

Test Report

Product	Remote Control Radio Transceiver		
Name and address of the applicant	Scanreco AB Stensåtravägen 13 127 39 Stockholm, Sweden		
Name and address of the manufacturer	Scanreco AB Stensåtravägen 13 127 39 Stockholm, Sweden		
Model	SRC-RCAN		
Rating	48V _{AC/DC}		
Trademark	SCANRECO		
Serial number	See clause 1.1		
Additional information	FHSS		
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / 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	412561		
Tested in period	2021-02-16 to 2021-03-24		
Issue date	2021-10-22		
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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CONTENTS

1	INFORMATION	3
1.1	Test Item	3
1.2	Normal test condition	4
1.3	Test Engineer(s)	4
1.4	Antenna Requirement	4
1.5	EUT Operating Modes	4
1.6	Comments	4
2	TEST REPORT SUMMARY	5
2.1	General	5
2.2	Test Summary	6
3	TEST RESULTS	7
3.1	Power Line Conducted Emissions	7
3.2	20dB Bandwidth	8
3.3	Pseudorandom Hopping Algorithm	10
3.4	Hopping Bandwidth	10
3.5	Occupancy Time	11
3.6	Occupied Bandwidth (99% BW)	12
3.7	Peak Power Output	14
3.8	Conducted Emissions at Antenna Connector	18
3.9	Restricted Bands of operation	21
3.10	Radiated Emissions, Band Edge	22
3.11	Radiated Emission, 30 – 1000 MHz	24
3.12	Radiated Emissions, 1-26 GHz	26
4	Measurement Uncertainty	34
5	LIST OF TEST EQUIPMENT	35
6	BLOCK DIAGRAM	36
6.1	Power Line Conducted Emission	36
6.2	Test Site Radiated Emission	36

1 INFORMATION

1.1 Test Item

Name	Scanreco
Model/version	SRC-RCAN
FCC ID	N5OSRCRCAN
ISED ID	6476A-SRCRCAN
Serial number	Sample with Int Ant: 1095200 Sample with Ext Ant: 1095184
Hardware identity and/or version	103110
Software identity and/or version	SRC-RCAN_RF-KC-0100
Frequency Range	2405–2480 MHz
Number of Channels	16
Type of Modulation	O-QPSK
Conducted Output Power	98 mW
Antenna Connector	Integral Antenna or RP-TNC connector
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	External Power (48 – 230 V _{AC})
Antennas tested with EUT	Internal F-Antenna External Antenna: M70XC External Short Whip Antenna

Description of Test Item

The EUT is a transceiver for remote control of cranes.

This device has been tested as a Frequency Hopping system and fulfils all requirements for FHSS systems.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	48V 60 Hz AC (RF tests) 120V 60 Hz AC (Power Line Conducted Test)

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen / Kristian Osvoll

1.4 Antenna Requirement

Does the EUT have detachable antenna(s)?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
If detachable, is the antenna connector(s) non-standard?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
The version with external Antenna Connector uses an RP-SMA connector.		

Requirement: FCC 15.203, 15.204

1.5 EUT Operating Modes

Description of operating modes	Continuous TX bursts on one channel or Hopping
Additional information	The following settings were used for all tests: Power Setting Internal F-Antenna: 236 Power Setting External Antenna: 220

1.6 Comments

The EUT uses Frequency Hopping with a proprietary protocol.

It was checked that power variations between 48V AC and 138V AC did not have any influence on output power.

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 and 3m.

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

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

DSS 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	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	Complies
Channel Separation and 20 dB BW	15.247(a)(1)	5.1 (4) (RSS-247)	7.8.2 (FHSS)	Complies
Number of Hopping Frequencies	15.31(m)	5.1 (6) (RSS-247)	7.8.3 (FHSS)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3) (RSS-247)	N/A (FHSS)	Complies
Time of Occupancy (dwell time)	15.247(a)(1)(iii)	5.1 (5) (RSS-247)	7.8.4 (FHSS)	Complies
Occupied Bandwidth	15.247(a)(1)	5.1 (7) (RSS-247)	6.9.2 FHSS)	Complies
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 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	Complies

Revision history

Revision	Date	Comment	Sign
00	2021-09-09	First edition	FS

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.207

ISED RSS-GEN Issue 5, Clause 7.2/8.8

Measurement procedure: ANSI C63.4-2014 using 50 μ H/50 ohms LISN.

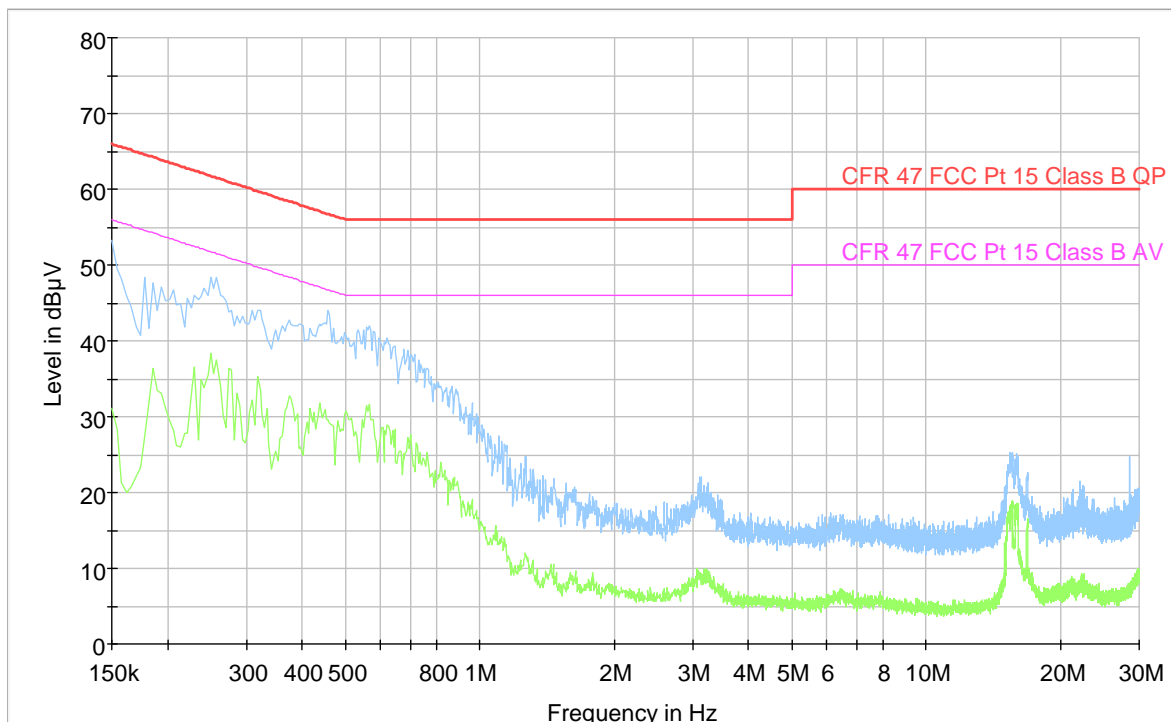
Test Results: Complies

Measurement Data: See attached plots.
 Tested with 48 V 60 Hz AC

Highest measured value (L1 and N):

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
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Full Spectrum



3.2 20dB Bandwidth

FCC Part 15.247(a)(1)

ISED RSS-247 Issue 2, Clause 5.1 (b)

Measurement procedure: ANSI C63.10-2013 Clause 7.8.2

Test Results: Complies

Measurement Data:

20dB Bandwidth		
2405 MHz	2440 MHz	2480 MHz
2.81 MHz	2.82 MHz	2.82 MHz
Channel Separation: 5.0 MHz		

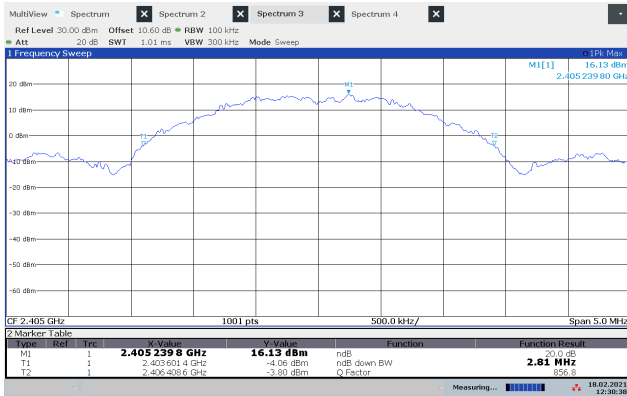
See attached plots.

Requirement:

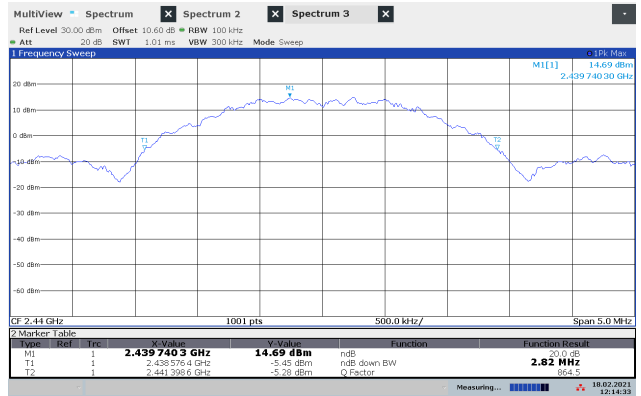
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

or:

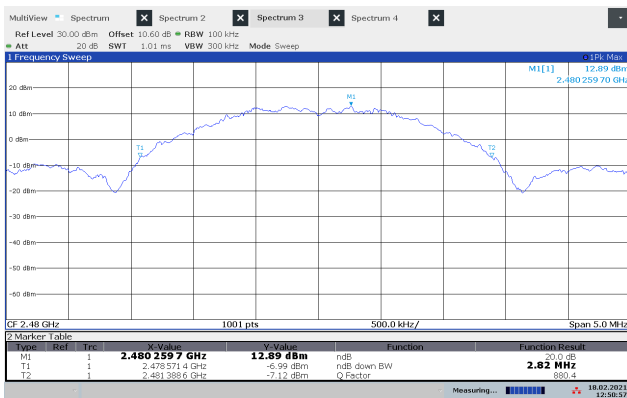
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.



20dB Bandwidth 2405 MHz



20dB Bandwidth 2440 MHz



20dB Bandwidth 2480 MHz

3.3 Pseudorandom Hopping Algorithm

FCC Part 15.247 (a)(1)

ISED Canada RSS-247 Issue 2, Clause 5.1

Test Results: **Complies**

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

3.4 Hopping Bandwidth

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

ISED Canada RSS-247 Issue 2, Clause 5.1

Measurement procedure: ANSI C63.10-2013 Clause 6.9.2 / 7.8.3

Test Results: **Complies**

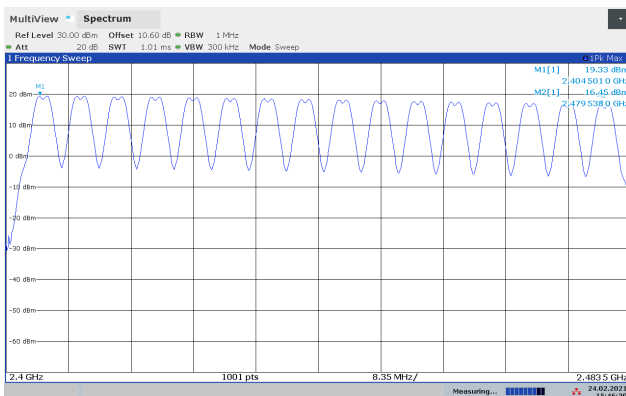
Measurement Data:

Number of RF Channels in use	16
Channel Centre Frequencies	2405 to 2480 MHz
Channel Separation	5.0 MHz

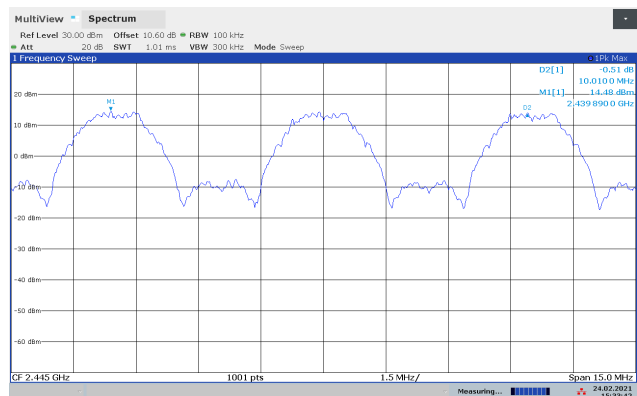
See attached plots.

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.



