

Test Report

Product	Mobile Unit for Engine Cut-Off Device
Name and address of the applicant	Fell AS Nedre Storgate 46, 3015 Drammen Norway
Name and address of the manufacturer	Same as above
Model	GU90115
Rating	3.0V DC
Trademark	WiMEA
Serial number	/
Additional information	Low Power Device
Tested according to	FCC Part 15.247 Digital Transmission Systems Industry Canada RSS-247, Issue 1 Low Power Licence-Exempt Radiocommunications Devices
Order number	299696
Tested in period	2015.12.09 and 2016.01.04
Issue date	2016.02.23
Name and address of the testing laboratory	 FCC No: 994405 IC OATS: 2040D-1 Instituttveien 6 Kjeller, Norway TEL: +47 22 96 03 30 FAX: +47 22 96 05 50
<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  Prepared by [Frode Sveinsen] </div> <div style="text-align: center;">  Approved by [G. Suhanthakumar] </div> </div>	
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CONTENTS

1	INFORMATION	3
1.1	Test Item.....	3
1.2	Test Environment	4
1.3	Test Engineer(s).....	4
1.4	Test Equipment	4
2	TEST REPORT SUMMARY	5
2.1	General.....	5
2.2	Test Summary	6
2.3	Description of modification for Modification Filing	6
2.4	Comments	6
2.5	Family List Rational	6
3	TEST RESULTS.....	7
3.1	Occupied Bandwidth.....	7
3.2	Minimum 6 dB Bandwidth.....	9
3.3	Peak Power Output	13
3.4	Spurious Emissions (Radiated)	20
3.5	Power Spectral Density (PSD).....	42
4	Measurement Uncertainty.....	46
5	LIST OF TEST EQUIPMENT	47
6	BLOCK DIAGRAM	48
6.1	Power Line Conducted Emission.....	48
6.2	Test Site Radiated Emission	48

1 INFORMATION

1.1 Test Item

Name :	WiMEA
FCC ID :	2AFOZGU90115
Industry Canada ID :	20622-GU90115
Model/version :	GU90115
Serial number :	/
Hardware identity and/or version:	1.0
Software identity and/or version :	1.0
Frequency Range :	906.5 – 922.5 MHz
Number of Channels :	5
Channel separation :	4 MHz
Type of Modulation :	2-GFSK
User Frequency Adjustment :	None
Rated Output Power :	0.0140 Watt (Conducted, Peak)
Type of Power Supply :	Primary Battery (CR 2030)
Number of Antennas :	1
Antenna Connector :	None (Internal antenna)
Antenna Diversity Supported :	No
Desktop Charger :	None

Description of Test Item

The EUT is the Mobile Unit for an Engine Cut-Off device for recreational crafts. The Boat Unit is continuously polling the Mobile Unit when the engine is operating, and if the reply from the Mobile Unit is lost the Boat Unit will stop the engine.

Exposure Evaluation

The EUT is a portable device and is designed to be used handheld or worn on the body. The EUT is exempted from SAR evaluation since the output power is below the exemption limit. A SAR Exemption Justification document is submitted with the application.

The EUT is exempted from RF Exposure Evaluation to Industry Canada requirements since the output power complies with the power levels of section 2.5.1 of RSS-102 Issue 5.

1.2 Test Environment

1.2.1 *Normal test condition*

Temperature: 21.1 – 21.8 °C

Relative humidity: 20 – 41 %

Normal test voltage: 3.0 V DC

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 Test Equipment

See list of test equipment in clause 5.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15C and Industry Canada RSS-247 Issue 1.

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

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

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

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DTS Equipment Code

☐ 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".

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2.2 Test Summary

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

¹ The EUT is battery operated

2.3 Description of modification for Modification Filing

Not applicable.

2.4 Comments

All ports were populated during spurious emission measurements.

2.5 Family List Rational

Not Applicable.

3 TEST RESULTS

3.1 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Results: Complies

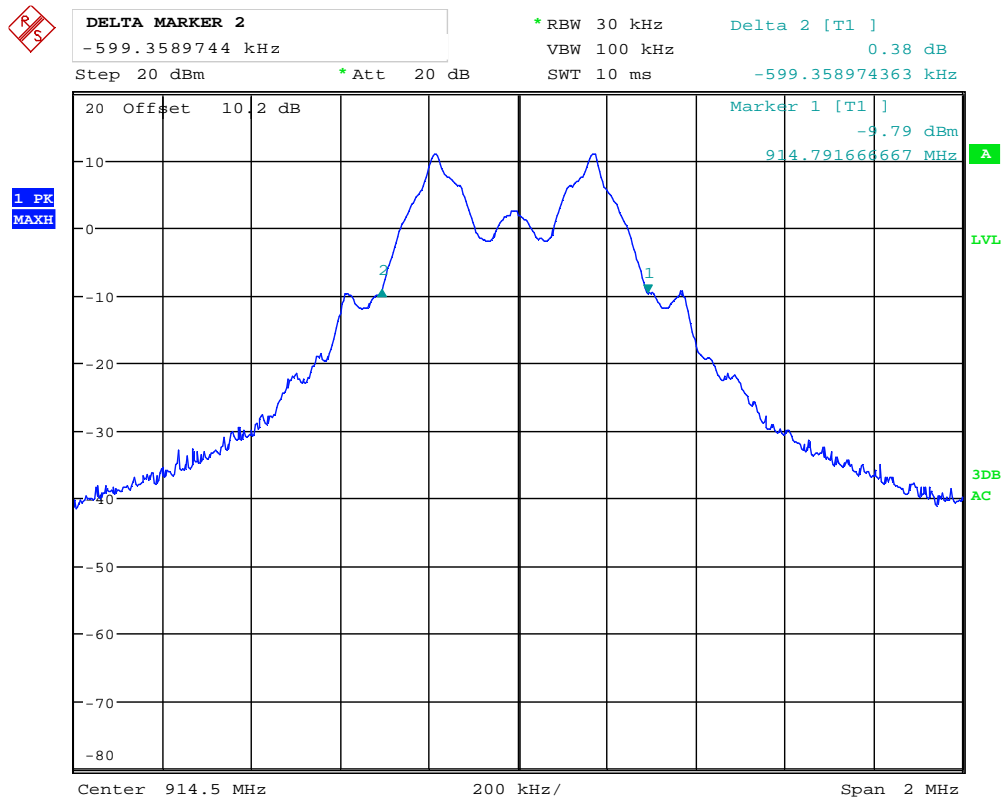
Measurement Data:

20 dB BW Measured on Centre Channel 914.5 MHz	599 kHz
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See attached plots.

Requirements:

No requirement for 20 dB BW, reported for information only.



Date: 4.JAN.2016 16:24:45

20 dB Bandwidth

3.2 Minimum 6 dB Bandwidth

Para. No.: 15.247 (a)(2)

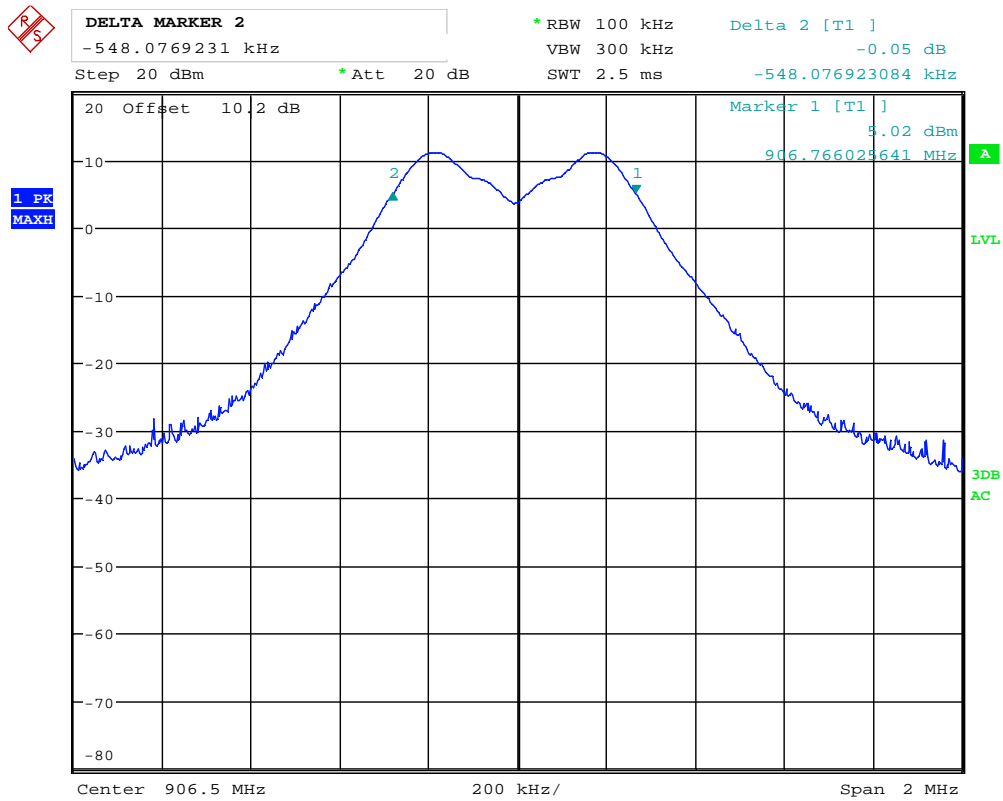
Test Results: Complies

Measurement Data:

Measured 6 dB Bandwidth (kHz)		
906.5 MHz	914.5 MHz	922.5 MHz
548	538	538

Requirements:

For Digital Transmission Systems in the 902 - 928 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.



Date: 4.JAN.2016 16:31:55

Minimum 6 dB Bandwidth, 906.5 MHz



DELTA MARKER 2

-538.4615385 kHz

* RBW 100 kHz

Delta 2 [T1]

