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Test report : 37429-6
Item tested : 13192-SARD
Type of equipment : Zigbee transceiver
FCC ID : SKA13192-SARD
Client : Freescale Semiconductor Danmark A/S

Tested according to :

FCC part 15.247
DTS Transmitter
2405 - 2480 MHz

Date of issue : 05 MARCH 2005

Authorized by :


.....
Kjell G. Haga
Managing Director


.....
Frode Sveinsen
Technical Supervisor

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1 GENERAL INFORMATION

1.1 Test house Info

Name : Nemko Comlab AS
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Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: <mailto:post@comlab.no>
Managing Director: Kjell G. Haga
FCC test firm registration number : 994405
Industry Canada OATS registration number : 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 : Johnny Jonassen
Telephone : +45 967 12 153
E-mail : jjonas1@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 Tested Item

Name :	13192-SARD
FCC ID :	SKA13192-SARD
Model/version :	13192-SARD
Serial number :	Marked on PCB "13192-SARD"
Hardware identity and/or version:	80000536000_R0300
Software identity and/or version :	PTC Version 1.05
Frequency Range :	2405 - 2480 MHz
Tunable Bands :	1
Number of Channels :	16 ¹
Modulation :	0-QPSK
Emissions Designator :	G1D
User Frequency Adjustment :	None, Software controlled.
Rated peak Output Power :	10 mW

1) 16 channels in use.

Theory of Operation

The 13192-SARD is a "Zigbee" low data rate wireless device according to IEEE 802.15.4, with 5MHz channel bandwidth.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 - 23 °C
Relative humidity:	29 - 50 %
Normal test voltage:	9.0 V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2005-02-07
Test period :	from 2005-02-07 to 2005-02-09

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Freescale Semiconductor Danmark A/S
Model No.: 13192-SARD
Serial No.: Marked on PCB "13192-SARD"

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC §15.247 for Digital Modulation devices. Radiated tests were conducted in accordance with ANSI C63.4-1992.

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

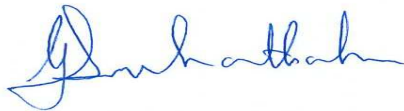
THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.

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

COMLAB

NEMKO COMLAB REF: 37429-6

TESTED BY:



G.Suhanthakumar, Test engineer

DATE: **05 March 2005**

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3.2 Test Summary

Name of test	Paragraph #	Result
Supply voltage variations	15.31 (e)	Complied
Number of operating frequencies	15.31 (m)	Complied
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	Complied
Radiated emissions limits for restricted bands	15.205(a)	Complied
Power line Conducted Emission	15.207(a)	Complied
Radiated emission limits	15.209(a)	Complied
Bandwidth	15.247(a)(2)	Complied
Peak Power Output	15.247(b)(3)	Complied
Power Spectral Density	15.247(d)	Complied
Out-of-band emissions (Antenna Conducted)	15.247(c)	N/A ¹
Out-of-band emissions (Radiated)	15.247(c)	Complied
Upper band edge radiated emission	15.247(c)	Complied

¹ The tested equipment has integrated antennas only.

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 19 and near bottom ch 11. And the output level is set to maximum in the software (code 00FC)The EUT complies at these channels.

The measurements are done with battery (DC power) and AC adapter. All ports were populated during spurious emissions measurements.

3.5 Family List Rational

None.

4 TEST RESULTS

4.1 Power line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suwanthakumar

Date of Test: 09 Feb 2005

Measurement procedure: CISPR 22 1997 Clause 5.1 Class B ITE using 50 μ H/50 ohms LISN.

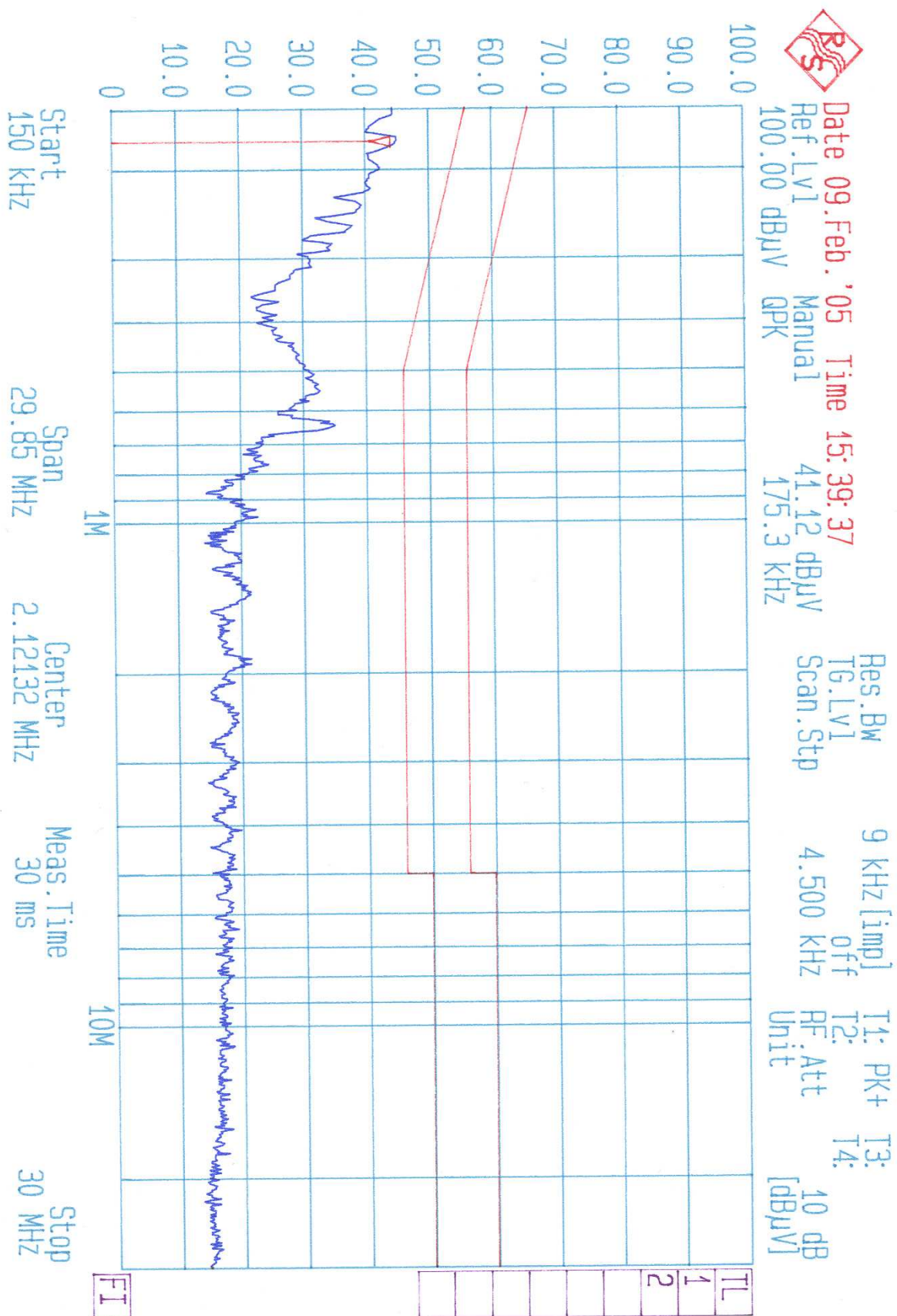
Test Results: **Complies.**

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

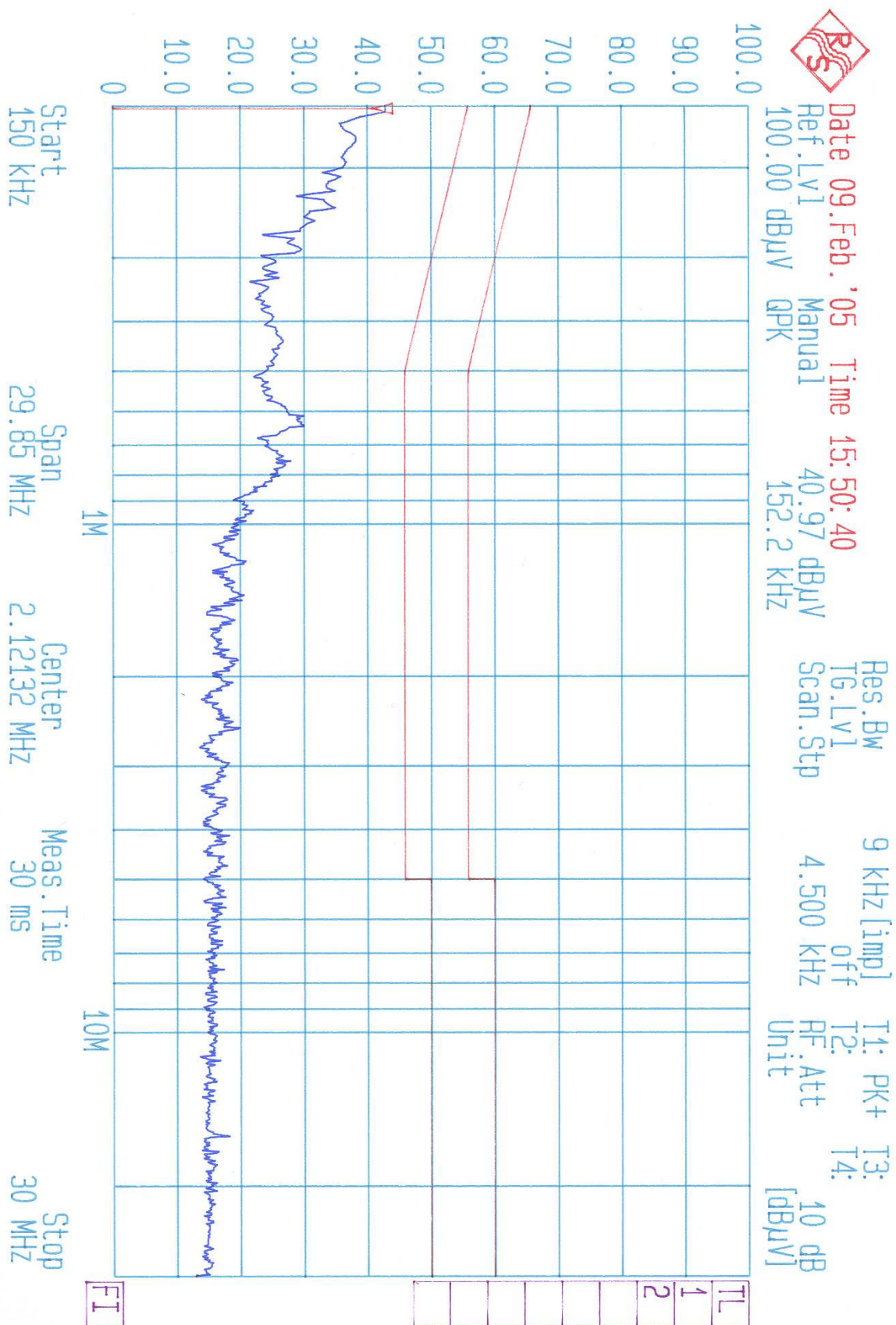
Highest measured value: for AC adapter

Frequency	Line	Detector	Measured value	Limit	Margin
MHz	L1/ N	Peak/QP/AV	dB μ V	dB μ V	dB
0.1563	L1	QP	39,8	56	
0.1563	L1	AV	25,1	46	
0.6463	L1	QP	26,5	56	
0.6463	L1	AV	19,1	46	
1,85	L1	QP	13,4	60	
1,85	L1	AV	7	50	
0.1743	L1	QP	41,1	60	
0.1743	L1	AV	29	50	
0,6414	N	QP	32,7	60	
0.6414	N	AV	27	50	
1,893	N	QP	16,3	50	
1,893	N	AV	11,8	50	

Test equipments used: 2, 4 & 16



AC adapter, phase N



AC adapter, phase L1

4.2 Bandwidth

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

Test Performed By: G.Suwanthakumar

Date of Test: 08. Feb 2005

Test Results: Complies

Measurement Data:

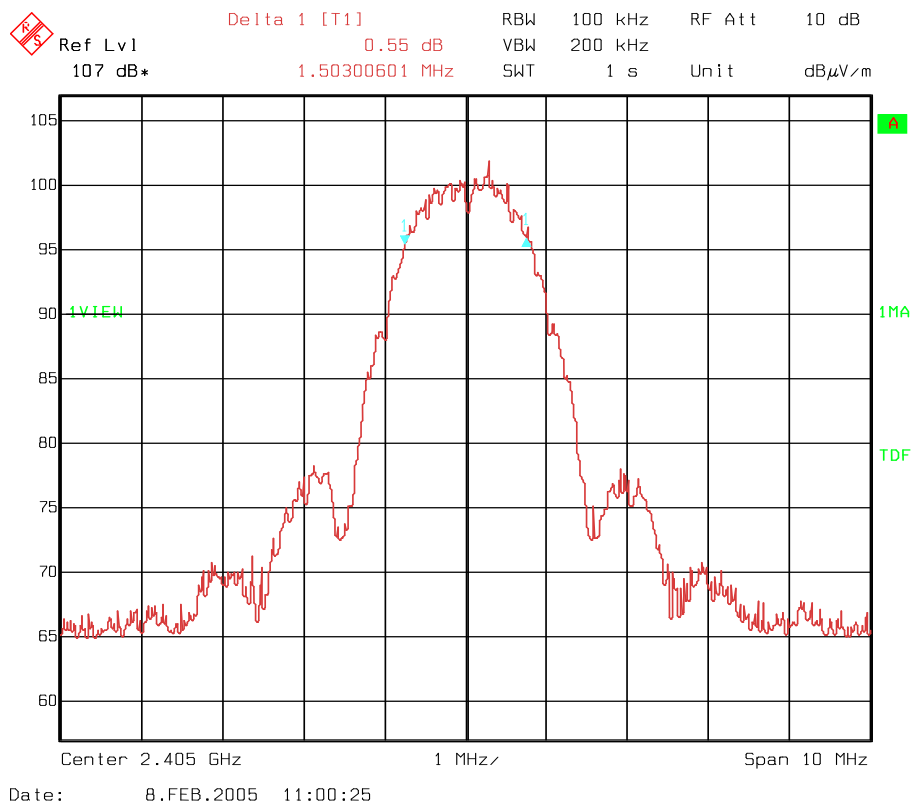
6 dB Bandwidth (MHz)		
Ch 11	Ch 19	Ch 26
1.50	1.58	1.60

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

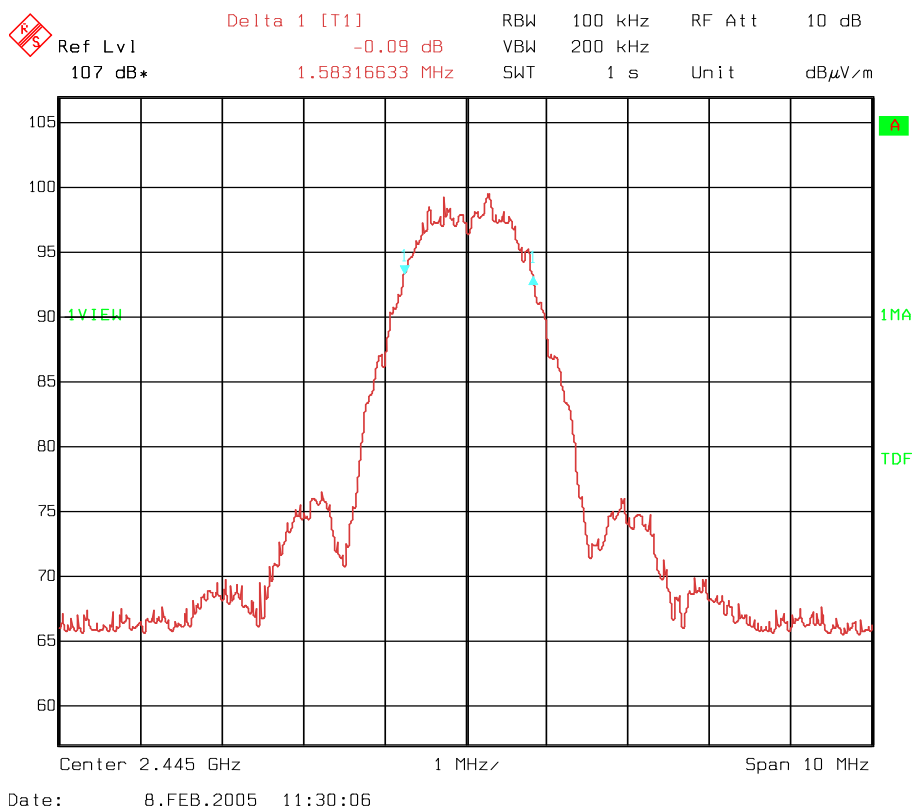
Requirements:

The minimum 6 dB bandwidth shall be at least 500 KHz.

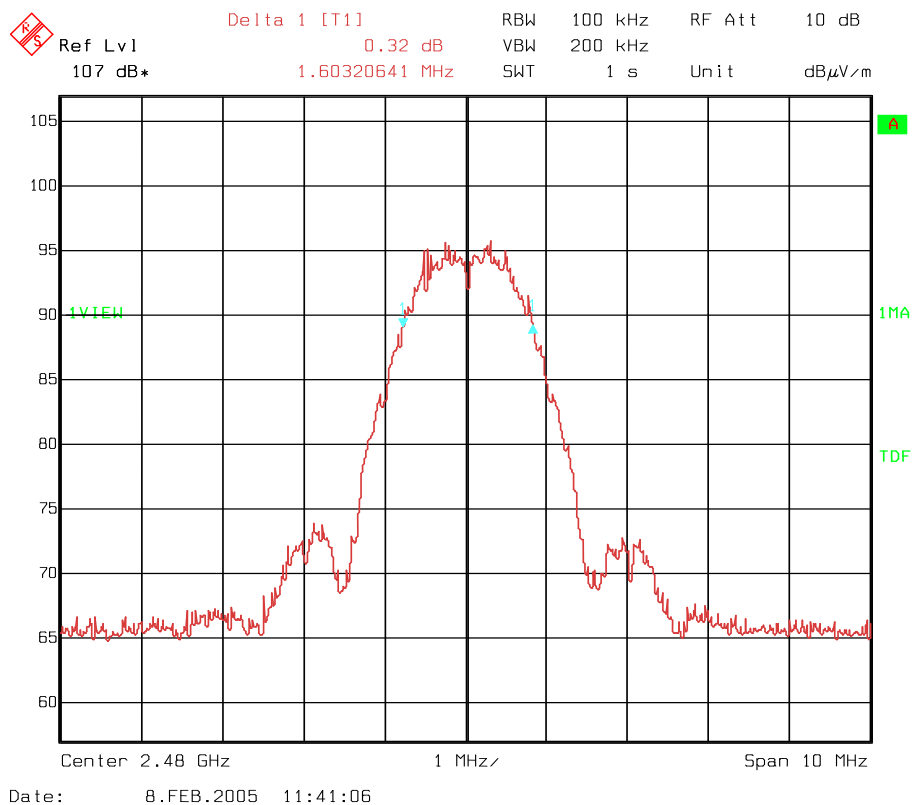
Test equipments used: 1, 3, 12 & 19



Ch 11, 6 dB bandwidth - 1.50 MHz



Ch 19, 6 dB bandwidth - 1.58 MHz



Ch 26, 6 dB bandwidth - 1.60 MHz

4.3 Peak Power Output

Para. No.: 15.247 (b)(3)

Test Performed By: G.Suwanthakumar	Date of Test: 05. Feb 2005
------------------------------------	----------------------------

Rated peak output power level 20 mW

Measured Peak EIRP, mW:

RF channel	11	19	26
EIRP with integrated antenna	22	12.7	5.6
Antenna gain given by the manufacturer for integrated antennas dBi	0	0	0

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

Conducted power $P_i = \text{EIRP} / 10^{(G/10)}$ mW

Calculated Conducted Peak Output Power, mW:

RF channel	11	19	26
Conducted	22	12.7	5.6

Test Results: Passed.

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

Measurement Data:

The maximum field strength of fundamental, RBW=10MHz, Ch 11 : 108.85dBμV/m

The maximum field strength of fundamental, RBW=10MHz, Ch 19 : 106.29 dBμV/m

The maximum field strength of fundamental, RBW=10MHz, Ch 26 : 102.65 dBμV/m

Calculated Data:

- The maximum field strength of fundamental in V/m ($10^{((108.65)/20)} \times 10^{-6}$) Ch11: 0.271V/m
- The maximum field strength of fundamental in V/m ($10^{((106.29)/20)} \times 10^{-6}$) Ch19: 0.206V/m
- The maximum field strength of fundamental in V/m ($10^{((102.65)/20)} \times 10^{-6}$) Ch26: 0.136V/m

Calculated maximum EIRP using free field formula:

- Ch11: P(EIRP) watts: $(3 \times 0.271)^2 / 30 = 22$ mW
- Ch19: P(EIRP) watts: $(3 \times 0.206)^2 / 30 = 12.7$ mW
- Ch26: P(EIRP) watts: $(3 \times 0.136)^2 / 30 = 5.6$ mW

The maximum power is obtained at Horizontal polarization and measured at 3 meters.

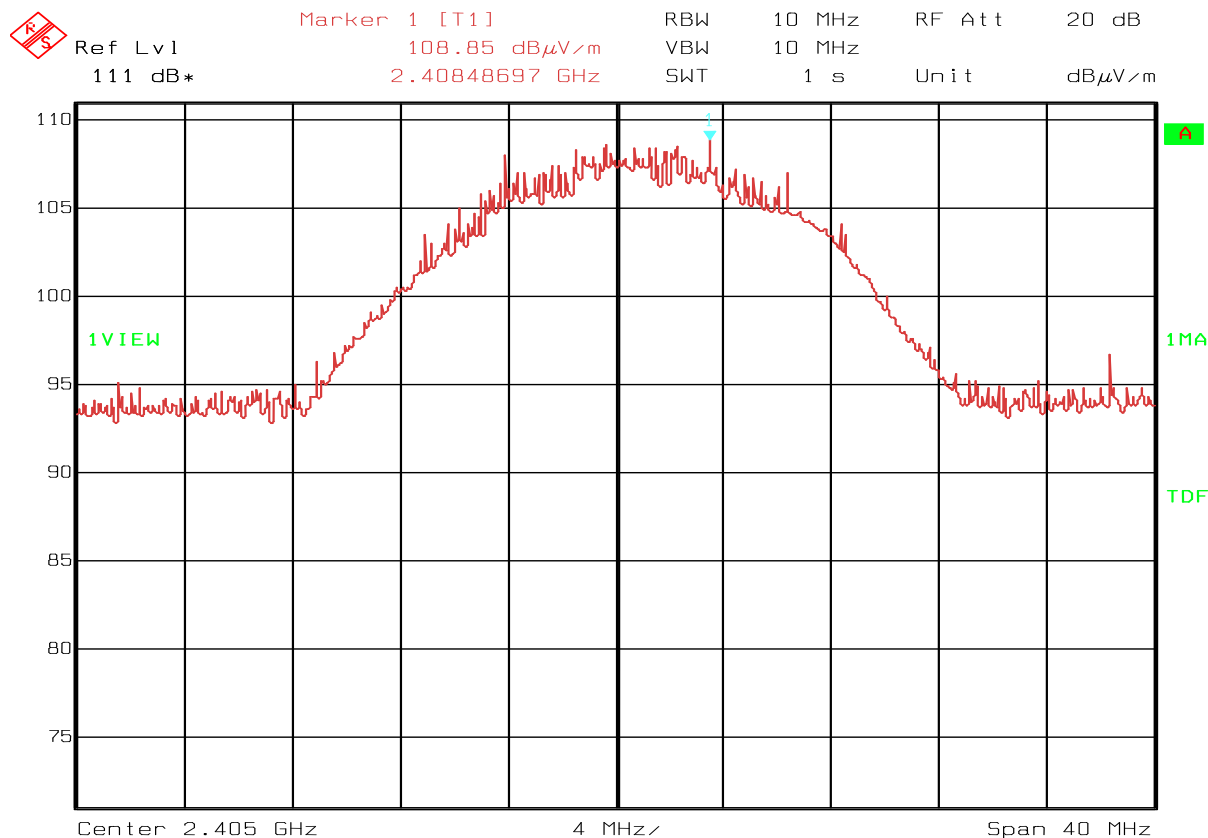
The antenna gain of the measurement antenna and cable loss have been taken into consideration.

