



Test report

according to ISO/IEC 17025:2017

FCC
(Federal Communications Commission)
Test Firm Registration Number: 768032
Designation Number DE0022

ISED
(Inovation, Science and Economic Development)
CAB identifier: DE0012
ISED#: 6155A

Electromagnetic compatibility

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C
RSS-210 – Licence - Exempt Radio Apparatus

Intentional Radiators



Deutsche
Akkreditierungsstelle
D-PL-17379-01-00
D-PL-17379-01-02
D-PL-17379-01-03



Bundesnetzagentur

BNetzA-CAB-18/21-19

TESTED
IN GERMANY

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Test report no.: 20/01-0048-A

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Location of test facility:



STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen
Germany

1. Client information

Name: APTIV Services Deutschland GmbH
Address: Am Technologiepark 1
42119 Wuppertal, Germany
Name of contact: Ljiljana Trivic
Telephone: +49 2261 971415
Fax: +49 2261 72691
E-mail: Ljiljana.trivic@aptiv.com

2. Equipment under test (EUT)

2.1 Identification of the EUT

Equipment: FCA Body Computer Module for Automotive Passive Entry Passive Start (PEPS) Immobilizer RKE TPMS
Model: FI7
Brand name: APTIV
Serial no.: -/-
Manufacturer: APTIV Services Hungary Kft.
Zanati ut 29/A
9700 Szombathely
Country of origin: Hungary
Power rating:
Highest frequency generated or used
in the device or on which the device
operates or tunes (MHz): 434 MHz
Date Sample Received: 30.01.2020
Tests were performed: 14.02.2020 – 19.02.2020

2.2 Additional information about the EUT:

The device includes a 433 MHz receiver, which will be authorized under the sDOC procedure.

To duplicate parts of this test report needs the written confirmation of the test laboratory.

The test results relate only to the above mentioned test sample(s).

3. Description of the Equipment under test and test conditions

FCC-ID:	LTQFI7																							
IC ID:	3659A-FI7																							
HVIN:	C2-R1-CND4																							
Power:	12 V = (8.0 V – 16.0 V) powered via vehicle battery																							
Cables:	DC: 195 cm																							
Approx. Size (l x w x h):	(19.5 x 13.5 x 7.0) cm																							
Test conditions:	<p>The "FCA Body Computer Module for Automotive Passive Entry Passive Start (PEPS) Immobilizer RKE TPMS – FI7" (= equipment under test – EUT) is an immobilizer system for vehicular use and had been tested in following modes:</p> <ul style="list-style-type: none"> (1) 125 kHz transmission for keyless entry function (PEPS) (2) 125 kHz transmission for passive start function (Shared immobilizer, LF IMMO) (3) 125 kHz transmission for Immobilizer function (Standalone Immobilizer, ABIC IMMO) (4) Receiving modulated 433.920 MHz signal <p>with maximum RF-output power in order to find the worst case. During the tests the EUT was powered with 12 V DC.</p> <p>Tests where performed with different antennas the table below show the tested combination of antenna types and transmitter function.</p> <table border="1"> <thead> <tr> <th>Function/involved antennas</th> <th>Antenna Type 1</th> <th>Antenna Type 2</th> <th>Antenna Type 3</th> <th>Coil Antenna</th> </tr> </thead> <tbody> <tr> <td>Mode 1 (PEPS)</td> <td>x</td> <td>x</td> <td>x</td> <td>-/-</td> </tr> <tr> <td>Mode 2 (Shared immobilizer)</td> <td>x</td> <td>x</td> <td>-/-</td> <td>-/-</td> </tr> <tr> <td>Mode 3 (Standalone Immobilizer)</td> <td>-/-</td> <td>-/-</td> <td>-/-</td> <td>x</td> </tr> </tbody> </table> <p>Remarke: There is no simultaneous 125 KHz transmission of antenna 1, 2, 3 or coil antenna in park mode or drive mode possible.</p>				Function/involved antennas	Antenna Type 1	Antenna Type 2	Antenna Type 3	Coil Antenna	Mode 1 (PEPS)	x	x	x	-/-	Mode 2 (Shared immobilizer)	x	x	-/-	-/-	Mode 3 (Standalone Immobilizer)	-/-	-/-	-/-	x
Function/involved antennas	Antenna Type 1	Antenna Type 2	Antenna Type 3	Coil Antenna																				
Mode 1 (PEPS)	x	x	x	-/-																				
Mode 2 (Shared immobilizer)	x	x	-/-	-/-																				
Mode 3 (Standalone Immobilizer)	-/-	-/-	-/-	x																				
Additional information:	-/-																							
Operating frequencies:	Transmitter: 125 kHz Receiver: 433,92 MHz																							
Type of modulation:	K1D																							
Spurious Emissions: radiated lowest margin to limit	LF PEPS mode 37,27 dB _u V/m (8,73 dB)	LF IMMO mode 37,33 dB _u V/m (8,67 dB)	ABIC IMMO 37,1dB _u V/m (8,9 dB)																					
Environmental conditions during tests:	<p>Ambient temperature: 20 °C Relative humidity 40 % Atmospheric pressure 965 mbar</p>																							
Antenna Transmitter:	<p>Model: Antenna Type 1 Antenna Type 2 Antenna Type 3 Coil Antenna</p> <p>Type: <input checked="" type="checkbox"/> External <input type="checkbox"/> Internal (integrated, PCB antenna)</p>																							
Antenna Receiver:	<p>Model: Printed PCB Antenna</p> <p>Type: <input type="checkbox"/> External <input checked="" type="checkbox"/> Internal (integrated, PCB antenna)</p>																							

4. Performed measurements and results

The complete list of measurements required in e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C & RSS-210 is given below.

Standard:	Standard:	Test Method:		Test requirements:			
				applicable:		fulfilled:	
				Yes	No	Yes	No
§ 15.207	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§ 15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.3 - 6.6	Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
§15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.4	Output Power of Fundamental Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
-/-	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.9.3	99% Power Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

All required / applicable tests according to the following standards were performed under Ref-No. 20/01-0048.

- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C with test Method according to ANSI C63.10-2013
- e-CFR data is current as of April 17, 2020

-RSS-210 issue 10 December 2019 Licence-Exempt Radio Apparatus: Category I Equipment
-RSS-Gen issue 5 March 2019 General Requirements for Compliance of Radio Apparatus

Remark: -/-

5. AC Mains conducted emissions

Applied standards

-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.207 Conducted limits
-RSS-Gen issue 05 section 7.2

Test site

Not applicable

Test equipment and test set up

Not applicable

Detector function selection and bandwidth

Not applicable

Frequency range to be scanned

Not applicable

Test conditions and configuration of EUT

Not applicable

Requirements

Frequency Range [MHz]	Quasi-Peak Limits [dB μ V]	Average Limits [dB μ V]
0.15 - 0.5	66 to 56 Note 1	56 to 46 Note 1
0.5 - 5.0	56	46
5.0 - 30.0	60	50

Note 1: The level decreases linearly with the logarithm of the frequency

Measurement

The measurement is not applicable. The EUT is powered via vehicle battery.

6. Radiated emission measurements

Test site

Measurement of radiated emissions from EUT was made in the semi-anechoic chamber SAC3 (DC to 40 GHz) located in the test facility.

Test equipment and test set up

Test equipment used for radiated measurements as given in clause Test equipment of this report. Test setup used for radiated measurements as given in clause Test Setups of this report.

Detector function selection and bandwidth

In radiated emissions measurement, an EMI test receiver with CISPR detectors was used.

Frequency range	Resolution Bandwidth
9KHz – 150kHz (Quasi Peak & Average* Detector)	200Hz
150KHz – 30MHz (Quasi Peak & Average* Detector)	9kHz
30MHz – 1GHz (Quasi Peak Detector)	120kHz
Above 1GHz (Peak & Average Detector)	1MHz

*Average Detector only in specified frequency range.

Antennas

Measurements were made using a calibrated loop antenna in the range 9 kHz – 30 MHz, as well as a calibrated bilog antenna in the range of 30 to 1000 MHz to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization in a SAC .

The horizontal distance between the receiving antenna and the EUT was 3 meters.

In the range of 1 GHz to 26 GHz measurements were made using a calibrated horn antenna to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization in a SAC with floor absorbers. The horizontal distance between the receiving antenna and the EUT was 3 meters.

Frequency range to be scanned

For radiated emissions measurements, the spectrum in the range of 9kHz MHz to 7 GHz was investigated as the highest used frequency in the EUT is 433,92 MHz.

Test conditions and configuration of EUT

The EUT was configured and operated with conditions as mentioned under “Test conditions” in clause 3.

During test the EUT was operated as specified in the technical instruction of the EUT. For frequencies below 1000 MHz the EUT was placed on a 80 cm and for frequencies above 1000 MHz the EUT was placed on a 150 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT. The procedure according to ANSI C63.10:2013 is used and all modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below.

Remarks:

-Correction factor included antenna factor and cable attenuation.

Applied standards

-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

-RSS-Gen issue 05 section 8.9

Requirements:

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

Frequency MHz	Limits [μ V/m] Quasi-peak	Limits [dB μ V/m] Quasi-peak	Limits [μ V/m] Average	Limits [dB μ V/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	2400/F (kHz)	48.5 – 28.5	300
0.090 - 0.110	2400/F (kHz)	28.5 – 26.8	-/-	-/-	300
0.110 – 0.490	-/-	-/-	2400/F (kHz)	26.8 – 13.8	300
0.490 - 1.705	24000/F (kHz)	33.8 – 23.0	-/-	-/-	30
1.705 - 30.0	30	29.5	-/-	-/-	30

acc. RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [μ A/m] Quasi-peak	Limits [dB μ A/m] Quasi-peak	Limits [μ A/m] Average	Limits [dB μ A/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	6.37/F (kHz)	-3.0 – -23.0	300
0.090 - 0.110	6.37/F (kHz)	-23.0 – -24.7	-/-	-/-	300
0.110 – 0.490	-/-	-/-	63.7/F (kHz)	-24.7 – -37.7	300
0.490 - 1.705	63.7/F (kHz)	-17.7 – -28.5	-/-	-/-	30
1.705 - 30.0	0.08	-22	-/-	-/-	30

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits and RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [μ V/m] Quasi-peak	Limits [dB μ V/m] Quasi-peak	Limits [μ V/m] Average	Limits [dB μ V/m] Average	Test distance [m]
30 - 88	100	40	-/-	-/-	3
88 - 216	150	43.5	-/-	-/-	3
216 - 960	200	46	-/-	-/-	3
960 - 1000	500	54	-/-	-/-	3
Above 1000	-/-	-/-	500	54	3

Measurements

The Measurement was performed on: 14.02.2020 - 19.02.2020

Result 9 kHz – 30 MHz

In the frequency range 9 kHz – 30 MHz the EUT had been scanned in a distance of 3 m and the Limit were corrected to the test distance of 3 m using a factor with 40 dB/decade acc. to § 15.31 (f)(2).

Only the worst case of the X,Y and Z axis measurement is documented in this report.

The logo consists of a small German flag icon followed by the text "TESTED IN GERMANY" in a bold, sans-serif font.

IT 3/4
Interference radiation (9kHz – 30MHz)
acc. FCC Subpart C § 15.209

ESTC

Ref.-No.: 20/01-0048

Product: Transmitting/Receiving System

Sample: 01

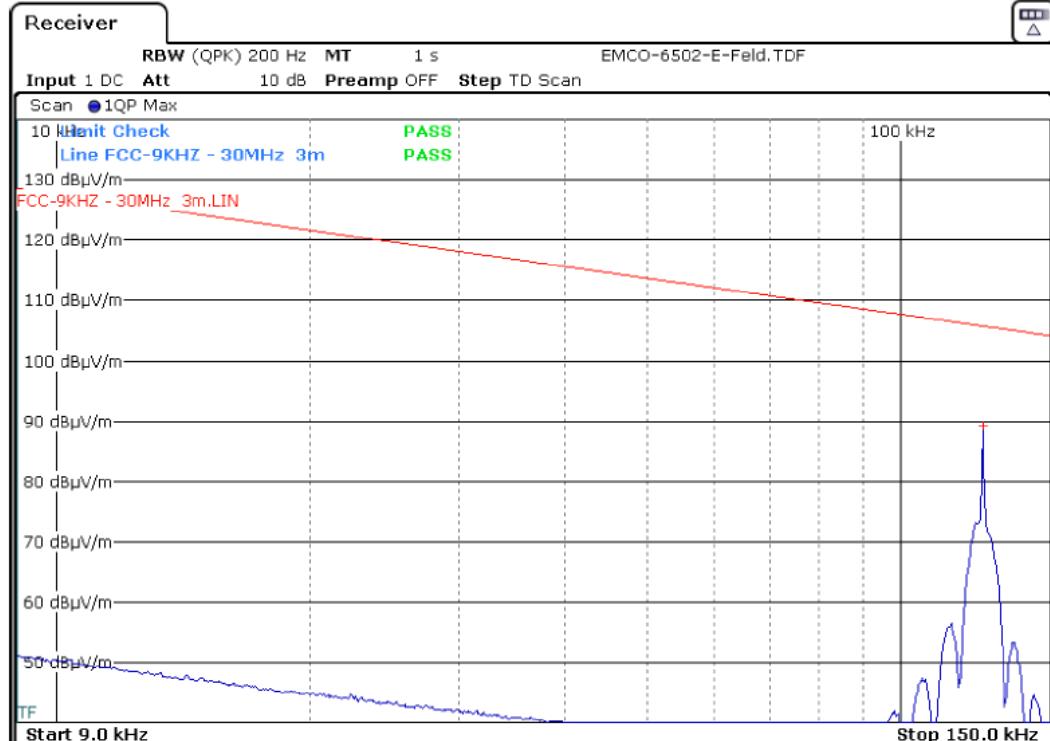
Date: 19.02.2020

Operator: B

Remarks: Input Voltage System: 12V/DC (modulated signal) Result:
Operation mode: Tx (125kHz / PEPS); ANTENNA 1

Operation mode: Tx (125kHz / PEPS); ANTENNA 1

Position Y (9kHz - 150kHz)



The logo consists of a small German flag icon followed by the text "TESTED IN GERMANY" in a bold, sans-serif font.

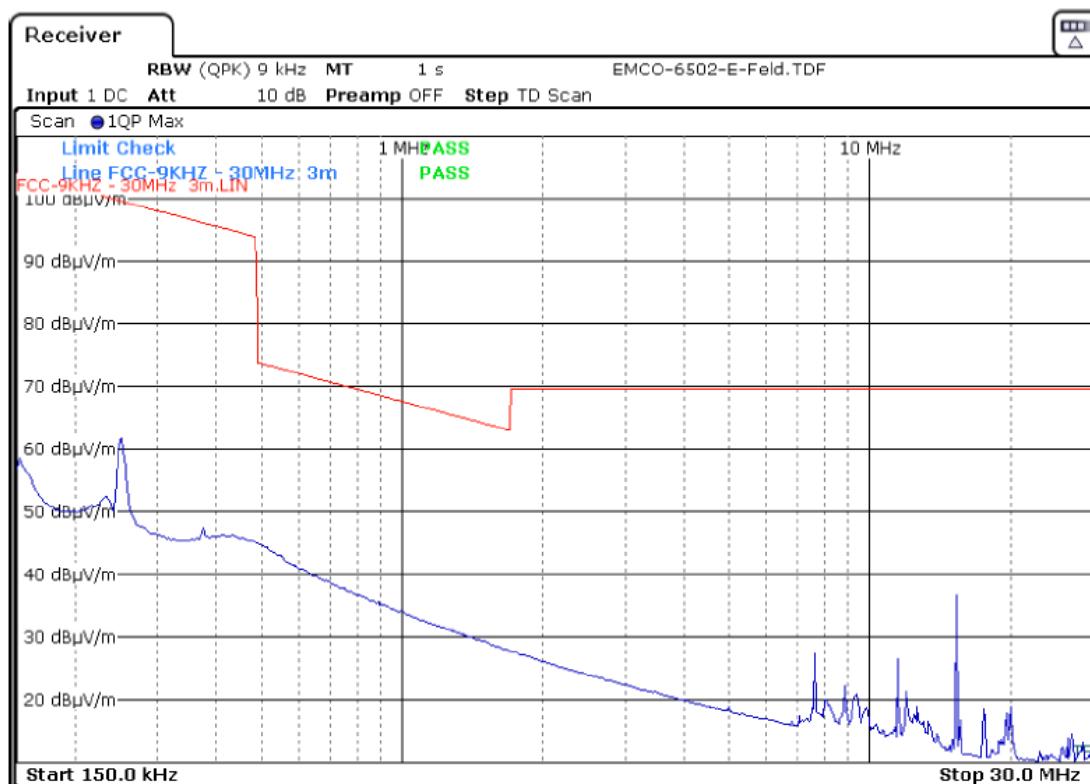
IT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

ESTC

Ref.-No.: 20/01-0048

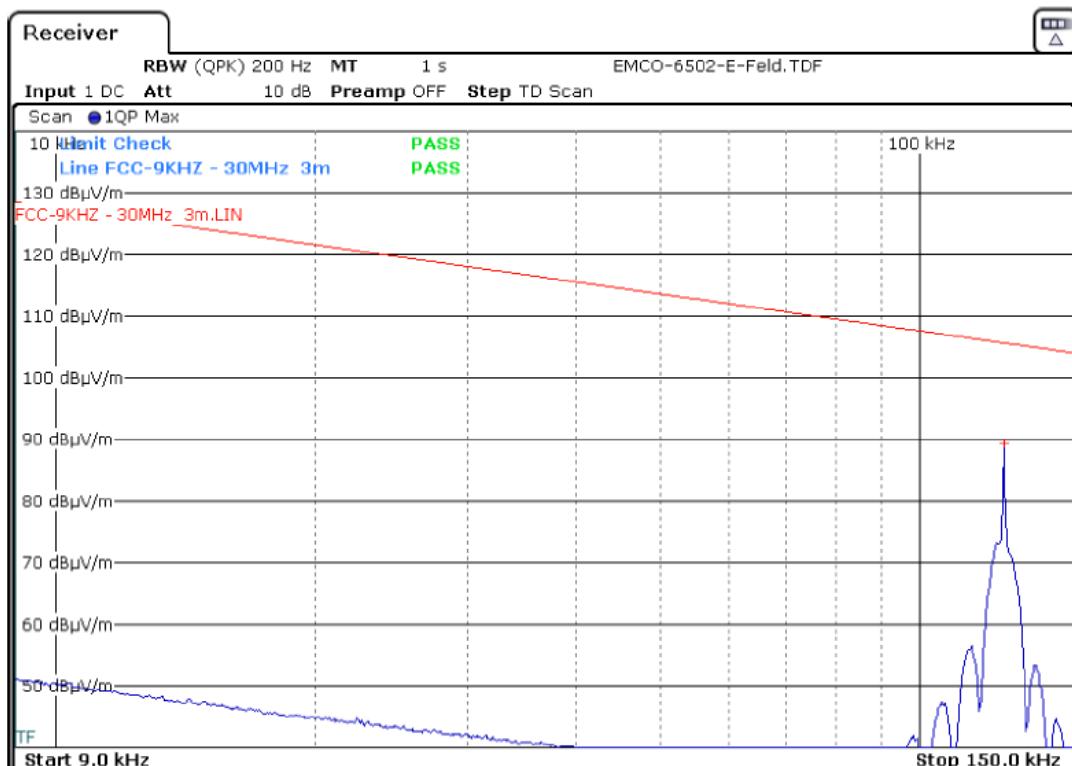
Operation mode: Tx (125kHz / PEPS); ANTENNA 1

Position Y (150kHz – 30MHz)



**TESTED
IN GERMANY****IT 3/4**
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209**ESTC**Ref.-No.: **20/01-0048**

Operation mode: Tx (125kHz / PEPS); ANTENNA 2

Position Y (9kHz - 150kHz)

Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
0,1251	91,7	-14,0	105,7	pass	

The logo consists of a small German flag (black, red, and gold horizontal stripes) followed by the text "TESTED IN GERMANY" in a bold, sans-serif font.

