

RF Data Report

Project Number: 5185096**Proposal: SUW-202405006418****Report Number: 5185096EMC03****Revision Level: 2****Client: Cognosos, Inc.****Equipment Under Test: Wearable****Model: RT-400****FCC ID: 2AKFQRT400****IC ID: 22165-RT400****Applicable Standards: ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)****RSS-247, Issue 3****RSS-GEN Issue 5****Report issued on: 10 October 2024****Report revised on: 21 November 2024****Test Result: Compliant**

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

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Tested by:


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1 Summary of Test Results

Test Description	Test Specification		Test Result
Duty Cycle	ANSI C63.10	RSS-GEN	Reported
Bandwidth	15.247(a)(2)	RSS-247 S5.2 (a) RSS-GEN S6.7	Compliant
Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 S5.5	Compliant
Emissions in Restricted Frequency Bands	15.247(d) 15.205, 15.209	RSS-247 S5.5 RSS-GEN S8.9, S8.10	Compliant
Band Edge Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN S8.9, S8.10	Compliant
Channel Separation	15.247(a)(1)	RSS-247 5.1(b)	Compliant
Number of Hopping Channels	15.247(a)(1)(iii)	RSS-247 5.1(d)	Compliant
Dwell Time	15.247(a)(1)(iii)	RSS-247 5.1(d)	Compliant
AC Powerline Conducted Emissions	15.207	RSS-GEN S8.8	N/A ⁽²⁾
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant ⁽¹⁾

(1) The device uses a PCB trace PIFA antenna which cannot be replaced by the end user.

(2) The product is DC powered. Mains testing does not apply.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Company Name: Cognosos, Inc.
Address: 1100 Spring Street NW, Suite 300A
City, State, Zip, Country: Atlanta, Georgia 30309

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

2.3 General Information of EUT

Product Marketing Name (PMN): Wearable
Model Number (HVIN): RT-400
Serial Number: Engineering Sample

Type / Frequency Range: BLE / 2402 – 2480 MHz
Modulation / Data Rate(s): GFSK / 2M PHY
Antenna: Internal Flag Antenna; +3.30 dBi*

Type / Frequency Range: Proprietary / 902.075-903.3 MHz
Modulation / Data Rate(s): FHSS / 7.5kHz
Antenna: Internal PCB Trace; +0.6 dBi*

Rated Voltage: 3Vdc (Lithium Manganese Dioxide Battery)
Test Voltage: 3Vdc (Lithium Manganese Dioxide Battery)

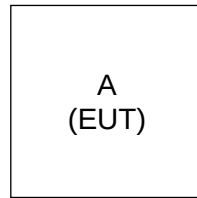
Sample Received Date: 05 June 2024
Dates of testing: 05 June 2024– 07 June 2024

**Data was not measured; therefore, the lab is not responsible for accuracy. Data was obtained via customer, specification sheet, previous regulatory filing, or other means.*

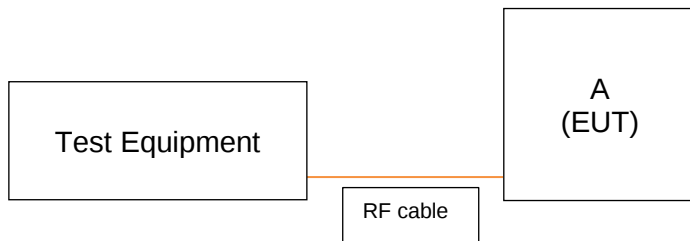
2.4 Operating Modes and Conditions

During emissions testing, the EUT was powered and the EUT set to a test mode to exercise the transmitter during testing. BLE only utilizes advertise/beacon and receive data modes. Worst case duty cycle is about 20% at the minimum interval setting in normal use. Proprietary is duty cycle limited to 26.6% in normal use.

2.5 EUT Connection Block Diagram – Radiated Measurements



2.6 EUT Connection Block Diagram – Conducted Measurements



2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Cognosos, Inc.	Wearable	RT-400	(Engineering Sample)

2.8 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
	None					

3 Duty Cycle

3.1 Test Result

Test Description	Test Specification		Test Result
Duty Cycle	ANSI C63.10	RSS-GEN	Reported

3.2 Test Methods

The DTS Duty Cycle measurements were performed using the procedure from ANSI C63.10 clause 11.6. Procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02 clause 6.

The BLE 2Mbps data mode was used for these tests.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

3.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

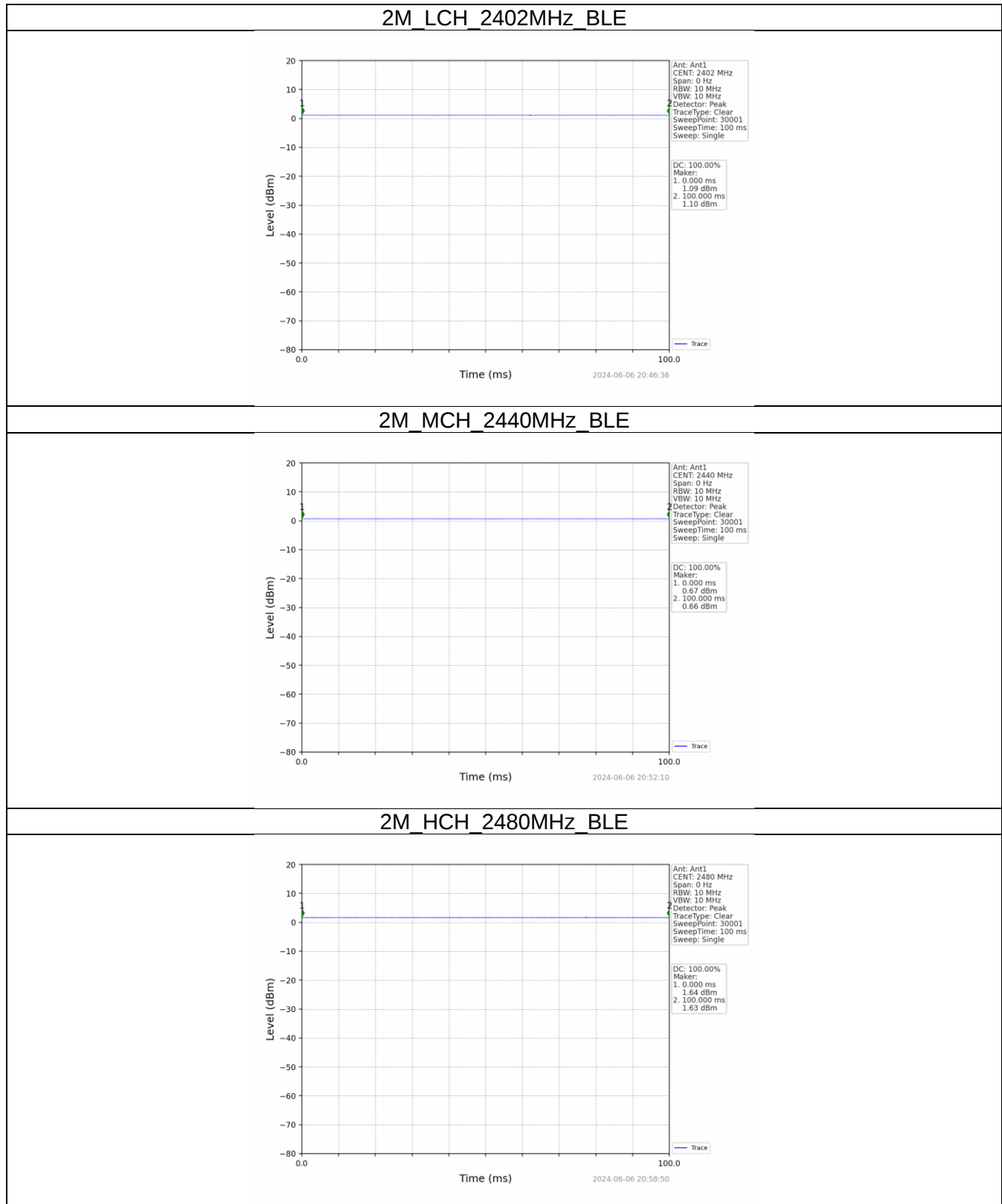
Software Profile: TSTPASS Version: 2.0 (2024.05.01_17.31.12)

3.5 Test Data

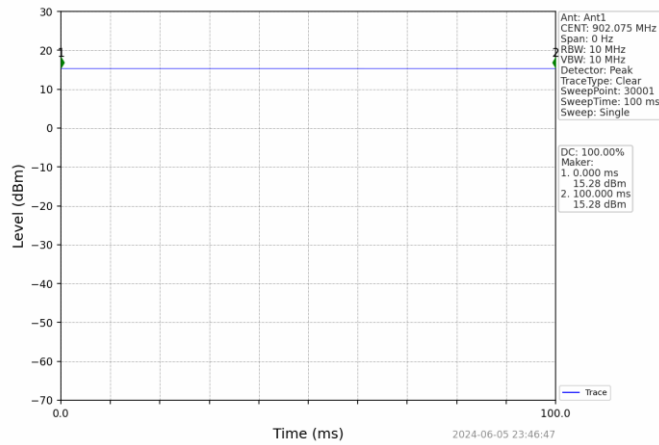
Proprietary							
Mode	TX Type	Frequency (MHz)	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
Band 1	SISO	902.075	100.000	100.000	100.00	0.00	0.00
		902.675	100.000	100.000	100.00	0.00	0.00
		903.3	100.000	100.000	100.00	0.00	0.00

BLE							
Mode	TX Type	Frequency (MHz)	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
2M	SISO	2402	100.000	100.000	100.00	0.00	0.00
		2440	100.000	100.000	100.00	0.00	0.00
		2480	100.000	100.000	100.00	0.00	0.00

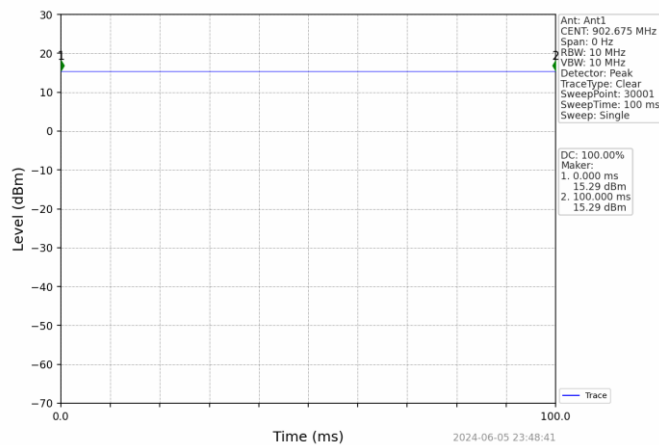
3.6 Test Graph



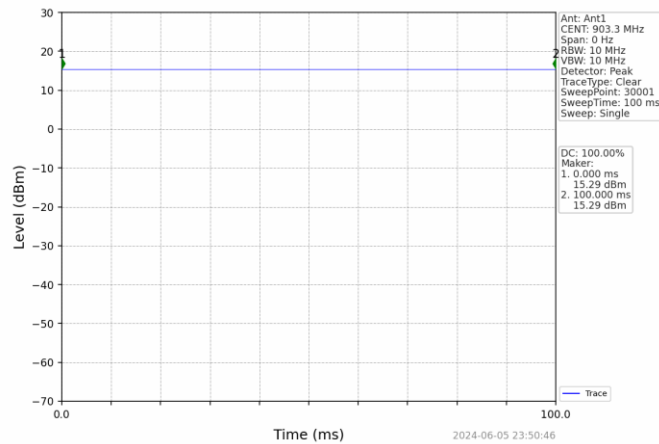
Band 1_LCH_902.075MHz_Proprietary



Band 1_MCH_902.675MHz_Proprietary



Band 1_HCH_903.3MHz_Proprietary



4 Bandwidth

4.1 Test Result

Test Description	Test Specification		Test Result
DTS Bandwidth (6dB)	15.247(a)(2)	RSS-247 S5.2 (a)	Compliant
Occupied Bandwidth (99%)	2.1049	RSS-GEN S6.7	Reported

4.2 Test Methods

The DTS 6dB bandwidth measurements were performed using the procedure from ANSI C63.10 clause 11.8.1, and the 99% occupied bandwidth measurements were performed using the procedure from ANSI C63.10 clause 6.9.3. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

The BLE 2Mbps data mode was used for these tests.

Limit

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

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

4.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

Software Profile:

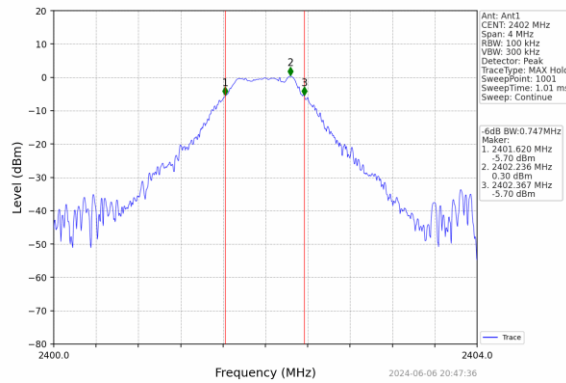
TSTPASS Version: 2.0 (2024.05.01_17.31.12)

4.5 Test Data – DTS Bandwidth (6dB) - BLE

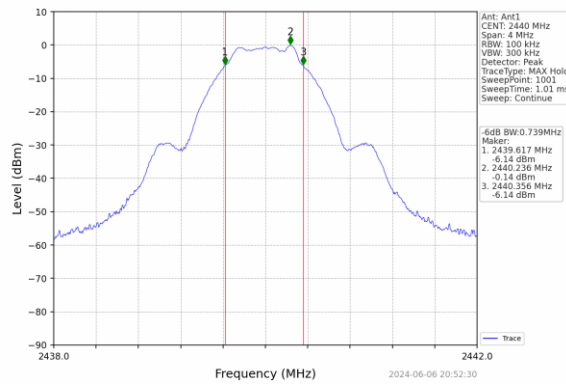
Mode	TX Type	Frequency (MHz)	ANT	6dB Bandwidth (MHz)		Verdict
				Result	Limit	
2M	SISO	2402	1	0.747	≥ 0.5	Pass
		2440	1	0.739	≥ 0.5	Pass
		2480	1	0.741	≥ 0.5	Pass

Representative Plot(s)

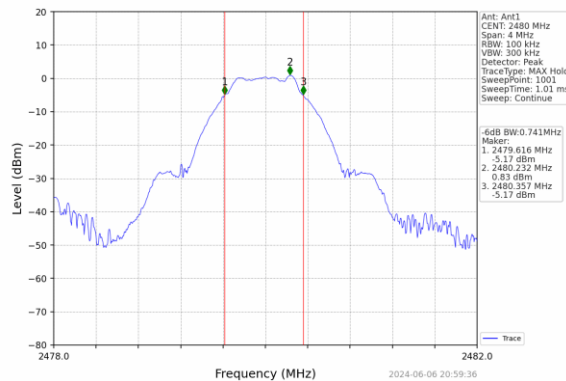
2M_LCH_2402MHz_Ant1_NTNV



2M_MCH_2440MHz_Ant1_NTNV



2M_HCH_2480MHz_Ant1_NTNV

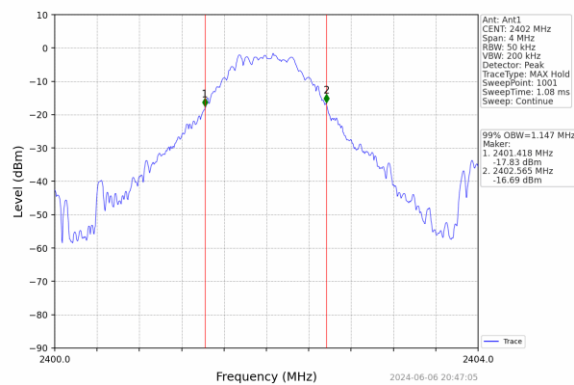


4.6 Test Data – 99% Occupied Bandwidth - BLE

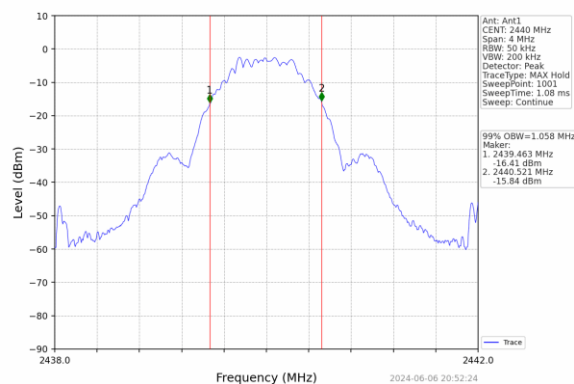
Mode	TX Type	Frequency (MHz)	ANT	99% Occupied Bandwidth (MHz)		Verdict
				Result	Limit	
2M	SISO	2402	1	1.147	/	Reported
		2440	1	1.058	/	Reported
		2480	1	1.062	/	Reported

Representative Plot(s)

