

EMI – TEST REPORT

- FCC Part 15.247, RSS247 -

Type / Model Name : TT-BAE2-17-01

Product Description : Control and display units 2,7" with BLE gateway

Applicant : medica Medizintechnik GmbH

Address : Blumenweg 8

88454 HOCHDORF, GERMANY

Manufacturer : medica Medizintechnik GmbH

Address : Blumenweg 8

88454 HOCHDORF, GERMANY

Licence holder : medica Medizintechnik GmbH

Address : Blumenweg 8

88454 HOCHDORF, GERMANY

Test Result according to the standards
listed in clause 1 test standards:

POSITIVE

Test Report No. : **T43063-00-01GK**

20. December 2017

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

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Attachment A as separate supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2017)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2017)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 558074 D01 v04	Guidance for performing compliance measurements on DTS operating under §15.247, April 5, 2017.

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.2 Equipment type

BLE device

2.3 Short description of the equipment under test (EUT)

The EUT is a control and display unit (2.7 inches). The EUT is compatible with the standard 802.15.1. It supports the 2.4 GHz frequency band. A single PCB antenna is used within the system. The EUT must be controlled via terminal program to select the modulation and data rate manually. A personal computer was used to control the settings of the EUT.

Number of tested samples:	2 (1 radiated and 1 conducted sample)
Serial number (radiated sample):	pre-production sample
Serial number)conducted sample):	pre-production sample
Firmware version:	V1.0
Bluetooth-Stack:	Softdevice V8.0 from Nordic Semiconductor

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

2.4 Variants of the EUT

None

2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan BT-Standard 802.15.1:

Channel	Frequency	Channel	Frequency
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

Note: the marked frequencies are determined for final testing.

2.6 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:

- 1000 kbps

(kbps = kilobits per second)

2.7 Antennas

The following antennas shall be used with the EUT:

Number	Characteristic	Certification name	Plug	Frequency (MHz)	Gain (dBi)
1	Omni	PCB antenna	none	2402	0.6
1	Omni	PCB antenna	none	2442	-2.3
1	Omni	PCB antenna	none	2480	-6.4

Note: The antenna gain was measured and calculated in the test report T43063-00-00GK of the test laboratory CSA Group Bayern GmbH.

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 3.3 V DC (powered by Theratrainner mobi or tigo 115 V AC / 60 Hz)

2.9 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- Laptop _____ Model : Fujitsu Siemens E780 _____
- _____ Model : _____
- _____ Model : _____

Note: The laptop is only connected during the settings but not during the measurements.

2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes.

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

For the final test the following channels and test modes are selected:

Available channels	Tested channels	Power setting	Modulation	Data rate
00 to 39	37, 18, 39	(0 dBm)	GFSK	1000 kbps

- TX continuous mode, 802.15.1

2.10.1 Test jig

No special test jig was used.

2.10.2 Test software

The test software nRFgo (Direct Test Mode) was used to set the EUT into test mode.

3 TEST RESULT SUMMARY

BLE device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS247, 5.2(a)	-6 dB EBW	passed
15.247(b)(3)	RSS247, 5.4(d)	Maximum peak conducted output power	passed
15.247(b)(4)	RSS247, 5.4(d)	Defacto limit	passed
15.247(d)	RSS247, 5.5	Unwanted emission, radiated	not applicable
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(e)	RSS247, 5.2(b)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.247(b)(4)	-	Antenna requirement	passed
	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 4, November 2014

RSS 247, Issue 2, February 2017

3.1 Final assessment

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 16 August 2017

Testing concluded on : 02 November 2017

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Konrad Graßl
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

4.4 Measurement protocol for FCC and ISCED

4.4.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.1.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.2 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.10 - "Testing Unlicensed Wireless Devices". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up

Please see Attachment B

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 1.71 dB at 0.4755 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

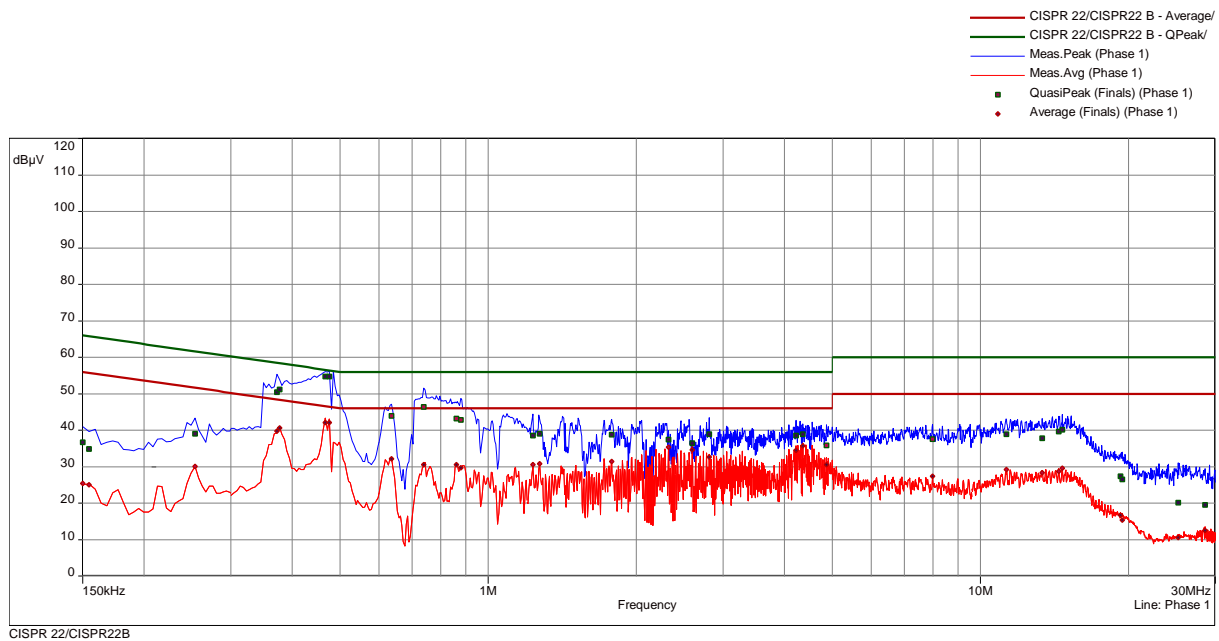
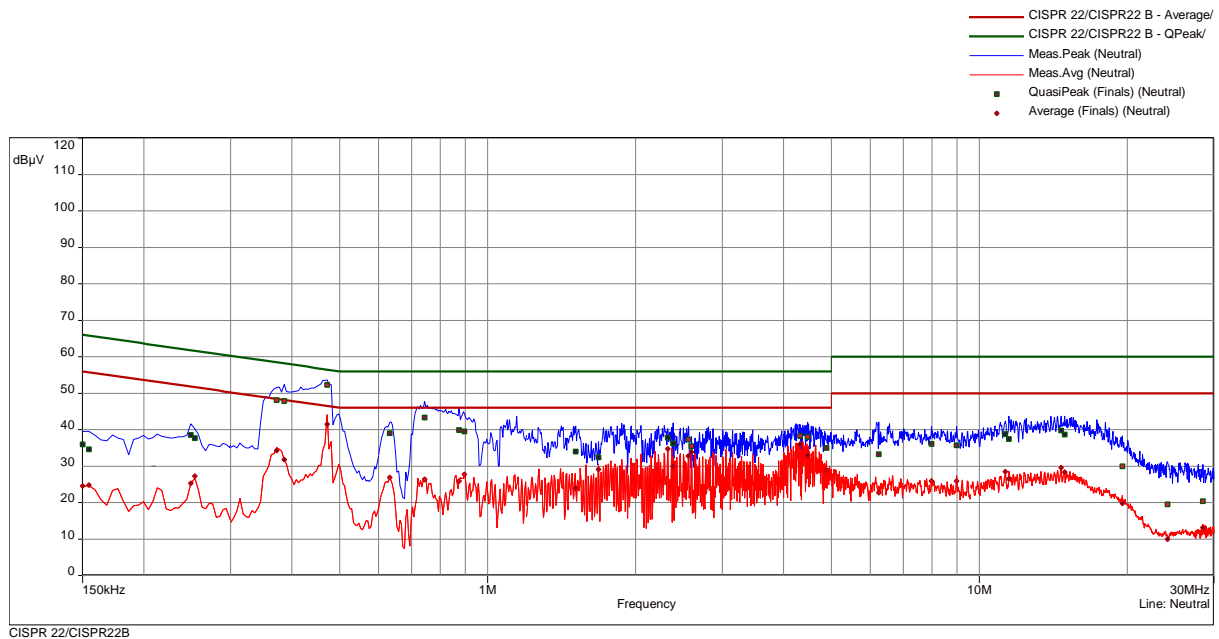
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED**.

Remarks: For detailed test result please see the following test protocols

Note: The EUT can be powered by Theratrainner mobi and tigo. These devices have an integrated motor which provides a minimal number of revolutions of 10 rpm and a maximal number of 60 rpm.

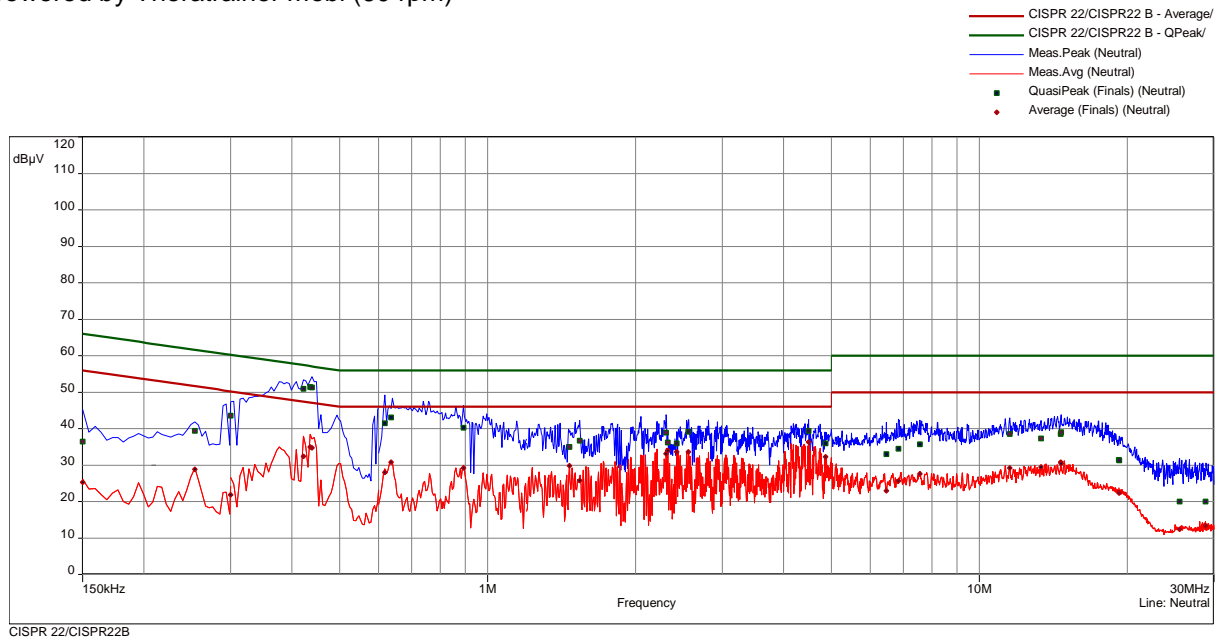
EUT powered by Theratrainner mobi (10 rpm)

