Report No. 324520-1

Test Report

Product	USB Dongle with dual RF Transceivers
Name and address of the applicant	Grundfos Management A/S Poul Due Jensens Vej 7 DK-8850 Bjerringbro, Denmark
Name and address of the manufacturer	Same as above
Model	MI301M01
Rating	3.7V DC (Li-Ion Battery)
Trademark	Grundfos
Serial number	98046398
Additional information	Zigbee (802.15.4), Bluetooth
Tested according to	**FCC Part 15.247** Frequency Hopping Transmitters / Digital Transmission Systems **Industry Canada RSS-247, Issue 2** Low Power Licence-Exempt Radiocommunications Devices
Order number	324520
Tested in period	2017.02.09 to 2017.02.13
Issue date	2017.03.29
Name and address of the testing laboratory	Nemko Instituttveien 6 Kjeller, Norway FCC No: 994405 IC OATS: 2040D-1 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50

Prepared by [Frode Sveinsen]	Approved by [G.Suhanthakumar]

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ENTERPRISE NUMBER NO974404532

CONTENTS

1 INFORMATION

1.1 Test Item

Name :	R10000 Universal Dongle
FCC ID :	OG3MI301M01
Industry Canada ID :	10447A-MI301M01
Model/version :	MI301M01
Serial number :	98046398
Hardware identity and/or version:	Rev 5.00
Software identity and/or version :	V2.3.0
Frequency Range :	2405 – 2480 MHz
Number of Channels :	16
Type of Modulation :	DSSS (O-QPSK)
Rated Output Power :	0.00043
Type of Power Supply :	3.7 VDC/ 560 mAh from a Lithium ion battery pack (rechargeable from USB port)
Antenna Connector :	Integrated chip antenna
Antenna Diversity Supported :	No
Charger :	Micro USB connector

Description of Test Item

The MI301M01 is a dual RF transceiver with a separate 2.4 GHz radio module per IEEE 802.15.4 with O-QPSK modulation (DSSS) and a Bluetooth module.

This test report does not cover the BT module (FCC ID: X3ZBTMOD5; IC: 8828A-MOD4).

The client supports the test pc model IBM ThinkPad (# L-no. 695) with Docklight test program for operate the EUT to enter the test mode and so on.

1.2 Normal test condition

Temperature:	20.1 – 22.3 °C
Relative humidity:	30 – 39 %
Normal test voltage:	3.7 V DC

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen
Jan G. Eriksen

1.4 Description of modification for Modification Filing

Not applicable.

1.5 Family List Rational

Not Applicable.

1.6 Antenna Requirement

Is the antenna detachable?	☐ Yes	☒ No
If detachable, is the antenna connector non-standard?	☐ Yes	☐ No

Type of antenna connector: N/A

Ref. FCC §15.203

1.7 Worst-Case Configuration and Mode

Radiated Emissions and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario.

1.8 Comments

All measurements were done with the EUT powered by a fully charged battery and connected to the computer by USB.

All ports were populated during spurious emission measurements.

This test report covers only Radiated Spurious Emissions; these tests have been retested due to change of chip antenna for the Zigbee transceiver in the dongle.

2 TEST REPORT SUMMARY

2.1 General

All measurements are tracable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2.

Tests were performed in accordance with ANSI C63.4-2014 and and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with the FCC and Industry Canada.

☐ New Submission
☒ Class II Permissive Change
DTS Equipment Code

☒ Production Unit
☐ Pre-production Unit
☐ Family Listing

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in “Summary of Test Data”.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 4 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Antenna Requirement	15.203	8.3 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	8.8 (RSS-GEN)	N/A
Occupied Bandwidth	N/A	6.6 (RSS-GEN)	N/A
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	N/A
Peak Power Output	15.247(b)	5.4 (RSS-247)	N/A
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	N/A
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	N/A
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

This test report covers only Radiated Spurious Emissions. All other tests are covered by the original test report (Nemko test report no: 208688-4).

3 TEST RESULTS

3.1 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 4 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 4, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		**0.96-1.24** **1.3-1.427**	**0.96-1.427**
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	**2.4835-2.5**	
6.215-6.218		**2.69-2.9**	**2.655-2.9**
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		**3.6-4.4**	**3.5-4.4**
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 **123-138**	**108-138**	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.

3.2 Spurious Emissions (Radiated)

FCC Part 15.247

Test Results: Complies

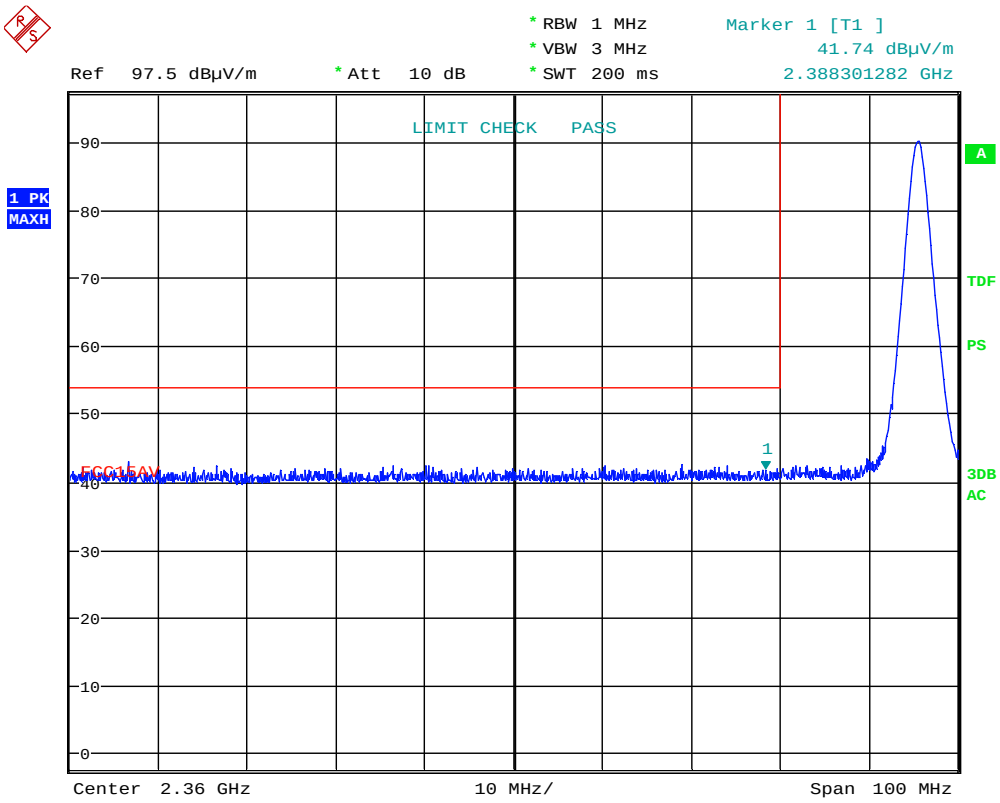
Measurement Data:

Band-edge conducted power

	Measured field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dBµV/m	dB	
Peak Detector	41.7	55.3	74	32.3	18.7
Average Detector	41.7	51.2	54	12.3	2.8

All measurements are performed with the EUt transmitting with 100% duty cycle.

See attached plots.



