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D-PL-18175-01-01
D-PL-18175-01-02
D-PL-18175-01-03
D-PL-18175-01-04

Nemko EMV Testzentrum

FCC / IC TEST REPORT

APPLICANT

Company:	**Hella Gutmann Solutions GmbH**
Address:	**Am Krebsbach 2** **79241 Ihringen, Germany**
Witness(es) at tests:	**-**

EQUIPMENT UNDER TEST (EUT)

Equipment:	**Vehicle diagnosis device**
Model/Type:	**mega macs 56**
Serial No.:	**342800**

TEST

Arrival of EUT:	**2016-04-14**
Date of measurement:	**2016-06-16; 06-17**
Standards:	**47 CFR Part 15, Subpart B §15.31(h) and §15.247(b)** **RSS-Gen Issue 4 clause 8.9 and RSS-247 clause 5.4 (2)**
Results:	**Passed - Details see test result summary**
Performed by:	**Dipl.-Ing. J. Szipanski**

LABORATORY

Test site:	**Nemko GmbH & Co. KG, Pfinztal, Germany**
FCC Reg. No.:	**989327 (2012-12-21)**

TEST REPORT

Identification No.:	**FC-1602-303851**	
Date of Report:	**2016-06-20**	
Provided by:	**Dipl.-Ing. J. Szipanski**	
	Person responsible	**Signature**
Approved by:	**Dipl.-Ing. P. Lukas**	
	Person responsible	**Signature**

QMV-5.10-2 e / Rev 5.10

Index of the testreport:

1 General information

1.1 Description of Equipment under test (EUT)

The EuT is part of a vehicle diagnosis system consisting of:

- Handheld diagnosis computer mega macs 56 with external AC/DC converter **(EuT)**
- OBD adapter (DT-VCI)
- connection cables

The EuT may be supplied

- by external AC/DC converter
- by external DC source (12 V)
- by internal accumulator

The EuT contains a 2.4 GHz combined Bluetooth / WiFi module ELLA-W133-A manufactured by u-blox AG. The WiFi section uses a chip antenna integrated on the module. The Bluetooth section is connected to an external antenna Molex 0479502011.
FCC ID: 2AEOK-HGS3
Industry Canada ID: 8595A-ELLAW133

1.2 Technical data

Maximum internal frequency	2500 MHz
Power supply	external AC/DC converter (100 – 240 V / 50 – 60 Hz) or: 12 V DC

1.3 Climatic conditions

parameter	**actual range**
Ambient temperature	23 - 25 °C
Relative humidity	33 - 35 %
Atmospheric pressure	998 - 1000 mbar

1.4 Other comments

All tests were performed using the supplied external AC/DC converter and a mains voltage of 115 V / 60 Hz.

1.5 Test equipment

See list of test equipment in clause 4.

1.6 Project history

test report (Ident.-No.)	**date of report**	**modification of the EuT**	**Change in standard in clause:**
FC-1602-303851	2016-06-20	-	initial test report

2 Test Report Summary

2.1 General

The tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with:

47 CFR Part 15, Subpart B §15.31(h), §15.247(b)
RSS-Gen Issue 4 clause 8.9, RSS-247 clause 5.4 (2)

The test methods have been in accordance with 47 CFR Part 15 and RSS where applicable.

☒ Production Unit
☐ Pre-production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.
Deviations from, additions to, or exclusions from the test specifications are described in "Test results".

TEST REPORT NO.: FC-1602-303851

2.2 Test Summary

Section in CFR 47		Result
15.247(b)	Maximum peak output power	PASS
15.31(h)	Spurious radiated emissions of composite system	PASS

Section in RSS		Result
RSS-247 clause 5.4 (2)	Maximum peak output power	PASS
RSS-Gen clause 8.9	Spurious radiated emissions	PASS

Explanations:
PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
X The measurement was done, but there is no applicable performance criteria.

3 Test Results

3.1 Maximum peak output power

The Bluetooth section of the EuT uses an antenna Molex 0479502011 that is not contained in the approved antennas list.

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Frequency range	2400 - 2483.5 MHz
Limits FCC	§15.247 (b)
Limits IC	RSS-247 clause 5.4 (2)
Test uncertainty U95	5.14 dB

EuT settings (as proposed by the applicant)

BT section: BT class 1.5, BTU power control disabled, power +8 dBm

Test method and limits

The test was performed in a test chamber according to ANSI C63.10-2013. The EUT was placed on a non-conductive 0.8 m high support standing on the turntable (see fig. 1, 2).
In order to find the maximum levels of the radiated signal the angle of the turntable and the lay-out of the EUT cables were varied during the tests. The test was performed separately with the measuring antenna being both in horizontal and vertical polarizations.
Spectrum analyzer settings: RBW = 1 MHz, VBW = 3 MHz, Sweep time = AUTO

FCC Part 15.247 (b) / RSS-247 clause 5.4 (2) limit values

Frequency band MHz	max peak conducted output power Watt / dBm	max antenna gain dBi	max peak radiated output power Watt / dBm
2400 - 2483.5	0.125 / 21	6	0.5 / 27

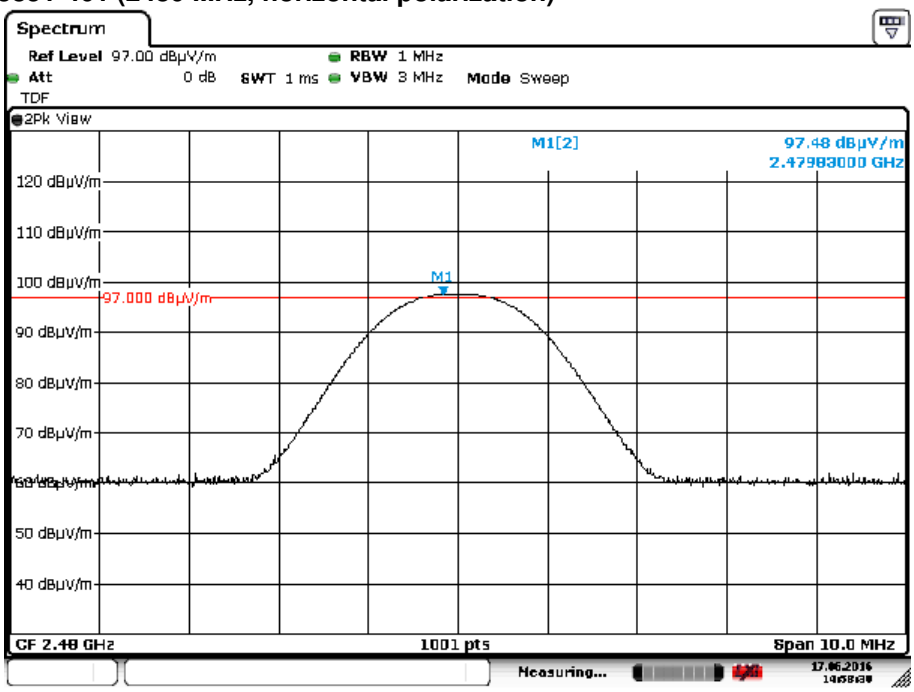
Effective radiated power (e.r.p.) had been calculated from the measured field strength (distance = 3 m) using the following equation:
e.r.p. (dBm) = E (dBµV/m) – 97.383

Test result: Passed.

Test Equipment Used: 9, 52, 46, 55, 56

Measurement results

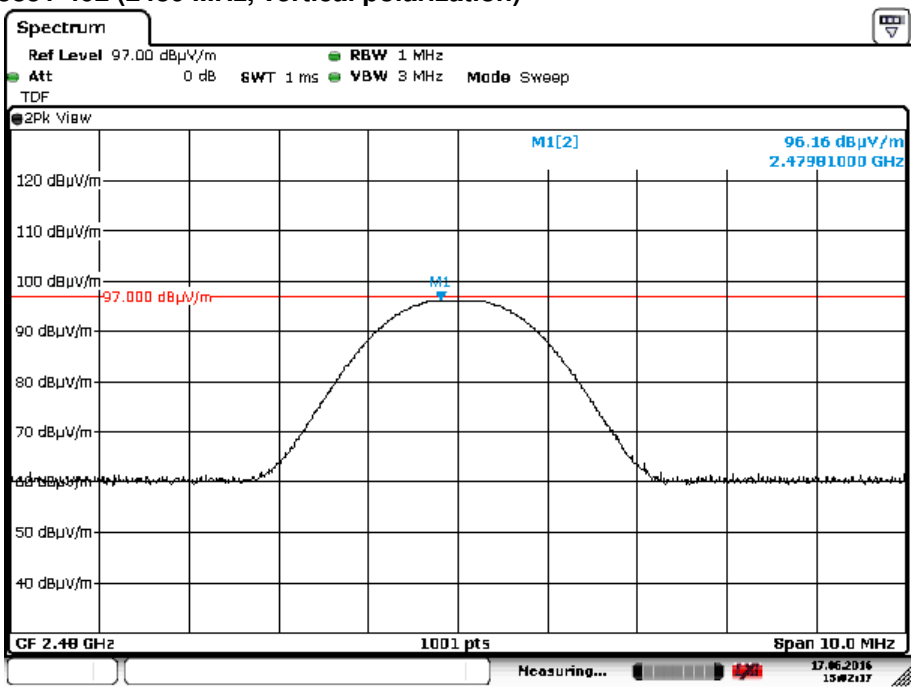
Diagram 303851-401 (2480 MHz, horizontal polarization)



