



EMI - TEST REPORT

- FCC Part 15.225 -

Type / Model Name : ROTALIGN touch

Product Description : Handheld measurement device

Applicant : PRÜFTECHNIK Condition Monitoring GmbH

Address : Oskar-Messter-Straße 19-21

85737 ISMANING, GERMANY

Manufacturer : PRÜFTECHNIK AG

Address : Oskar-Messter-Straße 19-21

85737 ISMANING, GERMANY

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

POSITIVE

Test Report No. : T39732-00-05GK

25. November 2015

Date of issue



DAkkS

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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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (October, 2014)

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 (October, 2014)

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 ID: CHORUNF1

2 SUMMARY

GENERAL REMARKS:

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 : 17. September 2015

Testing concluded on : 13. October 2015

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Konrad Graßl
Radio Team

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – See attachment A

3.2 Power supply system utilised

Power supply voltage: Battery powered 3.6 V (Lithium-Ion rechargeable battery)
100-240 V AC 50/60 Hz 1-phase (only for charging)

Note: There are two power adapters for testing. The standard power adapter, which is in the delivery content of the manufacturer and an USB power adapter off-the-shelf. For detailed information please see attachment A. According to the manufacturer the power adapters are only for charging the rechargeable battery and not for powering the device. It's allowed to charge the device during normal use.

Standard power adapter: GlobTek GT-43007-3612

USB power adapter: Apple NSW 24363 LPS

3.3 Short description of the equipment under test (EUT)

