

# EMI - TEST REPORT

- FCC Part 15C -

**Type / Model Name** : 1E0671-1 MCR2.9, 1E0671 LCM

**Product Description** : RFID reader

**Applicant** : Haberl Electronic GmbH & Co. KG

**Address** : Kochstraße 2

94424 Arnstorf

GERMANY

**Manufacturer** : Haberl Electronic GmbH & Co. KG

**Address** : Kochstraße 2

94424 Arnstorf

GERMANY

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

**POSITIVE**

**Test Report No. :** T39598-00-02JP

21. May 2015

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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# 1 TEST STANDARDS

The tests were performed according to following standards:

## **FCC Rules and Regulations Part 15 Subpart A - General (September, 2014)**

## **FCC Rules and Regulations Part 15 Subpart C - Unintentional Radiators (September, 2014)**

Part 15, Subpart C, Section 15.207	AC Line conducted emission
Part 15, Subpart C, Section 15.209	Radiated emission, general requirements
Part 15, Subpart C, Section 15.225	Operation within the band 13.110 - 14.010 MHz

ANSI C63.4: 2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
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CISPR 16-4-2: 2011 EN 55016-4-2: 2011	Uncertainty in EMC measurement
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## 2 EQUIPMENT UNDER TEST

### 2.1 Short description of the equipment under test (EUT)

The EuT is a RFID reader intended to be used in cars. The user can identify himself by use of an RFID tag to get access to the car.

### 2.2 Operation frequency and channel plan

LF reader: 125kHz

HF reader 13.56MHz

### 2.3 Antenna

Integral antennas are used. The user cannot change the antenna

### 2.4 Transmit operating modes

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

- continuous TAG reading at 125kHz

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- continuous TAG reading at 13.56MHz

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- continuous TAG reading at 125kHz & 13.56MHz

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### 2.5 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 13.5V DC

### 2.6 Peripheral devices and interface cables

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

- |                       |                            |
|-----------------------|----------------------------|
| - Cable harness       | Model : Supplied by client |
| - CAN / LIN interface | Model : VN1630, Vector     |

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### 3 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 : 28. April 2015

Testing concluded on : 04. Mai 2015

Checked by:

Tested by:

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Klaus Gegenfurtner  
Teamleader Radio

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Jürgen Pessinger

## 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.

## 4.4 Measurement protocol for FCC

### 4.4.1 General information

#### 4.4.1.1 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.

#### 4.4.1.2 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.

### 4.4.2 Details of test procedures

#### 4.4.2.1 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 Emission 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.

### 4.4.3 Conducted emission

#### 4.4.3.1 Description of measurement

The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit or to the CISPR limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \cdot \log(\mu\text{V}) \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50  $\Omega$  / 50  $\mu$ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. 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.

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### 4.4.4 Radiated emission (electrical field 30 MHz - 1 GHz)

#### 4.4.4.1 Description of measurement

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned in horizontal polarisation and is repeated vertically. To locate maximum emission from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dB $\mu$ V/m is calculated by add the antenna correction factor and cable loss factor (dB) on the reading from the EMI receiver (dB $\mu$ V). The FCC or CISPR limit is subtracted from this result in order to provide the delta to limit listed in the measurement protocol.

Example:

Frequency (MHz)	Reading level (dB $\mu$ V)	+	Correction Factor (dB/m)	=	Level (dB $\mu$ V/m)	-	CISPR Limit (dB $\mu$ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

### 4.4.5 Radiated emission (electrical field 1 GHz - 40 GHz)

#### 4.4.5.1 Description of measurement

Radiated emission from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emission under better uncertainty and is calculated to the specified test distance.



## **5 TEST CONDITIONS AND RESULTS**

### **5.1 Conducted emission**

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

#### **5.1.1 Description of the test location**

Test location: none

Used software: none

#### **5.1.2 Applicable standard**

According to FCC Part 15, Section 15.207:

#### **5.1.3 Test result**

Frequency range: none

Min. limit margin none

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

**Remarks:** TEST NOT APPLICABLE. The EuT is not connected to AC mains. It is used exclusively in vehicles.

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### 5.2 Field strength of the fundamental wave – 125 kHz

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 Applicable standard

According to FCC Part 15C, Section 15.209:

#### 5.2.3 Description of Measurement

The magnetic field strength from the EUT will be measured at an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The setup of the equipment under test will be in accordance to ANSI C63.4. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to FCC Part 15C, Section 15.31(f)(2). The final measurement will be performed with an EMI receiver set to 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 FCC Part 15C, Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBμV)	+	Corr. factor (dB/m)	=	Level dB(μV/m)	-	Limit dB(μV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

