

Test Report

Product	Codec for Telepresence Unit		
Name and address of the applicant	Cisco Systems Norway AS Philip Pedersens vei 1 1366 Lysaker, NORWAY		
Name and address of the manufacturer	Cisco Systems, Inc. 170 West Tasman Drive San Jose, CA 95134, USA		
Model	TTC6-15		
Rating	Mains (100-240V AC, 50-60Hz, 2.0-1.2A)		
Trademark	CISCO		
Additional information	Bluetooth LE, Bluetooth Classic, WiFi 6		
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	PRJ0014735		
Tested in period	2022-09-08 to 2023-01-06		
Issue date	2023-02-02		
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470   An accredited technical test executed under the Norwegian accreditation scheme		
 Prepared by [Frode Sveinsen]  Approved by [G.Suhanthakumar]			
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Revision history

Revision	Date	Comment	Sign
A	2023-01-16	First edition	FS
B	2023-02-02	Corrected Power Values	FS



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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1 INFORMATION

1.1 Test Item

Name	Cisco
Model/version	TTC6-15
FCC ID	LDK0615C2718
ISED ID	2461N-0615C2718
Serial number	FOC2641N3SK
Hardware identity and/or version	DV1
Software identity and/or version	RoomOS 10.20.X
Frequency Range	2402–2480 MHz
Number of Channels	79
Operating Modes	Bluetooth Basic Rate, Bluetooth 2-EDR and Bluetooth 3-EDR
Type of Modulation	BT Basic Rate: GFSK BT 2-EDR: $\pi/4$ -DPSK BT 3-EDR: 8-DPSK
Conducted Output Power	BT Basic Rate: 3.04 mW (Peak) BT 2-EDR: 3.12 mW (Peak) BT 3-EDR: 3.49 mW (Peak)
Antenna Connector	RP-SMA
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Powered from Mains (120V 60Hz AC)
Antennas	BT/BLE/WIFI: SMARTEQ Model 710689 EUT has 3 identical antennas, one for BT/BLE and two for WiFi 2.4GHz/5GHz All antennas have RP-SMA connectors

Description of Test Item

The EUT is a Codec for Telepresence Unit.

The Bluetooth part 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:	120 V 60 Hz

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)?	☒ YES	☐ NO
If detachable, is the antenna connector(s) non-standard?	☒ YES	☐ NO
The antenna connector is RP-SMA.		

Requirement: FCC 15.203, 15.204

1.5 EUT Operating Modes

Description of operating modes	Continuous TX and Hopping, Basic Rate, 2-EDR and 3-EDR
Additional information	The following settings were used for all tests: Bit Pattern: PSRB Frame Type: DH5, 2-DH5, 3-DH5

1.6 Comments

The measurements were done with the EUT powered by 120 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

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 distance of 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

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	15.107(a) 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 11.12	Complies

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.107 (a)

ISED RSS-GEN Issue 5, Clause 7.2/8.8

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

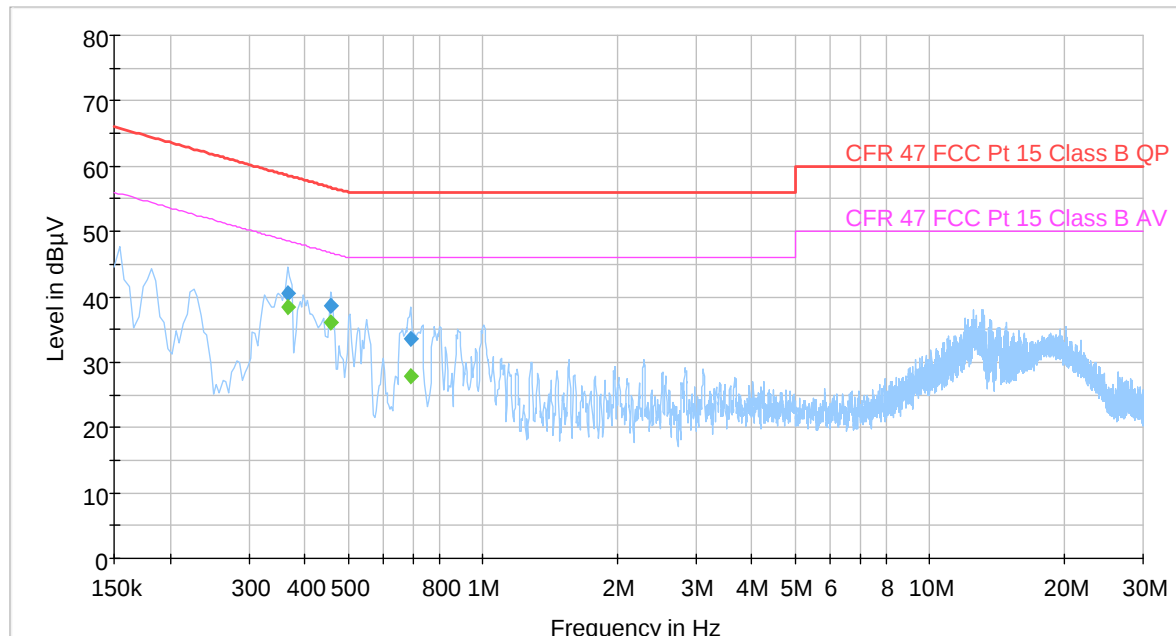
Test Results: Complies

Measurement Data: See attached plots.

Highest measured value (L1 and N):

Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.366000	---	38.50	48.59	10.09	15000.0	9.000	L1	ON	9.6
0.366000	40.50	---	58.59	18.09	15000.0	9.000	L1	ON	9.6
0.458000	---	36.17	46.73	10.56	15000.0	9.000	L1	ON	9.6
0.458000	38.69	---	56.73	18.03	15000.0	9.000	L1	ON	9.6
0.690000	---	27.78	46.00	18.22	15000.0	9.000	L1	ON	9.6
0.690000	33.57	---	56.00	22.43	15000.0	9.000	L1	ON	9.6

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:

Modulation	20dB Bandwidth (MHz)		
	2402 MHz	2441 MHz	2480 MHz
Basic Rate (GFSK)	0.88	0.88	0.88
2-EDR ($\pi/4$ -DPSK)	1.40	1.40	1.40
3-EDR (8-DPSK)	1.25	1.25	1.26

RF channel has no influence on 20 dB bandwidth.

See attached plots

Frequency Band	Requirement for Frequency Hopping
902-928 MHz	The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
2400-2483.5 MHz	The maximum 20 dB bandwidth shall be less than channel separation, alternatively, less than 150% of channel separation if output power is less than 125 mW.
5725-5850 MHz	The maximum 20 dB bandwidth of the hopping channel is 1 MHz.

No requirements for Digital Transmission Systems.



20dB Bandwidth 2402 MHz, GFSK



20dB Bandwidth 2402 MHz, $\pi/4$ -DPSK



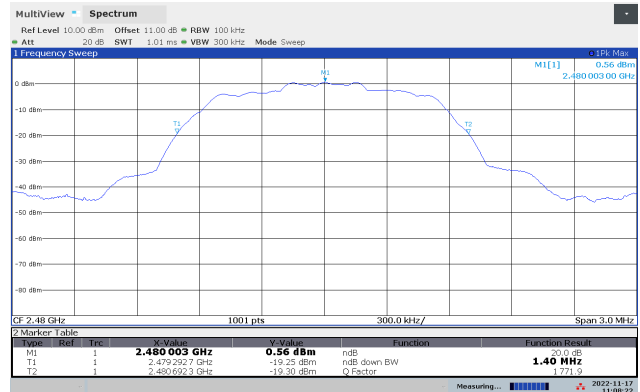
20dB Bandwidth 2441 MHz, GFSK



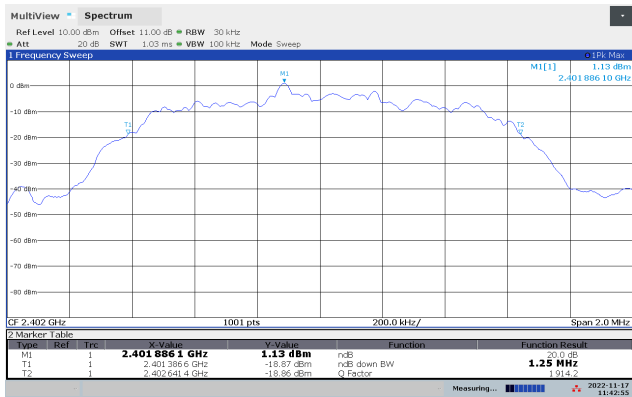
20dB Bandwidth 2441 MHz, $\pi/4$ -DPSK



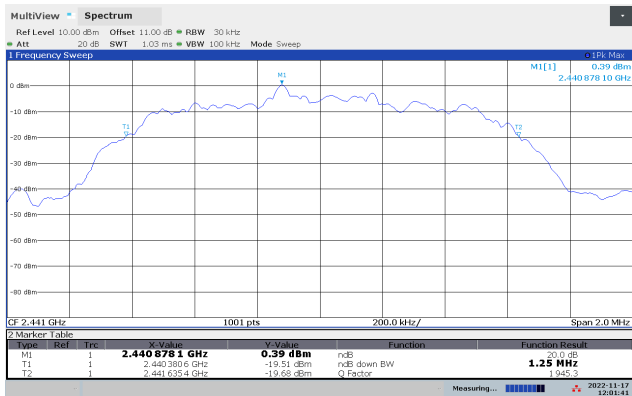
20dB Bandwidth 2480 MHz, GFSK



20dB Bandwidth 2480 MHz, $\pi/4$ -DPSK



20dB Bandwidth 2402 MHz, 8-DPSK



20dB Bandwidth 2441 MHz, 8-DPSK



20dB Bandwidth 2480 MHz, 8-DPSK

3.3 Pseudorandom Hopping Algorithm

FCC Part 15.247 (a)(1)

ISED Canada RSS-247 Issue 2, Clause 5.1

Test Results: **Complies**

The EUT follows the Bluetooth standard.

Requirements:

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

No requirements for Digital Transmission Systems.

