


# EMC Test Report

**Project Number: 4670216****Proposal Number: 11235****Report Number: 4670216EMC01****Revision Level: 0****Client: ADTRAN, Inc.****Equipment Under Test: LoRaWAN Gateway****Model / HVIN: 7310-8****Part Number: 17101318F****FCC ID: HDC73108GW****IC: 2250A-73108GW****Applicable Standards: FCC Part 15 Subpart C, §15.247****ANSI C63.10: 2013****RSS-247, Issue 2, February 2017****RSS-GEN, Issue 5, Amendment 1, March 2019****Report issued on: 30 SEP 2020****Test Result: Compliant**

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*Remarks: This report details the results of the testing carried out on one sample; the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.*

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## 1 Summary of Test Results

Test Description	Test Specification		Test Result
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant <sup>1</sup>
Bandwidth	15.247(a)(2)	RSS-247 5.2(a)	Compliant
Output Power	15.247(b)(3)	RSS-247 5.4(d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 5.2(b)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 5.5	Compliant
Radiated Spurious Emissions	15.247(d), 15.35(b), 15.205, 15.209	RSS-247 5.5 RSS-GEN 8.9 / 8.10	Compliant
AC Power Line Conducted Emission	15.207	RSS-GEN 8.8	Compliant

1) The device employs a female SMA connector for the antenna but is professionally installed.

### 1.1 Modifications Required for Compliance

None

## 2 General Information

### 2.1 Client Information

Name: ADTRAN, Inc.  
Address: 901 Explorer Blvd.  
City, State, Zip, Country: Huntsville, AL 35806

### 2.2 Test Laboratory

Name: SGS North America, Inc.  
Address: 620 Old Peachtree Road NW, Suite 100  
City, State, Zip, Country: Suwanee, GA 30024, USA

### 2.3 General Information of EUT – LoRa Radio

EUT: LoRaWAN Gateway  
Model Number / HVIN: 7310-8  
Part Number: 17101318F  
Serial Number: J3H213

Frequency Range: 923.3 – 927.5 MHz  
Number of channels: 8  
Modulation type: LoRa  
Channel spacing: 600 kHz  
Antenna: External Dipole: 2.0dBi (Taoglas, M/N: TI.19.2113)  
External Dipole: 3.0dBi (Siretta, M/N: Delta 22B)

Rated Voltage: 54Vdc PoE or 5Vdc USB

Sample Received Date: 03 SEP 2020  
Dates of testing: 08 SEP – 17 SEP 2020

### 2.4 General Information of EUT – Bluetooth Radio

FCC ID: 2AKZA-QCA9377  
IC: 22364-QCA9377  
Frequency Range: 2402 – 2480 MHz<sup>1</sup>  
Number of channels: 40  
Modulation type: GFSK (1Mbps BLE)  
Channel spacing: 2 MHz  
Antenna: Dipole (Inaccessible): 1.6dBi (Molex, M/N: TI.19.2113)

Rated Voltage: 5Vdc Powered from host

- 1) Note: Although the certified module supports WLAN operation, only the BLE functions will be enabled.

## 2.5 Operating Modes and Conditions

The EUT was configured in software to allow the user to control the operating channel, the Spreading Factor (SF7-SF12), and turn the transmission on continuously.

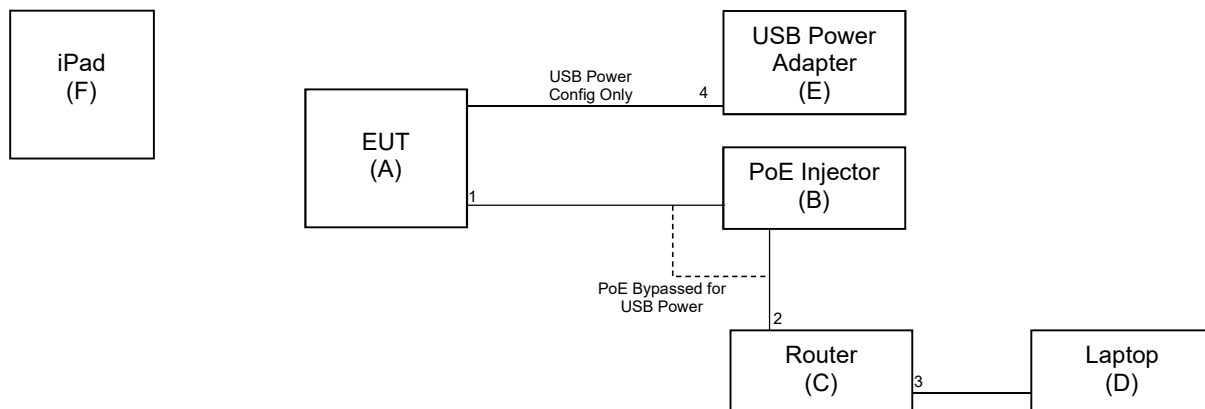
Test was performed in accordance with Section 5.1 of ANSI C63.10-2013 so that the low, mid and high channels could be tested independently.

Worst-case data rate for band edge measurements was SF7 and the worst-case for spurious emissions was SF11.

For intermodulation product testing (documented in a separate test report), BLE transmissions were maintained throughout testing by using an iPad paired with the EUT over the air.

During AC conducted emissions, testing was completed in both supported powering modes: Power over Ethernet and USB.

## 2.6 EUT Connection Block Diagram



## 2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	ADTRAN, Inc.	LoRaWAN Gateway	17101318F	J3H213
B	Emplus Technologies Inc	PoE Adapter	EPA5006GAT-B	173288245
C	Belkin	AC900 WiFi Router	F9K1117V2	20246GO7203253
D	Lenovo	T440p Laptop	20AW-S01Y02	PB-00UTCU 1402
E	Protop International Inc.	USB Wall Charger	B0773JFWDC	None
F	Apple, Inc.	iPad (5 <sup>th</sup> Gen)	MP2HLL/A	F9FTCB05HLFD

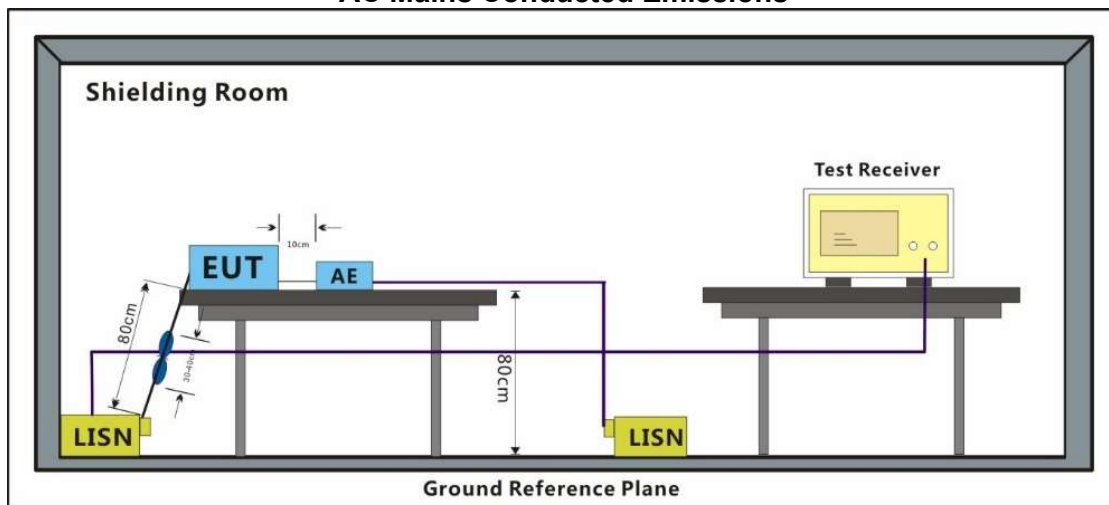
## 2.8 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	Ethernet (PoE)	EUT	Router	1.8 <sup>1</sup>	No	No
2	Ethernet	EUT	PoE Supply or Router	1.8	No	No
3	Ethernet	Laptop	Router	1.8	No	No
4	USB	EUT	USB Power Supply	2.0	No	Yes

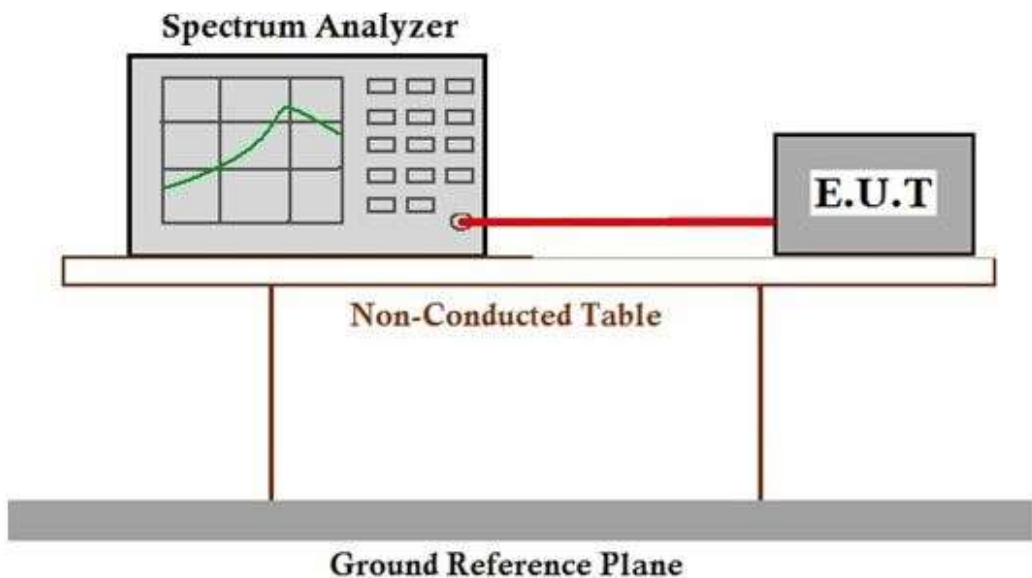
1) For radiated emissions tests this was extended to 8m.

## 2.9 Test Configurations

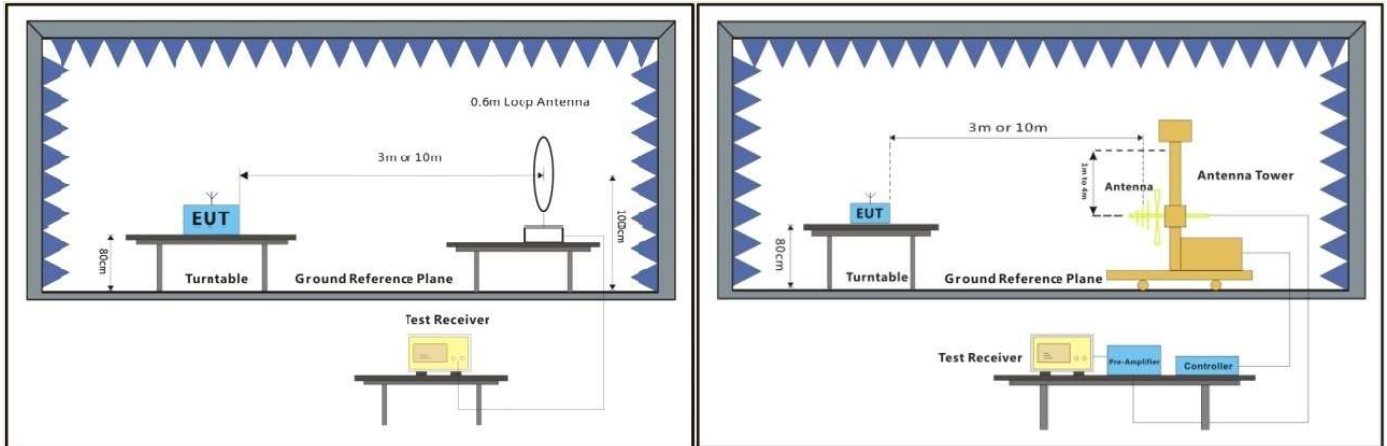
### AC Mains Conducted Emissions



### RF Antenna Port Conducted

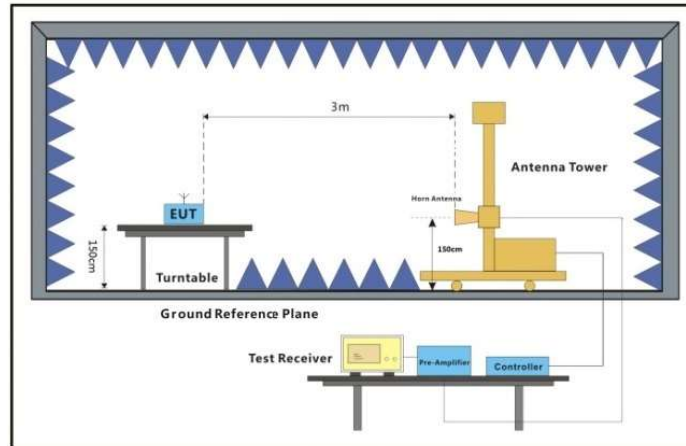


## Radiated Emissions



Below 30MHz

30MHz-1GHz



Above 1GHz



### 3 Bandwidth

#### 3.1 Test Result

Test Description	Basic Standards		Test Result
Bandwidth	15.247(a)(2)	RSS-247 5.2(a)	Compliant

#### 3.2 Test Method

The procedures from 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 Clause 6.9.2 and 6.9.3 were used to determine the 6 dB and 99% bandwidths.