Requirements:

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

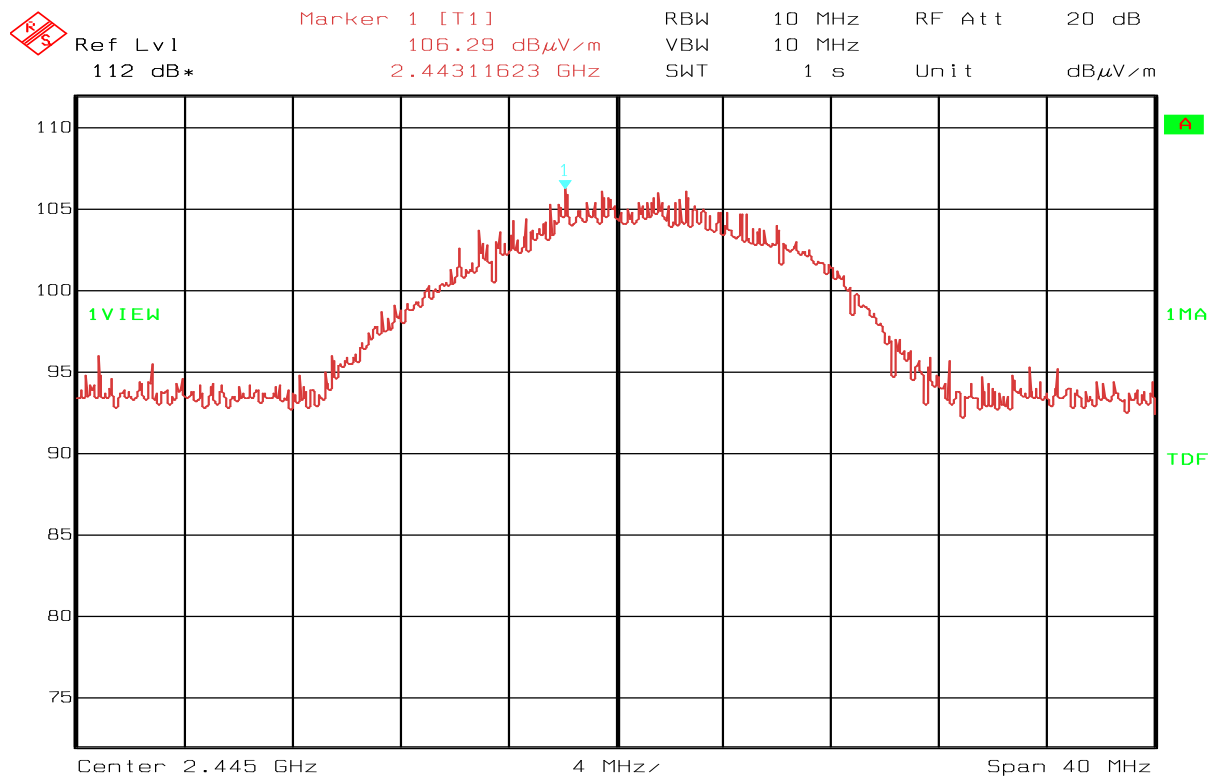
For systems using Digital Modulation in the 2400 - 2483.5 MHz band: less than or equal to 1 watt

Test equipments used: 1, 3, 12 & 19



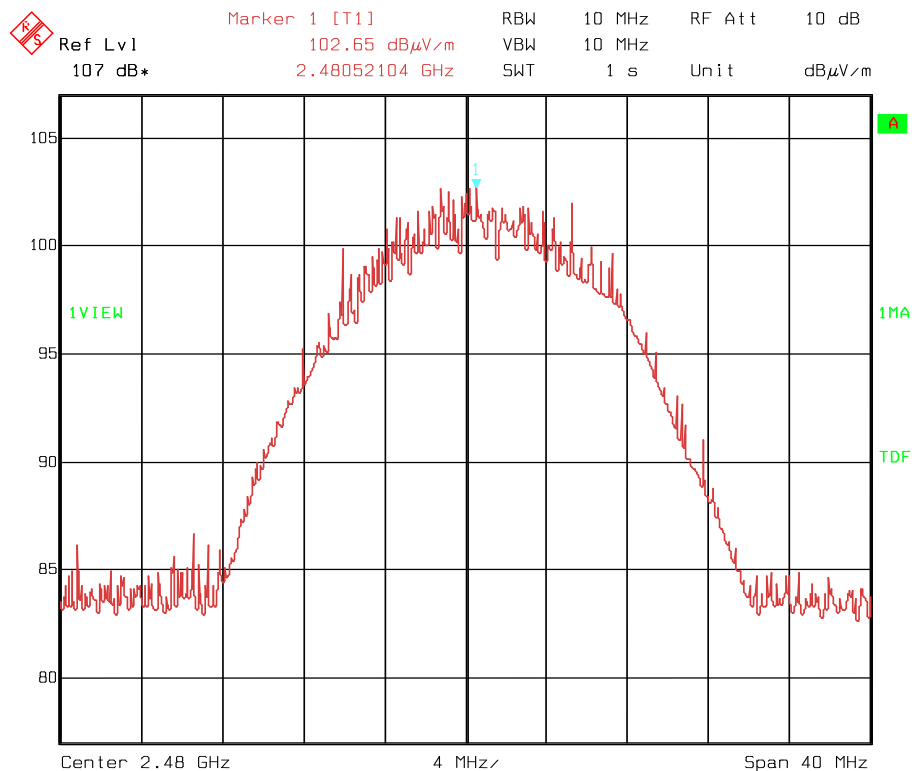
Date: 8.FEB.2005 11:08:14

Ch 11, Peak output power



Date: 8.FEB.2005 11:32:49

Ch 19, Peak output power



Date: 8.FEB.2005 11:36:46

Ch 26, Peak output power

4.4 Out-of-band emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suwanthakumar

Date of Test: 09. Feb 2005

Test Results: complies

Measurement Data:

Radiated emission (Integrated ant), 1-25 GHz, see attached table.

Highest value RF Ch 11: Peak 58.92 dB μ V/m, average 44.23 dB μ V/m, 7.214GHz

Ch 19: Peak 50.18 dB μ V/m, average 43.44 dB μ V/m, 1.830 GHz

Ch 26: Peak 49.52 dB μ V/m, average 42.78 dB μ V/m, 1.849 GHz

Duty Cycle Calculation:

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

$$20 \cdot \log (1.61\text{ms}/29.97\text{ms}) = -25.4 \text{ dB}$$

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

No components above 7.4 GHz were detected

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

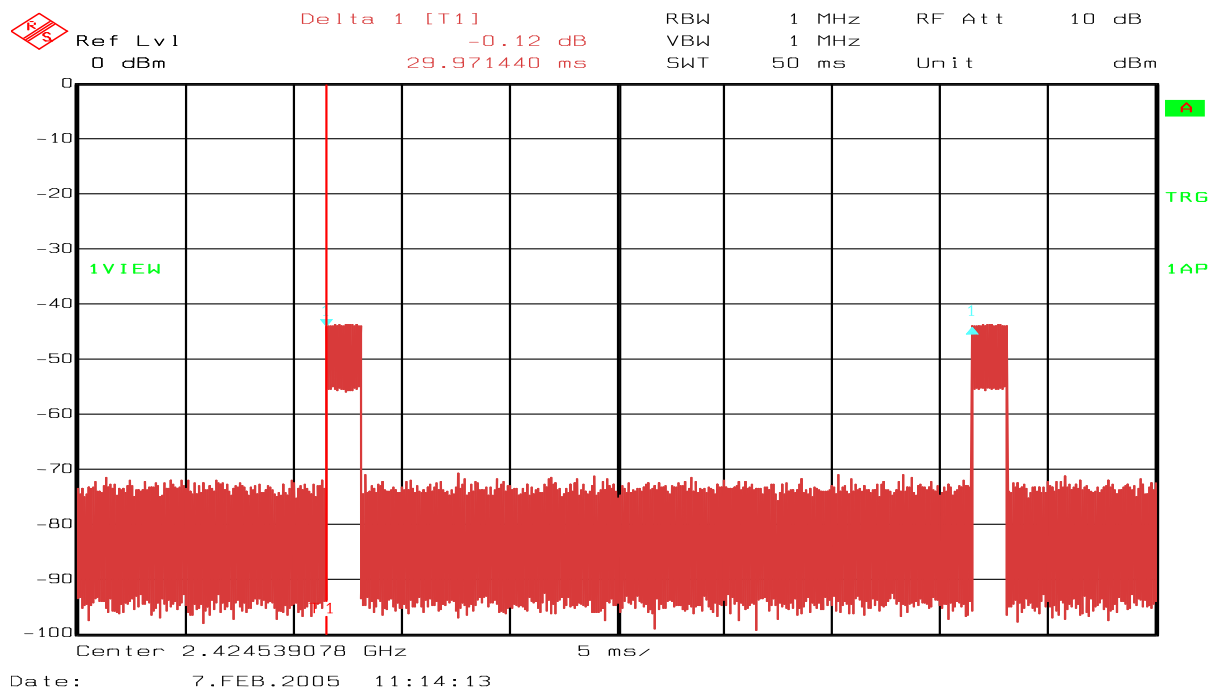
Example of frequency graph of radiated emission is also attached.

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

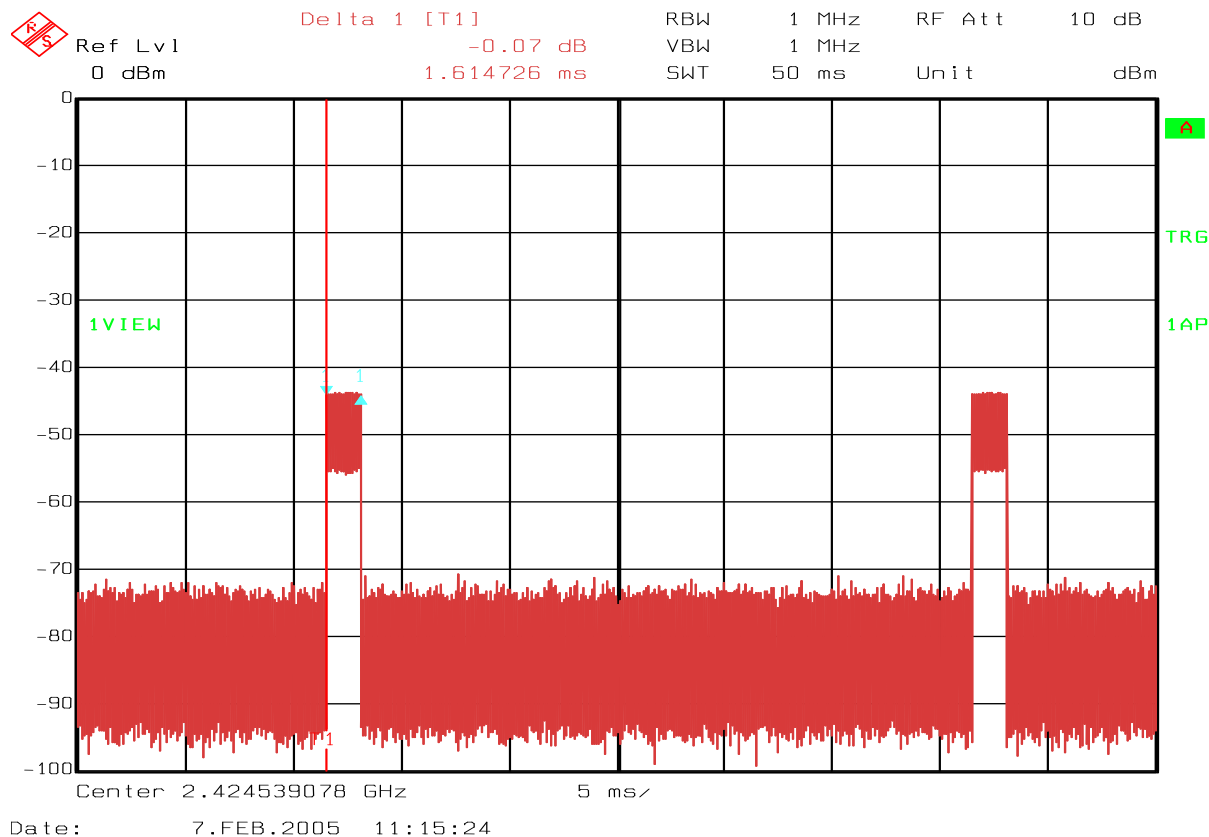
Requirements:

Not greater than -20dBc

Test equipments used: 1, 3, 7,8,9,10,11,12,17,18 , 19 & 20



OFF +ON time



ON time

Radiated Emission 1 – 25 GHz, Peak

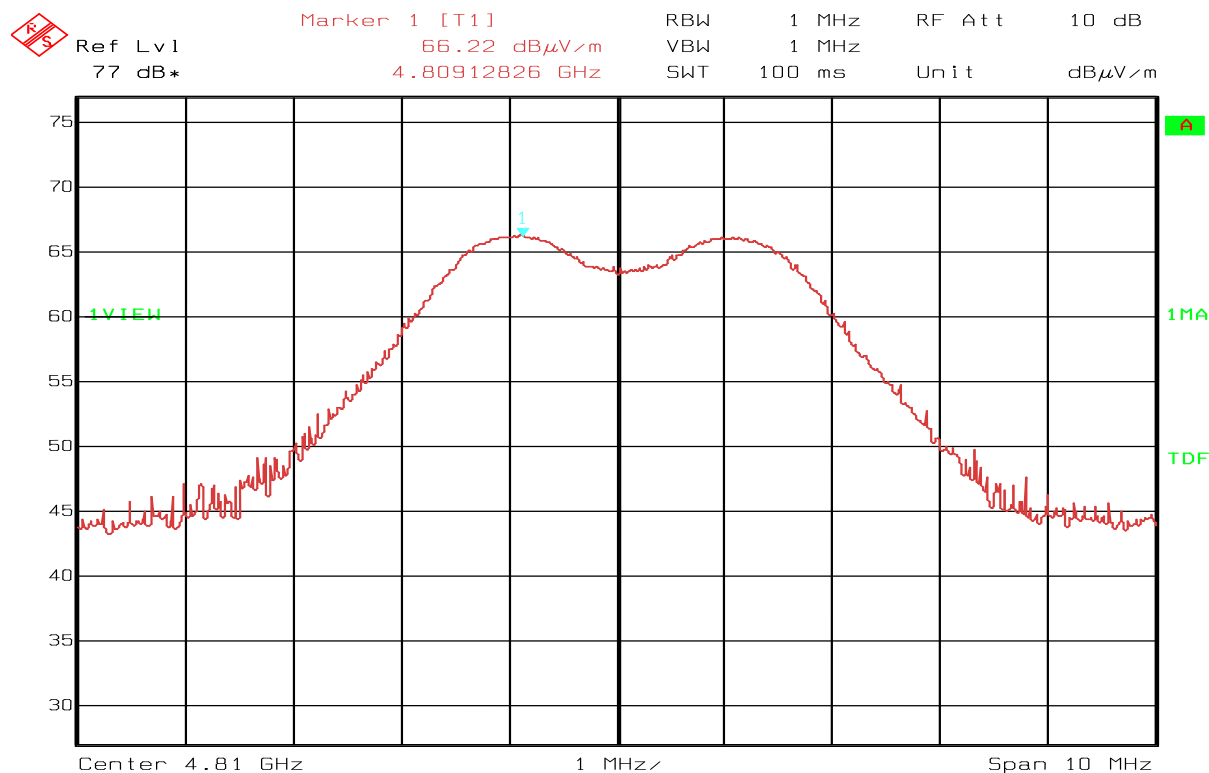
Measured with Peak Detector

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
4.809	11	0	66.22	-	74	7.78
4.891	19	0	64.59	-	74	9.41
4.961	26	0	64.93	-	74	9.07
7.216	11	0	68.19	-	74	5.81
7.336	19	0	67.31	-	74	6.69
7.438	26	0	67.50	-	74	6.5
7.5 -24	11	0	None detected	-	74	-
7.5 -24	19	0	None detected	-	74	-
7.5 - 24	26	0	None detected	-	74	-

Radiated emission 1- 25 GHz, Average

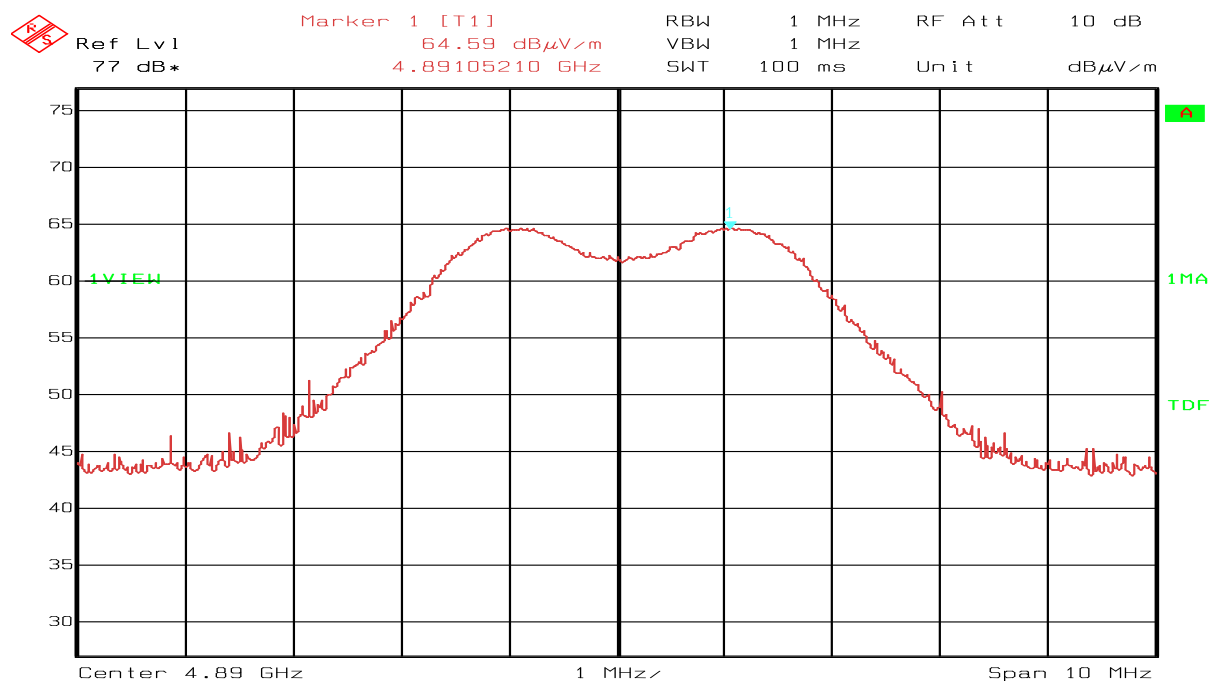
Calculated value from Peak Detector

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
4.809	11	0	66.22	-20	54	7.78
4.891	19	0	64.59	-20	54	9.41
4.961	26	0	64.93	-20	54	9.07
7.216	11	0	68.19	-20	54	5.81
7.336	19	0	67.31	-20	54	6.69
7.438	26	0	67.50	-20	54	6.5
7.5 -24	11	0	None detected	-20	54	-
7.5 -24	19	0	None detected	-20	54	-
7.5 - 24	26	0	None detected	-20	54	-



