

Test Report

Electromagnetic Compatibility


Test Report - Nr.: 07KFE007582-FCC-01

Date: 2007-12-10

Type:	ERT 660, ERT 661
Description:	Access control with tag
Serialnumber:	Test samples

Manufacturer:	Commend International GmbH
Customer:	Commend International GmbH
Address (Customer):	Saalachstrasse 51 A – 5020 Salzburg Austria

Test Laboratory:	Intertek Deutschland GmbH, Innovapark 20, D- 87600 Kaufbeuren
FCC registration number:	90714
Compiled by:	Marek Svoboda Team Leader EMC
Approved by:	R. Dressler Project Engineer



This test report consists of 28 pages. All measurement results exclusively refer to the equipment, which was tested.
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1. General description

1.1. Product description

The device is 4 - Wire Access Reader Module Series ER 600 with built – in antenna. It is activated by approaching the passive tag to reader. In this case the data sent through cable connection to control are evaluated by control unit.

The transmitter which the tag responds has operating frequency $f = 13,56$ MHz.

Necessary supply voltage is 13 V – 35 V AC or DC. The device was tested with 230 V 50 Hz AC /24 V AC Adapter delivered by the manufacturer and with 110 V 60 Hz /24 V AC adapter. In both cases the connection from mains adapter was performed with unshielded cable.

There were tested two models of the Series:

Model ERT 660 : without LED's on front panel

Model ERT 661 : with LED's on front panel.

The high frequency part of both models is identical.

Both models are constructed on the same PCB; Model ERT 660 has not filled components marked on the Schematic diagram by \$ sign.

The differences are documented in the Exhibit 2 : Internal photos.

Antenna type : Internal, Integral on PCB

Under normal operating conditions no approach of tag the device transmits 1.42 ms data pulse to check the integrity of system once in 200 ms.

The device is intended to be certified as modular device according to FCC Part 15 unlicensed modular approval.

1.2. Related submittal(s) Grants

This is application for certification of the transmitter.

No related devices are present.

1.3. Test Methodology

☒ The test setup and test was done according to: **ANSI C63.4: 2003**
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

☐ The test setup and test was done according to: **CISPR 22: 1998 + Corrigendum: 2003 + A1: 2000 + A2: 2003 and ANSI C63.4: 2003**

This conforms with requirements of FCC Part 15.207(a).

The test results detailed in this report apply only to the Series ERT 660 : Model ERT 660 and 661 with the test setup described. Any modification such as a change, addition to or inclusion of another device into this product will require an additional evaluation.

The support equipment listed as part of the emission tests is required to properly exercise and test the device under test.

1.4. Test Facility

The test site was semi-anechoic chamber Intertek Germany (PM KF 1150) and Open Field Test Site Intertek Germany. Radiated measurements were made with measurement distance EUT – Antenna was $d = 3\text{ m}$ and $d = 10\text{ m}$.

1.5. List of Exhibits

Following exhibits are delivered as separate pdf files. The name of file corresponds with description of exhibit with extension **.pdf**

Exhibit 1	External photos
Exhibit 2	Internal photos
Exhibit 3	Test setup photos
Exhibit 4	Installation manual
Exhibit 5	Block diagram
Exhibit 6	Circuit diagram
Exhibit 7	Operational description
Exhibit 8	Product labelling
Exhibit 9	Modular approval requirements

2. Measurements And Test Specifications

Emission - Requirements according to

- ☐ FCC, Part 15, Class A, verification
- ☐ FCC, Part 15, Class B, DoC
- ☐ FCC, Part 15, Class B, certification
- ☒ FCC, Part 15, intentional radiator, certification

2.1. Modifications to Test Report 07KFE007582-FCC-01

Chapter 5.4.1. **Extreme conditions – Temperature** : modified Table 2 – added detailed temperature dependencies. Added Fig. 7.

Chapter 5.5.1. **Radiated emissions 9 kHz-30 MHz – Field strength calculation** : corrected limit and calculated margin according to FCC part 15.225.

3. Description Of EUT

3.1. Configuration / Operating Conditions

☒ table-top EUT

☐ floor-standing EUT

There were two samples of each Model delivered :

Sample 1: was modified by manufacturer to transmit continuously. This sample was used for measurement of bandwidth and field strength ;

Sample 2 : has normal operation as specified by manufacturer . It was used for measurement of the duty cycle.

The equipment under test (EUT) was placed on non-conductive table 0,8 m above ground plane.

Measurements in the frequency range 9 kHz – 30 MHz were performed with shielded loop antenna and measuring receiver ESIB 26 in “Analyzer” mode. The measured values at distance 10 m (sample – antenna) were below noise level. The measurement was then repeated at distances 2m, 3m and 4m (Open area test site).

Measurements in frequency range 30 MHz – 1 GHz were performed with bilog antenna HL 562 and measuring receiver ESIB 26 in “Receiver” mode.

At all interference frequencies the height of the antenna is scanned in the range 1 m to 4 m with horizontal and vertical polarization and the turntable is rotated in the range 0° to 360° to obtain the highest field strength.

3.2. Major Subassemblies Or Internal Peripherals

Device	Manufacturer	Type	SN	FCC ID
none				

3.3. Peripheral Devices Used For Testing

Device	Manufacturer	Type	SN	FCC ID
Mains adaptor 230V/24 V AC	FRIWO	FE 4830	n/a	n/a
Power supply 110V AC/24 V DC	Laboratory sample	n/a	n/a	n/a

3.4. Supply- And Interconnecting Cables

Line	Length	shielded	non shielded	Shield on GND / PE
Supply cable AC/DC 24V	1.5 m	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

4. Test Results - Overview

	required	passed	passed with modification	not passed
Conducted emission	FCC 15.207	<input checked="" type="checkbox"/>		
Bandwidth	< 2.17 MHz, 0.25 % f_{op}	<input checked="" type="checkbox"/>		
Duty cycle	n/a for $f = 13.56$ MHz	<input type="checkbox"/>		
Radiated Emission				
9 kHz – 30 MHz	FCC 15.225	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30 MHz - 1000 MHz	FCC 15.225	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Measurement results detailed

5.1. Conducted Emission results

The conducted emission measurement was performed in frequency range 150 kHz – 30 MHz according to ANSI C63.4:2003. The EUT was for both models **sample 1** (modified by manufacturer to transmit continuously).

