Nemko

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Accredited Testing and Certification
EMC, Radio and Telecommunications

www.nemko.com

Test report no. : 126780-2

Item tested : KX-TG9381

Type of equipment : UPCS Basestation with Bluetooth Transceiver

FCC ID : ACJ96NKX-TG9381

Client : Panasonic Communications Co., Ltd.

FCC Part 15.247
Frequency Hopping Transmitters /
Digital Transmission System

RSS-210, Issue 7
Low Power Licence-Exempt
Radiocommunication Devices

22 June 2009

Authorized by : .....
Egil hauger
Technical Verificator

CONTENTS

1 GENERAL INFORMATION

1.1 Testhouse Info

Name :	Nemko AS
Address :	Nemko Comlab Gåsevikveien 8, Box 96 N-2027 Kjeller, NORWAY
Telephone :	+47 64 84 57 00
Fax :	+47 64 84 57 05
E-mail:	comlab@nemko.com
FCC test firm registration # :	994405
IC OATS registration # :	2040D-1
Total Number of Pages:	37

1.2 Client Information

Name :	Panasonic Communications Co. Ltd.
Address :	1-62, 4-chome, Minoshima, Hakata-ku, Fukuoka 812-8531, Japan
Telephone :	+81 92 477 1405

Contact:

Name :	Mr. Junji Sumi
Telephone :	+81 92 477 1405
E-mail :	sumi.junji@jp.panasonic.com

1.3 Manufacturer

Name :	/
Address :	/

2 Test Information

2.1 Test Item

Name :	Panasonic
FCC ID :	ACJ96NKX-TG9381
Model/version :	KX-TG9381
Serial number :	>
Hardware identity and/or version:	/
Software identity and/or version :	/
Frequency Range :	2402 – 2480 MHz
Number of Channels :	79 or 20 (adaptive)
Operating Modes :	Frequency Hopping Spread Spectrum
Type of Modulation :	Digital (GFSK)
User Frequency Adjustment :	None
Rated Output Power :	1 mW Peak
Type of Power Supply :	Power Adaptor, Model: PQLV219
Antenna Connector :	None
Number of Antennas :	1
Antenna Diversity Supported :	No
Desktop Charger :	None

Description of Test Item

The tested equipment is a Bluetooth Transceiver that is integrated into a UPCS base station.

This test report covers only the Bluetooth Transceiver of the EUT, the UPCS part is covered by Nemko test report **126780-3.**

The tested equipment has integral antennas only.

Theory of Operation

The tested EUT is a Frequency Hopping Transmitter that uses the Bluetooth protocols.

This version of Bluetooth normally uses all 79 BT channels, but will shift to 20 channels if interference is detected. The 20 channels then used can be either in the lower, middle or upper part of the 2.4 GHz frequency band, depending on the interference.

Exposure Evaluation

The EUT is designed to be fixed to a wall etc. and the user manual contains text that it shall be mounted with a separation distance of at least 20cm from any persons. For the purposes of exposure evaluation this EUT is a mobile or fixed device. MPE Calculation at 20cm satisfying FCC requirements is submitted as a separate document.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	21 - 23 °C
Relative humidity:	20 - 50 %
Normal test voltage:	120 V AC

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2009-04-23
Test period :	from 2009-04-24 to 2009-05-12

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Panasonic

Model No.: KX-TG9381

Serial No.: /

All measurements are tracable 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 7.

Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at a measuring distance of 3m.

☒ New Submission ☒ Production Unit

☐ Class II Permissive Change ☐ Pre-production Unit

DSS 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 #: 126780-2

TESTED BY: _____ DATE: 19 May 2009

Frode Sveinsen, Test engineer

3.2 Test Summary

Name of test	FCC Part 15 reference	RSS-210 Issue 7 reference	Result
Supply Voltage Variations	15.31(e)	8 (RSS-GEN)	Complies
Number of Operating Frequencies	15.31(m)	A8.1	Complies
Antenna Requirement	15.203	7.1.4 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2.2 (RSS-GEN)	Complies[2]
Channel Separation	15.247(a)(1)	A8.1	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	A8.1	Complies
Time of Occupancy	15.247(a)(1)(iii)	A8.1	Complies
Occupied Bandwidth	15.247(a)(1)	A8.1	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	A8.2	N/A[1]
Peak Power Output	15.247(b)	A8.4	Complies
Power Spectral Density	15.247(d)	A8.2	N/A[1]
Spurious Emissions (Antenna Conducted)	15.247(c)	A8.5	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	A8.5	Complies

[1] This requirement is not applicable for Frequency Hopping Transmitters

[2] See Nemko test report no. 126780-3.

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

This test report covers only the Bluetooth Module in the KX-TG9381.

The operating channel(s) and slot length was programmed with a computer and with the software supplied by the manufacturer.

The measurements were done with the EUT powered by 120 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.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Channel Separation

Para. No.: 15.247 (a)(1)

Test Performed By: Frode Sveinsen	**Date of Test: 28-April-2009**

Test Results: **Complies**

Measurement Data: Channel Separation: 1.000 MHz

20 dB Bandwidth of hopping channel: 930 kHz

RF channel has no influence on 20 dB bandwidth.

See attached graph

Channel Separation nominal value: 1.000 MHz.

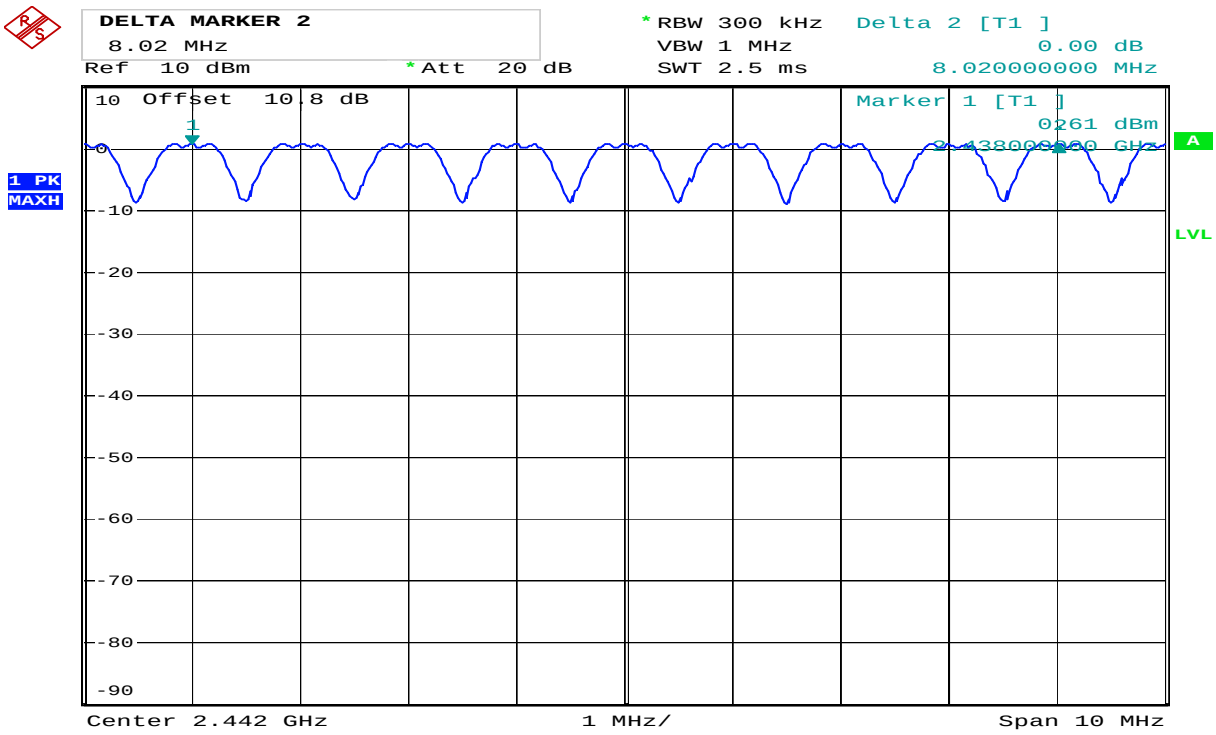
Requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

or:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.

No requirements for Digital Transmission Systems.



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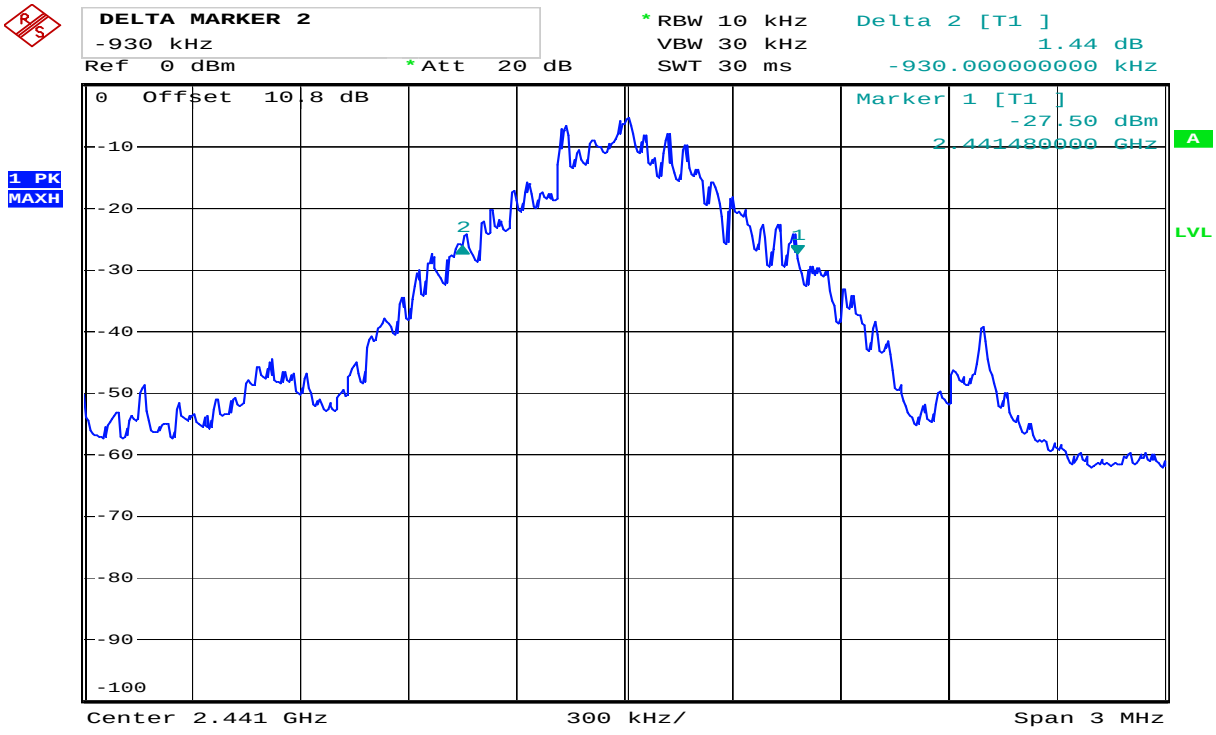
Channel Separation



Date: 24.APR.2009 10:54:36

20dB Bandwidth, ch39

4.2 Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Performed By: Frode Sveinsen	**Date of Test: 29-April-2009**

Test Results: Complies

Measurement Data: /

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

No requirements for Digital Transmission Systems.

Base Table Hopping Sequence

The equipment uses pseudo-random adaptive hopping based on the Bluetooth standard. See EXHIBIT I for more details.

4.3 Occupancy Time

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Frode Sveinsen	**Date of Test: 30-April-2009**

Test Results: Complies

Measurement Data:

Number of RF channels: 20

RF burst pr channel (worst case, DH5): 2.904 ms

Time between each RF burst on same RF channel: 3.725 x 20 = 74.5 ms

Time of occupancy: 2.904ms x 400 x 20 / 74.5 = 0.3118 seconds

Number of RF channels: 79

RF burst pr channel (worst case, DH5): 2.904 ms

Time between each RF burst on same RF channel: 3.725 x 79 = 294.275 ms

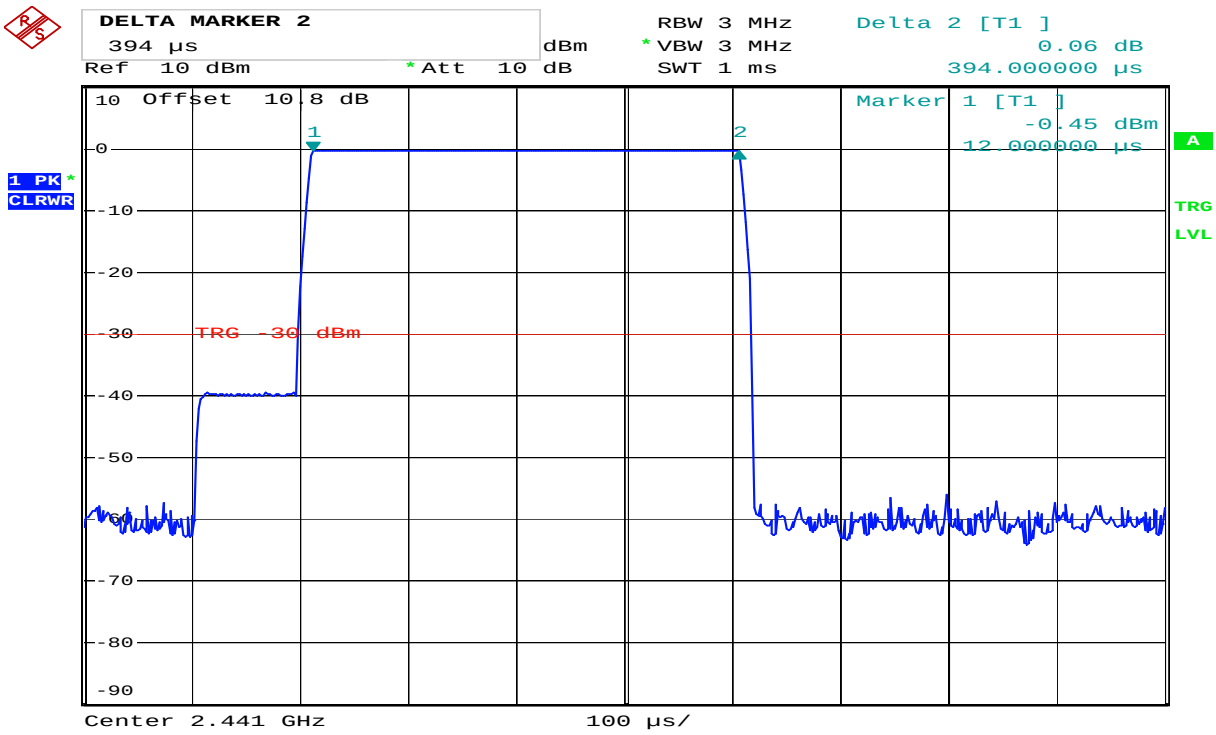
Time of occupancy: 2.904ms x 400 x 79 / 294.275 = 0.3118 seconds

See attached graph.

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

No requirements for Digital Transmission Systems.



