



**Test report no. : 182230-5**

**Item tested : CC2531Dongle**

**Type of equipment : 2.4GHz Transceiver**

**FCC ID : ZAT2531USB**

**Client : Texas Instruments Norway AS**

**FCC Part 15.247**

Digital Transmission System

**RSS-210, Issue 8**

Low Power Licence-Exempt  
Radiocommunication Devices

**2013-04-09**



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

G. Suhantakumar  
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  
E-mail: [comlab@nemko.com](mailto:comlab@nemko.com)  
FCC test firm : 994405  
IC OATS : 2040D-1  
Total Number of Pages: 33

### 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 : Fredrik Kervel  
Telephone : +47 22 95 8362  
E-mail : [f.kervel@ti.com](mailto:f.kervel@ti.com)

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

Name : /  
Address : /

## 2 Test Information

### 2.1 Test Item

Name :	Texas Instruments
FCC ID :	ZAT2531USB
Model/version :	CC2531Dongle
Serial number :	/
Hardware identity and/or version:	/
Software identity and/or version :	/
Frequency Range :	2425 – 2475 MHz
Number of Channels :	3
Type of Modulation :	Digital (QPSK)
User Frequency Adjustment :	None
Type of Power Supply :	Powered from USB
Antenna Connector :	None (PCB Antenna)
Antenna Diversity Supported :	No
Desktop Charger :	None

#### Description of Test Item

The tested EUT is a 2.4GHz transceiver on a USB Dongle.

#### 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:	42 - 52 %
Normal test voltage:	4.5 V DC

The radiated emissions tests were performed with the EUT powered from a test-jig with 3xAA primary batteries.

The values are the limit registered during the test period.

## **2.3 Test Period**

Item received date:	2011-08-15
Test period :	from 2011-08-12 to 2011-08-22

### 3 TEST REPORT SUMMARY

#### 3.1 General

Manufacturer: Texas Instruments

Model No.: CC2531 Dongle

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 C63.4-2009 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 #: 182230-5**

TESTED BY:



Frode Sveinsen, Test engineer

DATE: 2011-09-15

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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)	Pass
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

### 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 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: Thomas Dangle

Date of Test: 19 Aug 2011

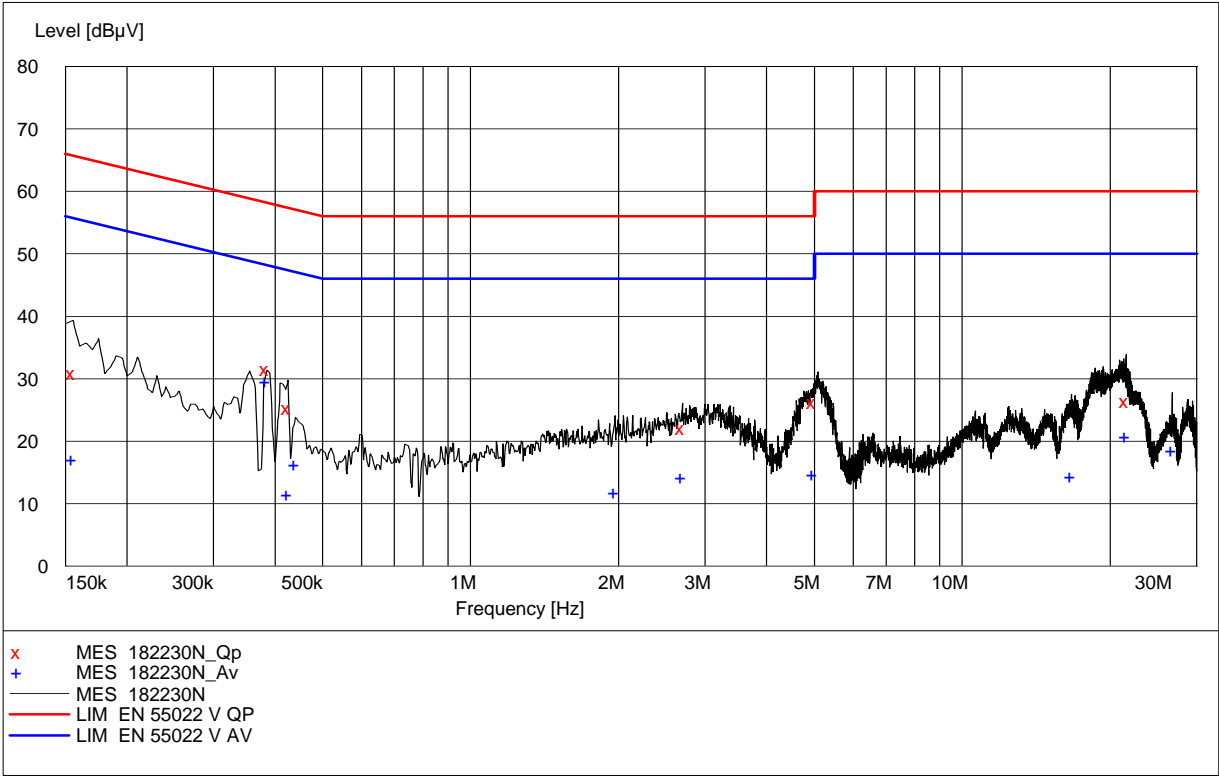
Measurement procedure: ANSI C63.4-2003 using 50  $\mu$ H/50 ohms LISN.

Test Results: Complies.

Measurement Data: See attached graph, (Peak detector).

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.155000	31.00	10.10	65.70	-34.70	QP	L1	Pass
0.385000	31.50	10.20	58.20	-26.70	QP	L1	Pass
0.425000	25.30	10.20	57.30	-32.00	QP	L1	Pass
2.695000	22.20	10.30	56.00	-33.80	QP	N	Pass
4.995000	26.30	10.40	56.00	-29.70	QP	L1	Pass
21.575000	26.50	11.30	60.00	-33.50	QP	L1	Pass
0.155000	17.10	10.10	55.70	-38.60	AV	L1	Pass
0.385000	29.70	10.20	48.20	-18.50	AV	L1	Pass
0.425000	11.60	10.20	47.30	-35.70	AV	L1	Pass
0.440000	16.30	10.20	47.10	-30.80	AV	L1	Pass
1.965000	11.90	10.20	46.00	-34.10	AV	N	Pass
2.695000	14.20	10.30	46.00	-31.80	AV	N	Pass
4.995000	14.80	10.40	46.00	-31.20	AV	L1	Pass
16.680000	14.50	10.90	50.00	-35.50	AV	N	Pass
21.575000	20.80	11.30	50.00	-29.20	AV	L1	Pass
26.755000	18.60	11.40	50.00	-31.40	AV	L1	Pass





## 4.2 Minimum 6 dB Bandwidth

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

Test Performed By: Frode Sveinsen

Date of Test: 17 Aug 2011

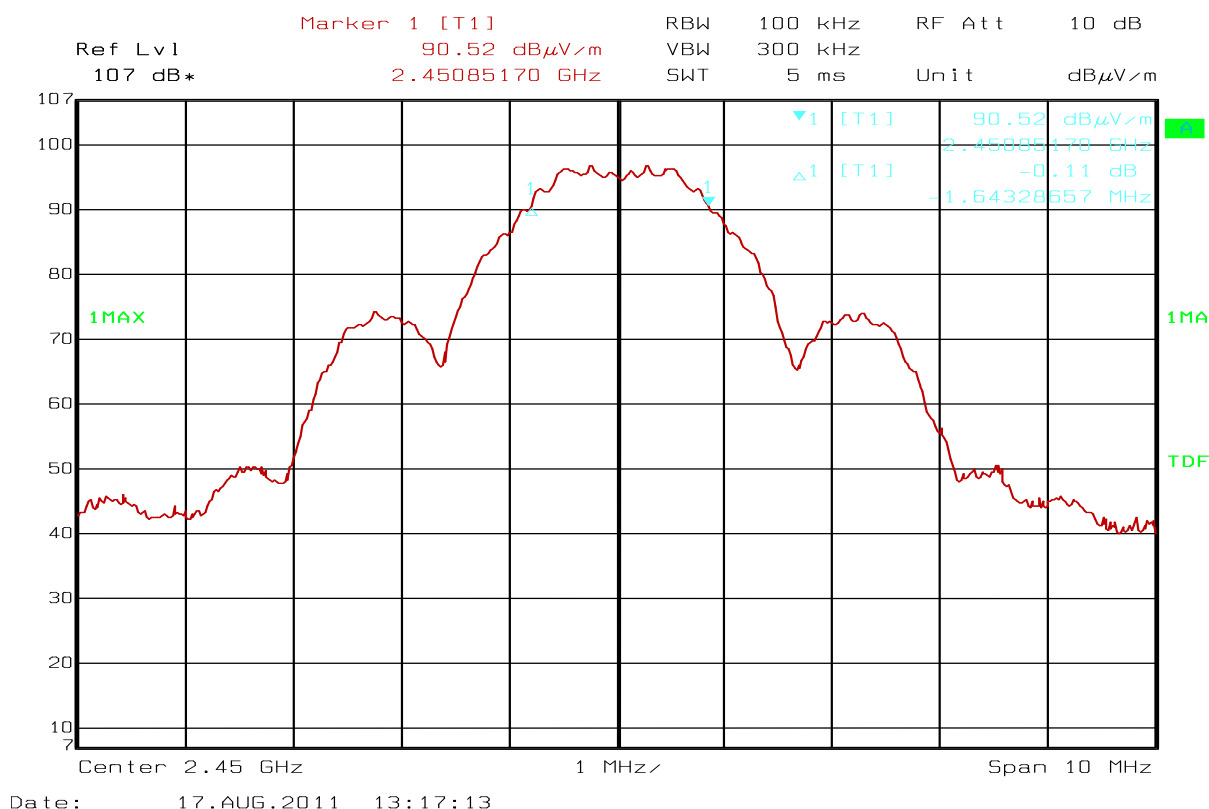
Test Results: Complies

Measurement Data:

Measured 6 dB Bandwidth (MHz)		
/	2440 MHz	/
/	1.64	/

### Requirements:

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



6 dB Bandwidth at 2440 MHz

### 4.3 20 dB Bandwidth

Test Performed By: Frode Sveinsen

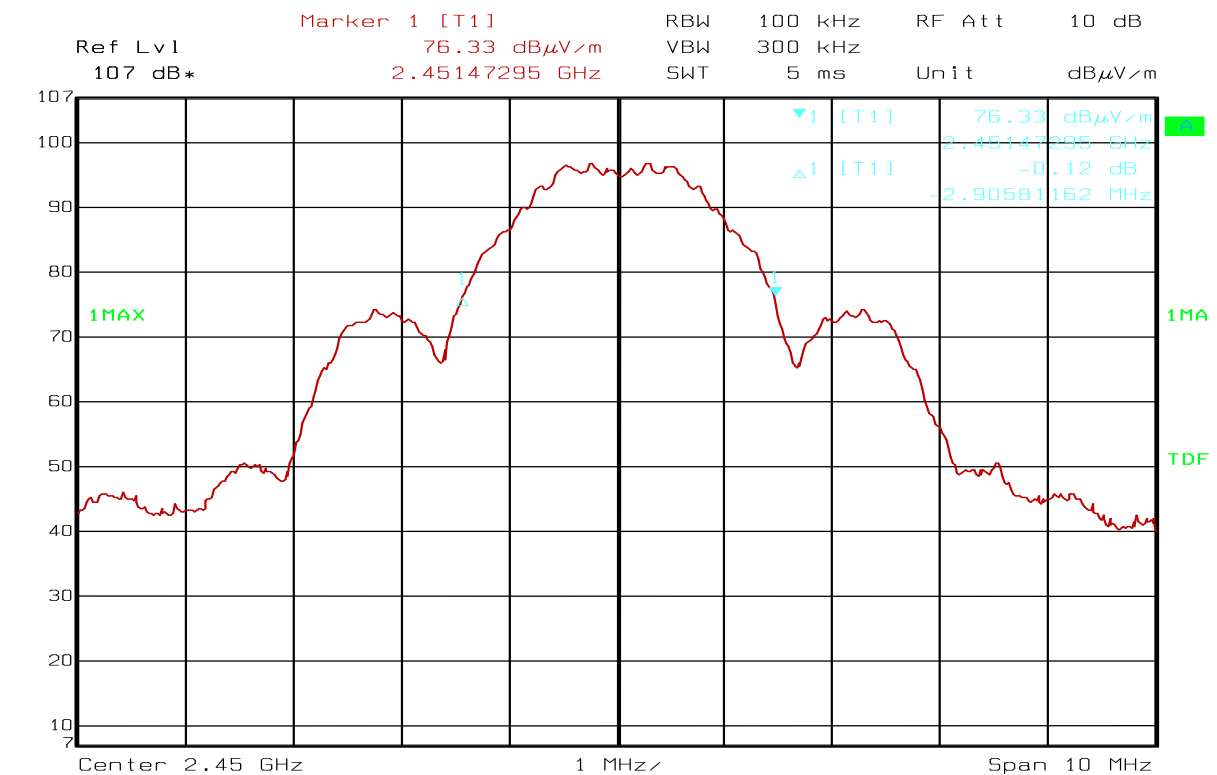
Date of Test: 17 Aug 2011

#### Measurement Data:

Measured 20 dB Bandwidth (MHz)
2450 MHz
2.45

#### Requirements:

No requirements. Reported for information only.



