

# **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





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Test report no .:

21/04-0029-A

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# Location of test facility:



STC Germany GmbH Ohmstrasse 1 84160 Frontenhausen Germany

#### 1. Client information

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Address:	5, Rue du chant des oiseaux 78360 Montesson FRANCE
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# 2. Equipment under test (EUT)

# 2.1 Identification of the EUT

Equipment:	Transmitter for Passive Entry Passive Start (PEPS) RKE TPMS
Model:	FI7
Brand name:	APTIV
Serial no.:	Sample 1: -/-
Manufacturer:	APTIV Services Hungary Kft. Zanati út 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:	29.04.2021
Tests were performed:	15.06.2021 – 28.06.2021

#### 2.2 Additional information about the EUT:

The device includes a 434 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:	3659A-FI7				
HVIN:	C2-R1-CND4				
Power:	12 V - (8.0 V - 16.0 V	) powered via	vehicle batter	ry	
Cables:	DC: 195 cm				
Approx. Size (I x w x h):	(19.5 x 13.5 x 7.0) cm				
Test conditions:	<ul> <li>The "Transmitter for Passive Entry Passive Start (PEPS) RKE TPMS" (= equipment under test – EUT) is an immobilizier system for vehicular use and had been tested in following Configurations:</li> <li>(1) 125 kHz transmission for keyless entry function (LF PEPS) Antenna 1 and Antenna 3</li> <li>(2) 125 kHz transmission for keyless entry function (Shared Immobilizer, LF IMMO) Antenna 1</li> <li>(3) 125 kHz transmission for passive start function (Shared immobilizier, LF IMMO) Coil Antenna Type 2</li> <li>(4) RX 433.920 MHz signal, Internal PCB Antenna</li> <li>with maximum RF-output power in order to find the worst case. During the tests the EUT was powered with 12 V DC.</li> </ul>				
	Tests where performed tested combination of a Function/involved				w show the Coil Antenna
	antennas Mode 1	Type 1	Antenna	Type 3	Type 2
	(PEPS TX) Mode 2	х	-/-	x	-/-
	(Shared immobilizer TX/RX))	x	-/-	-/-	-/-
	Mode 3 (Shared Immobilizer TX/RX)	-/-	-/-	-/-	x
	Mode 4 (RF Receiver RX)	-/-	x	-/-	-/-
	Remarke: There is no si coil antenna in park moo			ission of ante	enna 1, 3 or
Additional information:	-/-				
Operating frequencies:	Transmitter: 125 kHz	Receiver:	433,92 MHz		
Type of modulation:	K1D				
Environmental conditions during tests:					
Antenna Transmitter:	Model:       Antenna Type 1         Antenna Type 3         Coil Antenna Type 2         Type:       ⊠ External         □ Internal (integrated, PCB antenna)				
Antenna Receiver:	Model: Printed PCB Antenna Type:  External Internal (integrated, PCB antenna)				

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#### 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.

				Test	requir	ements	S:
Standard:	Standard:	Test Method:		applica	able:	fulfil	led:
				Yes	No	Yes	No
§ 15.207	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions				
§ 15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.3 - 6.6	Radiated Emissions				
§15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.4	Output Power of Fundamental Emissions				
-/-	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.9.3	99% Power Bandwidth				

The test § 15.209 (RSS-210 issue 10 / RSS-Gen issue 5) Radiated Emissions at 125 KHz were performed under the STC-Ref.-Nr. 20/01-0048. All other required / applicable tests were performed under the STC-Ref.-Nr. 21/04-0029.

- 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	Quasi-Peak Limits	Average Limits				
[MHz]	[dBµV]	[dBµV]				
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 7 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 9 kHz 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 intstruction 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.

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#### 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 [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/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 [µA/m] Quasi-peak	Limits [dBµA/m] Quasi-peak	Limits [µA/m] Average	Limits [dBµA/m] Average	Test distance [m]
0.009 - 0.090	-/-	-/-	6.37/F (kHz)	-3.023.0	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 [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/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: 15.06.2021 - 28.06.2021

# 6.1 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.

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

	Freq.	Measured Value @ 3m	Conversion to magnetic field <sup>Note 1</sup>		Limit @ 3m		Margin	Result		
Function	[MHz]	[dBµV/m]	[dBµA/m]	[µA/m]	[dBµA/m]	[µA/m]	[dB]	_		
Mode 1 (PEPS)										
Antenna Type 1	0.125	65.7	14.2	5.13	54.2	512.86	40.0	pass		
Antenna Type 3	0.125	65.6	14.1	5.07	54.2	512.86	40.2	pass		
Mode 2 (Shared immobilizer)										
Antenna Type 1	0.125	48.5	-3.0	7.08	54.2	512.86	57.2	pass		
Mode 3 (Shared Immobilizer)										
Coil Antenna Type 2	0.125	64.9	13.4	4.68	54.2	512.86	40.8	pass		
Mode 4 (RF Receiver)										
	0.009 – 0.490	< 86.8	< 22.3	-/-	77 - 42.3	-/-	>20	pass		
Internal PCB Antenna	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: Converstion E-field to H-Field:  $- x [dB\mu V/m] - 51.5 = y [dB\mu A/m]$ Converstion [dB $\mu$ A/m] in [ $\mu$ A/m]  $- 10 \land (y [dB\mu A/m] / 20) = z [\mu$ A/m]

Note 2: Measured Values are from Output Power Fundamental Emission (Clause 7)

Representative one plot of Receiving mode and each polarisation was added in this report.

