

Test report no. : 98175-5

Item tested : AVRRAVEN

**Type of equipment : IEEE 802.15.4, 2.4GHz
Evaluation Module**

FCC ID : VW4AVRRAVEN

Client : Atmel Norway AS

www.nemko.com

FCC Part 15.247
Digital Transmission System

RSS-210 Issue 7 & RSS Gen Issue 2
Low Power Licence-Exempt
Radiocommunication Devices

10 April 2008

Authorized by : A blue ink signature of Frode Sveinsen, written over a dotted line.

Frode Sveinsen
Technical Verificator

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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko AS
Nemko Comlab
Address : Gåsevikveien 8, Box 96
N-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: post@comlab.no
FCC test firm registration # : 994405
IC OATS registration # : 4443
Total Number of Pages: 35

1.2 Client Information

Name : Atmel Norway AS
Address : Vestre Rosten 79,
N-7075 Trondheim, Norway
Telephone : +47 72884388
Fax : --

Contact:

Name : Ingar Hanssen
Telephone : +47 72 88 43 88
E-mail : hanssen@atmel.com

1.3 Manufacturer

Same as client

2 Test Information

2.1 Test Item

Name :	AVRRAVEN
FCC ID :	VW4AVRRAVEN
Model/version :	Not stated
Serial number :	Not Stated
Hardware identity and/or version:	A09-0318
Software identity and/or version :	1.0
Frequency Range :	2405 – 2480 MHz
Tunable Bands :	1
Number of Channels :	16 ¹
Operating Modes :	TX & RX
Type of Modulation :	O-QPSK
Emissions Designator :	G1D
User Frequency Adjustment :	None, Software controlled
Rated Output Power :	2 mW (3 dBm)
Type of Power Supply :	3.0 V DC
Antenna Connector :	Integral antenna only
Antenna Diversity Supported :	None

1) 16 channels in use.

Theory of Operation

The AVRRAVEN transceiver module is an IEEE® 802.15.4-compliant device that operates in the 2.4 GHz ISM frequency band. This transceiver module specially designed for the Zigbee protocol stack for wireless star and mesh networks.

Description of Test Item

The AVRRAVEN is an evaluation module with dimension of 8 cm X 5.1cm.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 - 22 °C
Relative humidity:	20 - 40 %
Normal test voltage:	3.0 V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2007-12-13

Test period : from 2007-12-13 to 2007-12-14 & 2008-01-10

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Atmel Norway AS

Model No.: AVRRAVEN

Serial No.: Not stated

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15.247.

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 3 and 10 meters.

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DTS 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 #: 98175-5

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

DATE: 02.04.2008

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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 7 & RSS Gen Issue 2	Result
Supply voltage variations	15.31 (e)	8 (RSS-GEN)	N/A ²
Number of operating frequencies	15.31 (m)	A8.1	Complies
Power-line Conducted Emissions (Receiver)	15.107(a)	7.2.2 (RSS-GEN)	ref. 15.207(a)
Radiated Emissions limits (receiver)	15.109(a)	6 (RSS-GEN)	ref. 15.209(a)
Antenna requirement	15.203	7.1.4 (RSS-GEN)	Complies ¹
Radiated emissions limits for restricted bands	15.205(a)		Complies
Power Line Conducted Emissions	15.207(a)	7.2.2 (RSS-GEN)	N/A ²
Radiated emission limits	15.209(a)	A8.5	Complies
Bandwidth	15.247(a)(2)	A8.2	Complies
Peak Power Output	15.247(b)(3)	A8.4	Complies
Power Spectral Density	15.247(d)	A8.2	Complies
Out-of-band emissions (Antenna Conducted)	15.247(c)	A8.5	Complies ¹
Out-of-band emissions (Radiated)	15.247(c)	A8.5	Complies
Lower band edge radiated emission	15.247(c)	A8.5	Complies
Upper band edge radiated emission	15.247(c)	A8.5	Complies

¹ Integral antenna only . For testing purpose MPX connector was provided.

² The manufacturer specified voltage range is 3.0 V DC (Battery operated)

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The channels are selected with a laptop PC connected to the EUT. The laptop is only used for selection of channels. The measurements are performed at channels near top Ch 26, near middle Ch 18 and near bottom Ch 11. And the out put level is set to maximum in the software. The EUT complies at these channels.

The selection of channels are done by manufacturer out side the test chamber. The lab top is not used during the test. The laptop Model type is DELL Latitude, D610. The laptop is belongs to the manufacturer.

All measurements are done with fully charged battery.

The radiated measurements are tested on three axis

There are no ports to be populated during spurious emission measurements.

A temporary antenna connector is used only for making conducted RF measurements for evaluation purposes.

3.5 Family List Rationale

Not Applicable.

4 TEST RESULTS

4.1 Power-line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: -	Date of Test: -
----------------------	-----------------

Measurement procedure: ANSI C63.4-2003 using 50 μ H/50 ohms LISN.

Test Results: N/A

Measurement Data: N/A

The tested EUT is battery operated.

4.2 Minimum 6 dB Bandwidth

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

Test Performed By: G.Suwanthakumar

Date of Test: 13.12.2007

Test Results: Complies

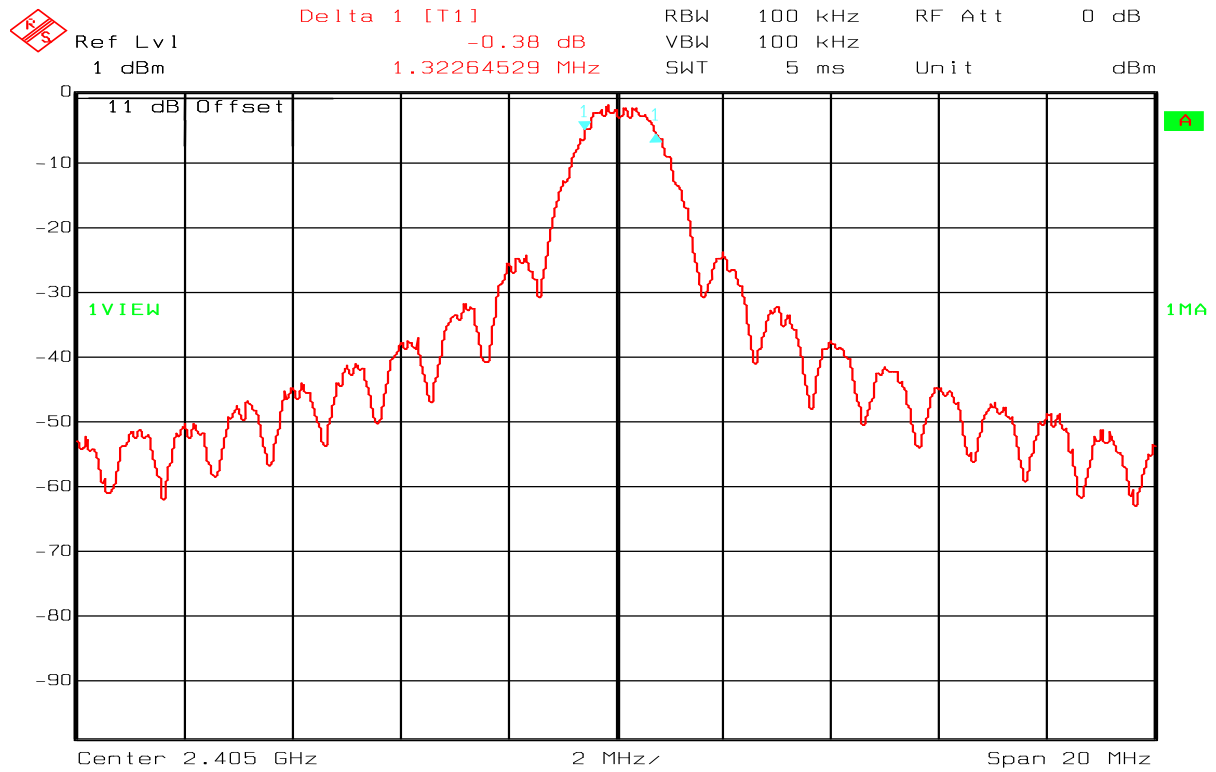
Measurement Data:

6 dB Bandwidth (MHz)		
Ch 11 2405MHz	Ch 19 2440MHz	Ch 26 2480MHz
1.32	1.48	1.60

A fully charged battery is used.

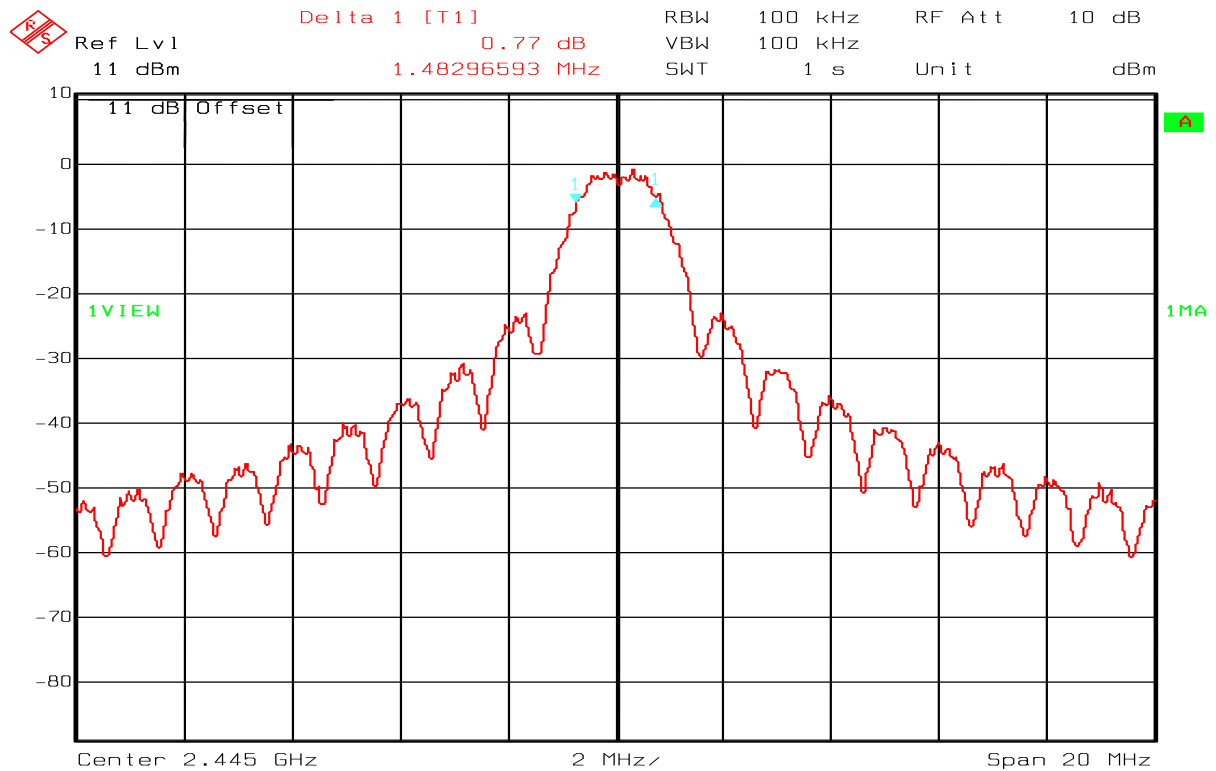
Requirements:

