



Test report no. : 182222-5

Item tested : CC2510EM

Type of equipment : 2.4GHz Transceiver

FCC ID : ZAT2510EM

Client : Texas Instruments Norway AS

FCC Part 15.247

Digital Transmission System

RSS-210, Issue 8

Low Power Licence-Exempt
Radiocommunication Devices

4 October 2013

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
FCC test firm : 994405
IC OATS : 2040D-1
Total Number of Pages: 34

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

1.3 Responsible Manufacturer (If other than client)

Name : /
Address : /

2 Test Information

2.1 Test Item

| | |
|------------------------------------|---------------------------|
| Name : | Texas Instruments |
| FCC ID : | ZAT2510EM |
| IC : | 451H-2510EM |
| Model/version : | CC2510EM |
| Serial number : | / |
| Hardware identity and/or version: | / |
| Software identity and/or version : | / |
| Frequency Range : | 2402 – 2480 MHz |
| Number of Channels : | / |
| Type of Modulation : | Digital (2-FSK) |
| Conducted Output Power : | 0.0020 W (Peak) |
| Data rate: | 500Kbps |
| User Frequency Adjustment : | None |
| Type of Power Supply : | Primary Battery (1x9V) |
| 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 – 22 °C |
| Relative humidity: | 27 – 36 % |
| Normal test voltage: | 9.0 V DC |

The radiated emissions tests were performed with the EUT powered from a test-jig with 9.0V primary battery. Fully charged battery is used.

The values are the limit registered during the test period.

2.3 Test Period

| | |
|---------------------|-------------------------------|
| Item received date: | 2011-11-30 |
| Test period : | from 2011-12-02 to 2011-12-06 |

3 TEST REPORT SUMMARY

3.1 General

All measurements are tracable 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 C63.4-2009 and ANSI C63.10-2009. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3m and 10m.

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

DTS Equipment Code

Family Listing

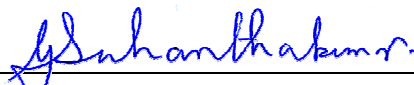
THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

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



TEST REPORT #: 182222-5

TESTED BY: _____


G.Suhanthakumar, Test engineer

DATE: 2013-09-05

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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: 6 Dec 2011 |
|------------------------------------|--------------------------|

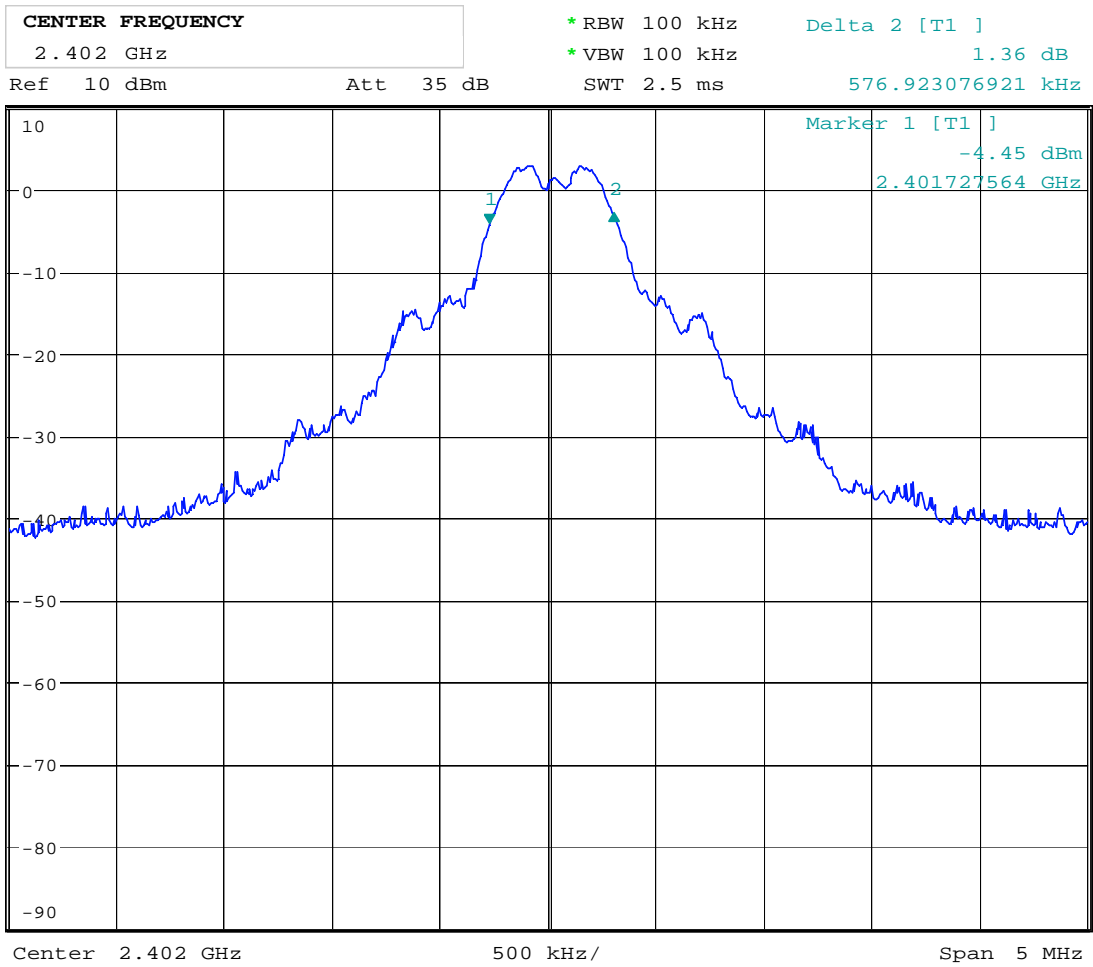
Test Results: Complies

Measurement Data:

| Measured 6 dB Bandwidth (kHz) | | |
|-------------------------------|----------|----------|
| 2402 MHz | 2440 MHz | 2480 MHz |
| 576.9 | 552.9 | 584.9 |

Requirements:

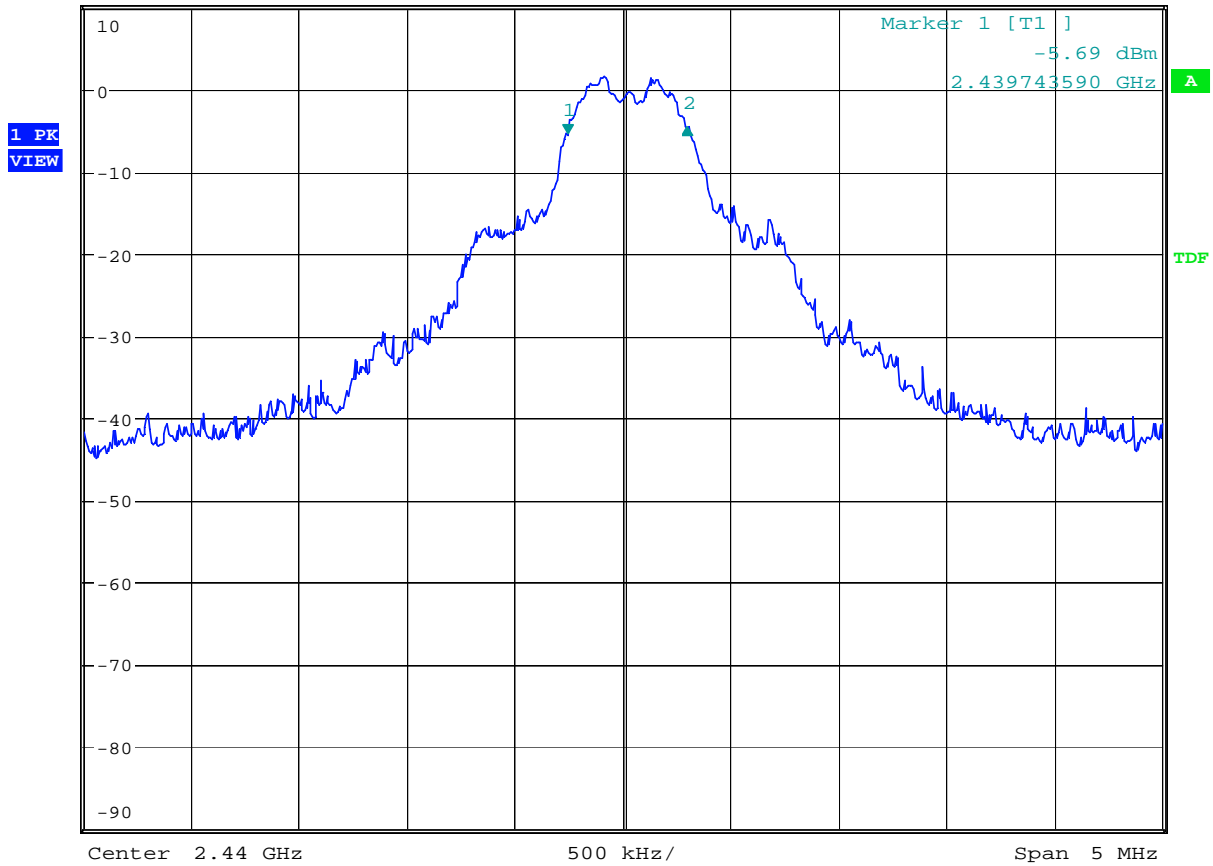
For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.



Date: 6.DEC.2011 09:26:42

6 dB Bandwidth at 2402 MHz

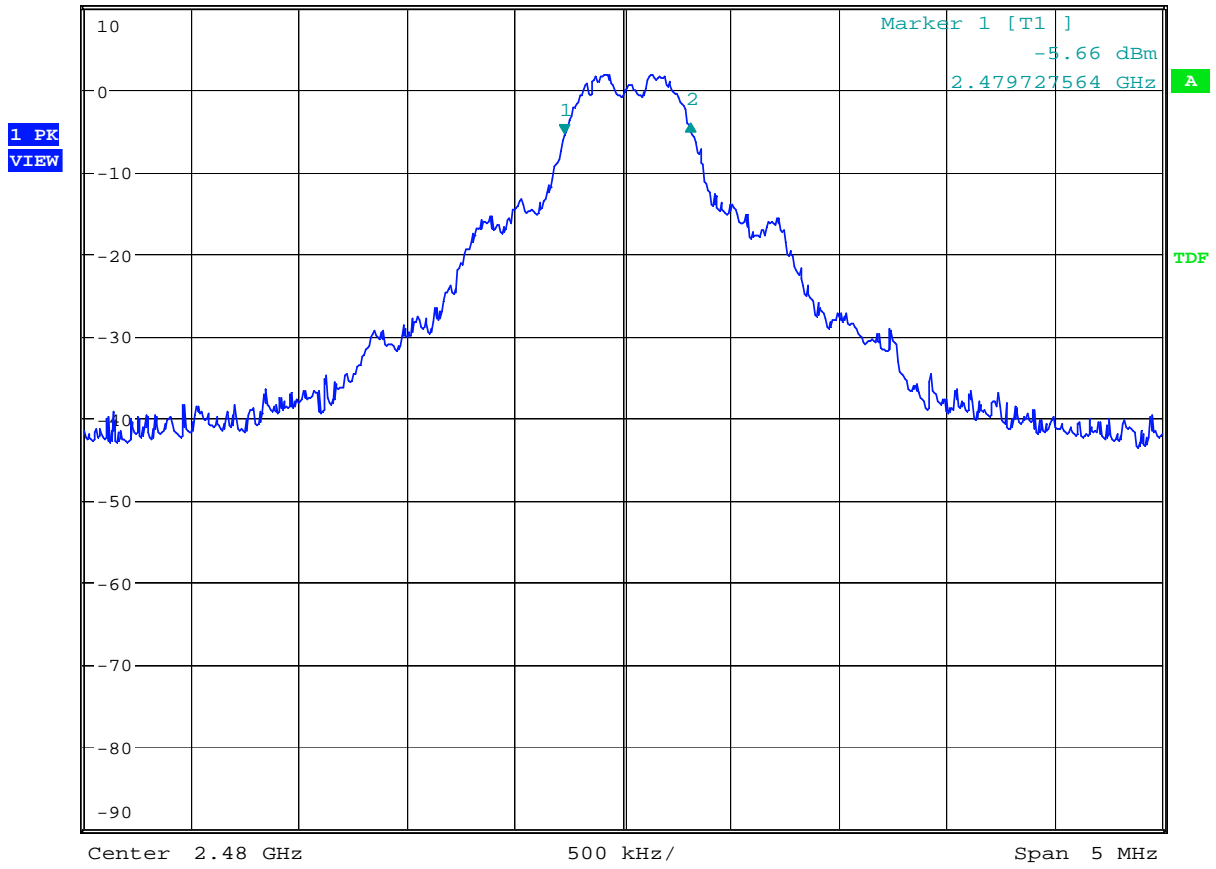
DELTA MARKER 2
 552.8846154 kHz
 Ref 10 dBm Att 35 dB *RBW 100 kHz Delta 2 [T1] 0.80 dB
 *VBW 100 kHz SWT 2.5 ms 552.884615381 kHz



