

No of Pages : 34

Test report # : 59171-3
Item tested : 13202-RFD
Type of equipment : IEEE 802.15.4, 2.4GHz (Daughter card)
FCC ID : SKA13202-RFD
Client : Freescale Semiconductor Denmark AS

www.nemko.com

Tested according to :
FCC part 15.247
Digital Transmission System

Date of issue : 9 March 2006

Authorized by : 
Frode Sveinsen
Technical Verificator

CONTENTS

1	GENERAL INFORMATION.....	3
1.1	Testhouse Info	3
1.2	Client Information.....	3
1.3	Manufacturer.....	3
2	Test Information	4
2.1	Test Item	4
2.2	Test Environment.....	5
	2.3 Test Period.....	5
3	TEST REPORT SUMMARY.....	6
3.1	General	6
3.2	Test Summary.....	7
3.3	Description of modification for Modification Filing	7
3.4	Comments.....	7
3.5	Family List Rational.....	7
4	TEST RESULTS.....	8
4.1	Powerline Conducted Emissions	8
4.2	Bandwidth	10
4.3	Peak Power Output.....	13
4.4	Spurious Emissions (Radiated)	16
4.5	Power Spectral Density (PSD).....	29
5	LIST OF TEST EQUIPMENT	32
6	BLOCK DIAGRAM	33
6.1	System set up	33
6.2	Powerline Conducted Emission	33
6.3	Test Site Radiated Emission.....	34

1 GENERAL INFORMATION

1.1 Testhouse Info

Name : 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
Industry Canada OATS registration # : 4443

1.2 Client Information

Name : Freescale Semiconductor Danmark A/S
Address : Skalhuse 5, 9240 Nibe, Denmark
Telephone : +45 967 10 000
Fax : +45 983 50 052

Contact:

Name : Flemming Nygaard
Telephone : +45 7024 14 65
E-mail : nygaard1@freescale.com

1.3 Manufacturer

Name : Freescale Semiconductor Danmark A/S
Address : Skalhuse 5, 9240 Nibe, Denmark
Telephone : +45 967 10 000
Fax : +45 983 50 052

2 Test Information

2.1 Test Item

Name :	13202-RFD
FCC ID :	SKA13202-RFD
Model/version :	13202-RFD
Serial number :	Marked as "Cond 7" & "Rad 8"
Hardware identity and/or version:	80000566000_R0100
Software identity and/or version :	PTC version 2.10 RFD
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
Type of Power Supply :	AC mains adapter (out put voltage 9Vdc)
Antenna Connector :	Integral antenna (SMA connector only for testing purpose)
Antenna Diversity Supported :	None

1) 16 channels in use.

Theory of Operation

The MC13202 RF transceiver is an IEEE® 802.15.4-compliant radio that operates in the 2.4 GHz ISM frequency band.

This daughter card (RFD) is mounted on M68EVB908GB60.

The M68EVB908GB60 single board computer is a fully assembled, fully functional development board for the Freescale M9S08GB60 microcontroller. Provided with wall plug power supply and serial cable. Support software for this development board is provided for Windows 95/98/NT/2000/XP operating systems.

Description of Test Item

The MC13202 RF Daughter Card, is used in conjunction with a microcontroller development board for RFIC evaluation, code development, and system evaluation. It interfaces directly to the M68EVB908GB60 Microcontroller Development, but it can be adapted to other boards that offer access to the MCU input/output ports.

2.2 Test Environment

2.2.1 Normal test condition

Temperature: 20 - 22 °C

Relative humidity: 30 - 40 %

Normal test voltage: 115 V AC

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2006-02-17

Test period : 2006-02-21

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Freescale Semiconductor Danmark AS

Model No.: 13202-RFD

Serial No.: Marked as "Cond 7" & "Rad 8"

All measurements are tracable 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 metres.

☒ 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 #: 59171-3

TESTED BY: 
G.Suwanthakumar, Test engineer

DATE: 27.02.2006

Nemko Comlab AS authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any reproduction of parts of this report requires approval in writing from Nemko Comlab AS.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Comlab AS accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report.

This test report applies only to the items and configurations tested.

3.2 Test Summary

Name of test	Paragraph #	Result
Supply voltage variations	15.31 (e)	Complies
Number of operating frequencies	15.31 (m)	Complies
Conducted Emission (Receiver)	15.107(a)	ref. 15.207(a)
Radiated Emission 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 Emission	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
Out-of-band emissions (Radiated)	15.247(c)	Complies
Upper band edge radiated emission	15.247(c)	Complies

¹ This equipment requires professional installation to comply with 15.203.

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 and the software for communication/test mode is delivered for testing by the manufacturer. The laptop is only used for selection of channels. The measurements are performed at channels near top ch 26, near middle ch 17 and near bottom ch 11. And the out put level is set to maximum in the software (the code 00FF) The EUT complies at these channels.

The LapTop is IBM type 2647 with serial nr: 5551GLP011, see page 33 for block diagram.

The AC adapter is from CINCON Electronics Ltd. model: TR10R090 ,serial number is not stated, see page 33 for block diagram.

The measurements were done with the EUT powered by 115 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during spurious emission measurements.

The board is fitted with a 50 ohm SMA connector that is disabled by default but can be enabled by removing a capacitor on the PCB. The board is intended only for professional users for evaluation and development purposes, and will not be sold to the general public. The antenna connector is intended only for making conducted RF measurements for evaluatrion purposes, and must not be used to connect an external antenna.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Powerline Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suwanthakumar

Date of Test: 21.02.2006

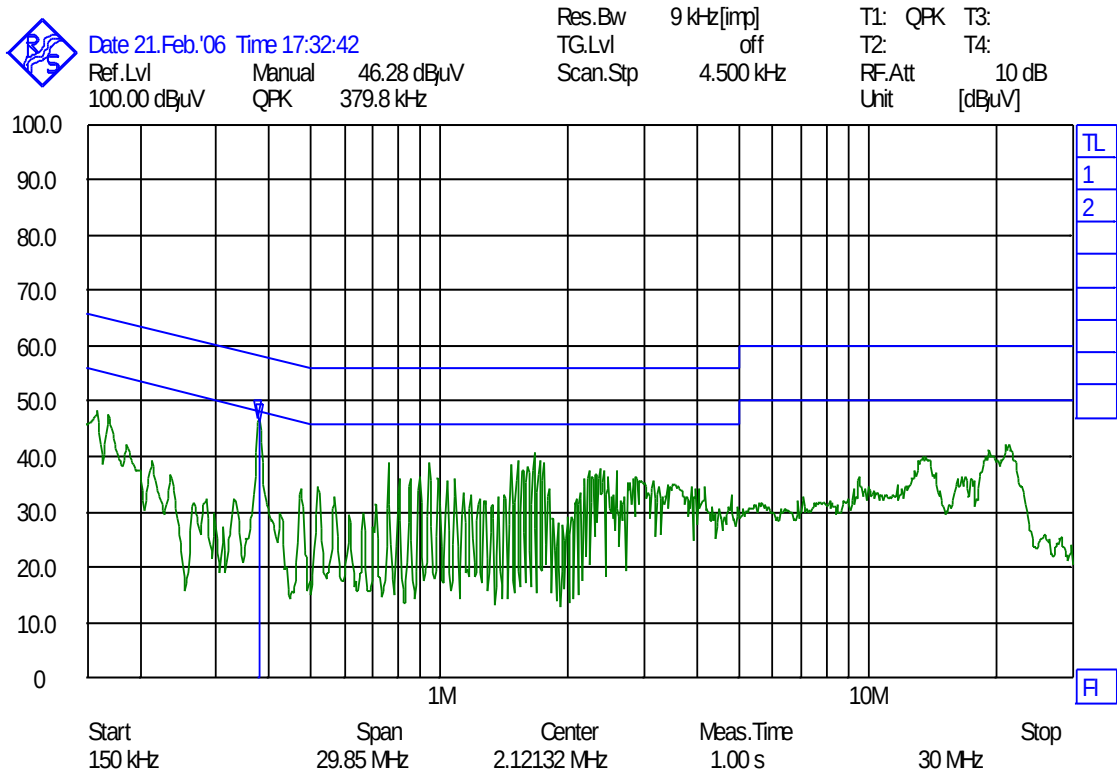
Measurement procedure: ANSI C63.4-2003 using 50 μ H/50 ohms LISN.

Test Results: Complies.

Measurement Data: See fig 1 to 2 (Peak detector).

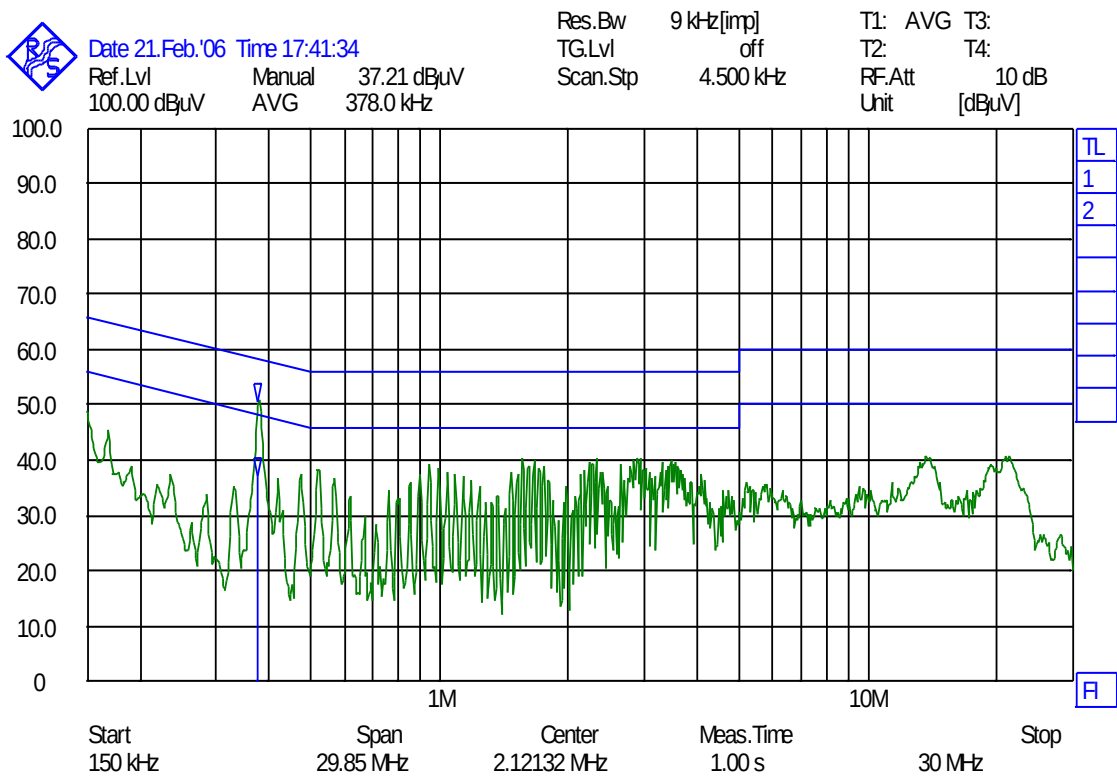
Measured value at 378kHz : QP= 48.64 dB μ V , AV = 37.26 dB μ V

