Test report no. : 182228-4

Item tested : CC1110EM-868-915

Type of equipment : Low power Transceiver
903.5 – 926.5 MHz

Client : Texas Instruments Norway AS

www.nemko.com

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 June 2013

Authorized by : .....

Frode Sveinsen
Technical Verificator

Nemko AS, Gaustadalléen 30, P.O.Box 73 Blindern, NO-0314 Oslo Norway **T** +47 22 96 03 30 **F** +47 22 96 05 50 Enterprise number NO974404532
Visiting address: Nemko Kjeller, Instituttveien 6, P.O.Box 96, NO-2027 Kjeller Norway **T** +47 64 84 57 00 **F** +47 64 84 57 05

CONTENTS

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:	45

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 :	CC1110EM-868-915
Model/version :	CC1110EM-868-915
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
Number of Channels :	1
Operating Modes :	TX & RX
Type of Modulation :	2-GFSK
Data rate:	1.2kbit/s
User Frequency Adjustment :	None, Software controlled
Rated Output Power :	10 dBm (maximum)
Type of Power Supply :	Tested with 9 V Primary Battery
Antenna Connector :	SMA
Antenna type:	Whip antenna
Antenna Diversity Supported :	None

Description of Test Item

The CC1110EM-868-915 is an RF-transceiver module. It is based on a system on-chip device.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 – 22 °C
Relative humidity:	35 – 45 %
Normal test voltage:	9.0 V 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 -2011-11-09

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

☒ New Submission ☒ Production Unit

☐ Class II Permissive Change ☐ Pre-production Unit

DXT Equipment Code ☐ 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 #: 182228-4

TESTED BY: G.Suhanthakumar, Test engineer DATE: 2011-11-10

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	N/A [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.Suhanthakumar	Date of Test: 04-Nov-2011

Measurement Data:

Temperature	Channel nr.	Given Frequency (MHz)	Measured value (MHz)	Deviation (Hz)
20 ° C	-	903.500	903.49717	0.00283
	-	915.000	914.99708	0.00292
	-	926.500	926.49701	0.00299

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-Nov-2011

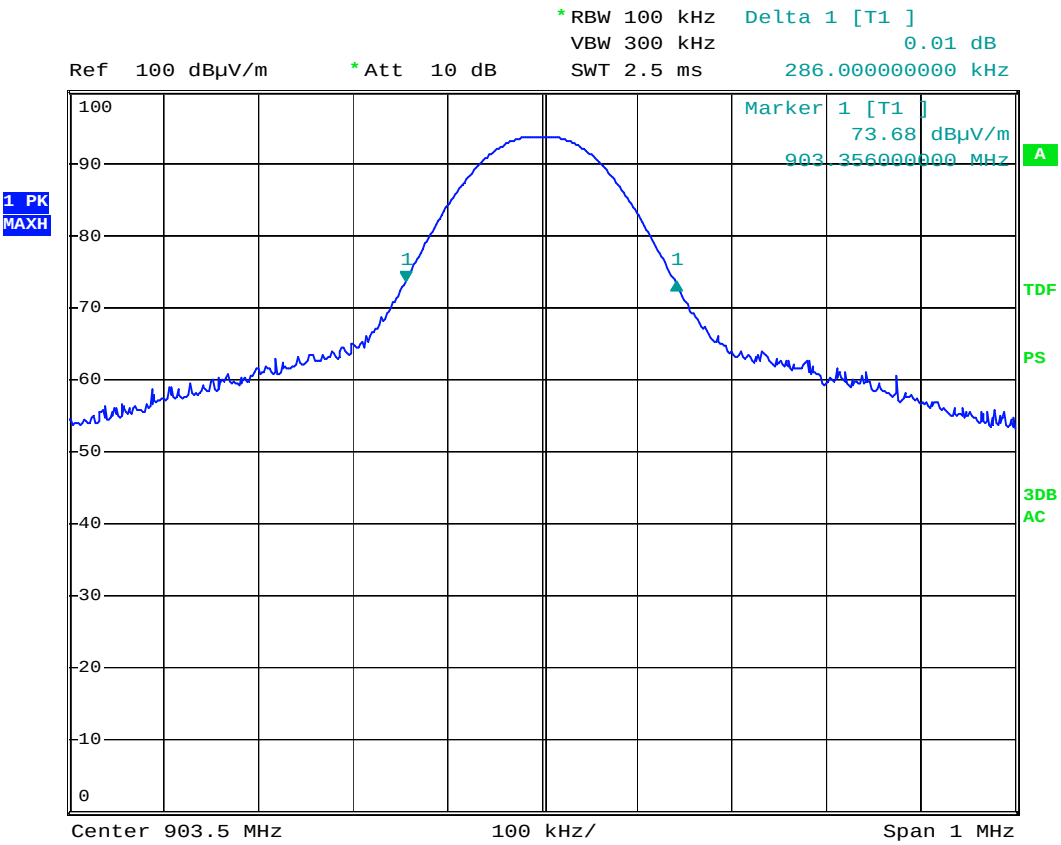
Test Results: Complies

Measurement Data:

Data Rate	20 dB Bandwidth (kHz)		
	903.500MHz	915.000MHz	926.500MHz
1.2kbps	286	276	272

Requirements:

For information only



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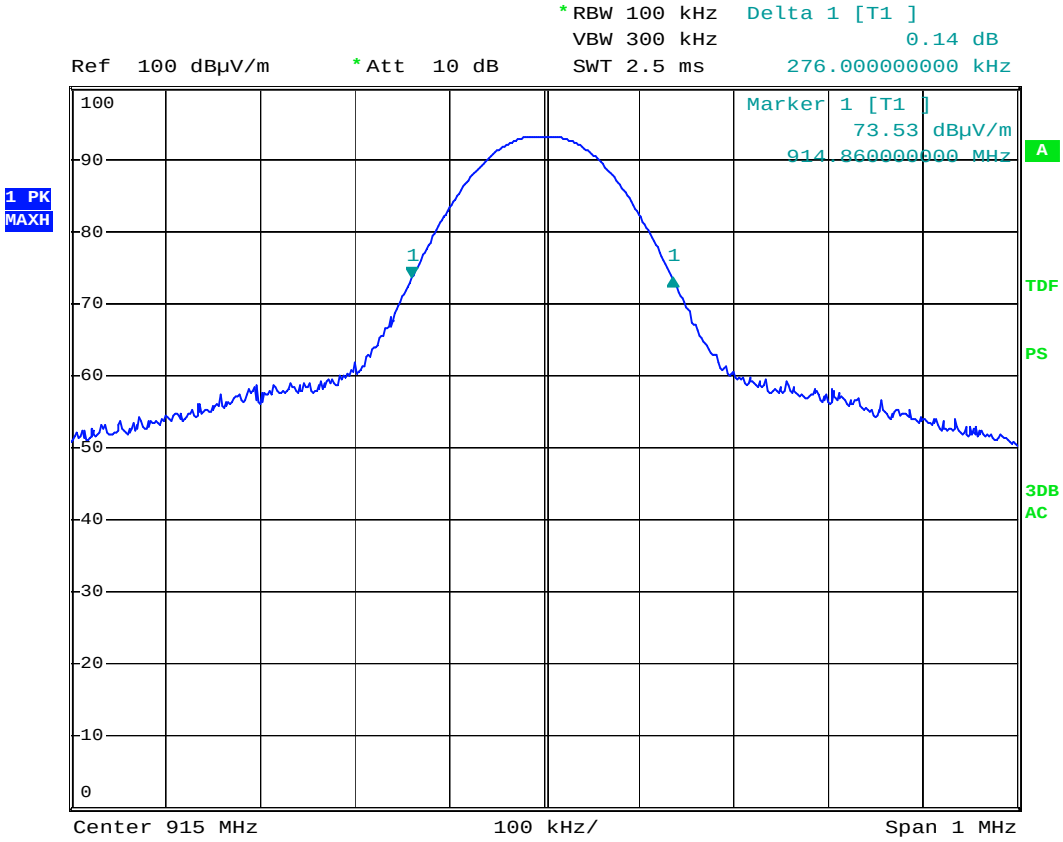
903.5MHz – 20 dB bandwidth – 286kHz



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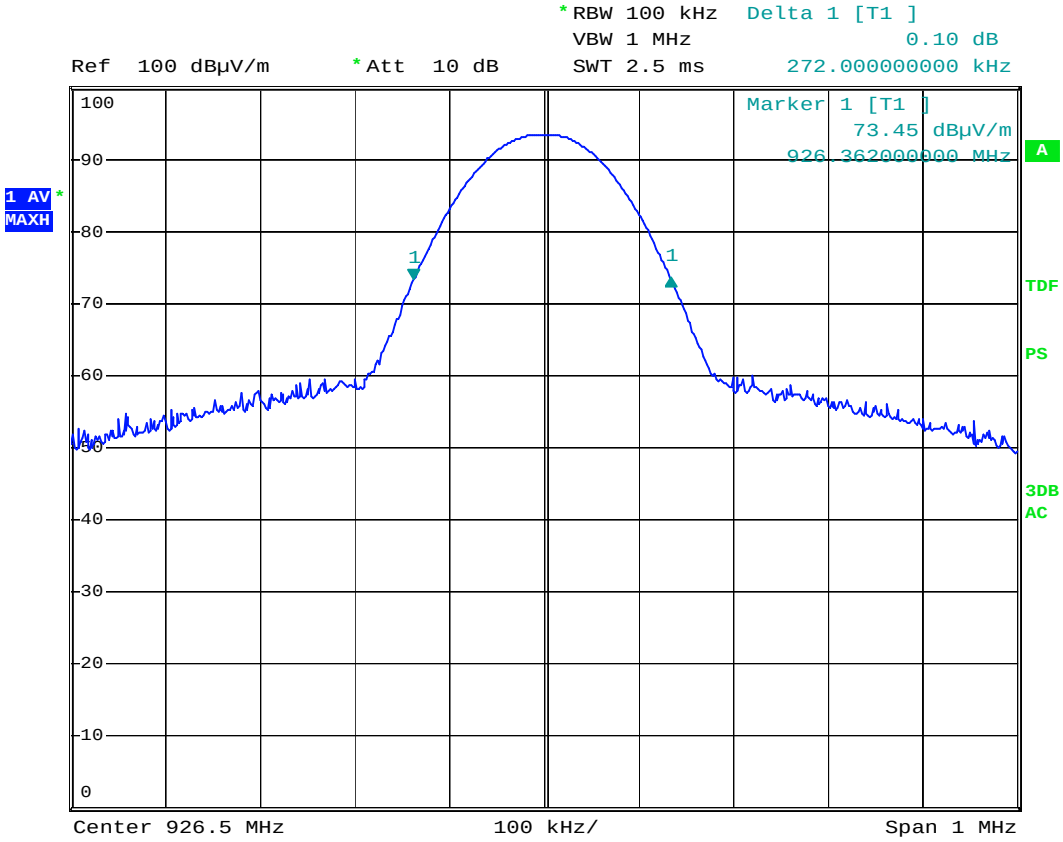
915MHz – 20 dB bandwidth – 276kHz



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926.5MHz – 20 dB bandwidth – 272kHz

4.3 Peak Power Output

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

Test Performed By: G.Suhanthakumar	**Date of Test: 04-Nov-2011**

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	**903.5MHz**	**915MHz**	**926.5MHz**
@ 1.2kbps, Measured value (dBm)	-4.00	-4.08	-4.11

Maximum Field strength

RF channel	**903.5MHz**	**915MHz**	**926.5MHz**
VP: Measured value (dBµV/m)	93.80	93.52	93.46
HP: Measured value (dBµV/m)	91.70	91.98	91.15

Calculated erp & antenna gain

RF channel	**903.5MHz**	**915MHz**	**926.5MHz**
Radiated power (mW)	0.72	0.67	0.67
Radiated erp (dBm)	-1.4	-1.7	-1.8
Antenna gain dBd	+2.6	+2.4	+2.3

Radiated measurements are done at 3 m distance.

