

EMC Test Report

Project Number: 4967994 **Proposal Number:** SUW-202209003414

Report Number: 4967994EMC02 **Revision Level:** 1

Client: Refrigerated Transport Electronics, Inc.

Equipment Under Test: Remote for Wireless Door Sensor

Model Name: Wireless Door Sensor

Model Number: 1H4468RHF

FCC ID: 2A2YD1H4468RHF

Applicable Standards: §15.231 Periodic Operation in the band 40.66-40.77MHz
and above 70MHz

ANSI C63.10:2013

Report issued on: 18 October 2022

Test Result: Compliant



FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

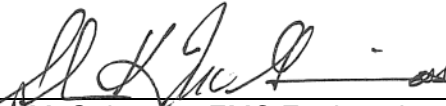
Report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by:



Brandon Osborn, Project Engineer

Reviewed by:



Shawn McGuinness, EMC Engineering Leader

Remarks: This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. And for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/terms-e-document.aspx>.

Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for a maximum of 30 days only.

Table of Contents

1	SUMMARY OF TEST RESULTS	3
1.1	MODIFICATIONS REQUIRED FOR COMPLIANCE	3
2	GENERAL INFORMATION	4
2.1	CLIENT INFORMATION	4
2.2	TEST LABORATORY	4
2.3	GENERAL INFORMATION OF EUT	4
2.4	RATINGS AND DECLARATIONS	4
2.5	OPERATING MODES AND CONDITIONS	5
2.6	EUT CONNECTION BLOCK DIAGRAM.....	5
2.7	SYSTEM CONFIGURATIONS	5
2.8	SUPPORT EQUIPMENT	5
3	INTENTIONAL RADIATOR ANTENNA REQUIREMENT	6
3.1	RESULT.....	6
3.2	REQUIREMENT.....	6
3.3	CONCLUSION	6
4	FIELD STRENGTH OF FUNDAMENTAL	7
4.1	TEST RESULT.....	7
4.2	TEST METHOD.....	7
4.3	TEST SETUP DIAGRAM.....	8
4.4	TEST SITE	8
4.5	TEST EQUIPMENT	9
4.6	TEST DATA – X-AXIS HIGHEST FUNDAMENTAL	10
5	FIELD STRENGTH OF SPURIOUS RADIATION	12
5.1	TEST RESULT.....	12
5.2	TEST METHOD.....	12
5.3	TEST SITE	13
5.4	TEST EQUIPMENT	13
5.5	TEST DATA.....	14
6	BANDWIDTH	21
6.1	TEST RESULT.....	21
6.2	TEST METHOD.....	21
6.3	TEST SITE	21
6.4	TEST EQUIPMENT	21
6.5	TEST SETUP PHOTOGRAPHS.....	21
6.6	TEST DATA.....	22
7	DEACTIVATION TIME	23
7.1	TEST RESULT.....	23
7.2	TEST METHOD.....	23
7.3	TEST SITE	23
7.4	TEST EQUIPMENT	23
7.5	TEST DATA.....	24
8	REVISION HISTORY	25

1 Summary of Test Results

Test Description	Test Specification	Test Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203	Compliant
Field strength of fundamental	15.231(b) ANSI C63.10:2013, Section 6.5	Compliant
Field strength of spurious radiation	ANSI C63.10:2013, Section 6.5	Compliant
Bandwidth	15.231(c) ANSI C63.10:2013, Section 6.9	Compliant
Deactivation Time (manual)	15.231(a)(1) ANSI C63.10:2013, Section 7.4	N/A ¹
Deactivation Time (automatic)	15.231(a)(2) ANSI C63.10:2013, Section 7.4	Compliant
Non-periodic; TX time per hour	15.231(a)(3)	N/A ²
Transmission time for setup	15.231(a)(5) ANSI C63.10:2013, Section 7.4	N/A ³
Frequency Stability	15.231(d) ANSI C63.10:2013, Section 6.8	N/A ⁴
Low power operation	15.231(e) ANSI C63.10:2013, Section 7.4	N/A ⁵

Notes:

- 1) Not applicable. There is no manual deactivation for this device.
- 2) Not applicable. There are no periodic transmissions for this device. It only transmits when requested to do so by the operator using a gateway device.
- 3) Not applicable. This function is not used for this device.
- 4) Not applicable. This device does not transmit in the 40.66-40.70 MHz frequency range.
- 5) Not applicable. This device does not operate under the provisions of this rule part.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Refrigerated Transport Electronics, Inc.
 Address: 1 West Center Street
 City, State, Zip, Country: McGraw, NY 13101, 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
 Certification Number: 3212.01

2.3 General Information of EUT

Product Name: Wireless Door Sensor
 Model Number: 1H4468RHF
 Serial Number: Sample ID – SUW-PK-20220900624
 Hardware Version: Not provided
 Software Version: Not provided

FCC ID: 2A2YD1H4468RHF

Transmitter Frequency: 433.05MHz
 Receiver Frequencies: 433.05MHz, 13.56MHz (NFC Tag)

Rated Voltage: 3.0 VDC (AA batteries)
 Test Voltage: 3.0 VDC

Sample Received Date: 15 September 2022
 Dates of testing: 21-26 September 2022

2.4 Ratings and declarations

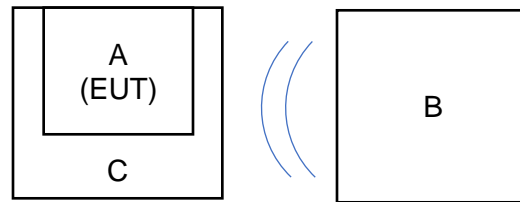
Operation Frequency Range (OFR) TX Mode:	433.05 MHz
Operation Frequency Range (OFR) RX Mode:	433.05MHz, 13.56MHz (NFC Tag)
Channel Bandwidth:	133.29 kHz
Effective radiated power:	-14.87dBm (80.33dBuV/m at 3.0 m)
Communication technique:	Digital
Modulation:	ASK
Antenna type and gain:	Embedded Module, -8dBi (peak) Linx Technologies, ANT-433-uSP410

2.5 Operating Modes and Conditions

Inserted 2 new alkaline AA batteries into Door Sensor (EUT). The EUT was placed in the test fixture to determine proper operation. When the fixture simulates an open door, then the sensor sends a signal to the gateway when the gateway operator checks status. The gateway acknowledges with a Green LED for okay or Red LED for door ajar.

Other than the fundamental transmission frequency, the highest clock frequency was 32.768kHz.

2.6 EUT Connection Block Diagram



2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Refrigerated Transport Electronics, Inc.	Wireless Door Sensor	1H446800	SUW-PK-20220900624

Note: Sample ID used for serial number.

2.8 Support Equipment

Device reference	Manufacturer	Description	Model Number	Serial Number
B	Refrigerated Transport Electronics, Inc.	Gateway	-	SUW-PK-20220900624
C	Refrigerated Transport Electronics, Inc.	Door Test Fixture	N/A	SUW-PK-20220900624

Note: Device C represents a door of a Refrigerated shipping container.

3 Intentional Radiator Antenna Requirement

3.1 *Result*

Test Description	Test Specification	Test Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203	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 an embedded module soldered to the main PCB and therefore cannot be easily replaced.

4 Field Strength of Fundamental

4.1 Test Result

Test Description	Test Specification	Test Result
Field strength of fundamental	ANSI C63.10:2013, Section 6.5	Compliant

4.2 Test Method

The test data was measured using a Peak detector. Average data were calculated 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.

