



Test report no. : 182234-4

Item tested : CC1101EM-868-915

Type of equipment : Low Power Transceiver

FCC ID : ZAT1101EM900

Client : Texas Instruments Norway AS

FCC Part 15.249

Low Power Transceiver
902-928 MHz Band

RSS-210, Issue 8 and RSS-GEN, Issue 3

Low-Power Licence-exempt Radiocommunications devices
902 – 928 MHz Band

13 December 2012

Authorized by : .....

Frode Sveinsen
Technical Verificator



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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko AS
Address : Nemko Kjeller
Instituttveien 6, Box 96
NO-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
Email: comlab@nemko.no
FCC test firm : 994405
IC OATS : 2040D-1
Total Number of Pages: 37

1.2 Client Information

Name : Texas Instruments Norway AS
Address : Gaustadallen 21,
NO-0349 Oslo, Norway
Telephone : +47 22 95 85 44
Fax : +47 22 95 85 46

Contact:

Name : Dag Grini
Telephone : +47 22 95 83 01
E-mail : d.grini@ti.com

1.3 Manufacturer

Same as client.

2 Test Information

2.1 Test Item

Name :	CC1101EM with TrxEB
Model/version :	CC1101EM-868-915
FCC ID :	ZAT1101EM900
IC :	451H-1101EM900
Serial number :	-
Hardware identity and/or version:	-
Software identity and/or version :	-
Frequency Range :	903.5 – 926.5 MHz
Operating Frequency:	903.5, 915, 926.5MHz
Operating Modes :	TX & RX
Type of Modulation :	2-GFSK
Data rate:	1.2kbit/s
Conducted Output Power :	0.00057 mW (Peak)
Type of Power Supply :	3.0V dc*
Antenna Connector :	SMA connector
Antenna type:	Whip -1/4 wave
Antenna Diversity Supported :	None

*Tested with battery pack (2xAA Primary batteries).

Theory of Operation

The CC1101EM-868-915 RF-transceiver is a development tool for the CC1101 chip.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	19 – 22 °C
Relative humidity:	30 – 45 %
Normal test voltage:	3.0V dc

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2011-09-20
Test period :	from 2011-11-04 -2011-11-30

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Texas Instruments Norway AS
Model No.: CC1110EM-868-915
Serial No.: -

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15.249.

Radiated tests were conducted in accordance with ANSI C63.4-2003 and ANSI C63.10-2009. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 meters.

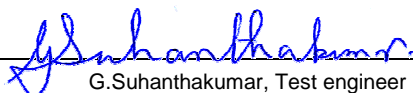
- | | |
|-----------------------------------------------------|-----------------------------------------------------|
| <input checked="" type="checkbox"/> New Submission | <input checked="" type="checkbox"/> Production Unit |
| <input type="checkbox"/> Class II Permissive Change | <input type="checkbox"/> Pre-production Unit |
| DXT Equipment Code | <input type="checkbox"/> Family Listing |

THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.

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



TEST REPORT #: 182234-4

TESTED BY:  DATE: 2011-12-01
G.Suhanthakumar, Test engineer

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This test report applies only to the items and configurations tested.

3.2 Test Summary

Name of test	FCC Part 15 reference	RSS210 Issue 8 & RSS Gen Issue 3	Result
Supply Voltage Variations	15.31(e)	4.5	Complies ¹
Transmitter frequency stability	15.31(m)	7.2.4	Complies
Antenna Requirement	15.203	7.1.4	Non-complies ²
Power-line Conducted Emission	15.207(c)	7.2.2	NA ¹
20 dB bandwidth	15.215(c)	-	Complies
Peak Power Output	15.249(a)(c)	A2.9	Complies
Band edge Emissions	15.249(d)	A.2.9	Complies
Spurious Emissions (Radiated)	15.249 (e)	A2.9 & 4.3	Complies
Spurious Emissions (Antenna Conducted)	15.249	7.2.3.1	Complies
Receiver Spurious Emissions (Radiated)	15.109	6 (RSS-GEN)	Complies
Receiver Spurious Emissions (Conducted)	N/A	6 (RSS-GEN)	-

¹ The power is taken from battery.

² SMA connector

RSS Gen issue 3 covers section 7 & 6

RSS 210 issue 8 covers section A2.9

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The channels are selected with a computer connected to the EUT. The computer is only used for selection of channels. The measurements are performed at channels near top , near middle and near bottom . And the output level is set to maximum in the software. The EUT complies at these channels.

The radiated measurements are tested on three axis.

Fully charged battery is used.

3.5 Family List Rationale

Not Applicable.

4 TEST RESULTS

4.1 Transmitter Frequency Stability

Para. No.: 15.31(m)/7.2.4

Test Performed By: G.Suwanthakumar	Date of Test: 04.11.2011
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Measurement Data:

Temperature	Channel nr.	Given Frequency (MHz)	Measured value (MHz)	Deviation (Hz)
20 ° C	-	903.500	903.49955	0.00045
	-	915.000	914.99951	0.00049
	-	926.500	926.49949	0.00051

Comment: Reported for information only. There are no requirements to frequency tolerance for low power devices in the 902-928 MHz band certified to 15.249 or RSS 210

4.2 20 dB Bandwidth

Para. No.: RSS-Gen

Test Performed By: G.Suhanthakumar	Date of Test: 04.11.2011
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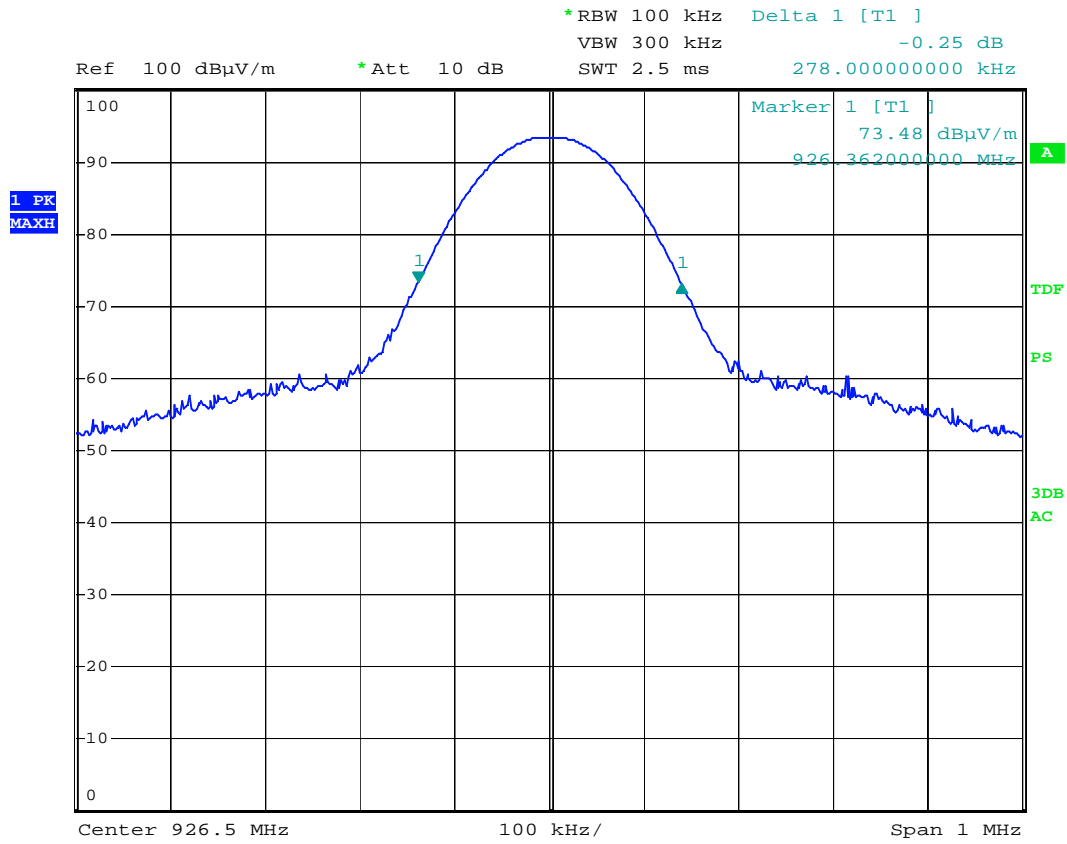
Test Results: Complies

Measurement Data:

Data Rate	20 dB Bandwidth (kHz)		
	903.500MHz	915.000MHz	926.500MHz
1.2kbps	-	-	278

Requirements:

For information only



Date: 4.NOV.2011 09:49:06

926.5MHz – 20 dB bandwidth – 278kHz

4.3 Peak Power Output

Para. No.: 15.249 (a)/A.2,9

Test Performed By: G.Suhandhakumar	Date of Test: 04.11.2011
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Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	903.5MHz	915MHz	926.5MHz
@ 1.2kbps, Measured value (dBm)	-2.41	-2.59	-2.74

Maximum Field strength

RF channel	903.5MHz	915MHz	926.5MHz
VP: Measured value (dB μ V/m)	94.00	93.89	93.45
HP: Measured value (dB μ V/m)	90.73	91.83	91.75

Calculated erp & antenna gain

RF channel	903.5MHz	915MHz	926.5MHz
Radiated power (mW)	0.46	0.45	0.41
Radiated erp (dBm)	-3.38	-3.49	-3.93
Antenna gain dBd	-0.97	-0.9	-1.19

Radiated measurements are done at 3 m distance.

Radiated Power is calculated from measured field strength by the formulas in ANSI C63.10-2009.

Detachable antenna? Yes No
 If detachable, is the antenna connector non-standard? Yes No
 SMA connector

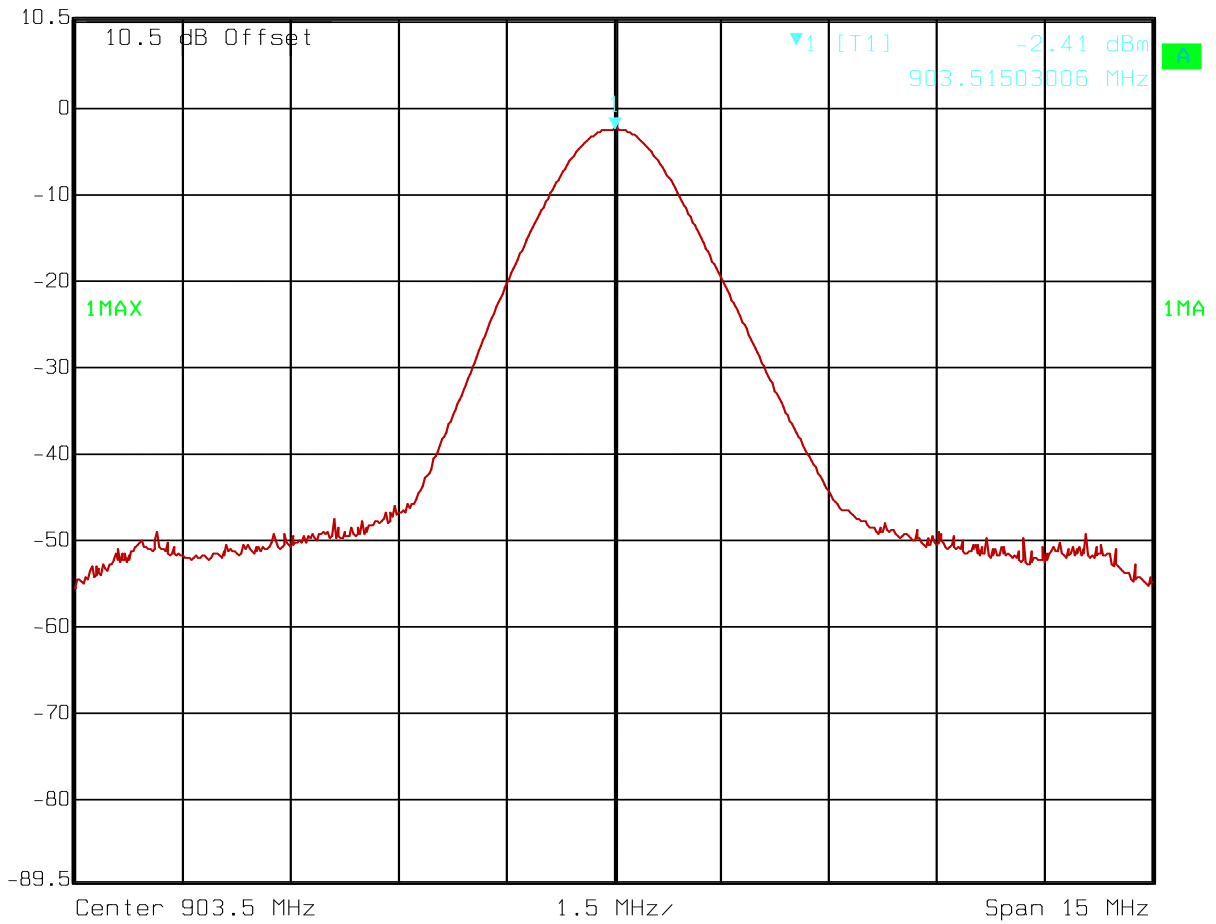
A fully charged battery was used.

