



**Test report no. : 182229-3**

**Item tested : CC2543EM**

**Type of equipment : 2.4GHz Transceiver**

**FCC ID : ZAT2543EM**

**Client : Texas Instruments Norway AS**

**FCC Part 15.247**

Digital Transmission System

**RSS-210, Issue 8**

Low Power Licence-Exempt  
Radiocommunication Devices

**2012-03-15**

**Authorized by :** .....

Frode Sveinsen  
Technical Vericator

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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  
E-mail: [comlab@nemko.com](mailto:comlab@nemko.com)  
FCC test firm : 994405  
IC OATS : 2040D-1  
Total Number of Pages: 36

### 1.2 Client Information

Name : Texas Instruments Norway AS  
Address : Gaustadalléen 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](mailto:d.grini@ti.com)

### 1.3 Responsible Manufacturer (If other than client)

Name : /  
Address : /

## 2 Test Information

### 2.1 Test Item

Name :	Texas Instruments
FCC ID :	ZAT2543EM
IC :	451H-2543EM
Model/version :	CC2543EM
Serial number :	/
Hardware identity and/or version:	/
Software identity and/or version :	/
Frequency Range :	2402 – 2480 MHz
Number of Channels :	/
Type of Modulation :	Digital (GFSK)
Rated output power:	/
Data rate:	2Mbps
User Frequency Adjustment :	None
Type of Power Supply :	Primary Batteries (2xAA batteries)
Antenna Connector :	SMA (Antenna type: W1010)
Antenna Diversity Supported :	No
Desktop Charger :	None

#### Description of Test Item

The tested EUT is a 2.4GHz transceiver with SMA connector.

#### Exposure Evaluation

The EUT is exempted from RF Exposure Evaluation.

## **2.2 Test Environment**

### **2.2.1 Normal test condition**

Temperature:	20 – 23 °C
Relative humidity:	33 – 45 %
Normal test voltage:	3.0 V DC

The radiated emissions tests were performed with the EUT powered from a test-jig with 2xAA primary batteries. New batteries were used for all tests.

The values are the limit registered during the test period.

## **2.3 Test Period**

Item received date: 2011-11-21

Test period : from 2011-11-24 to 2011-11-29 and 15.03.2012

### 3 TEST REPORT SUMMARY

#### 3.1 General

Manufacturer: Texas Instruments  
Model No.: CC2543EM  
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, paragraph 15.247 and Industry Canada RSS-210 Issue 8.

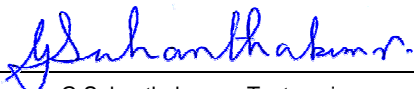
Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3m and 10m.

- |   |   |
|---|---|
| <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        |
| <b>DTS</b> Equipment Code                           | <input type="checkbox"/> 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".**



**TEST REPORT #: 182229-3**

TESTED BY:   
G.Suhanthakumar, Test engineer

DATE: 2012-03-15

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### 3.2 Test Summary

Name of test	FCC Part 15 reference	RSS-210 Issue 8 reference	Result
Antenna Requirement	15.203	7.1.4 (RSS-GEN)	Pass
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2.2 (RSS-GEN)	N/A*
Minimum 6 dB Bandwidth	15.247(a)(2)	A8.2	Pass
Peak Power Output	15.247(b)	A8.4	Pass
Power Spectral Density	15.247(d)	A8.2	Pass
Spurious Emissions (Antenna Conducted)	15.247(c)	A8.5	Pass
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	A8.5	Pass
Receiver Emissions (Radiated)	N/A	2.3	Pass

\*EUT is battery operated only.

### 3.3 Description of modification for Modification Filing

Not applicable.

### 3.4 Comments

All ports were populated during spurious emission measurements.

### 3.5 Family List Rational

Not Applicable.

## 4 TEST RESULTS

### 4.1 Minimum 6 dB Bandwidth

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

Test Performed By: G.Suwanthakumar	Date of Test: 15 Mar 2012
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Test Results: Complies

Measurement Data:

Measured 6 dB Bandwidth (MHz)		
2402MHz	2440 MHz	2480MHz
0.857	0.825	0.841

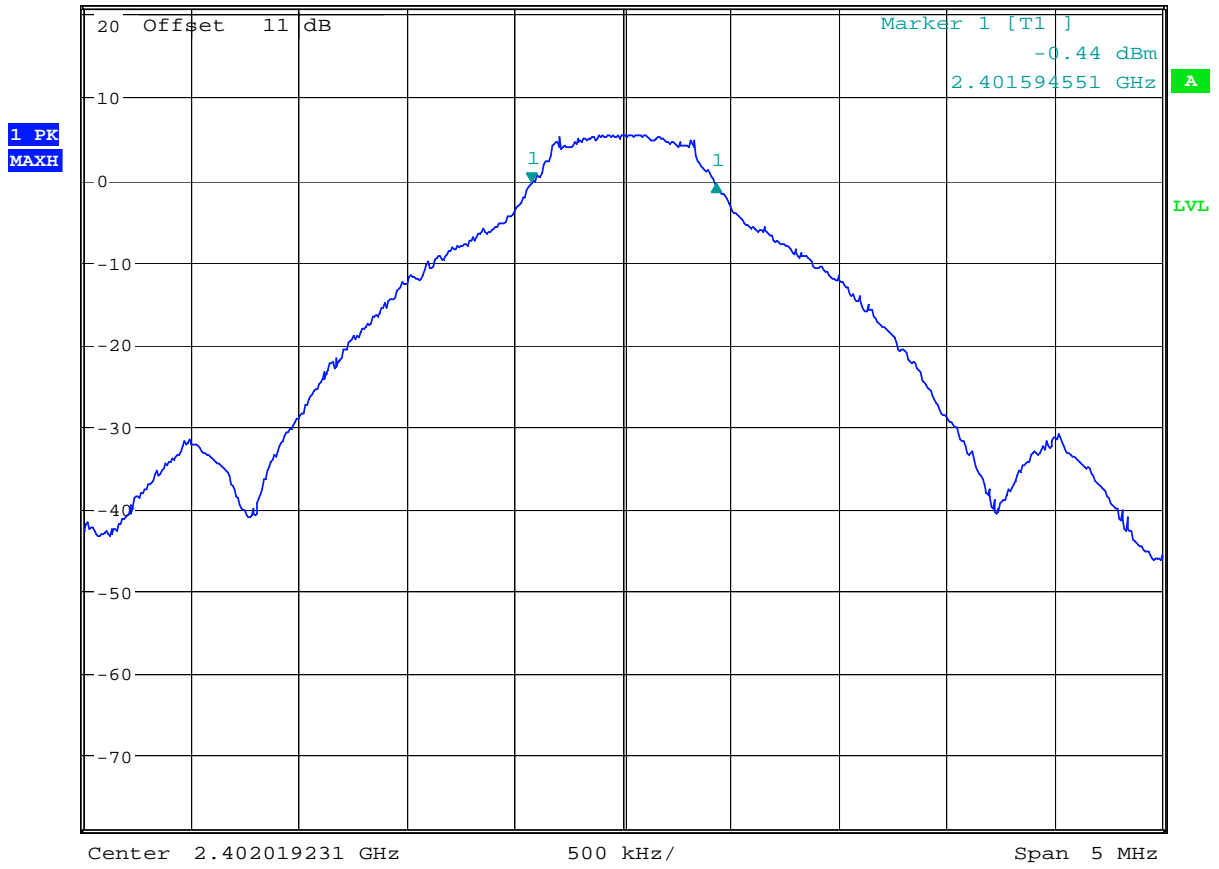
Conducted measurements

**Requirements:**

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.



<b>DELTA MARKER 1</b>		* RBW 100 kHz	Delta 1 [T1 ]
857.3717949 kHz		* VBW 100 kHz	-0.28 dB
Ref 21 dBm	* Att 10 dB	* SWT 5 ms	857.371794870 kHz

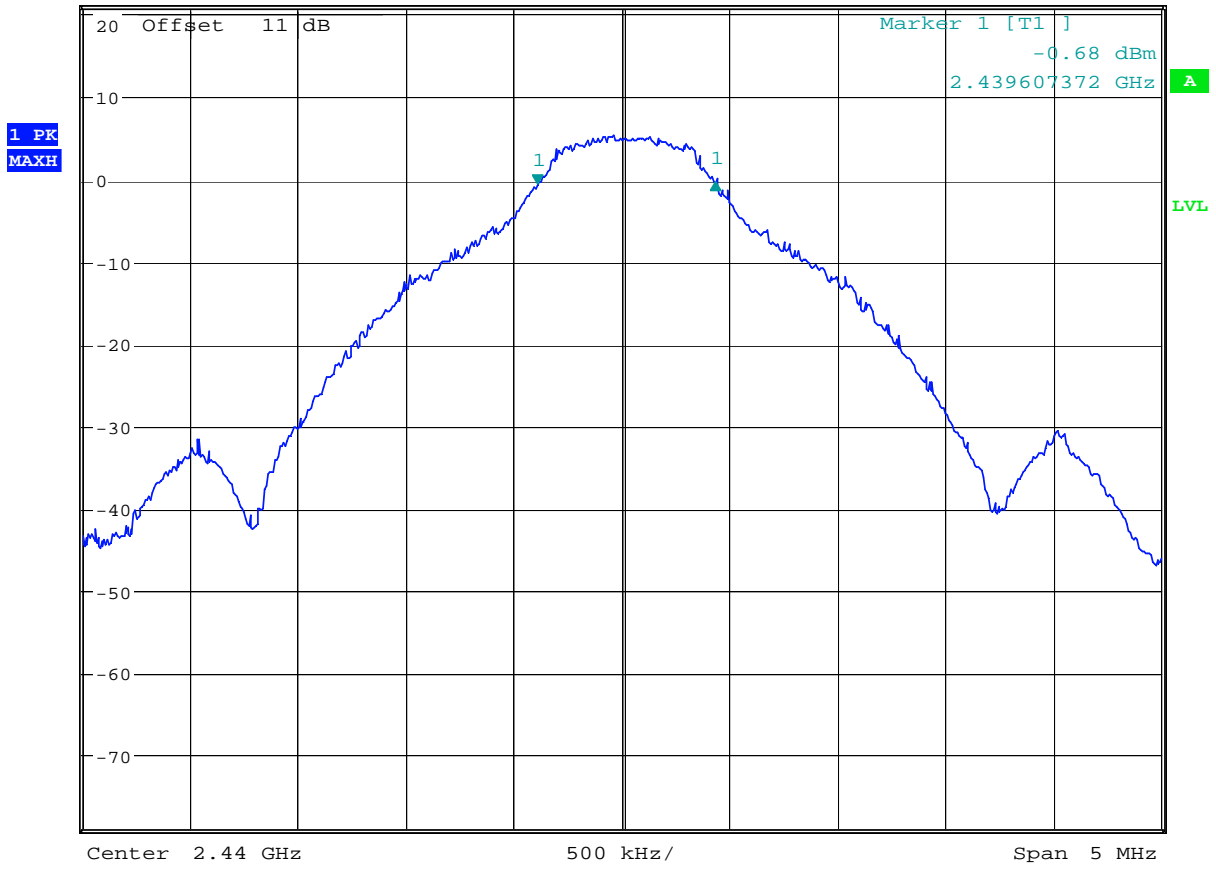


Date: 15.MAR.2012 15:42:12

**6 dB Bandwidth at 2402 MHz**

**DELTA MARKER 1**  
 825.3205128 kHz  
 Ref 21 dBm \* Att 10 dB

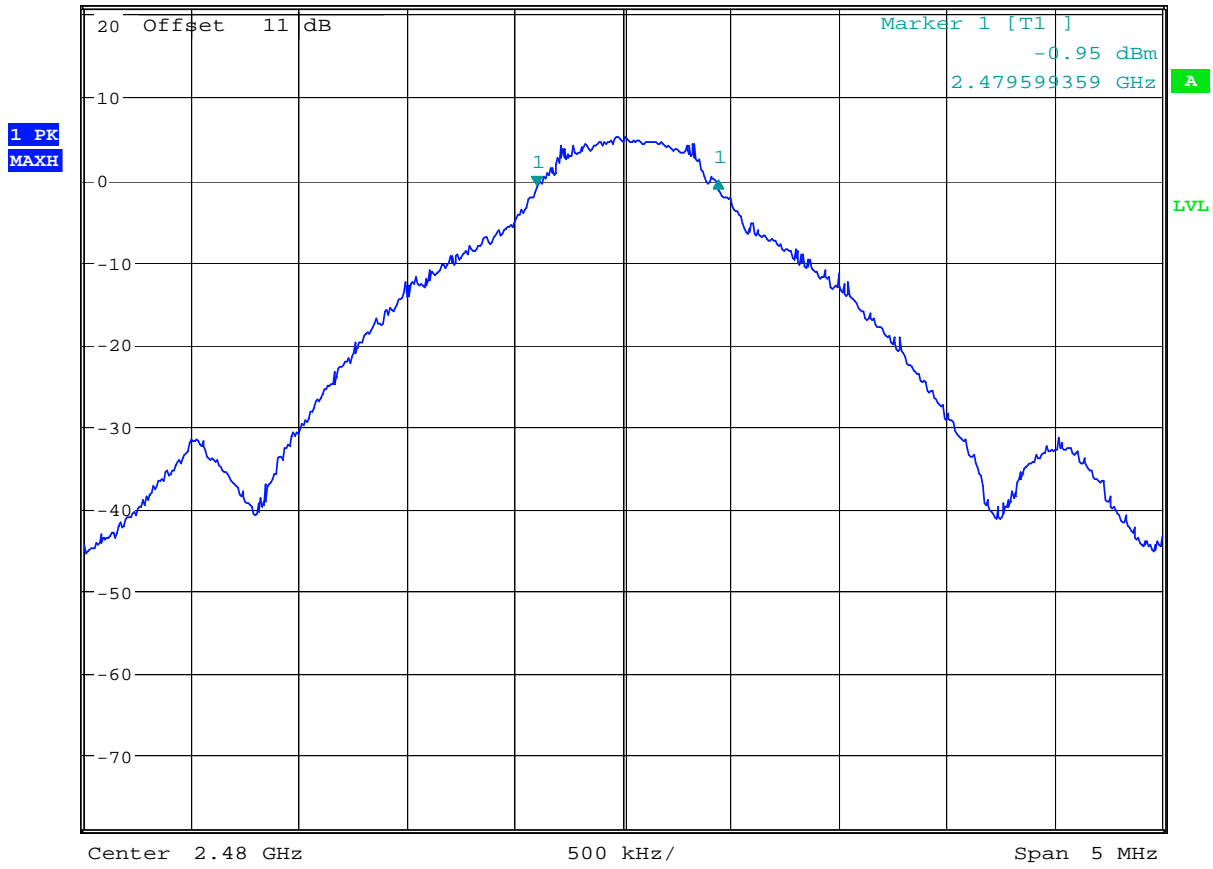
\* RBW 100 kHz Delta 1 [T1 ]  
 \* VBW 100 kHz 0.06 dB  
 \* SWT 5 ms 825.320512819 kHz



