



EMI - TEST REPORT

- FCC Part 15.225 -

Type / Model Name : RFM-2-NF

Product Description : B&R wireless board

Applicant : B&R Industrial Automation GmbH

Address : B&R Strasse 1

A-5142 Eggelsberg

Manufacturer : B&R Industrial Automation GmbH

Address : B&R Strasse 1

A-5142 Eggelsberg

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

POSITIVE

Test Report No. : T44510-00-07HU

29. April 2019

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-00

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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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (December 20, 2018)

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
Part 15, Subpart A, Section 15.38	Incorporation by reference

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (December 20, 2018)

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 15.215	Additional provisions to the general radiated emission limitations
Part 15, Subpart C, Section 15.225	Operation within the band 13.110 - 14.010 MHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

ANSI C63.10: 2013 Testing Unlicensed Wireless Devices

ANSI C95.1:2005 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

CISPR 16-4-2: 2003 Uncertainty in EMC measurement

2 SUMMARY

GENERAL REMARKS:

For testing, the B&R wireless board was set in TX-continuous mode.
The test software is available for testing only.

All radiated measurements were made with the device positioned in standard mounting position.
The values in the test report shows only the maximum measured value.

For detailed information about the device please refer to the user manual.

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 : 25. March 2019

Testing concluded on : 28. March 2019

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Markus Huber

FCC ID: 2ADFFV-RFM-2-NF

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – See attachment A

3.2 Power supply system utilised

Power supply voltage : Primary supplied via 24.0 V / DC
Secondary supplied via 5.0 V / DC

3.3 Short description of the equipment under test (EUT)

The B&R wireless board “RFM-2-NF” is used to add basic RFID functionality to a B&R Human-Machine-Interface. It will be implemented in the Automation Panel Series 1000 and 5000.

Number of tested samples: 3
Serial number: Pre production sample

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Cont. tag reading mode at 13.56 MHz modulated (ASK)

- Standby

EUT configuration:

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

- Supplied by B&R	Model : Test Jig3 (AP Series 5000)
- Power supply / supplied by B&R	Model : B&R PS1025
-	Model :
-	Model :

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 Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	$\pm 3.29 \text{ dB}$
20 dB Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	$\pm 3.53 \text{ dB}$
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	$\pm 3.71 \text{ dB}$
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	$\pm 2.34 \text{ dB}$
Peak conducted output power	902 MHz to 928 MHz	95%	$\pm 0.35 \text{ dB}$
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	$\pm 2.15 \text{ dB}$

FCC ID: 2ADFFV-RFM-2-NF**4.1 Measurement Protocol for FCC****4.1.1 GENERAL INFORMATION****4.1.1.1 Test methodology**

The test methods used comply with ANSI C63.10, „Testing Unlicensed Wireless Devices “.

4.1.1.2 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.

4.1.1.3 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011

4.2 Deviations or Exclusions from the Requirements and Standards

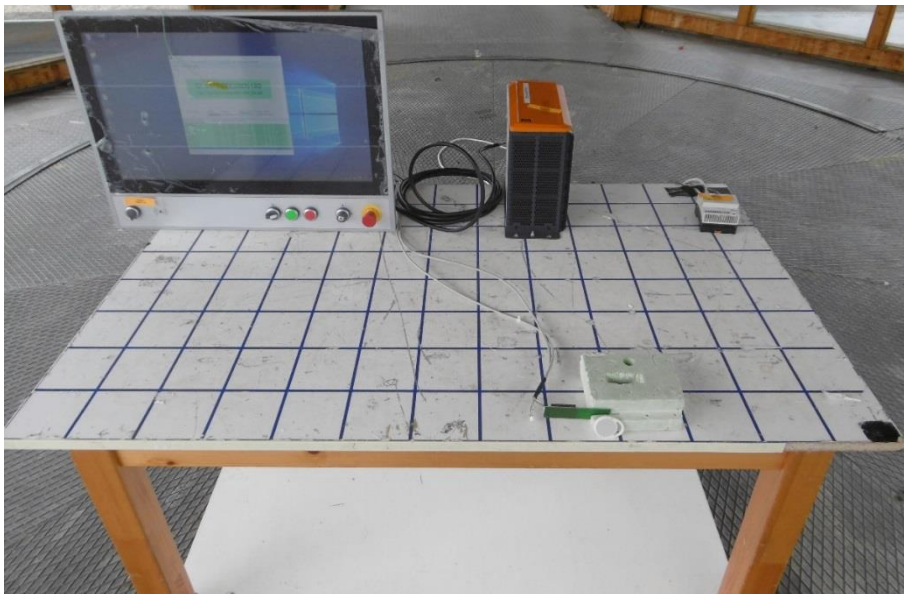
In practical use the B&R wireless board “RFM-2-NF” will be implemented in the Automation Panel Series 1000 and 5000.

This test report covers complete testing with an Automation Panel from Series 5000 (Test Jig 3) as supply and control unit.

The function during the tests was checked and controlled via RFID Tag in front of the reader and a test software on the panel.

To supply the B&R wireless board “RFM-2-NF” in conjunction with the Automation Panel during the tests a power supply from B&R was used (PS1025).

