

Test Report

Product	Wireless Module
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	LBEE5XV2EA
Trademark	CISCO
Additional information	Bluetooth LE, Bluetooth Classic, WiFi 6E
Tested according to	Parts of FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Parts of Industry Canada RSS-247, Issue 3 Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	PRJ0039024
Tested in period	2023-09-19 to 2023-10-02 and 2023-12-07
Issue date	2023-12-08
Name and address of the testing laboratory	 Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470 ISED No: 2040D-1   NORWEGIAN ACCREDITATION TEST 033 An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Frode Sveinsen]  Approved by [Jan G Eriksen]	
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CollaRevision history

Revision	Date	Comment	Sign
A	2023-11-28	First edition	FS
B	2023-12-08	Updated Radiated Emissions 1-18 GHz	FS

GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to ensure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is solely responsible for any modifications to the product that could result in non-compliance with the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither are opinions expressed regarding model variants covered by the testing of this report.

CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence, that the instruments remain within the calibrated levels.

MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests. Uncertainty figures are found in a separate clause in this report.

1 INFORMATION

1.1 Test Item

Name	Cisco
Model/version	LBEE5XV2EA
FCC ID	LDKXV2EA2797
ISED ID	2461N-XV2EA2797
Serial number	/
Hardware identity and/or version	1.0
Software identity and/or version	1.1.1.1 1.1.2.1 1.1.1.2 1.1.2.2
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	Internal U-FL
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Powered from Host
Antenna	Amphenol Model OCF608-15-000-R

Description of Test Item

The tested EUT is a module with WiFi and Bluetooth.

This report covers additional tests for use with the specified antennas.

All radiated tests were performed with the module installed in host model TTC60-36.

1.2 Hosts Used During Testing

Name	Cisco
Model No.	TTC60-35 TTC60-36
Serial number	TTC60-35: WZS2731L008 TTC60-36: WZS2731M00N
Hardware identity and/or version	DV1
Software identity and/or version	CE 11.9.0 / s01845-2.58.0.0
Antenna Connector	Internal U-FL
Power Supply	Mains (120V 60Hz AC)
Rating	TTC60-35: 100-240V _{AC} 50/60Hz 3.0-1.5A TTC60-36: 100-240V _{AC} 50/60Hz 4.0-2.0A

1.3 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.

1.4 Test Engineers

Frode Sveinsen

Jørn Gustavsen (Power Line Conducted)

1.5 Antenna Requirement

Does the EUT have detachable antenna(s)?	☐ YES	☒ NO
If detachable, is the antenna connector(s) non-standard?	☐ YES	☐ NO
The EUT have internal antennas.		

Requirement: FCC 15.203, 15.204

1.6 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

1.7 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 3 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 andISED.

☐ 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 3, 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

*Covered by SGS Test report No. TERF2211002256ER

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.107 (a)

ISED RSS-GEN Issue 5, Clause 7.2/8.8

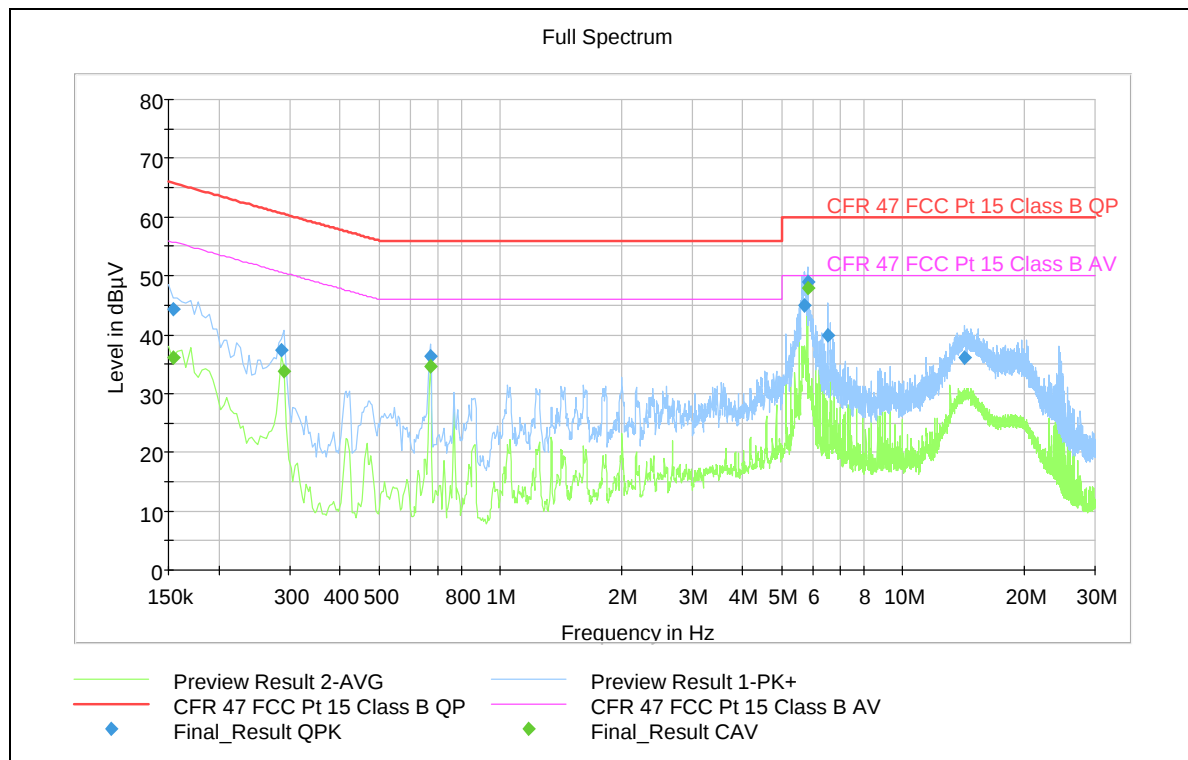
Measurement procedure: ANSI C63.4-2014 using 50 μ H/50 ohms LISN.