Date: 17.AUG.2011 13:18:15

**20 dB Bandwidth at 2450 MHz**

#### 4.4 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: Frode Sveinsen

Date of Test: 18 Aug 2011

Test Results: Complies

##### Measurement Data:

RF channel	2425 MHz	2450 MHz	2475 MHz
Measured EIRP (dBμV/m)	99.2	100.9	101.7
Output Power (dBm)	4.0	5.7	6.5
Output Power (W)	0.0025	0.0037	0.0044

The Output 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

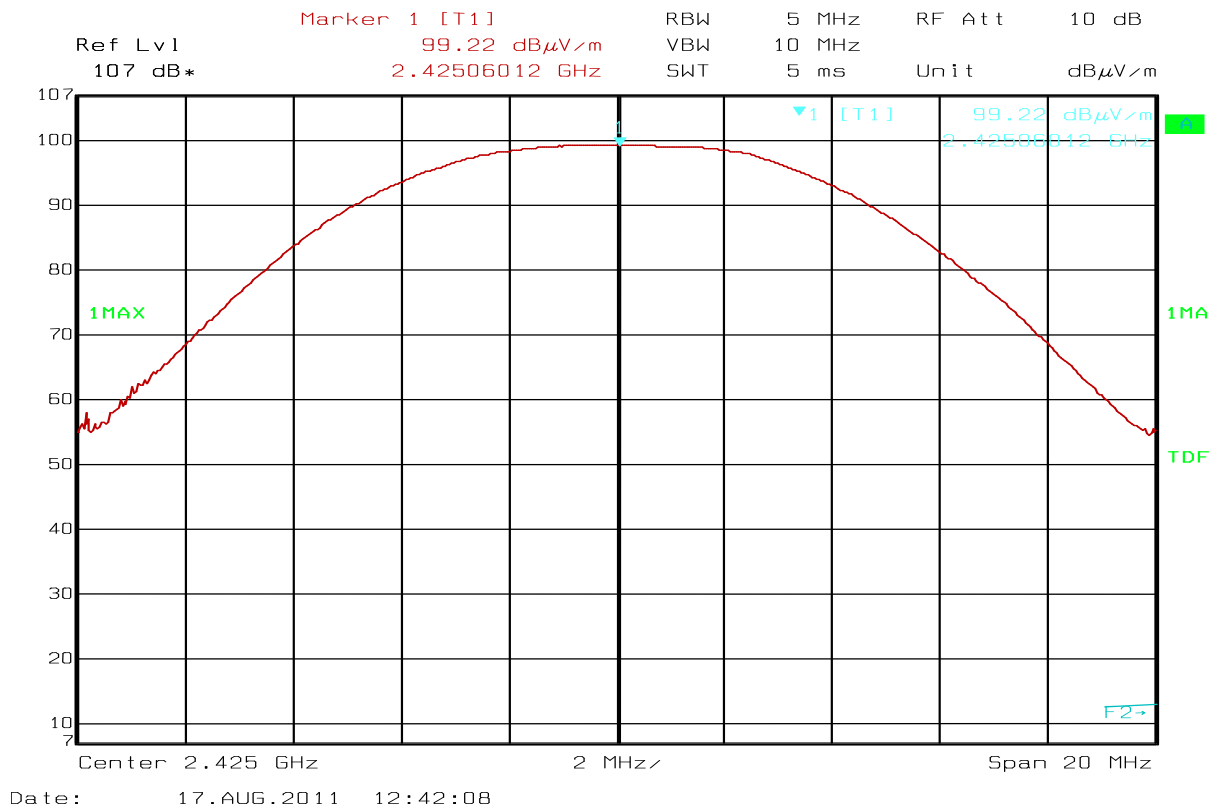
Type of antenna connector: None (PCB antenna).

##### Requirements:

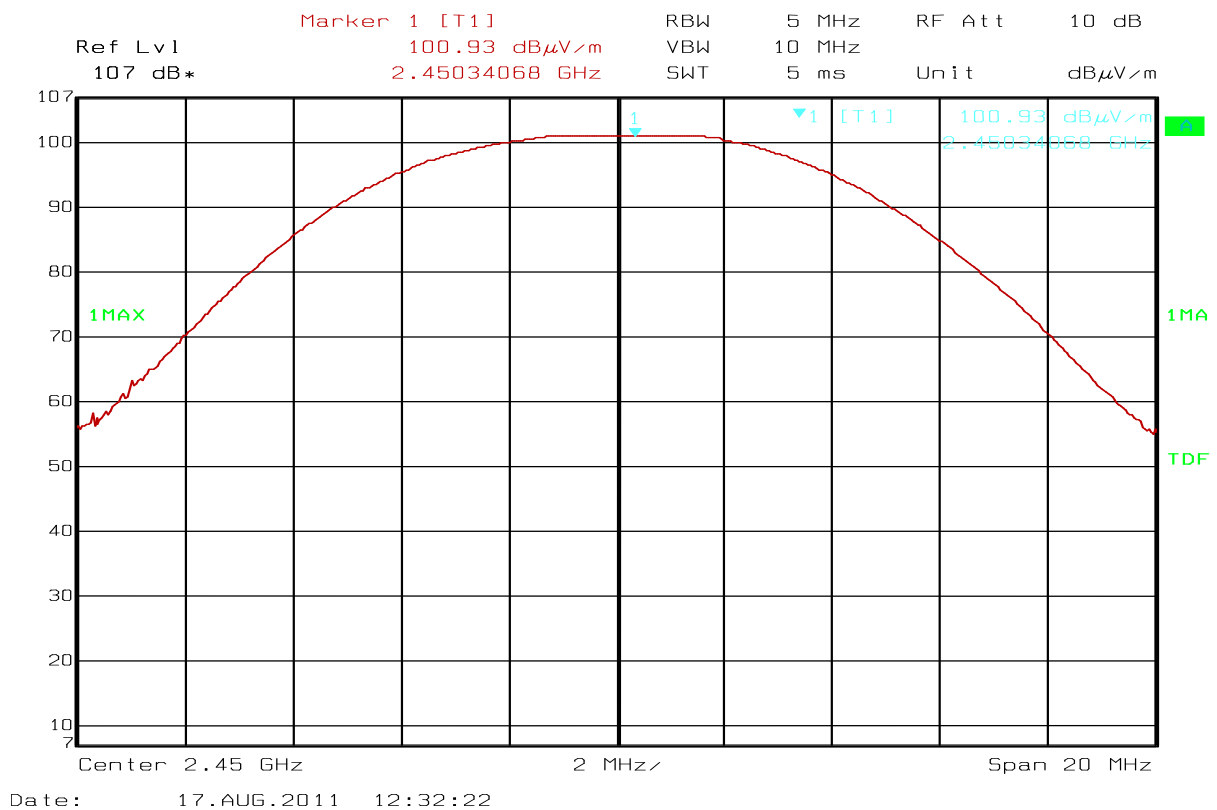
The maximum peak output power shall not exceed the following limits:

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

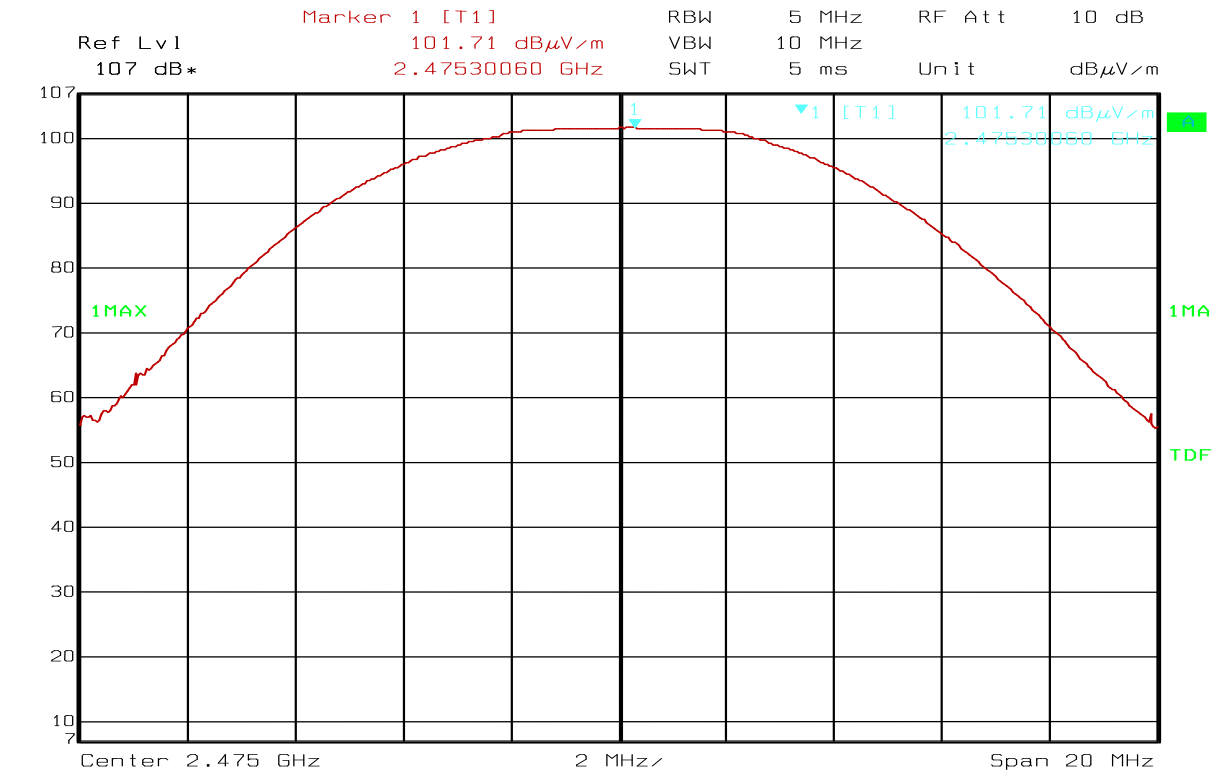
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



### Output Power, 2425 MHz



### Output Power, 2450 MHz



Date: 17.AUG.2011 12:35:13

**Output Power, 2475 MHz**

## 4.5 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: Frode Sveinsen

Date of Test: 17 Aug 2011

Test Results: Complies

Measurement Data:

Band-edge, @3m

Frequency	Measured Field Strength @3m, dB $\mu$ V/m	Detector	Limit dB $\mu$ V/m	Margin dB
2.39 GHz	34.7	AV	54	19.3
	43.3	PK	74	> 20
2.4835 GHz	40.9	AV	54	13.1
	49.4	PK	74	> 20

See attached plots.