Test setup:



5 TEST CONDITIONS AND RESULTS

5.1 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 – see Attachment B

5.1.3 Applicable standard

According to FCC Part 15, Section 15.107(a):

Except for Class A devices, for equipment 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. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured 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 12.04 dB at 0.168 MHz

Limit according to FCC Part 15, Section 15.107(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 refer to following test protocols

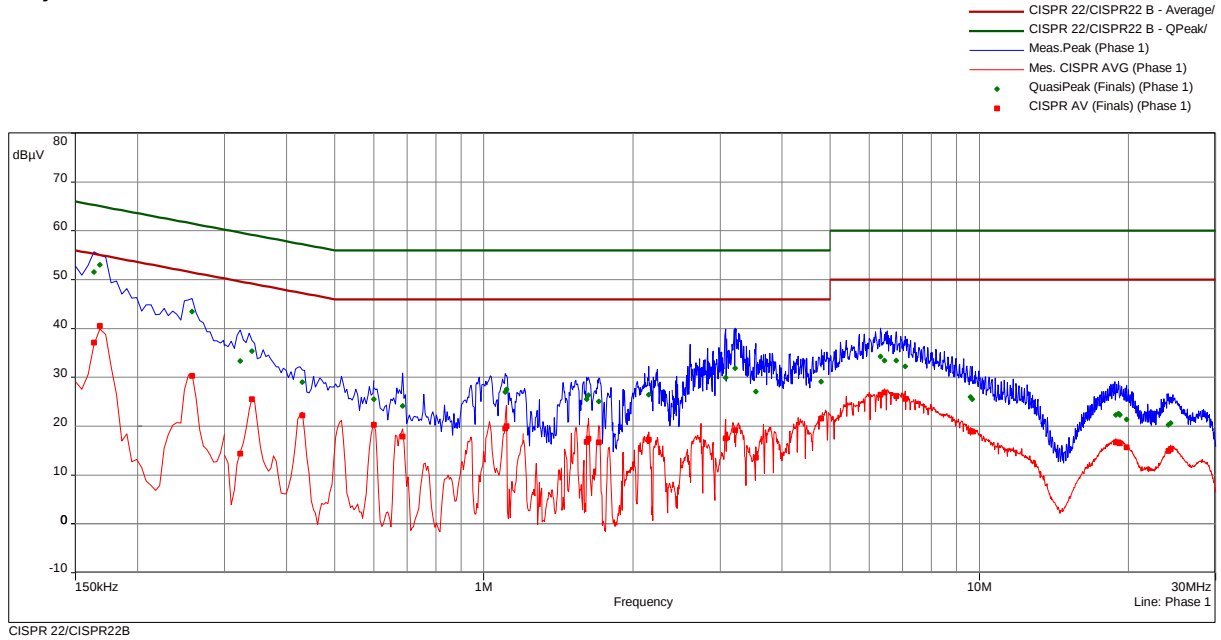
During the test, the EuT was supplied via power supply B&R PS1025.

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5.1.6 Test protocol

Test point L1
Operation mode: Cont. Tx at 13.56 MHz
Remarks: Test Jig3
Tested by: Huber Ma.

