

RADIO TEST REPORT

No. 1300020-1 Ed. 2

EQUIPMENT UNDER TEST

Equipment: Wireless Communication Hub
Type / model: AH40
Manufacturer: ASSA ABLOY AB
Tested by request of: ASSA ABLOY AB

SUMMARY

The equipment complies with the requirements of the following standards:

47 CFR, Part 15, Subpart B (2012) and Subpart C (2012);

RSS-GEN, Issue 3 (Dec 2010)

RSS-210, Issue 8 (Dec 2010)

Industry Canada listed test facility No. IC 2042G-2

Date of issue: 28 February, 2013

Tested by:



Åke Carlson

Approved by:



Niklas Boström

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REVISION HISTORY

Edition	Date	Description
1	2013-02-15	First release
2	2013-02-28	Peak output power result corrected for attenuation in the set-up configuration

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: ASSA ABLOY AB
Förmansvägen 11
117 43 Stockholm
SVERIGE
Name of contact: Magnus Axelsson

2. EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment: Wireless Communication Hub
Type/Model: AH40
Brand name: ASSA ABLOY
Serial number: R MAC: 00.17.7A.01.02.02.C0.A1
Manufacturer: ASSA ABLOY AB
Rating/Supplying voltage: 12 V
Rating RF output power: 13.5 dBm (measured)
Operating temperature range: 5 to 35 °C
Frequency range: 2405 – 2475 MHz
Number of channels 15

2.2 Modifications during the test

The EUT was modified with software that made it possible to step between different TX-modes. It was possible to set the EUT to modulated carriers for the transmitting channels. The unit could also be set for RX tests.

For some of the tests the antenna was replaced by an SMA connector.

3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2012) Subpart B – Unintentional radiators

FCC 47 CFR part 15 (2012) Subpart C – Intentional Radiators; §15.247 Operation within the bands 902-928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz.

Measurements methods according to ANSI C63.4-2009 - Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Measurements methods according to ANSI C63.4-2009 - Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz and ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices

RSS-Gen, Issue 3 (Dec 2010): General Requirements and Information for the Certification of Radiocommunication Equipment

RSS-210, Issue 8 (Dec 2010): Low Power Licence-Exempt Radio communication Devices (All Frequency Bands): Category I Equipment.

3.2 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standards.

3.3 Test set-up

Measurement set-ups for the test of out-of-band spurious emissions test are described in corresponding sections. During other tests the EUT was connected to the spectrum analyzer by cable.

3.4 Operating environment

If not additionally specified, the tests were performed under the following environmental conditions:

Air temperature: 20-25 °C
Relative humidity: 25-40 %

4. TEST PLAN

The results in this report apply only to the sample tested.

FCC reference	IC reference	Test	Result	Note
15.247(b)	RSS-210 A8.4 (4)	Peak output power	PASS	
15.247(a)	RSS-210 A8.2 (a)	6 dB Bandwidth	PASS	
15.247(a)	RSS-210 A8.2 (b)	Spectral power density	PASS	
15.247(d)	RSS-210 A8.5	Band edge compliance	PASS	
15.247(d)	RSS-210 A8.5	Out of band spurious emissions, radiated	PASS	
15.247(d)	RSS-210 A8.5	Out of band spurious emissions, conducted	PASS	
15B	RSS-Gen Table 5	Out of band spurious emissions, radiated	PASS	
15B	RSS-Gen Table 4	Conducted emission at AC port	N/A	
	RSS-GEN 4.6.1	Occupied Bandwidth	PASS	

N/A = Not applicable

5. PEAK OUTPUT POWER

5.1 Test protocol

Date of test: 2013-01-23

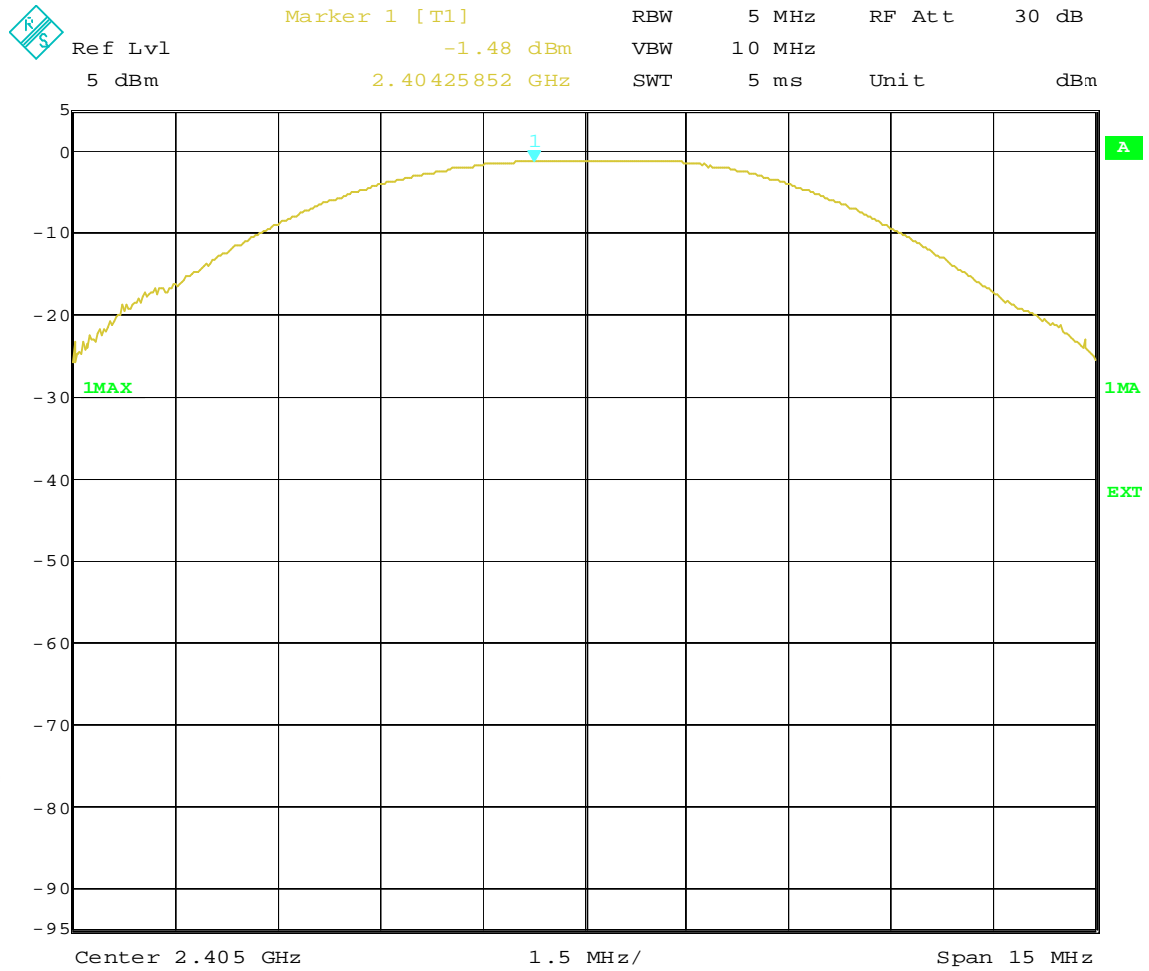
EUT mode of operation: continuous TX. Modulation on

Spectrum analyzer settings:

Span: 5 MHz
RBW: 5 MHz
VBW: 10 MHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Channel (MHz)	Peak Output Power (dBm)	Plot	Limit value (dBm)
2405	8.92	plot P5.1.	30
2440	8.82	plot P5.2	
2480	8.82	plot P5.3	

Plot P5.1



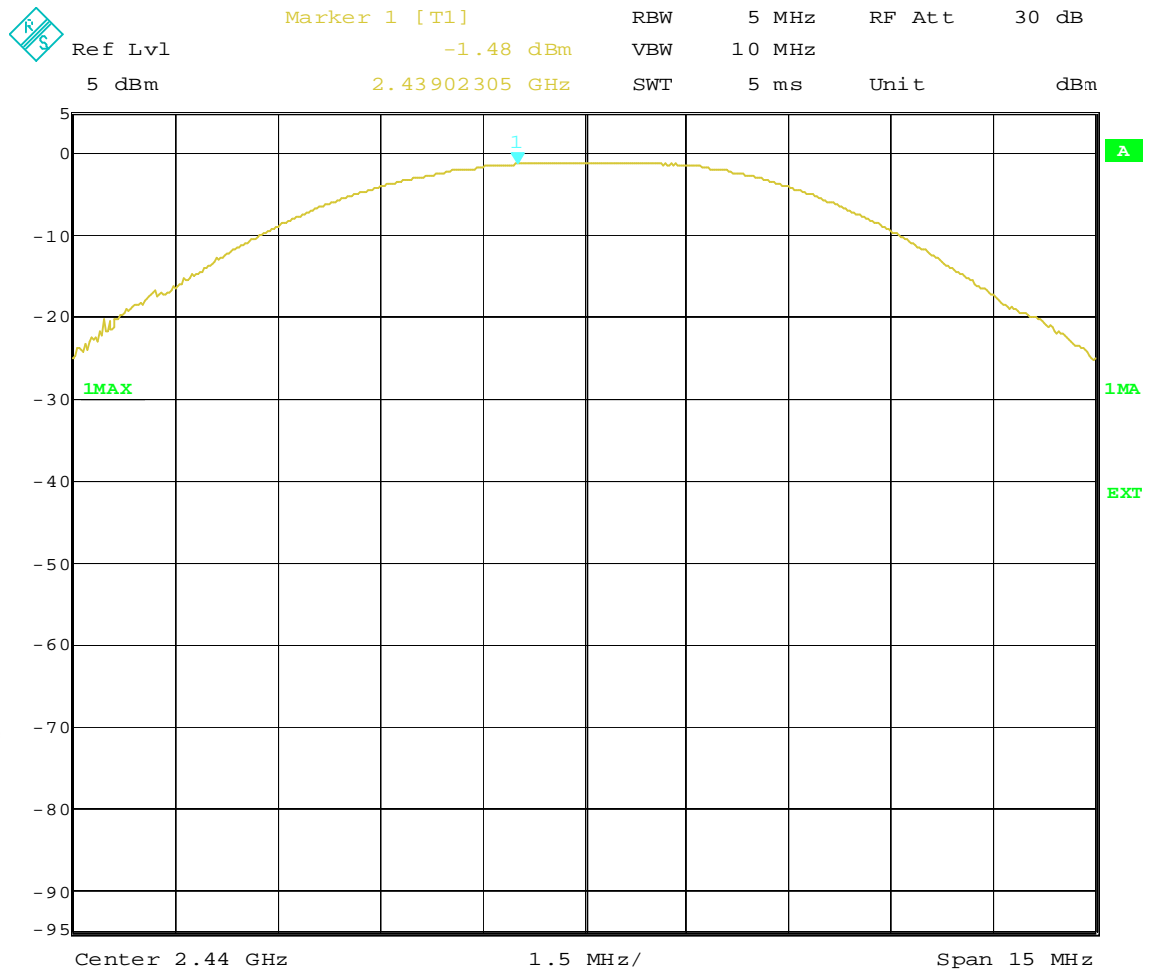
Date: 23.JAN.2013 14:07:11

Measurement results are corrected for attenuation in the set-up configuration.

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] = -1.48 + 10.4 = 8.92 dBm

Plot P5.2



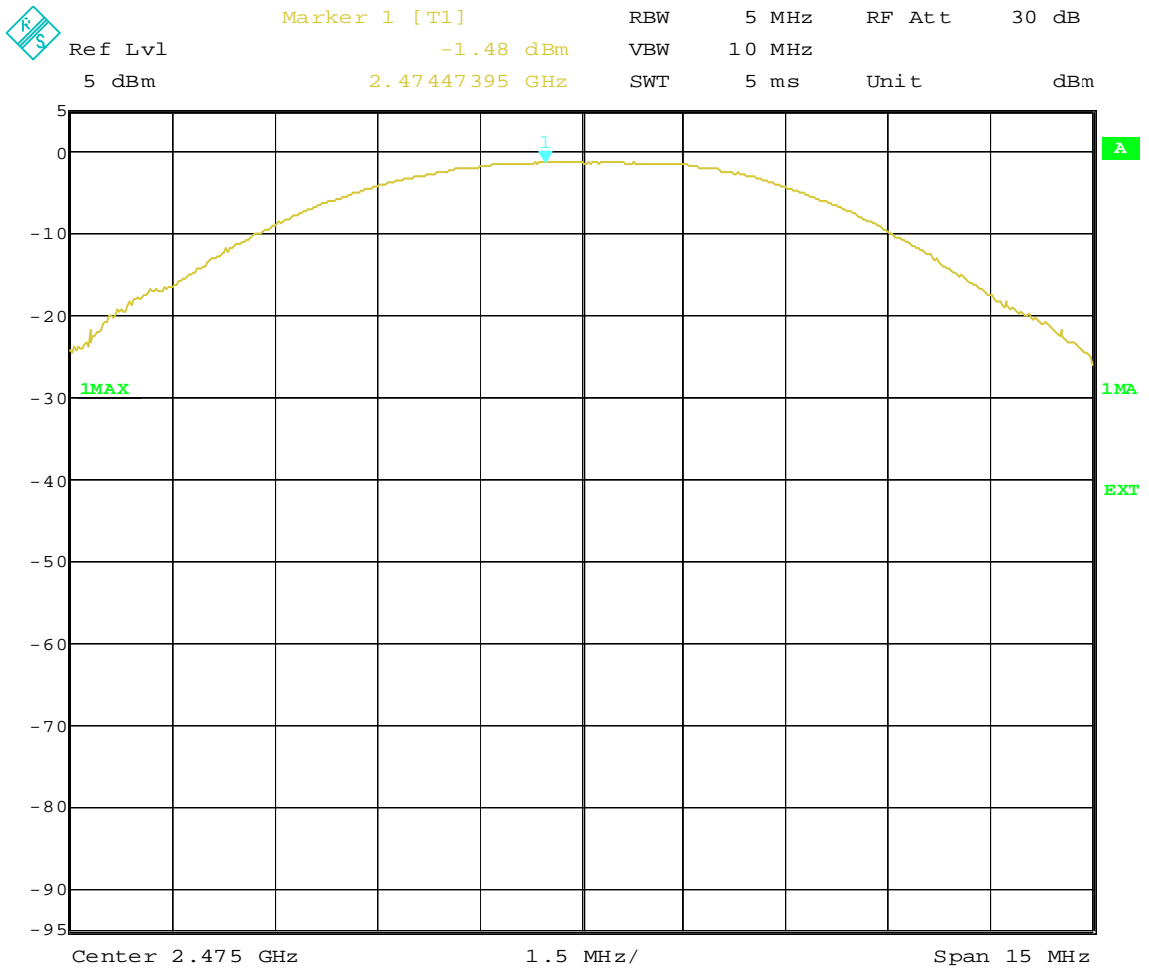
Date: 23.JAN.2013 14:14:39

Measurement results are corrected for attenuation in the set-up configuration.

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] = -1.48 + 10.3 = 8.82 dBm

Plot P5.3



Date: 23.JAN.2013 14:18:33

Measurement results are corrected for attenuation in the set-up configuration.

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] = -1.48 + 10.3 = 8.82 dBm

6. 6 dB BANDWIDTH

6.1 Test protocol

Date of test: 2013-01-24

EUT mode of operation: continuous TX. Modulation on

Spectrum analyzer settings:

Span: 6.25 MHz
RBW: 100 kHz
VBW: 100 kHz
Sweep time: 5 ms
Detector: Peak
Trace: Max Hold

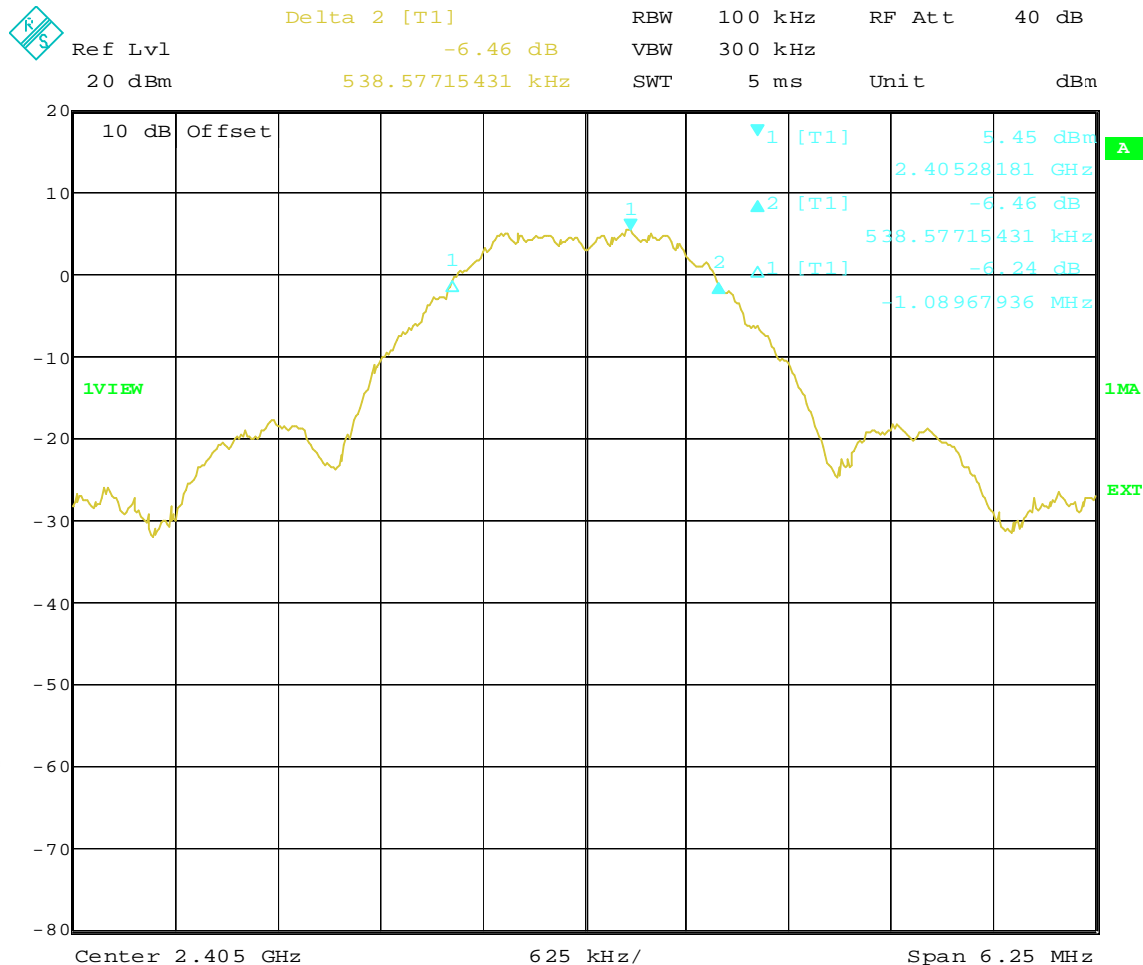
Channel (MHz)	6 dB Bandwidth (MHz)	Plot	Limit value (MHz)
Low	1.63	plot P6.1	> 0.5
Mid	1.59	plot P6.2	
High	1.67	plot P6.3	

Measurement results are corrected for attenuation in the set-up configuration and antenna gain declared by the manufacturer.

