



Test report no. : 215174-1

Item tested : CC110LEM-868-915

**Type of equipment : Low power Transceiver
903.5 – 926.5 MHz**

FCC ID : ZAT110LEM900

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

2013 June 18

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: 48

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 :	Texas Instruments
Model/version :	CC110LEM-868-915
FCC ID:	ZAT110LEM900
IC ID:	451H-110LEM900
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 :	/
Operating Modes :	TX & RX
Type of Modulation :	2-GFSK
Data rate:	1.2kbit/s
User Frequency Adjustment :	None, Software controlled
Rated Output Power :	0.28mW
Type of Power Supply :	Tested with 3.3V Primary Battery
Antenna Connector :	N/A
Antenna type:	PCB
Antenna Diversity Supported :	None

Description of Test Item

The CC110LEM-868-915 is an RF-transceiver module.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 – 22 °C
Relative humidity:	35 – 45 %
Normal test voltage:	3.0V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2012-06-20
Test period :	from 2012-07-09 -2012-07-17

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Texas Instruments
Model No.: CC110LEM-868-915

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.

- | | |
|---|---|
| <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 #: 215174-1

TESTED BY: G. Suhanthakumar
G.Suhanthakumar, Test engineer

DATE: 2012-07-17

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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	N/A ²
Power-line Conducted Emission	15.207(c)	7.2.2	N/A ¹
OBW/ 20 dB bandwidth	-	-	-
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 PCB antenna

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: 09-July-2012
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Measurement Data:

Temperature	Channel nr.	Given Frequency (MHz)	Measured value (MHz)	Deviation (kHz)
20 ° C	-	903.500	903.47346	26.54
	-	915.000	914.97313	26.86
	-	926.500	926.47283	27.17

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 Occupied Bandwidth

Para. No.: RSS-Gen

Test Performed By: G.Suhanthakumar	Date of Test: 09-July-2012
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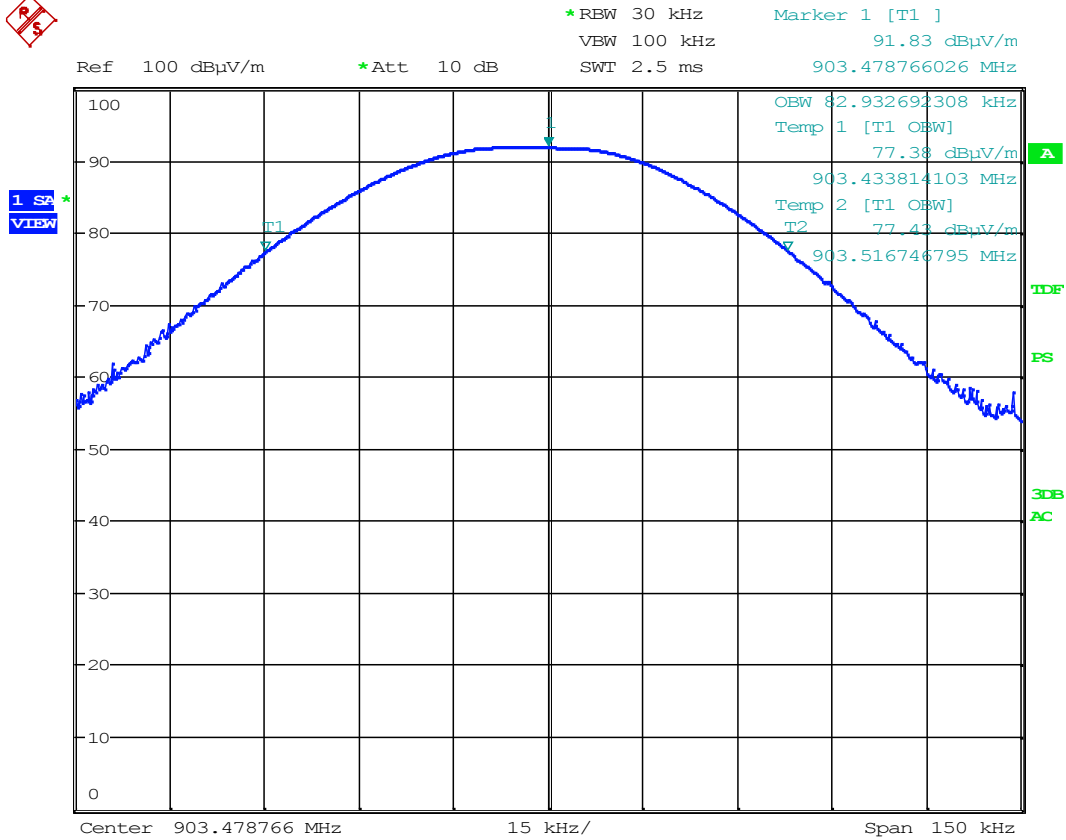
Test Results: Complies

Measurement Data:

Data Rate	OBW (kHz)		
	903.500MHz	915.000MHz	926.500MHz
1.2kbps	82.93	83.17	83.17

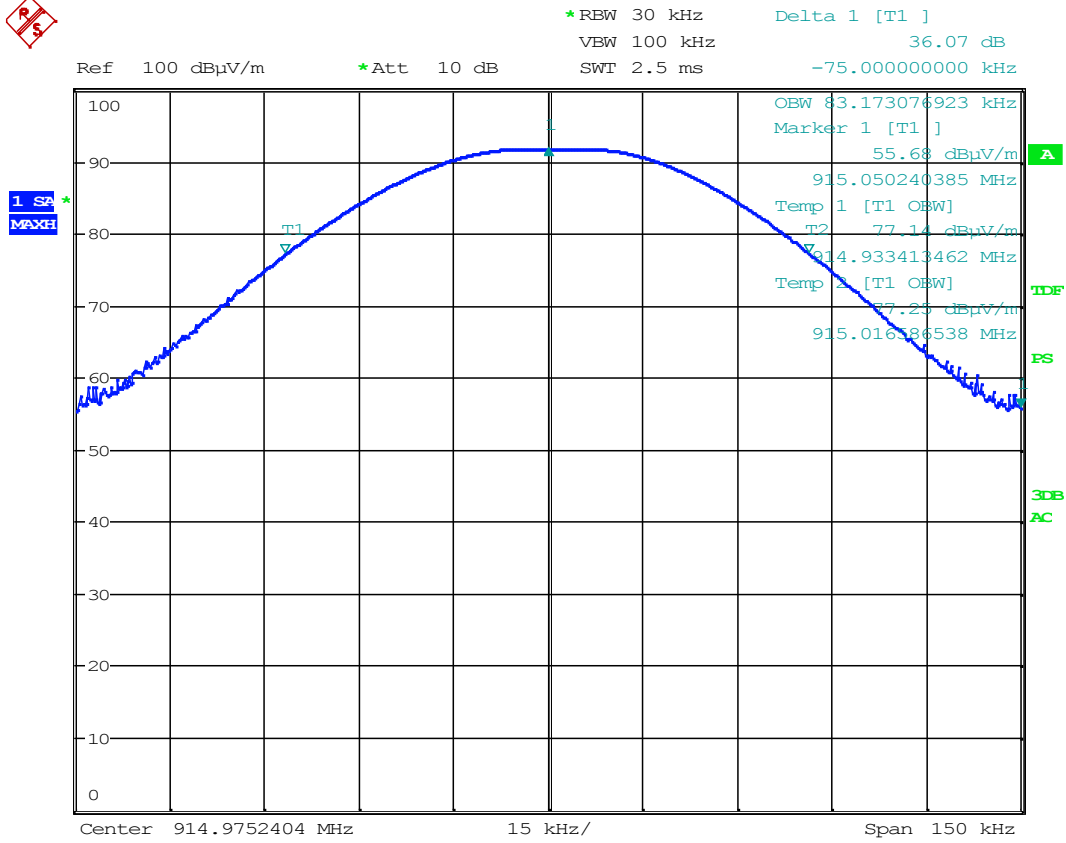
Requirements:

For information only



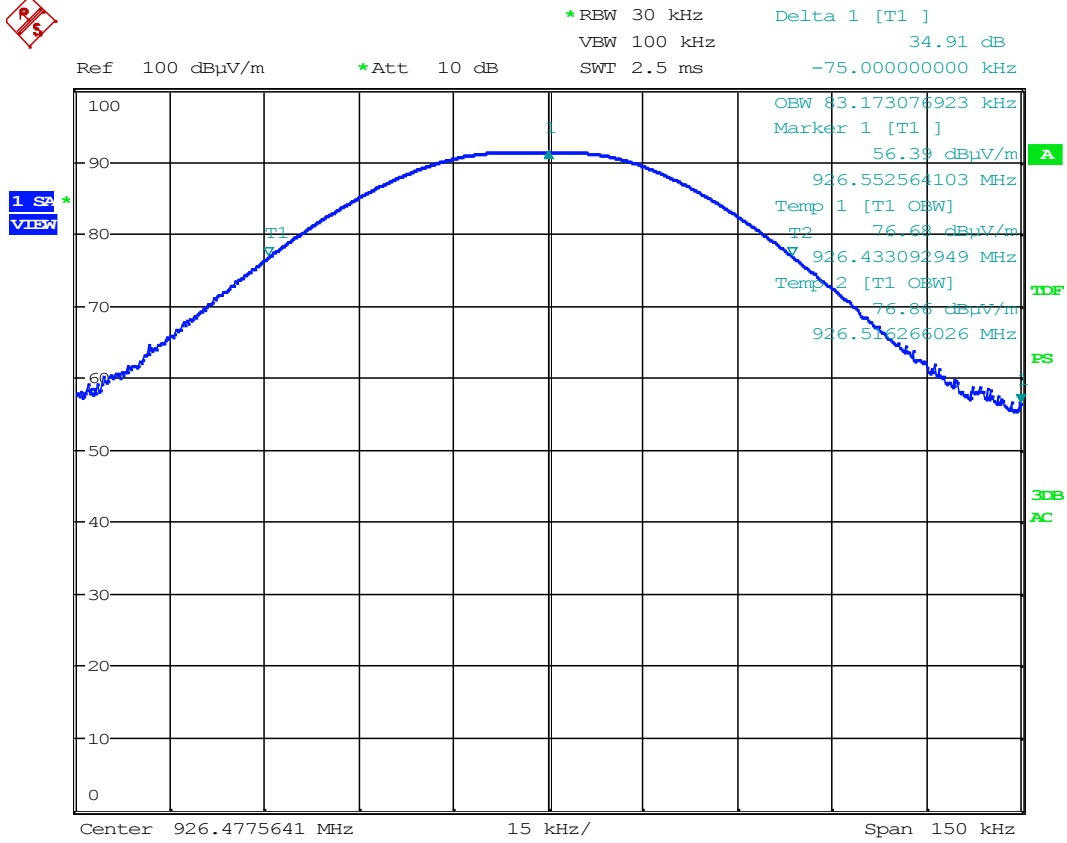
Date: 9.JUL.2012 10:57:53

903.5MHz – OBW – 82.93kHz



Date: 9.JUL.2012 10:51:14

915MHz – OBW – 83.17kHz



Date: 9.JUL.2012 10:48:51

926.5MHz – OBW – 83.17kHz

4.3 Peak Power Output

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

Test Performed By: G.Suhandhakumar	Date of Test: 09-July-2012 – 17-july-2012
------------------------------------	---

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	903.5MHz	915MHz	926.5MHz
@ 1.2kbps, Measured value (dBm)	-4.91	-5.01	-4.95

Maximum Field strength

RF channel	903.5MHz	915MHz	926.5MHz
VP: Measured value (dB μ V/m)	85.82	85.73	85.74
HP: Measured value (dB μ V/m)	91.87	91.77	91.19

Calculated erp & antenna gain

RF channel	903.5MHz	915MHz	926.5MHz
Radiated power (mW)	0.28	0.27	0.24
Radiated erp (dBm)	-5.51	-5.61	-6.19
Antenna gain dBd	-0.6	-0.6	-1.24

Radiated measurements are done at 3 m distance.

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

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

A new battery was used.

