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INTENTIONAL RADIATOR AND EMC TEST REPORT

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Laboratory Accreditations (per ISO/IEC 17025:2017)

ACCREDITED
CERT #3657.02

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Manufacturer:	**Tantalus Systems Corp.**
Address:	3555 Gilmore Way #200 Burnaby, BC, V5G 0B3, Canada

Equipment Tested:	**TRUSense Gateway with 900 MHz Radio**
Model Number(s):	RT-4200
FCC ID:	OZFTXG000
ISED ID:	3669A-TXG000
FVIN:	15.00

REVISION HISTORY

Date	Report Number	Details	Author's Initials
July 11, 2023	E10402-2303_Tantalus_TRUSense_FCC-ISED_Rev0.1	Initial draft	AH
July 18, 2023	E10402-2303_Tantalus_TRUSense_FCC-ISED_Rev1.0	Final	AH
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.			

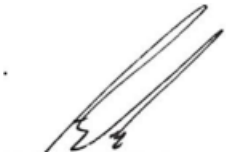
REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by the manufacturer and the results relate only to the item tested. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section I of this report as agreed upon by the Manufacturer under the quote 23RH06152.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required.

This report may comprise a partial list of tests that are required for FCC and ISED. A Declaration of Conformity can only be produced by the manufacturer. This is to certify that the following report is true and correct to the best of our knowledge.

This report is the confidential property of the client addressed. The report may only be reproduced in full. Publication of extracts from this report is not permitted without written approval from QAI. Any liability attached thereto is limited to the fee charged for the individual project file referenced. The results of this report pertain only to the specific items tested, calibrated, or sampled. Unless specifically stated or identified otherwise, QAI has utilized a simple acceptance rule to make conformity decisions on testing results contained in this report as applicable.



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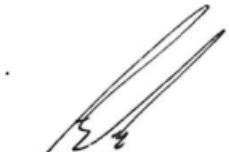

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QAI EMC ACCREDITATION

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EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	9543A	3657.02

EMC Facility Burnaby BC, Canada

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1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of TRUSense Gateway as per Sections 1.2 and 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 23RH06152:

CFR Title 47 FCC Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators

RSS-247 Issue 2 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 – General Requirements and Information for the Certification of Radio Apparatus

ICES-003 Issue 7 – Information Technology Equipment (Including Digital Apparatus)

1.3 Summary of Results

The following testing was performed pursuant to FCC Title 47 Part 15 and Industry Canada ICES-003 to demonstrate the testimony to "FCC, IC, & CE" mark Electromagnetic Compatibility testing for the product.

No.	Test	Applicable Standard	Description	Result
1	Antenna Requirement	FCC 47 CFR Part C 15.203 RSS-Gen Issue 5	No user access to antenna after professional installation.	Complies
2	Peak Output Power (Conducted & Radiated)	FCC 47 CFR Part C 15.247 RSS-247 Issue 2	Maximum peak conducted output power shall not exceed 1 W for systems employing at least 50 hopping channels.	Complies
3	20 dB Bandwidth	FCC 47 CFR Part C 15.247 RSS-247 Issue 2	Maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.	Complies
4	99% Occupied Bandwidth	Client Request	99% of the signal shall fall completely within the frequency range specified by the standard.	Complies
5	Band Edge	FCC 47 CFR Part C 15.247	In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.	Complies
6	Number of Hopping Channels	FCC 47 CFR Part C 15.247 RSS-247 Issue 2	If the 20 dB bandwidth of the hopping channel is < 250 kHz the system shall use at least 50 hopping channels.	Complies
7	Channel Separation	FCC 47 CFR Part C 15.247 RSS-247 Issue 2	Frequency hopping systems shall have channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.	Complies
8	Dwell Time & Time of Occupancy	FCC 47 CFR Part C 15.247 RSS-247 Issue 2	Average time of occupancy on any frequency shall not be greater than 0.4 s within a 20 s period.	Complies
9	Unintentional Conducted Emissions	FCC 47 CFR Part C 15.207 RSS-Gen Issue 5	Conducted emissions requirements as stated in the standards.	Complies
10	Unintentional Radiated Emissions	FCC 47 CFR Part A 15.33 FCC 47 CFR Part B 15.109 FCC 47 CFR Part C 15.209 ICES-003 RSS-247	Radiated emissions requirements as stated in the standards.	Complies
11	Current Carrier Emissions	FCC 47 CFR Part C 15.207 FCC 47 CFR Part C 15.209 RSS-Gen Issue 5	Radiated and conducted emissions requirements as stated in the standards.	Complies
12	Radio Collocation and Radiated Spurious Emissions	FCC 47 CFR Part A 15.33 FCC 47 CFR Part C 15.205 FCC 47 CFR Part C 15.209 FCC 47 CFR Part C 15.247 RSS-Gen Issue 5 RSS-247 Issue 2	Radiated emissions requirements as stated in the standards.	Complies

Table 1: Applicable Test Standards and Descriptions

Note: The gain of the antenna(s) is provided by the client to measure or calculate test results and is not independently measured by QAI.

2 GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

Figure 1: EUT

Equipment Under Test (EUT)

Equipment	TRUSense Gateway
Description	LAN portal
Manufacturer	Tantalus Systems Corp.
Model No.	RT-4200
Serial No.	00391D47DC
Clock frequencies tuned upon within the EUT:	12MHz, 25MHz, 32MHz
Highest frequency generated within the EUT:	5.8 GHz

Equipment Under Test (EUT) – RF Information

RF device type	902-928MHz FHSS
Model No. (HVIN)	RT-4200
Operating frequency	902 – 928 MHz
Number of available channels/Transmitter	100 available, 50 used
Channel separation	320 kHz, 330 kHz, 200 kHz – Varied with data rate
Channel bandwidth	120 kHz, 225 kHz, 167 kHz – Varied with data rate
Output Power/Transmitter	30 dBm, 24 dBm – Varied with data rate
Modulation type	FSK
Test Channels (L, M, H)	902 MHz, 915 MHz, 928 MHz
Data Rate	Low, High, 3rd Party Interface
Adaptive	No
Geo-location-capable	No
Number of antennas	3
Antenna type	Omni-Directional and Directional
Antenna gain	-2dBi, 3dBi and 5dBi

Notes: Bandwidth listed is 20 dB bandwidth

Equipment Under Test (EUT) – General Information

Tested as	Table top
Dimensions	15cm x 15cm x 6cm
Declared operating temperature range:	-40°C to 85°C
Input power	120V, 60Hz
Grounded	Yes
Device use	Fixed location

Notes: None.

Test Modes

Test	Transmitter State	Power
1	900 MHz Radio ON, 2.4 GHz preapproved module ON	120V, 60Hz
2	900 MHz Radio ON, 5.8 GHz preapproved module ON	120V, 60Hz
3	900 MHz Radio ON, preapproved module OFF	120V, 60Hz

Auxiliary Manufacturer Supplied Equipment

Equipment	Manufacturer	Product Description	Model No.
None	---	---	---

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	24 °C
Relative Humidity	46 %rh

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohde & Schwarz. Transducer factors such as antenna factors, cable losses and amplifier gains were stored in the test templates which are used to perform the emissions measurements. After the test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Table 2: Sample Quasi-Peak Correction Data – Radiated

Quasi-Peak reading shown in the table above is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi-Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Table 3: Sample Quasi-Peak Correction Data - Conducted Emissions

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Table 4: Sample Average Correction Data- Conducted Emissions

Quasi Peak or Average reading shown in the preceding table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi-Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.

Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	Com-Power	LI-220C	LISN	20070025	N/A	2026-Jan-23
2	EMCO	6502	22" Loop antenna	2178	N/A	2025-Dec-5
3	ETS Lindgren	3117	Horn Antenna, 1.0-18 GHz	75944	N/A	2026-Jan-28
4	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
5	ETS Lindgren	2125	Mast	00077487	N/A	N/A
6	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
7	Hewlett Packard	8449B	Preamplifier (1-26 GHz)	2933A00198	N/A	2025-Feb-15
8	Maturo Gmbh	BAM 4.0-P	Mast	365	3382.01	N/A
9	Rohde & Schwarz	ESW44	EMI Receiver	101604	4.73 SP4	2025-Jul-20
10	Rohde & Schwarz	FSU	Spectrum Analyzer	101388	4.71 SP6	2025-May-13
11	Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
12	Sunol Sciences	JB1	Biconilog Antenna 30MHz – 2GHz	A070209	N/A	2026-Jan-4

Note: Equipment listed above has 3-year calibration intervals.

Measurement Software

Sl. No.	Manufacturer	Model	Version	Description
1	Rhode & Schwarz	EMC 32	10.35.10	Emissions Test Software

3 DATA & TEST RESULTS

3.1 Antenna Requirements

Date Performed: June 20, 2023

Test Standard: FCC CFR 47 Part 15.203

Test Method: ANSI C63.10:2013

Modifications: None.

Final Result: Complies

Applicable Regulation:

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 a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of sections 15.211, 15.213, 15.217, 15.219, 15.221, or 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Manufacturers Description:

The EUT must be professionally installed and does not provide user access to the antenna after installation.

3.2 RF Peak Output Power (Conducted & Radiated)

Date Performed: June 20, 2023 - June 30, 2023

Test Standard: FCC CFR 47 Part 15.247 (b)(2)
IC RSS-247 Issue 2 (5.4) (a)

Test Method: ANSI C63.10:2013
Span = 1 MHz, RBW = 120 kHz, VBW = 300 kHz

Modifications: None.

Final Result: Complies

Applicable Regulation:

For frequency hopping systems operating in 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10:2013.

Measurement Data and Plots:

Frequency (MHz)	Data Rate	Raw Peak (dBm)	Correction Factor [1] (dB)	Corrected Peak Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)	Results
902.236	Low	9.00	20.39	29.39	30	0.61	Complies
915.036	Low	8.86	20.39	29.25	30	0.75	Complies
927.755	Low	8.71	20.38	29.09	30	0.91	Complies
902.319	High	9.26	20.39	29.65	30	0.35	Complies
915.027	High	9.07	20.39	29.46	30	0.54	Complies
927.667	High	8.92	20.38	29.30	30	0.70	Complies
902.944	3rd Party	2.50	20.39	22.89	30	7.11	Complies
914.944	3rd Party	3.14	20.39	23.53	30	6.47	Complies
926.745	3rd Party	3.42	20.38	23.80	30	6.20	Complies

[1] Correction factor consists of cable loss, external attenuator, and adapter(s)

Table 5: RF Peak Output Power (Conducted)

Antenna	Raw Peak [2] (dBµV/m)	Height (cm)	Pol	Azimuth (°)	Corr. Factor [1] (dB)	Corrected Peak (dBµV/m)	EIRP (dBm)
High Gain	96.79	123.1	V	36.5	31.12	127.91	32.68
Flat	98.54	101.8	V	169.8	31.17	129.71	34.48
Standard	90.86	100.0	H	285.1	31.60	122.46	27.23

[1] Correction factor consists of cable loss, antenna factor, and adapter(s)
[2] Measured at 3m

Table 6: EIRP

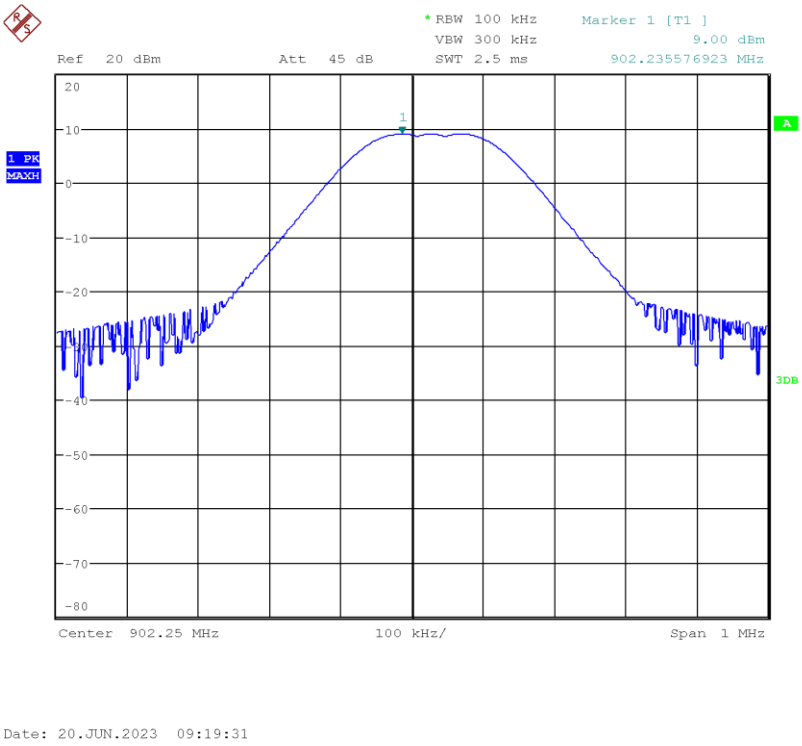

Figure 2: Peak Output Power – Low Data Rate, Lowest Frequency

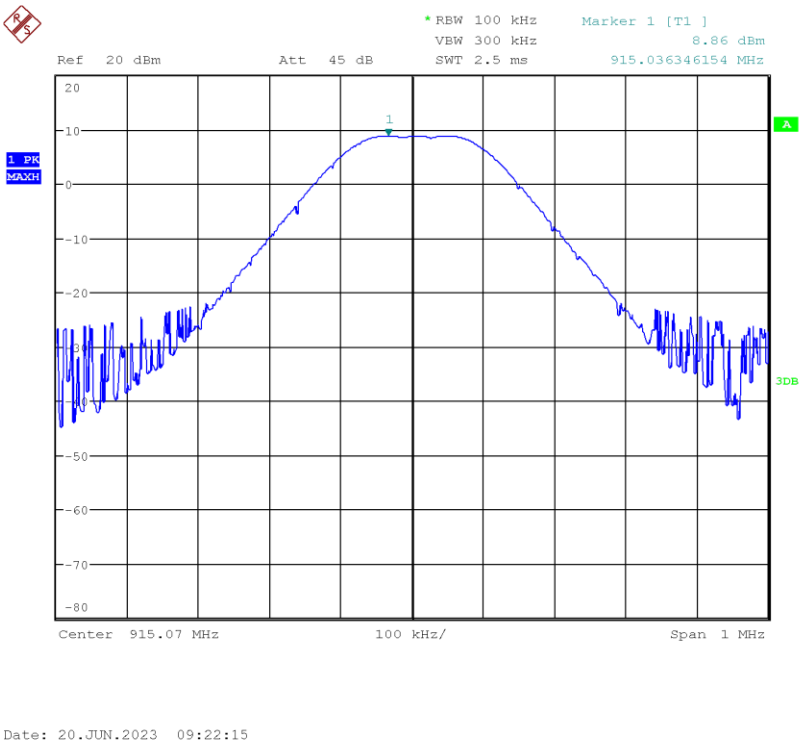

Figure 3: Peak Output Power - Low Data Rate, Middle Frequency

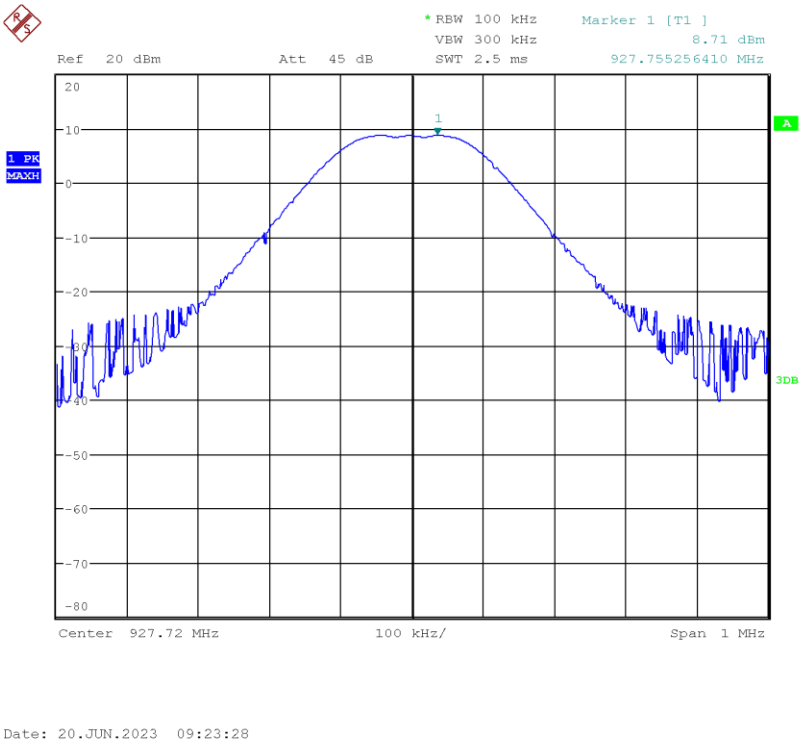

Figure 4: Peak Output Power - Low Data Rate, Highest Frequency

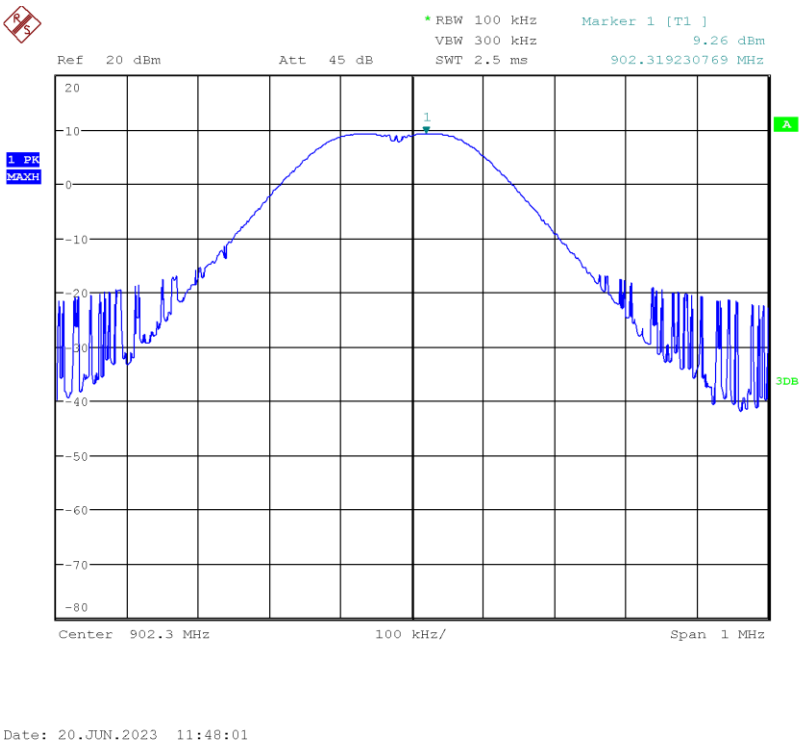

Figure 5: Peak Output Power – High Data Rate, Lowest Frequency

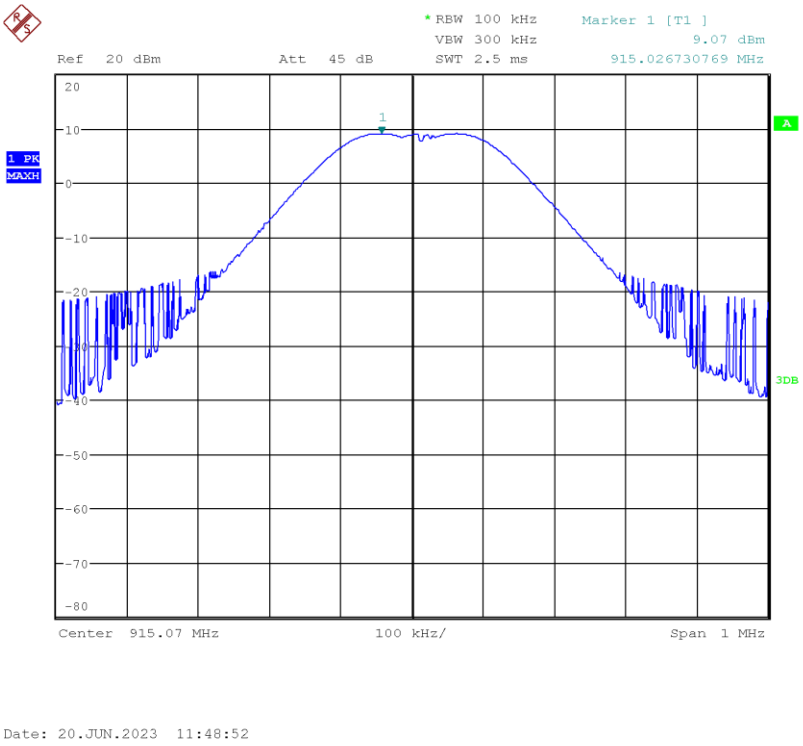

Figure 6: Peak Output Power - High Data Rate, Middle Frequency

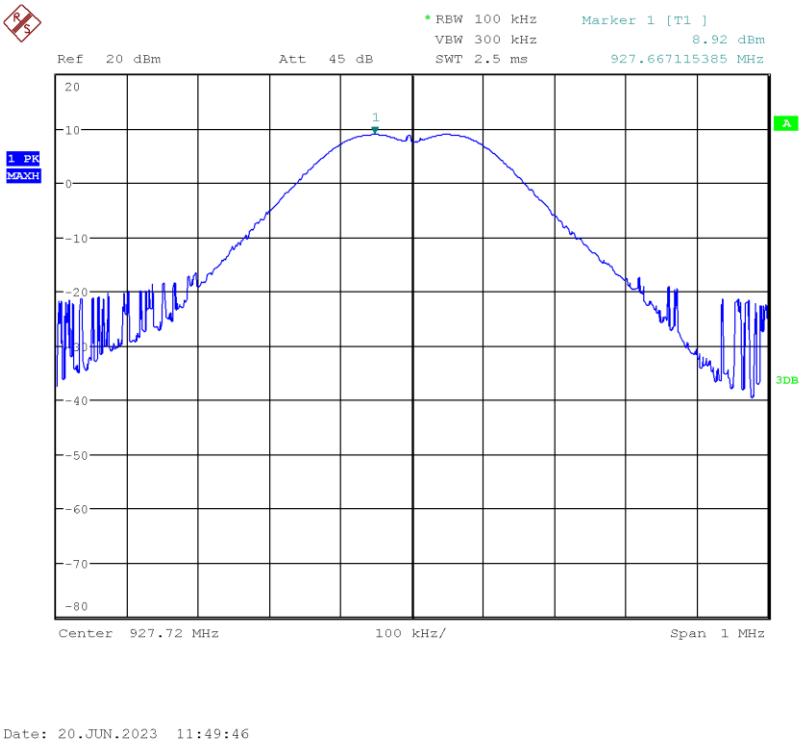

Figure 7: Peak Output Power - High Data Rate, Highest Frequency

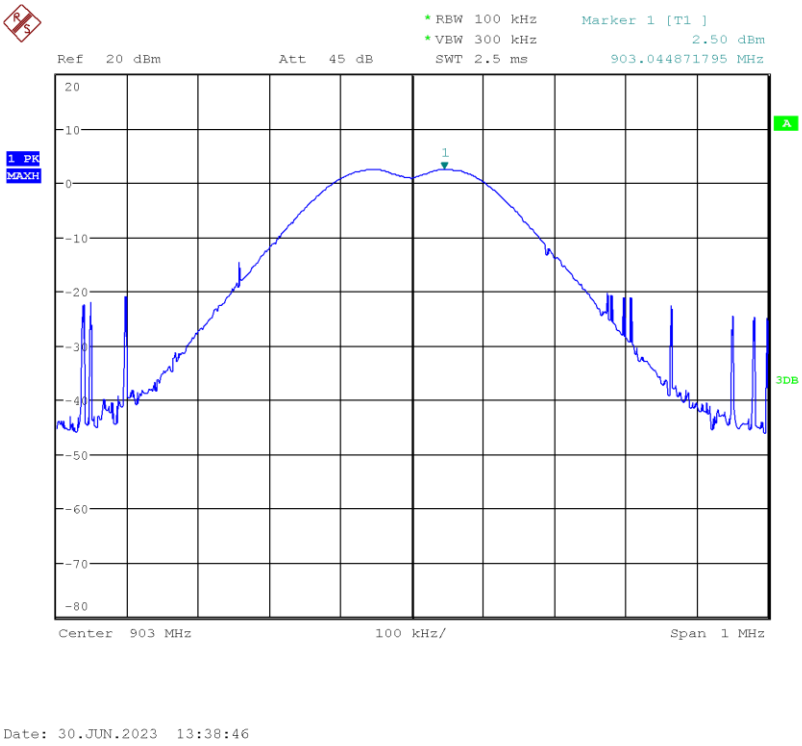

Figure 8: Peak Output Power – 3rd Party Data Rate, Lowest Frequency

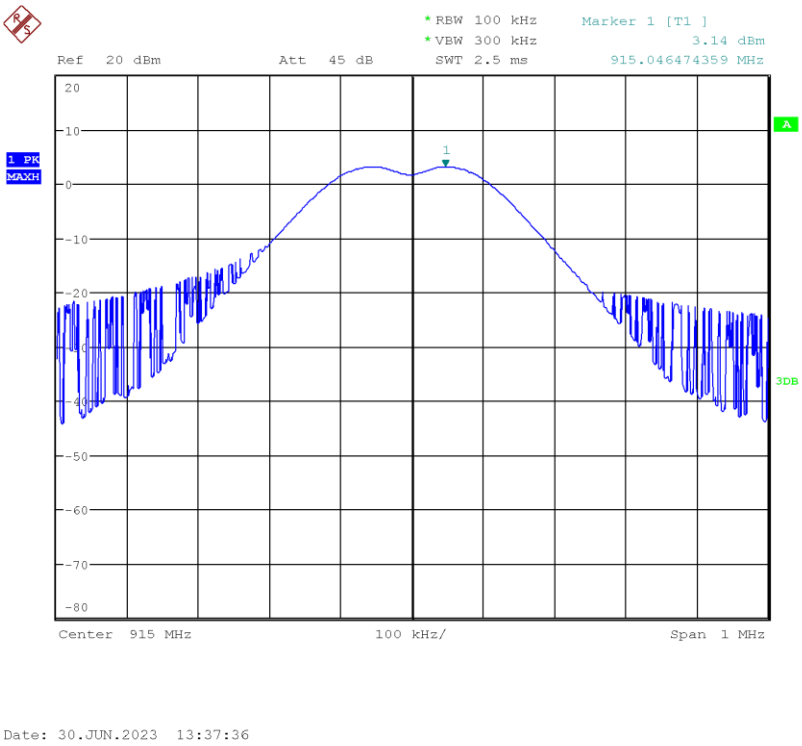

Figure 9: Peak Output Power - 3rd Party Data Rate, Middle Frequency

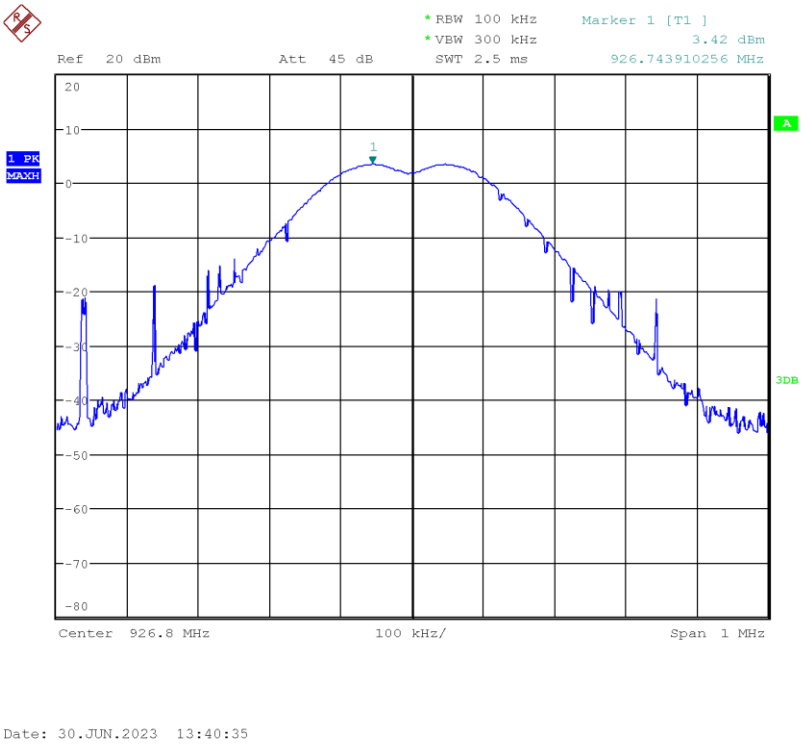

Figure 10: Peak Output Power - 3rd Party Data Rate, Highest Frequency

3.3 20 dB Bandwidth

Date Performed: June 20, 2023

Test Standard: FCC 47 CFR Part 15.247 (a)(1)(i)
RSS-247 Issue 2 (5.1) (c)

Test Method: ANSI C63.10:2013
Span = 2 to 5 x OBW, RBW = 1 to 5% of OBW, VBW = 3 x RBW
Ref Level > 10log(OBW/RBW) above signal peak

Modifications: None

Final Result: Complies

Applicable Regulations:

For frequency hopping systems operating in the 902-928 MHz band: the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10: 2013, 7.4.

