



EMI - TEST REPORT

- FCC Part 15.209 -

Type / Model Name : M# JA-125kHz

Product Description : Immobilizer

Applicant : Aptiv Services Deutschland GmbH

Address : Am Technologiepark 1
42119 Wuppertal, Germany

Manufacturer : Aptiv Services Deutschland GmbH

Address : Wiehlpuhl 4
51766 Engelskirchen, Germany

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. : T43743-01-02HU	09. July 2018 Date of issue
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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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2 SUMMARY

GENERAL REMARKS:

The EuT is working at frequency of 125.0 kHz.

The EUT is a part of a locking system, the test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst case position of the EuT.

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 : 29. March 2018

Testing concluded on : 12. April 2018

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage: : 12.0 V / DC (vehicle battery)

3.3 Short description of the Equipment under Test (EUT)

The EUT is an immobilizer system for vehicular use. It will be powered via vehicle battery.

Number of tested samples: 1 System

Serial number: Prototype

Art. No.: 28627735

Version: TRANSCV- INTI /THF

Sample No.: according to attached excell

Variant: W/ PROTRUSION

Project: JA20IM

EUT operation mode:

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

- Tx mode at 125.0 kHz

-

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EUT configuration:

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

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- customer specific cables

- unscreened power cables

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.

4.5 Measurement Protocol for FCC, VCCI and AUSTEL

4.5.1 GENERAL INFORMATION

4.5.1.1 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.

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.

4.5.1.2 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.

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: NONE

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

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

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

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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

5.1.4 Test result

Frequency range:

Min. limit margin

Remarks: The measurement is not applicable. The EuT is powered via vehicle battery.

5.2 Field strength of the fundamental wave

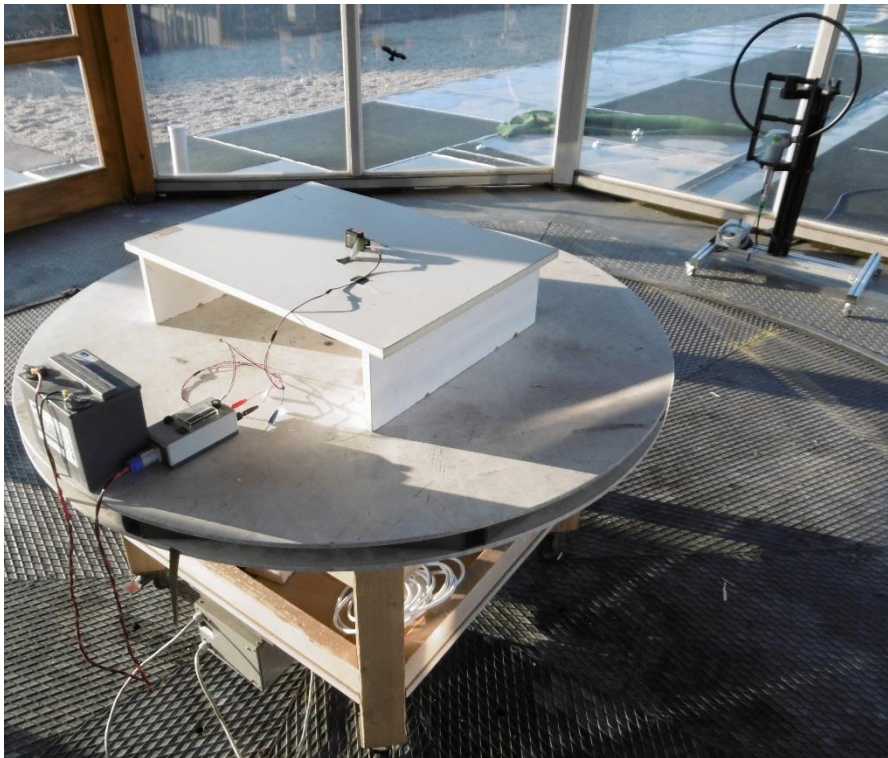
For test instruments and accessories used see section 6 Part CPR 1.

