

# Test Report

<b>Product</b>	Animal Collar for Sheep/Goat
<b>Name and address of the applicant</b>	Nofence Evjevegen 8, 6631 Batnfjordsøra, Norway
<b>Name and address of the manufacturer</b>	Nofence Evjevegen 8, 6631 Batnfjordsøra, Norway
<b>Model</b>	SG2
<b>Rating</b>	3.6VDC, rechargeable battery
<b>Trademark</b>	Nofence
<b>Serial number</b>	See page 3
<b>Additional information</b>	This test report covers Bluetooth Low Energy and intermodulation measurements. This device contains following FCC/ISED certified modules: - U-blox LTE-M FCC ID:XPYUBX18ZO01, ISED ID:8595A-UBX18ZO01
<b>Tested according to</b>	<b>FCC Part 15.247</b> Frequency Hopping Transmitters / Digital Transmission Systems <b>Industry Canada RSS-247, Issue 2</b> Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices FCC KDB 996369 D04 Module Integration Guide V01, section 2e Modular transmitter integration guide-guidance for host product manufactures composite system operation (Co-Location)
<b>Order number</b>	450722
<b>Tested in period</b>	2021-11-09 – 2021-11-12
<b>Issue date</b>	2022-05-20
<b>Name and address of the testing laboratory</b>	<div> Nemko Scandinavia AS  Instituttveien 6,  2007 Kjeller,  Norway </div> <div> CAB Number:  FCC: NO0001  ISED: NO0470    TEL: +47 22 96 03 30 </div> <div>   </div>
An accredited technical test executed under the Norwegian accreditation scheme	
<div> <div>  </div> <div>  </div> </div> <div> Prepared by [G.Suhanthakumar] </div> <div> Approved by [Frode Sveinsen] </div>	
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## Nemko Group

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# 1 INFORMATION

## 1.1 Test Item

Name	Nofence collar
Model/version	SG2
FCC ID	2A3V8SG2
ISED ID	2801-SG2
Serial number	Radiated sample: 58970 Conducted sample: Marked as 4507220002
Hardware identity and/or version	SG2
Software identity and/or version	FW 182,29,20,157,[267]
Frequency Range	2402–2480 MHz
Number of Channels	40
Operating Modes	TX/RX
Type of Modulation	GFSK
Conducted Output Power	1.10 mW (Peak)
Antenna Connector	None. integral antenna type-BLE: PCB integral antenna type-LTE M: Ethertronics P822601
Number of Antennas	1 for BLE and 1 for LTE-M
Diversity or Smart Antennas	No
Power Supply	Rechargeble Li-Ion polymer Battery (3.6Vdc)
Desktop Charger	Yes, Note 1

Note 1: Battery should be removed from the EUT and charged separately. The device can not be operated during charging.

### Description of Test Item

The tested device is an animal collar for sheep/goat. It contains BLE chip from Nordic semiconductor type nRF5282-QFAA.

In addition it contains certified LTE-M module from U-blox SARA-R412M-02B (FCC ID: XPYUBX18ZO01, ISED ID:8595A-UBX18ZO01) and GNSS module from U-blox ZOE-M8B

## 1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3.6V DC

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

G.Suwanthakumar

## 1.4 Antenna Requirement

Does the EUT have detachable antenna(s)?	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO
If detachable, is the antenna connector(s) non-standard?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
The tested equipment has only integral antennas. Conducted tests were performed with a temporary antenna connector.		

Requirement: FCC 15.203, 15.204

## 1.5 EUT Operating Modes

Description of operating modes	Continuous TX with GFSK modulation
Additional information	The following settings were used for all tests: Power Setting: 4 dBm Data rate: 1Mbit/s
	BLE in simulatenious mode with 2g and LTE-M bands.

## 1.6 Comments

All measurements were done with the EUT powered by a fully charged battery.

No intermodulation products were detected during BLE and 2g/LTE simulatenious transmissions. The output power level during simulatenious transmissions was set to maximum. The test results are given in page 24 to 28.

## 2 TEST REPORT SUMMARY

### 2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with FCC and ISSED.

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

**DTS** Equipment Code

☐ Family Listing



#### THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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## 2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A <sup>1</sup>
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies <sup>2</sup>
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A <sup>1</sup>
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	-
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 1	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	11.10.2 PKPSD (DTS)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 11.11 (DTS) 7.8.6 (FHSS) 7.8.8 (FHSS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

<sup>1</sup> The tested equipment only operates with battery

<sup>2</sup> Integral antenna.

-Only for information

## Revision history

Revision	Date	Comment	Sign
00	2022-01-25	First edition	gns
01	2022-03-03	FCC and ISSED ID numbers are included	gns
02	2022-05-20	Duty cycle corrected	gns

### 3 TEST RESULTS

#### 3.1 Occupied Bandwidth (99% BW)

FCC Part 15.247 (a)(1)(iii)

ISED Canada RSS-247 Issue 2, Clause 5.1

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3 / 7.8.3

Test Results: Complies

##### Measurement Data:

Carrier Frequency and Data Rate	Occupied Bandwidth (99% BW)
2402 MHz/1Mbit/s	905.45 kHz
2440 MHz/1Mbit/s	945.51 kHz
2480 MHz/1Mbit/s	952.52 kHz

Occupied Bandwidth is the same for all channels

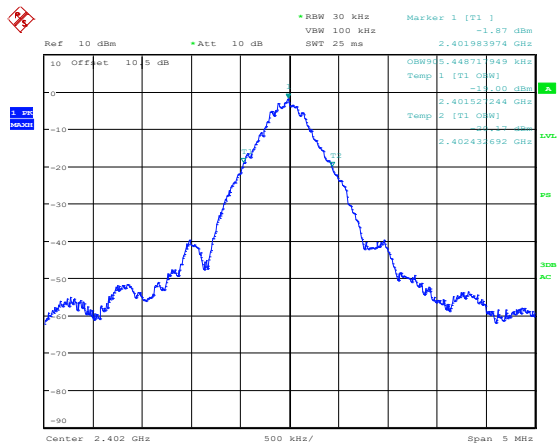
See attached plots.

##### Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

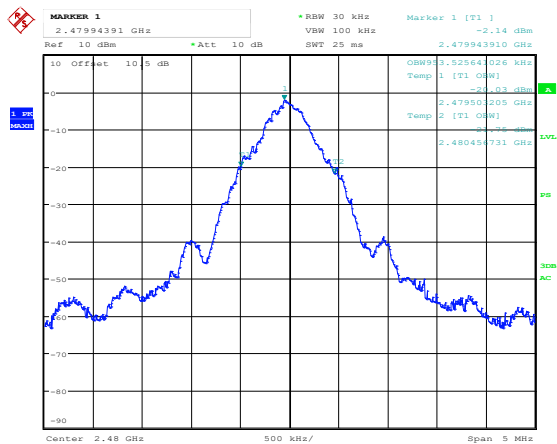
No requirements for Digital Transmission Systems.

No requirement for 99% BW, reported for information only.



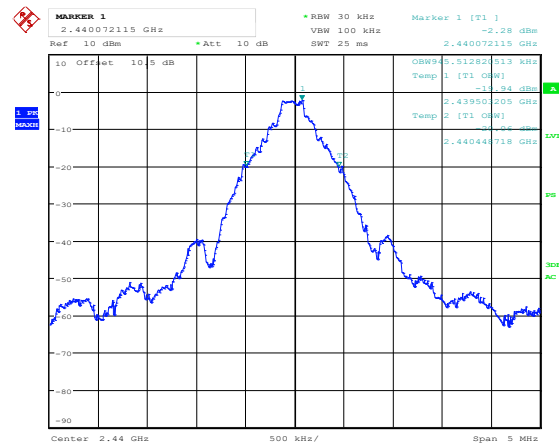
Date: 10.NOV.2021 13:42:30

### 99% Occupied BW, GFSK, ch2402MHz



Date: 10.NOV.2021 13:32:37

### 99% Occupied BW, GFSK, ch2480MHz



Date: 10.NOV.2021 13:50:23

### 99% Occupied BW, GFSK, ch2440MHz



### 3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 2, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

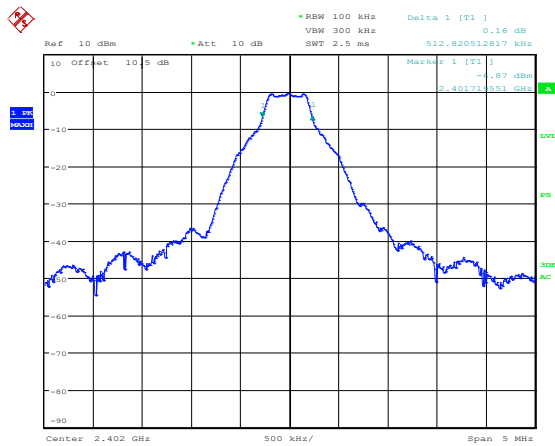
#### Measurement Data:

Operating Mode	DTS Bandwidth (6dB BW)		
	2402 MHz	2440 MHz	2480 MHz
GFSK, 1Mb/s	512.82 kHz	512.82 kHz	512.82 kHz

#### Requirements:

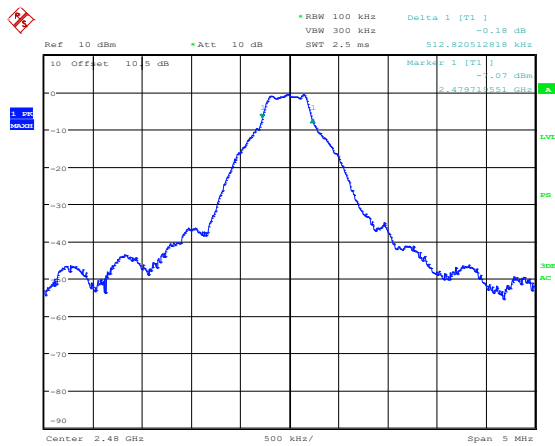
For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

No requirements for Frequency Hopping Systems.



