



Test report no. : 141282/6

Item tested : CMWA 8800

Type of equipment : Wireless Condition Monitoring Node

Client : SKF USA Inc.

FCC Part 15.247

Frequency Hopping Transmitters /
Digital Transmission System

RSS-210, Issue 8, Dec. 2010

Low Power Licence-Exempt
Radiocommunication Devices

2012-05-08

Authorized by : 

Roy Uggerud
Technical Vericator



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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko AS
Address : Nemko Kjeller
Instituttveien 6, 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: 40

1.2 Client Information

Name : SKF USA Inc.
Address : 5271 Viewridge Court,
San Diego,
California 92123,
USA
Telephone : +1 858 496-3400
Fax : -

Contact:

Name : Ted Johnson
Telephone : +1 858 496-3639
E-mail: ted.johnson@skf.com

1.3 Manufacturer

Name: Same as applicant

2 Test Information

2.1 Test Item

Name :	CMWA 8800
FCC ID :	>
Industry Canada ID :	>
Model/version :	XXXX
Serial number :	/
Hardware identity and/or version:	/
Software identity and/or version :	/
Frequency Range :	2405 – 2480 MHz
Tunable Bands :	None
Number of Channels :	15
Type of Modulation :	DSSS
User Frequency Adjustment :	None
Rated Output Power :	10 mW
Type of Power Supply :	Primary Battery (3V Lithium Battery)
Antenna Connector :	None
Number of antennas :	1
Antenna Diversity Supported :	No

Description of Test Item

The EUT is a battery operated vibration detector with a 2.4 GHz transceiver that uses Zigbee technology.

Exposure Evaluation

The EUT is exempted from RF Exposure Evaluation to FCC and Industry Canada SAR requirements since the output power is below the low threshold published by FCC and the limit in RSS-102 Issue 2, clause 2.5.1 for General Public Use.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	22 - 23 °C
Relative humidity:	35 - 45 %
Normal test voltage:	Primary Battery

The values are the limit registered during the test period.
The EUT was powered from a new battery during all tests.

2.3 Test Period

Item received date:	2009-08-24
Test period :	from 2009-08-24 to 2009-08-24

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: SKF Condition Monitoring Inc.

Model No.: CMWA 8800

Serial No.: XXXX

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 8.

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 3m and 10m.

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

DTS 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 #: 133167-2

TESTED BY:



Frode Sveinsen, Test engineer

DATE: 2009-08-25

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3.2 Test Summary

Name of test	FCC Part 15 reference	RSS-210 Issue 8 reference	Result
Supply Voltage Variations	15.31(e)	8 (RSS-GEN)	NA ²
Number of Operating Frequencies	15.31(m) 15.247(a)(1)	A8.1	NA ¹
Antenna Requirement	15.203	7.1.4 (RSS-GEN)	Pass
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2.2 (RSS-GEN)	NA ²
Channel Separation	15.247(a)(1)	A8.1	NA ¹
Pseudorandom Hopping Algorithm	15.247(a)(1)	A8.1	NA ¹
Time of Occupancy	15.247(a)(1)(iii)	A8.1	NA ¹
Time of Occupancy, Hybrid systems	15.247(f)	A8.1	Pass
Occupied Bandwidth	15.247(a)(1)	A8.1	NA ¹
Minimum 6 dB Bandwidth	15.247(a)(2)	A8.2	Pass
Peak Power Output	15.247(b)	A8.4	Pass
Power Spectral Density	15.247(d)	A8.2	Pass
Spurious Emissions (Antenna Conducted)	15.247(c)	A8.5	N/A ³
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	A8.5	Pass

¹ Not applicable for Digital Modulation systems

² Not applicable for EUT that operates from battery only.

³ The tested equipment has integrated antennas only.

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The test was performed on a sample that was programmed to transmit on one channel only. Since the bandwidth is more than 500 kHz the EUT is tested as a Digital Modulation device.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Minimum 6 dB Bandwidth

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

Test Performed By: Frode Sveinsen	Date of Test: 24-Aug-2009
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Test Results: Complies

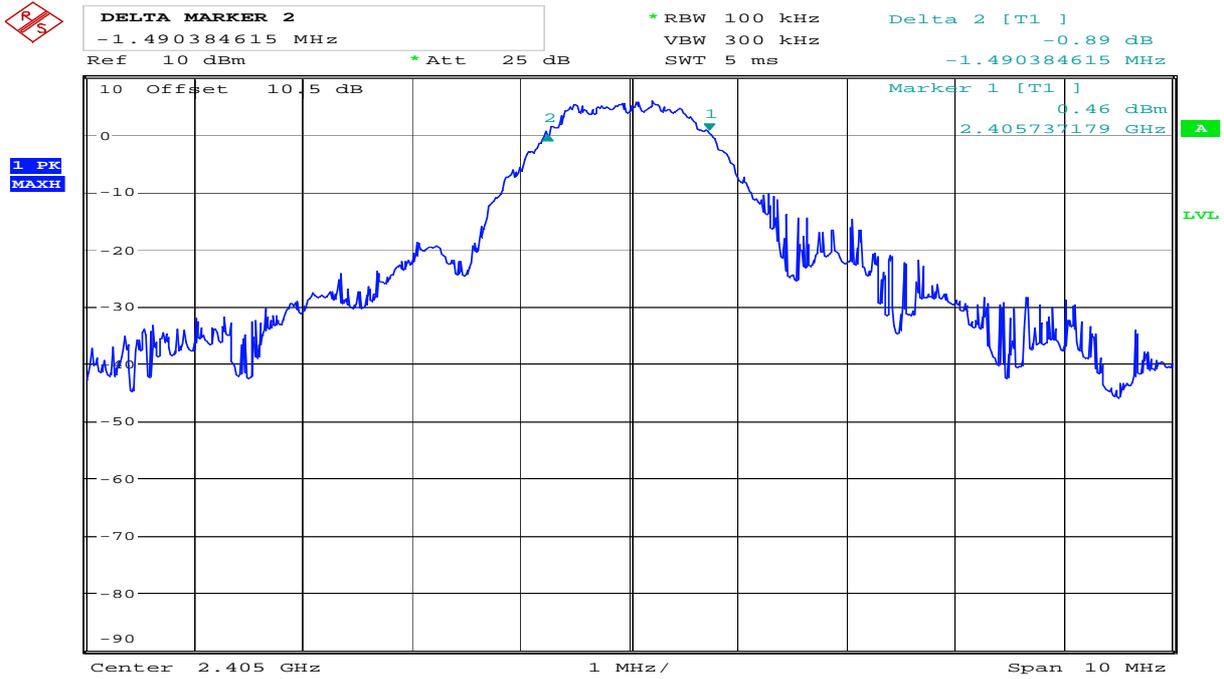
Measurement Data:

Measured 6 dB Bandwidth (kHz)		
2405 MHz	2440 MHz	2480 MHz
1490	1410	1506

Requirements:

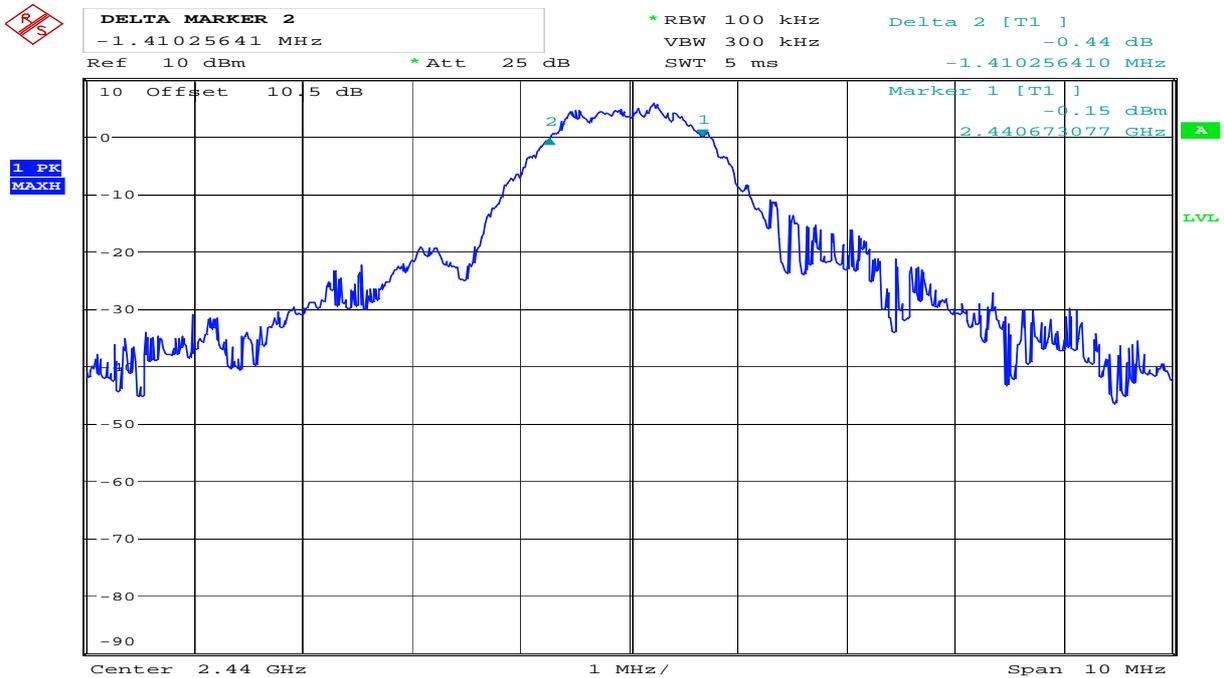
For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

No requirements for Frequency Hopping Systems.



Date: 24.AUG.2009 16:08:46

Minimum 6 dB Bandwidth, 2405 MHz



Date: 24.AUG.2009 16:44:36

Minimum 6 dB Bandwidth, 2440 MHz

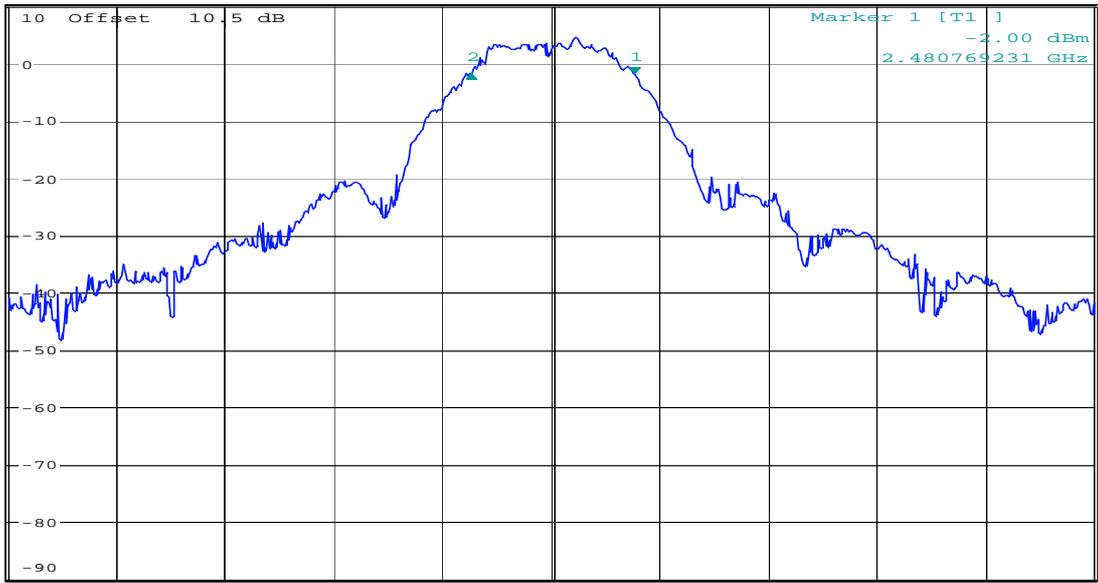


DELTA MARKER 2
 -1.506410256 MHz
 Ref 10 dBm * Att 25 dB

* RBW 100 kHz
 VBW 300 kHz
 SWT 5 ms

Delta 2 [T1]
 -0.03 dB
 -1.506410256 MHz

1 PK
 MAXH



Date: 24.AUG.2009 17:09:20

Minimum 6 dB Bandwidth, 2480 MHz

4.2 Occupancy Time

Para. No.: 15.247 (f)

Test Performed By: Frode Sveinsen

Date of Test: 24-Aug-2009

Test Results: **Complies**

Measurement Data: Number of RF channel: 15
RF burst pr channel: 4.28 ms
Time between each RF burst on same RF channel: 15x20.94 ms

Time of occupancy: $4.28\text{ms} \times (400\text{ms} \times 15) / (15 \times 20.94\text{ms}) = 81.75\text{ms}$

See attached graph.

Requirements:

For hybrid systems employing a combination of both frequency hopping and digital modulation techniques, 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.

4.3 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: Frode Sveinsen	Date of Test: 24-Aug-2009
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Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power, Watts

RF channel	2405 MHz	2440 MHz	2480 MHz
Measured value	0.0086	0.0076	0.0060

Maximum EIRP, Watts

RF channel	2405 MHz	2440 MHz	2480 MHz
Measured EIRP	0.0016	0.0021	0.0017
Antenna gain dBi	-7.4	-5.7	-5.5

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

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

See attached graph.

Detachable antenna?

Yes No

If detachable, is the antenna connector non-standard?