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



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.2 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 C63.4. 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 kHz
150 kHz – 30 MHz:	RBW:	9 kHz

FCC ID: LTQJA125

Example:

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

5.2.3 Test result

Measurement distance: 3 m

Frequency (kHz)	Level PK (dB μ V)	Level QP (dB μ V)	Level AV (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level QP dB(μ V/m)	Corrected Level AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
125.0	68.9	68.7	68.5	0.2	20	88.9	88.7	88.5	105.67	-17.17

Calculated value at distance: 300 m

Frequency (kHz)	Level PK (dB μ V)	Level QP (dB μ V)	Level AV (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level QP dB(μ V/m)	Corrected Level AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
125.0	-11.1	-11.3	-11.5	0.2	20	8.9	8.7	8.5	25.67	-17.7

Note: To find out the maximum magnetic field strength, test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst-case position of the EuT (Photo documentation of the test set-up).

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

Frequency (MHz)	Field strength of fundamental wave		Measurement distance (metres)
	(μ V/m)	dB(μ 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

The requirements are **FULFILLED**.

Remarks:

5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz

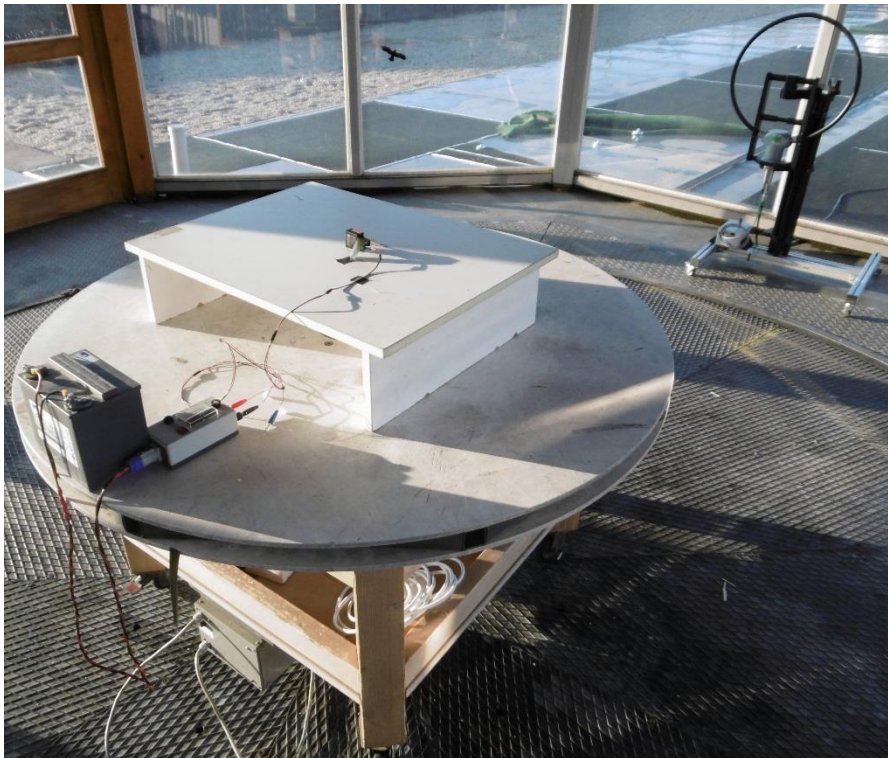
For test instruments and accessories used see section 6 Part SER 1.

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



5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

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 C63.4. 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

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Example:

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

5.3.5 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level QP (dB μ V)	Level AV (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level QP dB(μ V/m)	Corrected Level AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.250	27.54	20.52	15.78	9	20	47.54	40.52	35.78	99.65	-63.8
0.375	18.31	15.28	9.64	9	20	38.31	35.28	29.64	96.12	-66.5

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dB μ V)	Level QP (dB μ V)	Level AV (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level QP dB(μ V/m)	Corrected Level AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.250	-52.46	-59.48	-64.22	9	20	-32.46	-39.48	-44.22	19.65	-63.8
0.375	-61.69	-64.72	-70.36	9	20	-41.69	-44.72	-50.36	16.12	-66.5

Values at distance: 30m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit dB(μ V/m)	Delta (dB)
0.49 – 30.0				9	20				29.5	> 70

Note: To find out the maximum magnetic field strength, test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst-case position of the EuT (Photo documentation of the test set-up).