Date: 17.JUN.2016 14:58:31

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2480	97.48	0.1	26.9	0

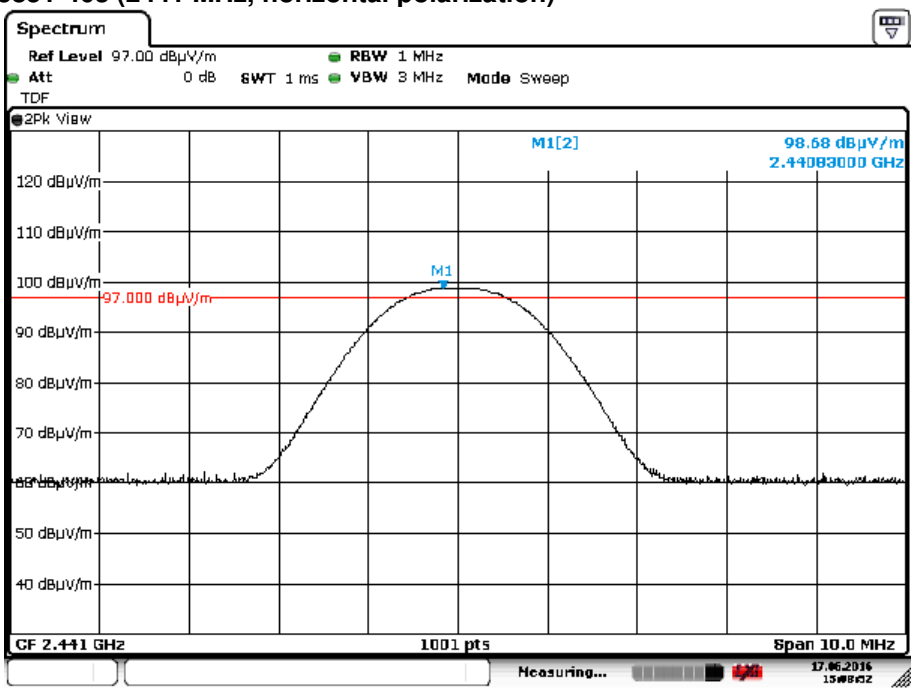
Diagram 303851-402 (2480 MHz, vertical polarization)



Date: 17.JUN.2016 15:02:15

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2480	96.16	-1.22	28.22	68

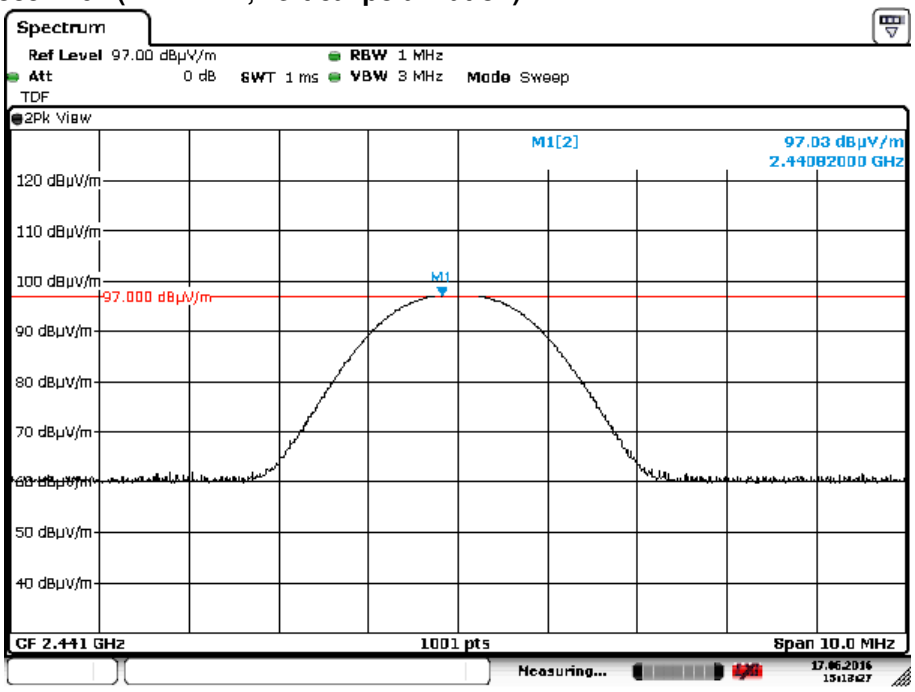
Diagram 303851-403 (2441 MHz, horizontal polarization)



Date: 17.JUN.2016 15:08:53

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2441	98.68	1.3	25.7	68

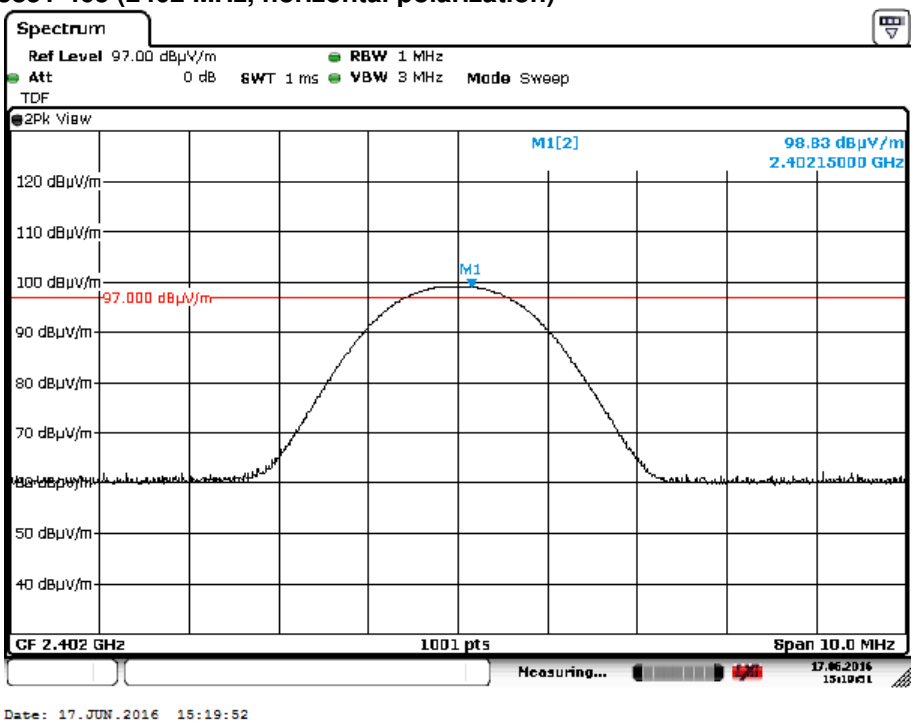
Diagram 303851-404 (2441 MHz, vertical polarization)



Date: 17.JUN.2016 15:13:28

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2441	97.03	-0.35	27.35	68

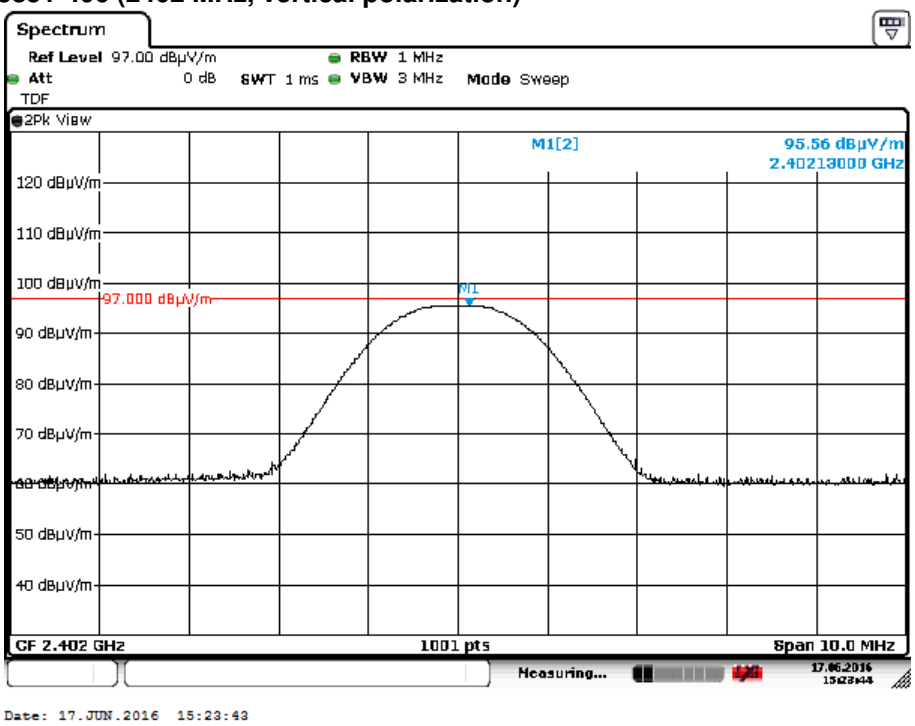
Diagram 303851-405 (2402 MHz, horizontal polarization)



Date: 17.JUN.2016 15:19:52

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2402	98.83	1.45	25.55	110

Diagram 303851-406 (2402 MHz, vertical polarization)



Date: 17.JUN.2016 15:23:43

Frequency (MHz)	PK level (dBµV/m)	PK level (dBm)	Margin (dB)	Angle (deg)
2402	95.56	-1.82	28.82	68

3.2 Spurious radiated emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Frequency range	1000 - 2400 MHz 2483.5 – 18000 MHz
Limits FCC	§15.209
Limits IC	RSS-Gen clause 8.9
Test uncertainty U95	5.14 dB

EuT settings (as proposed by the applicant)

WiFi section: Power: +18 dBm, continuous TX
BT section: BT class 1.5, BTU power control disabled, power +8 dBm
Using a special test mode, both RF transmitters were active at the same time on fixed frequencies.