Yes No

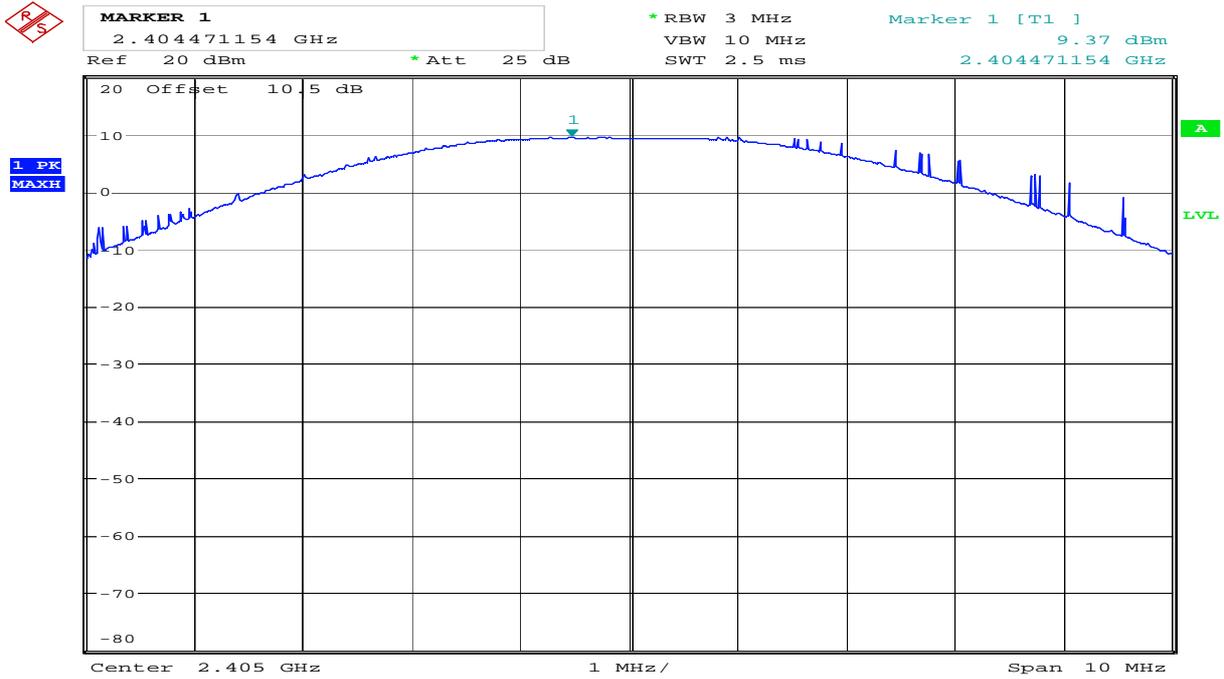
Type of antenna connector: N/A

Requirements:

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

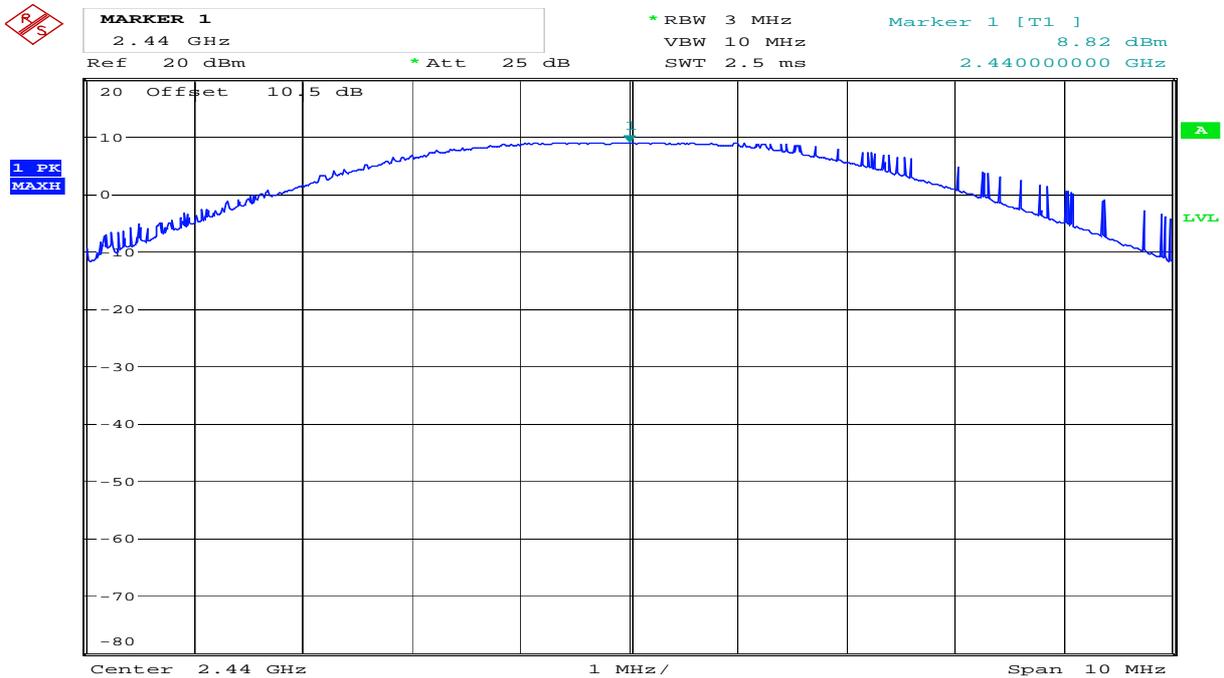
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

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.



Date: 24.AUG.2009 16:10:42

Peak Output Power, 2405 MHz



Date: 24.AUG.2009 16:42:25

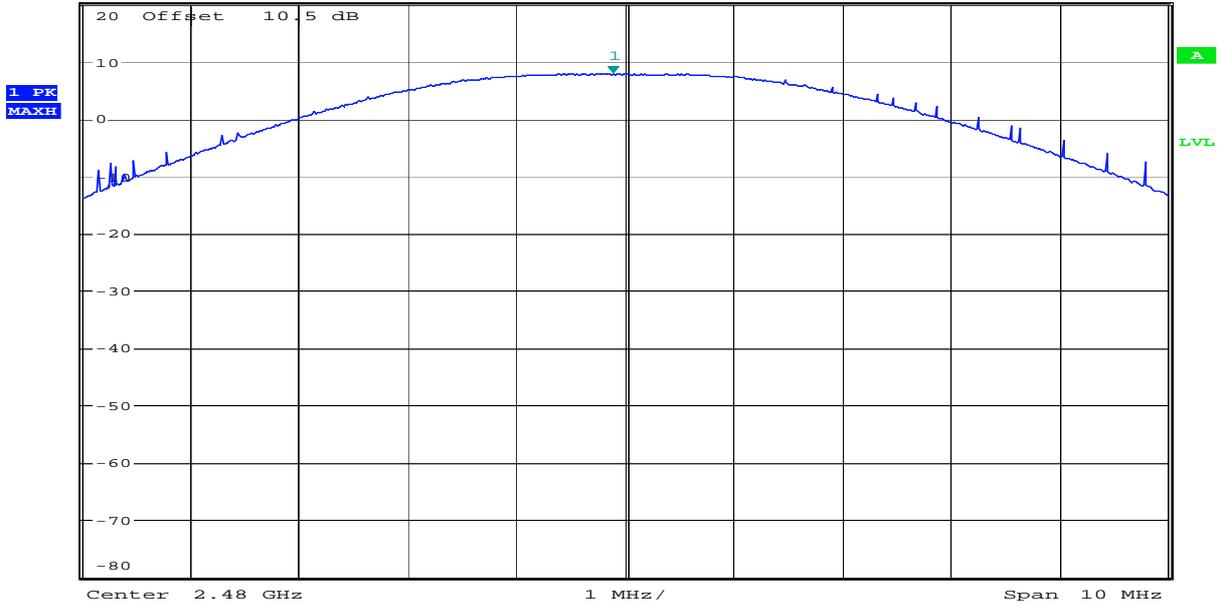
Peak Output Power, 2440 MHz



MARKER 1
2.479887821 GHz
Ref 20 dBm * Att 25 dB

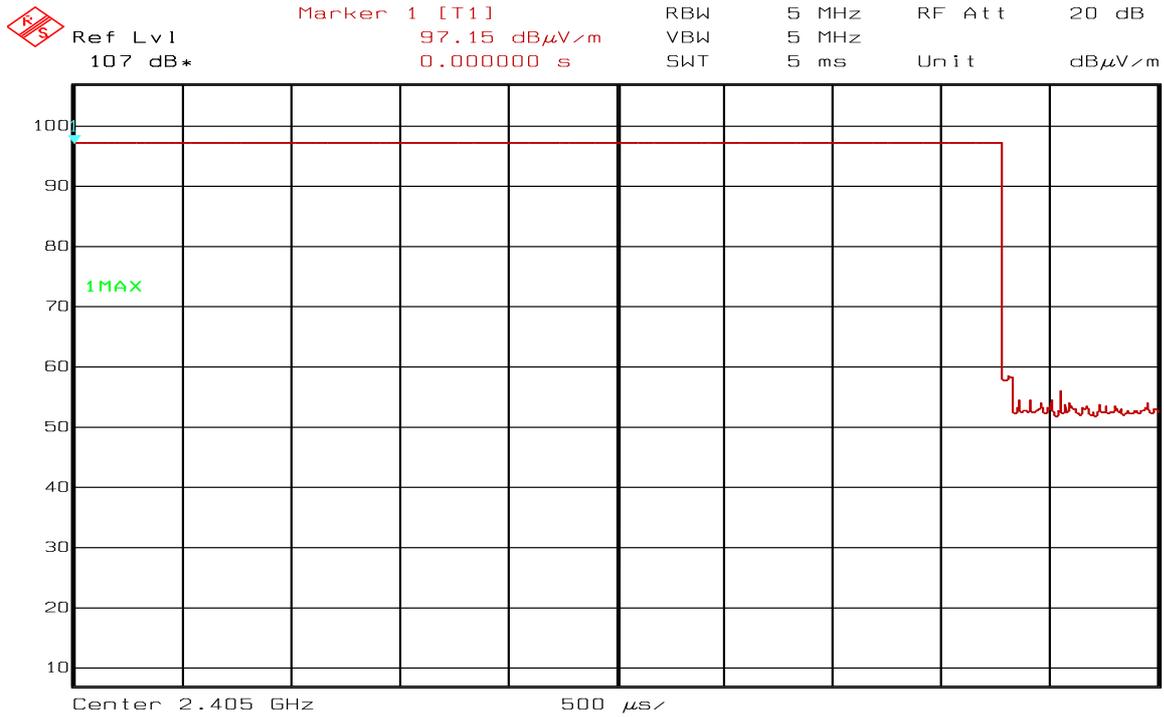
* RBW 3 MHz
VBW 10 MHz
SWT 2.5 ms

Marker 1 [T1]
7.78 dBm
2.479887821 GHz



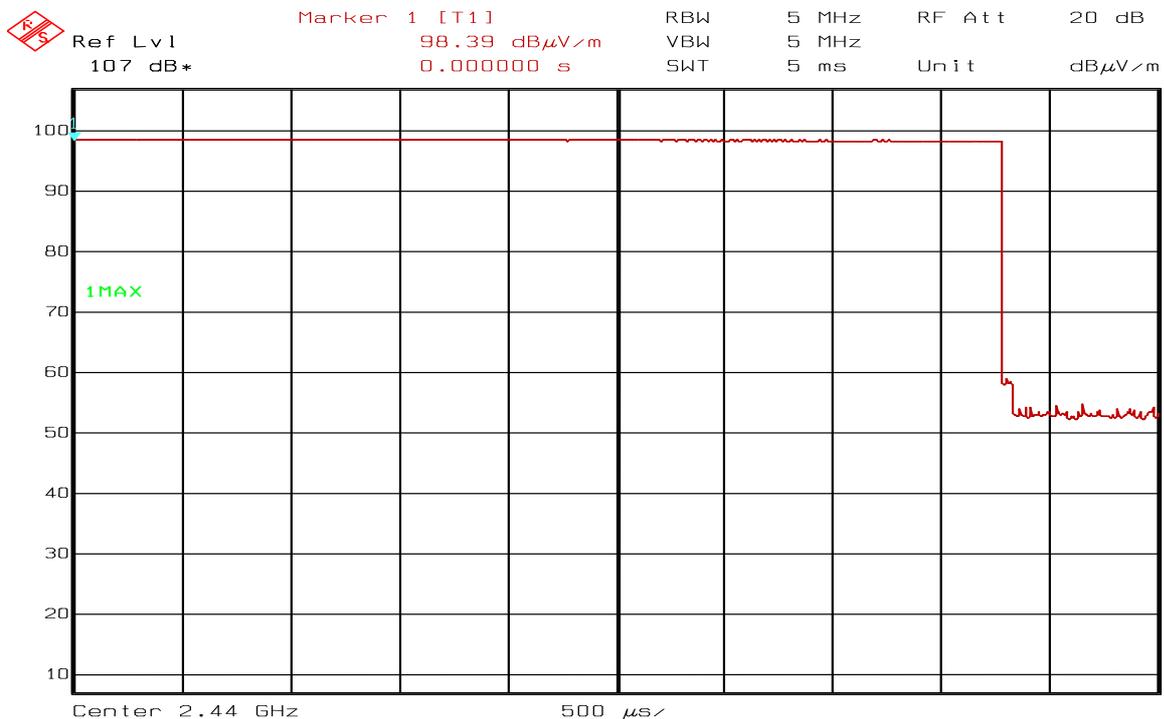
Date: 24.AUG.2009 17:06:35

Peak Output Power, 2480 MHz



Date: 24.AUG.2009 8:22:16

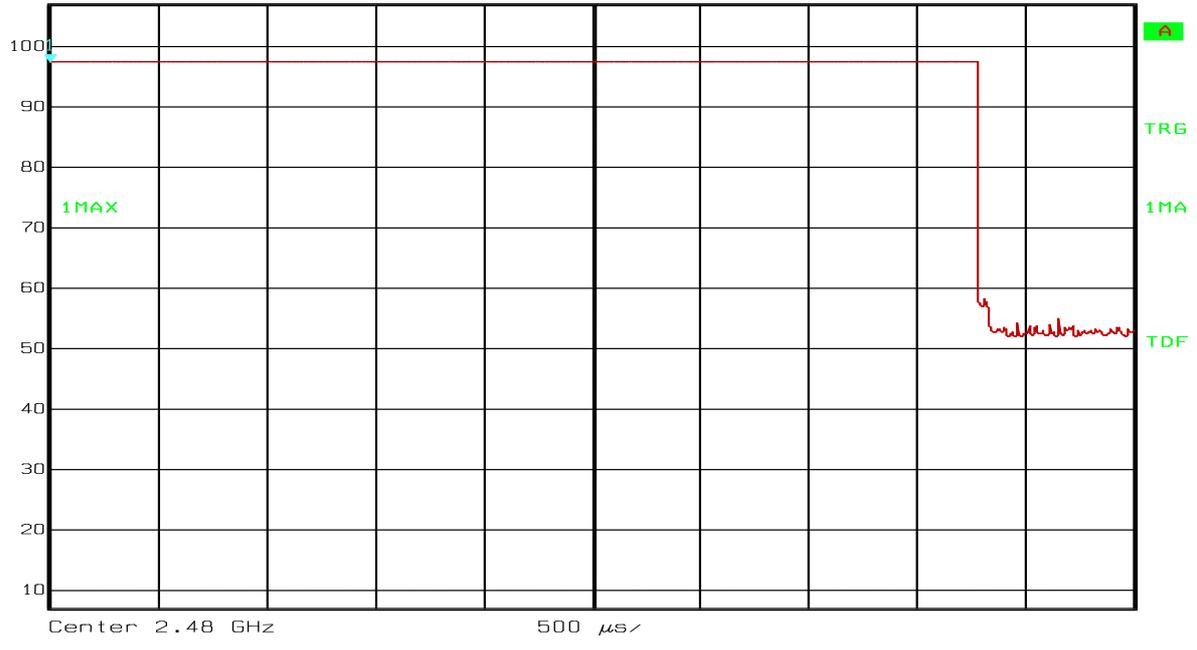
Maximum Radiated Power, 2405 MHz, VP



Date: 24.AUG.2009 8:34:51

Maximum Radiated Power, 2440 MHz, VP

Marker 1 [T1]
 Ref Lvl 107 dB* 97.50 dB μ V/m RBW 5 MHz RF Att 20 dB
 0.000000 s VBW 5 MHz Unit dB μ V/m
 SWT 5 ms



Date: 24.AUG.2009 8:42:54

Maximum Radiated Power, 2480 MHz, VP

4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: Frode Sveinsen	Date of Test: 24-Aug-2009
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Test Results: Complies

Measurement Data:

Band-edge conducted power.

Frequency	Power below nearest channel	Limit	Margin
GHz	dBµV/m	dBµV/m	dB
2.39	< 50	74	> 24
2.4835	70.4	74	3.6

See attached graph

RF conducted power to 25 GHz see attached graphs.