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



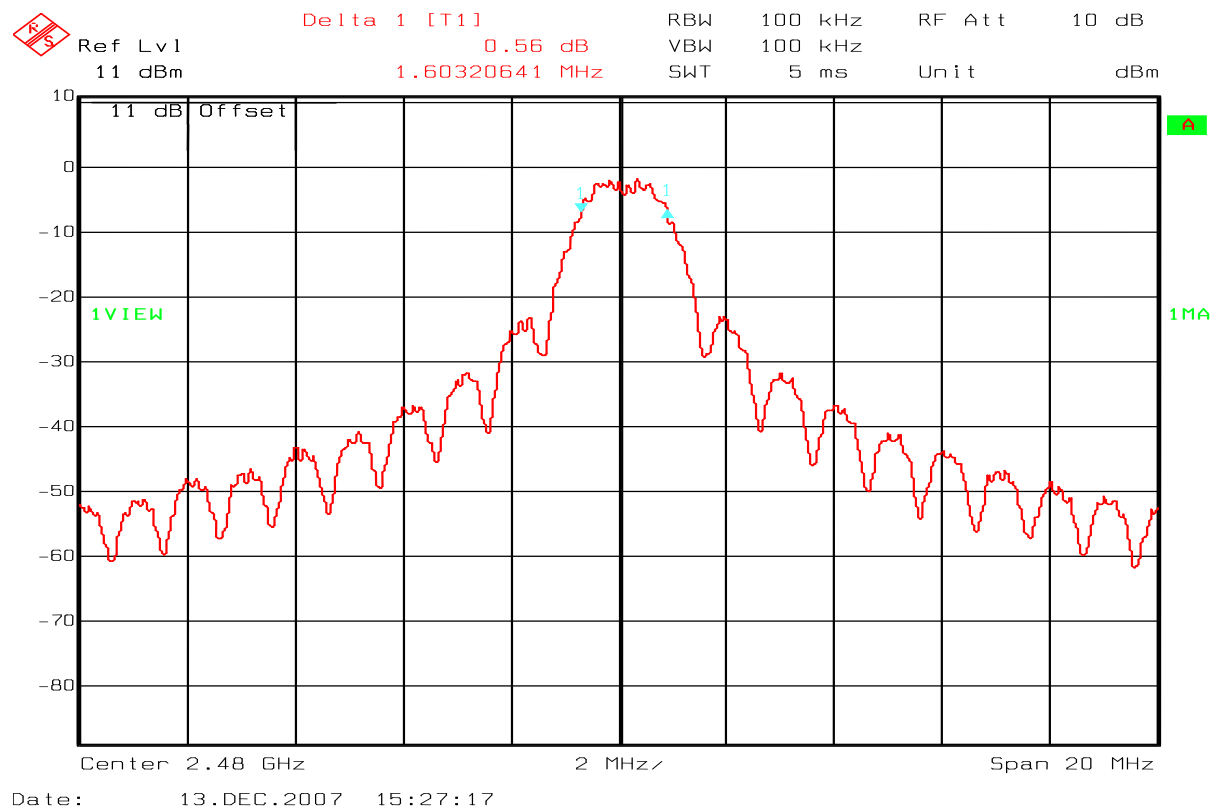
Date: 13.DEC.2007 14:48:29

Ch11 – 6 dB bandwidth – 1.32MHz



Date: 13.DEC.2007 15:09:50

Ch19 – 6 dB bandwidth – 1.48MHz



CH26 – 6 dB bandwidth – 1.60MHz

4.3 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suhandhakumar

Date of Test: 13.12.2007 & 10.01.2008

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	Ch 11	Ch 19	Ch 26
Measured value (mW)	1.91	1.77	1.57

Maximum field strength

RF channel	Ch 11	Ch 19	Ch 26
Measured value (dBμV/m)	105.89	105.52	105.83

Maximum EIRP

RF channel	Ch 11	Ch 19	Ch 26
Measured EIRP (mW)	5.8	7.1	5.1
Antenna gain dBi	4.8	6.0	5.1

Antenna gain = $10 \cdot \log(\text{EIRP} / \text{Conducted power})$ dBi

The EIRP is measured using substitution method. The maximum eirp is obtained at horizontal polarization.

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

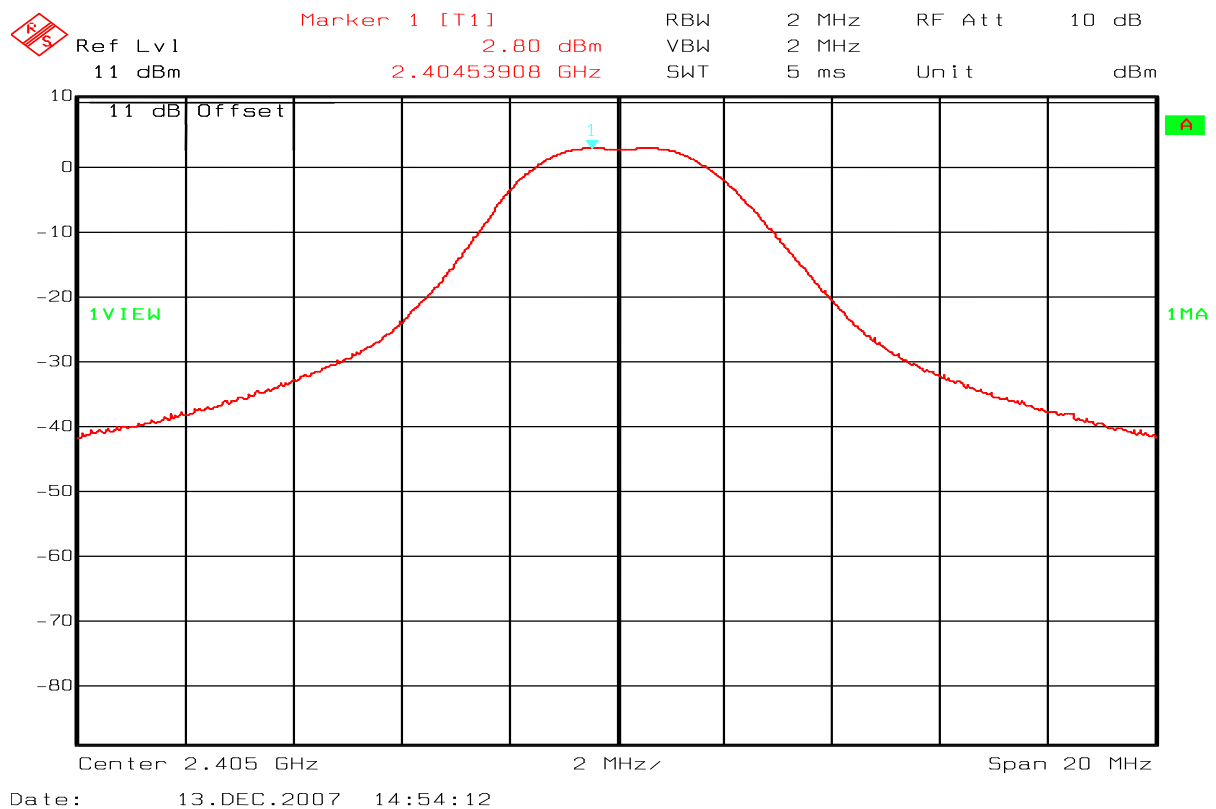
☐ Yes ☐ No

Requirements:

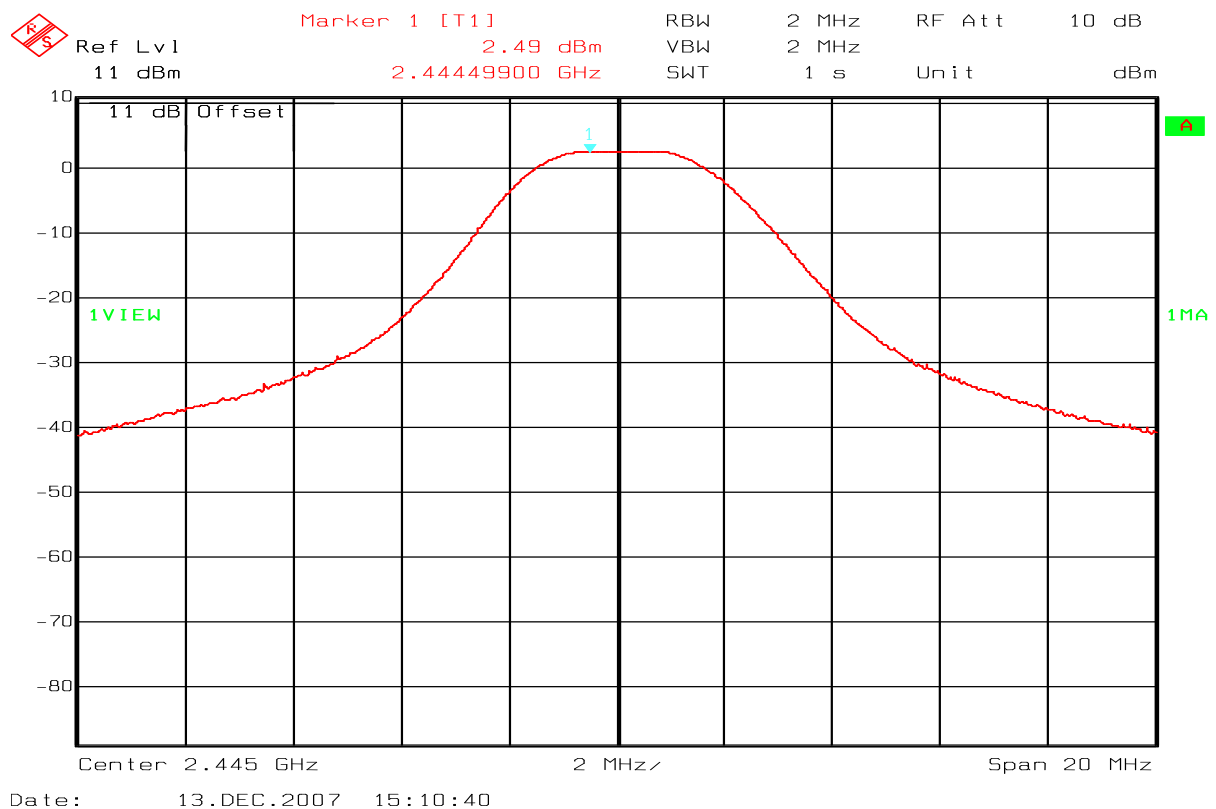
The maximum peak output power shall not exceed the following limits:

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

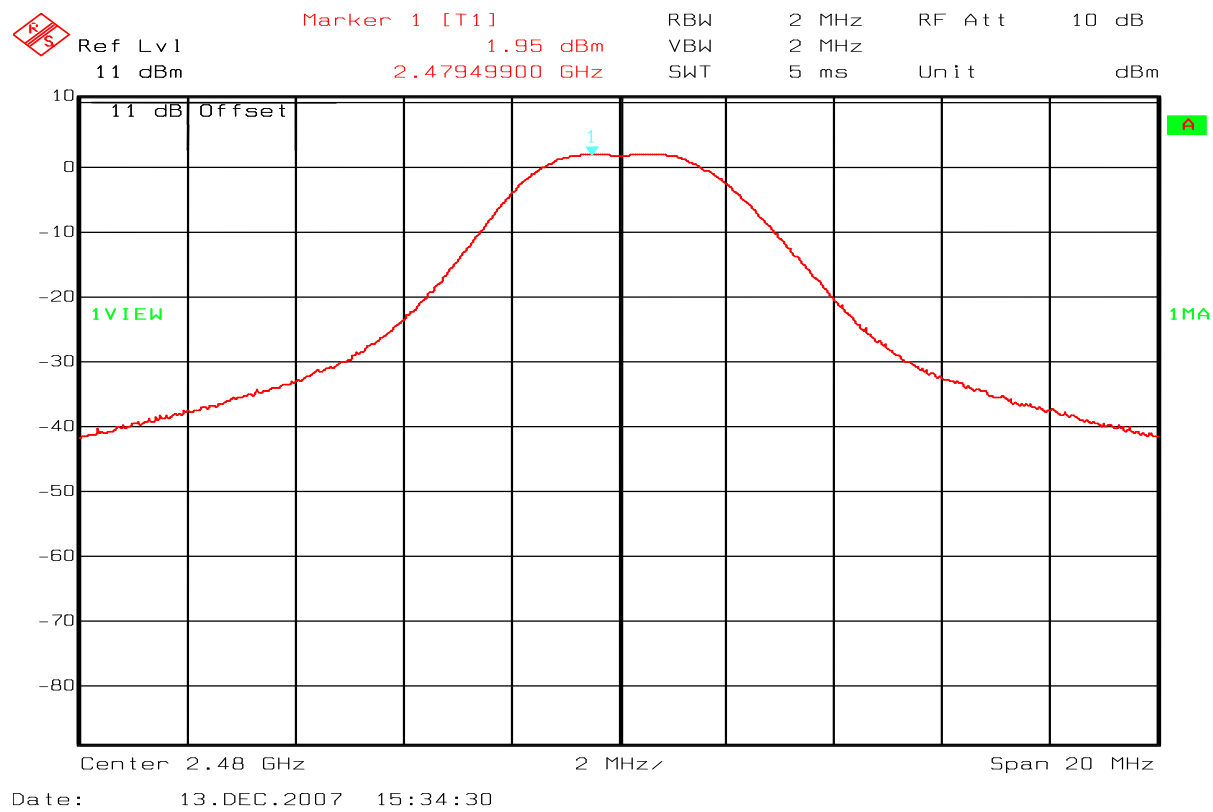
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Ch 11 – Conducted Peak Output Power