RF Channels in Use, Basic Rate



Channel Separation

3.5 Occupancy Time

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

ISED Canada RSS-247 Issue 2, Clause 5.1 (c)

Measurement procedure: ANSI C63.10-2013 Clause 7.8.4

Test Results: **Complies**

Measurement Data:

Burst Length (ms)	Frame Length (ms)	Time of Occupancy (ms)	Verdict
4.83	77.9	396.8	Complies

Time between RF burst on same channel = Frame Length * Number of Channels

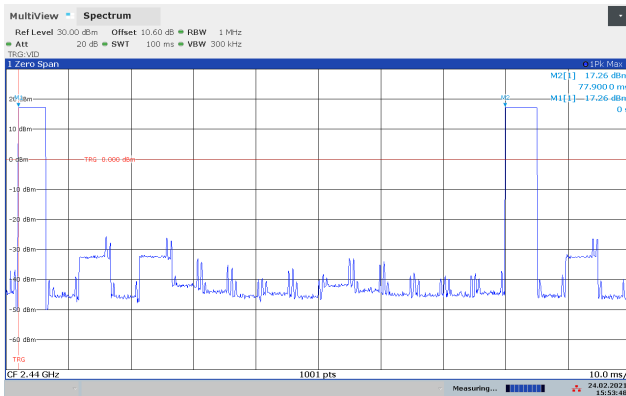
Time of occupancy = (Burst Length * Number of Channels * 400 ms) / Time Between Burst on Same Channel
 = (4.83ms * 16 * 400ms) / 77.9ms = 396.8 ms

Number of RF channels is 16.

See attached plots.

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Frame Length



Burst Length

3.6 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

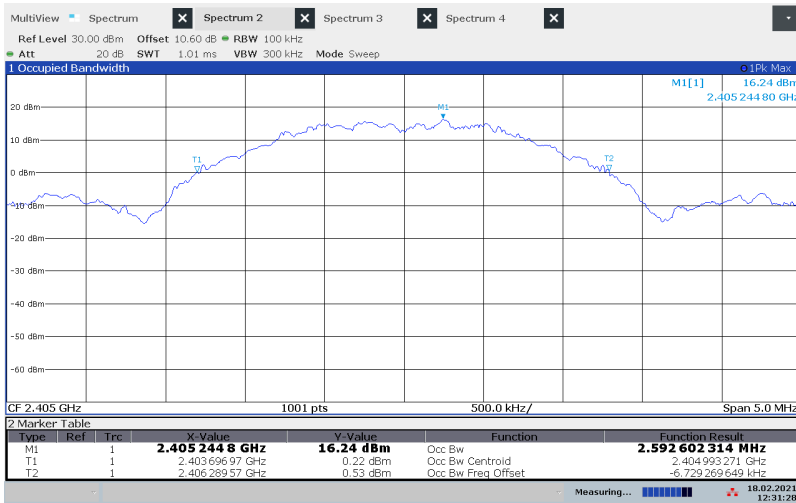
Measurement Data:

Carrier Frequency	Occupied Bandwidth (99% BW)
2405 MHz	2.592 MHz
2440 MHz	2.571 MHz
2480 MHz	2.569 MHz

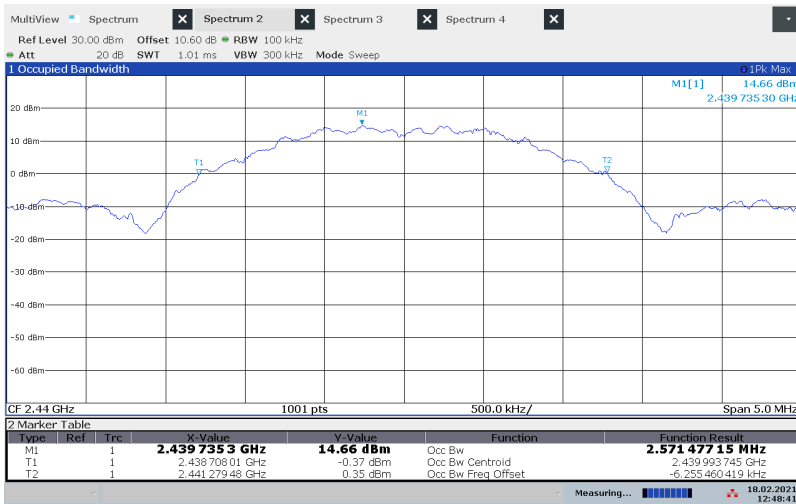
See attached plots.

Requirements:

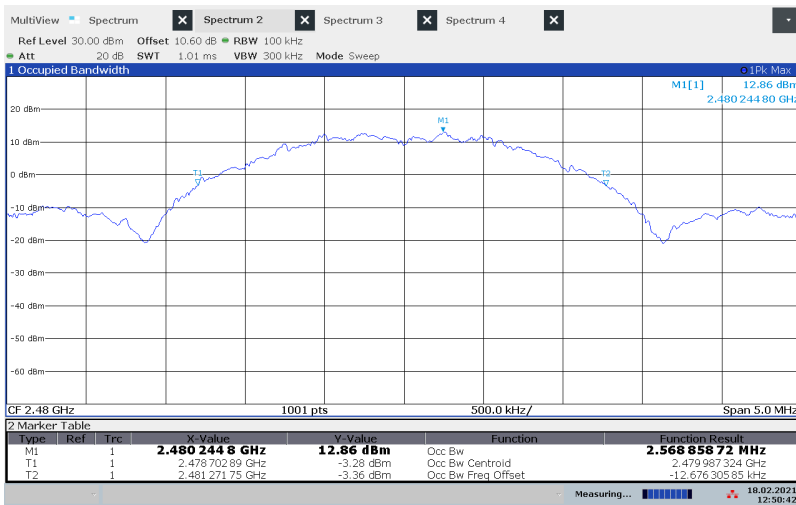
No requirement for 99% BW, reported for information only.



99% Occupied BW, 2405 MHz



99% Occupied BW, 2440 MHz



99% Occupied BW, 2480 MHz

3.7 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:

Power Level 236, Internal F-Antenna

Carrier Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dBµV/m)	EIRP (mW)	Antenna gain (dBi)
2405	19.9	97.7	116.6	137.1	1.5
2440	18.8	75.9	115.4	104.0	1.4
2480	17.0	50.1	113.9	73.6	1.7

Power Level 220, External Antenna M70XC

Carrier Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dBµV/m)	EIRP (mW)	Antenna gain (dBi)
2405	19.3	84.9	111.9	46.4	-2.6
2440	18.3	67.6	111.5	41.9	-2.1
2480	16.5	44.4	109.4	26.3	-2.3

Power Level 220, External Whip Antenna

Carrier Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dBµV/m)	EIRP (mW)	Antenna gain (dBi)
2405	19.3	84.9	116.5	134.3	2.0
2440	18.3	67.6	116.9	147.3	3.4
2480	16.5	44.4	116.0	118.6	4.3

Output Power reported is Maximum Peak Power.

Radiated Power 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.

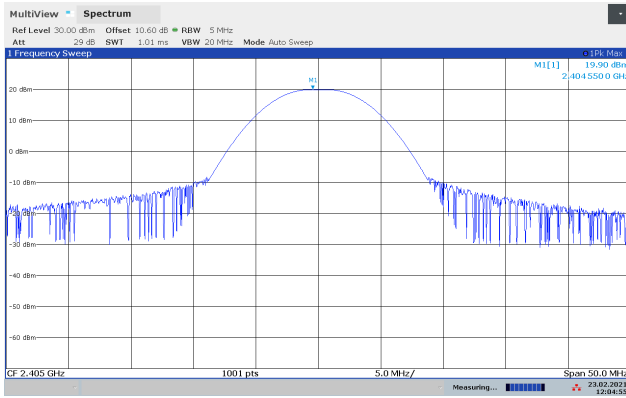
Requirements:

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

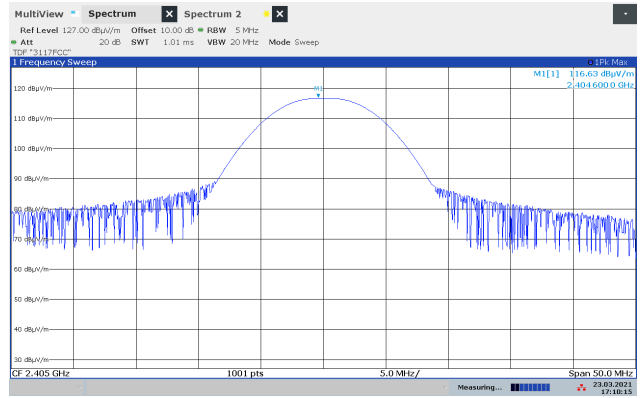
For frequency hopping systems employing at least 75 hopping channels: 1 Watt

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

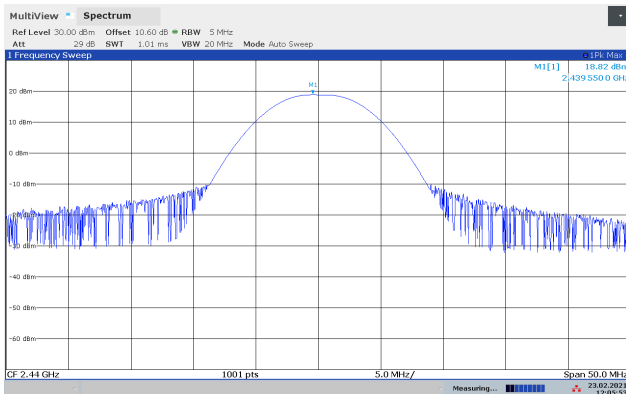
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



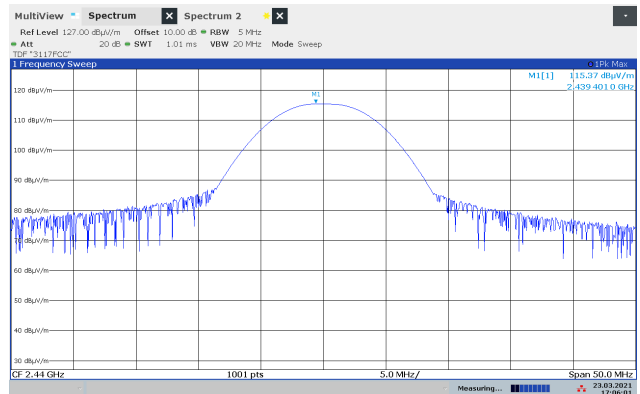
Peak Power, 2405 MHz, PLev 236



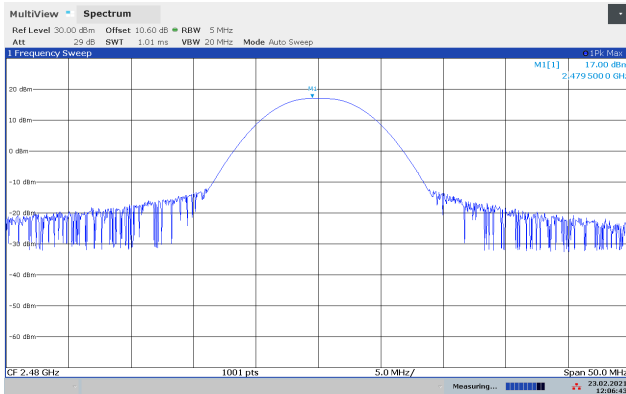
Maximum Field Strength, 2405 MHz, PLev 236, Int F-Ant



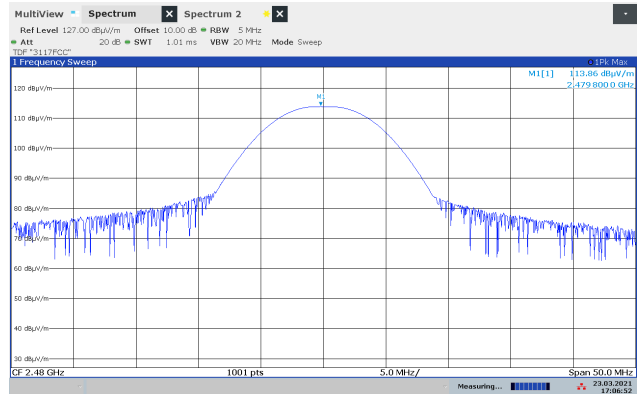
Peak Power, 2440 MHz, PLev 236



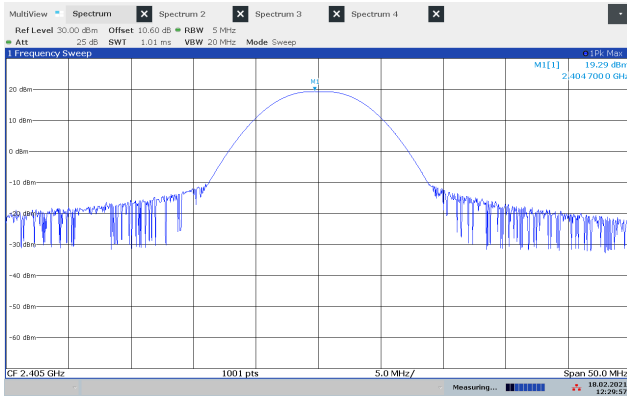
Maximum Field Strength, 2440 MHz, PLev 236, Int F-Ant