Maximum RF level outside operating band:

RF ch 2405 MHz: 39.0 dB/C, margin 19.0 dB

RF ch 2440 MHz: 39.7 dB/C, margin 19.7 dB

RF ch 2480 MHz: 36.4 dB/C, margin 16.4 dB

Limit: At least 20 dB below carrier when measured in a 100 kHz band.

Radiated emissions 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).

Radiated emission 30 – 1000 MHz.

Measuring distance 3 m, measured with Peak detector.

No component detected, see attached graph.

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	metres	dB μ V/m	dB
all	TX on	See plots	3	Se plots	> 10

See attached graphs.

Radiated Emissions, 1-25 GHz

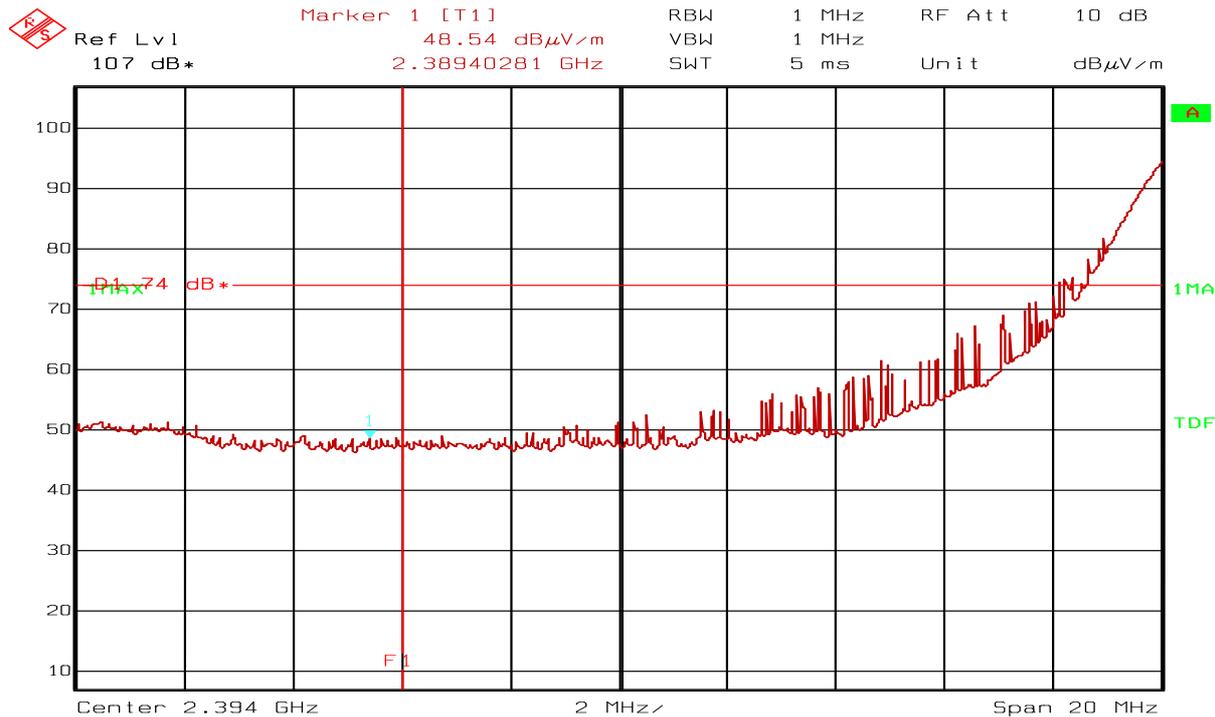
1-8.5 GHz measured at a distance of 3 m

8.5 – 25 GHz checked with prescan, no components detected.

Frequency	Operational condition	Field strength	Measuring distance	Peak Limit FCC15.209	Margin
MHz		dB μ V/m	metres	dB μ V/m	dB
4810	TX on	54.4	3	74	19.6
4880	TX on	53.8	3	74	20.2
7440	TX on	59.3	3	74	14.7

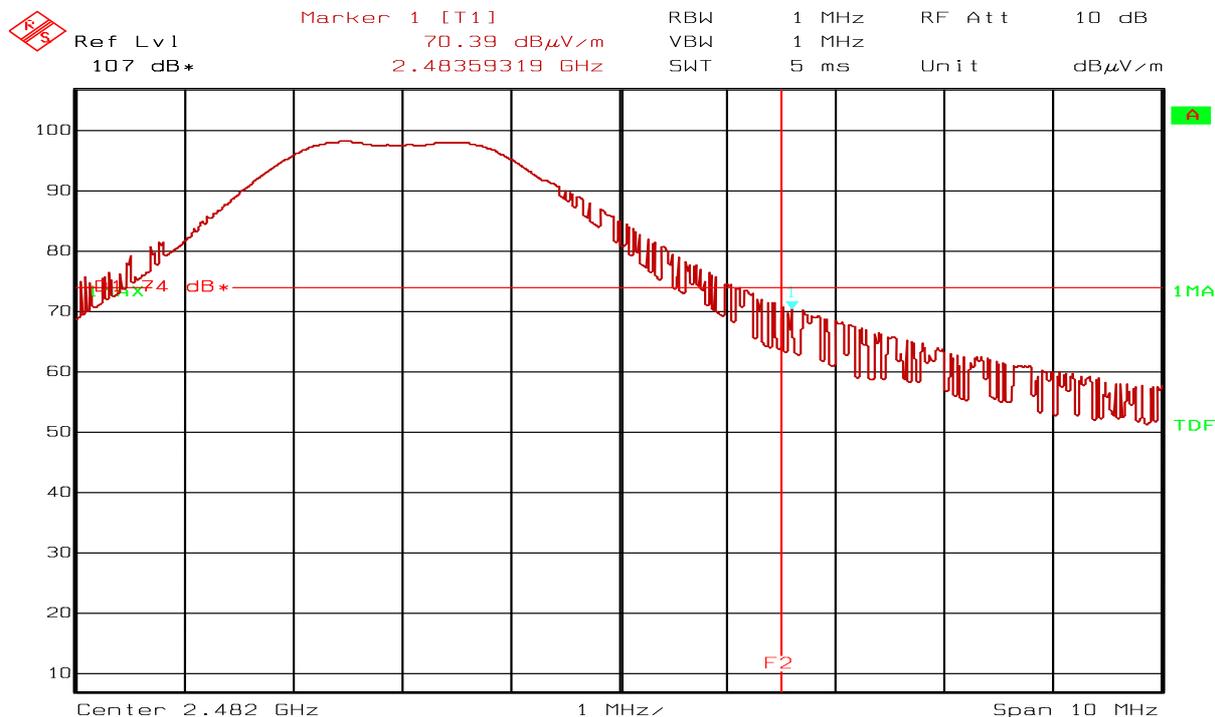
See attached graphs.

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



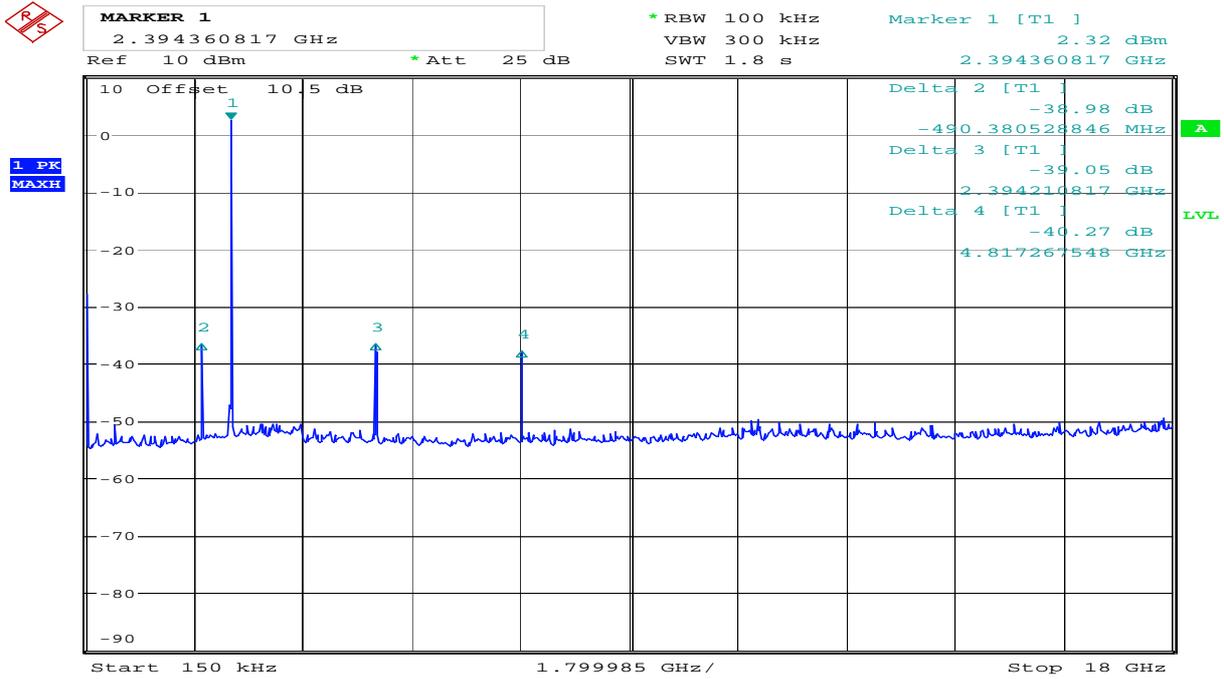
Date: 25.AUG.2009 11:49:13

Radiated Emissions at Band Edge, 2390 MHz



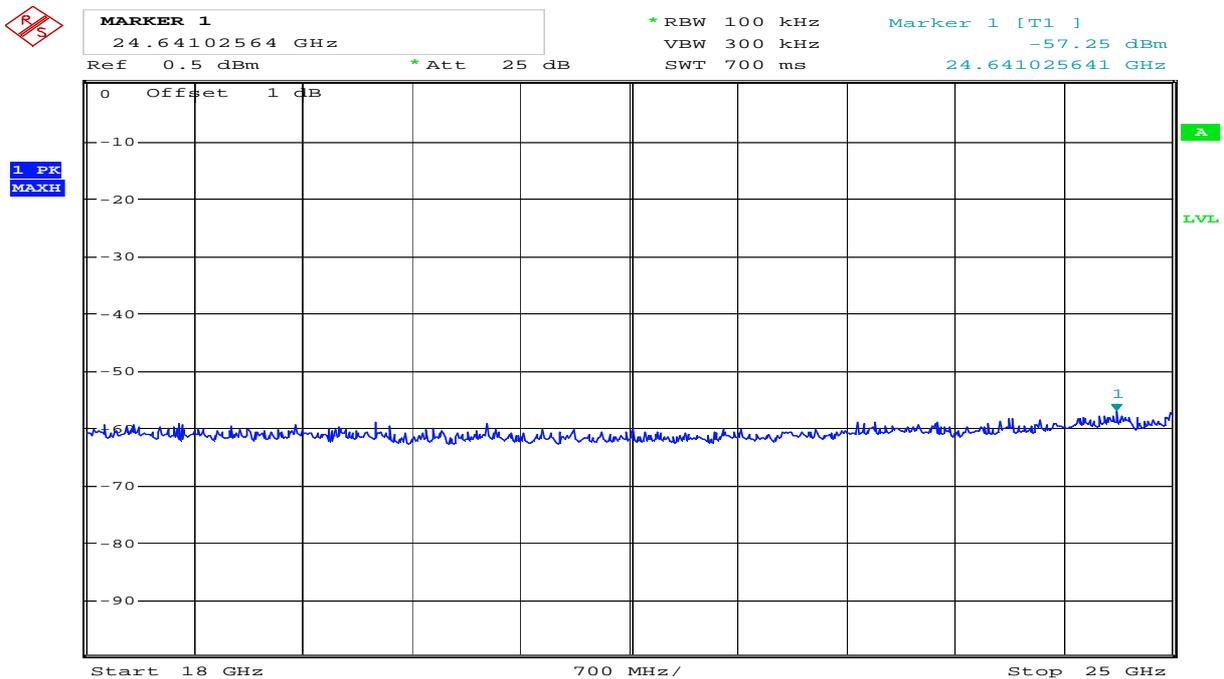
Date: 24.AUG.2009 9:37:04

Radiated Emissions at Band Edge, 2483.5 MHz



Date: 24.AUG.2009 16:36:13

Conducted Emissions, Lower Carrier, 150 kHz - 18 GHz



Date: 24.AUG.2009 16:38:14

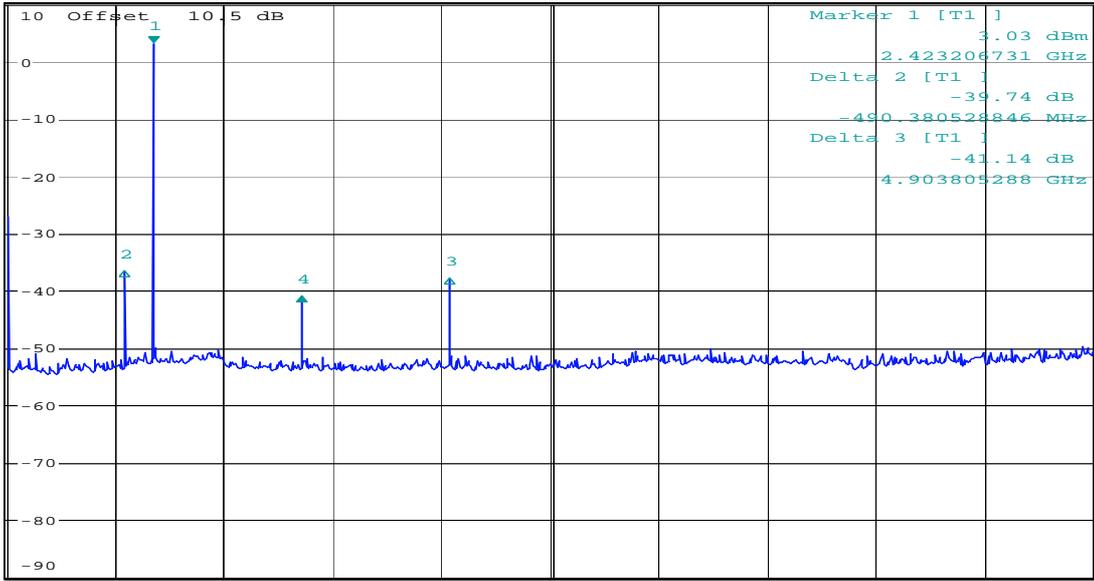
Conducted Emissions, Lower Carrier, 18 - 25 GHz