The Rotalign Touch is a handheld measurement device with four integrated RF-technologies. The RF- technologies are Bluetooth, Bluetooth low energy, WLAN and NFC. In this test report only NFC is in consideration. The device has only an integrated antenna.

Number of tested samples: 1
Serial number: 50200012

EUT operation mode:

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

- Continuous tag reading mode at 13.56 MHz

-

EUT configuration:

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

- NFC-TAG	Model : Supplied by manufacturer
- Laptop	Model : Fujitsu Siemens C 1410
-	Model :

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

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

4.2 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.3 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

4.4 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.

FCC ID: CHORUNF1**4.1 Measurement Protocol for FCC, VCCI and AUSTEL****4.1.1 GENERAL INFORMATION****4.1.1.1 Test methodology**

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

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.

4.1.2 DETAILS OF TEST PROCEDURES**General Standard information**

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 C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". 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 C63.4 and applying the CISPR 22 limits.

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



FCC ID: CHORUNF1**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 C63.4 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 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 1.27 dB at 13.56 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**.

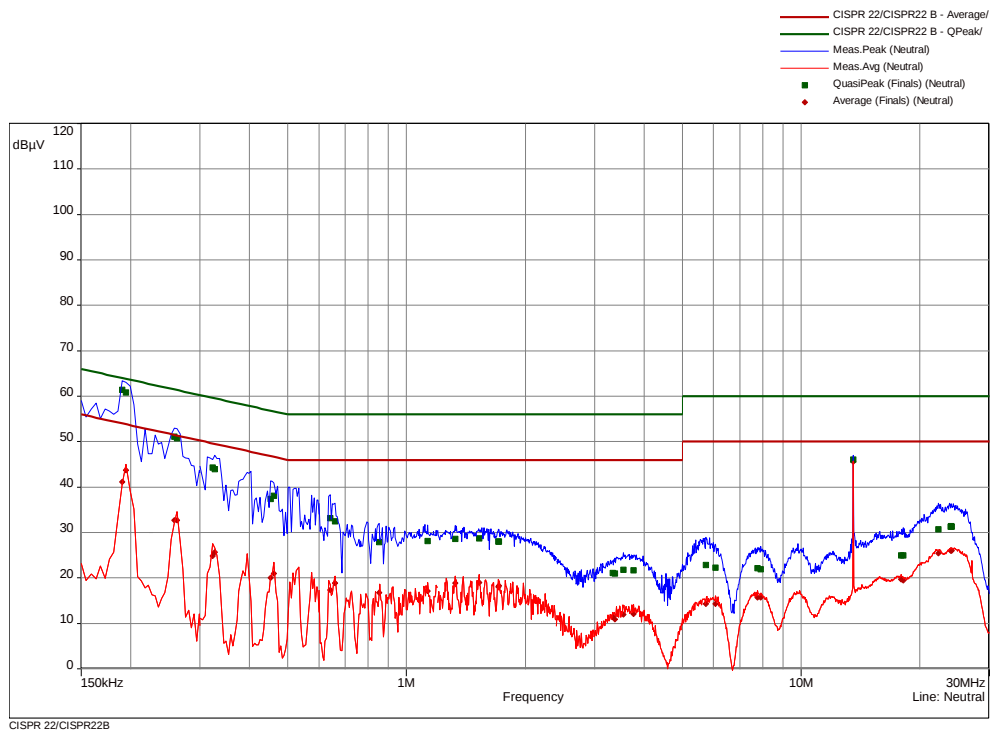
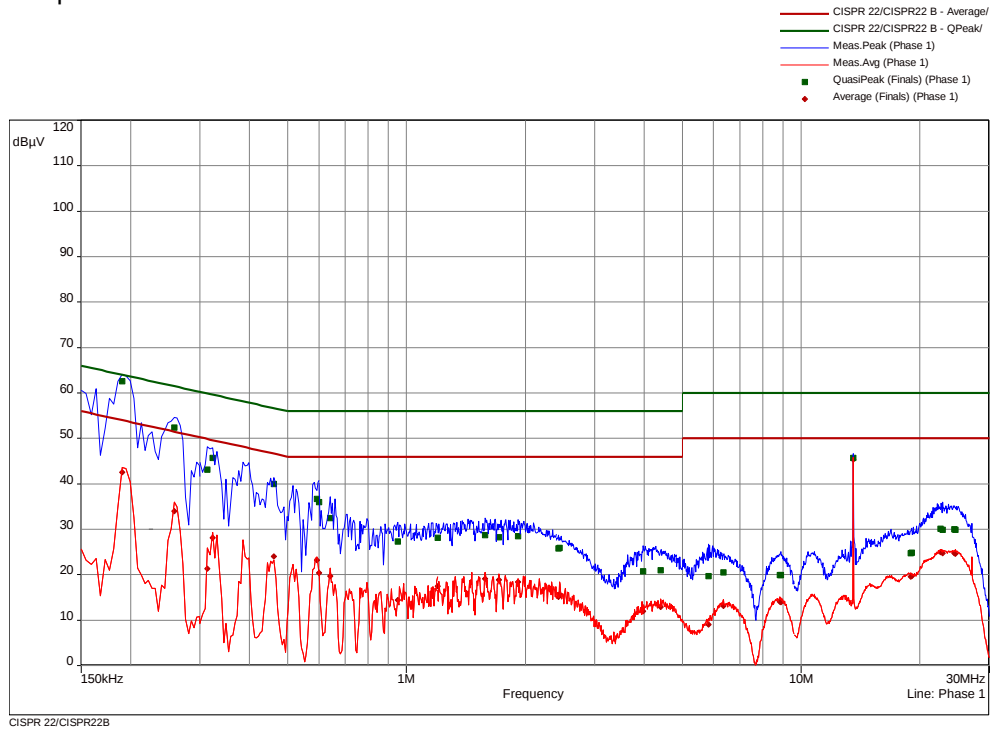
Remarks: For detailed test result please refer to following test protocols