Result: Passed

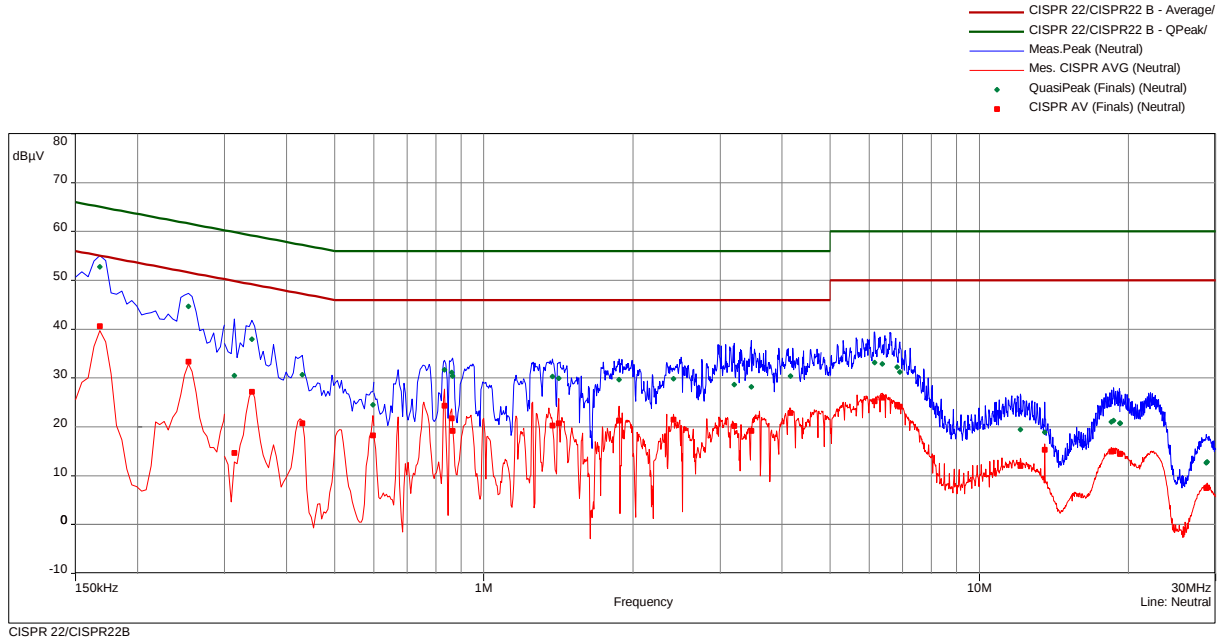


freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
0.1635	1	51.58	13.70	65.28	37.12	18.17	55.28	Phase 1	10.08
0.168	1	53.01	12.04	65.06	40.50	14.56	55.06	Phase 1	10.08
0.258	1	43.45	18.04	61.50	30.28	21.21	51.50	Phase 1	10.11
0.3225	2	33.33	26.31	59.64	14.35	35.29	49.64	Phase 1	10.13
0.3405	2	35.41	23.78	59.19	25.57	33.62	49.19	Phase 1	10.13
0.4305	2	29.05	28.19	57.24	22.20	25.05	47.24	Phase 1	10.14
0.6	3	25.53	30.47	56.00	20.28	25.72	46.00	Phase 1	10.15
0.6855	3	24.12	31.88	56.00	17.90	28.10	46.00	Phase 1	10.17
1.104	3	26.99	29.01	56.00	19.56	26.44	46.00	Phase 1	10.20
1.113	3	27.57	28.43	56.00	19.97	26.03	46.00	Phase 1	10.21
1.614	4	25.55	30.45	56.00	16.75	29.25	46.00	Phase 1	10.26
1.6275	4	26.38	29.62	56.00	17.48	28.52	46.00	Phase 1	10.26
1.7085	4	25.07	30.93	56.00	16.69	29.31	46.00	Phase 1	10.26
2.154	4	26.44	29.56	56.00	17.21	28.79	46.00	Phase 1	10.28
3.0795	5	29.94	26.06	56.00	17.52	28.48	46.00	Phase 1	10.35
3.219	5	31.83	24.17	56.00	19.21	26.79	46.00	Phase 1	10.35
3.543	5	27.05	28.95	56.00	13.60	32.40	46.00	Phase 1	10.35
4.7985	5	29.09	26.91	56.00	21.57	24.43	46.00	Phase 1	10.44
6.3255	6	34.23	25.77	60.00	26.45	23.55	50.00	Phase 1	10.56
6.438	6	33.46	26.54	60.00	26.87	23.13	50.00	Phase 1	10.57
6.798	6	33.46	26.54	60.00	26.22	23.78	50.00	Phase 1	10.60
7.0905	6	32.25	27.75	60.00	25.65	24.35	50.00	Phase 1	10.61
9.6	7	26.03	33.97	60.00	19.03	30.97	50.00	Phase 1	10.72
9.6765	7	25.56	34.44	60.00	18.94	31.06	50.00	Phase 1	10.73
18.87	7	22.27	37.73	60.00	16.68	33.32	50.00	Phase 1	11.40
19.104	7	22.62	37.38	60.00	16.71	33.29	50.00	Phase 1	11.42

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Test point N
Operation mode: Cont. Tx at 13.56 MHz
Remarks: Test Jig3
Tested by: Huber Ma.