A spectrum analyzer or other instrument providing a spectral display is recommended for these measurements. When using a spectrum analyzer or other instrument providing a spectral display, the video bandwidth shall be set to a value at least three times greater than the IF bandwidth of the measuring instrument to avoid the introduction of unwanted amplitude smoothing. Video filtering is not used during occupied bandwidth tests.

Measurement Data and Plots:

Channels	Frequency (MHz)	Data Rate	20dB Bandwidth (kHz)	Limit (kHz)	Result
Low	902.277	Low	113.5	500	Complies
Middle	915.076	Low	118.7	500	Complies
High	927.773	Low	113.5	500	Complies
Low	902.276	High	224.4	500	Complies
Middle	915.080	High	224.4	500	Complies
High	927.720	High	224.4	500	Complies
Low	903.000	3rd Party	166.7	500	Complies
Middle	915.080	3rd Party	166.7	500	Complies
High	926.790	3rd Party	168.3	500	Complies

Table 7: 20 dB Bandwidth Results

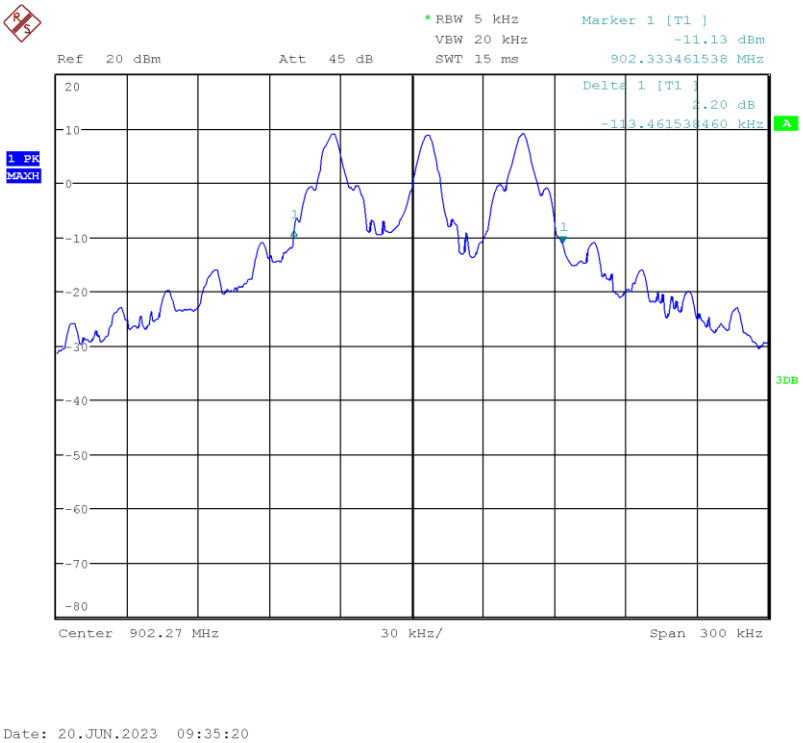

Figure 11: 20 dB Bandwidth – Low Data Rate, Low Channel

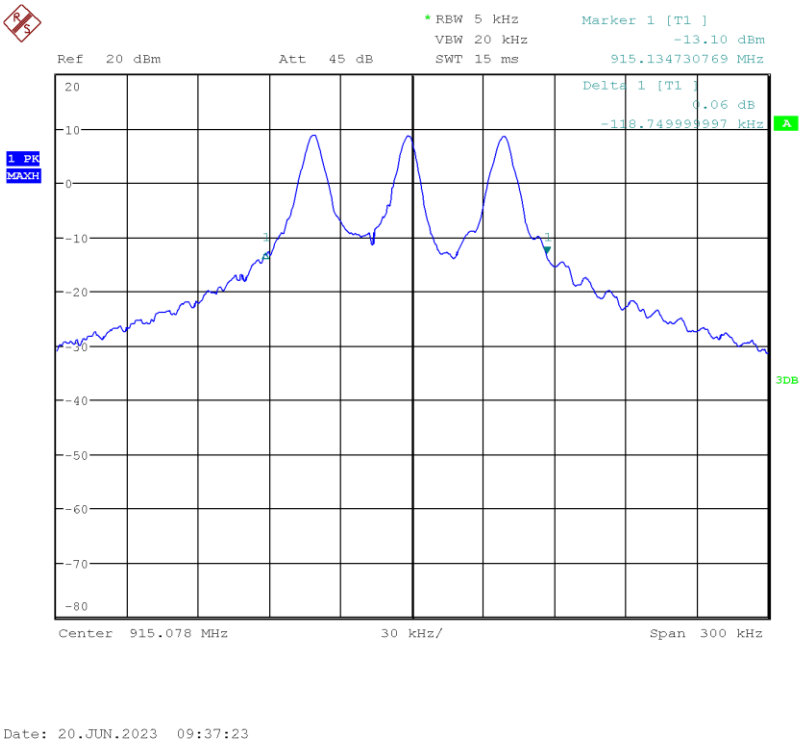

Figure 12: 20 dB Bandwidth - Low Data Rate, Middle Channel

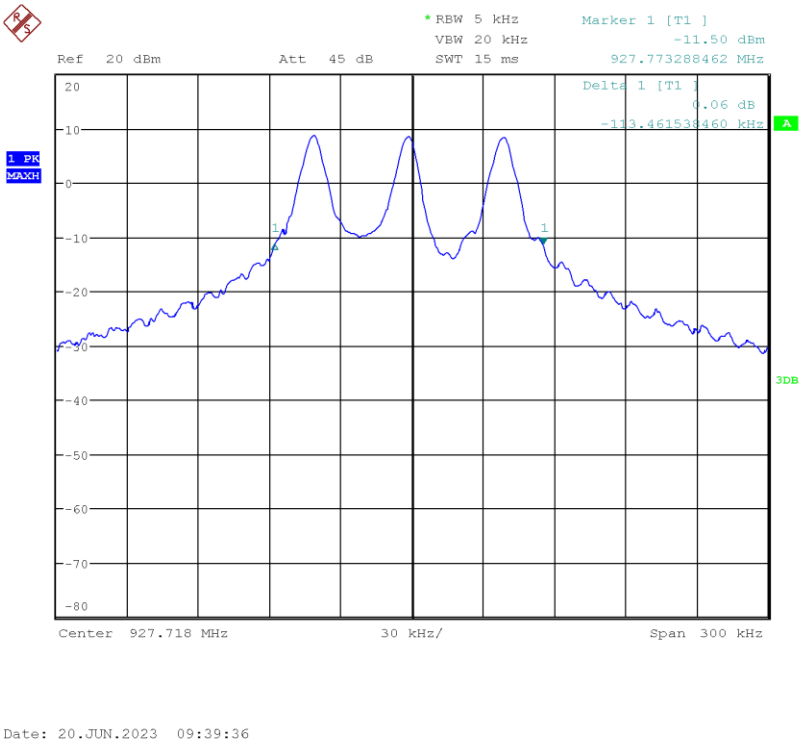

Figure 13: 20 dB Bandwidth - Low Data Rate, High Channel

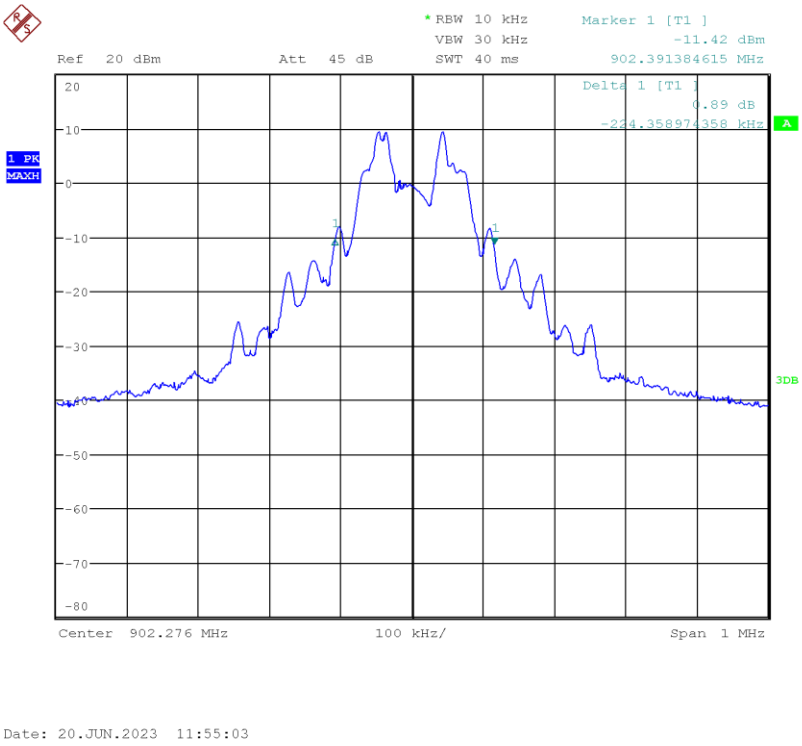

Figure 14: 20 dB Bandwidth – High Data Rate, Low Channel

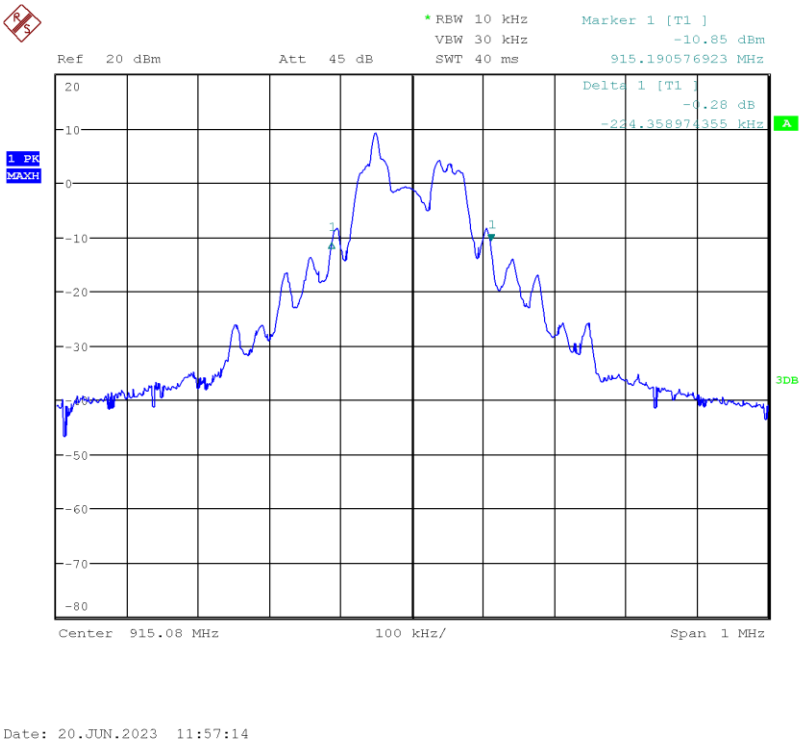

Figure 15: 20 dB Bandwidth - High Data Rate, Middle Channel

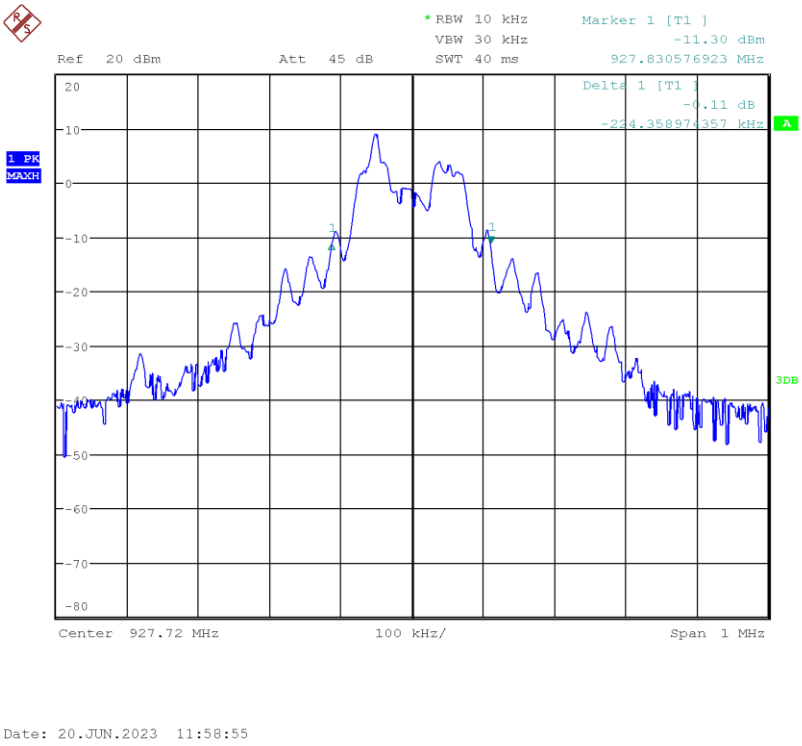

Figure 16: 20 dB Bandwidth - High Data Rate, High Channel

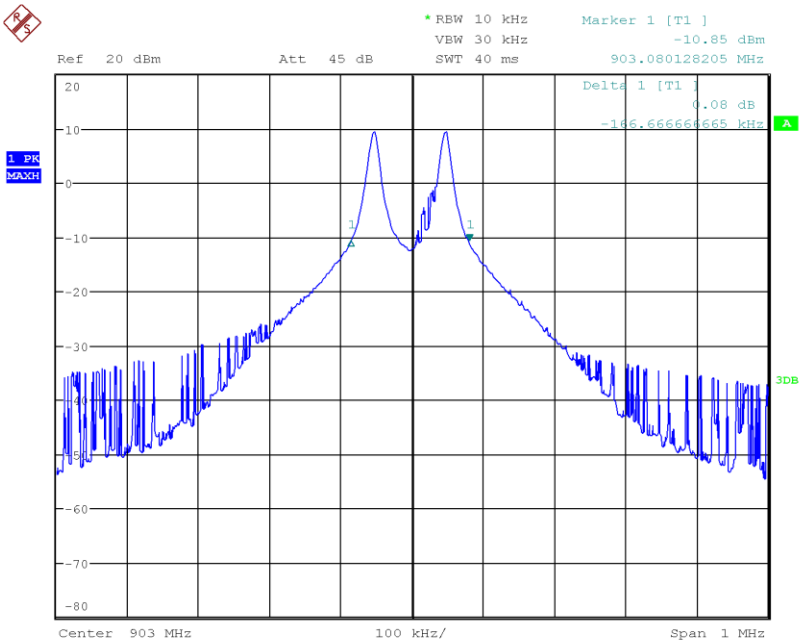

Figure 17: 20 dB Bandwidth – 3rd Party Data Rate, Low Channel

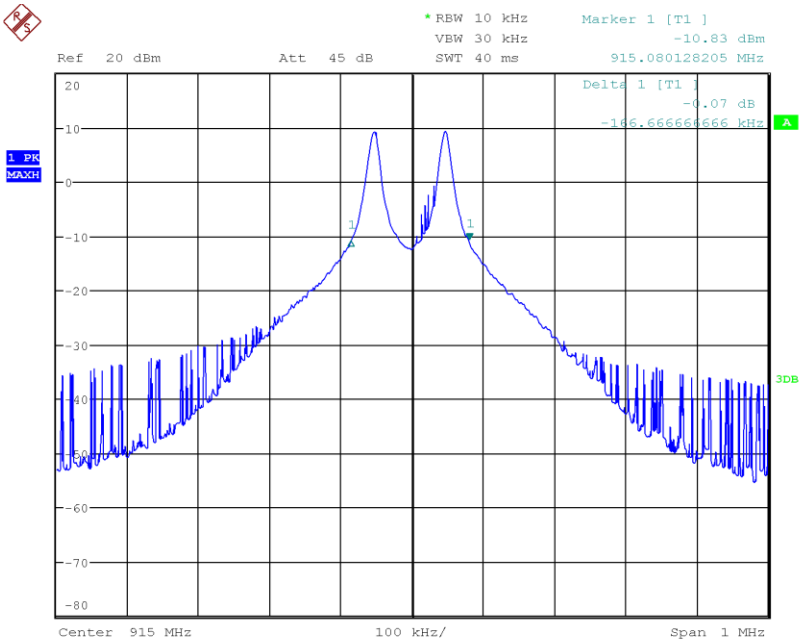

Figure 18: 20 dB Bandwidth - 3rd Party Data Rate, Middle Channel

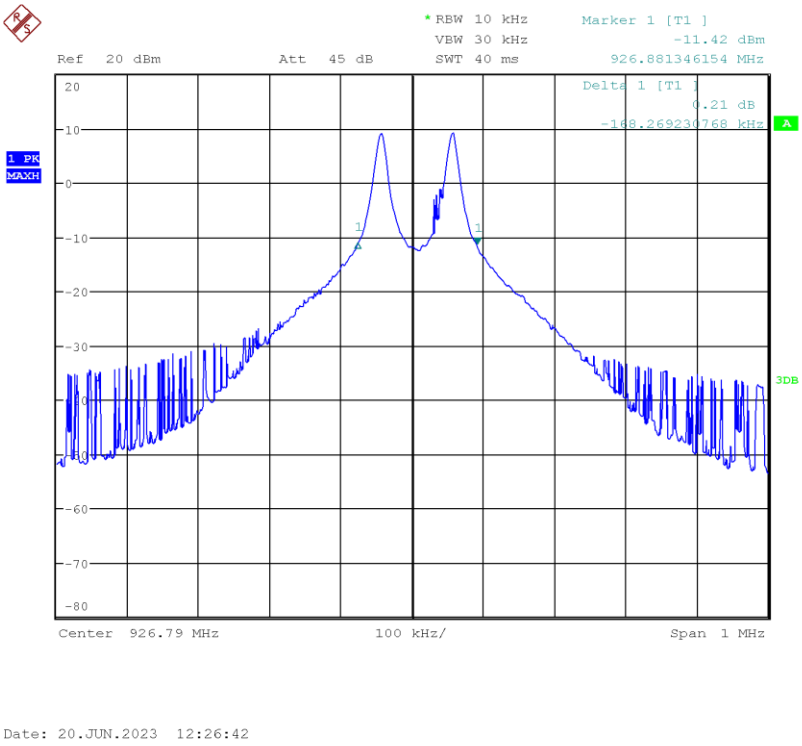

Figure 19: 20 dB Bandwidth - 3rd Party Data Rate, High Channel

3.4 99% Bandwidth

Date Performed: June 20, 2023

Test Standard: Client Request

Test Method: ANSI C63.10:2013
Span = 2 to 5 x OBW, RBW = 1 to 5% of OBW, VBW = 3 x RBW
Ref Level > 10log(OBW/RBW) above signal peak

Modifications: None

Final Result: Complies

Applicable Regulations:

N/A

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10: 2013, 7.4.

A spectrum analyzer or other instrument providing a spectral display is recommended for these measurements. When using a spectrum analyzer or other instrument providing a spectral display, the video bandwidth shall be set to a value at least three times greater than the IF bandwidth of the measuring instrument to avoid the introduction of unwanted amplitude smoothing. Video filtering is not used during occupied bandwidth tests.