Requirements:

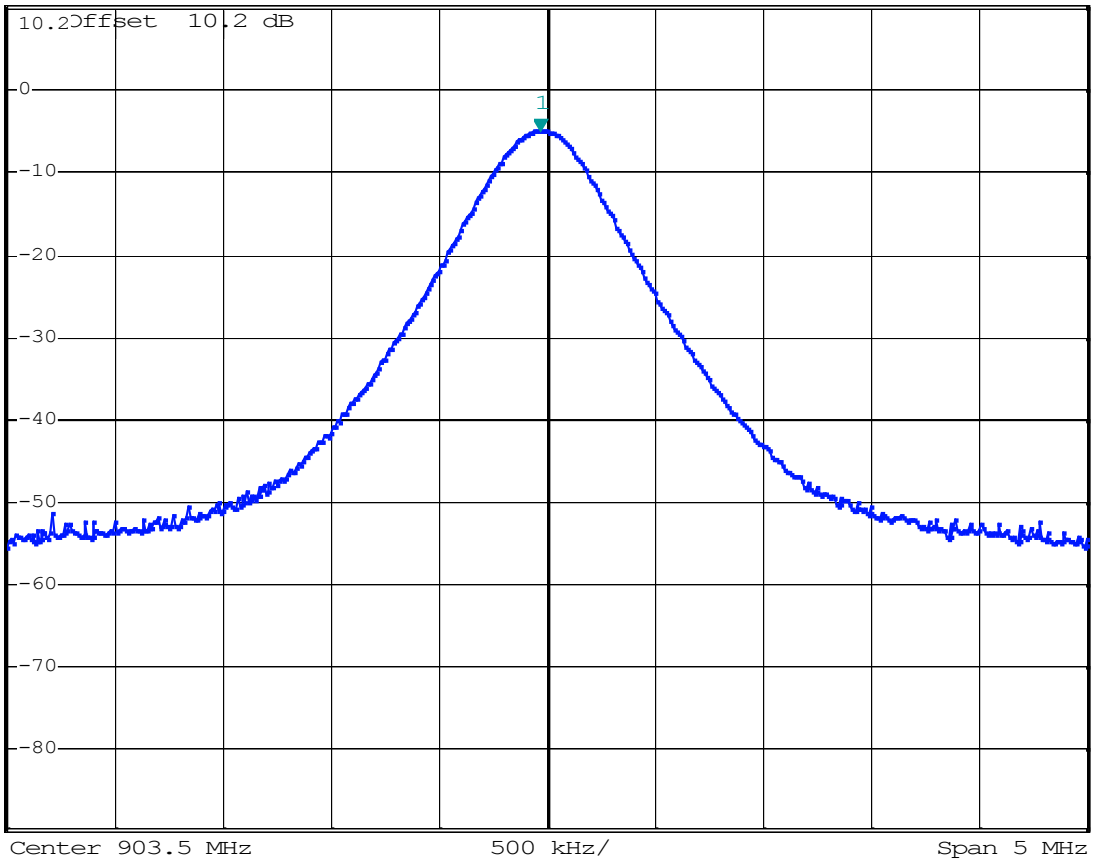
The maximum peak output power shall be ≤ 94 dB μ V/m



MARKER 1
 903.47 MHz
 Ref 10.2 dBm *Att 10 dB

*RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz -4.91 dBm
 SWT 2.5 ms 903.47000000 MHz

1 PR
 MAX



Date: 17.JUL.2012 08:00:57

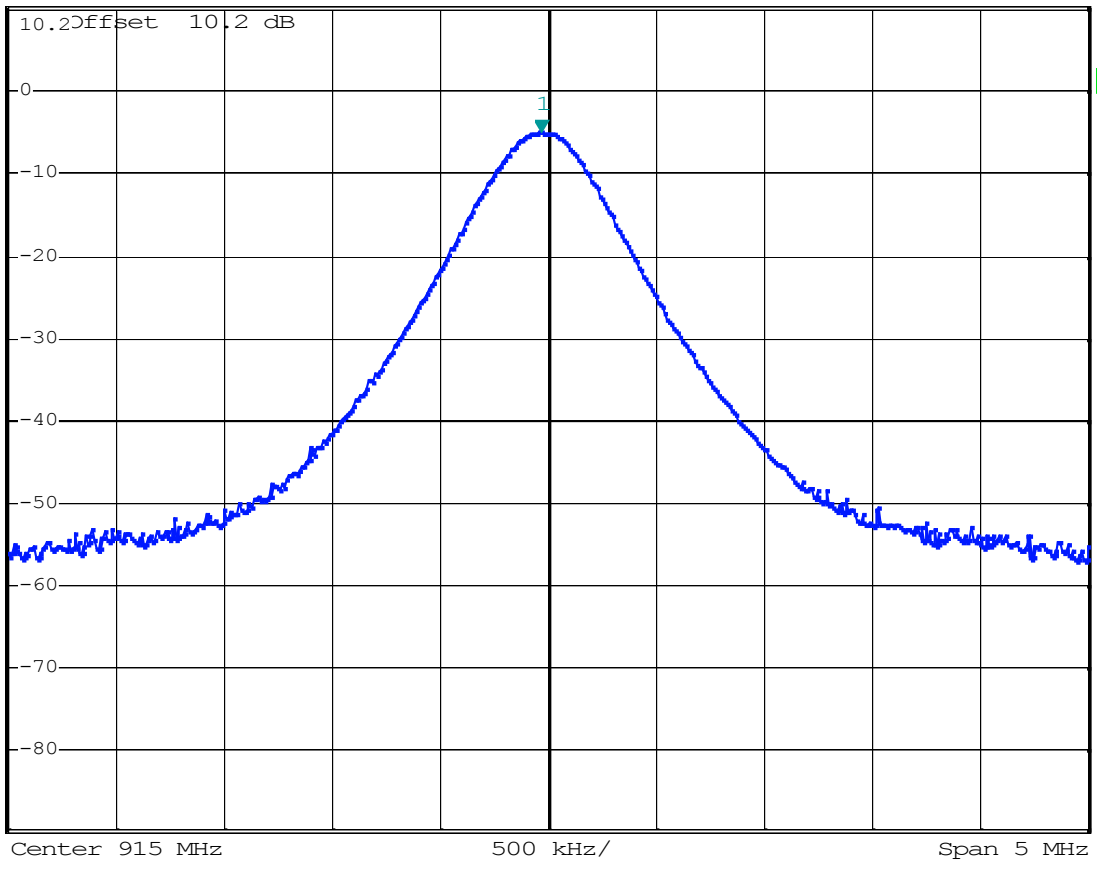
Conducted power – 903.5MHz



MARKER 1
 914.97 MHz
 Ref 10.2 dBm

*RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz -5.01 dBm
 SWT 2.5 ms 914.97000000 MHz

1 PK
 MAX



Date: 17.JUL.2012 08:01:54

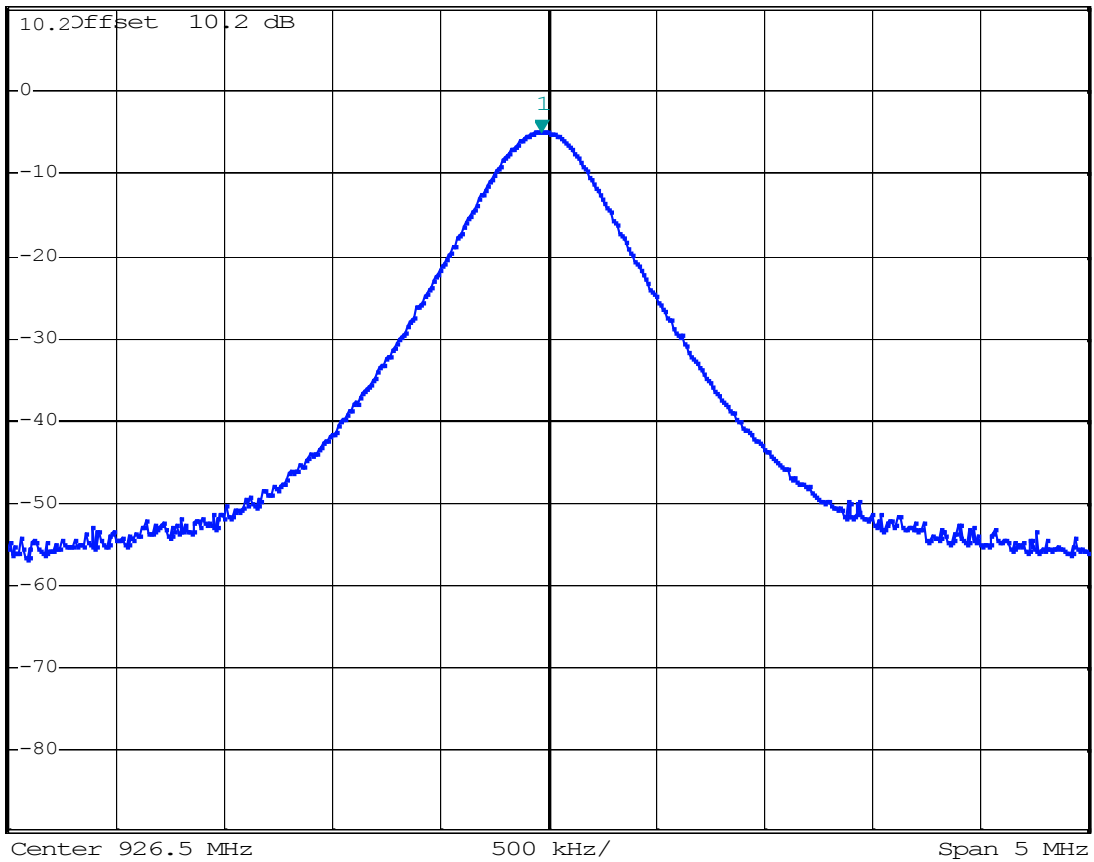
Conducted power – 915MHz



MARKER 1
926.47 MHz
Ref 10.2 dBm

*RBW 300 kHz Marker 1 [T1]
VBW 1 MHz -4.95 dBm
SWT 2.5 ms 926.47000000 MHz

1 PK
MAX

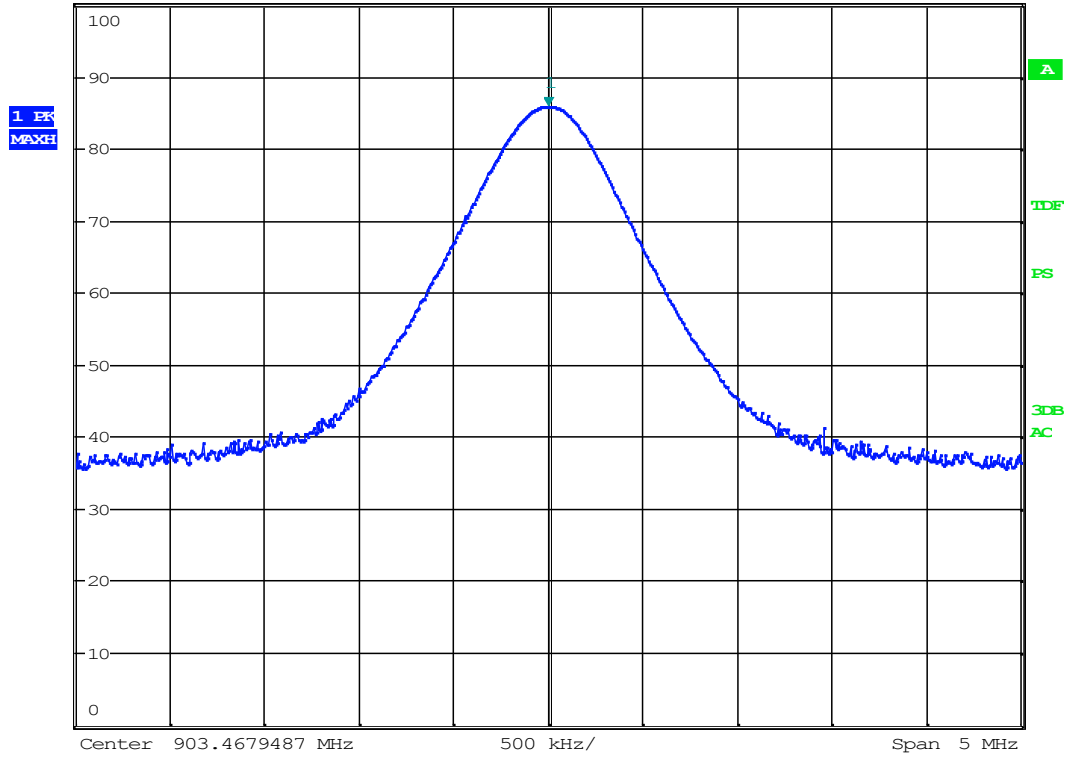


Date: 17.JUL.2012 08:01:28

Conducted power – 926.5MHz



Ref 100 dB μ V/m *Att 10 dB *RBW 300 kHz Marker 1 [T1]
VBW 1 MHz 85.82 dB μ V/m
SWT 2.5 ms 903.467948718 MHz

