telefication bv
The Netherlands
Chamber of Commerce
51565536
www.telefication.com

telefication

FCC and IC Test Report for Parts 15.247, 15.207 and 15.209 (DTS) and RSS-247, RSS Gen

Product name	BLE Radio Module
Applicant	National Instruments
FCC ID	2AGJ2-001
ISED ID	3523A-001

Test report No. : 181100648 001 v1.00

Laboratory information

Accreditation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001.

Telefication is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31889983600 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	18-12-2018	First draft	RvB
v1.00	15-02-2019	Initial release	RvB

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.203	--	Antenna requirement	1.6	Pass
15.247 (a)	RSS-247 5.2(a)	6dB Bandwidth	3.1	Pass
--	RSS-Gen 6.7	99% Bandwidth	3.2	Pass
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.3	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.4	Pass
15.247 (d)	RSS-247 5.5	Conducted Band edge	3.5	Pass
15.209 (a)	RSS-247 5.5	Radiated Spurious emissions	3.6	Pass
15.205 (a)/ 15.247 (d)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.6	Pass
15.207 (c)/ 15.247 (d)	RSS-Gen 8.8	Conducted spurious emissions on AC mains	3.7	Pass

1 General Description

1.1 Applicant

Client name:	National Instruments
Address	11500 N, Mopac Expressway, Austin, Texas, United States of America
Telephone:	512-683-9233
E-mail:	Kristine.song@ni.com
Contact name:	Ms. K. Song

1.2 Manufacturer

Manufacturer name:	National Instruments
Address:	11500 N, Mopac Expressway, Austin, Texas, United States of America
Telephone:	512-683-9233
E-mail:	Kristine.song@ni.com
Contact name:	Ms. K. Song

1.3 Tested Equipment Under Test (EUT)

Product name:	NI RM10
Brand name:	National Instruments
Product type:	BT 5.0 Module
FCC ID:	2AGJ2-001
ISED ID	3523A-001
Software version:	--
Hardware version:	--
Date of receipt	9-11-2018
Tests started:	27-11-2018
Testing ended:	17-12-2018

1.4 Product specifications of Equipment under test

TX Frequency range (MHz)	2400 – 2483.5
RX frequency range (MHz)	2400 – 2483.5
Maximum output power to antenna (dBm)	18.69
Antenna type	See chapter ”observation and remarks”
Antenna gain (dBi)	See chapter ”observation and remarks”
Type of modulation	Acc. to the Bluetooth spec.
Emission designator BT 5.0	2M05F1D

1.5 Observations and remarks

The Applicant provided 2 types of sample, one with a u.FL connector directly on the module. And one sample with and u.fl connector on the host PCB (called RF Through Path in this report). This test report covers both samples.

The Applicant provided 3 antenna types for testing.

#	Type	Max Gain (dBi)	Manufacturer	MNG Model #	NH Part #	Notes
1	Molded/SMT	2	TE Connectivity	1513504-1	680401-01	Used with the RF through connector
2	Rubber Duck Monopole	1.5	Pulse	W5010	754309-01	Used with u.FL on board
3	Rubber Duck Monopole	1.5	MMT Machrone	WAS002-000178B-S12	747209-01	Used with u.FL on board

A comparison measurement was performed to determine the worst case antenna for radiated spurious emissions and band edge testing. Antenna number 3 was determined to give the worst case radiated spurious emissions. And was used for all the radiated spurious emission and band edge tests.

1.6 Environmental conditions

Test date	10-12-2018	14-12-2018	17-12-2018
Ambient temperature	19.4 °C	20.8 °C	18.5 °C
Humidity	41.3 % RH	34.9 % RH	36.6 % RH

1.7 Measurement Standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247, §15.207, §15.209
- RSS-247 Issue 2, RSS-Gen Issue 5

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.8 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.8 *"Applicable standards".*

All tests are performed by:

Name : ing R. van Barneveld

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 15-02-2019

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

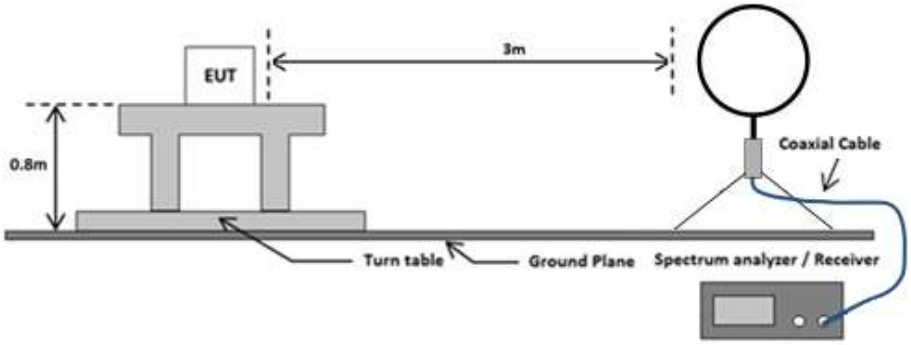
The applicant also provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

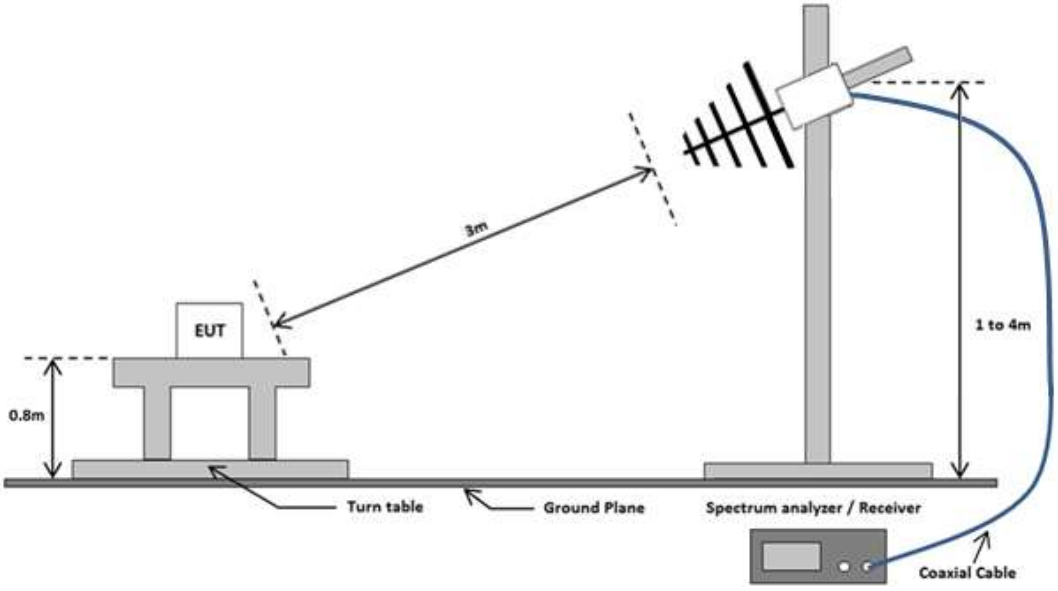
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth 5.0	37 (Low)	1/2 Mbps	2402
	17 (Mid)	1/2 Mbps	2440
	39 (High)	1/2 Mbps	2480

2.3 Test setups

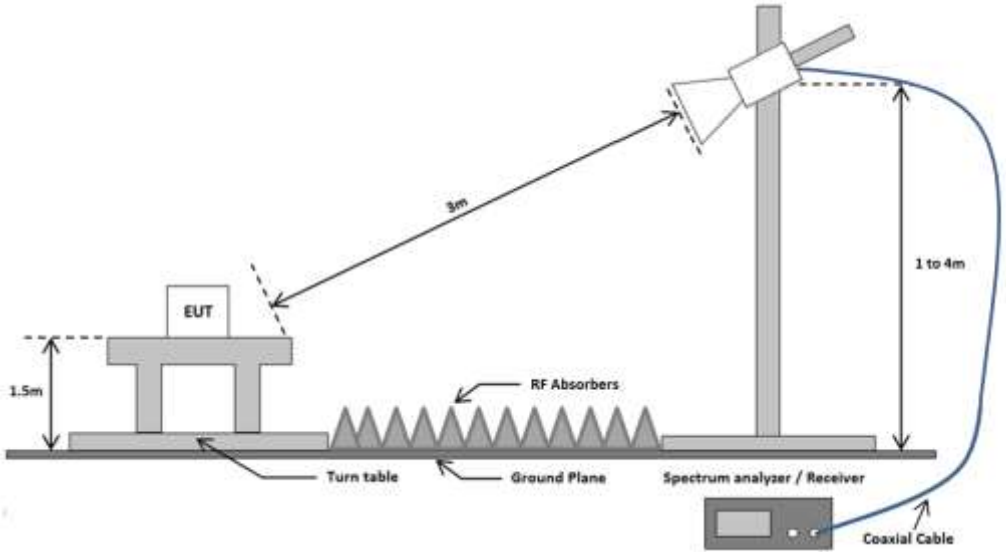
Radiated emissions test setup 9 kHz - 30 MHz



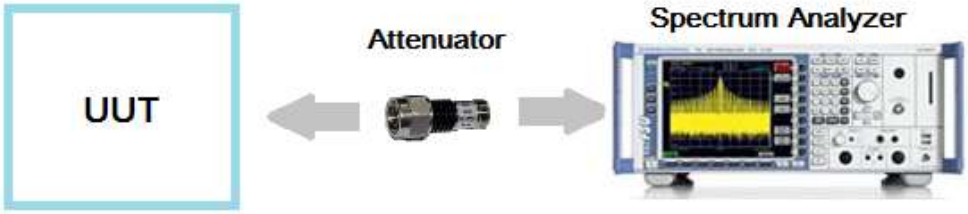
Radiated emissions test setup 30 MHz - 1 GHz



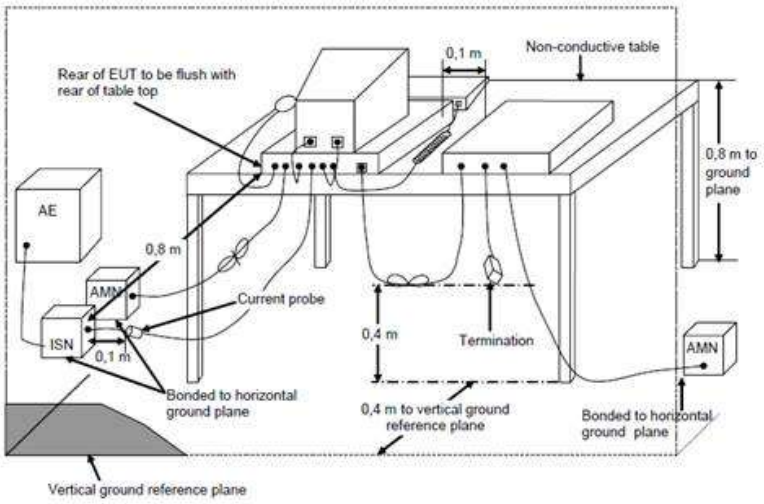
Radiated emissions test setup above 1 GHz



Conducted antenna port test setup



Conducted Emissions on the AC mains test setup



2.4 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV40	TE01269	3.1 – 3.5
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.6
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.6 – 3.7
Biconilog Antenna	Chase	CBL6112A	TE00967	3.6
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.6
Horn Antenna	Flann Microwave	20240-25	TE00818	3.6
SAC Chamber	Comtest Engineering BV	-	TE00861	3.6
Band reject filter	5N45-2441/T83-0/0	WHK3.0/18G-10EF	TE00932	3.6
Pre-amplifier	Miteq	Js4-18004000-30-8P-A1	TE11131	3.6
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE00092	3.6
Software	DARE Instruments	Radimation 2016.2.8	--	3.7
Software	DARE Instruments	Radimation 2017.2.5	--	3.6
Artificial Mains Network (AMN)	Rohde & Schwarz	ESH3-Z5	TE00208	3.7
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	TE00756	3.7
Active loop antenna	Rohde & Schwarz	HFH2-z2	TE00747	3.6

2.5 Sample calculation

Field Strength Measurement example:

Frequency (GHz)	Polarization	Height(m)	Peak (dBµV/m)
7,236	Horizontal	2	52.5

The following relation applies:

E (dBµV/m) = U(dBµV) + AF (dB/m) – G (dB) + CL (dB)

Where:

E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
G = Gain of the pre-amplifier
CL = Cable loss

(52.5 = 48.12 + 36.1 - 37.42 + 5.7)

3 Test results

3.1 6dB bandwidth Measurement

3.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.1.4 Test procedure

The testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

3.1.5 Test Results of the 6 dB bandwidth Measurement

U.FL

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth 5.0	37	2402	1 Mbps	691.39
	17	2440	1 Mbps	706.58
	39	2480	1 Mbps	714.54
Uncertainty	± 39 kHz			

U.FL

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low Energy	37	2402	2 Mbps	1102.39
	17	2440	2 Mbps	1124.82
	39	2480	2 Mbps	1132.05
Uncertainty	± 39 kHz			

RF Through Path

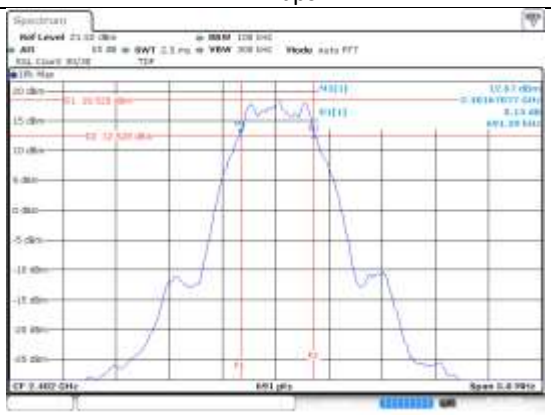
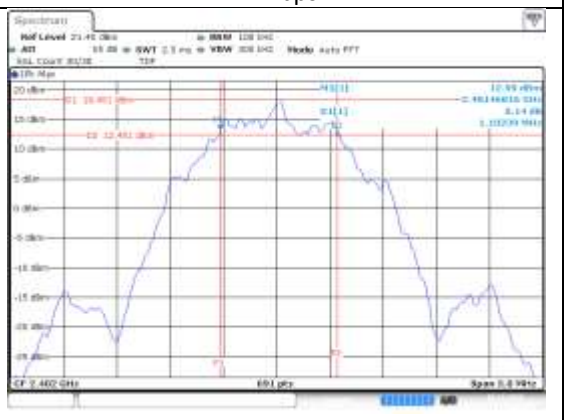
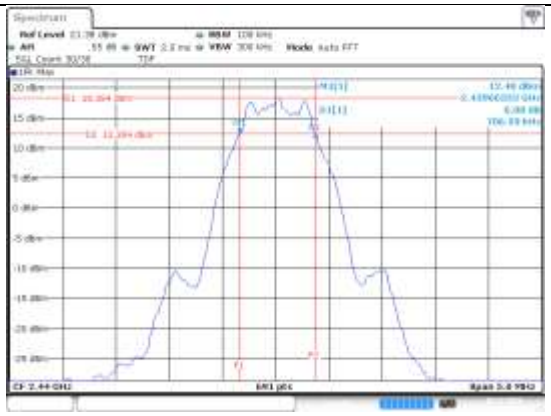
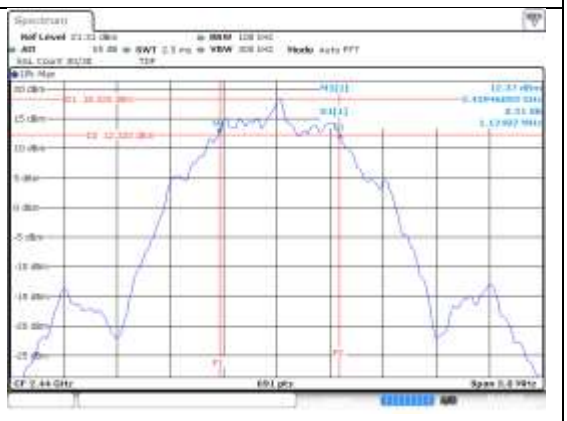
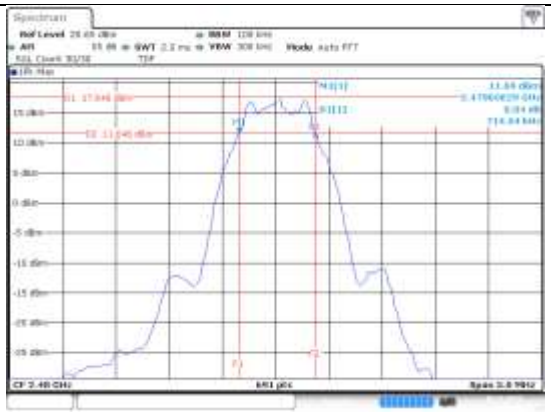
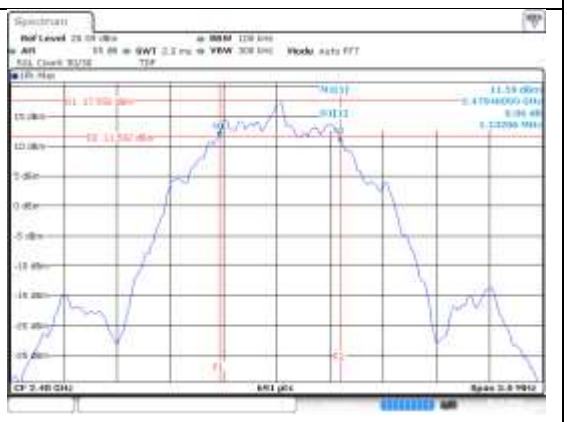
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth 5.0	37	2402	1 Mbps	691.39
	17	2440	1 Mbps	691.39
	39	2480	1 Mbps	691.39
Uncertainty	± 39 kHz			

RF Through Path

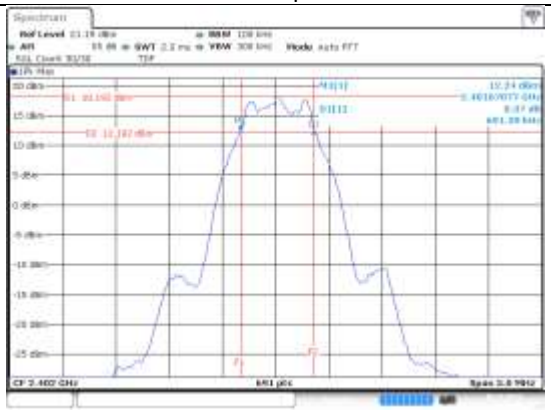
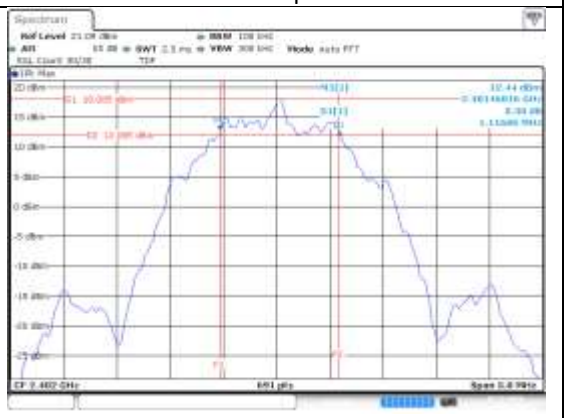
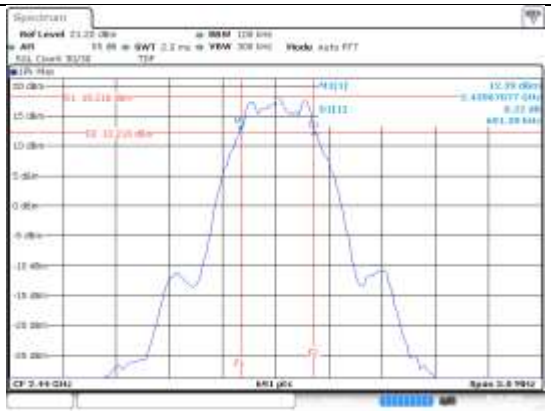
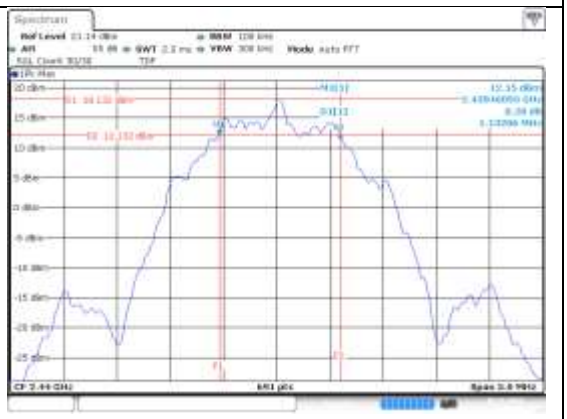
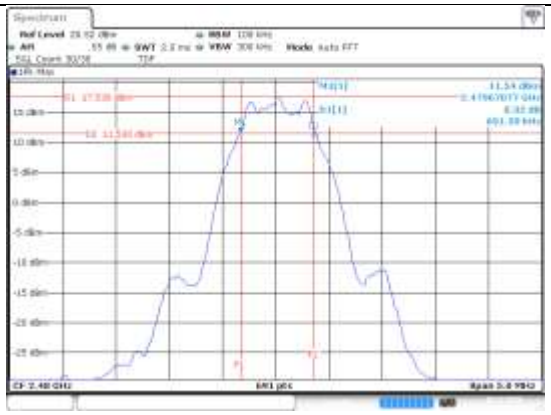
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low Energy	37	2402	2 Mbps	1116.86
	17	2440	2 Mbps	1132.05
	39	2480	2 Mbps	1132.05
Uncertainty	± 39kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

BT 5.0, 6 dB Bandwidth Measurement
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

BT 5.0, 6 dB Bandwidth Measurement
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

3.2 99% Occupied Bandwidth

3.2.1 Limit

According to RSS-Gen 6.7.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.2.4 Test procedure

IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

1 Set the centre frequency to the nominal EUT channel centre frequency.
2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
3 Set VBW ≥ 3 x RBW.
4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until the trace stabilizes) shall be used.

