

TEST REPORT

Test Report No.: 1-5652/17-01-04_A



BNetzA-CAB-02/21-102

Testing Laboratory

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Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

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Manufacturer

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Test Standard/s

FCC - Title 47 CFR Part 18	2018-10	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 18 - Industrial, scientific and medical equipment
MP-5	1986	FCC Methods of measurements of radio noise emissions from industrial, scientific and medical equipment

Test Item

Kind of test item: Koppelantenne
Model name: VW Koppelantenne Gen. 3
FCC ID: QZ9-KA3
IC: 5927A-KA3
S/N serial number: 1800011599
HW hardware status: H09
SW software status: 0050
Power Supply: DC 12V



This test report is electronically signed and valid without handwritten signature. The public keys can be requested at the test laboratory to verify the electronic signatures.

Test Report authorised:

Test performed:

Hans-Joachim Wolsdorfer
Radio Communications & EMC

Jens Hennemann
Radio Communications & EMC

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report replaces the test report with the number 1-5652_17-01-4 and dated 2018-11-20

2.2 Application details

Date of receipt of order: 2018-06-20
Date of receipt of test item: 2018-07-02
Start of test: 2018-07-09
End of test: 2018-10-26
Person(s) present during the test: -/-

3 Test standard/s:

Test Standard	Version	Test Standard Description
FCC - Title 47 CFR Part 18	2018-10	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 18 - Industrial, scientific and medical equipment
MP-5	1986	FCC Methods of measurements of radio noise emissions from industrial, scientific and medical equipment

4 Test Environment

Temperature: 20°C – 25°C
Relative humidity content: 30 % - 50 %
Air pressure: 1020 hPa
Power supply: 230 V / 50 Hz

5 Test Laboratories sub-contracted

6 Information about Test Conditions

6.1 Test Item

Kind of test item :	Koppelantenne		
Type identification :	VW Koppelantenne Gen. 3		
Equipment classification:	Equipment for vehicular use		
Environment classification:	Residential, commercial and light industry		
Supply voltage :	DC 12V		
Ports : (maximum cable lengths declared by manufacturer)	Description	Direction	Length
	DC power port	Input	> 3m
	Signal/control port: CAN interface	In / output	< 3m
	Signal/control port: GSM antenna	In / output	< 3m
	Signal/control port: GPS antenna	In / output	< 3m
Is mounting position / usual operating position defined?			No
Additional information:			
- the radio part with FCC ID QZ9-KA3 and IC 5927A-KA3 is already tested and not part of this test report			

6.2 EUT: Type, S/N etc. and Short Descriptions Used in this Test Report

short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	Koppelantenne	VW Koppelantenne Gen. 3	1800011599	H09	0050

*) EUT short description is used to simplify the identification of the EUT in this test report.

6.3 Auxiliary Equipment (AE): Type, S/N etc. and Short Descriptions

AE description*)	Auxiliary equipment	Type	S/N serial number	HW hardware status	SW software status
AE A	Notebook	Dell Latitude E5520 P15F001	36974941957	- / -	Microsoft Windows 7 pro
AE B	Testbox	provided by customer	- / -	unknown	unknown
AE C	dummy load	WLC dummy load	- / -	unknown	- / -

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

6.4 EUT Set-up(s)

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A + AE A + AE B + AE C	AE outside chamber

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

6.5 EUT Operating Modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	wireless charging	load 5W

*) EUT operating mode no. is used to simplify the test report.

7 Summary of Test Results

- No deviations from the technical specifications were ascertained
 There were deviations from the technical specifications ascertained

7.1 Emission

7.1.1 Enclosure

EMI Phenomenon	Frequency range	Basic standard	Result
Radiated Interference Field Strength	9KHz - 30MHz	FCC Part 18	passed
Radiated Interference Field Strength	30MHz - 1GHz	FCC Part 18	passed

7.1.2 AC Mains Power Input/Output Ports

EMI Phenomenon	Frequency range	Basic standard	Result
Conducted interference voltage	0,15– 30 MHz	FCC Part 18	NA7

Remarks:

NA1	Not tested because not required by used standard
NA2	Test not applicable because port does not exists
NA3	Test not applicable because port only for services
NA4	Test not applicable because port lengths not longer than 3m
NA5	Not tested because not required by customer
NA6	Not tested because used frequency < 108 MHz
NA7	Not tested because the device is for vehicular use

7.2 Measurement and Test Set-up

Note: The test configuration is in accordance with the requirements given in the standards in point 3

7.3 Measurement uncertainty

The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and national standards.

The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 4m Ø.

The table below shows the measurement uncertainties for each measurement method. The expended uncertainty (k=2 or 95%) was calculated with worst case values.

Measurement Method	Frequency area Impulse duration time	Description	Expanded uncertainty (k=2 or 95%)
Radiated Emission ANSI C63.4	9KHz – 18 GHz	- / -	± 4.28 dB
Conducted Emission ANSI C63.4	9 kHz – 30 MHz	- / -	± 3.49 dB

7.4 Limits

Equipment	operating frequency	RF power generated by equipment (watts)	field strength limit (µV/m)	distance (meters)
any type unless otherwise specified	any ISM frequency	below 500	25	300
		500 or more	25xSQRT(power/500)	1300
	any non ISM frequency	below 500	15	300
		500 or more	15xSQRT(power/500)	1300
industrial heaters and RF stabilized arc welders	on or below 5,725MHz	any	10	1600
	above 5,725MHz	any	(²)	(²)
medical diathermy	any ISM frequency any non ISM frequency	any	25	300
		any	15	300
ultrasonic	below 490kHz	below 500	2,400/F(kHz)	300
		500 and more	2,400/F(kHz)x SQRT(power/500)	³ 300
	490 to 1,600kHz	any	24,000/F(kHz)	30
	above 1,600kHz	any	15	30
induction cooking ranges	below 90kHz	any	1,500	430
	on or above 90kHz	any	300	430

1 Field strength may not exceed 10 µV/m at 1600 meters. Consumer equipment operating below 1000 MHz is not permitted the increase in field strength otherwise permitted here for power over 500 watts.

2 Reduced to the greatest extent possible.

3 Field strength may not exceed 10 µV/m at 1600 meters. Consumer equipment is not permitted the increase in field strength otherwise permitted here for over 500 watts.

4 Induction cooking ranges manufactured prior to February 1, 1980, shall be subject to the field strength limits for miscellaneous ISM equipment.