The disturbing voltage was measured with two mains adaptors:

a) 230 V 50 Hz/ 24 V AC at AC input 230 V; Model ERT 661

b) 110 V 60 Hz AC / 24 V DC at AC input 110 V: Models ERT 660 and ERT 661

Scan Setup: Voltage with 2-Line-LISN fin [EMI conducted] : all tests

Hardware Setup:

Voltage with 2-Line-LISN

Level Unit:

dBµV

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
150kHz - 30MHz	QuasiPeak; Average	10kHz	1s	ESHS

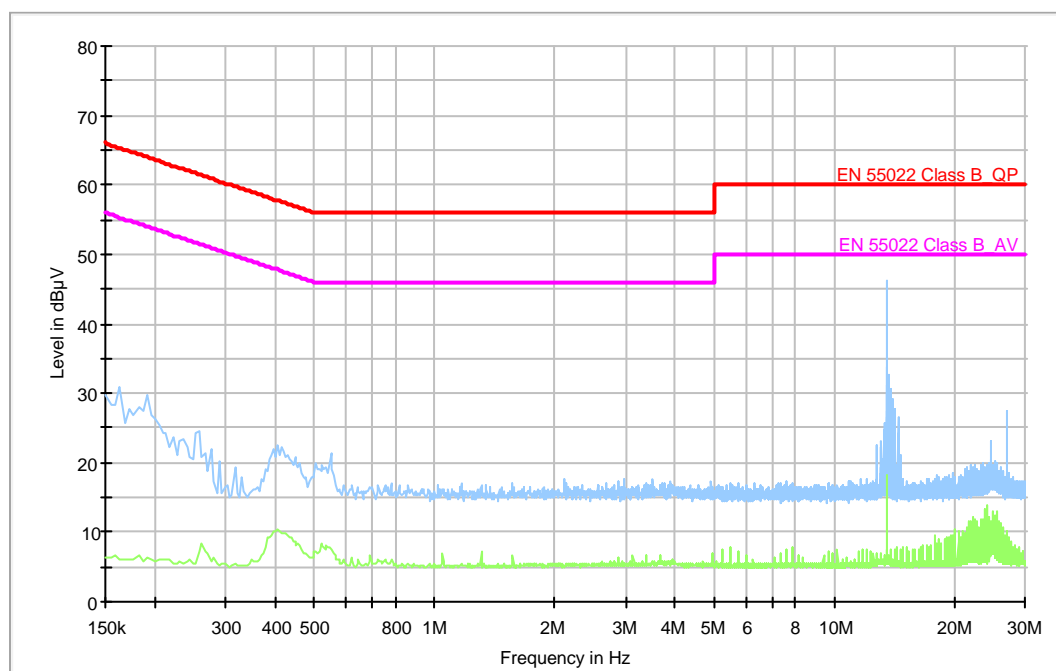
Conducted disturbance with Adaptor 110V AC 60 Hz/ 24 V AC :
Model ERT 660

EMC32 Report

Test information

EUT Name:	ER 660 (without LED's)
Serial Number:	Sample 1
Test Description:	110 V 60 Hz
Operating Conditions:	
Operator Name:	MSV
Comment:	

Voltage with 2-Line-LISN_EN55022 Class B



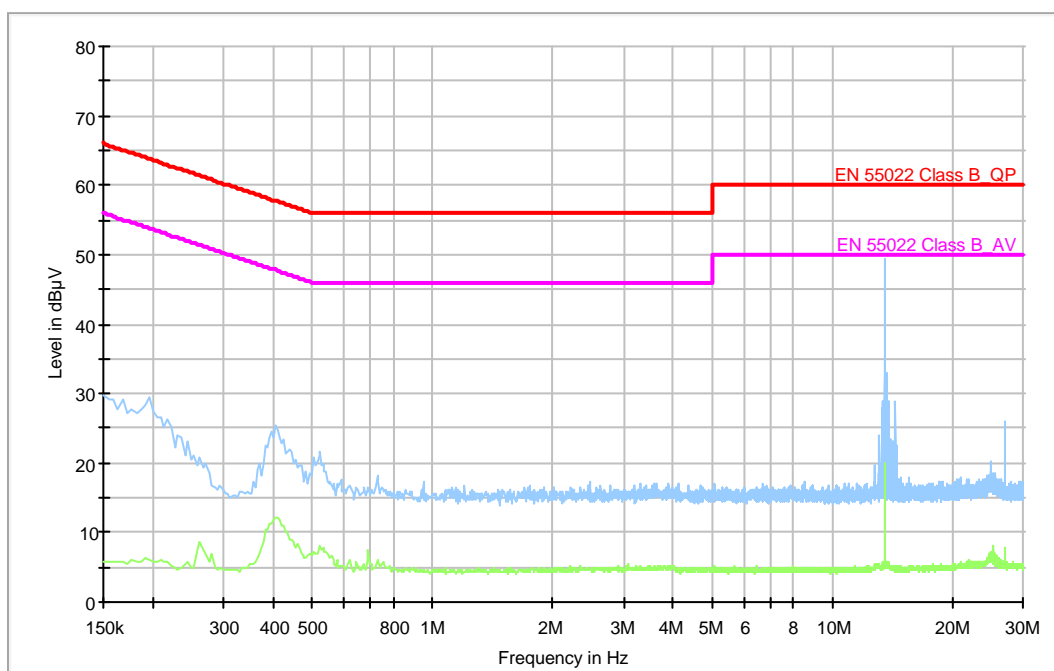
Conducted disturbance with Adaptor 110V AC 60 Hz/ 24 V AC :
Model ERT 661

EMC32 Report

Test information

EUT Name:	ER 661 (with LED's)
Serial Number:	Sample 1
Test Description:	110 V 60 Hz
Operating Conditions:	
Operator Name:	MSV
Comment:	

Voltage with 2-Line-LISN_EN55022 Class B



5.2. Duty cycle

The duty cycle was measured by means of the measuring receiver/spectrum analyzer ESIB 26 in “Analyzer mode”.