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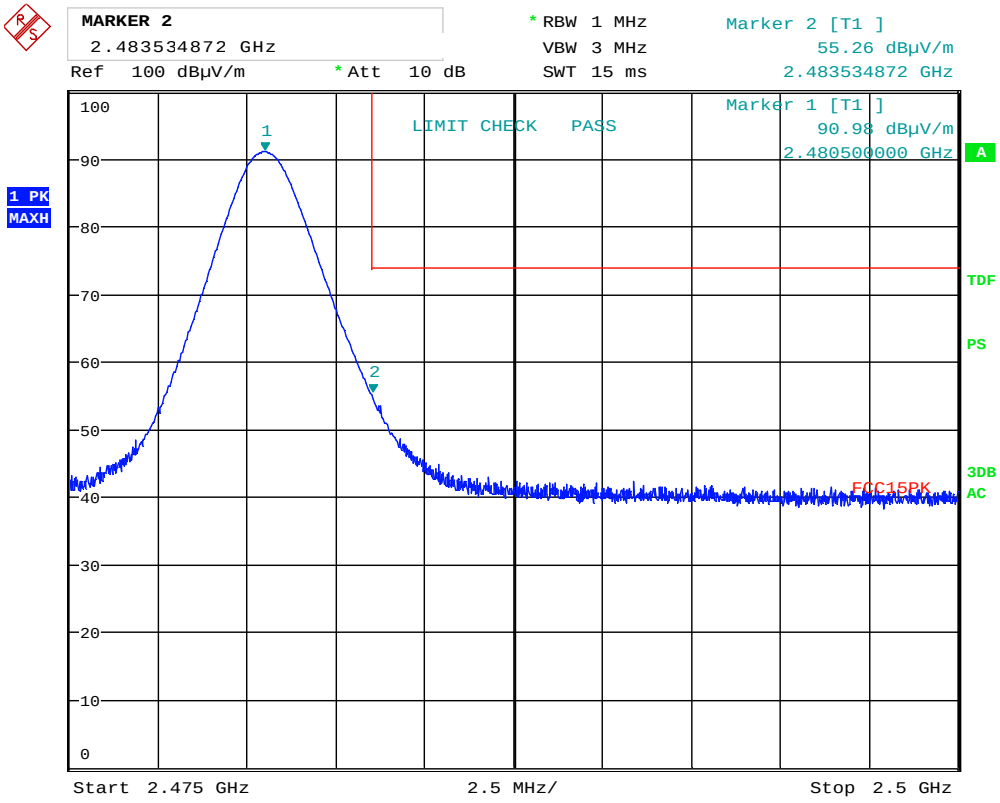
Lower Band Edge, 2405MHz, Peak (Max: EUT H1, VP)



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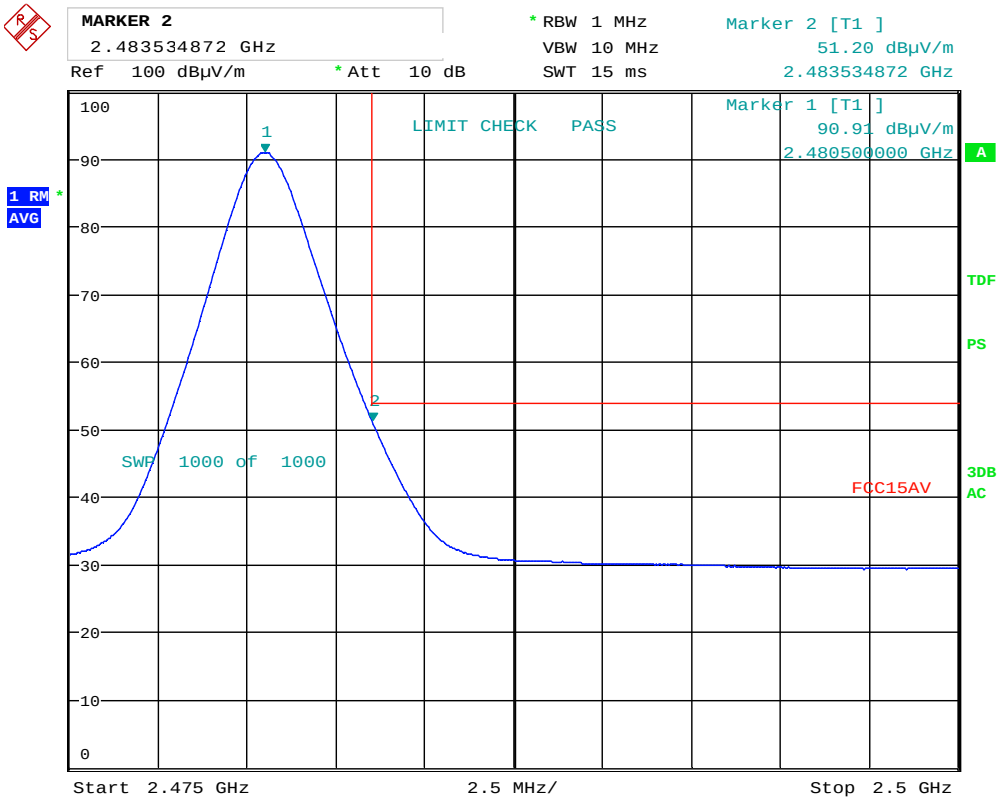
Upper Band Edge, 2480MHz, Peak (Max: EUT H1, VP)



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Upper Band Edge, 2480MHz, Average (Max: EUT H1, VP)

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 3m.

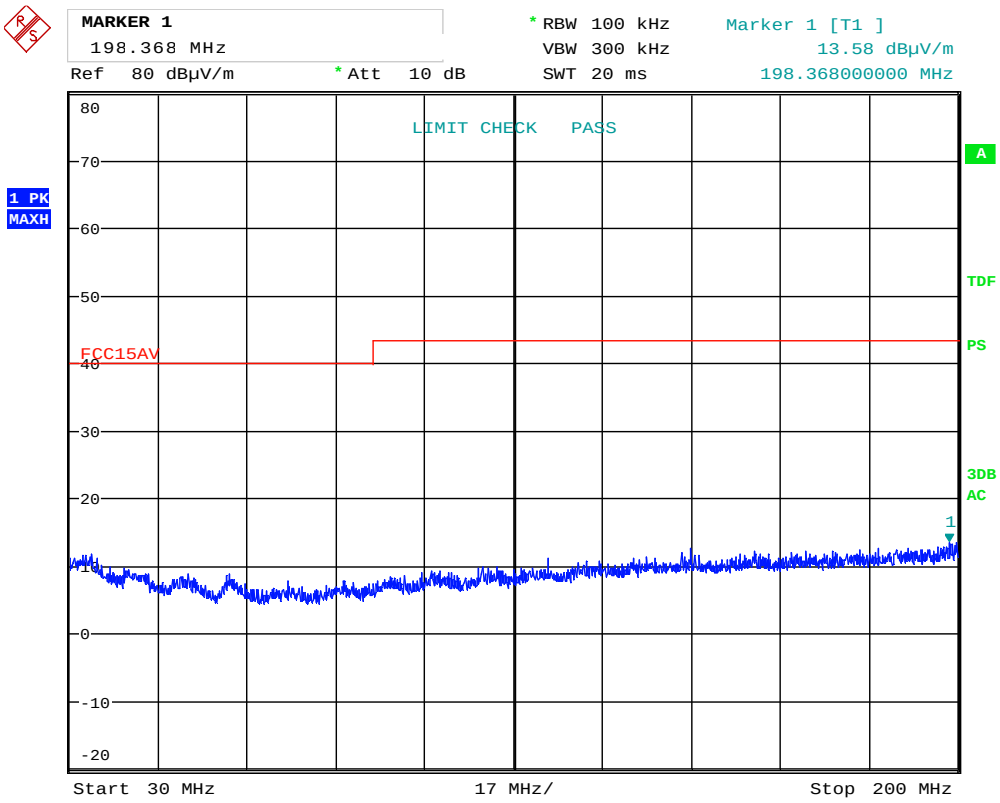
EUT was in test mode transmitting on 2440 MHz for this test.

No emissions were detected.