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

U.FL

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
Bluetooth 5.0	37	2402	1 Mbps	1.049
	17	2440	1 Mbps	1.049
	39	2480	1 Mbps	1.056
Uncertainty	±39 kHz			

U.FL

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
Bluetooth 5.0	37	2402	2 Mbps	2.047
	17	2440	2 Mbps	2.047
	39	2480	2 Mbps	2.047
Uncertainty	±39 kHz			

RF Through Path

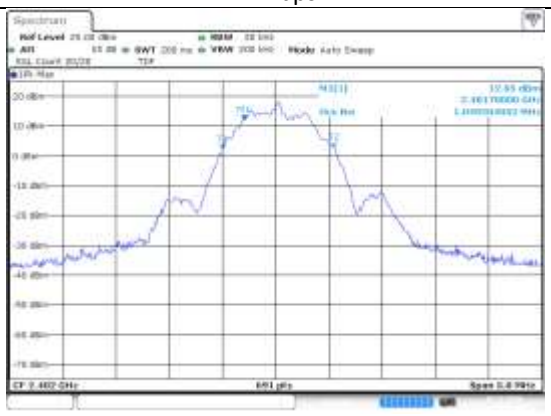
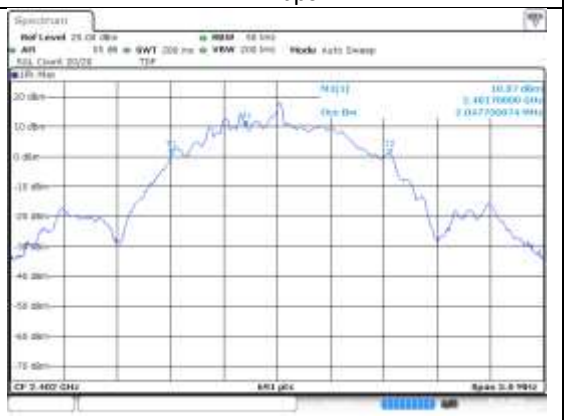
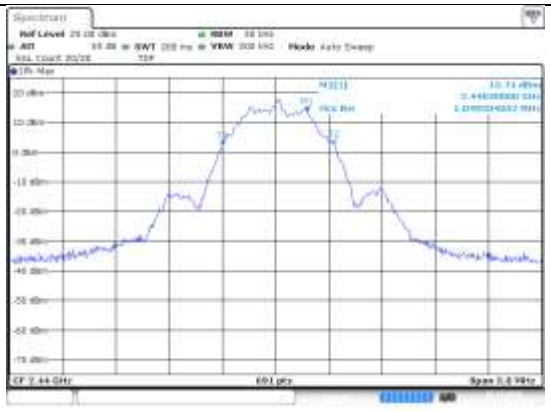
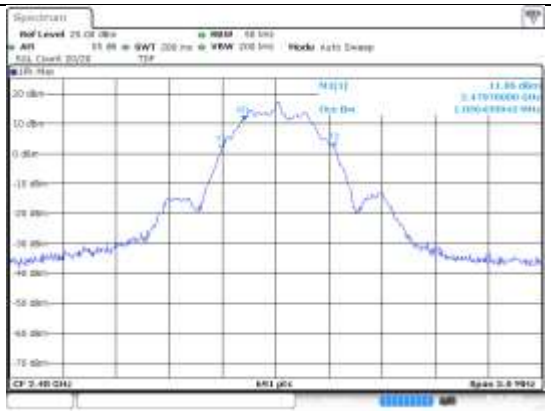
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
Bluetooth 5.0	37	2402	1 Mbps	1.049
	17	2440	1 Mbps	1.056
	39	2480	1 Mbps	1.056
Uncertainty	±39 kHz			

RF Through Path

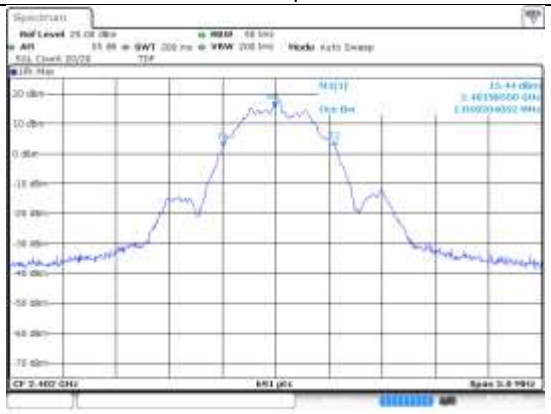
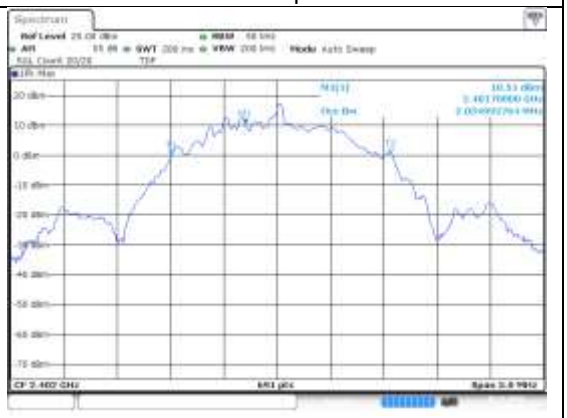
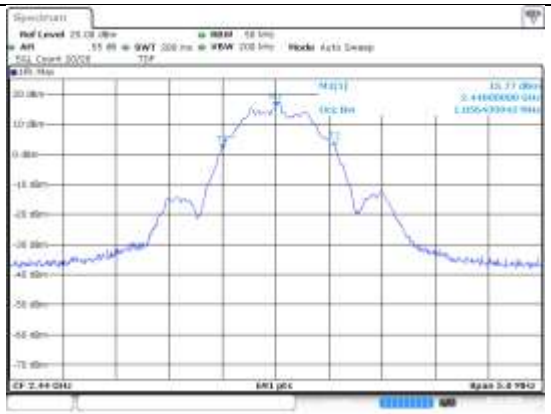
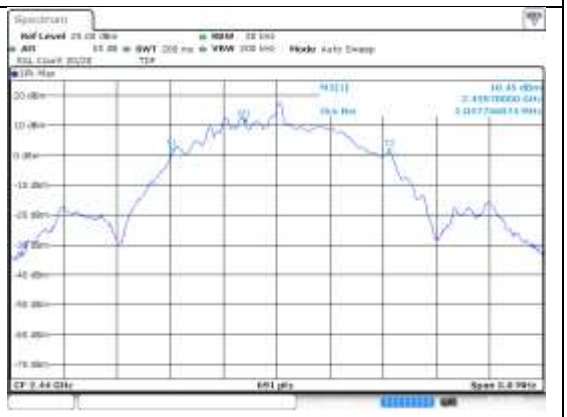
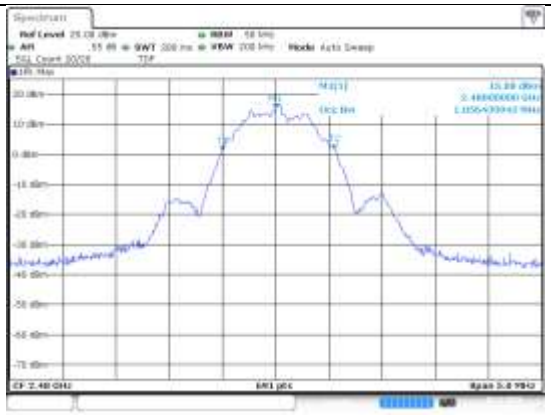
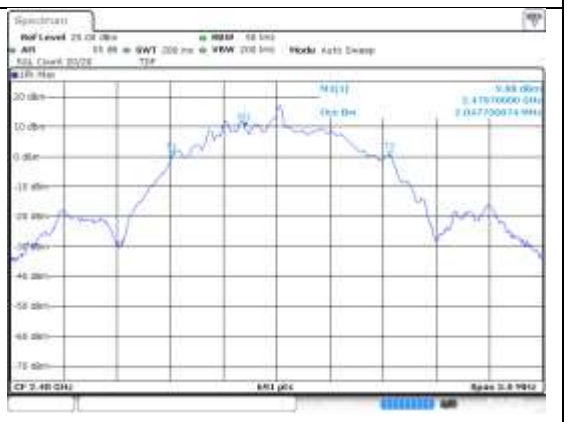
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
Bluetooth 5.0	37	2402	2 Mbps	2.055
	17	2440	2 Mbps	2.048
	39	2480	2 Mbps	2.048
Uncertainty	±39 kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

BT 5.0, 99% Bandwidth Measurement
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

BT 5.0, 99% Bandwidth Measurement
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

3.3 Output Power Measurement

3.3.1 Limit

15.247(b)

For systems using digital modulation in the 2400-2483.5 MHz band, the limit for the peak output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

RSS 247 section 5.4(d)

The EIRP shall not exceed 4W (36 dBm).

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.3.4 Test procedure

The testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.3.5 Test results of Output Power Measurement

U.FL

Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth 5.0	37	2402	1 Mbps	18.69
	17	2440	1 Mbps	18.56
	39	2480	1 Mbps	17.84
Uncertainty	± 0.71 dB			

U.FL

Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth 5.0	37	2402	2 Mbps	18.63
	17	2440	2 Mbps	18.50
	39	2480	2 Mbps	17.79
Uncertainty	± 0.71 dB			

RF Though Path

Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth 5.0	37	2402	1 Mbps	18.39
	17	2440	1 Mbps	18.40
	39	2480	1 Mbps	17.72
Uncertainty	± 0.71 dB			

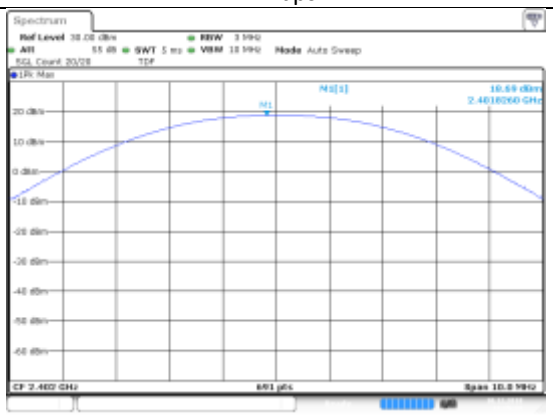
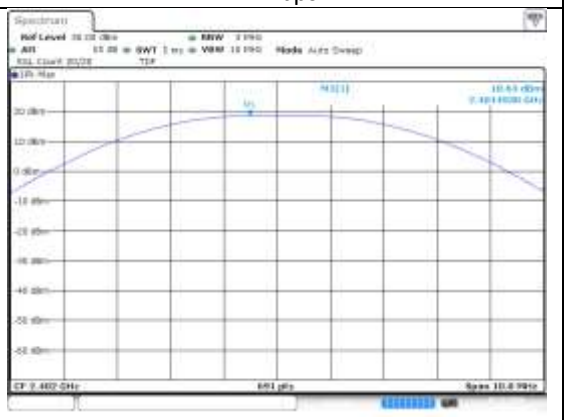
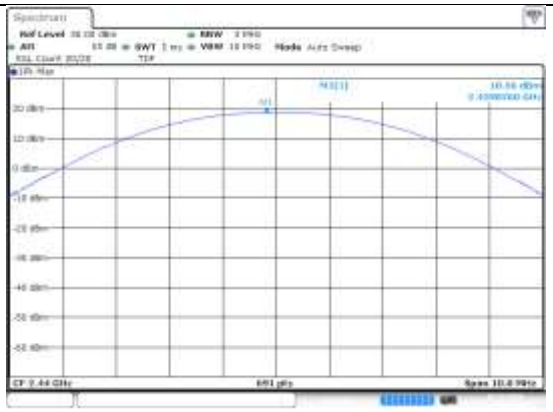
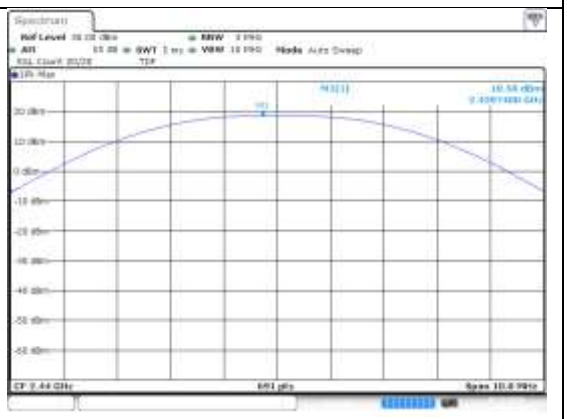
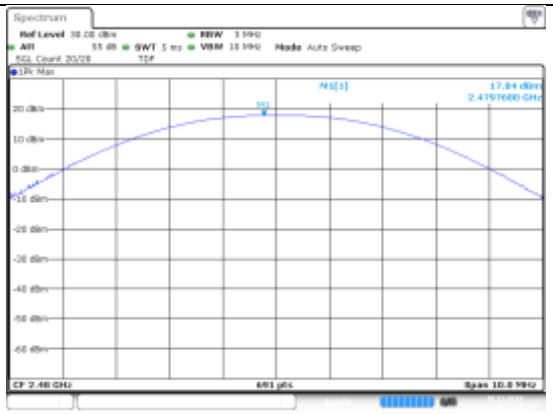
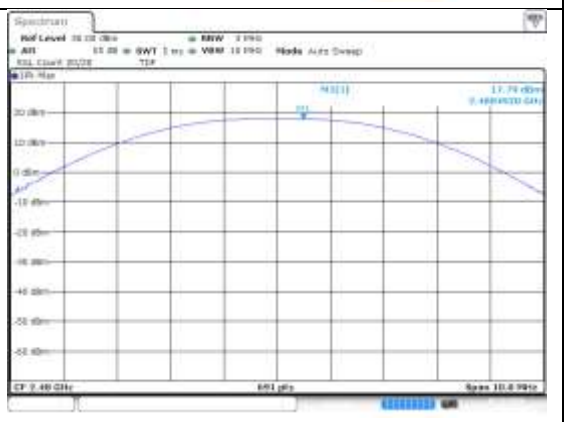
RF Through Path

Peak method

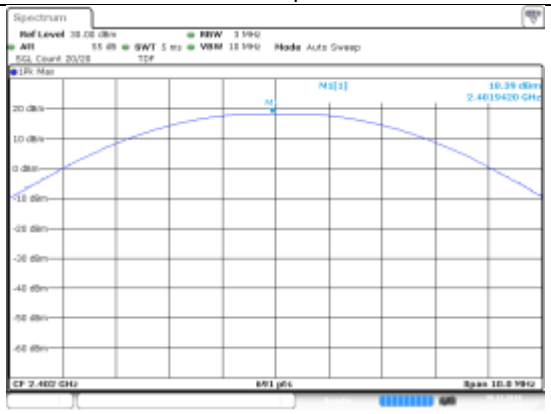
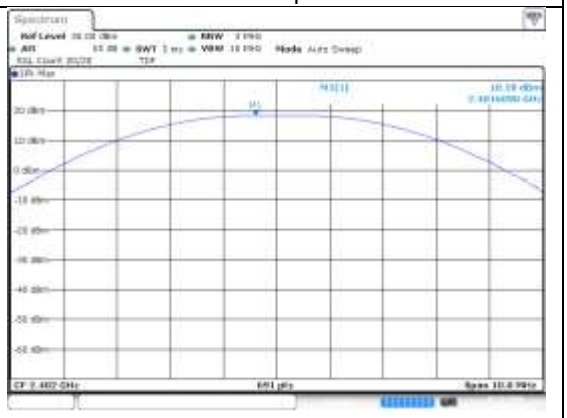
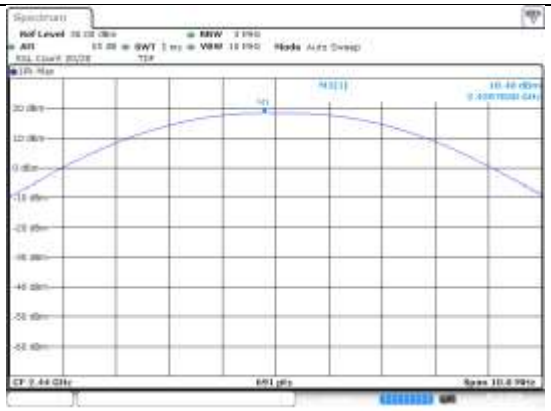
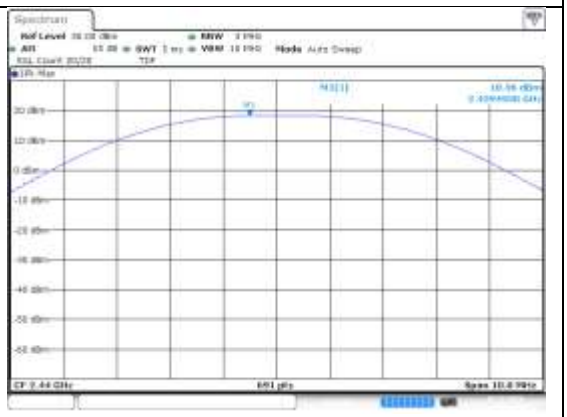
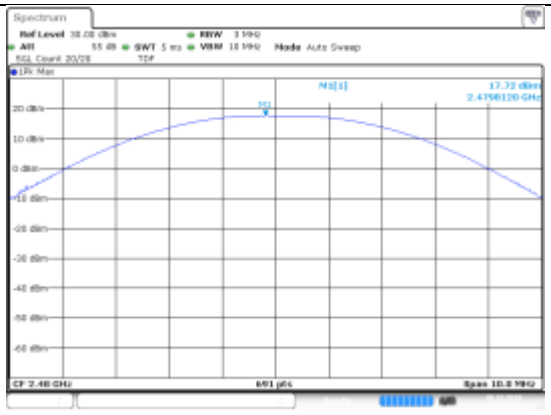
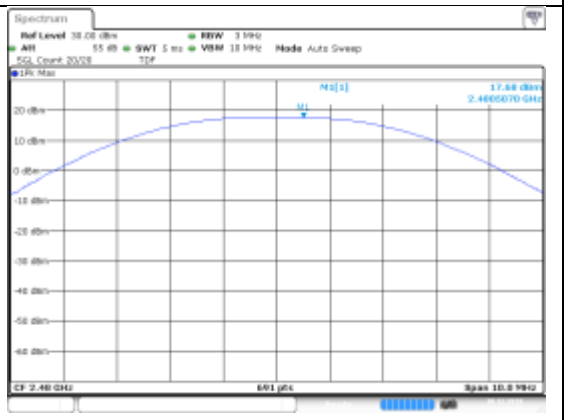
Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth 5.0	37	2402	2 Mbps	18.28
	17	2440	2 Mbps	18.36
	39	2480	2 Mbps	17.68
Uncertainty	± 0.71 dB			

3.3.6 Plots of Peak Output Power Measurement

BT 5.0, Output power Measurement
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

BT 5.0, Output power Measurement
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

3.4 Power Spectral Density

3.4.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.4.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.4.4 Test procedure

The testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.
IRN 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band).

3.4.5 Test results of Power Spectral Density Measurement

U.FL

Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth 5.0	37	2402	1 Mbps	3.02
	17	2440	1 Mbps	2.92
	39	2480	1 Mbps	2.21
Uncertainty	±2 dB			

U.FL

Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth 5.0	37	2402	2 Mbps	0.53
	17	2440	2 Mbps	0.44
	39	2480	2 Mbps	-0.27
Uncertainty	±2 dB			

RF Through Path

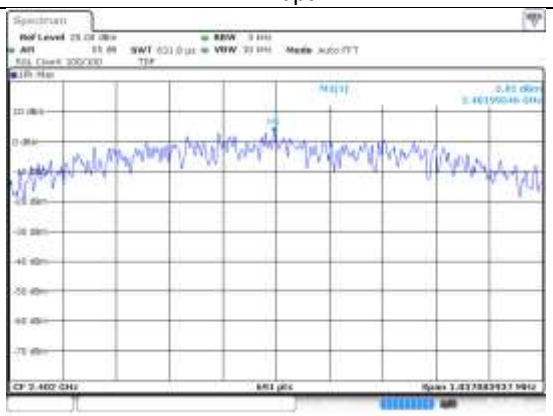
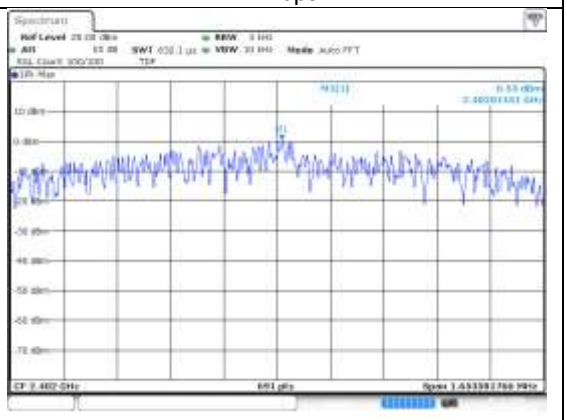
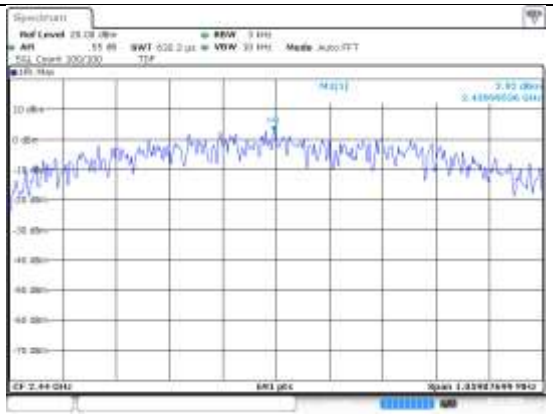
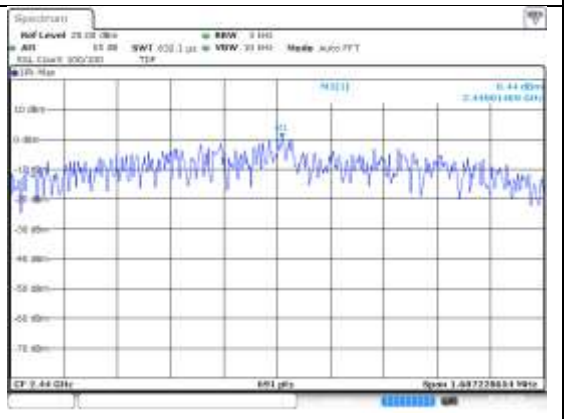
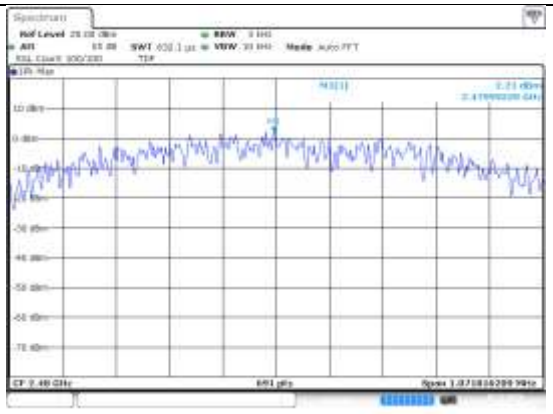
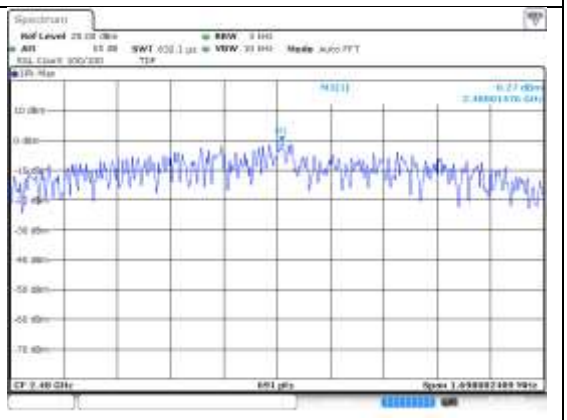
Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth 5.0	37	2402	1 Mbps	2.87
	17	2440	1 Mbps	2.71
	39	2480	1 Mbps	2.11
Uncertainty	±2dB			

