / 7.033 msec)	-25.2	-20

Table 4.3.2 Exposure Source Duty Cycle Results

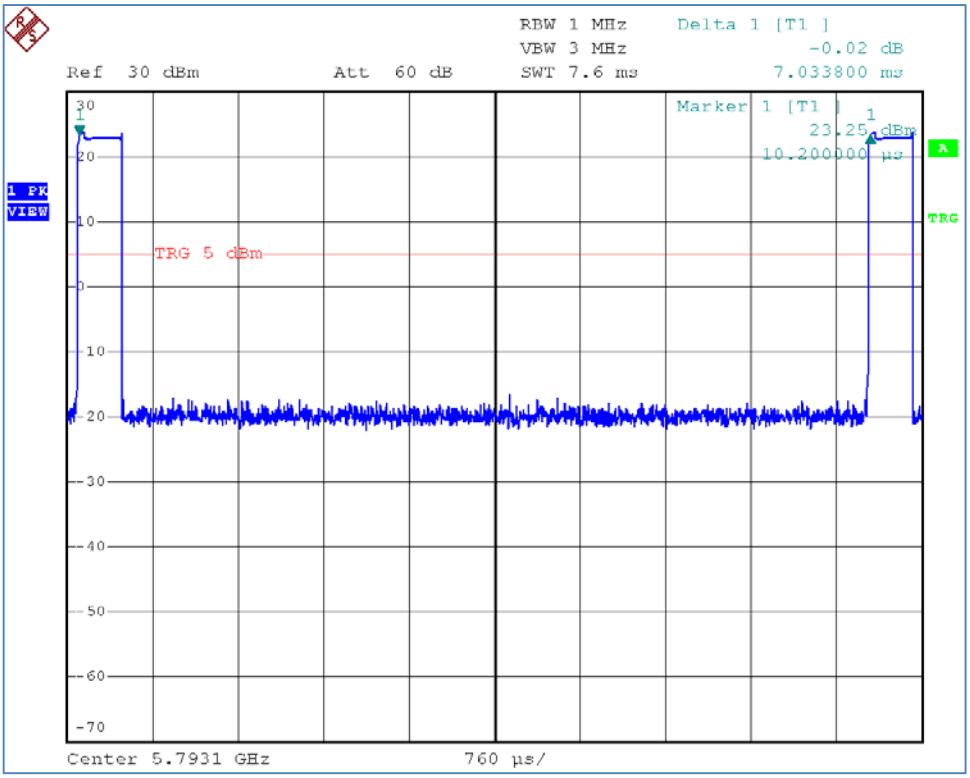
Measured On Time (msec)	Measured Time Interval (msec)	Exposure Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.38628	7.033	= 10 * Log_{10} (0.38628 msec / 7.033 msec)	-12.6	-12.6

Plotted measurements appear below.

4.3.1 Transmit On Time



4.3.2 Transmit Interval Time



5.0 Occupied Bandwidth

5.1 Test Procedure

Bandwidth is measured by conducted means. A recording of the results is included.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247(a)(2), 2.1049; KDB 558074 D01 // RSS-247, 5.2; RSS-Gen	Bandwidth, 6 dB, 20 dB	9 May 2015

5.3 Test Results

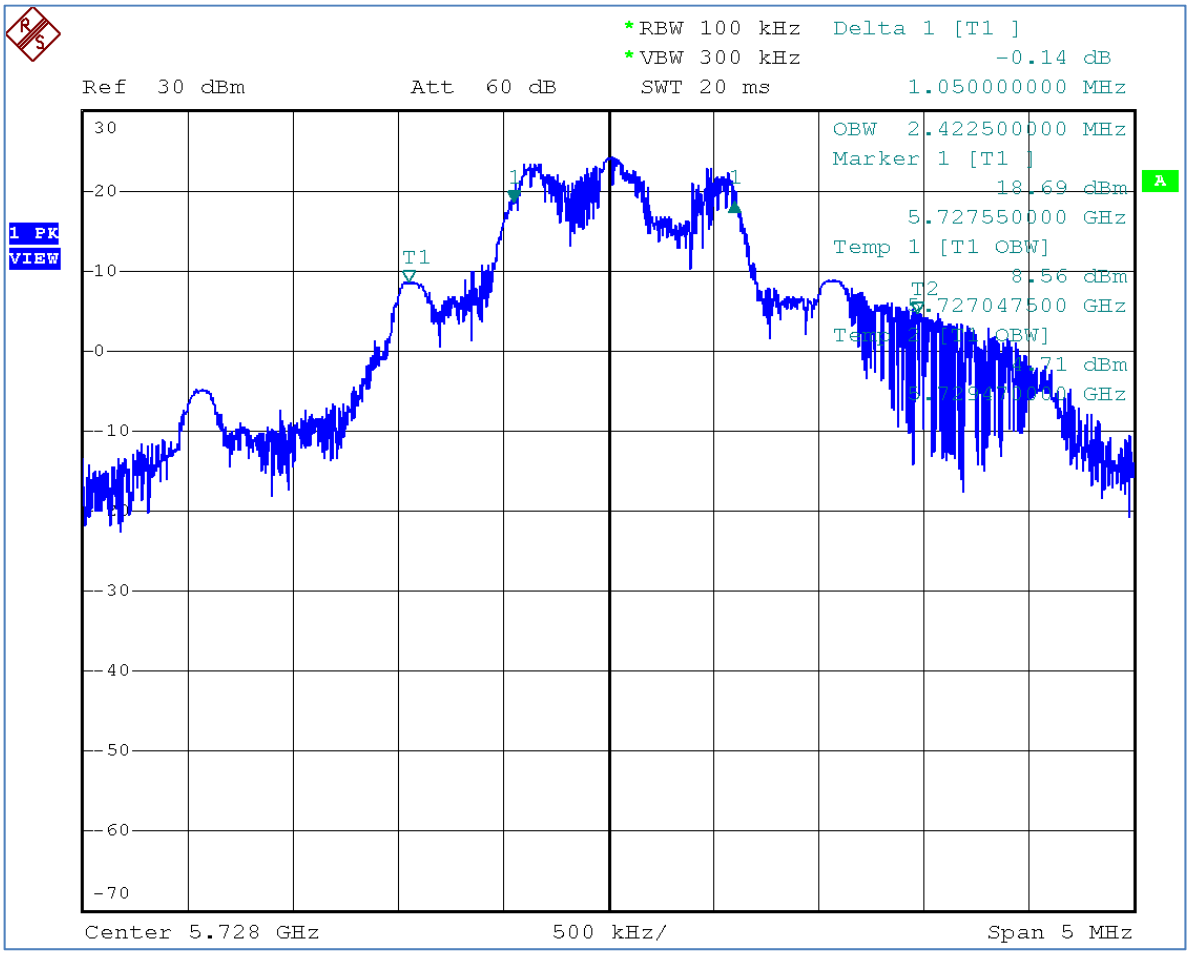
EUT was found to be in compliance with applicable requirements.

Table 5.3.1 Bandwidth 6 dB, Minimum 500 kHz			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Minimum BW (kHz)**
1050	1130	5640	**1050**

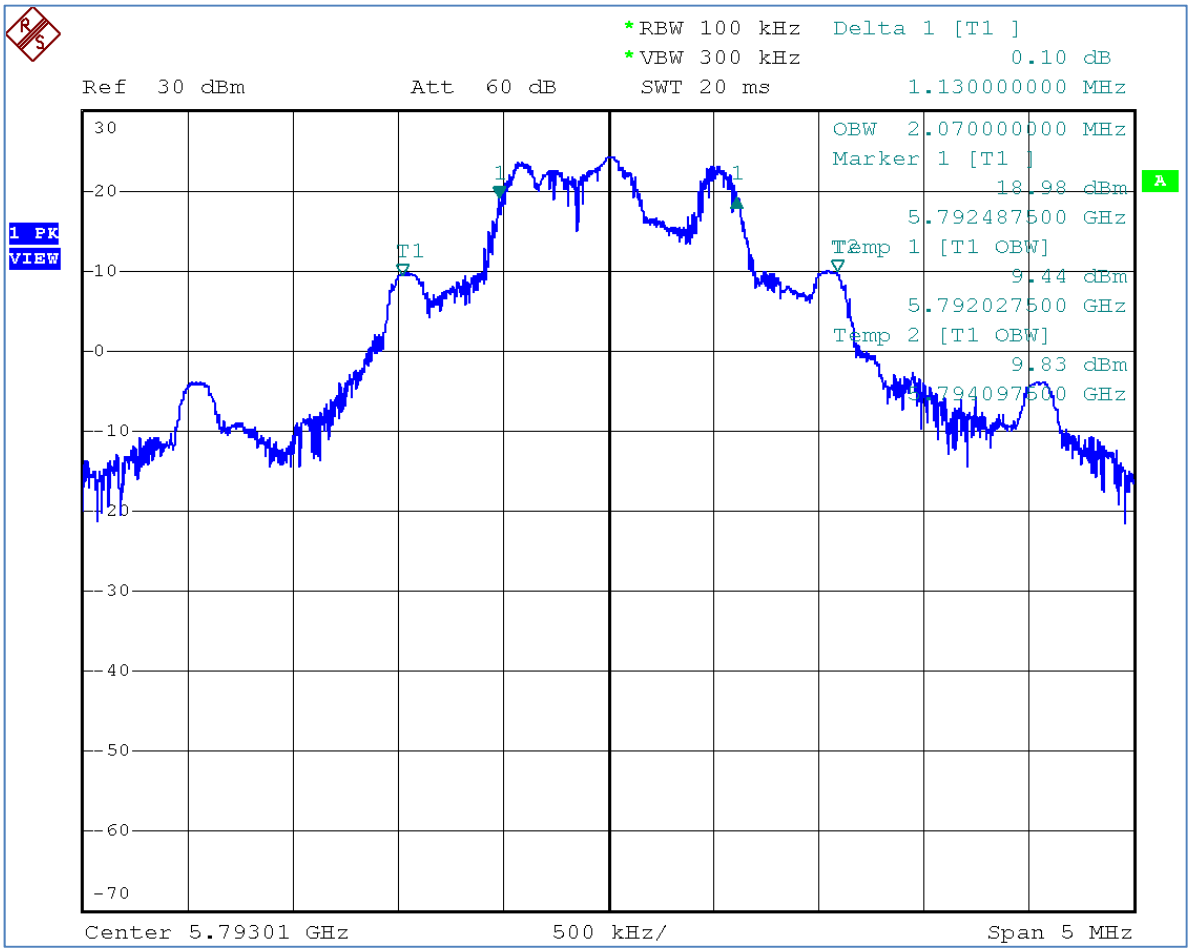
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
2422.5	2070	5655	**5655**

Plotted measurements appear on the following pages.

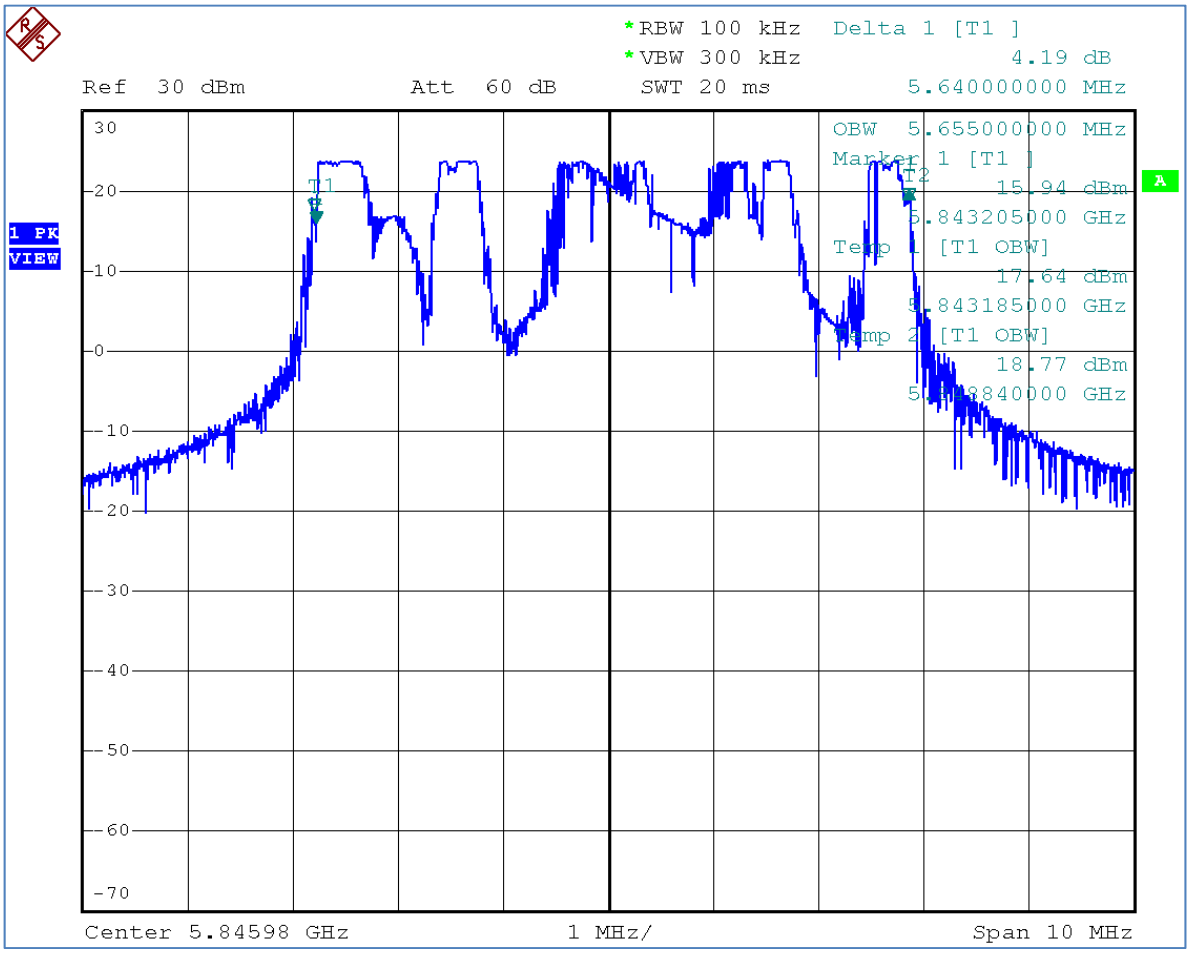
5.3.1 Low Channel, 6 dB & 20 dB



5.3.2 Middle Channel, 6 dB & 20 dB



5.3.3 High Channel, 6 dB & 20 dB



High Channel

6.0 Band Edge

6.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method of C63.4 is utilized.

6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247(d), 15.205// RSS-247, 5.5; RSS-Gen	Unwanted Emissions Adjacent to Authorized Band, Radiated	1 June 2015

6.3 Test Results

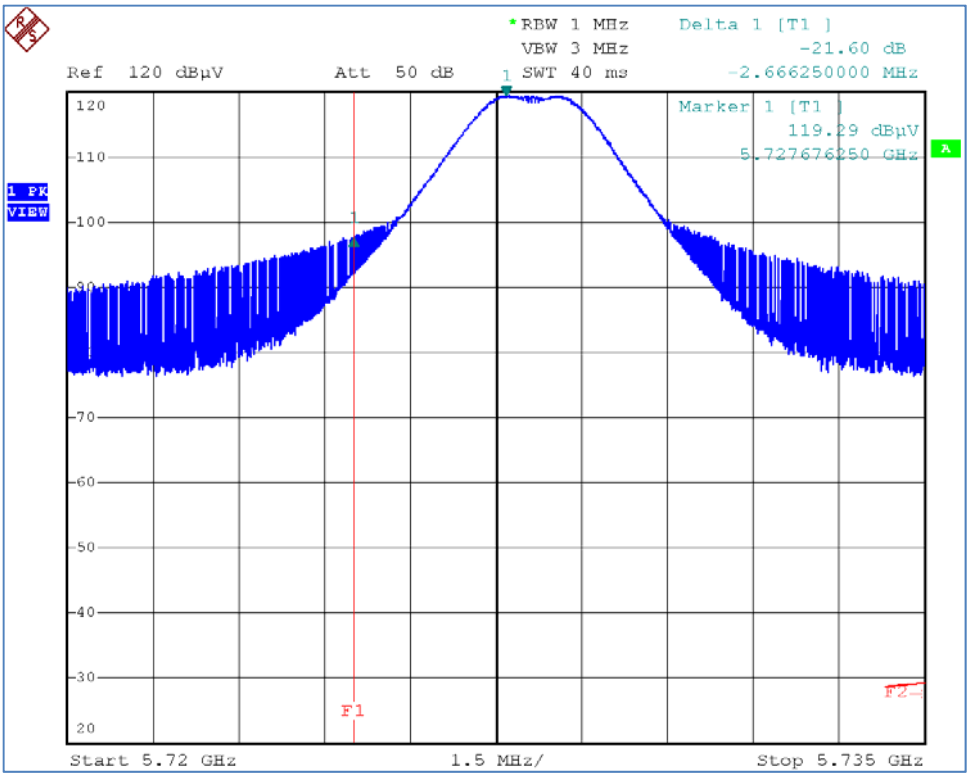
Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the declining emission levels. Peak detection with max-hold is employed. Note that there are no restricted bands adjacent to this band so only the -20 dBc criteria is applied.

Peak detection of emissions at band edges were below the -20 dBc criteria.

The average duty cycle factor is -20 dB so the average emission would be 20 dB below the peak detected levels.

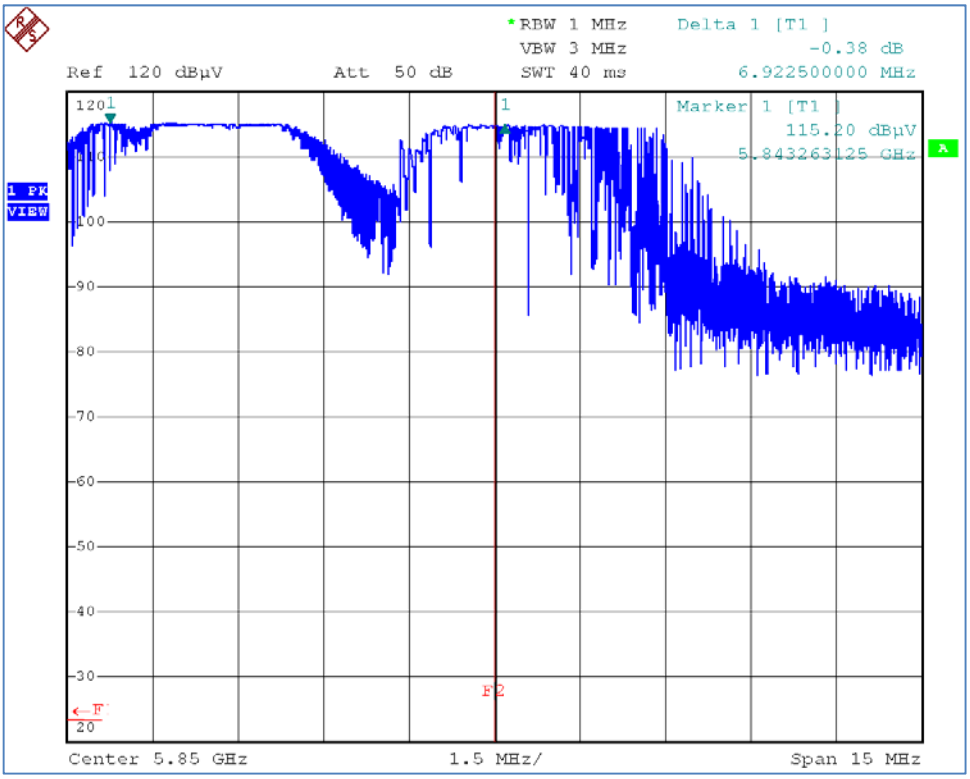
The EUT satisfied the criteria. Plotted results appears on the following pages.

6.3.1 Low Channel Band Edge



Band Edge Emission, Satisfies -20dBc Criteria

6.3.2 High Channel Band Edge



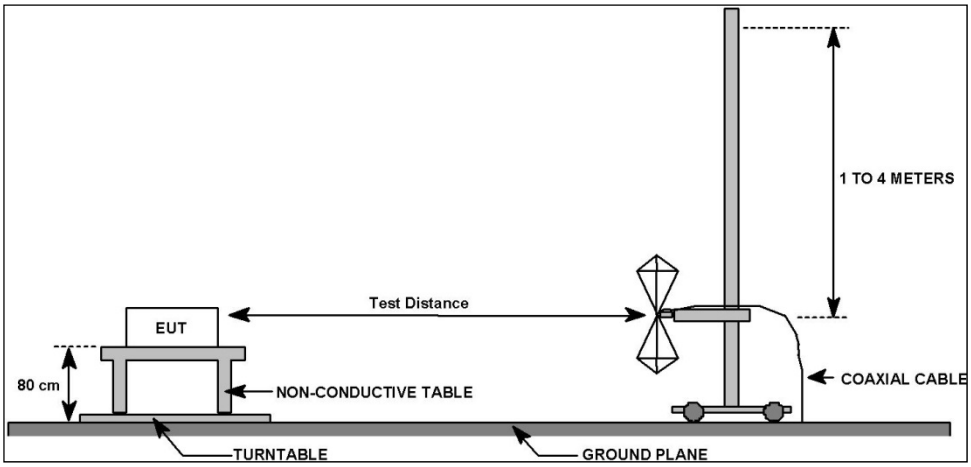
Band Edge Emission, Satisfies -20dBc Criteria

7.0 Radiated Spurious Emissions, Receive Mode

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate using resolution bandwidth 1 MHz. A diagram showing the test setup appears below.