VBW 300 kHz

-0.02 dB

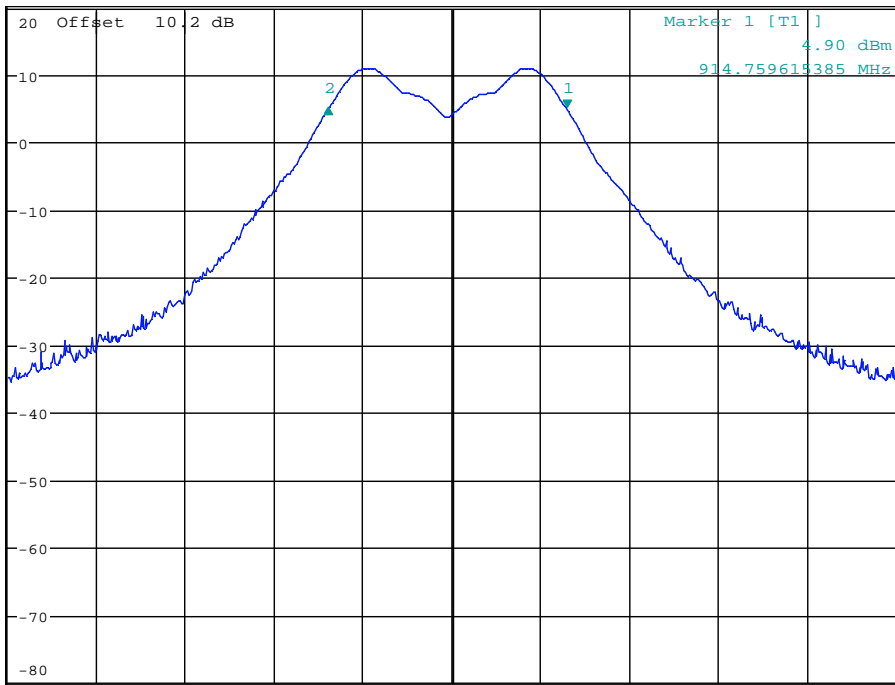
SWT 2.5 ms

-538.461538467 kHz

Step 20 dBm

* Att 20 dB

1 PK
MAXH



Center 914.5 MHz

200 kHz/

Span 2 MHz

Date: 4.JAN.2016 16:26:02

Minimum 6 dB Bandwidth, 914.5 MHz



DELTA MARKER 2

-538.4615385 kHz

Step 20 dBm

*Att 20 dB

*RBW 100 kHz

VBW 300 kHz

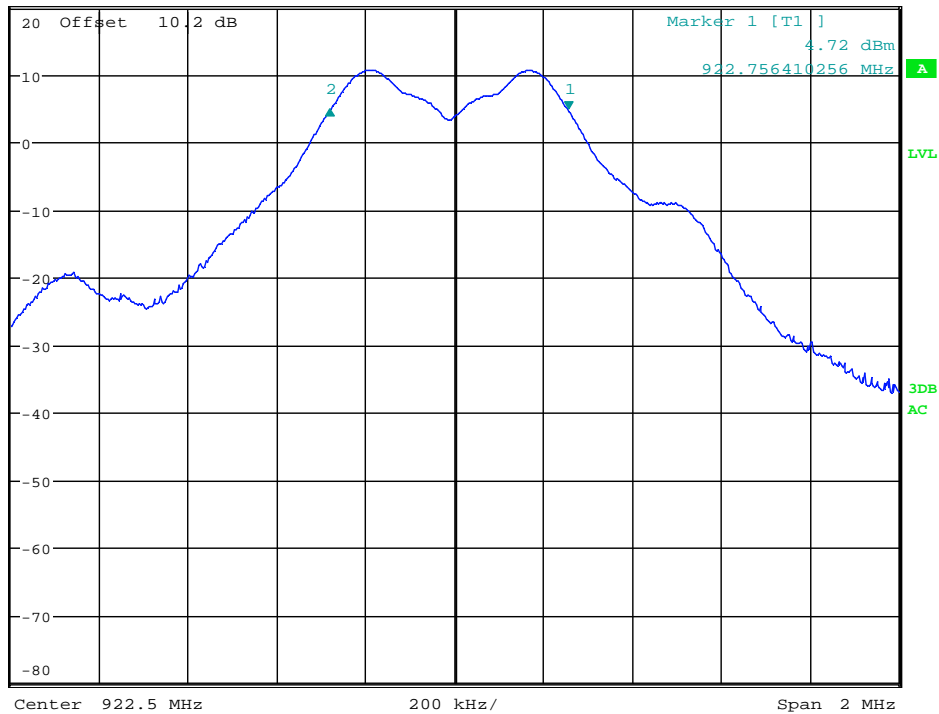
SWT 2.5 ms

Delta 2 [T1]

-0.00 dB

-538.461538468 kHz

1 PK
MAXH



Date: 4.JAN.2016 16:30:50

Minimum 6 dB Bandwidth, 922.5 MHz

3.3 Peak Power Output

Para. No.: 15.247 (b)

Test Results: Complies

Measurement Data:

	906.5 MHz	914.5 MHz	922.5 MHz
Conducted Power (dBm)	11.5	11.2	11.0
Conducted Power (mW)	14.0	13.3	12.5
Field Strength (dBμV/m)	102.0	101.3	100.5
EIRP, Calculated (mW)	4.74	4.01	3.33
Antenna gain (dBi)	-4.7	-5.2	-5.7

Antenna gain = $10 \cdot \log(\text{EIRP} / \text{Conducted power})$ dBi

EIRP is calculated from measured field strength by the formulas in KDB 412172 D01 Determining ERP and EIRP v01.

See attached graph.

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

☐ Yes ☐ No

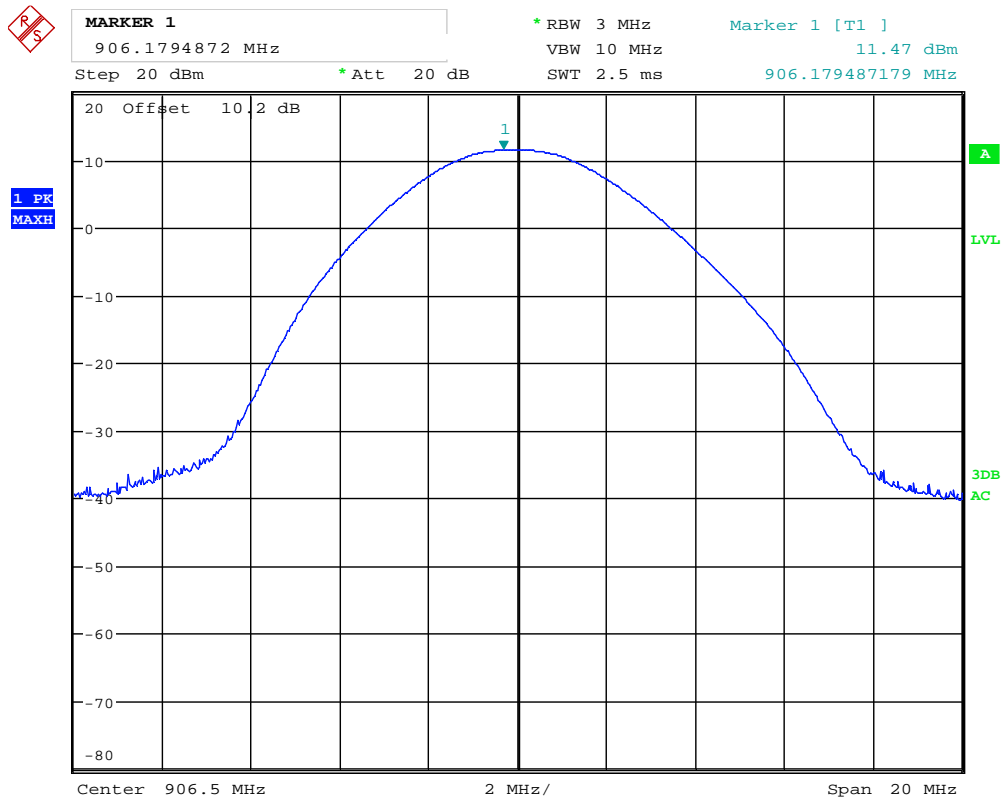
Type of antenna connector: None

Requirements:

The maximum peak output power shall not exceed the following limits:

For Digital Transmission Systems in the 902 - 928 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Date: 4.JAN.2016 16:19:13

Conducted Power, 906.5 MHz



MARKER 1

906.2435897 MHz

* RBW 3 MHz

VBW 10 MHz

* SWT 2.5 ms

Marker 1 [T1]