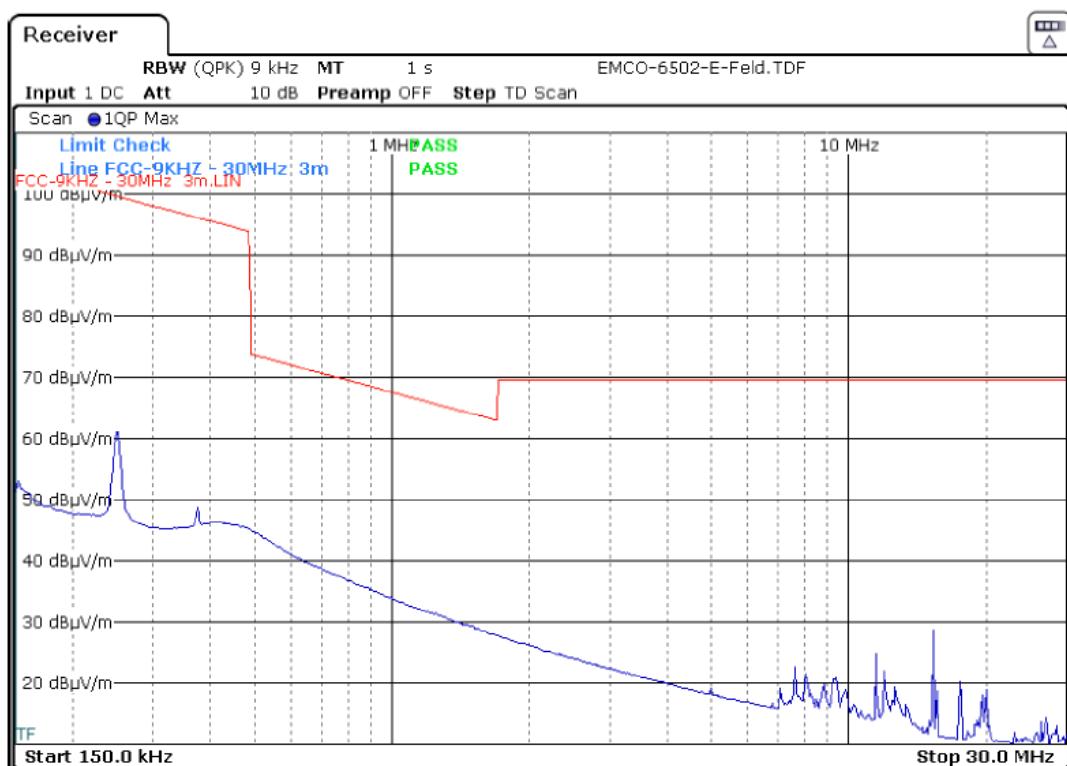
IT 3/4
Interference radiation (9kHz – 30MHz)
acc. FCC Subpart C § 15.209

STC

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / PEPS); ANTENNA 2

Position Y (150kHz – 30MHz)



The logo consists of a small German flag icon followed by the text "TESTED IN GERMANY" in a bold, sans-serif font.

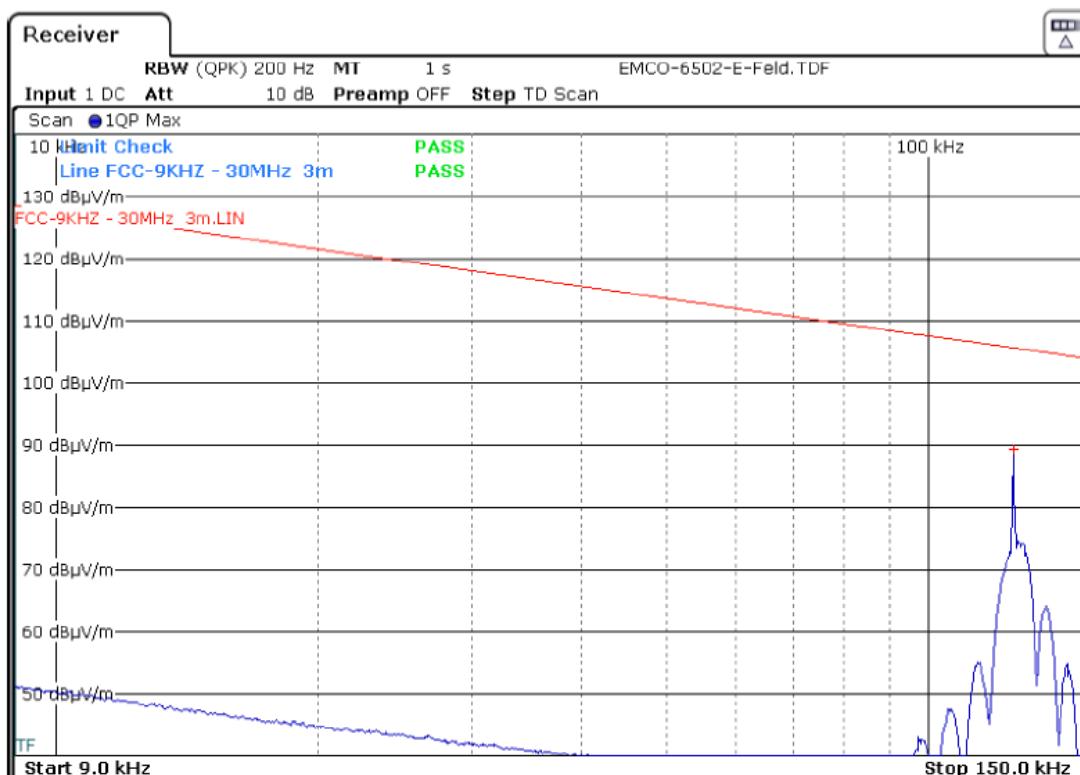
IT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

ESTC

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / PEPS): ANTENNA 3

Position Y (9kHz - 150kHz)

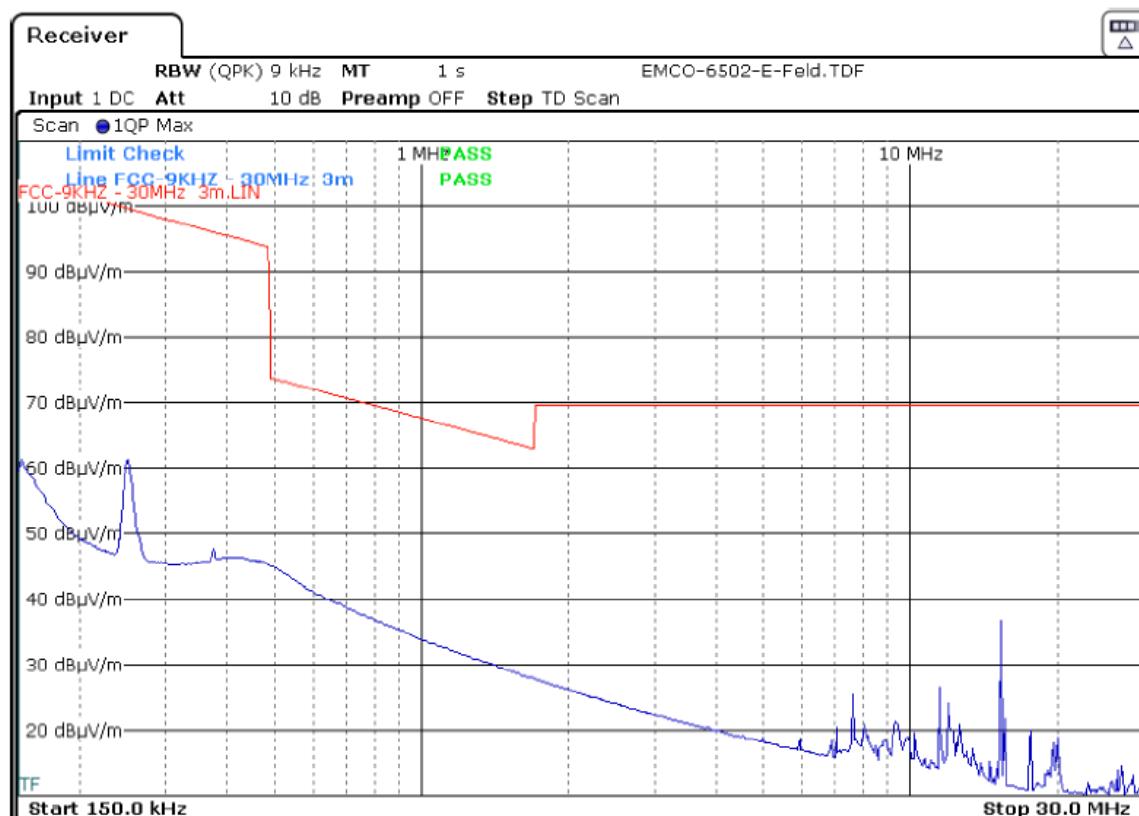


TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209TESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / PEPS); ANTENNA 3

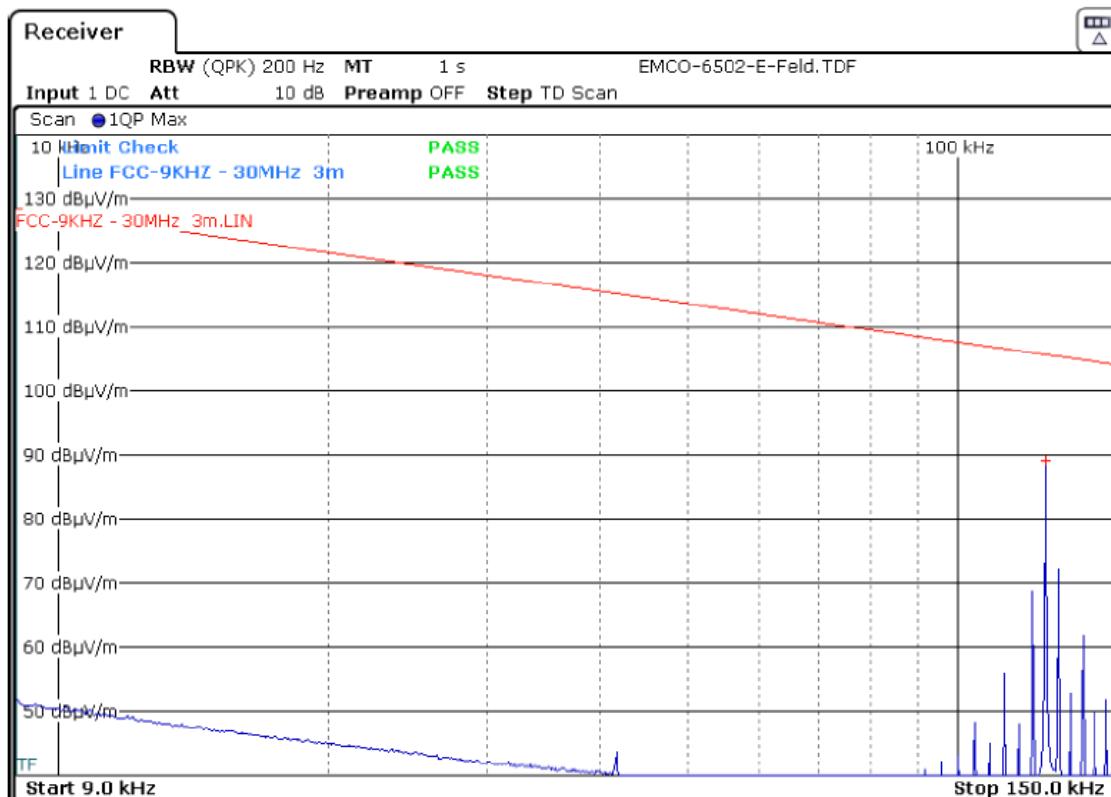
Position Y (150kHz – 30MHz)



Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
150kHz- 30MHz	-/-	>20	-/-	pass	

TESTED
IN GERMANY**IT 3/4**
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209**ESTC**Ref.-No.: **20/01-0048**

Operation mode: Tx (125kHz / LF IMMO); ANTENNA 1

Position Y (9kHz - 150kHz)

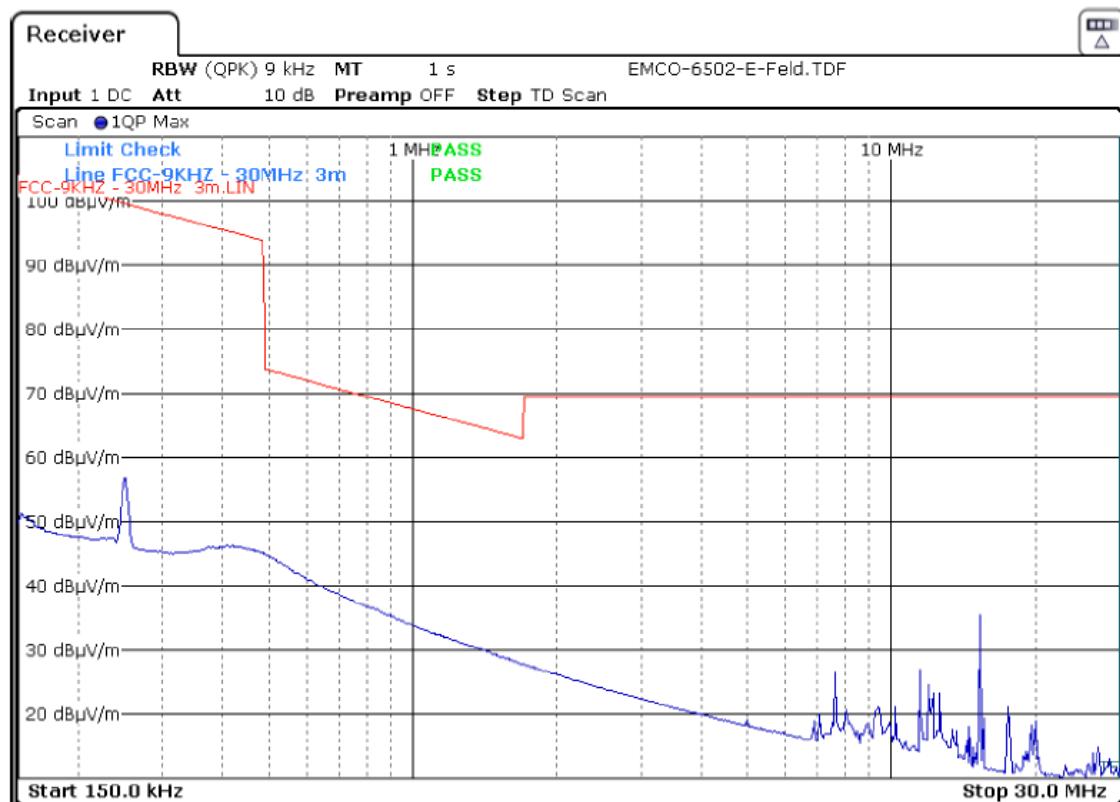
Position: Y					
Detector QP					
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	
0,1251	89,1	-16,5	105,7	pass	

TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209TESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / LF IMMO); ANTENNA 1

Position Y (150kHz – 30MHz)



Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
150kHz- 30MHz	-/-	>20	-/-	pass	

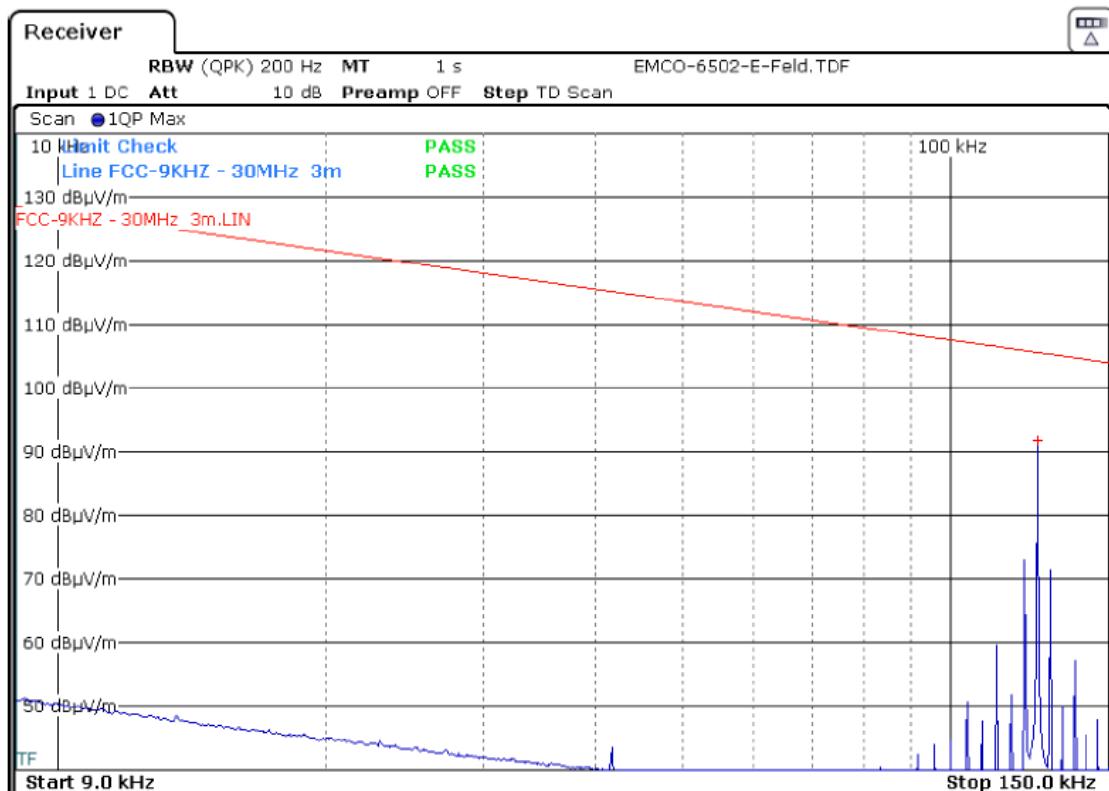
TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

ESTC

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / LF IMMO); ANTENNA 2

Position Y (9kHz - 150kHz)



Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
0,1251	91,7	-14,0	105,7	pass	