7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.109 // RSS-Gen, 7.1	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	8 May 2015

7.3 Test Results

The EUT was tuned to the middle channel.

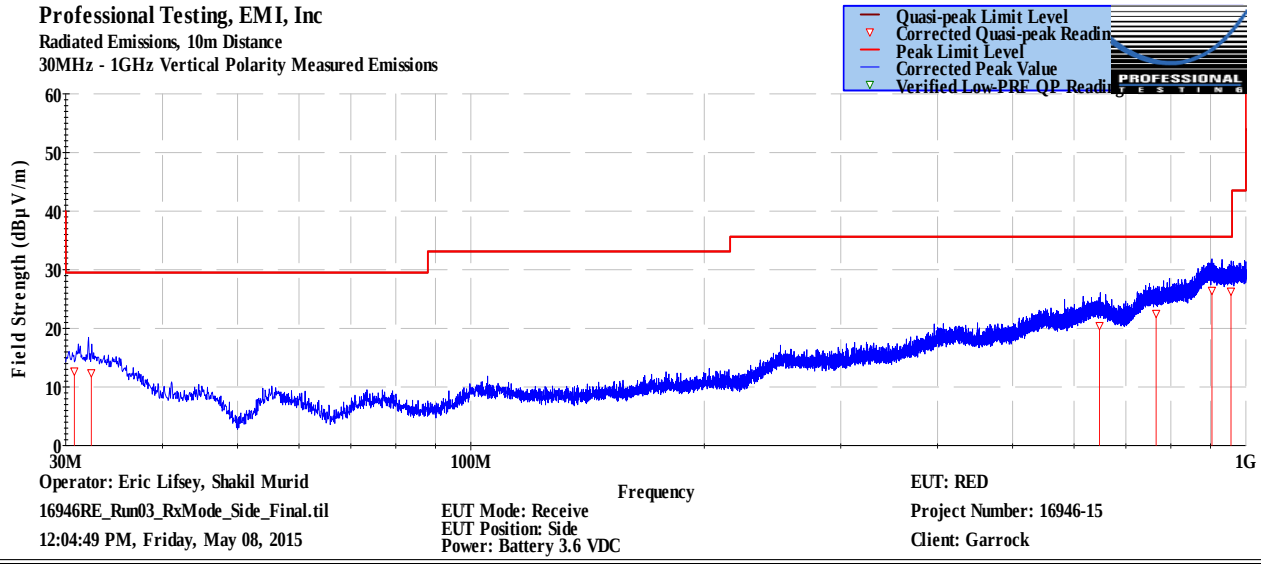
The EUT satisfied the criteria. Recorded data is presented below.

Table 7.3.1: Radiated Spurious Emissions, Receive Mode, < 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz		
EUT Mode of Operation:			Receive Mode			

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
30.7765	10	167	3.82	Quasi-peak	24.1	12.697	29.5	-16.8	Pass
32.367	10	107	1.3	Quasi-peak	23.9	12.401	29.5	-17.1	Pass
647.327	10	27	1.61	Quasi-peak	21.8	20.459	35.6	-15.1	Pass
765.955	10	230	3.97	Quasi-peak	21.5	22.526	35.6	-13.1	Pass
903.862	10	120	3.94	Quasi-peak	21.2	26.47	35.6	-9.1	Pass
956.639	10	199	1.25	Quasi-peak	21.1	26.321	35.6	-9.3	Pass



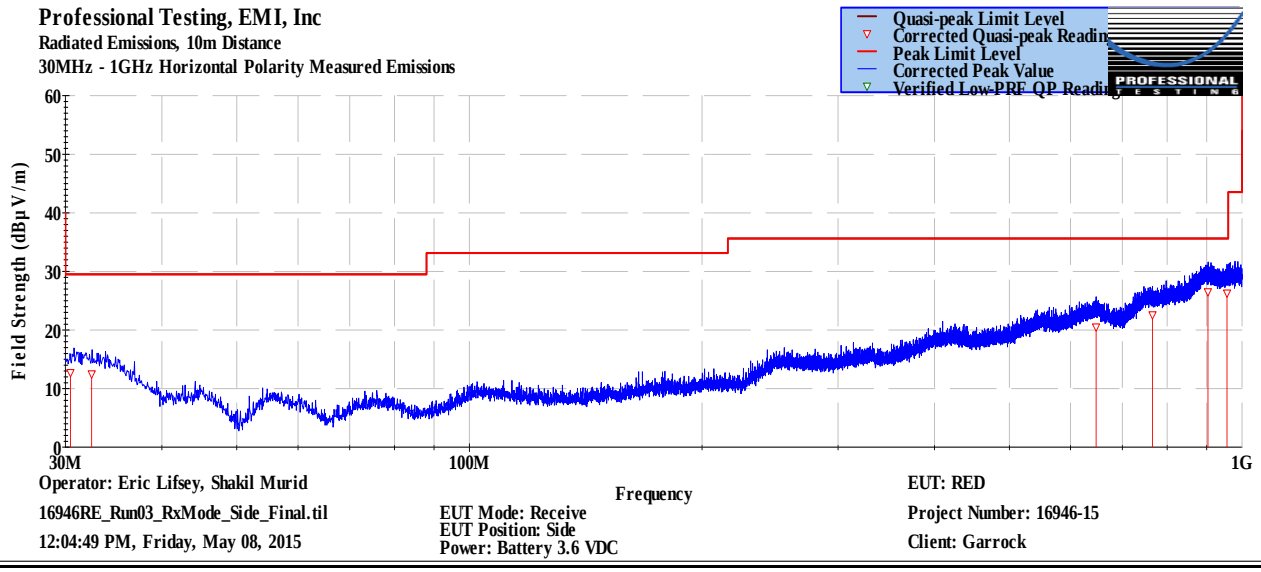
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.2: Radiated Spurious Emissions, Receive Mode, < 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

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
30.4603	10	63	2.98	Quasi-peak	24.2	12.708	29.5	-16.8	Pass
32.4427	10	151	1.28	Quasi-peak	24	12.476	29.5	-17.0	Pass
647.326	10	70	3.03	Quasi-peak	21.9	20.516	35.6	-15.1	Pass
766.094	10	256	3.94	Quasi-peak	21.6	22.558	35.6	-13.0	Pass
903.737	10	8	3.52	Quasi-peak	21.3	26.502	35.6	-9.1	Pass
956.64	10	320	1.36	Quasi-peak	21	26.293	35.6	-9.3	Pass



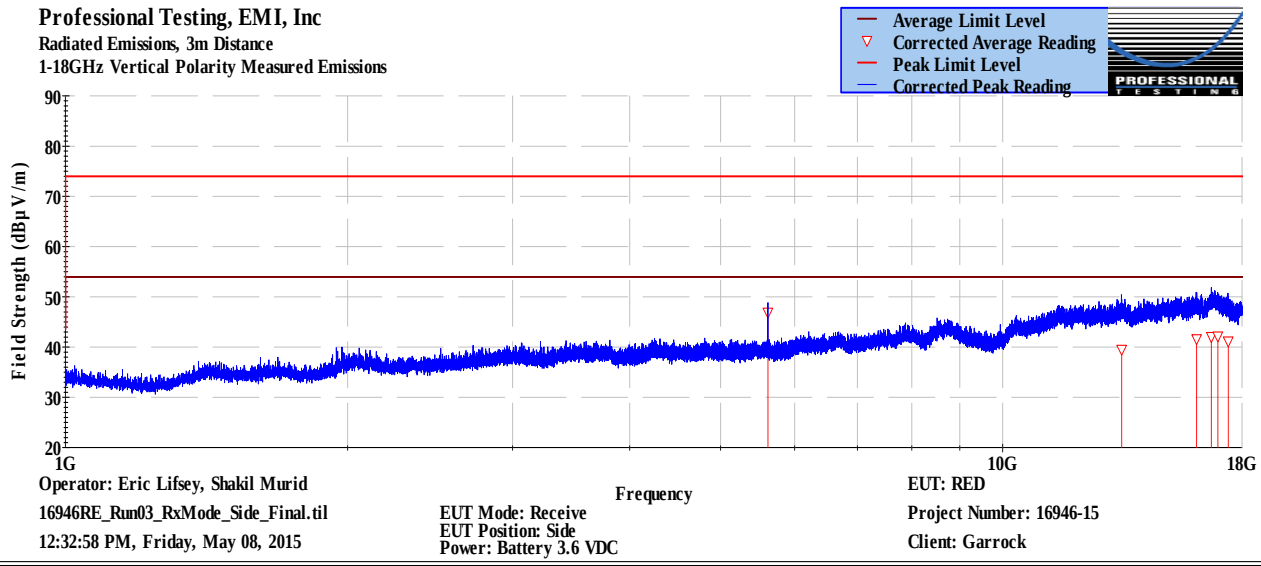
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: Radiated Spurious Emissions, Receive Mode, > 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation:	Receive Mode					

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
5611.53	3	128	0	Average	31.6	29.495	54.0	-24.5	Pass
13389	3	133	0	Average	28.7	39.451	54.0	-14.5	Pass
16096.6	3	135	0	Average	27.4	41.589	54.0	-12.4	Pass
16698.8	3	272	0	Average	27.3	41.999	54.0	-12.0	Pass
16952.4	3	44	0	Average	27.5	42.109	54.0	-11.8	Pass
17409.7	3	214	0	Average	27.1	41.219	54.0	-12.7	Pass



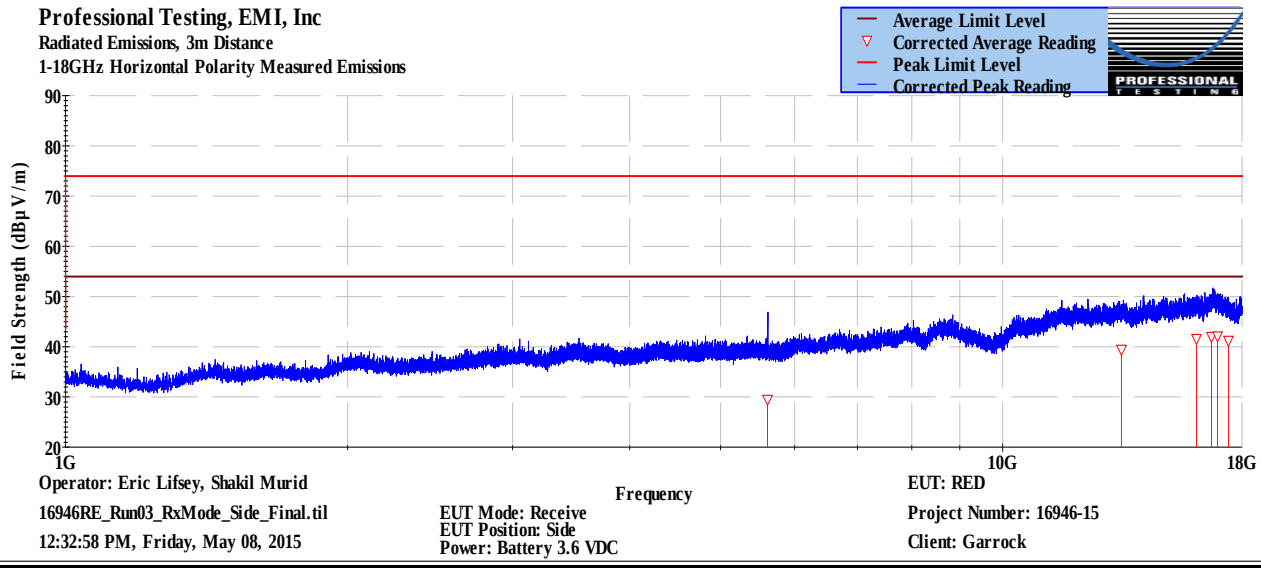
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: Radiated Spurious Emissions, Receive Mode, > 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Receive Mode			

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
5616.75	3	44	0	Average	49	46.893	54.0	-7.1	Pass
13393.8	3	97	0	Average	28.8	39.521	54.0	-14.4	Pass
16103	3	150	0	Average	27.4	41.611	54.0	-12.3	Pass
16697.9	3	32	0	Average	27.3	42.027	54.0	-11.9	Pass
16962.9	3	76	0	Average	27.5	42.166	54.0	-11.8	Pass
17401.3	3	182	0	Average	27	41.157	54.0	-12.8	Pass



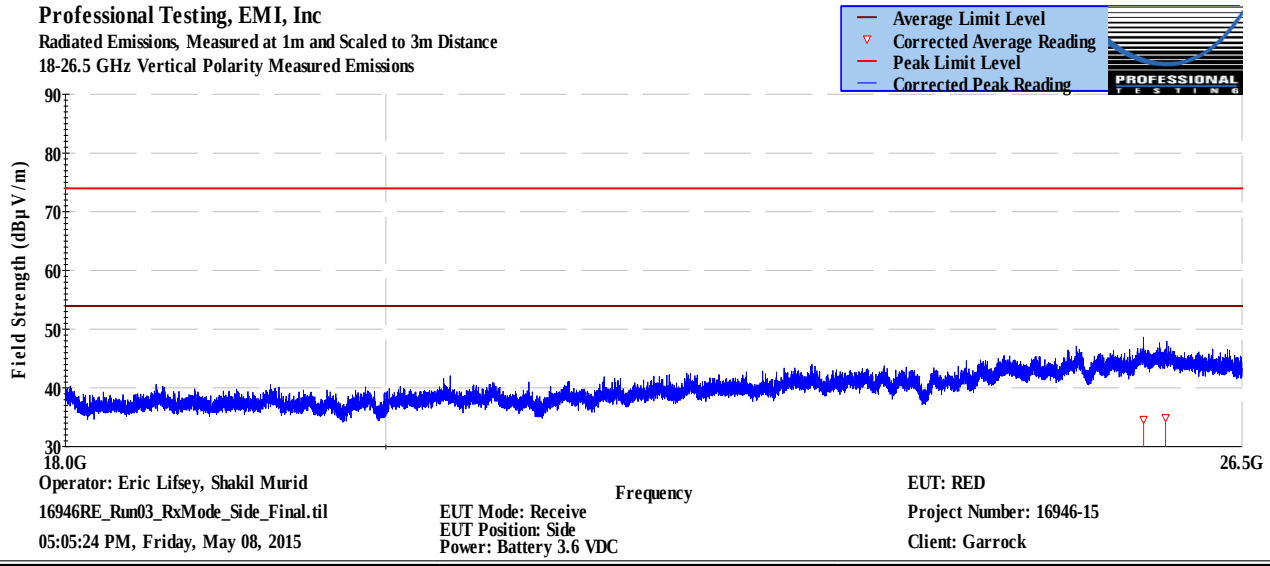
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.5: Radiated Spurious Emissions, Receive Mode, > 18 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT Mode of Operation:			Receive Mode		

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
25656.4	1	0	1	Average	NAN	34.608	63.5	-28.9	Pass
25842.8	1	0	1	Average	NAN	34.921	63.5	-28.6	Pass



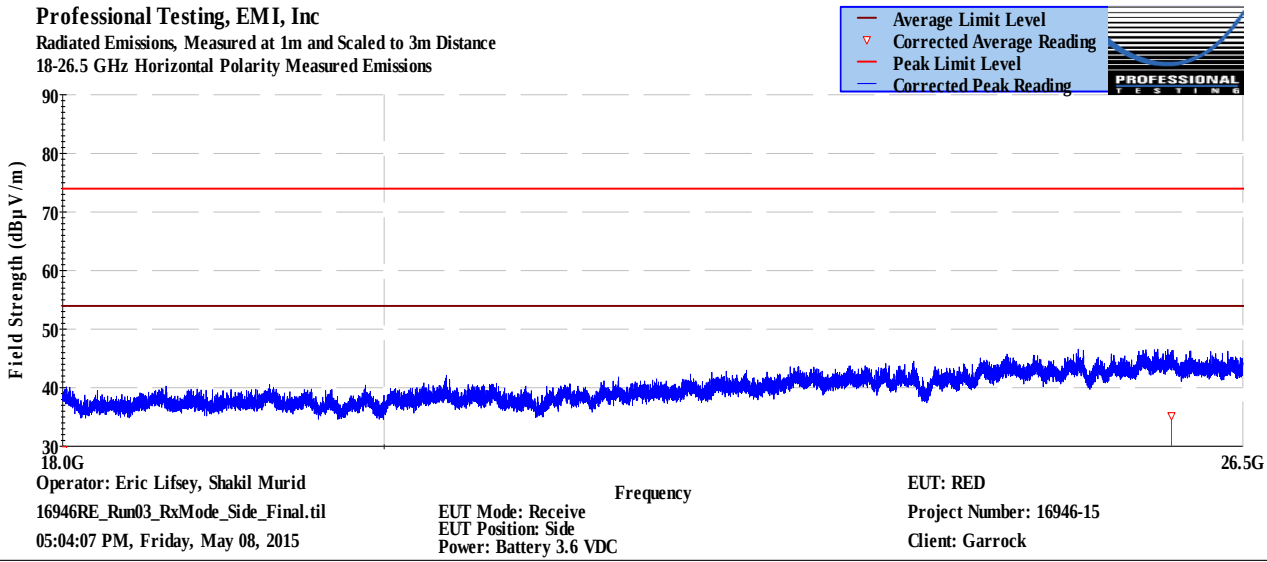
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.6: Radiated Spurious Emissions, Receive Mode, > 18 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	RED	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive Mode	

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
18004.8	1	0	1	Average	NAN	29.41	63.5	-34.1	Pass
25886.6	1	0	1	Average	NAN	35.228	63.5	-28.3	Pass

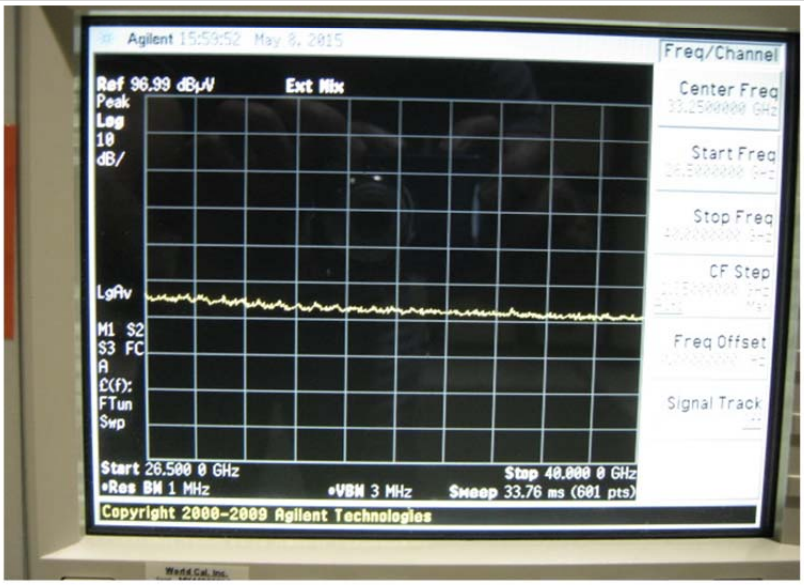


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.7: Radiated Spurious Emissions, Receive Mode, > 26.5 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/8/2015	**EUT Serial #:**	None
Customer:	Garrock	**EUT Part #:**	None
Project Number:	16946-15	**Test Technician:**	Eric Lifsey, Shakil Murad
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	RED	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet					Page:	1	of	1
EUT Line Voltage:	**3.6**	**VDC**	**EUT Power Frequency:**	**0**	**N/A**			
EUT Mode of Operation:			**Receive Mode**					



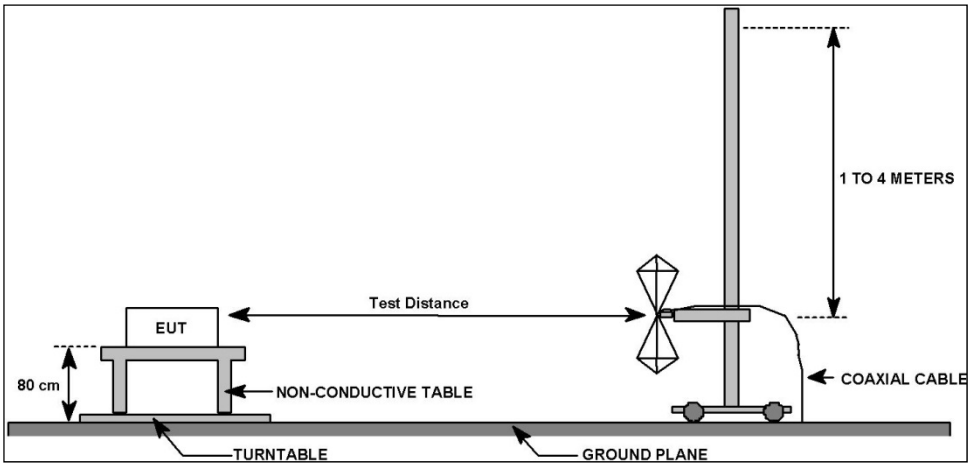
26.5 to 40 GHz, Composite Max-Hold of Vertical and Horizontal

8.0 Radiated Spurious Emissions, Transmit Mode

8.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



8.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247, 5.5; RSS-Gen, 6.13	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	8 May 2015, 1 June 2015

8.3 Test Results

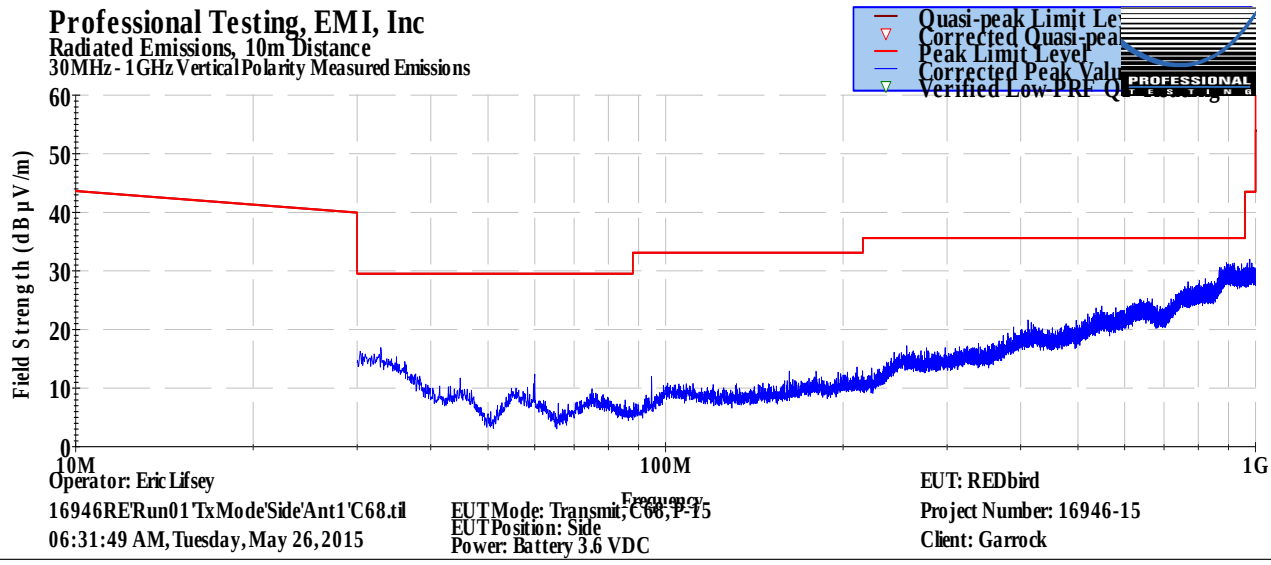
Below 1 GHz measurements were taken in transmit mode on the middle channel. Above 1 GHz measurements were taken on the three standard channels of the band and for the maximum emission orientation of the EUT. The maximum emission orientation was found to be Side. Emissions were measured for each of the two antenna ports.