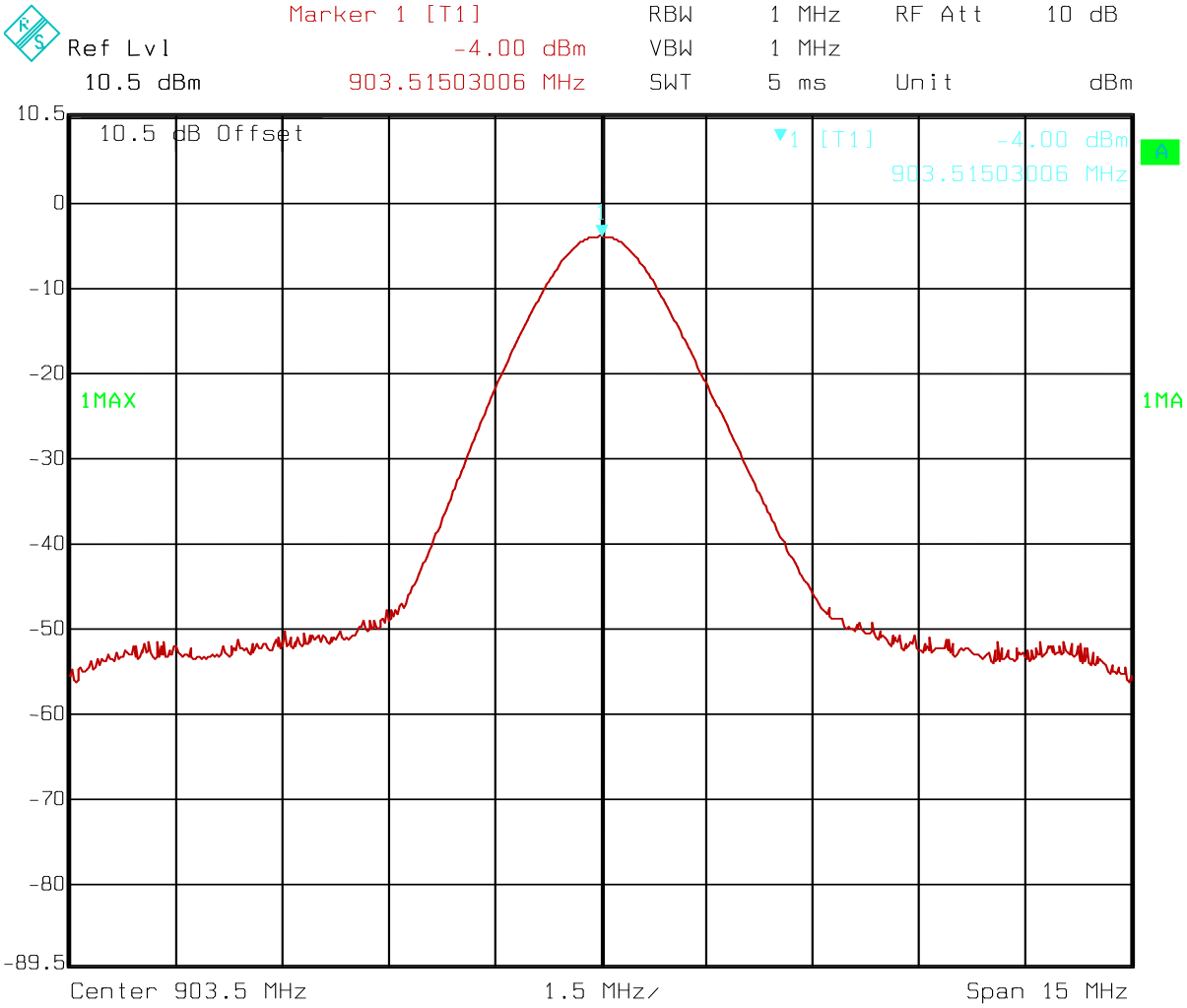
Radiated Power is calculated from measured field strength by the formula in DA00-705.

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

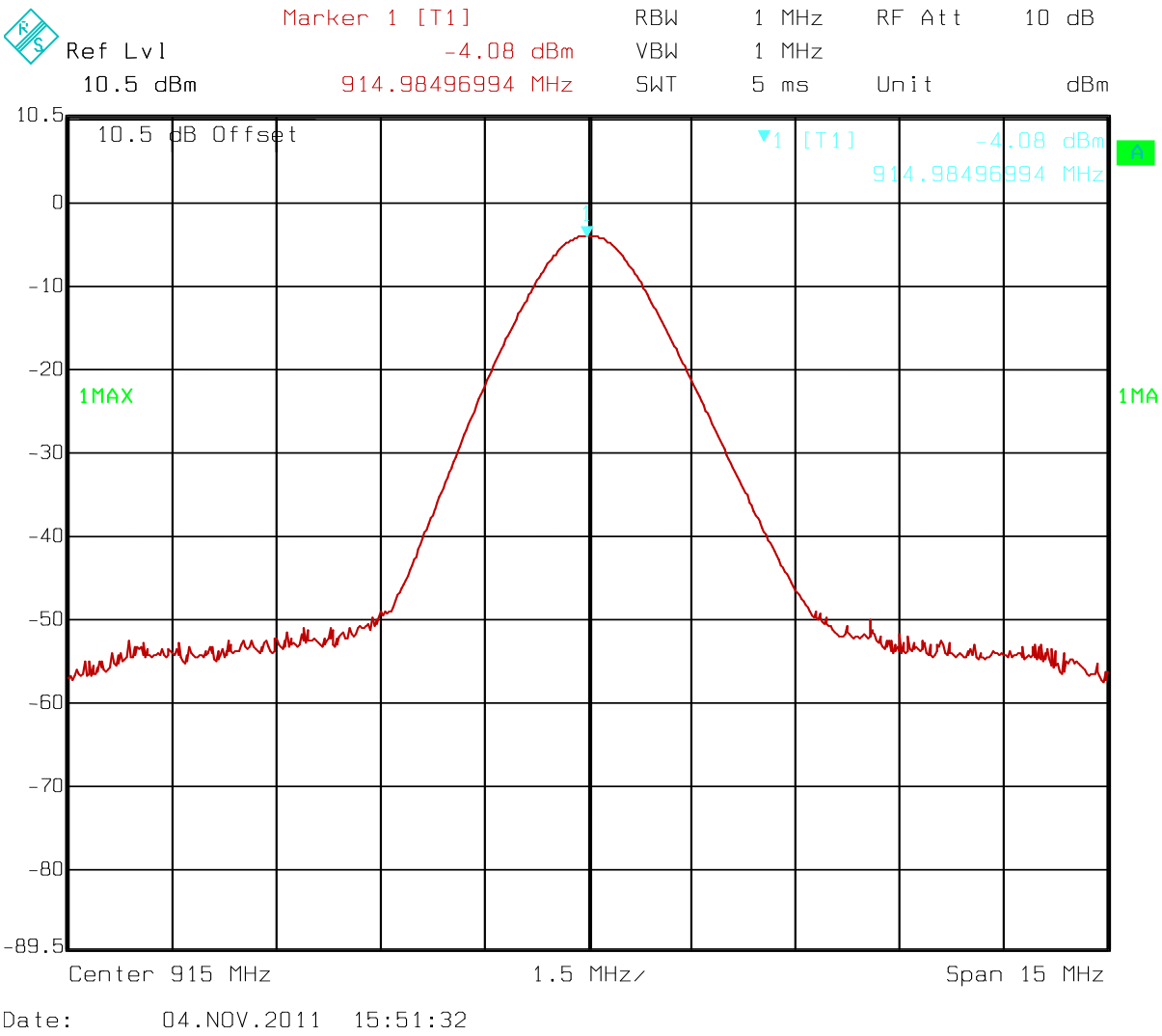
A new battery was used.

Requirements:

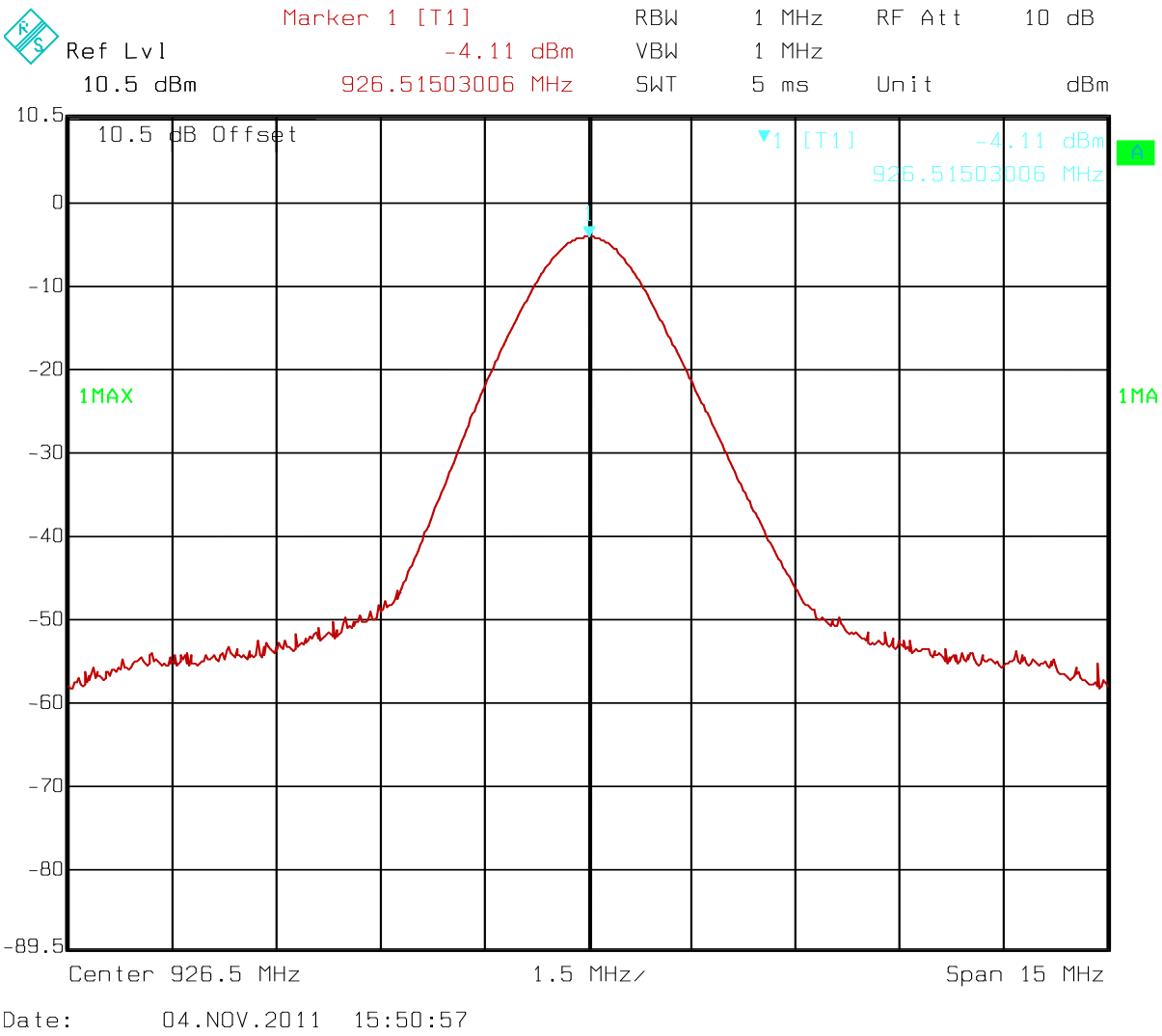
The maximum peak output power shall be ≤ 94dBµV/m