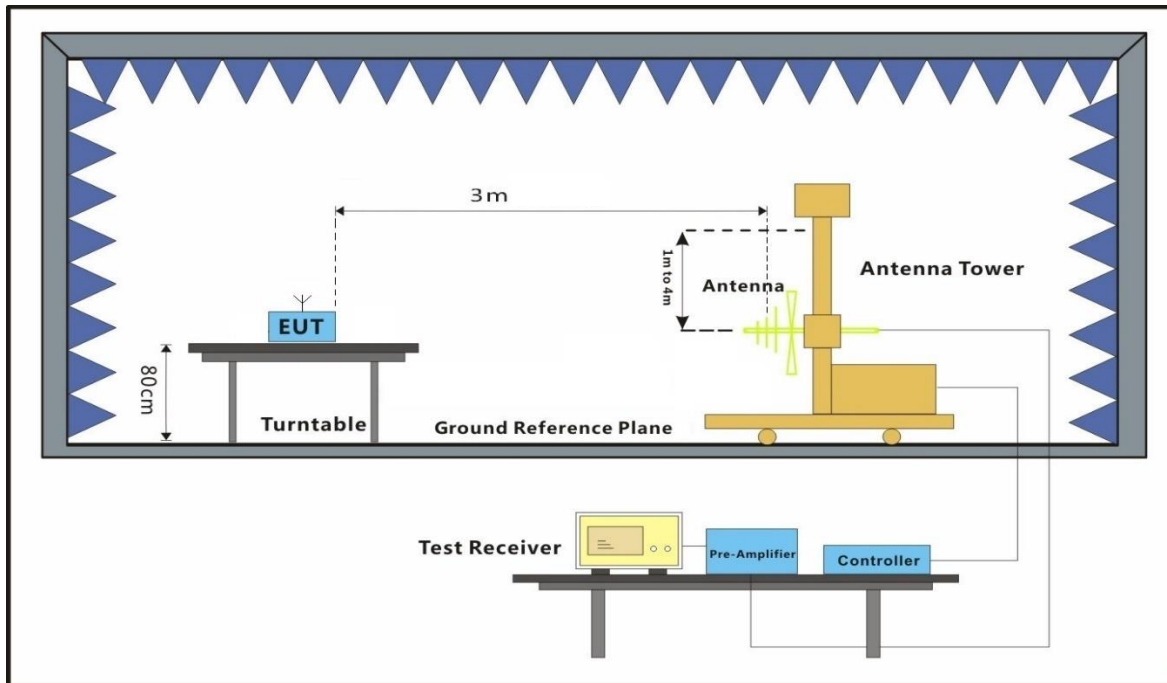
The radiation measurements are performed in X, Y, Z axis positioning. And found the X-axis positioning which it is worse case, only the test worst case mode is recorded in the report.

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

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750	125 to 375
174-260	3750	375
260-470	3750 to 12500	375 to 1250
Above 470	12500	1250

Remark: Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply.

4.3 Test Setup Diagram



4.4 Test Site

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

Environmental Conditions

Temperature: 21.2 °C
 Relative Humidity: 42.8 %
 Atmospheric Pressure: 98.05 kPa

4.5 Test Equipment

Field Strength

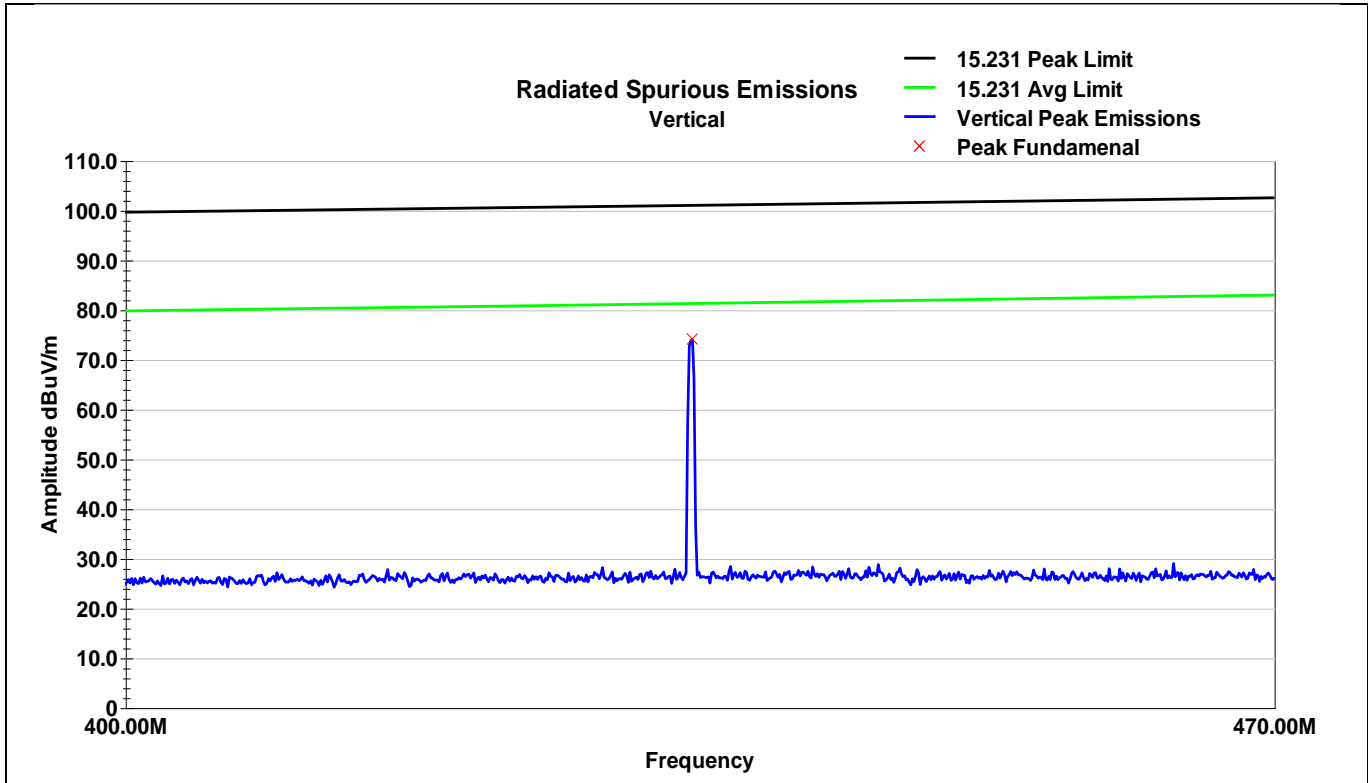
Test End Date: 30-Sep-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	19-Apr-2022	19-Apr-2024
ROTARY NM TO NF CONNECTOR	18-2120-0	DIAMOND ANTENNA AND MICROWAVE CORP	22008	16-Mar-2022	16-Mar-2023
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22000	10-Jan-2022	10-Jan-2023
RF CABLE	SF106	HUBER & SUHNER	B079713	25-Aug-2022	25-Aug-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20123	14-Feb-2022	14-Feb-2023
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079817	25-Aug-2022	25-Aug-2023
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20131	16-Mar-2022	16-Mar-2023
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023