5.1.6 Test protocol

Operation mode: all RF technologies active

Power supply voltage: 115 V/ 60 Hz

Standard power adapter



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freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.1905	1	62.64	1.38	64.01	42.52	11.50	54.01	Phase 1
0.258	1	52.39	9.11	61.50	33.95	17.54	51.50	Phase 1
0.3135	2	43.10	16.78	59.88	21.37	28.50	49.88	Phase 1
0.3225	2	45.70	13.94	59.64	28.08	21.56	49.64	Phase 1
0.462	2	40.00	16.65	56.66	24.05	22.61	46.66	Phase 1
0.5925	2	36.67	19.33	56.00	23.17	22.83	46.00	Phase 1
0.6	3	35.99	20.01	56.00	20.35	25.65	46.00	Phase 1
0.6405	3	32.50	23.50	56.00	19.73	26.27	46.00	Phase 1
0.951	3	27.27	28.73	56.00	14.40	31.60	46.00	Phase 1
1.2	3	28.16	27.84	56.00	17.41	28.59	46.00	Phase 1
1.5825	4	28.73	27.27	56.00	19.10	26.90	46.00	Phase 1
1.7175	4	28.30	27.70	56.00	18.90	27.10	46.00	Phase 1
1.92	4	28.45	27.55	56.00	18.41	27.59	46.00	Phase 1
2.4315	5	25.82	30.18	56.00	15.17	30.83	46.00	Phase 1
2.4405	5	25.91	30.09	56.00	15.66	30.34	46.00	Phase 1
3.975	5	20.77	35.23	56.00	11.91	34.09	46.00	Phase 1
4.407	5	21.03	34.97	56.00	12.85	33.15	46.00	Phase 1
5.8215	6	19.64	40.36	60.00	9.08	40.92	50.00	Phase 1
6.3615	6	20.52	39.48	60.00	13.10	36.90	50.00	Phase 1
8.832	6	19.98	40.02	60.00	14.10	35.90	50.00	Phase 1
8.895	6	19.95	40.05	60.00	13.99	36.01	50.00	Phase 1
13.56	7	45.72	14.28	60.00	45.35	4.65	50.00	Phase 1
18.96	7	24.79	35.21	60.00	19.55	30.45	50.00	Phase 1
19.041	7	24.90	35.10	60.00	19.74	30.26	50.00	Phase 1
22.5525	8	30.14	29.86	60.00	24.96	25.04	50.00	Phase 1
22.7955	8	29.89	30.11	60.00	24.69	25.31	50.00	Phase 1
24.483	8	30.06	29.94	60.00	24.75	25.25	50.00	Phase 1
24.6315	8	29.92	30.08	60.00	24.60	25.40	50.00	Phase 1
0.1905	9	61.36	2.65	64.01	41.19	12.83	54.01	Neutral
0.195	9	60.88	2.94	63.82	43.75	10.07	53.82	Neutral
0.258	9	51.11	10.38	61.50	32.66	18.83	51.50	Neutral
0.2625	9	50.70	10.66	61.35	32.68	18.67	51.35	Neutral
0.3225	10	44.28	15.37	59.64	24.90	24.74	49.64	Neutral
0.327	10	44.01	15.52	59.53	25.67	23.86	49.53	Neutral
0.453	10	37.39	19.43	56.82	20.02	26.80	46.82	Neutral
0.462	10	38.11	18.55	56.66	21.03	25.63	46.66	Neutral
0.6405	11	33.23	22.77	56.00	17.38	28.62	46.00	Neutral
0.6585	11	32.44	23.56	56.00	18.92	27.08	46.00	Neutral
0.852	11	27.94	28.06	56.00	16.79	29.21	46.00	Neutral
1.131	11	28.17	27.83	56.00	17.16	28.84	46.00	Neutral
1.3305	12	28.60	27.40	56.00	18.87	27.13	46.00	Neutral
1.5285	12	28.73	27.27	56.00	18.97	27.03	46.00	Neutral
1.7085	12	28.00	28.00	56.00	18.04	27.96	46.00	Neutral
1.713	12	28.07	27.93	56.00	18.33	27.67	46.00	Neutral
3.3315	13	21.06	34.94	56.00	11.45	34.55	46.00	Neutral