#### 3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

##### Environmental Conditions

Temperature: 22.2 °C  
 Relative Humidity: 49.1 %  
 Atmospheric Pressure: 97.9 kPa

#### 3.4 Test Equipment

Test End Date: 8-Sep-2020

Tester: JOP

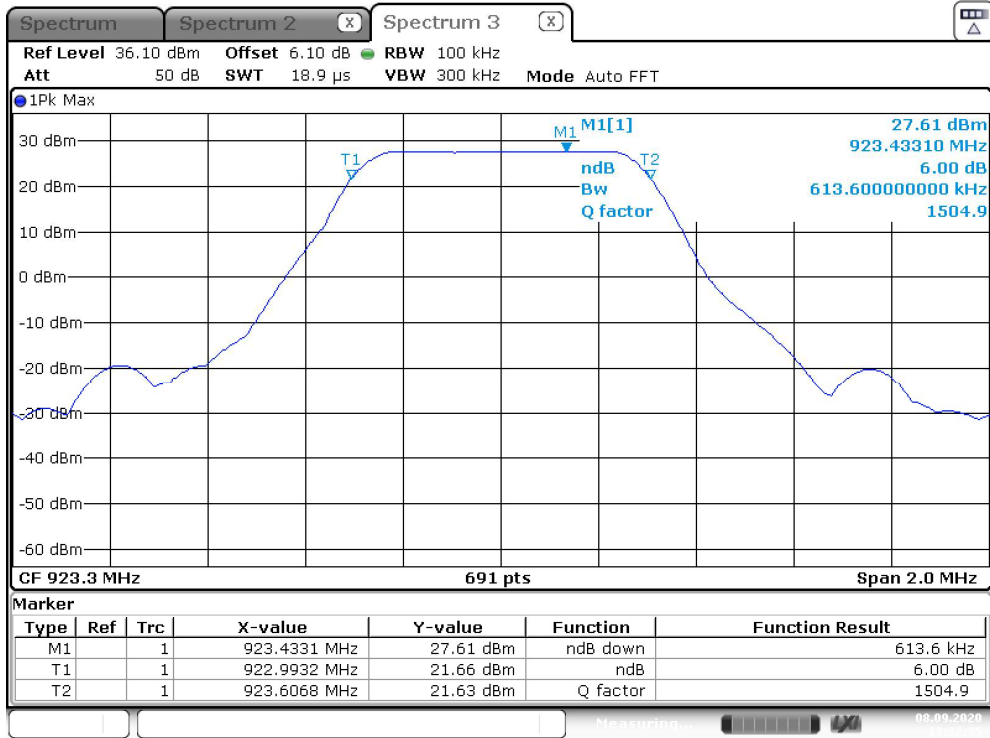
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	30-Mar-2020	30-Mar-2021
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

Note: Refer to table for equipment calibration period.

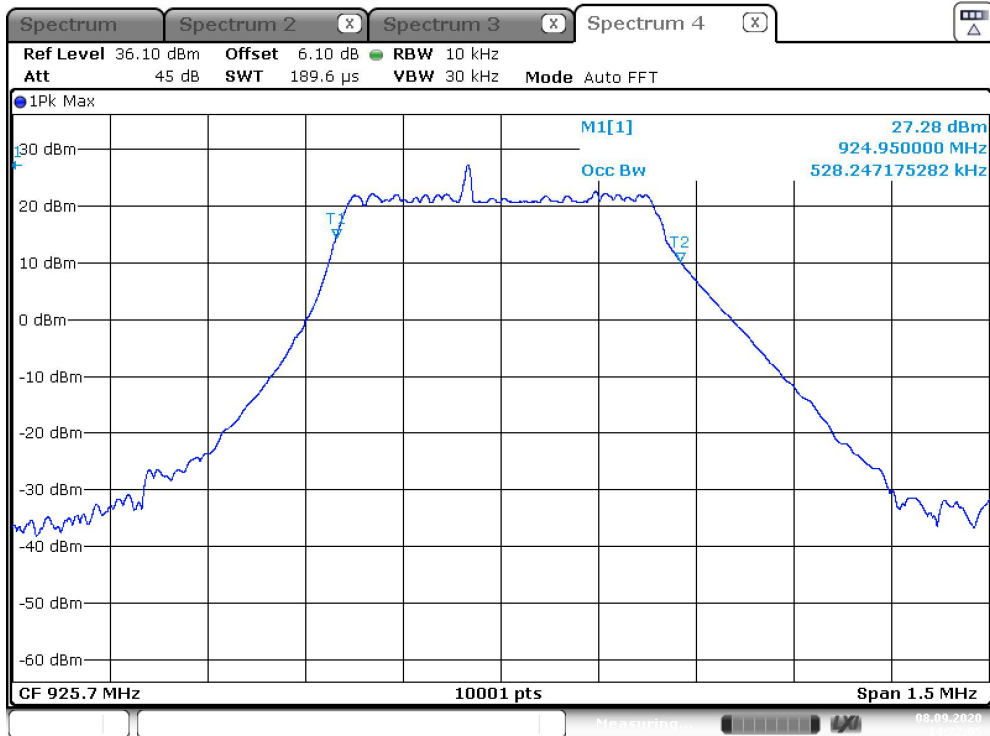
### 3.5 Test Data

Spreading Factor	Frequency (MHz)	6 dB Bandwidth (MHz)	99 % OBW (MHz)
SF7	923.3	0.614	0.500
	925.7	0.680	0.554
	927.5	0.692	0.538
SF8	923.3	0.645	0.504
	925.7	0.692	0.528
	927.5	0.680	0.522
SF9	923.3	0.695	0.522
	925.7	0.654	0.500
	927.5	0.677	0.506
SF10	923.3	0.631	0.496
	925.7	0.634	0.491
	927.5	0.634	0.495
SF11	923.3	0.643	0.497
	925.7	0.637	0.499
	927.5	0.637	0.497
SF12	923.3	0.640	0.502
	925.7	0.640	0.501
	927.5	0.640	0.503

### Sample Plot – 6dB BW (SF7 LCH)



### Sample Plot – 99% OBW (SF8 MCH)



## 4 Output Power

### 4.1 Test Result

Test Description	Test Specification		Test Result
Output Power	15.247(b)(3)	RSS-247 5.4(d)	Compliant

### 4.2 Test Method

Measurements were recorded using the test methods defined in 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10, Clause 11.9.2.2.2 Method AVGSA-1.

#### Limit

For DTS systems operating in the 902-928 MHz band: 1 watt.

### 4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 22.2 °C  
 Relative Humidity: 49.1 %  
 Atmospheric Pressure: 97.9 kPa

### 4.4 Test Equipment

Test End Date: 8-Sep-2020

Tester: JOP

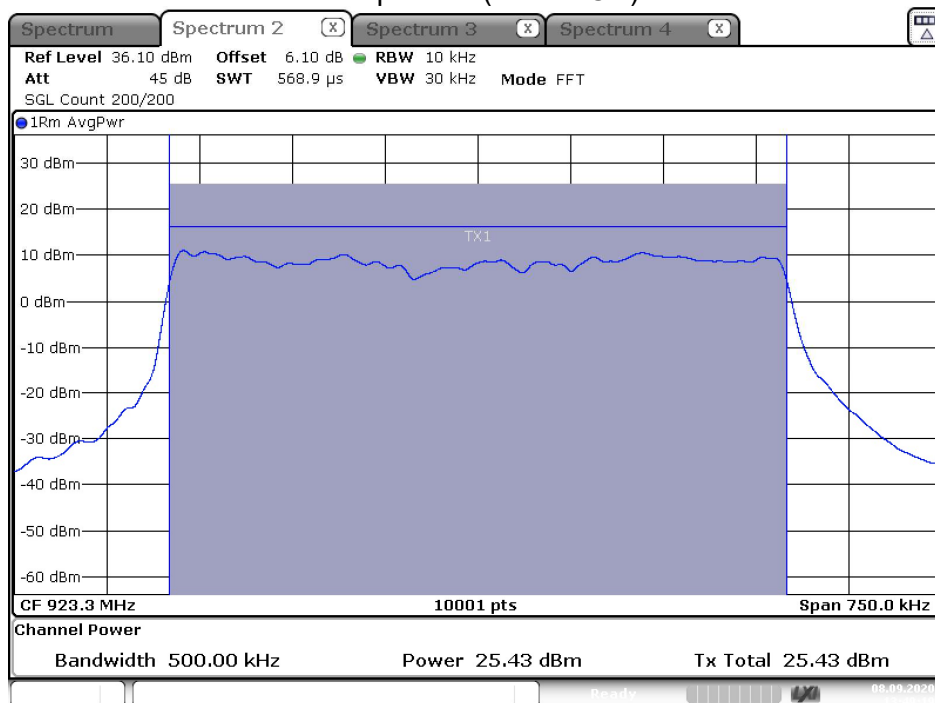
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	30-Mar-2020	30-Mar-2021
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

Note: Refer to table for equipment calibration period.

### 4.5 Test Data

Spreading Factor	Frequency	Average Output Power (dBm)	Average Output Power (W)	Output Power Limit (W)
SF7	923.3	21.8	0.151	1.0
	925.7	21.8	0.151	1.0
	927.5	21.9	0.155	1.0
SF8	923.3	23.6	0.229	1.0
	925.7	23.6	0.229	1.0
	927.5	23.61	0.230	1.0
SF9	923.3	24.94	0.312	1.0
	925.7	24.6	0.288	1.0
	927.5	24.72	0.296	1.0
SF10	923.3	24.75	0.299	1.0
	925.7	24.6	0.288	1.0
	927.5	24.9	0.309	1.0
SF11	923.3	25.43	0.349	1.0
	925.7	24.8	0.302	1.0
	927.5	24.84	0.305	1.0
SF12	923.3	25.1	0.324	1.0
	925.7	24.9	0.309	1.0
	927.5	24.8	0.302	1.0

Sample Plot (SF11 LCH)



## 5 Power Spectral Density

### 5.1 Test Result

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	Compliant

### 5.2 Test Method

Power spectral density measurements were recorded using the procedures from 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10: 2013 clause 11.10.3 Method AVGPSD-1.

#### Limit

The limit is 8 dBm.

### 5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 22.2 °C  
 Relative Humidity: 49.1 %  
 Atmospheric Pressure: 97.9 kPa

### 5.4 Test Equipment

Test End Date: 8-Sep-2020

Tester: JOP

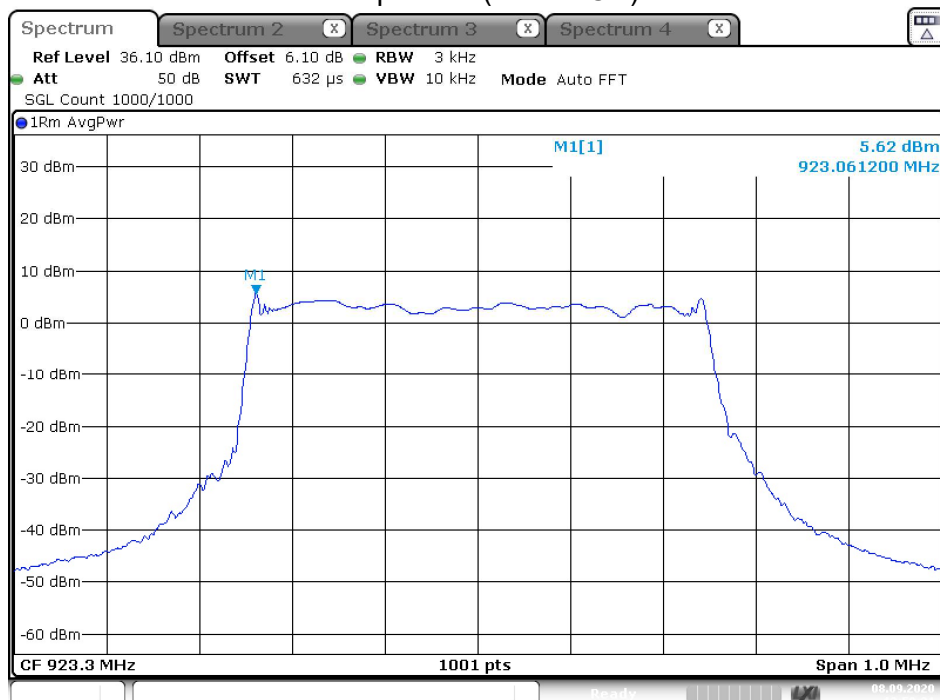
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	30-Mar-2020	30-Mar-2021
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

Note: Refer to table for equipment calibration period.

### 5.5 Test Data

Spreading Factor	Frequency	Average PSD (dBm/3kHz)	Average PSD Limit (dBm/3kHz)
SF7	923.3	2.44	8.0
	925.7	1.84	8.0
	927.5	2.85	8.0
SF8	923.3	3.42	8.0
	925.7	3.2	8.0
	927.5	3.71	8.0
SF9	923.3	4.47	8.0
	925.7	4.61	8.0
	927.5	4.21	8.0
SF10	923.3	5.48	8.0
	925.7	5.1	8.0
	927.5	5.58	8.0
SF11	923.3	5.62	8.0
	925.7	5.12	8.0
	927.5	5.28	8.0
SF12	923.3	5.42	8.0
	925.7	5.48	8.0
	927.5	5.3	8.0

Sample Plot (SF11 LCH)



## 6 Conducted Spurious Emissions

### 6.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	15.247(d)	RSS-247 5.5	Compliant

### 6.2 Test Method

Measurements were recorded using the test methods defined in 558074 D01 15.247 Meas Guidance v05r02 and ANS C63.10, Clause 11.11.