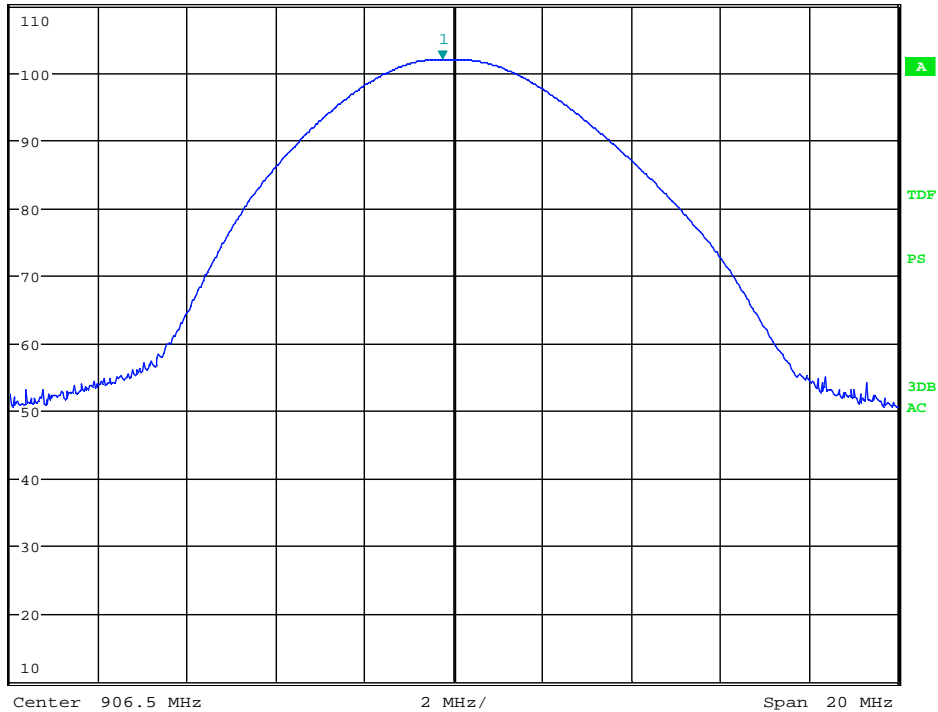
101.99 dBμV/m

906.243589744 MHz

Ref 110 dBμV/m

* Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 13:03:31

Radiated Power, 906.5 MHz

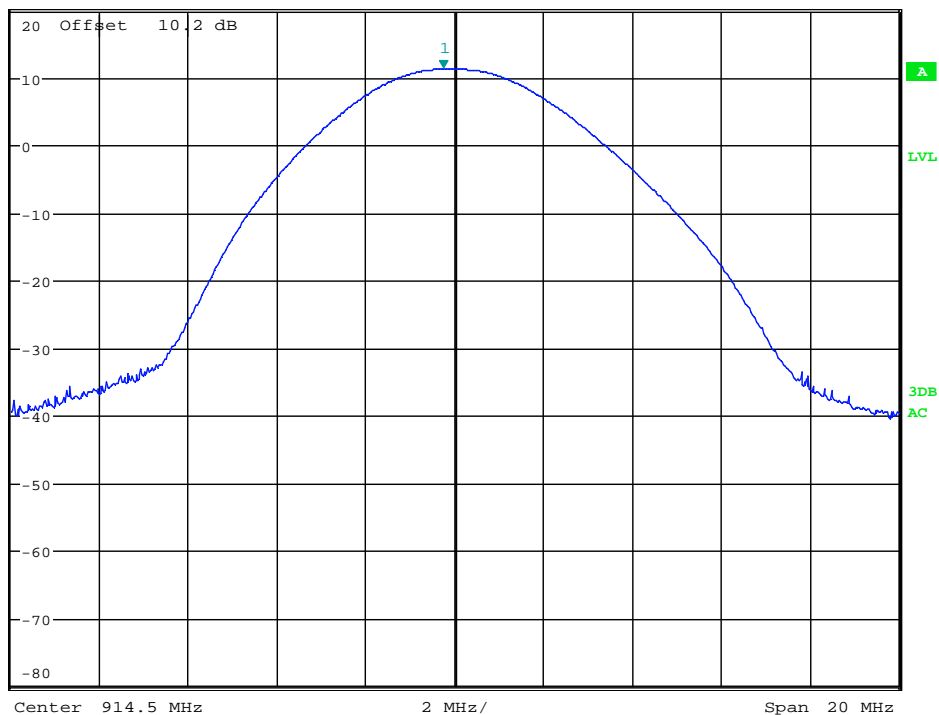


MARKER 1
914.2435897 MHz
Step 20 dBm

* RBW 3 MHz
VBW 10 MHz
SWT 2.5 ms

Marker 1 [T1]
11.23 dBm
914.243589744 MHz

1 PK
MAXH



Date: 4.JAN.2016 16:20:08

Conducted Power, 914.5 MHz



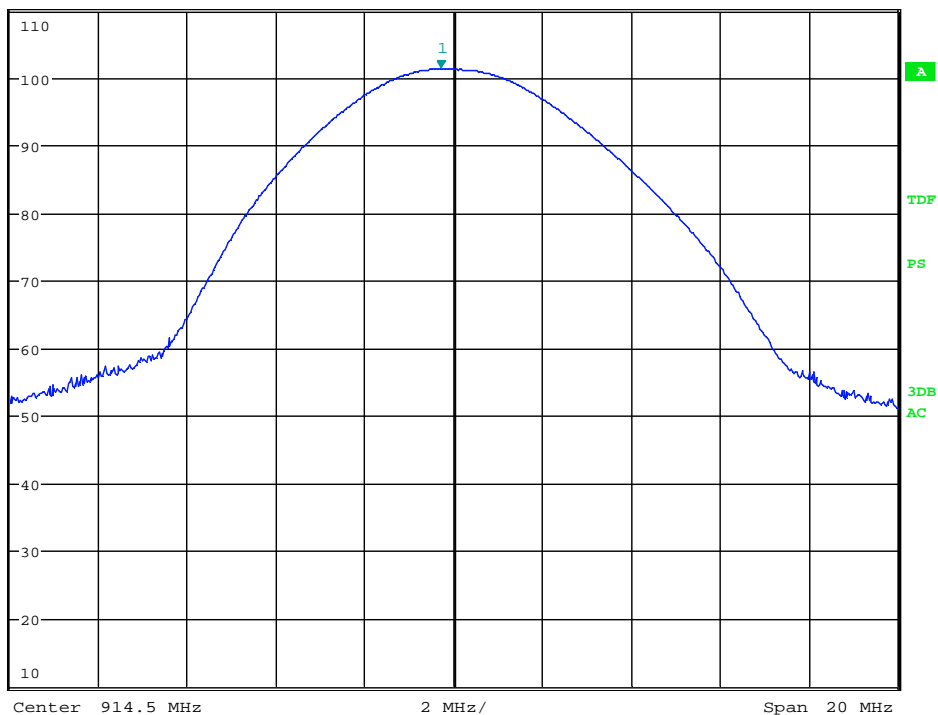
MARKER 1
914.2115385 MHz

* RBW 3 MHz
VBW 10 MHz
* SWT 2.5 ms

Marker 1 [T1]
101.26 dBμV/m
914.211538462 MHz

Ref 110 dBμV/m * Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 13:05:54

Radiated Power, 914.5 MHz



MARKER 1

922.2435897 MHz

* RBW 3 MHz

Marker 1 [T1]

VBW 10 MHz

10.97 dBm

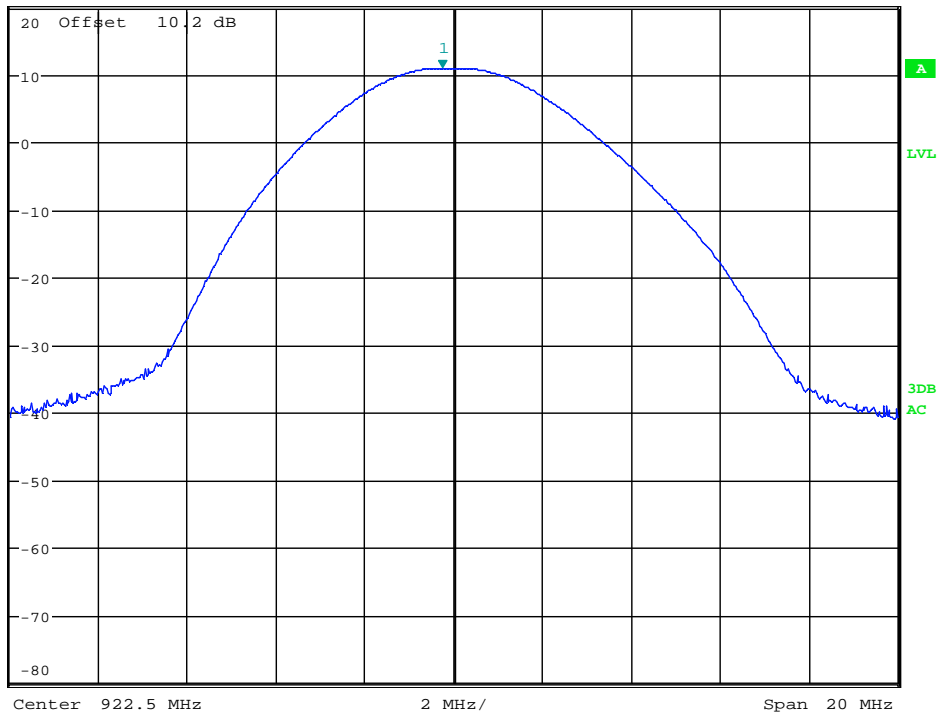
Step 20 dBm

* Att 20 dB

SWT 2.5 ms

922.243589744 MHz

1 PK
MAXH



Date: 4.JAN.2016 16:20:34

Conducted Power, 922.5 MHz



MARKER 1

922.275641 MHz

* RBW 3 MHz

VBW 10 MHz

* SWT 2.5 ms

Marker 1 [T1]

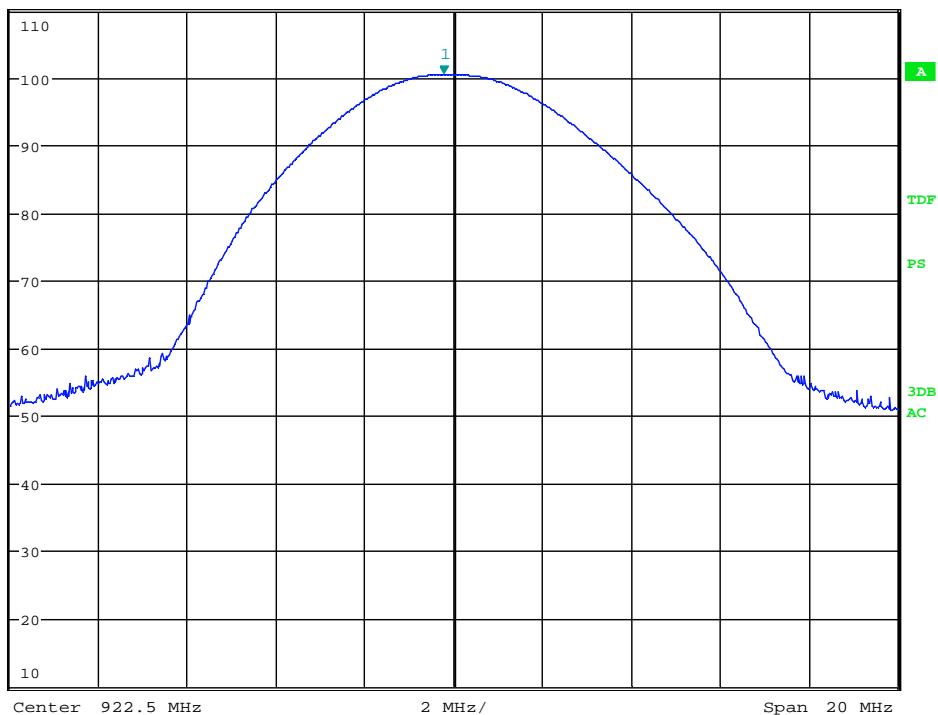
100.45 dBμV/m

922.275641026 MHz

Ref 110 dBμV/m

* Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 13:08:38

Radiated Power, 922.5 MHz

3.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Results: Complies

Measurement Data:

Band-edge conducted power

Frequency	Measured field strength (dB μ V/m) Peak Detector	Limit dB μ V/m	Margin dB
614 MHz	< 30	46	>16
960 MHz	< 40	54	>14

See attached plots.

Duty Cycle Correction Factor Calculation:

Duty Cycle = slot length / frame length

Duty Cycle Correction factor = $-20 \times \log(1.8\%) = 34.9$ dB

Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB

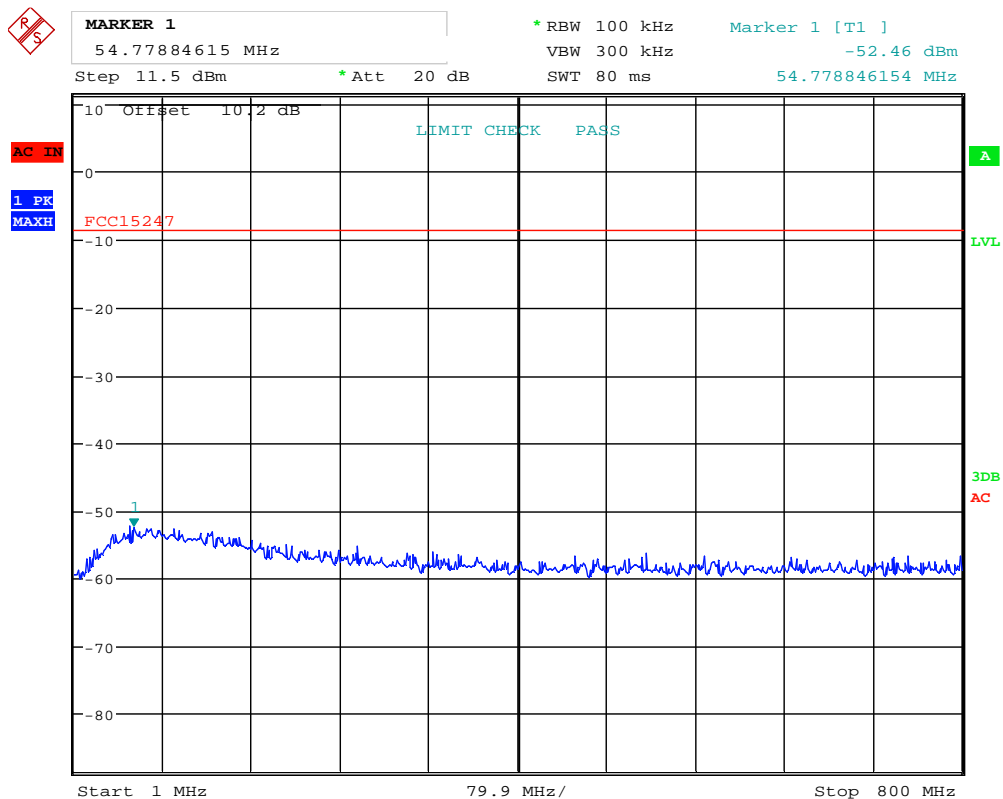
RF conducted power to 25 GHz see attached graph.

