EMC Test Report

Project Number:	**4741567**	**Proposal:**	**11807**
Report Number:	**4741567EMC02**	**Revision Level:**	**1**
Client:	**Cellular Tracking Technologies**		

Equipment Under Test:	**Wireless Tracking Device**
Model Name:	**Tracking device**
Model Number:	**GPT-01**
FCC ID:	**2AY2BGPT1**

Applicable Standards:	**FCC § 15.231 Periodic Operation in the band 40.66-40.77MHz and above 70MHz**
	RSS-210, Issue 10
	RSS-GEN, Issue 5
	ANSI C63.10: 2013

Report issued on:	**26 April 2021**
Test Result:	**Compliant**

Tested by: Brandon Osborn, Project Engineer

Reviewed by: Jeremy Pickens, RF Lab Manager

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	FCC Section 15.203 RSS-GEN Section 8.3	Compliant
20 dB bandwidth	ANSI C63.10, Section 6.9	Compliant
Dwell Time (15.231(e[1]))	ANSI C63.10, Section 7.8.4	Compliant
Field strength of fundamental	ANSI C63.10, Section 6.5	Compliant
Field strength of spurious radiation	ANSI C63.10, Section 6.5	Compliant

Note[1]: EUT transmits every 15 sec and therefore must meet paragraph (e) requirements. See section 1.2 for definition.

1.1 *Modifications Required for Compliance*

None

1.2 *FCC 15.231(e)*

Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emission (microvolts/meter)**
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500[1]	50 to 150[1]
174-260	1,500	150
260-470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

[1]Linear interpolations.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

2 General Information

2.1 *Client Information*

Name: Cellular Tracking Technologies
Address: 1293 Hornet Road, Suite 1
City, State, Zip, Country: Rio Grande, NJ 08242, USA

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
Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01
CAB Identifier: US0186

2.3 *General Information of EUT*

Product Name: Wireless Tracking Device
Model Number: GPT-01
Serial Number: 07 Dec 2020 (Production Date)
Hardware Version: Production
Firmware Version: 114
FCC ID: 2AY2BGPT1

Rated Voltage: 3.0 VDC (CR2032)
Test Voltage: 3.0 VDC

Sample Received Date: 04 March 2021
Dates of testing: 08-09 March 2021

2.4 *Ratings and declarations*

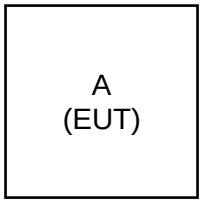
Operation Frequency Range (OFR) TX Mode:	433.95 MHz
TX Channels:	1
Operation Frequency Range (OFR) RX Mode:	-
RX Channels:	-
Channel Bandwidth:	124.2 kHz
Effective radiated power:	79.9 dBuV at 3.0 m
Communication technique:	Digital
Data rate:	25kbps
Modulation:	FSK
Antenna type and gain:	¼ Wave Wire type Omni, 0dBi

2.5 *Operating Modes and Conditions*

Manufacturer provided a sample that continuously transmits when battery is attached. Power level was set to -20dBm.

Other than the fundamental transmission frequency, the highest clock frequency less than 108MHz.

2.6 *EUT Connection Block Diagram*



2.7 *System Configurations*

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Cellular Tracking Technologies	Wireless Tracking device	GPT-01	Dec 07 2020

Note: Date code was used for serial number.

3 Intentional Radiator Antenna Requirement

3.1 *Result*

Test Description	Test Specification	Test Result
Antenna Requirement	FCC 15.203 RSS-GEN S8.3	Compliant

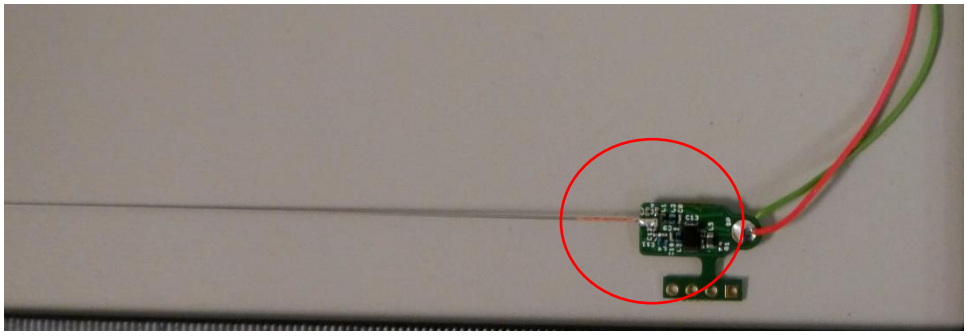
3.2 *Requirement*

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.3 *Conclusion*

The Antenna on this device is a fixed wire type mounted soldered to the main PCB and therefore cannot be easily replaced.

3.4 *Antenna Photograph*



4 Field Strength of Fundamental

4.1 *Test Result*

Test Description	Test Specification	Test Result
Field strength of fundamental	ANSI C63.10 Section 6.5	Compliant

4.2 *Test Method*

The test data was measured using a Peak detector. Average measurements were made by correcting the peak value with the duty cycle correction factor. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHz and higher. Measurements were made with the antenna positioned at a 3m distance from the EUT in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

The radiation measurements were performed in X, Y, Z axis positioning.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Limits for EUT were reduced to meet 15.231(e) since transmission timing is fixed to 15 seconds.

§15.231 e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following;

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emission (microvolts/meter)**
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500[1]	50 to 150[1]
174-260	1,500	150
260-470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

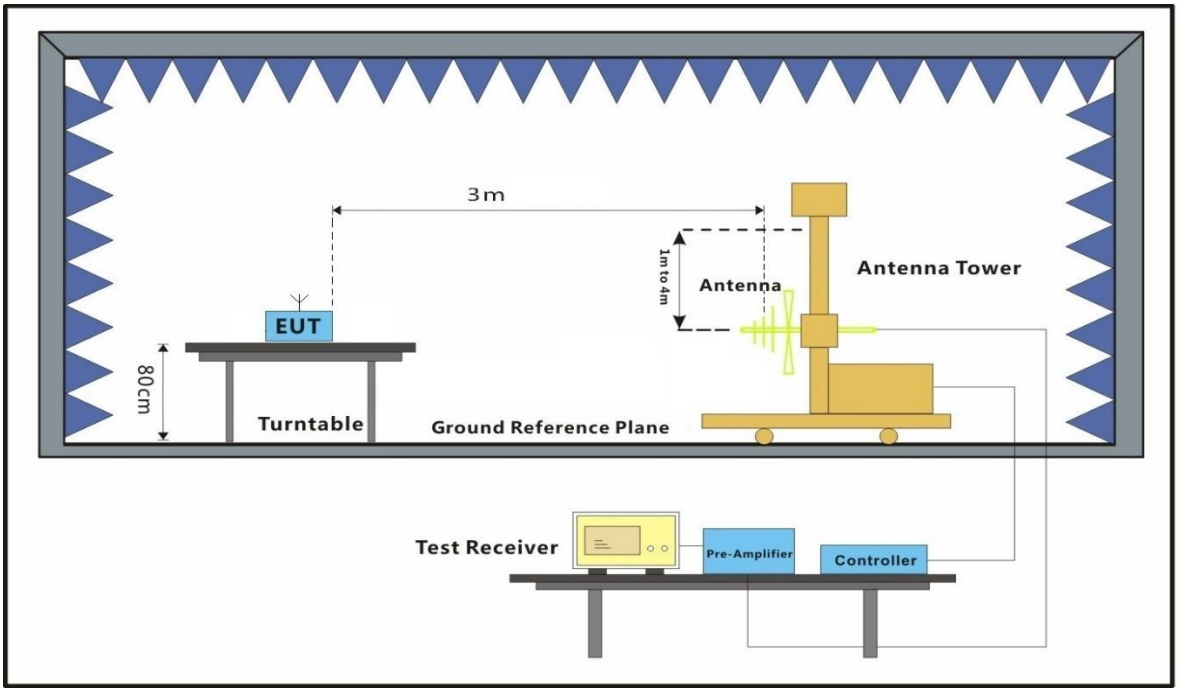
RSS-210 Section A.1.3 a) Devices may not meet the requirements in section A.1.1 and may be employed for any type of operation, provided the device complies with the requirements of section A.1.3 and the field strength corresponds with the limits specified in table A2.

d) Unwanted emissions shall be 10 times (20dB) below the fundamental emissions field strength limits in table A2 or comply with the general field strength limits specified in RSS-Gen, whichever is less stringent.