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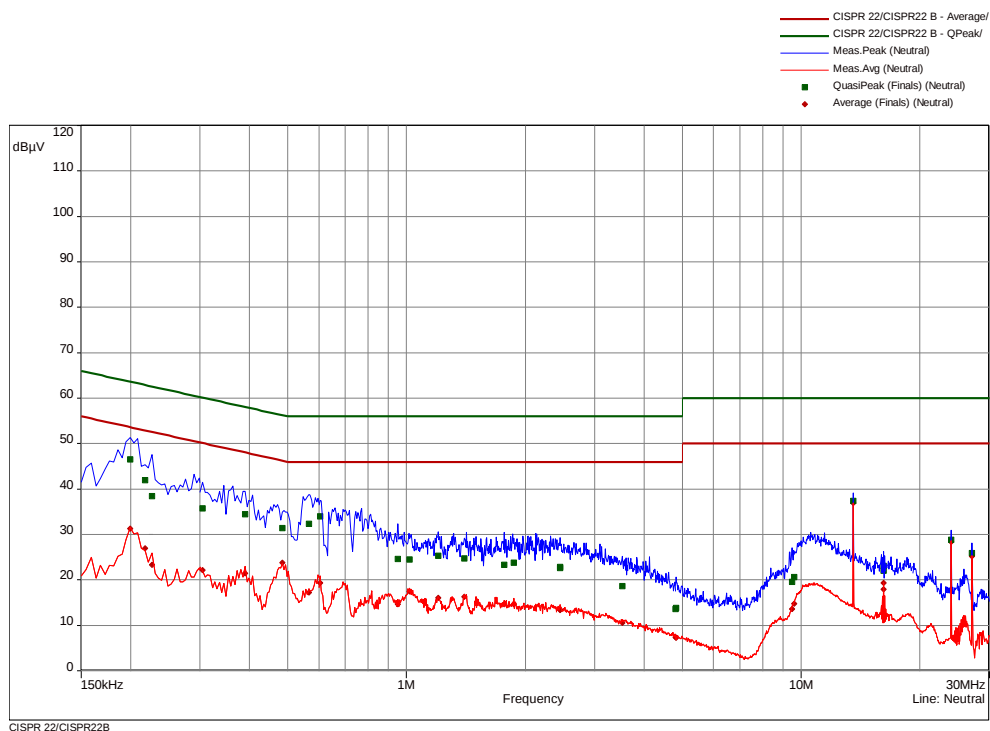
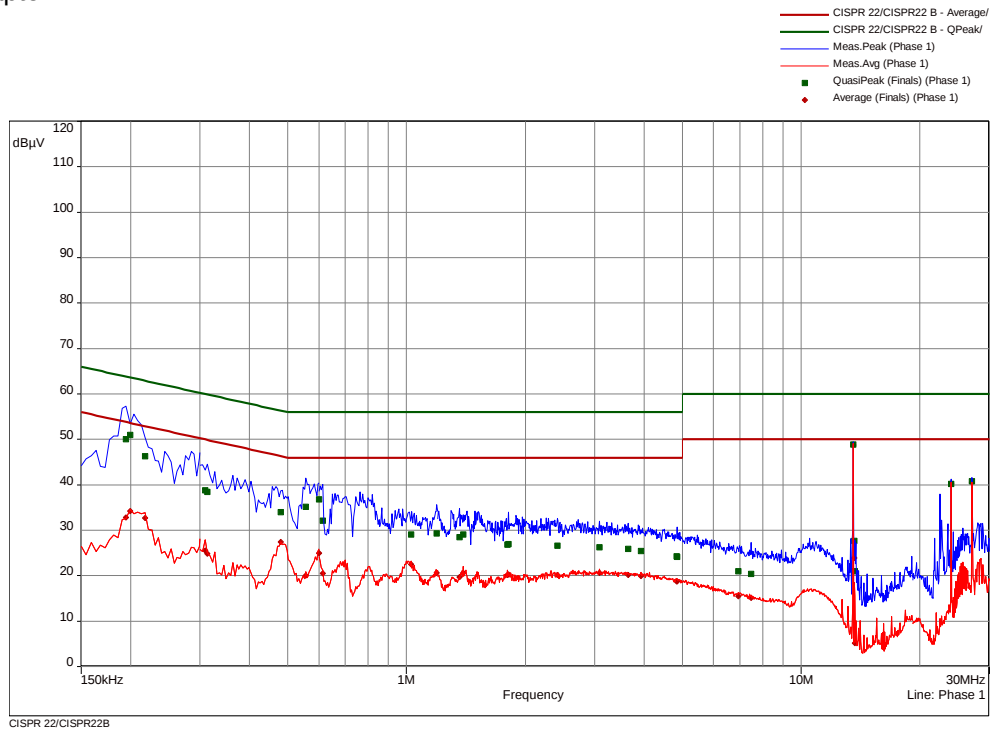
3.372	13	20.93	35.07	56.00	10.96	35.04	46.00	Neutral
3.5475	13	21.80	34.20	56.00	11.96	34.04	46.00	Neutral
3.7635	13	21.66	34.34	56.00	12.02	33.98	46.00	Neutral
5.736	14	22.89	37.11	60.00	14.35	35.65	50.00	Neutral
6.069	14	22.32	37.68	60.00	14.34	35.66	50.00	Neutral
7.743	14	22.12	37.88	60.00	15.67	34.33	50.00	Neutral
7.9095	14	21.93	38.07	60.00	15.69	34.31	50.00	Neutral
13.56	15	46.01	13.99	60.00	45.60	4.40	50.00	Neutral
17.9295	15	25.01	34.99	60.00	19.69	30.31	50.00	Neutral
18.1725	15	24.94	35.06	60.00	19.51	30.49	50.00	Neutral
22.251	16	30.67	29.33	60.00	25.49	24.51	50.00	Neutral
23.9475	16	31.25	28.75	60.00	26.05	23.95	50.00	Neutral
24.0285	16	31.40	28.60	60.00	26.04	23.96	50.00	Neutral
24.0645	16	31.27	28.73	60.00	25.98	24.02	50.00	Neutral