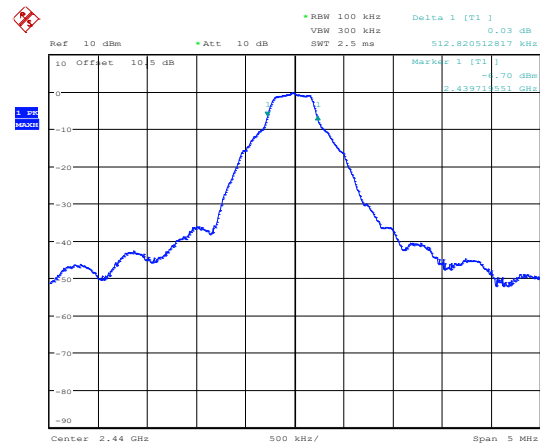
Date: 10.NOV.2021 13:43:03

### DTS BW, 2402 MHz, 1Mb



Date: 10.NOV.2021 13:33:32

### DTS BW, 2480 MHz, 1Mb



Date: 10.NOV.2021 13:50:01

### DTS BW, 2440 MHz, 1Mb

### 3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

#### Measurement Data:

Carrier Frequency (MHz)	Modulation Type	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dBμV/m)	EIRP (mW)	Antenna gain (dBi)
2402	GFSK	0.29	1.07	101.32	4.07	5.8
2440	GFSK	0.43	1.10	103.72	7.07	8.1
2480	GFSK	0.32	1.08	102.02	4.78	6.5

The maximum radiated field strength is obtained in YZ plane and Vertical polarization.

Output Power reported is Maximum Peak Power.

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

See attached plots.

#### Requirements:

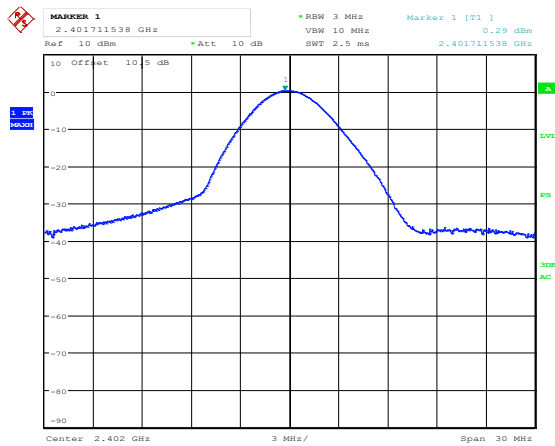
The maximum peak output power shall not exceed the following limits:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

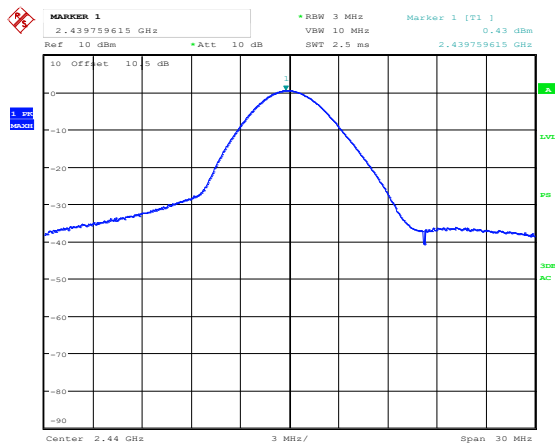
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



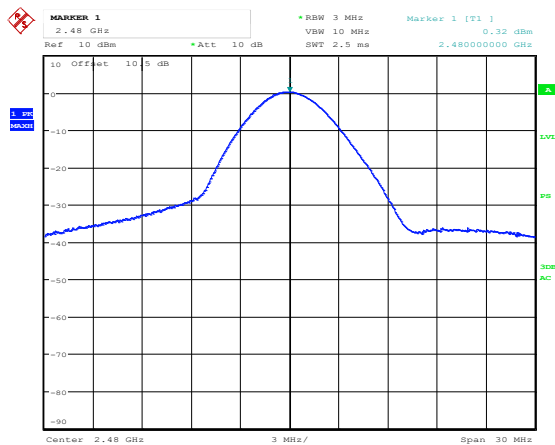
Date: 10.NOV.2021 13:37:40

### Peak Power, 2402 MHz, GFSK



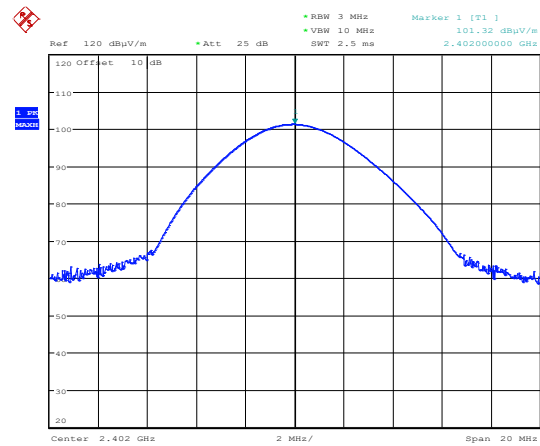
Date: 10.NOV.2021 13:51:21

### Peak Power, 2440 MHz, GFSK



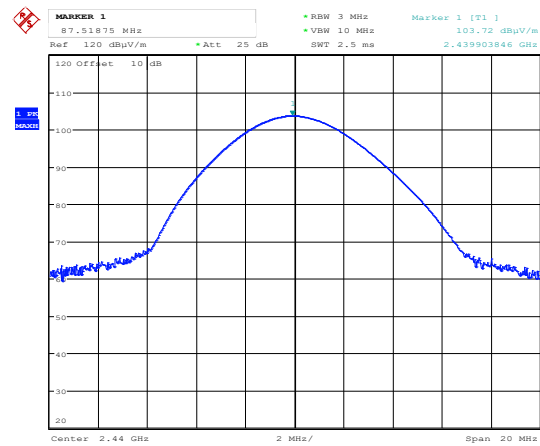
Date: 10.NOV.2021 13:32:07

### Peak Power, 2480 MHz, GFSK



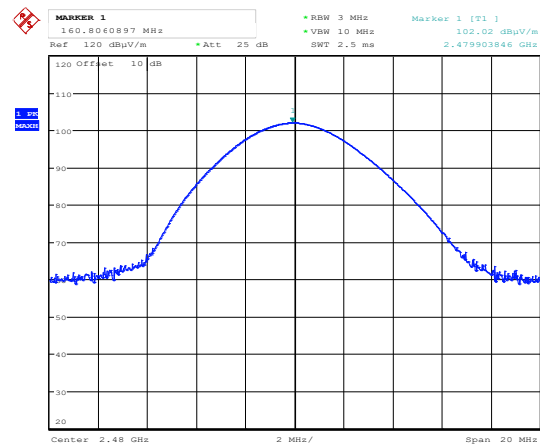
Date: 9.NOV.2021 16:20:56

### Maximum Field Strength, 2402 MHz, GFSK



Date: 10.NOV.2021 09:22:58

### Maximum Field Strength, 2440 MHz, GFSK



Date: 9.NOV.2021 16:43:10

### Maximum Field Strength, 2480 MHz, GFSK

### 3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

#### Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	45.32	> 20	Pass
2440 MHz	45.07	> 20	Pass
2480 MHz	43.27	> 20	Pass

Measured with Peak Detector

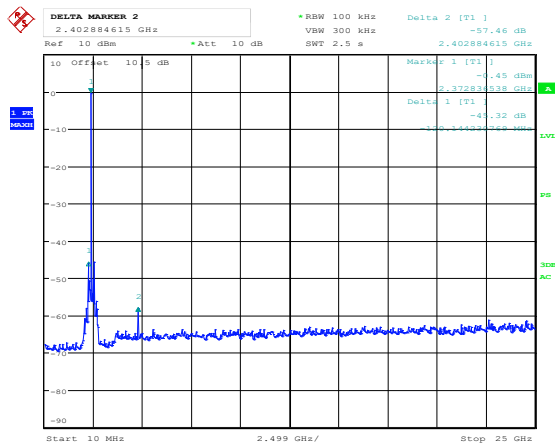
RF conducted power to 25 GHz: see attached plots.

#### Limit

Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

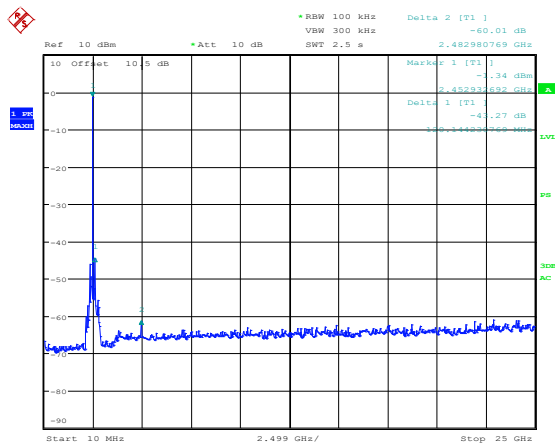
Detector type shall be the same as used for measuring Output Power.

