

Report on the FCC and IC Testing of the
 Dr. Ing. h.c. F. Porsche Aktiengesellschaft
 Charge Manager. Model: Porsche Home Energy
 Manager
 In accordance with FCC 47 CFR Part 15B and
 ICES-003

Prepared for: Dr. Ing. h.c. F. Porsche Aktiengesellschaft
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 70435 Stuttgart
 Germany

FCC ID: 2ATXC-HEM10
 ICES: 25236-HEM10



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Project Management	Alex Fink	2019-10-02	
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ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15B and ICES-003. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Stefan Moser Laura Werder	2019-10-02	

Laboratory Accreditation
 DAkkS Reg. No. D-PL-11321-11-02 Laboratory recognition
 Registration No. BNetzA-CAB-16/21-15 Industry Canada test site registration
 3050A-2

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15B and ICES-003:2017 and 2016.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2019-03-13
2	Applicant/Manufacturer corrected from "Porsche Engineering Group GmbH" to "Dr. Ing. h.c. F. Porsche Aktiengesellschaft". Model/Typ changed from "HCM" to "Porsche Home Energy Manager". FCC and ISED ID added	2019-08-12
3	Chapter 1.4 "Worst case evaluation" added. Hardware and Software versions corrected.	2019-10-02

Table 1

1.2 Introduction

Applicant	Dr. Ing. h.c. F. Porsche Aktiengesellschaft
Manufacturer	Dr. Ing. h.c. F. Porsche Aktiengesellschaft
Model Number(s)	Porsche Home Energy Manager
Serial Number(s)	N/A
Hardware Version(s)	C12
Software Version(s)	0210
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15B and ICES-003:2017 and 2016
Test Plan/Issue/Date	---
Order Number	5100067-4
Date	2018-09-25
Date of Receipt of EUT	2019-01-29
Start of Test	2019-02-04
Finish of Test	2019-03-12
Name of Engineer(s)	Stefan Moser and Laura Werder
Related Document(s)	ANSI C63.4: 2014

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15B and ICES-003 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: 120 V / 60 Hz AC Powered OP1				
2.1	15.109 and 6.2	Radiated Disturbance	Pass	ANSI C63.4: 2014---
2.2	15.107 and 6.1	Conducted Disturbance at Mains Terminals	Pass	ANSI C63.4: 2014---

Table 2



1.4 Worst case evaluation

Testing was performed with following configuration, which was stated by the applicant:

HCM operating mode for worst case

- Software: Test image v 1.7
- CPU core utilizes to maximum load using artificial load using Burn-neon and memtester
- ETH1, WiFi, PLC activated, paired with respective peers (ETH2 only connected)
- Frequent pings to simulate traffic and verify link status
- USB flash disk attached and mounted
- Relays on
- 3 phase mains voltage connected and continuously measured
- Current sensors connected to I1, I2 and I3 inputs, I1 carrying current, I2 and I3 left idle and all 12 channels continuously measured
- RS485/CAN ports are attached only with Cables (Not functional)