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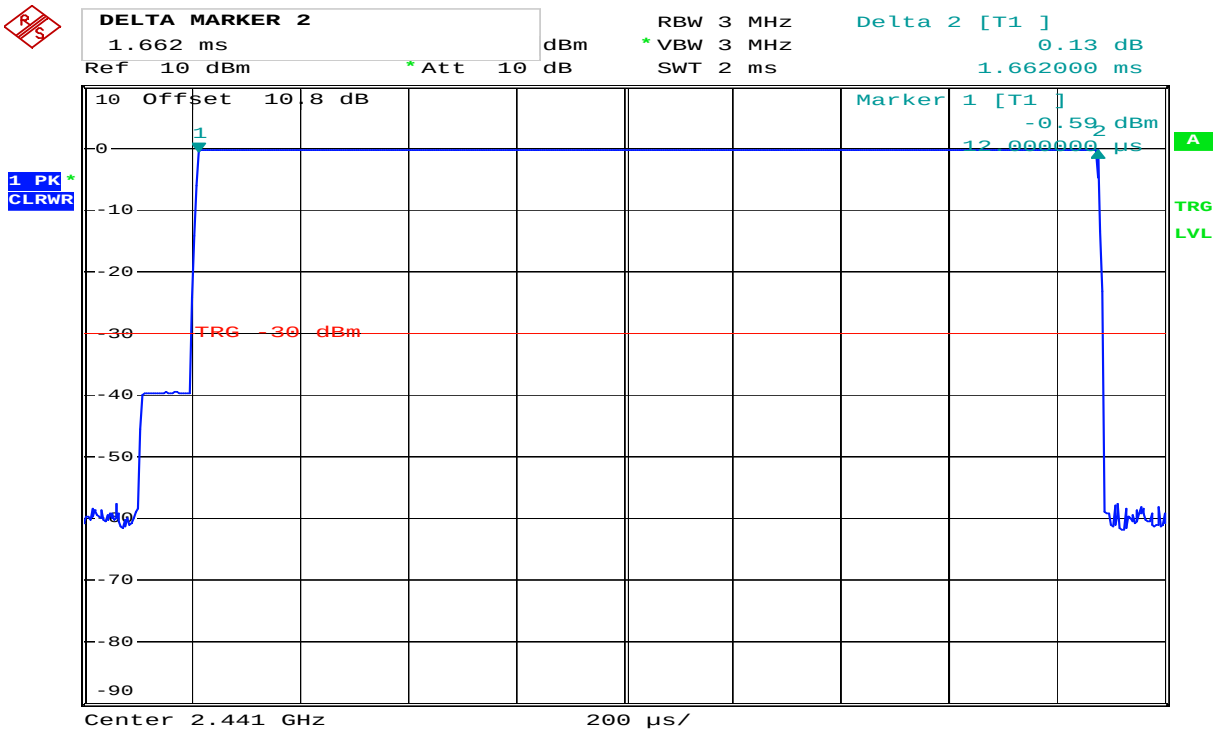
Slot Type DH1



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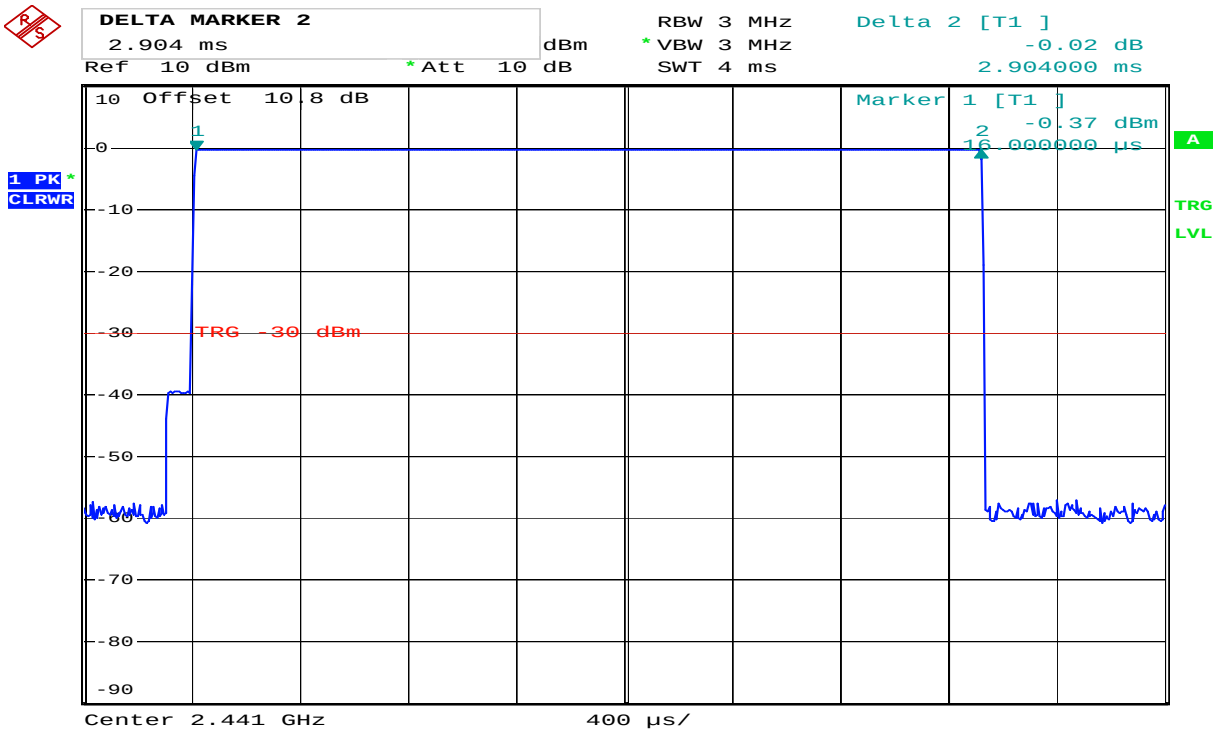
Slot Type DH3



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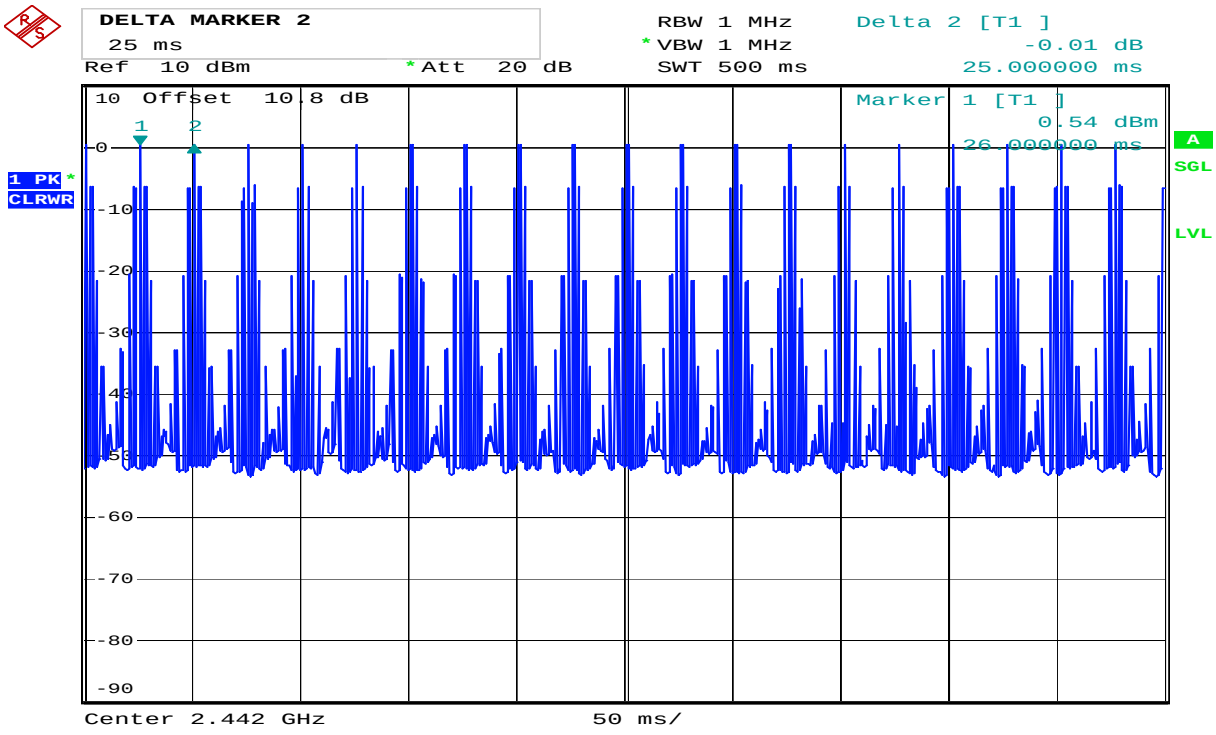
Slot Type DH5



Date: 24.APR.2009 10:46:27

Occupancy Time, Ch 28-47

4.4 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Frode Sveinsen	**Date of Test: 24/29 April 2009**

Test Results: Complies

Measurement Data: 79 or 20 RF channels in use.

See attached graph.

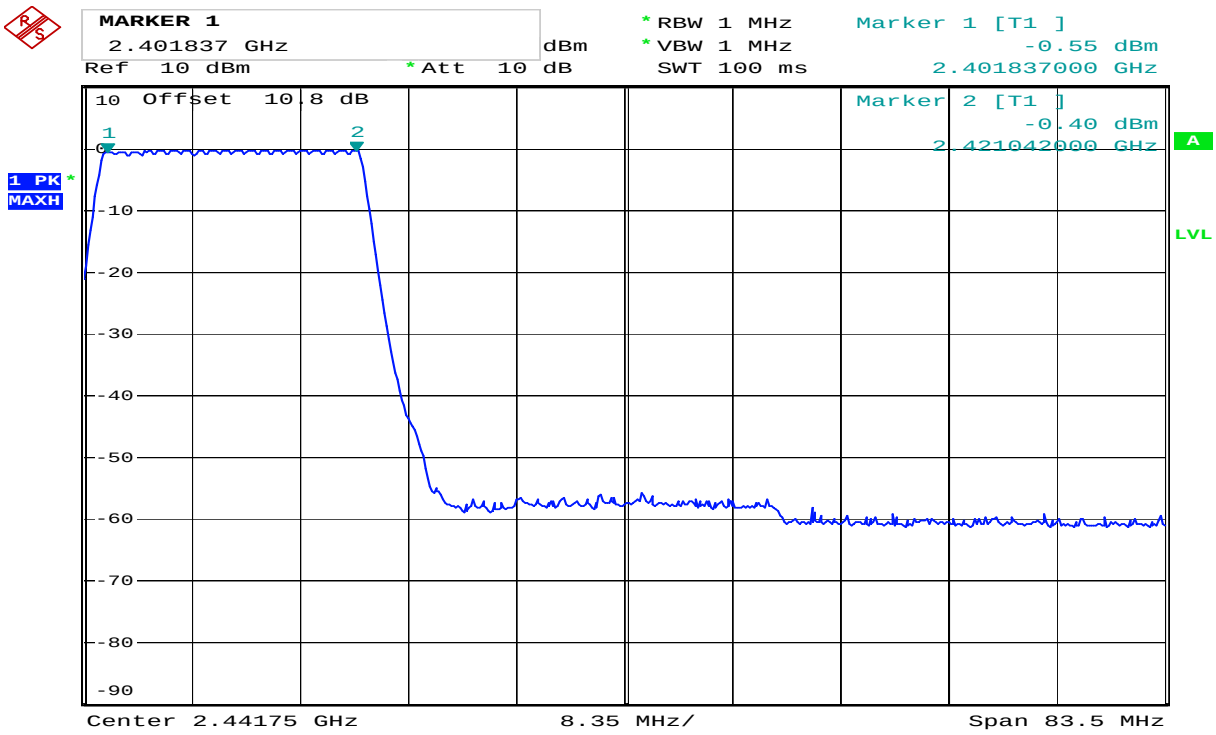
Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.

Channel Centre Frequencies

The 79 channels are centred at each full MHz from 2402 to 2480 MHz.



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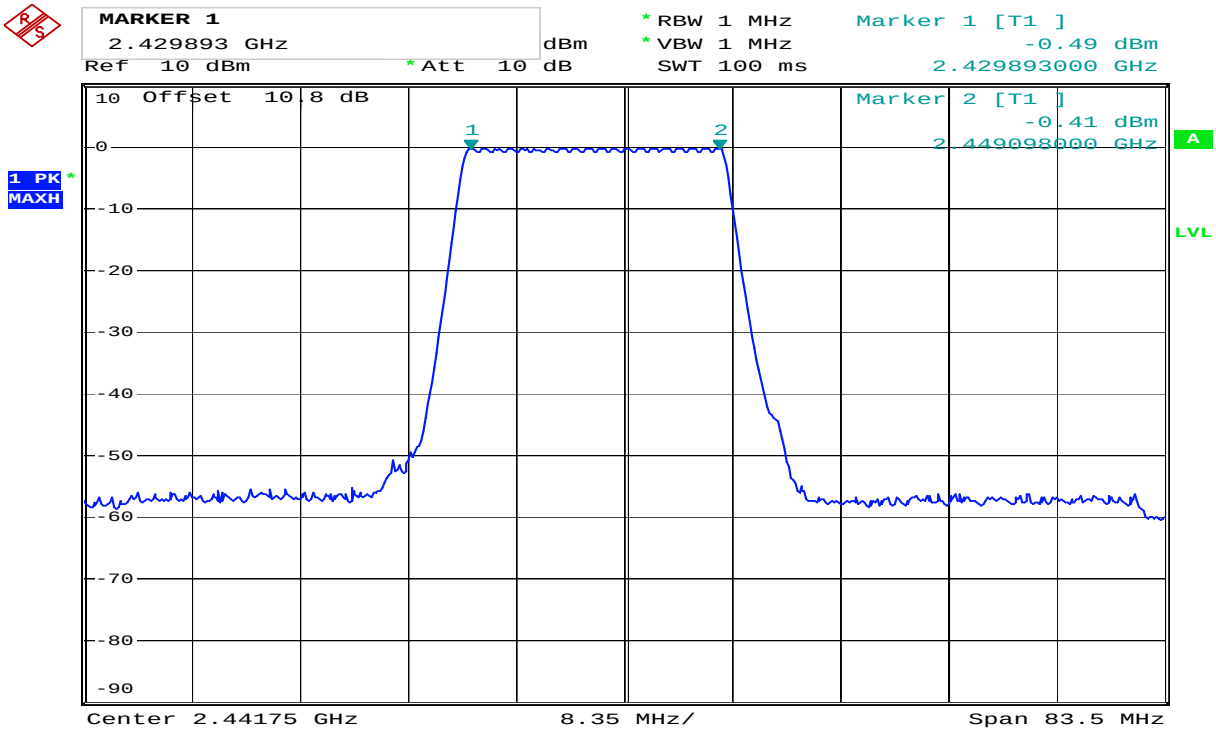
RF Channels in Use, 20 channels, Low