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#### Receiving mode 433 MHz, Internal Antenna

TESTED IN GER		<b>退STC</b>
RefNo.:	21/04-0029	
Product:	Transmitting/Receiving System	
Sample:	01	
Date:	08.06.2021	
Operator:	BI	pass fail

 $\boxtimes$ 

Result:

Remarks:

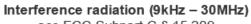
Operation mode: Receiving/Stand by 433,920MHz

### Position X (9kHz – 150kHz)

Spectrum Receiver 🗵		
RBW (QPK) 200 Hz MT	1 s	EMCO-6502-E-Feld.TDF
Input 1 DC Att 10 dB Preamp C	DFF S	Step TD Scan
Scan 🔵 1QP Max		
	ASS	100 kHz
	PASS	
130 dBµV/m		
FCC-9KHZ - 30MHz_3m.LIN		
120 dBµV/m		
110 dBµV/m		
100 dBµV/m		
90 dBµV/m		
80 dBµV/m		
70 dBµV/m		
60 dBµV/m		
50 dBµV/m-		
	min	home have been a second and a
Start 9.0 kHz		Stop 150.0 kHz

Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

IT 3/4



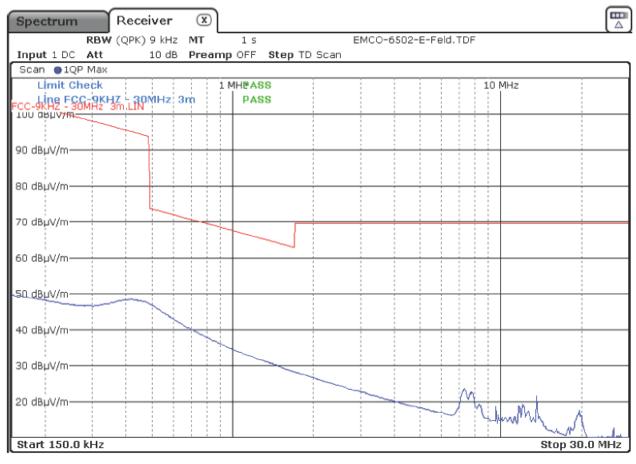
acc.FCC Subpart C § 15.209



Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

#### Position X (150kHz - 30MHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass

IT 3/4

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



Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

#### Position Y (9kHz - 150kHz)

Spectrum Receiver	×					
<b>RBW</b> (QPK) 200 Hz	MT 1s	EMCO-6502-E-Feld.TDF				
Input 1 DC Att 10 dB	Preamp OFF	Step TD Scan				
Scan 🔵 1QP Max						
10 kHønit Check	PASS	100 kHz				
Line FCC-9KHZ - 30MHz 3m	PASS					
130 dBµV/m						
FCC-9KHZ - 30MHz_3m.LIN						
120 dBµV/m						
110 dBµV/m						
110 000000						
100 dBµV/m						
90 dBµV/m						
80 dBµV/m						
70 dBµV/m						
60 dBµV/m						
50 dB						
Start 9.0 kHz Stop 150.0 kHz						

Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

IT 3/4

Interference radiation (9kHz – 30MHz)



acc.FCC Subpart C § 15.209

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

#### Position Y (150kHz - 30MHz)

Spectrum Receiver 🗵	
RBW (QPK) 9 kHz MT 1 s EMCO-6502-E-Feld.TDF	
Input 1 DC Att 10 dB Preamp OFF Step TD Scan	
Scan   1QP Max	
Limit Check 1 MHPASS 10 MHz	
FCC-9KHZ - 30MHz 3m PASS	
90 dBµV/m	
90 GBDA/W	
80 dBµV/m	
70 dBμV/m	
60 dBµV/m	
S0_dBuV/m	
40 dBµV/m	
30 dBµV/m	
20 dBµV/m	
Start 150.0 kHz Stop 30.0	) MHz

Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass

IT 3/4

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



Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

# Position Z (9kHz – 150kHz)

Spectrum Receiver	×					
RBW (QPK) 200 Hz	MT 1s		EMCO-6502-E-	-Feld.TDF		
Input 1 DC Att 10 dB		tep TD Scan				
Scan 🔵 1QP Max						
10 kHimit Check	PASS				100 kHz	
Line FCC-9KHZ - 30MHz 3n	n PASS					
130 dBµV/m						
FCC-9KHZ - 30MHz_3m.LIN						
120 dBµV/m						
110 dBµV/m						
100 dBµV/m	1	1				
90 dBµV/m						
so deptym						
80 dBµV/m						
70 dBµV/m						
60 dB 8//m						
60 dBµV/m						
SU dBµV/m						
Start 9.0 kHz					Stop 15	).0 kHz

Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

# TESTED

IT 3/4 Interference radiation (9kHz - 30MHz)



acc.FCC Subpart C § 15.209

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz)

#### Position Z (150kHz - 30MHz)

Spectrum Receiver 🗵			
RBW (QPK) 9 kHz MT	1 s	EMCO-6502-E-Feld.TDF	*
	mp OFF Step TD Scan		
Scan 🔵 1QP Max			
Limit Check	1 MHPASS		10 MHz
Line FCC-9KHZ - 30MHz 3m FCC-9KHZ - 30MHz 3m.LIN	PASS		
90 dBµV/m			
80 dBµV/m			
70 dBµV/m			
60 dBµV/m			
50 dBµV/m			
40 dBµV/m			
30 dBµV/m			
20 dBµV/m		M	
			monthly in
Start 150.0 kHz			Stop 30.0 MHz

Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass



# 6.2 Result 30 MHz – 1000 MHz

The highest emissions for each polarization (H/V) in the frequency range

Frequency [MHz]	Detector	Antenna polarization	Radiated emission [dBµV/m]	Radiated emission [µV/m]	Limit [dBµV/m] (3 m)	Limit [µV/m] (3 m)	Result
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
< 960.00	QP	V	< 36.00	63.10	46.00	200	Pass
< 960.00	QP	Н	< 36.00	63.10	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) =  $10 \wedge ((\text{Radiated emission } [dB\mu V/m] (4))/20)$ 

(6) = relevant limit in  $dB\mu V/m$ 

(7) = relevant limit in  $\mu V/m$ 

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

Representative one plot of Receiving mode and each polarisation was added in this report.

ESTC IN GERMANY		eport no.: -0029-A		Page 17 of 40 pages
Internal Antenna, Receiving TESTED IN GERMANY	IT Interferend	<b>5/6</b> ce radiation Subpart C §15.209	E	ISTC
RefNo.: 21/04-0029				
Product: Transmitting/	Receiving System			
Sample: 01	5 ,			
Date: 08.06.2021				
Operator: BI				pass fail
Remarks:			Result:	$\boxtimes$ $\square$
	Final M	easurement		
Operation mode: Receiving	/Stand by 433,920MF	łz		
Spectrum	(X)			
RBW (QPK) 120	_	CBL6111+cabl	e.TDF	[ ]
Input 1 DC 👄 Att		p TD Scan		
Scan ● 1Pk Max Limit Check	100 MH2PASS			
Line FCC Subpart C	PASS			
90 dBµV/m				
80 dBµV/m				
70 dBµV/m				
60 dBµV/m				
				_
50 dBµV/m				
FCC Subpart C.LIN				
HO ODDANI				
30 dBµV/m				way white when the
Mundament and a second		A Hickory	wwwwwww	
20 dBµV/fm	formation the market market	mennennender		
mary management	w iii			
10 dBµV/m				
Start 30.0 MHz				Stop 1.0 GHz
		ation: V		
Scan Detec Peak	tor		I Detector Iasi Peak	
Margin			Margin	

				I Ularis					
	S	can Detecto Peak	or				inal Detecto Quasi Peak		
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
30-1000	/	>10		pass					
*Retest w	ith Quasi Pe	ak	•		Retest wit	h Quasi Pea	k Detector I	not required	

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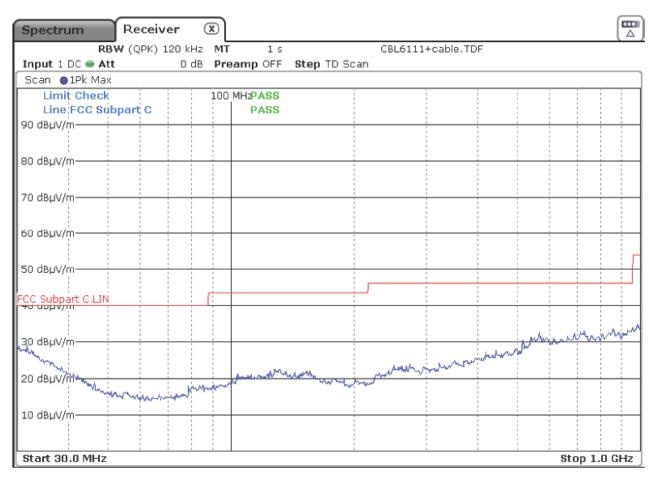
IT 5/6 Interference radiation



according to FCC Subpart C §15.209

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz



Polarisation: H									
Scan Detector					Final Detector				
Peak							Quasi Peak	I. I	
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. Level Margin [MHz] [dBμV/m] [dBμ [dBμ				Result
30-1000	/	>10		pass					
*Retest with Quasi Peak					Retest wit	h Quasi Pea	k Detector I	not required	

Testdistance Antenna/EUT: 3m

# 6.3 Result 1 GHz – 7 GHz

All emissions in the frequency range 1 GHz - 7 GHz are at least 10 dB below the relevant limit.

Representative one plot of Receiving mode and each polarisation was added in this report.