DELTA MARKER 4
 2.451902644 GHz
 Ref 10 dBm * Att 25 dB

* RBW 100 kHz Delta 4 [T1]
 VBW 300 kHz -44.13 dB
 SWT 1.8 s 2.451902644 GHz

1 PK
 MAXH



Date: 24.AUG.2009 16:40:21

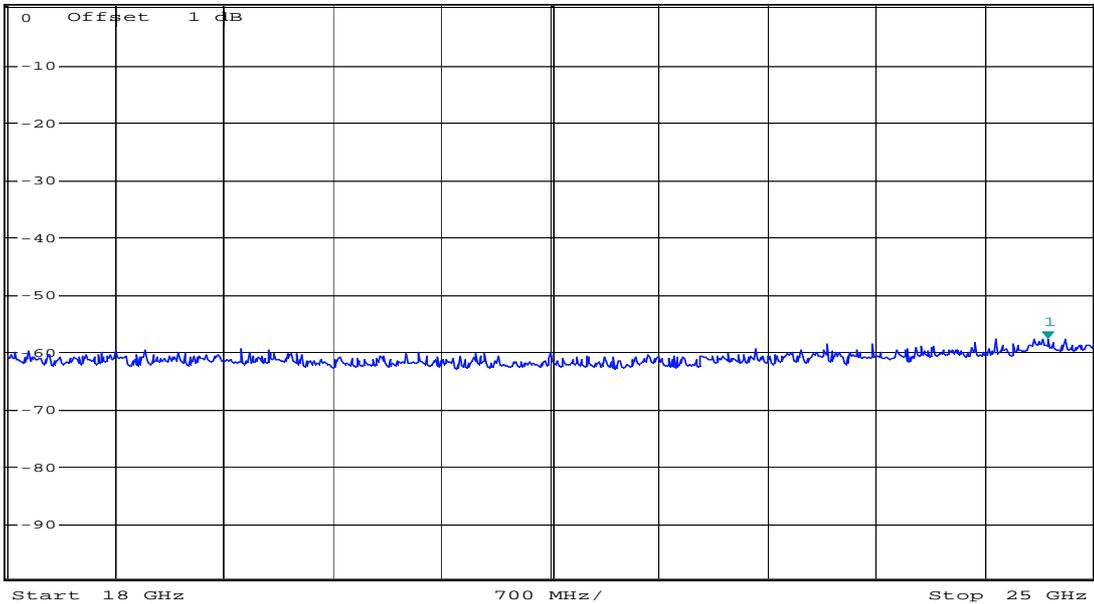
Conducted Emissions, Middle Carrier, 150 kHz - 18 GHz



MARKER 1
 24.708333333 GHz
 Ref 0.5 dBm * Att 25 dB

* RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz -57.77 dBm
 SWT 700 ms 24.708333333 GHz

1 PK
 MAXH



Date: 24.AUG.2009 16:38:50

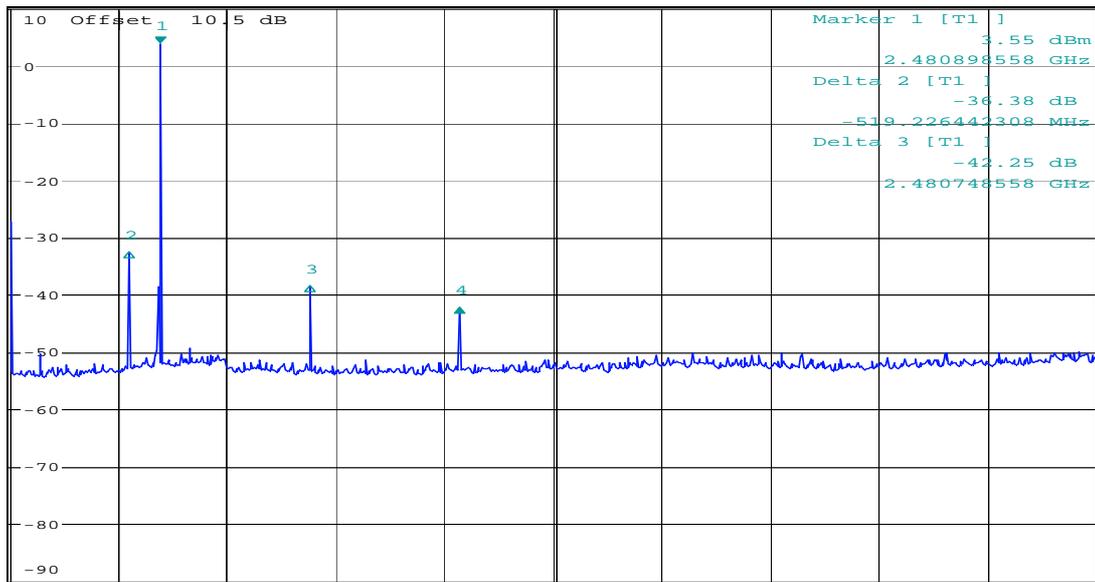
Conducted Emissions, Middle Carrier, 18 - 25 GHz



DELTA MARKER 4
 4.961497115 GHz
 Ref 10 dBm * Att 25 dB

* RBW 100 kHz Delta 4 [T1]
 VBW 300 kHz -45.94 dB
 SWT 1.8 s 4.961497115 GHz

1 PK
 MAXH



Date: 24.AUG.2009 17:10:55

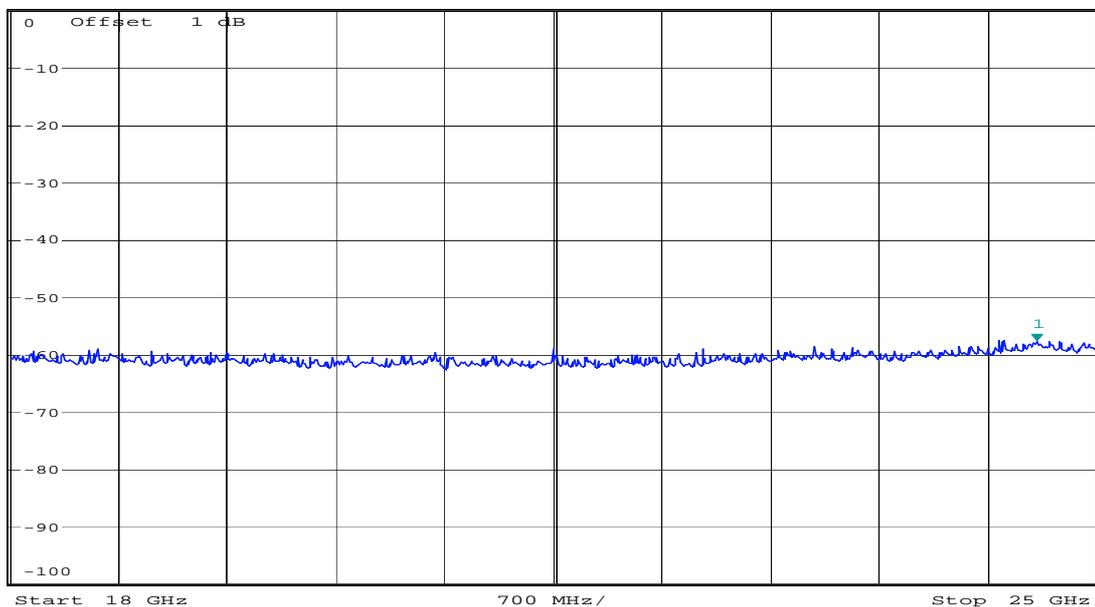
Conducted Emissions, Upper Carrier, 150 kHz - 18 GHz



MARKER 1
 24.61858974 GHz
 Ref 0 dBm * Att 25 dB

* RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz -57.91 dBm
 SWT 700 ms 24.61858974 GHz

1 PK
 MAXH



Date: 24.AUG.2009 17:12:45

Conducted Emissions, Upper Carrier, 18 - 25 GHz

Nemko AS Peak

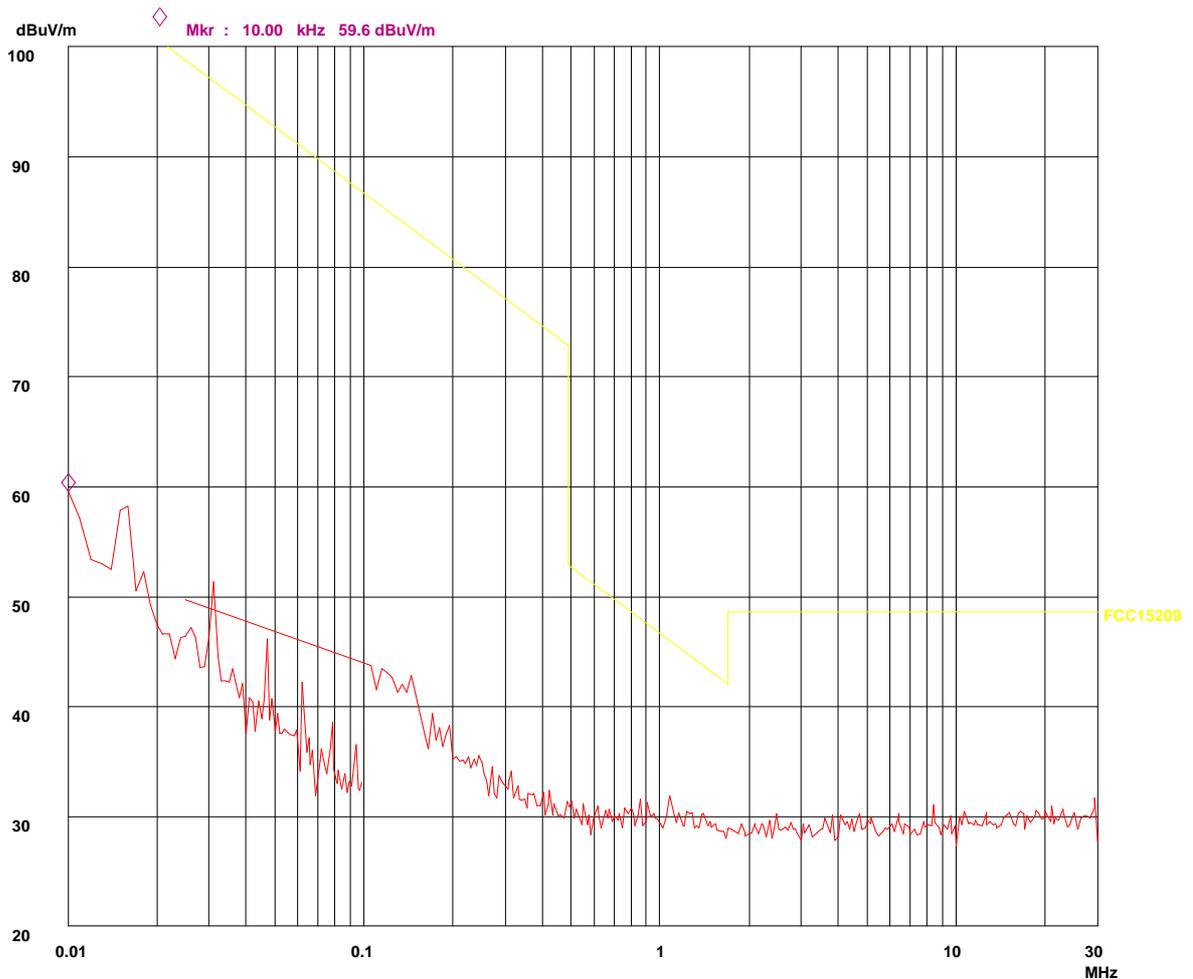
24. Aug 09 12:38

Operator: FS
 Comment: SKF CMWA 8800
 FCC 15.209
 d=10m

Scan Settings (4 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
10k	100k	1k	1k	PK	20ms	0dBLN	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