8 Detailed test results - Emission

8.1 Electromagnetic radiated emissions (distance 3 m)

8.1.1 Instrumentation for test (see equipment list)

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8	F 28			
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8.1.2 Test plan

EUT set-up	set 1		
Operating mode	Application	Limit	result
powered on and active	Enclosure	FCC part 18	passed

8.1.3 Radiated limits

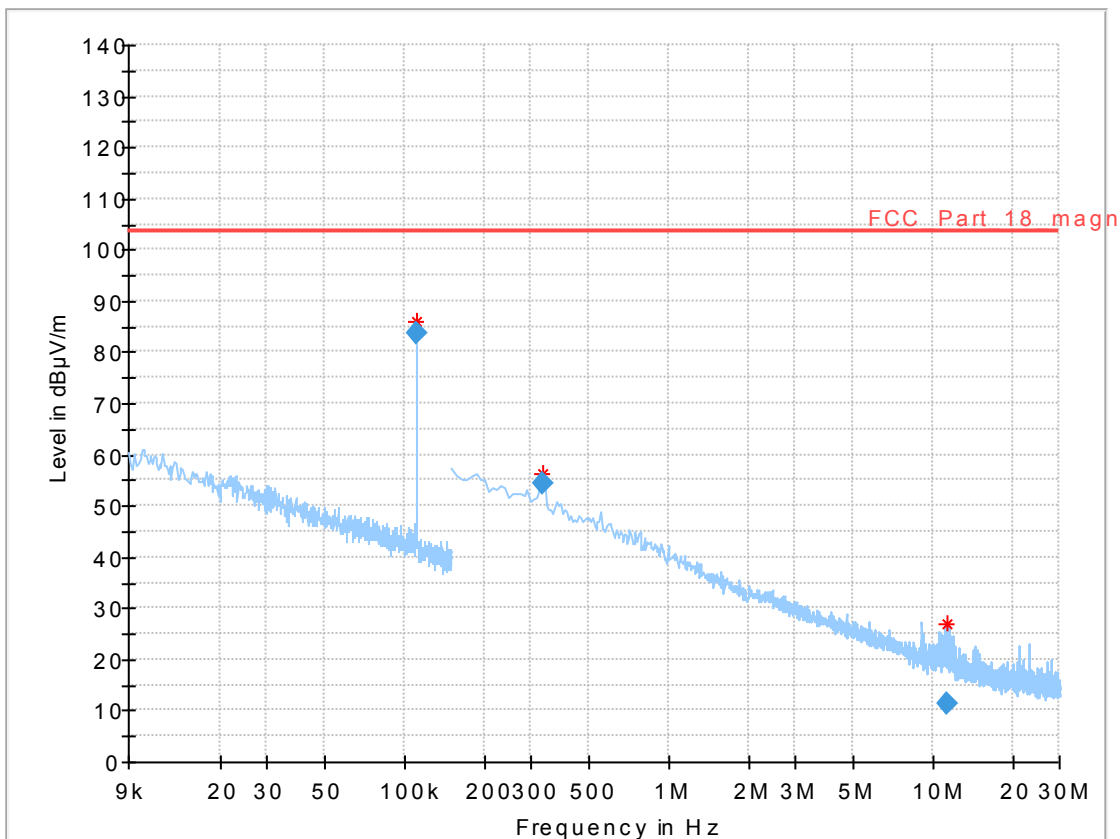
	FCC part 18
9KHz - 30 MHz	23,52dBµV/m@300m or 103,52dBµV/m@3m

Remarks:	- the measurements have been performed @3m distance, therefore the limit line was recalculated accordingly (distance correction for 300m: $40\log(300/3)=80\text{dB}$)
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8.1.4 Test results

Common Information

EUT: Koppelantenne Gen 3
 Serial number: 1800011599
 Test description: FCC part 18 @3m x-axis
 Operating condition: wireless charging, 5W load
 Operator name: Wolsdorfer
 Comment: DC 12V

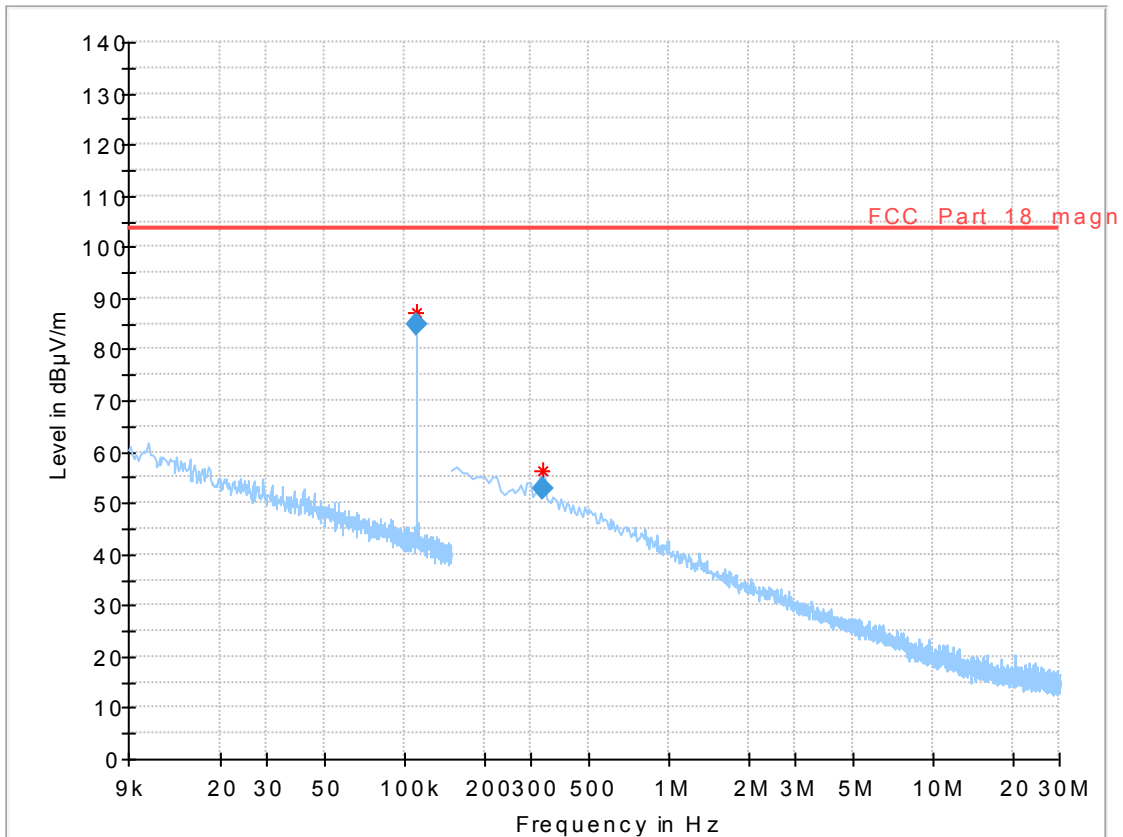


Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.111	83.56	103.5	19.94	1000	0.2	V	-15.0	12
0.334	54.38	103.5	49.12	1000	9	V	218.0	11
11.280	11.23	103.5	92.27	1000	9	V	94.0	11