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



13202RFD - 1 POLARITY

Fig 1 – L1 polarity – 13202RFD



13202RFD - N POLARITY

Fig 2. – N polarity – 13202RFD

4.2 6 dB Bandwidth

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

Test Performed By: G.Suwanthakumar

Date of Test: 21.02.2006

Test Results: Complies

Measurement Data:

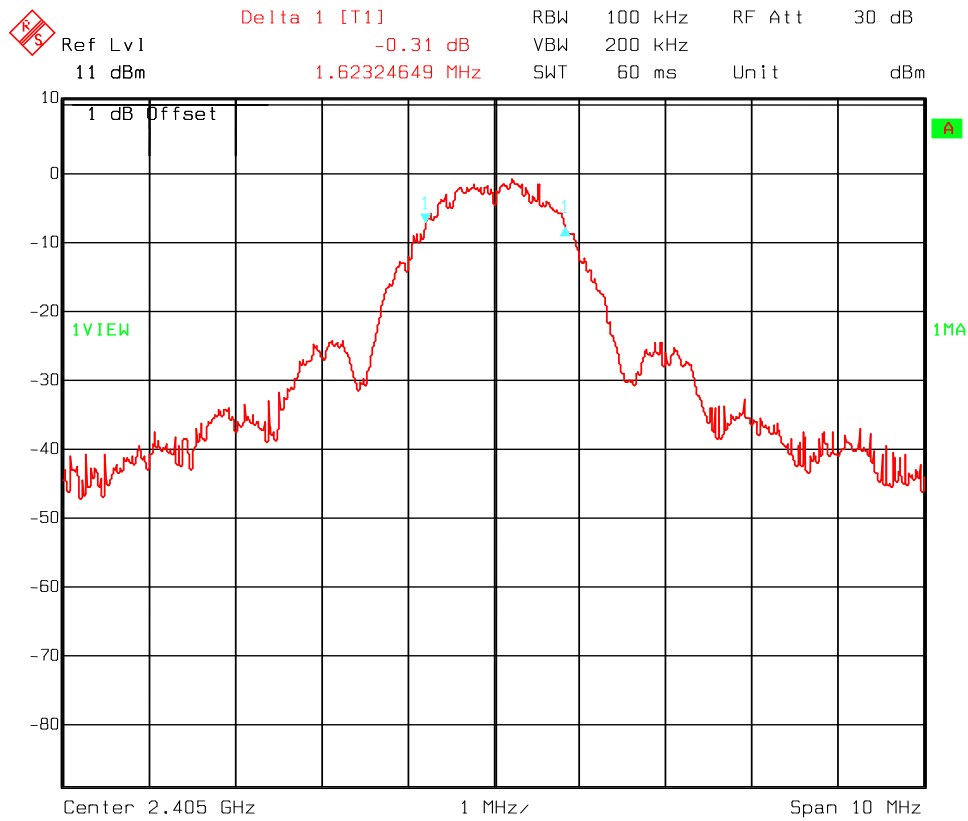
6 dB Bandwidth (MHz)		
Ch 11 2405MHz	Ch 18 2440MHz	Ch 26 2480MHz
1.62	1.64	1.64

See fig. 3 to 5

Power supply variation within 85 % to 115% of nominal value has no influence on measured value.

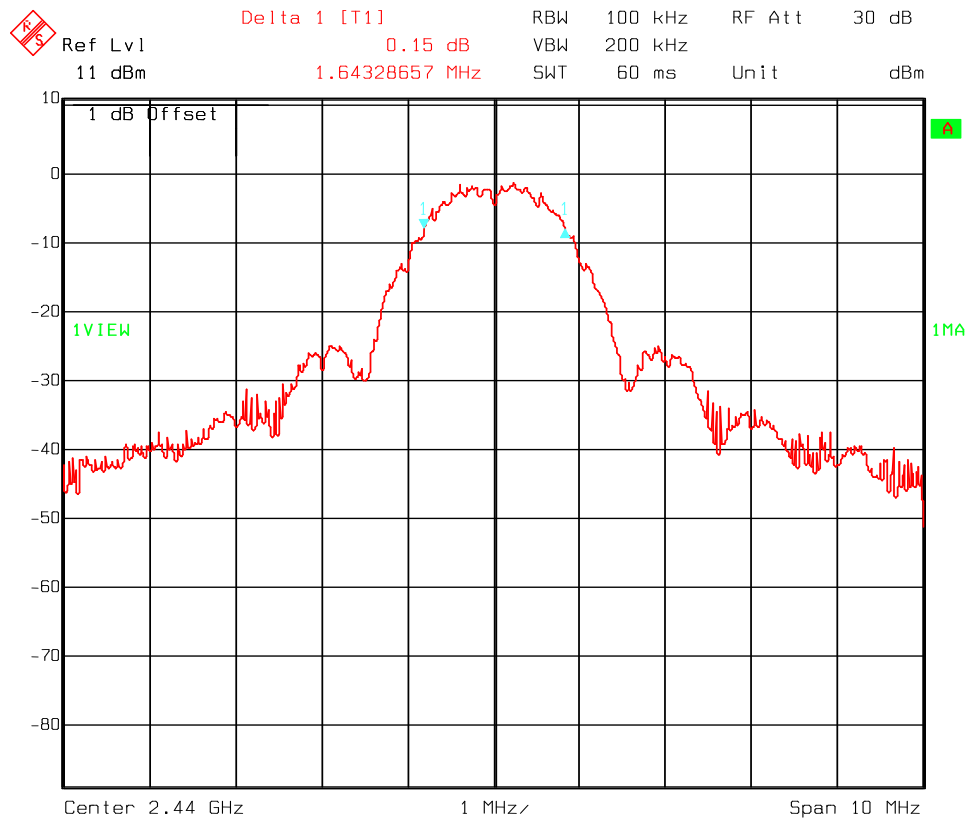
Requirements:

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



Date: 21.FEB.2006 13:52:55

Fig 3 – 13202RFD – Ch11 – 6 dB bandwidth – 1.62MHz



Date: 21.FEB.2006 13:57:40

Fig 4 – 13202RFD – Ch18 – 6 dB bandwidth – 1.60MHz

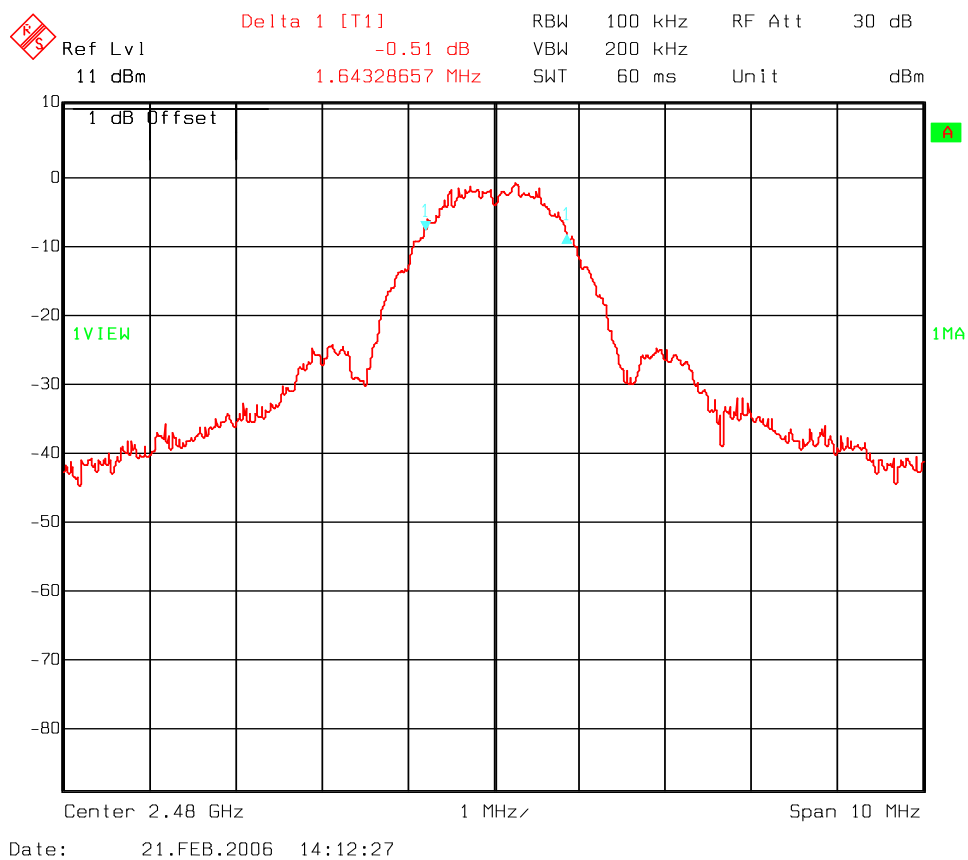


Fig. 5 – 13202RFD – CH26 – 6 dB bandwidth – 1.60MHz

4.3 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suwanthakumar	Date of Test: 21 .02.2006
------------------------------------	---------------------------

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power

RF channel	Ch11	Ch18	Ch26
Measured value (mW)	1.79	1.69	1.54

See fig 6 - 8

Maximum EIRP

RF channel	Ch11	Ch18	26
Measured EIRP (mW)	0.77	0.71	0.72
Antenna gain (dBi)	-3.66	-3.77	-3.30

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

The EIRP is measured using substitution method.

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

☐ Yes ☐ No

Comment: The equipment also has an SMA antenna connector for evaluation purposes, this is normally disabled but can be enabled by removing a capacitor on the PCB.

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.