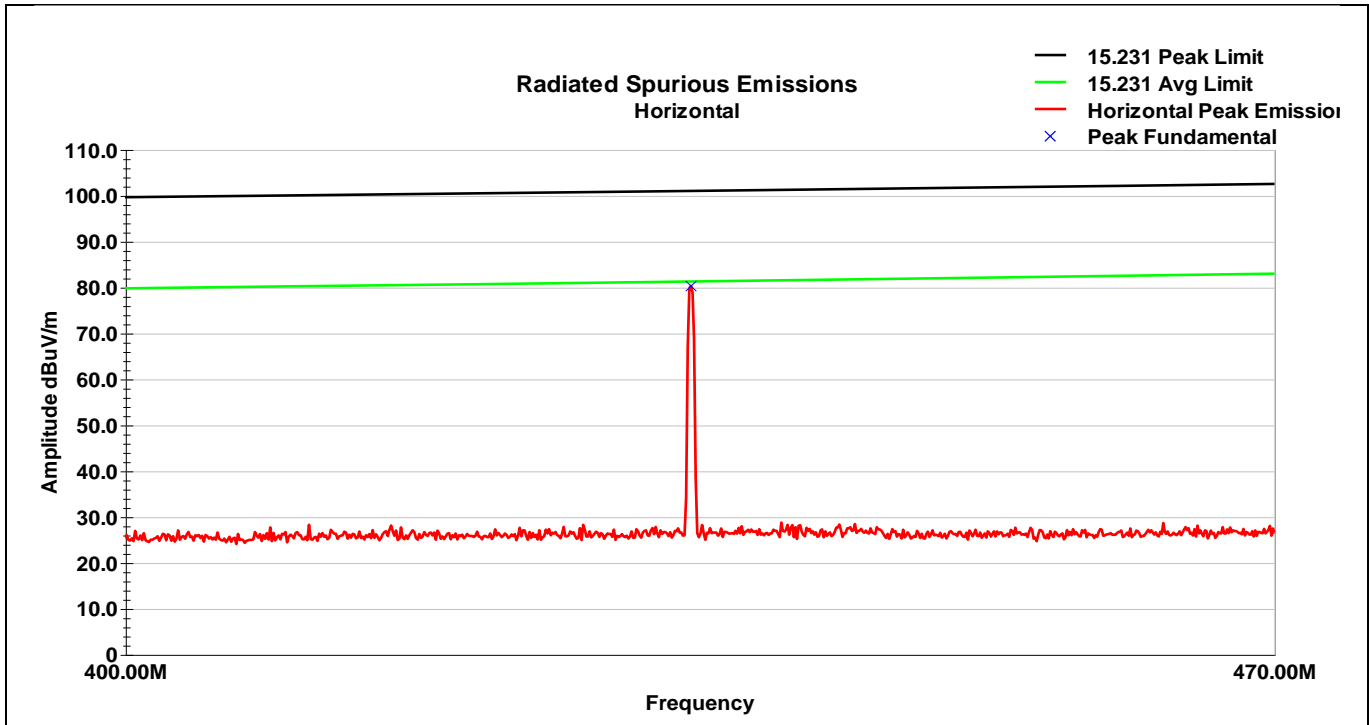
Note: Refer to table for calibration intervals.

4.6 Test Data – X-axis highest Fundamental



Vertical Fundamental Peak Power = 74.04dBuV

Peak is less than Average Limit, therefore Average was not calculated.



Horizontal Fundamental Peak Power = 80.33dBuV

Peak is less than Average Limit, therefore Average was not calculated.

5 Field Strength of Spurious Radiation

5.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	ANSI C63.10:2013, Section 6.5	Compliant

5.2 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 radiation measurements are performed in X, Y, Z axis positioning. Results for all 3 axes were ranked from highest to lowest measurement.

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

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750	125 to 375
174-260	3750	375
260-470	3750 to 12500	375 to 1250
Above 470	12500	1250

Remark: Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

5.3 Test Site

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

Environmental Conditions

Temperature: 21.1°C
Relative Humidity: 55.1%
Atmospheric Pressure: 98.1kPa

5.4 Test Equipment

30-1000MHz

Test End Date: 22-Sep-2022

Tester: LM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	26-May-2022	26-May-2024
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22001	10-Jan-2022	10-Jan-2023
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2022	17-Feb-2023
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	25-Aug-2022	25-Aug-2023
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079817	25-Aug-2022	25-Aug-2023
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	8-Sep-2022	8-Sep-2023

Above 1GHz

Test End Date: 22-Sep-2022

Tester: PL,ZH

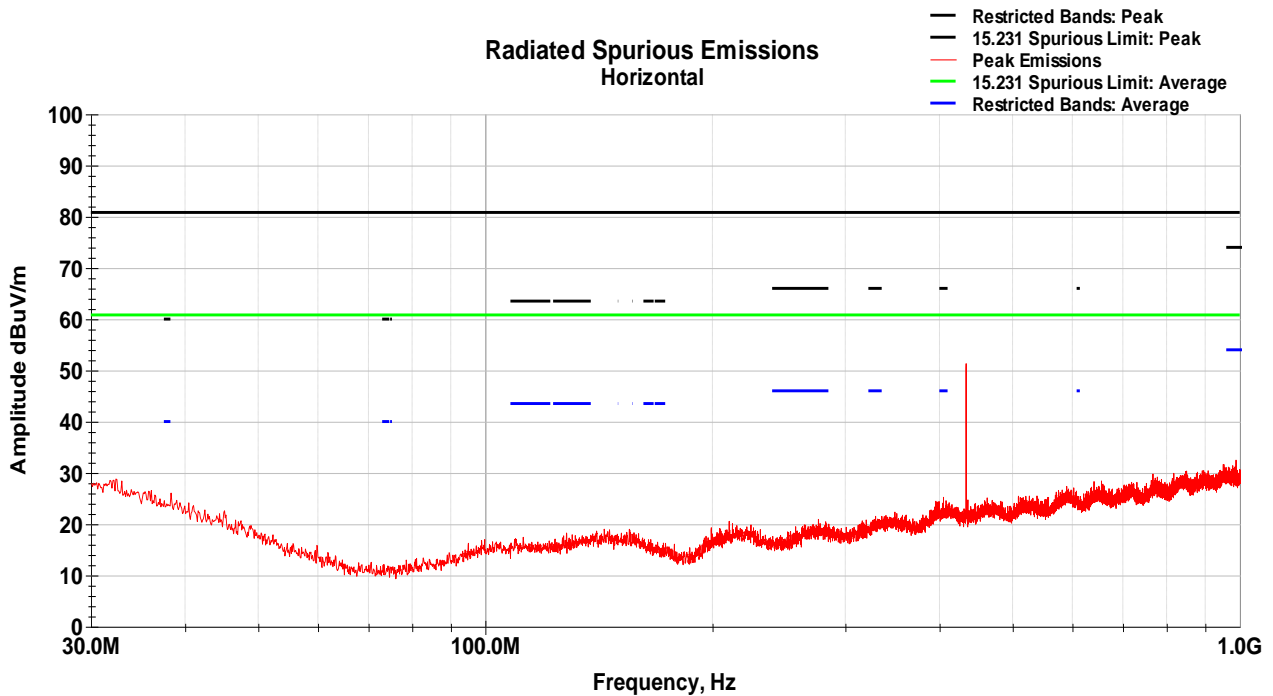
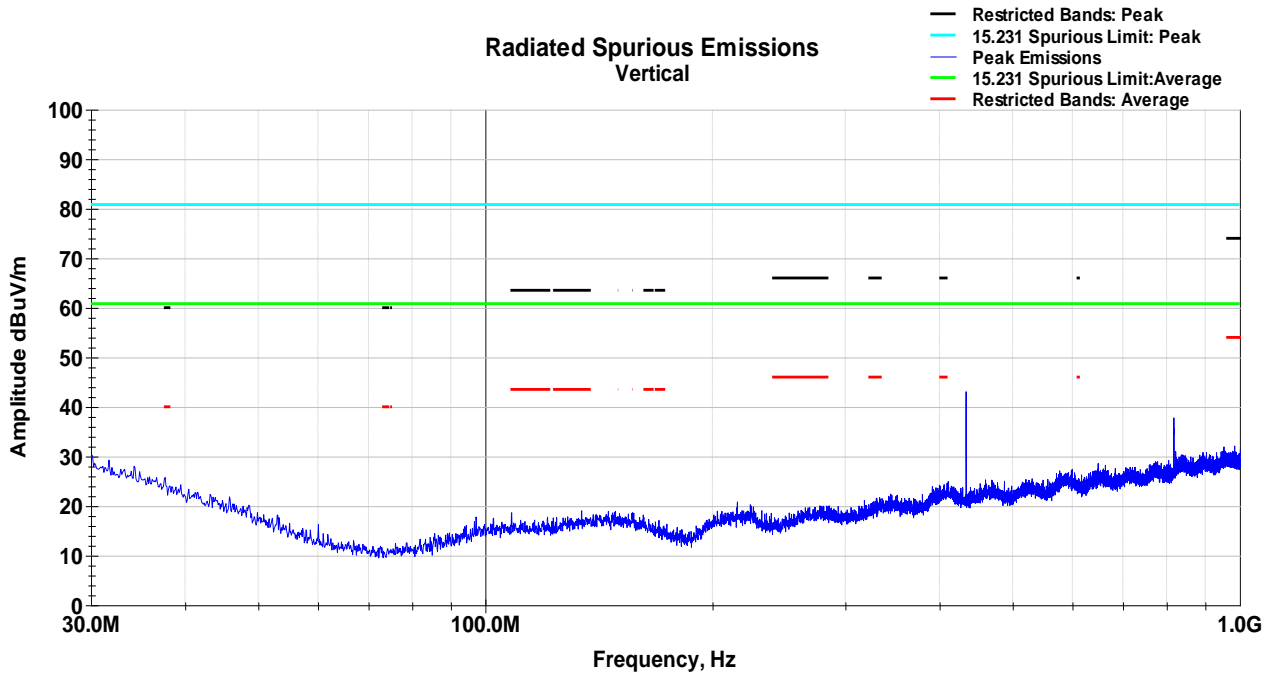
Equipment	Model	Manufacturer	LM	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	15-Aug-2022	15-Aug-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-157	TELEDYNE STORM MICROWAVE	20121	14-Feb-2022	14-Feb-2023
RF CABLE	104PE	HUBER & SUHNER	B079793	25-Aug-2022	25-Aug-2023
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	7-Oct-2021	7-Oct-2022
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
FILTER, HIGH PASS, >1000MHZ	HPM50108	MICRO-TRONICS	B079802	5-Jul-2022	5-Jul-2023