Example calculation:

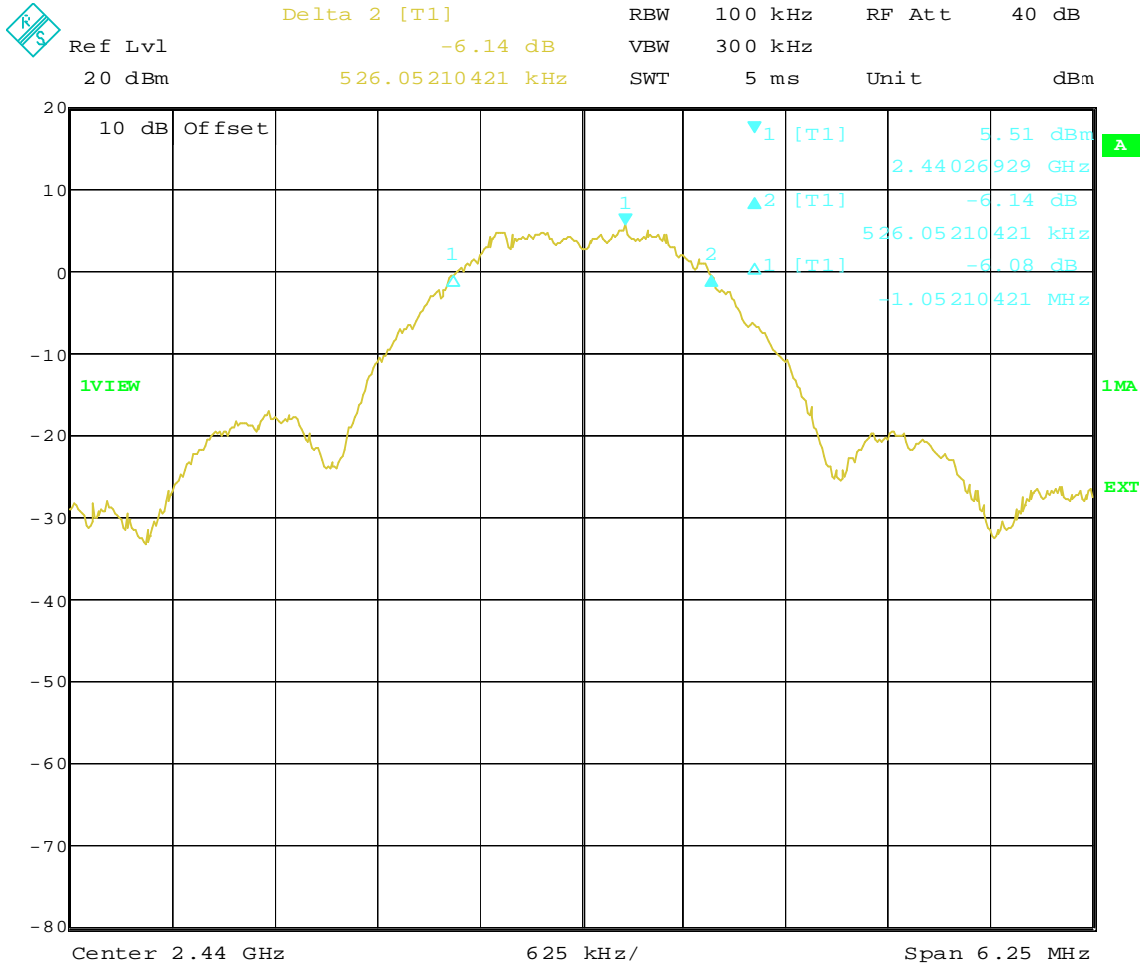
Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] + EUT antenna gain [dBi]

Plot P6.1



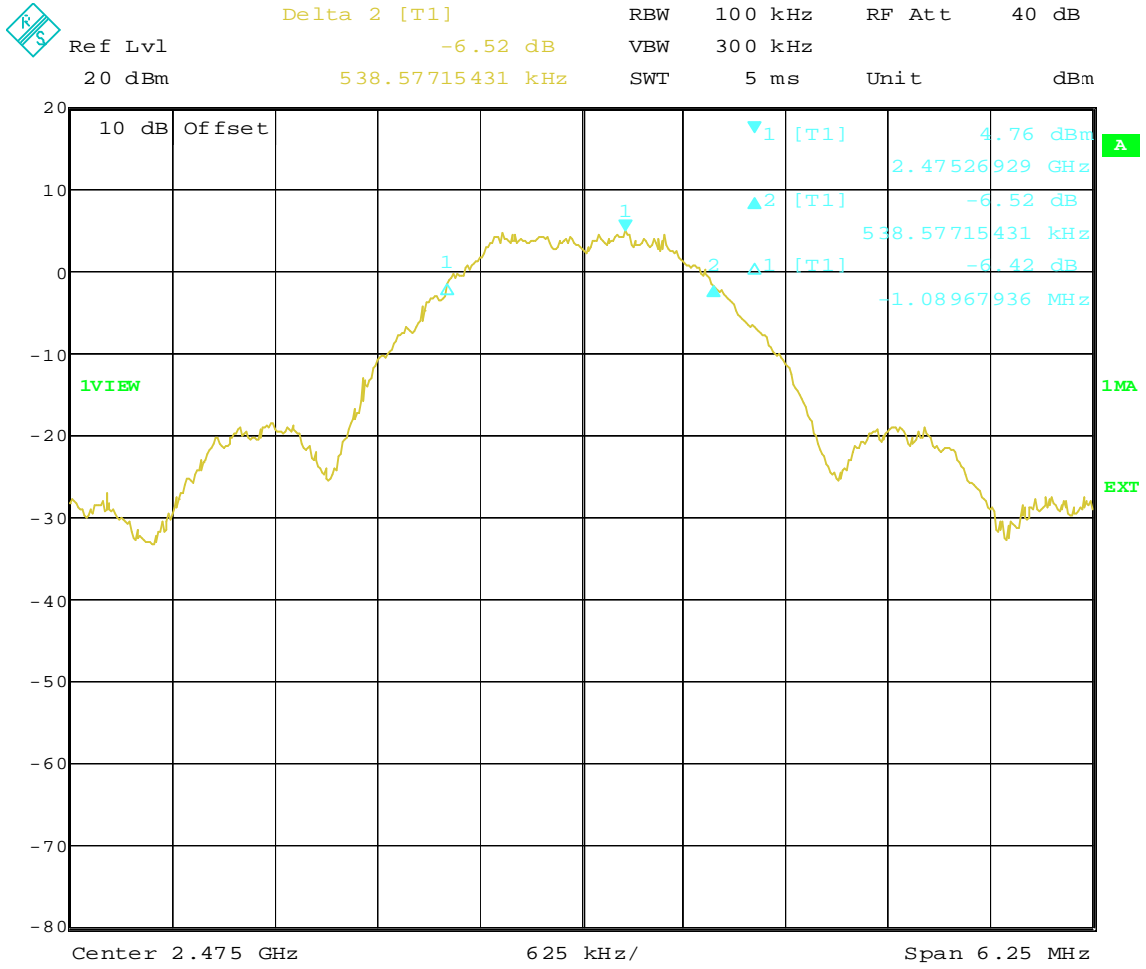
Date: 24.JAN.2013 14:23:10

Plot P6.2



Date: 24.JAN.2013 14:27:59

Plot P6.3



Date: 24.JAN.2013 14:34:35

7. SPECTRAL POWER DENSITY

7.1 Test protocol

Date of test: 2013-01-24

EUT mode of operation: continuous TX. Modulation on

Spectrum analyzer settings:

Span: 3 MHz

RBW: 3 kHz

VBW: 10 kHz

Sweep time: 1000 s

Detector: Peak

Trace: Max Hold

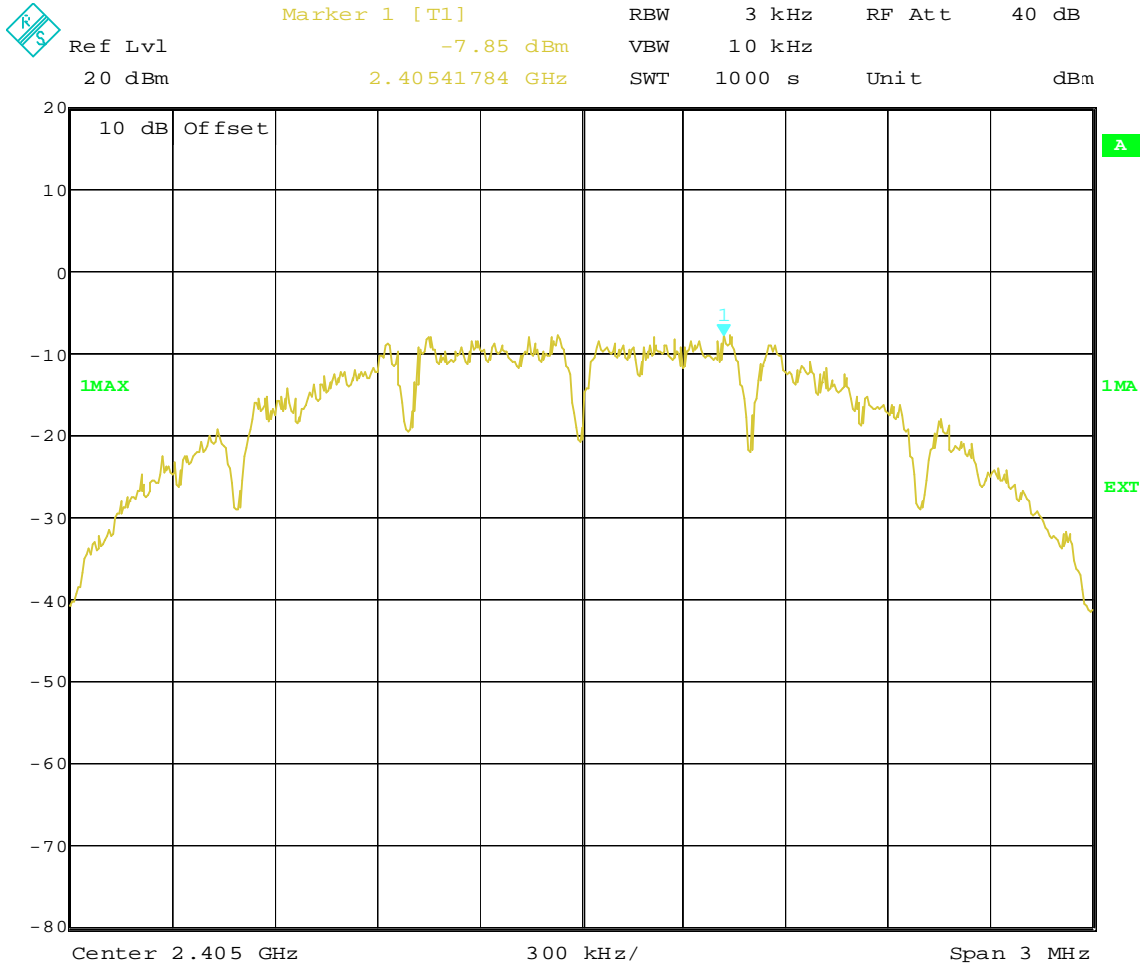
Channel	Power spectral density (dBm)	Plot	Limit value (dBm)
Low	-7.85	plot P7.1	8
Mid	-7.79	plot P7.2	8
High	-7,76	plot P7.3	8

Measurement results are corrected for attenuation in the set-up configuration and antenna gain declared by the manufacturer.

Example calculation:

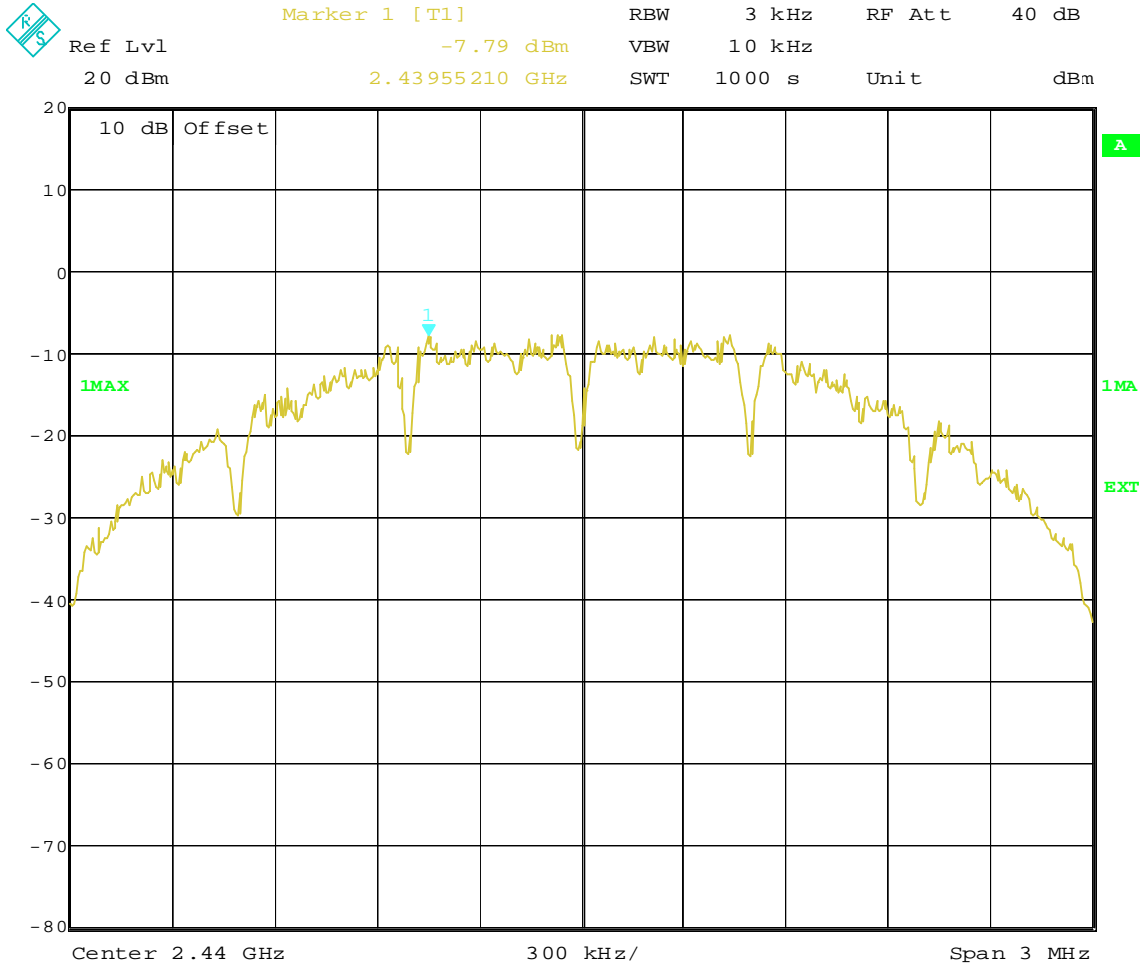
Power spectral density [dBm] = Analyser reading [dBm] + cable loss [dB] + EUT antenna gain [dBi]