Common Information

EUT:	Koppelantenne Gen 3
Serial number:	1800011599
Test description:	FCC part 18 @3m y-axis
Operating condition:	wireless charging, 5W load
Operator name:	Wolsdorfer
Comment:	DC 12V

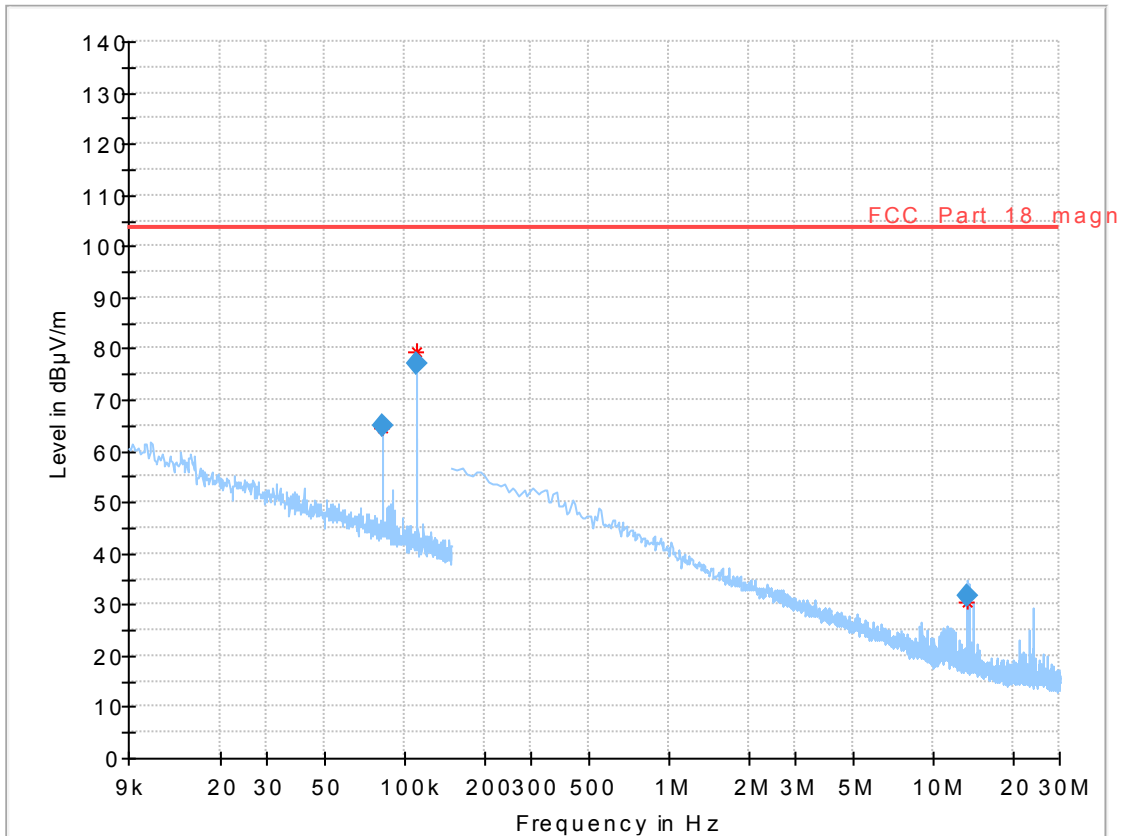


Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.111	84.87	103.5	18.63	1000	0.2	V	277.0	12
0.333	52.66	103.5	50.84	1000	9	V	119.0	11

Common Information

EUT:	Koppelantenne Gen 3
Serial number:	1800011599
Test description:	FCC part 18 @3m z-axis
Operating condition:	wireless charging, 5W load
Operator name:	Wolsdorfer
Comment:	DC 12V



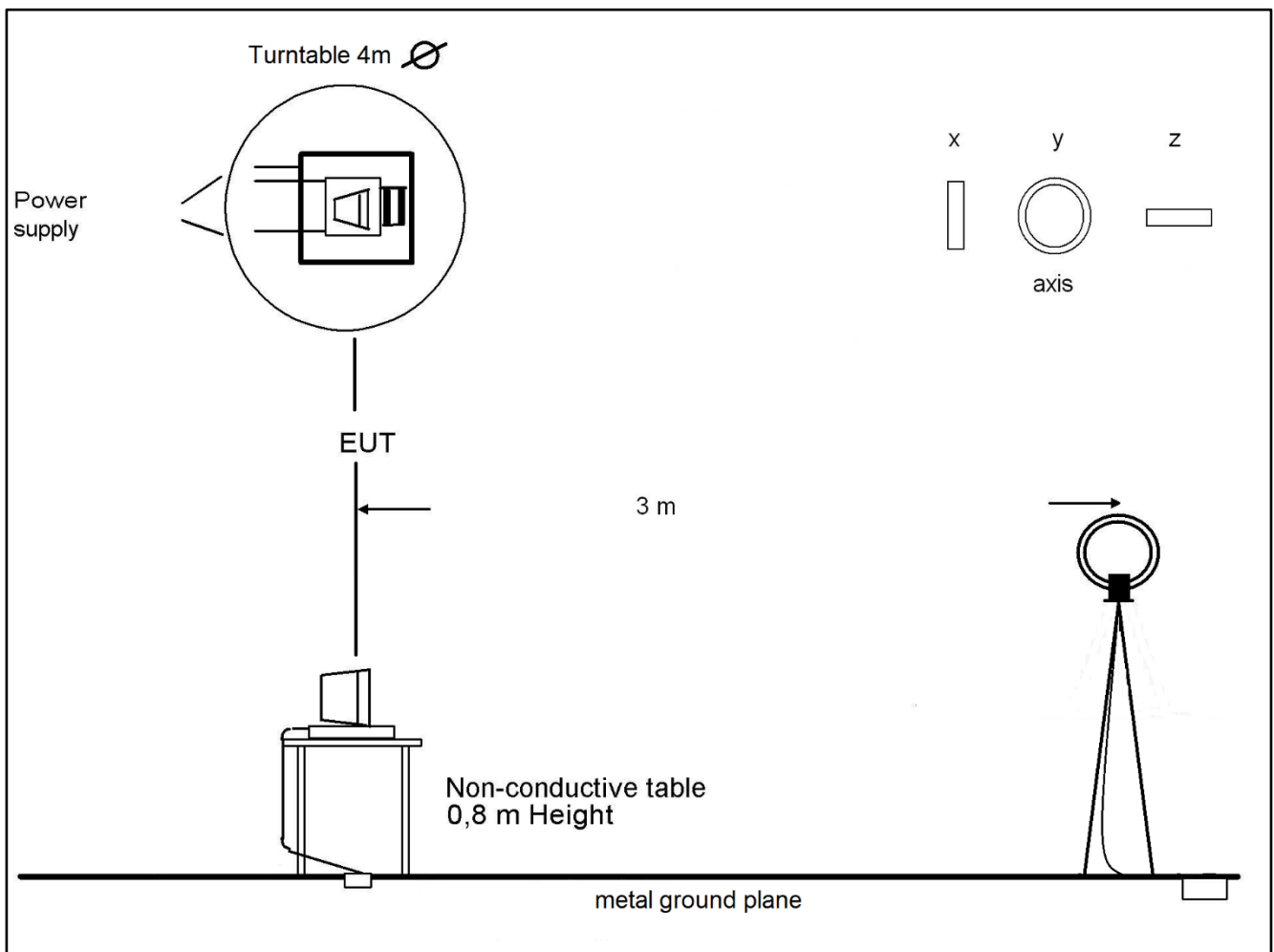
Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.083	65.02	103.5	38.48	1000	0.2	V	33.0	12
0.111	77.06	103.5	26.44	1000	0.2	V	63.0	12
13.532	31.69	103.5	71.81	1000	9	V	245.0	11