Date: 6.DEC.2011 09:28:41

6 dB Bandwidth at 2440 MHz

DELTA MARKER 2
 584.9358974 kHz
 Ref 10 dBm Att 35 dB *RBW 100 kHz *V BW 100 kHz SWT 2.5 ms Delta 2 [T1] 1.19 dB
 584.935897433 kHz



Date: 6.DEC.2011 09:30:18

6 dB Bandwidth at 2480 MHz

4.2 20 dB Bandwidth

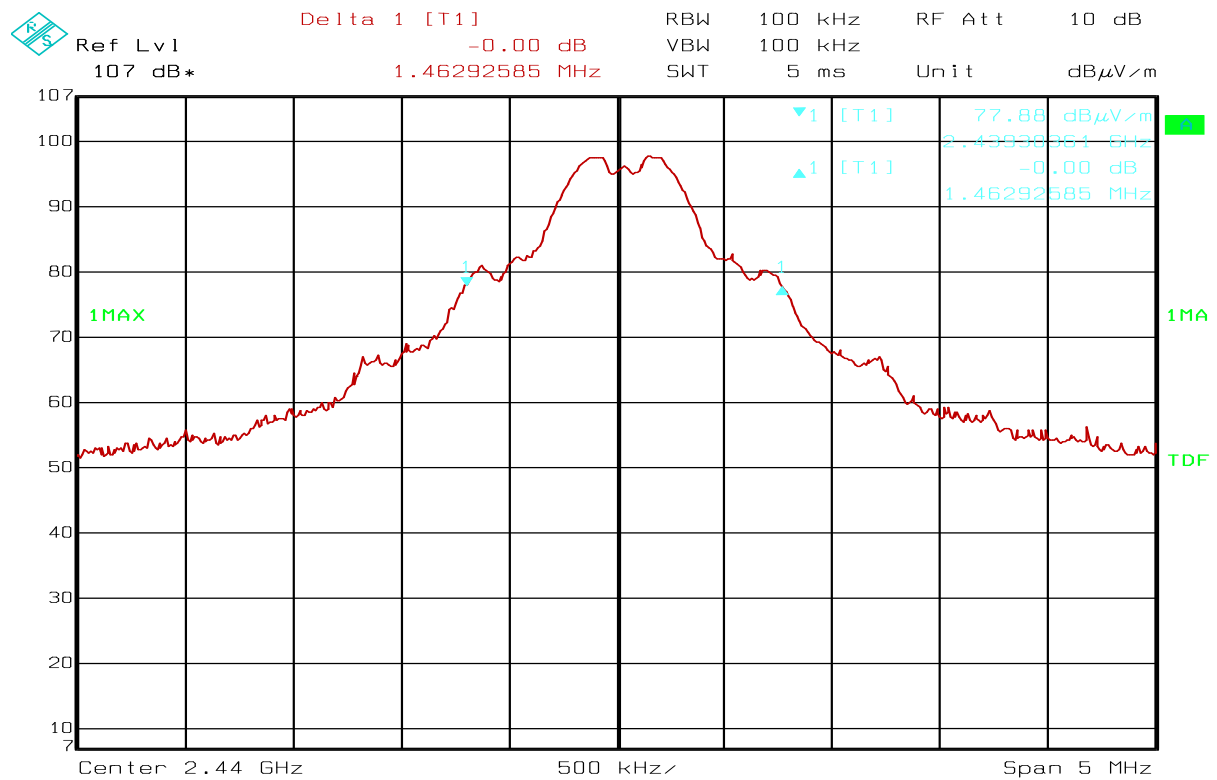
| | |
|------------------------------------|---------------------------|
| Test Performed By: G.Suhanthakumar | Date of Test: 02 Dec 2011 |
|------------------------------------|---------------------------|

Measurement Data:

| |
|---------------------------------------|
| Measured 20 dB Bandwidth (MHz) |
| 2440 MHz |
| 1.46 |

Requirements:

No requirements. Reported for information only.



Date: 02.DEC.2011 15:13:40

20 dB Bandwidth at 2440 MHz

4.3 Peak Power Output

Para. No.: 15.247 (b)

| | |
|------------------------------------|---------------------------|
| Test Performed By: G.Suwanthakumar | Date of Test: 02 Dec 2011 |
|------------------------------------|---------------------------|

Test Results: Complies

Measurement Data:

| RF channel | 2402 MHz | 2440 MHz | 2480 MHz |
|--|----------|----------|----------|
| Conducted Power (dBm) | 3.0 | 2.5 | 2.5 |
| Conducted Power (mW) | 0.0020 | 0.0018 | 0.0018 |
| Measured Maximum Field strength (dBµV/m) –VP | 98.2 | 98.6 | 97.2 |
| Radiated Power (dBm) | 3.0 | 3.4 | 1.9 |
| Antenna Gain (dB) | 0.0 | 0.9 | -0.6 |

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.

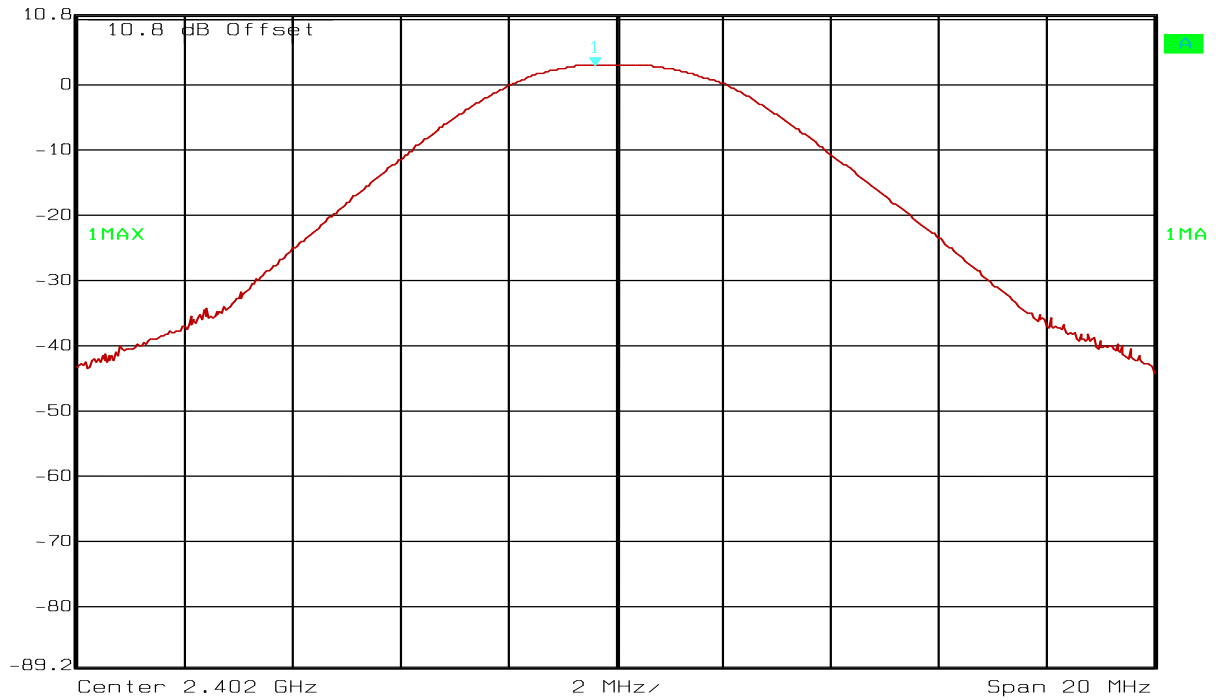
Requirements:

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.

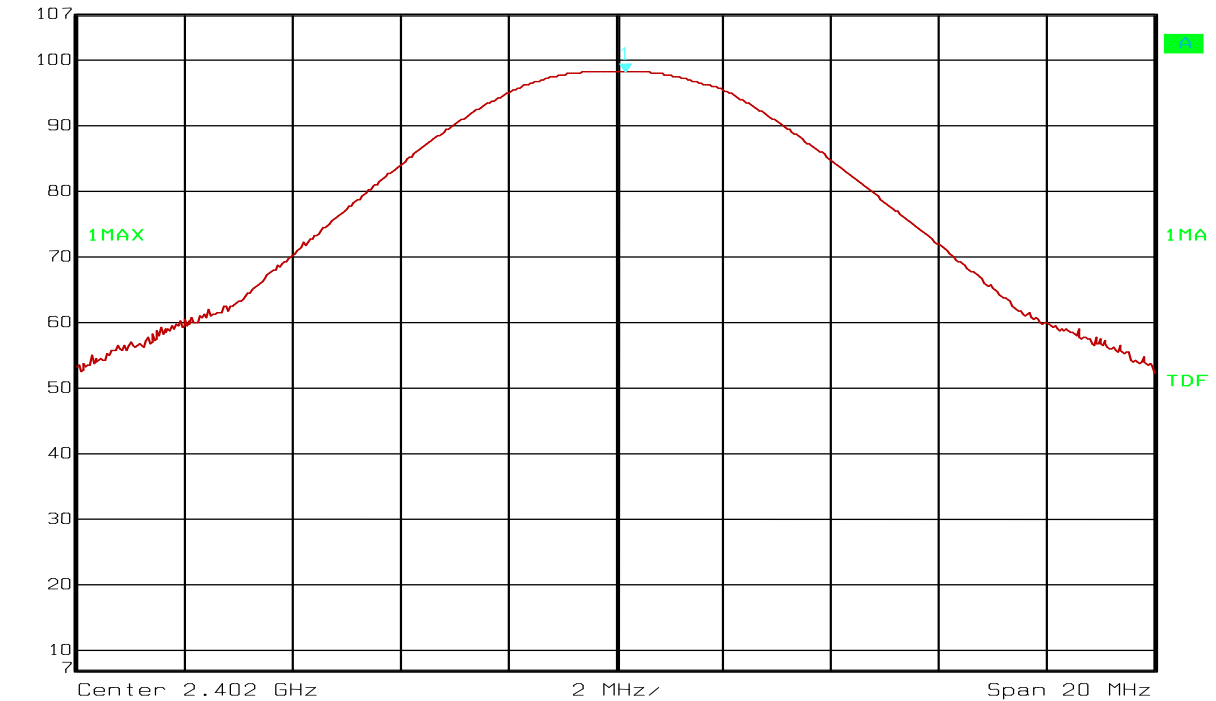
FS Marker 1 [T1] RBW 3 MHz RF Att 20 dB
 Ref Lvl 10.8 dBm 2.98 dBm VBW 3 MHz
 10.8 dB Offset 2.40161924 GHz SWT 5 ms Unit dBm



Date: 03.DEC.2011 23:31:27

Conducted Power, 2402 MHz

FS Marker 1 [T1] RBW 3 MHz RF Att 20 dB
 Ref Lvl 107 dB* 98.20 dB μ V/m VBW 3 MHz
 2.40218036 GHz SWT 5 ms Unit dB μ V/m

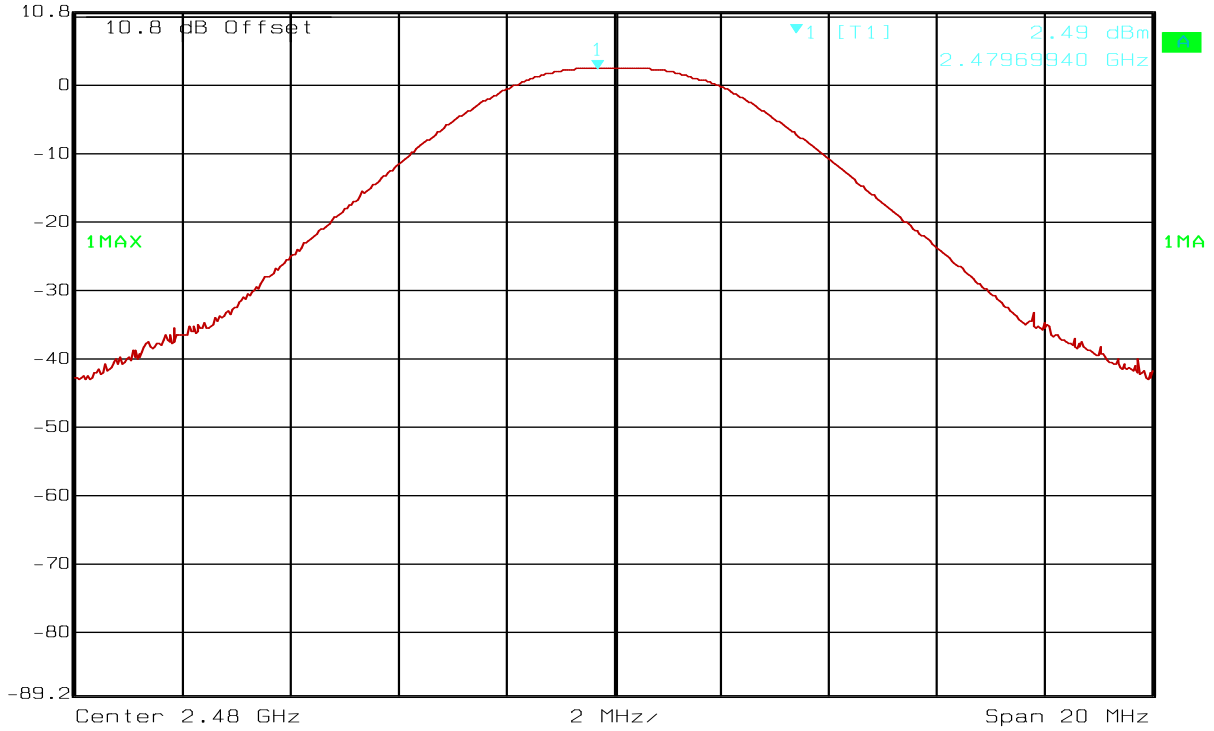


Date: 02.DEC.2011 14:35:30

Radiated Field strength, VP, 2402 MHz

◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆

◆ Marker 1 [T1] RBW 3 MHz RF Att 20 dB
 Ref Lvl 2.49 dBm VBW 3 MHz
 10.8 dBm 2.47969940 GHz SWT 5 ms Unit dBm