RF Through Path

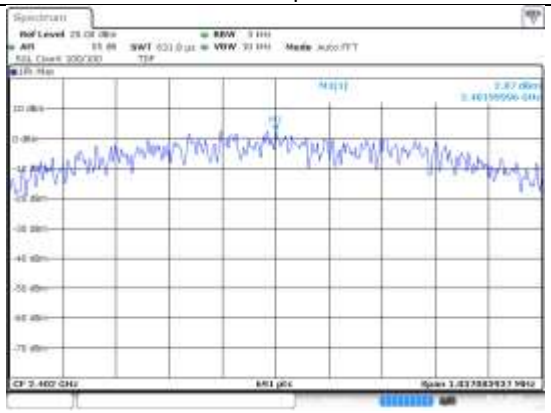
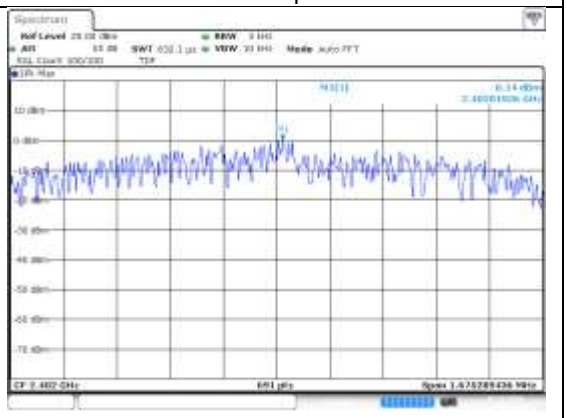
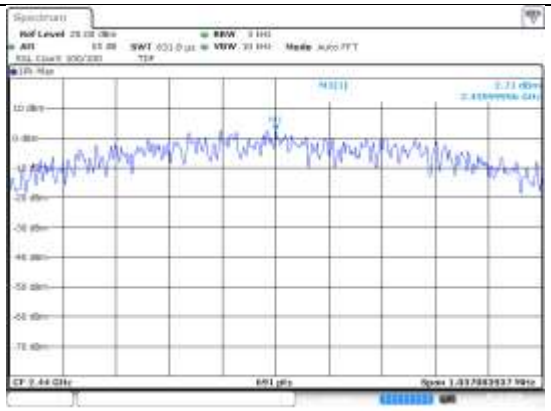
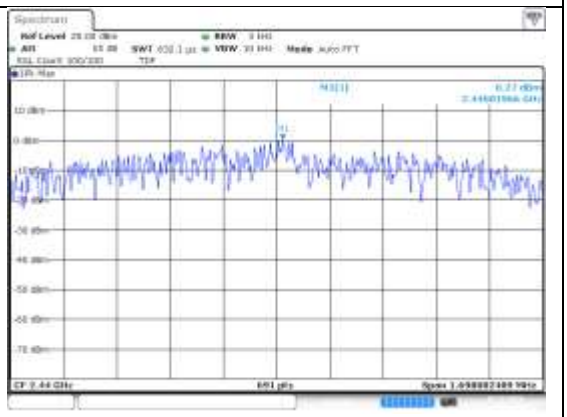
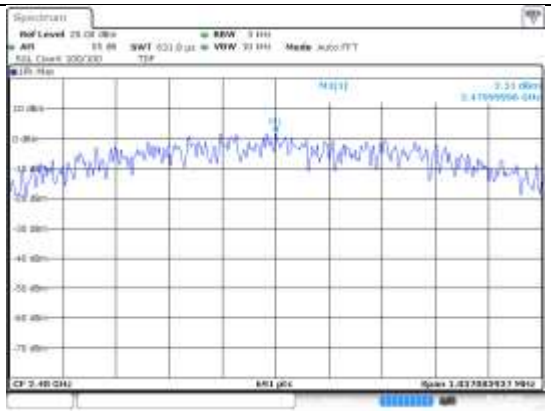
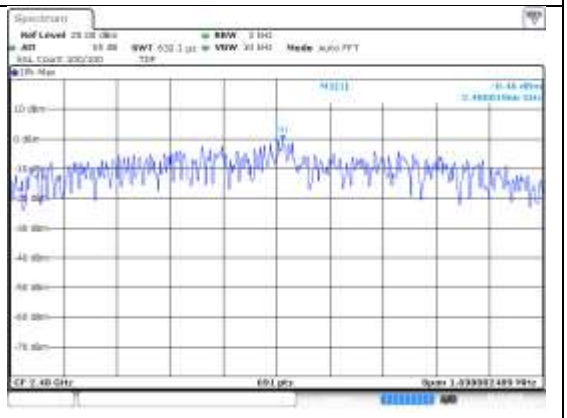
Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth 5.0	37	2402	2 Mbps	0.14
	17	2440	2 Mbps	0.27
	39	2480	2 Mbps	-0.46
Uncertainty	±2 dB			

3.4.6 Plots of the Power Spectral Density Measurements

BT 5.0, Power Spectral Density Measurement
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

BT 5.0, Power Spectral Density Measurement
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

3.5 Conducted Spurious Emissions Measurement

3.5.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.5.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.5.4 Test procedure

The testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 016 – Spurious emission (W) - Method 1/2/3.

3.5.5 Plots of the Conducted Spurious Emissions Measurement

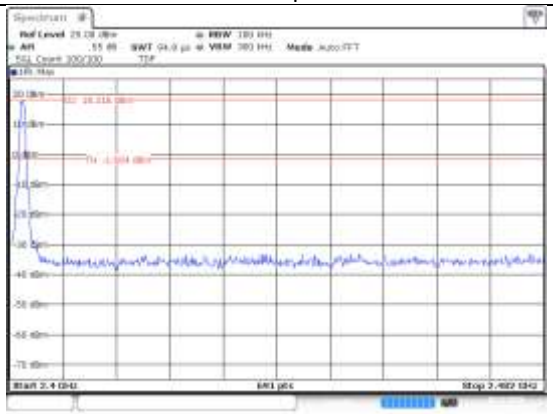
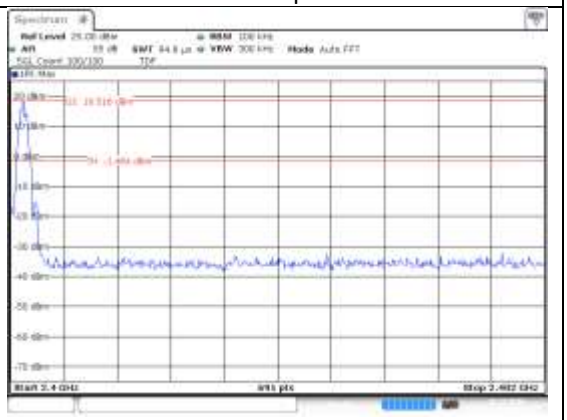
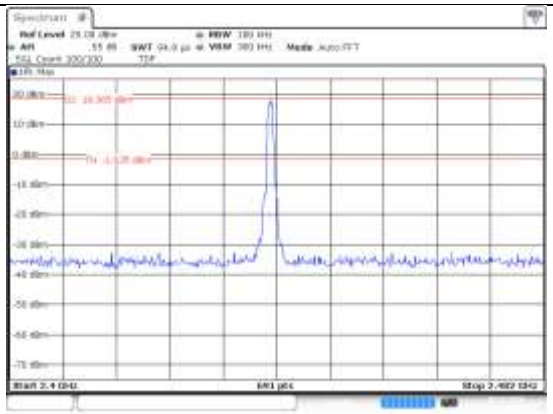
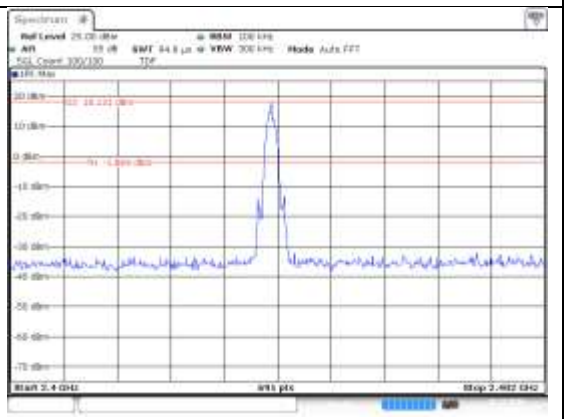
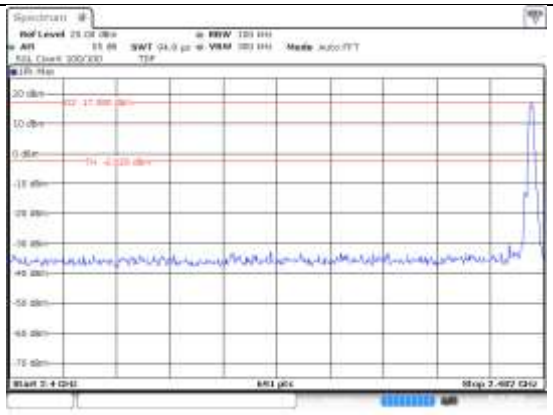
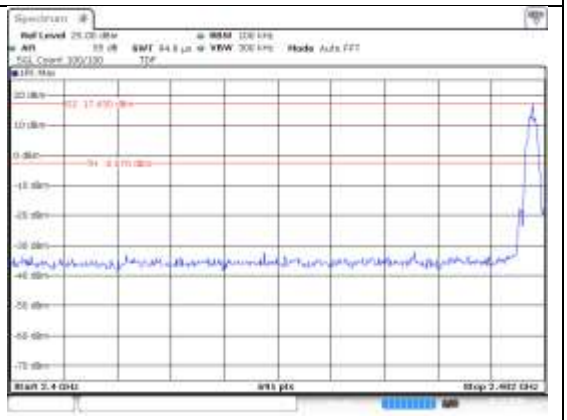
See next page.

3.5.6 Measurement Uncertainty

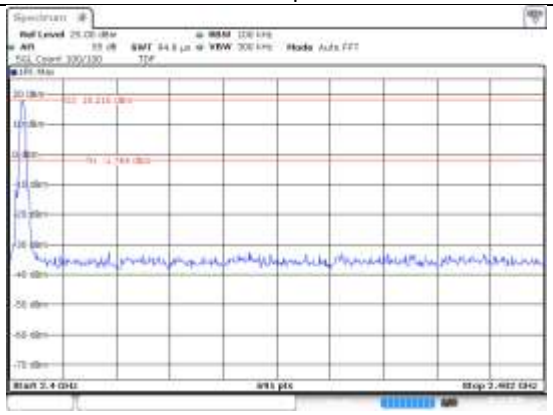
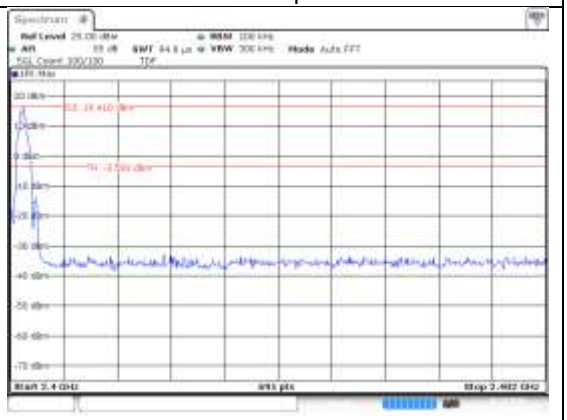
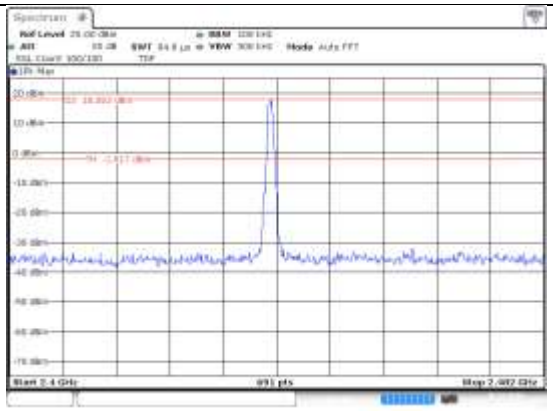
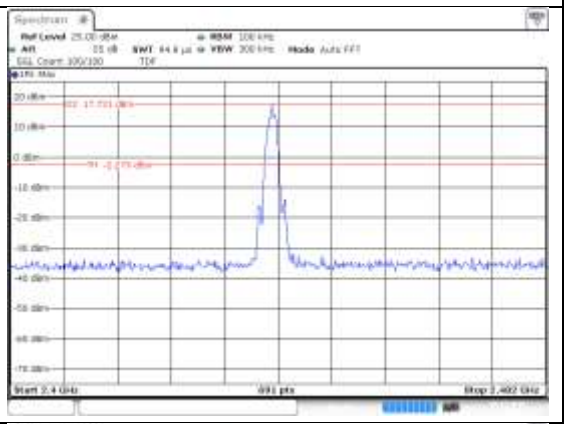
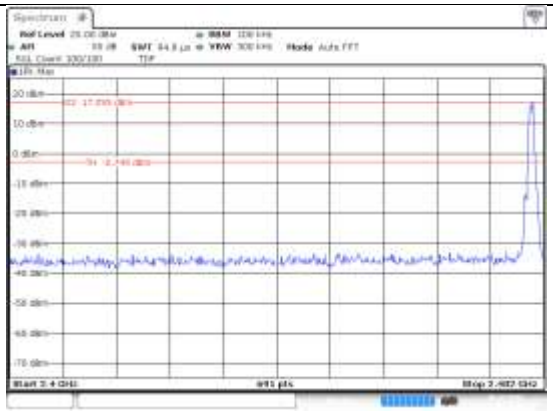
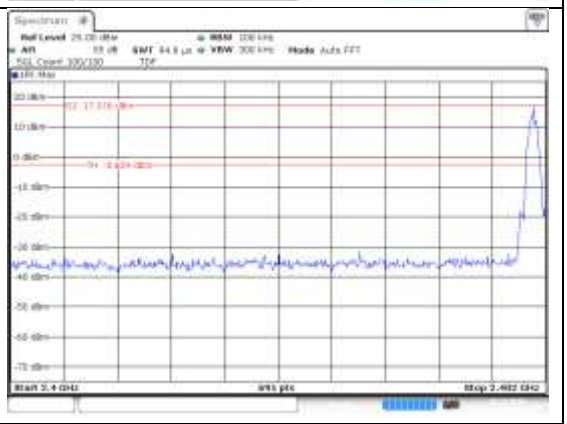
< 1 GHz	±1.1 dB
≥ 1 GHz	±1.1 dB

BT 5.0 Conducted Spurious Emissions Fundamental level

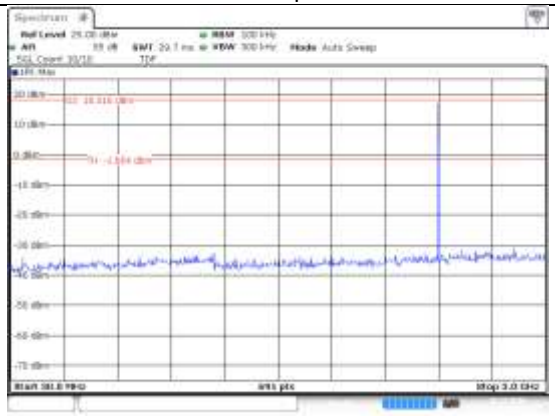
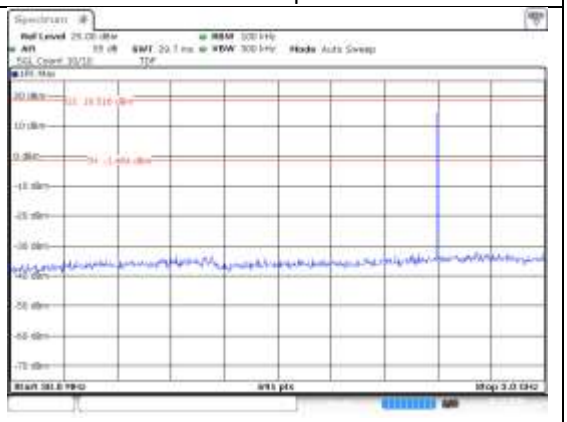
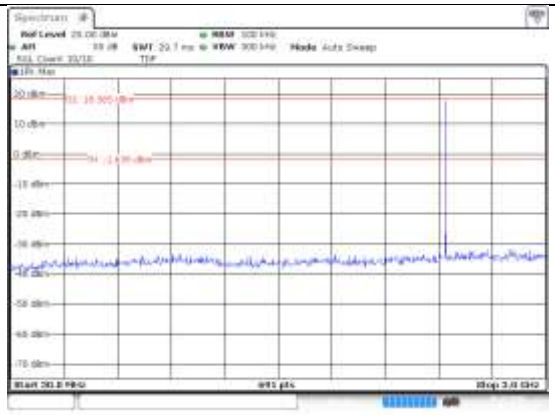
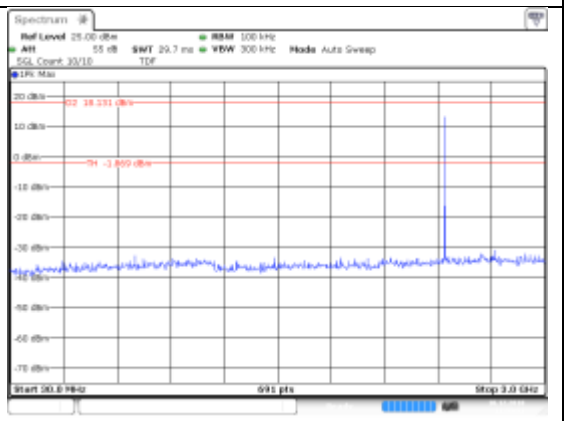
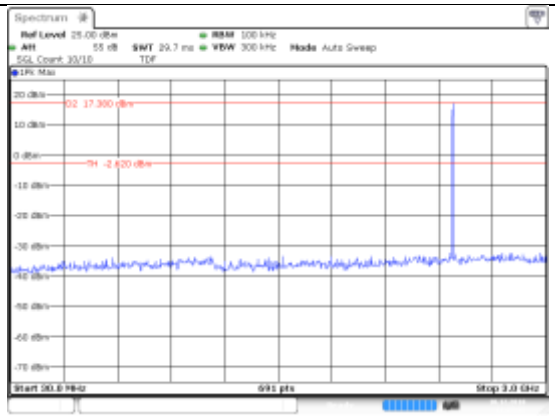
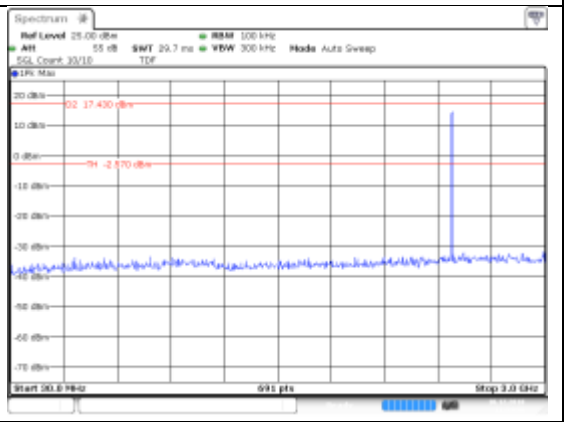
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 17		
Ch. 39		

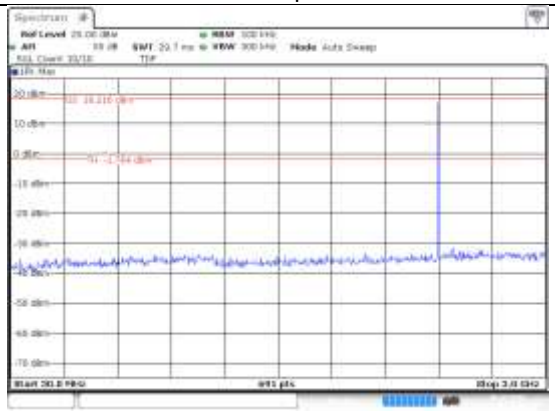
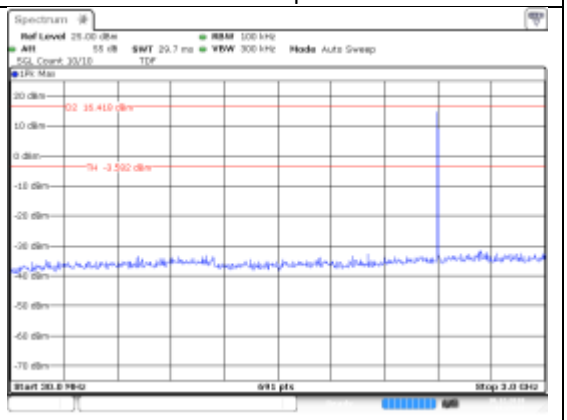
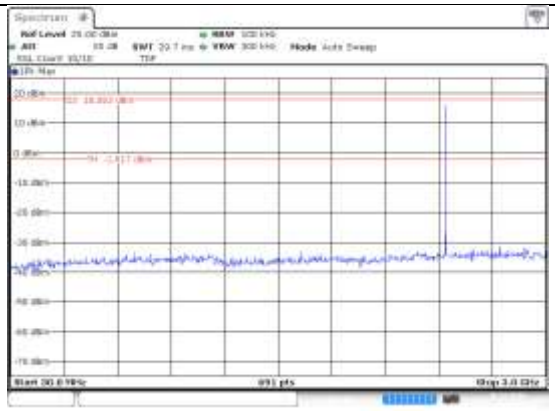
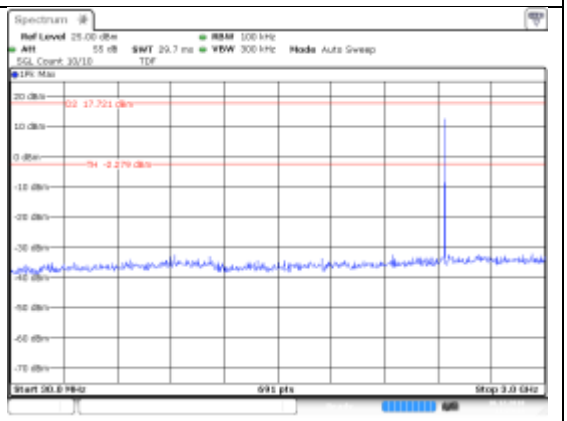
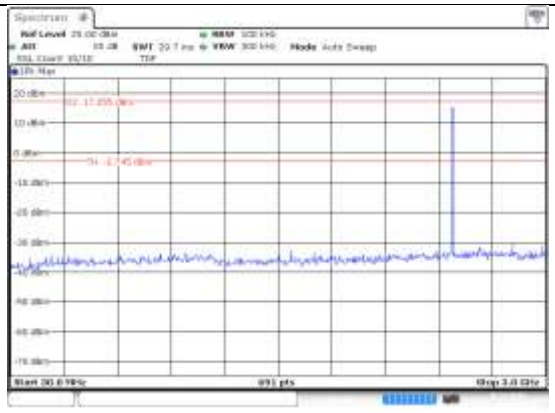
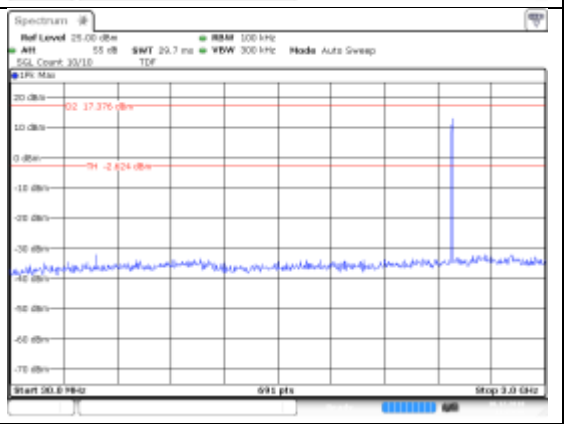
BT 5.0 Conducted Spurious Emissions Fundamental level
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch . 17		
Ch 39		