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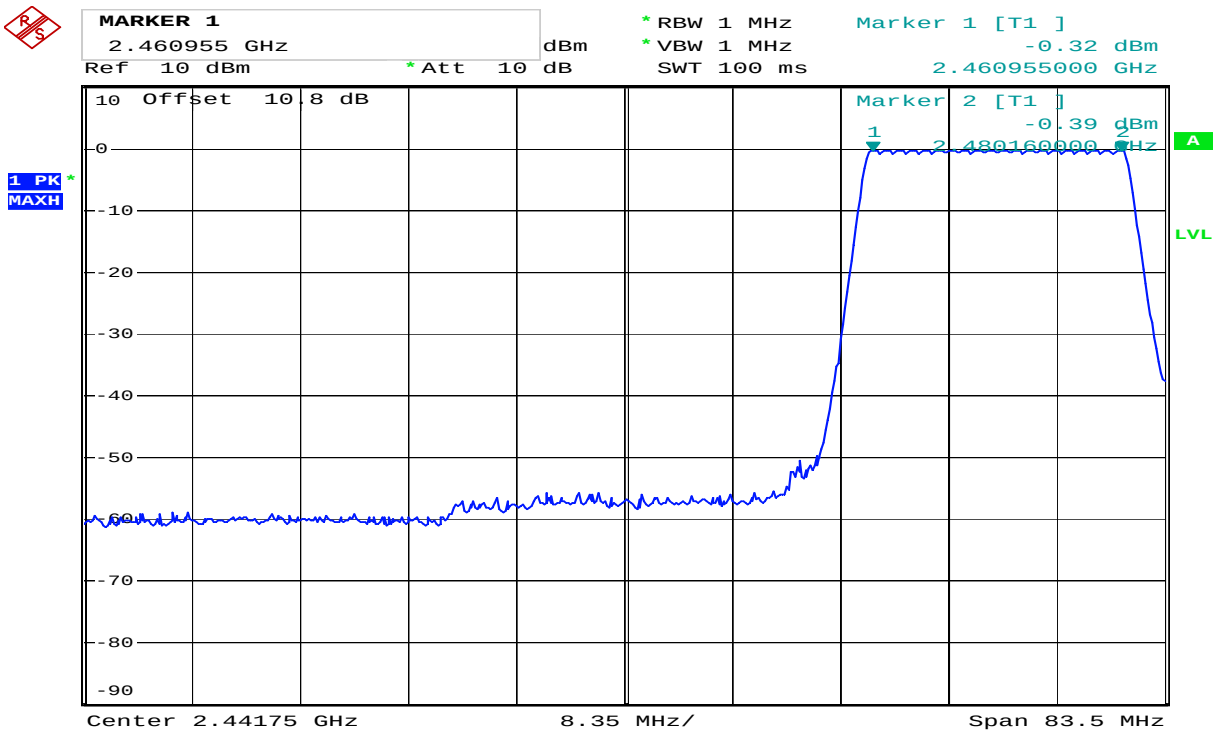
RF Channels in Use, 20 channels, Middle



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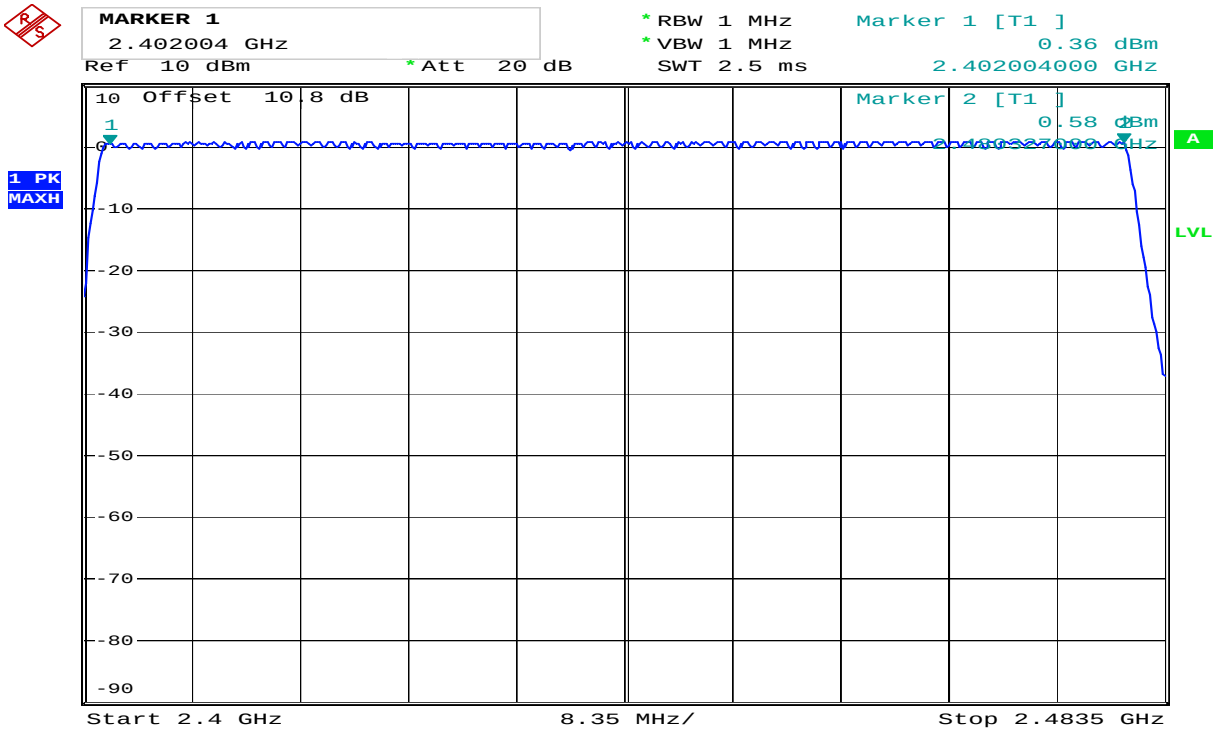
RF Channels in Use, 20 channels, High



Date: 24.APR.2009 10:40:42

RF Channels in Use, 79 channels

4.5 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: Frode Sveinsen	**Date of Test: 24/27 April 2009**

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power, mW

RF channel	0	39	78
Measured value	0.86	0.88	0.92

Maximum EIRP, mW

RF channel	0	39	78
Measured EIRP	2.5	2.5	2.4
Antenna gain dBi	4.6	4.6	4.1

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

The EIRP is calculated from measured field strength by the formula in DA00-705.

It was checked that input voltage variation of 85 and 115% of nominal value did not have any effect on the measured output power, neither radiated nor conducted.

See attached graph.

Detachable antenna? ☐ Yes ☒ No

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

The EUT has only integral antennas.

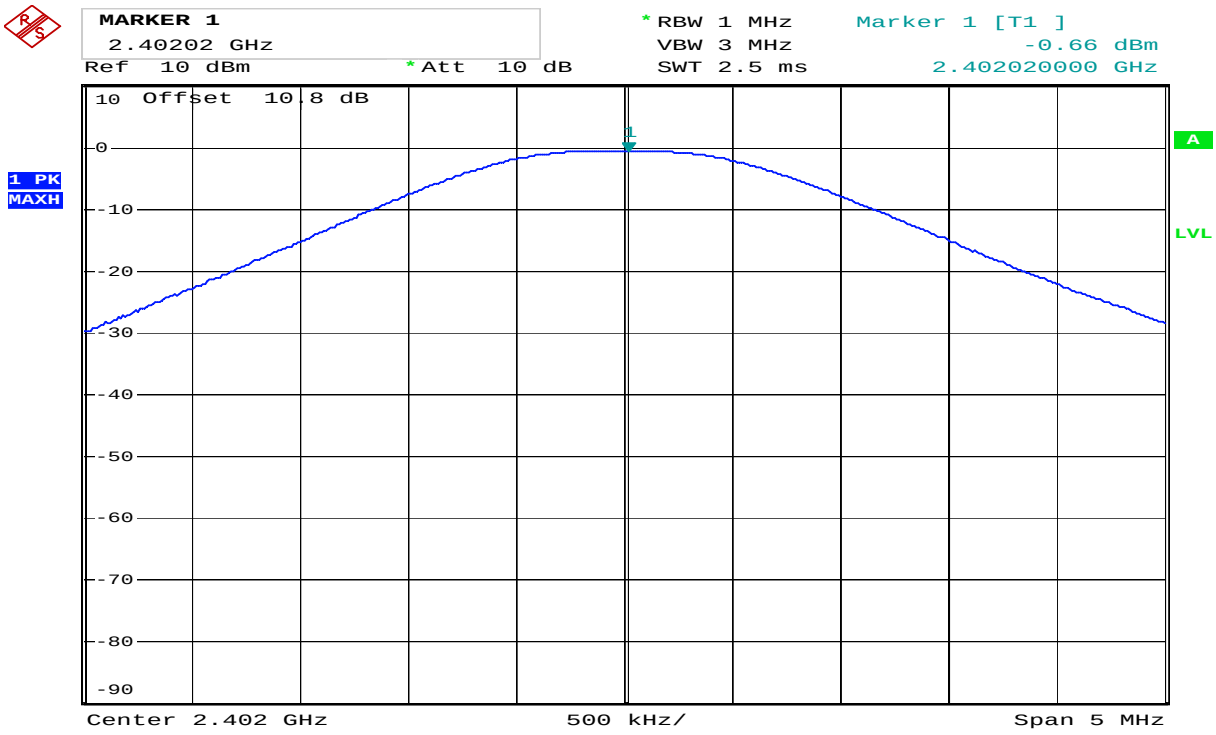
Requirements:

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

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

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.



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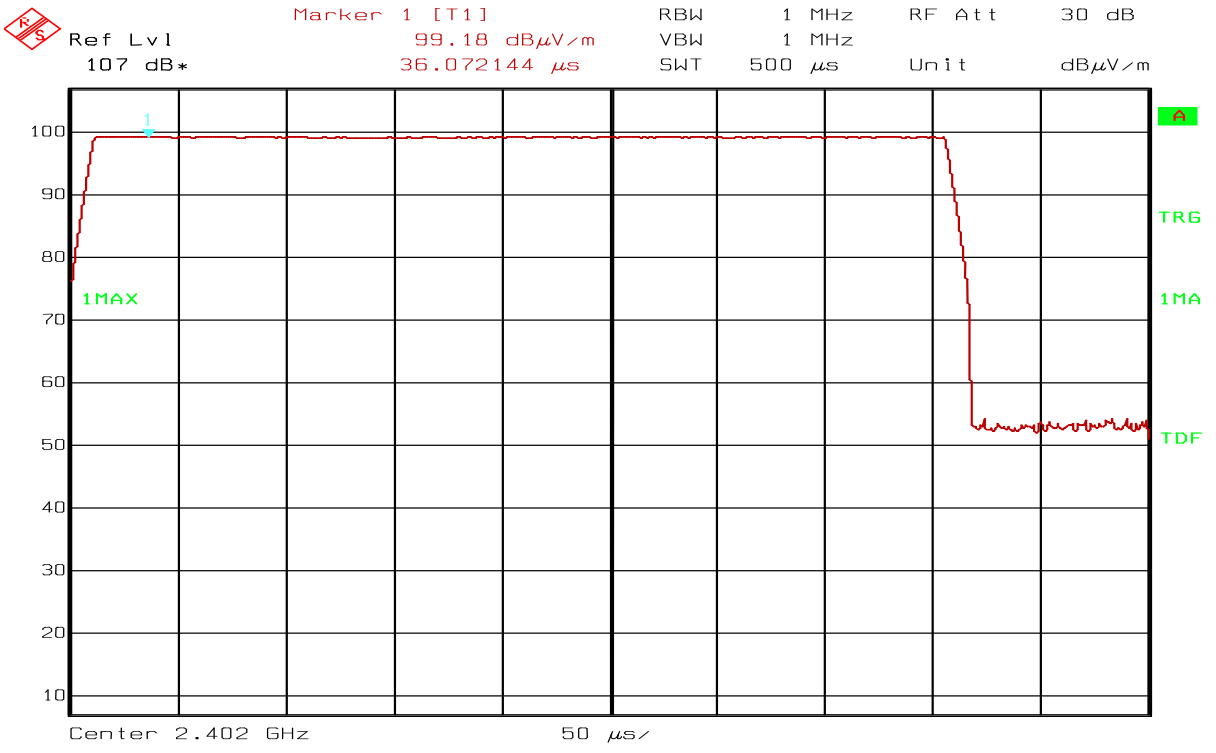
Conducted Output Power, ch 0