Test method and limits

The test was performed in a test chamber according to ANSI C63.10-2013. The EUT was placed on a non-conductive 0.8 m high support standing on the turntable (see fig. 1, 2).
In order to find the maximum levels of the disturbance radiation the angle of the turntable and the lay-out of the EUT cables were varied during the tests. The test was performed separately with the measuring antenna being both in horizontal and vertical polarizations.
Spectrum analyzer settings:
a) for PEAK measurements > 1000 MHz: RBW = 1 MHz, VBW = 3 MHz, Sweep time = AUTO
b) for AVERAGE measurements > 1000 MHz: RBW = 1 MHz, VBW = 10 Hz, Sweep time = AUTO

Receiver bandwidth and measuring distance:

Frequency band MHz	Receiver bandwidth kHz	Measuring distance m
30-1000	120	3
1000-25000	1000	3

FCC Part 15.209 / RSS-Gen limit values

Frequency band MHz	Quasi-peak µV/m	Quasi-peak dB(µV/m) @**3m**	Average dB(µV/m) @3m
30 - 88	100@3m	40.0@3m	-
88 - 216	150@3m	43.5@3m	-
216-960	200@3m	46.0@3m	-
960-1000	500@3m	54.0@3m	-
1000-25000	-	74.0@3m *)	54.0@3m

*) Peak

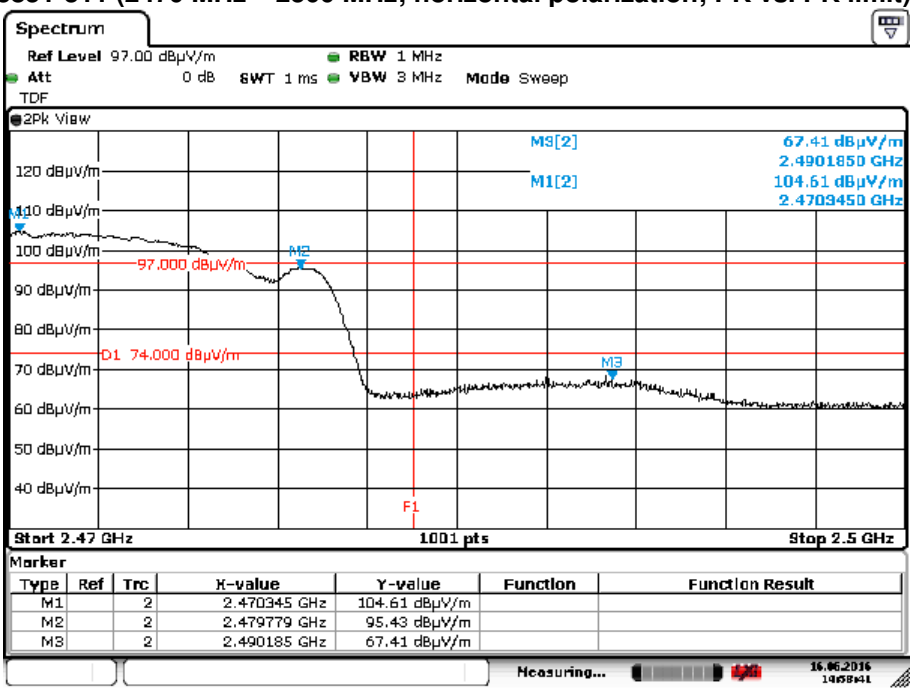
Note: No intermodulation products could be detected in frequency ranges 1000 MHz - 2300 MHz and 3 GHz - 18 GHz. As a consequence, measurements in ranges 30 MHz - 1000 MHz and 18 GHz - 25 GHz had not been carried out.
Also no spurii could be detected in the frequency ranges mentioned above. The impact of an external 2.4 GHz antenna on emissions below 1000 MHz and above 18 GHz is considered as negligible. As a consequence, measurements in these frequency ranges had not been carried out.

Test result: Passed.

Test Equipment Used (f = 2310 - 2500 MHz): 9, 52, 46, 55, 56
Test Equipment Used (f = 1 - 3 GHz): 9, 52, 46, 55, 56, 53, Attenuator 10 dB SMA (1-0872)
Test Equipment Used (f > 3 GHz): 9, 52, 53, 46, 55, 56, 69

Measurement results for EuT transmitting on 2472 MHz (WiFi) and 2480 MHz (BT)

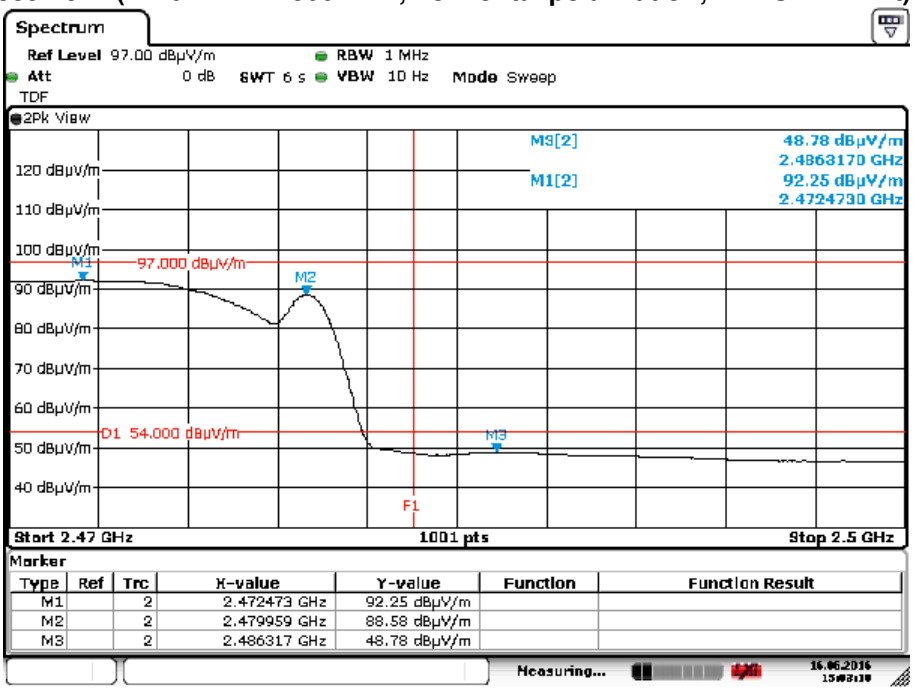
Diagram 303851-311 (2470 MHz – 2500 MHz; horizontal polarization; PK vs. PK limit)



Date: 16.JUN.2016 14:58:41

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	Angle (deg)
2490.2	67.41	74.00	6.59	166

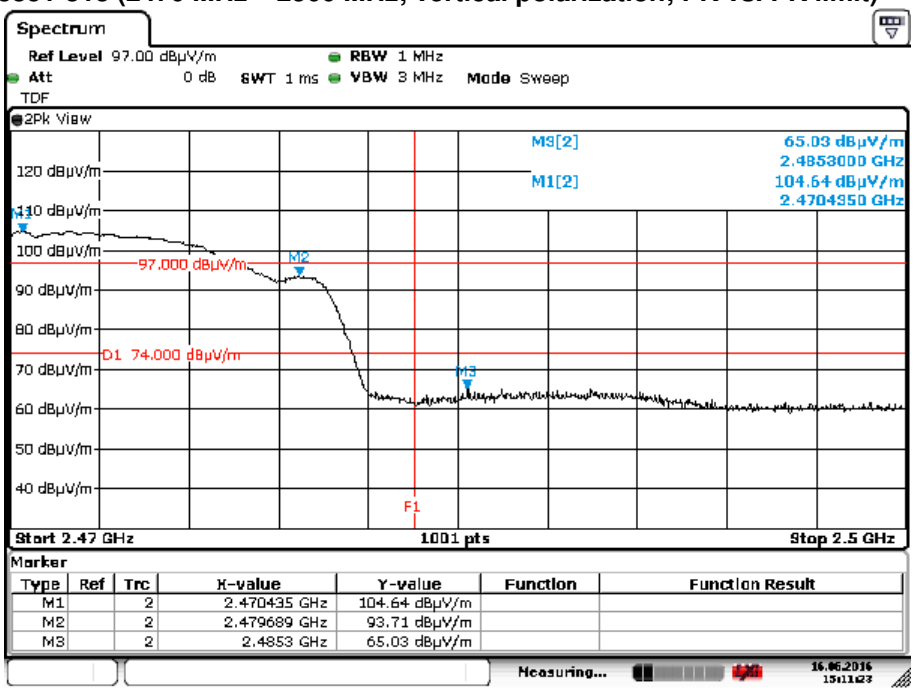
Diagram 303851-312 (2470 MHz – 2500 MHz; horizontal polarization; AV vs. AV limit)