Measurement Data and Plots:

Channels	Frequency (MHz)	Data Rate	Bandwidth (kHz)	Limit (kHz)	Result
Low	902.276	Low	131.3	N/A	Complies
Middle	915.075	Low	112.0	N/A	Complies
High	927.716	Low	112.0	N/A	Complies
Low	902.276	High	217.9	N/A	Complies
Middle	915.080	High	259.6	N/A	Complies
High	927.715	High	274.0	N/A	Complies
Low	903.019	3rd Party	187.5	N/A	Complies
Middle	914.995	3rd Party	189.1	N/A	Complies
High	926.795	3rd Party	189.1	N/A	Complies

Table 8: 99% Bandwidth Results

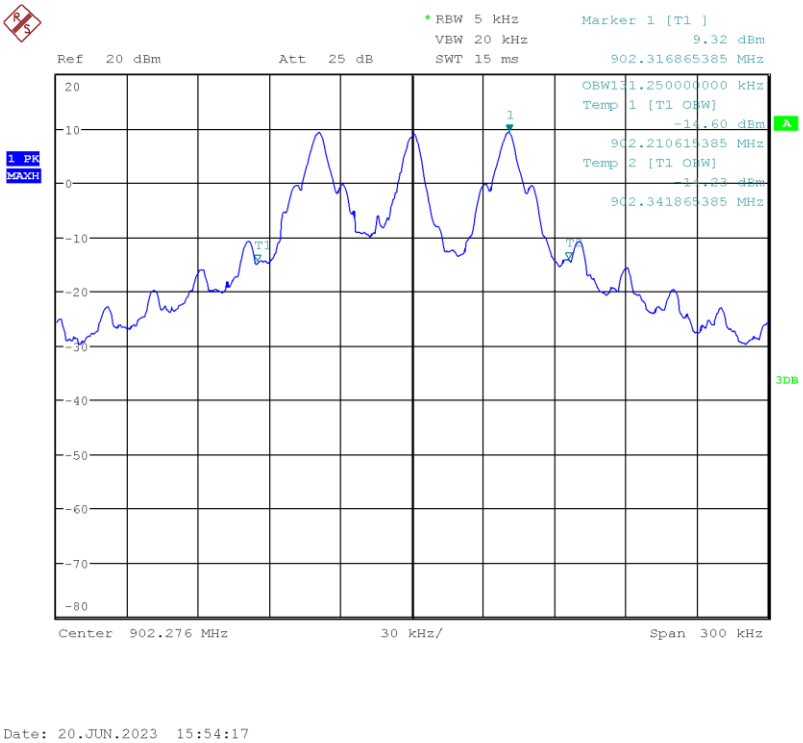

Figure 20: 99% Bandwidth – Low Data Rate, Low Channel

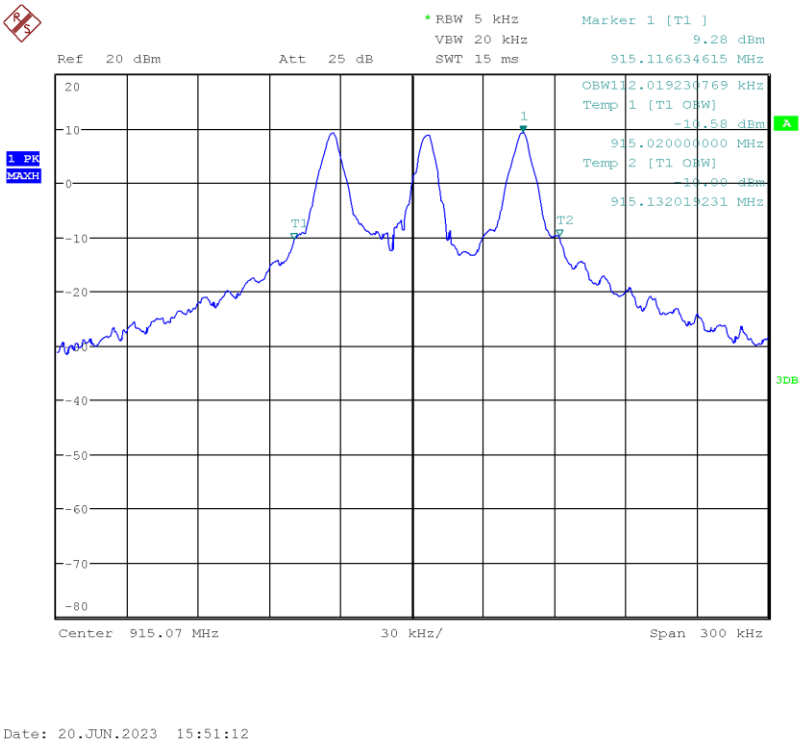

Figure 21: 99% Bandwidth - Low Data Rate, Middle Channel

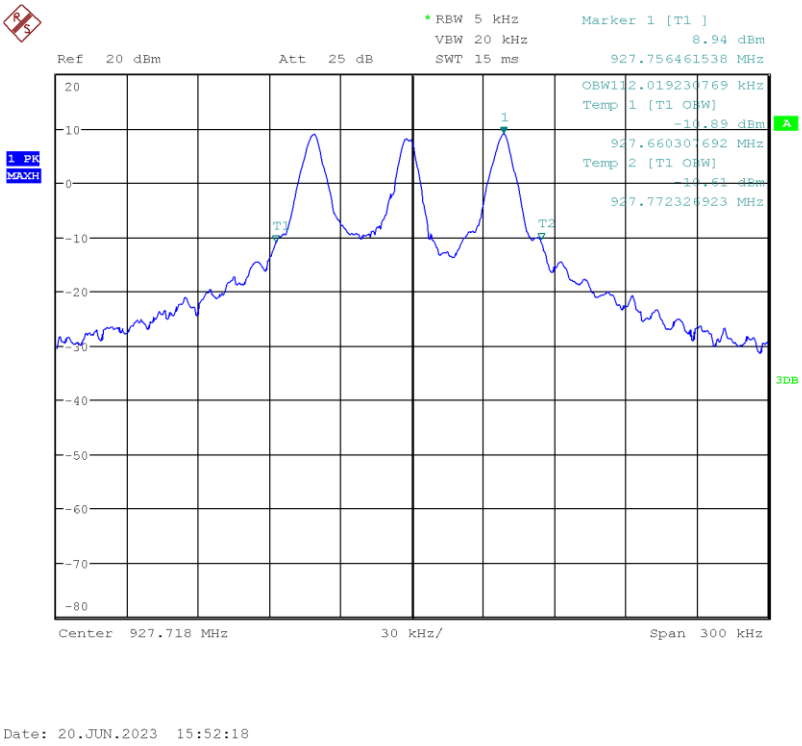

Figure 22: 99% Bandwidth - Low Data Rate, High Channel

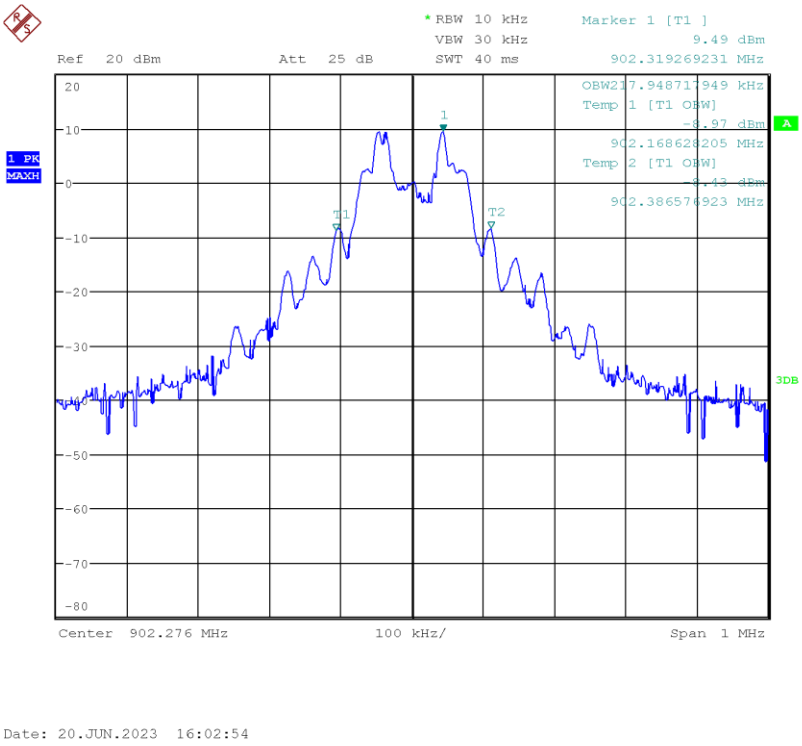

Figure 23: 99% Bandwidth – High Data Rate, Low Channel

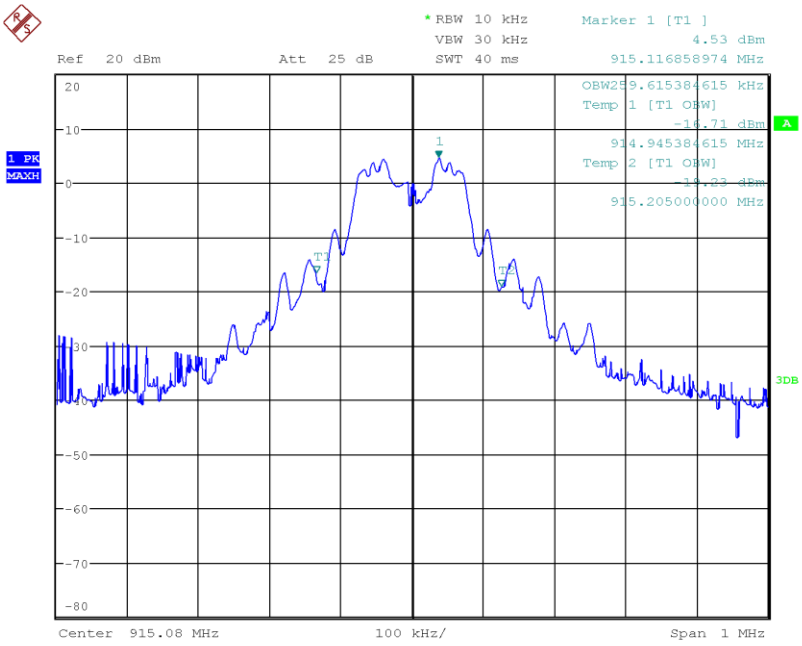

Figure 24: 99% Bandwidth - High Data Rate, Middle Channel

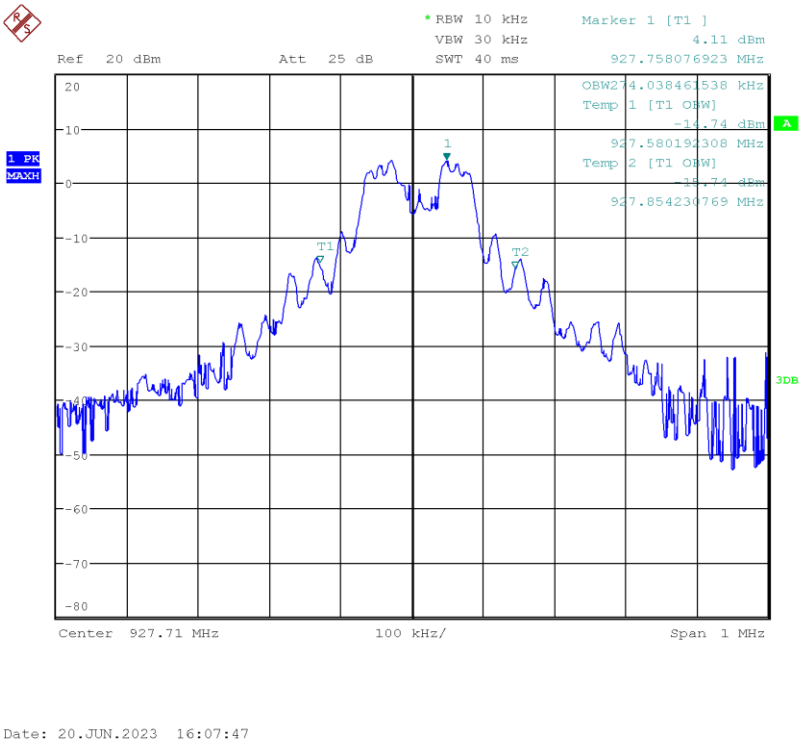

Figure 25: 99% Bandwidth - High Data Rate, High Channel

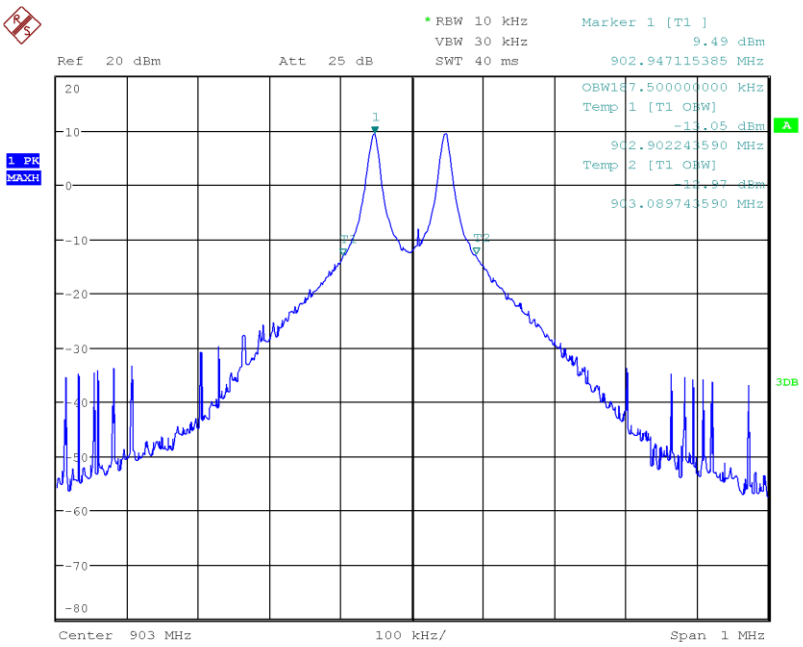

Figure 26: 99% Bandwidth – 3rd Party Data Rate, Low Channel

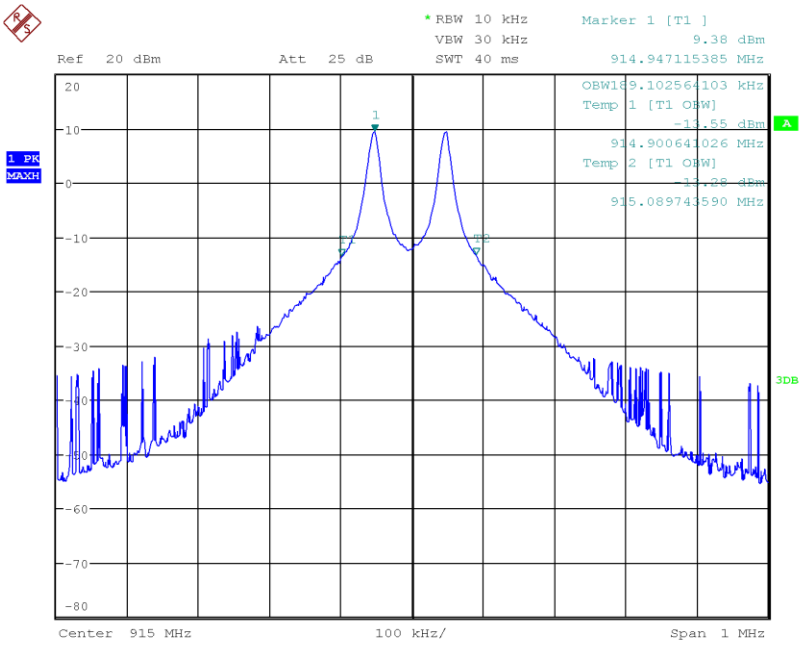

Figure 27: 99% Bandwidth - 3rd Party Data Rate, Middle Channel

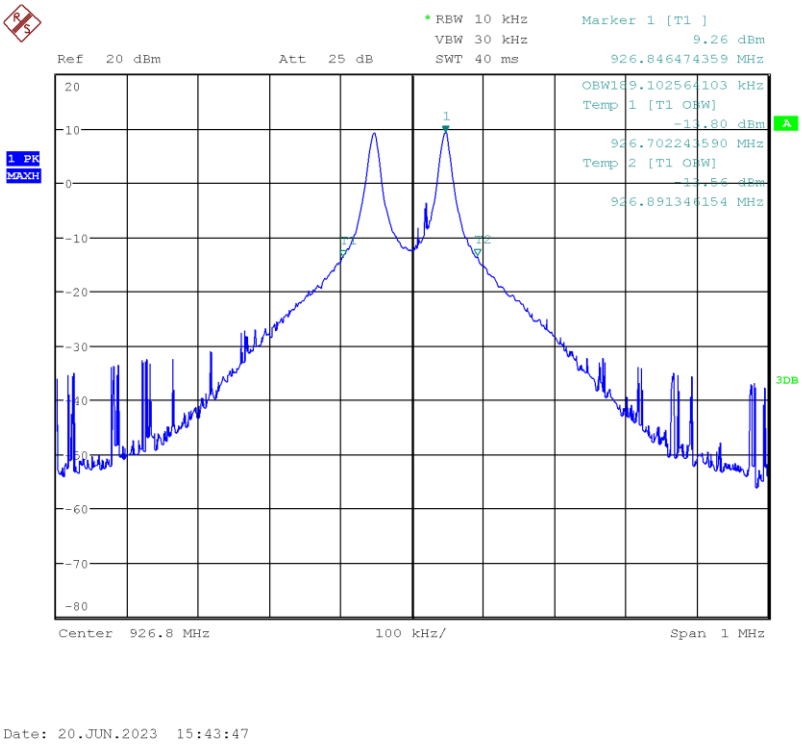

Figure 28: 99% Bandwidth - 3rd Party Data Rate, High Channel

3.5 Out-Of-Band Emissions (Band Edge)

Date Performed: June 20, 2023

Test Standard: FCC CFR 47 Part 15.247 (d)
RSS-247 Issue 2 (5.5)

Test Method: ANSI C63.10:2013
Span = Wide enough to capture the peak level of the emission closest to the band edge, as well as any modulation products that fall outside of the band.
Ref Level = High enough to keep the signal from overdriving the input mixer
RBW = 100 kHz, VBW = 300 kHz
Trace Detector: Peak, Trace: Max Hold

Modifications: None

Final Result: Complies

Applicable Regulation:

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval the attenuation shall be 30 dB instead of 20 dB.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10:2013.

The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods.

Measurement Data and Plots:

Band Edge	Data Rate	Limit	Result
Low	Low	-20 dB	Complies
High	Low	-20 dB	Complies
Low	High	-20 dB	Complies
High	High	-20 dB	Complies
Low	3rd Party	-20 dB	Complies
High	3rd Party	-20 dB	Complies

Table 9: Band Edge Results

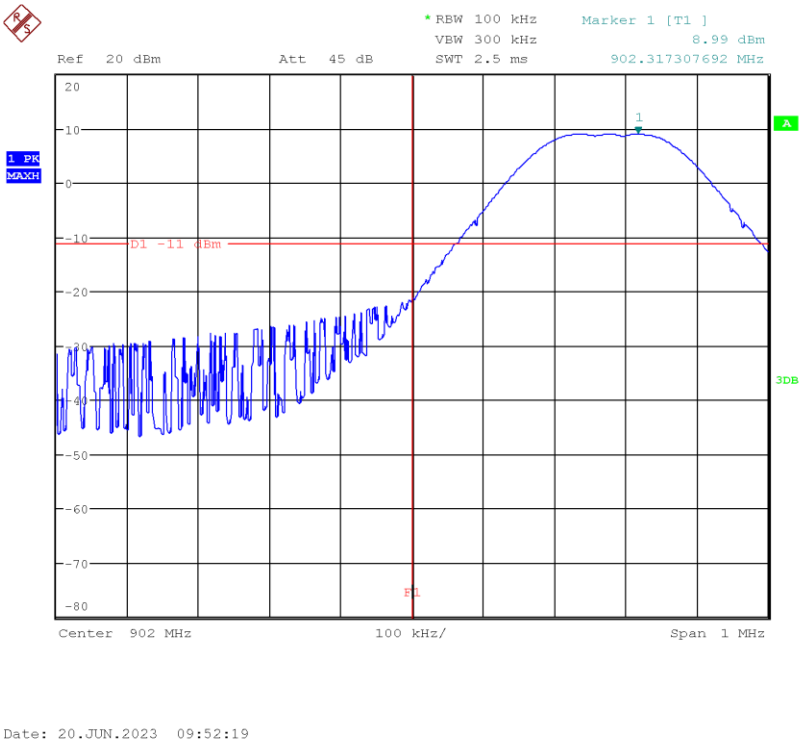

Figure 29: Band Edge – Low Data Rate, Low Channel

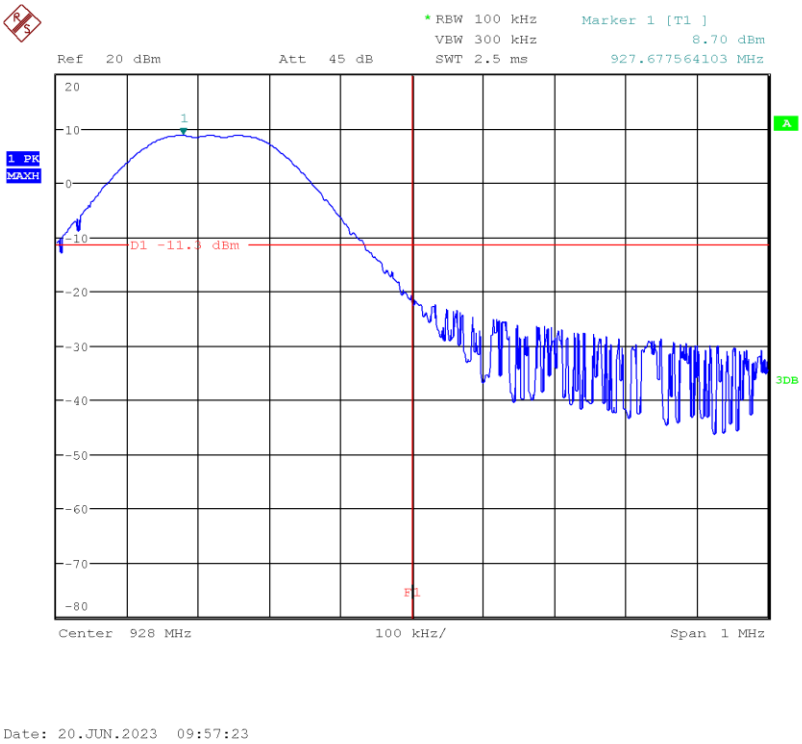

Figure 30: Band Edge – Low Data Rate, High Channel

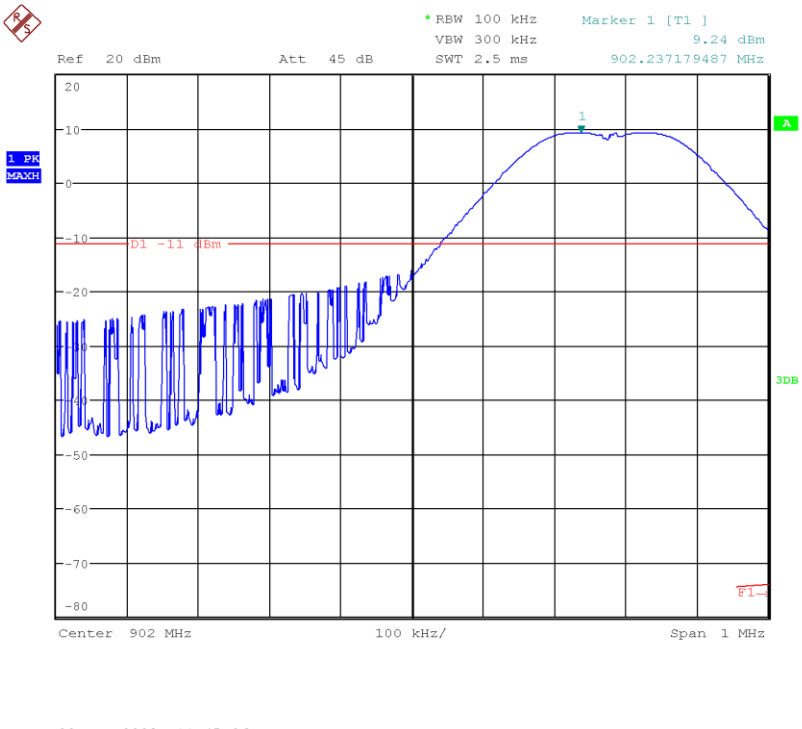

Figure 31: Band Edge – High Data Rate, Low Channel

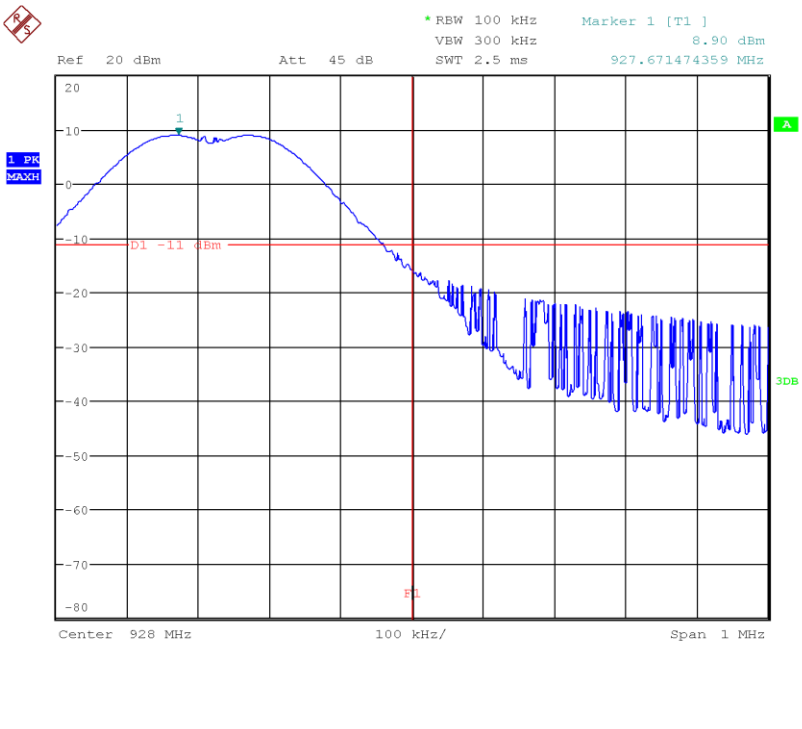

Figure 32: Band Edge – High Data Rate, High Channel

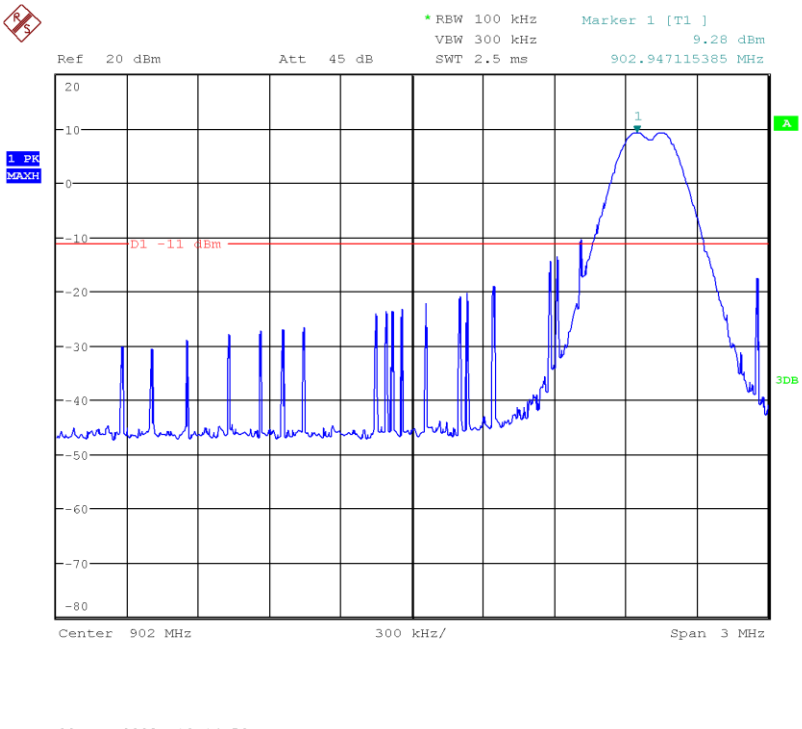

Figure 33: Band Edge – 3rd Party Data Rate, Low Channel

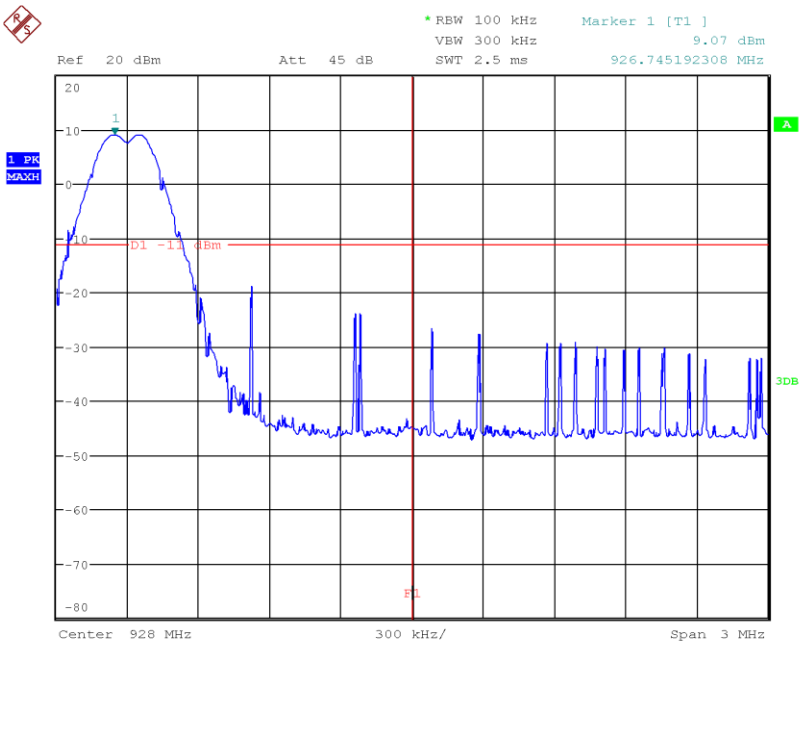

Figure 34: Band Edge – 3rd Party Data Rate, High Channel

3.6 Number of Hopping Channels

Date Performed: June 20, 2023 - June 22, 2023

Test Standard: FCC CFR 47 Part 15.247 (a)(1)
IC RSS-247 Issue 2 (5.1)(c)

Test Method: ANSI C63.10:2013
Span = The frequency band of operation. Depending on the number of channels the device
supports, it may be necessary to divide the frequency range of operation across multiple spans,
to allow the individual channels to be clearly seen.
RBW = 30% of the channel spacing or the 20 dB BW, whichever is smaller.
VBW ≥ RBW
Detector: Peak, **Trace:** Max Hold

Modifications: None

Final Result: Complies

Applicable Standard:

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10:2013.

