



## Test Report

**FCC ID: 2AVE9-TRKR01  
IC: 25817-TRKR01**

**FCC Rule Part: 15.247  
ISED Canada Radio Standards Specification: RSS-247**

**Report Number: AT72154363-1C2**

**Manufacturer: Swarm Technologies  
Product: Tracker  
Model: TRKR01**

**Test Begin Date: January 8, 2020  
Test End Date: January 16, 2020**

**Report Issue Date: April 9, 2020**



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

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

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**This report contains 27 pages**

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## 1 GENERAL

### 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

### 1.2 Applicant Information

Swarm Technologies  
435 N Whisman Road  
Suite 100  
Mountain View, California 94043

### 1.3 Product Description

The Tracker is a Remote 2-way data transfer device from anywhere on Earth via the Swarm satellite constellation. The Tracker connects to a third-party sensor and transmits the data to Swarm's space network. The Tracker contains a VHF satellite radio, GNSS Receiver, 802.11 WLAN radio, Bluetooth Classic, and Bluetooth Low Energy radio.

This report covers the compliance of the Bluetooth Low Energy radio only. All other radios are covered in separate reports accompanying this certification filing.

Technical Details:

Detail	Description
Frequency Range (MHz)	2402 – 2480
Number of Channels	40
Channel Spacing	2 MHz
Modulation Format	GFSK
Data Rates	1 MBPS
Operating Voltage	5 VDC
Antenna Type(s) / Gain(s)	Ceramic Chip Antenna / 1 dBi

Test Sample Serial Number(s): C3 (Radiated measurements)  
C7 (Antenna Port Conducted measurements)

Test Sample Condition: The equipment was provided in good condition without any physical damage.

#### **1.4 Test Methodology and Considerations**

All modes of operation, including all data rates, were evaluated and the data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was the Y-orientation. A 50-ohm non-radiating termination was placed on the VHF antenna port.

For antenna port conducted emissions, the EUT was coupled to the measuring equipment through a temporary SMA Pigtail in place of the ceramic chip antenna with suitable attenuation. A 50-ohm non-radiating termination was placed on the VHF antenna port and GNSS Antenna port.

For power line conducted emissions, the EUT was programmed for continuous modulated transmission on the BLE radio and the VHF radio. All combinations of VHF radio antennas were evaluated, and the worst case was with the quarter-wave antenna.

Radiated inter-modulation testing was performed for all combinations of simultaneous transmission and found to be compliant.

Power setting during test:       6

## **2 TEST FACILITIES**

### **2.1 Location**

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.  
5945 Cabot Pkwy, Suite 100  
Alpharetta, GA 30005  
Phone: (678) 341-5900

### **2.2 Laboratory Accreditations/Recognitions/Certifications**

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

## 2.3 Radiated Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5' in diameter and is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

