Nemko

COMLAB
Accredited Testing and Certification
EMC, Radio and Telecommunications

www.nemko.com

Test report no. : 75018/4

Item tested : UW-CM-08-24-CP-11

Type of equipment : IEEE 802.15.4, 2.4GHz Evaluation Module

FCC ID : U2VCM-08-24-CP-11

Client : UBIWAVE

FCC Part 15.247
Digital Transmission System

16 February 2007

Authorized by : .....
Frode Sveinsen
Technical Verificator

CONTENTS

1 GENERAL INFORMATION

1.1 Testhouse Info

Name :	Nemko Comlab
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E-mail:	post@comlab.no
FCC test firm registration # :	994405
IC OATS registration # :	4443
Total Number of Pages:	37

1.2 Client Information

Name :	Ubiwave
Address :	Lindestraat 19, BE-9240 ZELE, Belgium
Telephone :	+32 52 45 87 23
Fax :	--

Contact:

Name :	Wim De Kimpe
Telephone :	+32 52 45 87 23
E-mail :	wim.de.kimpe@ubiwave.com

1.3 Manufacturer

Name :	Ubiwave
Address :	Lindestraat 19, BE-9240 ZELE, Belgium
Telephone :	+32 52 45 87 23

2 Test Information

2.1 Test Item

Name :	UW-CM-08-24-CP-11
FCC ID :	U2VCM-08-24-CP-11
Model/version :	UW-CM-08-24-CP-11
Serial number :	001520000010020
Hardware identity and/or version:	1.00 200647
Software identity and/or version :	UW-CM-08 basic test software
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 :	70 mW
Type of Power Supply :	DC 2.6 – 3.6V
Antenna Connector :	Integral antenna only
Antenna Diversity Supported :	None

1) 16 channels in use.

Theory of Operation

The UW-CM-08-24-CP-11 transceiver module is an IEEE® 802.15.4-compliant surface-mounted 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 UW-CM-08-24-CP-11 is a complete shielded module with dimension of 16.5 x 29.2x3.5 mm.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 - 22 °C
Relative humidity:	20 - 40 %
Normal test voltage:	2.7 – 3.6 V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2006-12-04
Test period :	from 2006-12-04 to 2006-12-06

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Ubiwave

Model No.: UW-CM-08-24-CP-11

Serial No.: 001520000010020

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15.247 and Industry Canada RSS-210 Issue 6.

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 #: 75018/4

TESTED BY: _____ DATE: 16.02.2007

G.Suhanthakumar, Test engineer

3.2 Test Summary

Name of test	Paragraph #	Result
Supply voltage variations	15.31 (e)	Complies[2]
Number of operating frequencies	15.31 (m)	Complies
Power-line Conducted Emissions (Receiver)	15.107(a)	ref. 15.207(a)
Radiated Emissions limits (receiver)	15.109(a)	ref. 15.209(a)
Antenna requirement	15.203	Complies[1]
Radiated emissions limits for restricted bands	15.205(a)	Complies
Power Line Conducted Emissions	15.207(a)	Complies
Radiated emission limits	15.209(a)	Complies
Bandwidth	15.247(a)(2)	Complies
Peak Power Output	15.247(b)(3)	Complies
Power Spectral Density	15.247(d)	Complies
Out-of-band emissions (Antenna Conducted)	15.247(c)	Complies[1]
Out-of-band emissions (Radiated)	15.247(c)	Complies
Upper band edge radiated emission	15.247(c)	Complies

[1] Integral antenna only

[2] The manufacturer specified voltage range is 2.7 – 3.6 V DC

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 with “standard hyper-terminal software” via RS232 port. The laptop Model type is DELL Latitude, D610. The laptop is belongs to the Nemko test lab.

An external laboratory DC power supply is used for measurements. Model type Oltronix B32-10R (belongs to Nemko test lab)

The measurements were done with external DC supply of 3.4V. It was checked that power variations between 2.7 – 3.6 V DC did not have any influence on the measurements. The manufacturer specified voltage range is 2.7 – 3.6 V DC.

All ports were 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: G.Suhanthakumar	**Date of Test: 05.12.2006**

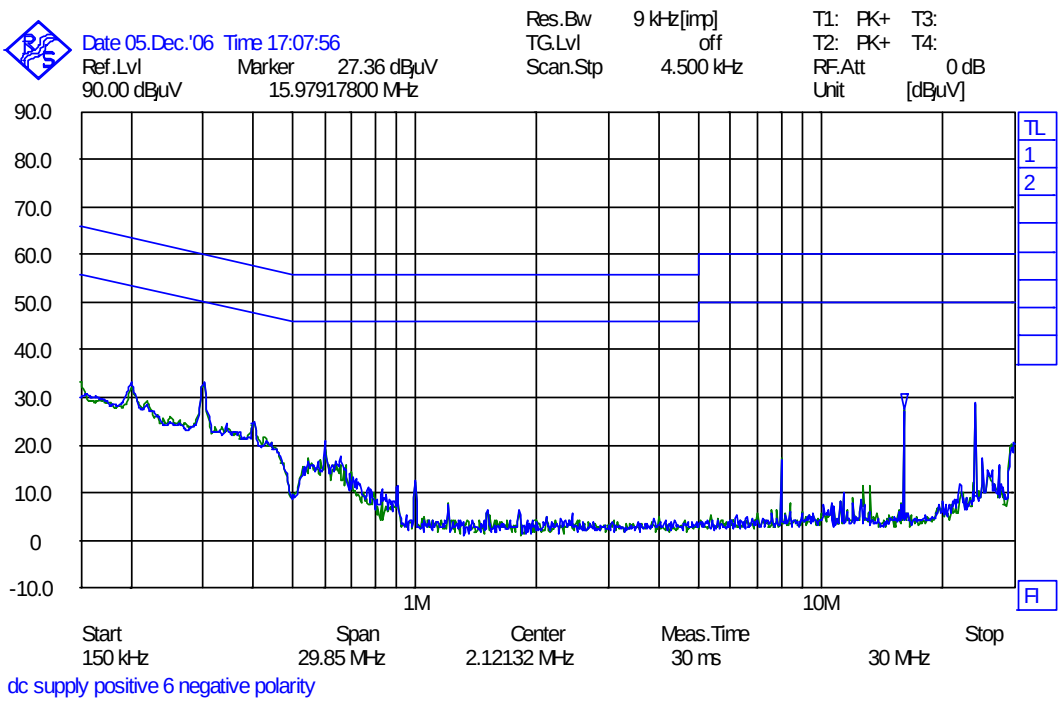
Measurement procedure: ANSI C63.4-2003 using 50 μH/50 ohms LISN.

Test Results: **Complies.**

Measurement Data: **Peak detector was used.**

External DC power supply used- Type Oltronix B32-10R

The measured peak values are below the Quasi-Peak and Average limit.



Positive & Negative Polarity

4.2 Minimum 6 dB Bandwidth

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

Test Performed By: G.Suhanthakumar	**Date of Test: 04.12.2006**

Test Results: Complies

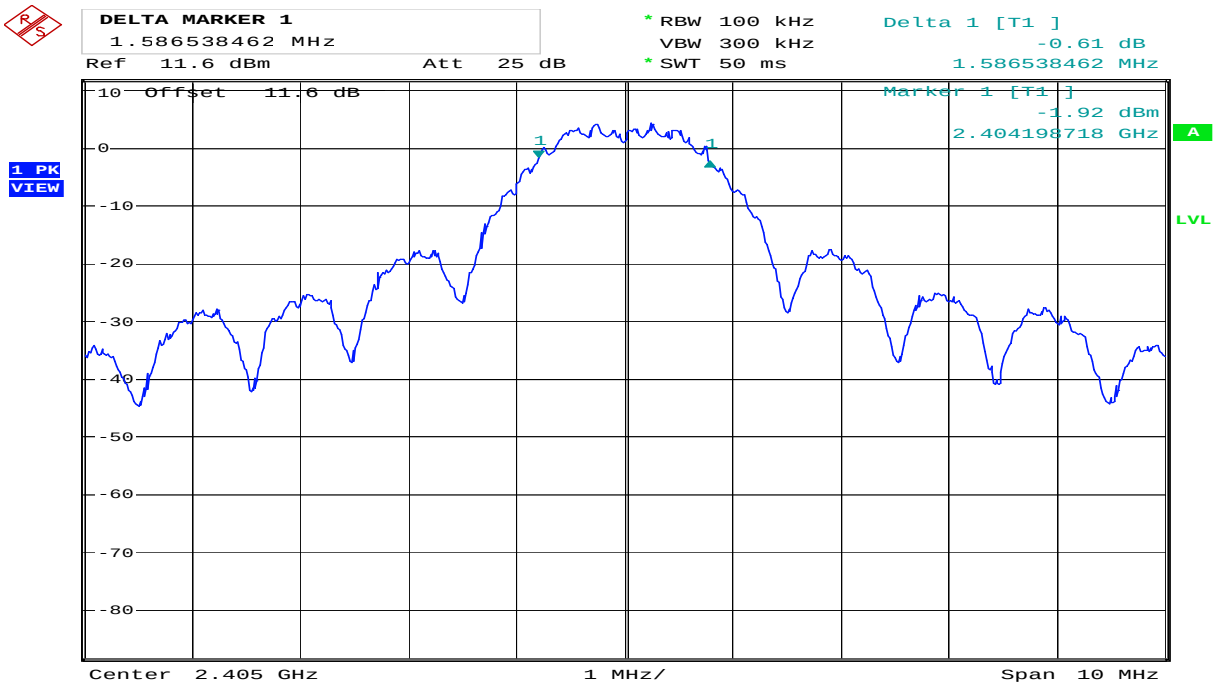
Measurement Data:

6 dB Bandwidth (MHz)		
Ch 11 **2405MHz**	**Ch 18** **2440MHz**	**Ch 26** **2480MHz**
1.58	1.53	1.58

Power supply variation within manufacturer specified range 2.7 – 3.6V DC has no influence on measured value.

Requirements:

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



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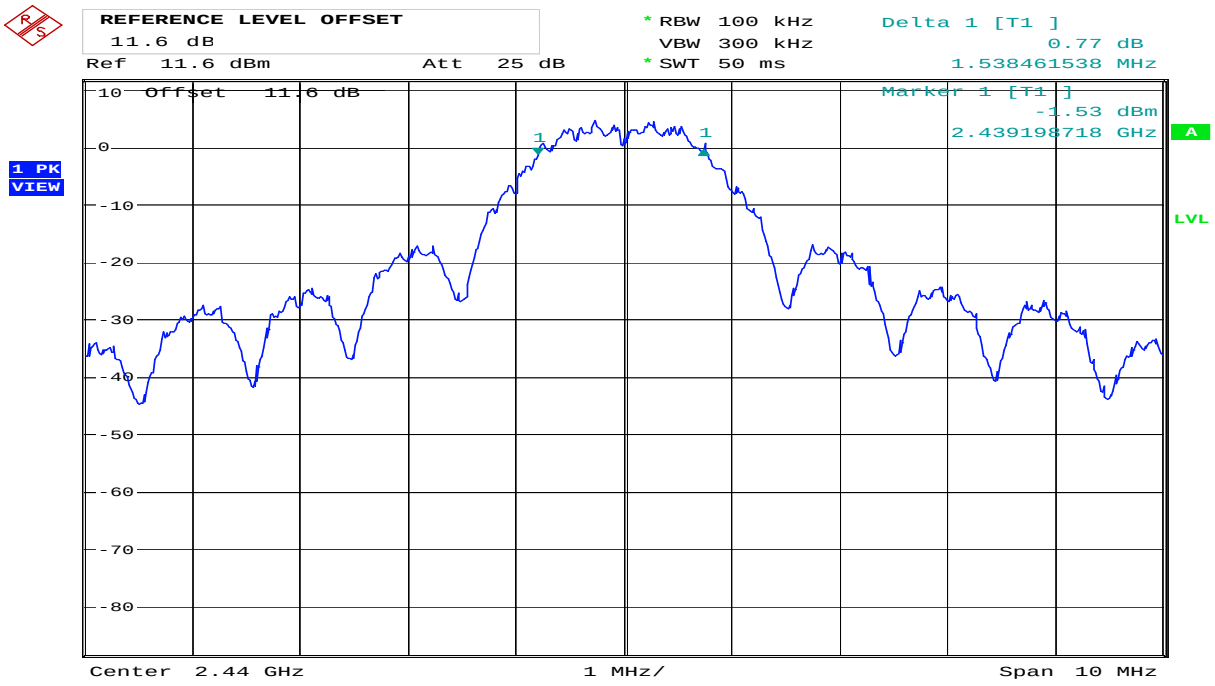
Ch11 – 6 dB bandwidth – 1.58MHz