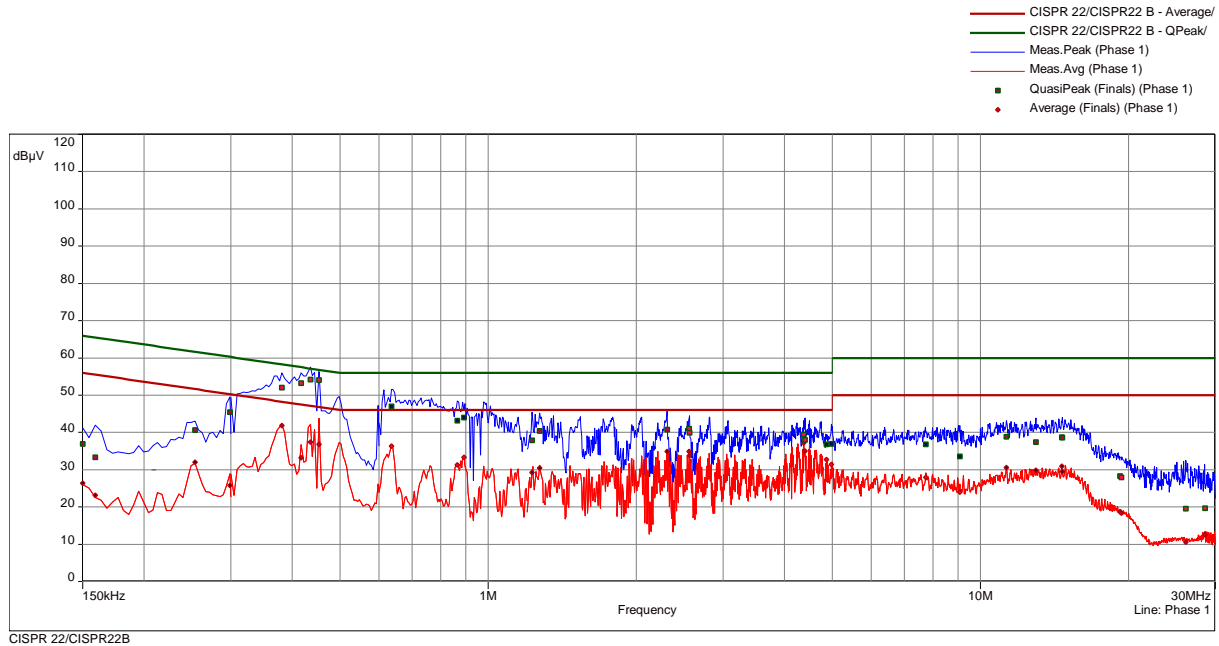


freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.15	1	36.69	29.31	66.00	25.40	30.60	56.00	Phase 1
0.1545	1	34.86	30.90	65.75	25.07	30.68	55.75	Phase 1
0.2535	1	39.08	22.56	61.64	30.11	21.54	51.64	Phase 1
0.372	2	50.46	8.00	58.46	39.75	8.70	48.46	Phase 1
0.3765	2	51.20	7.15	58.36	40.61	7.75	48.36	Phase 1
0.4665	2	54.70	1.87	56.58	42.11	4.47	46.58	Phase 1
0.4755	2	54.71	1.71	56.42	42.15	4.27	46.42	Phase 1
0.636	3	43.98	12.02	56.00	32.20	13.80	46.00	Phase 1
0.7395	3	46.40	9.60	56.00	30.53	15.47	46.00	Phase 1
0.861	3	43.21	12.79	56.00	30.53	15.47	46.00	Phase 1
0.879	3	42.84	13.16	56.00	29.74	16.26	46.00	Phase 1
1.2315	4	38.48	17.52	56.00	30.51	15.49	46.00	Phase 1
1.272	4	39.04	16.96	56.00	30.75	15.25	46.00	Phase 1
1.7805	4	38.74	17.26	56.00	31.36	14.64	46.00	Phase 1
2.325	4	37.42	18.58	56.00	35.40	10.60	46.00	Phase 1
2.598	5	36.42	19.58	56.00	34.63	11.37	46.00	Phase 1
2.814	5	38.85	17.15	56.00	32.70	13.30	46.00	Phase 1
4.218	5	38.56	17.44	56.00	34.53	11.47	46.00	Phase 1
4.3575	5	38.88	17.12	56.00	35.70	10.30	46.00	Phase 1
4.863	6	35.89	20.11	56.00	30.60	15.40	46.00	Phase 1
7.9905	6	37.55	22.45	60.00	27.31	22.69	50.00	Phase 1
11.292	7	38.85	21.15	60.00	29.20	20.80	50.00	Phase 1
13.3485	7	37.86	22.14	60.00	28.35	21.65	50.00	Phase 1
14.4105	7	39.61	20.39	60.00	28.66	21.34	50.00	Phase 1
14.6535	7	40.08	19.92	60.00	29.63	20.37	50.00	Phase 1
19.236	8	27.31	32.69	60.00	16.68	33.32	50.00	Phase 1
19.3935	8	26.53	33.47	60.00	15.37	34.63	50.00	Phase 1
25.1985	8	20.13	39.87	60.00	10.56	39.44	50.00	Phase 1
28.605	8	19.50	40.50	60.00	12.48	37.52	50.00	Phase 1
0.15	9	35.98	30.02	66.00	24.54	31.46	56.00	Neutral
0.1545	9	34.57	31.18	65.75	24.75	31.01	55.75	Neutral
0.249	9	38.49	23.31	61.79	25.26	26.53	51.79	Neutral
0.2535	9	37.72	23.93	61.64	27.29	24.35	51.64	Neutral
0.372	10	48.14	10.32	58.46	34.28	14.17	48.46	Neutral
0.3855	10	47.89	10.27	58.16	31.73	16.43	48.16	Neutral
0.471	10	52.28	4.22	56.50	41.53	4.97	46.50	Neutral
0.6315	11	39.07	16.93	56.00	26.87	19.13	46.00	Neutral
0.744	11	43.29	12.71	56.00	26.40	19.60	46.00	Neutral
0.8745	11	39.86	16.14	56.00	25.86	20.14	46.00	Neutral
0.897	11	39.51	16.49	56.00	27.70	18.30	46.00	Neutral
1.5105	12	33.98	22.02	56.00	23.88	22.12	46.00	Neutral
1.6815	12	32.45	23.55	56.00	29.15	16.85	46.00	Neutral
2.325	12	37.75	18.25	56.00	34.78	11.22	46.00	Neutral
2.3835	12	36.24	19.76	56.00	29.91	16.09	46.00	Neutral
2.5575	13	37.34	18.66	56.00	32.72	13.28	46.00	Neutral

2.598	13	35.50	20.50	56.00	33.85	12.15	46.00	Neutral
4.317	13	38.27	17.73	56.00	35.91	10.09	46.00	Neutral
4.4745	13	38.08	17.92	56.00	32.86	13.14	46.00	Neutral
4.8855	14	35.01	20.99	56.00	28.80	17.20	46.00	Neutral
6.2355	14	33.28	26.72	60.00	22.75	27.25	50.00	Neutral
7.986	14	36.03	23.97	60.00	25.91	24.09	50.00	Neutral
8.9895	14	35.66	24.34	60.00	25.85	24.15	50.00	Neutral
11.2875	15	38.81	21.19	60.00	28.54	21.46	50.00	Neutral
11.481	15	37.38	22.62	60.00	26.47	23.53	50.00	Neutral
14.6535	15	39.79	20.21	60.00	29.57	20.43	50.00	Neutral
14.8965	15	38.63	21.37	60.00	28.37	21.63	50.00	Neutral
19.524	16	29.90	30.10	60.00	19.82	30.18	50.00	Neutral
24.132	16	19.54	40.46	60.00	9.91	40.09	50.00	Neutral
28.497	16	20.42	39.58	60.00	13.14	36.86	50.00	Neutral

EUT powered by Theratrainner mobi (60 rpm)

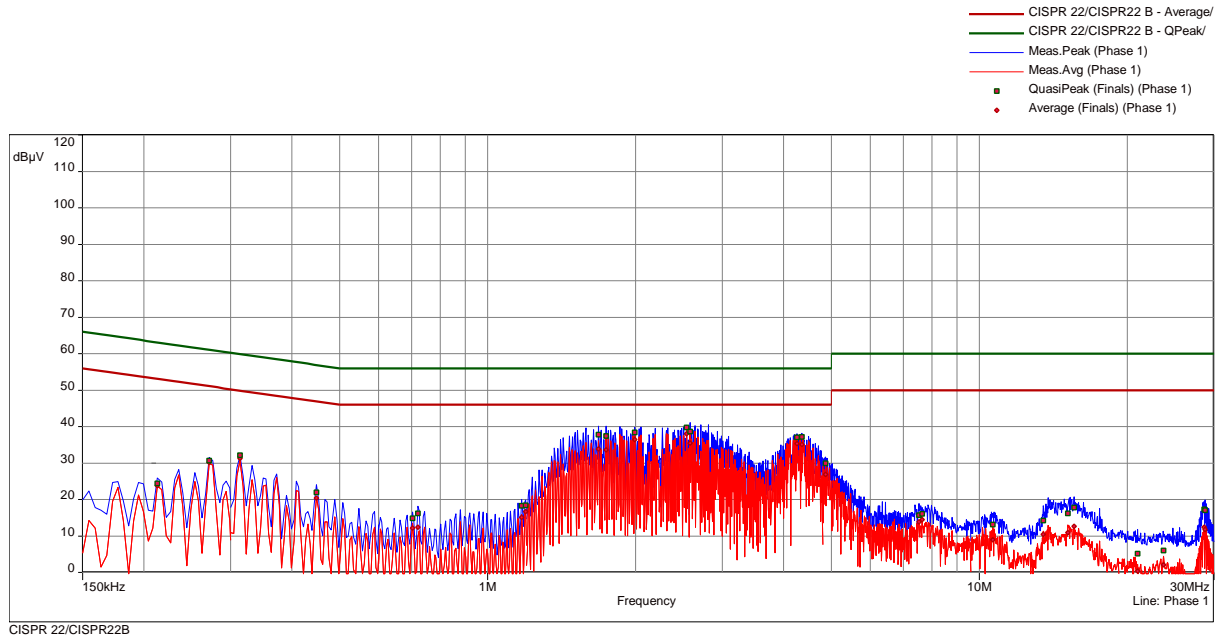




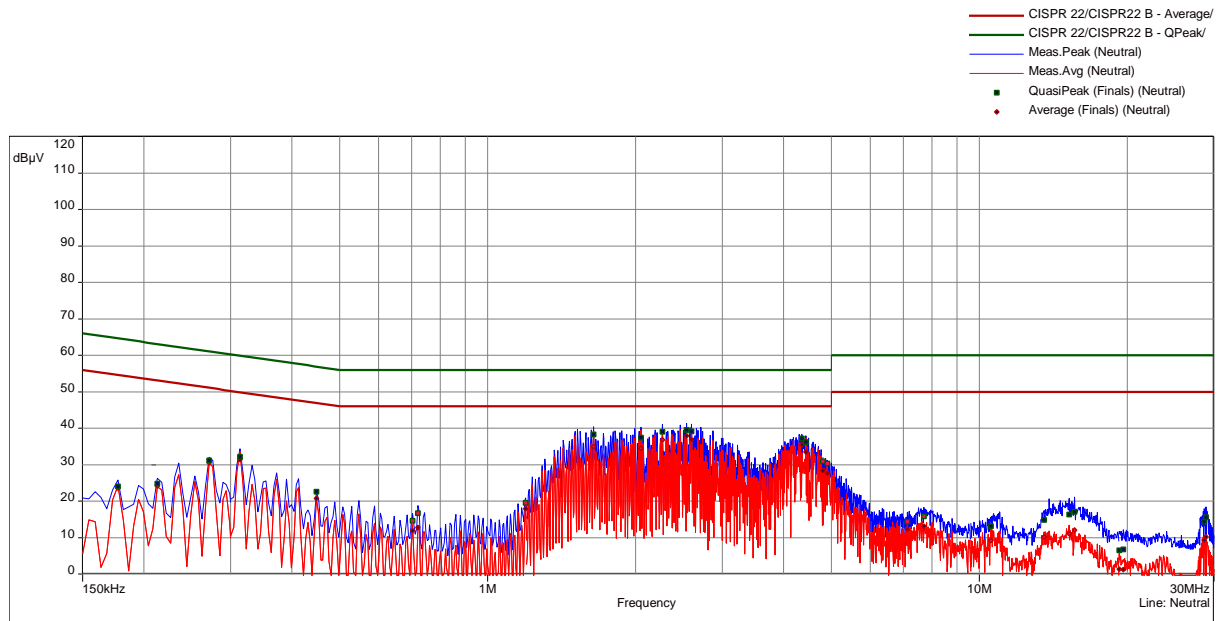
freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.15	1	36.90	29.10	66.00	26.34	29.66	56.00	Phase 1
0.159	1	33.34	32.17	65.52	23.09	32.42	55.52	Phase 1
0.2535	1	40.67	20.97	61.64	31.98	19.66	51.64	Phase 1
0.2985	1	45.40	14.89	60.28	25.81	24.47	50.28	Phase 1
0.381	2	52.09	6.16	58.26	41.90	6.36	48.26	Phase 1
0.417	2	53.20	4.31	57.51	33.26	14.25	47.51	Phase 1
0.435	2	54.19	2.97	57.16	37.44	9.72	47.16	Phase 1
0.453	2	54.04	2.78	56.82	36.81	10.01	46.82	Phase 1
0.636	3	47.04	8.96	56.00	36.38	9.62	46.00	Phase 1
0.8655	3	43.13	12.87	56.00	31.24	14.76	46.00	Phase 1
0.8925	3	44.00	12.00	56.00	33.28	12.72	46.00	Phase 1
1.227	4	37.88	18.12	56.00	29.27	16.73	46.00	Phase 1
1.272	4	40.45	15.55	56.00	30.52	15.48	46.00	Phase 1
2.307	4	40.82	15.18	56.00	34.89	11.11	46.00	Phase 1
2.5575	5	40.97	15.03	56.00	34.95	11.05	46.00	Phase 1
2.562	5	39.98	16.02	56.00	33.80	12.20	46.00	Phase 1
4.3755	5	39.43	16.57	56.00	37.20	8.80	46.00	Phase 1
4.398	5	38.04	17.96	56.00	35.01	10.99	46.00	Phase 1
4.863	6	36.87	19.13	56.00	32.76	13.24	46.00	Phase 1
4.98	6	36.90	19.10	56.00	31.47	14.53	46.00	Phase 1
7.743	6	36.83	23.17	60.00	28.00	22.00	50.00	Phase 1
9.0705	6	33.58	26.42	60.00	23.96	26.04	50.00	Phase 1
11.292	7	38.88	21.12	60.00	30.54	19.46	50.00	Phase 1
12.9705	7	37.47	22.53	60.00	29.81	20.19	50.00	Phase 1
14.6445	7	38.71	21.29	60.00	30.96	19.04	50.00	Phase 1
14.6715	7	38.66	21.34	60.00	29.44	20.56	50.00	Phase 1
19.2045	8	28.24	31.76	60.00	18.74	31.26	50.00	Phase 1