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

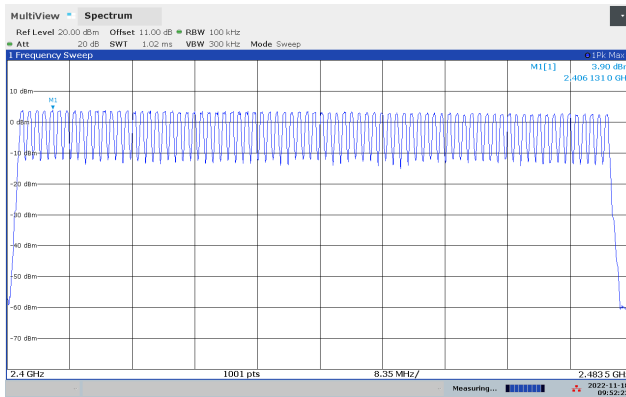
Measurement Data:

Number of RF Channels in use	20 to 79
Channel Centre Frequencies	2402 to 2480 MHz
Channel Separation	1 MHz

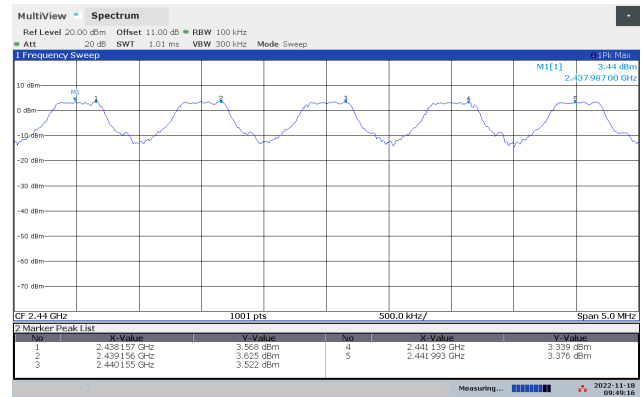
See attached plots.

Frequency Band	Requirement for Frequency Hopping
902-928 MHz	If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
2400-2483.5 MHz	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
5725-5850 MHz	Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies.

No requirements for Digital Transmission Systems.



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:

Frame Type and Data Rate	Burst Length (μs)	Frame Length (μs)	Time of Occupancy (ms)	Verdict
DH1	382	1250	122.2	Complies
DH3	1631	2500	261.0	Complies
DH5	1881	3750	307.3	Complies

Burst length is the same for all data rates

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

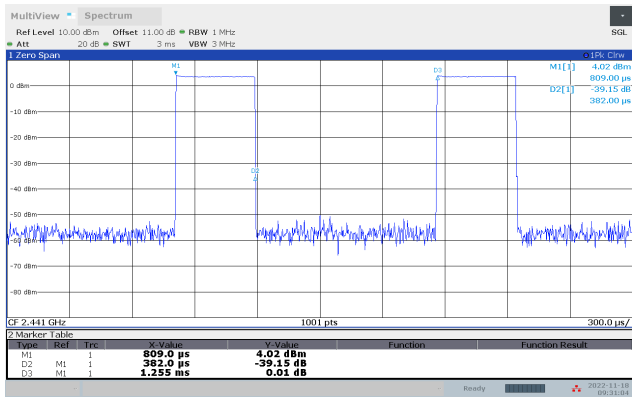
Time of occupancy = (Burst Length * Number of Channels * 400 ms) / Time Between Burst on Same Channel
= (Burst Length * 400 ms) / Frame Length

Number of RF channels is minimum 20 and maximum 78

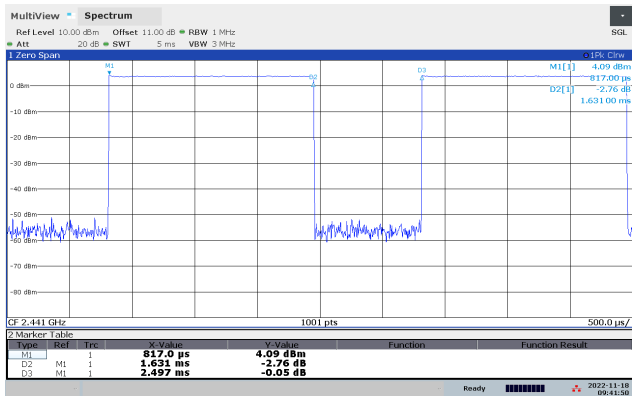
See attached plots

Frequency Band	Requirement for Frequency Hopping
902-928 MHz	The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.
2400-2483.5 MHz	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.
5725-5850 MHz	The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

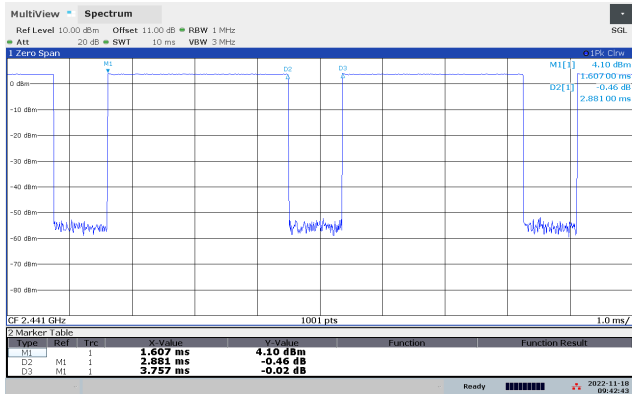
No requirements for Digital Transmission Systems.



RF Burst, DH1



RF Burst, DH3



RF Burst DH5

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 and Data Rate	Occupied Bandwidth (99% BW)
2441 MHz, GFSK	0.87 MHz
2441 MHz, $\pi/4$ -DPSK	1.18 MHz
2441 MHz, 8-DPSK	1.17 MHz

Occupied Bandwidth is the same for all channels

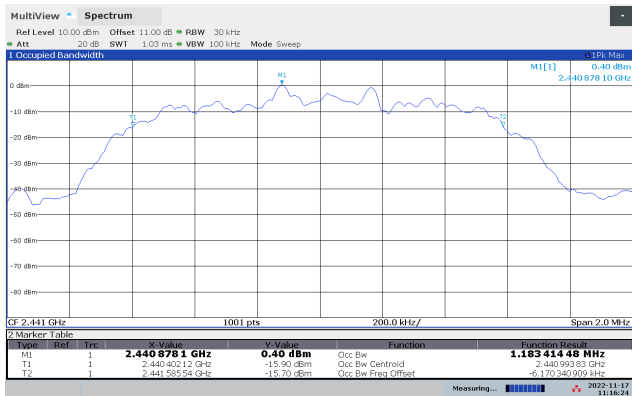
See attached plots.

Requirements:

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



99% Occupied BW, GFSK



99% Occupied BW, $\pi/4$ -DPSK



99% Occupied BW, 8-DPSK

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:

Carrier Frequency (MHz)	Modulation Type	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dBμV/m)	EIRP (dBm)	Antenna gain (dBi)
2402	GFSK	4.83	3.04	104.0	8.79	4.0
	π/4-DPSK	4.94	3.12	/	/	/
	8-DPSK	5.43	3.49	/	/	/
2441	GFSK	4.24	2.65	103.3	8.06	3.8
	π/4-DPSK	4.28	2.68	/	/	/
	8-DPSK	4.78	3.01	/	/	/
2480	GFSK	3.56	2.27	103.0	7.78	4.2
	π/4-DPSK	3.01	2.00	/	/	/
	8-DPSK	3.58	2.28	/	/	/

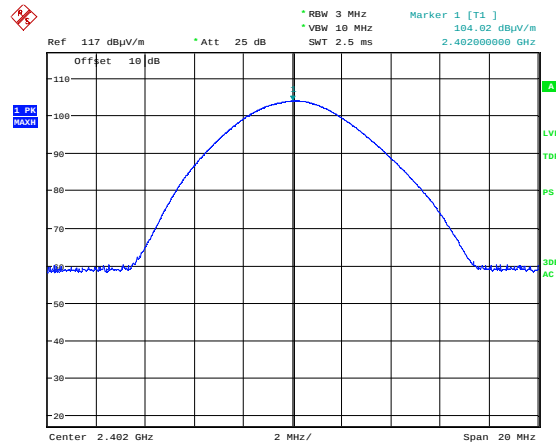
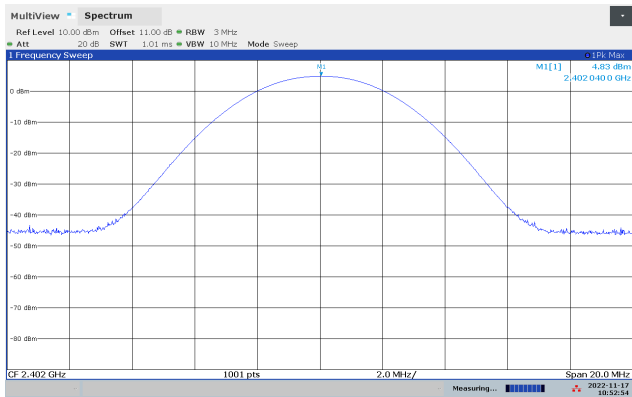
Output Power reported is Maximum Peak Power.

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

Antenna Gain is less than 6 dBi.

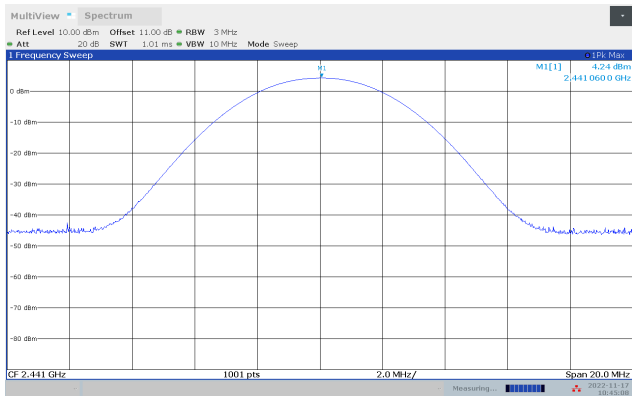
See attached plots.

Frequency Band	Requirements for Frequency Hopping systems
902-928 MHz	For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels
2400-2483.5 MHz	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
5725-5850 MHz	For all frequency hopping systems in the 5725-5850 MHz band: 1 watt
Requirements for Digital Modulation systems	
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the <i>maximum conducted output power</i> is the highest total transmit power occurring in any mode.	
Maximum allowed Antenna Gain	
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.	