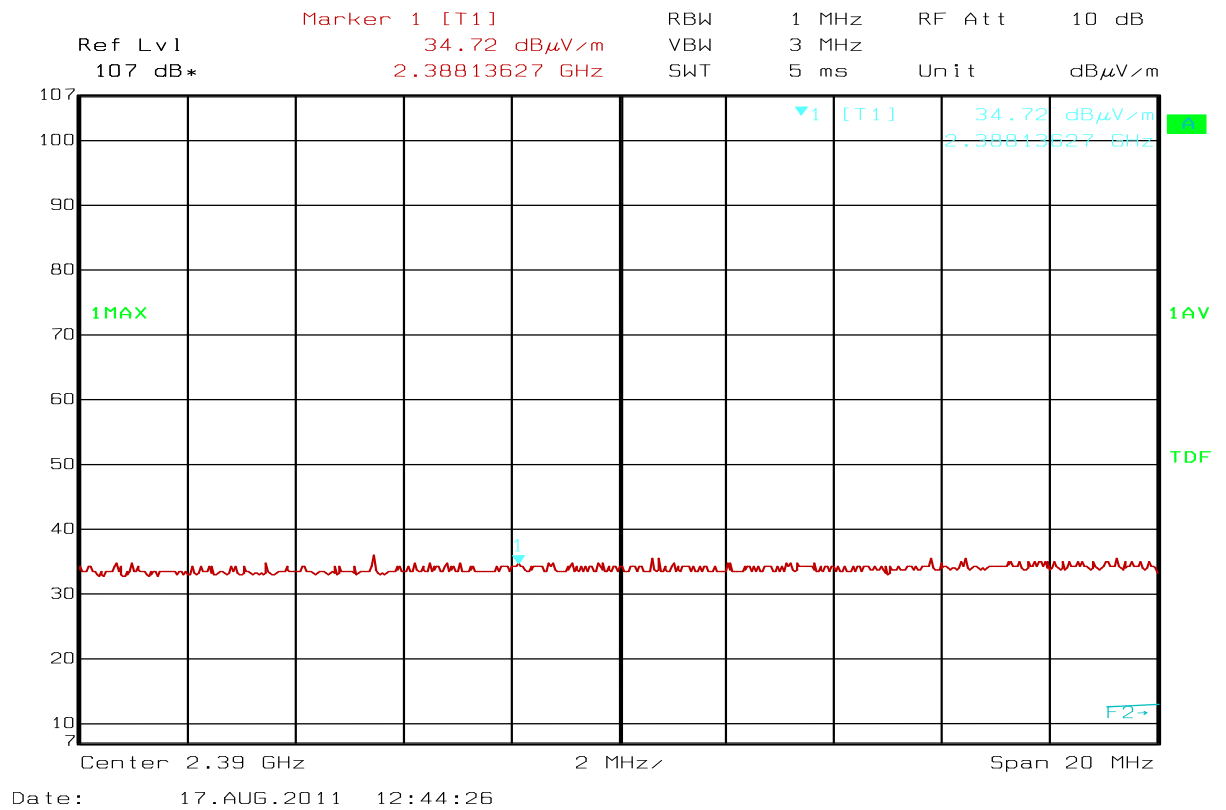
### RF conducted power

Scan performed radiated with 100 kHz Bandwidth from 1 to 12 GHz.

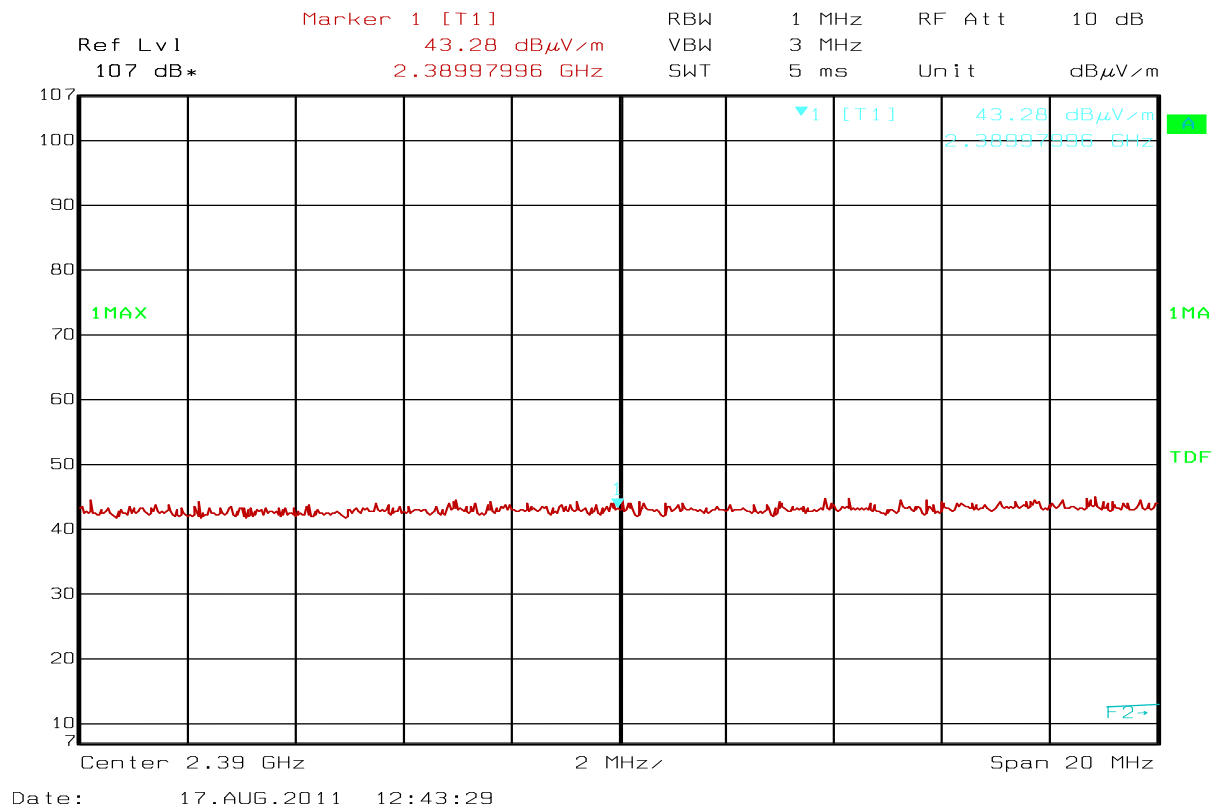
Scans at other frequencies were performed radiated with 1 MHz BW.

All emissions are more than 20dB below carrier.

See plots.