PlotP7.1



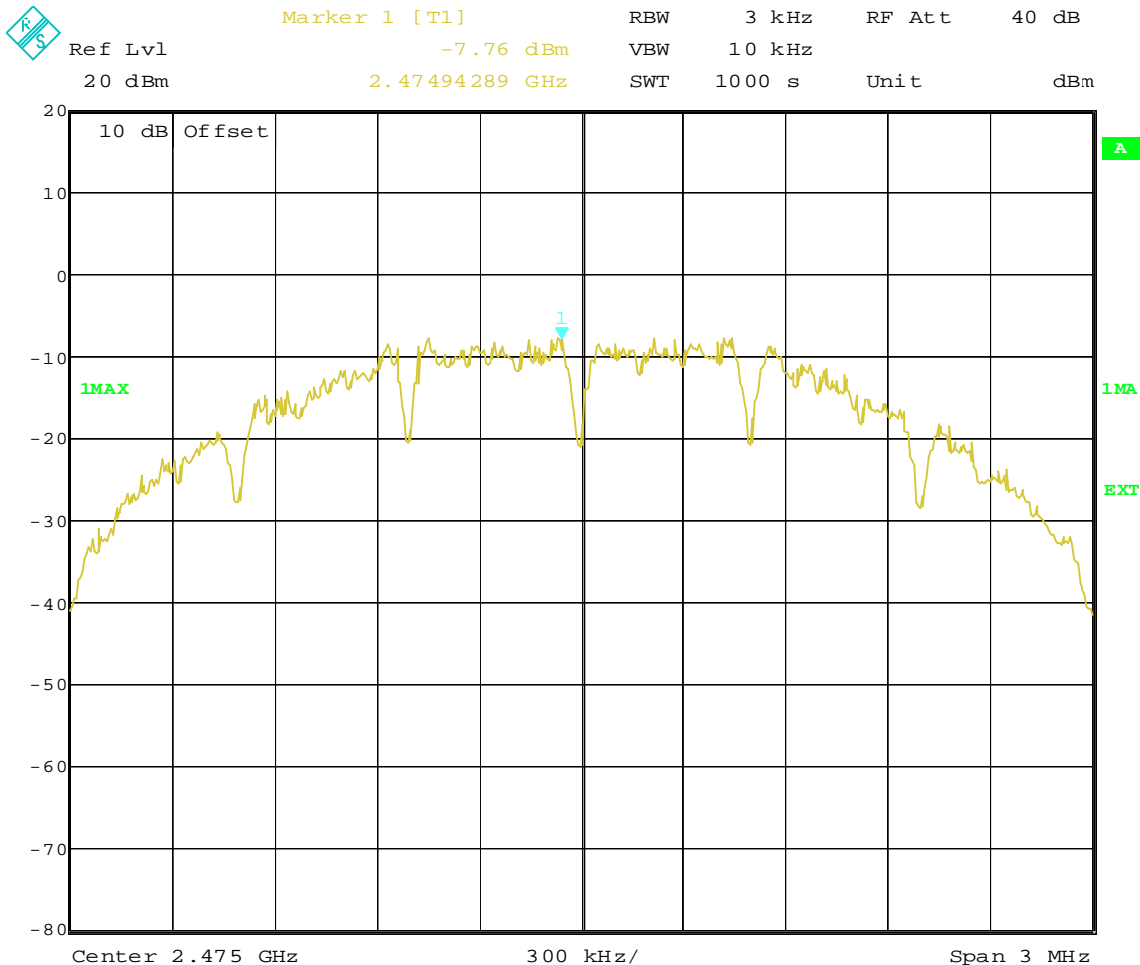
Date: 24.JAN.2013 15:54:46

Plot P7.2



Date: 24.JAN.2013 16:12:47

Plot P7.3



Date: 24.JAN.2013 17:27:42

8. BAND EDGE COMPLIANCE

8.1 Test protocol

Date of test: 2013-01-24

EUT mode of operation: continuous TX. Modulation on

Spectrum analyzer settings:

Span: 80 MHz
 RBW: 100 kHz
 VBW: 300 kHz
 Sweep time: Auto
 Detector: Peak
 Trace: Max Hold

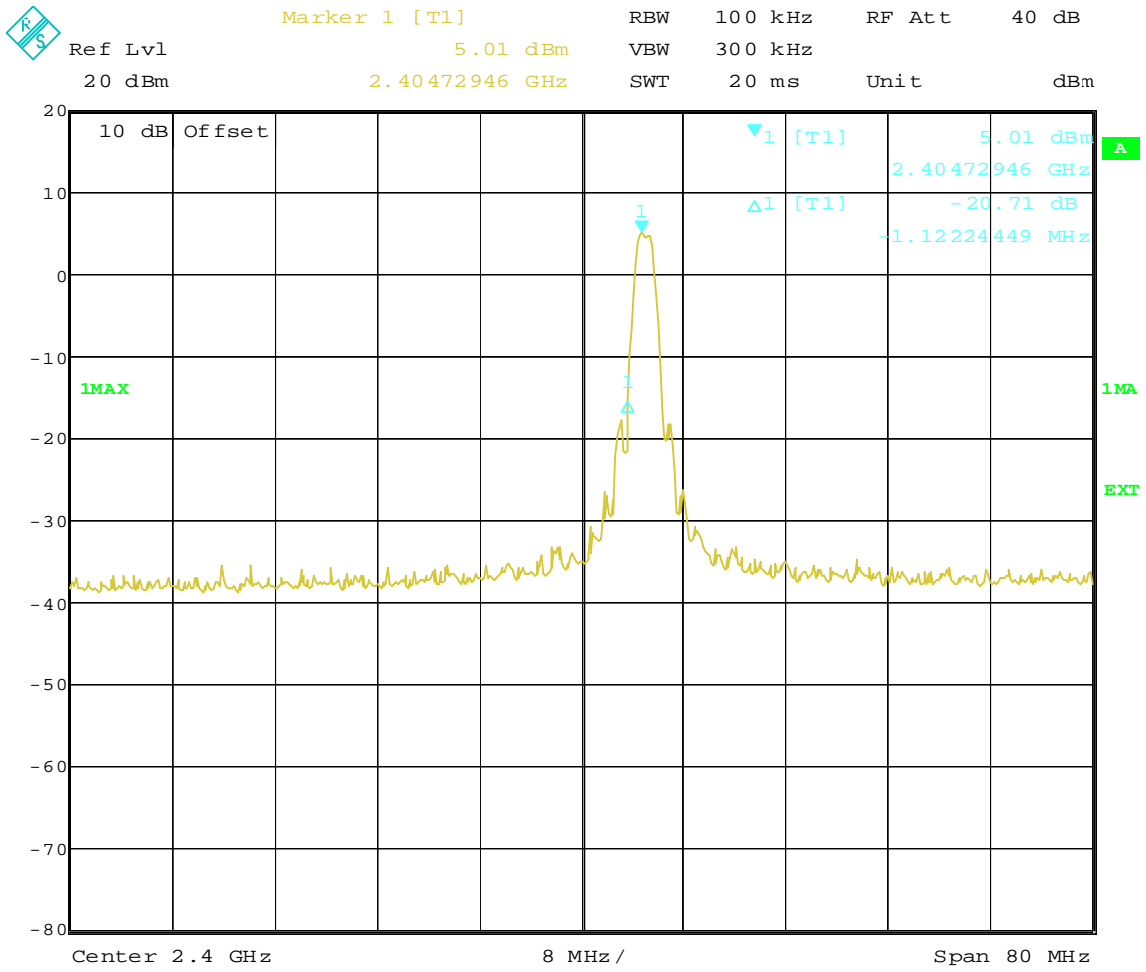
Channel	Plot	Results	Limit value (dBc)
Low	plot P8.1	PASS	20
High	Band 2483.5 – 2485.5 ; Peak: ≤ 62.7 dB(μ V/m) AV: ≤ 44.7 dB(μ V/m) Note 1	PASS	Peak: 74.0 dB(μ V/m) AV: 54 dB(μ V/m)

Note 1

Measured according to ANSI C63.10-2010 paragraph 6.9.3.

- a) Measured output level = 108.7 dB μ V/m
- b) Δ = 46 dB
- c) Peak level = measured output level – Δ , (108.7 – 46.0 = 62.7 dB μ V/m)

Plot P8.1



Date: 29.JAN.2013 12:21:32

9. RADIATED SPURIOUS EMISSIONS

9.1 Operating environment

Temperature: 20-25 °C (10 – 40 °C)

Relative Humidity: 25-40 % (10 - 90 %)

9.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: $\pm 4,6$ dB

Radiated disturbance electric field intensity, 1000 – 26000 MHz: $\pm 6,0$ dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.

The measurement uncertainty is given with a confidence of 95%.

9.3 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
<i>Test site: Semi-anechoic shielded chamber</i>			30300
Software:	Rohde & Schwarz	EMC 32	
Measurement receiver:	Rohde & Schwarz	ESU 8	12866
Antenna, bilog:	Chase	CBL6111B	12474
<i>Test site: Radio anechoic shielded chamber</i>			12285
Software:	Rohde & Schwarz	ES-K1, V1.70	
Signal analyser:	Rohde & Schwarz	FSIQ 40	40023
Preamplifier:	MITEQ	AFS6/AFS44	12335
Antennas:			
Double Ridge Guide Horn:	EMCO	3115	4936
Horn antenna:	EMCO	3160-08	30099
Horn antenna:	EMCO	3160-09	30101
High pass filter	K & L	4410-X4500/18000-0	5133
Band rejection filter	K & L	6N45-2450/T 100-0/0	12389
Transformer	Tufvassons	AFM-1500 30317	

9.4 Measurement set-up

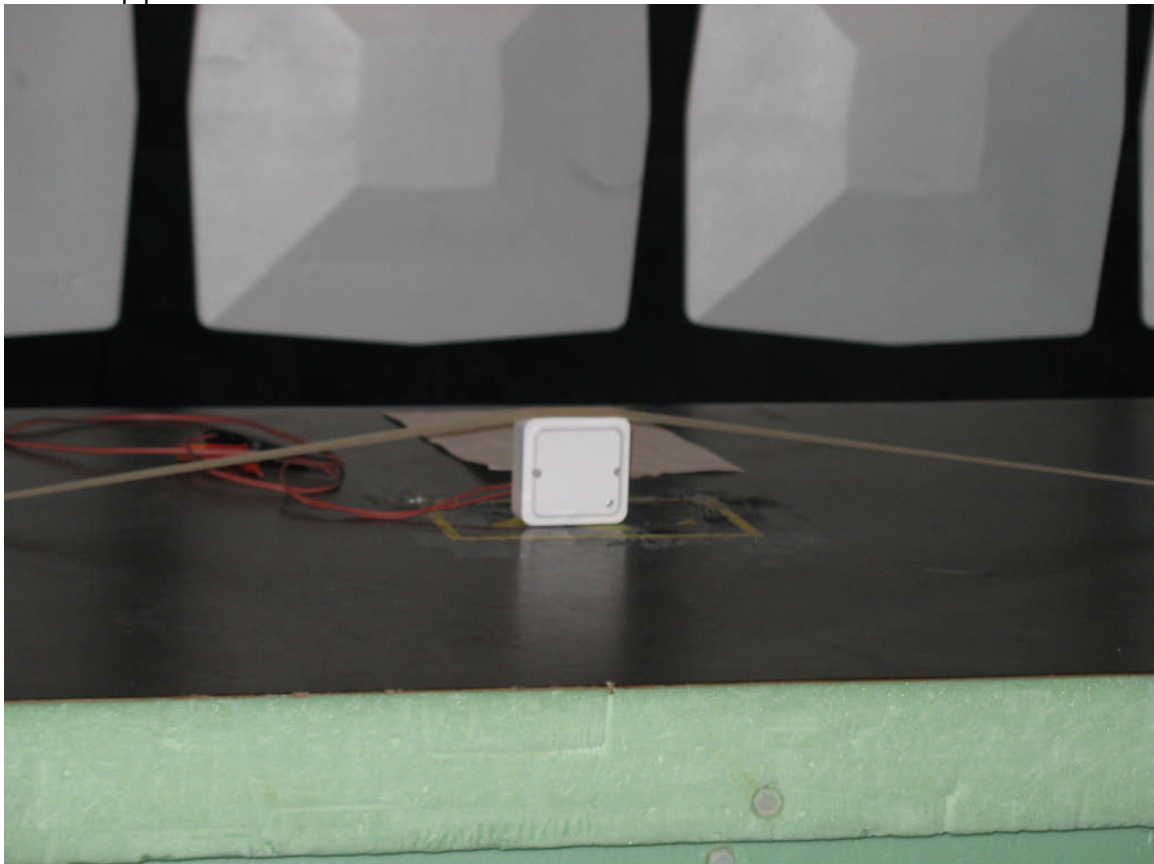
Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 3 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photo is given below.

An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements were carried out.

Test set-up photo:



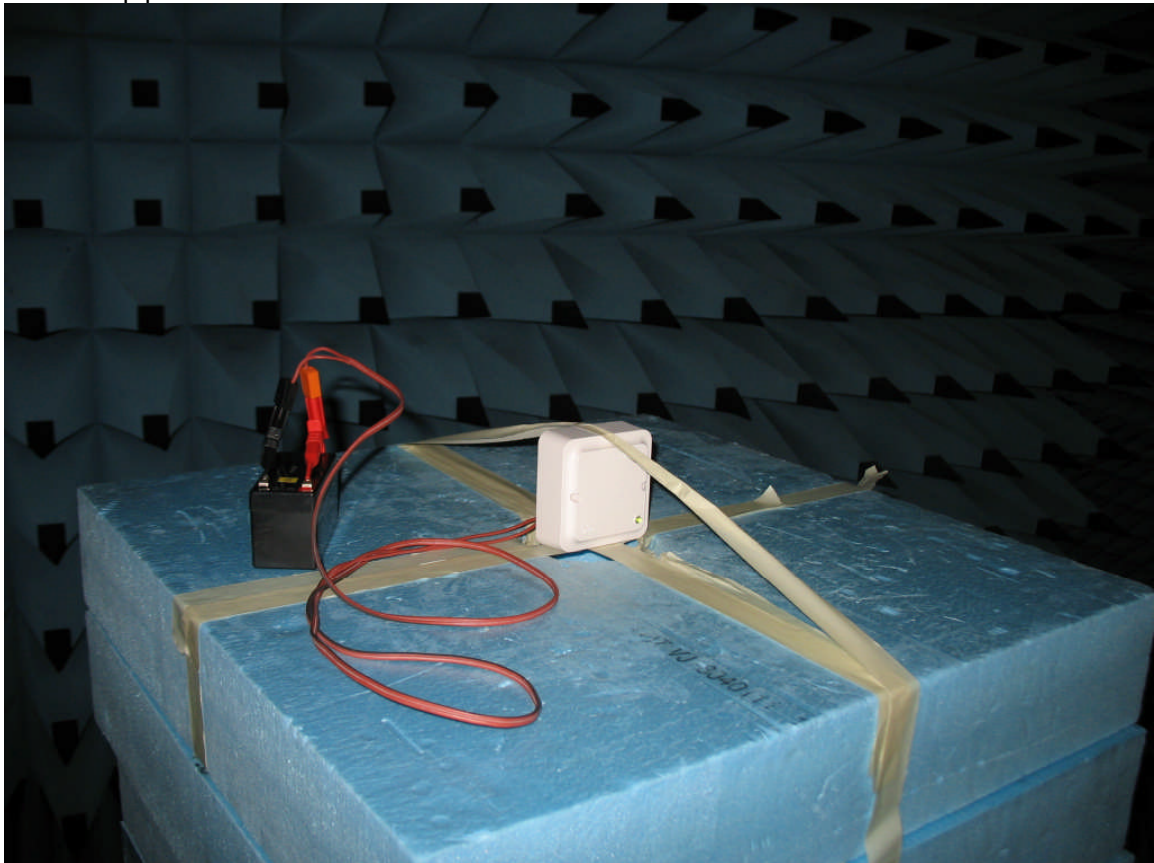
Test site: Radio anechoic shielded chamber (1 – 26 GHz)

In the Radio anechoic chamber the EUT was placed on a non-metallic table, 1,4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. The specified test mode was enabled.

An overview sweep with peak detection of the electric field intensity was performed with the spectrum analyser in max-hold and with the antenna placed 1,4 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements were carried out.