Table A2 — Reduced field strength limits for momentarily operated devices

Fundamental frequency (MHz), excluding restricted frequency bands specified in RSS-Gen	Field strength of the fundamental emissions (µV/m at 3 m)
70-130	500
130-174	500 to 1,500*
174-260**	1,500
260-470**	1,500 to 5,000*
Above 470	5,000

4.3 *Test Setup Diagram*



4.4 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions	Mar 09	Mar 15
Temperature:	23.9 °C	24.2 °C
Relative Humidity:	18.3 %	32.7 %
Atmospheric Pressure:	99.50 kPa	98.52 kPa

4.5 *Test Equipment*

Duty Cycle

Test End Date: 15-Mar-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2020	6-Apr-2021
Near Field Probes	N/A	Com-Power Corporation	16016	CNR	CNR
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079800	25-Sep-2020	25-Sep-2021
RF CABLE	104PE	HUBER & SUHNER	B079793	3-Sep-2020	3-Sep-2021

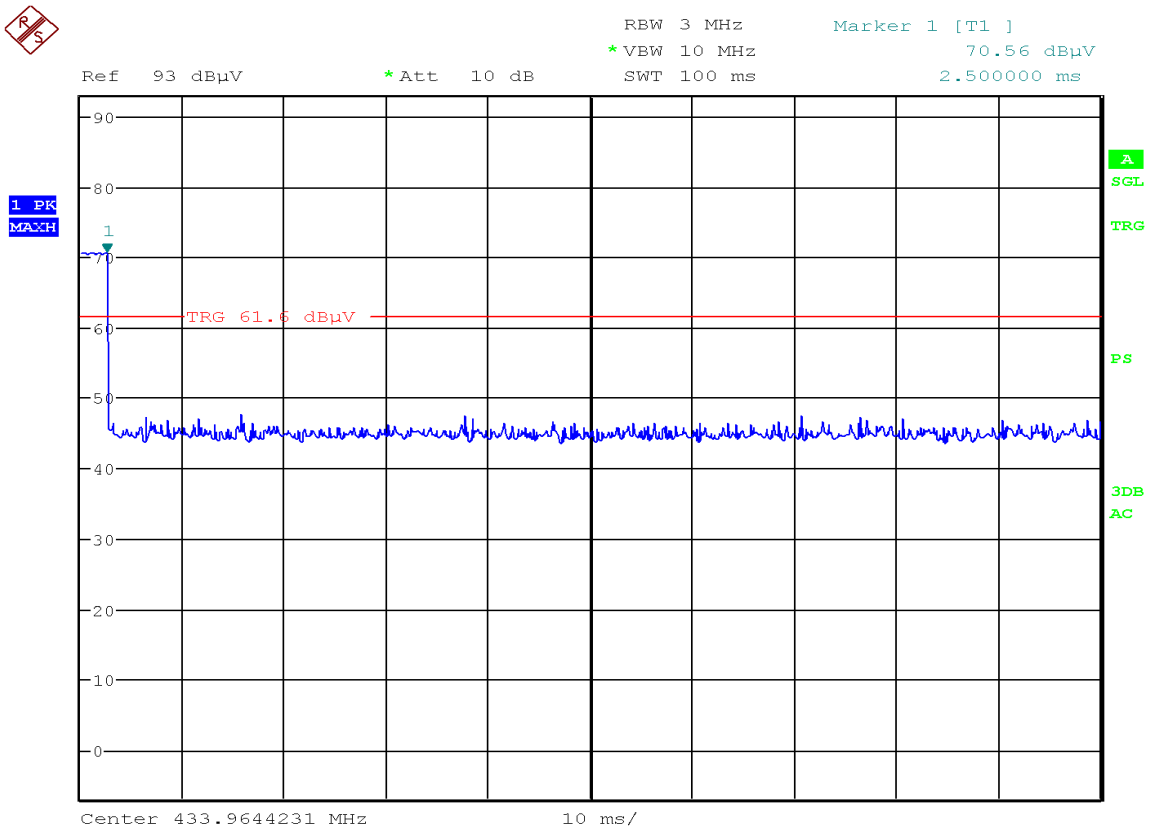
Field Strength

Test Date: 9-Mar-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2020	7-May-2021
RF CABLE	SF106	Huber & Suhner	B085903	28-Sep-2020	28-Sep-2021
RF CABLE	SF106	HUBER & SUHNER	B079713	3-Sep-2020	3-Sep-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	18-Feb-2021	18-Feb-2022
RF CABLE	104PE	HUBER & SUHNER	B079793	3-Sep-2020	3-Sep-2021
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	24-Nov-2020	24-Nov-2021

4.6 *Duty Cycle Correction Factor (DCCF)*

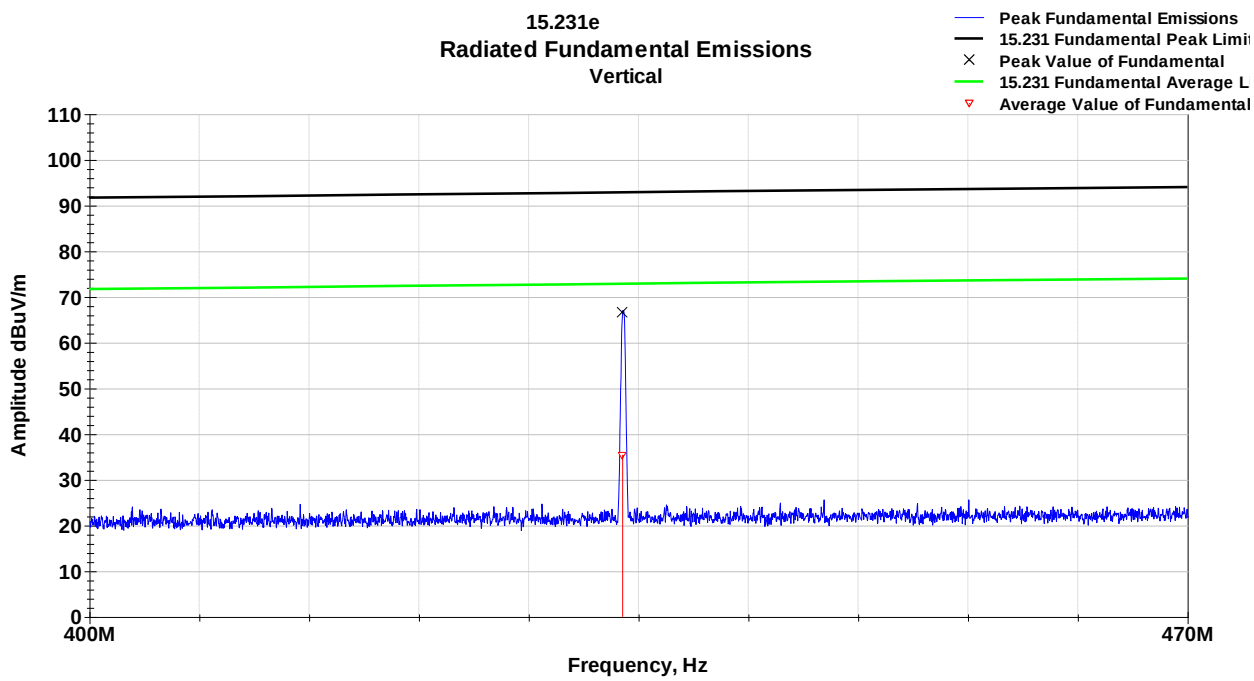
Duty Cycle				
Configuration	TX ON (ms)	Period, T (ms)	Duty Cycle (%)	DCCF (dB)
433.964 MHz	2.72	100	2.72 %	-31.3