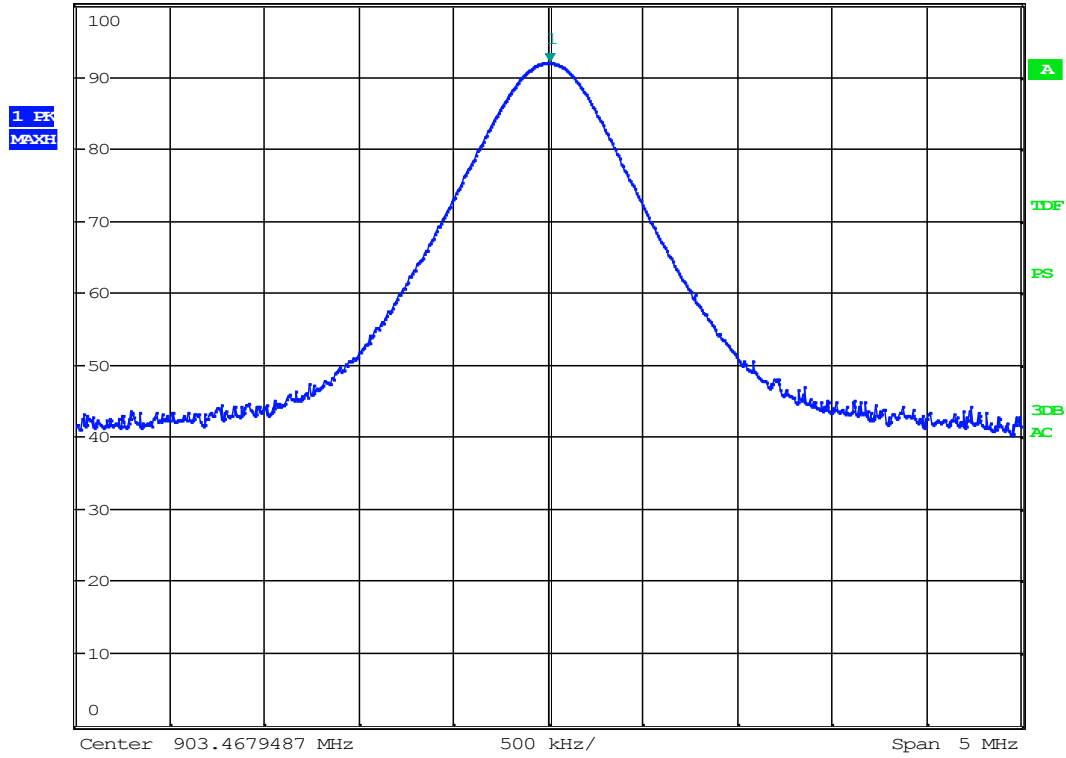


Date: 9.JUL.2012 10:55:57

VP: 903.5MHz – Field strength



*RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz 91.87 dBµV/m
 Ref 100 dBµV/m *Att 10 dB SWT 2.5 ms 903.475961538 MHz

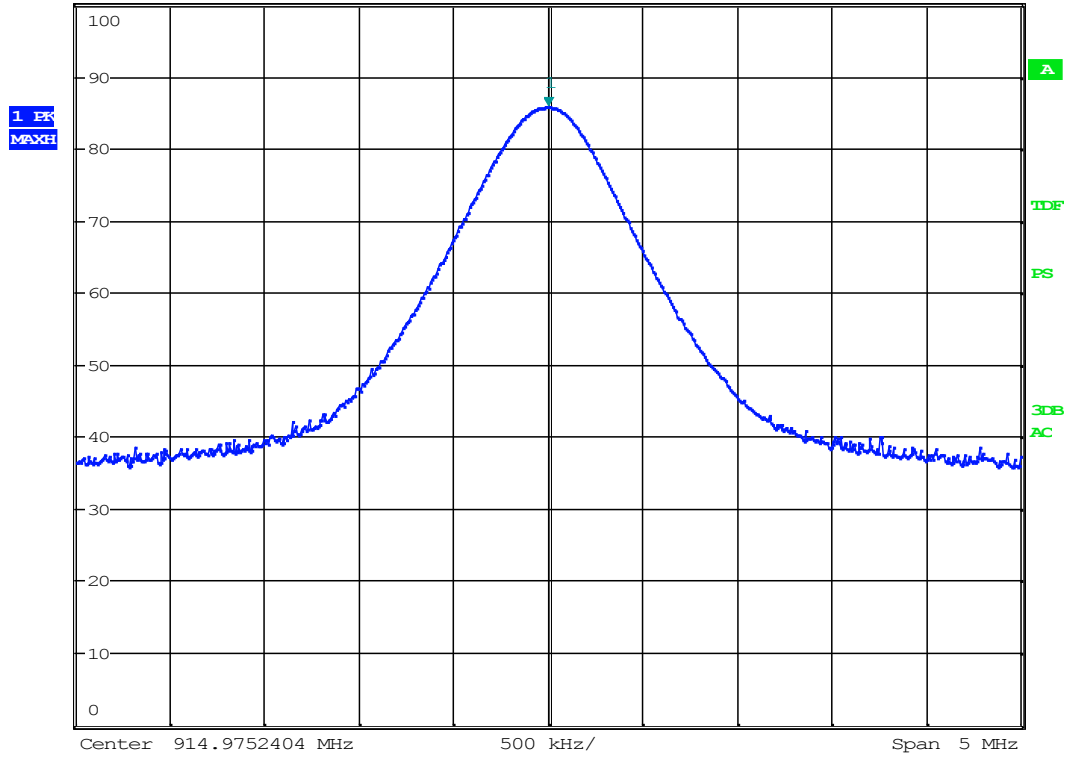


Date: 9.JUL.2012 10:56:52

HP: 903.5MHz – Field strength



Ref 100 dB μ V/m *Att 10 dB *RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz 85.73 dB μ V/m
 SWT 2.5 ms 914.975240385 MHz

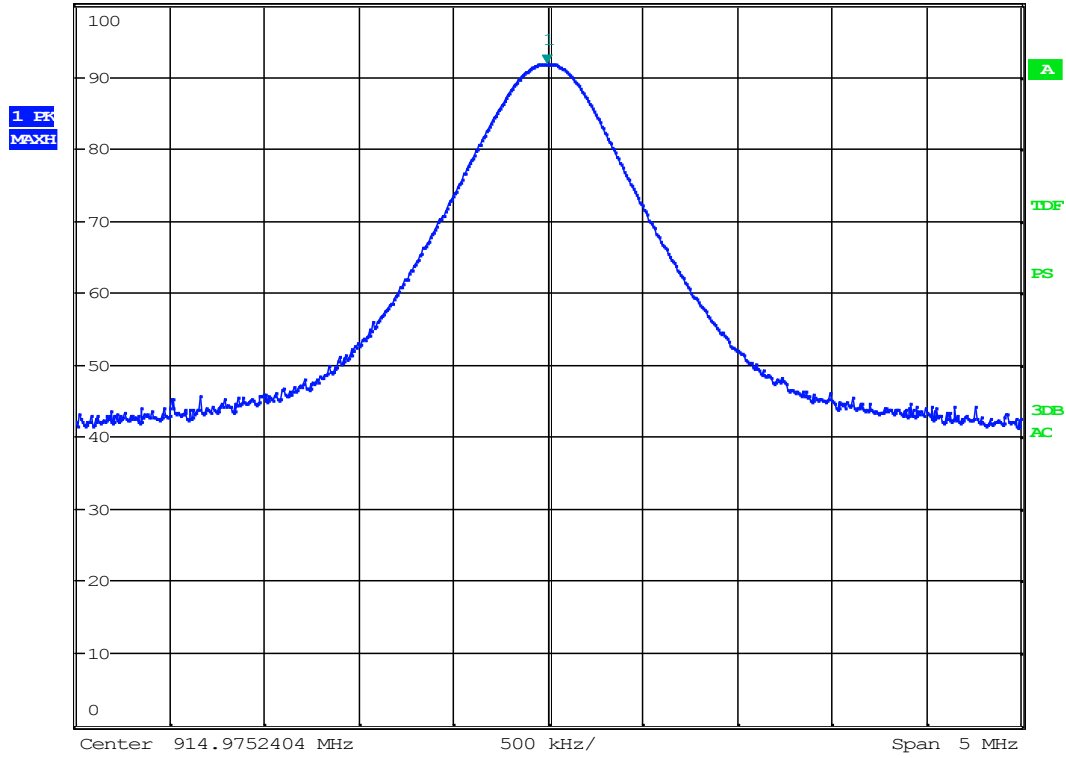


Date: 9.JUL.2012 10:54:28

VP: 915MHz – Field strength



Ref 100 dB μ V/m *Att 10 dB *RBW 300 kHz Marker 1 [T1]
VBW 1 MHz 91.77 dB μ V/m
SWT 2.5 ms 914.967227564 MHz

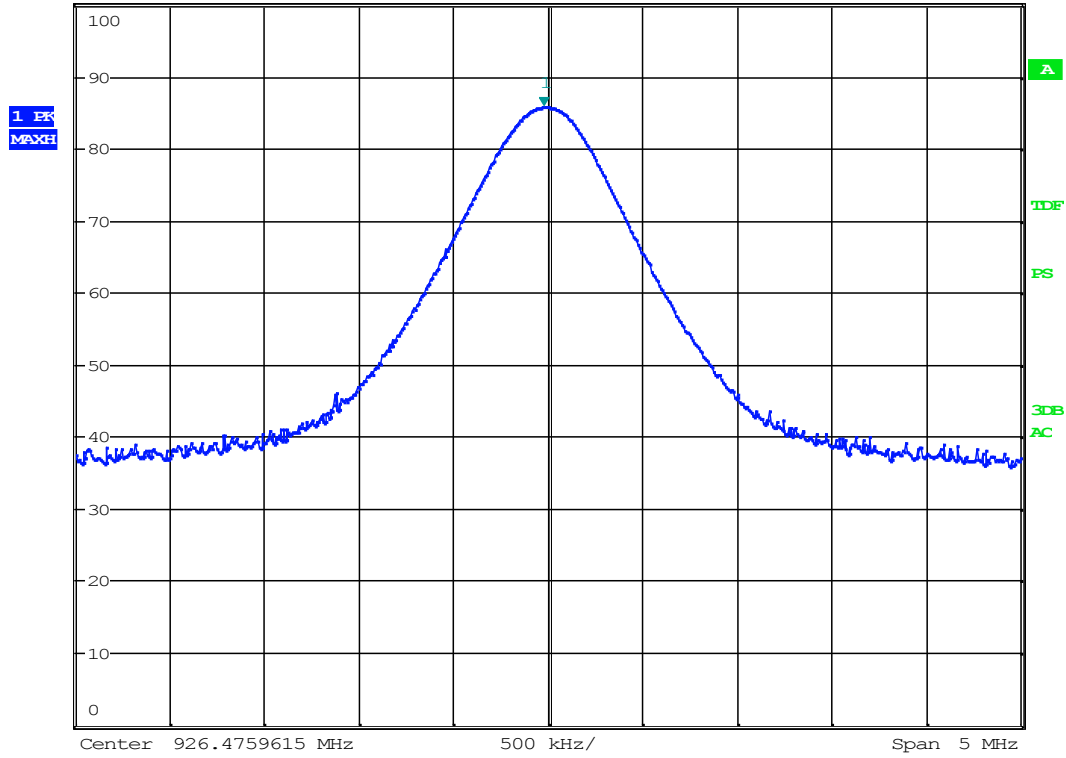


Date: 9.JUL.2012 10:52:36

HP: 915MHz – Field strength



Ref 100 dB μ V/m *Att 10 dB *RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz 85.74 dB μ V/m
 SWT 2.5 ms 926.451923077 MHz