Note: Refer to table for calibration intervals.

5.5 Test Data

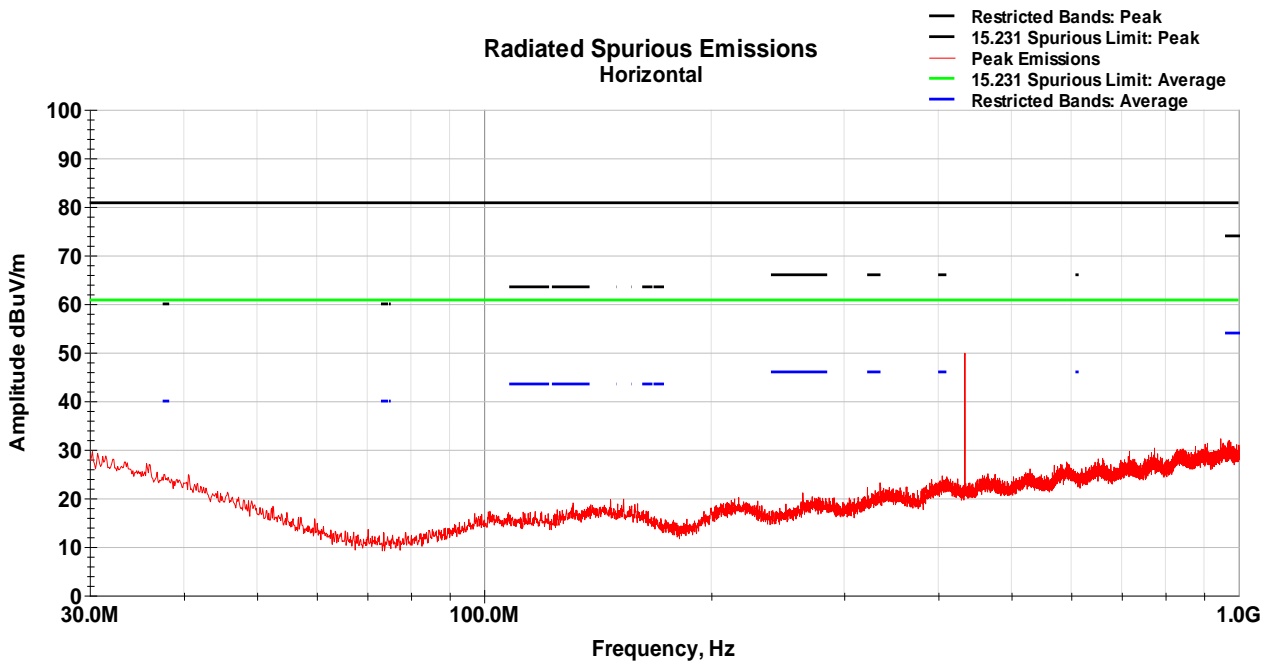
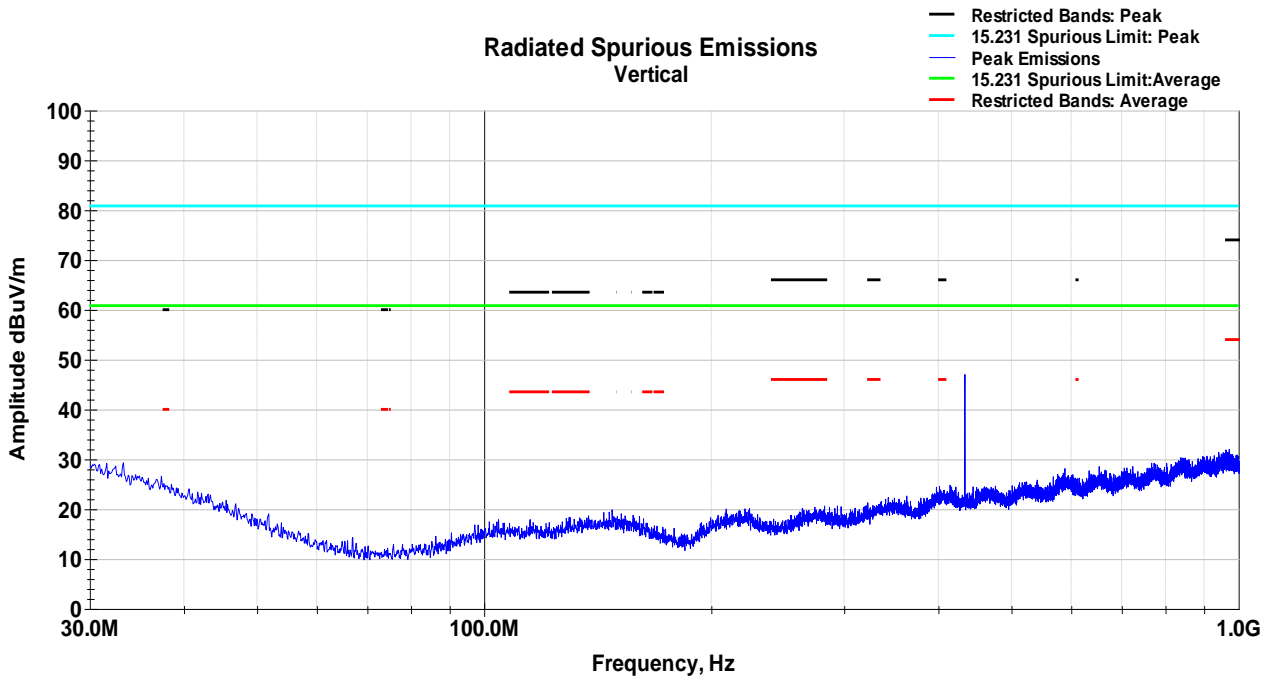
5.5.1 30 MHz to 1000 MHz