Requirements:

The maximum Peak Output Power shall be 94dB μ V/m or less.



Ref Lvl 10.5 dBm
 Marker 1 [T1] 903.51503006 MHz
 RBW 1 MHz
 RF Att 10 dB
 VBW 1 MHz
 Unit dBm
 SWT 5 ms

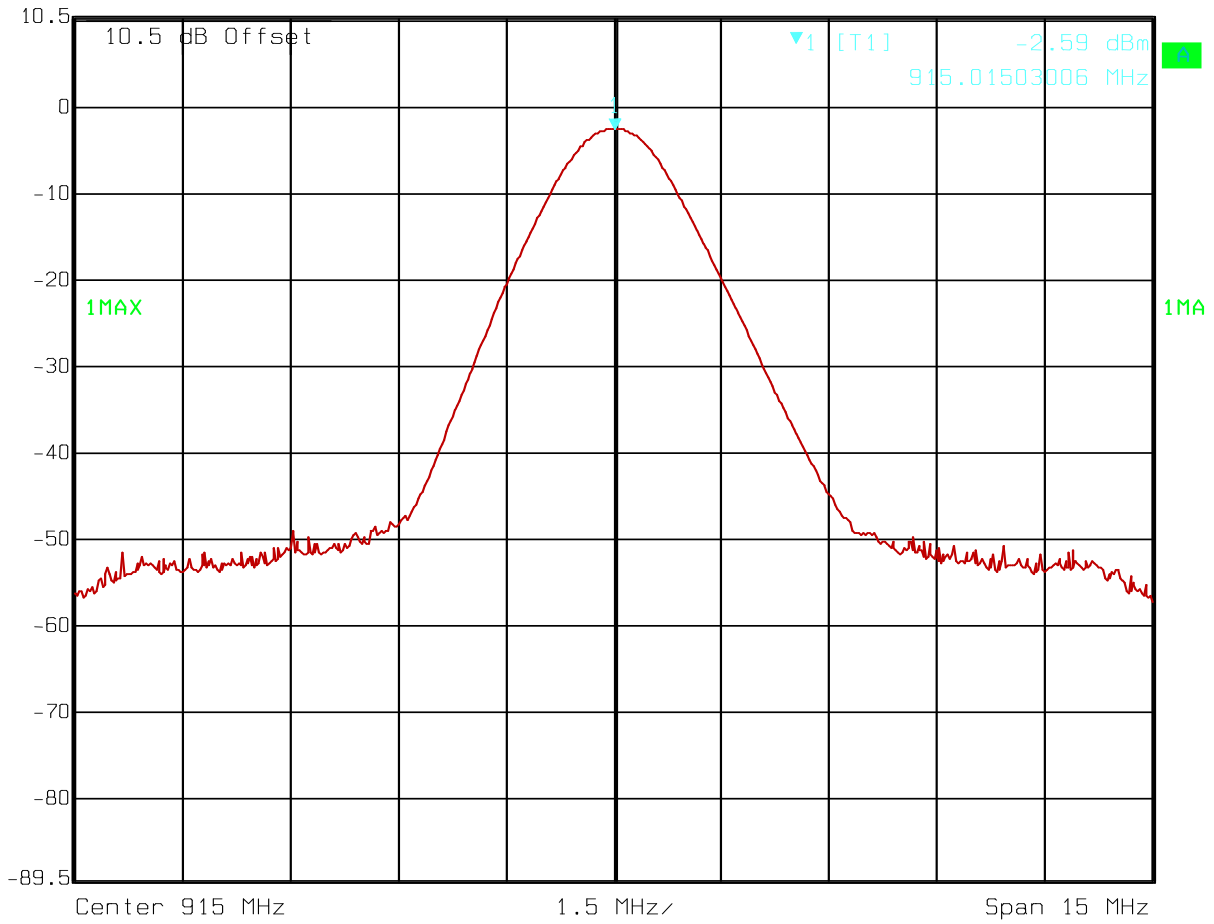


Date: 04.NOV.2011 15:58:57

Conducted Output Power – 903.5MHz



Ref Lvl 10.5 dBm Marker 1 [T1] 915.01503006 MHz RBW 1 MHz RF Att 10 dB
 -2.59 dBm VBW 1 MHz
 Unit dBm SWT 5 ms

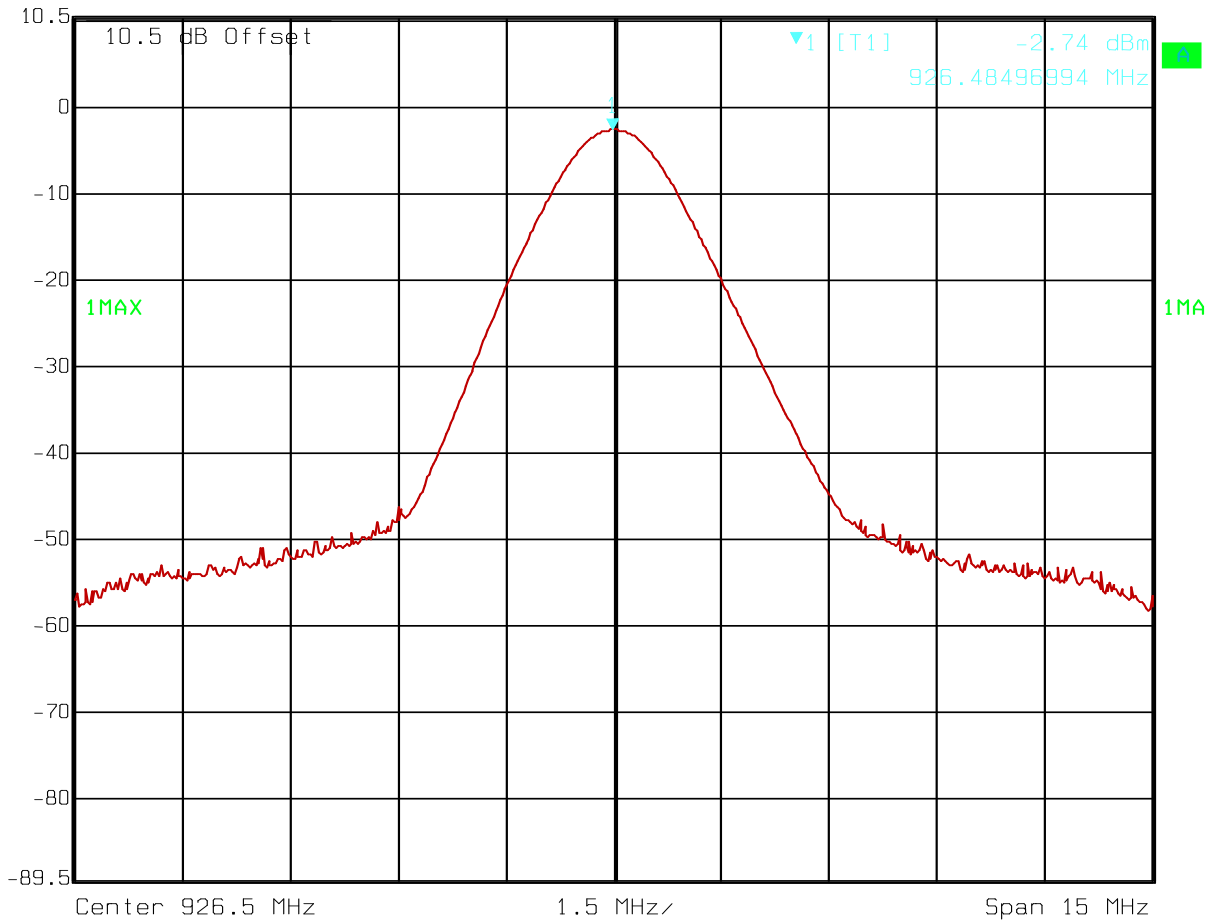


Date: 04.NOV.2011 15:57:15

Conducted Output Power – 915MHz

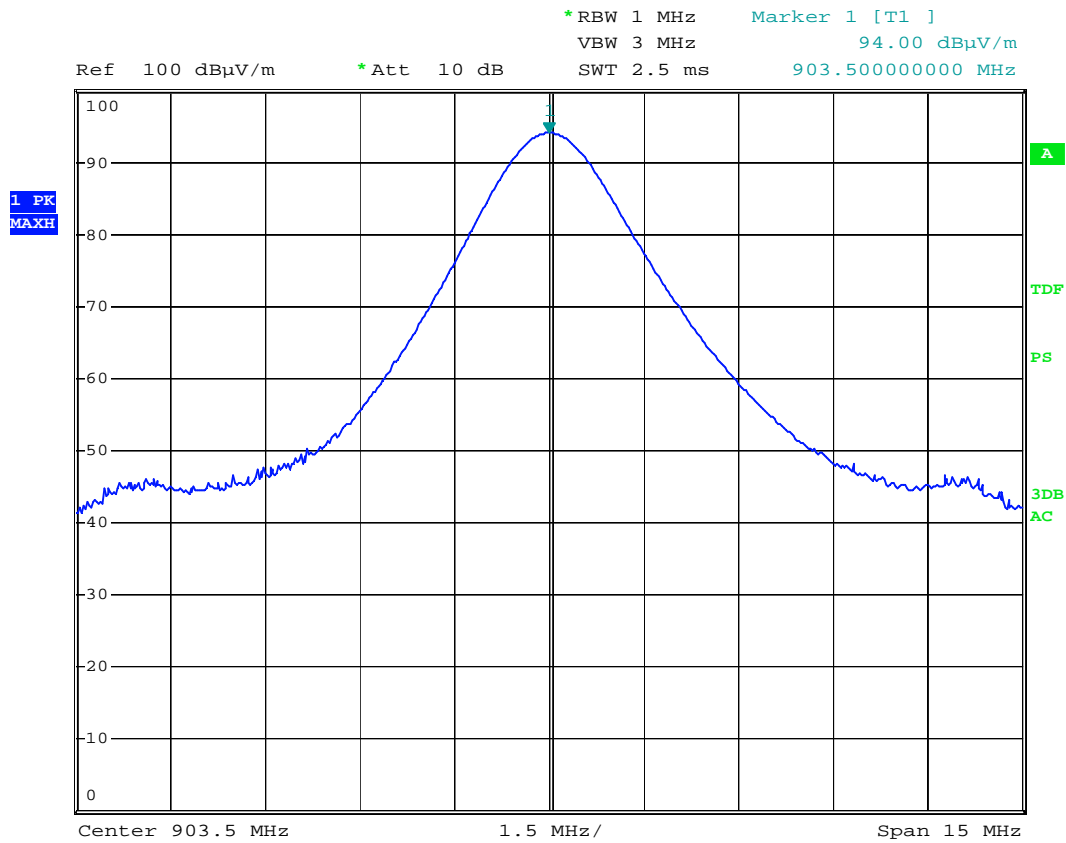


Ref Lvl 10.5 dBm Marker 1 [T1] RBW 1 MHz RF Att 10 dB
 -2.74 dBm VBW 1 MHz
 926.48496994 MHz SWT 5 ms Unit dBm