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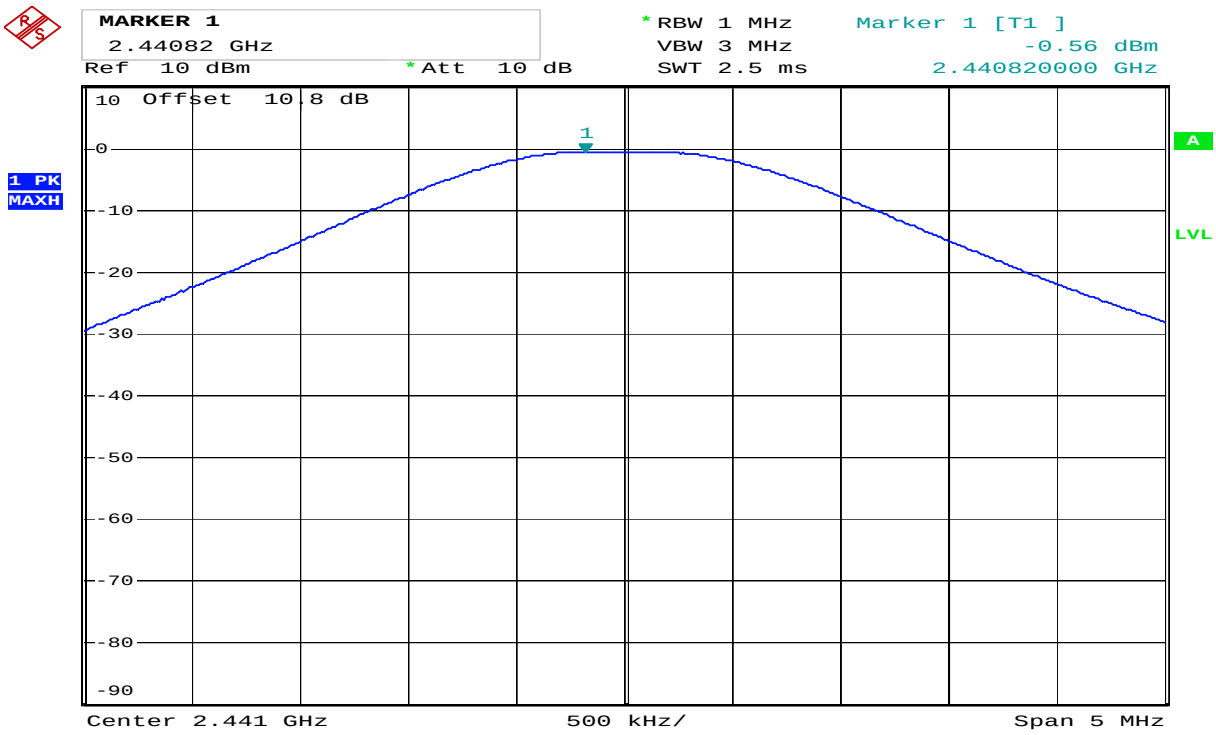
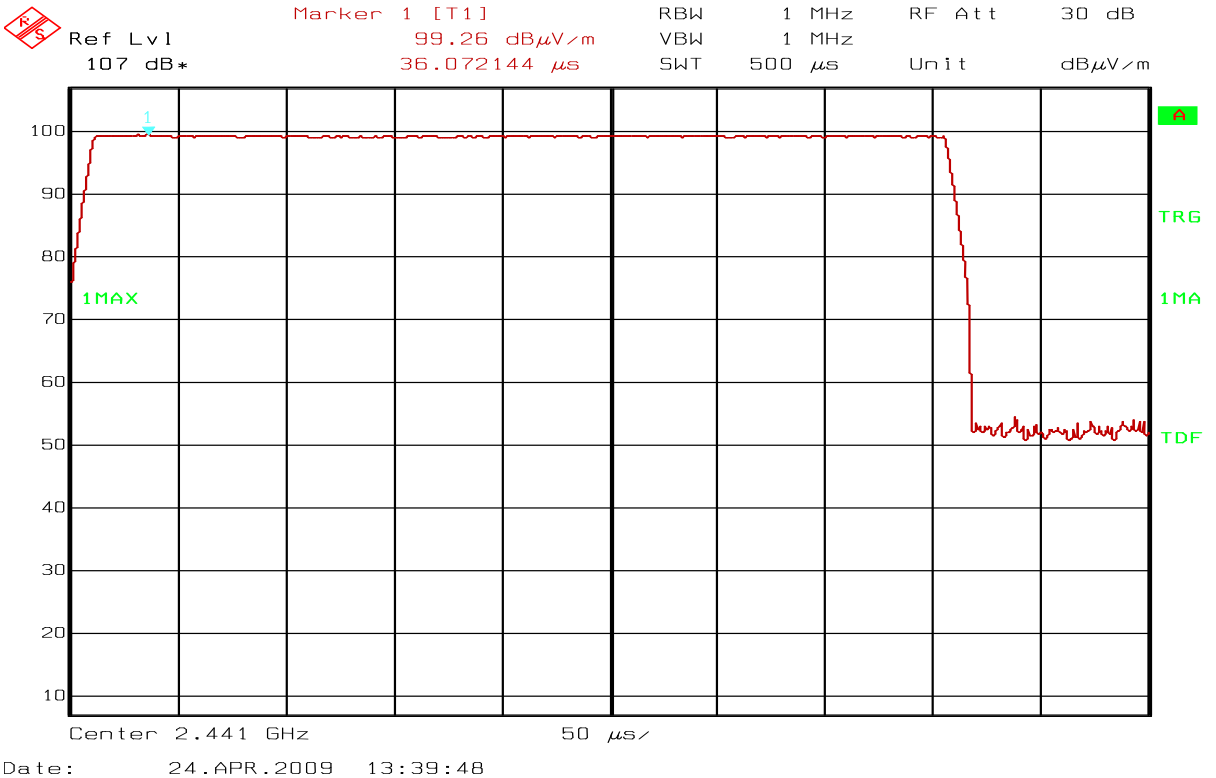
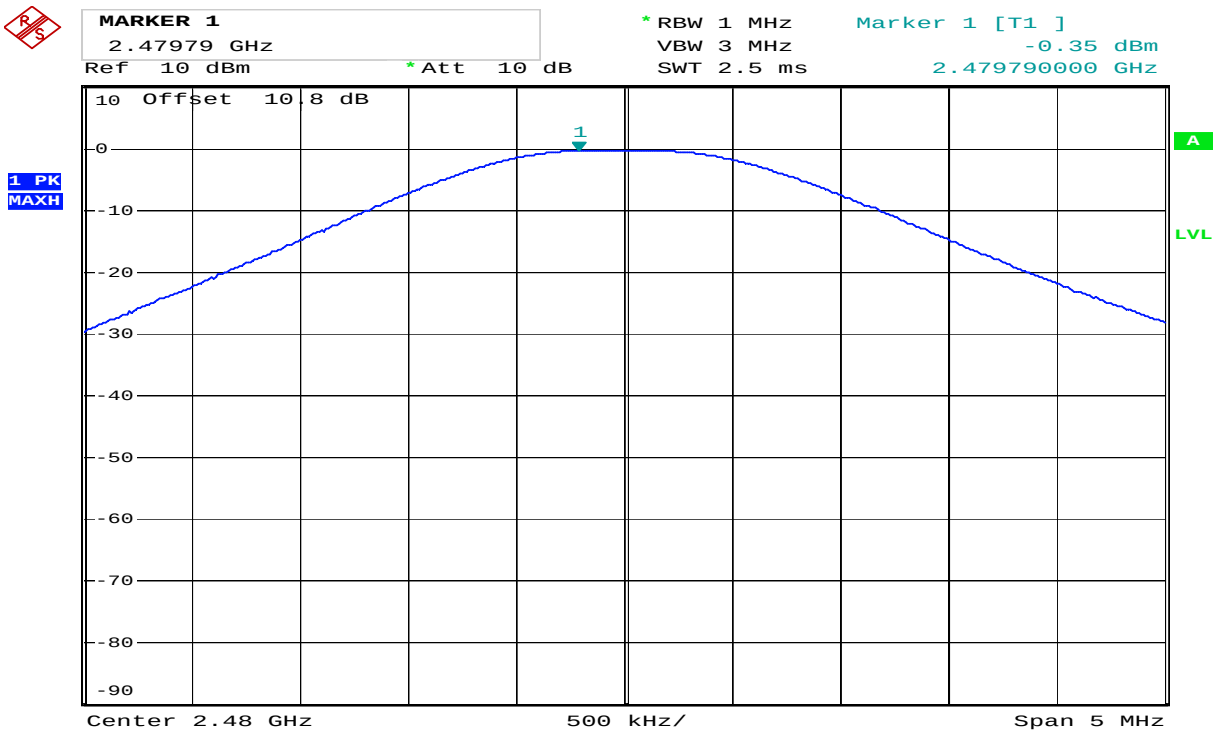
Radiated Output Power, ch 0



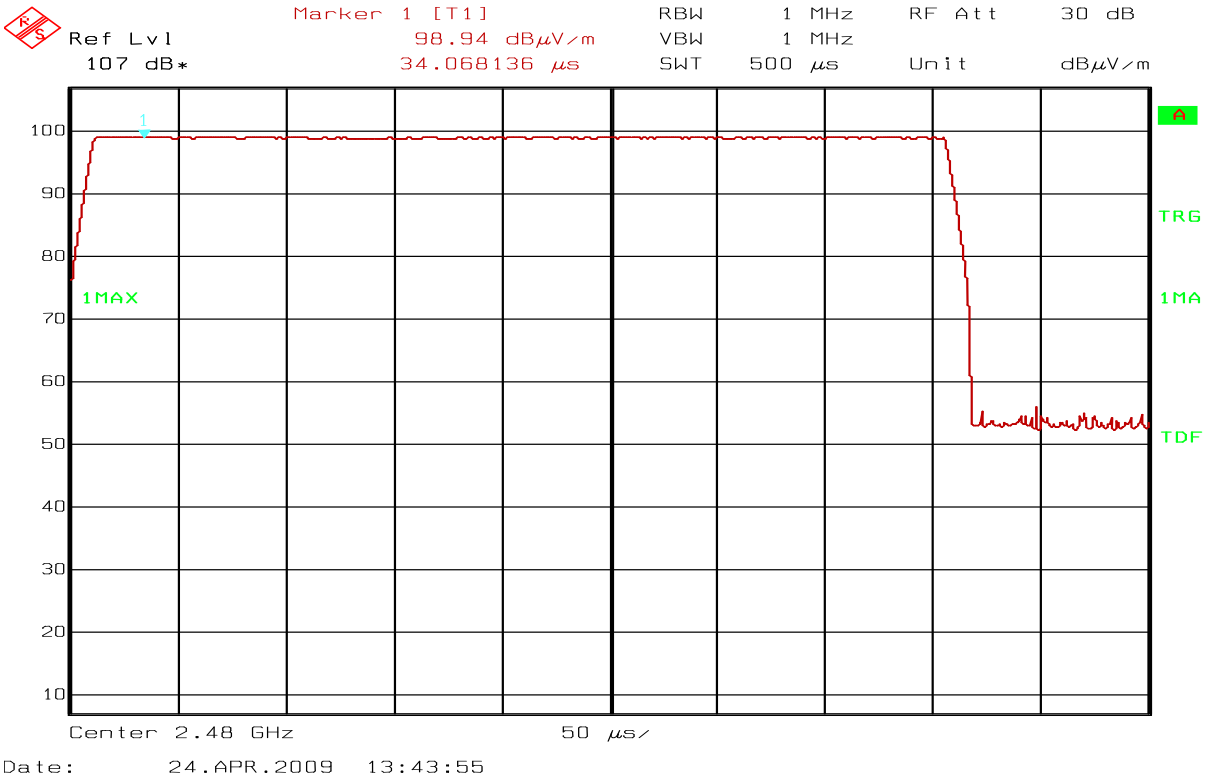
Conducted Output Power, ch 39



Radiated Output Power, ch 39



Conducted Output Power, ch 78



Radiated Output Power, ch 78

4.6 Spurious Emissions

Para. No.: 15.247 (c)

Test Performed By: Frode Sveinsen	**Date of Test: 24/27 April 2009**

Test Results: Complies

Measurement Data:

Band-edge, Radiated

Frequency	Field Strength ad Band Edge, dBµV/m		Limit	Margin
GHz	RF ch 0/78	Frequency hopping	dBµV/m	dB
2.39	45.9	44.1	74	28.1
2.4835	57.5	59.8	74	14.2

Hopping On:

Lower Band Edge: 99.2 dBµV/m – 55.1 dB = 44.1 dBµV/m
Upper Band Edge: 98.9 dBµV/m – 39.1 dB = 59.8 dBµV/m

See attached plots.

RF conducted power to 25 GHz see attached graph.

Maximum RF level outside operating band: 39.2 dB/C, margin: 19.2 dB

Radiated emission 30 – 1000 MHz.

Detector: Peak

Measuring distance 3m according to FCC 15.209.

See attached plots.

Radiated Emissions, 1 – 25 GHz

Detector: Peak

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

No Spurious Emissions were found.

See attached graphs.

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

Duty Cycle Correction Factor Calculation:

See also Para 4.4 Occupancy Time.

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

DH5 slots: 5 slots TX and 1 slot RX -> 5x0.625ms per frame -> frame length is 6x0.625ms = 3.75ms

Minimum number of hopping carriers: 20 -> The frame is repeated on the same channel every 74.5ms.

DC Correction factor = -20 x log((5 x 0.625ms) / 74.5ms) = 27.5 dB

Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB

This value is used to calculating the Peak Limit for radiated emissions above 1 GHz. The Peak Limit is the Average Limit (54 dBµV/m) plus the Duty Cycle Correction Factor, i.e. the Peak Limit is 74 dBµV/m when the DC Correction Factor is 20 dB.

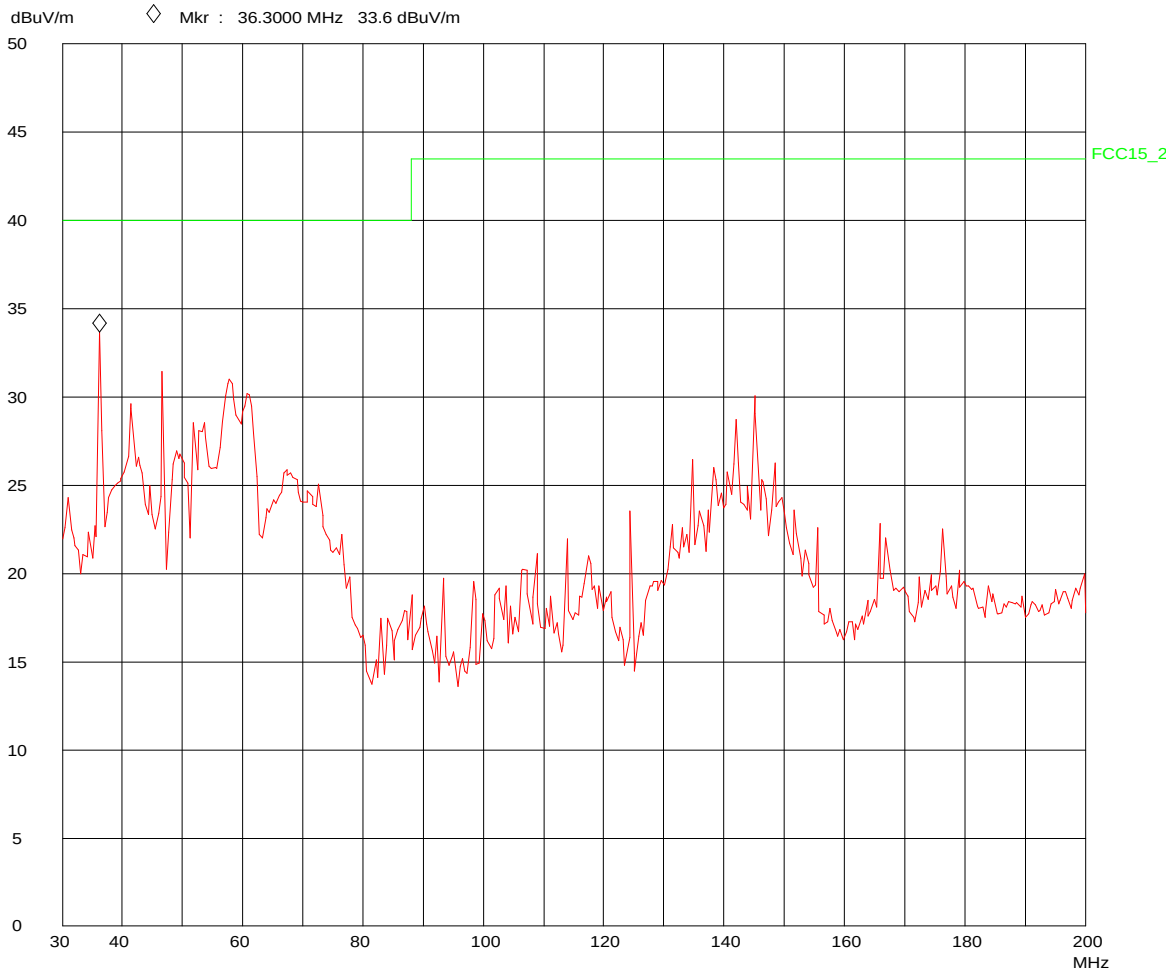
Nemko AS
Peak

24. Apr 09 16:41

Operator: FS
Comment: Panasonic KX-TG9381
BT Transceiver
VP
h=1m, Dist=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



Radiated Emissions, 30 – 200 MHz, Vertical Polarization

Nemko AS

24. Apr 09 16:47

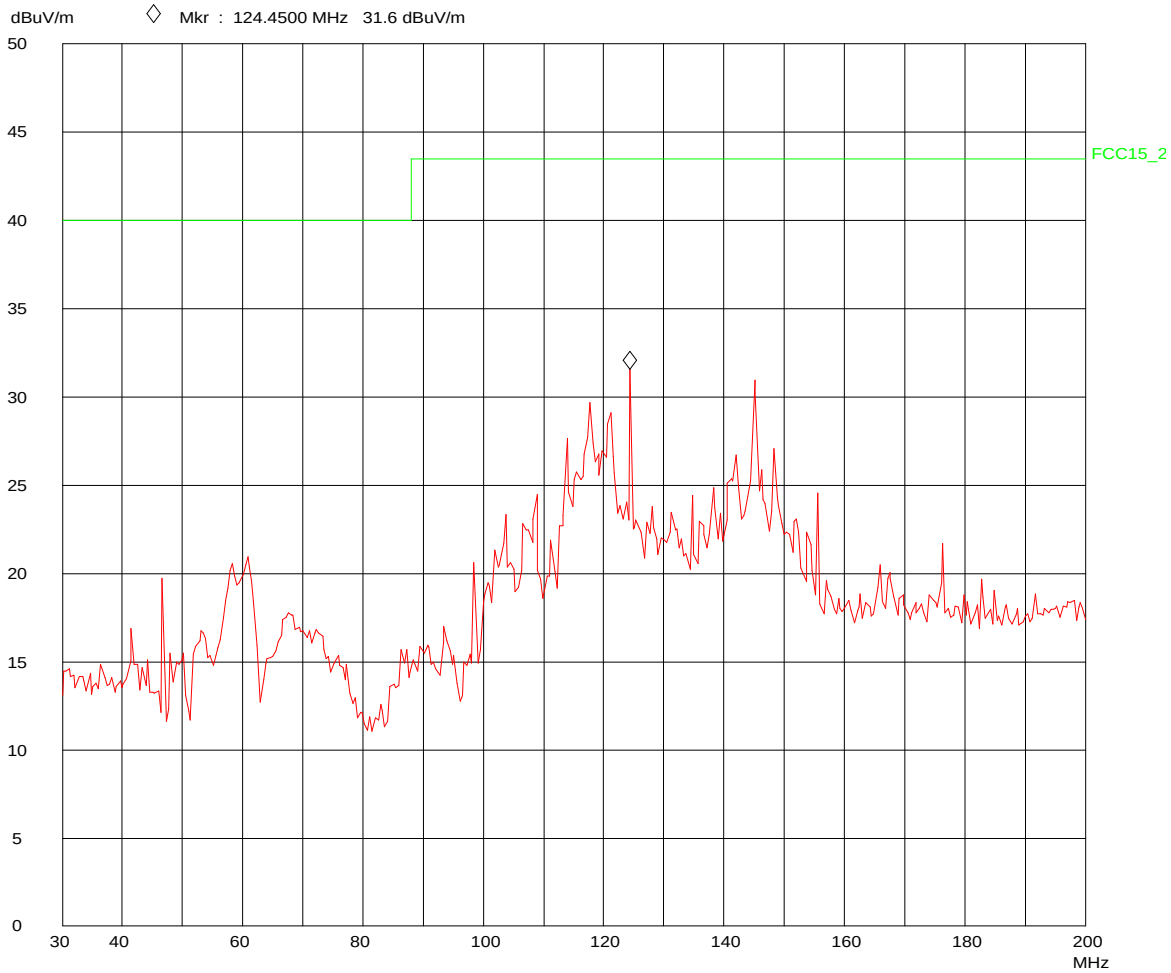
Peak

Operator: FS
Comment: Panasonic KX-TG9381
BT Transceiver
HP
h=2m, Dist=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