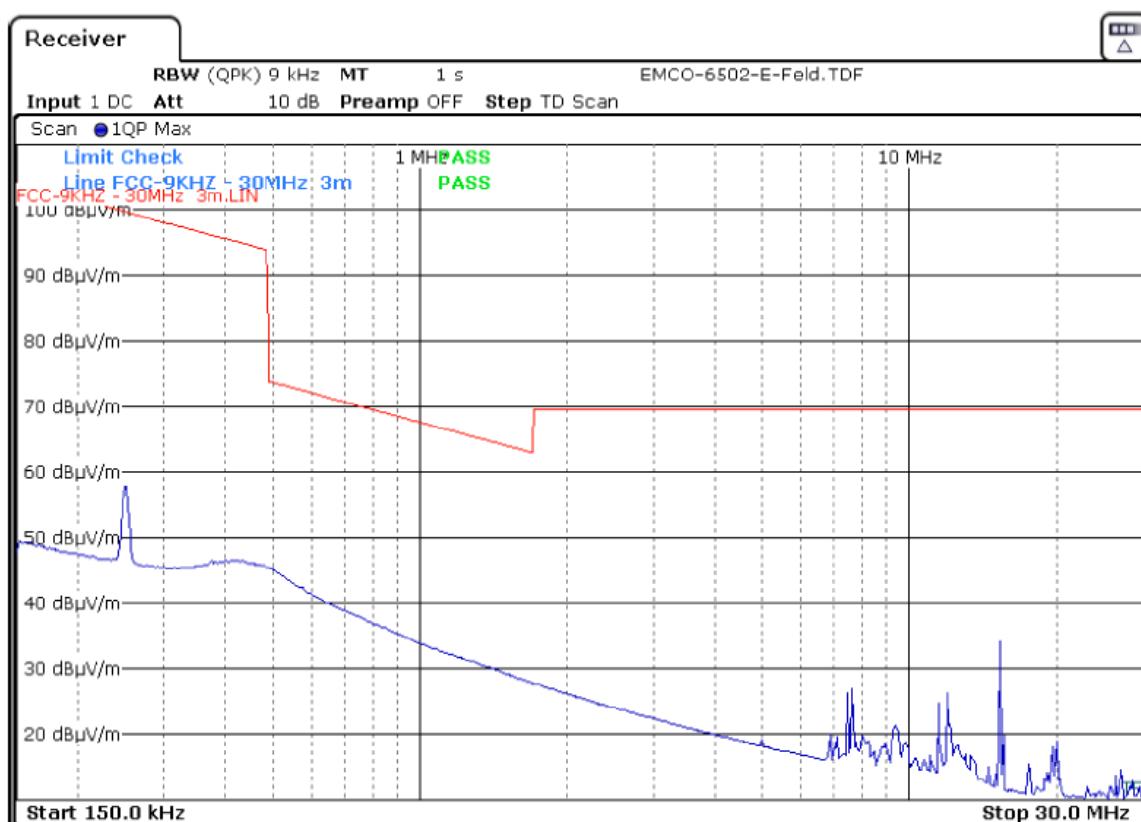
TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

TESTED

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / LF IMMO); ANTENNA 2

Position Y (150kHz – 30MHz)



Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
150kHz- 30MHz	-/-	>20	-/-	pass	

TESTED
IN GERMANY

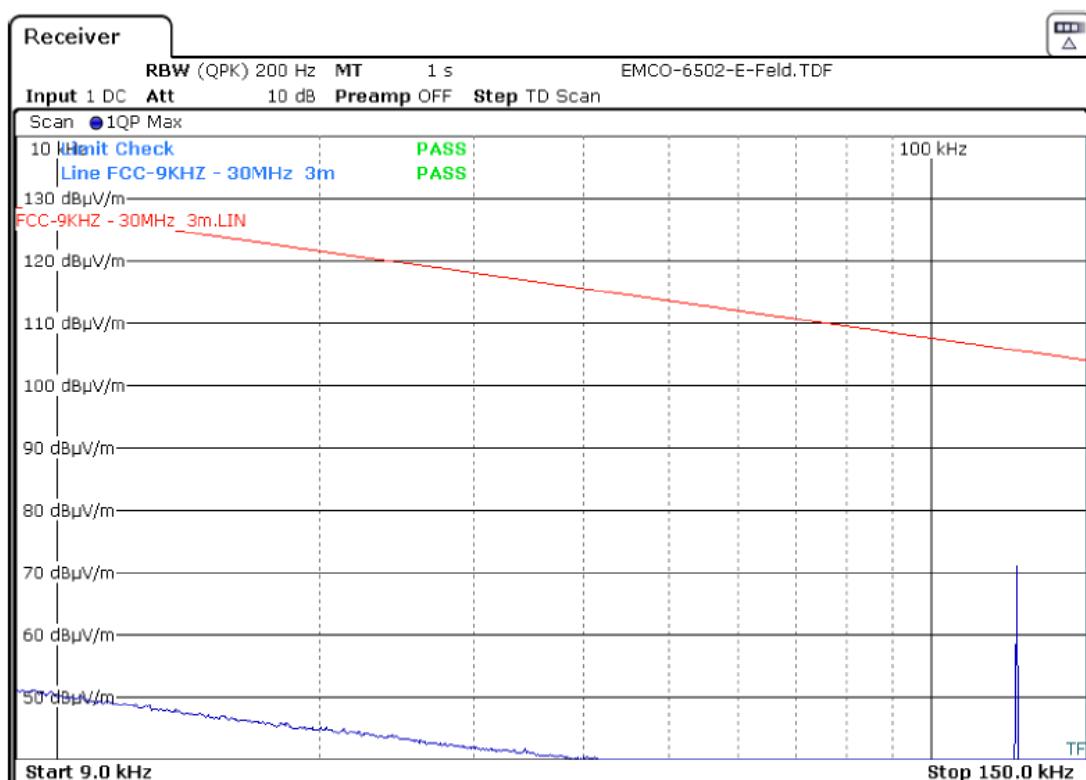
IT 3/4
Interference radiation (9kHz – 30MHz)
acc. FCC Subpart C § 15.209

STC

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / ABIC IMMO); Coil Antenna

Position Y (9kHz - 150kHz)



TESTED
IN GERMANY

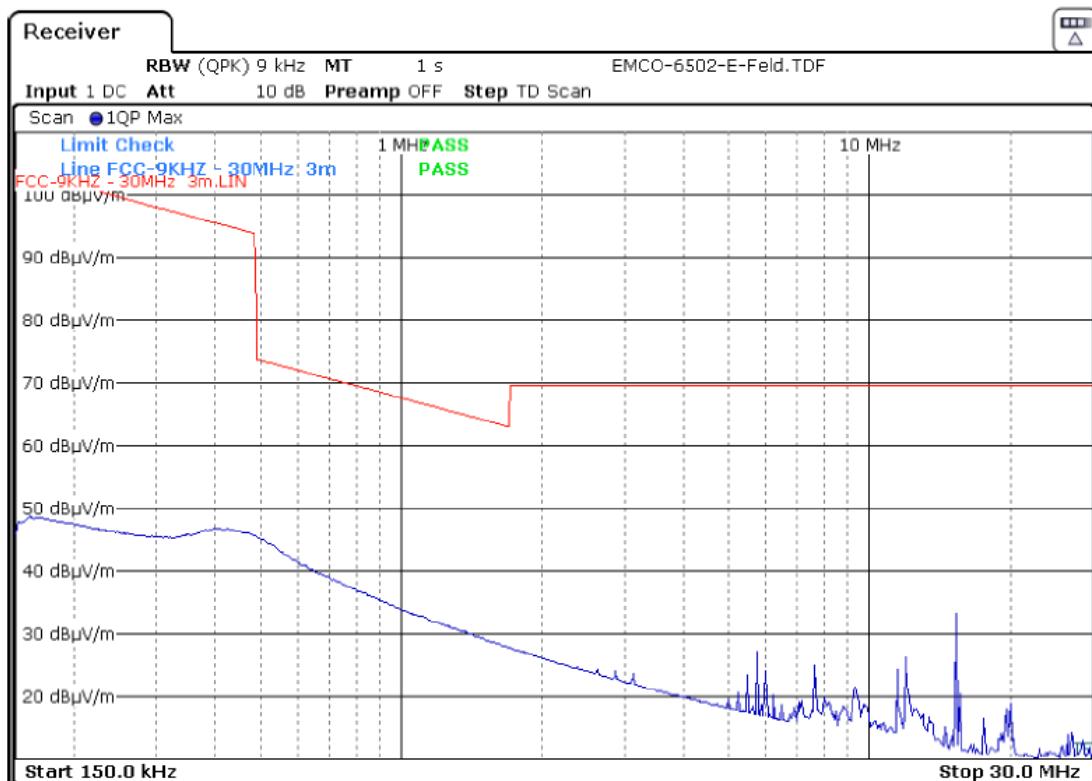
IT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

STC

Ref.-No.: 20/01-0048

Operation mode: Tx (125kHz / ABIC IMMO); Coil Antenna

Position Y (150kHz – 30MHz)



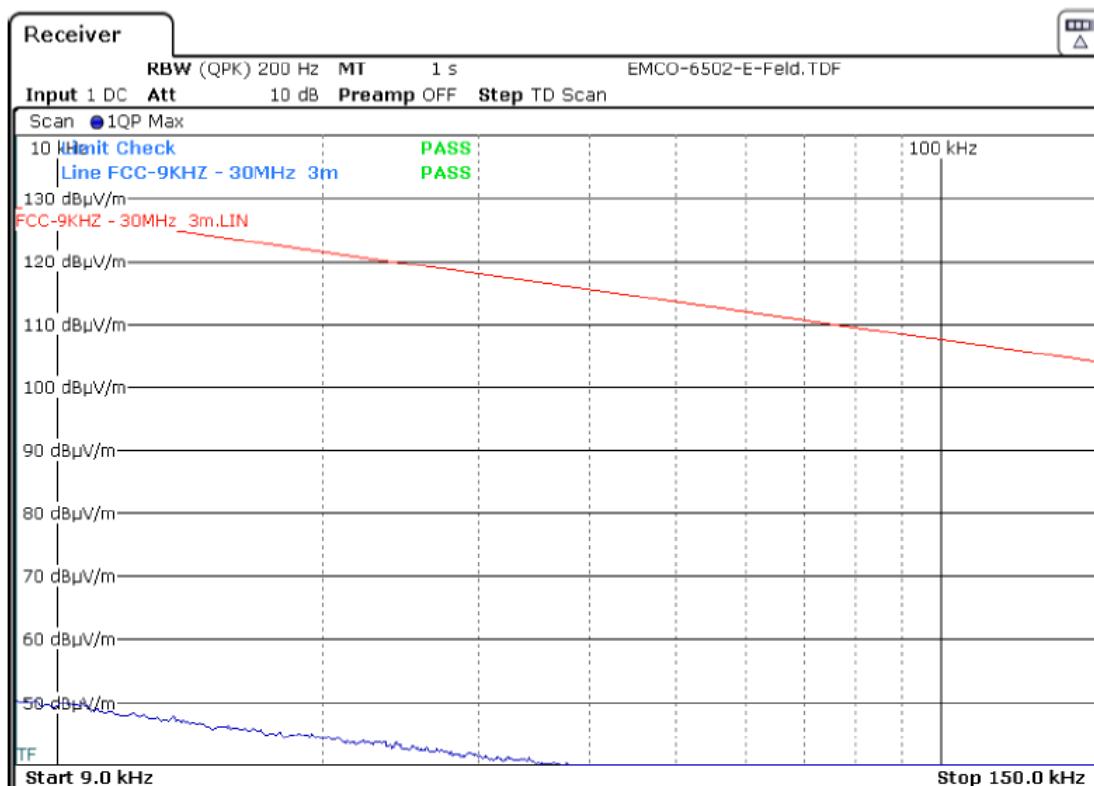
TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209

TESTED

Ref.-No.: 20/01-0048

Operation mode: Rx (433,920MHz)

Position Y (9kHz - 150kHz)



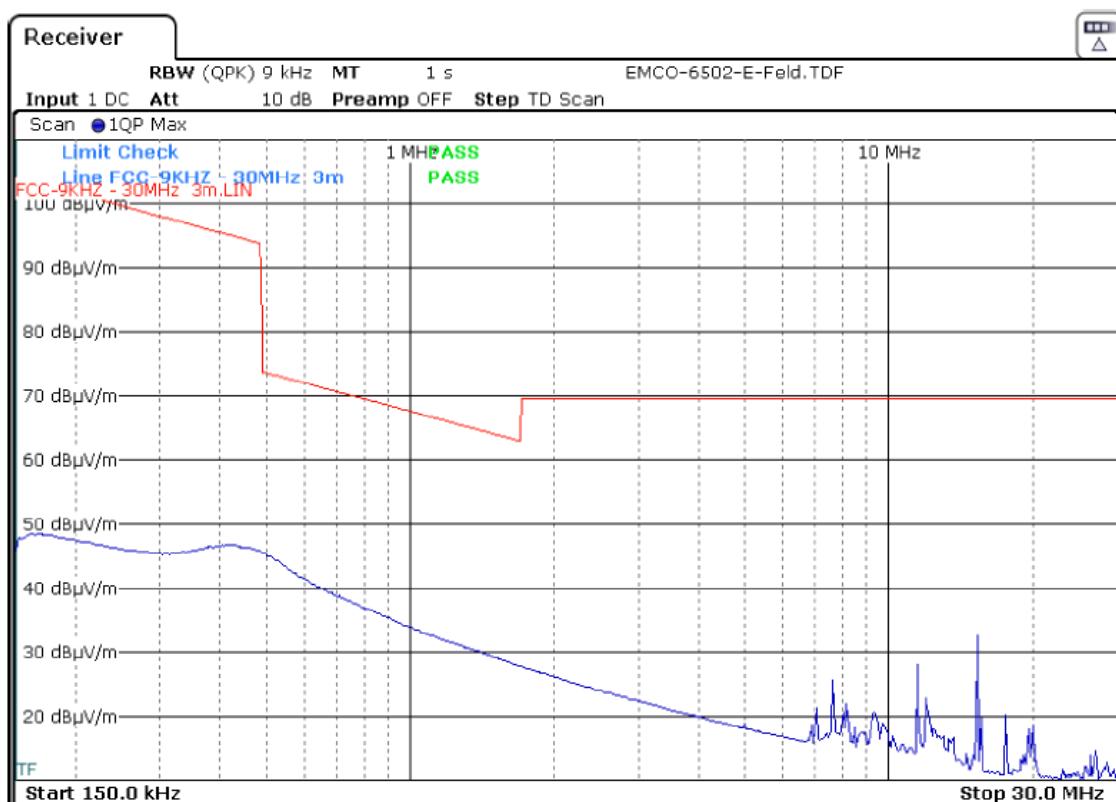
Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
9kHz - 150kHz	-/-	>20	-/-	pass	

TESTED
IN GERMANYIT 3/4
Interference radiation (9kHz – 30MHz)
acc.FCC Subpart C § 15.209TESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Rx (433,920MHz)

Position Y (150kHz – 30MHz)



Position: Y					
Detector QP					
Frequ. [MHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	
150kHz- 30MHz	-/-	>20	-/-	pass	

Summery result for frequency range 9 kHz - 30 MHz to show compliance with RSS-Gen limits:

Function	Freq.	Measured Value @ 3m	Conversion to magnetic field ^{Note 1}		Limit @ 3m		Margin	Result
	[MHz]	[dB μ V/m]	[dB μ A/m]	[μ A/m]	[dB μ A/m]	[μ A/m]	[dB]	
Mode 1 (PEPS)								
Antenna Type 1	0,1251	89,1	37,6	75,86	54,2	512,86	16,6	pass
Antenna Type 2	0,1251	91,7	40,2	102,33	54,2	512,86	14,0	pass
Antenna Type 3	0,1251	89,3	37,8	77,62	54,2	512,86	16,4	pass
Mode 2 (Shared immobilizer)								
Antenna Type 1	0,1251	89,1	37,6	75,86	54,2	512,86	16,6	pass
Antenna Type 2	0,1251	91,7	40,2	77,62	54,2	512,86	16,4	pass
Mode 3 (Standalone Immobilizer)								
Coil Antenna	0.009 – 0.490	< 86,8	< 22,3	-/-	77 - 42,3	-/-	>20	pass
	0.490 – 1.705	< 83,0	< -8,5	-/-	22,3 - 11,5	-/-	>20	pass
	1.705 - 30	< 89,5	< -2,0	-/-	18	-/-	>20	pass

Note 1: Conversion E-field to H-Field:

$$- x [\text{dB}\mu\text{V/m}] - 51.5 = y [\text{dB}\mu\text{A/m}]$$

 Conversion [dB μ A/m] in [μ A/m]

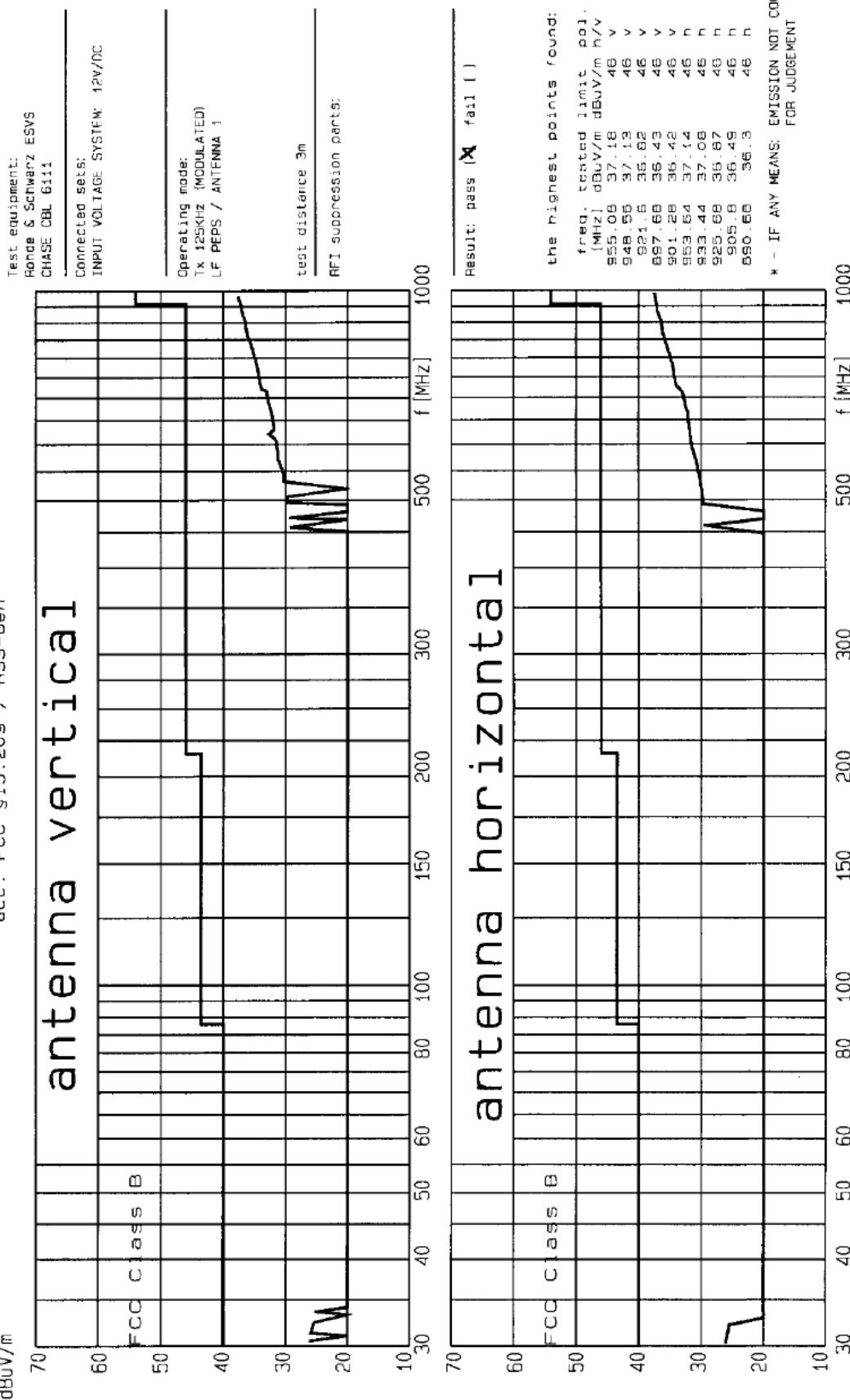
$$- 10^y [\text{dB}\mu\text{A/m}] / 20 = z [\mu\text{A/m}]$$