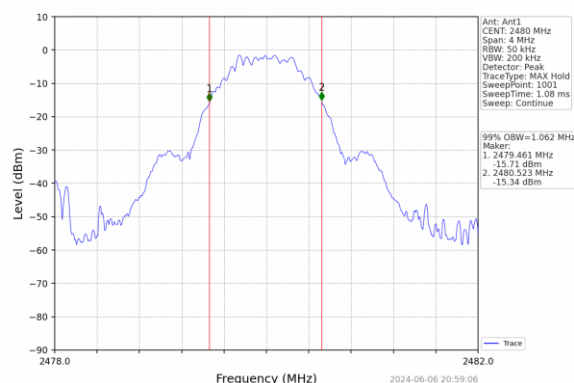
2M LCH 2402MHz Ant1 NTN



2M MCH 2440MHz Ant1 NTN



2M HCH 2480MHz Ant1 NTN

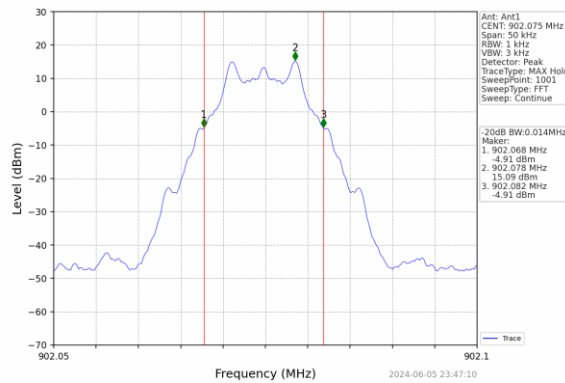


4.7 Test Data – DTS Bandwidth (20dB) – 900 MHz Proprietary

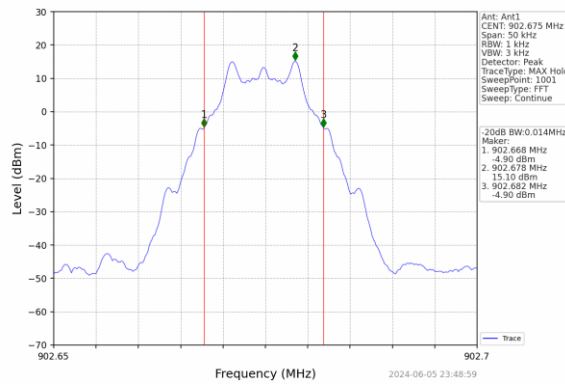
Mode	TX Type	Frequency (MHz)	ANT	20dB Bandwidth (MHz)		Verdict
				Result	Limit	
Band 1	SISO	902.075	1	0.014	/	Reported
		902.675	1	0.014	/	Reported
		903.3	1	0.014	/	Reported

Representative Plot(s)

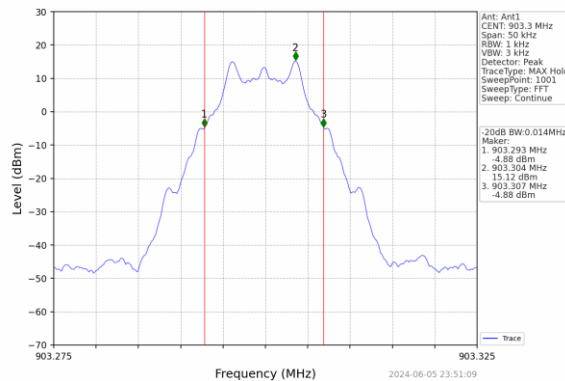
Band 1_LCH_902.075MHz_Ant1_NTNV



Band 1_MCH_902.675MHz_Ant1_NTNV



Band 1_HCH_903.3MHz_Ant1_NTNV

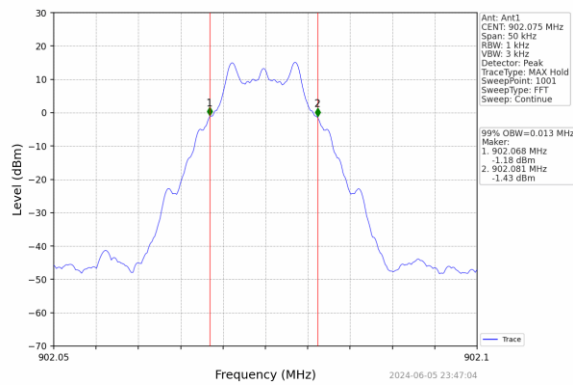


4.8 Test Data – 99% Occupied Bandwidth – 900 MHz Proprietary

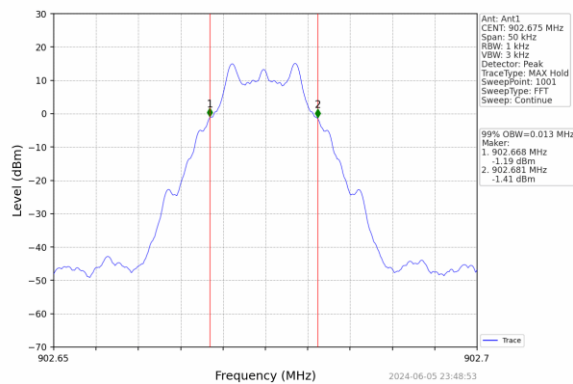
Mode	TX Type	Frequency (MHz)	ANT	99% Occupied Bandwidth (MHz)		Verdict
				Result	Limit	
Band 1	SISO	902.075	1	0.013	/	Reported
		902.675	1	0.013	/	Reported
		903.3	1	0.013	/	Reported

Representative Plots

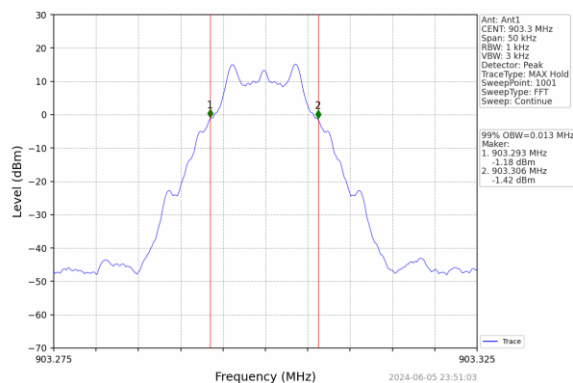
Band 1_LCH_902.075MHz_Ant1_NTNV



Band 1_MCH_902.675MHz_Ant1_NTNV



Band 1_HCH_903.3MHz_Ant1_NTNV



5 Output Power

5.1 Test Result

Test Description	Test Specification		Test Result
Fundamental Emission Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant

5.2 Test Method

Fundamental maximum peak conducted output power measurements were performed using the method described in ANSI C63.10:2013 clause 11.9.1.1. This procedure is referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

The BLE 2Mbps data mode was used for this test.

Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g., for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm). Also, the e.i.r.p. shall not exceed 4 Watts (36 dBm) based on RSS-247 S5.4 (d).

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C
Relative Humidity: 60.1 %
Atmospheric Pressure: 97.57 kPa

5.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

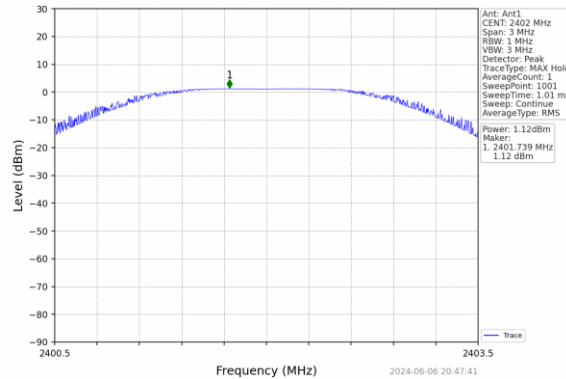
5.5 Test Data - BLE

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			ANT1	Limit	
2M	SISO	2402	1.12	<=30	Pass
		2440	0.69	<=30	Pass
		2480	1.68	<=30	Pass

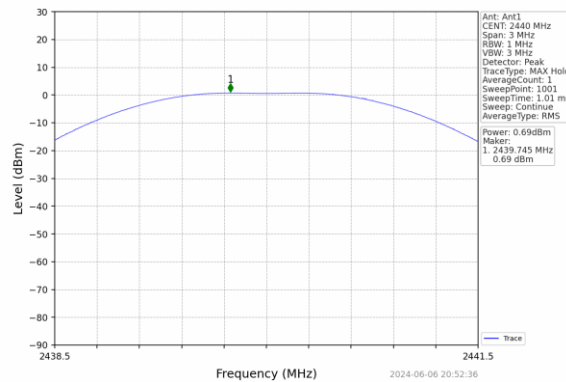
Note1: Antenna Gain: Ant1: +3.30dBi; EIRP of 4.98 dBm at 2480 MHz

Representative Plot(s)

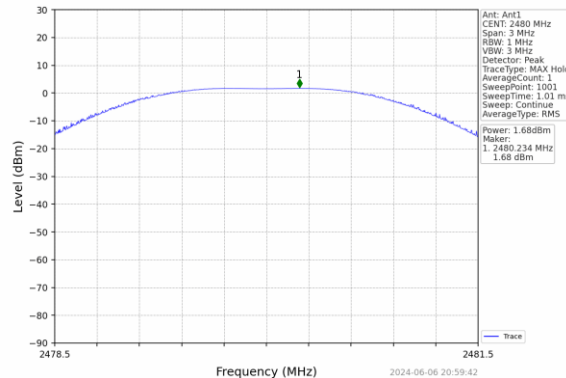
2M_LCH_2402MHz_Ant1_NTNV



2M_MCH_2440MHz_Ant1_NTNV



2M_HCH_2480MHz_Ant1_NTNV



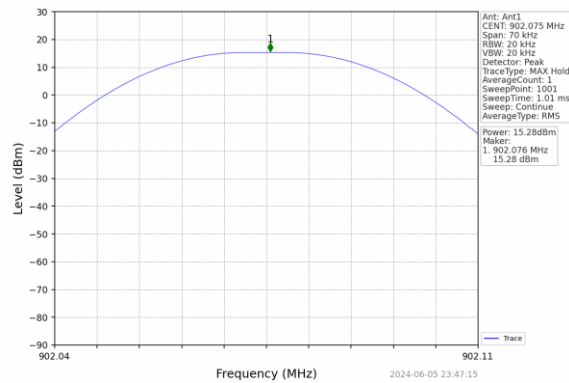
5.6 Test Data – 900 MHz Proprietary

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			ANT1	Limit	
Band 1	SISO	902.075	15.28	<=30	Pass
		902.675	15.30	<=30	Pass
		903.3	15.30	<=30	Pass

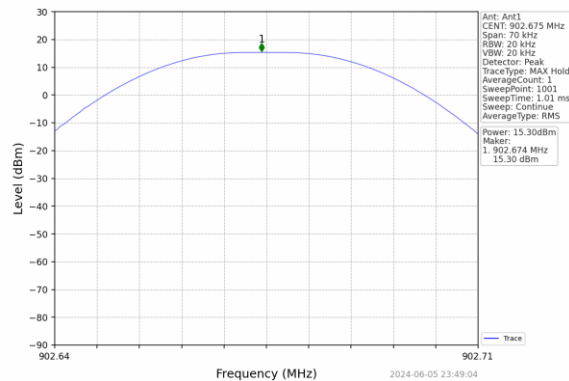
Note1: Antenna Gain: Ant1: +0.60dBi; EIRP of 15.9 dBm at 903.3 MHz

Representative Plots

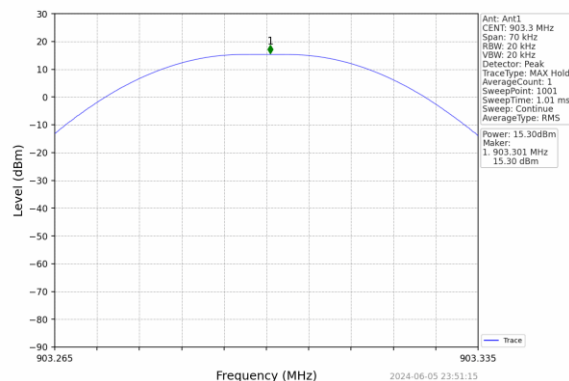
Band 1_LCH_902.075MHz_Ant1_NTNV



Band 1_MCH_902.675MHz_Ant1_NTNV



Band 1_HCH_903.3MHz_Ant1_NTNV



6 Power Spectral Density

6.1 Test Result

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

6.2 Test Method

Peak power spectral density measurements were performed using the procedures from ANSI C63.10: 2013 clause 11.10.2. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

The BLE 2Mbps data mode was used for this test.

Limit

The maximum limit is 8 dBm / 3 kHz.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

6.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

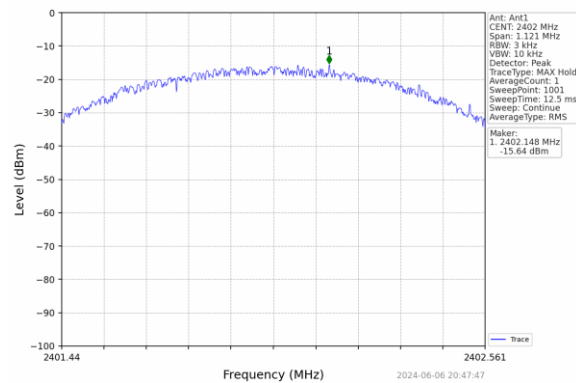
6.5 Test Data - BLE

Mode	TX Type	Frequency (MHz)	Maximum PSD (dBm/3kHz)		Verdict
			ANT1	Limit	
2M	SISO	2402	-15.64	<=8	Pass
		2440	-16.46	<=8	Pass
		2480	-15.53	<=8	Pass

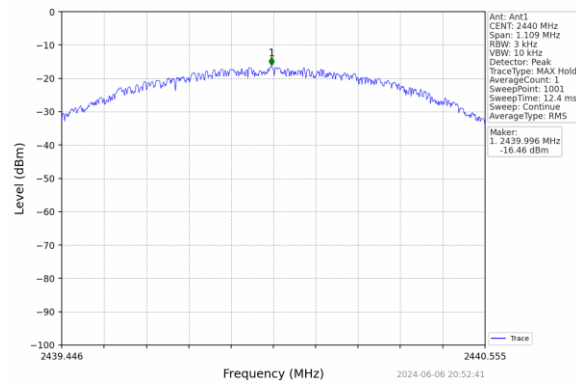
Note1: Antenna Gain: Ant1: +3.30dBi;

Representative Plot(s)

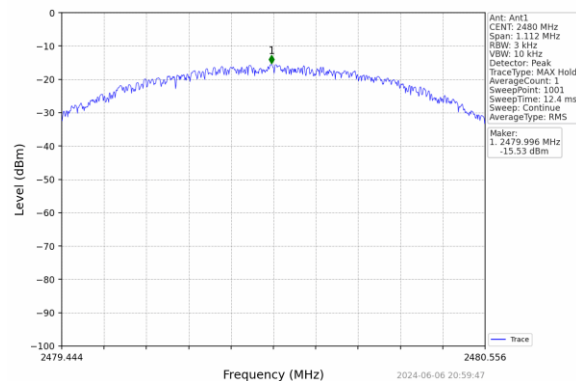
2M_LCH_2402MHz_Ant1_NTNV



2M_MCH_2440MHz_Ant1_NTNV



2M_HCH_2480MHz_Ant1_NTNV



7 Band Edge in the Non-Restricted Band

7.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious and Band Edge Emissions	15.247(d)	RSS-247 S5.5	Compliant

7.2 Test Method

Conducted band edge and spurious band emissions in non-restricted frequency bands were measured using the method defined in ANSI C63.10 clause 11.11. This procedure is referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

The BLE 2Mbps data mode was used for this test.

Limit

Because the maximum peak conducted output power was used to determine compliance with the output power limits, the limit in any 100 kHz band outside of the authorized band is 20 dB below the maximum in-band peak level.