Because average power and PSD measurements were used for compliance, the limit is 30 dB below the maximum in-band peak PSD level in 100kHz.

### 6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.4°C

Relative Humidity: 56.3%

Atmospheric Pressure: 101.9 kPa

### 6.4 Test Equipment

Test End Date: 10-Sep-2020

Tester: JOP

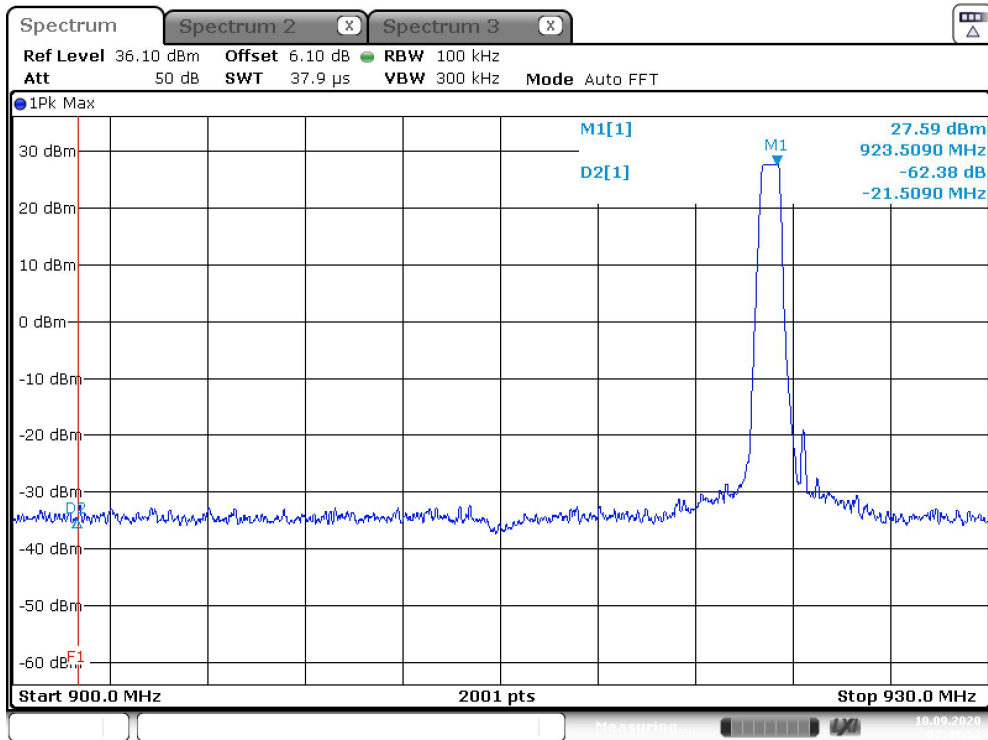
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	30-Mar-2020	30-Mar-2021
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

Note: Refer to table for equipment calibration period.

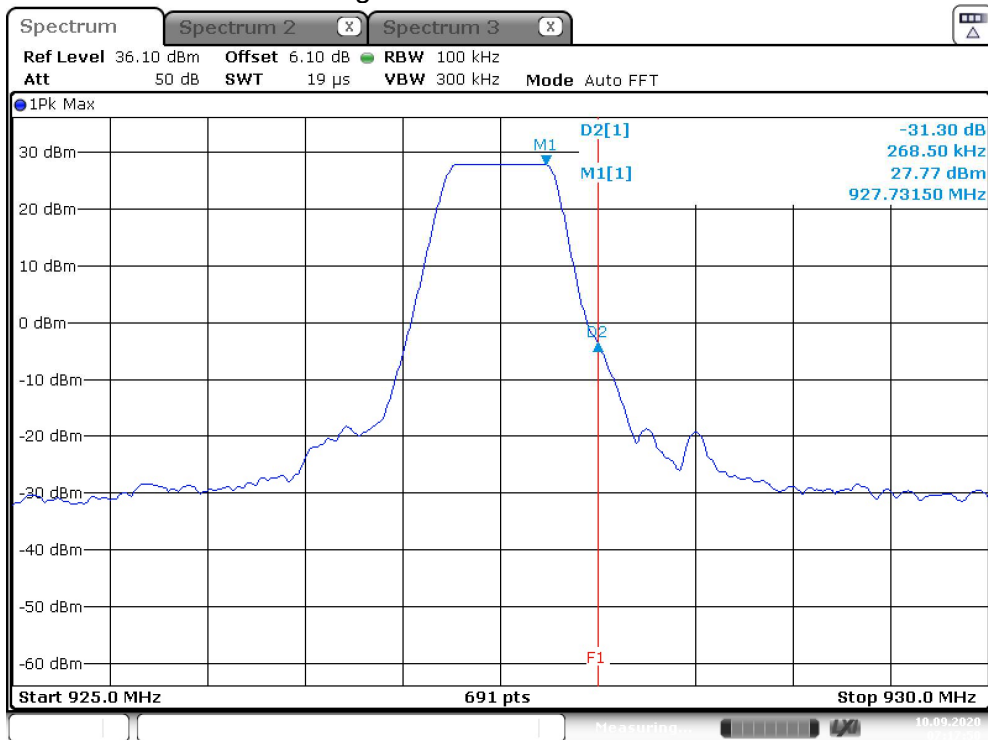


### 6.5 Test Data (Band-Edge)

Low Channel – 923.3MHz

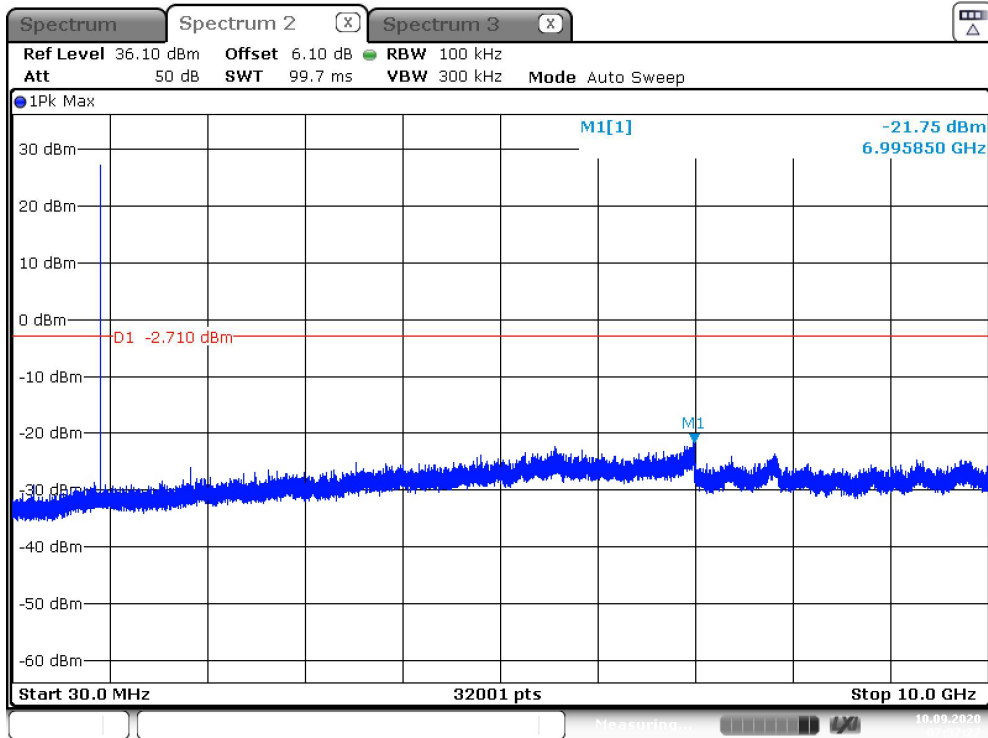


High Channel – 927.5MHz

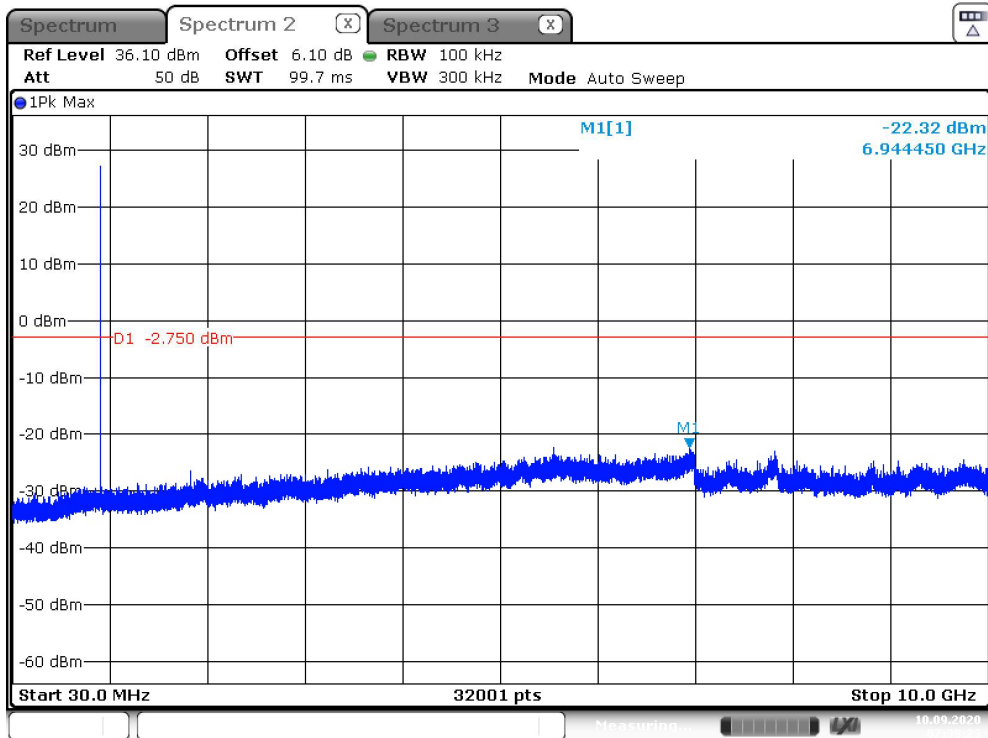


### 6.6 Test Data (Spurious Emissions)

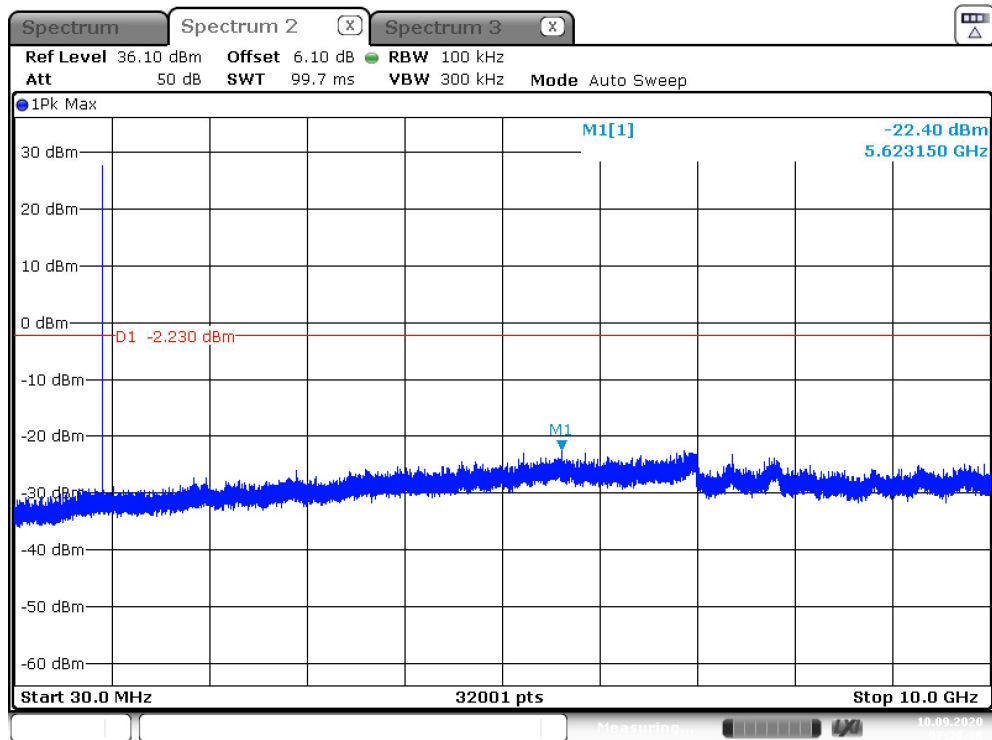
Low Channel – 923.3MHz



Mid Channel – 925.7MHz



High Channel – 927.5MHz



## 7 Field Strength of Spurious Radiation

### 7.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247(d), 15.35(b), 15.205, 15.209	Compliant

### 7.2 Test Method

Radiated spurious emissions measurements were recorded with the device configured to transmit at the lowest, middle, and highest channels. The frequency range investigated was up through the 10<sup>th</sup> harmonic of the fundamental transmit frequency. The methods defined in ANSI C63.10 were used.