Ch 19 – Conducted Peak Output Power



Ch 26 – Conducted Peak Output Power

4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suwanthakumar

Date of Test: 10.01.2008

Test Results: Complies

Measurement Data:

Lower Band-edge radiated measurements

Frequency	Power below nearest channel, dB	Limit	Margin
GHz	RF ch 11 DSS	dB	dB
2.4	37.38	-20	17.38

Band-edge field strength 2.4 GHz:

Marker Delta 100kHz RBW: 37.38dB

Peak Field Strength $105.48 - 37.38 = 68.1$ dB μ V/m

Average Field Strength: 68.1 dB μ V/m $- 20$ dB = 48.1 dB μ V/m

Upper Band-edge radiated measurements

Frequency	Power below nearest channel, dB	Limit	Margin
GHz	RF ch 26 DSS	dB	dB
2.4835	34.35	-20	14.35

Band-edge field strength 2.4835 GHz:

Marker Delta 100kHz RBW: 34.35dB

Peak Field Strength $105.72 - 34.35 = 71.37$ dB μ V/m

Average Field Strength: 71.37 dB μ V/m $- 20$ dB = 51.37 dB μ V/m

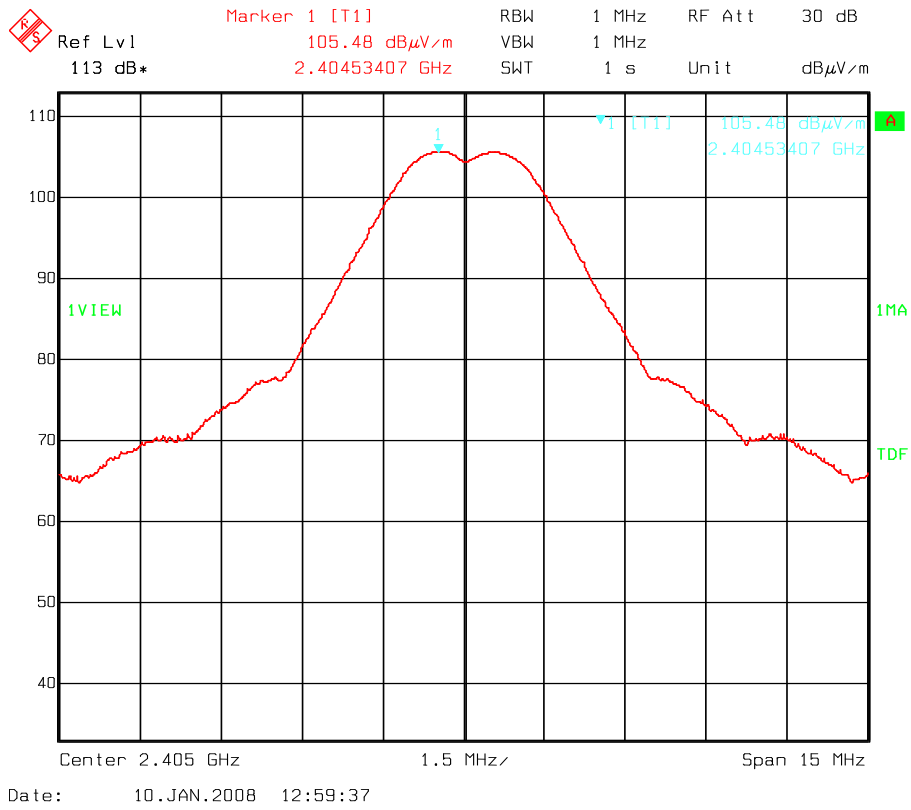
RF conducted emissions to 25 GHz

Maximum RF level outside operating band:

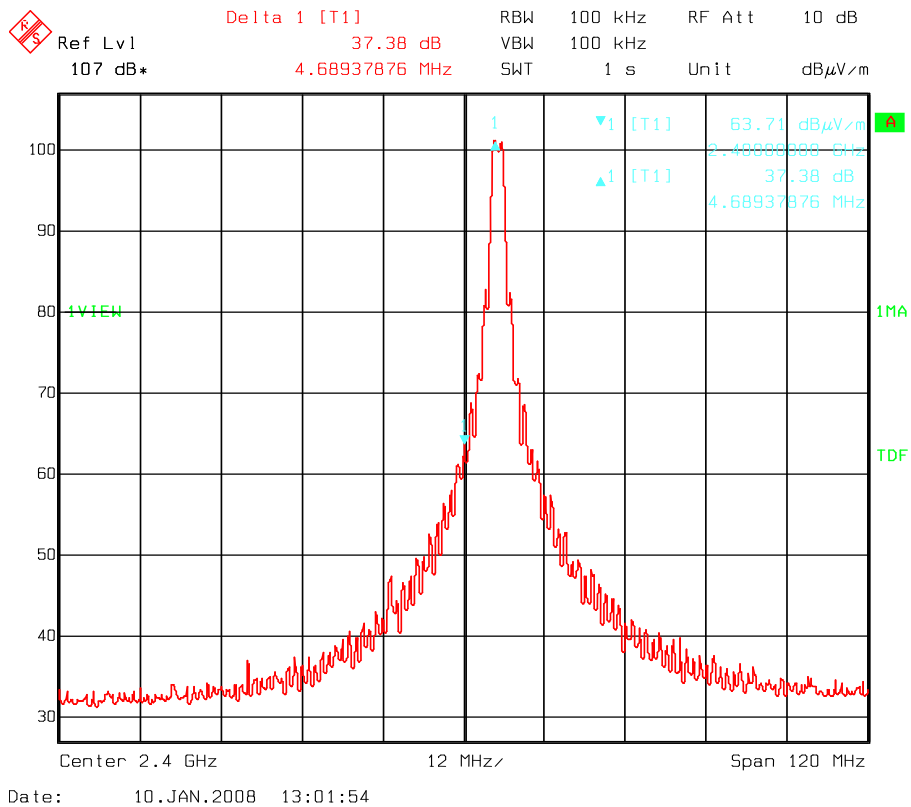
RF ch 11: 57.98 dB/C, margin > 20 dB

RF ch 19: 60.90 dB/C, margin > 20 dB

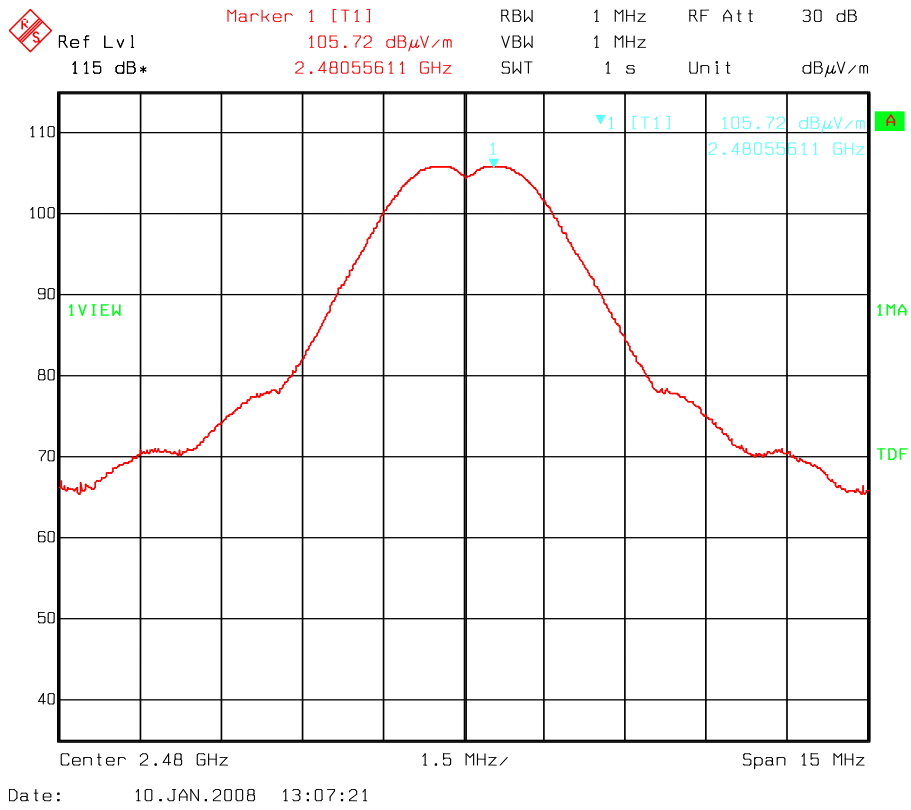
RF ch 26: 60.57 dB/C, margin > 20 dB



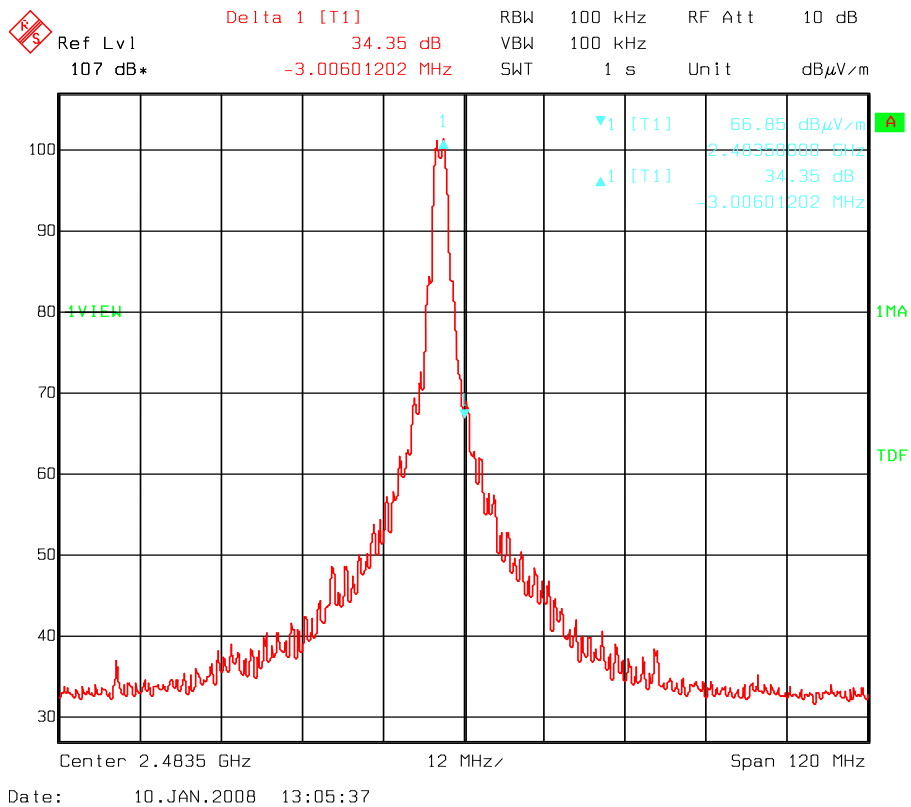
Ch11 – lower-band –field strength



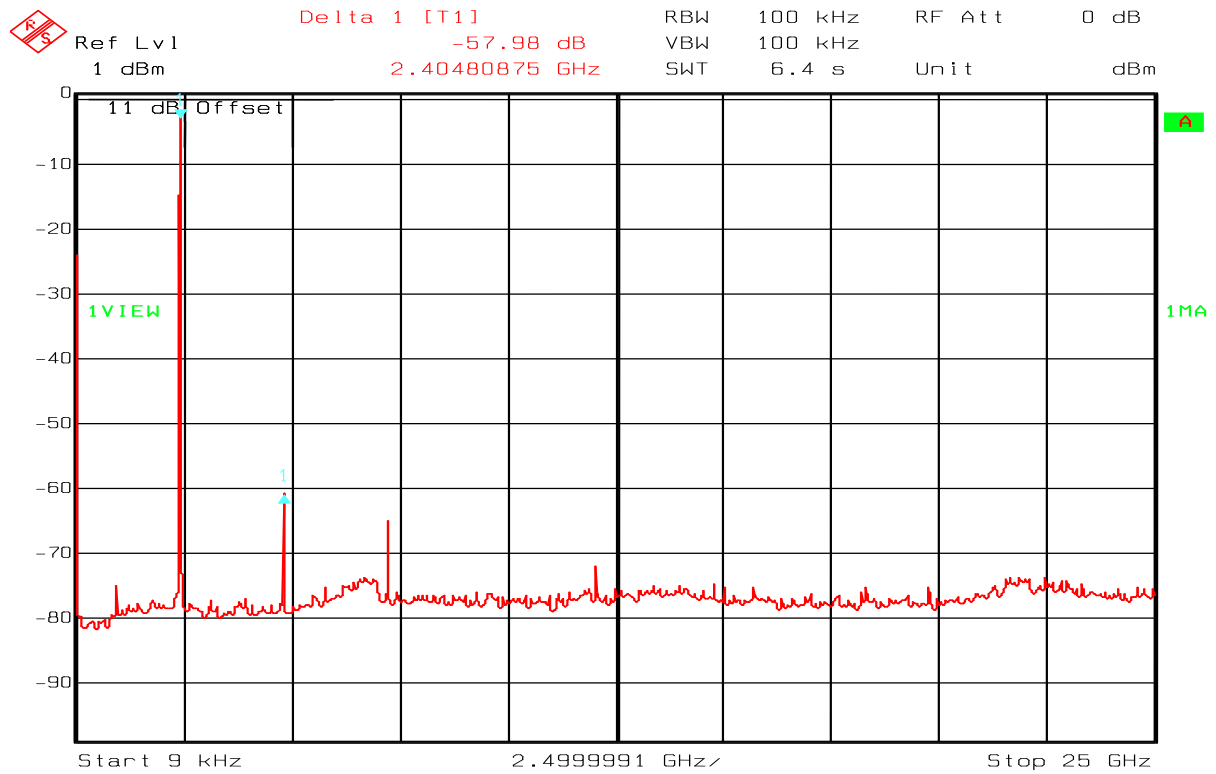
Ch11 – Lower-band-edge – Delta-marker



Ch26 – upper-band –field strength

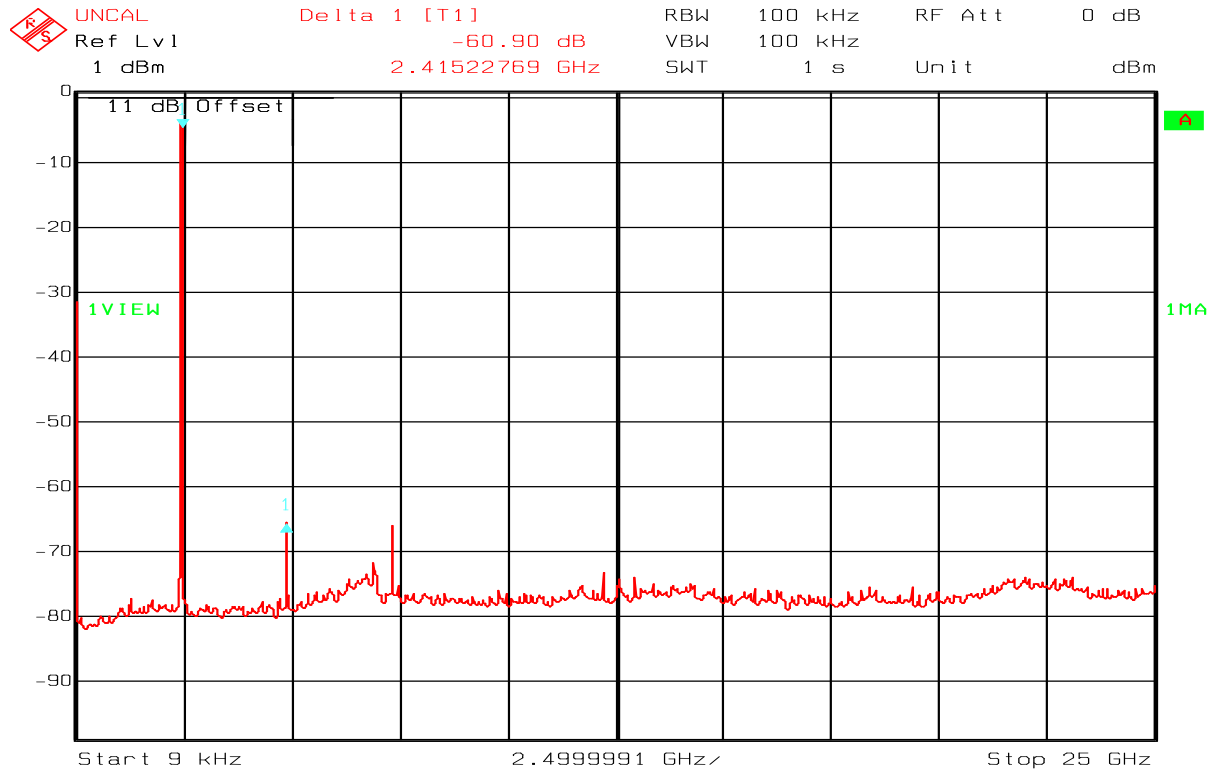


Ch26 – Upper-band-edge – Delta-marker



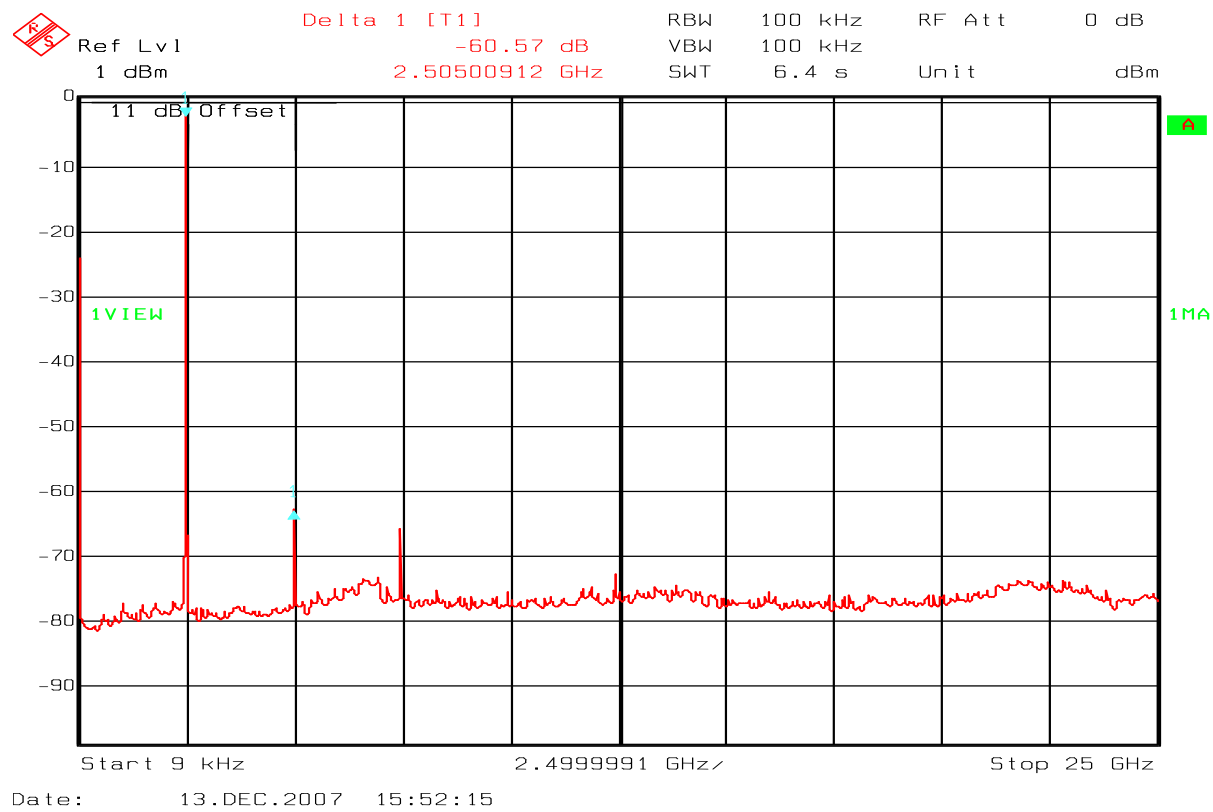
Date: 13.DEC.2007 14:46:12

Ch11 – Conducted Spurious – 9kHz – 25GHz



Date: 13.DEC.2007 15:12:00

Ch19 – Conducted Spurious – 9kHz – 25GHz



Ch26 – Conducted Spurious – 9kHz – 25GHz

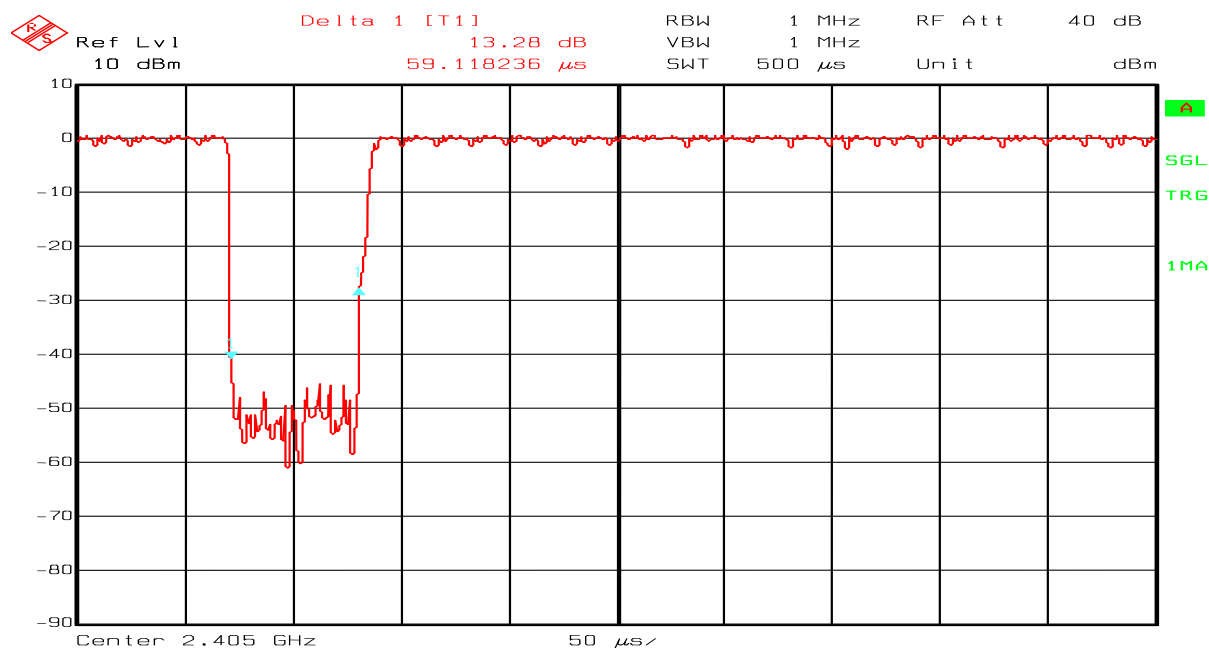
Duty Cycle Calculation:

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

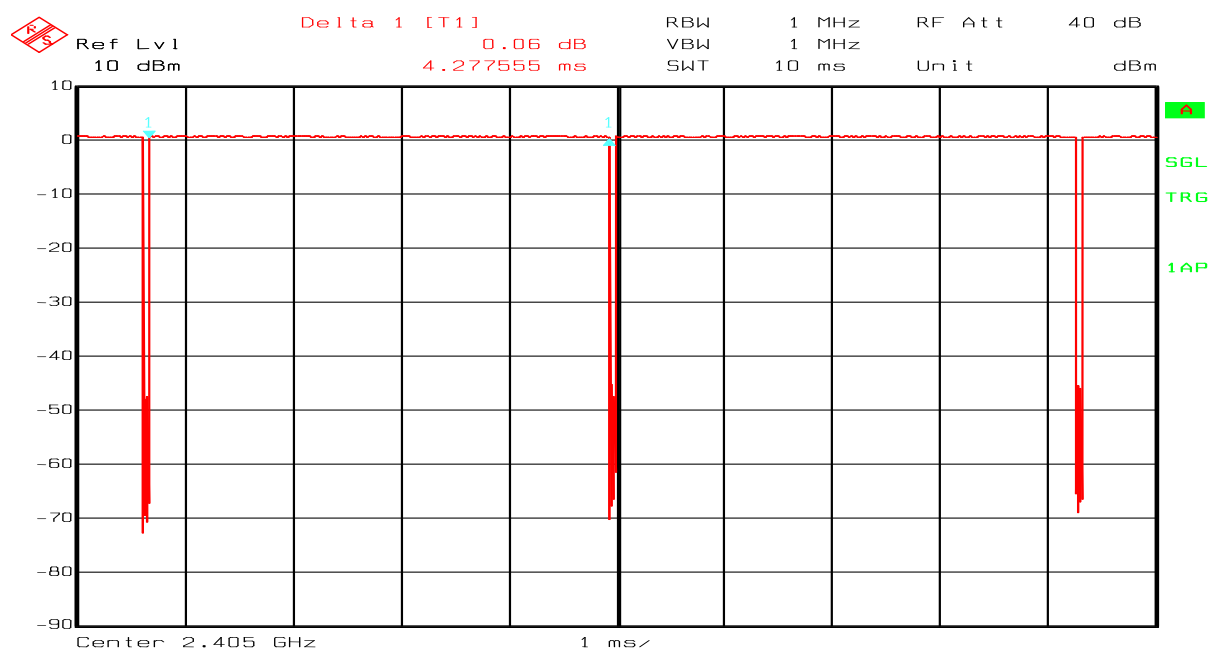
$$-20 \cdot \log(0.059\text{ms}/4.34\text{ms}) = 37.3 \text{ dB}$$

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

This value is used to calculate average field strength above 1 GHz from the measured Peak value.



Duty Cycle – ON-time



Duty Cycle – OFF time

Radiated Emissions, 1-25 GHz, peak

1-18 GHz measured at a distance of 3m, 18-25 GHz measured at 1m.

No radiated spurious emissions detected with 50 ohm load.

Radiated Emission 1 – 25 GHz, Peak

Measured with Peak Detector

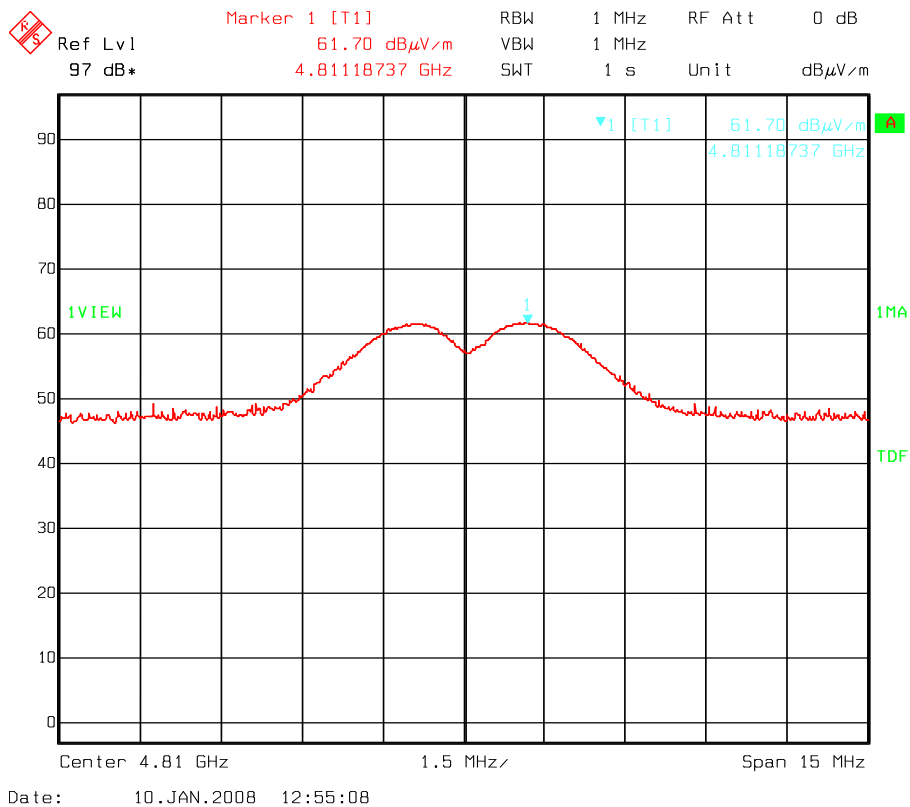
Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3m	Duty cycle corr. factor	Limit	Margin
GHz	11-26	dB	dBμV/m	dB	dBμV/m	dB
4.809	11	0	51.70	-	74	22.30
4.889	19	0	58.67	-	74	15.33
4.958	26	0	60.79	-	74	13.21
7.216	11	0	56.96	-	74	17.04
7.333	19	0	57.02	-	74	16.98
7.438	26	0	55.90	-	74	18.10
8 - 25	11,19,26	0	None detected	-	-	-

Radiated emission 1- 25 GHz, Average

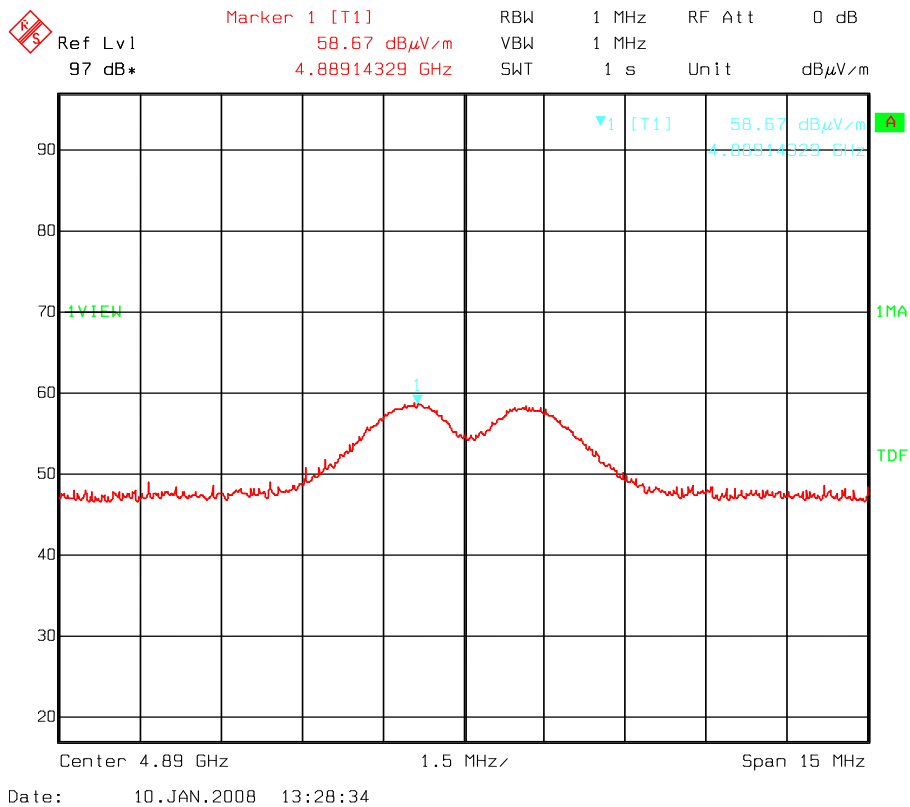
Calculated value from Peak Detector

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3 meters	Duty Cycle correction factor	Limit	Margin
GHz	11-26	dB	dBμV/m	dB	dBμV/m	dB
4.809	11	0	51.70	20	54	22.3
4.889	19	0	58.67	20	54	15.3
4.958	26	0	60.79	20	54	13.2
7.216	11	0	56.96	20	54	17.0
7.333	19	0	57.02	20	54	16.98
7.438	26	0	55.90	20	54	18.1
8 - 25	11,19,26	0	None detected	-	-	-

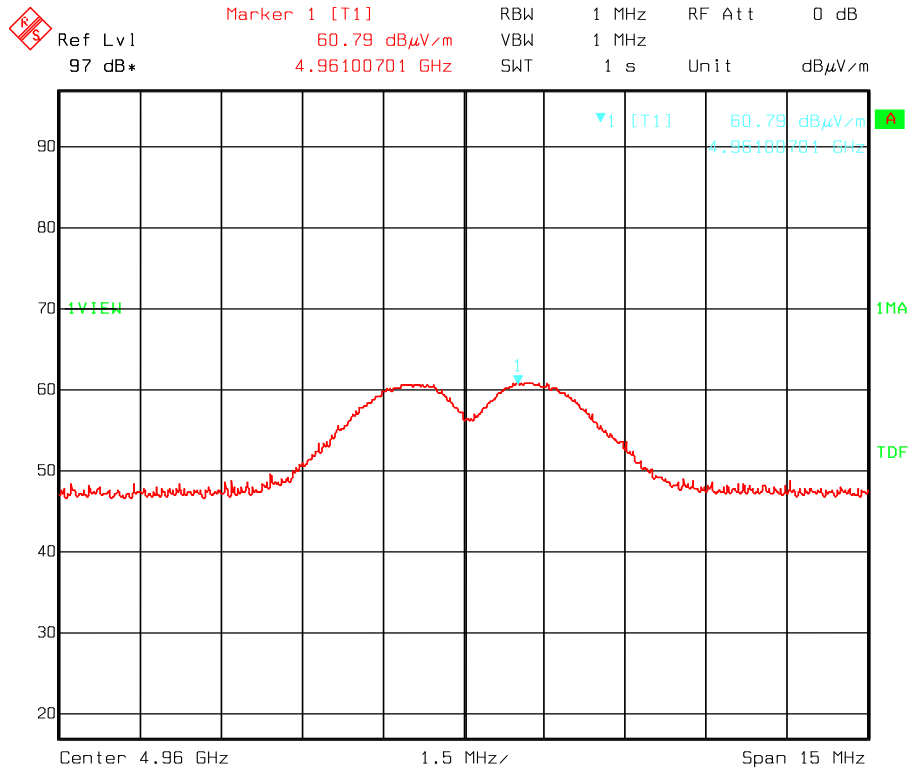
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".



