

Test Report

Product	GLoWPAN Transceiver		
Name and address of the applicant	Grundfos Holding A/S Poul Due Jensens Vej 7 DK-8850 Bjerringbro, Denmark		
Name and address of the manufacturer	Grundfos Holding A/S Poul Due Jensens Vej 7 DK-8850 Bjerringbro, Denmark		
Model	MI301M02		
Rating	3.7V _{DC} (Li-Ion Battery)		
Trademark	GRUNDFOS		
Serial number	See clause 1.1		
Additional information	Bluetooth Low Energy, GLoWPAN		
Tested according to	FCC Part 15.247 Digital Transmission Systems Industry Canada RSS-247, Issue 2 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices		
Order number	407662		
Tested in period	2021-01-07 to 2021-01-26		
Issue date	2021-05-31		
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com	CAB Number: FCC: NO0001 ISED: NO0470 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50	 
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [Frode Sveinsen]		 Approved by [G. Suhanthakumar]	
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1 INFORMATION

1.1 Test Item

Name	Grundfos
Model/version	MI301M02
FCC ID	OG3-MI301M02
ISED ID	10447A-MI301M02
Serial number	Radiated Sample: 00010 Conducted Sample: 00061
Hardware identity and/or version	V09
Software identity and/or version	V05
Frequency Range	2405–2480 MHz (5 MHz Channel Separation)
Number of Channels	16
Operating Modes	GLoWPAN
Type of Modulation	O-QPSK
Conducted Output Power	0.00114 Watts
Antenna Connector	None
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Secondary Battery (Li-Ion Battery, 3.6V DC)
Desktop Charger	N/A

Description of Test Item

The MI301M02 contains two radios, one Bluetooth Low Energy and one Grundfos GLoWPAN.

The Grundfos GLoWPAN is a special case of the GLoWPAN according to IEEE 802.15.4, is based on an AT86RF231 radio chip setup by commands via USB interface, using Docklight scripts.

The BLE is based on the CC2652R1 using Texas SmartRF Studio 7 to set the chip into various operating modes.

1.2 Normal test condition

Temperature: 20 - 24 °C
 Relative humidity: 20 - 50 %
 Normal test voltage: 3.6 V DC (Nominal Battery Voltage)

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen

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 and Burst TX. The EUT is programmed from a computer using the Docklight scripts. All tests were performed with the EUT transmitting 6LoWPAN frames continuously.
Additional information	The following settings were used for all tests: Power Setting: 3.0 dBm Bit Pattern: Mode = 1 Frame Setting: not possible to change

1.6 Comments

The EUT uses the 6LoWPAN and Bluetooth 5 Low Energy Protocols. This report covers the 6LoWPAN transmitter.
 The measurements were done with the EUT powered by from a new battery.

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 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 ISED.

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 ¹
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A ¹
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	Complies
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 2	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)	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

¹ The EUT operates only from a secondary battery

Revision history

Revision	Date	Comment	Sign
00	2021-03-22	First edition	FS
01	2021-05-31	Corrected EIRP and Duty Cycle Calculations	FS

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:

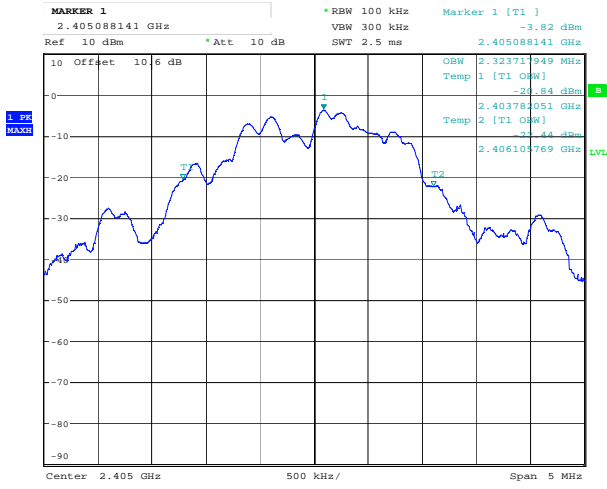
Carrier Frequency and Operating Mode	Occupied Bandwidth (99% BW)
2405 MHz 6LoWPAN	2.32 MHz
2435 MHz 6LoWPAN	2.30 MHz
2480 MHz 6LoWPAN	2.35 MHz

See attached plots.

Requirements:

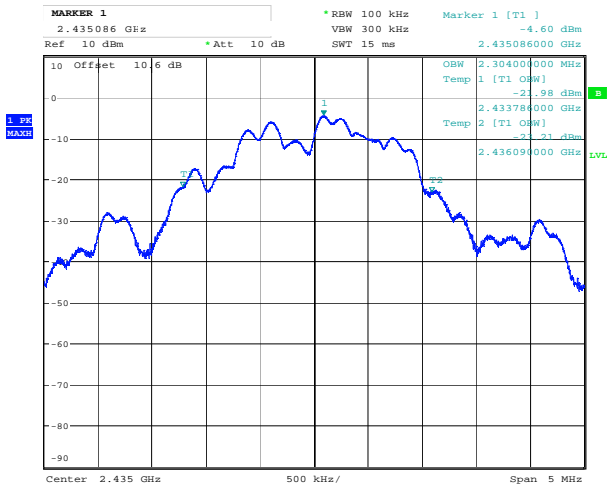
No requirements for Digital Transmission Systems.

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



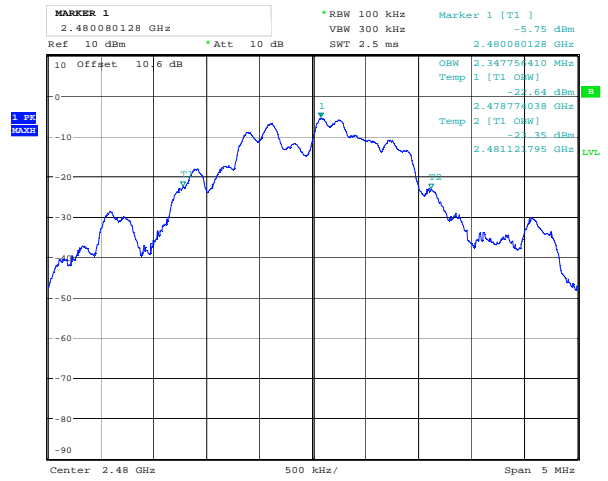
Date: 26.JAN.2021 16:24:52

99% Occupied BW, 6LoWPAN, 2405 MHz



Date: 26.JAN.2021 16:35:38

99% Occupied BW, 6LoWPAN, 2435 MHz



Date: 26.JAN.2021 16:43:48

99% Occupied BW, 6LoWPAN, 2480 MHz

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

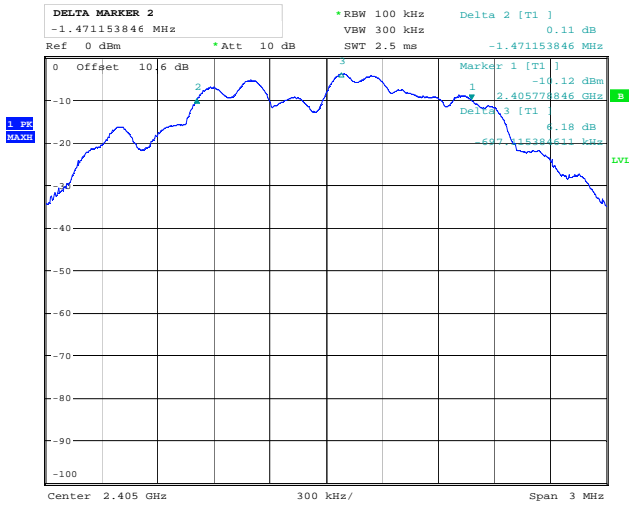
Test Results: Complies

Measurement Data:

Operating Mode	DTS Bandwidth (6dB BW)		
	2405 MHz	2435 MHz	2480 MHz
6LoWPAN	1.47 MHz	1.45 MHz	1.45 MHz