19.344	8	27.94	32.06	60.00	18.35	31.65	50.00	Phase 1
26.121	8	19.49	40.51	60.00	10.60	39.40	50.00	Phase 1
28.614	8	19.65	40.35	60.00	12.63	37.37	50.00	Phase 1
0.15	9	36.49	29.51	66.00	25.30	30.70	56.00	Neutral
0.2535	9	39.35	22.29	61.64	28.83	22.82	51.64	Neutral
0.3	9	43.58	16.67	60.24	21.82	28.42	50.24	Neutral
0.4215	10	50.92	6.49	57.42	32.38	15.03	47.42	Neutral
0.435	10	51.44	5.71	57.16	35.00	12.15	47.16	Neutral
0.4395	10	51.34	5.73	57.07	34.76	12.32	47.07	Neutral
0.618	11	41.45	14.55	56.00	27.95	18.05	46.00	Neutral
0.636	11	43.09	12.91	56.00	30.85	15.15	46.00	Neutral
0.8925	11	40.30	15.70	56.00	29.25	16.75	46.00	Neutral
1.4655	12	34.95	21.05	56.00	29.78	16.22	46.00	Neutral
1.5375	12	36.64	19.36	56.00	25.75	20.25	46.00	Neutral
2.3025	12	38.89	17.11	56.00	33.18	12.82	46.00	Neutral
2.325	12	36.21	19.79	56.00	33.98	12.02	46.00	Neutral
2.4225	13	35.96	20.04	56.00	33.63	12.37	46.00	Neutral
2.5575	13	39.14	16.86	56.00	33.57	12.43	46.00	Neutral
4.4925	13	39.44	16.56	56.00	36.32	9.68	46.00	Neutral
4.863	14	35.96	20.04	56.00	32.22	13.78	46.00	Neutral
6.474	14	33.03	26.97	60.00	22.94	27.06	50.00	Neutral
6.8385	14	34.45	25.55	60.00	25.63	24.37	50.00	Neutral
7.572	14	35.67	24.33	60.00	27.68	22.32	50.00	Neutral
11.526	15	38.54	21.46	60.00	29.25	20.75	50.00	Neutral
13.353	15	37.29	22.71	60.00	29.47	20.53	50.00	Neutral
14.6445	15	38.48	21.52	60.00	30.76	19.24	50.00	Neutral
14.658	15	38.98	21.02	60.00	30.42	19.58	50.00	Neutral
19.2225	16	31.42	28.58	60.00	22.42	27.58	50.00	Neutral
19.2405	16	31.25	28.75	60.00	22.34	27.66	50.00	Neutral
25.518	16	20.06	39.94	60.00	12.36	37.64	50.00	Neutral
28.8435	16	20.03	39.97	60.00	13.37	36.63	50.00	Neutral

EUT powered by Theratrainertigo (10 rpm)



CISPR 22/CISPR22B

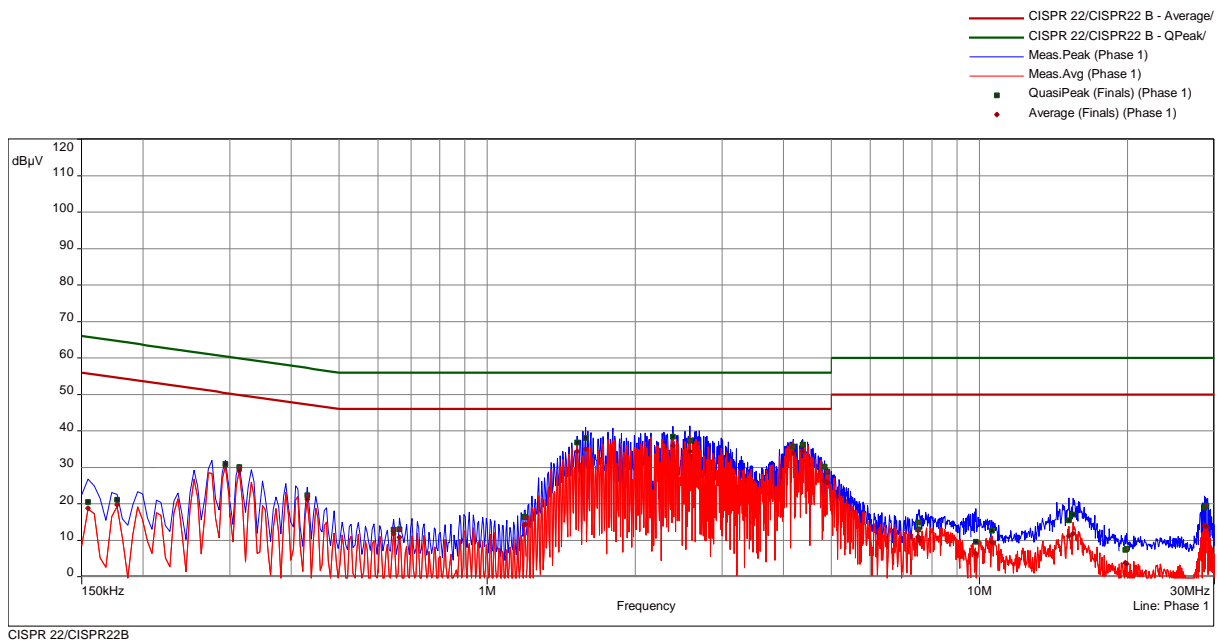
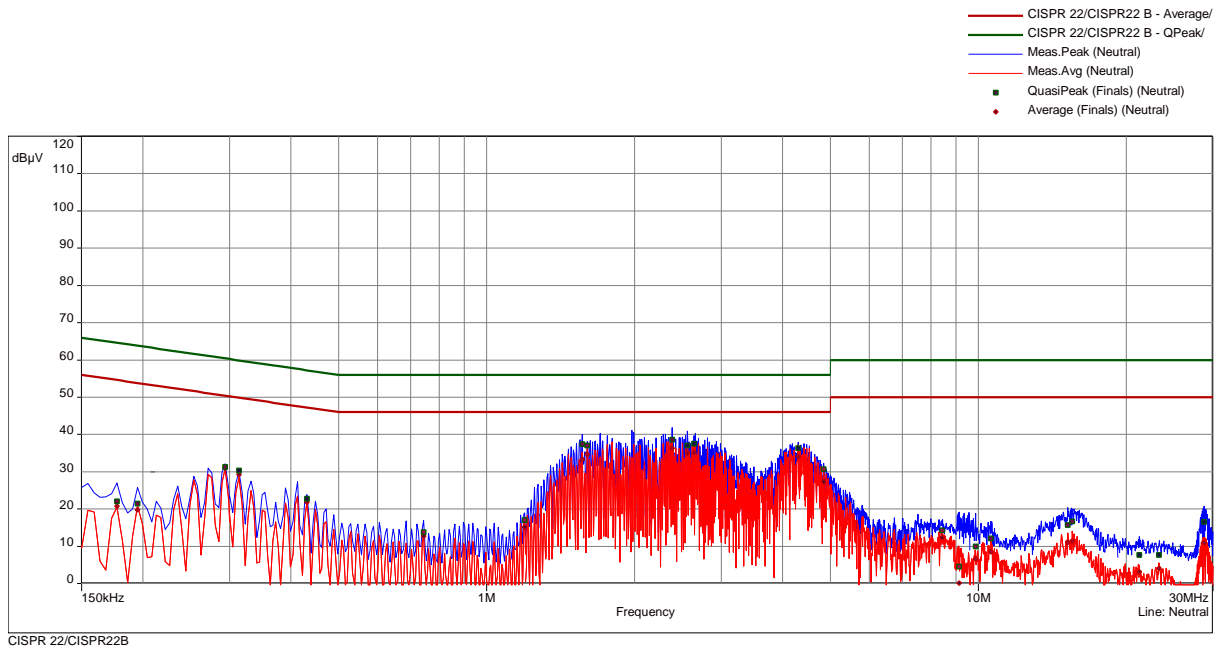


CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.213	1	24.37	38.71	63.09	23.86	29.22	53.09	Phase 1
0.2715	1	30.68	30.39	61.07	30.24	20.83	51.07	Phase 1
0.3135	2	32.11	27.77	59.88	31.32	18.56	49.88	Phase 1
0.4485	2	21.99	34.91	56.90	20.36	26.54	46.90	Phase 1
0.7035	3	14.91	41.09	56.00	12.18	33.82	46.00	Phase 1
0.7215	3	16.25	39.75	56.00	12.45	33.55	46.00	Phase 1
1.1715	3	18.28	37.72	56.00	15.05	30.95	46.00	Phase 1

1.194	3	18.43	37.57	56.00	16.71	29.29	46.00	Phase 1
1.6815	4	37.78	18.22	56.00	33.89	12.11	46.00	Phase 1
1.74	4	37.49	18.51	56.00	33.63	12.37	46.00	Phase 1
1.992	4	38.45	17.55	56.00	36.45	9.55	46.00	Phase 1
2.5395	5	39.82	16.18	56.00	38.10	7.90	46.00	Phase 1
2.58	5	38.72	17.28	56.00	35.47	10.53	46.00	Phase 1
4.2585	5	37.03	18.97	56.00	35.32	10.68	46.00	Phase 1
4.3575	5	37.17	18.83	56.00	35.09	10.91	46.00	Phase 1
4.863	6	29.99	26.01	56.00	26.94	19.06	46.00	Phase 1
7.5405	6	15.73	44.27	60.00	13.92	36.08	50.00	Phase 1
7.6395	6	16.09	43.91	60.00	14.46	35.54	50.00	Phase 1
10.6485	7	13.10	46.90	60.00	8.97	41.03	50.00	Phase 1
13.479	7	14.19	45.81	60.00	10.40	39.60	50.00	Phase 1
15.1215	7	16.15	43.85	60.00	10.92	39.08	50.00	Phase 1
15.5895	7	17.75	42.25	60.00	12.68	37.32	50.00	Phase 1
20.982	8	5.20	54.80	60.00	0.36	49.64	50.00	Phase 1
23.6595	8	6.04	53.96	60.00	2.11	47.89	50.00	Phase 1
28.6725	8	17.36	42.64	60.00	12.37	37.63	50.00	Phase 1
28.785	8	17.02	42.98	60.00	11.85	38.15	50.00	Phase 1
0.177	9	24.01	40.62	64.63	23.59	31.04	54.63	Neutral
0.213	9	24.74	38.35	63.09	24.22	28.87	53.09	Neutral
0.2715	9	31.11	29.96	61.07	30.57	20.50	51.07	Neutral
0.3135	10	32.18	27.70	59.88	31.43	18.45	49.88	Neutral
0.4485	10	22.57	34.33	56.90	20.77	26.14	46.90	Neutral
0.7035	11	14.62	41.38	56.00	11.96	34.04	46.00	Neutral
0.7215	11	16.71	39.29	56.00	12.75	33.25	46.00	Neutral
1.194	11	19.55	36.45	56.00	17.98	28.02	46.00	Neutral
1.641	12	38.30	17.70	56.00	34.95	11.05	46.00	Neutral
2.0505	12	37.39	18.61	56.00	34.44	11.56	46.00	Neutral
2.2665	12	39.07	16.93	56.00	36.76	9.24	46.00	Neutral
2.5395	13	39.47	16.53	56.00	37.97	8.03	46.00	Neutral
2.598	13	39.12	16.88	56.00	36.85	9.15	46.00	Neutral
4.3575	13	37.22	18.78	56.00	35.51	10.49	46.00	Neutral
4.434	13	36.18	19.82	56.00	33.52	12.48	46.00	Neutral
4.8045	14	30.89	25.11	56.00	28.37	17.63	46.00	Neutral
4.9035	14	30.33	25.67	56.00	27.59	18.41	46.00	Neutral
7.131	14	14.38	45.62	60.00	12.33	37.67	50.00	Neutral
7.716	14	15.88	44.12	60.00	13.09	36.91	50.00	Neutral
10.5495	15	13.11	46.89	60.00	9.23	40.77	50.00	Neutral
13.5375	15	14.82	45.18	60.00	10.20	39.80	50.00	Neutral
15.2205	15	16.29	43.71	60.00	11.02	38.98	50.00	Neutral
15.6075	15	17.06	42.94	60.00	11.98	38.02	50.00	Neutral
19.245	16	6.50	53.50	60.00	1.38	48.62	50.00	Neutral
19.614	16	6.78	53.22	60.00	1.24	48.76	50.00	Neutral
28.659	16	14.40	45.60	60.00	9.32	40.68	50.00	Neutral
28.8795	16	15.54	44.46	60.00	10.20	39.80	50.00	Neutral

EUT powered by Theratrainertigo (60 rpm)



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.1545	1	20.47	45.28	65.75	18.74	37.02	55.75	Phase 1
0.177	1	21.14	43.48	64.63	19.77	34.86	54.63	Phase 1
0.294	1	30.92	29.49	60.41	30.44	19.97	50.41	Phase 1
0.3135	2	30.04	29.83	59.88	29.04	20.84	49.88	Phase 1
0.4305	2	22.38	34.87	57.24	21.22	26.02	47.24	Phase 1
0.645	3	12.93	43.07	56.00	11.73	34.27	46.00	Phase 1
0.663	3	13.05	42.95	56.00	10.84	35.16	46.00	Phase 1
1.1895	3	16.43	39.57	56.00	14.18	31.82	46.00	Phase 1
1.194	3	16.27	39.73	56.00	14.38	31.62	46.00	Phase 1
1.524	4	36.81	19.19	56.00	34.41	11.59	46.00	Phase 1
1.5825	4	38.02	17.98	56.00	34.96	11.04	46.00	Phase 1
2.3835	4	38.43	17.57	56.00	35.96	10.04	46.00	Phase 1
2.58	5	37.33	18.67	56.00	34.37	11.63	46.00	Phase 1
4.182	5	35.74	20.26	56.00	33.93	12.07	46.00	Phase 1
4.3755	5	36.25	19.75	56.00	34.41	11.59	46.00	Phase 1
4.845	6	30.22	25.78	56.00	26.20	19.80	46.00	Phase 1
4.9035	6	28.89	27.11	56.00	25.84	20.16	46.00	Phase 1
7.5045	6	13.07	46.93	60.00	10.91	39.09	50.00	Phase 1
7.5405	6	14.82	45.18	60.00	10.08	39.92	50.00	Phase 1
9.825	7	9.56	50.44	60.00	6.33	43.67	50.00	Phase 1
10.608	7	12.69	47.31	60.00	9.47	40.53	50.00	Phase 1
15.2025	7	15.43	44.57	60.00	11.15	38.85	50.00	Phase 1
15.4725	7	17.04	42.96	60.00	11.73	38.27	50.00	Phase 1
19.7715	8	7.32	52.68	60.00	3.85	46.15	50.00	Phase 1
19.8885	8	7.62	52.38	60.00	3.53	46.47	50.00	Phase 1
28.65	8	19.06	40.94	60.00	13.95	36.05	50.00	Phase 1
28.8705	8	19.51	40.49	60.00	13.85	36.15	50.00	Phase 1
0.177	9	22.12	42.51	64.63	20.72	33.90	54.63	Neutral
0.195	9	21.47	42.35	63.82	19.82	34.00	53.82	Neutral
0.294	9	31.32	29.09	60.41	30.93	19.48	50.41	Neutral
0.3135	10	30.30	29.58	59.88	29.31	20.57	49.88	Neutral
0.4305	10	22.84	34.40	57.24	21.81	25.43	47.24	Neutral
0.744	11	13.80	42.20	56.00	12.73	33.27	46.00	Neutral
1.194	11	17.00	39.00	56.00	15.06	30.94	46.00	Neutral
1.5645	12	37.38	18.62	56.00	33.29	12.71	46.00	Neutral
1.6005	12	37.00	19.00	56.00	34.61	11.39	46.00	Neutral
2.3835	12	38.65	17.35	56.00	36.34	9.66	46.00	Neutral
2.5575	13	37.05	18.95	56.00	34.99	11.01	46.00	Neutral
2.6385	13	37.52	18.48	56.00	35.16	10.84	46.00	Neutral
4.299	13	36.37	19.63	56.00	34.10	11.90	46.00	Neutral
4.845	14	30.72	25.28	56.00	27.30	18.70	46.00	Neutral
8.4405	14	14.25	45.75	60.00	12.34	37.66	50.00	Neutral
9.129	14	4.55	55.45	60.00	0.10	49.90	50.00	Neutral
9.8655	15	10.00	50.00	60.00	6.60	43.40	50.00	Neutral
10.59	15	12.09	47.91	60.00	8.47	41.53	50.00	Neutral