Result 30 MHz – 1000 MHz

Operation Mode No.: 1. 125 kHz transmission for keyless entry function (PEPS) Antenna 1

IT 5/6

STC Germany GmbH

Interference Radiation 30 MHz – 1000 MHz
acc. FCC §15.209 / RSS-Gen

Operation Mode No.: 1. 125 kHz transmission for keyless entry function (PEPS) Antenna 2

IT 5/6

STC Germany GmbH

Interference Radiation 30 MHz – 1000 MHz
acc. FCC §15.209 / RSS-Gen

antenna vertical
dBuV/m

Ref.-No.: 20/01-0048
Product: TRANS.-/REC.-SYSTEM
Sample: 01
Date: 14 Feb 2020
Operator: BL

Test equipment:
CHASE CBL 6111

Connected sets:
Rohde & Schwarz ETSV
INPUT VOLTAGE SYSTEM: 12V/DC

Operating mode:
Tx 125kHz (MODULATED)
LF PEPS / ANTENNA 2

test distance 3m

RFI suppression parts:

Result: pass fail

the highest points found:
freq. tested limit pol.
[MHz] dBuV/m dBuV/m h/v

849.88	37.09	46
937.16	37.07	46
928.56	37.03	46
913.24	36.61	46
895.88	36.36	46
953.28	37.13	46
930.76	36.99	46
941.52	36.99	46
907.6	36.4	46
887.6	36.29	46

* - IF ANY MEANS: EMISSION NOT COUNTED
FOR JUDGEMENT



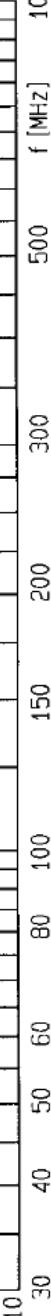
antenna horizontal
dBuV/m

Result: pass fail

the highest points found:
freq. tested limit pol.
[MHz] dBuV/m dBuV/m h/v

849.88	37.09	46
937.16	37.07	46
928.56	37.03	46
913.24	36.61	46
895.88	36.36	46
953.28	37.13	46
930.76	36.99	46
941.52	36.99	46
907.6	36.4	46
887.6	36.29	46

* - IF ANY MEANS: EMISSION NOT COUNTED
FOR JUDGEMENT



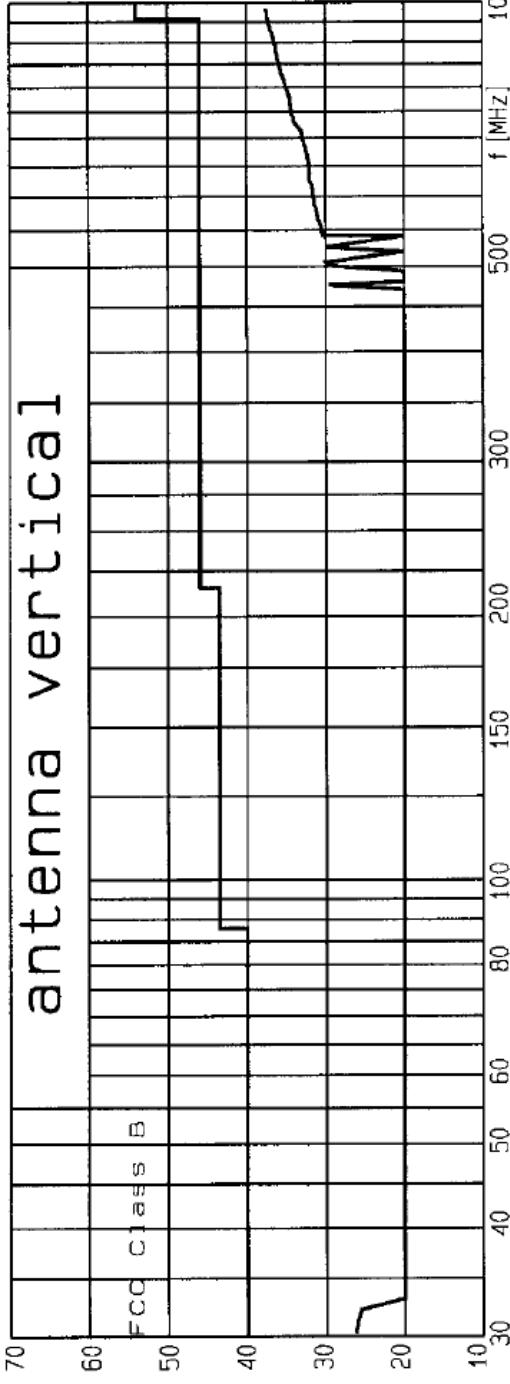
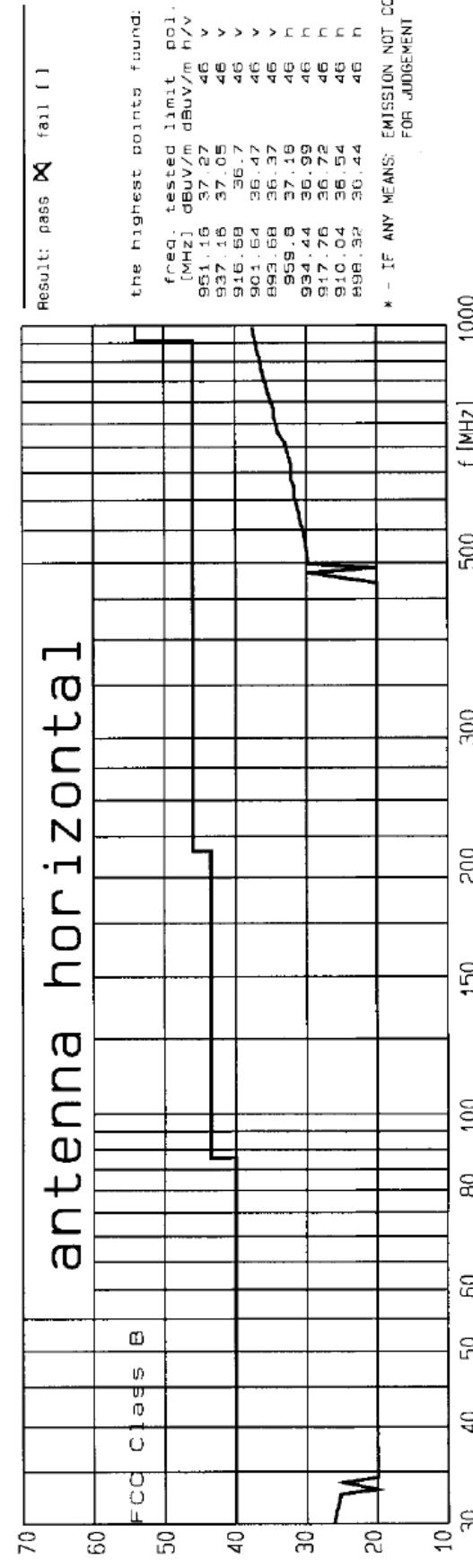
Operation Mode No.: 1. 125 kHz transmission for keyless entry function (PEPS) Antenna 3

IT 5/6

STC Germany GmbH

Interference Radiation 30 MHz - 1000 MHz
acc. FCC §15.209 / RSS-Gen

dBuV/m

**antenna horizontal**

the highest points found:
freq: tested limit no.
[MHz] dBuV/m dBuV/m H/V
951.16 37.27 46 v
937.18 37.05 46 v
916.68 36.7 46 v
901.64 36.47 46 v
893.68 36.37 46 v
959.6 37.16 46 h
934.44 36.99 46 h
917.76 36.72 46 h
910.04 36.54 46 h
898.32 36.44 46 h

* - IF ANY MEANS: EMISSION NOT COUNTED

FOR JUDGEMENT

Ref. -No.: 20/01-0048
Product: TRANS.-/REC.-SYSTEM
Sample: 01
Date: 14. Feb 2020
Operator: BL

Test equipment:

Rohde & Schwarz ETSV
CHASE CBL 6111

Connected sets:
INPUT VOLTAGE SYSTEM: 12V/DC

Operating mode:
Tx 125kHz (MODULATED)
LF PEPS / ANTENNA 3

test distance 3m

RFI suppression parts:

Result: pass fail

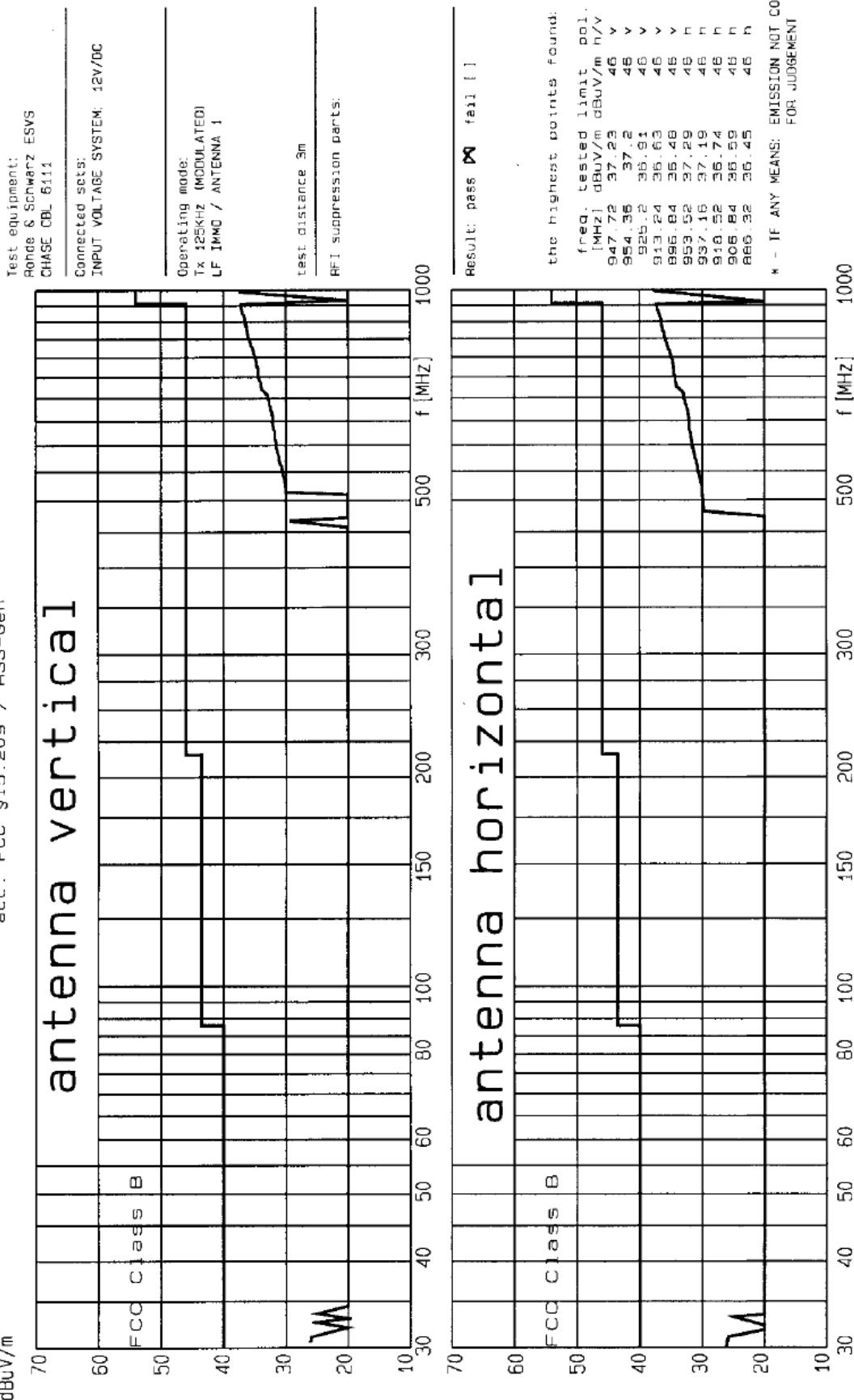
10 30 40 50 60 80 100 150 200 300 500 1000 f [MHz]

Operation Mode No.: 2. 125 kHz transmission for passiv start function (LF IMMO) Antenna 1

IT 5/6

STC Germany GmbH

Interference Radiation 30 MHz - 1000 MHz
acc. FCC §15.209 / RSS-Gen



Operation Mode No.: 2. 125 kHz transmission for passiv start function (LF IMMO) Antenna 2

IT 5/6

STC Germany GmbH

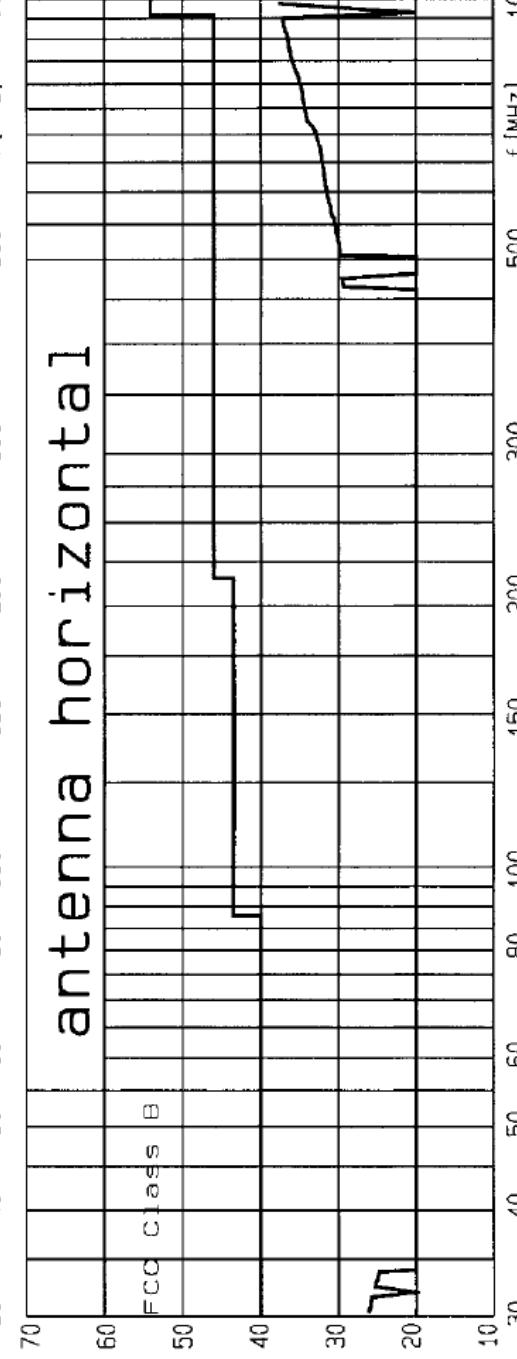
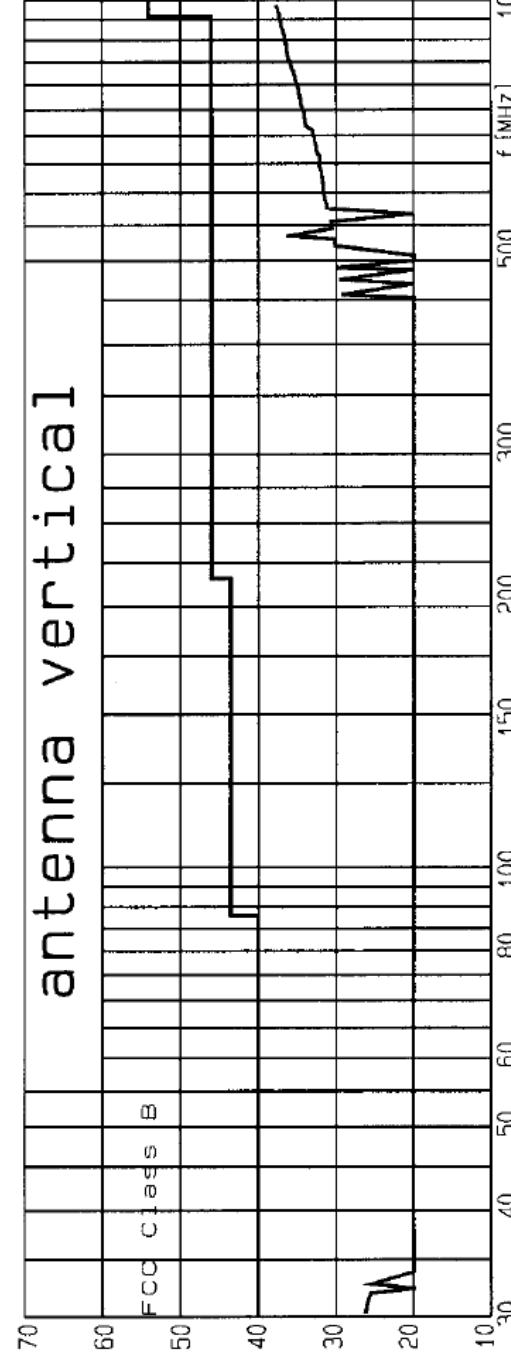
Interference Radiation 30 MHz - 1000 MHz
acc. FCC §15.209 / RSS-GenRef.-No.: 20/01-0048
Product: TRANS.-/REC.-SYSTEM
Sample: 01
Date: 14 Feb 2020
Operator: BLTest equipment:
Rohde & Schwarz ETSV
CHASE CBL 6111Connected sets:
INPUT VOLTAGE SYSTEM: 12V/DCOperating mode:
Tx 125kHz (MODULATED)
LF IMMO / ANTENNA 2

test distance 3m

RFI suppression parts:

Result: pass [] fail []

the highest points found:

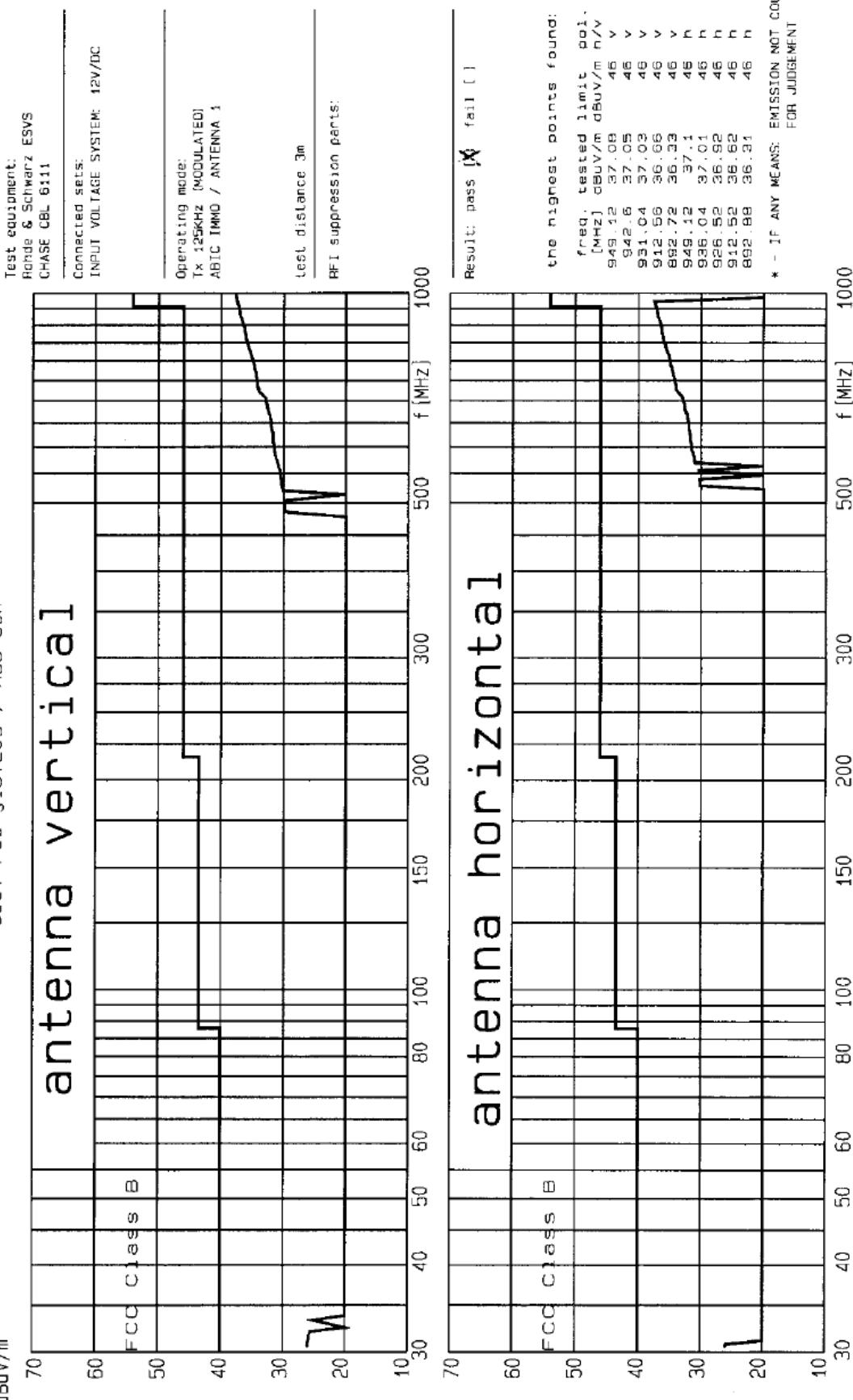
freq. tested limit pol.
[MHz] dBuV/m dBuV/m h/v
905.92 37.33 46 v
939.6 37.01 46 v
922.76 36.85 45 v
912.6 36.64 45 v
696.24 36.47 46 v
943.82 37.16 46 n
949.42 37.16 46 n
917.68 36.78 46 n
908.4 36.56 46 n
895.2 36.43 46 n* - IF ANY MEANS: EMISSION NOT COUNTED
FOR JUDGEMENT1000
f [MHz]
1000
f [MHz]

Operation Mode No.: 3. 125 kHz transmission for Immobilisier function (ABIC IMMO) Coil Antenna

IT 5/6

STC Germany GmbH

Interference Radiation 30 MHz - 1000 MHz
acc. FCC §15.209 / RSS-Gen



Operation Mode No.: 4. Receiving mode 433,92 MHz

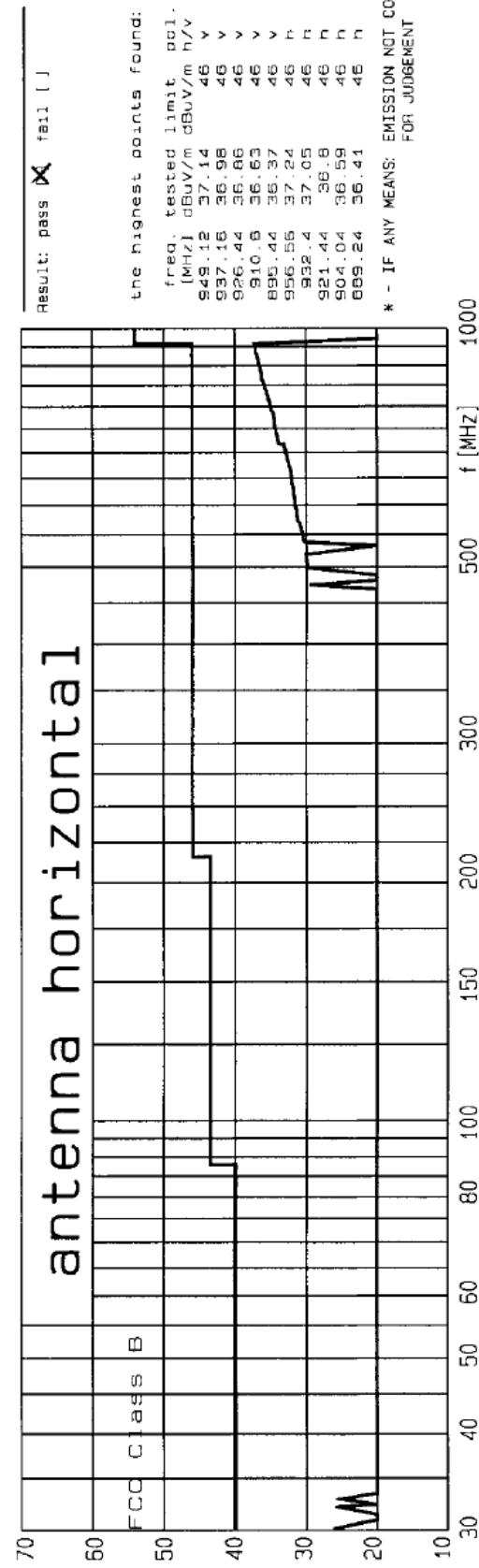
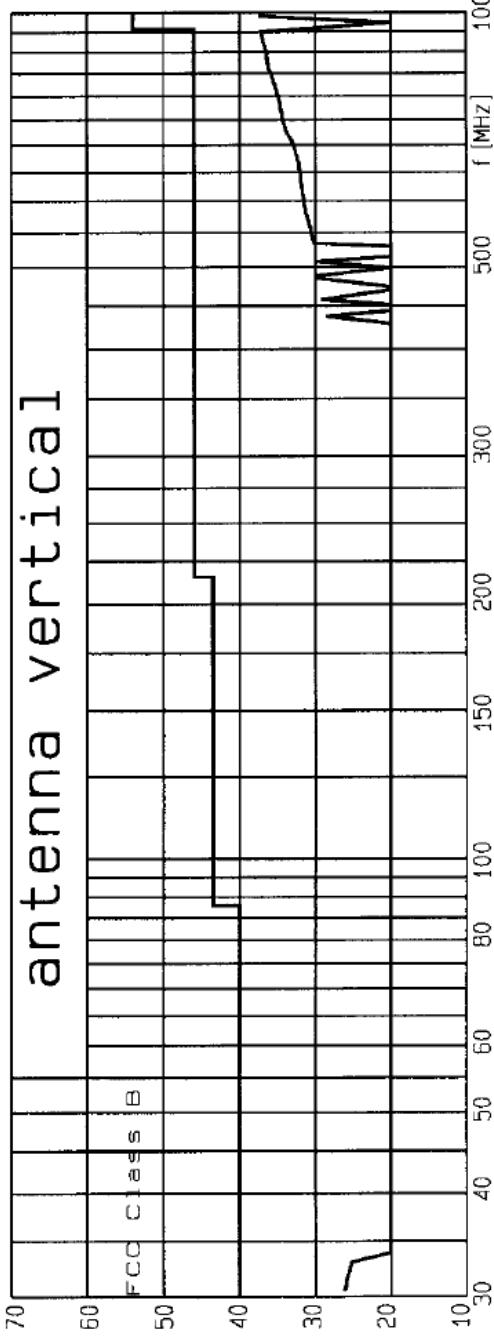
ITT 5/6

STC Germany GmbH

Interference Radiation 30 MHz - 1000 MHz
acc. FCC §15.209 / RSS-Gen

dBuV/m

antenna vertical



The highest points found:

freq. [MHz]	tested	limit	pol.
949.12	37.14	46	Y
937.18	36.98	46	Y
926.44	36.86	46	Y
910.6	36.63	46	Y
895.44	36.37	46	Y
896.56	37.24	46	Y
932.4	37.05	46	Y
921.44	36.8	46	Y
904.04	36.59	46	Y
889.24	36.41	46	Y

* - IF ANY MEANS EMISSION NOT COUNTED
FOR JUDGEMENT

The six highest emissions for each polarization (H/V) in the frequency range 30 MHz – 1000 MHz are as following:

Frequency [MHz] (1)	Detector (2)	Antenna polarization (3)	Radiated emission [dB μ V/m] (4)	Radiated emission [μ V/m] (5)	Limit [dB μ V/m] (3 m) (6)	Limit [μ V/m] (3 m) (7)	Result (8)
955,92	QP	V	37,33	73,54	46.00	200	Pass
951,16	QP	V	37,27	73,03	46.00	200	Pass
947,72	QP	V	37,23	72,69	46.00	200	Pass
954,36	QP	V	37,20	72,44	46.00	200	Pass
955,08	QP	V	37,18	72,28	46.00	200	Pass
948,56	QP	V	37,13	71,86	46.00	200	Pass
953,52	QP	H	37,29	73,20	46.00	200	Pass
937,16	QP	H	37,19	72,36	46.00	200	Pass
943,92	QP	H	37,16	72,11	46.00	200	Pass
949,12	QP	H	37,16	72,11	46.00	200	Pass
953,64	QP	H	37,14	71,94	46.00	200	Pass
953,28	QP	H	37,13	71,86	46.00	200	Pass

(1) = test frequency

(2) = used detector - quasi peak (QP), peak (PK), average (AV)

(3) = polarization of the test antenna (Horizontal/Vertical)

(4) = Reading of test receiver + coversaion factor

(5) = $10^{\wedge} ((\text{Radiated emission [dB}\mu\text{V/m]} (5))/20)$

(6) = relevant limit in dB μ V/m

(7) = relevant limit in μ V/m

(8) = comparison between Limit [dB μ V/m] (6) and Radiated emission [dB μ V/m] (4)

Result 1 GHz – 7 GHz

All emissions in the frequency range 1 GHz - 7 GHz are at least 20 dB below the relevant limit. Representative one plot for each operation mode and each polarisation was add in this report.

Operation Mode No.: 1. 125 kHz transmission for keyless entry function (PEPS)

TESTED
IN GERMANY

IT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-Gen

TESTED

Ref.-No.: 20/01-0048

Product: Transmitting/Receiving System

Sample: 01

Date: 19.02.2020

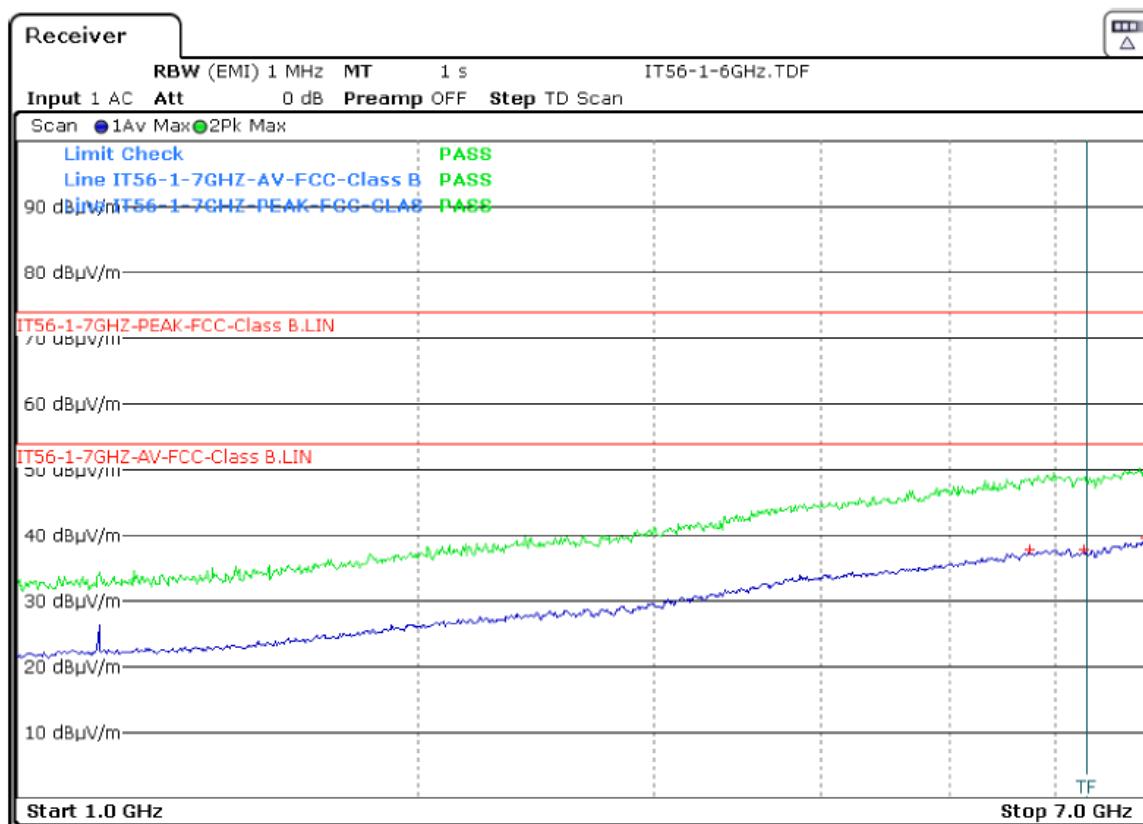
Operator: BI

pass fail

Remarks: Input Voltage System: 12V/DC (modulated signal)

Result:

Operation mode: Tx 125kHz (PEPS ANT1)

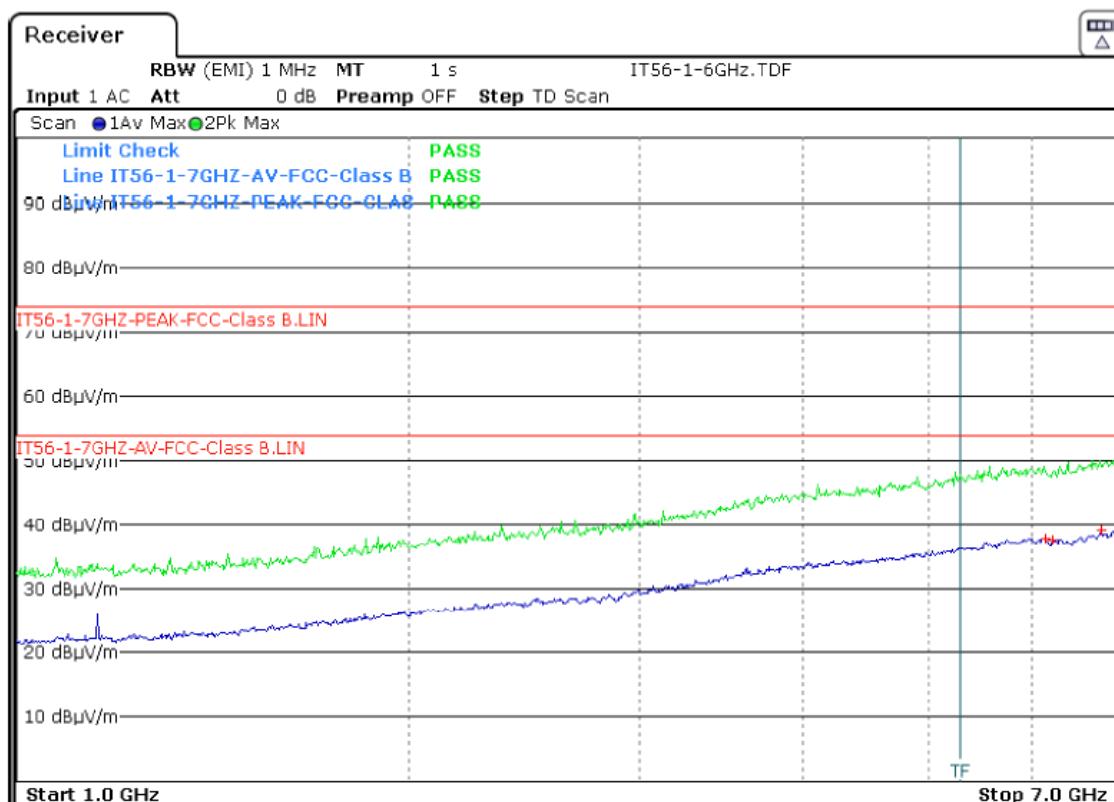


Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx 125kHz (PEPS ANT1)



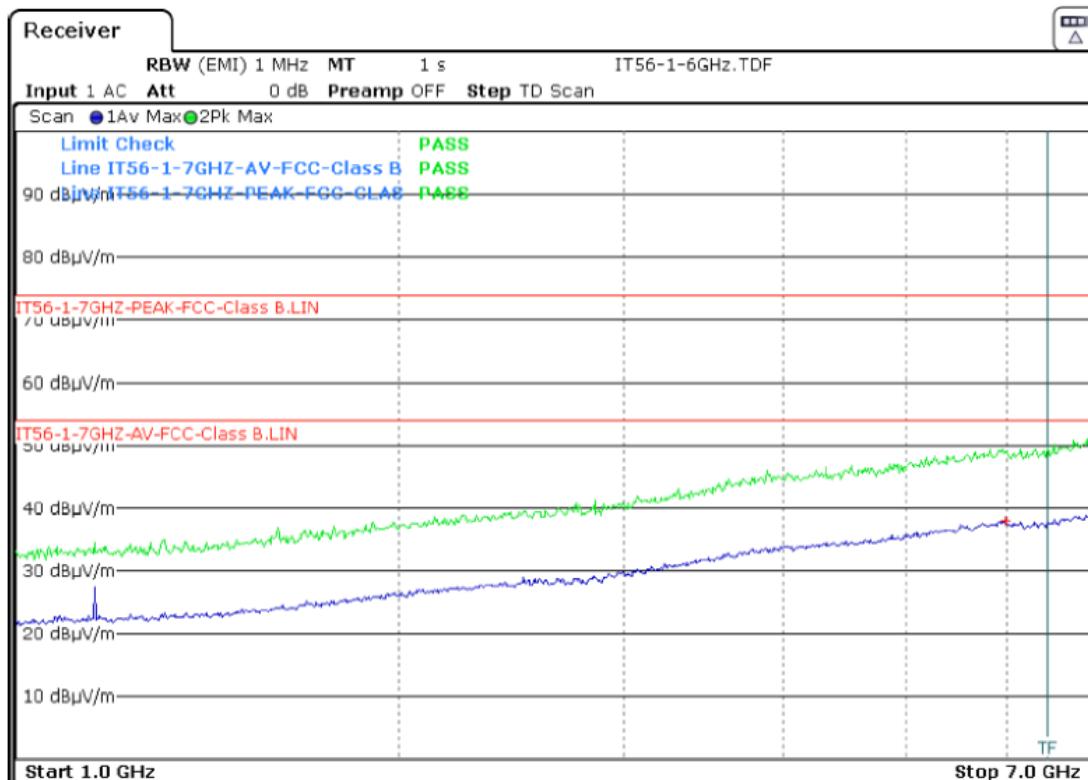
Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					
				pass					
				pass					
				pass					
				pass					