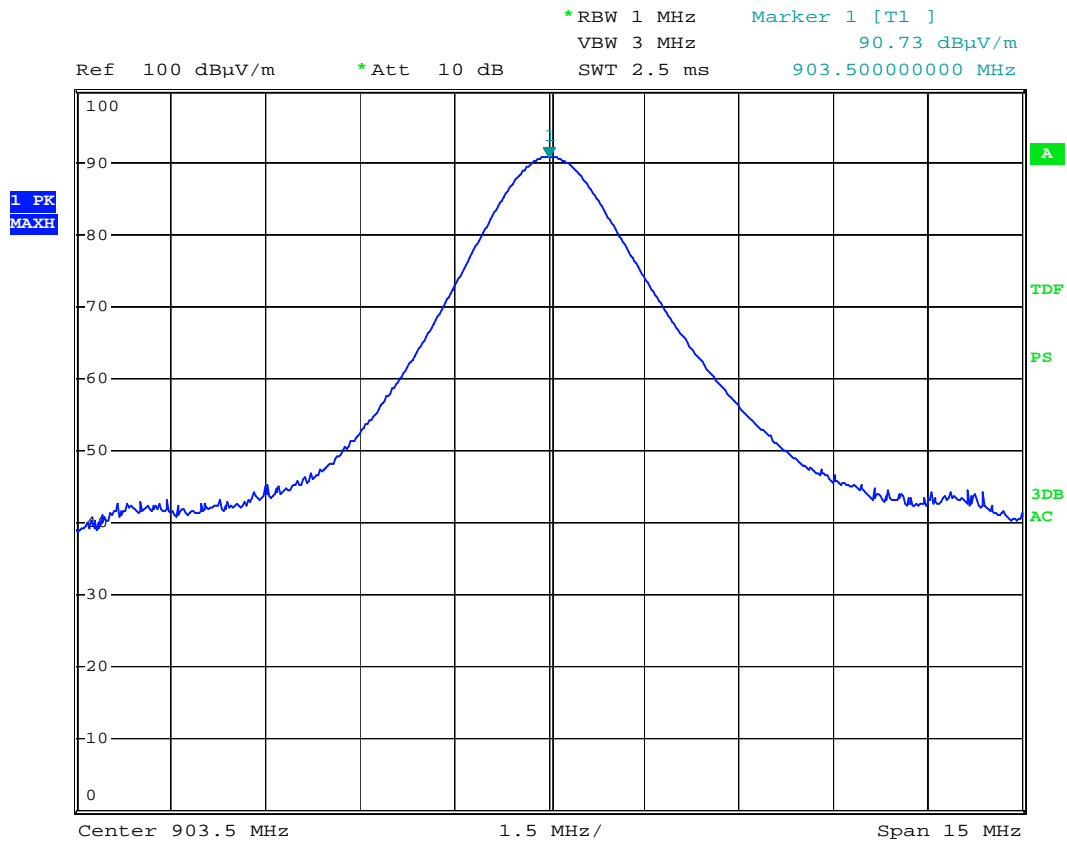
Date: 04.NOV.2011 15:54:54

Conducted Output Power – 926.5MHz



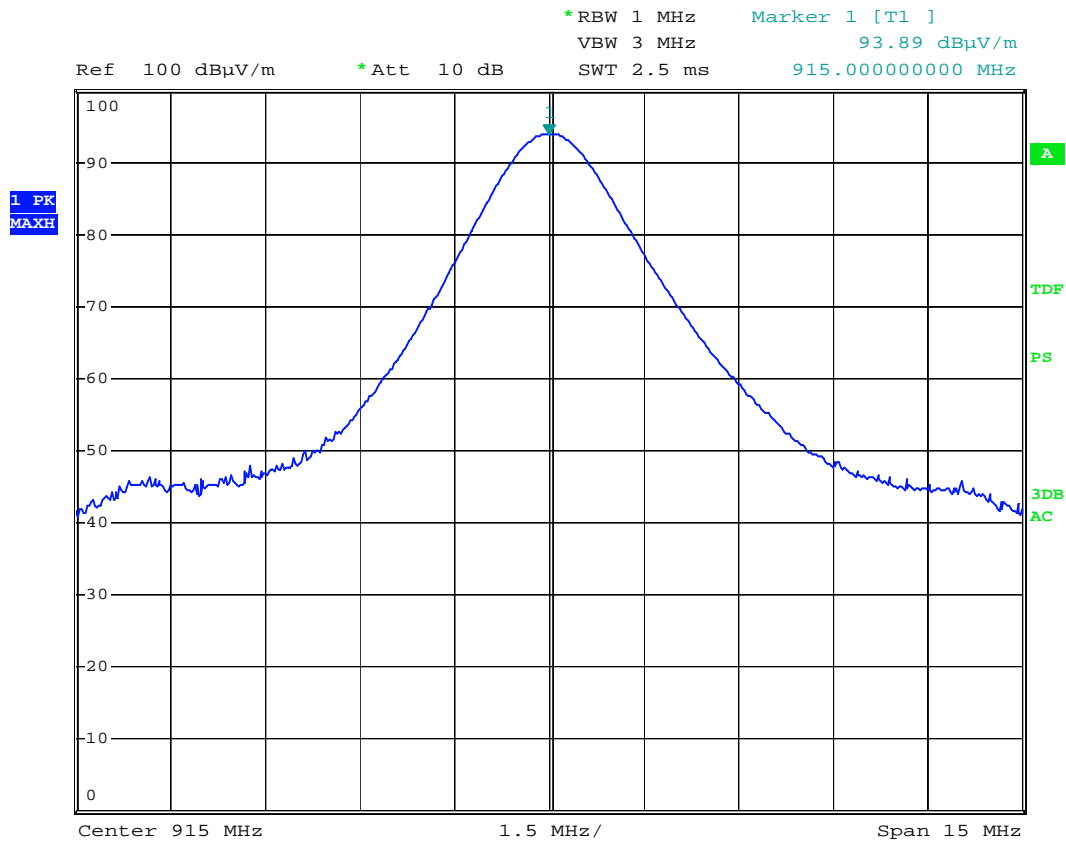
Date: 4.NOV.2011 09:57:25

VP: 903.5MHz – Field strength



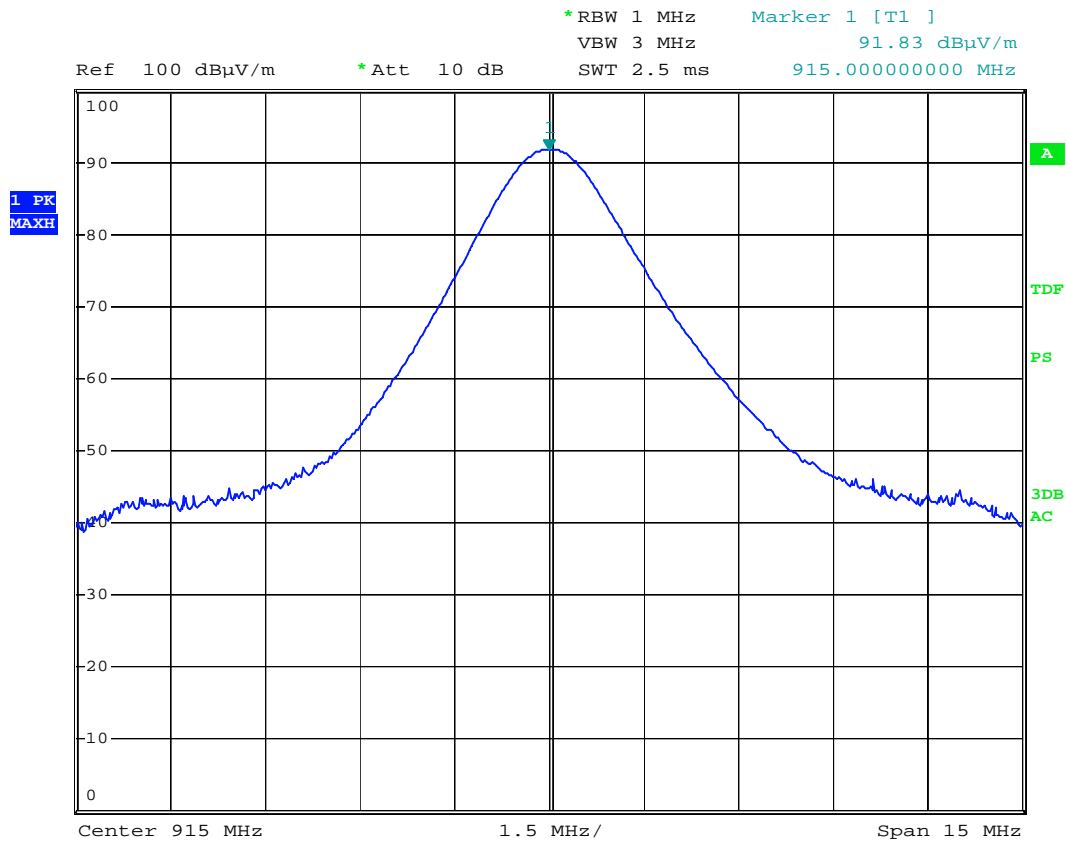
Date: 4.NOV.2011 09:56:04

HP: 903.5MHz – Field strength



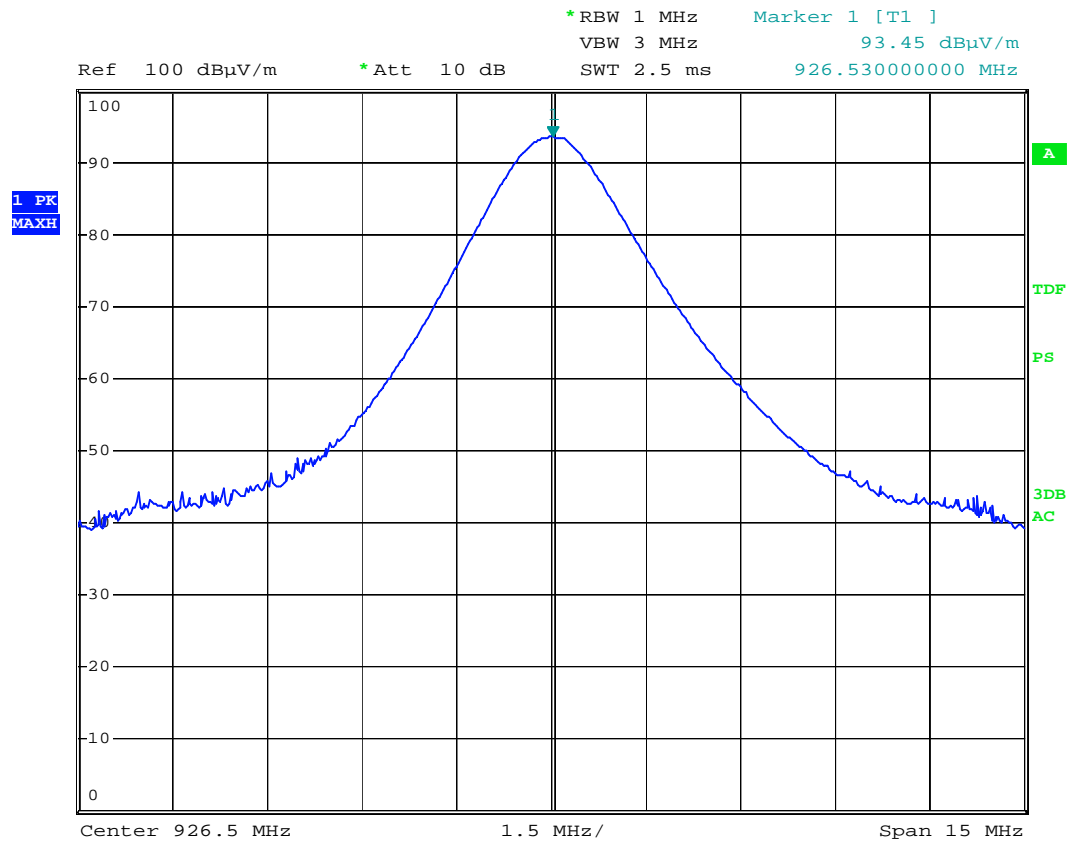
Date: 4.NOV.2011 09:52:06

VP: 915MHz – Field strength



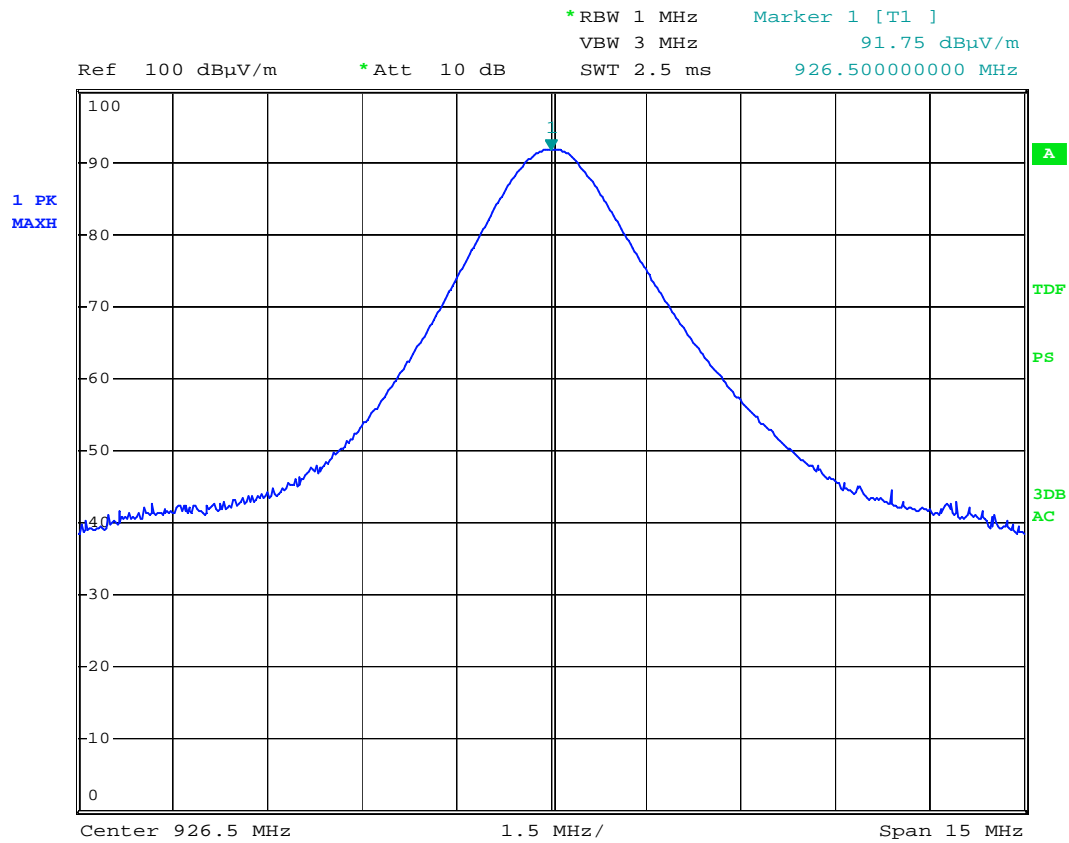
Date: 4.NOV.2011 09:54:17

HP: 915MHz – Field strength



Date: 4.NOV.2011 09:47:49

VP: 926.5MHz – Field strength