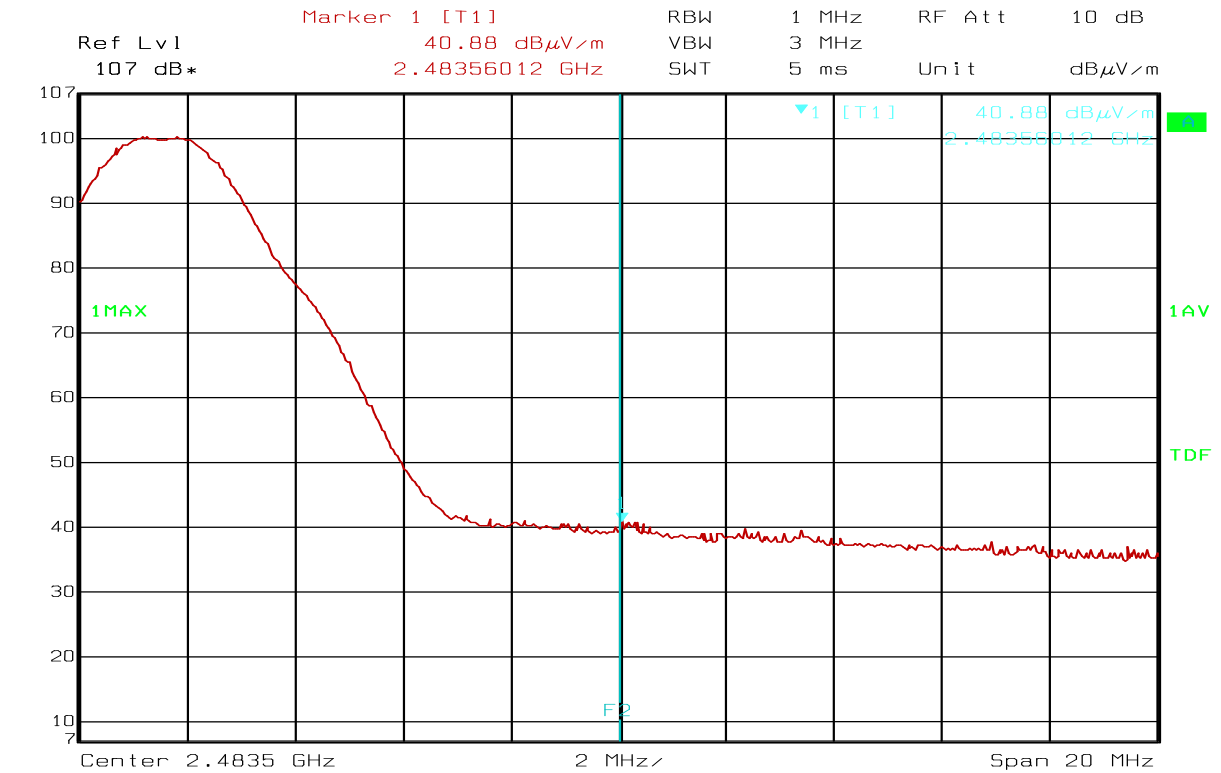


Band Edge, 2390 MHz, Average Detector



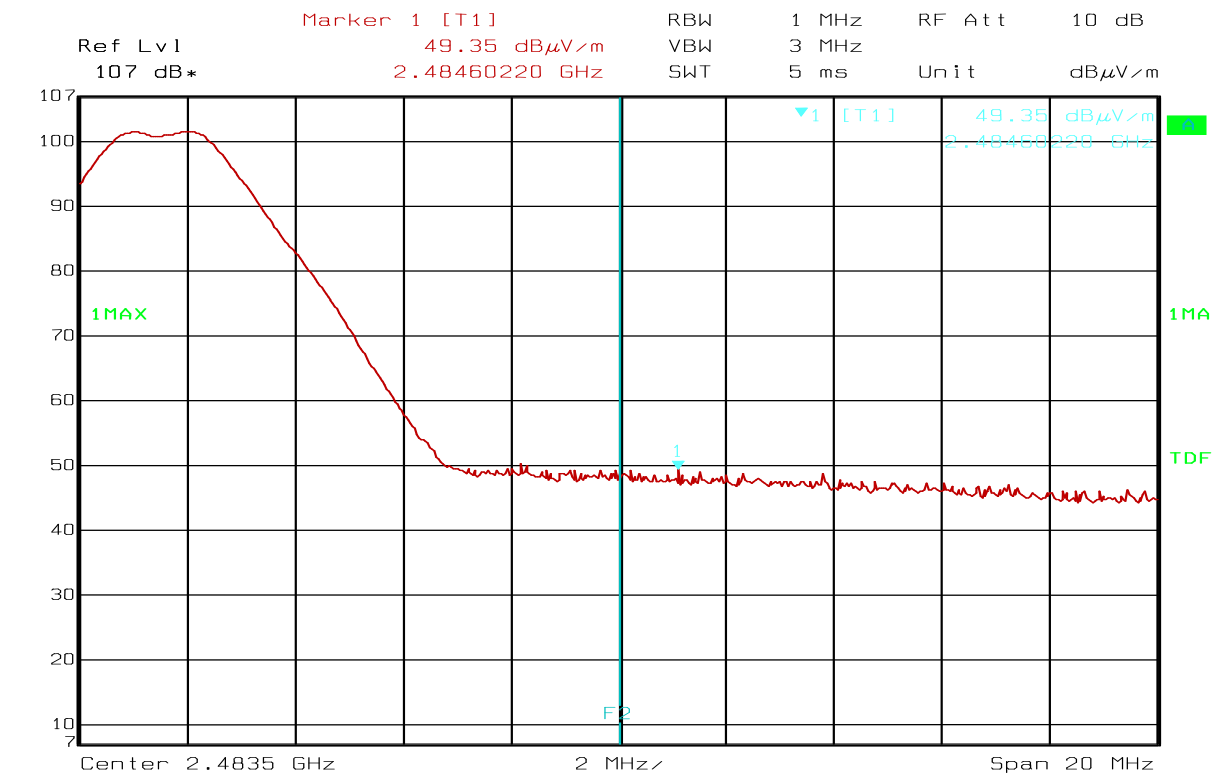
Band Edge, 2390 MHz, Peak Detector





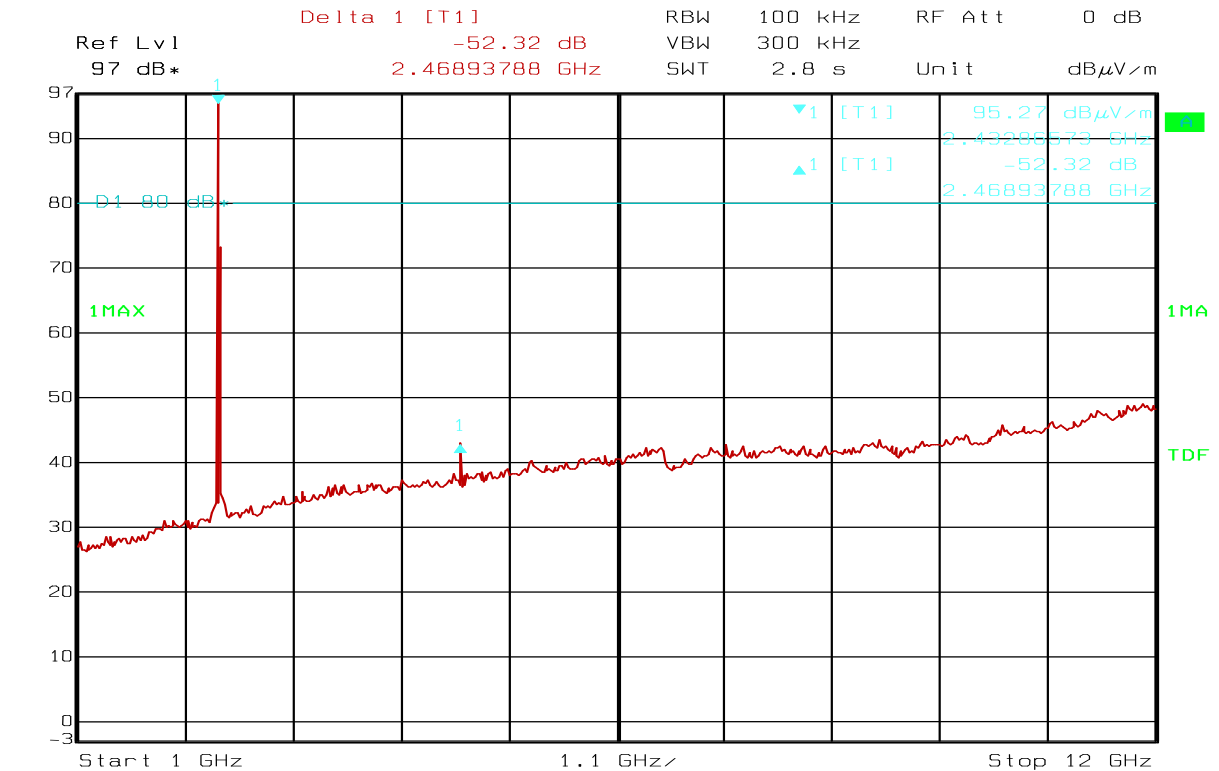
Date: 17.AUG.2011 12:38:53

### Band Edge, 2483.5 MHz, Average Detector



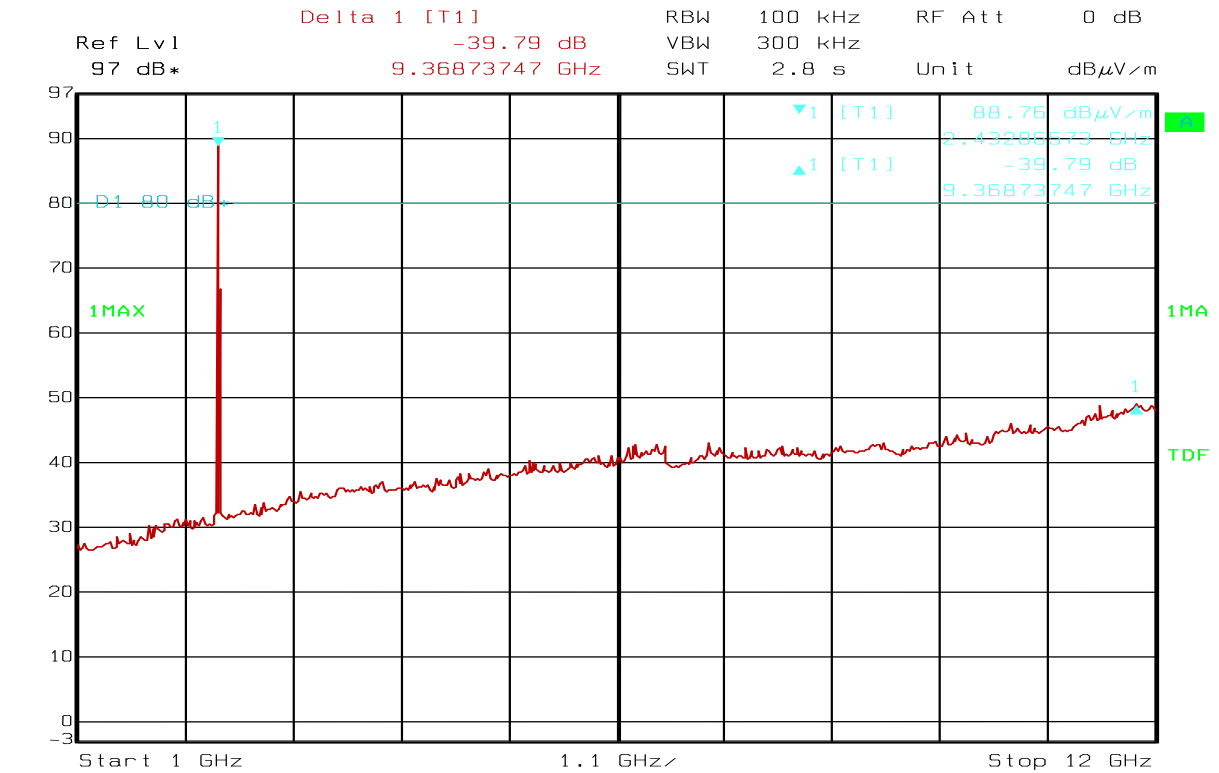
Date: 17.AUG.2011 12:37:14

### Band Edge, 2483.5 MHz, Peak Detector



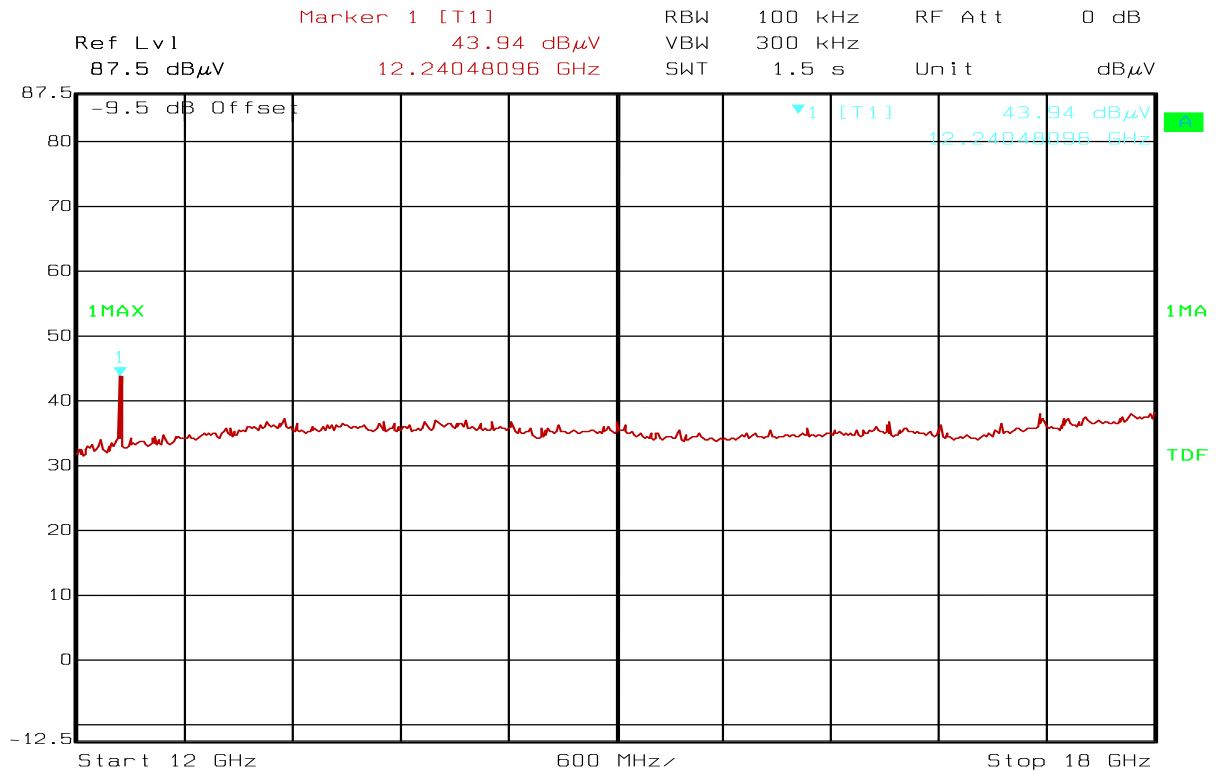
Date: 17.AUG.2011 13:27:48

### Radiated Emissions 100kHz, VP, 1 – 12 GHz



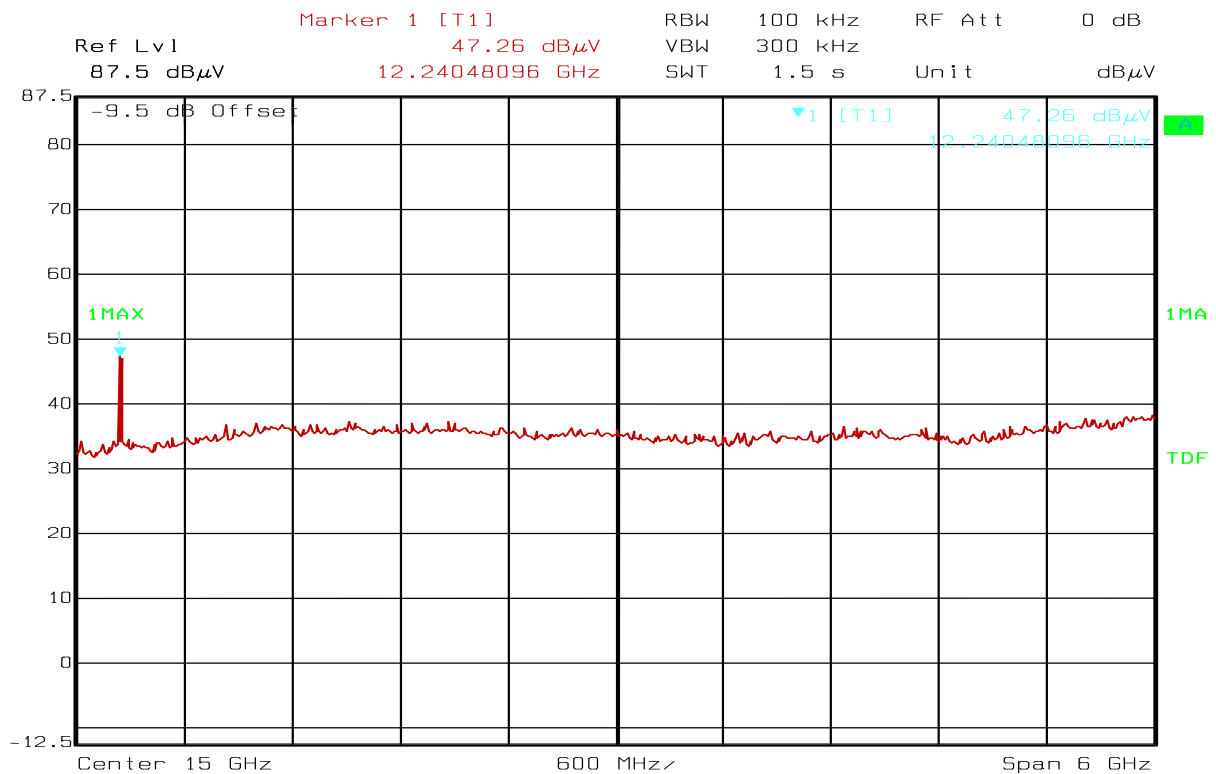
Date: 17.AUG.2011 13:30:03

### Radiated Emissions 100kHz, HP, 1 – 12 GHz



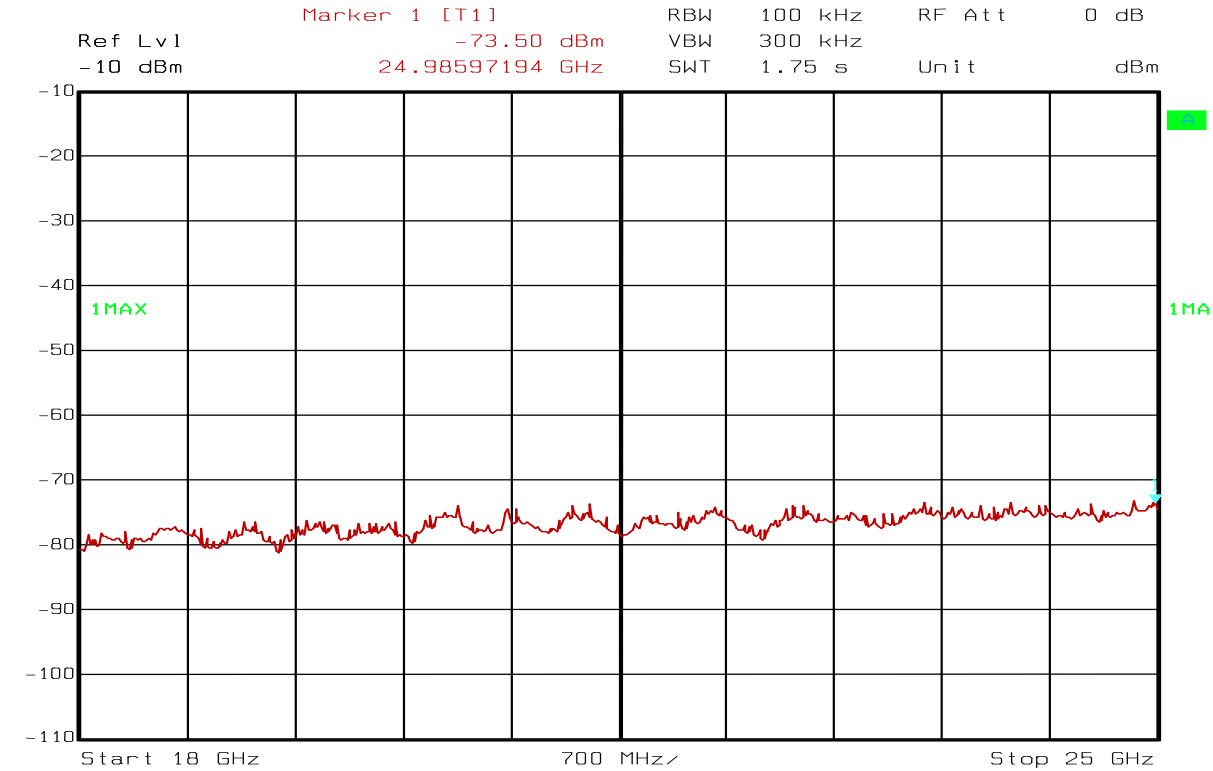
Date: 18.AUG.2011 15:20:42

### Radiated Emissions 100kHz, VP, 12 – 18 GHz



Date: 18.AUG.2011 15:22:34

### Radiated Emissions 100kHz, HP, 12 – 18 GHz



Date: 23.AUG.2011 09:20:18