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

7.4 Test Equipment

Test End Date: 6-June-2024

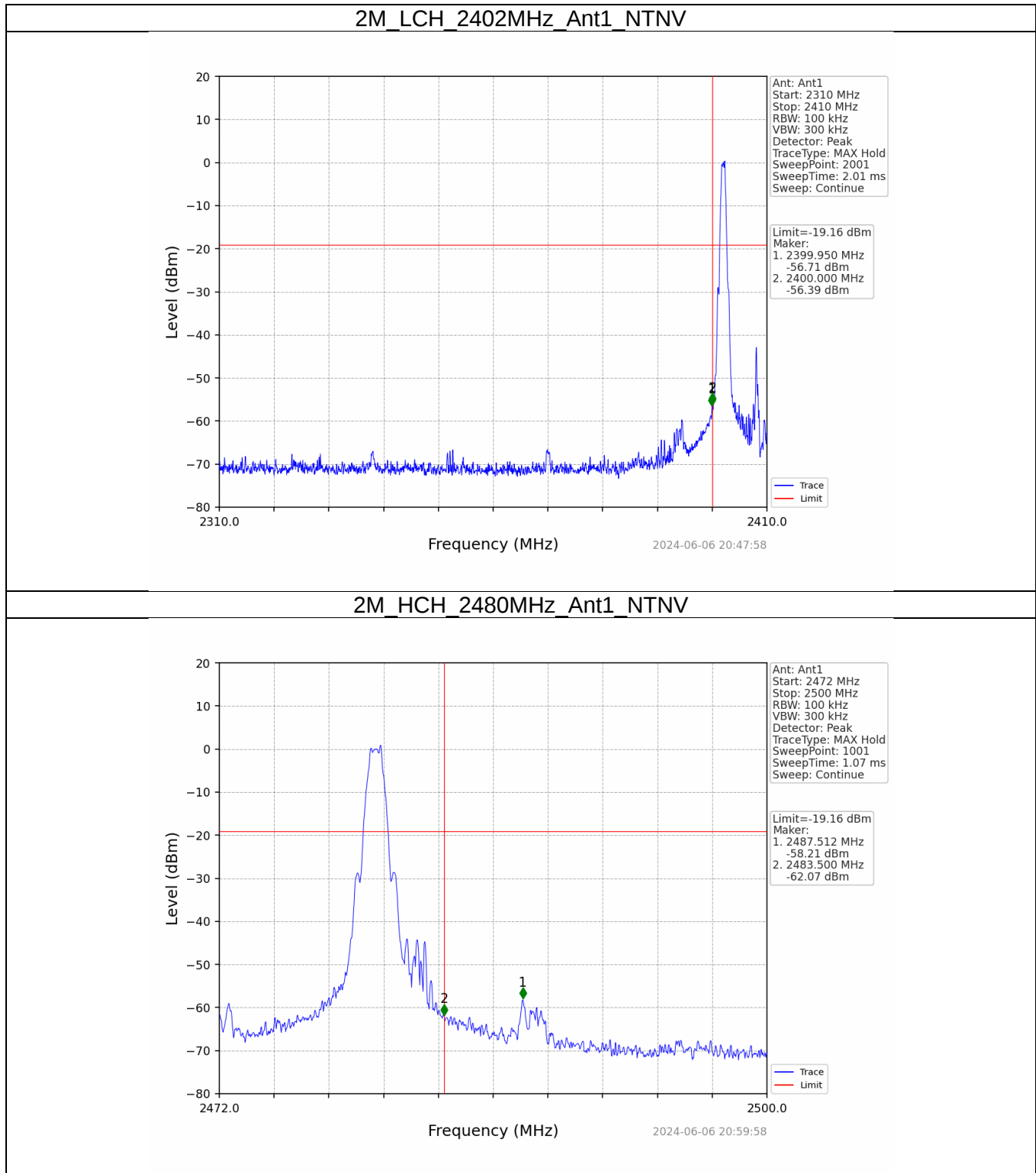
Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

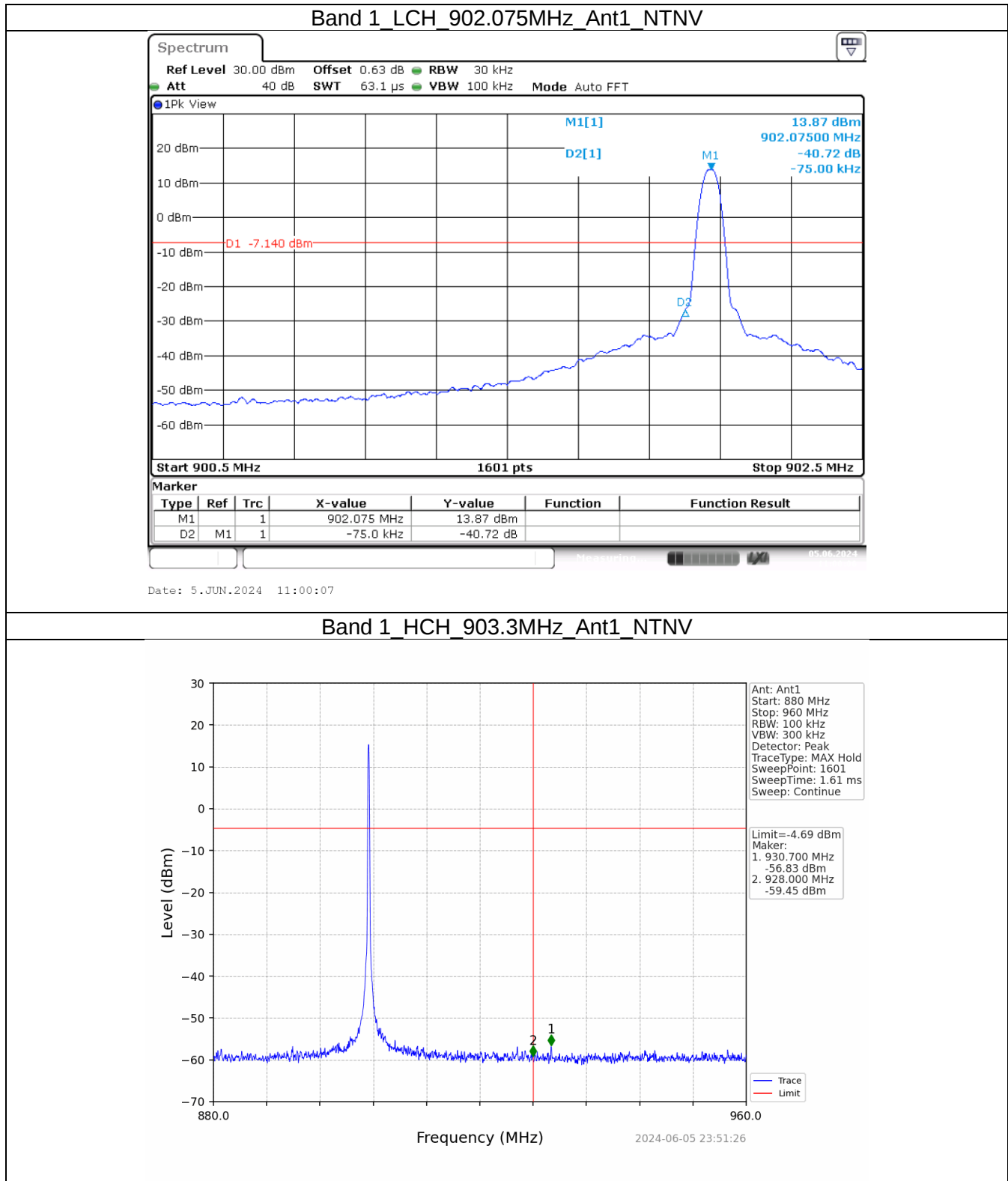
Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

7.5 Test Data – DTS Band Edge - BLE



7.6 Test Data – DTS Band Edge - Proprietary



8 Emissions in Restricted Frequency Bands

8.1 Test Result

Test Description	Test Specification		Test Result
Emissions in Restricted Frequency Bands	15.247(d) 15.205, 15.209	RSS-247 S5.5 RSS-GEN S8.9, S8.10	Compliant

8.2 Test Method

Radiated emissions in restricted frequency bands were measured using methods defined in ANSI C63.10 clause 11.12. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

Lowest, middle, and highest channels were investigated – the device was commanded to continuously transmit on channels 0, 19 and 39. Data rate with the highest spectral density measurement was used to perform testing.

Test distances for radiated tests:

- 9k to 30 MHz – Near field prescan to determine if there were any emissions
- 30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters
- 1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
- 18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

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

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

8.3 Test Site

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

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

Environmental Conditions

Temperature: 22.72 °C

Relative Humidity: 55%

Atmospheric Pressure: 97.53 kPa

8.4 Test Equipment

9kHz-30MHz

Test End Date: 06-June-2024

Tester: SGM

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
PASSIVE LOOP ANTENNA, 9KHZ - 30MHZ	6512	ETS LINDGREN	20151	13-Feb-2024	13-Feb-2025
N to N RF Cable	EM-B810NM-276	ECHOLON	23007	31-Mar-2024	31-Mar-2025
RF CABLE, NM TO NM.	90-195-157	TELEDYNE STORM MICROWAVE	21019	20-Mar-2024	20-Mar-2025
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20125	8-Aug-2023	8-Aug-2024
BROADBAND PREAMPLIFIER 9KHZ-2GHZ	BBV 9745	SCHWARZBECK MESS ELEKTRONIK	20157	10-Oct-2023	10-Oct-2024
Software	TILE 7	ETS LINDGREN	22032	CNR	CNR

30-1000MHz

Test End Date: 06-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	16-May-2024	16-May-2026
N to N RF Cable	EM-B810NM-276	ECHOLON	23007	31-Mar-2024	31-Mar-2025
N-FEMALE TO N-MALE RF CABLE	EM-B810NMNF-118	ECHOLON	23010	17-Apr-2024	17-Apr-2025
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20125	8-Aug-2023	8-Aug-2024
N to N RF Cable	90-076-020	TELEDYNE STORM MICROWAVE	22037	26-Dec-2023	26-Dec-2024
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079817	7-Aug-2023	7-Aug-2024
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22032	15-Nov-2023	15-Nov-2024

1-18GHz

Test End Date: 06-June-2024

Tester: SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	29-Jul-2022	29-Jul-2024
N to N RF Cable	EM-B810NM-276	ECHOLON	24000	15-Jan-2024	15-Jan-2025
RF CABLE	104PE	HUBER & SUHNER	B079793	7-Aug-2023	7-Aug-2024
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	10-Oct-2023	10-Oct-2024
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	3-Oct-2023	3-Oct-2024
FILTER, HIGH PASS, >2800MHZ	HPM50111	MICRO-TRONICS	22017	16-Jun-2023	16-Jun-2024

18-26GHz

Test End Date: 06-June-2024

Tester: SGM

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, DRG HORN (SMALL)	3116B	ETS LINDGREN	B079695	11-Aug-2022	11-Aug-2024
SMA to SMA RF Cable	NC12-K1K1-138	MEGAPHASE	22002	6-Feb-2024	6-Feb-2025
2.92MM MALE TO 2.92MM MALE RF CABLE	HULL140A-29P-60	HASCO COMPONENTS	18033	20-Mar-2024	20-Mar-2025
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	10-Oct-2023	10-Oct-2024
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	3-Oct-2023	3-Oct-2024



FILTER, HIGH PASS, >2800MHZ	HPM50111	MICRO-TRONICS	22017	16-Jun-2023	16-Jun-2024
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Software: "RSE 30-1000 MHz T7 220318" TILE 7! profile dated Mar 2022

"RSE 1-18GHz T7 220318" TILE 7! profile dated Mar 2022

"RSE 18-26 GHz T7 210212" TILE 7 profile dated Feb 2021

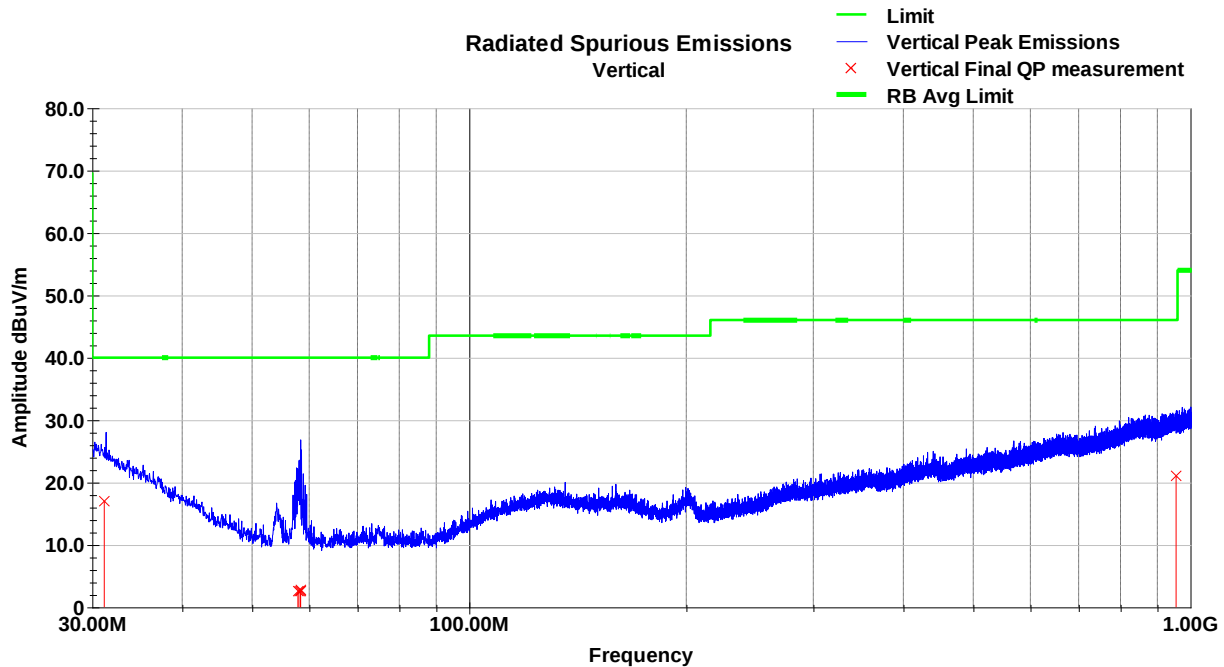
8.5 Test Data

No emissions were detected in the 9kHz to 30MHz frequency range.

8.5.1 30-1000 MHz BLE

There was no significant deviation based on axis or channel in the 30-1000MHz frequency range.

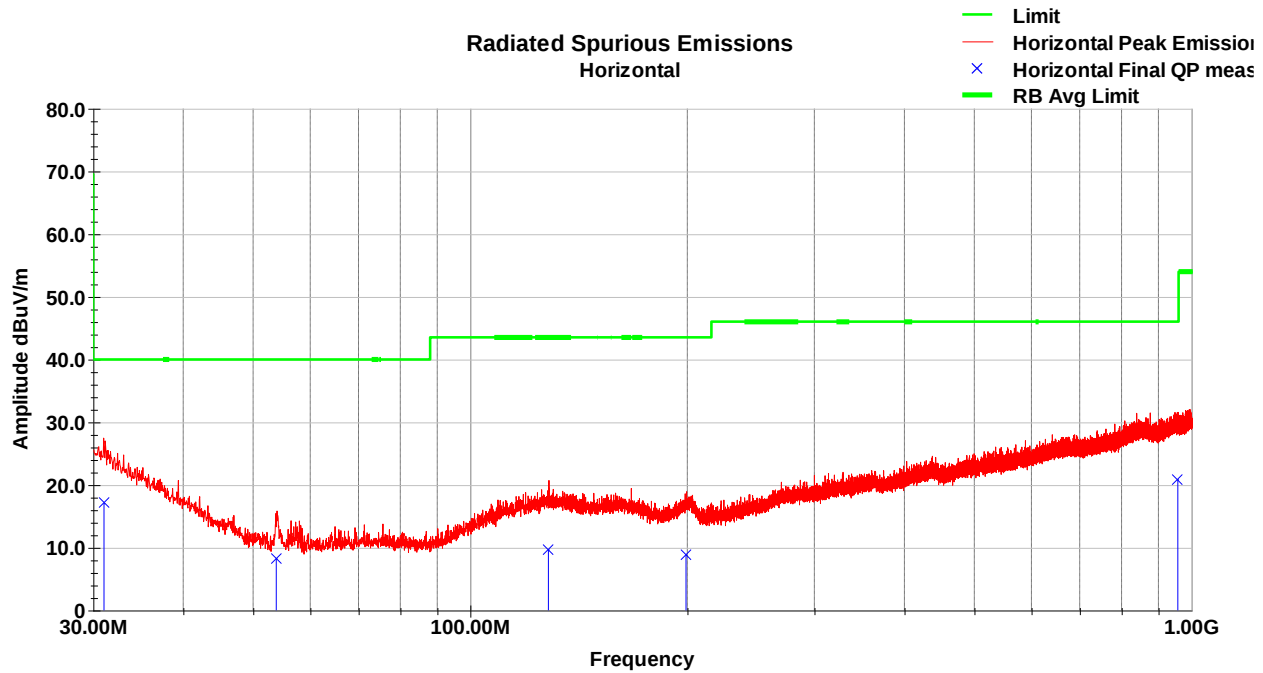
Vertical Polarity: Z-Axis Plot



Vertical Polarity: Z-Axis Test 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)
31.19	23.3	V	359.0	100.0	25.2	0.4	32.0	17.0	40.0	-23.0
57.86	22.5	V	20.0	160.0	11.4	0.6	32.0	2.5	40.0	-37.5
58.06	22.6	V	19.0	100.0	11.4	0.6	32.0	2.6	40.0	-37.4
58.35	22.7	V	20.0	100.0	11.4	0.6	32.0	2.7	40.0	-37.3
58.40	22.6	V	18.0	117.0	11.4	0.6	32.0	2.6	40.0	-37.4
955.55	21.6	V	89.0	117.0	27.5	2.9	31.1	21.0	46.0	-25.1
QP Value = Raw QP + AF + Loss - Amp										
Margin = QP Value - Limit										