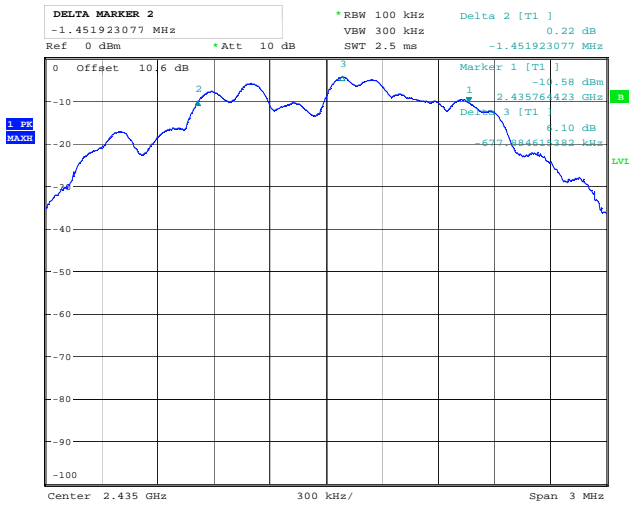
Requirements:

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



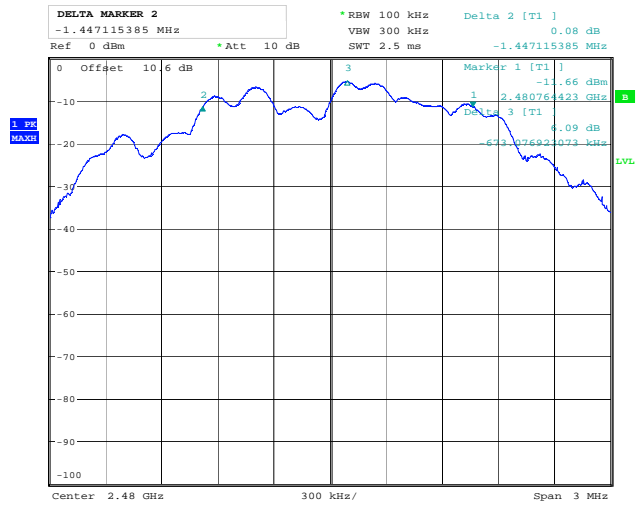
Date: 26.JAN.2021 16:51:32

DTS BW, 2405 MHz, 6LoWPAN



Date: 26.JAN.2021 16:50:23

DTS BW, 2435 MHz, 6LoWPAN



Date: 26.JAN.2021 16:49:11

DTS BW, 2480 MHz, 6LoWPAN

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	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dB μ V/m)	Calculated EIRP (dBm)	Antenna gain (dBi)
2405 MHz	0.57	1.14	96.14	0.91	0.3
2435 MHz	-0.17	0.96	97.31	2.08	2.3
2480 MHz	-1.18	0.76	99.29	4.06	5.2

Measured Output Power is Maximum Peak Power.

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

Antenna Gain is less than 6 dBi.

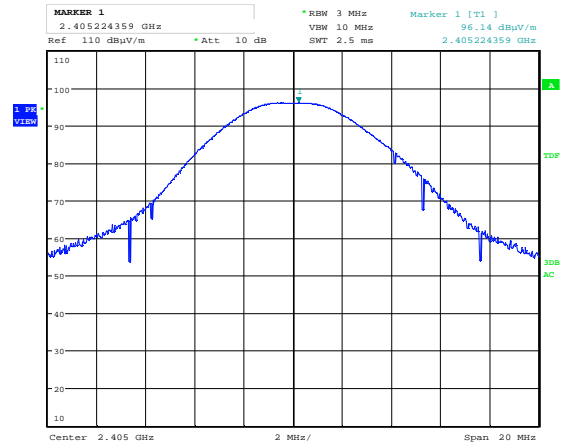
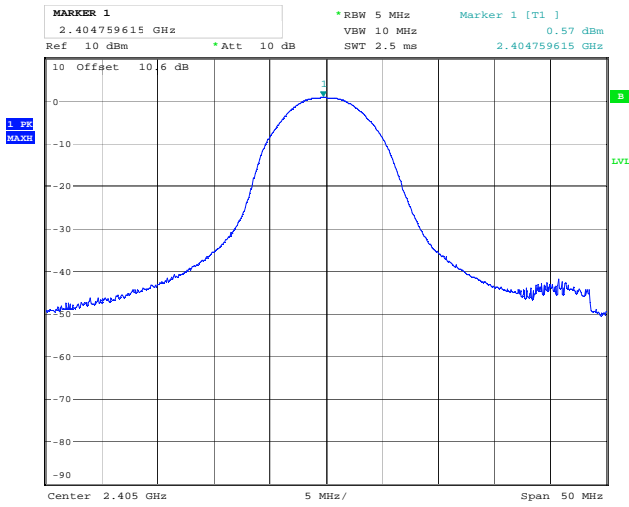
See attached plots.

Requirements:

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

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

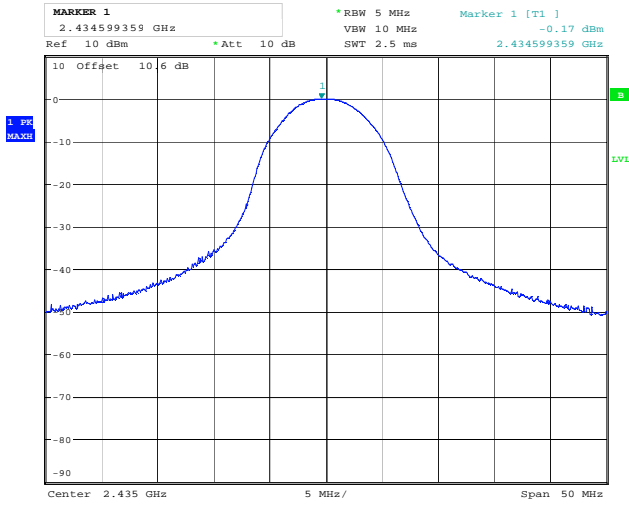
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



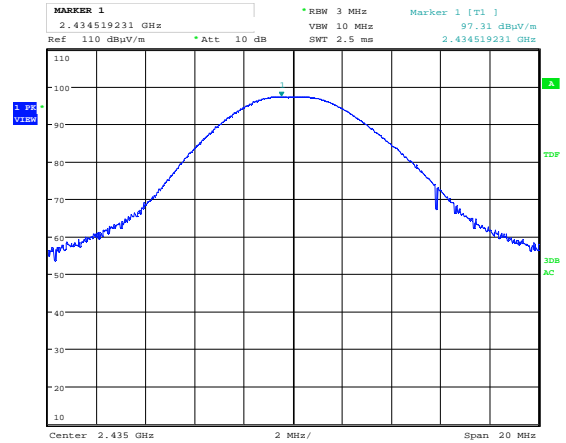
Date: 7.JAN.2021 14:02:07

Date: 26.JAN.2021 16:23:30

Peak Power, 2405 MHz, 6LoWPAN



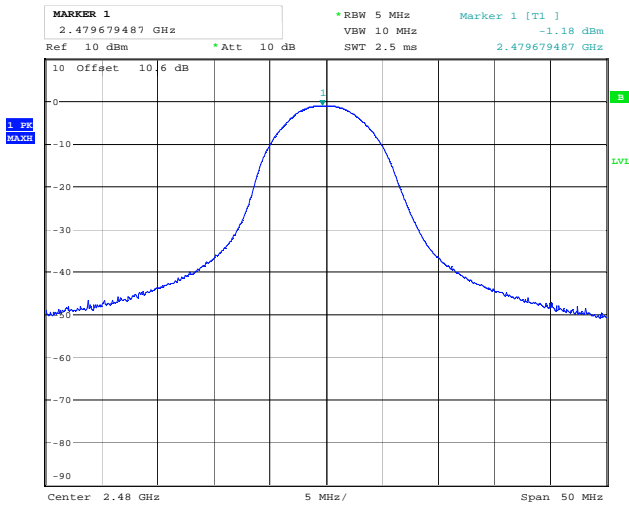
Maximum Field Strength, 2405 MHz, 6LoWPAN



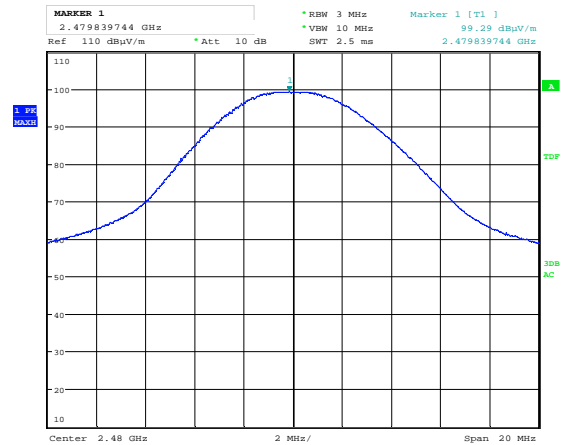
Date: 7.JAN.2021 14:15:21

Date: 26.JAN.2021 16:36:32

Peak Power, 2435 MHz, 6LoWPAN



Maximum Field Strength, 2435 MHz, 6LoWPAN



Date: 7.JAN.2021 13:27:42

Date: 26.JAN.2021 16:43:01

Peak Power, 2480 MHz, 6LoWPAN

Maximum Field Strength, 2480 MHz, 6LoWPAN

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
2405 MHz	> 30	> 10	Pass
2435 MHz	> 30	> 10	Pass
2480 MHz	> 30	> 10	Pass

