



TEST REPORT



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Laboratory Accreditations (per ISO/IEC 17025:2017)



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Manufacturer: **JSF Technologies Inc.**
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Equipment Tested: **WP6 - Wireless Platform 6**
Model Number(s): WP6
FCC ID: SFIWP6
ISED ID: 5301A-WP6



REVISION HISTORY

Date	Report Number	Details	Author's Initials
September 19, 2023	E11168-2301_JSF_Technologies_WP6(FSK)_FCC-ISED_Rev0.0	Initial draft	JS
October 16, 2023	E11168-2301_JSF_Technologies_WP6(FSK)_FCC-ISED_Rev0.1	Draft	AH
November 1, 2023	E11168-2301_JSF_Technologies_WP6(FSK)_FCC-ISED_Rev0.2	Draft	AH
November 9, 2023	E11168-2301_JSF_Technologies_WP6(FSK)_FCC-ISED_Rev1.0	Final	AH
December 18, 2023	E11168-2301_JSF_Technologies_WP6(FSK)_FCC-ISED_Rev1.1	Revision	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All previous versions of this report have been superseded by the latest dated revision as listed in the above table.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.			

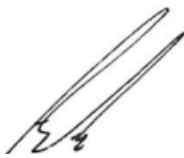
REPORT AUTHORIZATION

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 23TW08161R1.

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.

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QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

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

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1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of WP6 - Wireless Platform 6 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 23TW08161R1:

- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart B – Unintentional Radiators
- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators
- **RSS-Gen Issue 5** – General Requirements for Compliance of Radio Apparatus.
- **RSS-102 Issue 5** – Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands).
- **RSS-210 Issue 10** – License-Exempt Radio Apparatus: Category I Equipment
- **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	Test Method	Result
1	Antenna Requirement	FCC 47 CFR Part 15.203 RSS-Gen Issue 5	KDB 558074 D01	Complies
2	RF Peak Output Power	FCC 47 CFR Part 15.249 RSS-210 Issue 10	KDB 558074 D01 ANSI C63.10	Complies
3	20 dB Bandwidth	FCC 47 CFR Part 15.215	KDB 558074 D01 ANSI C63.10	Complies
4	Out-of-Band Emmissions (Band Edge)	FCC 47 CFR Part 15.249 RSS-210 Issue 10	KDB 558074 D01 ANSI C63.10	Complies
5	Unintentional Radiated Emissions	FCC 47 CFR Part 15.109 FCC 47 CFR Part 15.205 FCC 47 CFR Part 15.209 FCC 47 CFR Part 15.249 RSS-210 Issue 10	KDB 558074 D01 ANSI C63.10	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	WP6 - Wireless Platform 6
Description	The WP6 is a radio or push button activated solar powered LED assembly flasher to use primarily in crosswalk and related traffic warning applications.
Manufacturer	JSF Technologies Inc.
Model No.	WP6
Serial No.	Sample 1
Clock frequencies tuned upon within the EUT:	32 kHz, 32MHz
Highest frequency generated within the EUT:	928 MHz



Equipment Under Test (EUT) – RF Information

RF device type	Digital Transmission System (DTS)
Model No. (HVIN)	WP6
Operating frequency	902MHz to 927.25 MHz
Number of available channels/Transmitter	16 Channels, 50 kHz bandwidth (FSK)
Output Power/Transmitter	94 dBuV/m at 3m
Modulation type	FSK
Test Channels (L, M, H)	FSK: 902.5 MHz, 914.5 MHz, 927 MHz
Data Rate	FSK: 4800 bps
Adaptive	No
Geo-location-capable	No
Number of antennas	2
Antenna type 1 & gain	1/4 Wave, Chrome, Mobile Ant, 0dBi, LM Hole Mount.
Antenna type 2 & gain	Larson Q cone, 3.5"- Hinged-whip antenna, 2.5dBi

Notes: None.

Equipment Under Test (EUT) – General Information

Tested as	Table-top
Dimensions	WP6 Module case: 22 x 9.6 x 4 cm, Solar Enclosure: 78.4 x 33.7 x 11.5 cm
Declared operating temperature range:	-40C to +60C
Input power	20V Solar Input, 12-15V SLA Battery Input, 4A Battery load output maximum.
Grounded	No
Device use	Fixed Location – Physically secured and not easily moved.

Notes: None.

Test Modes

Test	Transmitter State	Power
1	On, Continuously Transmitting	12V, battery supplied
2	Off, Receive Only	12V, battery supplied

Auxiliary Manufacturer Supplied Equipment

Equipment	Manufacturer	Product Description	Model No.
Aux 1	Interstate Batteries	12V Battery	HSL1125

2.2 Environmental Conditions

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

Parameter	Conditions
Location	QAI Burnaby – Indoors
Temperature	25 °C
Relative Humidity	53% 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	±1°C
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:

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable loss}$$

Or

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable Loss} - \text{Amp gain (if pre-amplifier was used)}$$

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

$$\text{Corrected Quasi-Peak (dBμV/m)} = \text{Raw Quasi-Peak Reading} + \text{Antenna factor} + \text{Cable loss}$$

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:

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable loss}$$

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

$$\text{Corr. Quasi-Peak/Average Reading (dBμV)} = \text{Raw Quasi-Peak/Average Reading} + \text{Antenna factor} + \text{Cable loss}$$

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

$$\text{Margin (dB)} = \text{Limit} - \text{Quasi-Peak or Average reading}$$



3 DATA & TEST RESULTS

3.1 Antenna Requirements

Date Performed:	August 24, 2023
Test Standard:	FCC CFR 47 Part 15.203 IC RSS-Gen Issue 7 Section 7.1.2
Test Method:	ANSI C63.10:2013
Modifications:	None
Final Result:	Complies

Applicable Regulations:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in Section 1.1.

“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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.” ...
“the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in the Part are not exceeded.”

Data:

Ant.	Manufacturer	Part Number	Type	Connection	Max Gain (dBi)
1	Linx	ANT-916-CW-HWR-ccc	Mobile	SMA	0
2	Larsen	Q800	Hinged Whip	SMA	2.5

Note: Antenna gain provided by manufacturer

3.2 RF Output Power (Radiated)

Date Performed:	September 7, 2023
Test Standard:	FCC CFR 47 Part 15.249 IC RSS-210 Issue 10
Test Method:	FCC KDB 558074 D01 DTS Measurement Guidance V04 & ANSI C63.10:2013 Span = 5 MHz, RBW = 1 MHz, VBW = 2 MHz Trace stabilization time: 3.5 minutes
Modifications:	None.
Final Result:	Complies

Applicable Regulation:

FCC CFR 47 Part 15.249 (a):

Except as provide in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within the s frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (mV/m)	Field strength of harmonics (µV/m)
902 – 928 MHz	50	500
2400 – 2483.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

FCC CFR 47 Part 15.249 (c):

Field strength limits are specified at a distance of 3 meters.

RSS-210 Issue 10 Annex B.10:

Devices shall comply with the following requirements:

- The field strength of fundamental and harmonic emissions measured at 3m shall not exceed the limits in the following table.

Fundamental Frequency	Field strength of fundamental (mV/m)	Field strength of harmonics (mV/m)
902 – 928 MHz	50	0.5
2400 – 2483.5 MHz	50	0.5
5725 – 5875 MHz	50	0.5
24.0 – 24.25 GHz	250	2.5

The field strength shall be measured using an average detector, except for the fundamental emission in the frequency band 902 – 928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

- Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.



Test Setup:

The EUT was tested inside the SAC via radiated measurements per FCC KDB 558074 D01 & ANSI C63.10:2013 DTS Measurement Guidance V04.

Measurement Data:

Ant.	Freq. (MHz)	Raw Peak (dBμV/m)	Height (cm)	Pol	Azim. (°)	Corr. Factor (dB)	Corrected Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
1	902	58.66	140	V	355	29.9	88.56	94	5.44	Complies
	902	60.77	169	H	20	29.9	90.67	94	3.33	Complies
	915	57.79	164	V	19	29.9	87.69	94	6.31	Complies
	915	58.95	164	H	19	29.9	88.85	94	5.15	Complies
	928	55.66	113	V	340	29.9	85.56	94	8.44	Complies
	928	56.58	170	H	30	29.9	86.48	94	7.52	Complies
2	902	63.64	104	V	33	29.9	93.54	94	0.46	Complies
	902	50.84	108	H	216	29.9	80.74	94	13.26	Complies
	915	62.04	100	V	310	29.9	91.94	94	2.06	Complies
	915	52.73	172	H	18	29.9	82.63	94	11.37	Complies
	928	60.02	100	V	300	29.9	89.92	94	4.08	Complies
	928	51.21	162	H	24	29.9	81.11	94	12.89	Complies

Table 5: EIRP – Measured at 3m



3.3 20 dB Bandwidth

Date Performed: September 8, 2023

Test Standard: FCC 47 CFR Part 15.215

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:

FCC CFR 47 Part 15.215 (c):

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in 15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

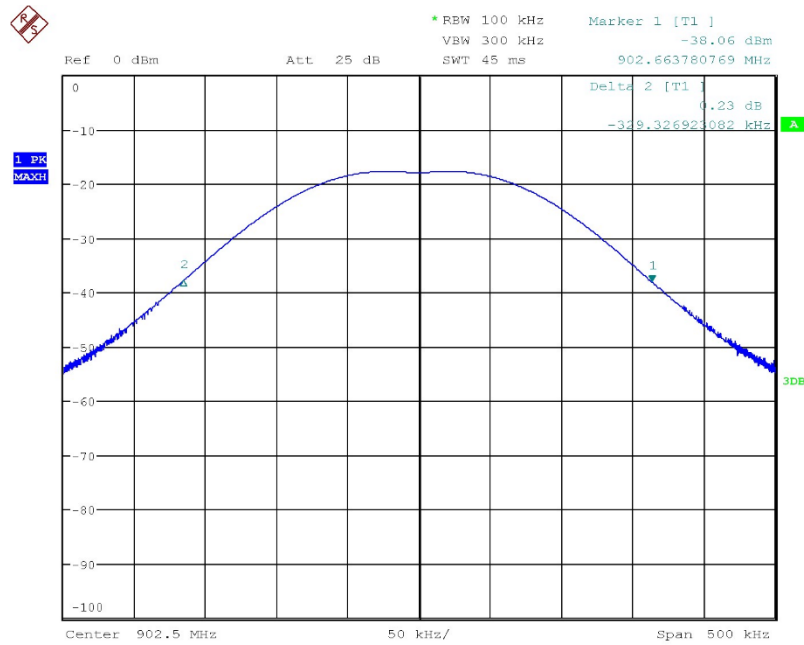
Test Setup:

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

Measurement Data and Plots:

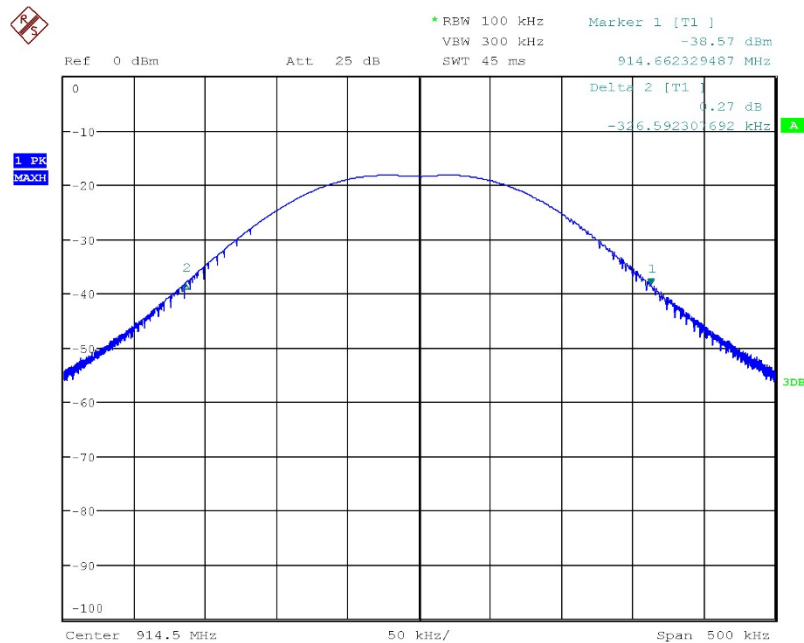
Channels	Modulation scheme	Frequency (MHz)	20dB Bandwidth (kHz)	Result
Low	FSK	902.5	329.32	Complies
Middle	FSK	914.5	326.59	Complies
High	FSK	927.0	328.11	Complies

Table 6: 20 dB Bandwidth Results



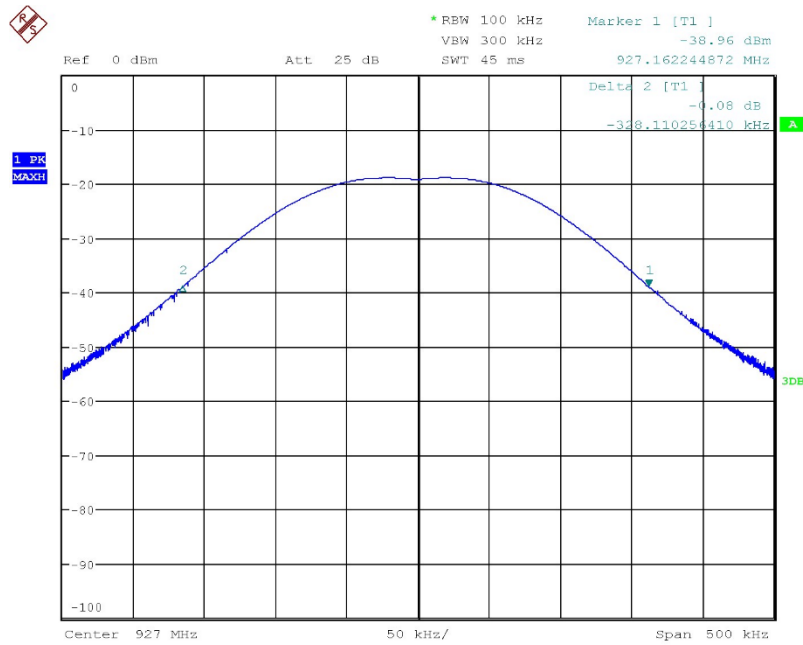
Date: 8.SEP.2023 14:21:29

Figure 2: 20 dB Bandwidth – FSK, Low channel, 902.5 MHz



Date: 8.SEP.2023 14:23:18

Figure 3: 20 dB Bandwidth – FSK, Mid channel, 914.5 MHz



Date: 8.SEP.2023 14:26:43

Figure 4: 20 dB Bandwidth – FSK, High channel, 927 MHz

3.4 Out-Of-Band Emissions (Band Edge)

Date Performed:	September 8, 2023
Test Standard:	FCC CFR 47 Part 15.249 (d) RSS-210 Issue 10
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:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits, whichever is the lesser attenuation.