Test Results: Complies

Measurement Data: 120V 60Hz, 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)
0.154000	---	36.04	55.78	19.74	15000.0	9.000	L1	OFF	9.7
0.154000	44.31	---	65.78	21.47	15000.0	9.000	L1	OFF	9.7
0.286000	37.46	---	60.64	23.18	15000.0	9.000	L1	OFF	9.7
0.290000	---	33.79	50.52	16.74	15000.0	9.000	L1	OFF	9.7
0.670000	---	34.72	46.00	11.28	15000.0	9.000	N	OFF	9.6
0.670000	36.33	---	56.00	19.67	15000.0	9.000	N	OFF	9.6
5.690000	44.92	---	60.00	15.08	15000.0	9.000	L1	OFF	9.8
5.798000	48.89	---	60.00	11.11	15000.0	9.000	L1	OFF	9.8
5.798000	---	47.84	50.00	2.16	15000.0	9.000	L1	OFF	9.8
6.510000	39.81	---	60.00	20.19	15000.0	9.000	N	OFF	9.6
14.234000	36.09	---	60.00	23.91	15000.0	9.000	N	OFF	9.7



3.2 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	< 50	/	74	54	> 20	> 20
2480 MHz GFSK	2483.5 MHz	< 50	/			> 20	> 20
2402 MHz 2-EDR	2390 MHz	< 50	/			> 20	> 20
2480 MHz 2-EDR	2483.5 MHz	< 50	/			> 20	> 20
2402 MHz 3-EDR	2390 MHz	< 50	/			> 20	> 20
2480 MHz 3-EDR	2483.5 MHz	< 50	/			> 20	> 20

Peak Detector values are below the Average Limit.

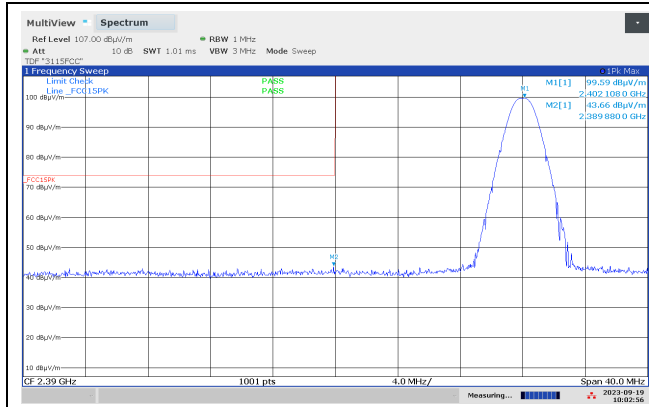
See attached plots.

Duty Cycle Correction Factor Calculation:

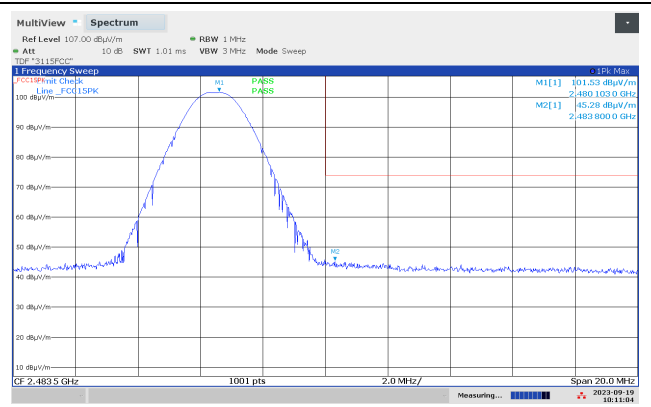
Duty Cycle = slot length / (frame length * Number of Hopping Channels)

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

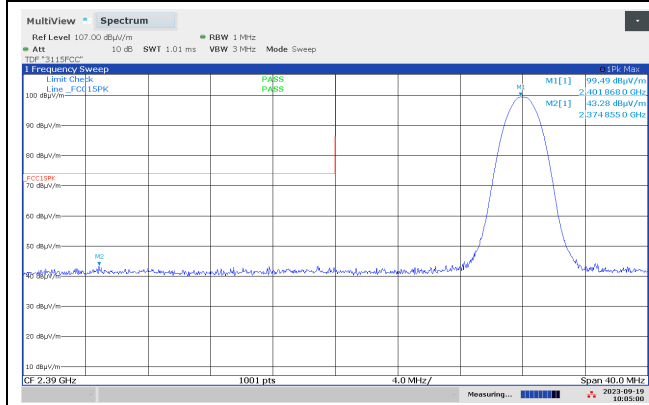
Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB



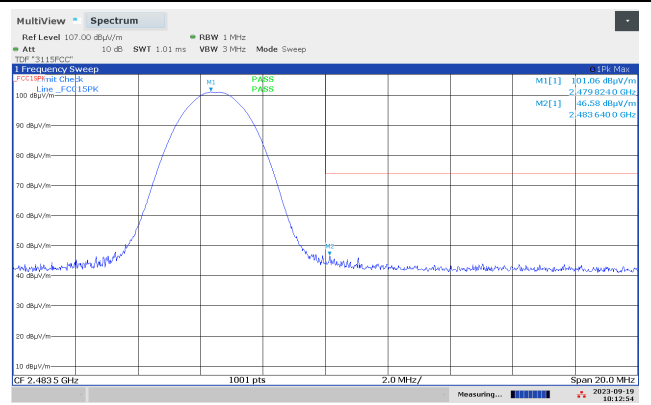
Lower Band Edge 2402 MHz, GFSK, Peak



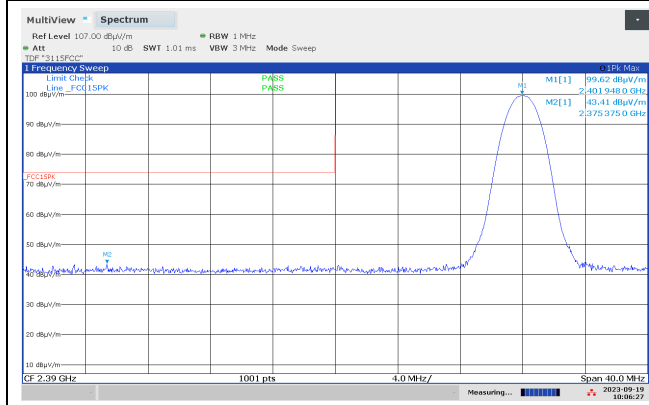
Upper Band Edge 2480 MHz, GFSK, Peak



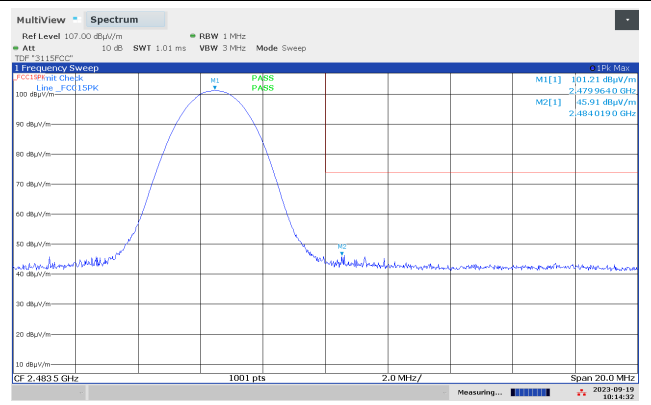
Lower Band Edge 2402 MHz, $\pi/4$ -DPSK, Peak



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



Lower Band Edge 2402 MHz, 8-DPSK, Peak



Upper Band Edge 2480 MHz, 8-DPSK, Peak

3.3 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 Ch39

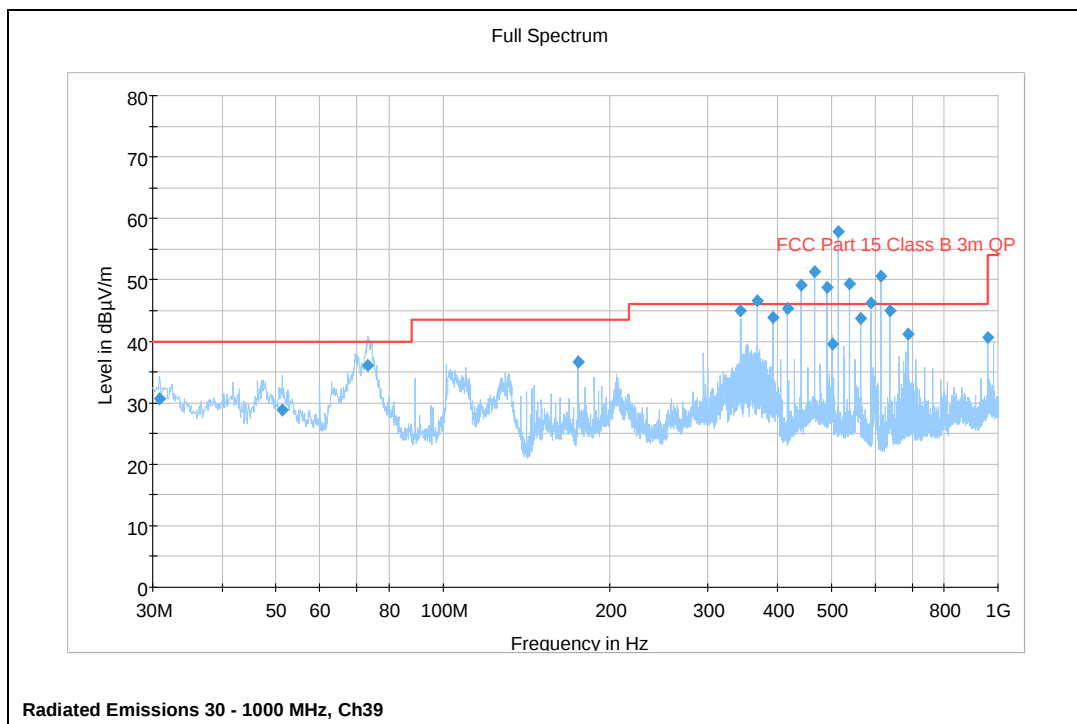
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
73.223374	36.04	40.00	3.96	15000.0	120.000	300.0	V	335.0	-17.7

Only frequencies in Restricted Band are listed above.

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		



3.4 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)
1m (18 – 26 GHz)

RBW=1 MHz

Carrier freq. (MHz)	Measured Freq. (MHz)	Mode	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Pk	Av	Pk	Av
2402	4804	GFSK	57.1	37.1	74	54	16.9	16.9
2442	4884	GFSK	60.6	40.6	74	54	13.4	13.4
		$\pi/4$ -DQPSK	53.5	33.5	74	54	20.5	20.5
		8-DPSK	53.6	33.6	74	54	20.4	20.4
2480	4960	GFSK	56.3	36.3	74	54	17.7	17.7
Any	2971*	Any	65.5	/	N/A	/	N/A	/
Any	5941*	Any	65.1	/	N/A	/	N/A	/
Any	Any other	Any	< 56	< 36	74	54	> 18	> 18

*Not in a Restricted Band

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

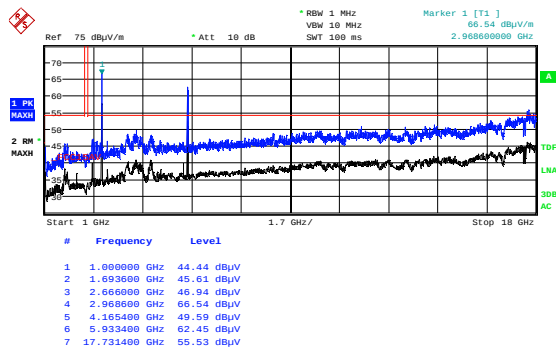
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz.