Radiated Emissions, 100 kHz – 30 MHz

Nemko AS Peak

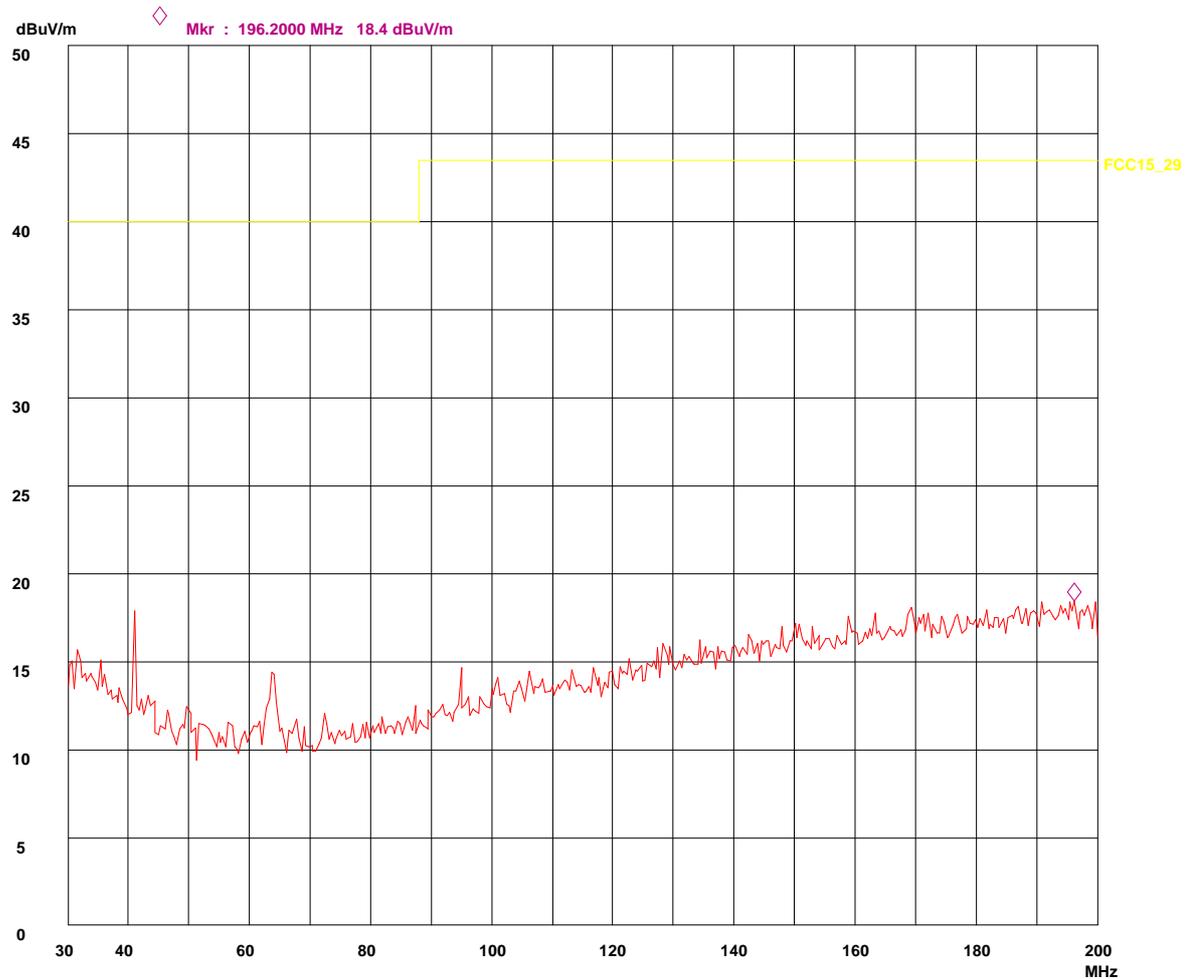
24. Aug 09 12:24

Operator: FS
 Comment: SKF CMWA 8800
 FCC 15.209
 d=3m, H=2m, HP

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, HP

Nemko AS Peak

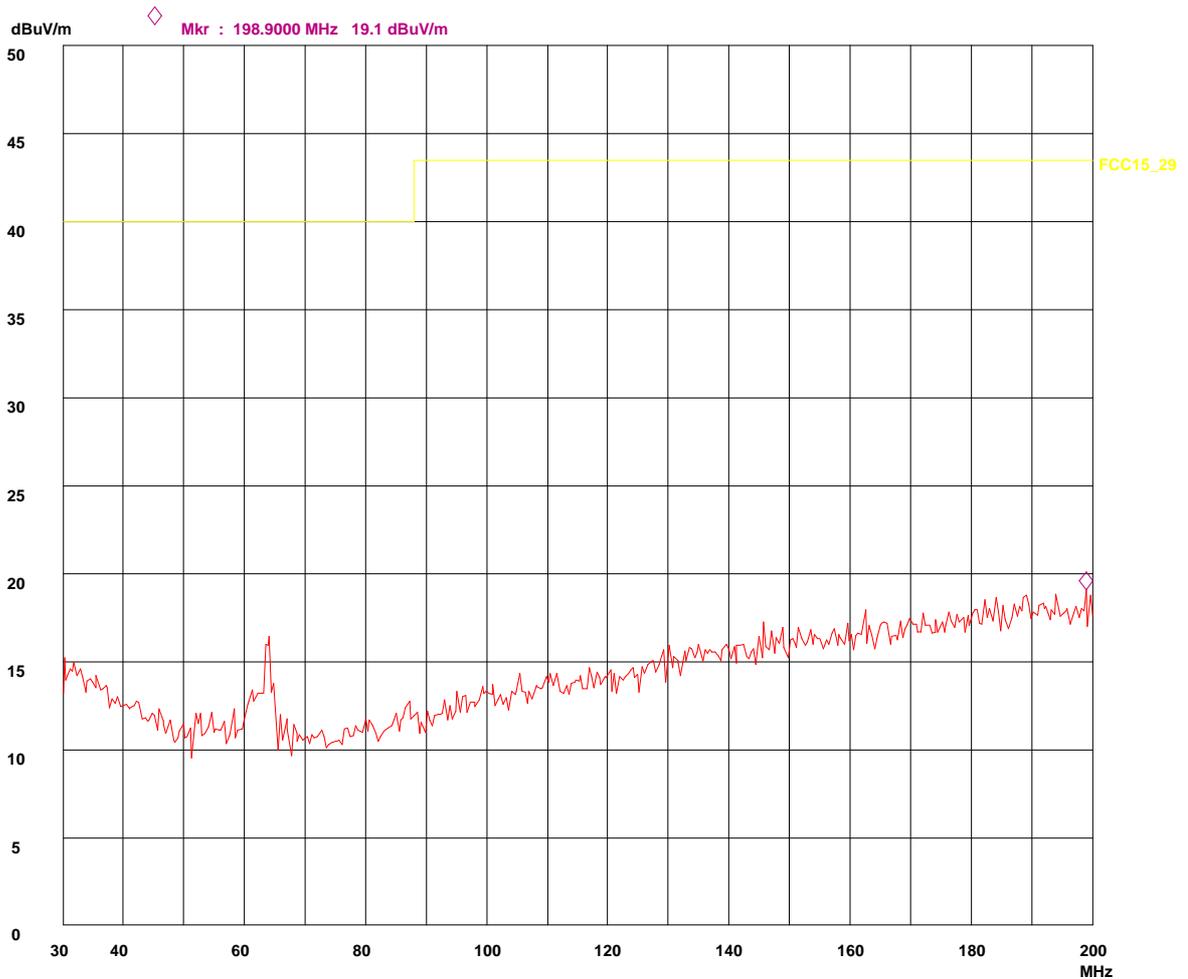
24. Aug 09 12:17

Operator: FS
 Comment: SKF CMWA 8800
 FCC 15.209
 d=3m, H=1m, VP

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, VP

Nemko AS Peak

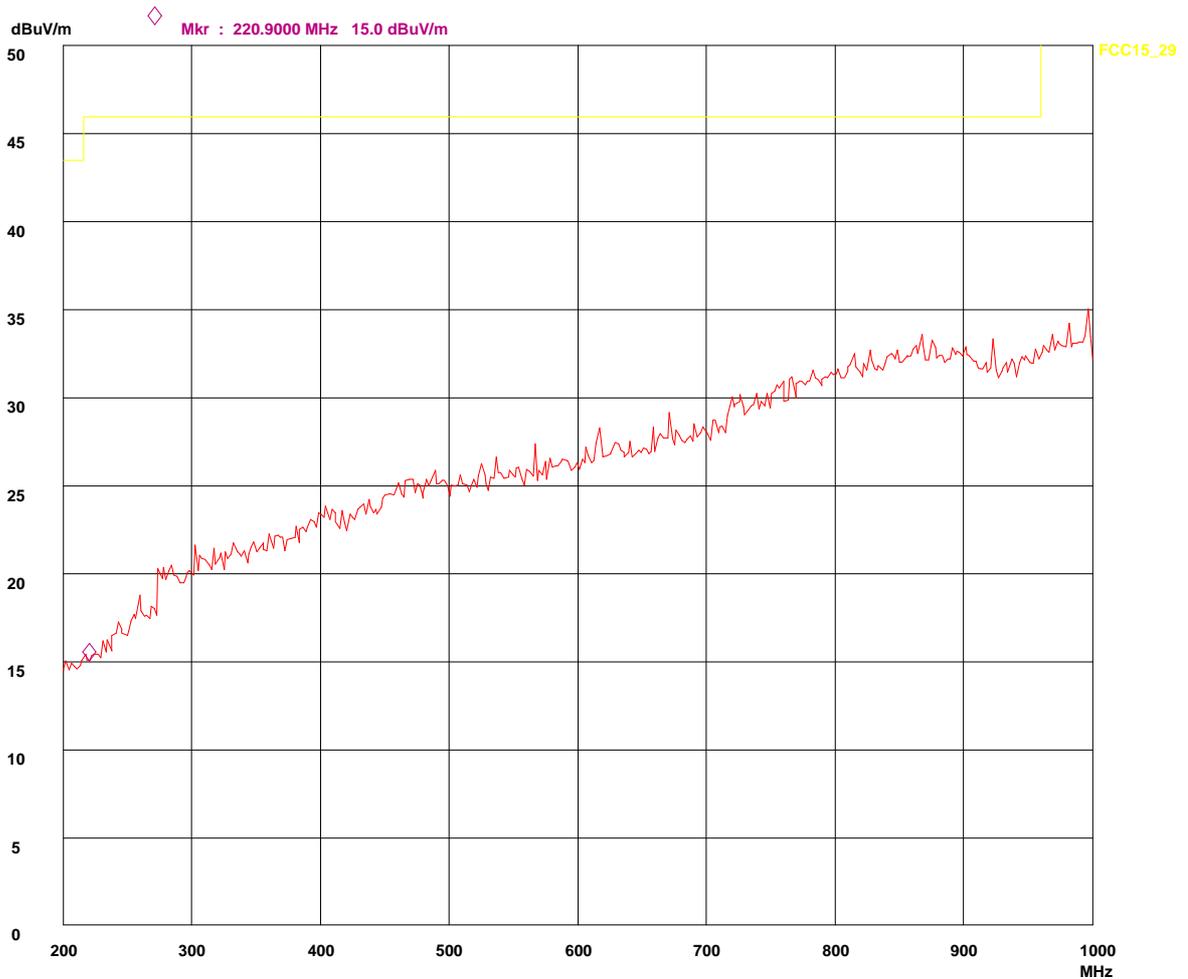
24. Aug 09 11:59

Operator: FS
 Comment: SKF CMWA 8800
 FCC 15.209
 d=3m, H=1m, HP

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, HP

Nemko AS Peak

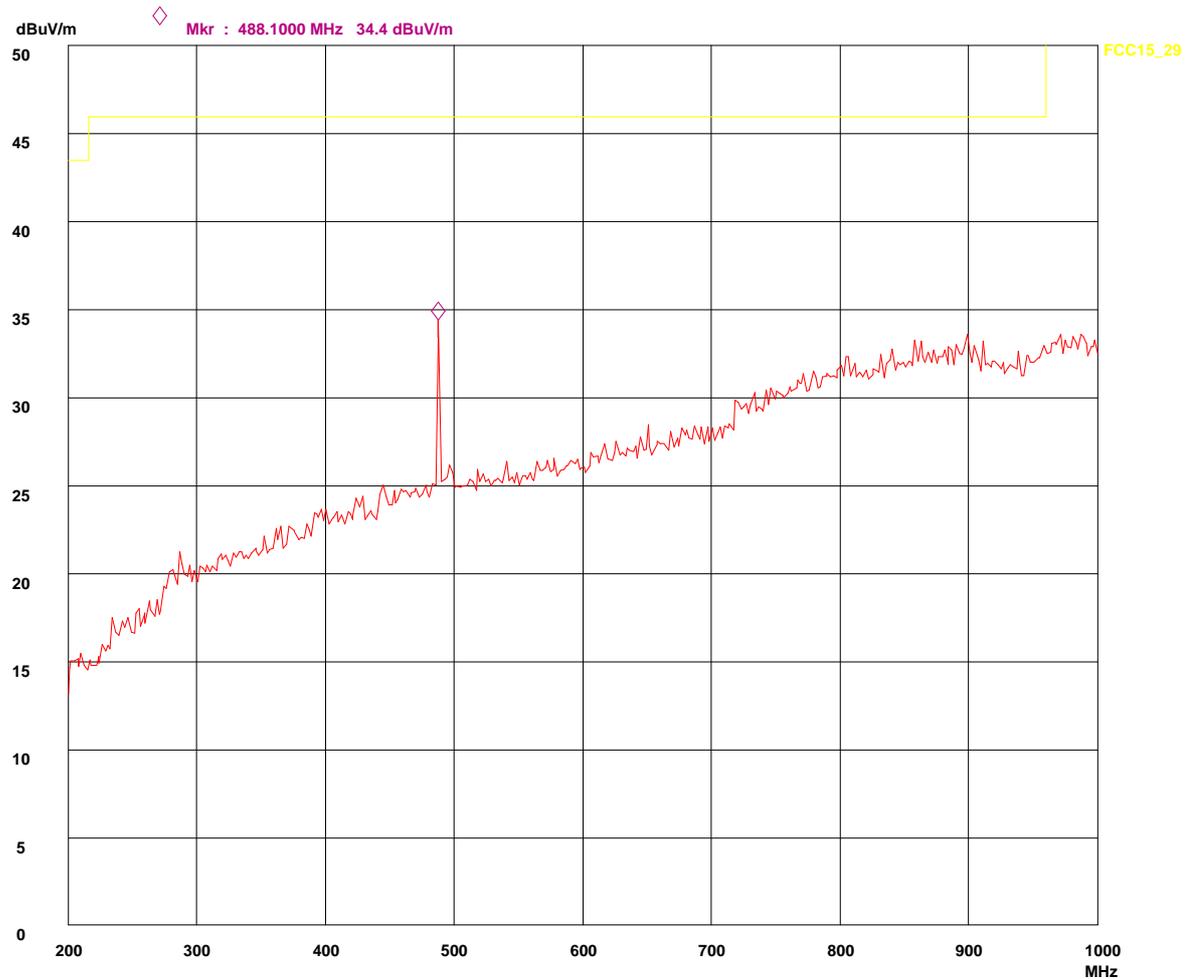
24. Aug 09 11:33

Operator: FS
 Comment: SKF CMWA 8800
 FCC 15.209
 d=3m, H=1m, VP

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

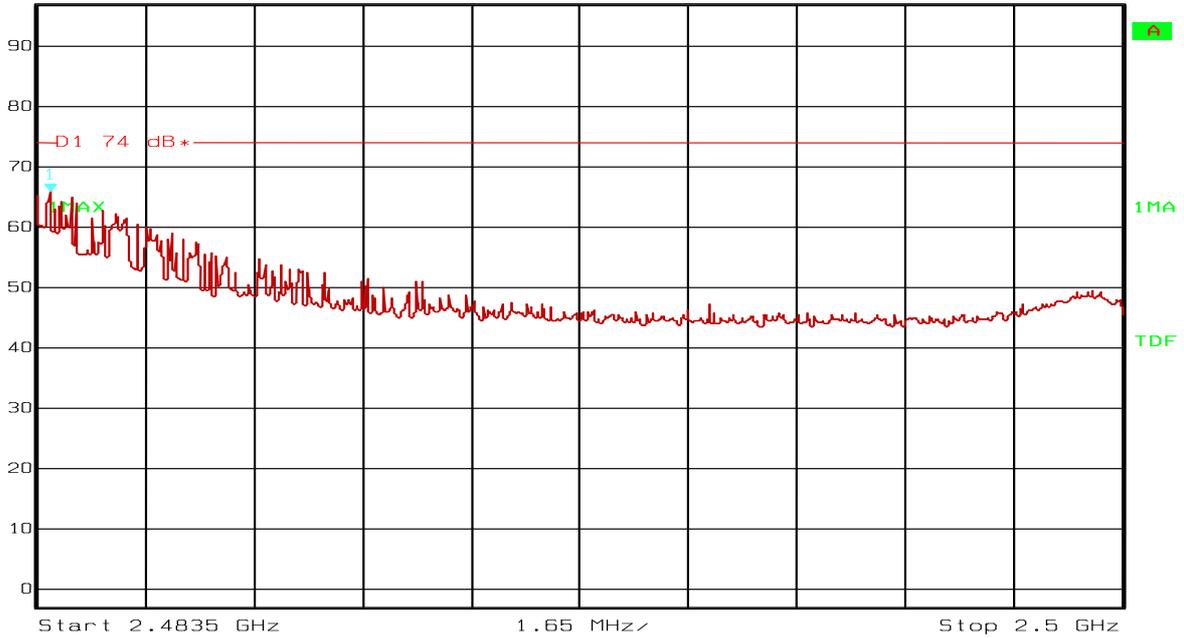
Transducer No.	Start	Stop	Name
21	200M	1000M	HL223



Radiated Emissions, 200 - 1000 MHz, VP

(The spike at 488.100 MHz is noise from the antenna controller and not from the EUT)

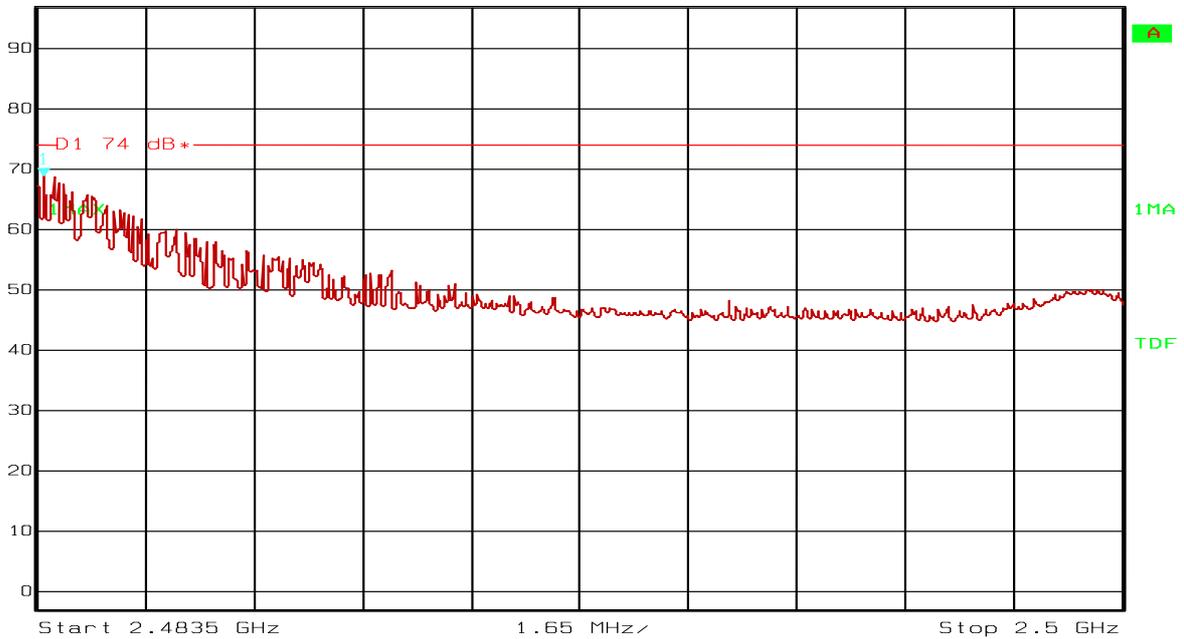
	Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
	97 dB*	65.88 dB μ V/m 2.48369840 GHz	VBW	1 MHz	Unit	dB μ V/m
			SWT	5 ms		