Radiated Emissions, 30 – 200 MHz, Horizontal Polarization

Nemko AS
Peak

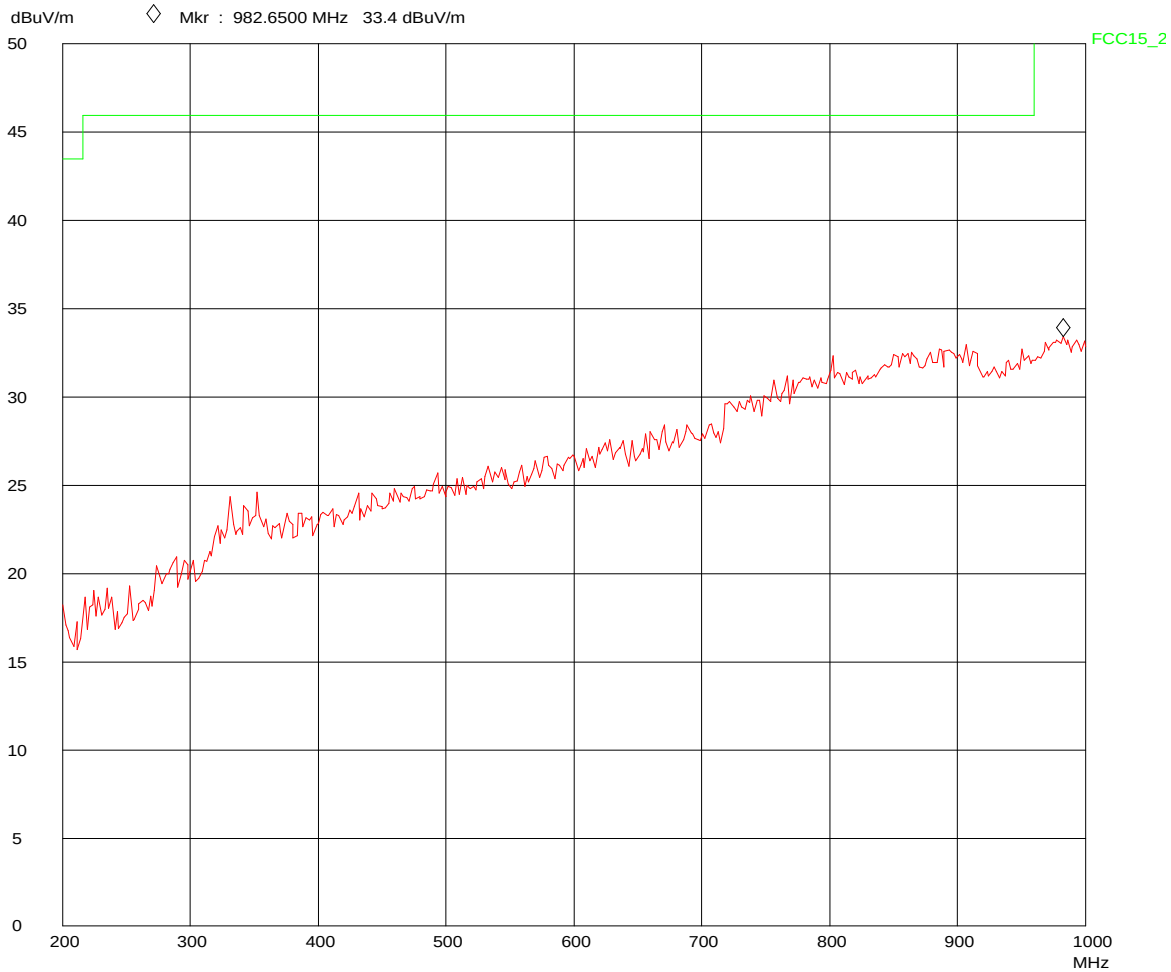
24. Apr 09 17:09

Operator: FS
Comment: Panasonic KX-TG9381
BT Transceiver
VP
h=1m, Dist=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



Radiated Emissions, 200 - 1000 MHz, Vertical Polarization

Nemko AS

24. Apr 09 17:25

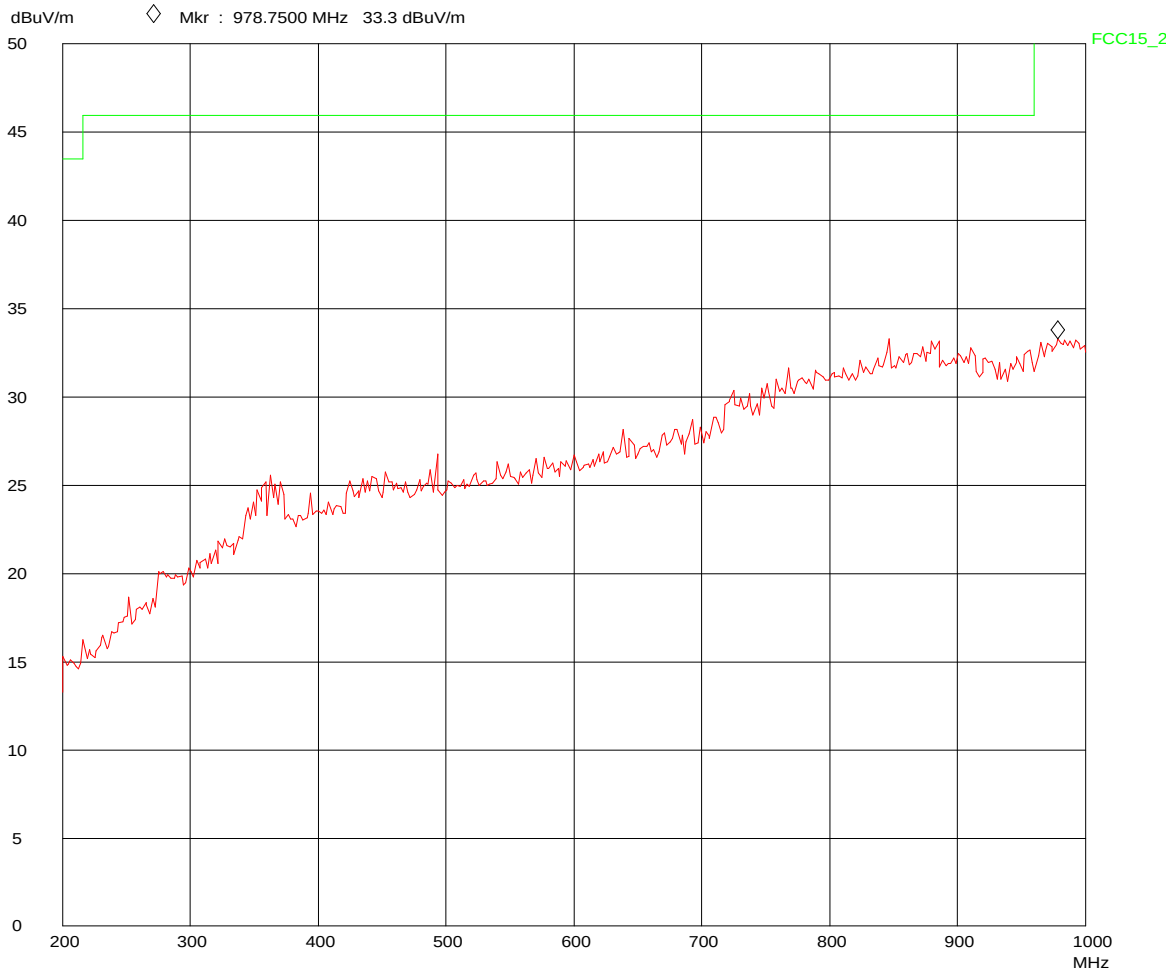
Peak

Operator: FS
Comment: Panasonic KX-TG9381
BT Transceiver
HP
h=2m, Dist=3m

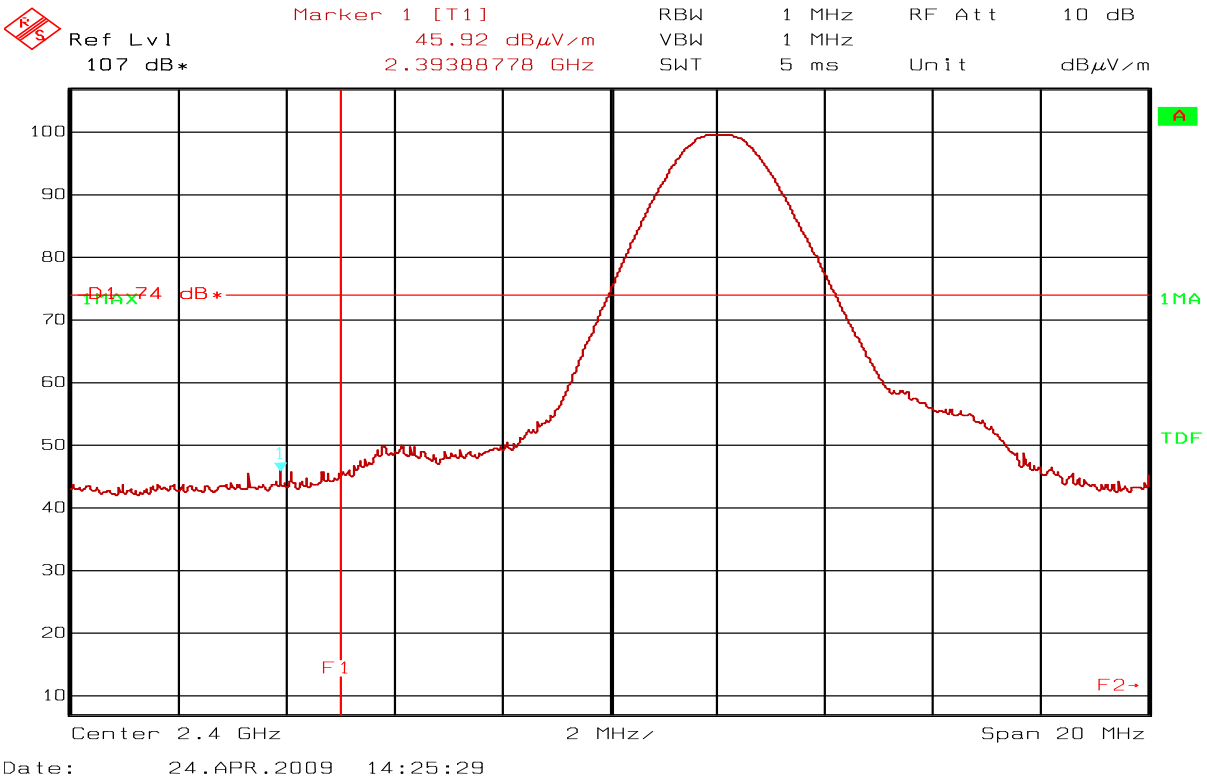
Scan Settings (1 Range)

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

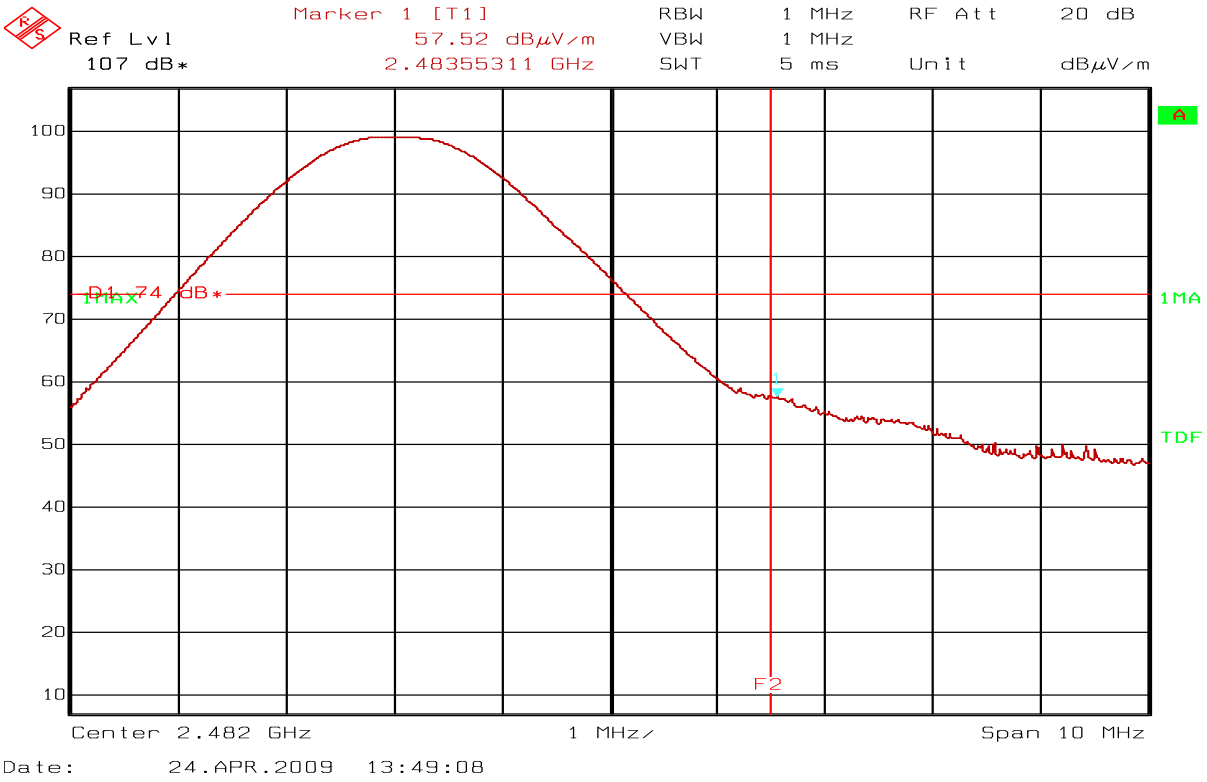
Transducer No.	Start	Stop	Name
21	200M	1000M	HL223