The applicable duty cycle factor for averaging of peak measurements above 1 GHz is -20 dB.

Table 8.3.1: TX Mode, < 1 GHz, Vertical Polarity, Port 1, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz	
EUT Mode of Operation: Port 1			Transmit Middle Channel		

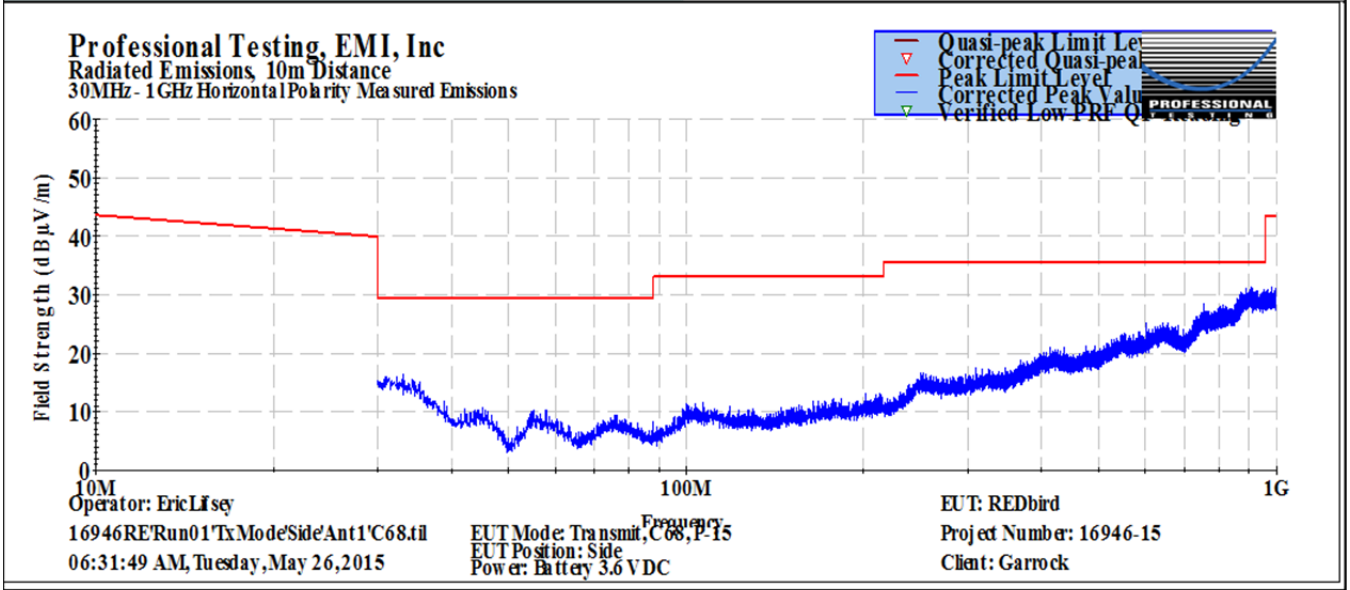


≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.2: TX Mode, < 1 GHz, Horizontal Polarity, Port 1, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz		
EUT Mode of Operation: Port 1			Transmit Middle Channel			



≤ 1GHz Horizontal Antenna Polarity Measured Emissions

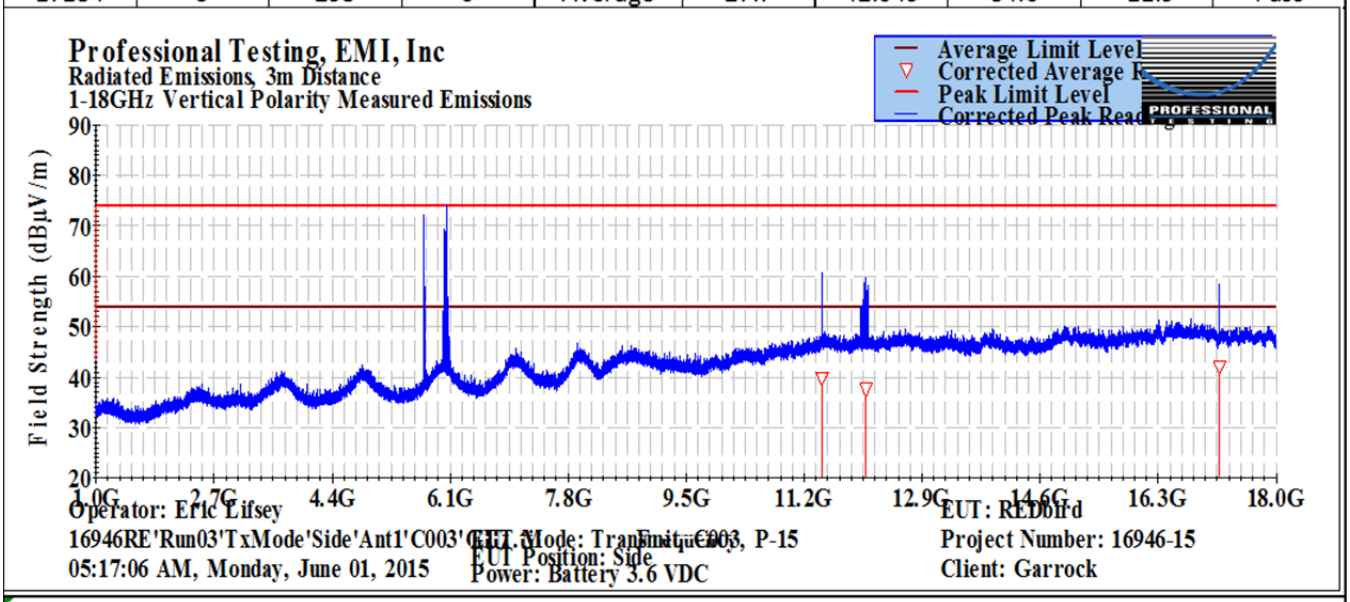
Table 8.3.3: TX Mode, > 1 GHz, Vertical Polarity, Port 1, Low Channel

Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 1			Transmit Low Channel			

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
11455.8	3	292	0	Average	29.1	39.847	54.0	-14.1	Pass
12091.5	3	94	0	Average	27.3	37.639	54.0	-16.3	Pass
17184	3	298	0	Average	27.7	42.049	54.0	-11.9	Pass



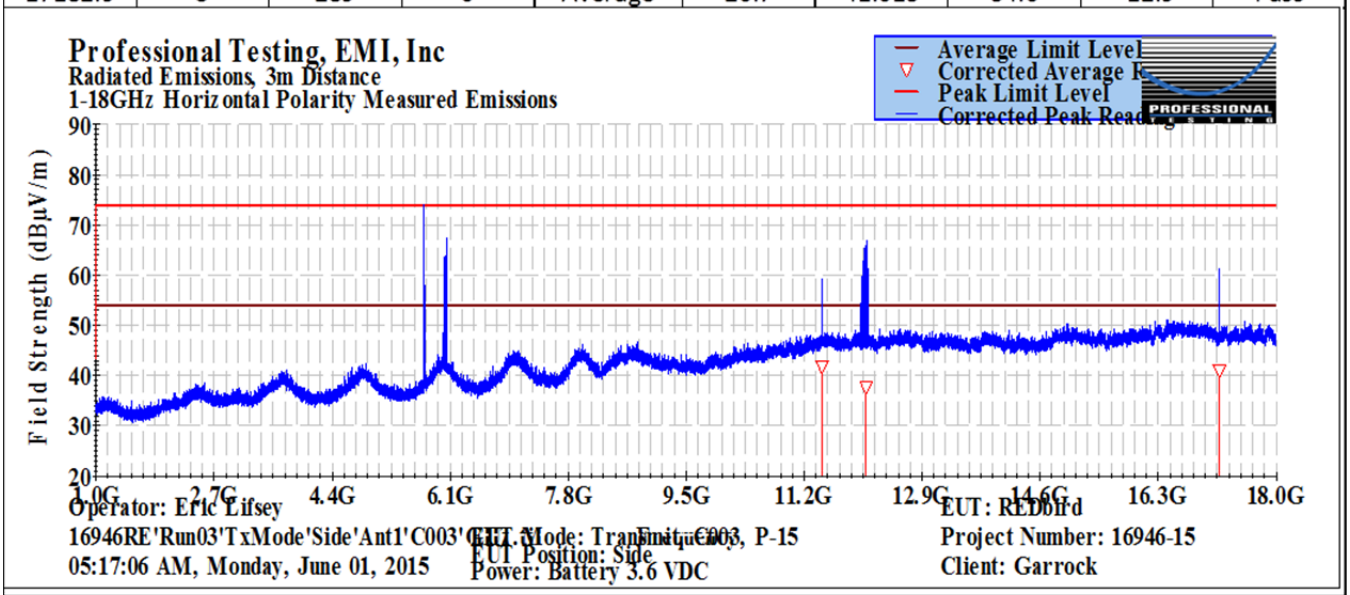
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.4: TX Mode, > 1 GHz, Horizontal Polarity, Port 1, Low Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation: Port 1		Transmit Low Channel	

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
11456.1	3	10	0	Average	31.2	41.864	54.0	-12.1	Pass
12092.3	3	52	0	Average	27.4	37.711	54.0	-16.2	Pass
17182.9	3	289	0	Average	26.7	41.015	54.0	-12.9	Pass



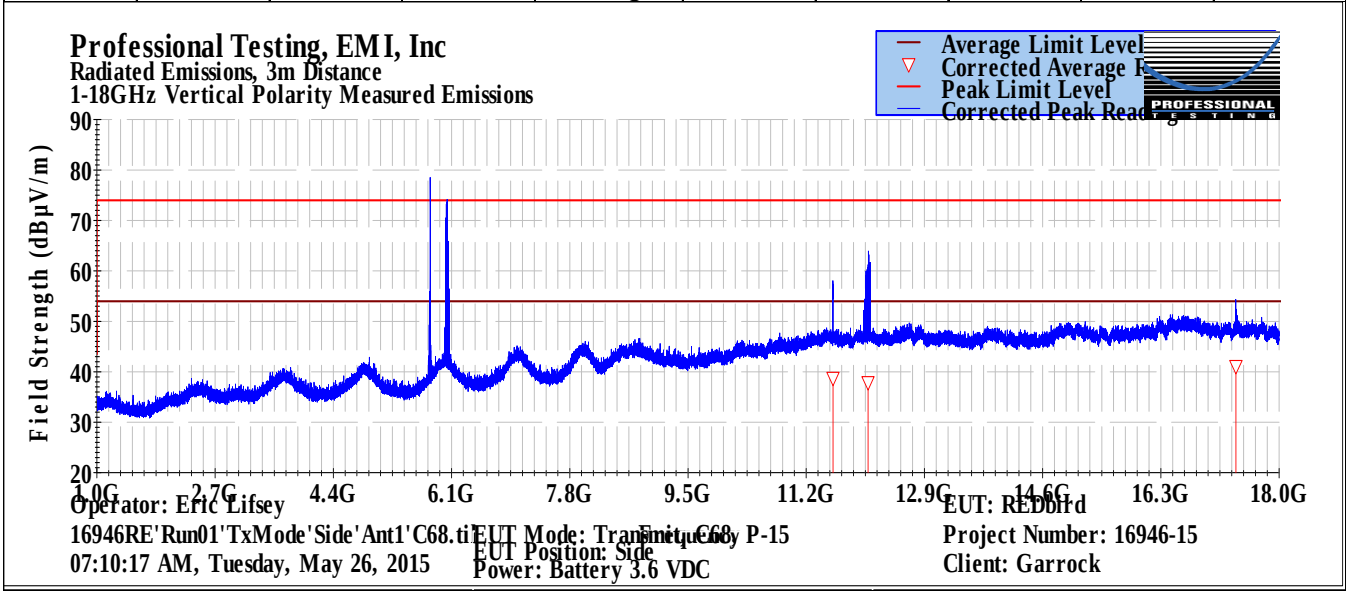
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.5: TX Mode, > 1 GHz, Vertical Polarity, Port 1, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 1			Transmit Middle Channel			

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
11585.7	3	285	0	Average	28.2	38.767	54.0	-15.2	Pass
12089.2	3	327	0	Average	27.6	37.901	54.0	-16.1	Pass
17379.3	3	9	0	Average	27	41.111	54.0	-12.8	Pass



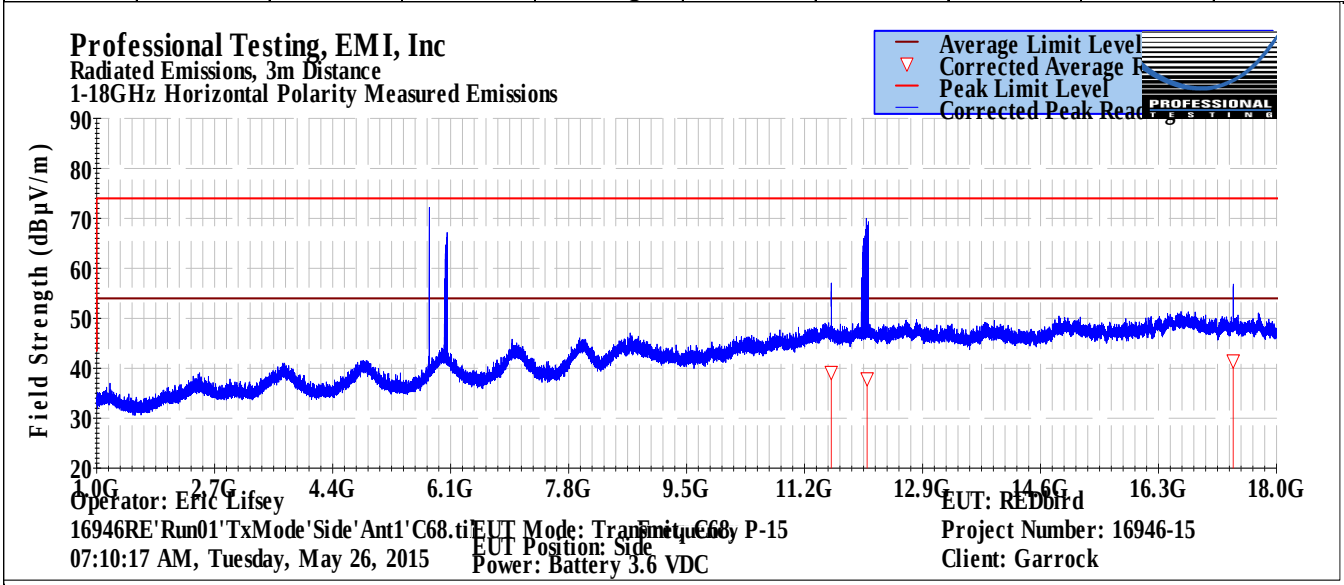
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.6: TX Mode, > 1 GHz, Horizontal Polarity, Port 1, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 1			Transmit Middle Channel			

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
11584.8	3	158	1	Average	28.7	39.225	54.0	-14.7	Pass
12101	3	53	1	Average	27.6	37.963	54.0	-16.0	Pass
17377.3	3	318	1	Average	27.4	41.53	54.0	-12.4	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

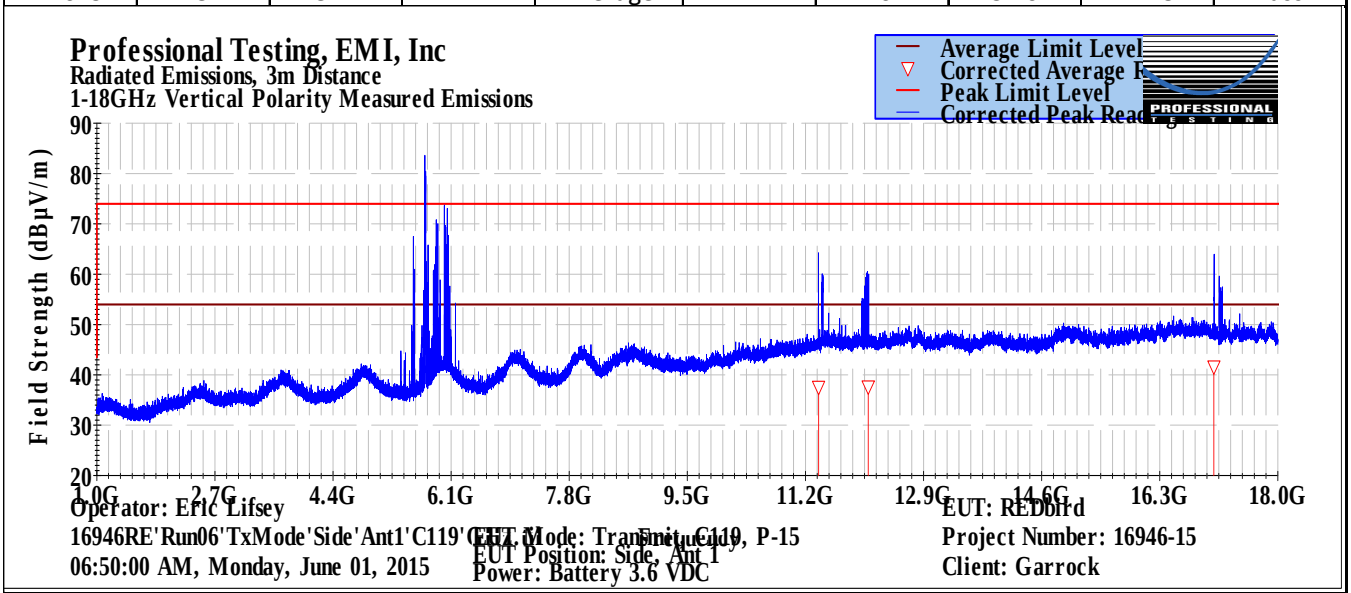
Table 8.3.7: TX Mode, > 1 GHz, Vertical Polarity, Port 1, High Channel

Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	**EUT Serial #:**	None
Customer:	Garrock	**EUT Part #:**	None
Project Number:	16946-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	REDbird	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	3.6	VDC	**EUT Power Frequency:**	0	N/A
Antenna Orientation:	Vertical		**Frequency Range:**	Above 1GHz	
EUT Mode of Operation: Port 1			**Transmit High Channel**		

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
11389.4	3	210	1	Average	27.2	37.588	54.0	-16.4	Pass
12105	3	235	1	Average	27.3	37.63	54.0	-16.3	Pass
17079	3	314	1	Average	27.1	41.627	54.0	-12.3	Pass