Date: 4.NOV.2011 09:45:35

HP: 926.5MHz – Field strength

4.4 Band Edge Emissions

Para. No.: 15.249 (d)

Test Performed By: G.Suhanthakumar	Date of Test: 04.11.2011
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Test Results: Complies

Measurement Data:

Lower Band edge :

RF channel	902 MHz
Measured maximum dBc	52.65

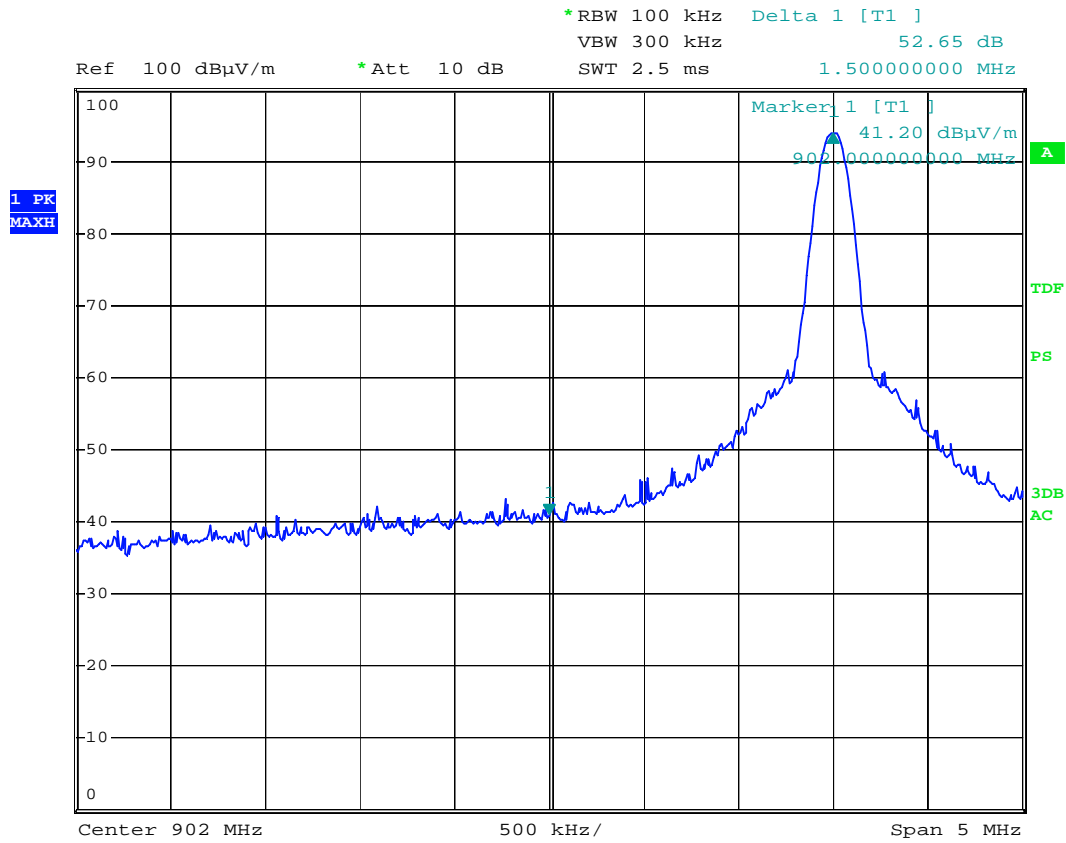
Upper Band edge :

RF channel	928 MHz
Measured maximum dBc	53.44

See the attached graphs

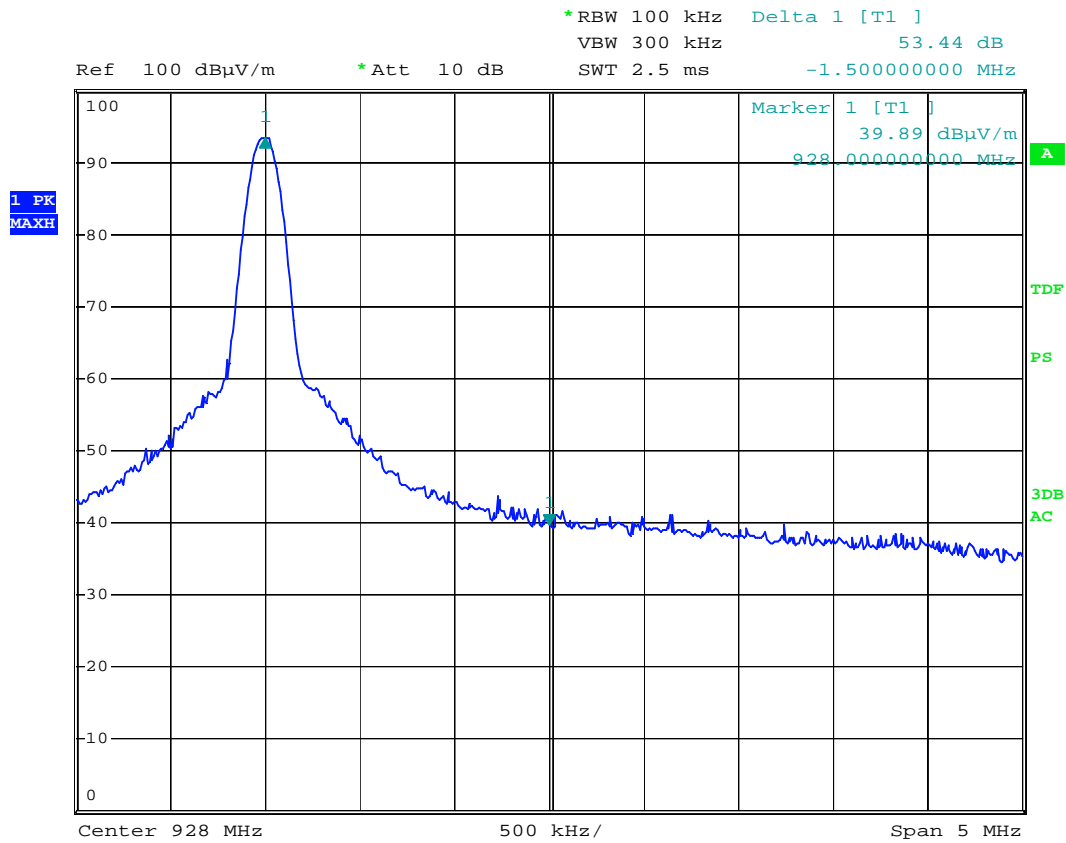
Requirements:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental.