1.5 Product Information

1.5.1 Technical Description



Figure 1 - Porsche Home Energy Manager - Front

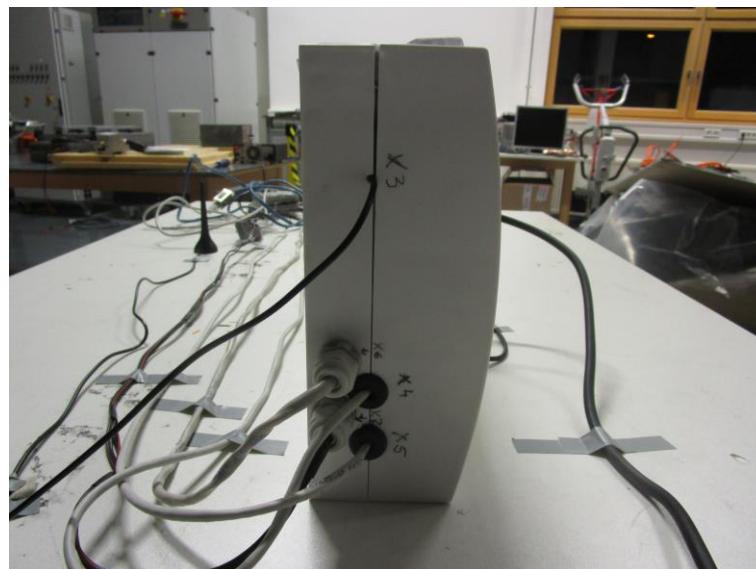


Figure 2 - Porsche Home Energy Manager – Left



Figure 3 - Porsche Home Energy Manager - Back

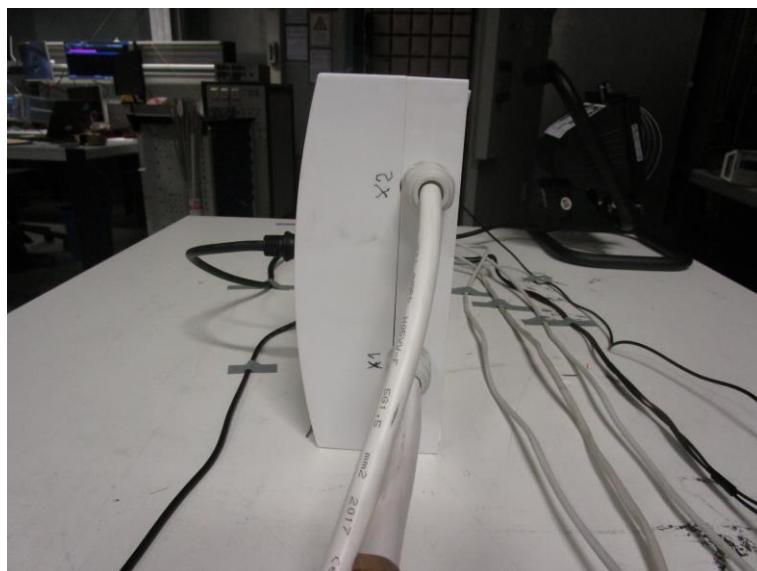


Figure 4 - Porsche Home Energy Manager - Right

1.5.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
120 V / 60 Hz AC Powered OP1				
AC power input	---	2 m	AC powered	No

Table 3

1.5.3 Test Configuration

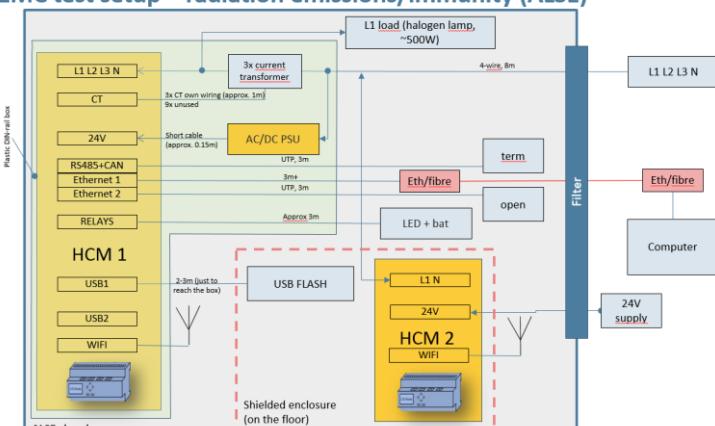
Configuration	Description
120 V / 60 Hz AC Powered	<p>EMC test setup – radiation emissions/immunity (ALSE)</p> 

Table 4

1.5.4 Modes of Operation

Mode	Description
OP1	<p>Porsche Home Energy Manager installed in a plastic enclosure, which contains Porsche Home Energy Manager, AC/DC power supply, 3 current transformers, necessary and internal wiring, outlet for external cables (3 PH Mains, Ethernet, USB, RS485, WiFi antenna, Relays)</p> <p>The Porsche Home Energy Manager communicates with non EUT Porsche Home Energy Manager placed in an shielded enclosure which communicates with EUT Porsche Home Energy Manager over WiFi and powerline communication, furthermore the Porsche Home Energy Manager is measuring an load of approx.. 500 W at L1 over current transformer and connected to an USB Flash drive over an 3 m USB cable.</p> <p>The Porsche Home Energy Manager runs an operating mode which is representative for the real use according to the client.</p>

Table 5

1.6 Deviations from the Standard

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable
1	SPI interface output driver reconfigured from 200MHz and fast edges mode to 50MHz and slow edges mode.	Jiri Naprstek	2019-03-12

Table 6

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: 120 V / 60 Hz AC Powered OP1	
Radiated Disturbance	Stefan Moser
Conducted Disturbance at Mains Terminals	Laura Werder

Table 7

Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany

2 Test Details

2.1 Radiated Disturbance

2.1.1 Specification Reference

FCC 47 CFR Part 15B and ICES-003, Clause 15.109 and 6.2

2.1.2 Equipment Under Test and Modification State

Porsche Home Energy Manager, S/N: N/A - Modification State 0
Porsche Home Energy Manager, S/N: N/A - Modification State 1

2.1.3 Date of Test

2019-02-06 to 2019-03-12

2.1.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8m above a reference ground plane.

A pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarisation using a peak detector; measurements were taken at a 3m distance. Using the pre-scan list of the highest emissions detected, their bearing and associated antenna polarisation, the EUT was then formally measured using a Quasi-Peak, Peak, Average detector as appropriate. The readings were maximised by adjusting the antenna height, polarisation and turntable azimuth, in accordance with the specification.