Date: 25.AUG.2009 12:04:57

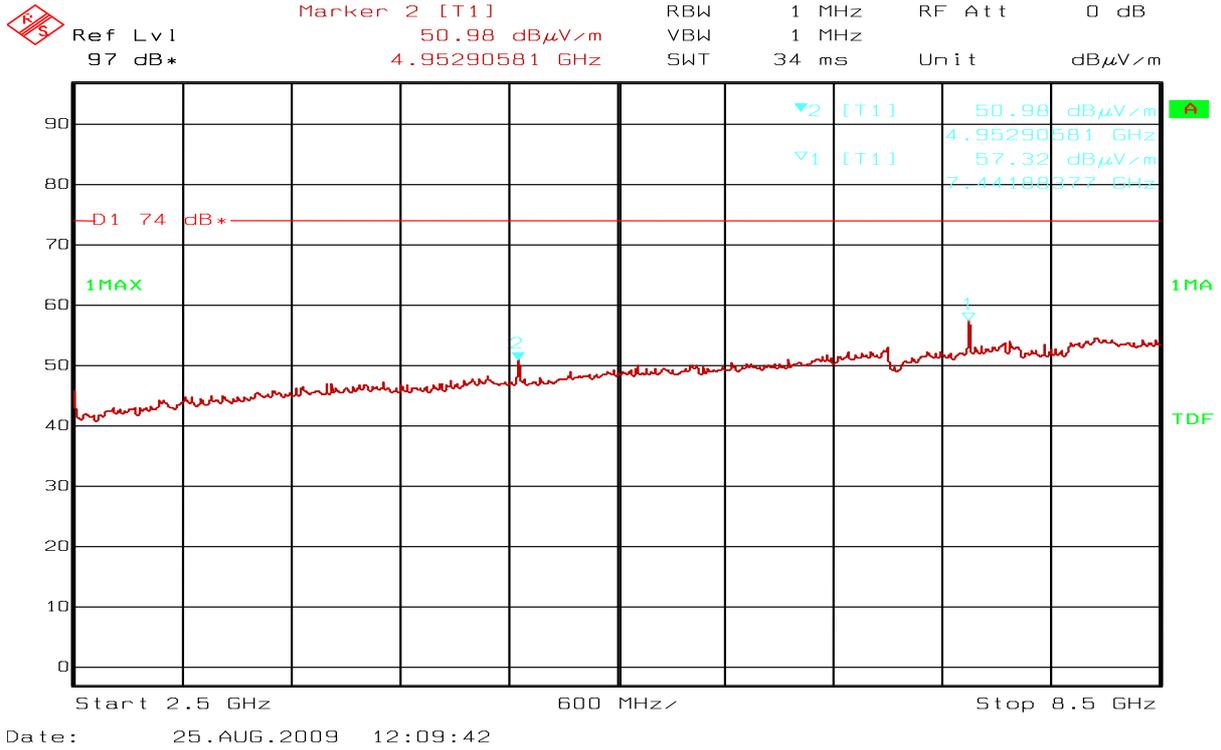
Radiated Emissions, 2.4835 - 2.5 GHz, HP

	Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
	97 dB*	68.76 dB μ V/m 2.48359920 GHz	VBW	1 MHz	Unit	dB μ V/m
			SWT	5 ms		

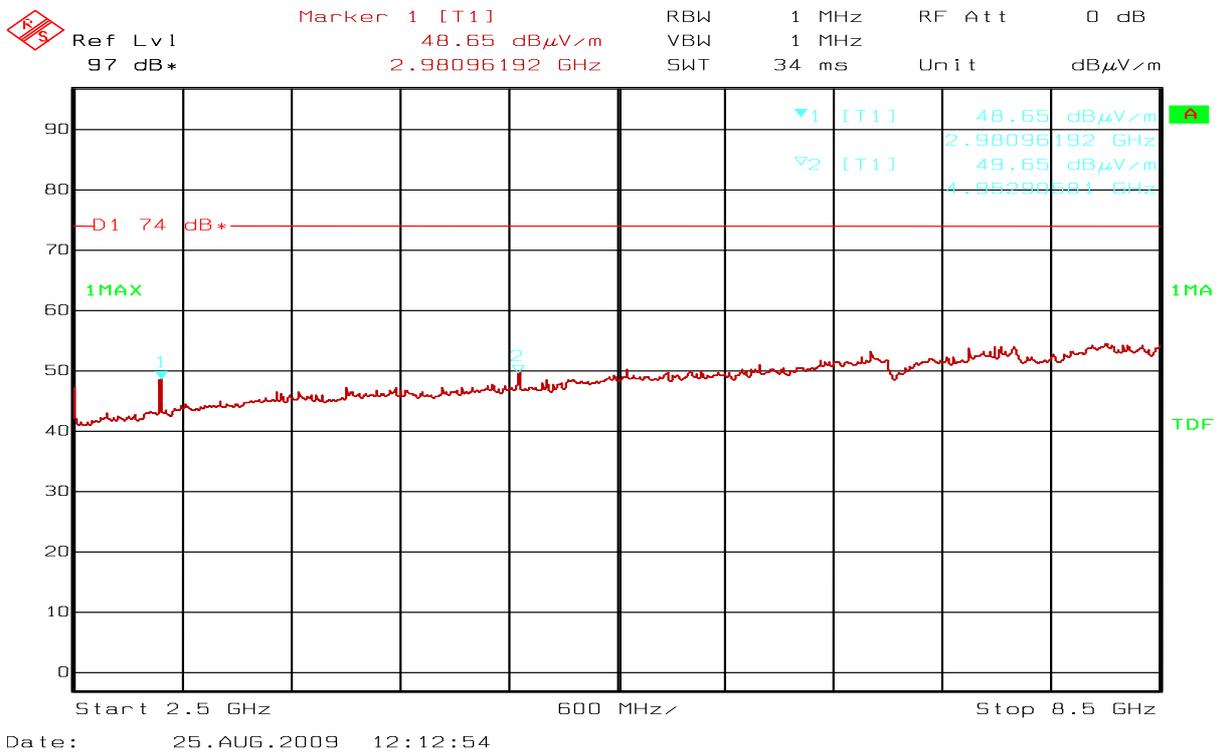


Date: 25.AUG.2009 12:00:39

Radiated Emissions, 2.4835 - 2.5 GHz, VP

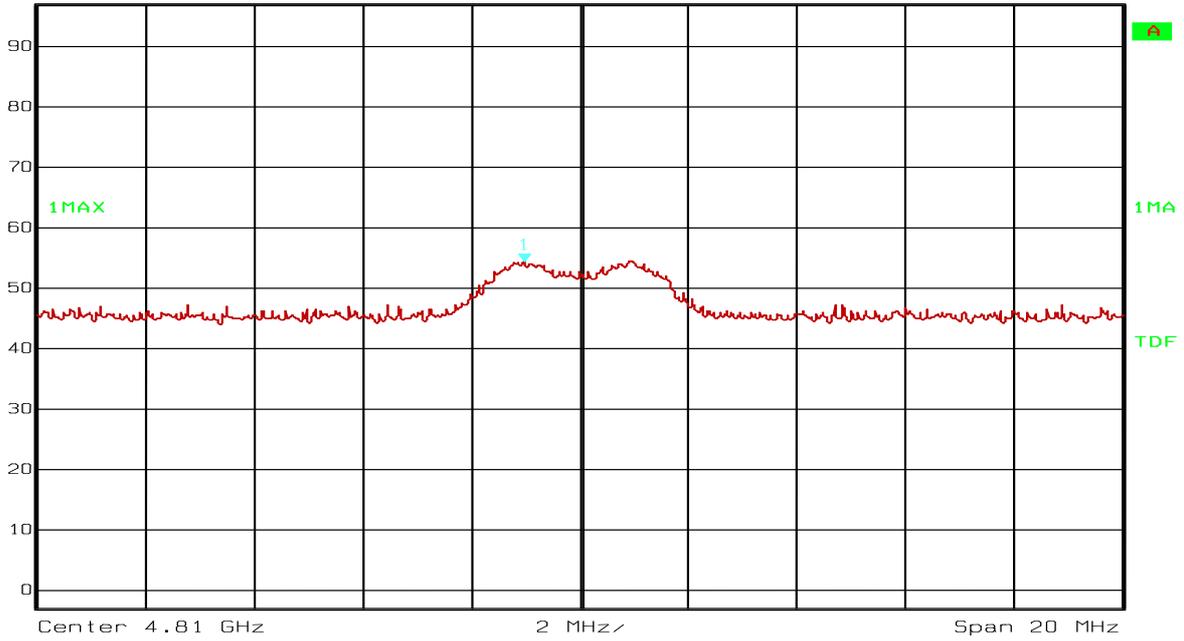


Radiated Emissions, 2.5 - 8.5 GHz, HP



Radiated Emissions, 2.5 - 8.5 GHz, VP

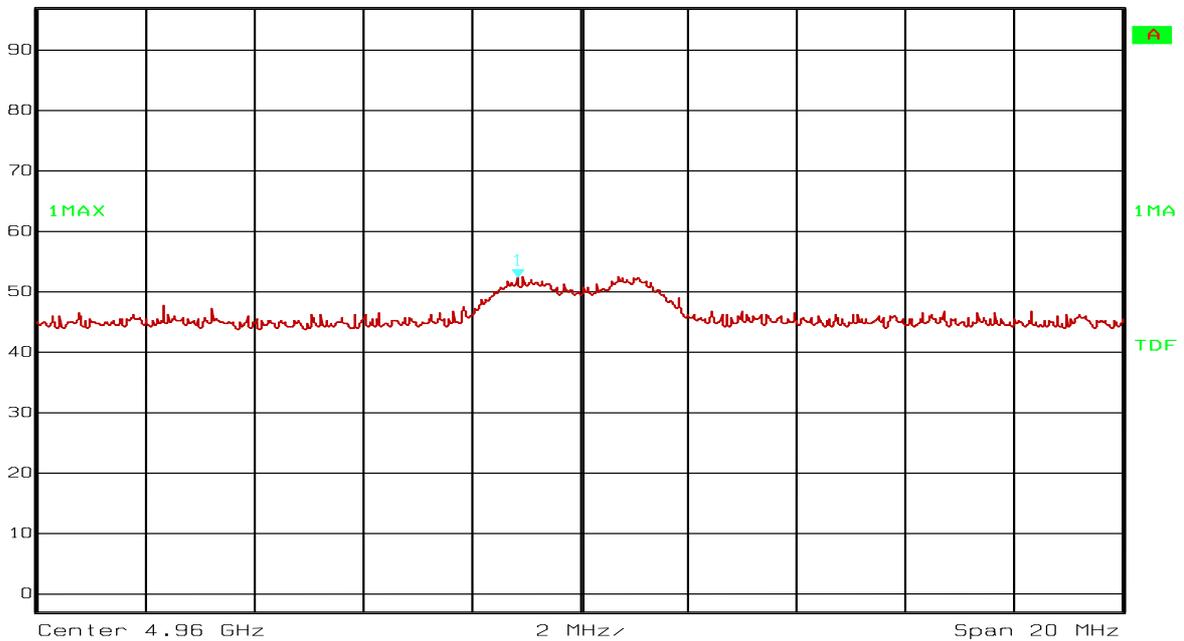
	Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	0 dB
	97 dB*	54.37 dB μ V/m	VBW	1 MHz		
		4.80897796 GHz	SWT	5 ms	Unit	dB μ V/m



Date: 24.AUG.2009 9:03:45

Radiated Emissions, 4.81 GHz, HP

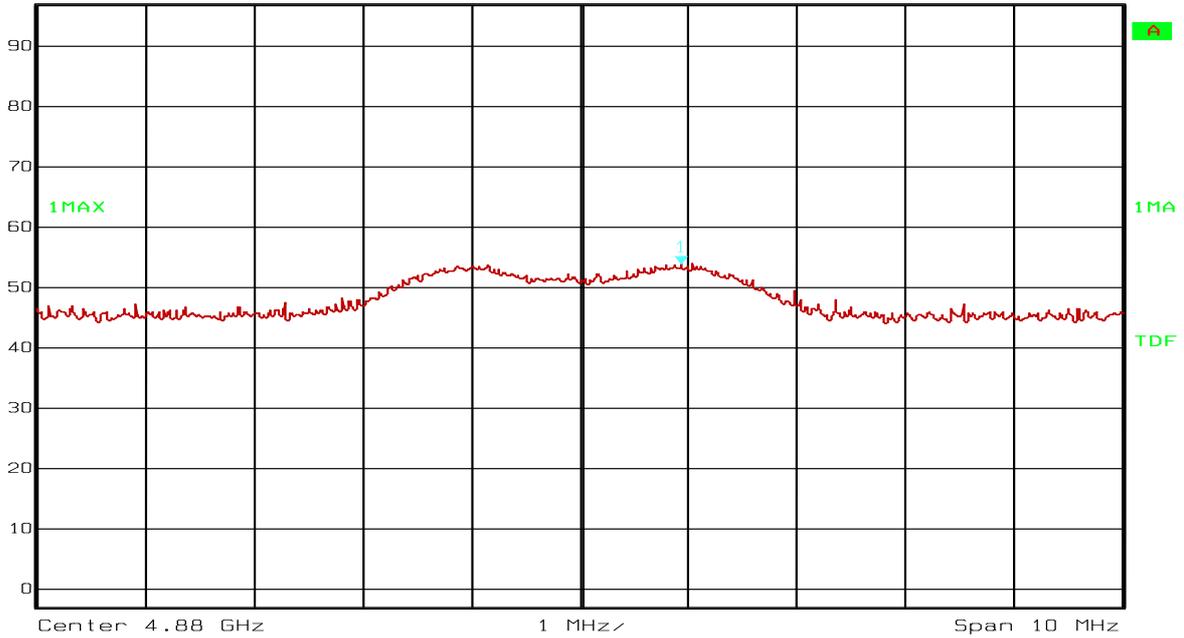
	Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	0 dB
	97 dB*	52.31 dB μ V/m	VBW	1 MHz		
		4.95885772 GHz	SWT	5 ms	Unit	dB μ V/m