15.2025	15	15.67	44.33	60.00	11.00	39.00	50.00	Neutral
15.513	15	16.61	43.39	60.00	11.43	38.57	50.00	Neutral
21.2565	16	7.71	52.29	60.00	3.10	46.90	50.00	Neutral
23.268	16	7.64	52.36	60.00	4.04	45.96	50.00	Neutral
28.7715	16	16.55	43.45	60.00	10.87	39.13	50.00	Neutral

5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **MB**.

5.2.1 Description of the test location

Test location: Shielded room 6

5.2.2 Photo documentation of the test set-up

Please see Attachment B

5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Span: 1.5 MHz EBW;

Spectrum analyser settings for OBW:

RBW: 30 kHz, VBW: 100 kHz, Detector: Max peak, Span: 2 MHz OBW;

5.2.5 Test result

EBW

Channel	Centre frequency (MHz)	6 dB bandwidth (kHz)	Minimum limit (MHz)
37	2402	671.30	0.5
18	2442	681.80	0.5
39	2480	696.80	0.5

OBW

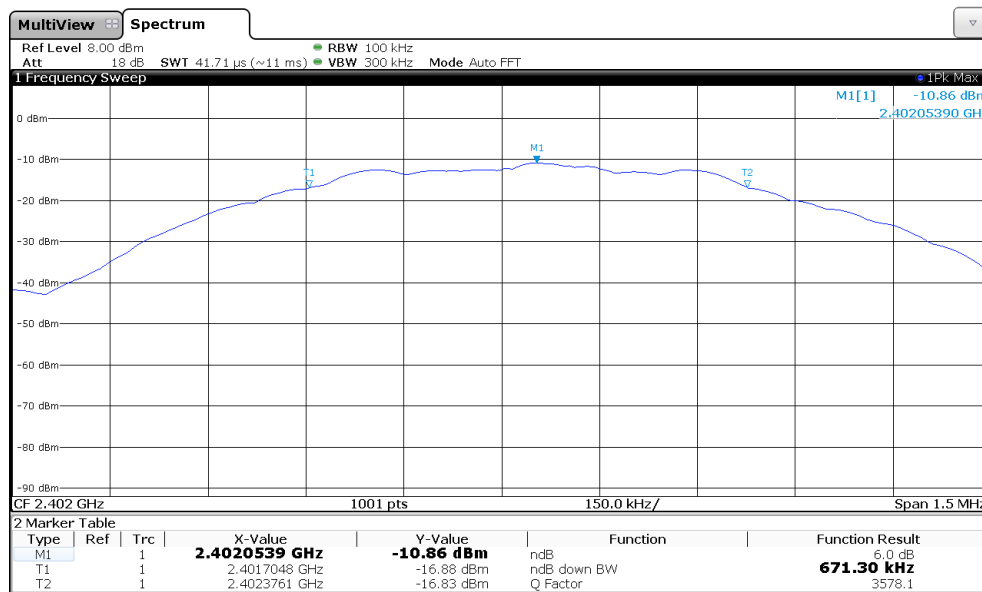
Channel	Centre frequency (MHz)	99 % bandwidth (kHz)
37	2402	996.07
18	2442	993.78
39	2480	1002.61

The requirements are **FULFILLED**.

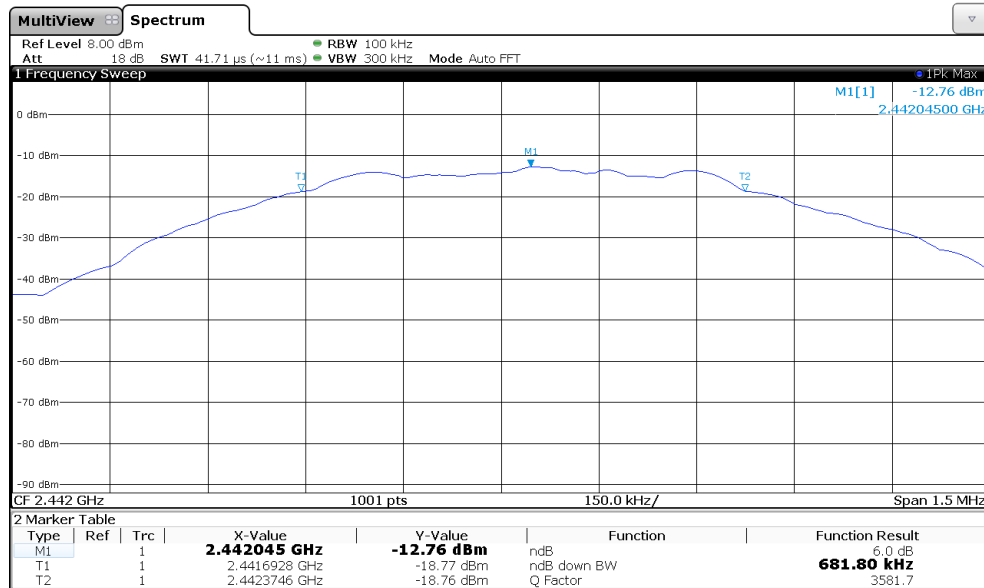
Remarks: For detailed test result please see the following test protocols

5.2.6 Test protocols EBW

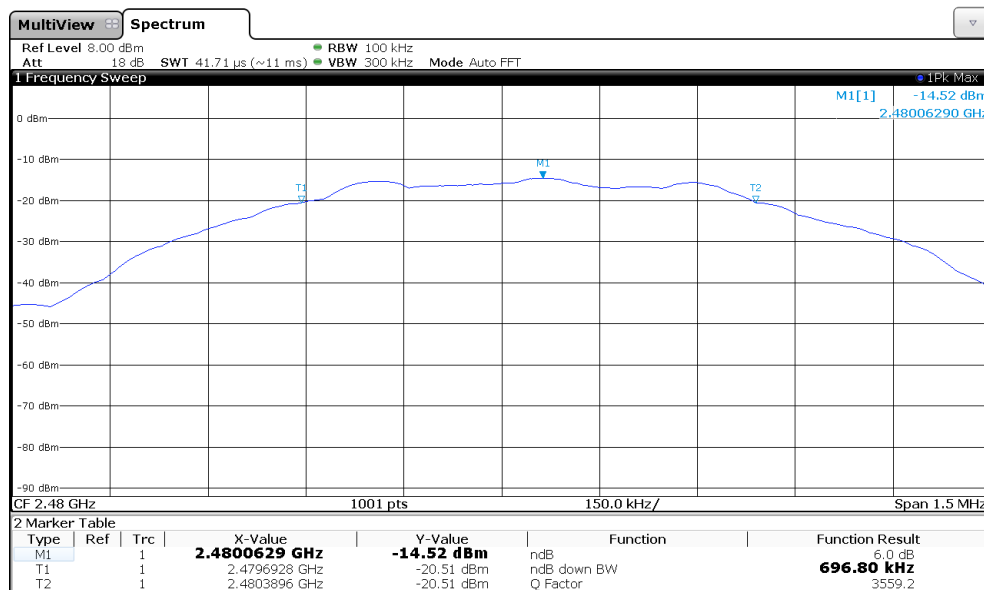
Channel 37 (2402 MHz)



Channel 18 (2442 MHz)

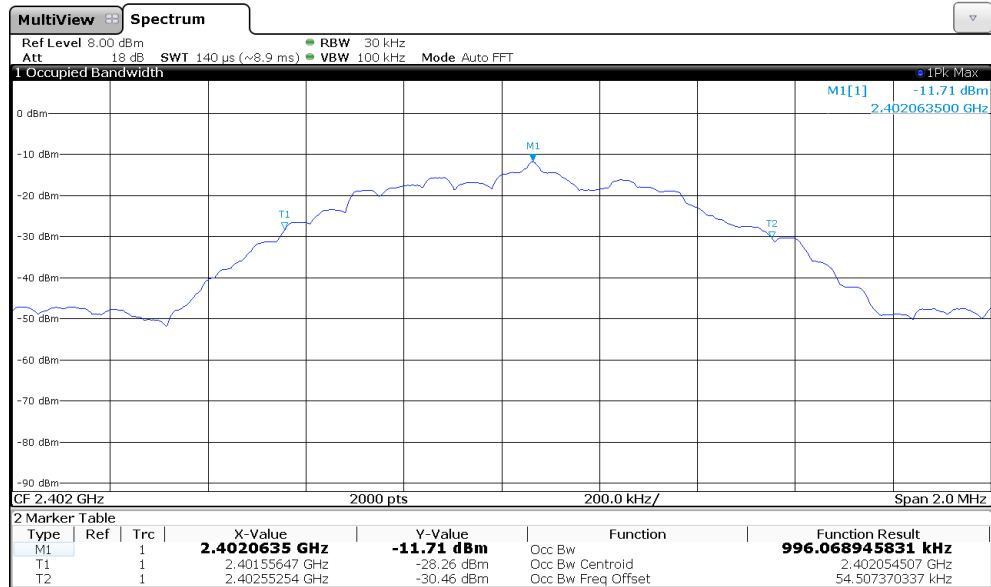


Channel 39 (2480 MHz)

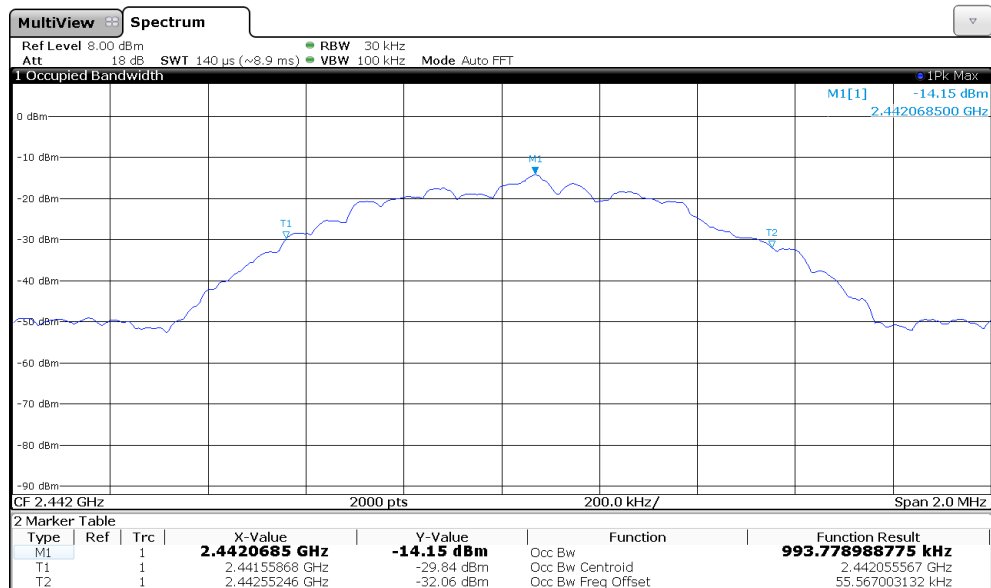


5.2.7 Test protocols OBW

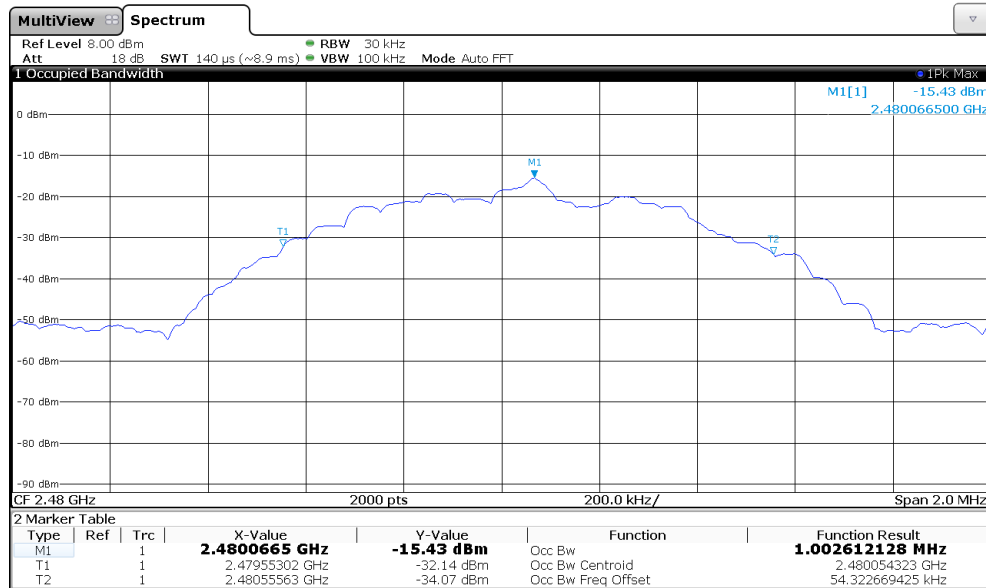
Channel 37 (2402 MHz)



Channel 18 (2442 MHz)



Channel 39 (2480 MHz)



5.3 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part **CPC 3**.