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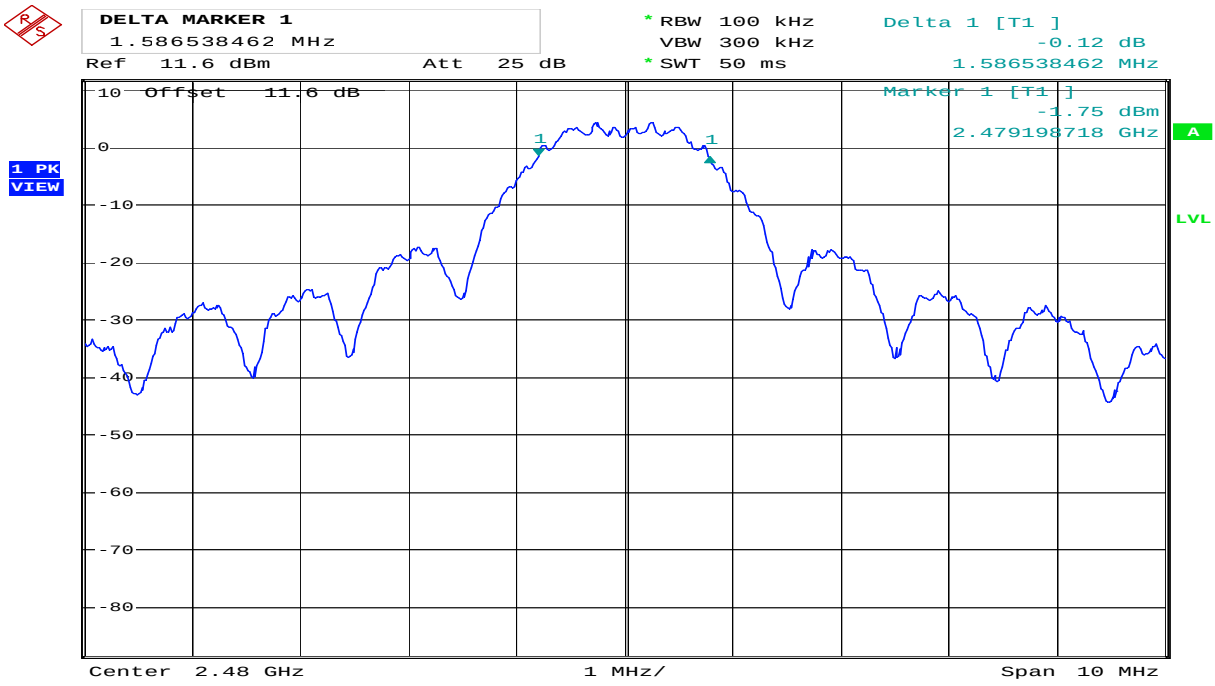
Ch18 – 6 dB bandwidth – 1.53MHz



Date: 4.DEC.2006 17:11:10

CH26 – 6 dB bandwidth – 1.58MHz

4.3 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suhanthakumar	**Date of Test: 04.12.2006**

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	**Ch11**	**Ch18**	**Ch26**
Measured value (mW)	64.6	71.1	23.3

Maximum EIRP

RF channel	**Ch11**	**Ch18**	**Ch 26**
Measured EIRP (mW)	12.58	16	4.78
Antenna gain dBi	-7.1	-6.5	-6.9

Antenna gain = 10*log(EIRP/Conducted power) dBi

The EIRP is measured using substitution method.

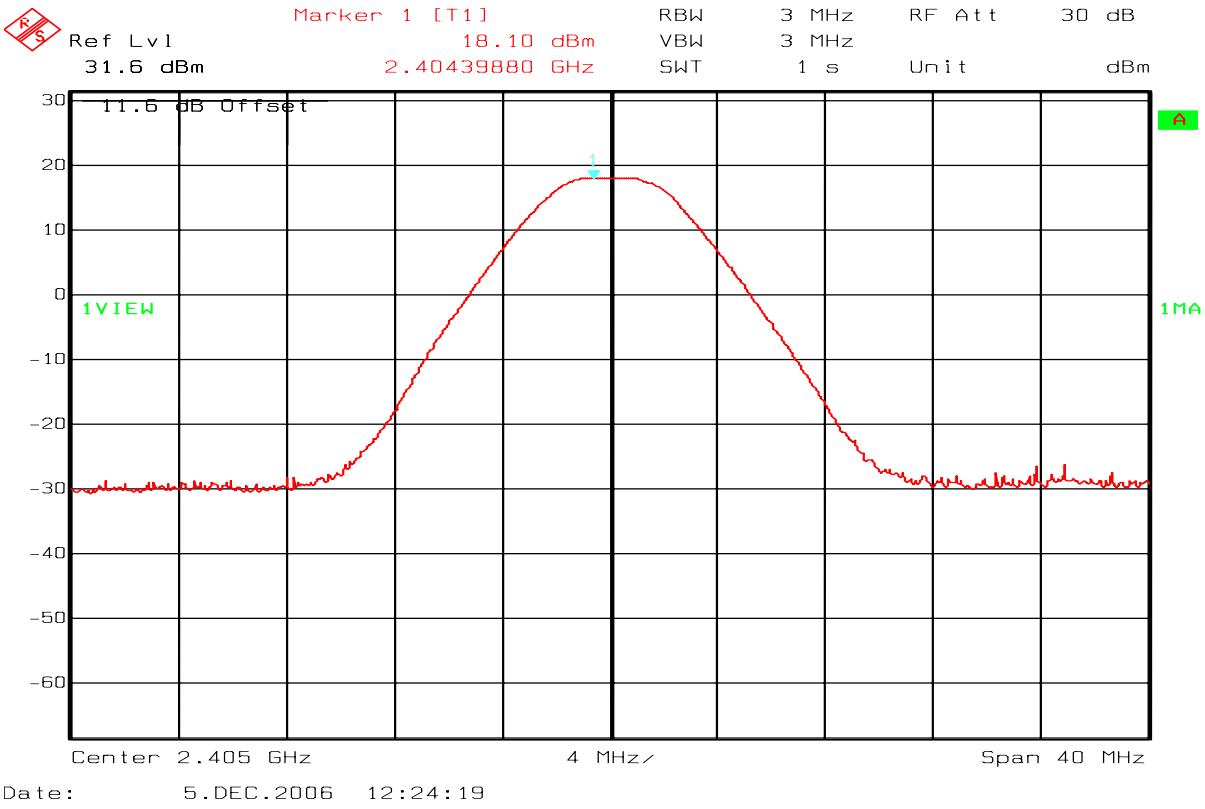
Detachable antenna?	☐ Yes	☒ No
If detachable, is the antenna connector non-standard?	☐ Yes	☐ No

Requirements:

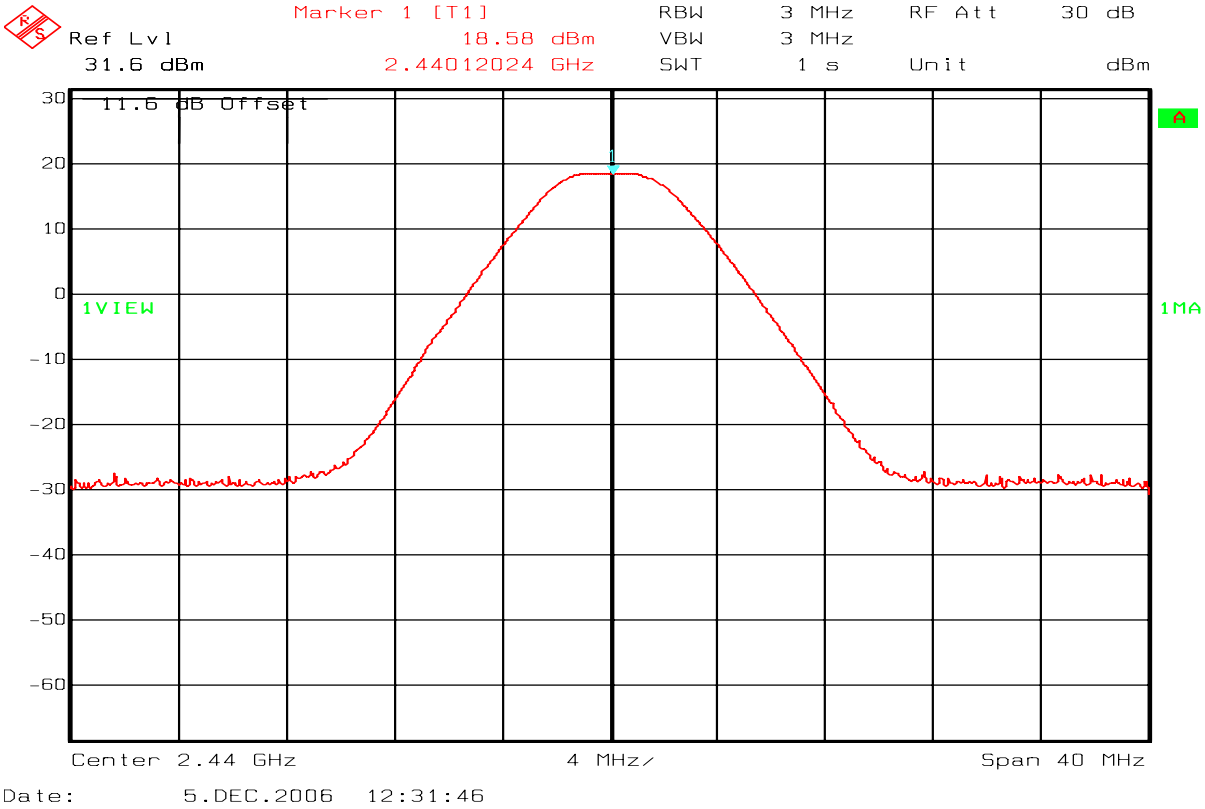
The maximum peak output power shall not exceed the following limits:

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

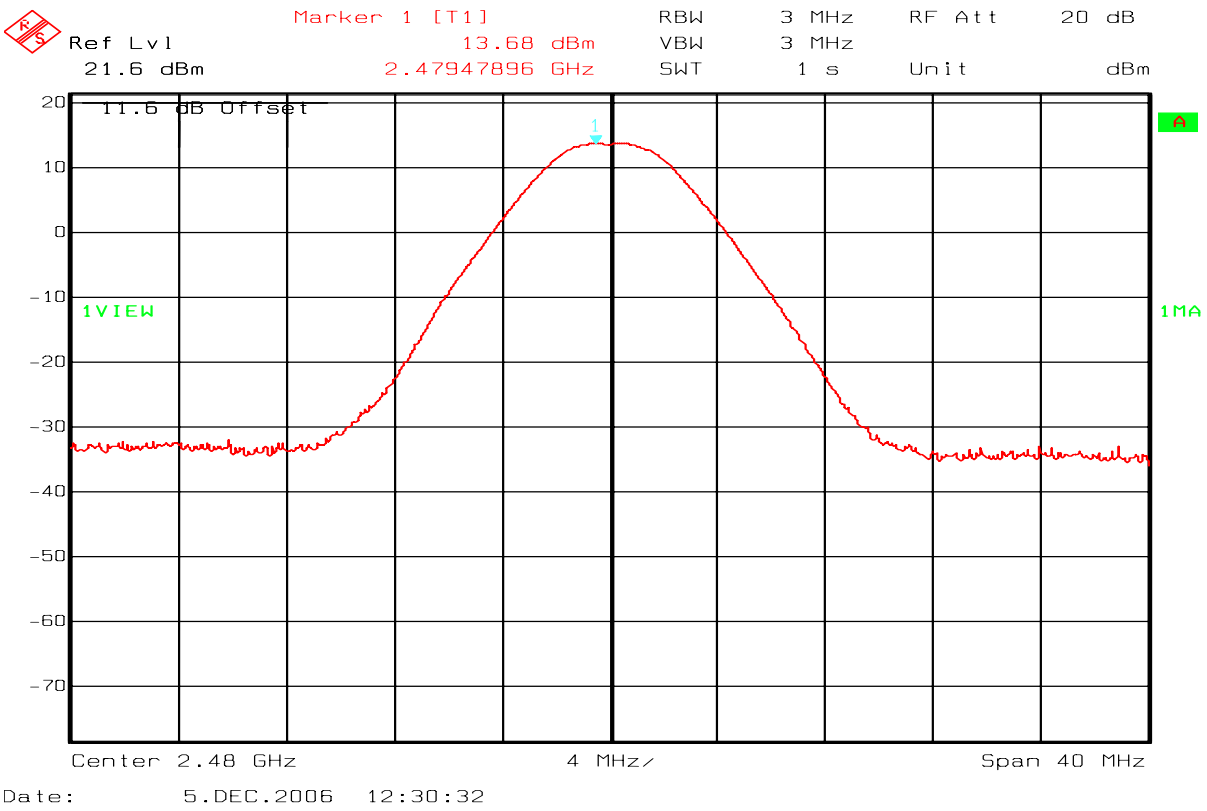
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Ch11 – Conducted Peak Output Power



Ch18 – Conducted Peak Output Power



Ch26 – Conducted Peak Output Power

4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suhanthakumar	**Date of Test: 05.12.2006**

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	39	-20	19

Band-edge field strength 2.4 GHz.