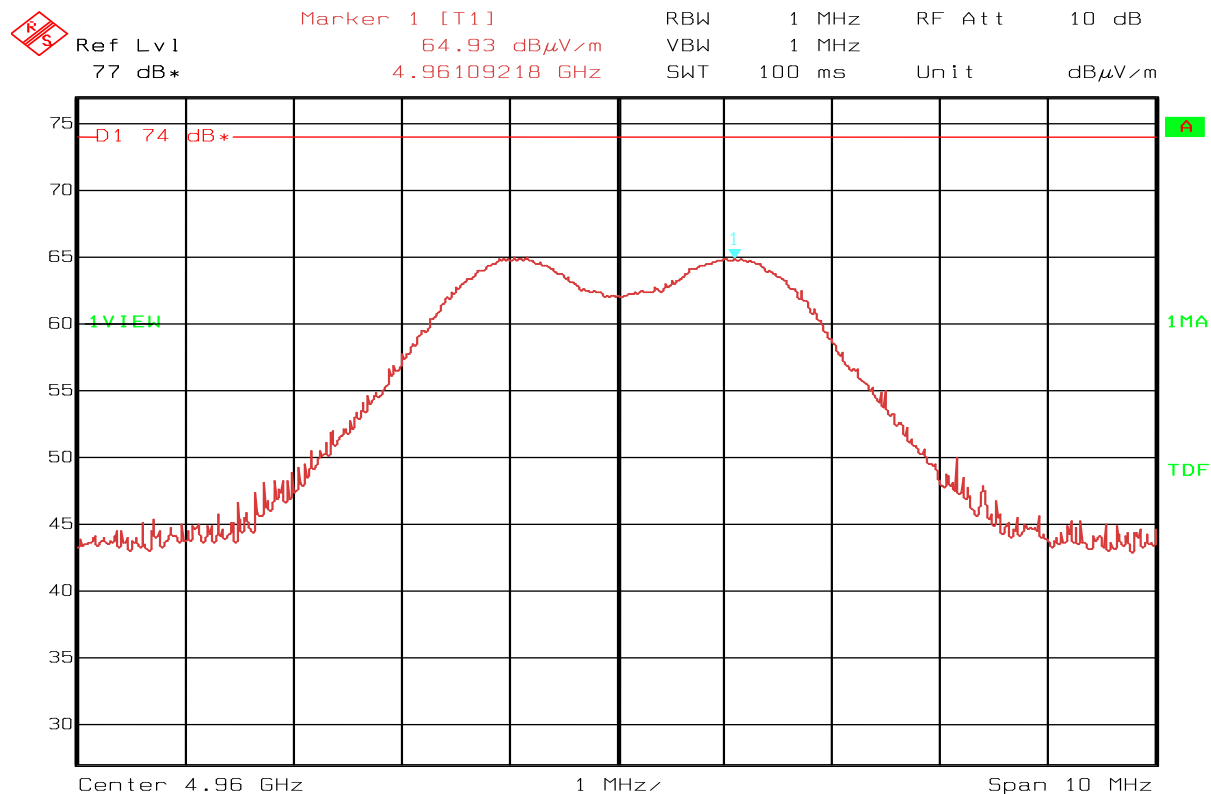
Date: 9.FEB.2005 12:50:18

Max field strength – radiated emission, 2nd Harmonic , ch 11



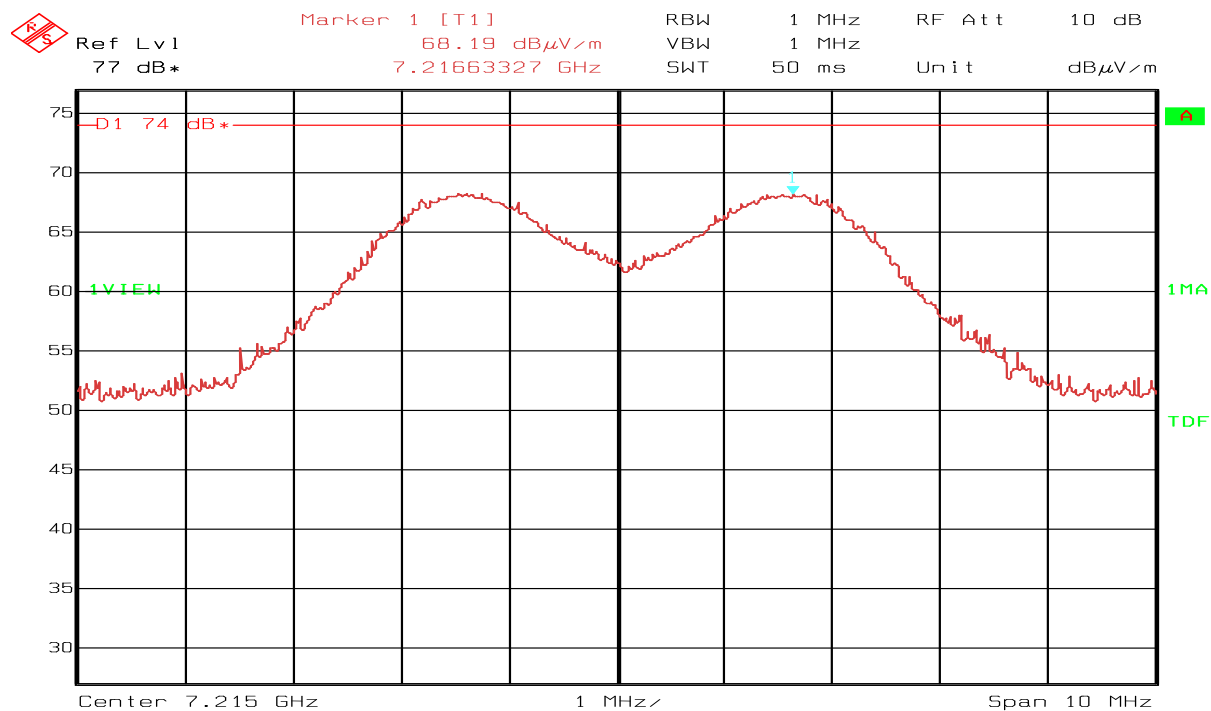
Date: 9.FEB.2005 12:52:08

Max field strength – radiated emission, 2nd Harmonic , ch 19



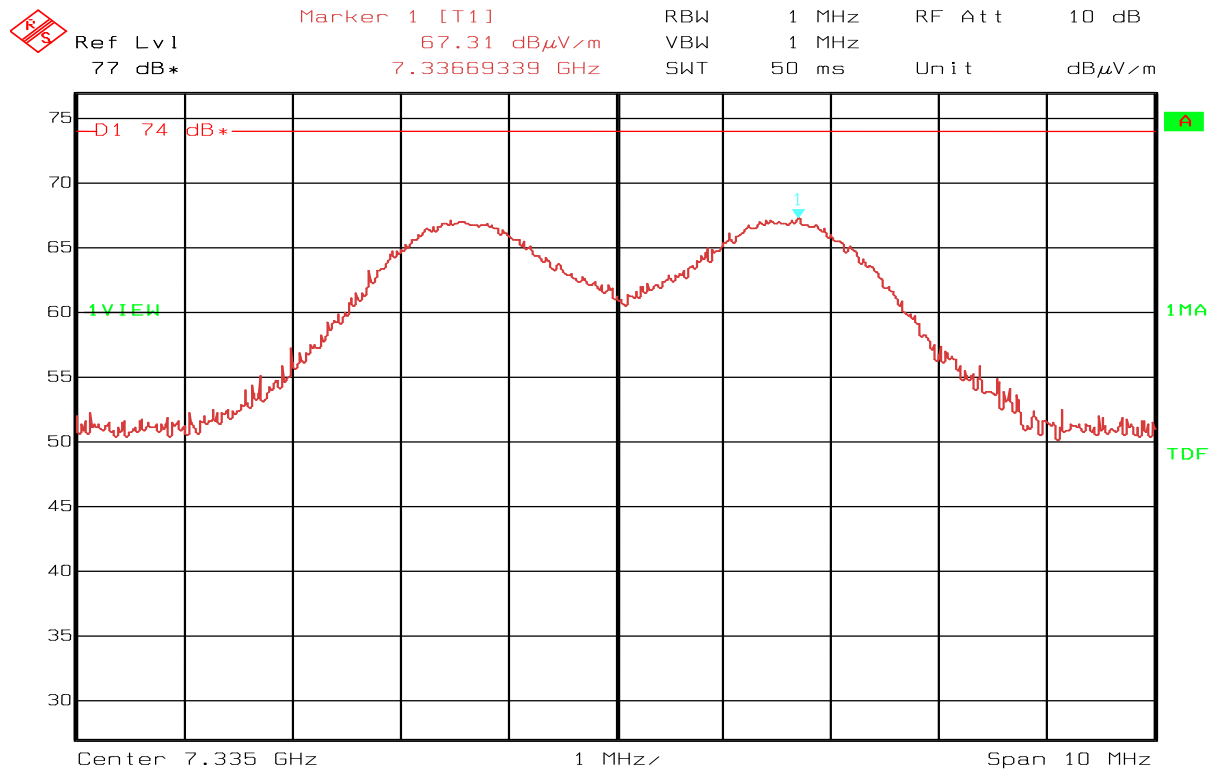
Date: 9.FEB.2005 12:54:11

Max field strength –radiated emission, 2nd Harmonic , ch 26

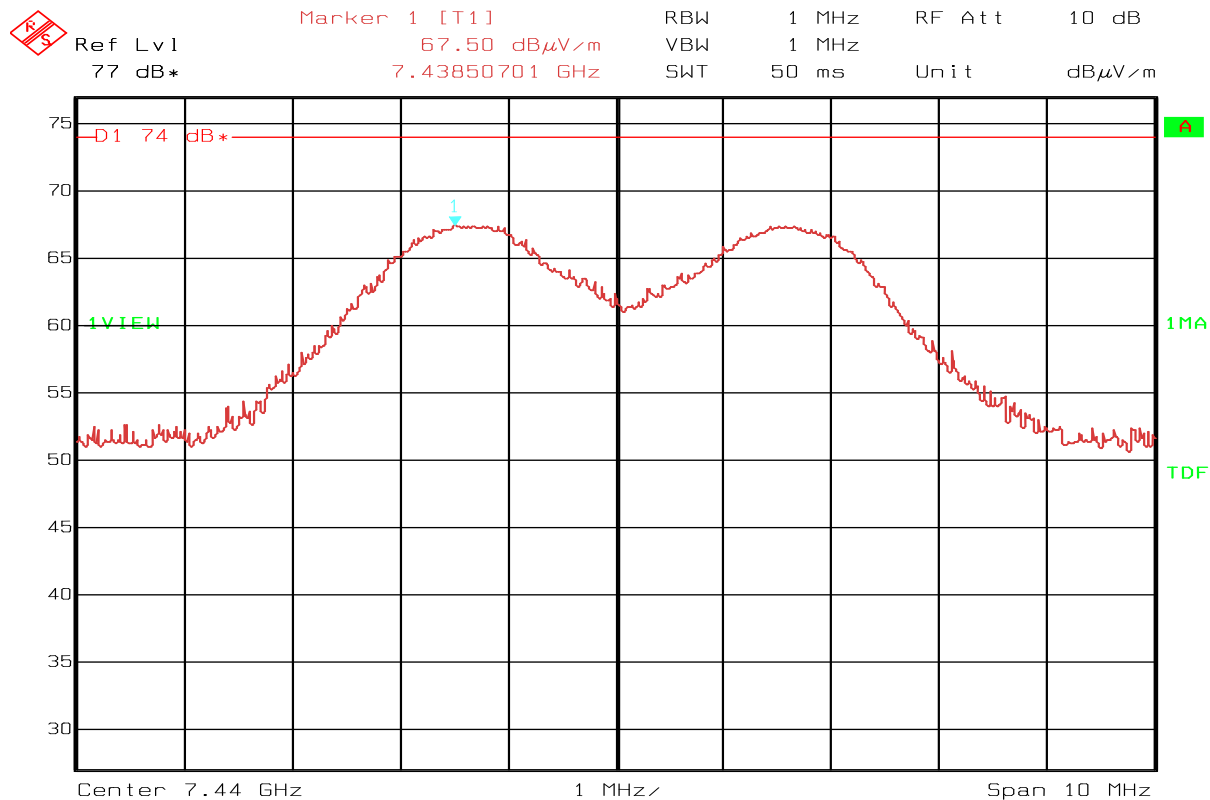


Date: 9.FEB.2005 13:18:24

Max field strength –radiated emission, 3rd Harmonic , ch 11.



Date: 9.FEB.2005 13:13:25

Max field strength -radiated emission, 3rd Harmonic , ch 19

Date: 9.FEB.2005 13:16:44

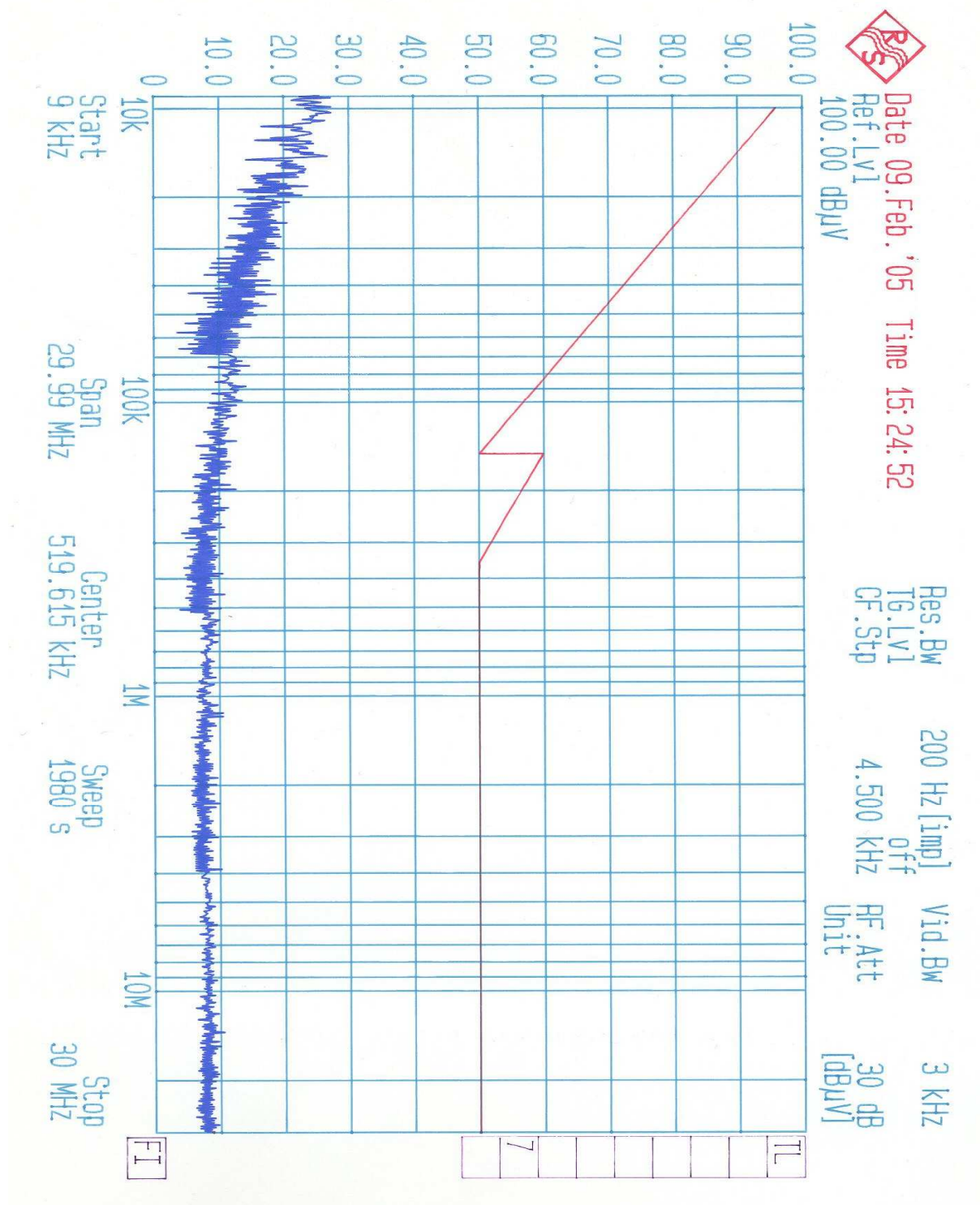
Max field strength -radiated emission, 3rd Harmonic , ch 26

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).



9 kHz – 30MHz –radiated emission

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 3 m according to CISPR 22.

No component detected, see attached graphs.