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

See plots.

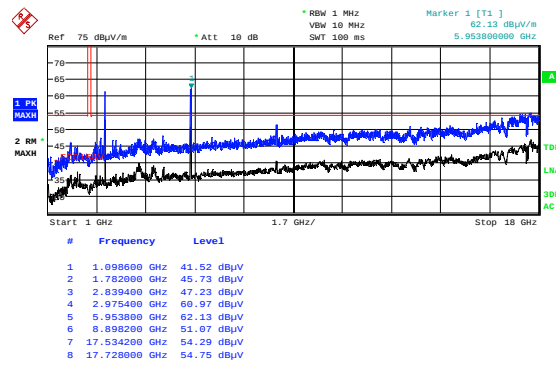
Requirements/Limit

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



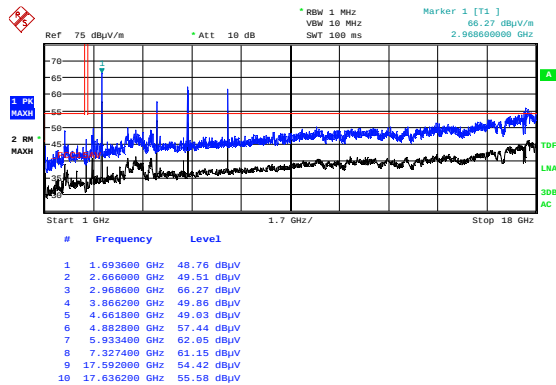
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Radiated Emissions 1 - 18 GHz, 2402 MHz, GFSK, HP



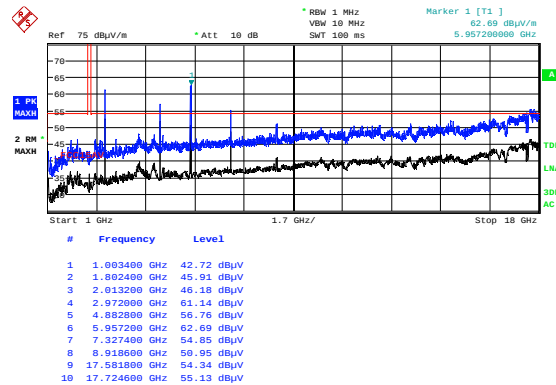
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VP