The measurement was performed with Model ERT 661, sample 2. The Model ERT 660 has identical high frequency part and identical duty cycle.

Fig. 1 shows the length of single data pulse in 5 ms window in absence of tag.

Fig. 2 demonstrates the duty cycle under normal operation in 500 ms window in absence of tag.

Fig. 3 shows the length of single data pulse in presence of tag.

Fig. 4 demonstrates the duty cycle under normal operation in 500 ms window in presence of tag.

Summary of duty cycle measurement (Table 1) :

	Pulse length in absence of tag	Pulse length in presence of tag
Single data pulse length	1.42 ms	7.4 ms
Repetition time	200 ms	200 ms

Table 1

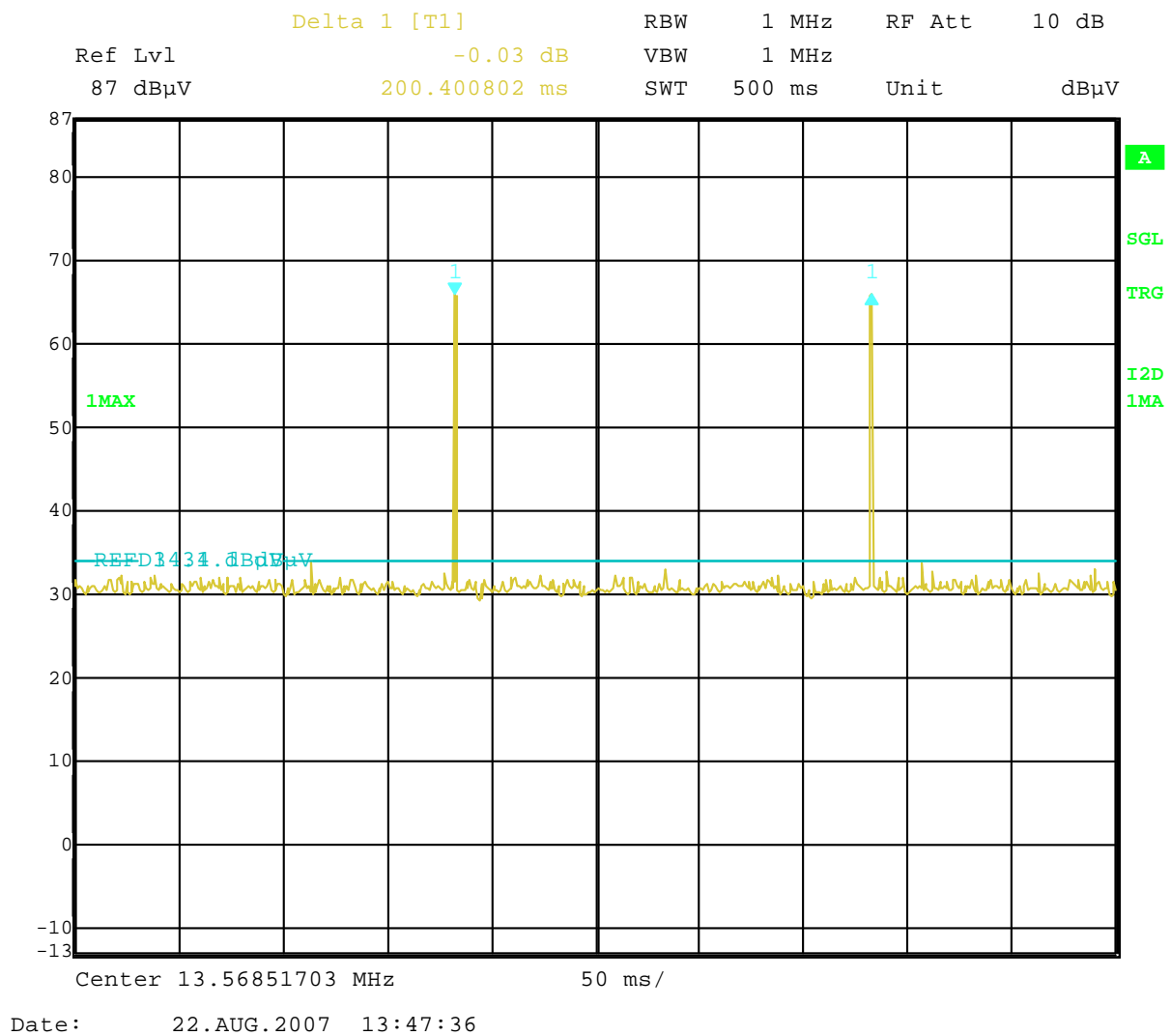


Fig .1

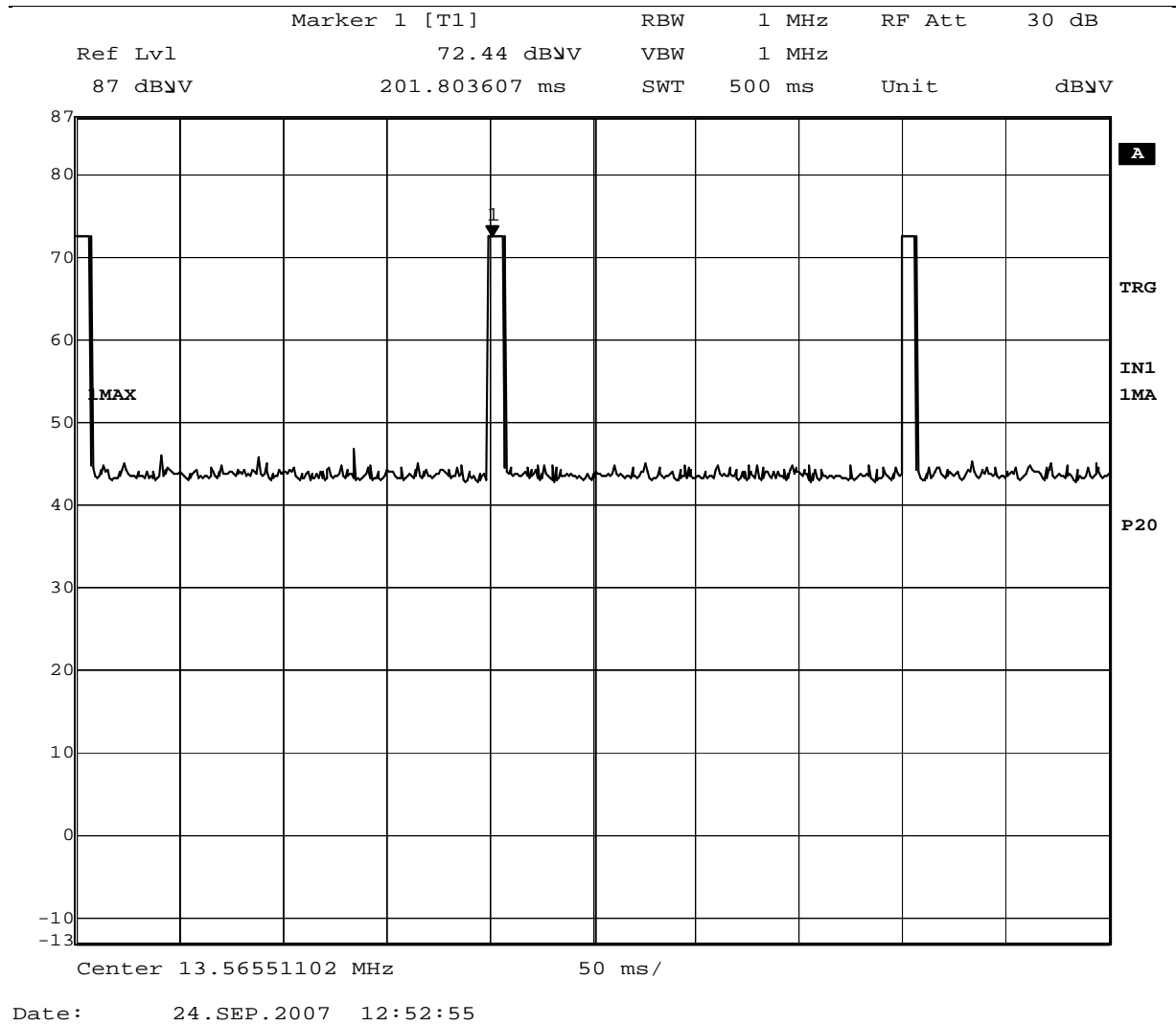


Fig .2

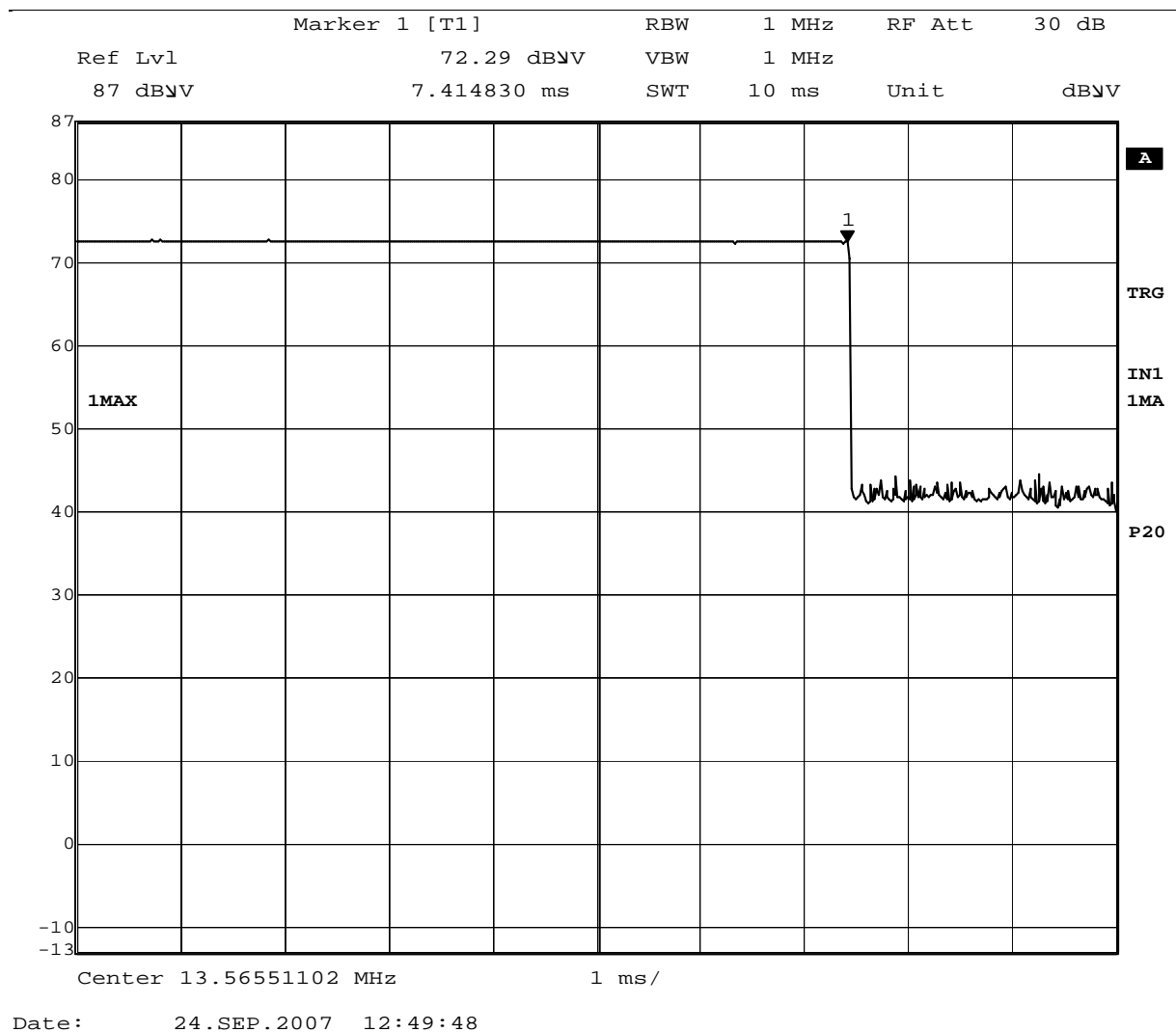


Fig .3

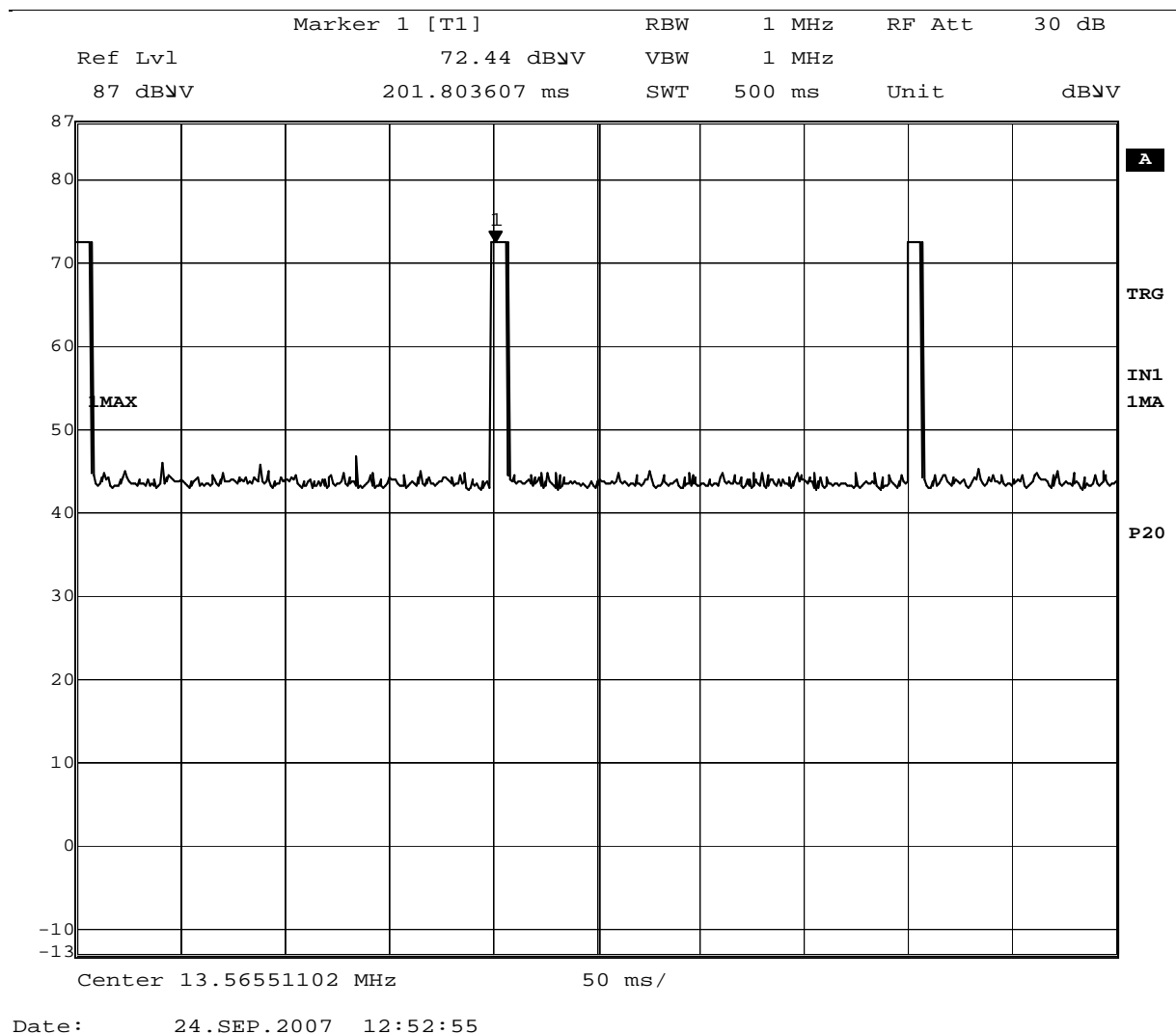


Fig .4

5.3. Bandwidth

The measurement was performed with Model ERT 661, sample 1. The Model ERT 660 has identical high frequency part / identical bandwidth.