Date: 16.JUN.2016 15:03:11

Frequency (MHz)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2486.3	48.78	54.00	5.22	166

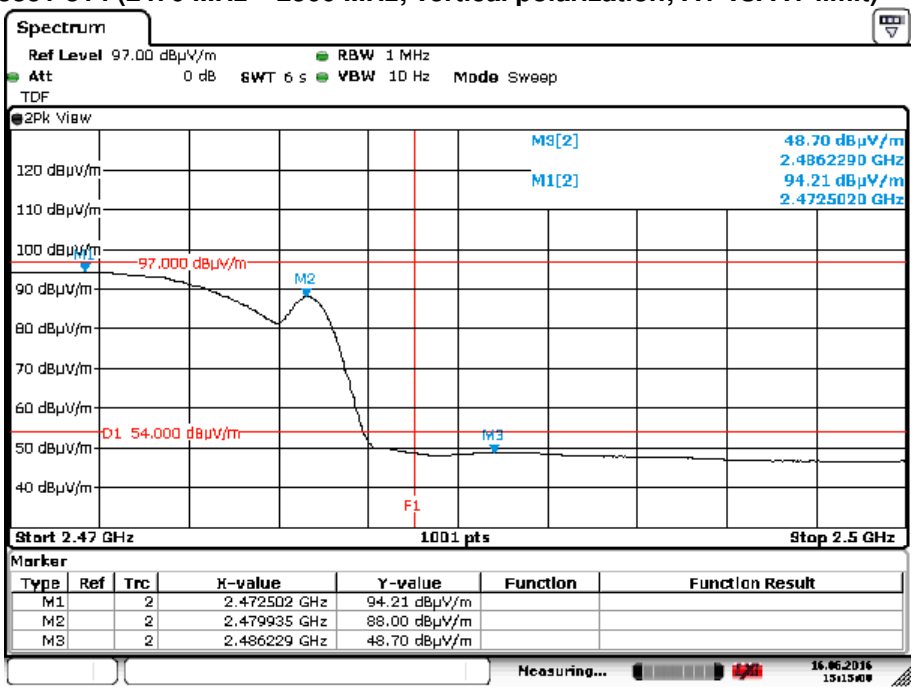
Diagram 303851-313 (2470 MHz – 2500 MHz; vertical polarization; PK vs. PK limit)



Date: 16.JUN.2016 15:11:24

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	Angle (deg)
2485.3	65.03	74.00	8.97	60

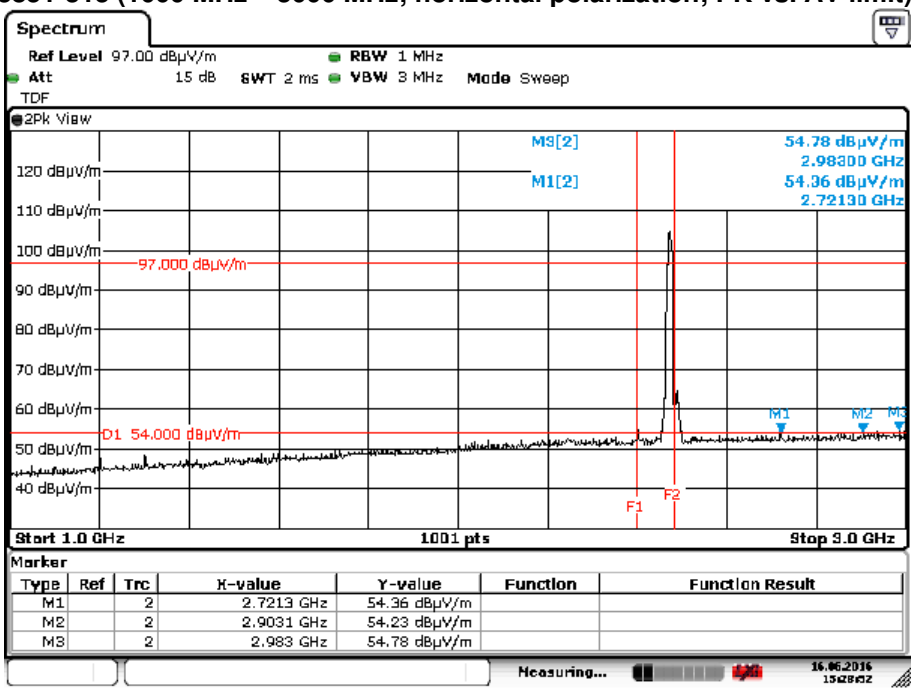
Diagram 303851-314 (2470 MHz – 2500 MHz; vertical polarization; AV vs. AV limit)



Date: 16.JUN.2016 15:15:00

Frequency (MHz)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2486.2	48.70	54.00	5.3	60

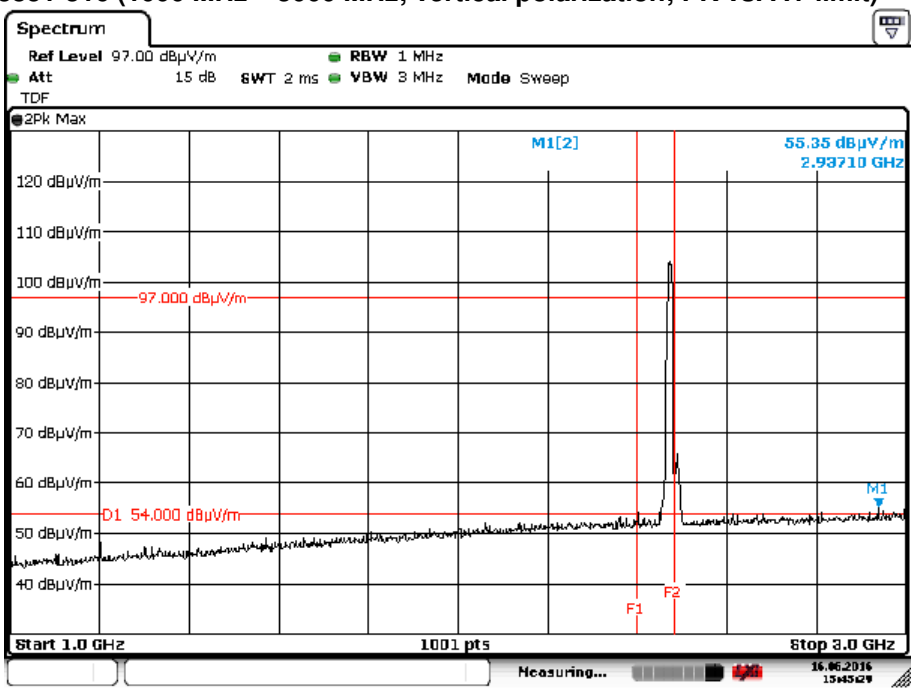
Diagram 303851-315 (1000 MHz – 3000 MHz; horizontal polarization; PK vs. AV limit)



Date: 16.JUN.2016 15:28:53

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2721.3	54.36	74.00	19.64	39.12	54.00	14.88	0
2903.1	54.23	74.00	19.77	39.58	54.00	14.42	0
2983.0	54.78	74.00	19.22	39.84	54.00	14.16	

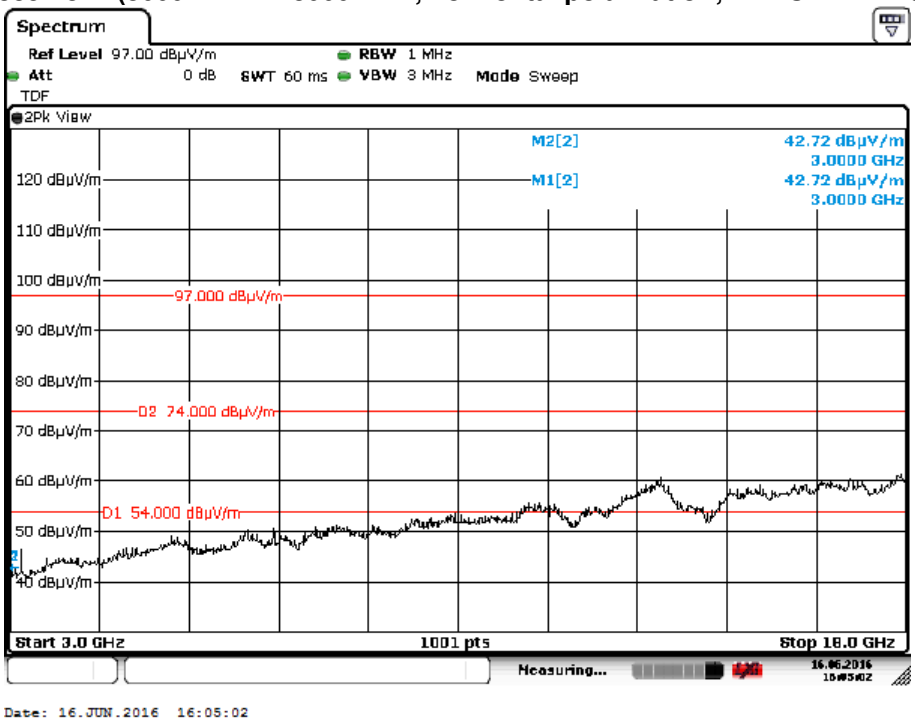
Diagram 303851-316 (1000 MHz – 3000 MHz; vertical polarization; PK vs. AV limit)