Marker Delta 100kHz RBW: 39dB

Peak Field Strength 106.75– 39 = 67.8 dBμV/m

Average Field Strength: 67.8 dBμV/m – 20.0 dB = 47.8 dBμV/m

Upper Band-edge radiated measurements

Frequency	Power below nearest channel, dB	Limit	Margin
GHz	RF ch 26 DSS	dB	dB
2.4835	31.8	-20	11.8

Band-edge field strength 2.4835 GHz.

Marker Delta 100kHz RBW: 31.8dB

Peak Field Strength 102.18– 31.8 = 70.38 dBμV/m

Average Field Strength: 70.38 dBμV/m – 20.0 dB = 50.4 dBμV/m

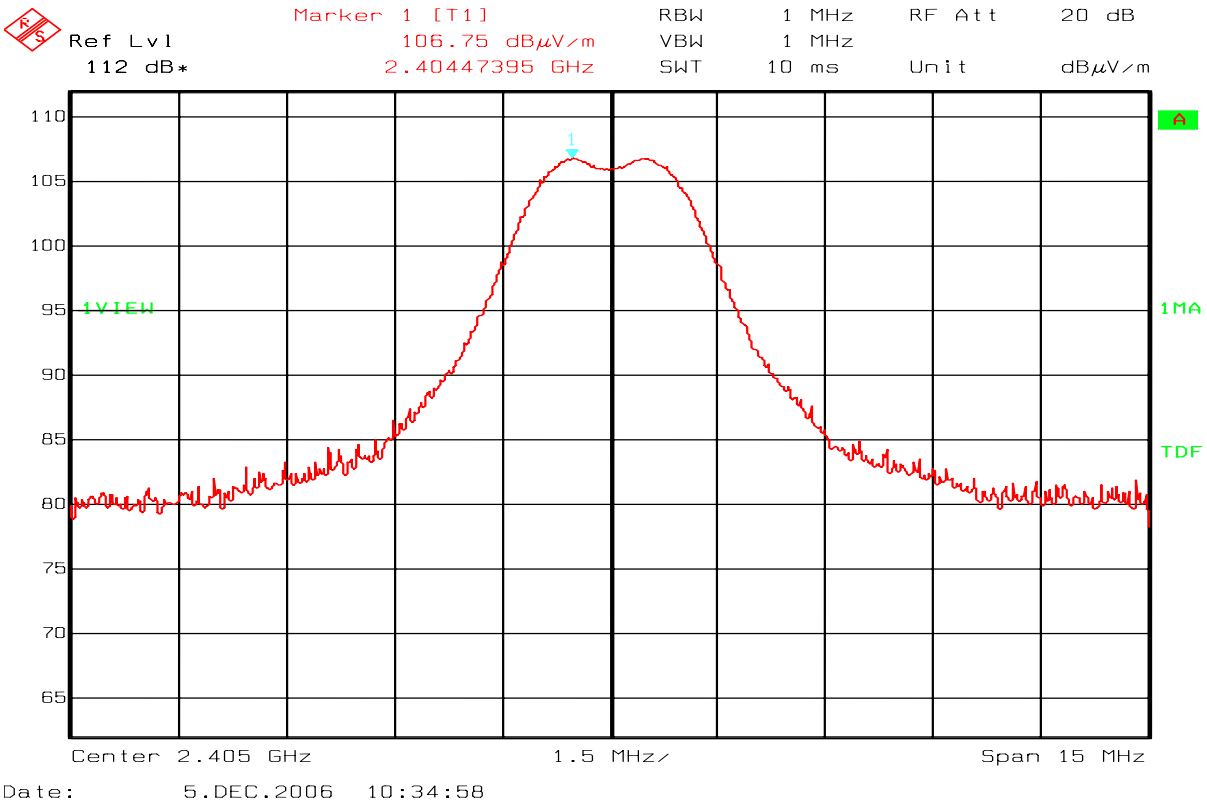
RF conducted emissions to 25 GHz

Maximum RF level outside operating band:

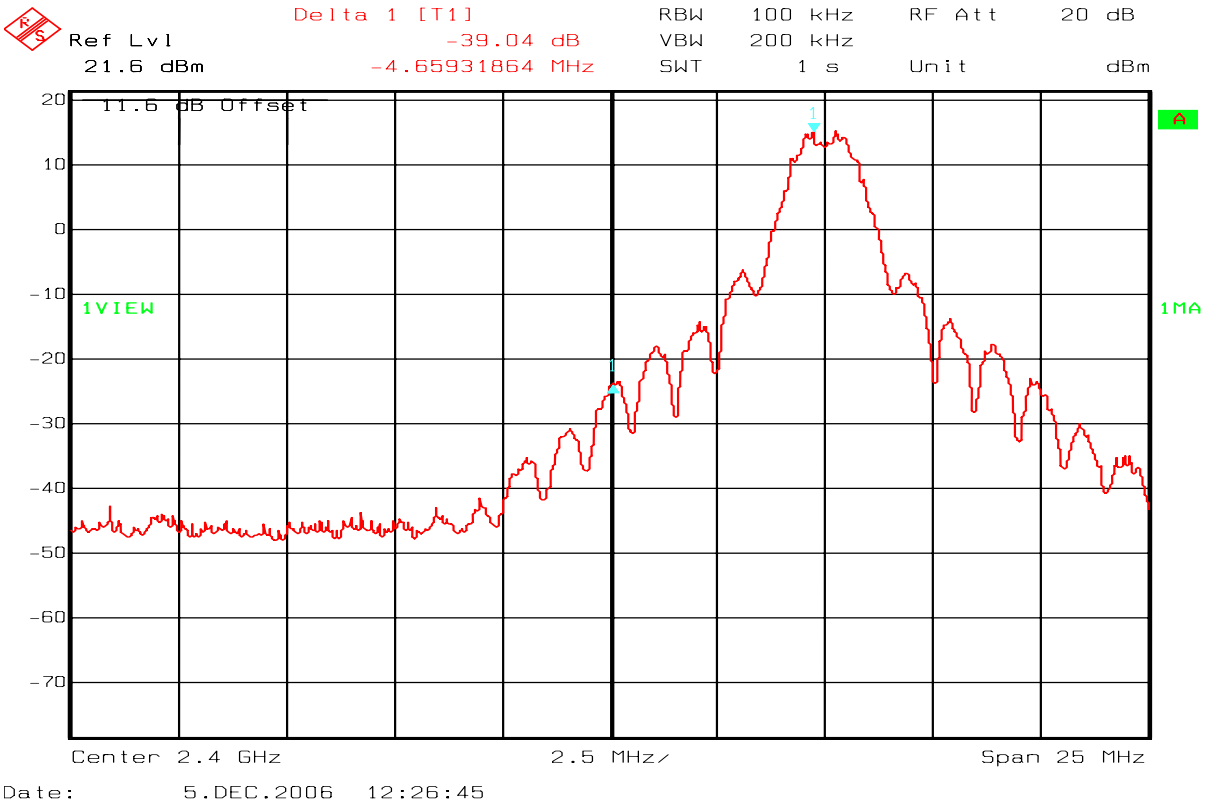
RF ch 11: 48.5 dB/C, margin > 20 dB

RF ch 18: 43.5 dB/C, margin > 20 dB

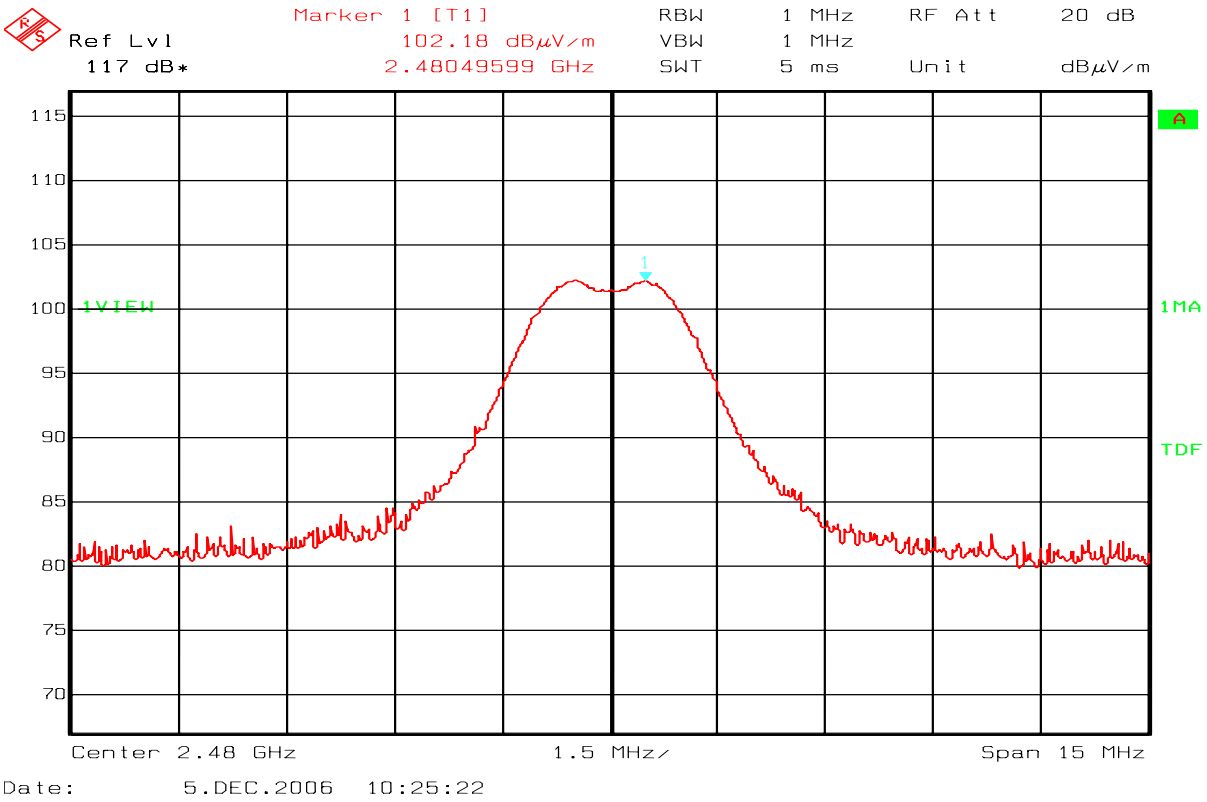
RF ch 26: 42.5 dB/C, margin > 20 dB



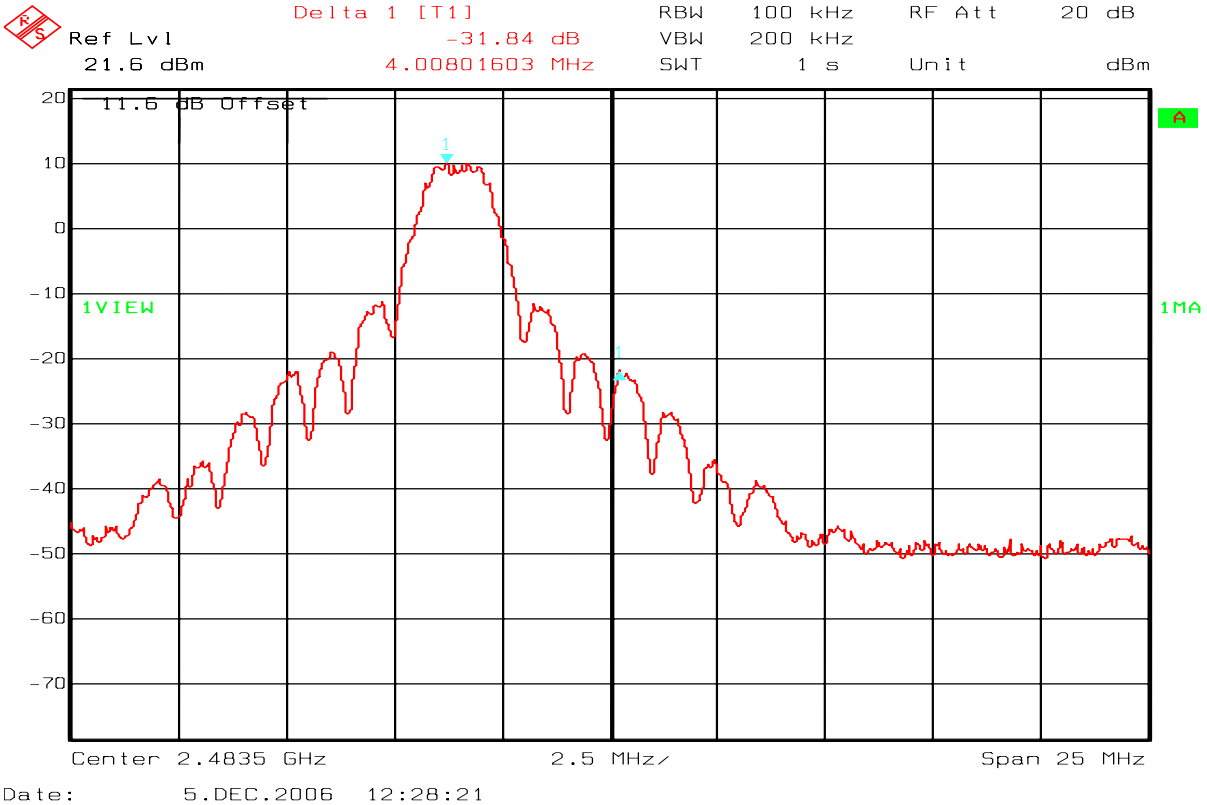
Ch11 – lower-band –field strength



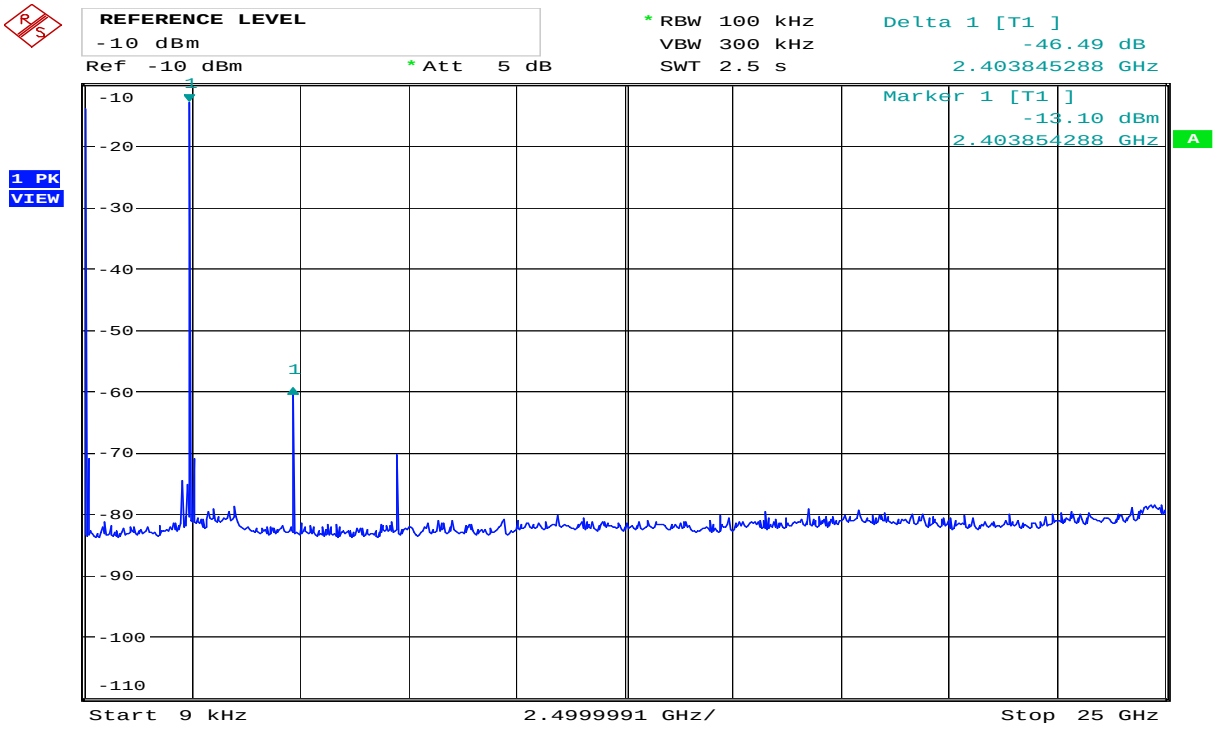
Ch11 – Lower-band-edge – Delta-marker



Ch26 – upper-band –field strength

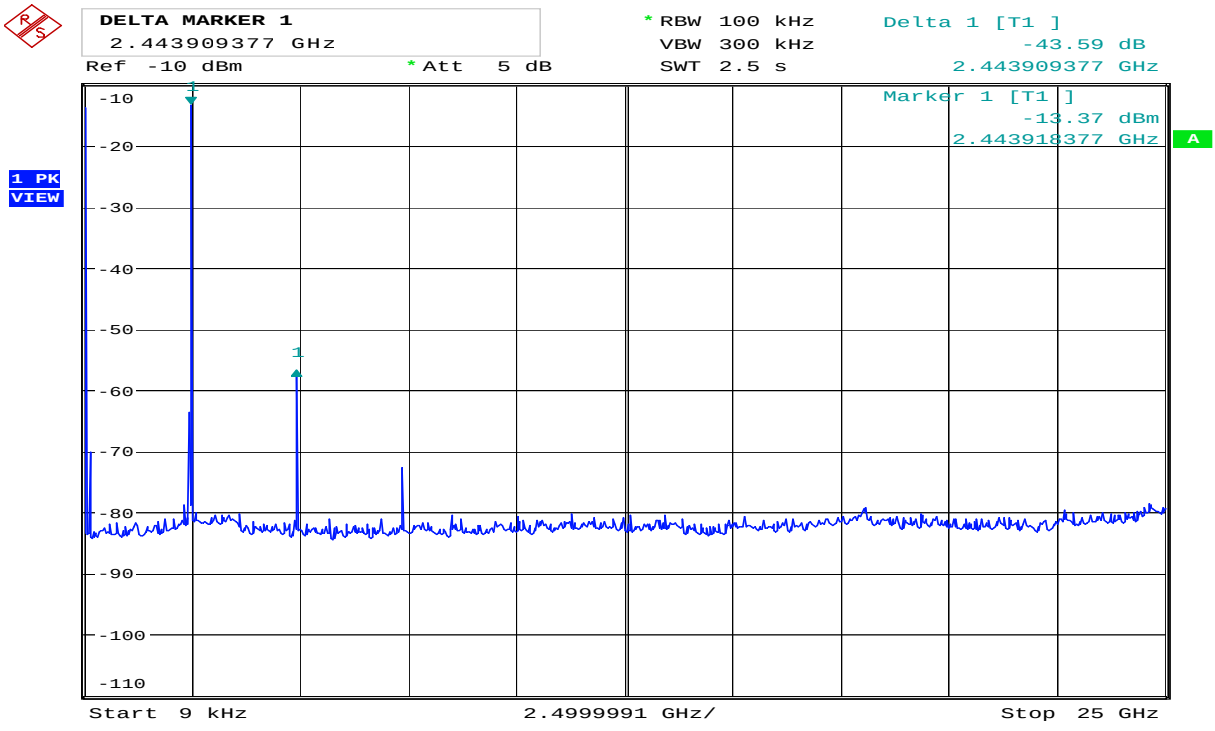


Ch26 – Upper-band-edge – Delta-marker



Date: 5.DEC.2006 15:40:46

Ch11 – Conducted Spurious – 9kHz – 25GHz



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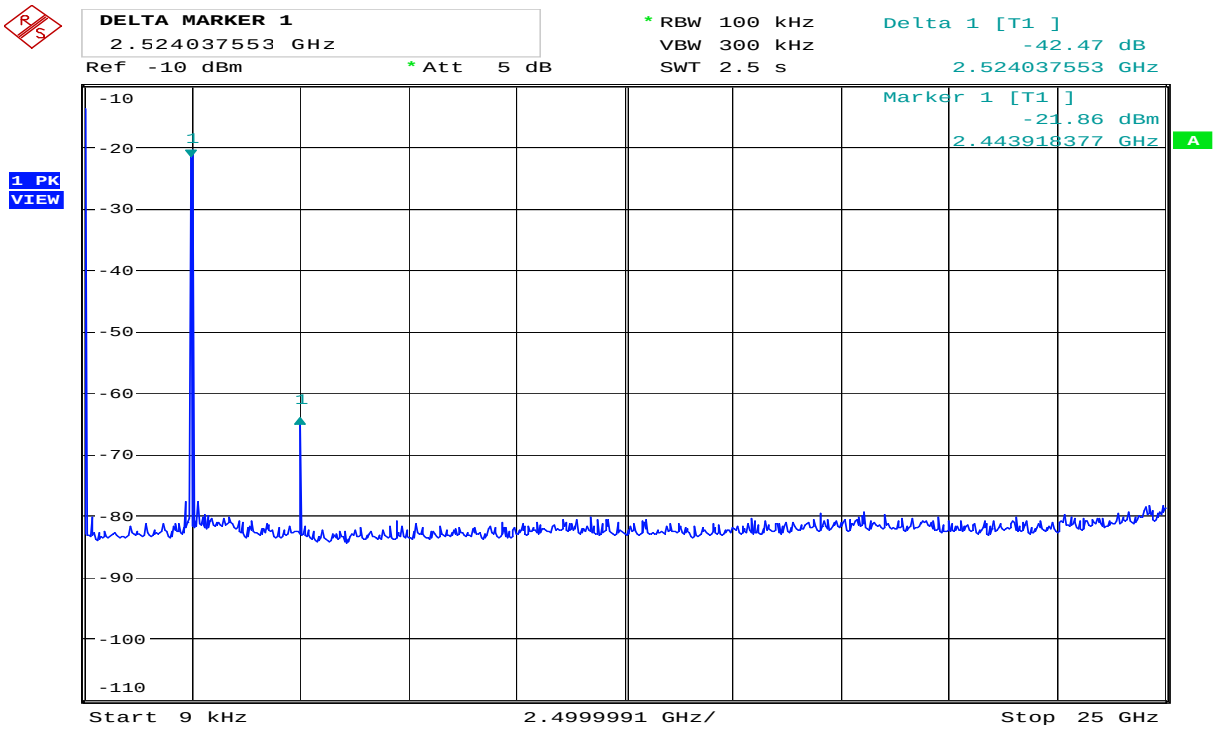
Ch18 – Conducted Spurious – 9kHz – 25GHz



Date: 5.DEC.2006 15:42:52

Ch26 – Conducted Spurious – 9kHz – 25GHz

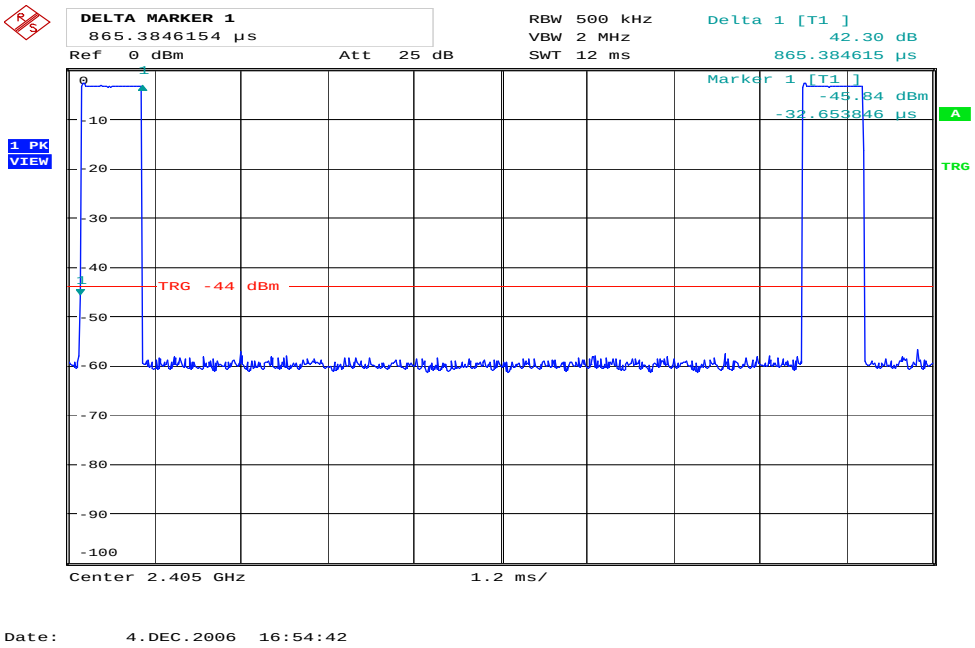
Duty Cycle Calculation:

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

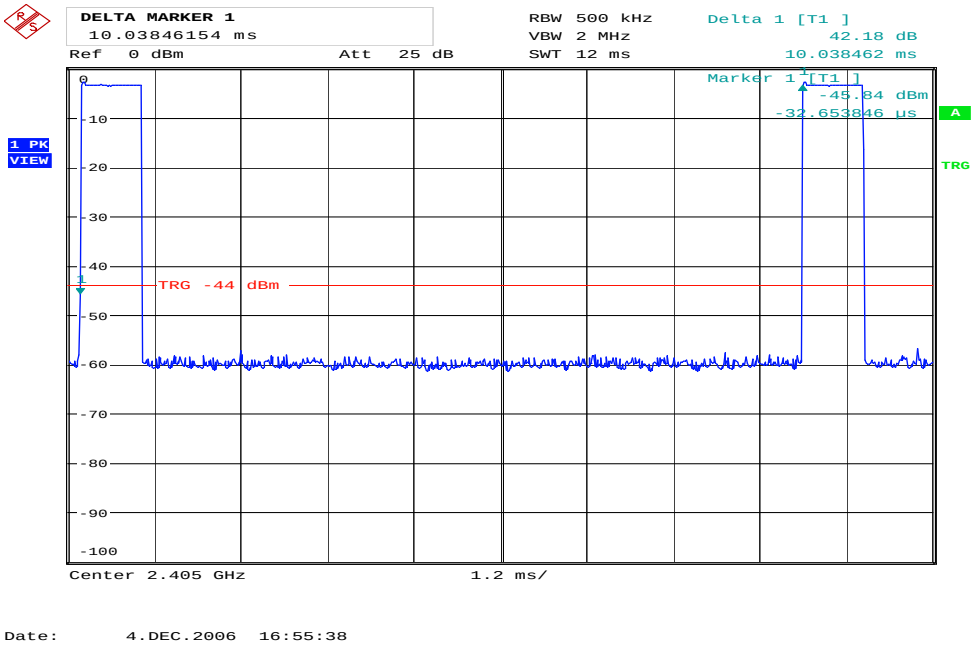
-20*log (0.865ms/10ms) = 21.25 dB

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

This value is used when measuring average field strength above 1 GHz with Peak Detector function employed on spectrum analyzer.