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Operation mode: all RF technologies active

Power supply voltage: 115 V/ 60 Hz

USB power adapter



FCC ID: CHORUNF1

freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.195	1	50.05	13.77	63.82	32.83	20.99	53.82	Phase 1
0.1995	1	50.98	12.65	63.63	34.26	19.37	53.63	Phase 1
0.2175	1	46.33	16.58	62.91	32.71	20.20	52.91	Phase 1
0.309	2	38.85	21.15	60.00	25.57	24.43	50.00	Phase 1
0.3135	2	38.45	21.43	59.88	24.84	25.03	49.88	Phase 1
0.48	2	33.99	22.35	56.34	27.42	18.92	46.34	Phase 1
0.5565	2	35.14	20.86	56.00	20.07	25.93	46.00	Phase 1
0.6	3	36.81	19.19	56.00	24.95	21.05	46.00	Phase 1
0.6135	3	32.07	23.93	56.00	20.57	25.43	46.00	Phase 1
1.0275	3	29.07	26.93	56.00	22.50	23.50	46.00	Phase 1
1.194	3	29.34	26.66	56.00	20.65	25.35	46.00	Phase 1
1.362	4	28.54	27.46	56.00	19.70	26.30	46.00	Phase 1
1.3935	4	29.06	26.94	56.00	20.63	25.37	46.00	Phase 1
1.803	4	26.84	29.16	56.00	20.16	25.84	46.00	Phase 1
1.812	4	26.99	29.01	56.00	20.23	25.77	46.00	Phase 1
2.4135	5	26.64	29.36	56.00	20.12	25.88	46.00	Phase 1
3.084	5	26.24	29.76	56.00	20.59	25.41	46.00	Phase 1
3.6465	5	25.87	30.13	56.00	20.20	25.80	46.00	Phase 1
3.9345	5	25.43	30.57	56.00	19.99	26.01	46.00	Phase 1
4.836	6	24.25	31.75	56.00	18.77	27.23	46.00	Phase 1
4.845	6	24.17	31.83	56.00	18.78	27.22	46.00	Phase 1
6.9285	6	20.97	39.03	60.00	15.42	34.58	50.00	Phase 1
7.464	6	20.40	39.60	60.00	15.09	34.91	50.00	Phase 1
13.56	7	48.88	11.12	60.00	48.73	1.27	50.00	Phase 1
13.6365	7	27.72	32.28	60.00	23.90	26.10	50.00	Phase 1
13.695	7	20.97	39.03	60.00	5.14	44.86	50.00	Phase 1
24.0015	8	40.21	19.79	60.00	40.29	9.71	50.00	Phase 1
27.12	8	40.73	19.27	60.00	40.55	9.45	50.00	Phase 1
0.1995	9	46.54	17.10	63.63	31.29	22.35	53.63	Neutral
0.2175	9	42.02	20.90	62.91	26.91	26.01	52.91	Neutral
0.2265	9	38.44	24.13	62.58	23.31	29.27	52.58	Neutral
0.3045	10	35.76	24.36	60.12	22.21	27.91	50.12	Neutral
0.39	10	34.45	23.61	58.06	21.48	26.59	48.06	Neutral
0.4845	10	31.40	24.87	56.26	23.84	22.42	46.26	Neutral
0.5655	10	32.40	23.60	56.00	17.22	28.78	46.00	Neutral
0.6045	11	34.00	22.00	56.00	19.36	26.64	46.00	Neutral
0.951	11	24.65	31.35	56.00	14.68	31.32	46.00	Neutral
1.0185	11	24.56	31.44	56.00	17.51	28.49	46.00	Neutral
1.2045	12	25.33	30.67	56.00	16.05	29.95	46.00	Neutral
1.4025	12	24.74	31.26	56.00	16.29	29.71	46.00	Neutral
1.7715	12	23.30	32.70	56.00	14.62	31.38	46.00	Neutral
1.8705	12	23.79	32.21	56.00	14.64	31.36	46.00	Neutral
2.4495	13	22.65	33.35	56.00	13.35	32.65	46.00	Neutral
2.454	13	22.88	33.12	56.00	13.43	32.57	46.00	Neutral
3.525	13	18.68	37.32	56.00	10.58	35.42	46.00	Neutral

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4.809	14	13.64	42.36	56.00	7.39	38.61	46.00	Neutral
4.8225	14	13.82	42.18	56.00	7.31	38.69	46.00	Neutral
9.498	14	19.58	40.42	60.00	13.58	36.42	50.00	Neutral
9.6	14	20.63	39.37	60.00	14.74	35.26	50.00	Neutral
13.56	15	37.41	22.59	60.00	36.95	13.05	50.00	Neutral
16.1655	15	23.14	36.86	60.00	19.30	30.70	50.00	Neutral
16.17	15	22.08	37.92	60.00	17.95	32.05	50.00	Neutral
24.0015	16	28.89	31.11	60.00	28.37	21.63	50.00	Neutral
27.12	16	25.92	34.08	60.00	25.23	24.77	50.00	Neutral

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



FCC ID: CHORUNF1

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 set up of the equipment under test will be in accordance with ANSI C63.4. 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. The final measurement has been performed with an EMI receiver using quasi peak detector and a resolution bandwidth of 9 kHz.

5.2.5 Test result

- integrated Antenna

a) Result at a measurement distance of 3m

Frequency (MHz)	Level (dB μV)	Ant. factor (dB 1/m)	Field strength dB($\mu\text{V/m}$)
13.56	33.6	20.0	53.6

b) Result extrapolated to a distance of 30 m

(measured value of 3 meters minus 40 dB= 53.6 dB $\mu\text{V/m}$ – 40 dB=13.6 dB $\mu\text{V/m}$)

Frequency (MHz)	Field strength dB($\mu\text{V/m}$)	Limit dB($\mu\text{V/m}$)	Delta (dB)
13.56	13.6	84.0	-70.4

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

Frequency (MHz)	Field strength of fundamental wave		Measurement distance (metres)
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	
13.553 - 13.567	15848	84.0	30

The requirements are **FULFILLED**.

Remarks:

FCC ID: CHORUNF1

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 (<30 MHz)

Test location: OATS3 (>30 MHz)

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up



FCC ID: CHORUNF1

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 set up of the equipment under test will be in accordance with ANSI C63.4. 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 (MHz)	Level AV (dBμV)	Level QP (dBμV)	Ant. factor (dB)	Field strength AV dB(μV/m)	Field strength QP dB(μV/m)
27.12	-3.6	1.9	20	16.4	21.9

Results at a measurement distance of 3m extrapolated to 30 m and a limit at 30 meters (1.705 MHz-30 MHz)

Measured QP value at 3 m minus 40 dB= calculated value at 30 m

21.9 dBμV/m – 40 dB = -18.1 dBμV/m

Measured AV value at 3 m minus 40 dB= calculated value at 30 m

16.4 dBμV/m – 40 dB = -23.6 dBμV/m

Frequency (MHz)	Level AV (dBμV)	Level QP (dBμV)	Ant. factor (dB)	Field strength AV dB(μV/m)	Field strength QP dB(μV/m)	Limit dB(μV/m) 30 meter	Delta (dB)
27.12	-43.6	-38.1	20	-23.6	-18.1	30.0	-48.1