#### 5.2.4 Test result

Measurement result at 3m measurement distance

Frequency (kHz)	Level Pk (dBμV)	Corr. factor (dB)	Corr. level Pk dB(μV/m)
125	63.3	20.0	83.8

Extrapolated values to a distance of 300m

Frequency (kHz)	Level Pk (dBμV)	Corr. factor (dB)	Corr. level Pk dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
125	-16.8	20.0	3.8	25.6	-21.8

Limit according to FCC Part 15C, Section 15.209(a):

Frequency (MHz)	Field strength		Measurement distance (metres)
	(μV/m)	dB(μV/m)	
<b>0.009-0.490</b>	<b>2400/F(kHz)</b>	--	<b>300</b>
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

**Remarks:** Peak level is below the average limit; therefore no average measurement was performed.

## FCC ID: 2AELV-1E0671-1

### 5.1 Field strength of the fundamental wave – 13.56MHz

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

#### 5.1.1 Description of the test location

Test location: OATS1  
Test distance: 3 metres

#### 5.1.2 Applicable standard

According to FCC Part 15, Section 15.225:

#### 5.1.3 Description of Measurement

The magnetic field strength from the EUT will be measured at an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The setup of the equipment under test will be in accordance to ANSI C63.4. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to FCC Part 15C, Section 15.31(f)(2). The final measurement will be performed with an EMI receiver set to 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 FCC Part 15C, Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBμV)	+	Corr. factor (dB/m)	=	Level dB(μV/m)	-	Limit dB(μV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

#### 5.1.4 Test result

Measurement result at 3m measurement distance

Frequency (kHz)	Level QP (dBμV)	Corr. factor (dB)	Corr. level QP dB(μV/m)
13.56	54.6	20.0	74.6

Extrapolated values to a distance of 30m

Frequency (kHz)	Level QP (dBμV)	Corr. factor (dB)	Corr. level QP dB(μV/m)	Limit QP dB(μV/m)	Delta (dB)
13.56	14.6	20.0	34.6	84.0	-49.4

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

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

The requirements are **FULFILLED**.

Remarks: none

## 5.2 Spurious emissions

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

### 5.2.1 Description of the test location

Test location: OATS1  
Test distance: 3 metres

### 5.2.1 Applicable standard

According to FCC Part 15C, Section 15.209:

### 5.2.2 Description of Measurement

The spurious emissions from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 1000 MHz using a tuned EMI receiver. In the case where larger measuring distances are required the results will be extrapolated, based on the values measured on the closer distances according to Section 15.31(f)(2). The final measurement will be performed with the EMI an Receiver set to 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)(2).

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

Example:

Frequency (MHz)	Level (dBμV)	+	Factor (dB)	=	Level dB(μV/m)	-	Limit dB(μV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

### 5.2.3 Test result

Operation mode: continous TAG reading at 125kHz

Measurement below 30MHz

f (kHz)	Level Pk@3m (dBμV)	Ant. factor (dB/m)	Field strength Pk@3m dB(μV/m)	Distance corr. 3m to 300m (dB)	Corrected level Pk@300m dB(μV/m)	Limit AV@300m dB(μV/m)	Delta (dB)
250	35.6	20	55.6	-80	-24.4	19.6	-44.0
375	32.0	20	52.0	-80	-28.0	16.1	-44.1
f (kHz)	Level QP@3m (dBμV)	Ant. factor (dB/m)	Field strength QP@3m dB(μV/m)	Distance corr. 3m to 30m (dB)	Corrected level QP@30m dB(μV/m)	Limit QP@30m dB(μV/m)	Delta (dB)
500	23.1	20	43.1	-40	3.1	33.6	-30.5
625	20.9	20	40.9	-40	0.9	31.6	-30.7
750	17.0	20	37.0	-40	-3.0	30.1	-33.1

NOTE: If the measured PK level is below the AV limit, no AV measurement was performed

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### Measurement 30MHz to 1000MHz

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)
50.00	9.8	9.9	15.4	14.2	25.2	24.1	40.0	-14.8
200.00	11.3	12.0	11.4	11.9	22.7	23.9	43.5	-19.6
500.00	3.2	2.8	22.6	22.4	25.8	25.2	46.0	-20.2

Shown values are background noise, no emissions from EuT found.