X-Axis



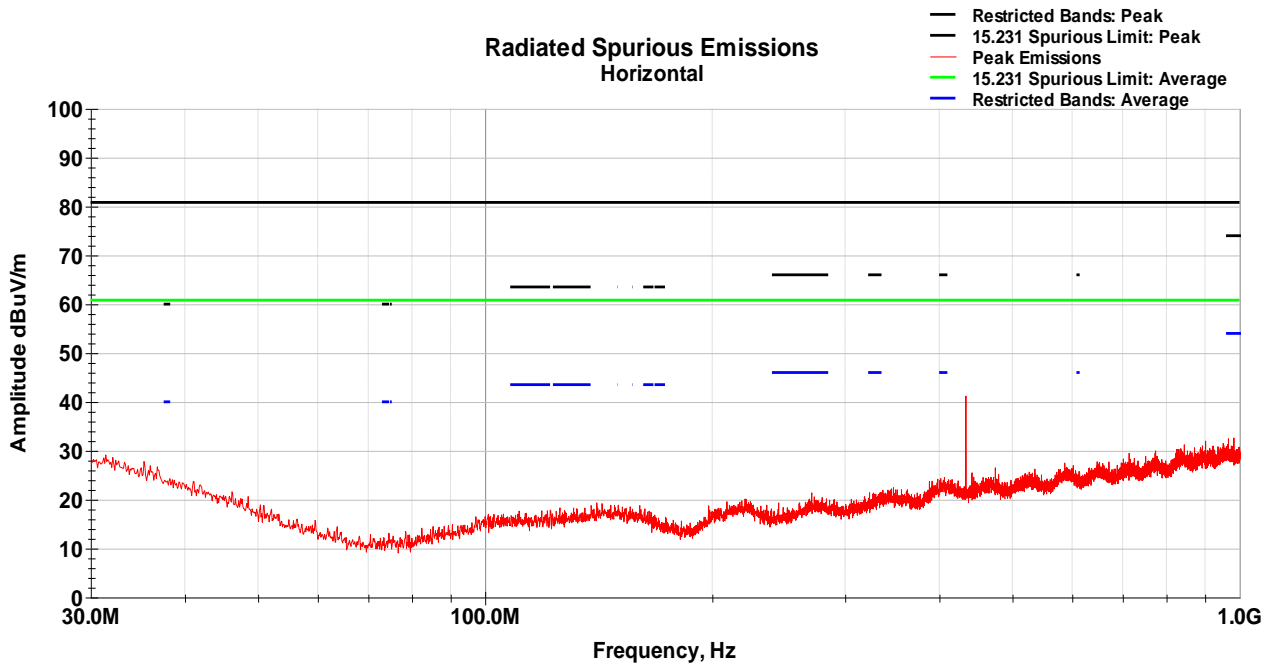
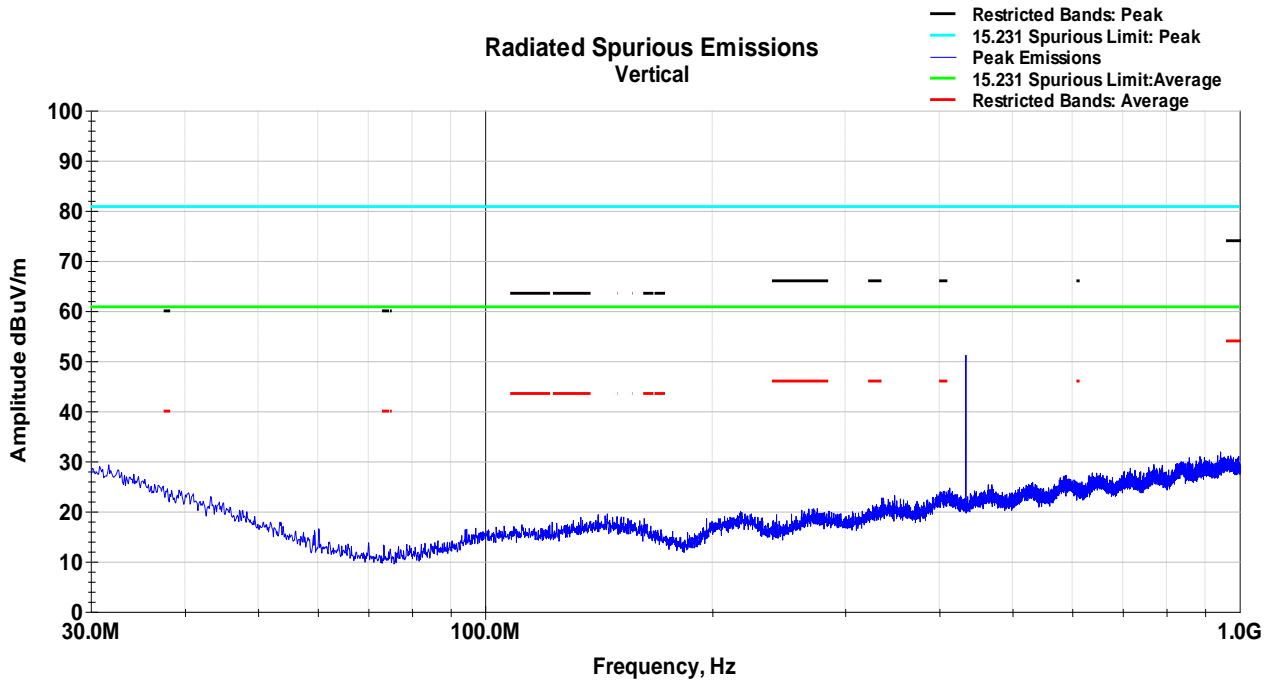
Note: Other than fundamental signal, no emissions within 20dB of limit.

Y-Axis



Note: Other than fundamental signal, no emissions within 20dB of limit.

Z-Axis



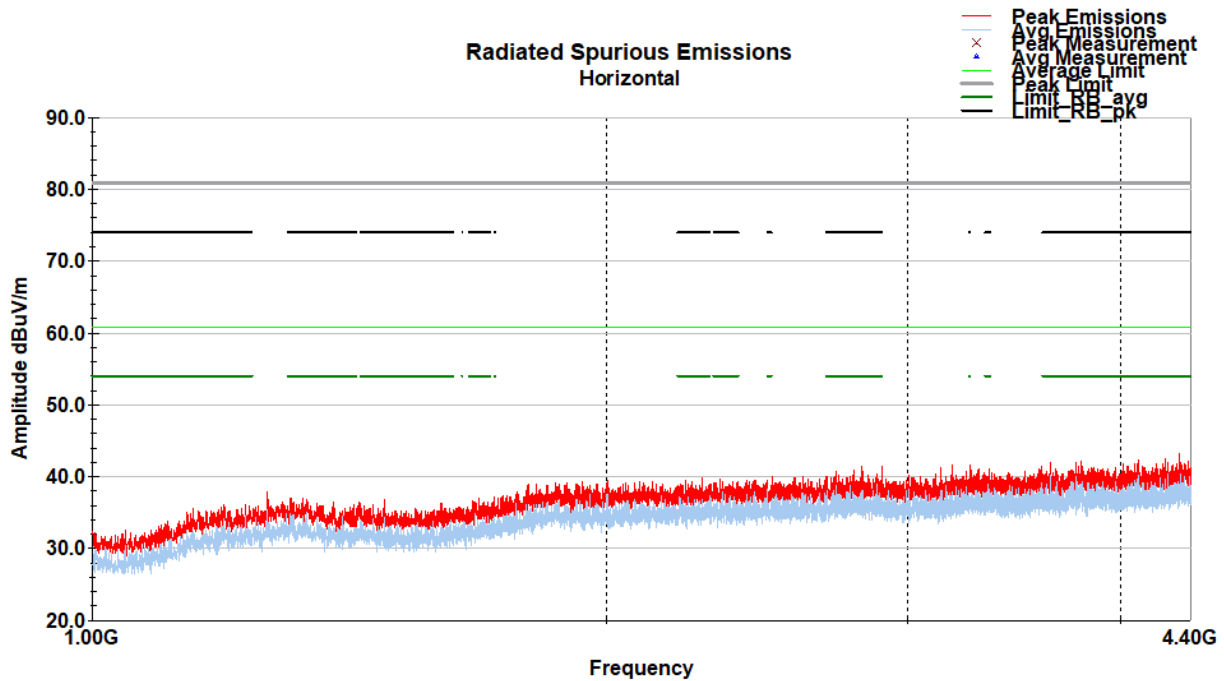
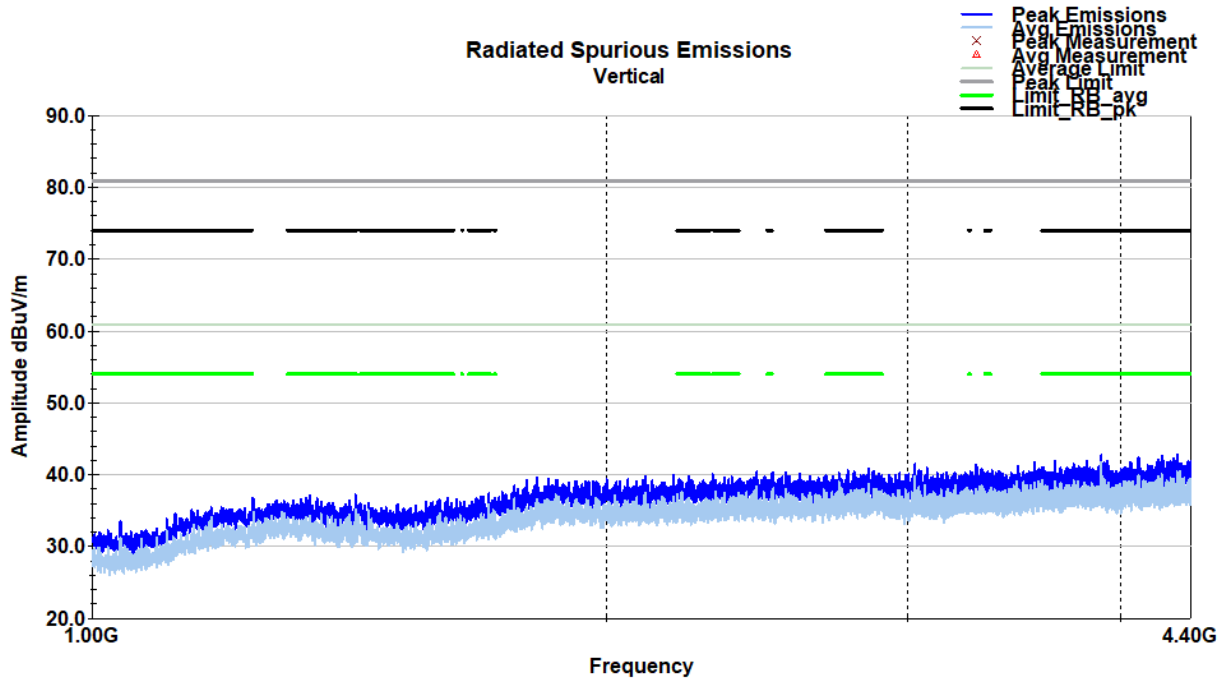
Note: Other than intentional, no emissions within 20dB of limit.