See attached graphs.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 4, Clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency (MHz)	**Quasi Peak (µV/m)**	**Quasi Peak (dBµV/m)**
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0



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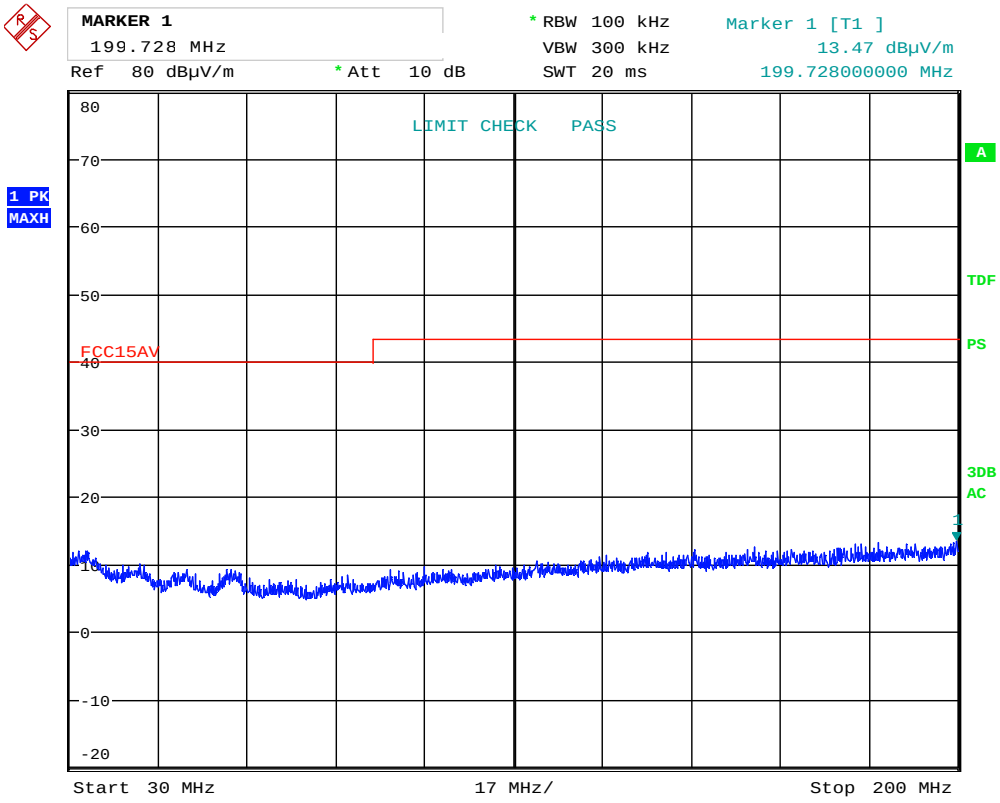
Radiated Emissions, 30 -200MHz, HP



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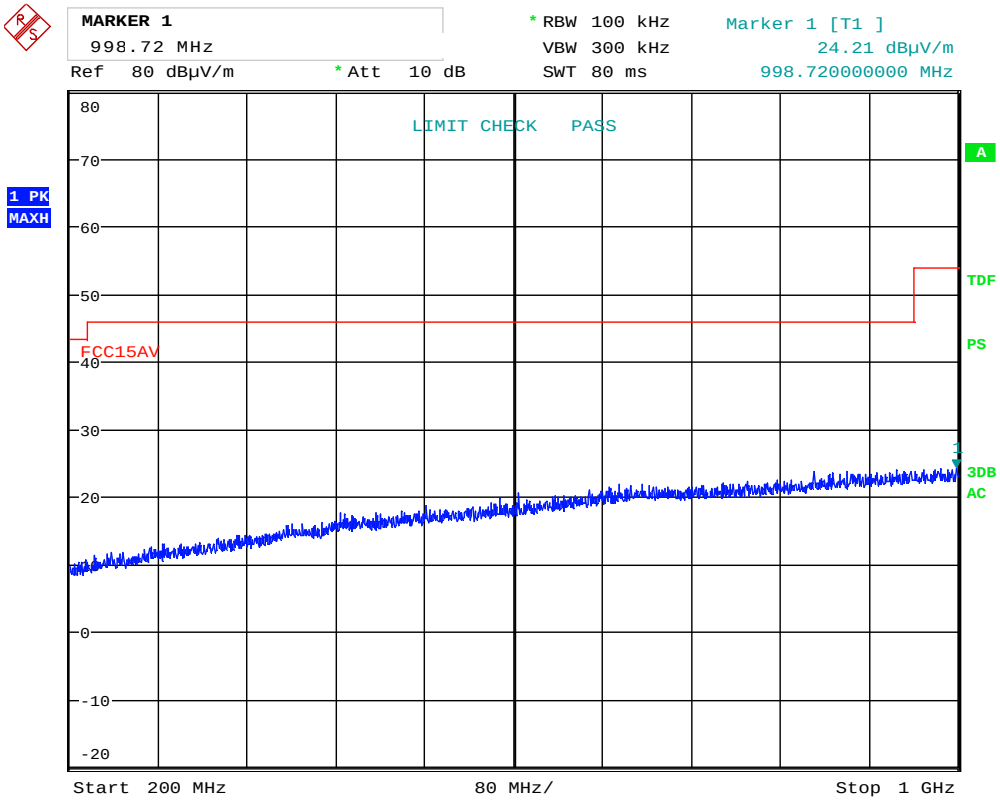
Radiated Emissions, 30 -200MHz, VP



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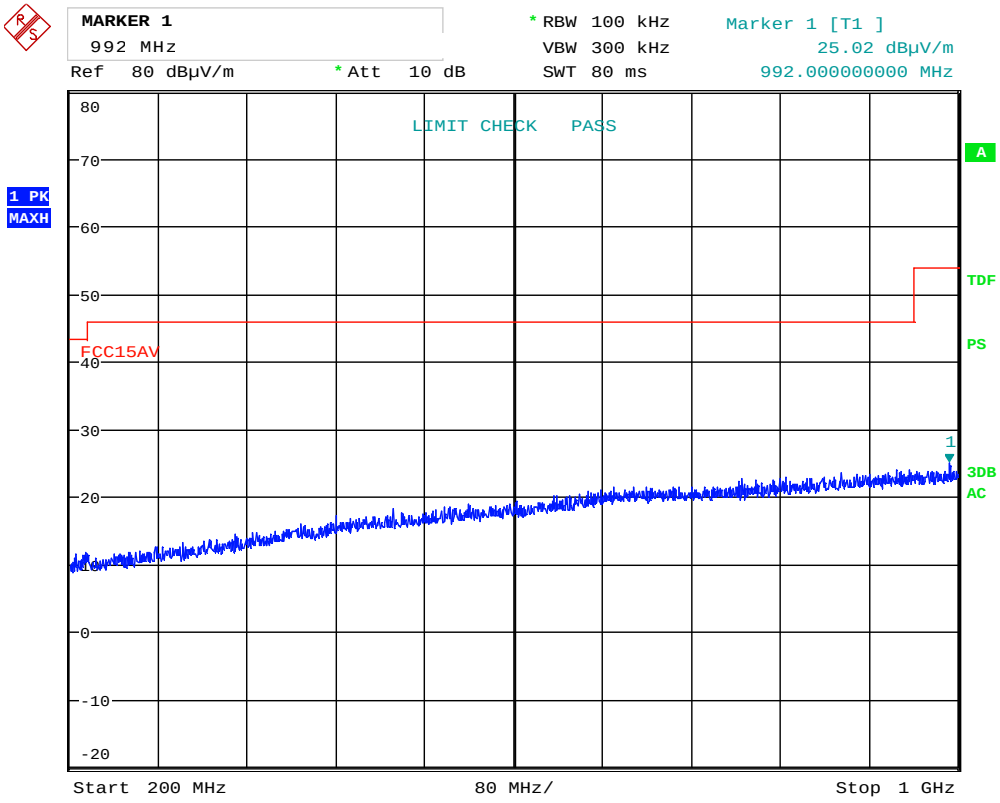
Radiated Emissions, 200 -1000MHz, HP



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Radiated Emissions, 200 -1000MHz, VP

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 8.5 GHz)
1m (8.0 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
MHz	L,M,H	dB	dBµV/m	dB	dBµV/m	dB
4880	M	0	47.3	20	74 / 54	26.7 / 6.7
12200	M	9.5	43.8	20	74 / 54	30.2 / 10.2
Other freqs	L,M,H	0	None detected	20	74 / 54	/

All emissions are below the Average Limit, even when using Peak detector.