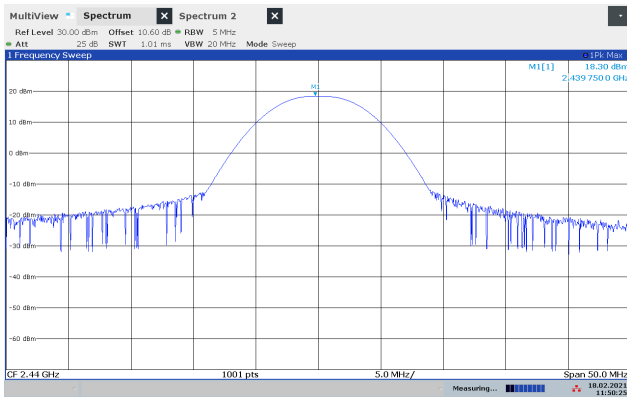
Peak Power, 2480 MHz, PLev 236



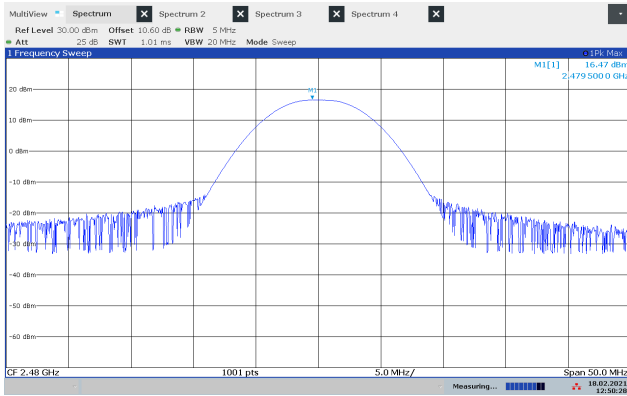
Maximum Field Strength, 2480 MHz, PLev 236, Int F-Ant



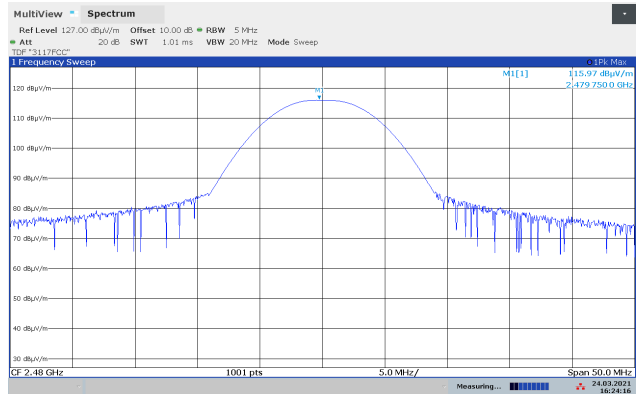
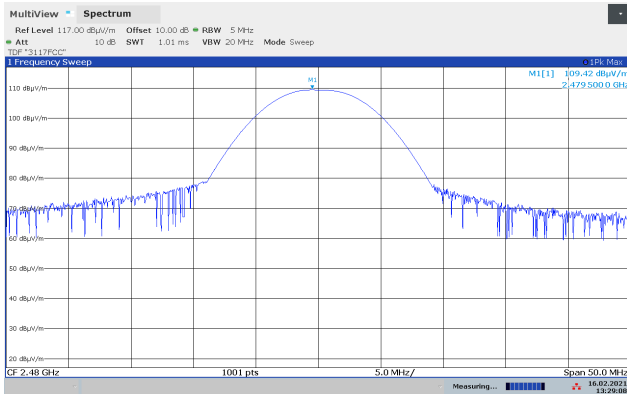
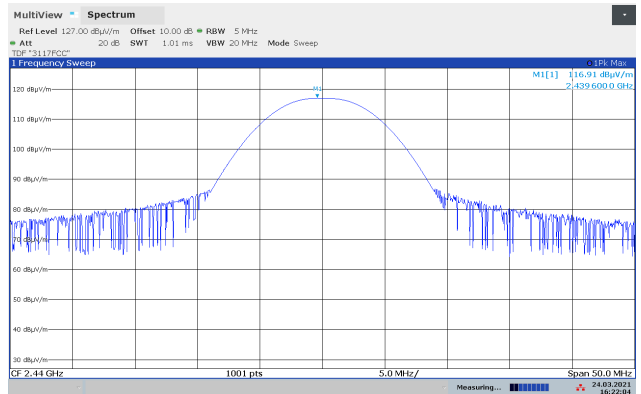
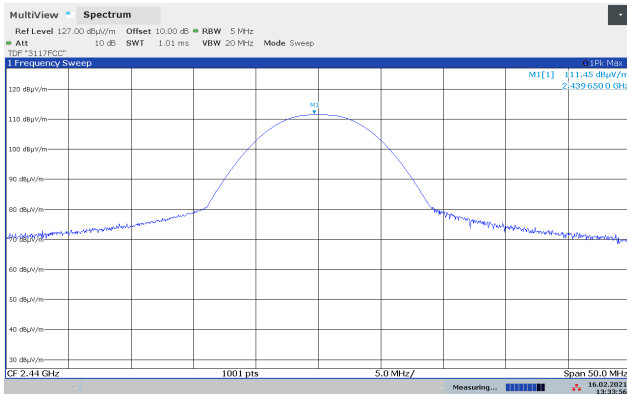
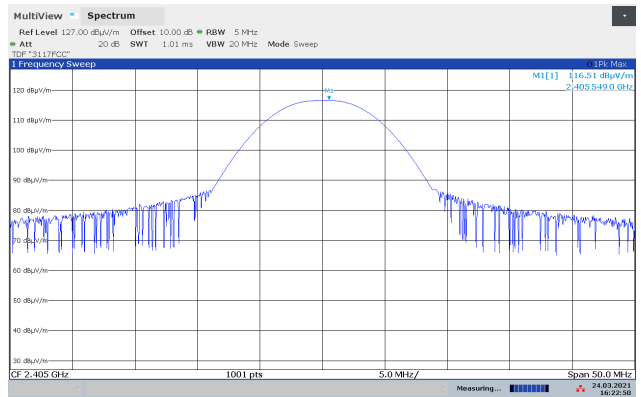
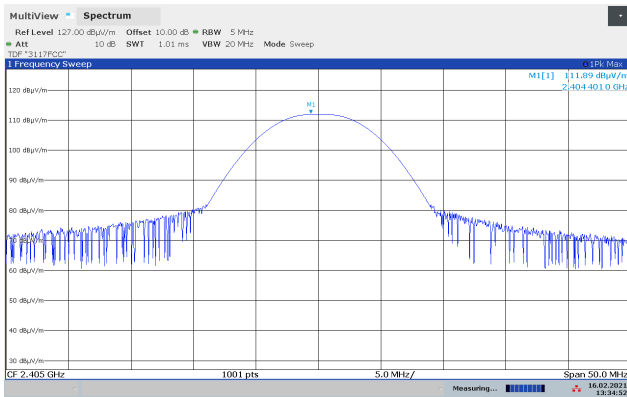
Peak Power, 2405 MHz, PLev 220



Peak Power, 2440 MHz, PLev 220



Peak Power, 2480 MHz, PLev 220



3.8 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	> 50	> 30	Complies
2440 MHz	> 50	> 30	Complies
2480 MHz	> 60	> 40	Complies

Measured with Peak Detector

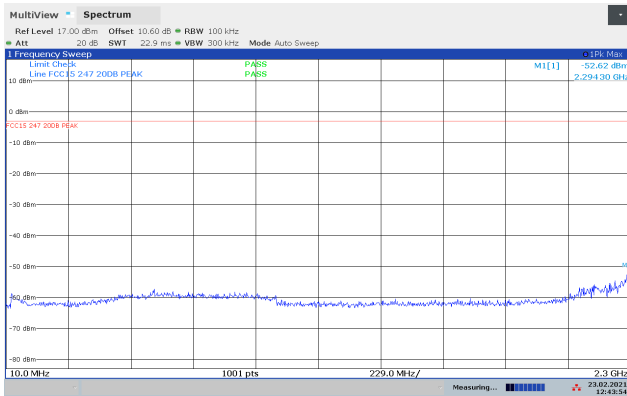
RF conducted power to 25 GHz: see attached plots.

Limit

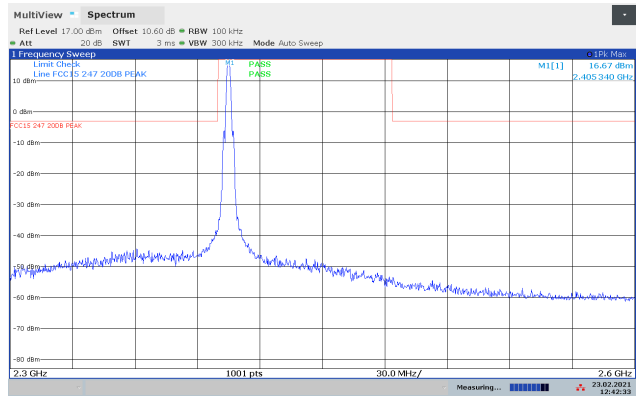
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

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

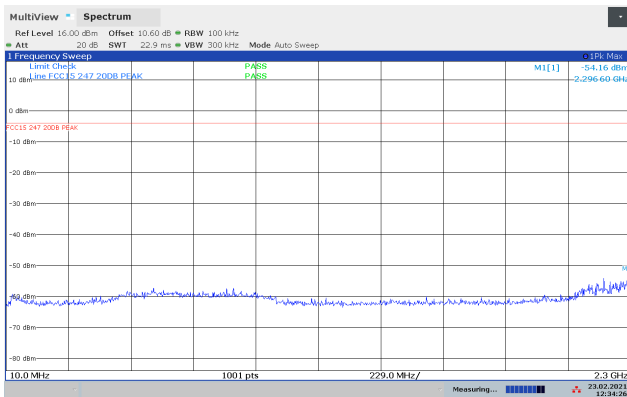
Attenuation below the general limits specified in part 15.209(a) is not required.



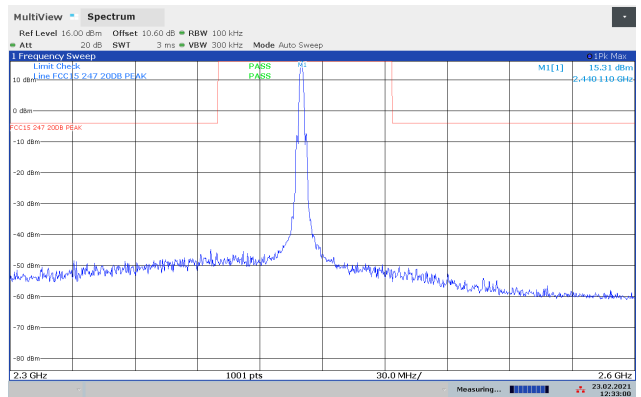
Conducted Emissions 10-2300 MHz, 2405 MHz, PLev 236



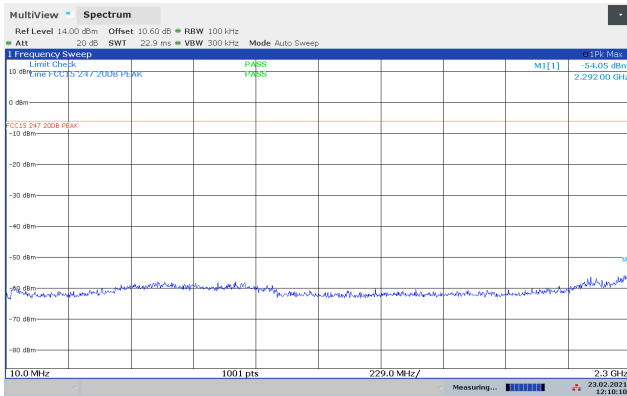
Conducted Emissions 2300-2600 MHz, 2405 MHz, PLev 236



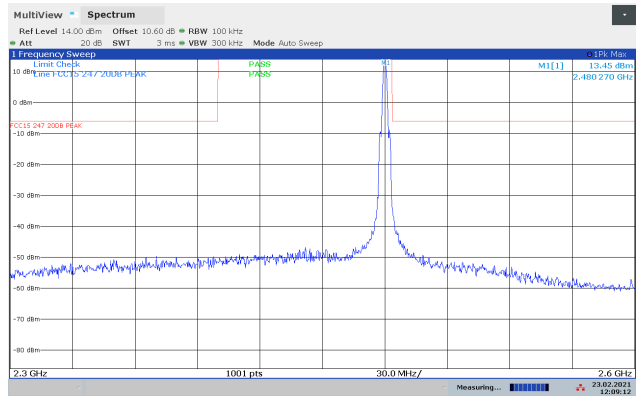
Conducted Emissions 10-2300 MHz, 2440 MHz, PLev 236