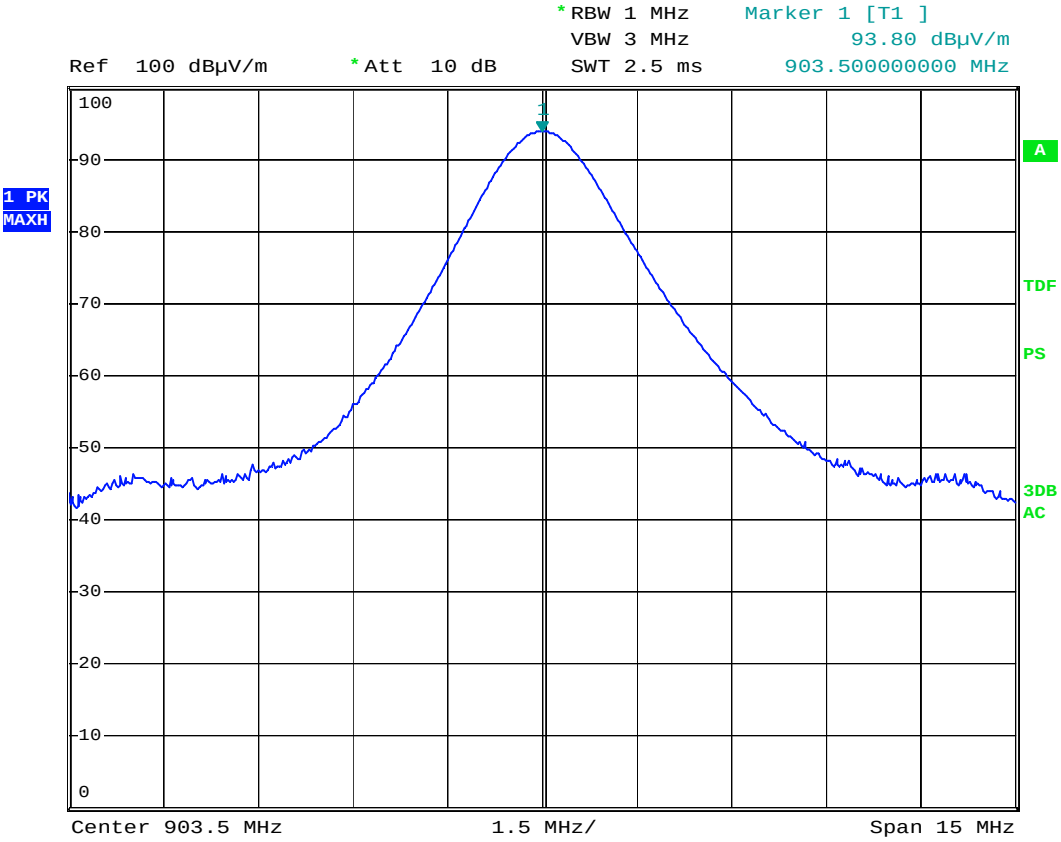
Conducted power – 903.5MHz



Conducted power – 915MHz



Conducted power – 926.5MHz



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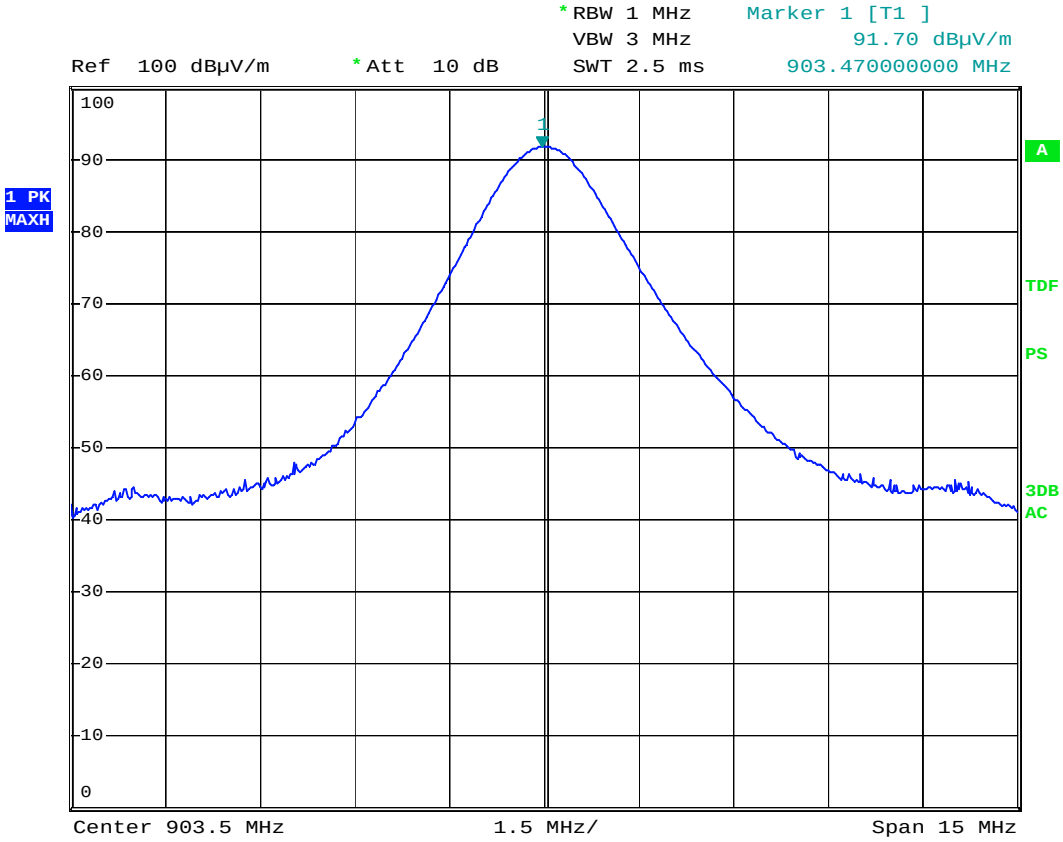
VP: 903.5MHz – Field strength



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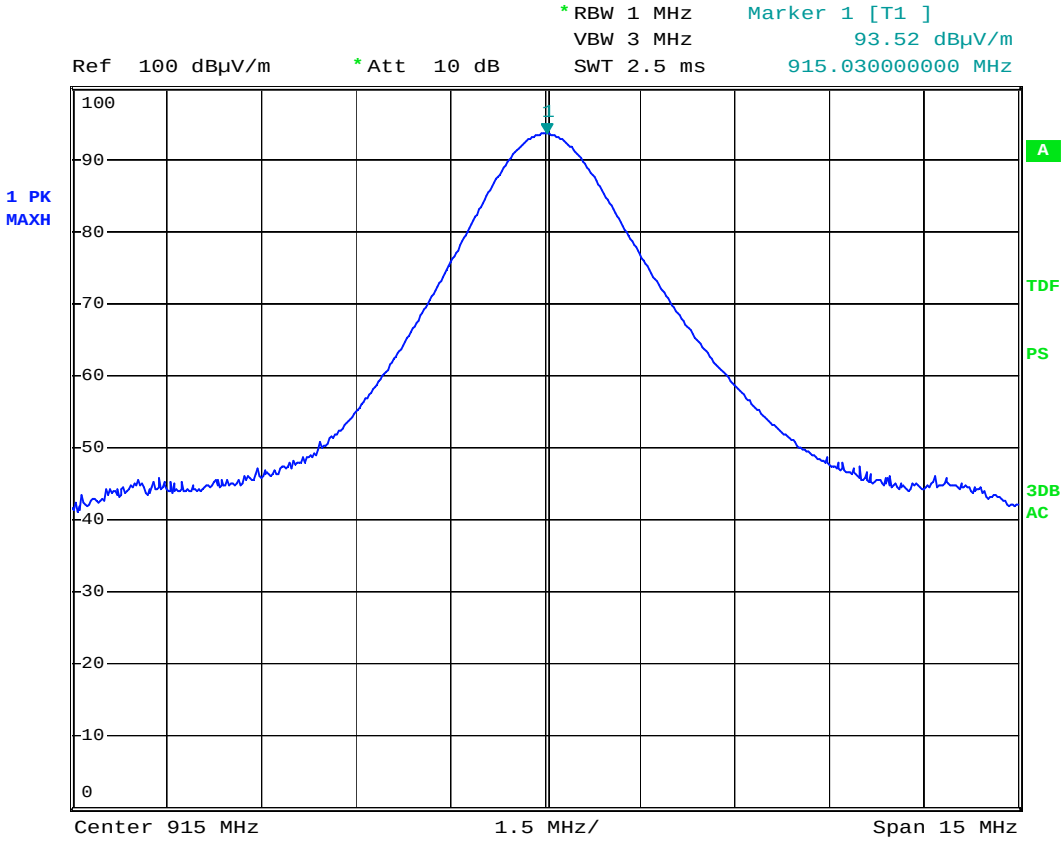
HP: 903.5MHz – Field strength



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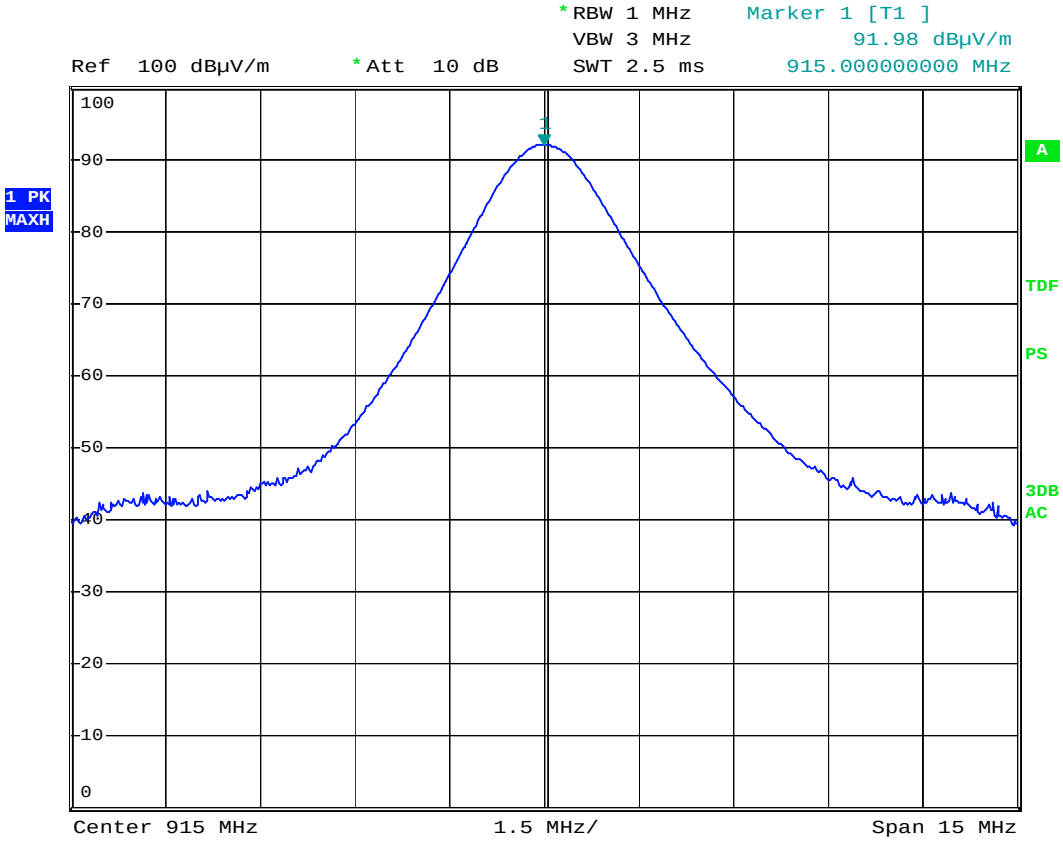
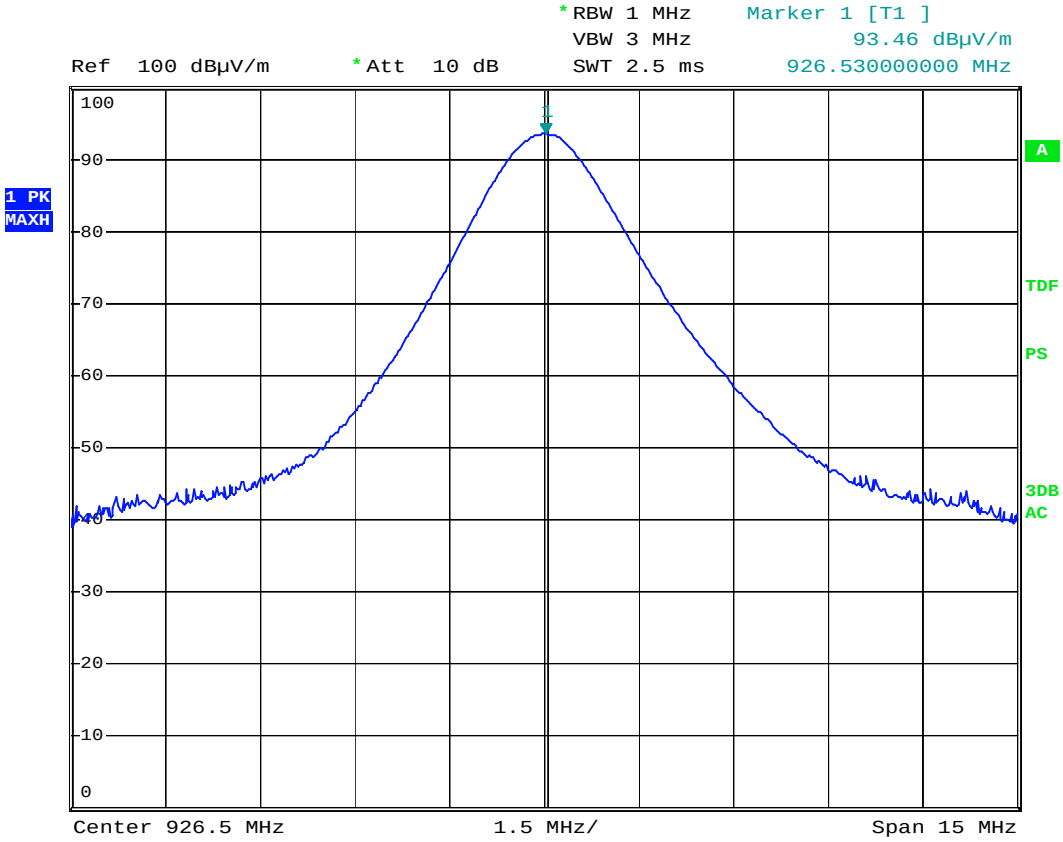
VP: 915MHz – Field strength