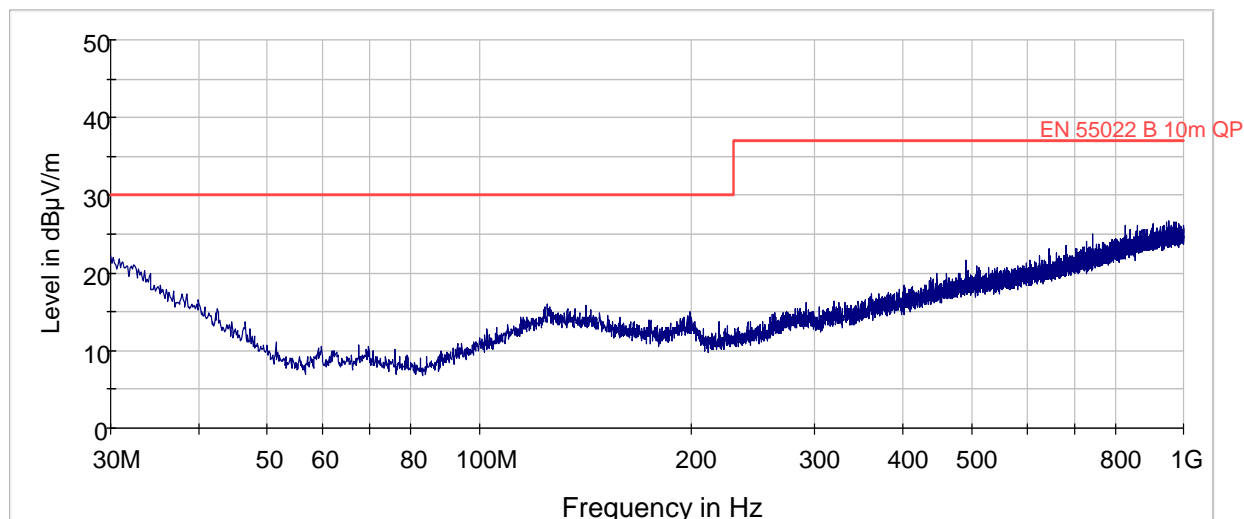
**Pre-scan 100kHz, 18 – 25 GHz**

### Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 10 m according to CISPR 22.

See attached plot.



Radiated Emissions, 30 – 1000 MHz, VP and HP, @10m

**Radiated Emissions, 1-25 GHz**

1-12 GHz measured at a distance of 3m, 12 - 25 GHz measured at 1m.

Frequency MHz	Measured Field strength @3m dB $\mu$ V/m	Duty Cycle Correction dB	Detector	Limit dB $\mu$ V/m	Margin dB
4900	51.6	/	Pk	74	22.4
4900	51.6	20	Av	54	22.4
12250	55.1	/	Pk	74	18.9
12250	55.1	20	Av	54	18.9

Distance Correction factor of 9.5 dB for measurements at 1m is included in above values

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

See attached plots.

**Duty Cycle Calculation:**

RF duty cycle: Calculation according to RF burst Para 15.35 (c)