Measured with Peak Detector

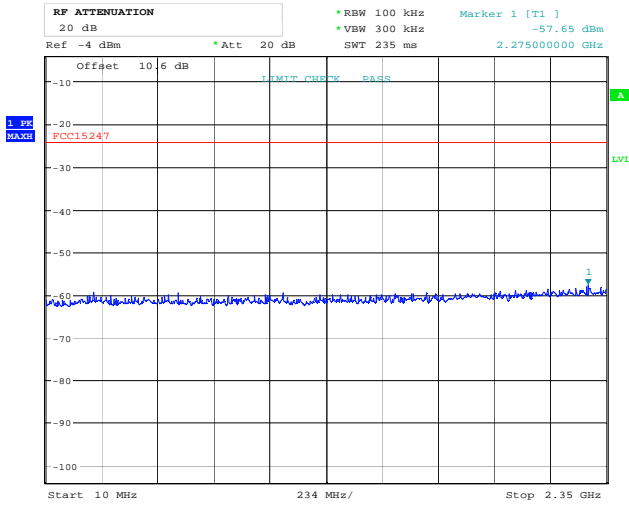
RF conducted power to 25 GHz: see attached plots.

Limit

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

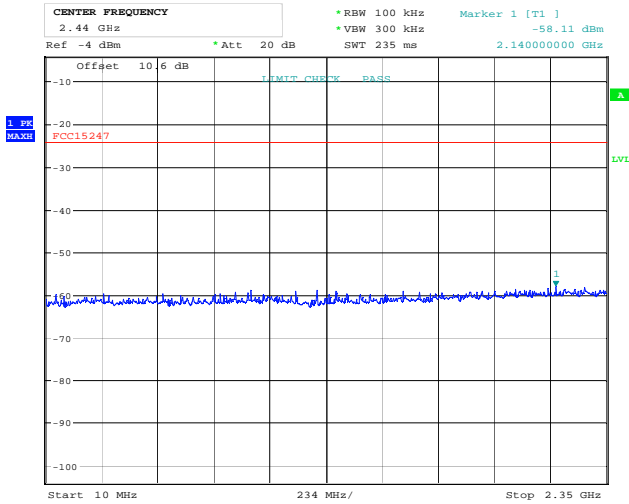
Detector type shall be the same as used for measuring Output Power.