5.3.1 Description of the test location

Test location: Shielded room 6

5.3.2 Photo documentation of the test set-up

Please see Attachment B

5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.3.4 Description of Measurement

The maximum peak conducted output power is measured using a peak power meter following the procedure set out in KDB 558074, item 9.1.2. The EUT is set in TX continuous mode while measuring.

5.3.5 Test result

		Test results conducted		
		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH37				
T_{nom}	V_{nom}	-4.5	30.0	-34.5
Middle frequency: CH18				
T_{nom}	V_{nom}	-6.4	30.0	-36.4
Highest frequency: CH39				
T_{nom}	V_{nom}	-8.0	30.0	-38.0

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1.0
2400-2483.5	30	1.0
5725-5850	30	1.0

The requirements are **FULFILLED**.

Remarks:

5.4 Power spectral density

For test instruments and accessories used see section 6 Part **CPC 3**.

5.4.1 Description of the test location

Test location: Shielded room 6

5.4.2 Photo documentation of the test set-up

Please see Attachment B

5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the power spectral density radiated from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the radiated output power shall be used to determine the power spectral density.

5.4.4 Description of Measurement

The measurement is performed using the procedure 10.2 set out in KDB-558074. Therefore the PKPSD is measured conducted. The max peak was located and measured with the spectrum analyser and the marker set to peak. The maximum antenna gain being computed in paragraph 5.9 of this test report is used to calculate the maximum peak power spectral density.

Spectrum analyser settings:

RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: Auto

5.4.5 Test result

	Test results conducted		
	PD [Pmax] (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Lowest frequency: 2402 MHz			
	-18.4	8.0	-26.4
Middle frequency: 2442 MHz			
	-19.7	8.0	-27.7
Highest frequency: 2480 MHz			
	-20.9	8.0	-28.9

Power spectral density limit according to FCC Part 15, Section 15.247(e):

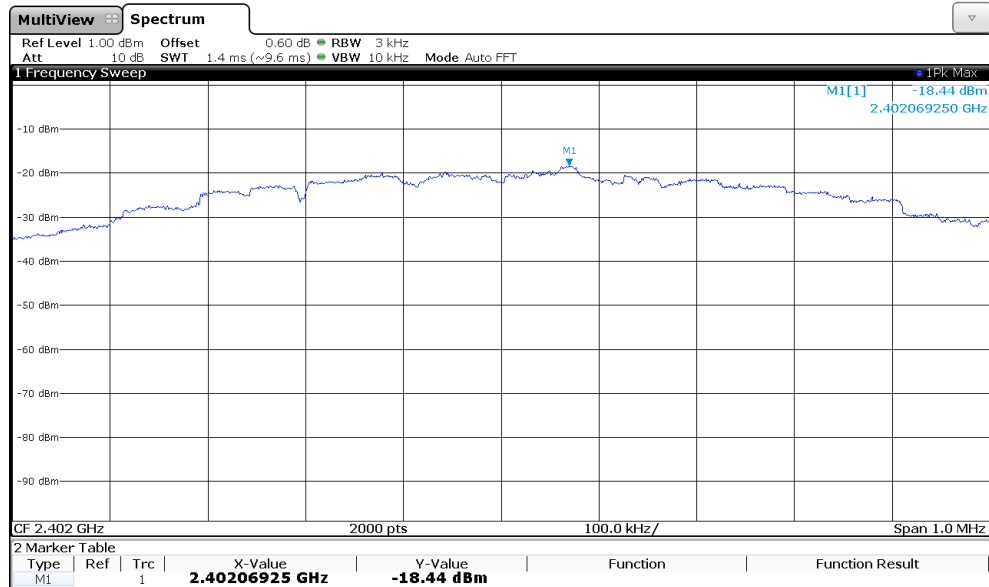
Frequency (MHz)	Power spectral density limit conducted
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

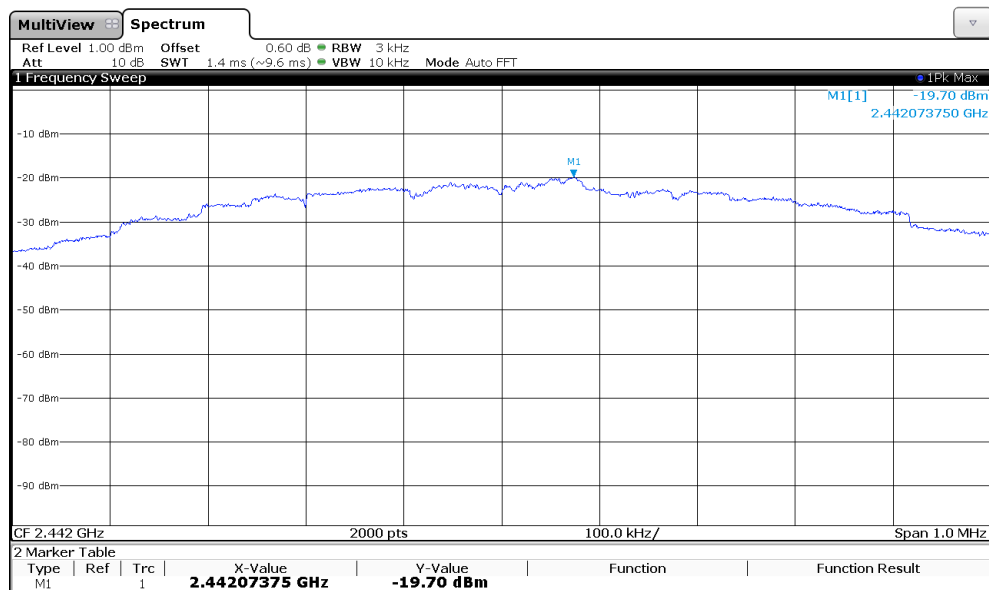
Remarks: For detailed test result please see the following test protocols

5.4.6 Test protocols

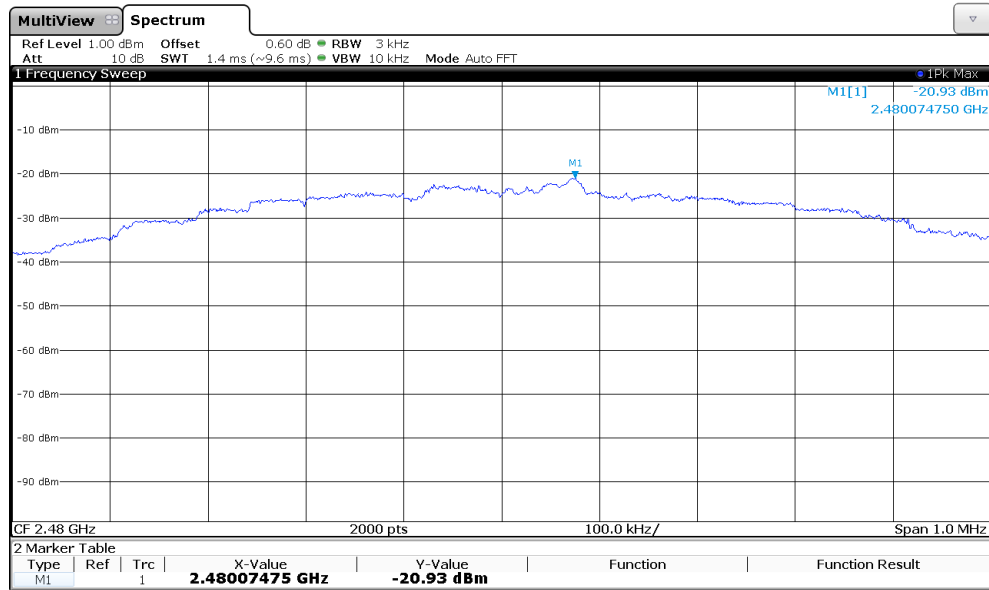
Channel 37 (2402 MHz)



Channel 18 (2442 MHz)



Channel 39 (2480 MHz)



5.5 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER 2, SER 3, DC**.

5.5.1 Description of the test location

Test location: OATS 1
Test location: Anechoic Chamber 1
Test distance: 3 m

5.5.2 Photo documentation of the test set-up

Please see Attachment B

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.5.3 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

5.5.4 Test result

Frequency range: 9 kHz - 25 GHz

Min. limit margin 11.1 dB at 7326.2 MHz at 3 m (CH 18)

Note: Pre-measurements have shown there are no detectable values below 30 MHz.

Emissions 30 MHz – 1000 MHz

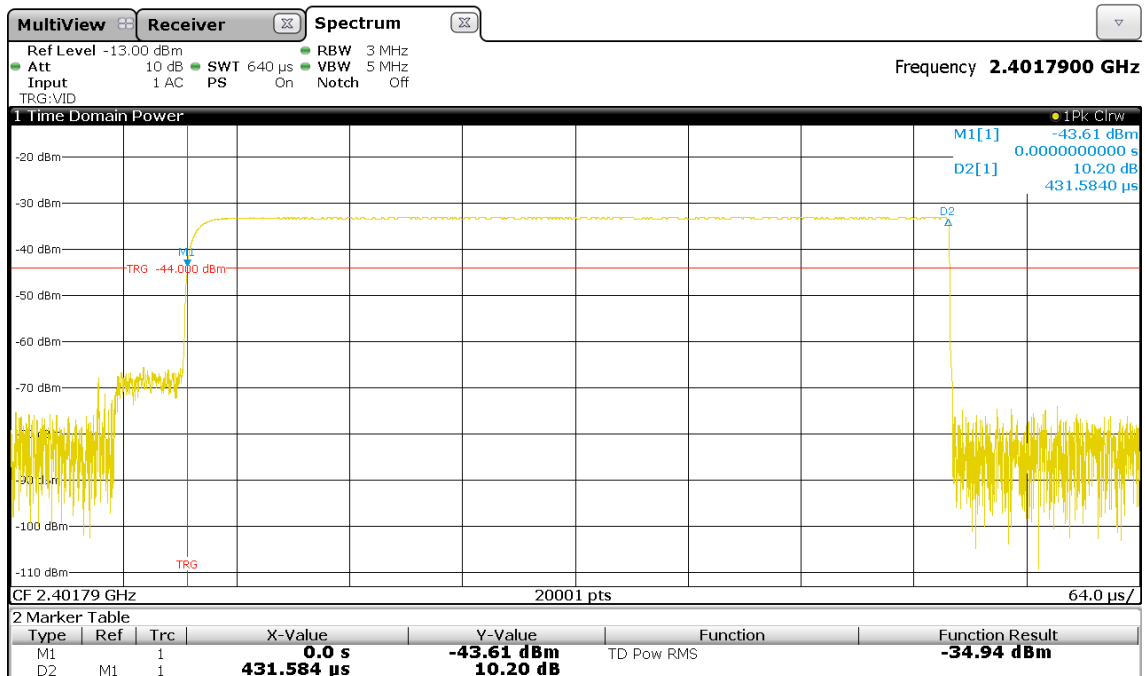
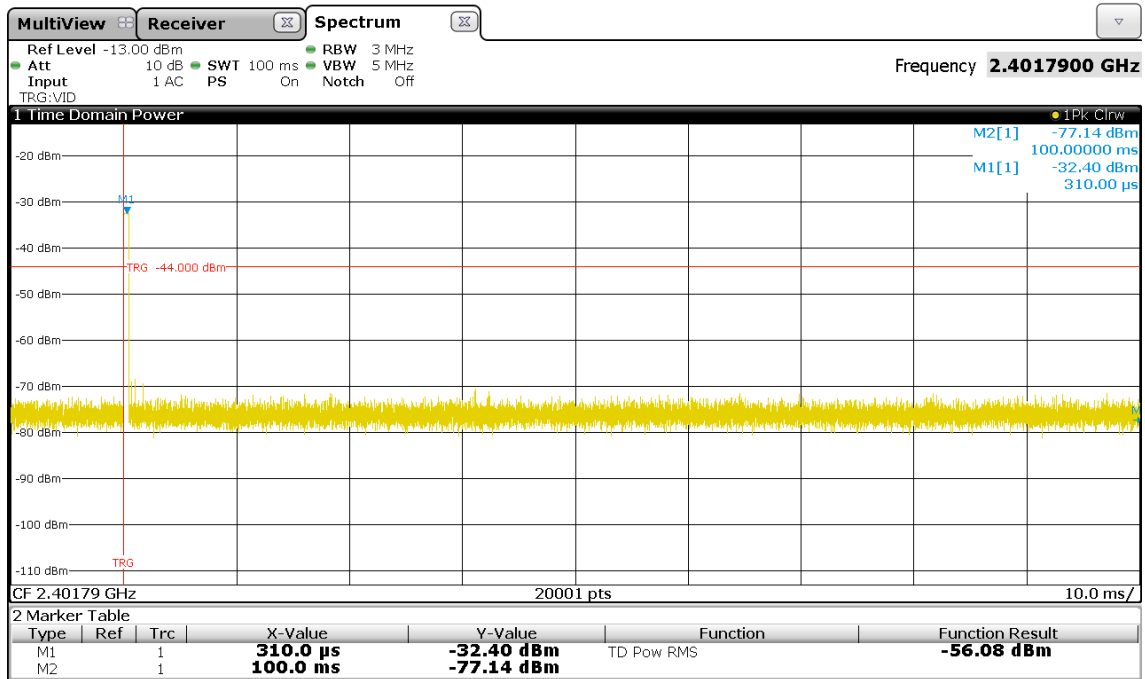
Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
33.00	1.3	-2.0	14.0	12.6	15.3	10.6	40.0	-24.7
45.00	0.9	-2.3	15.2	14.0	16.1	11.7	40.0	-23.9
54.60	2.2	-1.7	15.0	14.0	17.2	12.3	40.0	-22.8
69.50	3.5	-1.3	14.0	13.4	17.5	12.1	40.0	-22.5
76.30	7.0	0.4	12.2	11.7	19.2	12.1	40.0	-20.8
128.00	0.4	-1.5	12.8	13.4	13.2	11.9	43.5	-30.3
208.50	-1.5	-1.9	11.7	12.3	10.2	10.4	43.5	-33.1
311.70	-3.8	-2.9	17.2	16.8	13.4	13.9	46.0	-32.1
413.80	-4.0	-3.9	20.2	19.9	16.2	16.0	46.0	-29.8
555.60	3.1	-1.1	24.2	23.9	27.3	22.8	46.0	-18.7
621.60	-1.6	-0.9	25.8	25.5	24.2	24.6	46.0	-21.4
700.50	-1.6	-0.3	27.0	26.5	25.4	26.2	46.0	-19.8
821.60	-2.0	-1.9	29.8	29.3	27.8	27.4	46.0	-18.2
914.50	-1.9	-1.9	31.3	30.9	29.4	29.0	46.0	-16.6

Note: The table shows only values of the noise floor of OATS 1. No values could be detected belonging to the EUT.