Duty Cycle – ON-time



Duty Cycle – OFF time

Radiated Emissions, 1-25 GHz

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

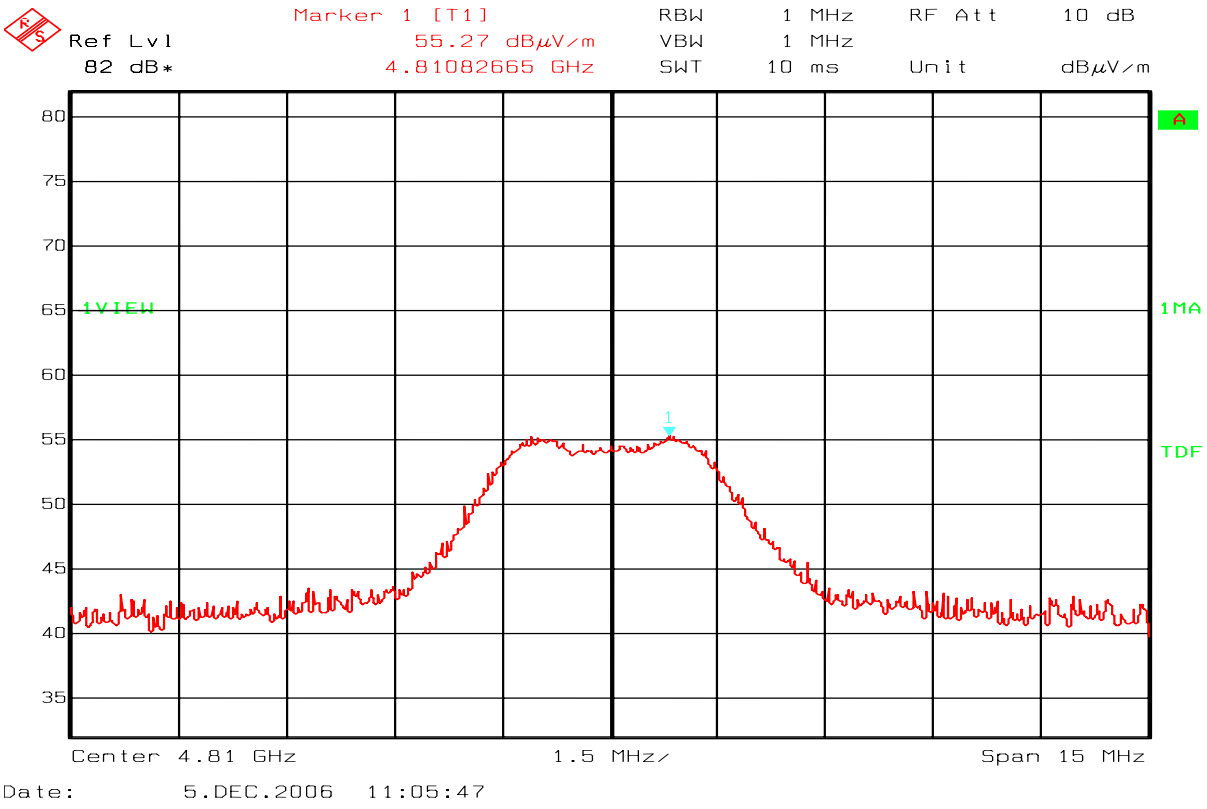
Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3m	Duty cycle corr. factor	Limit	Margin
GHz	11-26	dB	dBμV/m	dB	dBμV/m	dB
4.810	11	0	55.27	-	74	18.73
4.870	18	0	57.42	-	74	16.58
4.960	26	0	50.53	-	74	23.47
7.210	11	0	58.70	-	74	15.3
7.321	18	0	55.43	-	74	18.57
7.437	26	0	46.14	-	74	27.86
8 - 25	11,18,26	0	None detected	-	-	-

Radiated emission 1- 25 GHz, Average

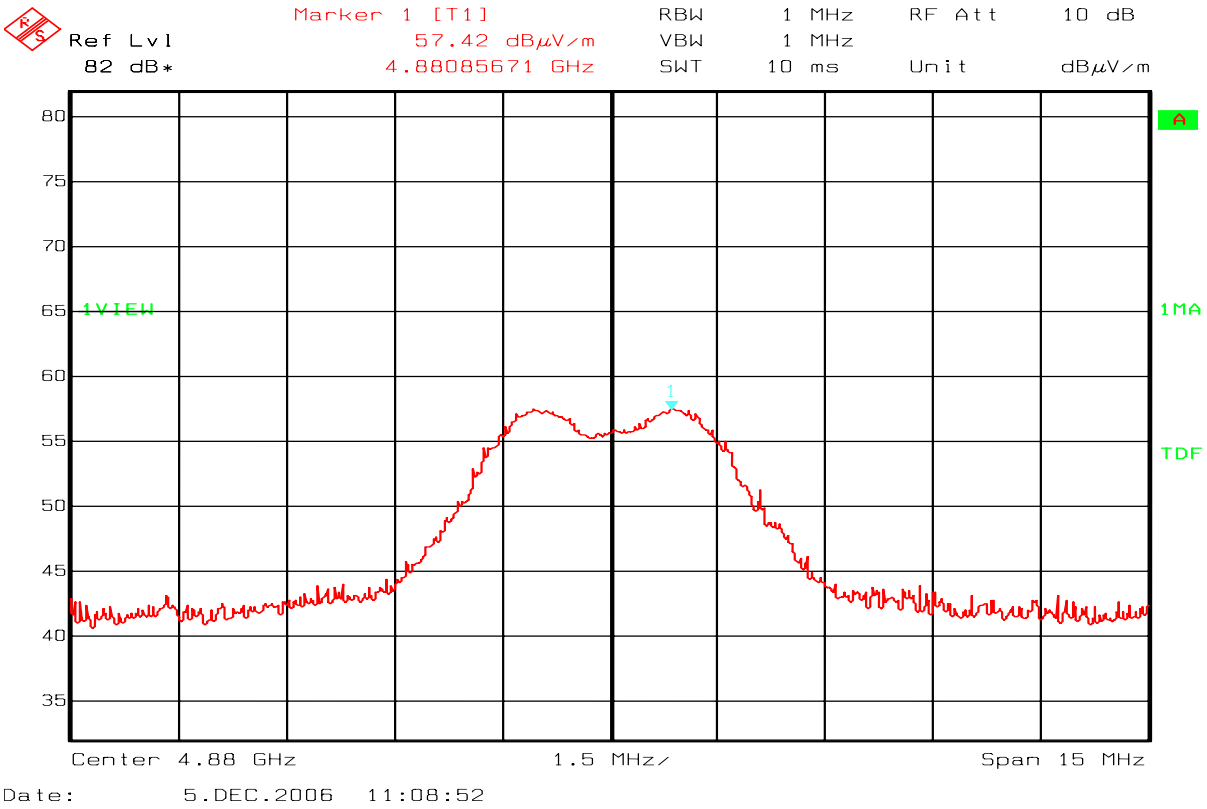
Calculated value from Peak Detector

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
4.810	11	0	55.27	20	54	18.73
4.880	18	0	57.42	20	54	16.58
4.960	26	0	50.53	20	54	23.47
7.210	11	0	58.70	20	54	15.3
7.321	18	0	55.43	20	54	18.57
7.437	26	0	46.14	20	54	27.86
8 - 25	11,18,26	0	None detected	20	-	-

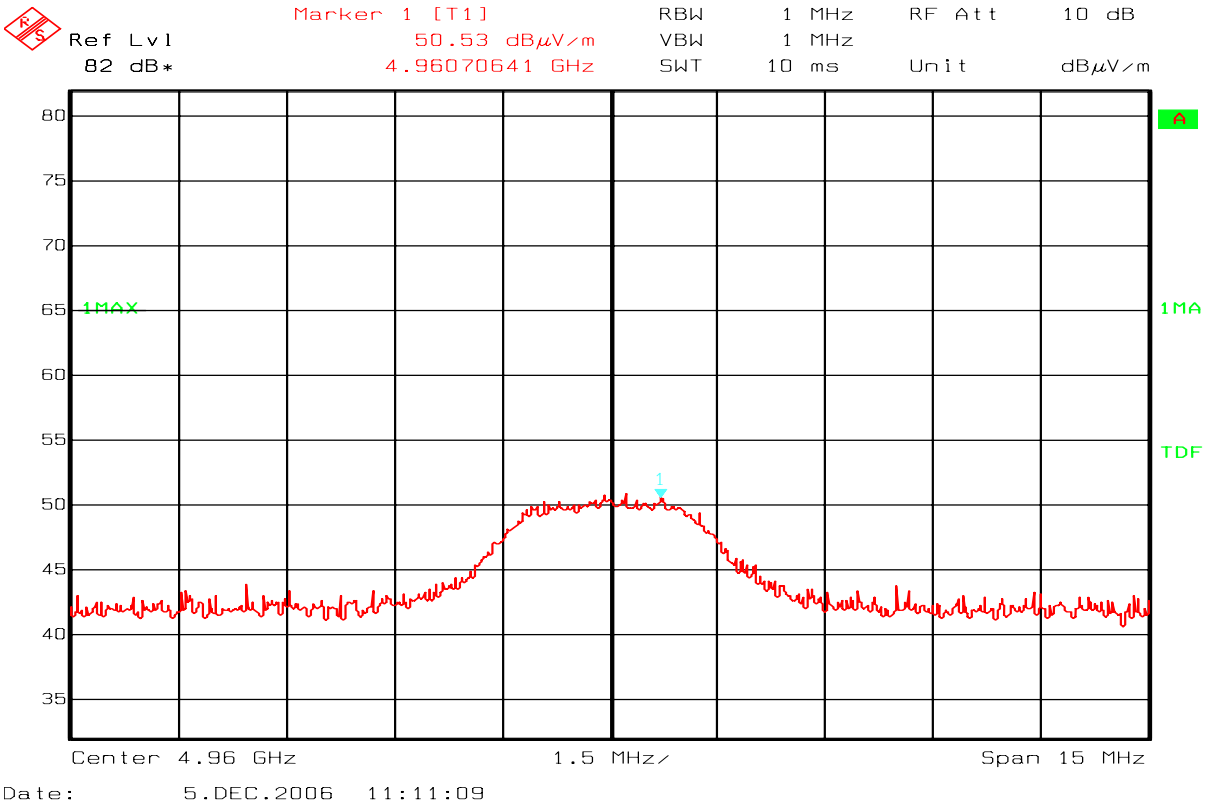
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer “Transducer factor”.