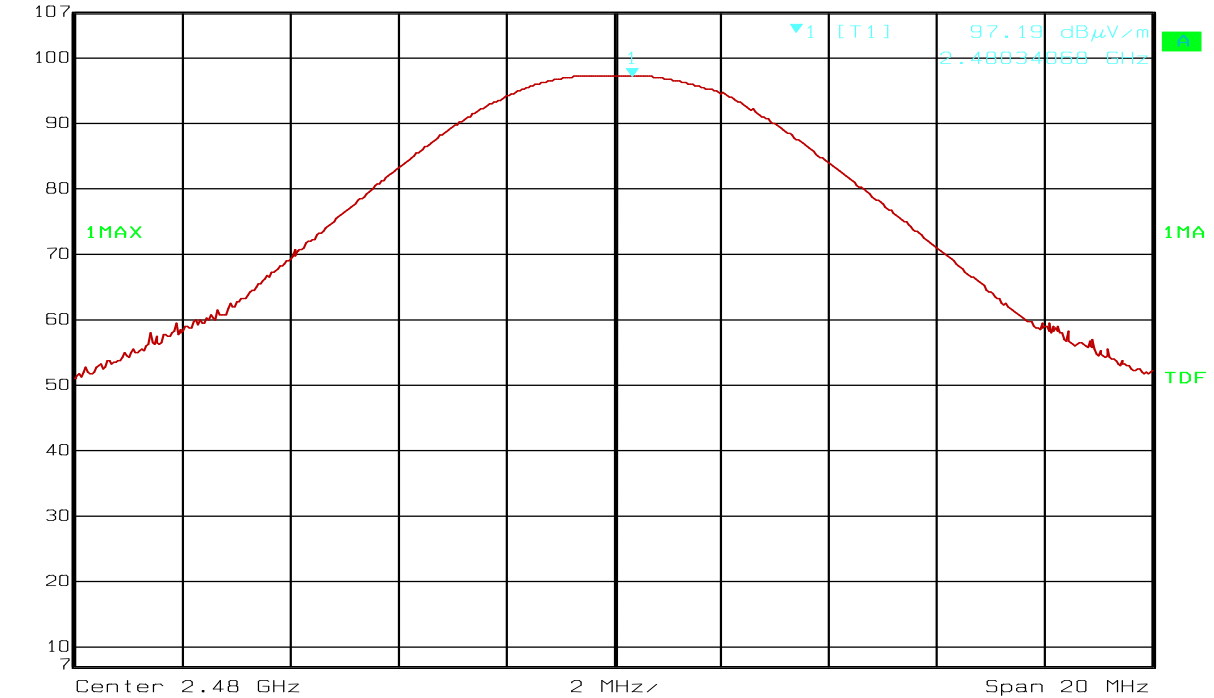


Date: 03.DEC.2011 23:43:50

Conducted Power, 2480 MHz

◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆

◆ Marker 1 [T1] RBW 3 MHz RF Att 10 dB
 Ref Lvl 97.19 dB μ V/m VBW 3 MHz
 107 dB* 2.48034068 GHz SWT 5 ms Unit dB μ V/m



Date: 02.DEC.2011 15:15:30

Radiated field strength, VP, 2480 MHz

4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

| | |
|---|----------------------------------|
| Test Performed By: G.Suhandhakumar | Date of Test: 02 Dec 2011 |
|---|----------------------------------|

Test Results: Complies

Measurement Data:

Band-edge, @3m

| Frequency | Measured Field Strength @3m, dB μ V/m | Detector | Limit dB μ V/m | Margin dB |
|-------------------|---|----------|--------------------|-----------|
| 2.39 GHz | 39.9 | AV | 54 | 14.1 |
| | 39.9 | PK | 74 | 34.1 |
| 2.4835 GHz | 48.0 | AV | 54 | 6.0 |
| | 48.0 | PK | 74 | 26.0 |

See attached plots.

Marker Delta Calculation:

Max: 97.1 dB μ V/m

Delta: 49.1 dB

Band Edge Field Strength, Peak: 97.1 – 49.1 dB μ V/m = 48.0 dB μ V/m

RF conducted power

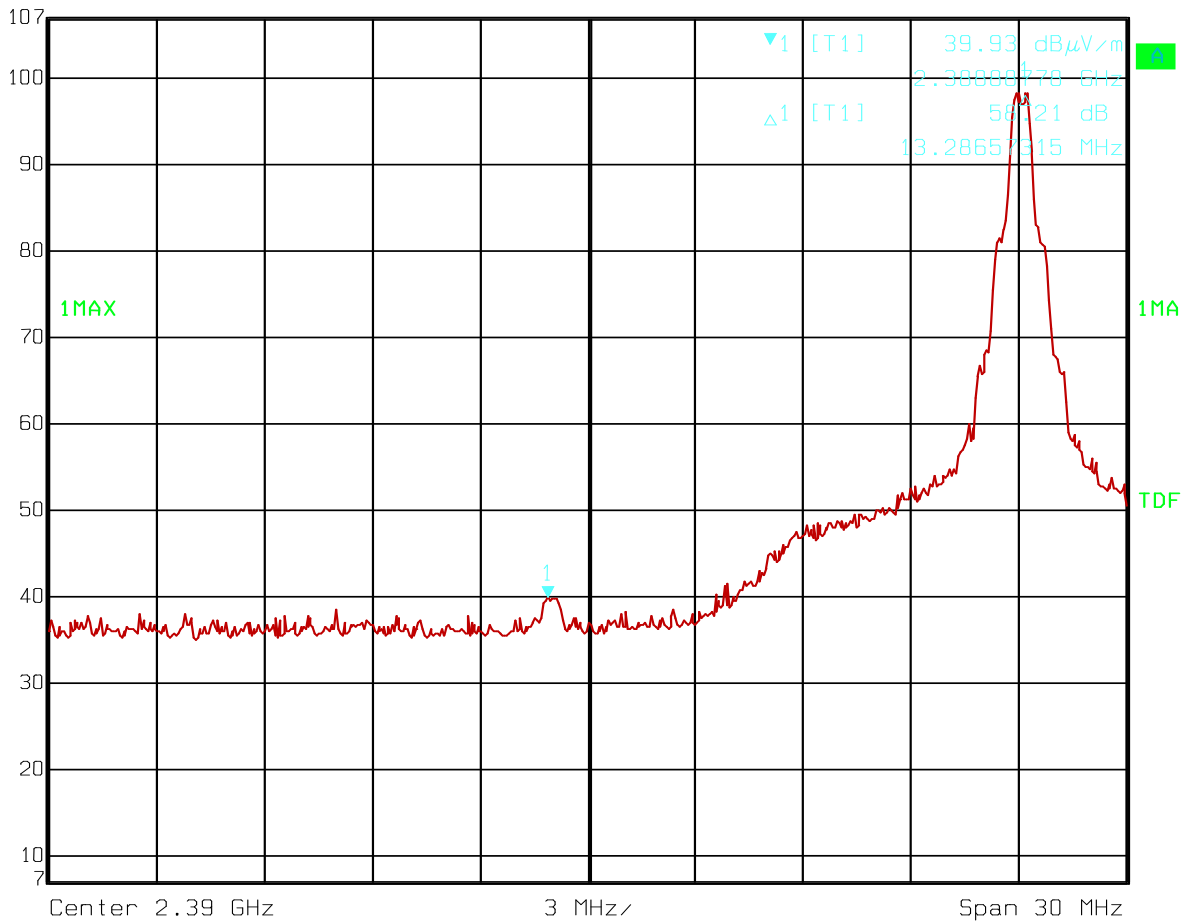
Scan performed radiated with 100 kHz Bandwidth from 0.001 to 25 GHz.

All emissions are more than 20dB below carrier.

See plots.



Ref Lvl 107 dB* Marker 1 [T1] 39.93 dB μ V/m RBW 100 kHz RF Att 20 dB
 2.38888778 GHz VBW 100 kHz Unit dB μ V/m
 2.38888778 GHz SWT 7.5 ms

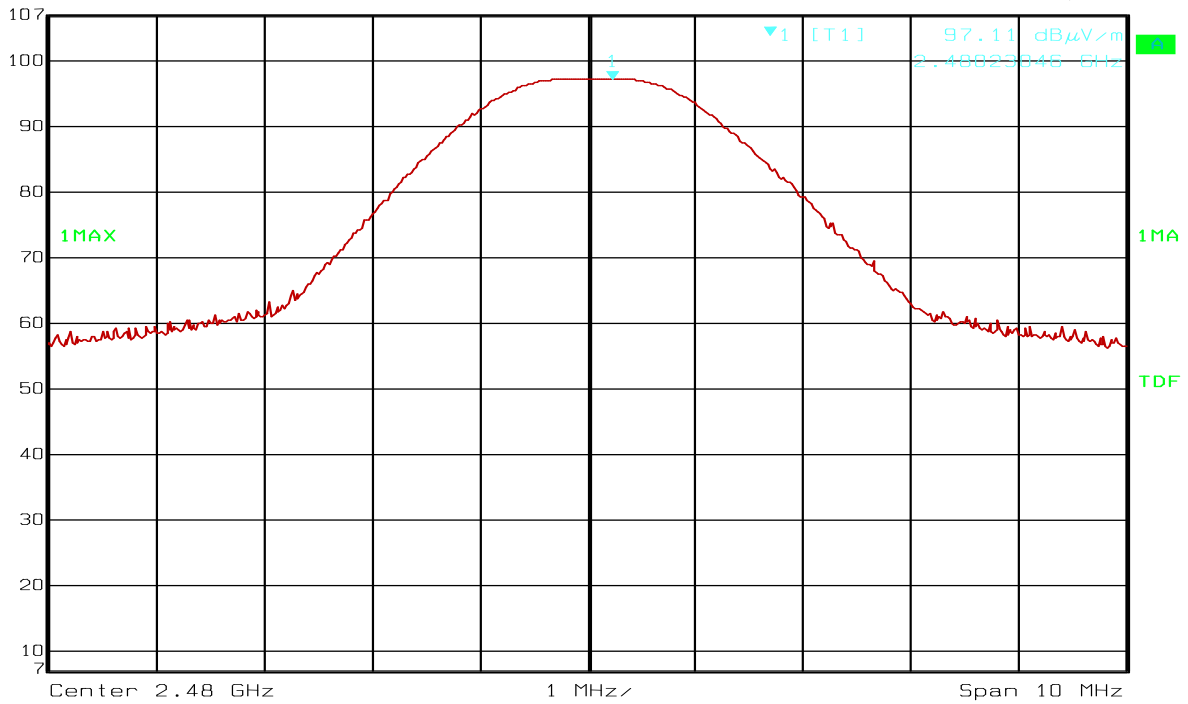


Date: 02.DEC.2011 14:50:25

Band Edge, 2390 MHz, Peak Detector

◆ ◆ ◆ ◆

| | | | | | |
|---------|--------------------|-----|-------|--------|--------------|
| Ref Lvl | Marker 1 [T1] | RBW | 1 MHz | RF Att | 10 dB |
| 107 dB* | 97.11 dB μ V/m | VBW | 1 MHz | | |
| | 2.48023046 GHz | SWT | 5 ms | Unit | dB μ V/m |