Result: Passed

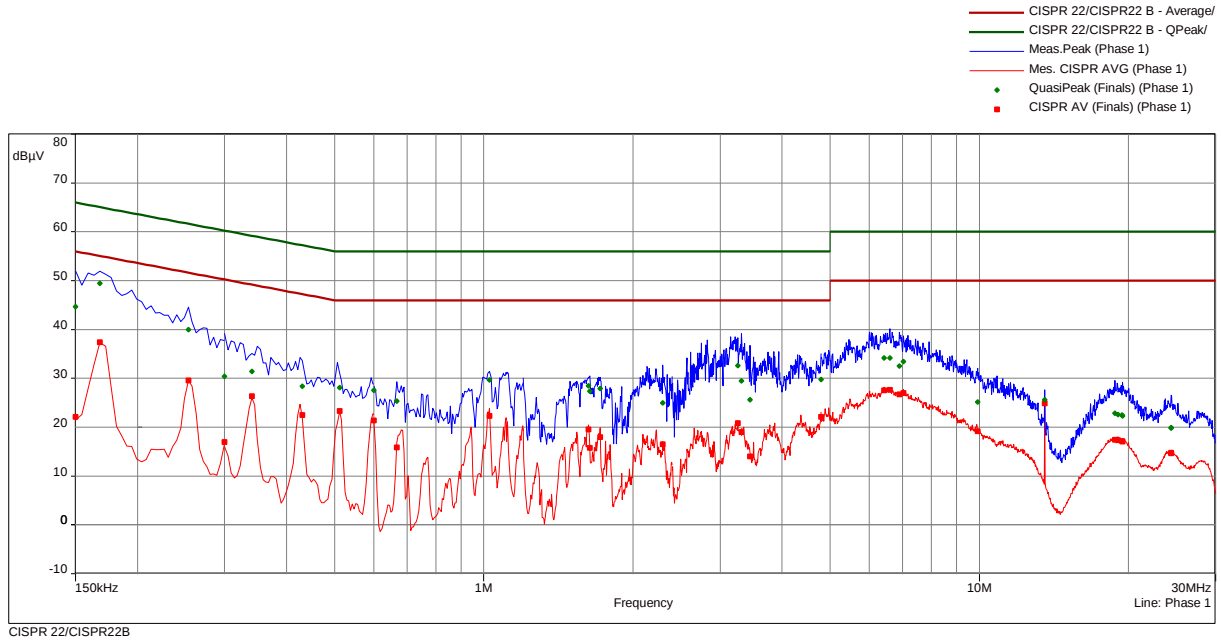


freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.168	9	52.79	12.27	65.06	40.66	14.40	55.06	Neutral	10.09
0.2535	9	44.69	16.96	61.64	33.35	18.29	51.64	Neutral	10.11
0.3135	10	30.47	29.40	59.88	14.68	35.20	49.88	Neutral	10.12
0.3405	10	37.92	21.27	59.19	27.18	22.02	49.19	Neutral	10.13
0.4305	10	30.67	26.57	57.24	20.72	26.53	47.24	Neutral	10.14
0.597	10	24.55	31.45	56.00	18.29	27.71	46.00	Neutral	10.15
0.834	11	31.71	24.29	56.00	24.36	21.64	46.00	Neutral	10.18
0.861	11	31.10	24.90	56.00	21.77	24.23	46.00	Neutral	10.18
0.8655	11	30.38	25.62	56.00	19.15	26.85	46.00	Neutral	10.18
1.3755	12	30.30	25.70	56.00	20.27	25.73	46.00	Neutral	10.24
1.416	12	29.95	26.05	56.00	20.76	25.24	46.00	Neutral	10.25
1.875	12	29.69	26.31	56.00	21.30	24.70	46.00	Neutral	10.26
2.4135	13	29.85	26.15	56.00	21.47	24.53	46.00	Neutral	10.31
3.201	13	28.65	27.35	56.00	20.23	25.77	46.00	Neutral	10.35
3.4665	13	28.20	27.80	56.00	19.14	26.86	46.00	Neutral	10.35
4.155	13	30.37	25.63	56.00	22.85	23.15	46.00	Neutral	10.40
6.1545	14	33.18	26.82	60.00	25.29	24.71	50.00	Neutral	10.53
6.375	14	32.93	27.07	60.00	26.02	23.98	50.00	Neutral	10.54
12.1155	15	19.49	40.51	60.00	12.03	37.97	50.00	Neutral	10.82
13.5645	15	18.87	41.13	60.00	15.31	34.69	50.00	Neutral	10.91
18.465	15	20.98	39.02	60.00	14.95	35.05	50.00	Neutral	11.18
18.681	15	21.27	38.73	60.00	15.00	35.00	50.00	Neutral	11.19
19.209	16	20.71	39.29	60.00	14.49	35.51	50.00	Neutral	11.22
19.254	16	20.75	39.25	60.00	14.48	35.52	50.00	Neutral	11.22
28.74	16	12.66	47.34	60.00	7.48	42.52	50.00	Neutral	11.13
28.839	16	12.87	47.13	60.00	7.62	42.38	50.00	Neutral	11.13

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Test point L1
Operation mode: Standby
Remarks: Test Jig3
Tested by: Huber Ma.