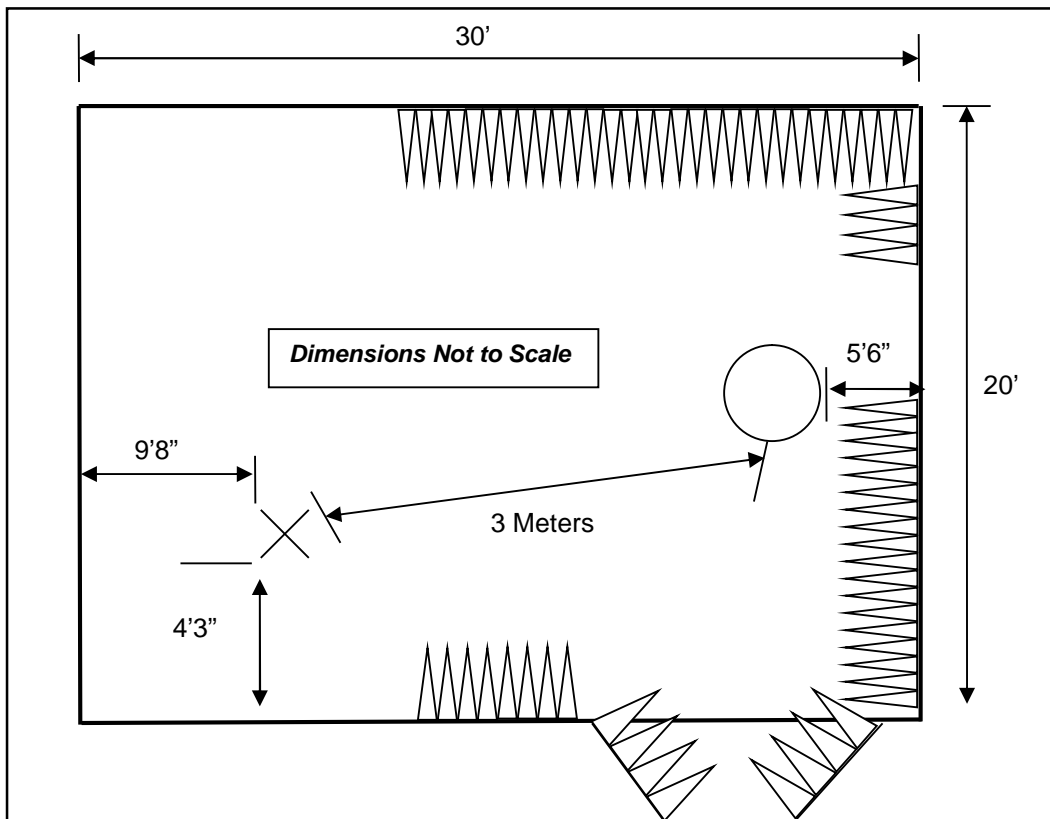


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

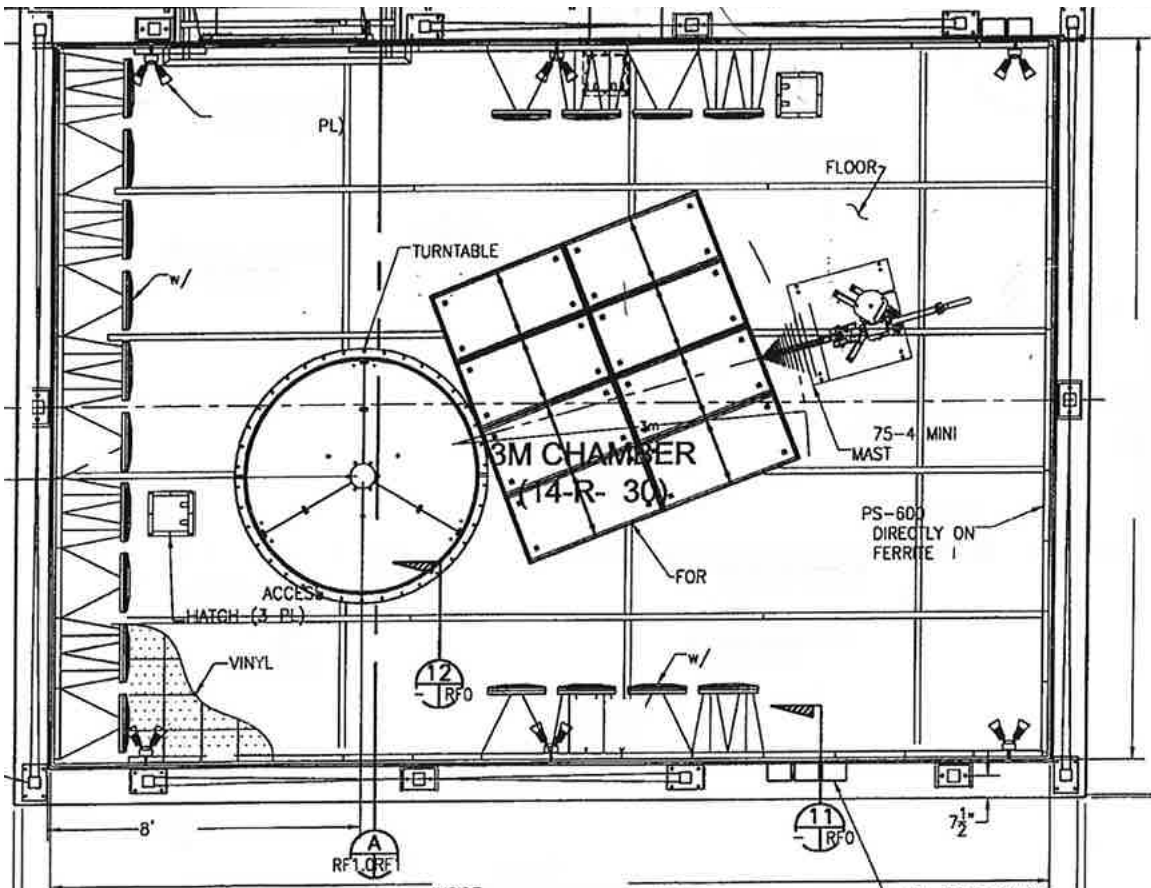
**2.3.2 Semi-Anechoic Chamber Test Site – Chamber B**

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.



**Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B**

## 2.4 Conducted Emissions Test Site Description

### 2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

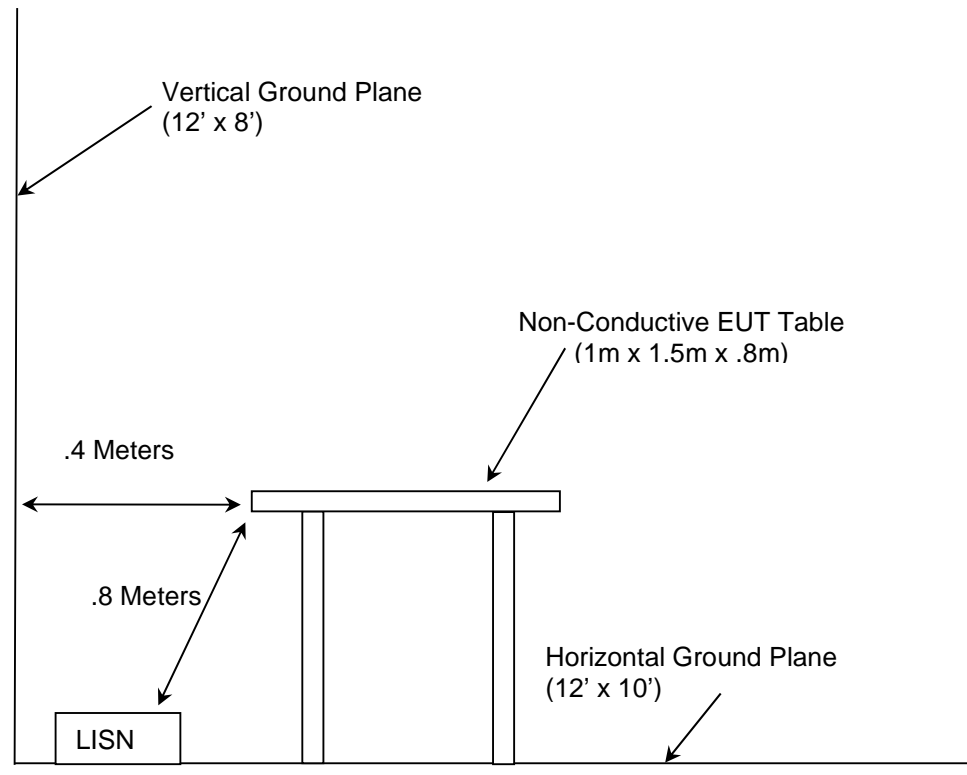


Figure 2.4.1-1: AC Mains Conducted EMI Site



### 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- ❖ FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 2, 2019
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018 + Amendment 1, March 2019