8.1.5 Hardware set-up

Frequency Range:	9 kHz - 30 MHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 4.42
Signal Path:	LOOP-Ant FW 1.0
Antenna:	EMCO6502 Correction Table (vertical): EMCO6502A_2016 Correction Table (horizontal): EMCO6502A Correction Table (vertical): SUB_Cable (1005) Correction Table (horizontal): SUB_Cable (1005)
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12
Software version:	V10.40.0

8.1.6 Test set-up



8.1.7 Sequence of testing

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC or DC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized successively in x, y and z axis
- The antenna height is 2 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position $\pm 45^\circ$
- The final measurement is done with average detector (as described in FCC/OET MP-5).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna position, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.1.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF$$

List of abbreviations:

SS	▶	signal strength
U_R	▶	voltage at the receiver
CL	▶	loss of the cable
AF	▶	antenna factor

List with correction factors:

Frequency [MHz]	CL [dB]	AF [1/m]
0,009	0,20	17,60
0,015	0,20	11,17
1,000	0,30	10,96
10,000	0,40	9,90
22,000	0,40	6,56
30,000	0,40	3,40

Example calculation:

For example at 1,000 MHz the measured Voltage (U_R) is 12,35 dB μ V, the loss of the cable (CL) is 0,30 dB and the antenna factor (AF) is 10,96 dB (m^{-1}) the final result will be calculated:

$$SS [dB\mu V/m] = 12,35 [dB\mu V] + 0,30 [dB] + 10,96 [dB (m^{-1})] = \underline{23,61 [dB\mu V/m]} \quad (15,1 \mu V/m)$$

8.2 Electromagnetic Radiated Emissions (distance 10 m)

8.2.1 Instrumentation for Test (see equipment list)

F 1	F 2	F 4b	F 5	F 6	F 7	F 8	F 28				
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8.2.2 Test Plan

EUT set-up	set 1		
Operating mode	Application	Limit	Result
op 1	Enclosure	FCC part 18	passed

Remarks:	- Powered by external power supply (12V DC) - the measurements have been performed @10m distance, therefore the limit line was recalculated accordingly (distance correction for 300m: $40\log(300/10)=59,08\text{dB}$)
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8.2.3 Radiated Limits

Frequency- range	FCC part 18	
30 MHz – 1000 MHz	23,52dB μ V/m@300m or 82,6 dB μ V/m@10m	
	* This values are recalculated from the limits at 300m antenna distance in §18.305 of the FCC rules	

8.2.4 Calibration Information

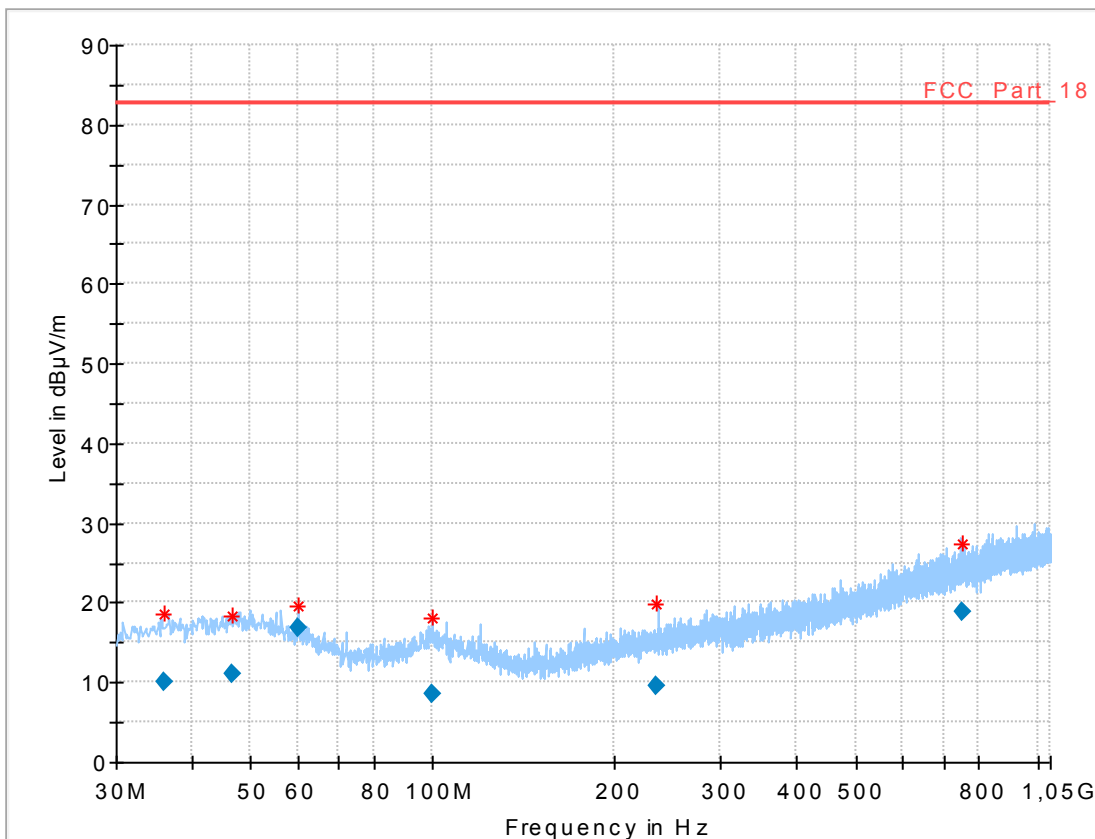
Device	Serial number	Internal Number	Calibration valid until	Calibration interval
ESCI 3 Receiver	100083/003	300003312	12/2018	12 month
Trilog Antenna	9163-371	300003854	11/2019	24 month