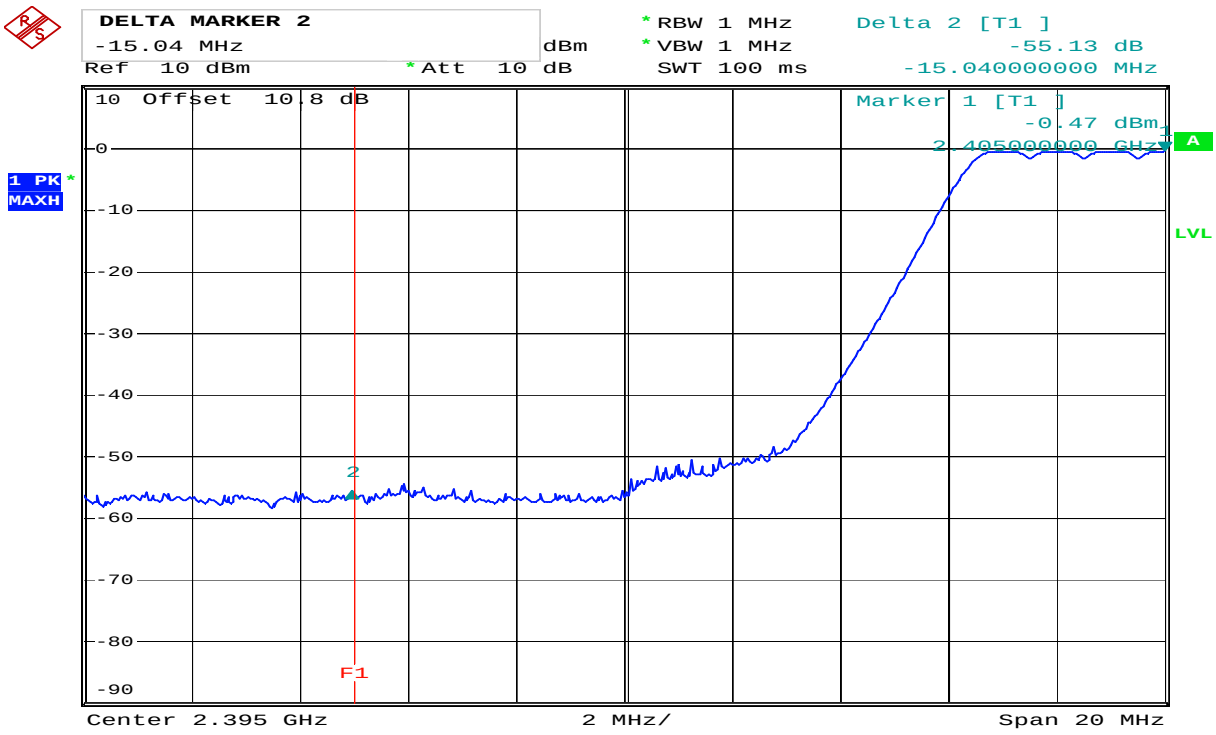
Radiated Emissions, 200 - 1000 MHz, Horizontal Polarization



Lower Band Edge, 2390 MHz, Ch 0, VP



Upper Band Edge, 2483.5 MHz, Ch 78, VP



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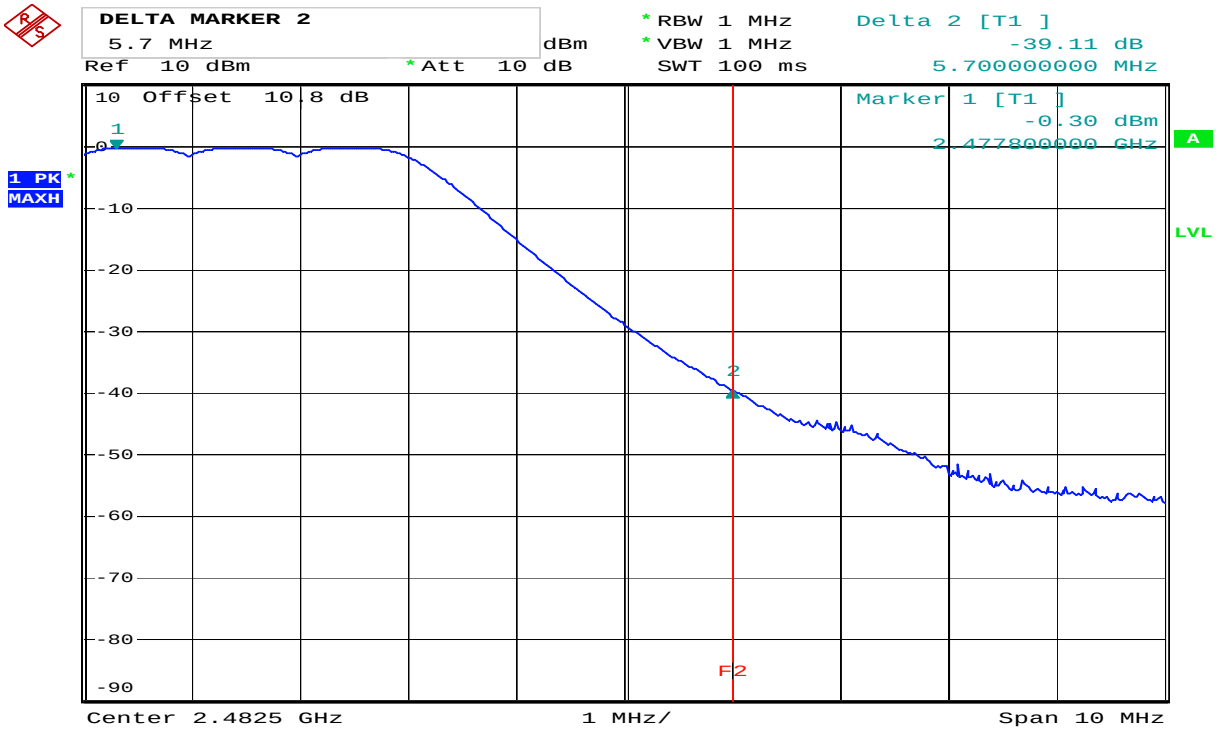
Lower Band Edge, Conducted, Hopping Active, 2390 MHz, Ch 0, VP



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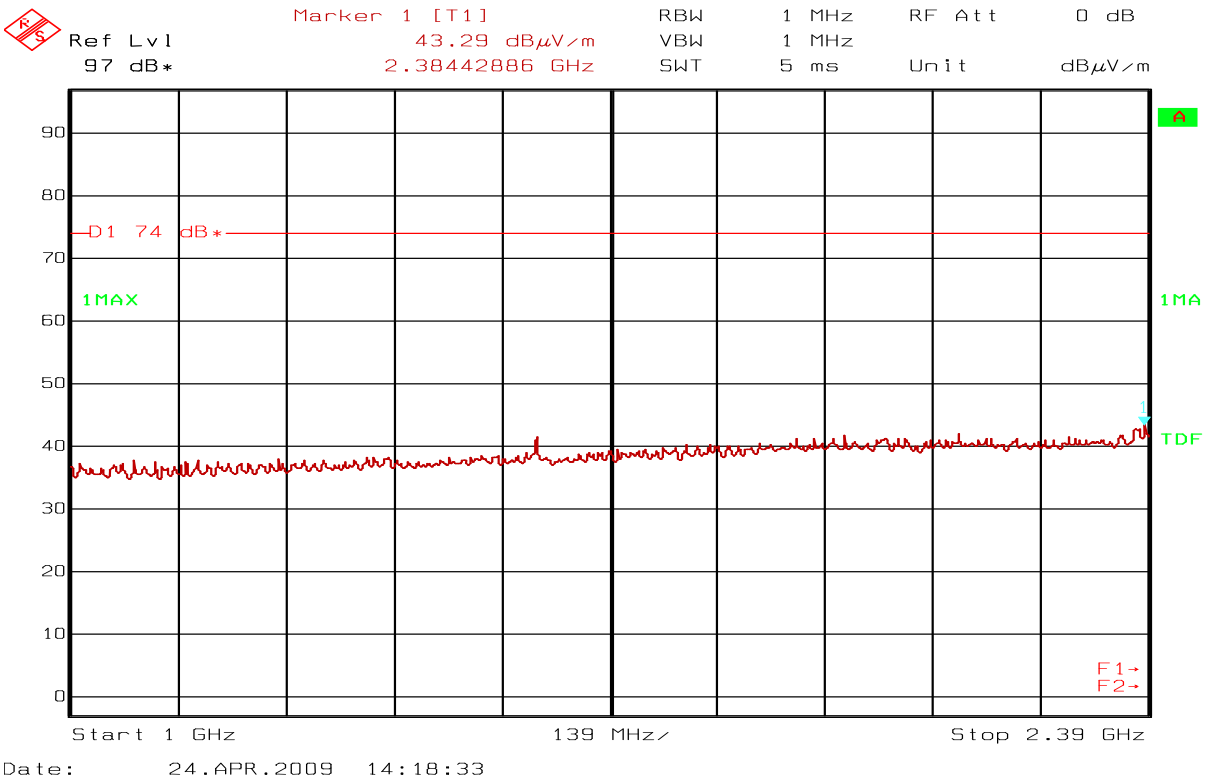
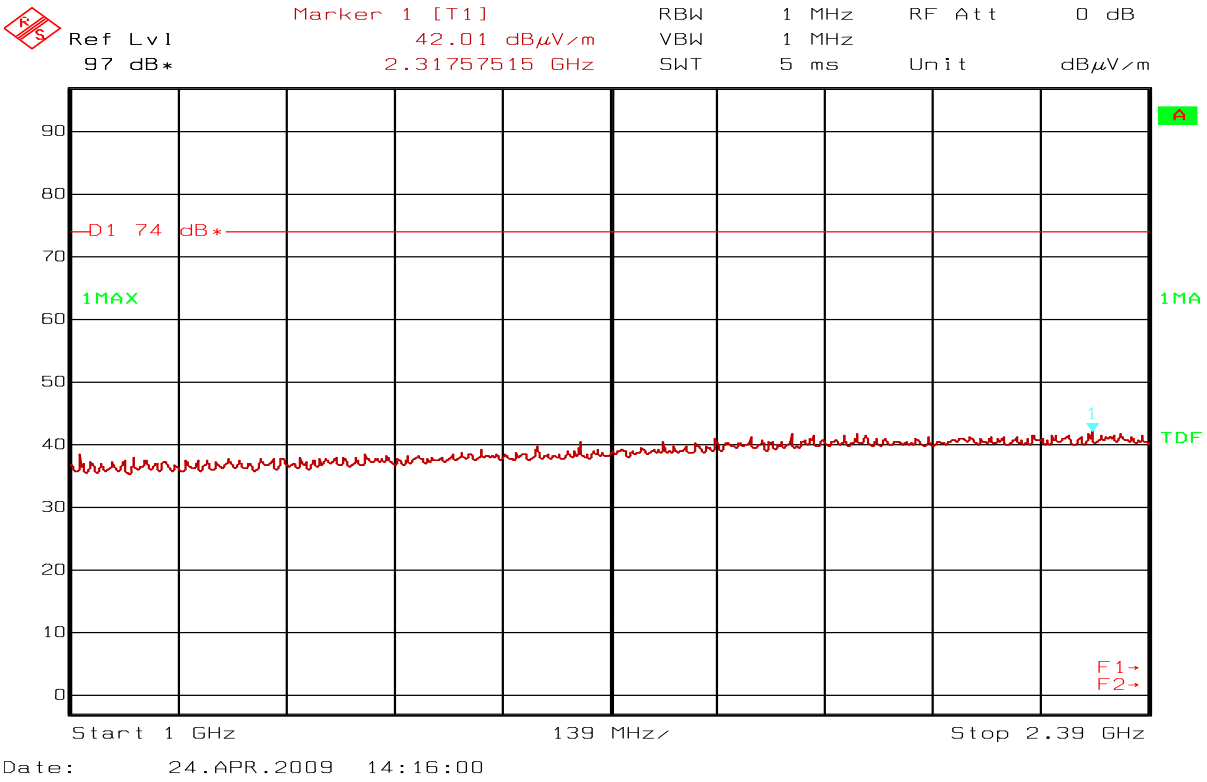
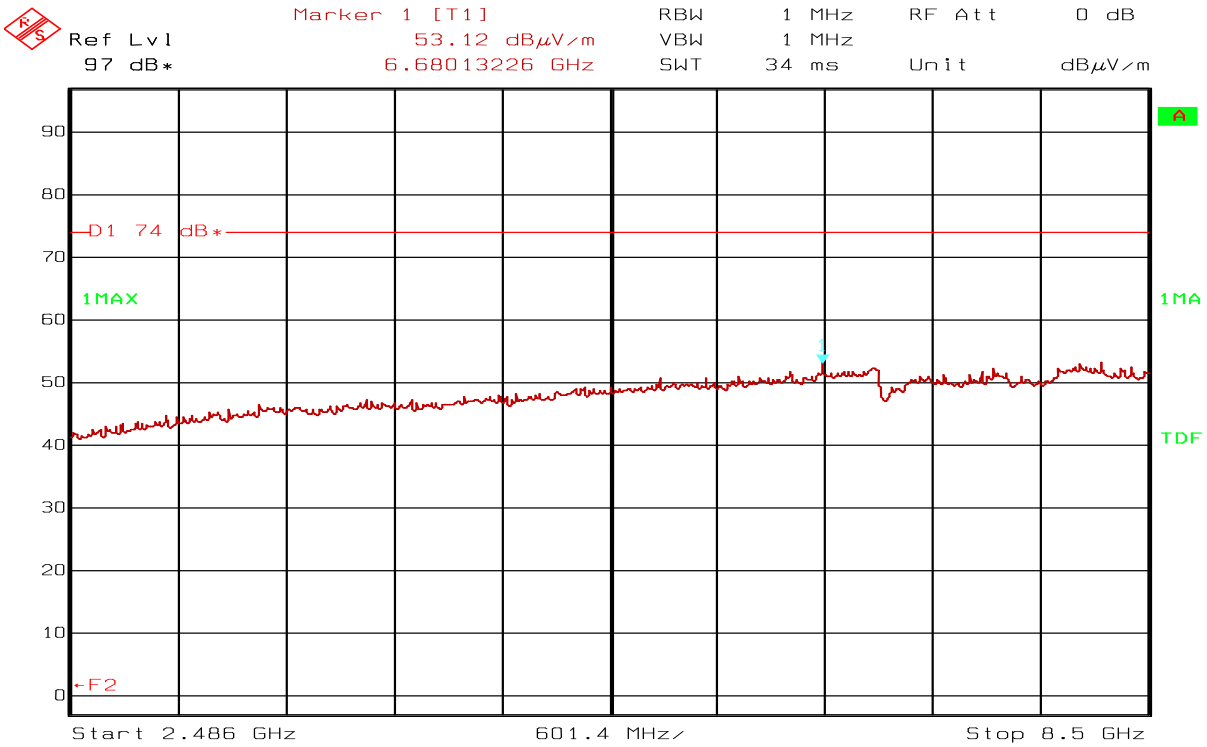
Upper Band Edge, Conducted, Hopping Active, 2483.5 MHz, Ch 78, VP