2.1.5 Environmental Conditions

Ambient Temperature 22.0 °C
Relative Humidity 26.0 %

2.1.6 Specification Limits

Required Specification Limits, Field Strength (Class B @ 3m)		
Frequency Range (MHz)	(μ V/m)	(dB μ V/m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54

Supplementary information:
Quasi-peak detector to be used for measurements < 1GHz
Average detector to be used for measurements > 1GHz

Table 8

2.1.7 Test Results

Results for Configuration and Mode : 120 V / 60 Hz AC Powered OP1.

Performance assessment of the EUT made during this test: Pass.
Intended transmitter 2.45 GHz with exclusion band of ± 120 MHz.

Detailed results are shown below.

Highest frequency generated or used within the EUT: 2,45
Which necessitates an upper frequency test limit of: 13 GHz

Frequency Range of Test: 30 MHz to 1 GHz

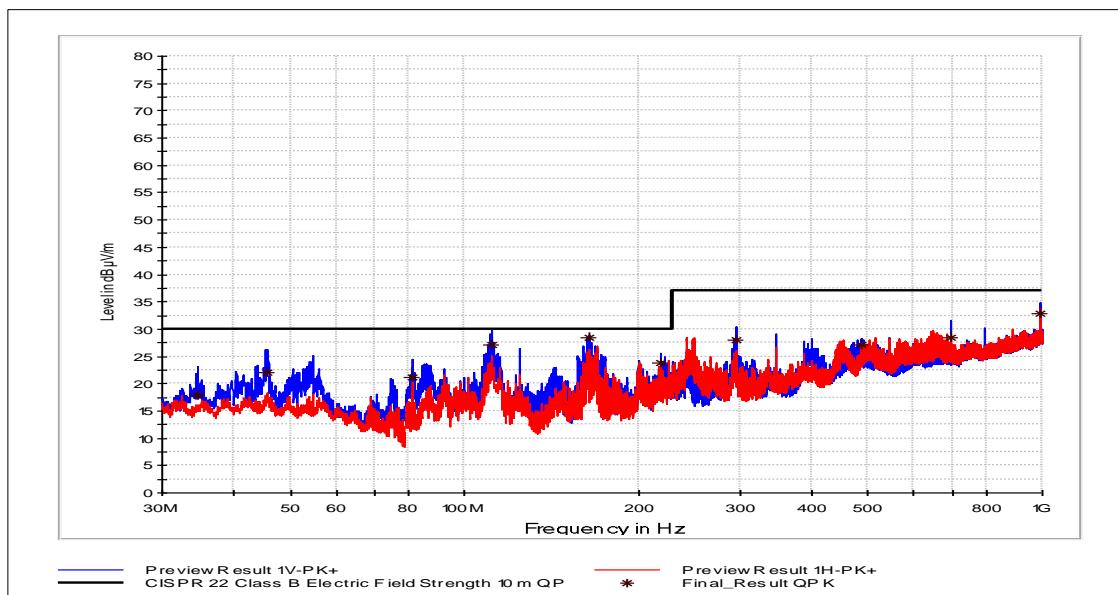


Figure 5 - Graphical Results - Horizontal and Vertical Polarity

Frequency MHz	QuasiPeak dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
34.650000	17.83	30.00	12.17	1000.0	120.000	198.0	V	121.0	12.9
45.750000	22.12	30.00	7.88	1000.0	120.000	300.0	V	138.0	14.7
81.180000	21.22	30.00	8.78	1000.0	120.000	200.0	V	76.0	8.1
111.390000	27.18	30.00	2.82	1000.0	120.000	125.0	V	-21.0	12.6
164.490000	28.36	30.00	1.64	1000.0	120.000	100.0	V	135.0	10.0
219.240000	23.73	30.00	6.27	1000.0	120.000	100.0	V	-28.0	12.8
295.320000	28.07	37.00	8.93	1000.0	120.000	121.0	V	-24.0	15.2
486.360000	27.08	37.00	9.92	1000.0	120.000	100.0	V	-24.0	19.8
692.940000	28.41	37.00	8.59	1000.0	120.000	214.0	V	27.0	22.8
995.940000	32.73	37.00	4.27	1000.0	120.000	165.0	V	-28.0	26.8