Remarks:
System check of all relevant devices and the chamber (weekly)

8.2.5 Test Results

Common Information

EUT: Koppelantenne Gen 3
 Serial number: 1800011599
 Test description: FCC part 18 @ 10 m
 Operating condition: wireless charging, 5W load
 Operator name: Hennemann
 Comment: DC: 12 V



Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
36.102	9.97	82.6	72.63	1000	100	100.0	H	195.0
46.628	11.15	82.6	71.45	1000	100	170.0	V	105.0
60.017	16.88	82.6	65.72	1000	100	101.0	V	264.0
100.116	8.62	82.6	73.98	1000	100	98.0	V	166.0
235.137	9.50	82.6	73.10	1000	100	101.0	V	9.0
751.292	18.75	82.6	63.85	1000	100	170.0	V	188.0

8.2.6 Hardware Set-up

Subrange 1

Frequency Range:	30 MHz - 2 GHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 4.42
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163 SN 9163-295, FW --- Correction Table (vertical): VULP6113 Correction Table (horizontal): VULP6113 Correction Table (vertical): Cable_EN_1GHz (1005) Correction Table (horizontal): Cable_EN_1GHz (1005)
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12
Software version	EMC32 V10.40.0

8.2.7 Sequence of testing

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position $\pm 45^\circ$ and antenna height between 1 and 4 m.
- The final measurement is done with average detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.2.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF$$

List of abbreviations:

SS	▶	signal strength
U_R	▶	voltage at the receiver
CL	▶	loss of the cable
AF	▶	antenna factor

List with correction factors:

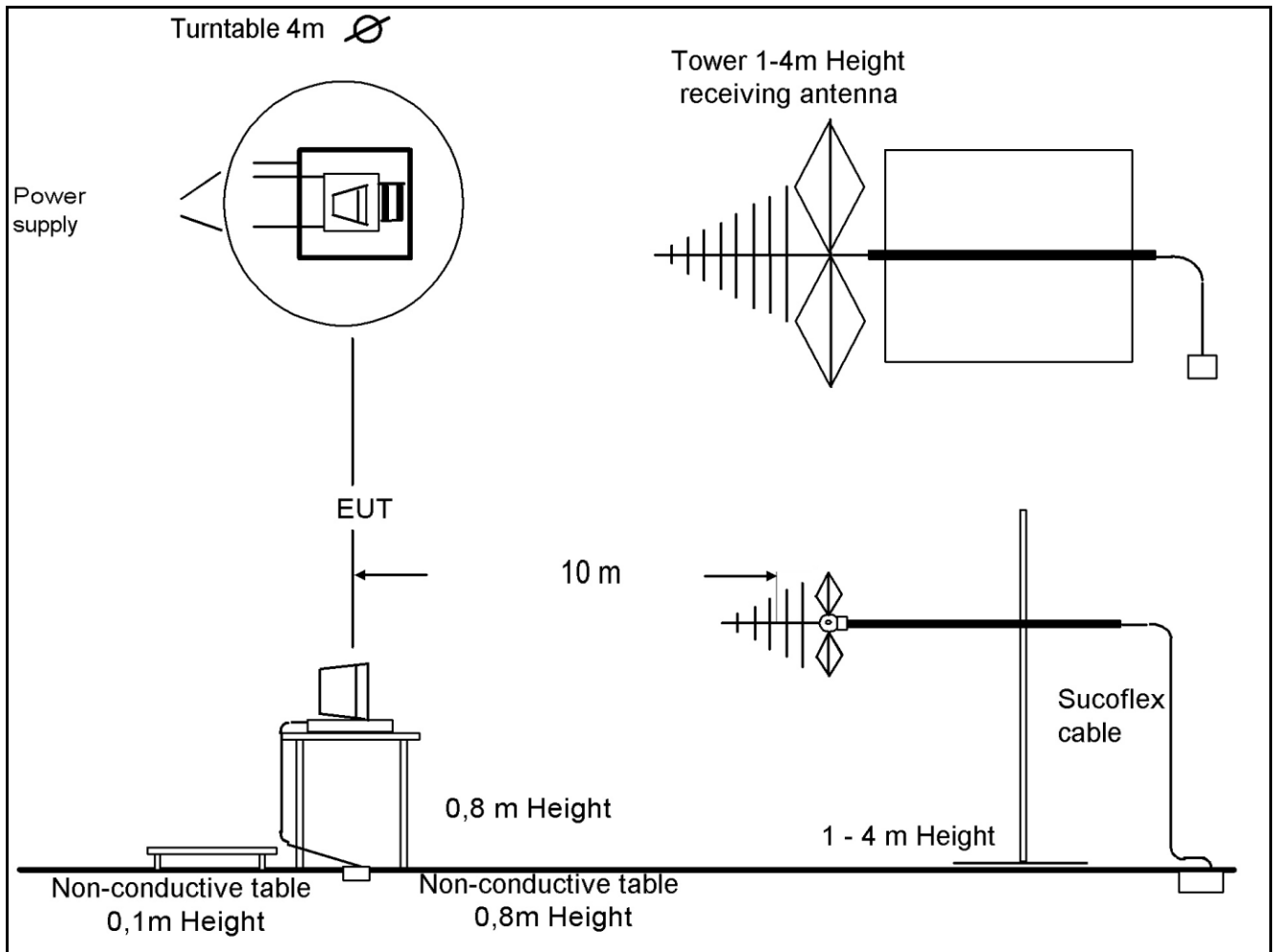
Frequency [MHz]	CL [dB]	AF [1/m]
30,000	0,20	12,30
100,000	0,60	11,30
200,000	1,10	10,60
300,000	1,30	13,20
400,000	1,60	15,30
500,000	1,90	16,80
600,000	2,00	18,80
700,000	2,20	20,30
800,000	2,30	21,50
900,000	2,40	22,80
1000,000	2,50	23,30

Example calculation:

For example at 500,000 000 MHz the measured Voltage (U_R) is 12,35 dB μ V, the loss of the cable (CL) is 1,90 dB and the antenna factor (AF) is 16,80 dB (m^{-1}) the final result will be calculated:

$$SS \text{ [dB}\mu\text{V/m]} = 12,35 \text{ [dB}\mu\text{V]} + 1,90 \text{ [dB]} + 16,80 \text{ [dB (m}^{-1}\text{)]} = \underline{31,05 \text{ [dB}\mu\text{V/m] (35,69 } \mu\text{V/m)}}$$