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Results at a measurement distance of 3m and a limit at 3 meters (above 30 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)
40.68		13.1		15.2		28.3	40.0	-11.7
54.24	14.7	17.1	14.7	14.7	29.4	31.8	40.0	-8.2
67.80	15.1	14.4	11.9	11.9	27.0	26.3	40.0	-13.0
81.36	18.6	22.8	11.1	11.1	29.7	33.9	40.0	-6.1
108.48	8.1	8.6	13.4	13.4	21.5	22.0	43.5	-21.5
122.04	10.4	10.9	12.2	12.2	22.6	23.1	43.5	-20.4
135.60	16.7	16.7	11.0	11.0	27.7	27.7	43.5	-15.8

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

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(µV/m)	dB(µV/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 the 10th harmonic (135.6 MHz).

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

FCC ID: CHORUNF1**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**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 $\pm 0.01\%$ of the operating frequency over a temperature range of $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ 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 $20\text{ }^{\circ}\text{C}$. 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 can not 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 $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ in steps of 10 degrees (According to FCC Part 2.1055).

FCC ID: CHORUNF1

5.4.5 Test result

Test conditions		Test result
		Frequency (MHz)
$T_{min} (-20)^{\circ}C$	V_{nom}	13.55905
$T (-10)^{\circ}C$	V_{nom}	13.55905
$T (0)^{\circ}C$	V_{nom}	13.55905
$T (10)^{\circ}C$	V_{nom}	13.55905
$T_{nom} (20)^{\circ}C$	$V_{min} (3.06 V)$	13.55900
	V_{nom}	13.55900
	$V_{max} (4.14 V)$	13.55900
$T (30)^{\circ}C$	V_{nom}	13.558975
$T (40)^{\circ}C$	V_{nom}	13.558975
$T_{max} (50)^{\circ}C$	V_{nom}	13.55895
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: $f_l = 13.55895 \text{ MHz}$

Lowest tolerance: $f_l - f_c = -1.05 \text{ kHz} < -1.356 \text{ kHz}$

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: CHORUNF1

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



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.

FCC ID: CHORUNF1

5.5.4 Description of Measurement

The frequency range has been measured radiated using a test fixture and a spectrum analyser. The ndB down function of the spectrum analyser was used. 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 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	13.55624	13.56158	5.34	14.0