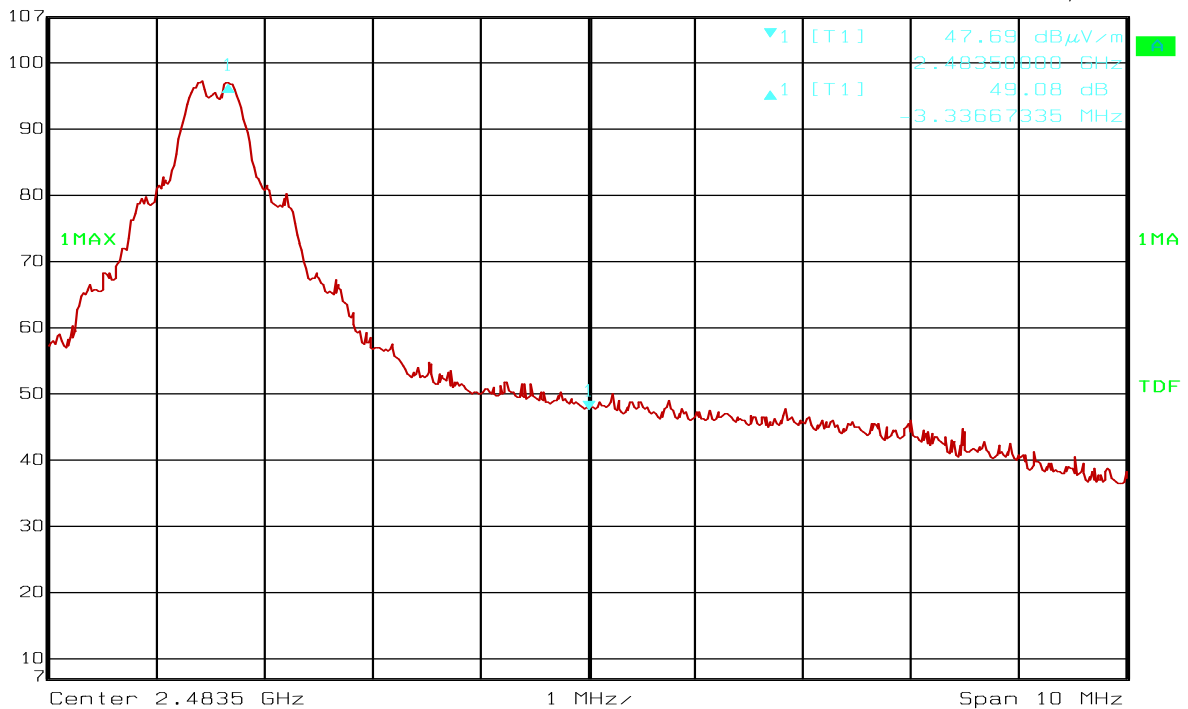


Date: 02.DEC.2011 15:16:07

Band Edge, 2483.5 MHz, Marker Delta, Max

◆ ◆ ◆ ◆

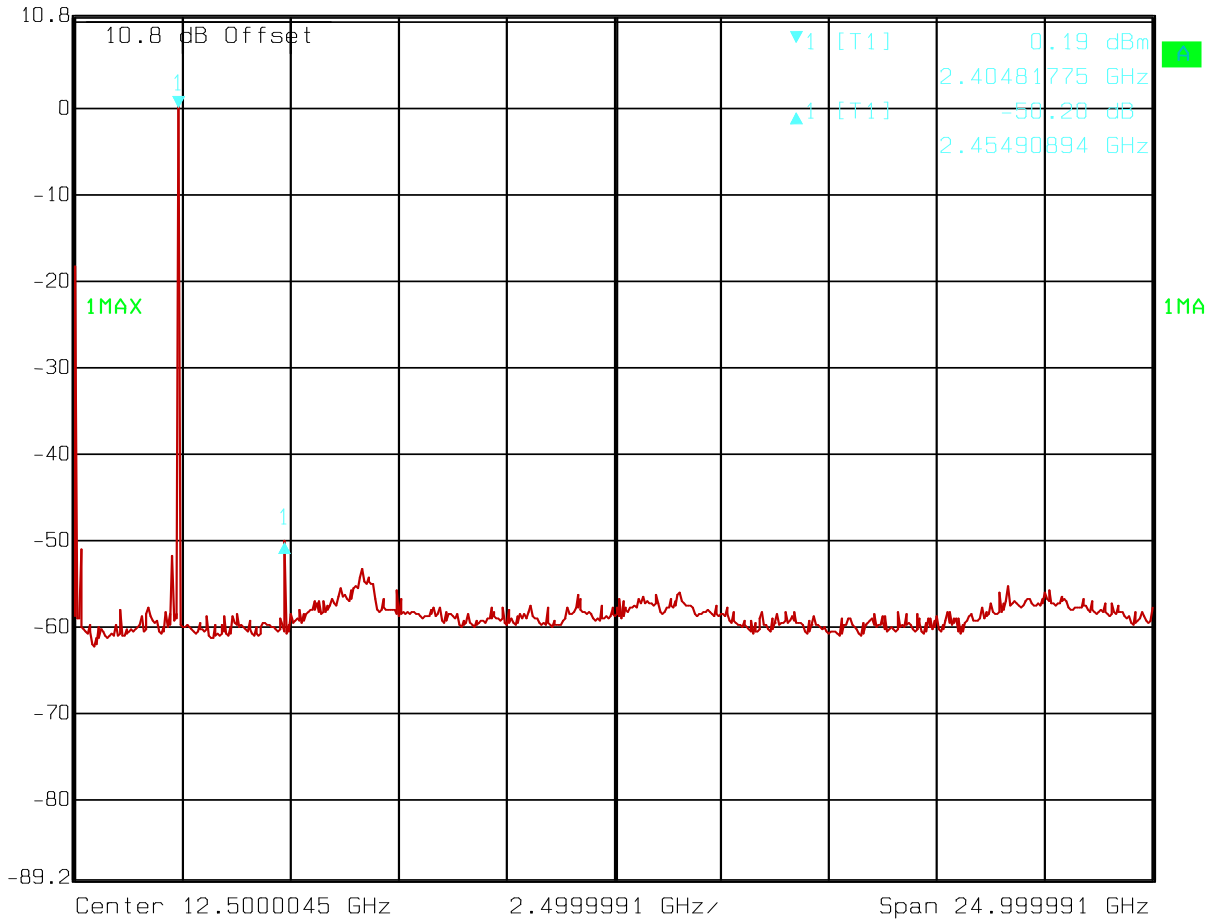
| | | | | | |
|---------|-----------------|-----|---------|--------|--------------|
| Ref Lvl | Delta 1 [T1] | RBW | 100 kHz | RF Att | 10 dB |
| 107 dB* | 49.08 dB | VBW | 100 kHz | | |
| | -3.33667335 MHz | SWT | 5 ms | Unit | dB μ V/m |



Date: 02.DEC.2011 15:17:22

Band Edge, 2483.5 MHz, Marker Delta, Delta

Delta 1 [T1] RBW 100 kHz RF Att 20 dB
 Ref Lvl 10.8 dBm -50.20 dB VBW 100 kHz
2.45490894 GHz SWT 6.4 s Unit dBm



Date: 03.DEC.2011 23:42:36

Conducted Emissions, 9 kHz – 25 GHz

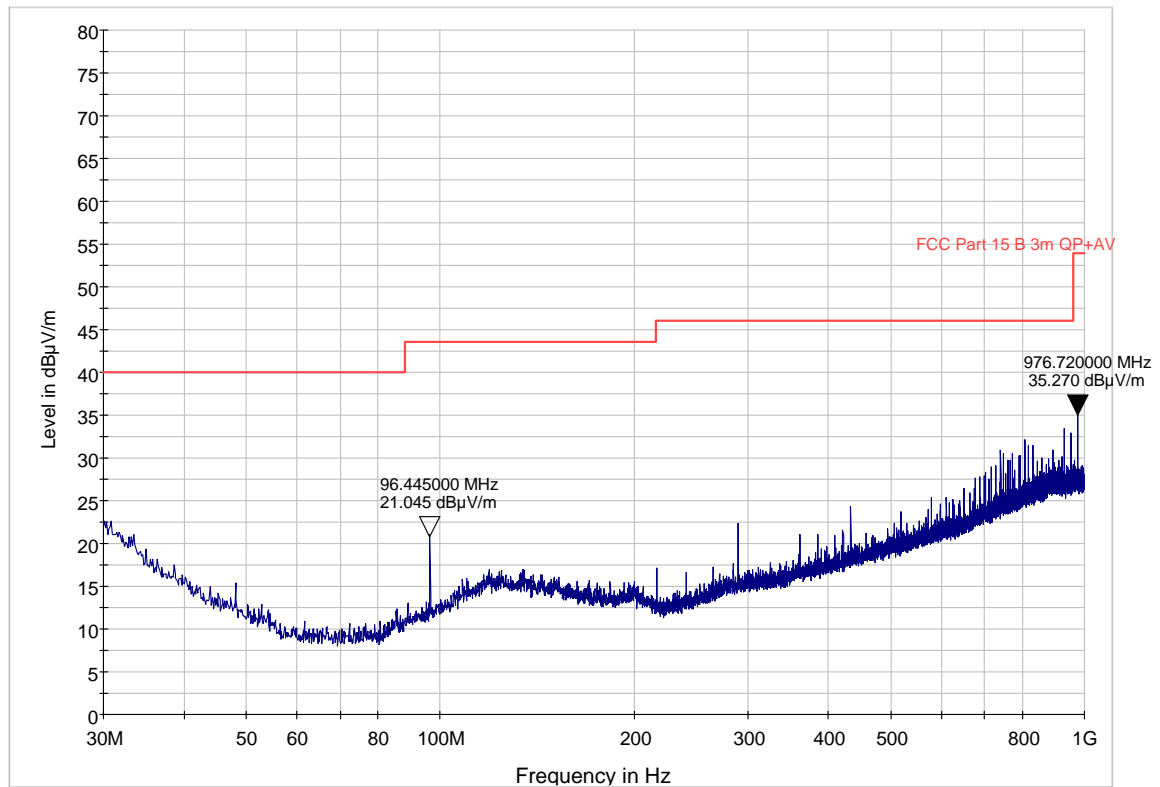
Radiated emission 30 – 1000 MHz.

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

Radiated Emissions, 1-25 GHz

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

10 - 18 GHz prescan at 1m

Prescan performed from 18 to 25 GHz at 1m.

PK- detector

| Frequency MHz | Field strength @3m dBµV/m | Detector | Limit dBµV/m | Margin dB |
|------------------|------------------------------|----------|-----------------|--------------|
| 4804 | 56.6 | Pk | 74 | 17.4 |
| 4880 | 55.9 | Pk | 74 | 18.1 |
| 4960 | 54.2 | Pk | 74 | 19.8 |

AV- detector

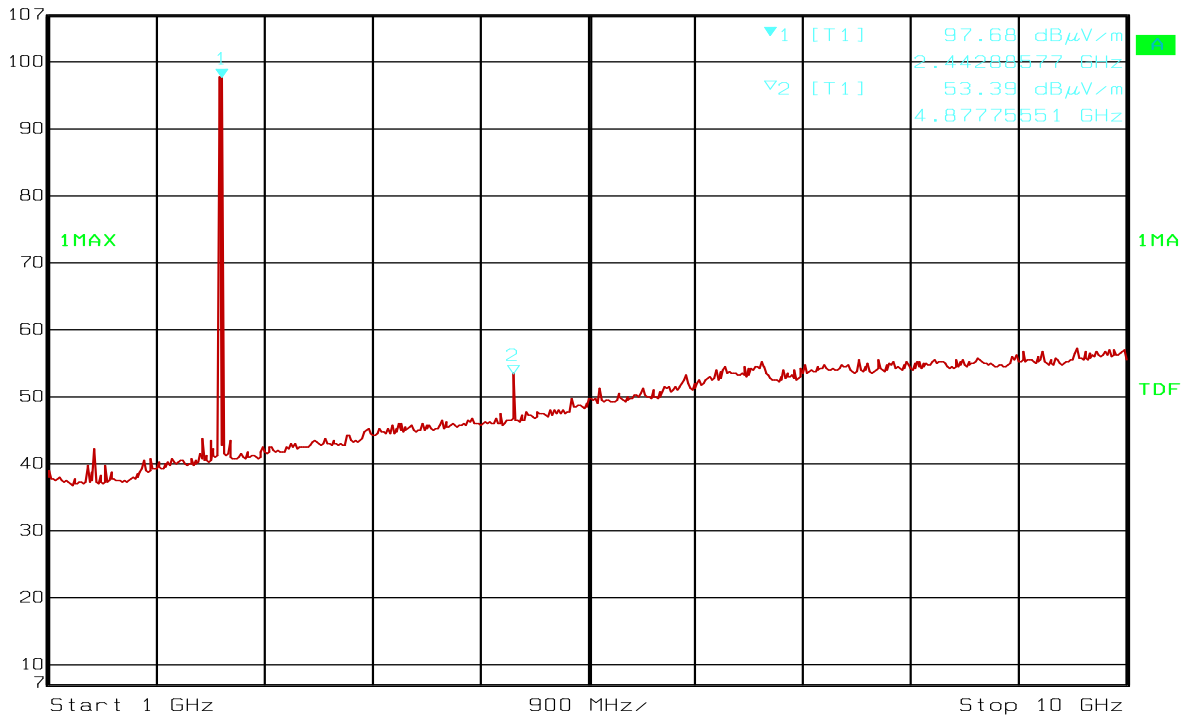
| Frequency MHz | Field strength @3m dBµV/m | Detector | Limit dBµV/m | Margin dB |
|------------------|------------------------------|----------|-----------------|--------------|
| 4804 | 53.2 | AV | 54 | 0.8 |
| 4880 | 53.3 | AV | 54 | 0.7 |
| 4960 | 50.8 | AV | 54 | 3.2 |

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.