Date: 4.NOV.2011 09:23:58

HP: 915MHz – Field strength



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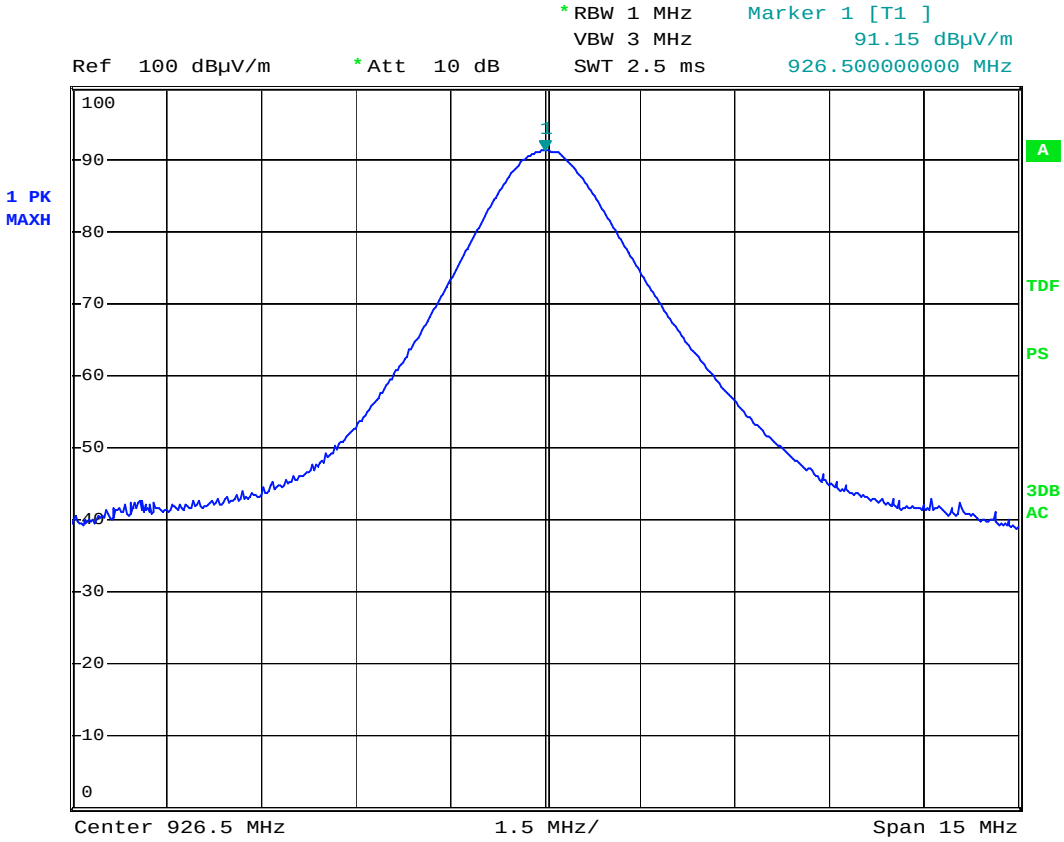
VP: 926.5MHz – Field strength



Date: 4.NOV.2011 09:11:04

HP: 926.5MHz – Field strength

4.4 Band Edge Emissions

Para. No.: 15.249 (d)

Test Performed By: G.Suhanthakumar	**Date of Test: 04-Nov-2011**

Test Results: Complies

Measurement Data:

Lower Band edge :

RF channel	**903.500MHz**
Measured maximum dBc	51.07

Upper Band edge :

RF channel	**926.500MHz**
Measured maximum dBc	52.21

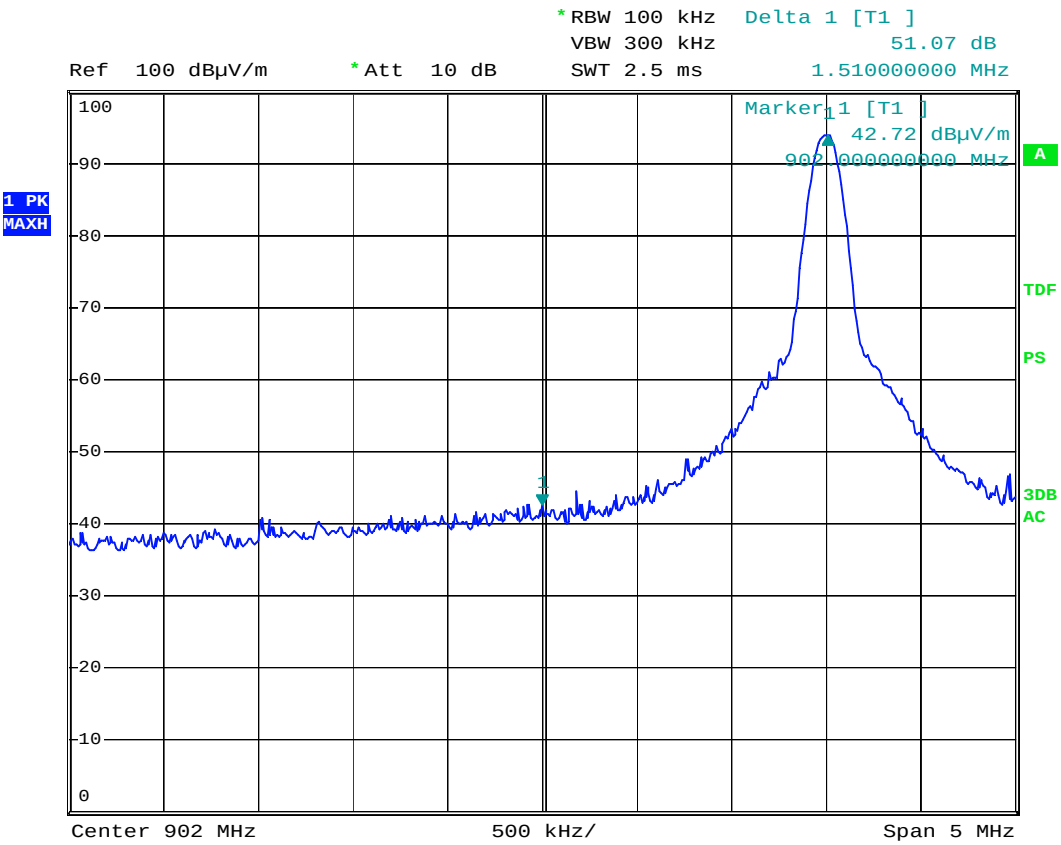
Band-edge, @3m

Frequency	**Measured Field Strength @3m, dBµV/m**	**Detector**	**Limit dBµV/m**	**Margin dB**
902.000MHz	-	AV	54	-
	42.72	PK	74	31.28
928.000MHz	-	AV	54	-
	41.12	PK	74	32.88

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.



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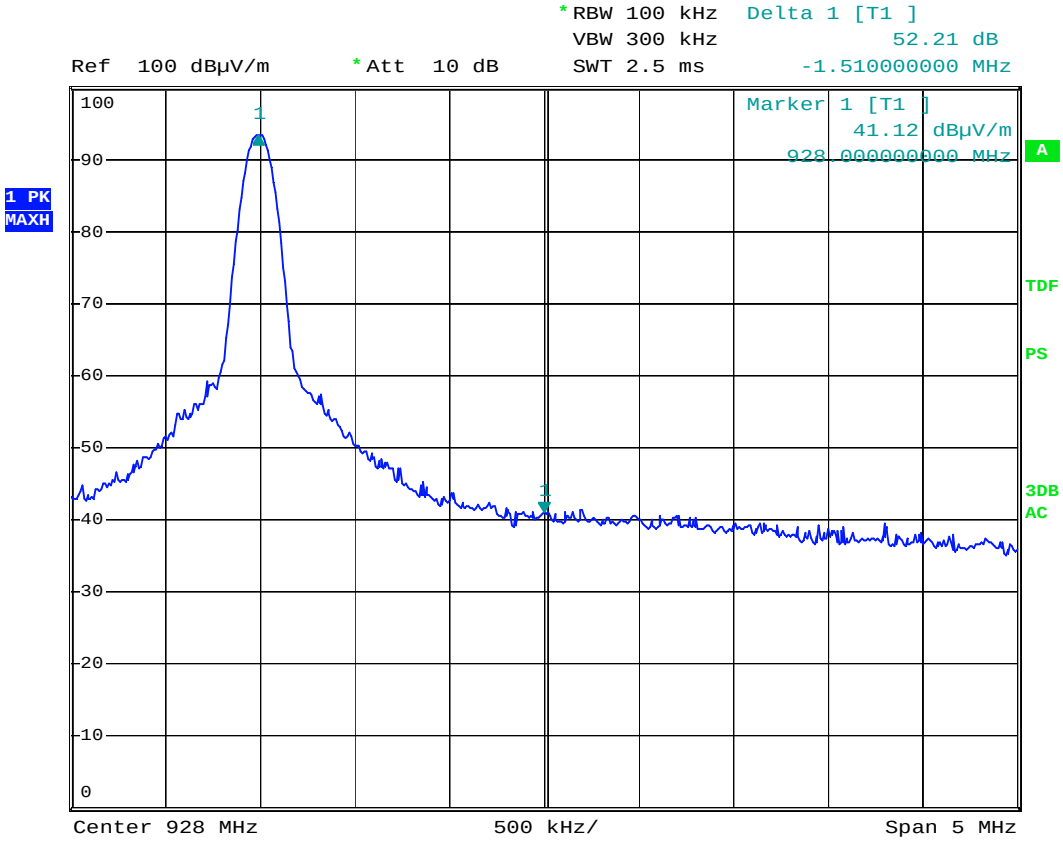
903.5MHz- Lower band edge –PK detector



Date: 4.NOV.2011 09:17:07

926.5MHz- upper band edge- PK detector

4.5 Spurious Emissions (Radiated)

Para. No.: 15.249 (e)

Test Performed By: G.Suhanthakumar	**Date of Test: 04-Nov-2011**

Test Results: Complies

Measurement Data:

Tested item's transmission is with 100% duty cycle

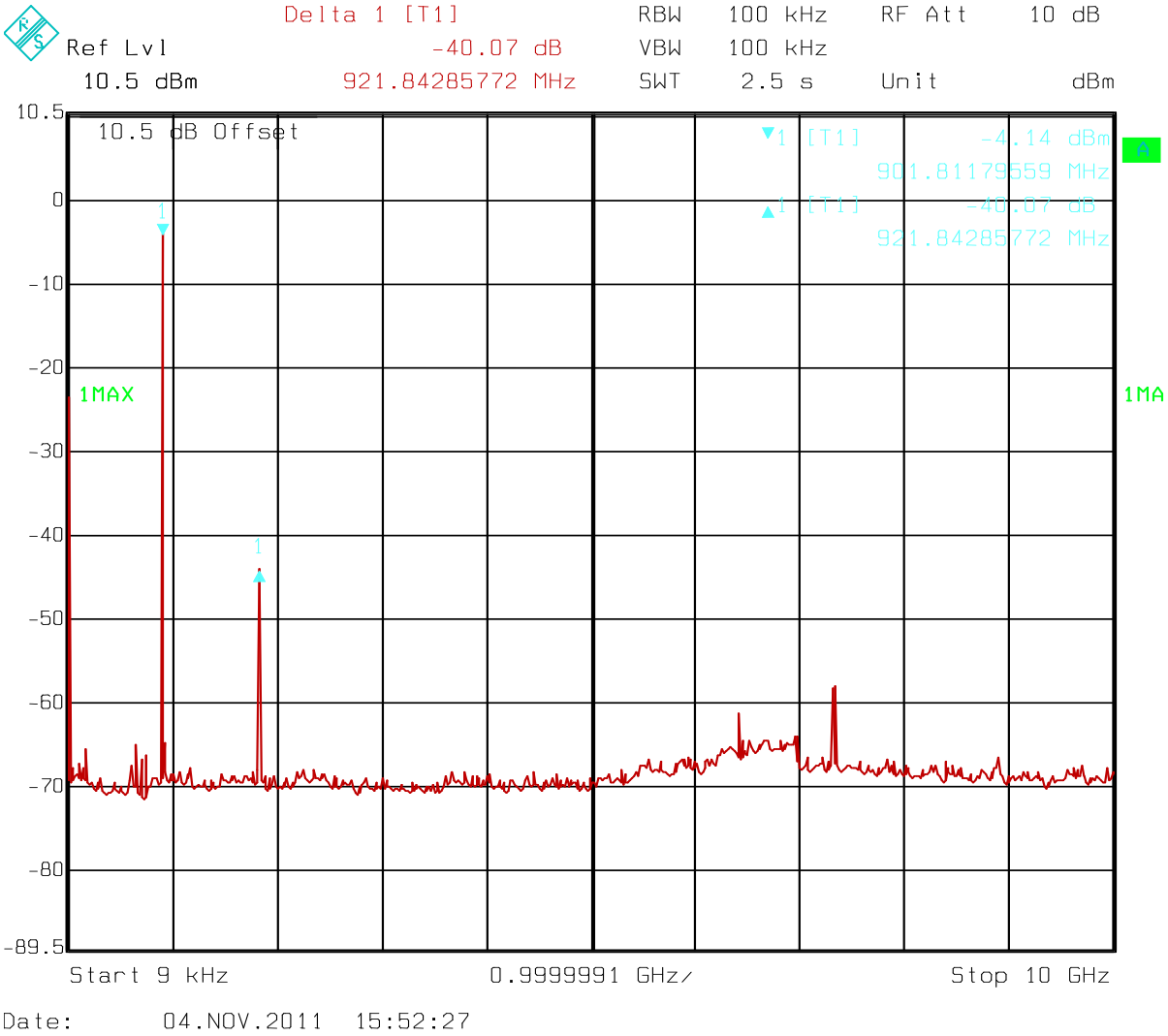
RF conducted emissions 9kHz to 10 GHz

Maximum RF level outside operating band:

RF 915MHz: 40.07 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.