Date: 15.MAR.2012 15:44:28

**6 dB Bandwidth at 2440 MHz**

<b>DELTA MARKER 1</b>		* RBW 100 kHz	Delta 1 [T1 ]
841.3461538 kHz		* VBW 100 kHz	0.69 dB
Ref 21 dBm	* Att 10 dB	* SWT 5 ms	841.346153844 kHz



Date: 15.MAR.2012 15:45:32

**6 dB Bandwidth at 2480 MHz**

## 4.2 20 dB Bandwidth

Test Performed By: G.Suwanthakumar

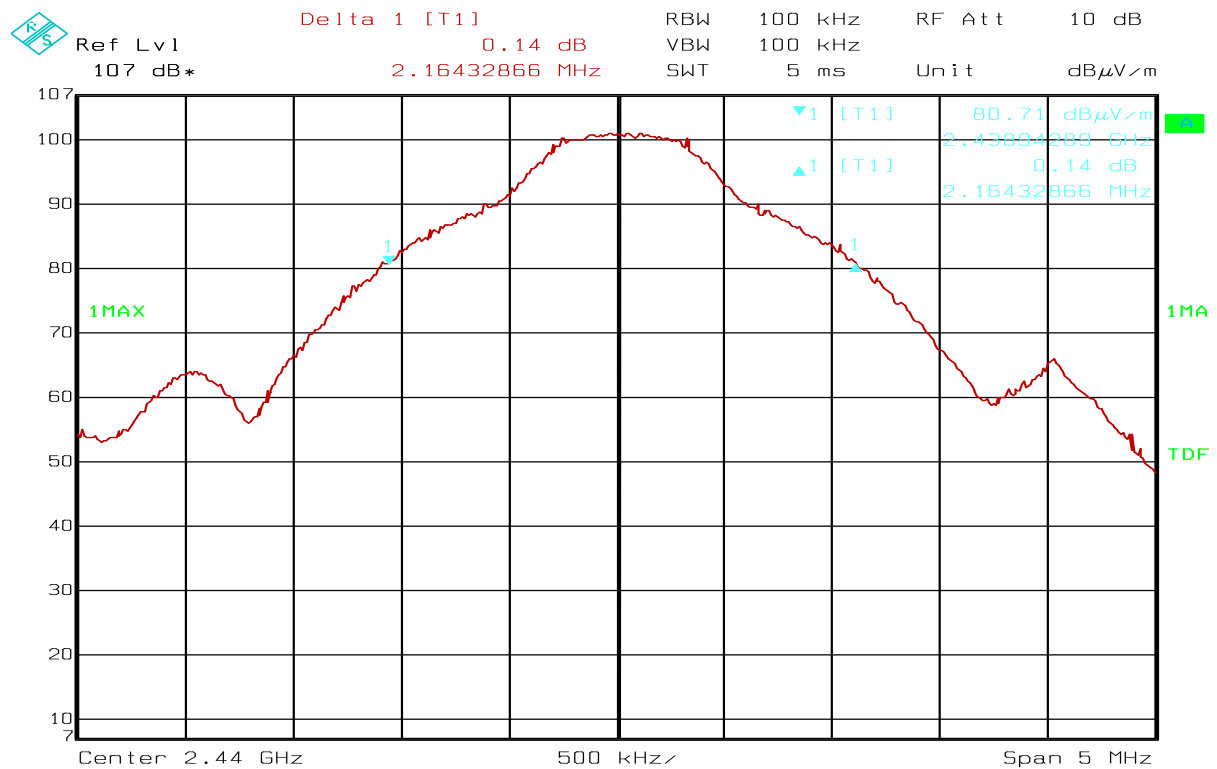
Date of Test: 24 Nov 2011

### Measurement Data:

Measured 20 dB Bandwidth (MHz)
2440 MHz
2.16

### Requirements:

No requirements. Reported for information only.



Date: 24.NOV.2011 13:08:41

### 20 dB Bandwidth at 2440 MHz

### 4.3 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suwanthakumar	Date of Test: 24 Nov 2011
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Test Results: Complies

**Measurement Data:**

RF channel	2402 MHz	2440 MHz	2480 MHz
Conducted Power (dBm)	6.14	5.99	5.93
Conducted Power (mW)	4.11	3.97	3.92
Measured Maximum Field strength (dBµV/m) –VP	103.00	101.76	101.84
Radiated Power (dBm)	7.77	6.53	6.61
Antenna Gain (dB)	1.63	0.54	0.68

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

**See attached graph.**

Detachable antenna?

Yes  No

If detachable, is the antenna connector non-standard?

Yes  No

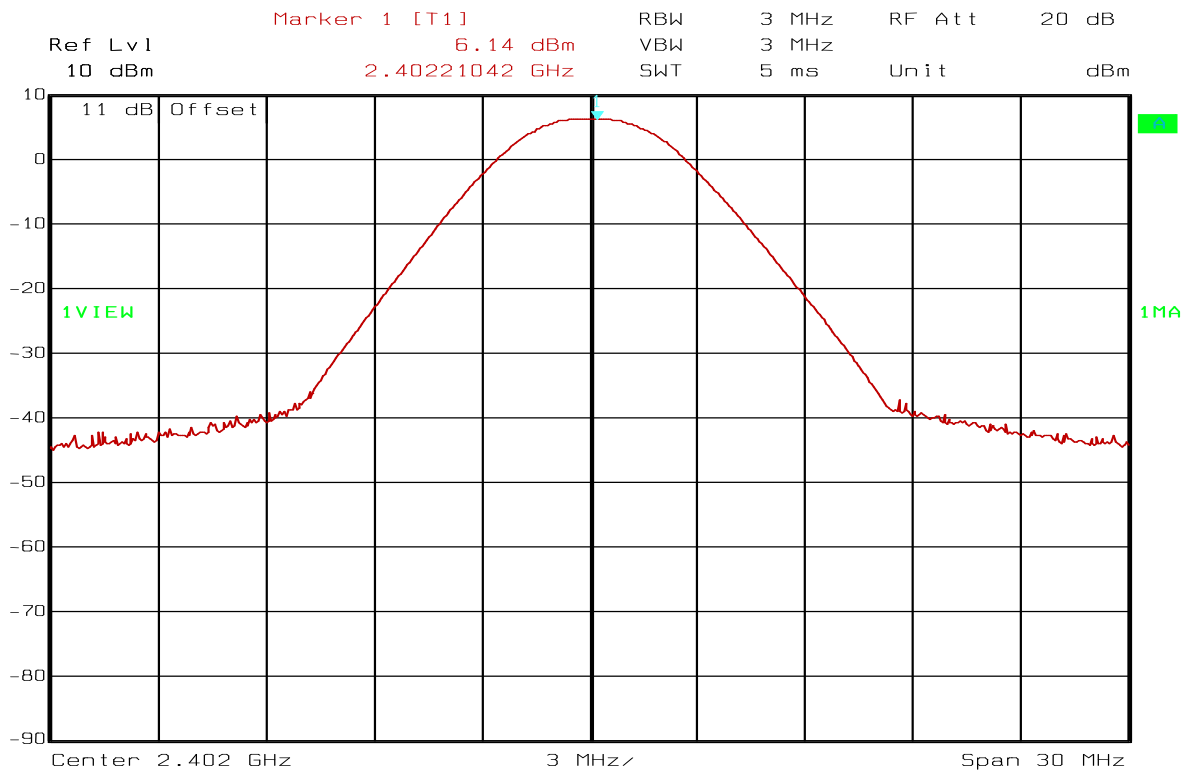
Type of antenna connector: SMA.

**Requirements:**

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

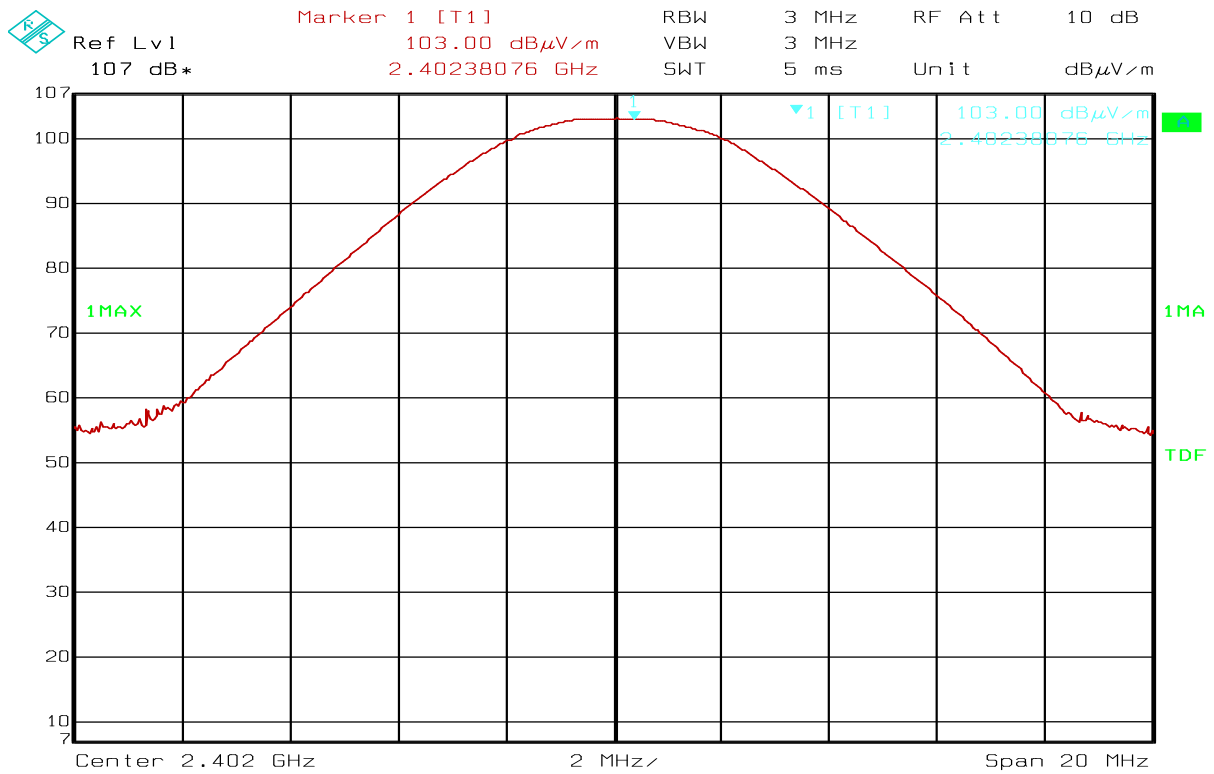
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

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.