8.2.9 Test Set-up



9 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
Radiated emission in chamber F					
F-1	Control Computer	F+W		2934939v001	300005258
F-2	Trilog-Antenna	Schwarzbeck	VULB 9163	9163-371	300003854
F-3a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-4b	Switch	Netgear	GS108P	26V12A3H50336	300000368
F-5	EMI Test receiver	R&S	ESCI	100083	300003312
F-6	Turntable Interface-Box	EMCO / ETS-LINDGREN	Model 105637	44583	300003747
F-7	Tower/Turntable Controller	EMCO / ETS-LINDGREN	Model 2090	64672	300003746
F-8	Tower	EMCO / ETS-LINDGREN	Model 2175	64762	300003745
F-9	Ultra Notch-Filter Rejected band Ch. 62	WRCD		9	
Radiated immunity in chamber F					
F-10	Control Computer	F+W		FW0502032	300003303
F-11	Signal Generator	R&S	SMB 100A	1406.6000k02-113856	300005266
F-13	RF-Amplifier	Bonn	BLWA 0860-250/100D	035491	300003210
F-14	Stacked Logper Antenna	Schwarzbeck	STLP9128 E	9128 E 013	300003408
F-14a	Bicon-Antenna	EMCO	3109	8906-2309	300000575
F-14b	Bicon-Antenna	Schwarzbeck	Balun VHBD 9134 elements BBFA 9146	3011 0057	300005385
F-15	RF-Amplifier	ar	1000LM20	20562	-/-
F-16	Directional Coupler	ar	DC7144A	312786	300003411
F-16a	Directional coupler	emv	DC 2000	9401-1677	300000592
F-18	Power Meter	R&S	NRP2	104973	300005114
F-19	Power sensor	R&S	NRP-Z91	103332	300005114-1
F-20	Power sensor	R&S	NRP-Z91	103333	300005114-2
F-35	RF- Amplifier	Bonn	BLMA 2060-5	097392A	300003908
F-36	Stacked Microwave Log.-Per. Antenna	Schwarzbeck	STLP9149	9149-044	300003919
Harmonics and flicker in front of chamber F					
F-21	Flicker and Harmonics Test System	Spitzenberger & Spies	PHE4500/B I PHE4500/B II	B5983 B5984	300003314
F-28	Power Supply	Hewlett Packard	6032 A	2920 A 04466	300000580
Radiated emission in chamber F > 1GHz					
F-29	Horn antenna	Schwarzbeck	BBHA 9120 B	188	300003896
F-30	Amplifier	ProNova	0518C-138	005	F 024
F-31	Amplifier	Miteq	42-00502650-28-5A	1103782	300003379
F-32	Horn antenna	Emco	3115	9709-5289	300000213
F-33	Spectrum Analyzer	R&S	FSU26	200809	300003874
F-34	Loop antenna	EMCO	6502	8905-2342	300000256

10 Observations

No observations, exceeding those reported with the single test cases, have been made.