For all measurements, the device was manipulated through three orthogonal axes. The worst-case for radiated spurious emissions was the Y-Axis. For radiated measurements, the antenna port was terminated into 50-Ohms.

Restricted band measurements were repeated using the antenna port conducted methods defined AN C63.10 Clause 11.12.2.

Test distance:

9 kHz to 30 MHz - The EUT to measurement antenna distance is 3 meters

30 MHz to 1 GHz - The EUT to measurement antenna distance is 3 meters

1 to 18 GHz - The EUT to measurement antenna distance is 3 meters

18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

Frequency	Limits <sup>(1)</sup>		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 <sup>(2)</sup>	--
88 - 216 MHz	150	43.5 <sup>(2)</sup>	--
216 - 960 MHz	200	46 <sup>(2)</sup>	--
960 - 1000 MHz	500	54 <sup>(2)</sup>	--
1 - 40 GHz	500	54 <sup>(3)</sup>	74

(1) These limits are applicable to emissions within the restricted bands of operation defined in FCC §15.205.

(2) Quasi-peak limit

(3) Average limit

### 7.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.5 °C

Relative Humidity: 43.6 %

### 7.4 Test Equipment

Test End Date: 17-Sep-2020

Tester: JOP

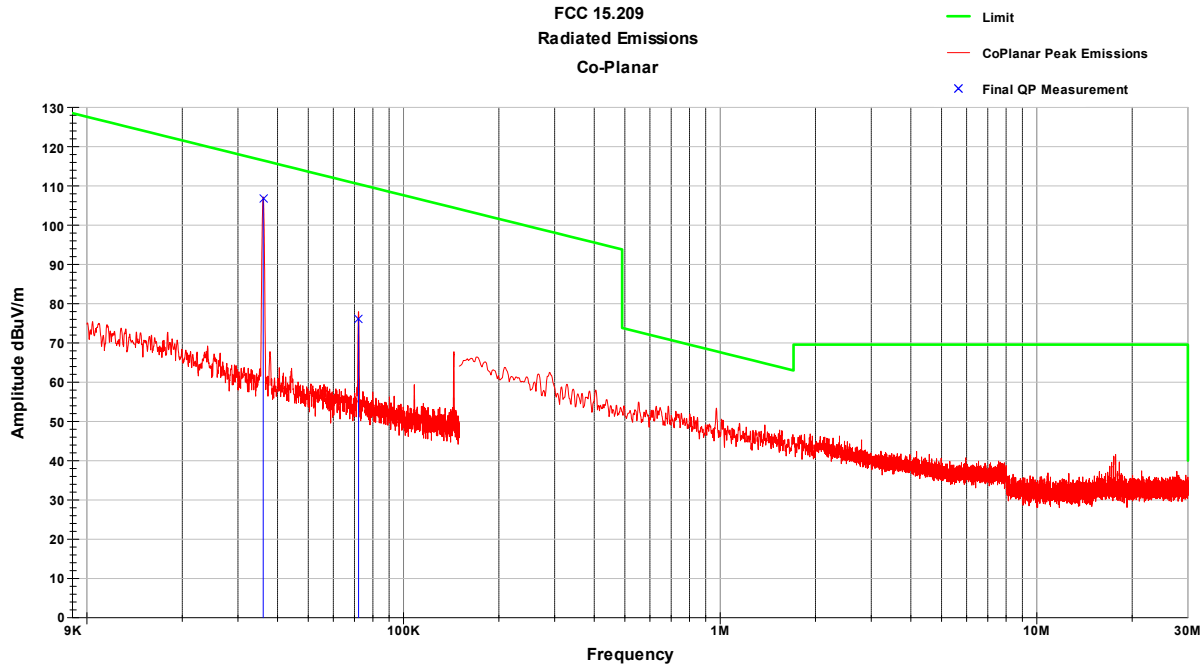
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
Attenuator, 6dB	BW-N6-W5+	Mini-Circuits	18031	3-Sep-2020	3-Sep-2021
6dB Attenuator NM to NF	BW-N6W5+	Mini-Circuits	19010	6-Apr-2020	6-Apr-2021
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	30-Mar-2020	30-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-276	TELEDYNE STORM MICROWAVE	20114	2-Mar-2020	2-Mar-2021
RF Cable Nm to Nf, 0.01-18GHz	90-213-118	TELEDYNE STORM MICROWAVE	20117	2-Mar-2020	2-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	2-Mar-2020	2-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20125	2-Mar-2020	2-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	2-Mar-2020	2-Mar-2021
Passive Loop Antenna, 9kHz - 30MHz	6512	ETS Lindgren	20151	21-Jul-2020	21-Jul-2022
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2020	6-Apr-2021
ANTENNA, BILOG	JB6	SUNOL	B079689	30-Oct-2018	30-Oct-2020
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079691	10-Aug-2020	10-Aug-2022
RF CABLE	SF106	HUBER & SUHNER	B079713	3-Sep-2020	3-Sep-2021
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2020	7-May-2021
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	3-Dec-2019	3-Dec-2020
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	3-Sep-2020	3-Sep-2021

Note: Refer to table for equipment calibration period.

### 7.5 Test Data – Radiated Spurious Emissions

Note: Below 1GHz, there was no discernible difference in the spurious emissions among the different transmit channels; therefore, only the low channel data is reported.

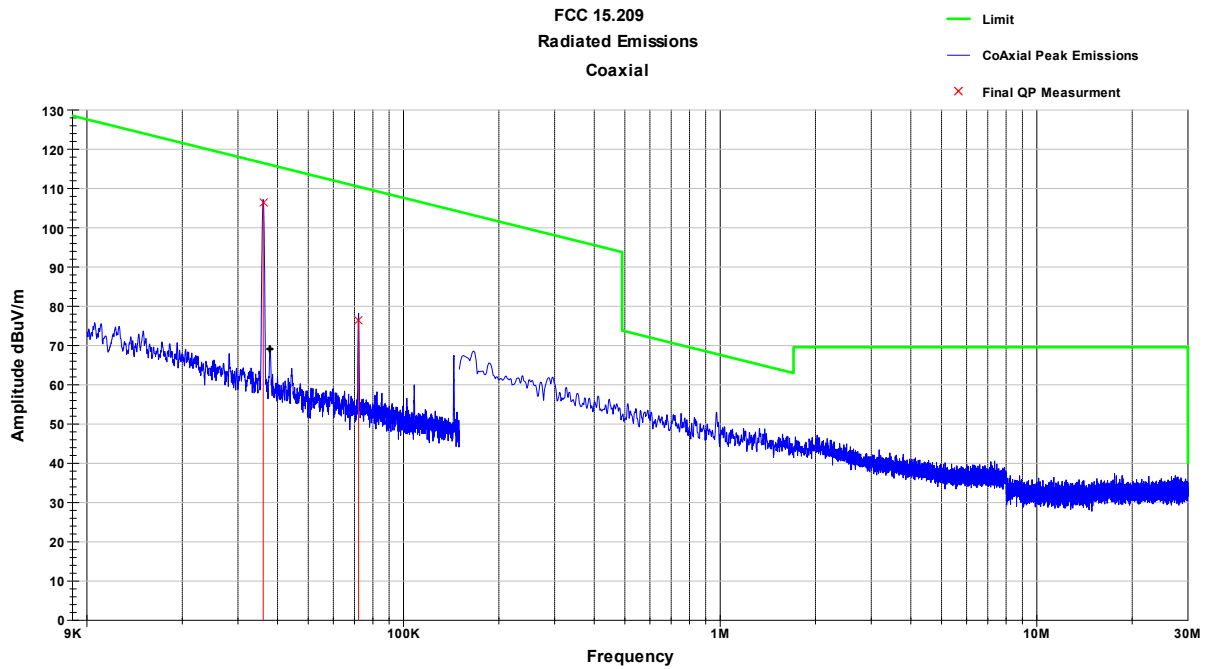
Low Channel (923.3 MHz)  
9kHz – 30MHz (Co-Planar)



Low Channel (923.3 MHz)  
9kHz – 30MHz (Co-Planar Data)

Frequency MHz	Raw QP (dBuV)	Azimuth (degrees)	Height (cm)	AF (dB)	CL (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.036	31.1	58.0	100.0	75.5	0.1	106.6	116.5	-9.9
0.072	6.1	125.0	100.0	69.8	0.1	76.0	110.4	-34.5
QP Value = Level + AF + CL								
Margin = QP Value - Limit								

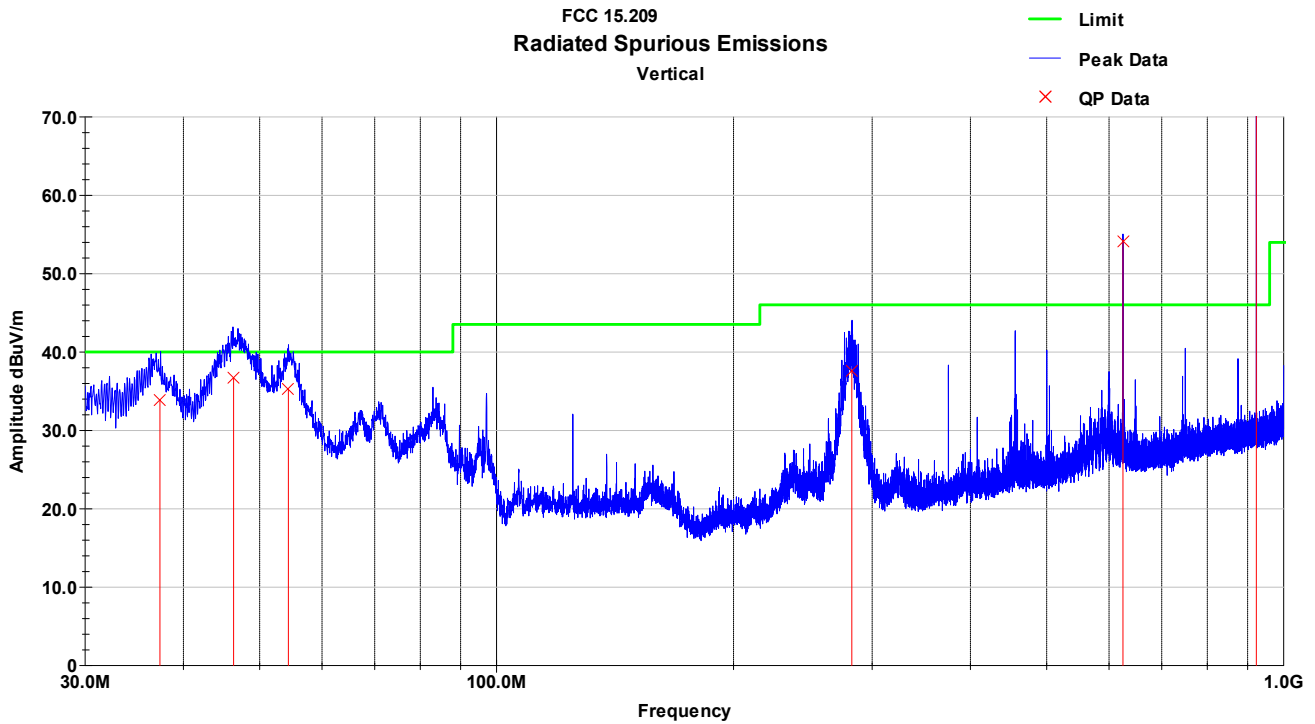
Low Channel (923.3 MHz)  
9kHz – 30MHz (Co-Axial)



Low Channel (923.3 MHz)  
9kHz – 30MHz (Co-Axial Data)

Frequency MHz	Raw QP (dBuV)	Azimuth (degrees)	Height (cm)	AF (dB)	CL (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.036	31.0	58.0	100.0	75.0	0.0	107.0	116.0	-10.0
0.072	6.6	335.0	100.0	70.0	0.0	76.0	110.0	-34.0
QP Value = Level + AF + CL								
Margin = QP Value - Limit								

Low Channel (923.3 MHz)  
30MHz – 1GHz (Vertical Plot)