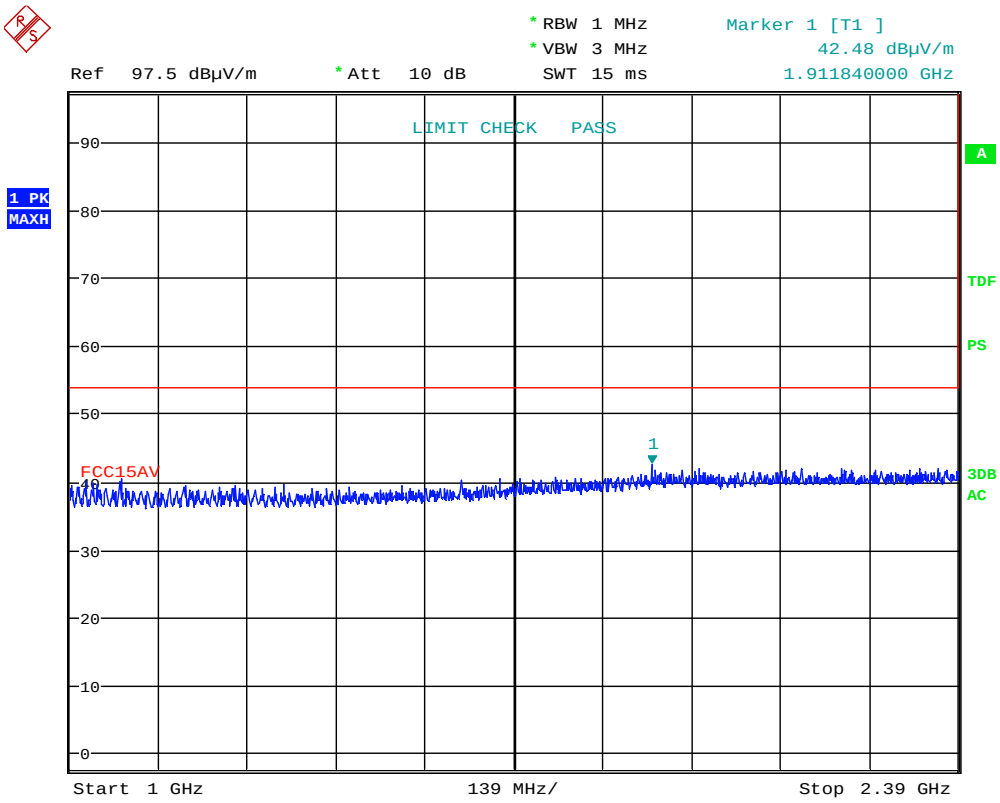
Average Detector values are calculated from Peak values by Duty Cycle Correction Factor.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer “Transducer factor”.

See plots.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 4, Clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency (MHz)	**AV (dBµV/m)**	**Peak (dBµV/m)**
Above 1 GHz	54.0	74.0



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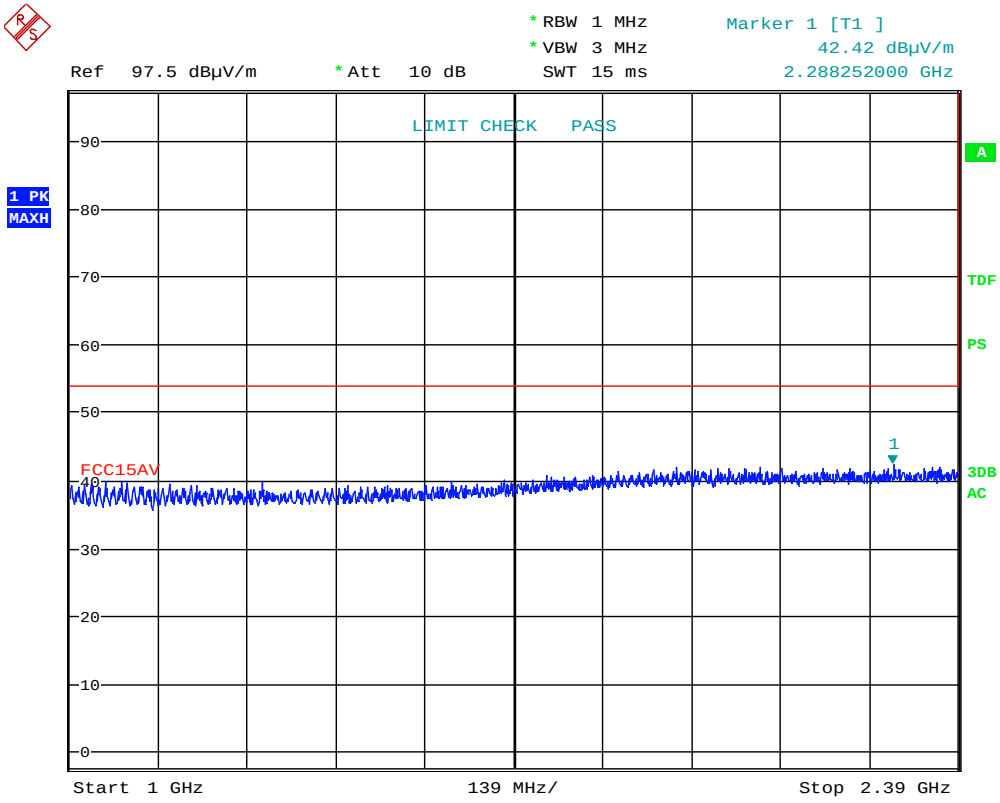
Radiated Emissions, 1000 -2390MHz, 2405 MHz, HP



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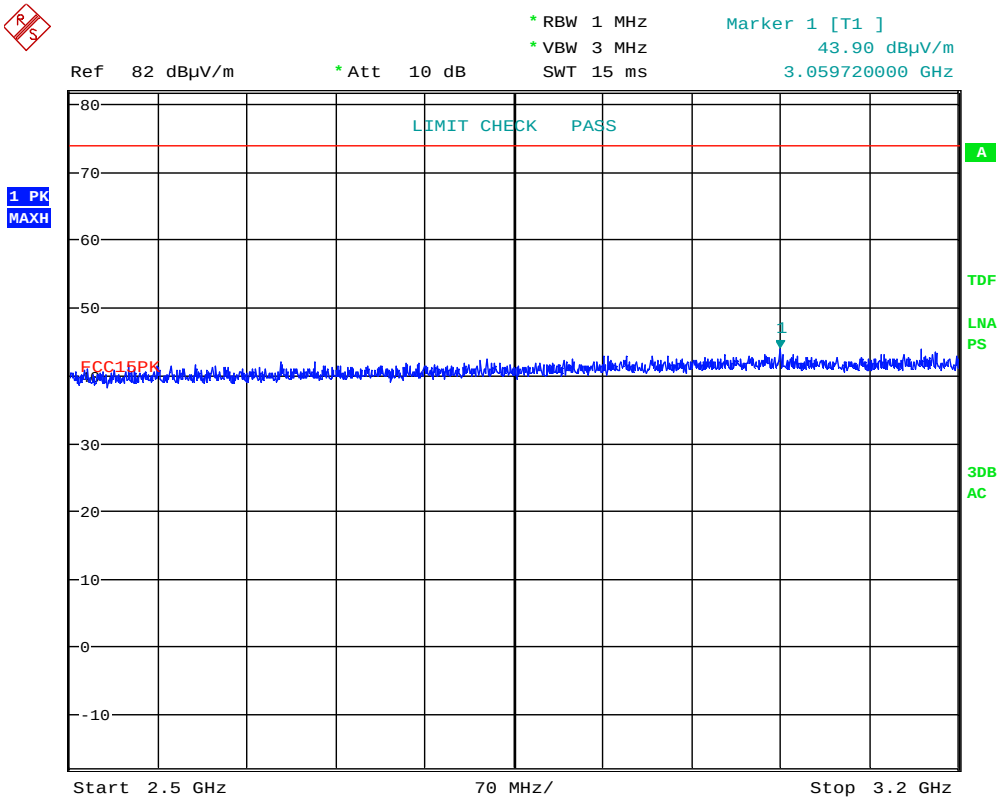
Radiated Emissions, 1000 -2390MHz, 2405 MHz, VP