Horizontal Polarity: Z-Axis Plot



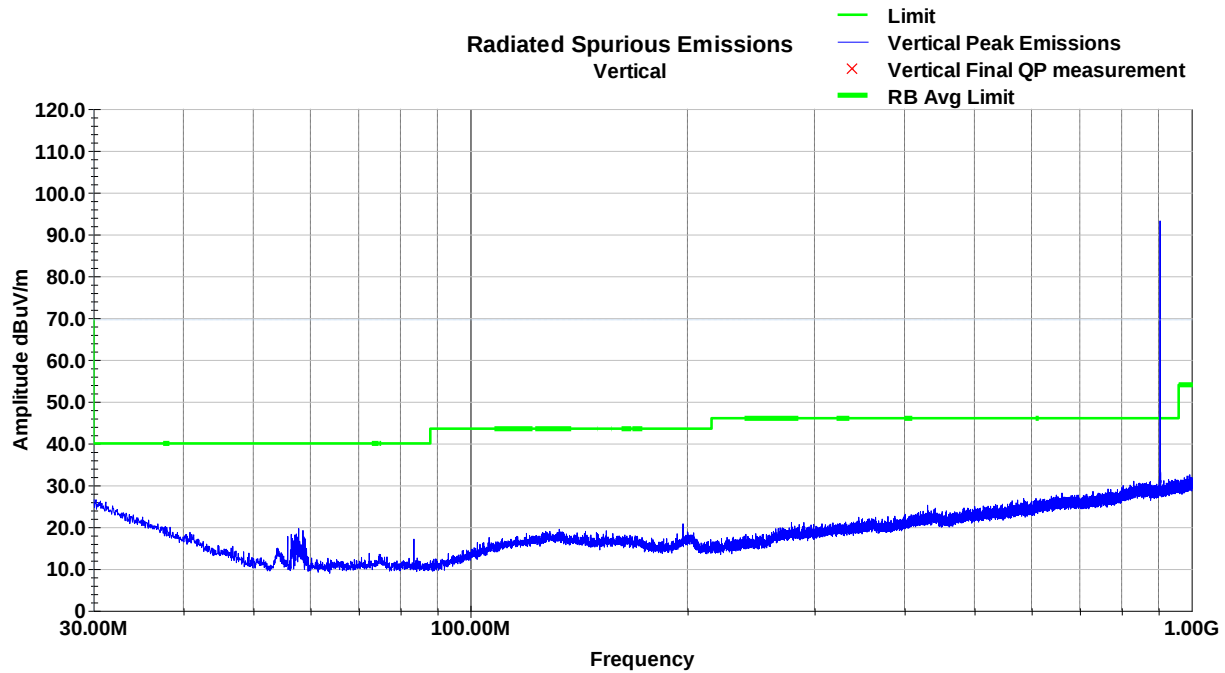
Horizontal Polarity: Z-Axis Test Data

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)
31.06	23.3	H	266.0	400.0	25.4	0.4	32.0	17.1	40.0	-22.9
53.83	28.0	H	177.0	117.0	11.7	0.6	32.0	8.3	40.0	-31.7
128.38	22.8	H	357.0	400.0	17.9	0.9	31.8	9.7	43.5	-33.8
199.15	22.3	H	258.0	267.0	16.8	1.4	31.7	8.9	43.5	-34.6
957.56	21.5	H	256.0	380.0	27.5	2.9	31.1	20.9	46.0	-25.1
QP Value = Raw QP + AF + Loss - Amp										
Margin = QP Value - Limit										

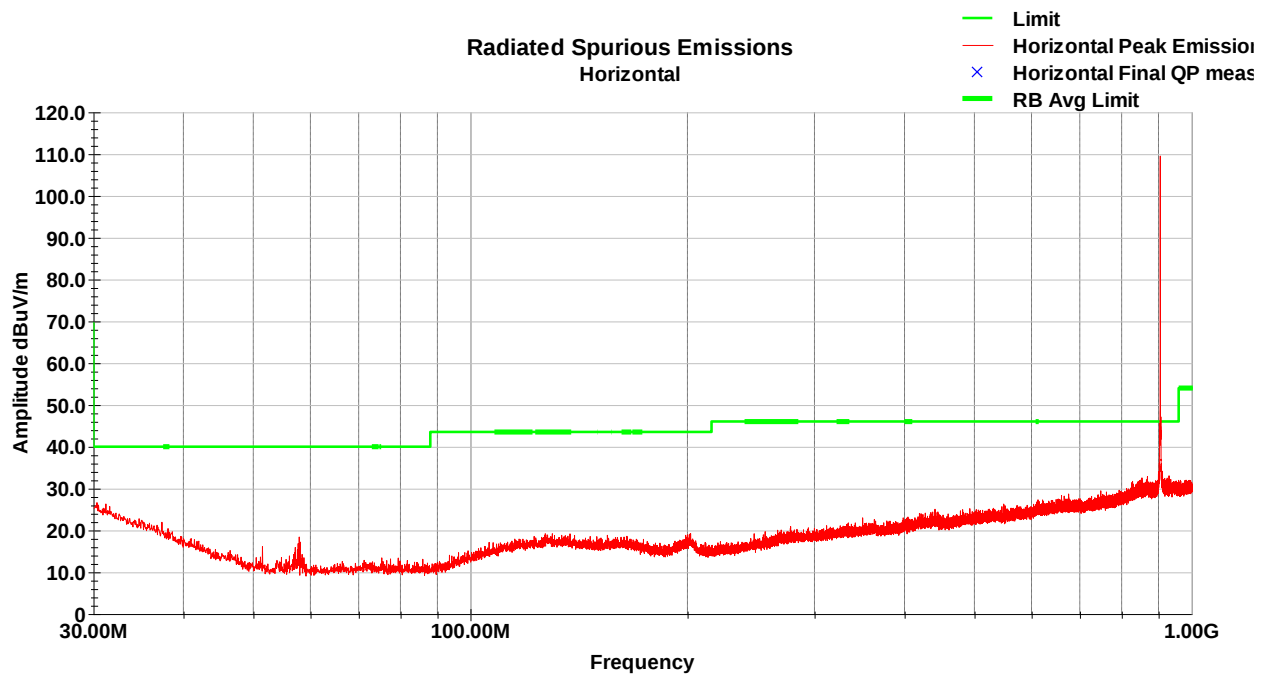
8.5.2 30-1000 MHz Proprietary

There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – Mid Channel - X-Axis – Test Plot



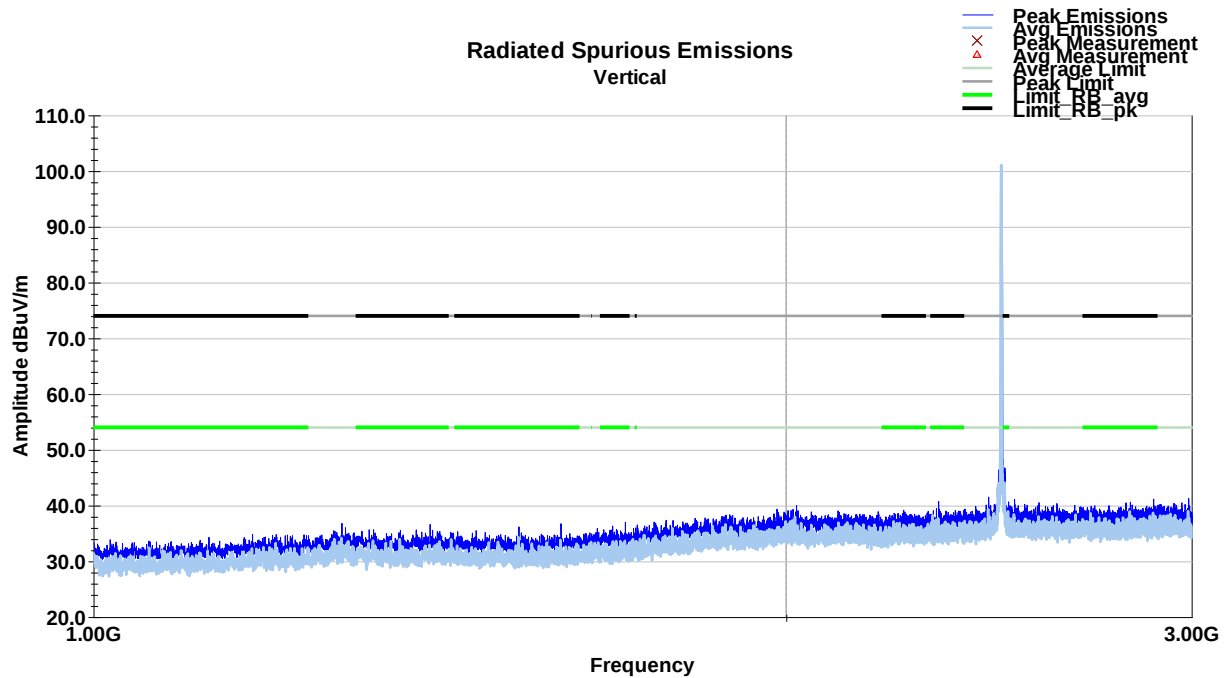
Horizontal Polarity – High Channel - X-Axis – Test Plot



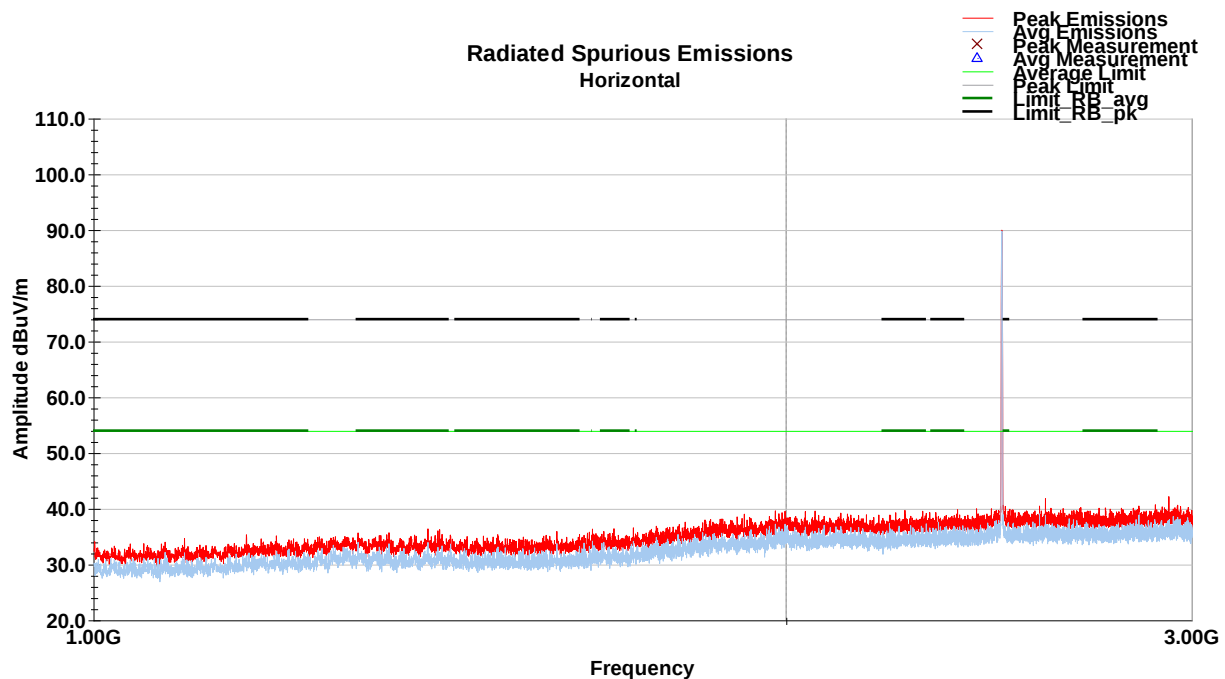
8.5.3 1-3 GHz BLE

There was no significant deviation based on axis. Z-Axis was the worst case reported.

Vertical - High Channel – Z-Axis - Test Plot

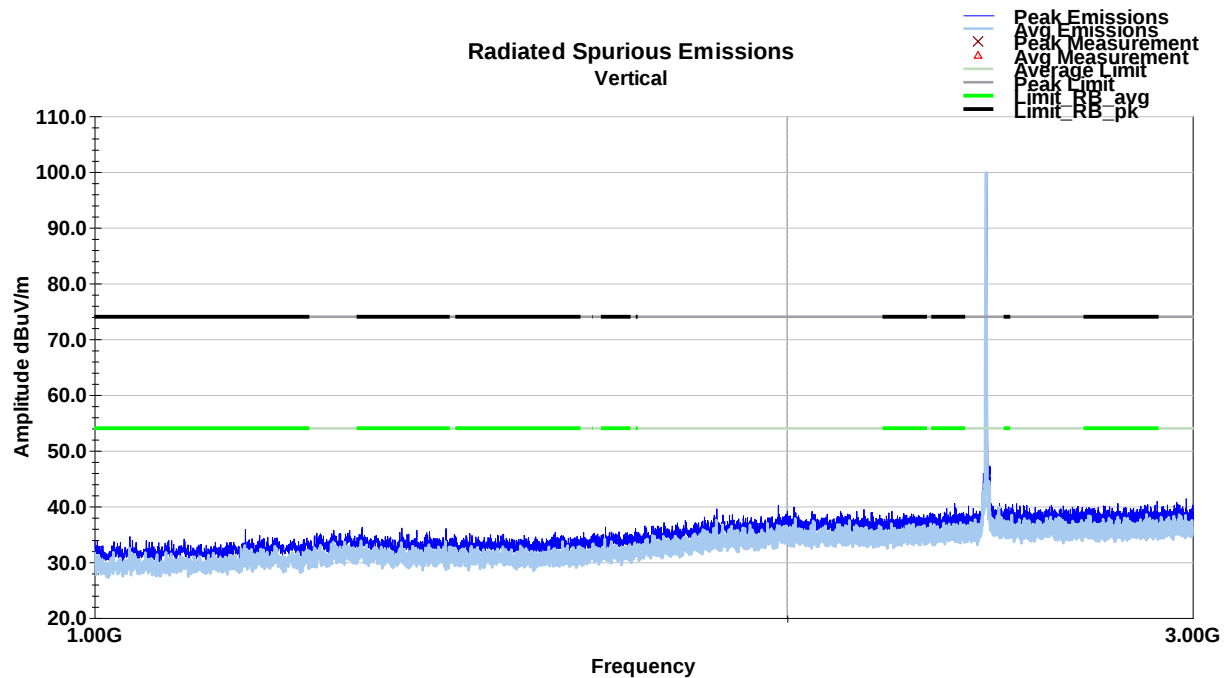


Vertical - High Channel – Z-Axis – Test Plot

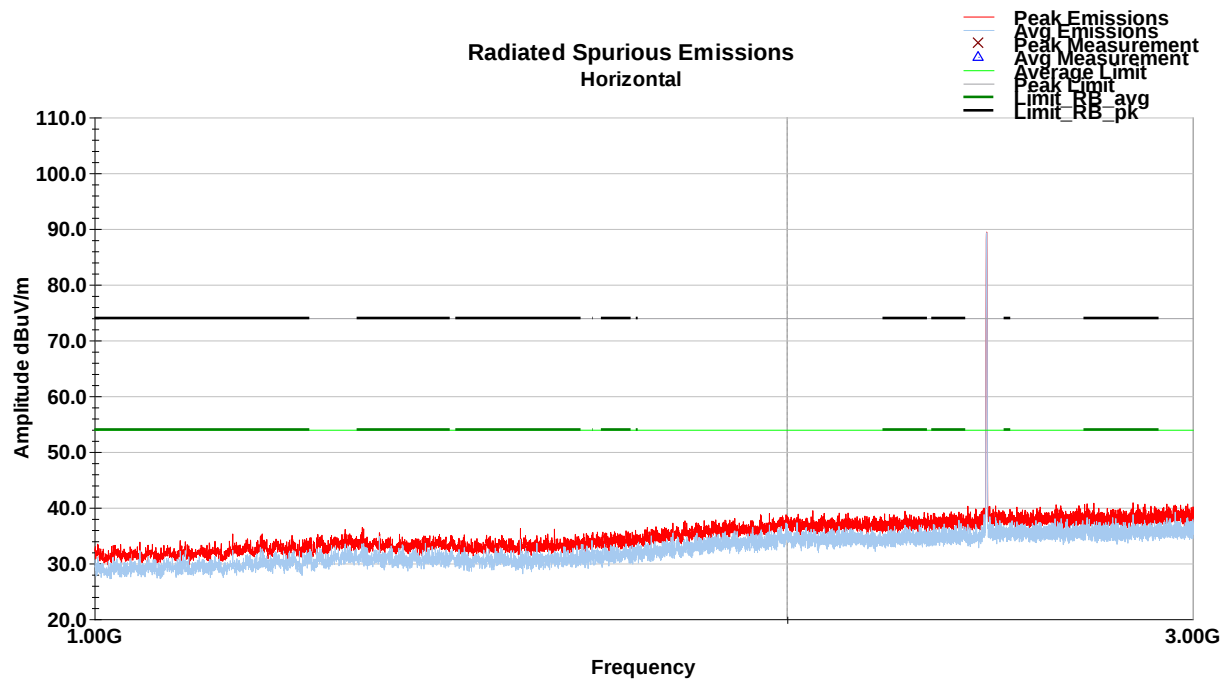


There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – Mid Channel - Z-Axis – Test Plot