Date: 4.NOV.2011 09:59:23

903.5MHz- Lower band edge –PK detector



Date: 4.NOV.2011 09:49:41

926.5MHz- upper band edge- PK detector

4.5 Spurious Emissions (Radiated)

Para. No.: 15.249 (e)

Test Performed By: G.Suwanthakumar

Date of Test: 04.11.2011

Test Results: Complies

Measurement Data:

Tested item's transmission is with 100% duty cycle

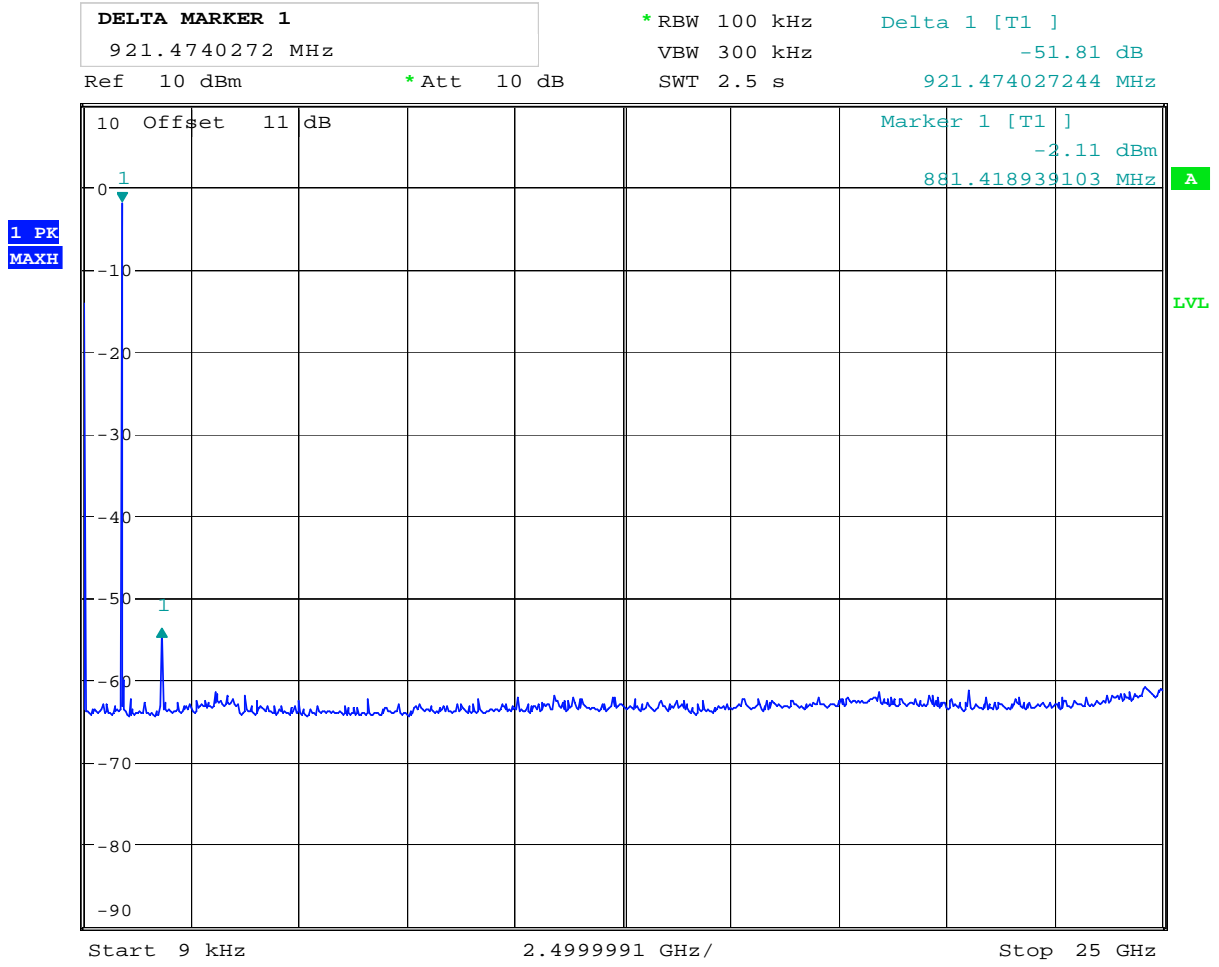
RF conducted emissions 9kHz to 10 GHz

Maximum RF level outside operating band:

RF 915MHz: 51.81 dBC, margin > 20 dB

Requirements:

As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.



Date: 30.NOV.2011 17:17:18

915MHz – Conducted Spurious – 9kHz – 10GHz

Radiated Emissions with antenna, 1-10 GHz

1-10 GHz measured at a distance of 3m.

Peak Detector

Frequency	Dist. corr. factor	Field strength, Peak	Duty cycle corr. factor	Limit	Margin
GHz	dB	dB μ V/m	dB	dB μ V/m	dB
1.807	0	53.58	-	74	20.42
1.830	0	51.37	-	74	22.63
1.853	0	50.14	-	74	23.86
>1.86 - 10	0	None detected	-	74	-

Average Detector

Frequency	Dist. corr. factor	Field strength, AV	Duty cycle corr. factor	Limit	Margin
GHz	dB	dB μ V/m	dB	dB μ V/m	dB
1.807	0	52.77	-	54	1.23
1.830	0	50.14	-	54	3.86
1.853	0	48.42	-	54	0.09
>1.86 - 10	0	None detected	-	54	-

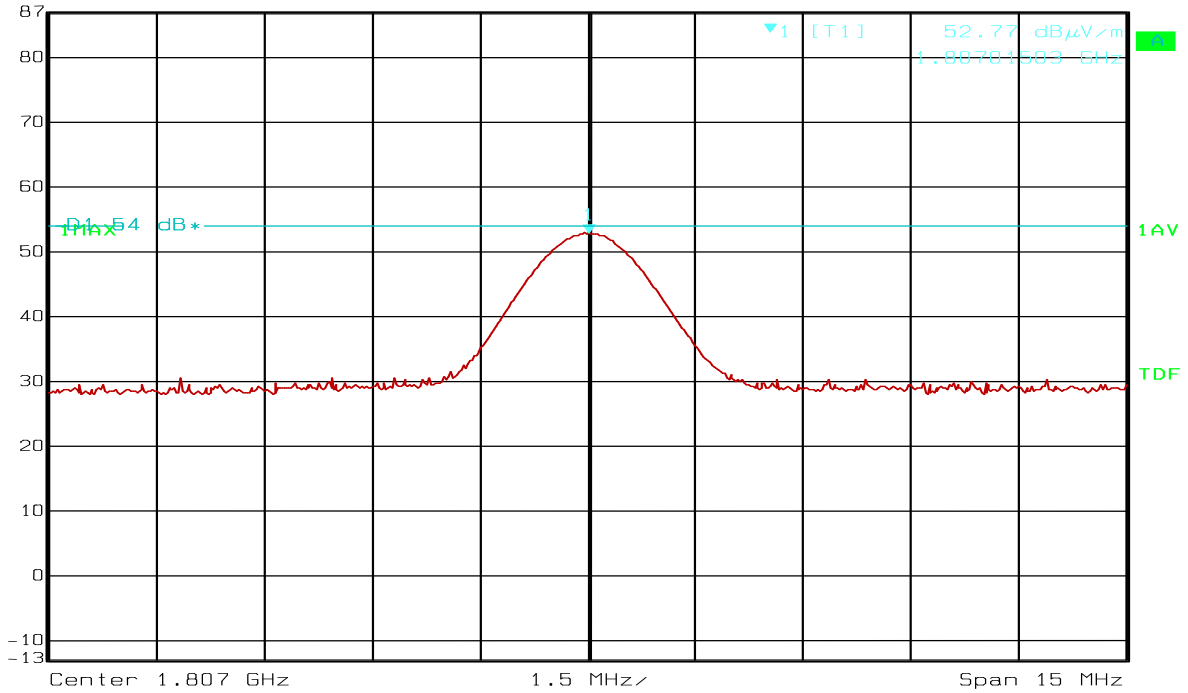
Maximum level is observed with Vertical polarization

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

Requirement:

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

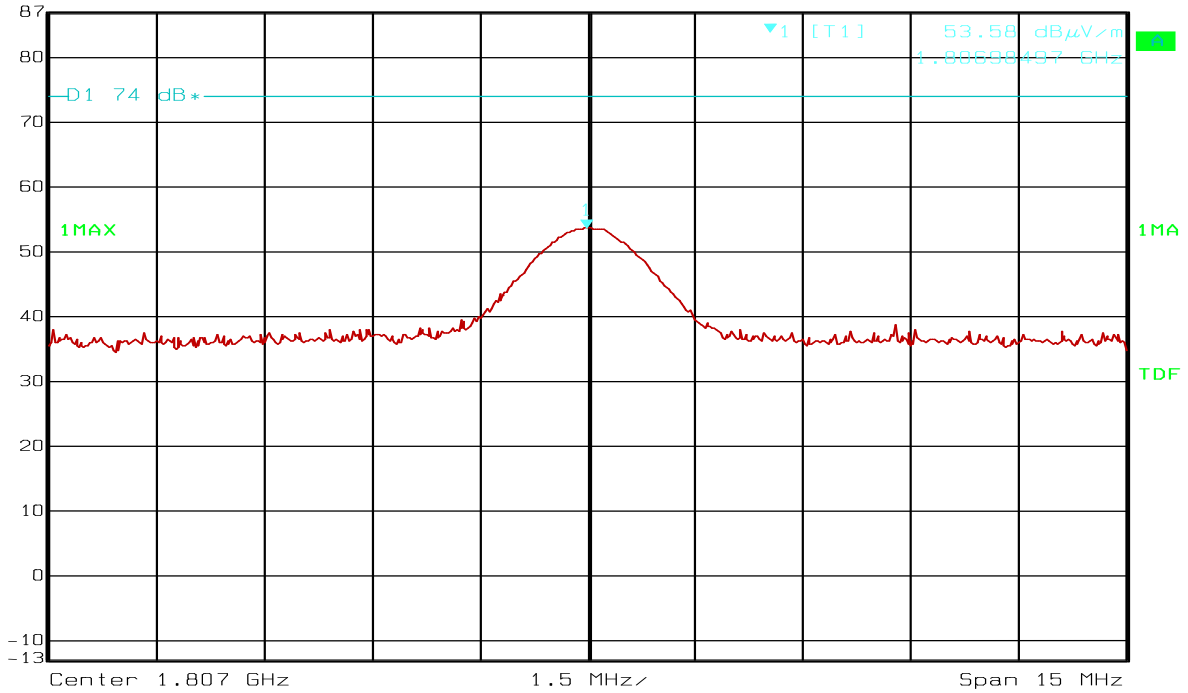
FS
Marker 1 [T1]
RBW 1 MHz RF Att 0 dB
Ref Lvl 87 dB*
52.77 dB μ V/m
VBW 10 MHz
1.80701503 GHz
SWT 5 ms Unit dB μ V/m



Date: 25.NOV.2011 17:02:05

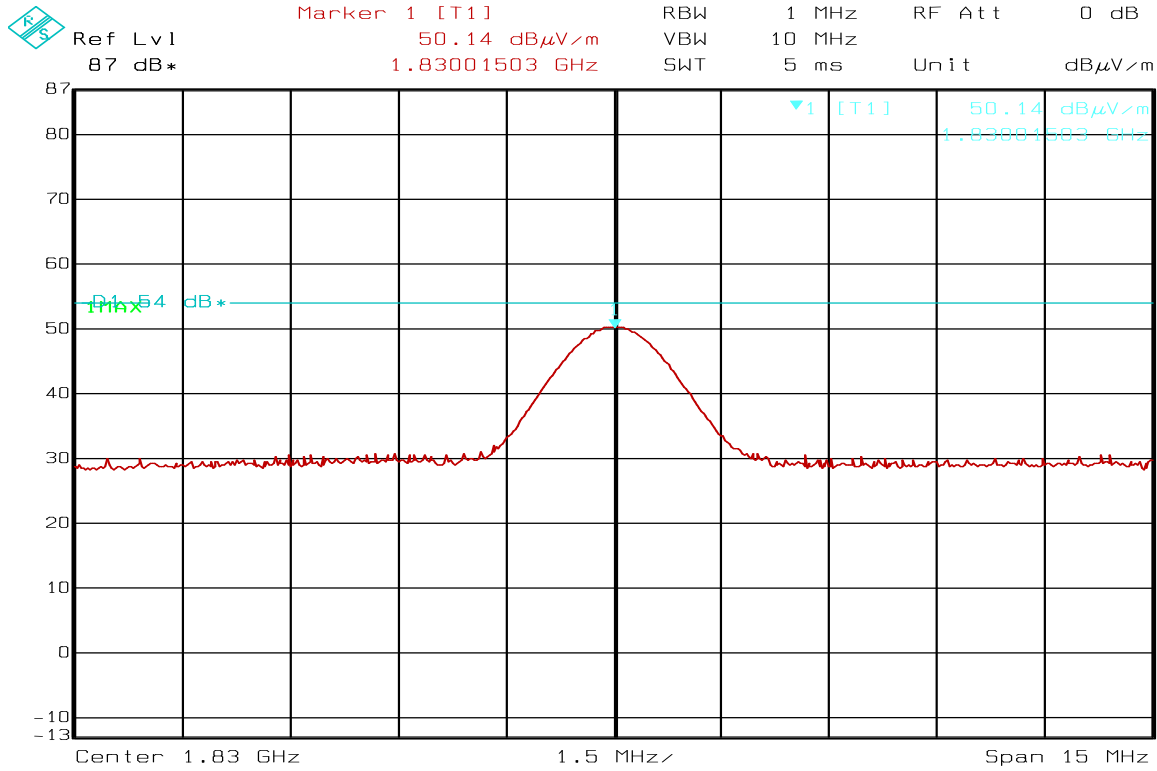
903.5MHz - 2nd Harmonic- AV

FS
Marker 1 [T1]
RBW 1 MHz RF Att 0 dB
Ref Lvl 87 dB*
53.58 dB μ V/m
VBW 1 MHz
1.80698497 GHz
SWT 5 ms Unit dB μ V/m