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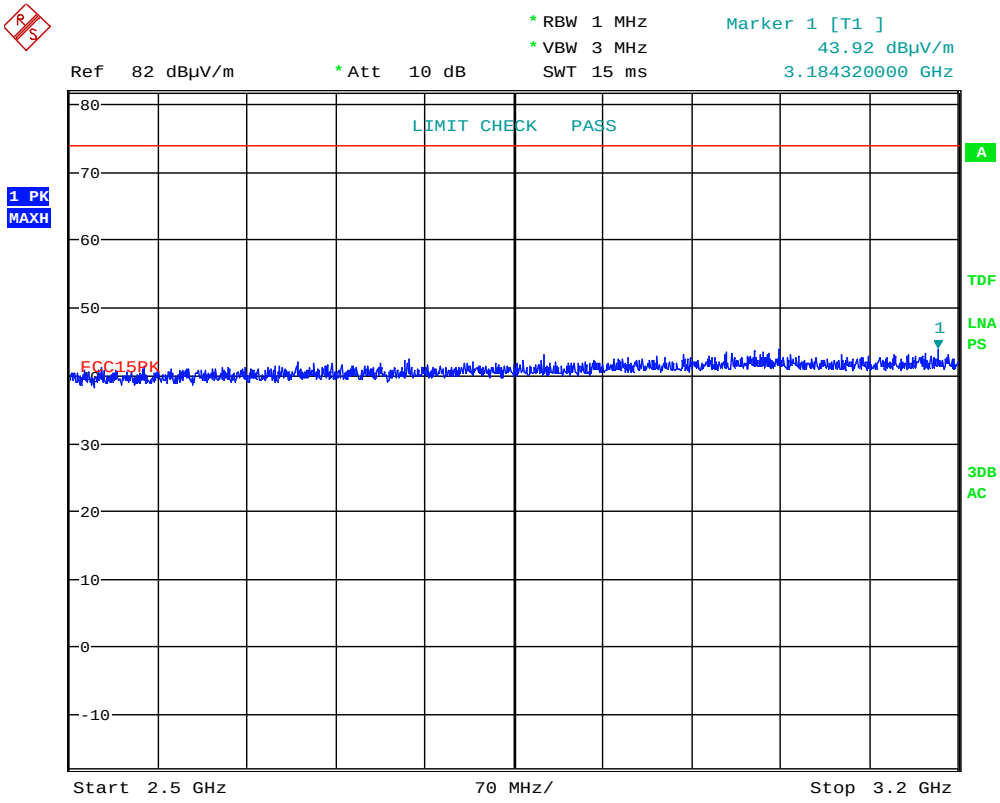
Radiated Emissions, 2500 -3200MHz, 2480 MHz, HP



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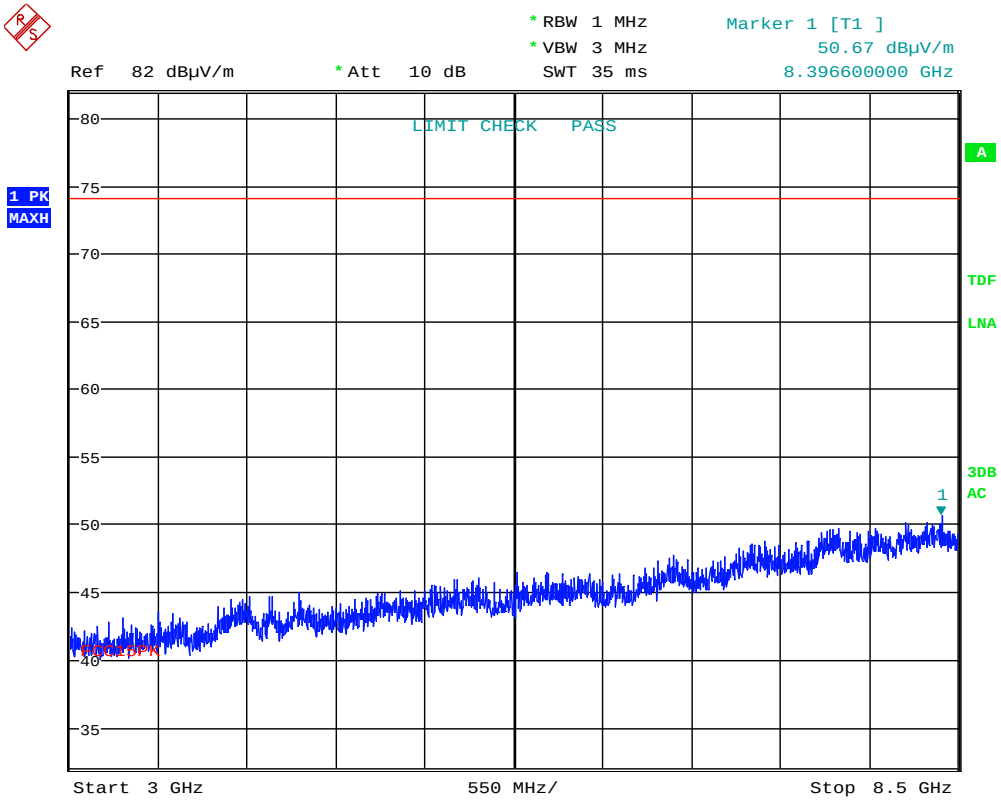
Radiated Emissions, 2500 -3200MHz, 2480 MHz, VP



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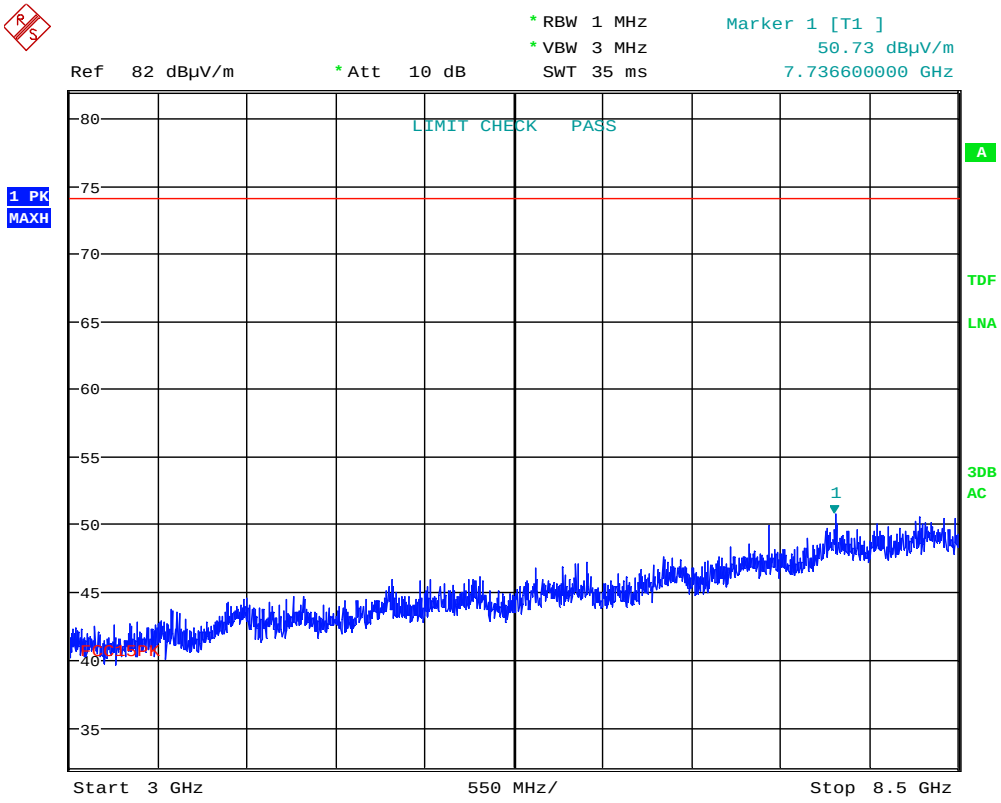
Radiated Emissions, 3000 -8500MHz, 2440 MHz, HP