Test Setup:

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

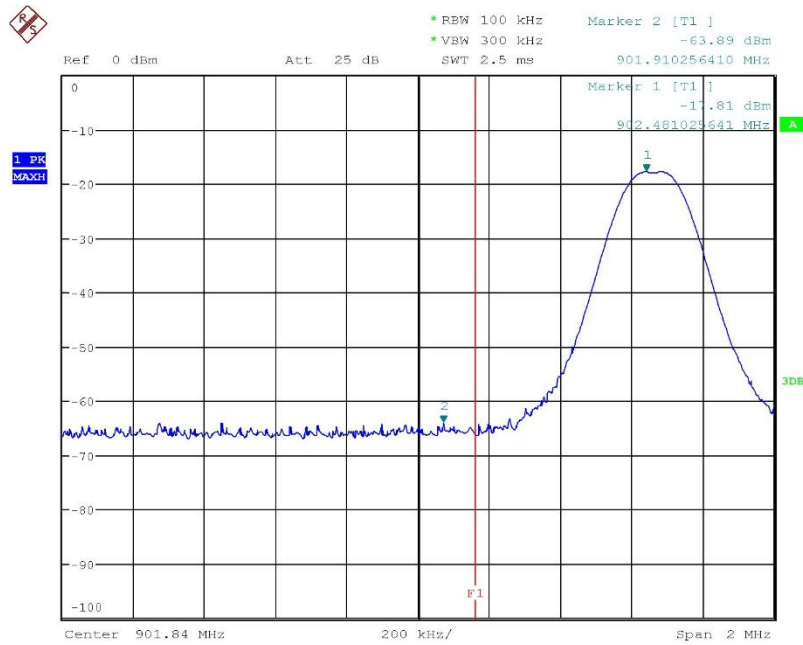
For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with 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:

Modulation Scheme	Channel	Frequency (MHz)	Out-of-Band Emission (dB)	Limit ¹ (dBm)	Margin (dB)	Result
FSK	Low	902.5	-63.89	-43.5	20.39	Complies
FSK	High	927	-64.27	-43.5	20.77	Complies

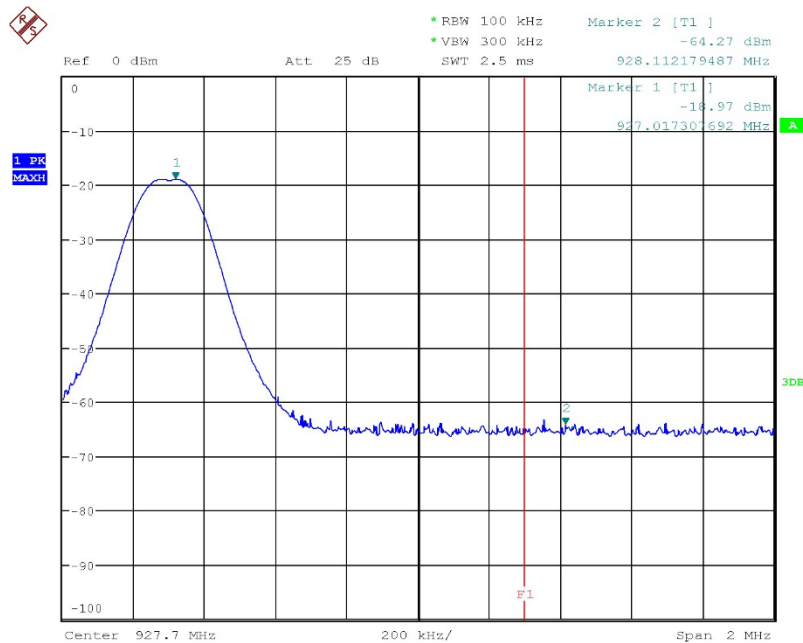
¹ Limit converted from 54 dBuV/m at 3m, radiated emissions limit, using 2.5 dBi antenna.

Table 7: Band Edge Results



Date: 11.SEP.2023 10:27:42

Figure 5: Band Edge – FSK, Low channel, 902.5 MHz



Date: 11.SEP.2023 10:35:16

Figure 6: Band Edge – FSK, High channel, 927 MHz

3.5 Unintentional Radiated Emissions

Date Performed:	August 25, 2023 - August 31, 2023
Test Standard:	FCC 47 CFR Part 15.33 (a)(1), (5) FCC 47 CFR Part 15.109 FCC 47 CFR Part 15.209 FCC 47 CFR Part 15.249 ICES-003 Issue 7 RSS-210 Issue 10
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	5 th 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, <i>f</i> (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 CFR 47 Part 15.249 (a):

Except as provide in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within the s frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (mV/m)	Field strength of harmonics (μV/m)
902 – 928 MHz	50	500
2400 – 2483.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

FCC CFR 47 Part 15.249 (c):

Field strength limits are specified at a distance of 3 meters.

FCC CFR 47 Part 15.249 (d):

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation.

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 (dB μ V/m)	Class A Peak (dB μ V/m)	Class B Average (dB μ V/m)	Class B Peak (dB μ V/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

RSS-210 Issue 10 Annex B.10:

Devices shall comply with the following requirements:

- a) The field strength of fundamental and harmonic emissions measured at 3m shall not exceed the limits in the following table.

Fundamental Frequency	Field strength of fundamental (mV/m)	Field strength of harmonics (mV/m)
902 – 928 MHz	50	0.5
2400 – 2483.5 MHz	50	0.5
5725 – 5875 MHz	50	0.5
24.0 – 24.25 GHz	250	2.5

The field strength shall be measured using an average detector, except for the fundamental emission in the frequency band 902 – 928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

- b) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Test Setup:

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

3.5.1 150kHz to 30 MHz

Antenna 1, Tested August 31, 2023:

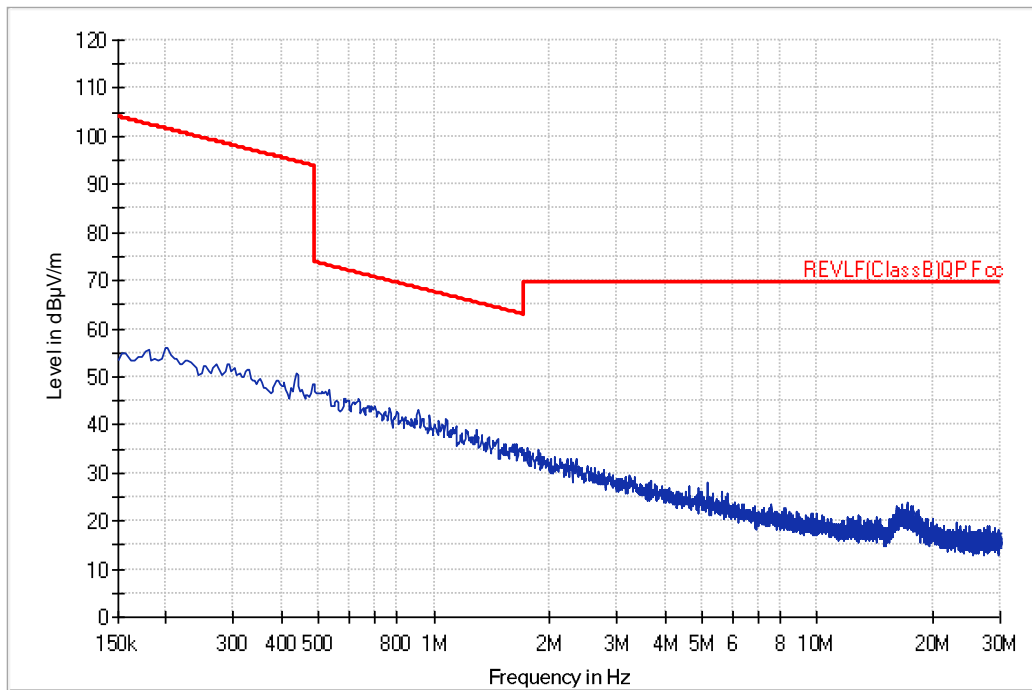


Figure 7: Radiated Emissions Measured at 3m – Antenna 1, Vertically Polarized, FSK Low channel.

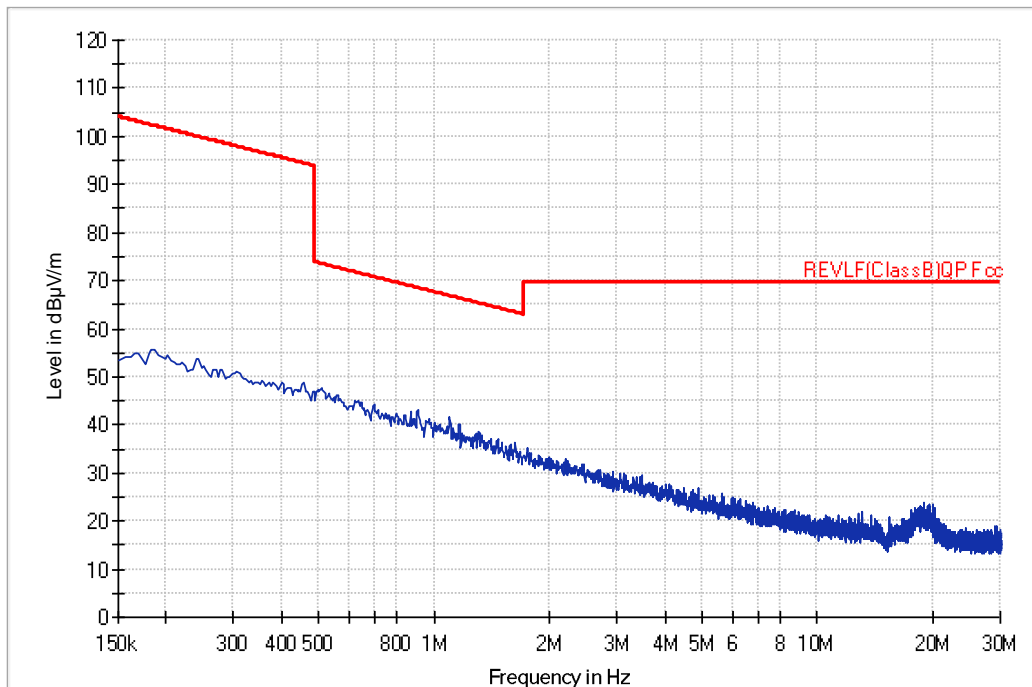


Figure 8: Radiated Emissions Measured at 3m – Antenna 1, Horizontally Polarized, FSK Low channel.

No significant emissions were seen in either vertical or horizontal polarizations.

Antenna 1, Tested August 31, 2023:

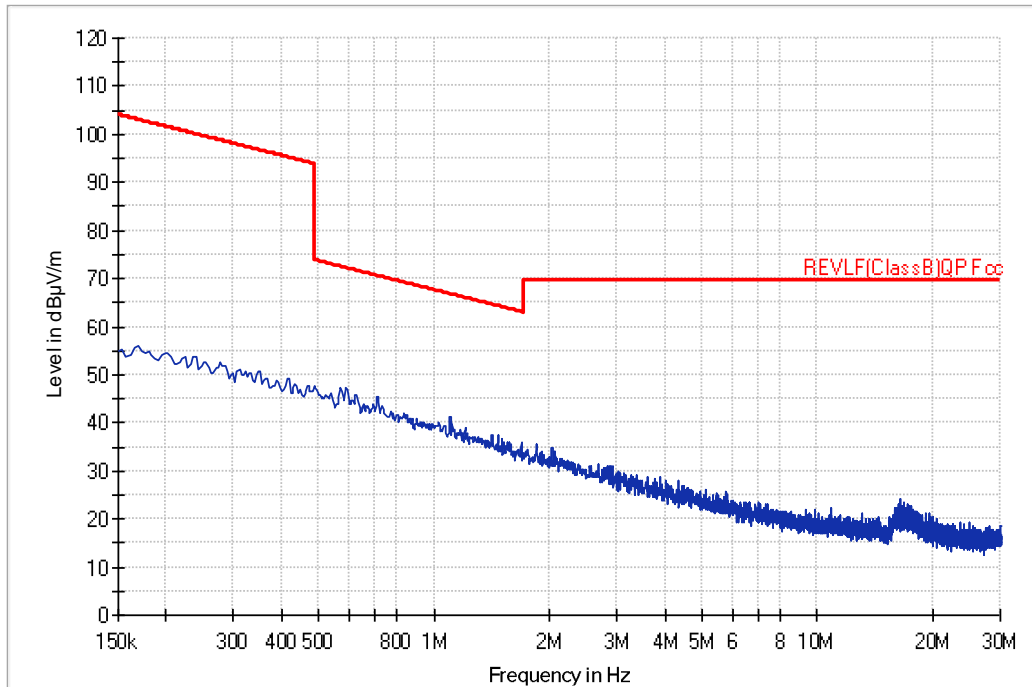


Figure 9: Radiated Emissions Measured at 3m – Antenna 1, Vertically Polarized, FSK Mid channel.

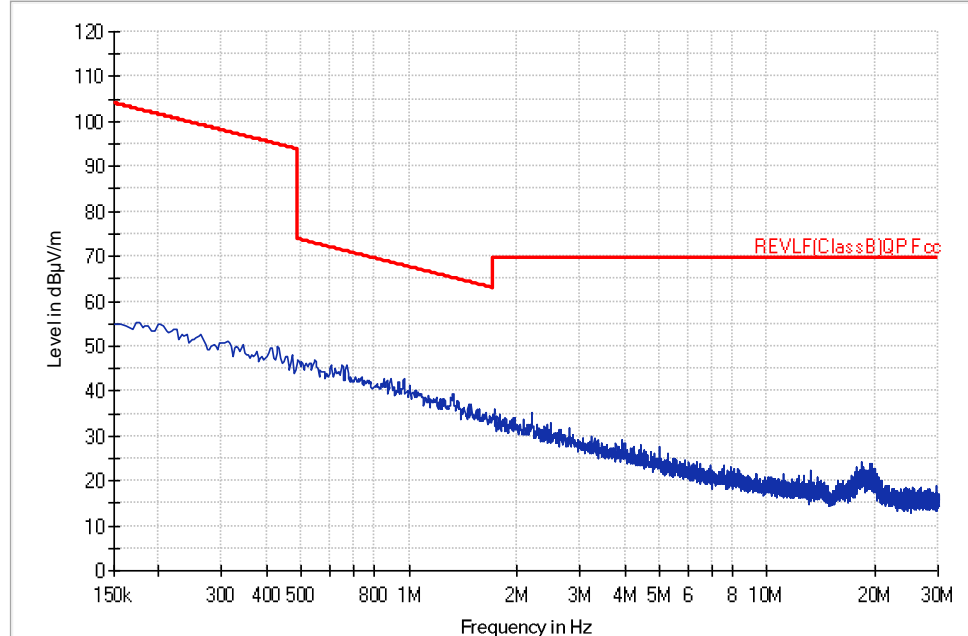


Figure 10: Radiated Emissions Measured at 3m – Antenna 1, Horizontally Polarized, FSK Mid channel.