Attenuation below the general limits specified in part 15.209(a) is not required.



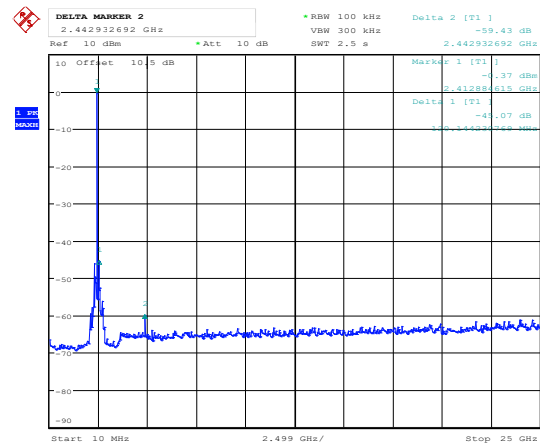
Date: 10.NOV.2021 13:44:23

### Conducted Emissions 10-25000 MHz, 2402 MHz, GFSK



Date: 10.NOV.2021 13:30:33

### Conducted Emissions 10-25000 MHz, 2440 MHz, GFSK



Date: 10.NOV.2021 13:47:18

### Conducted Emissions 10 - 25000 MHz, 2440 MHz, GFSK

### 3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISCED are defined in FCC Part 15.205 and ISCED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISCED Canada (MHz)	FCC (GHz)	ISCED Canada (GHz)
0.090-0.110		<b>0.96-1.24</b> <b>1.3-1.427</b>	<b>0.96-1.427</b>
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	<b>3.020-3.026</b>	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	<b>5.677-5.683</b>	2.4835-2.5	
6.215-6.218		<b>2.69-2.9</b>	<b>2.655-2.9</b>
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		<b>3.6-4.4</b>	<b>3.5-4.4</b>
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
<b>108-121.94</b> <b>123-138</b>	<b>108-138</b>	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISCED, all other frequencies are common.

### 3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

#### Measurement Data:

Carrier Frequency and Data Rate	Band Edge Frequency	Measured Field Strength (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
		Peak Detector	Average Detector	Peak Det	Average Det	Peak Det	Average Det
2402 MHz GFSK	2376 MHz	54.69	34.69	74	54	19.31	19.31
2480 MHz GFSK	2483.5 MHz	66.07	46.07			7.93	7.93

Average Detector values are measured with Peak Detector and corrected for Duty Cycle.

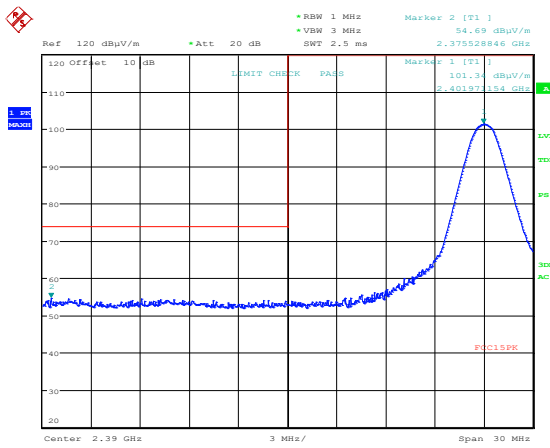
See attached plots.

**Duty Cycle Correction Factor Calculation: According to the operational discription..**

Duty Cycle Correction factor =  $-20 \times \log(1.152 \text{ ms}/100 \text{ ms}) = -38.77 \text{ dB}$

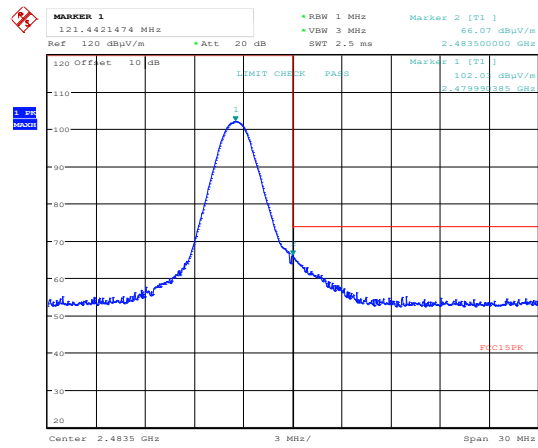
**Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB**





Date: 9.NOV.2021 16:21:40

**Lower Band Edge 2402 MHz, GFSK, Peak**



Date: 9.NOV.2021 16:44:06

**Upper Band Edge 2480 MHz, GFSK, Peak**

### 3.8 Radiated Emission, 30 – 1000 MHz.

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

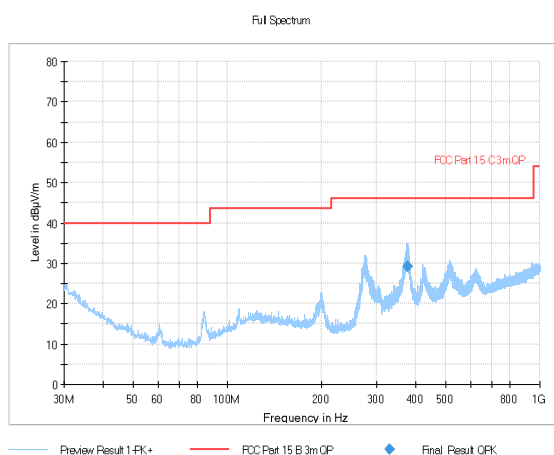
#### Measurement Data:

Detector: Peak (found frequencies were measured with Quasi-Peak Detector)

Measuring distance 3 m

Tested in active mode.

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
376.296300	29.31	46.00	16.69	1000.0	120.000	102.0	H	106.0



#### Radiated Emissions 30 - 1000 MHz, GFSK

#### Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 $\mu$ V/m	40.0 dB $\mu$ V/m
88 – 216 MHz	150 $\mu$ V/m	43.5 dB $\mu$ V/m
216 – 960 MHz	200 $\mu$ V/m	46.0 dB $\mu$ V/m
960 – 1000 MHz	500 $\mu$ V/m	54.0 dB $\mu$ V/m
Limits above are with Quasi Peak Detector		

### 3.9 Radiated Emissions, 1-26 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector, RBW=1 MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Modulation	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2402	7.205	GFSK	54.38	74	/
2440	7.32	GFSK	51.32	74	21.53
2480	7.439	GFSK	50.37	74	/

Average Detector, RBW=1 MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Modulation	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2402	7.205	GFSK	34.38	54	19.62
2440	7.32	GFSK	/	54	/
2480	7.439	GFSK	/	54	/

Duty Cycle Correction Factor Calculation: According to the operational discription..

Duty Cycle Correction factor =  $-20 \times \log(1.152 \text{ ms}/100 \text{ ms}) = -38.77 \text{ dB}$

Average Detector values are calculated from Peak values by Duty Cycle Correction Factor

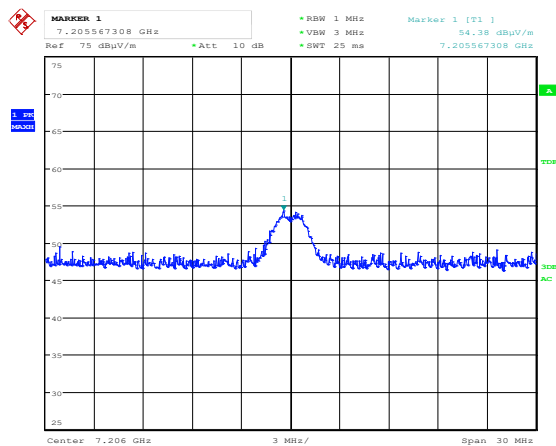
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor"

See plots

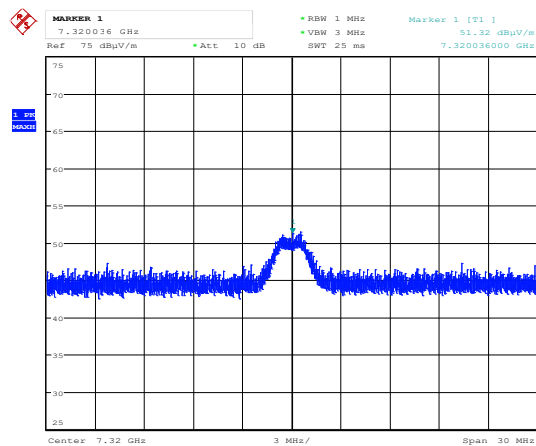
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 26 GHz	54.0 dBμV/m	74.0 dBμV/m