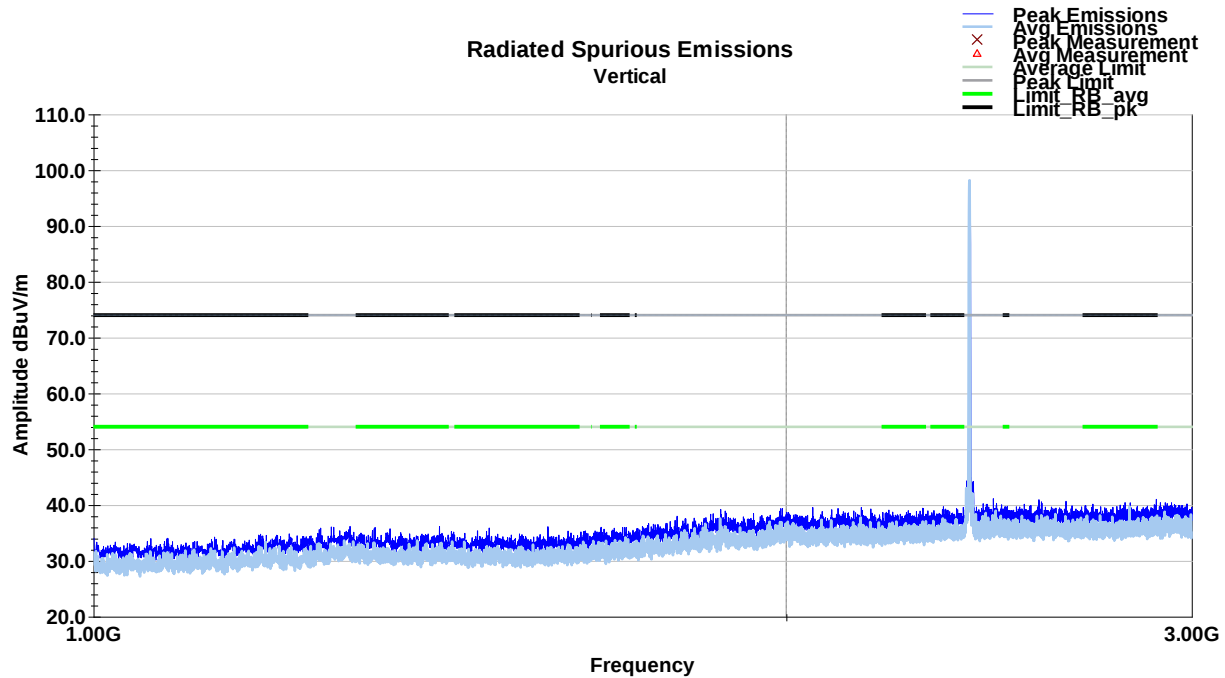


Horizontal Polarity – Mid Channel - Z-Axis – Test Plot

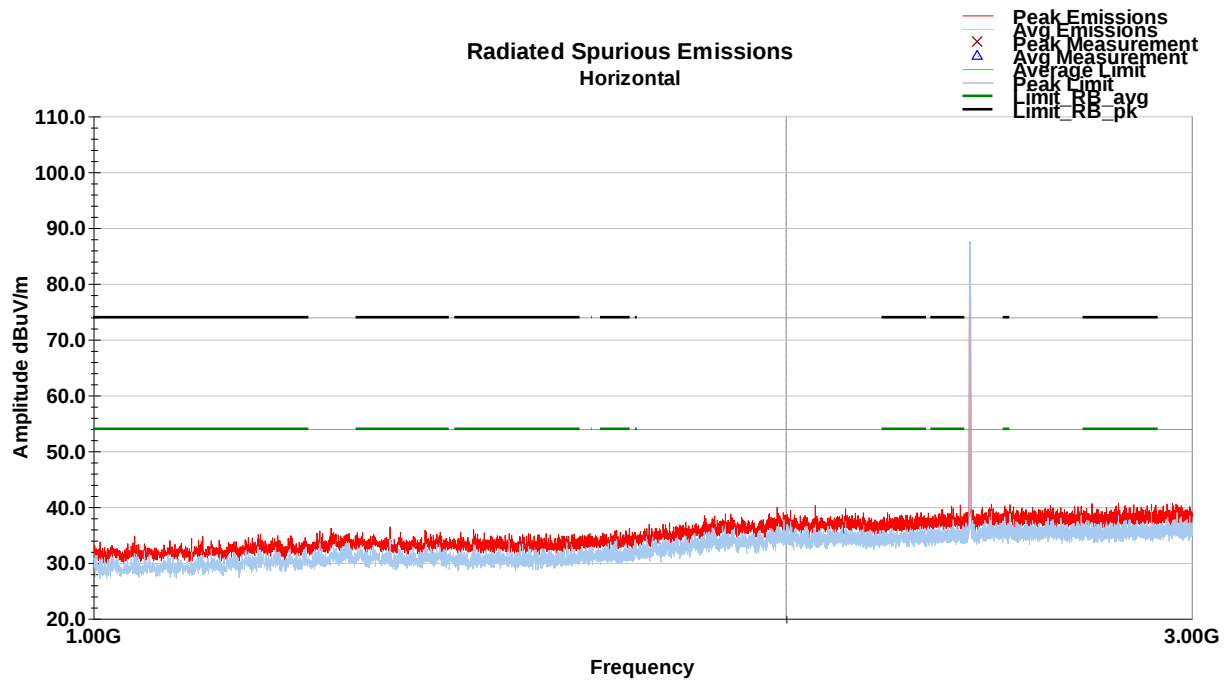


There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – Low Channel - Z-Axis – Test Plot



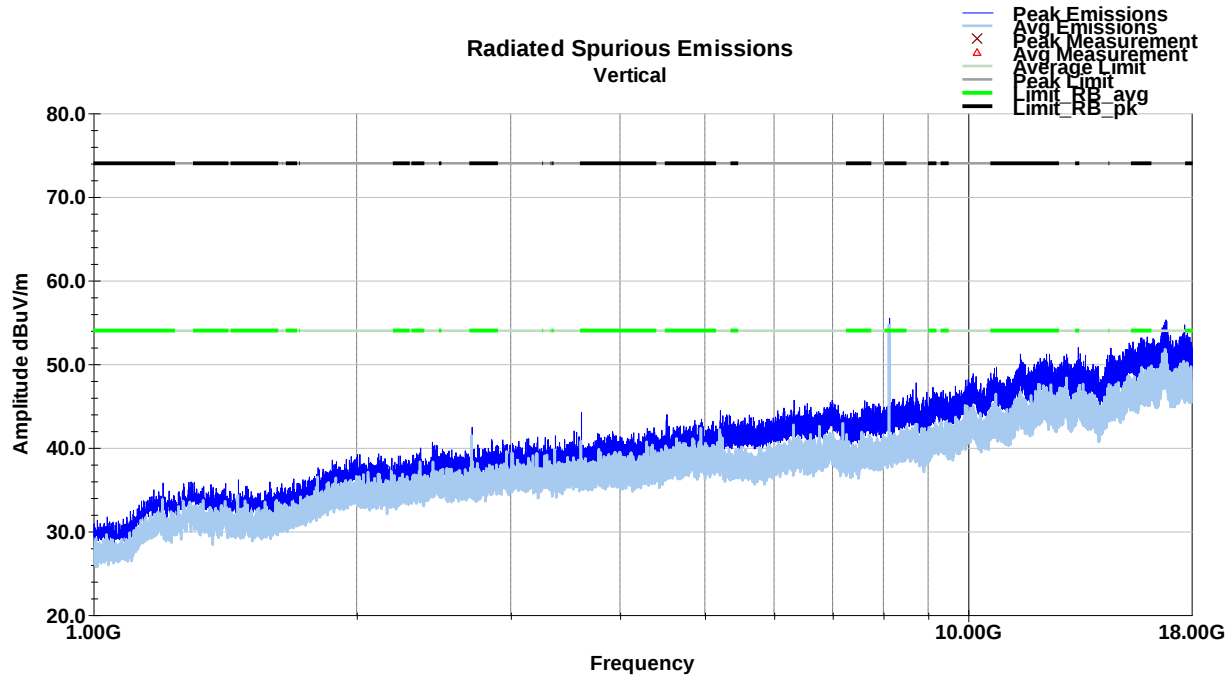
Horizontal Polarity – Low Channel - Z-Axis – Test Plot



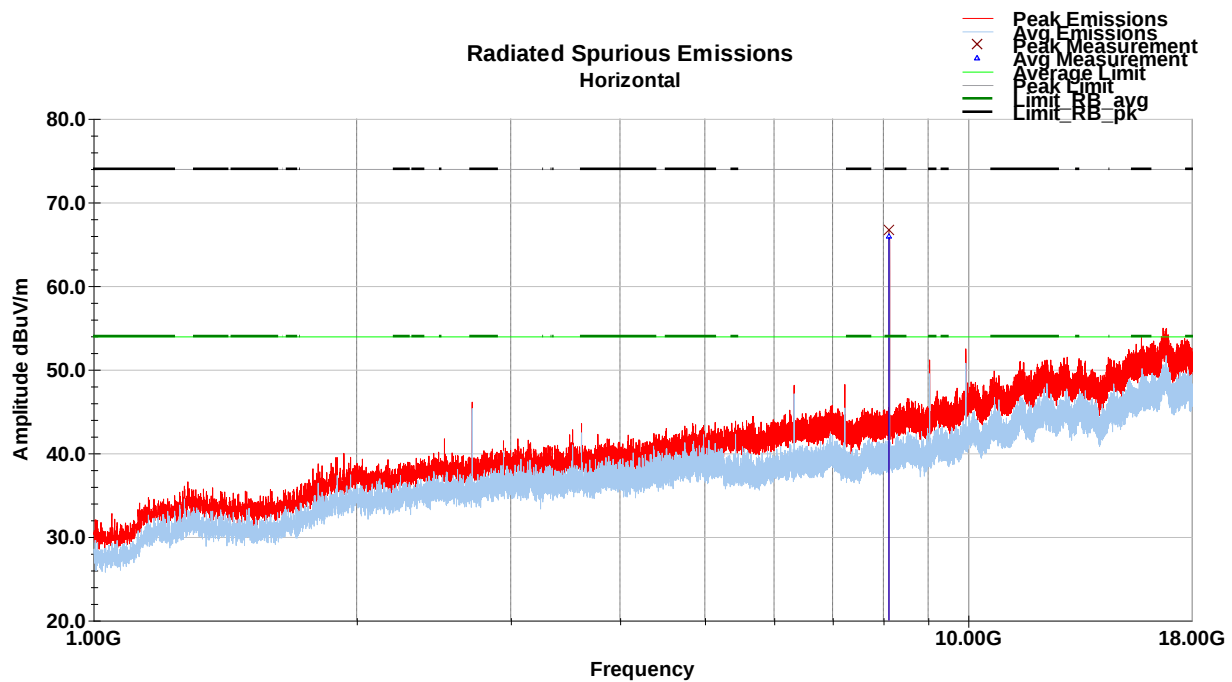
8.5.4 1-18 GHz Proprietary

There was no significant deviation based on axis or channel. Y-Axis was the worst case reported.

1-18 GHz – Vertical - Low Channel – Y Axis – Test Plot



1-18 GHz – Horizontal - Low Channel – Y Axis – Test Plot



There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Horizontal Polarity – Low Channel - Y-Axis – Tabular Data

Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
8120.25	64.8	H	347.0	194.0	35.8	3.8	42.0	62.5	74.0	-11.5
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	DCCF (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
8120.25	63.7	H	347.0	194.0	35.8	3.8	42.0	-11.7	49.7	54.0	-4.3
Final Avg = Raw Avg + AF + Loss - Amp											
Margin = Final Avg - Limit											

Note: Duty Cycle Correction Factor was used to take into account the maximum protocol limited duty cycle used in normal operation for the average measurement taken as referenced in KBD 558074 D01 15.247 Meas Guidance V05r02 - Question 3 – part c.

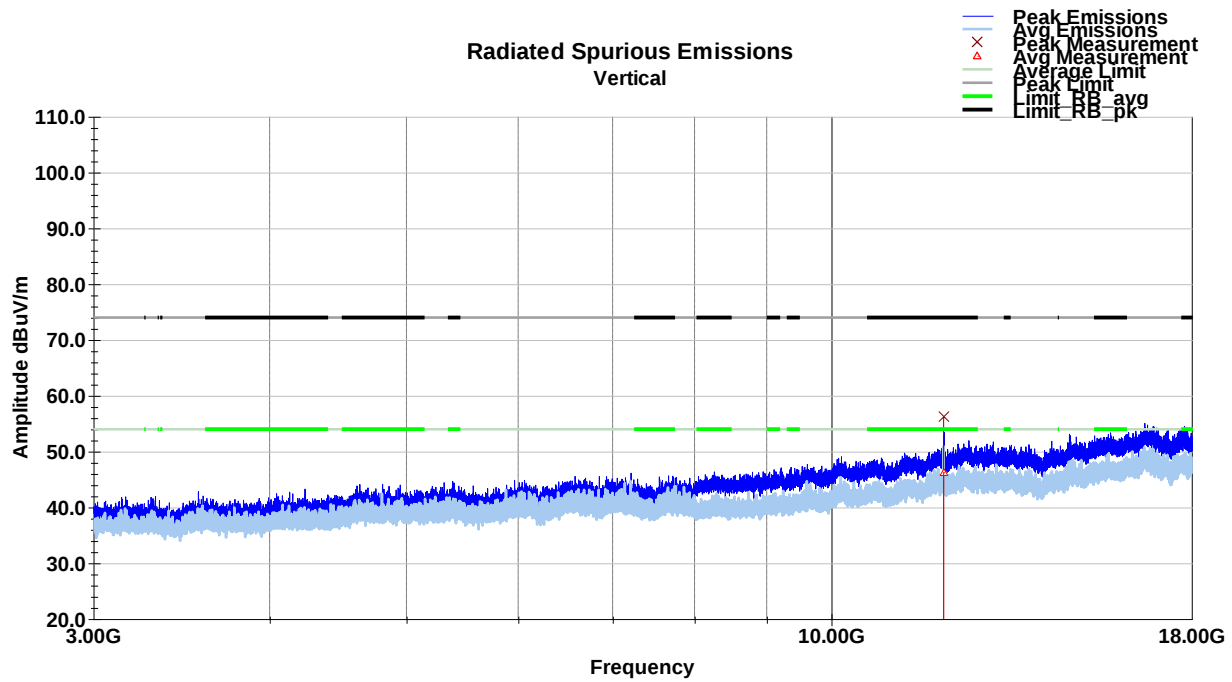
Protocol Limited Duty Cycle is: 26%

Duty Cycle used during testing was: 100%

Duty Cycle Correction factor of -11.7 dB was calculated. This is added to the average measurement to account for the maximum operating duty cycle used in normal operation.