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



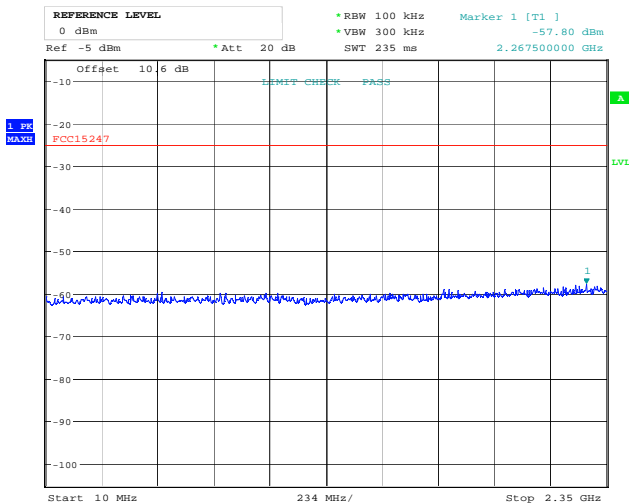
Date: 26.JAN.2021 16:59:31

Conducted Emissions 10-2350 MHz, 2405 MHz, 6LoWPAN



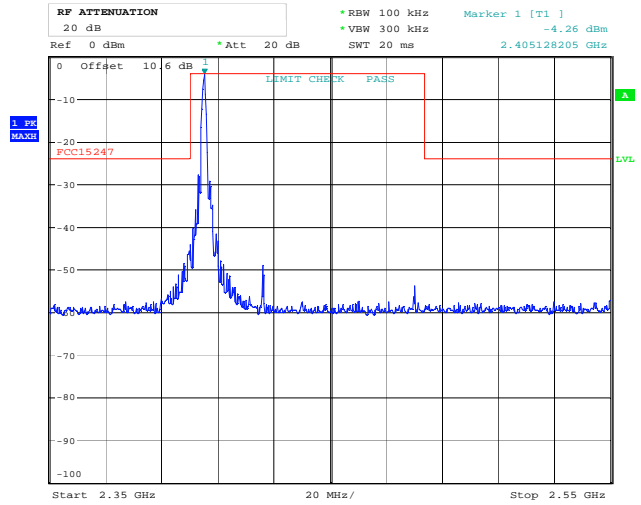
Date: 26.JAN.2021 17:08:02

Conducted Emissions 10-2350 MHz, 2435 MHz, 6LoWPAN



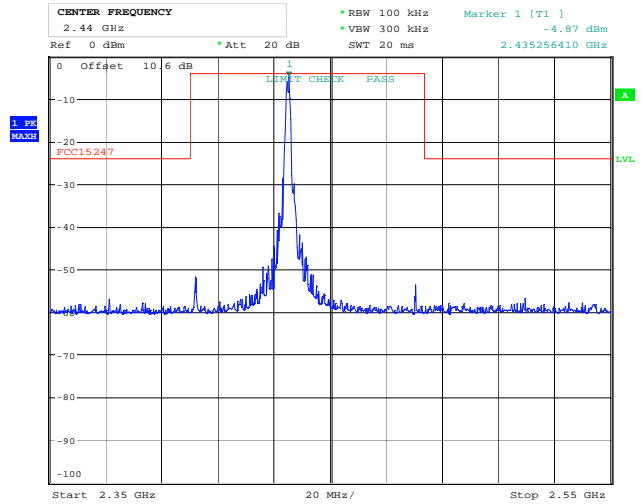
Date: 26.JAN.2021 17:17:27

Conducted Emissions 10-2350 MHz, 2480 MHz, 6LoWPAN



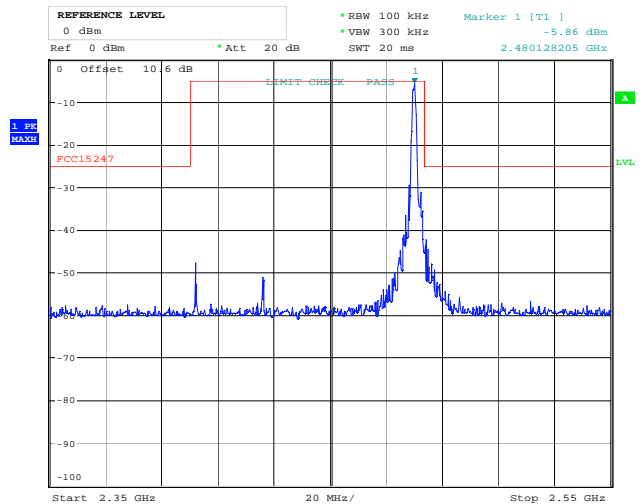
Date: 26.JAN.2021 16:58:44

Conducted Emissions 2350-2550 MHz, 2405 MHz, 6LoWPAN



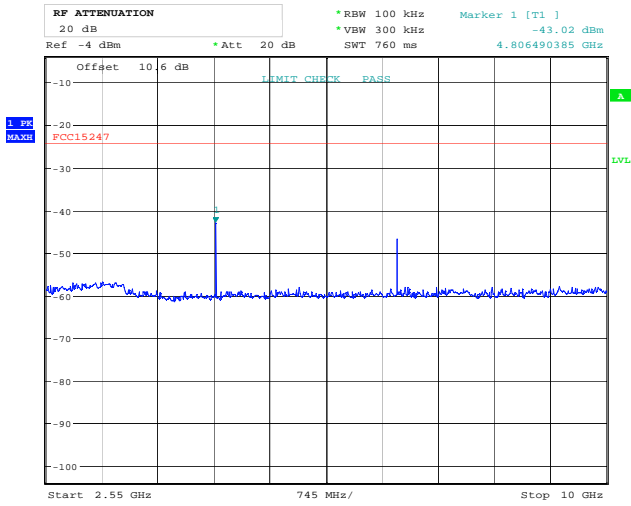
Date: 26.JAN.2021 17:07:15

Conducted Emissions 2350-2550 MHz, 2435 MHz, 6LoWPAN



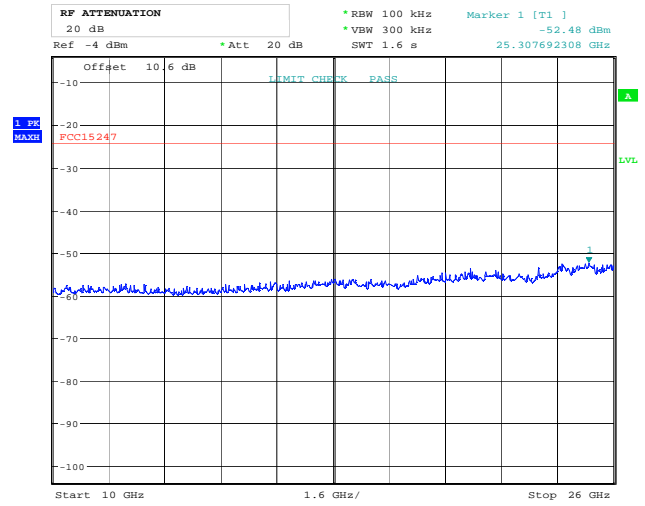
Date: 26.JAN.2021 17:16:41

Conducted Emissions 2350-2550 MHz, 2480 MHz, 6LoWPAN



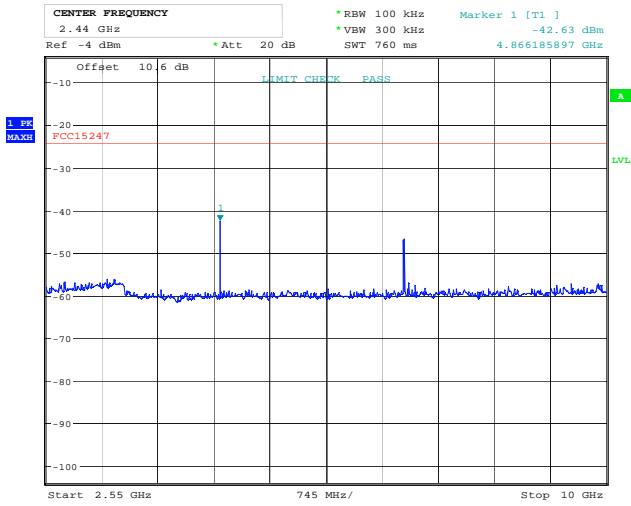
Date: 26.JAN.2021 17:00:37

Conducted Emissions 2550-10000 MHz, 2405 MHz, 6LoWPAN



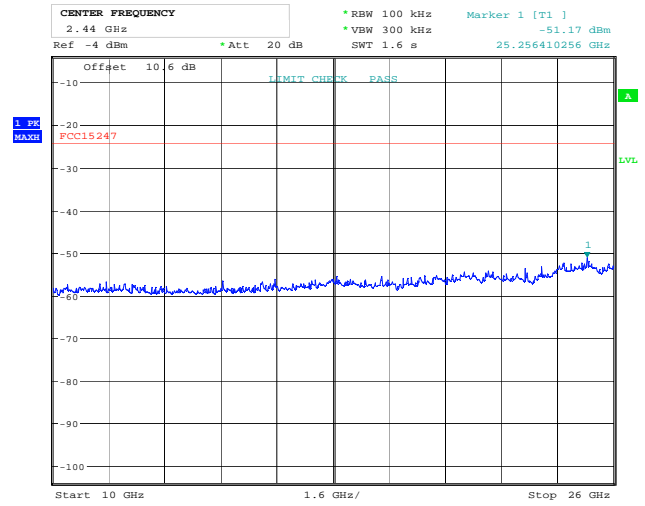
Date: 26.JAN.2021 17:01:24

Conducted Emissions 10000-26000 MHz, 2405 MHz, 6LoWPAN



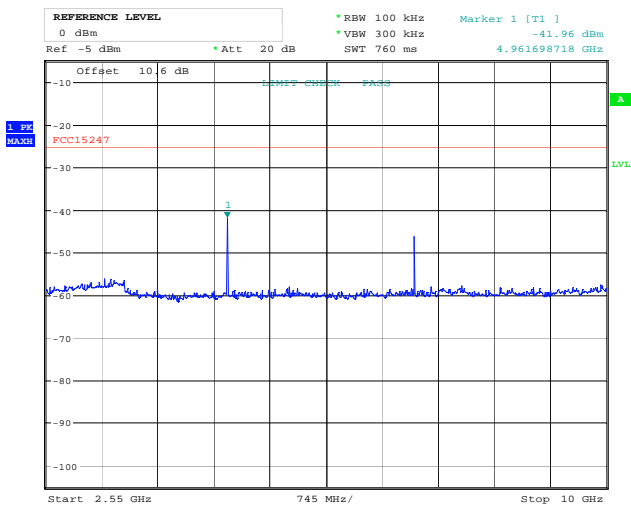
Date: 26.JAN.2021 17:09:09

Conducted Emissions 2550-10000 MHz, 2435 MHz, 6LoWPAN



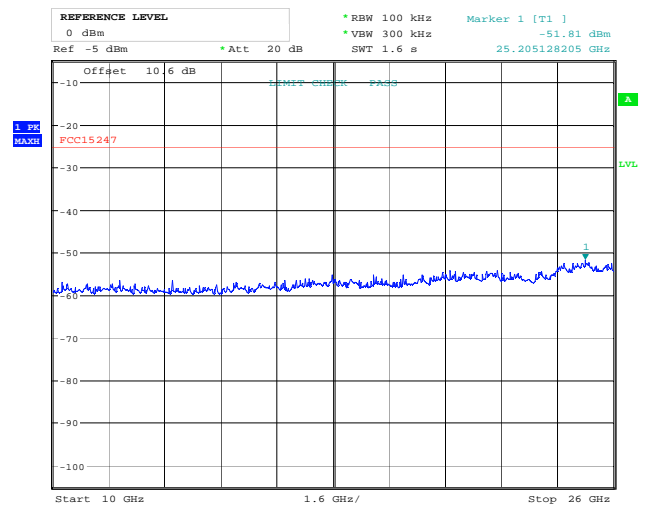
Date: 26.JAN.2021 17:09:56

Conducted Emissions 10000-26000 MHz, 2435 MHz, 6LoWPAN



Date: 26.JAN.2021 17:18:34

Conducted Emissions 2550-10000 MHz, 2480 MHz, 6LoWPAN



Date: 26.JAN.2021 17:19:21

Conducted Emissions 10000-26000 MHz, 2480 MHz, 6LoWPAN

3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED 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)	ISED Canada (MHz)	FCC (GHz)	ISED Canada (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	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	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
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		3.6-4.4	3.5-4.4
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	
108-121.94 123-138	108-138	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 ISED, 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:

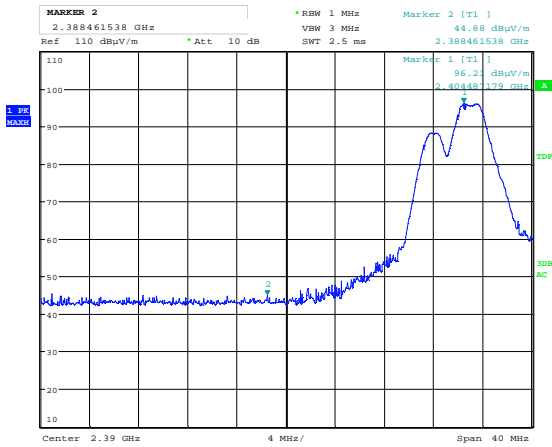
Carrier Frequency and Data Rate	Band Edge Frequency	Measured Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak Detector	Average Detector	Peak Det	Average Det	Peak Det	Average Det
2405 MHz	2390 MHz	44.9	/	74	54	29.1	/
2480 MHz	2483.5 MHz	64.2	36.1			9.8	17.9

See attached plots.