The channel separation measurement was made by connecting the spectrum analyzer to the active antenna port using a 20 dB attenuator. Testing was done using the maximum power output with the system configured for normal operation using a pseudorandom hopping pattern.

Measurement Data and Plots:

Data Rate	Modulation	Number of Hopping Channels	20 dB Bandwidth (kHz)	Minimum Number of Channels	Result
Low	FSK	50	112	50	Complies
High	FSK	50	220	50	Complies
3rd Party	FSK	120	190	50	Complies

Table 10: Number of Hopping Channels Results

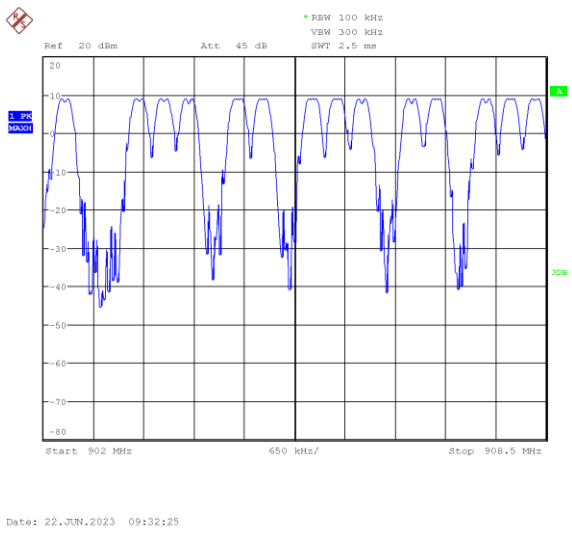

Figure 35: Number of Hopping Channels Low Data Rate (902-908.5 MHz)

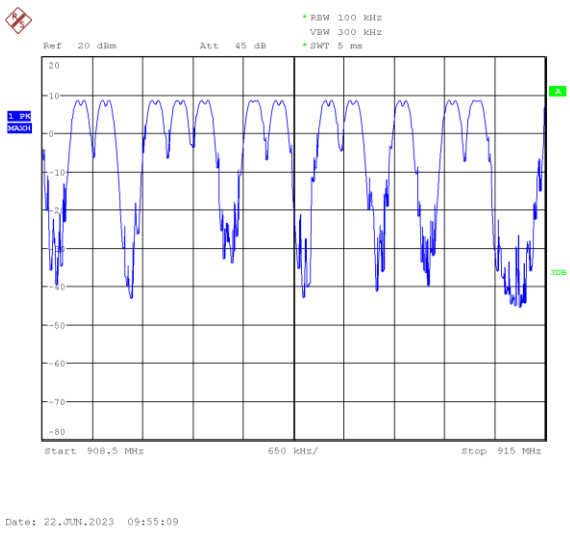

Figure 36: Number of Hopping Channels Low Data Rate (908.5-915 MHz)

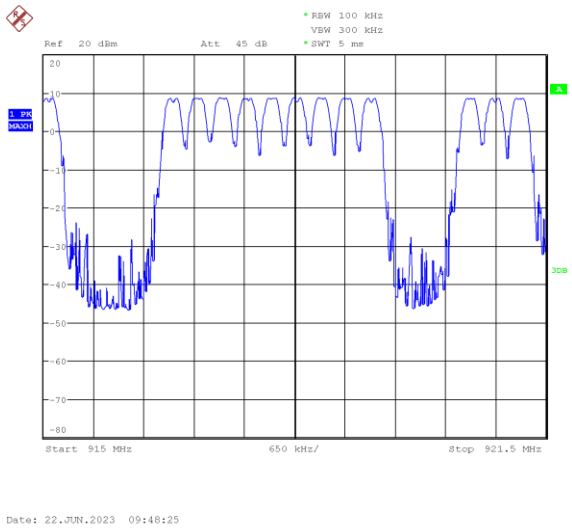

Figure 37: Number of Hopping Channels Low Data Rate (915-921.5 MHz)

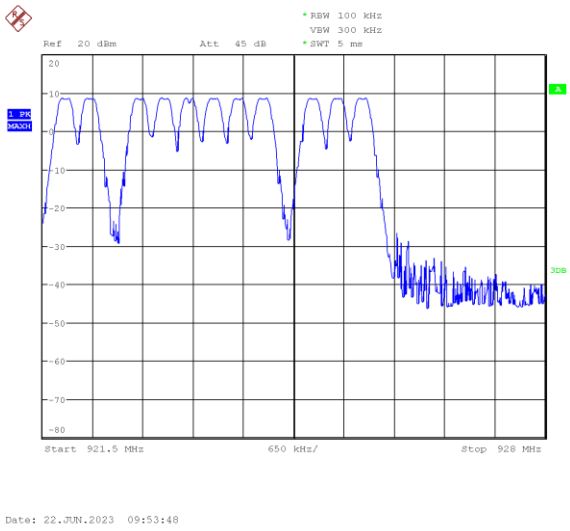

Figure 38: Number of Hopping Channels Low Data Rate (921.5-928 MHz)

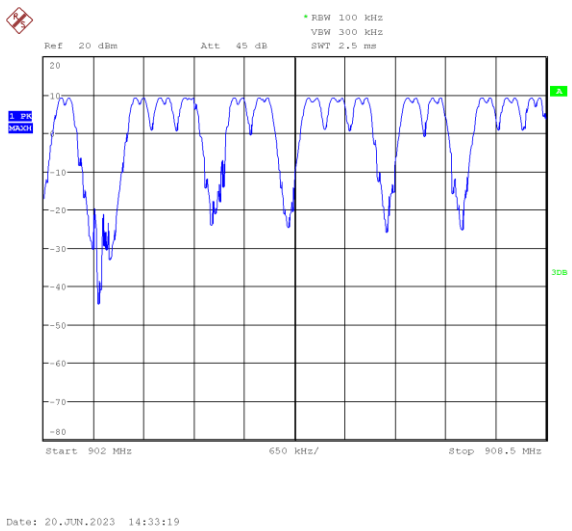

Figure 39: Number of Hopping Channels High Data Rate (902-908.5 MHz)

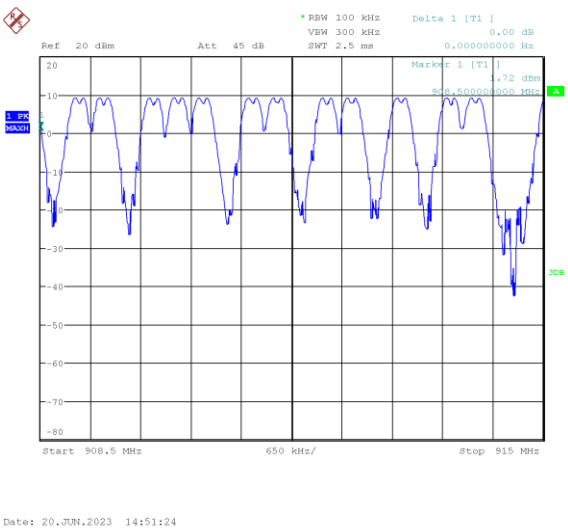

Figure 40: Number of Hopping Channels High Data Rate (908.5-915 MHz)

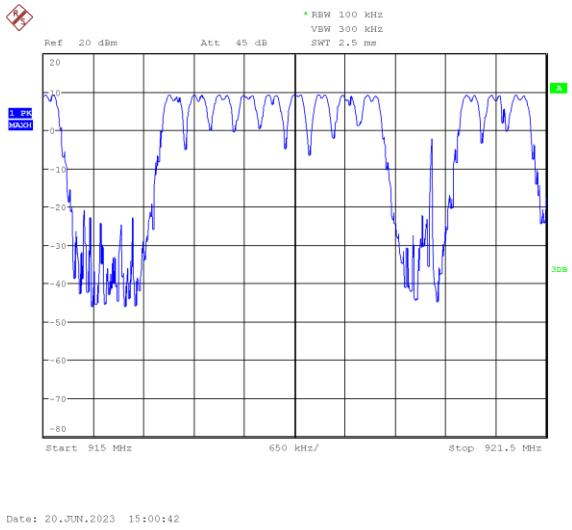

Figure 41: Number of Hopping Channels High Data Rate (915-921.5 MHz)

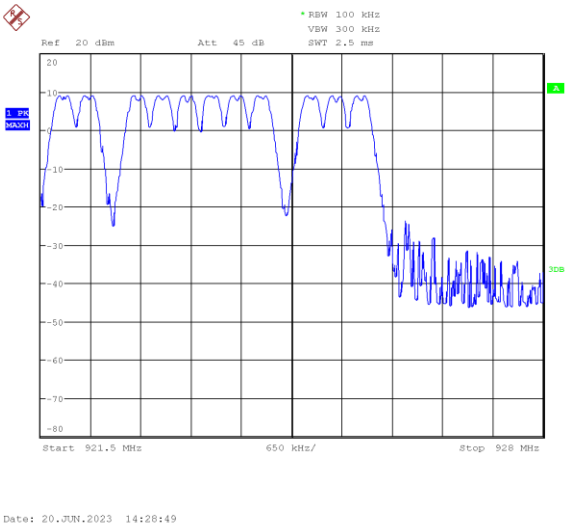

Figure 42: Number of Hopping Channels High Data Rate (921.5-928 MHz)

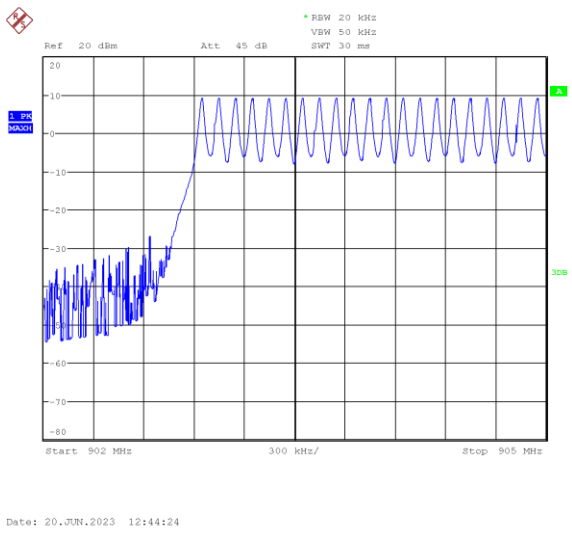

Figure 43: Number of Hopping Channels 3rd Party Data Rate (902-905 MHz)

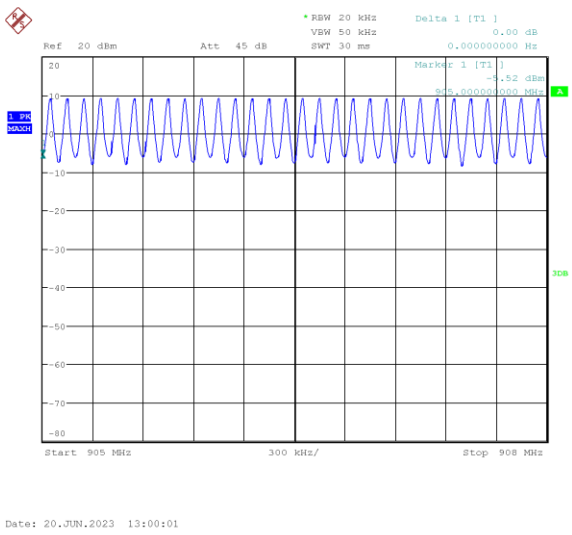

Figure 44: Number of Hopping Channels 3rd Party Data Rate (905-908 MHz)

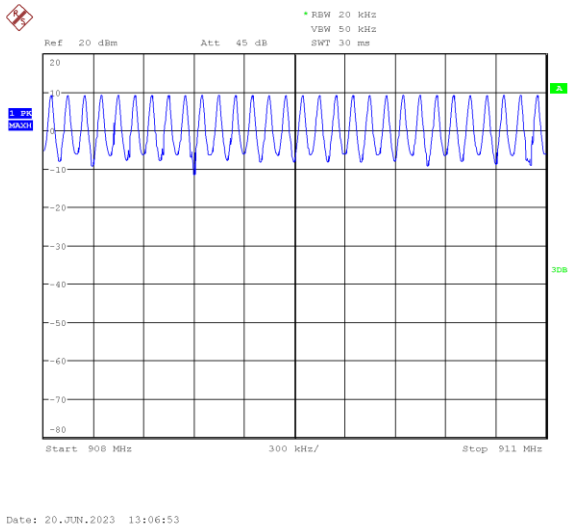

Figure 45: Number of Hopping Channels 3rd Party Data Rate (908-911 MHz)

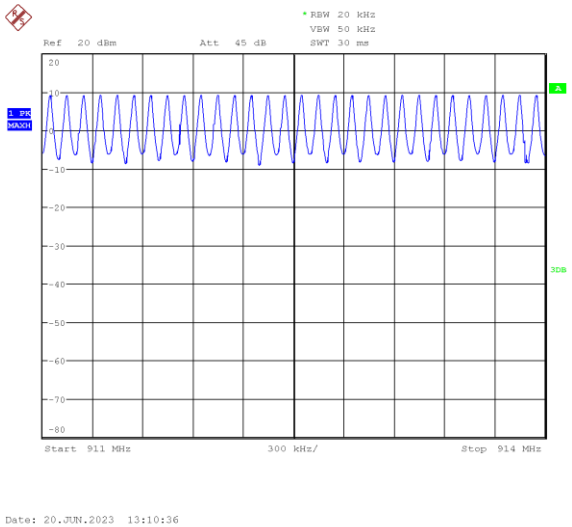

Figure 46: Number of Hopping Channels 3rd Party Data Rate (911-914 MHz)

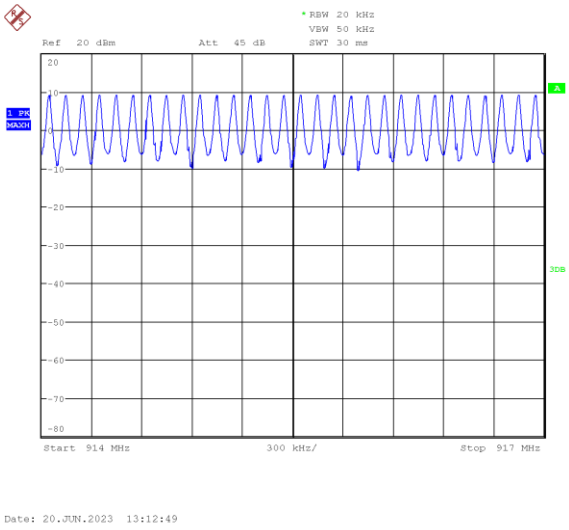

Figure 47: Number of Hopping Channels 3rd Party Data Rate (914-917 MHz)

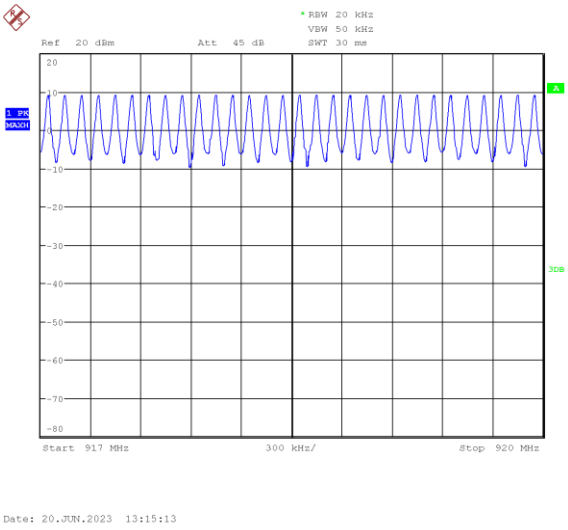

Figure 48: Number of Hopping Channels 3rd Party Data Rate (917-920 MHz)

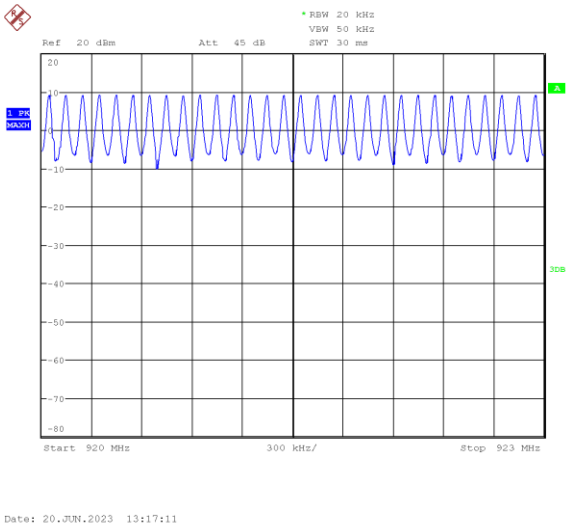

Figure 49: Number of Hopping Channels 3rd Party Data Rate (920-923 MHz)

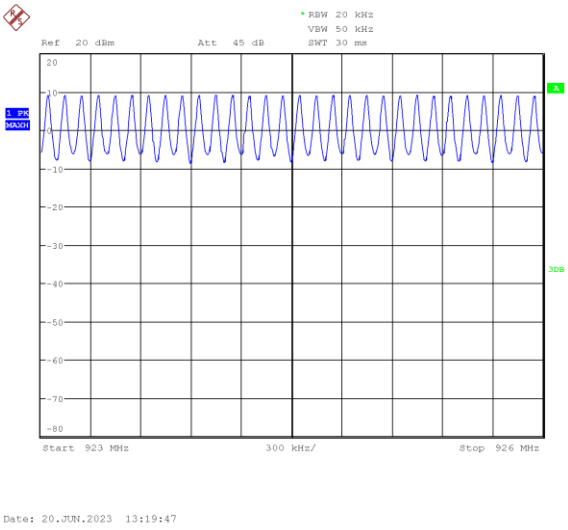

Figure 50: Number of Hopping Channels 3rd Party Data Rate (923-926 MHz)

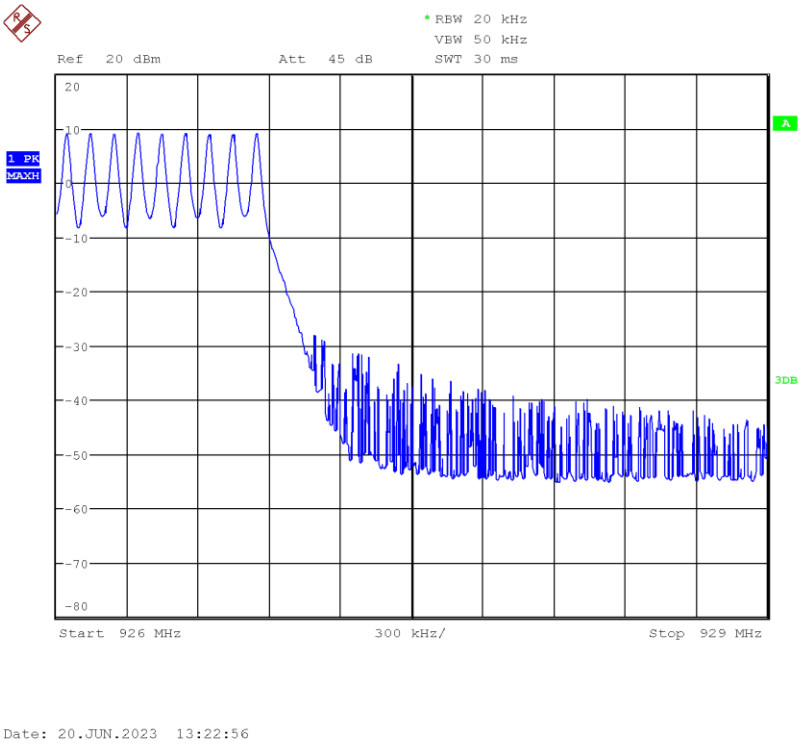

Figure 51: Number of Hopping Channels – 3rd Party Data Rate (926-929 MHz)

3.7 Channel Separation

Date Performed: June 20, 2023 - June 22, 2023

Test Standard: FCC CFR 47 Part 15.247 (a)(1)(i)
RSS-247 Issue 2 (5.1)(a)

Test Method: ANSI C63.10:2013
Span = Wide enough to capture the peak of two adjacent channels.
Ref Level = High enough to keep the signal from overdriving the input mixer
RBW = Approximately 30% of the channel spacing; adjusted as necessary to identify the center of each individual channel.
VBW ≥ RBW
Trace Detector: Peak, Trace: Max Hold

Modifications: None.

Final Result: Complies

Applicable Standard:

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.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10:2013.

The channel separation measurement was made by connecting the spectrum analyzer to the active antenna port using a 20dB attenuator. Testing was done using the maximum power output with the system configured for normal operation using a pseudorandom hopping pattern.

Measurement Data and Plots:

Data Rate	Modulation	Channel Separation (kHz)	Minimum Limit (Greater of)		Result
			20dB Bandwidth (kHz)	Minimum Limit (kHz)	
Low	FSK	317.3	114	25	Complies
High	FSK	329.2	224	25	Complies
3rd Party	FSK	200.0	167	25	Complies

Table 11: Channel Separation Results

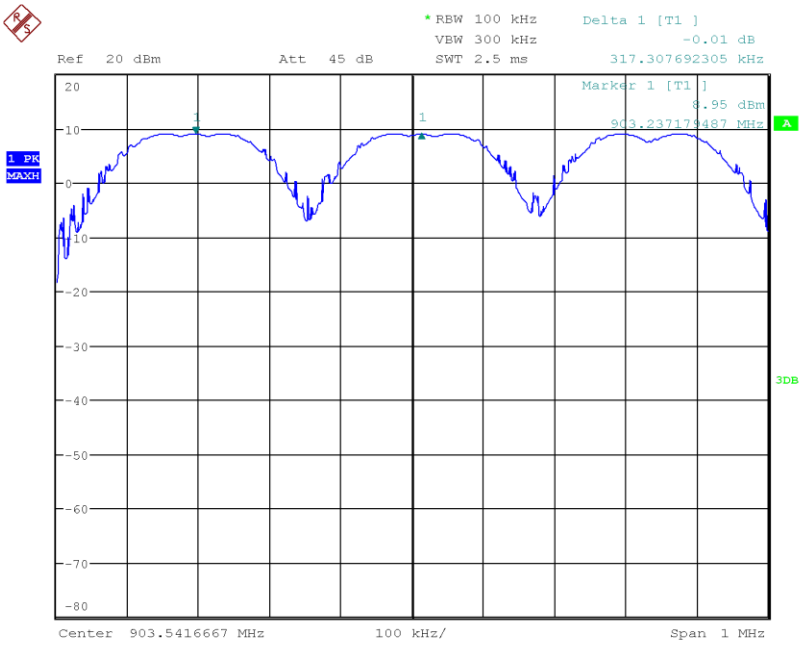

Figure 52: Channel Separation – Low Data Rate

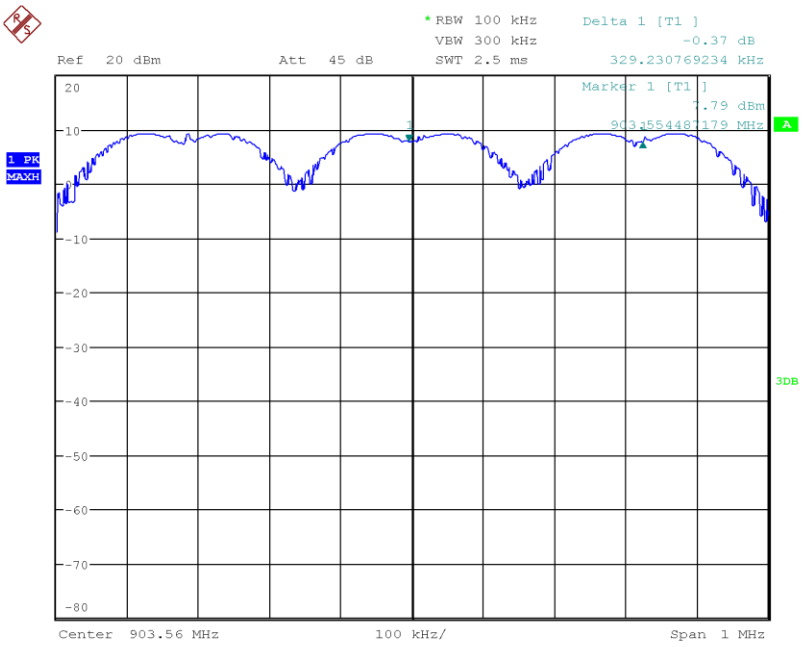

Figure 53: Channel Separation – High Data Rate

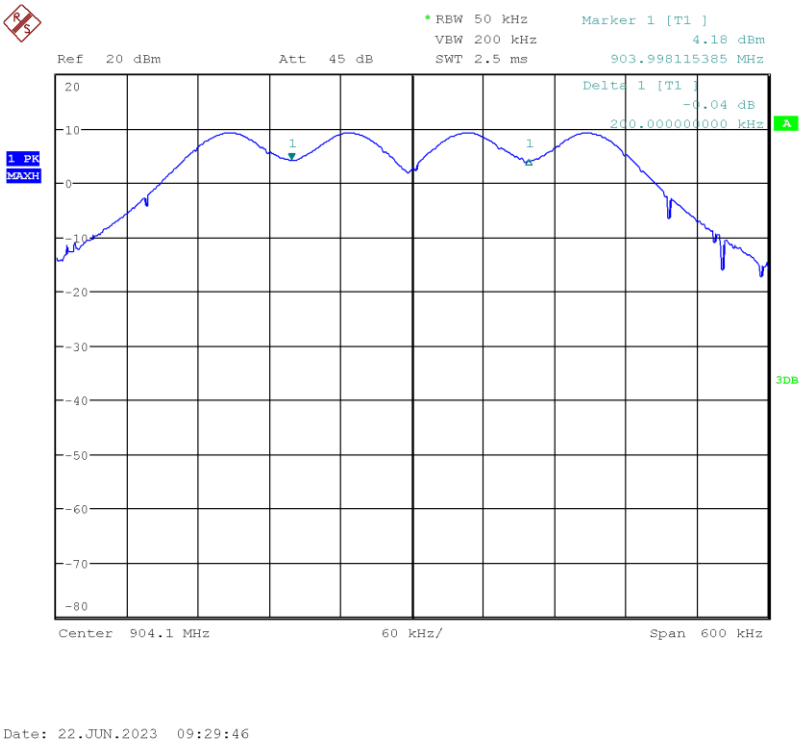

Figure 54: Channel Separation – 3rd Party Data Rate

3.8 Time of Occupancy & Dwell Time

Date Performed: June 20, 2023

Test Standard: FCC CFR 47 Part 15.247 (a)(1)(i)
IC RSS-247 Issue 2 (5.1)(a)

Test Method: ANSI C63.10:2013
Span = Zero span on a hopping channel.
RBW = ≤ Channel spacing and where possible RBW >> 1/*T* where *T* is the expected dwell time.
Detector: Peak, **Trace:** Max Hold

Modifications: None

Final Result: Complies

Applicable Standard:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Test Setup:

Bandwidth and band-edge measurements for frequency-hopping spread spectrum systems are typically made by connecting the spectrum analyzer to the active antenna port using a suitable RF attenuator. These measurements require verification that the antenna port selected is the active one if the system has more than one antenna. Testing shall be done using the maximum power output. The system shall be configured for normal operation using a pseudorandom hopping pattern.