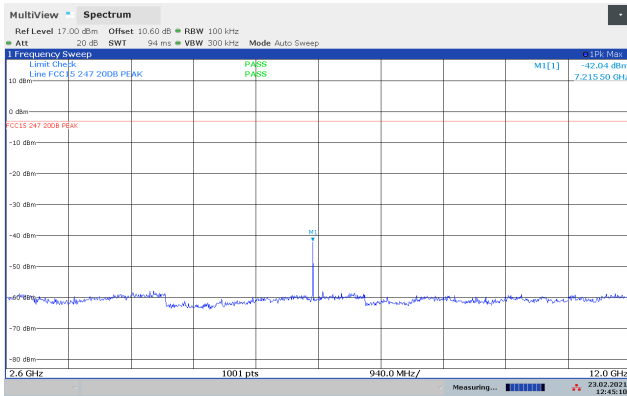
Conducted Emissions 2300-2600 MHz, 2440 MHz, PLev 236



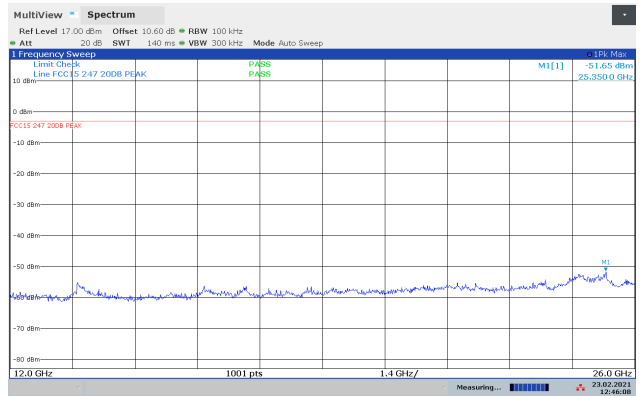
Conducted Emissions 10-2300 MHz, 2480 MHz, PLev 236



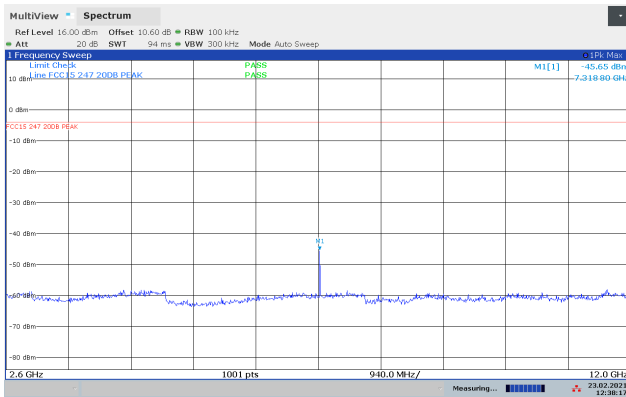
Conducted Emissions 2300-2600 MHz, 2480 MHz, PLev 236



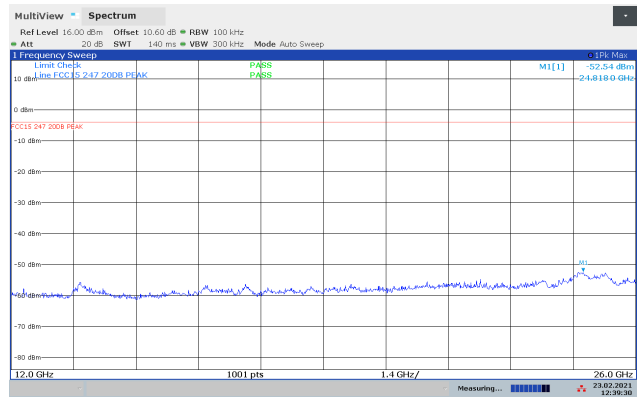
Conducted Emissions 2600-12000 MHz, 2405 MHz, PLev 236



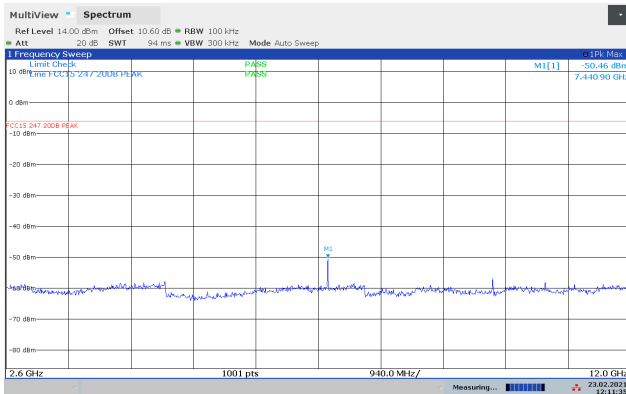
Conducted Emissions 12000-26000 MHz, 2405 MHz, PLev 236



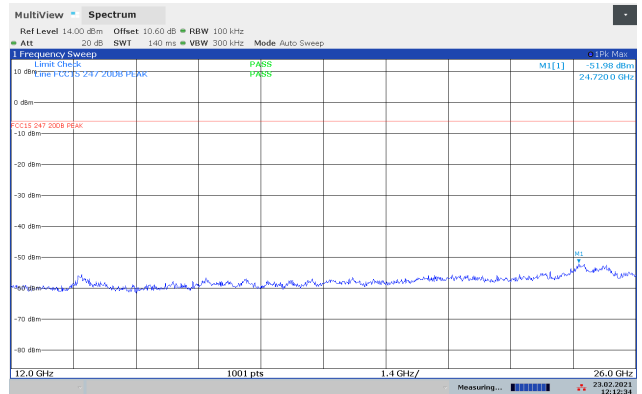
Conducted Emissions 2600-12000 MHz, 2440 MHz, PLev 236



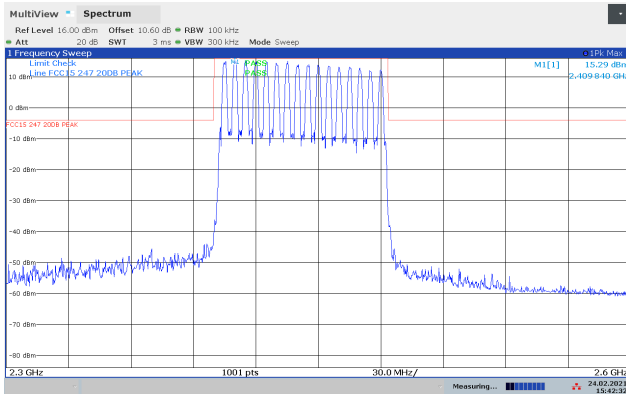
Conducted Emissions 12000 -26000 MHz, 2440 MHz, PLev 236



Conducted Emissions 2600-12000 MHz, 2480 MHz, PLev 236



Conducted Emissions 12000 -26000 MHz, 2480 MHz, PLev 236



Conducted Emissions 2300-2600 MHz, Hopping, PLev 236

3.9 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.

3.10 Radiated Emissions, Band Edge

FCC Part 15.205, 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:

Antenna	Carrier Frequency	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
Int F-Ant	2405 MHz	2390 MHz	69.5	49.5	74	54	4.5	4.5
	2480 MHz	2483.5 MHz	71.8	51.8			2.2	2.2
Ext M70XC Ant	2405 MHz	2390 MHz	63.2	43.2	74	54	10.8	10.8
	2480 MHz	2483.5 MHz	67.1	47.1			6.9	6.9
Ext Short Whip Ant	2405 MHz	2390 MHz	66.9	46.9	74	54	7.1	7.1
	2480 MHz	2483.5 MHz	73.8	53.8			0.2	0.2

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

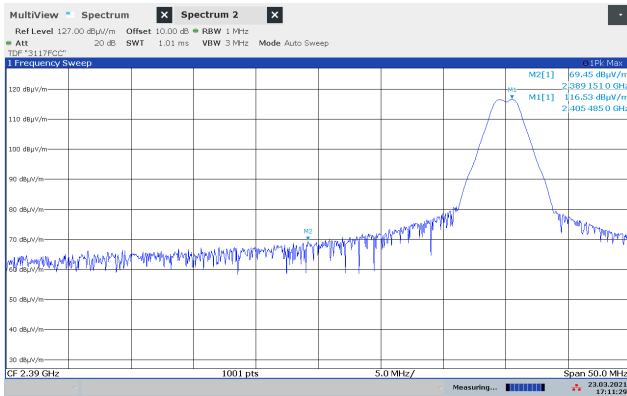
See attached plots.

Duty Cycle Correction Factor Calculation:

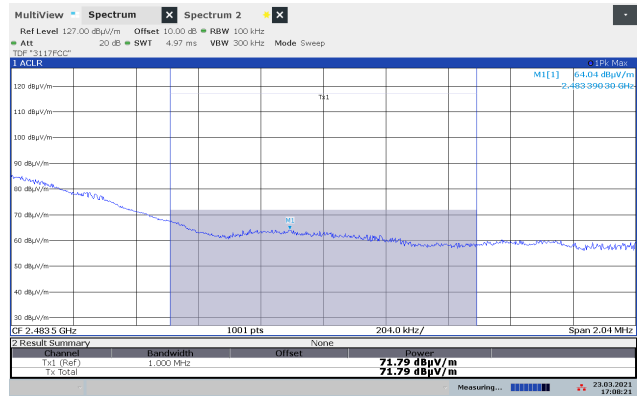
Duty Cycle = (Number of slots per 100ms) * 4.83ms / 100ms = 2*4.83ms / 100ms = 0.0966

Duty Cycle Correction factor = -20 x log₁₀(0.0966) = 20.3 dB

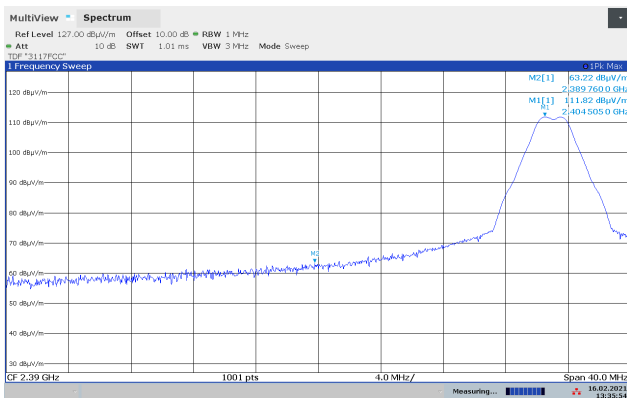
Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB



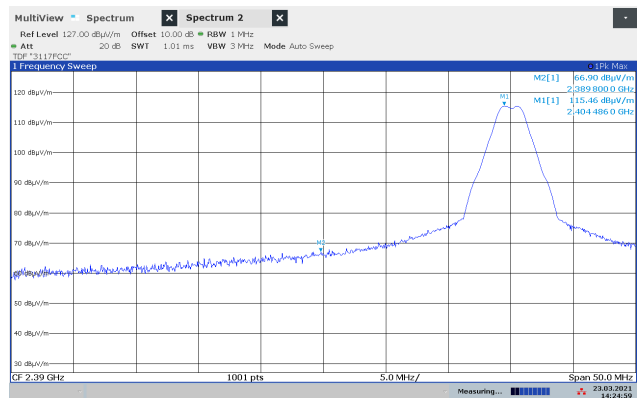
Band Edge 2405 MHz, GFSK, Peak, PowLev 236, Int F-Ant



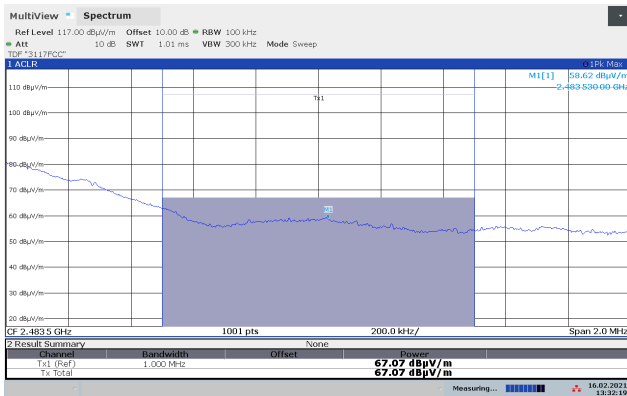
Band Edge 2480 MHz, GFSK, Peak, PowLev 236, Int F-Ant



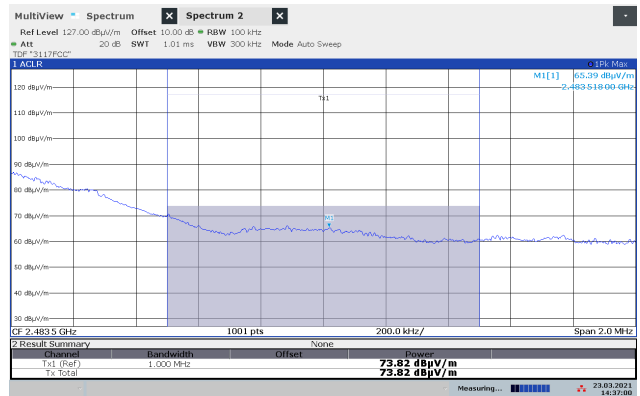
Band Edge 2405 MHz, GFSK, Peak, PowLev 220, M70XC Ant



Band Edge 2405 MHz, GFSK, Peak, PowLev 220, Ext Whip Ant



Band Edge 2480 MHz, GFSK, Peak, PowLev 220, M70XC Ant



Band Edge 2480 MHz, GFSK, Peak, PowLev 220, Ext Whip Ant

3.11 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 3m

Tested in test mode with active connection.