No significant emissions were seen in either vertical or horizontal polarizations.

Antenna 1, Tested August 31, 2023:

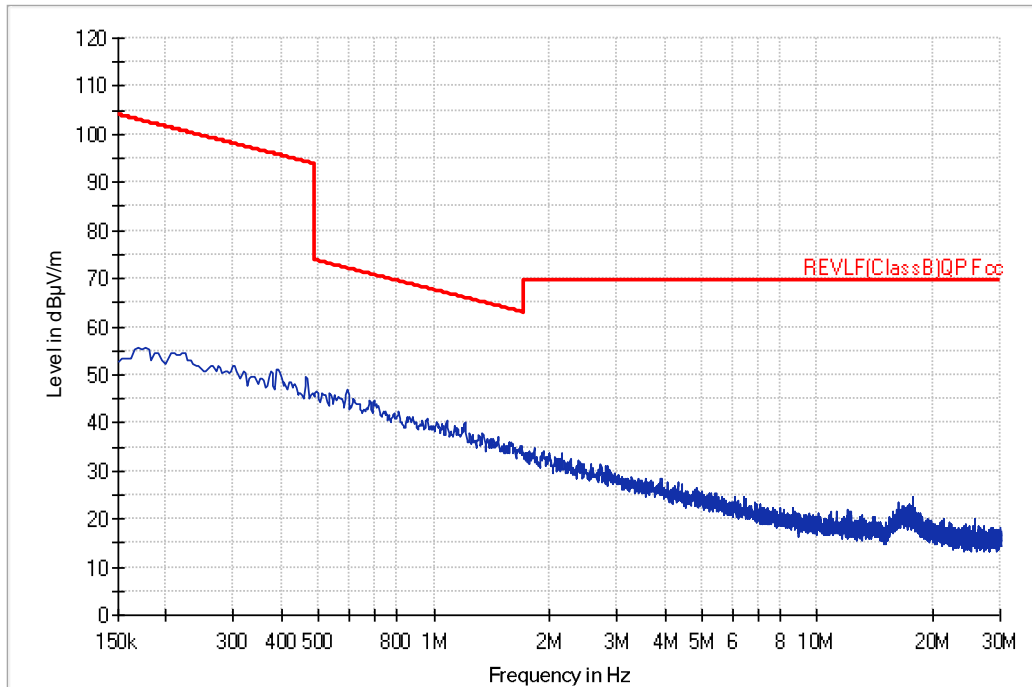


Figure 11: Radiated Emissions Measured at 3m – Antenna 1, Vertically Polarized, FSK High channel.

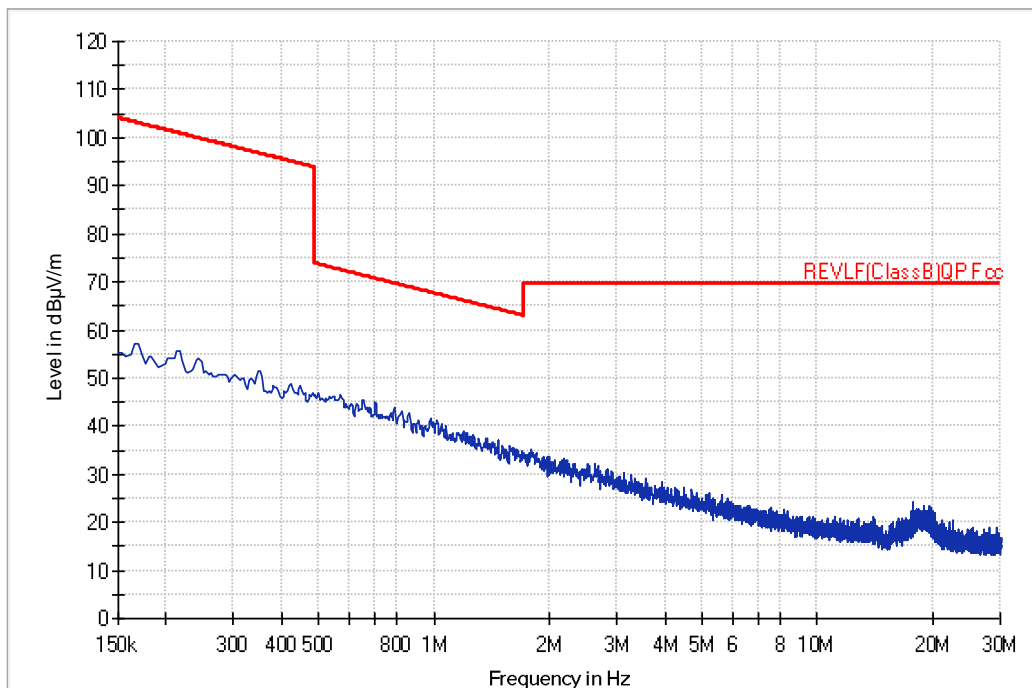


Figure 12: Radiated Emissions Measured at 3m – Antenna 1, Horizontally Polarized, FSK High channel.

No significant emissions were seen in either vertical or horizontal polarizations.

Antenna 2, Tested August 31, 2023:

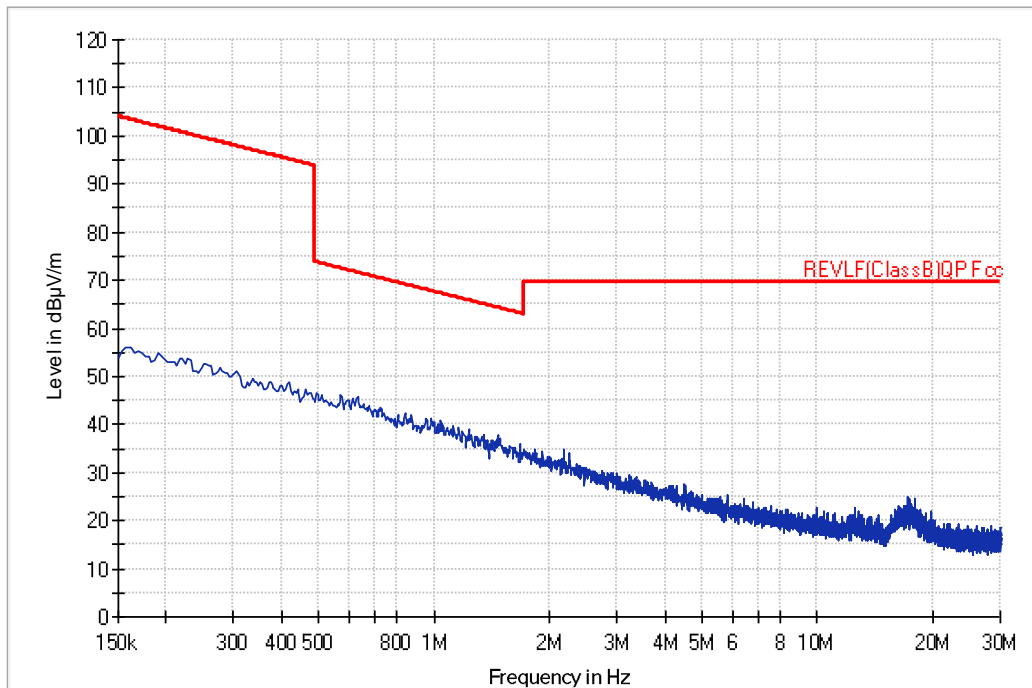


Figure 13: Radiated Emissions Measured at 3m – Antenna 2, Vertically Polarized, FSK Low channel.

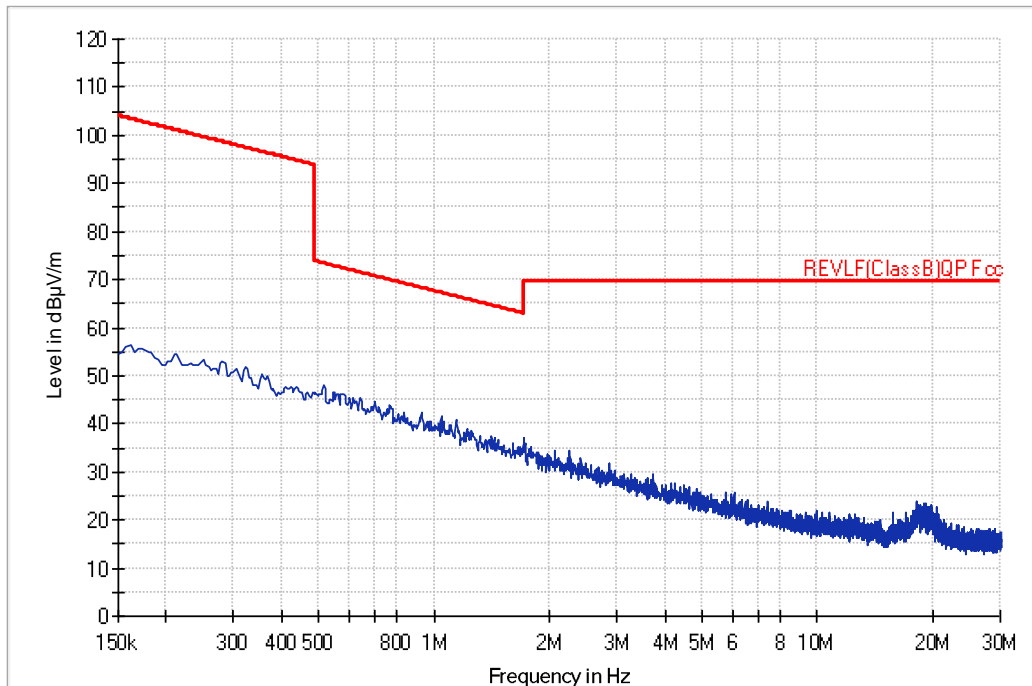


Figure 14: Radiated Emissions Measured at 3m – Antenna 2, Horizontally Polarized, FSK Low channel.

No significant emissions were seen in either vertical or horizontal polarizations.

Antenna 2, Tested August 31, 2023:

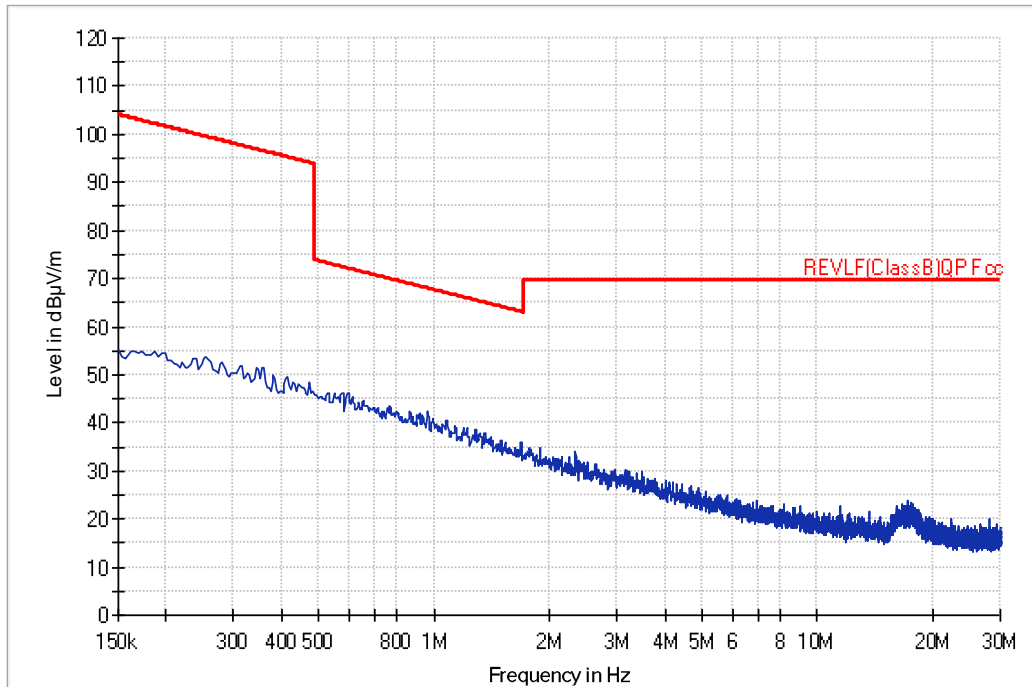


Figure 15: Radiated Emissions Measured at 3m – Antenna 2, Vertically Polarized, FSK Mid channel.

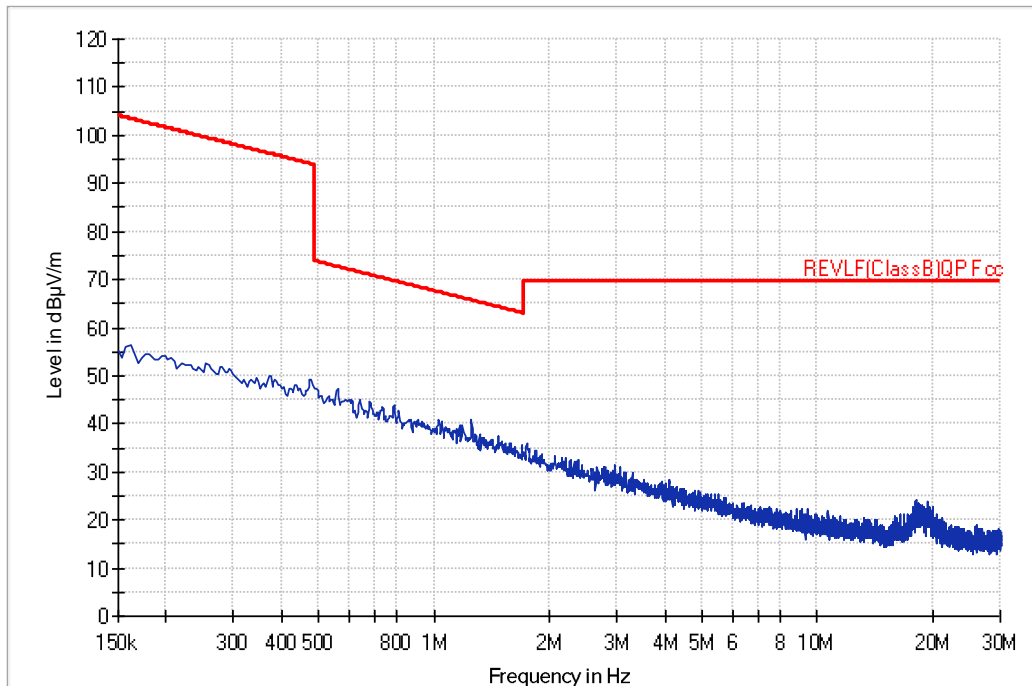


Figure 16: Radiated Emissions Measured at 3m – Antenna 2, Horizontally Polarized, FSK Mid channel.

No significant emissions were seen in either vertical or horizontal polarizations.