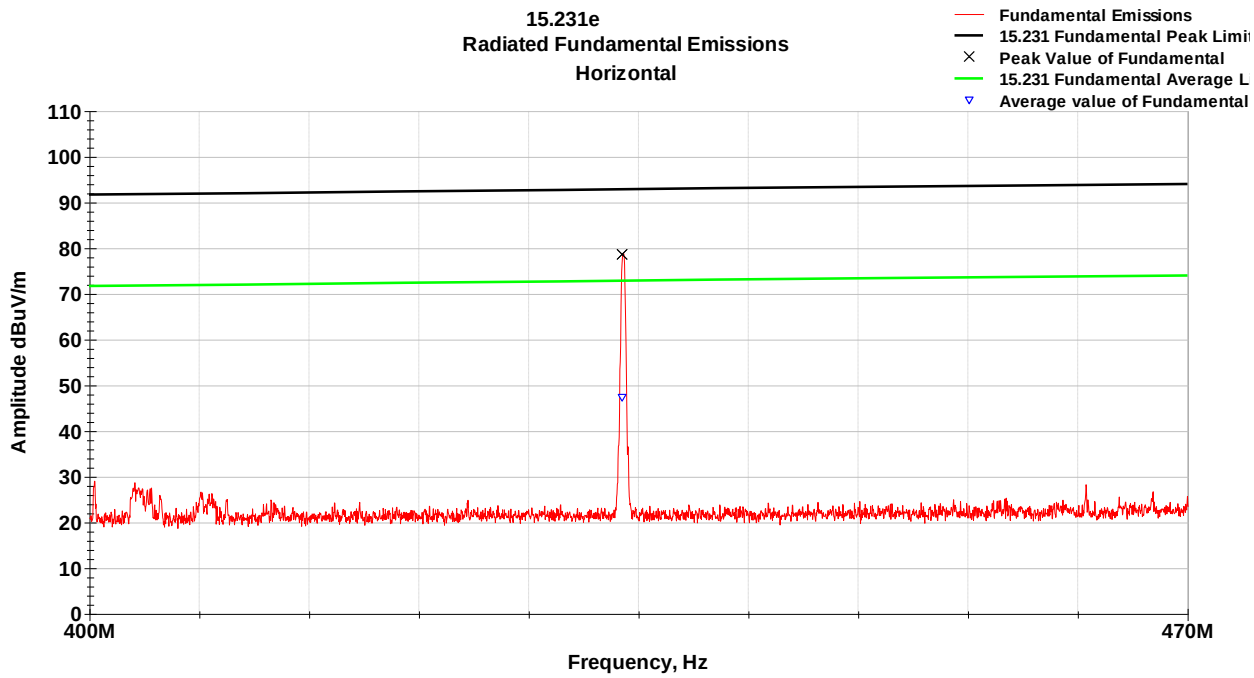
Date: 15.MAR.2021 13:30:03

4.7 *Test Data*

4.7.1 X-axis

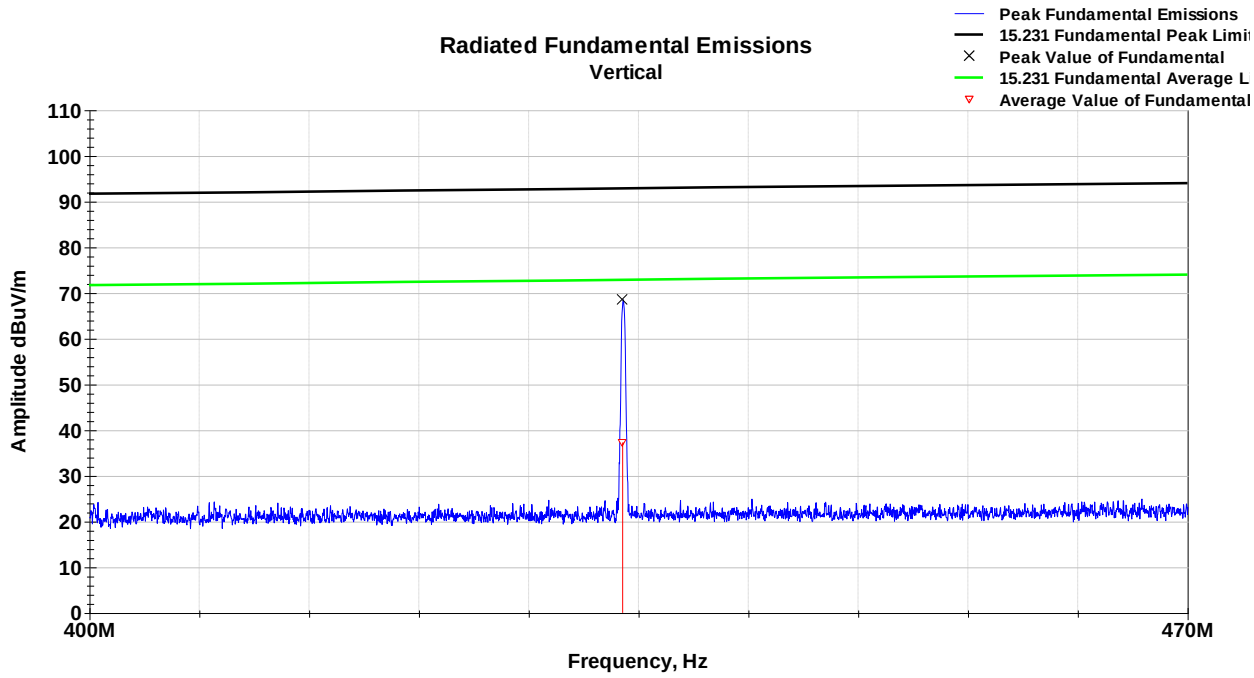


Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Avg Margin (dB)
433.99	V	67.7	92.9	-25.2	-31.3	36.4	72.9	-36.5
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								

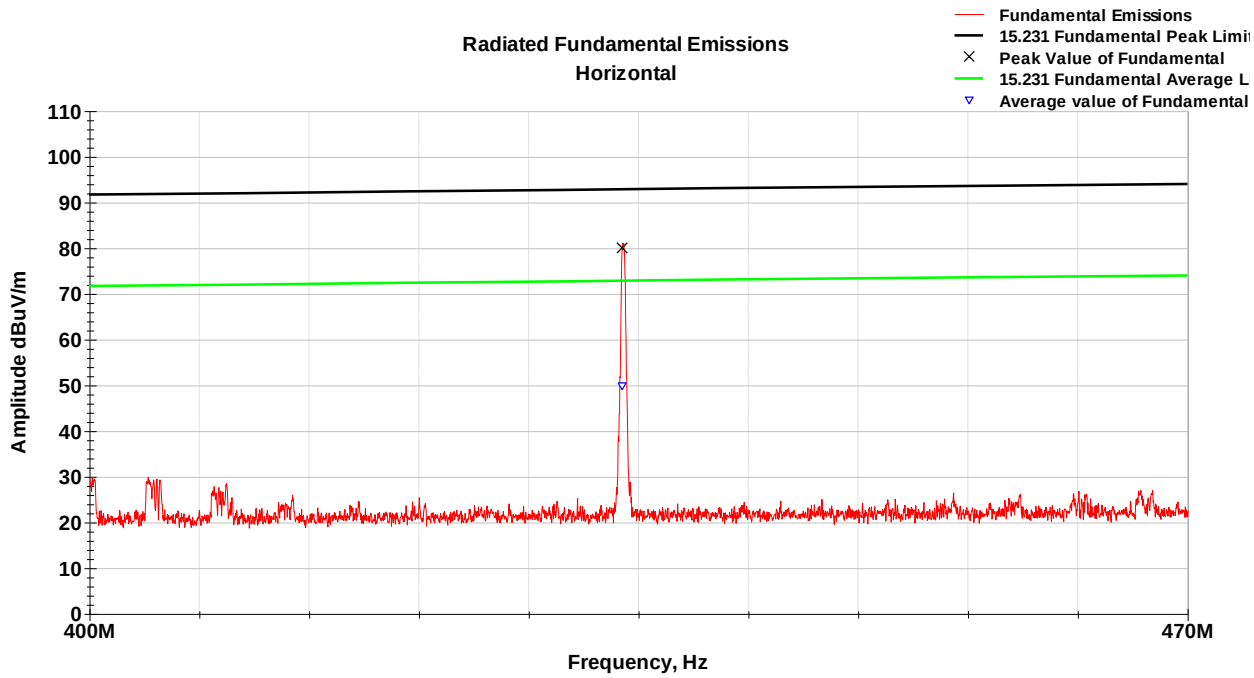


Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Avg Margin (dB)
434.02	H	78.3	92.9	-14.6	-31.3	47.0	72.9	-25.9
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								

5.1.1 Y-axis

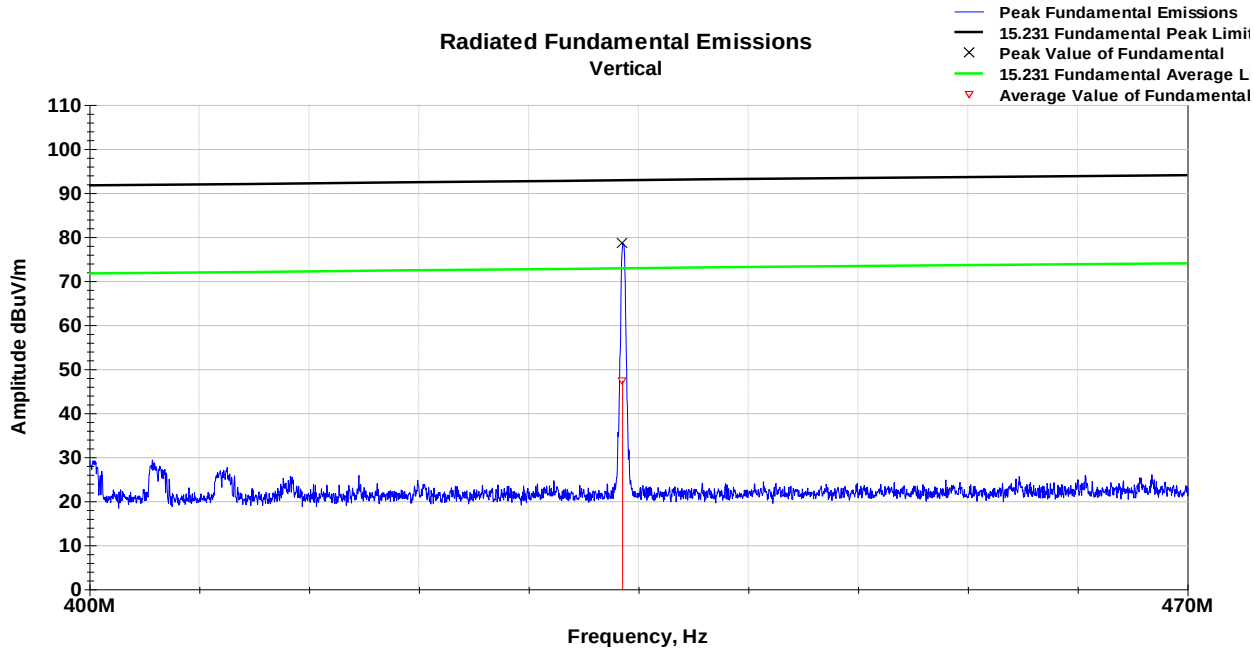


Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Avg Margin (dB)
433.95	V	69.9	92.9	-23.0	-31.3	38.6	72.9	-34.3
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								