Maximum Duty Cycle according to Channel Occupance Calculation:

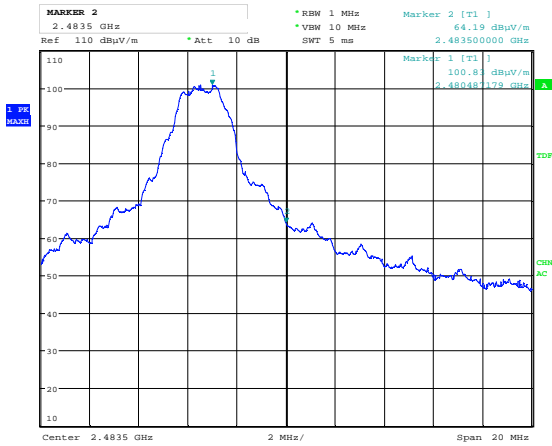
Duty Cycle = Burst length / Frame Length = 2ms / 80ms = 0.025 => 32.0 dB

Duty Cycle Correction: 20 dB



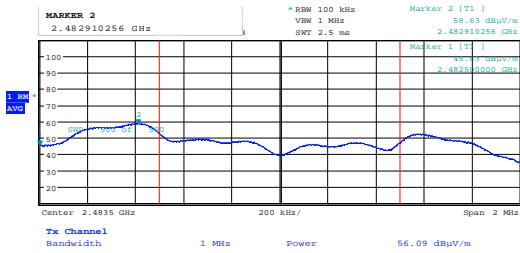
Date: 7.JAN.2021 14:03:12

Lower Band Edge 2405 MHz, Peak



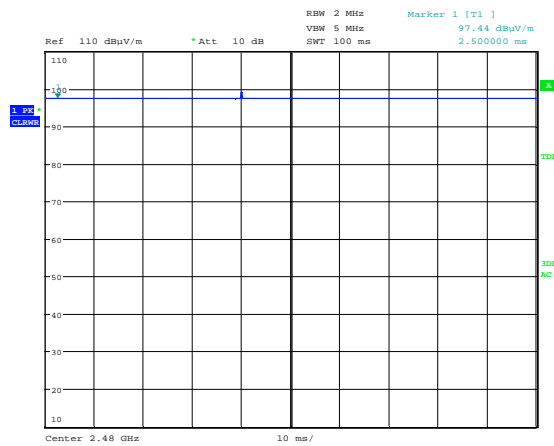
Date: 7.JAN.2021 13:56:21

Upper Band Edge 2480 MHz, Peak



Date: 7.JAN.2021 13:58:55

Upper Band Edge 2480 MHz, Average



Date: 7.JAN.2021 14:00:11

Measured with Duty Cycle = 100%

3.7 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)

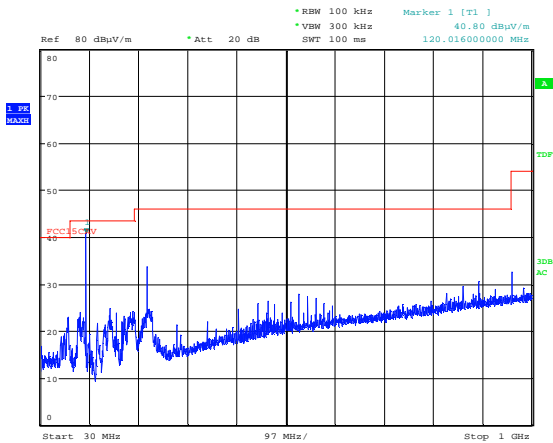
Measuring distance 3 m

Measured Frequency (MHz)	Carrier Frequency (MHz)	Measured Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
30 – 88	2435	< 20	40.0	> 20
88 – 216	2435	< 20	43.5	> 23
216 – 960	2435	< 26	46.0	> 20
960 – 1000	2435	< 30	54.0	> 24

See attached plots

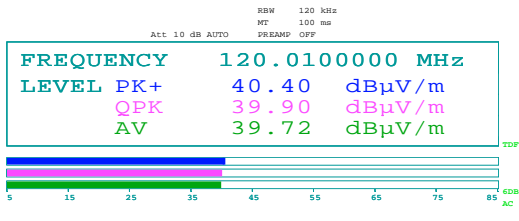
Requirements/Limit

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



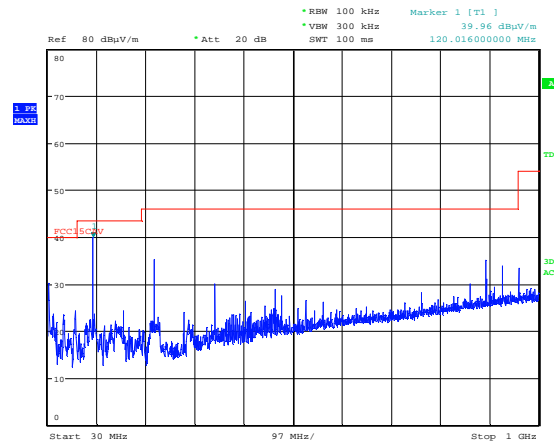
Date: 7.DEC.2020 15:12:23

Radiated Emissions 30 - 1000 MHz, HP



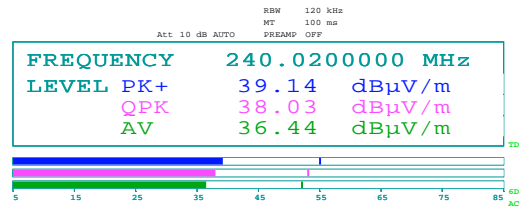
Date: 7.DEC.2020 15:29:58

Radiated Emissions, 120 MHz (Max: HP)



Date: 7.DEC.2020 15:10:23

Radiated Emissions 30 - 1000 MHz, VP



Date: 7.DEC.2020 15:47:09

Radiated Emissions, 240 MHz (Max: HP)



3.8 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.

Carrier freq.	Spurious Frequency (MHz)	Measured Emissions (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
		Peak	Average	Peak	Average	Peak	Average
2405 MHz	4810	57.1	46.4	74	54	16.9	7.6
	7215	57.0	49.3	74	54	17.0	4.7
2435 MHz	4870	54.1	46.8	74	54	19.9	7.2
	7305	57.5	50.2	74	54	16.5	3.8
2480 MHz	4960	57.4	47.3	74	54	16.6	6.7
	7440	59.2	52.1	74	54	14.8	1.9
Any	Any Other	< 60	< 50	74	54	>14	>4

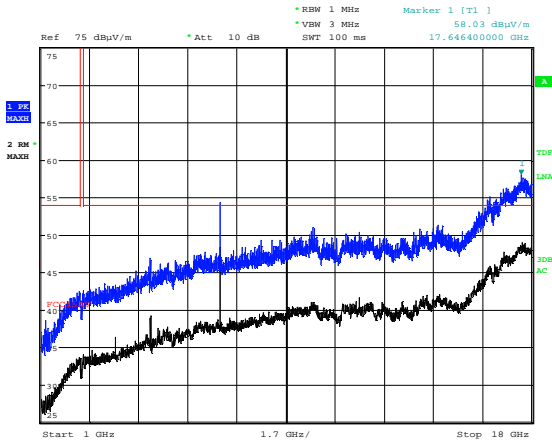
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz.

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

See plots.