Antenna 2, Tested August 31, 2023:

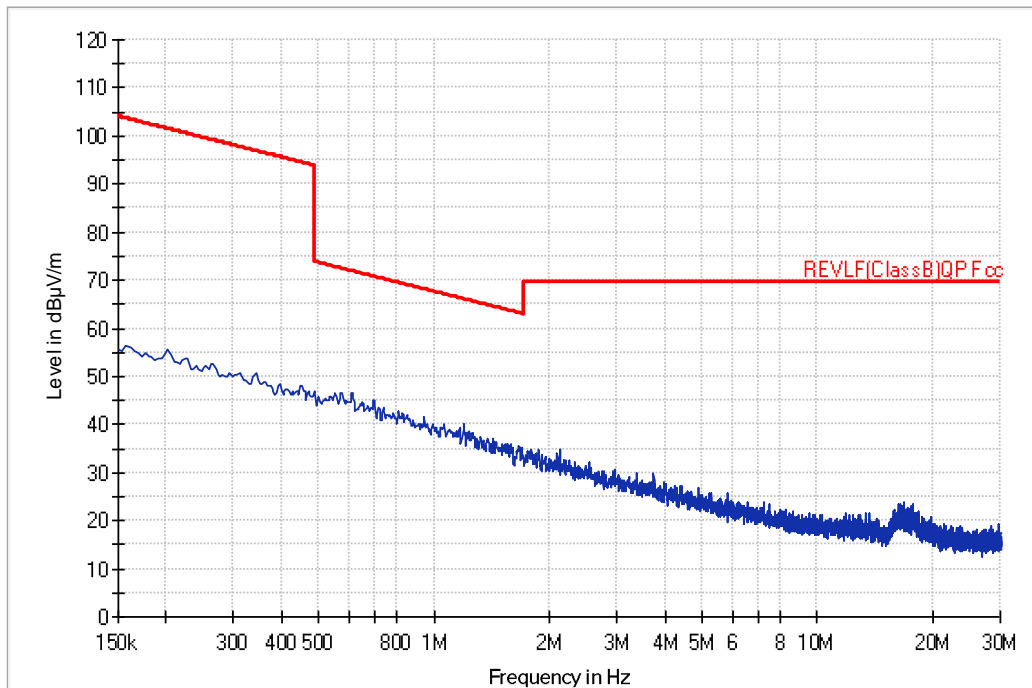


Figure 17: Radiated Emissions Measured at 3m – Antenna 2, Vertically Polarized, FSK High channel.

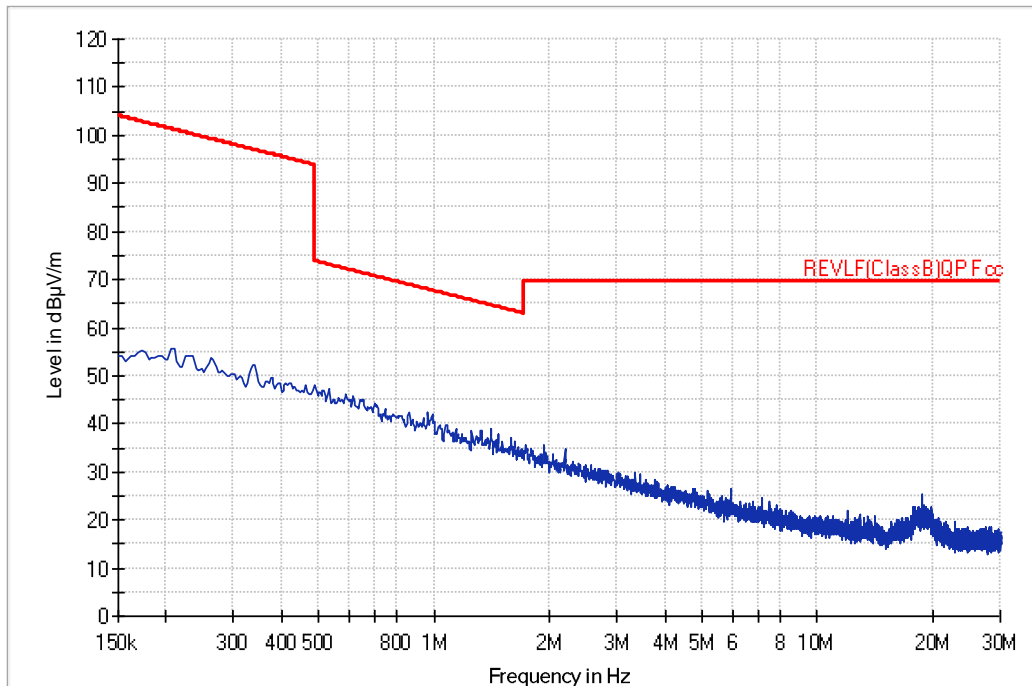


Figure 18: Radiated Emissions Measured at 3m – Antenna 2, Horizontally Polarized, FSK High channel.

No significant emissions were seen in either vertical or horizontal polarizations.

3.5.2 30 MHz to 1 GHz

Tested August 29, 2023:

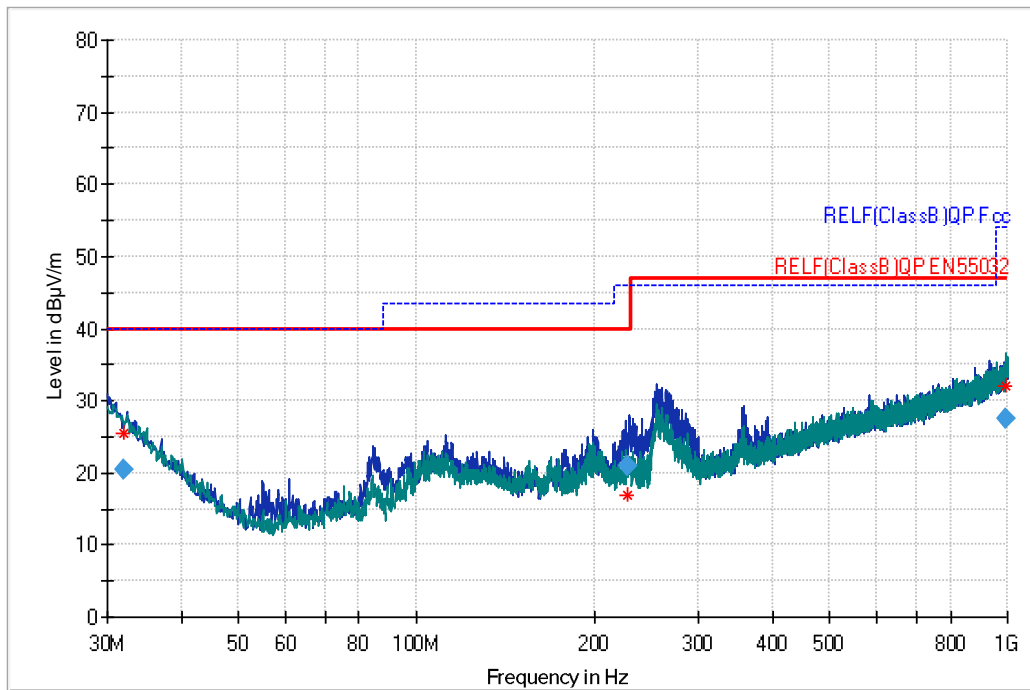


Figure 19: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 1, FSK Low channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
31.9481	20.53	40.00	19.47	1000.0	120.0	258.0	H	356	25.1	Complies
227.7228	20.90	40.00	19.10	1000.0	120.0	100.0	H	279	17.2	Complies
991.6062	27.58	47.00	19.42	1000.0	120.0	275.0	V	176	31.5	Complies

Table 8: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 1, FSK Low channel.

Tested August 29, 2023:

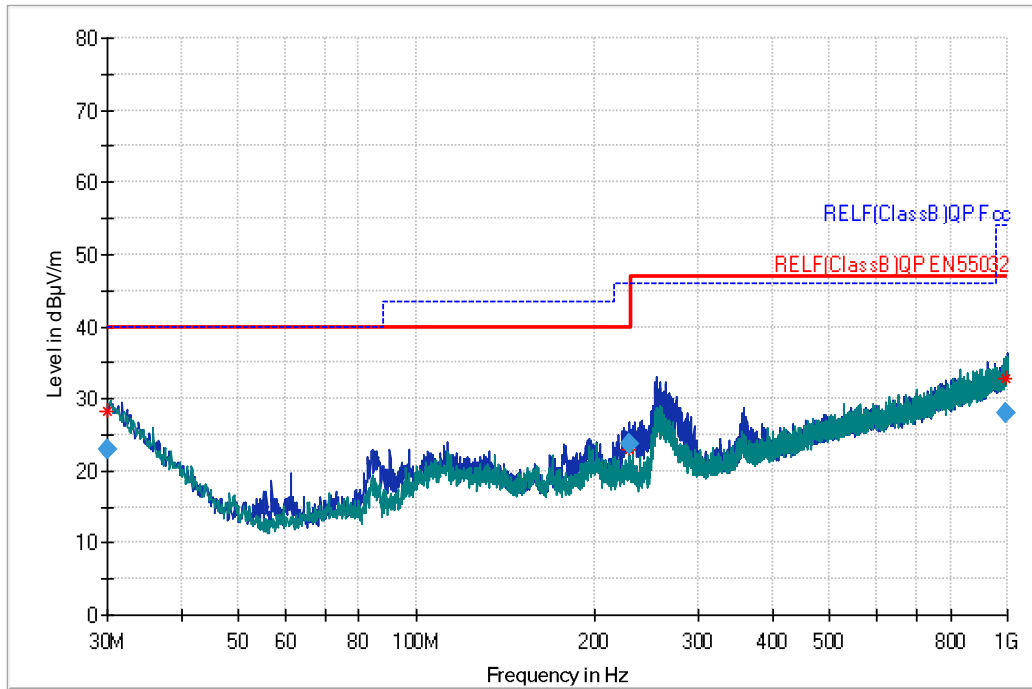


Figure 20: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 1, FSK Mid channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
30.0995	23.08	40.00	16.92	1000.0	120.0	187.0	V	164	26.4	Complies
228.6199	23.78	40.00	16.22	1000.0	120.0	140.0	H	286	17.3	Complies
995.4600	27.92	47.00	19.08	1000.0	120.0	287.0	H	161	31.9	Complies

Table 9: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 1, FSK Mid channel.

Tested August 29, 2023:

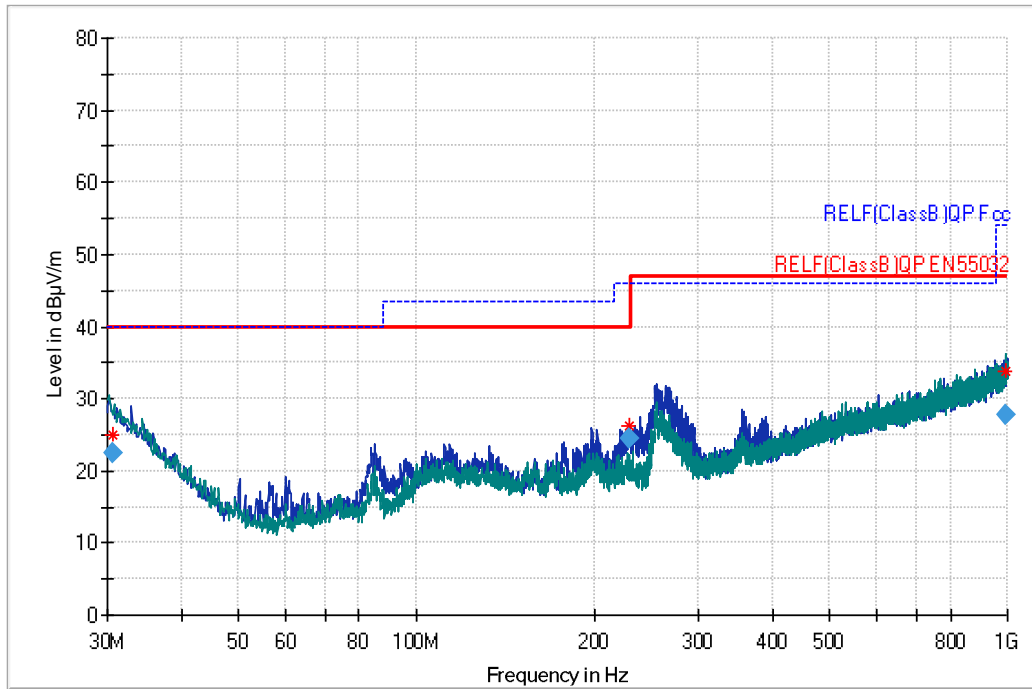


Figure 21: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 1, FSK High channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
30.6296	22.50	40.00	17.50	1000.0	120.0	186.0	V	335	26.1	Complies
229.4811	24.43	40.00	15.57	1000.0	120.0	136.0	H	301	17.3	Complies
994.6796	27.81	47.00	19.19	1000.0	120.0	198.0	V	234	31.8	Complies

Table 10: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 1, FSK High channel.

Tested August 25, 2023:

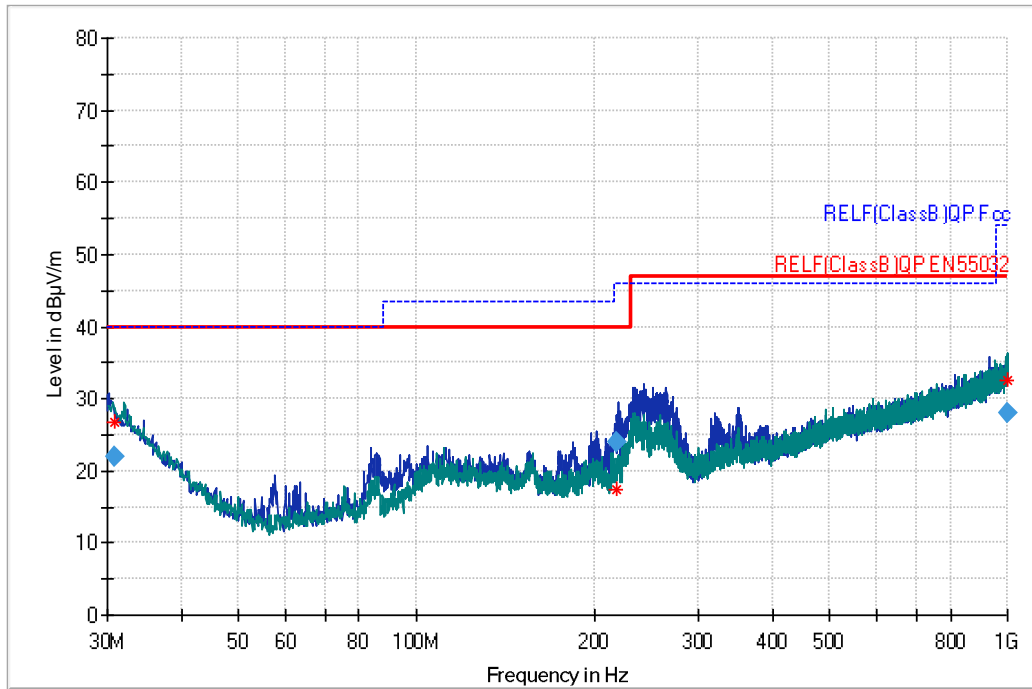


Figure 22: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 1, FSK channel 11 Receive.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
30.9100	21.98	40.00	18.02	1000.0	120.0	100.0	H	316	25.9	Complies
218.6100	23.94	40.00	16.06	1000.0	120.0	140.0	H	112	16.6	Complies
999.5626	28.12	47.00	18.88	1000.0	120.0	261.0	V	29	32.2	Complies

Table 11: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 1, FSK channel 11 Receive.