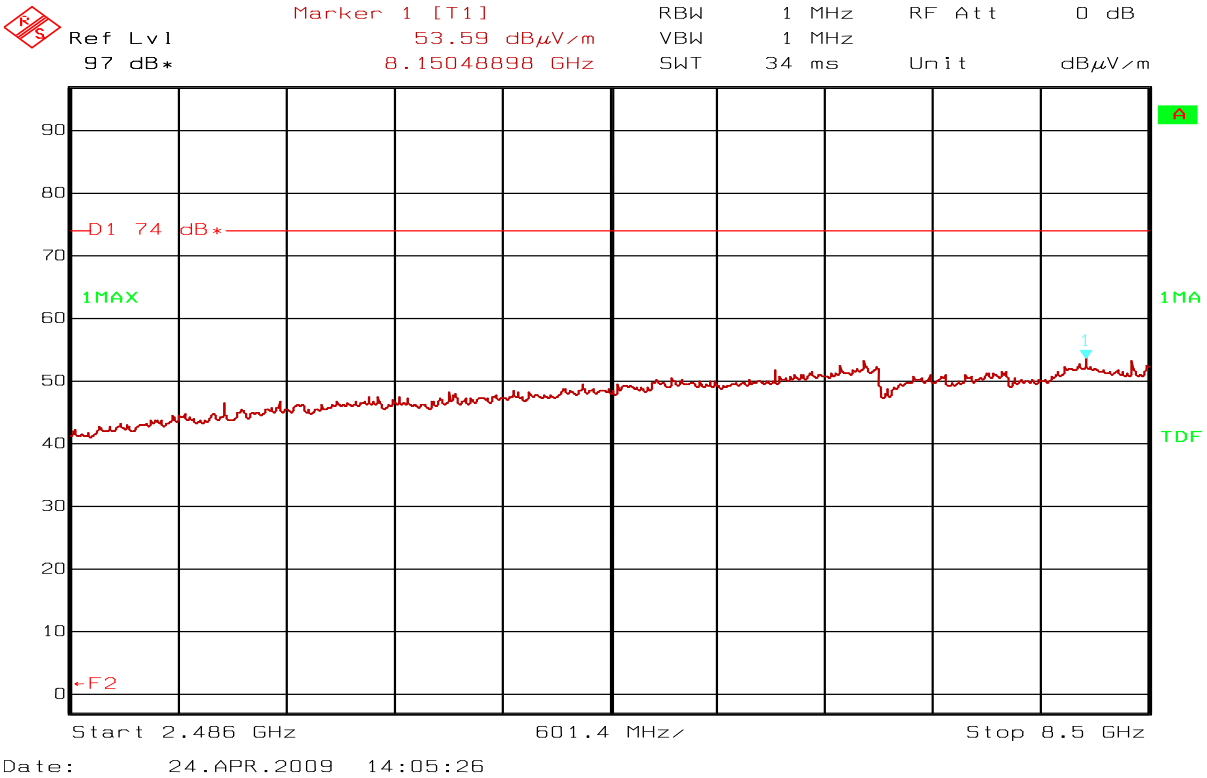
Radiated Emissions, 1 – 2.39 GHz, VP



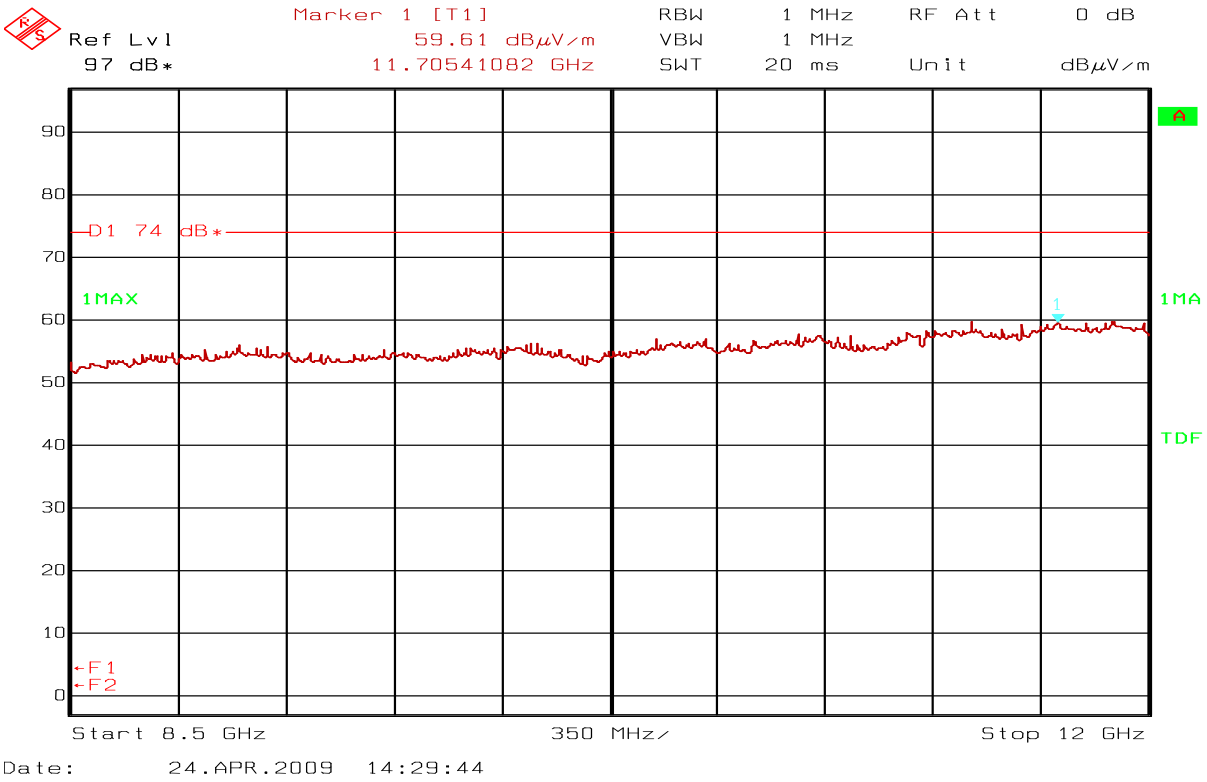
Radiated Emissions, 1 – 2.39 GHz, HP



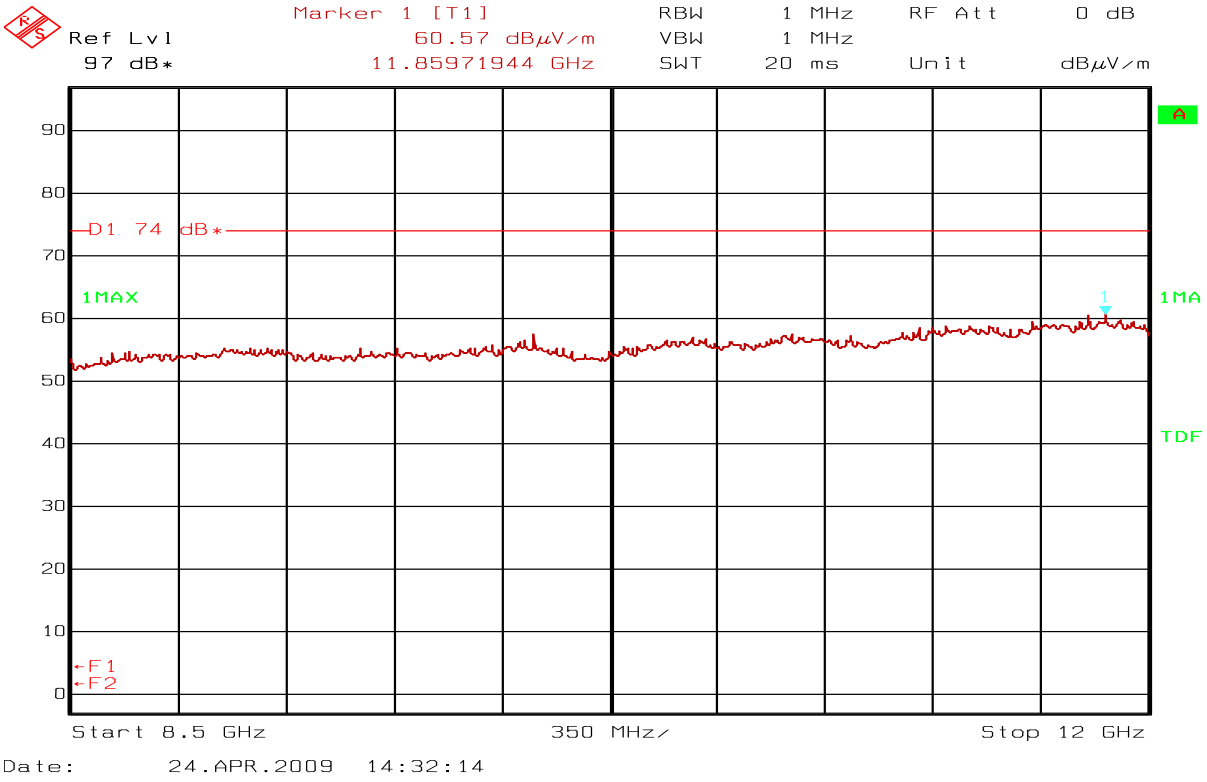
Radiated Emissions, 2.486 – 8.5 GHz, VP



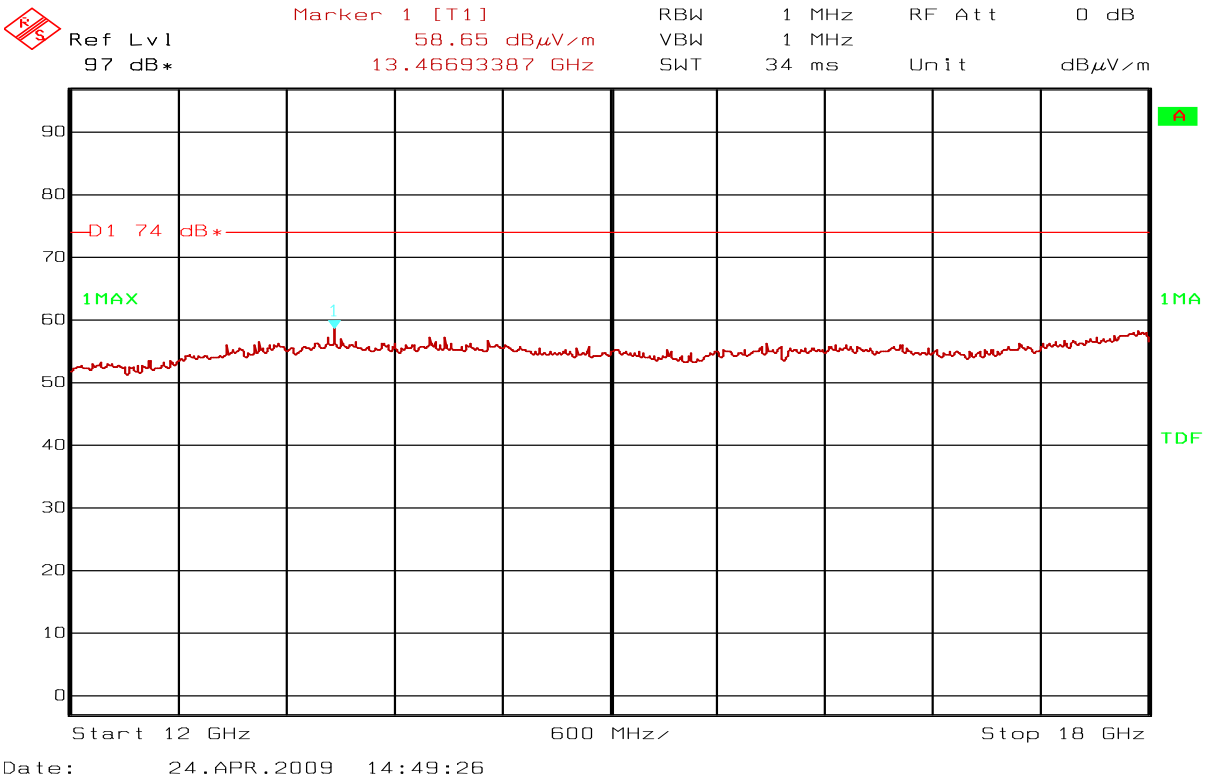
Radiated Emissions, 2.486 – 8.5 GHz, HP



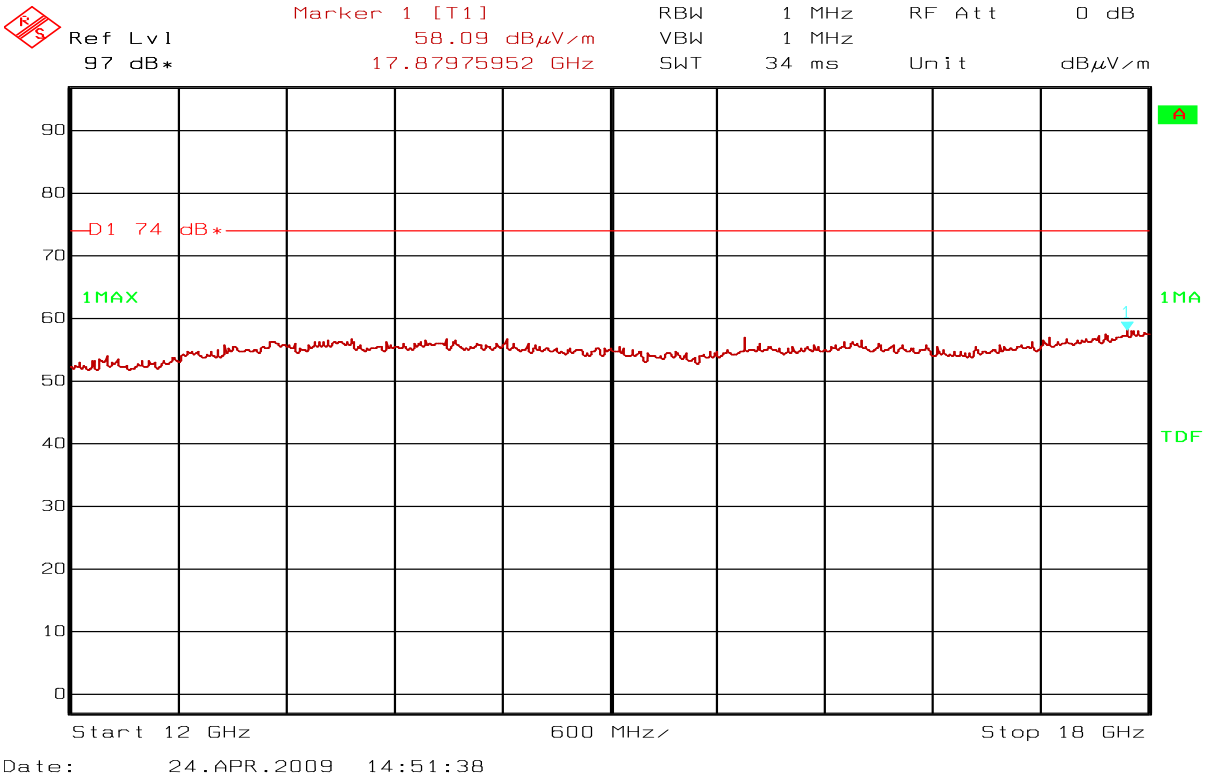
Radiated Emissions, 8.5 – 12 GHz, VP



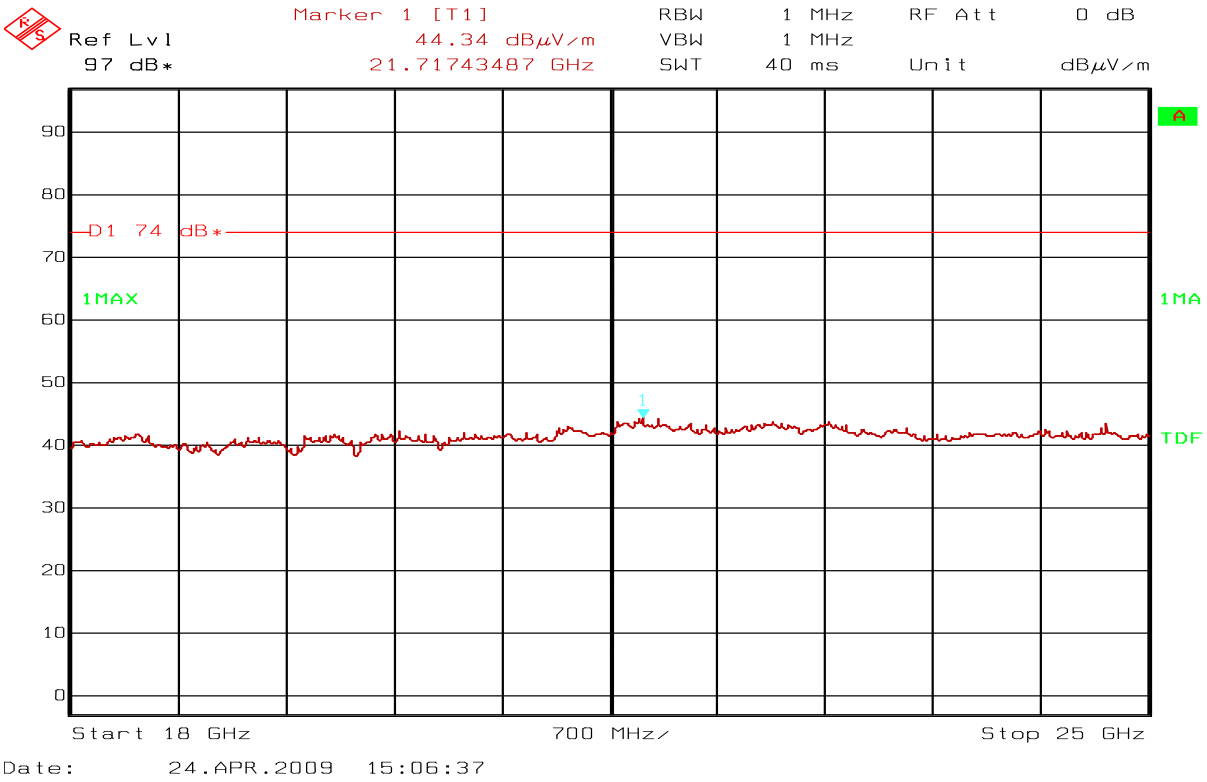
Radiated Emissions, 8.5 – 12 GHz, VP



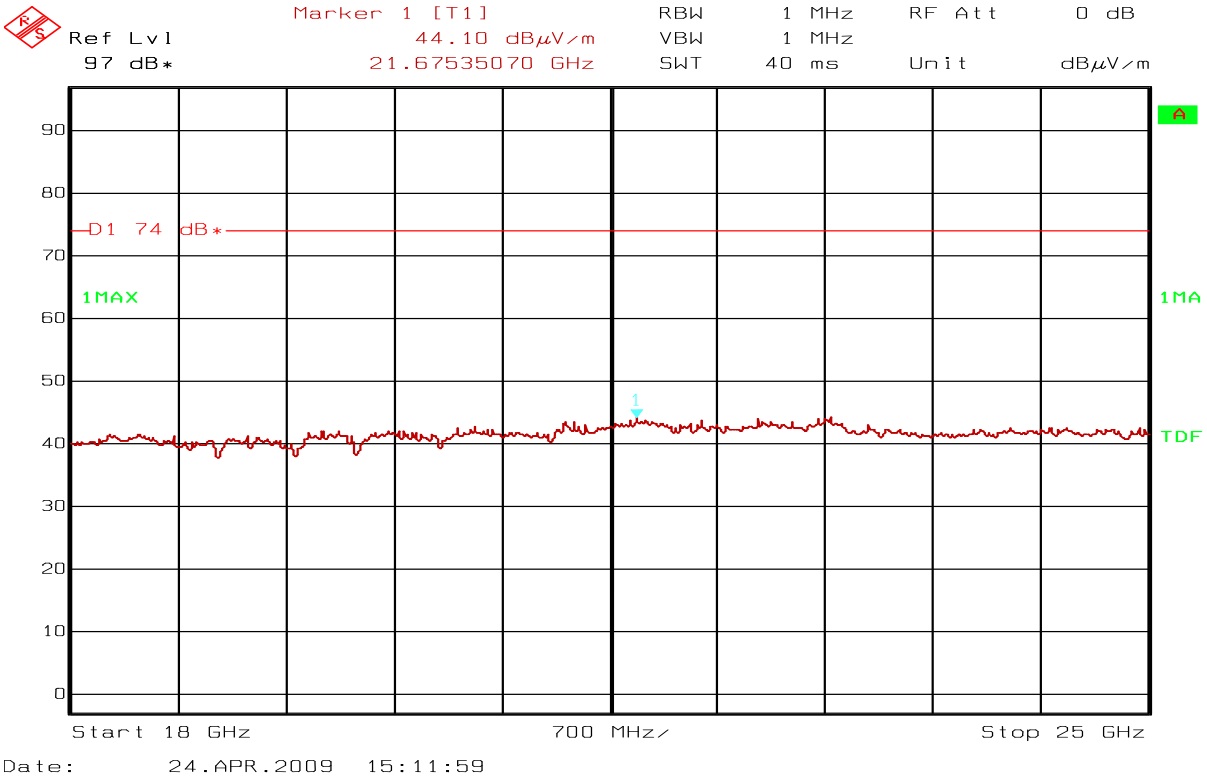
Radiated Emissions, 12 – 18 GHz, VP, 1m



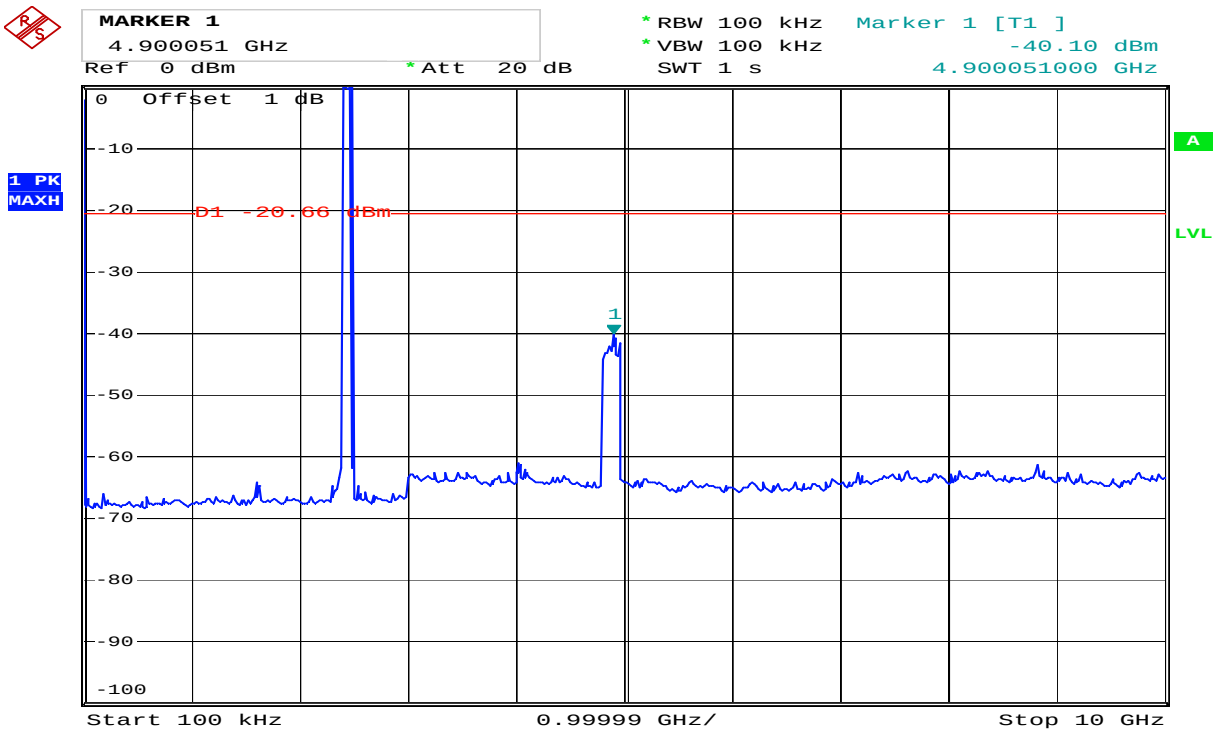
Radiated Emissions, 12 – 18 GHz, HP, 1m



Radiated Emissions, 18 – 25 GHz, VP, 1m

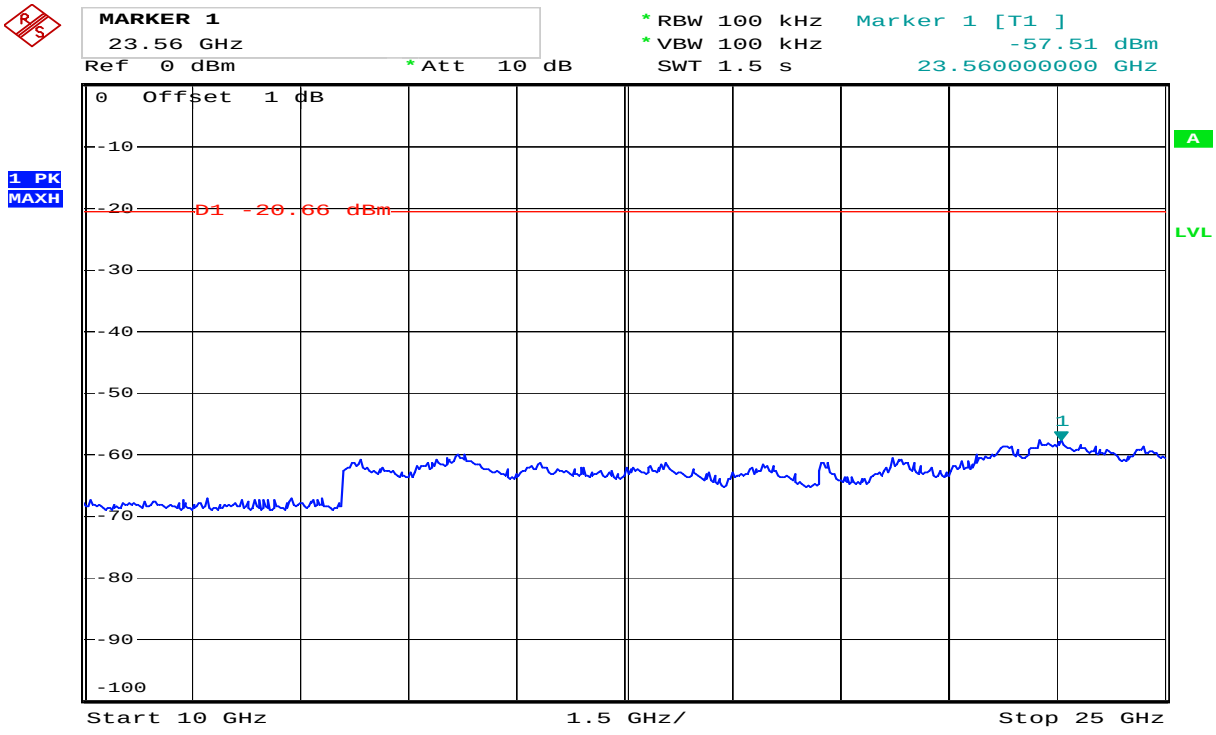


Radiated Emissions, 18 – 25 GHz, HP, 1m



Date: 27.APR.2009 14:44:52

Conducted Emissions, 100 kHz – 10 GHz, Hopping Active