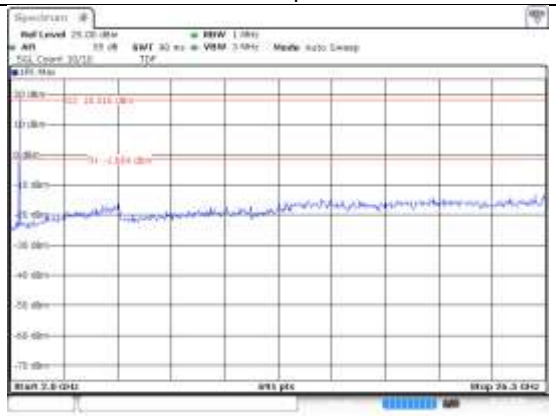
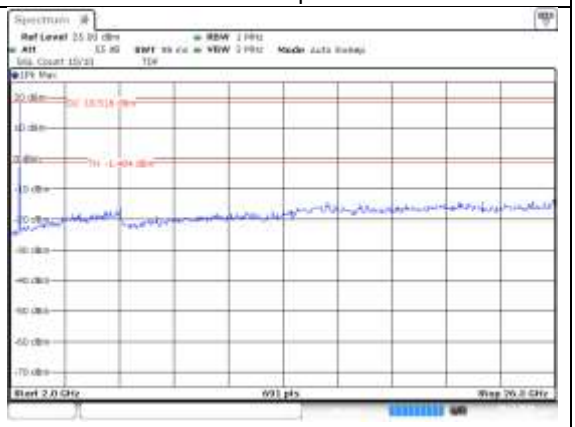
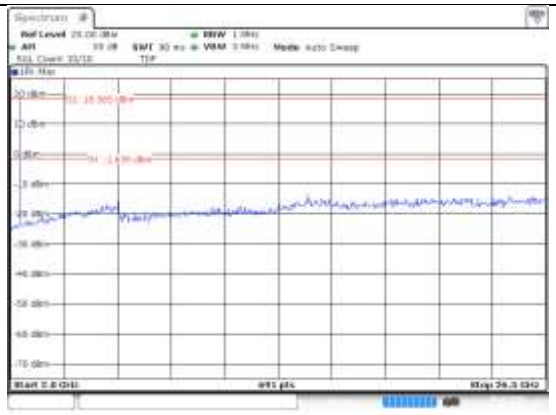
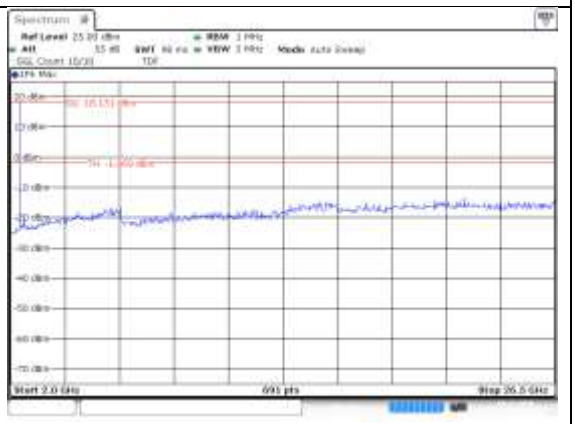
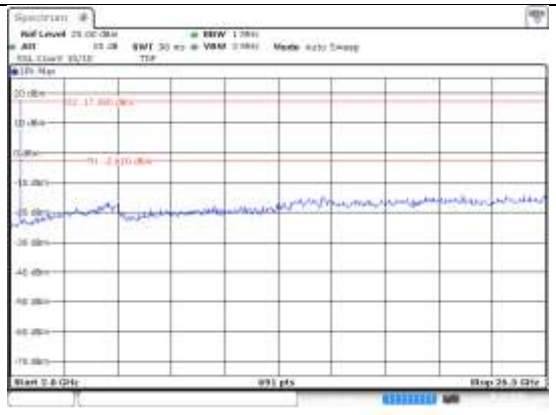
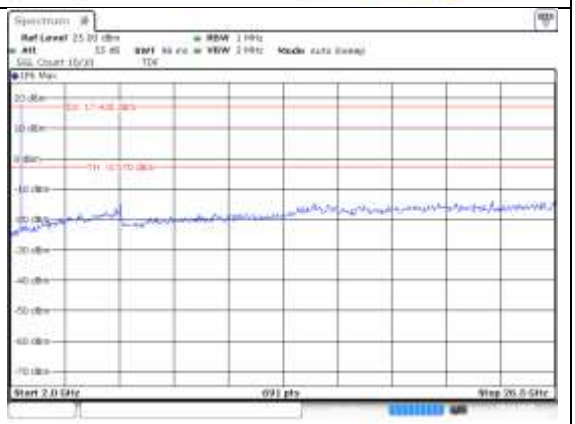
BT 5.0 Conducted Spurious Emissions 30 – 3000 MHz
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch 17		
Ch 39		

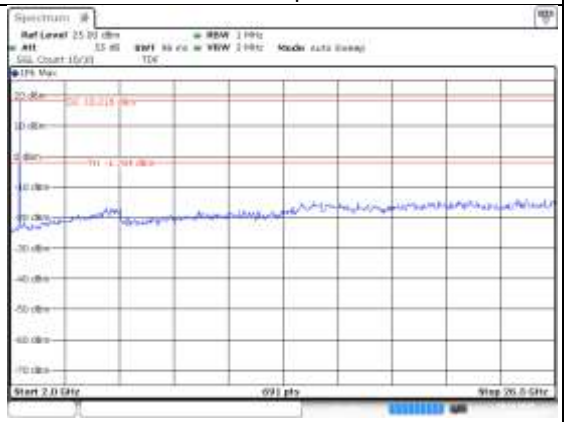
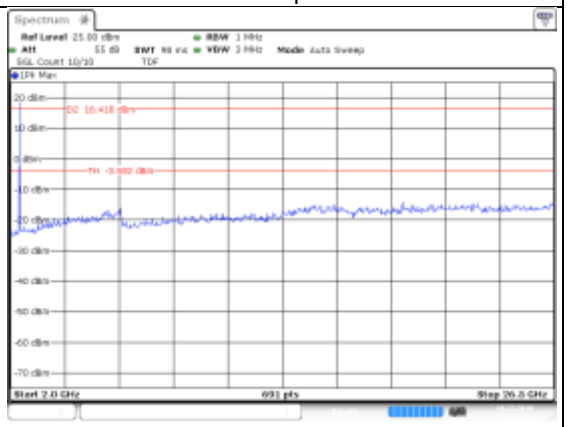
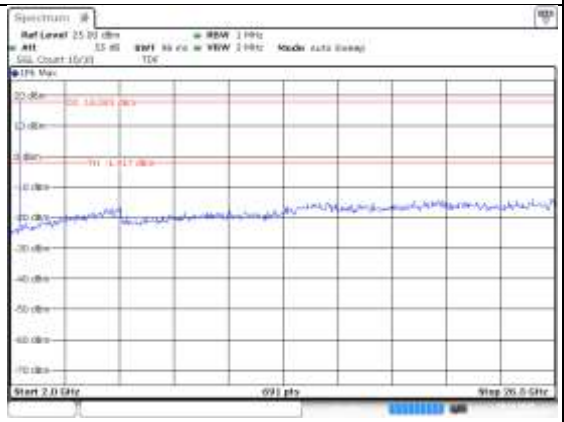
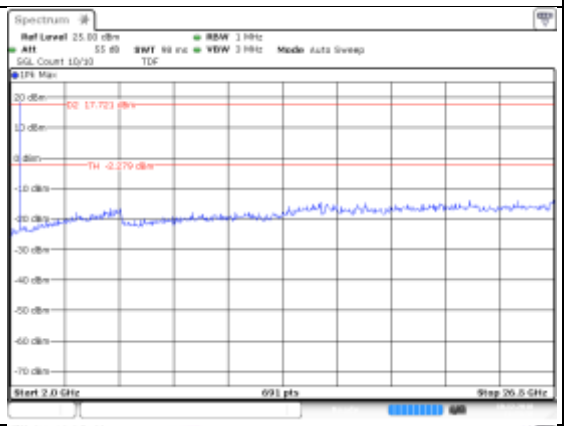
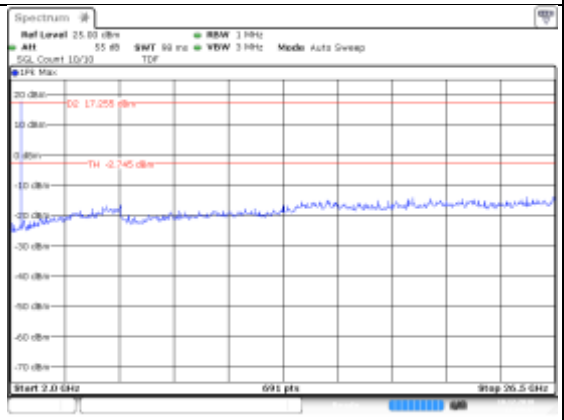
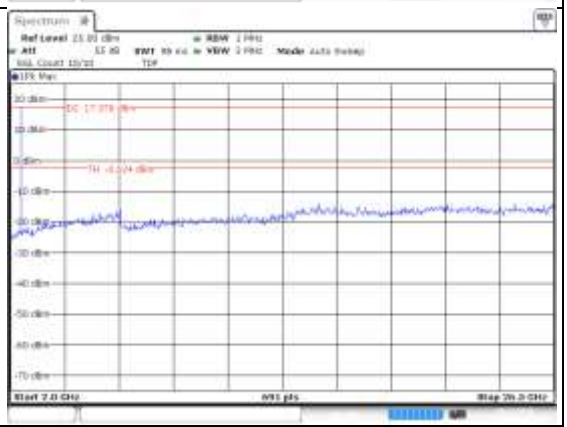
BT 5.0 Conducted Spurious Emissions 30 – 3000 MHz
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch 17		
Ch 39		

BT 5.0 Conducted Spurious Emissions 2 – 26.5 GHz
U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch 17		
Ch 39		

BT 5.0 Conducted Spurious Emissions 2 – 26.5 GHz
RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch 17		
Ch . 39		

3.6 Band edge emissions in the Authorized and Restricted band

3.6.1 Limit

At least 20 dB attenuation in a 100 kHz bandwidth relative to the highest fundamental channel power spectral density in 100 kHz.

3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.6.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.6.4 Test procedure

The testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.
IRN 026 - Radiated electrical disturbance (V per m) Method 7 – Radiated electrical disturbance at the Restricted band edge.

3.6.5 Test results of band edge measurements

U.FL

Technology Std.	Channels	Frequency (MHz)	Data rate	Attenuation (dB)
Bluetooth 5.0	37	2402	1 Mbps	-28.80
	39	2480	1 Mbps	-31.26
Uncertainty	+/- 1.7 dB			

U.FL

Technology Std.	Channels	Frequency (MHz)	Data rate	Attenuation (dB)
Bluetooth 5.0	37	2402	2 Mbps	-13.87
	39	2480	2 Mbps	-30.43
Uncertainty	+/- 1.7 dB			

RF Through Path

Technology Std.	Channels	Frequency (MHz)	Data rate	Attenuation (dB)
Bluetooth 5.0	37	2402	1 Mbps	-30.73
	39	2480	1 Mbps	-30.83
Uncertainty	+/- 1.7 dB			

RF Through Path

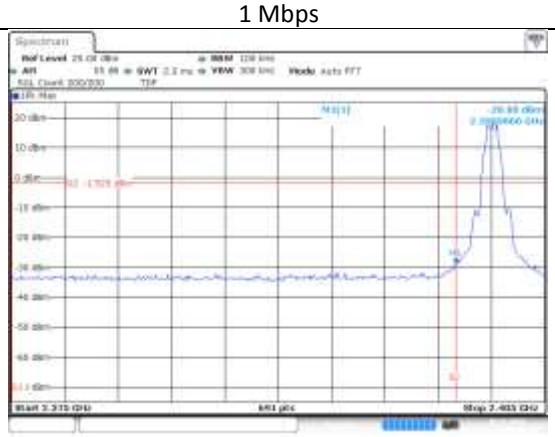
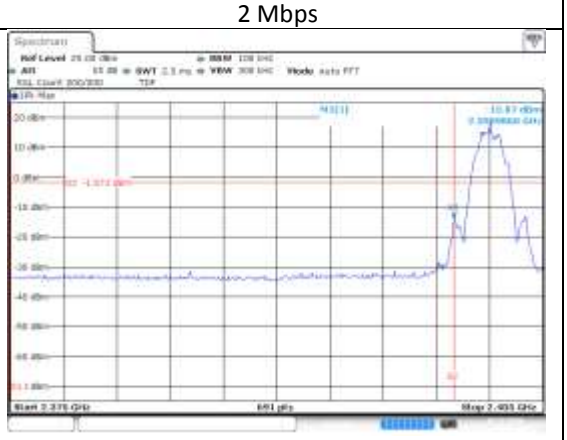
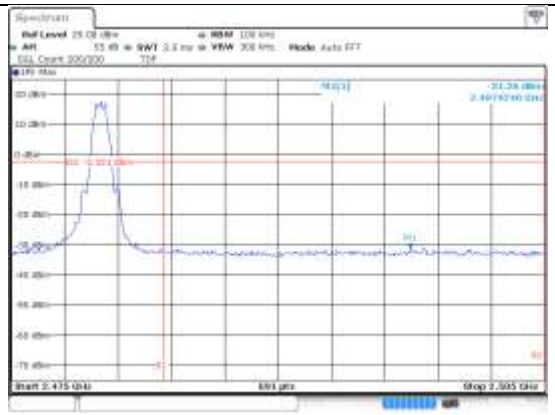
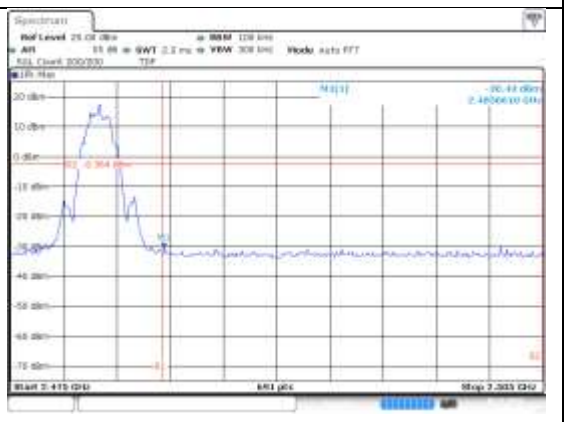
Technology Std.	Channels	Frequency (MHz)	Data rate	Attenuation (dB)
Bluetooth 5.0	37	2402	2 Mbps	-13.85
	39	2480	2 Mbps	-30.75
Uncertainty	+/- 1.7 dB			

3.6.6 Measurement Uncertainty

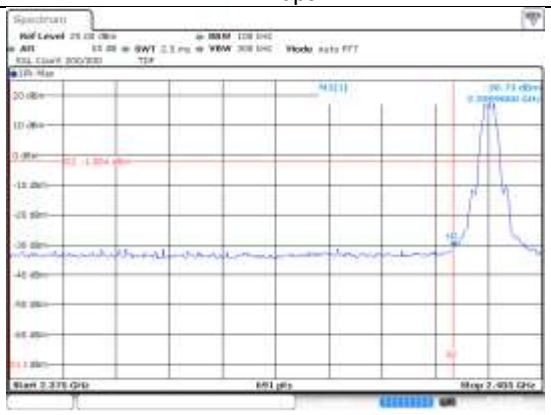
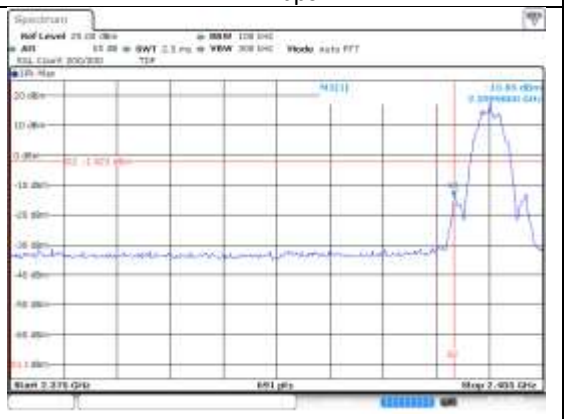
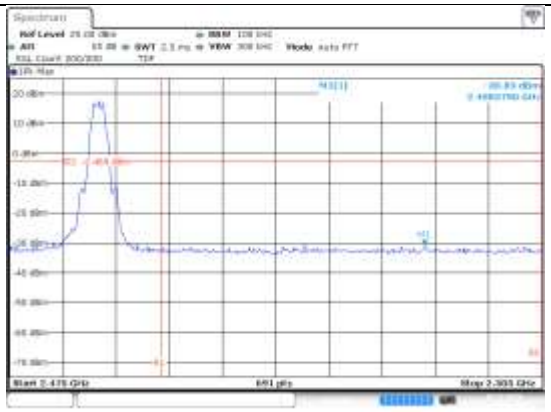
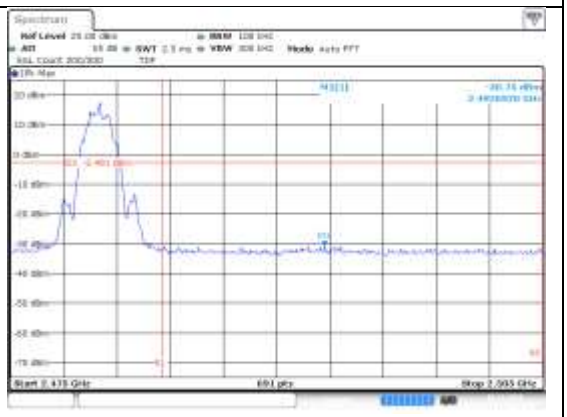
≥ 1 GHz	±1.1 dB

3.6.7 Plots of the band edge measurements

U.FL

	1 Mbps	2 Mbps
Ch 37		
Ch. 39		

RF Through Path

	1 Mbps	2 Mbps
Ch 37		
Ch. 39		

3.7 Radiated Spurious Emissions Measurement

3.7.1 Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 - 30	30	30
30 -88	100	3
88 - 216	150	3
216-960	200	3
Above 960	500	3

3.7.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.7.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.7.4 Test procedure

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz.
Radiated emission limits in these three bands are based on measurements employing an average detector.

Other details are according to ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05

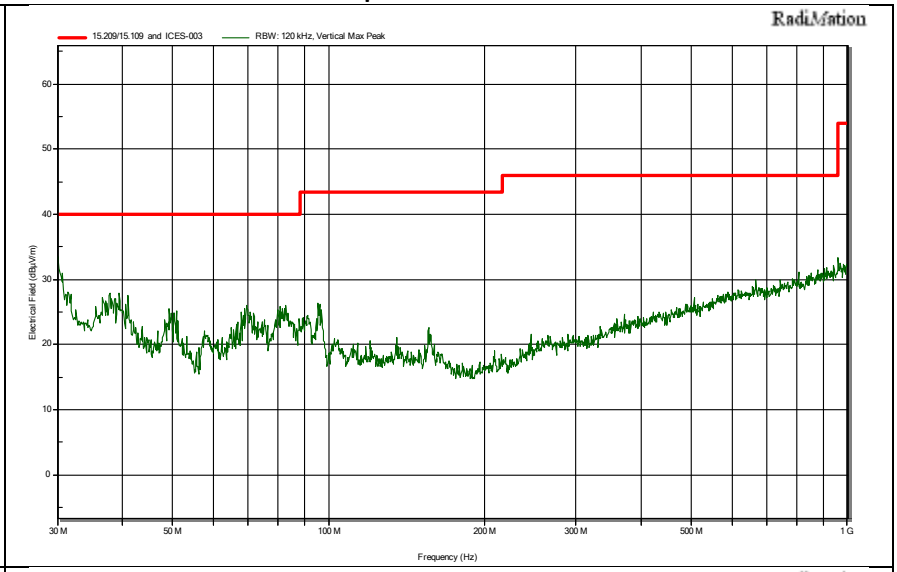
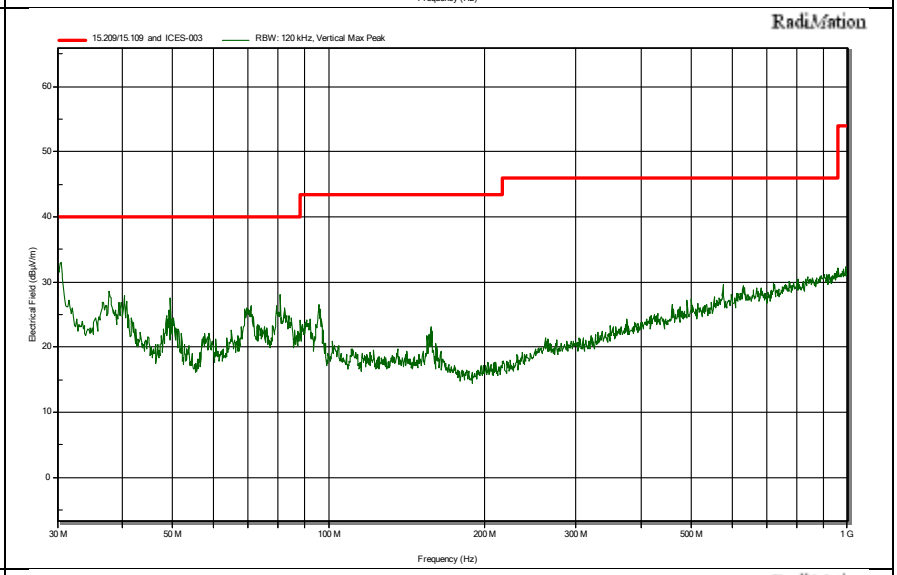
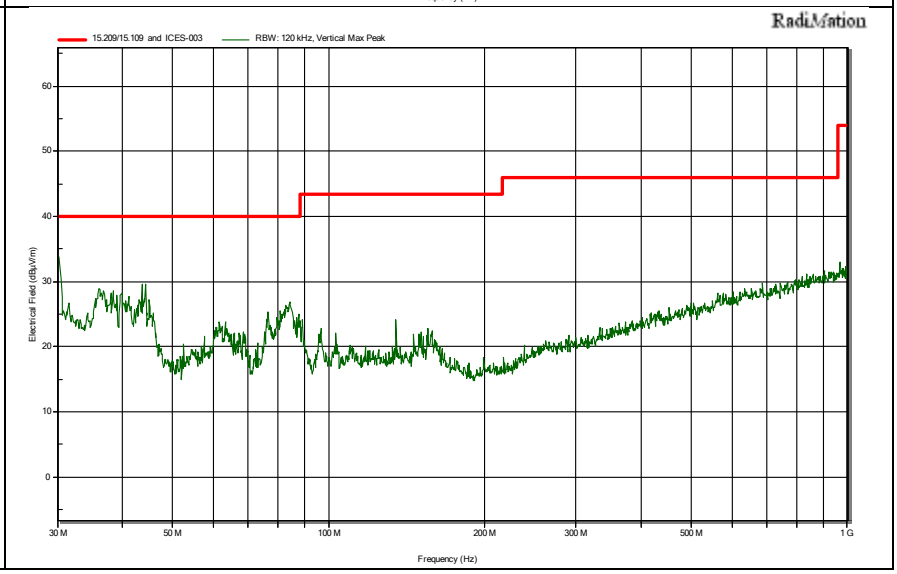
3.7.5 Notes

- In the frequency range of 1 – 18 GHz the green trace is measured using a peak detector and the red trace is measured using an average detector. The top limit line represent the peak limit and the bottom limit represents the average limit.
- The test result below have been made with the following settings: 1 Mbps and antenna nr.3 (see chapter “observations and remarks”)
- For the frequency range 1 -18 GHz a high pass filter was used see chapter 2.4.
- All spurious emissions in the 9 kHz to 30 MHz range are 20 dB below the limit and are there for not reported.