Table 9

Frequency Range of Test: 1 GHz to 6 GHz

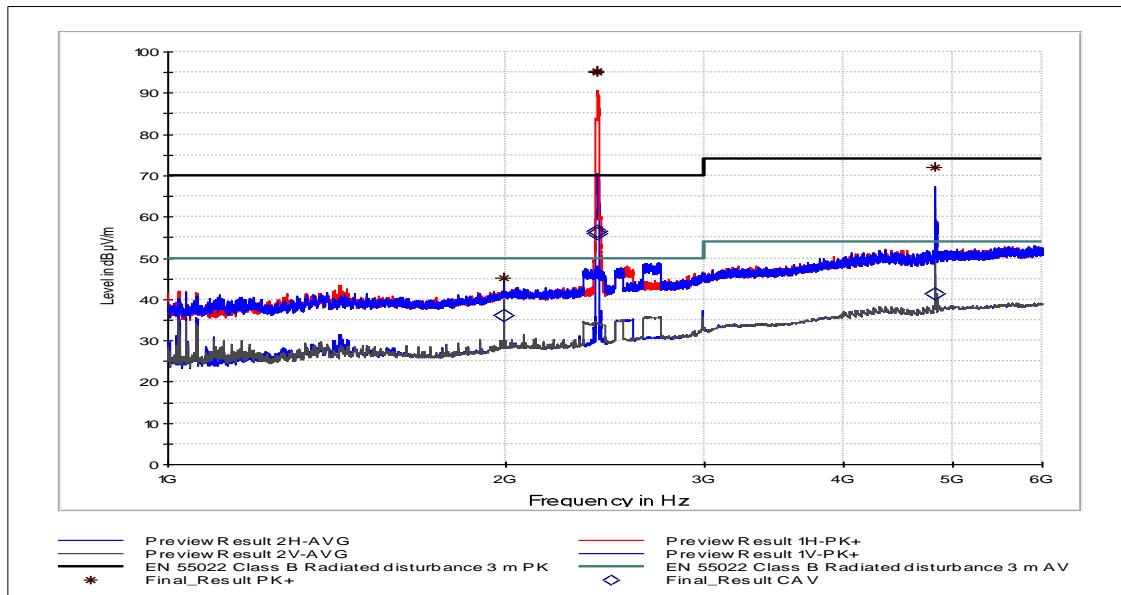


Figure 6 - Graphical Results - Horizontal and Vertical Polarity

Frequency MHz	MaxPeak dB μ V/m	CAverage dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
1991.750000	---	36.03	50.00	13.97	1000.0	1000.000	200.0	V	15.0	32.6
1991.750000	45.16	---	70.00	24.84	1000.0	1000.000	200.0	V	15.0	32.6
2412.750000	---	56.02	50.00	-6.02	1000.0	1000.000	250.0	H	126.0	33.3
2412.750000	95.01	---	70.00	-25.01	1000.0	1000.000	250.0	H	126.0	33.3
2413.000000	---	56.56	50.00	-6.56	1000.0	1000.000	250.0	H	129.0	33.3
2413.000000	95.41	---	70.00	-25.41	1000.0	1000.000	250.0	H	129.0	33.3
4824.000000	---	41.54	54.00	12.46	1000.0	1000.000	300.0	V	125.0	40.9
4824.000000	71.95	---	74.00	2.05	1000.0	1000.000	300.0	V	125.0	40.9