Operation Mode No.: 2. 125 kHz transmission for passiv start function (LF IMMO)

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx 125kHz (LF IMMO ANT1)



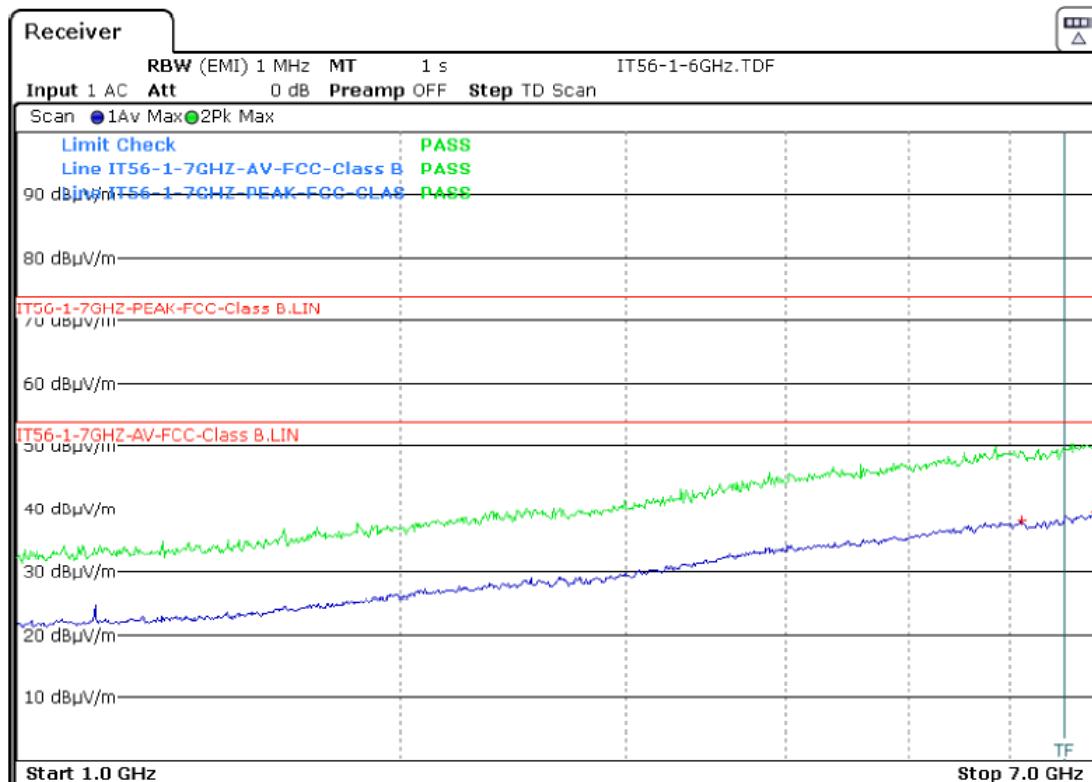
Polarisation: V

Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-	>20	54	pass	1 - 7	-	>20	74	pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx 125kHz (LF IMMO ANT1)



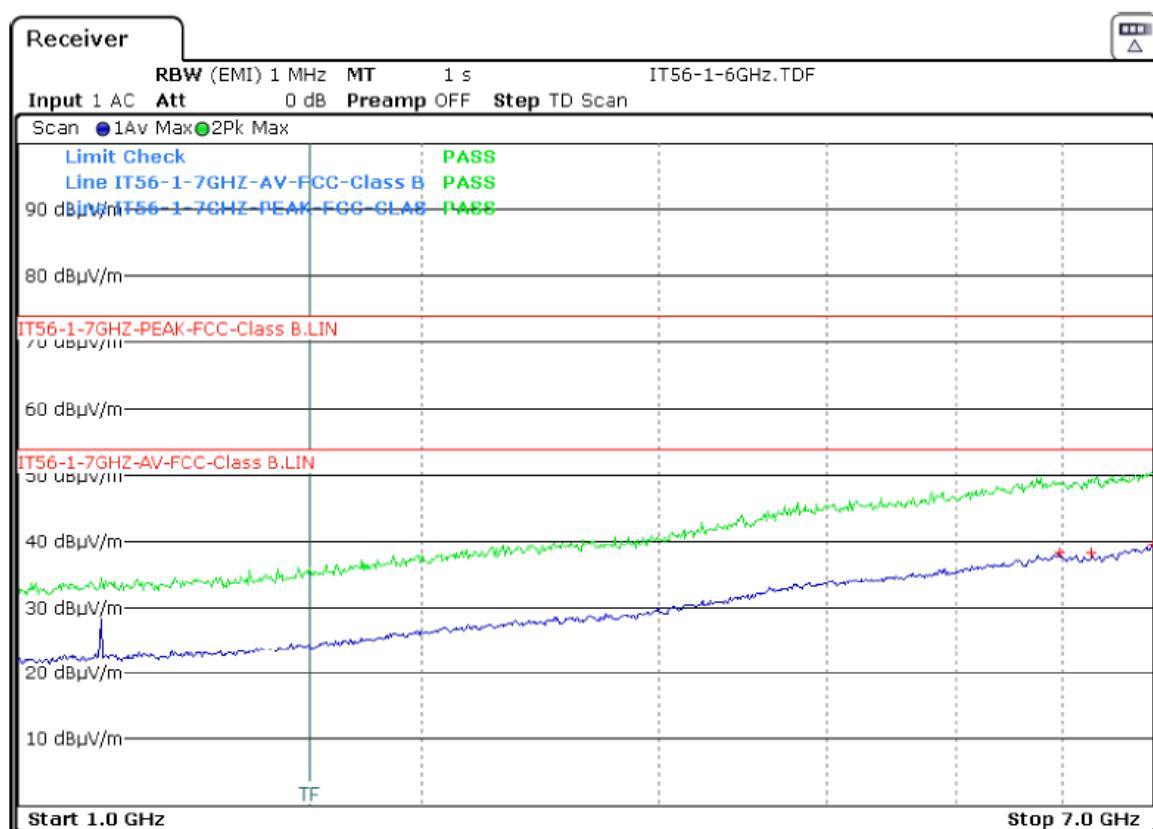
Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					
				pass					
				pass					
				pass					
				pass					

Operation Mode No.: 3. 125 kHz transmission for Immobilisier function (ABIC IMMO) Coil Antenna

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx 125kHz (ABIC IMMO Coil Antenna)

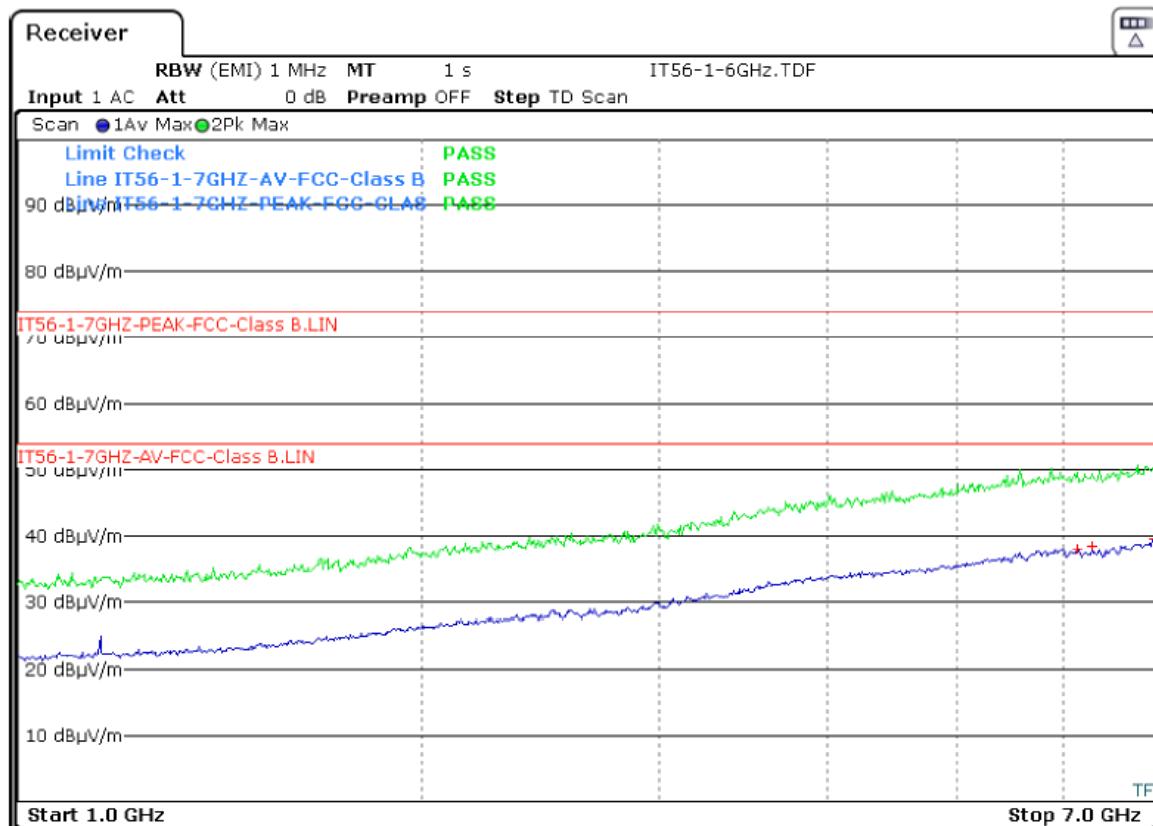


Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Tx 125kHz (ABIC IMMO Coil Antenna)



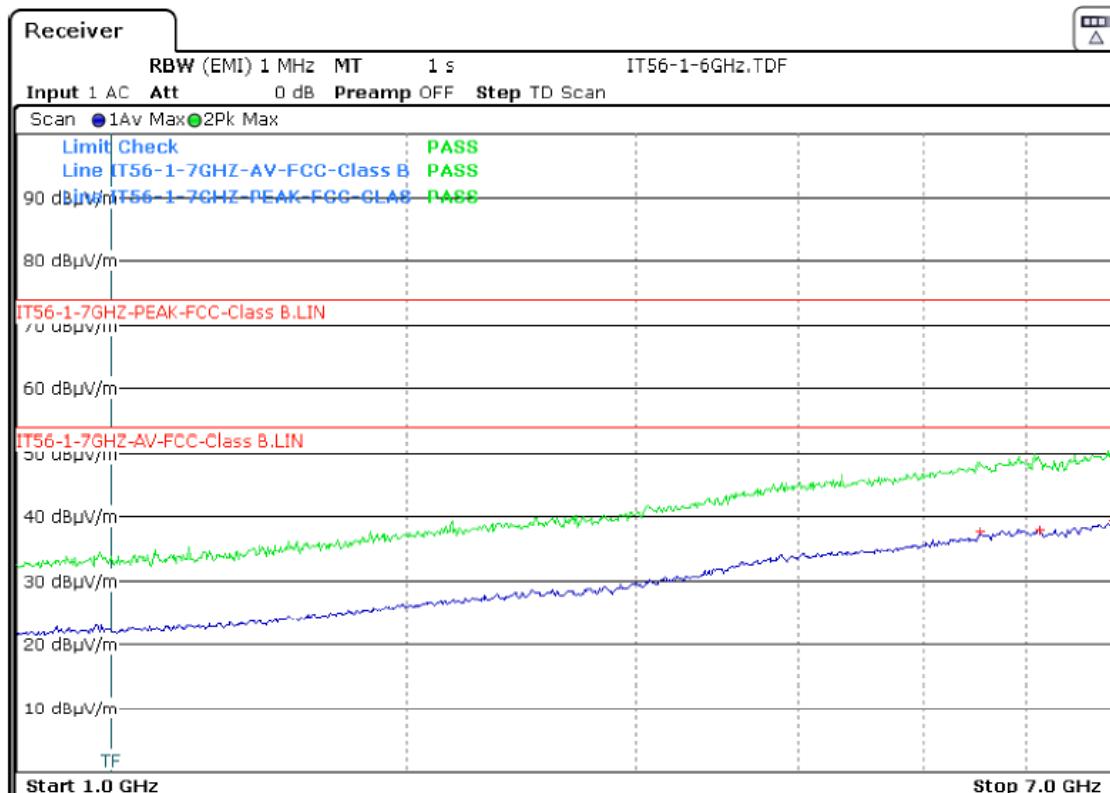
Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					
				pass					
				pass					
				pass					
				pass					

Operation Mode No.: 4. Receiving mode 433,92 MHz

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-GenTESTED
IN GERMANY

Ref.-No.: 20/01-0048

Operation mode: Rx 433,920MHz



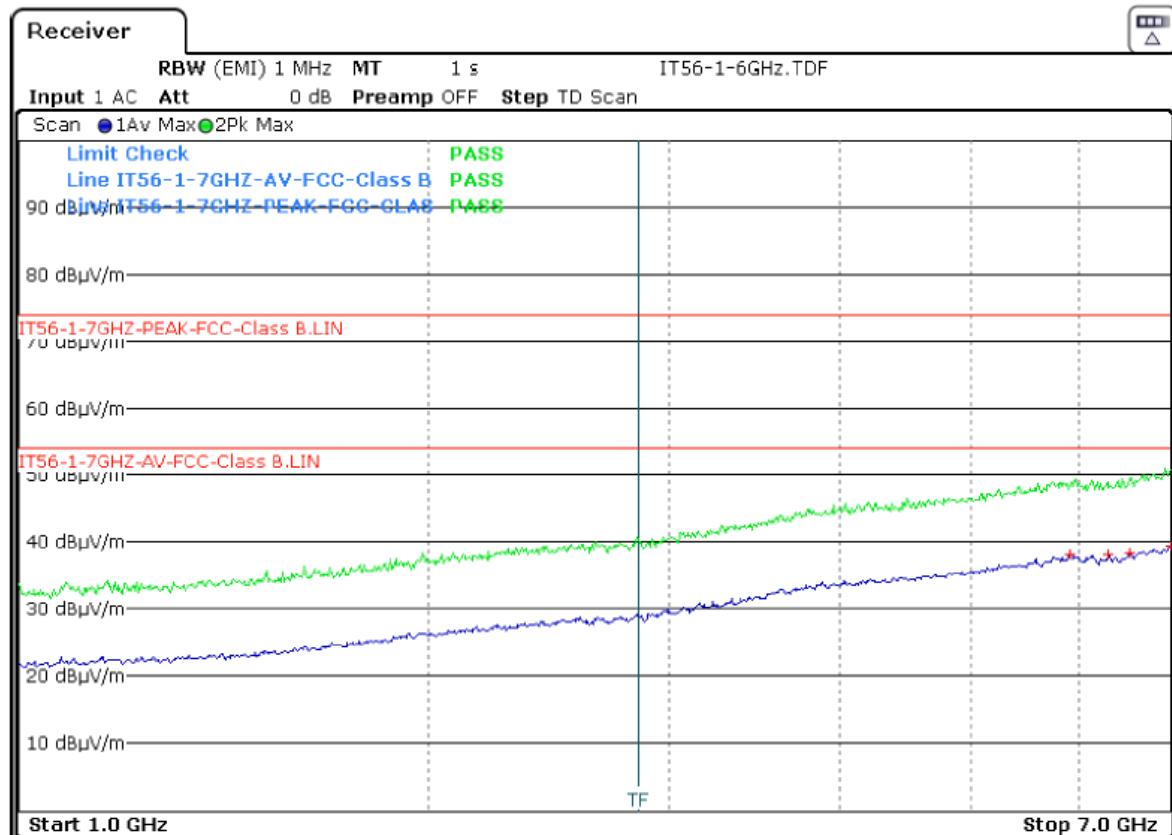
Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result	Frequ. [GHz]	Level [dB μ V/m]	Margin to Limit [dB]	Limit [dB μ V/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass

TESTED
IN GERMANYIT 5/6
Interference radiation
acc. to FCC § 15.209 / RSS-Gen

TESTED

Ref.-No.: 20/01-0048

Operation mode: RX 433,920MHz



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dB _{AV} /m]	Margin to Limit [dB]	Limit [dB _{AV} /m]	Result	Frequ. [GHz]	Level [dB _{AV} /m]	Margin to Limit [dB]	Limit [dB _{AV} /m]	Result
1 - 7	-/-	>20	54	pass pass	1 - 7	-/-	>20	74	pass
				pass					
				pass					
				pass					
				pass					
				pass					

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Radiated Emissions**.

7. Output Power of Fundamental Emission

Applied standards

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits
RSS-210 Issue 10 section 5
RSS-Gen issue 05 section 7.3

Test equipment and test set up

Test equipment used for radiated measurements as given in clause Test equipment of this report.
Test setup used for radiated measurements as given in clause Test setups of this report.

Measurement:

The Measurement was performed on: 18.02.2020

Measurement distance 3 m

Function	Frequency of fundamental Emission	Antenna Type 1 [dB μ V/m]	Antenna Type 2 [dB μ V/m]	Antenna Type 3 [dB μ V/m]	Coil Antenna [dB μ V/m]	Limit [dB μ V/m]	Result
Mode 1 (PEPS)	125 kHz	89,1	91,7	89,3	-/-	105,7	pass
Mode 2 (Shared immobilizer)	125 kHz	89,1	91,7	-/-	-/-	105,7	pass
Mode 3 (Standalone Immobilizer)	125 kHz	-/-	-/-	-/-	71,2	105,7	pass

Converted value at distance 300 m^{Note 1}

Function	Frequency of fundamental Emission	Antenna Type 1 [dB μ V/m]	Antenna Type 2 [dB μ V/m]	Antenna Type 3 [dB μ V/m]	Coil Antenna [dB μ V/m]	Limit [dB μ V/m]	Result
Mode 1 (PEPS)	125 kHz	9,1	11,7	9,3	-/-	25,7	pass
Mode 2 (Shared immobilizer)	125 kHz	9,1	11,7	-/-	-/-	25,7	pass
Mode 3 (Standalone Immobilizer)	125 kHz	-/-	-/-	-/-	-8,8	25,7	pass

Note 1: using a conversion factor of 40 dB/decade acc. to § 15.31 (f)(2)

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements of **Output Power of Fundamental Emissions**.