Ch11 – 2nd harmonic

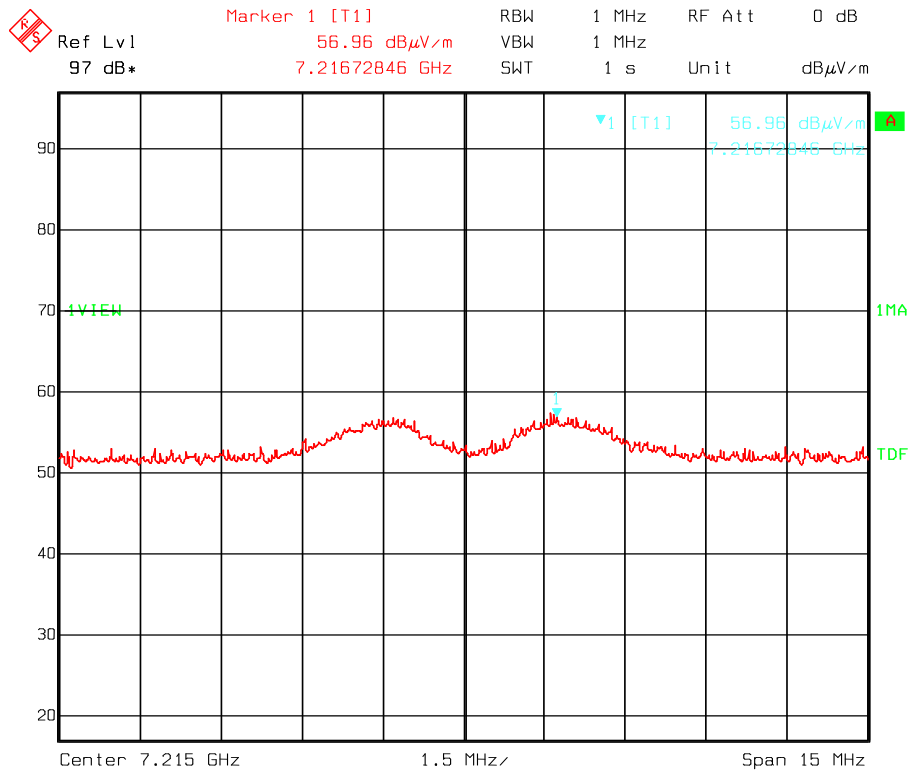


Ch19 – 2nd Harmonic



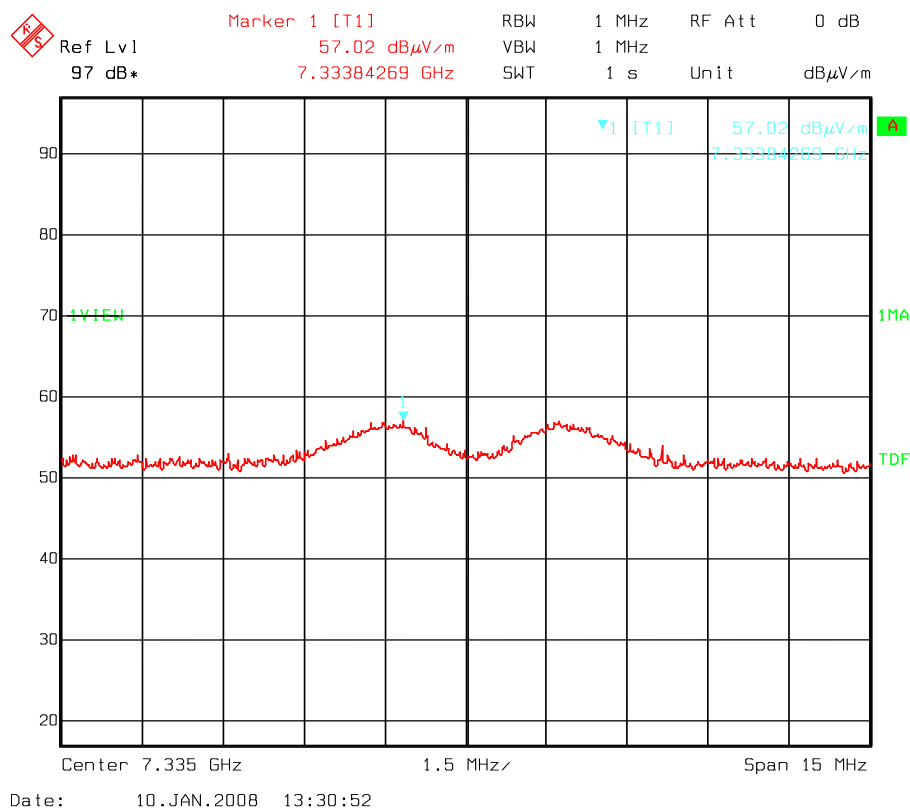
Date: 10.JAN.2008 13:14:55

Ch26 - 2nd Harmonic

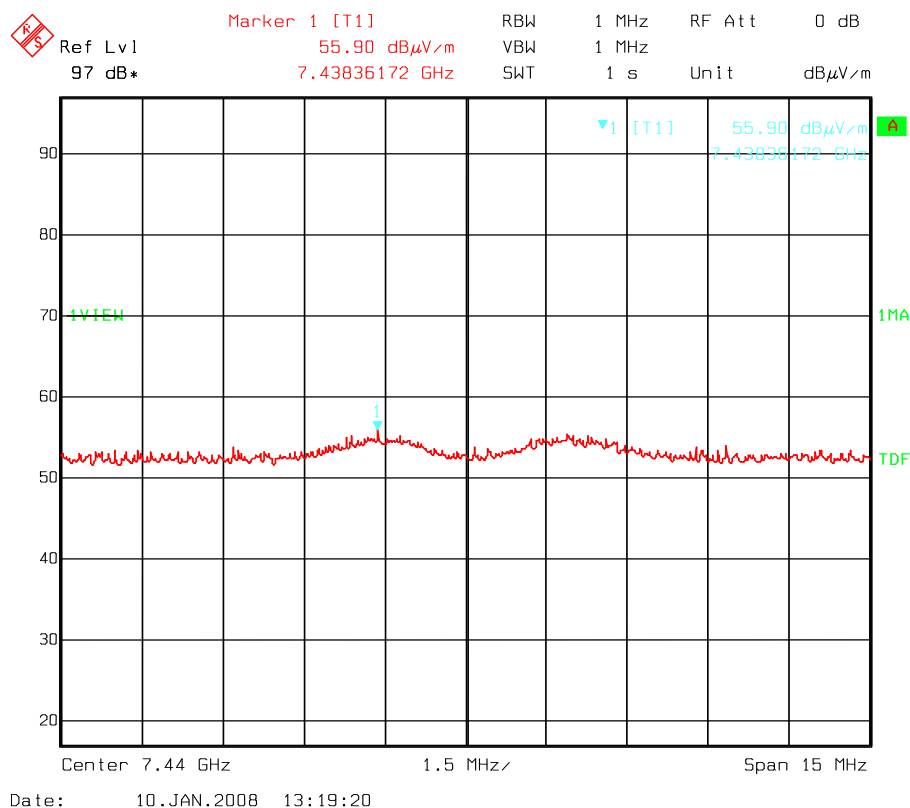


Date: 10.JAN.2008 12:57:57

CH11 - 3rd harmonic



CH19 - 3rd Harmonic



CH26 - 3rd Harmonic

Radiated emissions 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 3 m.

Tested in active mode.

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	m	dB μ V/m	dB
30 -200	TX ON/RX	< 20	3	40	>20
200 -1000	TX on/RX	< 20	3	40	>20

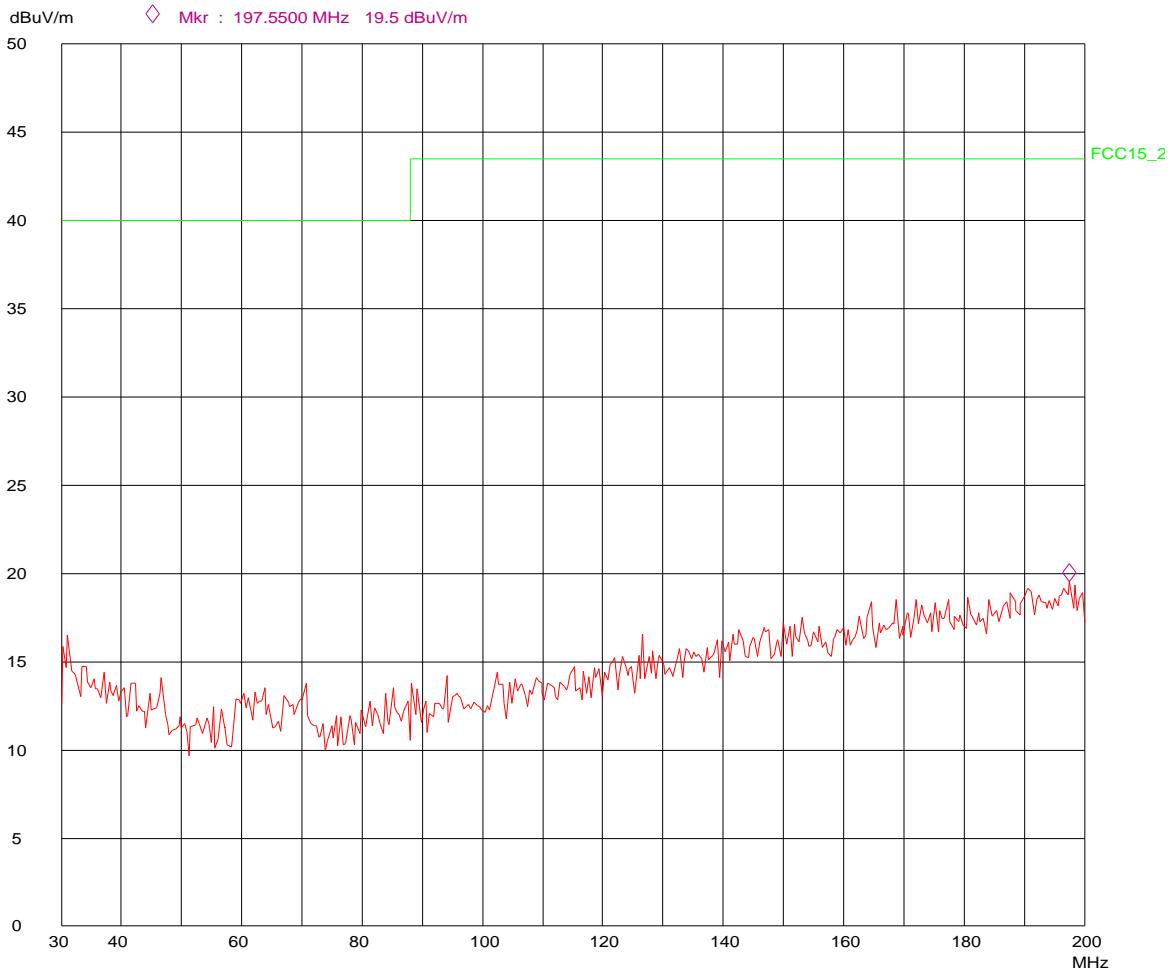
Nemko Comlab
Peak

13. Dec 07 16:23

EUT: AVR RAVEN LCD
Manuf: ATMEL
Op Cond: 1m vp, 3 mdistance
Operator: gns
Test Spec: FCC part 15.247
Comment: TX active

Scan Settings (1 Range)									
Frequencies					Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30M	200M	50k	120k	PK	50ms	0dBLN	ON	60dB	