### 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment**

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
213	TEC	PA 102	Amplifier	44927	07/22/2019	07/22/2020
335	Suhner	SF-102A	Cable (40GHZ)	882/2A	07/08/2019	07/08/2020
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2019	07/15/2021
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/31/2019	05/31/2020
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/30/2018	07/30/2020
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
638	Rohde & Schwarz	OSP 120	Open Switch and Control Unit	101229	06/11/2019	06/11/2021
651	Rohde & Schwarz	TS-PR26	18GHz to 26.5GHz Pre-Amplifier	100023	07/10/2019	07/10/2020
652	Rohde & Schwarz	3160-09	High Frequency Antenna 18GHz to 26.5GHz	060922-21894	NCR	NCR
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/01/2019	05/01/2020
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	05/01/2019	05/01/2020
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/01/2019	05/01/2020
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
857	ETS Lindgren	3117	Horn Antenna 1-18GHz	00153608	11/12/2019	11/12/2021
RE880	Rhode & Schwarz USA	Test Receiver	R&S ESW44	1206247	11/06/2019	11/06/2020

**NCR = No Calibration Required**

**NOTE: All test equipment was used only during active calibration cycles as reported above.**

## 5 SUPPORT EQUIPMENT

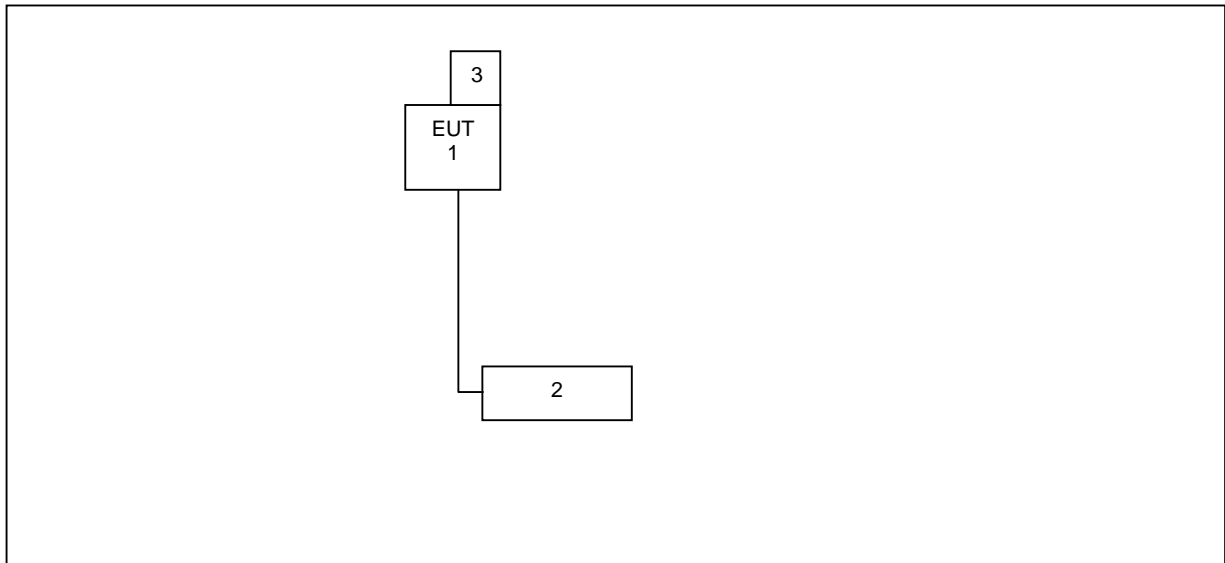
**Table 5-1: Support Equipment**

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Swarm Technologies	TRKR01	C3 (Radiated) C7 (RF Conducted)
2	Wall Wart Power Supply	Anker Innovations Limited	A2627	AFYQAJ0926171083
3	50-ohm Termination	Mini Circuits	ANNE-50+	N/A

**Table 5-2: Cable Description**

Item	Cable Type	Length	Shield	Termination
A	USB-C Cable	2 m	Yes	1 – 2

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



**Figure 6-1: Test Setup Block Diagram**

## 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

### 7.1 Antenna Requirement – FCC: Section 15.203

The EUT utilizes a Ceramic Chip Antenna. The antenna is integral to the device and cannot be removed or replaced by the end user. The gain of the antenna is 1 dBi.

### 7.2 Power Line Conducted Emissions – FCC: Section 15.207, ISED Canada: RSS-Gen Section 8.8

#### 7.2.1 Measurement Procedure

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**  
**Margin = Applicable Limit - Corrected Reading**

#### 7.2.2 Measurement Results

Performed by: Eugene Sello

**Table 7.2.2-1: Power Line Conducted Emissions – Line 1**

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
0.15	48.05	27.7	66	56	17.95	28.3	9.45
0.162	46.25	25.48	65.36	55.36	19.11	29.88	9.45
0.19	45.46	22.54	64.04	54.04	18.58	31.5	9.47
0.202	42.19	22.5	63.53	53.53	21.34	31.03	9.47
0.218	42.1	27.1	62.89	52.89	20.79	25.79	9.48
0.238	41.59	22.31	62.17	52.17	20.58	29.86	9.48
0.25	38.69	22.23	61.76	51.76	23.07	29.53	9.48
0.35	38.54	23.51	58.96	48.96	20.42	25.45	9.5
0.442	40.97	28.89	57.02	47.02	16.05	18.13	9.51
0.478	43.32	39.6	56.37	46.37	13.05	6.77	9.53

Table 7.2.2-2: Power Line Conducted Emissions – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
0.154	45.01	25.05	65.78	55.78	20.77	30.73	9.43
0.166	43.84	22.61	65.16	55.16	21.32	32.55	9.43
0.178	43.34	22.58	64.58	54.58	21.24	32	9.44
0.19	41.7	22.49	64.04	54.04	22.34	31.55	9.44
0.21	41.02	22.41	63.21	53.21	22.19	30.8	9.44
0.222	41.82	24.43	62.74	52.74	20.92	28.31	9.44
0.474	43.23	39.4	56.44	46.44	13.21	7.04	9.48
2.886	35.09	22.83	56	46	20.91	23.17	9.72
2.938	35.31	22.85	56	46	20.69	23.15	9.72
2.97	35.51	22.87	56	46	20.49	23.13	9.72

**7.3 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2), ISED Canada: RSS-247 Section 5.2(a), RSS-GEN Section 6.7****7.3.1 Measurement Procedure**

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 Section 8.2 which references Subclause 11.8 of ANSI C63.10. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to  $\geq 3$  times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