Measurement Data and Plots:

Data Rate	Number of Hopping Channels	Time Between Bursts (s)	Number of Bursts in 20 seconds	Dwell Time (ms)	Time of Occupancy (ms)	Limit (ms)	Result
Low	50	1.162	17	8.15	138.55	400	Complies
High	50	0.323	61	2.26	137.86	400	Complies
3rd Party	120	9.030	2	46.06	92.12	400	Complies

Table 12: Time of Occupancy (Dwell Time) Results

Note: The number of bursts in 20 seconds was calculated by:

$$N_{Bursts} = 20\ seconds * \frac{1}{T_{burst}}$$

Where:
T_{burst} is the time between bursts

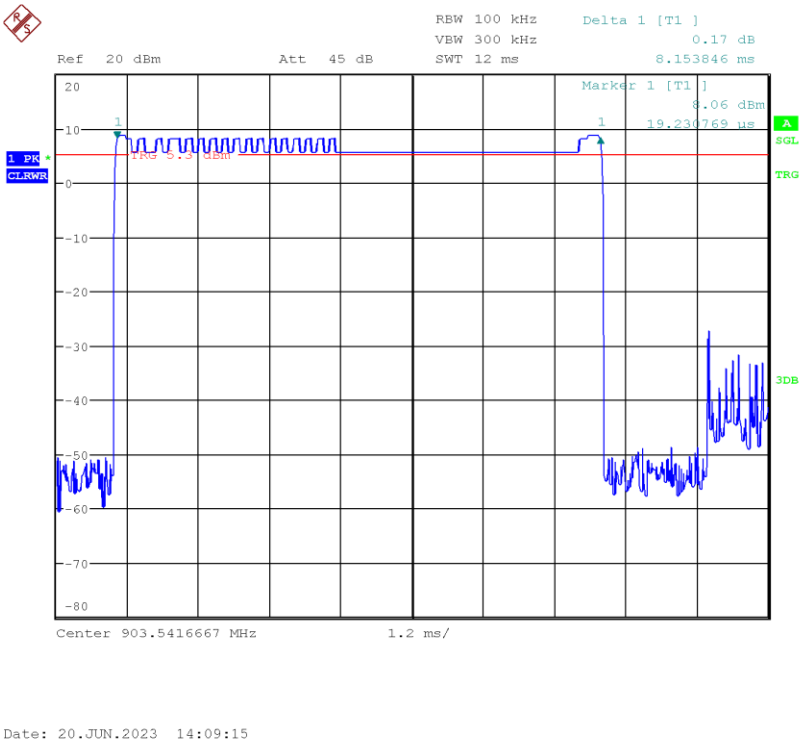

Figure 55: Dwell Time – Low Data Rate

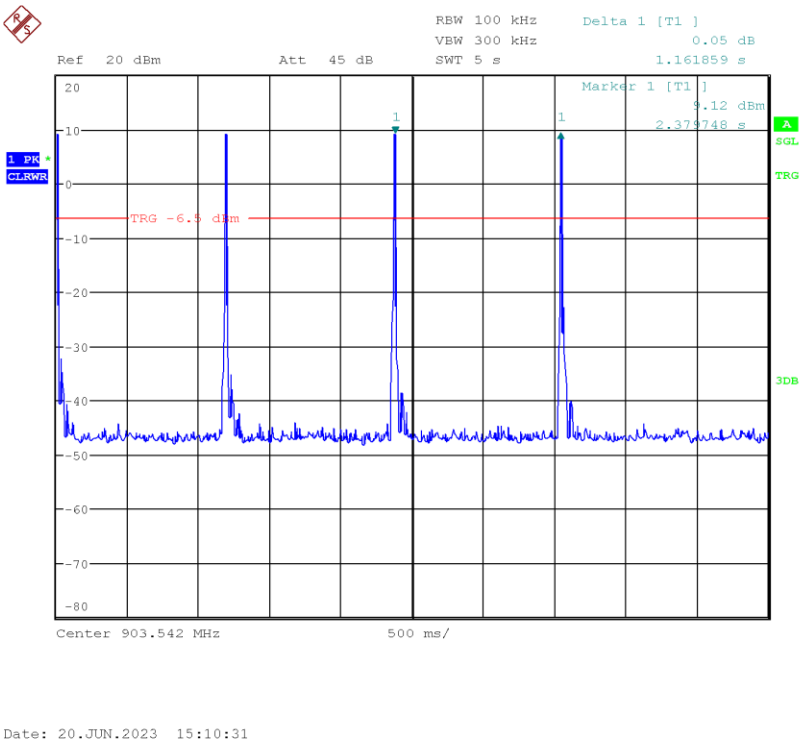

Figure 56: Hopping Period – Low Data Rate

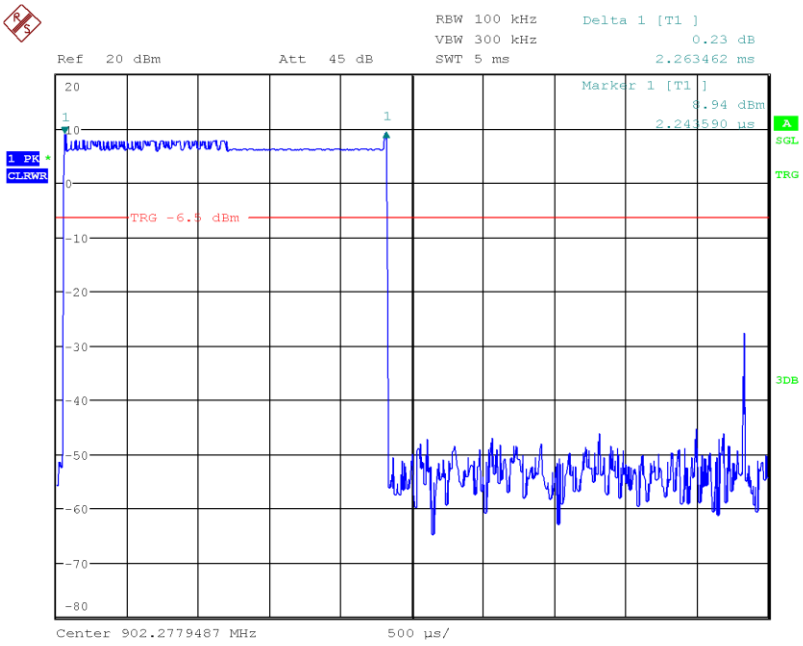

Figure 57: Dwell Time – High Data Rate

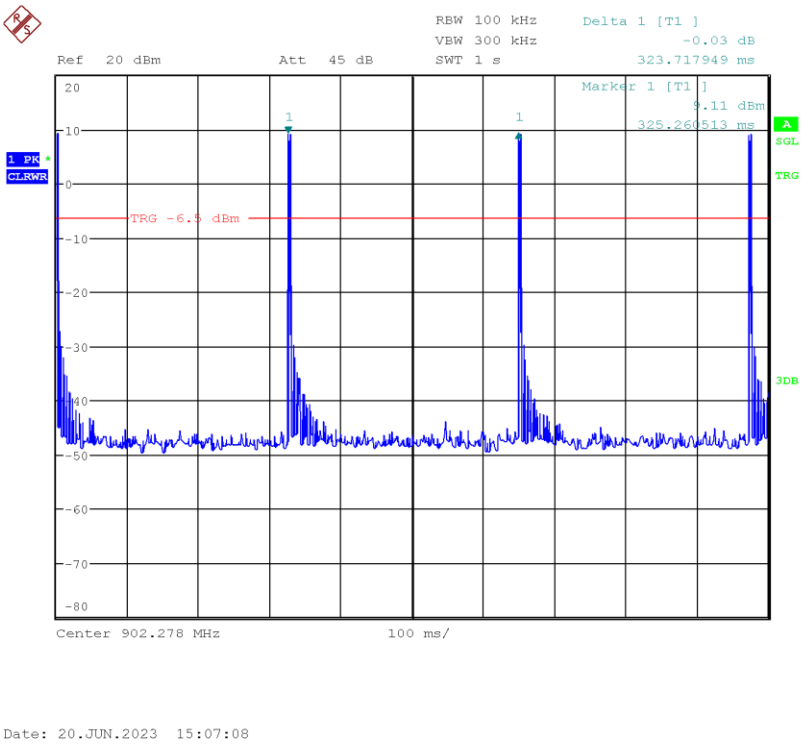

Figure 58: Hopping Period – High Data Rate

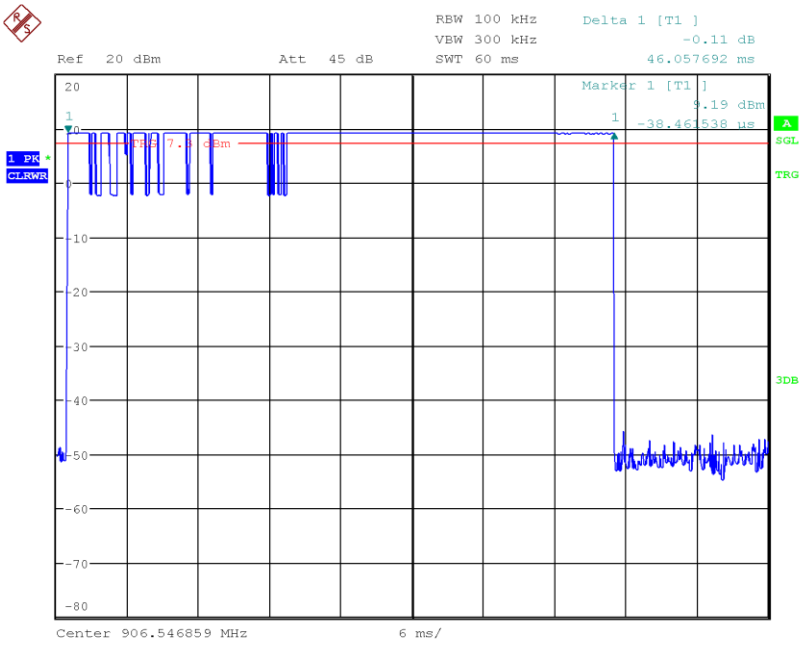

Figure 59: Dwell Time – 3rd Party Data Rate

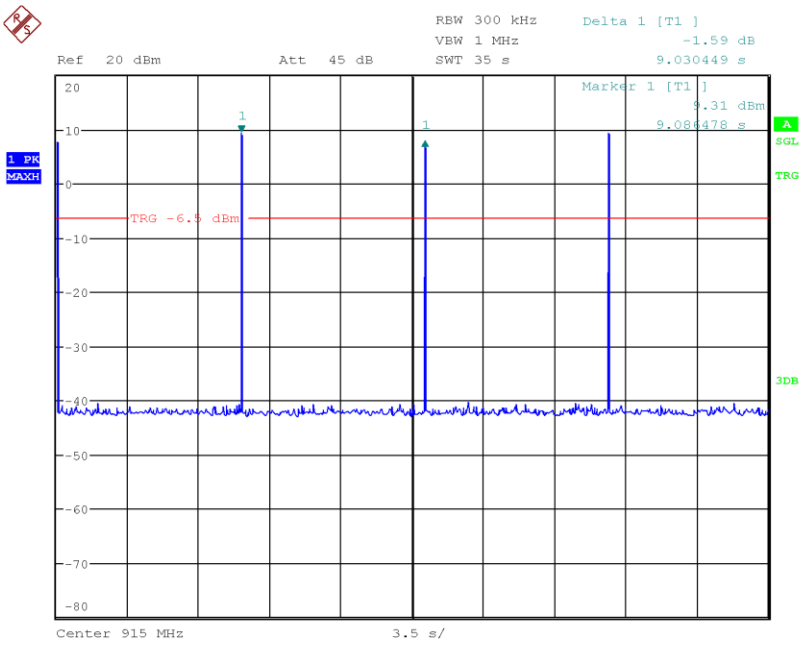

Figure 60: Hopping Period – 3rd Party Data Rate

3.9 Unintentional Conducted Emissions

Date Performed: June 19, 2023

Test Standard: FCC CFR 47 Part 15.207
IC RSS-Gen Issue 5 (8.8)

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.207: Conducted limits

a) For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, withing the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH / 50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

*Decreases with the logarithm of the frequency.

RSS-Gen (8.8) AC power-line conducted emissions limits

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 Note 1	56 to 46 Note 1
0.5 – 5	56	46
5 – 30	60	50

Note 1 The level decreases linearly with the logarithm of the frequency.

Test Setup:

The EUT was tested inside the SAC using a 50 µH / 50 Ω lisn per ANSI C63.10:2013.

Measurement Data and Plots:

Frequency MHz	QuasiPeak (dBuV/m)	Average (dBuV/m)	Line	PE	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.1506	63.26	---	L1	GND	10.6	65.97	2.70	Complies
0.1514	63.27	---	L1	GND	10.6	65.92	2.65	Complies
0.1522	63.55	---	L1	GND	10.6	65.88	2.33	Complies
0.1540	63.41	---	L1	GND	10.6	65.78	2.37	Complies
0.1548	63.34	---	L1	GND	10.6	65.74	2.40	Complies
0.1566	63.38	---	L1	GND	10.6	65.64	2.26	Complies
0.1574	63.35	---	L1	GND	10.6	65.60	2.25	Complies
0.1600	63.40	---	L1	GND	10.6	65.46	2.06	Complies
0.1608	63.16	---	L1	GND	10.6	65.42	2.26	Complies
0.1626	62.81	---	L1	GND	10.6	65.33	2.52	Complies
0.1634	62.84	---	L1	GND	10.6	65.29	2.45	Complies
0.1660	62.65	---	L1	GND	10.6	65.16	2.51	Complies
0.1668	62.40	---	L1	GND	10.6	65.12	2.72	Complies
0.1694	62.31	---	L1	GND	10.6	64.99	2.68	Complies
0.1780	60.95	---	L1	GND	10.6	64.58	3.63	Complies
0.6374	52.72	---	L1	GND	10.4	56.00	3.28	Complies
0.6426	52.70	---	L1	GND	10.4	56.00	3.30	Complies
0.6426	---	36.89	L1	GND	10.4	46.00	9.11	Complies
0.6444	---	37.69	L1	GND	10.4	46.00	8.31	Complies
0.6470	---	38.09	L1	GND	10.4	46.00	7.91	Complies
0.6478	---	38.27	L1	GND	10.4	46.00	7.73	Complies
0.6504	---	39.05	L1	GND	10.4	46.00	6.95	Complies
0.6514	---	39.52	L1	GND	10.4	46.00	6.48	Complies
0.6530	55.08	---	L1	GND	10.4	56.00	0.92	Complies
0.6530	---	40.19	L1	GND	10.4	46.00	5.81	Complies
0.6538	---	40.38	L1	GND	10.4	46.00	5.62	Complies
0.6548	---	40.62	L1	GND	10.4	46.00	5.38	Complies
0.6556	---	40.63	L1	GND	10.4	46.00	5.37	Complies
0.6564	55.51	---	L1	GND	10.4	56.00	0.49	Complies
0.6564	---	40.74	L1	GND	10.4	46.00	5.26	Complies
0.6574	55.47	---	L1	GND	10.4	56.00	0.53	Complies
0.6574	---	40.62	L1	GND	10.4	46.00	5.38	Complies
0.6582	---	40.61	L1	GND	10.4	46.00	5.39	Complies
0.6590	---	40.44	L1	GND	10.4	46.00	5.56	Complies
0.6600	---	40.17	L1	GND	10.4	46.00	5.83	Complies
0.6608	---	40.08	L1	GND	10.4	46.00	5.92	Complies
0.6616	---	39.78	L1	GND	10.4	46.00	6.22	Complies
0.6626	---	39.58	L1	GND	10.4	46.00	6.42	Complies
0.6634	---	39.37	L1	GND	10.4	46.00	6.63	Complies
0.6642	---	39.10	L1	GND	10.4	46.00	6.91	Complies

Table 13: AC Conducted Emissions, Line 1

Frequency MHz	QuasiPeak (dBuV/m)	Average (dBuV/m)	Line	PE	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.1516	61.05	---	L2	GND	10.6	65.91	4.86	Complies
0.1532	60.89	---	L2	GND	10.6	65.83	4.93	Complies
0.1550	60.85	---	L2	GND	10.6	65.73	4.88	Complies
0.1584	60.88	---	L2	GND	10.6	65.55	4.67	Complies
0.1618	60.56	---	L2	GND	10.6	65.37	4.81	Complies
0.1636	60.56	---	L2	GND	10.6	65.28	4.72	Complies
0.1670	60.31	---	L2	GND	10.6	65.11	4.80	Complies
0.1704	59.77	---	L2	GND	10.6	64.94	5.17	Complies
0.1738	59.16	---	L2	GND	10.6	64.78	5.62	Complies
0.1790	58.50	---	L2	GND	10.6	64.53	6.03	Complies
0.6482	---	40.86	L2	GND	10.4	46.00	5.14	Complies
0.6508	53.73	---	L2	GND	10.4	56.00	2.27	Complies
0.6508	---	41.90	L2	GND	10.4	46.00	4.10	Complies
0.6516	---	42.32	L2	GND	10.4	46.00	3.68	Complies
0.6524	54.44	---	L2	GND	10.4	56.00	1.56	Complies
0.6526	---	42.84	L2	GND	10.4	46.00	3.16	Complies
0.6534	---	43.22	L2	GND	10.4	46.00	2.78	Complies
0.6542	---	43.48	L2	GND	10.4	46.00	2.52	Complies
0.6542	54.95	---	L2	GND	10.4	56.00	1.05	Complies
0.6552	---	43.78	L2	GND	10.4	46.00	2.22	Complies
0.6560	---	44.05	L2	GND	10.4	46.00	1.95	Complies
0.6560	55.38	---	L2	GND	10.4	56.00	0.62	Complies
0.6568	---	44.12	L2	GND	10.4	46.00	1.88	Complies
0.6576	55.47	---	L2	GND	10.4	56.00	0.53	Complies
0.6578	---	44.09	L2	GND	10.4	46.00	1.91	Complies
0.6586	---	43.97	L2	GND	10.4	46.00	2.03	Complies
0.6586	55.46	---	L2	GND	10.4	56.00	0.54	Complies
0.6594	55.34	---	L2	GND	10.4	56.00	0.66	Complies
0.6594	---	43.75	L2	GND	10.4	46.00	2.25	Complies
0.6604	55.28	---	L2	GND	10.4	56.00	0.72	Complies
0.6604	---	43.56	L2	GND	10.4	46.00	2.44	Complies
0.6612	55.03	---	L2	GND	10.4	56.00	0.97	Complies
0.6612	---	43.37	L2	GND	10.4	46.00	2.63	Complies
0.6620	---	43.14	L2	GND	10.4	46.00	2.86	Complies
0.6630	54.54	---	L2	GND	10.4	56.00	1.46	Complies
0.6630	---	42.74	L2	GND	10.4	46.00	3.26	Complies
0.6638	---	42.56	L2	GND	10.4	46.00	3.44	Complies
0.6646	---	42.17	L2	GND	10.4	46.00	3.83	Complies
0.6664	---	41.46	L2	GND	10.4	46.00	4.54	Complies
0.6742	---	39.78	L2	GND	10.4	46.00	6.22	Complies

Table 14: AC Conducted Emissions, Line 2

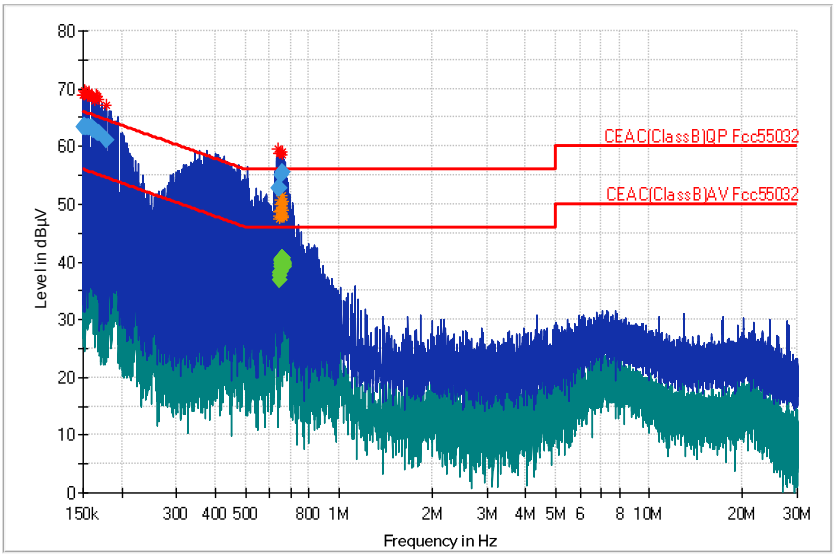

Figure 61: AC Conducted Emissions, Line 1

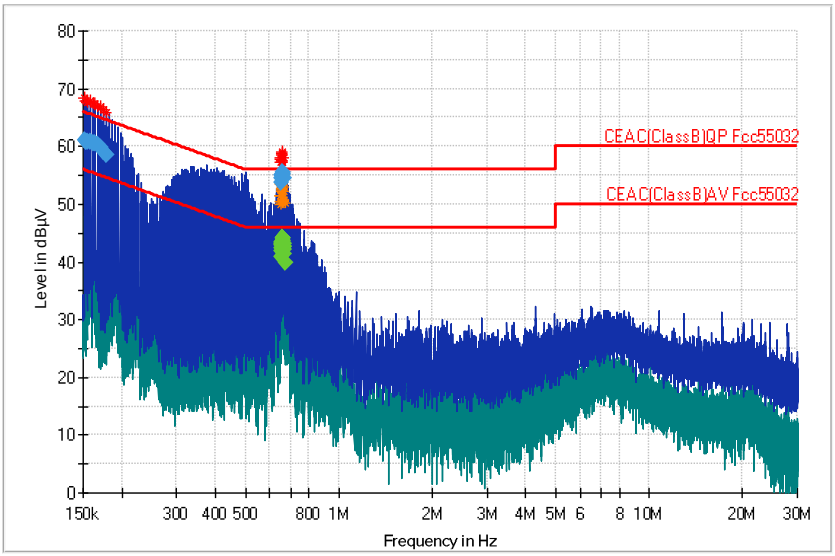

Figure 62: AC Conducted Emissions, Line 2

3.10 Unintentional Radiated Emissions

Date Performed: June 16, 2023 - June 22, 2023

Test Standard: FCC 47 CFR Part 15.33 (a)(1), (5)
FCC 47 CFR Part 15.109
FCC 47 CFR Part 15.209
ICES-003 Issue 7
RSS-247

Test Method: ANSI C63.4:2014

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.33 (b)(1): Frequency range of radiated measurements

For an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.075	30
1.075 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

FCC 47 CFR Part 15.109: Radiated emission limits

a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

e) Carrier current systems used as unintentional radiator or other unintentional radiators that are designed to conduct their radio frequency emissions via connecting wires or cables and that operate in the frequency range of 9 kHz to 30 MHz, including devices that deliver the radio frequency energy to transducers, such as ultrasonic devices not covered under Part 18, shall comply with the radiated emission limits for intentional radiators provided in 15.209 for the frequency range of 9 kHz to 30 MHz.

FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements

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

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	20*log(2400/F(kHz)) + 40 dB
0.490 – 1.705	20*log(24000/F(kHz)) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz.

Radiated emission limits in these three bands are based on measurements employing an average detector

ICES-003 3.2.2 Radiated emission limits

The quasi-peak limits for the electric component of the radiated field strength emitted from ITE or digital apparatus, within 30 MHz to 1 GHz, for a measurement distance of 3 m or 10 m, are:

Frequency Range (MHz)	Class A (3 m) Quasi-peak (dBµV/m)	Class A (10 m) Quasi-peak (dBµV/m)	Class B (3 m) Quasi-peak (dBµV/m)	Class B (10 m) Quasi-peak (dBµV/m)
30 – 88	50.0	40.0	40.0	30.0
88 – 216	54.0	43.5	43.5	33.1
216 – 230	56.9	46.4	46.0	35.6
230 – 960	57.0	47.0	47.0	37.0
960 - 1000	60.0	49.5	54.0	43.5

At and above 1 GHz, except for outdoor units of home satellite receiving systems, the ITE or digital apparatus shall comply with:

Frequency Range (MHz)	Class A Average (dBµV/m)	Class A Peak (dBµV/m)	Class B Average (dBµV/m)	Class B Peak (dBµV/m)
1 - F_M	60	80	54	74

F_M is determined by:

Highest internal frequency (F_X)	Highest measurement frequency (F_M)
$F_X \leq 108$ MHz	1 GHz
108 MHz $\leq F_X \leq$ 500 MHz	2 GHz
500 MHz $\leq F_X \leq$ 1 GHz	5 GHz
$F_X >$ 1 GHz	5 x F_X up to a maximum of 40 GHz

Test Setup:

The EUT was tested in a 3 m SAC and was positioned on the front of the turntable and the radiated output of the device was measured for all emissions up to 18 GHz.

Measurement Data and Plots:

Frequency MHz	QuasiPeak (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
30	31.71	100	V	93	28.5	40	8.29	Complies
86.648	20.43	350	H	335	14.4	40	19.57	Complies
142.035	28.11	200	H	326	20.5	43.5	15.39	Complies
202.466	24.74	150	H	0	20.4	43.5	18.76	Complies
243.4	26.75	100	H	0	19.5	46	19.25	Complies
249.899	27.17	100	H	10	19.5	46	18.83	Complies
254.167	27.45	150	V	0	19.6	46	18.55	Complies
278.805	29.34	100	H	349	21.2	46	16.66	Complies
282.685	29.39	100	H	0	21.2	46	16.61	Complies
284.431	30.02	100	H	201	21.2	46	15.98	Complies
286.468	31.42	100	H	37	21.2	46	14.58	Complies
290.348	30.31	100	H	10	21.3	46	15.69	Complies
410.725	33.23	200	H	0	24.2	46	12.77	Complies
551.86	33.1	100	V	356	26.6	46	12.9	Complies
559.62	33.11	200	V	0	26.8	46	12.89	Complies
890.39	36.76	150	H	0	30.9	46	9.24	Complies

Table 15: Unintentional Radiated Emissions: 30 MHz - 1 GHz

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1038	---	45.17	200	H	0	-7.4	54	8.83	Complies
1334.5	---	42.95	400	V	90	-5.3	54	11.05	Complies
2007	---	45.71	100	V	0	1.5	54	8.29	Complies
3707	---	47.23	200	H	306	3.8	54	6.77	Complies
4758.5	---	48.67	400	V	278	7.1	54	5.33	Complies
5827	---	49.9	350	H	119	8.3	54	4.1	Complies
6274.8	---	35.33	250	V	76	-7.1	54	18.67	Complies
7471.2	---	35.25	250	H	2	-4.6	54	18.75	Complies
8341.2	---	37.76	200	V	280	-2.8	54	16.24	Complies
10090.8	---	39.6	300	V	242	2.8	54	14.4	Complies
10851.6	---	41.56	250	H	313	4.5	54	12.44	Complies
12610.8	---	42.6	100	H	118	7.6	54	11.4	Complies
15687.6	---	43.6	100	H	16	12.3	54	10.4	Complies
16744.8	---	45.88	150	V	274	12.9	54	8.12	Complies

Table 16: Unintentional Radiated Emissions: 1 GHz - 18 GHz

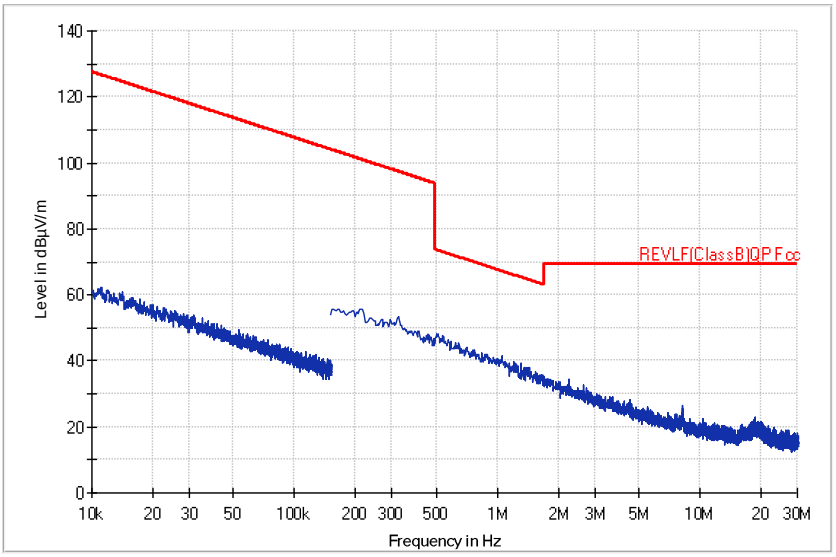

Figure 63: Unintentional Radiated Emissions: 10 kHz - 30 MHz, Horizontal

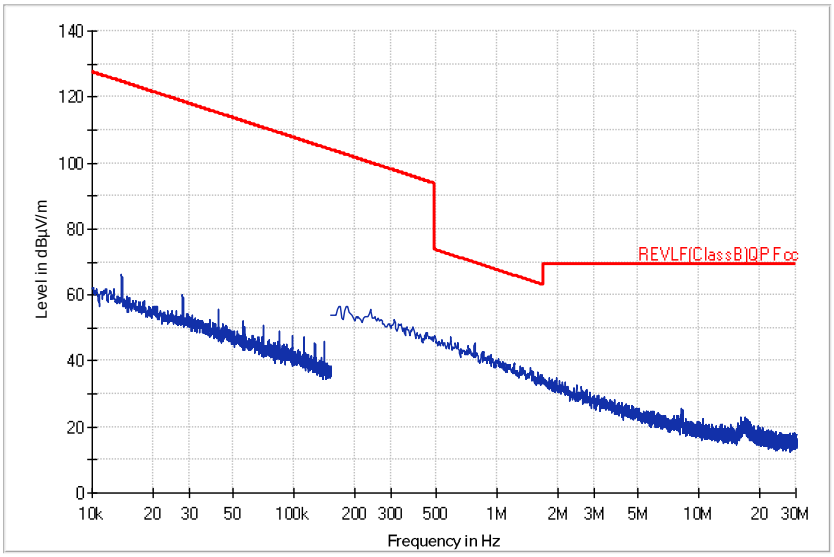

Figure 64: Unintentional Radiated Emissions: 10 kHz - 30 MHz, Vertical

Note:

1. No significant emissions were seen to be within 20 dB of the limit.

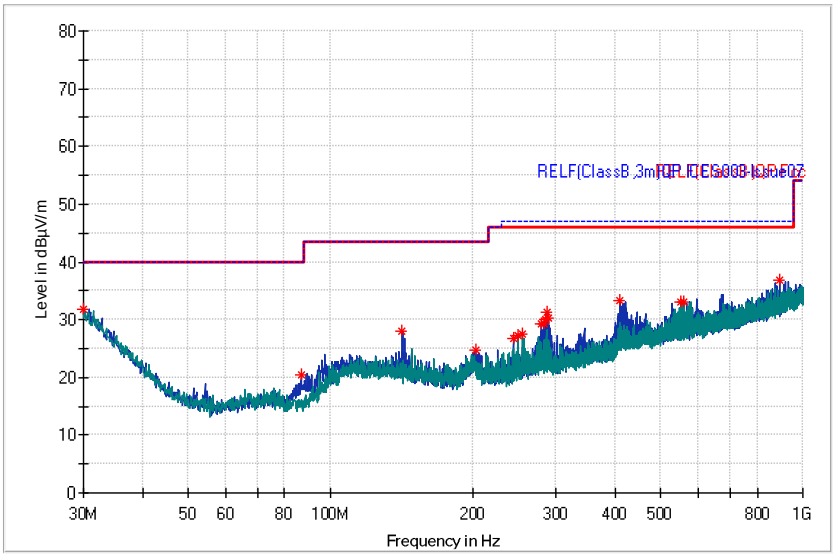

Figure 65: Unintentional Radiated Emissions: 30 MHz - 1 GHz

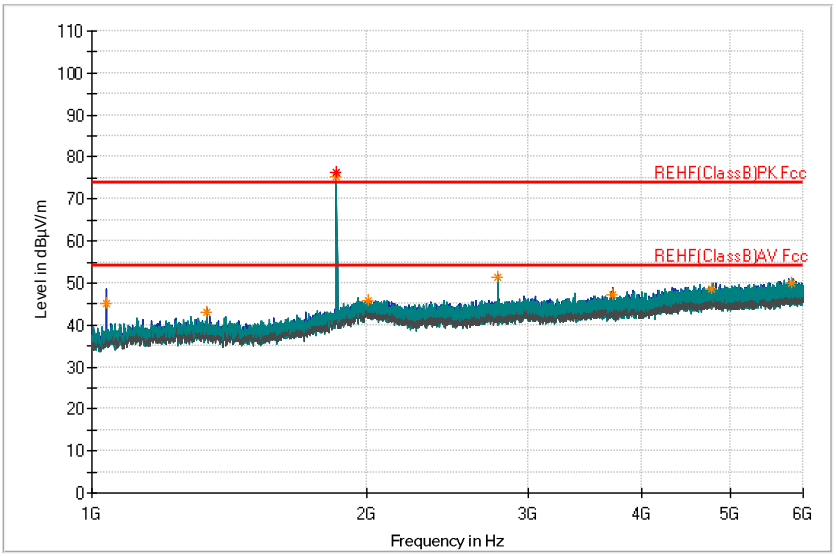

Figure 66: Unintentional Radiated Emissions: 1 GHz - 6 GHz

Note:

1. Emission at 1.8 GHz and 2.7 GHz are harmonics of the 900 MHz intentional transmitter and evaluated in Section 3.11: Intentional Radiated Emissions.

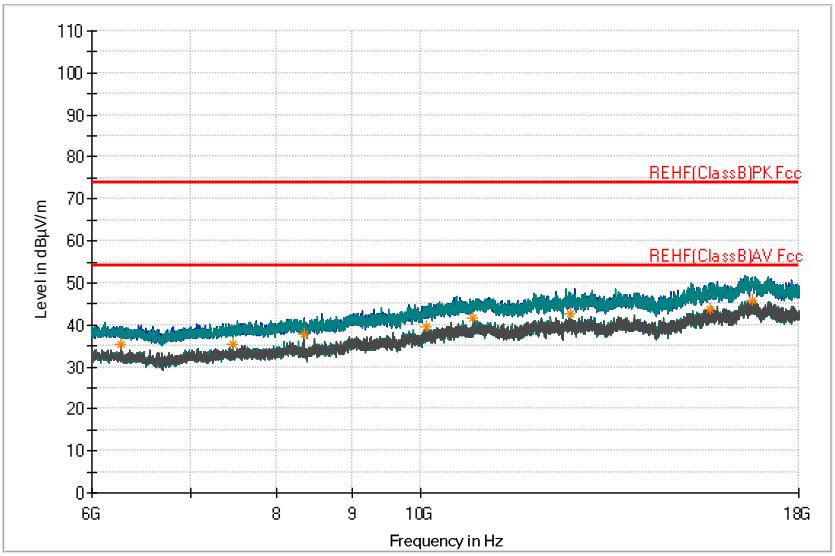

Figure 67: Unintentional Radiated Emissions: 6 GHz - 18 GHz

3.11 Current Carrier Emissions

Date Performed: June 22, 2023

Test Standard: FCC CFR 47 Part 15.207
FCC CFR 47 Part 15.209
IC RSS-Gen Issue 5 (8.9)

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.207: Conducted limits

b) Limits shown in 15.207 (a) shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:
   1. For carrier current systems containing their fundamental emission within the frequency band 535 – 1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
   2. For all other carrier current systems: 1000 µV within the frequency band 535 – 1705 kHz, as measured using a 50 µH / 50 Ω line impedance stabilization network (LISN).
   3. Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in 15.205, 15.209, 15.221, 15.223, or 15.227, as appropriate.

FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements

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

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	20*log(2400/F(kHz)) + 40 dB
0.490 – 1.705	20*log(24000/F(kHz)) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz.

Radiated emission limits in these three bands are based on measurements employing an average detector

RSS-Gen (8.9) Transmitter emission limits

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in the following table. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Frequency of emission (MHz)	Magnetic Field Strength (µA/m)	Measurement Distance (m)
9 – 490 kHz [Note 1]	6.37/F (F in kHz)	300
0.5 – 5	63.7/F (F in kHz)	30
5 – 30	0.08	30

[Note 1] The emission limits for the ranges 9 – 90 kHz and 110 – 490 kHz are based on measurements employing a linear average detector.

Test Setup:

The EUT was tested inside the SAC using a 50 µH / 50 Ω lisn for conducted emissions and measured at 3m using a loop antenna for radiated emissions per ANSI C63.10:2013.

Measurement Data and Plots:

3.11.1 Conducted Emissions

Frequency MHz	QuasiPeak (dBuV/m)	Average (dBuV/m)	Line	PE	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.5362	43.58	---	L1	GND	10.4	60.00	16.42	Complies
0.5430	42.56	---	L1	GND	10.4	60.00	17.44	Complies
0.6472	---	34.73	L1	GND	10.4	46.00	11.27	Complies
0.6506	---	36.52	L1	GND	10.4	46.00	9.48	Complies
0.6506	47.63	---	L1	GND	10.4	60.00	12.37	Complies
0.6514	---	36.88	L1	GND	10.4	46.00	9.12	Complies
0.6524	---	37.33	L1	GND	10.4	46.00	8.67	Complies
0.6524	48.23	---	L1	GND	10.4	60.00	11.77	Complies
0.6532	---	37.54	L1	GND	10.4	46.00	8.46	Complies
0.6540	---	37.82	L1	GND	10.4	46.00	8.18	Complies
0.6542	48.85	---	L1	GND	10.4	60.00	11.15	Complies
0.6548	---	37.88	L1	GND	10.4	46.00	8.12	Complies
0.6556	49.19	---	L1	GND	10.4	60.00	10.81	Complies
0.6558	---	37.93	L1	GND	10.4	46.00	8.07	Complies
0.6566	---	38.04	L1	GND	10.4	46.00	7.96	Complies
0.6574	---	38.14	L1	GND	10.4	46.00	7.86	Complies
0.6574	49.32	---	L1	GND	10.4	60.00	10.68	Complies
0.6582	49.39	---	L1	GND	10.4	60.00	10.61	Complies
0.6592	49.40	---	L1	GND	10.4	60.00	10.60	Complies
0.6592	---	38.04	L1	GND	10.4	46.00	7.96	Complies
0.6600	49.38	---	L1	GND	10.4	60.00	10.62	Complies
0.6600	---	37.87	L1	GND	10.4	46.00	8.14	Complies
0.6608	---	37.85	L1	GND	10.4	46.00	8.15	Complies
0.6608	49.24	---	L1	GND	10.4	60.00	10.76	Complies
0.6618	49.03	---	L1	GND	10.4	60.00	10.97	Complies
0.6618	---	37.56	L1	GND	10.4	46.00	8.44	Complies
0.6626	---	37.42	L1	GND	10.4	46.00	8.58	Complies
0.6626	48.94	---	L1	GND	10.4	60.00	11.06	Complies
0.6634	---	37.34	L1	GND	10.4	46.00	8.66	Complies
0.6634	48.81	---	L1	GND	10.4	60.00	11.19	Complies
0.6652	48.49	---	L1	GND	10.4	60.00	11.51	Complies
0.6652	---	36.79	L1	GND	10.4	46.00	9.21	Complies
0.6660	---	36.58	L1	GND	10.4	46.00	9.42	Complies
0.6660	48.41	---	L1	GND	10.4	60.00	11.59	Complies
0.6678	47.97	---	L1	GND	10.4	60.00	12.03	Complies
0.6678	---	35.98	L1	GND	10.4	46.00	10.02	Complies
0.6686	---	35.82	L1	GND	10.4	46.00	10.18	Complies
0.6694	47.74	---	L1	GND	10.4	60.00	12.26	Complies
0.6704	47.63	---	L1	GND	10.4	60.00	12.37	Complies
0.6870	44.34	---	L1	GND	10.4	60.00	15.66	Complies

Table 17: Carrier Current Conducted Emissions, Line 1

Frequency MHz	QuasiPeak (dBuV/m)	Average (dBuV/m)	Line	PE	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.5368	44.40	---	L2	GND	10.4	60.00	15.60	Complies
0.5402	44.24	---	L2	GND	10.4	60.00	15.76	Complies
0.6490	---	37.60	L2	GND	10.4	46.00	8.40	Complies
0.6490	49.10	---	L2	GND	10.4	60.00	10.90	Complies
0.6498	---	38.01	L2	GND	10.4	46.00	7.99	Complies
0.6506	---	38.30	L2	GND	10.4	46.00	7.70	Complies
0.6522	50.40	---	L2	GND	10.4	60.00	9.60	Complies
0.6524	---	39.11	L2	GND	10.4	46.00	6.89	Complies
0.6532	---	39.34	L2	GND	10.4	46.00	6.66	Complies
0.6540	50.84	---	L2	GND	10.4	60.00	9.16	Complies
0.6540	---	39.51	L2	GND	10.4	46.00	6.49	Complies
0.6548	50.90	---	L2	GND	10.4	60.00	9.10	Complies
0.6558	---	39.68	L2	GND	10.4	46.00	6.32	Complies
0.6558	51.06	---	L2	GND	10.4	60.00	8.94	Complies
0.6566	51.09	---	L2	GND	10.4	60.00	8.91	Complies
0.6566	---	39.80	L2	GND	10.4	46.00	6.20	Complies
0.6574	51.13	---	L2	GND	10.4	60.00	8.87	Complies
0.6574	---	39.80	L2	GND	10.4	46.00	6.20	Complies
0.6582	51.13	---	L2	GND	10.4	60.00	8.87	Complies
0.6584	---	39.77	L2	GND	10.4	46.00	6.23	Complies
0.6592	---	39.69	L2	GND	10.4	46.00	6.31	Complies
0.6592	51.02	---	L2	GND	10.4	60.00	8.98	Complies
0.6600	---	39.59	L2	GND	10.4	46.00	6.41	Complies
0.6608	50.73	---	L2	GND	10.4	60.00	9.27	Complies
0.6610	---	39.51	L2	GND	10.4	46.00	6.49	Complies
0.6618	50.59	---	L2	GND	10.4	60.00	9.41	Complies
0.6618	---	39.41	L2	GND	10.4	46.00	6.59	Complies
0.6626	---	39.21	L2	GND	10.4	46.00	6.79	Complies
0.6626	50.35	---	L2	GND	10.4	60.00	9.65	Complies
0.6636	50.20	---	L2	GND	10.4	60.00	9.80	Complies
0.6642	50.07	---	L2	GND	10.4	60.00	9.93	Complies
0.6644	---	38.82	L2	GND	10.4	46.00	7.18	Complies
0.6652	---	38.77	L2	GND	10.4	46.00	7.23	Complies
0.6660	---	38.39	L2	GND	10.4	46.00	7.61	Complies
0.6678	49.58	---	L2	GND	10.4	60.00	10.42	Complies
0.6678	---	37.99	L2	GND	10.4	46.00	8.01	Complies
0.6686	49.49	---	L2	GND	10.4	60.00	10.51	Complies
0.6686	---	37.80	L2	GND	10.4	46.00	8.20	Complies
0.6694	49.50	---	L2	GND	10.4	60.00	10.50	Complies
0.6712	49.27	---	L2	GND	10.4	60.00	10.73	Complies

Table 18: Carrier Current Conducted Emissions, Line 2

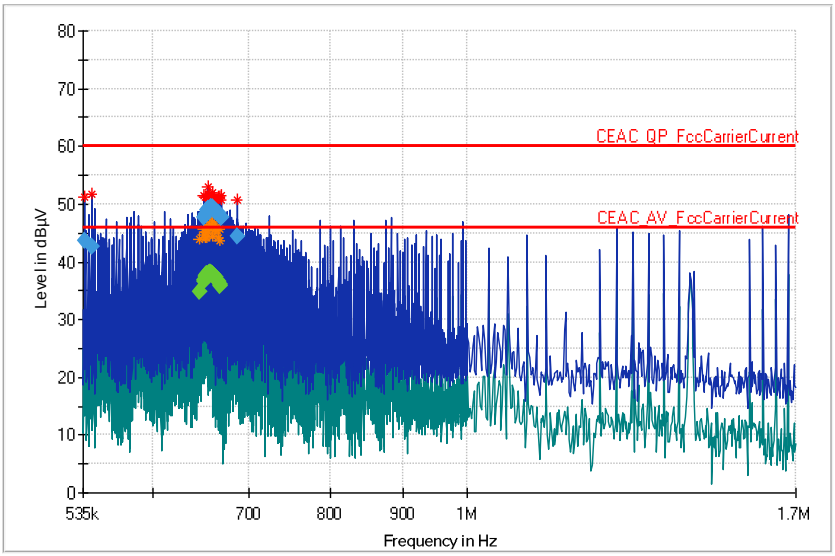

Figure 68: Carrier Current Conducted Emissions, Line 1

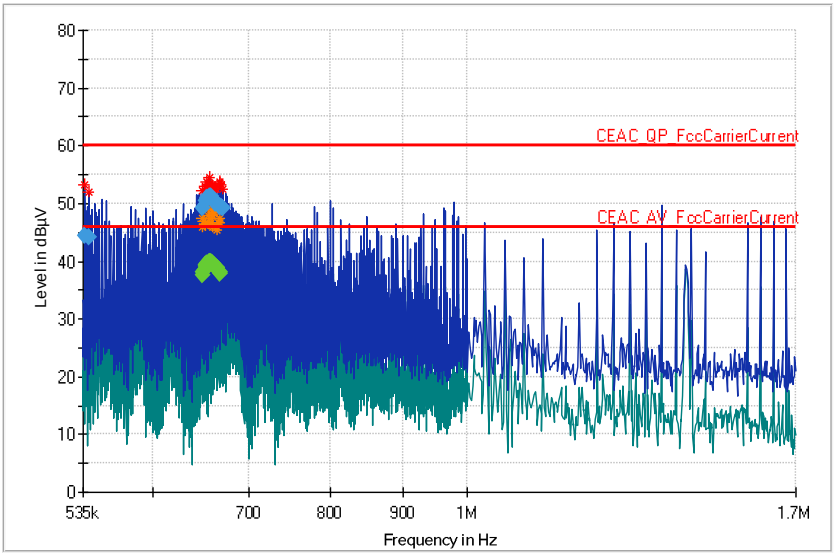

Figure 69: Carrier Current Conducted Emissions, Line 2

3.11.2 Radiated Emissions

Frequency MHz	QuasiPeak (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
30.4433	25	192	V	113	28.1	40	15	Complies
582.6849	36.75	143	H	71	27.1	46	9.25	Complies
586.5236	37.57	140	H	67	27.1	46	8.43	Complies
590.3743	36.07	100	V	0	27.1	46	9.93	Complies
594.2135	36.67	143	H	76	27.3	46	9.33	Complies
598.0613	36.32	130	H	55	27.3	46	9.68	Complies