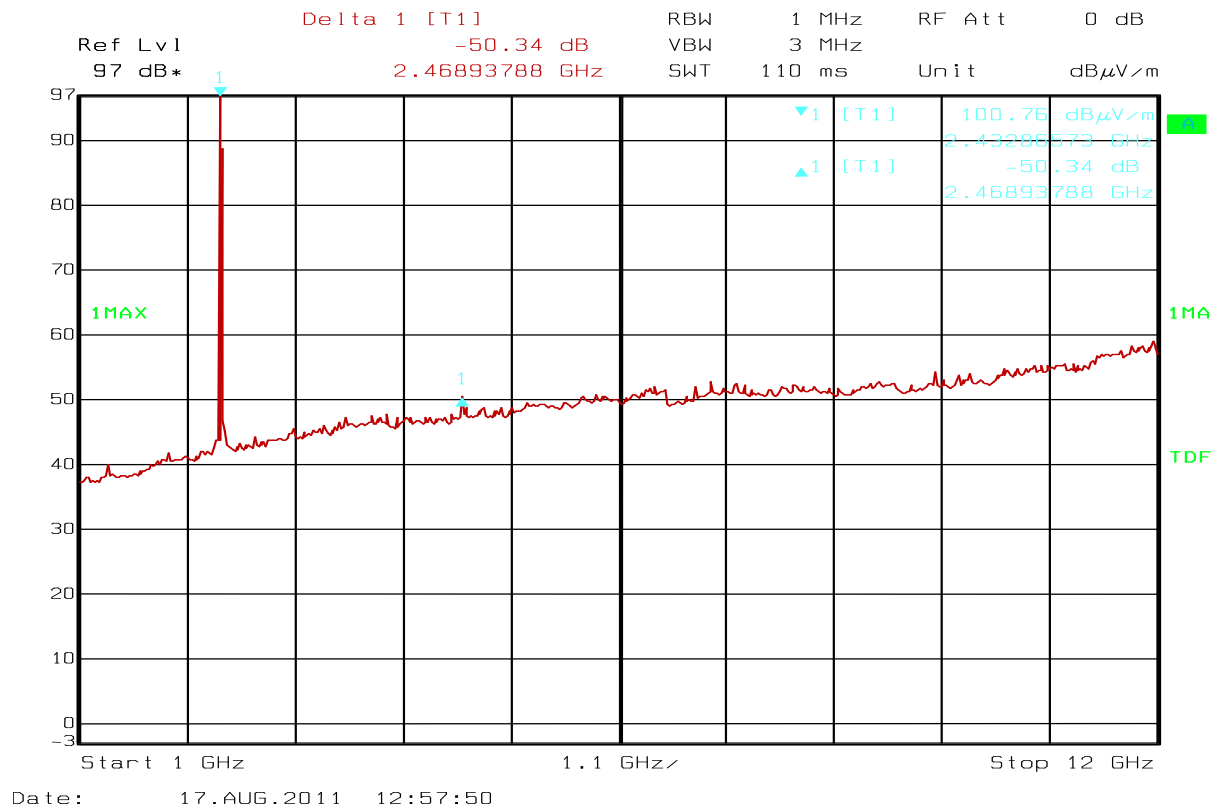
Max Transmit time per 100 ms: 9 ms

Duty Cycle Correction Factor =  $-20 \times \log(0.09) = 20.9$  dB

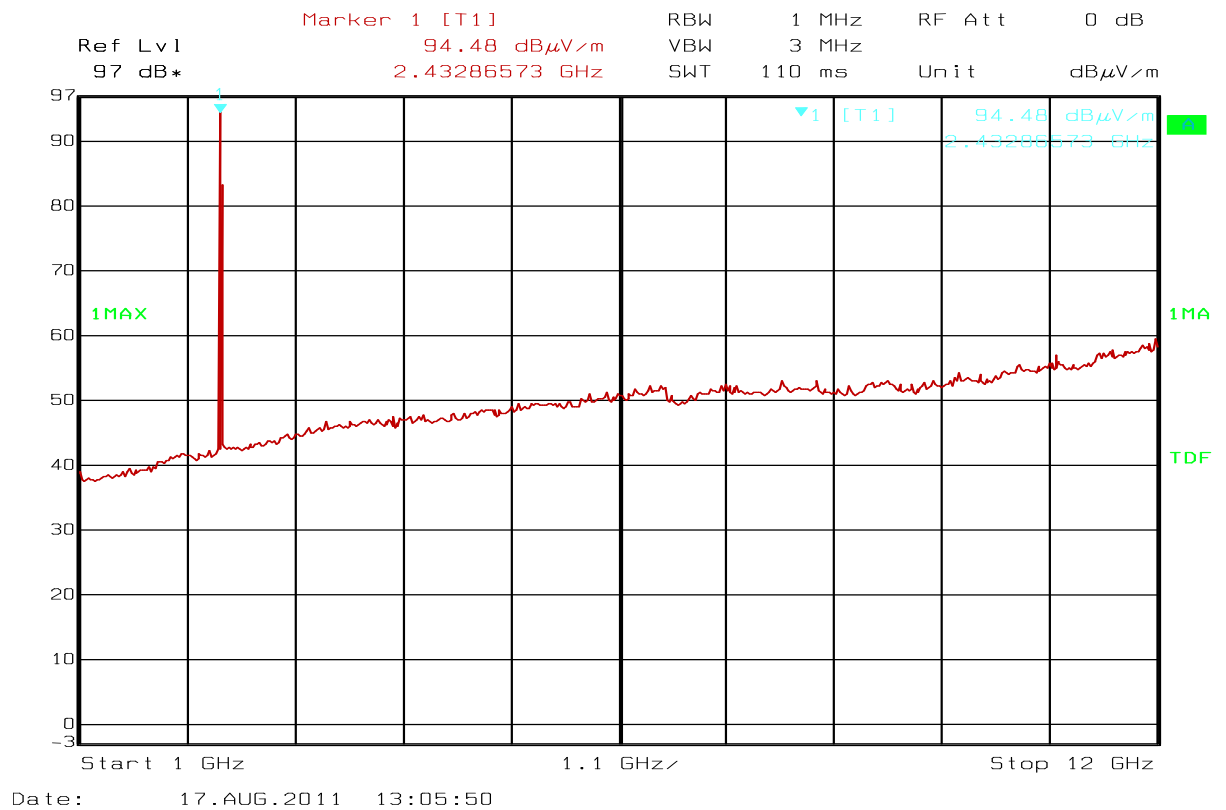
Maximum duty cycle according to Para 15.35 (b): 20 dB

This value is used when calculating average field strength above 1 GHz from measurement performed with continuous transmit.

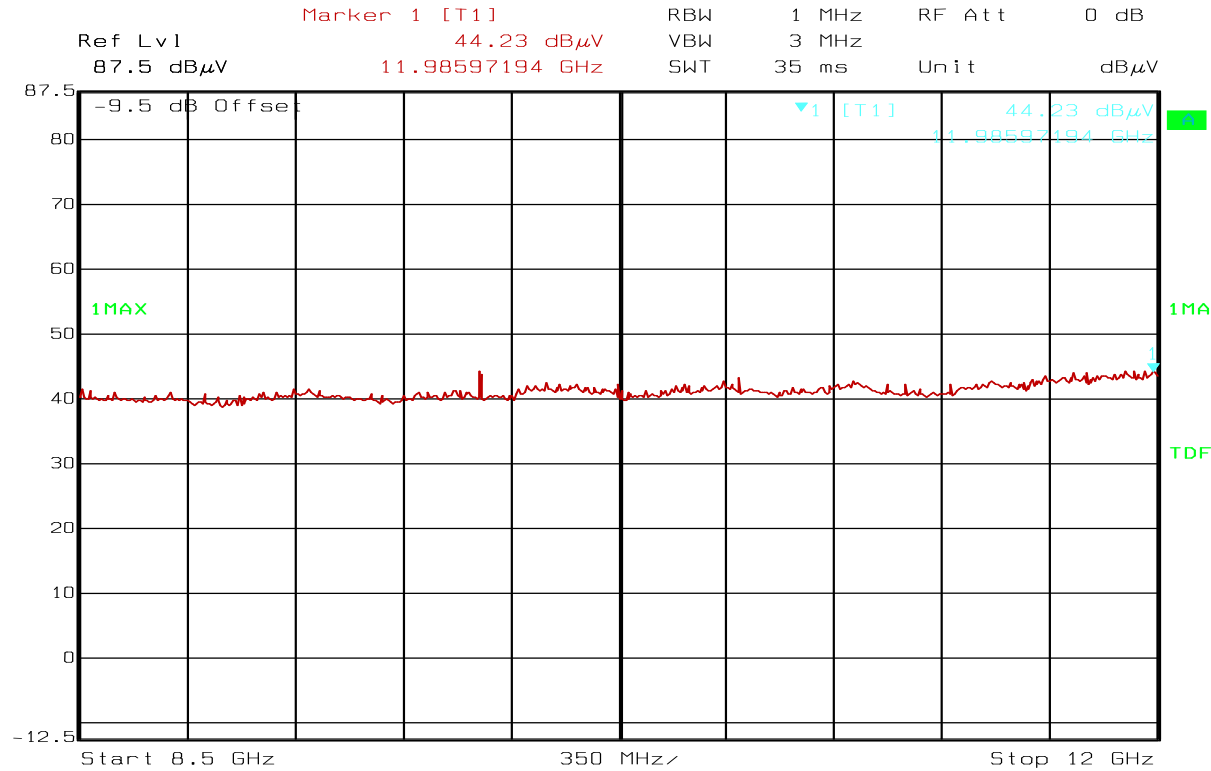
Maximum transmit time per 100 ms is a value provided by the manufacturer. The test samples only have continuous transmit mode.



Radiated Emissions, 1 – 12 GHz, VP

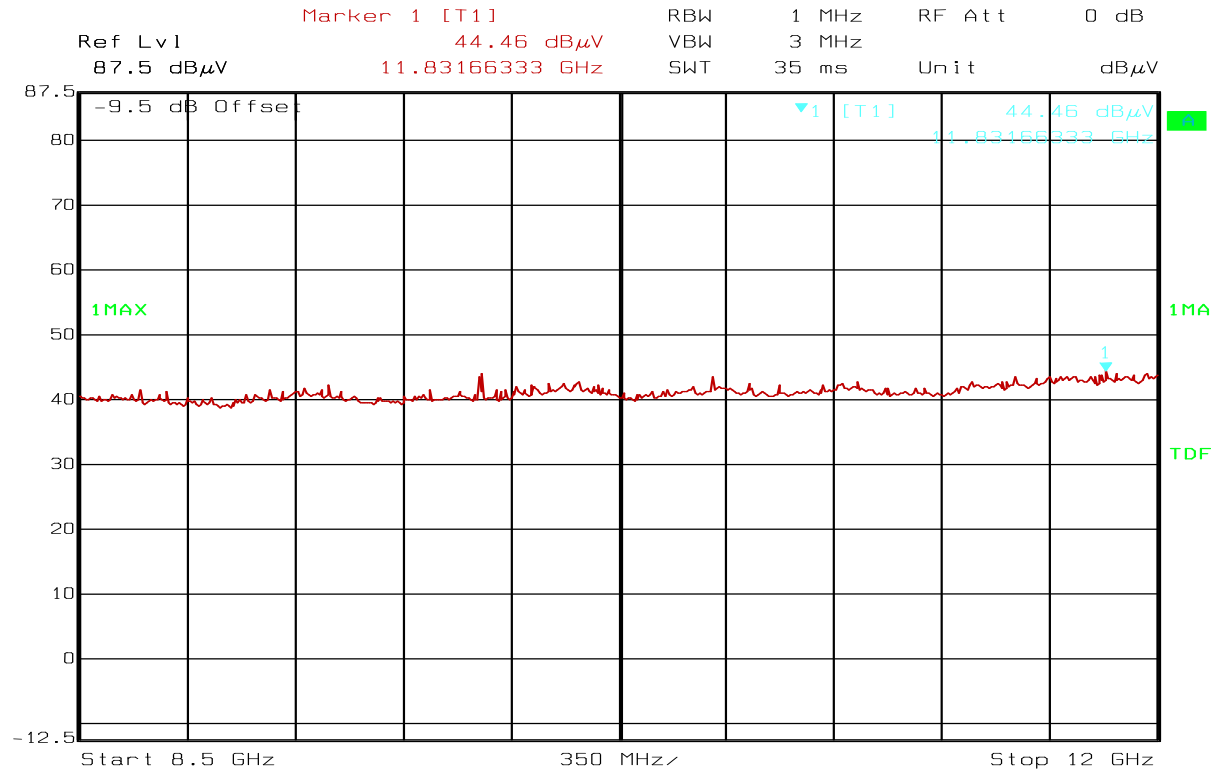


Radiated Emissions, 1 – 12 GHz, HP



Date: 18.AUG.2011 12:55:35

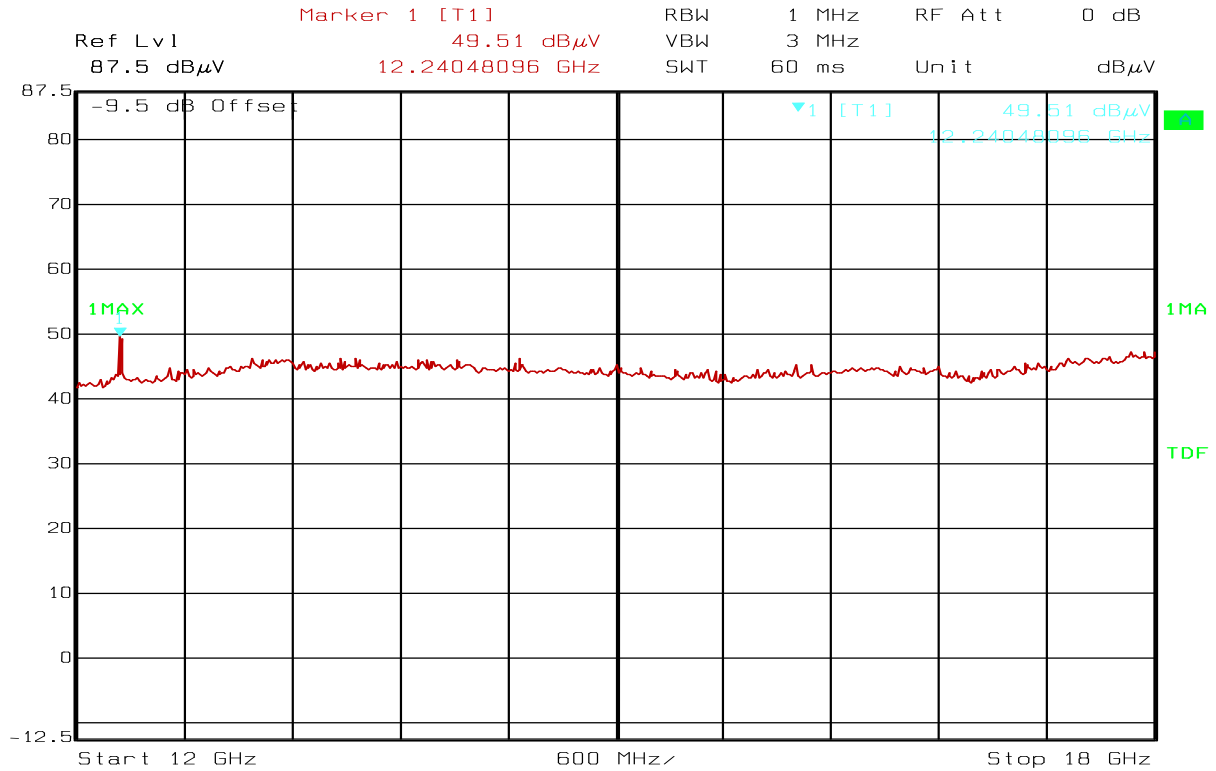
### Radiated Emissions, 8.5 – 12 GHz, VP