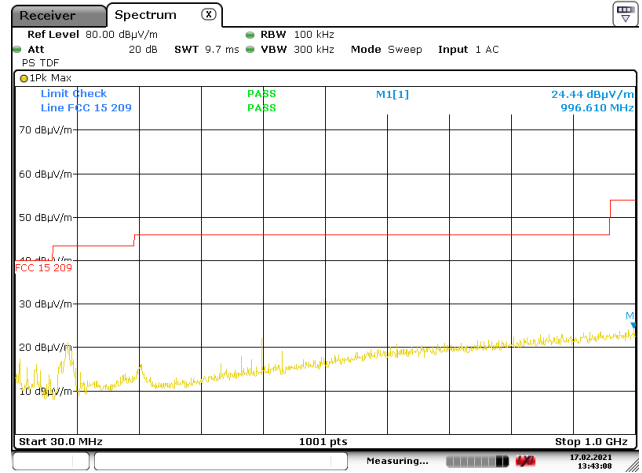
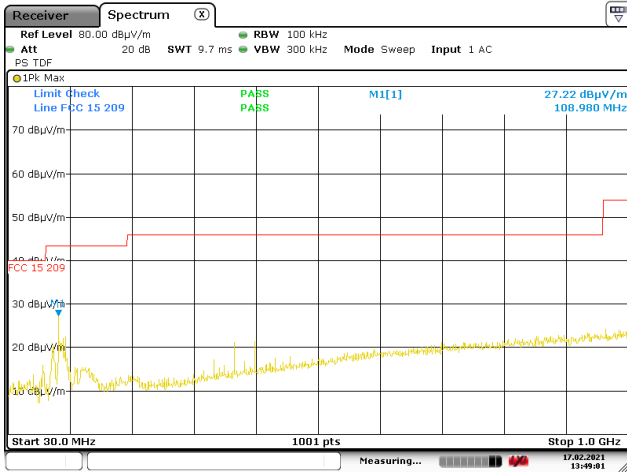
Measured Frequency (MHz)	Carrier Frequency (MHz)	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 – 88	Any	< 30	40.0	> 10
88 – 216	Any	< 30	43.5	> 13.5
216 – 960	Any	< 30	46.0	> 16
960 – 1000	Any	< 30	54.0	> 24

See attached plots.

A LowPass filter with cut-off at 1 GHz was used for this test.

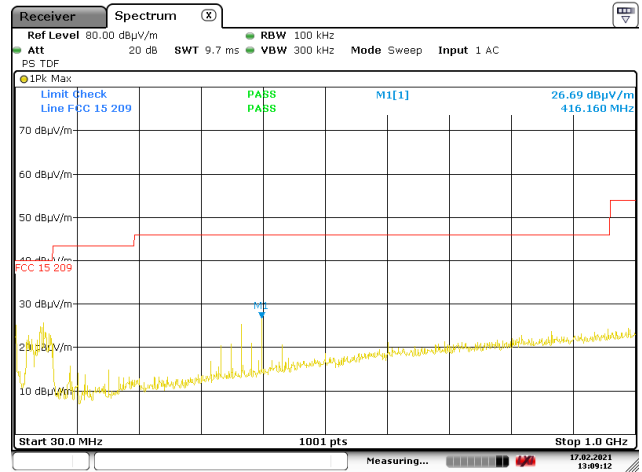
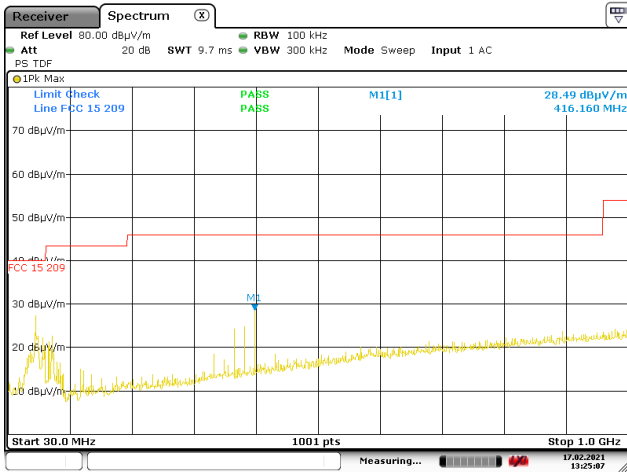
Requirements/Limit

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 µV/m	40.0 dBµV/m
88 – 216 MHz	150 µV/m	43.5 dBµV/m
216 – 960 MHz	200 µV/m	46.0 dBµV/m
960 – 1000 MHz	500 µV/m	54.0 dBµV/m
	Limits above are with Quasi Peak Detector	



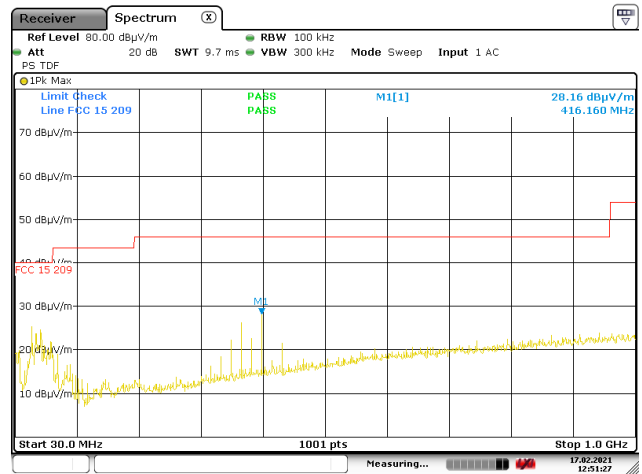
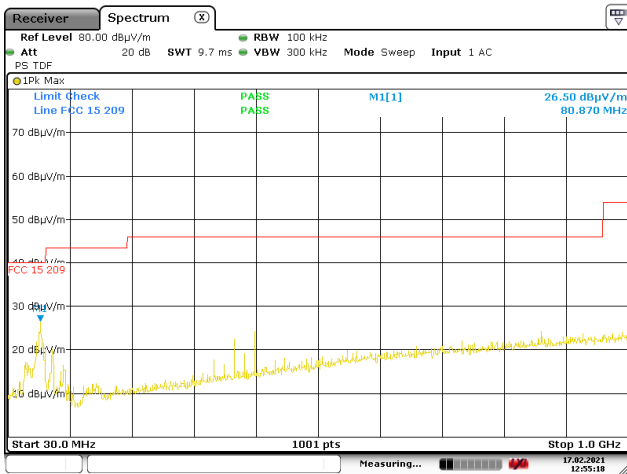
Radiated Emissions 30 - 1000 MHz, HP, Int F-Ant

Radiated Emissions 30 - 1000 MHz, VP, Int F-Ant



Radiated Emissions 30 - 1000 MHz, HP, M70XC Ant

Radiated Emissions 30 - 1000 MHz, VP, M70XC Ant



Radiated Emissions 30 - 1000 MHz, HP, Ext Short Whip Ant

Radiated Emissions 30 - 1000 MHz, VP, Ext Short Whip Ant

3.12 Radiated Emissions, 1-26 GHz

FCC Part 15.205, 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)
 1m (18 – 25 GHz)

Internal F-Ant, RBW / VBW = 1MHz / 3MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Measured Emission (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
		Peak	Average	Peak	Average	Peak	Average
4880	2440	63.3	43.3	74	54	10.7	10.7
7230	2410	70.7	50.7	74	54	3.3	3.3
7320	2440	71.6	51.6	74	54	2.4	2.4
7440	2480	67.1	47.1	74	54	6.9	6.9
12200	2440	57.5	37.5	74	54	16.5	16.5
14640	2440	61.1	41.1	74	54	12.9	12.9
17080	2440	59.0	39.0	74	54	15.0	15.0
19240	2405	55.2	35.2	74	54	18.8	18.8
19520	2440	55.5	35.5	74	54	18.5	18.5

External M70XC Ant, RBW / VBW = 1MHz / 3MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Measured Emission (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
		Peak	Average	Peak	Average	Peak	Average
4880	2440	63.0	43.0	74	54	11.0	11.0
7215	2405	65.0	45.0	74	54	9.0	9.0
7320	2440	65.3	45.3	74	54	8.7	8.7
7440	2480	63.5	43.5	74	54	10.5	10.5
12200	2440	55.9	35.9	74	54	18.1	18.1
14640	2440	59.4	39.4	74	54	14.6	14.6
17080	2440	56.4	36.4	74	54	17.6	17.6
19520	2440	54.7	34.7	74	54	19.3	19.3

External Short Whip Ant, RBW / VBW = 1MHz / 3MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Measured Emission (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak	Average	Peak	Average	Peak	Average
4880	2440	63.3	43.3	74	54	10.7	10.7
7230	2410	72.0	52.0	74	54	2.0	2.0
7320	2440	72.4	52.4	74	54	1.6	1.6
7440	2480	69.0	49.0	74	54	5.0	5.0
12200	2440	57.4	37.4	74	54	16.6	16.6
14640	2440	60.3	40.3	74	54	13.7	13.7
19240	2405	55.4	35.4	74	54	18.6	18.6
19520	2440	56.1	36.1	74	54	17.9	17.9
19840	2480	55.4	35.4	74	54	18.6	18.6

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".

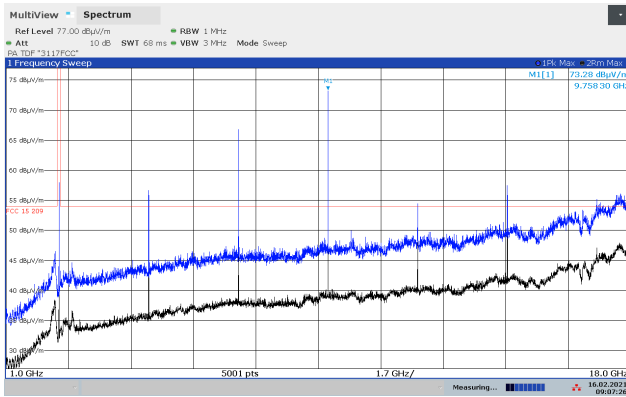
Internal F-Ant was tested with Power Level 236.

External M70XC and Short Whip Antennas were tested with Power Level 220.

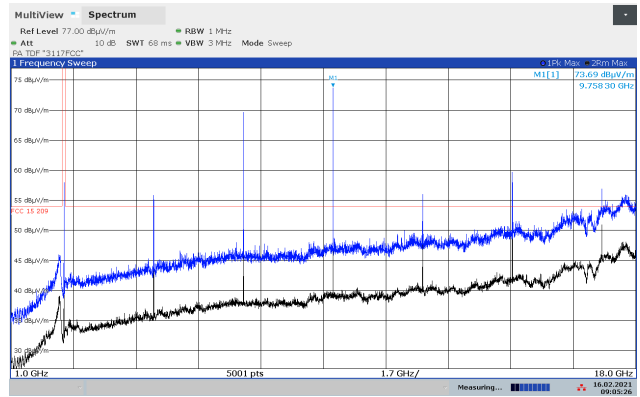
See plots.