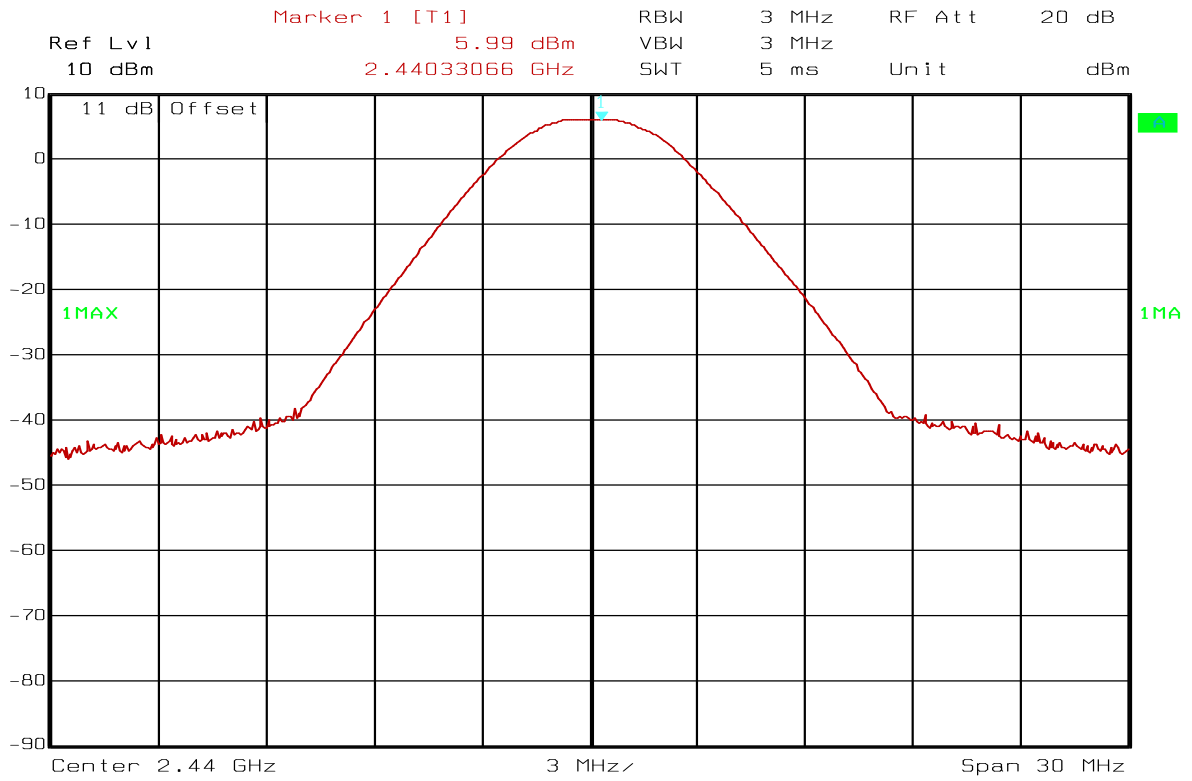
Date: 24.NOV.2011 15:38:59

**Conducted Power, 2402 MHz**



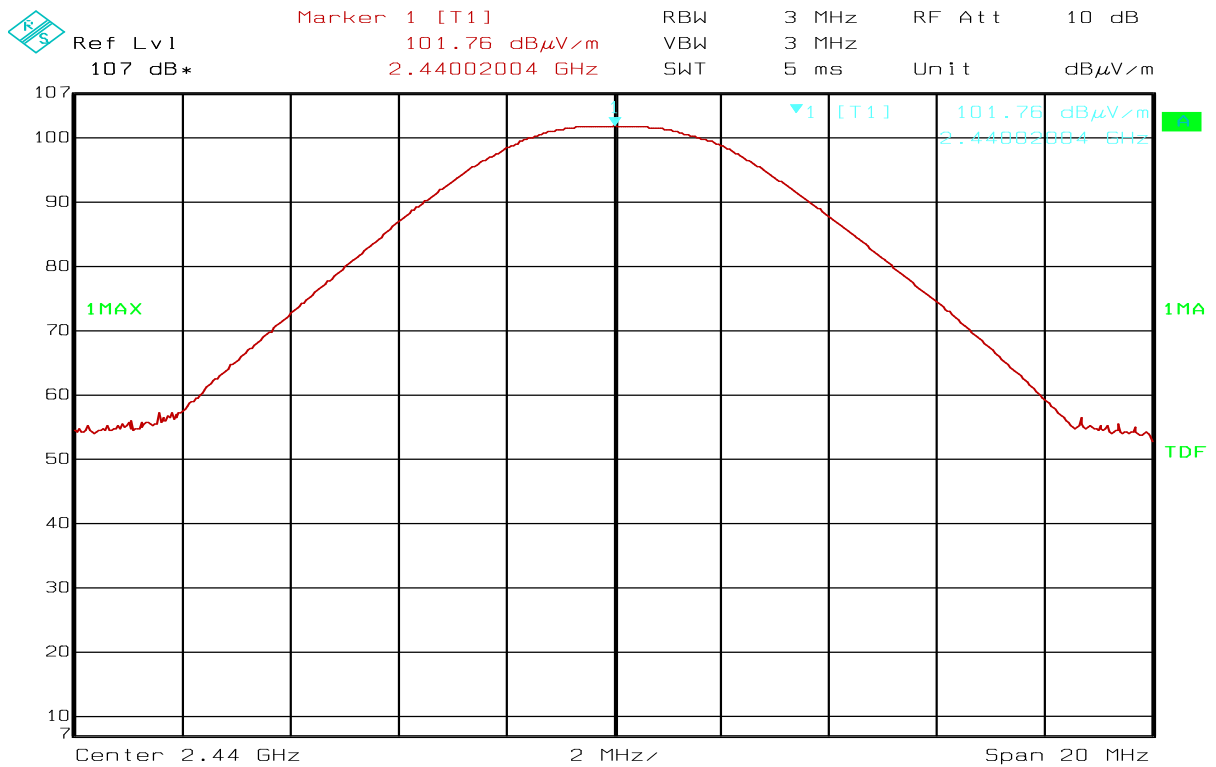
Date: 24.NOV.2011 12:00:01

**Radiated Field strength, VP , 2402 MHz**



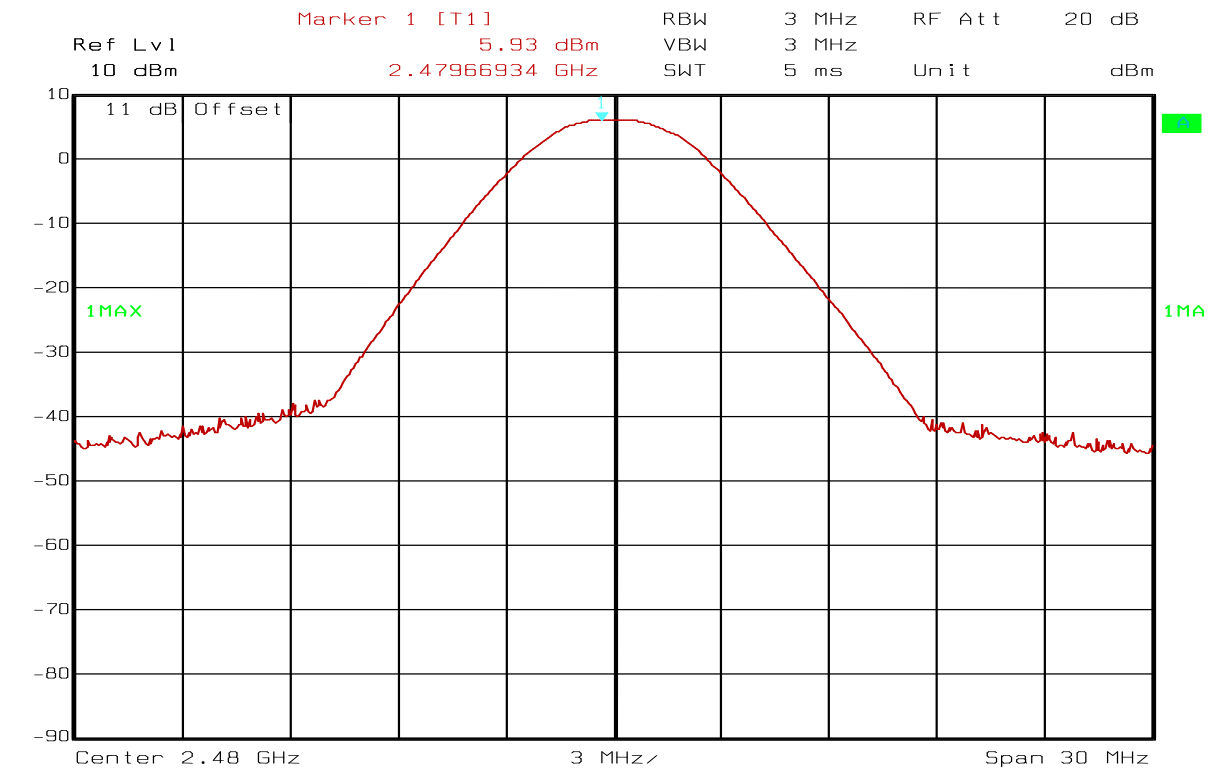
Date: 24.NOV.2011 15:39:59

**Conducted Power, 2440 MHz**



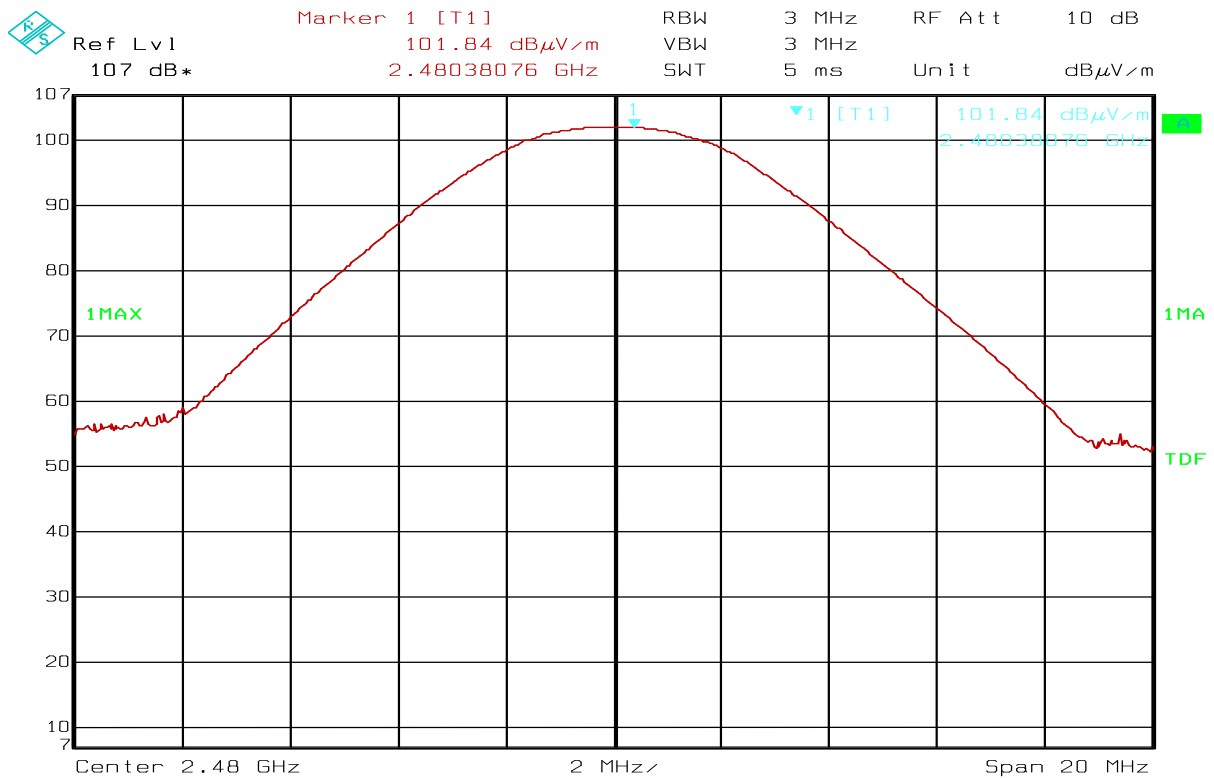
Date: 24.NOV.2011 13:06:52

**Radiated field strength,VP, 2440 MHz**



Date: 24.NOV.2011 15:40:28

**Conducted Power, 2480 MHz**



Date: 24.NOV.2011 13:21:31

**Radiated field strength, 2480 MHz**



#### 4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suhandhakumar	Date of Test: 24 nov 2011
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Test Results: Complies

**Measurement Data:**

**Band-edge, @3m**

Frequency	Measured Field Strength @3m, dBµV/m	Detector	Limit dBµV/m	Margin dB
2.39 GHz	-	AV	54	-
	48.00	PK	74	26.00
2.4835 GHz	-	AV	54	-
	50.23	PK	74	23.77

See attached plots.

**Marker Delta Calculation:**

Max: 101.85 dBµV/m

Delta: 53.70 dB

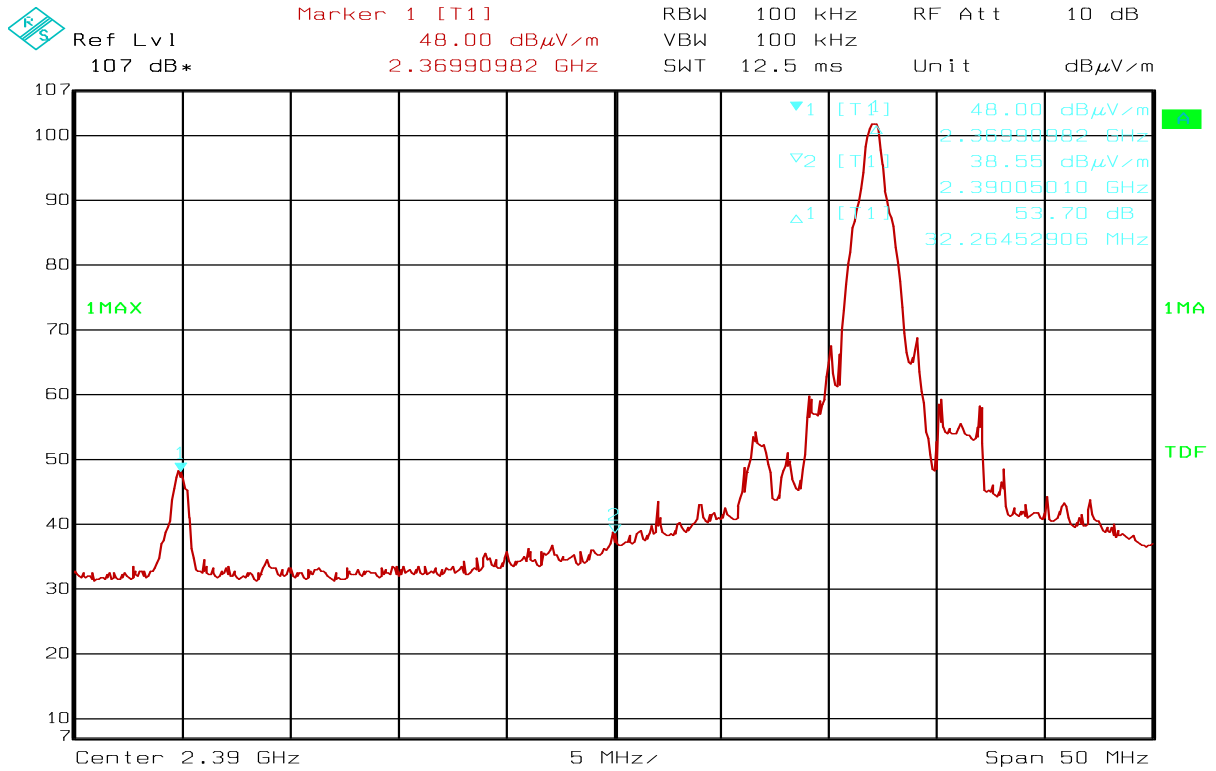
Band Edge Field Strength, Peak:  $101.85 - 53.70 \text{ dB}\mu\text{V/m} = 48.15 \text{ dB}\mu\text{V/m}$

**RF conducted power**

Scan performed radiated with 100 kHz Bandwidth from 0.001 to 25 GHz.

All emissions are more than 20dB below carrier.