Tested August 30, 2023:

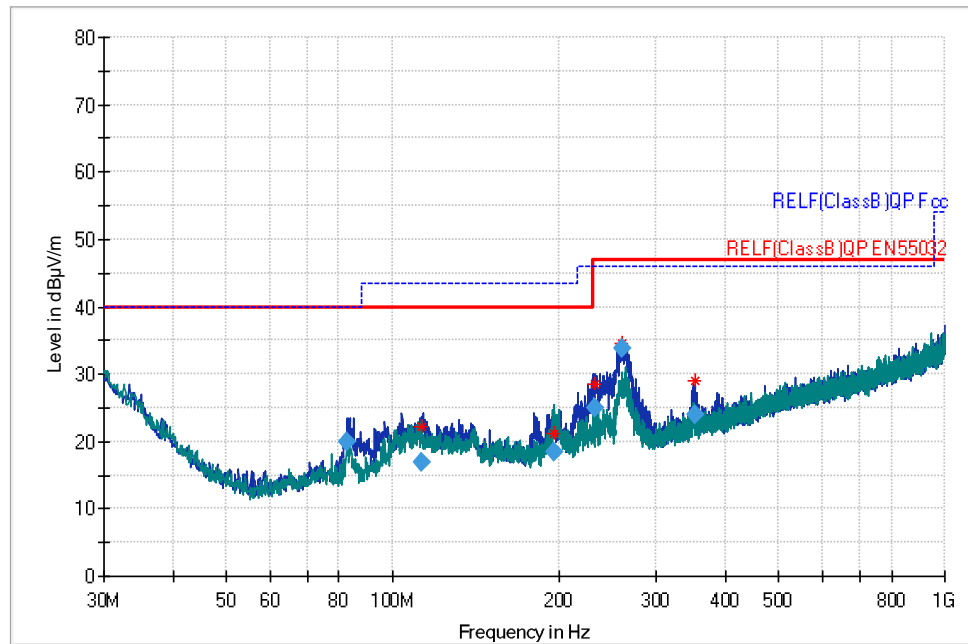


Figure 23: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 2, FSK Low channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
82.7013	19.89	40.00	20.11	1000.0	120.0	243.0	H	37	12.7	Complies
112.6613	16.96	40.00	23.04	1000.0	120.0	342.0	H	25	18.1	Complies
196.2176	18.46	40.00	21.54	1000.0	120.0	127.0	V	28	17.7	Complies
232.2416	25.09	47.00	21.91	1000.0	120.0	103.0	H	308	17.4	Complies
260.8397	33.71	47.00	13.29	1000.0	120.0	114.0	H	306	18.2	Complies
352.1774	24.09	47.00	22.91	1000.0	120.0	112.0	H	299	21.0	Complies

Table 12: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 2, FSK Low channel.

Tested August 30, 2023:

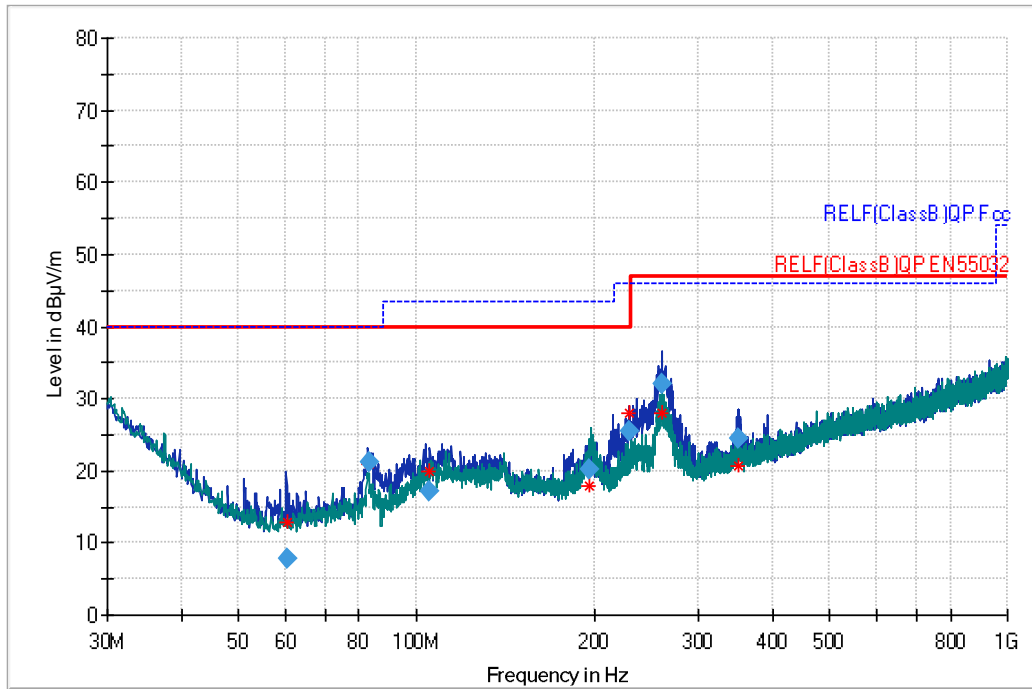


Figure 24: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 2, FSK Mid channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
60.6672	7.92	40.00	32.08	1000.0	120.0	225.0	H	269	12.3	Complies
82.9408	21.17	40.00	18.83	1000.0	120.0	237.0	H	25	12.7	Complies
104.9229	17.18	40.00	22.82	1000.0	120.0	114.0	H	178	16.6	Complies
196.6166	20.09	40.00	19.91	1000.0	120.0	100.0	V	26	17.8	Complies
229.3728	25.54	40.00	14.46	1000.0	120.0	162.0	H	283	17.3	Complies
260.0294	32.11	47.00	14.89	1000.0	120.0	129.0	H	320	18.2	Complies
351.6691	24.44	47.00	22.56	1000.0	120.0	105.0	H	352	21.0	Complies

Table 13: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 2, FSK Mid channel.

Tested August 29, 2023:

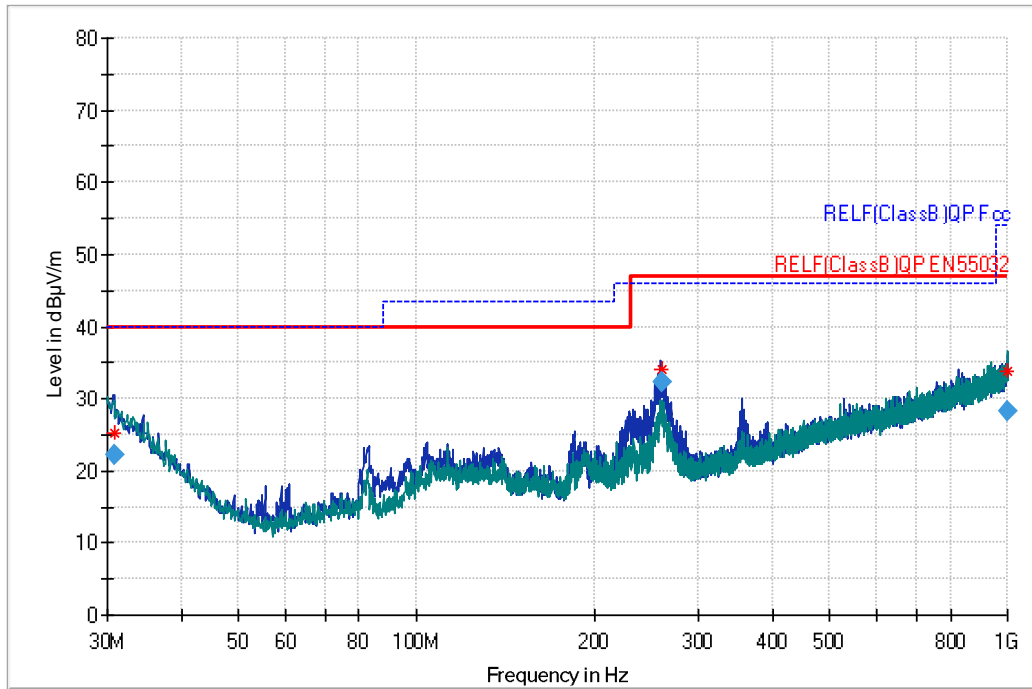


Figure 25: Radiated Emissions (30-1000 MHz) Measured at 3m – Antenna 2, FSK High channel.

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
30.8169	22.30	40.00	17.70	1000.0	120.0	375.0	H	140	25.9	Complies
259.5322	32.22	47.00	14.78	1000.0	120.0	100.0	H	305	18.1	Complies
998.4164	28.22	47.00	18.78	1000.0	120.0	278.0	V	149	32.1	Complies

Table 14: Radiated Emissions (30-1000 MHz) Measured at 3m - Antenna 2, FSK High channel.

3.5.3 1 GHz to 6 GHz

Tested August 30, 2023:

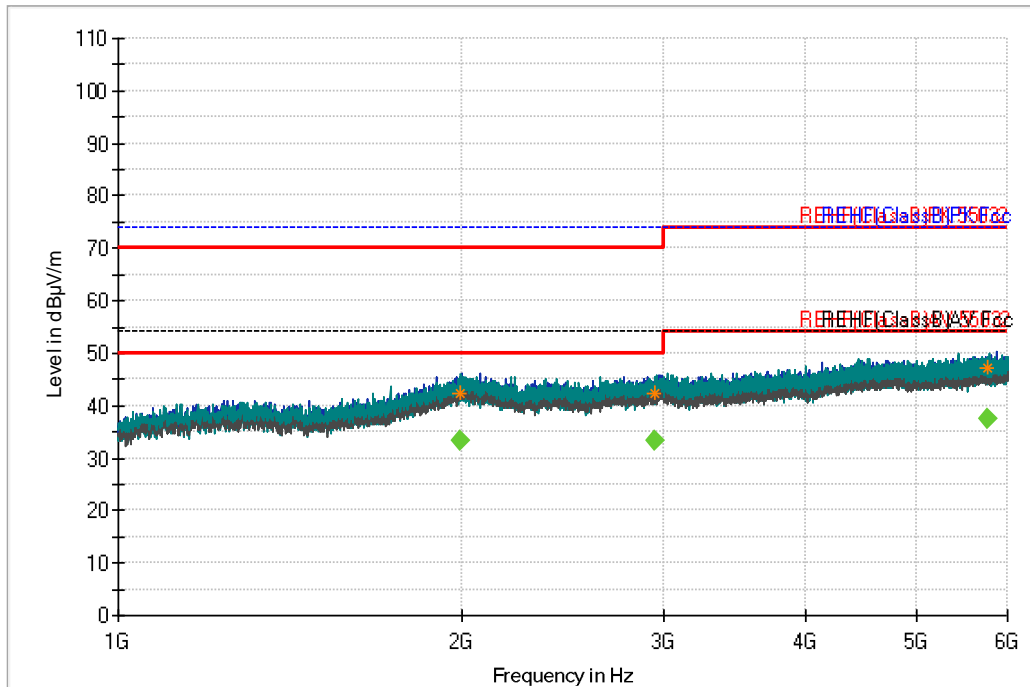


Figure 26: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 1, FSK Low channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
1988.3440	33.42	50.00	16.58	1000.0	1000.0	349.0	V	233	1.3	Complies
2942.1880	33.20	50.00	16.80	1000.0	1000.0	400.0	V	60	1.5	Complies
5764.8480	37.35	54.00	16.65	1000.0	1000.0	349.0	V	218	8.2	Complies

Table 15: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 1, FSK Low channel.

Tested August 30, 2023:

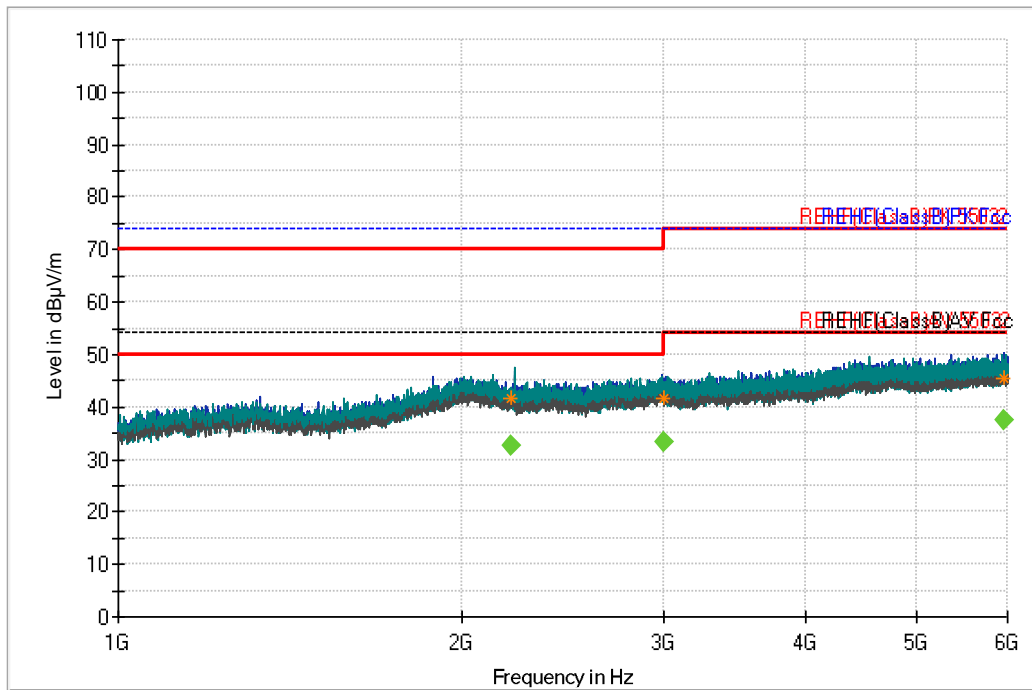


Figure 27: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 1, FSK Mid channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
2208.3520	32.58	50.00	17.42	1000.0	1000.0	199.0	H	352	0.0	Complies
3005.2200	33.33	54.00	20.67	1000.0	1000.0	199.0	H	344	1.6	Complies
5962.6600	37.56	54.00	16.44	1000.0	1000.0	399.0	H	284	8.4	Complies

Table 16: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 1, FSK Mid channel.