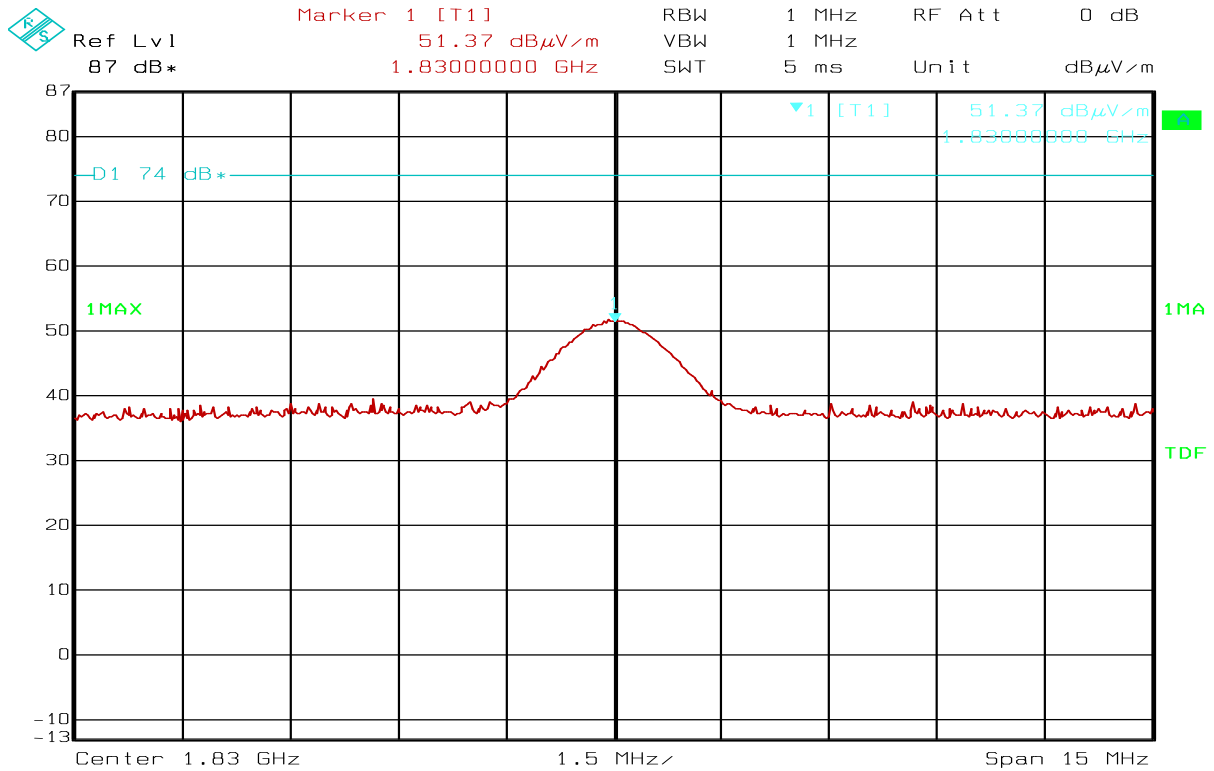


Date: 25.NOV.2011 17:01:27

903.5MHz - 2nd Harmonic- PK



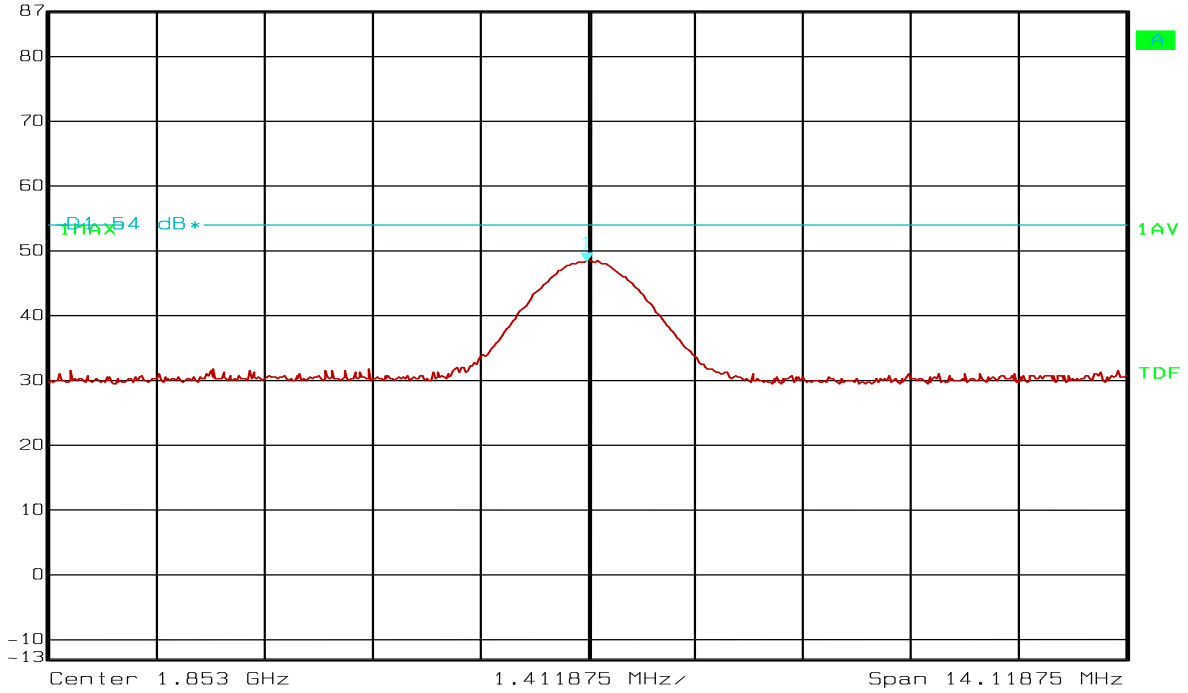
915MHz – 2nd harmonic- AV



915MHz – 2nd Harmonic – PK

◆ ◆ ◆ ◆

Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
87 dB*	48.42 dB μ V/m	VBW	10 MHz		
	1.85298585 GHz	SWT	5 ms	Unit	dB μ V/m

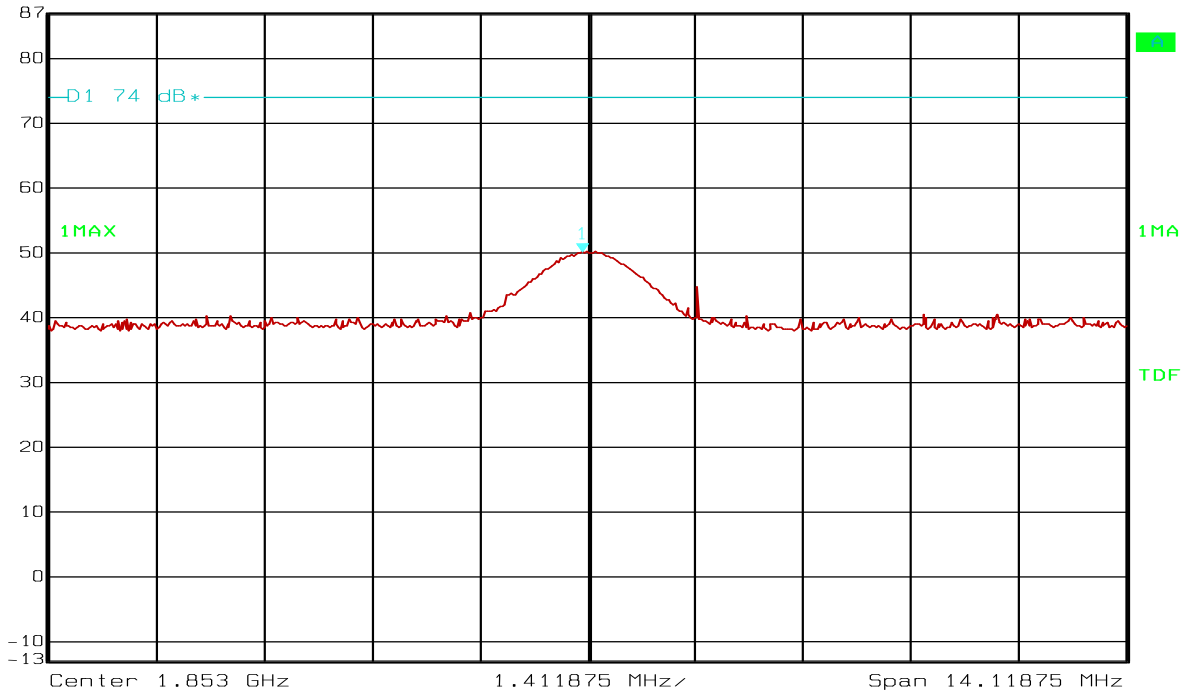


Date: 25.NOV.2011 16:44:19

926.5MHz - 2nd harmonic- AV

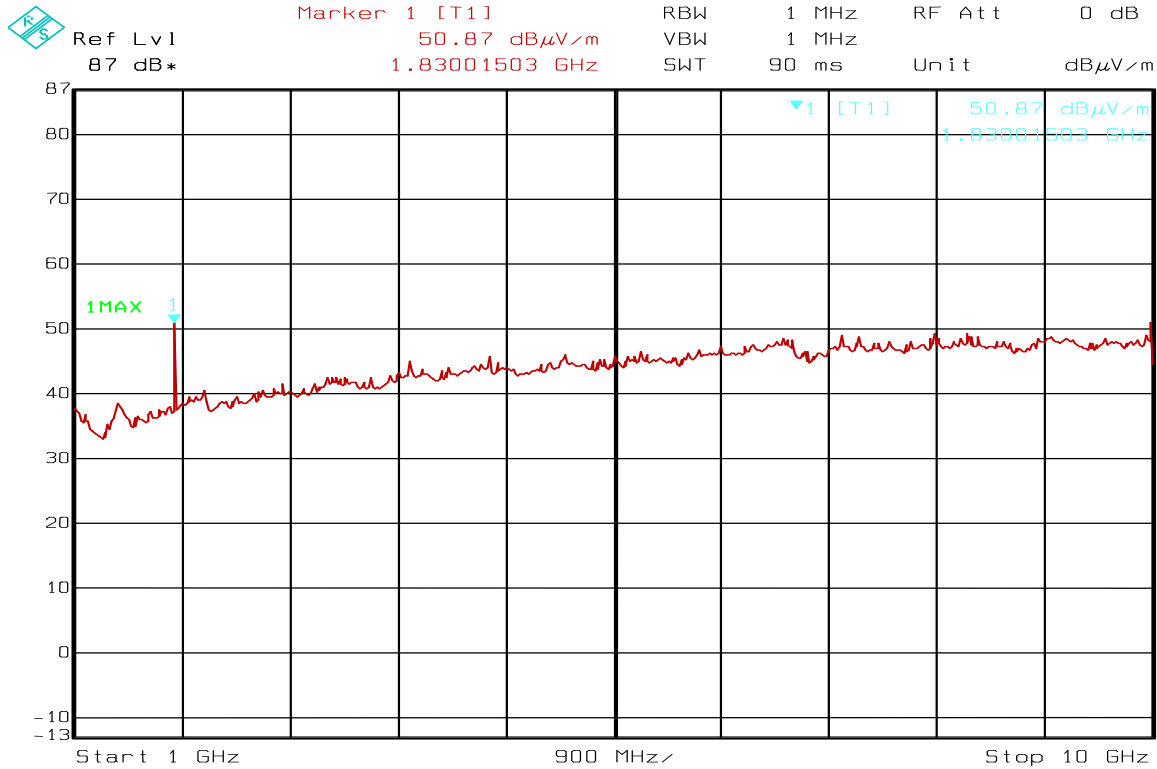
◆ ◆ ◆ ◆

Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
87 dB*	50.14 dB μ V/m	VBW	1 MHz		
	1.85292926 GHz	SWT	5 ms	Unit	dB μ V/m