Date: 24.AUG.2009 8:53:03

Radiated Emissions, 4.96 GHz, HP

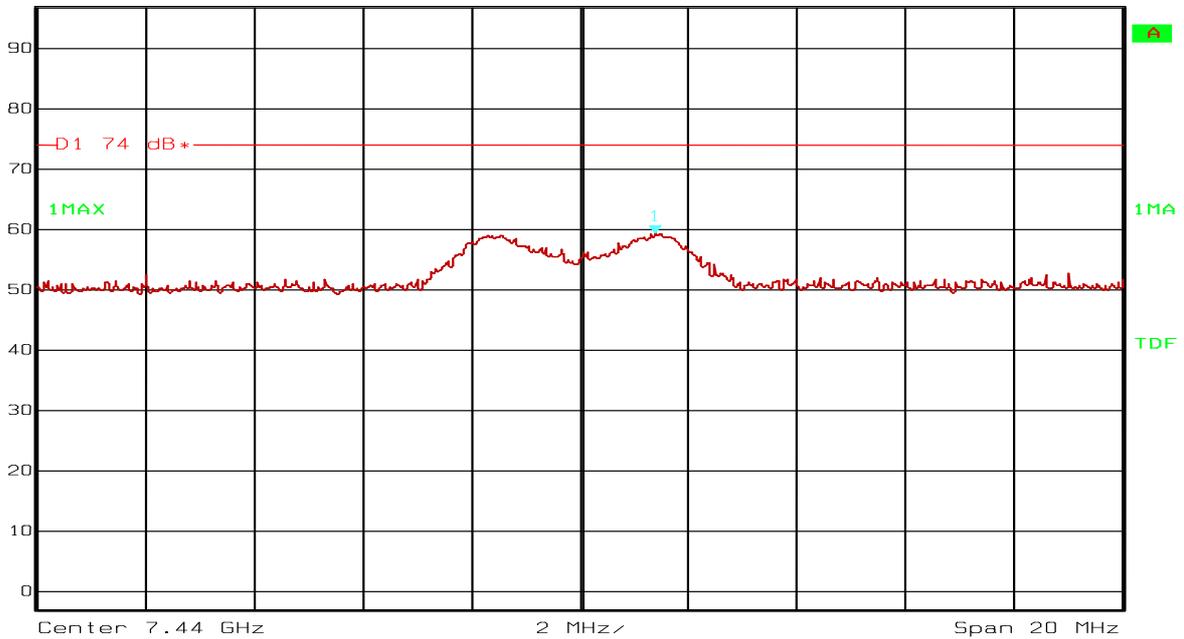
Marker 1 [T1]
 Ref Lvl 97 dB* 53.79 dB μ V/m RBW 1 MHz RF Att 0 dB
 4.88093186 GHz VBW 1 MHz Unit dB μ V/m
 SWT 5 ms



Date: 24.AUG.2009 9:13:31

Radiated Emissions, 4.88 GHz, HP

Marker 1 [T1]
 Ref Lvl 97 dB* 59.26 dB μ V/m RBW 1 MHz RF Att 0 dB
 7.44138277 GHz VBW 1 MHz Unit dB μ V/m
 SWT 5 ms



Date: 25.AUG.2009 12:18:35

Radiated Emissions, 7.44 GHz, HP

Duty Cycle Calculation:

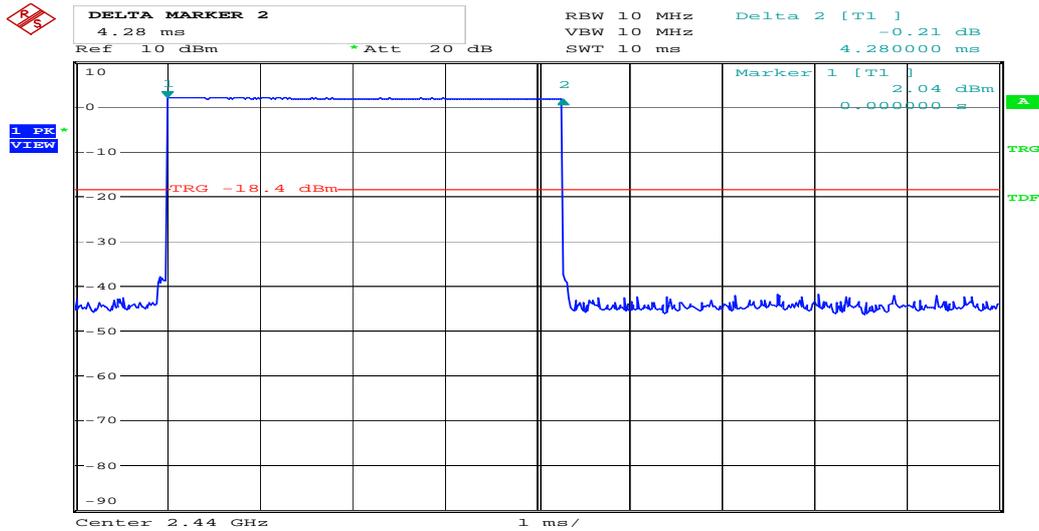
See also Para 4.4 Occupancy Time.

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

$$-20 \log (4.28\text{ms} / (15 \times 20.94\text{ms})) = 37.3 \text{ dB}$$

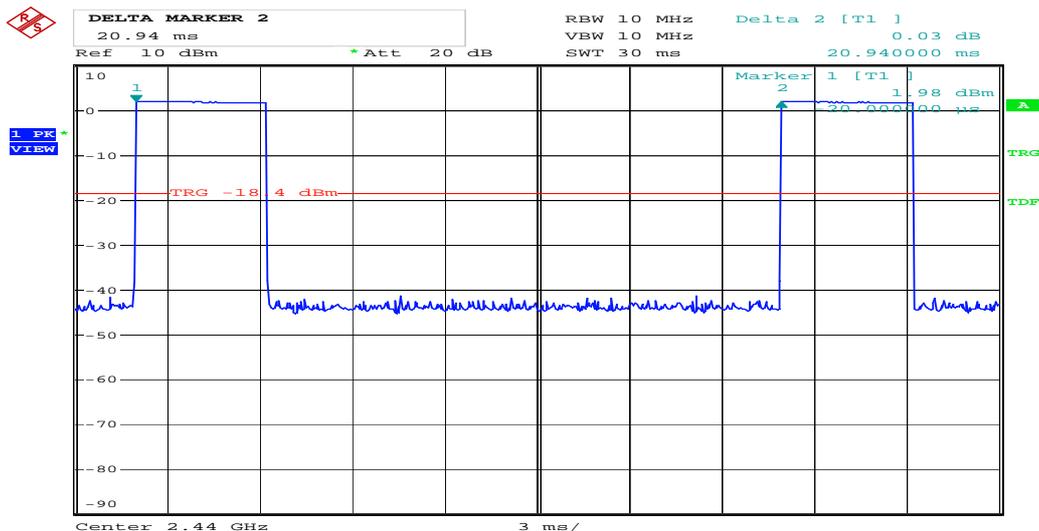
Maximum duty cycle according to Para 15.35 (b): **20 dB**

This value is used when calculating average field strength above 1 GHz from measurement performed with Peak Detector. The calculation takes into account that the EUT is using frequency hopping and transmits equally on all 15 channels.



Date: 24.AUG.2009 13:10:47

Transmit Period



Date: 24.AUG.2009 13:09:42

Period length

4.5 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: Frode Sveinsen	Date of Test: 24/25 Aug 2009
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Test Results: Passed

Measured and Calculated Data:

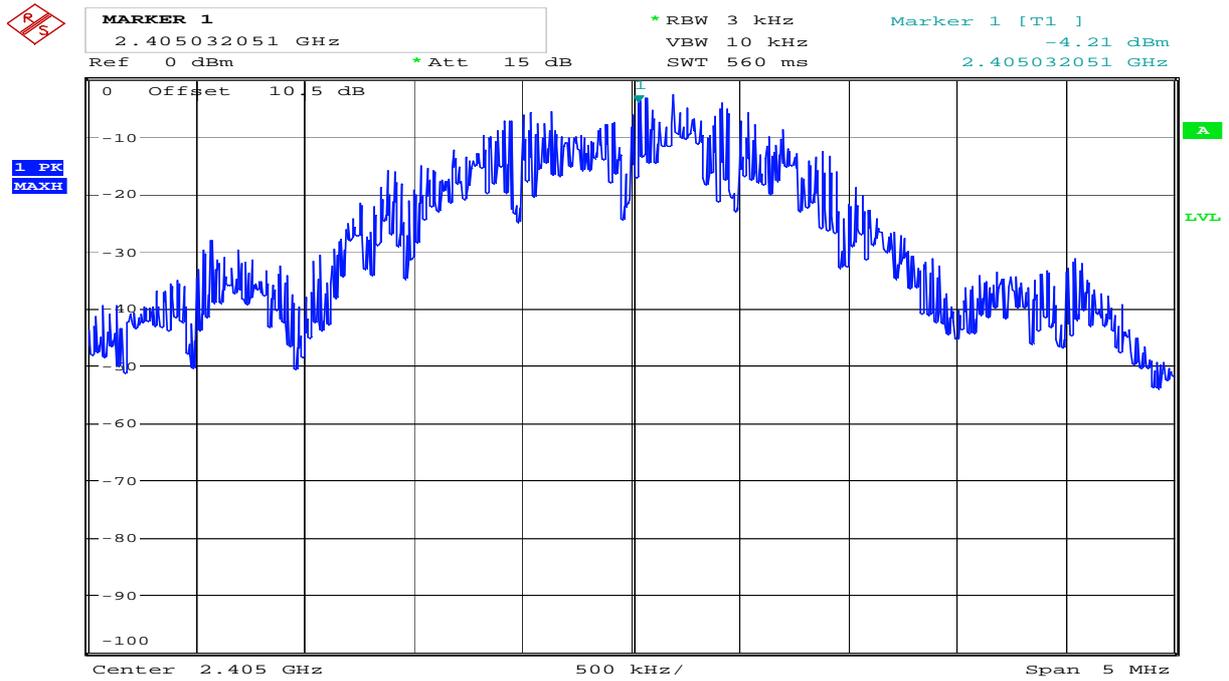
PSD Option 1 as described in "Measurement of Digital Transmission Systems Operating under Section 15.247, March 23, 2005" is used.

RF Channel	2405 MHz	2440 MHz	2480 MHz
Measured PSD	-2.4 dBm	-2.8 dBm	-3.9 dBm

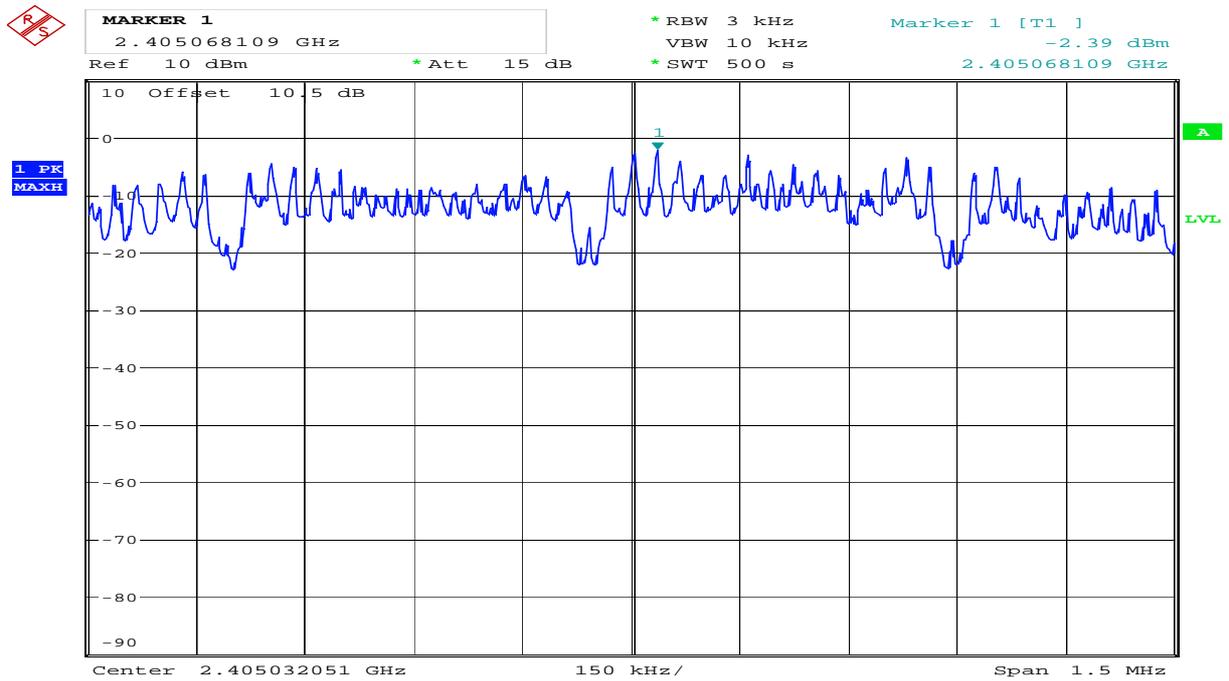
Requirements:

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

No requirements for Frequency Hopping Systems.