Result: Passed

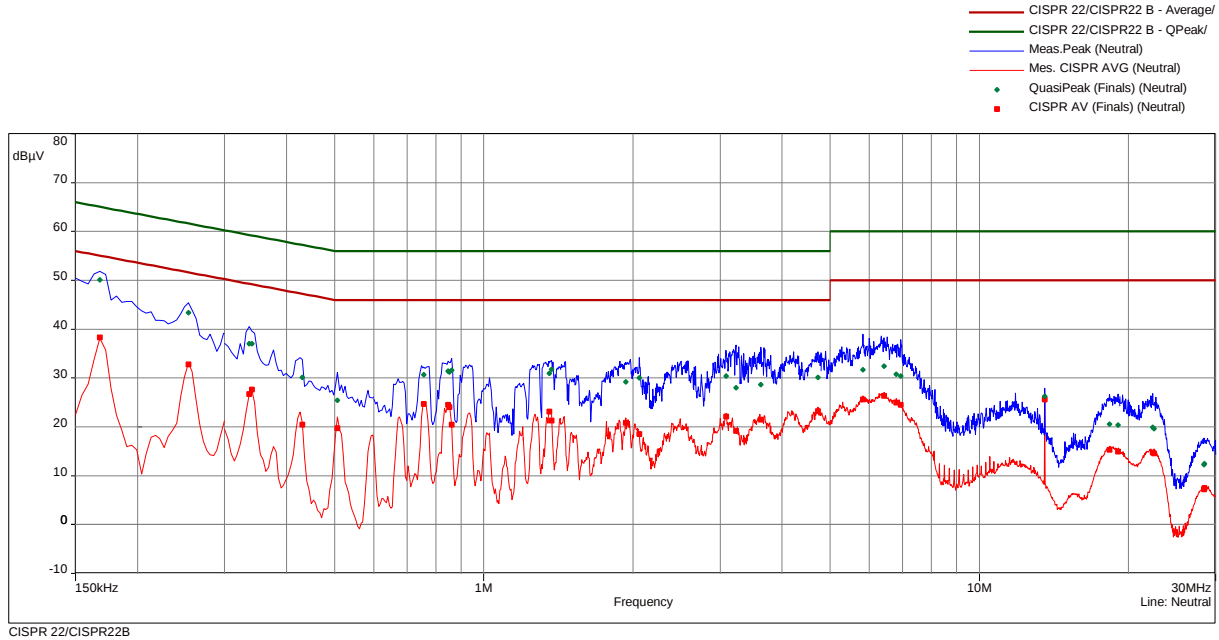


freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	1	44.66	21.34	66.00	22.16	33.84	56.00	Phase 1	10.07
0.168	1	49.49	15.57	65.06	37.43	17.63	55.06	Phase 1	10.08
0.2535	1	40.02	21.62	61.64	29.62	22.02	51.64	Phase 1	10.10
0.3	2	30.40	29.85	60.24	16.96	33.28	50.24	Phase 1	10.12
0.3405	2	31.41	27.79	59.19	26.33	22.86	49.19	Phase 1	10.13
0.4305	2	28.42	28.82	57.24	22.47	24.77	47.24	Phase 1	10.14
0.5115	2	28.09	27.91	56.00	23.33	22.67	46.00	Phase 1	10.14
0.6	3	27.59	28.41	56.00	21.40	24.60	46.00	Phase 1	10.15
0.6675	3	25.36	30.64	56.00	15.86	30.14	46.00	Phase 1	10.17
1.0275	3	29.63	26.37	56.00	22.31	23.69	46.00	Phase 1	10.19
1.6275	4	28.52	27.48	56.00	19.54	26.46	46.00	Phase 1	10.26
1.6365	4	27.39	28.61	56.00	15.76	30.24	46.00	Phase 1	10.26
1.7175	4	27.91	28.09	56.00	18.01	27.99	46.00	Phase 1	10.26
2.298	4	25.00	31.00	56.00	16.54	29.46	46.00	Phase 1	10.30
3.2595	5	32.63	23.37	56.00	20.83	25.17	46.00	Phase 1	10.35
3.309	5	29.44	26.56	56.00	18.96	27.04	46.00	Phase 1	10.35
3.4485	5	25.61	30.39	56.00	14.07	31.93	46.00	Phase 1	10.35
4.794	5	29.76	26.24	56.00	22.09	23.91	46.00	Phase 1	10.44
6.429	6	34.15	25.85	60.00	27.54	22.46	50.00	Phase 1	10.57
6.6045	6	34.21	25.79	60.00	27.64	22.36	50.00	Phase 1	10.58
6.897	6	32.53	27.47	60.00	26.75	23.25	50.00	Phase 1	10.60
7.032	6	33.45	26.55	60.00	26.97	23.03	50.00	Phase 1	10.61
9.924	7	25.18	34.82	60.00	19.21	30.79	50.00	Phase 1	10.74
13.56	7	25.66	34.34	60.00	24.84	25.16	50.00	Phase 1	11.06

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Test point N
Operation mode: Standby
Remarks: Test Jig3
Tested by: Huber Ma.

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.168	9	50.06	14.99	65.06	38.28	16.78	55.06	Neutral	10.09
0.2535	9	43.34	18.30	61.64	32.77	18.87	51.64	Neutral	10.11
0.336	10	37.06	22.24	59.30	26.73	22.57	49.30	Neutral	10.13
0.3405	10	37.00	22.20	59.19	27.66	21.53	49.19	Neutral	10.13
0.4305	10	30.13	27.12	57.24	20.45	26.80	47.24	Neutral	10.14
0.507	10	25.42	30.58	56.00	19.74	26.26	46.00	Neutral	10.14
0.7575	11	30.69	25.31	56.00	24.69	21.31	46.00	Neutral	10.18
0.8475	11	31.45	24.55	56.00	24.50	21.50	46.00	Neutral	10.18
0.852	11	31.24	24.76	56.00	24.03	21.97	46.00	Neutral	10.18
0.861	11	31.57	24.43	56.00	20.51	25.49	46.00	Neutral	10.18
1.3575	12	30.98	25.02	56.00	23.10	22.90	46.00	Neutral	10.24
1.371	12	31.74	24.26	56.00	21.31	24.69	46.00	Neutral	10.24
1.9335	12	29.23	26.77	56.00	20.87	25.13	46.00	Neutral	10.26
2.0595	12	30.05	25.95	56.00	18.55	27.45	46.00	Neutral	10.27
3.084	13	30.38	25.62	56.00	22.17	23.83	46.00	Neutral	10.34
3.2325	13	28.02	27.98	56.00	19.17	26.83	46.00	Neutral	10.35
3.624	13	28.65	27.35	56.00	21.47	24.53	46.00	Neutral	10.36
4.722	13	30.16	25.84	56.00	23.27	22.73	46.00	Neutral	10.43
5.826	14	31.74	28.26	60.00	25.65	24.35	50.00	Neutral	10.50
6.42	14	32.43	27.57	60.00	26.36	23.64	50.00	Neutral	10.54
6.798	14	30.73	29.27	60.00	24.99	25.01	50.00	Neutral	10.57
6.942	14	30.44	29.56	60.00	24.52	25.48	50.00	Neutral	10.58
13.56	15	26.23	33.77	60.00	25.60	24.40	50.00	Neutral	10.91
18.3075	15	20.58	39.42	60.00	15.33	34.67	50.00	Neutral	11.17