Maximum RF level outside operating band:

RF 906.5 MHz: >30 dB/C, margin >10 dB

RF 914.5 MHz: >30 dB/C, margin >10 dB

RF 922.5 MHz: >30 dB/C, margin >10 dB



Date: 4.JAN.2016 16:36:15

Conducted Emissions, 1 – 800 MHz, 906.5 MHz



MARKER 1

906.4102564 MHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

11.36 dBm

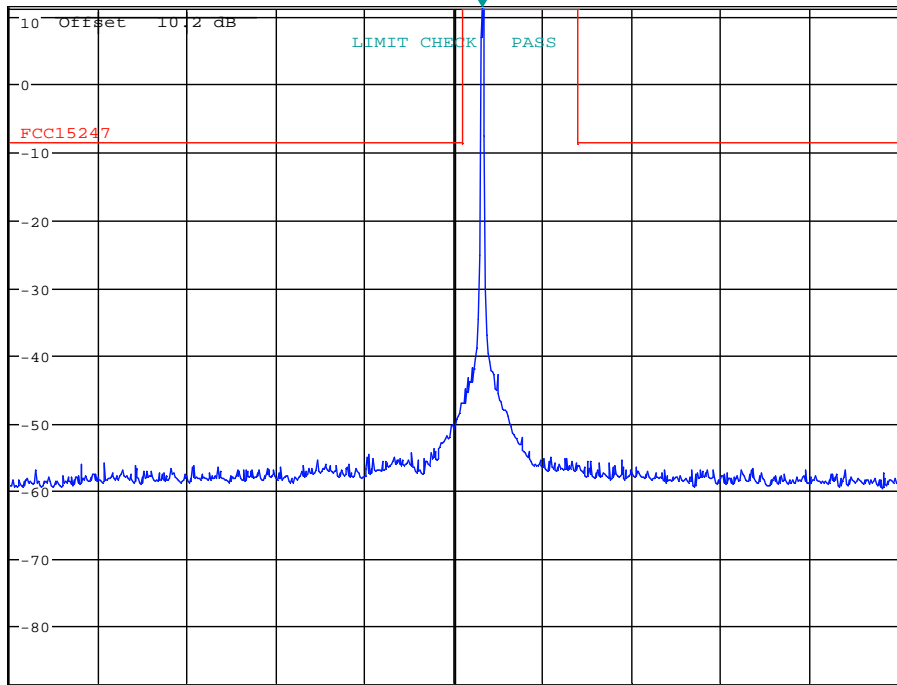
Step 11.5 dBm

*Att 20 dB

SWT 20 ms

906.410256410 MHz

1 PK
MAXH



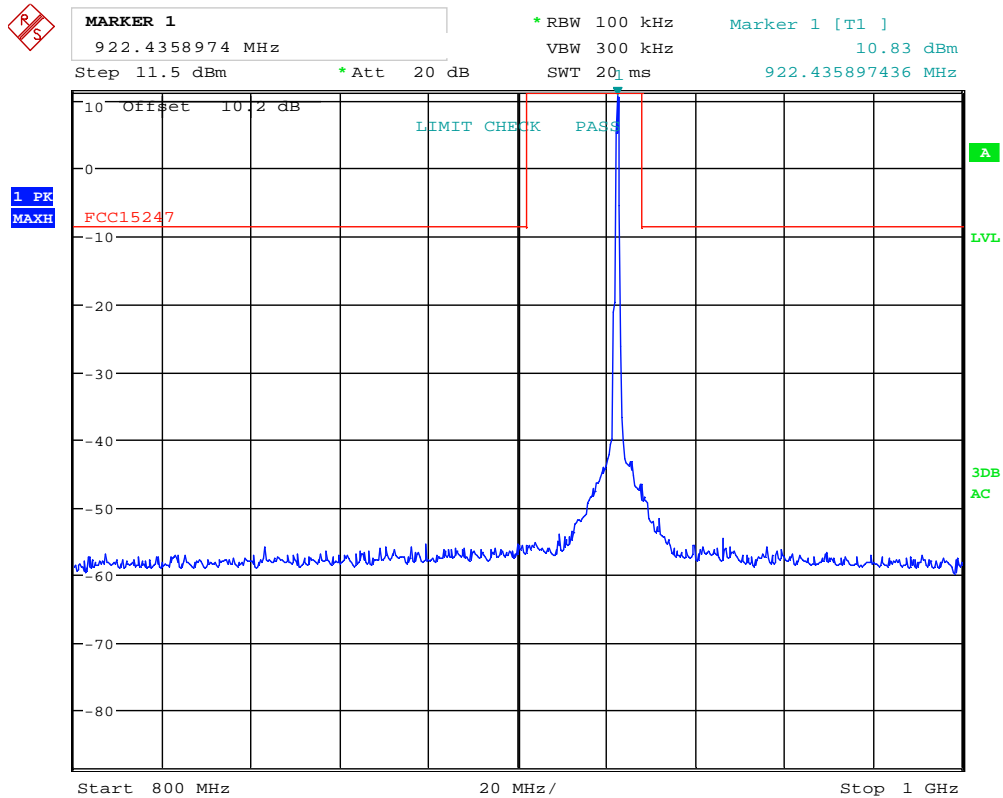
Start 800 MHz

20 MHz /

Stop 1 GHz

Date: 4.JAN.2016 16:36:59

Conducted Emissions, 800 - 1000 MHz, 906.5 MHz



Date: 4.JAN.2016 16:37:52

Conducted Emissions, 800 - 1000 MHz, 922.5 MHz



MARKER 1

1.807692308 GHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

-26.24 dBm

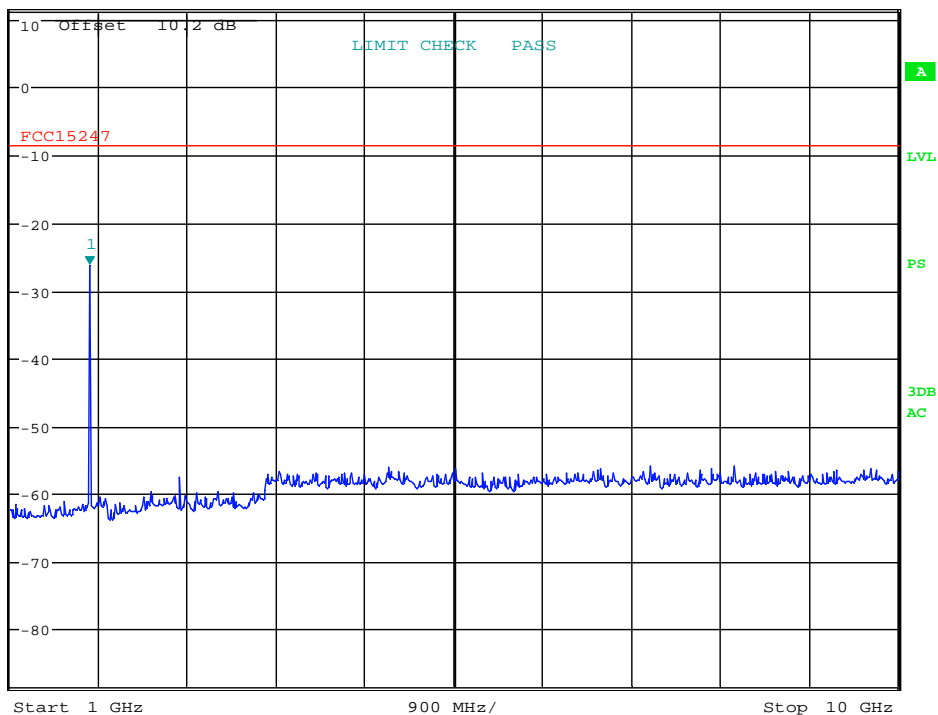
Step 11.5 dBm

*Att 20 dB

SWT 900 ms

1.807692308 GHz

1 PK
MAXH



Date: 4.JAN.2016 16:40:00