915MHz – Conducted Spurious – 9kHz – 10GHz

Radiated Emissions with antenna, 1-10 GHz, peak

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

Measured with Peak Detector

Frequency	Dist. corr. factor	Field strength, Peak	Duty cycle corr. factor	Limit	Margin
GHz	dB	dBµV/m	dB	dBµV/m	dB
1.807	0	54.10	-	74	19.90
1.830	0	53.36	-	74	20.64
1.853	0	52.96	-	74	21.04
>1.86 - 10	0	None detected	-	74	-

Radiated emissions with antenna,1- 10 GHz, Average Detector

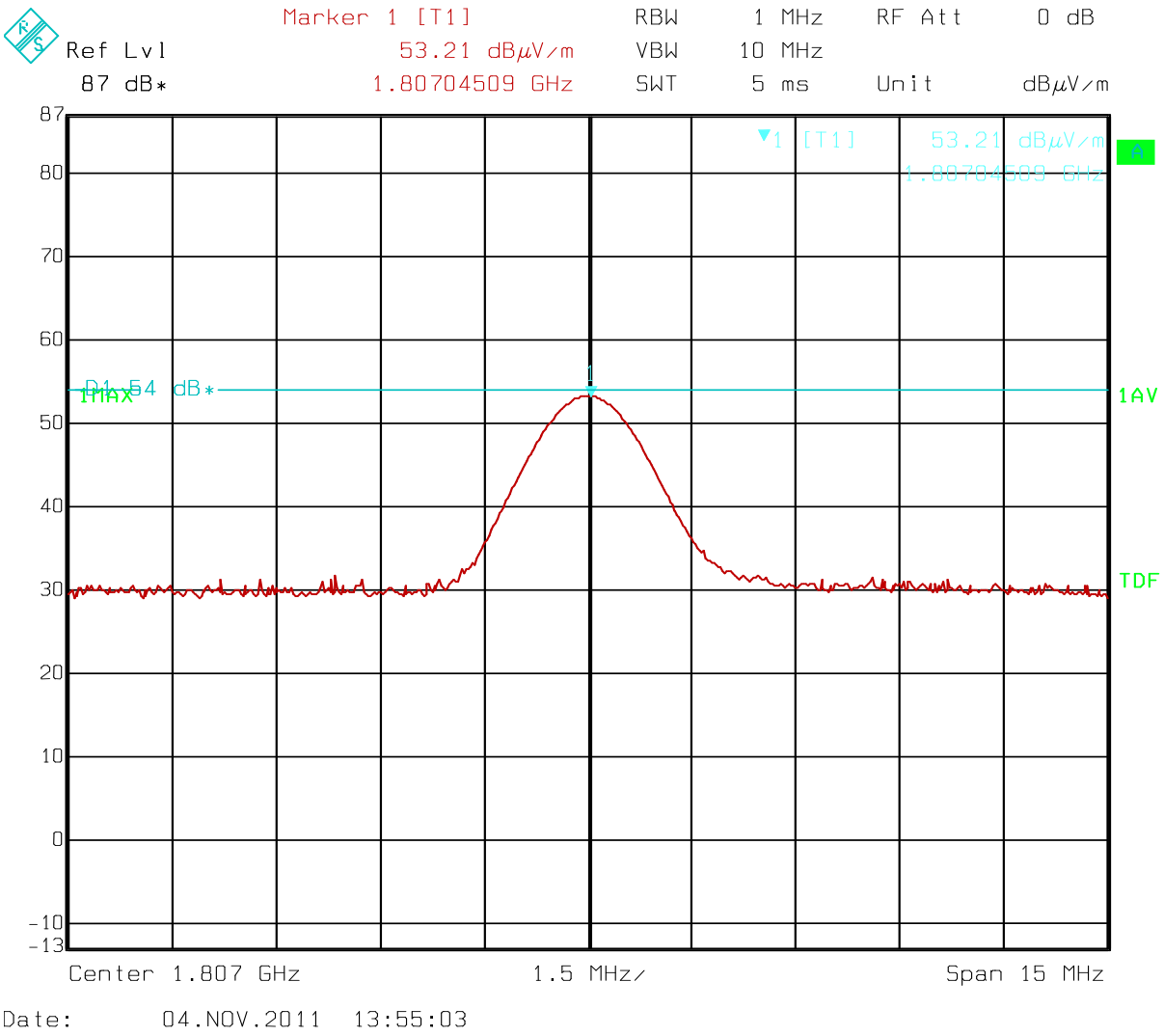
Frequency	Dist. corr. factor	Field strength, AV	Duty cycle corr. factor	Limit	Margin
GHz	dB	dBµV/m	dB	dBµV/m	dB
1.807	0	53.21	-	54	0.79
1.830	0	52.39	-	54	1.61
1.853	0	51.82	-	54	2.18
>1.86 - 10	0	None detected	-	54	-

The maximum is observed in Vertical polarization

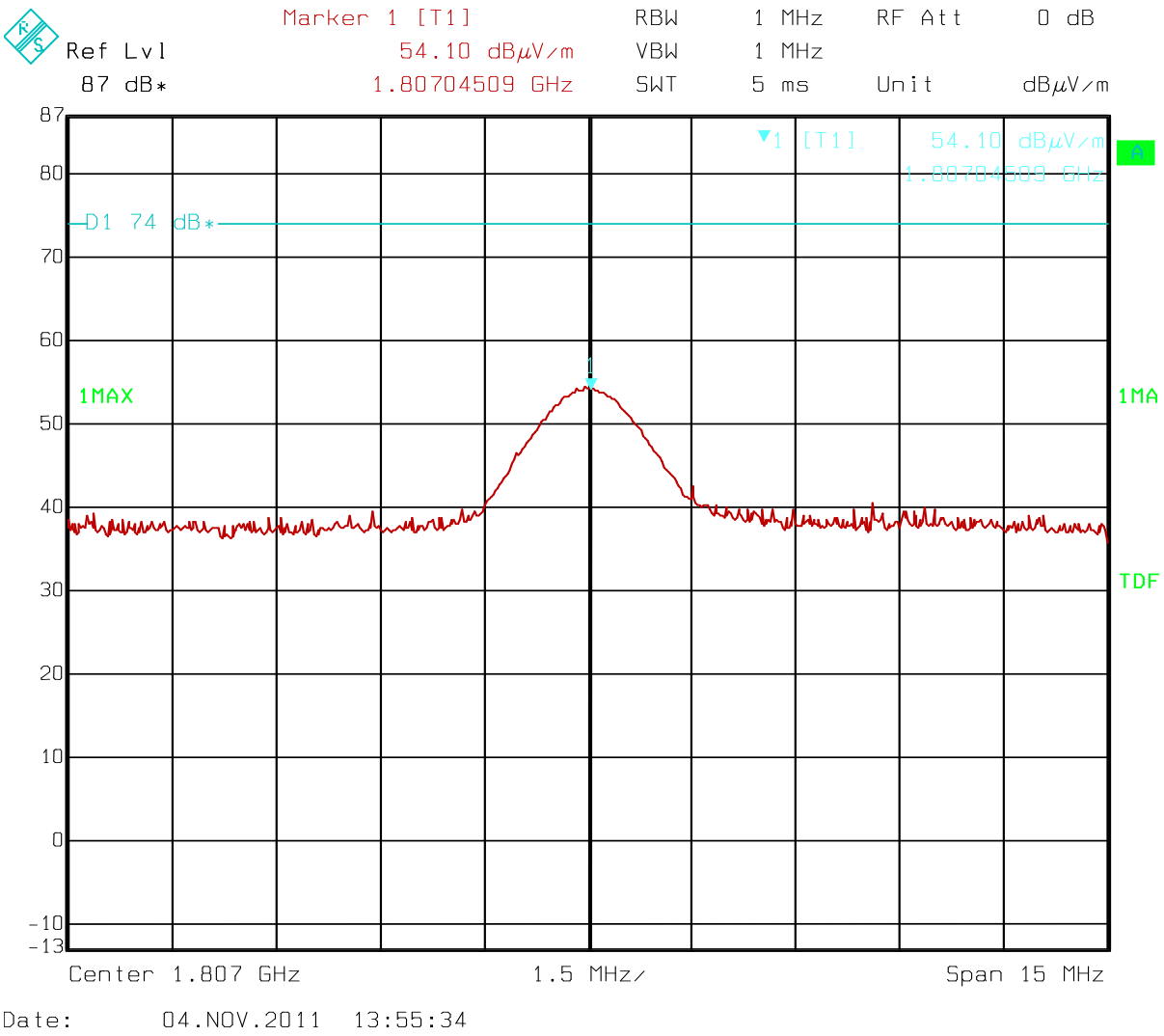
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

Requirement:

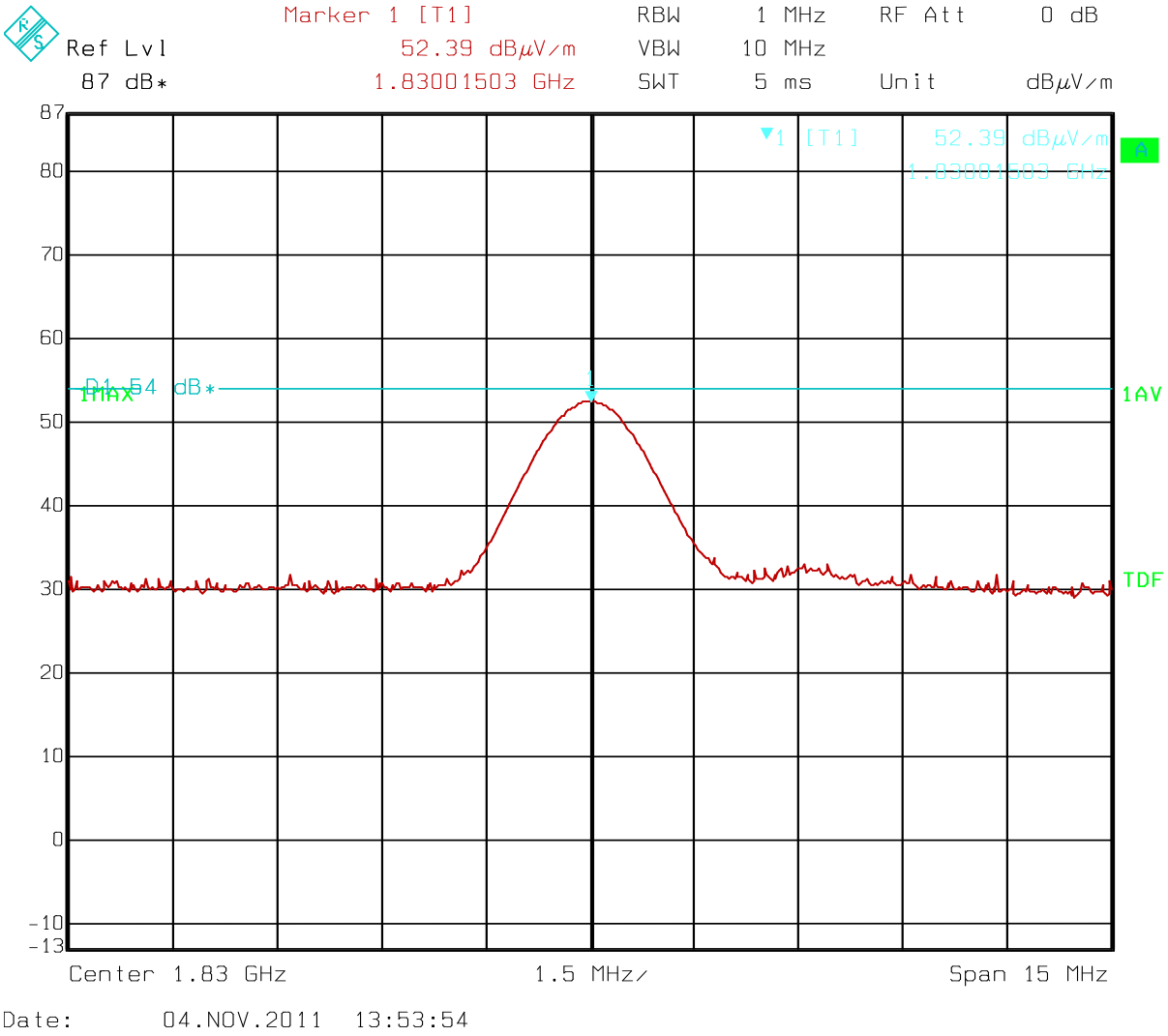
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.