Tested August 30, 2023:

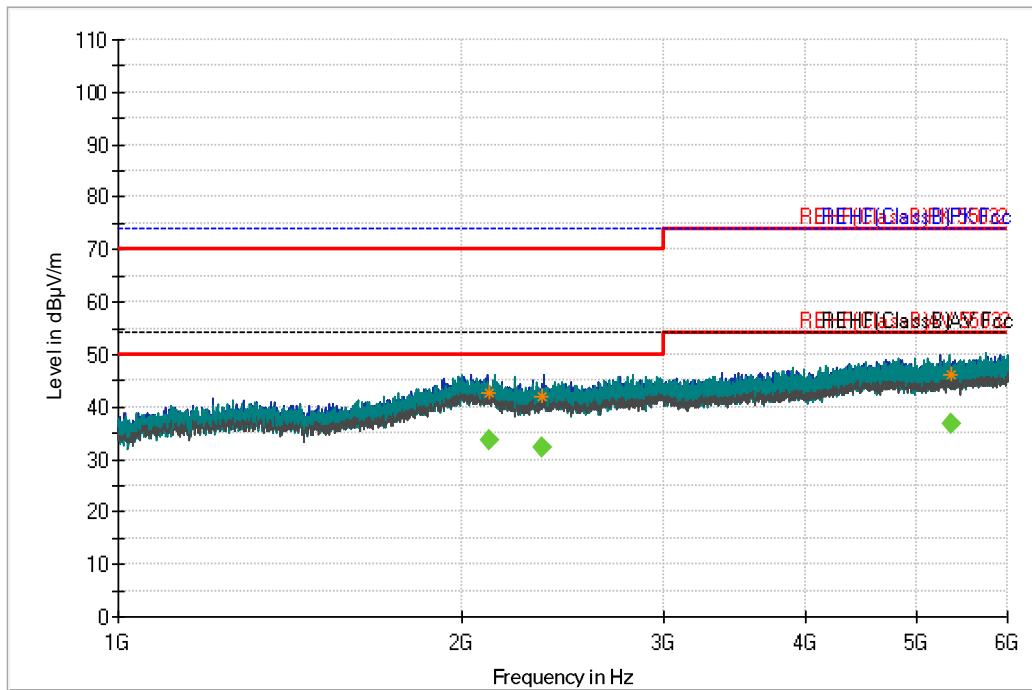


Figure 28: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 1, FSK high channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
2109.0440	33.60	50.00	16.40	1000.0	1000.0	249.0	H	12	0.7	Complies
2344.2360	32.44	50.00	17.56	1000.0	1000.0	149.0	H	287	0.0	Complies
5354.1200	36.77	54.00	17.23	1000.0	1000.0	399.0	V	0	7.4	Complies

Table 17: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 1, FSK high channel.

Tested August 31, 2023:

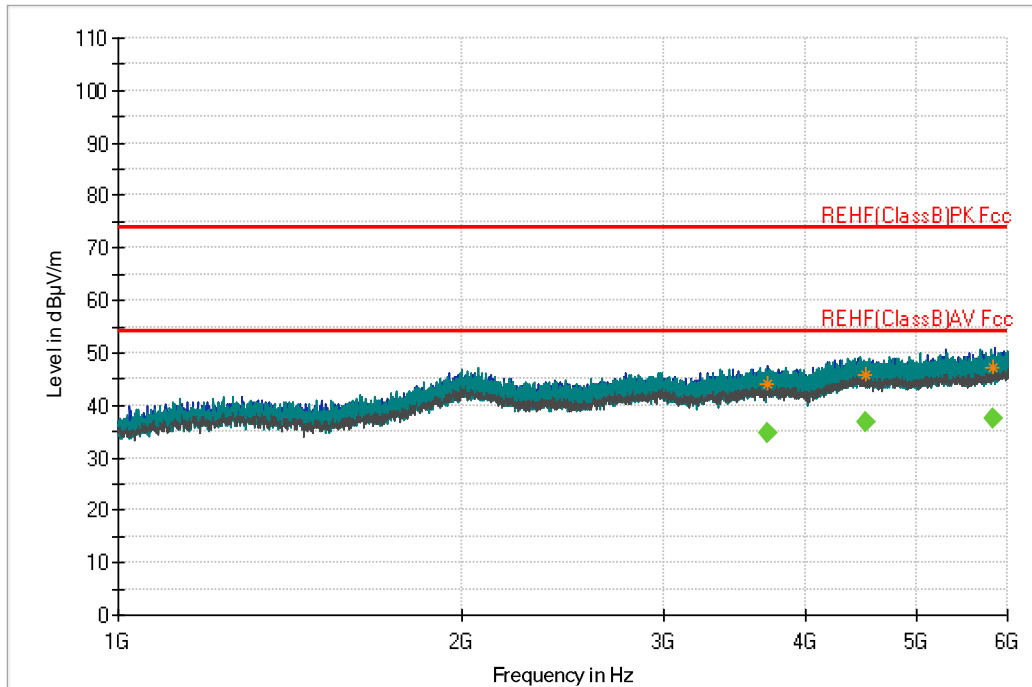


Figure 29: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 2, FSK receive.

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
3693.1280	34.53	54.00	19.47	1000.0	1000.0	149.0	V	244	3.8	Complies
4505.2520	36.67	54.00	17.33	1000.0	1000.0	399.0	V	1	6.2	Complies
5819.2600	37.62	54.00	16.38	1000.0	1000.0	100.0	V	177	8.2	Complies

Table 18: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 2, FSK receive.

Tested August 30, 2023:

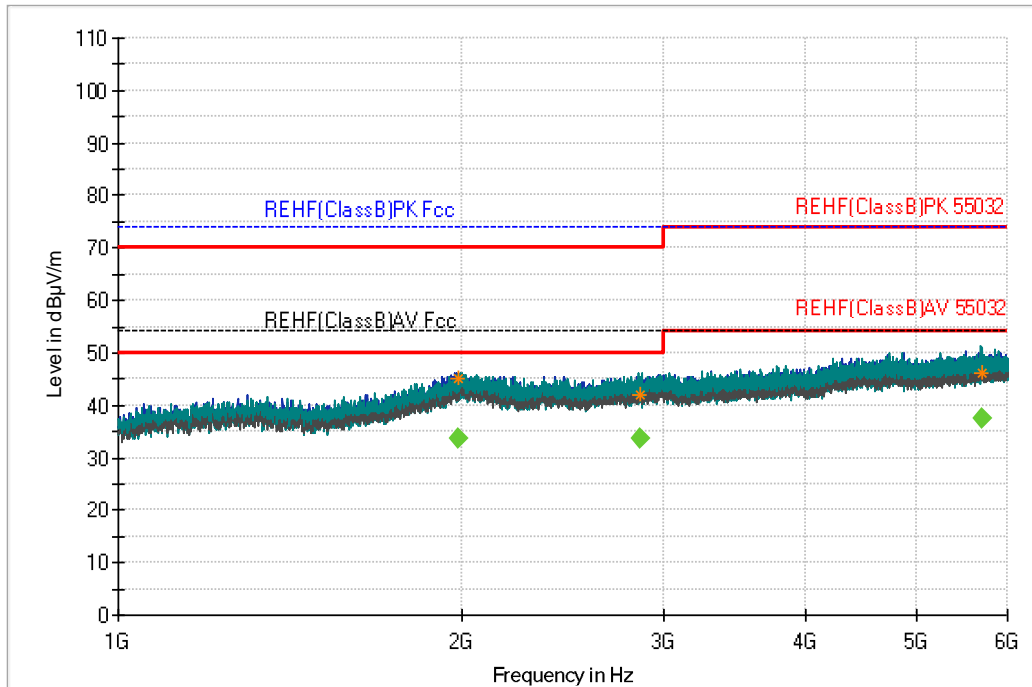


Figure 30: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 2, FSK Low channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
1985.2120	33.67	50.00	16.33	1000.0	1000.0	100.0	V	62	1.3	Complies
2866.7000	33.64	50.00	16.36	1000.0	1000.0	299.0	V	219	1.3	Complies
5698.6920	37.63	54.00	16.37	1000.0	1000.0	199.0	V	278	8.0	Complies

Table 19: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 2 FSK Low channel.

Tested August 30, 2023

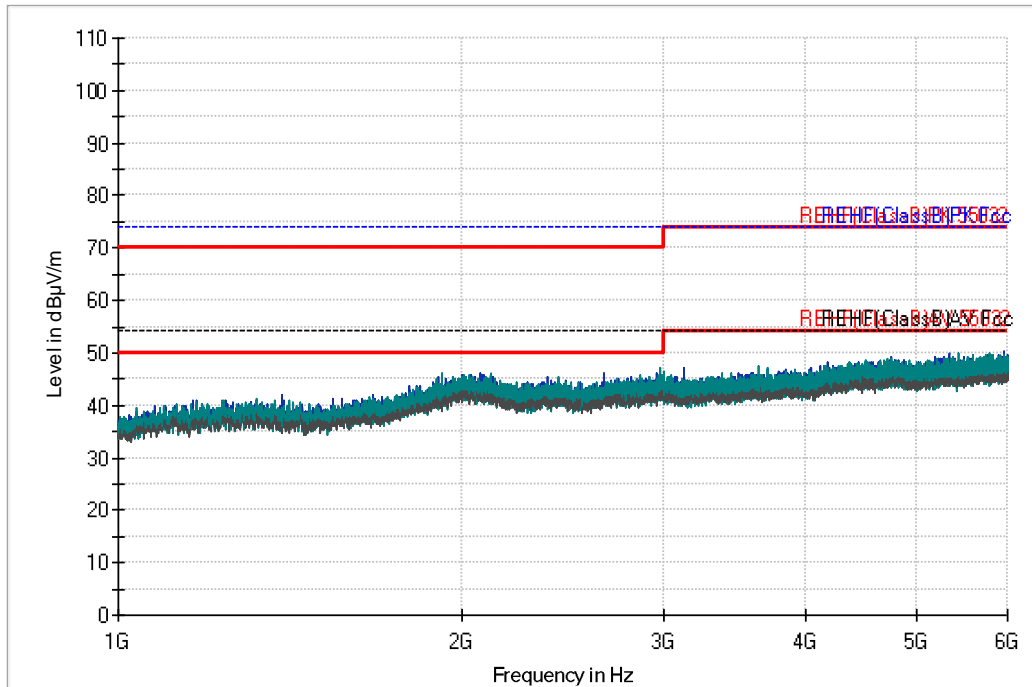


Figure 31: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 2, FSK Mid channel.

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
2997.0000	45.10	50.00	4.90	1000.0	1000.0	350.0	V	348	0.2	Complies
3628.0000	45.49	50.00	4.51	1000.0	1000.0	200.0	V	283	1.6	Complies
5954.0000	49.62	54.00	4.38	1000.0	1000.0	300.0	H	73	8.4	Complies

Table 20: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 2 FSK Mid channel.

Tested August 30, 2023

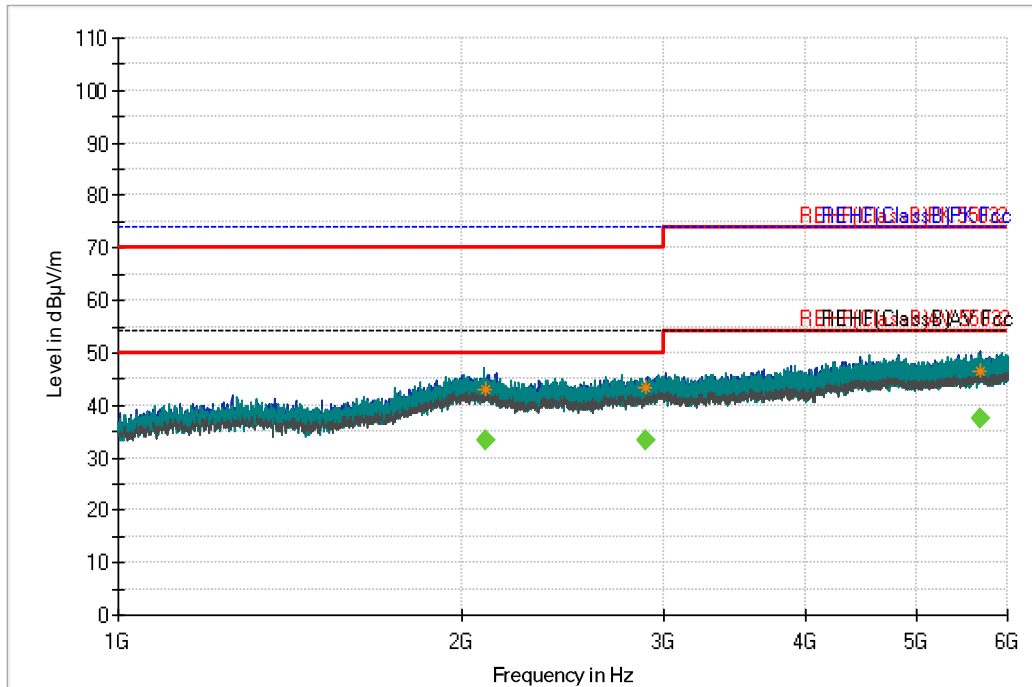


Figure 32: Radiated Emissions (1-6 GHz) Measured at 3m – Antenna 2, FSK High channel.

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
2092.4360	33.33	50.00	16.67	1000.0	1000.0	100.0	V	16	0.8	Complies
2895.7360	33.22	50.00	16.78	1000.0	1000.0	349.0	H	127	1.4	Complies
5688.3800	37.65	54.00	16.35	1000.0	1000.0	199.0	H	0	8.0	Complies

Table 21: Radiated Emissions (1-6 GHz) Measured at 3m - Antenna 2 FSK High channel.

3.5.4 6 GHz to 18 GHz

Tested August 30, 2023

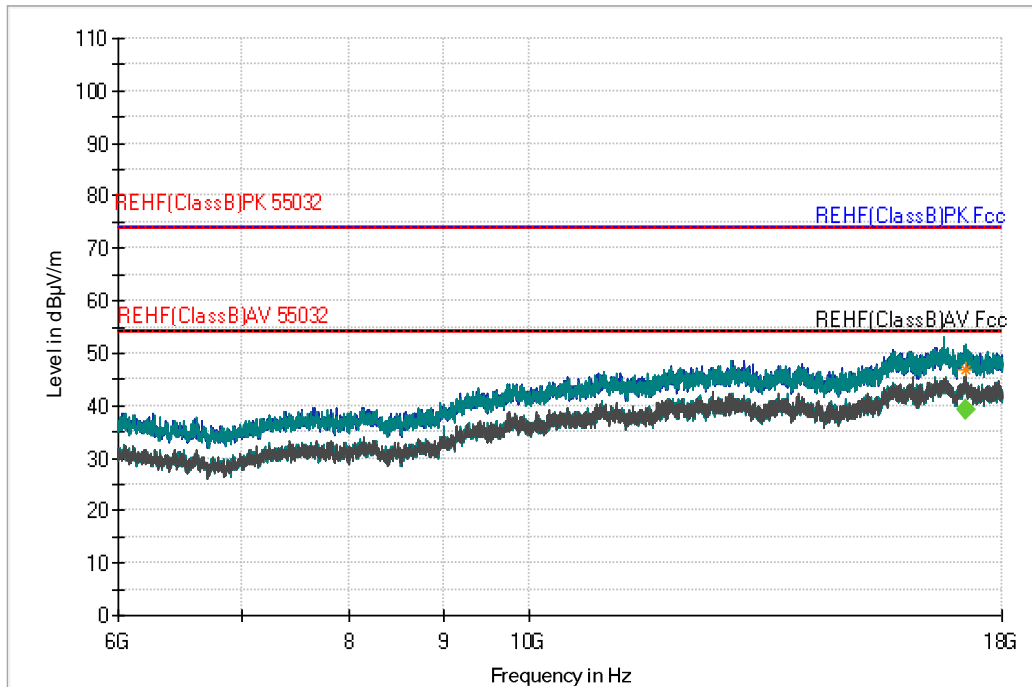


Figure 33: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 1, FSK Low channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
17192.5640	39.22	54.00	14.78	1000.0	1000.0	198.0	V	104	13.3	Complies

Table 22: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 1 FSK Low channel.