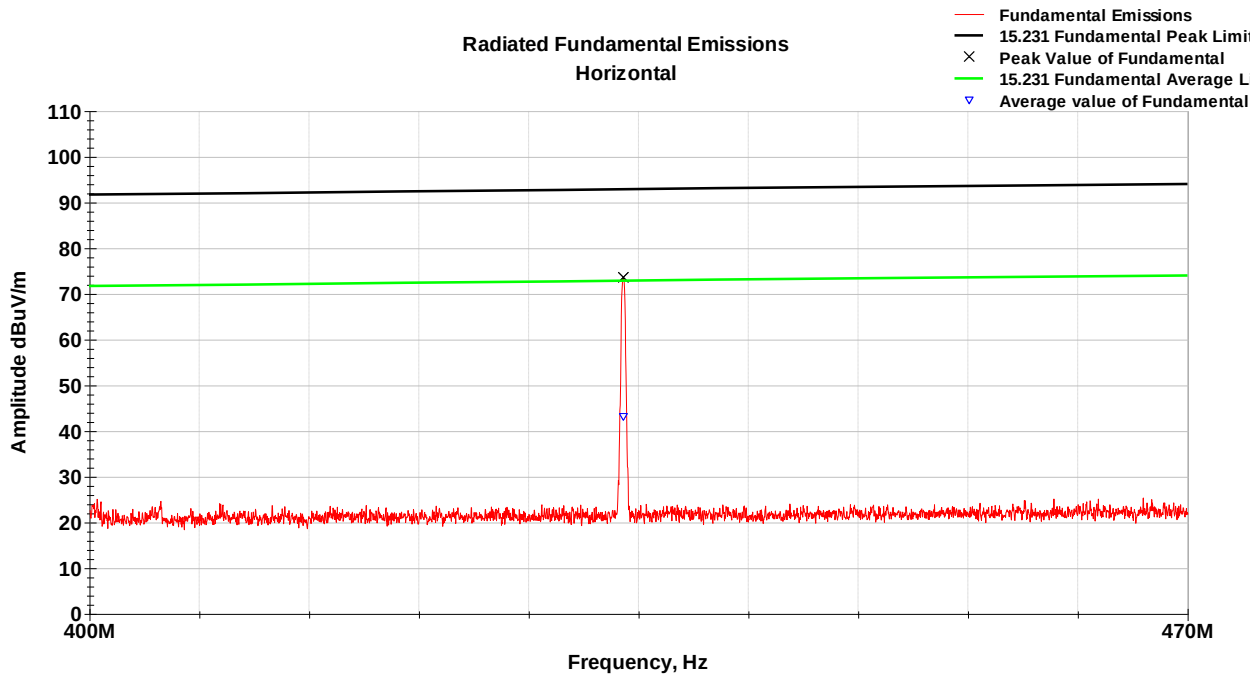


Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Avg Margin (dB)
434.08	H	79.9	92.9	-13.0	-31.3	48.6	72.9	-24.3
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								

5.1.2 Z-axis



Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Avg Margin (dB)
434.02	V	78.6	92.9	-14.3	-31.3	47.3	72.9	-25.6
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								



Frequency MHz	Polarity (V/H)	Peak Value (dBuV/m)	Peak Limit (dBuV/m)	Pk Margin (dB)	DCCF (dB)	Avg Value (dBuV/m)	Avg Limit (dBuV/m)	Avg Margin (dB)
434.02	H	73.5	92.9	-19.4	-31.3	42.2	72.9	-30.7
Peak Value = Level + Antenna Factor + Cable Loss - Amp								
Average Value = Peak Value + DCCF								
Margin = Value - Limit								

6 Field Strength of Spurious Radiation

6.1 *Test Result*

Test Description	Test Specification	Test Result
Field strength of spurious radiation	ANSI C63.10, Section 6.5	Compliant

6.2 *Test Method*

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. For harmonics of the fundamental, Average measurements were made by correcting the peak value with the duty cycle correction factor. For emissions other than harmonics of the fundamental, the Average measurements were made using the Average detector. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHz and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

The device was oriented in each of its orthogonal axes and data for each was reported.

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emission (microvolts/meter)**
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500[1]	50 to 150[1]
174-260	1,500	150
260-470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

6.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature:	23.9 °C
Relative Humidity:	18.3 %
Atmospheric Pressure:	99.52 kPa

6.4 *Test Equipment*

30-1000MHz

Test Date: 9-Mar-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2020	7-May-2021
RF CABLE	SF106	Huber & Suhner	B085903	28-Sep-2020	28-Sep-2021
RF CABLE	SF106	HUBER & SUHNER	B079713	3-Sep-2020	3-Sep-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	18-Feb-2021	18-Feb-2022
RF CABLE	104PE	HUBER & SUHNER	B079793	3-Sep-2020	3-Sep-2021
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	24-Nov-2020	24-Nov-2021

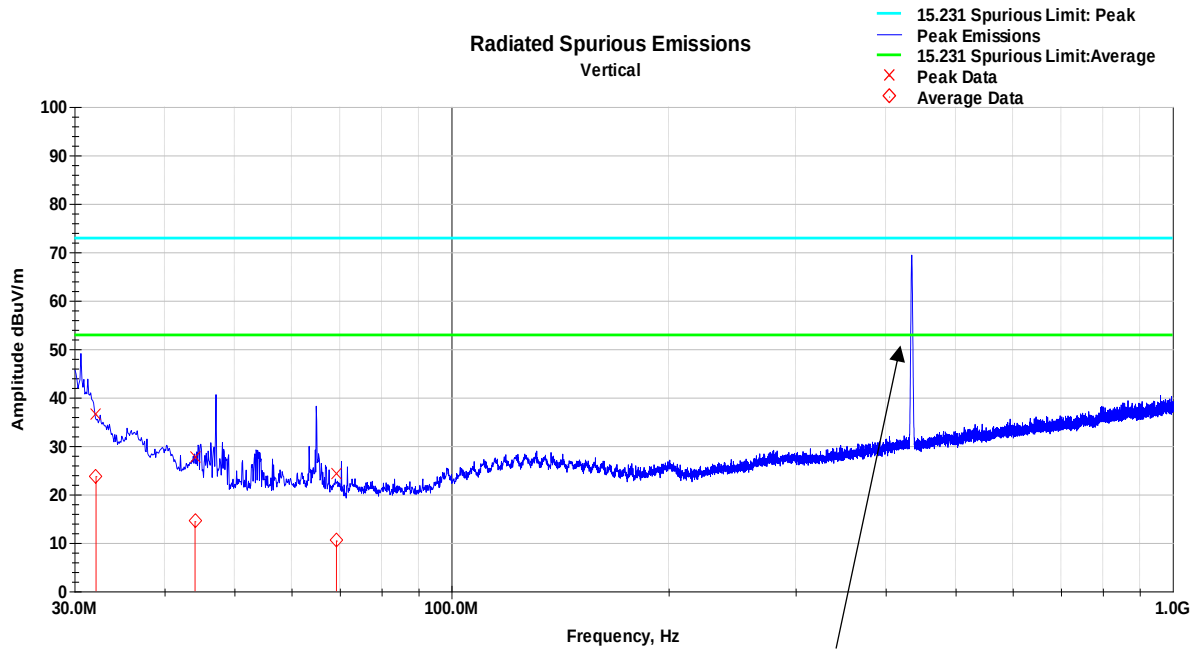
Above 1GHz

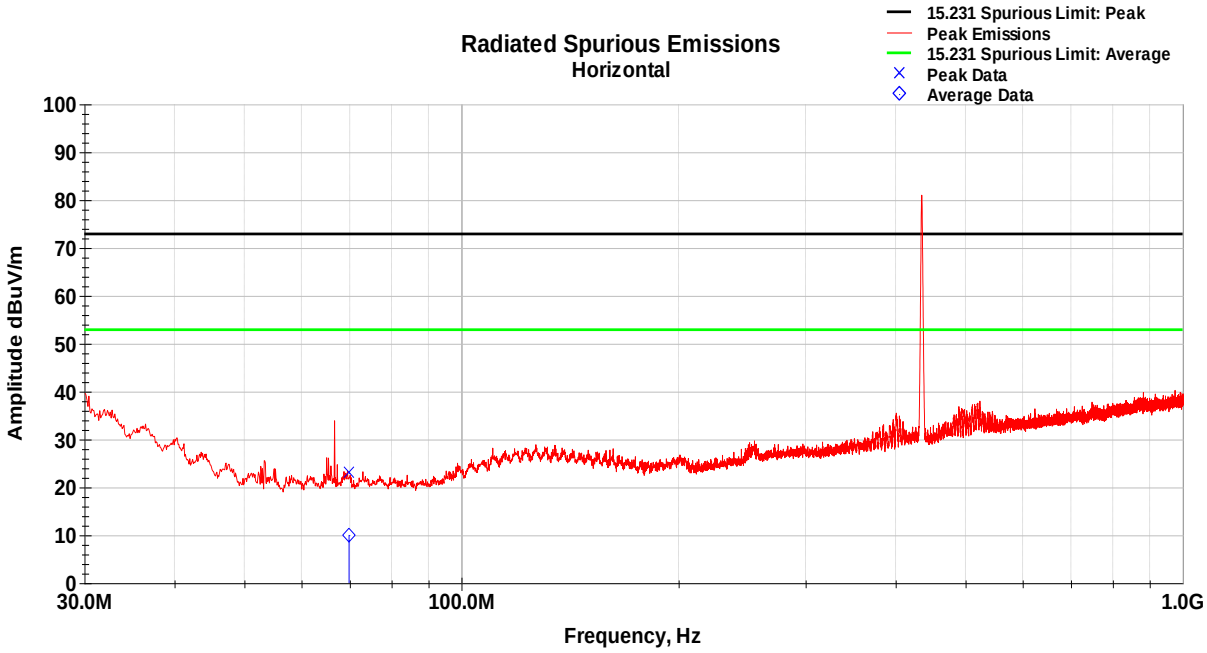
Test Date: 9-Mar-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2020	7-May-2021
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	24-Nov-2020	24-Nov-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-157	TELEDYNE STORM MICROWAVE	20121	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20125	17-Feb-2021	17-Feb-2022
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079691	10-Aug-2020	10-Aug-2022