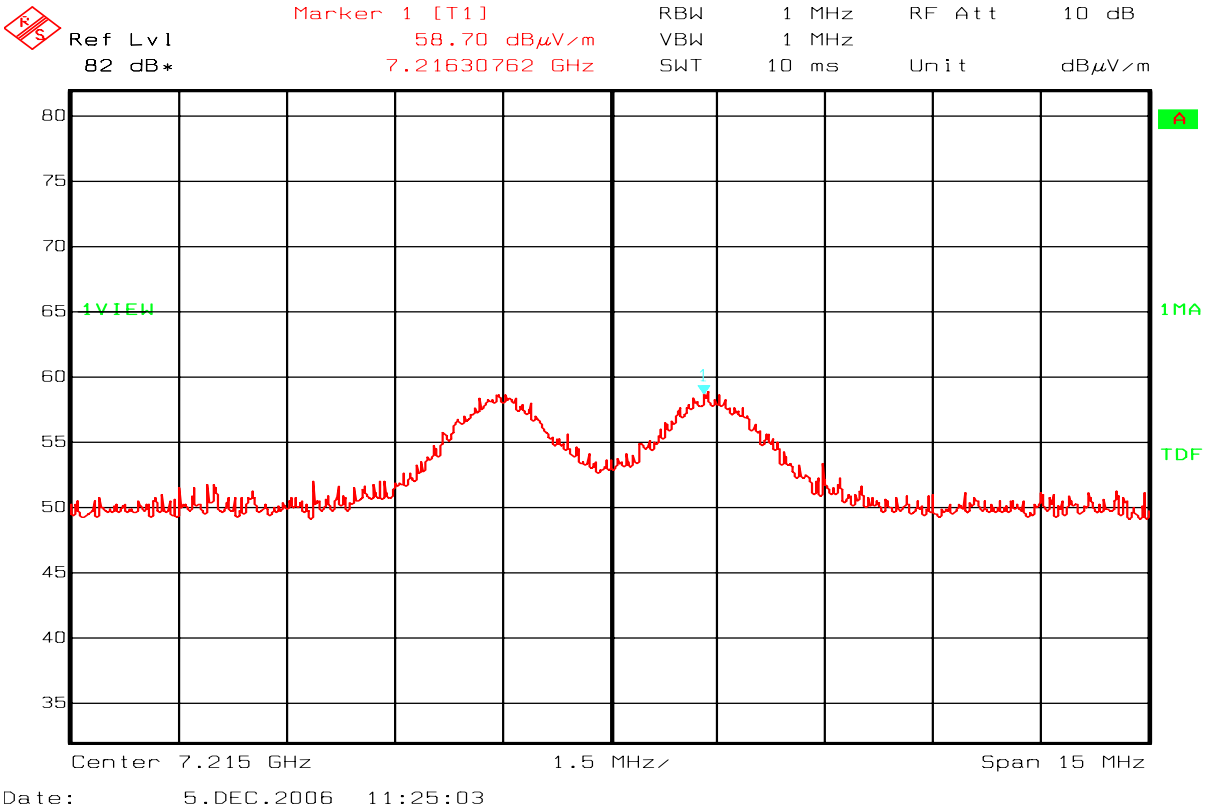
Ch11 – 2nd harmonic



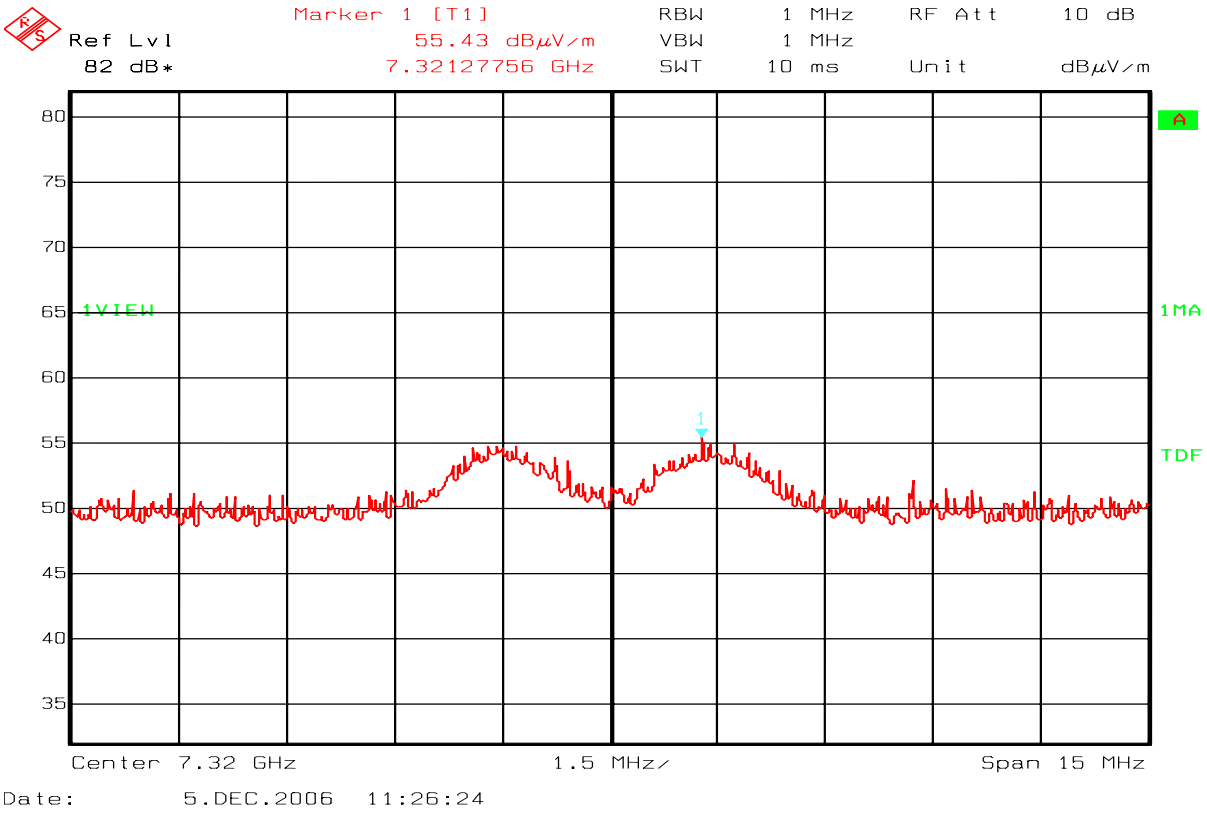
Ch18 – 2nd Harmonic



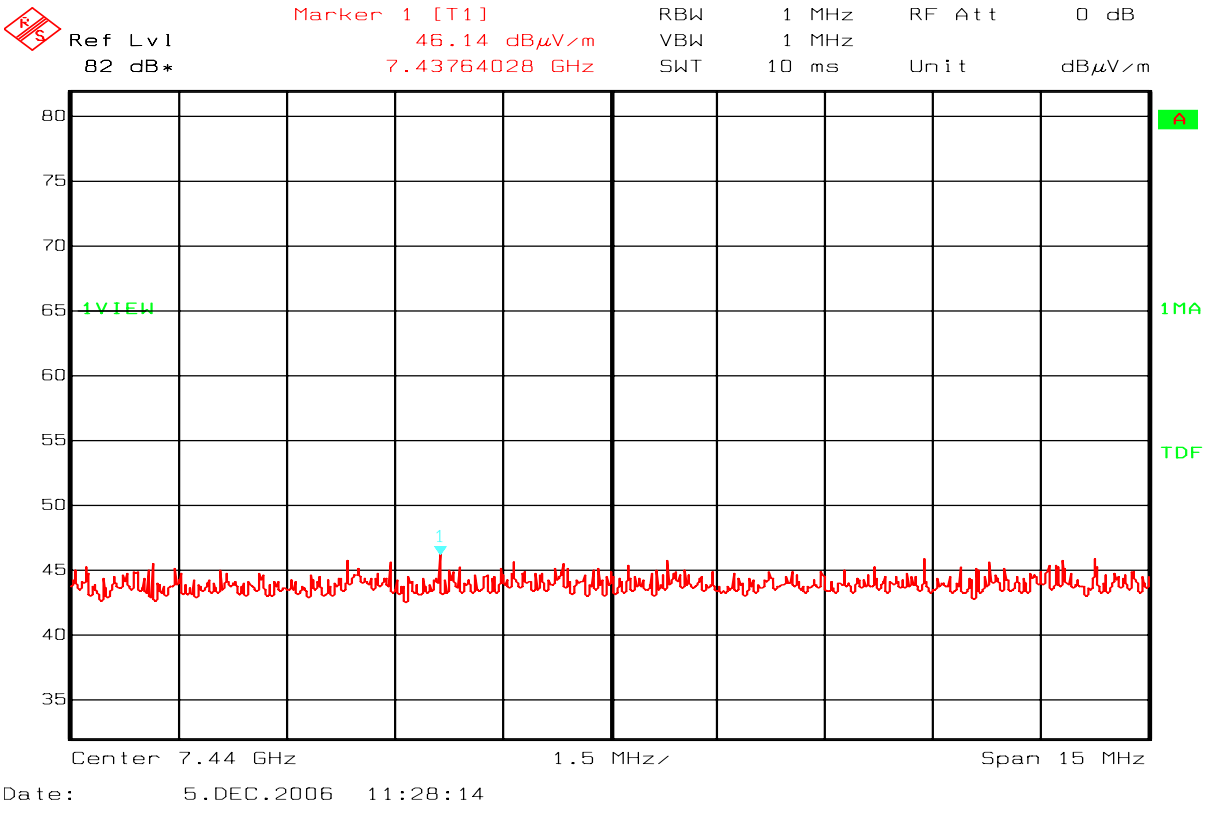
Ch26 – 2nd Harmonic



CH 11 – 3rd harmonic



CH 18 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		dBμV/m	m	dBμV/m	dB
30 -200	TX ON/RX	< 30	3	40	>10
200 -1000	TX on/RX	< 30	3	40	>10

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05. Dec 06 13:04

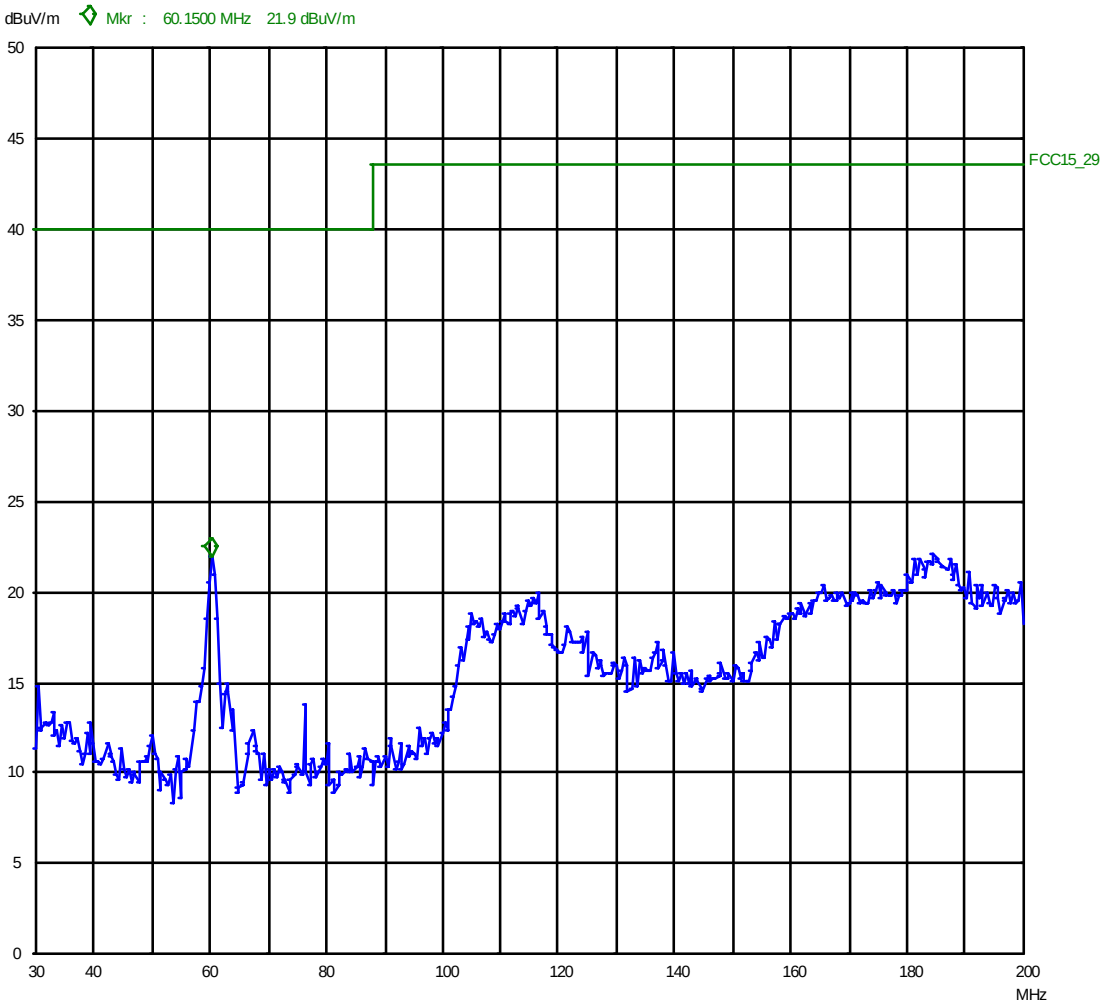
Peak

EUT: RC2201HP-UW
Op Cond: 1m vp
Operator: gns
Test Spec: fcc 15
Comment: 3m

Scan Settings (1 Range)