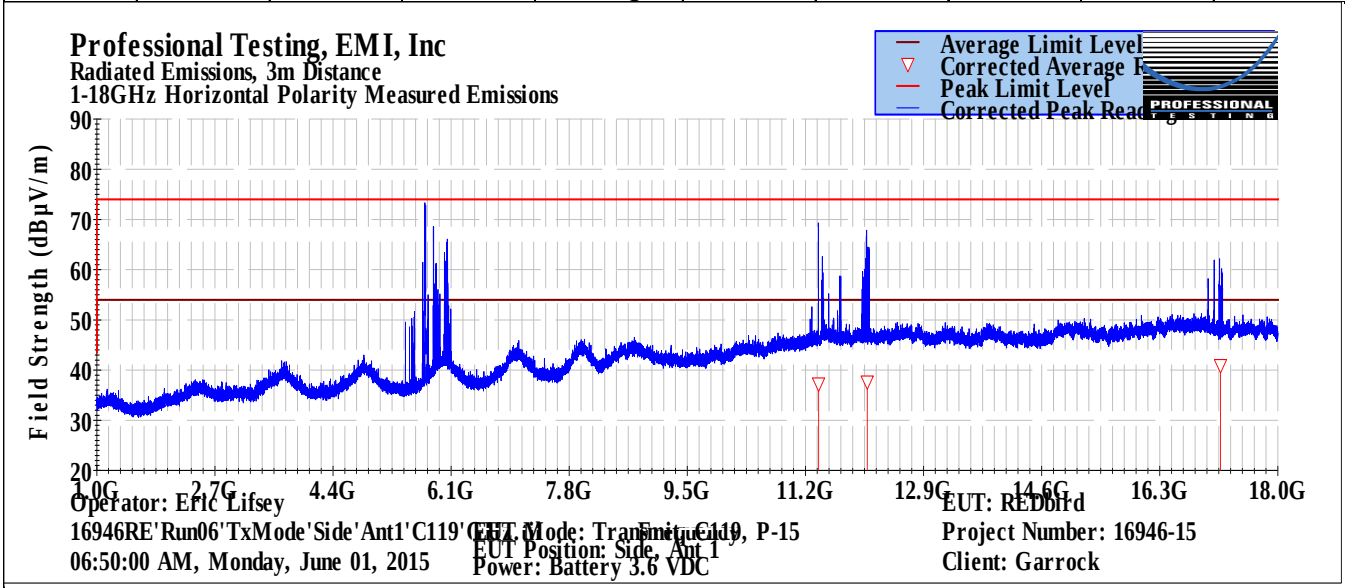
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.8: TX Mode, > 1 GHz, Horizontal Polarity, Port 1, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 1			Transmit High Channel			

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
11389.2	3	81	1	Average	26.9	37.294	54.0	-16.7	Pass
12089.3	3	190	1	Average	27.3	37.684	54.0	-16.3	Pass
17174.4	3	186	1	Average	26.6	40.944	54.0	-13.0	Pass

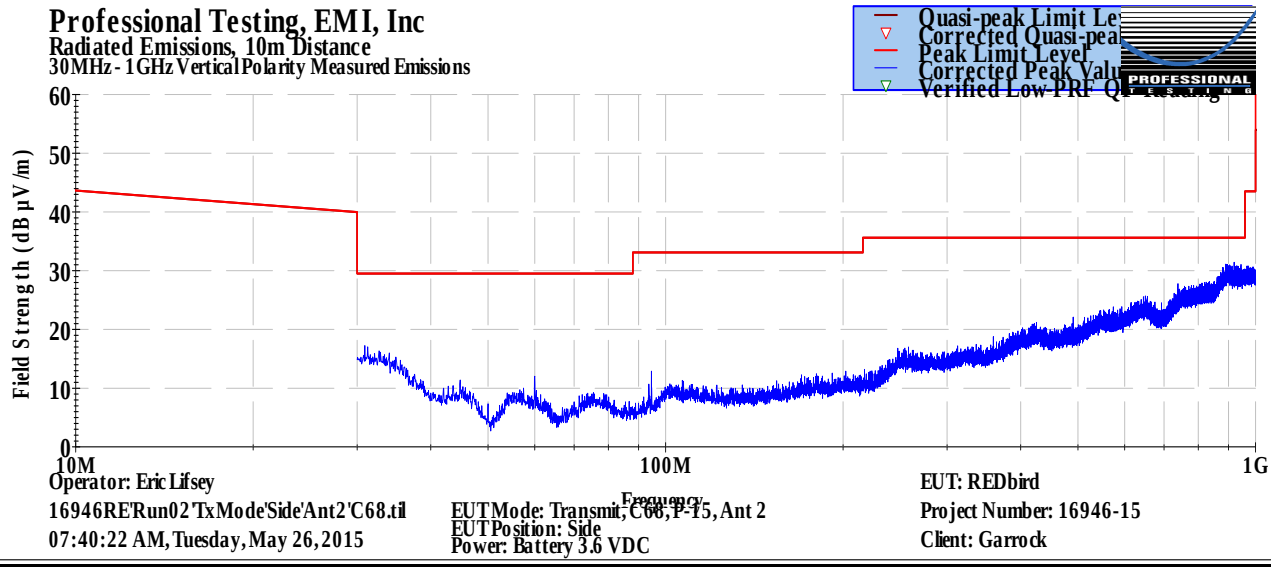


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.9: TX Mode, < 1 GHz, Vertical Polarity, Port 2, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz		
EUT Mode of Operation: Port 2			Transmit Middle Channel			

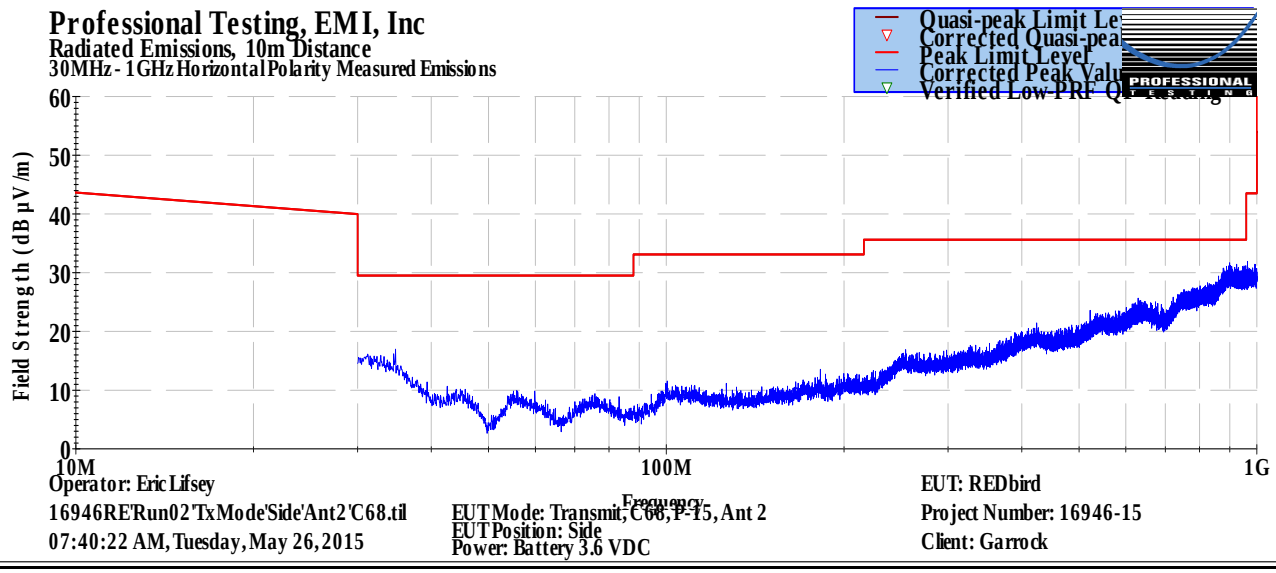


≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.10: TX Mode, < 1 GHz, Horizontal Polarity, Port 2, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz		
EUT Mode of Operation: Port 2			Transmit Middle Channel			



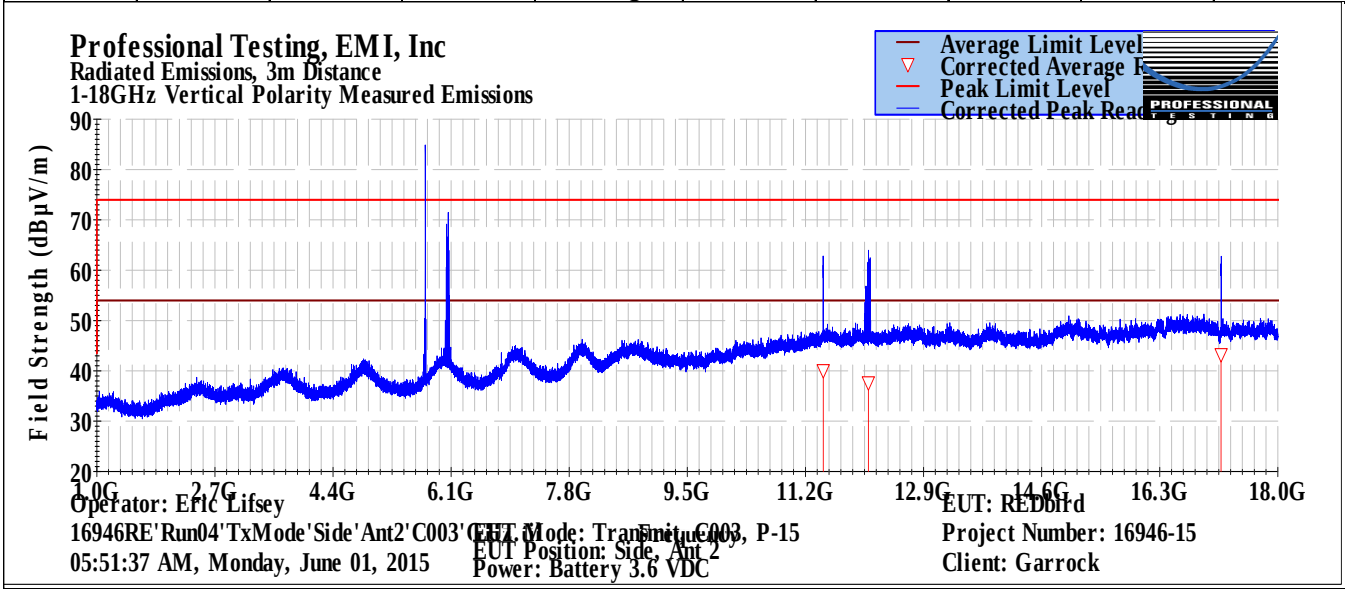
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.11: TX Mode, > 1 GHz, Vertical Polarity, Port 2, Low Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit Low Channel			

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
11456	3	142	1	Average	29.4	40.111	54.0	-13.8	Pass
12106.2	3	107	1	Average	27.4	37.703	54.0	-16.3	Pass
17183.4	3	12	1	Average	28.9	43.273	54.0	-10.7	Pass



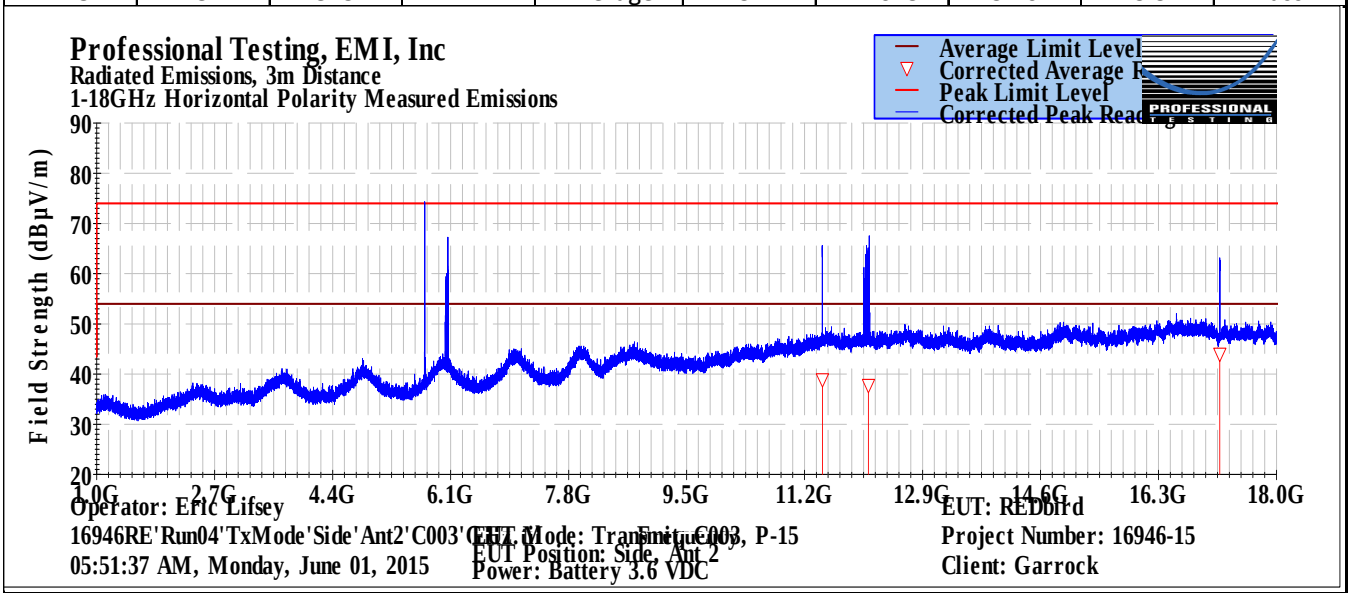
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.12: TX Mode, > 1 GHz, Horizontal Polarity, Port 2, Low Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6 VDC		EUT Power Frequency:	0 N/A		
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit Low Channel			

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
11457.3	3	311	1	Average	28.2	38.93	54.0	-15.0	Pass
12121.3	3	212	1	Average	27.5	37.788	54.0	-16.2	Pass
17184	3	315	1	Average	29.7	44.023	54.0	-9.9	Pass



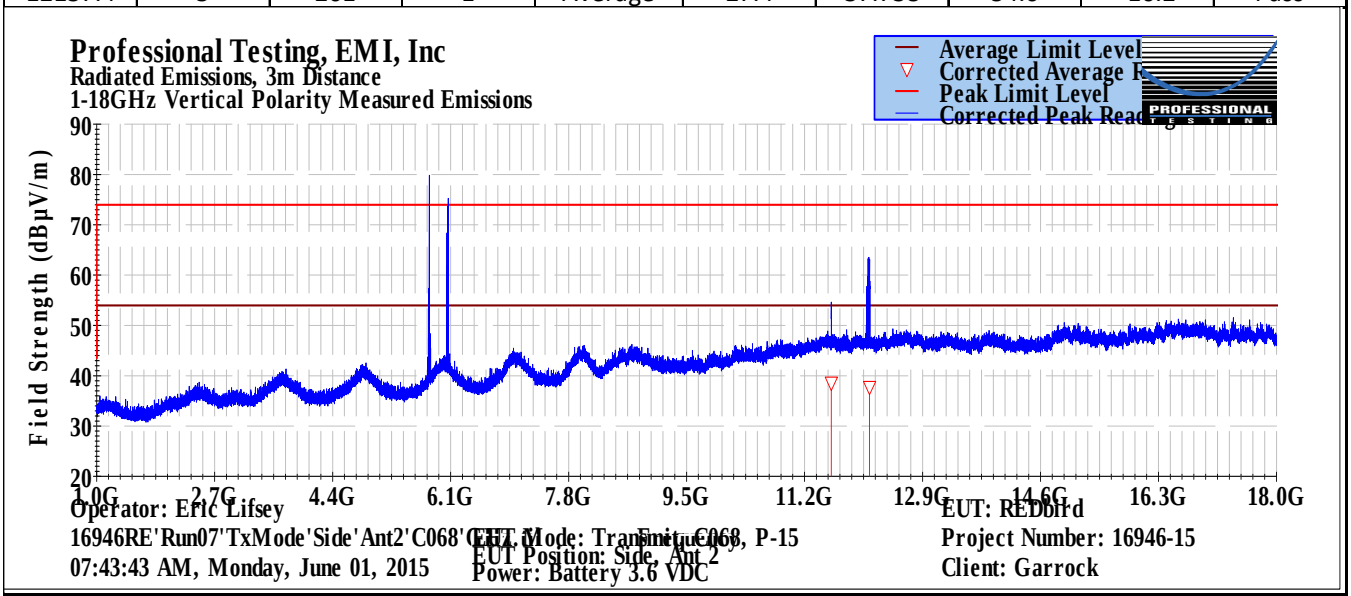
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.13: TX Mode, > 1 GHz, Vertical Polarity, Port 2, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit Middle Channel			

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
11584.9	3	32	1	Average	28	38.57	54.0	-15.4	Pass
12137.4	3	261	1	Average	27.4	37.738	54.0	-16.2	Pass



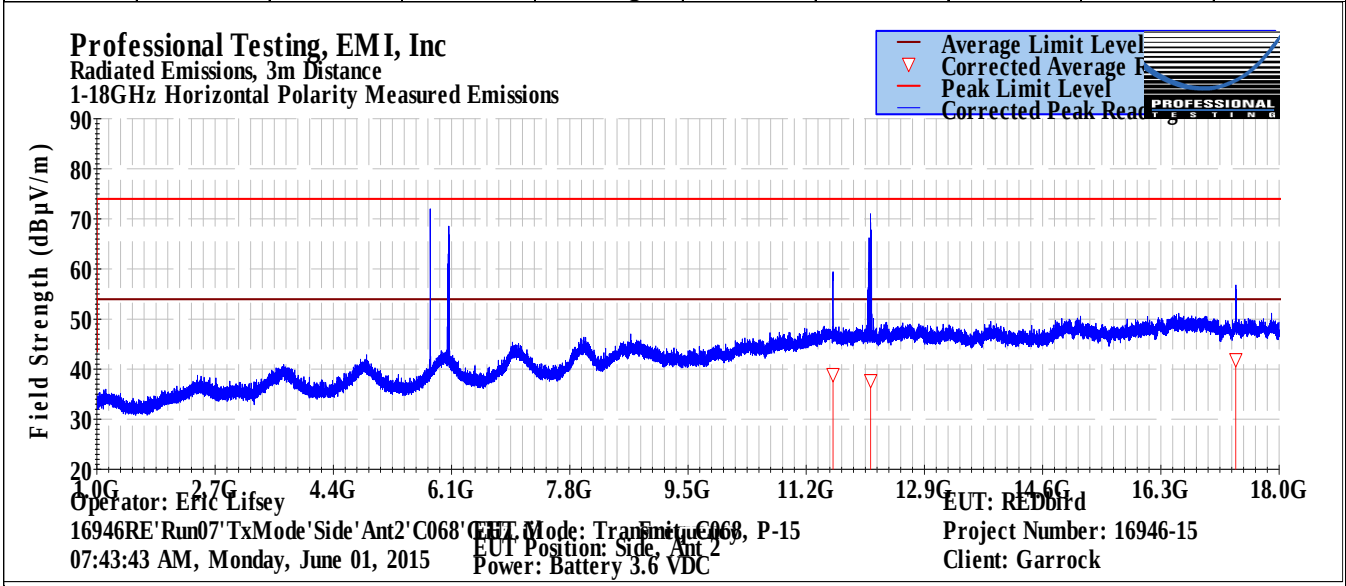
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.14: TX Mode, > 1 GHz, Horizontal Polarity, Port 2, Mid Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6 VDC		EUT Power Frequency:	0 N/A		
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit Middle Channel			

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
11585.9	3	311	1	Average	28.4	38.999	54.0	-15.0	Pass
12127.4	3	134	1	Average	27.5	37.798	54.0	-16.2	Pass
17377.7	3	127	1	Average	27.8	41.977	54.0	-12.0	Pass



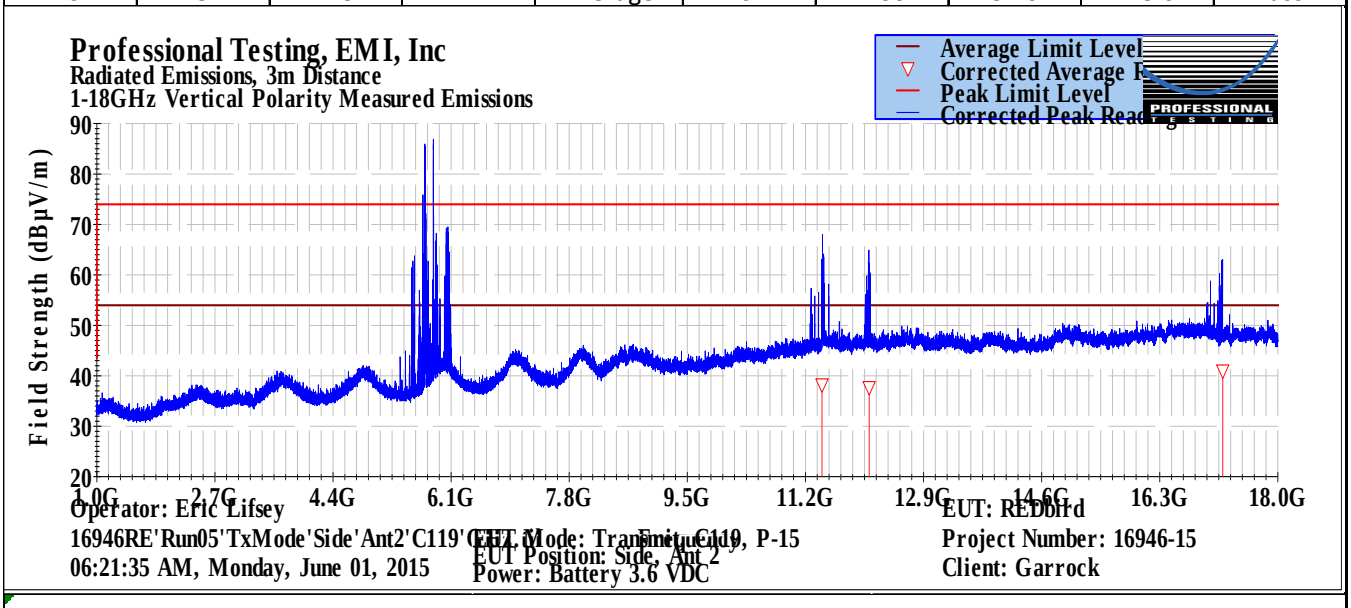
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.15: TX Mode, > 1 GHz, Vertical Polarity, Port 2, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit High Channel			