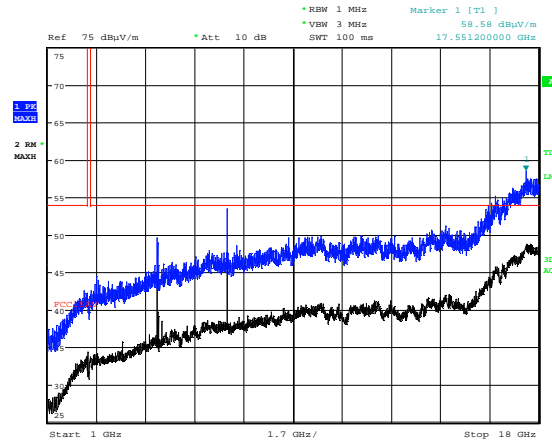
Requirements/Limit

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 dB μ V/m	74.0 dB μ V/m



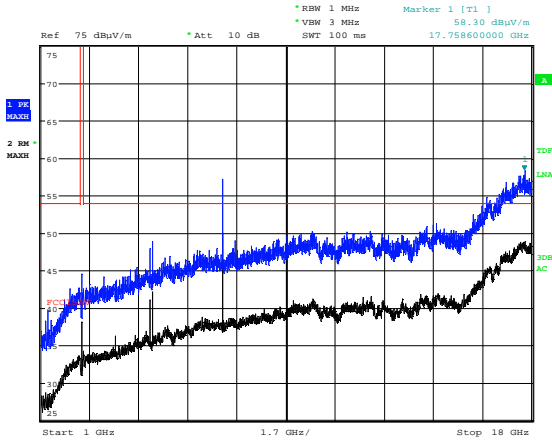
Date: 7.JAN.2021 14:37:14

Radiated Emissions 1 - 18 GHz, 2405 MHz, HP



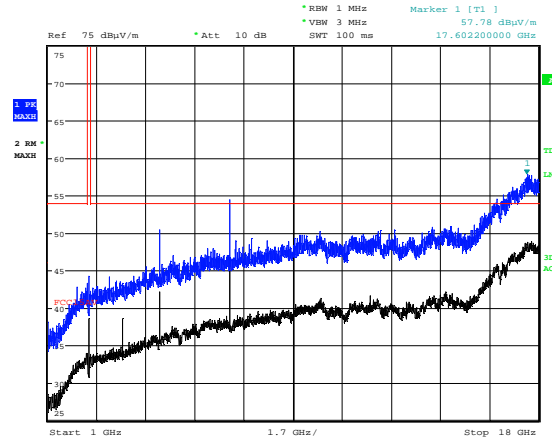
Date: 7.JAN.2021 14:35:12

Radiated Emissions 1 - 18 GHz, 2405 MHz, VP



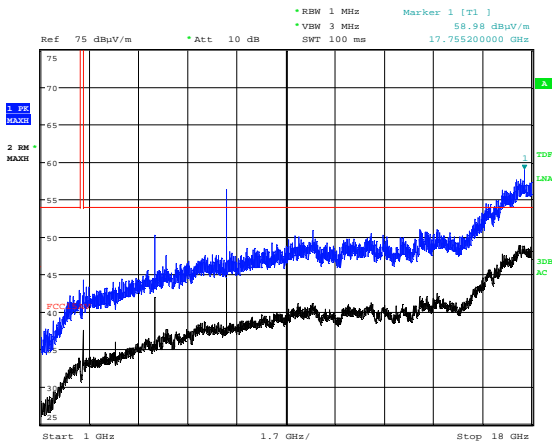
Date: 7.JAN.2021 14:30:51

Radiated Emissions 1 - 18 GHz, 2435 MHz, HP



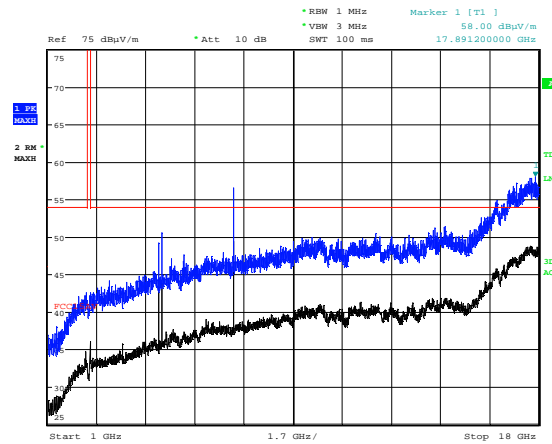
Date: 7.JAN.2021 14:28:49

Radiated Emissions 1 - 18 GHz, 2435 MHz, VP



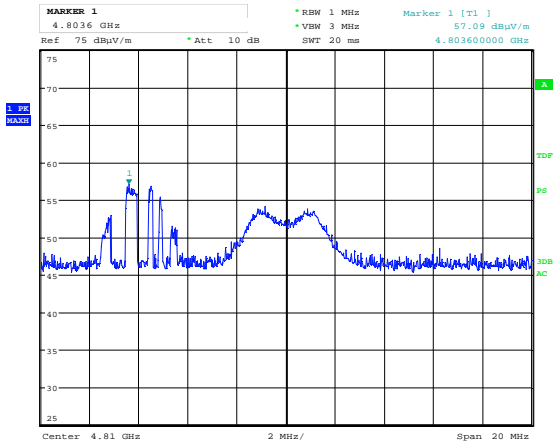
Date: 7.JAN.2021 14:42:59

Radiated Emissions 1 - 18 GHz, 2480 MHz, HP



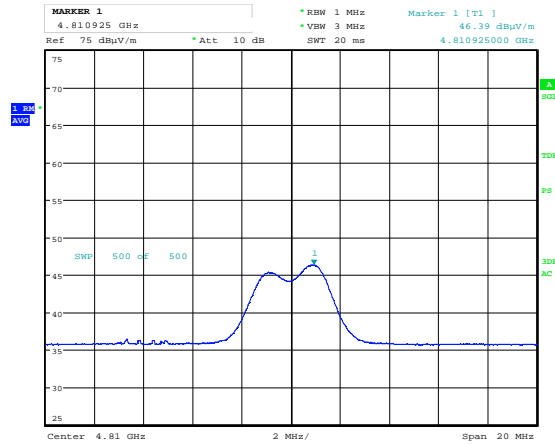
Date: 7.JAN.2021 14:40:58

Radiated Emissions 1 - 18 GHz, 2480 MHz, VP



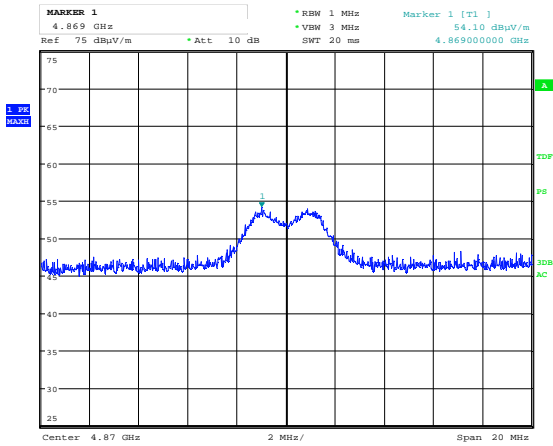
Date: 7.JAN.2021 15:42:47

Radiated Emissions 4810 MHz, 2405 MHz, Max Peak Det



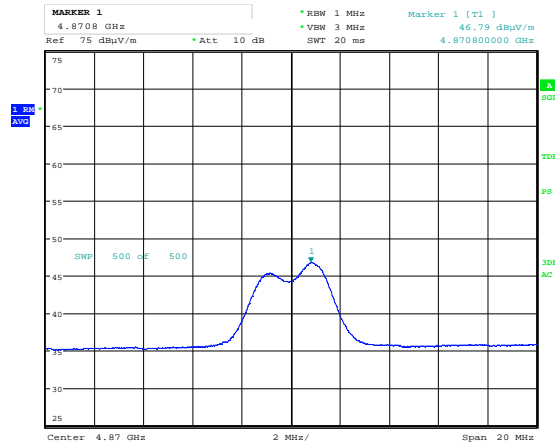
Date: 7.JAN.2021 15:41:54

Radiated Emissions 4810 MHz, 2405 MHz, Max Average Det



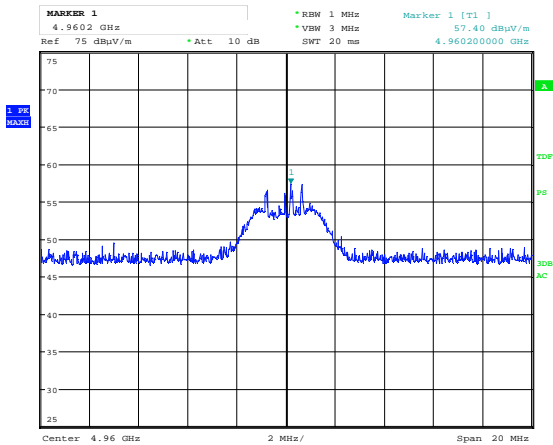
Date: 7.JAN.2021 15:35:18

Radiated Emissions 4870 MHz, 2435 MHz, Max Peak Det



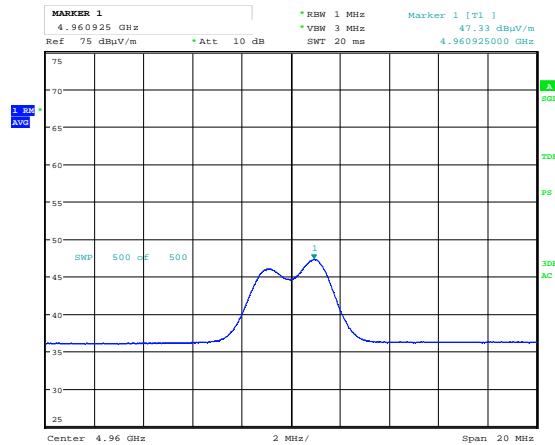
Date: 7.JAN.2021 15:40:36

Radiated Emissions 4870 MHz, 2435 MHz, Max Average Det