Date: 16.JUN.2016 15:45:29

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2937.1	55.35	74.00	18.65	39.29	54.00	14.71	0

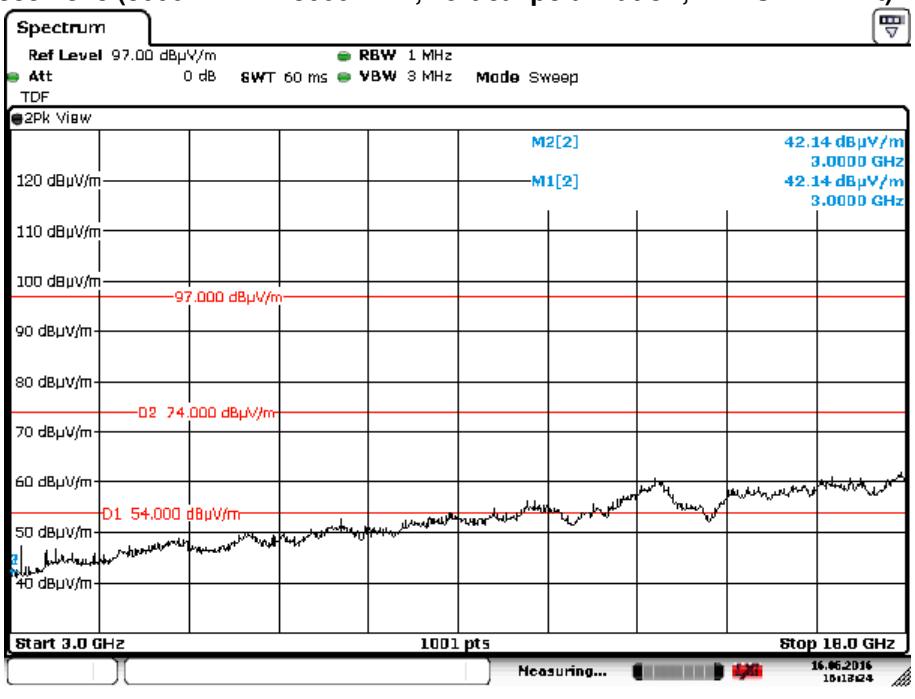
Diagram 303851-317 (3000 MHz – 18000 MHz; horizontal polarization; PK vs. AV limit)



Date: 16.JUN.2016 16:05:02

No relevant spurii outside 2.4 GHz ISM band.

Diagram 303851-318 (3000 MHz – 18000 MHz; vertical polarization; PK vs. AV limit)

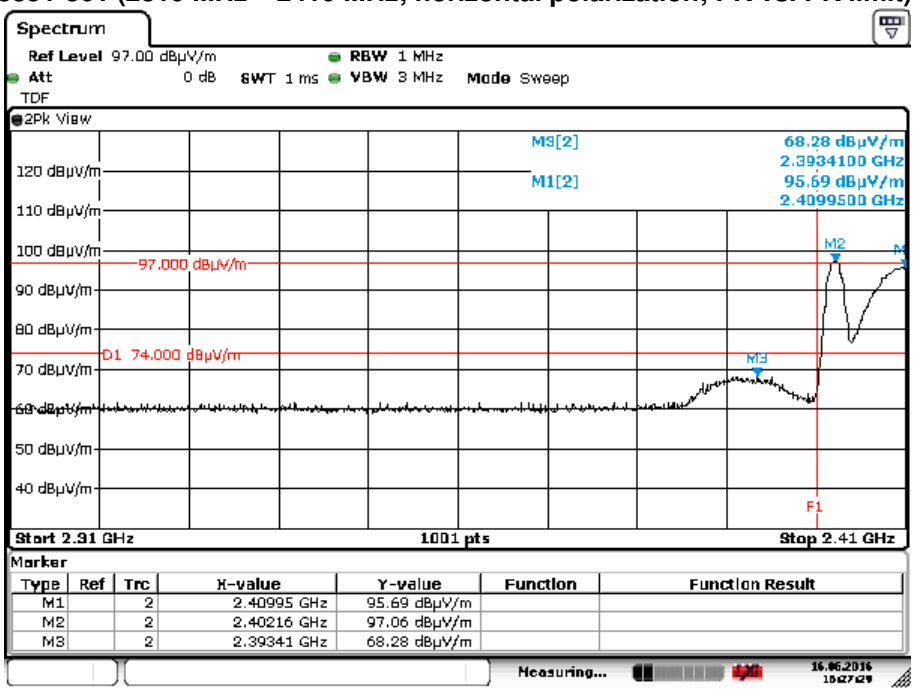


Date: 16.JUN.2016 16:13:25

No relevant spurii outside 2.4 GHz ISM band.

Measurement results for EuT transmitting on 2412 MHz (WiFi) and 2402 MHz (BT)

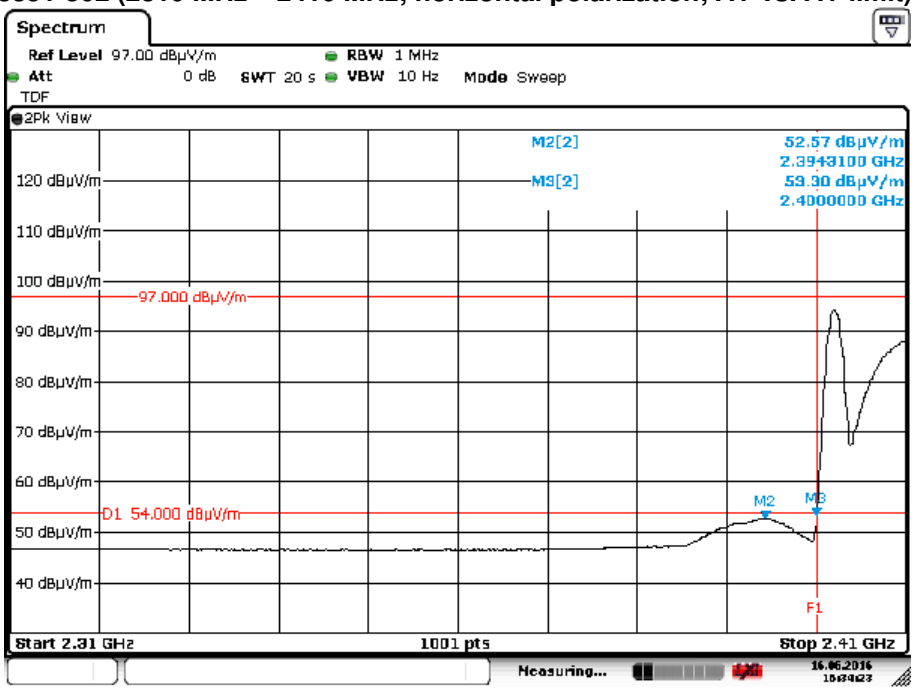
Diagram 303851-301 (2310 MHz – 2410 MHz; horizontal polarization; PK vs. PK limit)



Date: 16.JUN.2016 16:27:29

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	Angle (deg)
2393.4	68.28	74.00	5.72	115

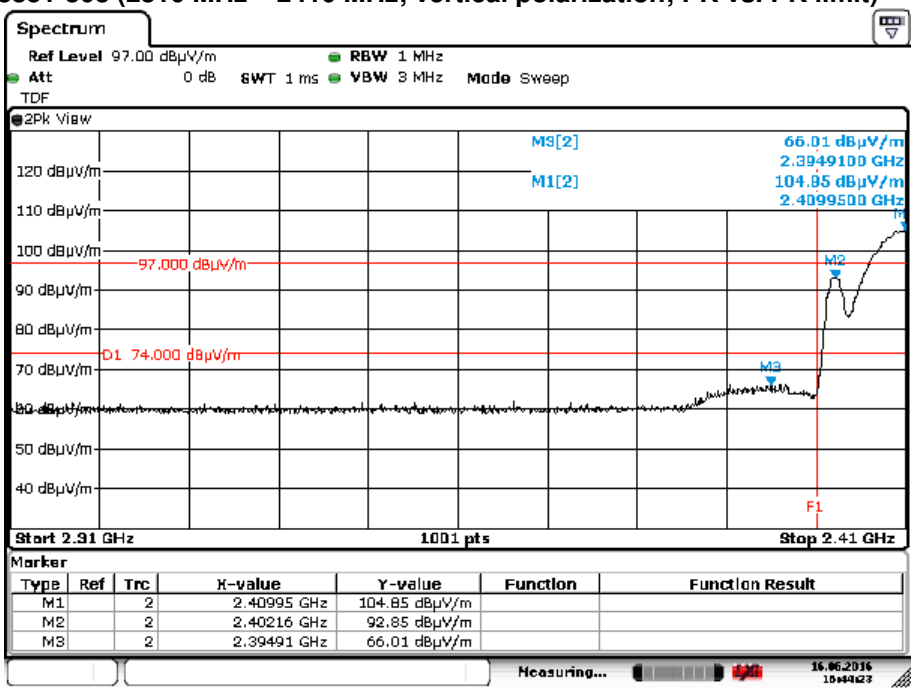
Diagram 303851-302 (2310 MHz – 2410 MHz; horizontal polarization; AV vs. AV limit)