Test set-up photo:



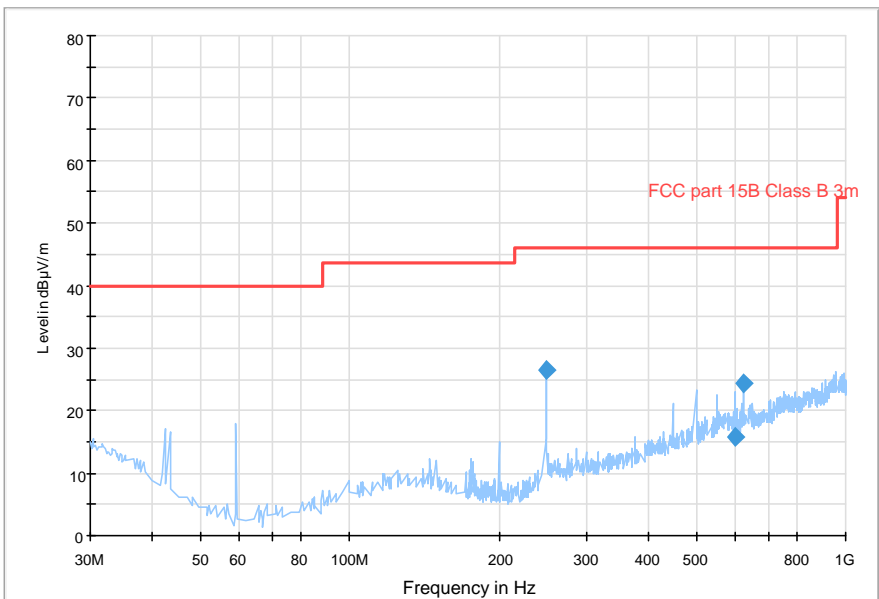
9.5 Test protocol

Semi-anechoic shielded chamber

Date of test: 2013-01-24

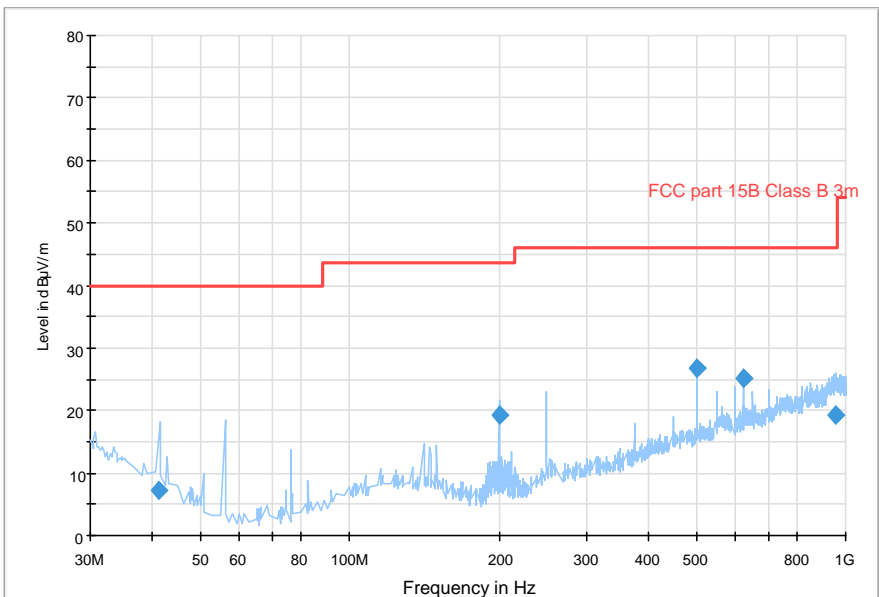
30 – 1000 MHz, max peak at a distance of 3 m on the lower TX channel

FCC 30 - 1000 MHz FCC class B 3m



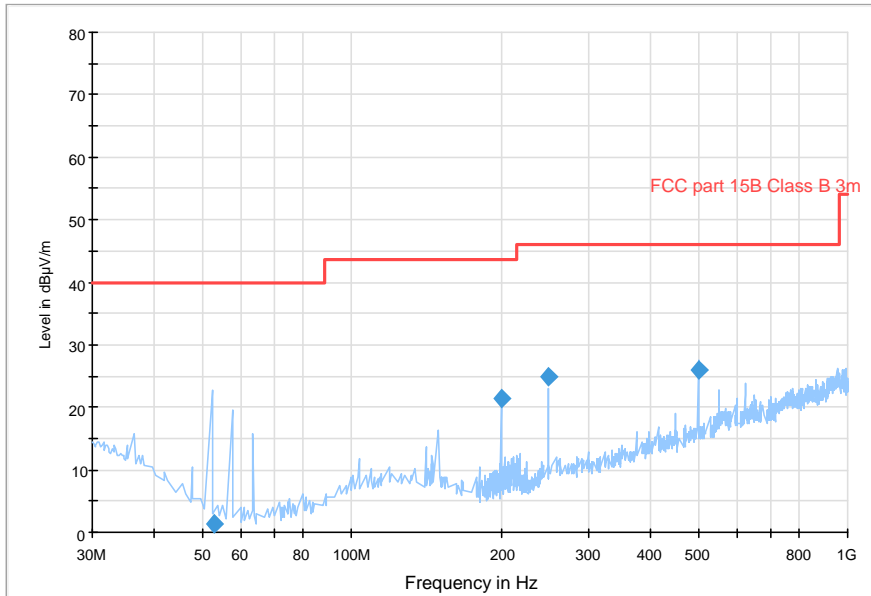
30 – 1000 MHz, max peak at a distance of 3 m on the middle TX channel

FCC 30 - 1000 MHz FCC class B 3m



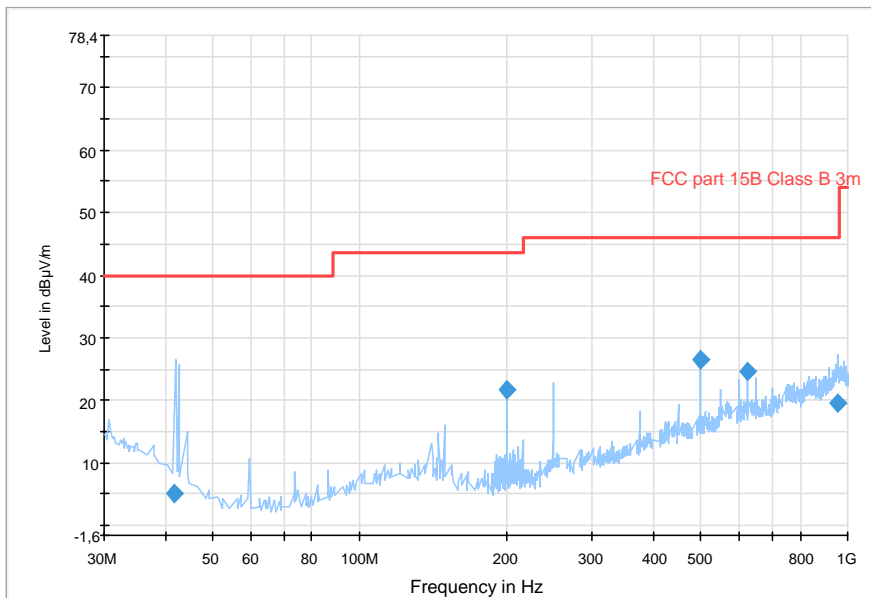
30 – 1000 MHz, max peak at a distance of 3 m on the upper TX channel

FCC 30 - 1000 MHz FCC class B 3m



30 – 1000 MHz, max peak at a distance of 3 m in the RX mode

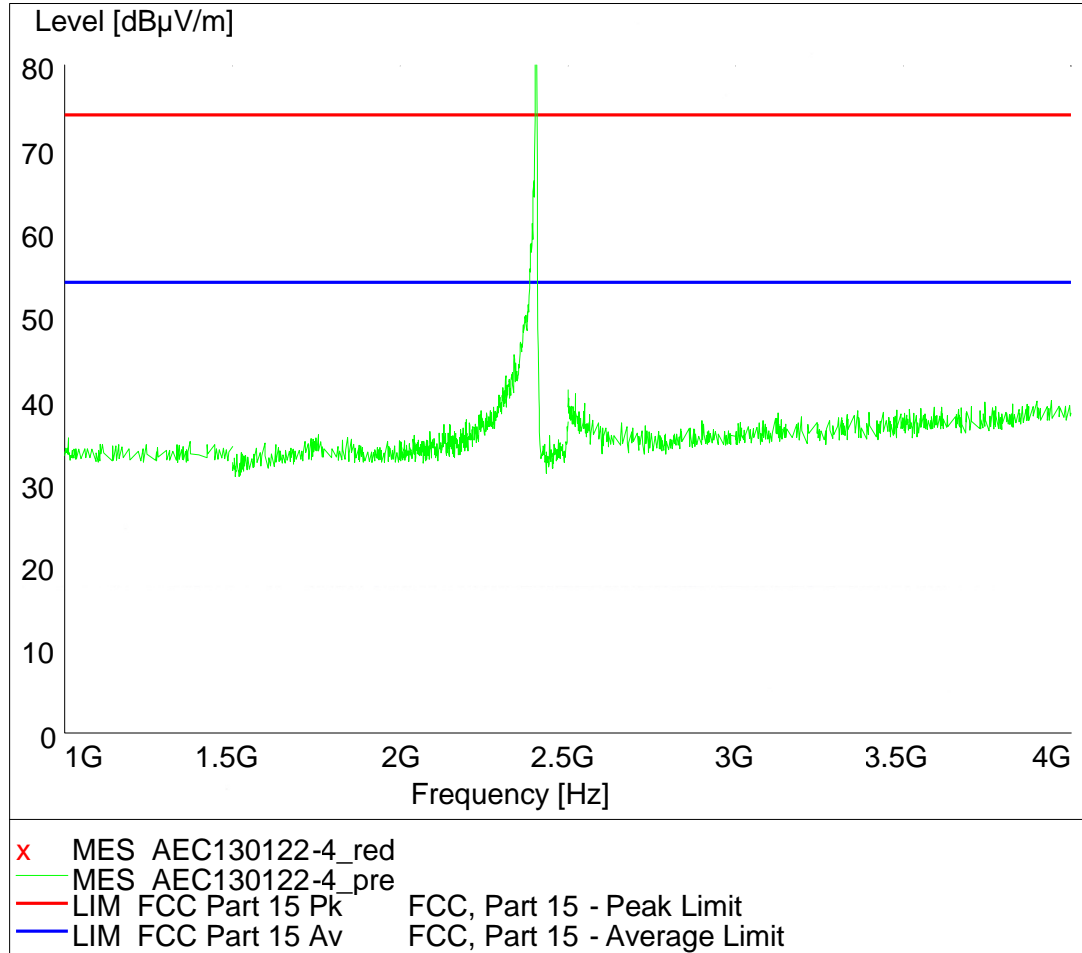
FCC 30 - 1000 MHz FCC class B 3m



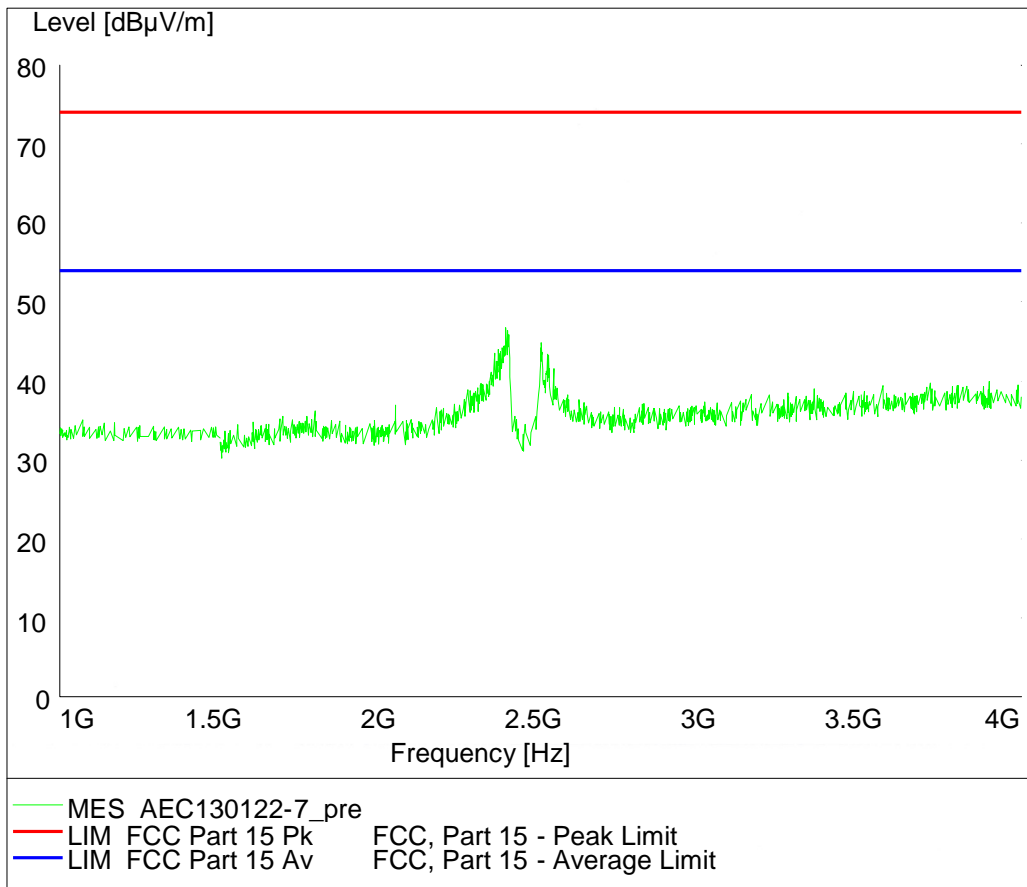
Radio anechoic shielded chamber

Date of test: 2013-01-22

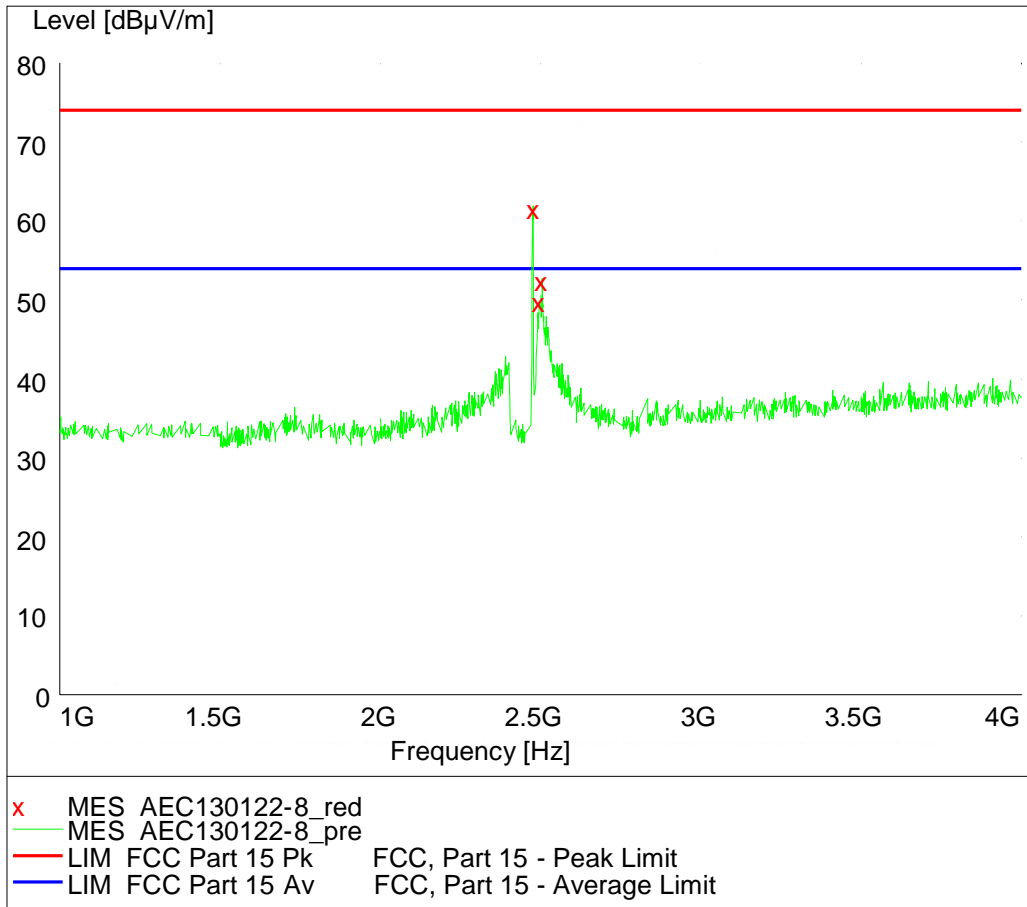
1000 – 4000 MHz, max peak at a distance of 3 m on the lower TX channel, Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



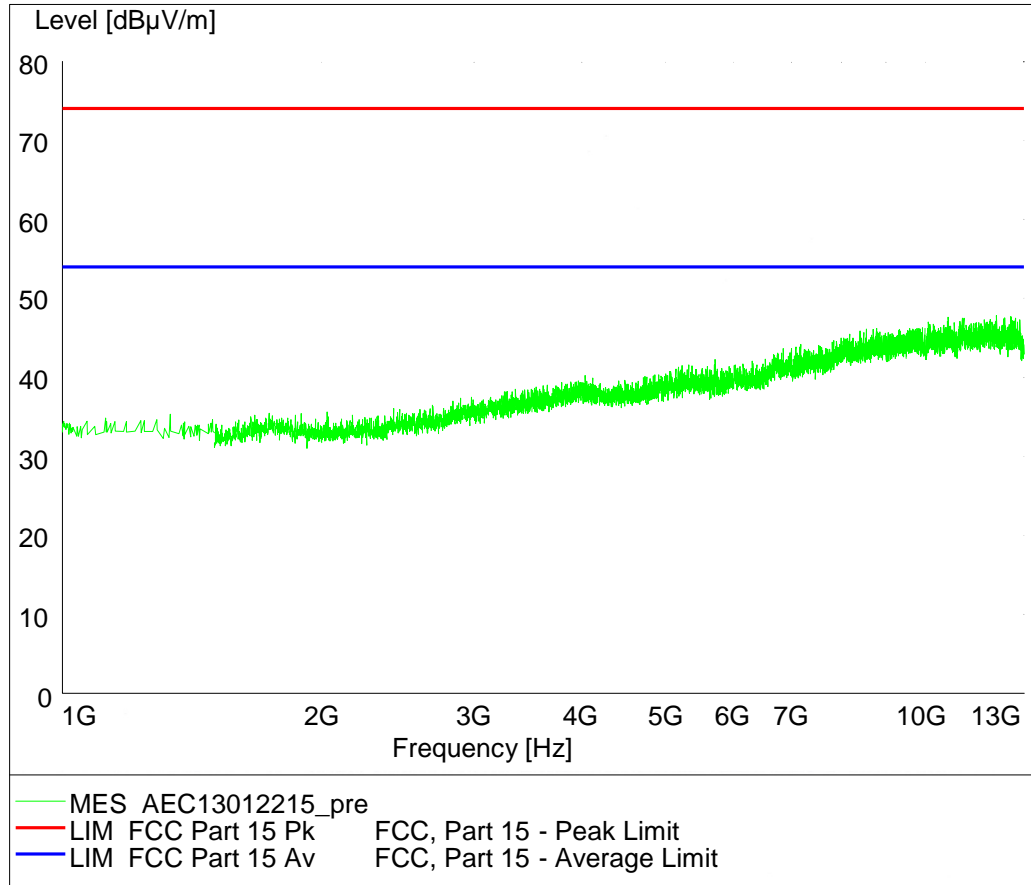
1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel, Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