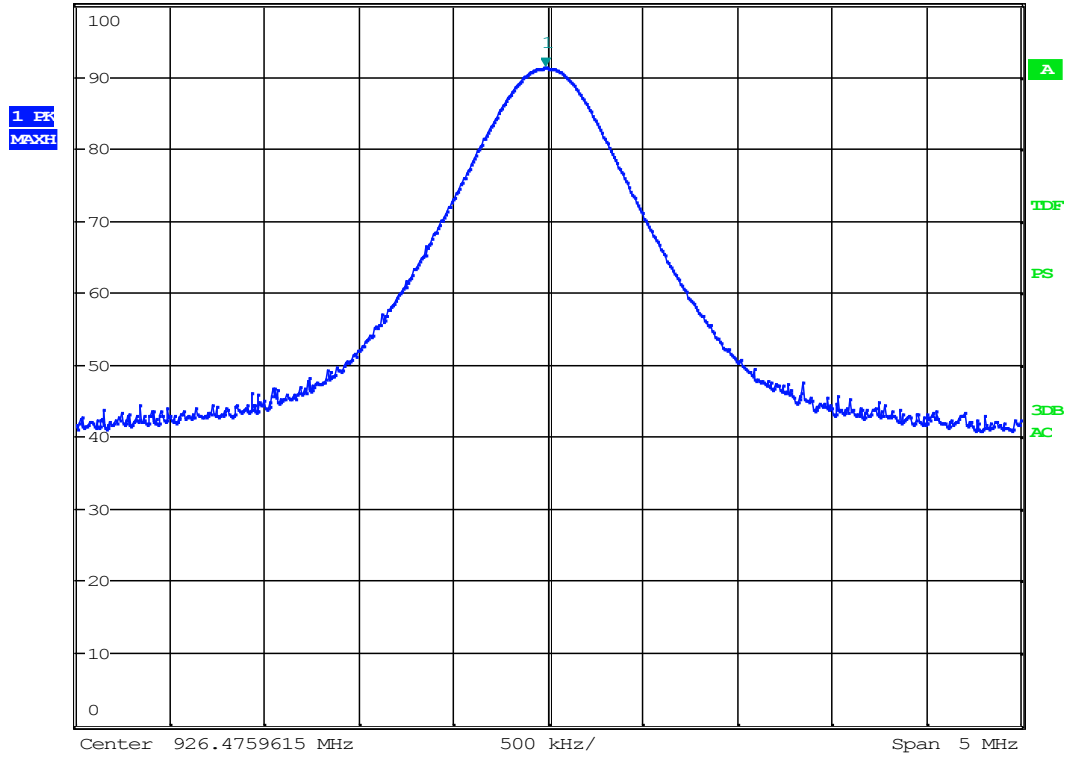


Date: 9.JUL.2012 08:37:13

VP: 926.5MHz – Field strength



Ref 100 dB μ V/m *Att 10 dB *RBW 300 kHz Marker 1 [T1]
 VBW 1 MHz 91.19 dB μ V/m
 SWT 2.5 ms 926.459935897 MHz



Date: 9.JUL.2012 08:48:20

HP: 926.5MHz – Field strength

4.4 Band Edge Emissions

Para. No.: 15.249 (d)

Test Performed By: G.Suwanthakumar	Date of Test: 09-NJuly-2012
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Test Results: Complies

Measurement Data:

Lower Band edge :

RF channel	903.500MHz
Measured maximum dBc	58.69

Upper Band edge :

RF channel	926.500MHz
Measured maximum dBc	53.12

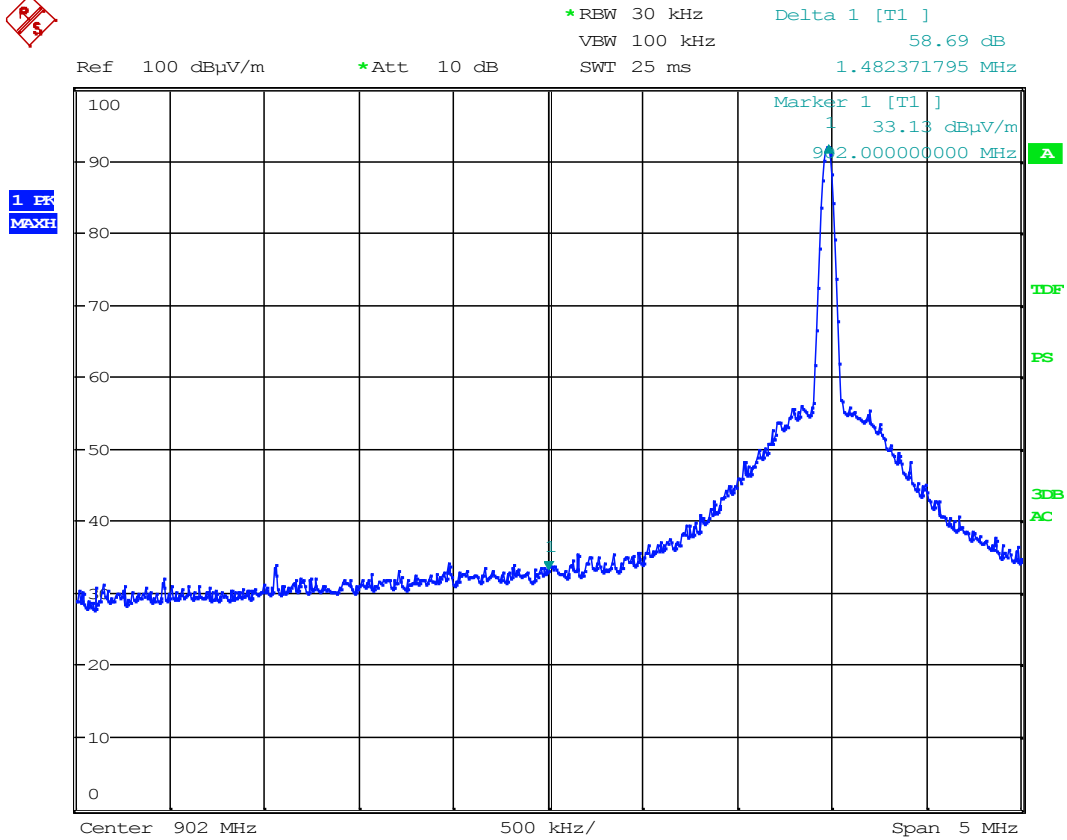
Band-edge, @3m

Frequency	Measured Field Strength @3m, dBµV/m	Detector	Limit dBµV/m	Margin dB
902.000MHz	-	AV	54	-
	33.13	PK	74	40.87
928.000MHz	-	AV	54	-
	38.12	PK	74	35.88

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.

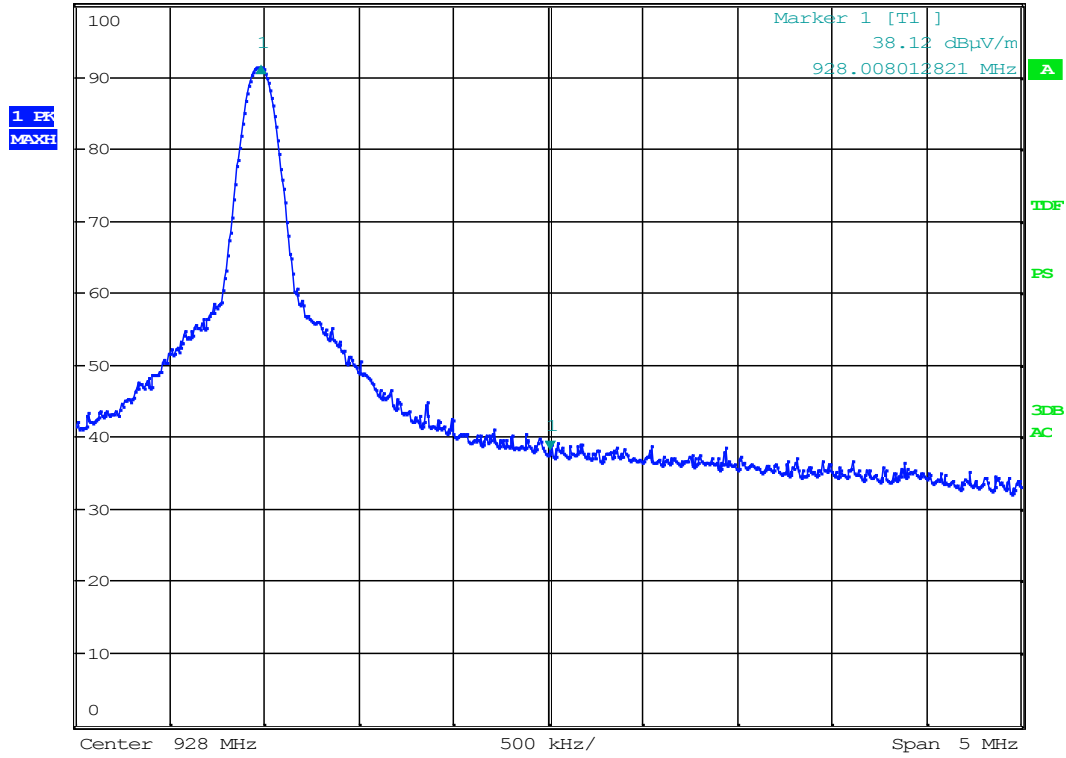


Date: 9.JUL.2012 10:59:08

903.5MHz- Lower band edge –PK detector



Ref 100 dB μ V/m *Att 10 dB *RBW 100 kHz Delta 1 [T1]
 VBW 300 kHz 53.12 dB
 SWT 2.5 ms -1.530448718 MHz



Date: 9.JUL.2012 10:47:20

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: 09-July-2012

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 903.5MHz: 50.06 dBC, margin > 20 dB

RF 915MHz: 49.90 dBC, margin > 20 dB

RF 926.5MHz: 48.08 dBC, margin > 20 dB

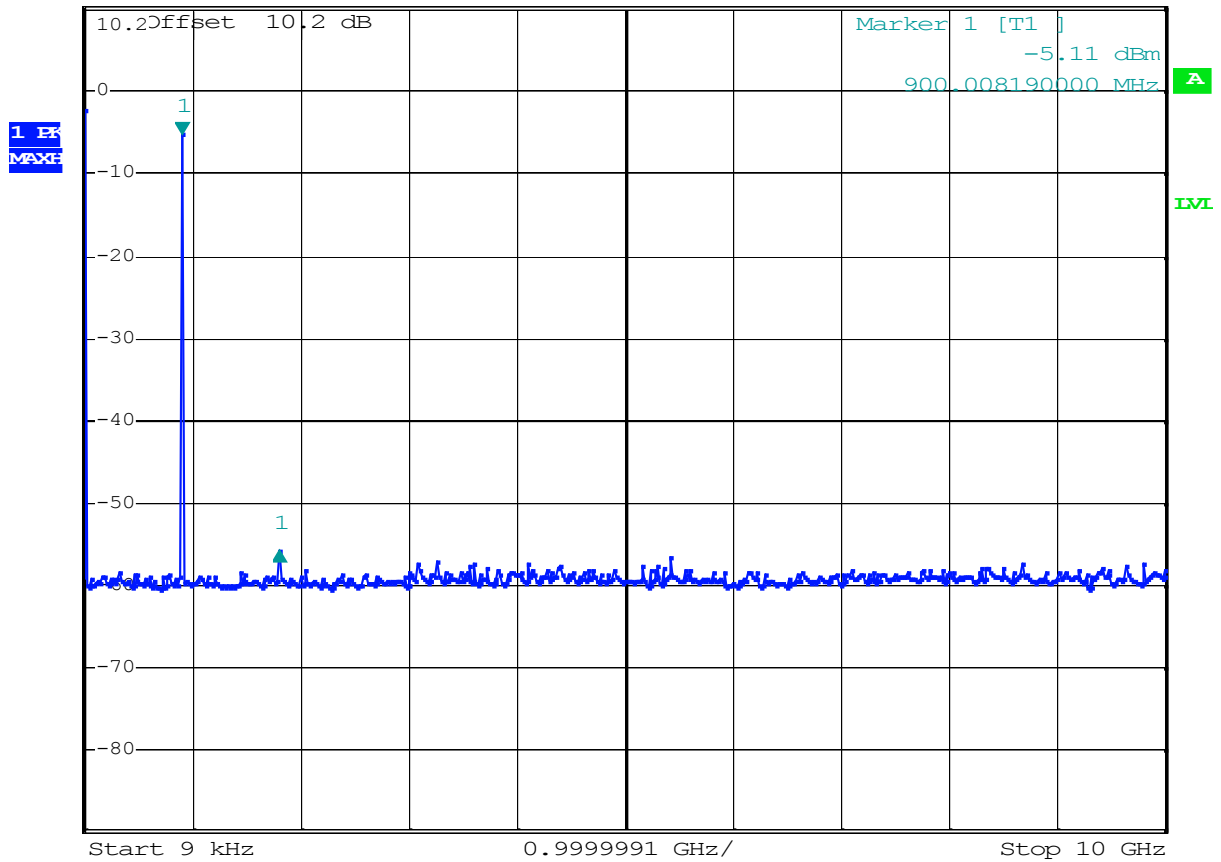
Requirements:

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.