Tested August 30, 2023

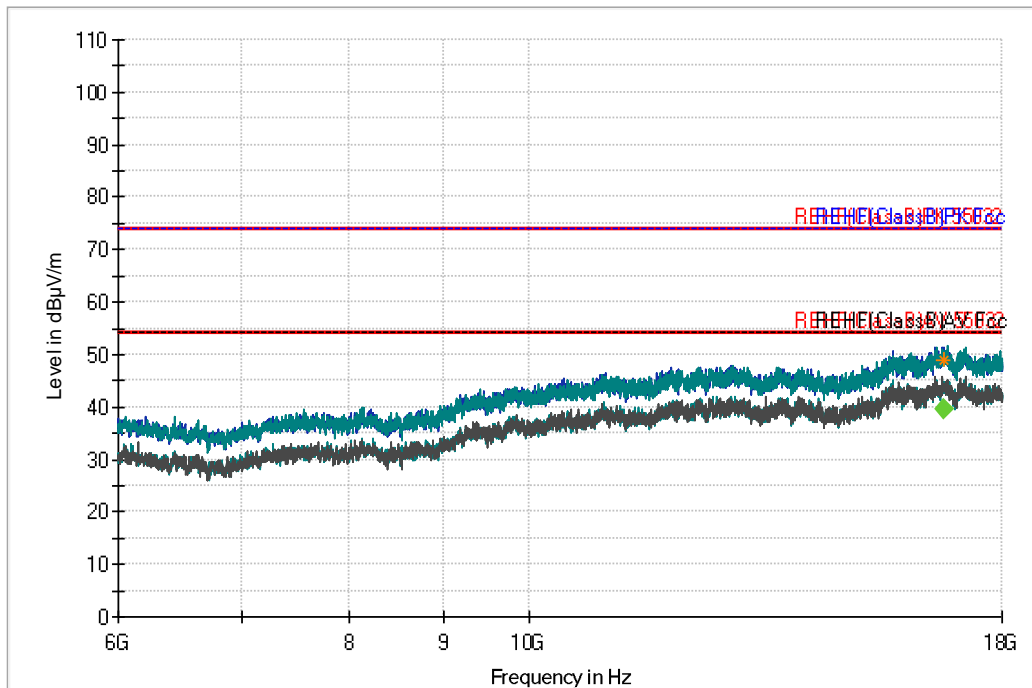


Figure 34: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 1, FSK Mid channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
16737.8600	39.48	54.00	14.52	1000.0	1000.0	172.0	V	210	12.9	Complies

Table 23: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 1 FSK Mid channel.

Tested August 30, 2023

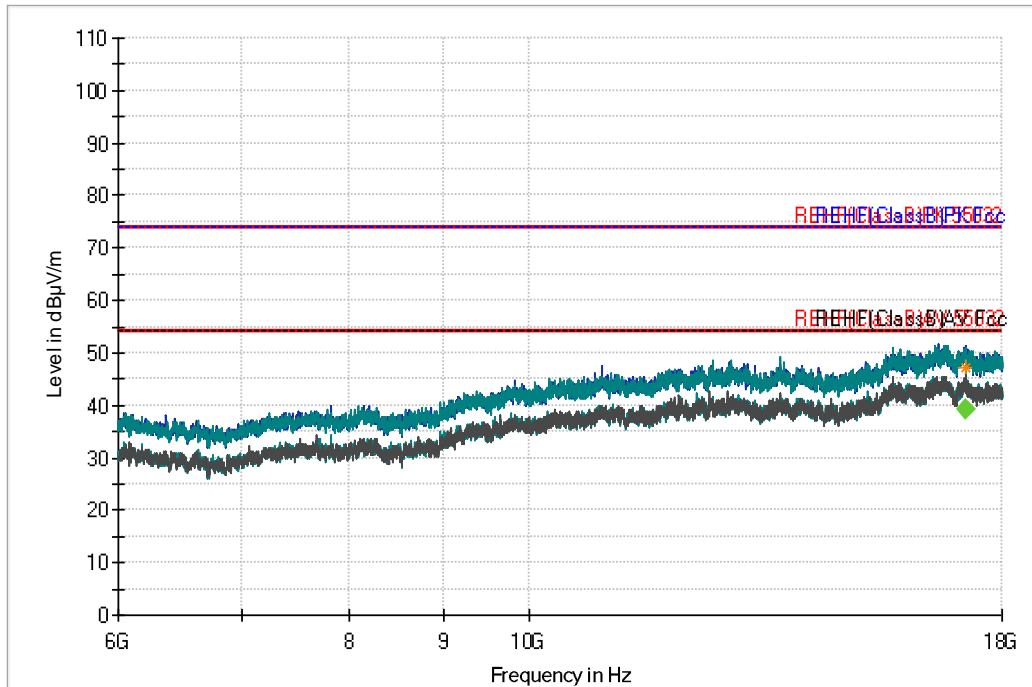


Figure 35: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 1 FSK High channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
17196.1040	39.35	54.00	14.65	1000.0	1000.0	400.0	V	231	13.3	Complies

Table 24: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 1 FSK High channel.

Tested August 31, 2023

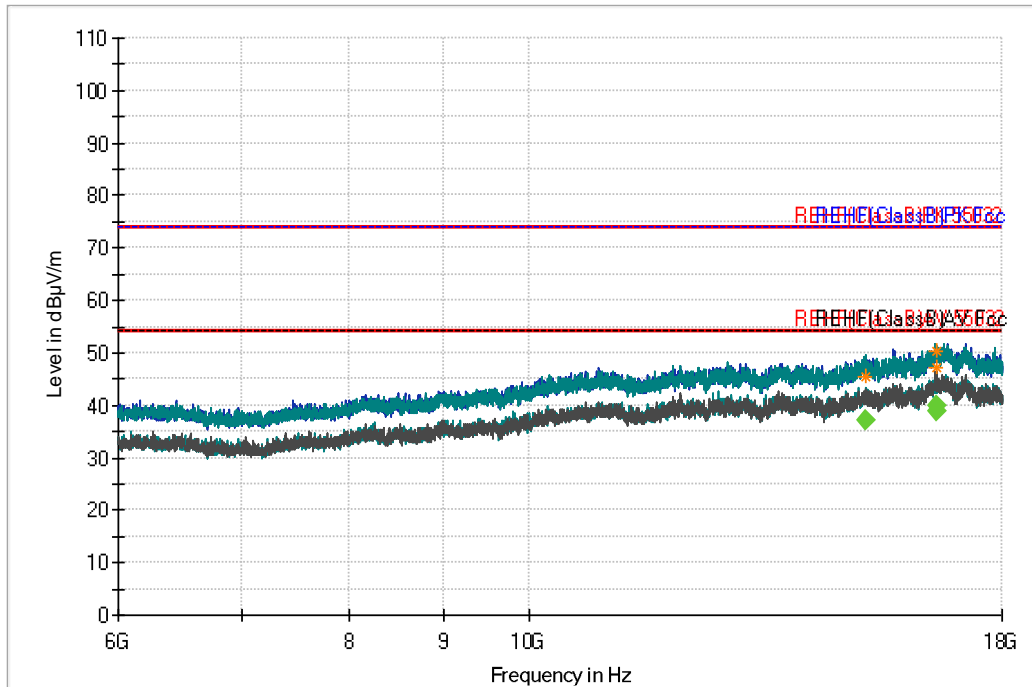


Figure 36: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 2, FSK Low channel.

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
15209.0680	37.10	54.00	16.90	1000.0	1000.0	312.0	H	294	10.6	Complies
16591.1680	38.85	54.00	15.15	1000.0	1000.0	212.0	V	185	12.9	Complies
16606.1720	39.86	54.00	14.14	1000.0	1000.0	400.0	V	259	12.9	Complies

Table 25: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 2 FSK Low channel.

Tested August 31, 2023

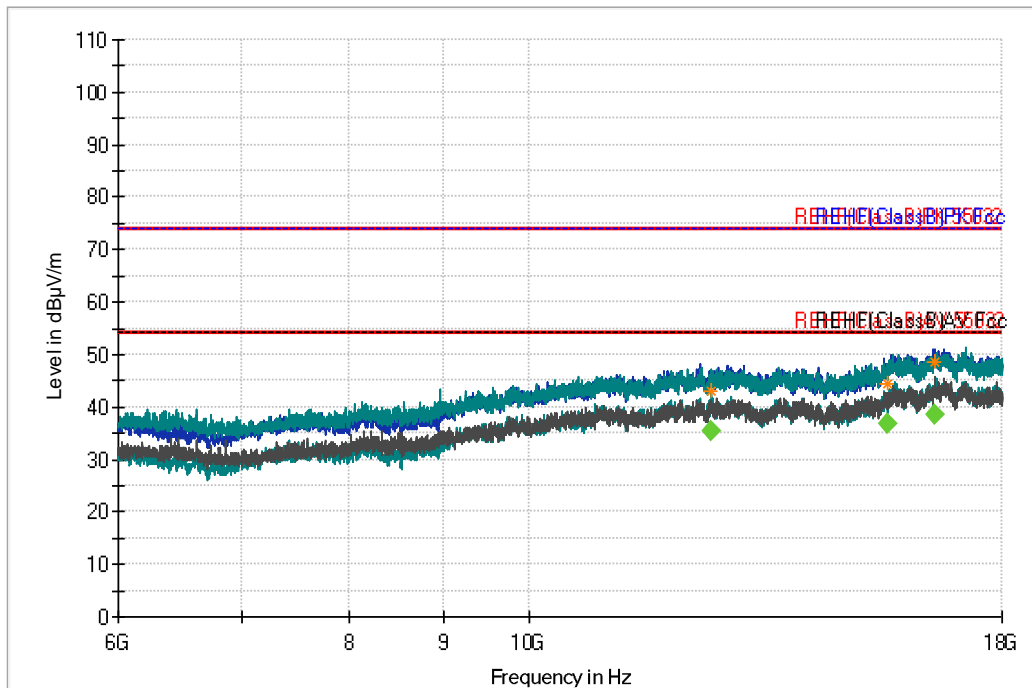


Figure 37: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 2, FSK Mid channel.

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
12531.6680	35.33	54.00	18.67	1000.0	1000.0	153.0	H	69	7.6	Complies
15628.3840	36.83	54.00	17.17	1000.0	1000.0	124.0	H	180	11.8	Complies
16569.9160	38.56	54.00	15.44	1000.0	1000.0	189.0	V	24	12.9	Complies

Table 26: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 2 FSK Mid channel.

Tested August 31, 2023

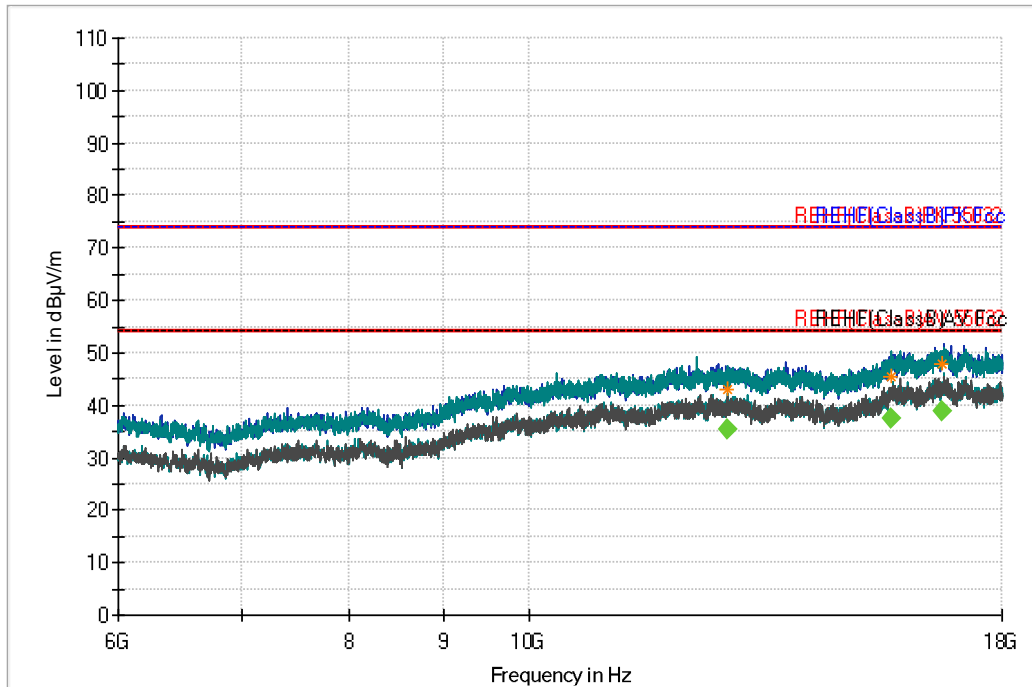


Figure 38: Radiated Emissions (6-18 GHz) Measured at 3m – Antenna 2, FSK High channel.

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band Width (kHz)	Height (cm)	Pol.	Azim. (Deg)	Cor. Factor (dB)	Result
12805.8760	35.23	54.00	18.77	1000.0	1000.0	211.0	H	193	7.5	Complies
15674.5760	37.59	54.00	16.41	1000.0	1000.0	179.0	H	252	12.2	Complies
16722.4160	38.95	54.00	15.05	1000.0	1000.0	114.0	H	48	12.9	Complies

Table 27: Radiated Emissions (6-18 GHz) Measured at 3m - Antenna 2 FSK High channel.