**7.3.2 Measurement Results**

Performed by: Ryan McGann

**Table 7.3.2-1: 6dB / 99% Bandwidth**

Modulation	Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
GFSK	2402	0.673268	1.010000
	2440	0.752475	1.035000
	2480	0.752475	1.040000

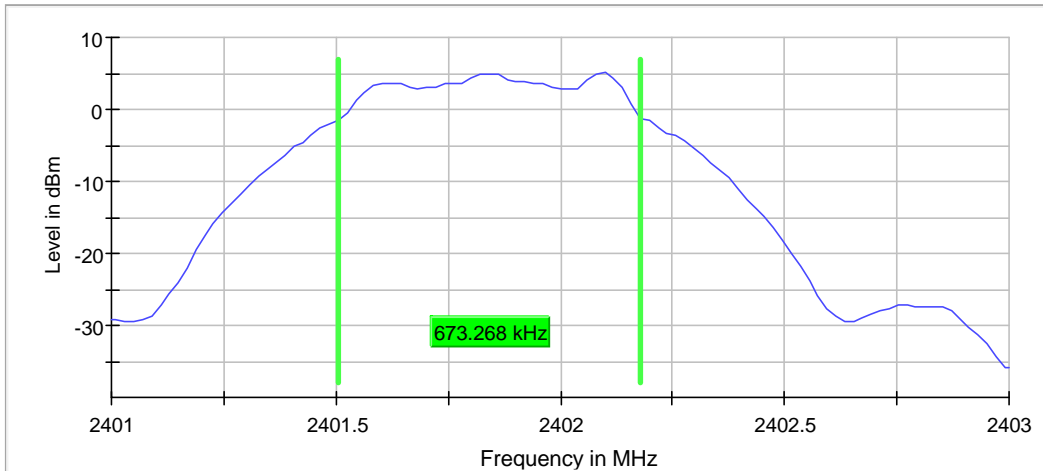


Figure 7.3.2-1: Sample Plot - 6dB BW

Table 7.3.2-2: Sample Measurement Settings (6dB BW)

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 $\mu$ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	14 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.04 dB	0.50 dB

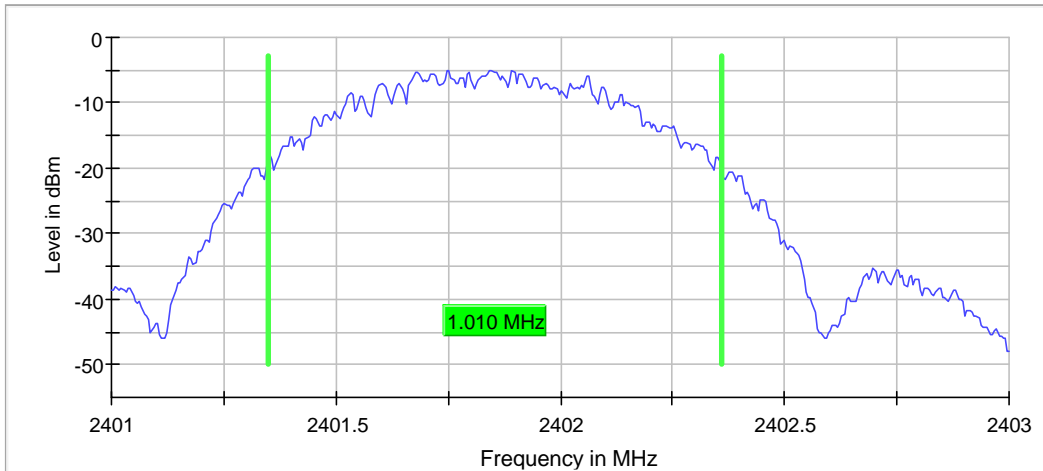


Figure 7.3.2-2: Sample Plot - 99% OBW

Table 7.3.2-3: Sample Measurement Settings (OBW)

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	>= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 $\mu$ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	7 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.15 dB	0.30 dB

**7.4 Fundamental Emission Output Power – FCC: Section 15.247(b)(3), ISED Canada: RSS-247 Section 5.4(d)**

**7.4.1 Measurement Procedure**

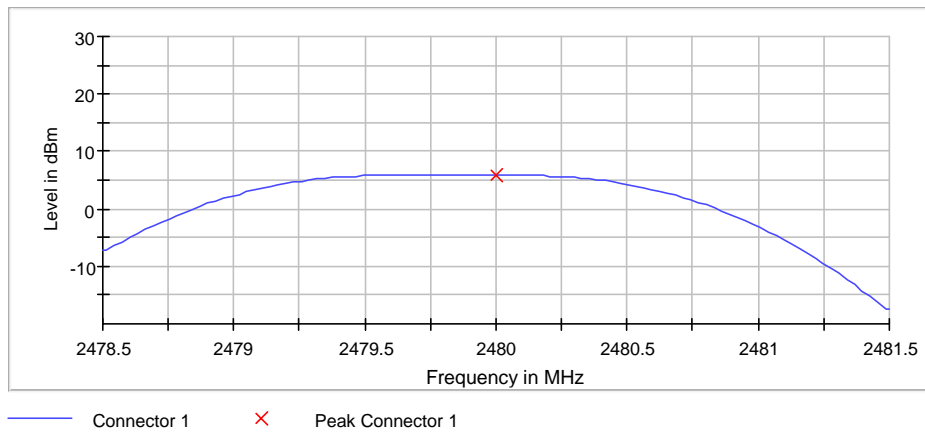
The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 utilizing the RBW ≥ DTS Bandwidth method. The RF output of the equipment under test was directly connected to the input of the analyzer applying suitable attenuation. Worst-case power across all data rates is reported.

**7.4.2 Measurement Results**

Performed by: Ryan McGann

**Table 7.4.2-1: Conducted Output Power**

Modulation	Frequency [MHz]	Peak Power [dBm]
GFSK	2402	5.3
	2440	5.5
	2480	5.8



**Figure 7.4.2-1: Sample Plot**

**Table 7.4.2-2: Sample Measurement Settings**

Setting	Instrument Value	Target Value
Start Frequency	2.47850 GHz	2.47850 GHz
Stop Frequency	2.48150 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz
RBW	1.000 MHz	≥ 752.476 kHz
VBW	3.000 MHz	≥ 3.000 MHz
SweepPoints	101	~ 101
SweepTime	1.907 μs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.02 dB	0.50 dB



7.5 Emission Levels

7.5.1 Emissions into Non-restricted Frequency Bands – FCC 15.247(d); ISED Canada: RSS-247 5.5

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 Section 8.5. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. The worst-case for each modulation was investigated at the lower and upper band edges.