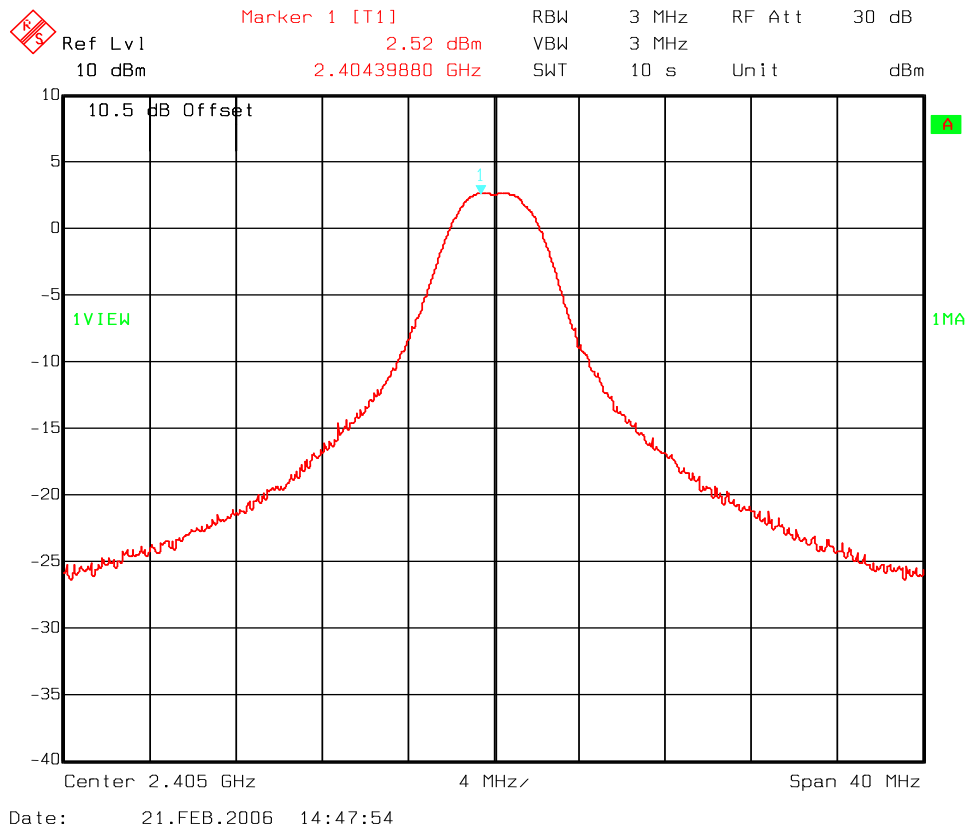


Fig 6 – 13202RFD – Ch11 – Conducted Peak Output Power

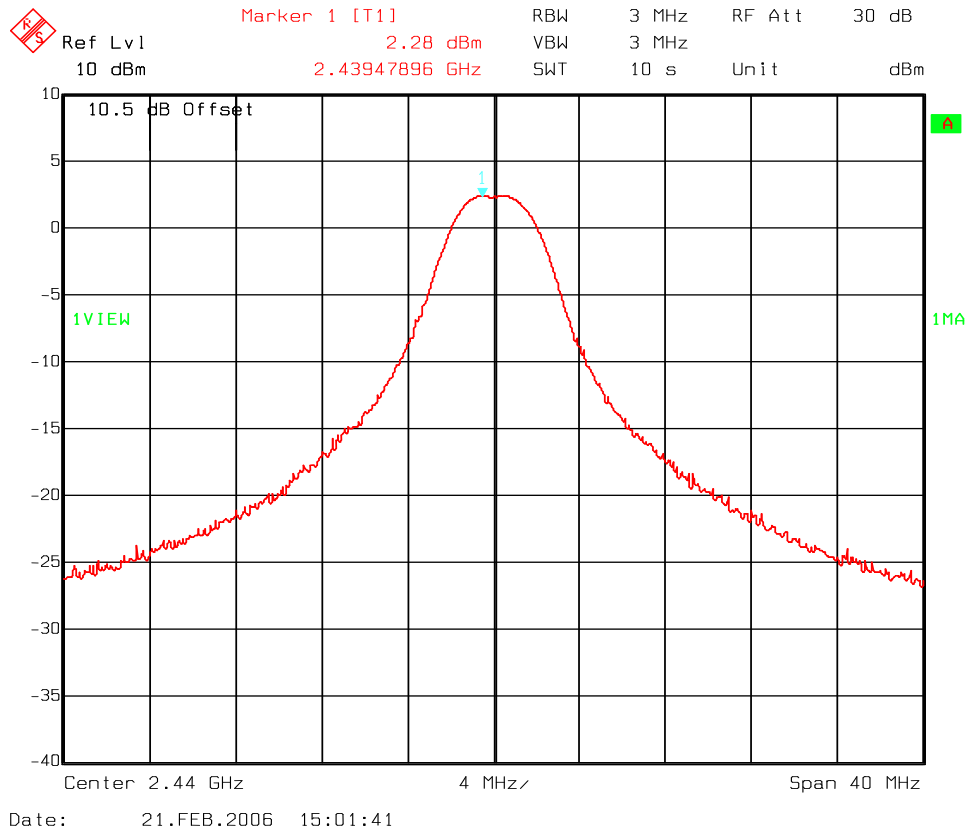


Fig 7– 13202RFD – Ch18 – Conducted Peak Output Power

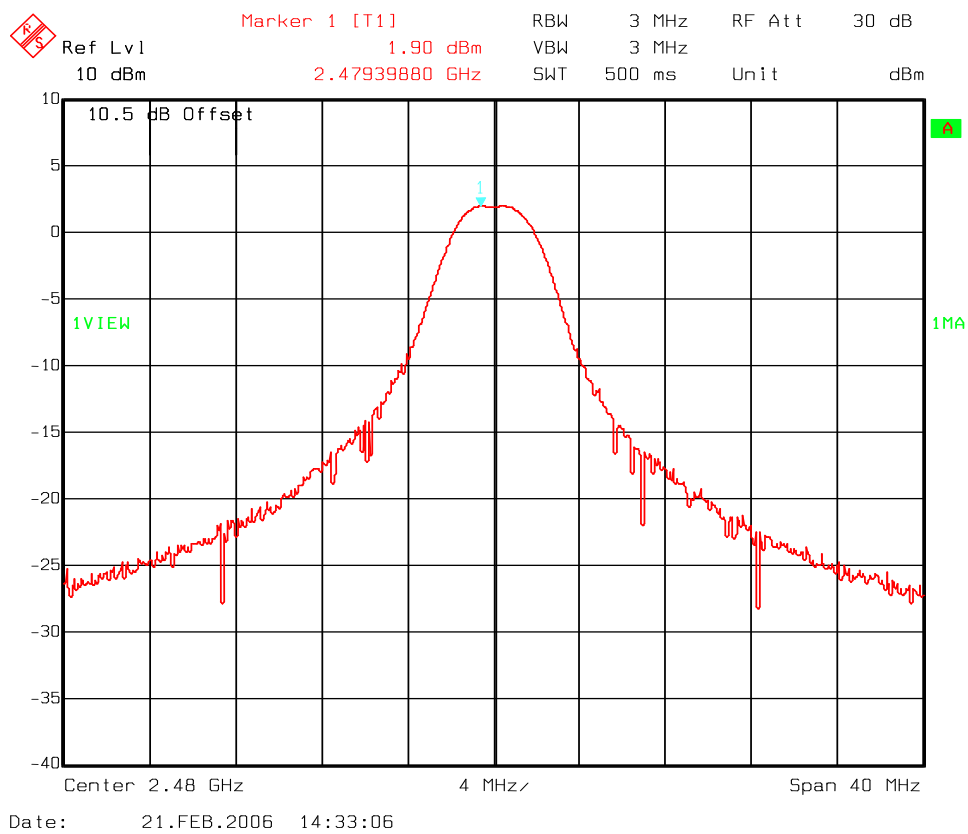


Fig 8 – 13202RFD – Ch26 – Conducted Peak Output Power

4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suwanthakumar

Date of Test: 21.02.2006

Test Results: Complies

Measurement Data:

Upper Band-edge radiated measurements

Frequency	Power below nearest channel, dB	Limit	Margin
GHz	RF ch 26 DSS	dB	dB
2.4835	37.58	-20	17.58

See fig. 9 & 10

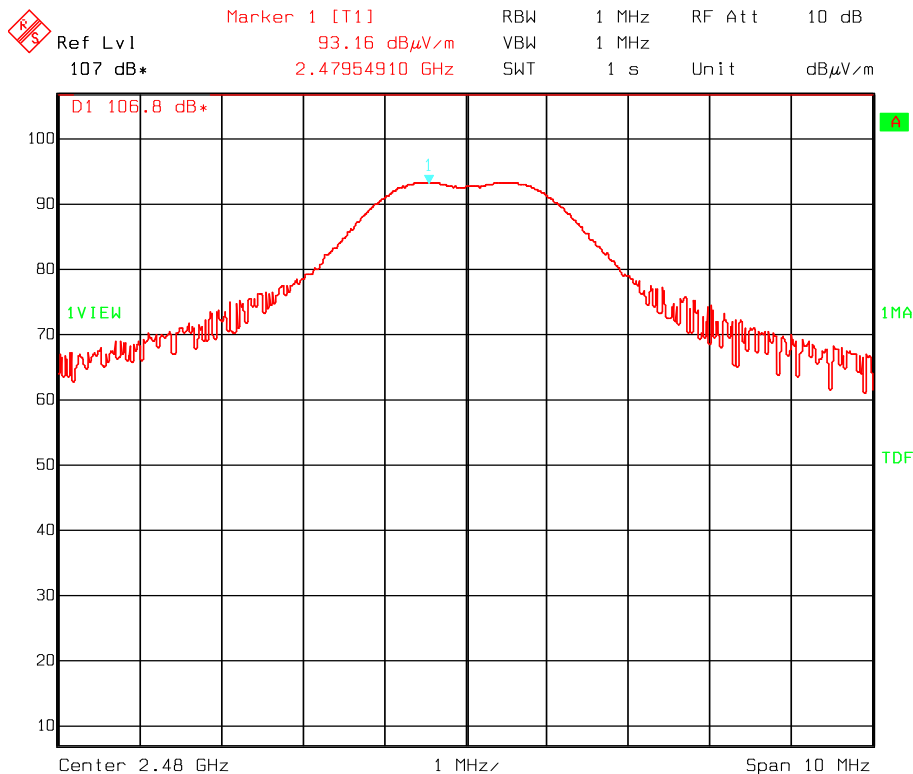
Band-edge field strength 2.4835 GHz.