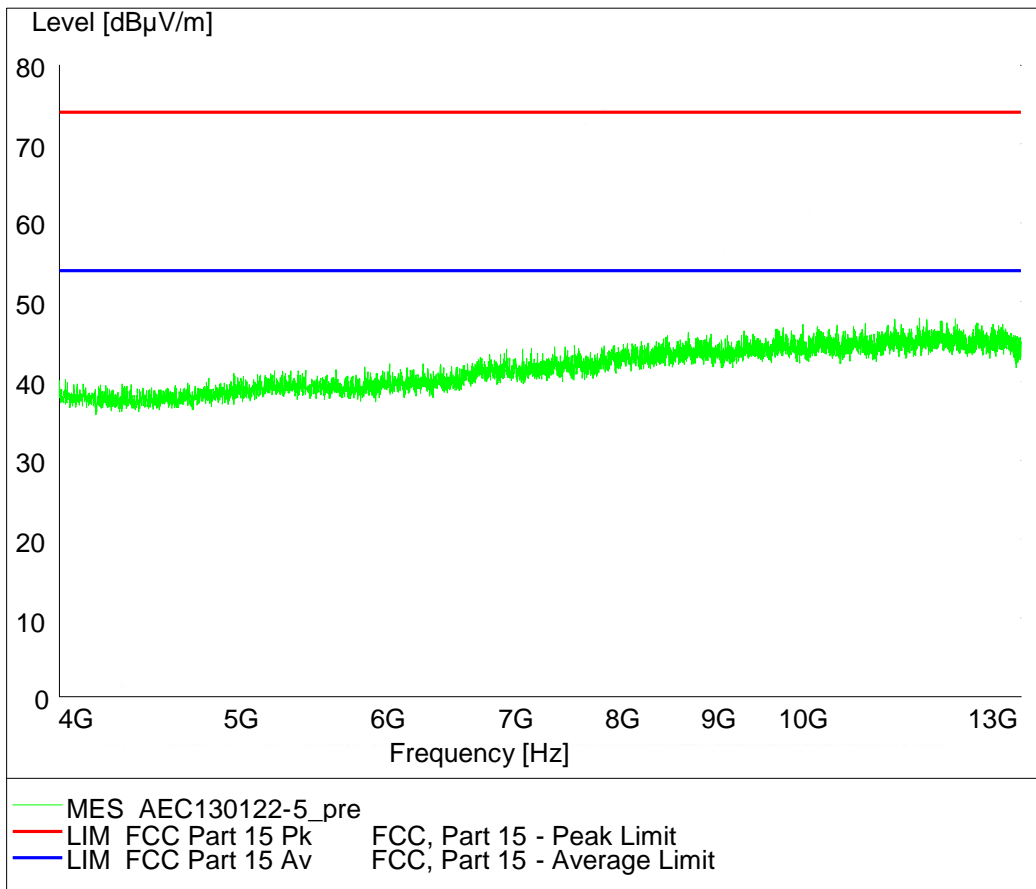
1000 – 4000 MHz, max peak at a distance of 3 m on the high TX channel, Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



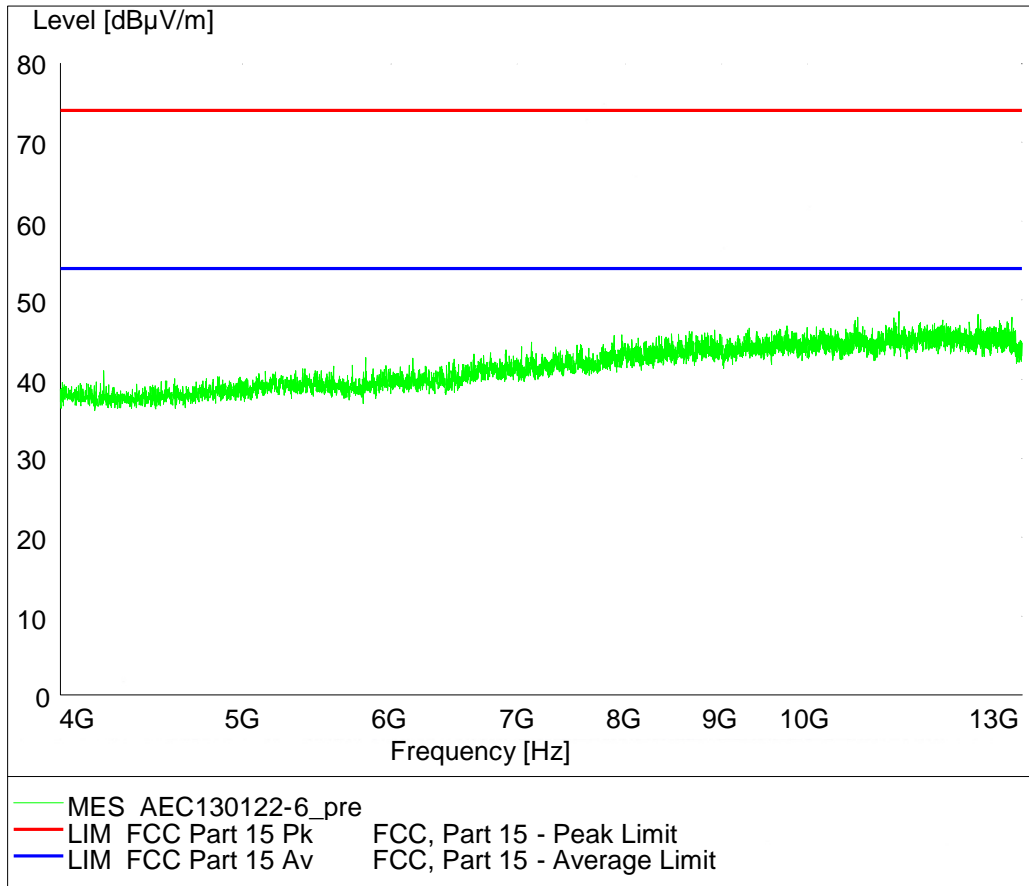
1000 – 13000 MHz, max peak at a distance of 3 m on RX mode



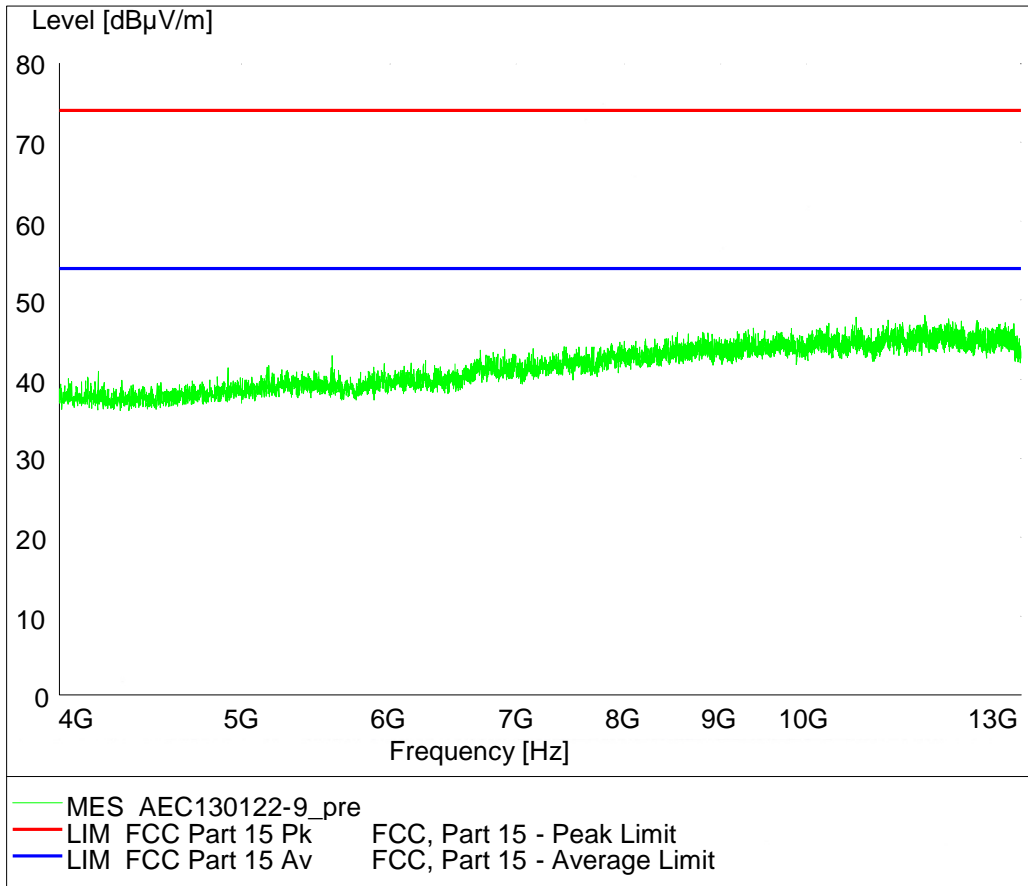
4000 – 13000 MHz, max peak at a distance of 3 m on the low TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



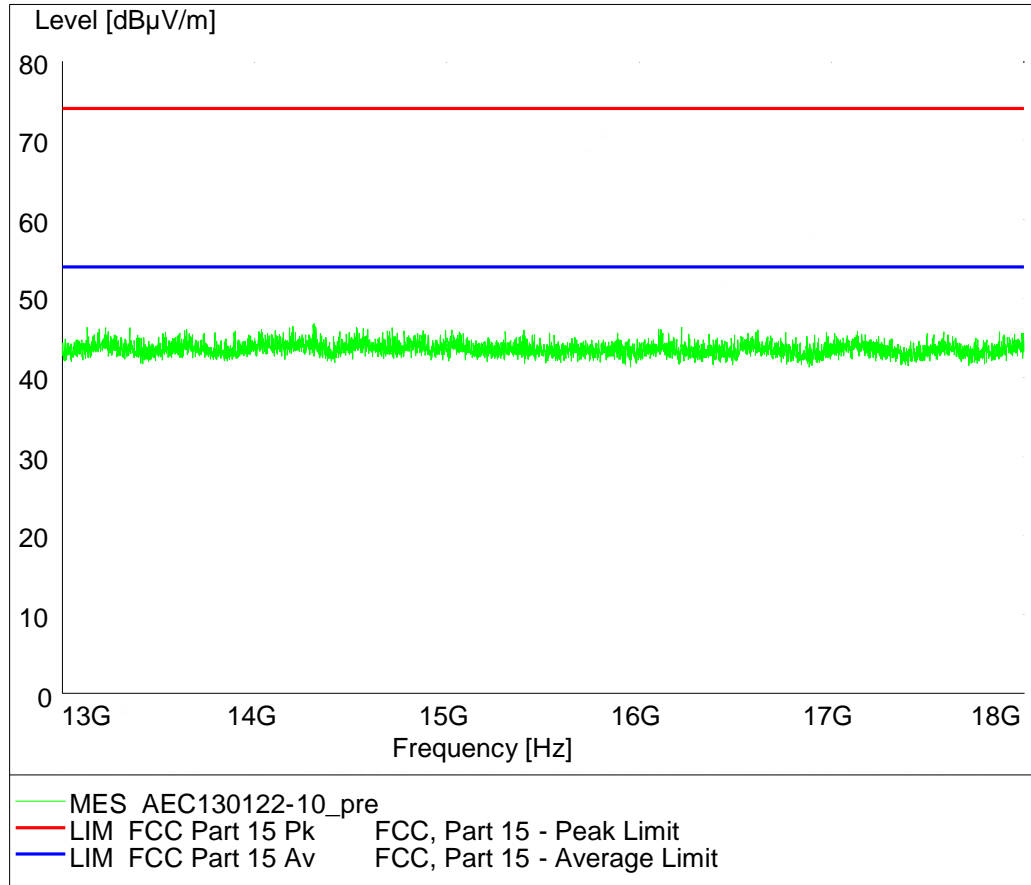
4000 – 13000 MHz, max peak at a distance of 3 m on the mid TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



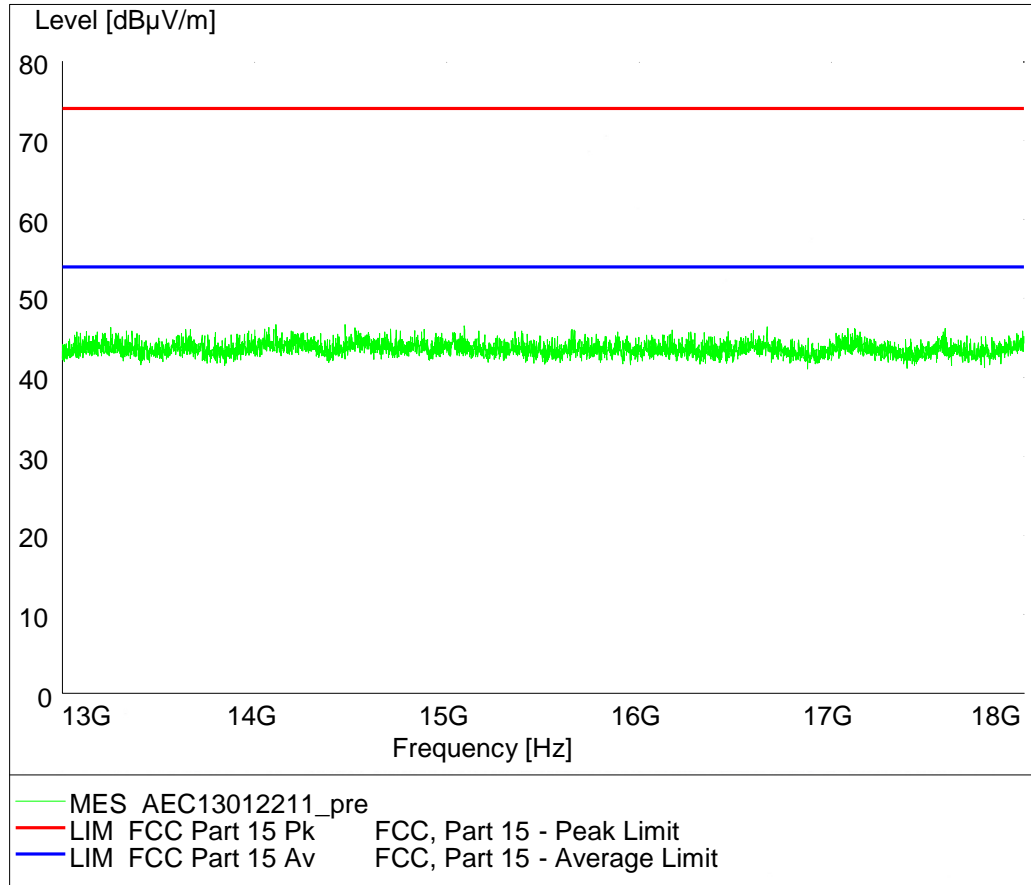
4000 – 13000 MHz, max peak at a distance of 3 m on the high TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



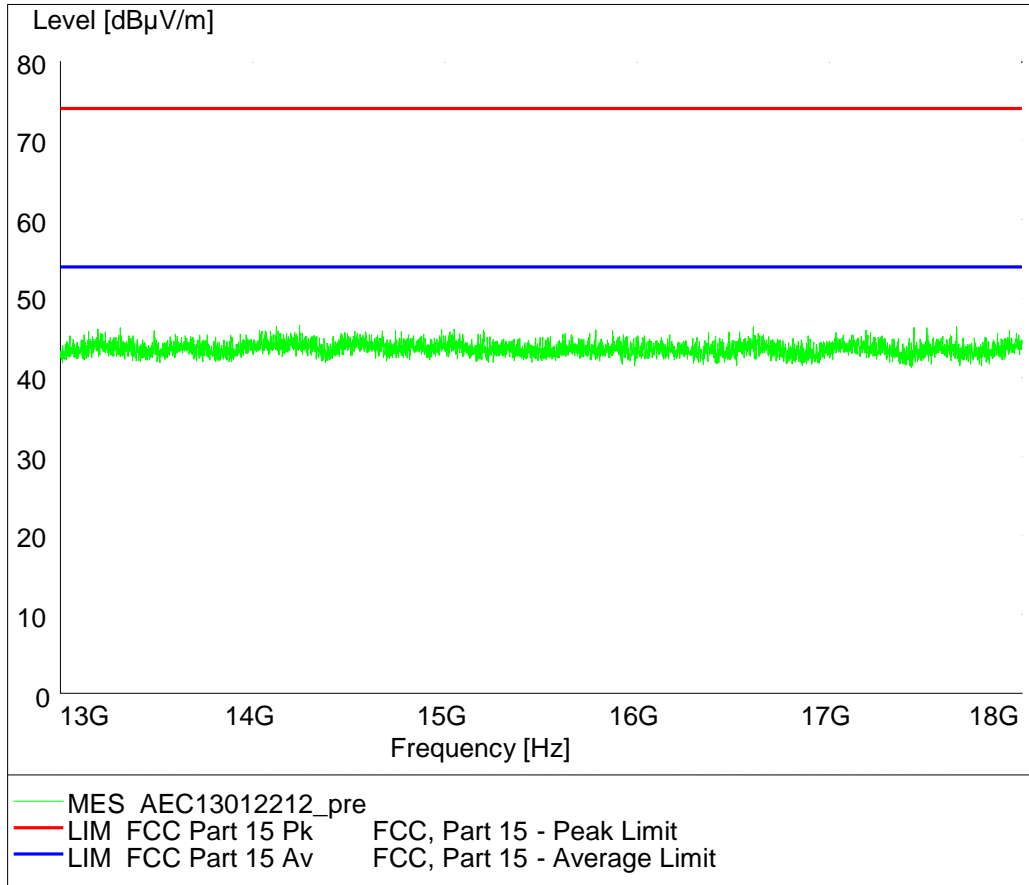
13000 – 18000 MHz, max peak at a distance of 3 m on the lower TX channel