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

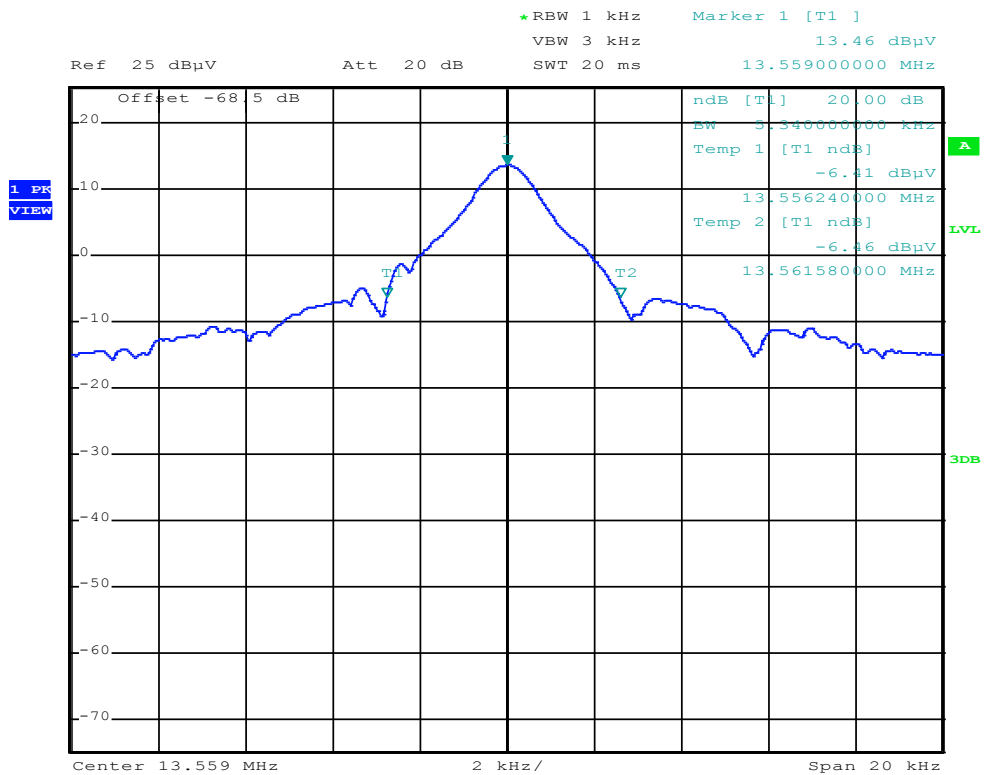
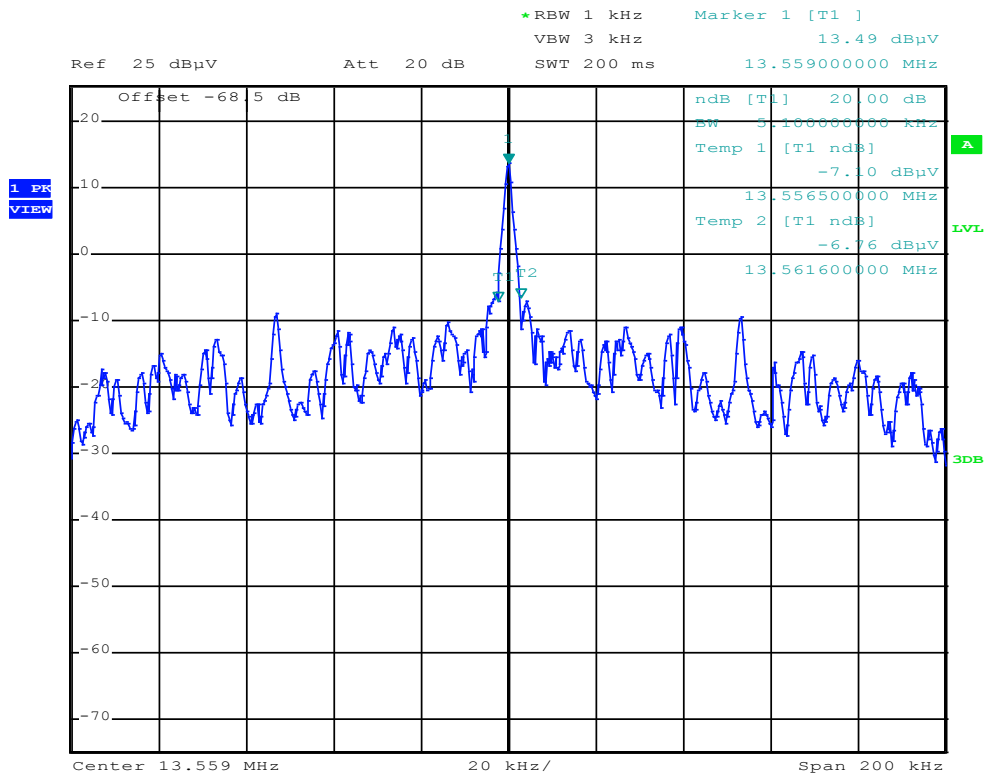
Frequency band (MHz)	Limit 20 dB bandwidth (kHz)
13.553 - 13.567	14.0

The requirements are **FULFILLED**.

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

FCC ID: CHORUNF1

5.5.6 Test protocol



FCC ID: CHORUNF1

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



FCC ID: CHORUNF1

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 the analyser and has to be adjusted to the limits at 30 meters (see table below). The value at 13.56 MHz is adjusted with the reference level offset function to the extrapolated value at 30 m. The measurement was performed radiated.

5.6.5 Test result

Frequency band (MHz)	Emission level (dB μ V/m)	Limit (dB μ V/m)
13.110 – 13.410	-15	40.5
13.410 - 13.553	-9	50.5
13.553 - 13.567	13.62	84.0
13.567 – 13.710	-9	50.5
13.710 – 14.010	-15	40.5
outside of 13.110 – 14.010	-15	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 (μ V/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