Peak Field Strength: 93.16 dB μ V/m

Marker Delta 100kHz RBW: 37.58dB

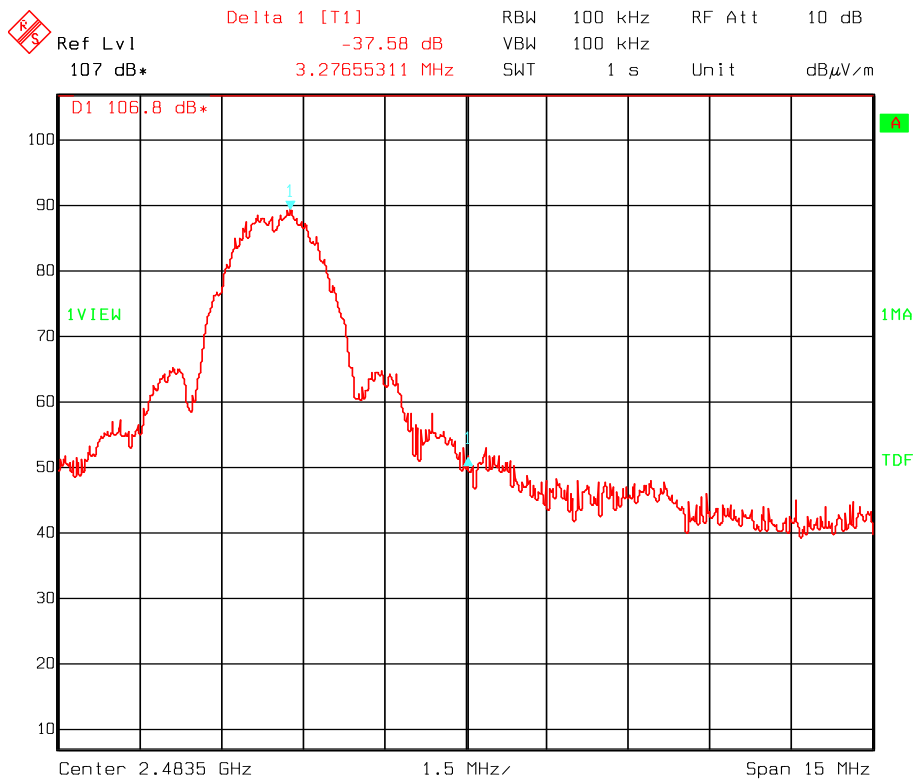
Peak Field Strength 93.16– 37.58 = 55.59 dB μ V/m

Average Field Strength: 55.59 dB μ V/m – 20.0 dB = 35.59 dB μ V/m



Date: 21.FEB.2006 13:04:28

Fig. 9 –13202RFD - Ch26 – upper-band –field strength



Date: 21.FEB.2006 13:07:31

Fig. 10 – 13202RFD - Ch26 – Upper-band-edge – Delta-marker

RF conducted power

to 25 GHz see fig 11 - 13

Maximum RF level outside operating band:

RF ch 11: 54.63 dB/C, margin >20 dB

RF ch 17: 51.18 dB/C, margin >20 dB

RF ch 26: 45.48 dB/C, margin >20 dB

Duty Cycle Calculation:

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

$$20 \cdot \log (1.39\text{ms}/51.49\text{ms}) = -31.37 \text{ dB}$$

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

See fig 14 & 15

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

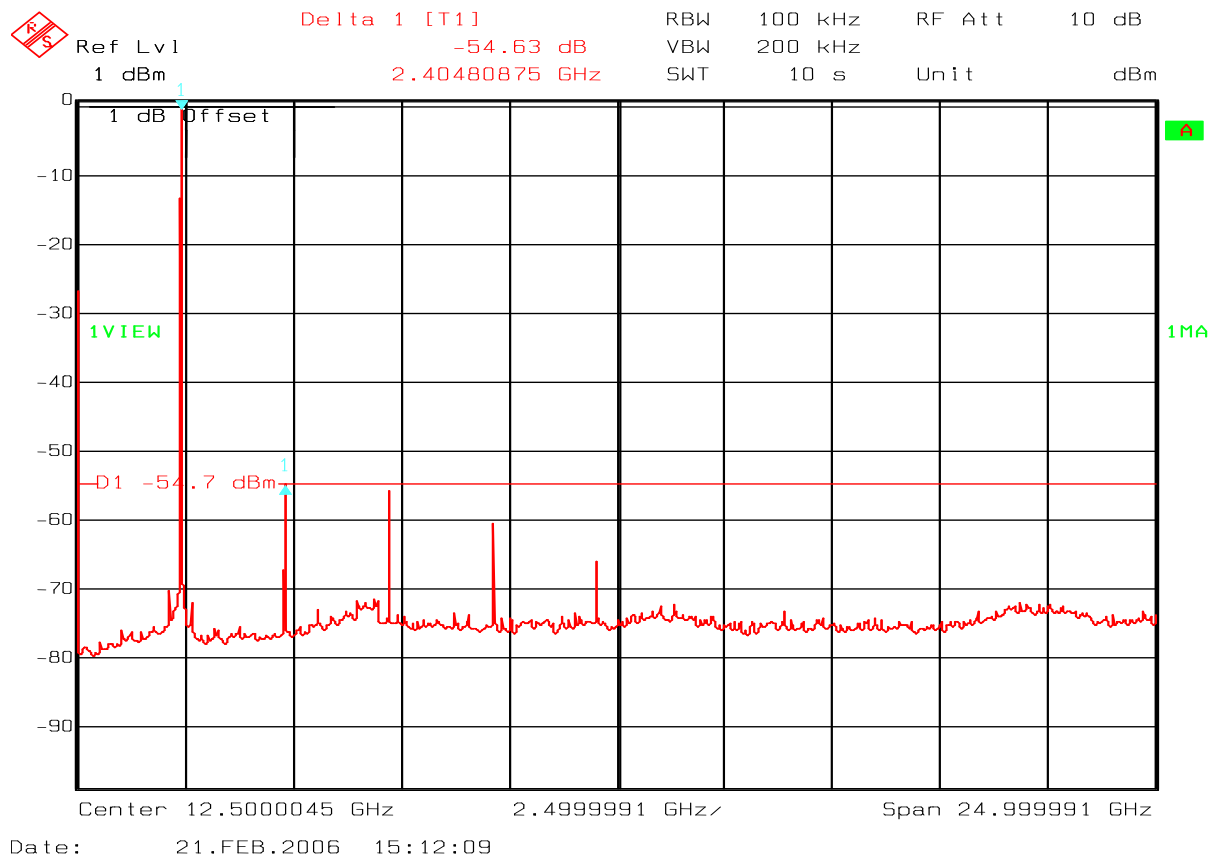


Fig. 11– 13202RFD - Ch11 – Conducted Spurious – 9kHz – 25GHz

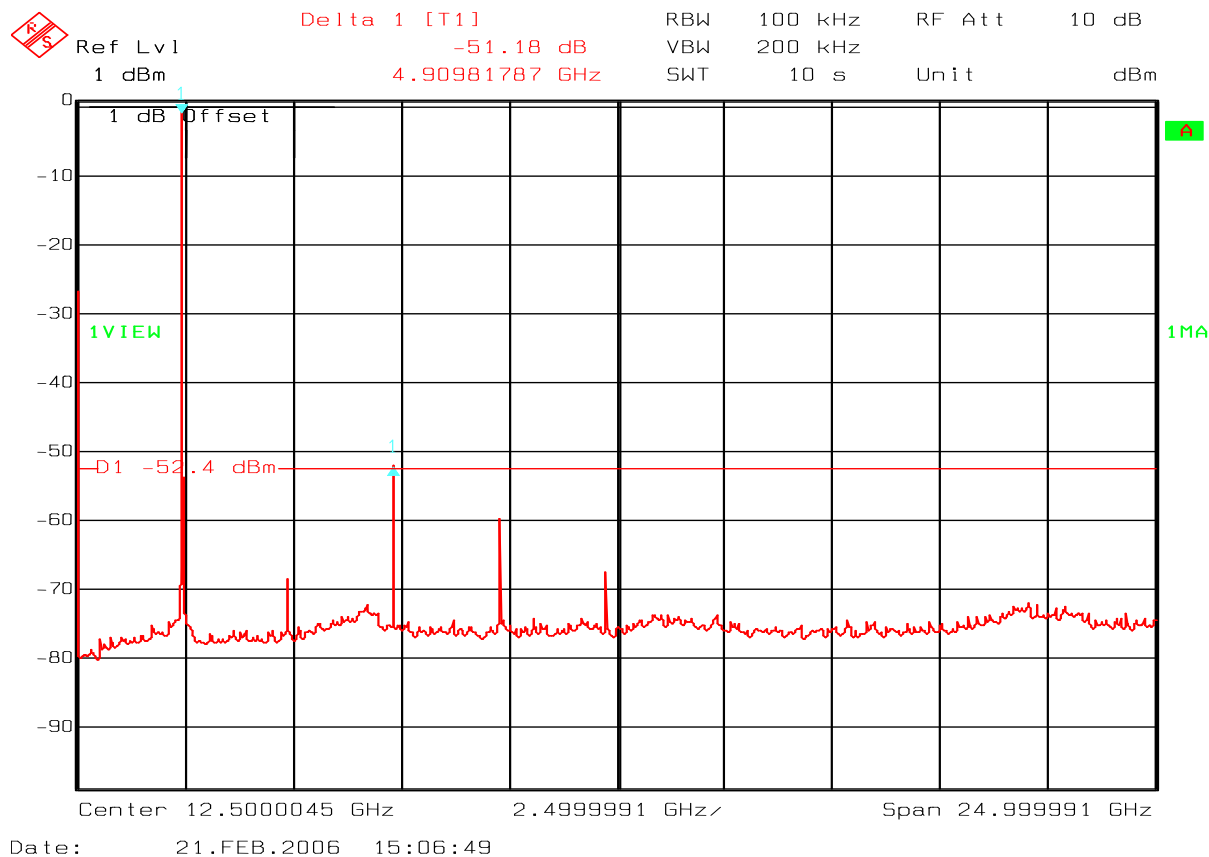


Fig. 12 –13202RFD- Ch18 – Conducted Spurious – 9kHz – 25GHz

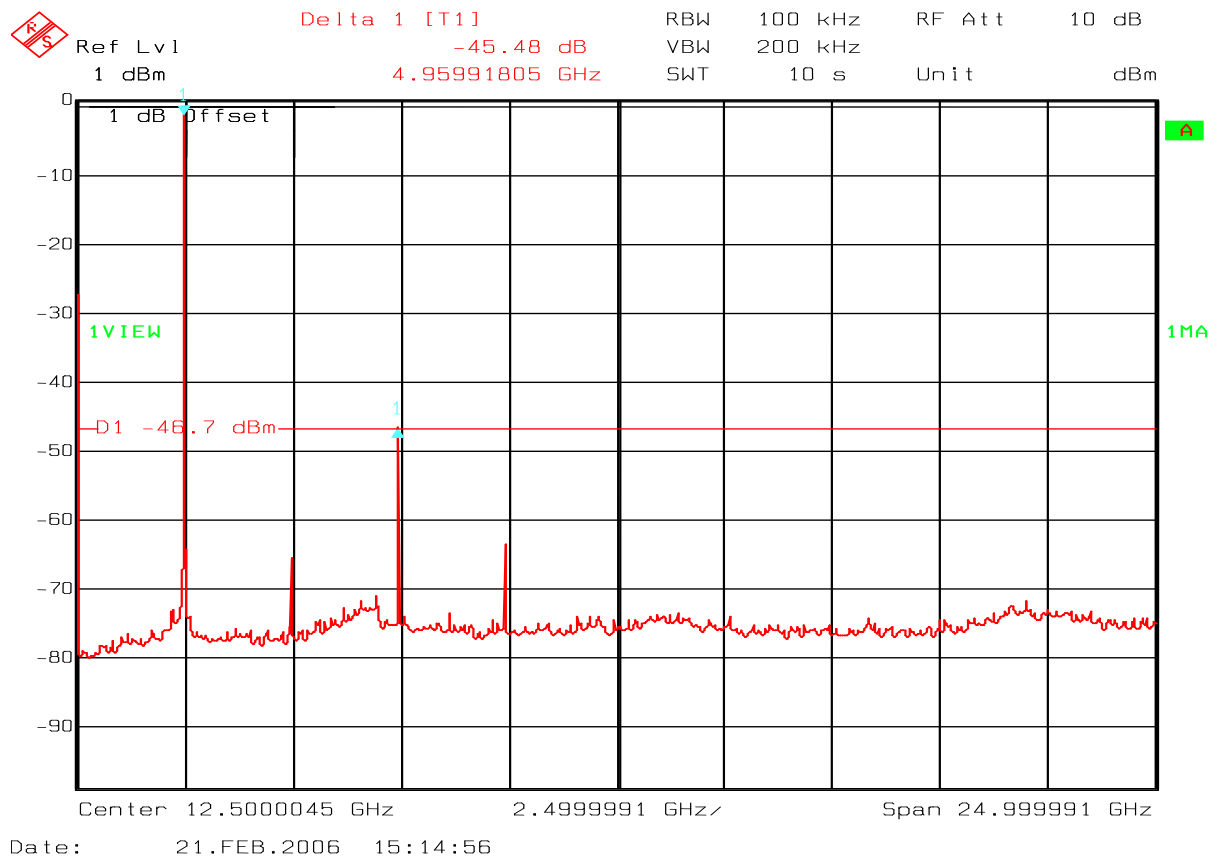
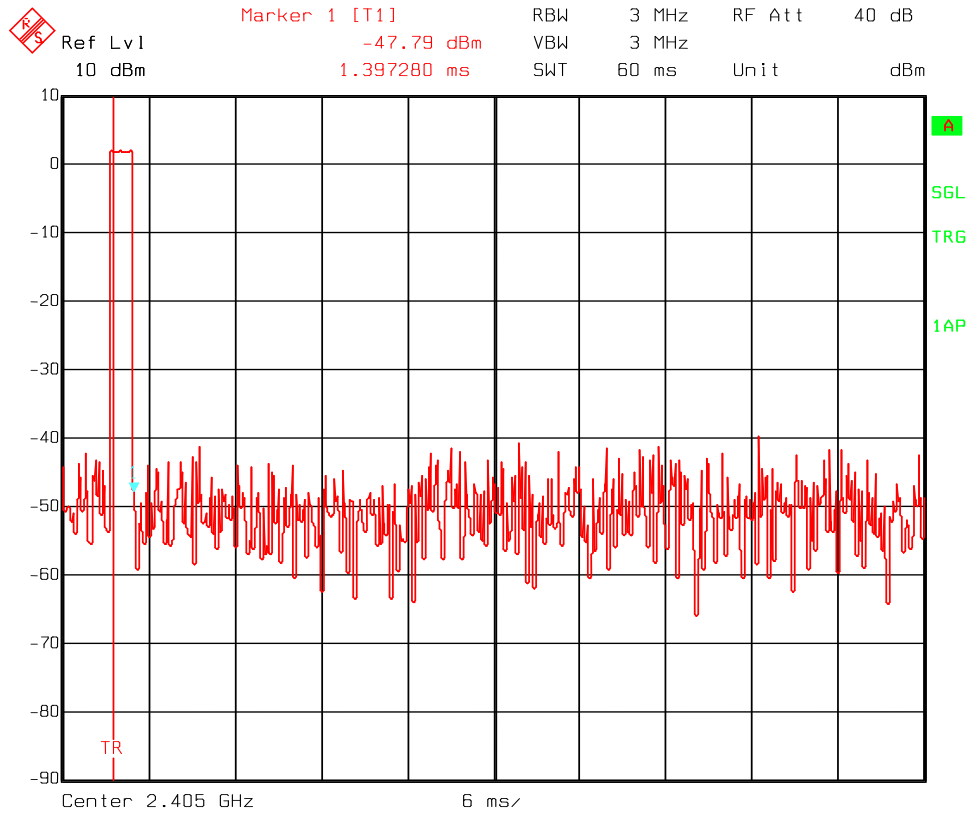
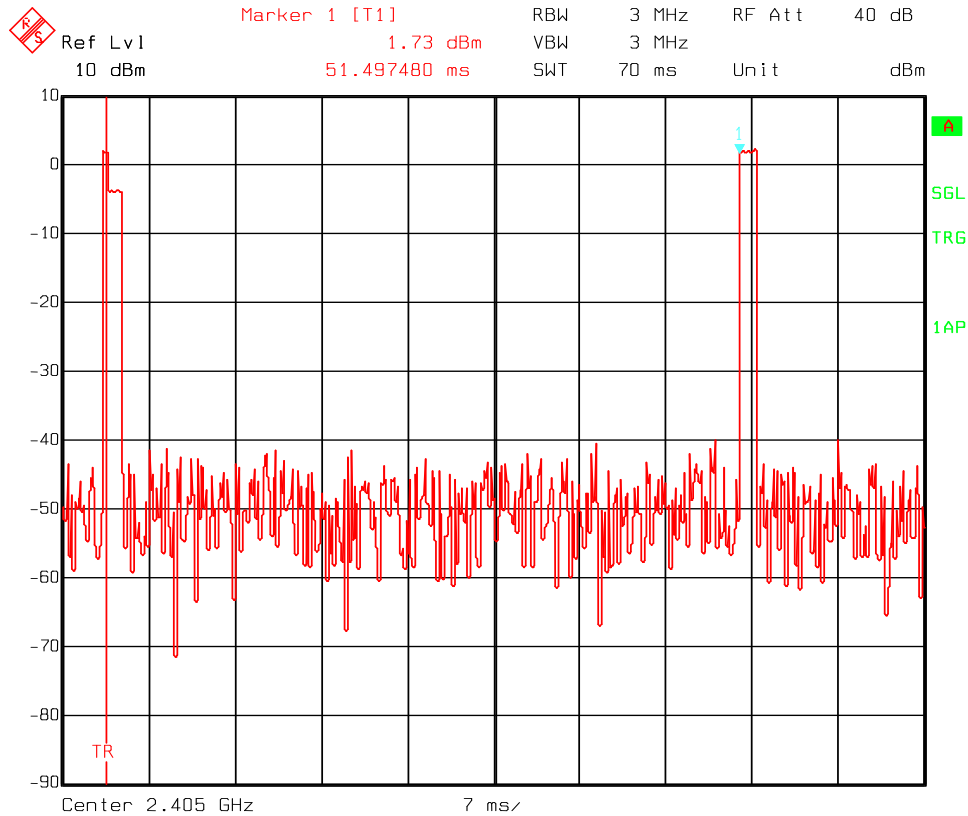


Fig. 13 – 13202RFD - Ch26 – Conducted Spurious – 9kHz – 25GHz



Date: 21.FEB.2006 13:45:34

Fig 14 – 13202RFD – Duty Cycle – ON-time



Date: 21.FEB.2006 13:42:14

Fig. 15 – 13202RFD – Duty Cycle – OFF time

Radiated Emissions, 1-25 GHz

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

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	dB μ V/m	dB	dB μ V/m	dB
1 - 25	11	0	None detected	-	74	-
1 - 25	18	0	None detected	-	74	-
1 - 25	26	0	None detected	-	74	-

Radiated emission 1- 25 GHz, Average

Calculated value from Peak Detector

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3 meters	Duty cycle corr. factor	Limit	Margin
GHz	11-26	dB	dB μ V/m	DB	dB μ V/m	dB
1 - 25	11	0	None detected	-20	54	-
1 - 25	18	0	None detected	-20	54	-
1 - 25	26	0	None detected	-20	54	-

Radiated emission 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	metres	dB μ V/m	dB
30 -200	TX ON/RX	<30	3	40	>10
200 -1000	TX on/RX	<30	3	40	>10

See fig 19 - 22

Radiated emission 10 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

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

See fig 23

Nemko Comlab AS

21. Feb 06 08:53

Peak

EUT: 13202RFD
Manuf: Freescale Semiconductor
Op Cond: 1m VP
Operator: gns
Test Spec: FCC 15.209, 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