Date: 16.JUN.2016 16:34:23

Frequency (MHz)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2394.3	52.57	54.00	1.43	115
2400.0	53.30	54.00	0.70	115

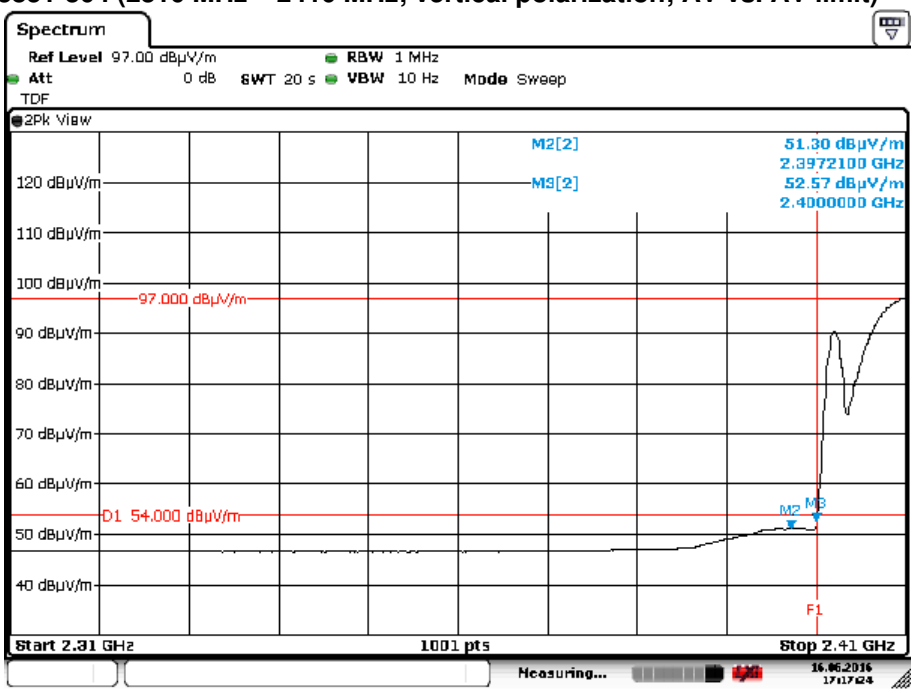
Diagram 303851-303 (2310 MHz – 2410 MHz; vertical polarization; PK vs. PK limit)



Date: 16.JUN.2016 16:44:22

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	Angle (deg)
2394.1	66.01	74.00	7.99	100

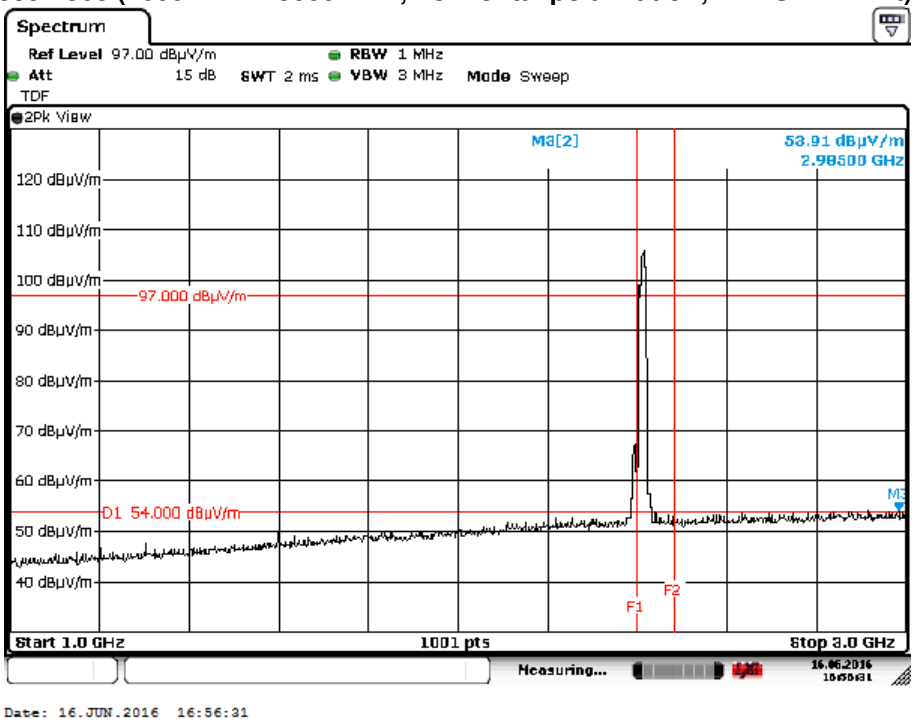
Diagram 303851-304 (2310 MHz – 2410 MHz; vertical polarization; AV vs. AV limit)



Date: 16.JUN.2016 17:17:24

Frequency (MHz)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2397.2	51.30	54.00	2.70	100
2400.0	52.57	54.00	1.43	100

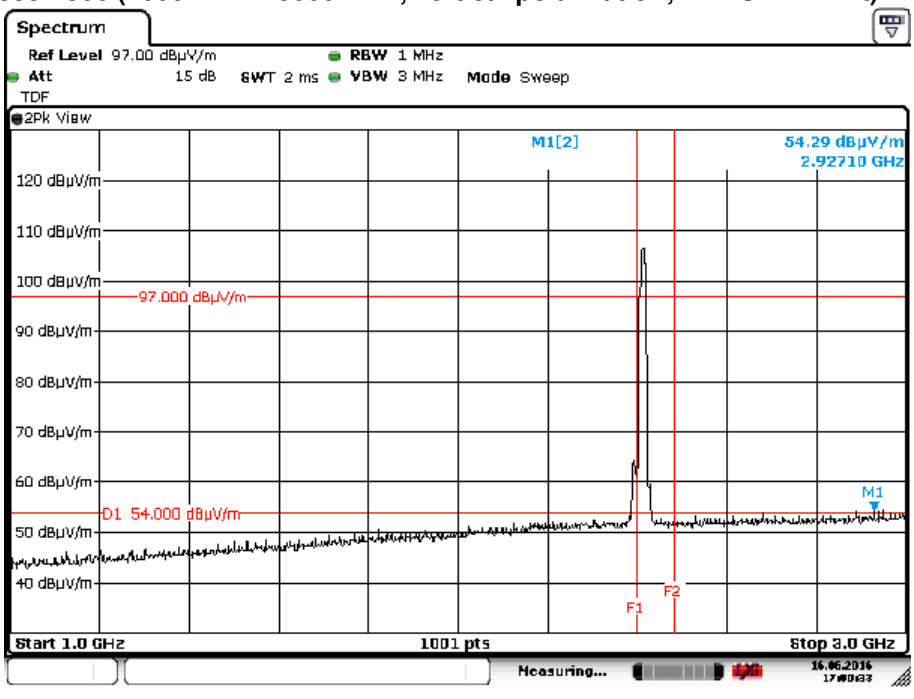
Diagram 303851-305 (1000 MHz – 3000 MHz; horizontal polarization; PK vs. AV limit)



Date: 16.JUN.2016 16:56:31

No relevant spurii outside 2.4 GHz ISM band.

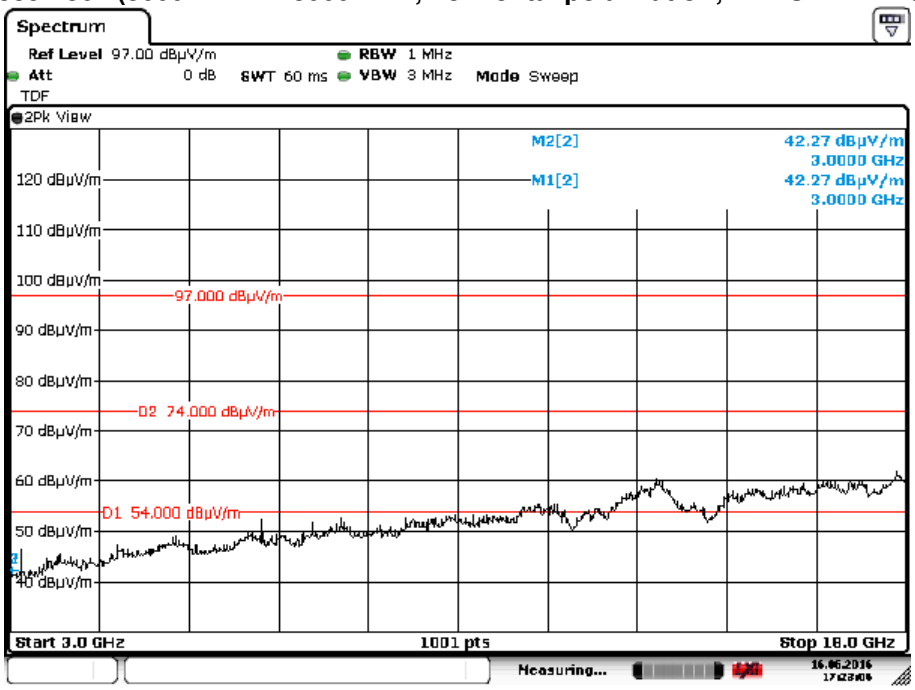
Diagram 303851-306 (1000 MHz – 3000 MHz; vertical polarization; PK vs. AV limit)