Emissions 1 GHz – 25 GHz

Note: If the peak measurement fulfills the peak limit and the average limit than no further RMS measurement or duty cycle correction was performed. The plots show the worst case.

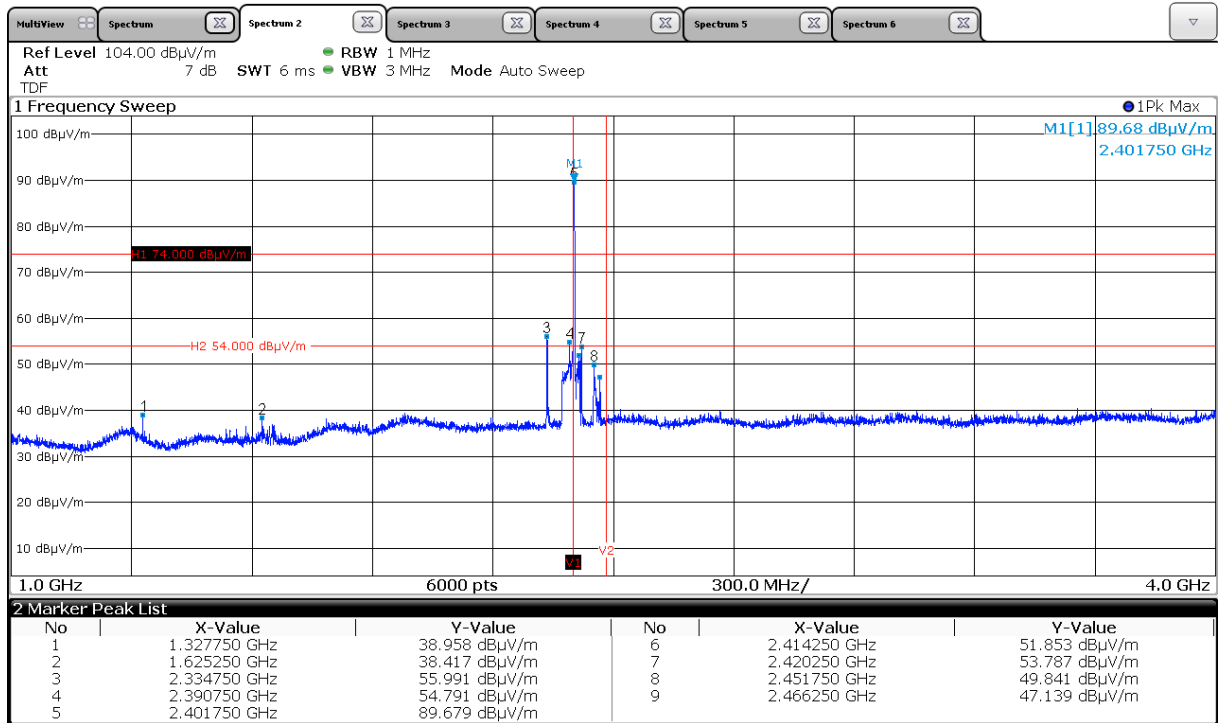
Duty cycle at 2402 MHz (in advertising mode):



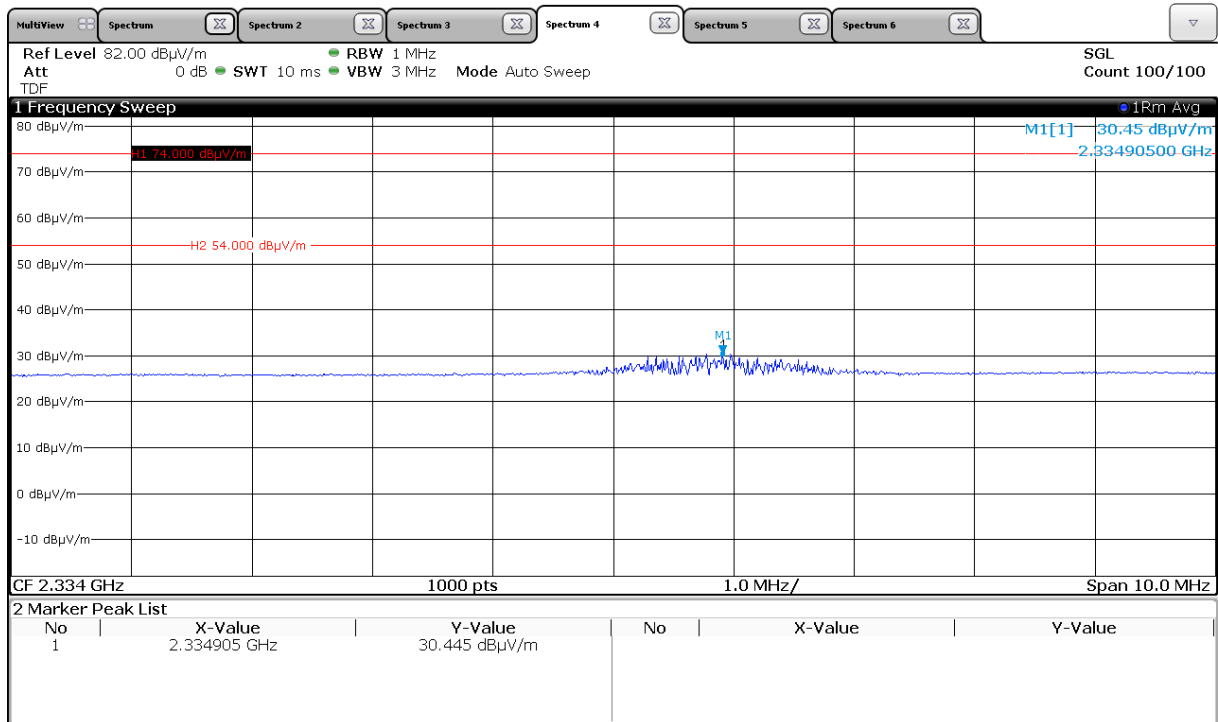
Calculated duty cycle = $431.584 \mu\text{s} / 100 \text{ ms} = 0.00432 = -47.3 \text{ dB}$