FCC ID: 2ADFFV-RFM-2-NF**5.2 Field strength of the fundamental wave**

For test instruments and accessories used see section 6 Part CPR 1.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up – see Attachment B**5.2.3 Applicable standard**

According to FCC Part 15, Section 15.225(a):

The field strength of any emission within the band 13.553 – 13.567 MHz shall not exceed 15848 $\mu\text{V/m}$ at 30 m.

5.2.4 Description of Measurement

The transmitted field strength of the EUT has to be measured at an open area test site using a tuned receiver and a shielded loop antenna. The setup of the equipment under test will be in accordance with ANSI C63.10. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade.

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5.2.5 Test result

a) Result at a measurement distance of 3m

Frequency (MHz)	Level PK (dBμV)	Level AV (dBμV)	Level QP (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level AV dB(μV/m)	Corrected Level QP dB(μV/m)
13.56	31.0	24.3	28.8	9.0	20	51.0	44.3	48.8

b) Result extrapolated to a distance of 30 m

Frequency (MHz)	Level PK (dBμV)	Level AV (dBμV)	Level QP (dBμV)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level AV dB(μV/m)	Corrected Level QP dB(μV/m)	Limit dB(μV/m)	Delta (dB)
13.56	-9.0	-15.7	-11.2	20	11.0	4.3	8.8	84.0	-79.7

Limit according to FCC Part 15, Section 15.225(a):

Frequency (MHz)	Field strength of fundamental wave		Measurement distance
	(μV/m)	dB(μV/m)	(metres)
13.553 - 13.567	15848	84.0	30

The requirements are **FULFILLED**.

Remarks:

FCC ID: 2ADFEV-RFM-2-NF

5.3 Spurious emissions

For test instruments and accessories used see section 6 Part SER 1, SER 2.

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up – see Attachmet B

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from an intentional radiator shall not exceed the field strength levels specified in the table below.

5.3.4 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The setup of the equipment under test will be in accordance with ANSI C63.10. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz:	RBW:	200 Hz
150 kHz – 30 MHz:	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz

5.3.5 Test result

Results at a measurement distance of 3m

Frequency [kHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

Frequency [MHz]	L: QP [dBµV]	Correct. [dB]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges.
Only ambient noises could be detected!

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Limit according to FCC Part 15 Subpart 15.209(a):

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	
0.009 - 0.490	2400/F(kHz)	--	300
0.490 - 1.705	24000/F (kHz)	--	30
1.705 - 30.0	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

The requirements are **FULFILLED**.

Remarks: Measurement has been performed up to 1 GHz.

No undesired emissions occurred in the frequency range from 9 kHz up to 135.6 MHz

5.4 Frequency tolerance

For test instruments and accessories used see section 6 Part FE.

5.4.1 Description of the test location

Test location: AREA4 (Climatic Chamber)

5.4.2 Photo documentation of the test set-up – see Attachment B

5.4.3 Applicable standard

According to FCC Part 15, Section 15.225(e):

The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature range of -20 °C to $+50$ °C at normal supply voltage and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. For battery-operated equipment, the equipment shall be performed using a new battery.

5.4.4 Description of Measurement

The frequency tolerance has been measured radiated using a spectrum analyser. The center frequency of the spectrum analyser has been set to the fundamental frequency. This is an alternative test method because the EuT cannot be operated in un-modulated mode. The limit line was set to 10 dB below the carrier. The frequencies of the upper (f_u) and lower (f_l) points, where the displayed power envelope of the modulation including frequency drift is equal to the appropriate level, have been recorded. The centre frequency is calculated as $f_c = (f_u + f_l)/2$. The measurement has been performed at normal and extreme test conditions from -20 °C to $+50$ °C in steps of 10 degrees (According to FCC Part 2.1055).

FCC ID: 2ADFV-RFM-2-NF
5.4.5 Test result

Test conditions		Test result
		Frequency (MHz)
$T_{min} (-20)^{\circ}C$	$V_{nom} (24.0 V)$	13.560255
$T (-10)^{\circ}C$	$V_{nom} (24.0 V)$	13.560255
$T (0)^{\circ}C$	$V_{nom} (24.0 V)$	13.560255
$T (10)^{\circ}C$	$V_{nom} (24.0 V)$	13.560262
$T_{nom} (20)^{\circ}C$	$V_{min} (20.4 V)$	13.560269
	$V_{nom} (24.0 V)$	13.560269
	$V_{max} (27.6 V)$	13.560269
$T (30)^{\circ}C$	$V_{nom} (24.0 V)$	13.560270
$T (40)^{\circ}C$	$V_{nom} (24.0 V)$	13.560270
$T_{max} (50)^{\circ}C$	$V_{nom} (24.0 V)$	13.560270
Measurement uncertainty		$\pm 10 \text{ Hz}$

Carrier frequency: $f_c = 13.56 \text{ MHz}$

Max. tolerance: $\pm 0.01 \% \text{ of } 13.56 \text{ MHz} = \pm 1.356 \text{ kHz}$

Lowest frequency: $f_l = 13.560255 \text{ MHz}$

Lowest tolerance: $f_l - f_c = -0.26 \text{ kHz} < -1.356 \text{ kHz}$

Limit according to FCC Part 15, Section 15.225(e):

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01 \%$ of the operating frequency.