Table 10

Frequency Range of Test: 6 GHz to 13 GHz

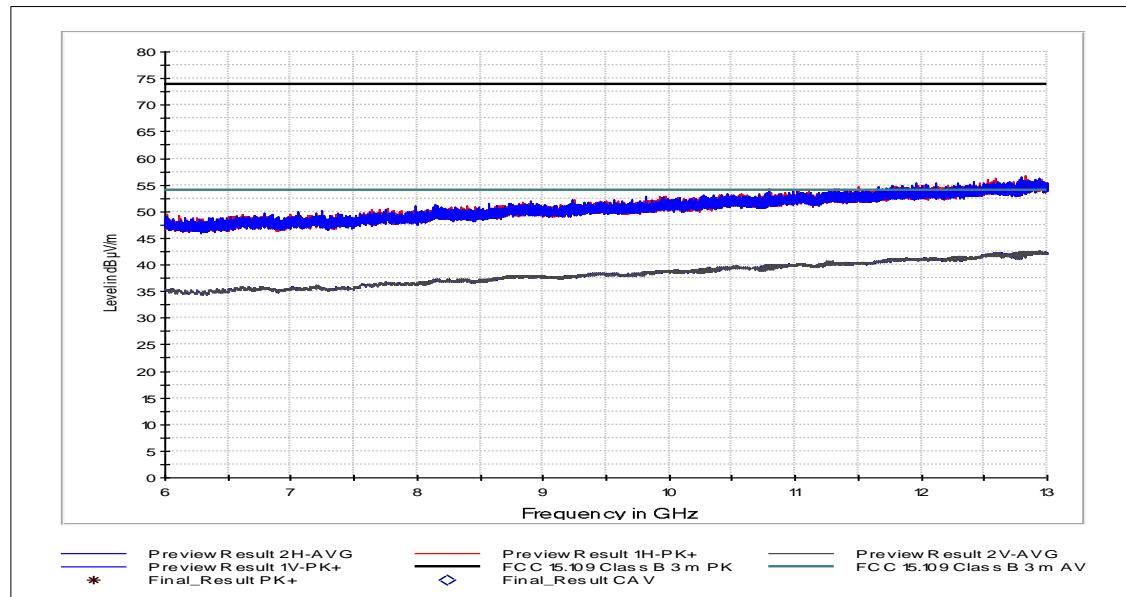


Figure 7 - Graphical Results - Horizontal and Vertical Polarity



Figure 8 – Test setup

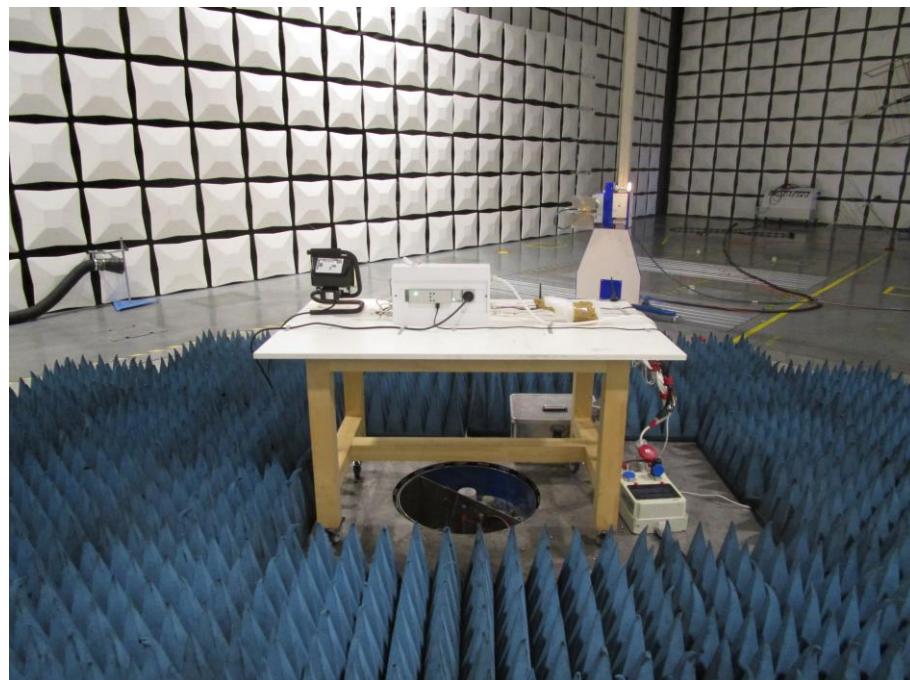


Figure 9 – Test setup

2.1.8 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
TRILOG Broadband Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	19669	36	31.07.2020
Microwave cable	Rosenberger Micro-Coax	FB293C1080005050	19915	---	---
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505G	19916	---	---
Semi anechoic room	Albatross Projects GmbH	Cabin no. 8	19917	36	30.09.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505	19928	---	---
Double ridged horn antenna	Rohde & Schwarz GmbH & Co. KG	HF907	19933	24	30.06.2019
Double ridged waveguide horn antenna	EMCO Elektronik GmbH	3115	1516	36	29.02.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF040005050G	19994	---	---
RF test cable with ferrites	Albatross Projects GmbH	EF393/11N50/11N50/8000 F	20050	---	---
HF-cable for TS8997	Rosenberger Hochfrequenztechnik GmbH & Co. KG	LU1-037-1500	23262	---	---
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESW26	28268	12	31.05.2019

Table 11

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable

2.2 Conducted Disturbance at Mains Terminals

2.2.1 Specification Reference

FCC 47 CFR Part 15B and ICES-003, Clause 15.107 and 6.1

2.2.2 Equipment Under Test and Modification State

Porsche Home Energy Manager, S/N: N/A - Modification State 0

2.2.3 Date of Test

2019-02-04

2.2.4 Test Method

The EUT was placed on a non-conductive table 0.8m above a reference ground plane and 0.4m away from a vertical coupling plane. All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted disturbance voltage measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.

2.2.5 Environmental Conditions

Ambient Temperature 22,0 °C

Relative Humidity 31,0 %

2.2.6 Specification Limits

Required Specification Limits (Class B)			
Line Under Test	Frequency Range (MHz)	Quasi-peak (dB μ V)	Average (dB μ V)
AC Power Port	0.15 to 0.5	66 to 56*	56 to 46*
	0.5 to 5	56	46
	5 to 30	60	50

Supplementary information: *Decreases with the logarithm of the frequency.