7.5.1.2 Measurement Results

Performed by: Ryan McGann

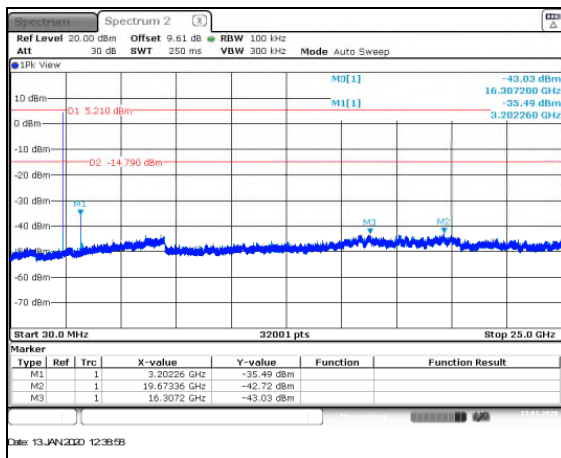


Figure 7.5.1.2-1: LCH – 30MHz–25GHz

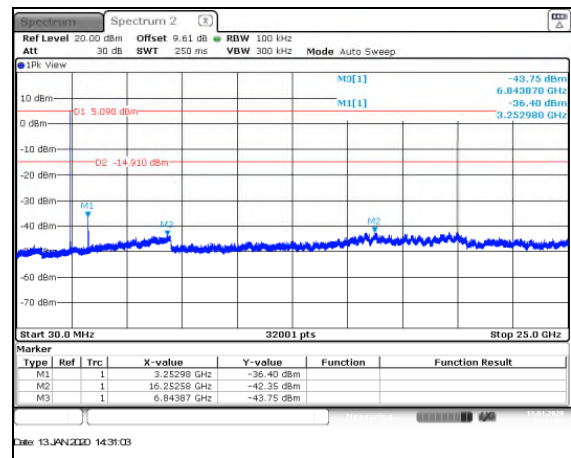


Figure 7.5.1.2-2: MCH – 30MHz–25GHz

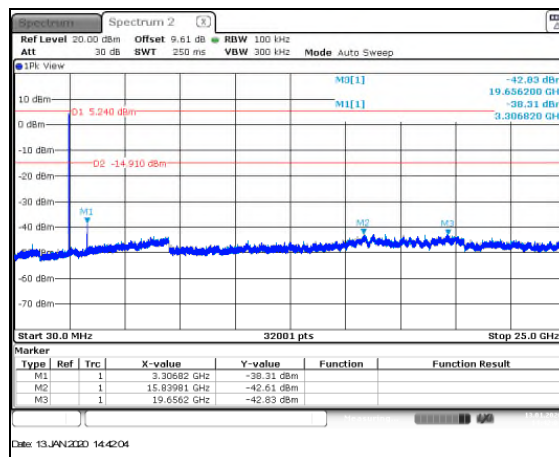


Figure 7.5.1.2-3: HCH – 30MHz–25GHz

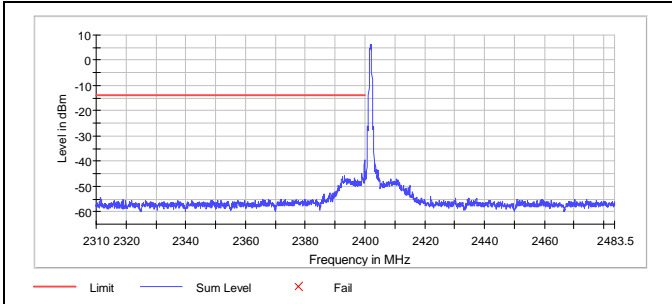


Figure 7.5.1.2-4: Lower Band-edge

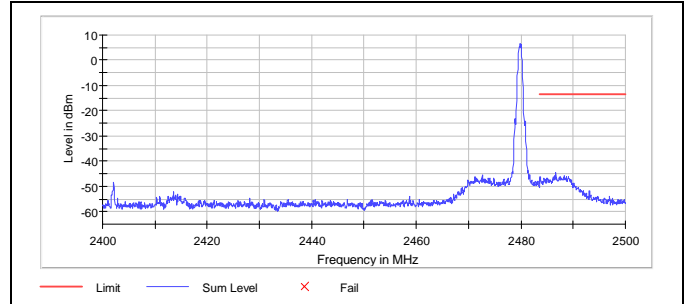


Figure 7.5.1.2-5: Upper Band-edge

Table 7.5.1.2-1: Lower Band-edge- Low Channel

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.875000	-39.3	25.6	-13.7	PASS
2399.825000	-39.4	25.7	-13.7	PASS
2399.775000	-41.6	27.9	-13.7	PASS
2399.925000	-42.6	29.0	-13.7	PASS
2399.025000	-45.0	31.4	-13.7	PASS
2399.975000	-45.5	31.8	-13.7	PASS
2393.225000	-45.8	32.1	-13.7	PASS
2399.075000	-45.8	32.1	-13.7	PASS
2393.275000	-46.0	32.3	-13.7	PASS
2398.975000	-46.3	32.6	-13.7	PASS
2392.475000	-46.3	32.6	-13.7	PASS
2392.425000	-46.4	32.7	-13.7	PASS
2399.725000	-46.7	33.0	-13.7	PASS
2396.325000	-46.8	33.1	-13.7	PASS
2399.275000	-46.8	33.1	-13.7	PASS