The measured 20 dB bandwidth is shown on Fig. 5

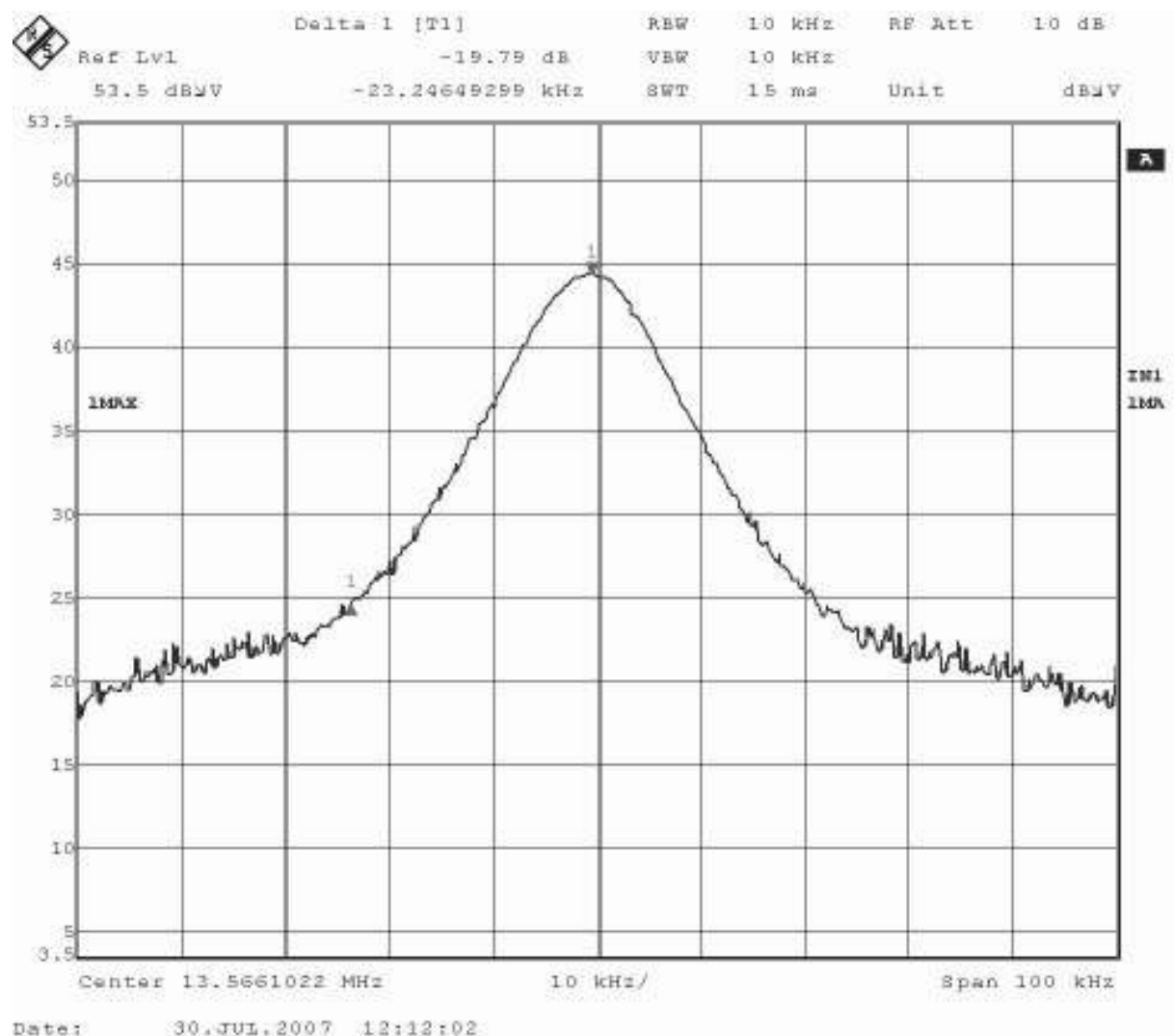


Fig .5

The BW is 46,5 kHz, operating frequency $f = 13,56$ MHz.

5.4. Extreme conditions

5.4.1. Temperature

The measurement was performed with Model ERT 661, sample 4. The Model ERT 660 has identical high frequency part.

During the test was recorded center frequency of transmitter and shape of resonance curve.

The frequency stability of the transmitter was tested under extremal operational conditions in climatic chamber :

Results are given in Table 2 and Fig. 6, deviation from center frequency ($T = 20^{\circ}\text{C}$) is demonstrated in Fig. 7.

Temperature	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
Center f (MHz)	13,56521	13,56519	13,56518	13,56509	13,56521	13,56500	13,56502	13,56491
Deviation from $f_{T=20^{\circ}\text{C}}$ (%)	0,0000%	0,0001%	0,0002%	0,0009%	0,0000%	0,0016%	0,0014%	0,0022%