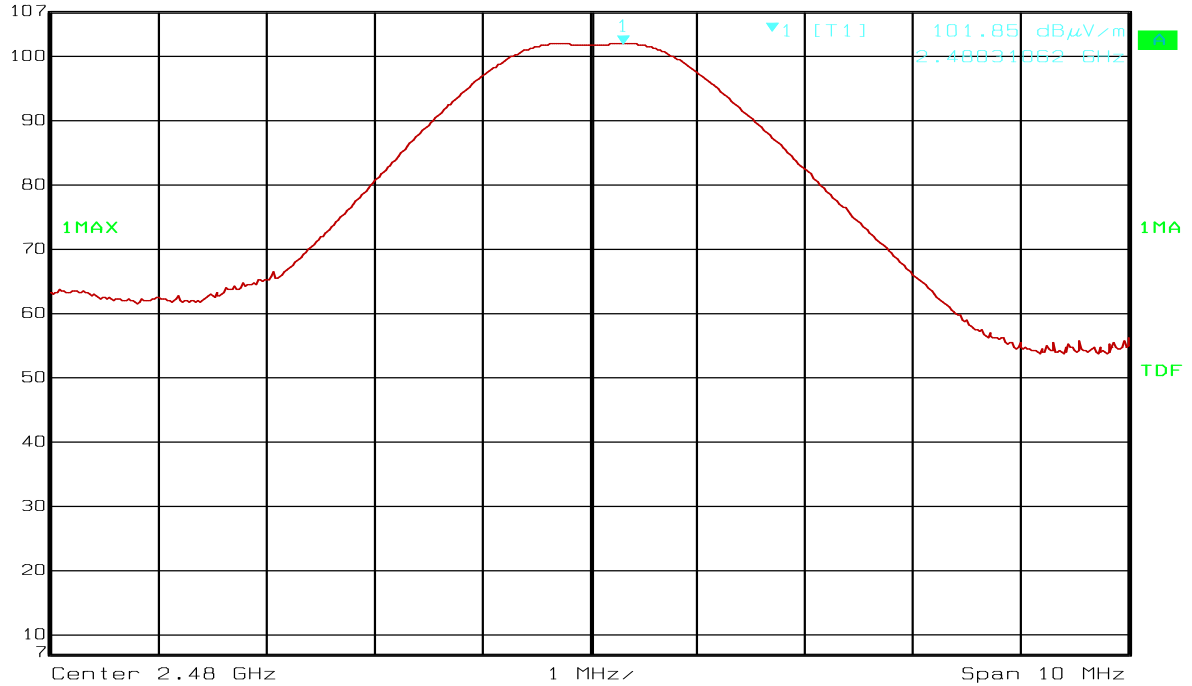
See plots.



Date: 29.NOV.2011 08:45:15

**Band Edge, 2390 MHz, Peak Detector**

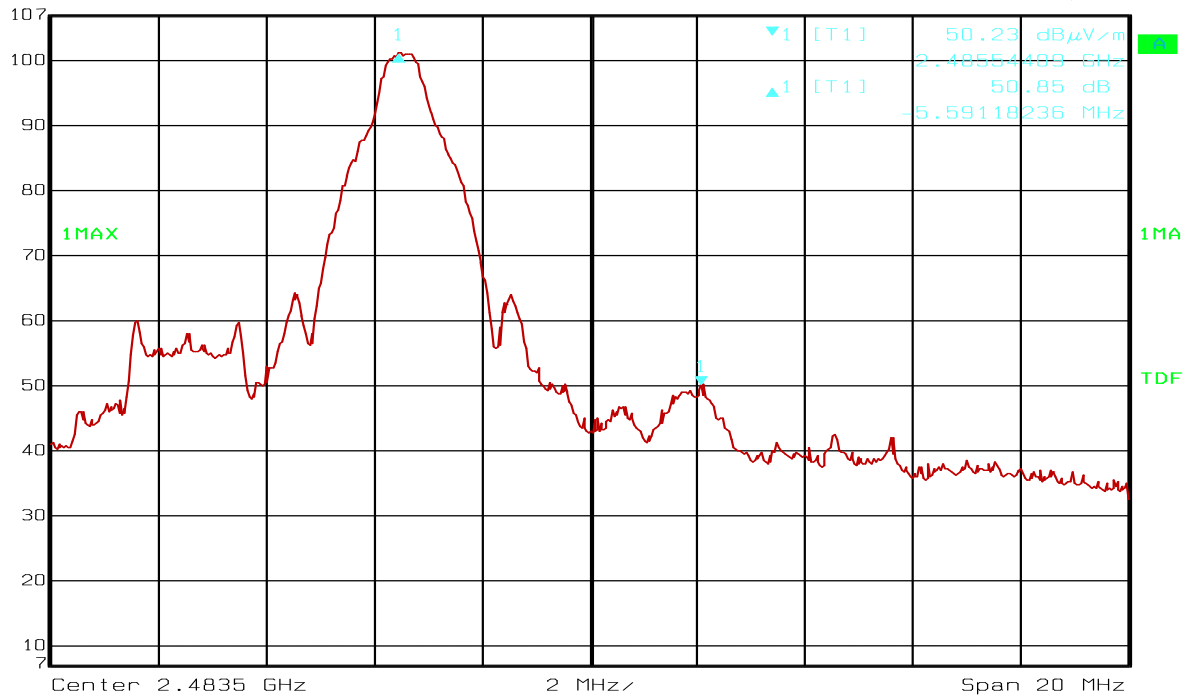
Marker 1 [T1]  
101.85 dB $\mu$ V/m  
2.48031062 GHz  
 Ref Lvl 107 dB\*  
 RBW 1 MHz RF Att 10 dB  
 VBW 1 MHz  
 SWT 5 ms Unit dB $\mu$ V/m



Date: 24.NOV.2011 13:22:00

**Band Edge, 2483.5 MHz, Marker Delta, Max**

Delta 1 [T1]  
50.85 dB  
-5.59118236 MHz  
 Ref Lvl 107 dB\*  
 RBW 100 kHz RF Att 10 dB  
 VBW 100 kHz  
 SWT 5 ms Unit dB $\mu$ V/m

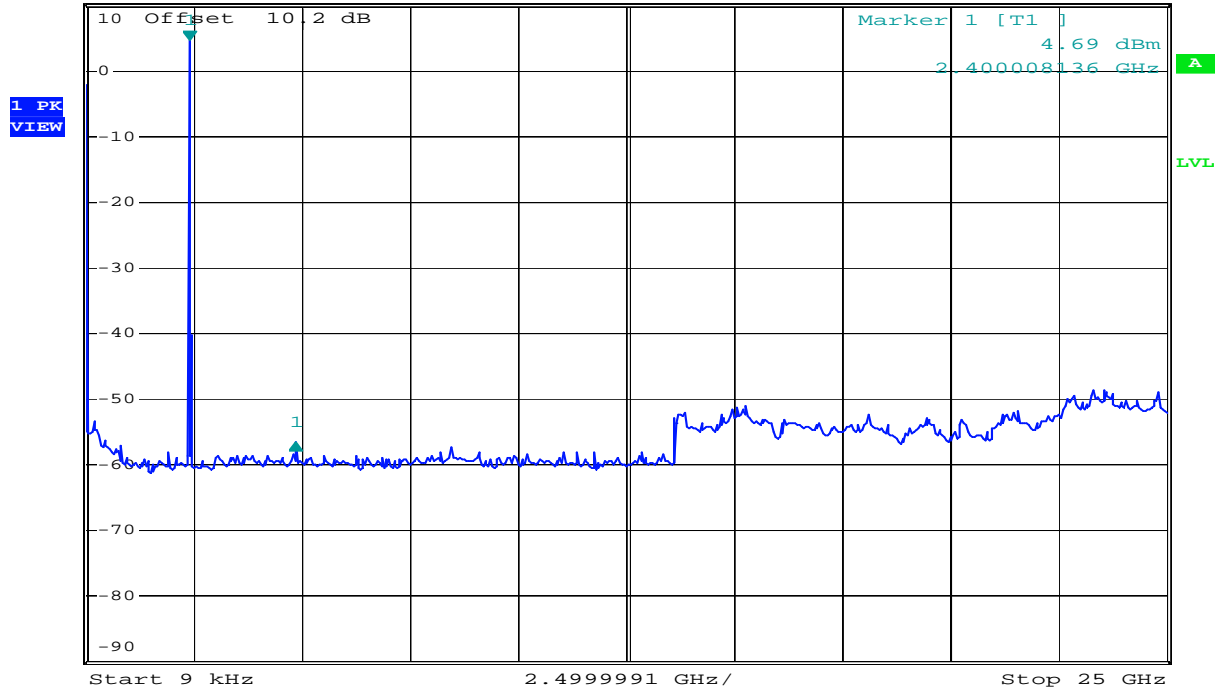


Date: 24.NOV.2011 13:23:34

**Band Edge, 2483.5 MHz, Marker Delta, Delta**



Ref 10 dBm      \* Att 10 dB      \* RBW 100 kHz      Delta 1 [T1 ]  
 \* VBW 100 kHz      -61.26 dB  
 SWT 2.5 s      2.449999118 GHz



Date: 29.NOV.2011 08:28:36

**Conducted Emissions, 9kHz – 25GHz**

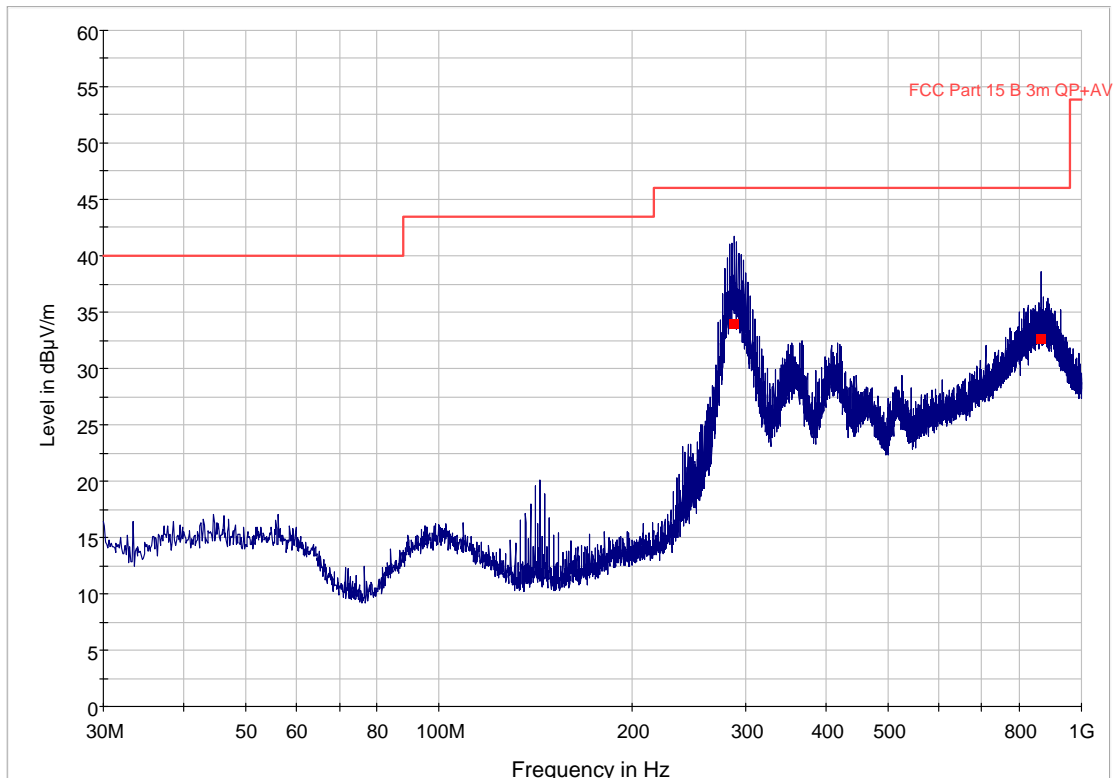
**Radiated emission 30 – 1000 MHz.**

Detector: Peak

Measuring distance 3m.

All values are below the limit even when measured with Peak Detector.

See attached plot.



**Radiated Emissions, 30 – 1000 MHz, VP and HP, @3m**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
288.620670	34.0	1000.0	120.000	117.0	H	105.0	-8.1	12.0	46.0	
864.068096	32.6	1000.0	120.000	100.0	H	110.0	2.2	13.4	46.0	

**Radiated Emissions, 1-25 GHz**

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

10 - 18 GHz measured at 1m

Prescan performed from 18 to 25 GHz.

**PK- detector**

Frequency MHz	Field strength @3m dB $\mu$ V/m	Detector	Limit dB $\mu$ V/m	Margin dB
4810	56.39	Pk	74	17.61
4880	54.84	Pk	74	19.16
4960	54.91	Pk	74	19.09

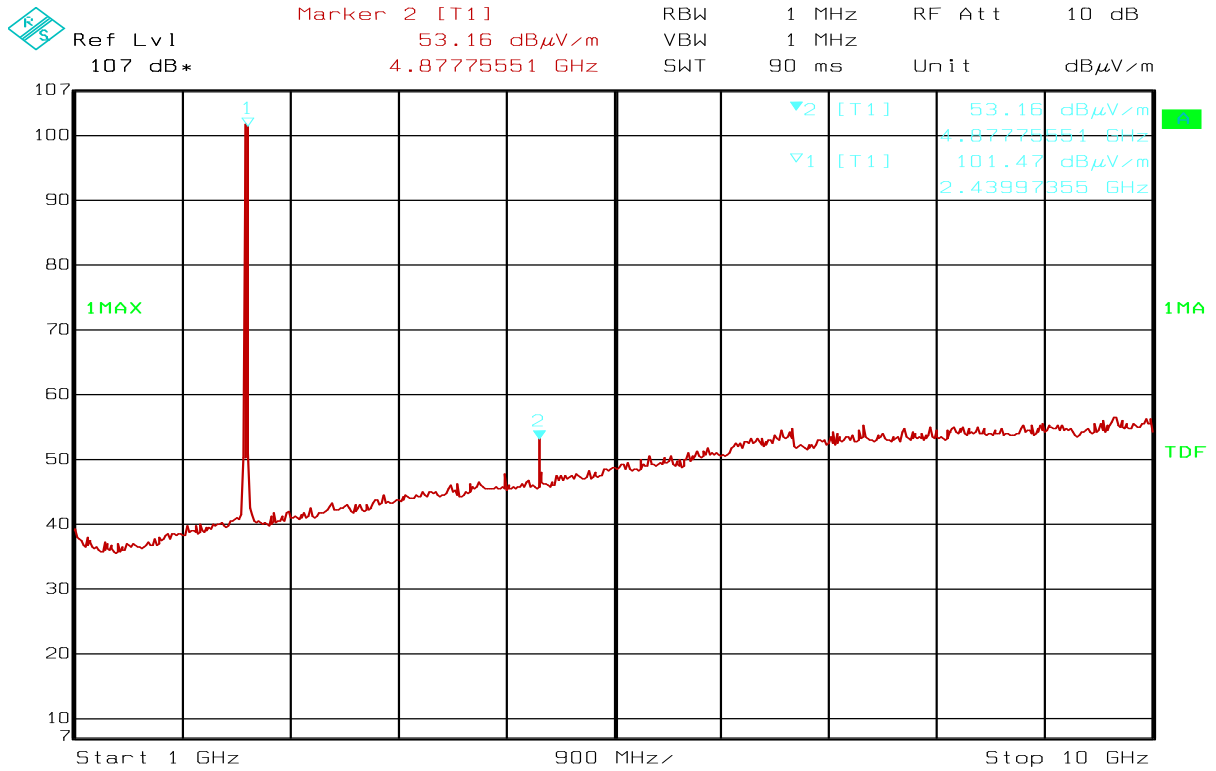
**AV- detector**

Frequency MHz	Field strength @3m dB $\mu$ V/m	Detector	Limit dB $\mu$ V/m	Margin dB
4810	53.00	AV	54	1.00
4880	50.49	AV	54	3.51
4960	50.19	AV	54	3.81

All emissions are below the Average Limit, even when measured with Peak Detector.