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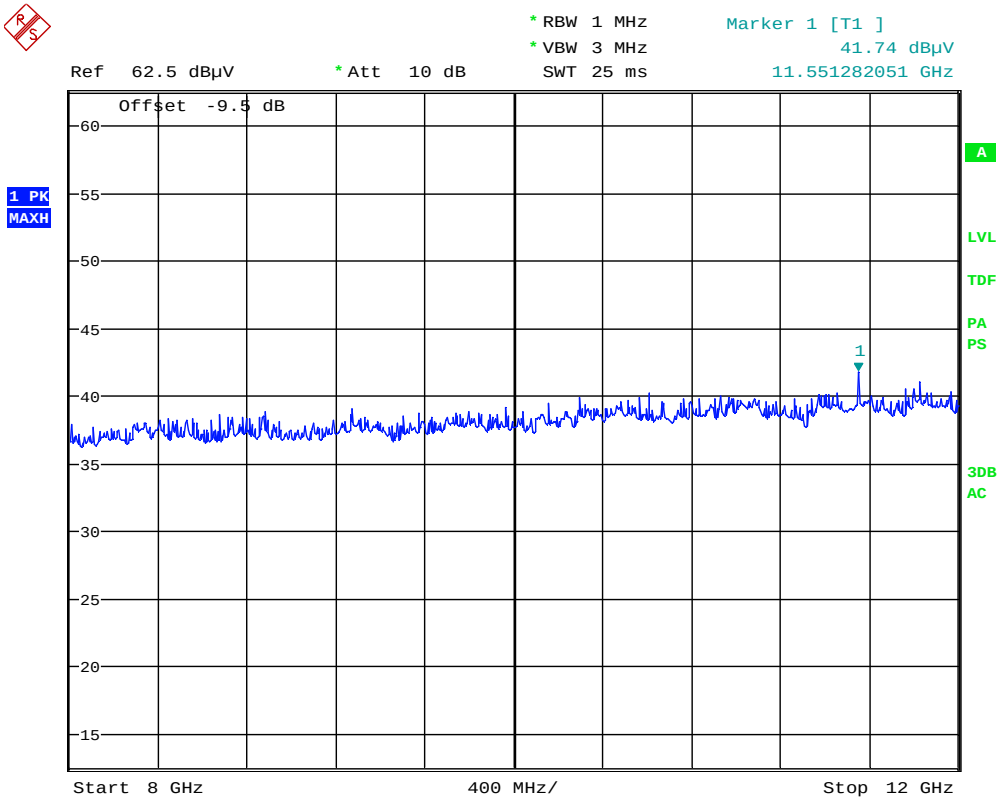
Radiated Emissions, 3000 -8500MHz, 2440 MHz, VP



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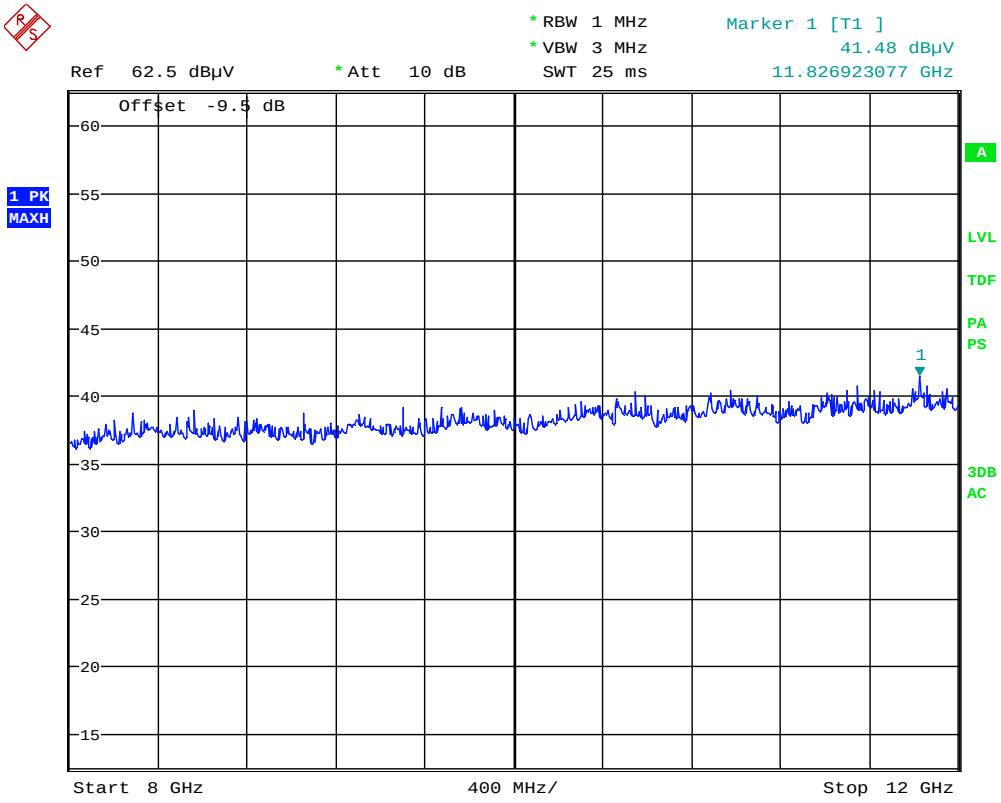
Radiated Emissions, 8000 -12000MHz, 2440 MHz, HP



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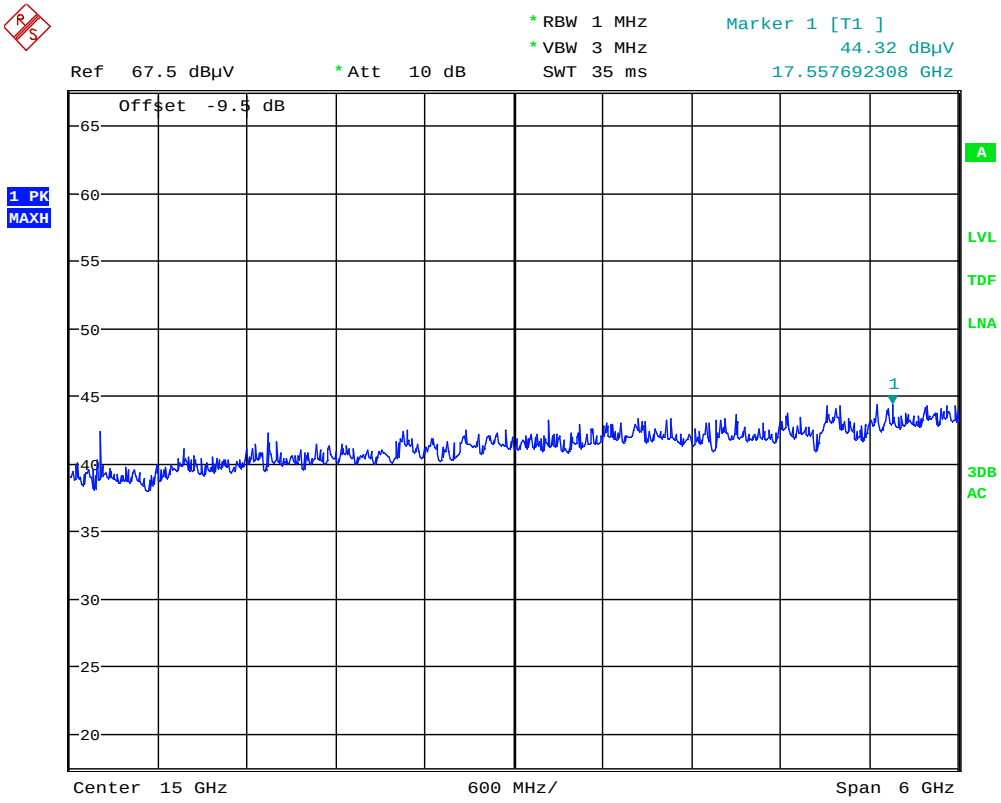
Radiated Emissions, 8000 -12000MHz, 2440 MHz, VP