Table 7.5.1.2-2: Upper Band-edge – High Channel

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2486.675000	-44.4	30.9	-13.5	PASS
2486.725000	-45.1	31.6	-13.5	PASS
2486.625000	-45.4	31.9	-13.5	PASS
2488.275000	-45.7	32.3	-13.5	PASS
2486.425000	-45.8	32.4	-13.5	PASS
2487.525000	-46.1	32.6	-13.5	PASS
2486.225000	-46.1	32.7	-13.5	PASS
2486.175000	-46.2	32.7	-13.5	PASS
2488.225000	-46.2	32.8	-13.5	PASS
2486.375000	-46.2	32.8	-13.5	PASS
2489.125000	-46.2	32.8	-13.5	PASS
2487.375000	-46.2	32.8	-13.5	PASS
2487.575000	-46.3	32.8	-13.5	PASS
2488.325000	-46.3	32.9	-13.5	PASS
2483.725000	-46.4	32.9	-13.5	PASS

## 7.5.2 Emissions into Restricted Frequency Bands – FCC: 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

### 7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

### 7.5.2.2 Measurement Results

Performed by: Jeremy Pickens

**Table 7.5.2.2-1: Radiated Spurious Emissions Tabulated Data**

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Channel 0 (2402MHz)</b>										
2390	54.50	41.60	H	-1.17	53.33	40.43	74.0	54.0	20.7	13.6
2390	50.60	37.70	V	-1.17	49.43	36.53	74.0	54.0	24.6	17.5
4804	48.50	37.80	H	3.29	51.79	41.09	74.0	54.0	22.2	12.9
4804	48.40	36.50	V	3.29	51.69	39.79	74.0	54.0	22.3	14.2
<b>Channel 19 (2440MHz)</b>										
4882	48	36.4	H	3.34	51.34	39.74	74.0	54.0	22.7	14.3
4882	48.1	37.4	V	3.34	51.44	40.74	74.0	54.0	22.6	13.3
<b>Channel 39 (2480MHz)</b>										
2483.5	56.30	42.80	H	-0.96	55.34	41.84	74.0	54.0	18.7	12.2
2483.5	53.00	39.50	V	-0.96	52.04	38.54	74.0	54.0	22.0	15.5
4960	47.2	36	H	3.38	50.58	39.38	74.0	54.0	23.4	14.6
4960	47.5	36.7	V	3.38	50.88	40.08	74.0	54.0	23.1	13.9

**7.5.2.3 Sample Calculation:**

$$R_C = R_U + CF_T$$

Where:

 $CF_T =$  Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) $R_U =$  Uncorrected Reading $R_C =$  Corrected Level $AF =$  Antenna Factor $CA =$  Cable Attenuation $AG =$  Amplifier Gain $DC =$  Duty Cycle Correction Factor**Example Calculation: Peak**Corrected Level:  $56.30 - 0.96 = 55.34\text{dBuV/m}$ Margin:  $74\text{dBuV/m} - 55.34\text{dBuV/m} = 18.7\text{dB}$ **Example Calculation: Average**Corrected Level:  $42.80 - 0.96 - 0 = 41.84\text{dBuV}$ Margin:  $54\text{dBuV} - 41.84\text{dBuV} = 12.2\text{dB}$

**7.6 Maximum Power Spectral Density in the Fundamental Emission – FCC 15.247(e) ISED Canada: RSS-247 5.2(b)**

**7.6.1 Measurement Procedure**

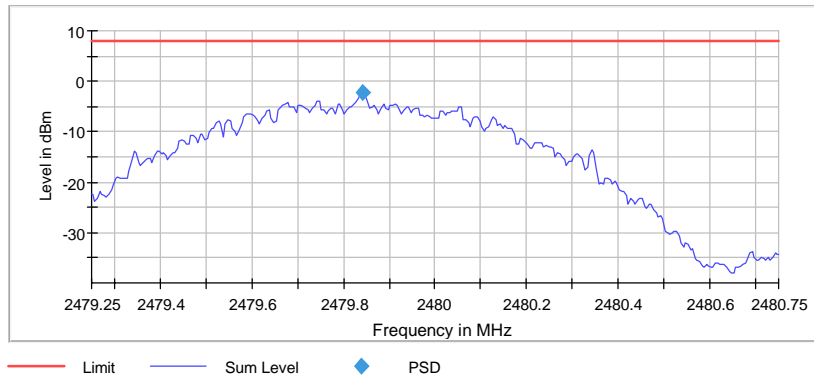
The power spectral density was measured in accordance with the FCC KDB 558074 D01 utilizing Section 8.4. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 10 kHz. The Video Bandwidth (VBW) was set to 30 kHz. Span was set to 1.5 times the channel bandwidth. The trace was set to max hold with the peak detector active.

**7.6.2 Measurement Results**

Performed by: Ryan McGann

**Table 7.6.2-1: Power Spectral Density**

Modulation	Frequency (MHz)	PSD (dBm)
GFSK	2402	-4.814
	2440	-2.984
	2480	-2.249



**Figure 7.6.2-1: Sample PSD Plot**

**Table 7.6.2-2: Sample Measurement Settings (PSD)**

Setting	Instrument Value	Target Value
Start Frequency	2.47925 GHz	2.47925 GHz
Stop Frequency	2.48075 GHz	2.48075 GHz
Span	1.500 MHz	1.500 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	300	~ 300
Sweeptime	1.500 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	7 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.22 dB	0.50 dB

## 8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures ( $U_{\text{Lab}}$ ) provided below correspond to an expansion factor (coverage factor)  $k = 1.96$  which provide confidence levels of 95%.