Table 12

2.2.7 Test Results

Results for Configuration and Mode : 120 V / 60 Hz AC Powered OP1.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Line Under Test: AC power input - L1

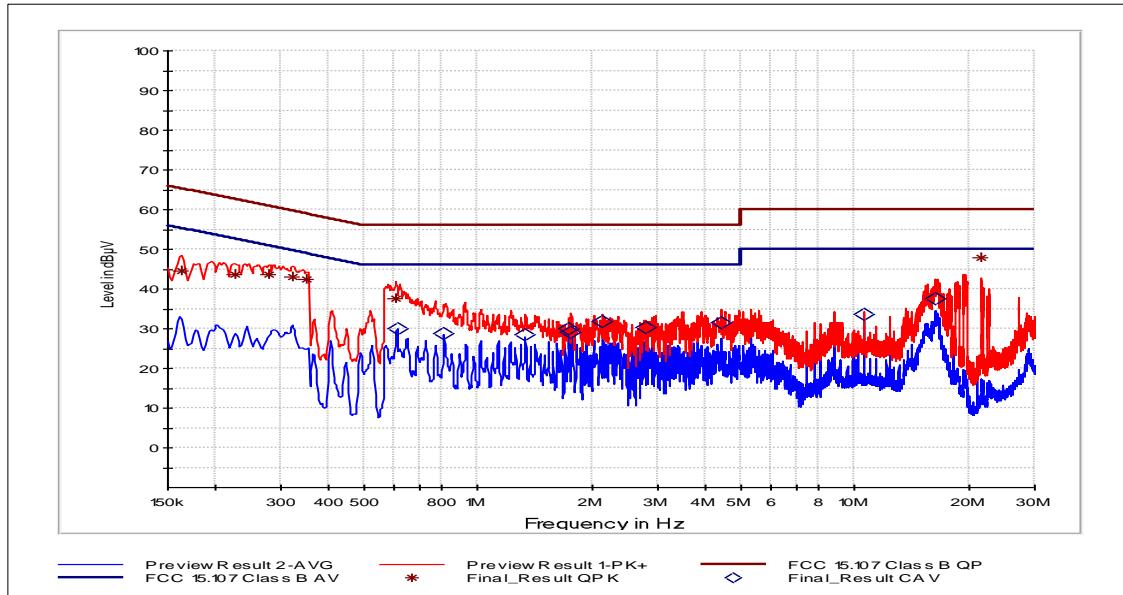
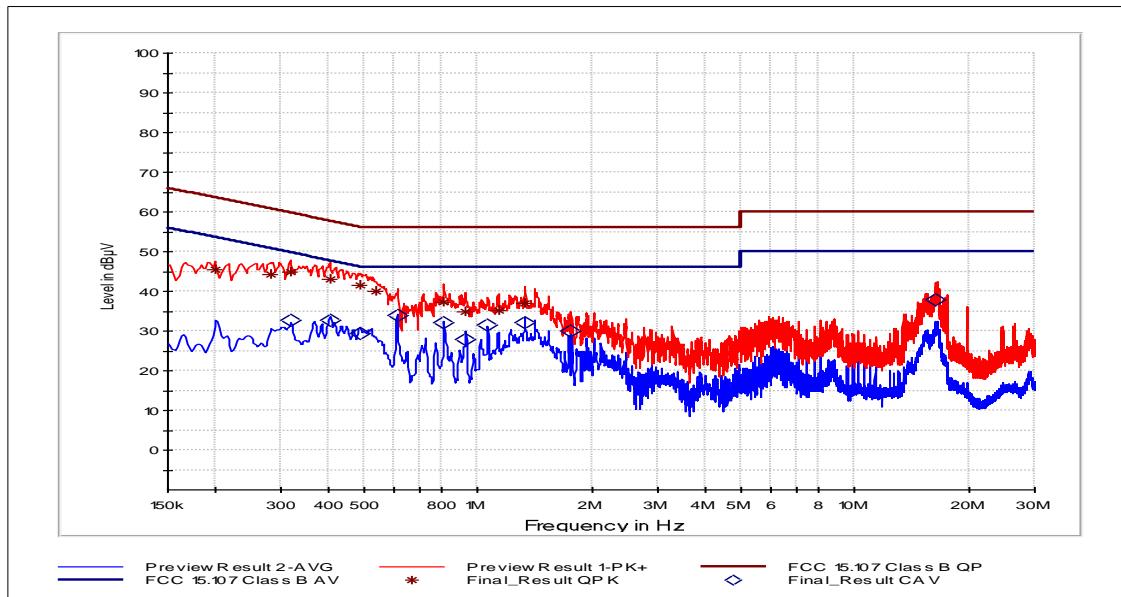