Date: 18.AUG.2011 12:57:29

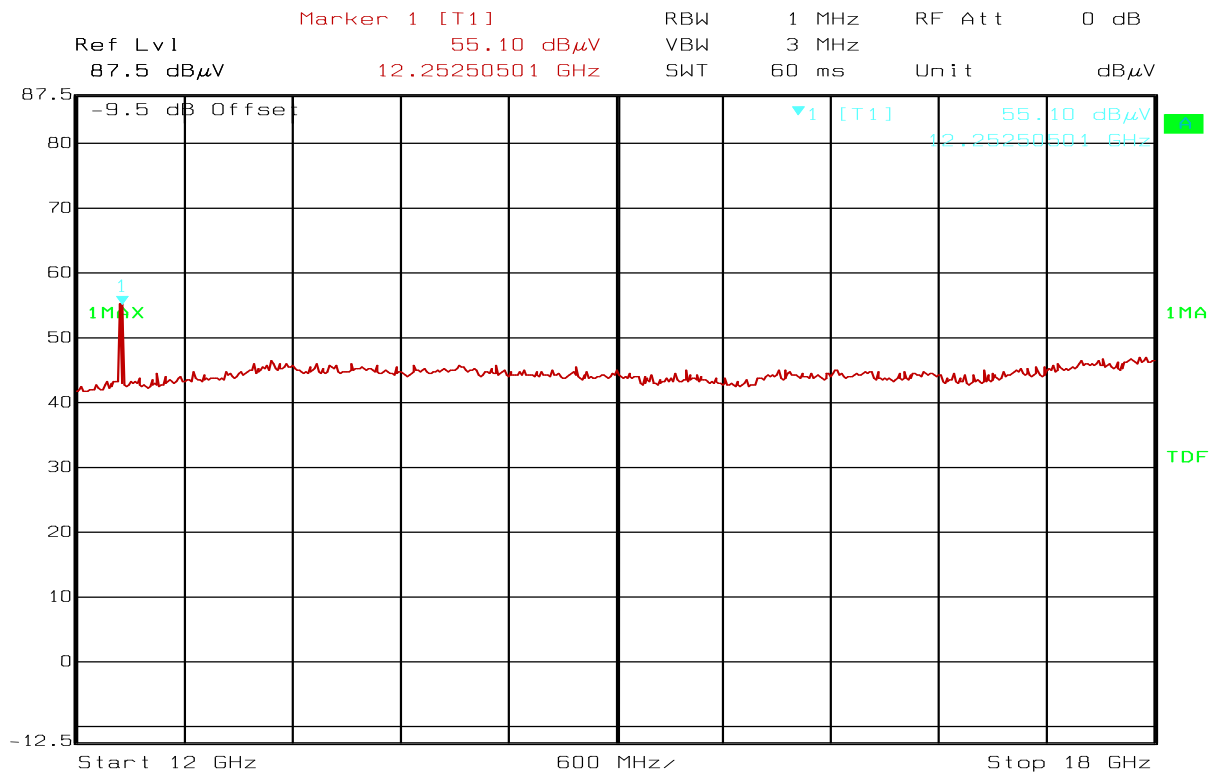
### Radiated Emissions, 8.5 – 12 GHz, HP





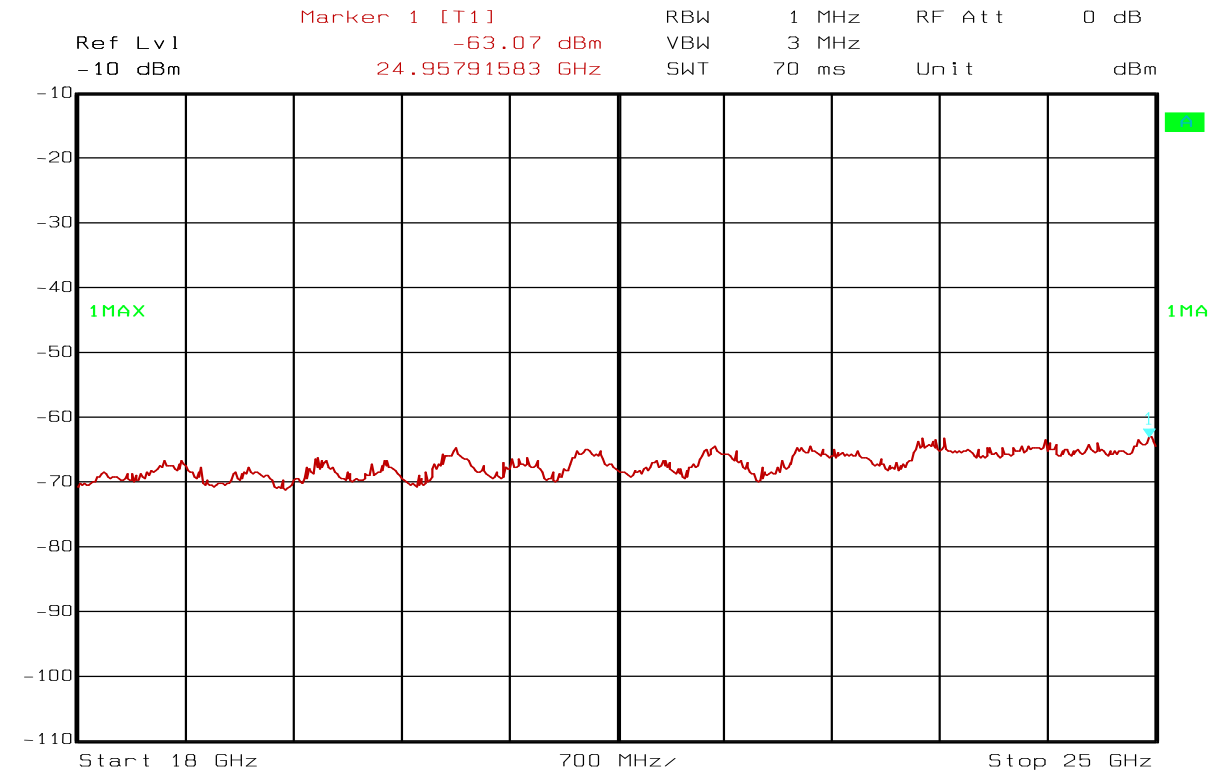
Date: 18.AUG.2011 13:00:29

### Radiated Emissions, 12 – 18 GHz, VP



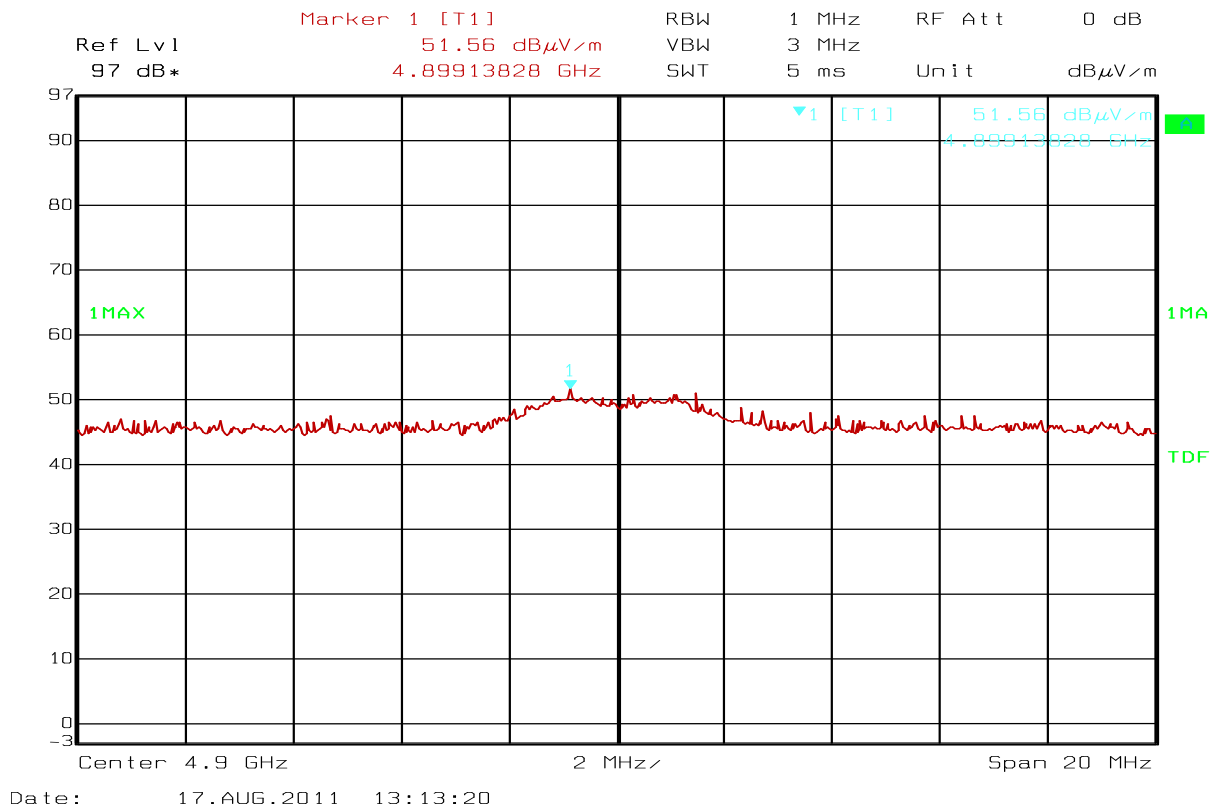
Date: 18.AUG.2011 13:02:22

### Radiated Emissions, 12 – 18 GHz, HP

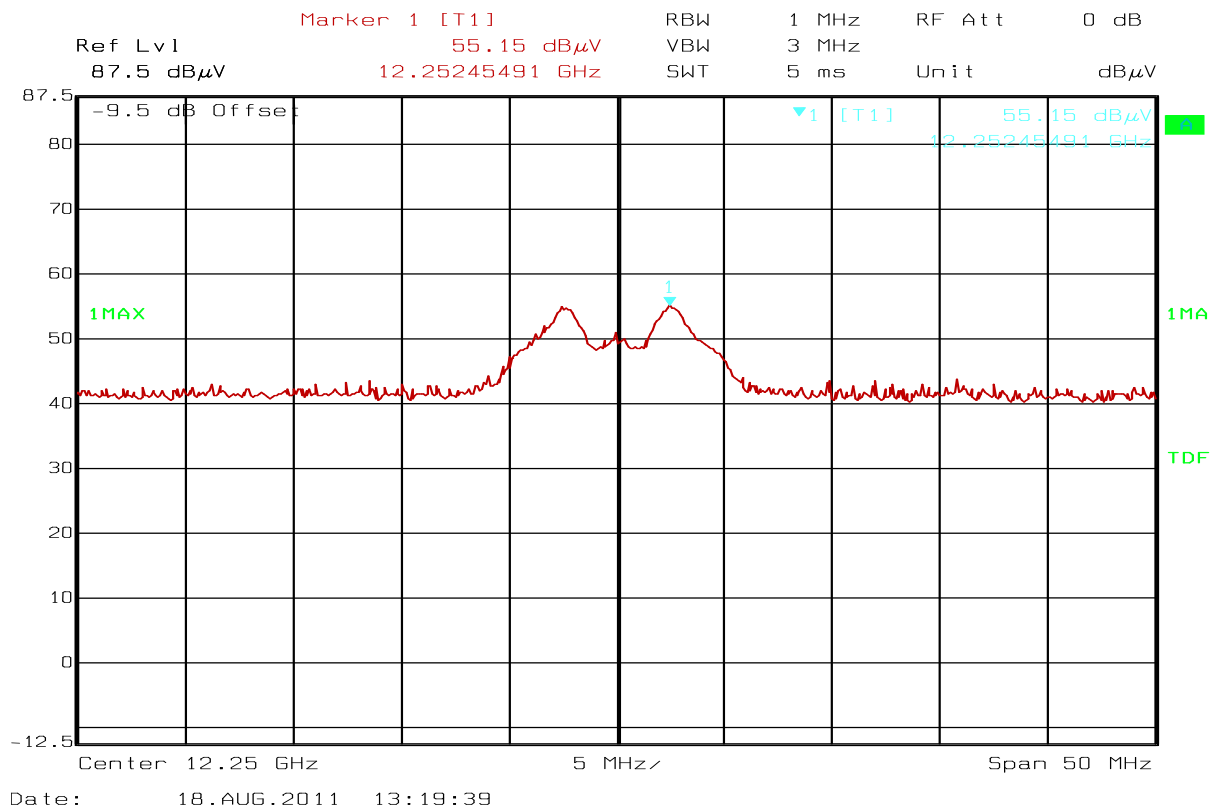


Date: 23.AUG.2011 09:21:06

### Pre-scan, 18 – 25 GHz



### Radiated Emissions, 4900 MHz, VP



### Radiated Emissions, 12250 MHz, HP

## 4.6 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	/	/
2450	4900	38.9	54	15.1
> 1000 (all others)	all	None found	54	/