DELTA MARKER 1
 899.99919 MHz
 Ref 10.2 dBm *Att 10 dB

*RBW 100 kHz Delta 1 [T1]
 VBW 300 kHz -50.60 dB
 SWT 1 s 899.999190000 MHz



Date: 17.JUL.2012 08:00:10

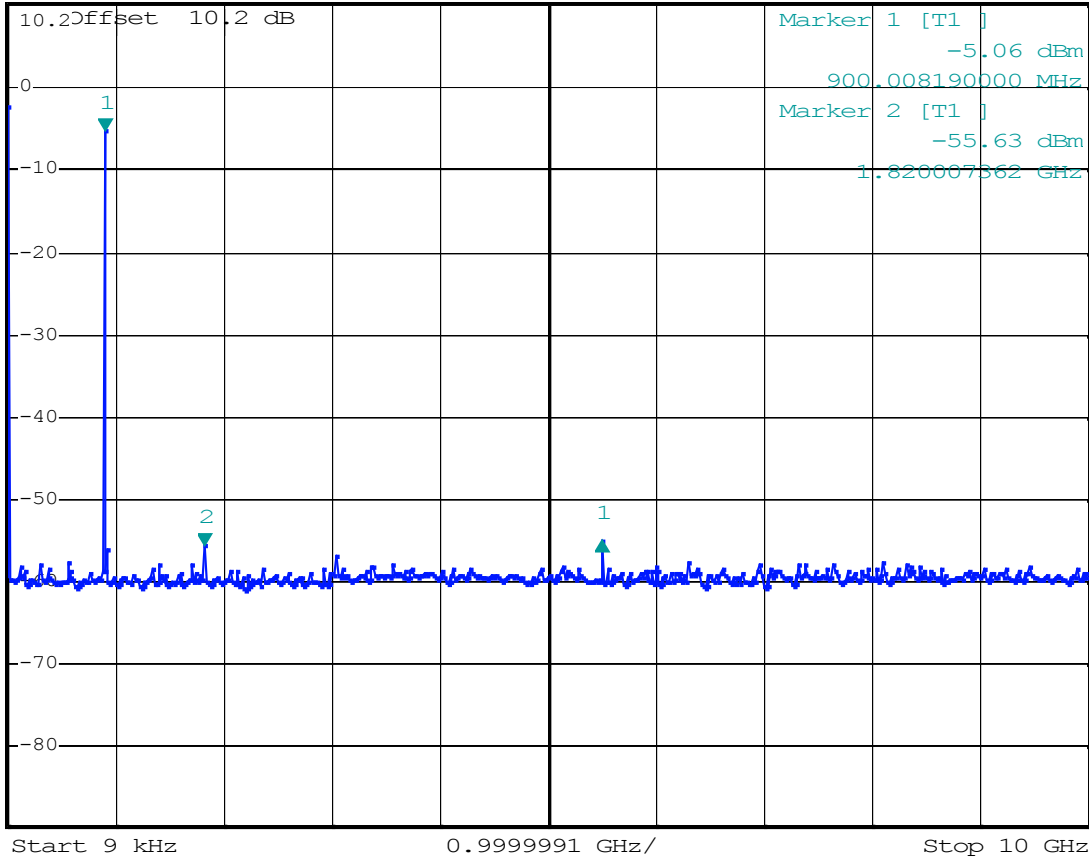
903.5MHz – Conducted Spurious – 9kHz – 10GHz



DELTA MARKER 1
 4.59999586 GHz
 Ref 10.2 dBm *Att 10 dB

*RBW 100 kHz Delta 1 [T1]
 VBW 300 kHz -49.90 dB
 SWT 1 s 4.599995860 GHz

1 Fx
 MAXH



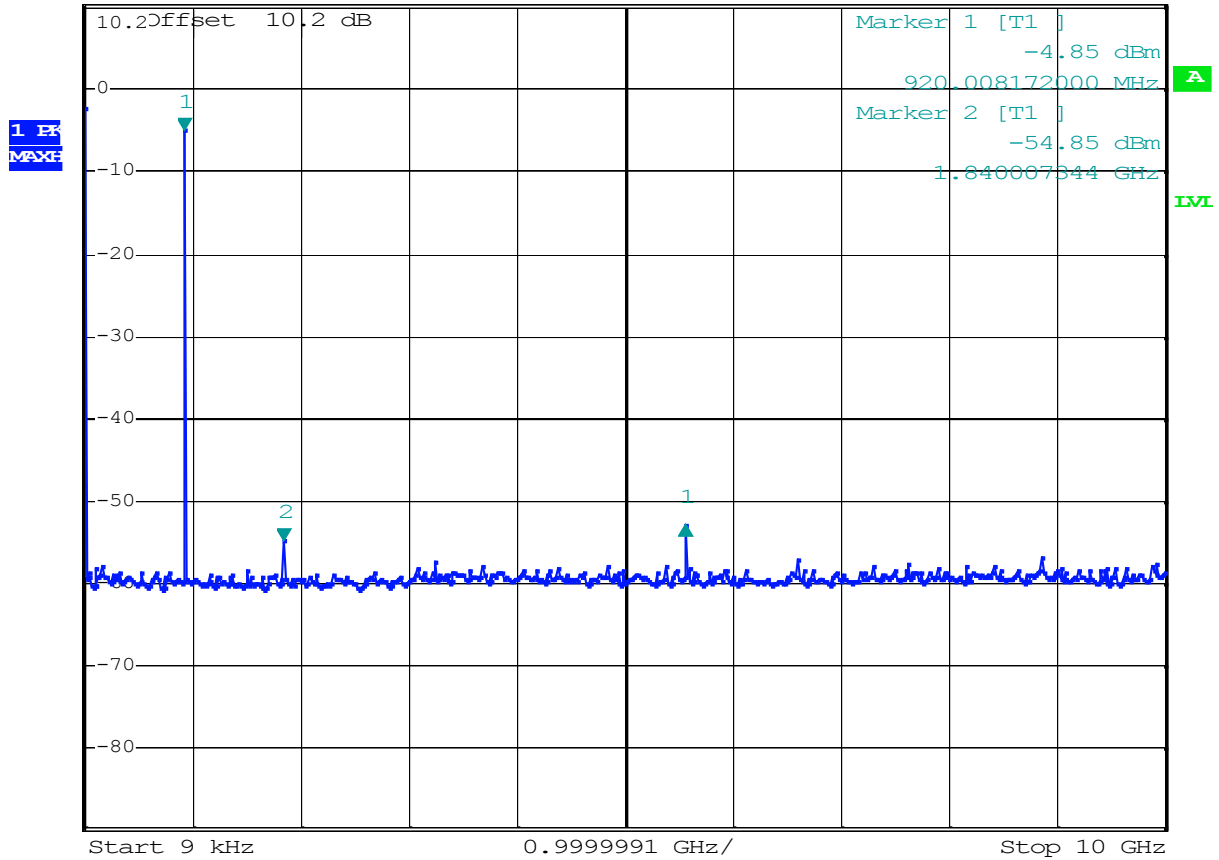
Date: 17.JUL.2012 07:59:10

915MHz – Conducted Spurious – 9kHz – 10GHz



DELTA MARKER 1
4.639995824 GHz
Ref 10.2 dBm *Att 10 dB

*RBW 100 kHz Delta 1 [T1]
VBW 300 kHz -48.08 dB
SWT 1 s 4.639995824 GHz



Date: 17.JUL.2012 07:58:02

926.5MHz – 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	dB μ V/m	dB	dB μ V/m	dB
1.806	0	45.01	-	74	28.99
1.829	0	47.06	-	74	26.94
1.852	0	49.58	-	74	24.42
>1.86 - 10	0	None detected	-	74	

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

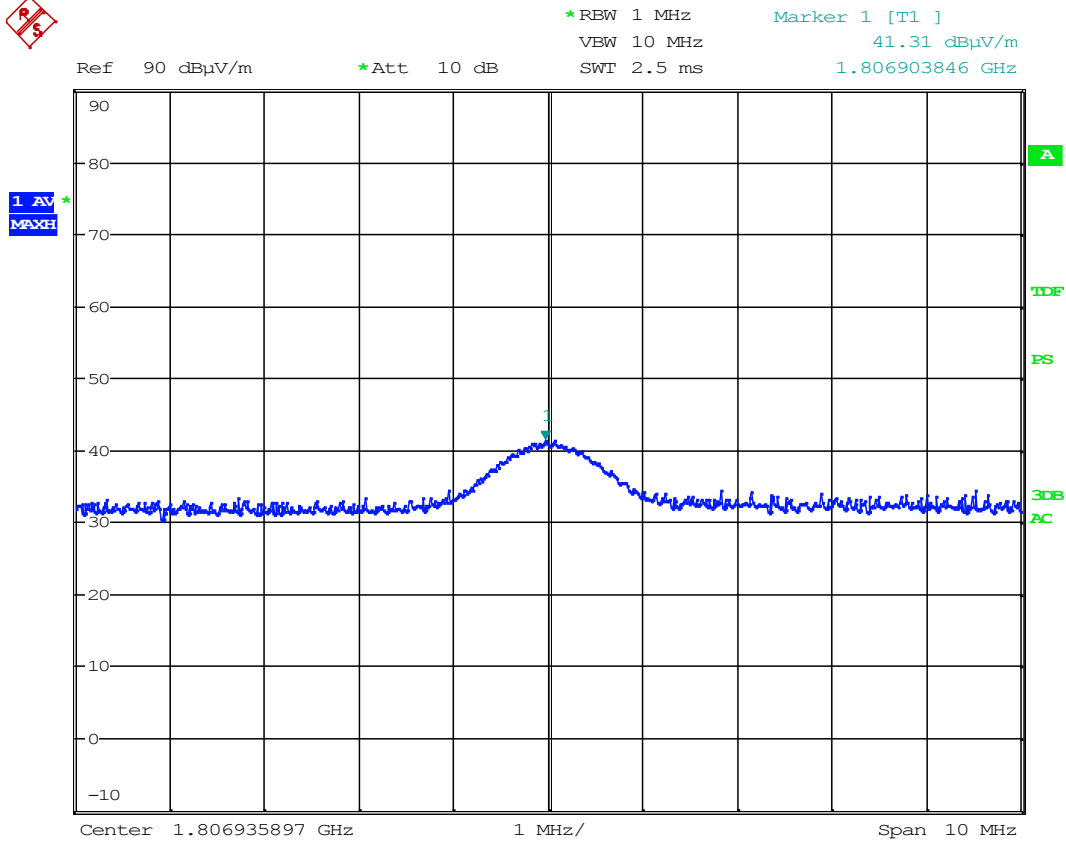
Frequency	Dist. corr. factor	Field strength, AV	Duty cycle corr. factor	Limit	Margin
GHz	dB	dB μ V/m	dB	dB μ V/m	dB
1.806	0	41.31	-	54	12.69
1.829	0	45.25	-	54	8.75
1.852	0	47.48	-	54	6.52
>1.86 - 10	0	None detected	-	54	-

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.