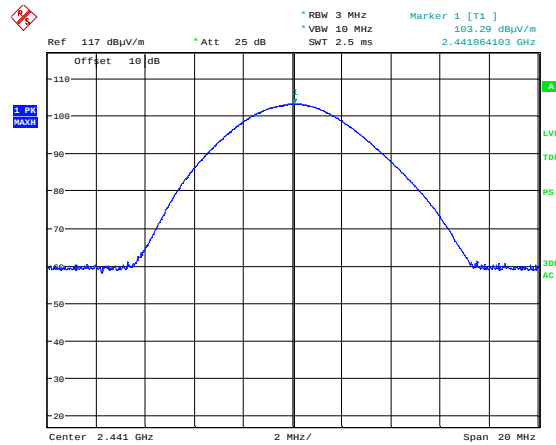


Date: 16.NOV.2022 10:28:09

Peak Power, 2402 MHz, GFSK

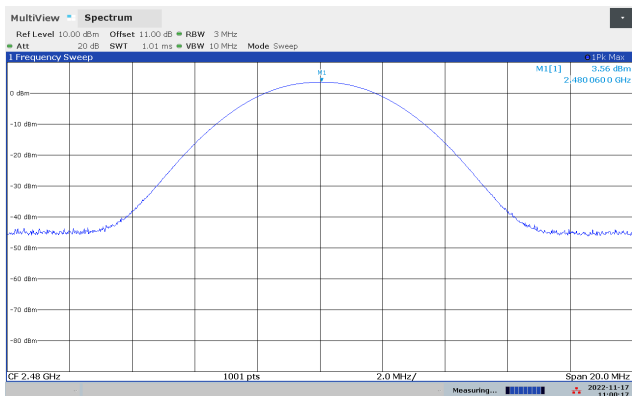


Maximum Field Strength, 2402 MHz, GFSK

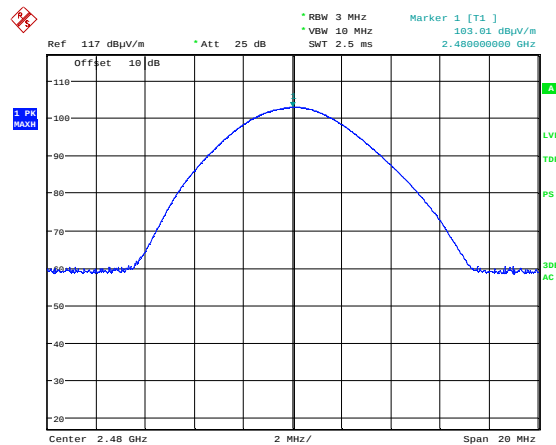


Date: 16.NOV.2022 10:31:55

Peak Power, 2441 MHz, GFSK



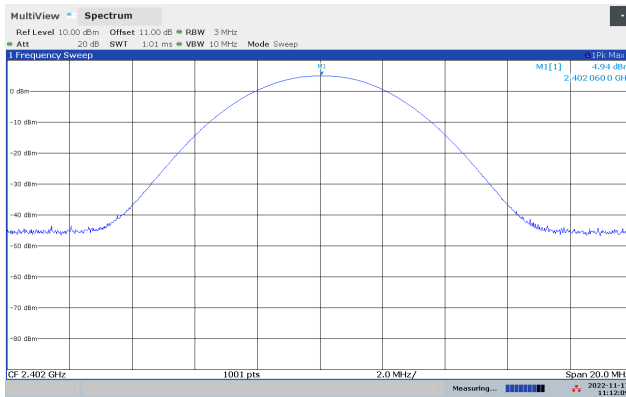
Maximum Field Strength, 2441 MHz, GFSK



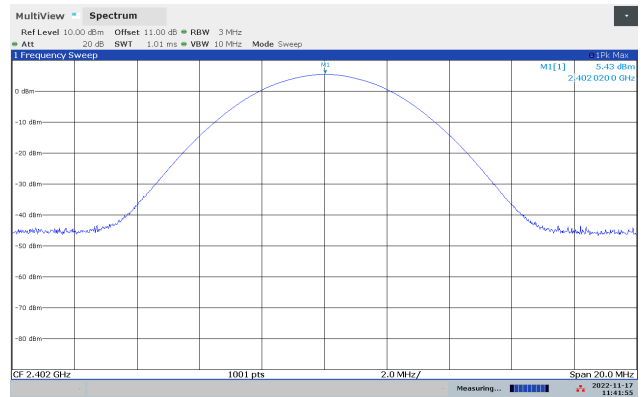
Date: 16.NOV.2022 10:38:44

Peak Power, 2480 MHz, GFSK

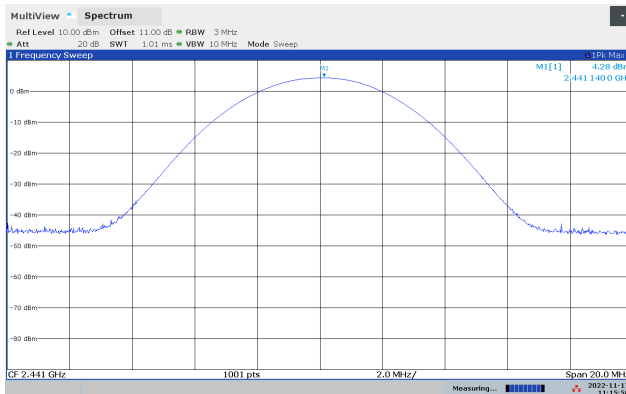
Maximum Field Strength, 2480 MHz, GFSK



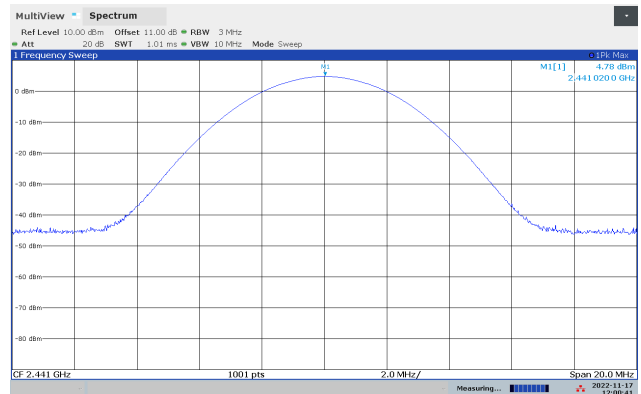
Peak Power, 2402 MHz, $\pi/4$ -DPSK



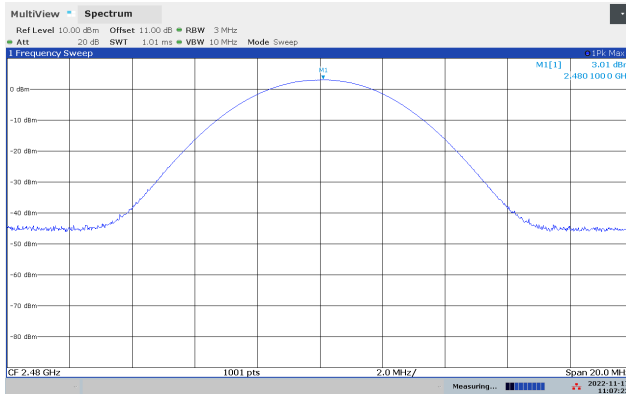
Peak Power, 2402 MHz, 8-DPSK



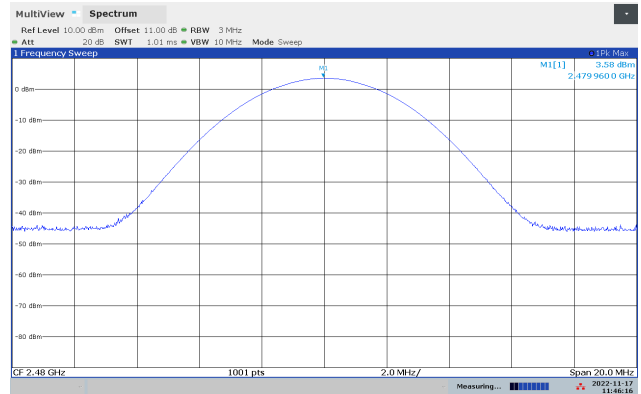
Peak Power, 2441 MHz, $\pi/4$ -DPSK



Peak Power, 2441 MHz, 8-DPSK



Peak Power, 2480 MHz, $\pi/4$ -DPSK



Peak Power, 2480 MHz, 8-DPSK

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

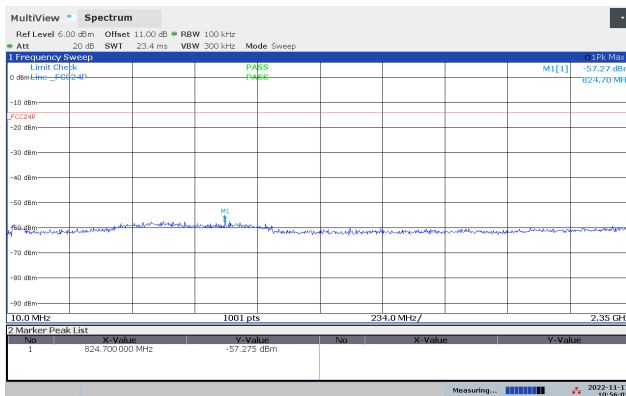
Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	> 40	> 20	Pass
2441 MHz	> 40	> 20	Pass
2480 MHz	> 40	> 20	Pass

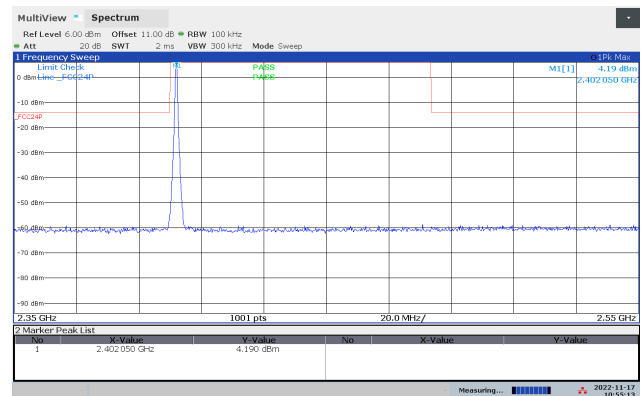
Measured with Peak Detector

RF conducted power to 25 GHz: see attached plots.

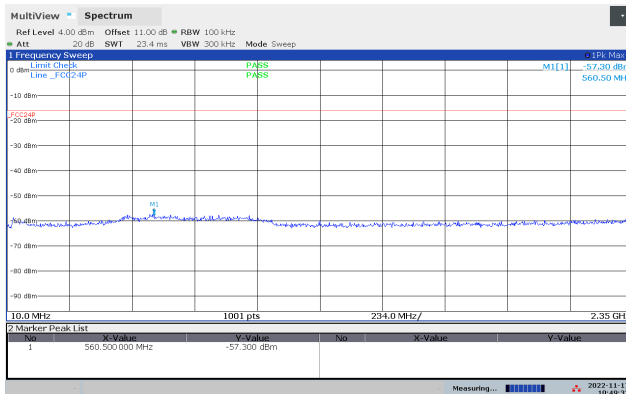
Requirements for all systems	
Peak measurement	RMS averaging (alternative measurement)
20 dB or more below carrier measured in 100 kHz bandwidth	30 dB or more below carrier measured in 100 kHz bandwidth
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required.	