### Operation mode: continous TAG reading at 13.56MHz

### Measurement below 30MHz

f (MHz)	Level QP@3m (dBμV)	Ant. factor (dB/m)	Field strength QP@3m dB(μV/m)	Distance corr. 3m to 30m (dB)	Corrected level QP@30m dB(μV/m)	Limit QP@30m dB(μV/m)	Delta (dB)
27.12	0.8	20	20.8	-40	-19.2	29.5	-48.7

### Measurement 30MHz to 1000MHz

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)
40.67	20.7	6.1	14.7	13.6	35.4	19.7	40.0	-4.6
54.23	22.8	7.0	15.1	14.0	37.9	21.0	40.0	-2.1
67.79	25.5	13.5	14.2	13.5	39.7	27.0	40.0	-0.3
149.15	4.5	-1.2	14.0	14.7	18.5	13.5	43.5	-25.0
284.75	8.2	1.7	16.0	15.7	24.2	17.4	46.0	-21.8
501.71	7.3	3.7	22.6	22.4	29.9	26.1	46.0	-16.1

### Operation mode: continous TAG reading at 125kHz & 13.56MHz

### Measurement below 30MHz

f (kHz)	Level Pk@3m (dBμV)	Ant. factor (dB/m)	Field strength Pk@3m dB(μV/m)	Distance corr. 3m to 300m (dB)	Corrected level Pk@300m dB(μV/m)	Limit AV@300m dB(μV/m)	Delta (dB)
250	35.6	20	55.6	-80	-24.4	19.6	-44.0
375	32.0	20	52.0	-80	-28.0	16.1	-44.1
f (kHz)	Level QP@3m (dBμV)	Ant. factor (dB/m)	Field strength QP@3m dB(μV/m)	Distance corr. 3m to 30m (dB)	Corrected level QP@30m dB(μV/m)	Limit QP@30m dB(μV/m)	Delta (dB)
500	23.1	20	43.1	-40	3.1	33.6	-30.5
625	20.9	20	40.9	-40	0.9	31.6	-30.7
750	17.0	20	37.0	-40	-3.0	30.1	-33.1
27120	0.8	20	20.8	-40	-19.2	29.5	-48.7

NOTE: If the measured PK level is below the AV limit, no AV measurement was performed

## FCC ID: 2AELV-1E0671-1

Measurement 30MHz to 1000MHz

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)
40.67	20.7	6.1	14.7	13.6	35.4	19.7	40.0	-4.6
54.23	22.8	7.0	15.1	14.0	37.9	21.0	40.0	-2.1
67.79	25.5	13.5	14.2	13.5	39.7	27.0	40.0	-0.3
149.15	4.5	-1.2	14.0	14.7	18.5	13.5	43.5	-25.0
284.75	8.2	1.7	16.0	15.7	24.2	17.4	46.0	-21.8
501.71	7.3	3.7	22.6	22.4	29.9	26.1	46.0	-16.1

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

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	(µV/m)	dB(µV/m)	(metres)
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:** none

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### 5.3 Frequency tolerance

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

#### 5.3.1 Description of the test location

Test location: AREA4

#### 5.3.2 Applicable standard

According to FCC Part 15, Section 15.225:

#### 5.3.3 Description of Measurement

The frequency tolerance is measured with the spectrum analyzer. The sweep points were set to maximum for higher the frequency resolution or the function "frequency counter" is used. The signal is unmodulated; the marker of the analyzer is set to maximum amplitude at normal temperature, the frequency was recorded. Than the maximum supply voltage is set and the marker of the analyzer is set to maximum amplitude. This procedure is done again for the minimum supply voltage. The EUT was now driven at normal supply voltage but in the climatic chamber to range the temperature from -20 °C to +50 °C in steps of 10 degrees. The drifting carrier is measured by setting the marker at the analyzer.