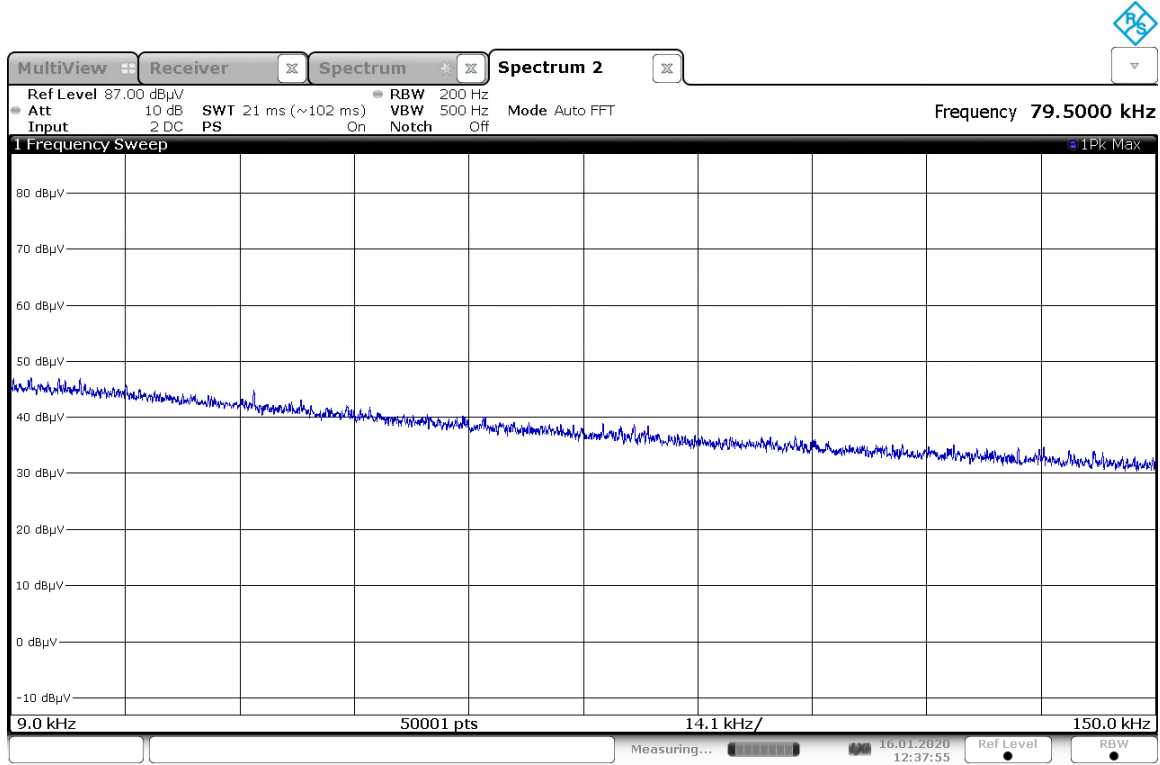
**Table 8-1: Estimation of Measurement Uncertainty**

Parameter	$U_{\text{lab}}$
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^\circ\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

## 9 CONCLUSION

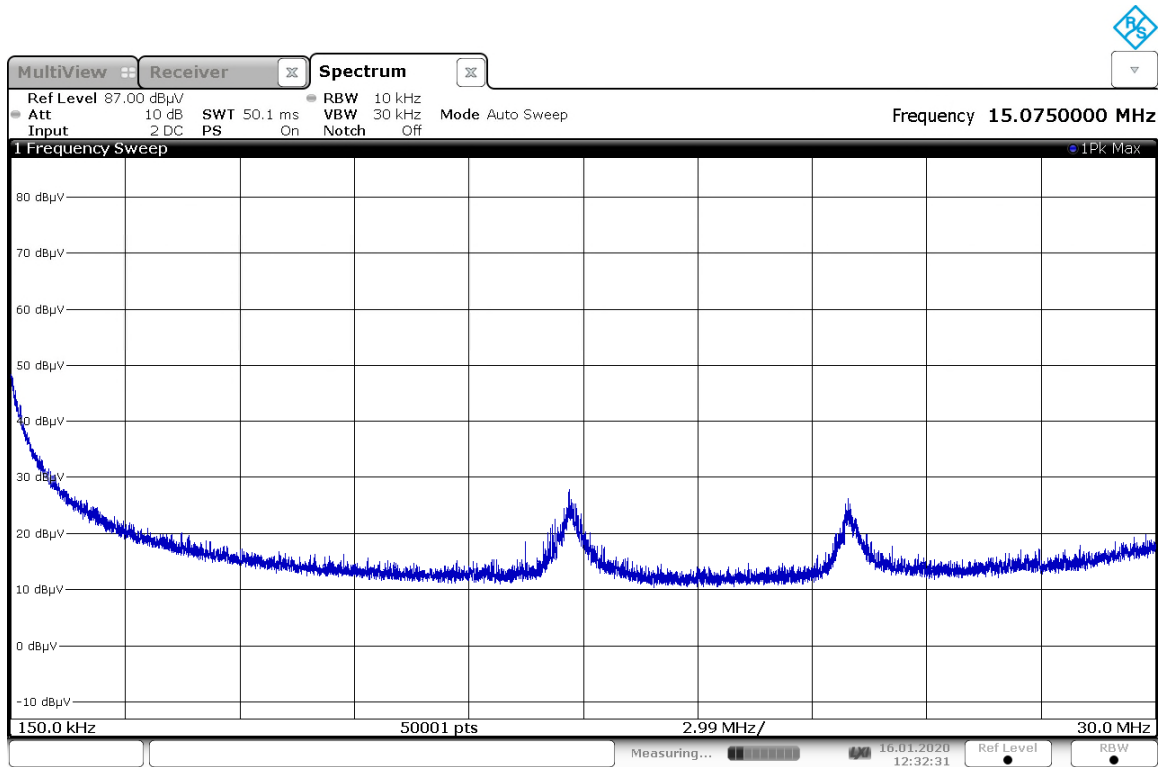
In the opinion of TUV SUD the Tracker, manufactured by Swarm Technologies meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for the tests documented herein.