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

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



VP – 30 – 200 MHz

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05. Dec 06 13:18

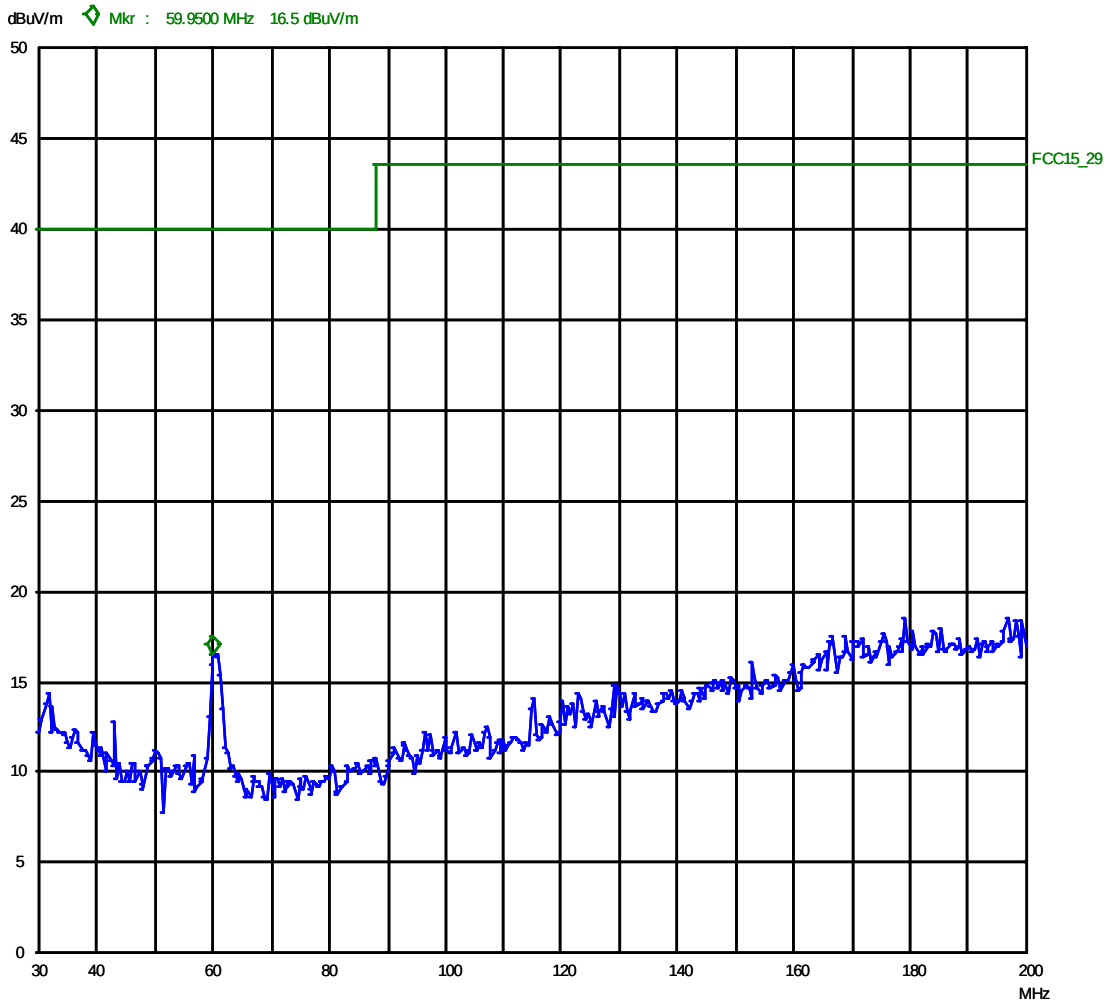
Peak

EUT: RC2201HP-UW
Op Cond: 4m hp
Operator: gns
Test Spec: fcc 15
Comment: 3m

Scan Settings (1 Range)

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

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



HP – 30 – 200MHz

Nemko Comlab

05. Dec 06 13:26

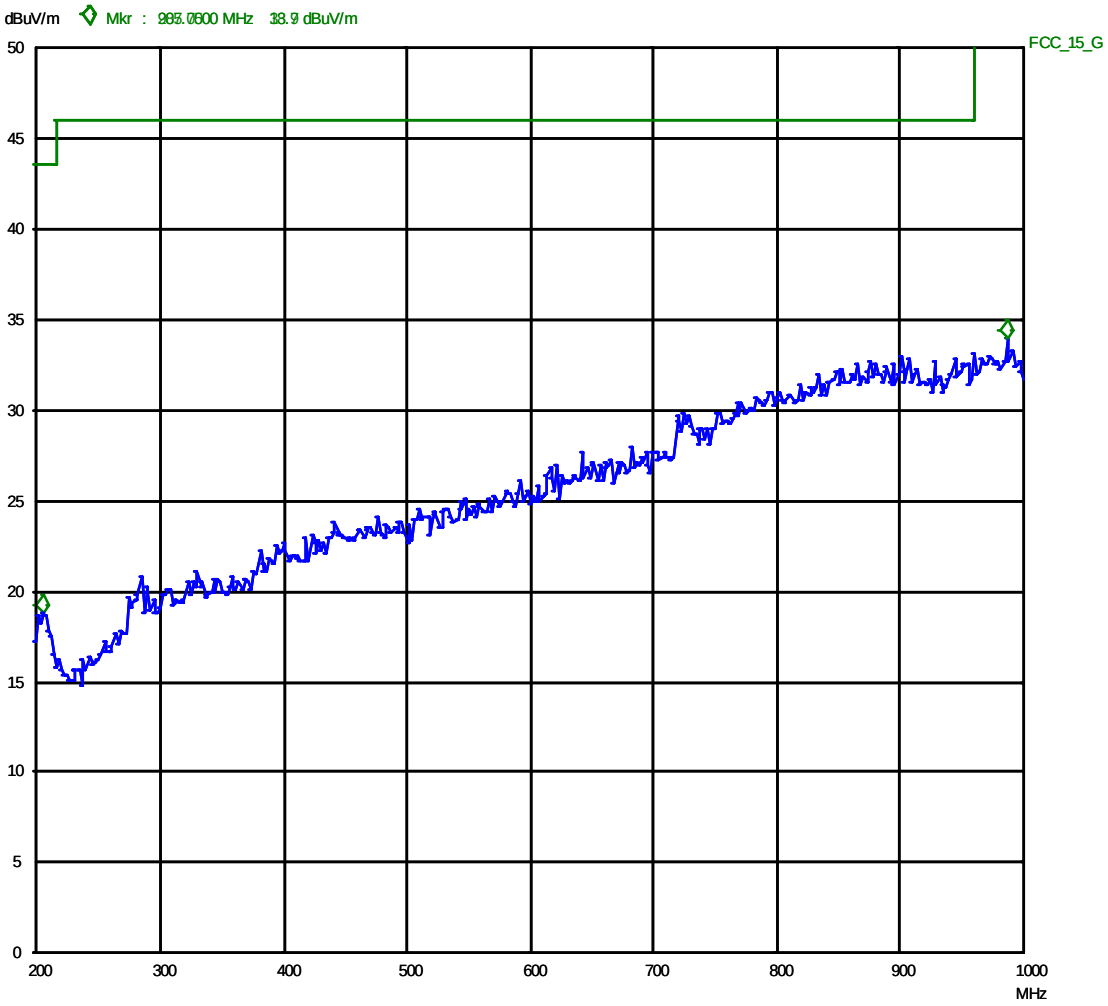
Peak

EUT: RC2201HP-UW
Op Cond: 1m vp
Operator: gns
Test Spec: fcc 15
Comment: 3m

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

05. Dec 06 13:42

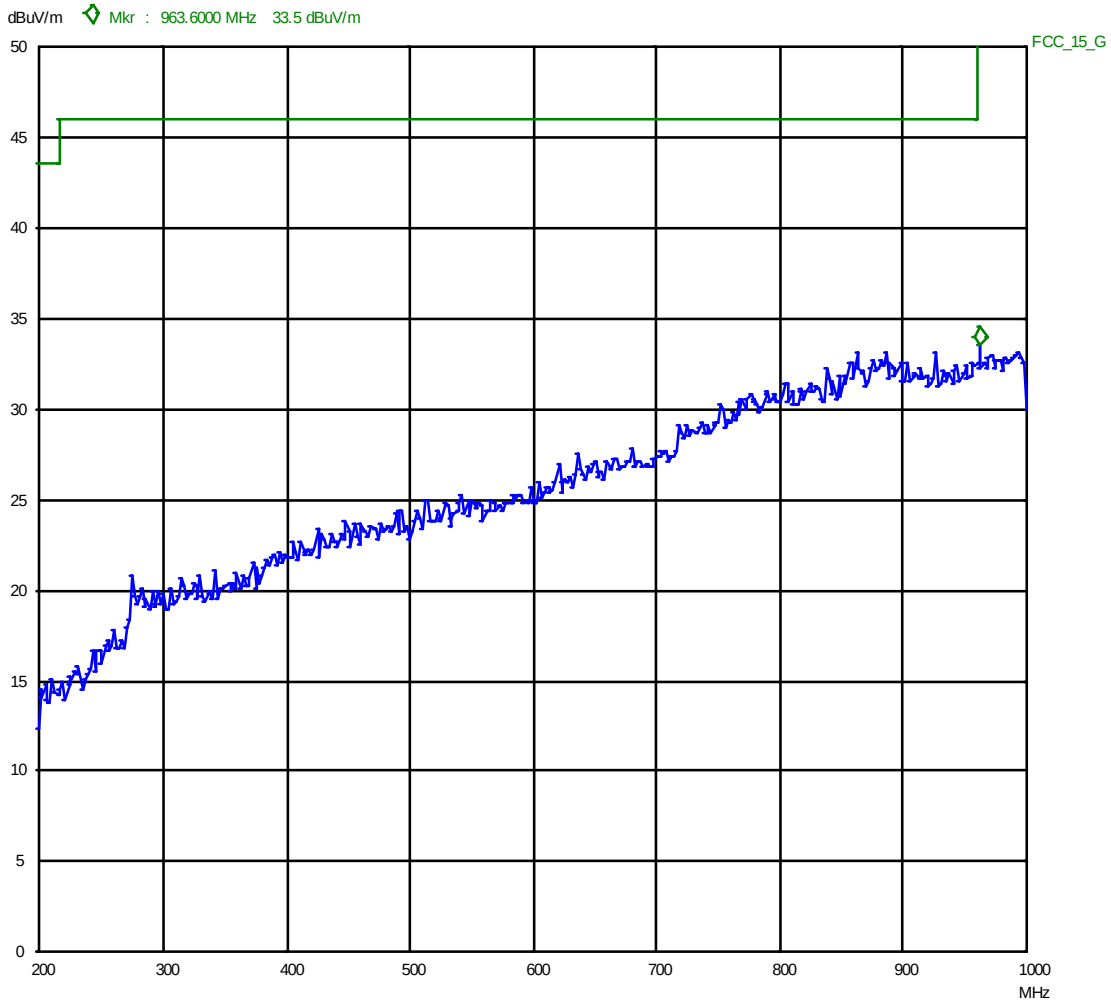
Peak

EUT: RC2201HP-UW
Op Cond: 4m hp
Operator: gns
Test Spec: fcc 15
Comment: 3m

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

Radiated emission 10 kHz-30 MHz.

Measuring distance 10m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10m using 40 dB/decade according to 15.31 (f) (2).

NEMKO COMLAB 05. Dec 06 14:12

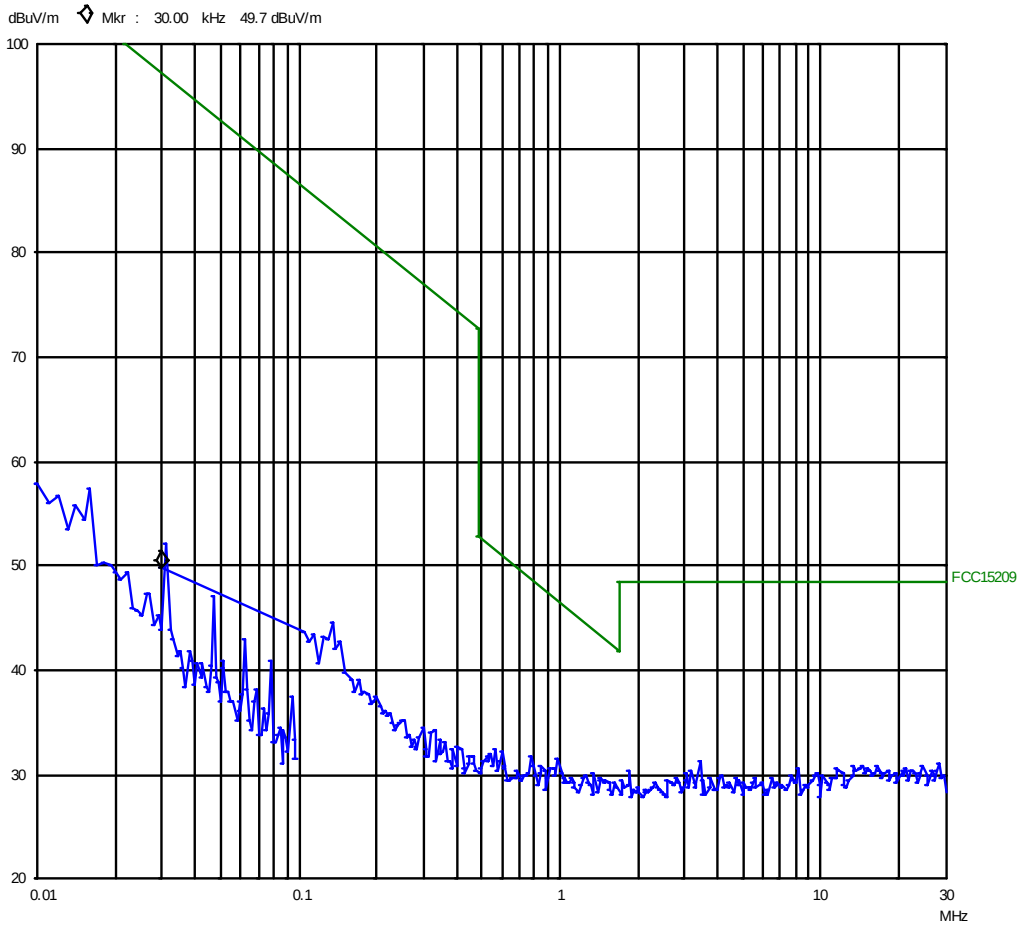
Peak

Operator: gns
FCC 15

Scan Settings (4 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
10k	100k	1k	1k	PK	20ms	0dB	LN OFF	60dB
20k	20k	5k	9k	PK	20ms	AUTO	LN ON	60dB
20k	10M	5k	9k	PK	20ms	AUTO	LN OFF	60dB
10M	30M	5k	9k	PK	20ms	AUTO	LN OFF	60dB