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
11439.2	3	26	1	Average	27.6	38.226	54.0	-15.7	Pass
12116.9	3	9	1	Average	27.4	37.713	54.0	-16.2	Pass
17207.1	3	129	1	Average	26.7	41.002	54.0	-13.0	Pass



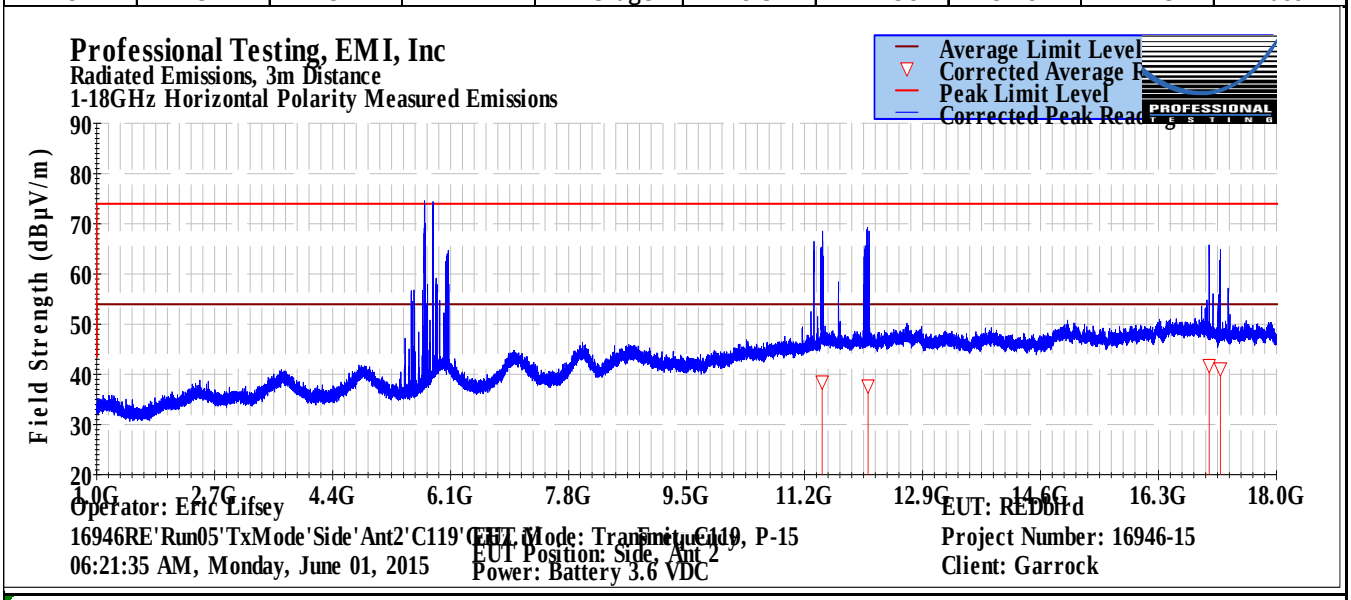
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.16: TX Mode, > 1 GHz, Horizontal Polarity, Port 2, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4		
Section:	15.109, RSS-Gen Section 7.1.2		
Test Date(s):	5/26/2015	EUT Serial #:	None
Customer:	Garrock	EUT Part #:	None
Project Number:	16946-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	REDbird	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.6 VDC		EUT Power Frequency:	0 N/A		
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation: Port 2			Transmit High Channel			

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
11453.6	3	213	1	Average	27.9	38.551	54.0	-15.4	Pass
12115.4	3	64	1	Average	27.4	37.742	54.0	-16.2	Pass
17029.8	3	111	1	Average	27.3	41.846	54.0	-12.1	Pass
17191.7	3	192	1	Average	26.8	41.156	54.0	-12.8	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.17 TX Mode, 18 GHz to 26.5 GHz

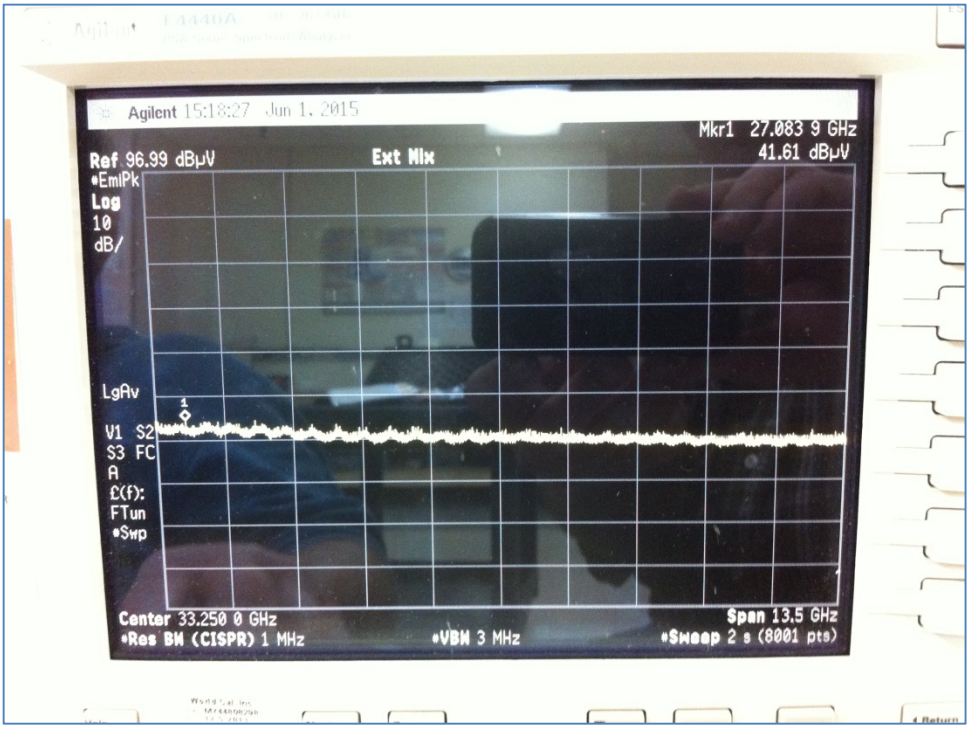
Professional Testing (EMI), Inc.					
Radiated Emissions Measured Indoors					
V 3.0 18-26.5 GHz					
Client:	Garrock	Polarity:	Max of Vert/Horz	Distance:	1 meter
Test Date:	June 1, 2015	EUT:	REDbird		
Voltage:	3.6 V Battery	Serial #:	None		
Frequency:	NA	Project #:	16946		
Technician:	Eric Lifsey	Test Type:	15.247	Class:	B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Channel	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Function
18.187	Low	0.8	55.22	31.4	36.7	0.00	60.6	63.54	-3.0	Peak
18.196	Mid	0.8	50.24	31.4	36.7	0.00	55.6	63.54	-8.0	Peak
18.208	High	0.8	51.33	31.4	36.7	0.00	56.6	63.54	-6.9	Peak

For this test the EUT was held in line with the horn axis and manually rotated through all orientations and polarities.

8.3.18 TX Mode, 26.5 GHz to 40 GHz



26.5 to 40 GHz: No Emissions Attributed to EUT Observed
(Composite max-hold of all three channels and all orientations/polarities.)

9.0 Conducted Spurious Emissions, Transmit Mode

9.1 Test Procedure

The EUT is connected to a spectrum analyzer and using 100 kHz resolution bandwidth the conducted antenna port emissions are measured.

9.2 Test Criteria

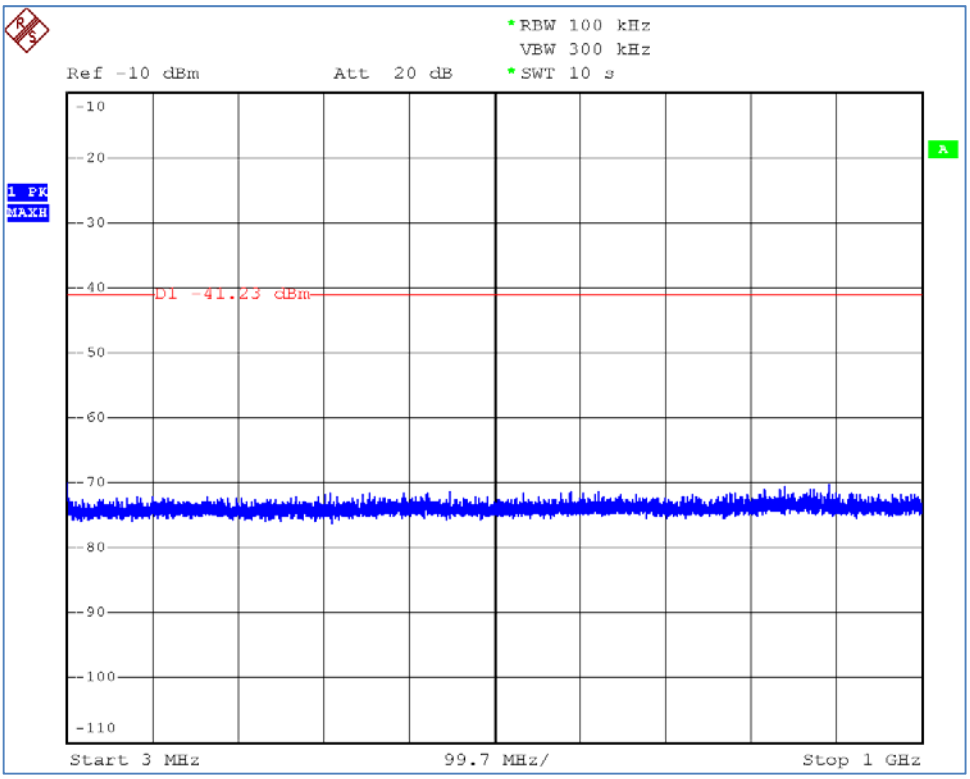
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-Gen Issue 3, 4.9, 4.10	Strength of Conducted Spurious/Harmonic Emissions Transmit Mode	20 May 2015, 21 May 2015

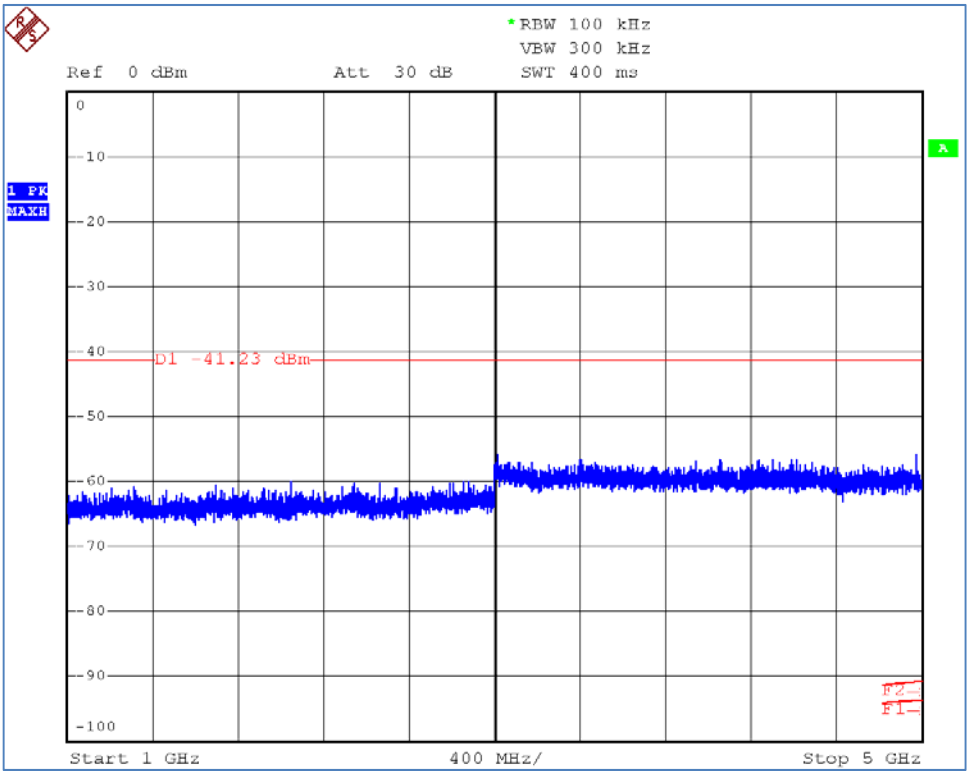
9.3 Test Results

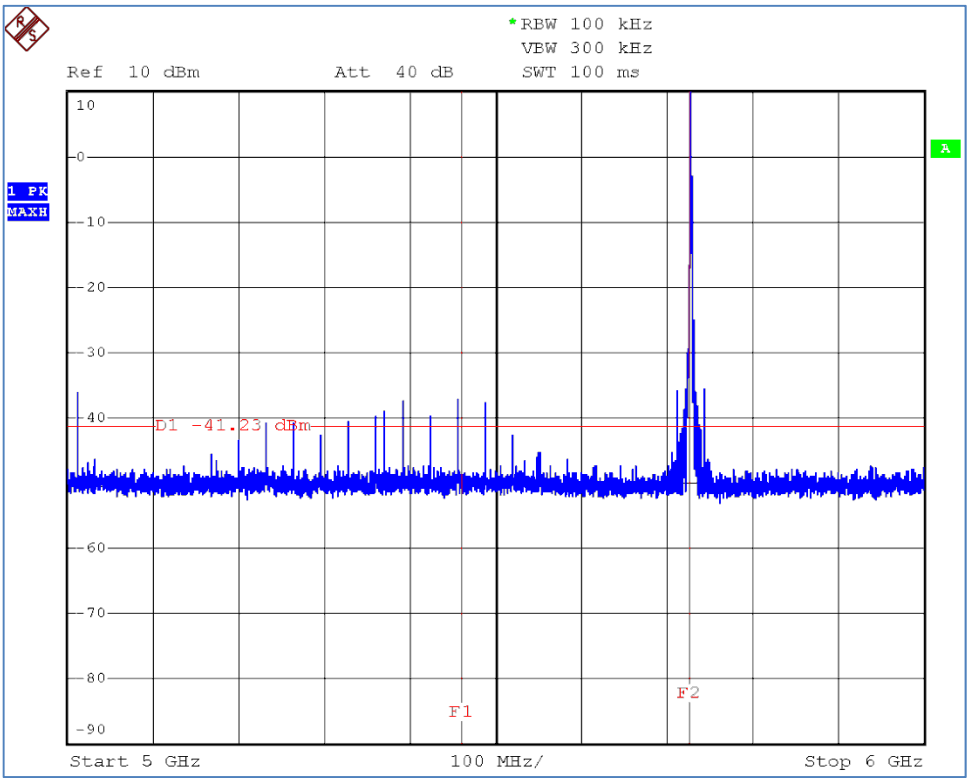
The EUT satisfied the requirements. Plotted results appear on the following pages. The connection was direct to the spectrum analyzer input so no external factors were required.

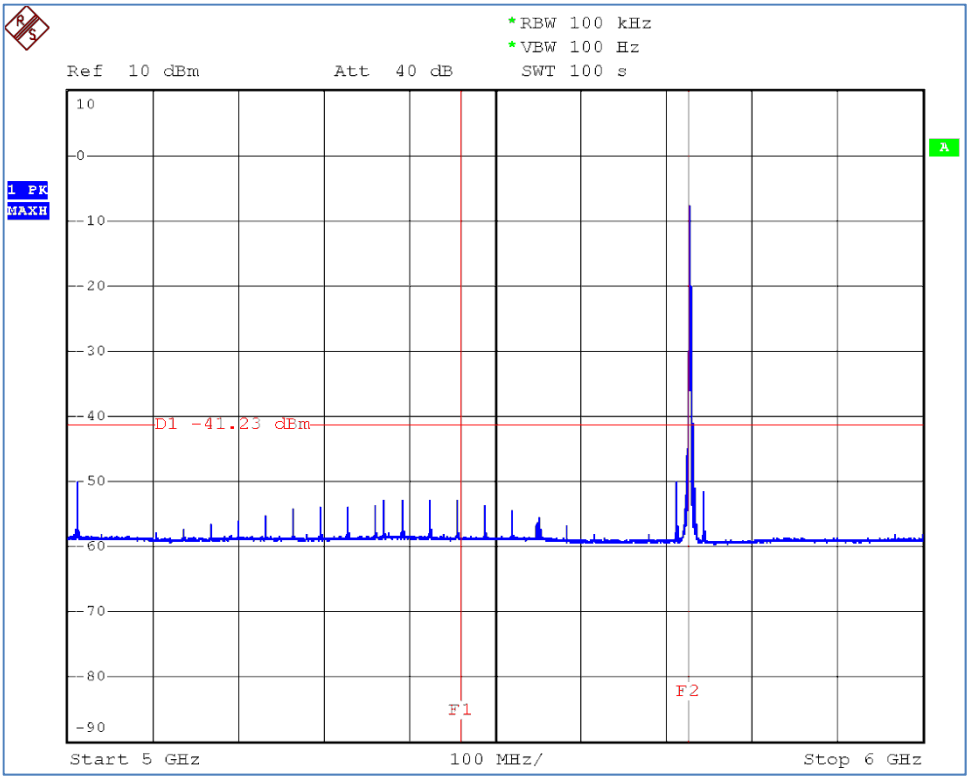
Limit lines are also included for the general emission limits, and where peaks were measured above average limits, video averaging was also measured. Measurements are taken from 3 MHz to 30 GHz; above 30 GHz the spurious are measured by radiated means.