	TESTED N GERMANY	Test report no.: 21/04-0029-A				Page 20 of 40 page		
ceiving mo	de 433,92 MHz	, Internal		16		_		
IN GERMANY		IT 5/6 Interference radiation acc. to FCC § 15.209				DISTC		
RefNo.:	21/04-0029							
Product:	Transmitting/	Receiving	system					
Sample:	01							
Date:	08.07.2021							
Operator:	BI						pass	fail
Remarks:					1	Result:	$\boxtimes$	
Operation n	node: Receiving	/Stand by	433,920MHz					
Spectrum	Receiver	×						
	RBW (EMI) 1 MH		1 s	IT56-1-6G	Hz.TDF			
Input 1 AC	/ Max@2Pk Max	s Preamp	OFF Step TD	scan				
Limit C			PASS					
	56-1-7GHZ-AV-F( 5 <del>6-1-7GHZ-PEAK</del>							
80 dBµV/m—								
TE6 1 20112								
1130-1-7GHZ-	PEAK-FCC-Class B.L	IN						
70 uspv/m-	PEAK-FCC-Class B.L	IN						
	PEAK-FCC-Class B.L	IN						
60 dBµV/m—								
60 dBµV/m—	PEAK-FCC-Class B.L AV-FCC-Class B.LIN						and the second	
60 dBµV/m— IT56-1-7GHZ- эо авµv/ні—					www.		n an	reportante
60 dBµV/m—	AV-FCC-Class B.LIN		M.M. Marganian Jackson		www.			repsin repaired
60 dBµV/m— 1756-1-7GHZ- эо uBµV/m— 40 dBµV/m—			and the contraction of the contr		une and a second		norman and	and a second sec
60 dBµV/m— IT56-1-7GHZ- эо авµv/ні—	AV-FCC-Class B.LIN			when and when the second	un and a second		n and a start	regular segmenter
60 dBµV/m— 1756-1-7GHZ- эо uBµV/m— 40 dBµV/m—	AV-FCC-Class B.LIN			when and when the second	waama ahaa		www.enerryW	pelpilyun produce
60 dBµV/m-	AV-FCC-Class B.LIN			when a construction of the second			n an	regular segmenter
60 dBµV/m-	AV-FCC-Class B.LIN				www.www.			pegolyus my medune

				Polarisati	on: V				
Detector Average							Detector Peak		
<b>Frequ.</b> [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					pass
				pass					pass
				pass					pass
					P				

TESTED				
IN GERMANY				

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



Ref.-No.: 21/04-0029

Operation mode: : Receiving/Stand by 433,920MHz

Spectrum Receiver 🛞
RBW (EMI) 1 MHz MT 1 s IT56-1-6GHz.TDF
Input 1 AC Att 0 dB Preamp OFF Step TD Scan
Scan   1Av Max 2Pk Max
Limit Check PASS
Line IT56-1-7GHZ-AV-FCC-Class B PASS
90 dBjrwini <del>T56-1-7CHZ-PEAK-FCC-CLA8 PA88</del>
80 dBµV/m
IT56-1-7GHZ-PEAK-FCC-Class B.LIN
70 uBp0/m
60 dBµV/m
IT56-1-7GHZ-AV-FCC-Class B.LIN
40 dBµV/m
and the second
40 dBµV/m
www.human.mah.human.hum
30 dBµV/m
20 dBµV/m-
10 dBµV/m
Start 1.0 GHz Stop 7.0 GHz

				Polarisati	on: 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					
	-				μ				

#### 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 Annex D 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: 21.06.2021

Measurement distance 3 m

Function	Frequency of fundamental Emission	Antenna Type 1 [dBµV/m]	Antenna Type 3 [dBµV/m]	Coil Antenna [dBµV/m]	Limit [dBµV/m]	Result
Mode 1 (LF PEPS)	125 kHz	65.7	65.6	-/-	105,7	pass
Mode 2 (LF IMMO)	125 kHz	48.5	-/-	-/-	105,7	pass
Mode 3 (LF IMMO)	125 kHz	-/-	-/-	64.9	105,7	pass

Converted value at distance 300 mNote 1

Function	Frequency of fundamental Emission	Antenna Type 1 [dBµV/m]	Antenna Type 3 [dBµV/m]	Coil Antenna [dBµV/m]	Limit [dBµV/m]	Result
Mode 1 (LF PEPS)	125 kHz	-14.3	-14.4	-/-	25,7	pass
Mode 2 (LF IMMO)	125 kHz	-31.5	-/-	-/-	25,7	pass
Mode 3 (LF IMMO)	125 kHz	-/-	-/-	-15.1	25,7	pass

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

#### Results

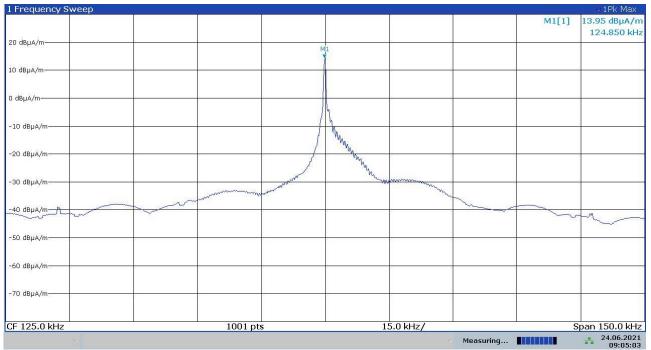
From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements of **Output Power of Fundamental Emissions**.