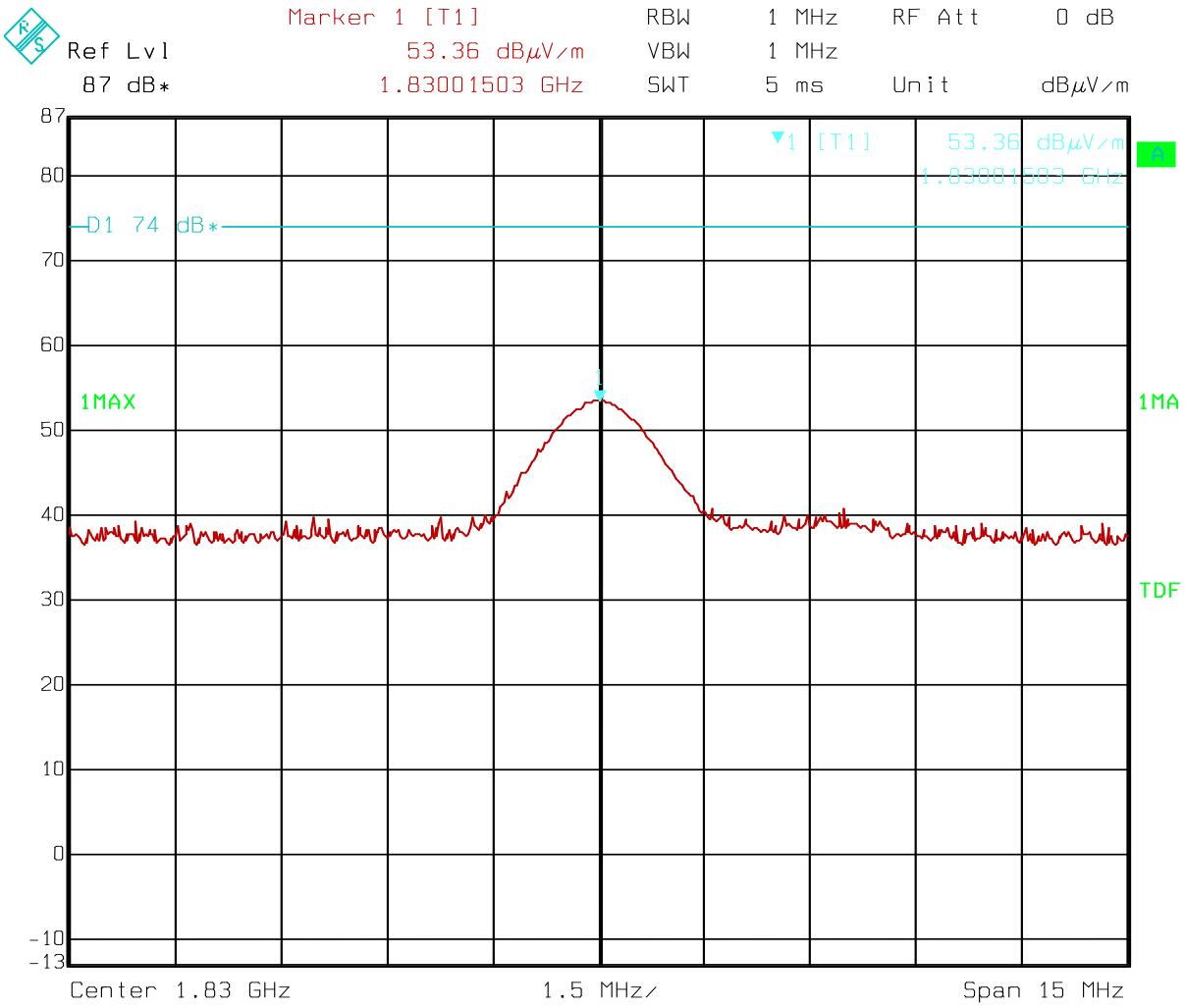
903.5MHz – 2nd Harmonic- AV



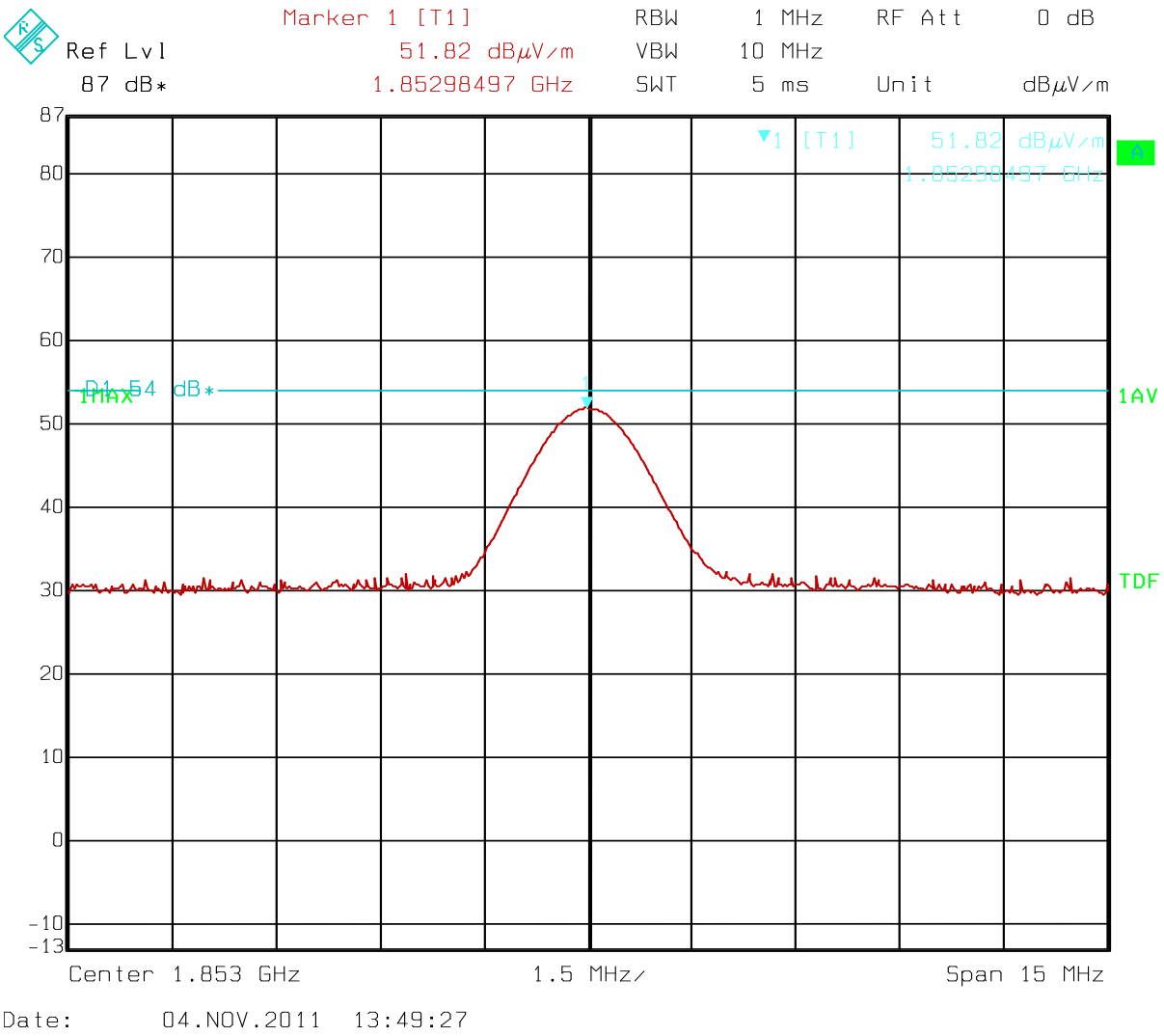
903.5MHz – 2nd Harmonic- Pk



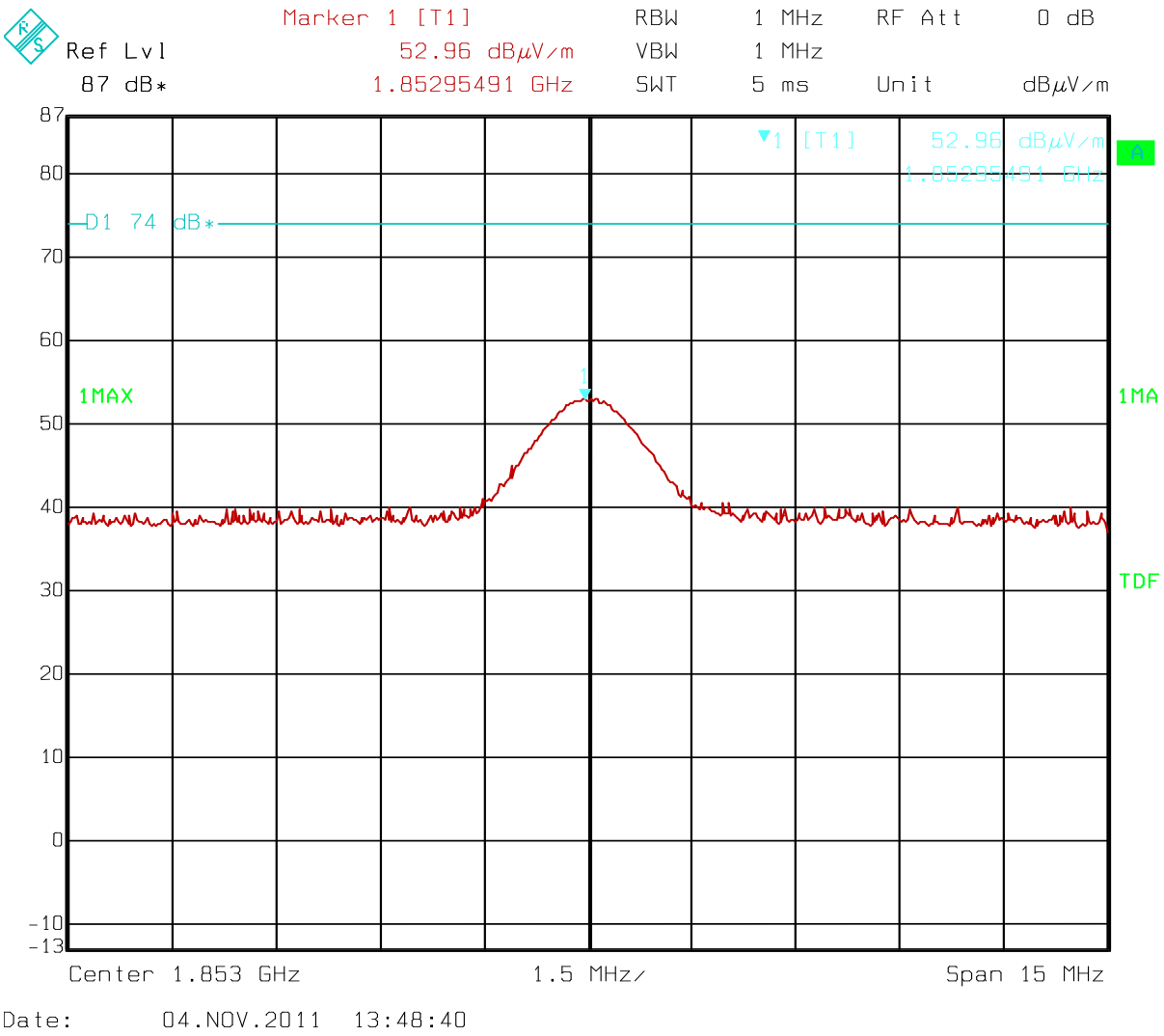
915MHz – 2nd harmonic- AV



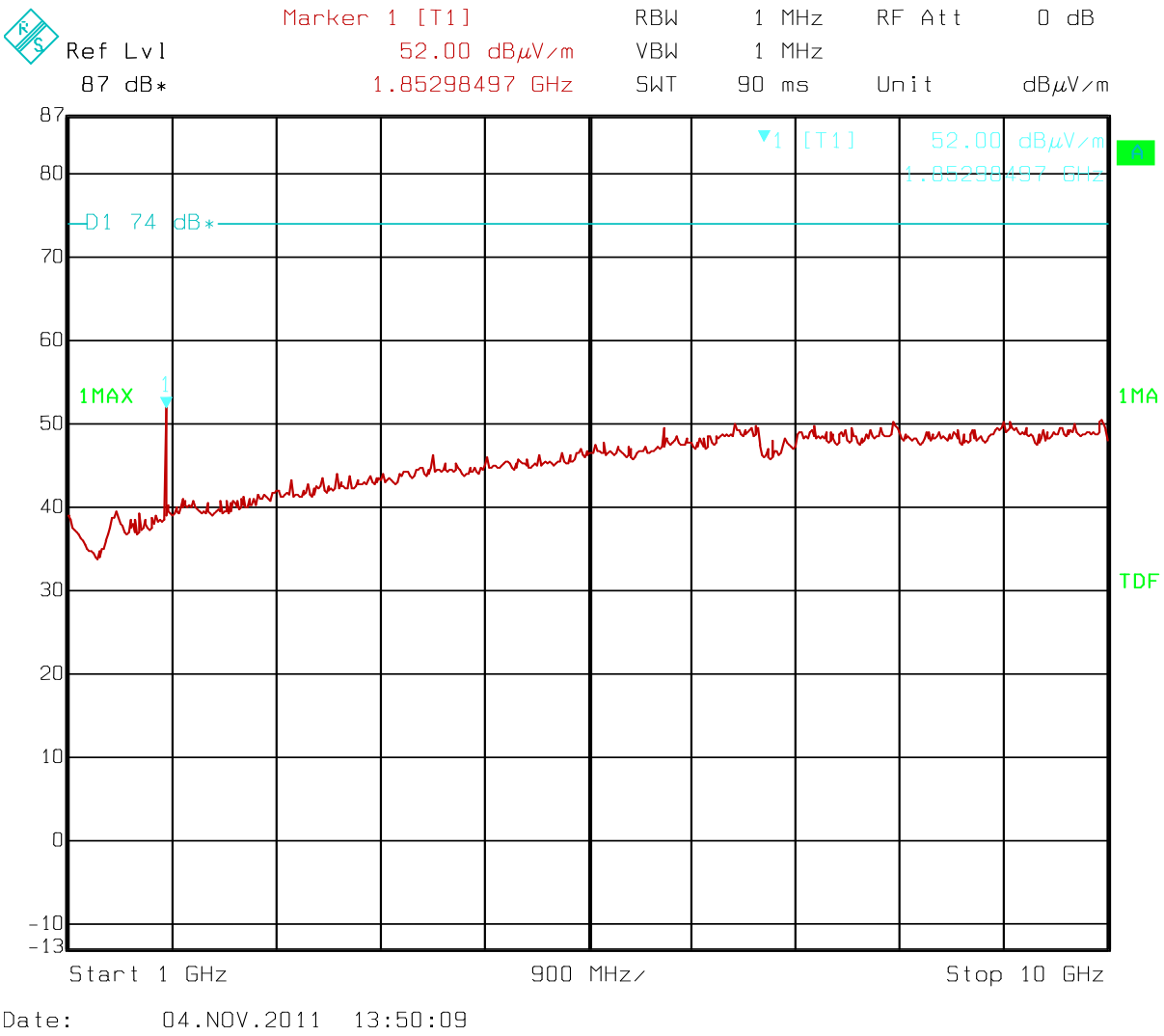
915MHz – 2nd Harmonic – Pk



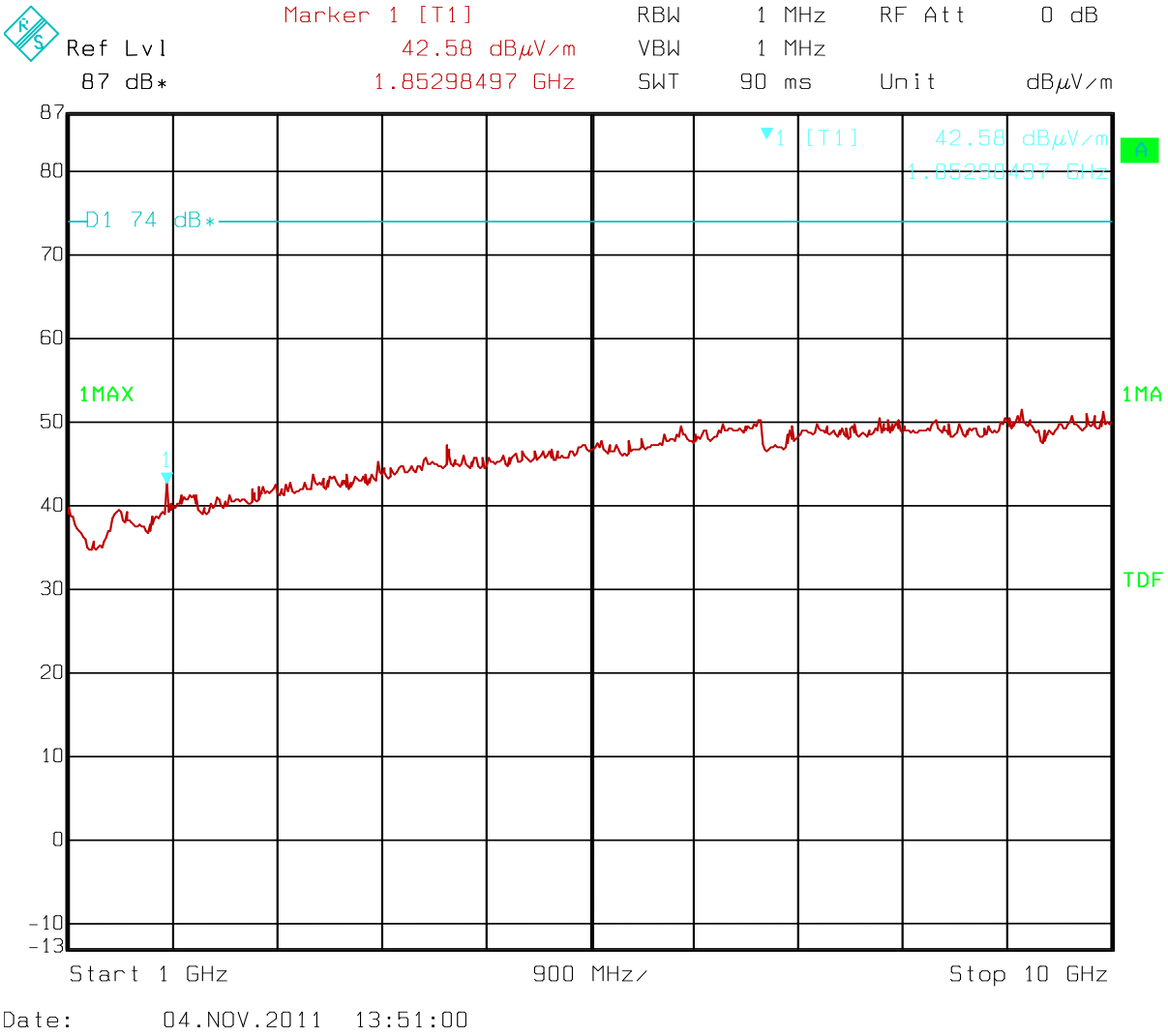
926.5MHz – 2nd harmonic- AV



926.5MHz – 2nd harmonic- Pk



VP: pre- scan 1 - 10GHz-Pk



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

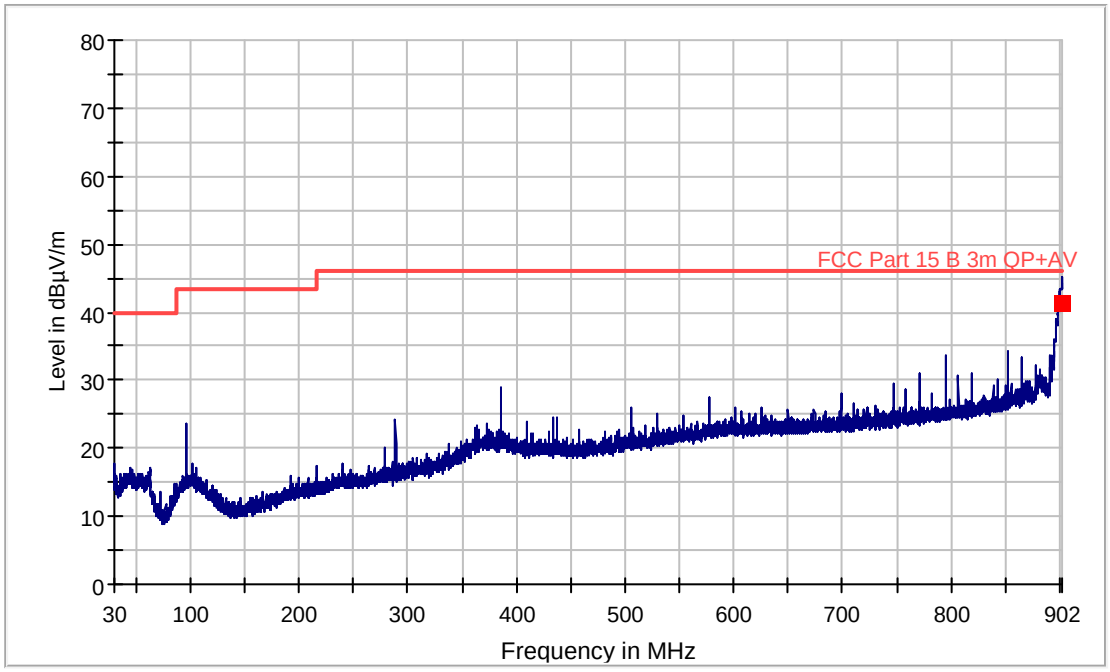
Radiated emissions 30 – 1000 MHz.

Detector: Peak

Measuring distance 3 m.

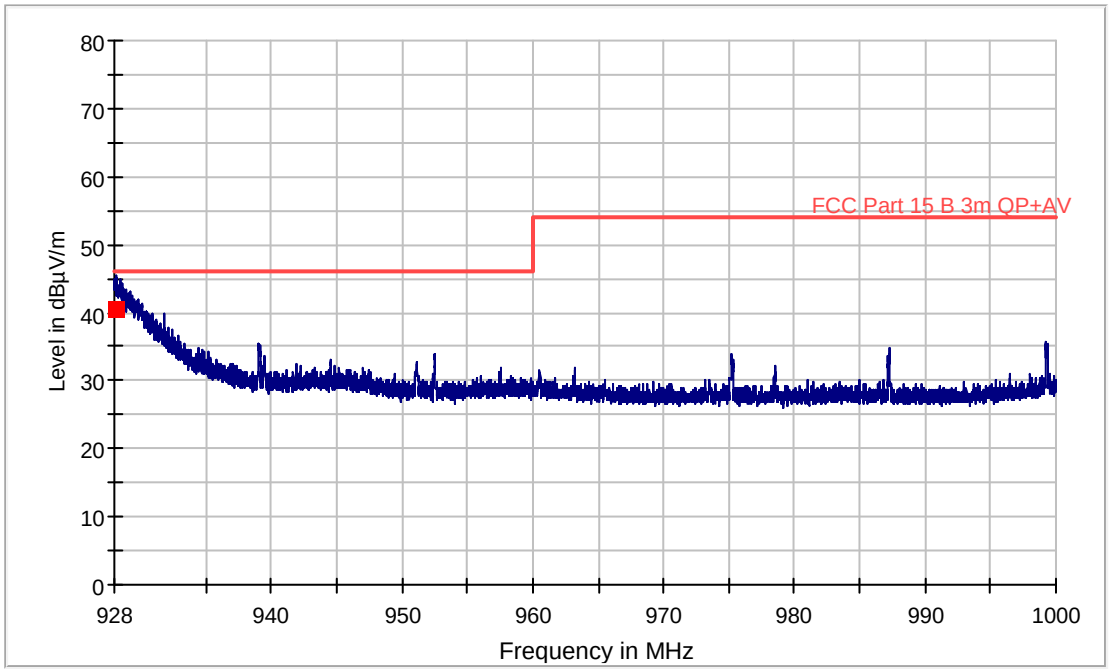