Conducted Emissions, 1 - 10 GHz, 906.5 MHz



MARKER 1

1.822115385 GHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

-25.94 dBm

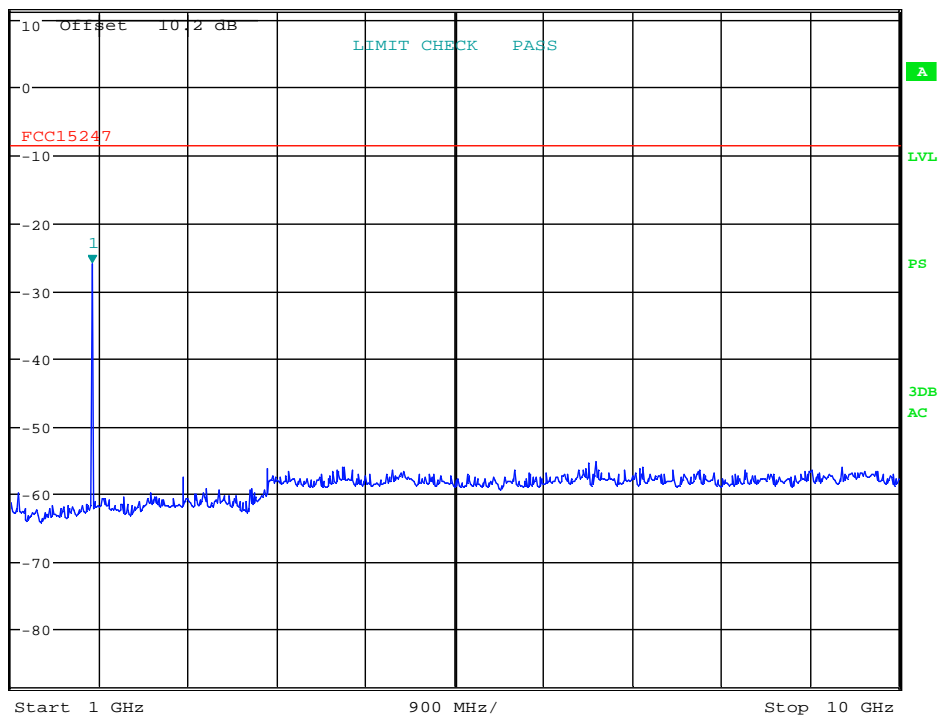
Step 11.5 dBm

*Att 20 dB

SWT 900 ms

1.822115385 GHz

1 PK
MAXH



Date: 4.JAN.2016 16:39:28

Conducted Emissions, 1 - 10 GHz, 914.5 MHz



MARKER 1

1.836538462 GHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

-25.11 dBm

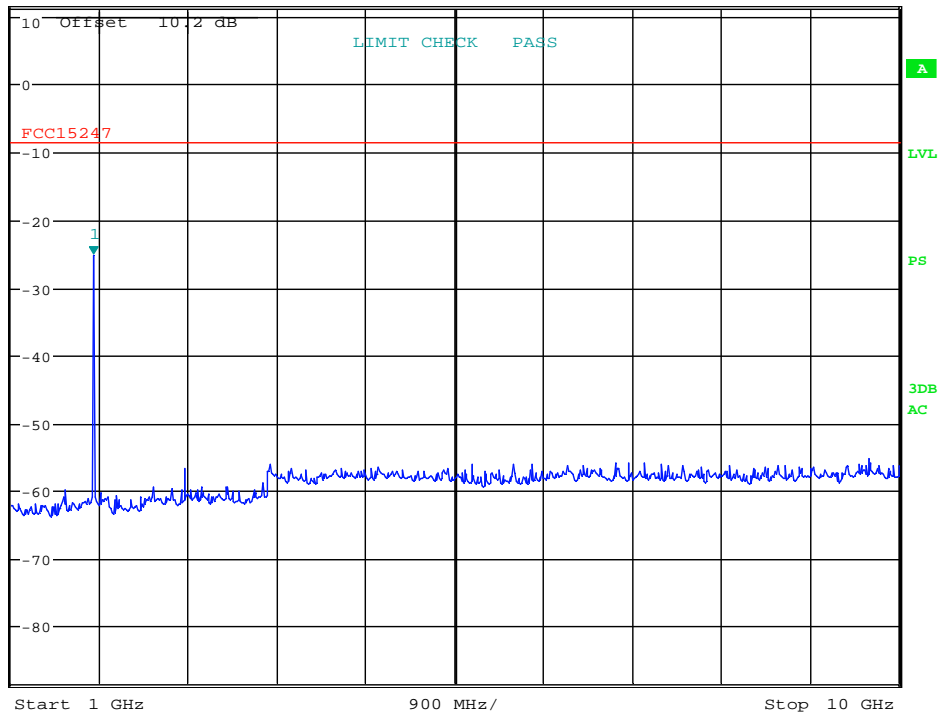
Step 11.5 dBm

*Att 20 dB

SWT 900 ms

1.836538462 GHz

1 PK
MAXH



Date: 4.JAN.2016 16:38:48

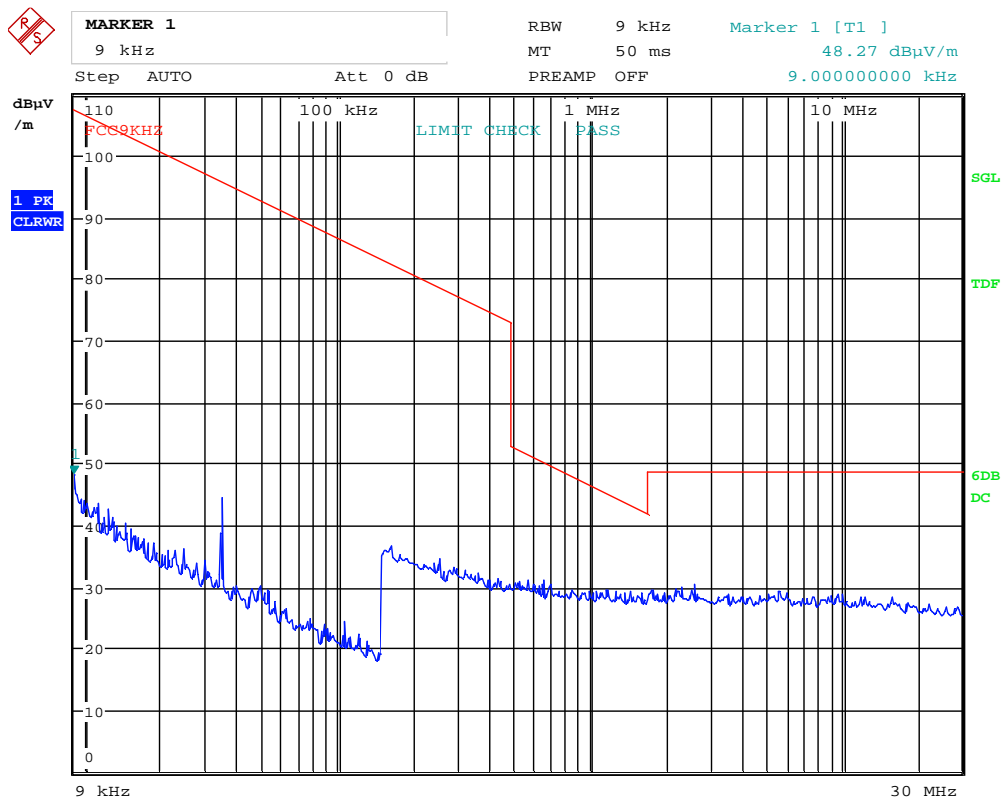
Conducted Emissions, 1 - 10 GHz, 922.5 MHz

Radiated emissions 10 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).



Date: 4.JAN.2016 16:09:08

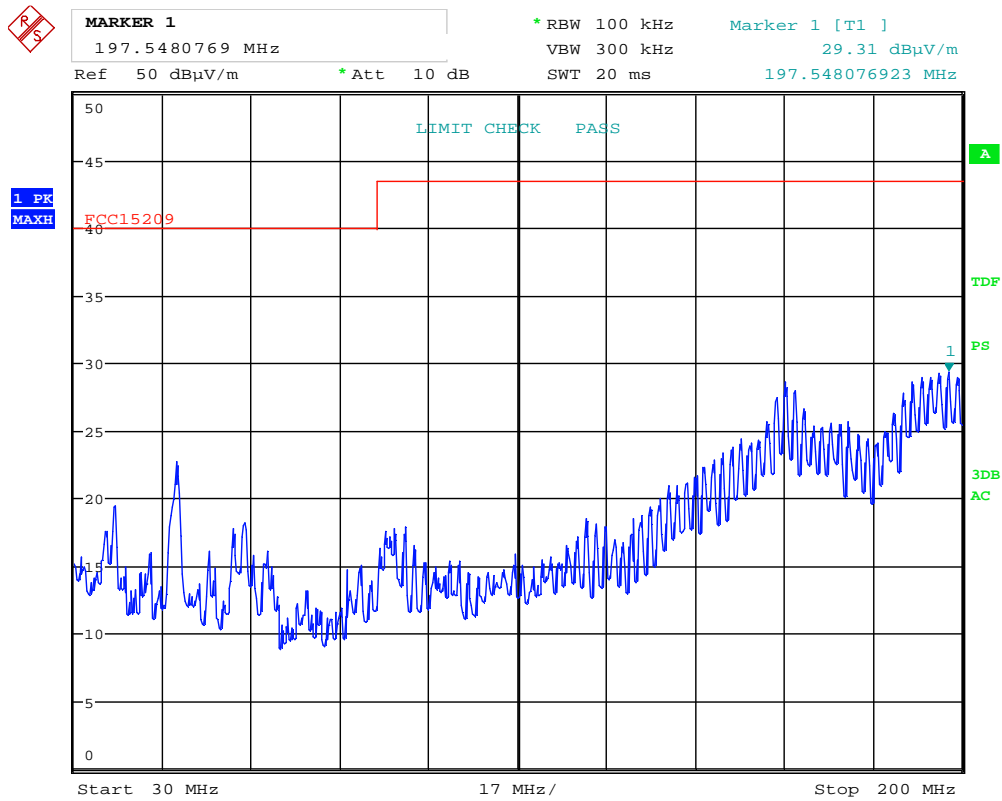
Radiated emission 30 – 1000 MHz.

Detector: Peak Detector

Measuring distance 3 m

Tested in normal mode with active connection.

See attached graphs.