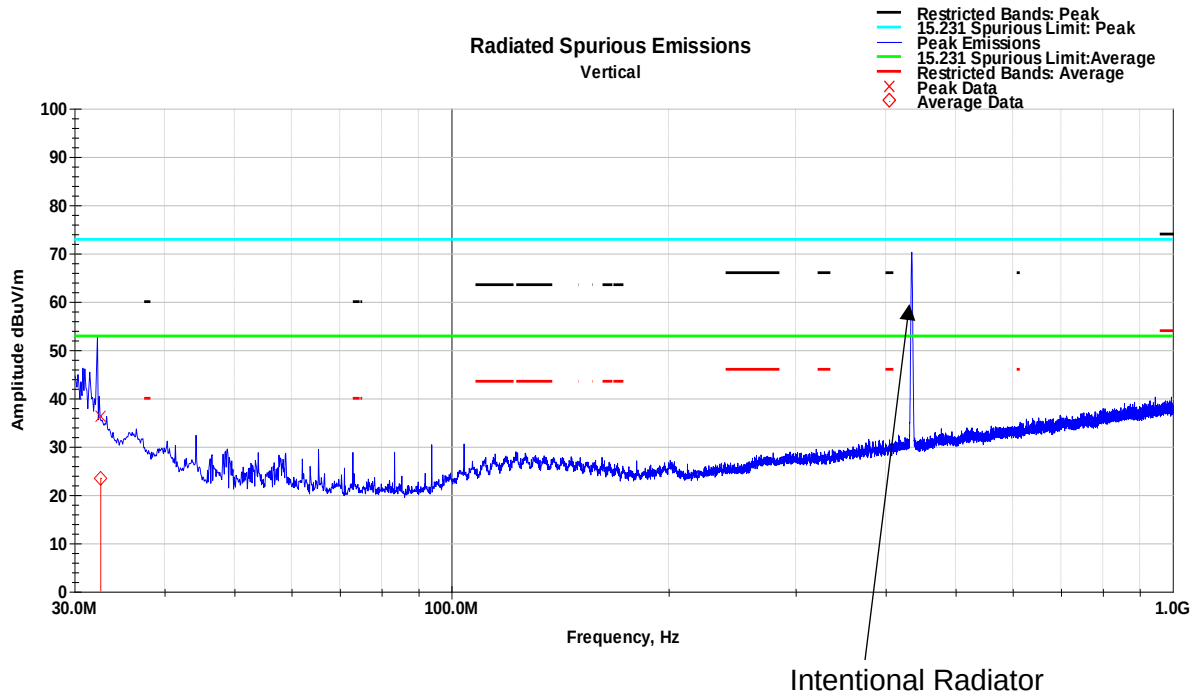
6.5 *Test Data – 30 MHz to 1 GHz*

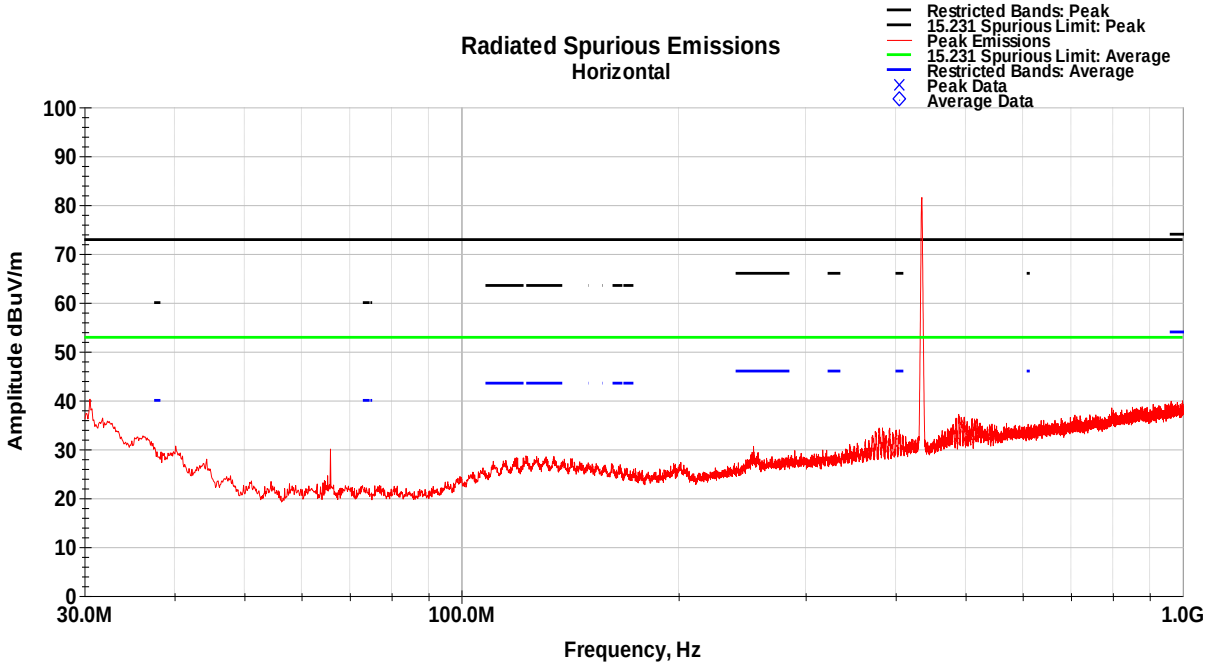
X-Axis



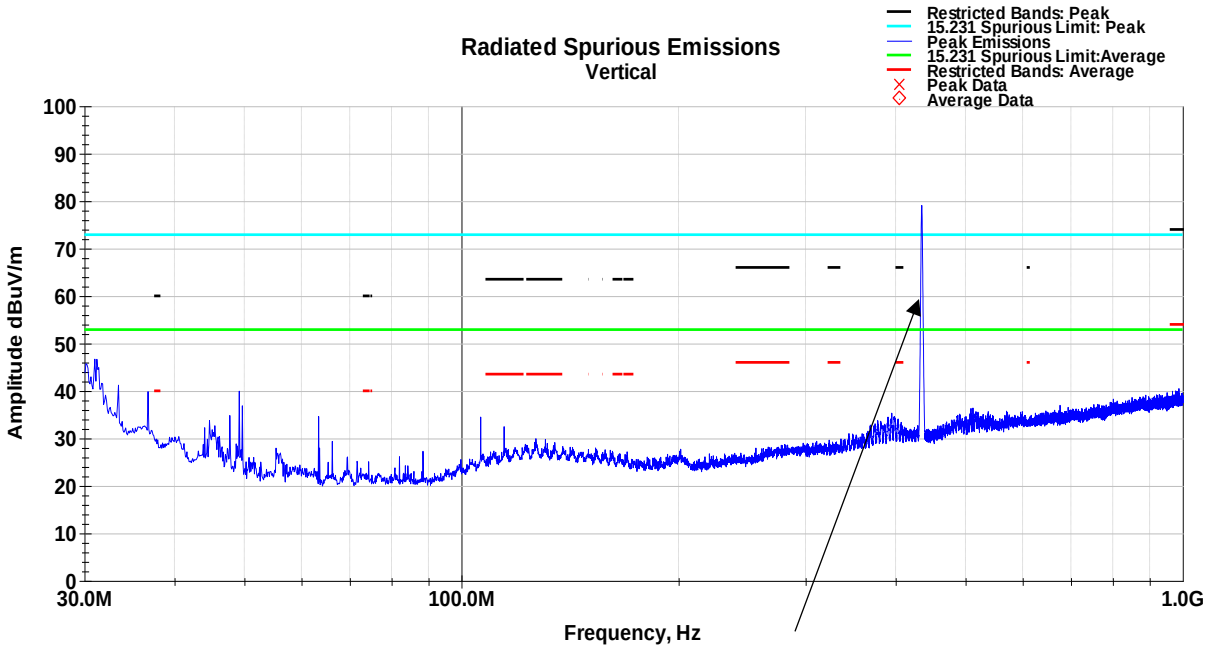


Y-Axis

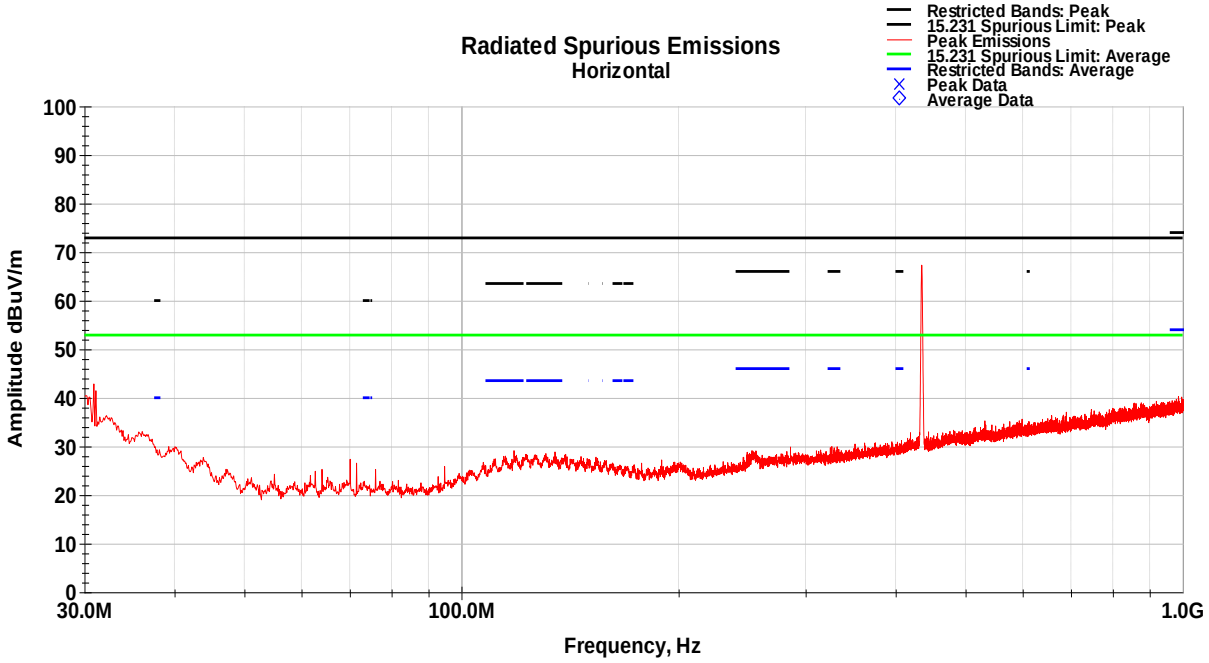

Radiated Spurious Emissions
Vertical
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit:Average
Restricted Bands: Average
Peak Data
Average Data
Amplitude dBuV/m
Frequency, Hz
30.0M
100.0M
1.0G
Intentional Radiator