The requirements are **FULFILLED**.

Remarks:

FCC ID: 2ADFFV-RFM-2-NF

5.5 20 dB Bandwidth

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

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up – see Attachment B

5.5.3 Applicable standard

According to FCC Part 15C, Section 15.215(c):

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in section 15.217 to 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed.

5.5.4 Description of Measurement

The frequency range has been measured radiated using a test fixture and a spectrum analyser. The limit line is set to 20 dB below the carrier. The frequency of the upper (F_H) and lower (F_L) points, where the displayed power envelope of the modulation including frequency drift is equal to the appropriate level, is recorded as the modulation bandwidth. The measurement has been performed at normal and extreme test conditions in modulated transmitting mode.

Spectrum analyzer settings:

RBW: 1 kHz
VBW: 3 kHz
Detector Peak

5.5.5 Test result

Carrier Frequency (MHz)	(F_L) (MHz)	(F_H) (MHz)	Bandwidth (kHz)	Limit (kHz)
13.56	13.55752	13.56248	4.96	14.0

Limit according to FCC Part 15C, Section 15.215(c):

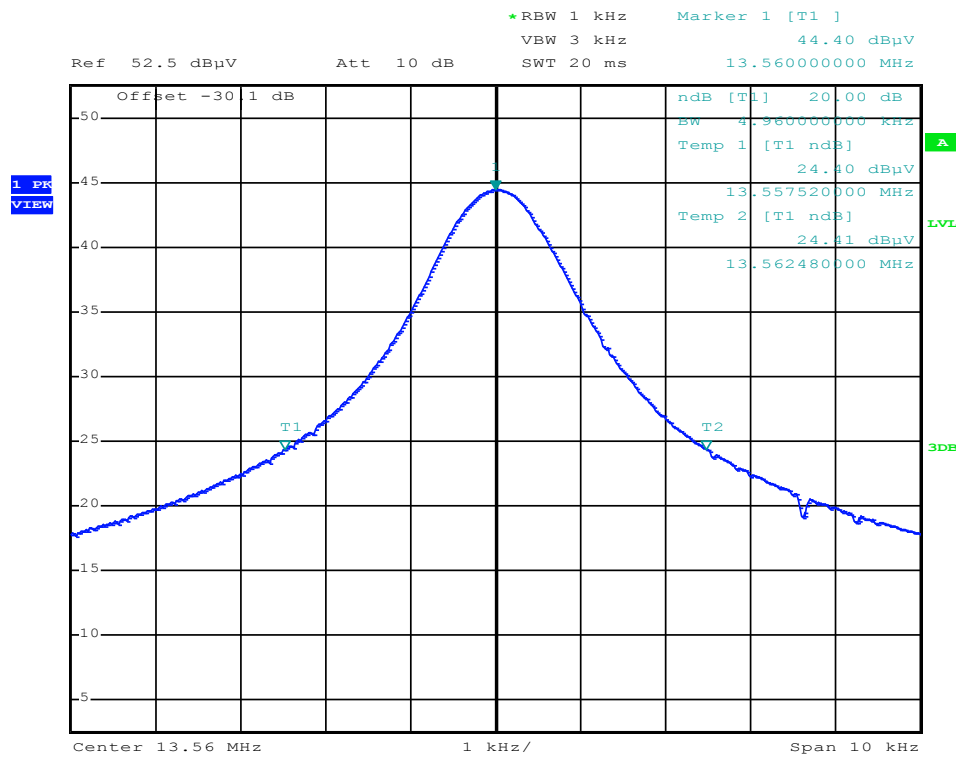
Frequency band (MHz)	Limit 20 dB bandwidth (kHz)
13.553 - 13.567	14.0

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocol.

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5.5.6 Test protocol



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5.6 Transmitter spectrum mask

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

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up – see Attachment B

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.225 (a-d):

The field strength of any emission shall not exceed the limits given in FCC Part 15C, Section 15.225 (a-d)

5.6.4 Description of Measurement

The spectrum mask is measured using a spectrum analyser. The profile of the spectrum mask is displayed on analyser and have to be adjusted to the reference level given as maximum output power measured in OATS. The marker is set up manually to the particular maximum level at the effective limit in the frequency range and recorded. The measurement was performed radiated.