Date: 4.JAN.2016 10:36:08

Radiated Emissions, 30 – 200 MHz, VP



MARKER 1

199.4551282 MHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

35.77 dBµV/m

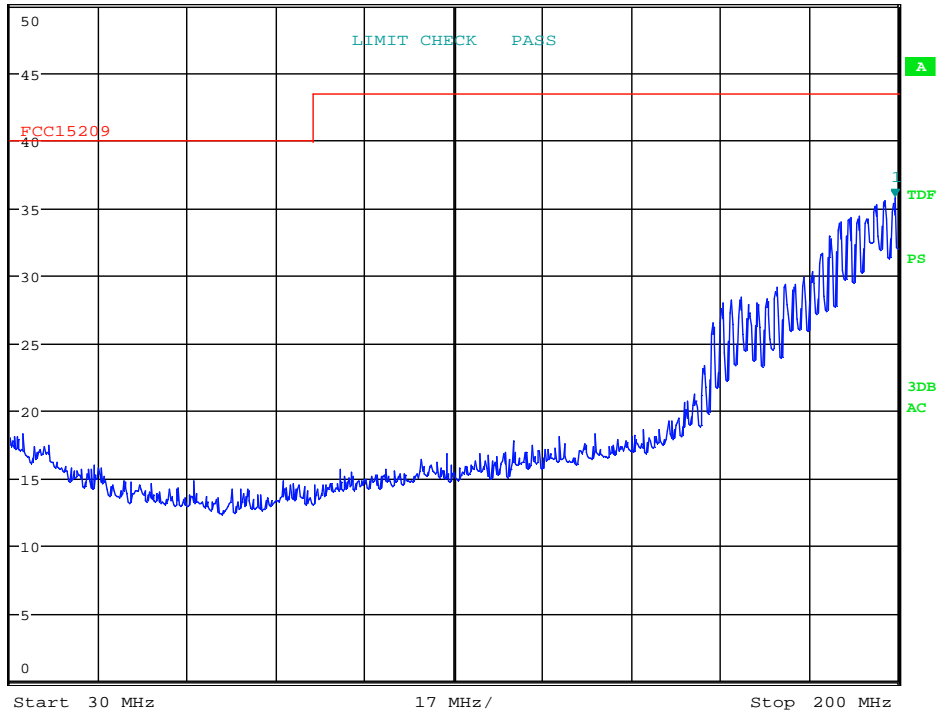
SWT 20 ms

199.455128205 MHz

Ref 50 dBµV/m

*Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 10:51:50

Radiated Emissions, 30 – 200 MHz, HP



MARKER 1

489.9326923 MHz

*RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

41.75 dBµV/m

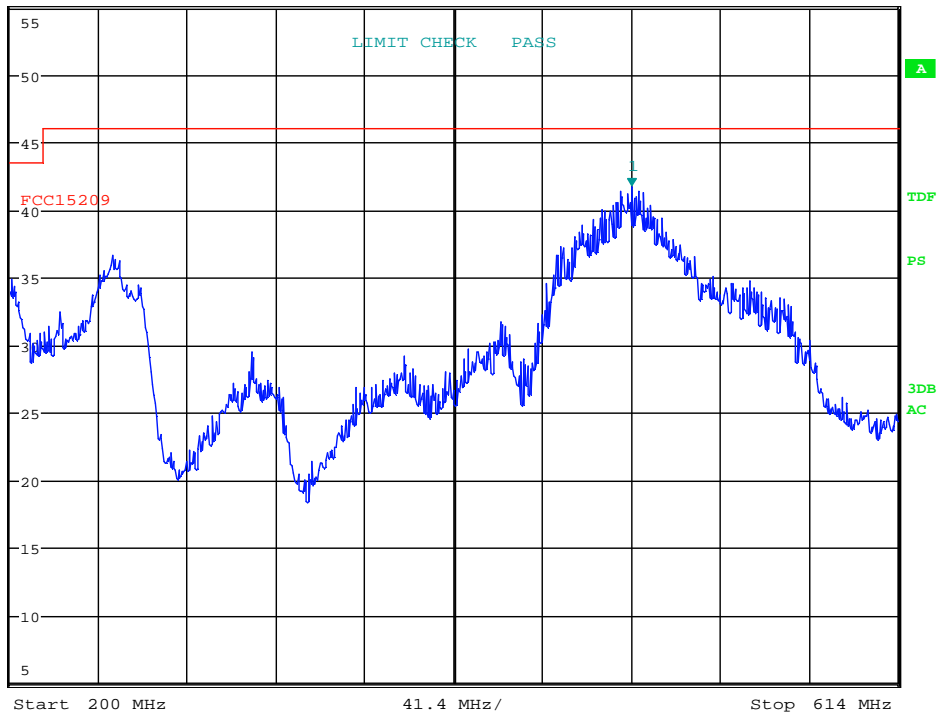
Ref 55 dBµV/m

*Att 10 dB

SWT 45 ms

489.932692308 MHz

1 PK
MAXH



Date: 4.JAN.2016 10:15:18

Radiated Emissions, 200 - 614 MHz, VP



MARKER 1

493.9134615 MHz

* RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

38.01 dBµV/m

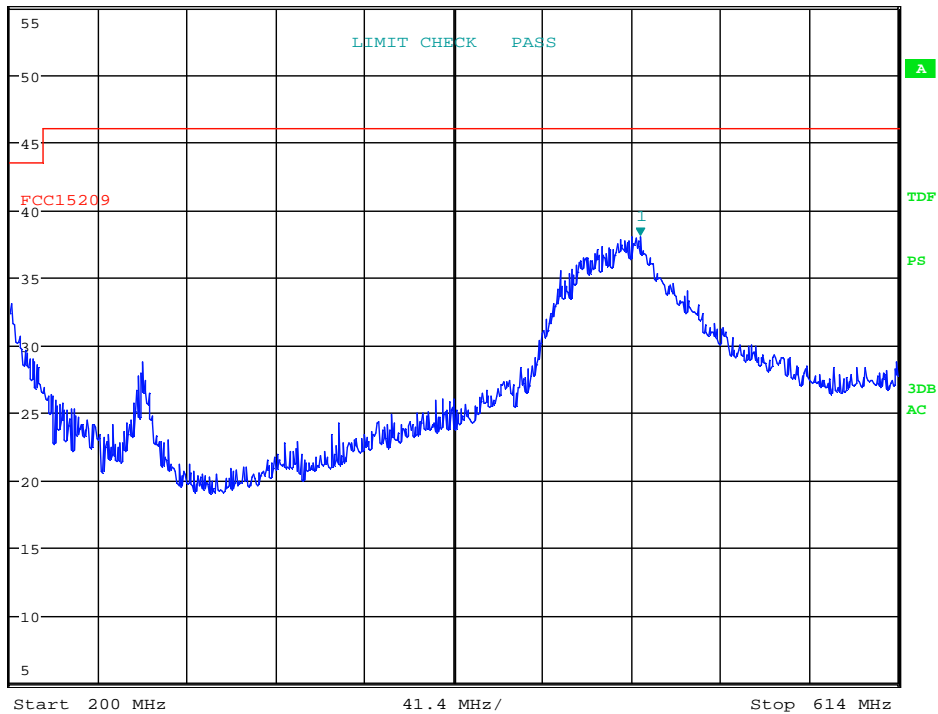
SWT 45 ms

493.913461538 MHz

Ref 55 dBµV/m

* Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 10:22:54

Radiated Emissions, 200 - 614 MHz, HP



MARKER 1

971.3461538 MHz

* RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

36.43 dBμV/m

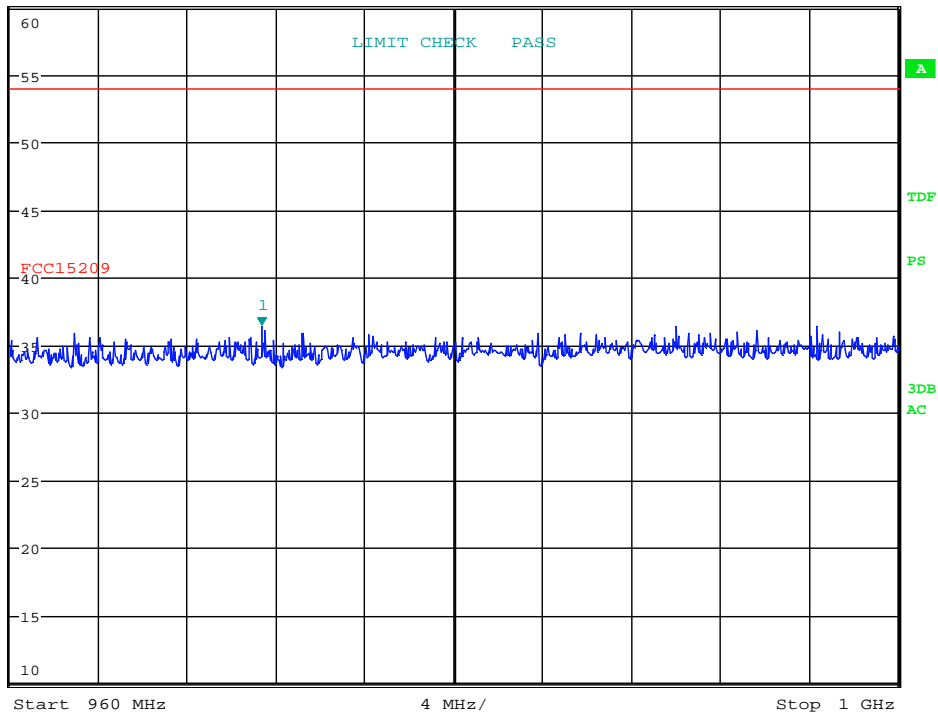
Ref 60 dBμV/m

* Att 20 dB

SWT 15 ms

971.346153846 MHz

1 PK
MAXH

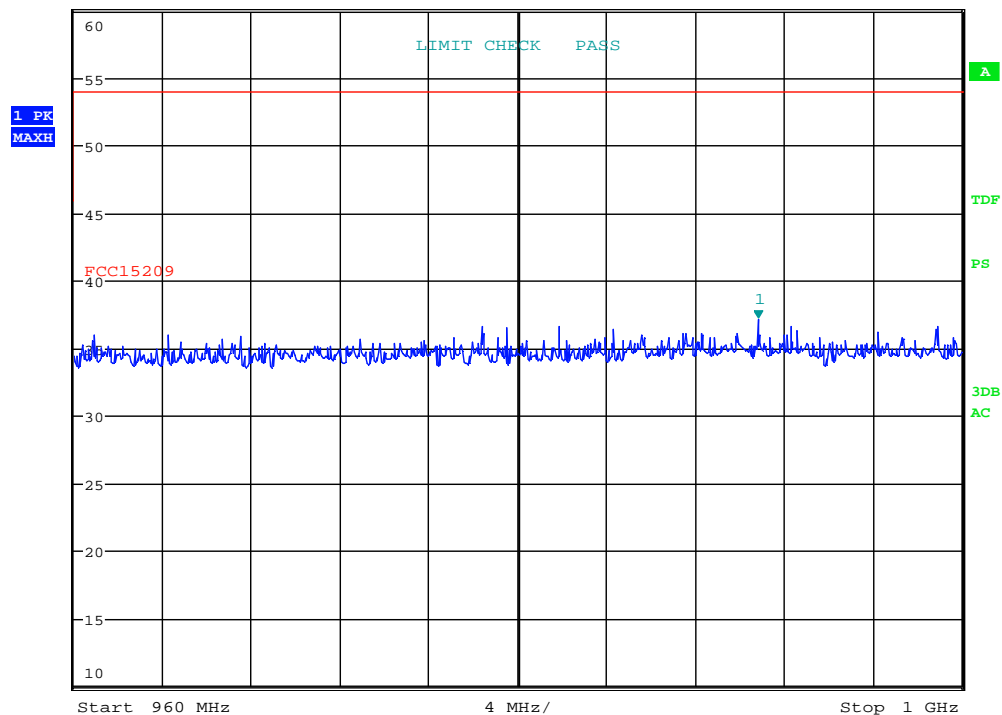


Date: 4.JAN.2016 10:26:04

Radiated Emissions, 960 - 1000 MHz, VP



MARKER 1
990.8333333 MHz
Ref 60 dBμV/m *Att 20 dB *RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 37.16 dBμV/m
SWT 15 ms 990.833333333 MHz



Date: 4.JAN.2016 10:29:49

Radiated Emissions, 960 - 1000 MHz, HP

Radiated Emissions, 1-10 GHz

Measuring distance: 3m (1 – 8.5 GHz)
1m (8.5 – 10 GHz)

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dB μ V/m	dB	dB μ V/m	dB
1.829	M	0	59.4	20	74	14.6
Other freqs	L,M,H	0	None detected	20	74	>20

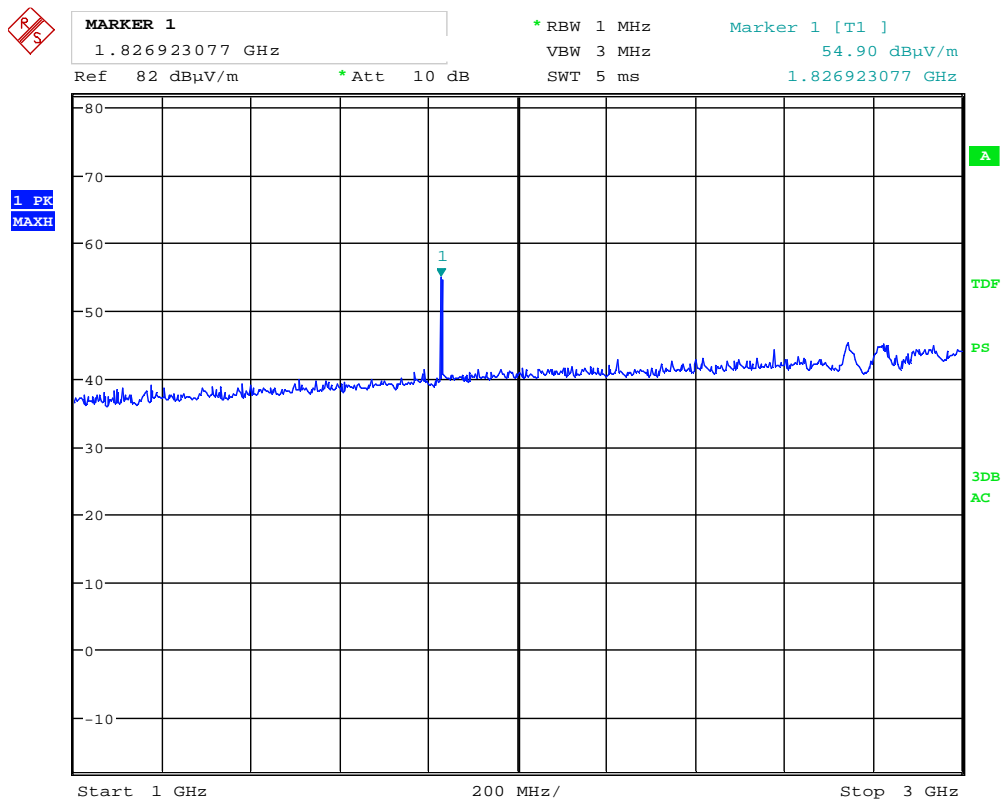
Average Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dB μ V/m	dB	dB μ V/m	dB
1.829	M	0	39.4	20	54	14.6
Other freqs	L,M,H	/	None detected	20	54	>20

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.



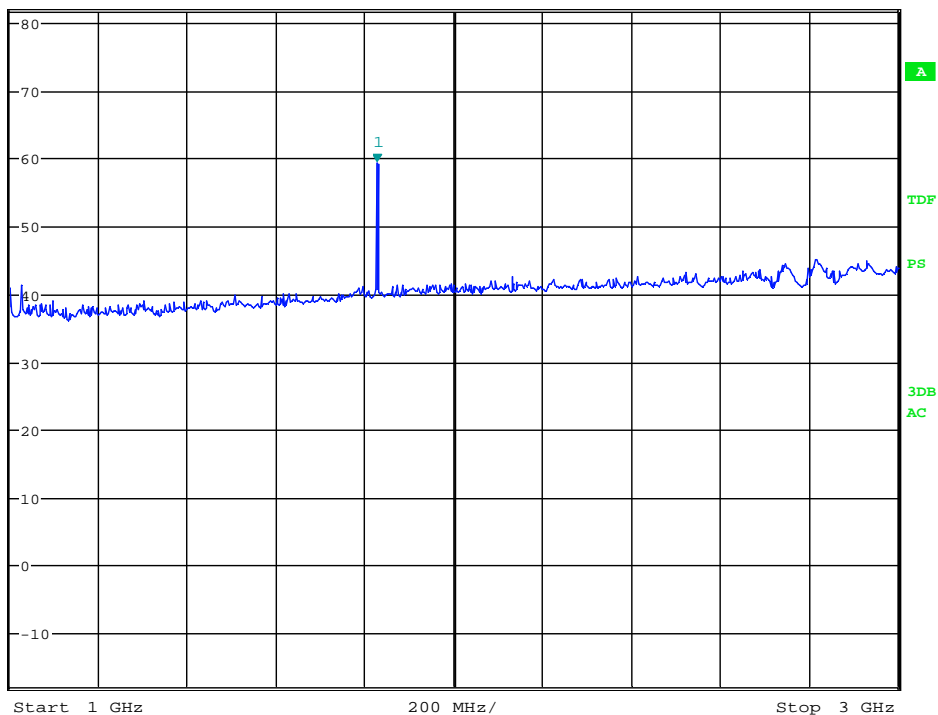
Date: 4.JAN.2016 14:46:04

Radiated Emissions, 1 – 3 GHz, VP



MARKER 1
1.826923077 GHz
Ref 82 dBμV/m *Att 10 dB *RBW 1 MHz Marker 1 [T1] 59.44 dBμV/m
VBW 3 MHz SWT 5 ms 1.826923077 GHz