Transducer No.	Start	Stop	Name
20	30M	200M	HK116



VP – 30 – 200 MHz

Nemko Comlab
Peak

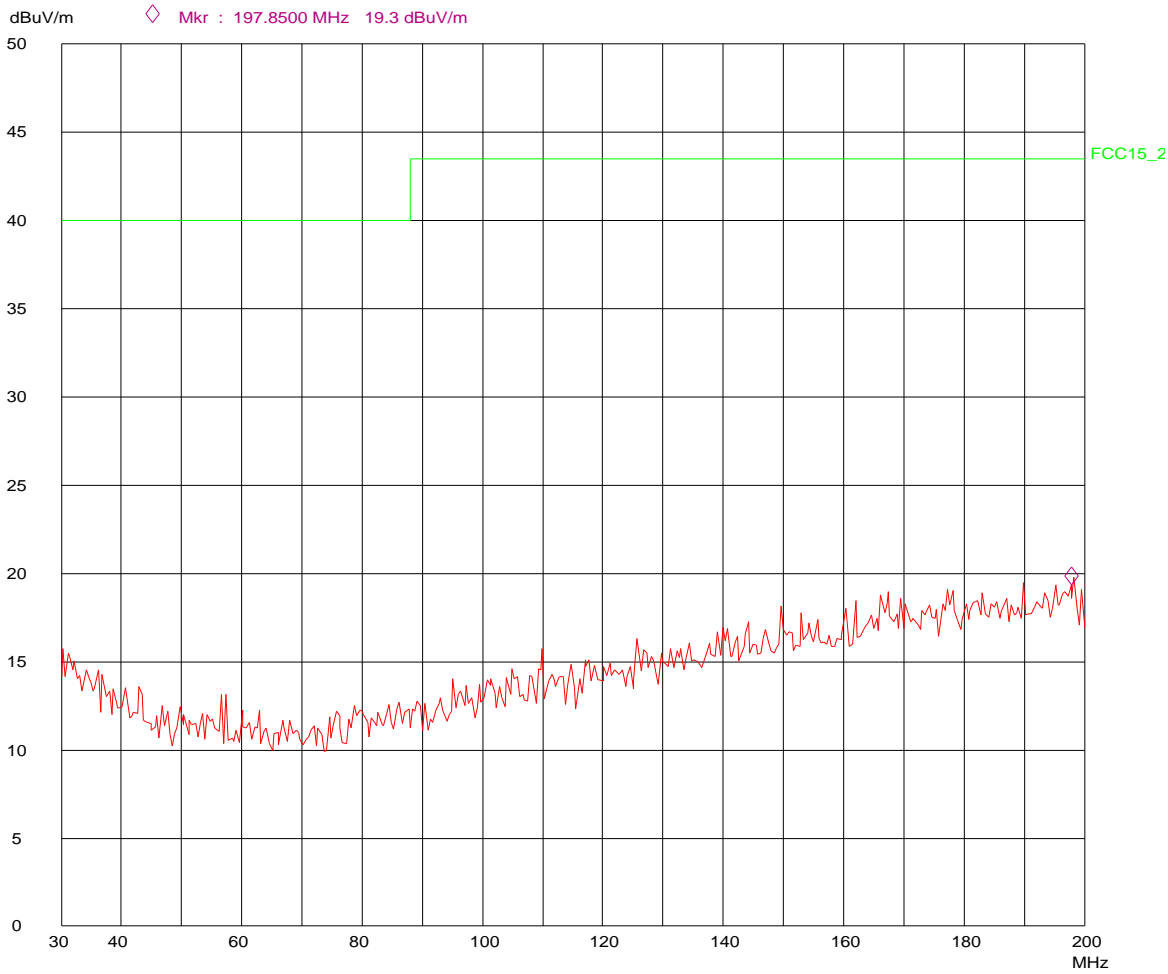
13. Dec 07 16:32

EUT: AVR RAVEN LCD
Manuf: ATMEL
Op Cond: 4m hp, 3 mdistance
Operator: gns
Test Spec: FCC part 15.247
Comment: TX active

Scan Settings (1 Range)

----- Frequencies -----||----- Receiver Settings -----
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
30M 200M 50k 120k PK 50ms 0dBLN ON 60dB

Transducer No. Start Stop Name
20 30M 200M HK116



HP – 30 – 200MHz

Nemko Comlab
Peak

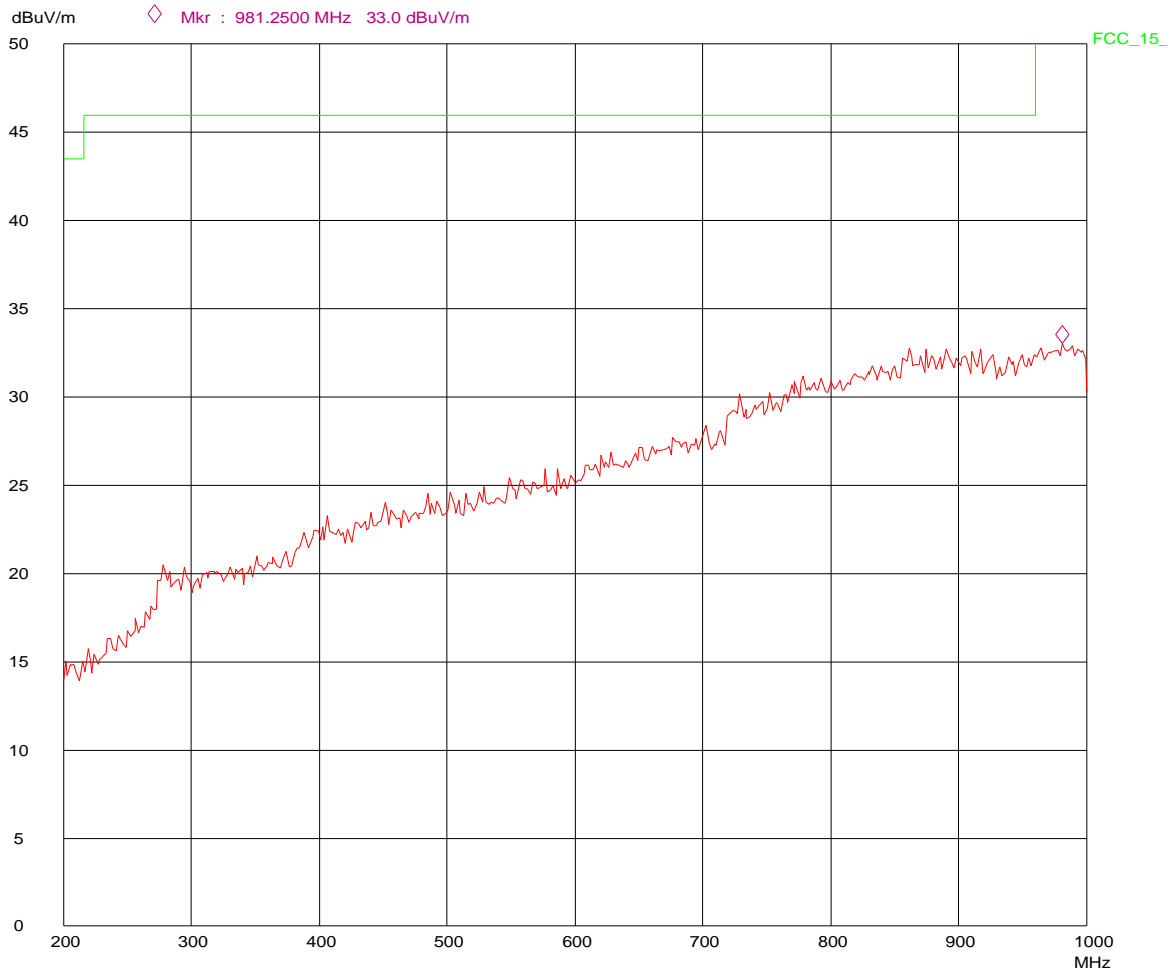
13. Dec 07 16:06

EUT: AVR RAVEN LCD
Manuf: ATMEL
Op Cond: 1m vp, 3 mdistance
Operator: gns
Test Spec: FCC part 15.247
Comment: TX active

Scan Settings (1 Range)

----- Frequencies -----||----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB

Transducer No. Start Stop Name
21 200M 1000M HL223



VP – 200 – 1000GHz

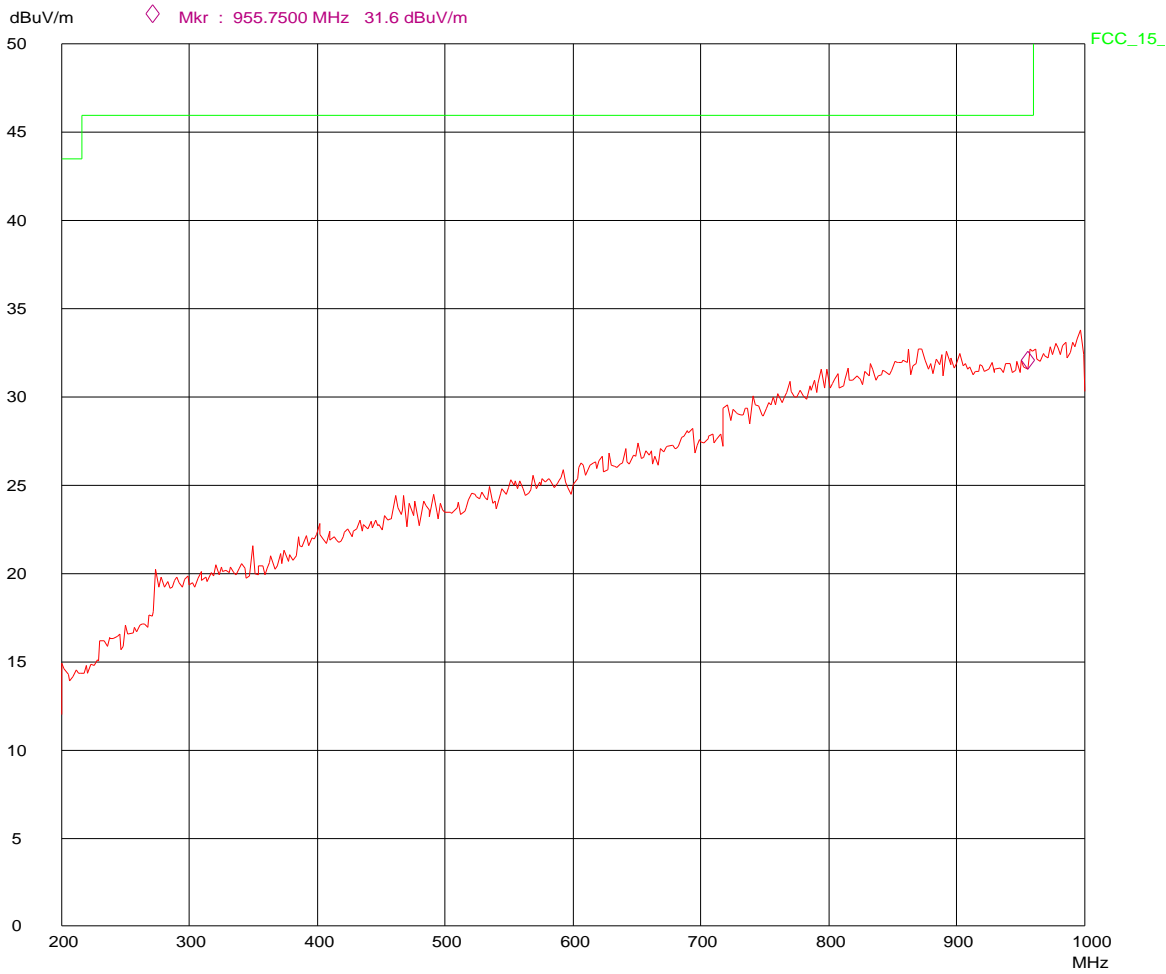
Nemko Comlab
Peak

13. Dec 07 15:51

EUT: AVR RAVEN LCD
Manuf: ATMEL
Op Cond: 4m hp, 3 mdistance
Operator: gns
Test Spec: FCC part 15.247
Comment: TX active