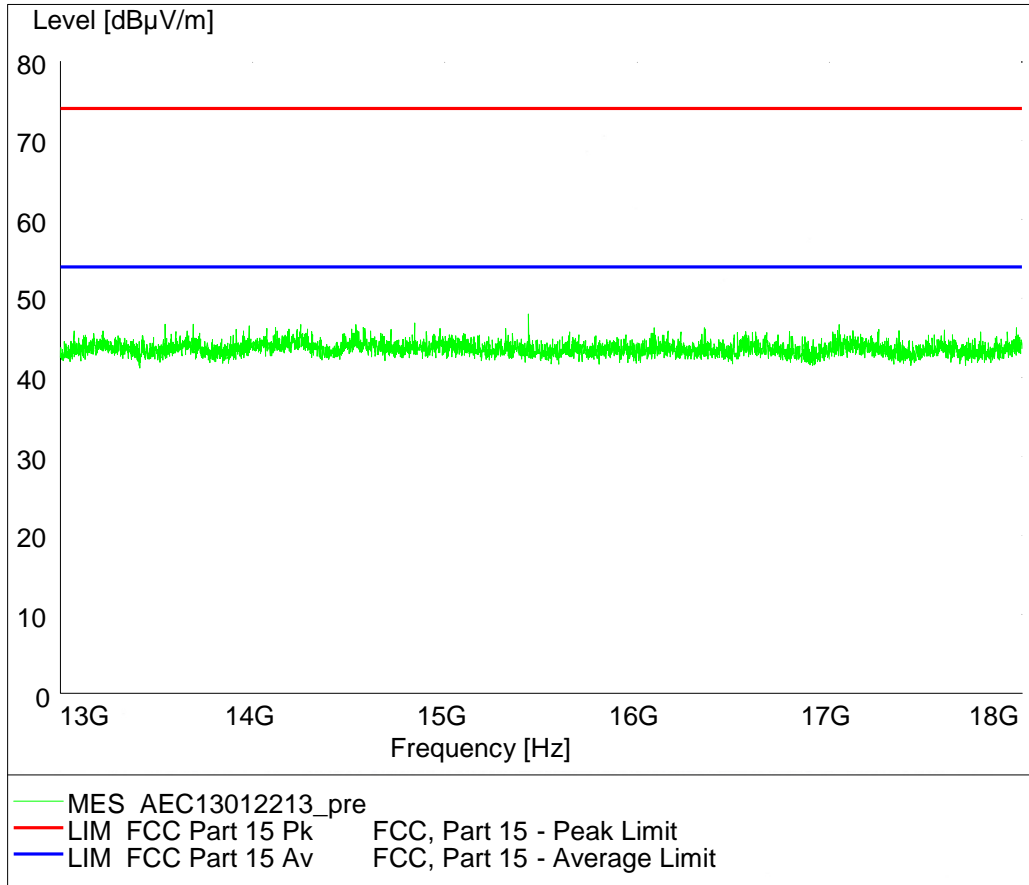
13000 – 18000 MHz, max peak at a distance of 3 m on the mid TX channel



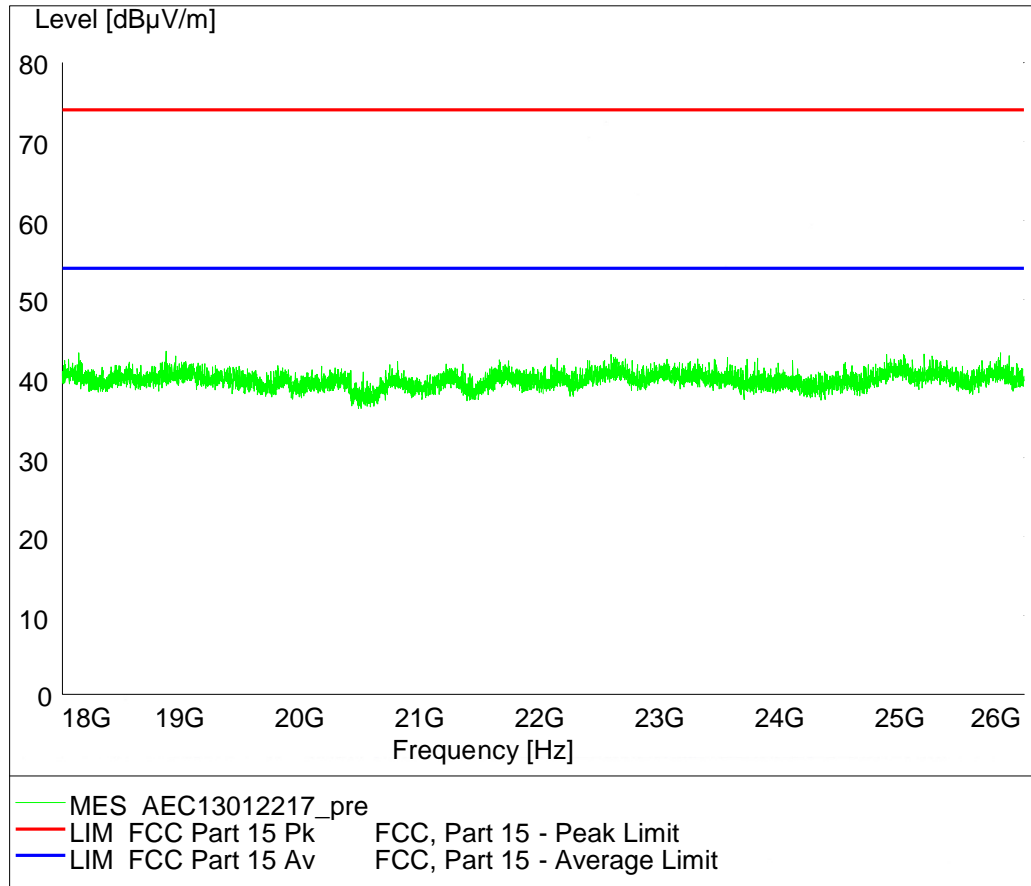
13000 – 18000 MHz, max peak at a distance of 3 m on the high TX channel



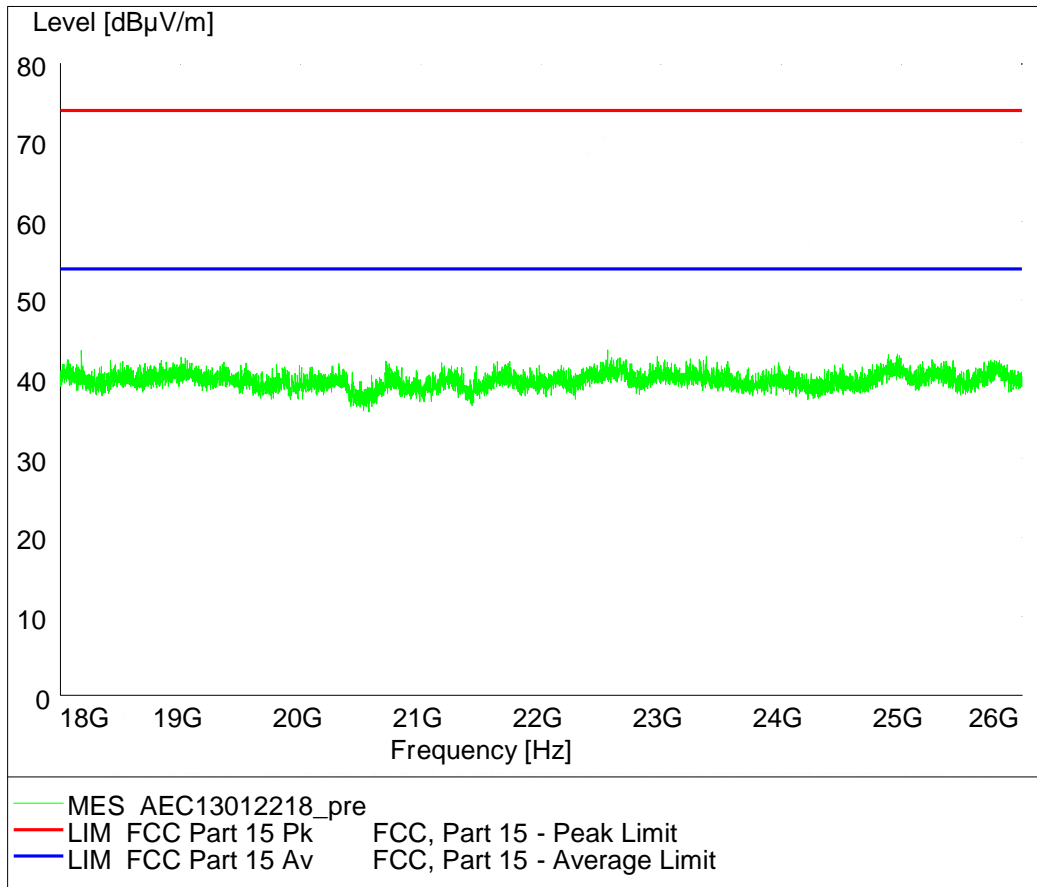
13000 – 18000 MHz, max peak at a distance of 3 m on RX



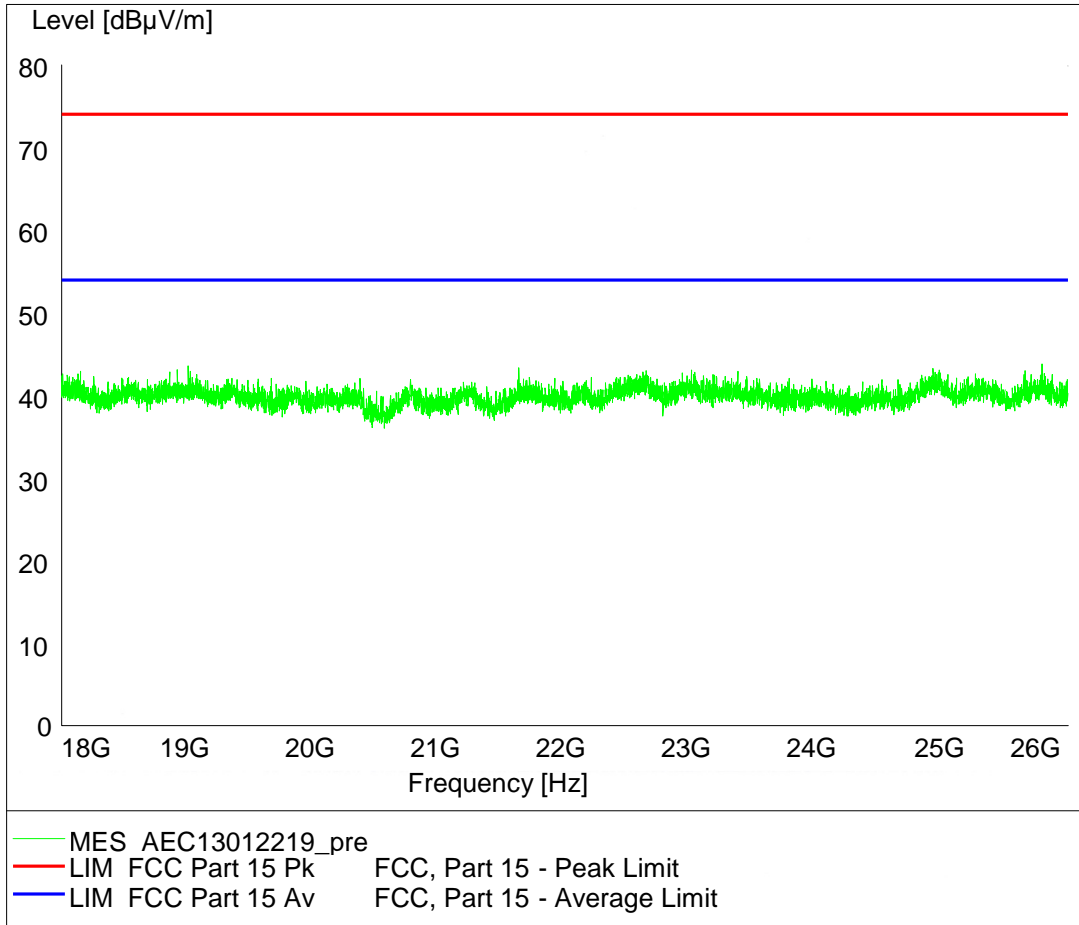
18000 – 26000 MHz, max peak at a distance of 3 m on the lower TX channel,



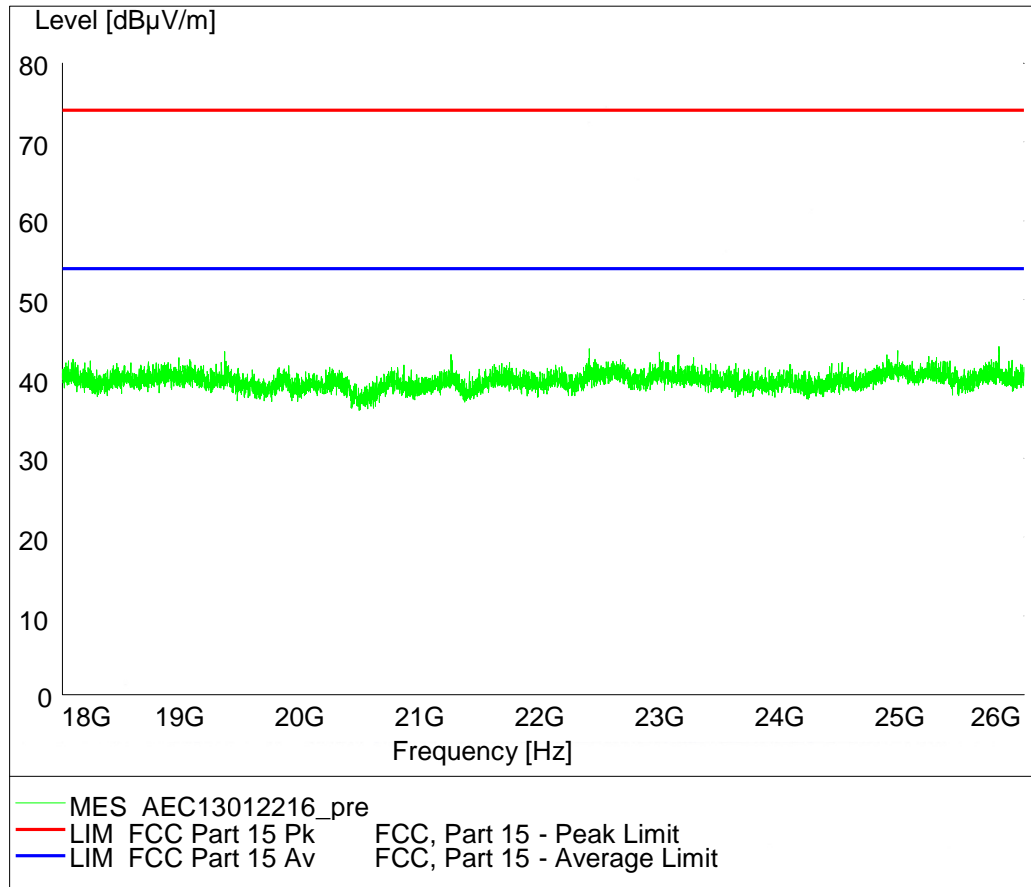
18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



18000 – 26000 MHz, max peak at a distance of 3 m on the high TX channel



18000 – 26000 MHz, max peak at a distance of 3 m on the RX mode



Data summary

Field strength of spurious emissions low channel						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		QP/Peak [dB(μV/m)]	AV [dB(μV/m)]	Peak [dB(μV/m)]	AV [dB(μV/m)]	
59.54	120	-1.0	-	40	-	
250.04	120	26.4	-	46	-	
600.09	120	15.7	-	46	-	
625.07	120	24.5	-	46	-	
1000-26000	1000	-	-	-	-	No significant peaks above noise floor

Field strength of spurious emissions middle channel						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		QP/Peak [dB(μV/m)]	AV [dB(μV/m)]	Peak [dB(μV/m)]	AV [dB(μV/m)]	
41.21	120	7.3	-	40	-	
56.07	120	-0.9	-	40	-	
200.02	120	19.2	-	43.5	-	
500.06	120	26.6	-	46	-	
625.07	120	25.0	-	46	-	
952.35	120	19.3	-	46	-	
1000-26000	1000	-	-	-	-	No significant peaks above noise floor

Field strength of spurious emissions high channel						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		QP/Peak [dB(μV/m)]	AV [dB(μV/m)]	Peak [dB(μV/m)]	AV [dB(μV/m)]	
52.67	120	1.4	-	40	-	
57.43	120	-0.9	-	40	-	
200.02	120	21.4	-	43.5	-	
250.04	120	24.9	-	46	-	
500.06	120	25.9	-	46	-	
1000-26000	1000	-	-	-	-	No significant peaks above noise floor

Field strength of spurious emissions RX mode						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		QP/Peak [dB(μV/m)]	AV [dB(μV/m)]	Peak [dB(μV/m)]	AV [dB(μV/m)]	
41.82	120	5.1	-	40	-	
200.02	120	21.7	-	43.5	-	
500.06	120	26.6	-	46	-	
625.07	120	24.7	-	46	-	
955.68	120	19.5	-	46	-	
1000-26000	1000	-	-	-	-	No significant peaks above noise floor

Example calculation:

Measured level [dBμV/m] = Analyser reading [dBμV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [1/m]

10. OUT OF BAND SPURIOUS EMISSIONS, CONDUCTED AT ANTENNA PORT

Date of test: 2013-01-24

EUT mode of operation: continuous TX.