#### 5.3.4 Test result

Test conditions		Test result
		Frequency (MHz)
$T_{min} (-20)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56010
$T (-10)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56014
$T (0)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56014
$T (10)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56014
$T_{nom} (20)^{\circ}\text{C}$	$V_{min} (11.4 \text{ V})$	13.56006
$T_{nom} (20)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56008
$T_{nom} (20)^{\circ}\text{C}$	$V_{max} (15.6 \text{ V})$	13.56008
$T (30)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56006
$T (40)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56000
$T_{max} (50)^{\circ}\text{C}$	$V_{nom} (13.5 \text{ V})$	13.56000
Measurement uncertainty		$\pm 10 \text{ Hz}$

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

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

Highest frequency measured:  $f_h = 13.56014 \text{ MHz}$

Lowest frequency measured:  $f_l = 13.56000 \text{ MHz}$

Positive tolerance:  $f_h - f_c = -0.14 \text{ kHz} < + 1.356 \text{ kHz}$

Negative tolerance:  $f_l - f_c = -0.0 \text{ kHz} < - 1.356 \text{ kHz}$

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: Not applicable for the 125kHz part

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

**5.4.1 Description of the test location**

Test location: AREA4

**5.4.2 Applicable standard**

According to FCC Part 15C, Section 15.215:

**5.4.3 Description of Measurement**

The bandwidth is measured at an amplitude level related to the reference level by a specified ratio of -20 dB. The reference level is the level of the highest amplitude signal observed from 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. As alternative the bandwidth was measured with the function "n-dB down" of the spectrum analyzer and recorded. The measurement was performed conducted. The test signal may be modulated as intended.

Spectrum analyzer settings:

RBW: 1 kHz VBW: 1 kHz Detector Peak  
Sweep time auto

**5.4.4 Test result**

Channel Frequency (MHz)	20 dB bandwidth (kHz)
0.125	25.0
13.56	34.4

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

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.

The requirements are **FULFILLED**.

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

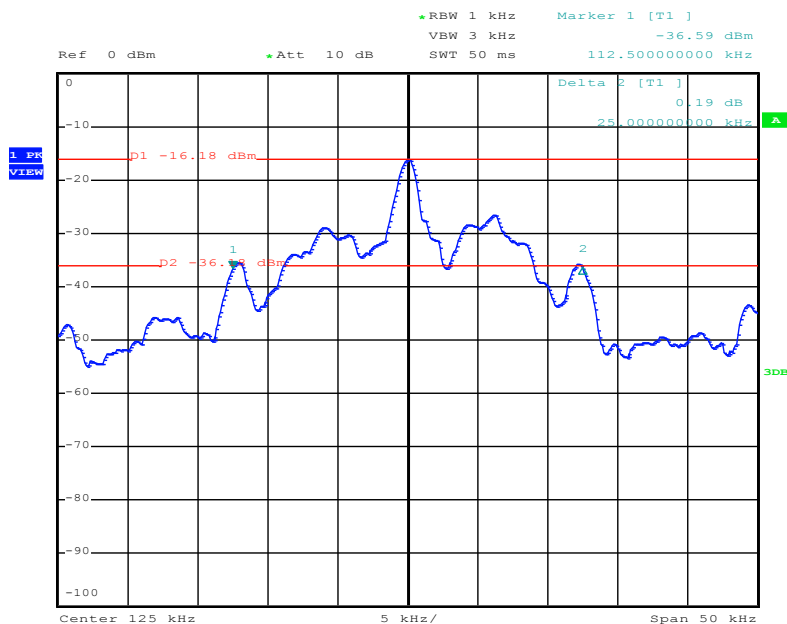
The -20dBc line is below the general field strength limit according to FCC part 15.209.