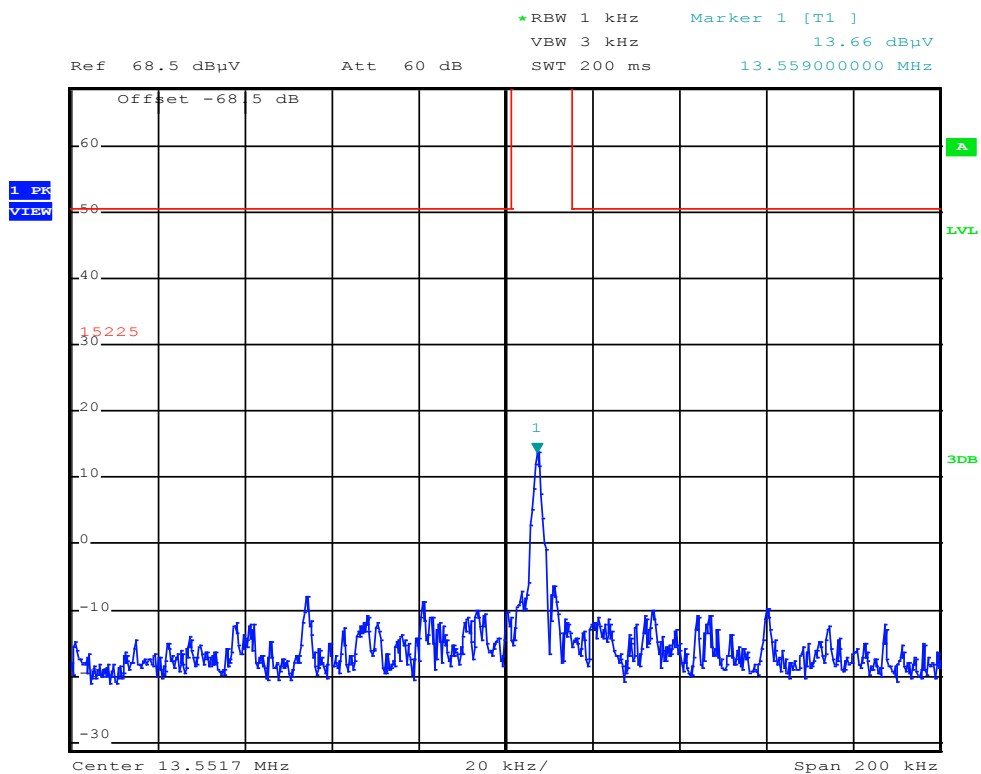
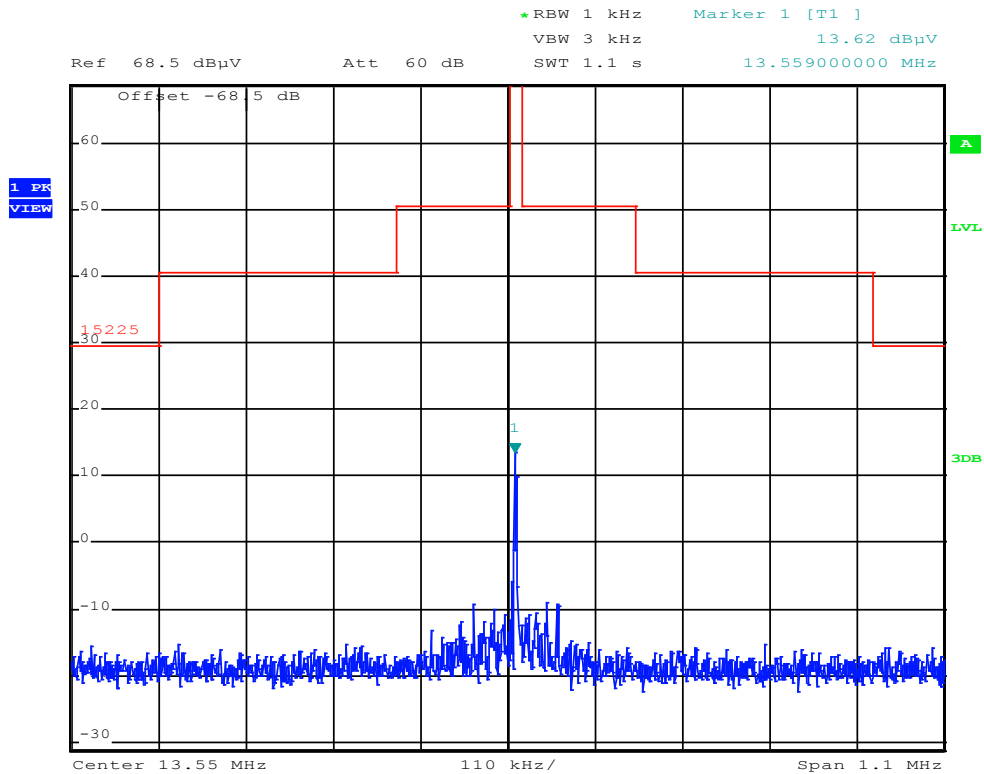
The requirements are **FULFILLED**.

Remarks:

FCC ID: CHORUNF1

5.6.6 Test protocol

Spectrum mask of modulated signal



FCC ID: CHORUNF1

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. The receive mode is too short to make an assessment.

FCC ID: CHORUNF1

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	ESCI	02-02/03-15-001	15/05/2016	15/05/2015		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2015	18/10/2013	21/01/2016	21/07/2015
	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	19/11/2015	19/11/2014	09/12/2015	09/06/2015
	6430	02-02/50-13-014				
CPR 1	FMZB 1516	01-02/24-01-018			19/01/2016	19/01/2015
	ESCI	02-02/03-05-005	09/12/2015	09/12/2014		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
FE	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRAHIT WORLD	02-02/32-15-001	26/11/2015	26/11/2014		
	6543A	02-02/50-05-157				
MB	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRAHIT WORLD	02-02/32-15-001	26/11/2015	26/11/2014		
	6543A	02-02/50-05-157				
SER 1	FMZB 1516	01-02/24-01-018			19/01/2016	19/01/2015
	ESCI	02-02/03-05-005	09/12/2015	09/12/2014		
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	VULB 9163	01-02/24-01-006	17/11/2017	17/11/2014	14/01/2016	14/07/2015
	HCC	01-02/50-01-021				
	N-3000-N	01-02/50-05-122				
	RST 070	01-05/60-02-003				
	ESVS 30	02-02/03-05-006	26/06/2016	26/06/2015		