Spectrum analyzer settings:

RBW: 100 kHz
VBW: 100 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

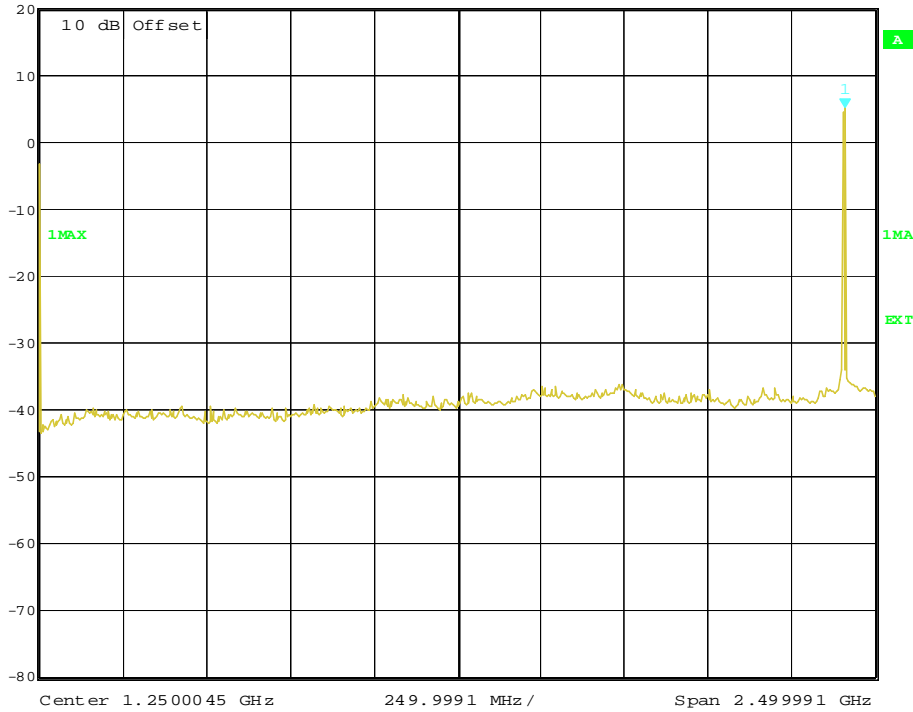
Channel	Plot	Results	Limit value (dBc)
Low	10.1 – 10.4	PASS	20
Middle	10.5 – 10.8	PASS	20
High	10.9 – 10.12	PASS	20

Limit: In any 100 kHz bandwidth outside the operating frequency band (2400 – 2483.5 MHz), the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Plot P10.1



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
 Ref Lvl 5.04 dBm VBW 300 kHz
 20 dBm 2.40981996 GHz SWT 640 ms Unit dBm