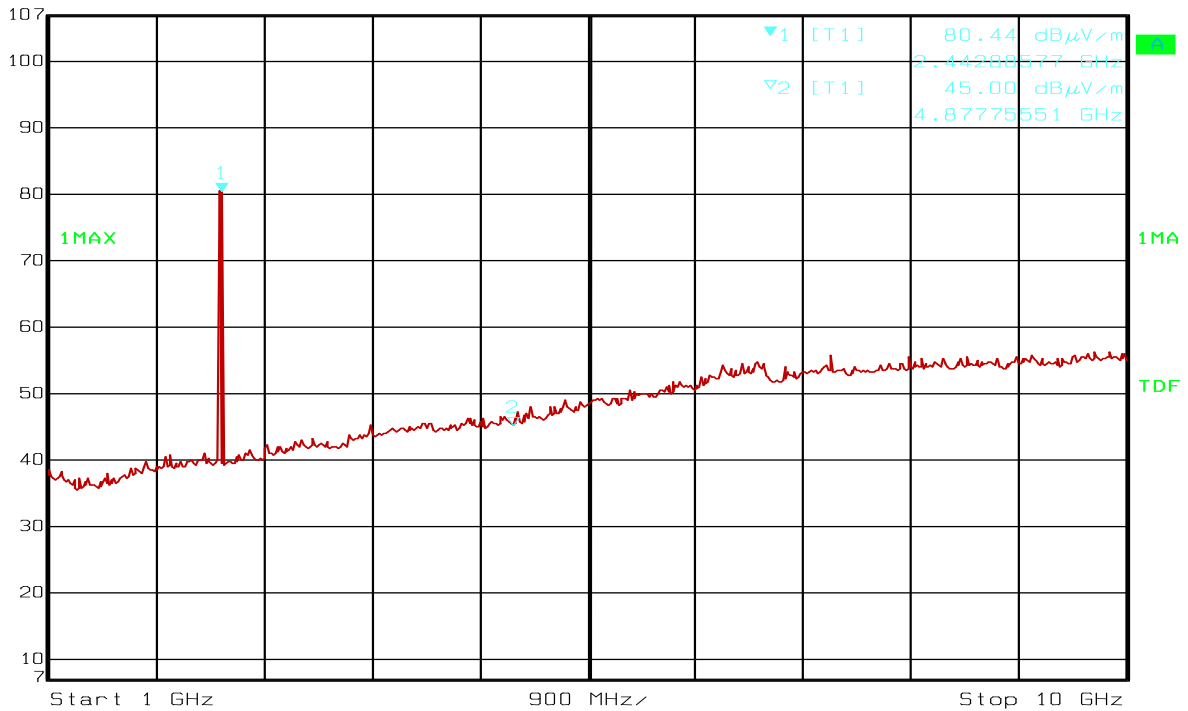
FS
Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl 107 dB*
97.68 dB μ V/m
VBW 1 MHz
Unit dB μ V/m
2.44288577 GHz
SWT 90 ms



Date: 02.DEC.2011 15:05:22

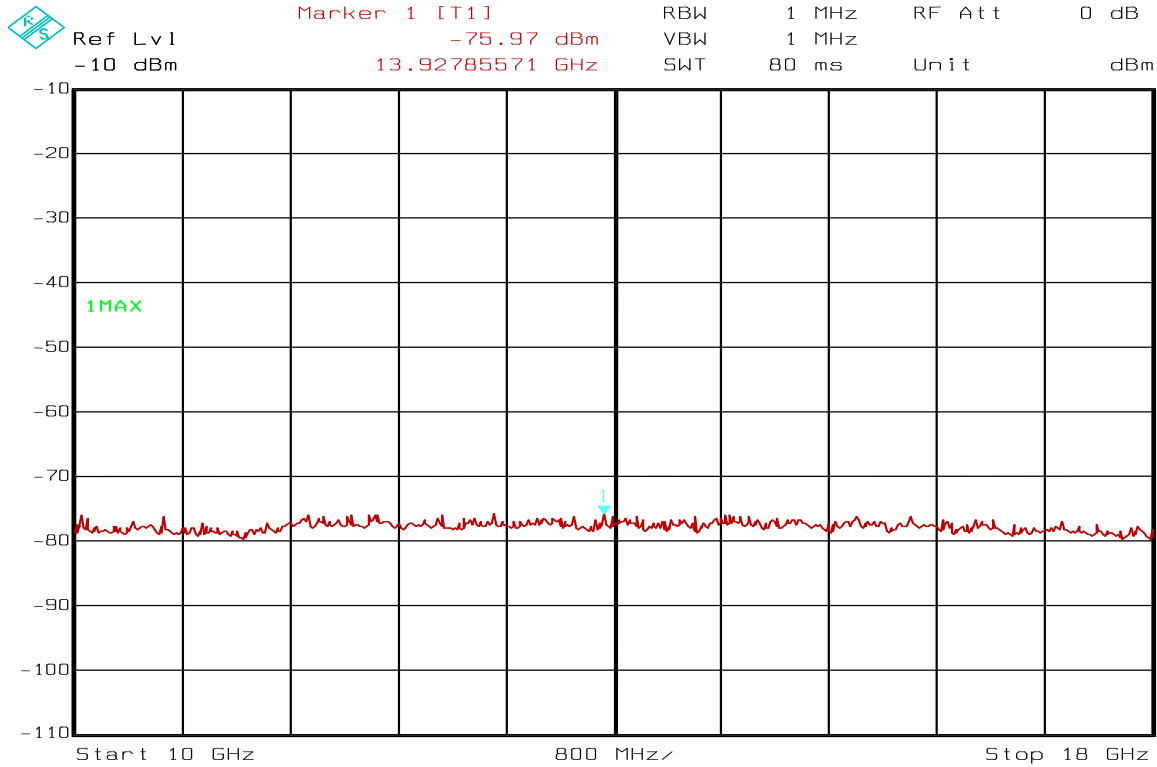
Radiated Emissions, 1 – 10 GHz, VP, @3m

FS
Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl 107 dB*
80.44 dB μ V/m
VBW 1 MHz
Unit dB μ V/m
2.44288577 GHz
SWT 90 ms