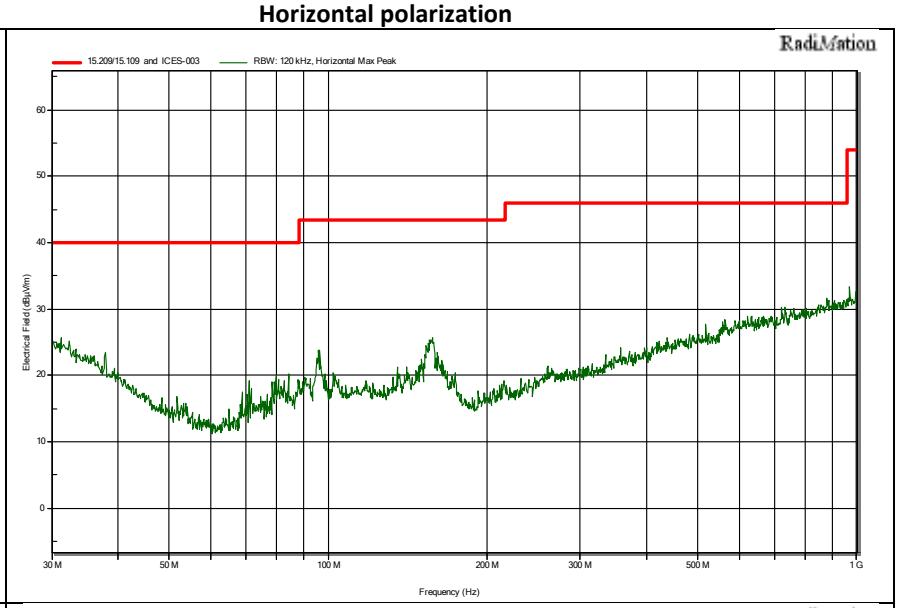
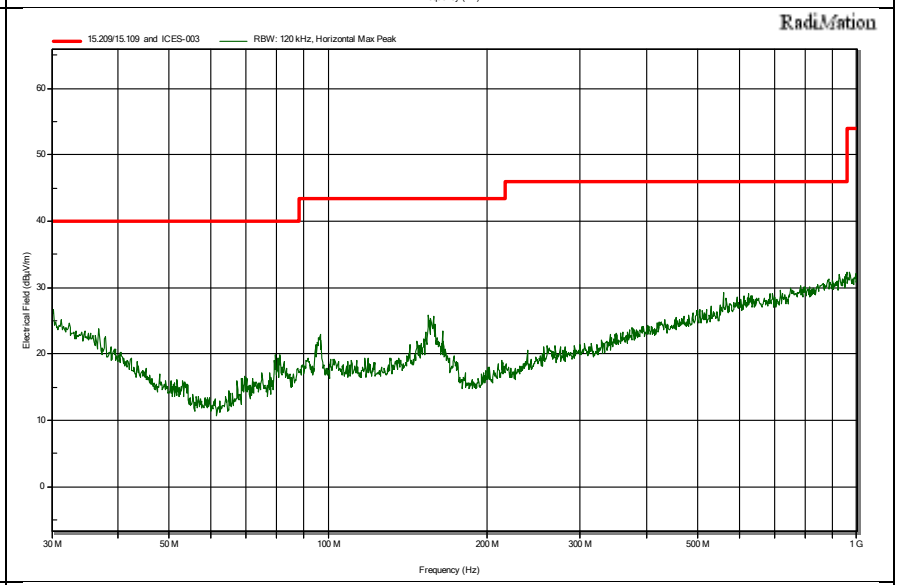
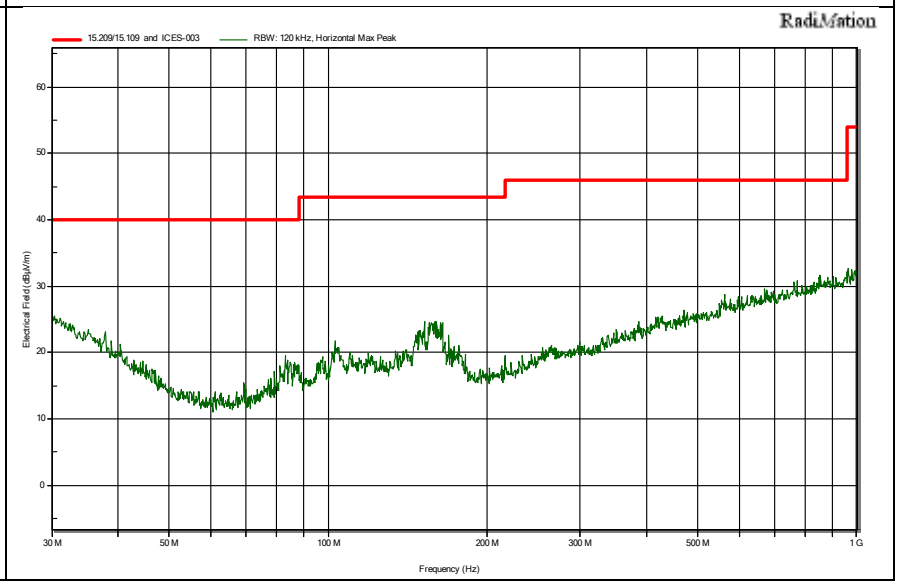
3.7.6 Plots of the Radiated Spurious Emissions Measurement

30 – 1000 MHz (U.FL)

Vertical polarization

Low ch	
Mid ch	
High ch	

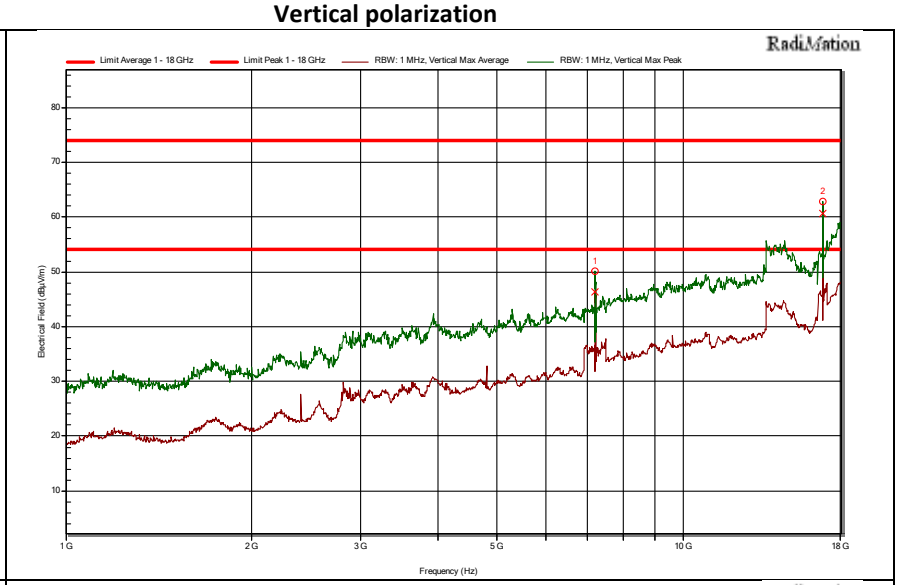
Horizontal polarization

Low ch	
Mid ch	
High ch	

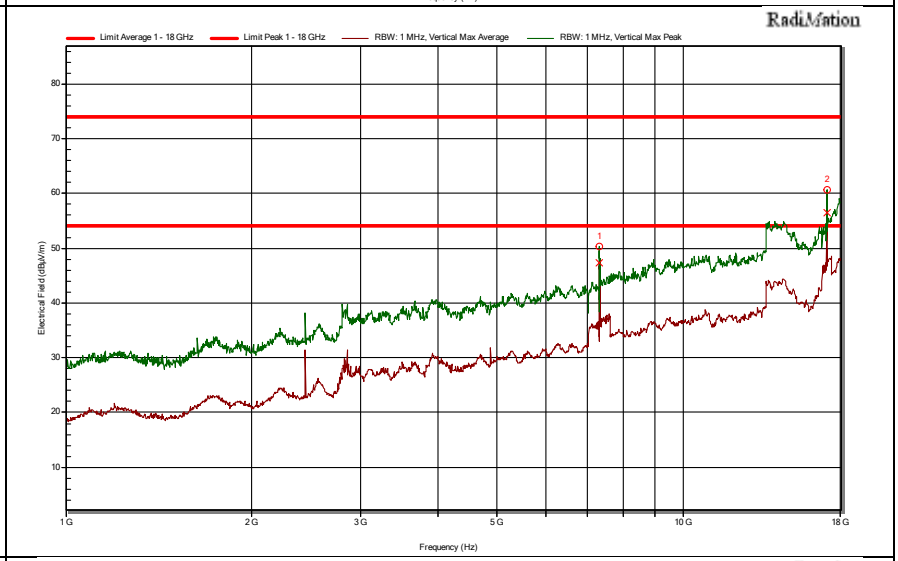
2483.5 MHz – 18 GHz (U.FL)

Vertical polarization

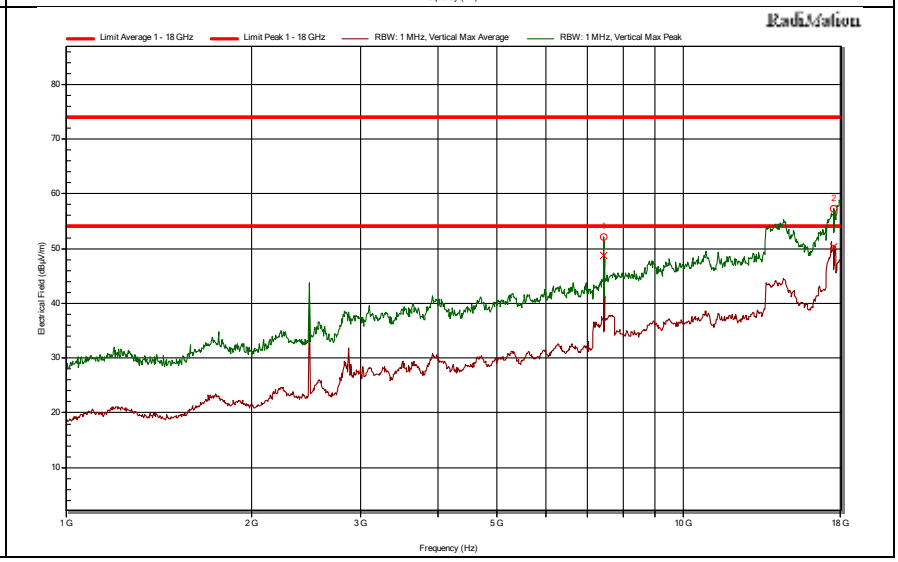
Low ch



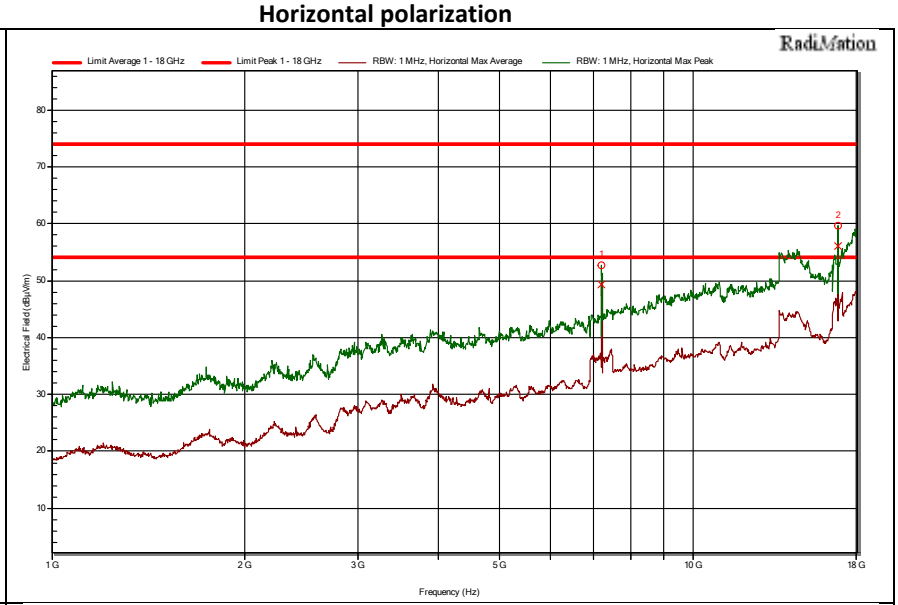
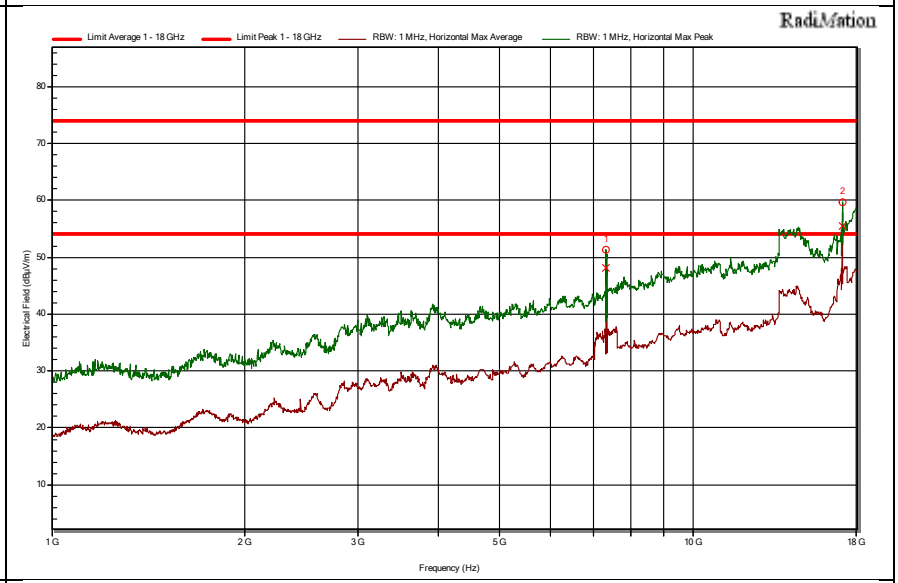
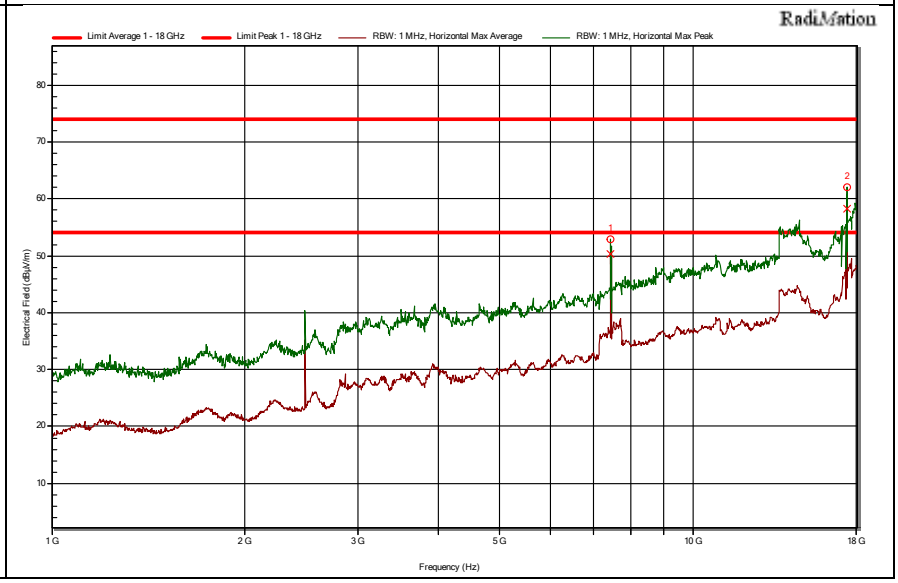
Mid ch



High ch



Horizontal polarization

Low ch	
Mid ch	
High ch	

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,205 GHz	Horizontal	1 m	52,7 dBµV/m	49,4 dBµV/m	74 dBµV/m	54 dBµV/m	-21,3 dB	-4,6 dB
16,816 GHz	Horizontal	2 m	59,6 dBµV/m	56,2 dBµV/m	--	--	--	--

Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,205 GHz	Vertical	1 m	50,2 dBµV/m	46,4 dBµV/m	74 dBµV/m	54 dBµV/m	-23,8 dB	-7,6 dB
16,812 GHz	Vertical	1 m	62,8 dBµV/m	60,6 dBµV/m	--	--	--	--

Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,321 GHz	Horizontal	1 m	51,3 dBµV/m	48,1 dBµV/m	74 dBµV/m	54 dBµV/m	-22,7 dB	-5,9 dB
17,078 GHz	Horizontal	3 m	59,6 dBµV/m	55,4 dBµV/m	--	--	--	--

Measured peaks Vertical 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,321 GHz	Vertical	2,5 m	50,4 dBµV/m	47,3 dBµV/m	74 dBµV/m	54 dBµV/m	-23,6 dB	-6,7 dB
17,078 GHz	Vertical	1 m	60,6 dBµV/m	56,5 dBµV/m	--	--	--	--

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,439 GHz	Horizontal	1 m	52,9 dBµV/m	50,2 dBµV/m	74 dBµV/m	54 dBµV/m	-21,1 dB	-3,8 dB
17,358 GHz	Horizontal	2,5 m	62 dBµV/m	58,2 dBµV/m	--	--	--	--

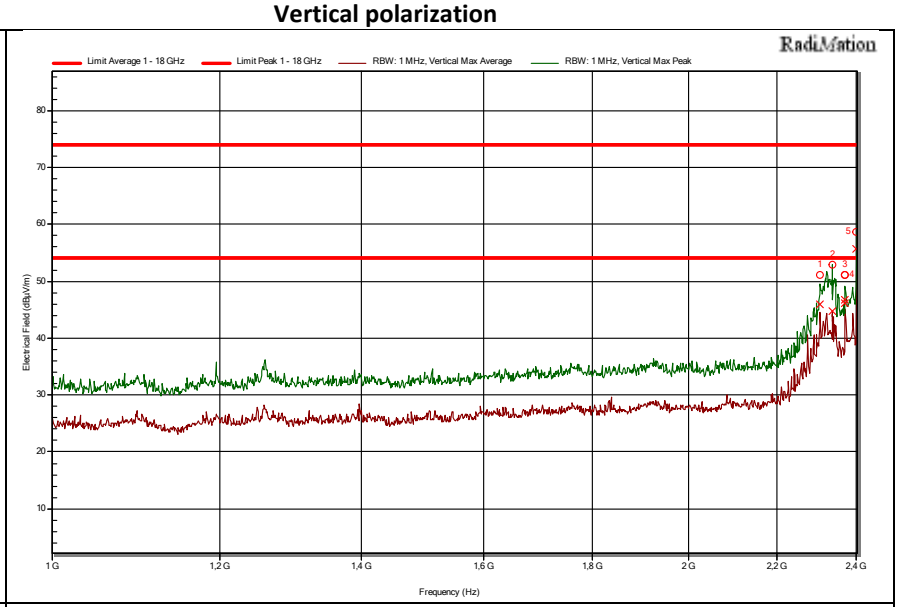
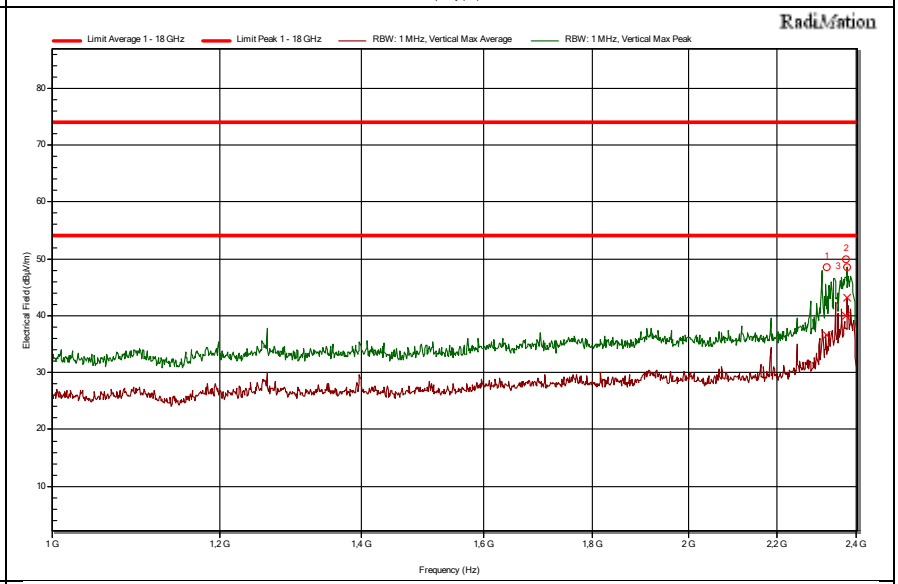
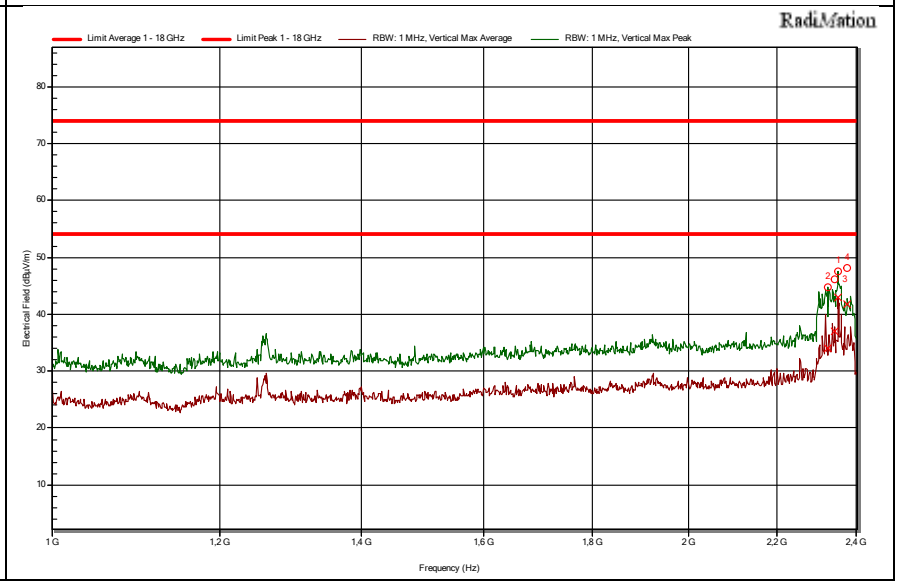
Measured peaks Vertical 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,439 GHz	Vertical	1 m	52,1 dBµV/m	48,7 dBµV/m	74 dBµV/m	54 dBµV/m	-21,9 dB	-5,3 dB
17,554 GHz	Vertical	1 m	57,3 dBµV/m	50,4 dBµV/m	--	--	--	--