5.6.5 Test result

Frequency band (MHz)	Emission level (dBμV/m)	Limit (dBμV/m)
13.110 – 13.410	≤ 10	40.5
13.410 - 13.553	≤ 10	50.5
13.553 - 13.567	4.3	84.0
13.567 – 13.710	≤ 10	50.5
13.710 – 14.010	≤ 10	40.5
outside of 13.110 – 14.010	≤ 10	29.5

Limits according to FCC Part 15C, Section 15.225(a-d):

The absolute levels of RF power at any frequency shall not exceed the limits defined in the following table:

Frequency band (MHz)	Emission level limit at 30 m (μV/m)
13.110 – 13.410	106
13.410 - 13.553	334
13.553 - 13.567	15.848
13.567 – 13.710	334
13.710 – 14.010	106
outside of 13.110 – 14.010	30

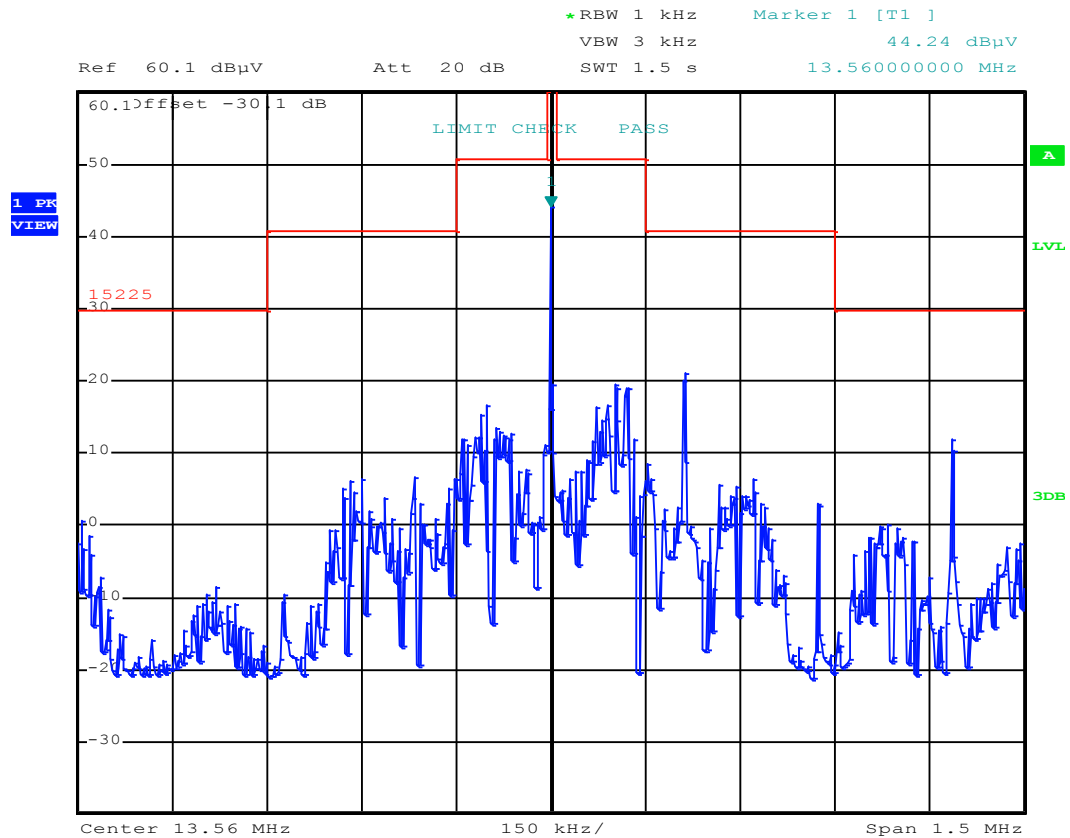
The requirements are **FULFILLED**.

Remarks:

FCC ID: 2ADFFV-RFM-2-NF

5.6.6 Test protocol

Spectrum mask of modulated signal



The values of the plot are extrapolated to a measurement distance of 3 m. (calculated Limit 124 dBμV/m)

5.7 Receiver radiated emissions**5.7.1 Description of the test location**

Test location: None

5.7.2 Applicable standard

According to FCC Part 15, Section 15.109(a):

The emission of an unintentional radiator shall not exceed the specified field strength level at 3 m.

Remarks: This test is not applicable. In practical operation the receive mode is too short
to make an assessment.

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 3.18.0.23	01-02/68-13-001				
	ESCI	02-02/03-15-001	11/06/2019	11/06/2018		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/04/2019	31/10/2018
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	18/11/2019	18/11/2016	06/05/2019	06/11/2018
	SP 103 /3.5-60	02-02/50-05-182				
CPR 1	ESCI	02-02/03-05-005	11/12/2019	11/12/2018		
	HFH 2 - Z 2	02-02/24-15-001	22/03/2019	22/03/2018		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
FE	FSP 30	02-02/11-05-001	09/10/2019	09/10/2018		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRA HIT World	02-02/32-10-001	19/10/2019	19/10/2018		
	WK-340/40	02-02/45-05-001	06/04/2019	06/04/2018		
	6543A	02-02/50-05-157				
MB	FSP 30	02-02/11-05-001	09/10/2019	09/10/2018		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRA HIT World	02-02/32-10-001	19/10/2019	19/10/2018		
	WK-340/40	02-02/45-05-001	06/04/2019	06/04/2018		
	6543A	02-02/50-05-157				
SER 1	ESCI	02-02/03-05-005	11/12/2019	11/12/2018		
	HFH 2 - Z 2	02-02/24-15-001	22/03/2019	22/03/2018		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018		
	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				