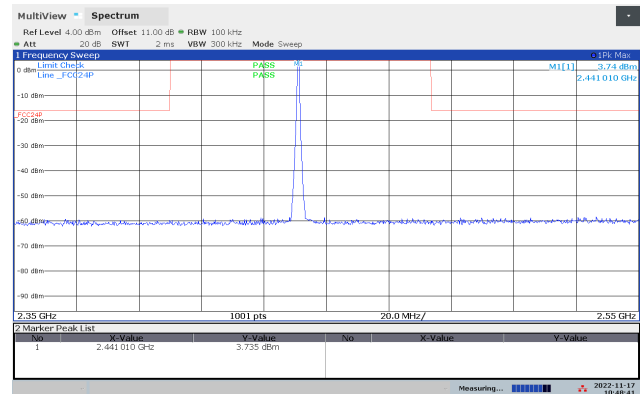
Conducted Emissions 10-2350 MHz, 2402 MHz, GFSK



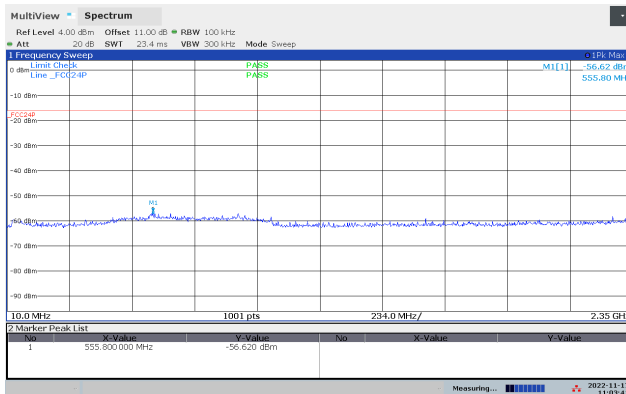
Conducted Emissions 2350-2550 MHz, 2402 MHz, GFSK



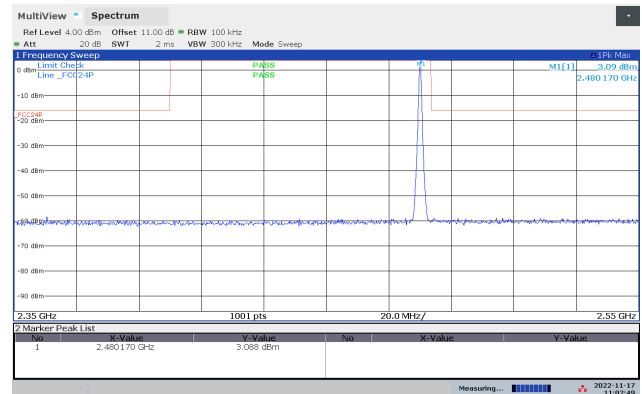
Conducted Emissions 10-2350 MHz, 2441 MHz, GFSK



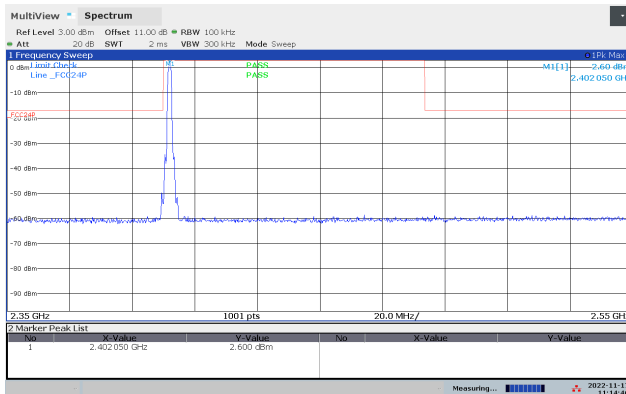
Conducted Emissions 2350-2550 MHz, 2441 MHz, GFSK



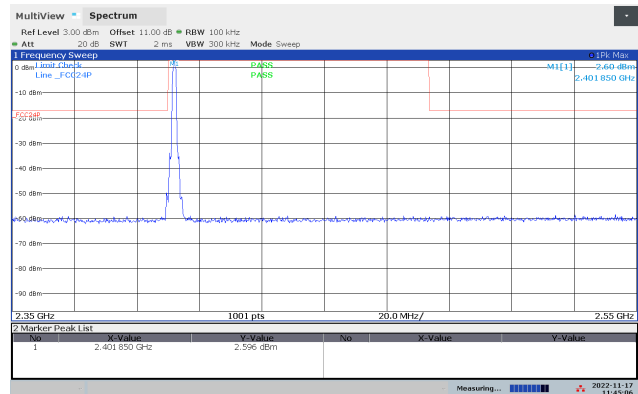
Conducted Emissions 10-2350 MHz, 2480 MHz, GFSK



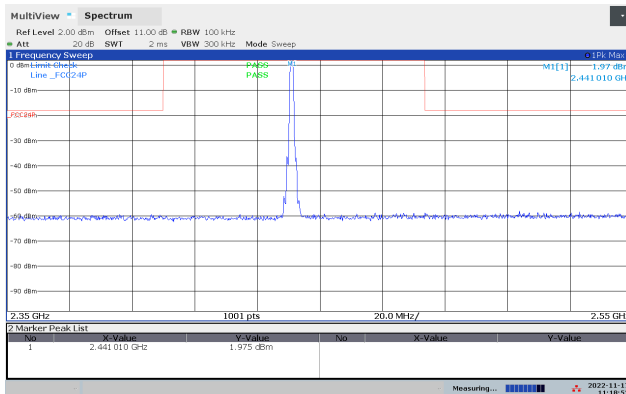
Conducted Emissions 2350-2550 MHz, 2480 MHz, GFSK



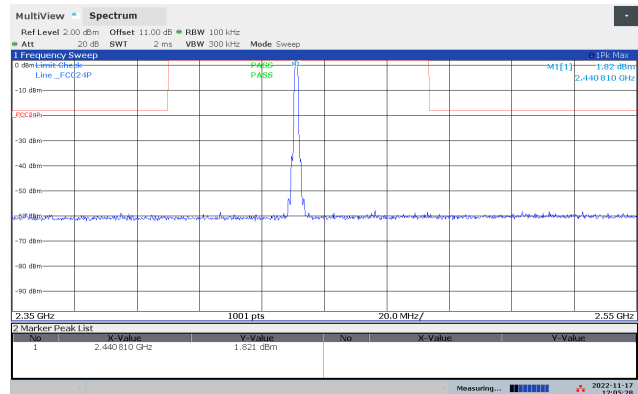
Conducted Emissions 2350-2550 MHz, 2402 MHz, $\pi/4$ -DPSK



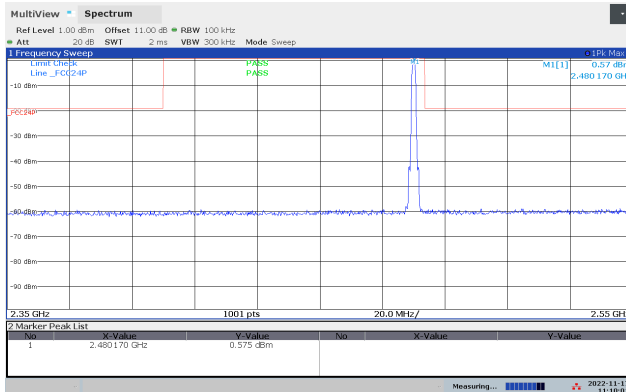
Conducted Emissions 2350-2550 MHz, 2402 MHz, 8-DPSK



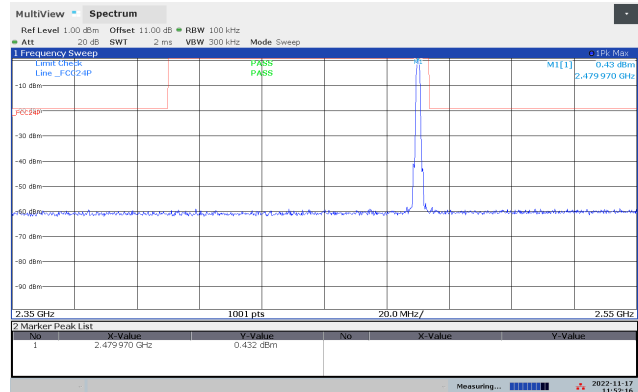
Conducted Emissions 2350-2550 MHz, 2441 MHz, $\pi/4$ -DPSK



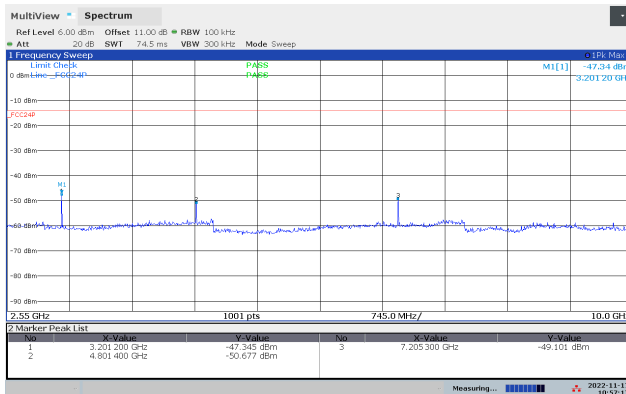
Conducted Emissions 2350-2550 MHz, 2441 MHz, 8-DPSK



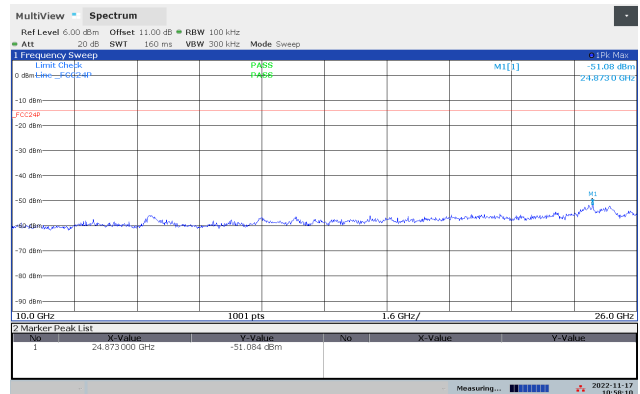
Conducted Emissions 2350-2550 MHz, 2480 MHz, $\pi/4$ -DPSK