Radiated Spurious Emissions
Horizontal
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit: Average
Restricted Bands: Average
Peak Data
Average Data
Amplitude dBuV/m
Frequency, Hz
30.0M
100.0M
1.0G

Z-Axis

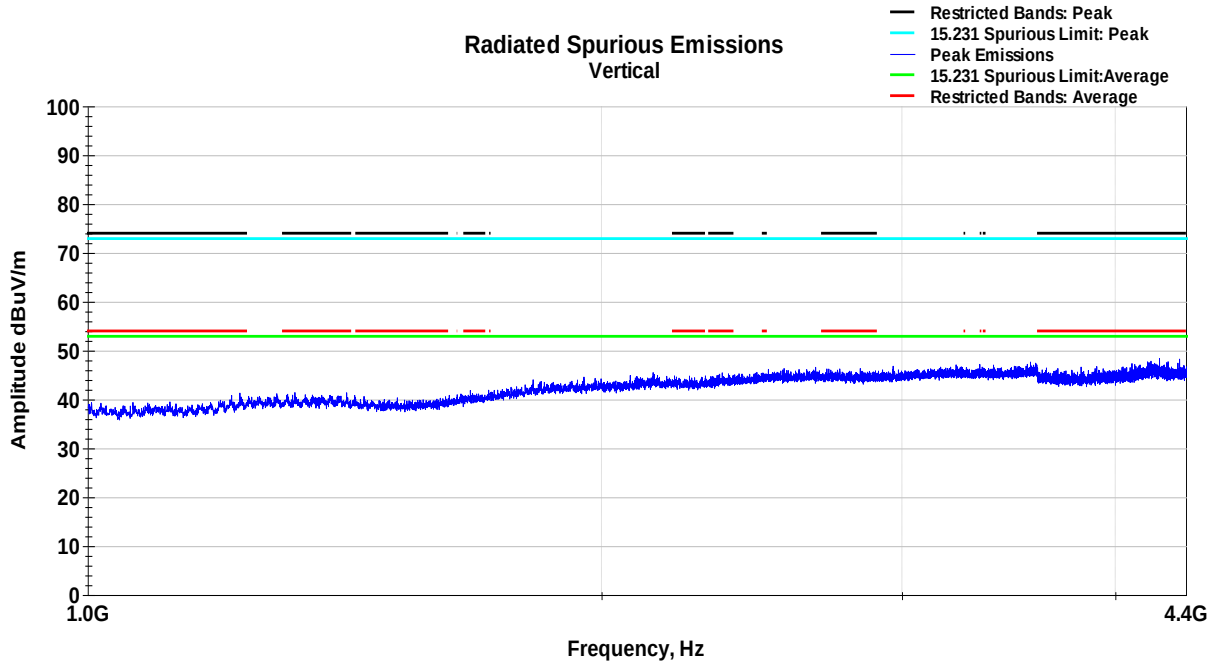


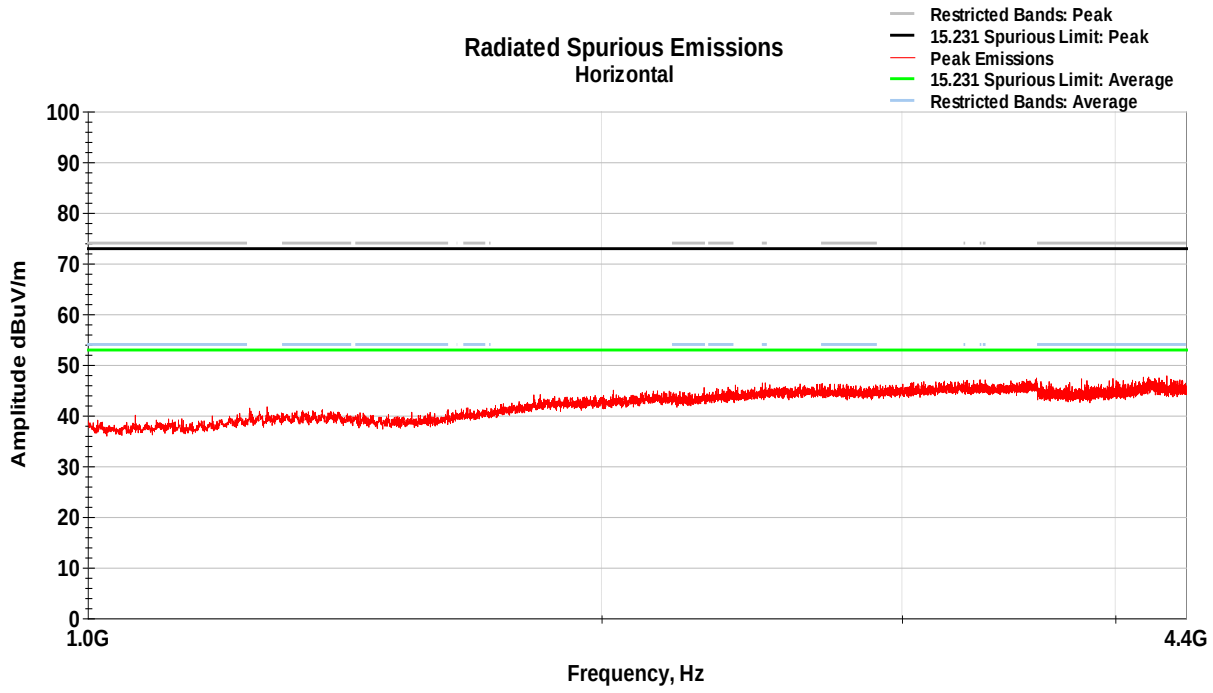
Intentional Radiator



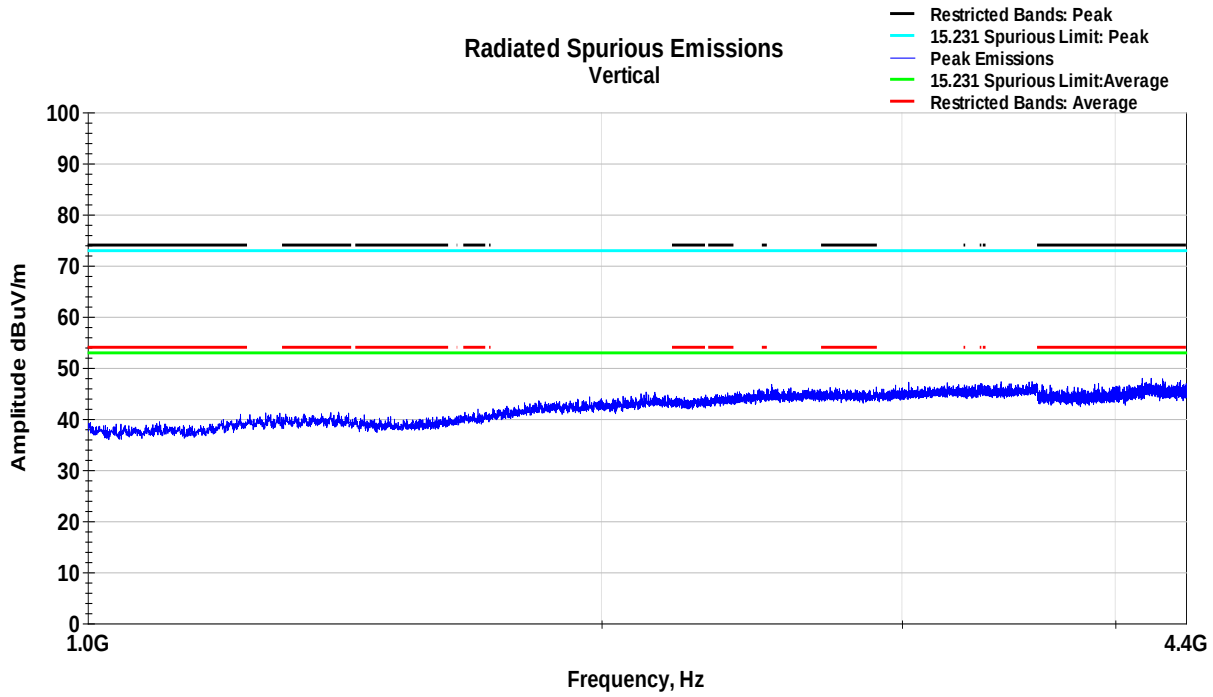
6.6 *Test Data –1 GHz to 4.4 GHz*

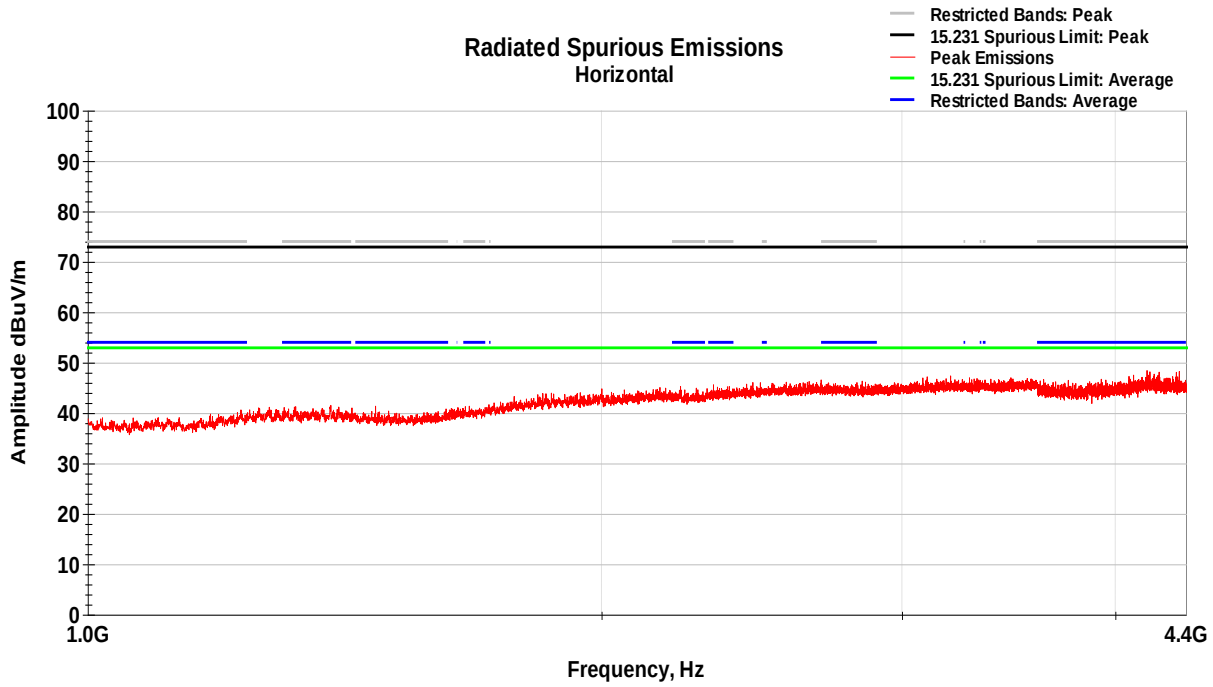
X-Axis



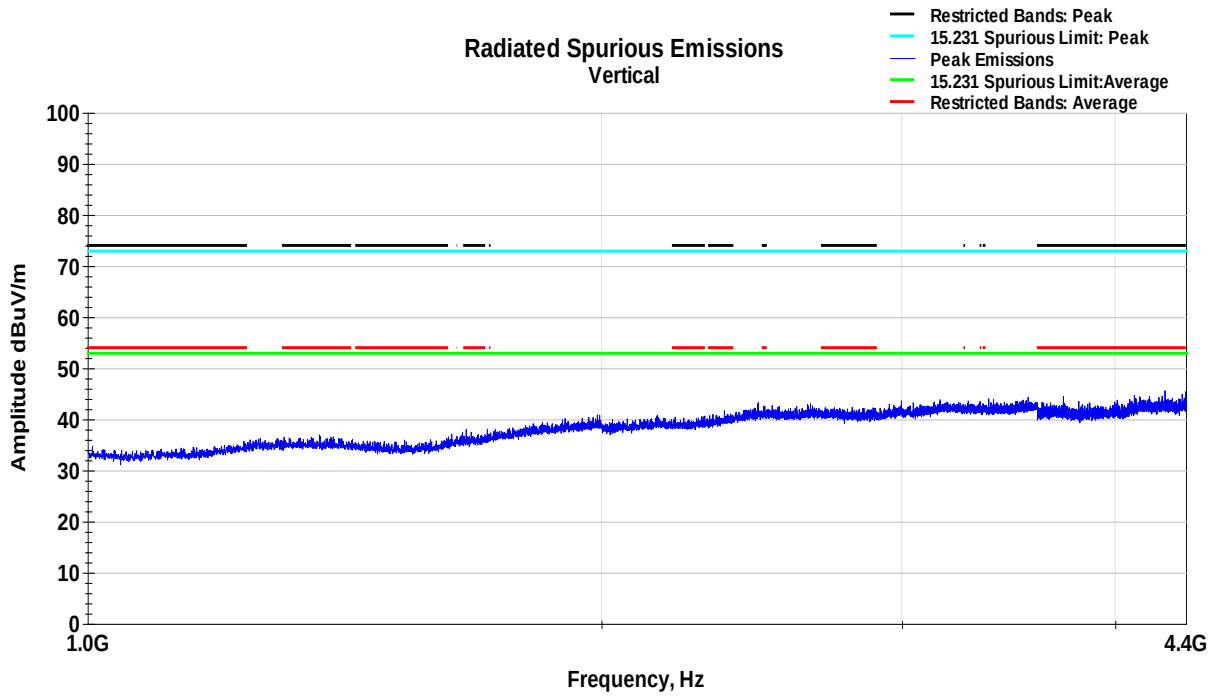


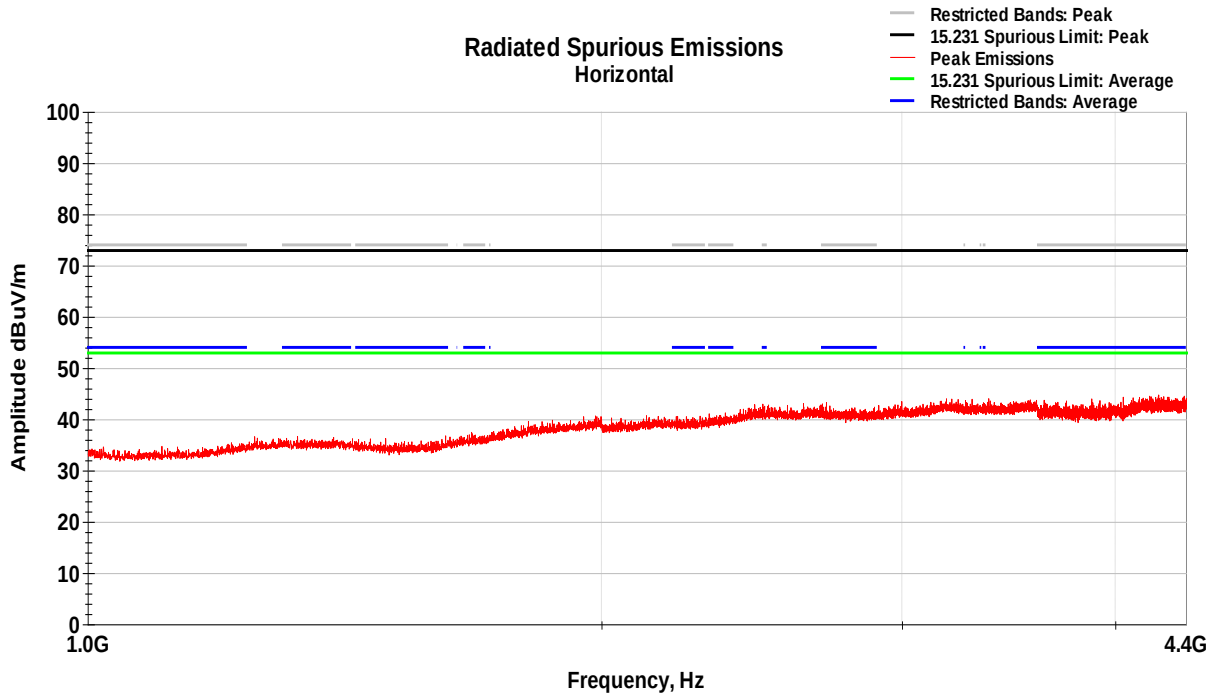
Y-Axis


Radiated Spurious Emissions
Vertical
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit:Average
Restricted Bands: Average
Amplitude dBuV/m
100
90
80
70
60
50
40
30
20
10
0
1.0G
4.4G
Frequency, Hz


Radiated Spurious Emissions
Horizontal
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit: Average
Restricted Bands: Average
Amplitude dBuV/m
100
90
80
70
60
50
40
30
20
10
0
1.0G
4.4G
Frequency, Hz

Z-Axis


Radiated Spurious Emissions
Vertical
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit:Average
Restricted Bands: Average
Amplitude dBuV/m
100
90
80
70
60
50
40
30
20
10
0
1.0G
4.4G
Frequency, Hz


Radiated Spurious Emissions
Horizontal
Restricted Bands: Peak
15.231 Spurious Limit: Peak
Peak Emissions
15.231 Spurious Limit: Average
Restricted Bands: Average
Amplitude dBuV/m
100
90
80
70
60
50
40
30
20
10
0
1.0G
4.4G
Frequency, Hz

7 20 dB Bandwidth

7.1 *Test Result*

Test Description	Basic Standards	Test Result
20 dB bandwidth	ANSI C63.10 Section 6.9	Compliant

7.2 *Test Method*

The procedures from ANSI C63.10 (2013) clause 6.9 were used to determine the 20 dB bandwidth.