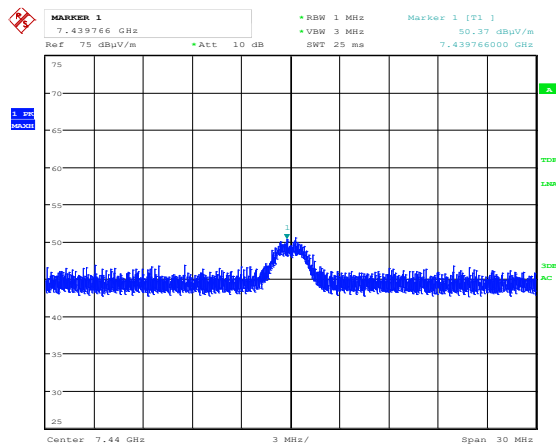
Date: 9.NOV.2021 16:04:05

### 3<sup>rd</sup> harmonic, ch2402MHz,VP, PK



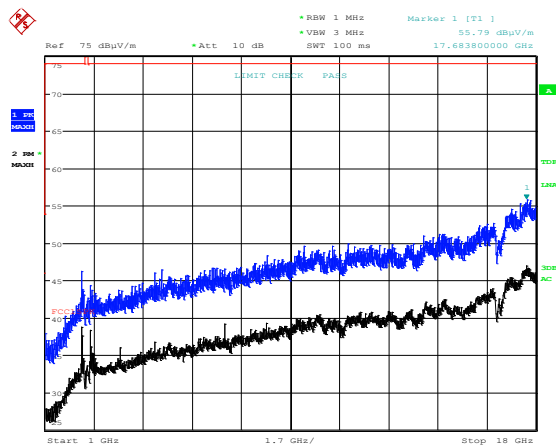
Date: 10.NOV.2021 09:00:42

### 3<sup>rd</sup> harmonic, ch2440MHz,VP, PK



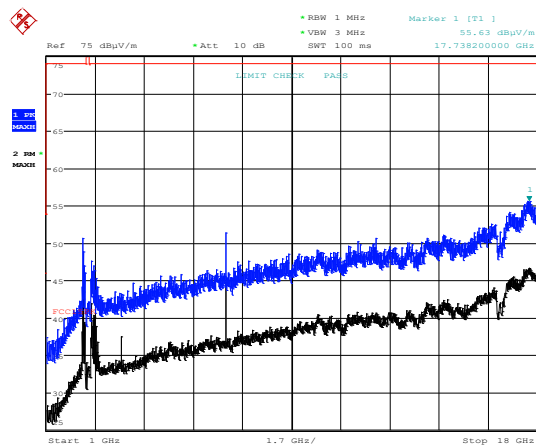
Date: 10.NOV.2021 09:05:42

### 3<sup>rd</sup> harmonic, ch2480MHz,VP, PK



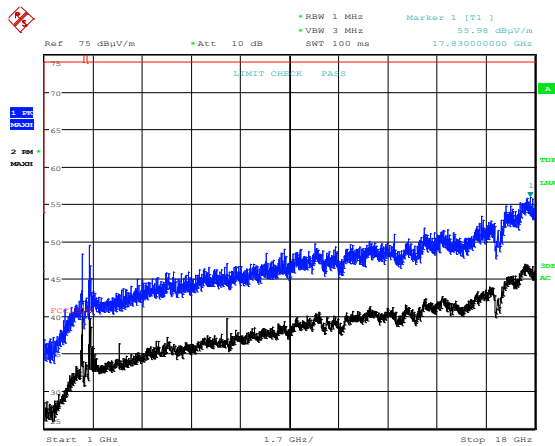
Date: 9.NOV.2021 15:53:02

### Radiated Emissions 1 - 18 GHz, 2402 MHz, GFSK, HP



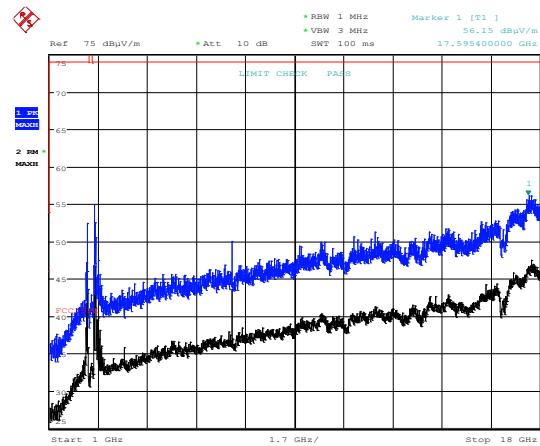
Date: 9.NOV.2021 15:51:12

### Radiated Emissions 1 - 18 GHz, 2402 MHz, GFSK, VP



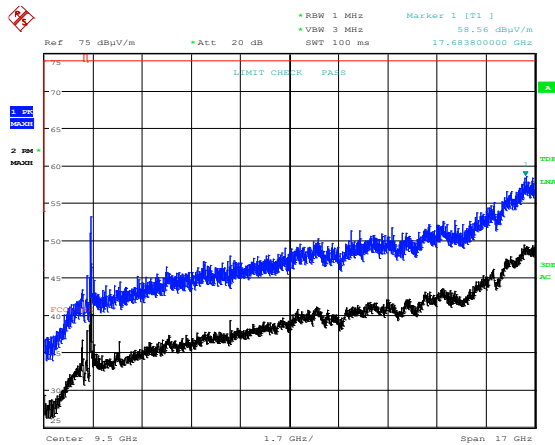
Date: 10.NOV.2021 08:55:17

### Radiated Emissions 1 - 18 GHz, 2440 MHz, GFSK, HP



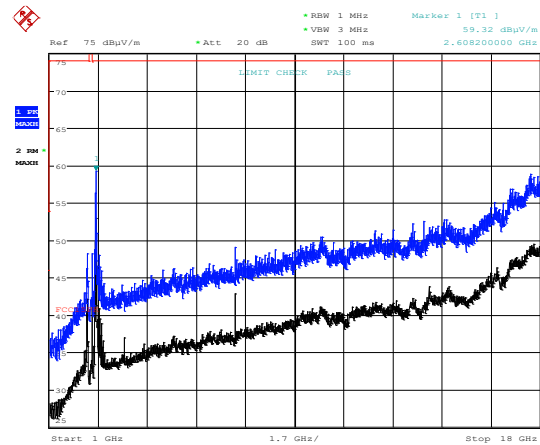
Date: 10.NOV.2021 08:53:27

### Radiated Emissions 1 - 18 GHz, 2440 MHz, GFSK, VP



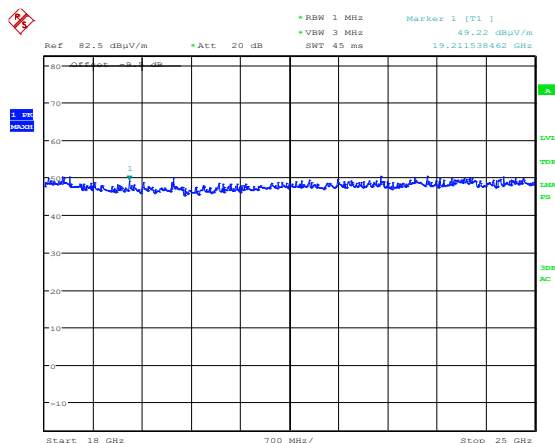
Date: 10.NOV.2021 07:20:27

### Radiated Emissions 1 - 18 GHz, 2480 MHz, GFSK, HP



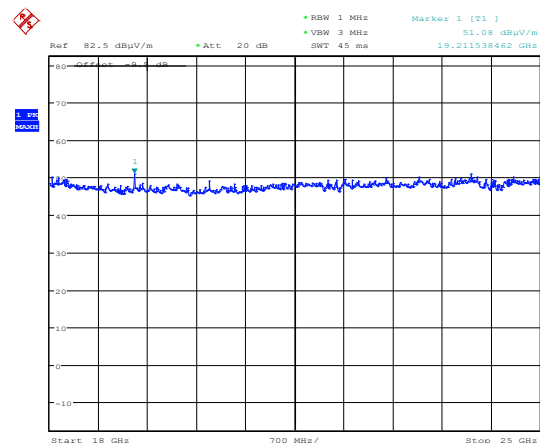
Date: 10.NOV.2021 07:18:37

### Radiated Emissions 1 - 18 GHz, 2480 MHz, GFSK, VP



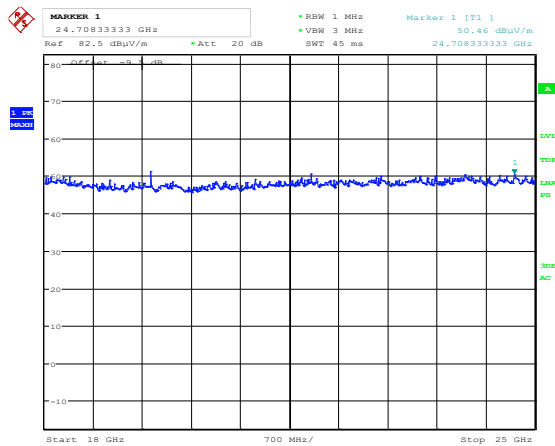
Date: 10.NOV.2021 09:53:44

### Radiated Emissions 18 - 25 GHz, 2402 MHz, GFSK, HP, pk scan @1m



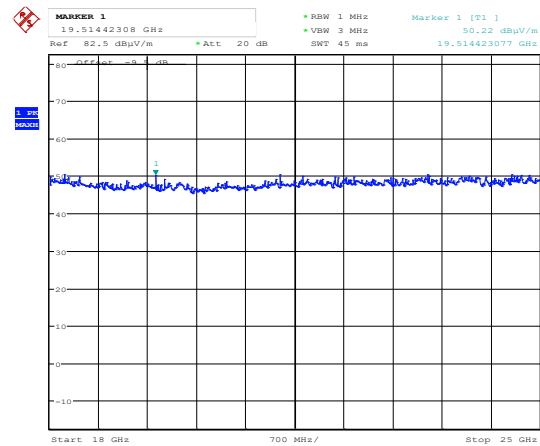
Date: 10.NOV.2021 09:53:23

### Radiated Emissions 18 - 25 GHz, 2402 MHz, GFSK, VP, pk scan @1m



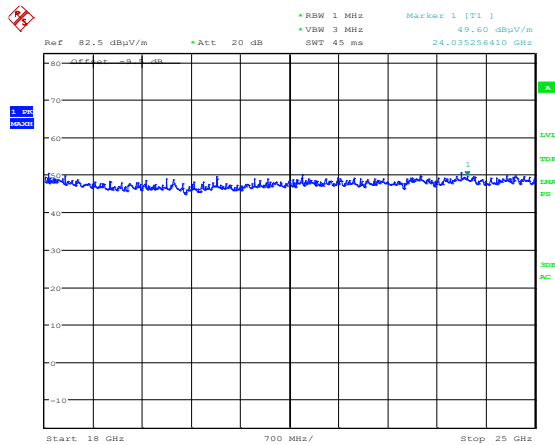