## Appendix A: Plots



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Figure A-1: 9kHz-150kHz

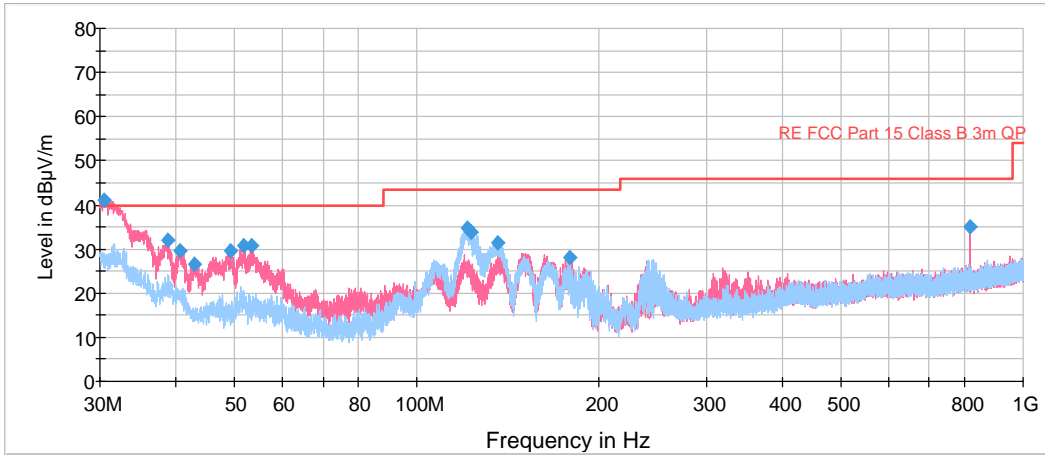


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Figure A-2: 150kHz-30MHz



Full Spectrum



Note: Emissions above the noise floor are from the digital sections of the DUT and not associated with the radio.

Figure A-3: 30MHz-1GHz

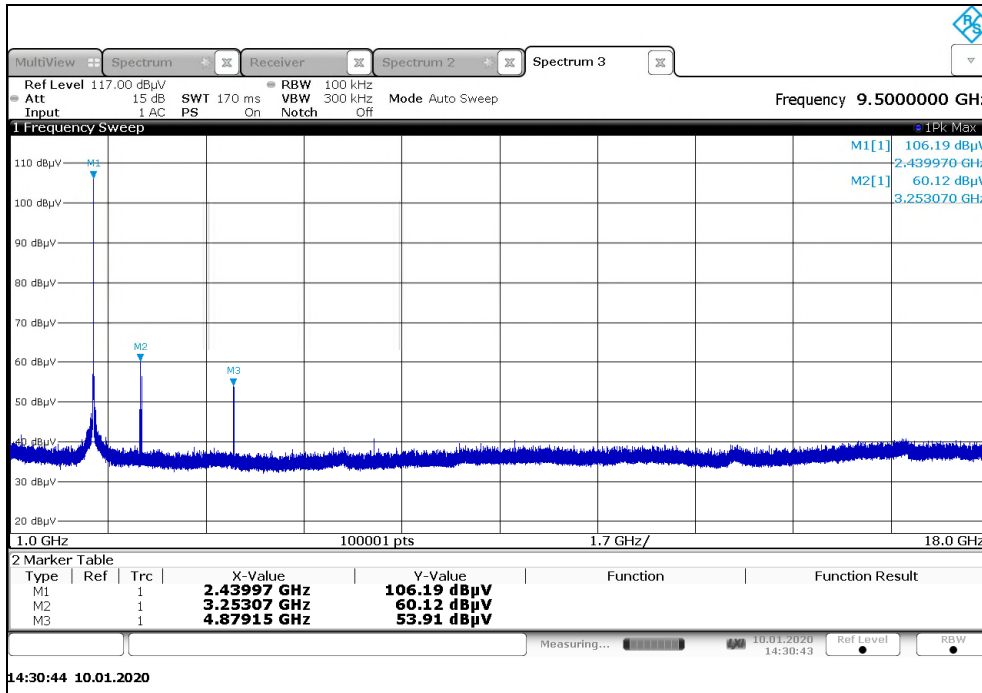


Figure A-4: 1GHz-18GHz

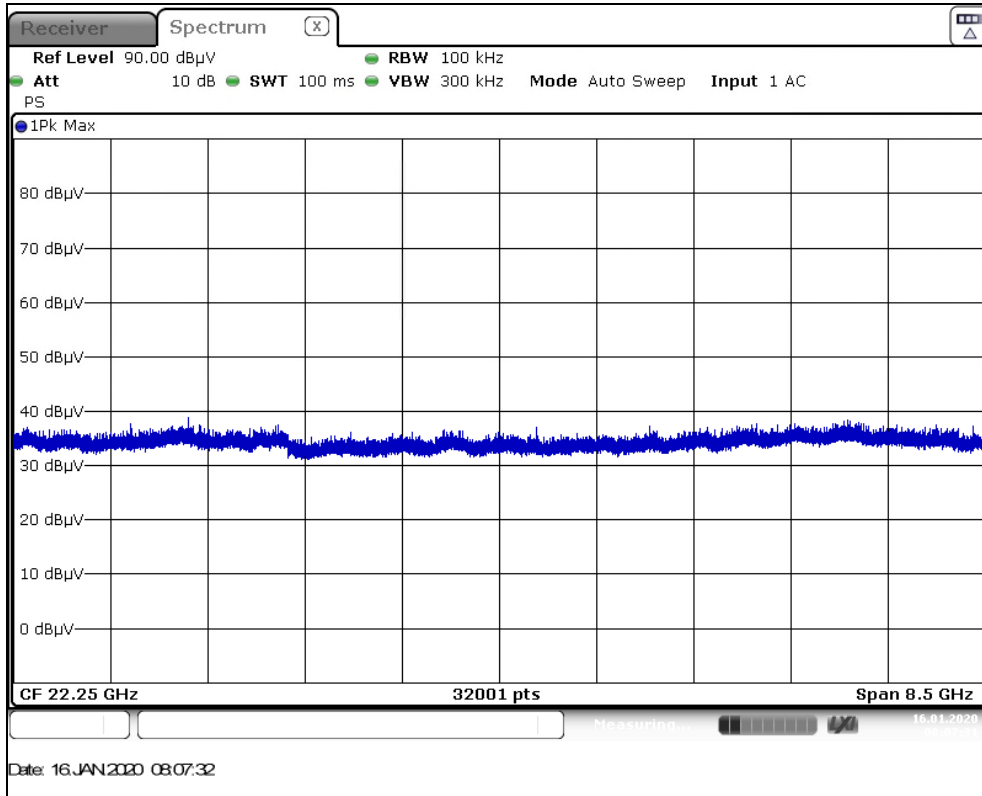


Figure A-5: 18GHz-25GHz

**END REPORT**