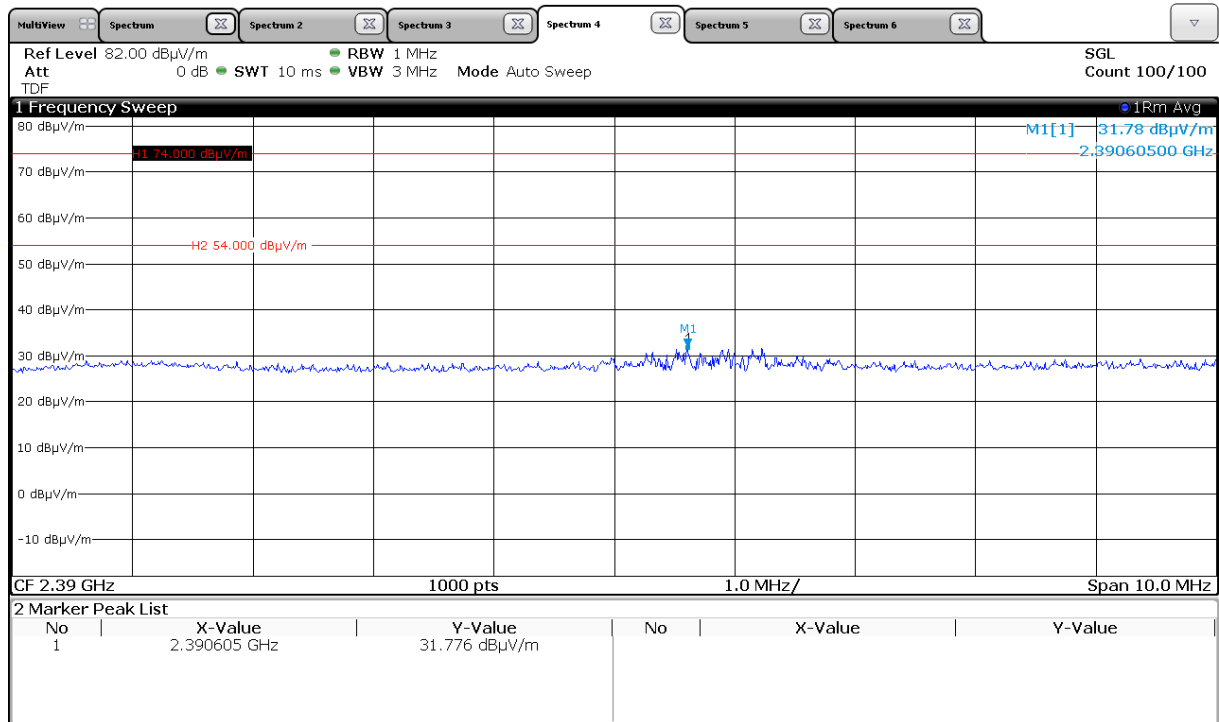
Channel 37

Peak measurement

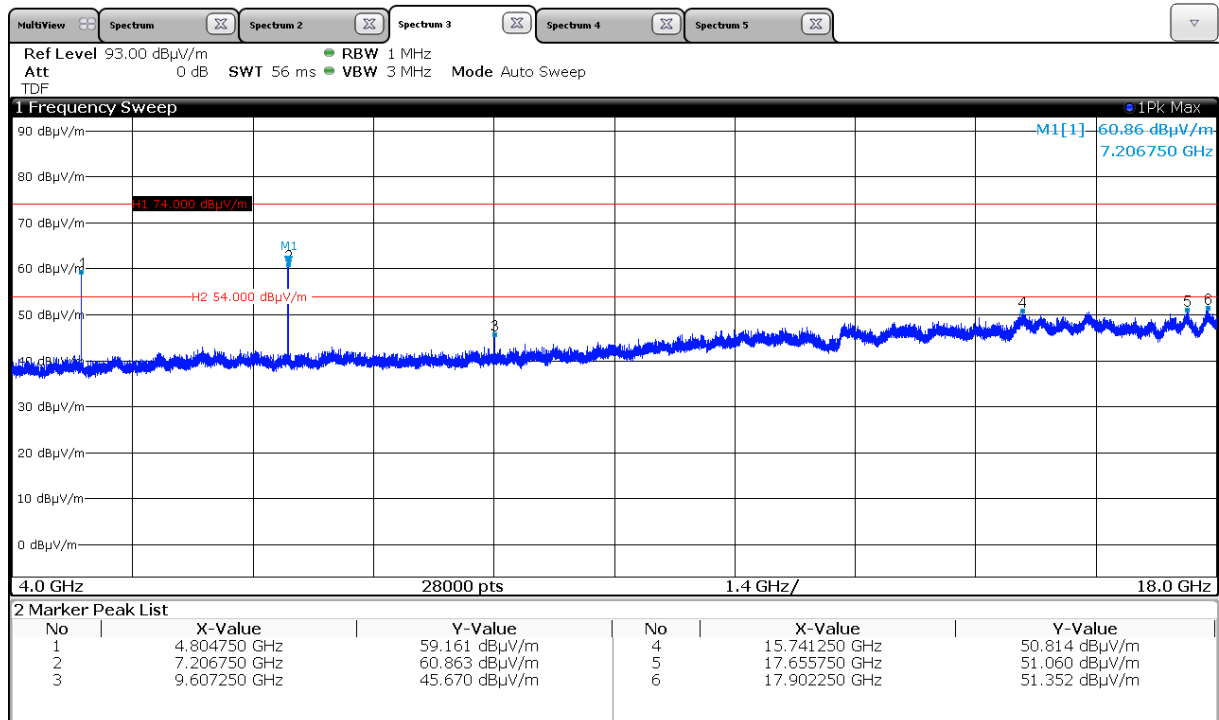


RMS re-measurement





Peak measurement

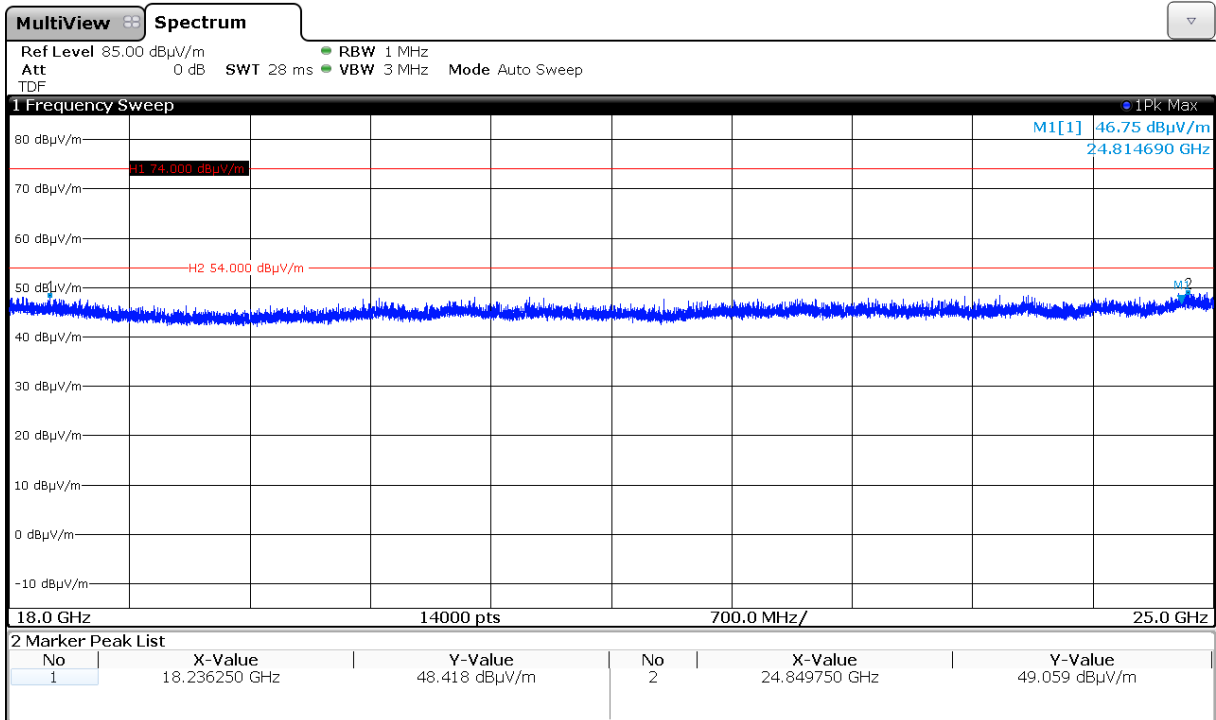


Average calculation:

At 4804.7 MHz: Peak value – DC = 59.16 dBμV/m – 47.3 dB = 11.86 dBμV/m

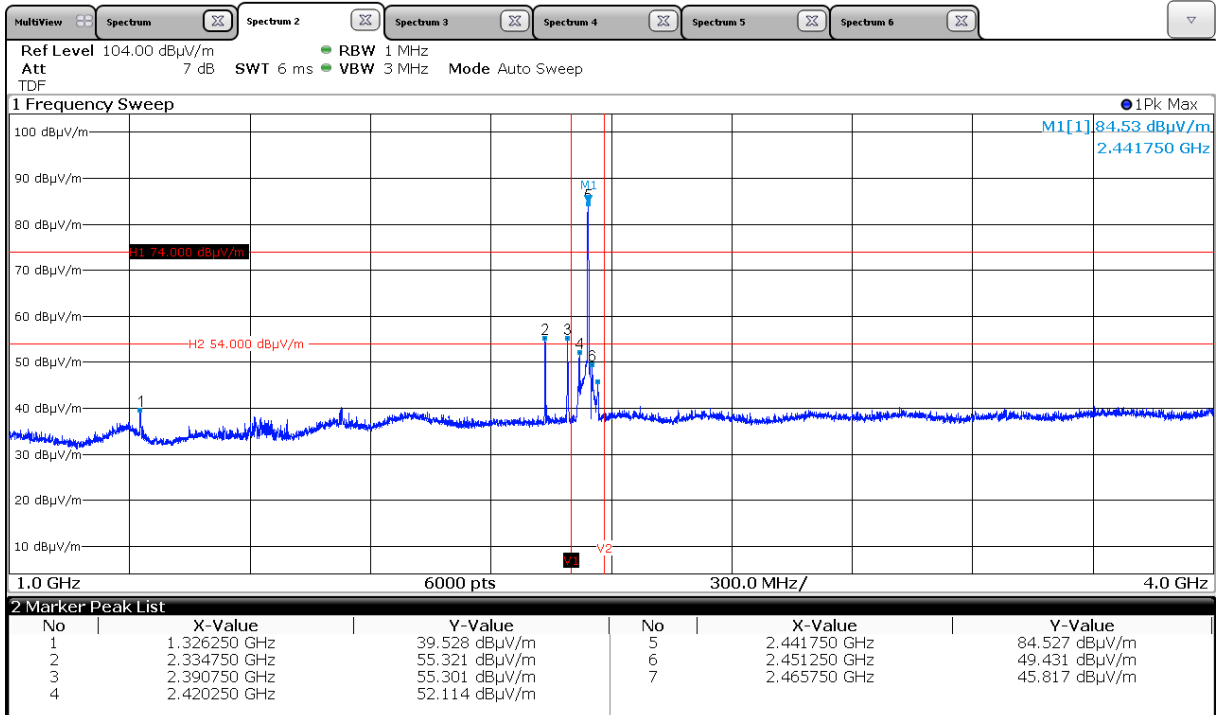
At 7206.7 MHz: Peak value – DC = 60.86 dBμV/m – 47.3 dB = 13.56 dBμV/m

Peak measurement

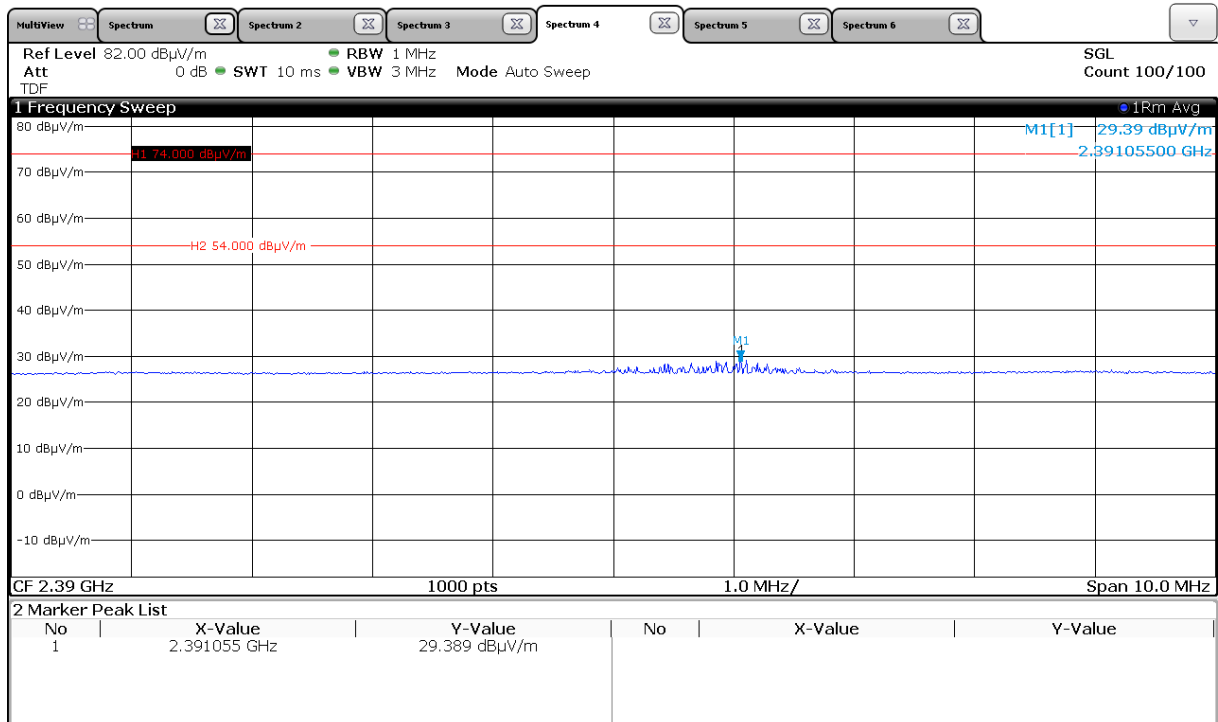
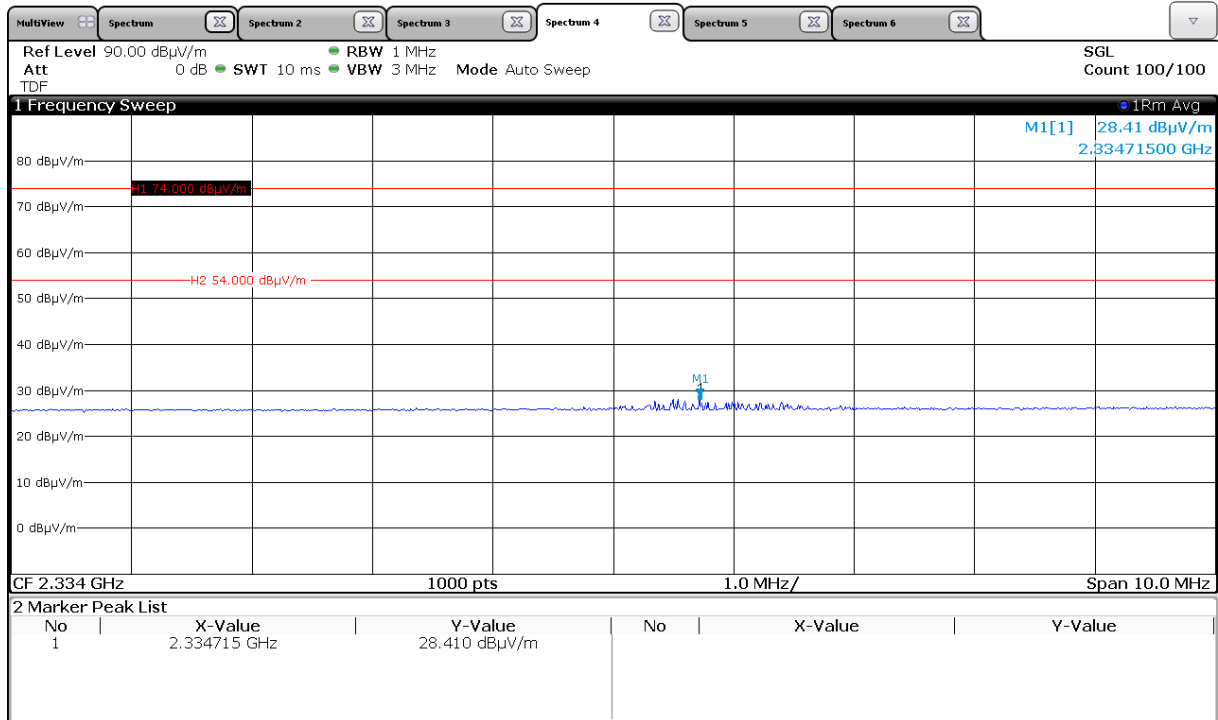