Date: 16.JUN.2016 17:00:32

Frequency (MHz)	PK level (dBµV/m)	PK limit (dBµV/m)	Margin (dB)	AV level (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	Angle (deg)
2927.1	54.29	74.00	19.71	39.29	54.00	14.71	0

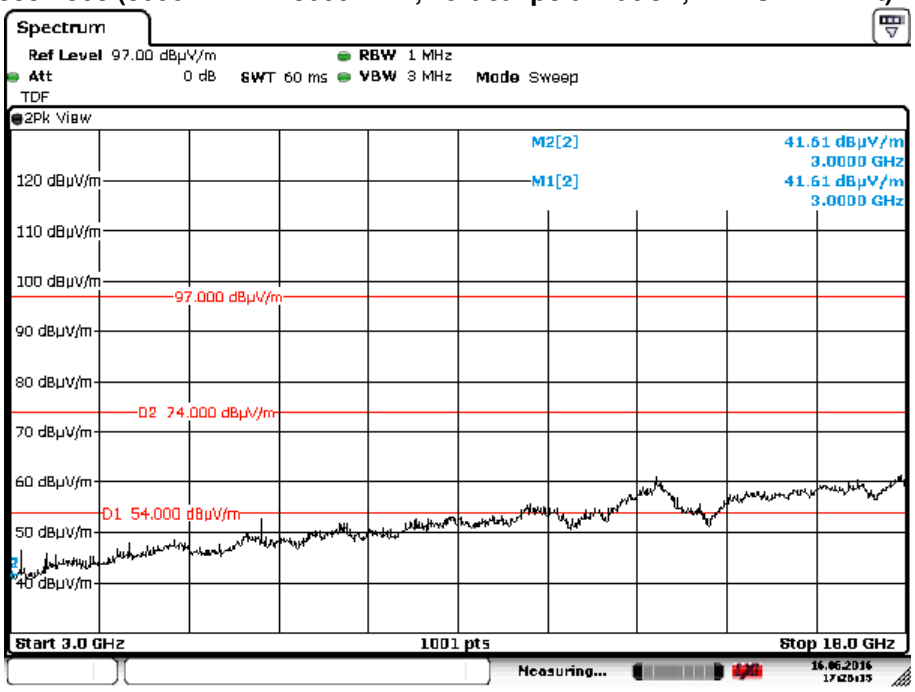
Diagram 303851-307 (3000 MHz – 18000 MHz; horizontal polarization; PK vs. AV limit)



Date: 16.JUN.2016 17:23:05

No relevant spurii outside 2.4 GHz ISM band.

Diagram 303851-308 (3000 MHz – 18000 MHz; vertical polarization; PK vs. AV limit)



Date: 16.JUN.2016 17:26:14

No relevant spurii outside 2.4 GHz ISM band.

4 Test equipment used

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the test house.

No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1	PSG 1000 B	RF signal generator	Farnell	1-0074	2015-07	2016-07
2	RG 213	Coaxial cable (gen. to PA)	-	1-0369	-	-
3	200W1000M7A	Power amplifier	Amplifier Research	1-0390	-	-
4	URV5	RF-Voltmeter	Rohde & Schwarz	1-0086	2015-08	2017-08
5	URV5-Z4	Probe for RF-Voltmeter	Rohde & Schwarz	1-0249	2015-08	2016-08
6	RG 213	Coaxial cable (PA to FAC)	Rohde & Schwarz	1-0371	-	-
7	RF 214-N/7	Antenna cable 2	Kabelwerk Eupen	1-0364	-	-
8	EM 6954	Log.-per. antenna	Electro-Metrics	1-0082	-	-
9	-	Semi anechoic chamber	R&M München	1-0361	2014-10	2017-10
10	EMC	Isotropic field sensor	Narda	1-0251	2014-06	2016-06
11	EMC	Field monitoring system	Narda	1-0252	2014-06	2016-06
12	RSUS	EMS Software	NeWeTec	1-0078	-	-
13	SML03	RF signal generator	Rohde & Schwarz	1-0250	2014-06	2017-06
14	ecoflex 10	Coaxial cable (gen. to PA)	SSB electronic	1-0370	-	-
15	30S1G3	Power amplifier	Amplifier Research	1-0254	-	-
16	ecoflex 15	Antenna cable (horn ant.)	SSB electronic	1-0368	-	-
17	BBHA 9120	Horn antenna	Schwarzbeck	1-0256	-	-
18	ESD 30000	ESD generator	Schlöder	1-0919	2015-12	2017-12
19	HCP	Horizontal coupling plane	Nemko	1-0201	-	-
20	VCP	Vertical coupling plane	Nemko	1-0202	-	-
21	STLP 9128D	Log.-per. antenna	Schwarzbeck	1-0626	-	-
22	EFT 500	BURST generator	EM-Test	1-0058	2015-07	2016-07
23	CNI 503	Coupling/Decoupling network	EM-Test	1-0059	2015-07	2016-07
24	-	EM-Test software	EM-Test	1-0060	-	-
25	HFK	Capacitive coupling clamp	EM-Test	1-0093	2015-07	2016-07
26	ALPHA 250/75 A	Power amplifier	ALPHA	1-0085	-	-
27	50 FH-006-100-N	Attenuator	JFW	1-0089	-	-
28	FCC-801-M2-16	M2 - CDN	FCC	1-0094	2015-07	2016-07
29	FCC-801-M3-16	M3 - CDN	FCC	1-0083	2015-07	2016-07
30	L-801 M5	M5 - CDN	Lüthi	1-0374	2015-07	2016-07
31	F-203I-23mm	EM-injection clamp	FCC	1-0196	2015-09	2016-09
32	CWG 1500	SURGE generator	Schlöder EMV-Systeme	1-0785	2015-07	2016-07
33	CWG 523	Coupling/Decoupling network	Schlöder EMV-Systeme	1-0784	2015-07	2016-07
34	EMV-Soft 8.0	Test software	Schlöder EMV-Systeme	1-0786	-	-
35	MegaPulse 10 x 700 - 7	SURGE generator	Compliance West	1-0654	2015-07	2016-07

No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
36	ESH3-Z5	Artificial mains network, 1ph	Rohde & Schwarz	1-0072	2015-08	2016-08
37	ESH2-Z5	Artificial mains network, 3ph	Rohde & Schwarz	1-0037	2015-08	2016-08
38	ESH3-Z2	Pulse limiter	Rohde & Schwarz	1-0054	2015-08	2016-08
39	RG 213	Coaxial cable (to chamber)	-	1-0362	-	-
40	ESHS 10	Measuring receiver	Rohde & Schwarz	1-0069	2015-09	2016-09
41	ES-K1	EMI-Software ES-K1	Rohde & Schwarz	1-0071	-	-
42	EZ-17	Current clamp	Rohde & Schwarz	1-0353	2014-10	2016-10
43	FG33X15	Absorber	Lüthi	1-0090	-	-
44	-	Shielded chamber	Euroshield	1-0359	-	-
45	HFH2-Z2	Loop antenna	Rohde & Schwarz	1-0039	2015-08	2016-08
46	FSV40	Signal analyzer	Rohde & Schwarz	1-0611	2015-08	2016-08
47	ESU8	EMI test receiver	Rohde & Schwarz	1-0604	2016-01	2017-01
48	1000SB	Climate chamber	Weiss Technik	1-0334	2015-07	2016-07
49	SyCore	Control unit	Spitzenberger + Spies	1-0506	-	-
50	PAS-10000	Power amplifier	Spitzenberger + Spies	1-0503	-	-
51	VULB 9163	Trilog antenna	Schwarzbeck	1-0200	2015-12	2018-12
52	STLP9148	Log.-per. antenna	Schwarzbeck	1-0614	2013-07-23	2016-07-22
53	BBV 9718	Pre amplifier	Schwarzbeck	1-0615	2015-07	2017-07
54	ARS 16/3	Analyzer reference system	Spitzenberger + Spies	1-0507	2015-09	2016-09
55	SF106	Antenna cable 3	Huber & Suhner	1-0620	2014-01	2017-01
56	SF106	Coaxial cable (to SAC)	Huber & Suhner	1-0619	2014-01	2017-01
57	SMP04	RF signal generator	Rohde & Schwarz	1-0729	2014-10	2017-10
58	DC7144M1	Directional coupler	Amplifier Research	1-0255	-	-
59	CDN-M1-321	Coupling / Decoupl. network	Nemko	1-0876	2015-07	2016-07
60	CDN-S-RJ45	Coupling / Decoupl. network	Nemko	1-0877	-	-
61	CDN-S-USB3.0	Coupling / Decoupl. network	Nemko	1-0878	-	-
62	CDN-S-BNC 50 Ω	Coupling / Decoupl. network	Nemko	1-0879	2015-07	2016-07
63	CDN-S-HDMI	Coupling / Decoupl. network	Nemko	1-0880	-	-
64	6.2.4	Coupling adapter	Nemko	1-0881	-	-
65	CDN-AF-8	Coupling / Decoupl. network	Nemko	1-0882	-	-
66	CH 340	Climate chamber	Angelantoni	1-0538	2015-07	2016-07
67	VHF-740+	High pass filter	Mini-circuits	1-0791	2015-11	2018-11
68	VHF-1320+	High pass filter	Mini-circuits	1-0789	2015-11	2018-11
69	VHF-3100+	High pass filter	Mini-circuits	1-0790	2015-11	2018-11
70	50DR-125 SMA	Step attenuator	JFW	1-0795	2015-09	2018-09
71	ZFRSC-42-S+	Power splitter 6 dB	Mini-circuits	1-0792	2015-11	2018-11
72	CDN-S-RS232	Coupling / Decoupl. network	Nemko	1-0912	-	-
73	-	Connection cable, 1 m, SMA	-	1-0923	2015-11	2018-11
74	-	Connection cable, 1 m, SMA	-	1-0924	2015-11	2018-11
75	-	Connection cable, 1 m, SMA	-	1-0925	2015-11	2018-11
76	-	Connection cable, 1 m, SMA	-	1-0926	2015-11	2018-11
77	-	Connection cable, 1 m, SMA	-	1-0927	2015-11	2018-11