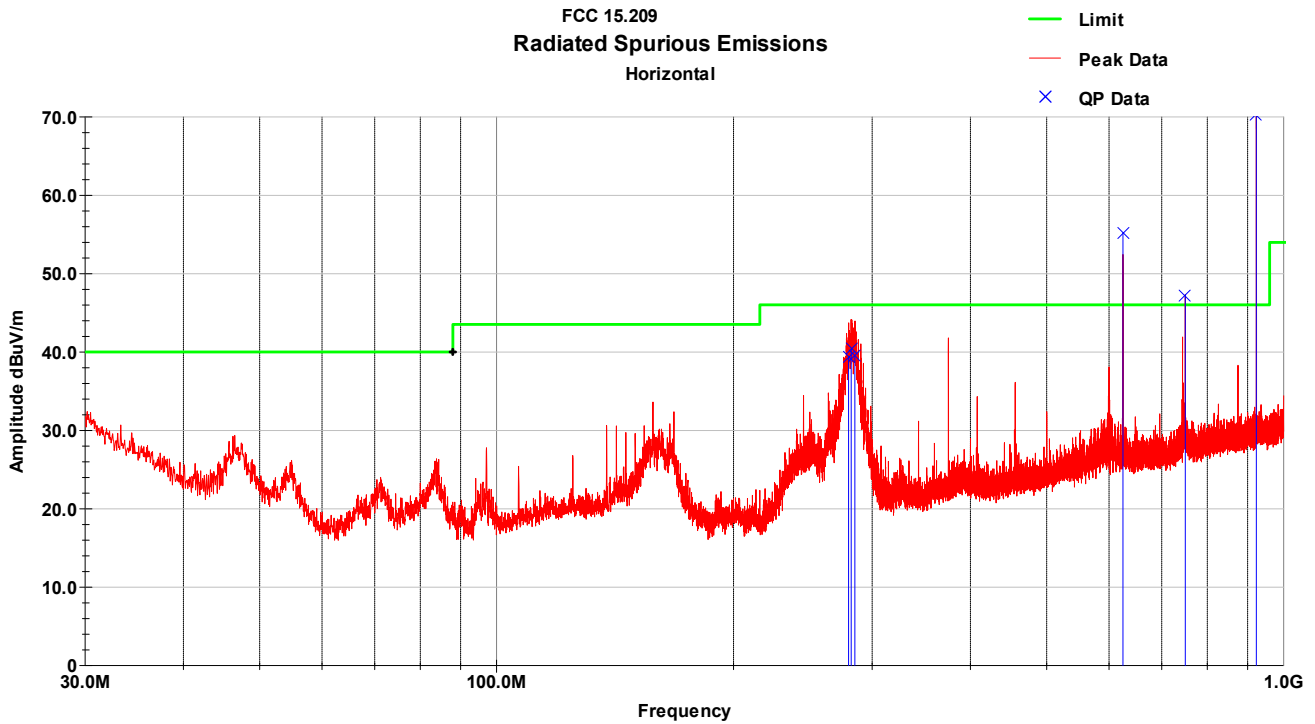
Low Channel (923.3 MHz)  
30MHz – 1GHz (Vertical Data)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
37.35	46.0	V	356.0	103.0	16.4	6.4	35.0	33.9	40.0	-6.1
46.33	54.9	V	69.0	115.0	10.4	6.5	35.1	36.7	40.0	-3.3
54.38	56.1	V	350.0	116.0	7.9	6.5	35.2	35.3	40.0	-4.7
282.76	51.1	V	171.0	201.0	14.0	7.4	35.0	37.6	46.0	-8.5
625.03	61.1	V	212.0	177.0	20.0	8.1	35.0	54.2	46.0	8.2
923.30	78.0	V	187.0	102.0	23.2	8.6	35.0	74.8	46.0	28.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Note: Emission at 923.3MHz is the fundamental transmit frequency  
Other emissions are not associated with the radio operation and subject to the digital device limits  
(Class A) documented in a separate test report.



Low Channel (923.3 MHz)  
30MHz – 1GHz (Horizontal Plot)



Low Channel (923.3 MHz)  
30MHz – 1GHz (Horizontal Data)

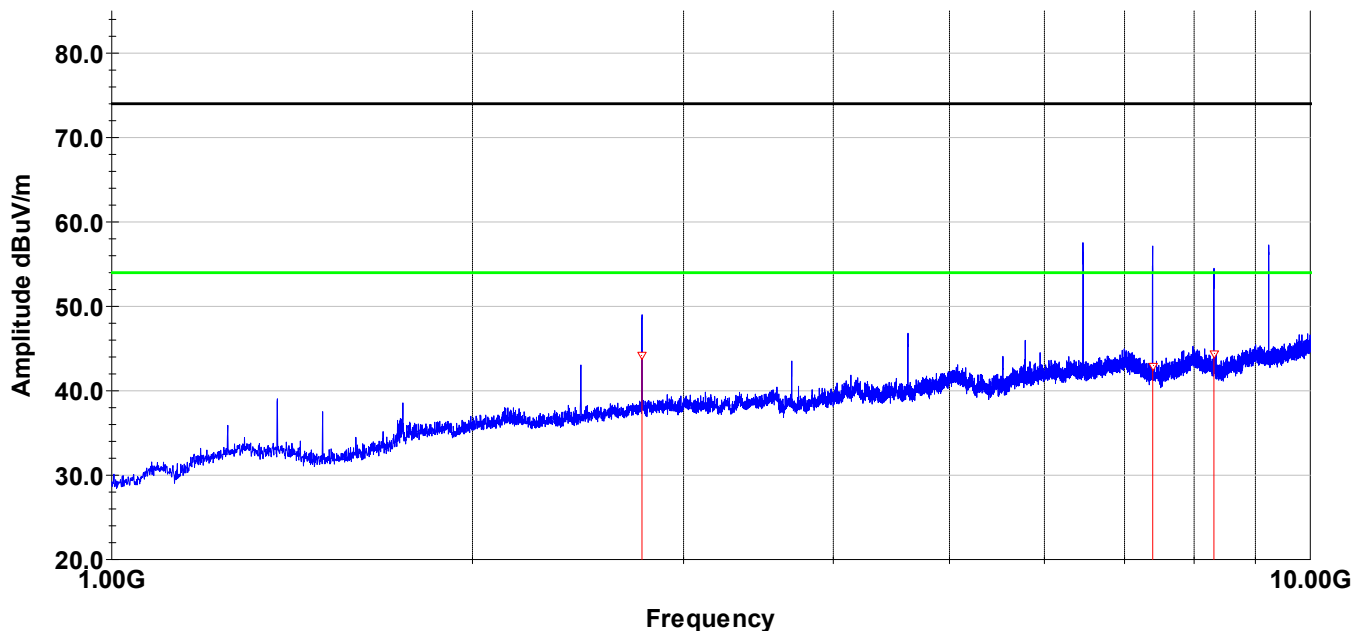
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
280.05	53.1	H	244.0	100.0	13.9	7.4	35.0	39.4	46.0	-6.6
282.19	54.0	H	254.0	100.0	14.0	7.4	35.0	40.4	46.0	-5.6
285.25	53.1	H	127.0	113.0	14.0	7.4	34.9	39.6	46.0	-6.4
625.02	62.1	H	139.0	150.0	20.0	8.1	35.0	55.2	46.0	9.2
750.00	52.6	H	67.0	114.0	21.3	8.3	35.0	47.2	46.0	1.2
923.38	73.5	H	358.0	150.0	23.2	8.6	35.0	70.3	46.0	24.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Note: Emission at 923.3MHz is the fundamental transmit frequency  
Other emissions are not associated with the radio operation and subject to the digital device limits  
(Class A) documented in a separate test report.

Low Channel (923.3 MHz)  
1GHz – 10GHz (Vertical Plot)

FCC 15.209  
Radiated Emissions  
Vertical

- Peak Scan
- ▼ Average Data
- AVG Limit
- Peak Limit



Low Channel (923.3 MHz)  
1GHz – 10GHz (Vertical Data)

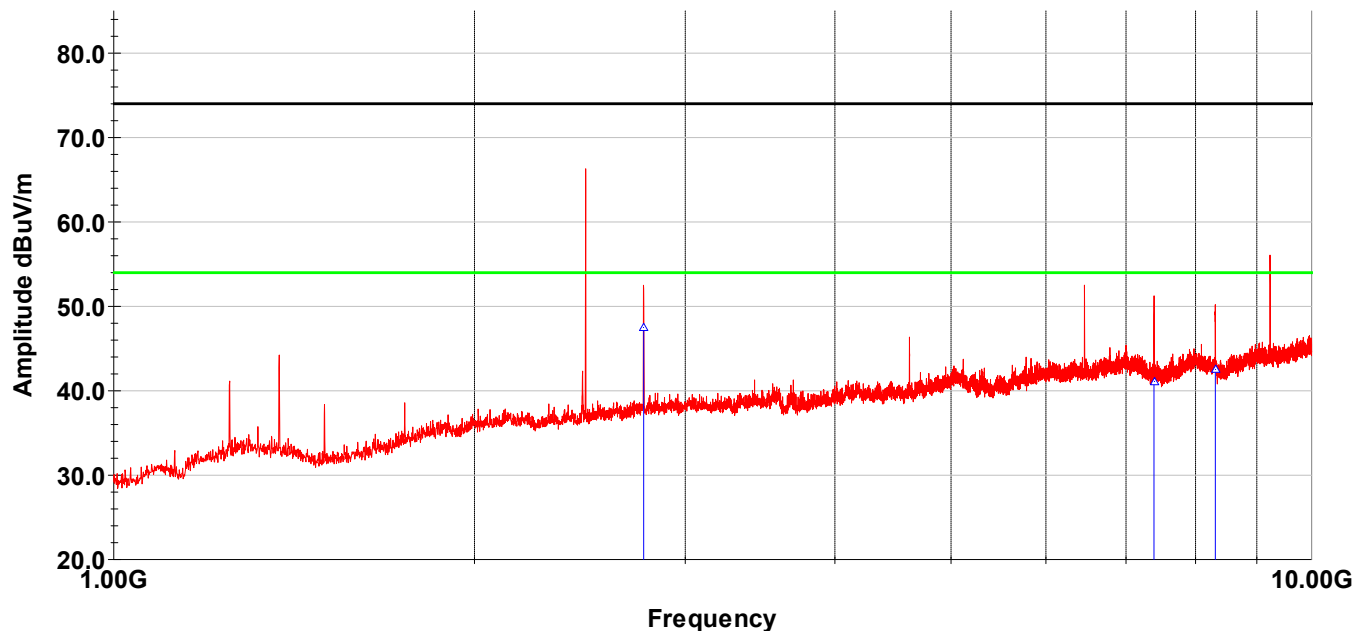
Frequency MHz	Raw Avg (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
2769.90	42.1	V	196.2	271.7	32.5	5.5	34.9	45.1	54.0	-8.9
7386.40	35.0	V	224.2	292.8	35.8	9.1	35.4	44.5	54.0	-9.5
8309.70	36.1	V	166.2	359.0	35.9	9.7	35.4	46.2	54.0	-7.8
11081.60	32.6	V	92.0	100.0	37.9	11.5	35.7	46.3	54.0	-7.7
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits

Low Channel (923.3 MHz)  
1GHz – 10GHz (Horizontal Plot)

FCC 15.209  
Radiated Emissions  
Horizontal

- Peak Scan
- ▲ Average
- AVG Limit
- Peak Limit



Low Channel (923.3 MHz)  
1GHz – 10GHz (Horizontal Data)

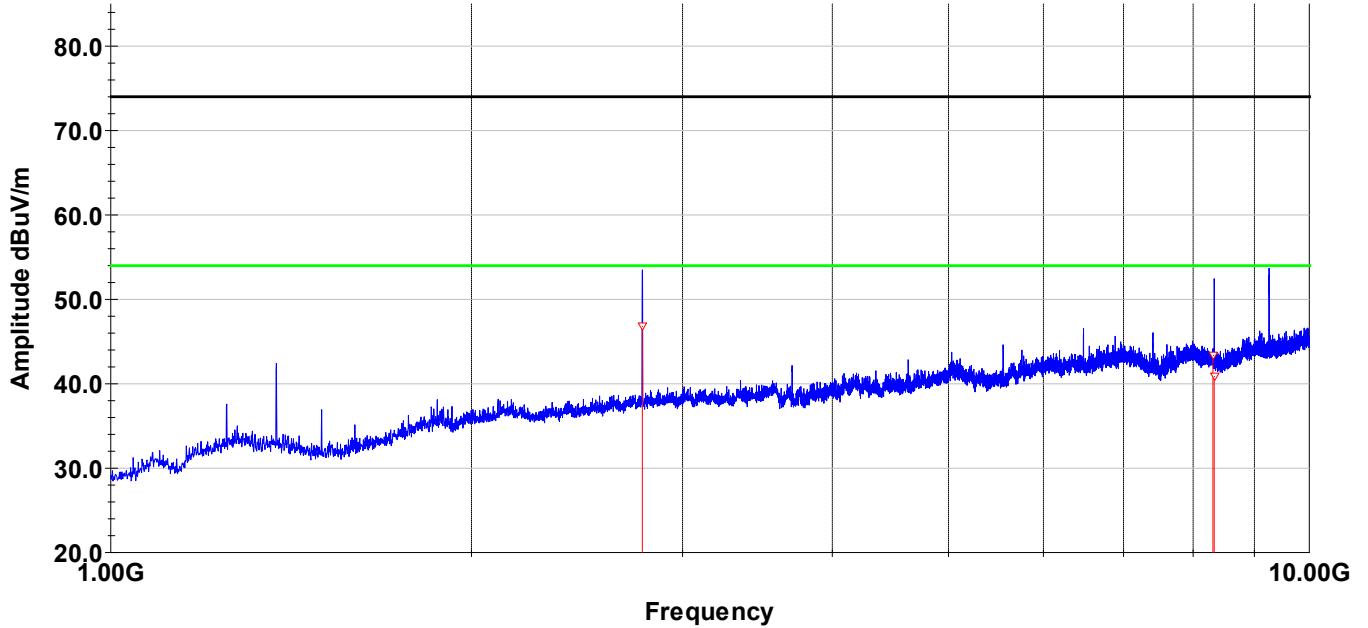
Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2769.90	45.3	H	151.0	190.0	32.5	5.5	34.9	48.3	54.0	-5.7
7386.40	33.1	H	255.0	123.0	35.8	9.1	35.4	42.6	54.0	-11.4
8309.70	34.2	H	265.0	100.0	35.9	9.7	35.4	44.3	54.0	-9.7
11081.60	32.3	H	316.0	104.0	37.9	11.5	35.7	46.0	54.0	-8.0
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits  
Emission at 2450MHz was the BLE Radio and not a function of the 900MHz radio.