Requirements/Limit

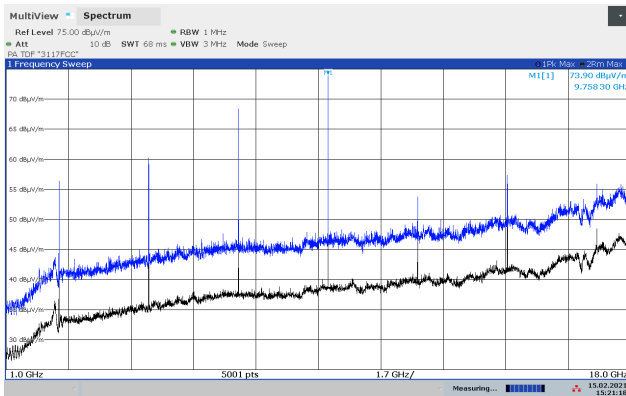
FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 26 GHz	54.0 dBµV/m	74.0 dBµV/m



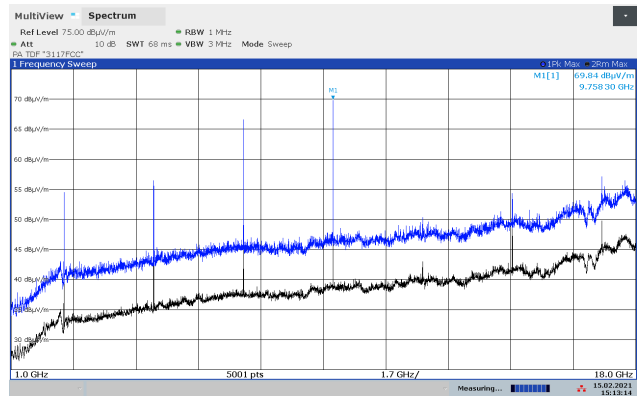
Radiated Emissions 1 - 18 GHz, 2440 MHz, HP, Int F-Ant



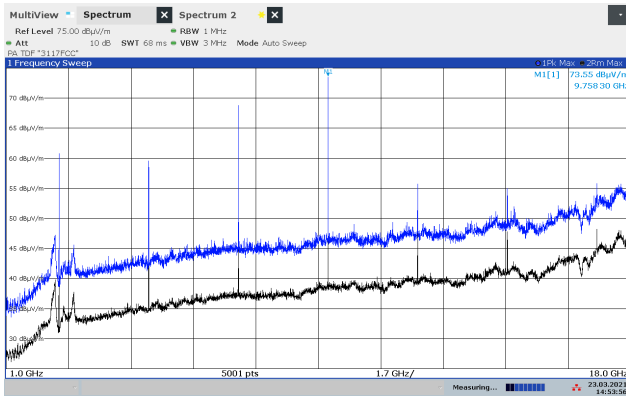
Radiated Emissions 1 - 18 GHz, 2440 MHz, VP, Int F-Ant



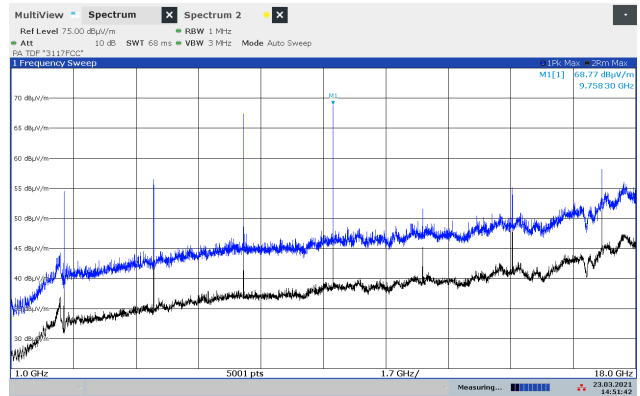
Radiated Emissions 1 - 18 GHz, 2440 MHz, HP, M70XC Ant



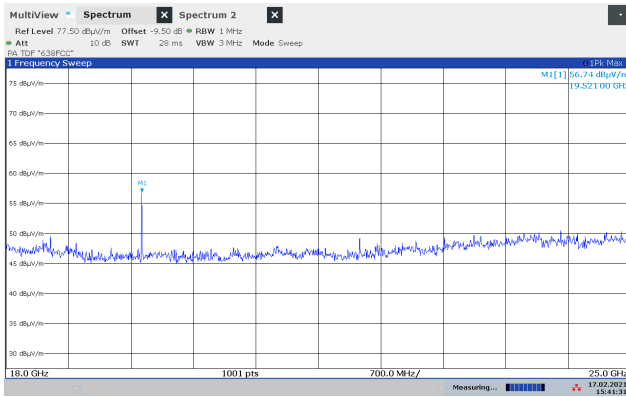
Radiated Emissions 1 - 18 GHz, 2440 MHz, VP, M70XC Ant



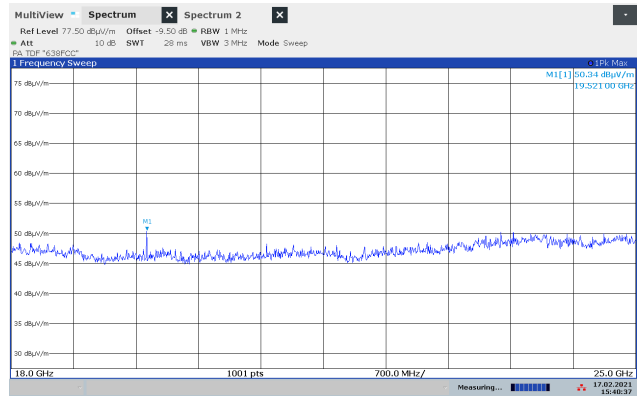
Radiated Emissions 1 - 18 GHz, 2440 MHz, HP, Ext Short Whip Ant



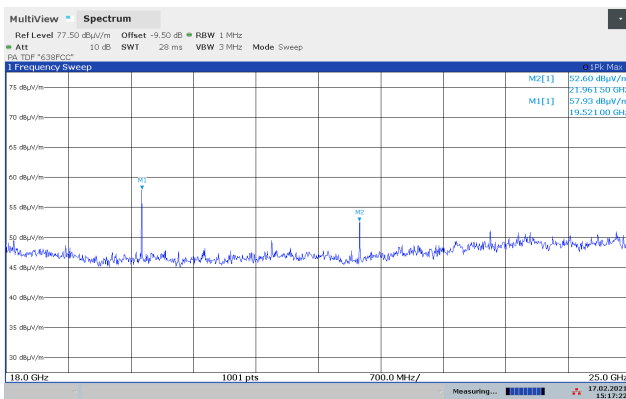
Radiated Emissions 1 - 18 GHz, 2440 MHz, VP, Ext Short Whip Ant



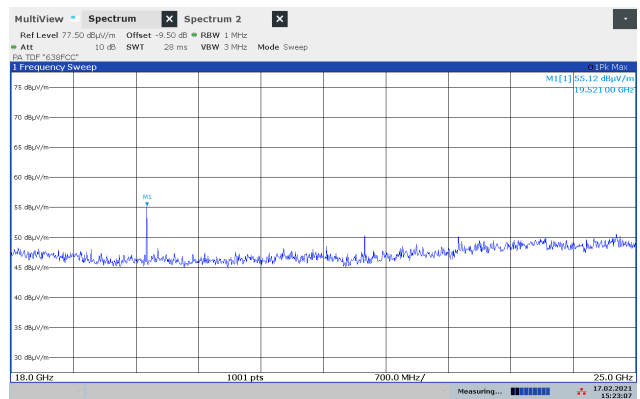
Radiated Emissions 18 - 25 GHz, 2440 MHz, HP @ 1m, Int F-Ant



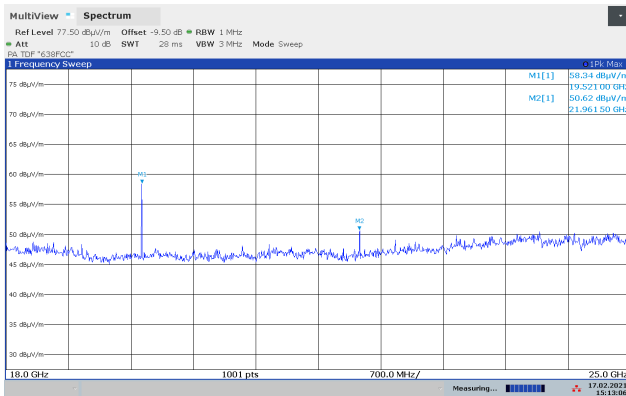
Radiated Emissions 18 - 25 GHz, 2440 MHz, VP @ 1m, Int F-Ant



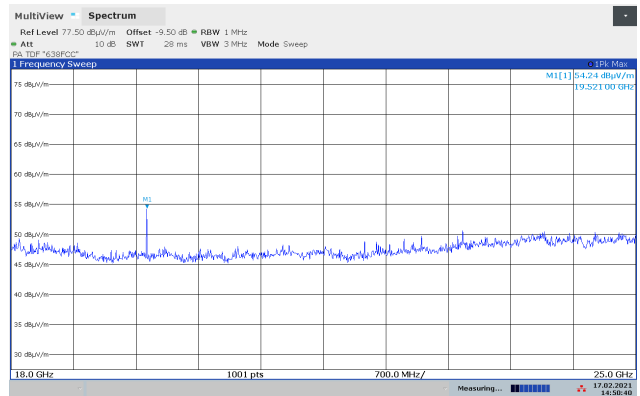
Radiated Emissions 18 - 25 GHz, 2440 MHz, HP @ 1m, M70XC Ant



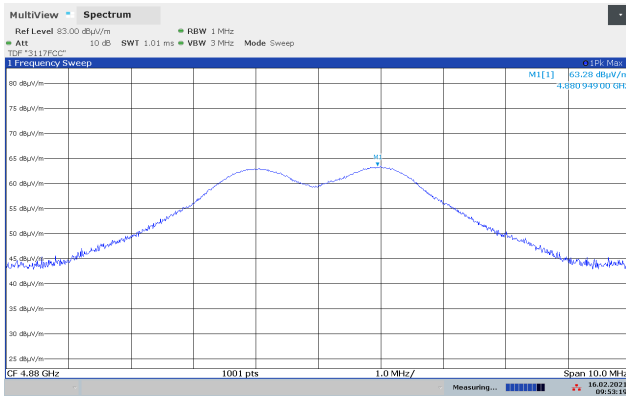
Radiated Emissions 18 - 25 GHz, 2440 MHz, VP @ 1m, M70XC Ant



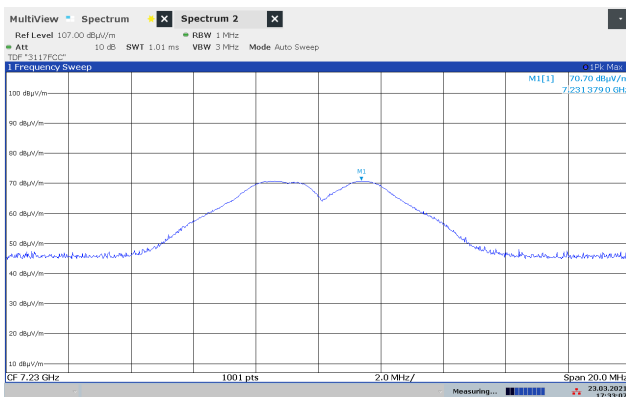
Radiated Emissions 18 - 25 GHz, 2440 MHz, HP, Ext Short Whip Ant



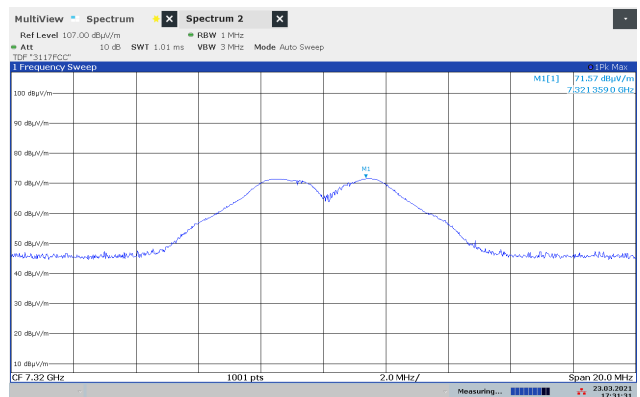
Radiated Emissions 18 - 25 GHz, 2440 MHz, VP, Ext Short Whip Ant



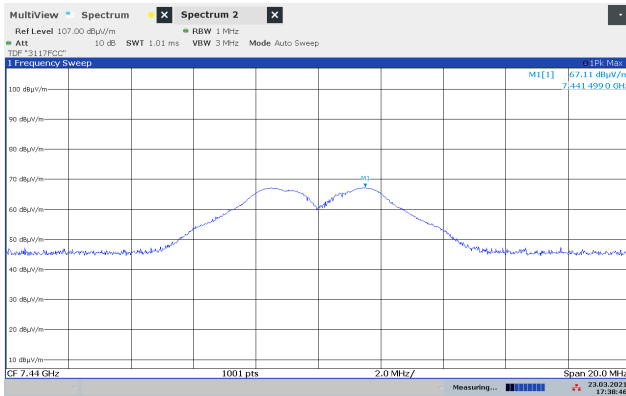
Emissions 4880 MHz, 2440 MHz, GFSK, VP, Int F-Ant



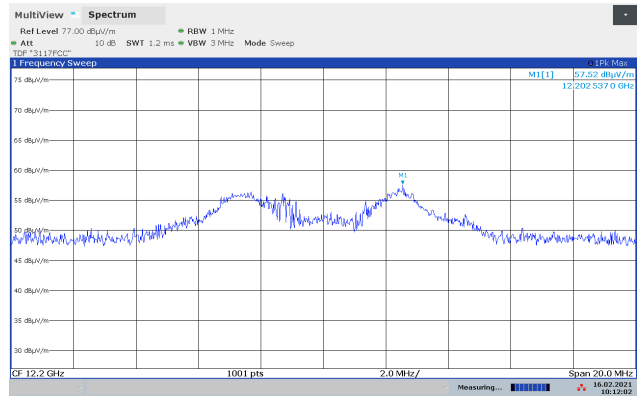
Emissions 7230 MHz, 2410 MHz, GFSK, VP, Int F-Ant