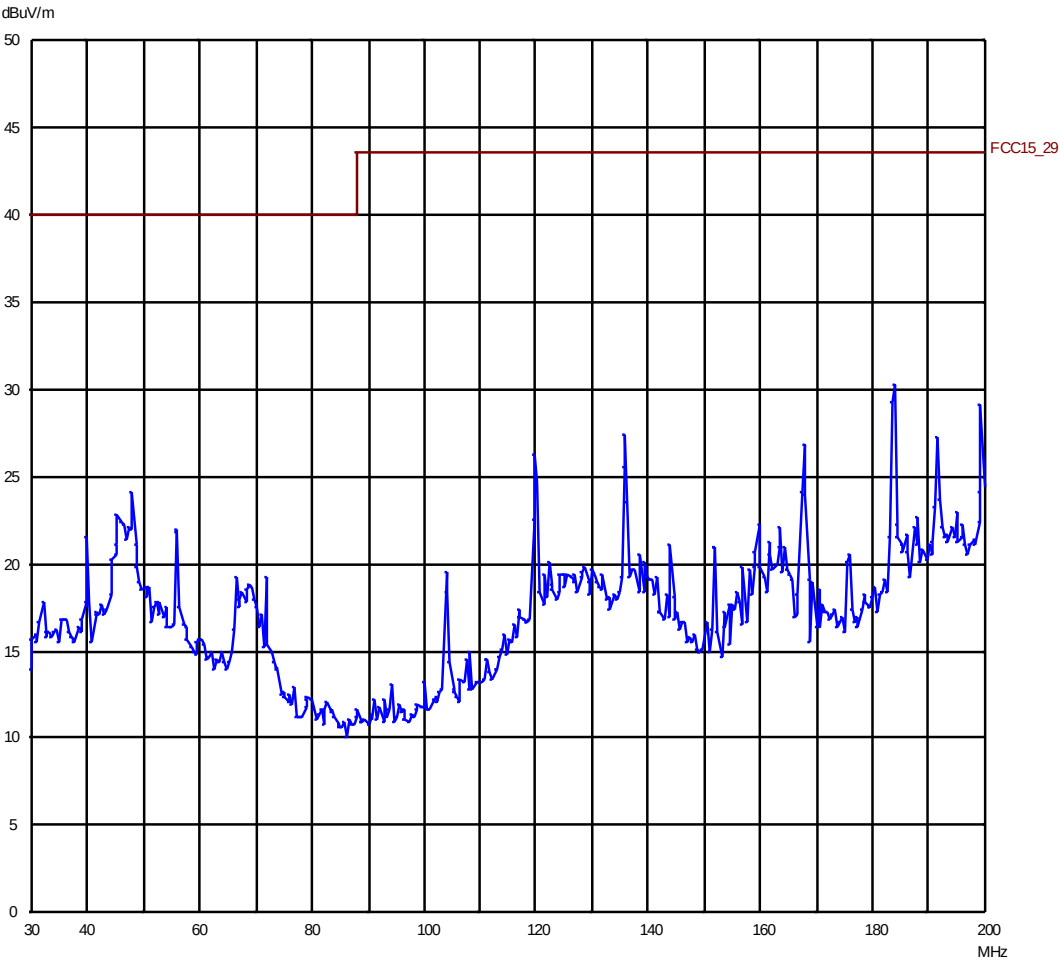


Fig 19 – 13202RFD – VP – 30 – 200 MHz

Nemko Comlab AS

21. Feb 06 09:06

Peak

EUT:

13202RFD

Manuf:

Freescall Semiconductor

Op Cond:

4m hp

Operator:

gns

Test Spec:

FCC 15.209, 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

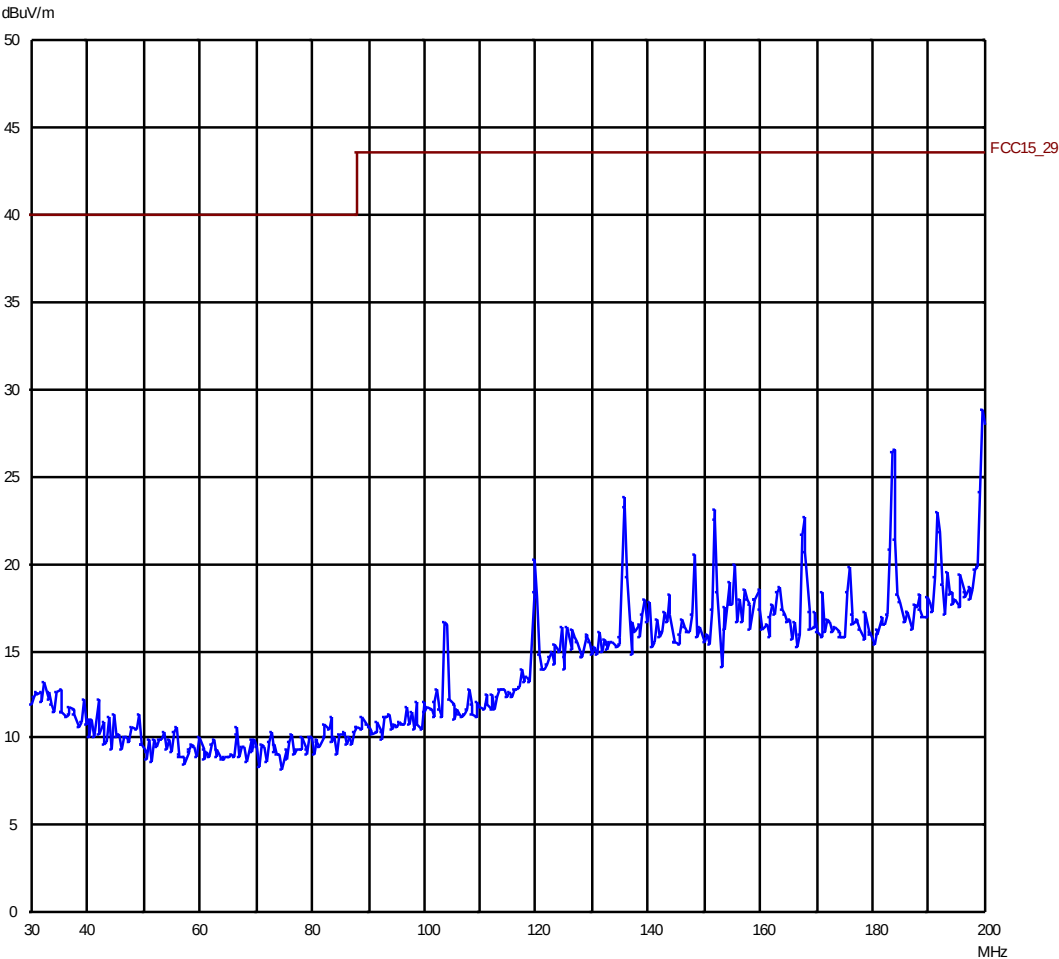


Fig 20 – 13202RFD – HP – 30 – 200MHz

Nemko Comlab AS

21. Feb 06 09:27

Peak

EUT: 13202RFD
Manuf: Freescale Semiconductor
Op Cond: 1m vp
Operator: gns
Test Spec: FCC 15.209, 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				

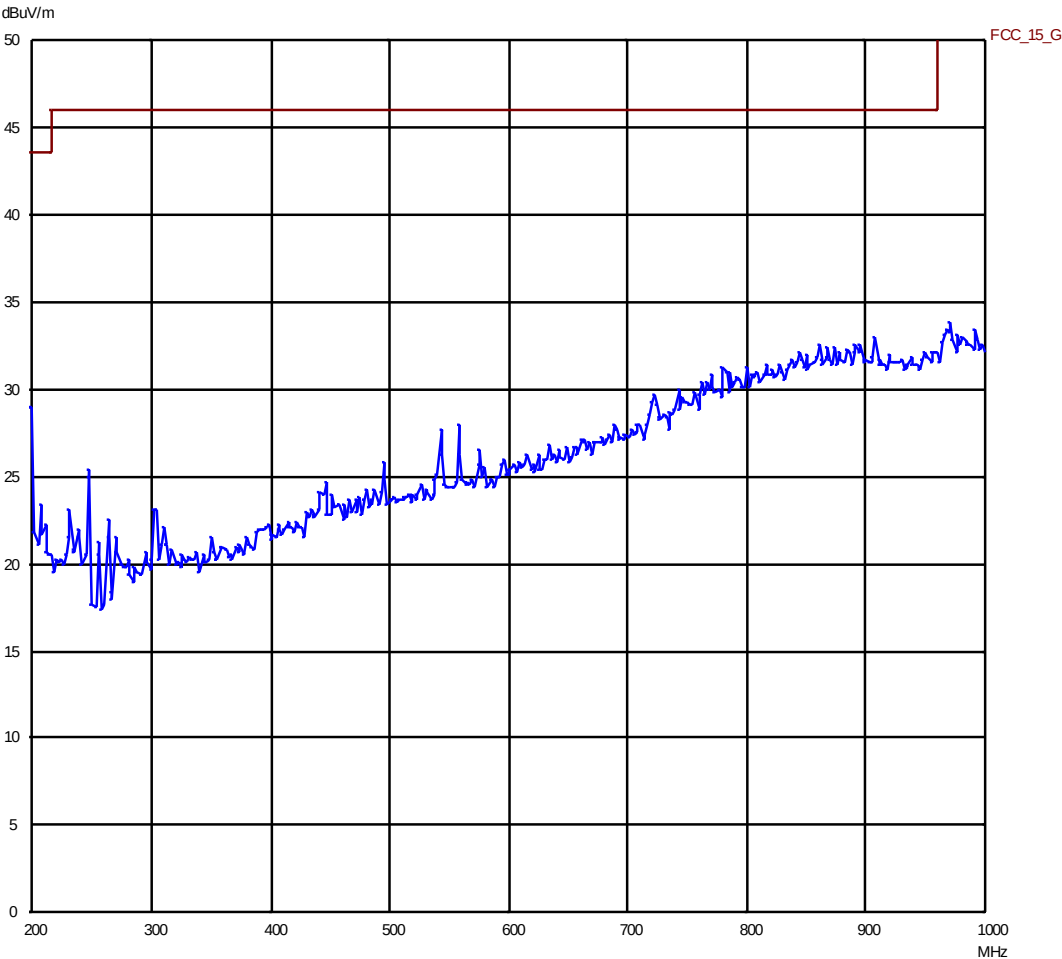


Fig 21 – 13202RFD – VP – 200 – 1000GHz

Nemko Comlab AS

21. Feb 06 09:44

Peak

EUT: 13202RFD
Manuf: Freescale Semiconductor
Op Cond: 4m hp
Operator: gns
Test Spec: FCC 15.209, 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