Mid Channel (925.7 MHz)  
1GHz – 10GHz (Vertical Plot)

FCC 15.209  
Radiated Emissions  
Vertical

- Peak Scan
- ▼ Average Data
- AVG Limit
- Peak Limit



Mid Channel (925.7 MHz)  
1GHz – 10GHz (Vertical Data)

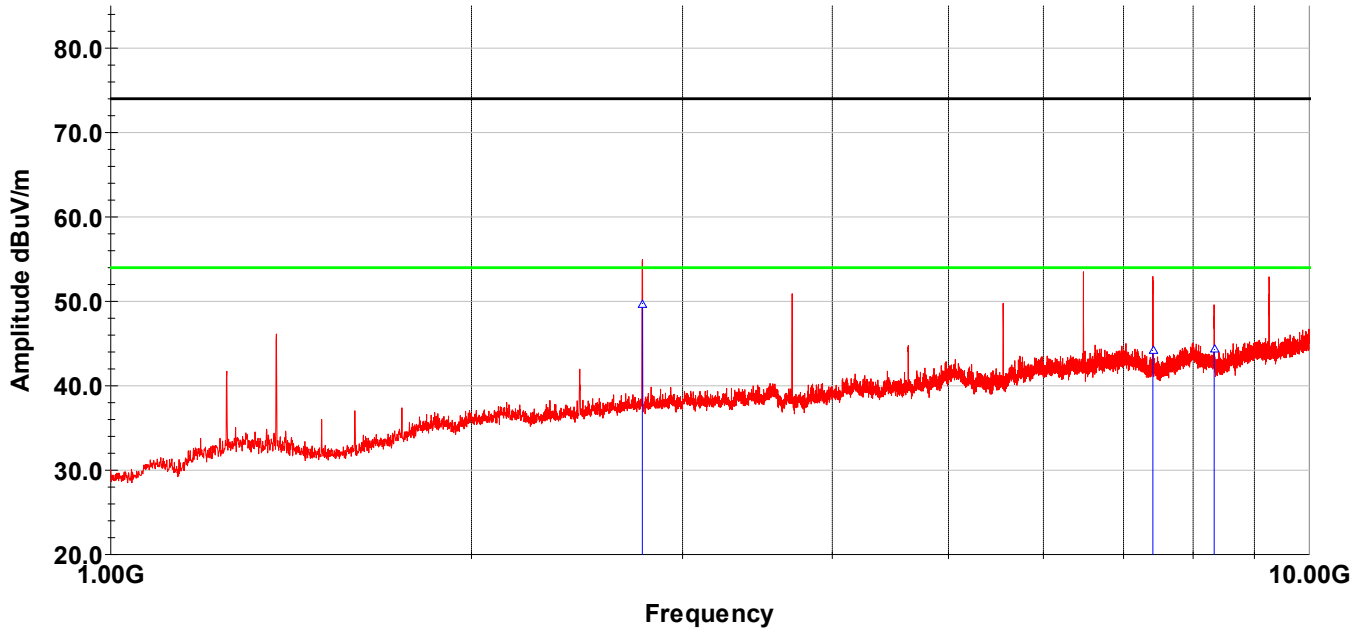
Frequency MHz	Raw Avg (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
2777.10	44.6	V	91.0	203.0	32.5	5.5	34.9	47.6	54.0	-6.4
8331.30	35.0	V	90.0	100.0	35.9	9.7	35.4	45.1	54.0	-8.9
11108.40	34.1	V	59.0	100.0	37.9	11.5	35.7	47.8	54.0	-6.2
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits

Mid Channel (925.7 MHz)  
1GHz – 10GHz (Horizontal Plot)

FCC 15.209  
Radiated Emissions  
Horizontal

- Peak Scan
- △ Average
- AVG Limit
- Peak Limit



Mid Channel (925.7 MHz)  
1GHz – 10GHz (Horizontal Data)

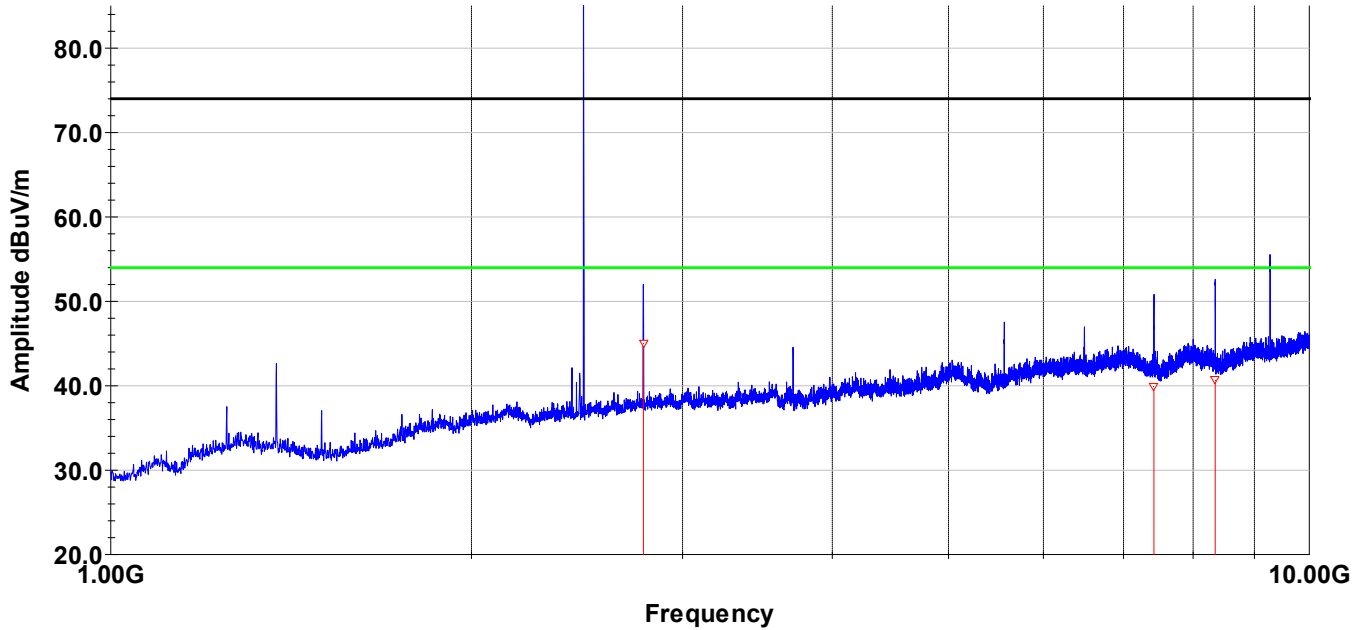
Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2777.10	47.6	H	107.0	175.0	32.5	5.5	34.9	50.6	54.0	-3.4
7405.60	36.2	H	126.0	228.0	35.8	9.1	35.4	45.7	54.0	-8.3
8331.30	36.0	H	118.0	198.0	35.9	9.7	35.4	46.1	54.0	-7.9
11077.30	35.1	H	144.0	358.0	37.9	11.5	35.7	48.8	54.0	-5.2
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits

High Channel (927.5 MHz)  
1GHz – 10GHz (Vertical Plot)

FCC 15.209  
Radiated Emissions  
Vertical

- Peak Scan
- ▼ Average Data
- AVG Limit
- Peak Limit



High Channel (927.5 MHz)  
1GHz – 10GHz (Vertical Data)

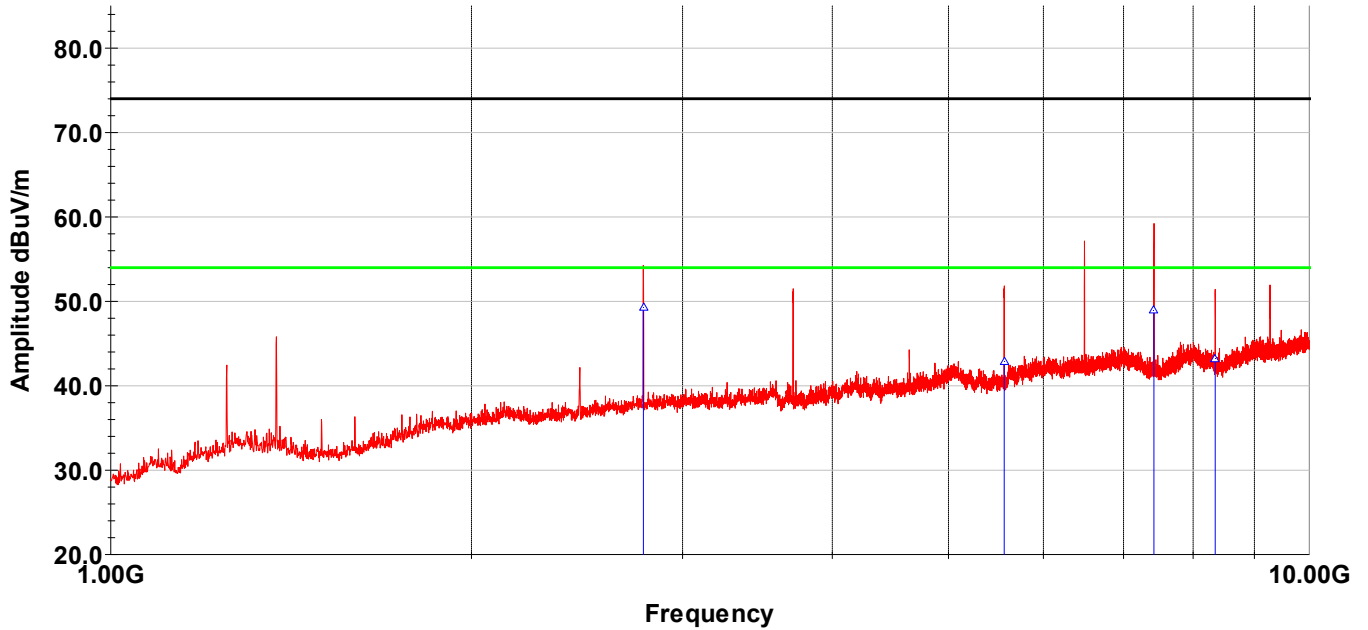
Frequency MHz	Raw Avg (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
2782.50	42.9	V	75.0	100.0	32.5	5.5	34.9	45.9	54.0	-8.1
7420.00	32.0	V	138.0	100.0	35.8	9.1	35.4	41.5	54.0	-12.5
8347.50	32.4	V	90.0	100.0	35.9	9.7	35.4	42.5	54.0	-11.5
11130.00	33.5	V	75.0	100.0	37.9	11.5	35.7	47.2	54.0	-6.8
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits  
Emission at 2450MHz was the BLE Radio and not a function of the 900MHz radio.

High Channel (927.5 MHz)  
1GHz – 10GHz (Horizontal Plot)

FCC 15.209  
Radiated Emissions  
Horizontal

- Peak Scan
- △ Average
- AVG Limit
- Peak Limit



High Channel (927.5 MHz)  
1GHz – 10GHz (Horizontal Data)

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2782.50	46.3	H	89.0	124.0	32.5	5.5	34.9	49.3	54.0	-4.7
7420.00	39.4	H	125.0	227.0	35.8	9.1	35.4	48.9	54.0	-5.1
8347.50	33.1	H	107.0	227.0	35.9	9.7	35.4	43.2	54.0	-10.8
11130.00	31.5	H	144.0	150.0	37.9	11.5	35.7	45.2	54.0	-8.8
Avg Value = Level + AF + CL - Amp										
Margin = Avg Value - Limit										

Note: Other peak emissions were not in restricted bands and not subject to the 15.209 limits