8.5.5 3-18 GHz BLE

Vertical Polarity – Low Channel - X-Axis – Test Plot



Vertical Polarity – Low Channel - X-Axis – Tabular Data

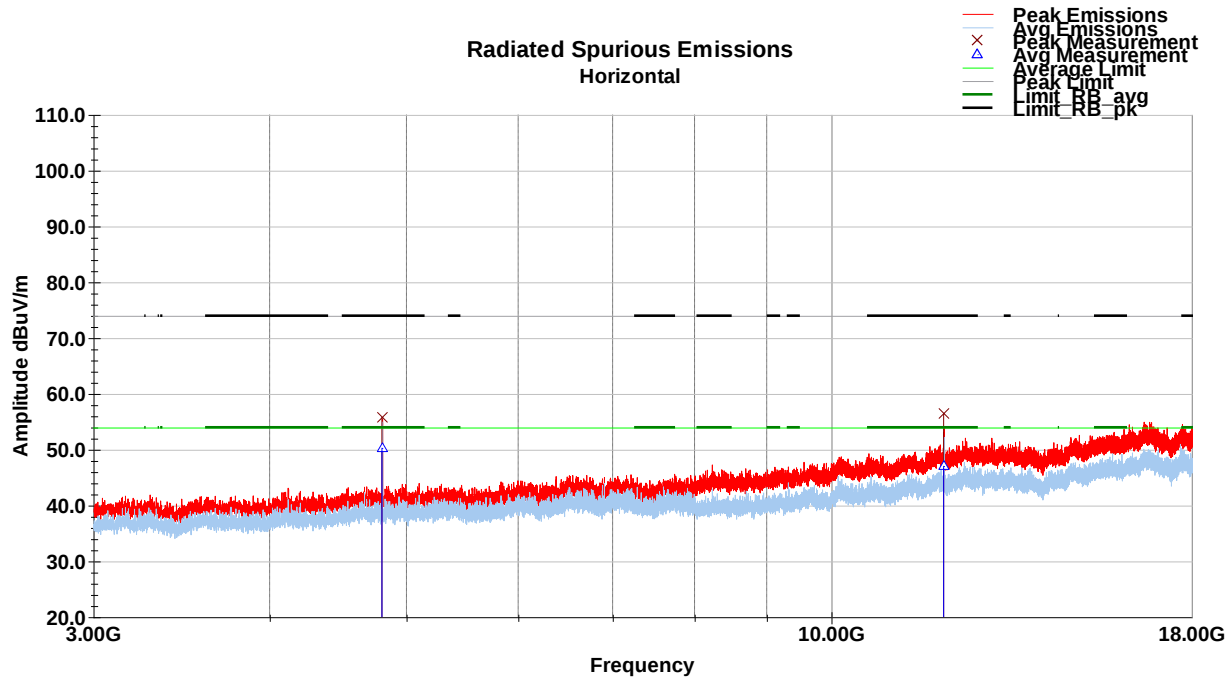
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
12011.28	53.9	V	224.0	103.0	38.8	5.0	41.5	56.2	74.0	-17.8
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
12011.28	44.0	V	224.0	103.0	38.8	5.0	41.5	46.3	54.0	-7.7
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Horizontal Polarity – Low Channel - X-Axis – Test Plot



Horizontal Polarity – Low Channel - X-Axis – Tabular Data

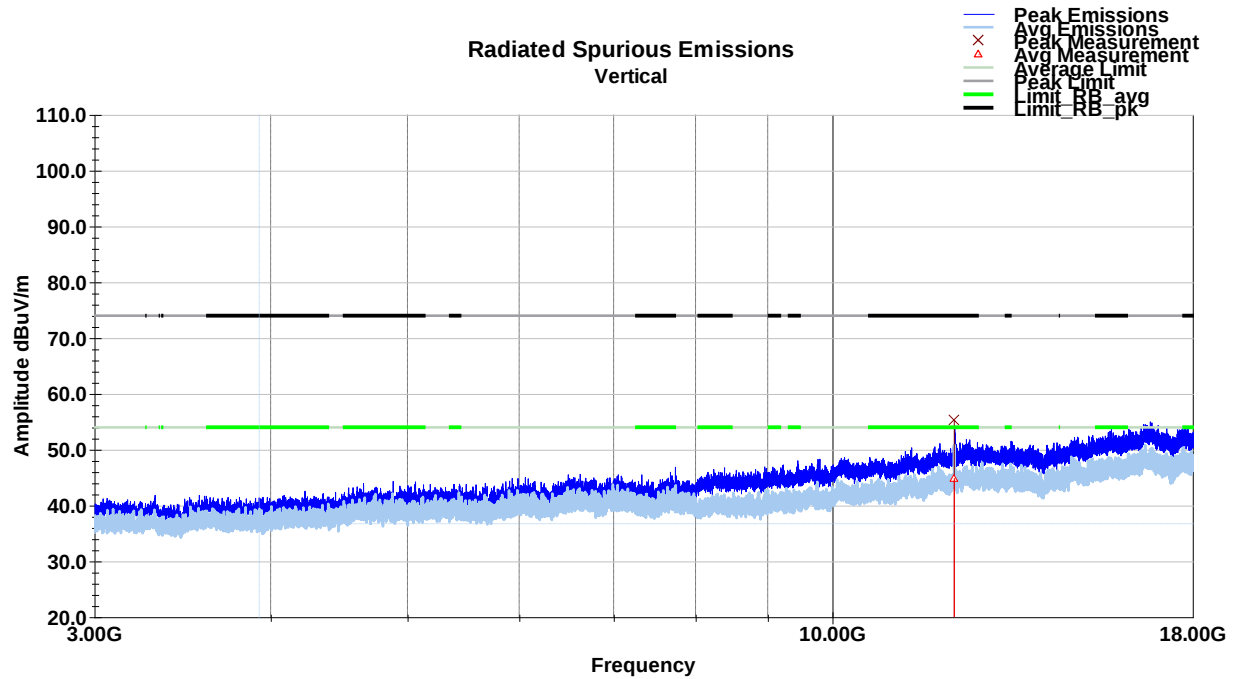
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4804.50	60.7	H	336.0	110.0	34.6	2.9	42.4	55.8	74.0	-18.2
12011.18	54.2	H	129.0	106.0	38.8	5.0	41.5	56.5	74.0	-17.5
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
4804.50	55.2	H	336.0	110.0	34.6	2.9	42.4	50.3	54.0	-3.7
12011.18	44.8	H	129.0	106.0	38.8	5.0	41.5	47.1	54.0	-6.9
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Vertical Polarity – Mid Channel - X-Axis – Test Plot



Vertical Polarity – Mid Channel - X-Axis – Tabular Data

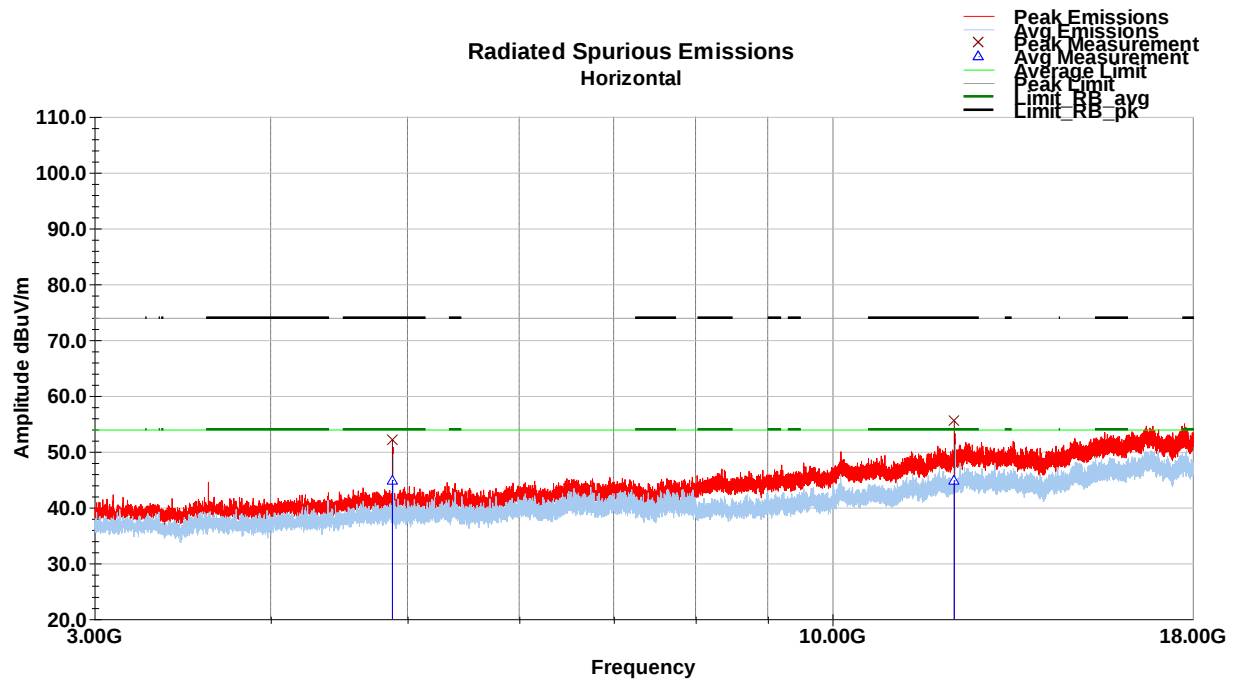
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
12201.32	52.3	V	130.0	105.0	39.0	5.0	41.1	55.2	74.0	-18.8
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
12201.32	42.0	V	130.0	105.0	39.0	5.0	41.1	44.9	54.0	-9.1
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Horizontal Polarity – Mid Channel - X-Axis – Test Plot



Horizontal Polarity – Mid Channel - X-Axis – Tabular Data

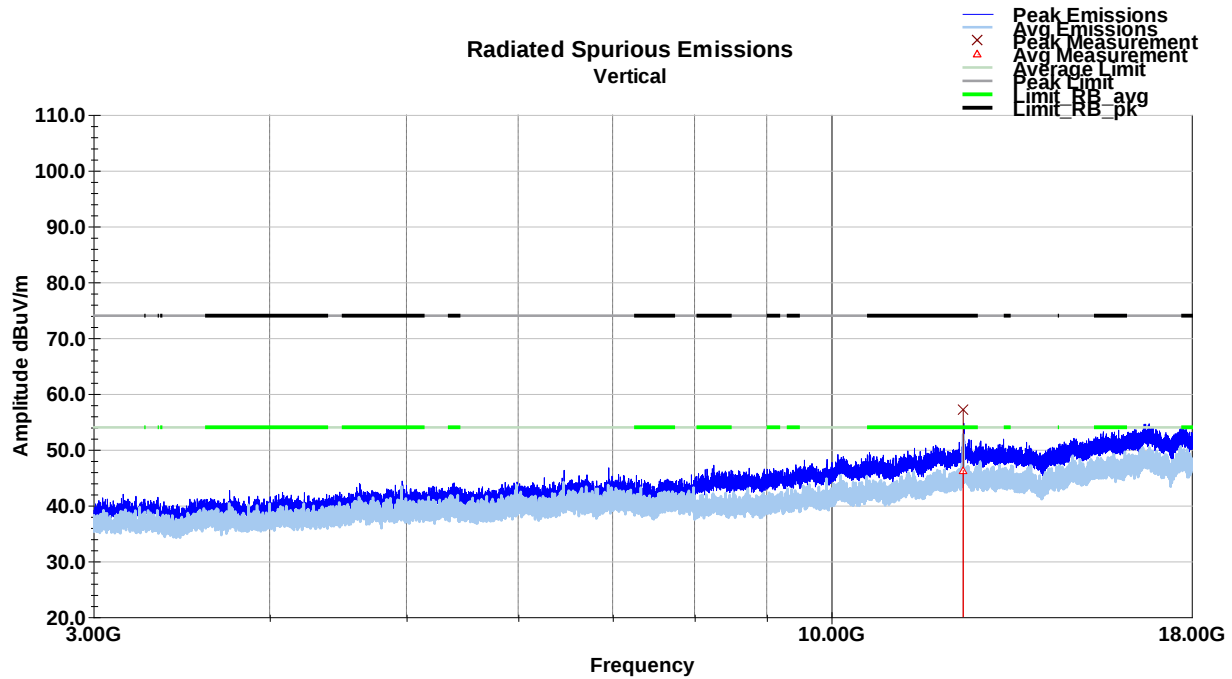
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4879.46	56.7	H	151.0	103.0	34.5	3.1	42.2	52.1	74.0	-21.9
12201.54	52.6	H	308.0	106.0	39.0	5.0	41.1	55.5	74.0	-18.5
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
4879.46	49.5	H	151.0	103.0	34.5	3.1	42.2	44.9	54.0	-9.1
12201.54	42.0	H	308.0	106.0	39.0	5.0	41.1	44.9	54.0	-9.1
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Vertical Polarity – High Channel - X-Axis – Test Plot



Vertical Polarity – High Channel - X-Axis – Tabular Data

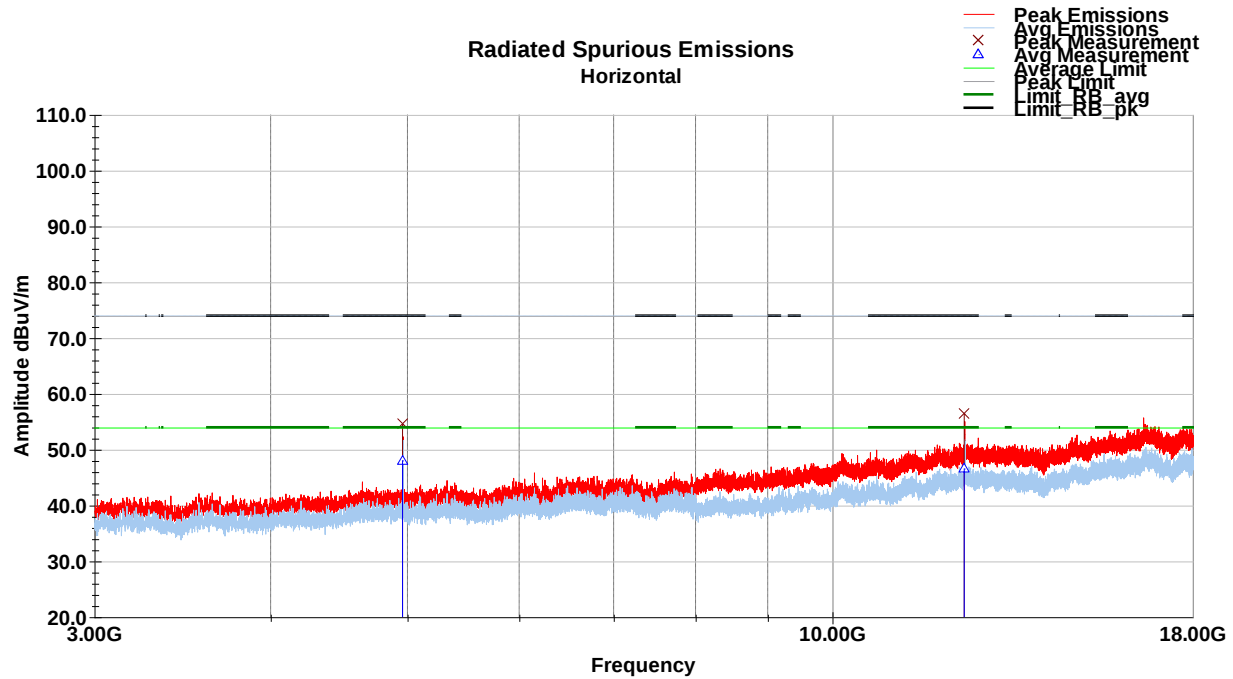
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
12401.44	53.8	V	106.0	106.0	38.9	5.3	40.8	57.2	74.0	-16.8
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
12401.44	42.9	V	106.0	106.0	38.9	5.3	40.8	46.3	54.0	-7.7
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Horizontal Polarity – High Channel - X-Axis – Test Plot



Horizontal Polarity – High Channel - X-Axis – Tabular Data

Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4960.50	58.6	H	158.0	113.0	34.5	3.2	41.7	54.5	74.0	-19.5
12401.08	53.1	H	298.0	102.0	38.9	5.2	40.8	56.5	74.0	-17.5
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

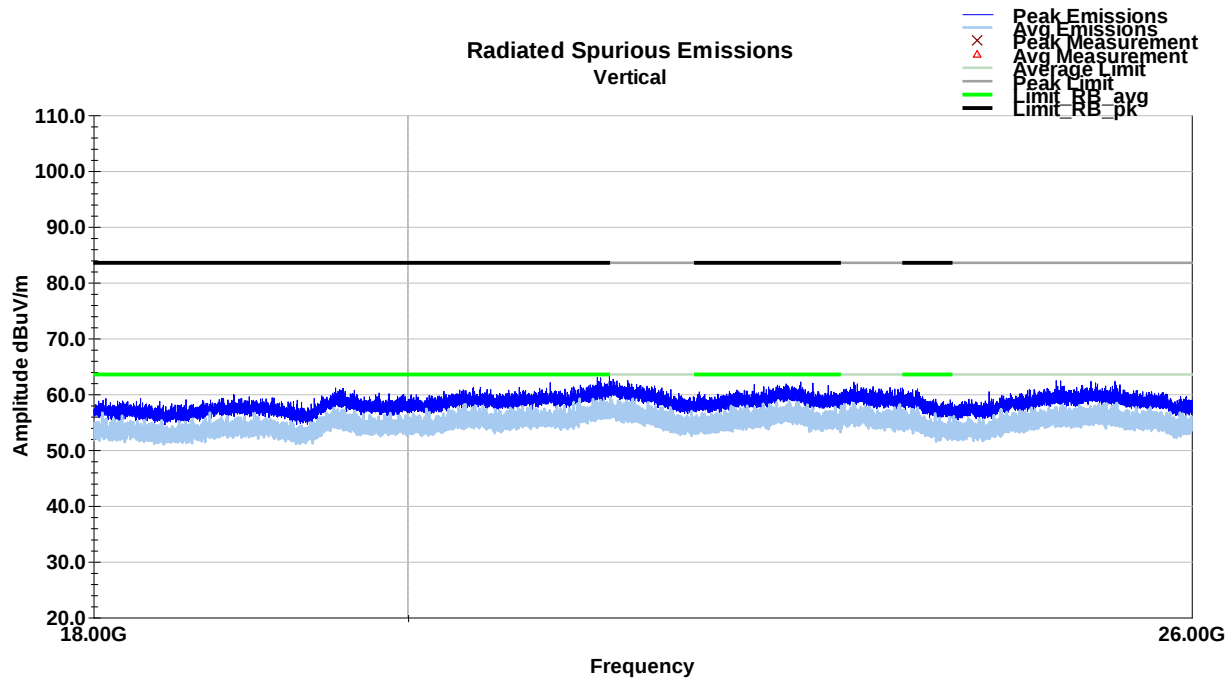
Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
4960.50	52.2	H	158.0	113.0	34.5	3.2	41.7	48.1	54.0	-5.9
12401.08	43.2	H	298.0	102.0	38.9	5.2	40.8	46.6	54.0	-7.4
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