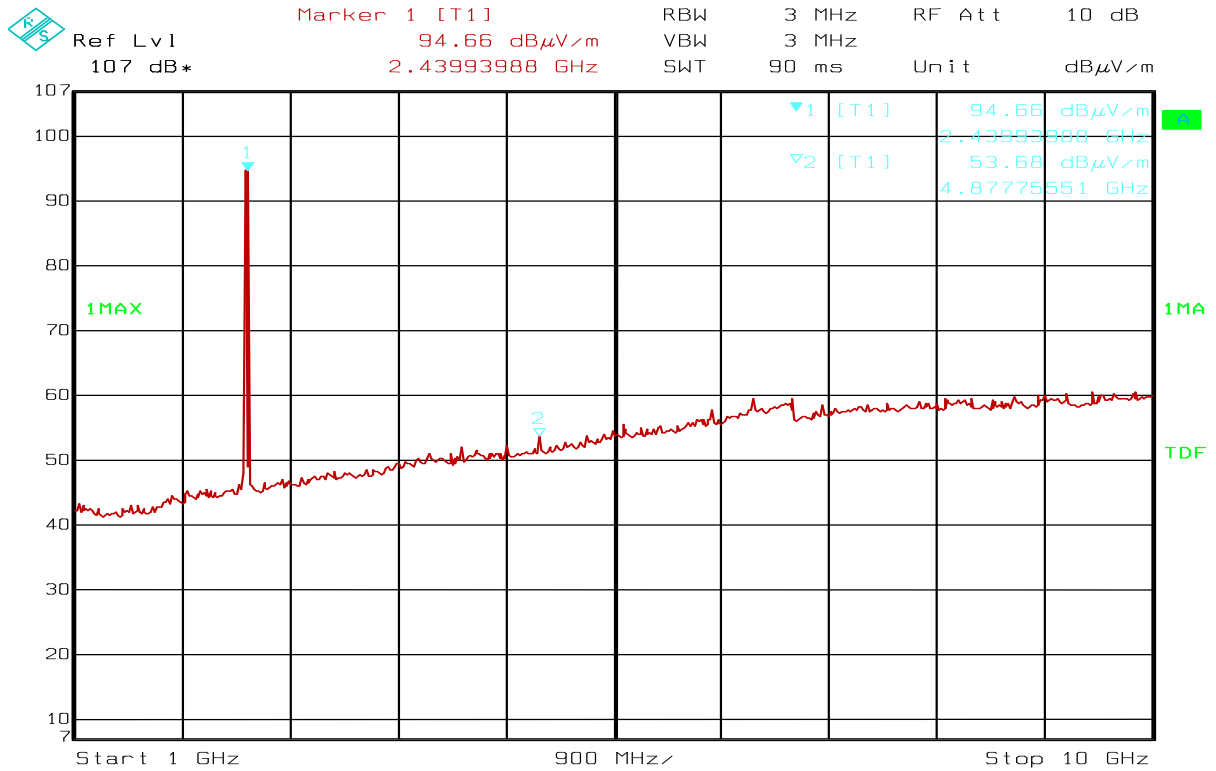
Antenna factor, amplifier gain and cable loss are included in Spectrum Analyzer "Transducer factor".

See attached graphs.