8. 99% Power Bandwidth

Applied standards

- RSS-210 issue 10 Section 5
- RSS-Gen issue 5 Section 6.7

Test equipment and test set up

Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

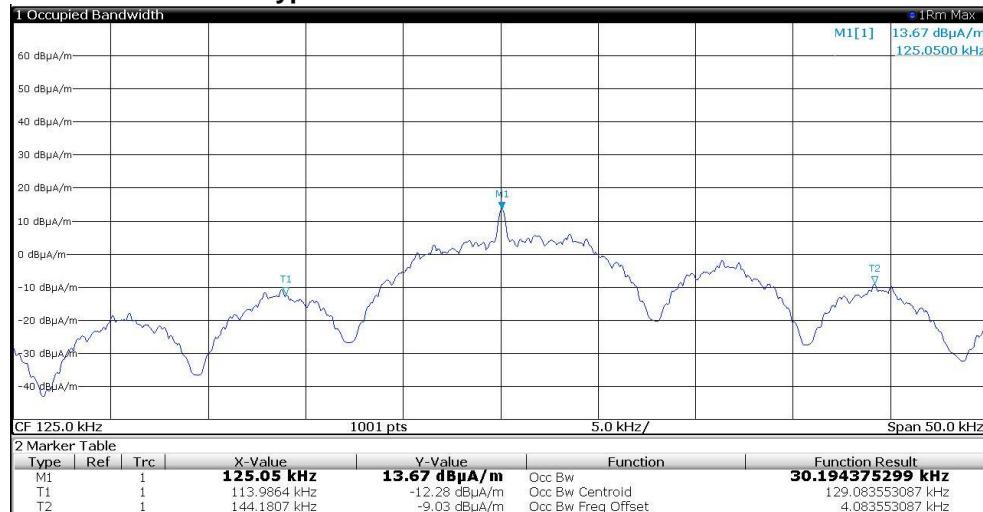
Description

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The 99% power bandwidth function of the instrument was used for the measurement.

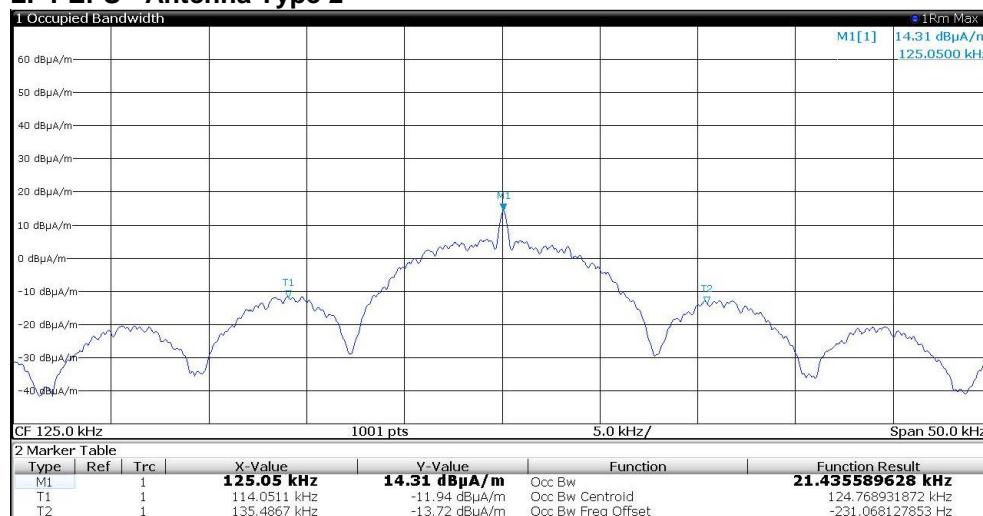
Measurement:

The Measurement was performed on: 18.02.2020

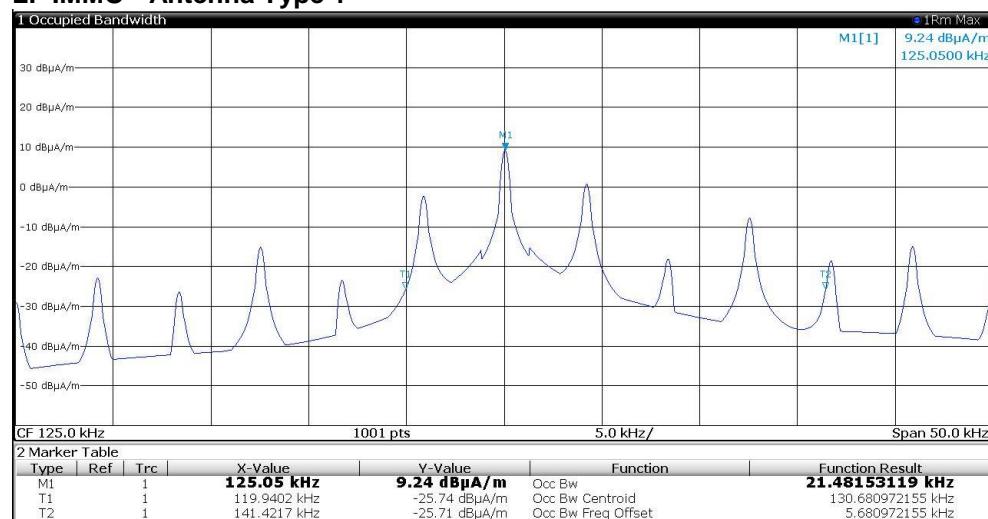
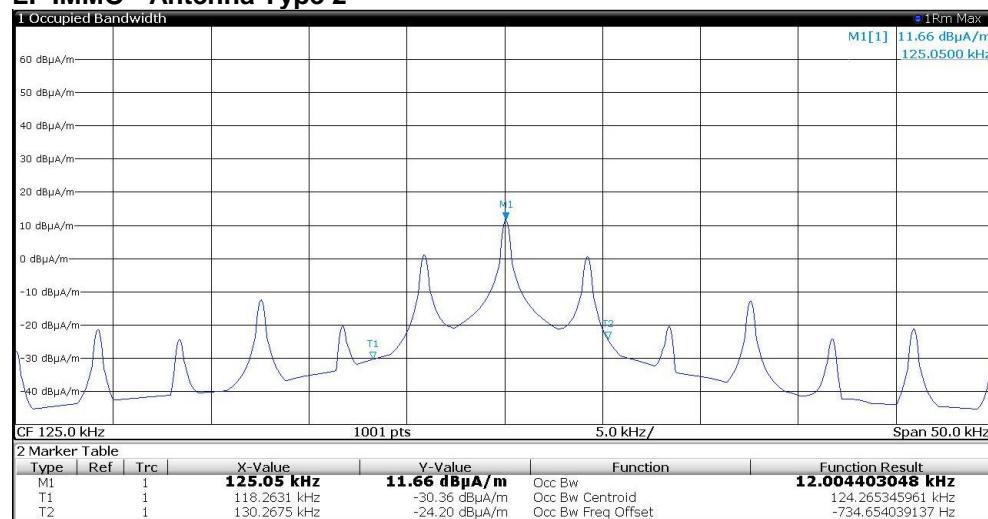
LF PEPS - Antenna Type 1



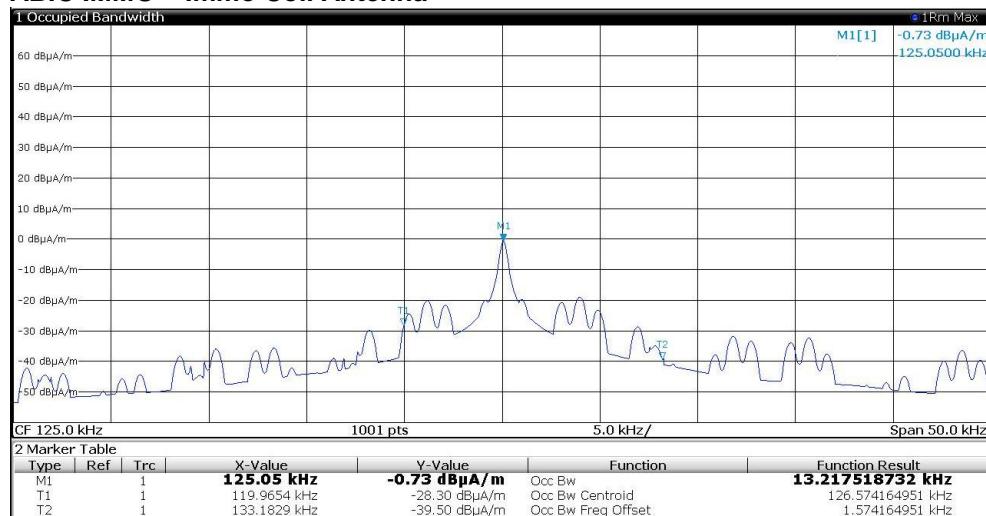
LF PEPS - Antenna Type 2



LF PEPS - Antenna Type 3

LF IMMO - Antenna Type 1

LF IMMO - Antenna Type 2


ABIC IMMO – Immo Coil Antenna



Summary List of Bandwidth

EUT Frequency (kHz)	99% OBW lower (f _L) frequency [kHz]	99% OBW upper (f _H) frequency [kHz]	Centre frequency [kHz]	99% Bandwidth [kHz]	Result	Comment
125	113.987	144.181	129.084	30.19	pass	LF PEPS - Antenna 1
125	114.051	135.487	124.992	21.43	pass	LF PEPS - Antenna 2
125	114.829	142.912	128.870	28.08	pass	LF PEPS - Antenna 3
125	119.940	141.422	130.680	21.48	pass	LF IMMO - Antenna 1
125	118.263	130.268	124.265	12.00	pass	LF IMMO - Antenna 2
125	119.695	131.183	126.574	13.22	pass	ABIC IMMO Col Antenna

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **99% Power Bandwidth**.

9. RF Exposure

Refer to "0048-ised-rep-RF-Exposure.pdf" file

10. Test equipment

Test equipment used for radiated Measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
ESR7 EMI Testreceiver 7GHz	Rohde & Schwarz	ESR7	11676	101694	2018-March	3 years
Test-Receiver	Rohde & Schwarz	ESVS30	10572	833825/010	2017-Mar.	3 years
					2020-April	3 years
Antenna 9 kHz – 30 MHz	EMCO	6502	10546	2018	2017-Nov.	3 years
Antenna 30 MHz – 1 GHz	Chase	CBL6111C	10022	1064	2019-Dec.	3 years
Antenna 1GHz – 18 GHz	Electro Metric	RGA50/60	10273	2753	2017-Nov.	3 years
Broadband-Preamplifier 1-18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2017-Okt.	3 years
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017-Dec.	3 years
Shielded room/Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2019-March	3 years

Test equipment used for conducted measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
Signal Spectrum Analyzer 2Hz – 26.5 GHz	Rohde & Schwarz	FSW 26 Instrument FW 2.60	11571	102047	2019 - Jan.	3 years
EMI-Test-Receiver	Rohde & Schwarz	ESR7 Instrument FW 3.36	11505	101103	2017 - Nov.	3 years
Automatisation unit RF switch and power meter	Rohde & Schwarz	OSP120 and OSP B157	11573	101282	2017 - Dec.	3 years
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017 - Dec.	3 years

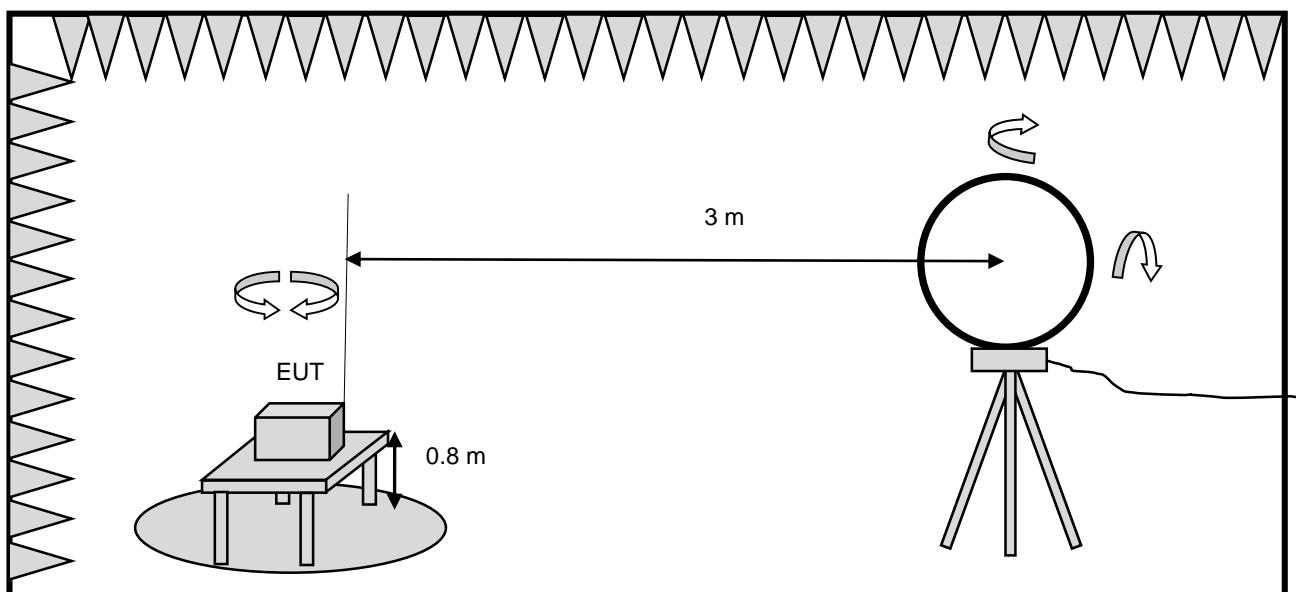
All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of conducted emissions was made with instruments conforming to American National Standard Specification, ANSI C63.4-2014.

Test equipment to support EUT functions:

Kind of equipment	Manufacturer	Type	Ident no.
Power supply	Elektro-Automatik	EA-3021S	10375
-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-

11. Test Setups

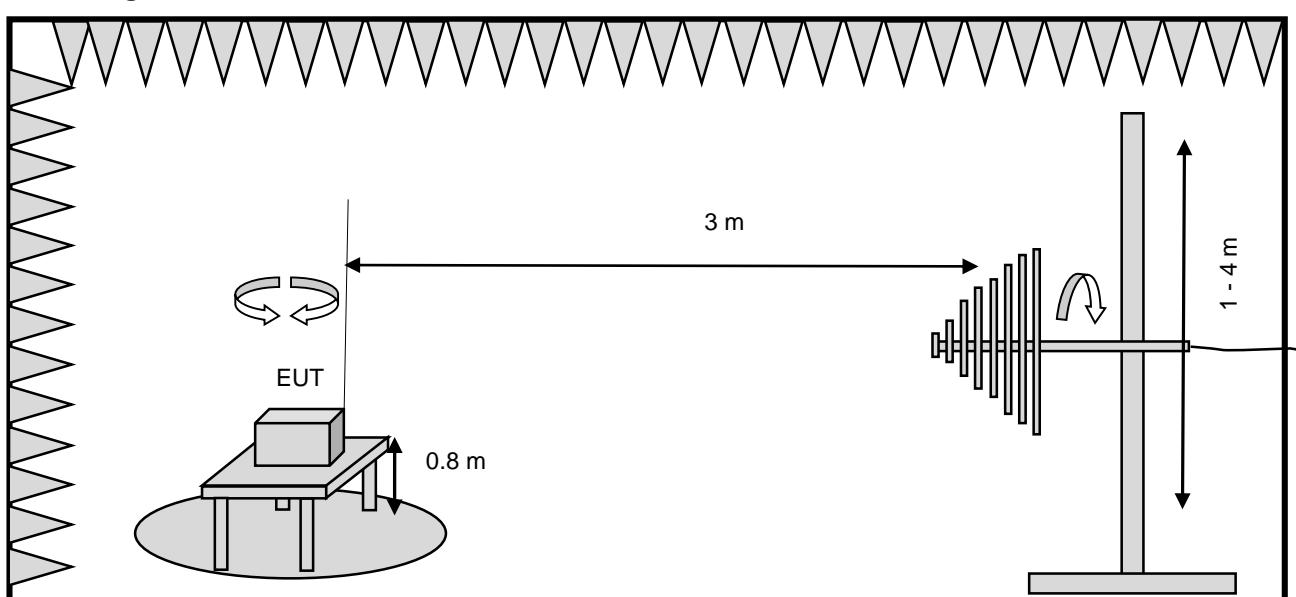
Block diagram Radiated emissions



Semi anechoic chamber with absorber and ferrite tiles



Block diagram Radiated emissions

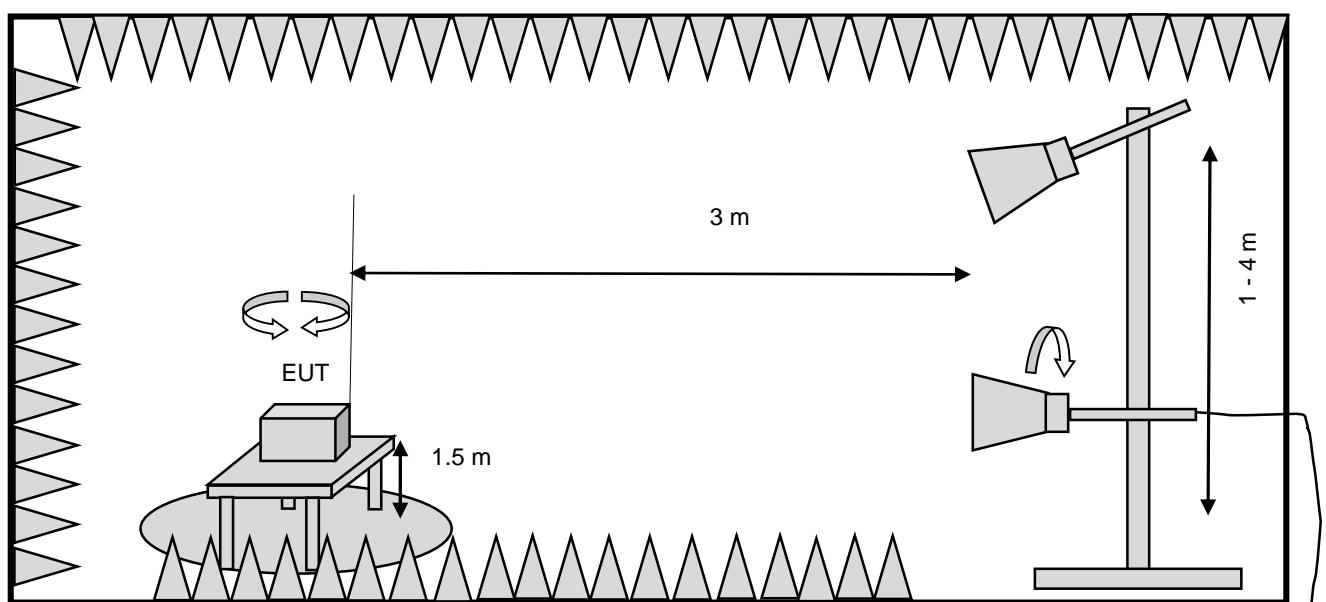


Semi anechoic chamber with absorber and ferrite tiles



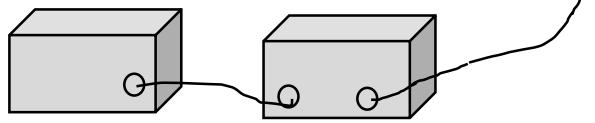
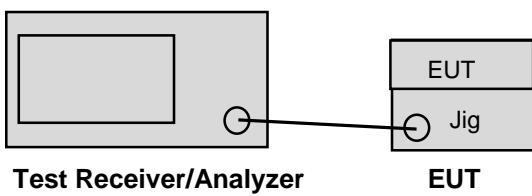
tested frequency range 9 kHz - 30 MHz

tested frequency range 30 MHz - 1000 MHz

**Semi anechoic chamber with absorber and ferrite tiles**

Spectrum analyzer

Amplifier

tested frequency range > 1000 MHz**Block diagram for conducted measurements**

12. Measurement uncertainty

according to CISPR 16-4-2 Edition 2.0 2011-06

Measurement	calculated uncertainty U_{lab}	Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}
Conducted disturbance at mains port using AMN 9 kHz – 150 kHz	3.6 dB	3.8 dB
Conducted disturbance at mains port using AMN 150 kHz – 30 MHz	3.2 dB	3.4 dB
Magn. fieldstrength 9kHz - 30MHz	3.4 dB	-/-
Radiated disturbance (electric field strength in the SAC) 30 MHz to 1 000 MHz	4.7 dB	6.3 dB
Radiated disturbance (electric field strength in the SAC) 1 GHz to 26.5 GHz	4.1 dB	-/-

Measurement	calculated uncertainty U_{lab}	Maximum measurement uncertainty
Channel Bandwidth	±1.17 %	±5 %
RF output power, conducted	±1.36 dB	±1.5 dB
Power Spectral Density, conducted	±1.99 dB	±3 dB
Unwanted Emissions, conducted	±1.71 dB	±3 dB
All emissions, radiated	±4.8 dB	±6 dB
Temperature	±0.72 °C	±3 °C
Supply voltages	±0.76 % (DC up to 40V) ±1.74 % (AC 50Hz up to 400V)	±3 %
Time	±0.012 %	±5 %

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

The measurement uncertainty was given with a confidence of 95 % (k = 2).