Nemko Comlab AS
 Peak

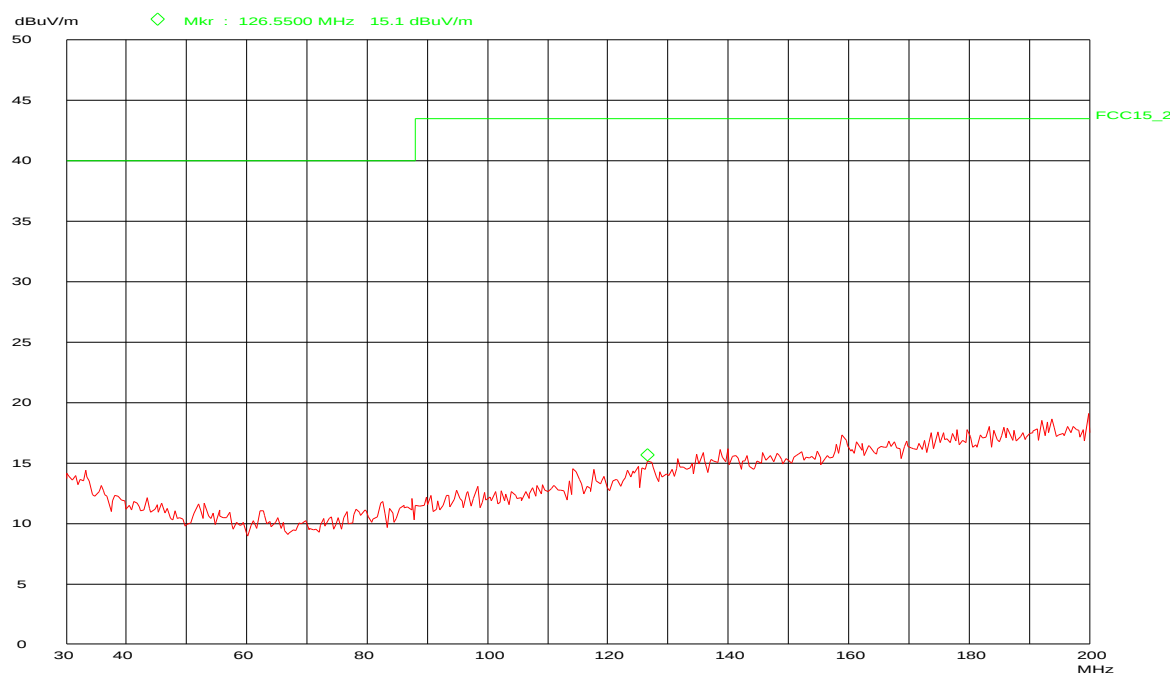
09. Feb 05 14:17

EUT: 13192/sard
 Manuf: freescale
 Op Cond: hp10
 Operator: gns
 Test Spec: FCC 15

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



Radiated emission 30 –200MHz, Horizontal polarization

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	meters	dB μ V/m	dB
126.53	TX on	25	3	43.5	25,5

In the column 3 peak values are given for 3 meter.

Nemko Comlab AS
Peak

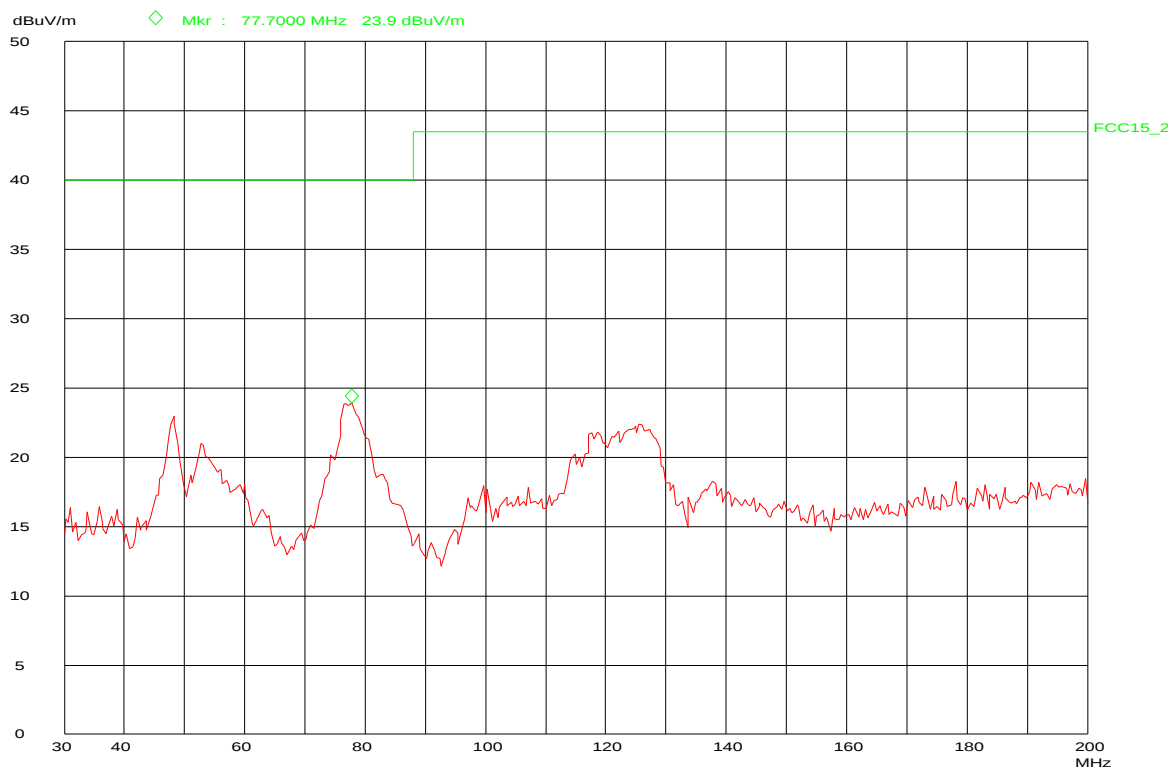
09. Feb 05 14:09

EUT: 13192/sard
Manuf: freescale
Op Cond: vp10
Operator: gns
Test Spec: FCC 15

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



Radiated emission 30 –200MHz, Vertical polarization

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	meters	dB μ V/m	dB
77,3	TX on	35	3	43.5	8.5

Nemko Comlab AS
Peak

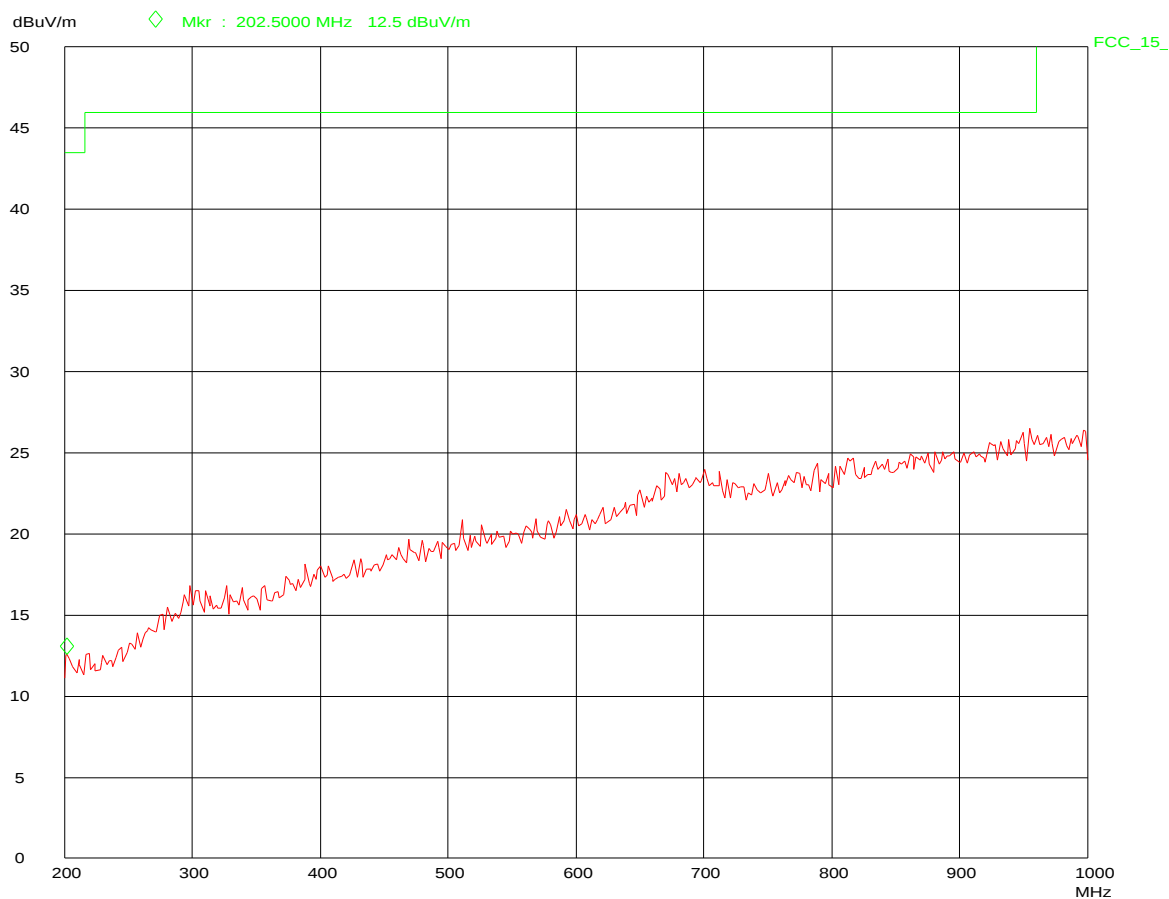
09. Feb 05 13:16

EUT: 13192/sard
Manuf: freescale
Op Cond: hp10
Operator: gns
Test Spec: FCC 15

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
3	15	200M	580M 3146ahp
16	580M	960M	3146bhp
17	960M	1000M	3146chp



Radiated emission 200 –902 MHz, Horizontal polarization

Nemko Comlab AS
Peak

09. Feb 05 13:37

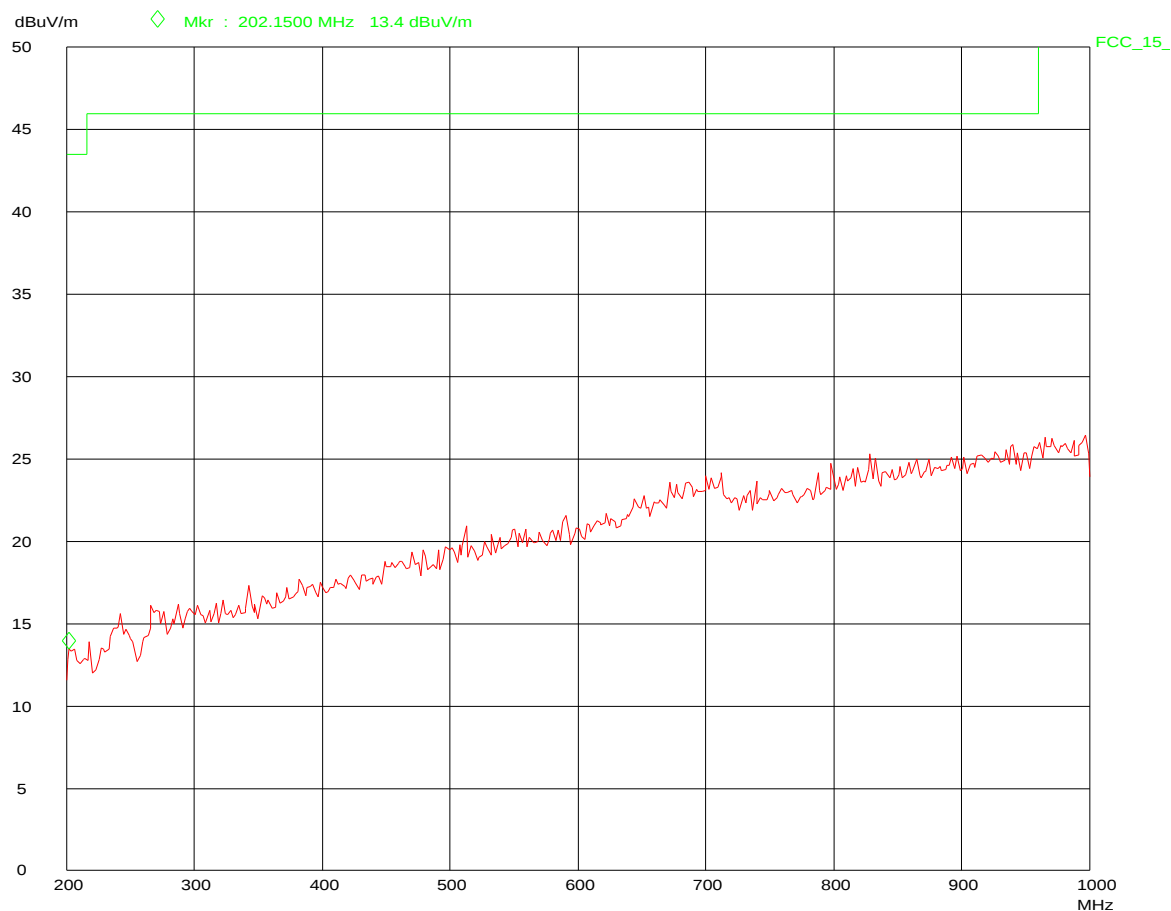
EUT: 13192/sard
Manuf: freescale
Op Cond: vp10
Operator: gns
Test Spec: FCC 15

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
3 15	200M	580M	3146ahp
16	580M	960M	3146bhp
17	960M	1000M	3146chp



Radiated emission 200 - 902MHz, Vertical polarization

4.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suwanthakumar

Date of Test: 09.Feb.2005

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.