Table of measured radiated spurious emissions: 30-1000 MHz

No emissions within 20dB of limit.

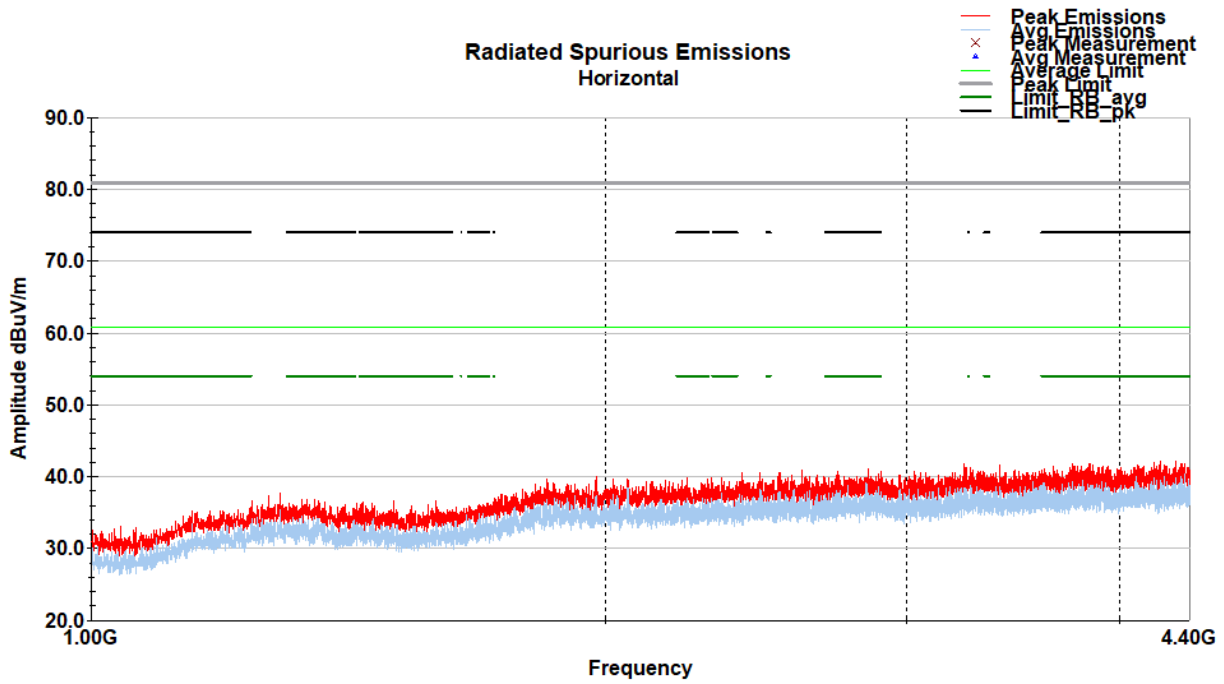
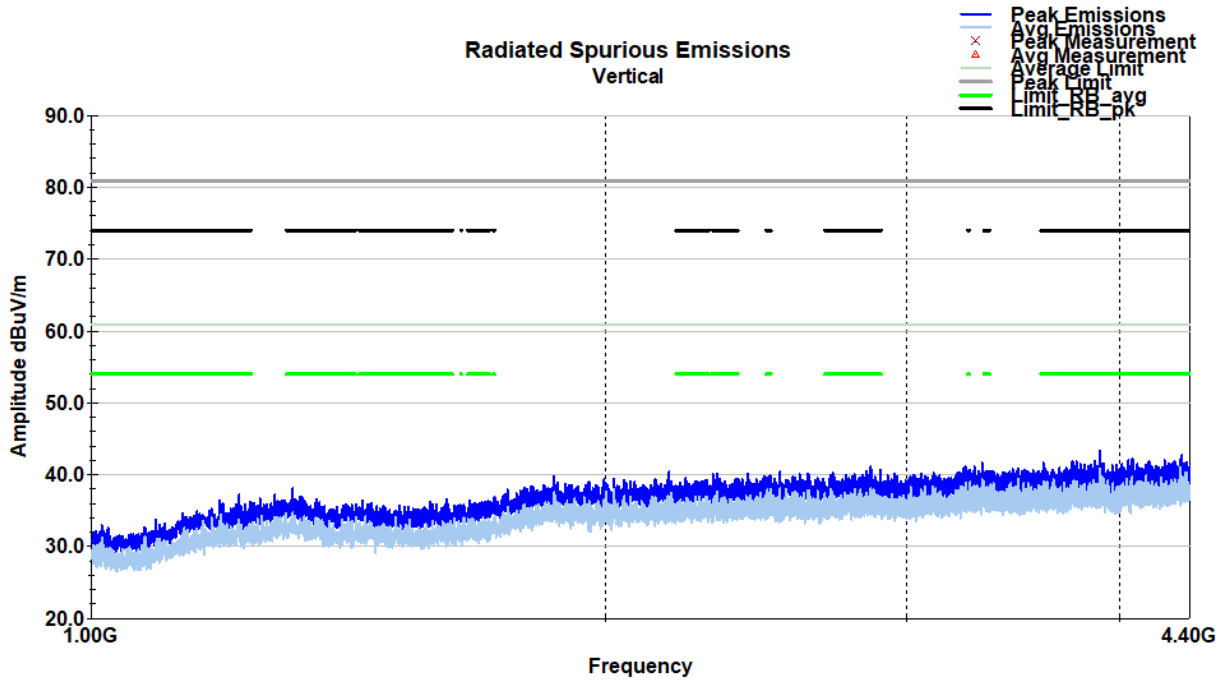
5.5.2 1 GHz to 4.4 GHz