13. Photos setup

Refer to "0048-fcc-ised-photos test setup.pdf" file

14. Conclusions

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant §15.209 Radiated emission limits; general requirements.

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant RSS-210 issue 10 Digital Licence-Exempt Radio Apparatus: Category I Equipment.

Following specific modifications and/or special attributes are necessary to pass the above mentioned requirements:

none

This test report replaces the test report no. 20/01-0048 dated 15.05.2020.

07.10.2020
Erstellt am/prepared on

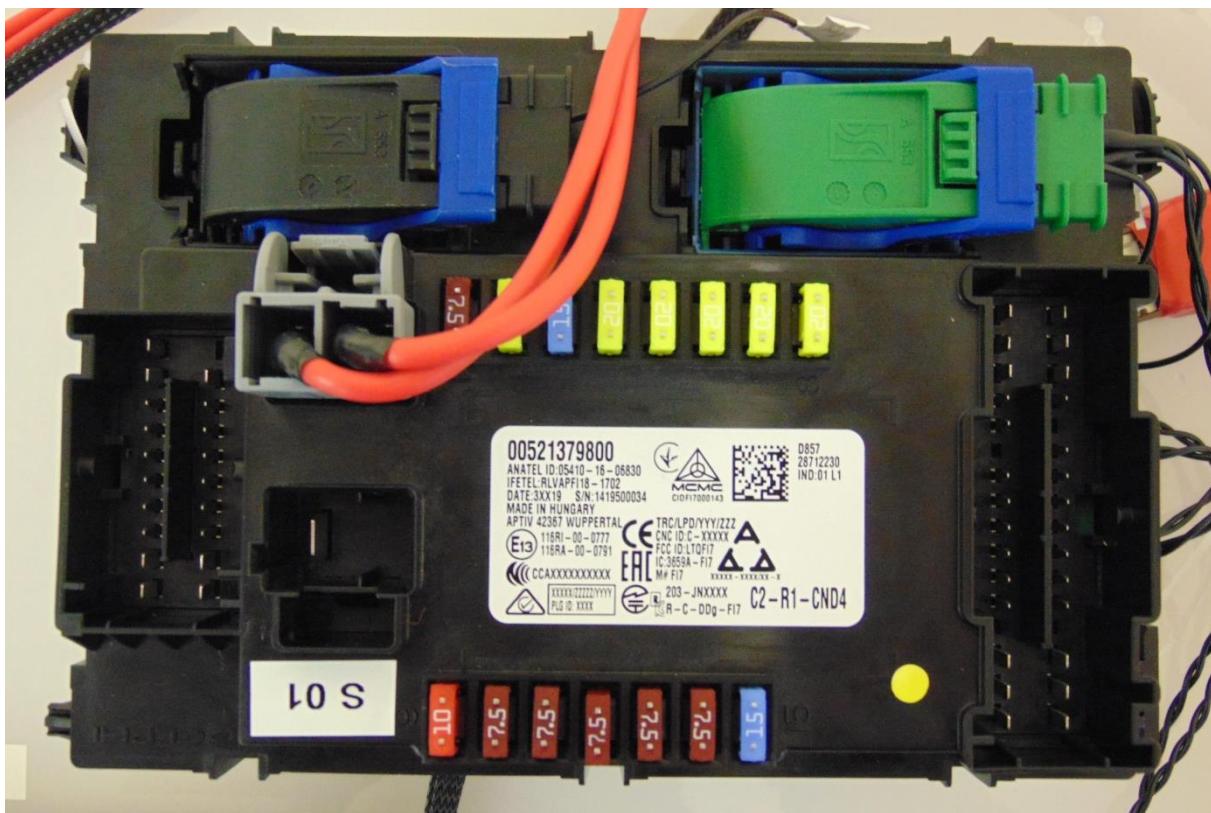
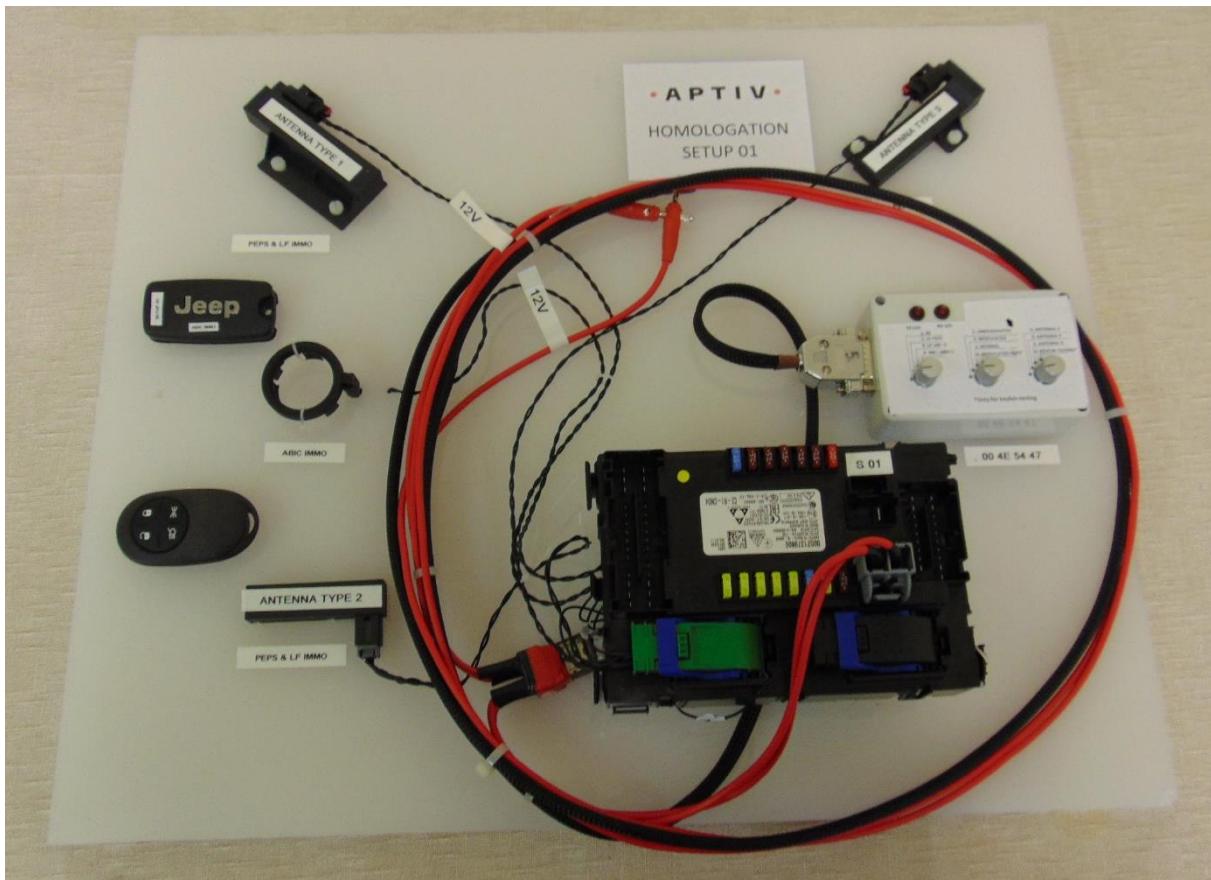
A. Tropmann, Head of Laboratory
(Name/name / Stellung/position)

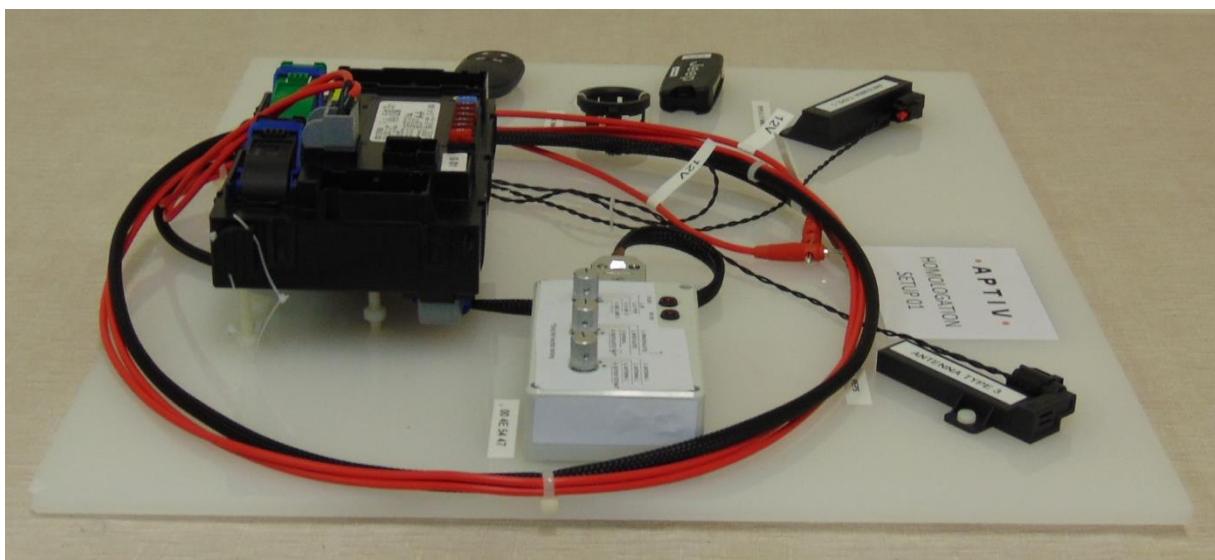
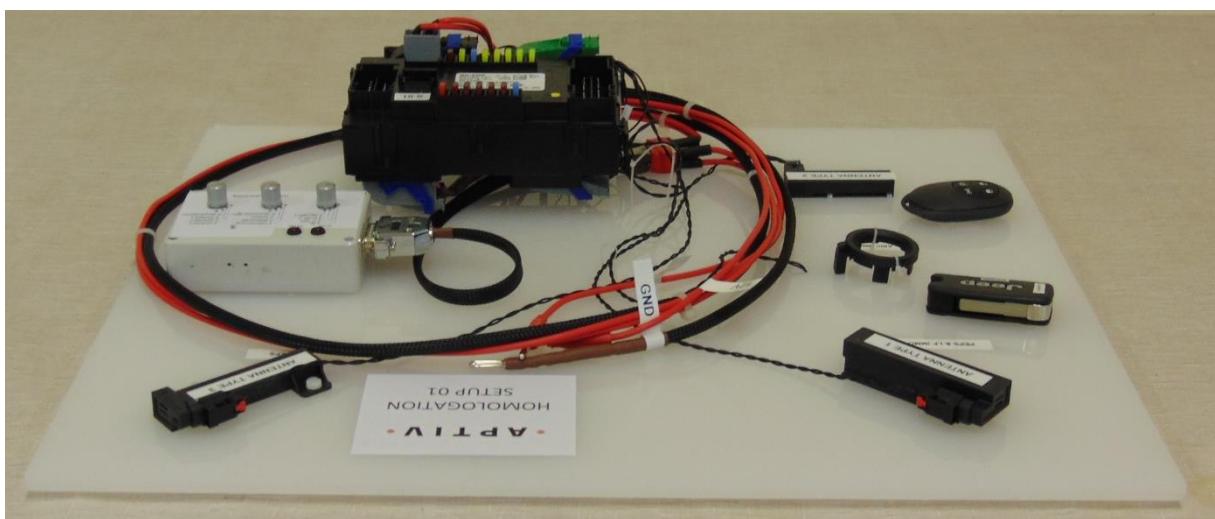
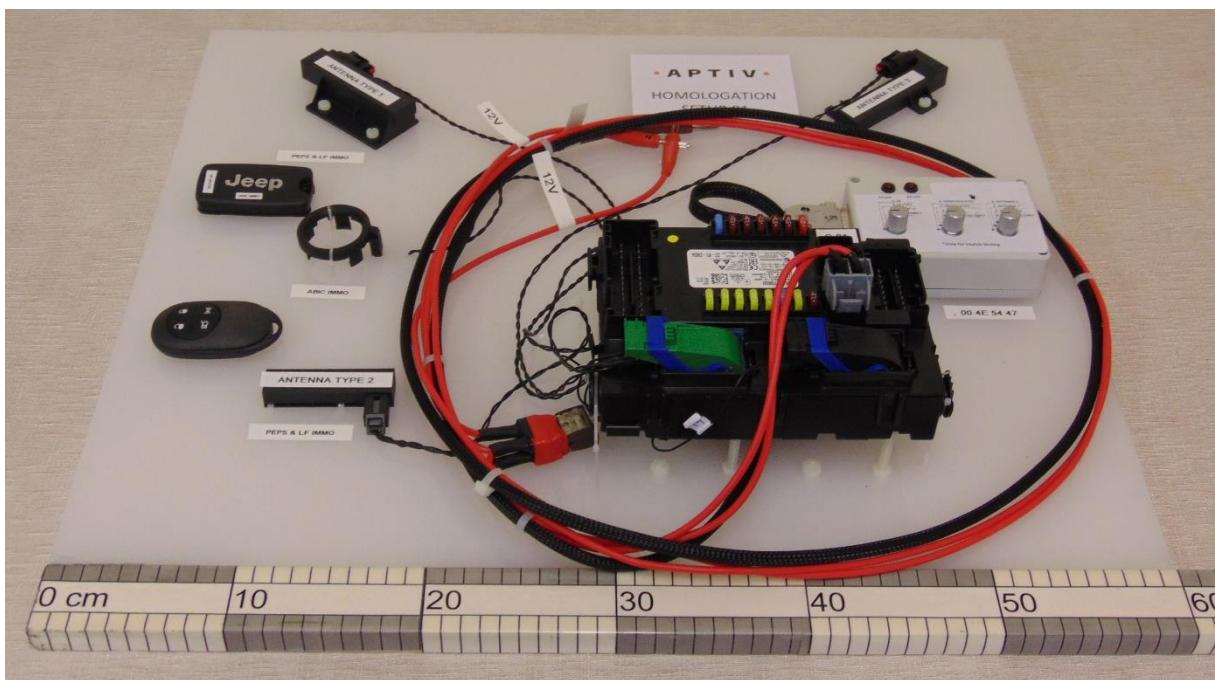

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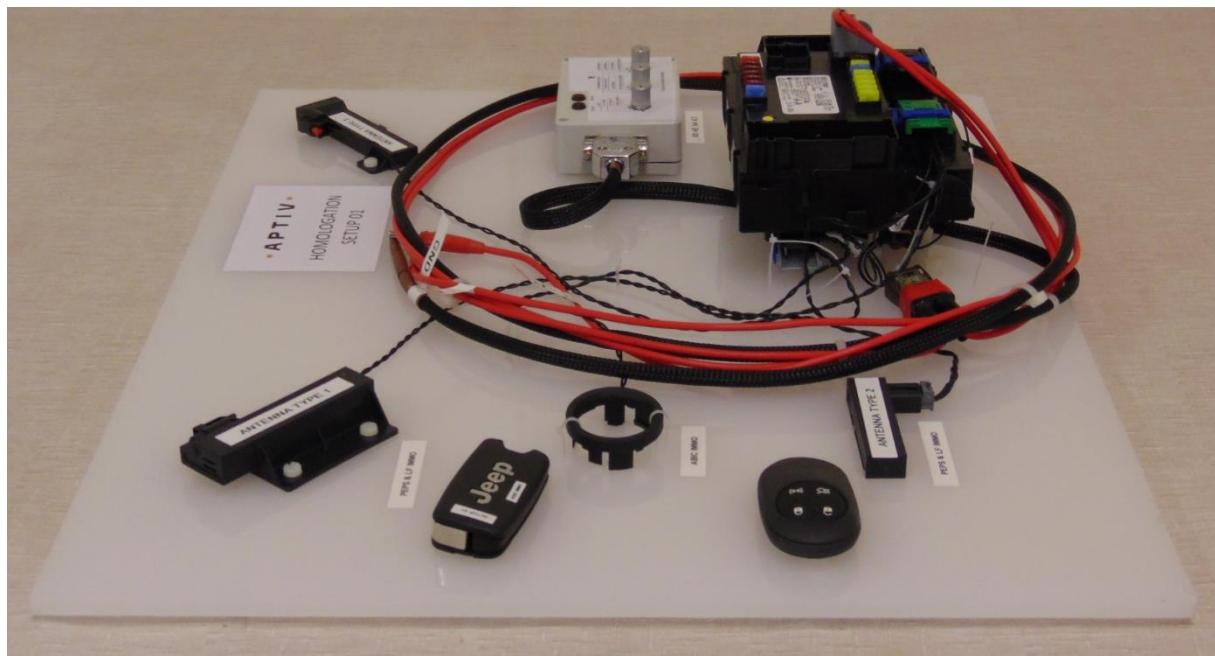
07.10.2020
Freigabe am/released on

K. Simon, Deputy Head of Laboratory
(Name/name / Stellung/position)


(Unterschrift/signature)

15. Photos of tested sample





End of test report