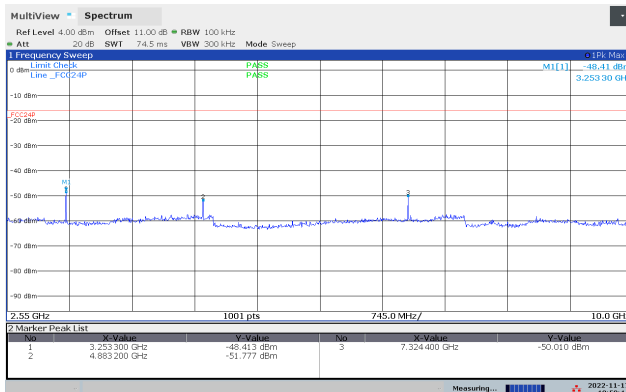
Conducted Emissions 2350-2550 MHz, 2480 MHz, 8-DPSK



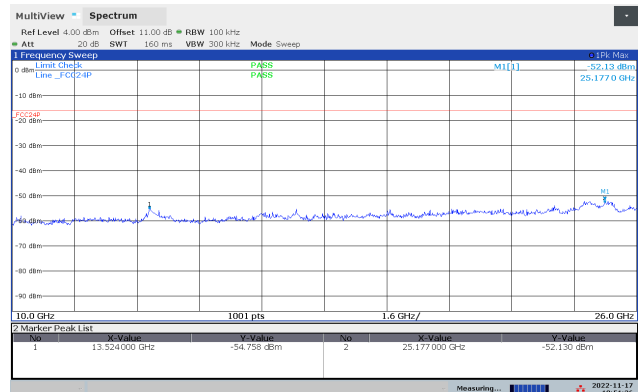
Conducted Emissions 2550-10000 MHz, 2402 MHz, GFSK



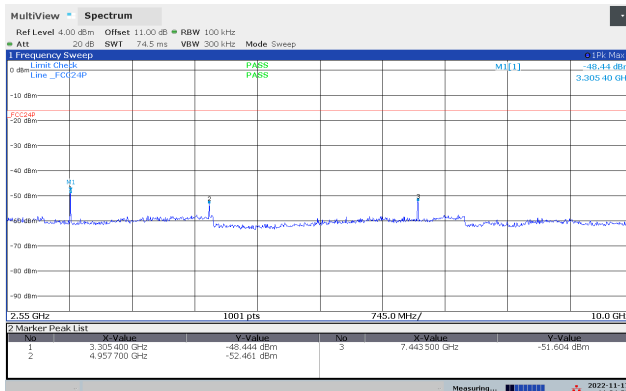
Conducted Emissions 10000-26000 MHz, 2402 MHz, GFSK



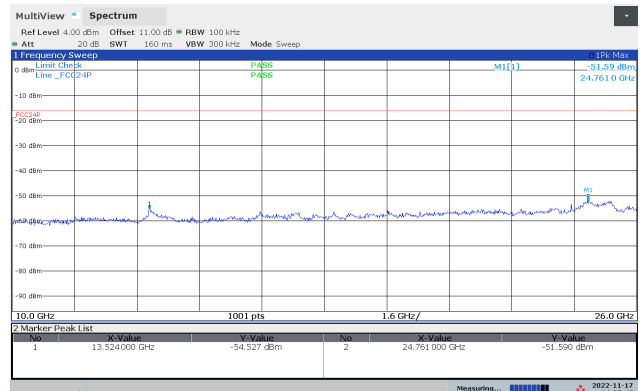
Conducted Emissions 2550-10000 MHz, 2441 MHz, GFSK



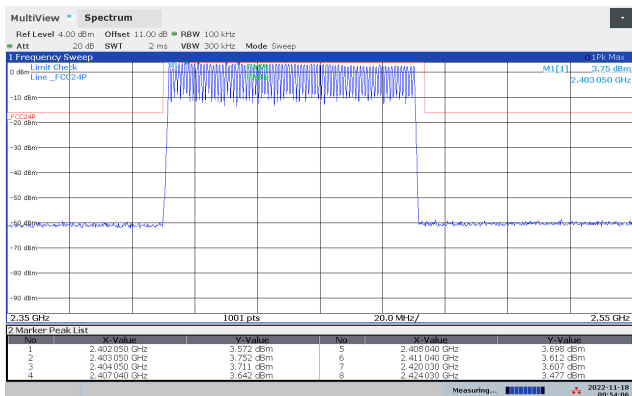
Conducted Emissions 10000-26000 MHz, 2441 MHz, GFSK



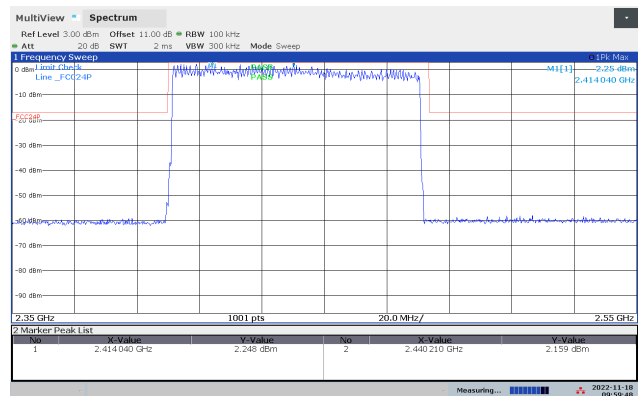
Conducted Emissions 2550-10000 MHz, 2480 MHz, GFSK



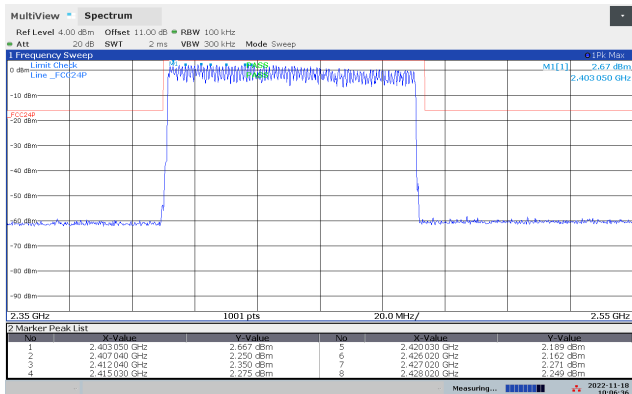
Conducted Emissions 10000-26000 MHz, 2480 MHz, GFSK



Conducted Emissions 2350-2550 MHz, Hopping, GFSK



Conducted Emissions 2350-2550 MHz, Hopping, $\pi/4$ -DPSK



Conducted Emissions 2350-2550 MHz, Hopping, 8-DPSK

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 15.209 (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	2390 MHz	54.4	34.4	74	54	19.6	19.6
2480 MHz GFSK	2483.5 MHz	60.9	40.9			13.1	13.1
2402 MHz 2-EDR	2390 MHz	53.9	33.9			20.1	20.1
2480 MHz 2-EDR	2483.5 MHz	60.4	40.4			13.6	13.6
2402 MHz 3-EDR	2390 MHz	54.9	34.9			19.1	19.1
2480 MHz 3-EDR	2483.5 MHz	60.5	40.5			13.5	13.5

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

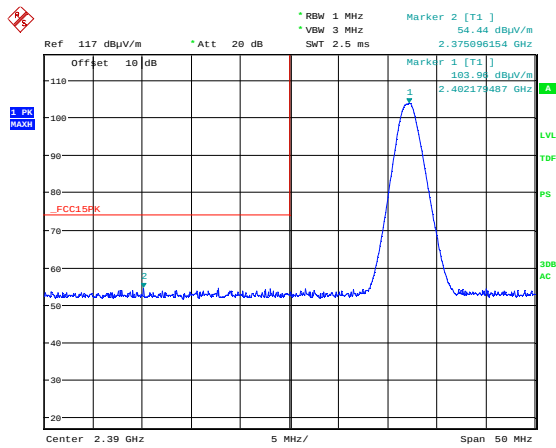
See attached plots.

Duty Cycle Correction Factor Calculation:

Duty Cycle = slot length / frame length

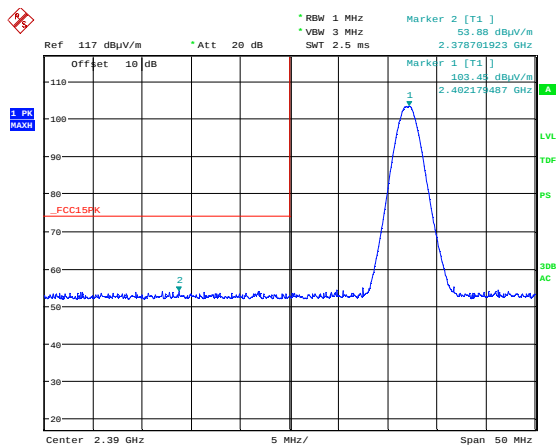
Duty Cycle Correction factor = $-20 \times \log(\text{Duty Cycle}) = 27.5 \text{ dB}$