Date: 10.NOV.2021 09:38:07

**Radiated Emissions 18 - 25 GHz, 2440 MHz, GFSK, HP, pk scan @1m**



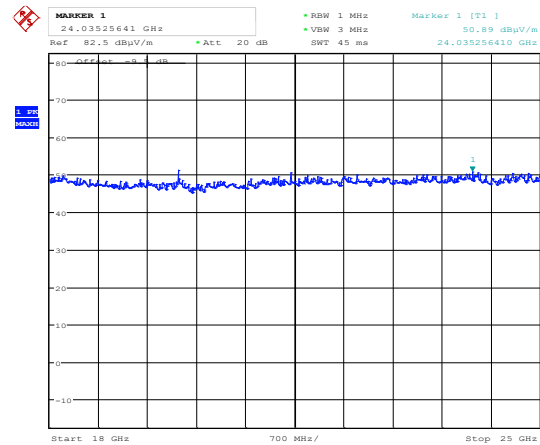
Date: 10.NOV.2021 09:38:38

**Radiated Emissions 18 - 25 GHz, 2440 MHz, GFSK, VP, pk scan @1m**



Date: 10.NOV.2021 09:56:24

**Radiated Emissions 18 - 25 GHz, 2480 MHz, GFSK, HP, pk scan @1m**

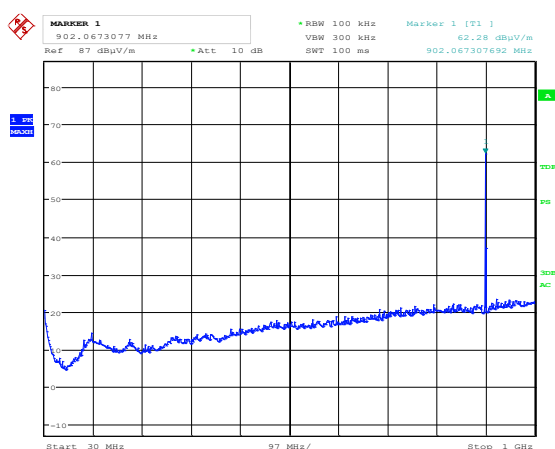


Date: 10.NOV.2021 09:56:05

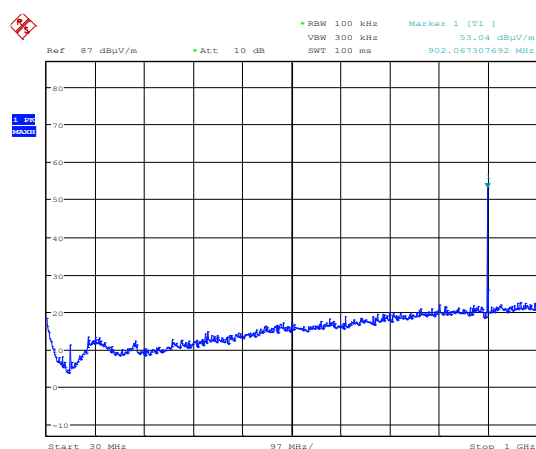
**Radiated Emissions 18 - 25 GHz, 2480 MHz, GFSK, VP, pk scan @1m**

### Intermodulation radiated spurious emissions BLE with 2G/LTE cat-M:

Used LTE cat M Band number	Frequency (MHz)	Intermodulation products
2	1909.21	None detected
3 and 4	1710.67	None detected
5	824.67	None detected
12	715.2	None detected
20	832.8	None detected
Used 2 g bands	-	-
900MHz	902	None detected
1800MHz	1748	None detected

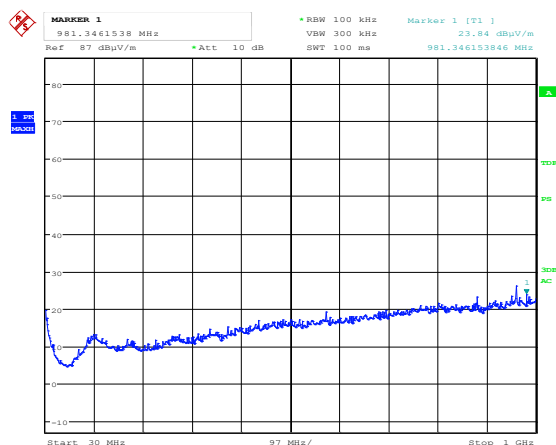


Date: 11.NOV.2021 16:11:17



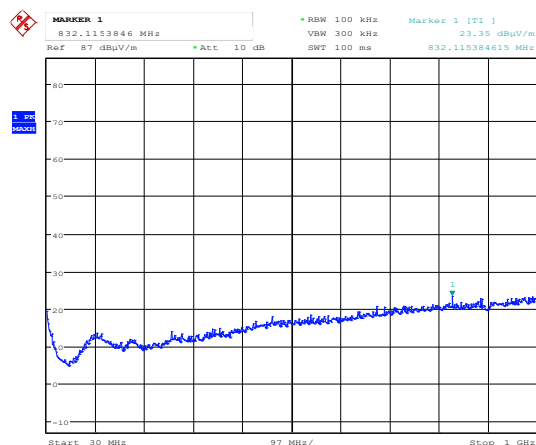
Date: 11.NOV.2021 16:11:37

### Radiated Emissions 30 - 1000 MHz,2g band 900/BLE, HP ,pk scan



Date: 11.NOV.2021 16:09:57

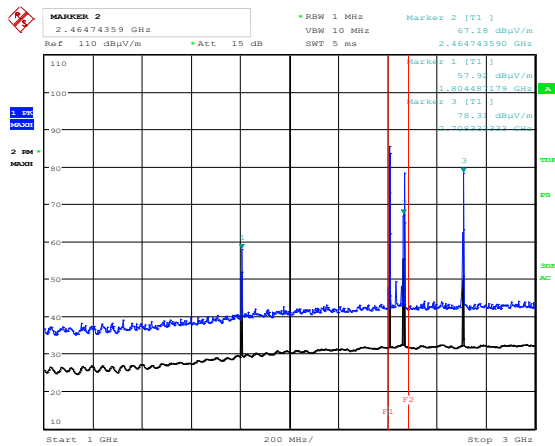
### Radiated Emissions 30 - 1000 MHz,2g band 900/BLE, VP ,pk scan



Date: 11.NOV.2021 16:09:15

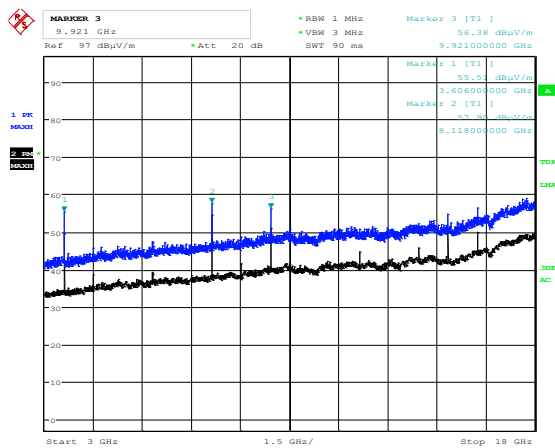
### Radiated Emissions 30 - 1000 MHz,LTE band 3 and 4/BLE, HP ,pk scan

### Radiated Emissions 30 - 1000 MHz,LTE band 3 and 4/BLE, VP ,pk scan



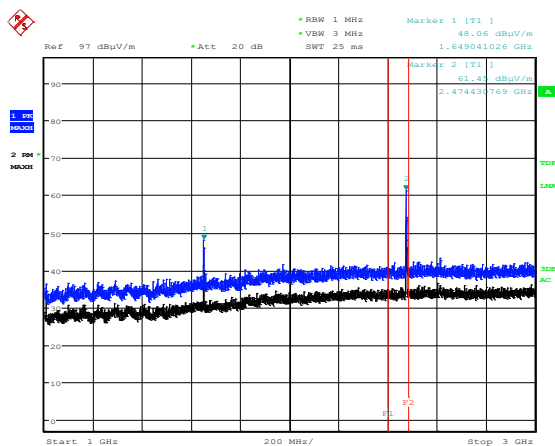
Date: 11.NOV.2021 15:27:26

### Radiated Emissions 1 - 3GHz, 2G band 900/BLE, HP, pk scan



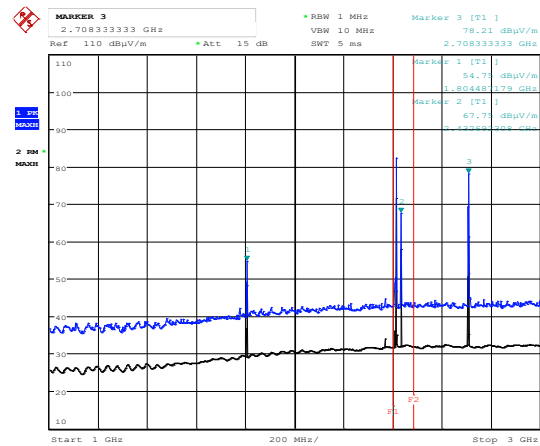
Date: 11.NOV.2021 15:08:03

### Radiated Emissions 3 - 18GHz, 2g band 900/BLE, HP, pk scan (only harmonics of 900MHz are detected above)



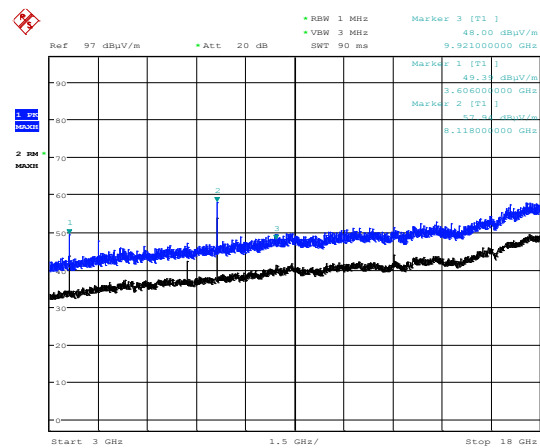
Date: 11.NOV.2021 12:33:27

### Radiated Emissions 1 - 3GHz, LTE band 12/BLE, HP, pk scan (only harmonics of 715.2MHz are detected above)



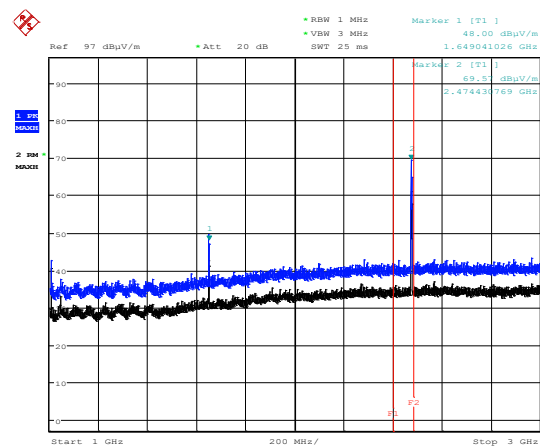
Date: 11.NOV.2021 15:26:29

### Radiated Emissions 1 - 3GHz, 2G band 900/BLE, VP, pk scan



Date: 11.NOV.2021 15:08:29

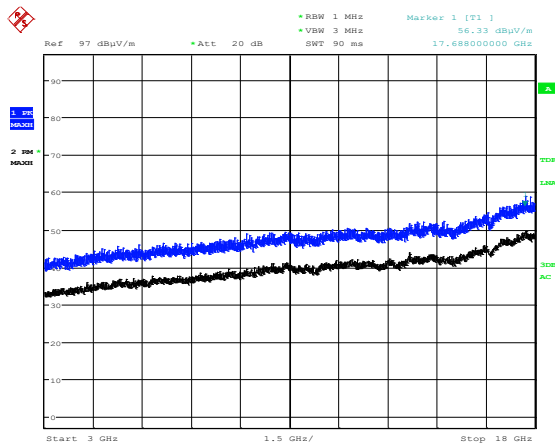
### Radiated Emissions 3 - 18GHz, 2g band 1800/BLE, VP, pk scan (only harmonics of 900MHz are detected above)



Date: 11.NOV.2021 12:33:53

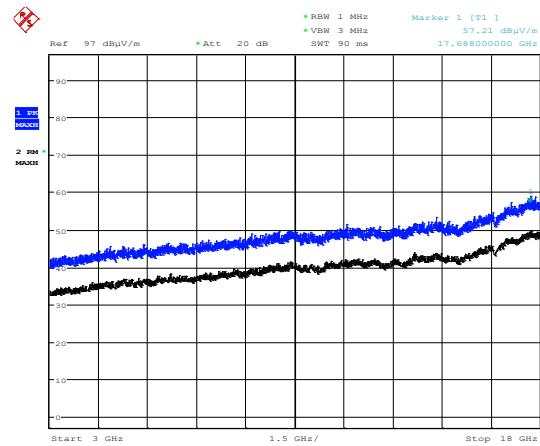
### Radiated Emissions 1 - 3GHz, LTE band 12/BLE, VP, pk scan (only harmonics of 715.2MHz are detected above)