### 7.6 Test Data – Conducted Spurious Emissions

Conducted measurements were converted to 3-meter radiated field strength using the following equation:

$$E = \text{EIRP} - 20 \log d + 104.8$$

where

$E$  is the electric field strength in dB $\mu$ V/m

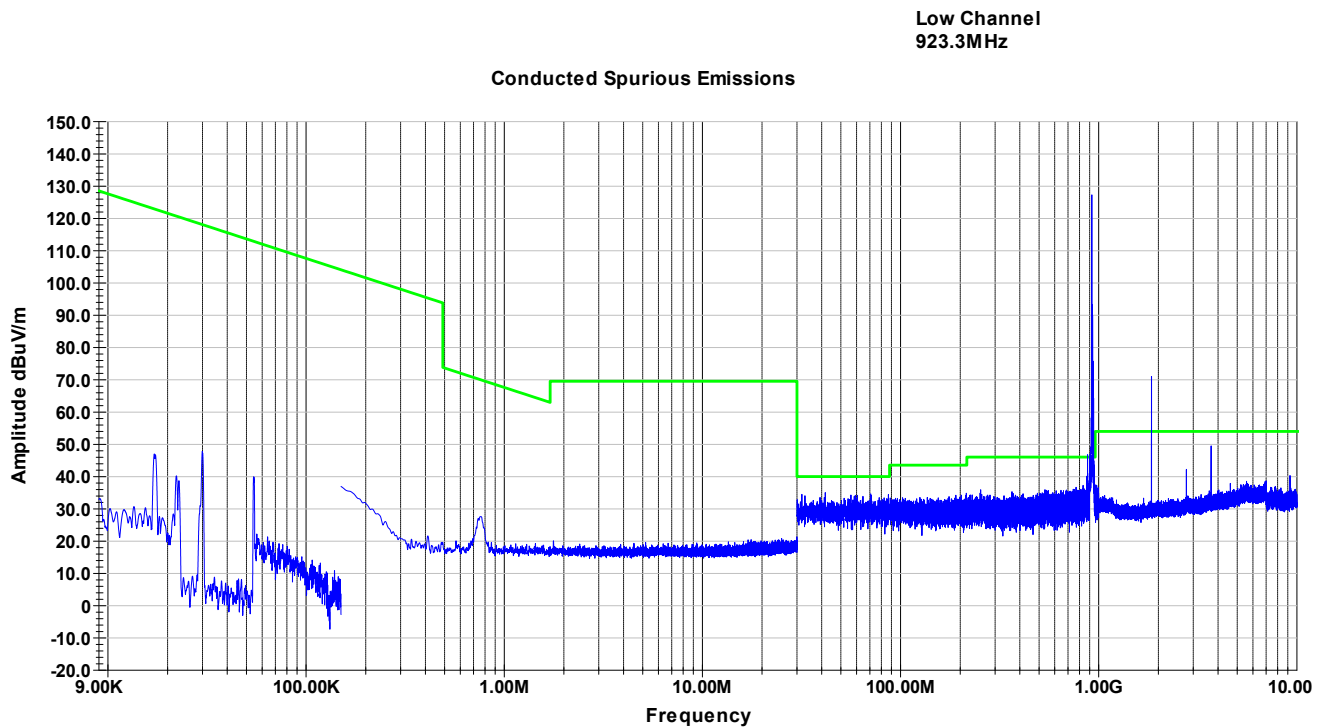
EIRP is the equivalent isotropically radiated power in dBm

$d$  is the specified measurement distance in m

Additionally, the following ground reflection factors were added:

- 6dB for frequencies below 30MHz
- 4.7dB for frequencies between 30 and 1000MHz
- 0 dB for frequencies > 1000MHz

Low Channel (923.3 MHz)

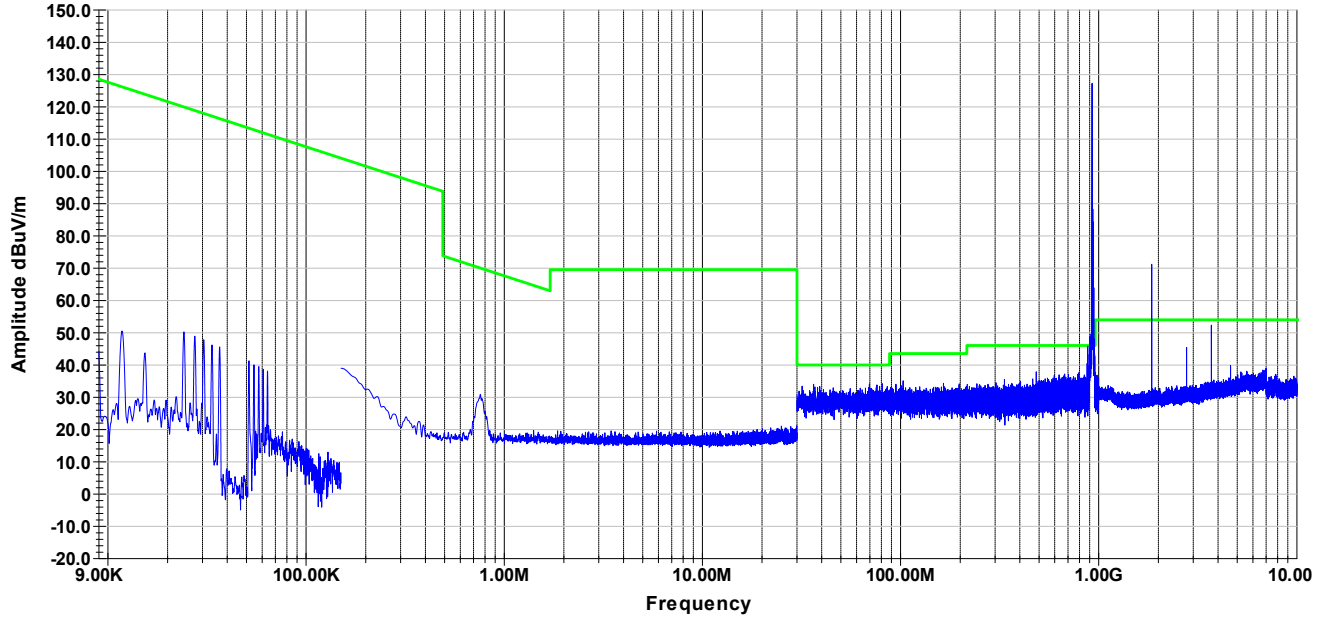




Mid Channel (925.7 MHz)

Mid Channel  
925.7MHz

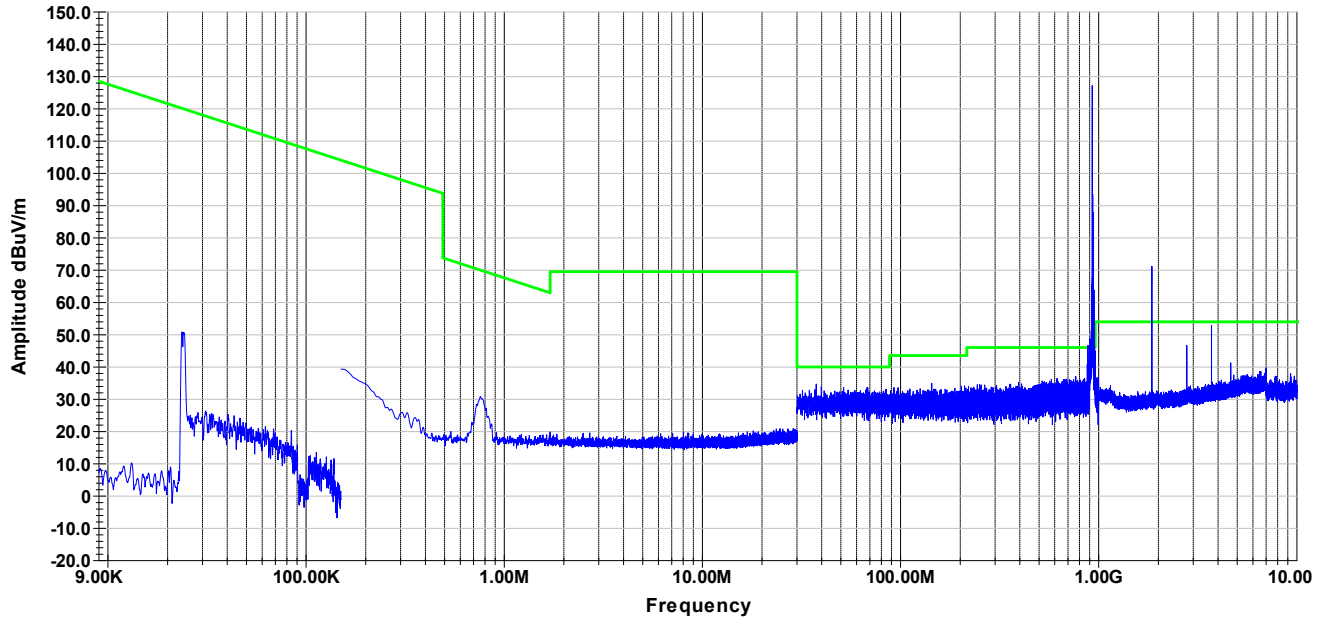
Conducted Spurious Emissions



High Channel (927.5 MHz)

High Channel  
927.5MHz

Conducted Spurious Emissions



**Tabular Data - Average**

Frequency (MHz)	Raw RMS (dBm)	Path Loss (dB/m)	Antenna Gain (dB)	Constant (dB)	D (m)	DCCF (dB)	RMS Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
<b>Low Channel (932.3MHz)</b>									
2769.90	-61.3	1.1	3.0	104.8	3.0	0.0	38.0	54.0	16.0
3693.20	-54.0	1.0	3.0	104.8	3.0	0.0	45.3	54.0	8.7
<b>Mid Channel (932.3MHz)</b>									
2777.10	-58.5	1.1	3.0	104.8	3.0	0.0	40.8	54.0	13.2
3702.80	-51.2	1.0	3.0	104.8	3.0	0.0	48.1	54.0	5.9
<b>High Channel (932.3MHz)</b>									
2782.50	-58.0	1.1	3.0	104.8	3.0	0.0	41.3	54.0	12.7
3710.00	-50.4	1.0	3.0	104.8	3.0	0.0	48.9	54.0	5.1
RMS Value = Raw RMS + PL + AG + 104.8 - 20*LOG(D) + DCCF									
Margin = QP Value - Limit									

**Tabular Data – Peak**

Frequency (MHz)	Raw Peak (dBm)	Path Loss (dB/m)	Antenna Gain (dB)	Constant (dB)	D (m)	DCCF (dB)	Peak Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
<b>Low Channel (932.3MHz)</b>									
2769.90	-57.3	1.1	3.0	104.8	3.0	0.0	42.0	74.0	32.0
3693.20	-50.2	1.0	3.0	104.8	3.0	0.0	49.1	74.0	24.9
<b>Mid Channel (932.3MHz)</b>									
2777.10	-53.9	1.1	3.0	104.8	3.0	0.0	45.4	74.0	28.6
3702.80	-47.2	1.0	3.0	104.8	3.0	0.0	52.1	74.0	21.9
<b>High Channel (932.3MHz)</b>									
2782.50	-52.6	1.1	3.0	104.8	3.0	0.0	46.7	74.0	27.3
3710.00	-46.4	1.0	3.0	104.8	3.0	0.0	52.9	74.0	21.1
Peak Value = Raw Peak + PL + AG + 104.8 - 20*LOG(D) + DCCF									
Margin = QP Value - Limit									

Note: The 2<sup>nd</sup> harmonic emissions do not fall within a restricted band and are not subject to these limits

## 8 Conducted Emissions

### 8.1 Test Result

Test Description	Test Specification		Test Result
Conducted Emissions, Class B	15.207	RSS-GEN 8.8	Compliant

### 8.2 Test Method

With the receiver's resolution bandwidth was set to 9 kHz the exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBuV)	Class B Limits (dBuV) CISPR
0.15 to 0.5 MHz	Avg 66 QP 79	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 60 QP 73	Avg 46 Pk 56
5 to 30 MHz	Avg 60 QP 73	Avg 50 Pk 60

### 8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 21.4°C  
 Relative Humidity: 56.3%  
 Atmospheric Pressure: 101.9 kPa

### 8.4 Test Equipment

Test End Date: 10-Sep-2020

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	3-Sep-2020	3-Sep-2021
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2020	6-Apr-2021
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	16-Dec-2019	16-Dec-2020

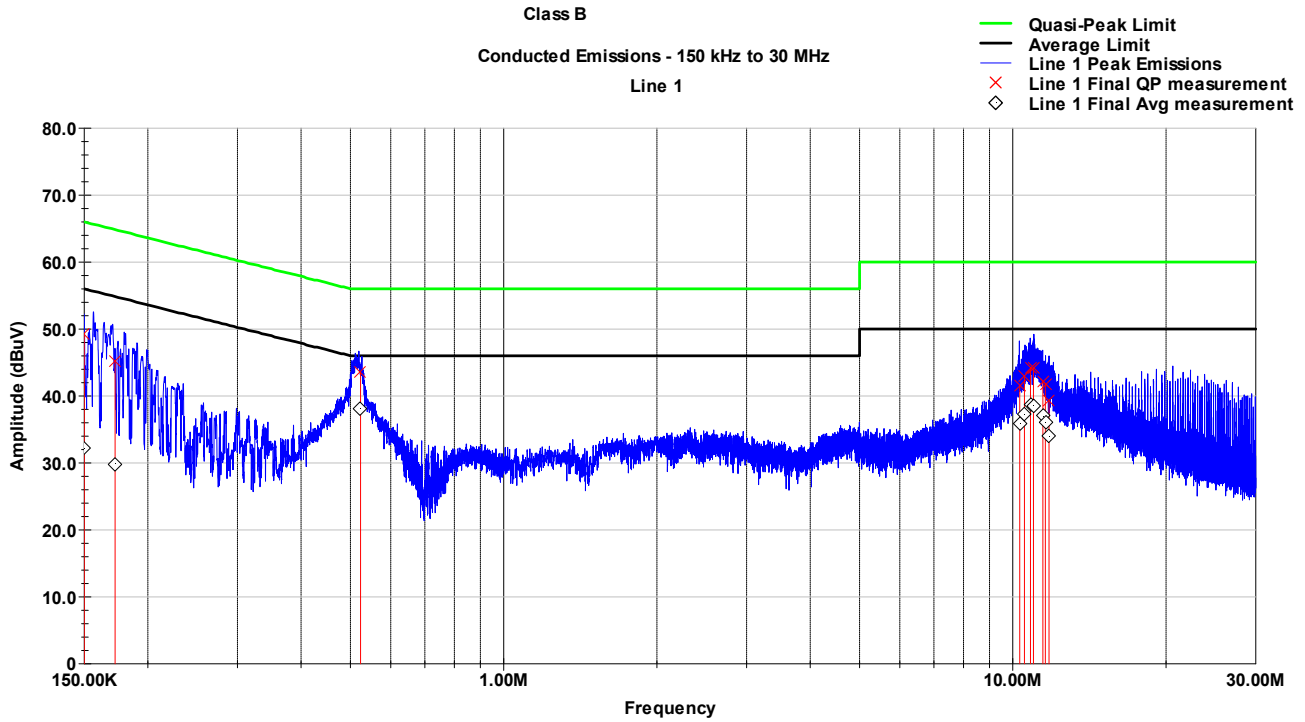
Note: Refer to table for equipment calibration period.