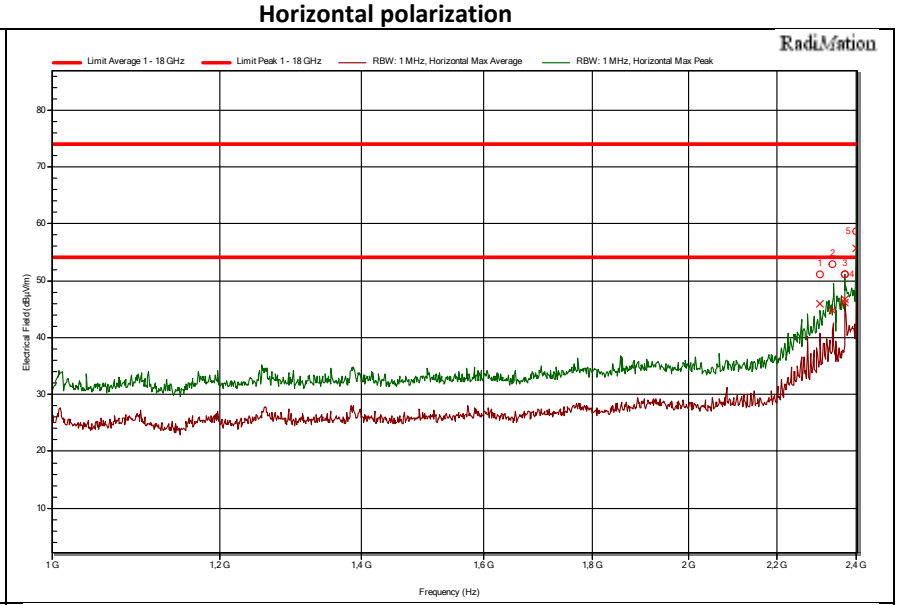
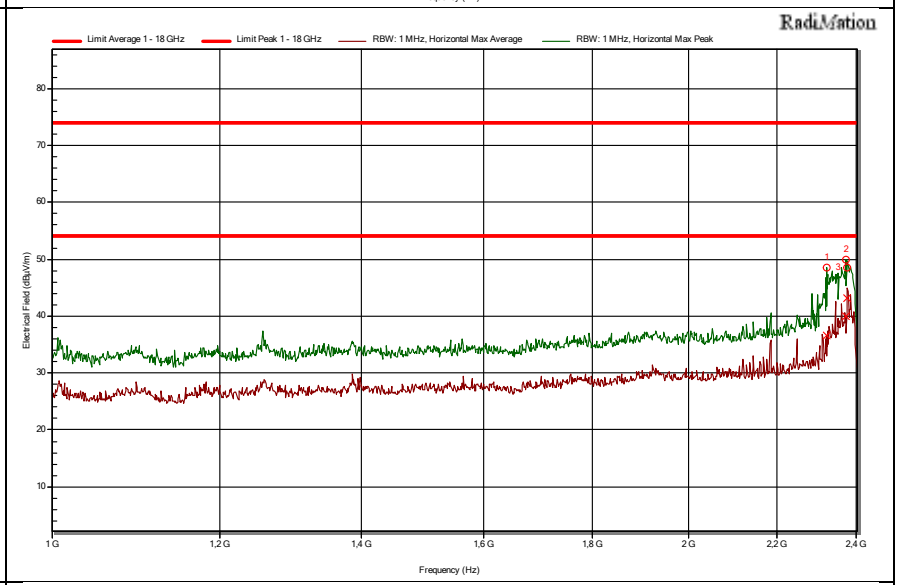
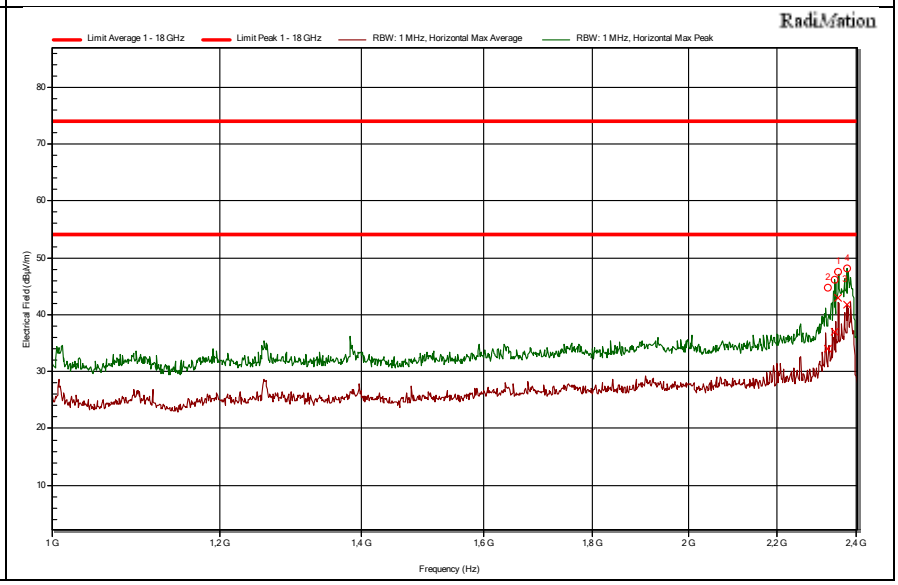
Note: the peaks measured at 16.812 to 17.554 GHz are not subject to the FCC part 15.209 limits at these frequencies are not located in the restricted bands as specified in FCC part 15.205.

1 – 2.4 GHz (U.FL)

Vertical polarization

Low ch	
Mid ch	
High ch	

Horizontal polarization

Low ch	
Mid ch	
High ch	

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,37 GHz	Horizontal	1,5 m	51 dBµV/m	46,1 dBµV/m	74 dBµV/m	54 dBµV/m	-23,0 dB	-7,9 dB
2,37 GHz	Horizontal	1,5 m	51,2 dBµV/m	46,7 dBµV/m	74 dBµV/m	54 dBµV/m	-22,8 dB	-7,3 dB
2,4 GHz	Horizontal	1 m	58,6 dBµV/m	55,7 dBµV/m				

Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,306 GHz	Vertical	1 m	51,1 dBµV/m	45,9 dBµV/m	74 dBµV/m	54 dBµV/m	-22,9 dB	-8,1 dB
2,338 GHz	Vertical	1 m	52,8 dBµV/m	44,8 dBµV/m	74 dBµV/m	54 dBµV/m	-21,2 dB	-9,2 dB

Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,322 GHz	Horizontal	2 m	48,5 dBµV/m	36,5 dBµV/m	74 dBµV/m	54 dBµV/m	-25,5 dB	-17,5 dB
2,373 GHz	Horizontal	1 m	49,8 dBµV/m	40 dBµV/m	74 dBµV/m	54 dBµV/m	-24,2 dB	-14,0 dB

Measured peaks Vertical 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,376 GHz	Vertical	2 m	48,5 dBµV/m	43,1 dBµV/m	74 dBµV/m	54 dBµV/m	-25,5 dB	-10,9 dB

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,343 GHz	Horizontal	1,5 m	46,1 dBµV/m	36,9 dBµV/m	74 dBµV/m	54 dBµV/m	-27,9 dB	-17,1 dB
2,376 GHz	Horizontal	1 m	48,2 dBµV/m	41,7 dBµV/m	74 dBµV/m	54 dBµV/m	-25,8 dB	-12,3 dB

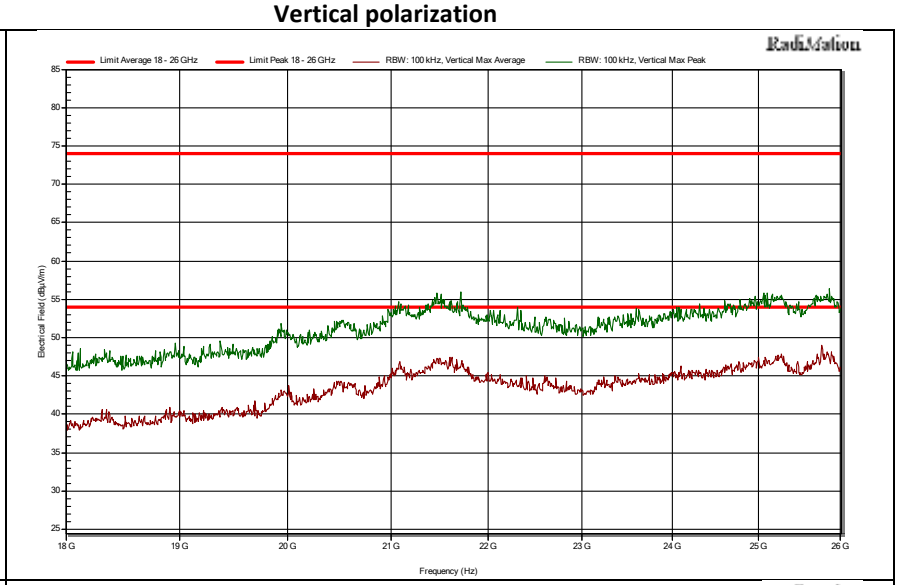
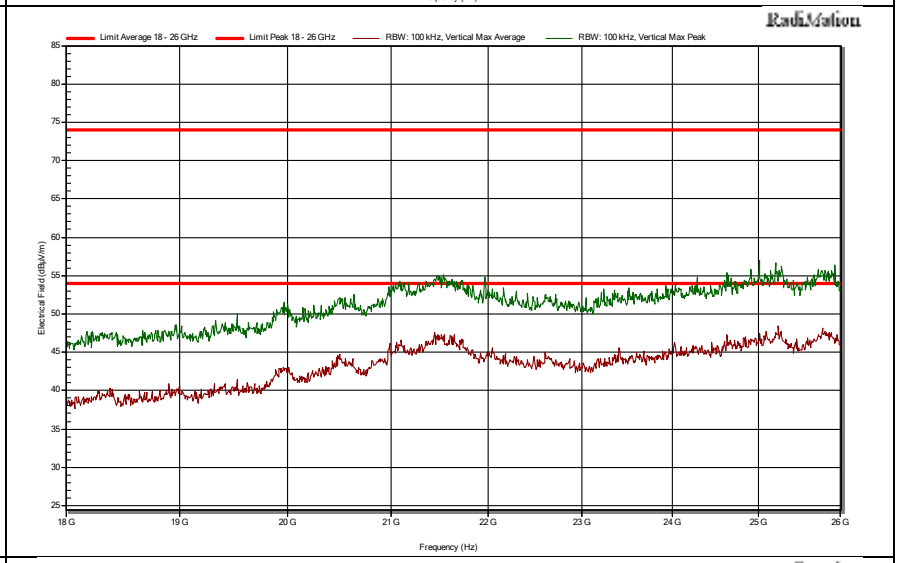
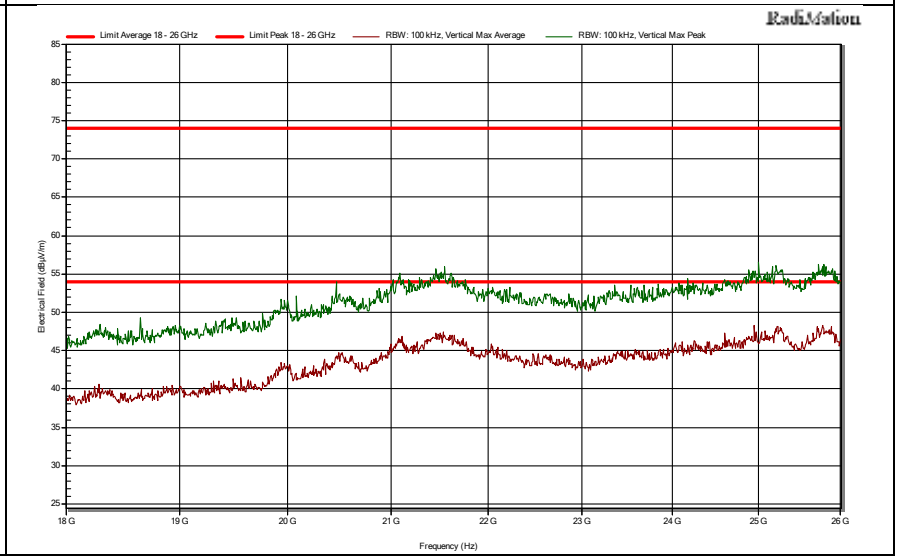
Measured peaks Vertical 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,325 GHz	Vertical	1 m	44,7 dBµV/m	33,9 dBµV/m	74 dBµV/m	54 dBµV/m	-29,3 dB	-20,1 dB
2,352 GHz	Vertical	1,5 m	47,5 dBµV/m	42,9 dBµV/m	74 dBµV/m	54 dBµV/m	-26,5 dB	-11,1 dB

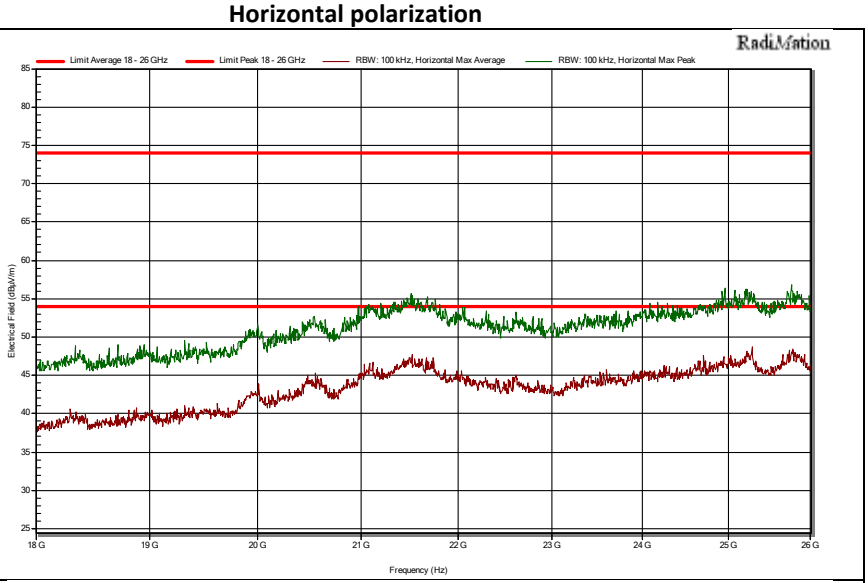
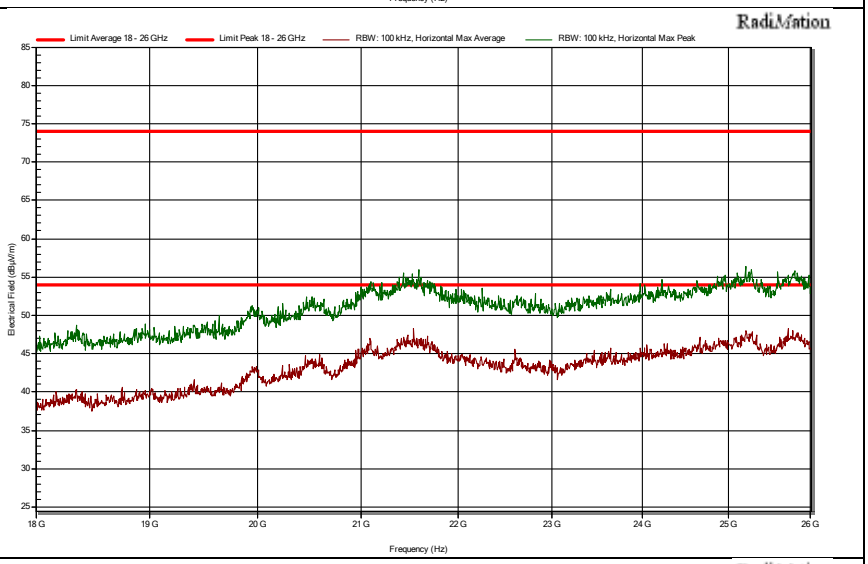
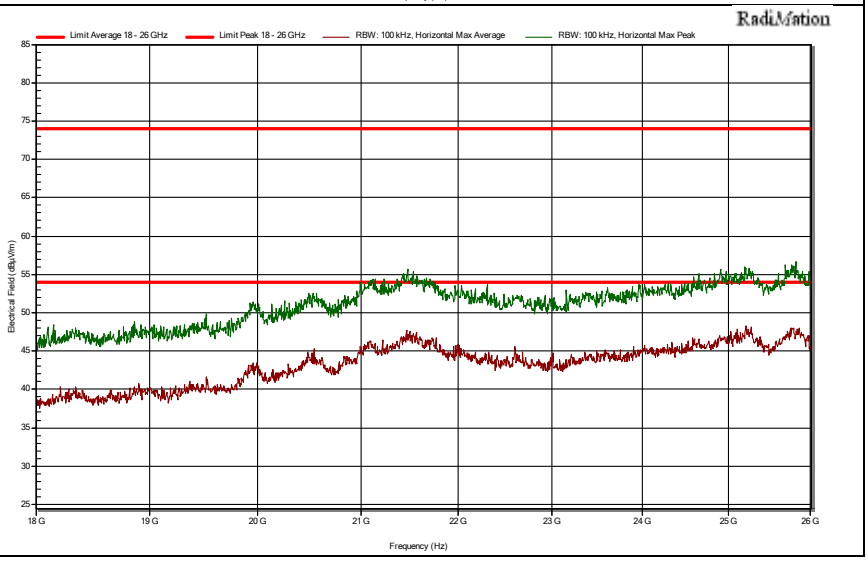
Note: the peak measured at 2.4 GHz is not subject to the FCC part 15.209 limits at this frequency is not located in the restricted bands as specified in FCC part 15.205.

18 GHz to 26.5 GHz (U.FL)

Vertical polarization

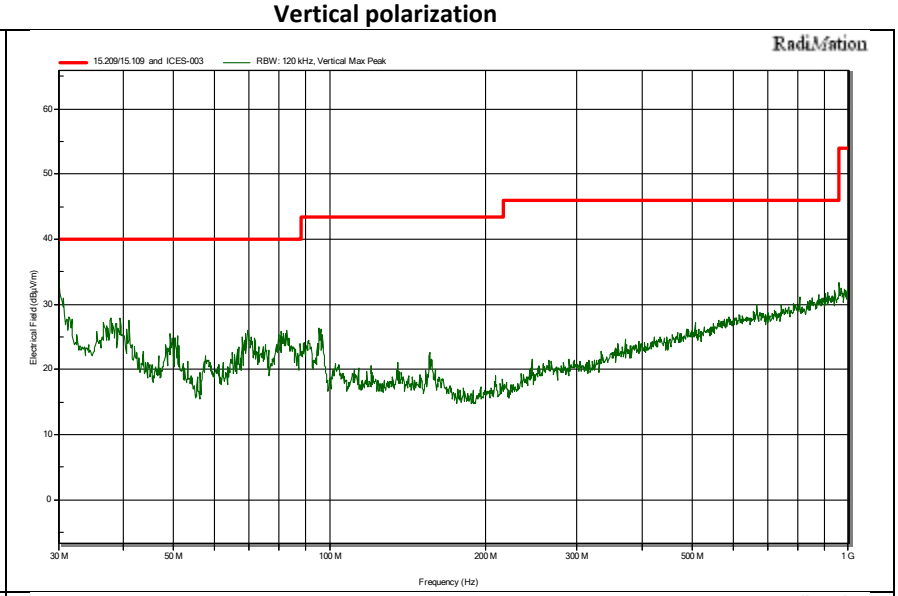
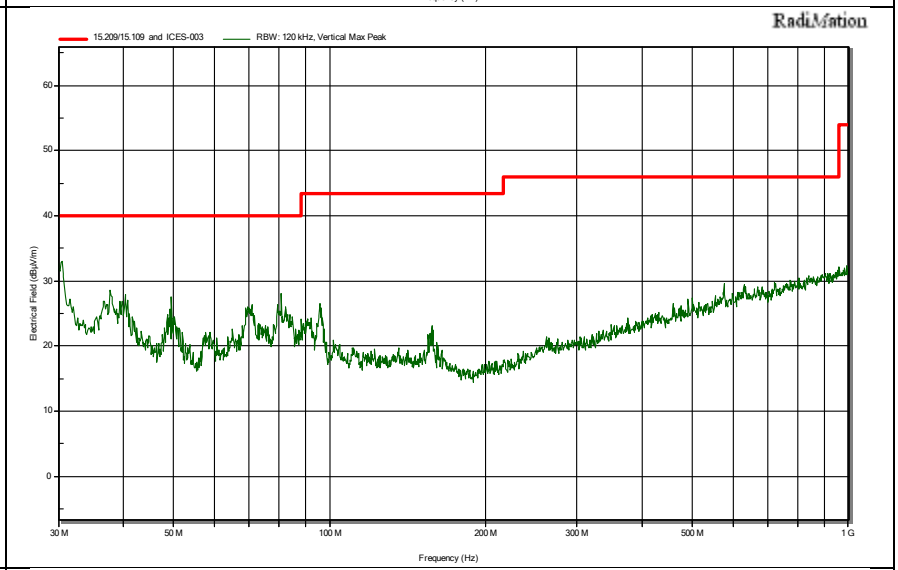
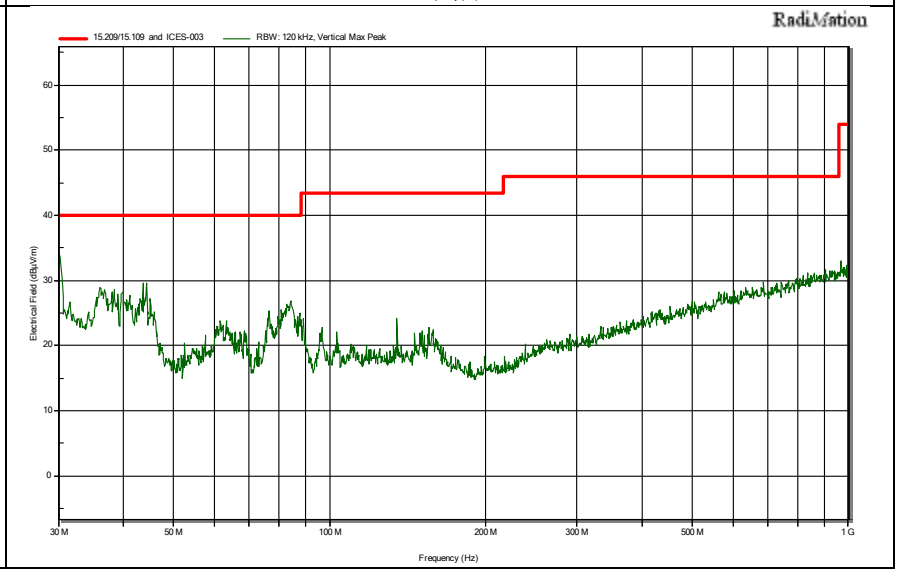
Low ch	
Mid ch	
High ch	