The graph shows peak scan and highest values. The QP values are given in the table below.

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
901.634098	41.4	1000.0	120.000	100.0	V	275.0	2.6	4.6	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
928.091012	40.5	1000.0	120.000	100.0	V	288.0	2.9	5.5	46.0	

4.6 Receiver Spurious Emissions (Radiated)

Para. No.: RSS-Gen (6)

Test Performed By: G.Suhanthakumar	**Date of Test: 04-Nov-2011**

Test Results: Complies

Measurement Data:

Radiated Emissions: 30MHz – 10GHz

Measured with Peak Detector

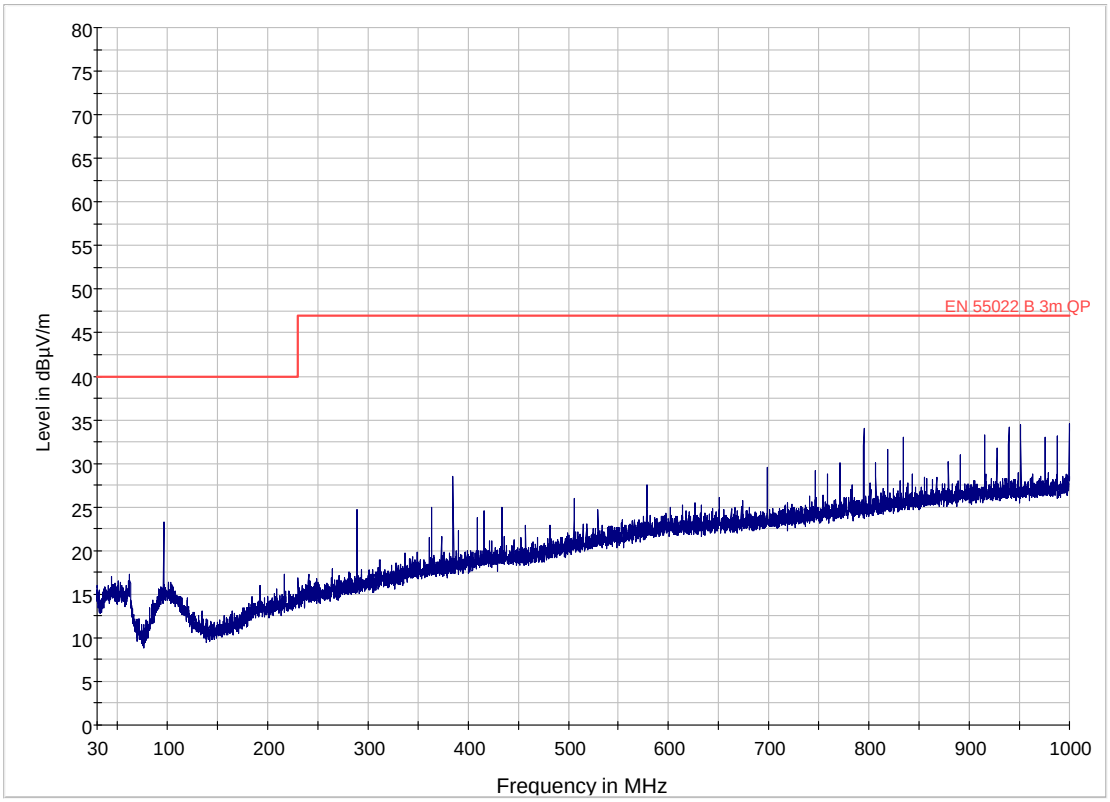
See attached plots below.