## FCC ID: 2AELV-1E0671-1

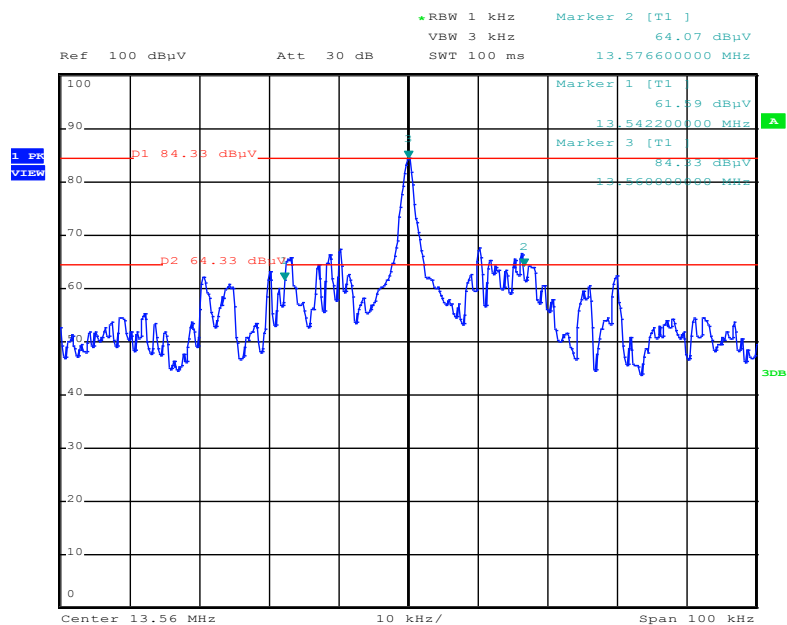
### 5.4.5 Test protocol

125kHz



Date: 12.MAY.2015 09:12:50

13.56MHz



Date: 27.APR.2015 17:54:17

## FCC ID: 2AELV-1E0671-1

### 5.5 Transmitter spectrum mask

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

#### 5.5.1 Description of the test location

Test location: AREA4

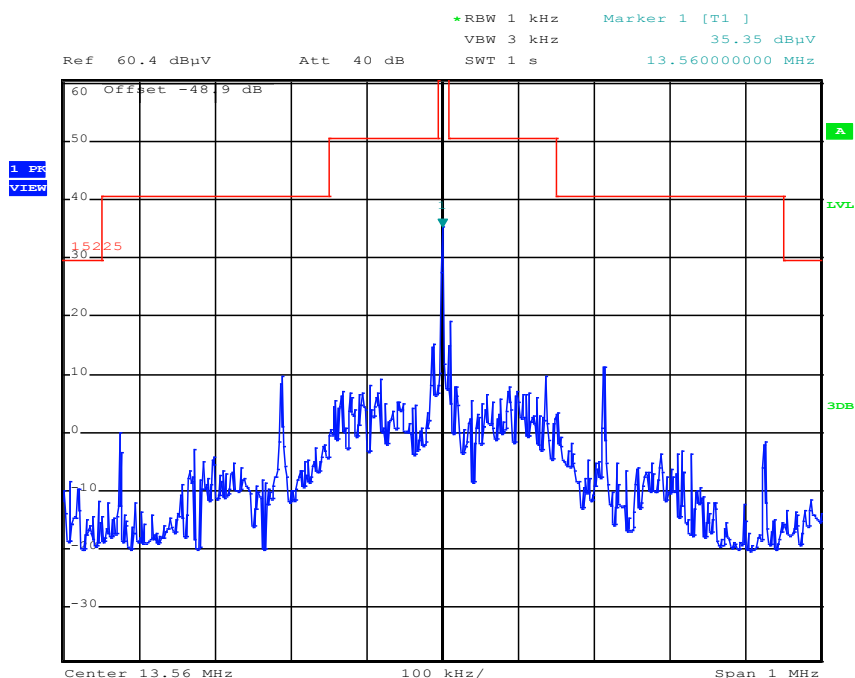
#### 5.5.2 Applicable standard

According to FCC Part 15C, Section 15.225:

#### 5.5.3 Description of Measurement

The spectrum mask is measured using a spectrum analyser. The profile of the spectrum mask is displayed on analyser and has to be adjusted to the reference level given as maximum output power at 30m measurement distance according to subclause 5.2.5. The test signal may be modulated as intended.

#### 5.5.4 Test result



Date: 27.APR.2015 17:51:02

**FCC ID: 2AELV-1E0671-1**

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 ( $\mu\text{V/m}$ )	Emission level limit at 30 m (dB $\mu\text{V/m}$ )
13.110 – 13.410	106	40.5
13.410 - 13.553	334	50.5
13.553 - 13.567	15,848	84.0
13.567 – 13.710	334	50.5
13.710 – 14.010	106	40.5
outside of 13.110 – 14.010	30	29.5

The requirements are **FULFILLED**.

**Remarks:** Not applicable for the 125kHz part

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## **6 USED TEST EQUIPMENT AND ACCESSORIES**

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

<b>Test ID</b>	<b>Model Type</b>	<b>Equipment No.</b>	<b>Next Calib.</b>	<b>Last Calib.</b>	<b>Next Verif.</b>	<b>Last Verif.</b>
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		
	S10162-B	02-02/50-05-031				
	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	20/10/2015	20/10/2014		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	WK-340/40	02-02/45-05-001	24/06/2015	24/06/2014		
	6543A	02-02/50-05-157				
MB	FSP 30	02-02/11-05-001	20/10/2015	20/10/2014		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	WK-340/40	02-02/45-05-001	24/06/2015	24/06/2014		
	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		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	03/07/2015	03/07/2014	17/10/2015	17/04/2015
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015		
	S10162-B	02-02/50-05-032				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				