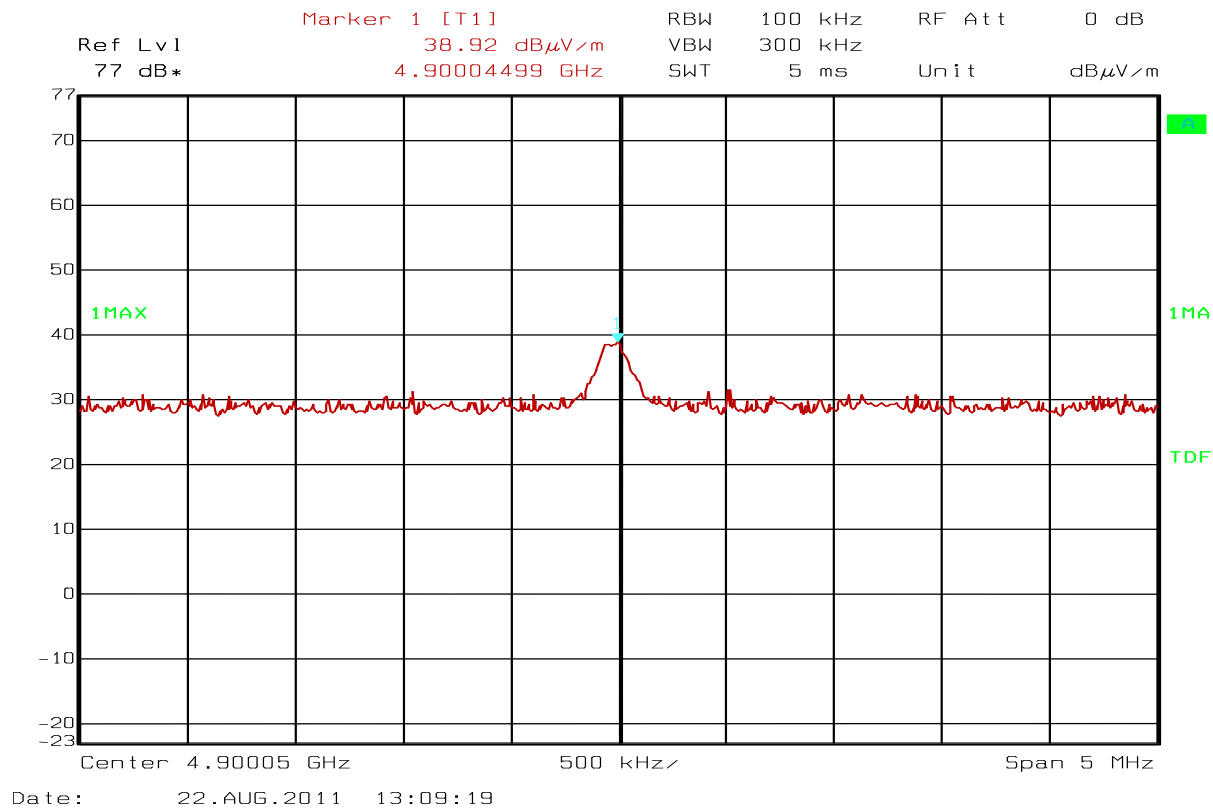
The measurement was performed radiated with the EUT in receive-only mode.

### 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.



**Receiver Radiated Emissions, 4900 MHz**

## 4.7 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: Frode Sveinsen

Date of Test: 17 Aug 2011

Test Results: Passed

### Measured and Calculated Data:

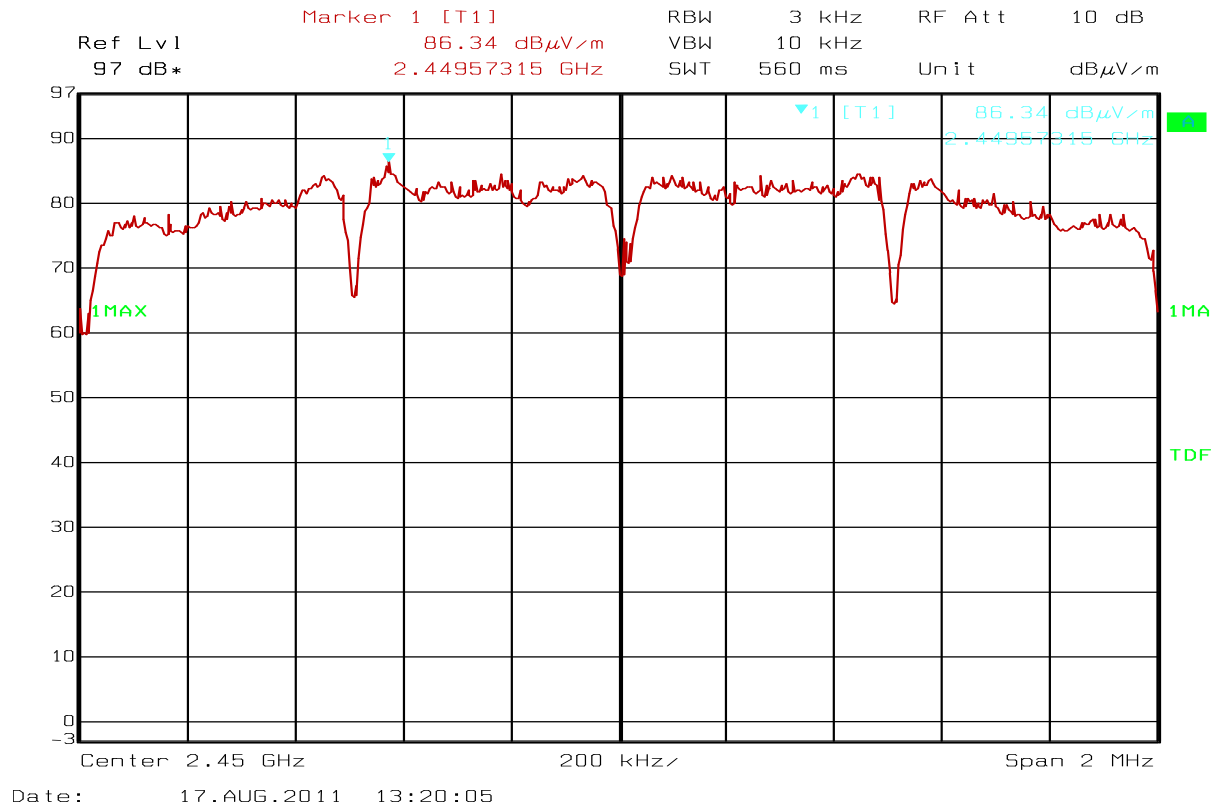
The alternative test procedures in point 2) A , B and formula 1 described in guidance on measurements for Digital Transmission Systems is used.

	Measured Field Strength @3m dB $\mu$ V/m	Calculated PSD dBm
Power Spectral Density @2440 MHz	86.2	-9.0

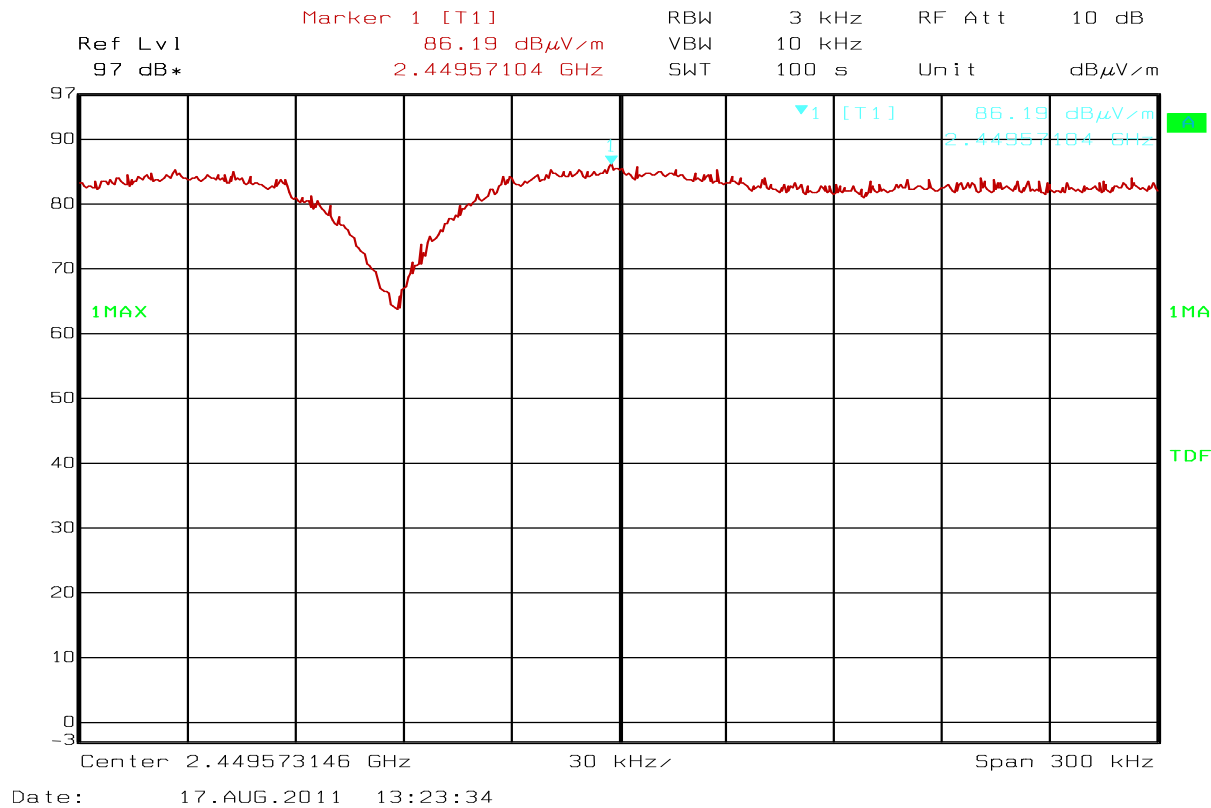
PSD in dBm is calculated from the field strength value using the Free Field Formula.

### Requirements:

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



# PSD Overview



# PSD Measurement

## 5 LIST OF TEST EQUIPMENT

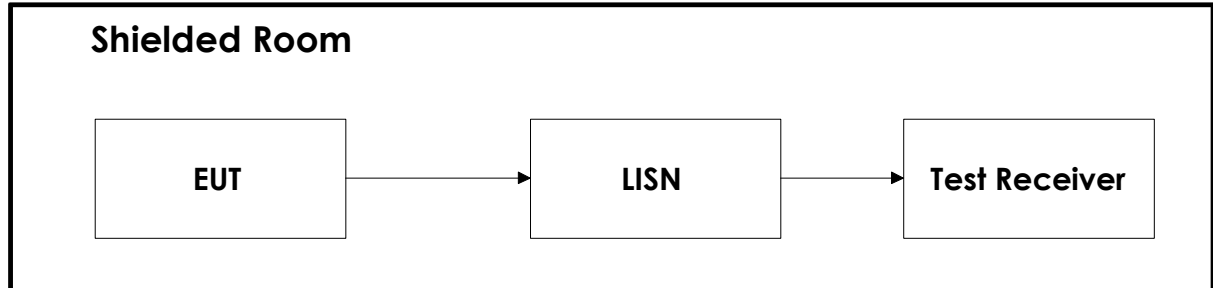
To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

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	LR 1090	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	N-4525	2010-09	2011-09
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	2011.11.02
13	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076	2009-10-22	2011-10-22
14	80S	Signal Generator	Powertron	LT 502	Cal b4 use	
15	Model 87 V	Multimeter	Fluke	LR 1598	2010-12-14	2011-12-14



## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission