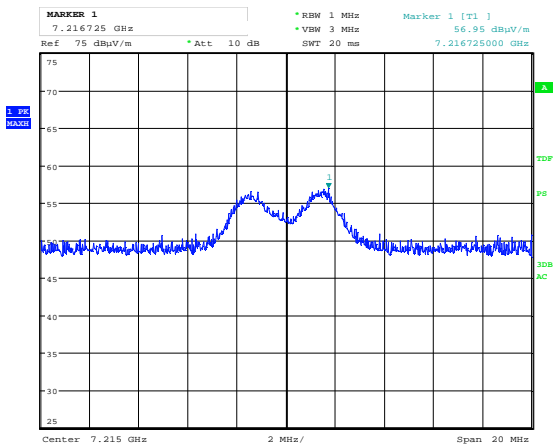
Date: 7.JAN.2021 15:26:02

Radiated Emissions 4960 MHz, 2480 MHz, Max Peak Det



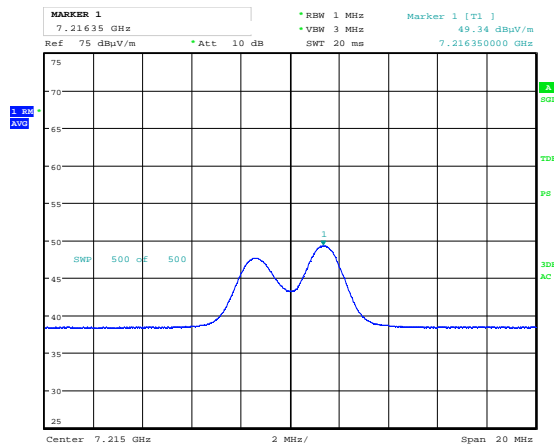
Date: 7.JAN.2021 15:33:38

Radiated Emissions 4960 MHz, 2480 MHz, Max Average Det



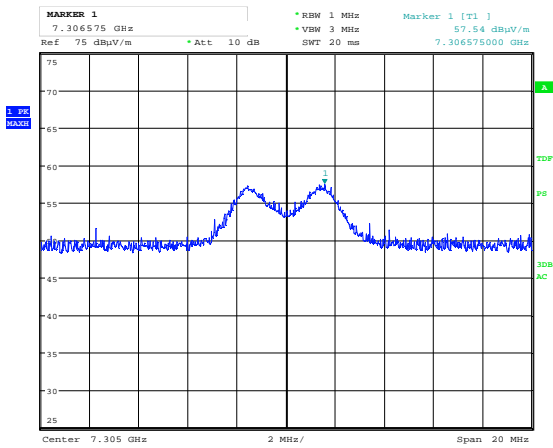
Date: 7.JAN.2021 15:08:13

Radiated Emissions 7215 MHz, 2405 MHz, Max Peak Det



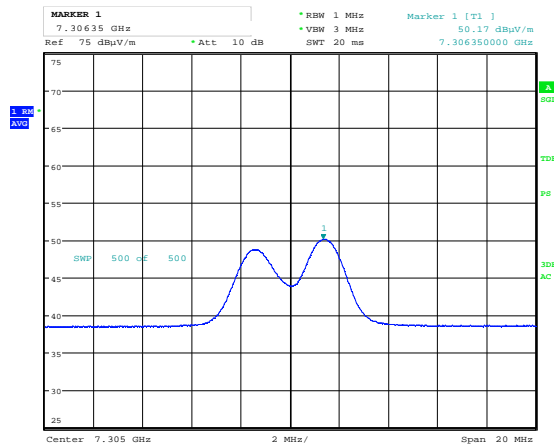
Date: 7.JAN.2021 15:08:54

Radiated Emissions 7215 MHz, 2405 MHz, Max Average Det



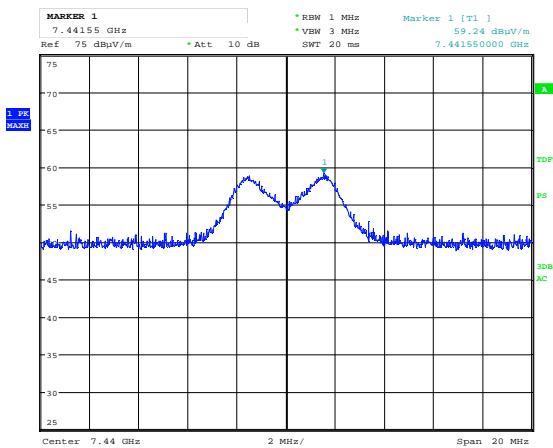
Date: 7.JAN.2021 15:05:42

Radiated Emissions 7305 MHz, 2435 MHz, Max Peak Det



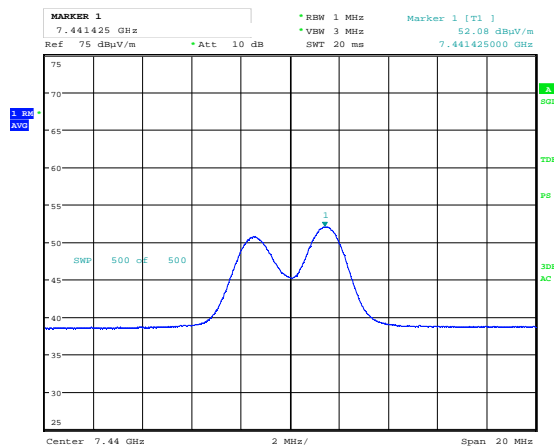
Date: 7.JAN.2021 15:06:51

Radiated Emissions 7305 MHz, 2435 MHz, Max Average Det



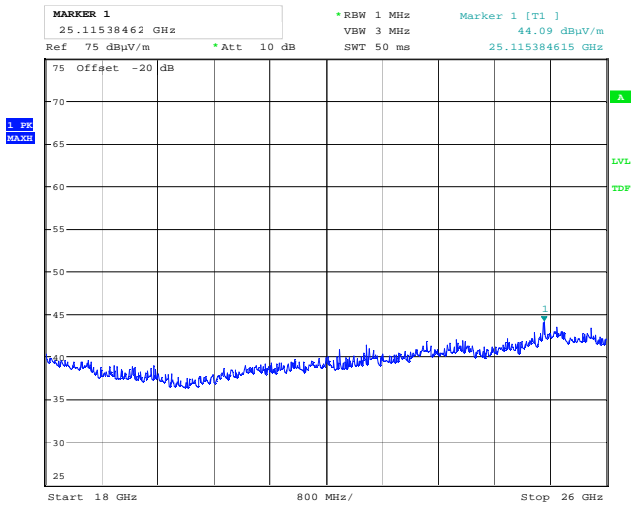
Date: 7.JAN.2021 14:57:35

Radiated Emissions 7440 MHz, 2480 MHz, Max Peak Det



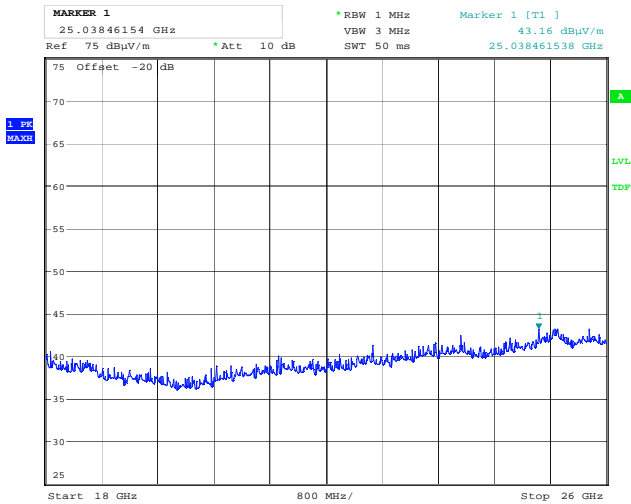
Date: 7.JAN.2021 14:58:20

Radiated Emissions 7440 MHz, 2480 MHz, Max Average Det



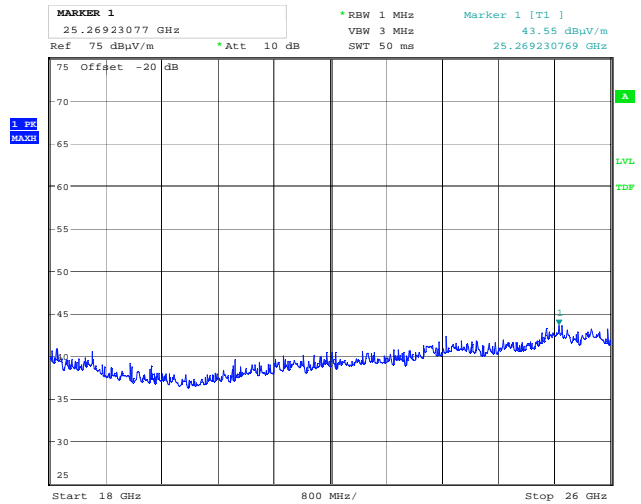
Date: 16.DEC.2020 15:37:30

Pre-scan 18 - 26 GHz, 2405 MHz, GFSK, @approx 10cm



Date: 16.DEC.2020 15:35:20

Pre-scan 18 - 26 GHz, 2435 MHz, GFSK, @approx 10cm



Date: 16.DEC.2020 15:34:07

Pre-scan 18 - 26 GHz, 2480 MHz, GFSK, @approx 10cm

3.9 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:

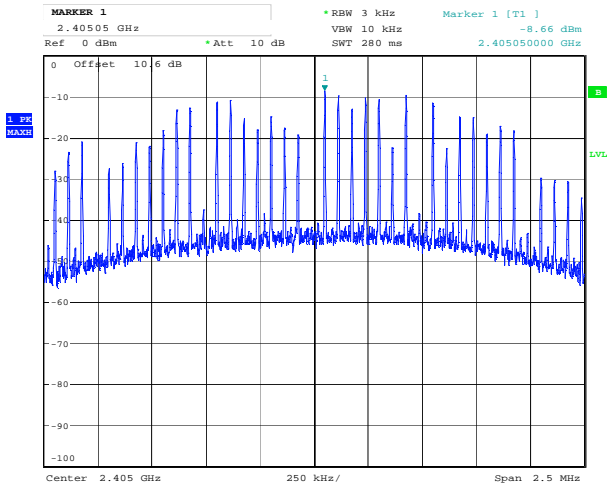
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

Modulation Type	Measured Power Spectral Density (dBm/3kHz)		
	2405 MHz	2435 MHz	2480 MHz
6LoWPAN	-8.7	-9.4	-10.3

Requirements:

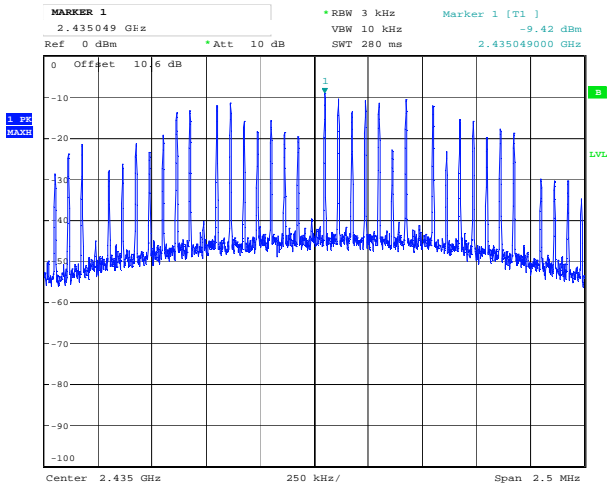
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band.

No requirements for Frequency Hopping Systems.



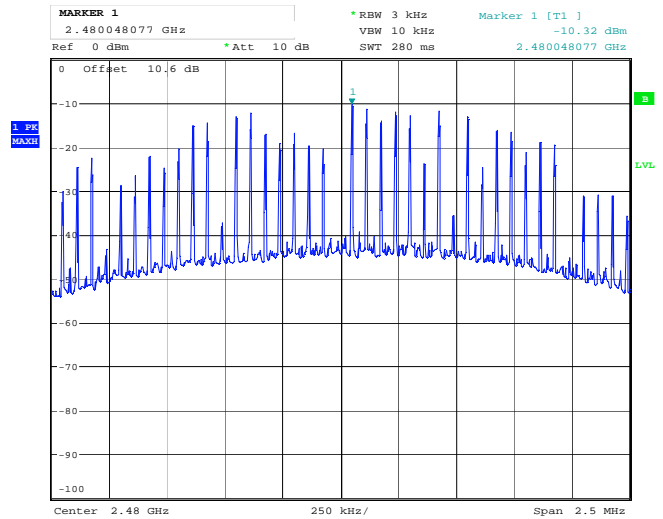
Date: 26.JAN.2021 16:33:26

PSD, 2405 MHz, 6LoWPAN



Date: 26.JAN.2021 16:35:05

PSD, 2435 MHz, 6LoWPAN



Date: 26.JAN.2021 16:46:10

PSD, 2480 MHz, 6LoWPAN

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.

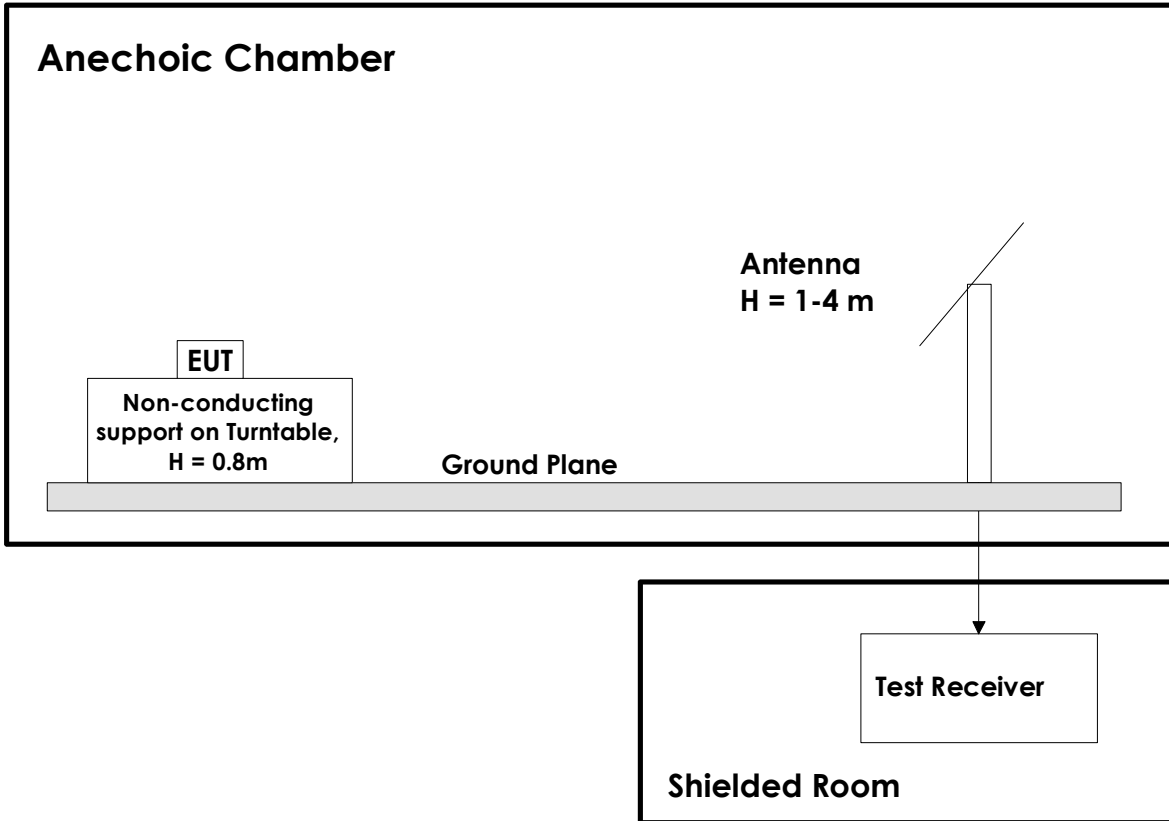
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1502	2020-01	2021-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2020-01	2021-01
3	6810.17B	Attenuator	Suhner	LR 1669	2020-08	2021-08
4	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	COU	
5	VULB 9163	BiLog Antenna	Schwarzbech	LR 1616	2020-01	2023-01
6	317	Preamplifier	Sonoma Inst.	LR 1687	2020-08	2021-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2017-12	2020-12
8	WLK5-1100-1485-7000-40SS	Low Pass Filter	Wainwright Inst.	LR 1761	COU	
9	638	Antenna Horn	Narda	LR 1480	2010-06	2030-06
10	8449A	Preamplifier	Hewlett Packard	LR 1666	2020-08	2021-08
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	Nemko AS	RSPlot	1.0.10.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 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 with absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.