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

Frequency (MHz)	Field strength of spurious emissions (μ V/m)	dB(μ V/m)	Measurement distance (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

The requirements are **FULFILLED**.

Remarks:

5.4 Spurious emissions radiated (electric field)

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

5.4.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15C, Section 15.231(b), Section 15.209(a) and Section 15.205(a):
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.4.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized 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 cm above the ground plane. Floor standing equipment is placed directly on the turntable ground plane. The set up of the EUT will be in accordance to ANSI C63.4. The interface cables closer than 40 cm to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 cm away from the ground plane. Cables to simulators/testers are routed through the centre of the table to a screen room located outside the test area. To locate maximum emission from the test sample the antenna is varied in height from 1 to 4 m, measurement scans are made in horizontal and vertical antenna polarization and the EUT is turned 360 degrees.

FCC ID: LTQJA125

The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz: RBW: 120 kHz

1000 MHz – 18000 MHz: RBW: 1 MHz

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor (dB)	=	Level dB(μ V/m)	-	Limit dB(μ V/m)	=	Delta (dB)
170.5	5	+	20	=	25	-	30	=	-5

5.4.5 Test result f < 1 GHz

Frequency [MHz]	L: QP [dB μ V]	Correct. [dB]	L: QP [dB μ V/m]	Limit [dB μ V/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!

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Frequency (MHz)	15.209 Limits (μ V/m)	15.209 Limits dB(μ V/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

Additionally there is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.

FCC ID: LTQJA125

Restricted bands of operation according to FCC Part 15C, Section 15.205(a):

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

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

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to 1 GHz.