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



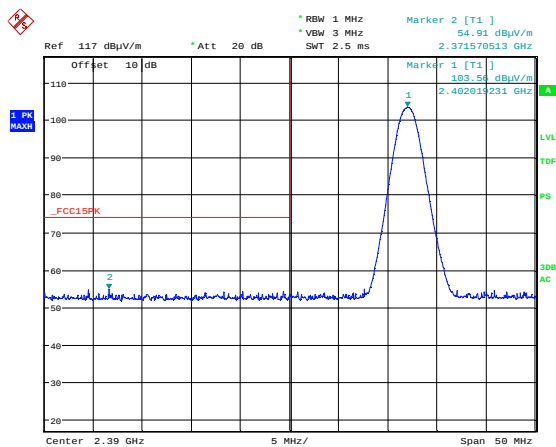
Date: 16.NOV.2022 10:21:11

Lower Band Edge 2402 MHz, GFSK, Peak



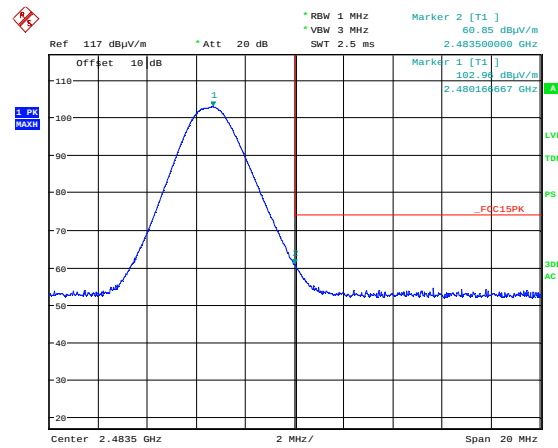
Date: 16.NOV.2022 10:25:00

Lower Band Edge 2402 MHz, $\pi/4$ -DPSK, Peak



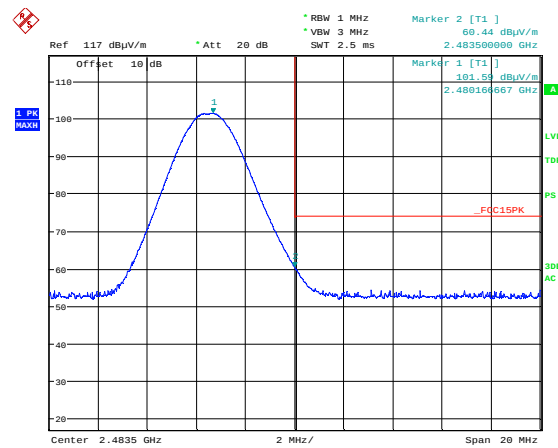
Date: 16.NOV.2022 10:27:07

Lower Band Edge 2402 MHz, 8-DPSK, Peak



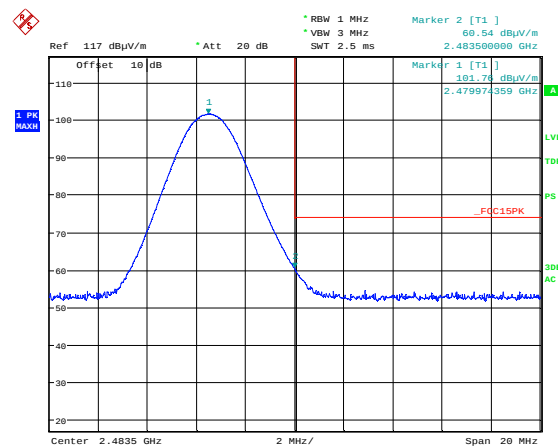
Date: 16.NOV.2022 10:40:34

Upper Band Edge 2480 MHz, GFSK, Peak



Date: 16.NOV.2022 10:43:27

Upper Band Edge 2480 MHz, $\pi/4$ -DPSK, Peak



Date: 16.NOV.2022 10:46:20

Upper Band Edge 2480 MHz, 8-DPSK, Peak

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

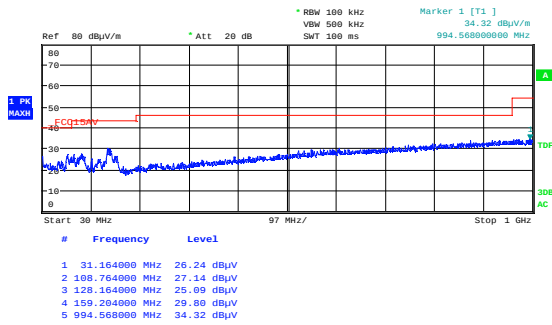
Tested in test mode with EUT transmitting on 2442 MHz

Measured Frequency (MHz)	Carrier Frequency (MHz)	Mode	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 – 88	2440	1Mb / 2Mb	< 35	40.0	> 5
88 – 216	2440	1Mb / 2Mb	< 30	43.5	>10
216 – 960	2440	1Mb / 2Mb	< 35	46.0	> 10
960 – 1000	2440	1Mb / 2Mb	< 36	54.0	> 18
31.57	Any	Any	34.5	40.0	5.5

See attached plots

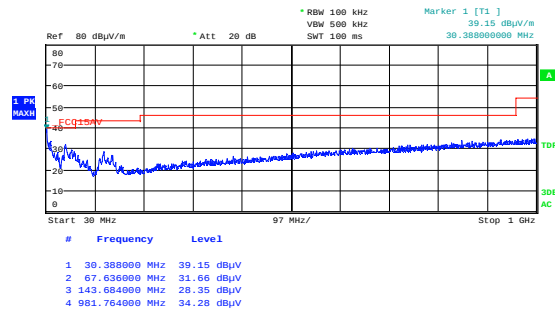
Requirements/Limit

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 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	



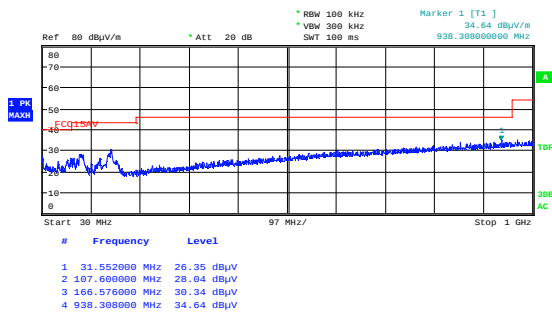
Date: 7.SEP.2022 16:21:20

Radiated Emissions 30 - 1000 MHz, GFSK, HP



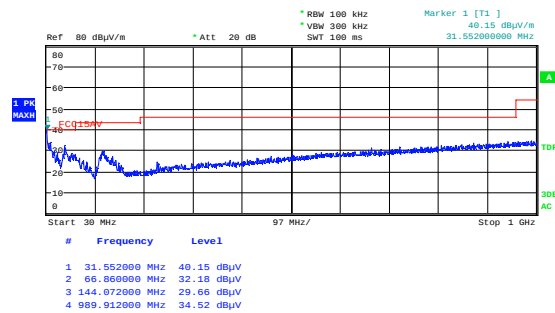
Date: 7.SEP.2022 16:19:25

Radiated Emissions 30 - 1000 MHz, GFSK, VP



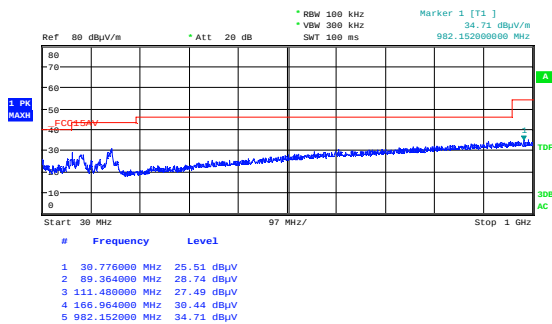
Date: 7.SEP.2022 16:45:09

Radiated Emissions 30 - 1000 MHz, $\pi/4$ -DPSK, HP



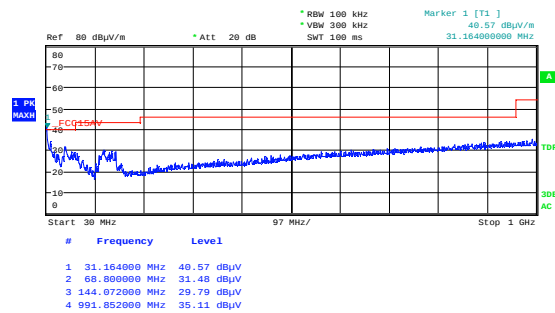
Date: 7.SEP.2022 16:43:02

Radiated Emissions 30 - 1000 MHz, $\pi/4$ -DPSK, VP



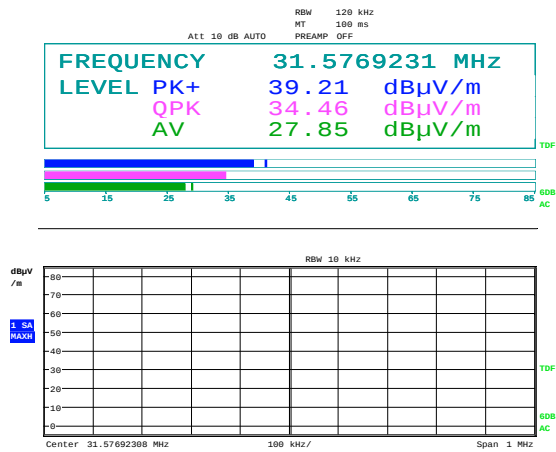
Date: 7.SEP.2022 16:54:37

Radiated Emissions 30 - 1000 MHz, 8-DPSK, HP



Date: 7.SEP.2022 16:52:31

Radiated Emissions 30 - 1000 MHz, 8-DPSK, VP



Date: 7-SEP-2022 16:38:44

Spurious 31.57 MHz Max: VP

3.12 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.

RBW=1 MHz

Carrier freq. (MHz)	Measured Freq. (GHz)	Mode	Measured Emissions (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
			Peak	Average	Pk	Av	Pk	Av
2402	3202.7	GFSK	50.4	/	74	54	23.6	/
	3254.7	π/4-DQPSK	51.7	/	74	54	22.3	/
	3306.7	8-DPSK	51.4	/	74	54	22.6	/
2441	3202.7	GFSK	53.6	/	74	54	20.4	/
	3254.7	π/4-DQPSK	55.3	35.3	74	54	18.7	18.7
	3306.7	8-DPSK	55.0	35.0	74	54	19.0	19.0
2480	3202.7	GFSK	53.6	/	74	54	20.4	/
	3254.7	π/4-DQPSK	54.3	34.3	74	54	19.7	19.7
	3306.7	8-DPSK	55.1	35.1	74	54	18.9	18.9

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

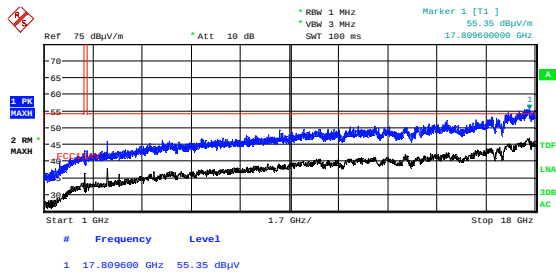
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