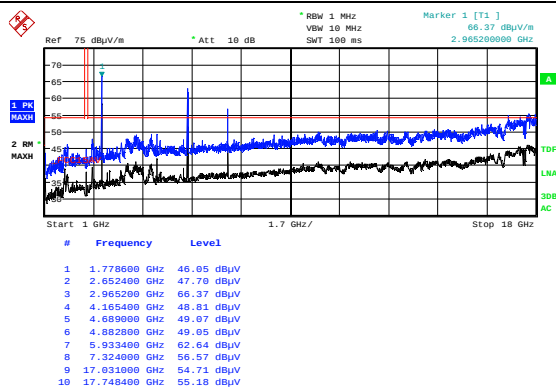
Date: 7.DEC.2023 17:58:47

Radiated Emissions 1 - 18 GHz, 2442 MHz, GFSK, HP



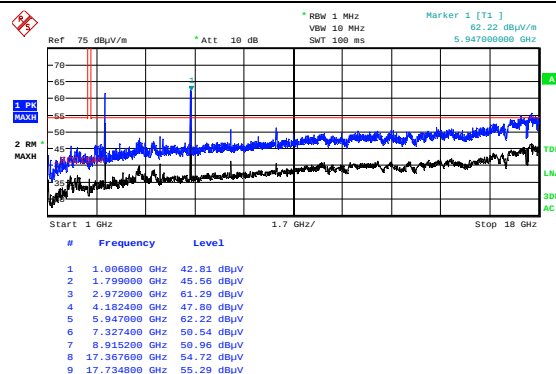
Date: 7.DEC.2023 17:56:50

VP



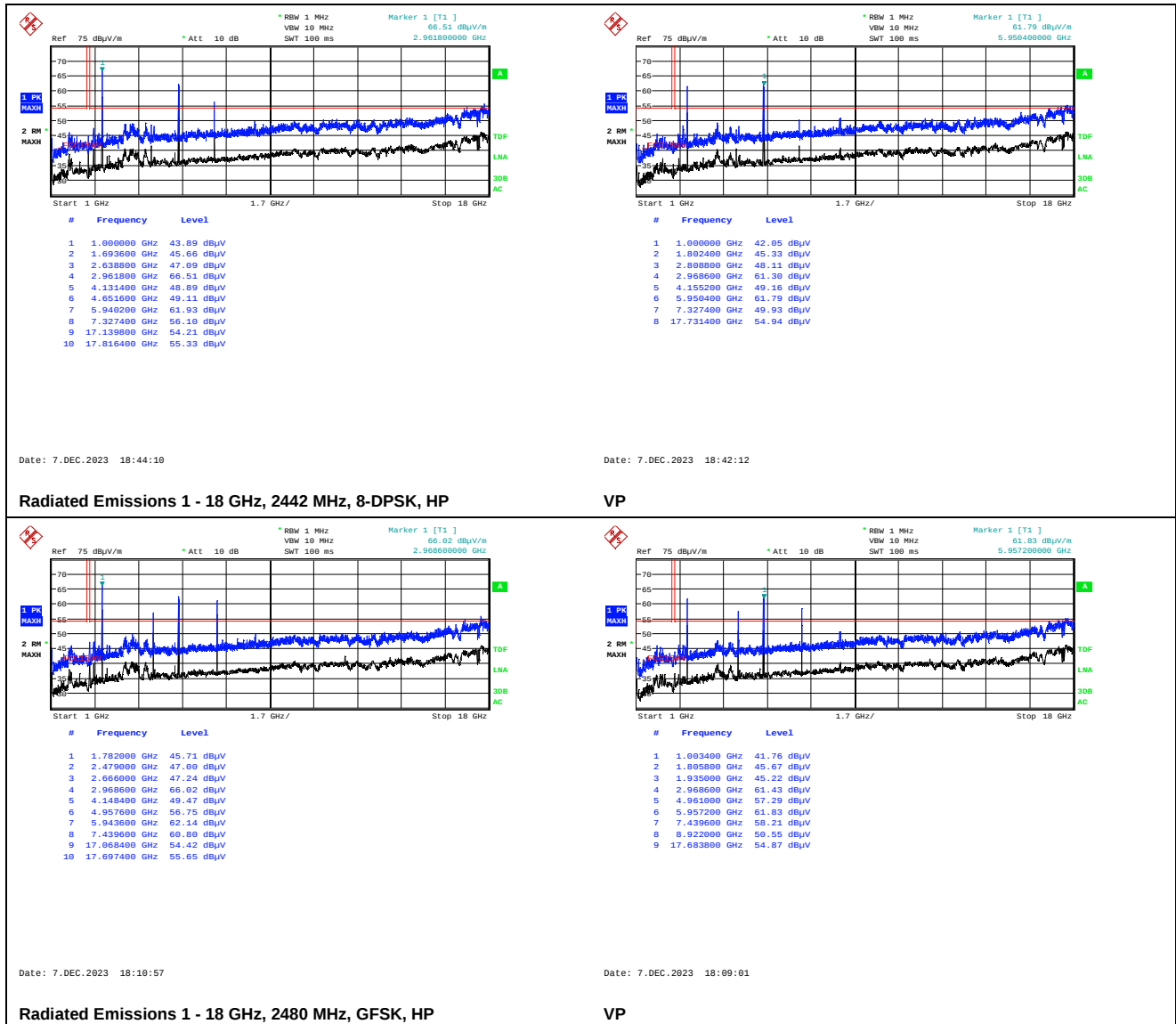
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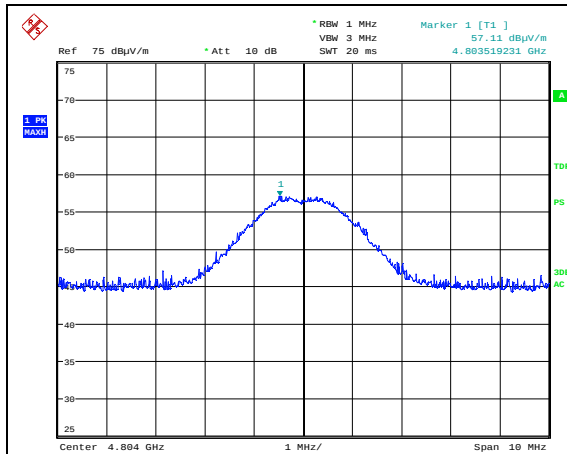
Radiated Emissions 1 - 18 GHz, 2442 MHz, π/4-DQPSK, HP