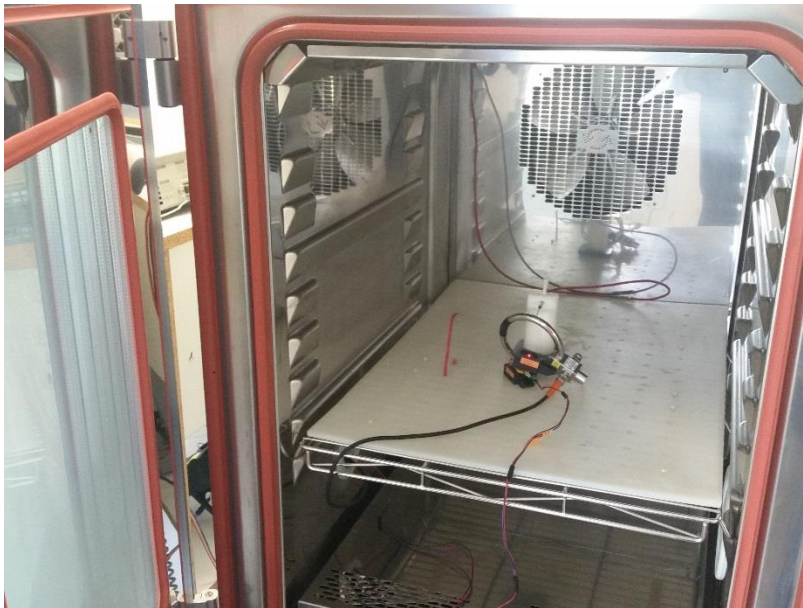
5.5 Emission Bandwidth

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

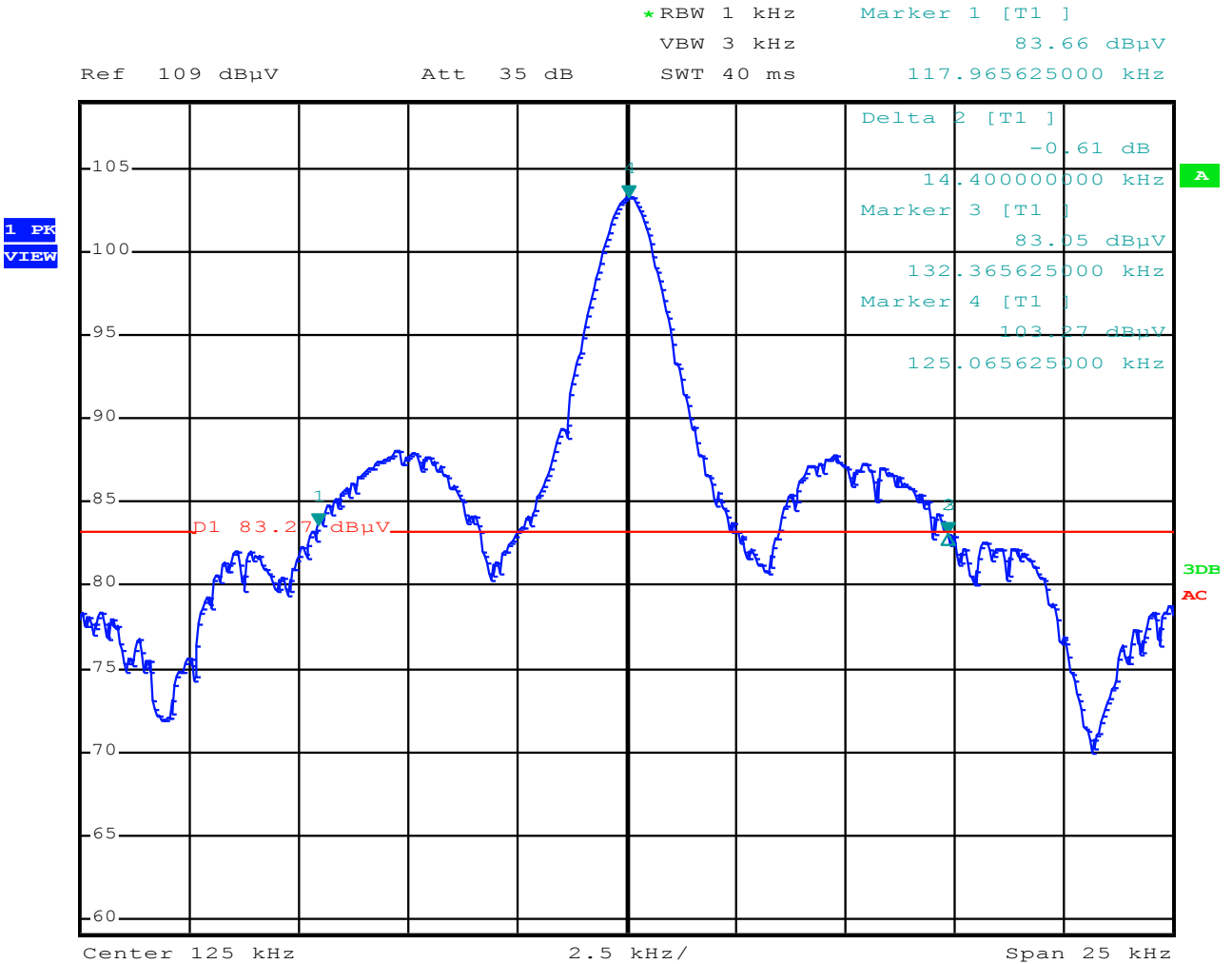


Fundamental [kHz] See Plot 1	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth [kHz]
125.0	117.965625	132.365625	14.40

Remarks:

5.5.3 Test protocol

Emission Bandwidth plots



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.
CPR 1	ESCI	02-02/03-05-005	14/12/2018	14/12/2017		
	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				
MB	ESCI	02-02/03-05-005	14/12/2018	14/12/2017		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRA HIT World 6543A	02-02/32-10-001	17/10/2018	17/10/2017		
		02-02/50-05-157				
SER 1	ESCI	02-02/03-05-005	14/12/2018	14/12/2017		
	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	03/07/2018	03/07/2017		
	VULB 9168	02-02/24-05-005	12/04/2018	12/04/2017	21/09/2018	21/03/2018
	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				