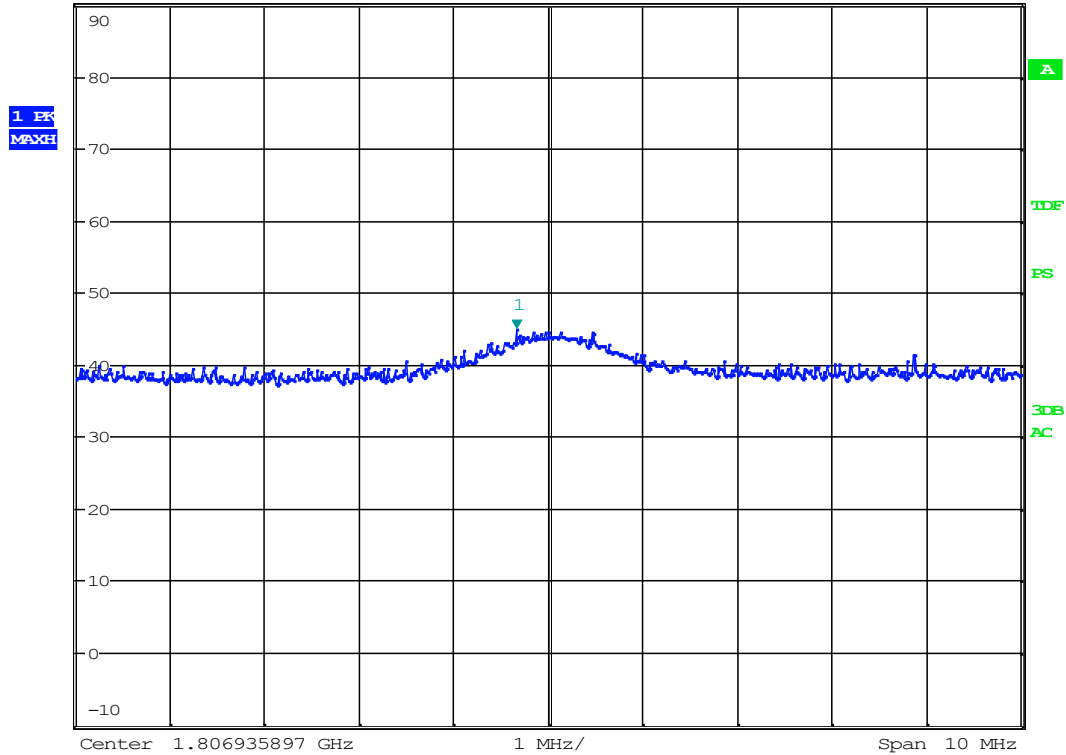


Date: 9.JUL.2012 12:46:37

VP: 903.5MHz – 2nd Harmonic- AV

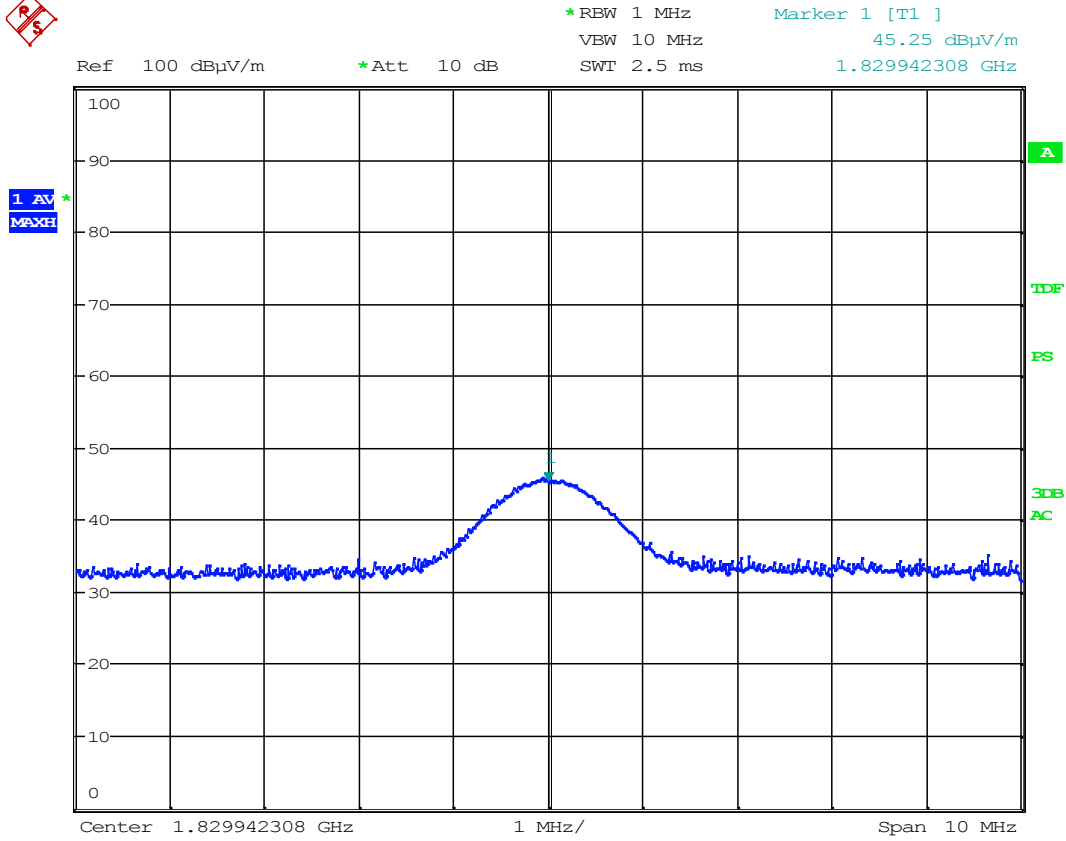


Ref 90 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 45.01 dB μ V/m
 SWT 2.5 ms 1.806599359 GHz



Date: 9.JUL.2012 12:46:14

VP: 903.5MHz – 2nd Harmonic- Pk



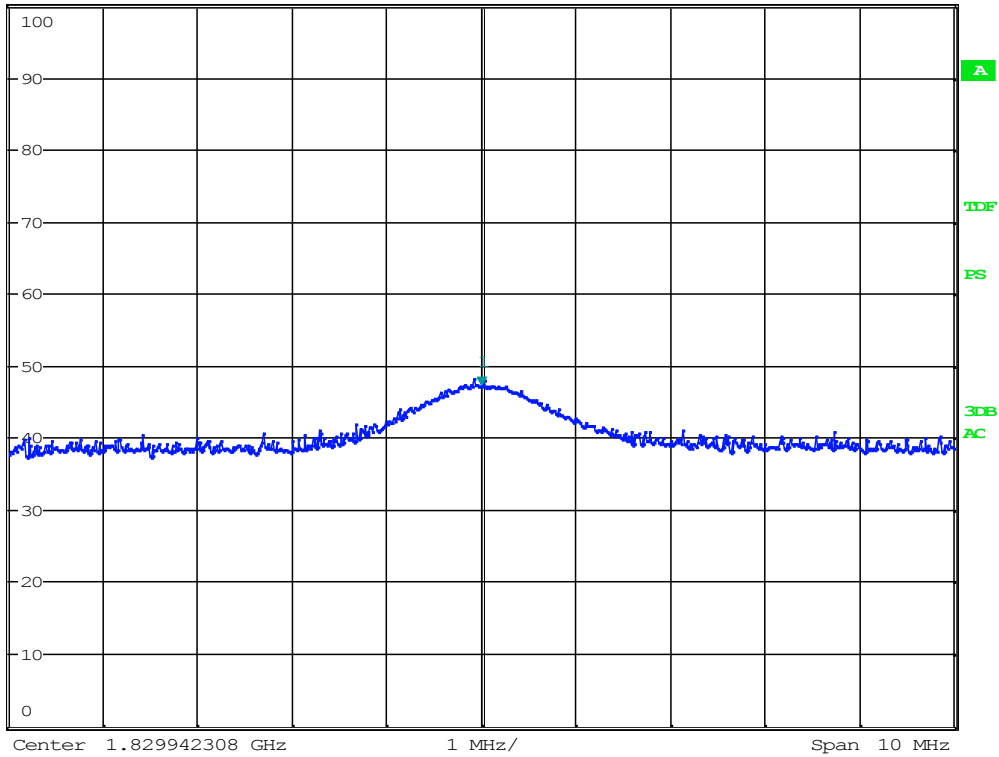
Date: 9.JUL.2012 12:35:03

VP: 915MHz – 2nd harmonic- AV



1 PK
MAXH

Ref 100 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 47.06 dB μ V/m
 SWT 2.5 ms 1.829942308 GHz

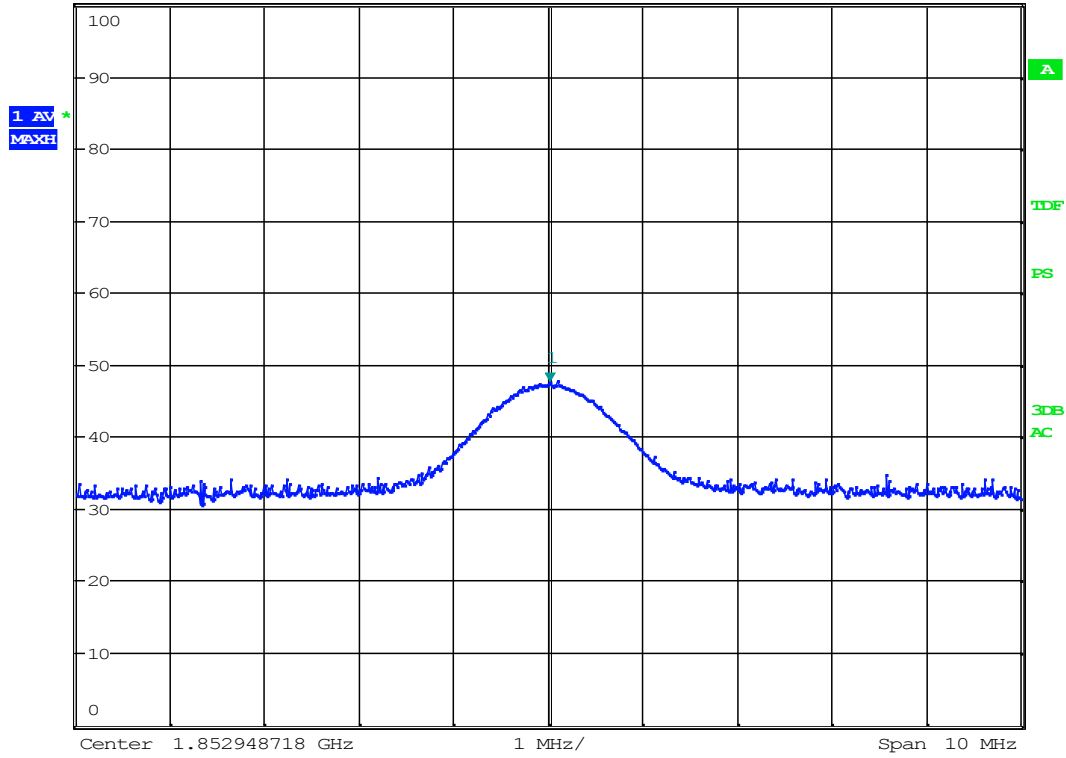


Date: 9.JUL.2012 12:35:23

VP: 915MHz – 2nd Harmonic – Pk



Ref 100 dBµV/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 10 MHz 47.48 dBµV/m
 SWT 2.5 ms 1.852964744 GHz