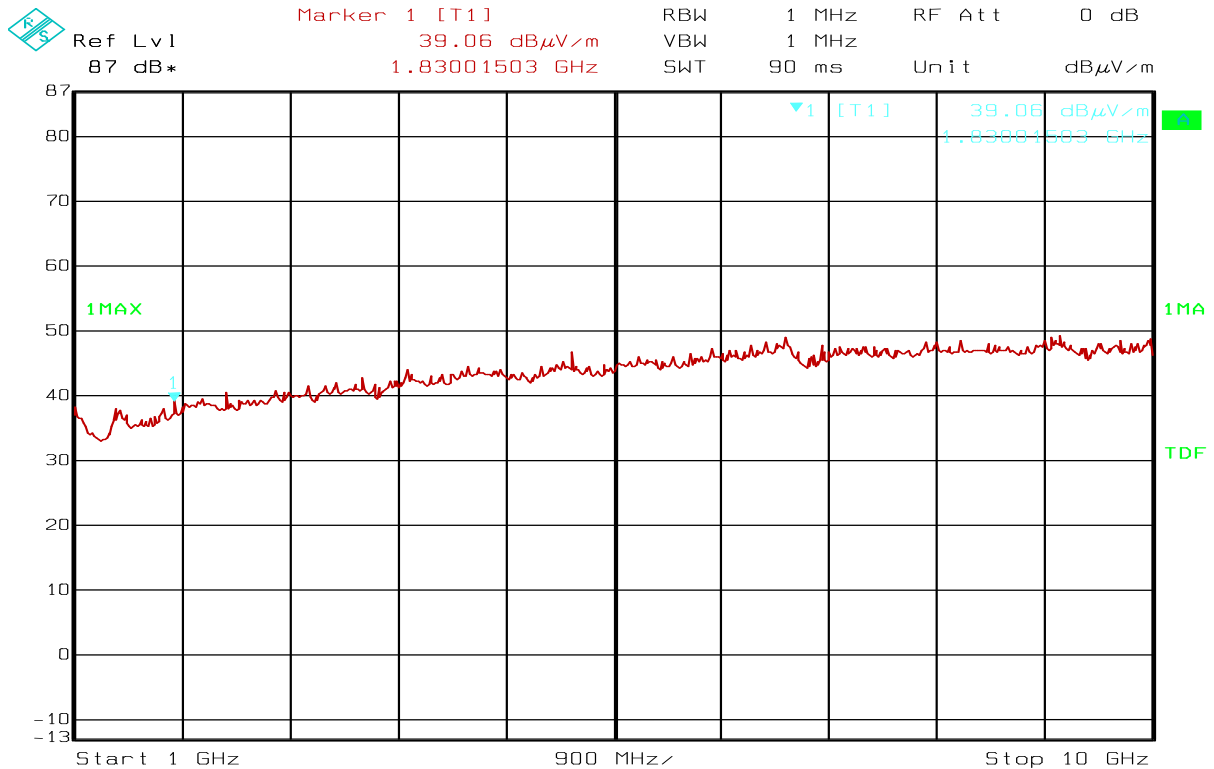
Date: 25.NOV.2011 16:43:24

926.5MHz - 2nd harmonic- PK



Date: 25.NOV.2011 16:58:24

VP: pre-scan 1 - 10GHz -Pk



Date: 25.NOV.2011 16:59:08

HP: pre-view scan 1 - 10GHz -pk

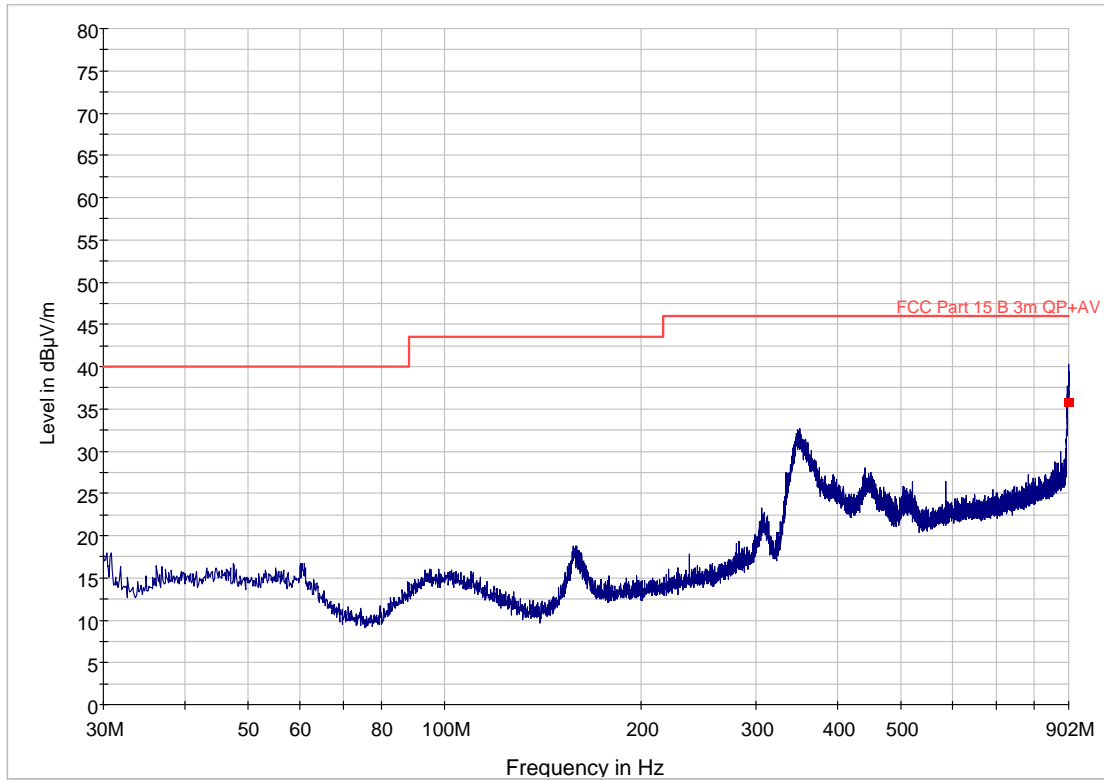
Radiated emissions 30 – 1000 MHz

Detector: Peak

Measuring distance 3 m.

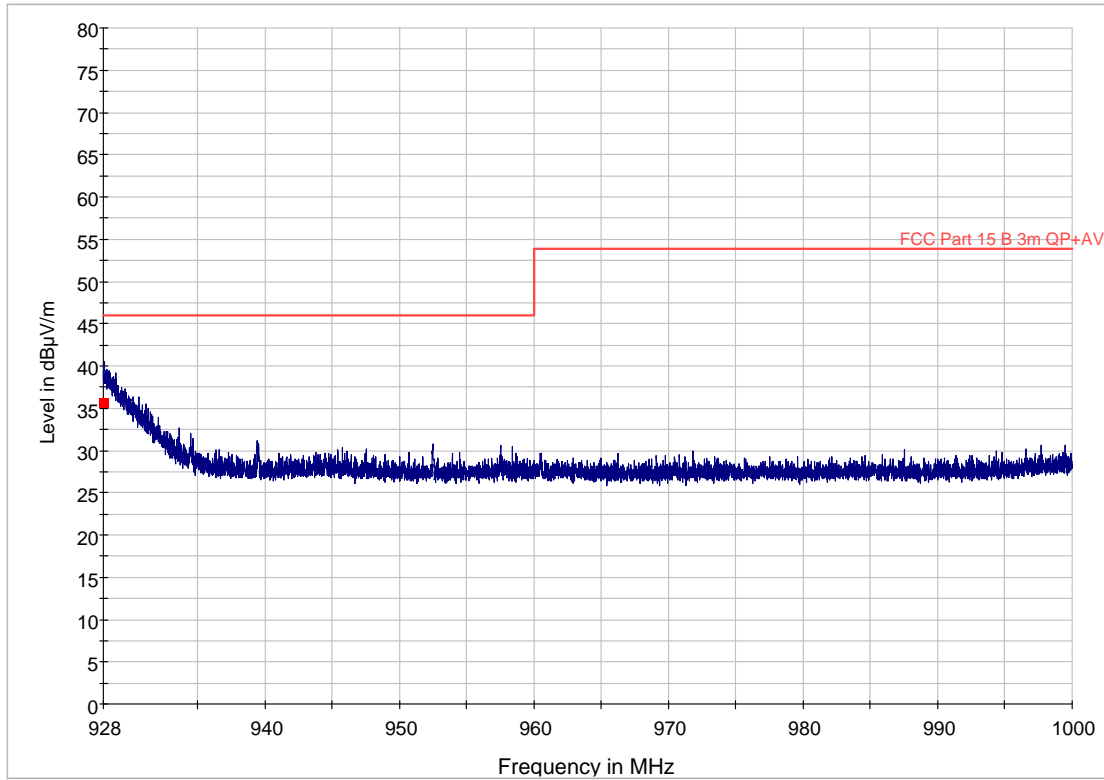
The graph shows peak scan and highest values. The QP values are given in the table below.

FCC Pt15 Class B 30-902M, @3m



Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
901.896490	35.8	1000.0	120.000	100.0	V	94.0	2.7	10.2	46.0	

FCC Pt15 Class B 928-1000M, @3m



Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
928.051692	35.6	1000.0	120.000	100.0	V	0.0	2.9	10.4	46.0	

4.6 Receiver Spurious Emissions (Radiated)

Para. No.: RSS-Gen (6)

Test Performed By: G.Suwanthakumar	Date of Test: 04.11.2011
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Test Results: Complies

Measurement Data:

Radiated Emissions: 30MHz – 10GHz

Measured with Peak Detector

See attached plots below.