Channel 18

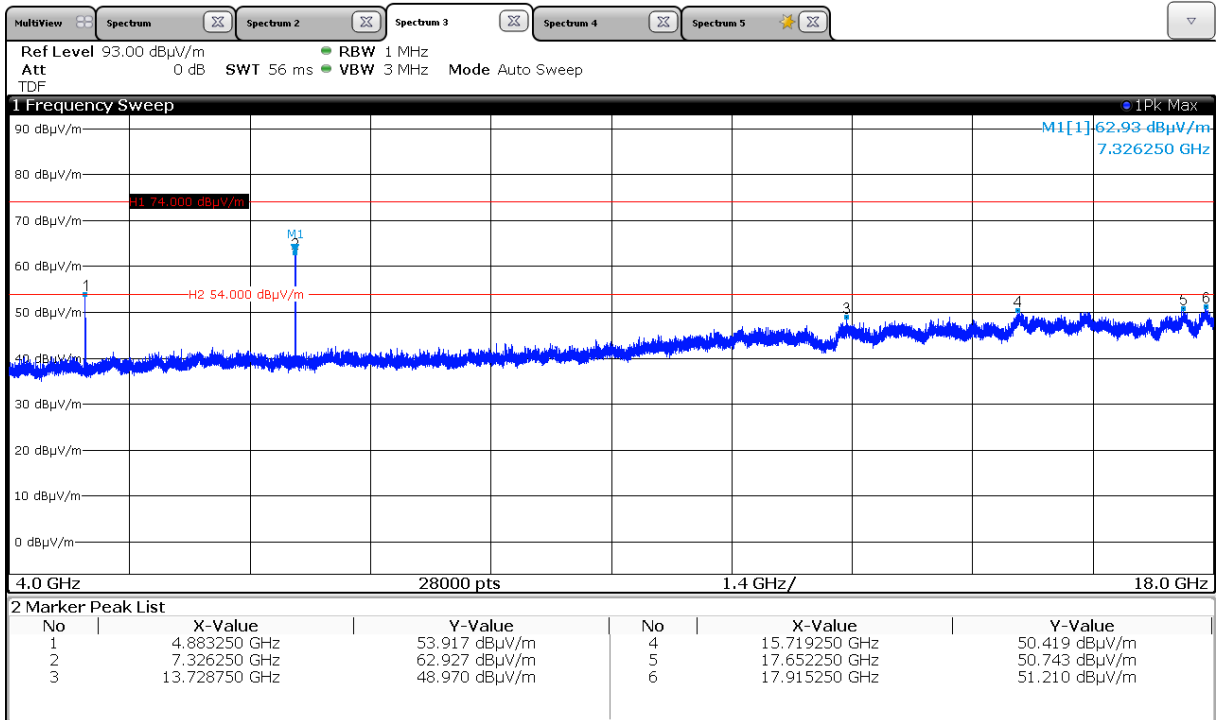
Peak measurement



RMS re-measurement



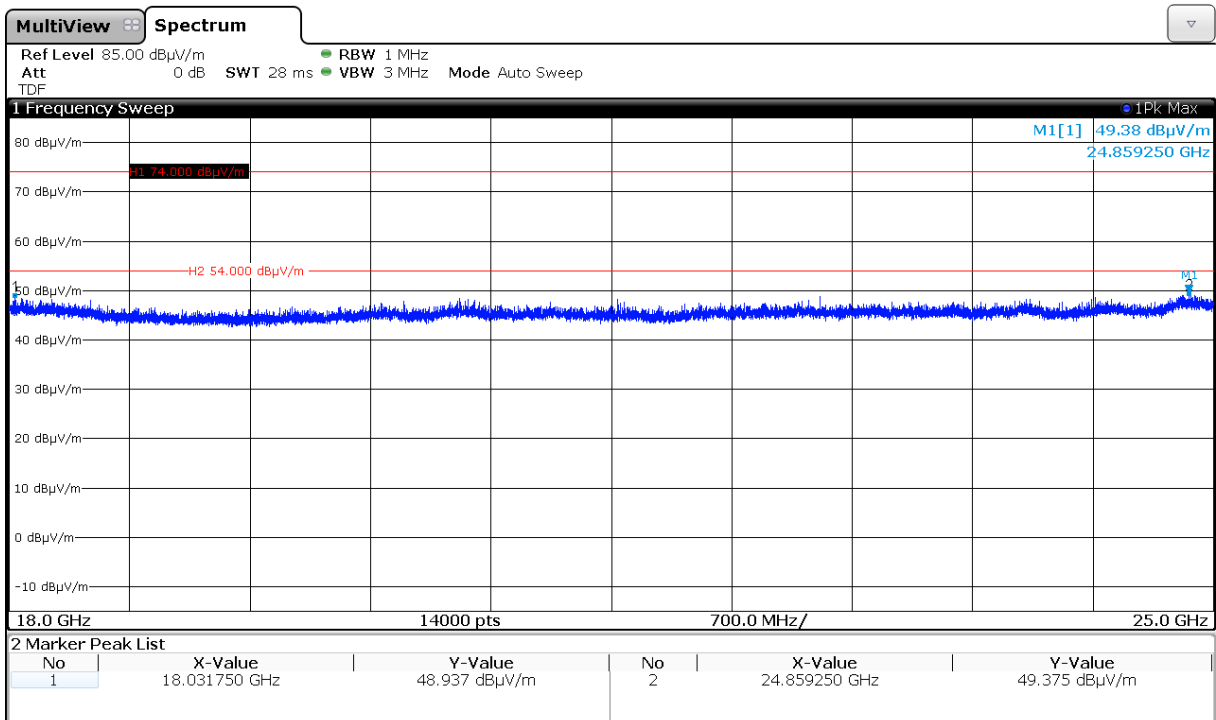
Peak measurement



Average calculation:

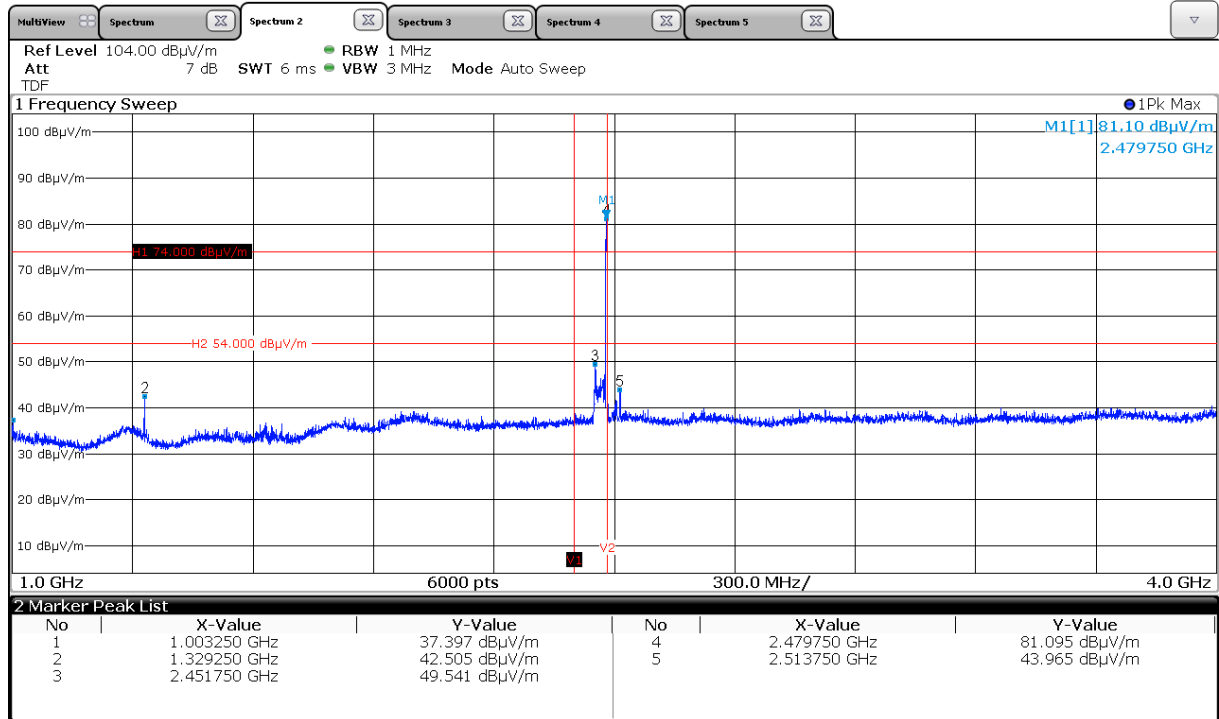
At 7326.2 MHz: Peak value – DC = 62.9 dBμV/m – 47.3 dB = 15.6 dBμV/m

Peak measurement

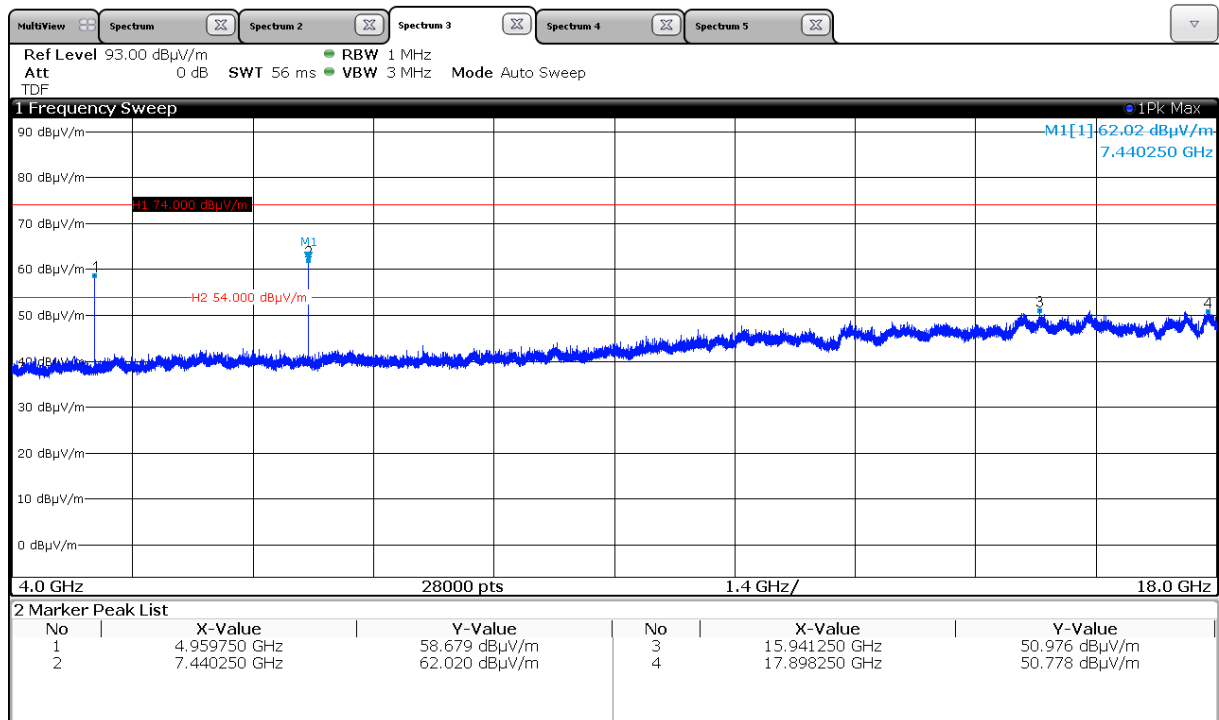


Channel 39

Peak measurement



Peak measurement

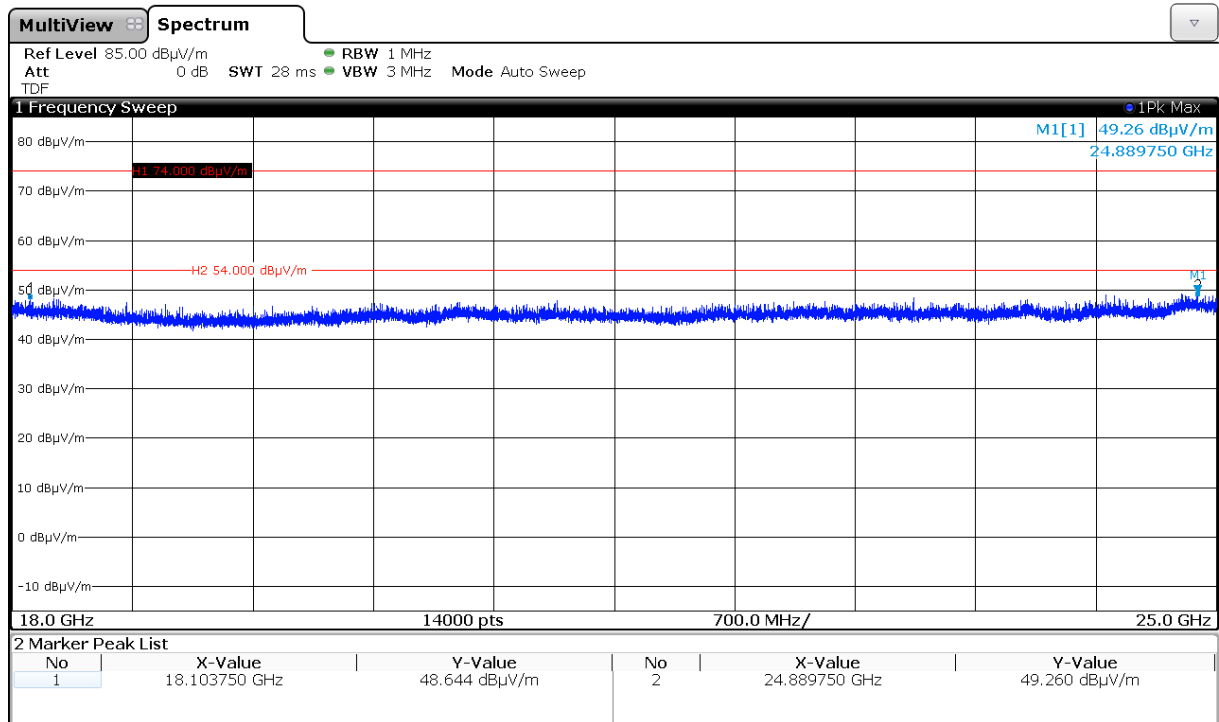


Average calculation:

At 4959.7 MHz: Peak value – DC = 58.7 dB μ V/m – 47.3 dB = 11.4 dB μ V/m

At 7440.2 MHz: Peak value – DC = 62.0 dB μ V/m – 47.3 dB = 14.7 dB μ V/m

Peak measurement



Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic. The complete frequency range up to
.25 GHz was evaluated against the general limit.

5.6 Spurious emissions radiated

Remarks: Not applicable. All emissions of the EUT are below the general limit (please see clause 5.5),
Therefore a spurious emissions measurement is not necessary.

5.7 Antenna application

5.7.1 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

The supplied antenna meets the requirements of part 15.203 and 15.204.

5.7.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Defacto EIRP-Limit:

$$P_{out} = 30 - (G_x - 6);$$

Antenna	G _x	Cond. limit	max. G	A [P20]	Limit P _{out}	Reduction
	(dBi)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
PCB	0.6	30.0	6.0	-4.5	35.4	-39.9

Remarks: No power reduction results from the defacto limit.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.16.0.73	01-02/68-13-001				
	ESCI	02-02/03-15-001	31/05/2018	31/05/2017		
	ESH 2 - Z 5	02-02/20-05-004	26/10/2017	26/10/2015	18/01/2018	18/07/2017
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2 6430	02-02/50-05-155 02-02/50-13-014	18/11/2019	18/11/2016	21/10/2017	21/04/2017
CPC 3	FSW43	02-02/11-15-001	07/04/2018	07/04/2017		
	SF104/11SMA/11N/1500MM	02-02/50-13-012				
DC	ESW26	02-02/03-17-002	20/09/2018	20/09/2017		
	RF Antenna	02-02/24-05-032				
MB	FSW43	02-02/11-15-001	07/04/2018	07/04/2017		
	SF104/11SMA/11N/1500MM	02-02/50-13-012				
SER 2	ESR 3	01-02/03-13-001	29/08/2018	29/08/2017		
	VULB 9168	02-02/24-05-005	12/04/2018	12/04/2017	28/03/2018	28/09/2017
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	07/04/2018	07/04/2017		
	JS4-18004000-30-5A	02-02/17-05-017				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	10/05/2018	10/05/2017		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	09/12/2017	09/12/2016
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11N/11N/300MM	02-02/50-13-008				
	Ultimate 1000W	02-02/50-16-004				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	Bandpass Filter	02-02/50-17-019				