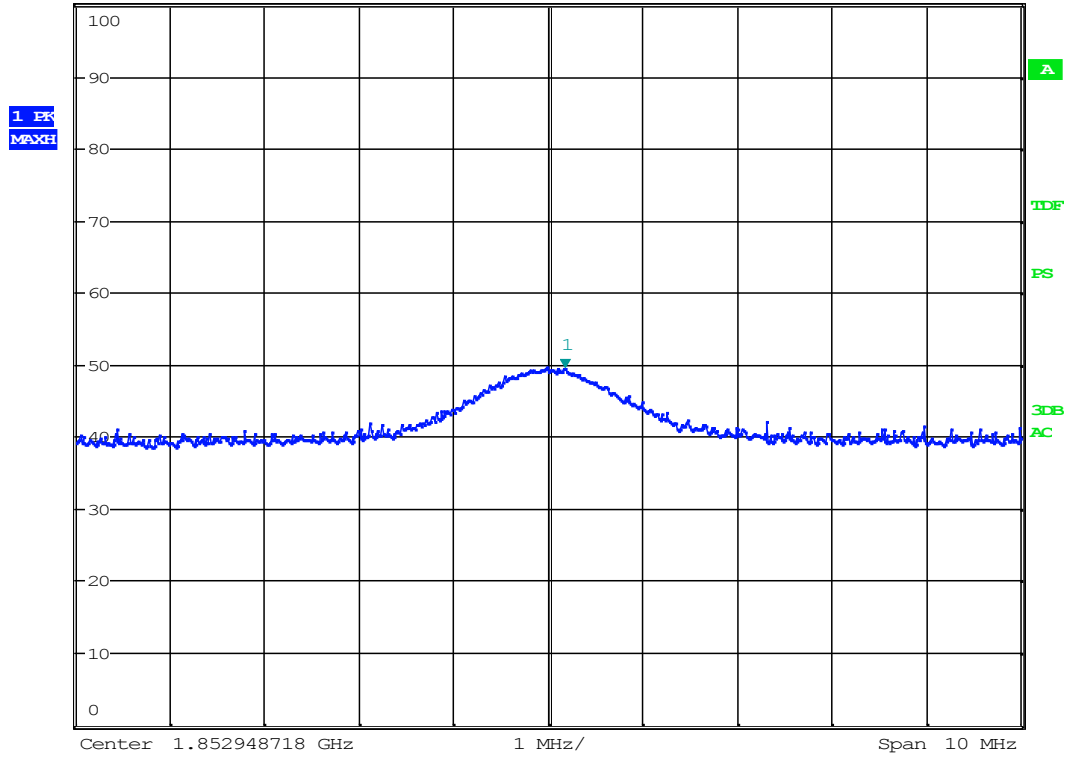


Date: 9.JUL.2012 12:33:23

VP: 926.5MHz – 2nd harmonic- AV

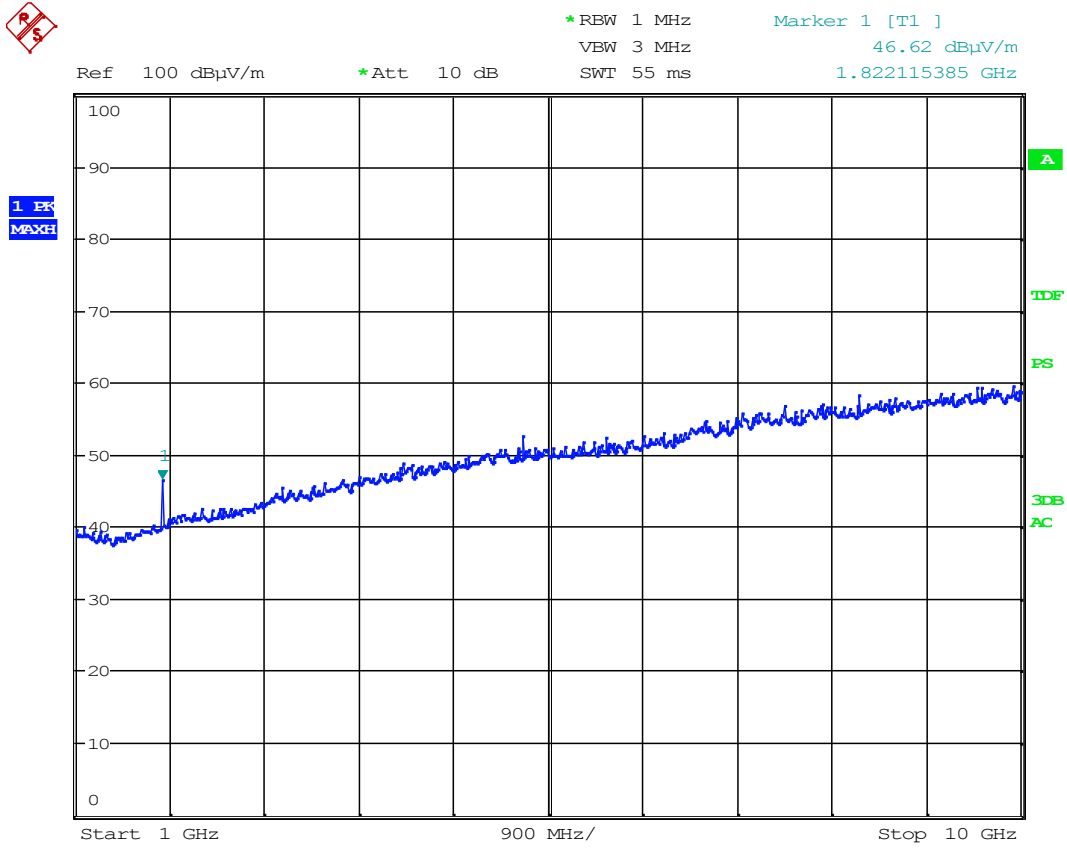


Ref 100 dBµV/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 49.58 dBµV/m
 SWT 2.5 ms 1.853125000 GHz



Date: 9.JUL.2012 12:32:58

VP: 926.5MHz – 2nd harmonic- Pk

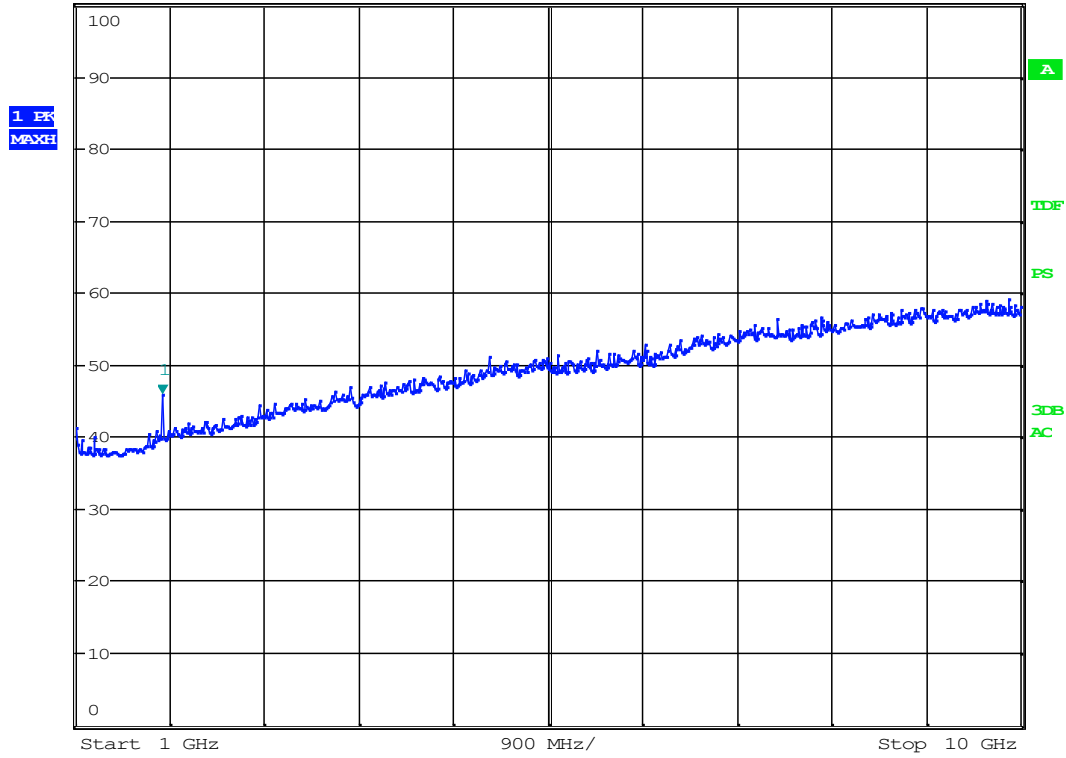


Date: 9.JUL.2012 12:40:03

VP: pre-scan 1 - 10GHz-Pk



Ref 100 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 45.95 dB μ V/m
 SWT 55 ms 1.822115385 GHz



Date: 9.JUL.2012 12:38:40

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

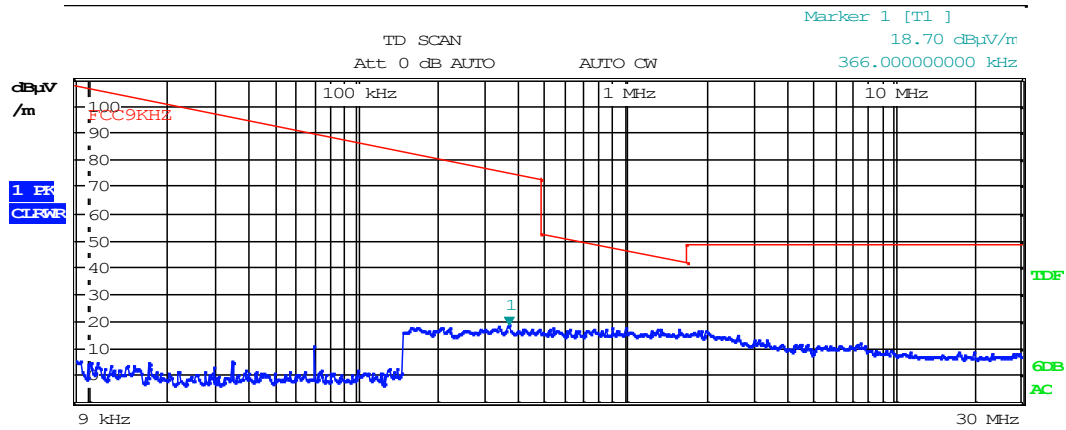
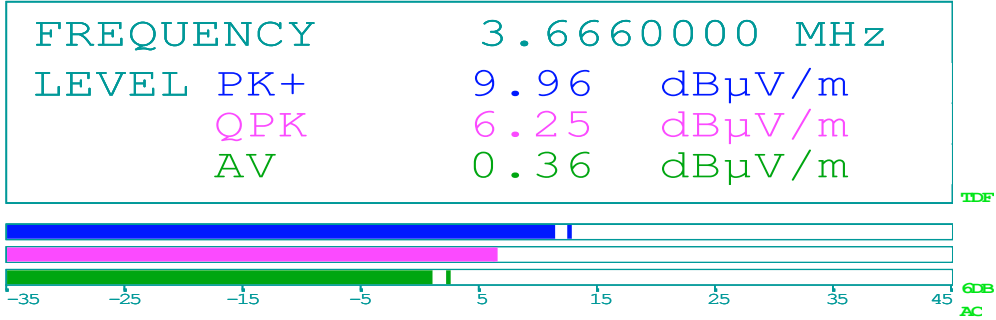
Radiated emissions 9kHz – 30 MHz.

Detector: Peak

Measuring distance 10 m.



Att 0 dB AUTO REW 9 kHz
 MF 100 ms
 PREAMP ON



Date: 9.JUL.2012 15:30:28

Radiated emissions 30 – 1000 MHz.

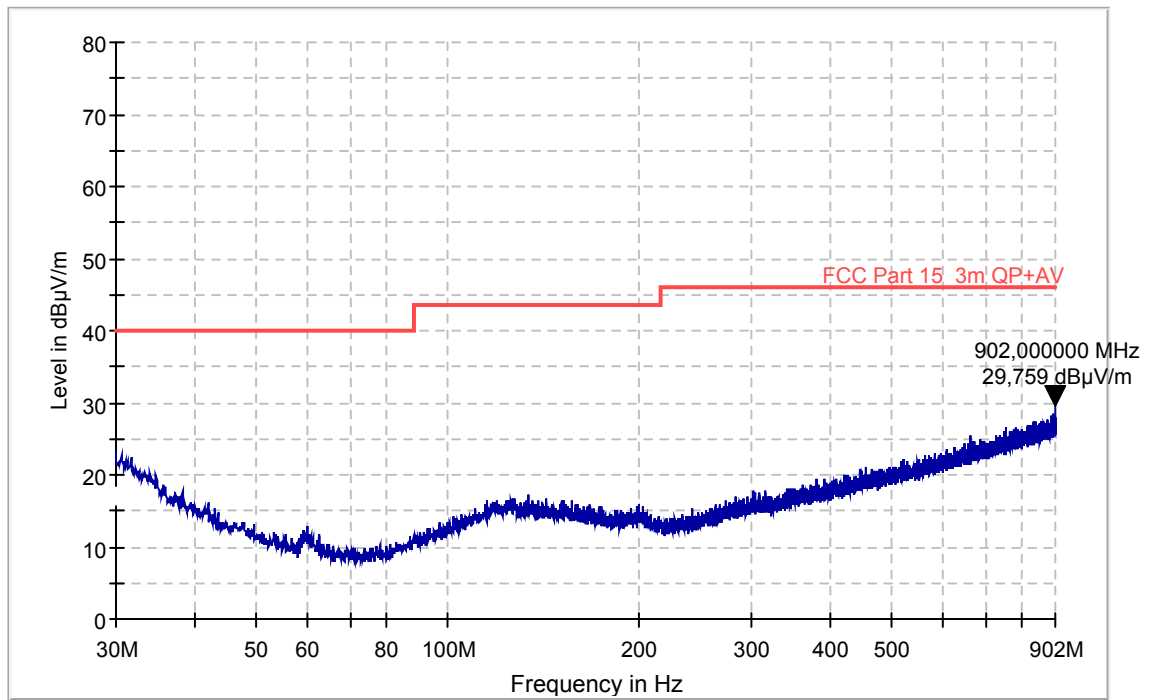
Detector: Peak

Measuring distance 3 m.