EUT's antenna gain G : 0 dBi --> $10^{(0)} = 1$

Ch11:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 90.42 dBμV/m

The calculated field strength $E = 33.19$ mV/m

The calculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (33.19 \text{ mV/m} \times 3)^2 / (30 \times 1) = 330.5 \mu \text{ Watts}$

PSD in dBm = $10 \log (P/1 \text{ mW}) = -4.81$ dBm

Ch19:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 88.32 dBμV/m

The calculated field strength $E = 26.06$ mV/m

The calculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (0.0261 \text{ V/m} \times 3)^2 / (30 \times 1) = 204.36 \mu \text{ Watts}$

PSD in dBm = $10 \log (P/1 \text{ mW}) = -6.89$ dBm

Ch26:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 86.39 dBμV/m

The calculated field strength $E = 20.87$ mV/m

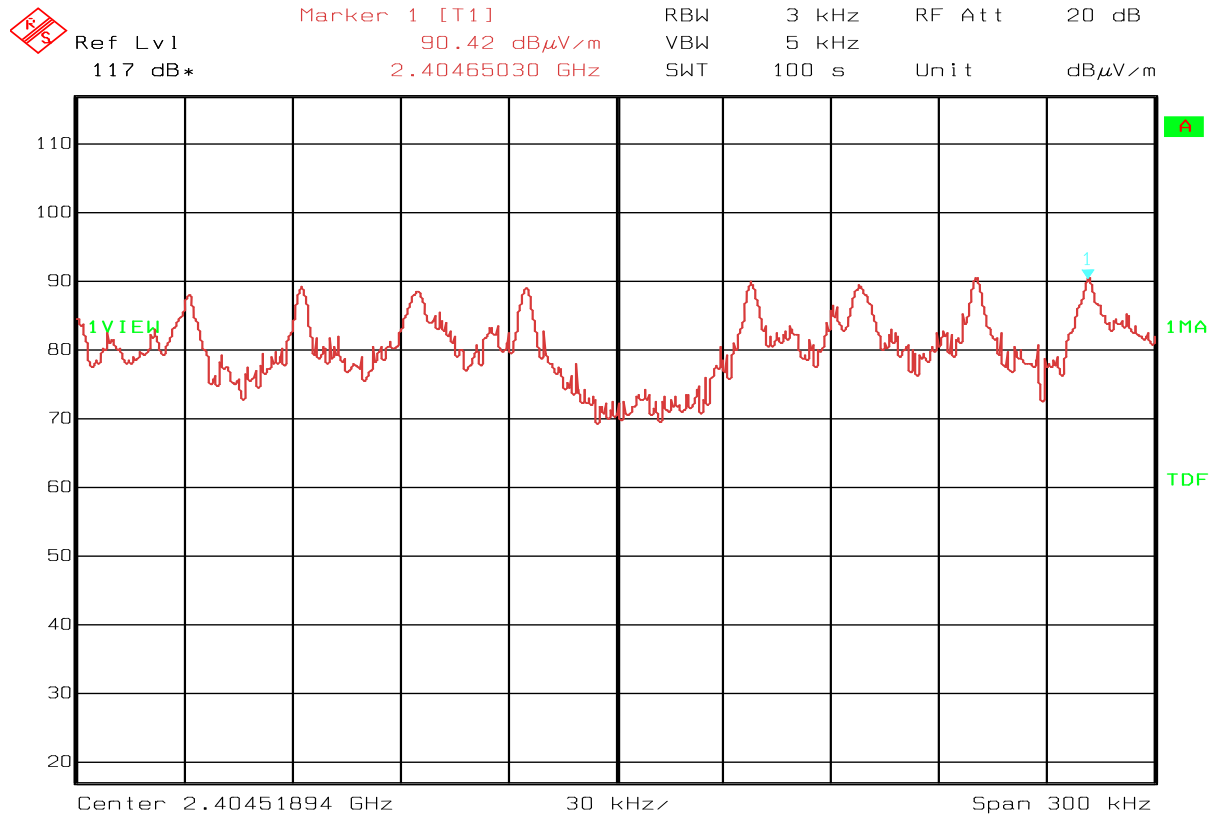
The calculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (0.02087 \text{ V/m} \times 3)^2 / (30 \times 1) = 130.67 \mu \text{ Watts}$

PSD in dBm = $10 \log (P/1 \text{ mW}) = -8.83$ dBm

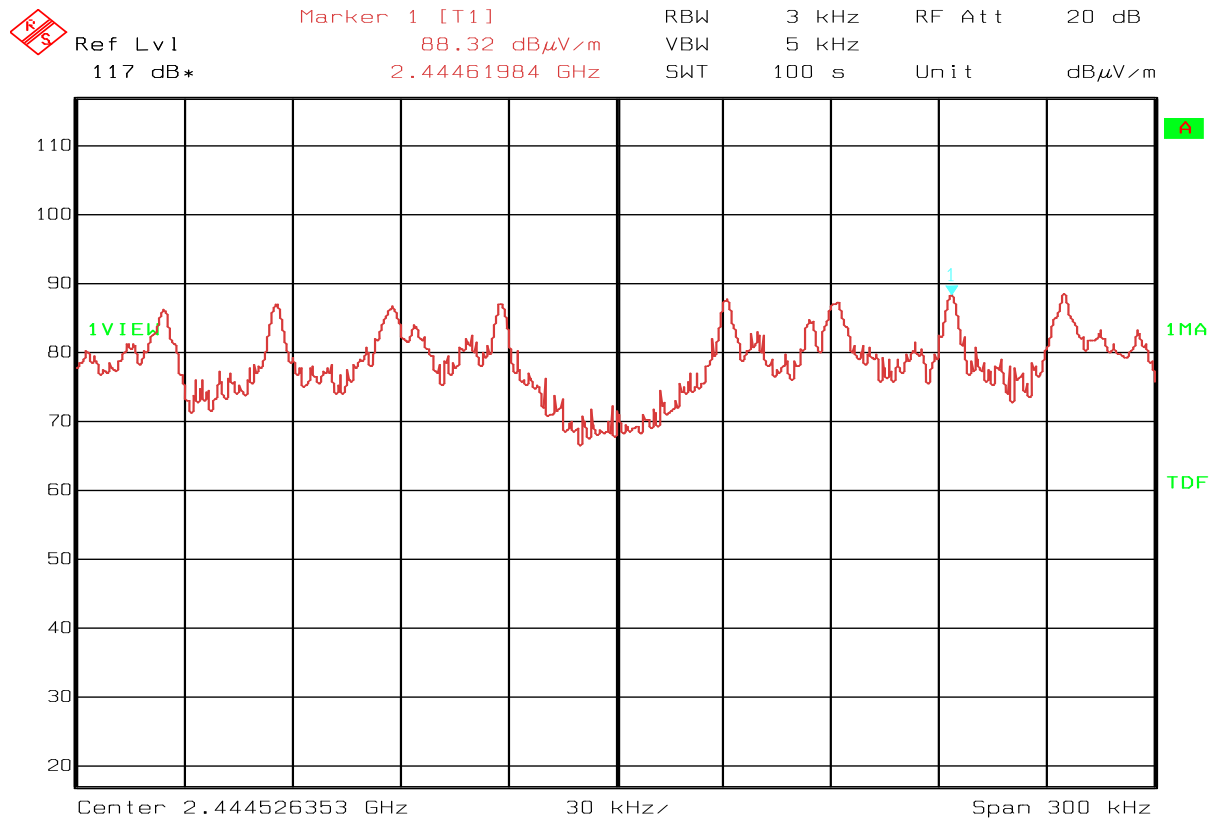
Requirements:

No greater than +8 dBm in any 3kHz band

The Test equipments used: 1, 3, 12 & 19



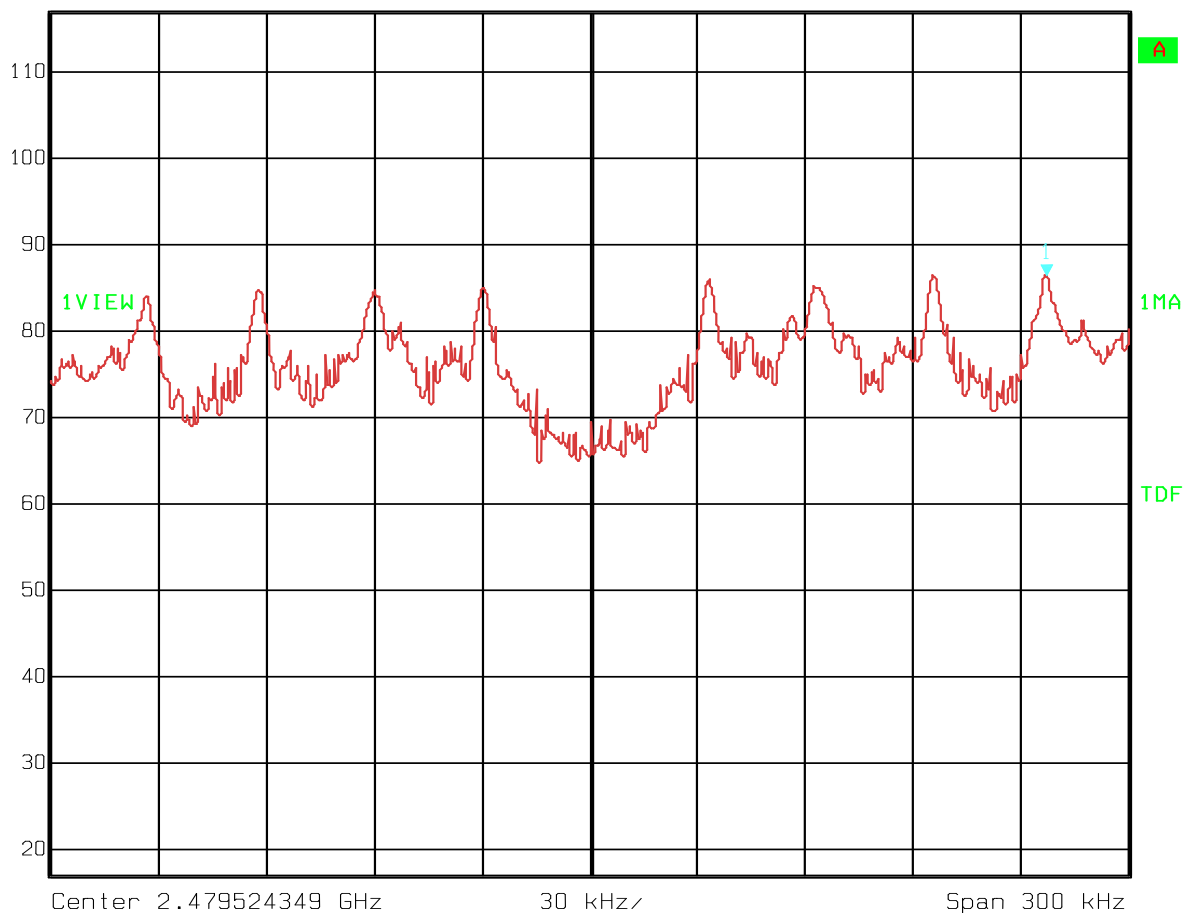
Ch11 Peak level for PSD



Ch 19 Peak level for PSD



Ref Lvl 117 dB* Marker 1 [T1] 86.39 dB μ V/m 2.47965150 GHz RBW 3 kHz RF Att 20 dB
VBW 5 kHz Unit dB μ V/m
SWT 100 s