# Mode 1: LF PEPS, Antenna Type 1, Transmitting mode 125 kHz

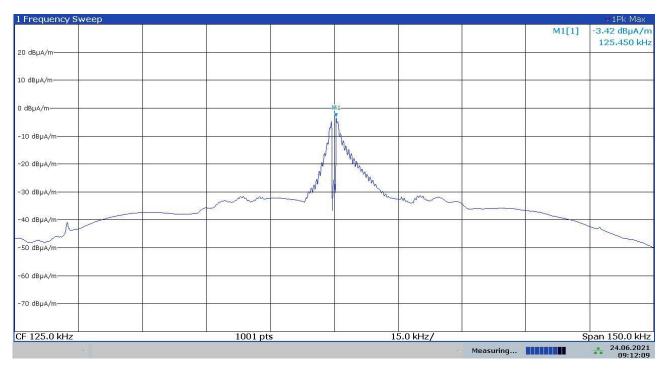
Scan 💿 1QP Max			
10 Wilmit Check	N	/1[1]	65.70 dBµV/m
Line FCC-9KHZ - 30MHz_3m	C	).000 s	124.950 kHz
_130 dBµV/m			
FCC-9KHZ - 30MHz_3m_			
120_dBµV/m			
110 dBµV/m			
100_dBµV/m			
90 dBµV/m			
80 dBµV/m			
70 dBµV/m			IM
			The second se
60 dBµV/m			
50°d8⊭V/m			
Start 9.0 kHz	and the second s		Stop 150.0 kHz
			300p 130.0 KHZ J
1 Frequency Sweep			⊙1Pk Max
			M1[1] 13.91 dBµA/m
			124.850 kHz
20 dBµA/m	MI		
10 dBµA/m			
0 dBµA/m			
-10 dBµA/m			
	M. M.		
-20 dBµA/m	/ Mh.		
	m		
-30 dBµA/m			
mound	where a second		
-40 dBµA/m			
-50 dependitions			
-60 dBµA/m-			
-70 dвµA/m			
CF 125.0 kHz 1001	nts	15.0 kHz/	Span 150.0 kHz
1001	2		g <b>10000 (</b> 12) g <b>24.06.2021</b> 09:03:10

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#### Mode 1: LF PEPS, Antenna Type 3, Transmitting mode 125 kHz



#### Mode 2: LF IMMO Antenna Type 1, Transmitting mode 125 kHz





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# Mode 3: LF IMMO, Coil Antenna Type 2, Transmitting mode 125 kHz

MultiView	Spectrum	I.							•
			0 dB <b>= RBW</b> 30 ms) <b>VBW</b> 1						
Att TDF "einheit" DC		14 ms (~24	ms) VBW I	KHZ Mode Au					
1 Frequency Sv									⊜1Pk Max
								M1[1]	13.90 dBµA/m
20 dBµA/m									125.000 kHz
NUM DECEMBER				M	1				
10 dBµA/m		1					,		
0 dBµA/m	,	1							
1405 6427 1532				1					
-10 dBµA/m		1		/	A .				
-20 dBµA/m				/!					
-30 dBµA/m				F					
78 39									
-40 dBµA/m									
-50 dBµA/m			1	5		0			
-60 dBµA/m		VV							
399									
-70 dBµA/m			<i></i>	8	12	2			
CF 125.0 kHz		1	1001 pts	5	1	5.0 kHz/	1	S	pan 150.0 kHz
							Measuring		24.06.2021 09:13:48

09:13:48 24.06.2021



#### 8. 99% Power Bandwidth

#### **Aplied standards**

-RSS-210 issue 10 Annex D -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: 21.06.2021

#### Mode 1: LF PEPS - Antenna Type 1

1 Occupied Bandwidth	18					o1Pk Max
				2	M1[1]	14.02 dBµA/m
00 40						124.900 0 kHz
20 dBµA/m		MI				
		A				
10 dBµA/m		//				
N						
0 dBµA/m				÷.	3	
2			1			
-10 dBµA/m		ŢŢ,	My TZ	-		
		N.	- Viz			
-20 dBµA/m			man.			
		~	vin			
-30 dBµA/m			0	~~~~		
m					<u>×</u>	
-40 dBµA/m-						
-50 dBµA/m-						
-60 dBµA/m						
CF 125.0 kHz	11	001 pts	5.0 kHz/		No.	Span 50.0 kHz
2 Marker Table		ior pro	510 KHZ7			opun colo kriz
Type Ref Trc	X-Value	Y-Value	Function		Function R	tesult
M1 1	X-Value 124.9 kHz	14.02 dBµA/m	Occ Bw		5.401 926	833 kHz
T1 1	123.0621 kHz	-14.38 dBµA/m	Occ Bw Centroid			145 366 kHz
T2 1	128.464 kHz	-17.50 dBµA/m	Occ Bw Freq Offset		763.045	366 228 Hz

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#### Mode 1: LF PEPS - Antenna Type 3

1 Occupied Bar	ndwidth								o1Pk Max
50 dBµA/m	A							M1[1]	13.55 dBµA/m
									124.9000 kHz
40 dBµA/m									
30 dBµA/m									
20 dBµA/m				M	1				+
10 dBµA/m				/					
				//	A.				
0 dBµA/m		-			<u>d</u>	10			+
-10 dBµA/m				T1/	4				
10 000,				7	T2				
-20 dBµA/m		+			- M				-
-30 dBµA/m			~						
-30 dBµA/m			<u> </u>						
40 dBµA/m-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						~		
-50 dBµA/m									
-50 ubpA/m			_			T		$\Box$	Т
-60 dBµA/m		<u> </u>							+
CF 125.0 kHz		L	1001 pts			5.0 kHz/		to.	Span 50.0 kHz
2 Marker Table	2								
Type Ref	Trc	X-Value		Y-Value		Function		Function R	esult
M1	1	124.9 kHz 123.28 kHz		.55 dBμA/m -13.94 dBμA/m				4.535 438	<b>409 kHz</b> 15275 kHz
T1 T2	1	127.8154 kHz		-13.94 dBµA/m -17.49 dBµA/m					274894 Hz