Date: 27.APR.2009 14:51:26

Conducted Emissions, 10 - 25 GHz, Hopping Active

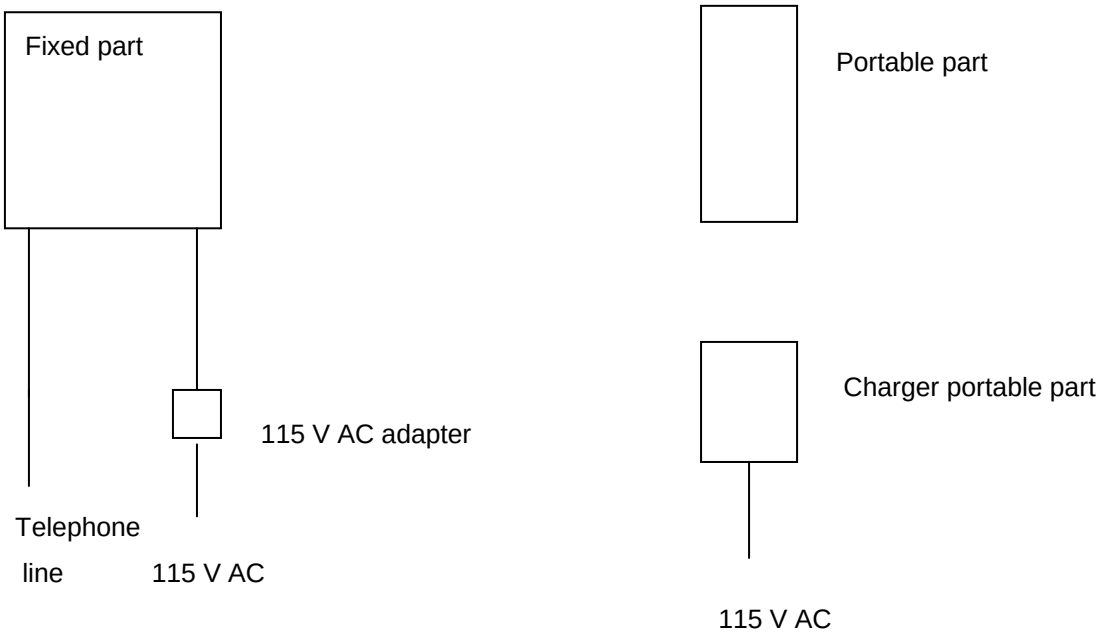
5 LIST OF TEST EQUIPMENT

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.

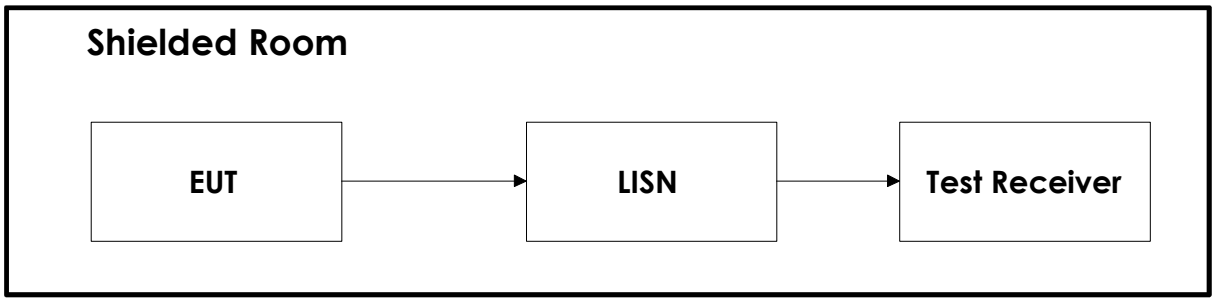
No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1	FSEK30	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	FSP30	Spectrum Analyzer	Rohde & Schwarz	LR 1551
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Siverts 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 042
11	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076
12	8449B	Amplifier	Hewlett Packard	LR 1322
13	ESN	Test Receiver	Rohde & Schwarz	LR 1237
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

6 BLOCK DIAGRAM

6.1 System set up



6.2 Power Line Conducted Emission



6.3 Test Site Radiated Emission