Transducer No.	Start	Stop	Name
13	10k	30M	HFH2Z2



4.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar	**Date of Test: 06.12.2006**

Test Results: Passed

Measured and Calculated Data:

Measured Conducted Values:

Ch11 - Lower Channel:

PSD = 35 – 41.18 dBm/Hz= - 6.2 dBm

Ch18 - Middle Channel:

PSD = 35 – 42.64dBm/Hz = - 7.6 dBm

Ch 26 - Upper Channel:

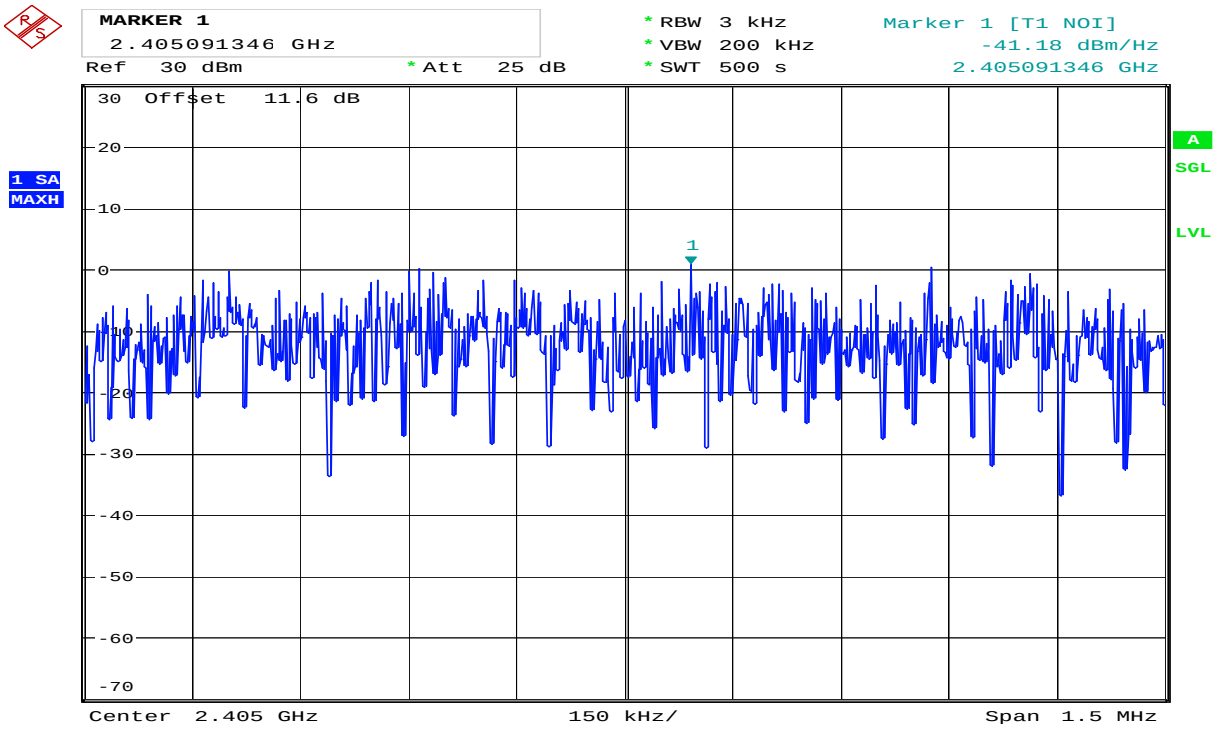
PSD = 35 - -49.51 dBm/Hz = -14.5 dBm

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

Requirements:

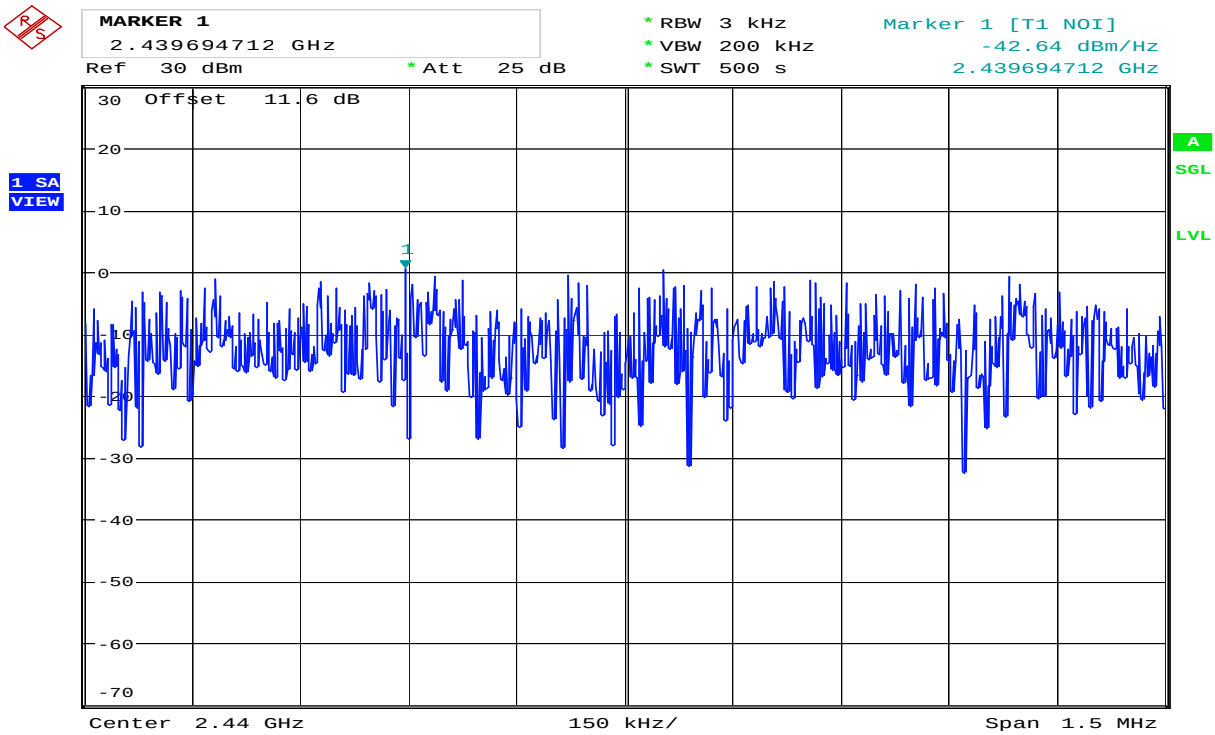
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3kHz band

No requirements for Frequency Hopping Systems.



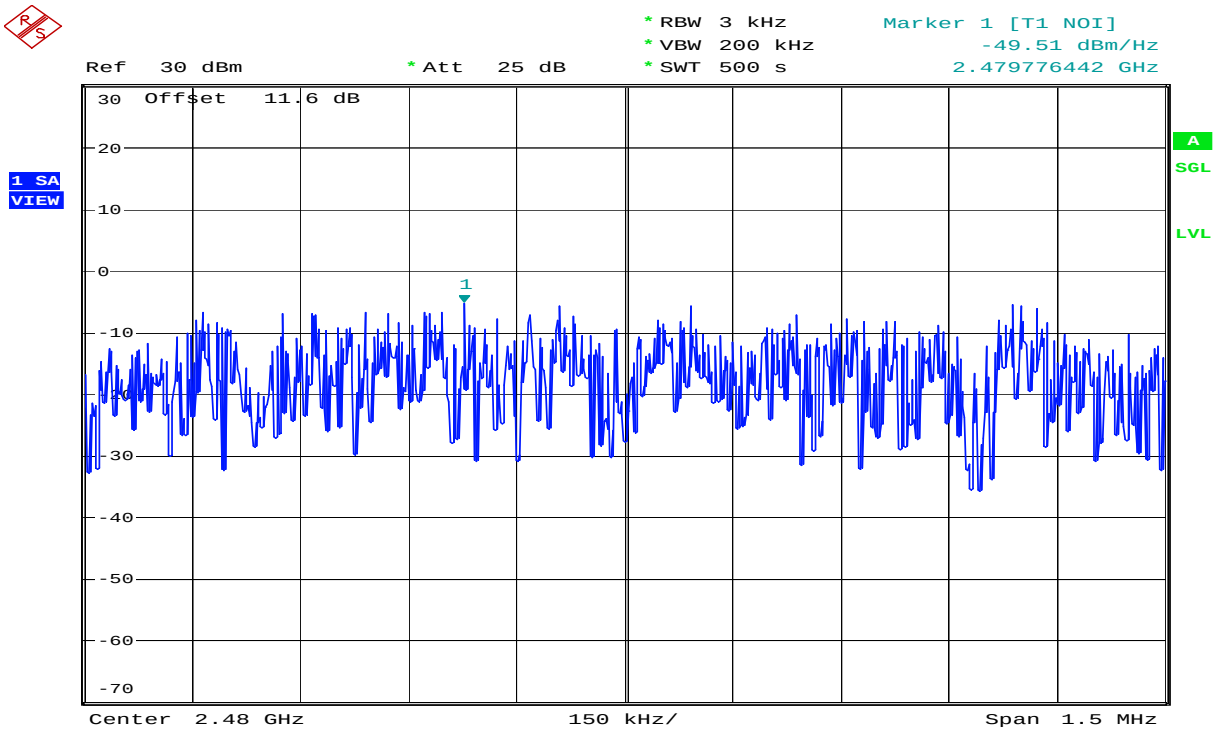
Date: 6.DEC.2006 10:25:28

Ch11 – Power Density – Conducted measurement



Date: 6.DEC.2006 10:34:40

Ch18 – Power Density – Conducted measurement



Date: 6.DEC.2006 10:44:09

Ch26 – Power Density – Conducted measurement

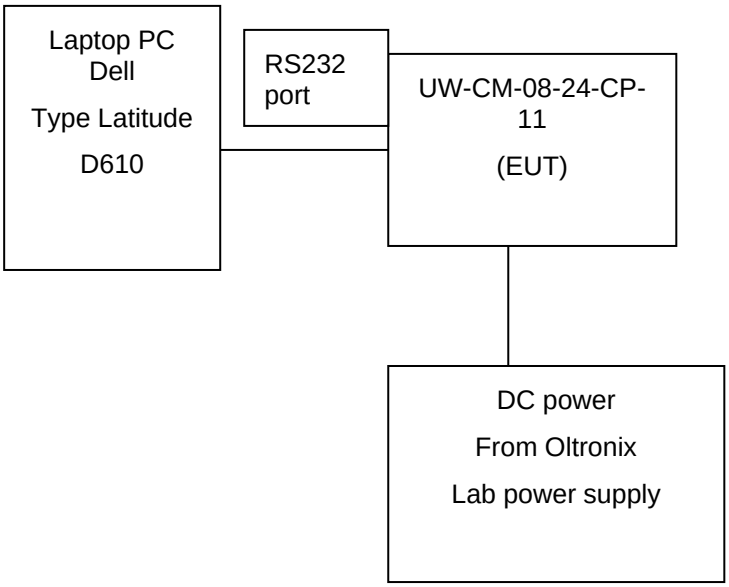
5 LIST OF TEST EQUIPMENT

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.

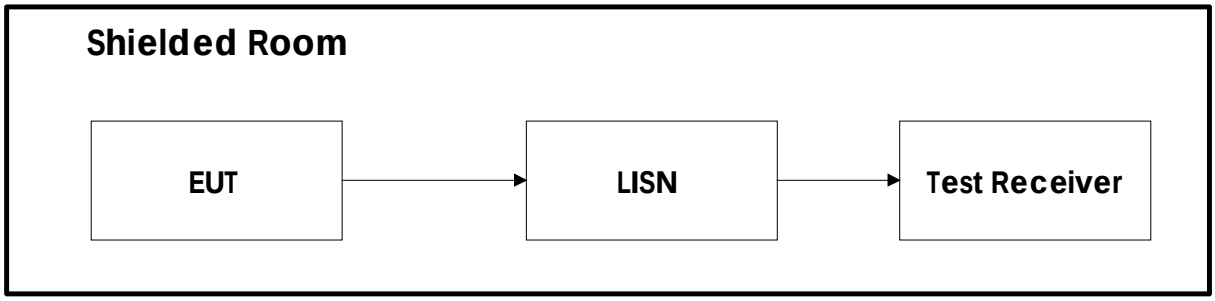
No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	ESN	EMI Receiver	Rohde & Schwarz	LR 1237
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Sivers lab	LR 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 Powerline Conducted Emission



6.3 Test Site Radiated Emission