#### Mode 2: LF IMMO - Antenna Type 1

1 Occupied Bandw	vidth							o1Pk Max
							M1[1]	9.31 dBµA/m
20 dBµA/m					0 0			124.900 0 kHz
			MI					
10 dBµA/m			1		20			
0 dBµA/m			(_)					
з авряли-			1					
-10 dBµA/m			/	h			-	
			TIN	Mr.	T2 R			
-20 dBµA/m				V	the		3	
-30 dBµA/m			$\mathcal{N}$		m			
						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
-40 dBµA/m								
-50 dBµA/m								
-60 dBµA/m								
-70 dBµA/m								
-80 dBµA/m								
ou appayin								
CF 125.0 kHz		1001 pts			5.0 kHz/			Span 50.0 kHz
2 Marker Table								
Contraction of the local distance of the loc	Trc X-Value		Y-Value		Function		Function R	esult
M1	1 124.9 kH		31 dBµA/m	Occ Bw	an an an an An An		7.161 330	
T1 T2	1 122.9719 kH 1 130.1332 kH		-18.33 dBµA/m -19.94 dBµA/m	Occ Bw Ce Occ Bw Fre				23 963 kHz 23 963 kHz
	100,1002 101	-		000 011 110	1 11000		1.0020.	

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#### Mode 3: LF IMMO – Immo Coil Antenna Type 2

1 Occupied Ba	andwidth							o1Pk Max
						с.	M1[1]	13.23 dBµA/m
20 dBµA/m	-		-		1	2		124.900 0 kHz
100000 10000 10000 1000					1			
10 dBµA/m						R)		
					\ <u>.</u>			
0 dBµA/m				/	1			
-10 dBµA/m	-		-	T1	12			
				y	V			
-20 dBµA/m			8		~	4		
-30 dBµA/m						M		
SU OBDAVIII		~	$\sim$			~		100000 - 60
-40 dBµA/m							 $\sim\sim$	$\sim\sim\sim$
-50 dBµA/m								
-60 dBµA/m						0.		
-70 dBµA/m		1	2					
-80 dBµA/m								
-оо авраут-								
CF 125.0 kHz			1001 pt:	-	ç	5.0 kHz/		Span 50.0 kHz
2 Marker Tab			1001 pt.			510 KHZ/		3part 3010 Ki iz
Type Re		X-Value		Y-Value		Function	Function R	esult
M1	1	124.9 kH		.23 dBµA/m	Occ Bw	42 23 83	3.73312	. 54 kHz
T1 T2	1	123.2047 kł 126.9378 kł		-14.69 dBµA/m				52 896 kHz 396 406 Hz

#### Summery List of Bandwidth

EUT Frequency (kHz)	99% OBW lower (f⊾) frequency [kHz]	99% OBW upper (f <sub>⊦</sub> ) frequency [kHz]	Centre frequency [kHz]	99% Bandwidth [kHz]	Result	Comment
125	123.062	128.464	125.763	5.40	pass	LF PEPS - Antenna 1
125	123.280	127.815	125.548	4.54	pass	LF PEPS - Antenna 3
125	122.972	130.133	126.553	7.16	pass	LF IMMO - Antenna 1
125	123.205	126.938	125.071	3.73	pass	LF IMMO Coil 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 "0029-ised-rep-RF-Exposure.pdf" file



# 10. Test equipment

#### Test equipment used for radiated Measurements:

Kind of equipment	Manufacturer	Туре	Ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Signal Spectrum Analyzer 2 Hz - 26.5 GHz	Rohde & Schwarz	FSW26 Instrument FW 2.60	11571	102047	2019-Jan.	3 years
ESR 7 EMI Testreceiver 7 GHz	Rohde & Schwarz	ESR 7 Instrument FW 3.36	11676	101694	2021-April	3 years
Antenna 1 GHz – 18 GHz	Electro Metric	RGA 50/60	10273	2753	2021-Jan.	3 years
Antenna (FCC) 30 MHz – 1 GHz	Chase	CBL6111	10022	1064	2019-Dec.	3 years
Antenna 9 kHZ – 30 MHz	Schwarzbeck	EMCO 6502	10546	2018	2021-Jan.	3 years
Shielded room/ Chamber	Frankonia	SAC3 "SEMI- ANECHOIC- CHAMBER"	11609	004/16	2019-May	3 years
Broadband-Preamplifier 1 GHz - 18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2021-Jan.	3 years
Cable 8 m	el-spec GmbH	FlexCore-SMA11- SMA11-8000-ARM	11625	-/-	2020-Oct.	3 years
Cable 1.5 m	Suhner	Sucoflex 100	11648	-/-	2020-Oct.	3 years

#### Test equipment used for conducted Measurements:

Kind of equipment	Manufacturer	Туре	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
EMC32 Test software	Rohde & Schwarz	EMC32 Test software	-/-	-/-	-/-	
Signal Spectrum Analyzer 2 Hz - 26.5 GHz	Rohde & Schwarz	FSW26 Instrument FW 2.60	11571	102047	2019-Jan.	3 years
Testsystem- Automatisierung und HF- Umschaltung Automatisation unit and RF switch	Rohde & Schwarz	OSP120	11573	100947	2020-Oct.	3 years
Cable 1.5 m	Suhner	Sucoflex 100	11648	-/-	2020-Oct.	3 years