Scan Settings (1 Range)
|----- Frequencies -----||----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB

Transducer No. Start Stop Name
21 200M 1000M HL223



HP 200 – 1000MHz

4.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suwanthakumar

Date of Test: 13.12.2007

Test Results: Passed

Measured and Calculated Data:

Measured Conducted Values:

Ch11 - Lower Channel:

$$\text{PSD} = 35 - 48.1 \text{ dBm/Hz} = -13.10 \text{ dBm}$$

Ch19 - Middle Channel:

$$\text{PSD} = 35 - 48.42 \text{ dBm/Hz} = -13.42 \text{ dBm}$$

Ch 26 - Upper Channel:

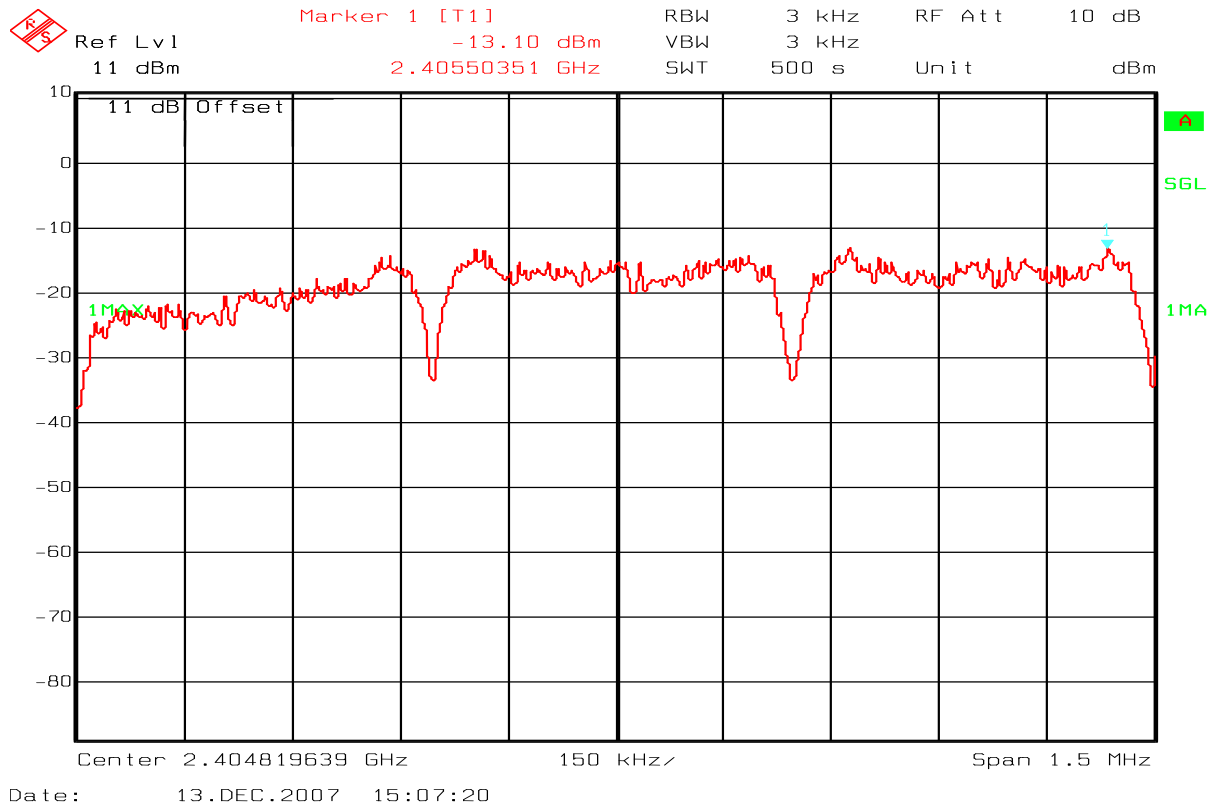
$$\text{PSD} = 35 - 49.22 \text{ dBm/Hz} = -14.22 \text{ dBm}$$

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

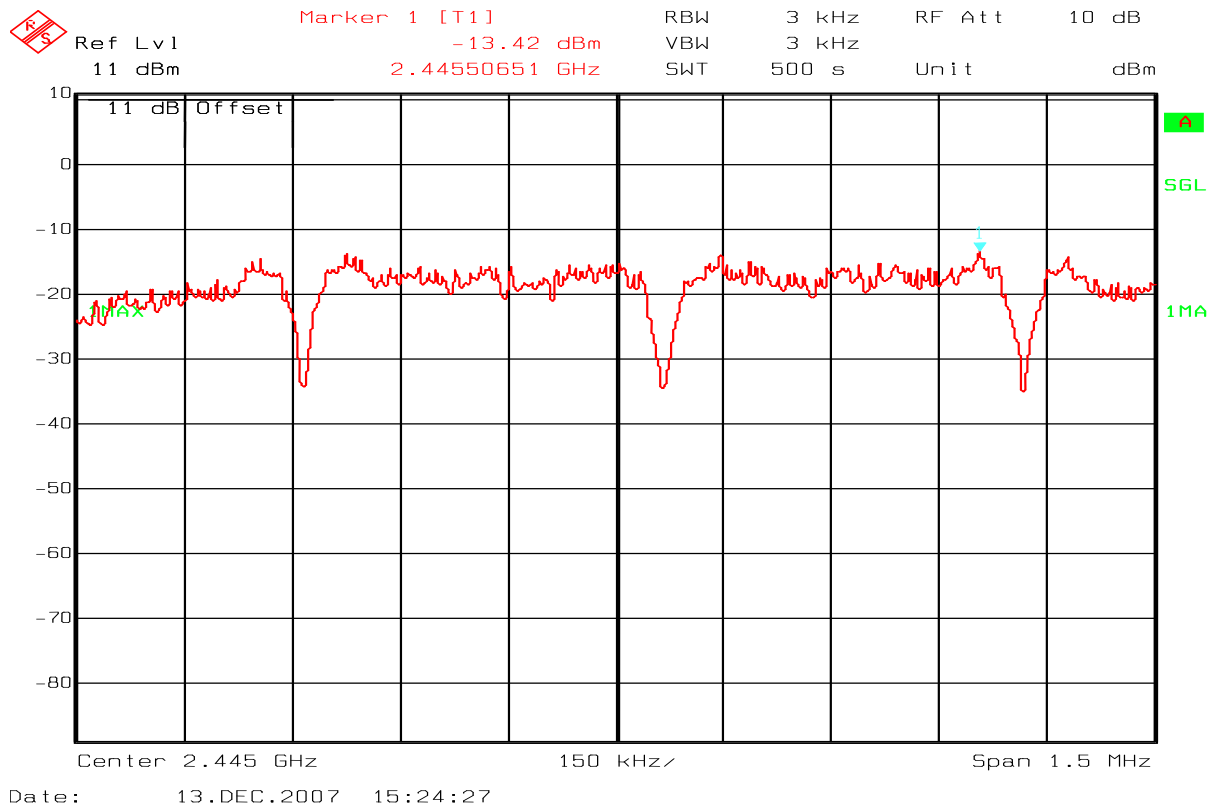
Requirements:

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

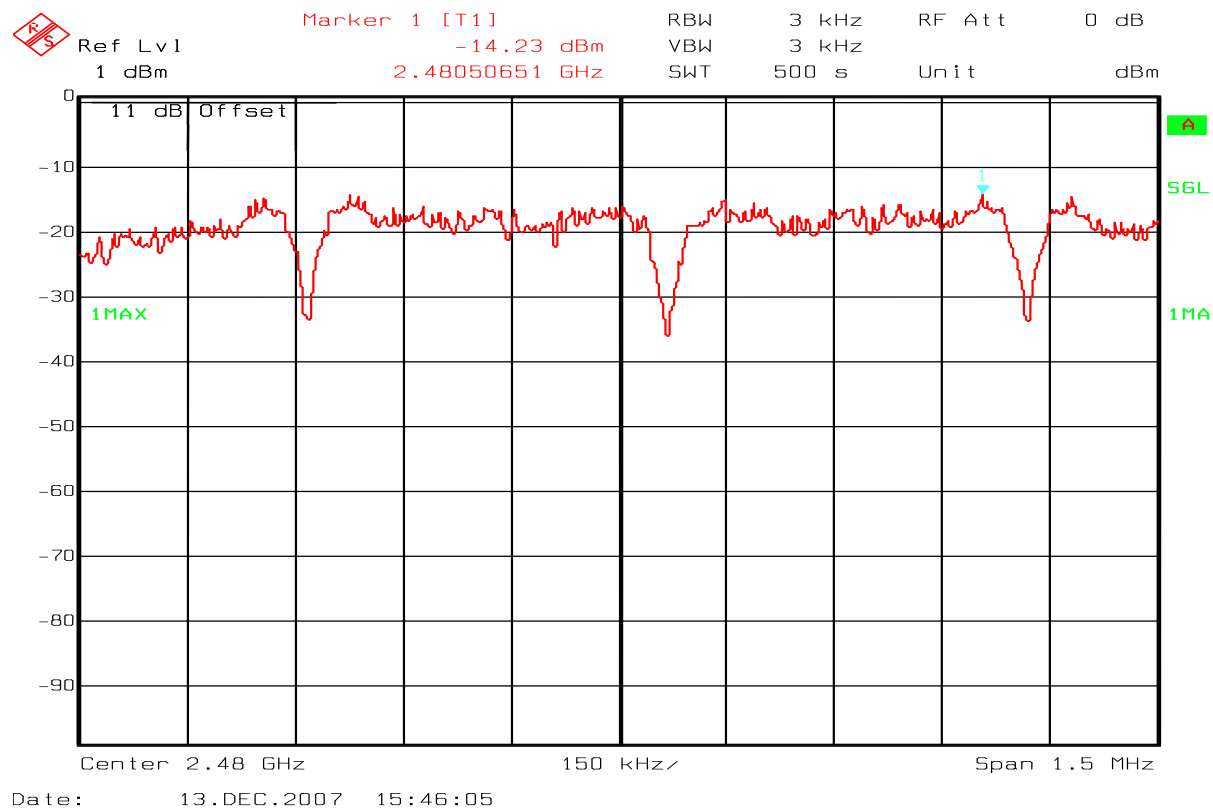
No requirements for Frequency Hopping Systems.



Ch11 – Power Density – Conducted measurement



Ch19 – Power Density – Conducted measurement



Ch26 – Power Density – Conducted measurement

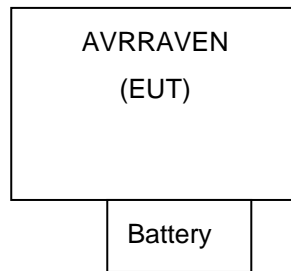
5 LIST OF TEST EQUIPMENT

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.
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	ESN	EMI Receiver	Rohde & Schwarz	LR 1237
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Sivers lab	LR 103
7	DBF-520-20	Antenna horn	Systron Donner	LR 101
8	638	Antenna horn	Narda	LR 098
9	Sucoflex 102E	Cable microwave	Suhner	LR 1370
10	6032A	Power supply	HP	LR 1062
11	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076
12	8449B	Amplifier	Hewlett Packard	LR 1322
13	959C	Printer	Hewlett Packard	LR 1414
14	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285
15	10855A	Amplifier	Hewlett Packard	LR 1445
16	HL223	Antenna log.per	Rohde & Schwarz	LR 1261
17	HK116	Antenna biconic	Rohde & Schwarz	LR 1260
18	ESVS 30	Test Receiver	Rohde & Schwarz	LR 1101
19	R3271	Spectrum Analyzer	Advantest	LR 1123
20	B32-10R	Power supply	Oltronix	LR 126
21	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504

6 BLOCK DIAGRAM

6.1 System set up



6.2 Test Site Radiated Emission