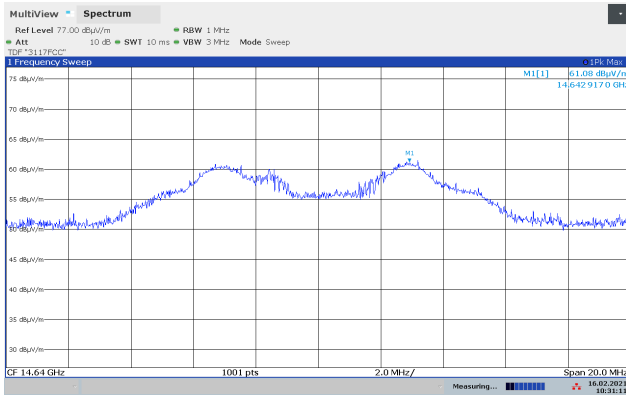
Emissions 7320 MHz, 2440 MHz, GFSK, VP, Int F-Ant



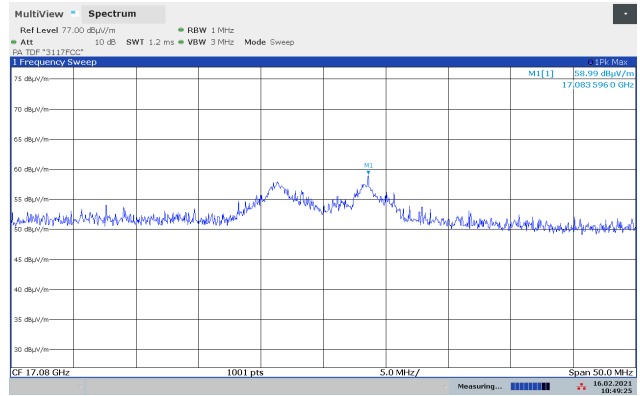
Emissions 7440 MHz, 2480 MHz, GFSK, VP, Int F-Ant



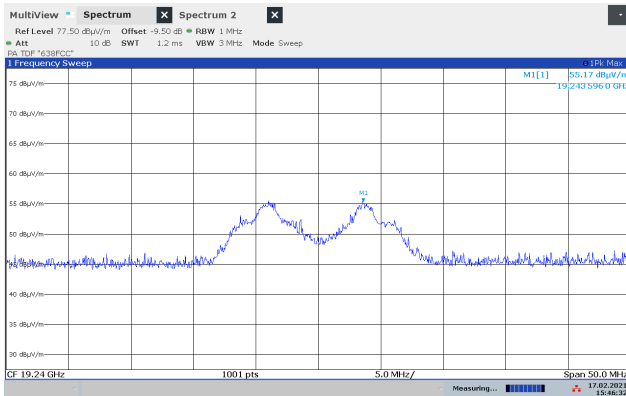
Emissions 12200 MHz, 2440 MHz, GFSK, VP, Int F-Ant



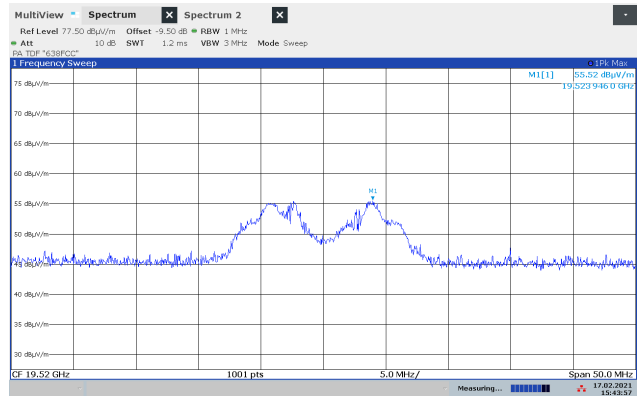
Emissions 14640 MHz, 2440 MHz, GFSK, VP, Int F-Ant



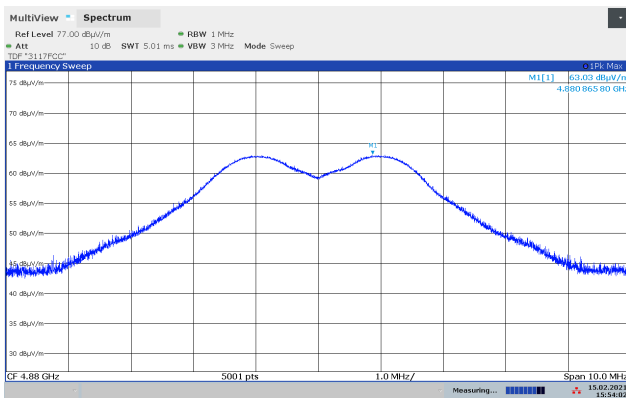
Emissions 17080 MHz, 2440 MHz, GFSK, VP, Int F-Ant



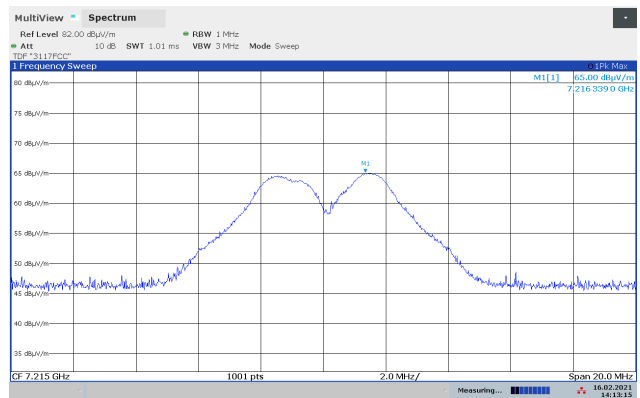
Emissions 19240 MHz, 2405 MHz, GFSK, VP @1m, Int F-Ant



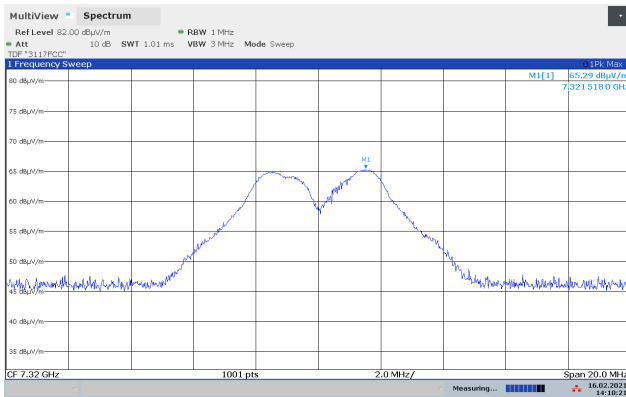
Emissions 19520 MHz, 2440 MHz, GFSK, VP @1m, Int F-Ant



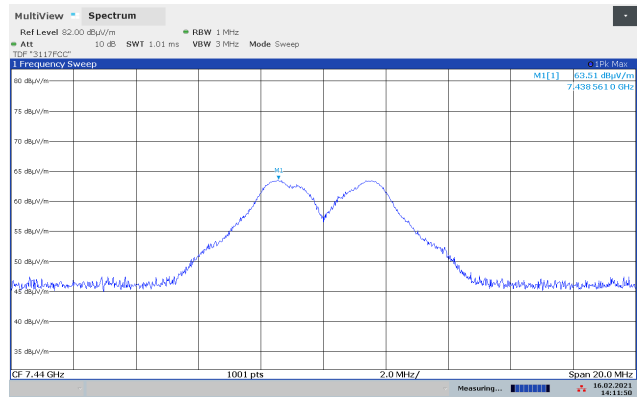
Emissions 4880 MHz, 2440 MHz, GFSK, VP, M70XC Ant



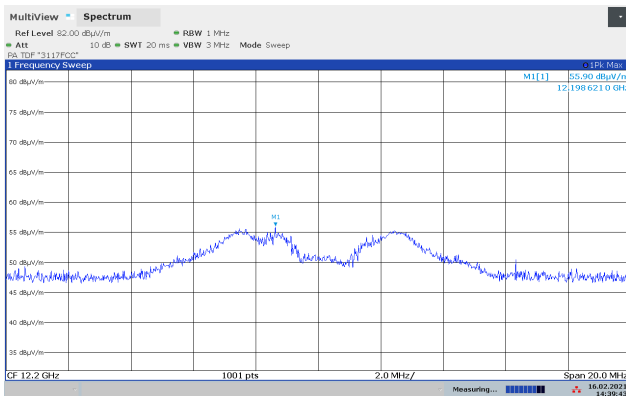
Emissions 7215 MHz, 2405 MHz, GFSK, VP, M70XC Ant



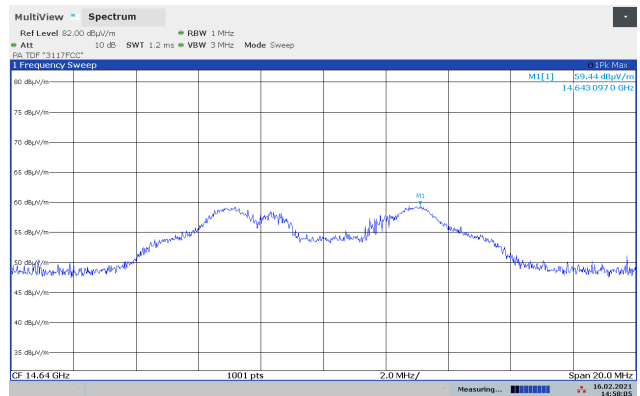
Emissions 7320 MHz, 2440 MHz, GFSK, VP, M70XC Ant



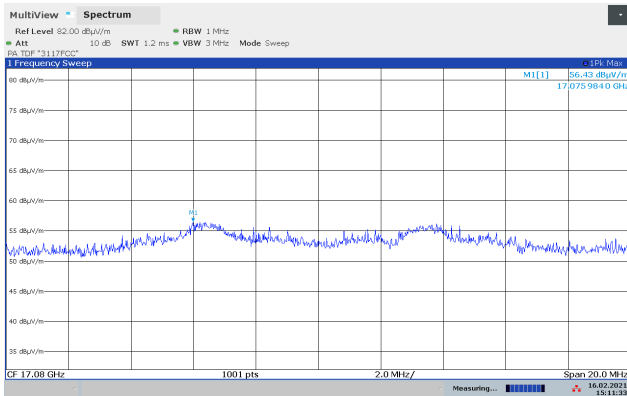
Emissions 7440 MHz, 2480 MHz, GFSK, VP, M70XC Ant



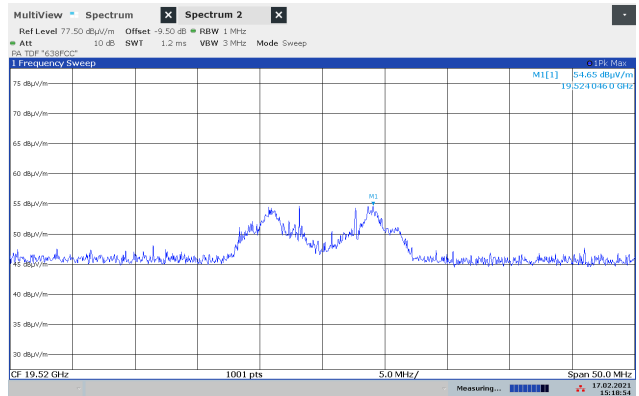
Emissions 12200 MHz, 2440 MHz, GFSK, HP, M70XC Ant



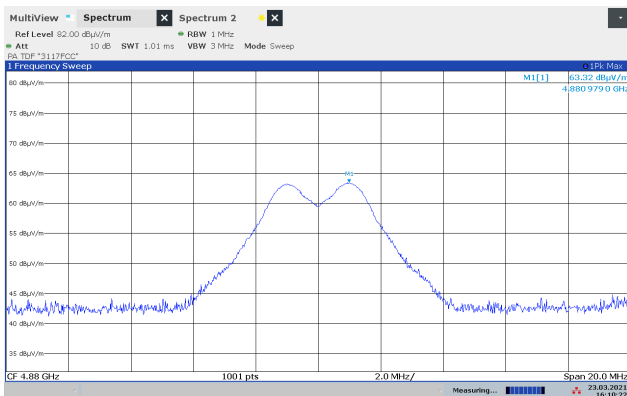
Emissions 14640 MHz, 2440 MHz, GFSK, HP, M70XC Ant