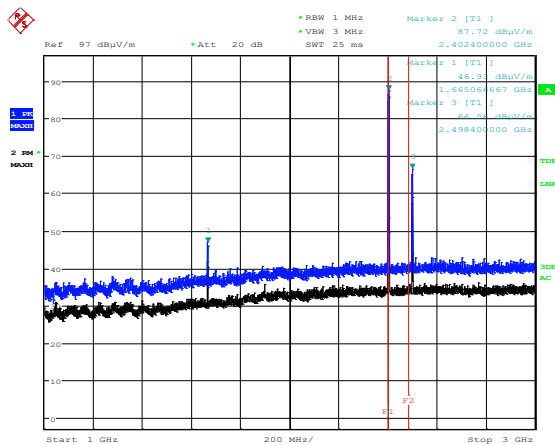
Date: 11.NOV.2021 15:01:24

**Radiated Emissions 3 - 18GHz, LTE band 12/BLE, HP ,pk scan (only harmonics of 715.2MHz are detected above)**



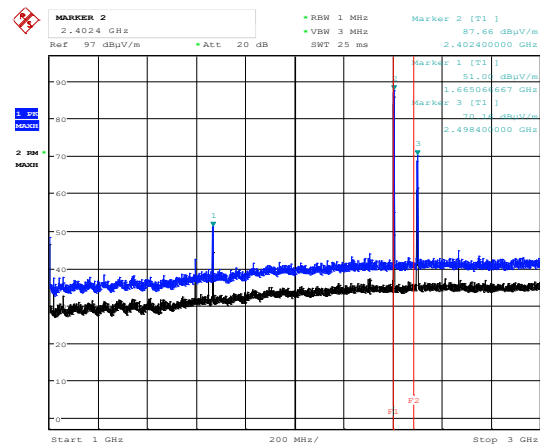
Date: 11.NOV.2021 15:01:44

**Radiated Emissions 3 - 18GHz, LTE band 12/BLE, VP ,pk scan (only harmonics of 715.2MHz are detected above)**



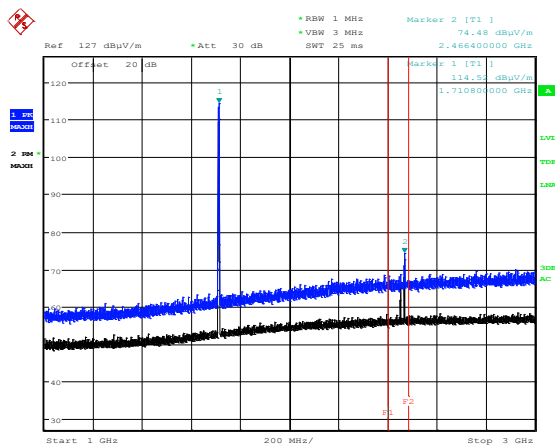
Date: 11.NOV.2021 13:18:38

**Radiated Emissions 1 - 3GHz, LTE band 20/BLE, HP ,pk scan (only harmonics of 832.8MHz are detected above)**



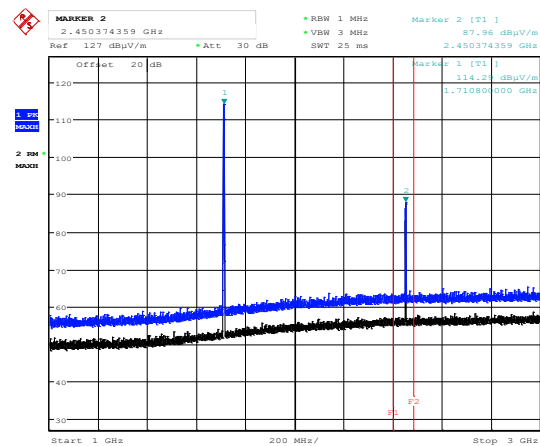
Date: 11.NOV.2021 13:16:50

**Radiated Emissions 1 - 3GHz, LTE band 20/BLE, VP ,pk scan (only harmonics of 832.8MHz are detected above)**



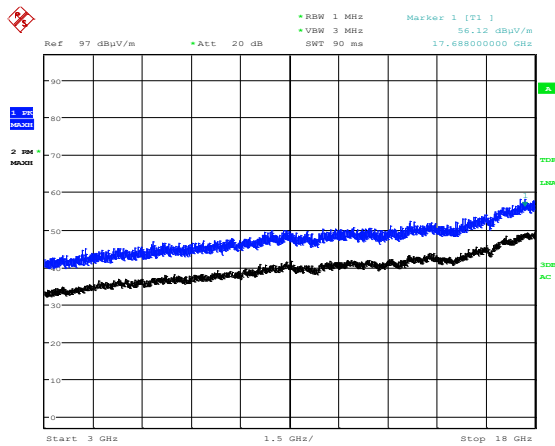
Date: 11.NOV.2021 11:03:46

**Radiated Emissions 1 - 3GHz, LTE band 2/BLE, HP ,pk scan (only harmonics of 1909.21MHz are detected above)**



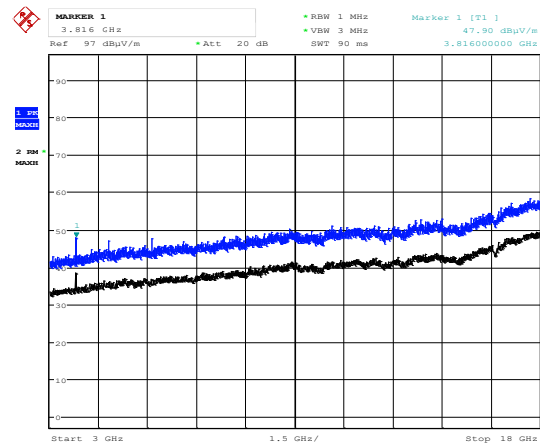
Date: 11.NOV.2021 11:05:01

**Radiated Emissions 1 - 3GHz, LTE band 2/BLE, VP ,pk scan (only harmonics of 1909.21MHz are detected above)**



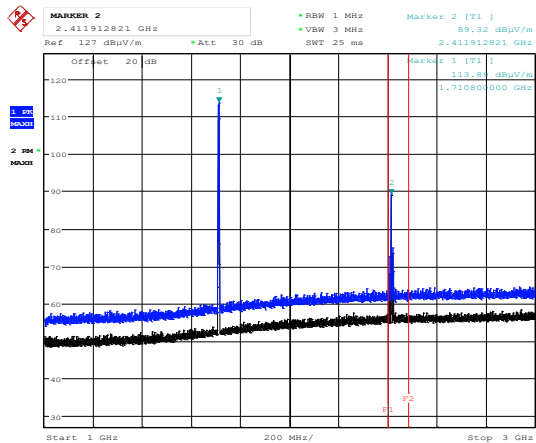
Date: 11.NOV.2021 15:05:37

**Radiated Emissions 3 - 18GHz, LTE band 2/BLE, HP, pk scan (only harmonics of 1909.21MHz are detected above)**



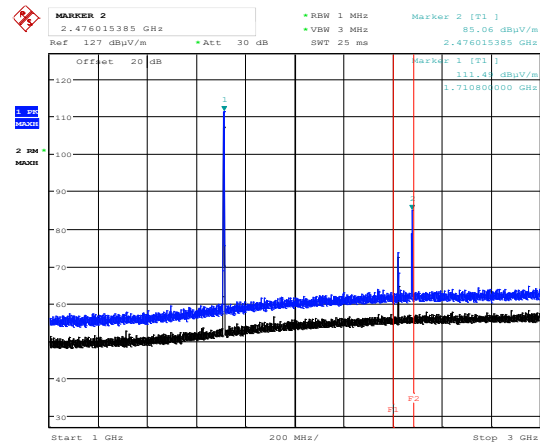
Date: 11.NOV.2021 15:10:03

**Radiated Emissions 3 - 18GHz, LTE band 2/BLE, VP, pk scan (only harmonics of 1909.21MHz are detected above)**



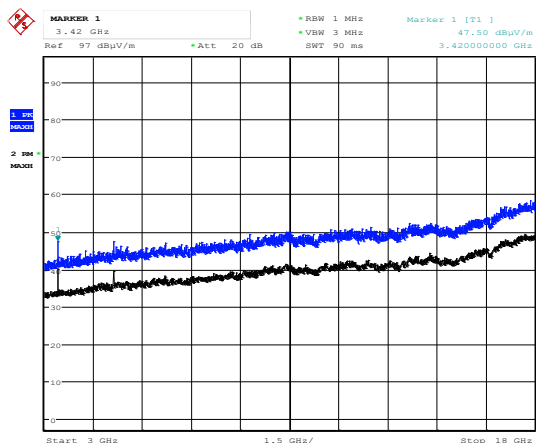
Date: 11.NOV.2021 11:08:12

**Radiated Emissions 1 - 3GHz, LTE band 3&4/BLE, HP, pk scan (only harmonics of 1710.67MHz are detected above)**



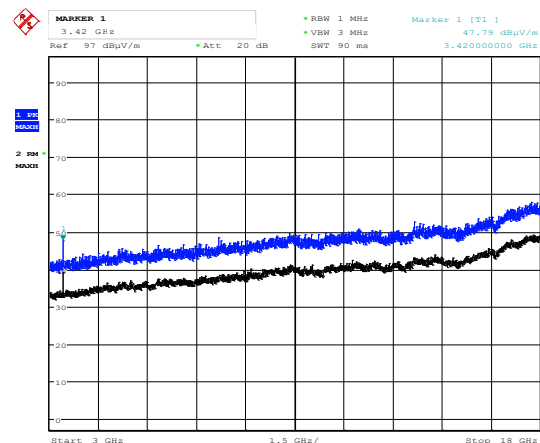
Date: 11.NOV.2021 11:06:57

**Radiated Emissions 1 - 3GHz, LTE band 3&4/BLE, VP, pk scan (only harmonics of 1710.67MHz are detected above)**



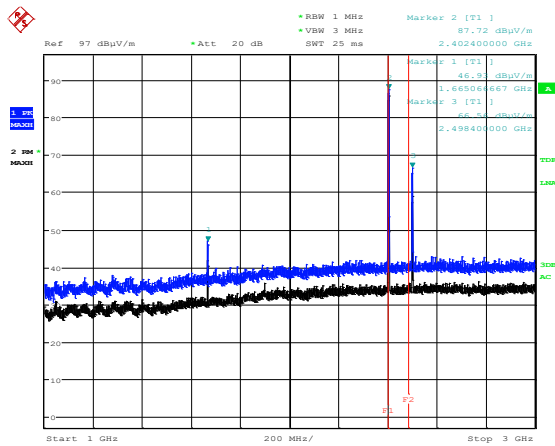
Date: 11.NOV.2021 15:11:47

**Radiated Emissions 3 - 18GHz, LTE band 3&4/BLE, HP, pk scan (only harmonics of 1710.67MHz are detected above)**



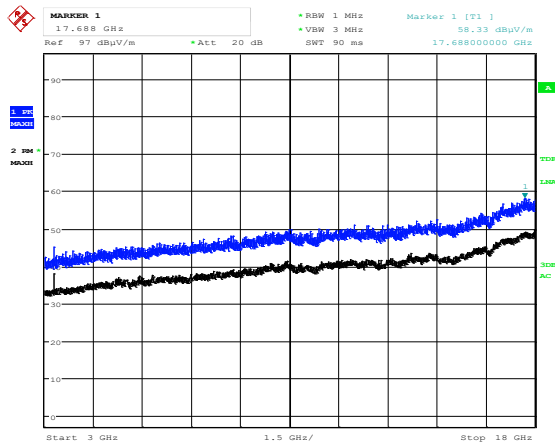
Date: 11.NOV.2021 15:12:17

**Radiated Emissions 3 - 18GHz, LTE band 3&4/BLE, HP, pk scan (only harmonics of 1710.67MHz are detected above)**



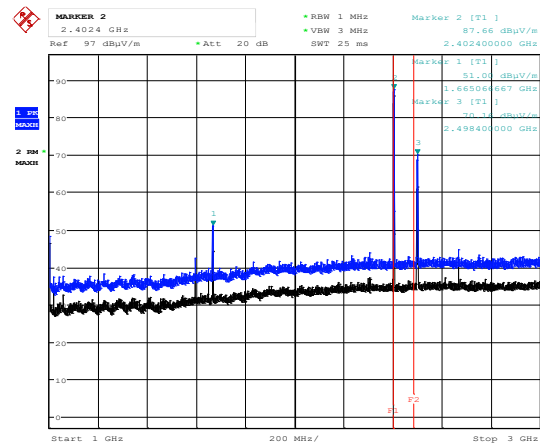
Date: 11.NOV.2021 13:18:38

**Radiated Emissions 1 - 3GHz, LTE band 5/BLE, HP, pk scan (only harmonics of 824.67MHz are detected above)**



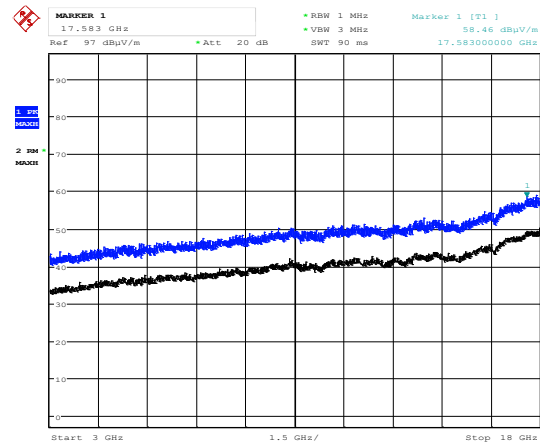