Date: 7.DEC.2023 18:36:52

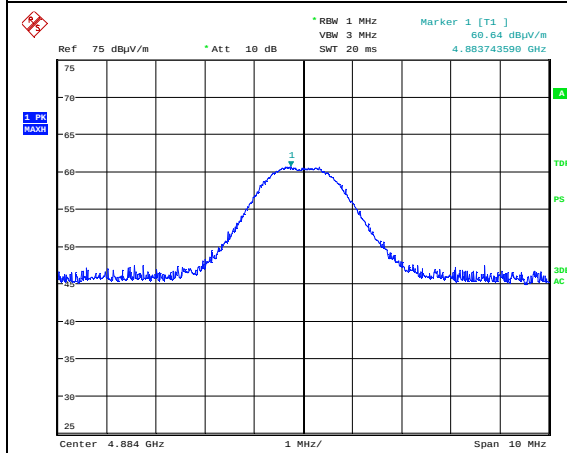
VP





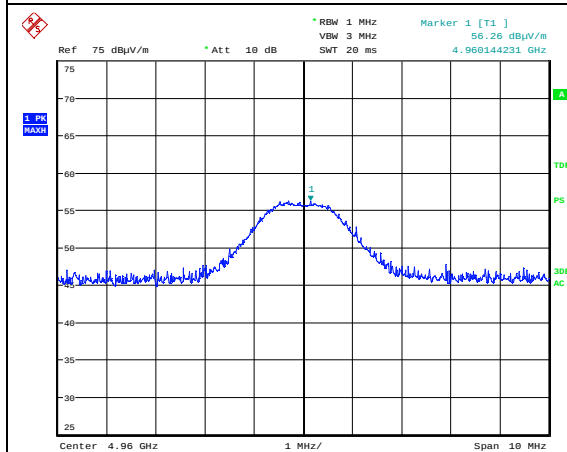
Date: 7.DEC.2023 18:33:17

Radiated Emissions 4804 MHz, 2402 MHz, GFSK, HP, Pk



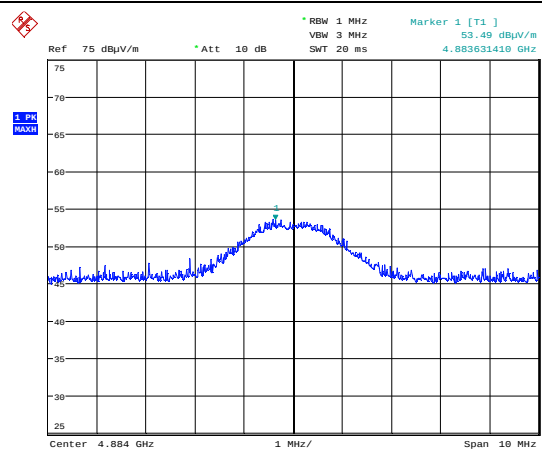
Date: 7.DEC.2023 18:23:43

Radiated Emissions 4884 MHz, 2442 MHz, GFSK, HP, Pk



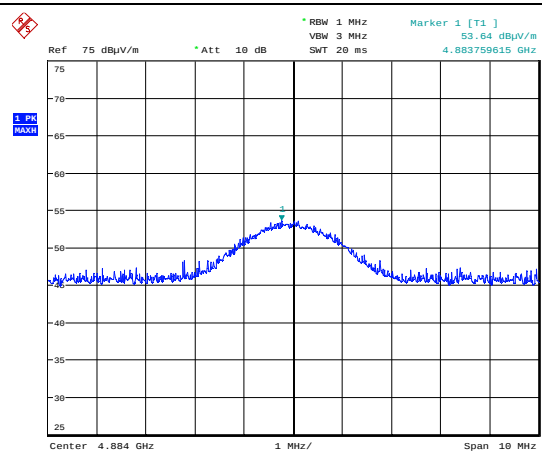
Date: 7.DEC.2023 18:15:37

Radiated Emissions 4960 MHz, 2480 MHz, GFSK, HP, Pk



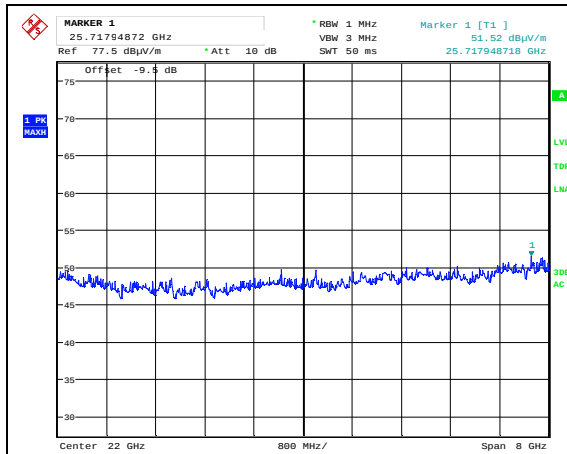
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Radiated Emissions 4884 MHz, 2442 MHz, $\pi/4$ -DQPSK, HP, Pk



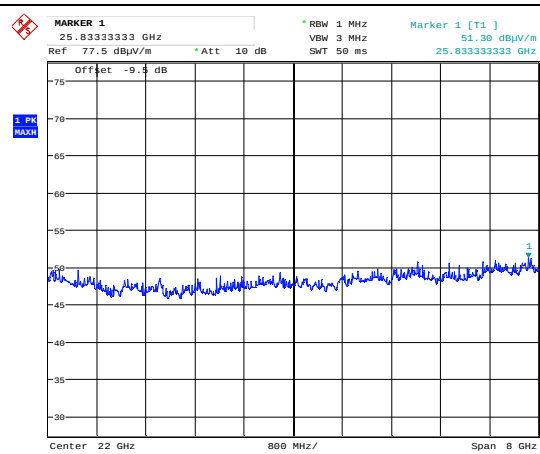
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Radiated Emissions 4884 MHz, 2442 MHz, 8-DPSK, HP, Pk



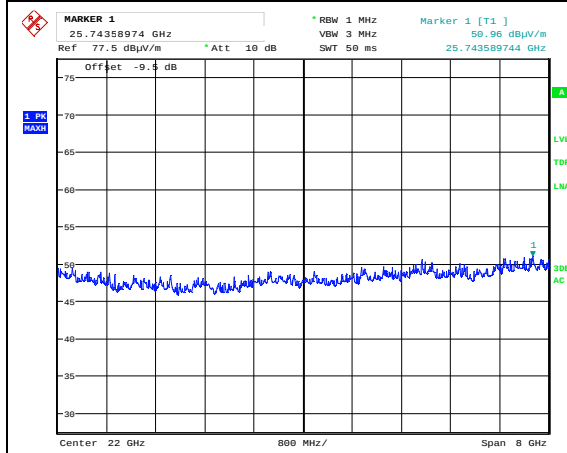
Date: 2.OCT.2023 12:29:32

Radiated Emissions 18 - 26 GHz, 2402 MHz, GFSK, HP, @1m



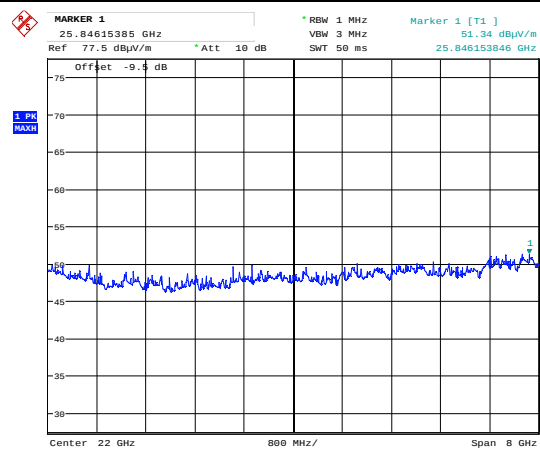
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VP, @1m