Appendix A: Test Setup Photos

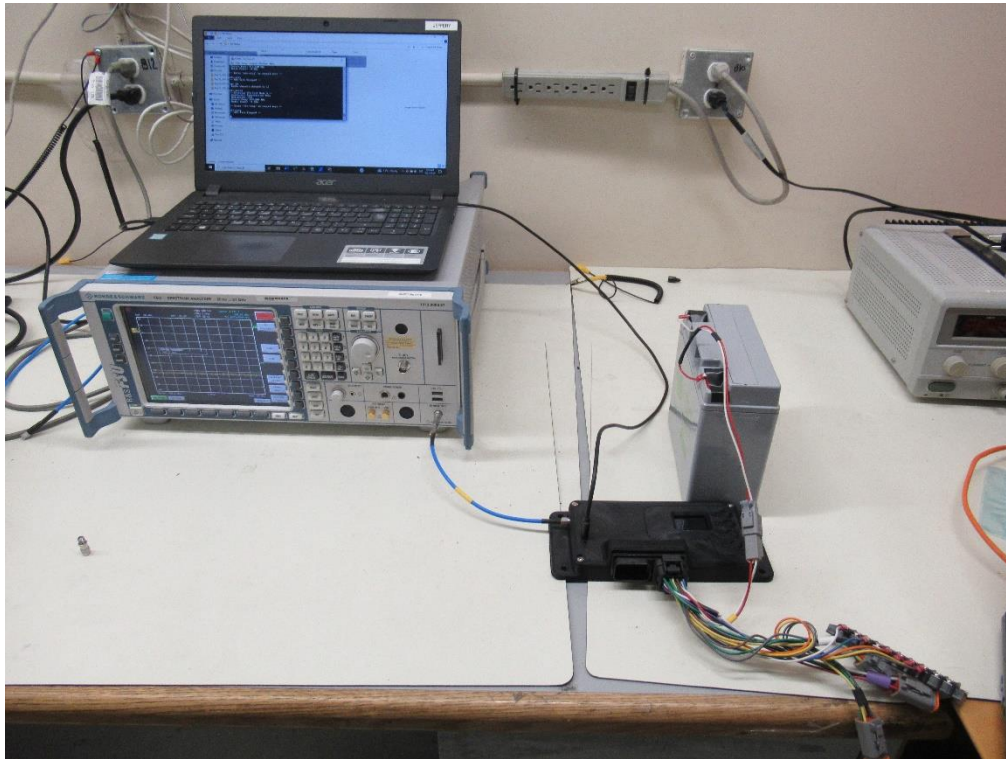


Figure 39: Conducted RF Measurement Setup

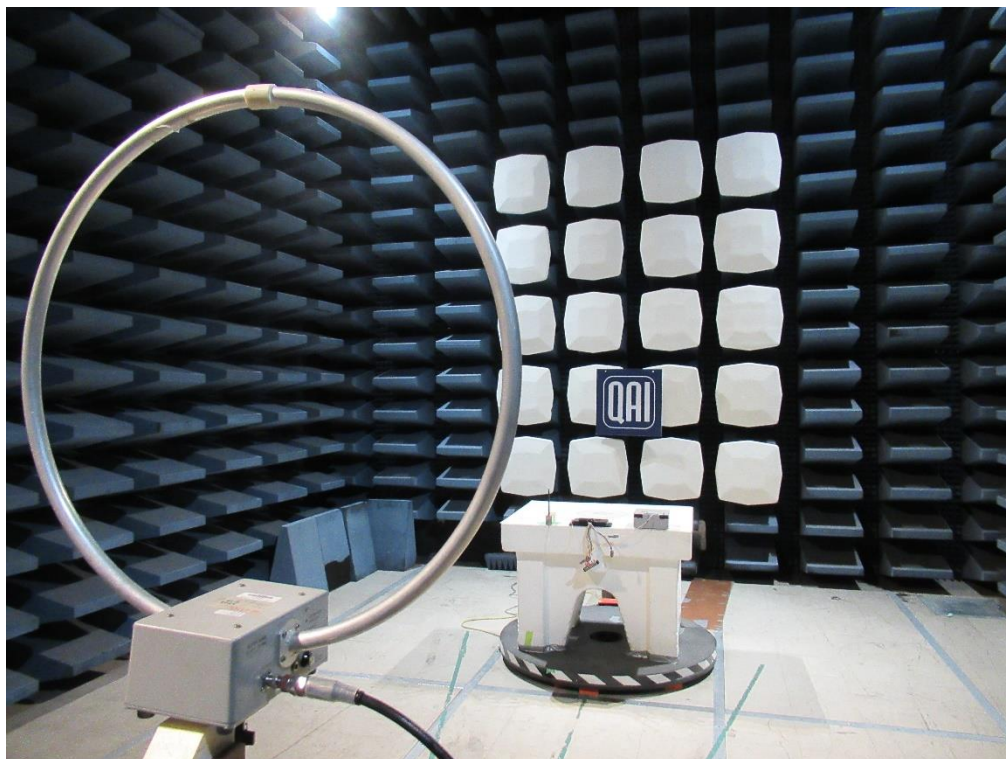


Figure 40: Radiated Measurement Setup, < 30 MHz, Antenna 1

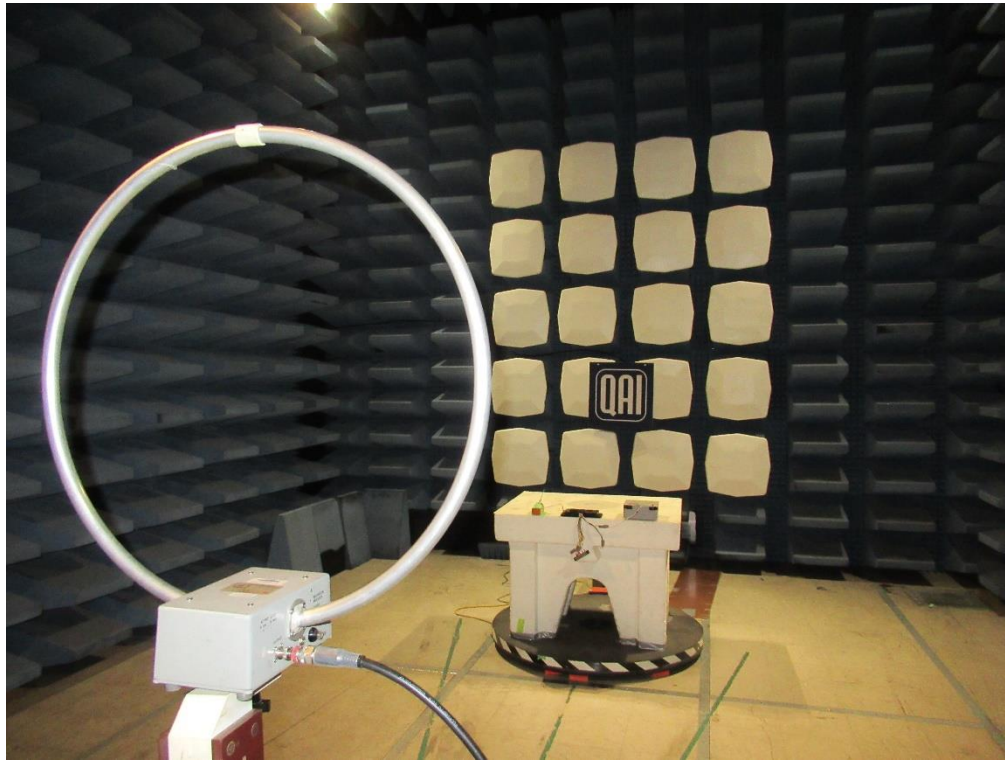


Figure 41: Radiated Measurement Setup, < 30 MHz, Antenna 2

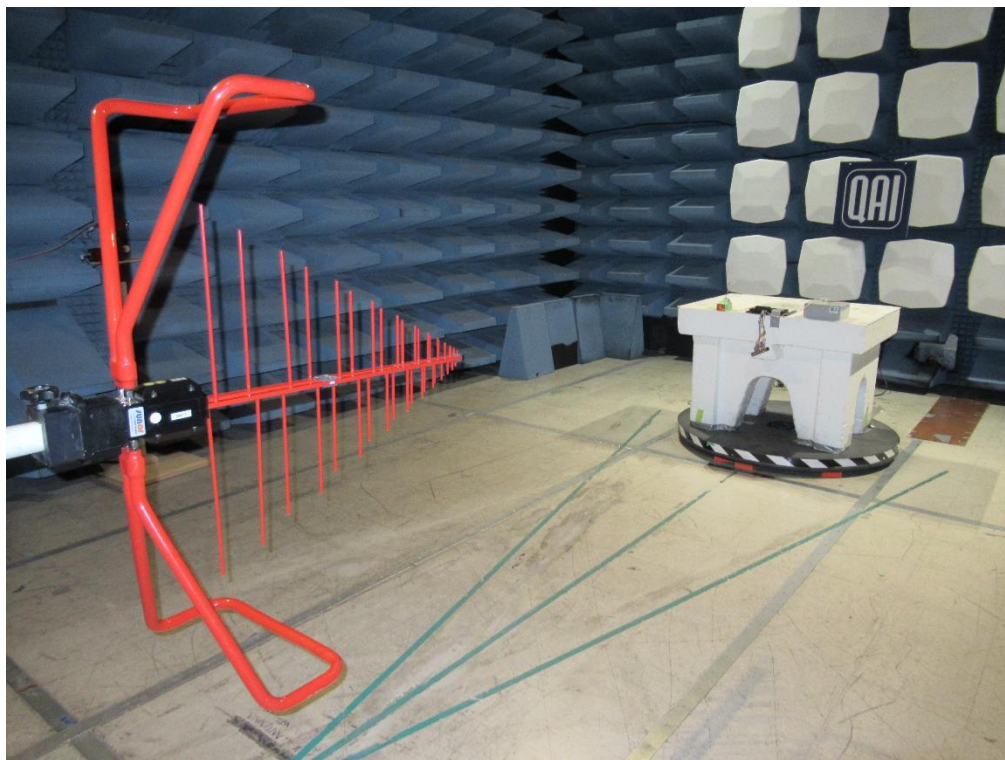


Figure 42: Radiated Measurement Setup, 30 MHz to 1 GHz, Antenna 1

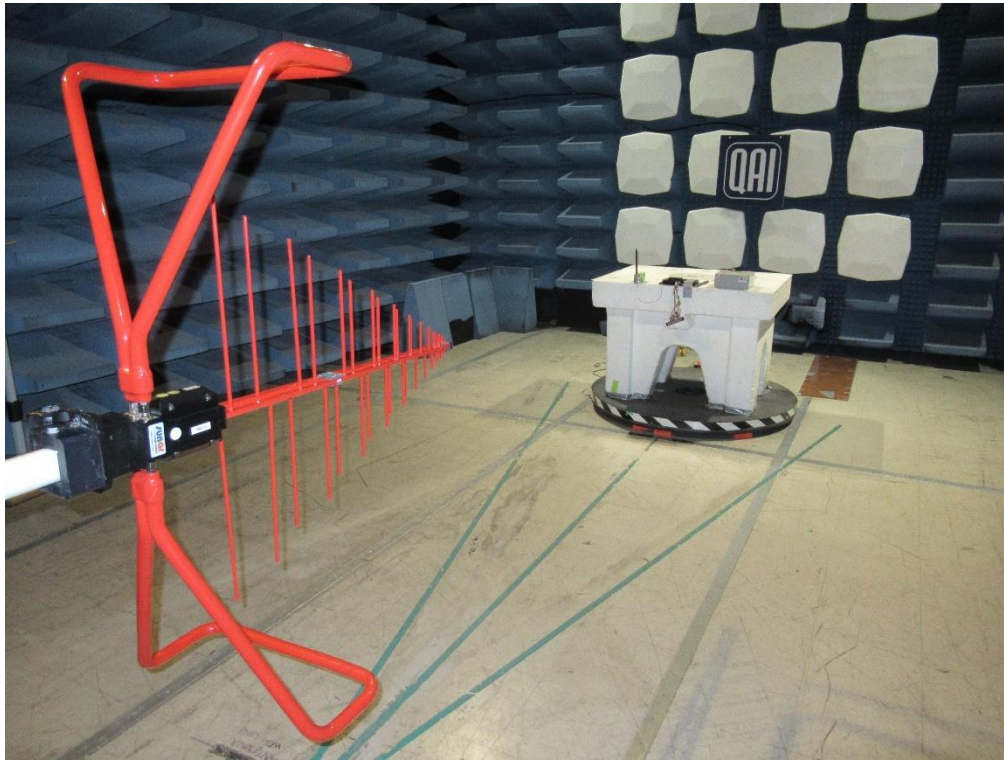


Figure 43: Radiated Measurement Setup, 30 MHz to 1 GHz, Antenna 2

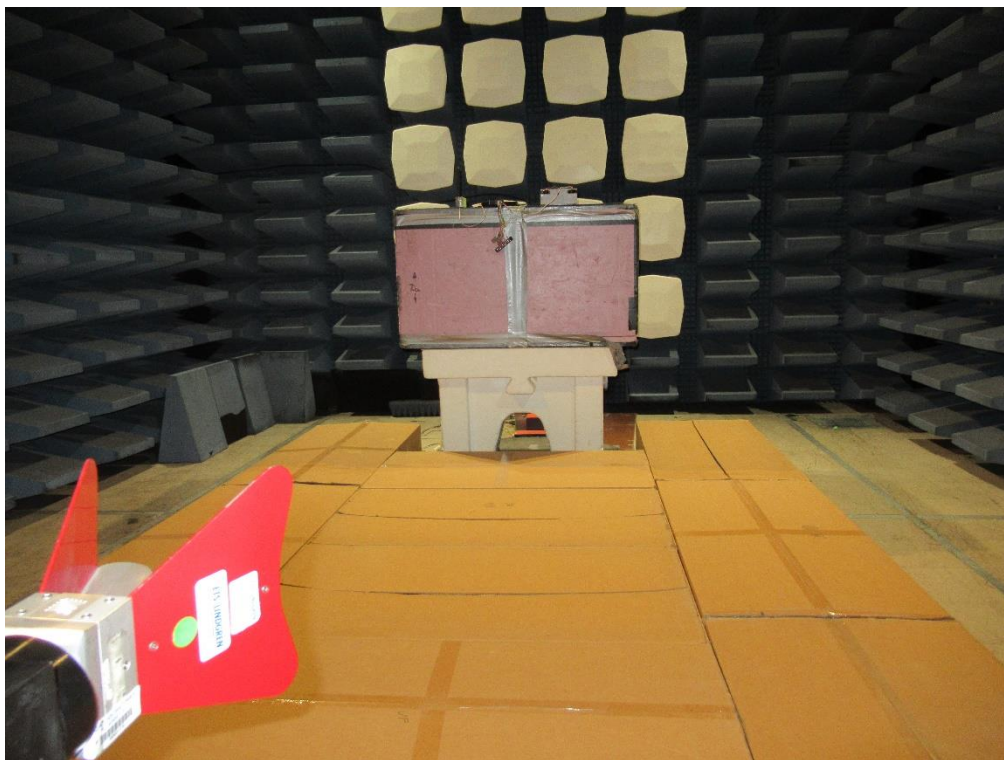


Figure 44: Radiated Measurement Setup, > 1 GHz, Antenna 1



Figure 45: Radiated Measurement Setup, > 1 GHz, Antenna 2



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