Date: 24.AUG.2009 16:13:30



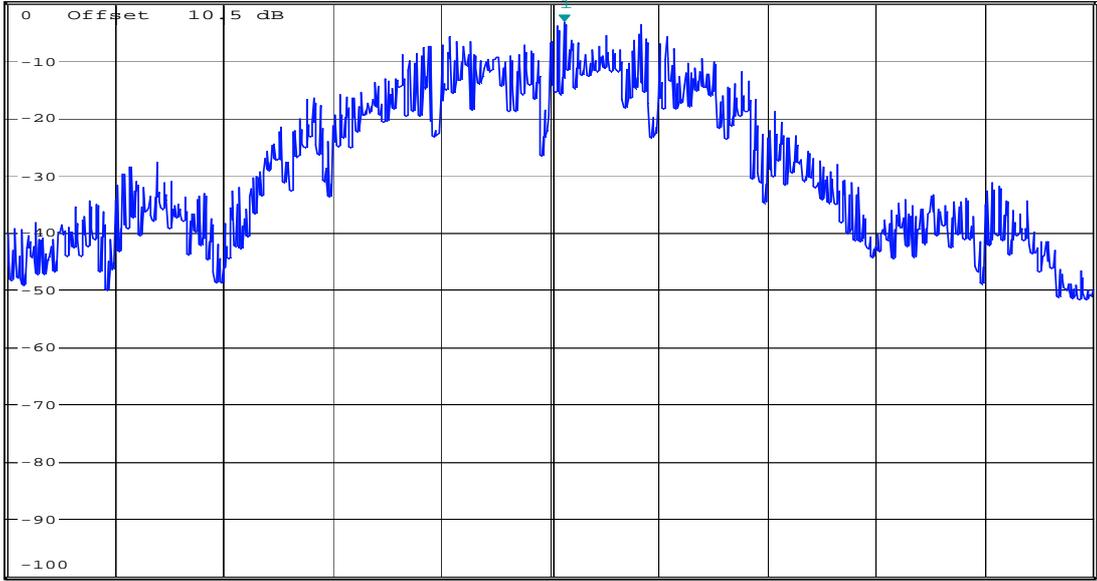
Date: 24.AUG.2009 16:32:15

Power Spectral Density, 2405 MHz



MARKER 1
 2.440064103 GHz
 Ref 0 dBm * Att 15 dB * RBW 3 kHz
 VBW 10 kHz Marker 1 [T1]
 SWT 560 ms -3.56 dBm
 2.440064103 GHz

1 PK
 MAXH



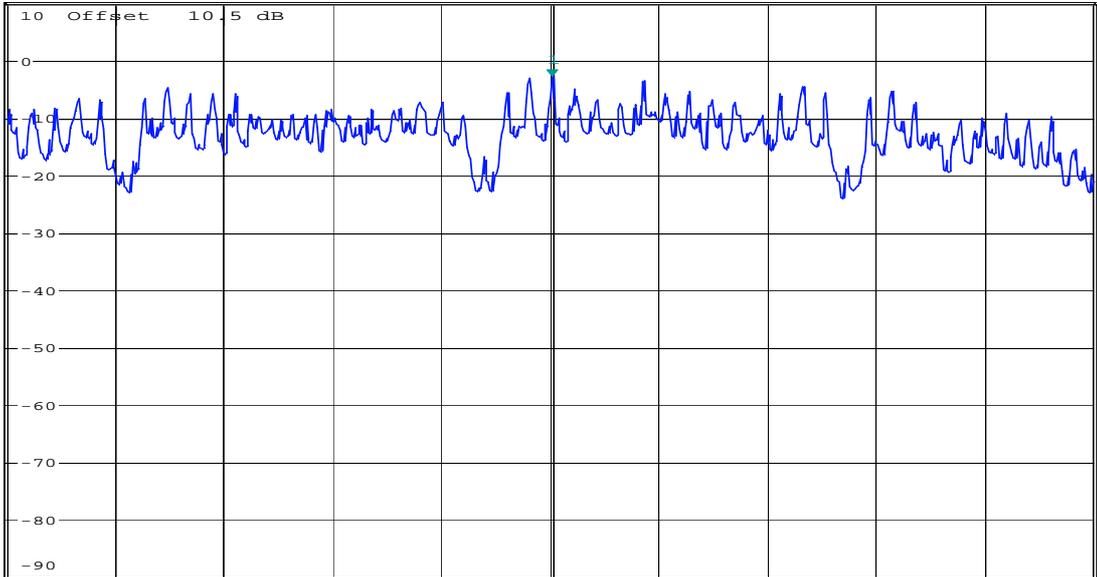
Center 2.44 GHz 500 kHz/ Span 5 MHz

Date: 24.AUG.2009 16:46:38



MARKER 1
 2.440066507 GHz
 Ref 10 dBm * Att 15 dB * RBW 3 kHz
 VBW 10 kHz Marker 1 [T1]
 SWT 500 s -2.84 dBm
 2.440066507 GHz

1 PK
 MAXH

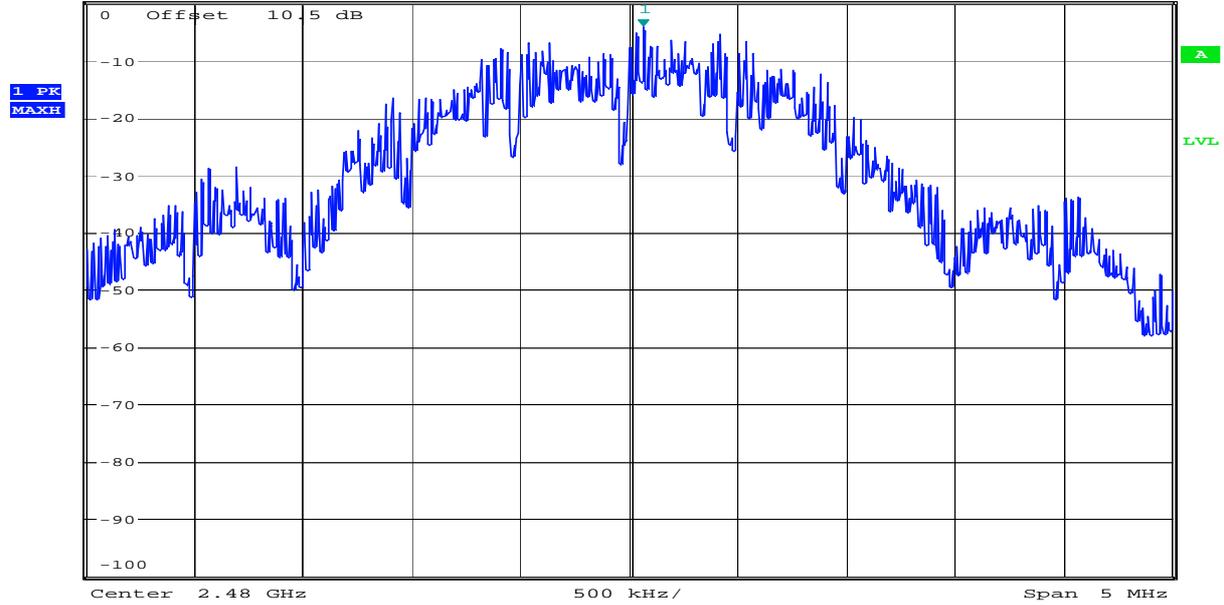


Center 2.440064103 GHz 150 kHz/ Span 1.5 MHz

Date: 24.AUG.2009 17:04:53



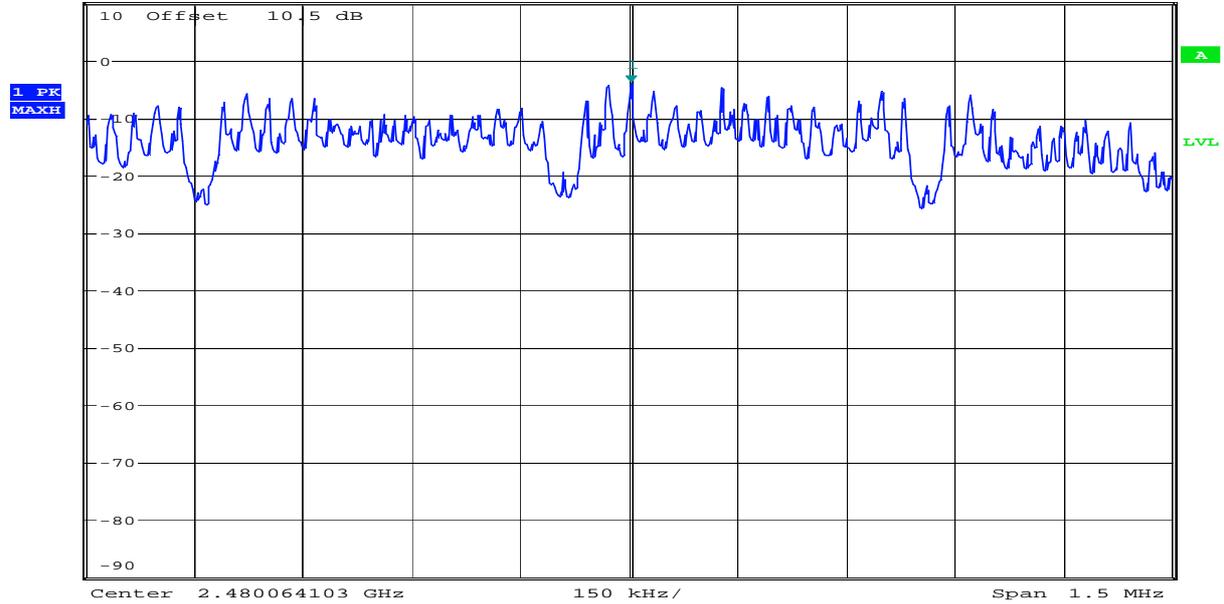
MARKER 1
 2.480064103 GHz
 Ref 0 dBm * Att 15 dB * RBW 3 kHz Marker 1 [T1]
 VBW 10 kHz -4.22 dBm
 SWT 560 ms 2.480064103 GHz



Date: 24.AUG.2009 17:15:30



MARKER 1
 2.480066506 GHz
 Ref 10 dBm * Att 15 dB * RBW 3 kHz Marker 1 [T1]
 VBW 10 kHz -3.94 dBm
 * SWT 500 s 2.480066506 GHz



Date: 24.AUG.2009 17:33:24

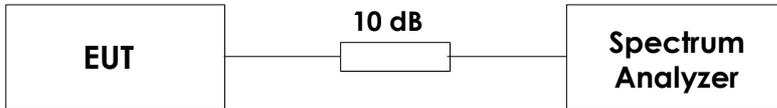
5 LIST OF TEST EQUIPMENT

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	FSU	Spectrum Analyzer	Rohde & Schwarz	LR 1504
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	6810.17B	Attenuator	Suhner	LR1212
10	8449B	Amplifier	Hewlett Packard	LR 1322
11	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285
12	HL223	Antenna log-period	Rohde & Schwarz	LR 1261
13	HK116	Antenna biconical	Rohde & Schwarz	LR 1260
14	ESN	Test Receiver	Rohde & Schwarz	LR 1237

6 Test set-ups

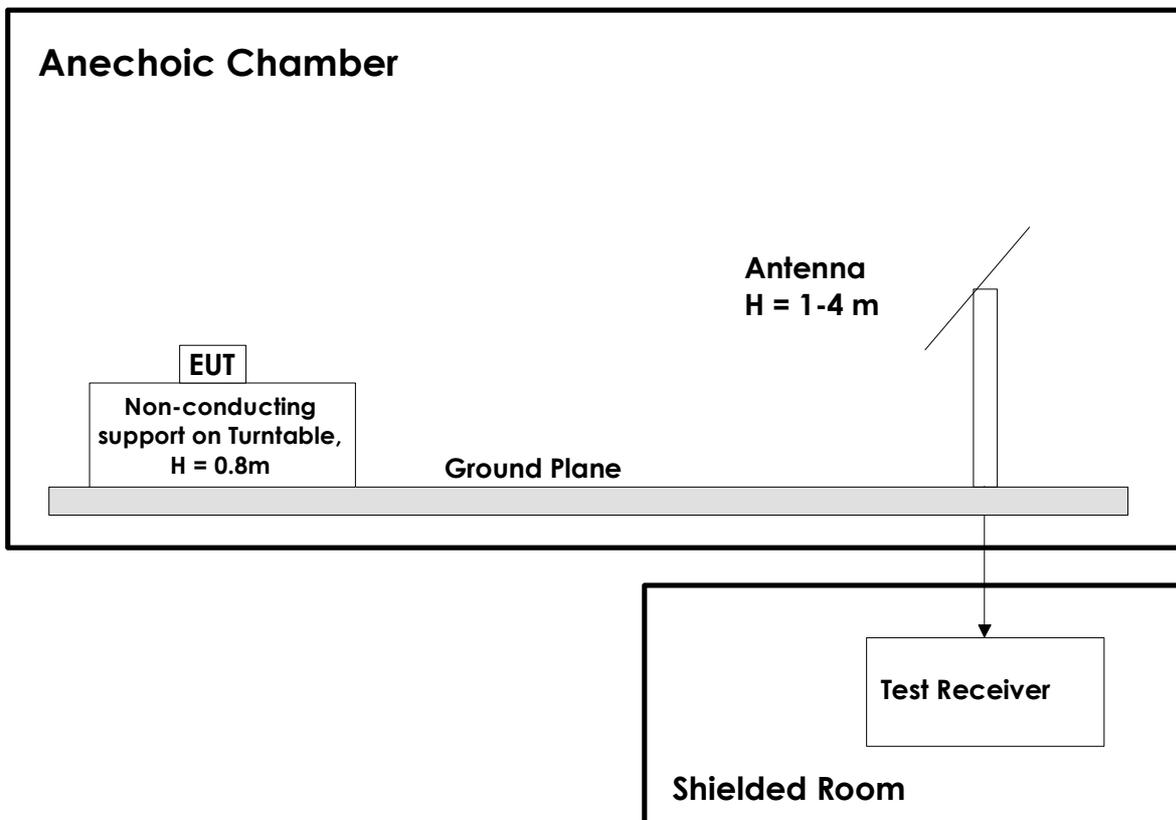
6.1 Conducted tests



Test equipment: 2, 9

This setup is used for the conducted emission tests.

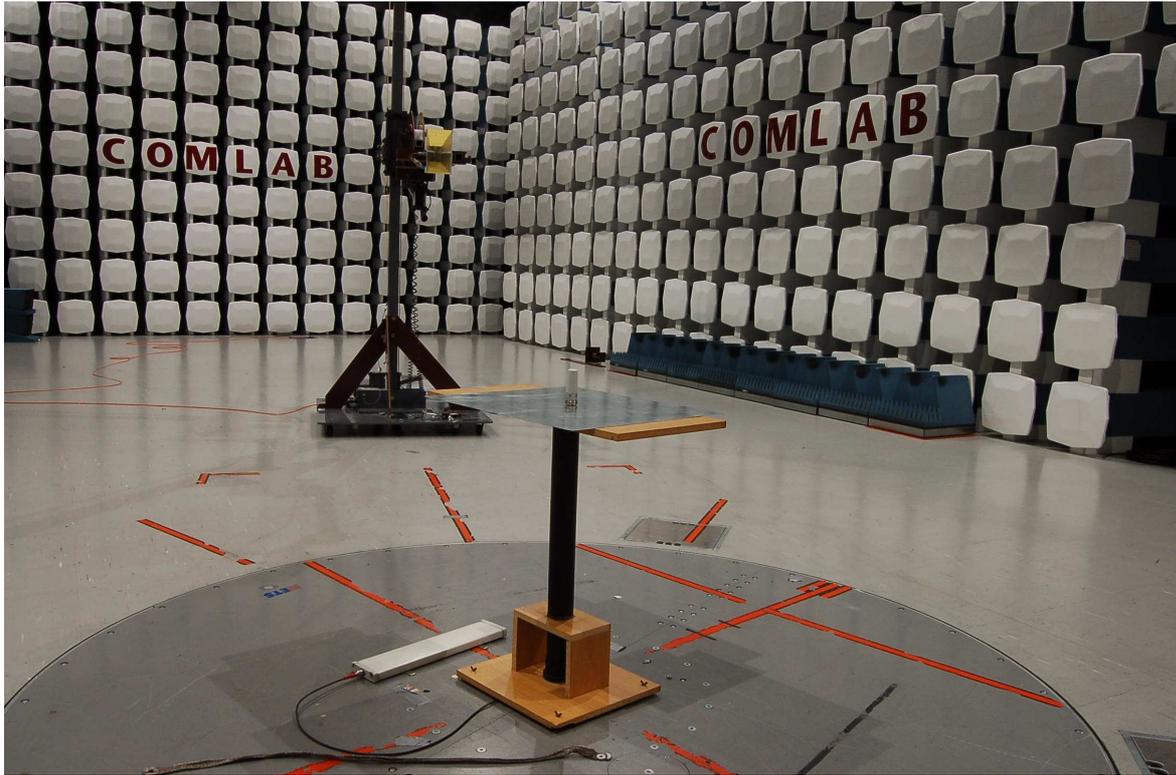
6.2 Radiated Emission



Test equipment: 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14

This test setup is used for measuring radiated output power and radiated emissions.

The measurements are performed in a 10m Semi-Anechoic Chamber with Spectrum Analyzer or Measuring Receiver.



Radiated Spurious emission