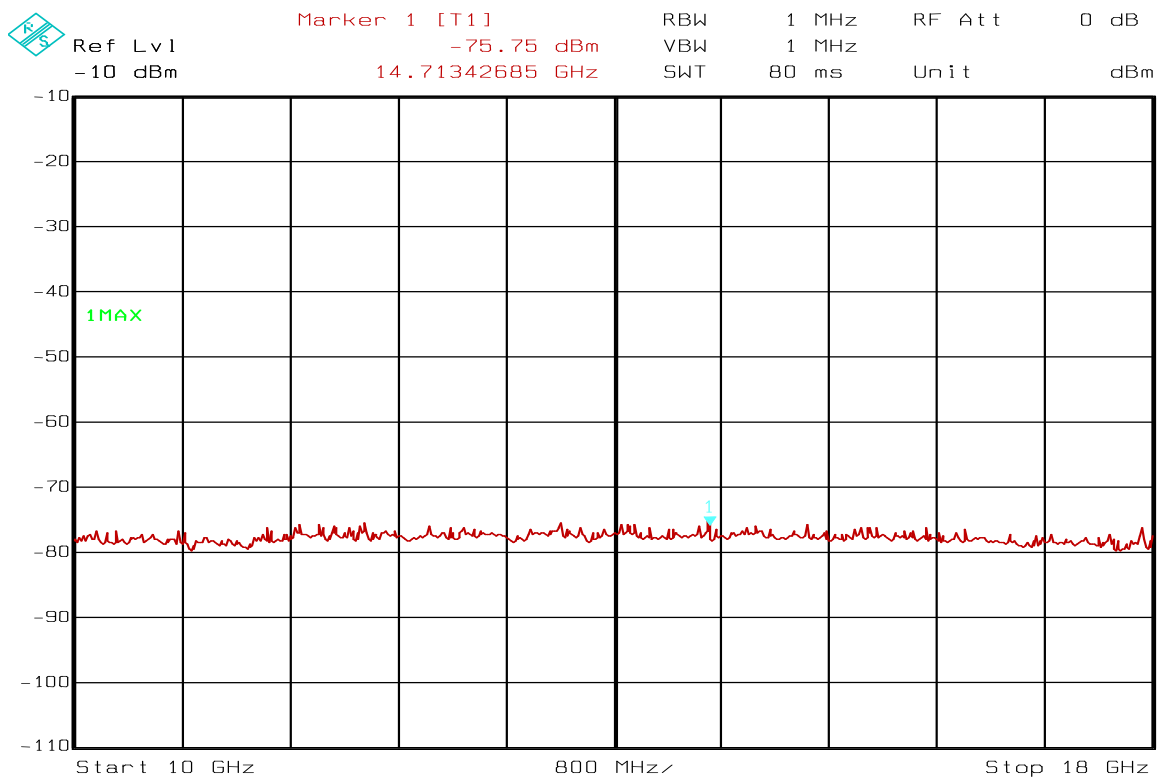
Date: 02.DEC.2011 15:05:52

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



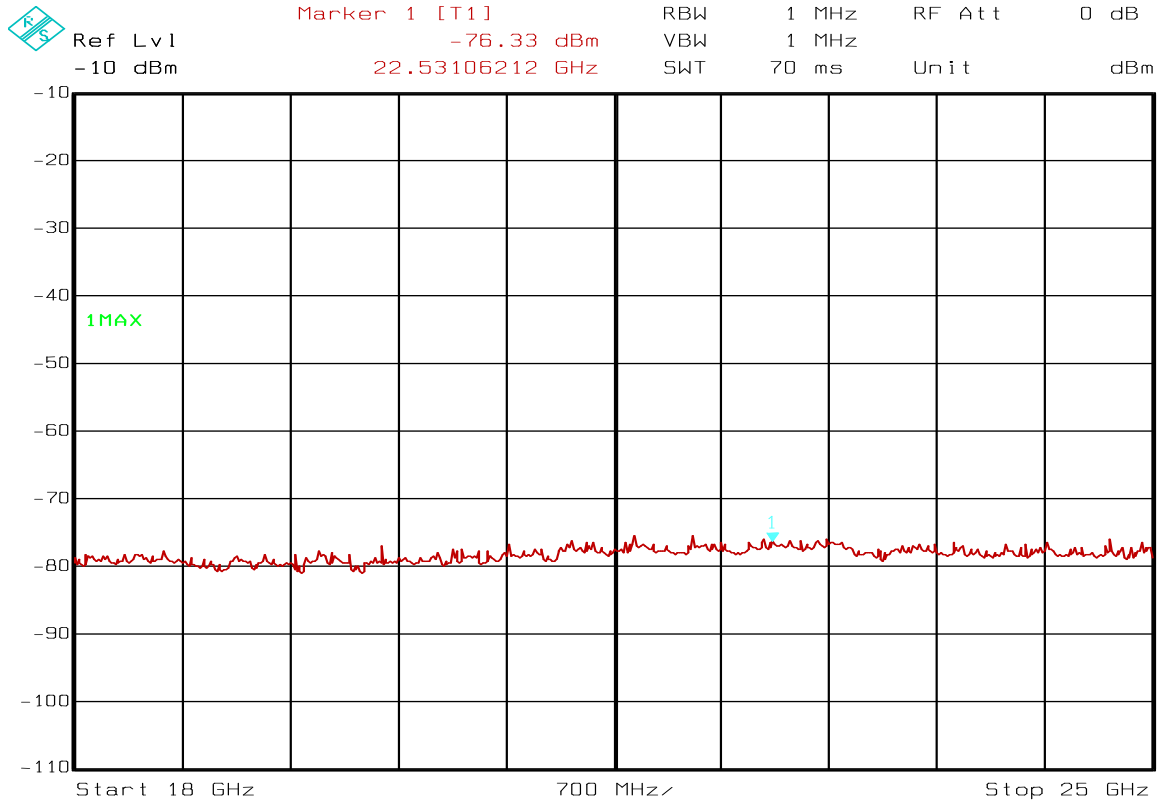
Date: 06.DEC.2011 08:40:40

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



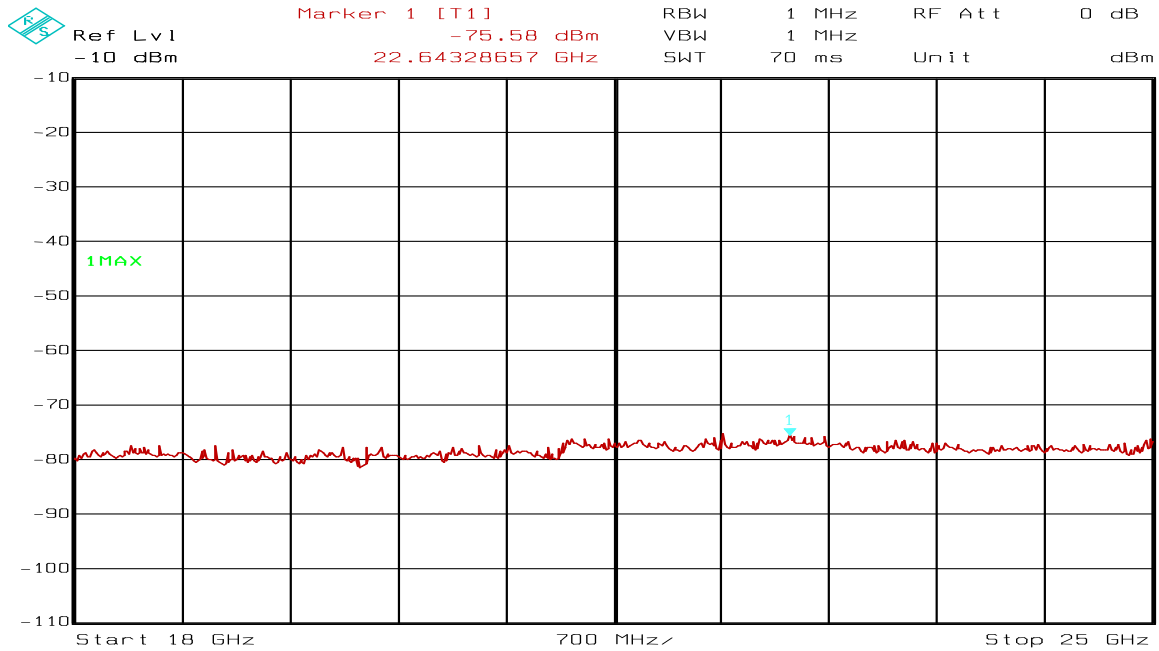
Date: 06.DEC.2011 08:42:17

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



Date: 06.DEC.2011 08:41:46

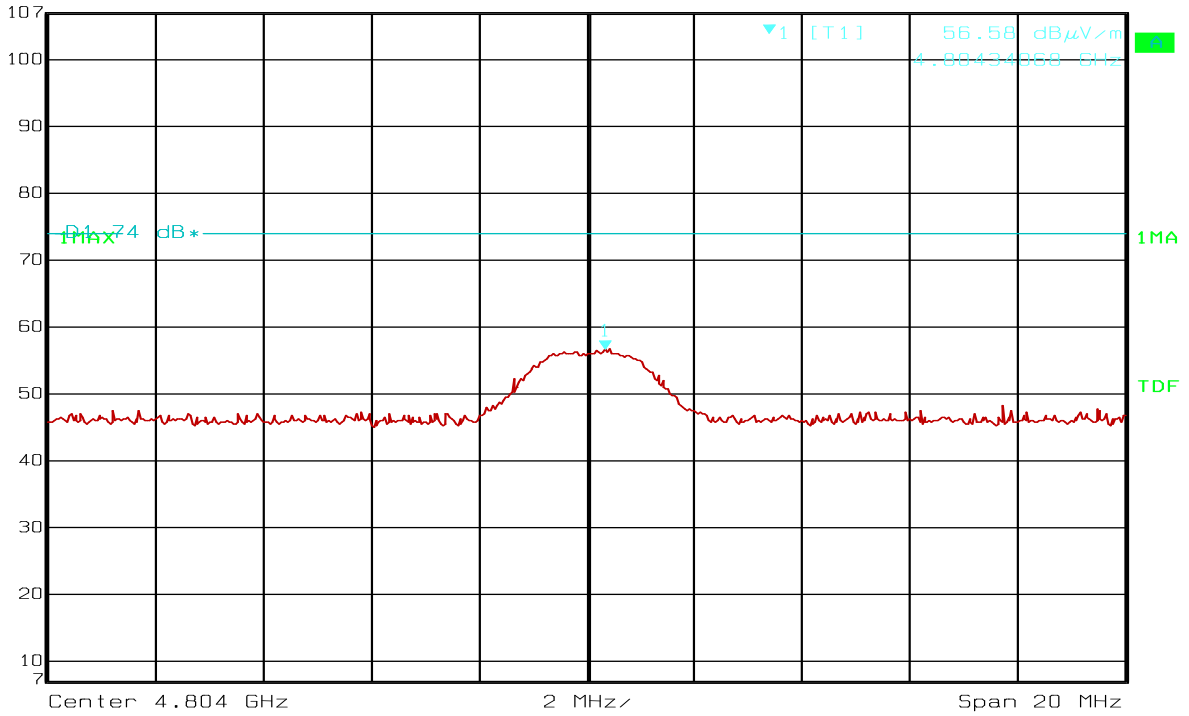
Radiated Emissions, 18 – 25 GHz, HP, @1m , pre-view scan



Date: 06.DEC.2011 08:41:18

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

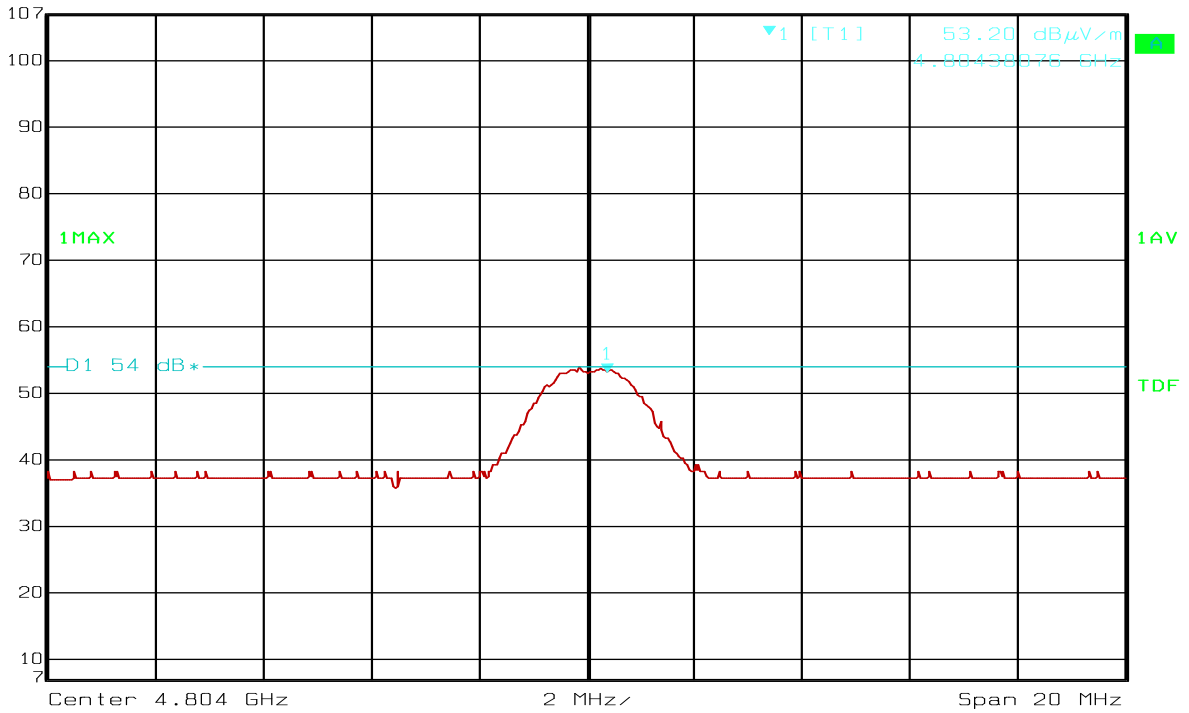
FS
Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl 107 dB*
56.58 dB μ V/m
VBW 1 MHz
Unit dB μ V/m
107 dB*
4.80434068 GHz
SWT 5 ms



Date: 02.DEC.2011 14:59:21

Radiated Emissions, 4804 MHz, Max, Pk Det.

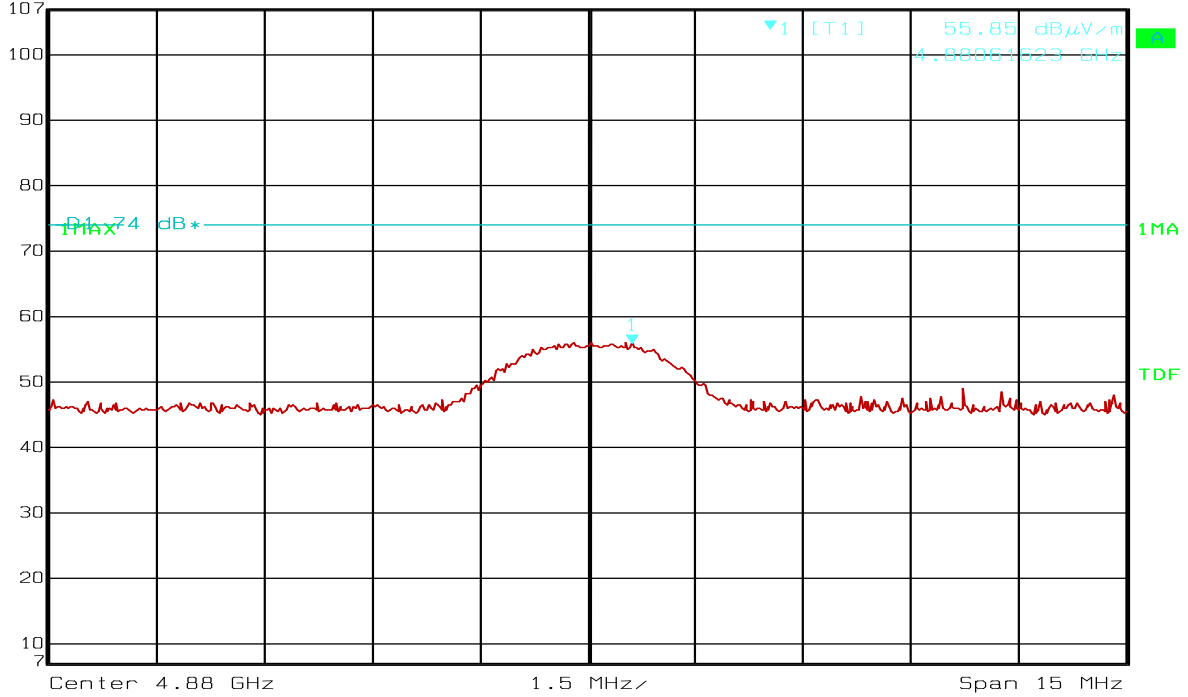
FS
Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl 107 dB*
53.20 dB μ V/m
VBW 10 MHz
Unit dB μ V/m
107 dB*
4.80438076 GHz
SWT 5 ms



Date: 02.DEC.2011 15:00:22

Radiated Emissions, 4804 MHz, Max, AV Det.