#### Software:

"181112 Conducted Emissions Tile7" TILE! profile dated 12 November 2018

### 8.5 Test Data

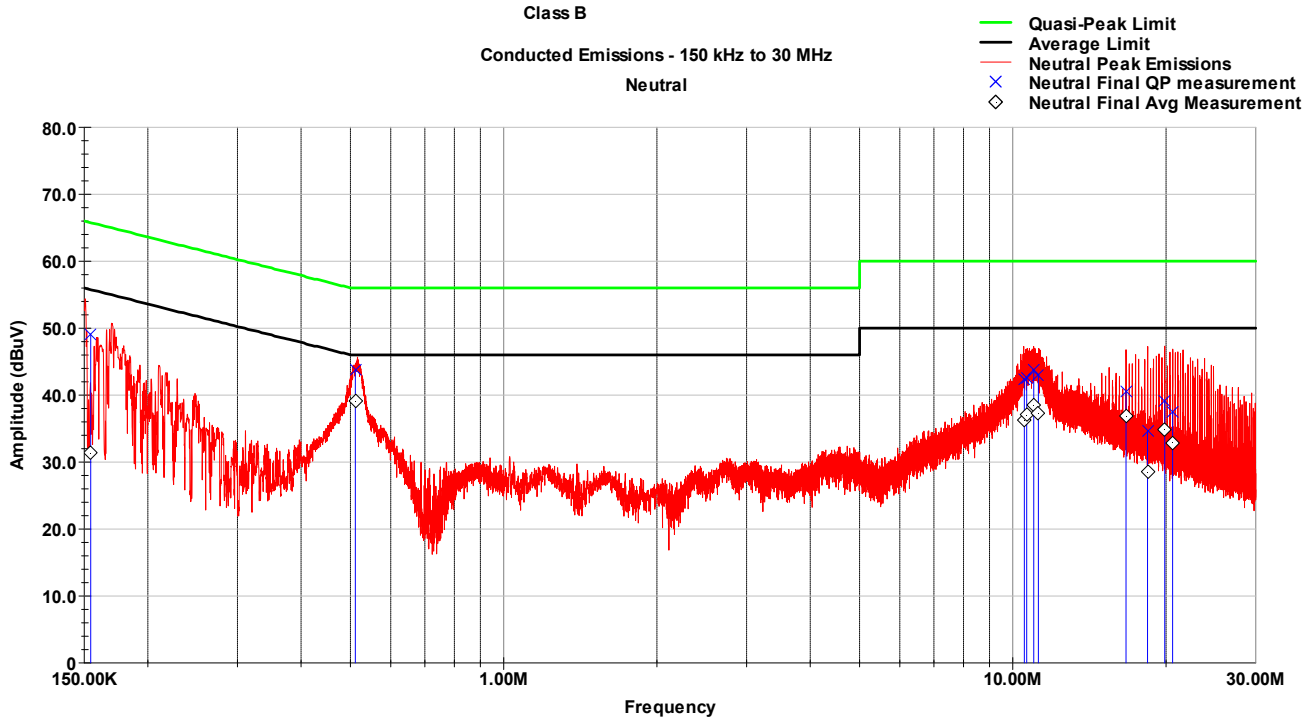
Line 1 Conducted Emissions Plot 150-30MHz (PoE Mode)



Line 1 Conducted Emissions Data 150-30MHz (PoE Mode)

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.150	49.3	66.0	-16.7	32.2	56.0	-23.8
0.172	45.1	64.8	-19.7	29.9	54.9	-25.0
0.523	43.6	56.0	-12.4	38.2	46.0	-7.8
10.319	41.6	60.0	-18.4	35.9	50.0	-14.1
10.540	43.0	60.0	-17.0	37.2	50.0	-12.8
10.832	44.2	60.0	-15.8	38.7	50.0	-11.3
10.981	44.3	60.0	-15.7	38.6	50.0	-11.4
11.459	42.2	60.0	-17.8	37.0	50.0	-13.0
11.582	41.8	60.0	-18.2	36.1	50.0	-13.9
11.779	39.3	60.0	-20.7	34.0	50.0	-16.0

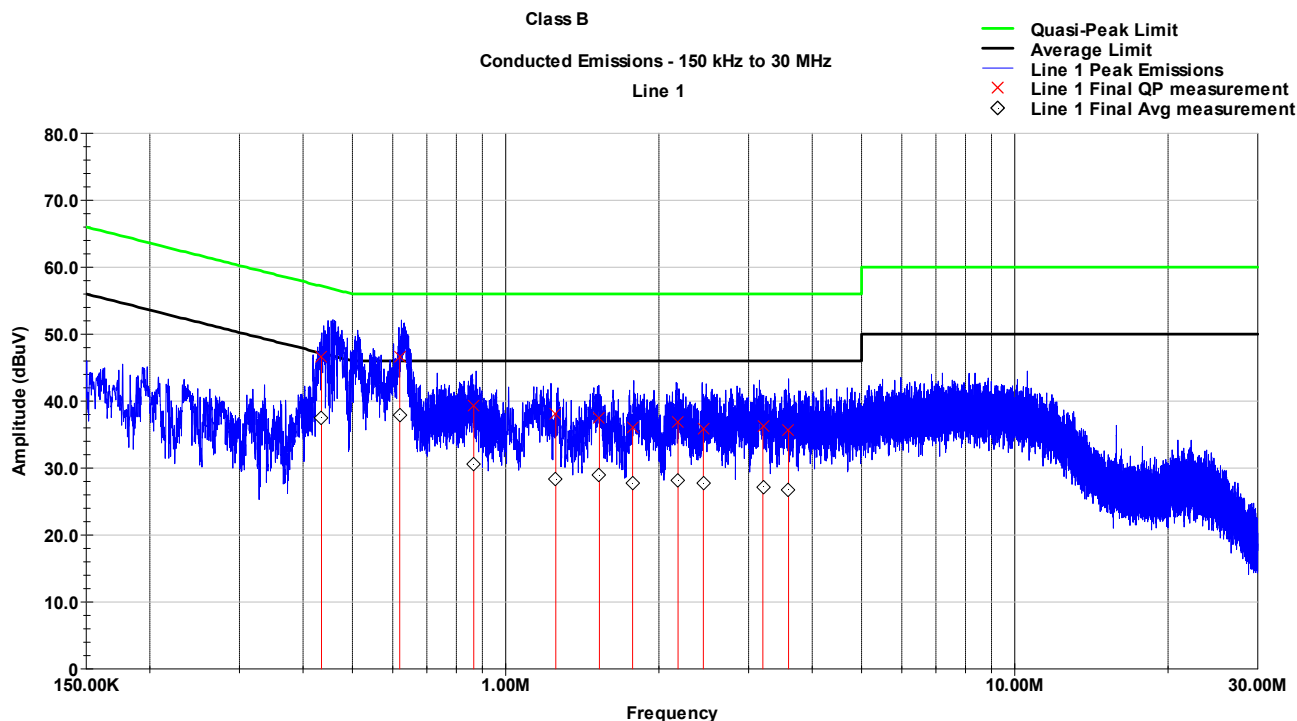
Neutral Conducted Emissions Plot 150-30MHz (PoE Mode)



Neutral Conducted Emissions Data 150-30MHz (PoE Mode)

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.154	49.1	65.7	-16.6	31.3	55.7	-24.4
0.511	43.8	56.0	-12.2	39.0	46.0	-7.0
10.537	42.3	60.0	-17.7	36.3	50.0	-13.7
10.650	42.5	60.0	-17.5	37.0	50.0	-13.0
10.996	43.7	60.0	-16.3	38.5	50.0	-11.5
11.226	43.0	60.0	-17.0	37.3	50.0	-12.7
16.686	40.5	60.0	-19.5	36.9	50.0	-13.1
18.389	34.7	60.0	-25.3	28.5	50.0	-21.5
19.881	39.1	60.0	-20.9	34.9	50.0	-15.1
20.605	37.5	60.0	-22.5	32.9	50.0	-17.1

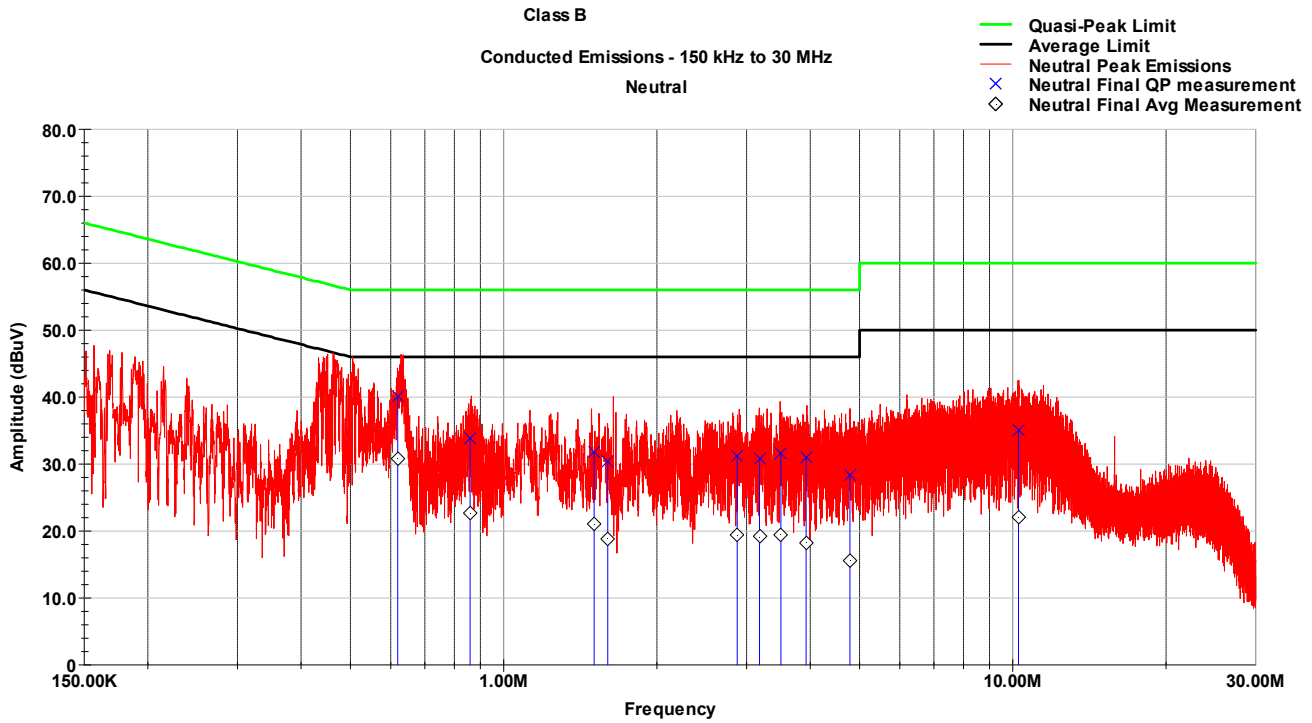
Line 1 Conducted Emissions Plot 150-30MHz (USB Mode)



Line 1 Conducted Emissions Data 150-30MHz (USB Mode)

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.435	46.6	57.2	-10.6	37.5	47.2	-9.7
0.619	46.6	56.0	-9.4	38.0	46.0	-8.0
0.865	39.3	56.0	-16.7	30.5	46.0	-15.5
1.254	38.2	56.0	-17.8	28.3	46.0	-17.7
1.528	37.6	56.0	-18.4	28.9	46.0	-17.1
1.775	36.0	56.0	-20.0	27.7	46.0	-18.3
2.181	36.9	56.0	-19.1	28.1	46.0	-17.9
2.445	35.9	56.0	-20.1	27.7	46.0	-18.3
3.200	36.2	56.0	-19.8	27.2	46.0	-18.8
3.594	35.7	56.0	-20.3	26.8	46.0	-19.2

### Neutral Conducted Emissions Plot 150-30MHz (USB Mode)



Neutral Conducted Emissions Data 150-30MHz (USB Mode)

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.619	40.1	56.0	-15.9	30.8	46.0	-15.2
0.859	33.8	56.0	-22.2	22.7	46.0	-23.3
1.506	31.7	56.0	-24.3	20.9	46.0	-25.1
1.601	30.4	56.0	-25.6	18.9	46.0	-27.1
2.874	31.3	56.0	-24.7	19.4	46.0	-26.6
3.181	30.9	56.0	-25.1	19.1	46.0	-26.9
3.505	31.6	56.0	-24.4	19.5	46.0	-26.5
3.926	31.1	56.0	-24.9	18.2	46.0	-27.8
4.788	28.3	56.0	-27.7	15.6	46.0	-30.4
10.261	35.1	60.0	-24.9	22.0	50.0	-28.0

## 9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial Release	30 SEP 2020