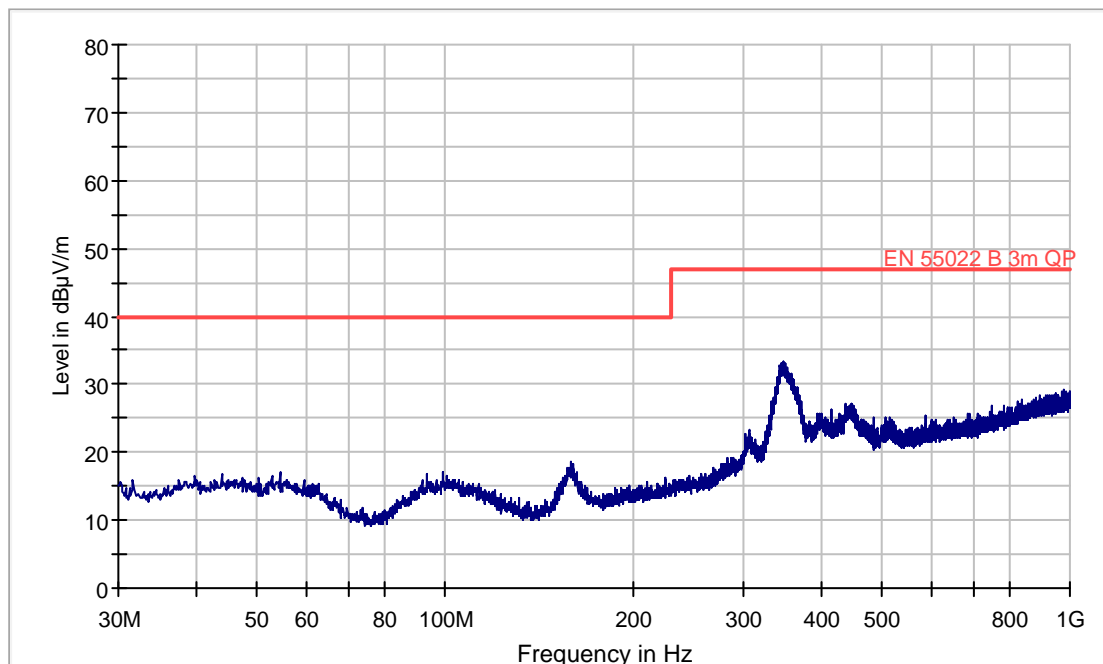
Requirement(Radiated):

Spurious emissions from receivers shall not exceed the radiated limits as given in RSS-Gen table 2 or FCC part 15B.109 (a) or CISPR 22

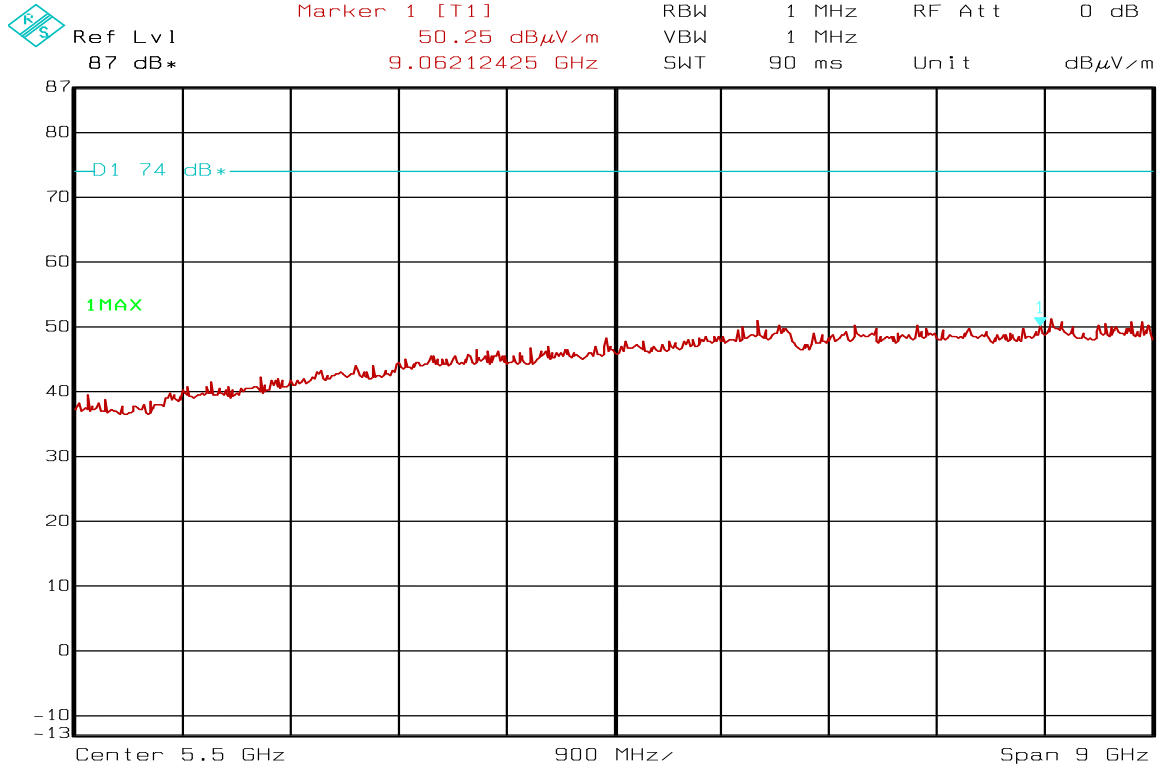
Requirement(Conducted):

Receiver spurious emissions at any discrete frequency shall not exceed 2 nano watts in the band 30-1000 MHz, and 5 nano watts above 1000 MHz

EN 55022 Class B 0-1G 3m

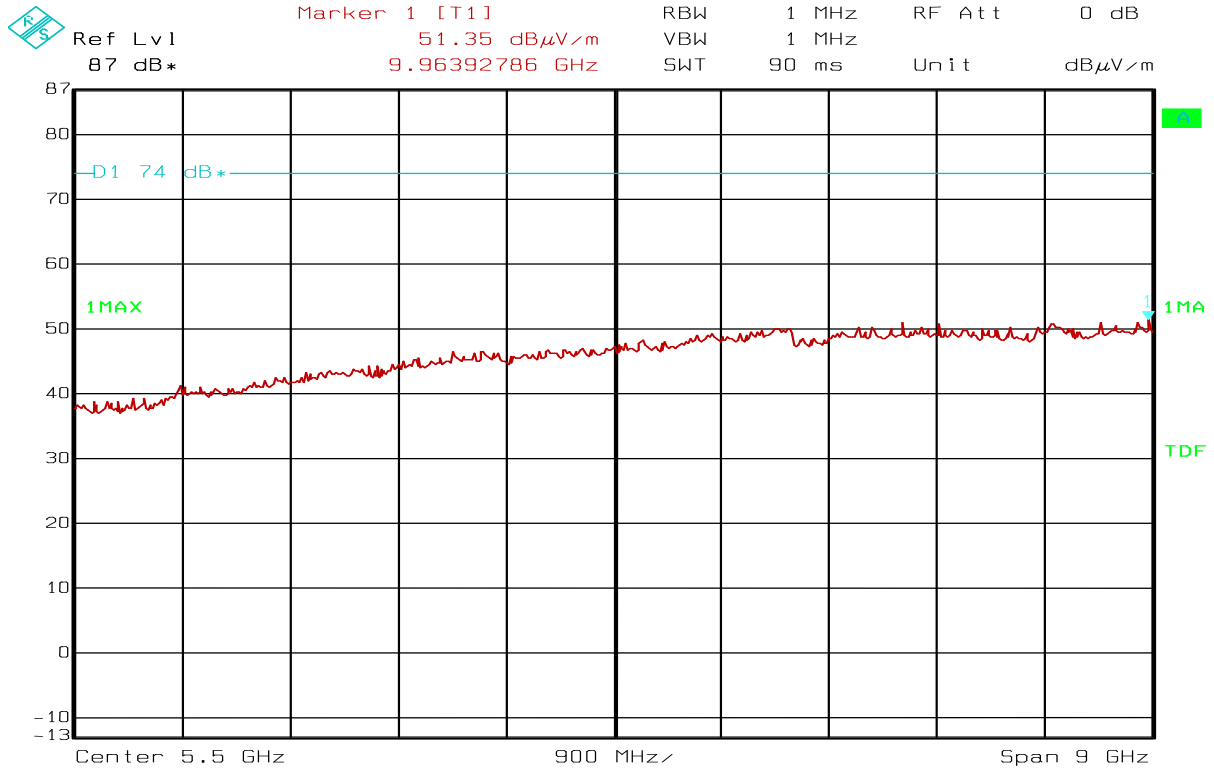


Class B 30MHz-1GHz 3m, peak



Date: 04.NOV.2011 13:03:59

RX, VP - 1 - 10GHz -Pk



Date: 04.NOV.2011 13:03:29

RX, HP 1 - 10GHz -Pk

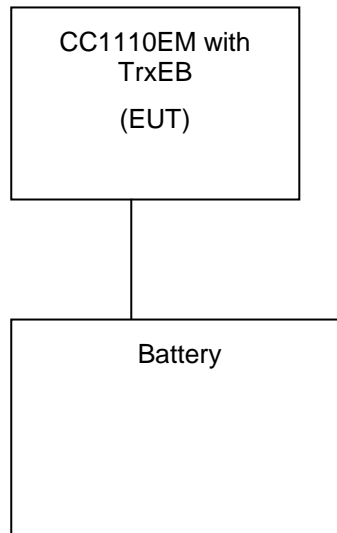
5 LIST OF TEST EQUIPMENT

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.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337	2010.12.15	2012.12.15
2	ESHS10	Spectrum Analyzer	Rohde & Schwarz	N-3528	2011.06.21	2012.06.21
3	3115	Antenna horn	EMCO	LR 1330	2010.08.05	2013.08.05
4	643	Antenna horn	Narda	LR 093	2009.01.26	2012.01.26
5	642	Antenna horn	Narda	LR 220	2009.01.26	2012.01.26
6	PM7320X	Antenna horn	Siverts lab	LR 103	2009.01.26	2012.01.26
7	DBF-520-20	Antenna horn	Systron Donner	LR 101	2009.01.26	2012.01.26
8	638	Antenna horn	Narda	LR 098	2010.06.17	2015.06.17
9	VULB 9163	Antenna TriLog	Schwarzbeck	LR1616	2010-08	2012-08
10	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2011-09-27	2012-09-27
11	LNA6900	Pre-amplifier	Teseq	LR 1593	2010-11	2011-11
12	ESCI	Test Receiver	Rohde & Schwarz	N-4529	2010.11.08	2012.11.08
13	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076	2011-11-03	2013-11-03
14	80S	Signal Generator	Powertron	LT 502	Cal b4 use	
15	Model 87 V	Multimeter	Fluke	LR 1598	2010-12-14	2011-12-14
16	FSP30	Spectrum Analyzer	Rohde & Schwarz	LR 1551	2011-03	2012-02
17	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	2010.09.28	2012.09.28
18	ESH3-Z2	Puls Limiter	Rohde & Schwarz	N-3932	2010.11.04	2012.11.04

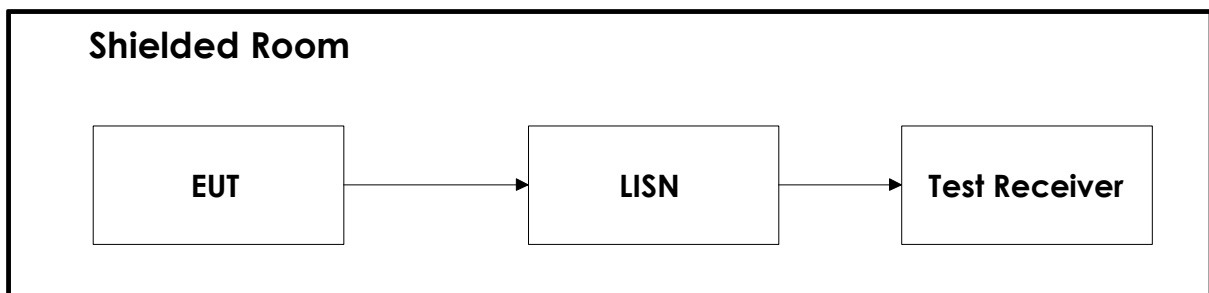
6 BLOCK DIAGRAM

6.1 System set up for radiated measurements



Test equipment: 2, 3, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

6.2 Power line Conducted Emission



Test equipment: 17,18,19,20,21

6.3 Test Site Radiated Emission