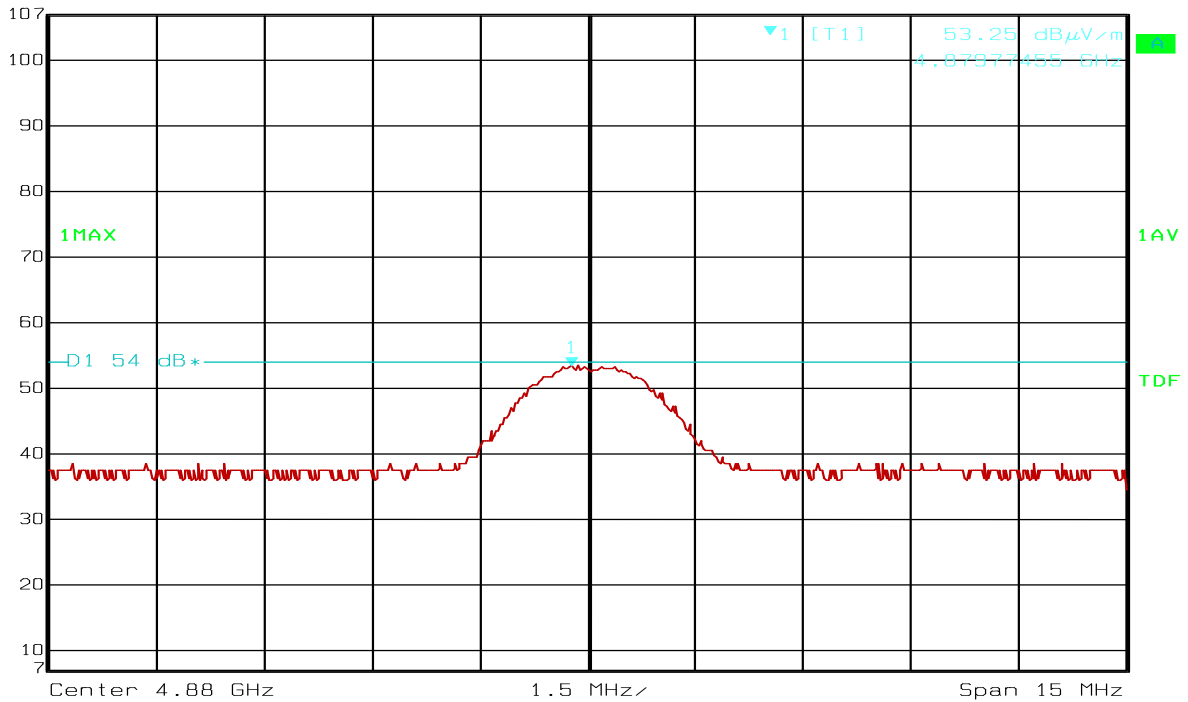

 Ref Lvl 107 dB*
 Marker 1 [T1] 55.85 dB μ V/m
 4.88061623 GHz
 RBW 1 MHz RF Att 10 dB
 VBW 1 MHz
 SWT 5 ms Unit dB μ V/m



Date: 02.DEC.2011 15:07:16

Radiated Emissions, 4880 MHz, Max, Pk Det.

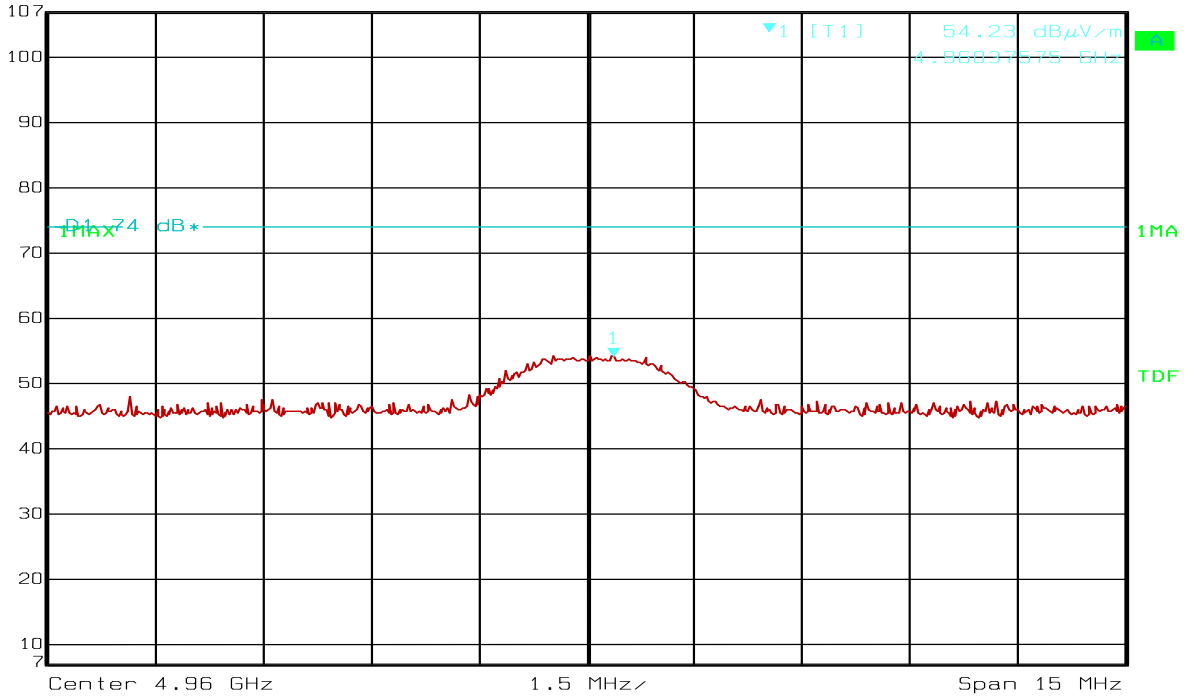

 Ref Lvl 107 dB*
 Marker 1 [T1] 53.25 dB μ V/m
 4.87977455 GHz
 RBW 1 MHz RF Att 10 dB
 VBW 10 MHz
 SWT 5 ms Unit dB μ V/m



Date: 02.DEC.2011 15:07:56

Radiated Emissions, 4880 MHz, Max, AV Det.

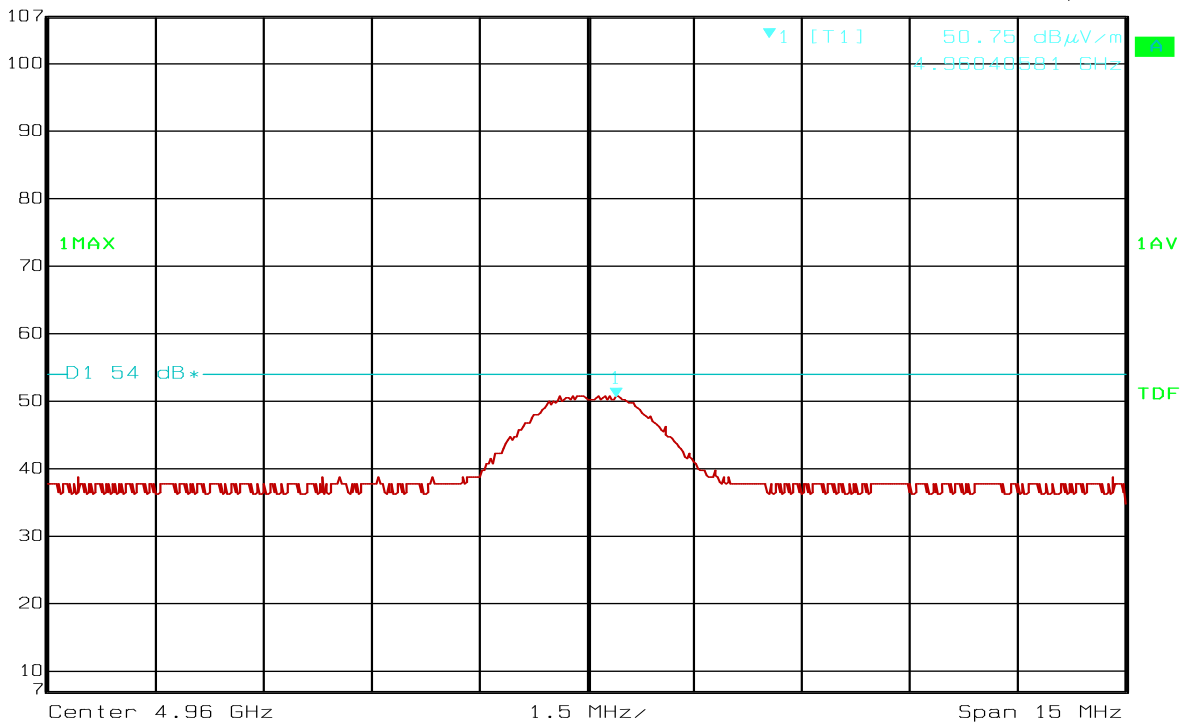

 Ref Lvl 107 dB*
 Marker 1 [T1] 54.23 dB μ V/m
 4.96037575 GHz
 RBW 1 MHz RF Att 10 dB
 VBW 1 MHz
 SWT 5 ms Unit dB μ V/m



Date: 02.DEC.2011 15:21:18

Radiated Emissions, 4960 MHz, Max, Pk Det.


 Ref Lvl 107 dB*
 Marker 1 [T1] 50.75 dB μ V/m
 4.96040581 GHz
 RBW 1 MHz RF Att 10 dB
 VBW 10 MHz
 SWT 5 ms Unit dB μ V/m



Date: 02.DEC.2011 15:22:05

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 | / |

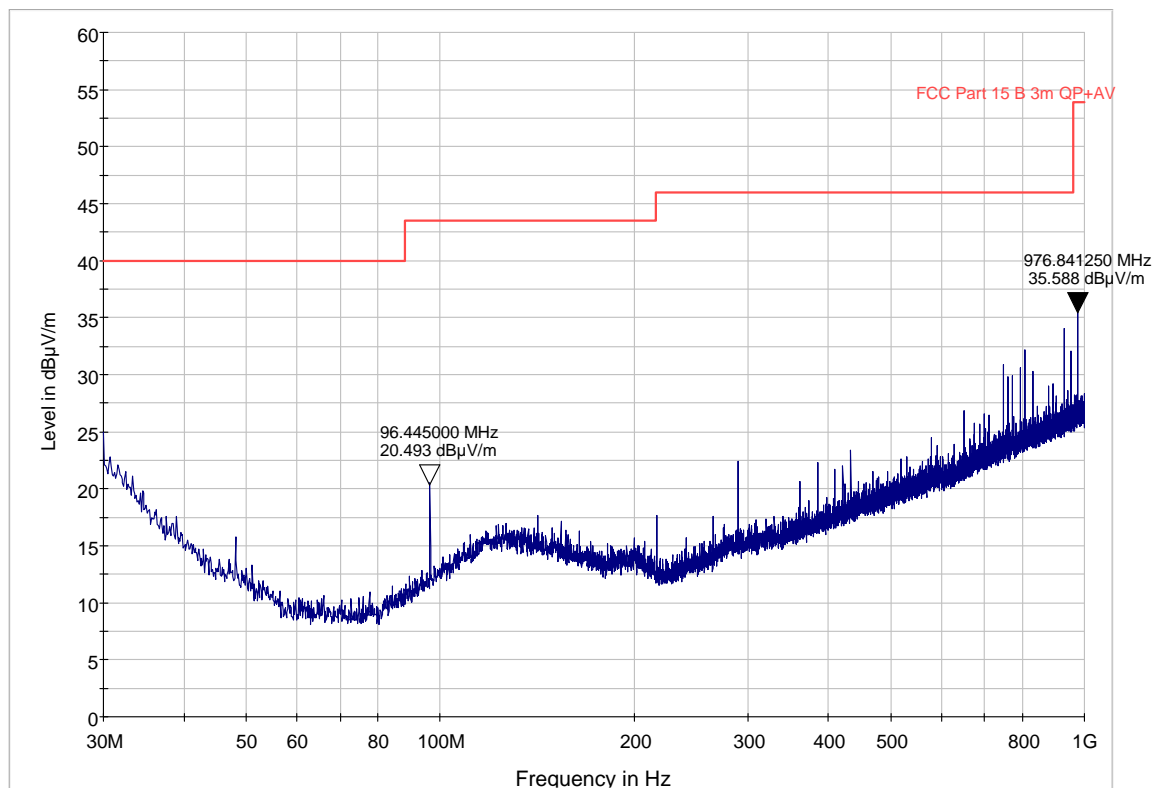
The measurement was performed radiated with the EUT in receive-only mode.

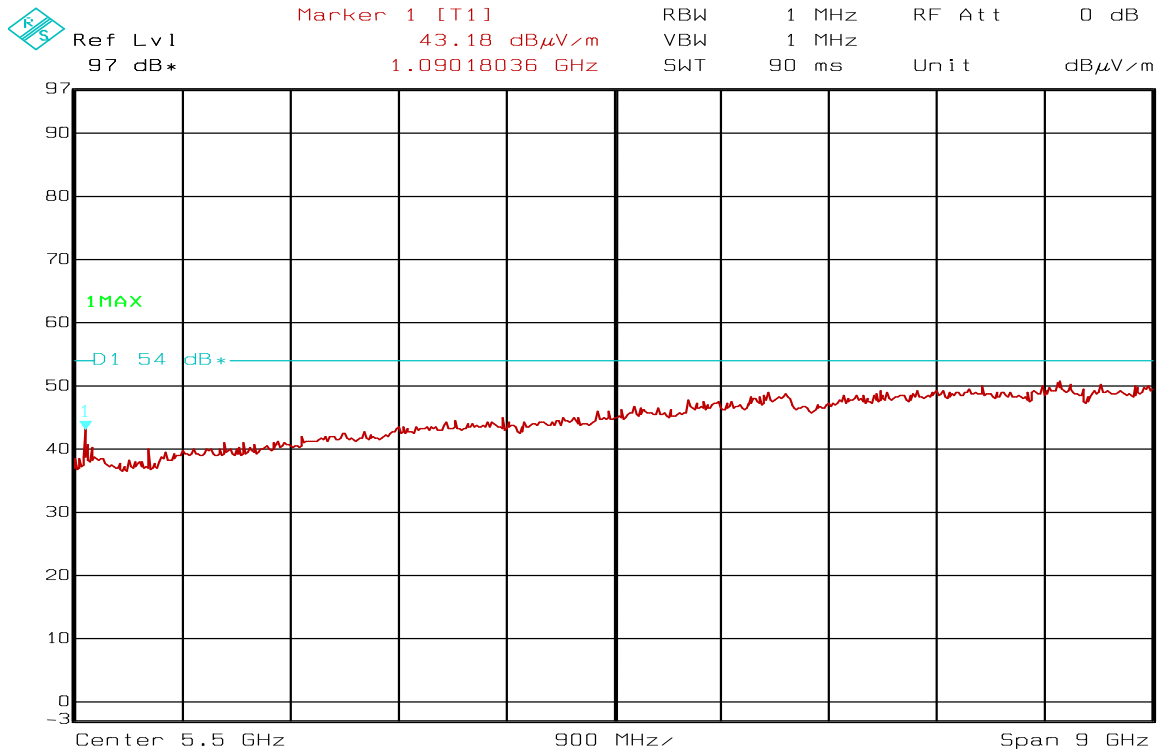
Requirements, RSS-GEN Issue 3, clause 6

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.