Figure 70: Carrier Current Radiated Emissions

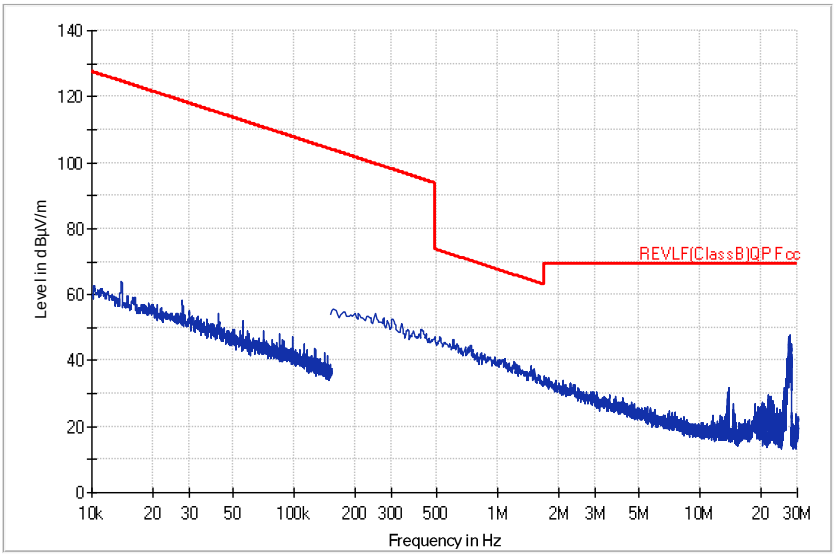

Figure 71: Carrier Current Radiated Emissions, 10 kHz - 30 MHz, Vertical

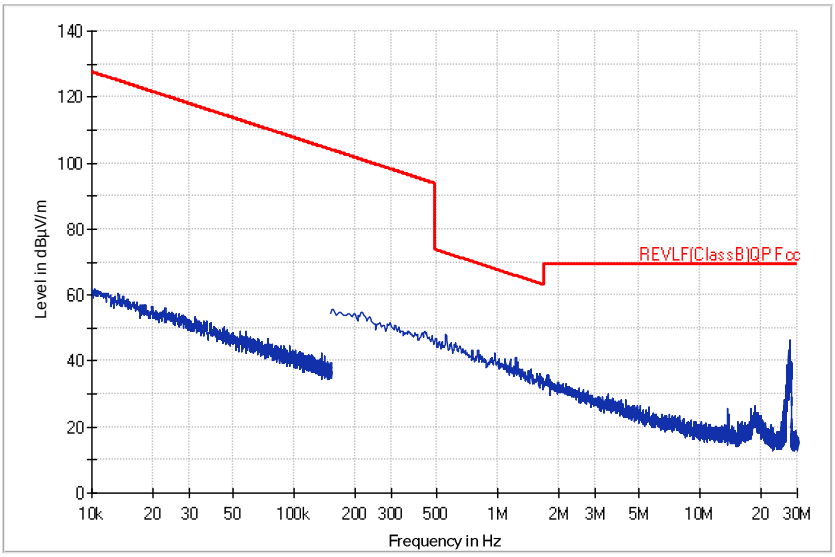

Figure 72: Carrier Current Radiated Emissions, 10 kHz - 30 MHz, Horizontal

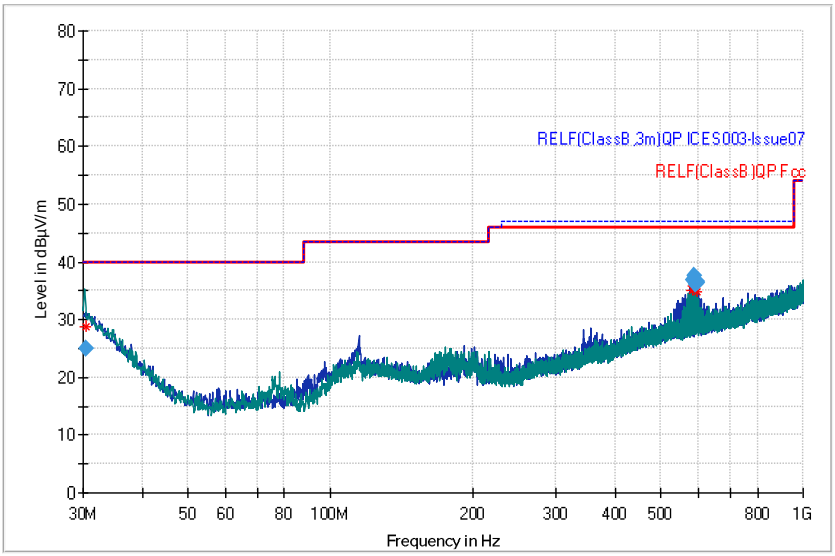

Figure 73: Carrier Current Radiated Emissions, 30 MHz - 1 GHz

3.12 Intentional Radiator Emissions and Radio Collocation

Date Performed: June 16, 2023 - June 30, 2023

Test Standard: FCC 47 CFR Part 15.33 (a)(1), (5)
FCC 47 CFR Part 15.205 (a), (b)
FCC 47 CFR Part 15.209 (a)
FCC 47 CFR Part 15.247 (b)
RSS-247 Issue 2
RSS-Gen Issue 5

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.33 (a)(1), (5): Frequency range of radiated measurements

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

FCC 47 CFR Part 15.205 (a), (b): Restricted bands of operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits show in § 15.209

FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements

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

Frequency, *f* (MHz)	**Maximum Field strength Quasi-peak (dBµV/m at 3 m)**
0.009 – 0.490	20*log(2400/F(kHz)) + 40 dB
0.490 – 1.705	20*log(24000/F(kHz)) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector	

FCC 47 CFR Part 15.247 (d): Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Calculation of Duty Cycle Correction Factor for Frequency Hopping Emissions:

Per KDB 558074 D01 15.247 Meas Guidance v05r02: the use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (e.g. within a Government Restricted Band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (ie, not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period. The test report provided with the certification application must provide clear and complete documentation of the justification for use of the procedure as well as the calculations and assumptions that are used. Subclause 7.5 of ANSI C63.10 provides additional measurement guidance applicable to determination of the DCCF.

Per ANSI C63.10:2013: Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The DCCF is calculated as:

$$\delta(dB) = 20\log(\Delta)$$

Where

δ is the duty cycle correction factor in dB
Δ is the duty cycle (dimensionless)

Data Rate	Dwell Time (ms)	Averaging Time (ms)	Duty Cycle	DCCF (dB)
Low	8.15	100	0.0815	-21.78
High	2.26	100	0.0226	-32.92
3rd Party	46.06	100	0.4606	-6.73

Table 19: Duty Cycle Correction Factors

Test Setup:

The EUT was tested in a 3 m SAC and was positioned on the front of the turntable. The transmitter was set for continuous transmission. The radiated output of the device was measured for all emissions up to the 10th harmonic of the 900 MHz transmitter under test.

3.12.1 Radiated Emissions Corrected Data:

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1804.5000	85.91	---	100.0	V	47	-2	102.46	16.55	Complies
1804.5000	---	62.60	100.0	V	47	-23.78	102.46	39.86	Complies
1830.0000	80.93	---	200.0	V	61	-1.5	102.46	21.53	Complies
1830.0000	---	58.44	200.0	V	61	-23.28	102.46	44.02	Complies
1855.0000	---	52.52	150.0	V	0	-22.88	102.46	49.94	Complies
1855.0000	75.47	---	100.0	V	75	-1.1	102.46	26.99	Complies
2706.5000	71.45	---	100.0	H	355	1	74	2.55	Complies
2706.5000	---	49.22	100.0	H	355	-20.78	54	4.78	Complies
2745.0000	66.06	---	350.0	H	300	1.1	74	7.94	Complies
2745.0000	---	43.56	350.0	H	300	-20.68	54	10.44	Complies
2783.0000	---	35.10	200.0	H	297	-20.58	54	18.9	Complies
3609.0000	---	31.99	250.0	V	102	-20.58	54	22.01	Complies
3711.0000	---	32.40	200.0	H	297	-17.98	54	21.6	Complies
4511.0000	---	30.07	150.0	H	22	-15.58	54	23.93	Complies
5283.0000	---	28.01	350.0	V	203	-14.48	102.46	74.45	Complies
6493.2	---	35.47	150	H	37	-28.38	102.46	66.99	Complies
7420.8	57.26	---	100	H	137	-4.7	74	16.74	Complies
7420.8	---	35.71	100	H	137	-26.48	54	18.29	Complies
8120.4	65.66	---	200	V	0	-3.3	74	8.34	Complies
8120.4	---	42.87	200	V	0	-25.08	54	11.13	Complies
8235.6	64.79	---	150	H	0	-3	74	9.21	Complies
8235.6	---	43.48	150	H	0	-24.78	54	10.52	Complies
8349.6	---	45.83	150	H	37	-24.58	54	8.17	Complies
8349.6	67.86	---	150	H	37	-2.8	74	6.14	Complies
10204.8	60.81	---	150	H	349	3.3	102.46	41.65	Complies
10204.8	---	32.82	150	H	349	-18.48	102.46	69.64	Complies
10827.6	57.28	---	200	H	262	4.5	74	16.72	Complies
10827.6	---	29.36	200	H	262	-17.28	54	24.64	Complies
10980	61.1	---	150	H	0	4.5	74	12.9	Complies
10981.2	---	30.76	100	H	0	-17.28	54	23.24	Complies
11132.4	---	30.55	150	H	53	-16.88	54	23.45	Complies
11132.4	62.34	---	150	H	53	4.9	74	11.66	Complies
11896.8	---	25.47	150	H	0	-14.18	54	28.53	Complies
11896.8	59.17	---	150	H	0	7.6	74	14.83	Complies
12060	---	22.99	250	V	359	-13.68	54	31.01	Complies
12988.8	---	25.09	150	H	349	-14.18	102.46	77.37	Complies
12988.8	57.3	---	150	H	349	7.6	102.46	45.16	Complies
14842.8	---	17.63	150	H	349	-12.78	102.46	84.83	Complies
16579.2	---	12.11	300	V	50	-8.88	102.46	90.35	Complies

Table 20: Radiated Spurious and Radio Collocation Emissions - Low Data Rate Collocated with 2.4 GHz Transmitter

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1155	---	6.89	150	V	220	-39.12	102.46	95.57	Complies
1490.5	---	7.53	150	V	0	-38.52	54	46.47	Complies
1804	---	50.35	150	V	50	-34.92	102.46	52.11	Complies
1804.5	84.56	---	150	V	50	-2	102.46	17.9	Complies
1830	81.87	---	150	V	66	-1.5	102.46	20.59	Complies
1830	---	48.23	150	V	66	-34.42	102.46	54.23	Complies
1855	75.23	---	200	V	99	-1.1	102.46	27.23	Complies
1855	---	41.77	200	V	99	-34.02	102.46	60.69	Complies
2042	---	12.28	350	V	208	-31.72	102.46	90.18	Complies
2706.5	72.03	---	200	H	289	1	74	1.97	Complies
2706.5	---	38.63	200	H	289	-31.92	54	15.37	Complies
2745	---	33.91	250	H	283	-31.82	54	20.09	Complies
2745	67.6	---	250	H	283	1.1	74	6.4	Complies
2783	---	24.79	200	H	275	-31.72	54	29.21	Complies
2783	58.29	---	200	H	275	1.2	74	15.71	Complies
3609	56.05	---	100	H	290	3.5	74	17.95	Complies
3609	---	22.59	100	H	290	-29.42	54	31.41	Complies
3711	---	21.19	200	H	275	-29.12	54	32.81	Complies
3711	54.97	---	200	H	275	3.8	74	19.03	Complies
4511	---	16.24	250	H	268	-26.72	54	37.76	Complies
5348.5	---	16.22	100	V	323	-25.52	54	37.78	Complies
6493.2	---	50.13	200	H	0	-6.6	102.46	52.33	Complies
7216.8	---	54.19	150	H	134	-5	102.46	48.27	Complies
7216.8	60.23	---	150	H	134	-5	102.46	42.23	Complies
8119.2	61.15	---	250	H	78	-36.22	74	12.85	Complies
8120.4	---	23.46	150	H	0	-36.22	54	30.54	Complies
8234.4	64.09	---	250	V	0	-35.92	74	9.91	Complies
8235.6	---	27.45	150	V	72	-35.92	54	26.55	Complies
8349.6	---	30.91	200	V	8	-35.72	54	23.09	Complies
8349.6	67.12	---	200	V	8	-35.72	74	6.88	Complies
9022.8	58.08	---	100	V	0	-33.82	74	15.92	Complies
9276	57.54	---	200	V	8	-0.3	102.46	44.92	Complies
10204.8	---	58.13	250	H	310	3.3	102.46	44.33	Complies
10204.8	61.98	---	250	H	310	3.3	102.46	40.48	Complies
10826.4	---	21.3	100	V	302	-28.42	54	32.7	Complies
10981.2	60.28	---	150	H	0	-28.42	74	13.72	Complies
10981.2	---	25.01	150	H	0	-28.42	54	28.99	Complies
11132.4	59.19	---	250	H	45	-28.02	74	14.81	Complies
11132.4	---	22.79	100	H	351	-28.02	54	31.21	Complies
11730	---	21.54	150	H	0	-26.42	54	32.46	Complies
11895.6	---	22.11	150	H	0	-25.32	54	31.89	Complies
11895.6	58.55	---	150	H	0	-25.32	74	15.45	Complies
12987.6	---	54.68	250	H	45	7.6	102.46	47.78	Complies
12987.6	56.71	---	250	H	45	7.6	102.46	45.75	Complies
14844	---	47.96	200	H	356	9	102.46	54.5	Complies
16240.8	---	49.92	200	V	58	11.7	102.46	52.54	Complies

Table 21: Radiated Spurious and Radio Collocation Emissions - High Data Rate Collocated with 2.4 GHz Transmitter

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1038	---	38.44	200	H	0	-14.13	54	15.56	Complies
1098	---	33.18	200	V	299	-13.53	54	20.82	Complies
1235.5	---	34.29	100	H	304	-12.13	54	19.71	Complies
1334.5	---	36.22	400	V	90	-12.03	54	17.78	Complies
1335	---	33.8	300	H	142	-12.03	54	20.2	Complies
1434.5	---	33.96	200	H	174	-12.23	102.46	68.5	Complies
1805.5	80.61	---	100	V	64	-2	102.46	21.85	Complies
1805.5	---	73.29	100	V	64	-8.73	102.46	29.17	Complies
1829.5	79.07	---	100	V	82	-1.5	102.46	23.39	Complies
1829.5	---	71.82	100	V	82	-8.23	102.46	30.64	Complies
1853	---	68.58	150	V	109	-7.83	102.46	33.88	Complies
1853	76.38	---	150	V	109	-1.1	102.46	26.08	Complies
1969	---	38.73	200	V	245	-5.73	102.46	63.73	Complies
1995.5	---	39.71	400	V	77	-5.23	102.46	62.75	Complies
2007	---	38.98	100	V	0	-5.23	102.46	63.48	Complies
2708.5	54.28	---	300	H	305	1	74	19.72	Complies
2708.5	---	46.72	300	H	305	-5.73	54	7.28	Complies
2744.5	---	43.77	300	H	35	-5.63	54	10.23	Complies
2780	---	44.48	250	V	0	-5.53	54	9.52	Complies
3611.5	---	43.98	200	H	305	-3.23	54	10.02	Complies
3659.5	---	41.7	150	H	269	-3.03	54	12.3	Complies
3707	---	40.5	200	H	306	-2.93	54	13.5	Complies
4481	---	42.15	250	H	70	-0.63	54	11.85	Complies
4696	---	41.48	350	V	142	0.17	54	12.52	Complies
4758.5	---	41.94	400	V	278	0.37	54	12.06	Complies
5827	---	43.17	350	H	119	1.57	102.46	59.29	Complies
5859.5	---	43.17	350	H	286	1.57	102.46	59.29	Complies
5991	---	42.77	100	H	165	1.67	102.46	59.69	Complies
6274.8	---	28.6	250	V	76	-13.83	102.46	73.86	Complies
6320.4	---	29.24	150	H	144	-13.73	102.46	73.22	Complies
6366	---	27.81	300	V	37	-13.63	102.46	74.65	Complies
7471.2	---	28.52	250	H	2	-11.33	54	25.48	Complies
7664.4	---	28.76	150	H	308	-10.93	54	25.24	Complies
7807.2	---	28.37	200	H	16	-10.63	102.46	74.09	Complies
8126.4	---	41.47	100	H	307	-10.03	54	12.53	Complies
8234.4	---	39.38	200	H	291	-9.73	54	14.62	Complies
8341.2	---	31.03	200	V	280	-9.53	54	22.97	Complies
9028.8	---	41.35	150	H	0	-7.63	54	12.65	Complies
9150	---	36	200	V	0	-7.33	54	18	Complies
9932.4	---	33.9	100	V	1	-4.53	102.46	68.56	Complies
10090.8	---	32.87	300	V	242	-3.93	102.46	69.59	Complies
10839.6	---	34.34	150	H	178	-2.23	54	19.66	Complies
10851.6	---	34.83	250	H	313	-2.23	54	19.17	Complies
11739.6	---	36.13	150	H	0	-0.13	54	17.87	Complies
12540	---	36.34	350	H	136	0.87	54	17.66	Complies
12610.8	---	35.87	100	H	118	0.87	54	18.13	Complies

Table 22: Radiated Spurious – 3rd Party Data Rate

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
12651.6	---	35.65	200	H	113	0.77	54	18.35	Complies
15271.2	---	37.48	150	V	141	4.17	102.46	64.98	Complies
15536.4	---	37.71	150	H	54	4.47	54	16.29	Complies
15687.6	---	36.87	100	H	16	5.57	54	17.13	Complies
16714.8	---	39.39	200	V	9	6.17	102.46	63.07	Complies
16744.8	---	39.15	150	V	274	6.17	102.46	63.31	Complies
16746	---	39.49	200	V	328	6.17	102.46	62.97	Complies

Table 23: Radiated Spurious - 3rd Party Data Rate (Continued)

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1804.5	---	83	100	V	56	27.1	102.46	19.46	Complies
1804.5	84.49	---	100	V	56	27.1	102.46	17.97	Complies
1829.5	---	77.63	150	V	25	27.1	102.46	24.83	Complies
1855	---	72.74	150	V	42	27.1	102.46	29.72	Complies
2706.5	---	48.15	150	H	56	9.22	54	5.85	Complies
2745	---	45.64	250	H	306	9.22	54	8.36	Complies
17950.8	---	35.38	400	V	2	12.72	54	18.62	Complies

Table 24: Radiated Spurious and Radio Collocation Emissions - Low Data Rate Collocated with 5.8 GHz Transmitter

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1804	---	50.7	100	V	22	-5.82	102.46	51.76	Complies
1804.5	85.01	---	100	V	22	27.1	102.46	17.45	Complies
1830	---	46.29	200	V	80	-5.82	102.46	56.17	Complies
1855	---	40.03	150	V	42	-5.82	102.46	62.43	Complies
2706.5	---	36.12	100	H	0	-1.92	54	17.88	Complies
2745	---	34.25	200	H	288	-1.92	54	19.75	Complies
17791.2	---	19.51	300	V	75	-3.92	54	34.49	Complies

Table 25: Radiated Spurious and Radio Collocation Emissions - High Data Rate Collocated with 5.8 GHz Transmitter

3.12.2 Radiated Emissions Uncorrected Plots

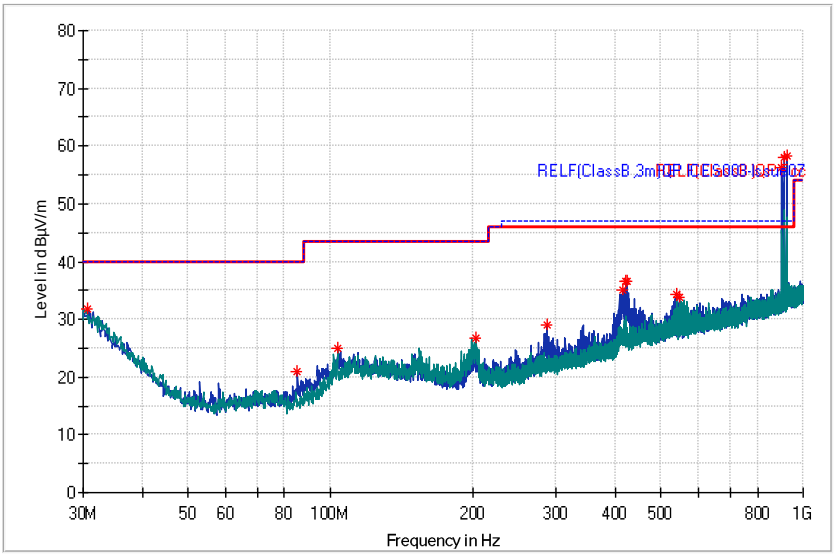

Figure 74: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 2.4 GHz Transmitter; 30 MHz – 1 GHz

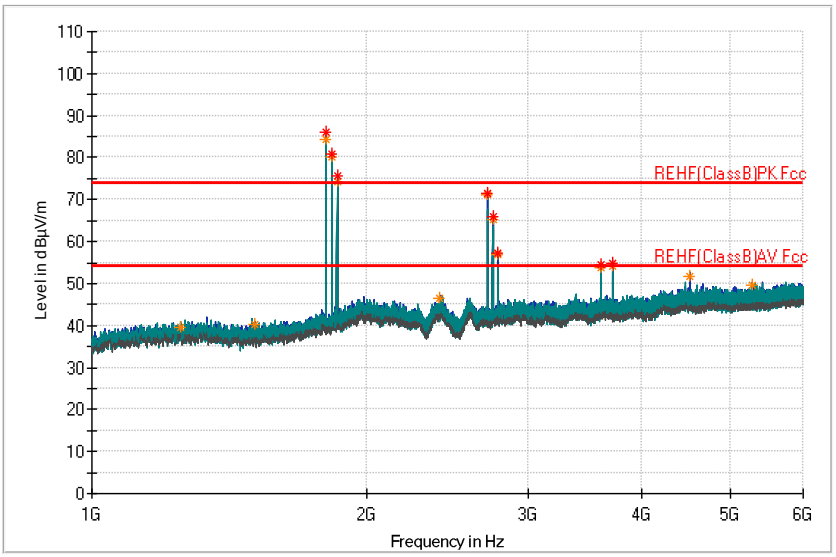

Figure 75: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 2.4 GHz Transmitter; 1 GHz – 6 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. Emissions at 900 MHz and 2.4 GHz are intentional transmitters.
3. Emissions below 900 MHz are not due to the intentional transmitter and are evaluated in Section 3.10: Unintentional Radiated Emissions.
4. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

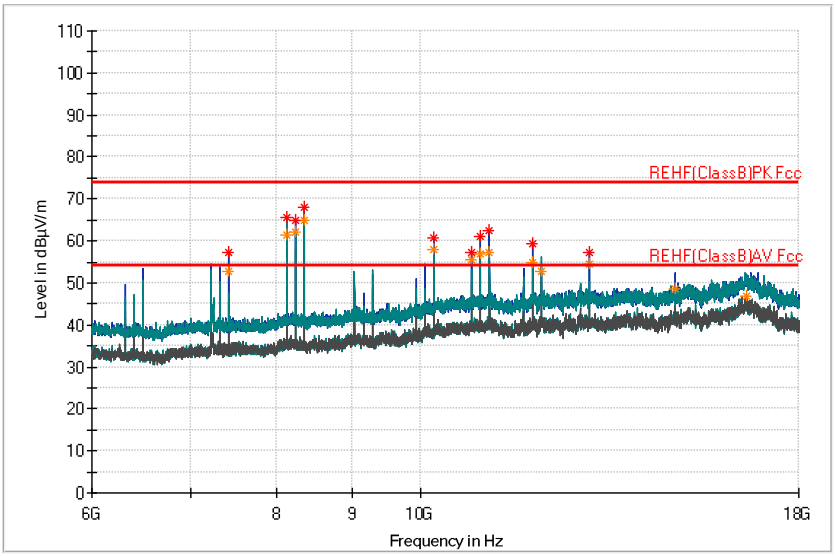

Figure 76: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 2.4 GHz Transmitter; 6 GHz – 18 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

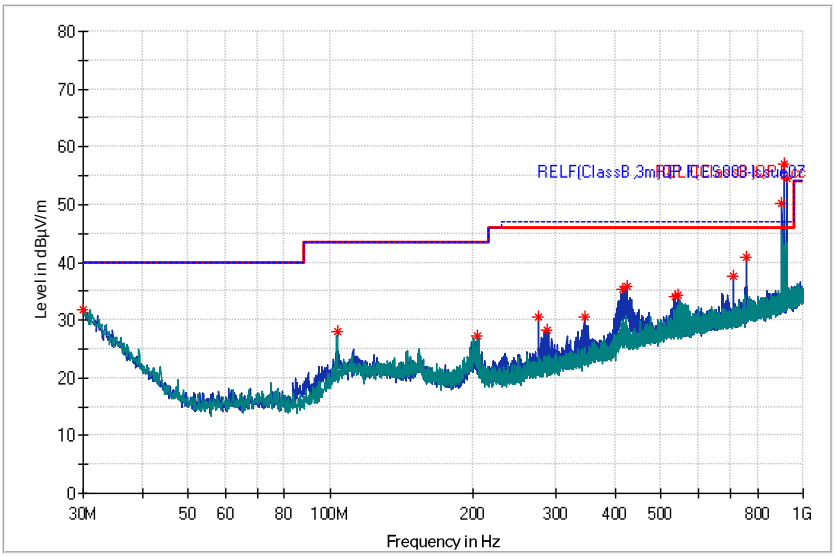

Figure 77: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 5.8 GHz Transmitter; 30 MHz – 1 GHz

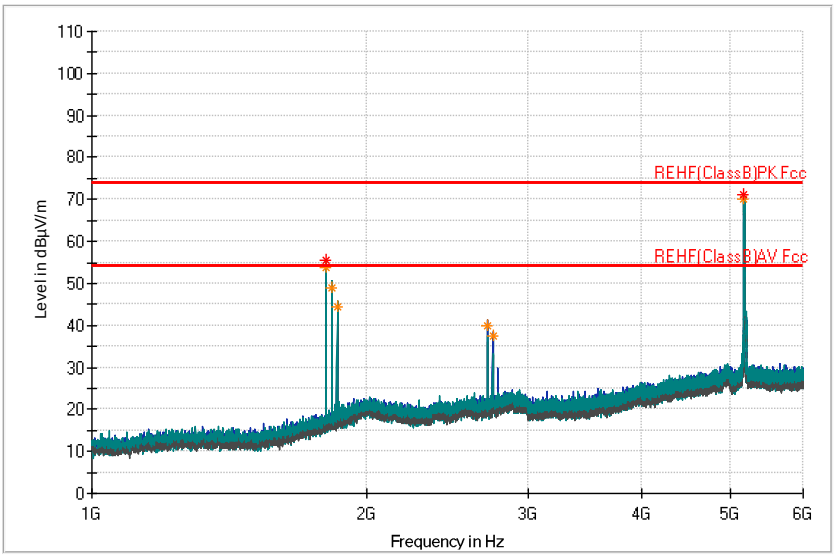

Figure 78: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 5.8 GHz Transmitter; 1 GHz – 6 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. Emissions at 5 GHz are from the intentional transmitter.
3. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