Table 2

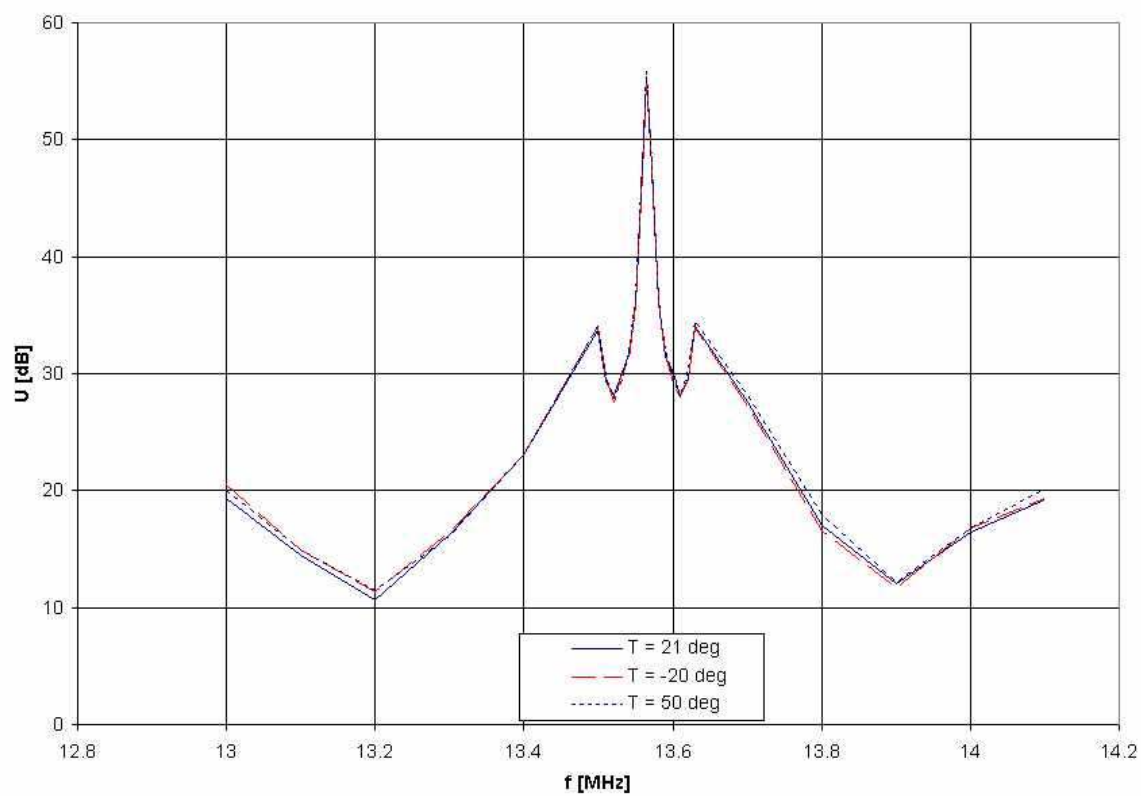


Fig .6

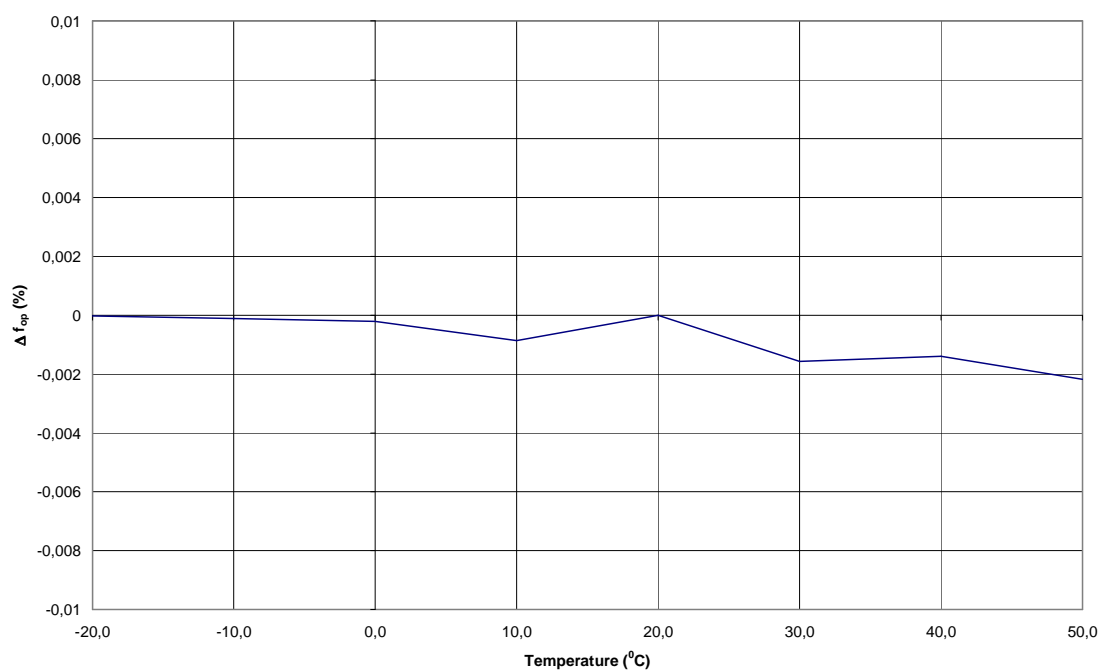


Fig .7

There was found no dependence of oscillator center frequency on temperature in range 0,01 %.

5.4.2 Feeding voltage

Voltage : 12V , 24 V , 35 V both AC and DC

The measurement was performed with Model ERT 661, sample 1. The Model ERT 660 has identical high frequency part.

The feeding voltage was applied directly on device supply input without using AC/AC or AC/DC adaptor. Results are given in Table 3 and Table 4.

Input voltage (V) AC	12	24	35
Center f (MHz)	13,566	13.566	13,566

Table 3

Input voltage (V) DC	12	24	35
Center f (MHz)	13,566	13.566	13,566

Table 4

There was found no dependence of transmitter frequency on feeding voltage.

5.5. Radiated Emission 9 kHz – 30 MHz

The measurement was performed with Model ERT 661, sample 1 (continuous transmission). Model ERT 660 has identical high frequency part.

In the frequency range $9 \text{ kHz} < f < 30 \text{ MHz}$ was used shielded loop antenna and the receiver ESIB 26 in "Analyzer mode". Data was measured for worst case configuration which resulted in highest emission level.

Measured values performed at distance $d = 10 \text{ m}$ (shielded loop antenna – EUT) , were bellow the noise level.

Therefore measurement was performed at closer distances and values calculated to $d = 30 \text{ m}$.

Measured values are as follows :

$$f = 13,565 \text{ MHz}$$

d	2 m	3 m	4 m
RR dB μ V	34,95	28,11	25,26

The detector used was PEAK.

5.5.1 Field strength calculation

The field strength is calculated by adding the reading on the measuring receiver to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when the specified limit is related to average detector and measurements are made with peak detector.

A sample of calculation is included below :

$$E = RR + AF + CF - AG + PD + AV$$

Where

- E field strength in dB μ V/m
 - RR receiver reading including preamplifier in dB μ V
 - CF cable attenuation factor in dB
 - AF antenna factor in dB/m
 - AG amplifier gain in dB
- Calculated values :

Factors are as follows :

$$CF = 0,2 \text{ dB}$$

AF = 37,5 dB/m – amplifier included
PD = 0 dB

Then the measured field strength at specified distances is:
 $f = 13,566 \text{ MHz}$

d	2 m	3 m	4 m
RR (dB μ V)	32,67	25,56	20,98
CF (dB)	0,2	0,2	0,2
AF (dB/m)	37,5	37,5	37,5
E (dB μ V/m)	70,37	63,26	58,68

To compare with limits the 40 dB/decade extrapolation was used.
Extrapolated field strength at distance $d = 30 \text{ m}$ calculated from measuring distances 2 m, 3 m and 4 m is :

E (dBμV/m)	23,3	23,3	23,7
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Limit according to FCC part 15.225 is at $f = 13,566 \text{ MHz}$: $E = 15,848 \text{ } \mu\text{V/m}$,
corresponding to 84 dB μ V/m.