Annex A Photographs of the test set-up

Photo 1: radiated emission 9KHz - 30MHz x-axis

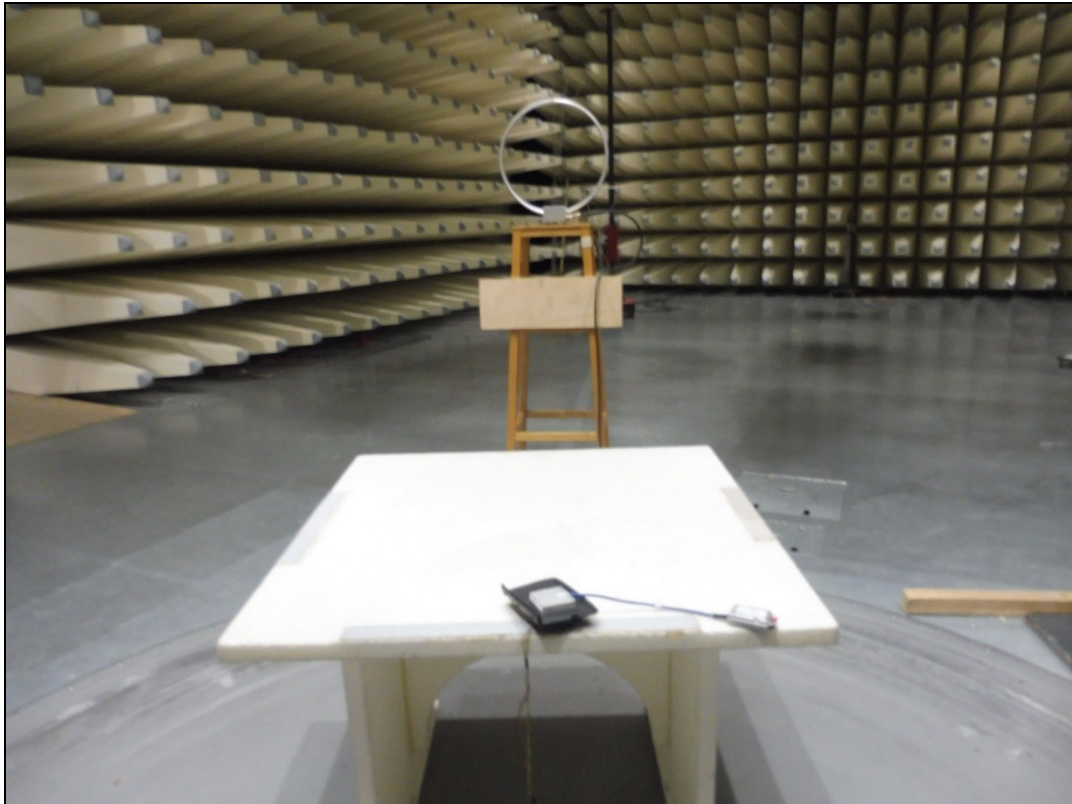


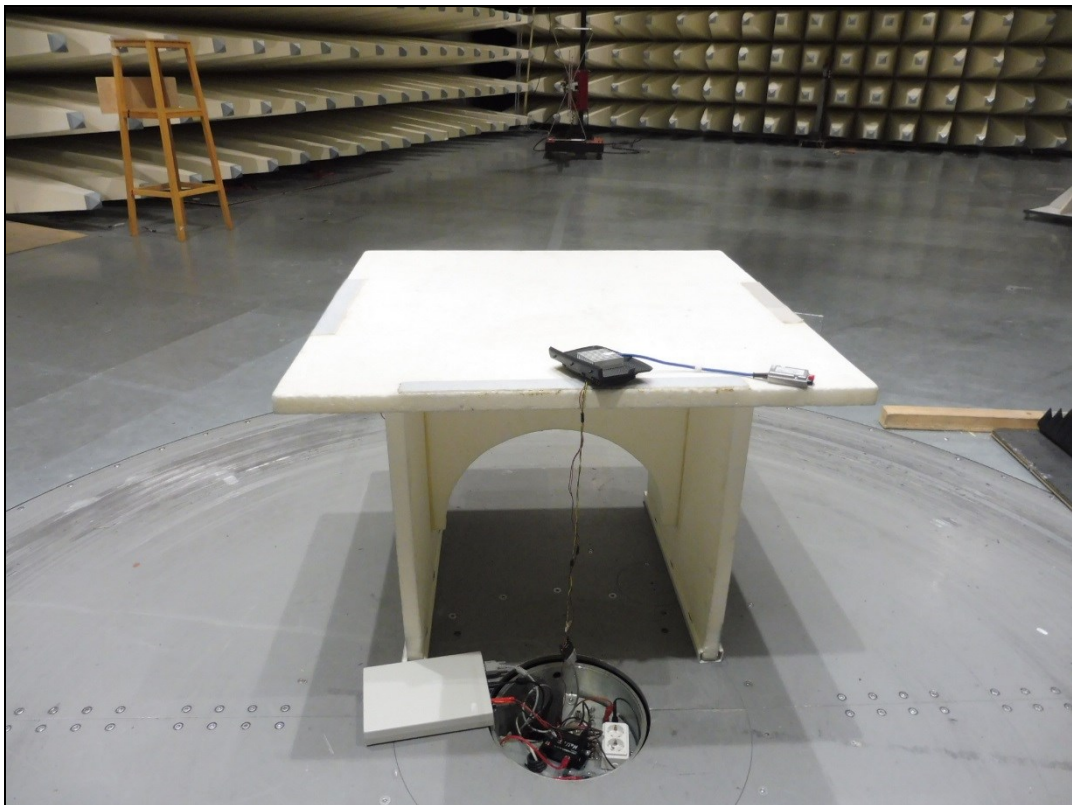
Photo 2: radiated emission 9KHz - 30MHz y-axis