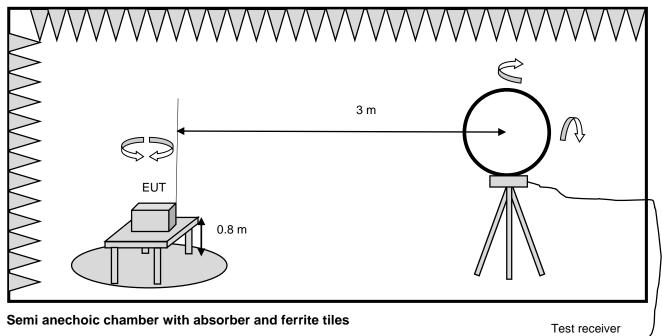
All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of conducted emissions was made with instruments conforming to American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

#### Test equipment to support EUT functions:

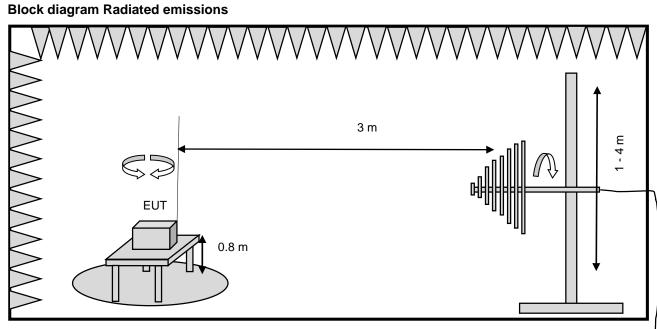
Kind of equipment	Manufacturer	Туре	Ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Power supply	Elektro-Automatik	EA-3013	10093	-/-	-/-	-/-
Multimeter	Fluke	79111	10938	71150461	2020-April	3 years
-/-	-/-	-/-	-/-	-/-	-/-	-/-

#### 11. Test Setups

**Block diagram Radiated emissions** 



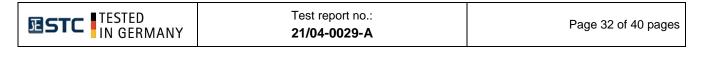
tested frequency range 9 kHz - 30 MHz

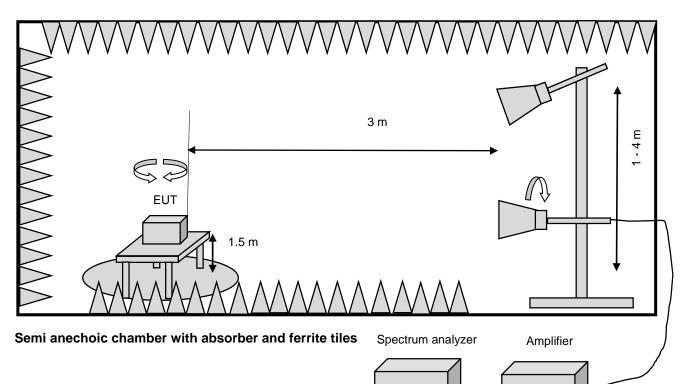


Test receiver

Semi anechoic chamber with absorber and ferrite tiles

tested frequency range 30 MHz - 1000 MHz





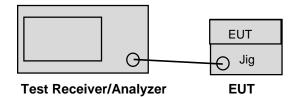
θ

Q

G

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 <sub>lab</sub>	Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U <sub>CISPR</sub>
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 <sub>lab</sub>	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.

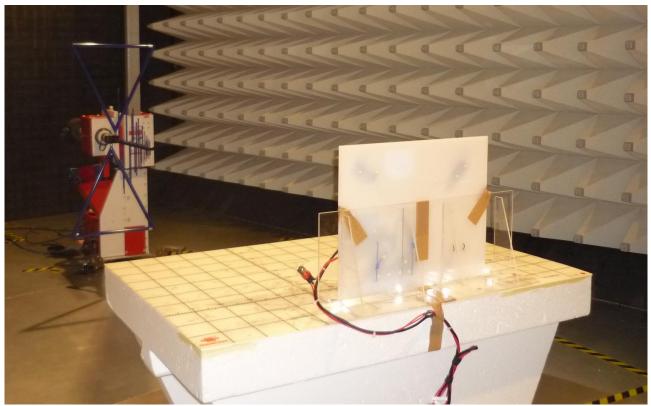
The measurement uncertainty was given with a confidence of 95 % (k = 2).