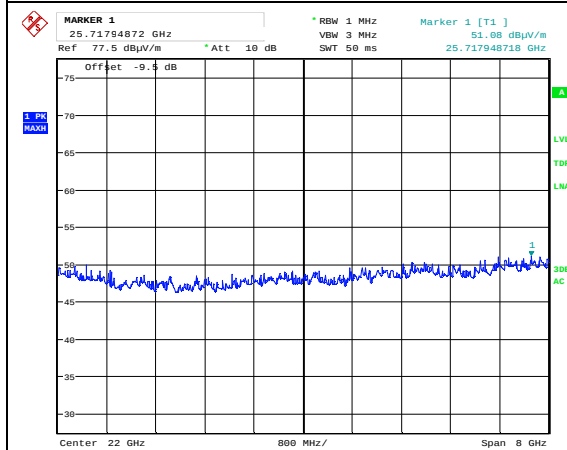
Date: 2.OCT.2023 12:26:58

Radiated Emissions 18 - 26 GHz, 2441 MHz, GFSK, HP, @1m



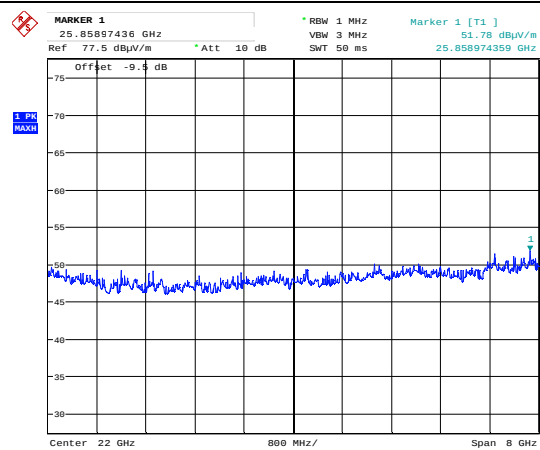
Date: 2.OCT.2023 12:22:33

VP, @1m



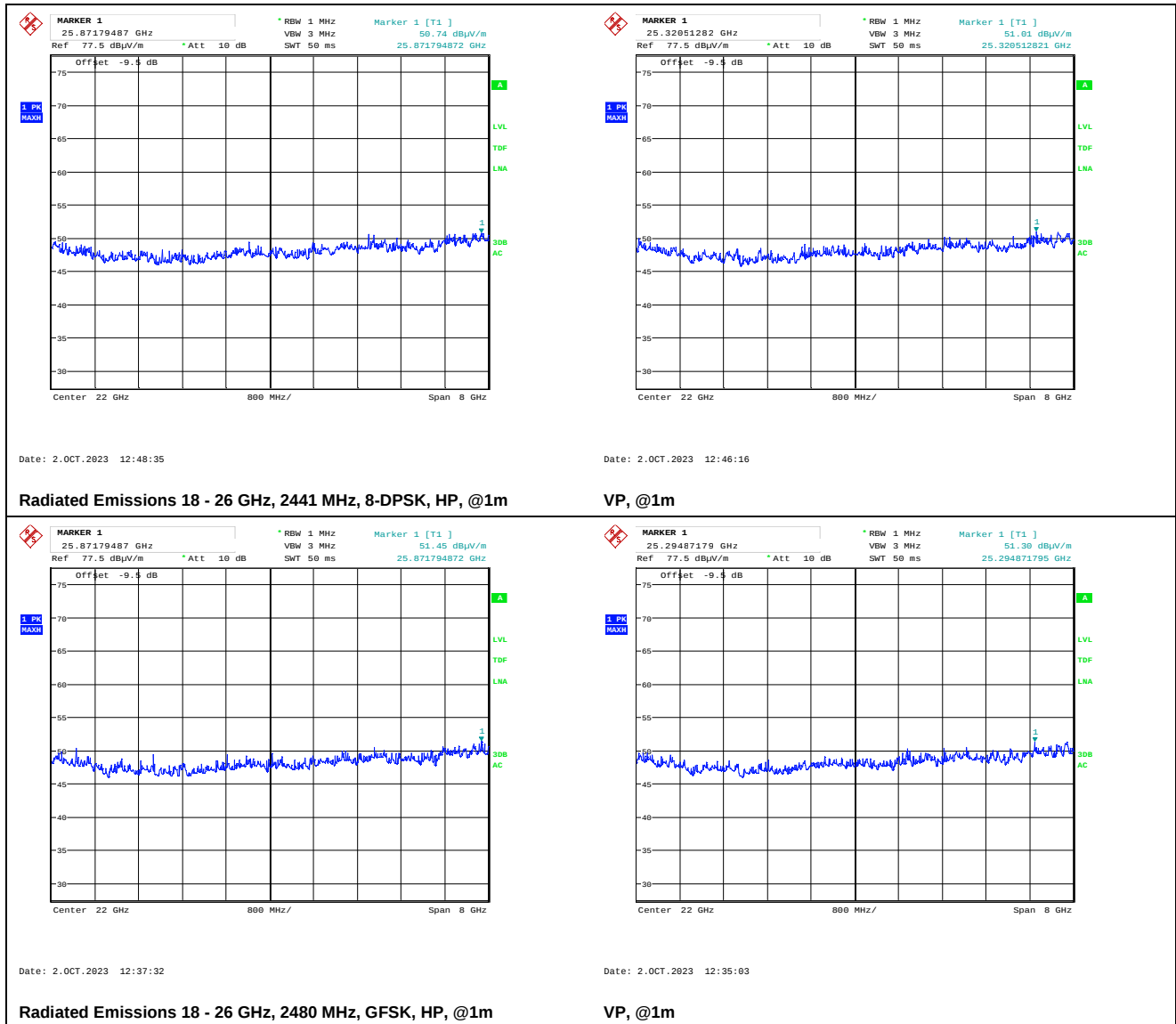
Date: 2.OCT.2023 12:41:42

Radiated Emissions 18 - 26 GHz, 2441 MHz, π/4-DQPSK, HP, @1m



Date: 2.OCT.2023 12:43:52

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.