7.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.9 °C
Relative Humidity: 36.8 %
Atmospheric Pressure: 98.52 kPa

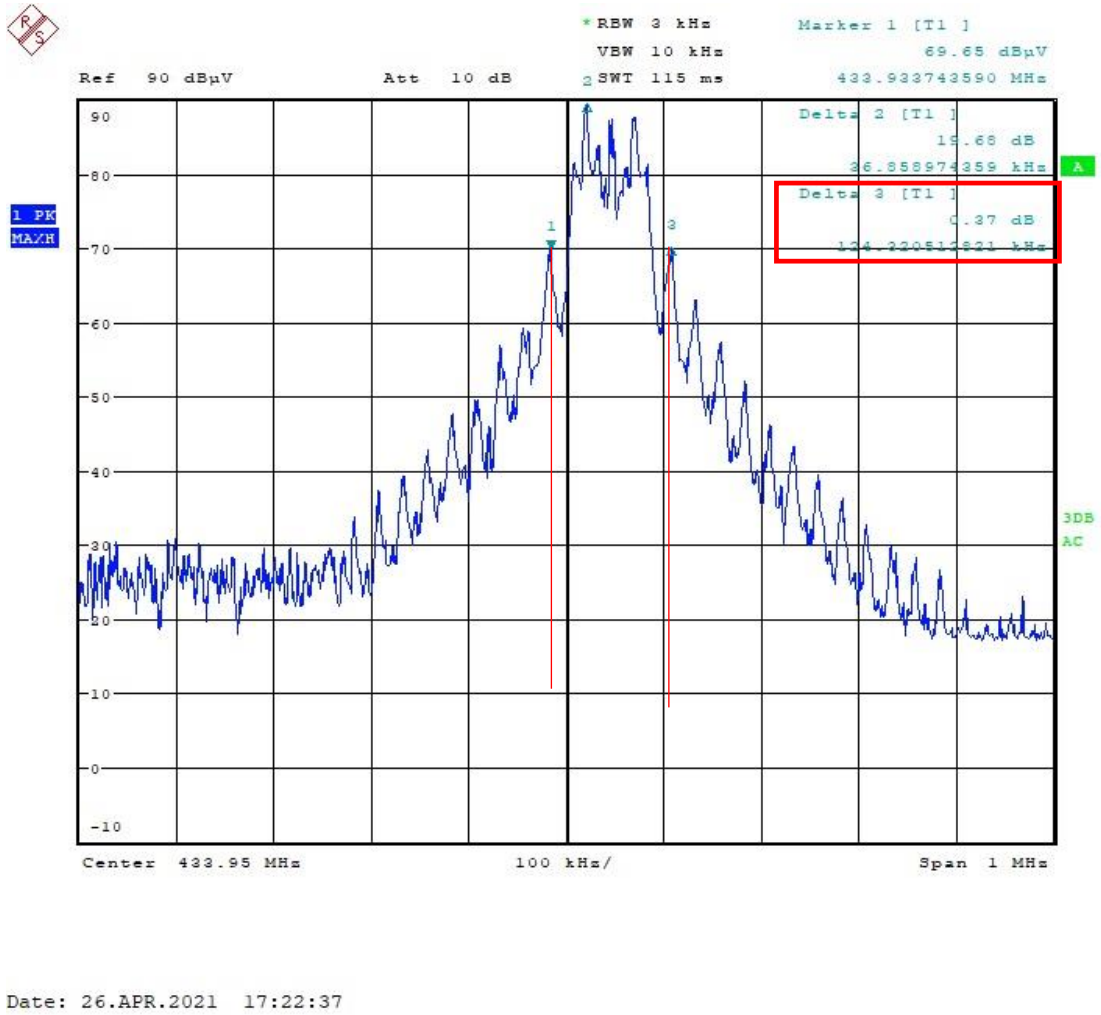
7.4 *Test Equipment*

Test End Date: 26-Apr-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2020	7-May-2021

7.5 *Test Data*

20 dB Bandwidth Plot



20dB BW = 124.22kHz

8 Dwell Time

8.1 *Test Result*

Test Description	Basic Standards	Test Result
Dwell Time <5sec	ANSI C63.10:2013, Section 7.8.4	Compliant

8.2 *Test Method*

ANSI C63.10, Section 6.9 was used for test method.

From FCC Part 15.231 (e) - devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

From RSS-210 A.1.4 b - devices operated under the provisions of this section shall be capable of automatically limiting their operation so that the duration of each transmission is not greater than 1 second and the silent period between transmissions is at least 30 times the duration of the transmission, but not less than 10 seconds under any circumstances.

Note: 30 * 2.72ms = 81.6ms, so 10 seconds was the applied limit for time between transmissions

8.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	24.2 °C
Relative Humidity:	32.7 %
Atmospheric Pressure:	98.52 kPa

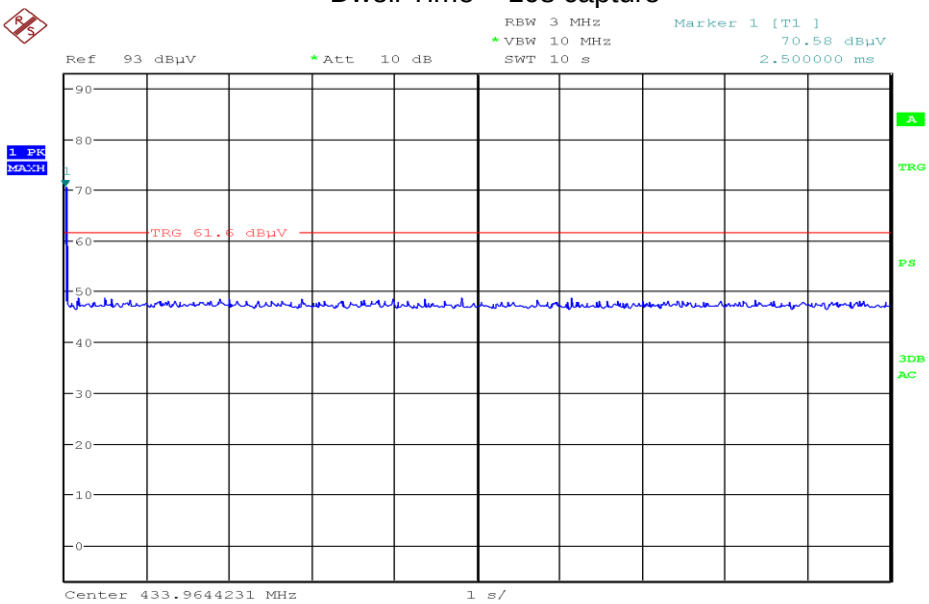
8.4 *Test Equipment*

Test End Date: 15-Mar-2021 Tester: BEO

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2020	6-Apr-2021
Near Field Probes	N/A	Com-Power Corporation	16016	CNR	CNR
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079800	25-Sep-2020	25-Sep-2021
RF CABLE	104PE	HUBER & SUHNER	B079793	3-Sep-2020	3-Sep-2021

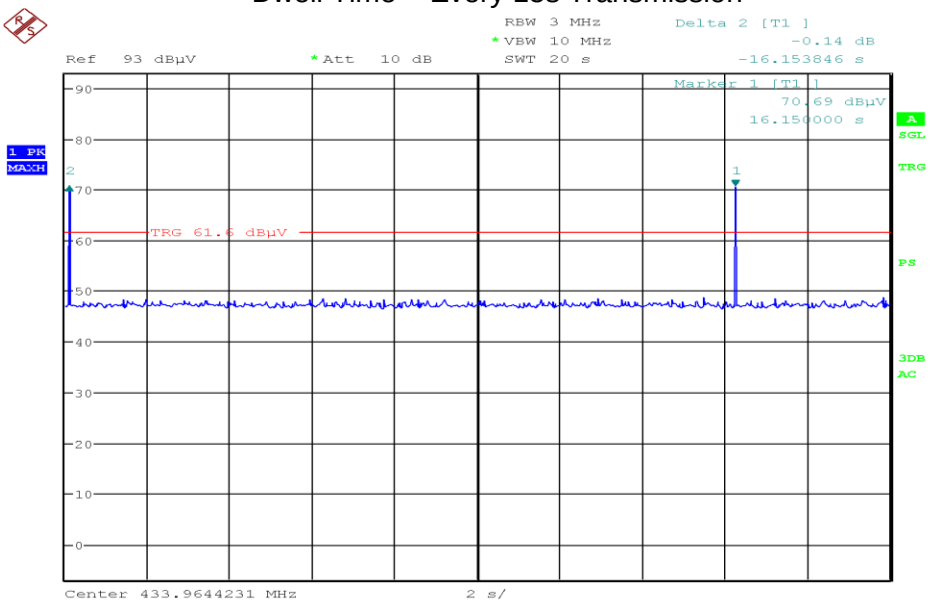
8.5 *Test Data*

Dwell Time – 10s capture



Date: 15.MAR.2021 13:35:03

Dwell Time – Every 15s Transmission



Date: 15.MAR.2021 13:42:10

8.6 *Timing Tables*

Per FCC 15.231e and RSS-210 A.1.4 b)

Individual Transmission

Time On (ms)	Limit (ms)	Result
2.72	< 1000	Pass

Off Period

Time On (ms)	Time Off (ms)	Time Off Minimum (ms)	Result
2.72	16150	>10000	Pass

9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	24 March 2021
1	Updated Summary to 15.231(e) with explanation in Section 1.2. Updated 20dB plot and C63.10 version in Section 7.	26 April 2021