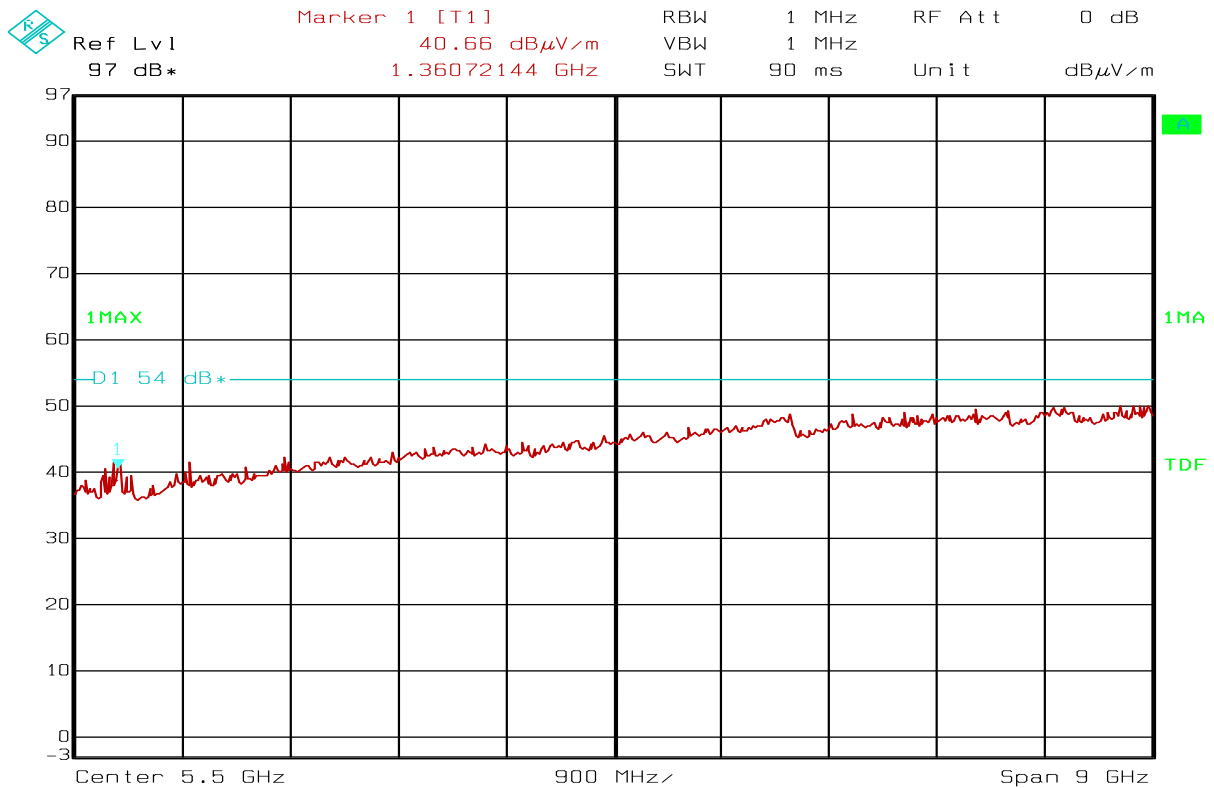
When measured Radiated: See Table 2 in RSS-GEN Issue 3, clause 6.





Date: 02.DEC.2011 14:24:11

Receiver Radiated Emissions, 1 - 10GHz , VP



Date: 02.DEC.2011 14:25:28

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: 02 Dec 2011 |
|------------------------------------|---------------------------|

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 @2440 MHz | -8.93 |

2440MHz - Middle Channel:

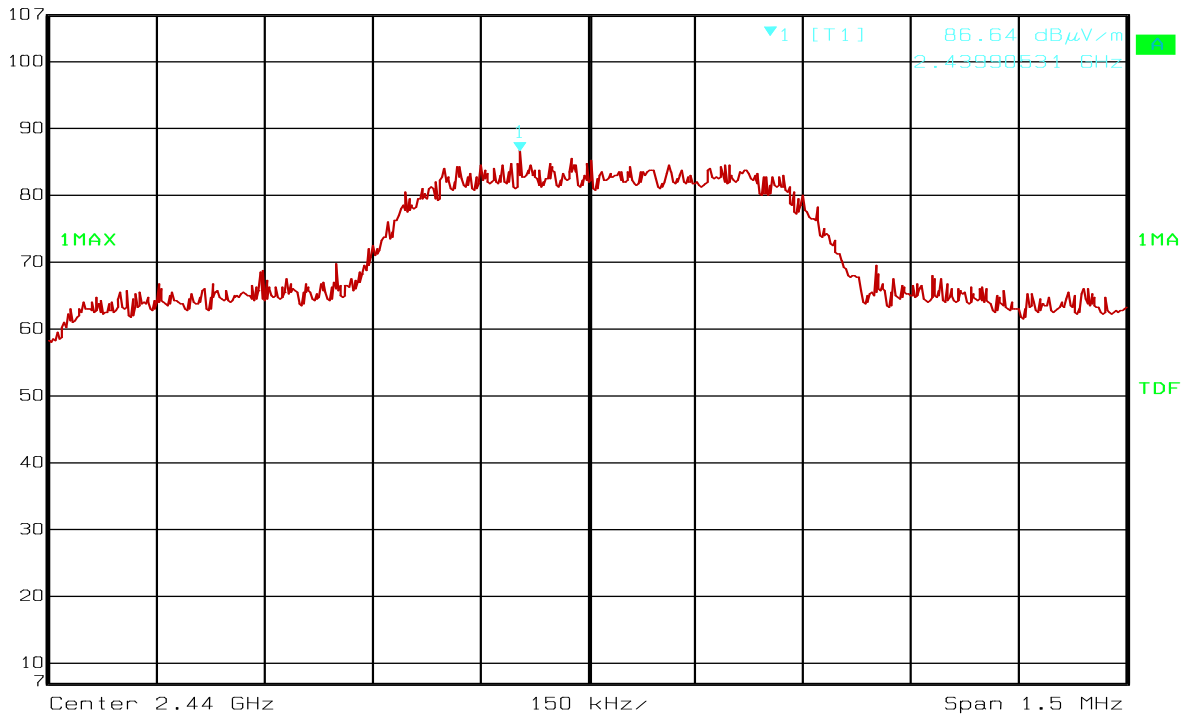
$$\text{PSD} = 35 - 43.93 \text{ dBm/Hz} = -8.93 \text{ dBm}$$

The spectrum line spacing is less than 3 kHz, therefore used noise power density and corrected 35 dB for 3 kHz

Requirements:

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

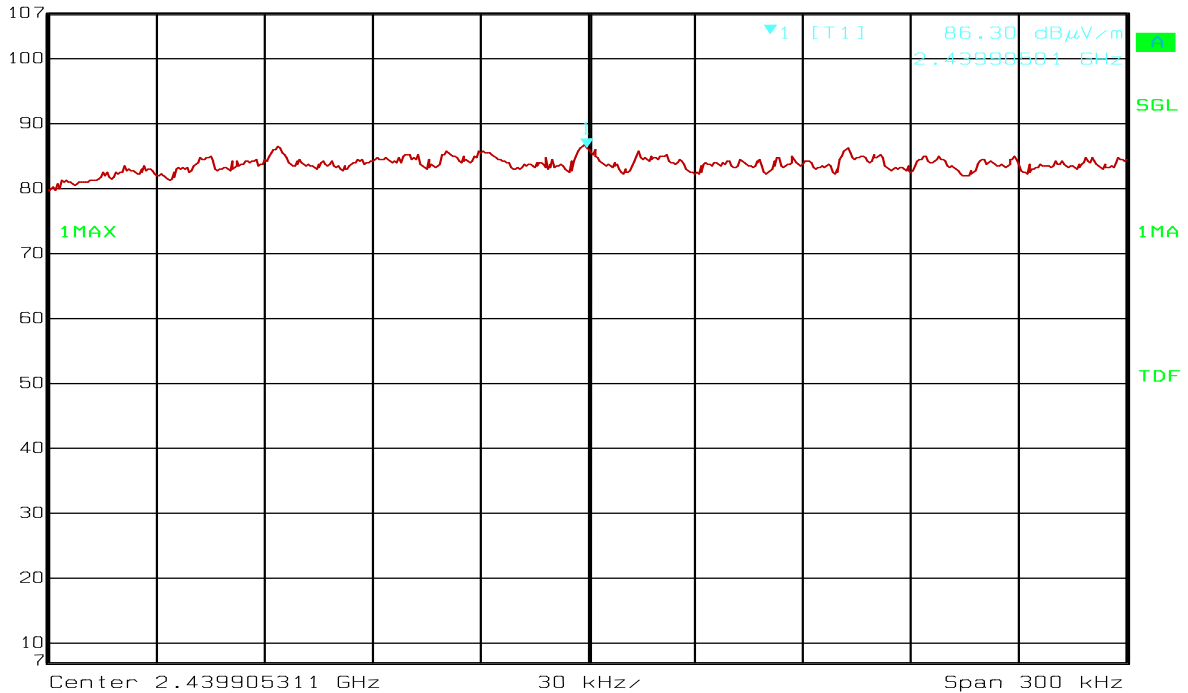
PS
Marker 1 [T1]
RBW 3 kHz
RF Att 10 dB
Ref Lvl 107 dB*
86.64 dB μ V/m
VBW 10 kHz
Unit dB μ V/m
2.43990531 GHz
SWT 420 ms



Date: 03.DEC.2011 23:18:47

PSD Overview

PS
Marker 1 [T1]
RBW 3 kHz
RF Att 10 dB
Ref Lvl 107 dB*
86.30 dB μ V/m
VBW 10 kHz
Unit dB μ V/m
2.43990501 GHz
SWT 100 s



Date: 03.DEC.2011 23:21:47

PSD Measurement

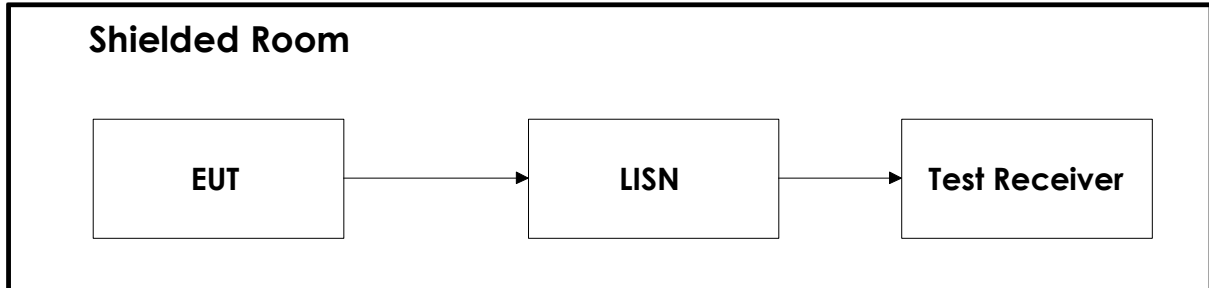
5 LIST OF TEST EQUIPMENT

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 | JB3 | Antenna Bilog | Sunol Sciences Inc. | N-4525 | 2011.09 | 2012.09 |
| 10 | 8449B | Pre-amplifier | Hewlett Packard | LR 1322 | 2011-09-27 | 2012-09-27 |
| 11 | LNA6900 | Pre-amplifier | Teseq | LR 1593 | 2011.11.24 | 2013.11.24 |
| 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 | SMP04 | Signal Generator | Rohde & Schwarz | LR 1336 | 2010.11.09 | 2012.11.09 |
| 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 Power Line Conducted Emission



6.2 Test Site Radiated Emission