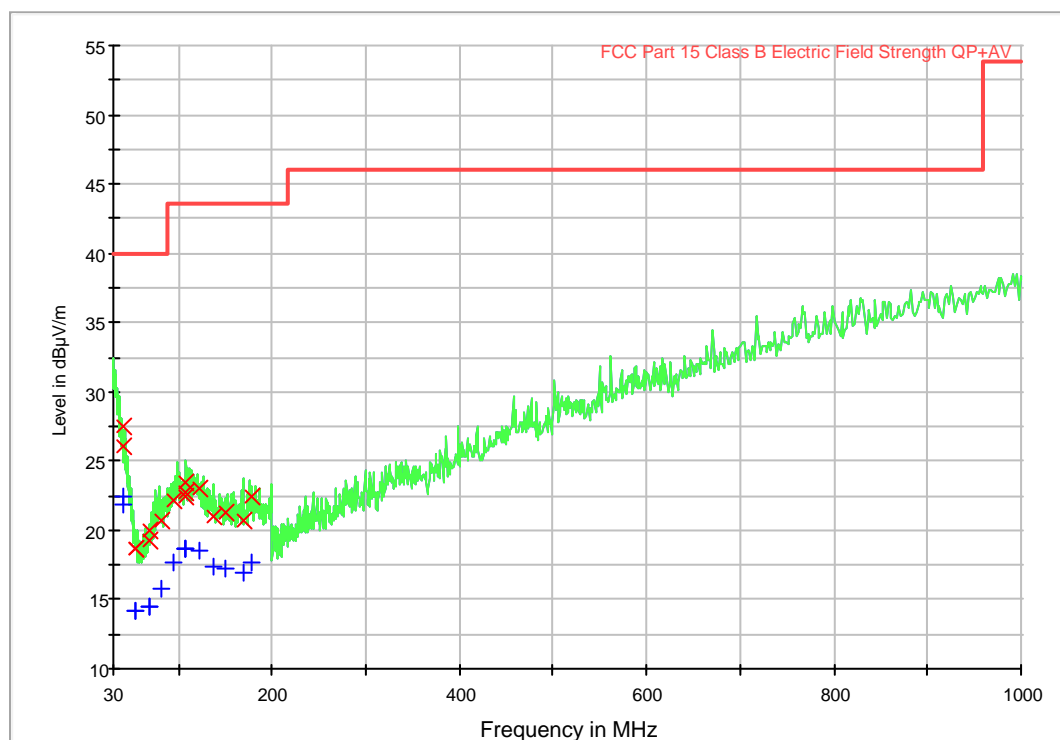
Margin to limit (extrapolated from result at $d = 4 \text{ m}$) is : **56.3 dB**

Spurious emissions of the fundamental frequency in the frequency range up to 30 MHz were not found.

5.6. Radiated Emission 30 MHz – 1 GHz

The measurement was performed with Model ERT 661, sample 1. The Model ERT 660 has identical high frequency part and no LED's.

Radiated emissions in the frequency range $30 \text{ MHz} < f < 1000 \text{ MHz}$



Result Table_Single

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)
40.680000	22.4	1000.00	120.000	160.0	V	0.0	14.2	< -10
54.240000	14.2	1000.00	120.000	250.0	V	0.0	6.7	< -10
67.800000	14.4	1000.00	120.000	250.0	V	0.0	6.6	< -10
81.120000	15.8	1000.00	120.000	250.0	V	0.0	8.7	< -10
94.920000	17.6	1000.00	120.000	250.0	V	0.0	9.5	< -10
108.103845	18.6	1000.00	120.000	100.0	V	0.0	10.6	< -10
108.103845	18.6	1000.00	120.000	250.0	V	0.0	10.6	< -10
122.360115	18.5	1000.00	120.000	250.0	V	0.0	10.6	< -10
136.846055	17.4	1000.00	120.000	231.0	V	0.0	9.1	< -10
149.421134	17.2	1000.00	120.000	250.0	V	0.0	8.6	< -10
168.115439	16.9	1000.00	120.000	250.0	V	0.0	8.4	< -10
176.726077	17.7	1000.00	120.000	250.0	V	0.0	8.9	< -10

There were found no spurious emissions in the frequency range 30 MHz-1000 MHz.

Normative references

Limits equivalent:	FCC, Part 15.225, Part 15.209 where appropriate
Methods of Measurement equivalent:	ANSI C63.4

Test requirement

Class	B
Distance Antenna – EUT	3 m
Frequency range	30 MHz - 1000 MHz

Place of measurement

- ☒ Semi anechoic chamber Intertek Germany PM KF 1150.
☐ Open Area Test Site

Measurement devices

Measurement device	Manufacturer	Type	SN	Asset No.	Last Calibr. at ion	Inter- val
<input checked="" type="checkbox"/> Test receiver, 20Hz-26GHz	ESIB26	Rohde & Schwarz	100150	PM KF 0948	07-03	1
<input checked="" type="checkbox"/> Antenna, 9 kHz-30 MHz	MessTec	RA 30.1	960101	PM KF 0875	09-05	2
<input checked="" type="checkbox"/> Antenna, 30-3000 MHz	HL562	Rohde & Schwarz	100354	PM KF 1123	07-03	2
<input type="checkbox"/> Horn antenna, 1-18 GHz	Rohde & Schwarz	HF906	100188	PM KF 0947	05-05	2
<input type="checkbox"/> Horn antenna preamp.	Bonn	BLMA0118-4A	35352	PM KF 0946	05-05	2

Emission Test results

Test requirements ☒ **passed** ☐ **passed with modification** ☐ **not passed**

Comment:

The radiated emissions between 30 MHz and 1000 MHz are under the limit specified in FCC 15.209.

6. Test setup Photo documentation

Exhibit 3

7. Technical specification

7.1. External photos

Exhibit 1

7.2. Internal photos

Exhibit 2

7.3. Block Diagram Of The EUT

Exhibit 5

7.4. Circuit Diagram Of The layout

Exhibit 6

7.5. Installation manual

Exhibit 4

7.6. Operational description

Exhibit 7

7.7. Product Labelling

EXHIBIT 8

8. **Modular approval requirements**

EXHIBIT 9