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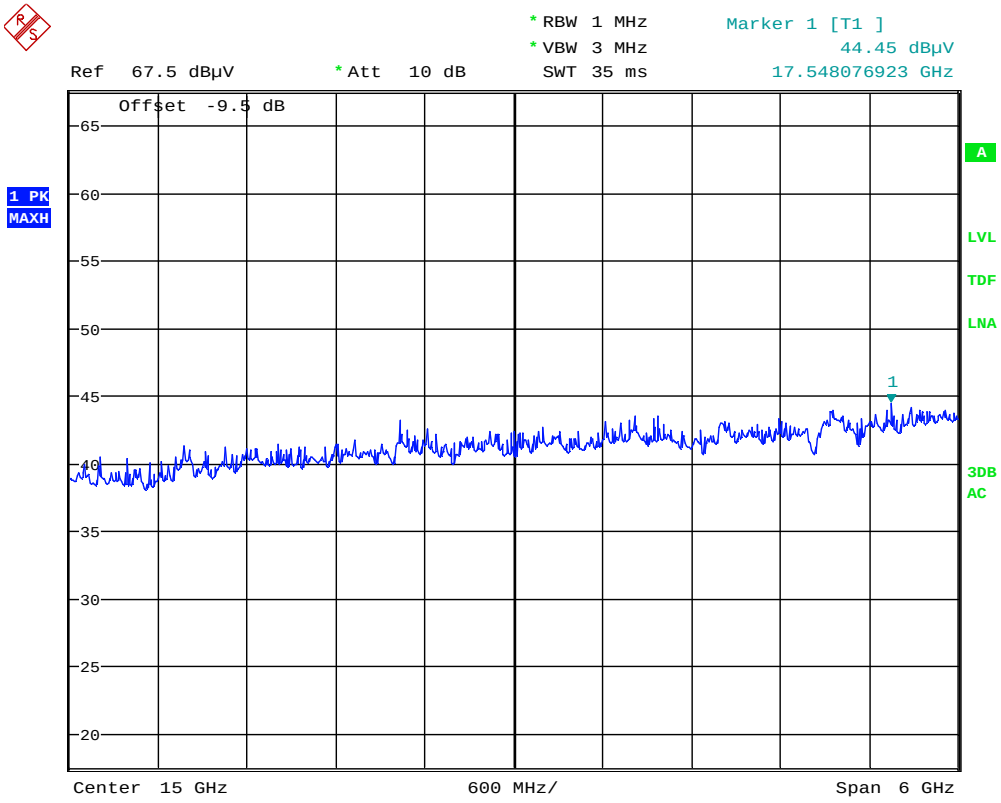
Radiated Emissions, 12000 -18000MHz, 2440 MHz, HP



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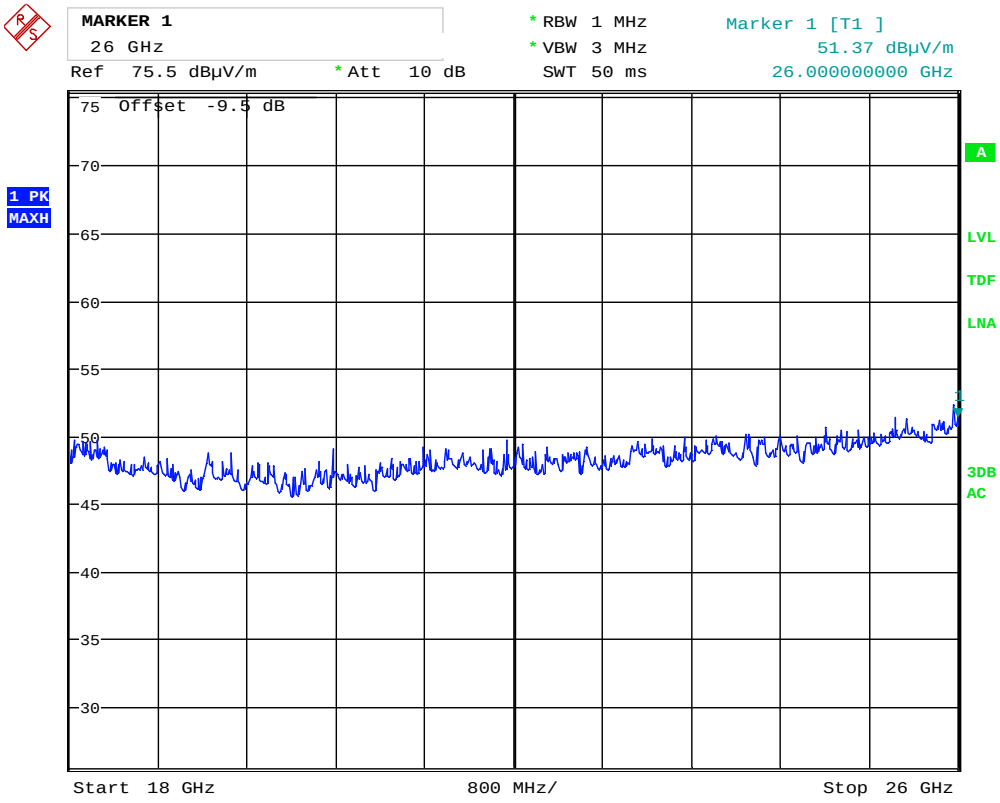
Radiated Emissions, 12000 -18000MHz, 2440 MHz, VP



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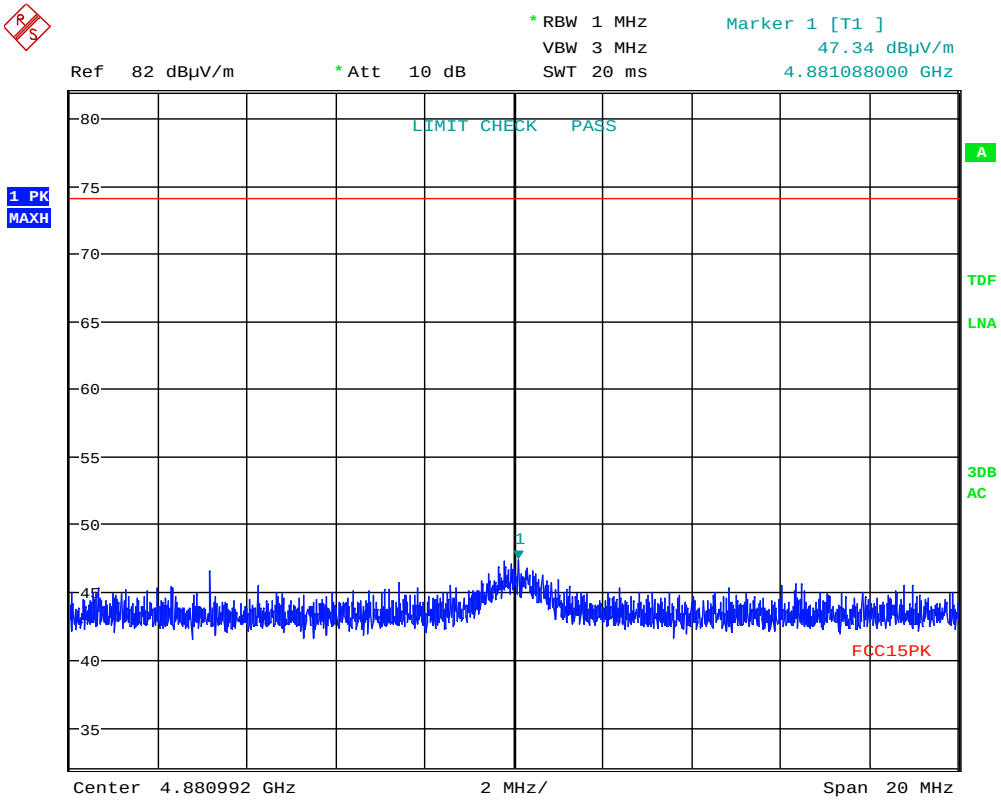
Pre-scan, 18000 -26000MHz, 2440 MHz, 10cm