Horizontal polarization

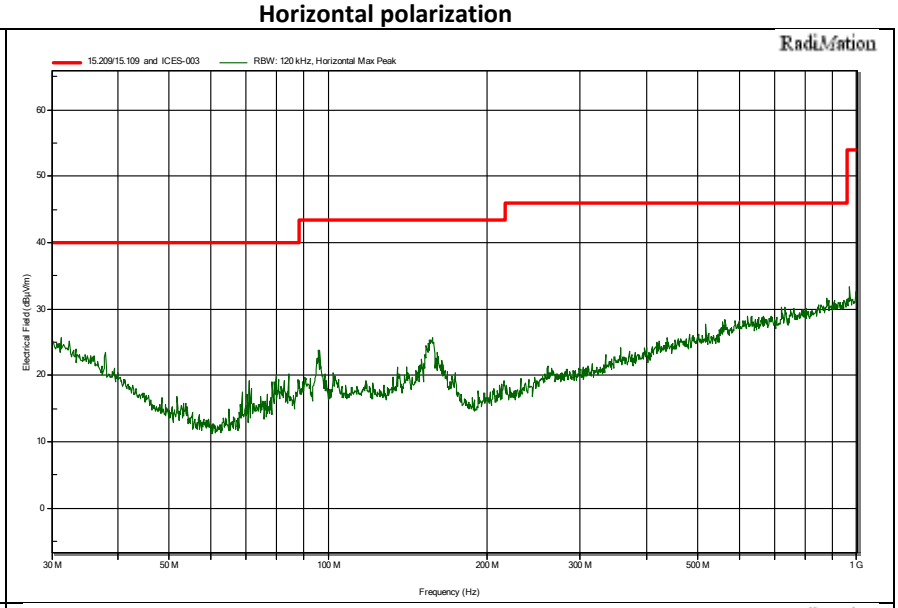
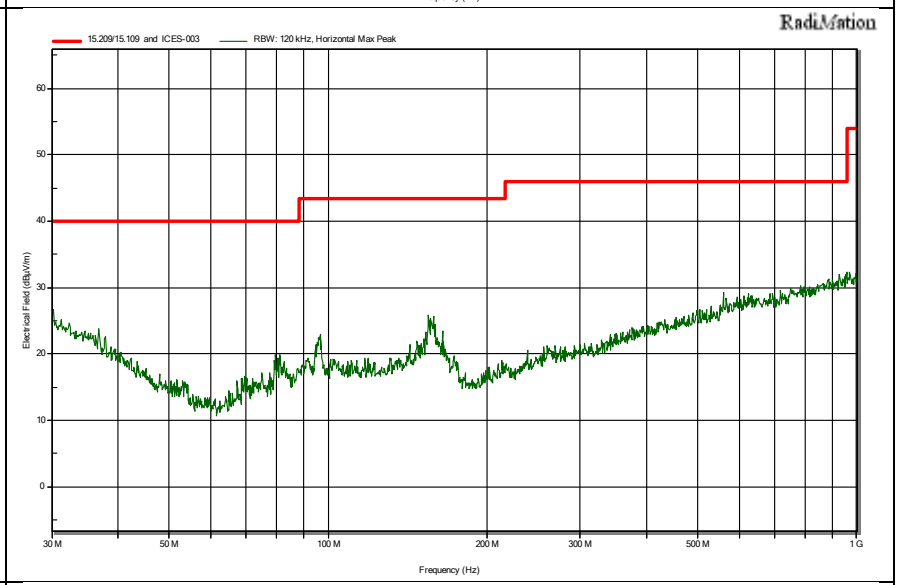
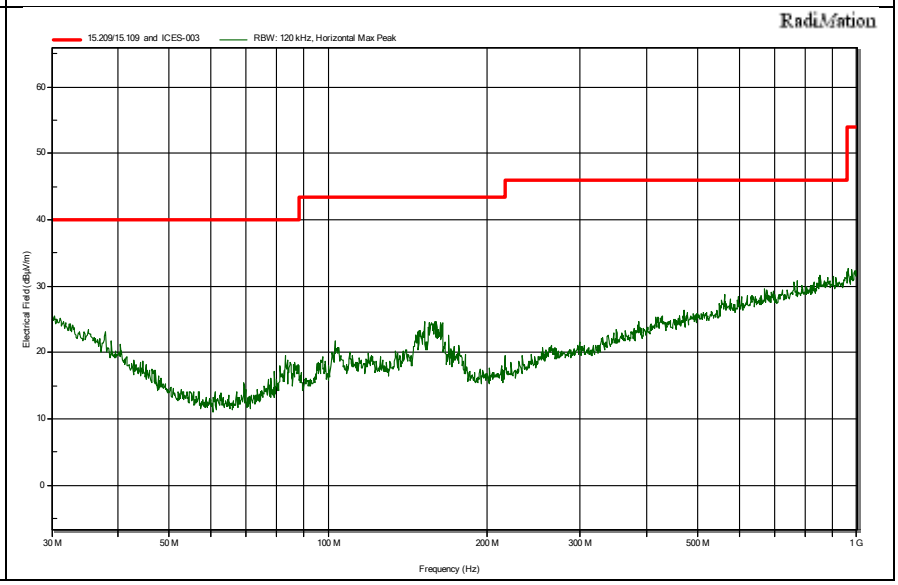
Low ch	
Mid ch	
High ch	

30 – 1000 MHz (RF Through Path)

Vertical polarization

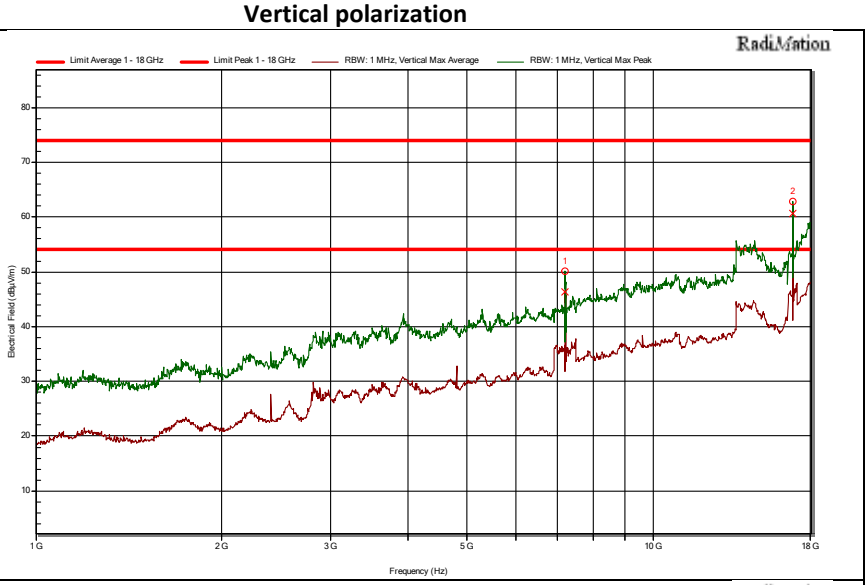
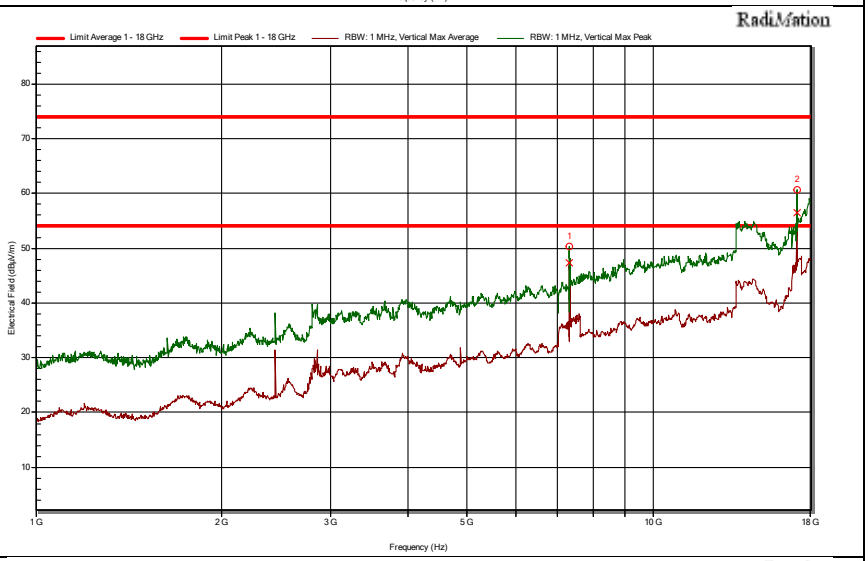
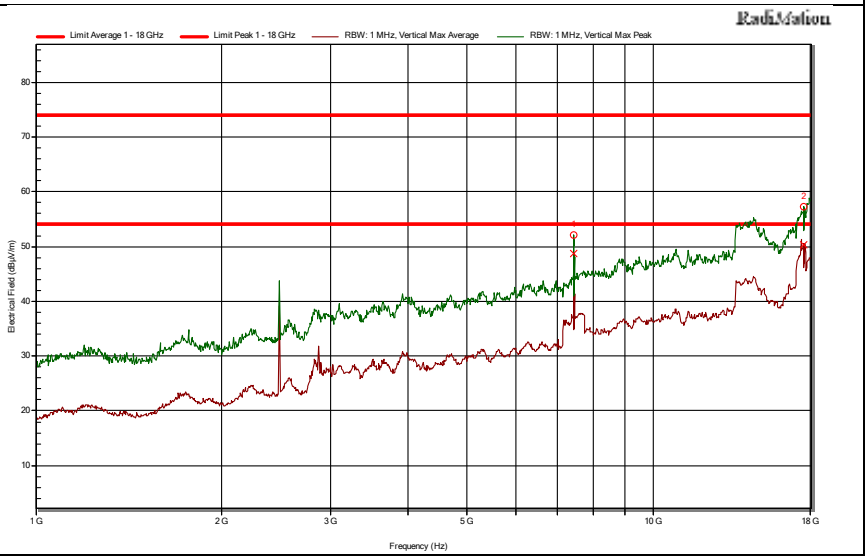
Low ch	
Mid ch	
High ch	

Horizontal polarization

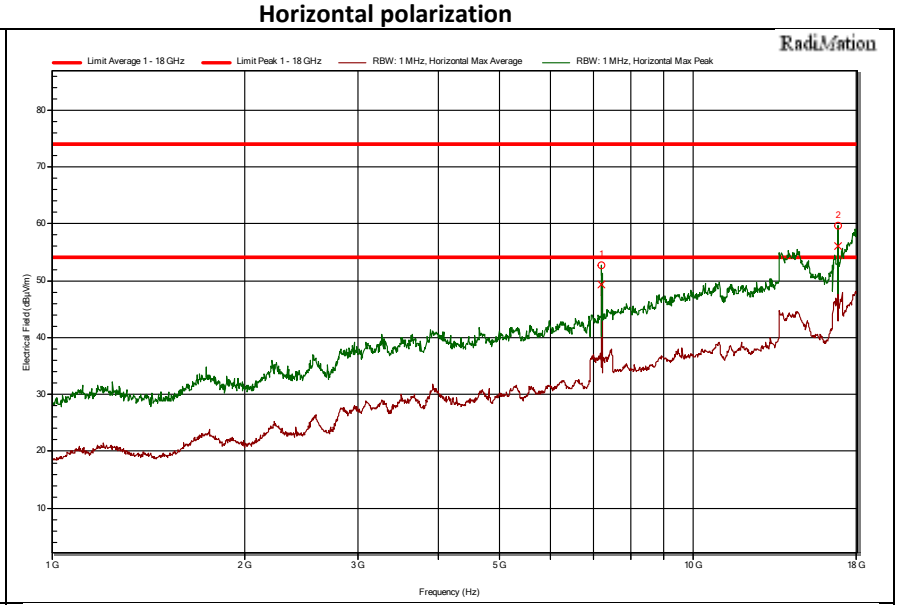
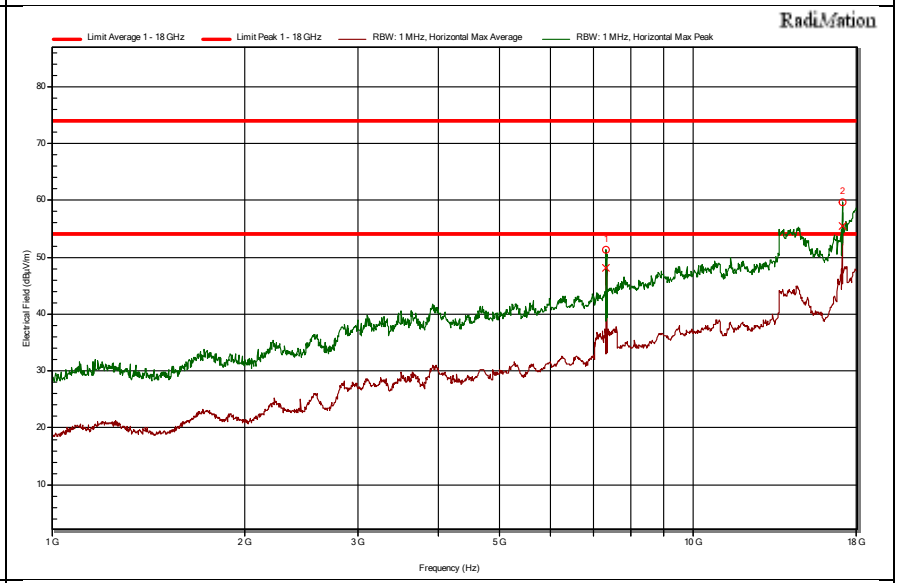
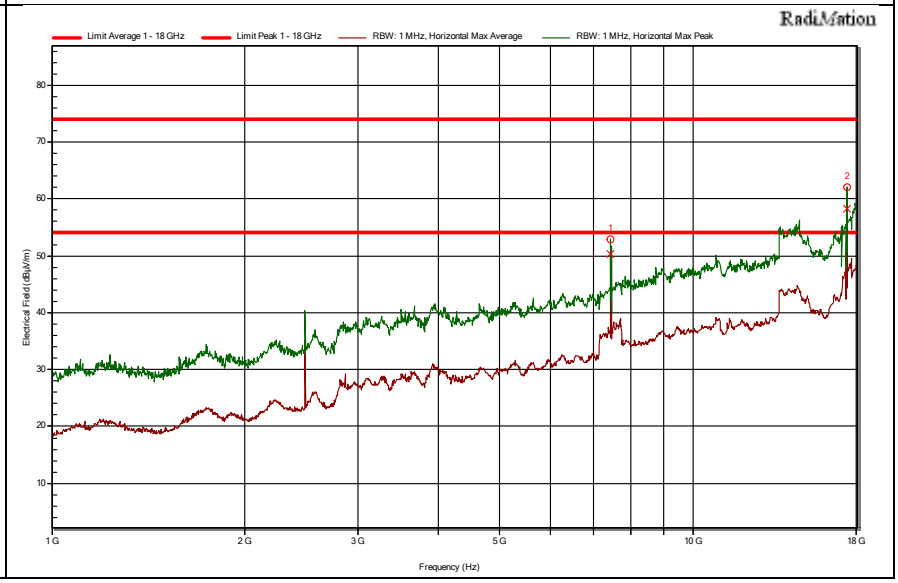
Low ch	
Mid ch	
High ch	

2483.5 MHz – 18 GHz (RF Through Path)

Vertical polarization

Low ch	
Mid ch	
High ch	

Horizontal polarization

Low ch	
Mid ch	
High ch	

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,205 GHz	Horizontal	1 m	52,7 dBµV/m	49,4 dBµV/m	74 dBµV/m	54 dBµV/m	-21,3 dB	-4,6 dB
16,816 GHz	Horizontal	2 m	59,6 dBµV/m	56,2 dBµV/m				

Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,205 GHz	Vertical	1 m	50,2 dBµV/m	46,4 dBµV/m	74 dBµV/m	54 dBµV/m	-23,8 dB	-7,6 dB
16,812 GHz	Vertical	1 m	62,8 dBµV/m	60,6 dBµV/m				

Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,321 GHz	Horizontal	1 m	51,3 dBµV/m	48,1 dBµV/m	74 dBµV/m	54 dBµV/m	-22,7 dB	-5,9 dB
17,078 GHz	Horizontal	3 m	59,6 dBµV/m	55,4 dBµV/m				

Measured peaks Vertical 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,321 GHz	Vertical	2,5 m	50,4 dBµV/m	47,3 dBµV/m	74 dBµV/m	54 dBµV/m	-23,6 dB	-6,7 dB
17,078 GHz	Vertical	1 m	60,6 dBµV/m	56,5 dBµV/m				

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,439 GHz	Horizontal	1 m	52,9 dBµV/m	50,2 dBµV/m	74 dBµV/m	54 dBµV/m	-21,1 dB	-3,8 dB
17,358 GHz	Horizontal	2,5 m	62 dBµV/m	58,2 dBµV/m				

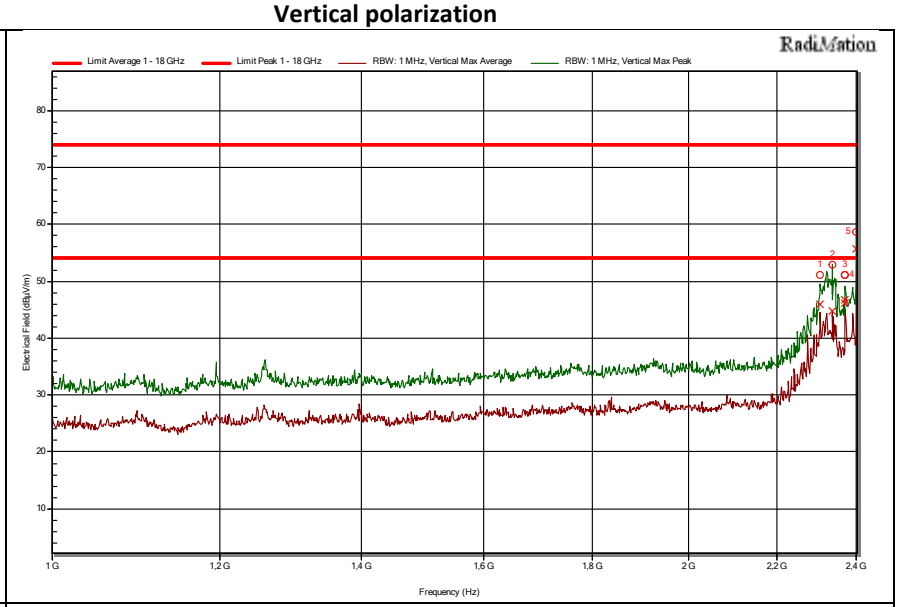
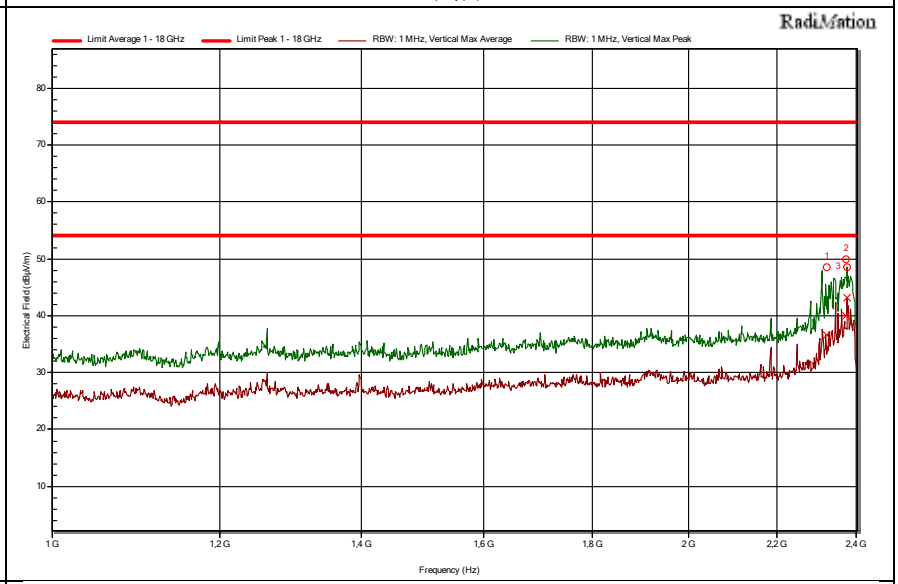
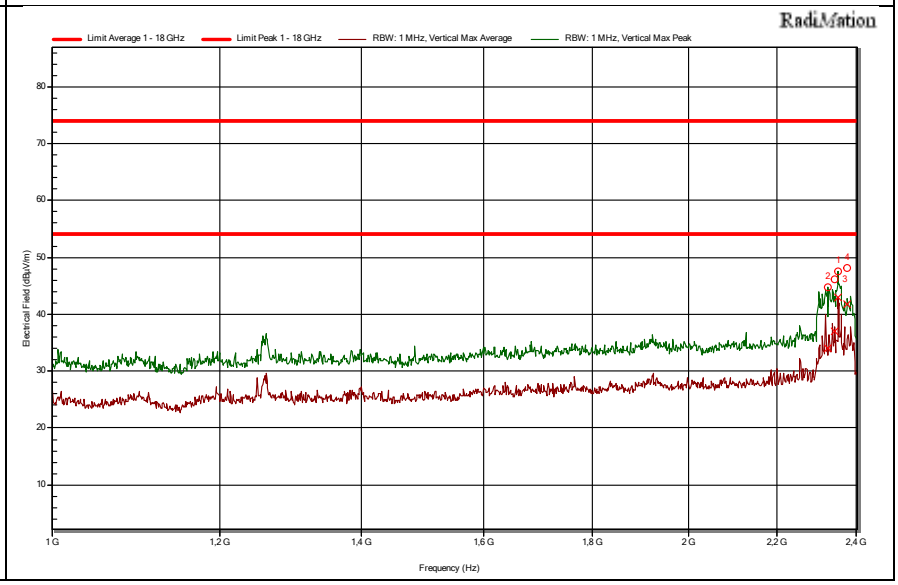
Measured peaks Vertical 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Margin	Average Margin
7,439 GHz	Vertical	1 m	52,1 dBµV/m	48,7 dBµV/m	74 dBµV/m	54 dBµV/m	-21,9 dB	-5,3 dB
17,554 GHz	Vertical	1 m	57,3 dBµV/m	50,4 dBµV/m				