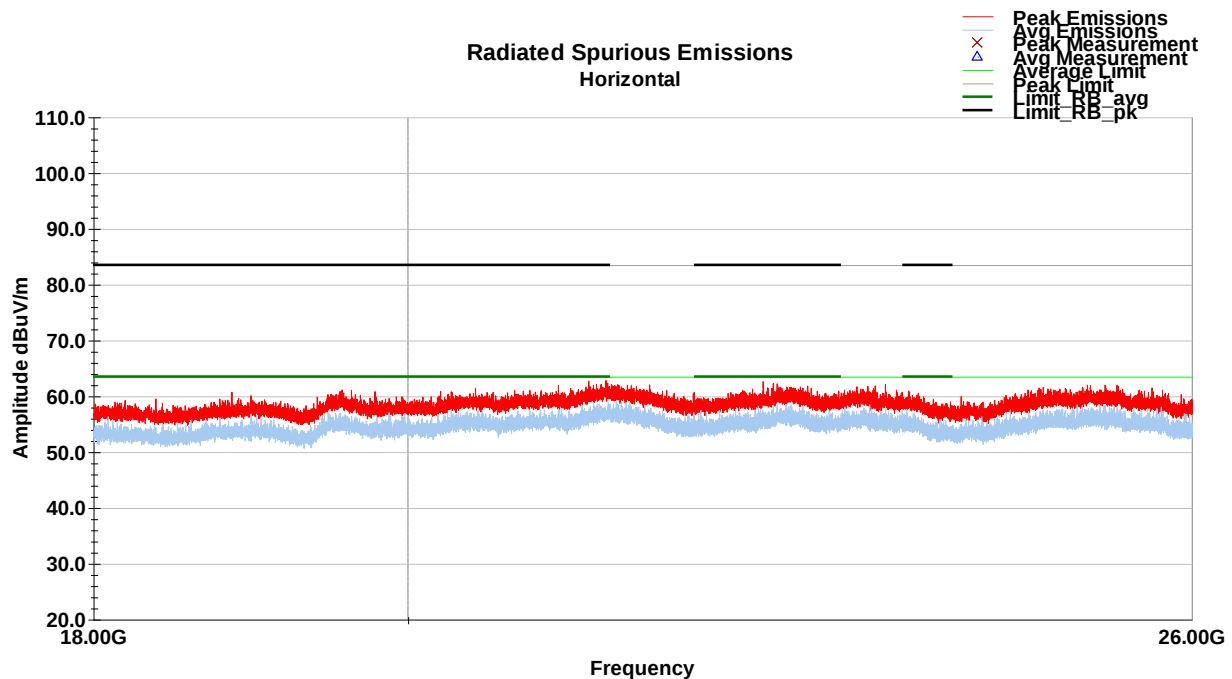
8.5.6 18-26 GHz BLE

There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – Low Channel - X-Axis – Test Plot

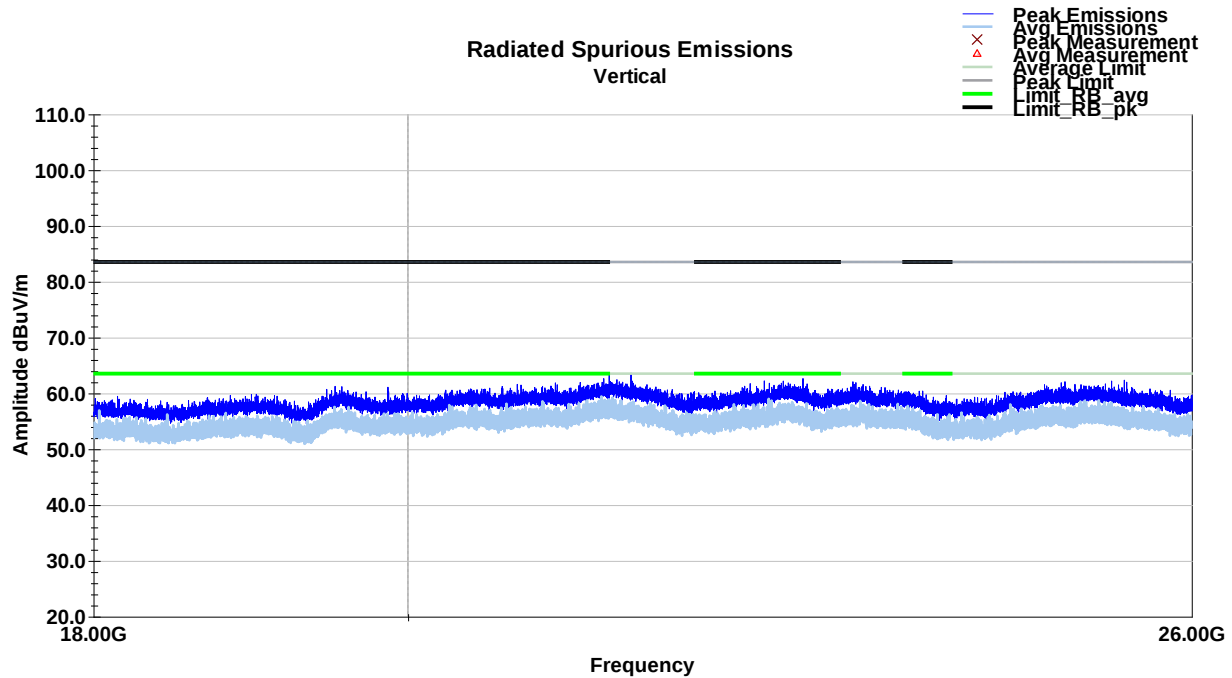


Horizontal Polarity – Low Channel - X-Axis – Test Plot

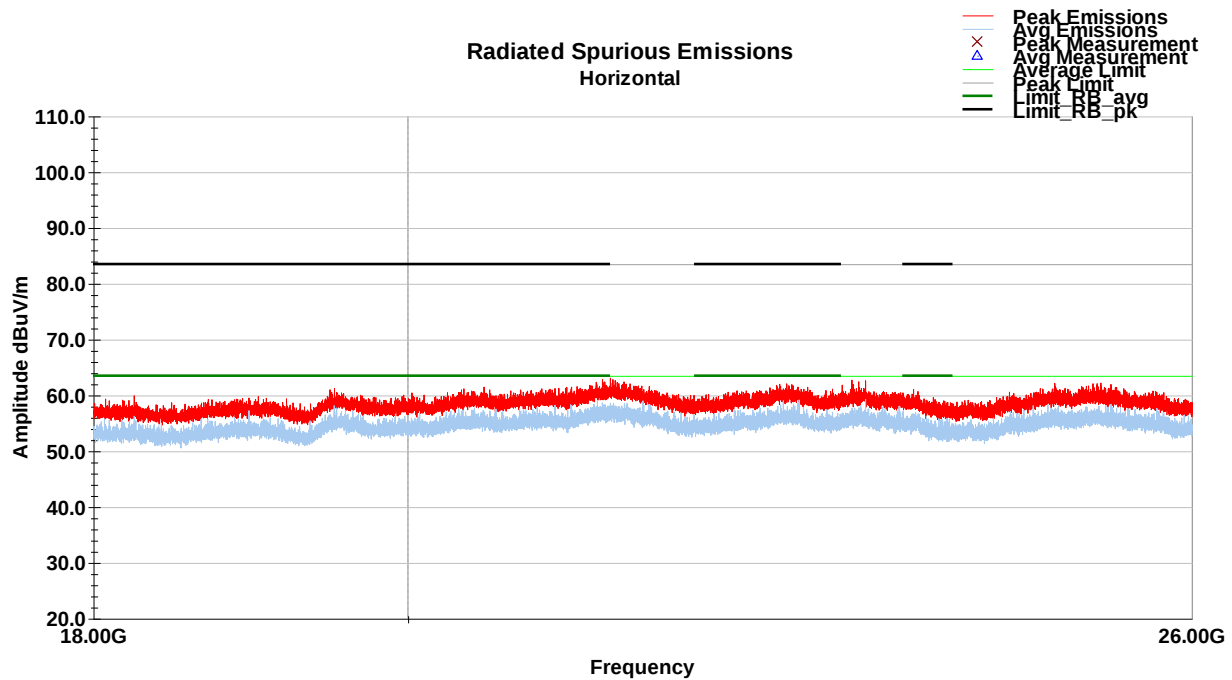


There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – Middle Channel - X-Axis – Test Plot

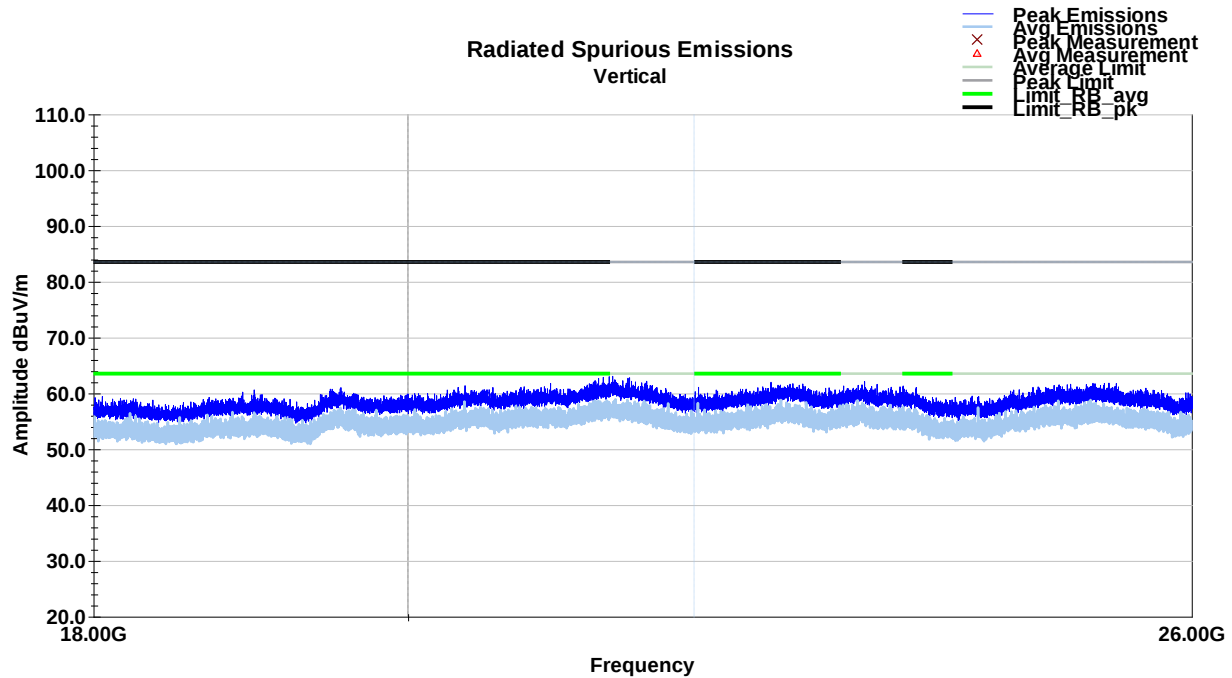


Horizontal Polarity – Middle Channel - X-Axis – Test Plot

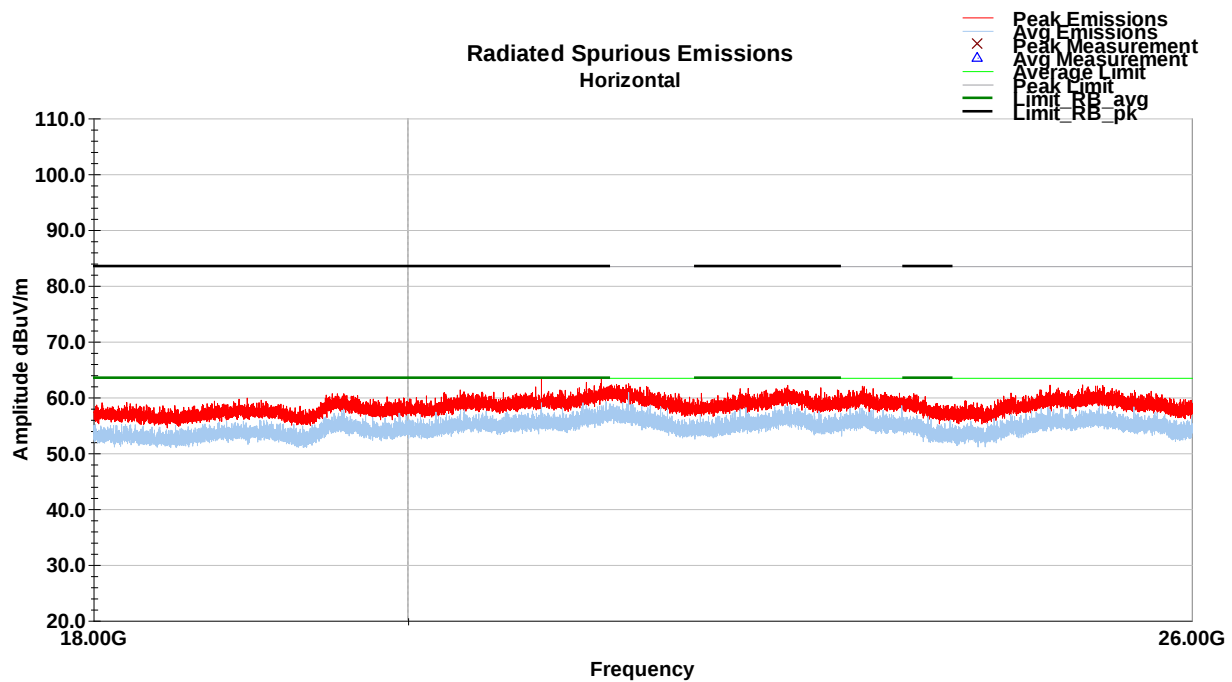


There was no significant deviation based on axis or channel in the 30-1000MHz frequency range. Worst case was reported.

Vertical Polarity – High Channel - X-Axis – Test Plot



Horizontal Polarity – High Channel - X-Axis – Test Plot



9 Band Edge Emissions in Restricted Frequency Bands

9.1 Test Result

Test Description	Test Specification		Test Result
Band Edge Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN S8.9, 8.10	Compliant

9.2 Test Method

Field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz. Measurements were made using the conducted methods defined in ANSI C63.10: 2013 clause 11.12.2. The measurements were converted to a radiated field strength equivalent using the equations defined in that section. Both peak and average measurements were performed at the antenna port. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

A reference level offset was applied to the spectrum analyzer so that conducted measurements represent field strength measurements in dBμV/m.

The BLE 2Mbps data mode was used for this test.

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

9.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

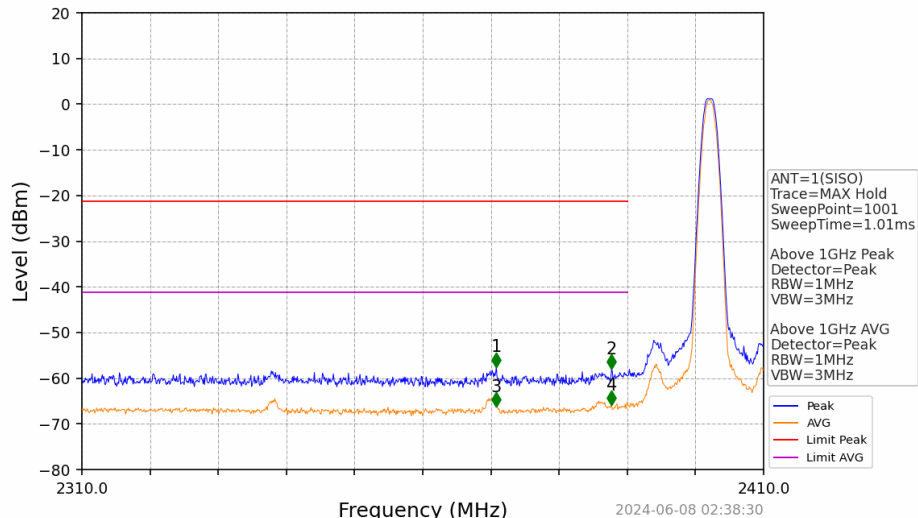
Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

9.5 Test Data – DTS Band Edge - BLE

BLE - Lower band edge

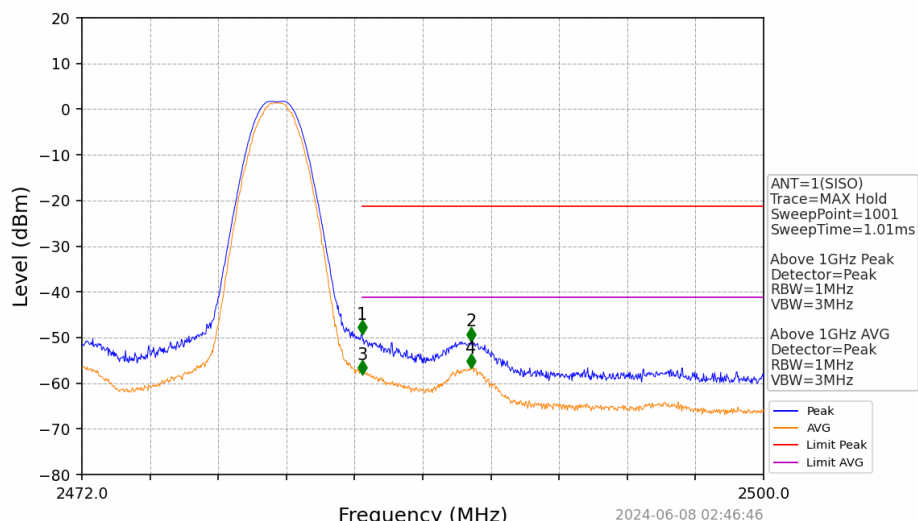
2M_LCH_2402MHz_Ant1_NTNV



No	Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Status	Remark	No	Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Status	Remark
1	2370.800	-57.53	-21.20	36.33	Pass	Peak	3	2370.800	/	-21.20	/	/	AVG
2	2387.700	-58.01	-21.20	36.81	Pass	Peak	4	2387.700	/	-21.20	/	/	AVG