Figure 10 - Graphical Results - AC power input - L1

Frequency MHz	QuasiPeak dB μ V	CAverage dB μ V	Limit dB μ V	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Corr. dB
0.163500	44.62	---	65.28	20.67	1000.0	9.000	L1	0.0
0.226500	43.51	---	62.58	19.07	1000.0	9.000	L1	0.0
0.278250	43.49	---	60.87	17.38	1000.0	9.000	L1	0.0
0.323250	43.04	---	59.62	16.58	1000.0	9.000	L1	0.0
0.352500	42.51	---	58.90	16.39	1000.0	9.000	L1	0.0
0.604500	37.50	---	56.00	18.50	1000.0	9.000	L1	0.0
0.609000	---	30.06	46.00	15.94	1000.0	9.000	L1	0.0
0.811500	---	28.88	46.00	17.12	1000.0	9.000	L1	0.0
1.335750	---	28.63	46.00	17.37	1000.0	9.000	L1	0.0
1.740750	---	29.86	46.00	16.14	1000.0	9.000	L1	0.1
1.767750	---	28.95	46.00	17.05	1000.0	9.000	L1	0.1
2.145750	---	31.85	46.00	14.15	1000.0	9.000	L1	0.1
2.793750	---	30.27	46.00	15.73	1000.0	9.000	L1	0.2
4.416000	---	31.55	46.00	14.45	1000.0	9.000	L1	0.3
10.603500	---	33.49	5---	16.51	1000.0	9.000	L1	0.0
16.401750	---	37.63	5---	12.37	1000.0	9.000	L1	0.4
21.646500	47.92	---	6---	12.08	1000.0	9.000	L1	0.2

Table 13

Line Under Test: AC power input - N



Frequency MHz	QuasiPeak dB μ V	CAverage dB μ V	Limit dB μ V	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Corr. dB
0.199500	45.52	---	63.63	18.11	1000.0	9.000	N	0.0
0.280500	44.38	---	60.80	16.42	1000.0	9.000	N	0.0
0.316500	44.85	---	59.80	14.95	1000.0	9.000	N	0.0
0.318750	---	32.83	49.74	16.90	1000.0	9.000	N	0.0
0.404250	---	32.70	47.77	15.06	1000.0	9.000	N	0.0
0.404250	43.16	---	57.77	14.60	1000.0	9.000	N	0.0
0.485250	---	29.29	46.25	16.96	1000.0	9.000	N	0.0
0.487500	41.39	---	56.21	14.82	1000.0	9.000	N	0.0
0.537000	39.90	---	56.00	16.10	1000.0	9.000	N	0.0
0.609000	---	33.95	46.00	12.05	1000.0	9.000	N	0.0
0.811500	37.22	---	56.00	18.78	1000.0	9.000	N	0.0
0.811500	---	32.12	46.00	13.88	1000.0	9.000	N	0.0
0.924000	34.90	---	56.00	21.10	1000.0	9.000	N	0.0
0.926250	---	27.91	46.00	18.09	1000.0	9.000	N	0.0
1.059000	---	31.53	46.00	14.47	1000.0	9.000	N	0.0
1.131000	35.18	---	56.00	20.82	1000.0	9.000	N	0.0
1.333500	---	32.21	46.00	13.79	1000.0	9.000	N	0.0
1.335750	37.02	---	56.00	18.98	1000.0	9.000	N	0.0
1.767750	---	29.88	46.00	16.12	1000.0	9.000	N	0.1
16.458000	---	37.74	5---	12.26	1000.0	9.000	N	0.4