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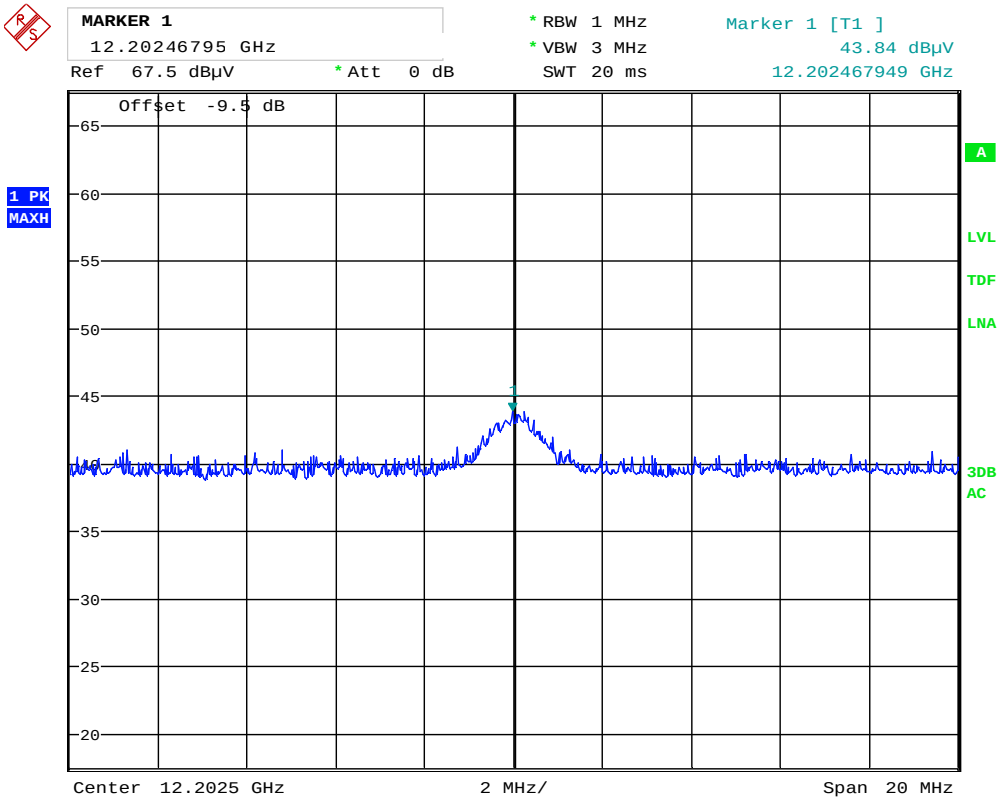
Radiated Emissions, 4880MHz, 2440 MHz, (Max: EUT H1, VP)



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Radiated Emissions, 12200MHz, 2440 MHz, (Max: EUT V, VP)

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		**Uncertainty**
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	**< 3.6 GHz**	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	**< 1 GHz**	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	**Frequency**	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

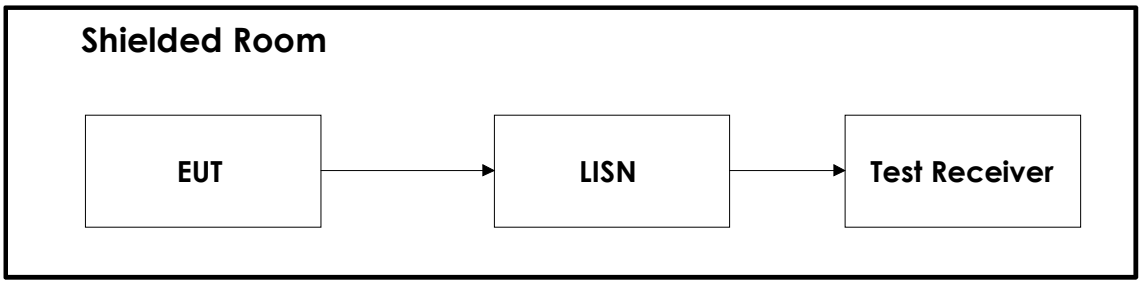
To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2016.12	2017.12
2	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
3	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2018.12
4	HL223	LogPeriod Antenna	Rohde & Schwarz	LR 1261	2013.12	2018.12
5	317	Preamplifier	Sonoma Instrument	LR 1687	2016.05	2017.05
6	3115	Horn Antenna	EMCO	LR 1330	2016.10	2021.10
7	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2016.10	2017.10
8	PM7320X	Antenna Horn	Sivers Lab	LR 102	2009.01	2019.01
9	DBF-520-20	Antenna Horn	Systron Donner	LR 100	2009.01	2019.01
10	638	Antenna Horn	Narda	LR 1480	2010.06	2020.06

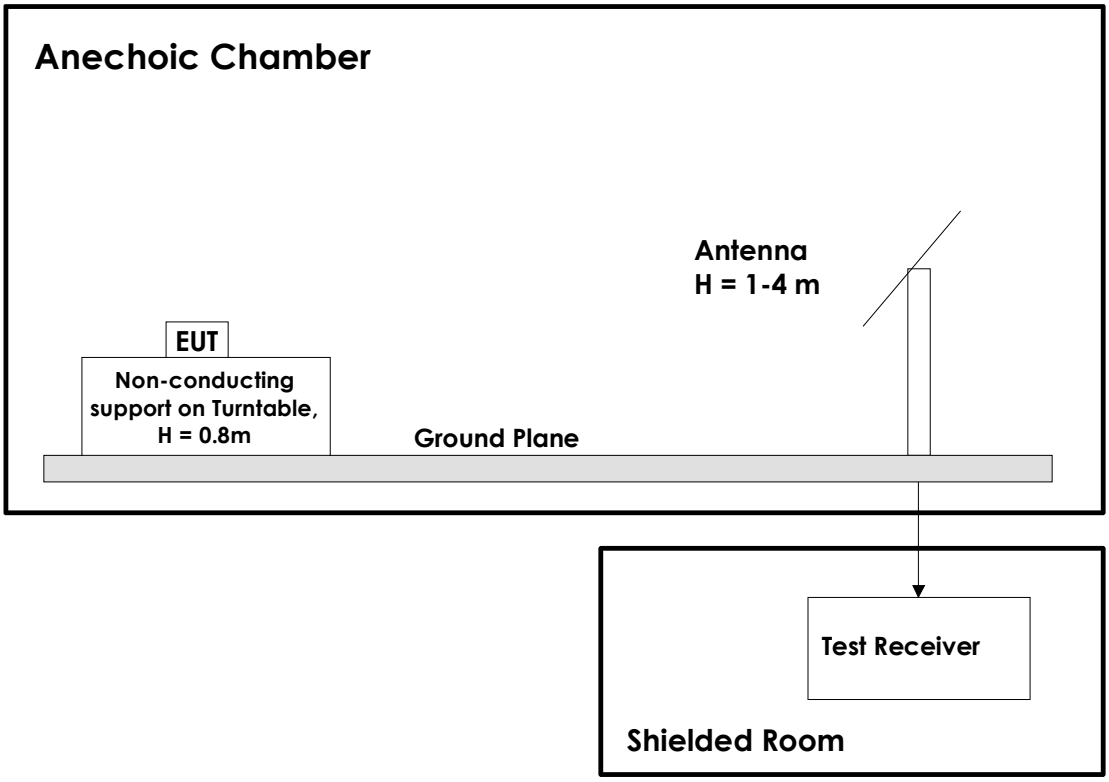
Test Software List			
Description	**Manufacturer**	**Model**	**Version**
/	/	/	/

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



Measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers.

Revision history

Version	Date	Comment	Sign
1.0	2017.03.29	First edition	FS