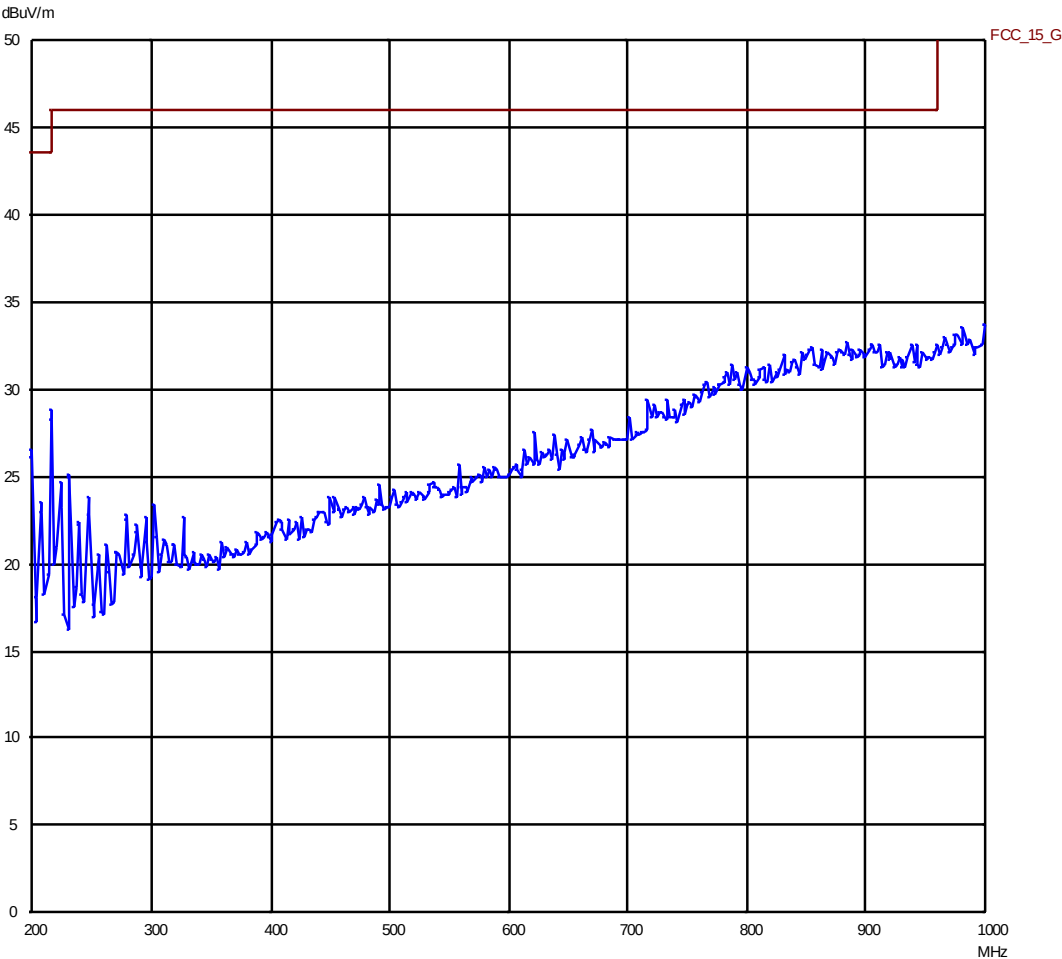


Fig. 22 – 13202RFD – HP 200 – 1000MHz

Nemko COMLAB AS

21. Feb 06 09:03

Peak

Operator: gns
Comment: 13202-RFD
FCC 15
Freescale
10 m distance

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	HFH222
----	-----	-----	--------

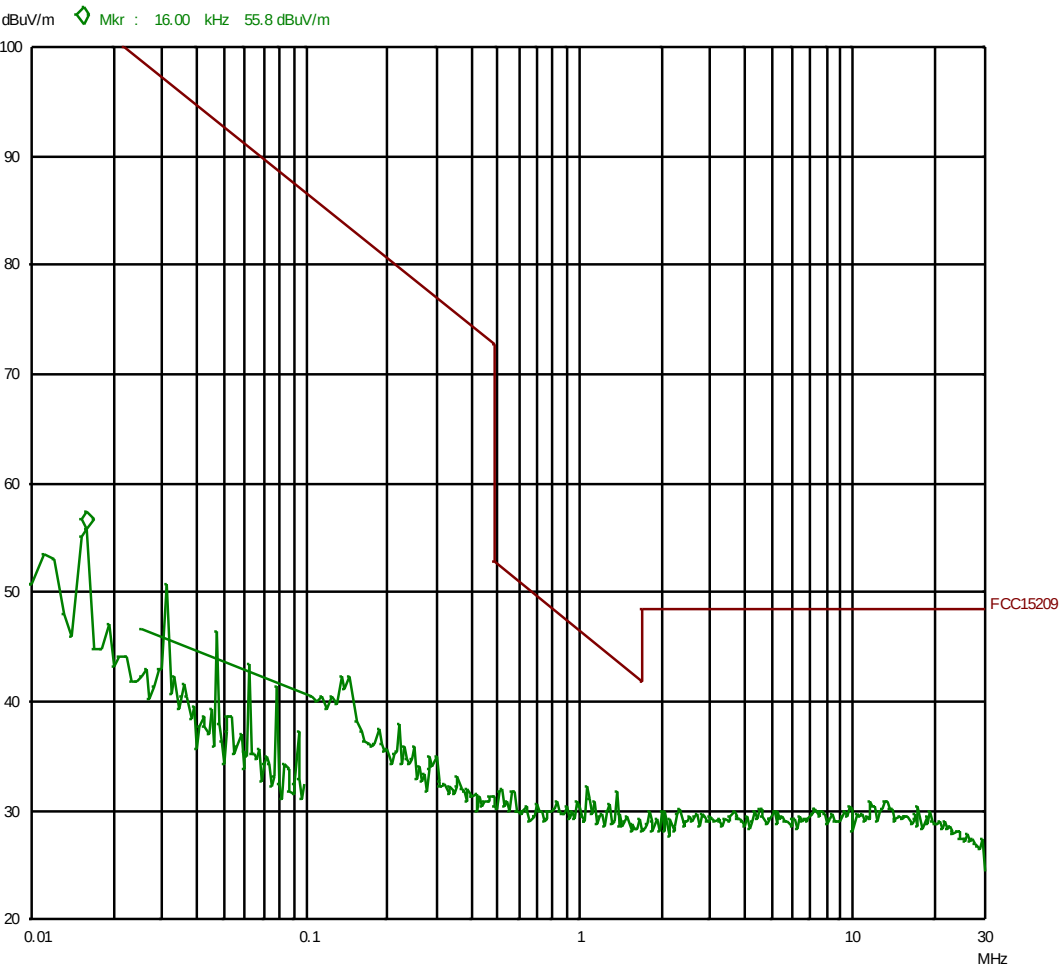


Fig 23 – 13213-NCB/SRB - 9 kHz – 30 MHz

4.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar	Date of Test: 21.02.2006
---	---------------------------------

Test Results: Passed

Measured and Calculated Data:

Ch11 - Lower Channel:

PSD = -9.54 dBm - see fig 24

Ch18 - Middle Channel:

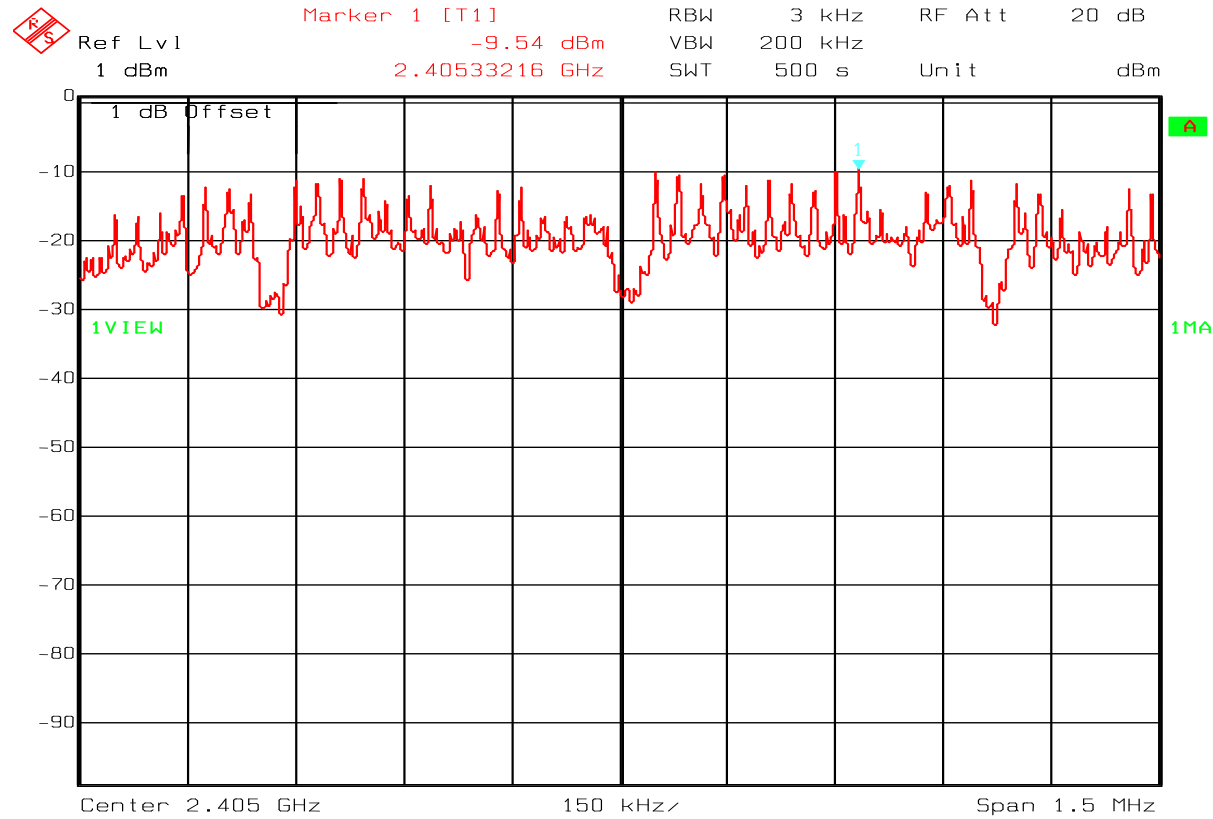
PSD = -10.11 dBm - see fig 25

Ch 26 - Upper Channel:

PSD = -10.29 dBm – see fig 26

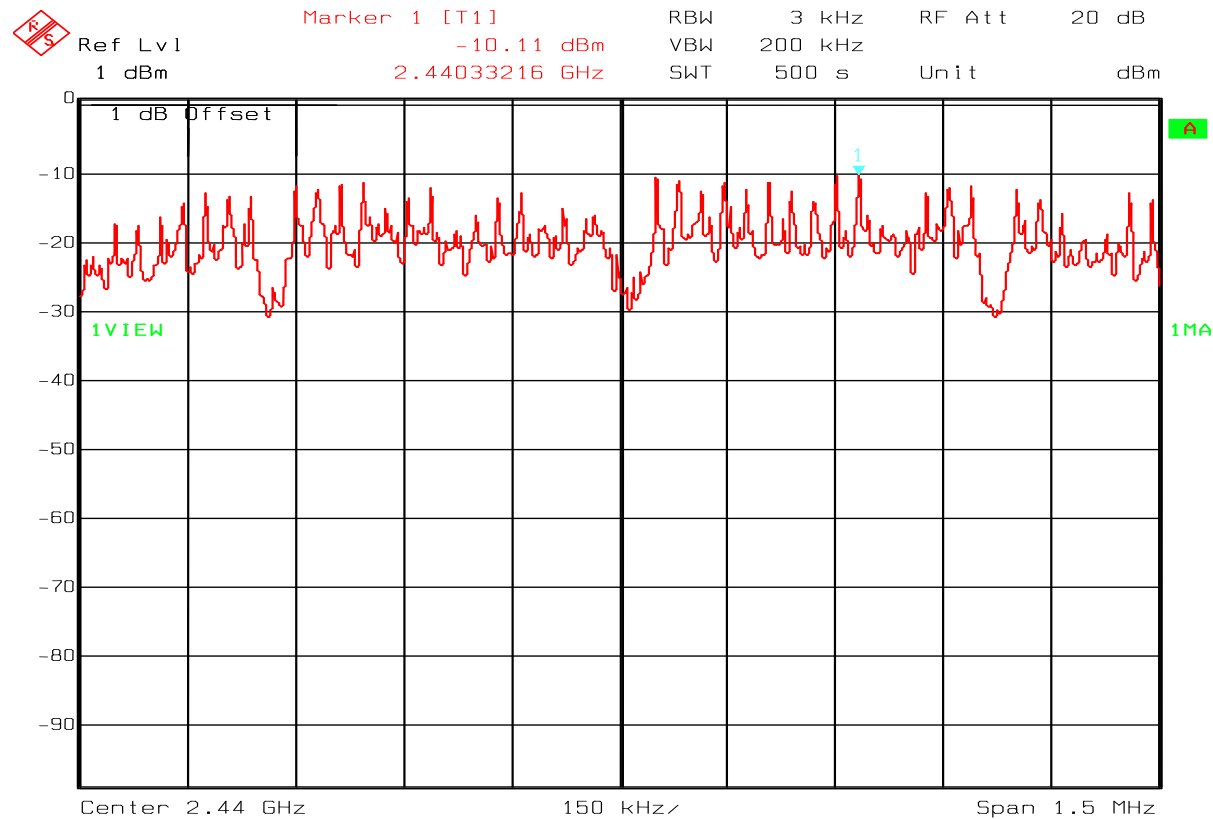
Requirements:

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



Date: 21.FEB.2006 15:26:21

Fig 24- 13202RFD- Ch11 – Power Density – Conducted measurement



Date: 21.FEB.2006 15:35:46

Fig 25- 13202RFD – Ch18 – Power Density – Conducted measurement

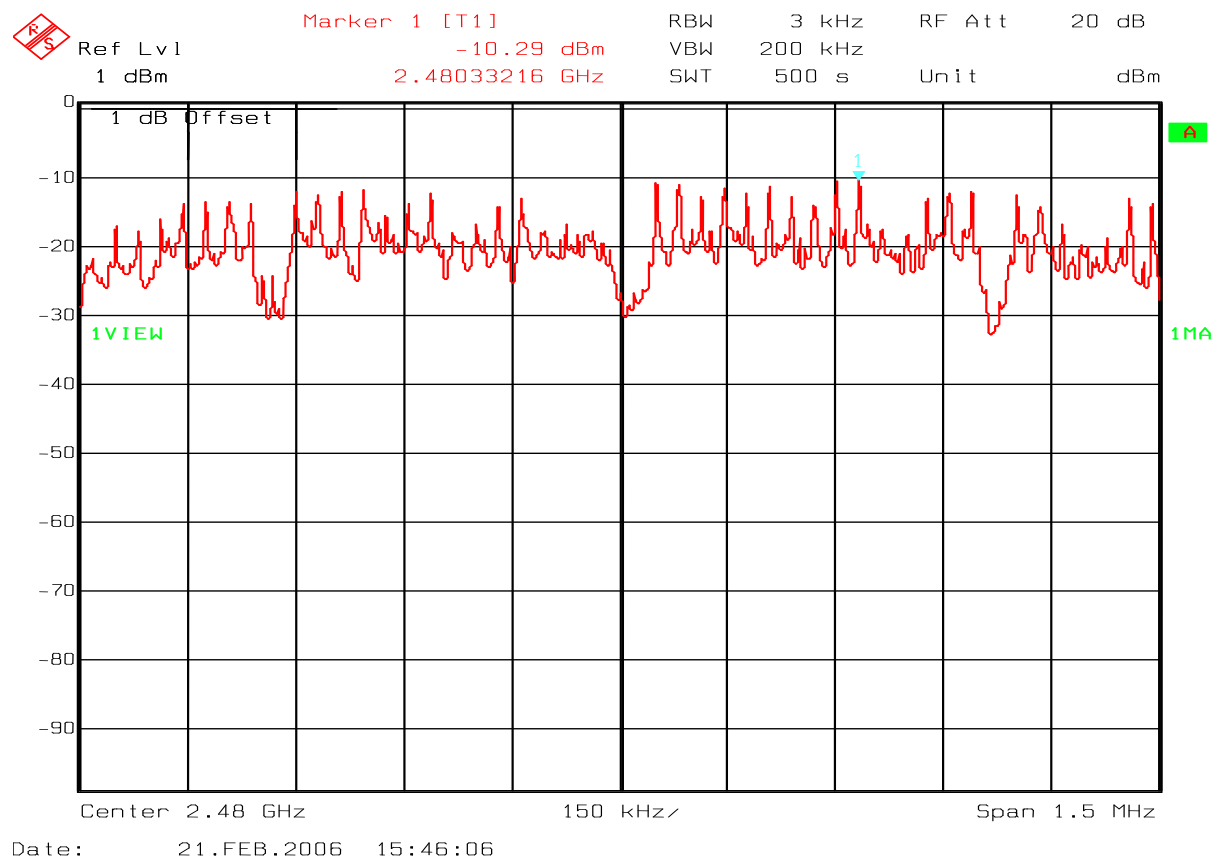


Fig 26- 13202RFD – Ch26 – Power Density – Conducted measurement

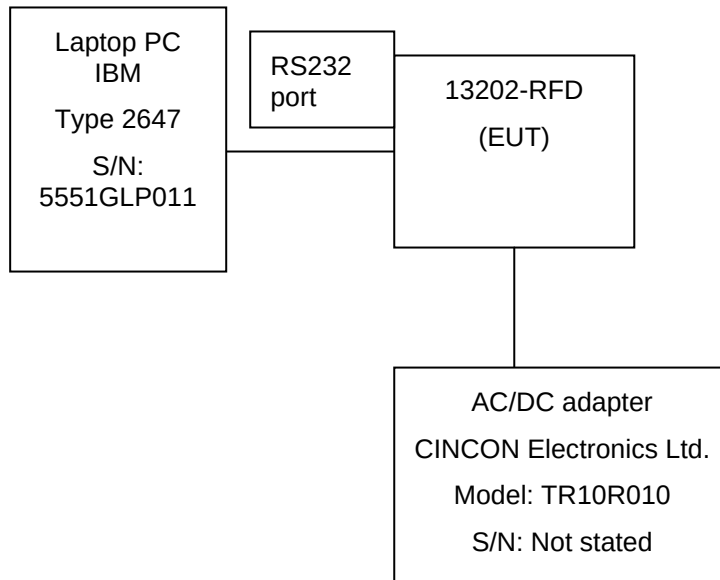
5 LIST OF TEST EQUIPMENT

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.

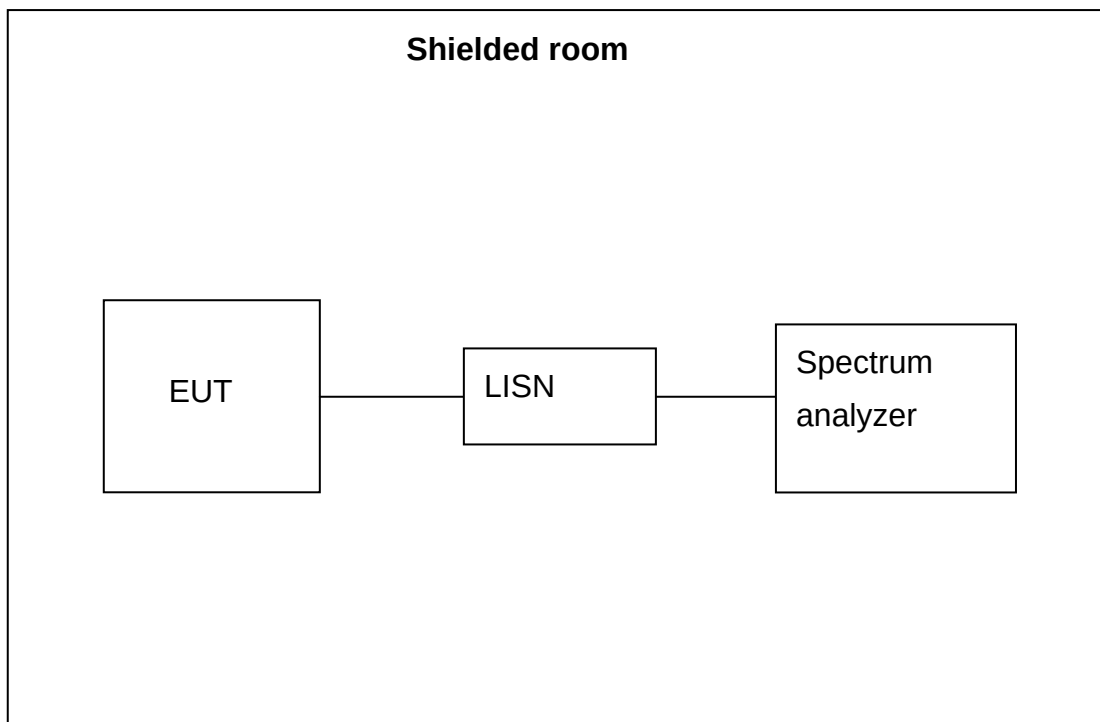
No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	ESN	EMI Reciever	Rohde & Schwarz	LR 1237
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Siverts lab	LR 103
7	DBF-520-20	Antenna horn	Systron Donner	LR 101
8	638	Antenna horn	Narda	LR 098
9	5VF1000/2000	BP filter	Trilithic	LR 1174
10	5VF2000/4000	BP filter	Texscan	LR 42
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 Analyser	Advantest	LR 1123

6 BLOCK DIAGRAM

6.1 System set up



6.2 Powerline Conducted Emission



6.3 Test Site Radiated Emission