1 PK
MAXH



Date: 4.JAN.2016 14:48:28

Radiated Emissions, 1 – 3 GHz, HP



MARKER 1

8.253205128 GHz

* RBW 1 MHz

Marker 1 [T1]

VBW 3 MHz

54.14 dBµV/m

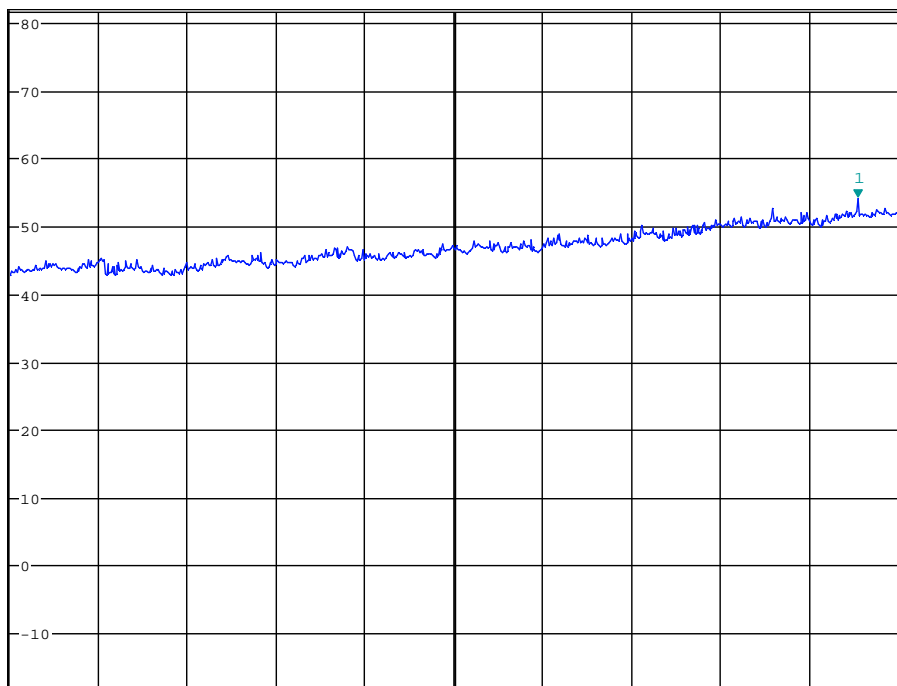
Ref 82 dBµV/m

* Att 10 dB

SWT 35 ms

8.253205128 GHz

1 PK
MAXH



Start 3 GHz

550 MHz/

Stop 8.5 GHz

Date: 4.JAN.2016 14:57:12

Radiated Emissions, 3 – 8.5 GHz, VP



MARKER 1

8.376602564 GHz

* RBW 1 MHz

Marker 1 [T1]

VBW 3 MHz

53.33 dBμV/m

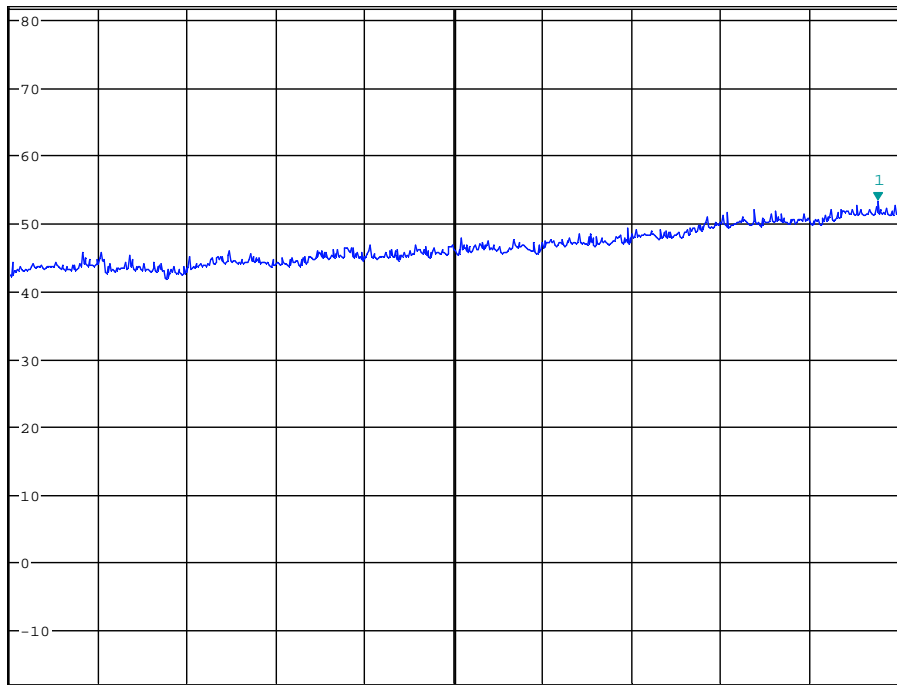
Ref 82 dBμV/m

* Att 10 dB

SWT 35 ms

8.376602564 GHz

1 PK
MAXH



Start 3 GHz

550 MHz/

Stop 8.5 GHz

Date: 4.JAN.2016 14:52:32

Radiated Emissions, 3 – 8.5 GHz, HP



MARKER 1

9.728365385 GHz

* RBW 1 MHz

Marker 1 [T1]

VBW 3 MHz

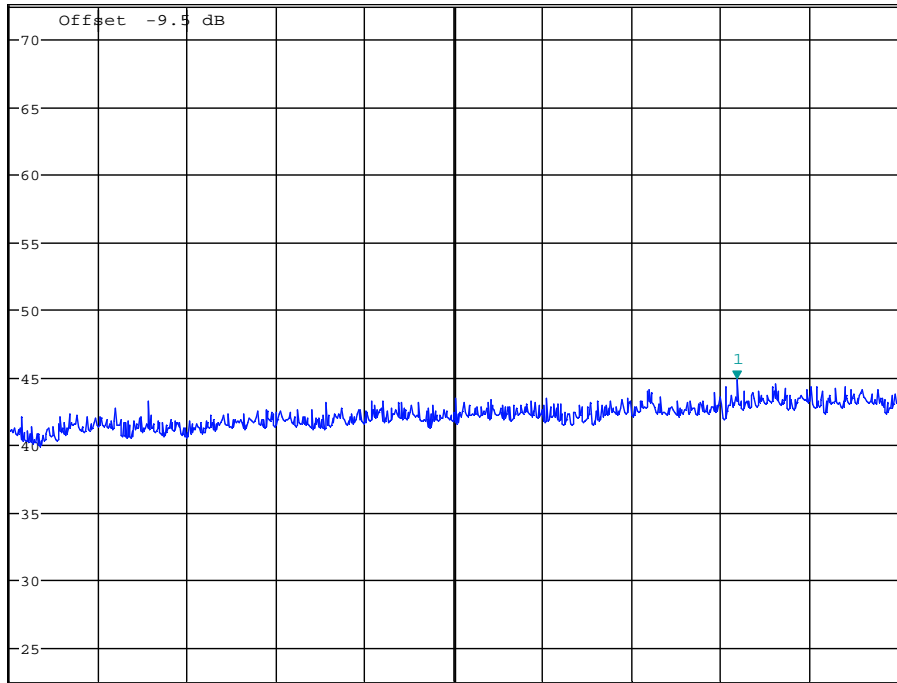
44.86 dBμV/m

Ref 72.5 dBμV/m * Att 10 dB

SWT 20 ms

9.728365385 GHz

1 PK
MAXH



Start 8.5 GHz 150 MHz/ Stop 10 GHz

Date: 4.JAN.2016 15:31:39

Radiated Emissions, 8.5 – 10 GHz, VP, 1m



MARKER 1

9.728365385 GHz

* RBW 1 MHz

Marker 1 [T1]

VBW 3 MHz

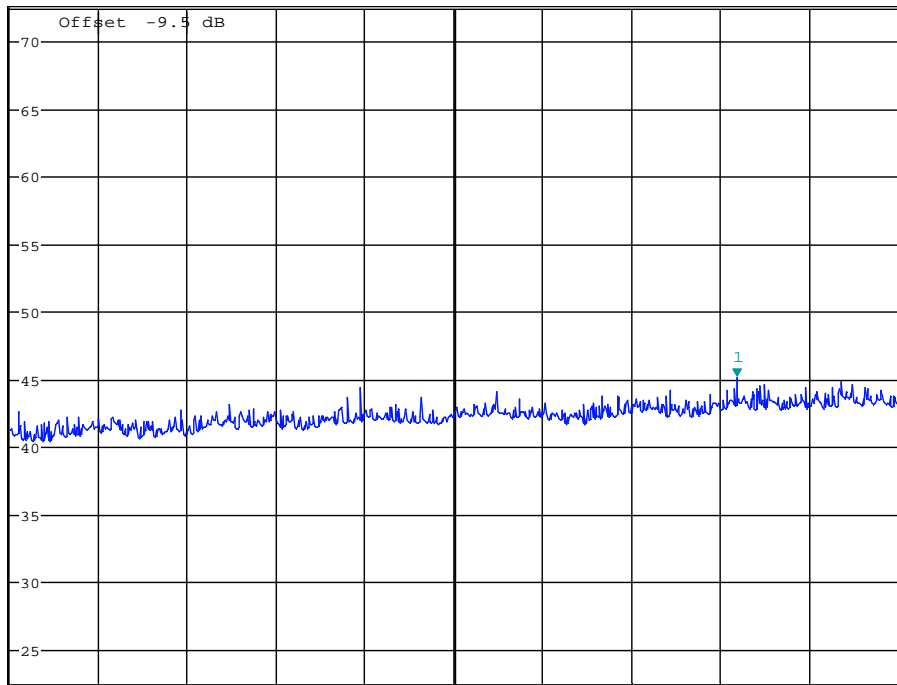
45.12 dBμV/m

Ref 72.5 dBμV/m * Att 10 dB

SWT 20 ms

9.728365385 GHz

1 PK
MAXH



Start 8.5 GHz 150 MHz/ Stop 10 GHz

Date: 4.JAN.2016 15:36:40

Radiated Emissions, 8.5 – 10 GHz, HP, 1m

3.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Results: Passed

Measured and Calculated Data:

	906.5 MHz	914.5 MHz	922.5 Mhz
Measured value (dBm)	1.9	2.0	1.8

Requirements:

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band



MARKER 1

906.6403846 MHz

* RBW 3 kHz

VBW 10 kHz

SWT 70 ms

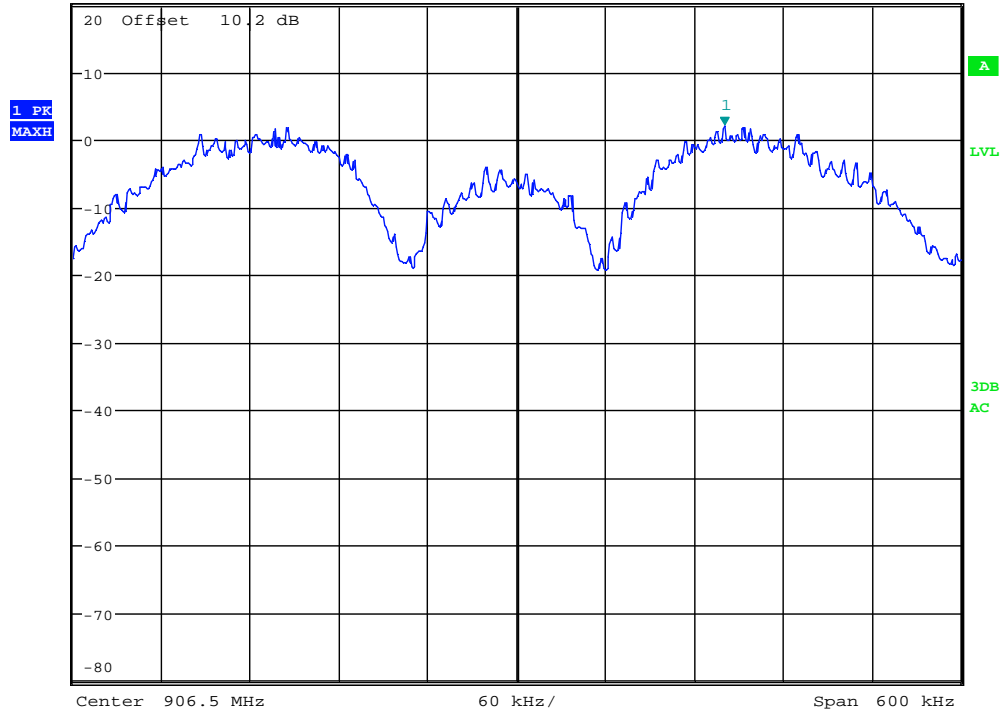
Marker 1 [T1]

1.94 dBm

906.640384615 MHz

Step 20 dBm

* Att 20 dB



Date: 4.JAN.2016 16:28:48

Power Spectral Density, 906.5 MHz



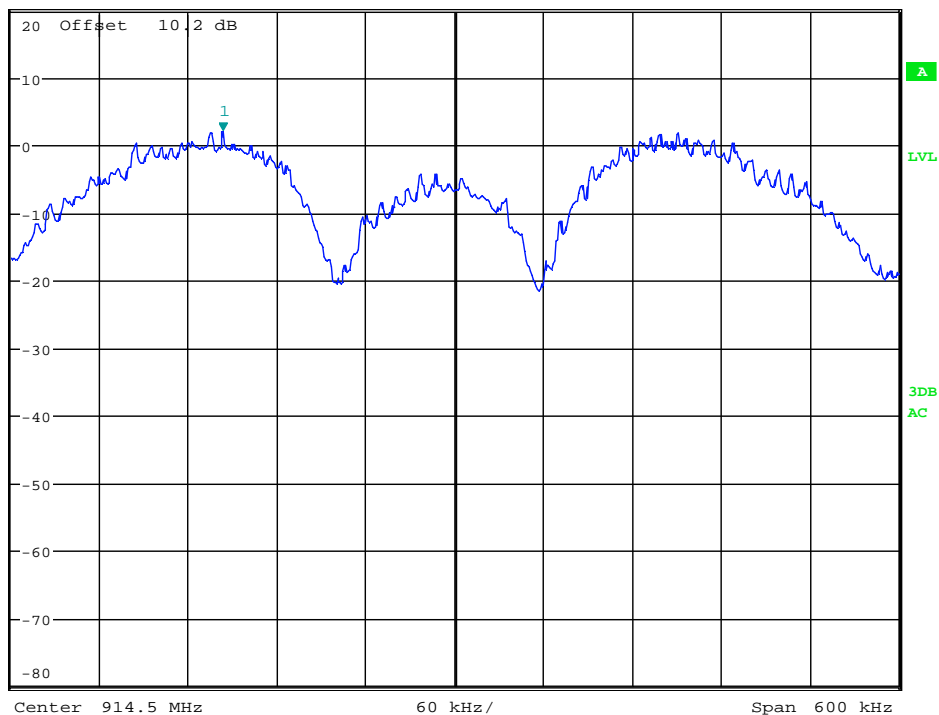
MARKER 1
914.3432692 MHz

*RBW 3 kHz
VBW 10 kHz
SWT 70 ms

Marker 1 [T1]
2.00 dBm
914.343269231 MHz

Step 20 dBm *Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 16:27:58

Power Spectral Density, 914.5 MHz



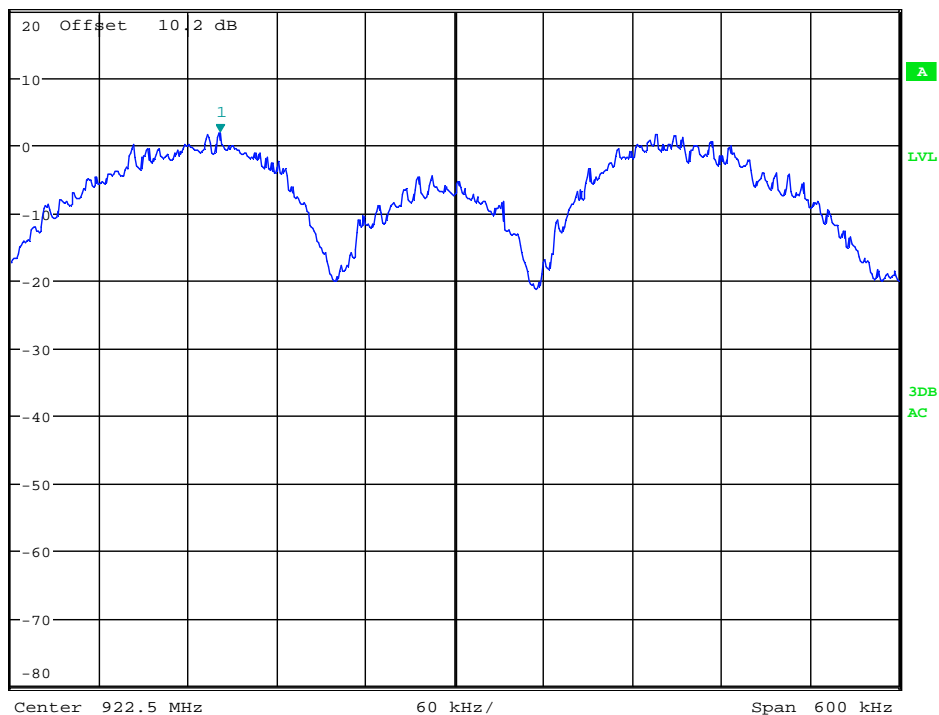
MARKER 1
922.3413462 MHz

*RBW 3 kHz
VBW 10 kHz
SWT 70 ms

Marker 1 [T1]
1.83 dBm
922.341346154 MHz

Step 20 dBm *Att 20 dB

1 PK
MAXH



Date: 4.JAN.2016 16:29:29

Power Spectral Density, 922.5 MHz

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

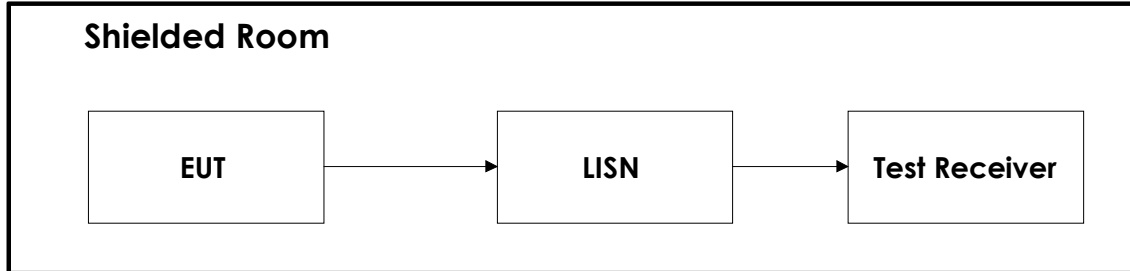
5 LIST OF TEST EQUIPMENT

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.

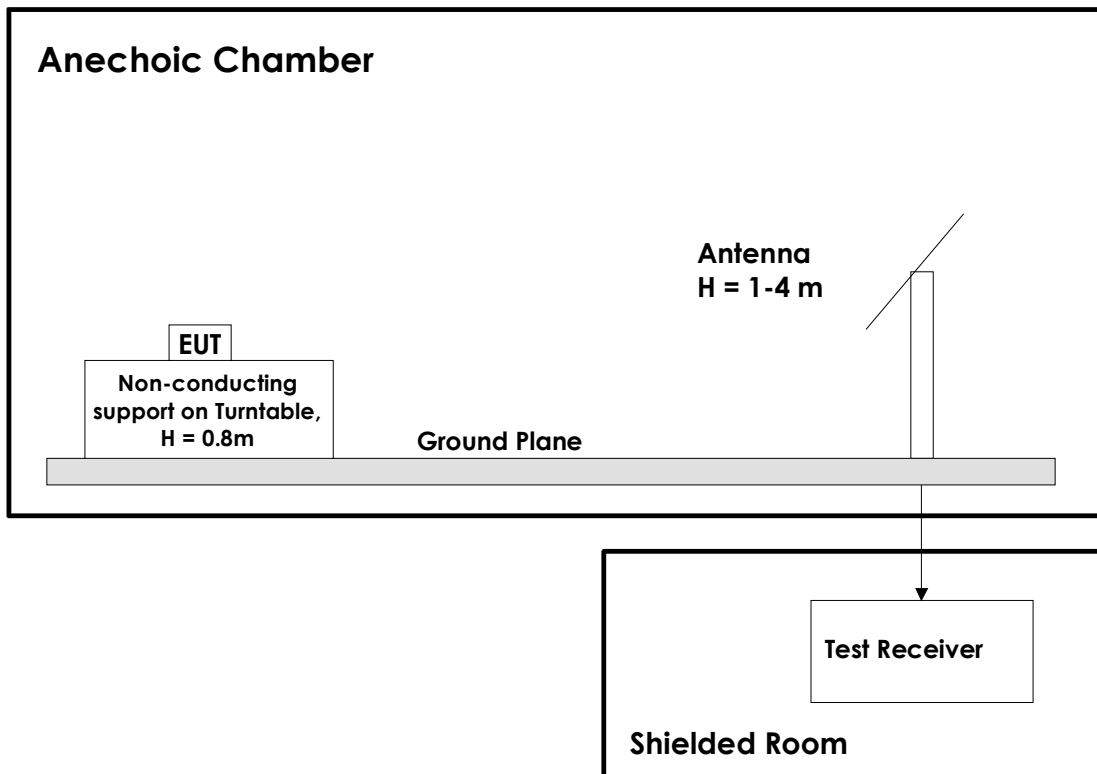
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2015.11	2016.11
2	6810A.17B	Attenuator	Suhner	LR 1669	Cal b4 use	
3	6HC1500/18000	Highpass Filter	Trilithic	LR 1612	Cal b4 use	
4	HL223	LogPeriod Antenna	Rohde & Schwarz	LR 1261	2013.12	2017.12
5	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2017.12
6	HFH2-Z2	Loop Antenna	Rohde & Schwarz	LR 1660	2014.10	2016.10
7	3115	Horn Antenna	EMCO	LR 1226	2013.12	2018.12
8	PM7320X	Antenna Horn	Sivers Lab	LR 103	2009.01.26	2017.01.26
9	HP 10855A	Preamplifier	Hewlett Packard	LR 1445	2015.10	2016.10
10	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2015.10	2016.10
11	Model 87V	Multimeter	Fluke	N-4669	2015.10	2016.10
12	B32-10R	Power Supply	Oltronics	LR 015	Cal b4 use	

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



Revision history

Version	Date	Comment	Sign
1.0	2016.01.25	Version for TCB review	FS
2.0	2016.02.23	Editorial corrections	FS