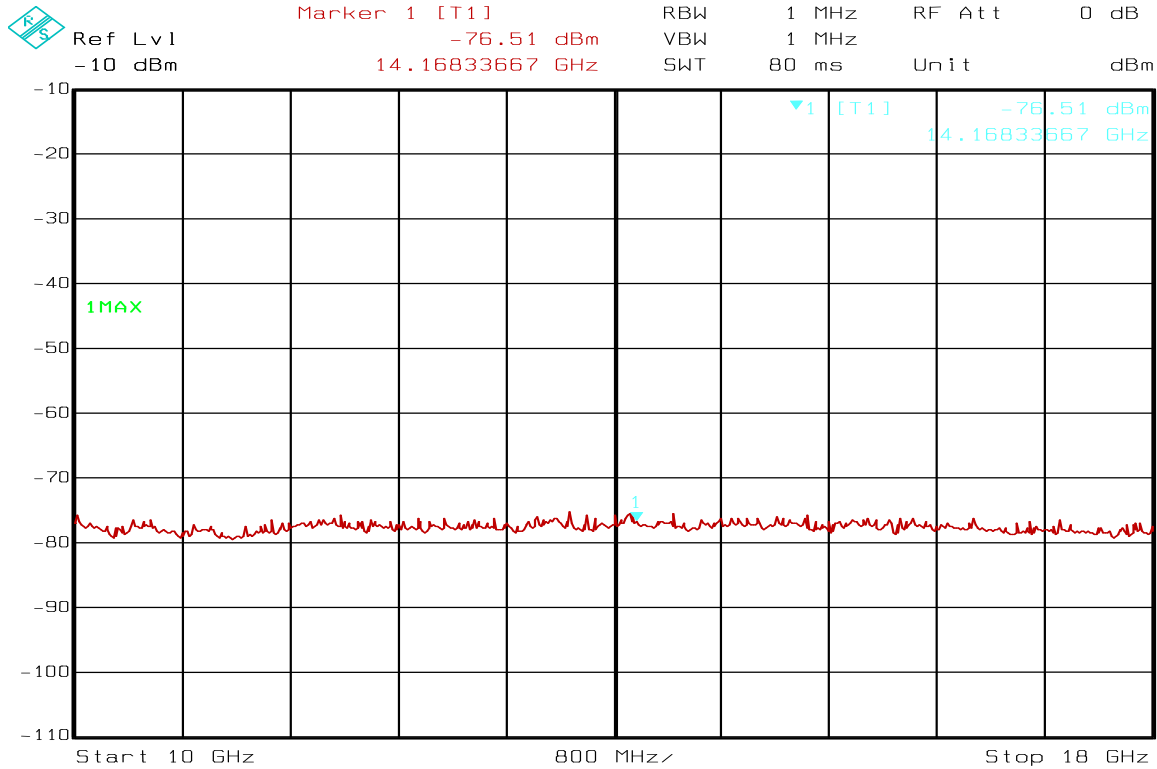
Date: 24.NOV.2011 13:13:02

**Radiated Emissions, 1 – 10 GHz, VP, @3m**

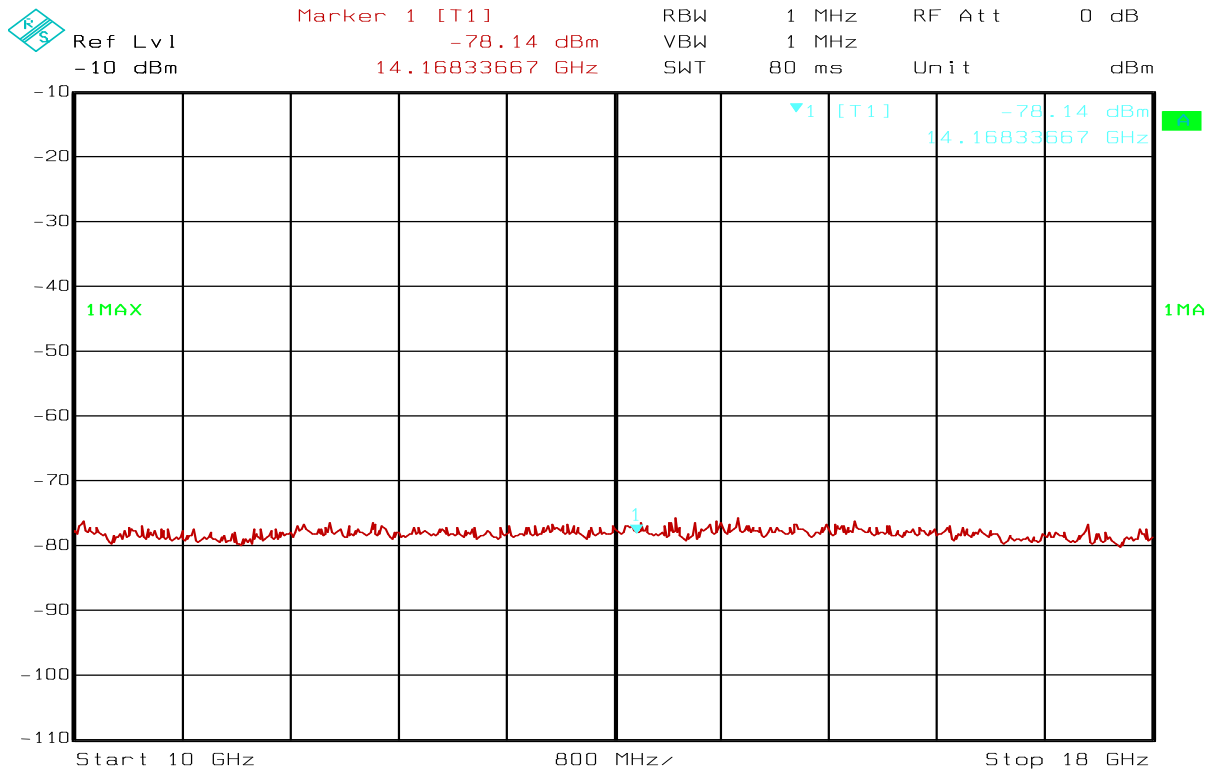


Date: 24.NOV.2011 13:17:46

**Radiated Emissions, 1 – 10 GHz, HP, @3m**

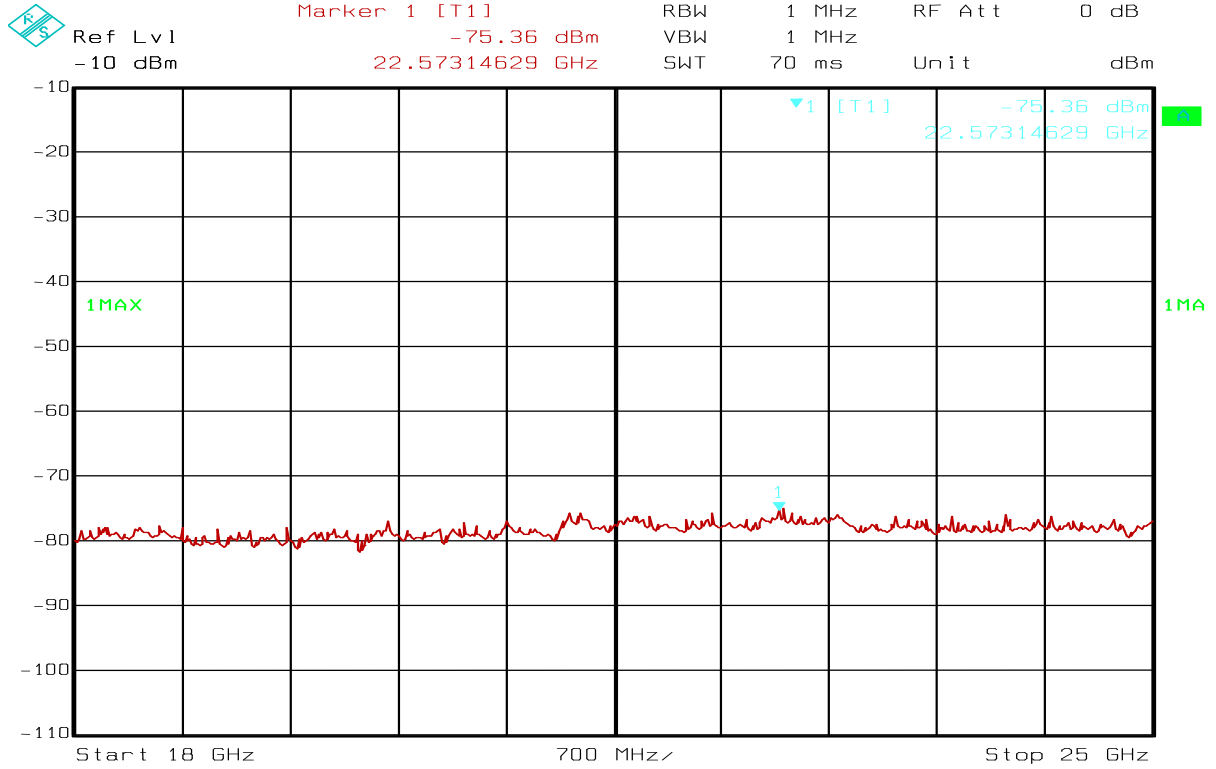


**Radiated Emissions, 10 – 18 GHz, VP, @1m – pre-view scan**

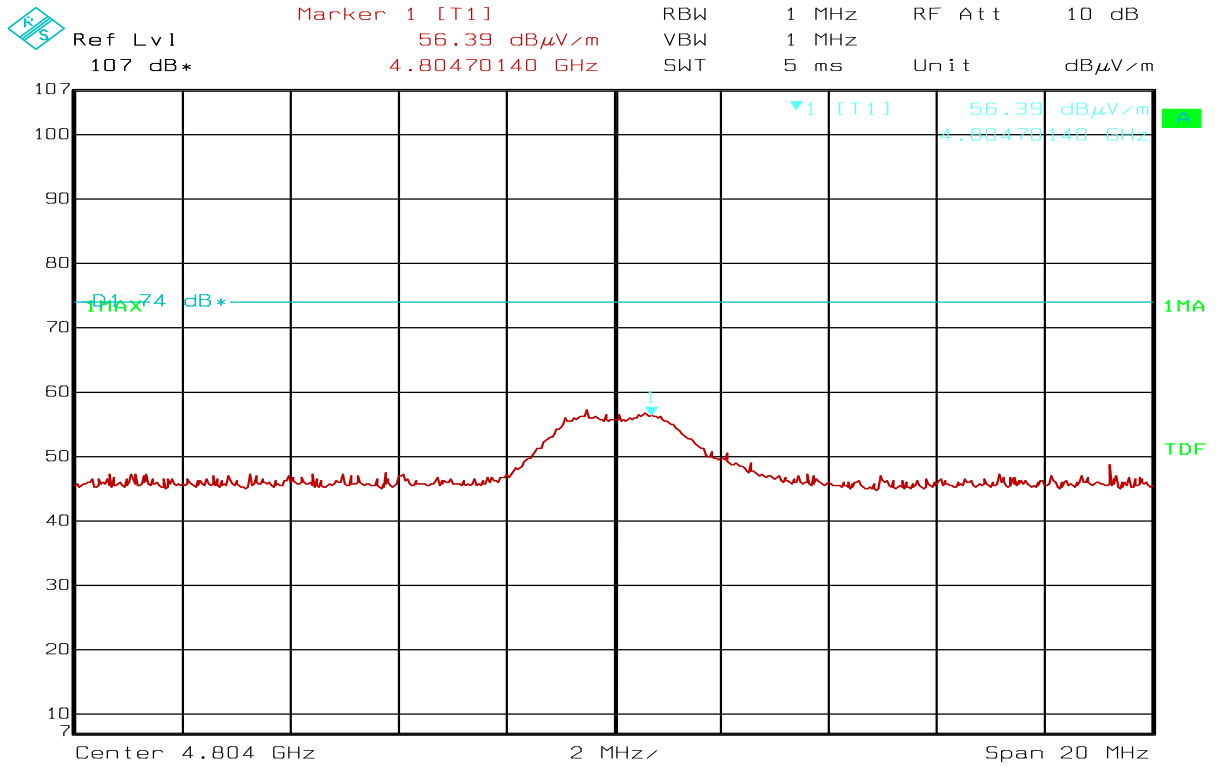


**Radiated Emissions, 18 – 25 GHz, HP, @1m , pre-view scan**



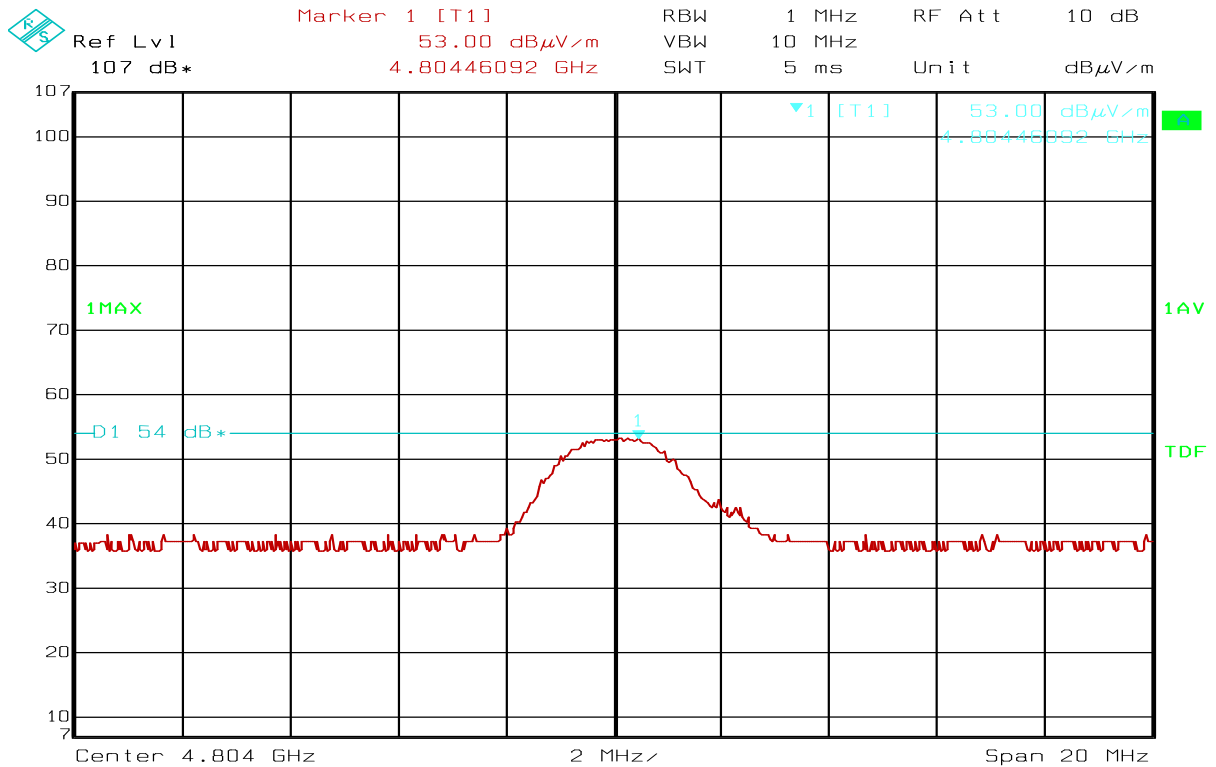


**Radiated Emissions, 18 – 25 GHz, VP, @1m, Pre-view scan**



Date: 24.NOV.2011 12:04:49

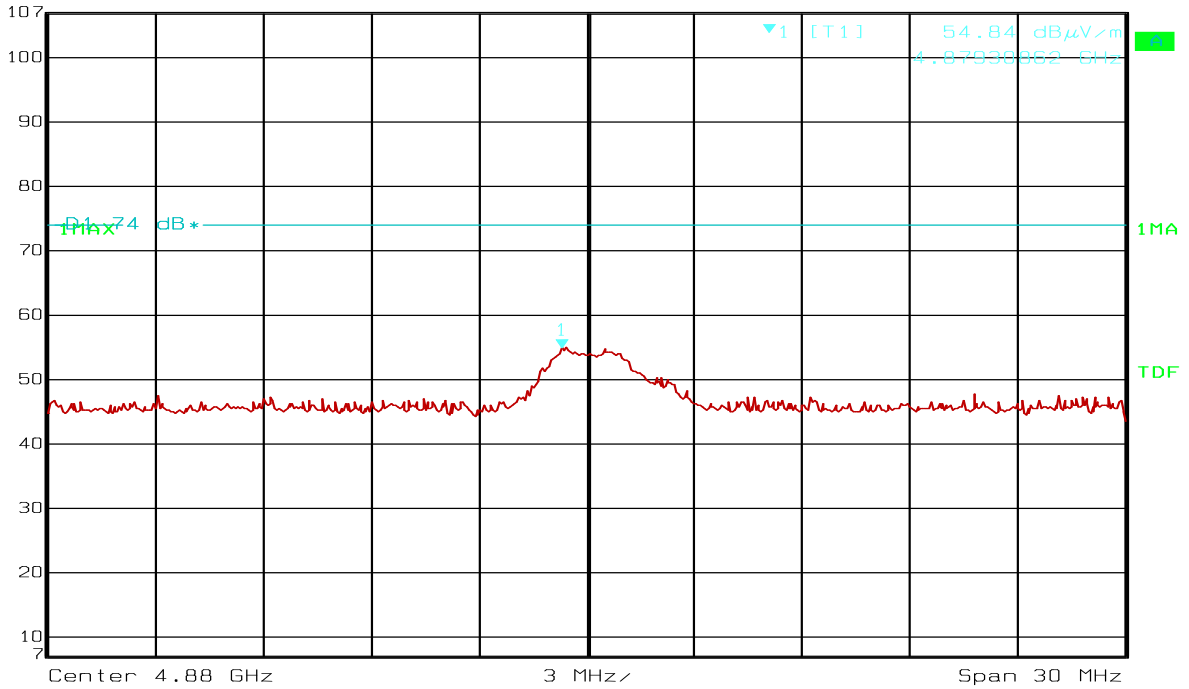
**Radiated Emissions, 4804 MHz, Max, Pk Det.**



Date: 24.NOV.2011 12:05:24

**Radiated Emissions, 4804 MHz, Max, AV Det.**

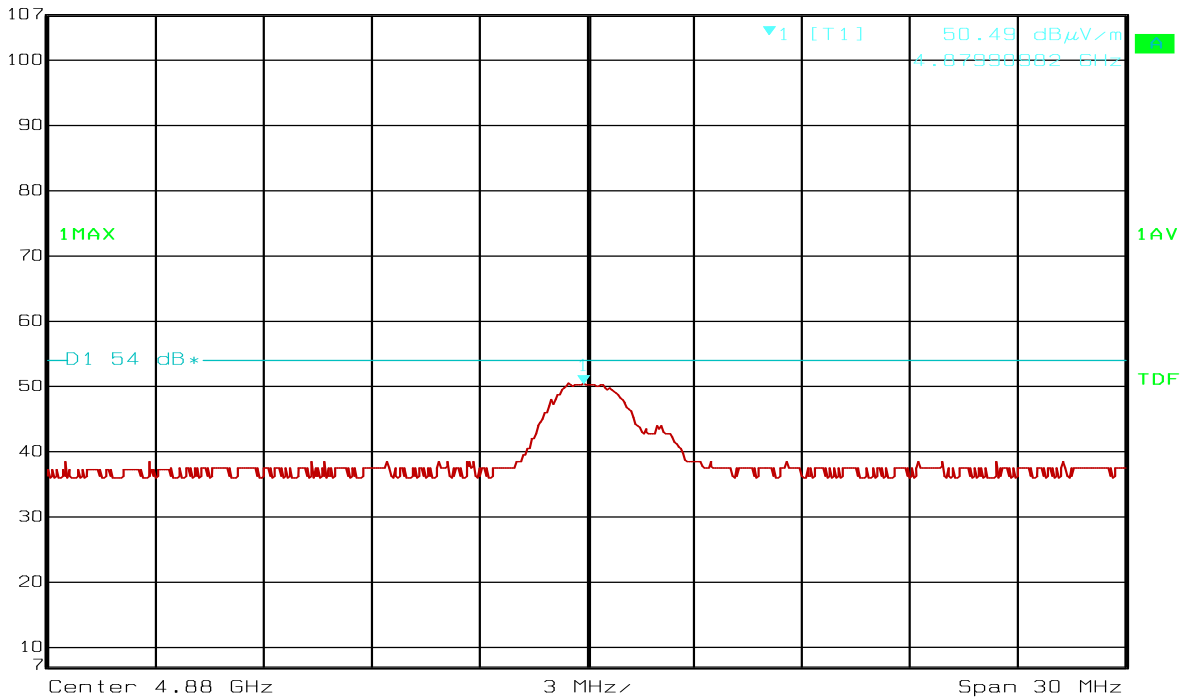
Marker 1 [T1]  
54.84 dB $\mu$ V/m  
4.87930862 GHz  
 Ref Lvl 107 dB\*  
 RBW 1 MHz RF Att 10 dB  
 VBW 1 MHz  
 SWT 5 ms Unit dB $\mu$ V/m



Date: 24.NOV.2011 13:14:22

**Radiated Emissions, 4880 MHz, Max, Pk Det.**

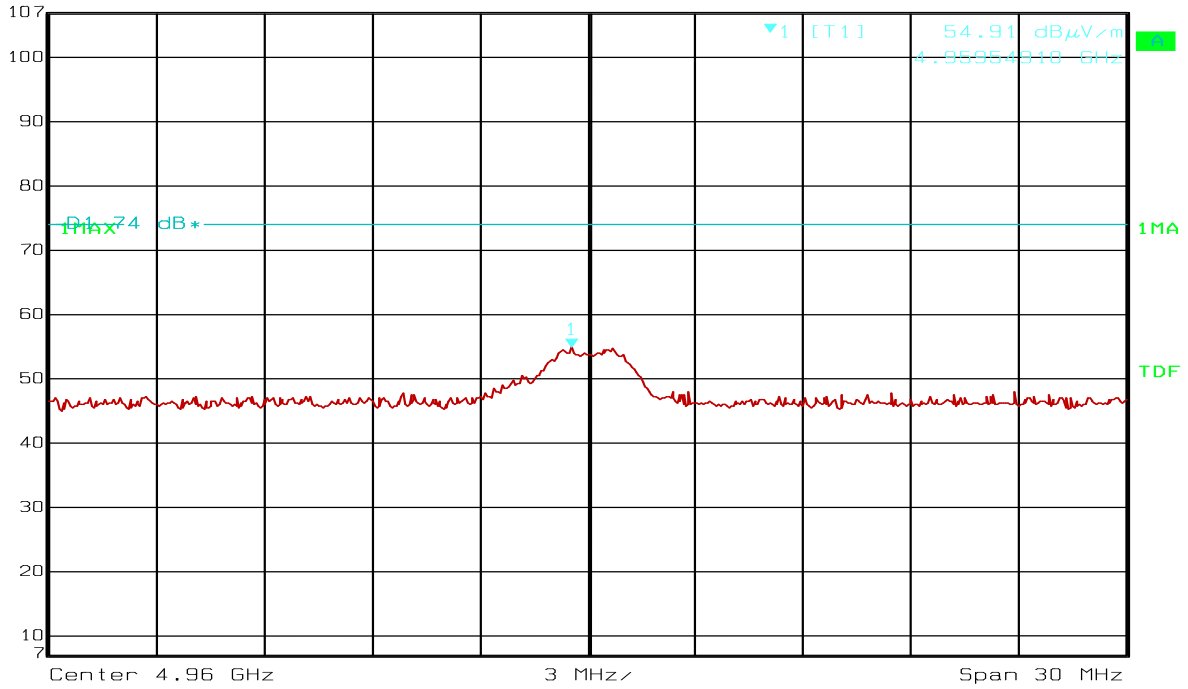
Marker 1 [T1]  
50.49 dB $\mu$ V/m  
4.87990982 GHz  
 Ref Lvl 107 dB\*  
 RBW 1 MHz RF Att 10 dB  
 VBW 10 MHz  
 SWT 5 ms Unit dB $\mu$ V/m