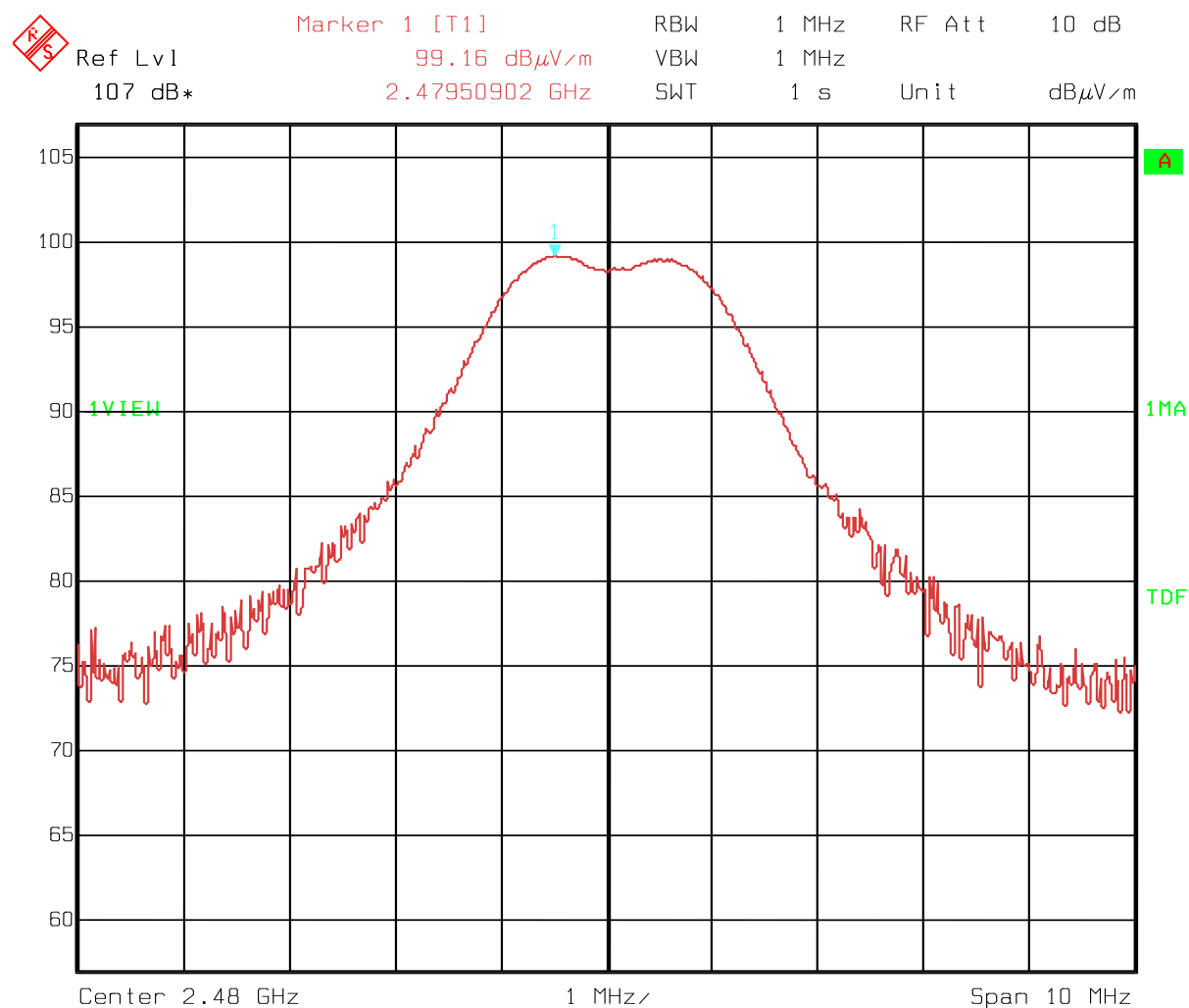
Date: 9.FEB.2005 19:06:51

Ch 26 Peak level for PSD

4.6 Upper Band Edge Radiated Emissions

This document calculates the spurious radiations at the upper band edge (at 2483.5 MHz) when the equipment is transmitting on channel 26. All measurements were performed at 3 metres.

The calculations are done according to the "Marker-Delta Method".

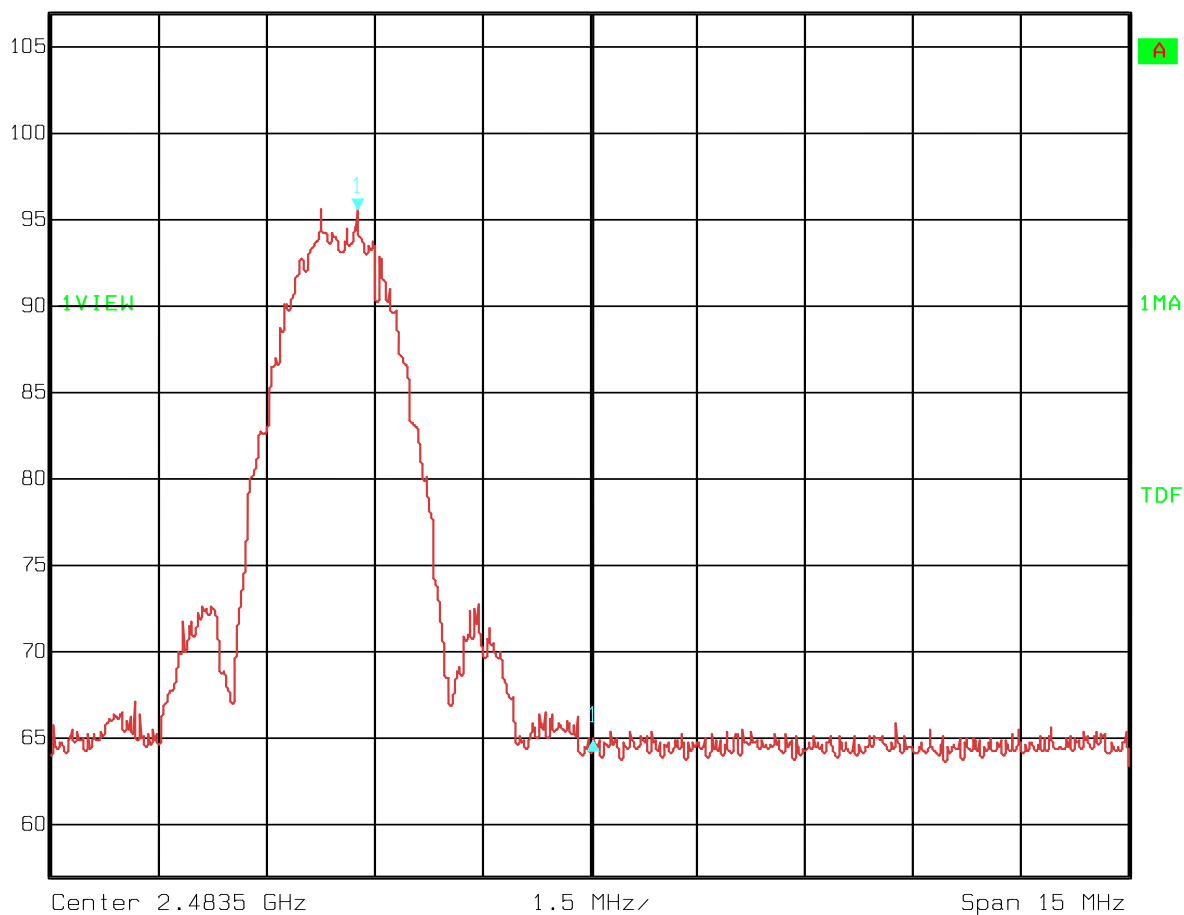


Date: 8.FEB.2005 11:44:14

Peak field strength at 2.480GHz, ch 26



Ref Lvl 107 dB*
Delta 1 [T1] -30.64 dB
3.27655311 MHz
RBW 100 kHz
VBW 100 kHz
SWT 1 s
RF Att 10 dB
Unit dBμV/m



Date: 8.FEB.2005 11:47:59

Marker delta , ch 26, Upper Band Edge

Peak Field Strength: 99.16 dBμV/m

Marker Delta 100kHz RBW: 30.64dB

Therefore:

Peak Field Strength 99.16 – 30.64 = 68.52 dBμV/m

Average Field Strength: 68.52 dBμV/m – 20.0 dB = 48.52 dBμV/m

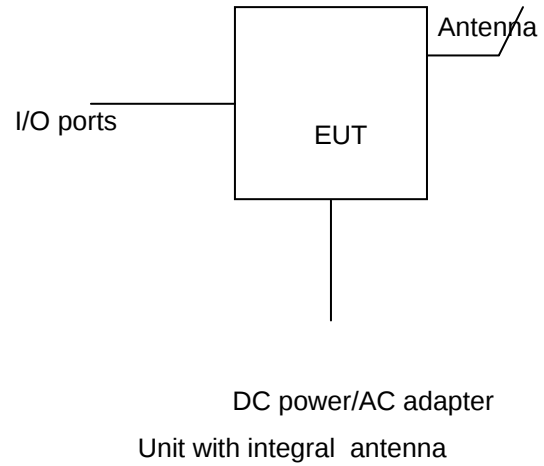
LIST OF TEST EQUIPMENT

To facilitate inclusion of the test equipment used for related tests on each page, each item is numbered by the test house.

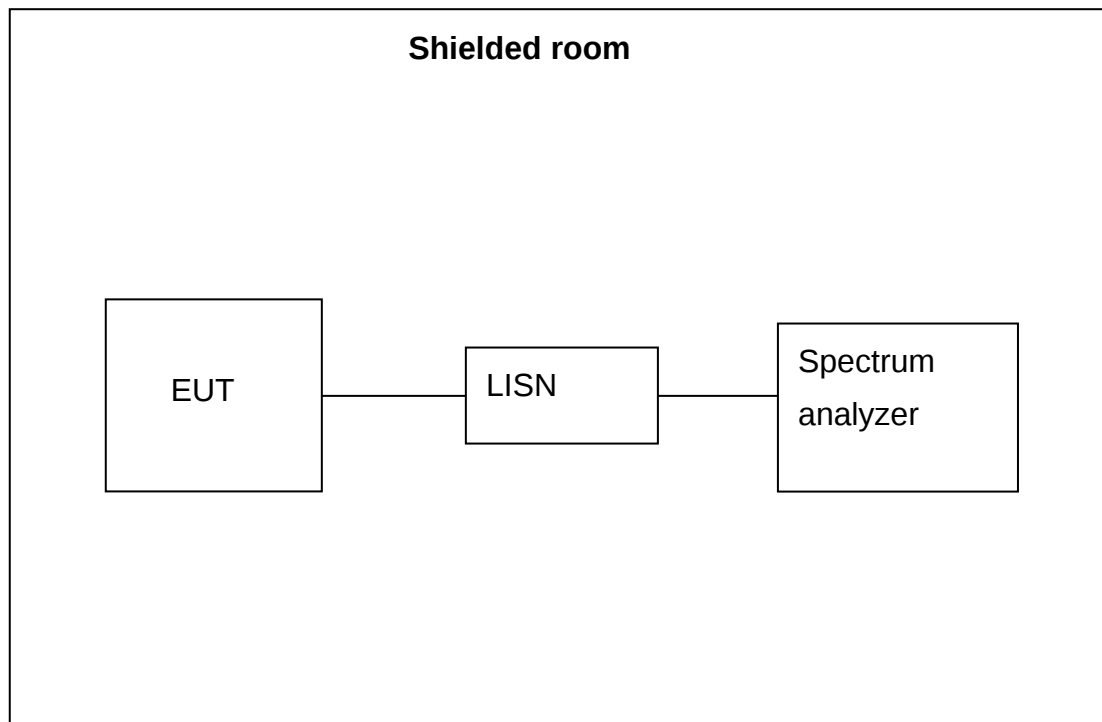
No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1.	FSEK	Spectrum Analyzer	Rohde & Schwarz	1337
2.	ESAI	Spectrum Analyzer	Rohde & Schwarz	1090
3.	3115	Antenna horn	EMCO	1330
4.	ESH3-Z3	LISN	Rohde & Schwarz	1076
5.	8449B	Amplifier	Hewlett Packard	1322
6.	959C	Printer	Hewlett Packard	1414
7.	HFH2-Z2	Antenna loop	Rohde and Schwarz	285
8.	10855A	Amplifier	Hewlett Packard	1445
9.	HL223	Antenna log.per	Rohde & Schwarz	1261
10.	3104C	Antenna biconical	EMCO	1262
11.	ESN	Test Receiver	R&S	1237
12.	HP6032A	Power Supply, program.	HP	1062
13.	5VF2000/400	Filter Band Pass	Texn	042
14.	5VF1000/2000	Filter Band Pass	Trilithic	1174
15.	77	Multimeter, Digital	Fluke	302
16.	B504D	Power Supply	Oltronix	600
17.	EMCO	Antenna Horn	3116	1328
18.	Suhner	Cable Microwave	Sucoflex 102E	1369
19.	ETS	Shielded room	Semi-anechoic	1410
20.	ESVS30	EMI-Receiver	R&S	1101

5 BLOCK DIAGRAM

5.1 System set up



5.2 Power line Conducted Emission



5.3 Test Site Radiated Emission and peak power output