9.3.1 Antenna Port 1, Low Channel

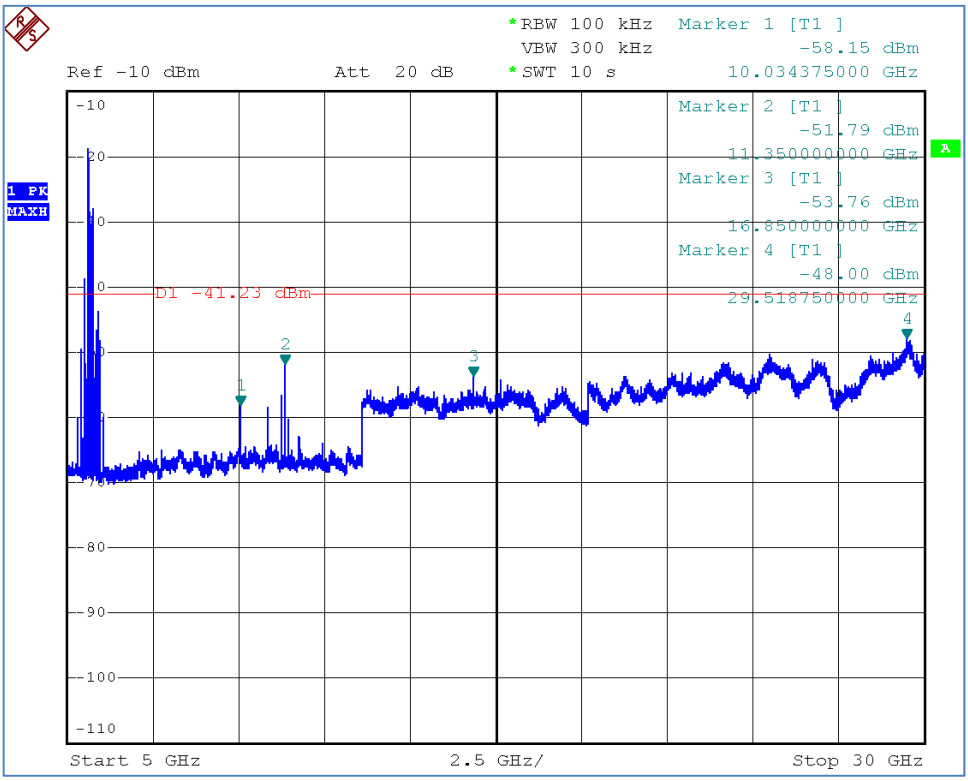




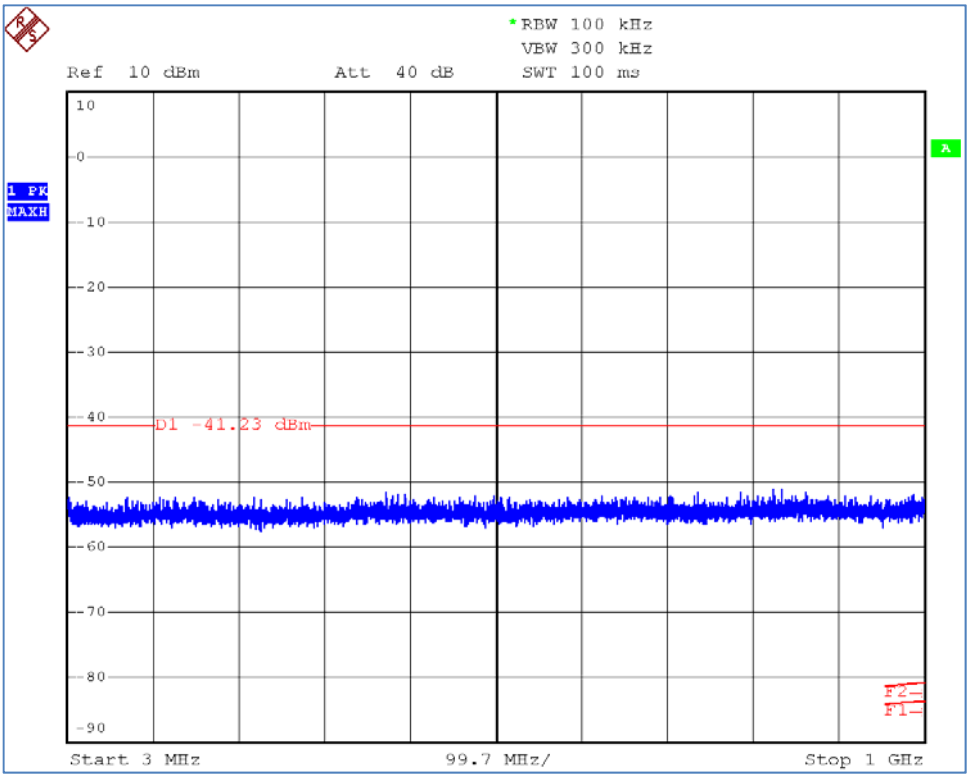


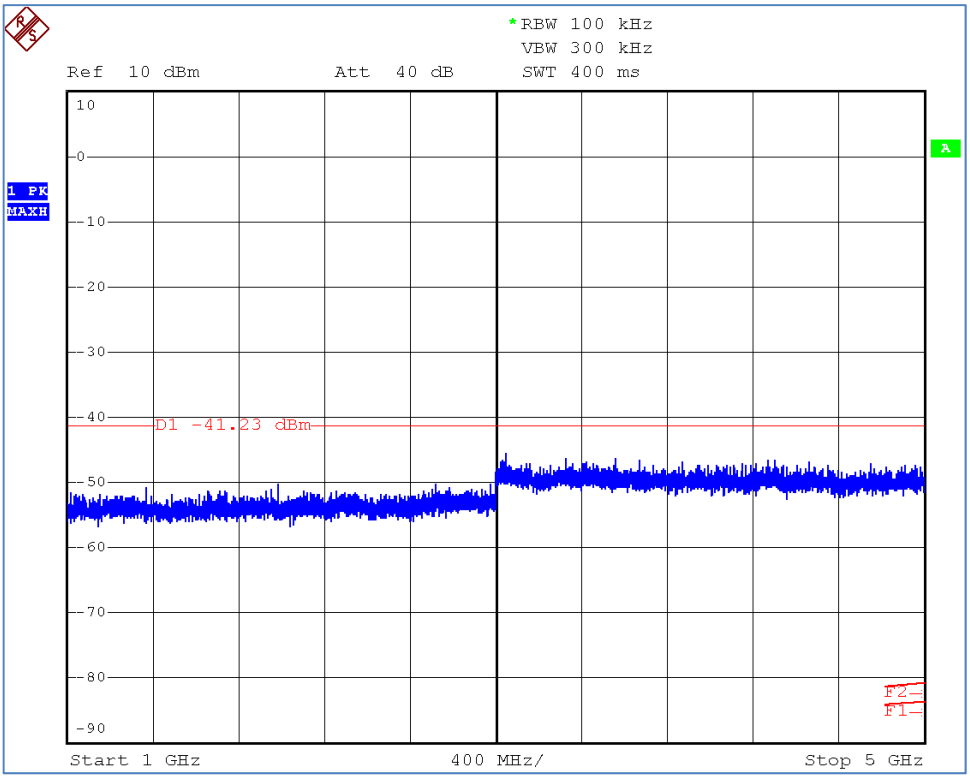


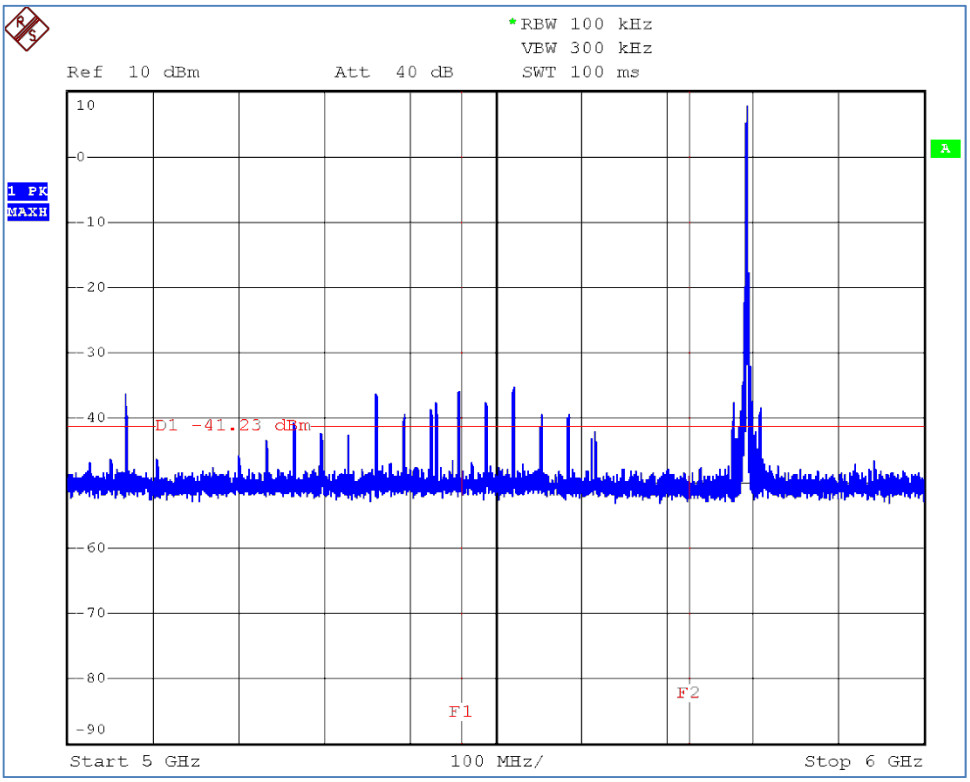
Averaging in 100 Hz VBW

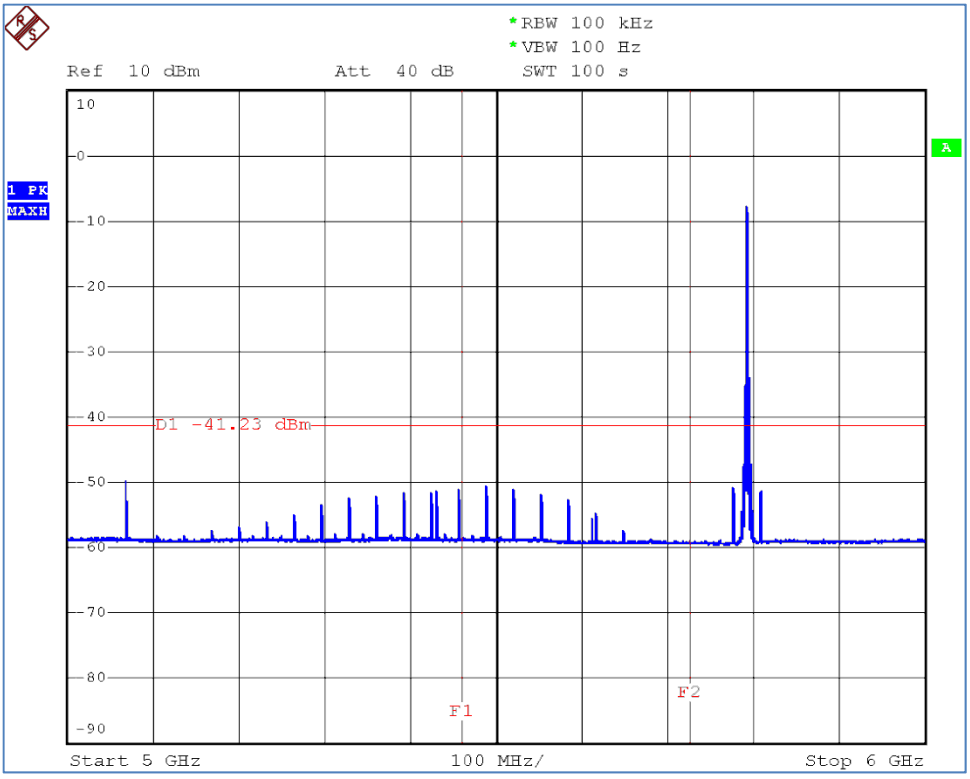

*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 1 [T1]
-58.15 dBm
10.034375000 GHz
Ref -10 dBm
Att 20 dB
Marker 2 [T1]
-51.79 dBm
11.350000000 GHz
Marker 3 [T1]
-53.76 dBm
16.850000000 GHz
Marker 4 [T1]
-48.00 dBm
29.518750000 GHz
1 PK
MAXH
D1 -41.23 dBm
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz

9.3.2 Antenna Port 1, Middle Channel

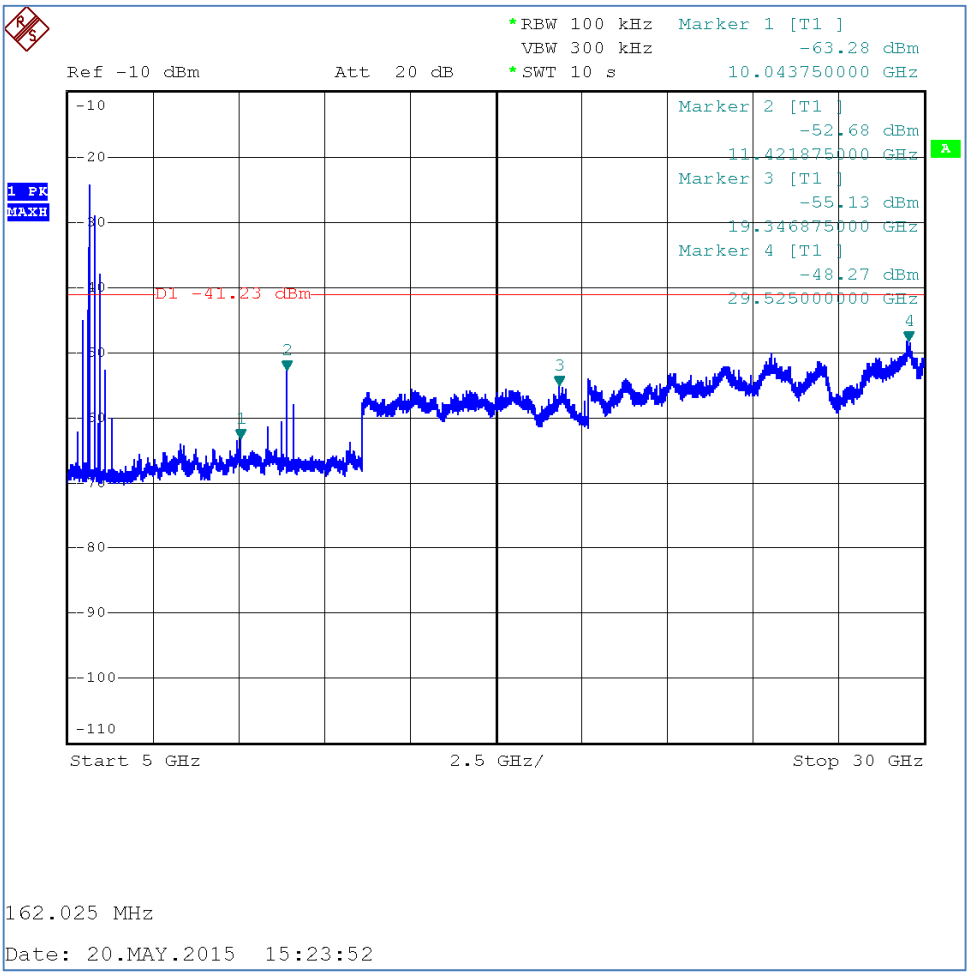




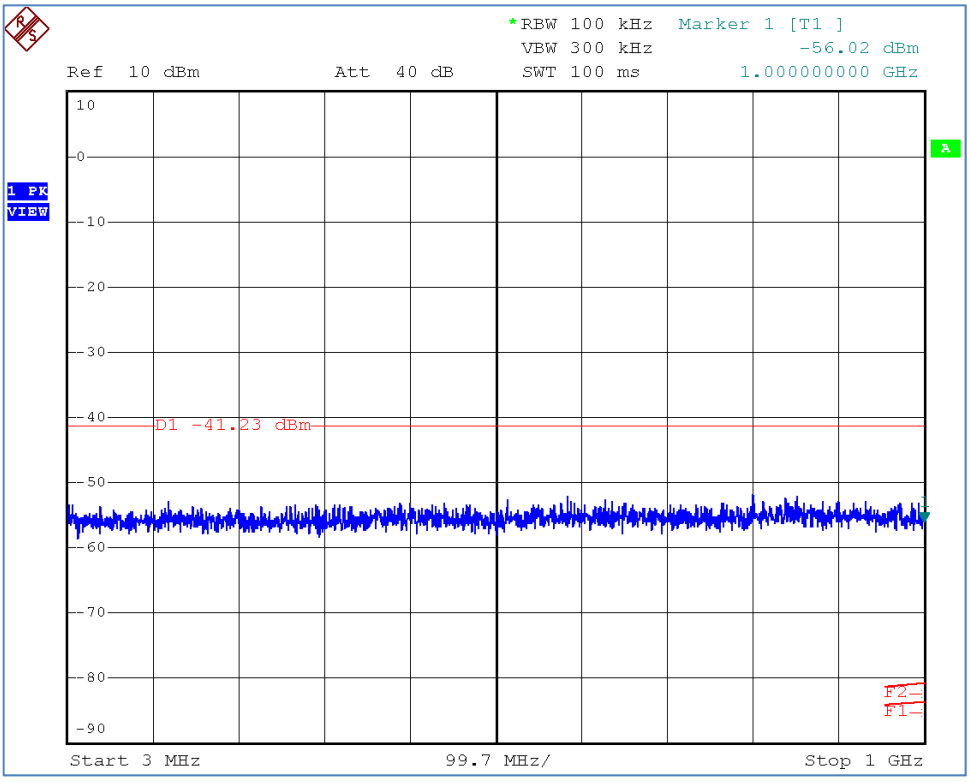


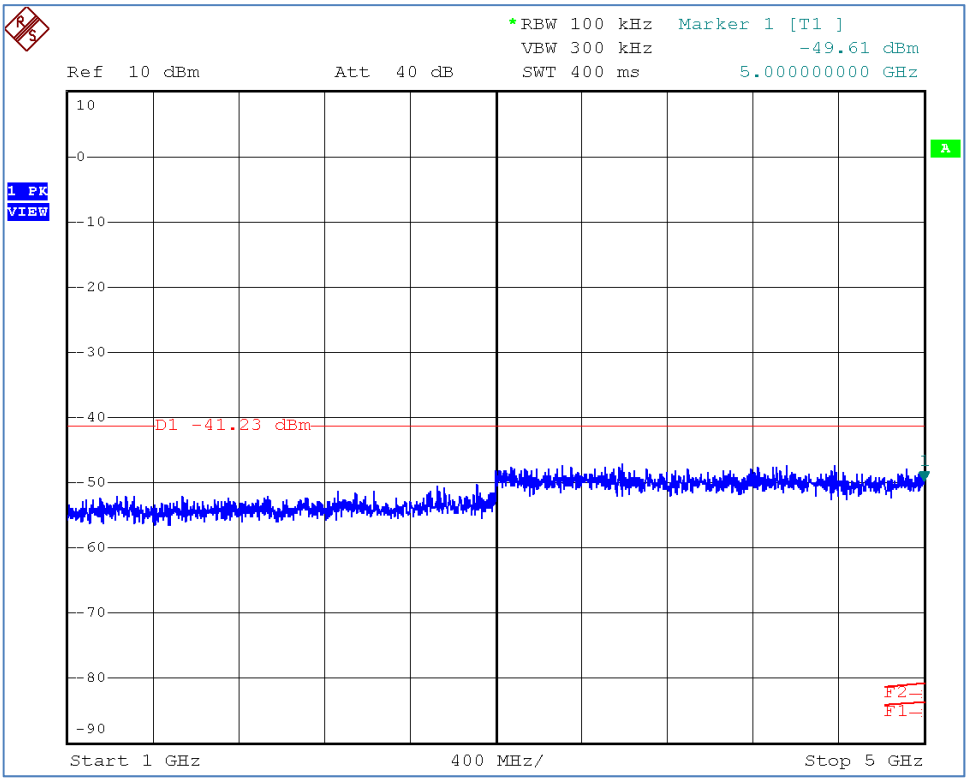


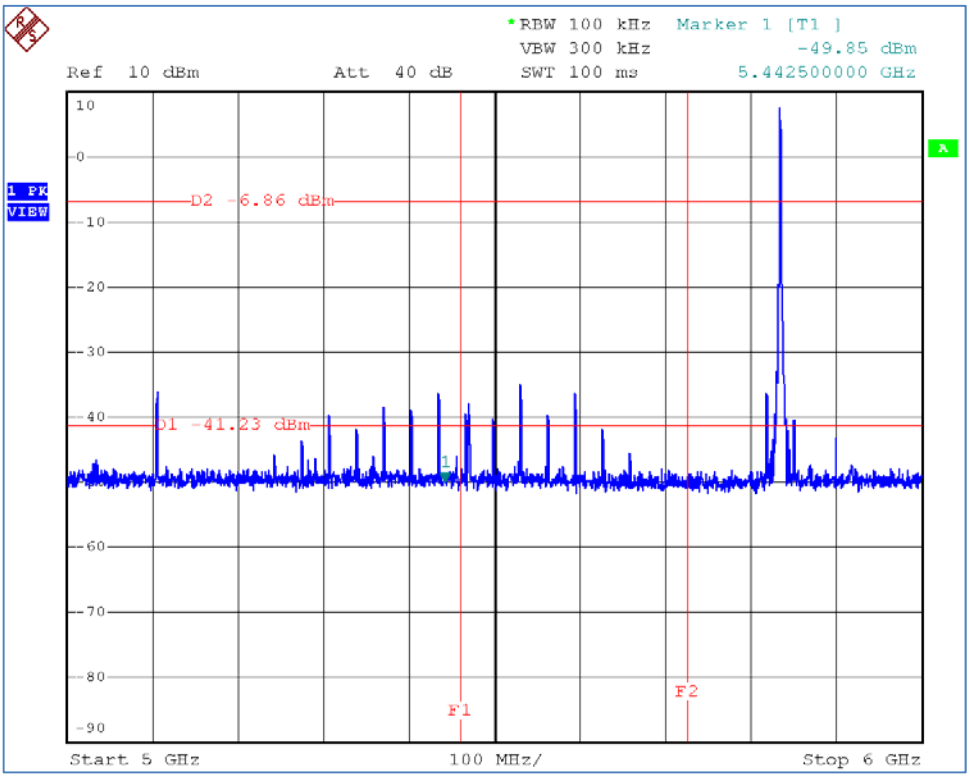
Averaging in 100 Hz VBW

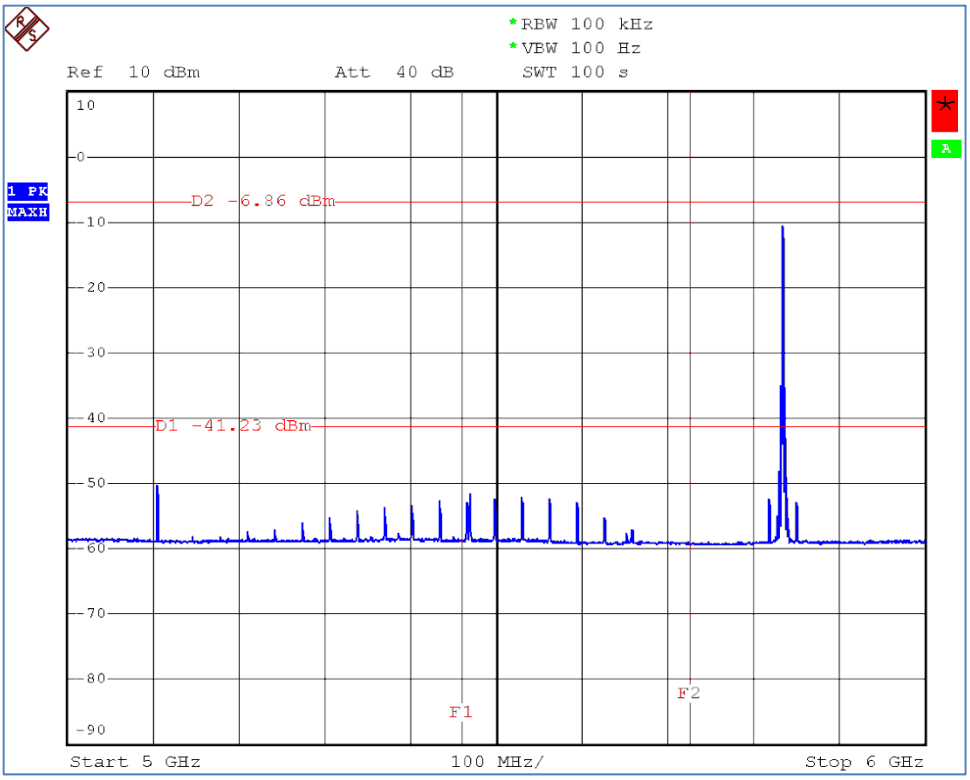

*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 1 [T1]
-63.28 dBm
10.043750000 GHz
Ref -10 dBm
Att 20 dB
Marker 2 [T1]
-52.68 dBm
11.421875000 GHz
Marker 3 [T1]
-55.13 dBm
19.346875000 GHz
Marker 4 [T1]
-48.27 dBm
29.525000000 GHz
1 PK
MAXH
D1 -41.23 dBm
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz
162.025 MHz
Date: 20.MAY.2015 15:23:52

9.3.3 Antenna Port 1, High Channel

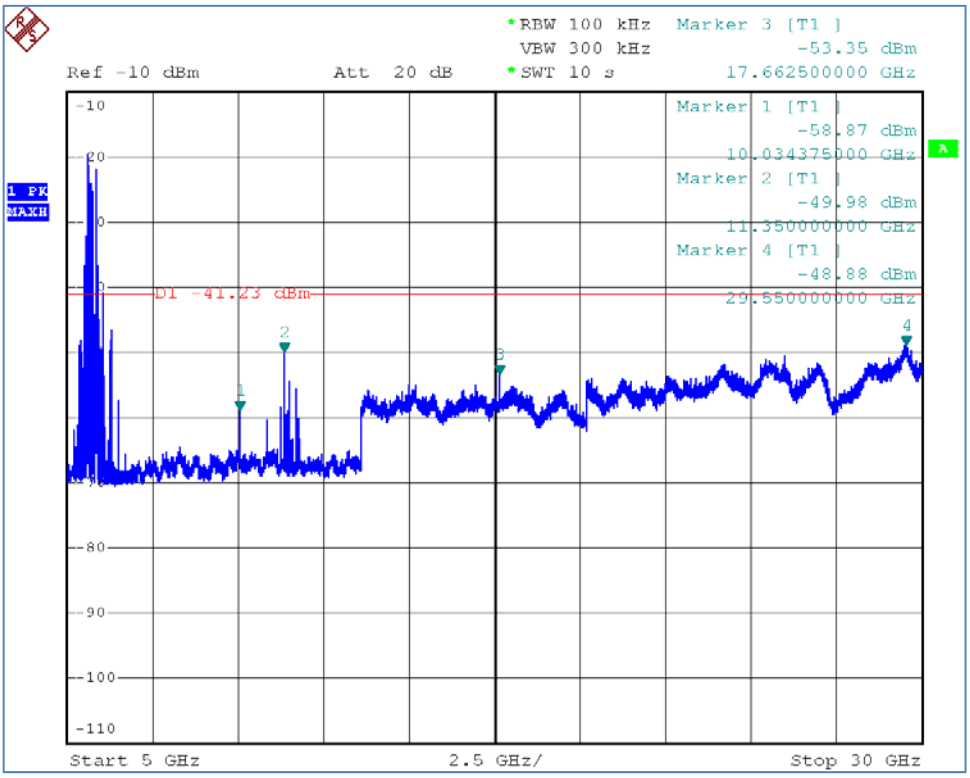




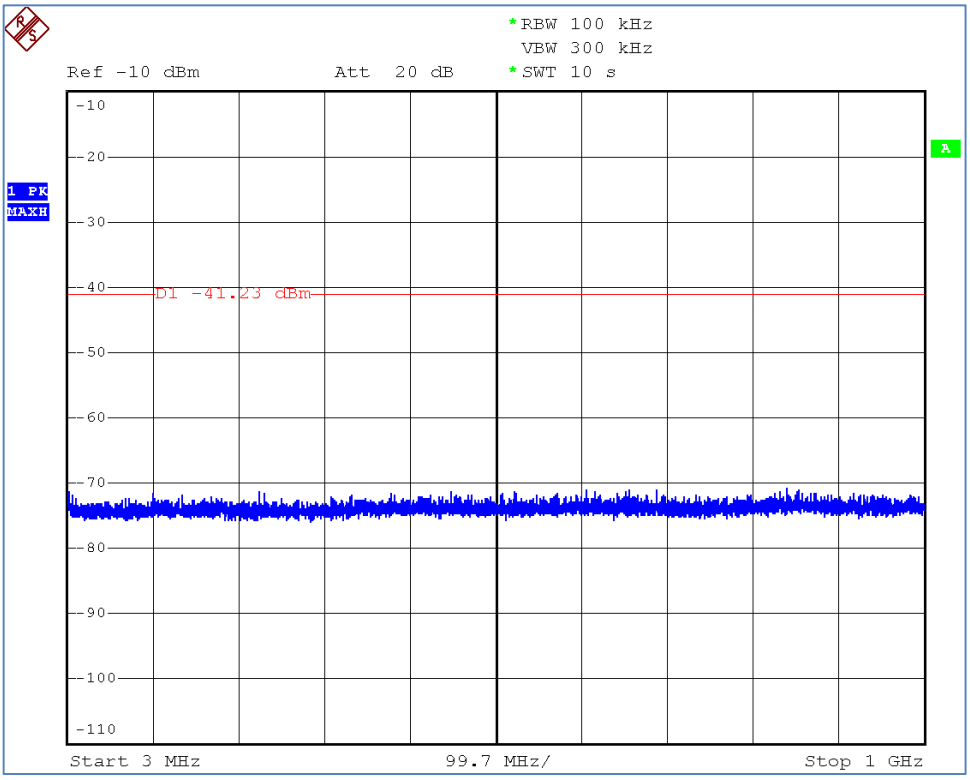


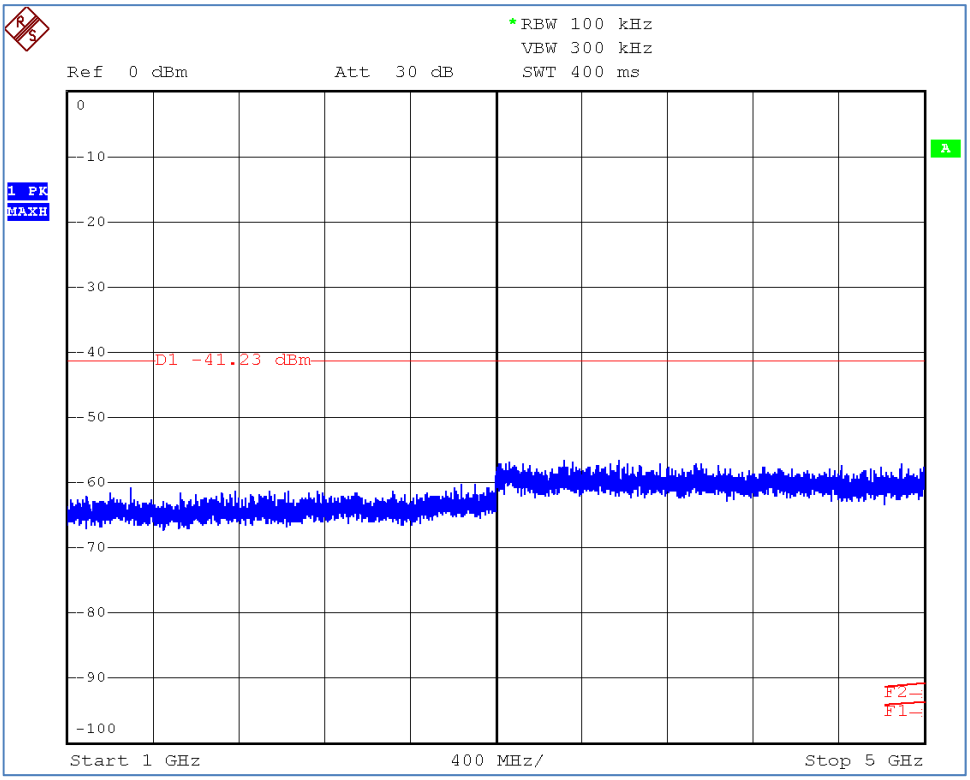


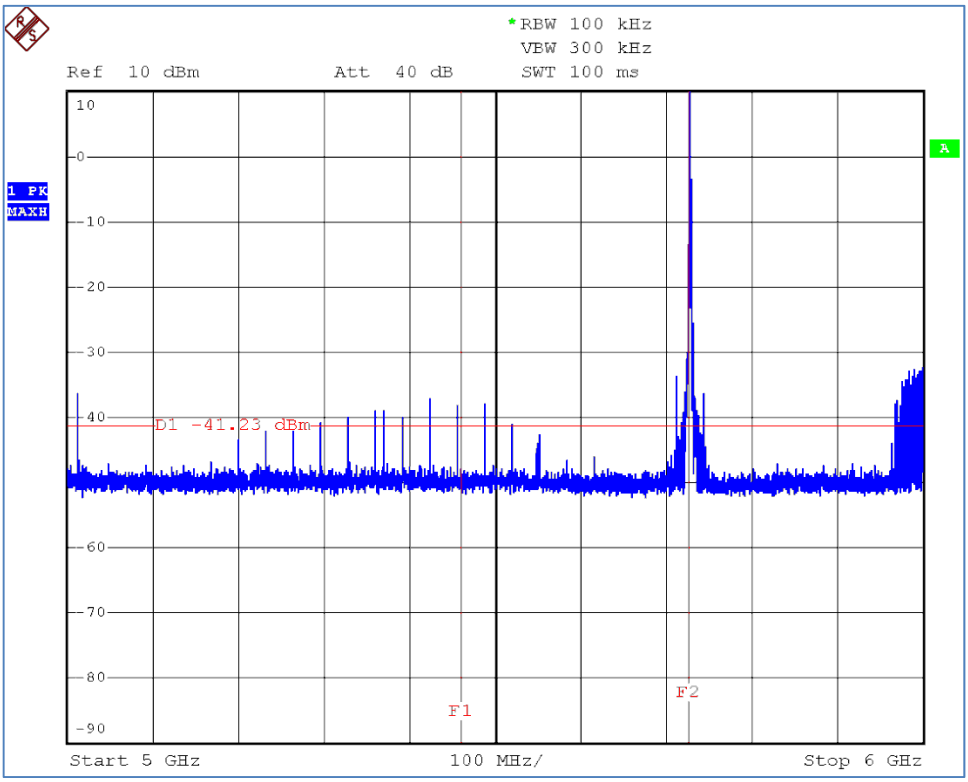
Averaging in 100 Hz VBW

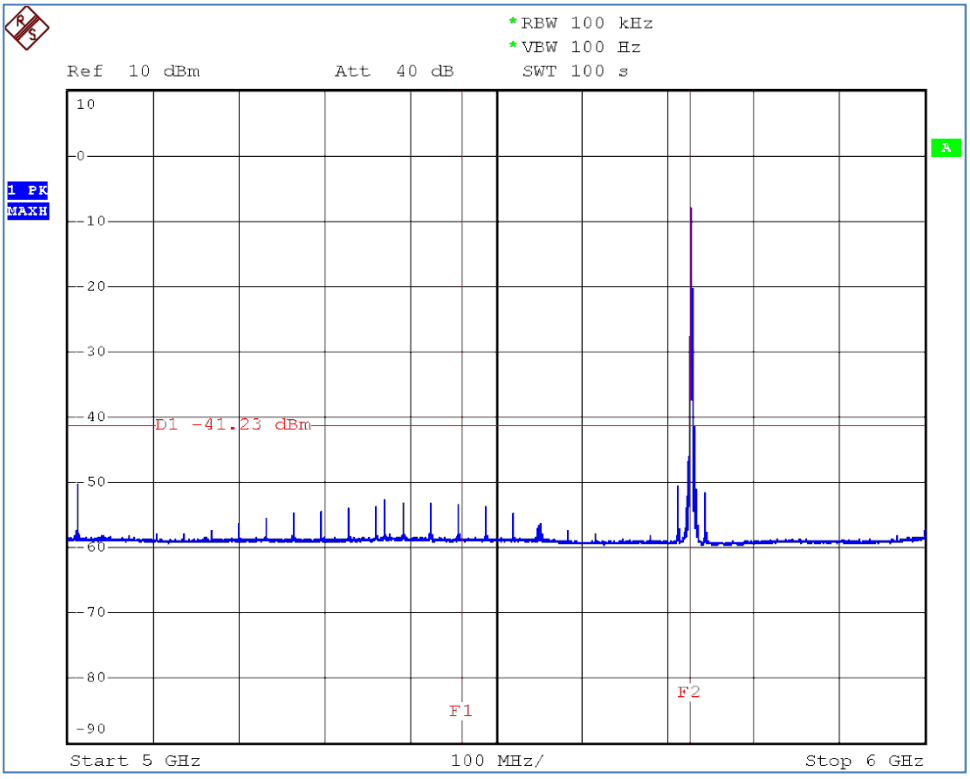

*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 3 [T1]
-53.35 dBm
17.662500000 GHz
Ref -10 dBm
Att 20 dB
Marker 1 [T1]
-58.87 dBm
10.034375000 GHz
Marker 2 [T1]
-49.98 dBm
11.350000000 GHz
Marker 4 [T1]
-48.88 dBm
29.550000000 GHz
1 PK
MAXH
D1 -41.23 dBm
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz

9.3.4 Antenna Port 2, Low Channel

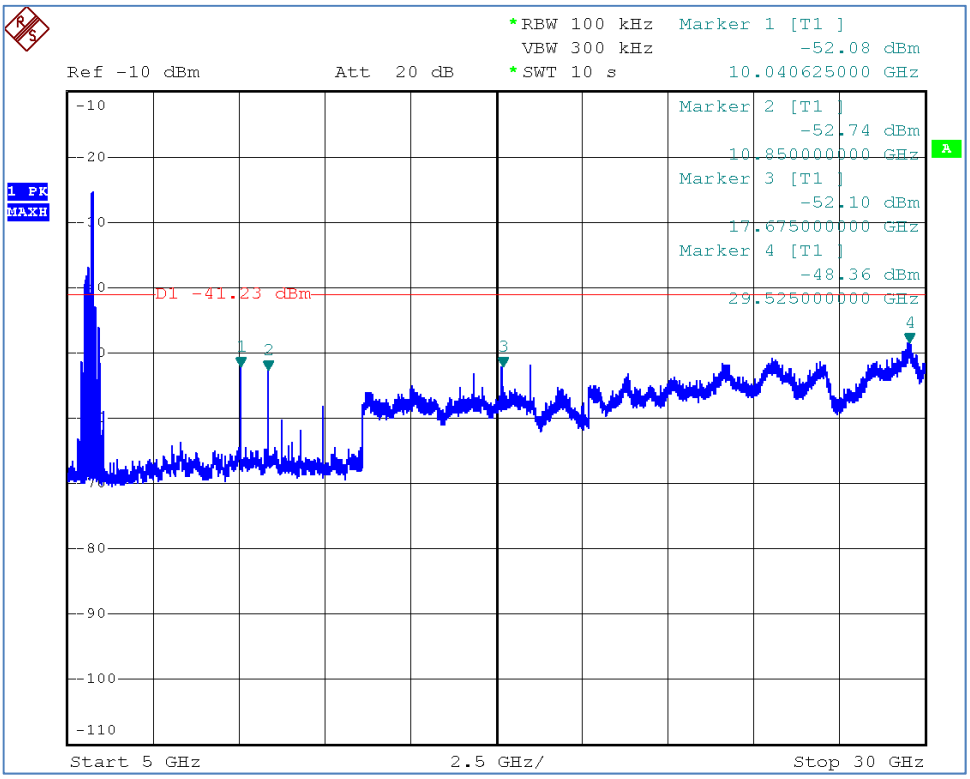




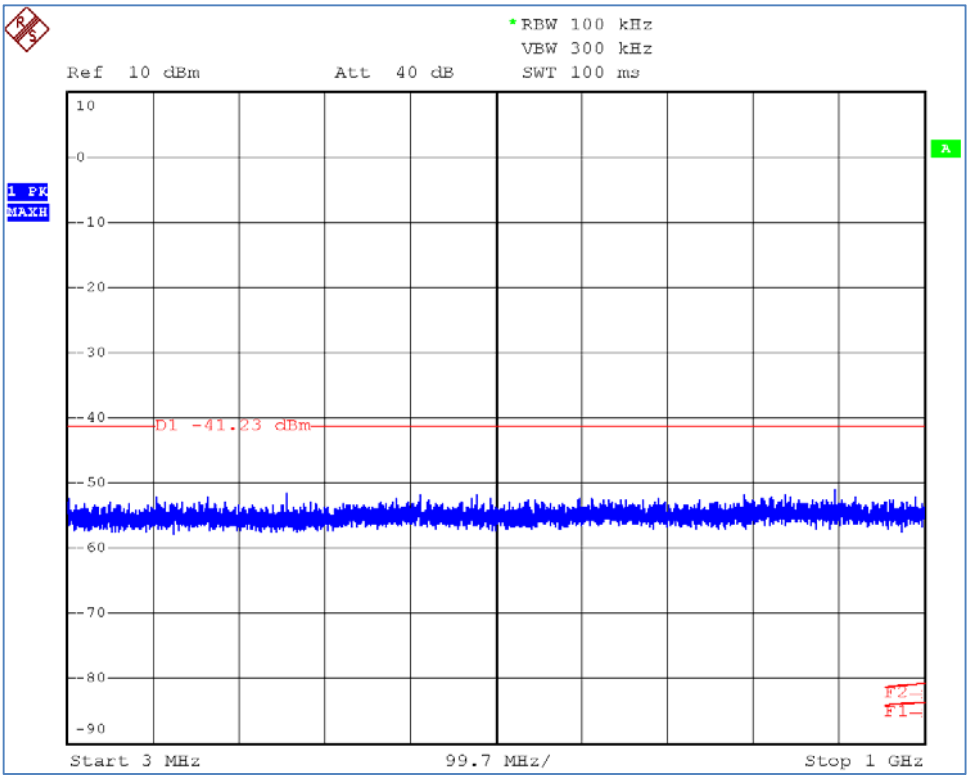


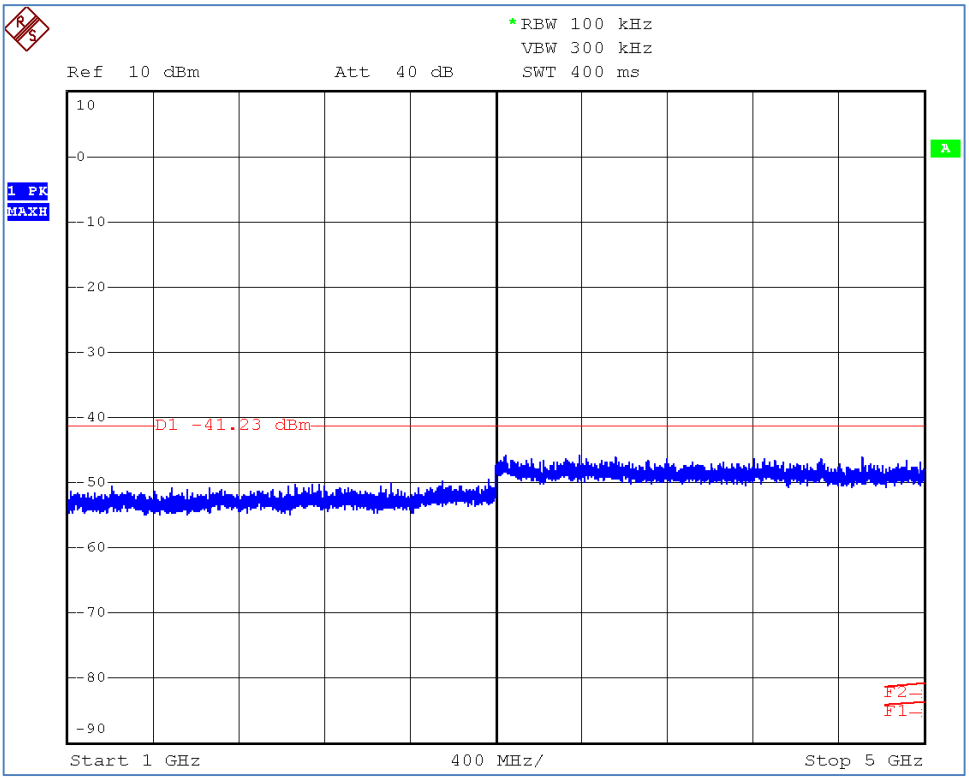


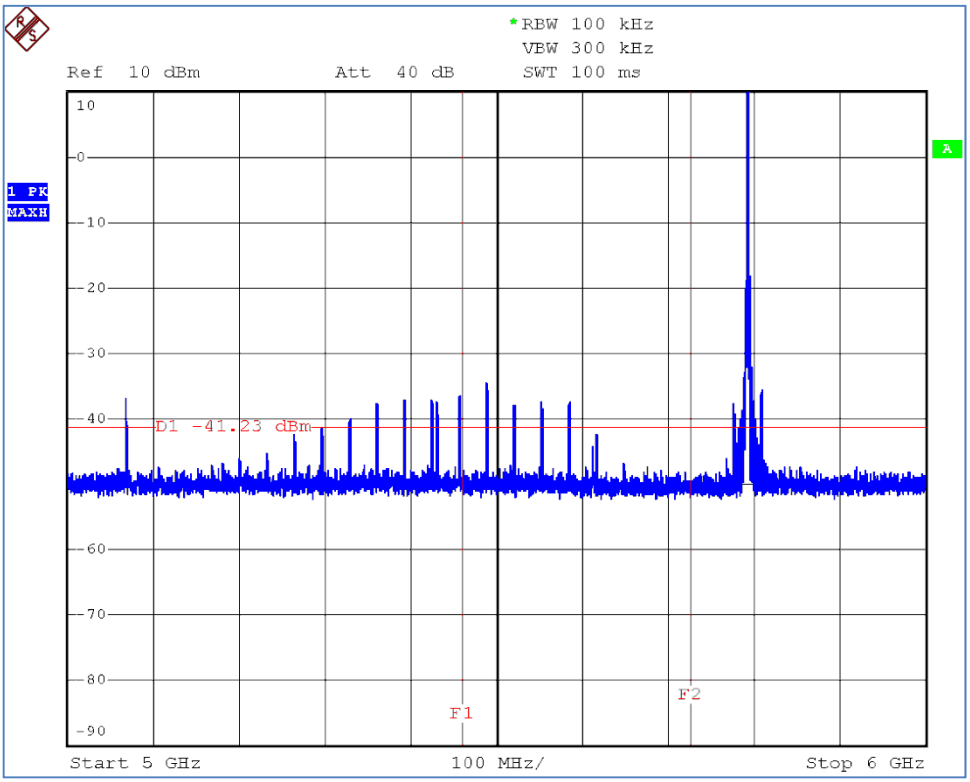
Averaging in 100 Hz VBW

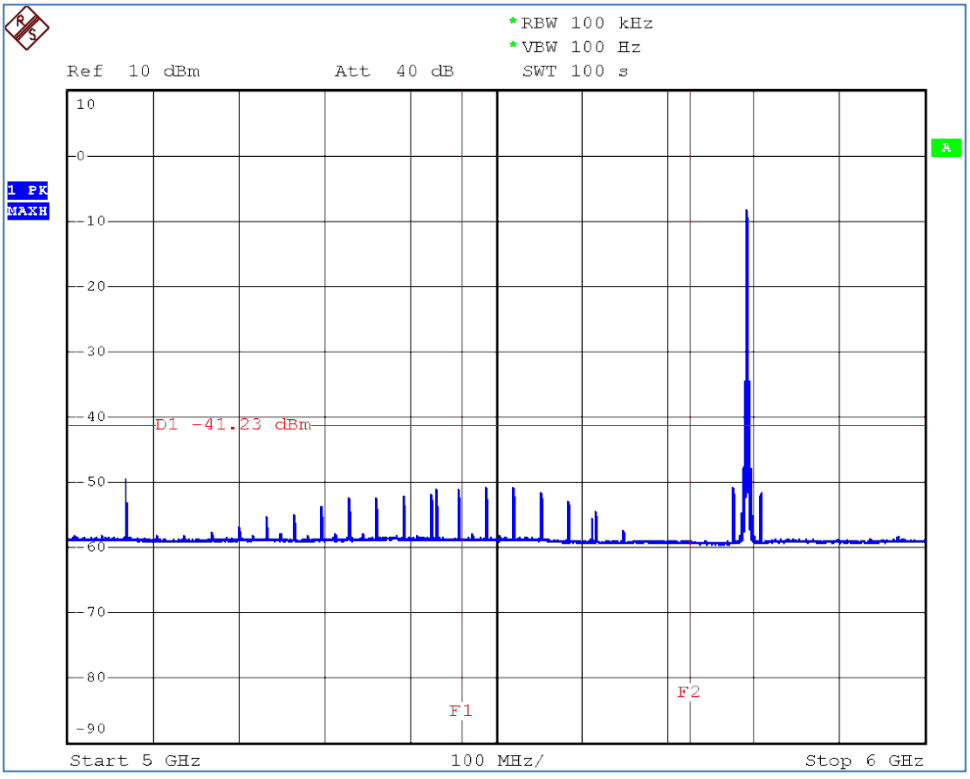

*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 1 [T1]
-52.08 dBm
10.040625000 GHz
Ref -10 dBm
Att 20 dB
Marker 2 [T1]
-52.74 dBm
10.850000000 GHz
Marker 3 [T1]
-52.10 dBm
17.675000000 GHz
Marker 4 [T1]
-48.36 dBm
29.525000000 GHz
1 PK
MAXH
A
D1 -41.23 dBm
-10
-20
-30
-40
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz

9.3.5 Antenna Port 2, Middle Channel

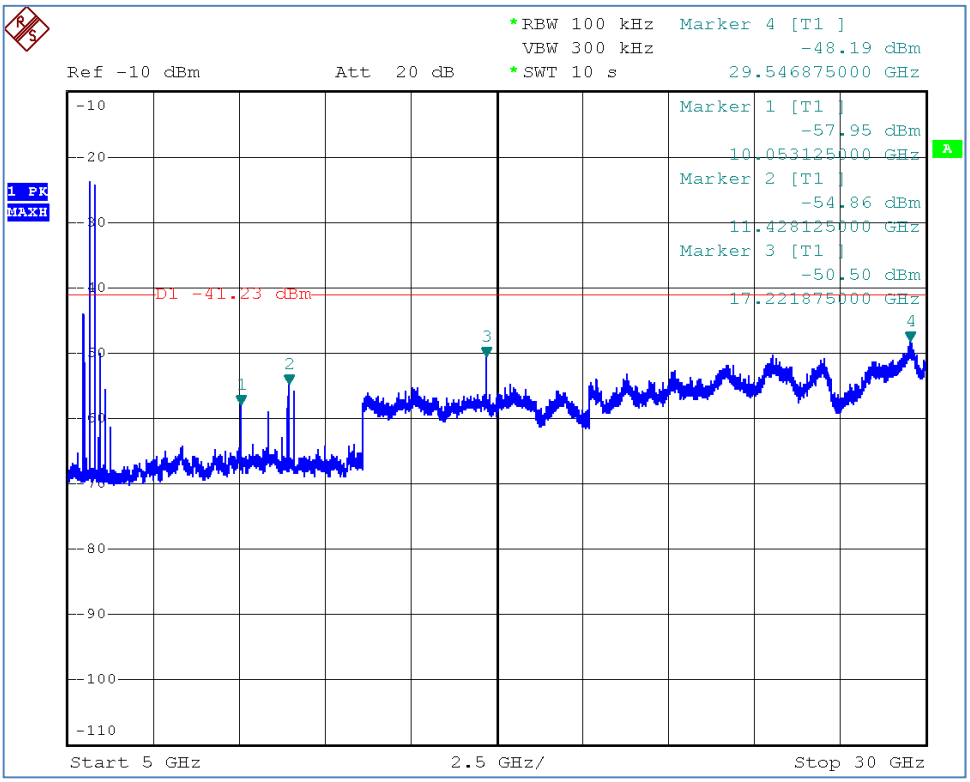




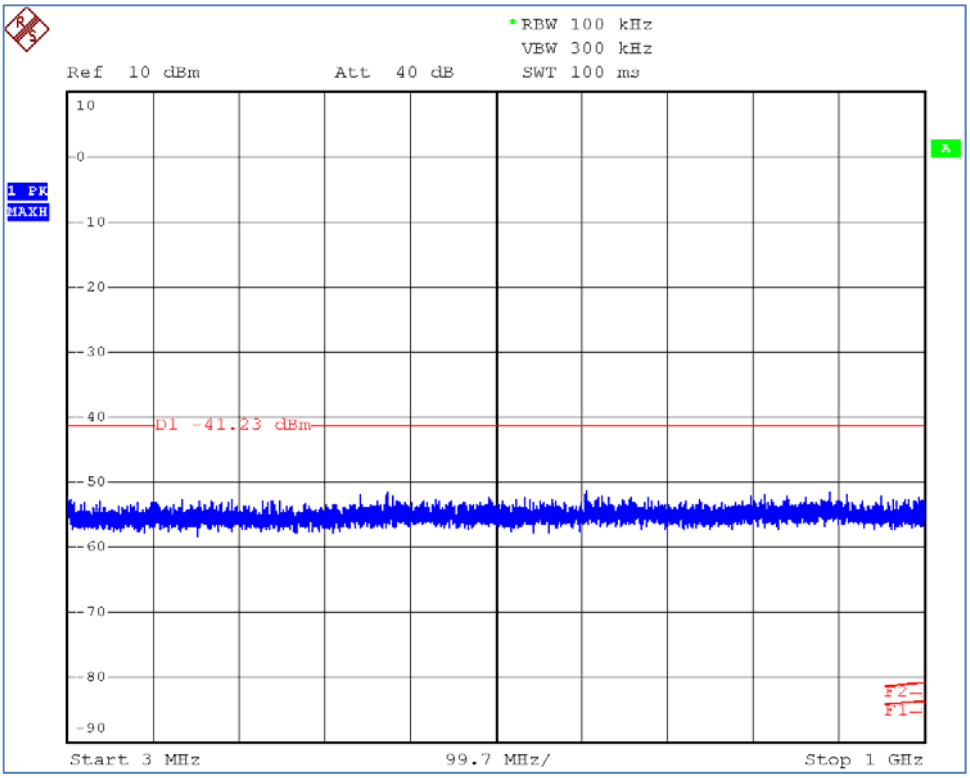


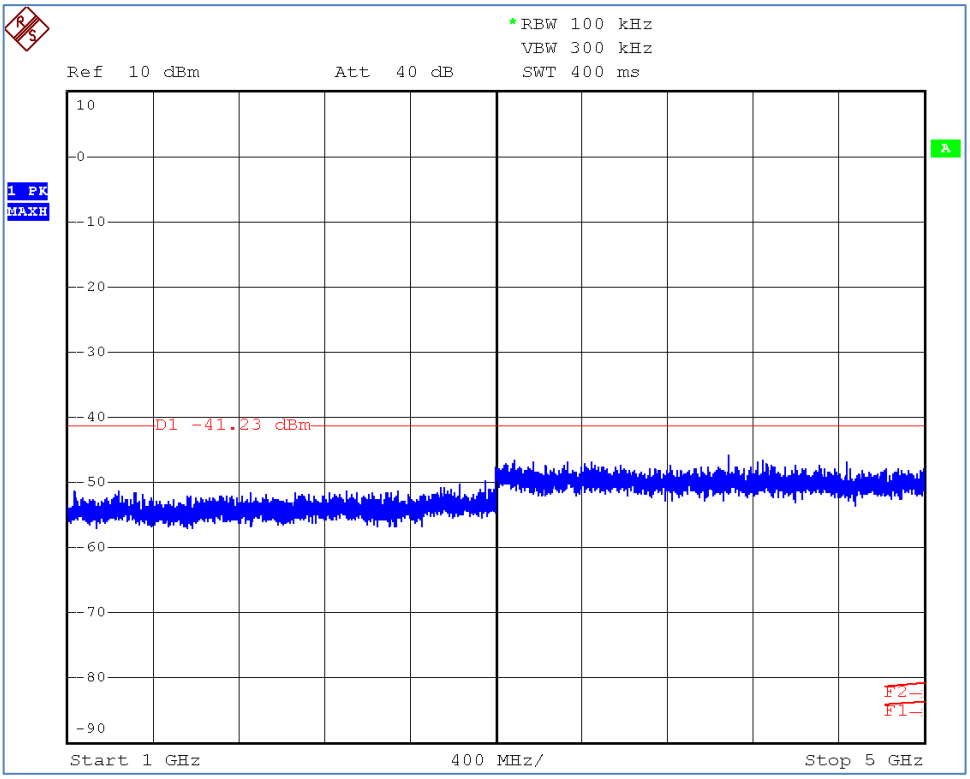


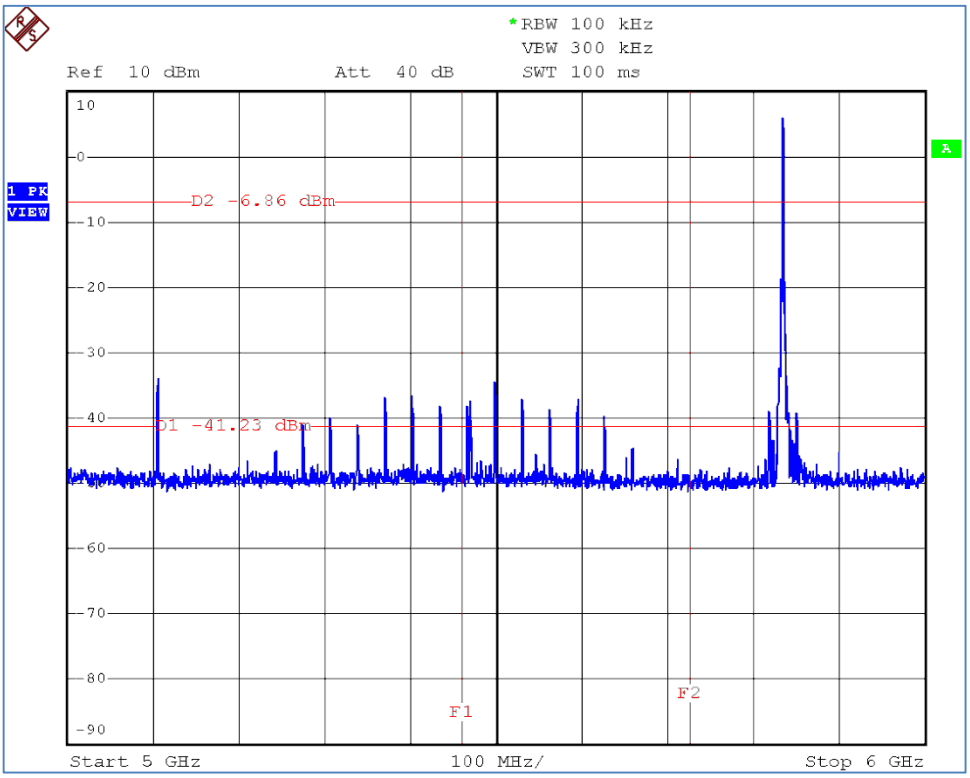
Averaging in 100 Hz VBW

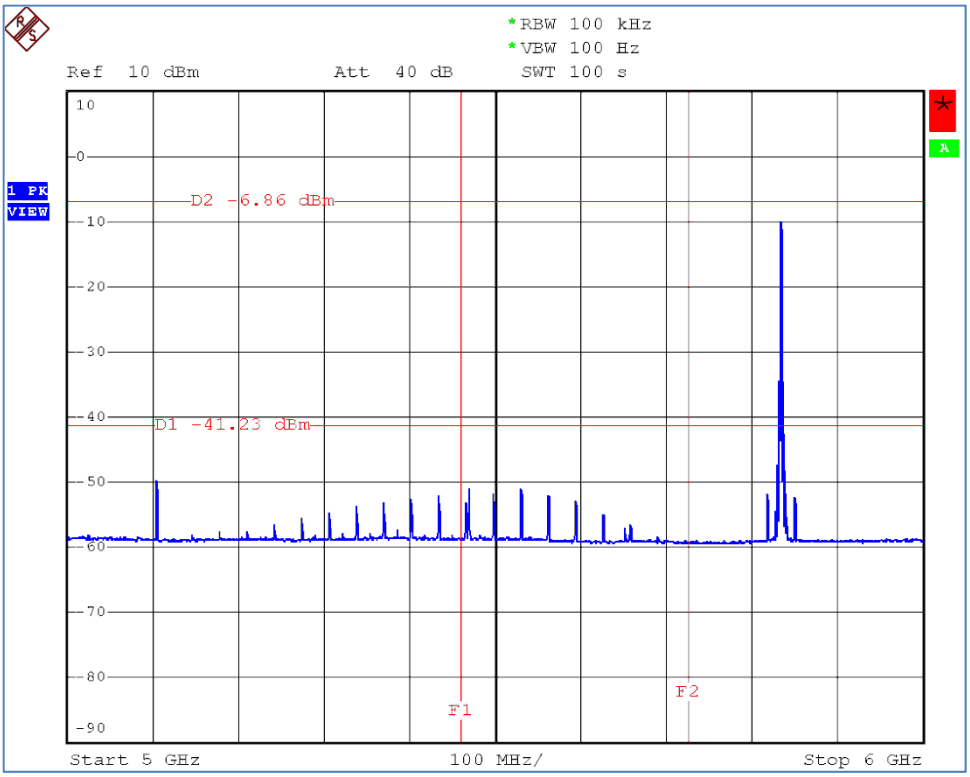

*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 4 [T1]
-48.19 dBm
29.546875000 GHz
Ref -10 dBm
Att 20 dB
Marker 1 [T1]
-57.95 dBm
10.053125000 GHz
Marker 2 [T1]
-54.86 dBm
11.428125000 GHz
Marker 3 [T1]
-50.50 dBm
17.221875000 GHz
1 PK
MAXH
A
D1 -41.23 dBm
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz

9.3.6 Antenna Port 2, High Channel

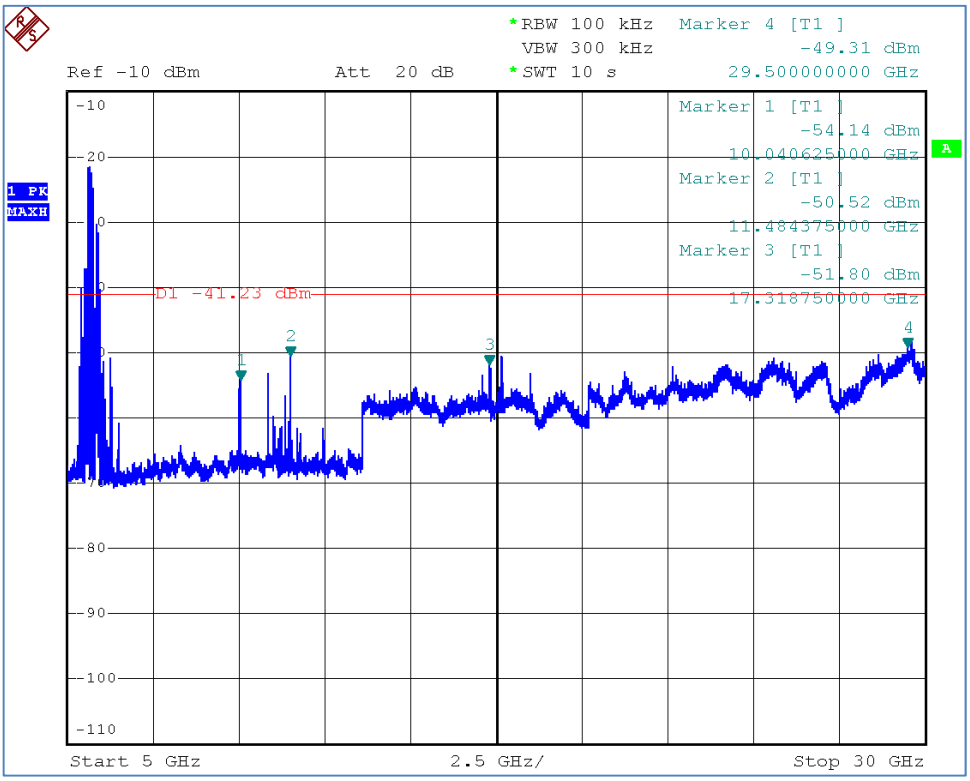








Averaging in 100 Hz VBW


*RBW 100 kHz
VBW 300 kHz
*SWT 10 s
Marker 4 [T1]
-49.31 dBm
29.500000000 GHz
Ref -10 dBm
Att 20 dB
Marker 1 [T1]
-54.14 dBm
10.040625000 GHz
Marker 2 [T1]
-50.52 dBm
11.484375000 GHz
Marker 3 [T1]
-51.80 dBm
17.318750000 GHz
1 PK
MAXH
A
D1 -41.23 dBm
-10
-20
-80
-90
-100
-110
Start 5 GHz
2.5 GHz/
Stop 30 GHz

10.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

10.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

10.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-247, 5.4; RSS-Gen	Antenna Gain & Construction	1 June 2015

10.3 Results

Table 10.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	**Specifications**
Manufacturer: Kent Electronics Model: AR58-6 Gain: 5.5 to 6.0 dBi	Patch style antenna

The modules user manual specifies the antenna listed above as the only allowed antenna.

The antenna design above satisfies the requirements of the rules.

11.0 Equipment

11.1 Spurious Radiated Emissions 30 MHz to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,**		
In accordance with:	**FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits, RSS-Gen Iss 4**		
Section:	**15.109, RSS-Gen Section 7.1.2**		
Test Date(s):	**5/26/2015**	**EUT Serial #:**	**None**
Customer:	**Garrock**	**EUT Part #:**	**None**
Project Number:	**16946-15**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**REDbird**	**Witness' Name:**	**None**

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

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	5/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/26/2016
C027	N/A	RG214	Cable Coax, N-N, 25m	none	10/22/2015
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	N/A	0	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/26/2016

11.2 Timing, Bandedge, and Bandwidth Measurements, Conducted

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29

11.3 Spurious Emissions, Conducted

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29

11.4 Radiated Emissions 18-26.5 GHz

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29
1973	Agilent	83017A	Microwave Amplifier	2015-12-01
1542	AH Systems	SAS-572	Horn, Octave, 18 GHz to 26.5 GHz	NCR

11.5 Radiated Emissions 26.5 to 40 GHz

Asset #	Manufacturer	Model #	Description	Calibration Due
1937	Agilent	E4440A	Spectrum Analyzer SN MY44303298	2015-12-02
None	Agilent	5061-5458	Agilent harmonic mixer cable 1: IF/LO SN none	NCR
None	Agilent	5061-5458	Agilent harmonic mixer cable 2: IF/LO SN none	NCR
2063	Agilent	11970A	Mixer, Harmonic, 26.5 - 40 GHz SN 3003A08717	NCR

12.0 Measurement Bandwidths, Radiated Emissions, Spurious

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

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

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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