Requirement(Radiated):

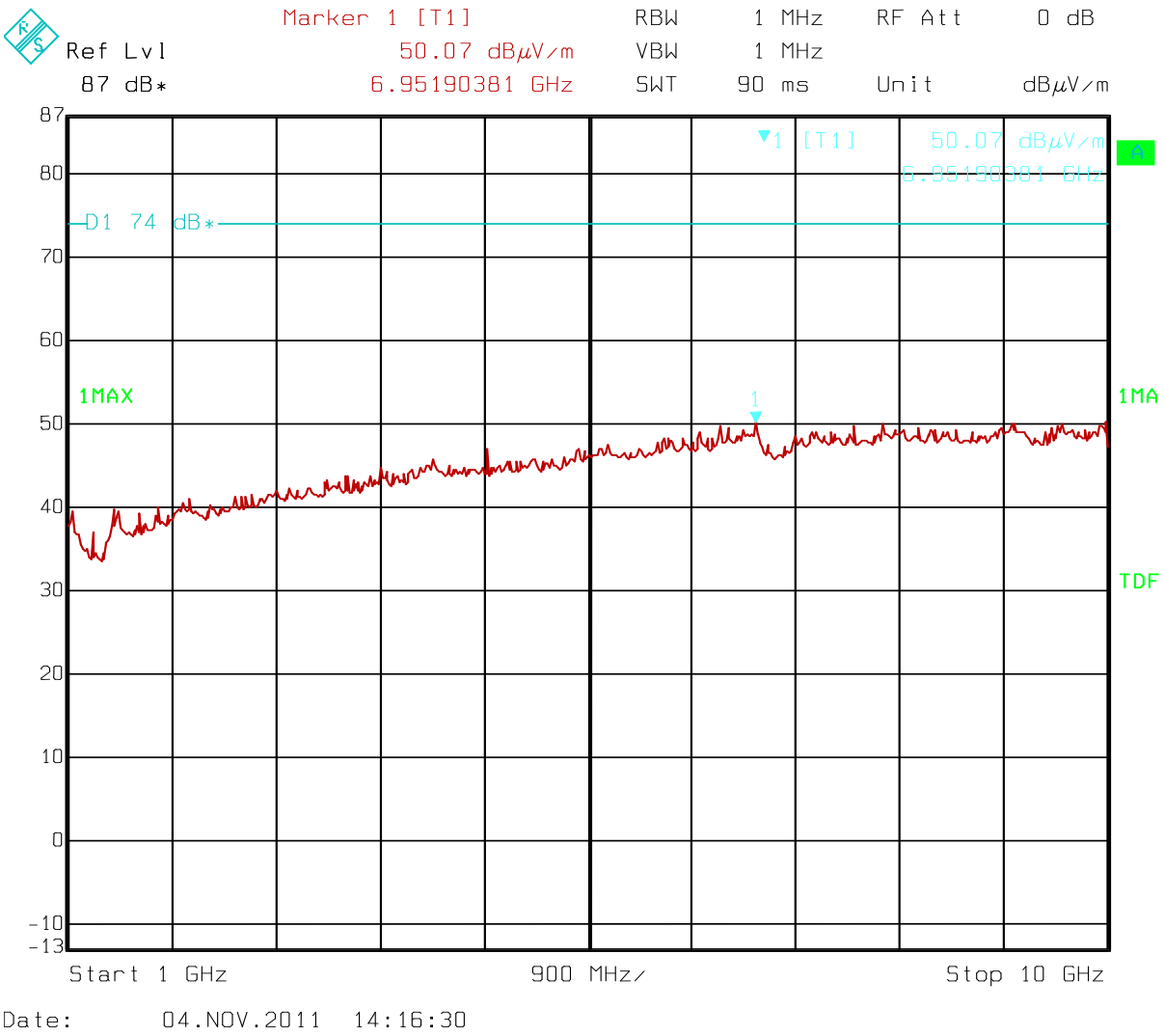
Spurious emissions from receivers shall not exceed the radiated limits as given in RSS-Gen table 2 or FCC.part 15B.109 (a) or CISPR 22

Requirement(Conducted):

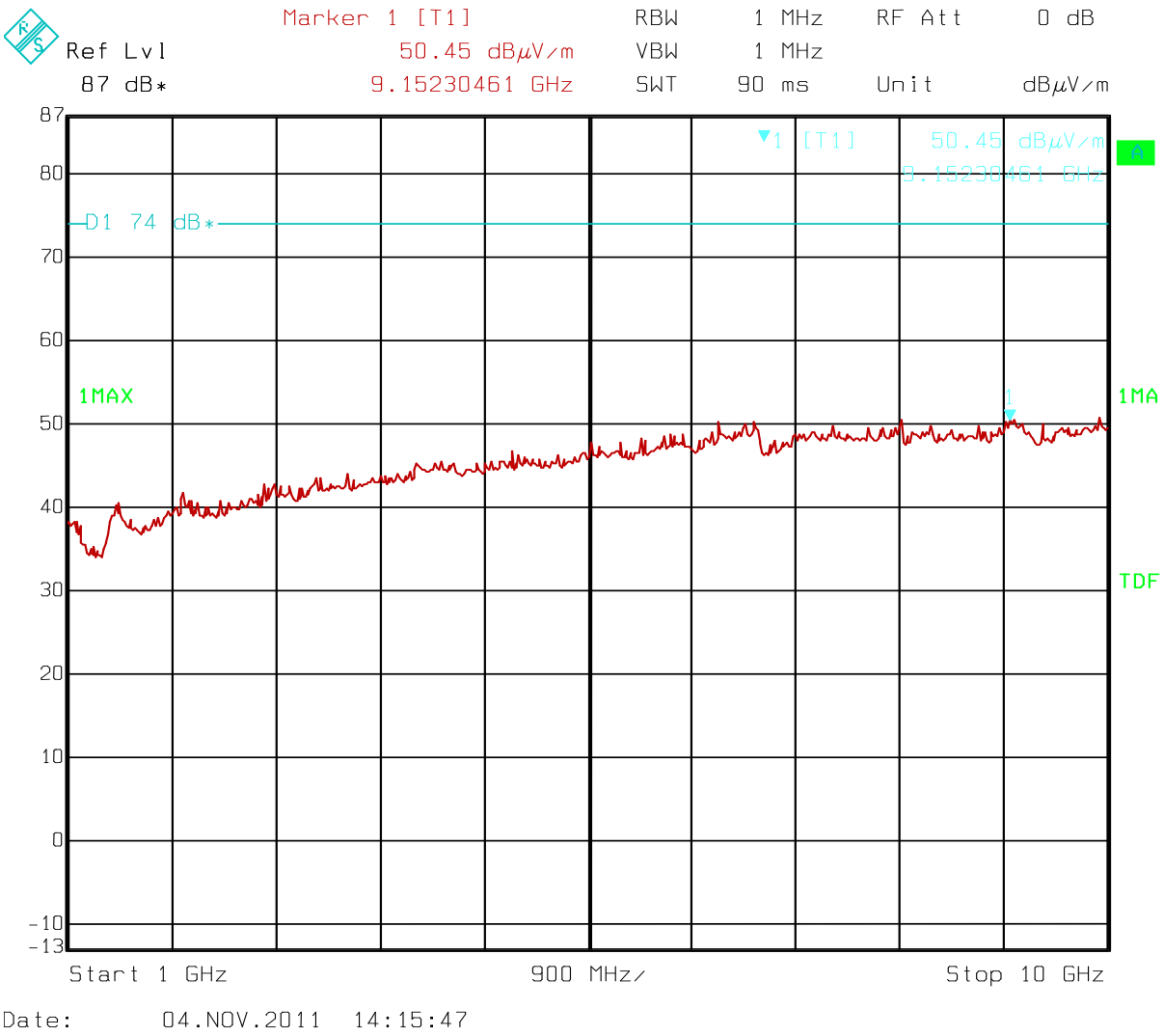
Receiver spurious emissions at any discrete frequency shall not exceed 2 nano watts in the band 30-1000 MHz, and 5 nano watts above 1000 MHz



Class B 30MHz-1GHz 3m, peak



RX, VP – 1 – 10GHz -pk



RX, HP 1 – 10GHz -pk

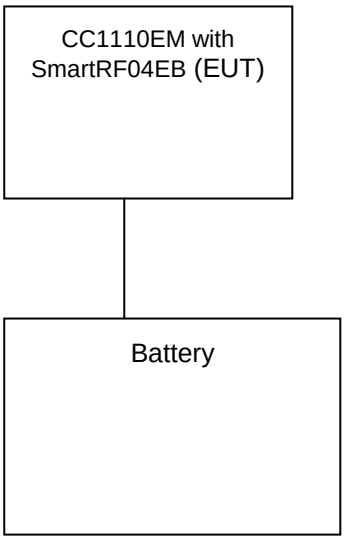
5 LIST OF TEST EQUIPMENT

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.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1.	ESCI	EMI Receiver	Rohde & Schwarz	N 4259	09.09.2010	09.09.2012
2.	FSEK 1088,3494,30	Spectrum Analyzer	R&S	1337	15.12.2010	15.12.2011
3.	3115	Antenna horn	EMCO	LR 1330	05.08.2010	05.08.2013
4.	643	Antenna horn	Narda	LR 093	26.01.2009	26.01.2012
5.	642	Antenna horn	Narda	LR 220	26.01.2009	26.01.2012
6.	PM7320X	Antenna horn	Sivers lab	LR 103	26.01.2009	26.01.2012
7.	DBF-520-20	Antenna horn	Systron Donner	LR 101	26.01.2009	26.01.2012
8.	638	Antenna horn	Narda	LR 098	26.01.2009	26.01.2012
9.	Sucoflex 102E	Cable microwave	Suhner	LR 1370	-	-
10.	6032A	Power supply	HP	LR 1062	-	-
11.	87V	Multimeter, Digital	Fluke	LR1601	15.12.2010	15.12.2012
12.	8449B	Amplifier	Hewlett Packard	LR 1322	26.09.2011	26.09.2012
13.	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285	08.10.2010	08.10.2013
14.	10855A	Amplifier	Hewlett Packard	LR 1445	12.10.2011	12.10.2012
15.	HL223	Antenna log.per	Rohde & Schwarz	LR 1261	19.05.2010	09.05.2013
16.	HK116	Antenna biconic	Rohde & Schwarz	LR 1260	19.05.2010	09.05.2013
17.	ESN	Test Receiver	Rohde & Schwarz	LR 1237	21.10.2010	21.21.2012
18.	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076	22.10.2009	22.10.2011
19.	B504D	Power supply	Oltronix	LR 534	-	-
20.	ESHS 10	EMI Receiver	Rohde & Schwarz	N3520	21.06.2011	14.04.2012
21.	ESH3-Z2	Pulse Limiter	Rohde & Schwarz	LR 1074	03.03.2010	03.03.2012
22.	VULB 9163	Antenna TriLog	Schwarzbeck	LR1616	2010-08	2012-08

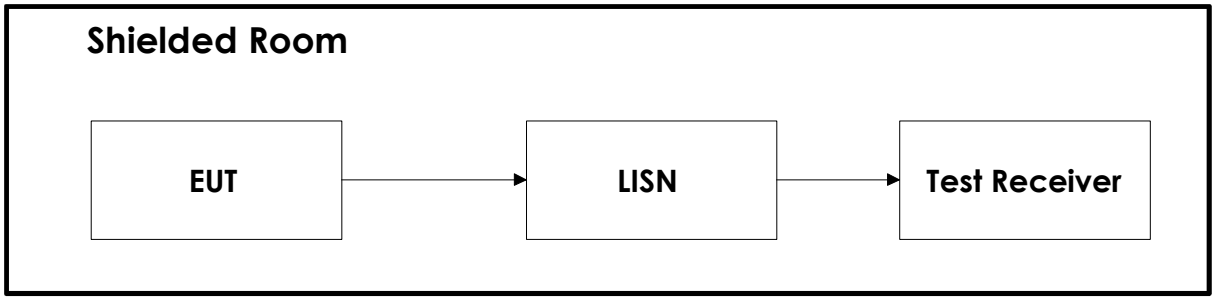
6 BLOCK DIAGRAM

6.1 System set up for radiated measurements



Test equipment: 2, 3, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18,22

6.2 Power line Conducted Emission



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

6.3 Test Site Radiated Emission