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

See plots

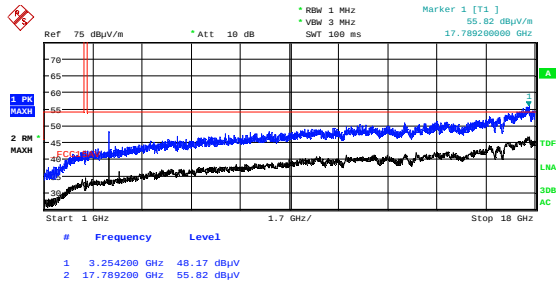
Requirements/Limit

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



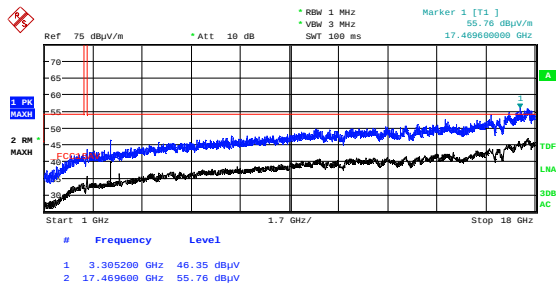
Date: 16.NOV.2022 12:49:29

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



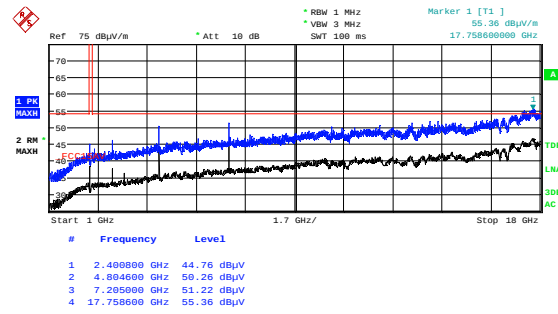
Date: 16.NOV.2022 10:56:23

Radiated Emissions 1 - 18 GHz, 2441 MHz, GFSK, HP



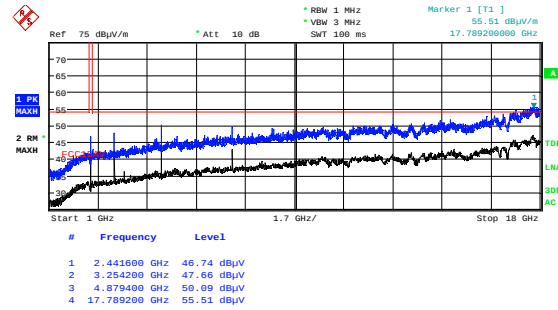
Date: 16.NOV.2022 12:55:34

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



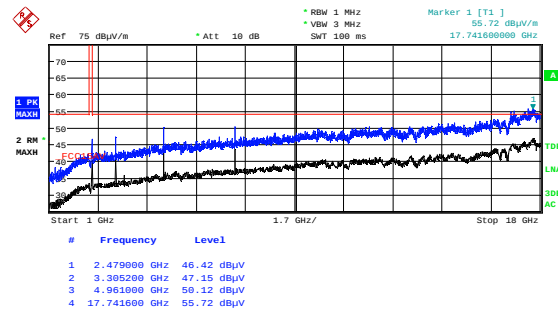
Date: 16.NOV.2022 12:47:34

VP



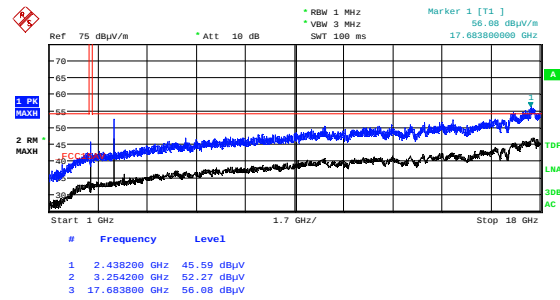
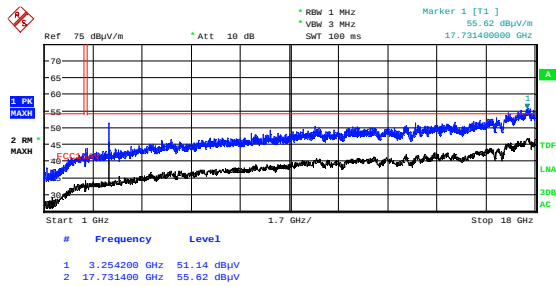
Date: 16.NOV.2022 10:54:28