X-Axis



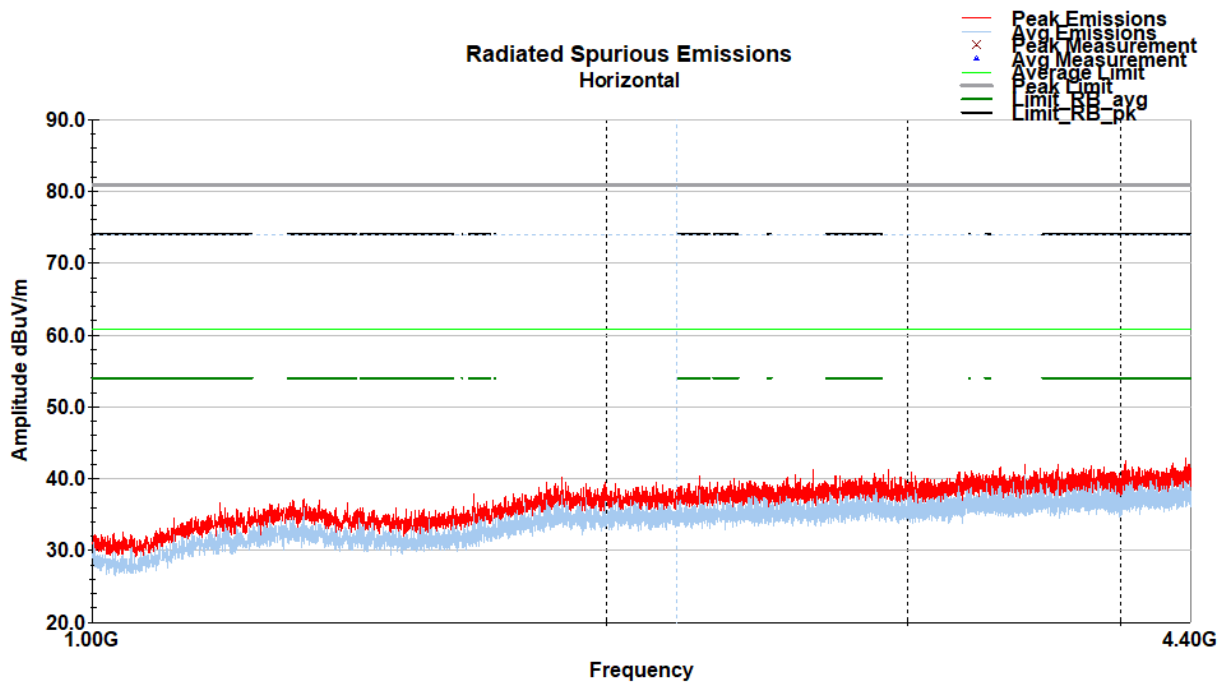
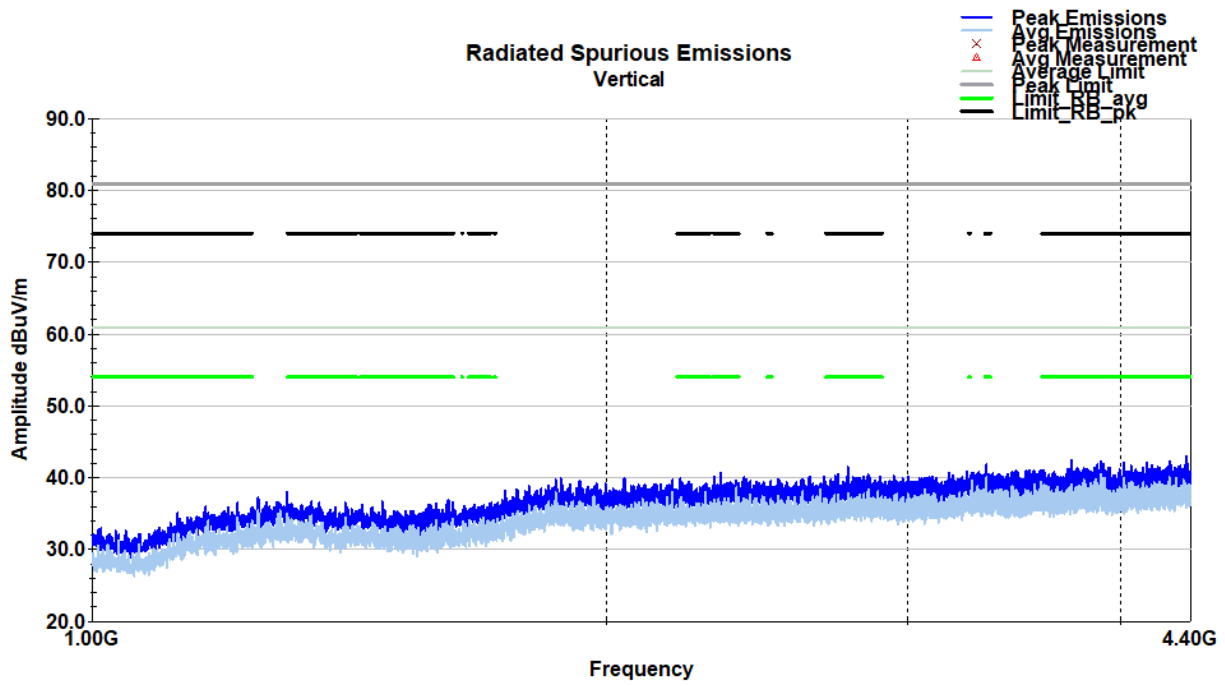
Note: No emissions within 20dB of limit.

Y-Axis



Note: No emissions within 20dB of limit.

Z-Axis



Note: No emissions within 20dB of limit.

6 Bandwidth

6.1 Test Result

Test Description	Basic Standards	Test Result
20 dB bandwidth	ANSI C63.10:2013, Section 6.9	Compliant

6.2 Test Method

The procedures from ANSI C63.10 (2009) clause 6.9 were used to determine the 20dB bandwidth.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

6.4 Test Equipment

Test End Date: 26-Sep-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE NM TO BNCM, 0.01-4GHZ	90-2476-079	TELEDYNE STORM MICROWAVE	20130	16-Mar-2022	16-Mar-2023
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
NEAR FIELD PROBES	N/A	COM-POWER CORPORATION	16016	CNR	CNR