Date: 24.NOV.2011 13:14:56

**Radiated Emissions, 4880 MHz, Max, AV Det.**

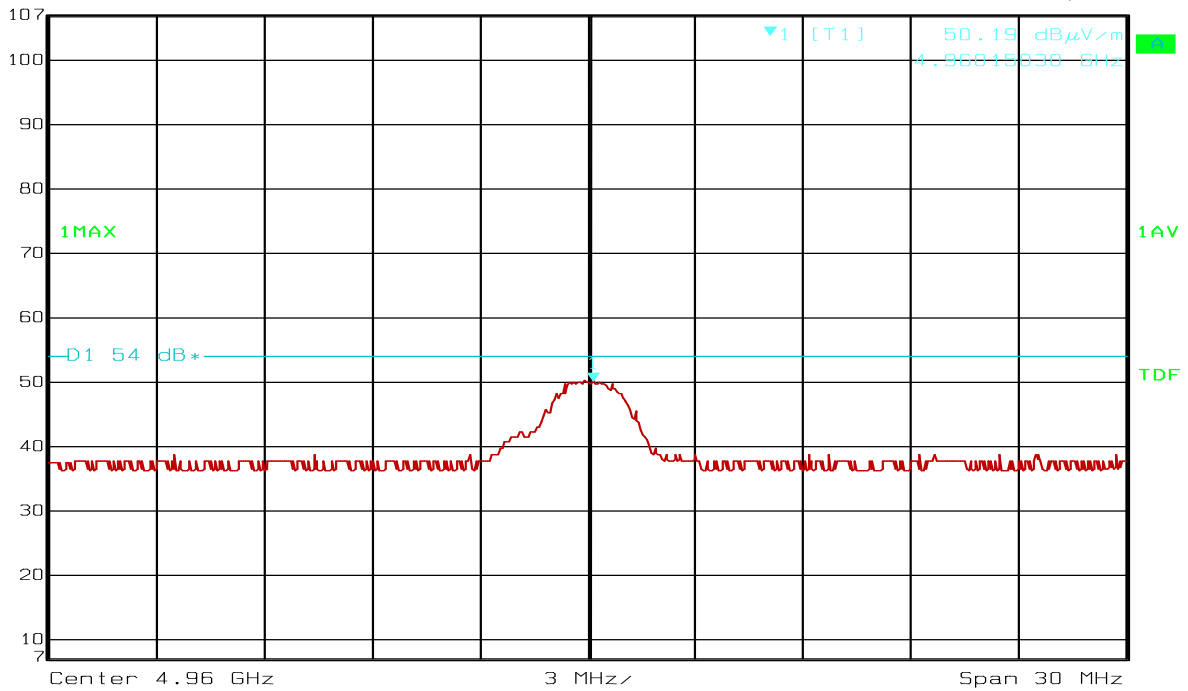
Marker 1 [T1] RBW 1 MHz RF Att 10 dB  
54.91 dB $\mu$ V/m VBW 1 MHz  
4.95954910 GHz SWT 5 ms Unit dB $\mu$ V/m  
 Ref Lvl 107 dB\*



Date: 24.NOV.2011 13:25:55

**Radiated Emissions, 4960 MHz, Max, Pk Det.**

Marker 1 [T1] RBW 1 MHz RF Att 10 dB  
50.19 dB $\mu$ V/m VBW 10 MHz  
4.96015030 GHz SWT 5 ms Unit dB $\mu$ V/m  
 Ref Lvl 107 dB\*



Date: 24.NOV.2011 13:26:29

**Radiated Emissions, 4960 MHz, Max, AV Det.**

## 4.5 Receiver Spurious Emissions

### Measurement Procedure:

Industry Canada RSS-210 paragraph 2.3 and RSS-GEN paragraphs 4.10 and 6.

### Test results:

Frequency MHz	Carrier Freq. MHz	Measured Value Radiated dBuV/m @3m	Limit dBuV/m @3m	Margin dB
30 – 1000	all	None found	/	/
> 1000 (all others)	all	None found	54	/

The measurement was performed radiated with the EUT in receive-only mode.

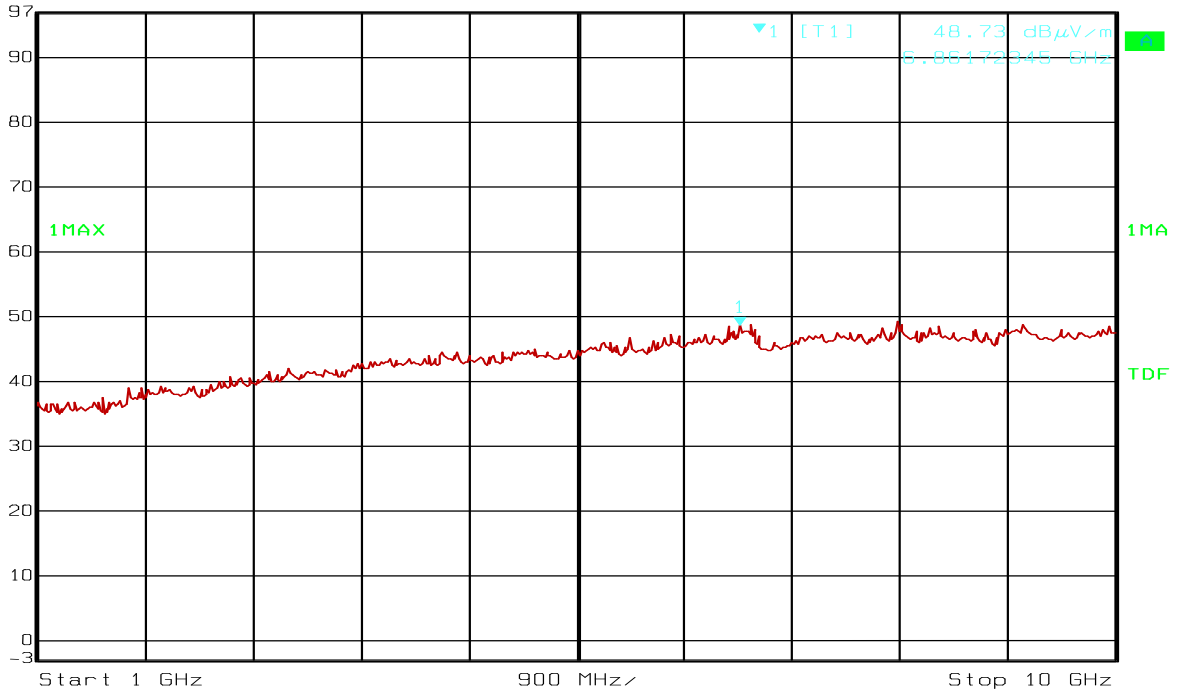
### Requirements, RSS-GEN Issue 3, clause 6

The measurement can be performed either radiated or conducted.

**When measured Conducted:** no spurious signals appearing at the antenna terminals shall exceed 2 nW per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nW above 1 GHz.

**When measured Radiated:** See Table 2 in RSS-GEN Issue 3, clause 6.

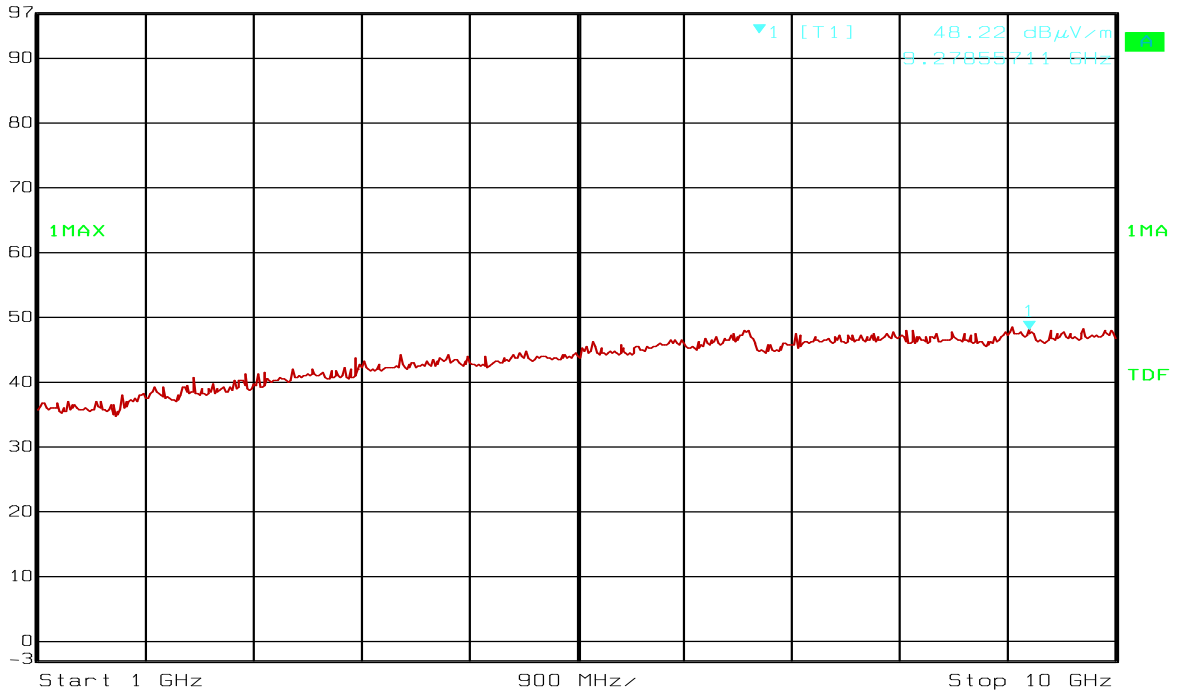
Marker 1 [T1]  
 Ref Lvl 97 dB\*      48.73 dB $\mu$ V/m      RBW 1 MHz      RF Att 0 dB  
 6.86172345 GHz      VBW 1 MHz  
 Unit dB $\mu$ V/m      SWT 90 ms



Date: 24.NOV.2011 13:28:02

**Receiver Radiated Emissions, 1 - 10GHz, VP**

Marker 1 [T1]  
 Ref Lvl 97 dB\*      48.22 dB $\mu$ V/m      RBW 1 MHz      RF Att 0 dB  
 9.27855711 GHz      VBW 1 MHz  
 Unit dB $\mu$ V/m      SWT 90 ms



Date: 24.NOV.2011 13:28:47

**Receiver Radiated Emissions, 1 - 10GHz, HP**

#### 4.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suwanthakumar	Date of Test: 15 Mar 2012
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Test Results: Passed

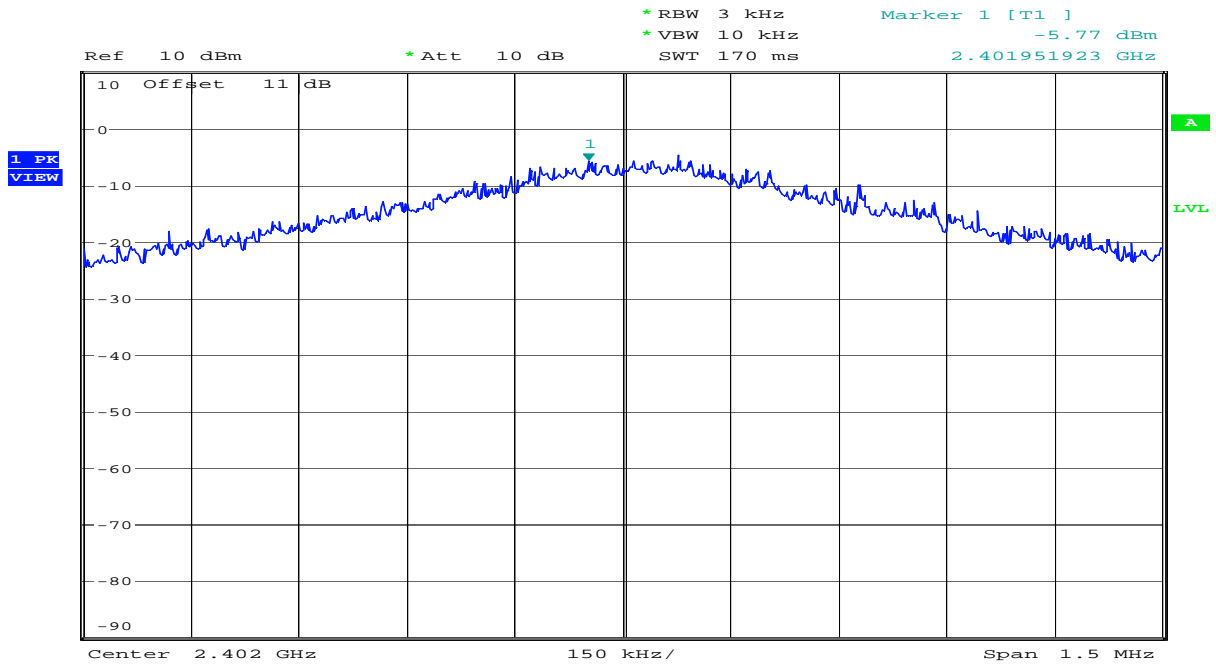
##### Measured and Calculated Data:

The alternative test procedures in point 2) A , B and formula 1 described in guidance on measurements for Digital Transmission Systems is used.