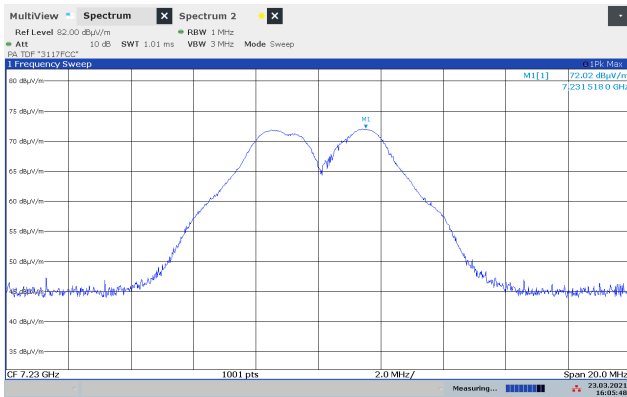
Emissions 17080 MHz, 2440 MHz, GFSK, HP, M70XC Ant



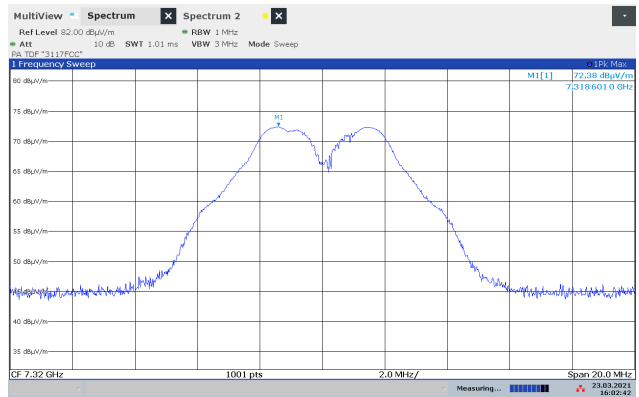
Emissions 19520 MHz, 2440 MHz, GFSK, HP @1m, M70XC Ant



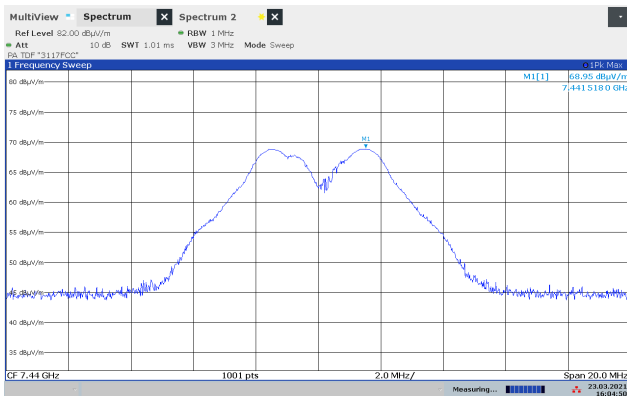
Emissions 4880 MHz, 2440 MHz, GFSK, VP, Ext Short Whip Ant



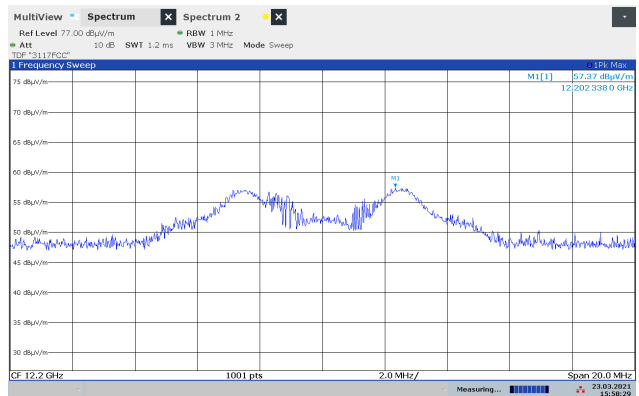
Emissions 7230 MHz, 2410 MHz, GFSK, VP, Ext Short Whip Ant



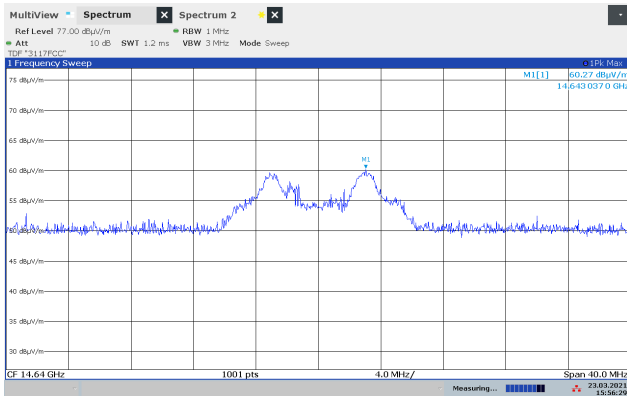
Emissions 7320 MHz, 2440 MHz, GFSK, VP, Ext Short Whip Ant



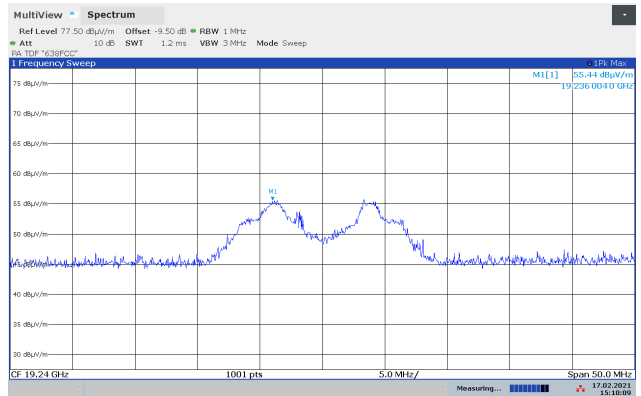
Emissions 7440 MHz, 2480 MHz, GFSK, VP, Ext Short Whip Ant



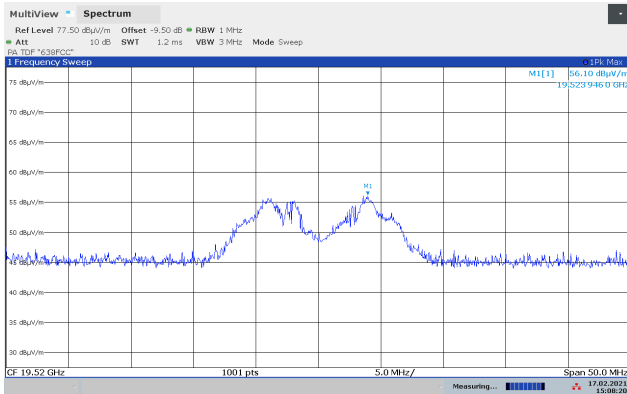
Emissions 12200 MHz, 2440 MHz, GFSK, VP, Ext Short Whip Ant



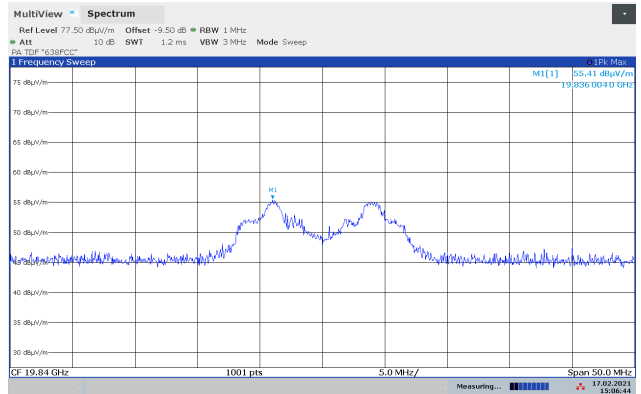
Emissions 14640 MHz, 2440 MHz, GFSK, VP, Ext Short Whip Ant



Emissions 19240 MHz, 2405 MHz, GFSK, HP @1m, Ext Short Whip Ant



Emissions 19520 MHz, 2440 MHz, GFSK, HP @1m, Ext Short Whip Ant



Emissions 19840 MHz, 2480 MHz, GFSK, HP @1m, Ext Short Whip Ant

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.

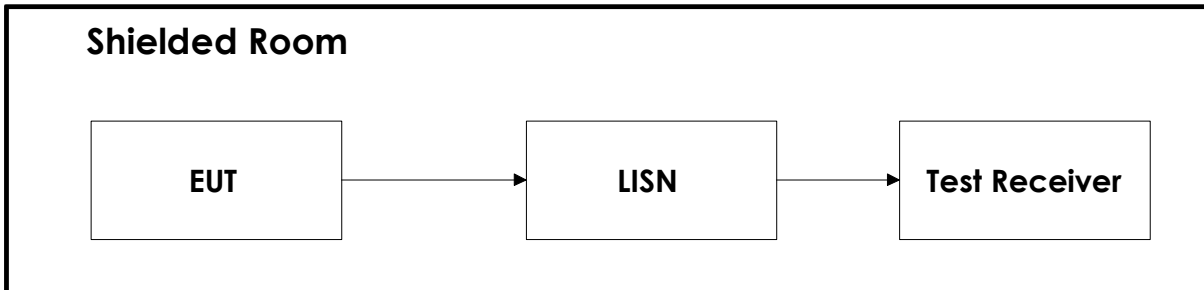
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2020-10	2022-10
2	ESR7	Measuring Receiver	Rohde & Schwarz	LR 1675	2021-07	2023-07
3	6810.17B	Attenuator	Suhner	LR 1669	COU	
4	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	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	2020-08	2021-08
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2020-08	2021-08
9	WLK5-1100-1485-7000-40SS	Low Pass Filter	Wainwright Inst.	LR 1761	COU	
10	638	Antenna Horn	Narda	LR 1480	N/A	
11	Model 87V	Multimeter	Fluke	N 4672	2020-11	2022-11
12	6812B	AC Power Source	Agilent	LR 1515	2020-04	2022-04
13	ESCI	Measuring Receiver	Rohde & Schwarz	N 4259	2019-10	2021-10
14	ENV216	Two-Line V-Network	Rohde & Schwarz	LR 1665	2019-11	2021-11
15	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	2020-08	2021-08

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

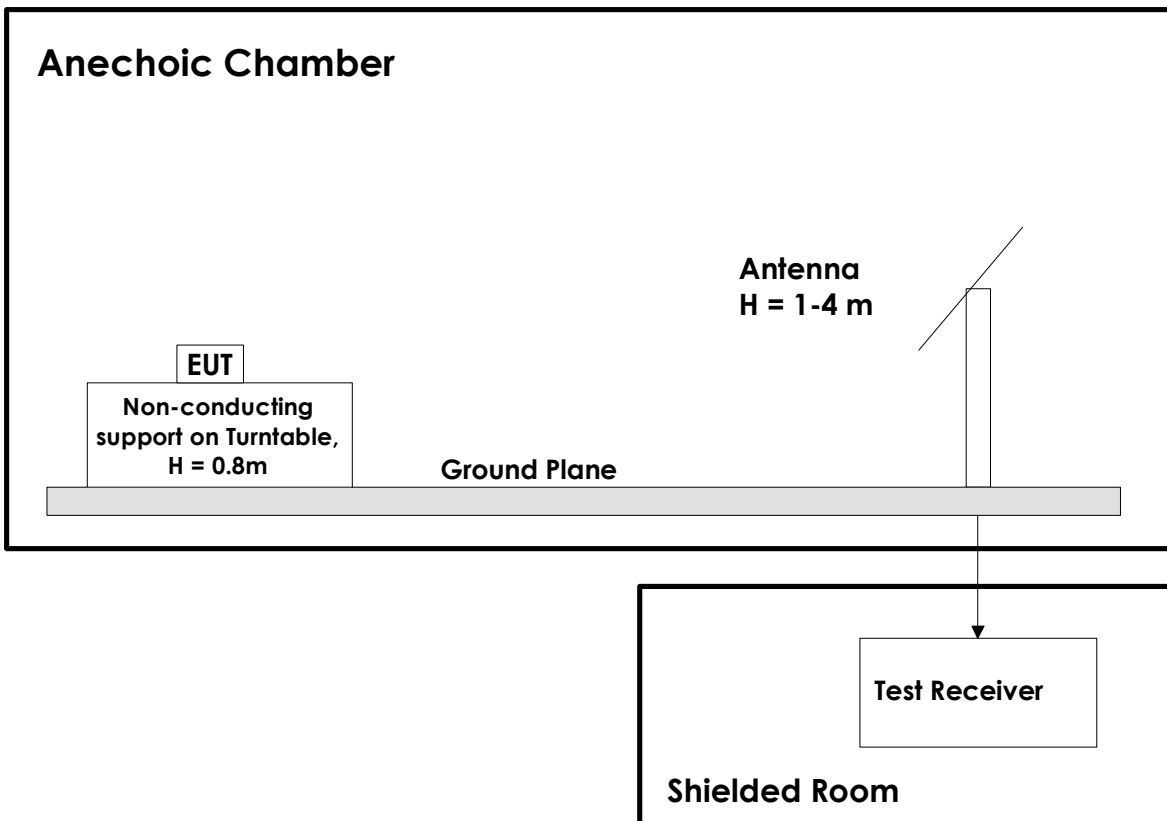
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	Power Line Conducted test software
2	Nemko AS	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

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. The measuring distance 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 a HighPass or BandStop filter is used for all harmonics. A LowPass filter is used below 1 GHz.