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# 13. Photos setup

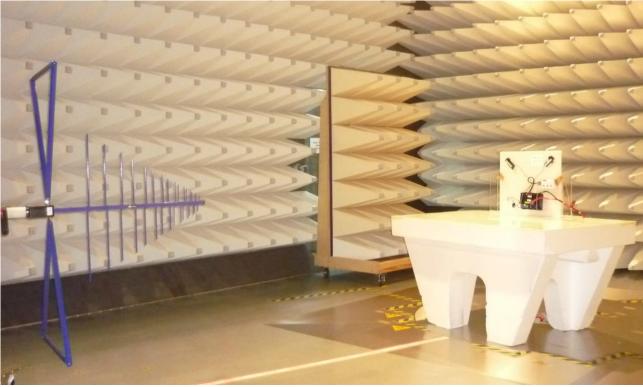


Tested frequency range 9 kHz – 30 MHz

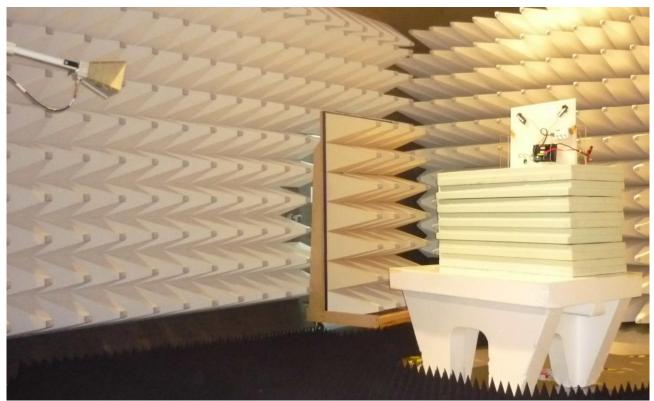


Tested frequency range 30 MHz -1.000 MHz

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Tested frequency range 30 MHz -1.000 MHz



Tested frequency range > 1 GHz

# 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. 21/04-0029 dated 28.06.2021.

17.01.2022

Erstellt am/prepared on

M. Wundrak, Laboratory Engineer (Name/name / Stellung/position)

lised Hande

(Unterschrift/signature)

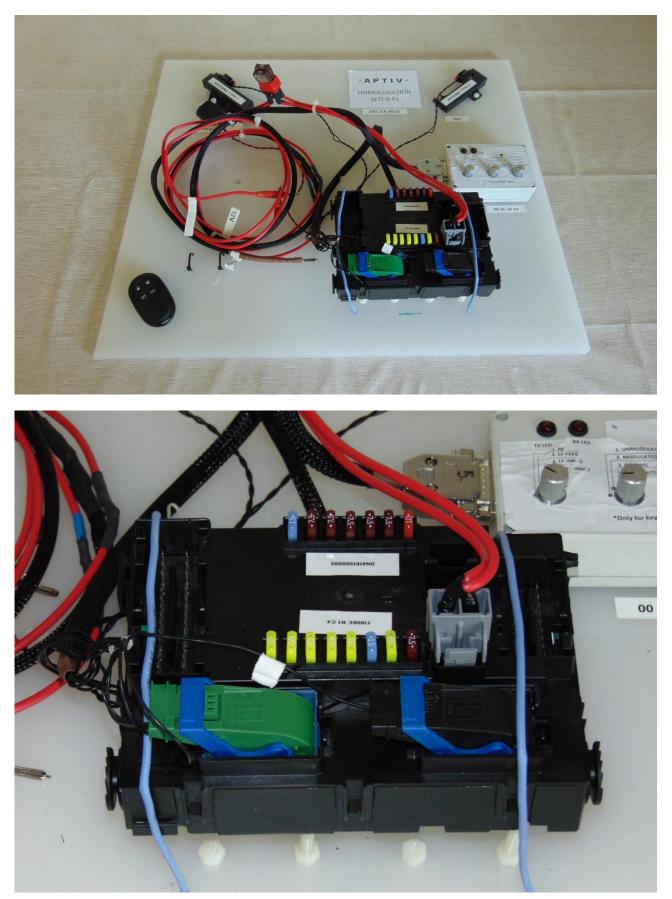
17.01.2022 Freigabe am/released on K. Simon, Head of Laboratory (Name/name / Stellung/position)

Ka

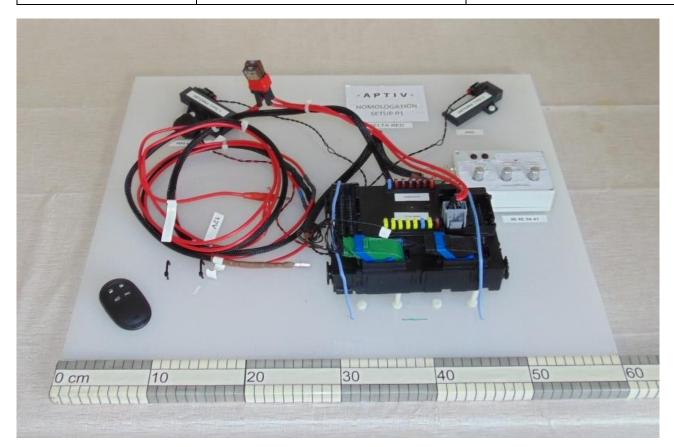
(Unterschrift/signature)

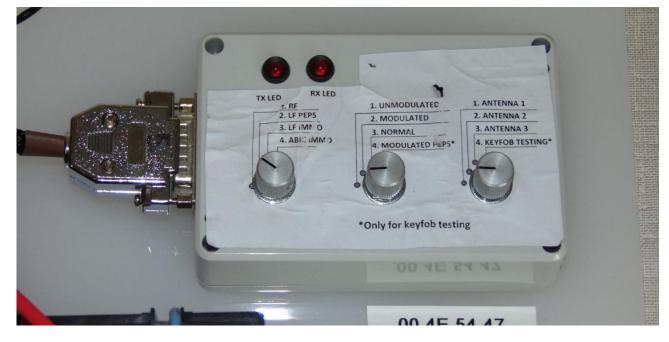
ESTC TESTED	
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# 15. Photos of tested sample









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