VP



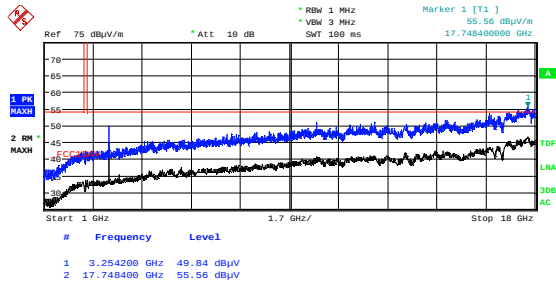
Date: 16.NOV.2022 12:53:38

VP



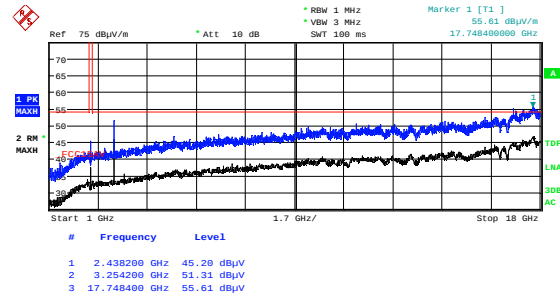
Date: 16.NOV.2022 11:13:23

Radiated Emissions 1 - 18 GHz, 2442 MHz, $\pi/4$ -DQPSK, HP



Date: 16.NOV.2022 11:11:28

VP

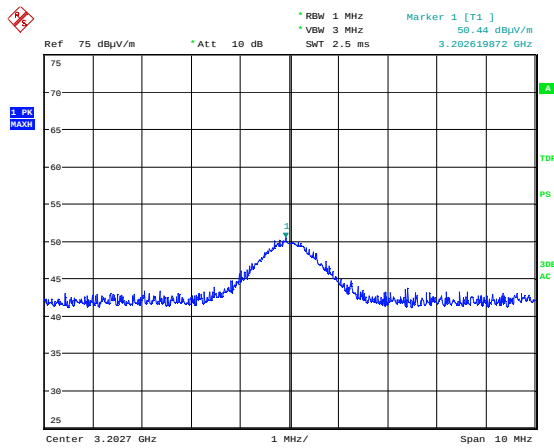


Date: 16.NOV.2022 12:44:55

Radiated Emissions 1 - 18 GHz, 2442 MHz, 8-DPSK, HP

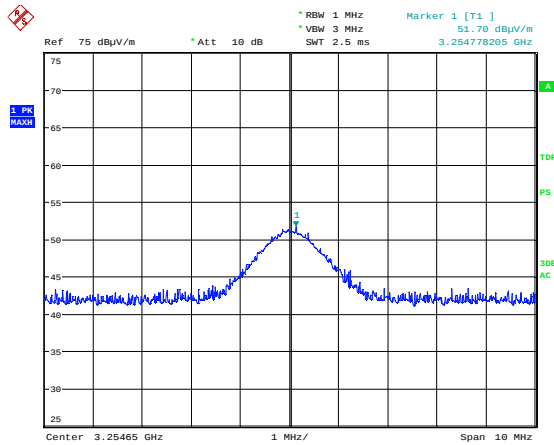
Date: 16.NOV.2022 12:43:00

VP



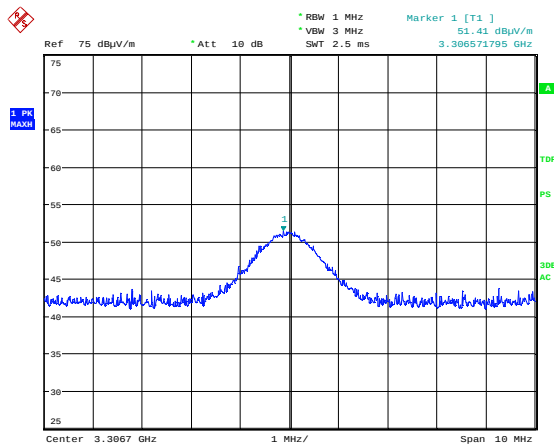
Date: 16.NOV.2022 12:36:27

Emissions 3202.7 GHz, 2402 MHz, GFSK, Max: VP



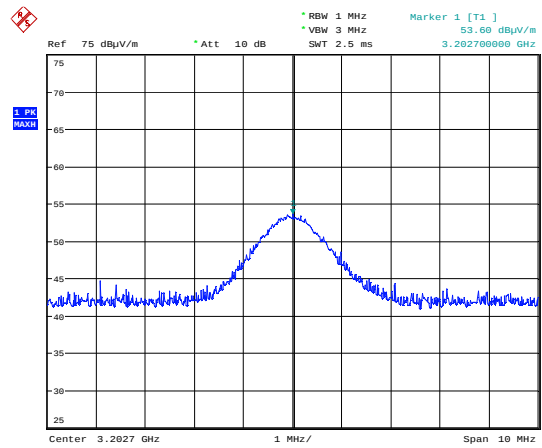
Date: 16.NOV.2022 12:02:55

Emissions 3254.6 GHz, 2441 MHz, GFSK, Max: VP



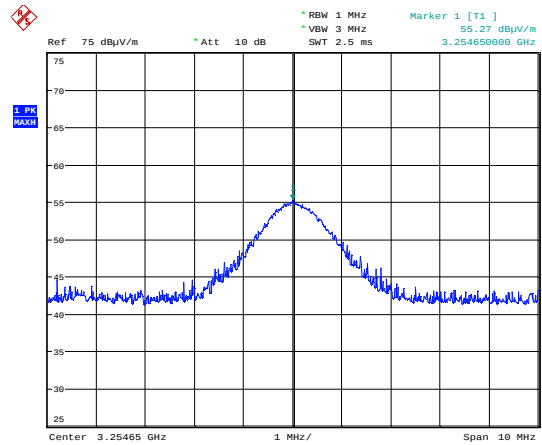
Date: 16.NOV.2022 12:23:30

Emissions 3306.7 GHz, 2480 MHz, GFSK, Max: VP



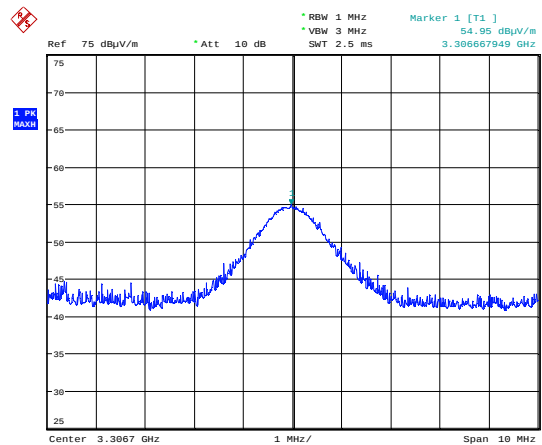
Date: 16.NOV.2022 12:29:38

Emissions 3202.7 GHz, 2402 MHz, π/4-DQPSK, Max: VP



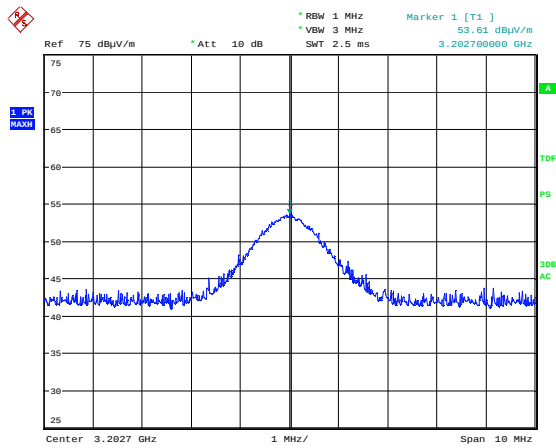
Date: 16.NOV.2022 12:06:30

Emissions 3254.6 GHz, 2441 MHz, π/4-DQPSK, Max: VP



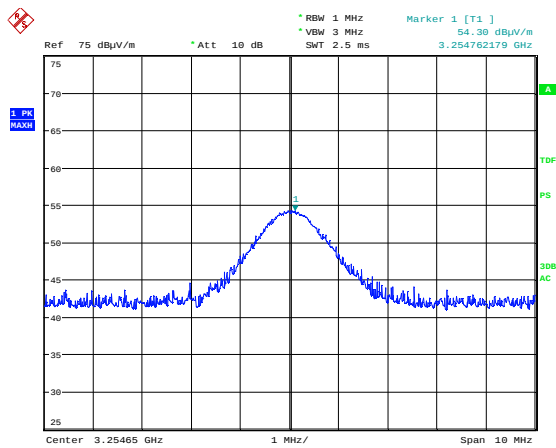
Date: 16.NOV.2022 12:12:29

Emissions 3306.7 GHz, 2480 MHz, π/4-DQPSK, Max: VP



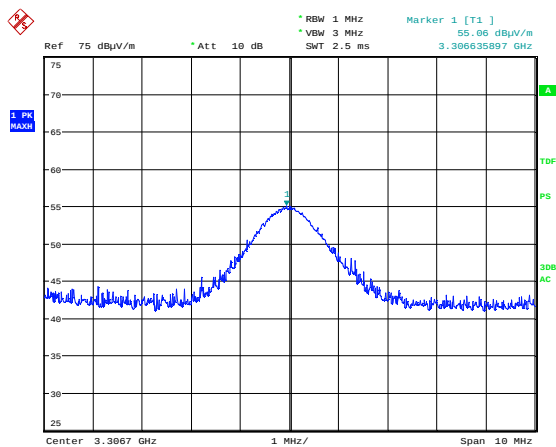
Date: 16.NOV.2022 12:35:00

Emissions 3202.7 GHz, 2402 MHz, 8-DPSK, Max: VP



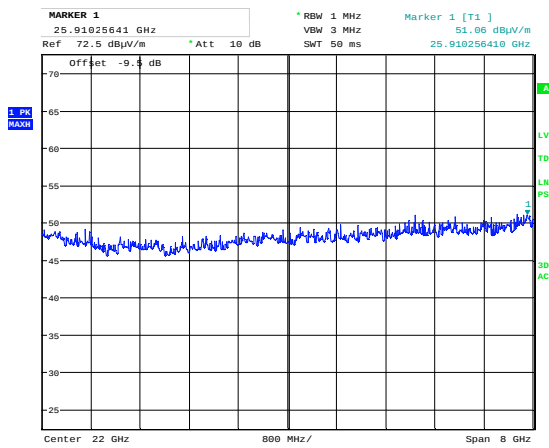
Date: 16.NOV.2022 11:52:39

Emissions 3254.6 GHz, 2441 MHz, 8-DPSK, Max: VP



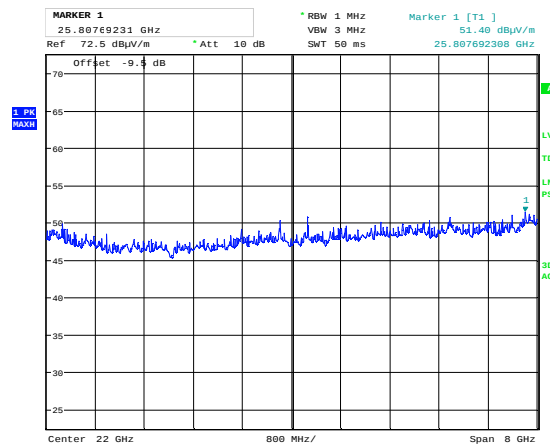
Date: 16.NOV.2022 12:19:53

Emissions 3306.7 GHz, 2480 MHz, 8-DPSK, Max: VP



Date: 8.SEP.2022 13:06:34

Radiated Emissions 18 - 26 GHz, 2442 MHz, GFSK, HP, @1m



Date: 8.SEP.2022 13:05:42

VP, @1m

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.

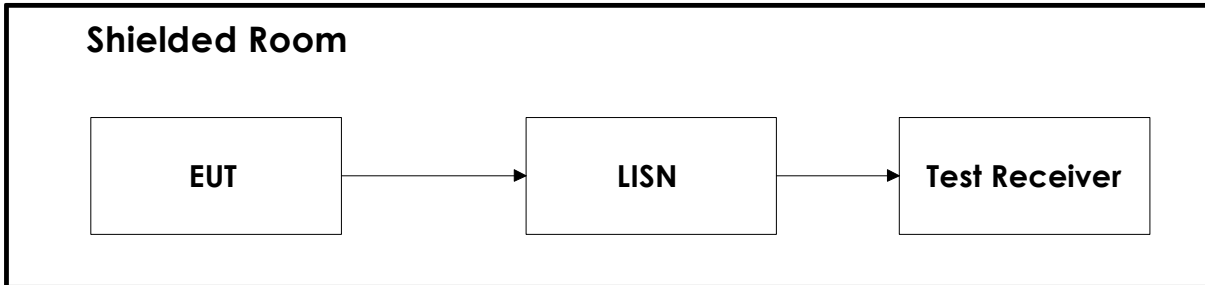
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2022-01	2023-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2022-01	2023-01
3	6810.17B	Attenuator	Suhner	LR 1669	2022-05	2023-05
4	NO324415	Band Reject Filter (2.4 GHz)	Microwave Circuits	LR 1760	COU	
5	VULB 9163	BiLog Antenna	Schwarzbech	LR 1616	2021-05	2024-05
6	317	Pre-amplifier	Sonoma Inst.	LR 1687	2022-08	2023-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2022-08	2023-08
8	L01G18G1	LowPass Filter (1 GHz)	Microwave Circuits	LR 1768	COU	
9	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2022-08	2023-08
10	638	Antenna Horn	Narda	LR 1480	N/A	
11	6812B	AC Power Source	Agilent	LR 1515	2022-11	2024-11
12	Model 87V	Multimeter	Fluke	LR 1600	2022-03	2024-03
13	ENV216	Two Line V-Network	Rohde & Schwarz	LR 1665	2021-12	2023-12
14	ESCI3	Measuring Receiver	Rohde & Schwarz	N-4259	2021-10	2023-10
15	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

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

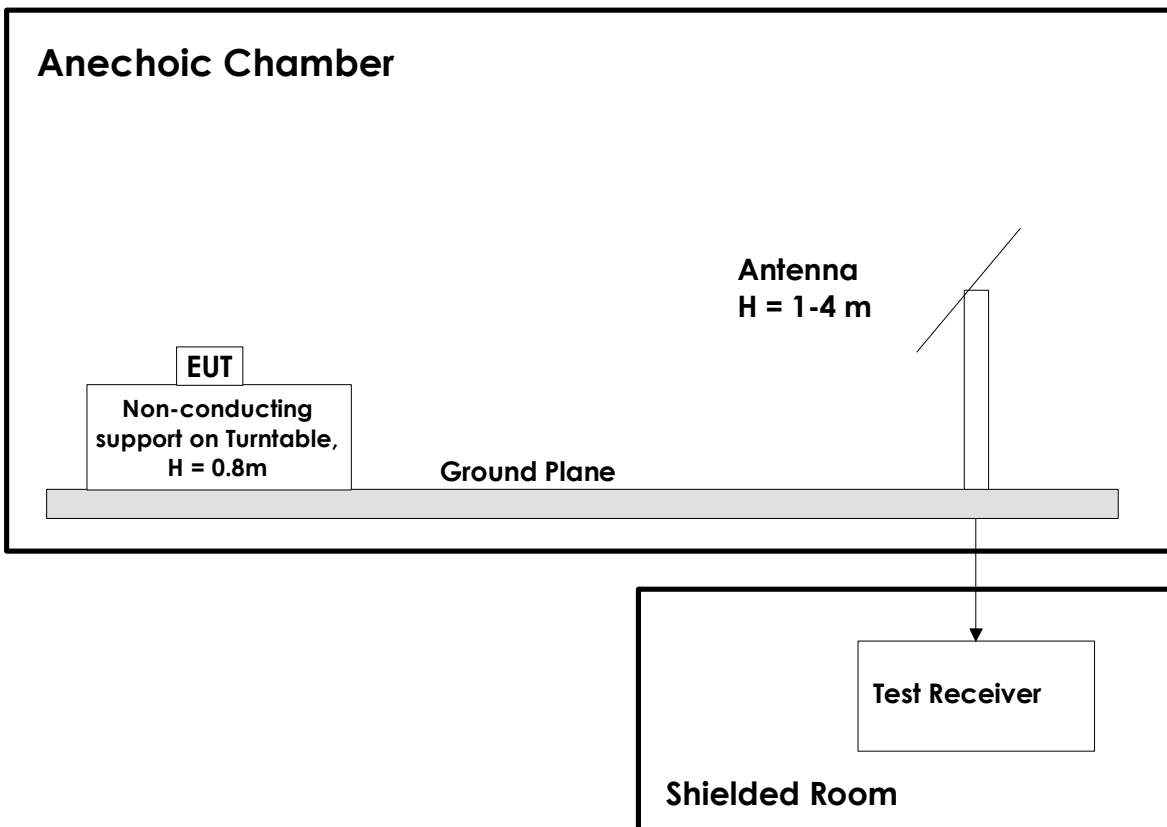
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Nemko AS	RSPlot	1.0.8.0	Screen capture from R&S Spectrum Analyzers

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.