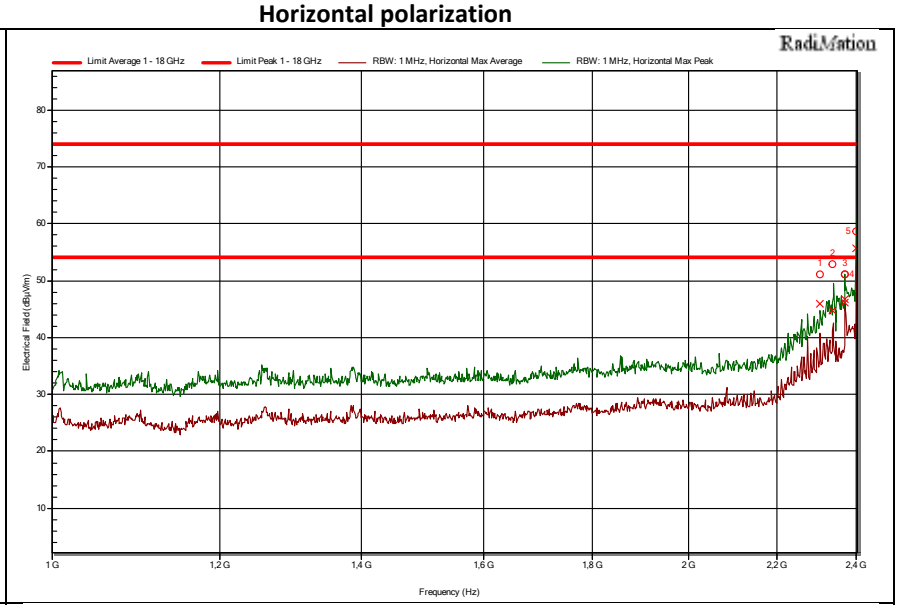
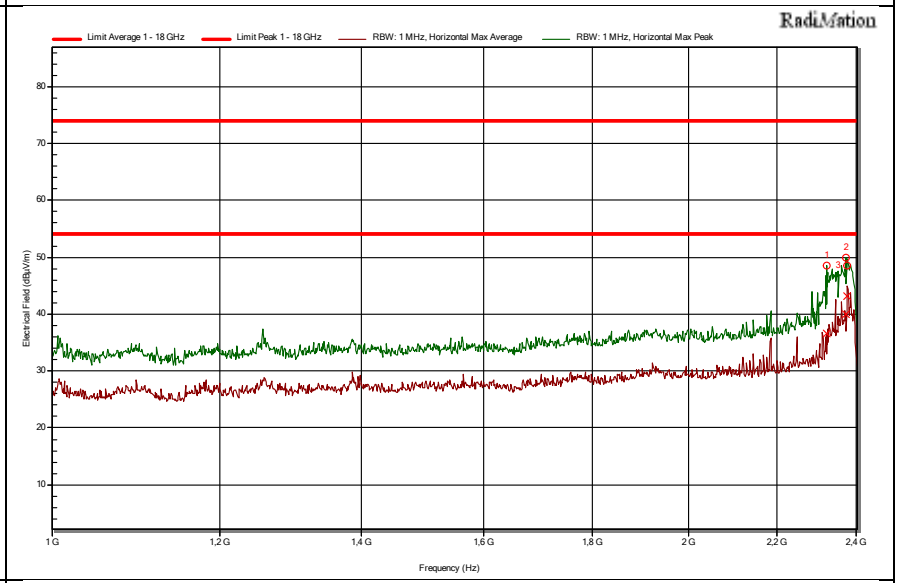
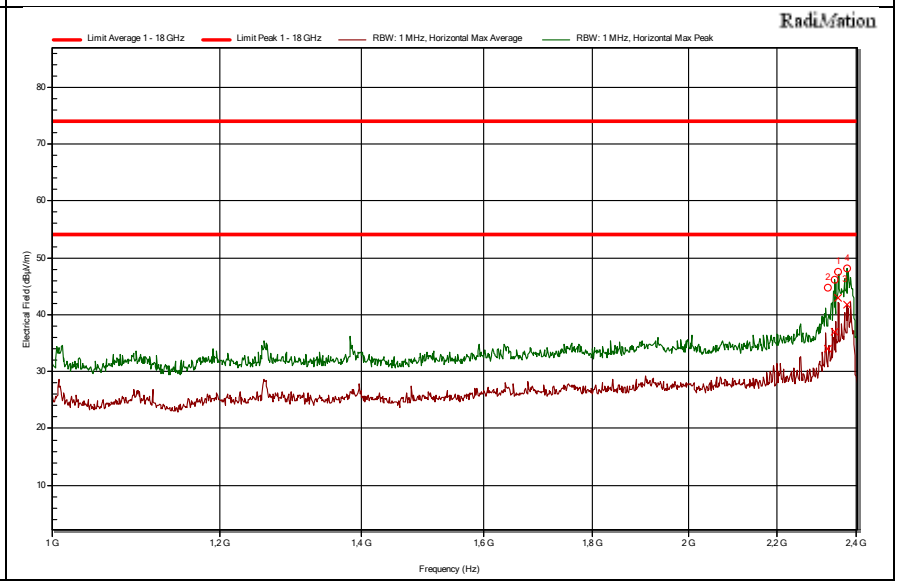
Note: the peaks measured at 16.812 to 17.554 GHz are not subject to the FCC part 15.209 limits at these frequencies are not located in the restricted bands as specified in FCC part 15.205.

1 – 2.4 GHz (RF Through Path)

Vertical polarization

Low ch	
Mid ch	
High ch	

Horizontal polarization

Low ch	
Mid ch	
High ch	

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,37 GHz	Horizontal	1,5 m	51 dBµV/m	46,1 dBµV/m	74 dBµV/m	54 dBµV/m	-23,0 dB	-7,9 dB
2,37 GHz	Horizontal	1,5 m	51,2 dBµV/m	46,7 dBµV/m	74 dBµV/m	54 dBµV/m	-22,8 dB	-7,3 dB
2,4 GHz	Horizontal	1 m	58,6 dBµV/m	55,7 dBµV/m				

Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,306 GHz	Vertical	1 m	51,1 dBµV/m	45,9 dBµV/m	74 dBµV/m	54 dBµV/m	-22,9 dB	-8,1 dB
2,338 GHz	Vertical	1 m	52,8 dBµV/m	44,8 dBµV/m	74 dBµV/m	54 dBµV/m	-21,2 dB	-9,2 dB

Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,322 GHz	Horizontal	2 m	48,5 dBµV/m	36,5 dBµV/m	74 dBµV/m	54 dBµV/m	-25,5 dB	-17,5 dB
2,373 GHz	Horizontal	1 m	49,8 dBµV/m	40 dBµV/m	74 dBµV/m	54 dBµV/m	-24,2 dB	-14,0 dB

Measured peaks Vertical 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,376 GHz	Vertical	2 m	48,5 dBµV/m	43,1 dBµV/m	74 dBµV/m	54 dBµV/m	-25,5 dB	-10,9 dB

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,343 GHz	Horizontal	1,5 m	46,1 dBµV/m	36,9 dBµV/m	74 dBµV/m	54 dBµV/m	-27,9 dB	-17,1 dB
2,376 GHz	Horizontal	1 m	48,2 dBµV/m	41,7 dBµV/m	74 dBµV/m	54 dBµV/m	-25,8 dB	-12,3 dB

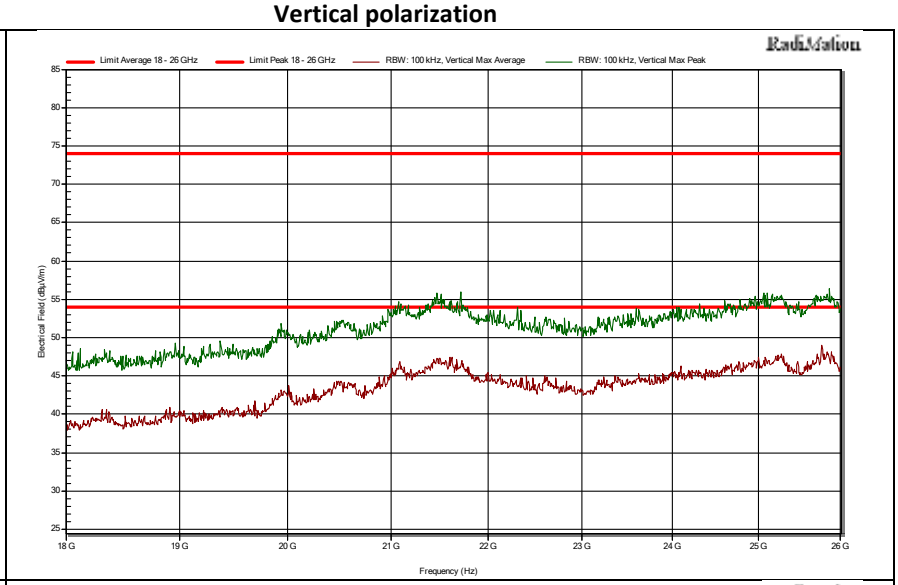
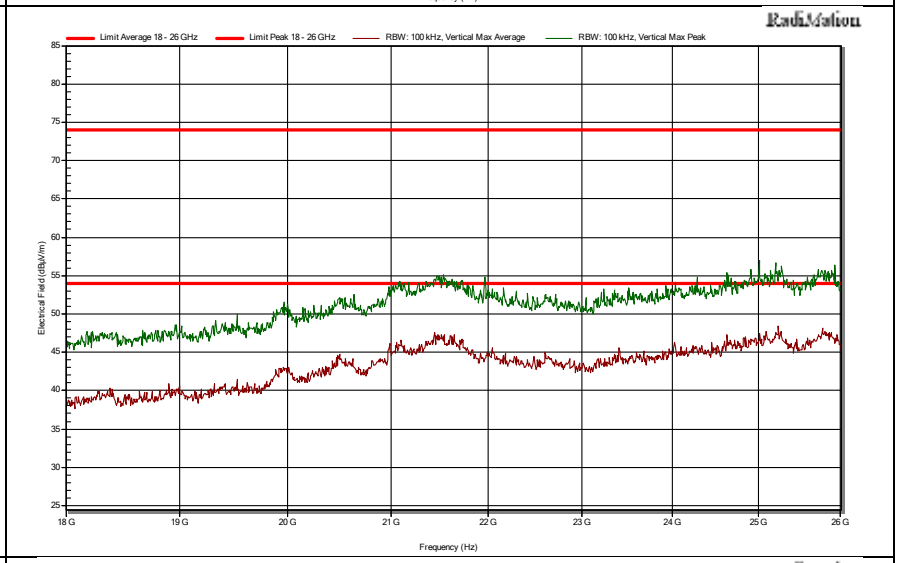
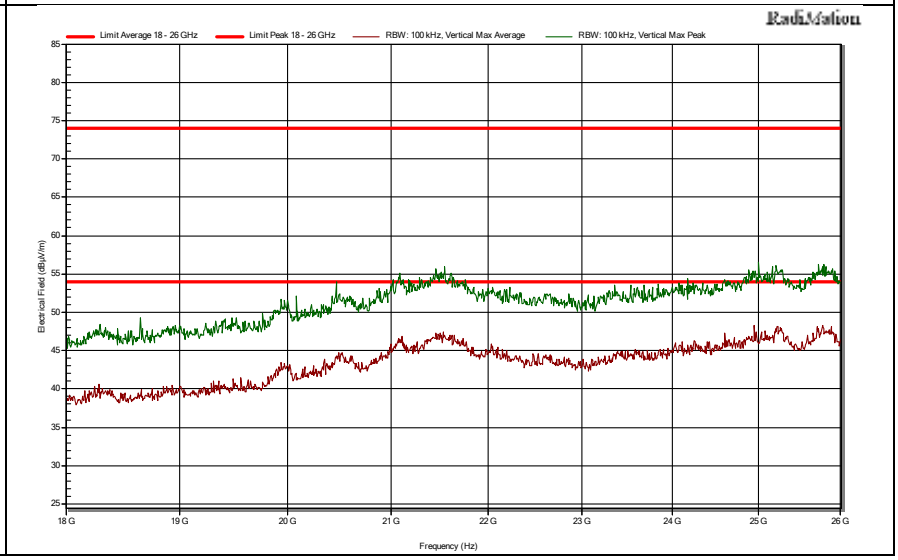
Measured peaks Vertical 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
2,325 GHz	Vertical	1 m	44,7 dBµV/m	33,9 dBµV/m	74 dBµV/m	54 dBµV/m	-29,3 dB	-20,1 dB
2,352 GHz	Vertical	1,5 m	47,5 dBµV/m	42,9 dBµV/m	74 dBµV/m	54 dBµV/m	-26,5 dB	-11,1 dB

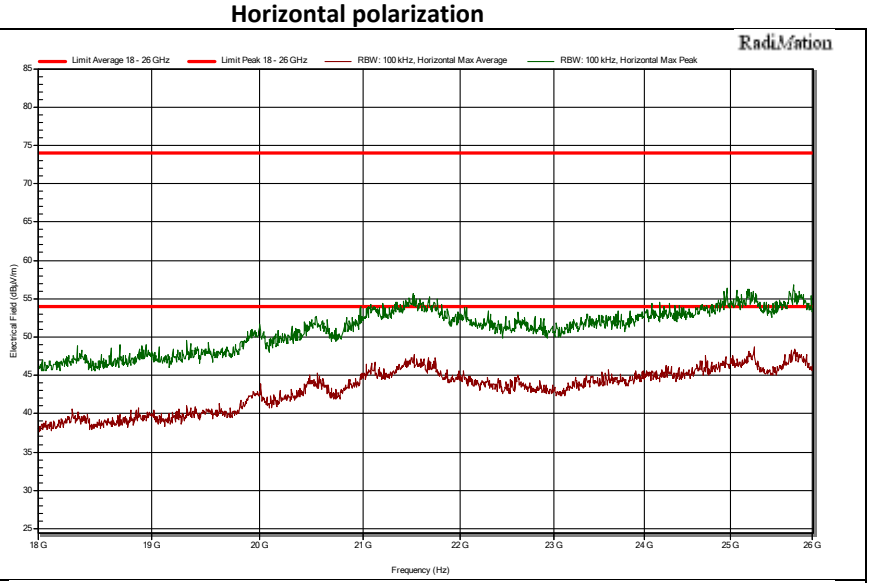
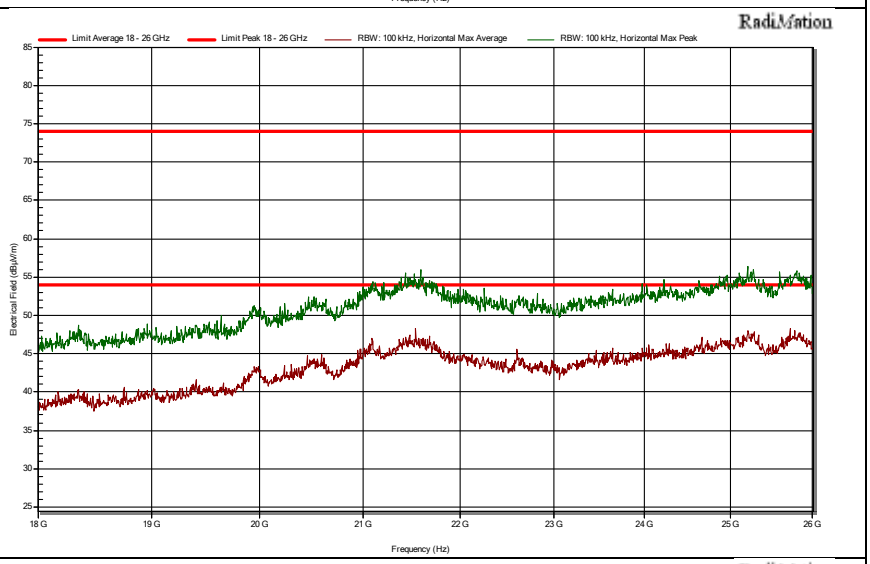
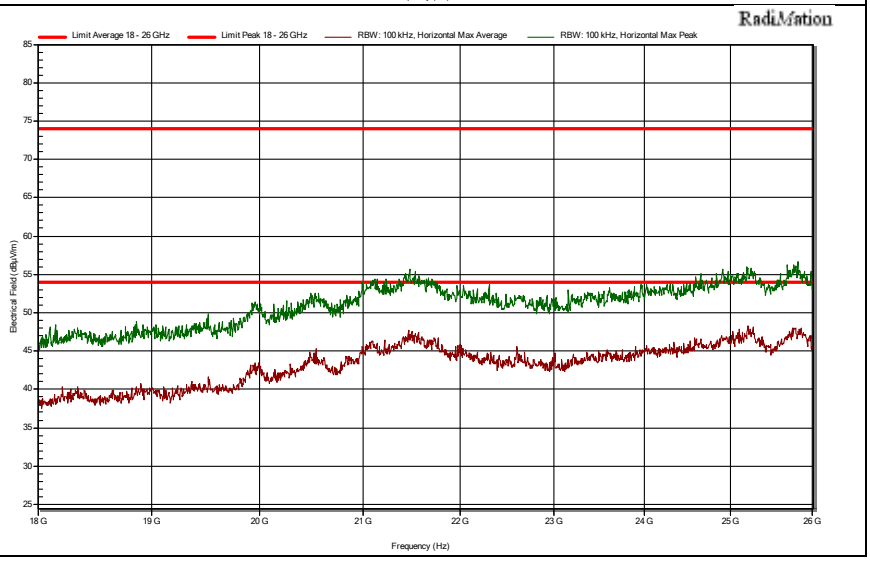
Note: the peak measured at 2.4 GHz is not subject to the FCC part 15.209 limits at this frequency is not located in the restricted bands as specified in FCC part 15.205.

18 GHz to 26.5 GHz (RF Through Path)

Vertical polarization

Low ch	
Mid ch	
High ch	

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.7.7 Measurement Uncertainty

Measurement uncertainty Radiated emissions below 1 GHz

Horizontal polarization	
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
Vertical polarization	
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB

Measurement uncertainty Radiated emissions above 1 GHz

1000- 18000 MHZ	5.7 dB
18000 – 26000 MHZ	4.9 dB

3.8 AC conducted mains measurement

3.8.1 Limit

According to 15.207 (c).

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

3.8.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.8.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.8.4 Test procedure

According to ANSI C63.4: 2014, section 13.3.
IRN 029 - Conducted disturbance (V) Method 1 – AC mains conducted disturbance.

3.8.5 Test results and plots of the AC conducted mains measurement

The test results can be found on the next page.

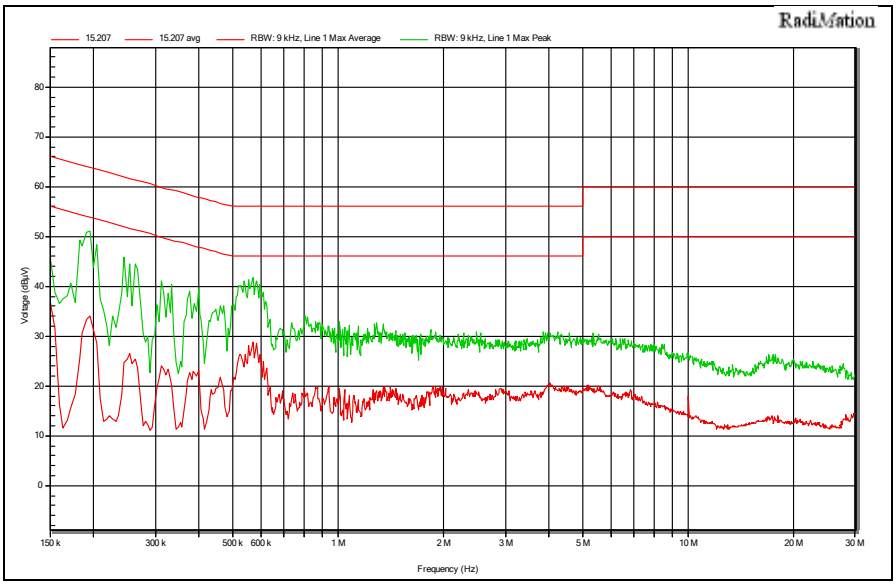
3.8.6 Measurement uncertainty

+/- 3.6 dB.

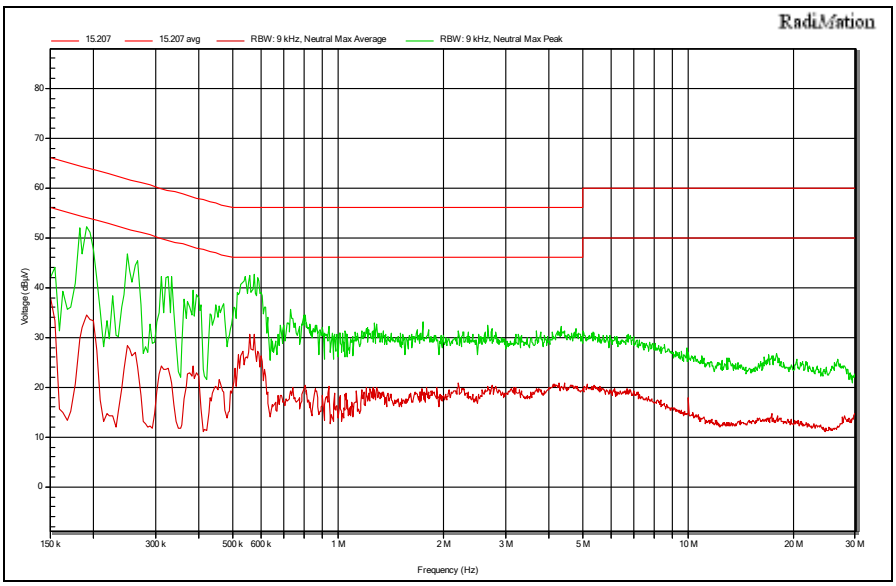
3.8.7 Plots of the AC conducted spurious measurement

U.FL

Phase

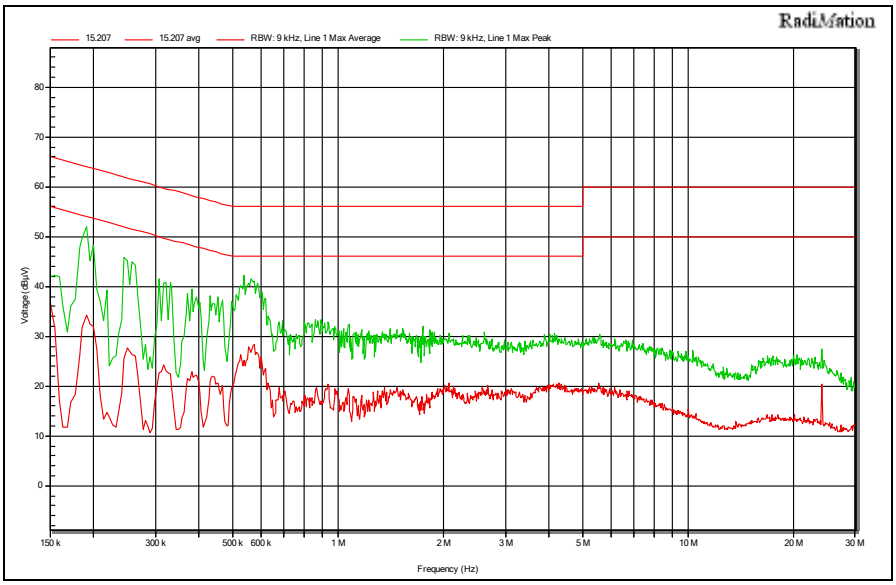


Neutral



RF Through Path

Phase



Neutral