5 Photos of the EuT

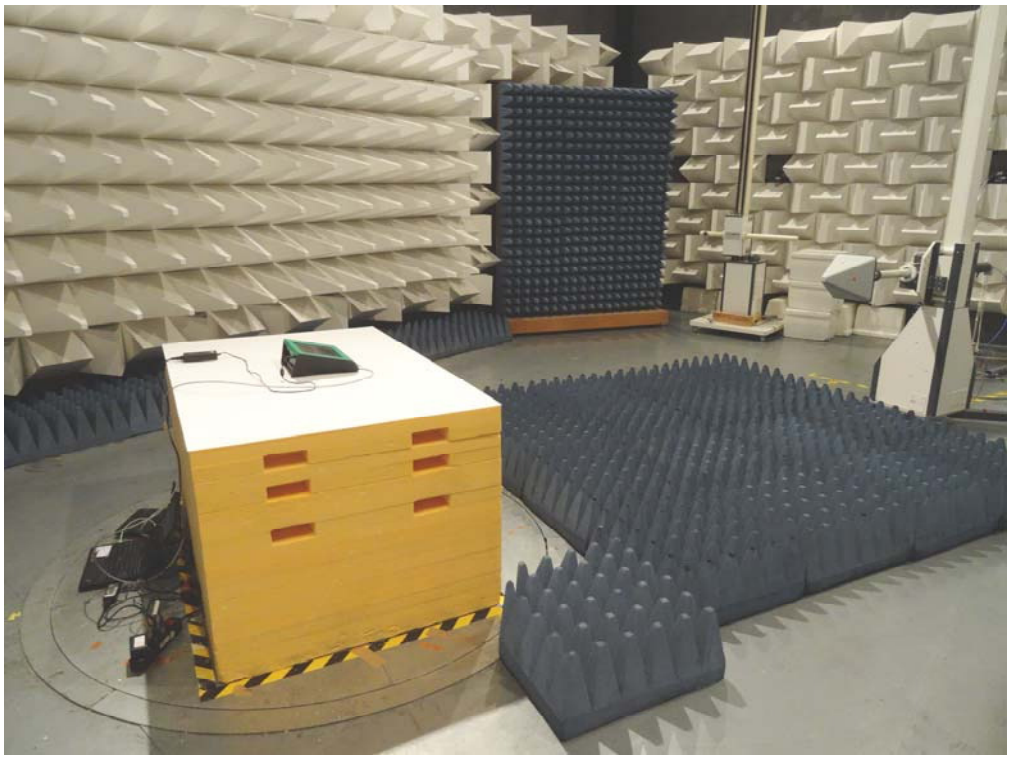


Figure 1 EUT / test set up - spurious radiated emissions

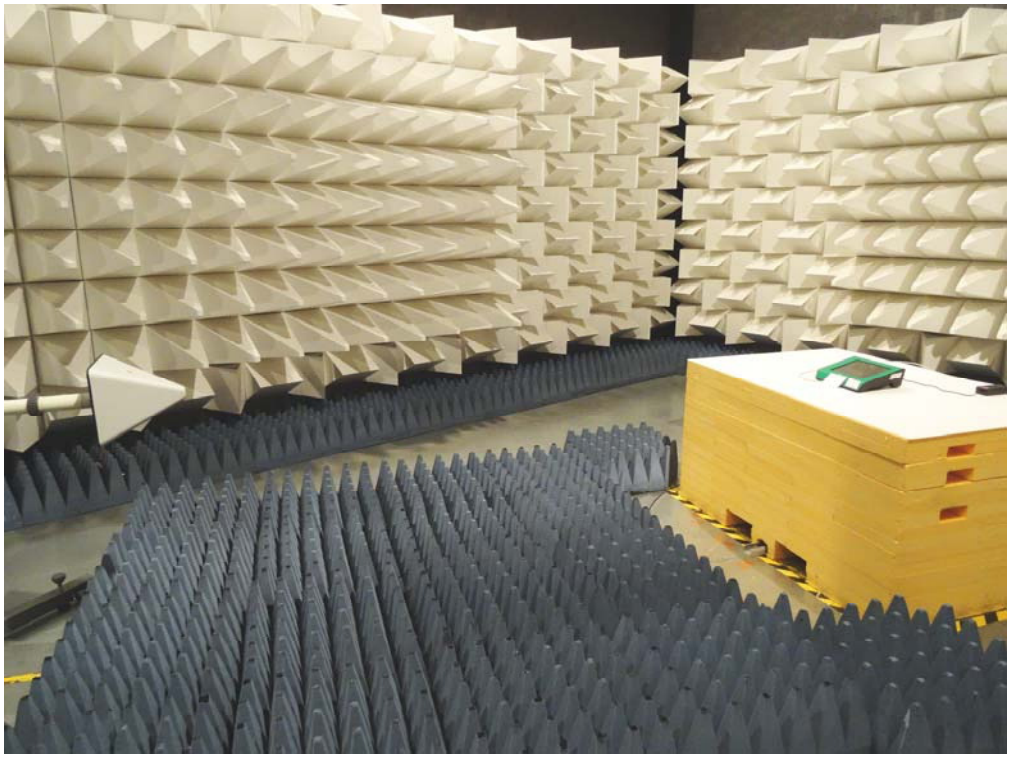


Figure 2 EUT / test set up - spurious radiated emissions

Figure 3 EUT / type label

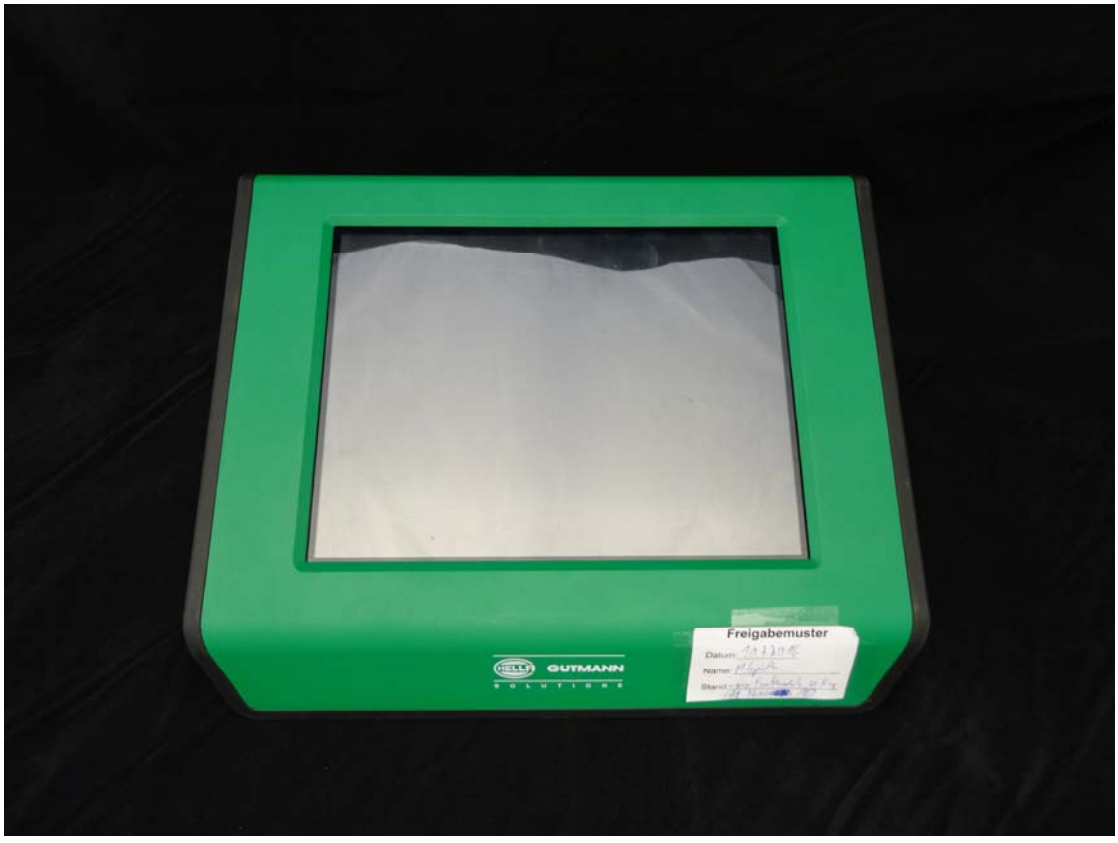


Figure 4 EUT / front view

Figure 5 EUT / bottom view

Figure 6 EUT / rear view