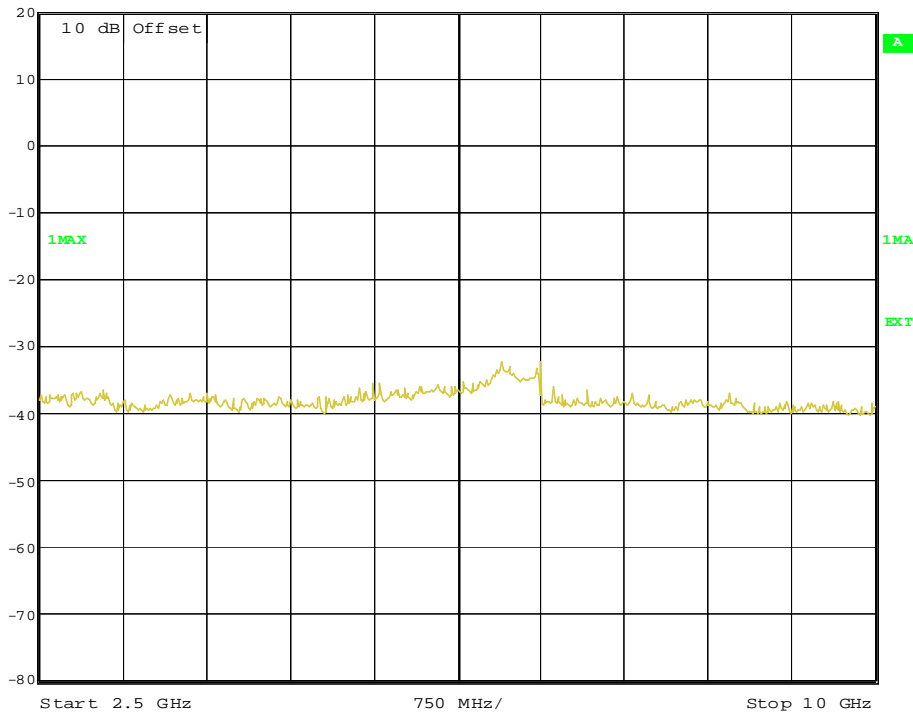


Date: 24.JAN.2013 12:38:54

Plot P10.2



RBW 100 kHz RF Att 40 dB
 Ref Lvl 20 dBm VBW 300 kHz
 SWT 1.9 s Unit dBm



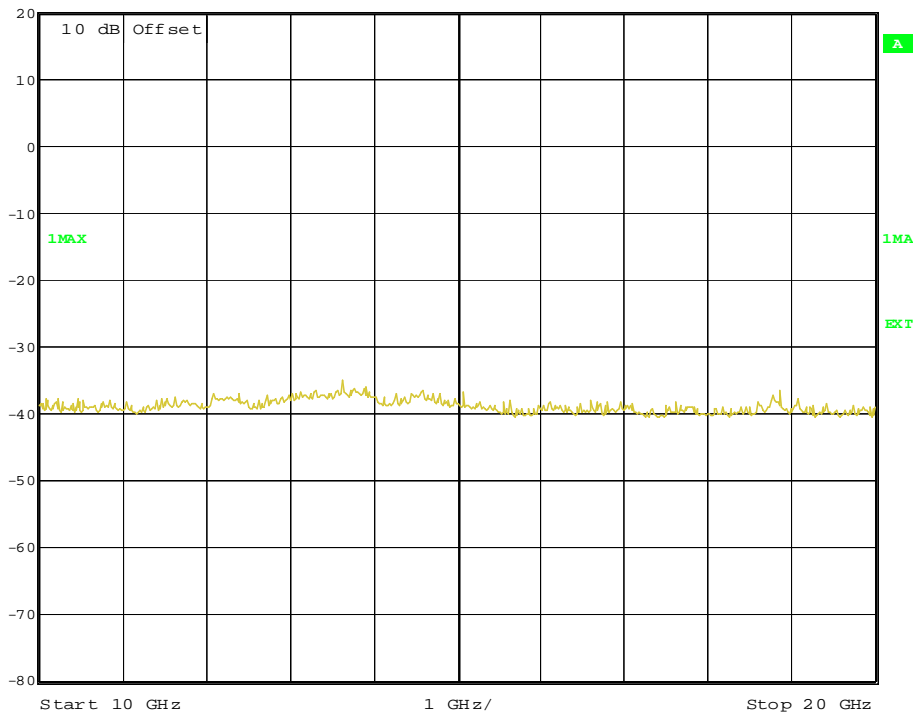
Date: 24.JAN.2013 12:39:48

Plot P10.3



Ref Lvl
20 dBm

RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 2.5 s Unit dBm



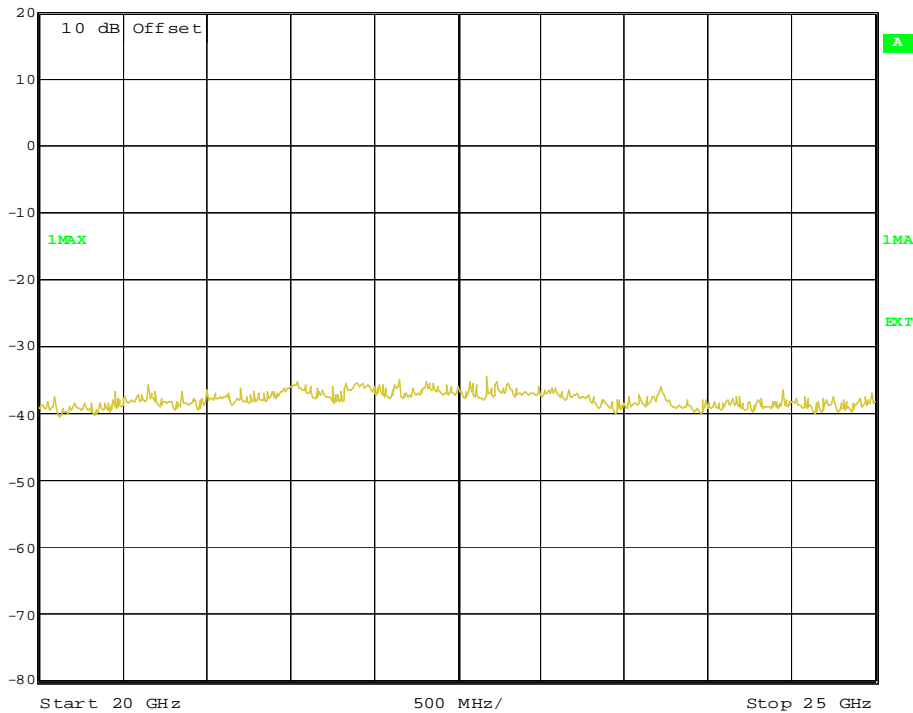
Date: 24.JAN.2013 12:40:35

Plot P10.4



Ref Lvl
20 dBm

RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 1.25 s Unit dBm



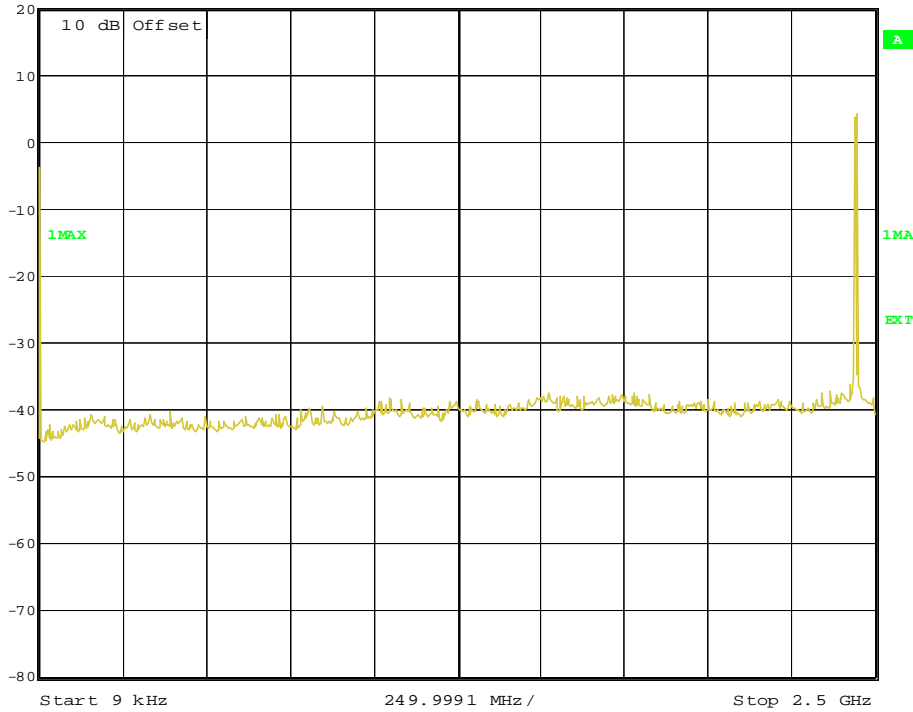
Date: 24.JAN.2013 12:41:18

Plot P10.5



Ref Lvl
20 dBm

RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 640 ms Unit dBm



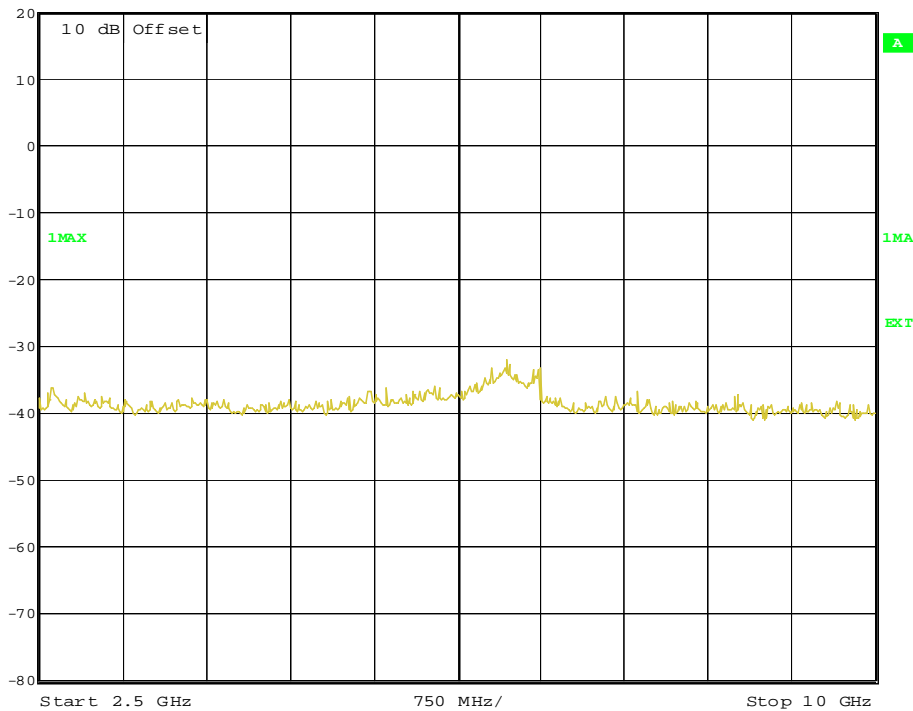
Date: 24.JAN.2013 12:47:48

Plot P10.6



Ref Lvl
20 dBm

RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 1.9 s Unit dBm



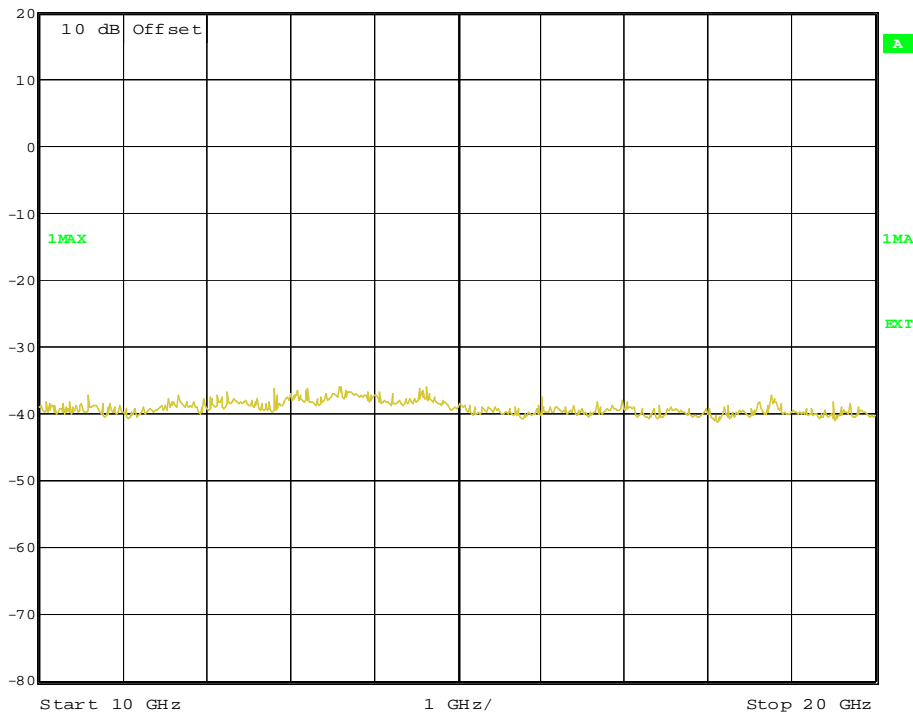
Date: 24.JAN.2013 12:47:10

Plot P10.7



Ref Lvl
20 dBm

RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 2.5 s Unit dBm



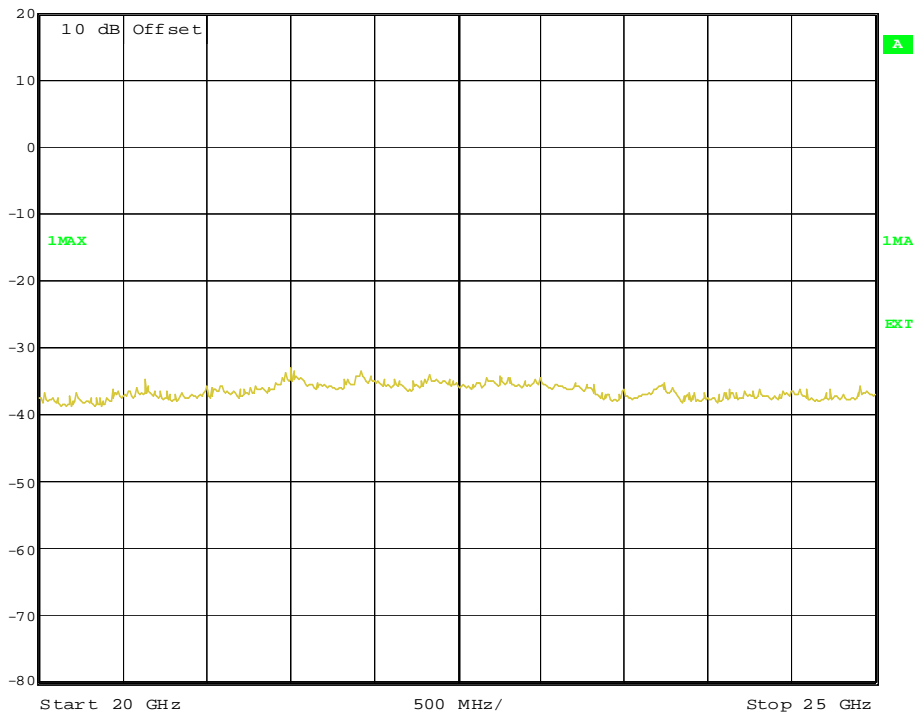
Date: 24.JAN.2013 12:46:21

Plot P10.8




Ref Lvl
20 dBm

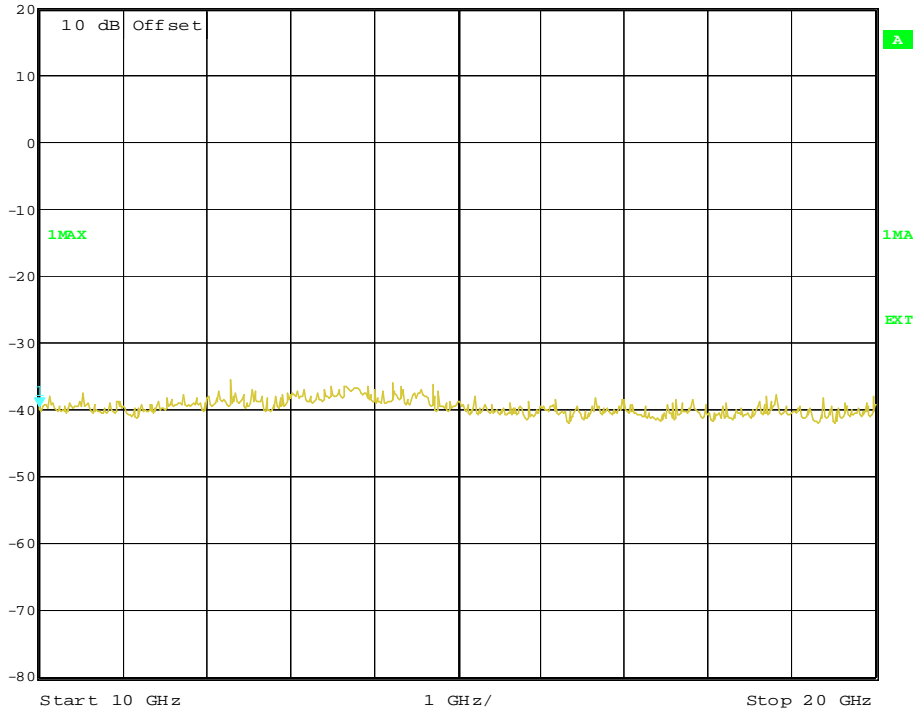
RBW 100 kHz RF Att 40 dB
VBW 300 kHz
SWT 1.25 s Unit dBm



Date: 24.JAN.2013 12:45:43


Plot P10.11

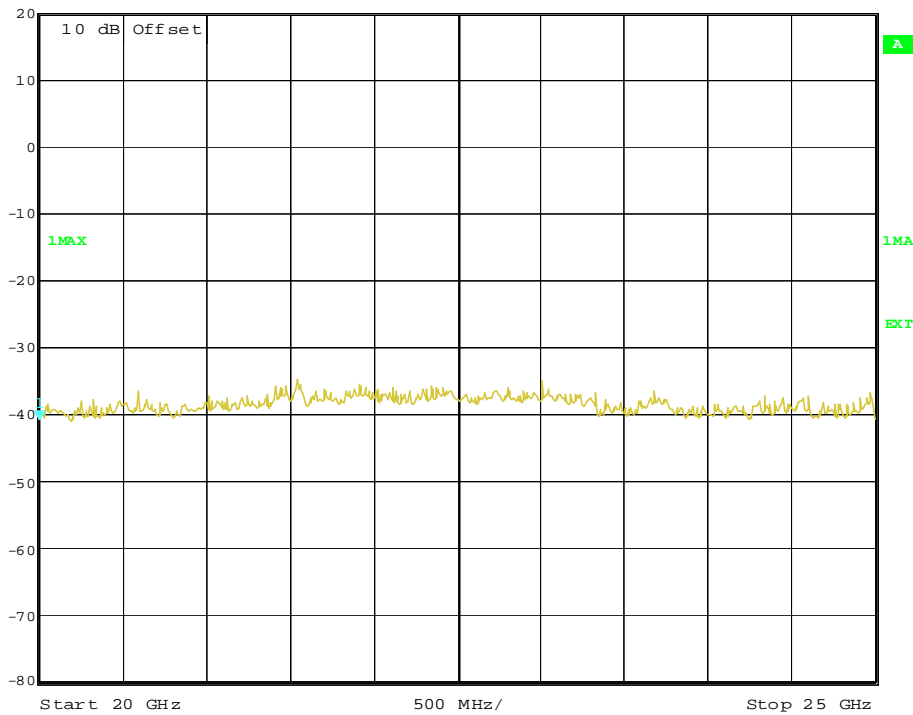

Marker 1 [T1]
RBW 100 kHz
RF Att 40 dB
Ref Lvl -39.65 dBm
VBW 300 kHz
20 dBm
10.0000000 GHz
SWT 2.5 s
Unit dBm



Date: 24.JAN.2013 12:50:35

Plot P10.12


Marker 1 [T1]
RBW 100 kHz
RF Att 40 dB
Ref Lvl -40.94 dBm
VBW 300 kHz
20 dBm
20.0000000 GHz
SWT 1.25 s
Unit dBm



Date: 24.JAN.2013 12:51:04

11. 99% BANDWIDTH

11.1 Test protocol

Date of test: 2013-01-29

EUT mode of operation: continuous TX. Modulation on

Spectrum analyzer settings:

Span: 10 MHz
RBW: 100 kHz
VBW: 300 kHz
Sweep time: Auto
Detector: Sample
Trace: Max Hold

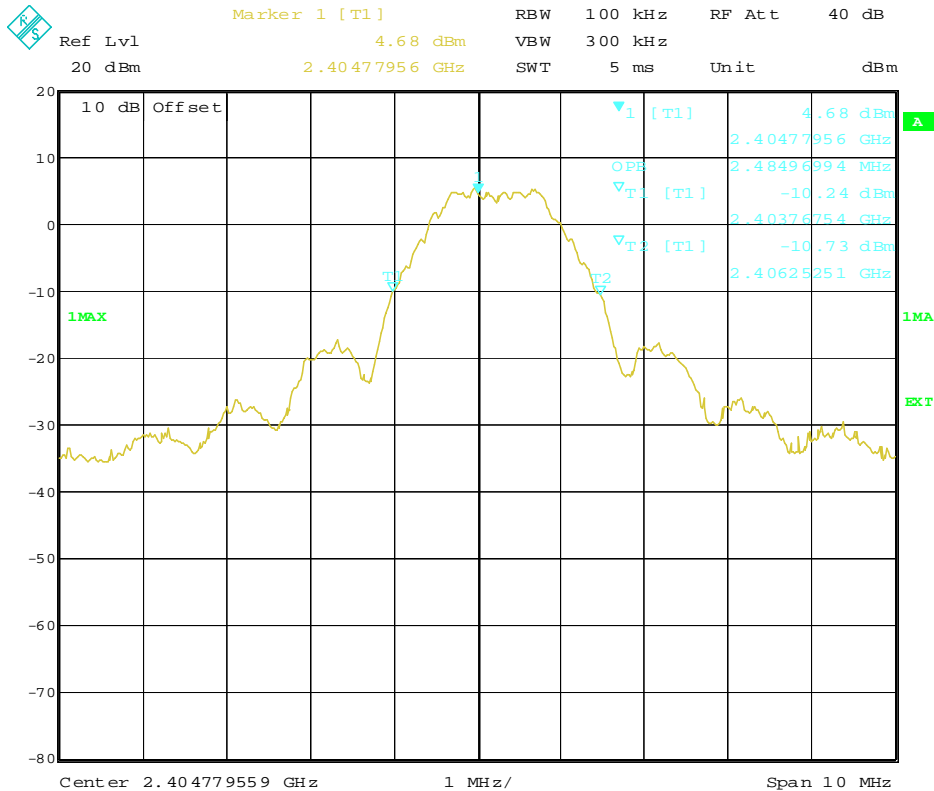
Channel	Plot	Measured value MHz	Limit value MHz
Low	plot 11.1	2.47	-
Middle	plot 11.2	2.47	-
High	plot 11.3	2.47	-

Measurement results are corrected for attenuation in the set-up configuration and antenna gain declared by the manufacturer.

Example calculation:

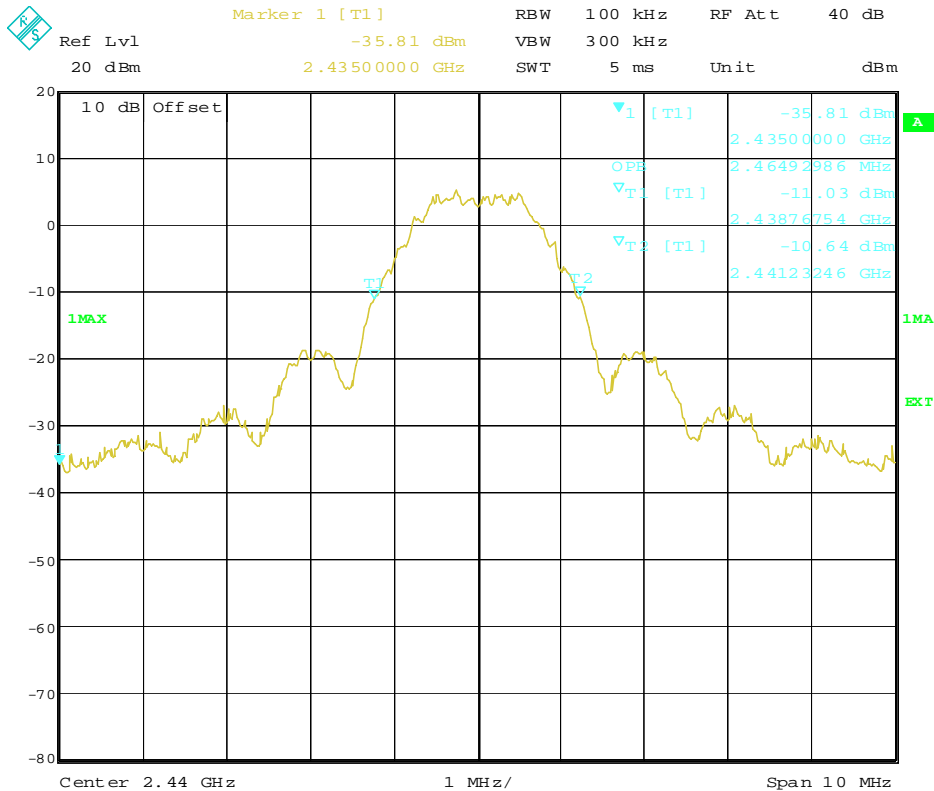
Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] + EUT antenna gain [dBi]

Plot P11.1



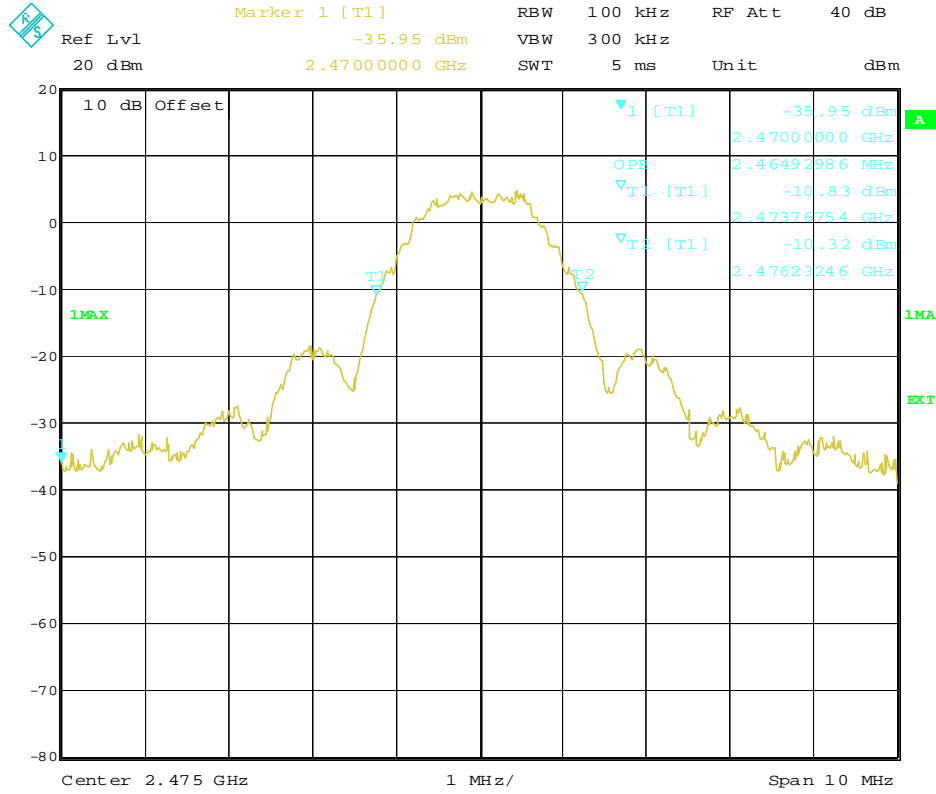
Date: 29.JAN.2013 12:32:43

Plot P11.2



Date: 29.JAN.2013 12:36:19

Plot P11.3



Date: 29.JAN.2013 12:39:15

12 INSTRUMENTATION LIST

Invnr	Equipment	Manufacturer	Type	Last Calibrated	Calibration due
4936	HORNANTENNA	EMCO	3115	2011-08	2013-08
5185	CABLE	HUBER + SUHNER	SUCOFLEX 104 2m	2012-06	2013-06
5190	CABLE	HUBER + SUHNER	SUCOFLEX 104 1,5m	2012-06	2013-06
5192	CABLE	HUBER + SUHNER	SUCOFLEX 104 1,5m	2012-06	2013-06
5193	CABLE	HUBER + SUHNER	SUCOFLEX 104 1,5m	2012-06	2013-06
5616	RUBIDIUM REFERENS	PHILIPS	PM6685R/071	2012-08	2013-08
7861	POWER SENSOR	ROHDE & SCHWARZ	NRV-Z51	2012-06	2013-06
7982	ATTENUATOR	HEWLETT-PACKARD	8491A	2012-06	2013-06
8337	ATTENUATOR	NARDA	776B-10	2012-06	2013-06
8578	ANTENNA	CHASE ELECTR. LIMITED	CBL 6111	2011-09	2013-09
9444	ATTENUATOR	AEROFLEX / WEINSCHEL	46-10-34	2012-06	2013-06
9750	CABLE	HUBER + SUHNER	SUCOFLEX 104	2012-06	2013-06
12335	PREAMPLIFIER	SANGUS	AFS6-00101400- 23-10P -6-S ; AFS44-12002400- 32-10P -44	2012-06	2013-06
12455	POWERMETER	ROHDE & SCHWARZ	NRVD	2012-06	2013-06
12792	SIGNALGENERATOR	ROHDE & SCHWARZ	SMIQ 03B	2012-06	2013-06
12793	SIGNALANALYZER	ROHDE & SCHWARZ	FSIQ 40	2009-06	2013-06
12866	MEASUREMENT RECIEVER	ROHDE & SCHWARZ	ESU	2012-06	2013-06
30090	ATTENUATOR	HEWLETT-PACKARD	8491A	2012-06	2013-06
30099	HORNANTENNA	EMCO	460420	2010-08	2013-08
30101	HORNANTENNA	EMCO	460451	2010-08	2013-08
40017	SIGNALGENERATOR	ROHDE & SCHWARZ	SMIQ 03B	2012-06	2013-06
40035	CABLE	SUHNER	SUCOFLEX 104PEA	2012-06	2013-06
40036	CABLE	SUHNER	SUCOFLEX 104	2012-06	2013-06

APPENDIX – PHOTOS OF THE EUT