Date: 11.NOV.2021 13:22:40

**Radiated Emissions 3 - 18GHz, LTE band 5/BLE, HP, pk scan (only harmonics of 824.67MHz are detected above)**



Date: 11.NOV.2021 13:16:50

**Radiated Emissions 1 - 3GHz, LTE band 5/BLE, VP, pk scan (only harmonics of 824.67MHz are detected above)**



Date: 11.NOV.2021 13:22:09

**Radiated Emissions 3 - 18GHz, LTE band 5/BLE, VP, pk scan (only harmonics of 824.67MHz are detected above)**

### 3.10 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 2, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

#### Measurement Data:

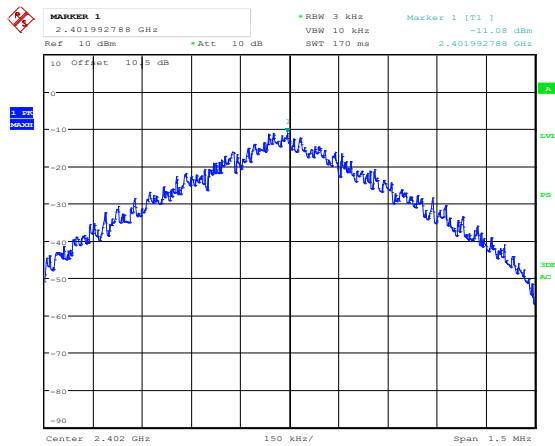
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

Modulation Type	Measured Power Spectral Density (dBm/3kHz)		
	2402 MHz	2440 MHz	2480 MHz
GFSK	-11.08	-10.77	-11.44

#### Requirements:

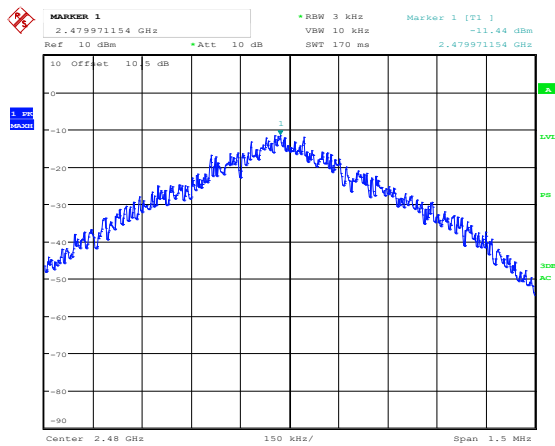
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

No requirements for Frequency Hopping Systems.



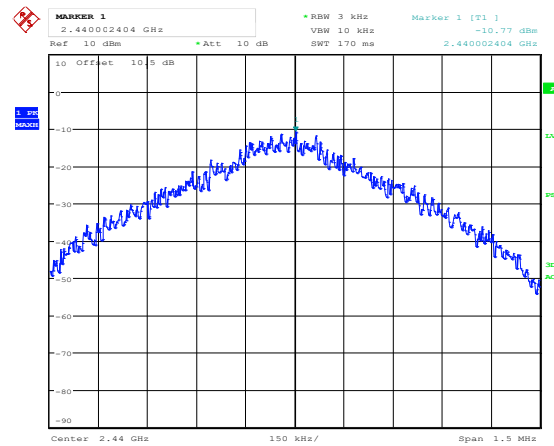
Date: 10.NOV.2021 13:43:23

### PSD, 2402 MHz, GFSK



Date: 10.NOV.2021 13:33:59

### PSD, 2480 MHz, GFSK



Date: 10.NOV.2021 13:47:53

### PSD, 2440 MHz, GFSK

## 4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

## 5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

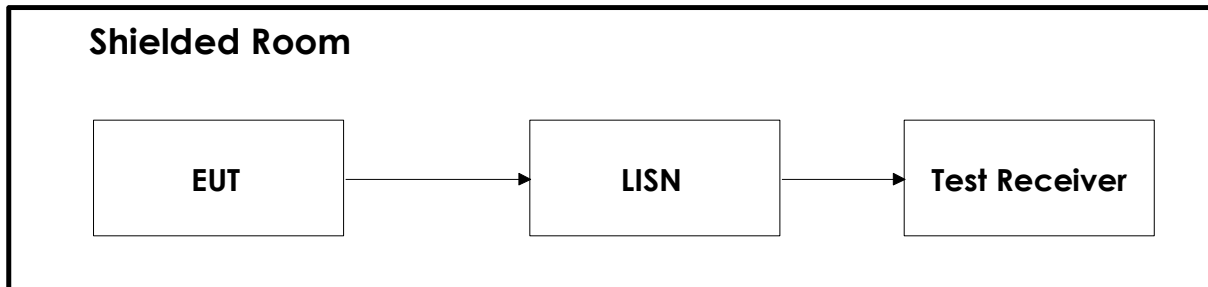
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1.	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	2020-01	2022-01
2.	6810.17B	Attenuator	Suhner	LR 1668	COU	
3.	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	COU	
4.	JB3	Biconical-Log Hybrid	Sunol Sciences	N-4525	2020-03	2023-03
5.	316	Preamplifier	Sonoma Inst.	LR 1686	2021-08	2022-08
6.	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2017-08	2022-08
7.	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2021-08	2022-08
8.	638	Antenna Horn	Narda	LR 1480	N/A	
9.	4768-10	Attenuator	Narda	LR 1670	COU	
10	Model 87V	Multimeter	Fluke	LR 1599	2021-01	2023-01
11	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

The software listed below has been used for one or more tests.

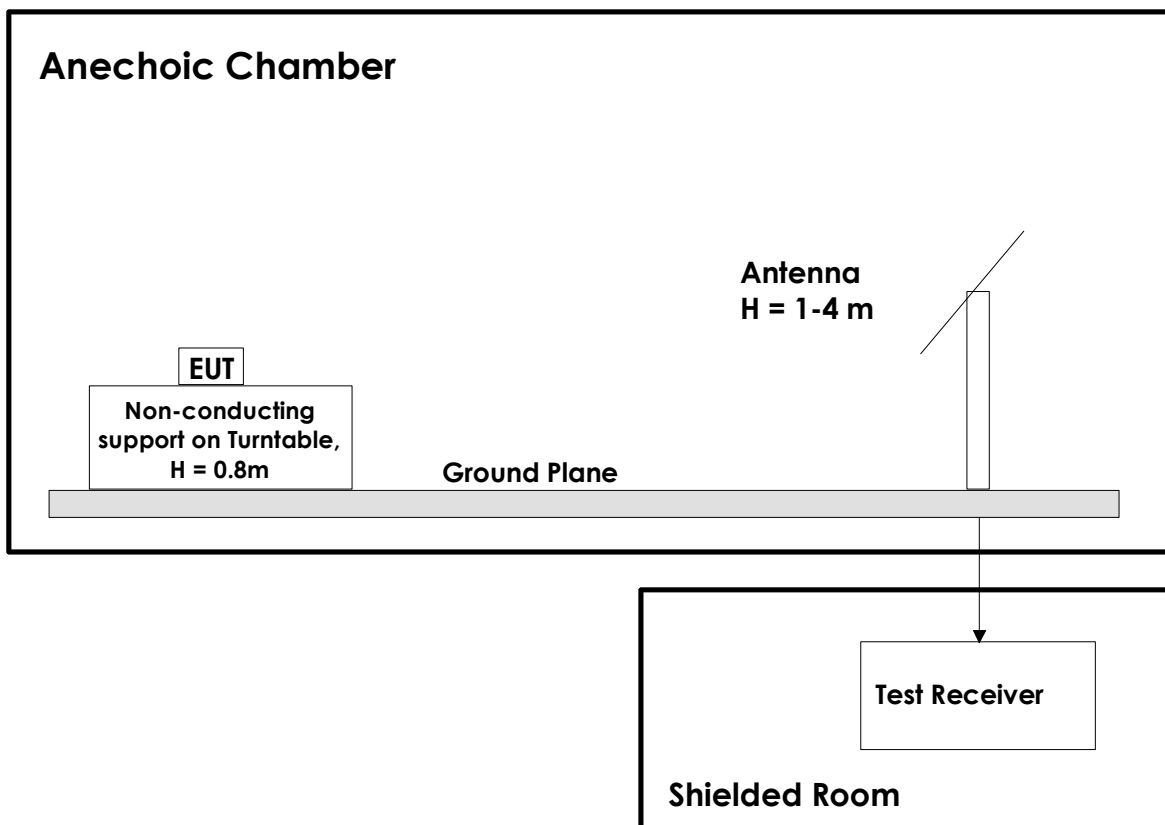
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.30.10	Power Line Conducted test software
2	Rohde & Schwarz	EMC32	10.30.10	Radiated Emission test software
3	Nemko AS	RSPlot	1.0.8.0	Screen capture from R&S Spectrum Analyzers

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.