BLE - Upper band edge

2M_HCH_2480MHz_Ant1_NTNV

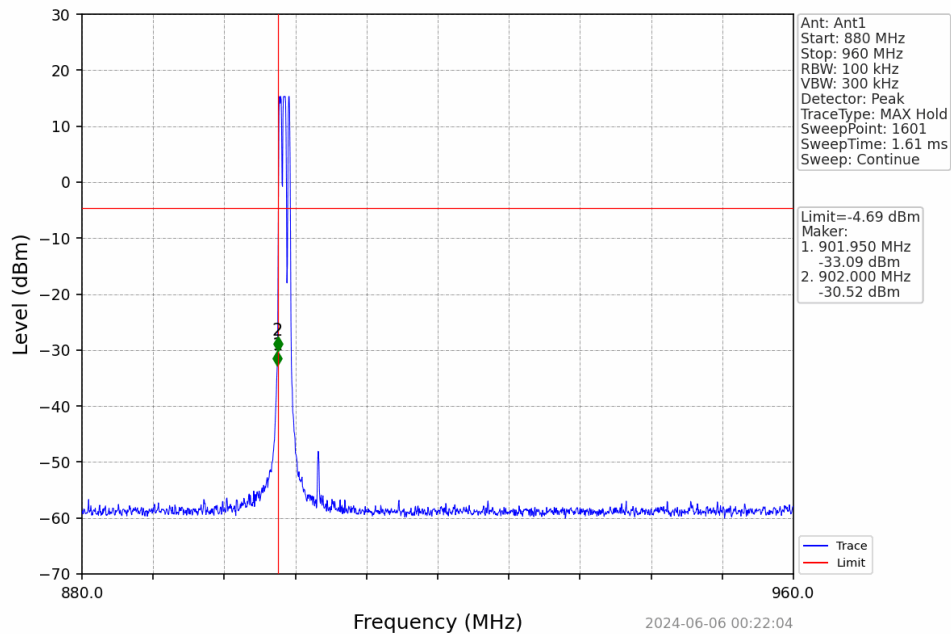


No	Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Status	Remark	No	Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Status	Remark
1	2483.508	-49.29	-21.20	28.09	Pass	Peak	3	2483.508	/	-21.20	/	/	AVG
2	2487.988	-50.80	-21.20	29.61	Pass	Peak	4	2487.988	/	-21.20	/	/	AVG

9.6 Test Data – DTS Band Edge - Proprietary

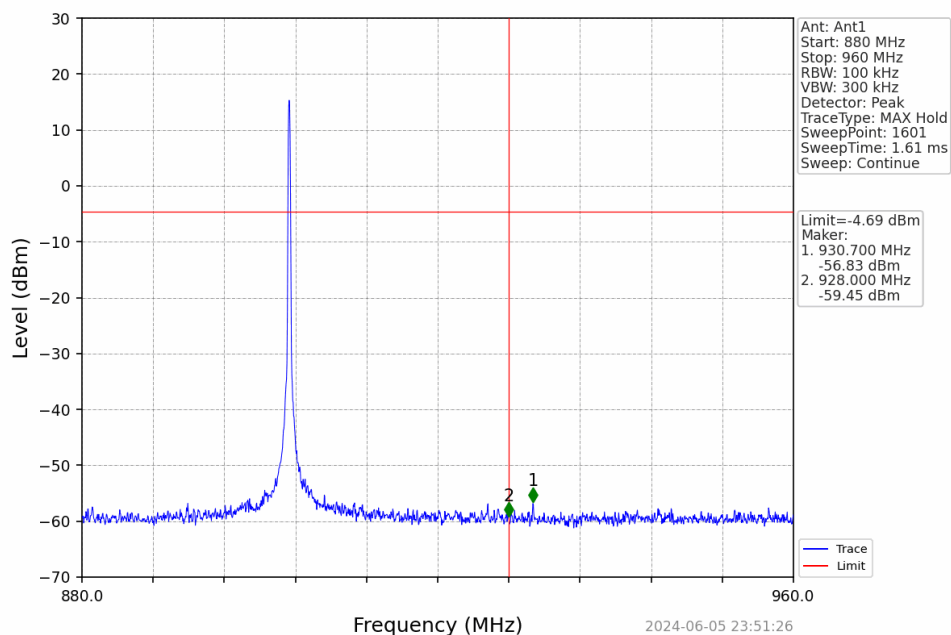
Proprietary - Lower band edge

1_LCH_2402MHz_Ant1_NTNV



Proprietary - Upper band edge

1_HCH_2480MHz_Ant1_NTNV



10 Channel Separation

10.1 Test Result

Test Description	Test Specification	Test Result
Channel Separation	ANSI C63.10:2013 15.247(a)(1) RSS-247 5.1(b)	Compliant

10.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.2. The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 100 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

10.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

10.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

Software Profile:

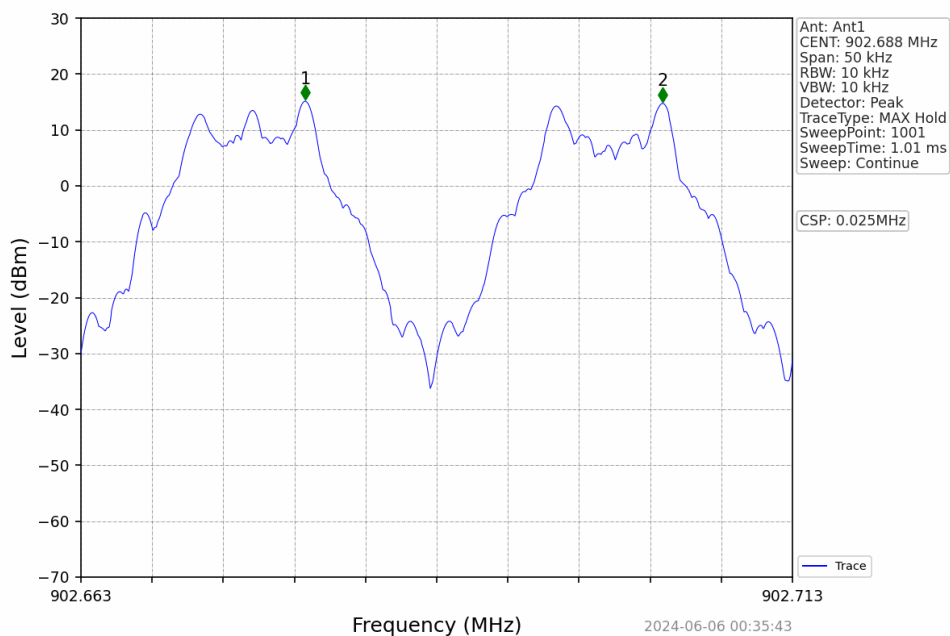
TSTPASS Version: 2.0 (2024.05.01_17.31.12)

10.5 Test Data

Ant1						
Mode	TX Type	Frequency (MHz)	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
Band 1	SISO	HOPP	0.025	0.014	>=0.025	Pass

Sample Plot

Band 1_HOPP_Ant1_NTNV



11 Number of Hopping Channels

11.1 Test Result

Test Description	Test Specification	Test Result
Number of Hopping Channels	ANSI C63.10:2013 15.247(a)(1)(iii) RSS-247 5.1(d)	Compliant

11.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.3. The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 30 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

11.3 Test Site

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

11.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

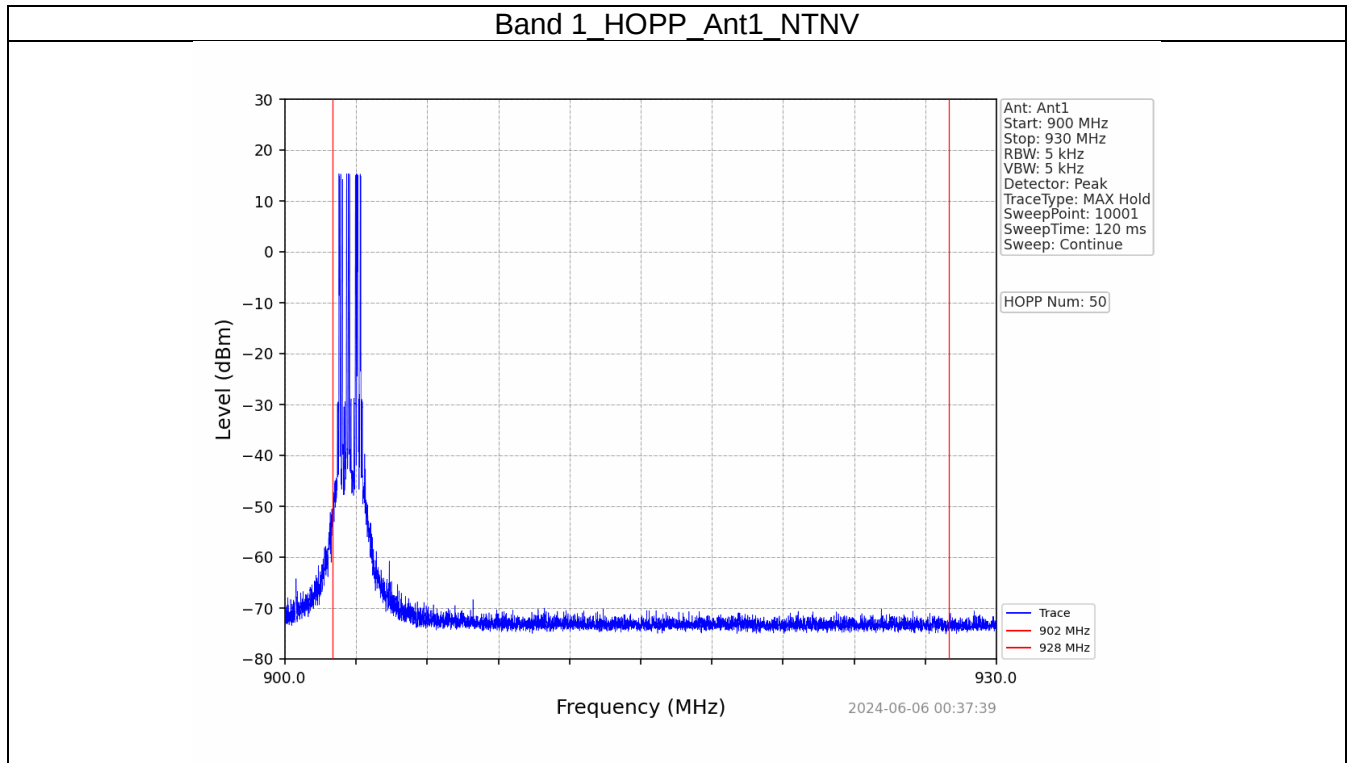
Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

11.5 Test Data

Mode	TX Type	Frequency (MHz)	Num of Hopping Frequencies		Verdict
			ANT1	Limit	
Band 1	SISO	HOPP	50	>=50	Pass

Sample Plot



12 Dwell Time

12.1 Test Result

Test Description	Test Specification	Test Result
Dwell Time	ANSI C63.10:2013 15.247(a)(1)(iii) RSS-247 5.1(d)	Compliant

12.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.4. For each packet type and data rate, the pulse width of the packet was measured, and the pulses were counted over the total observation period.

Requirement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed ($0.4 \times 79 = 31.6s$).

12.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.76 °C

Relative Humidity: 60.1 %

Atmospheric Pressure: 97.57 kPa

12.4 Test Equipment

Test End Date: 6-June-2024

Tester:SGM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	3/20324	20-Mar-2025
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	3-Jan-2024	3-Jan-2025
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	8-Apr-2024	8-Apr-2025

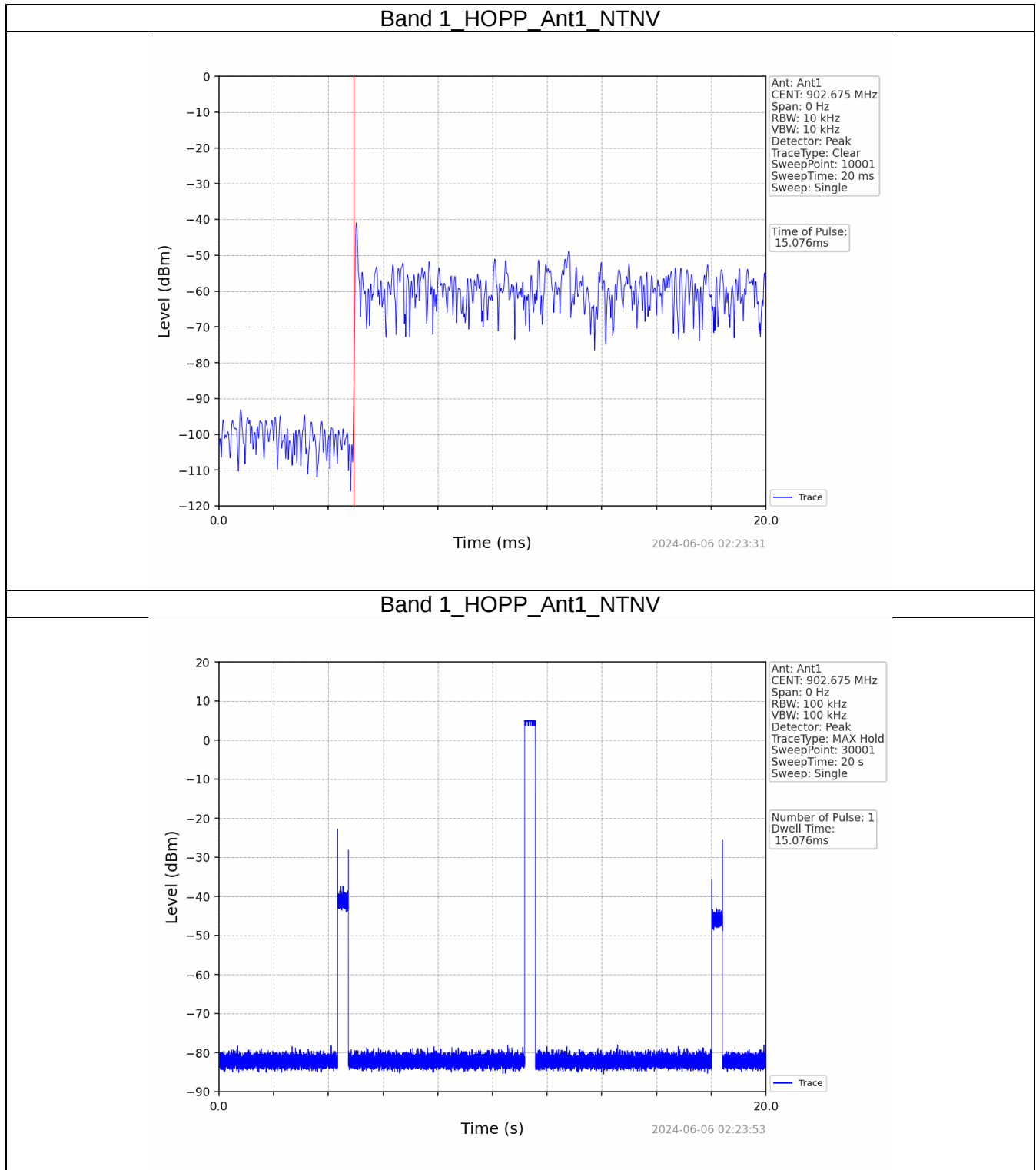
Software Profile:

TSTPASS Version: 2.0 (2024.05.01_17.31.12)

12.5 Test Data

Ant1								
Mode	TX Type	Frequency (MHz)	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
Band 1	SISO	HOPP	15.076	20.000	1	15.076	<=400	Warning

Sample Plot



13 Measurement Uncertainty

The measurement uncertainty figures are be calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) $k = 2$ (which provide confidence levels of 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Expanded Uncertainty for Normal k factor equal to 2		
Parameter	Required	Laboratory Actual
Radio Frequency	$\pm 1 \times 10^{-5}$	$\pm 9.8 \times 10^{-8}$
total RF power, conducted	± 1.5 dB	± 1.2 dB
RF power density, conducted	± 3 dB	± 0.7 dB
spurious emissions, conducted	± 3 dB	± 2.1 dB
all emissions, radiated	± 6 dB	± 4.8 dB
temperature	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	± 5 %	± 3.5 %
DC and low frequency voltages	± 3 %	± 0.4 %

14 Revision History

Revision Level	Description of changes	Revision Date
Draft	Draft Release	14 June 2024
Draft1	Corrected section 7.5.4 data to account for Duty Cycle Correction Factor.	27 September 2024
0	Initial Release	10 October 2024
1	Correction of sections 10-12	20 November 2024
2	Updated section 8.4	21 November 2024