	Measured PSD
Power Spectral Density @2402 MHz	-3.09
Power Spectral Density @2440 MHz	-3.20
Power Spectral Density @2480 MHz	-3.44

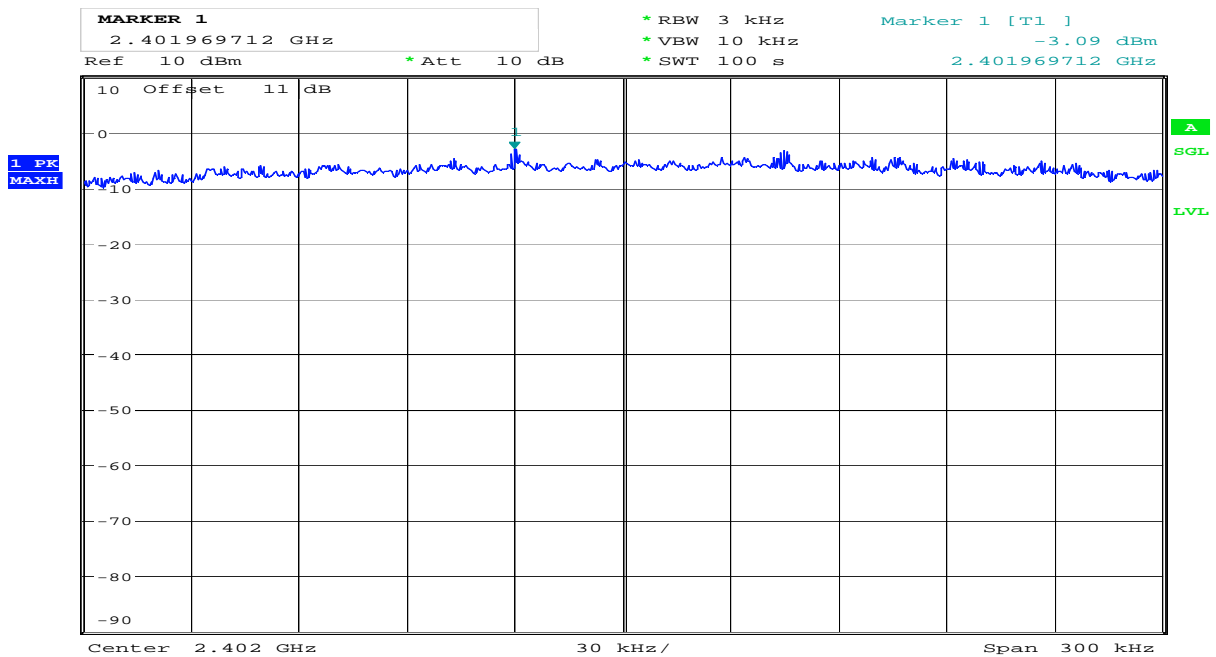
##### Requirements:

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



Date: 15.MAR.2012 15:59:21

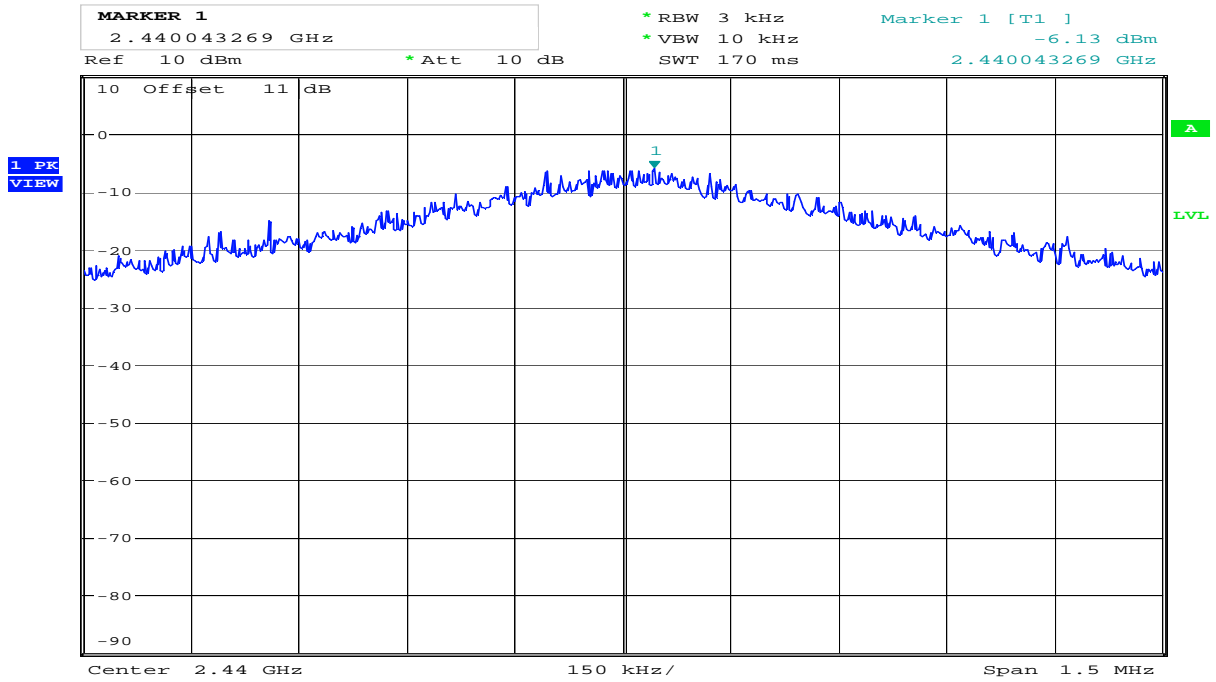
**PSD Overview - 2402MHz**



Date: 15.MAR.2012 16:02:25

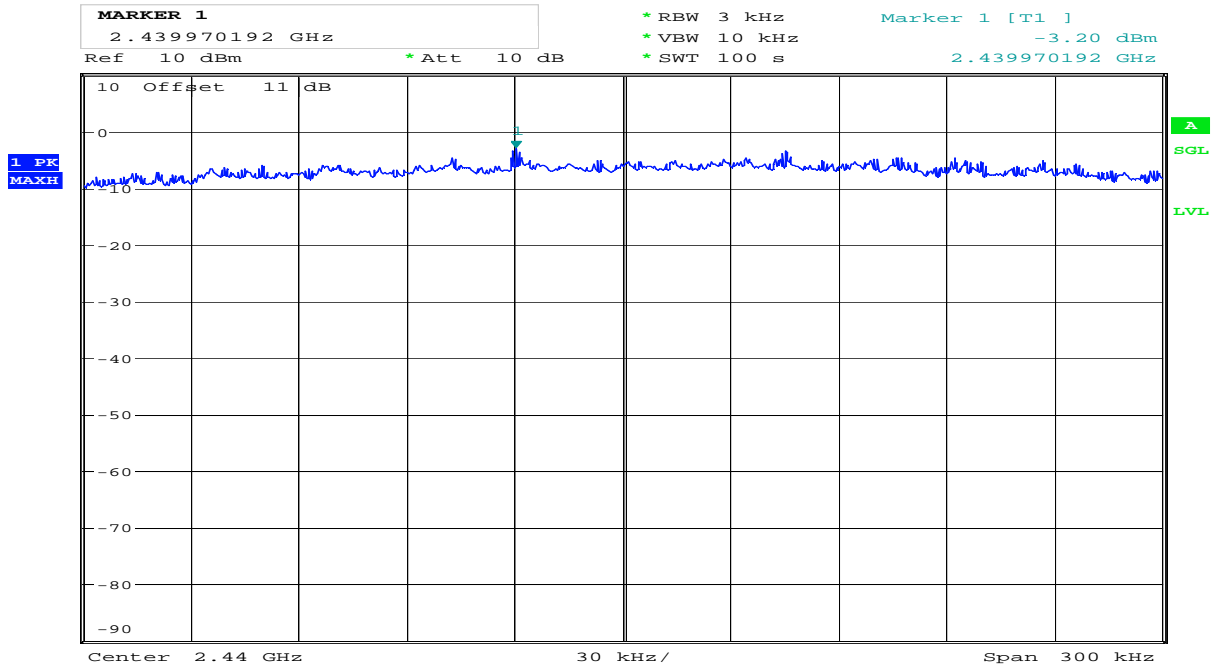
**PSD Measurement - 2402MHz**





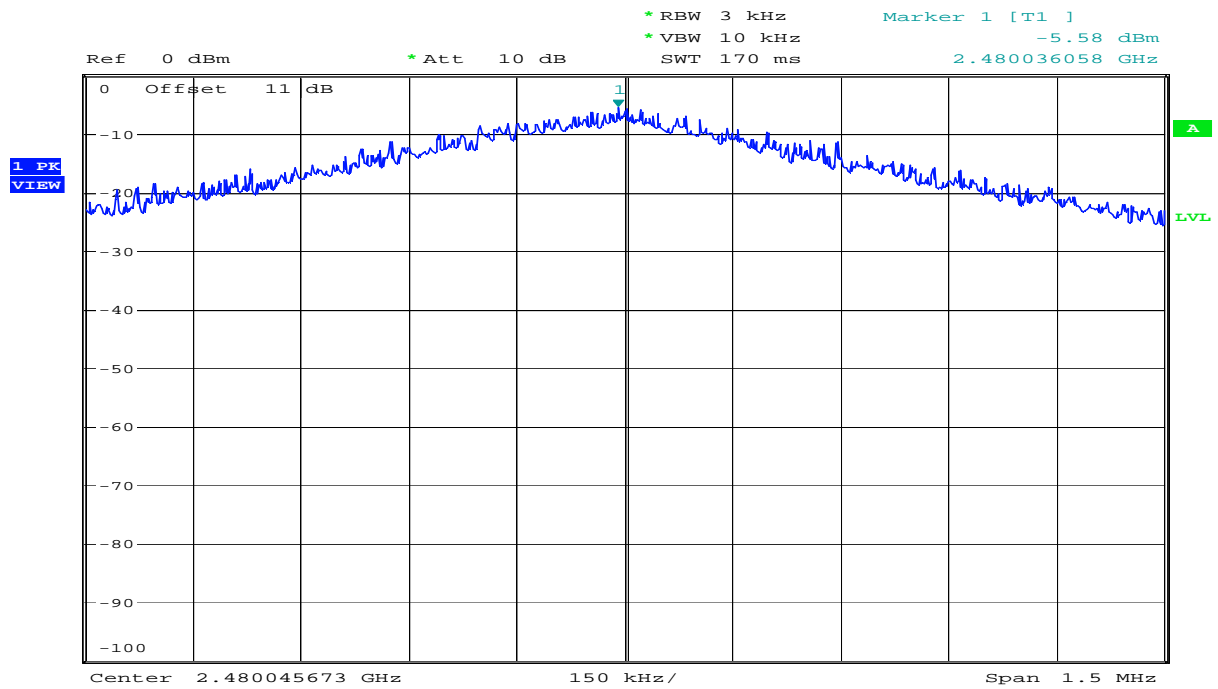
Date: 15.MAR.2012 16:03:08

**PSD Overview- 2440MHz**



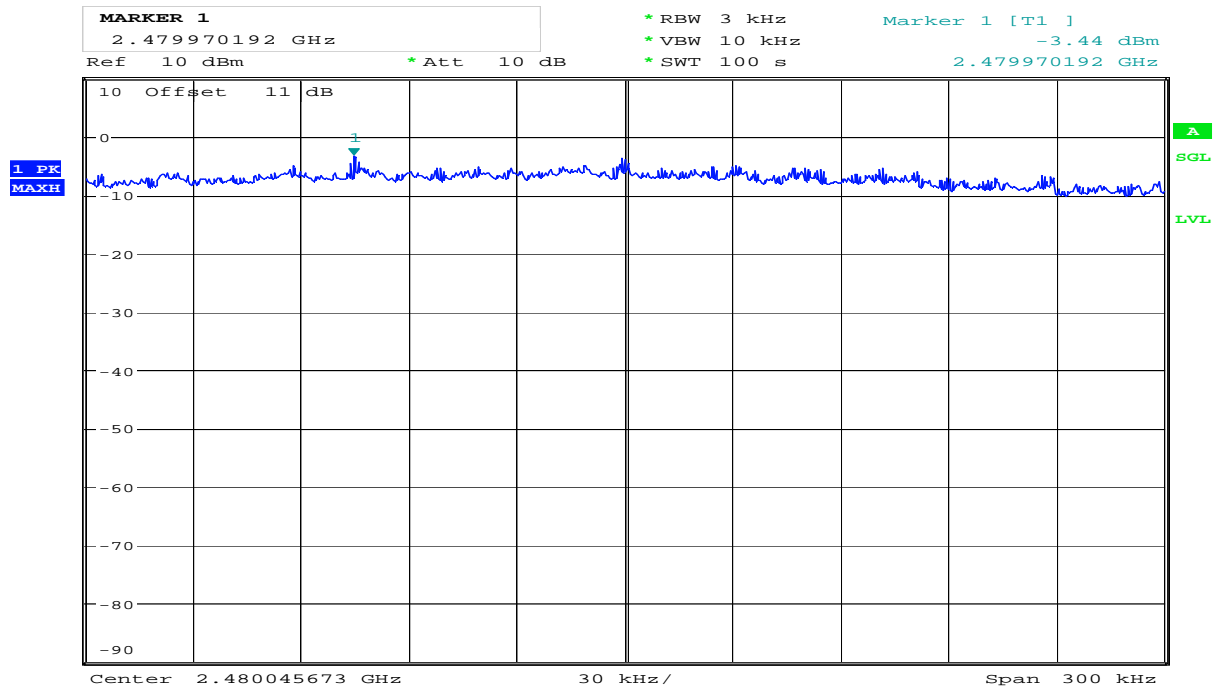
Date: 15.MAR.2012 16:06:05

**PSD Measurement – 2440MHz**



Date: 15.MAR.2012 15:49:32

**PSD Overview – 2480MHz**



Date: 15.MAR.2012 15:57:23

**PSD Measurement - 2480MHz**

## 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.

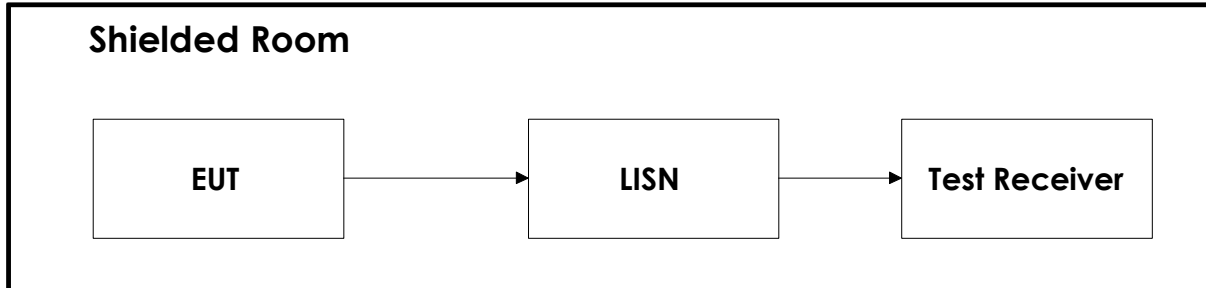
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337	2010.12.15	2012.12.15
2	ESHS10	Spectrum Analyzer	Rohde & Schwarz	N-3528	2011.06.21	2012.06.21
3	3115	Antenna horn	EMCO	LR 1330	2010.08.05	2013.08.05
4	643	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
19	6810.17A	10 attenuator	Suhner	LR 1143	2010.09.15	2012.09.15
20	FA210A1010003030	Microwave cable	Rosenberger	LR1566	Cal b4 use	

15-03-2012

No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	2010.09.28	2012.09.28
2	6810.17A	10 attenuator	Suhner	LR 1143	2010.09.15	2012.09.15
3	FA210A1010003030	Microwave cable	Rosenberger	LR1566	Cal b4 use	

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission