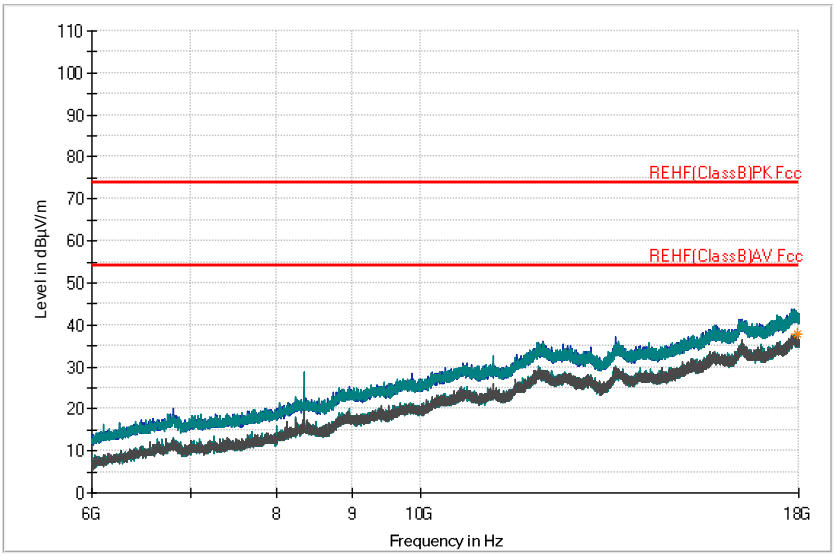

Figure 79: Intentional Radiator Spurious Emissions, Low Data Rate, Collocated with 5.8 GHz Transmitter; 6 GHz – 18 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

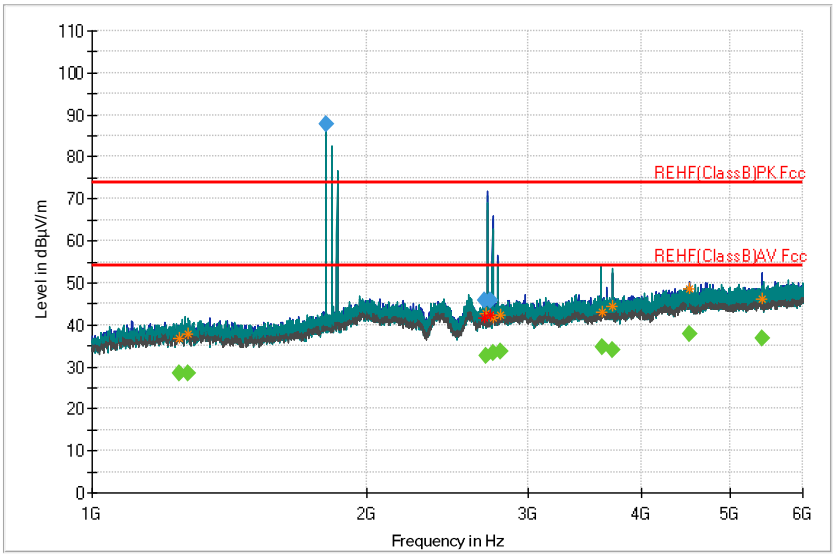

Figure 80: Intentional Radiator Spurious Emissions, High Data Rate, Collocated with 2.4 GHz Transmitter; 1 GHz – 6 GHz

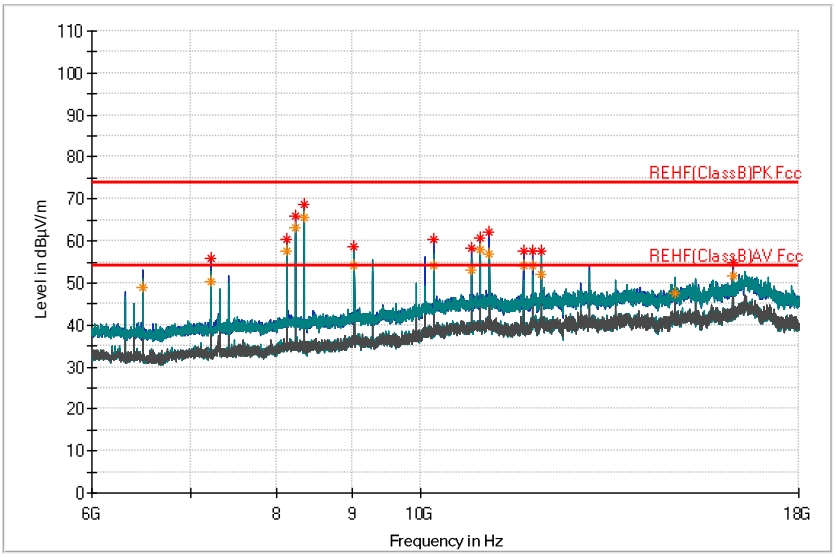

Figure 81: Intentional Radiator Spurious Emissions, High Data Rate, Collocated with 2.4 GHz Transmitter; 6 GHz – 18 GHz

Notes:

1. Software was unable to determine value of emissions, as shown with green and purple diamonds. Emissions were manually verified.
2. Red limit lines are for restricted bands only.
3. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

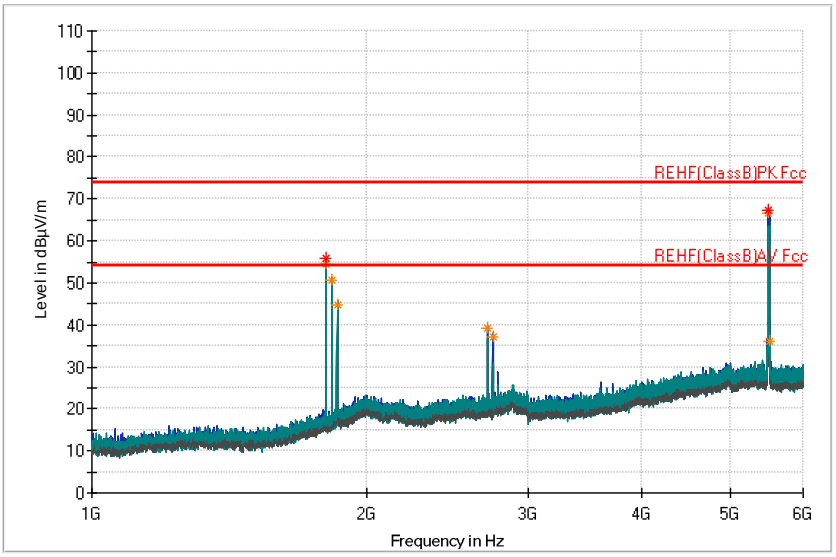

Figure 82: Intentional Radiator Spurious Emissions, High Data Rate, Collocated with 5.8 GHz Transmitter; 1 GHz – 6 GHz

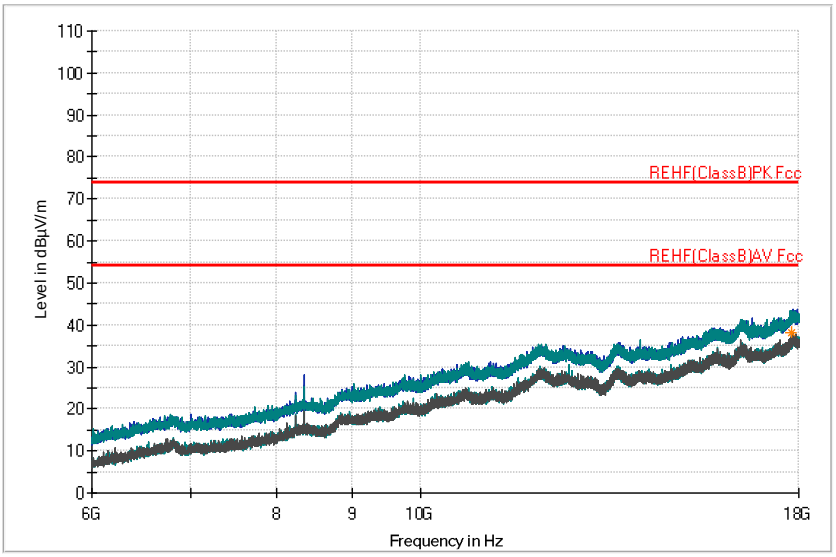

Figure 83: Intentional Radiator Spurious Emissions, High Data Rate, Collocated with 5.8 GHz Transmitter; 6 GHz – 18 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. Emissions at 5 GHz are from the intentional transmitter.
3. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

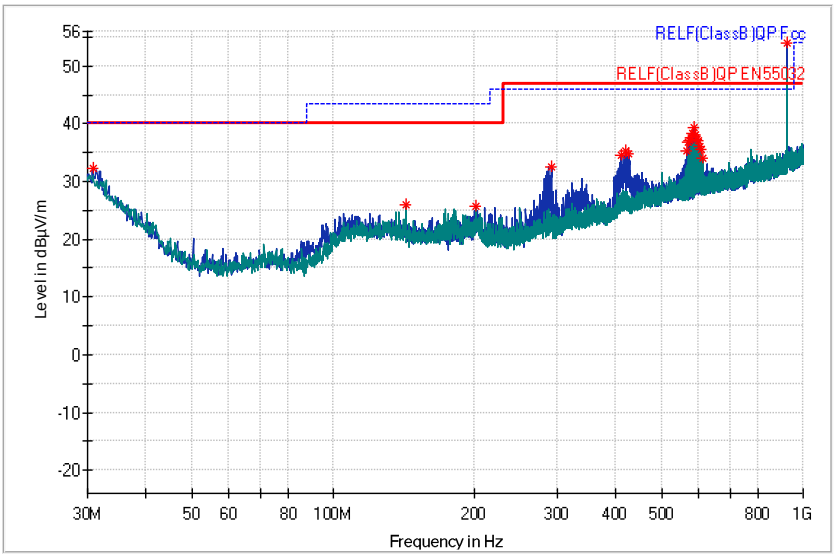

Figure 84: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, Low Channel; 30 MHz - 1 GHz

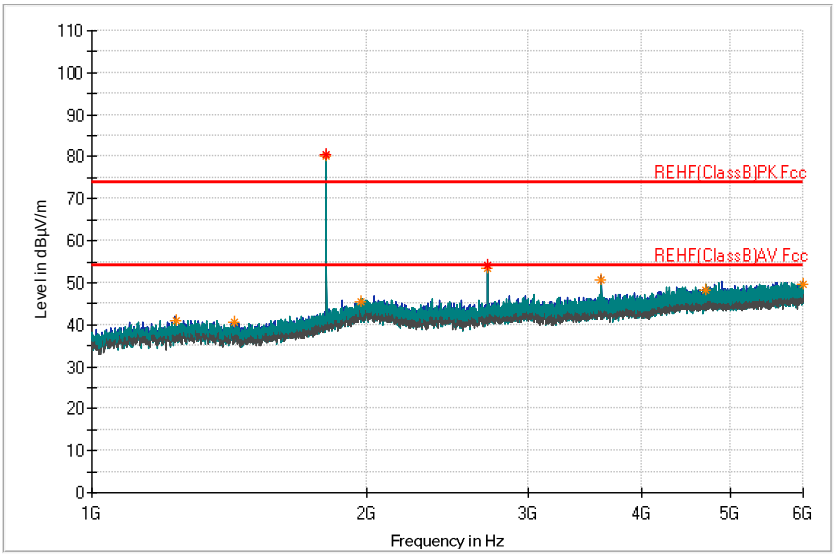

Figure 85: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, Low Channel; 1 GHz - 6 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. Emissions at 900 MHz are from the intentional transmitter.
3. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

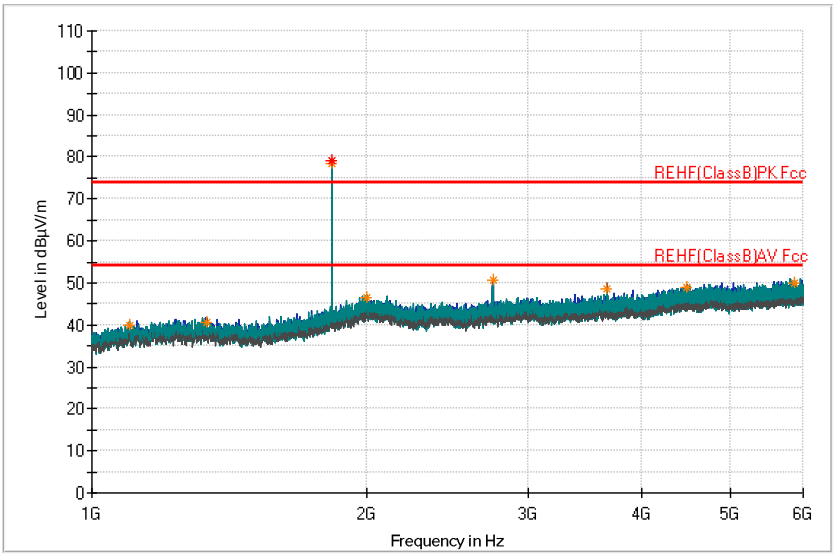

Figure 86: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, Mid Channel; 1 GHz - 6 GHz

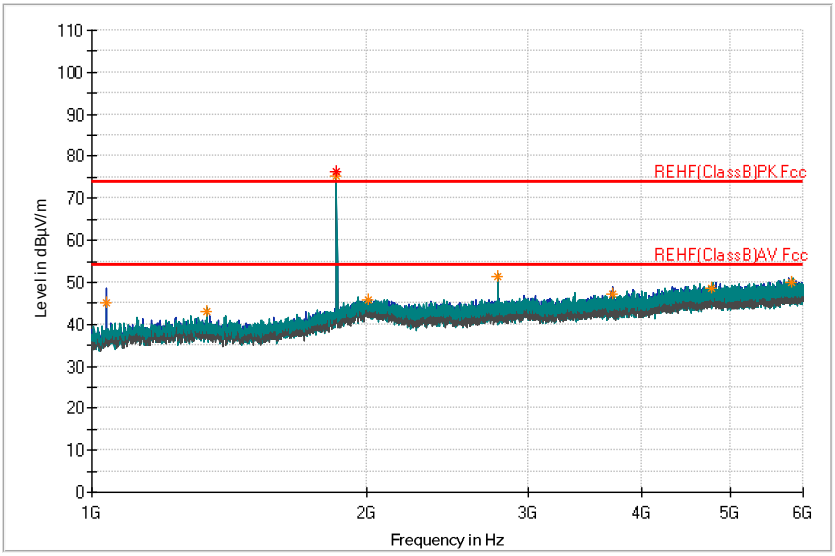

Figure 87: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, High Channel; 1 GHz - 6 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

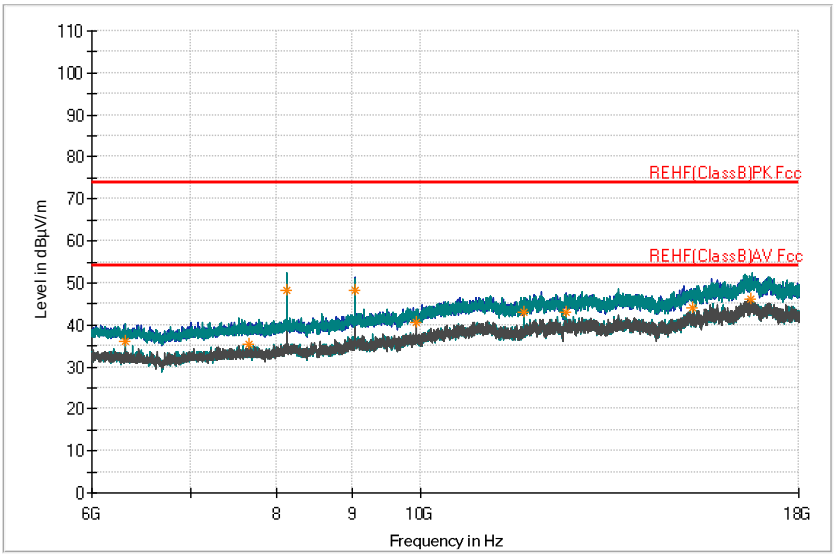

Figure 88: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, Low Channel; 6 GHz - 18 GHz

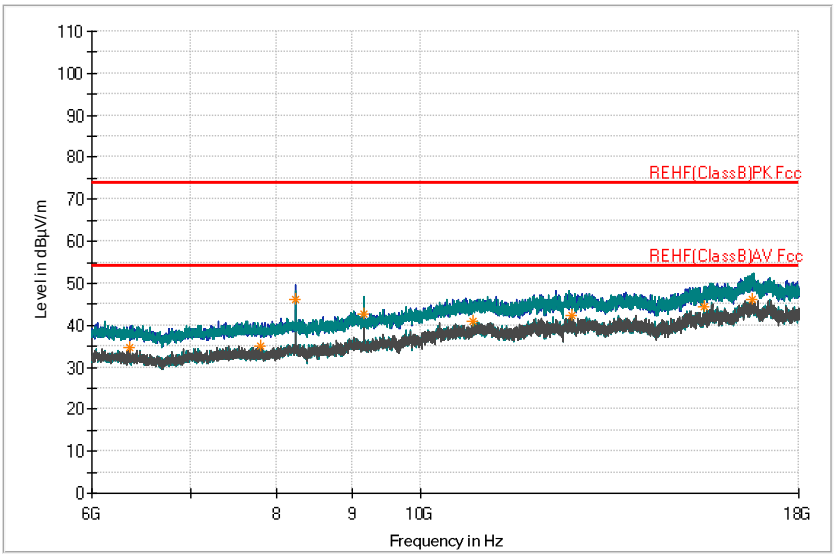

Figure 89: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, Mid Channel; 6 GHz - 18 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

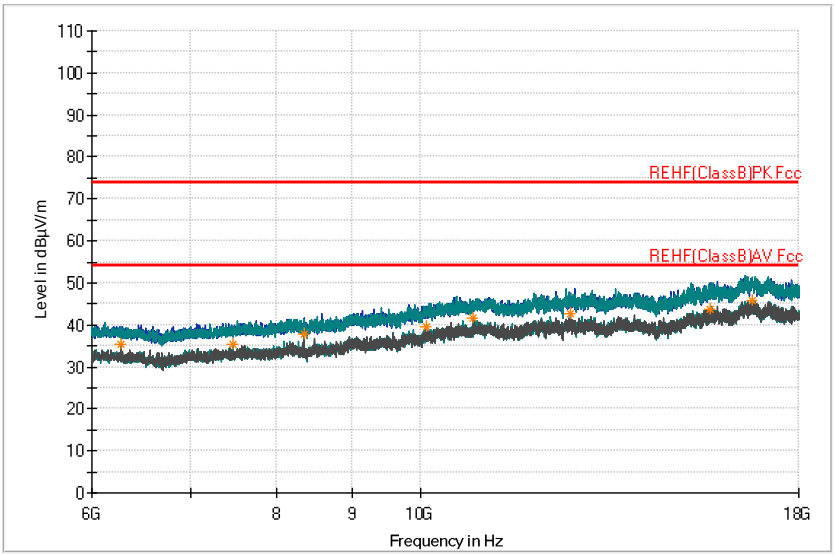

Figure 90: Intentional Radiator Spurious Emissions, 3rd Party Data Rate, High Channel; 6 GHz - 18 GHz

Notes:

1. Red limit lines are for restricted bands only.
2. See section 3.11.1 for corrected values of emissions evaluated against appropriate limits.

Appendix A: Test Setup Photos

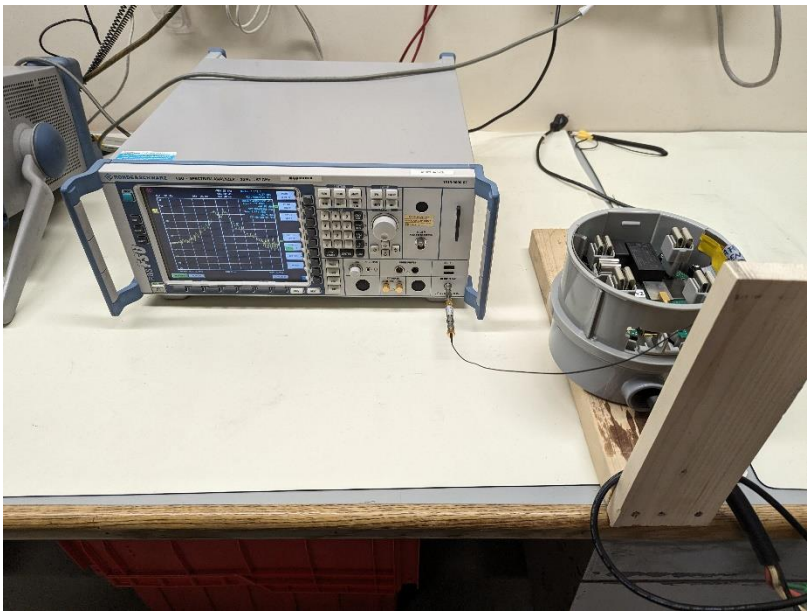

Figure 91: Conducted RF Measurement Setup

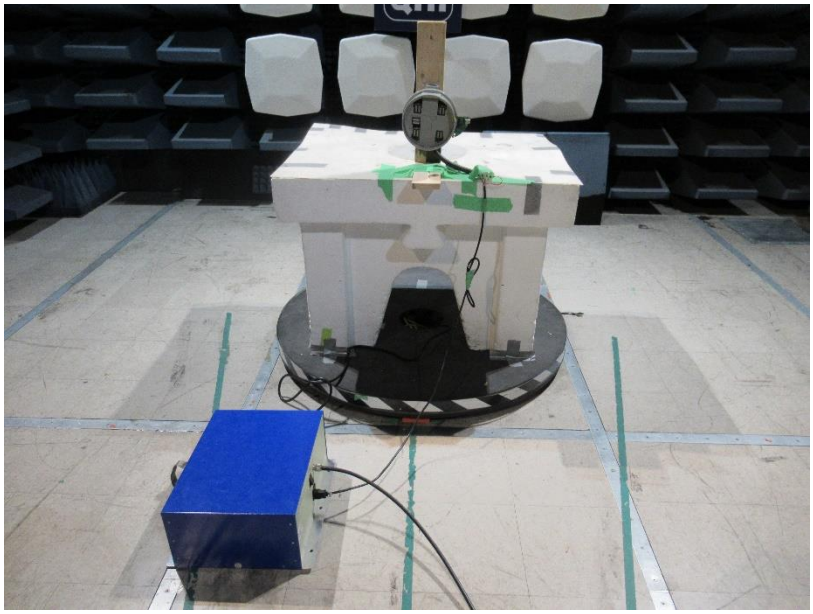

Figure 92: AC Conducted Measurement Setup

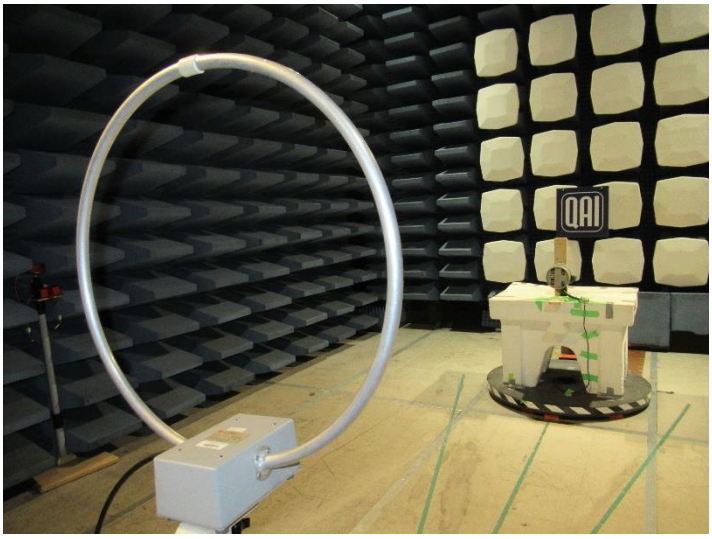

Figure 93: Radiated Measurement Setup, < 30 MHz

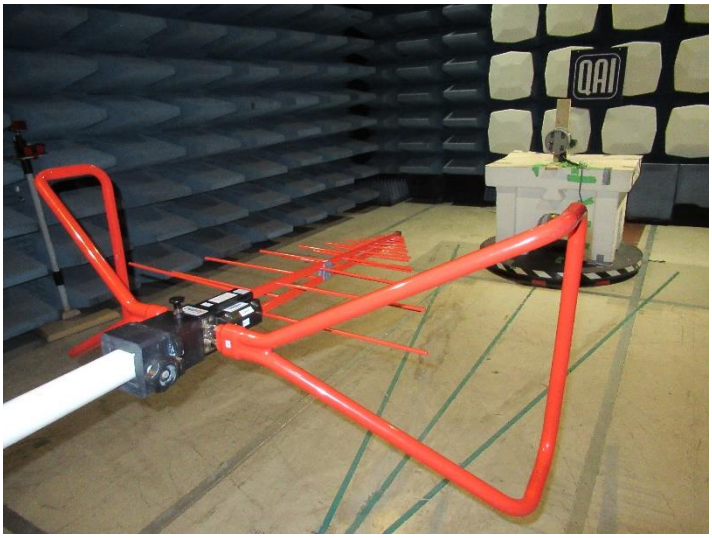

Figure 94: Radiated Measurement Setup, 30 MHz to 1 GHz

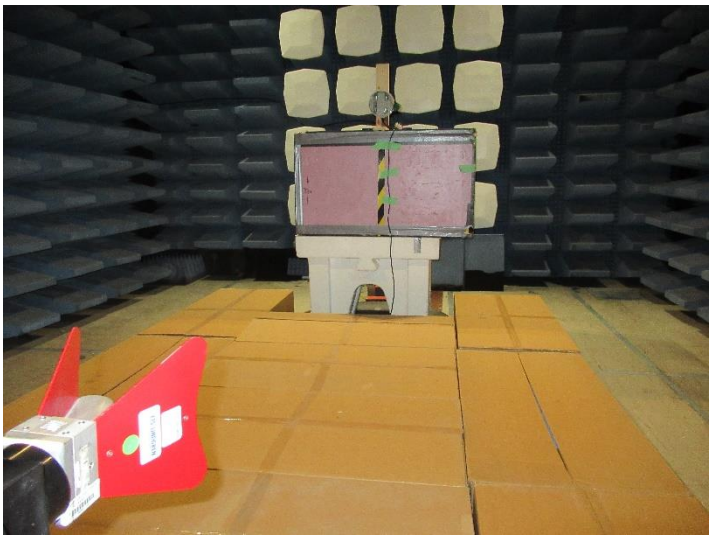

Figure 95: Radiated Measurement Setup, > 1 GHz

Appendix B: Abbreviations

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FVIN	Firmware Version Identification Number FVIN
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

END OF REPORT