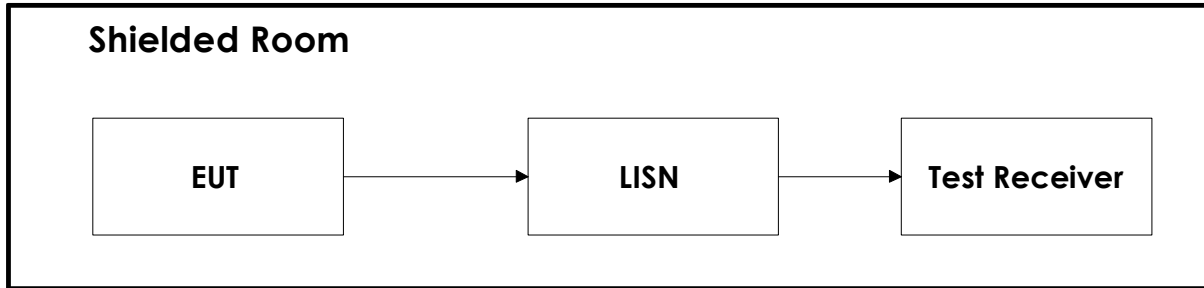
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2023-01	2024-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
3	6810.17B	Attenuator	Suhner	LR 1669	2023-05	2024-05
4	NO324415	Band Reject Filter (2.4 GHz)	Microwave Circuits	LR 1760	COU	
5	VULB 9163	BiLog Antenna	Schwarzbech	LR 1616	2021-05	2024-05
6	310	Pre-amplifier	Sonoma Inst.	LR 1686	2023-08	2024-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2023-08	2024-08
8	L01G18G1	LowPass Filter (1 GHz)	Microwave Circuits	LR 1768	COU	
9	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2023-08	2024-08
10	3115	Horn Antenna	EMCO	LR 1226	2022-11	2027-11
11	638	Antenna Horn	Narda	LR 1480	N/A	
12	6812B	AC Power Source	Agilent	LR 1515	2022-11	2024-11
13	Model 87V	Multimeter	Fluke	LR 1600	2022-03	2024-03
14	ENV216	Two Line V-Network	Rohde & Schwarz	LR 1665	2021-12	2023-12
15	ESCI3	Measuring Receiver	Rohde & Schwarz	N-4259	2021-10 2023-11	2023-10 2025-11
16	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

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

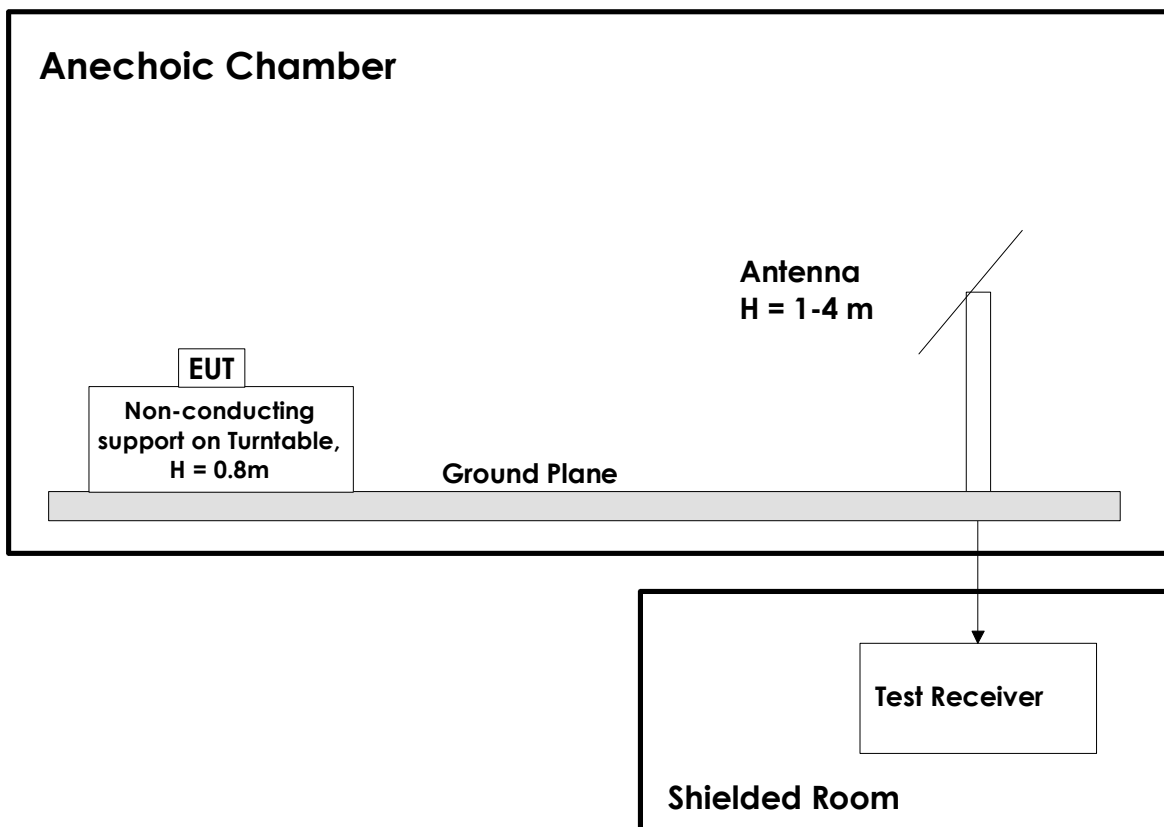
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Nemko AS	RSPlot	1.0.8.0	Screen capture from R&S Spectrum Analyzers

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.