Photo 3: radiated emission 9KHz - 30MHz z-axis



Photo 4: radiated emission 30MHz - 1-GHz



Annex B Photographs of the EUT

Photo 5: EUT A

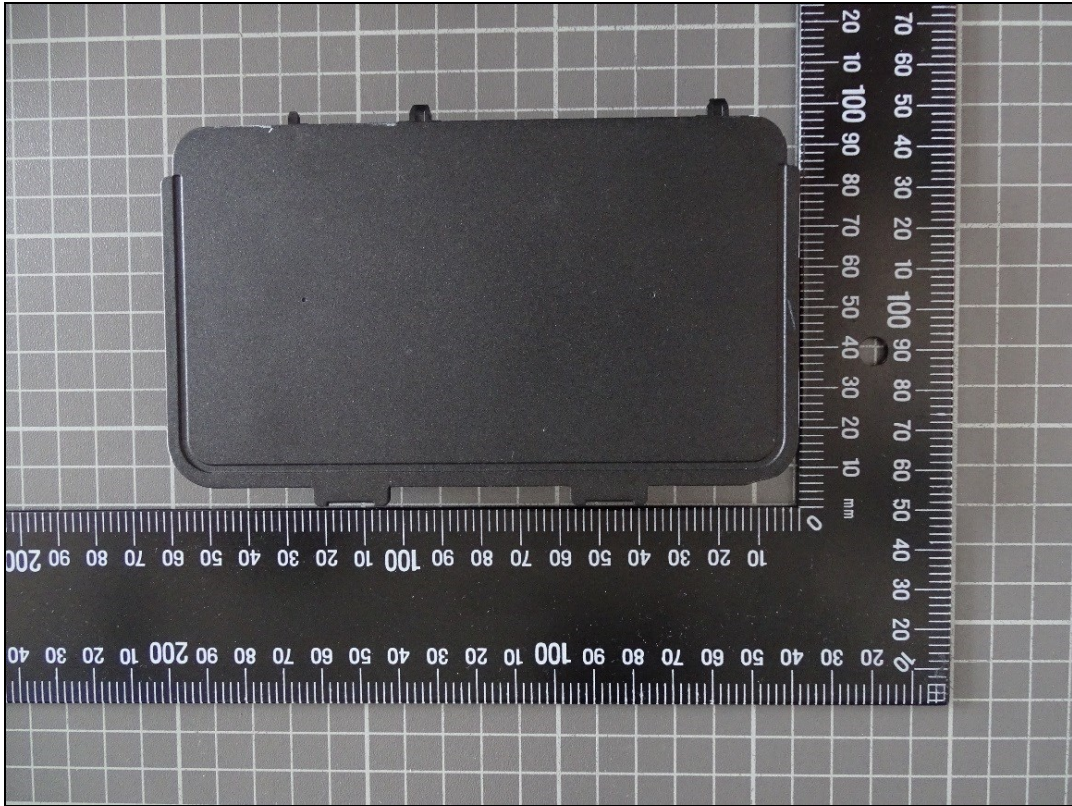


Photo 6: EUT A

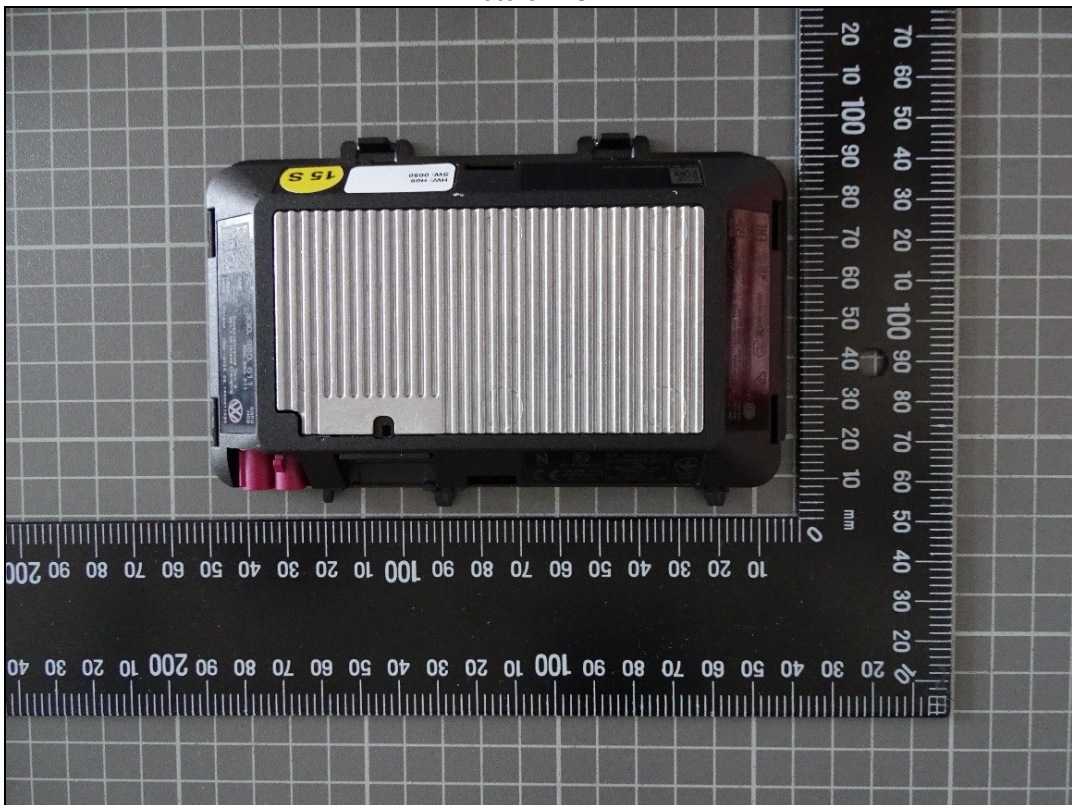


Photo 7: EUT A

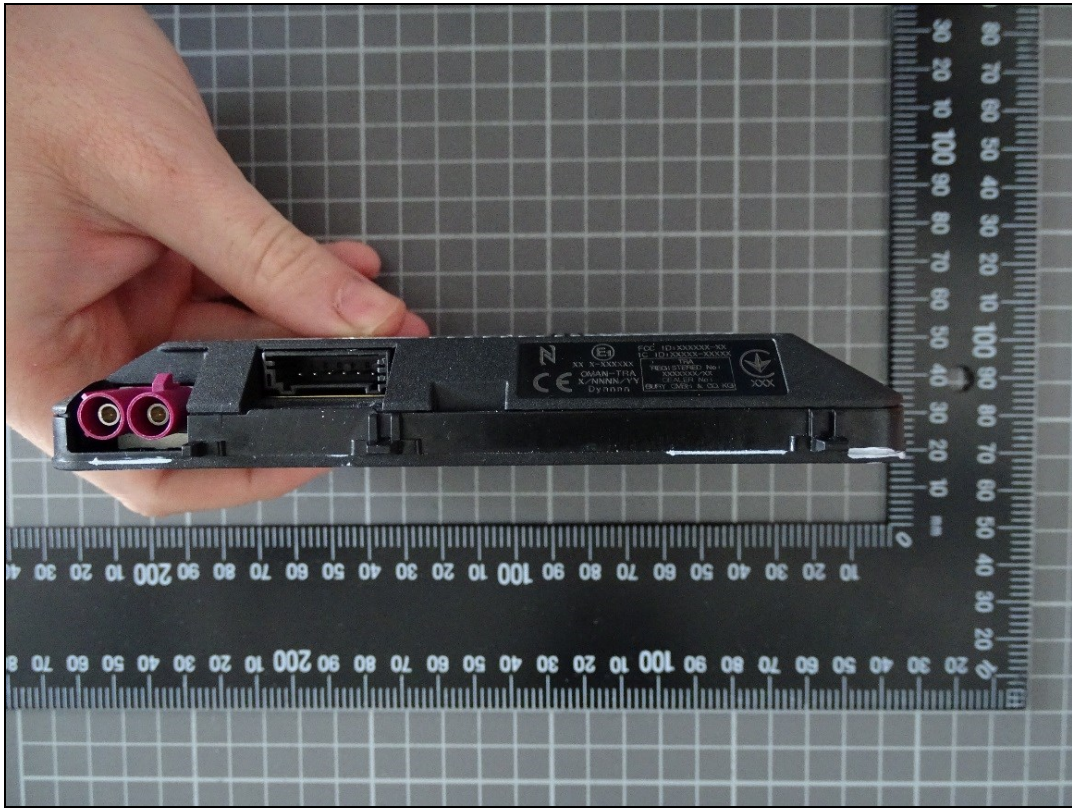


Photo 8: EUT A



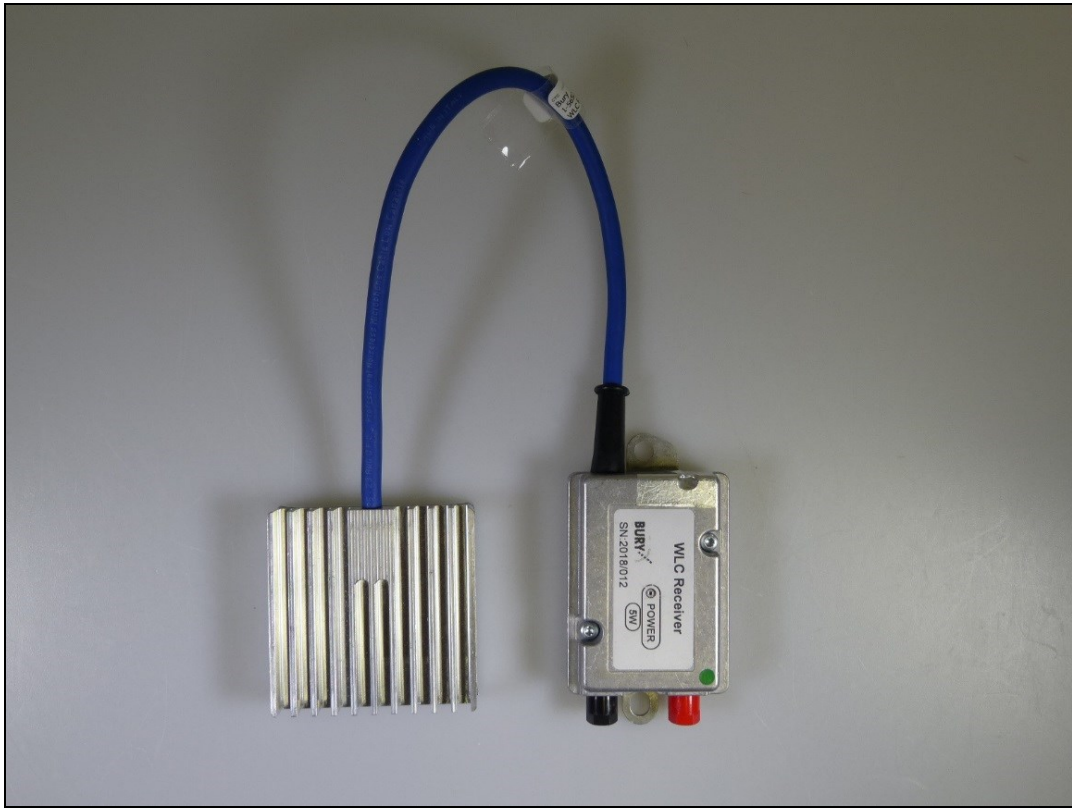
Photo 9: Label of EUT A



Photo 10: AE B



Photo 11: AE C



Annex C Document history

Version	Applied changes	Date of release
- / -	Initial release	2018-11-20
_A	editorial changes	2019-03-05

Annex D Further information**Glossary**

DUT	-	Device under Test
EMC	-	Electromagnetic Compatibility
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software