Table 14

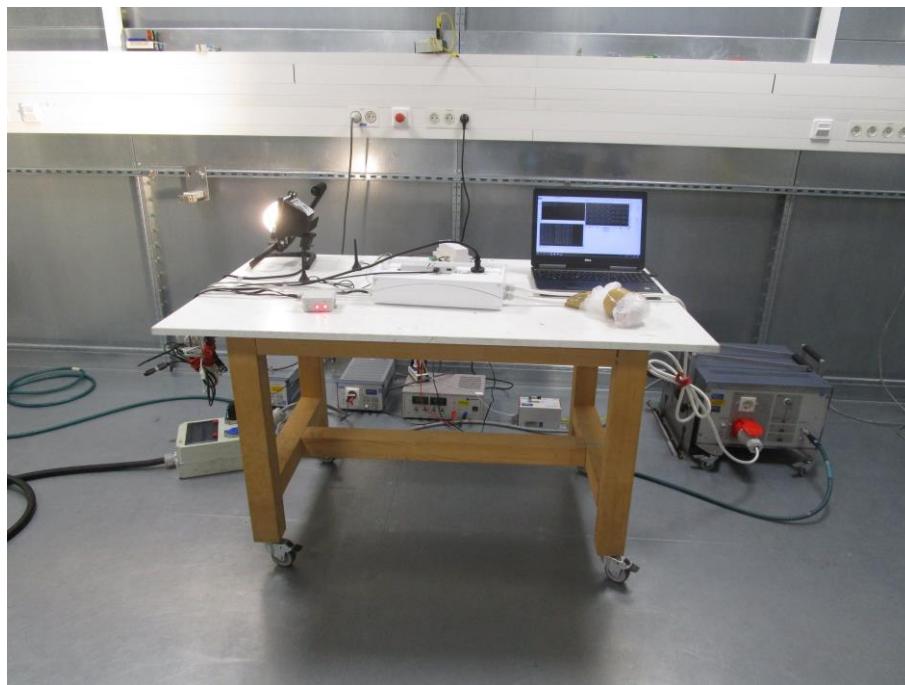


Figure 12 – Test setup

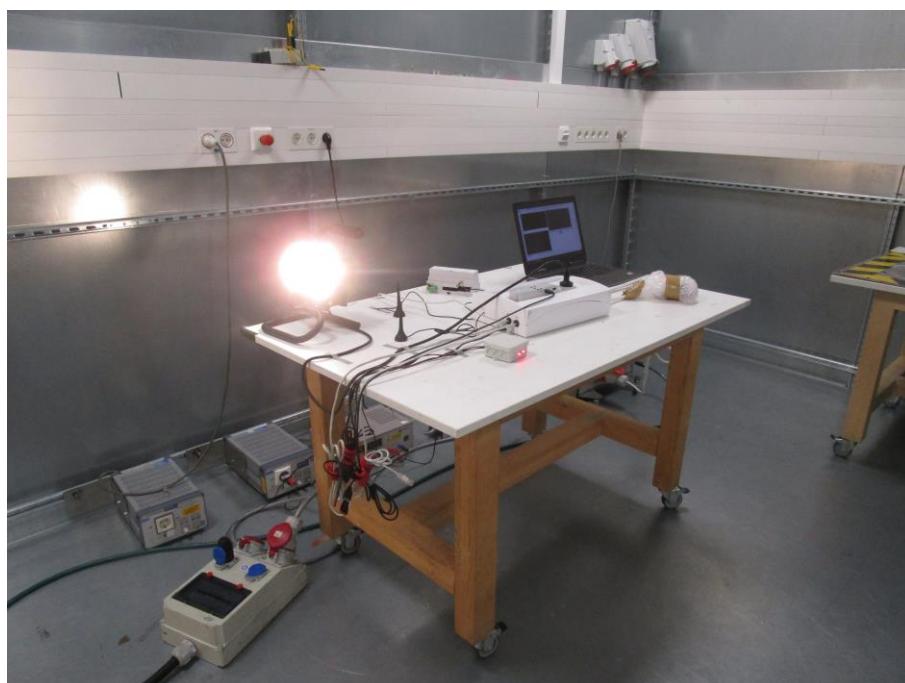


Figure 13 – Test setup

2.2.8 Test Location and Test Equipment Used

This test was carried out in Shielded room - cabin no. 9.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
V-network	Rohde & Schwarz GmbH & Co. KG	ESH3-Z5	18919	36	31.10.2019
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU8	19904	12	31.12.2019
Microwave cable	Rosenberger Micro-Coax	FB293C1080005050	20024	---	---
Shielded room	Albatross Projects GmbH	Cabin no. 9	21083	---	---

Table 15

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable

3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
TRILOG Broadband Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	19669	36	31.07.2020
Microwave cable	Rosenberger Micro-Coax	FB293C1080005050	19915	---	---
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505G	19916	---	---
Semi anechoic room	Albatross Projects GmbH	Cabin no. 8	19917	36	30.09.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505	19928	---	---
Double ridged horn antenna	Rohde & Schwarz GmbH & Co. KG	HF907	19933	24	30.06.2019
Double ridged waveguide horn antenna	EMCO Elektronik GmbH	3115	1516	36	29.02.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF040005050G	19994	---	---
RF test cable with ferrites	Albatross Projects GmbH	EF393/11N50/11N50/8000 F	20050	---	---
HF-cable for TS8997	Rosenberger Hochfrequenztechnik GmbH & Co. KG	LU1-037-1500	23262	---	---
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESW26	28268	12	31.05.2019
V-network	Rohde & Schwarz GmbH & Co. KG	ESH3-Z5	18919	36	31.10.2019
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU8	19904	12	31.12.2019
Microwave cable	Rosenberger Micro-Coax	FB293C1080005050	20024	---	---

Table 16

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable



4 Incident Reports

No incidents reports were raised.

5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1

Table 17

Note 1:

The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%