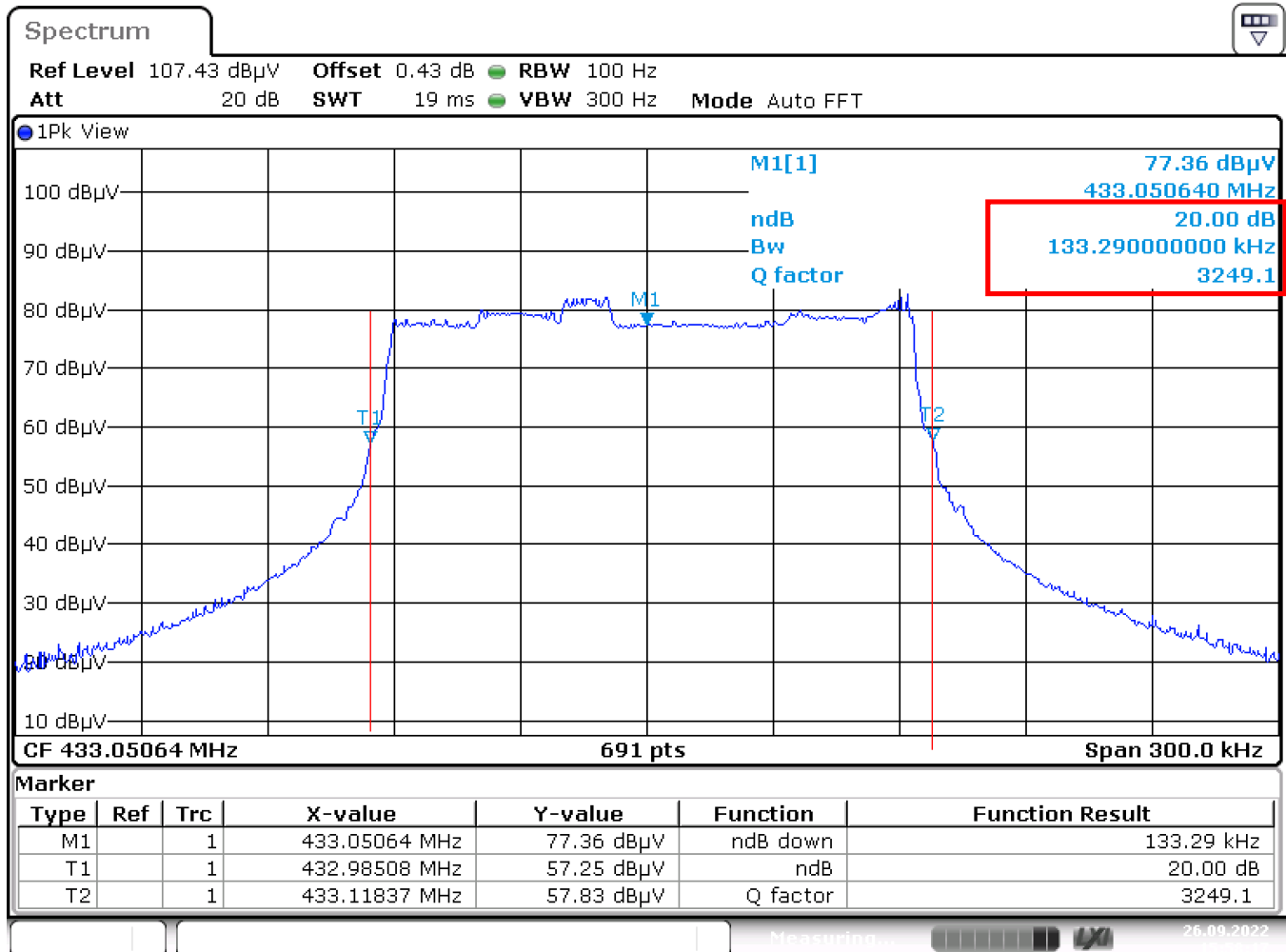
Note: Refer to table for calibration intervals.

6.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

6.6 Test Data

20 dB Bandwidth Plot



Date: 26.SEP.2022 15:58:17

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating from 70MHz to 900MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

$$20\text{dB Down BW} \leq 0.25\% \text{ of Modulated Carrier}$$

FCC Part 15.321 allows up to 1.0826 MHz for this modulated carrier.

133.29kHz BW is compliant for this transmit frequency

7 Deactivation Time

7.1 Test Result

Test Description	Basic Standards	Test Result
Deactivation Time	ANSI C63.10:2013, Section 7.4	Compliant

7.2 Test Method

ANSI C63.10:2013, Section 7.4 was used for test method.

15.231 – Periodic operation in the band 40.66-40.7 MHz and above 70 MHz.

FCC Part 15.231(a)(2)

“A transmitter activated automatically shall cease transmission within 5 seconds after activation.”

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 20.7 °C

Relative Humidity: 42.6 %

Atmospheric Pressure: 98.60 kPa

7.4 Test Equipment

Test End Date: 28-Sep-2022

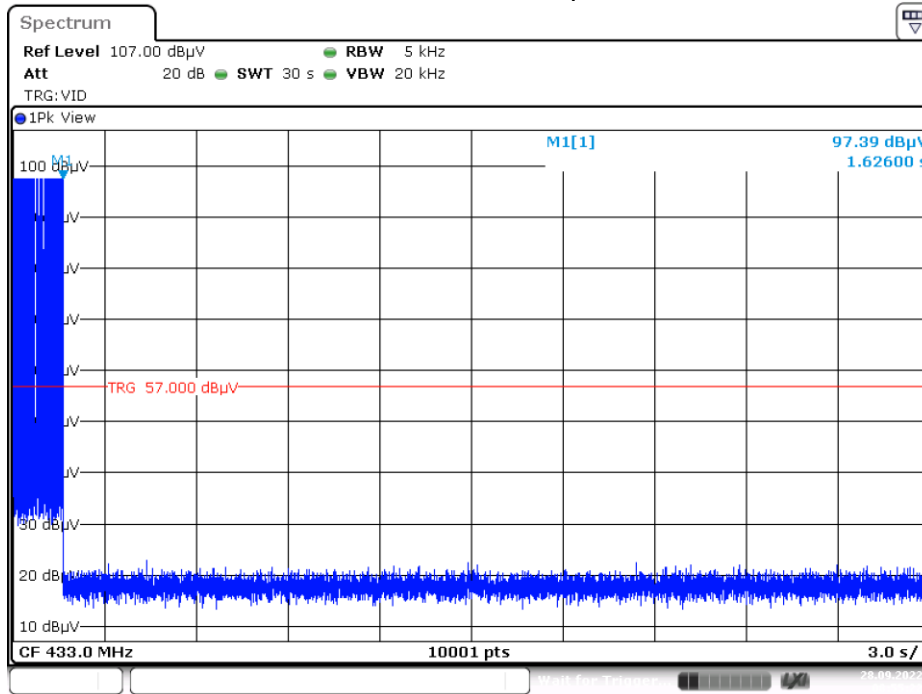
Tester: AB

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
NEAR FIELD PROBES	N/A	COM-POWER CORPORATION	16016	CNR	CNR
RF CABLE NM TO BNCM, 0.01-4GHZ	90-2476-079	TELEDYNE STORM MICROWAVE	20130	16-Mar-2022	16-Mar-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

Note: Refer to table for calibration intervals.

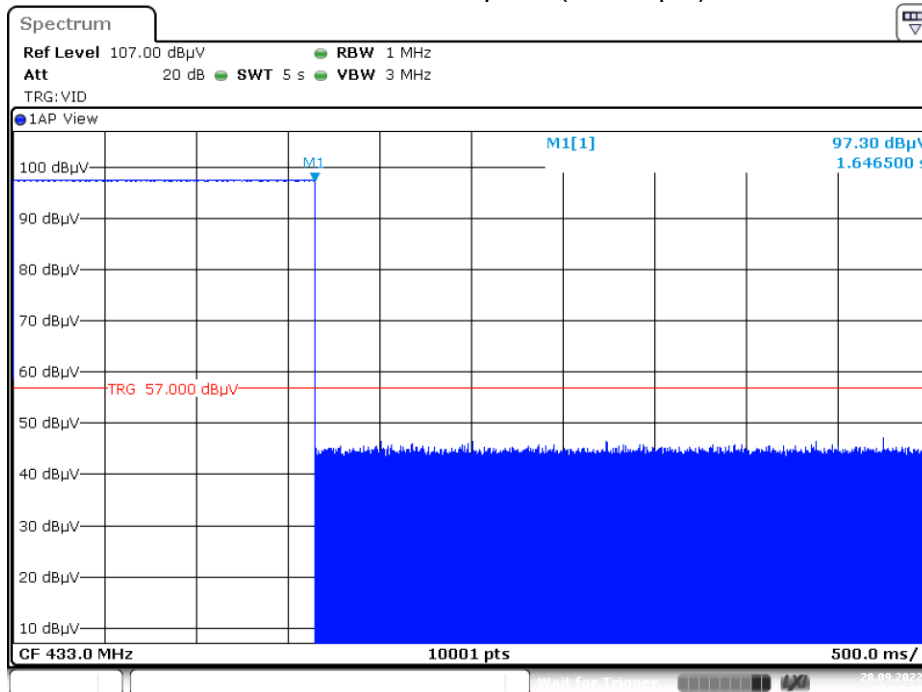
7.5 Test Data

Dwell Time – 30s capture



Date: 28.SEP.2022 08:55:23

Transmitter does not retransmit.
 Dwell Time – 5s capture (10000 pts)



Date: 28.SEP.2022 08:57:20

Transmitter maximum time = 1646.5ms. Compliant.

8 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	4 October 2022
1	Removed internal photo of antenna	18 October 2022