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

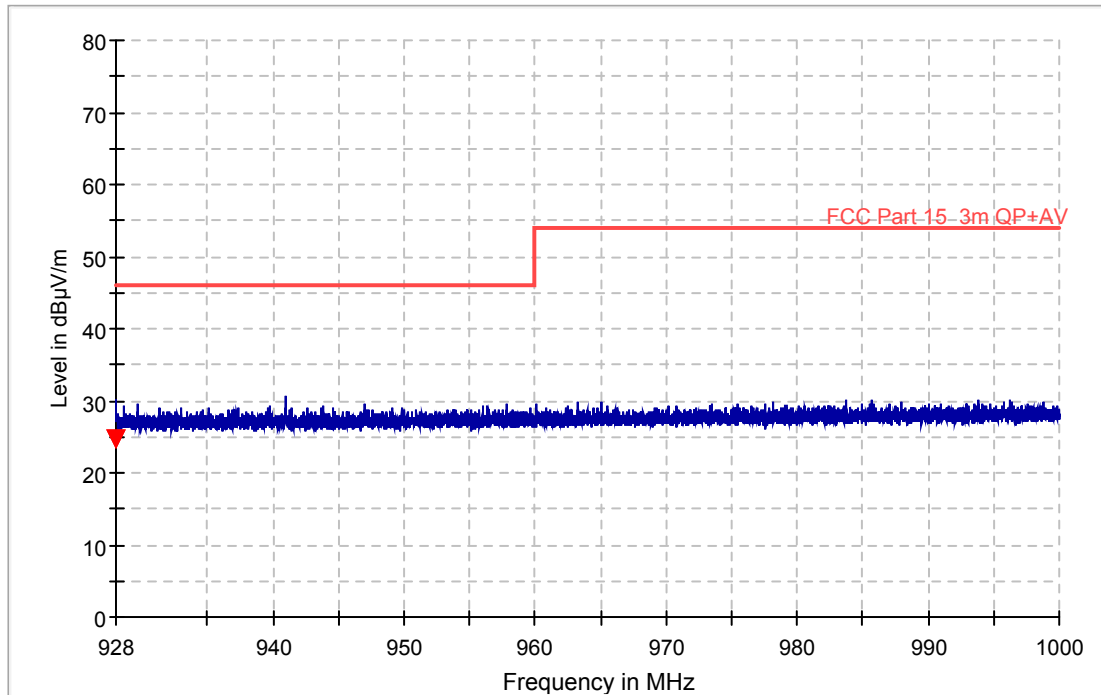
FCC Pt15 Class B 30-902M 3m

FCC Pt15 Class B 30-1000M 3m



FCC Pt15 Class B 928-1000M 3m

FCC Pt15 Class B 30-1000M 3m



Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
928.000000	24.7	1000.0	120.000	140.0	V	141.0	2.1	21.3	46.0	
928.000000	24.7	1000.0	120.000	139.0	V	141.0	2.1	21.3	46.0	

4.6 Receiver Spurious Emissions (Radiated)

Para. No.: RSS-Gen (6)

Test Performed By: G.Suwanthakumar

Date of Test: 09-July-2012

Test Results: Complies

Measurement Data:

Radiated Emissions: 30MHz – 10GHz

Measured with Peak Detector

See attached plots below.

Requirement(Radiated):

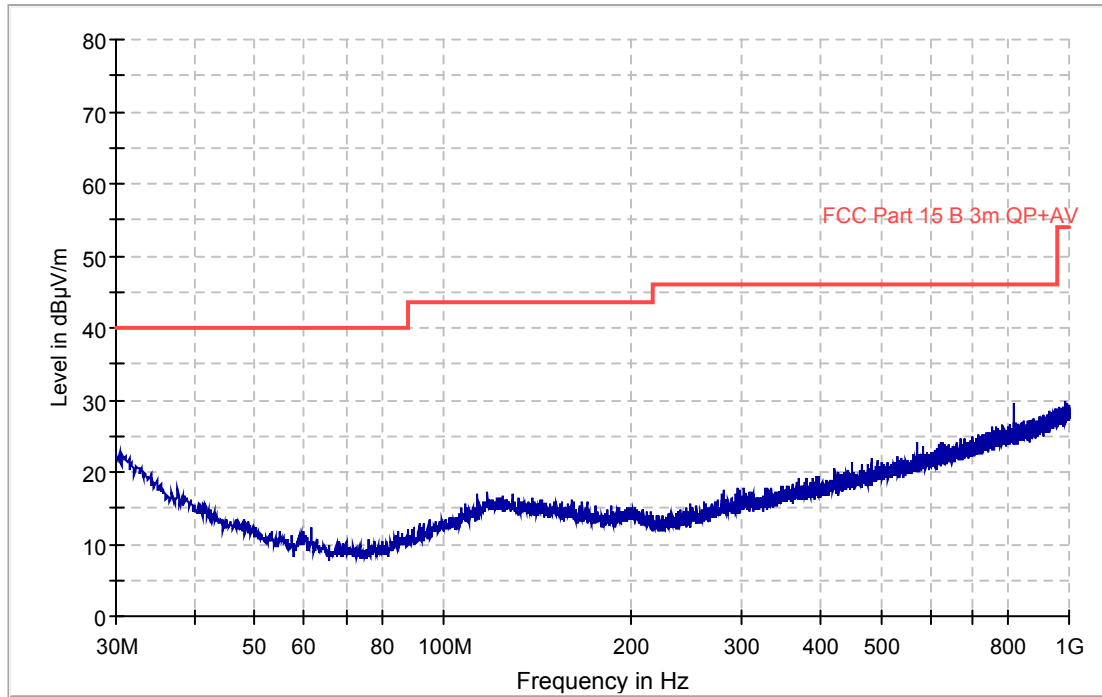
Spurious emissions from receivers shall not exceed the radiated limits as given in RSS-Gen table 2 or FCC.part 15B.109 (a) or CISPR 22

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

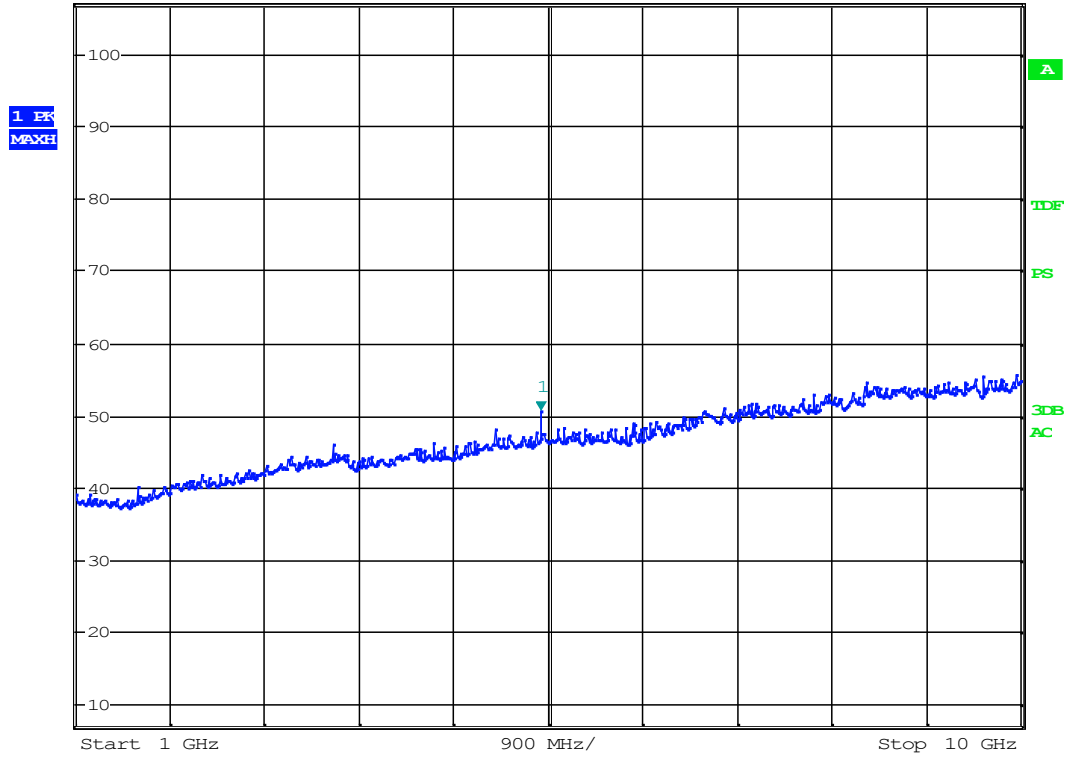
**Class B 30MHz-1GHz 3m,
peak**

FCC Pt15 Class B 30-1000M 3m





Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 50.64 dBµV/m
 SWT 55 ms 5.427884615 GHz

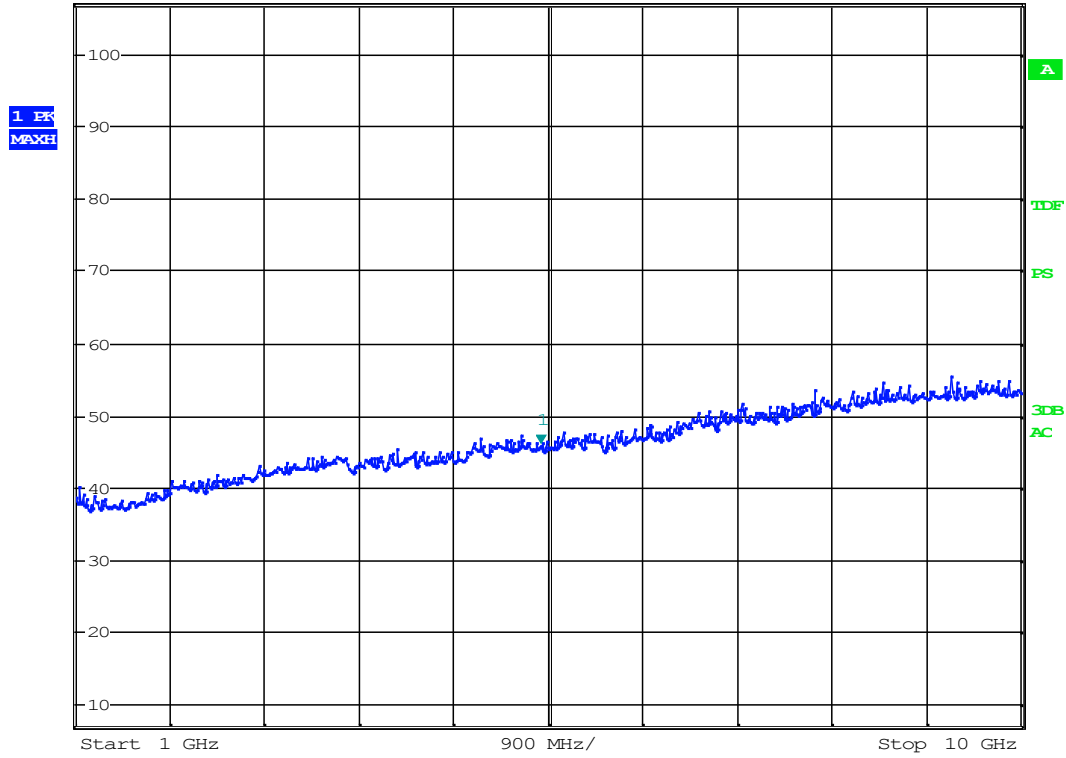


Date: 9.JUL.2012 13:52:02

RX, VP – 1 – 10GHz -pk



Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
VBW 3 MHz 45.91 dBµV/m
SWT 55 ms 5.427884615 GHz



Date: 9.JUL.2012 13:52:23

RX, HP 1 – 10GHz -pk

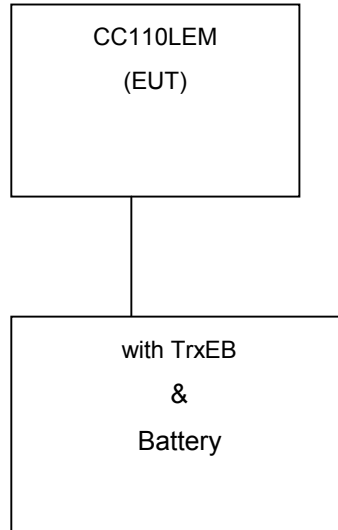
5 LIST OF TEST EQUIPMENT

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.	ESU40	EMI Receiver	Rohde & Schwarz	LR1639	2010.06	2013.06
2.	3115	Antenna horn	EMCO	LR 1330	2010.08.05	2013.08.05
3.	FA147A1010 02020	Cable microwave	Rosenberger	LR 1360	-	-
4.	6810.17A	Attenuator	Suhner	LR 1185	2011.10.18	2013.10.18
5.	87V	Multimeter, Digital	Fluke	LR1599	2010.12.15	2012.12.15
6.	8449B	Amplifier	Hewlett Packard	LR 1322	2011.09.26	2012.09.26
7.	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285	2010.10.08	2013.10.08
8.	10855A	Amplifier	Hewlett Packard	LR 1445	2011.10.12	2012.10.12
9.	HL223	Antenna log.per	Rohde & Schwarz	LR 1261	2010.05.09	2013.05.09
10.	HK116	Antenna biconic	Rohde & Schwarz	LR 1260	2010.05.09	2013.05.09
11.	LNA6900	Amplifier, low noise	Teseq	LR1593	2011.11.24	2013.11.24
12.	JB3	Antenna Bilog	Sunol Sceiences	N4525	2010.09	2012.09

6 BLOCK DIAGRAM

6.1 System set up for radiated measurements



Test equipment: 1- 12

6.2 Test Site Radiated Emission

