RADIO TEST REPORT

No. 1209525-1, Ed. 3

EQUIPMENT UNDER TEST

Equipment:	FHSS radio
Type / model:	W-DMX TRX
Manufacturer:	Interlite AB Project Wireless Solution
Tested by request of:	Interlite AB Project Wireless Solution

SUMMARY

All selected test cases specified in this report comply with the requirements according to the following standards:

47 CFR, Part 15, Subpart B (2011) and Subpart C (2011);

RSS-GEN, Issue 3 (Dec 2010)
RSS-210, Issue 8 (Dec 2010)

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

Date of issue: 2012-08-29

Tested by: Åke Carlson

Approved by: Stefan Andersson

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REVISION HISTORY

Edition	Date	Description
1	2012-04-25	First release
2	2012-07-11	Model with linear regulation for DC supply added
3	2012-08-29	Date of calibration for test equipment and graph of occupied bandwidth added to report

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company:	Interlite AB Project Wireless Solution
Name of contact:	Niclas Arvidsson

2. EQUIPMENT UNDER TEST (EUT)

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

Equipment:	FHSS radio
Type/Model:	W-DMX-TRX
Brand name:	Wireless Solution A50052-H
Serial number:	21385 0117, 0118, 0104,
Manufacturer:	Interlite AB Project Wireless Solution
Rating/Supplying voltage:	5 V DC
Rating RF output power:	19.3 dBm (measured)
External antenna connector:	Yes
Operating temperature range:	0 - 55˚C
Frequency range:	2402 – 2459 MHz
Number of channels:	58
Modulation characteristics:	FHSS

2.2 Additional hardware information

There are two versions of W-DMX-TRX, one with a linear regulation on the DC supply and one without DC regulation. According to the manufacturer the linear regulation of DC supply support the FHSS radio with 5.0 V DC.The radio parts of the products are identical for both versions and the linear regulation of DC supply is not considered to affect RF performance.
Tested model is W-DMX-TRX without DC regulation.

2.3 Modifications during the test

The EUT was modified with circuit boards for low channel, middle channel, high channel and FHSS. One circuit board was also set for RX tests.

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

The peak output power has been modified during the test. The peak output power was reduced to be lower than 21 dBm. After the modification the peak output power was retested.

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3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2011) Subpart B – Unintentional radiators

FCC 47 CFR part 15 (2011) 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 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	%

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4. TEST PLAN

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

FCC 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	NA	
15.247(a)	RSS-210 A8.2 (b)	Spectral power density	NA	
15.247(a)	RSS-210	Number of hopping frequencies	PASS	
15.247(a)	RSS-210	Hopping channel separation, channel bandwidth	PASS	
15.247(a)	RSS-210	Dwell time of each frequency	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	Occupied Bandwidth	PASS	

N/A = Not applicable

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5. NUMBER OF HOPPING FREQUENCIES

5.1 Test protocol

Date of test: 2012-02-22

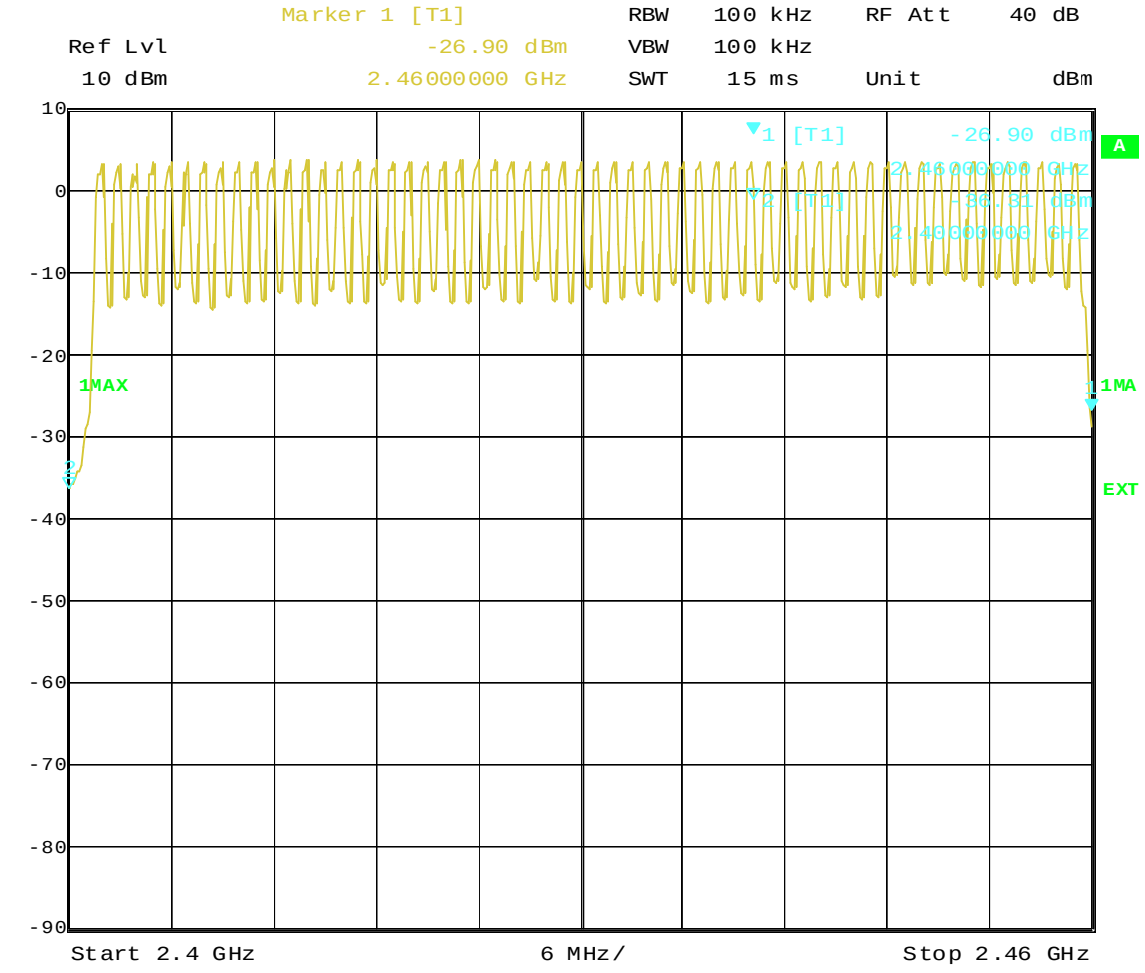
EUT mode of operation: continuous TX. FHSS on

Spectrum analyzer settings:

Span: 60 MHz
RBW: 100 kHz
VBW: 100 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Mode	Plot	Measured	Results	Limit
FHSS	P5.1	58	PASS	≥ 15

Plot P5.1



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6. HOPPING CHANNEL SEPARATION, CHANNEL BANDWIDTH

6.1 Test protocol

Date of test: 2012-02-22

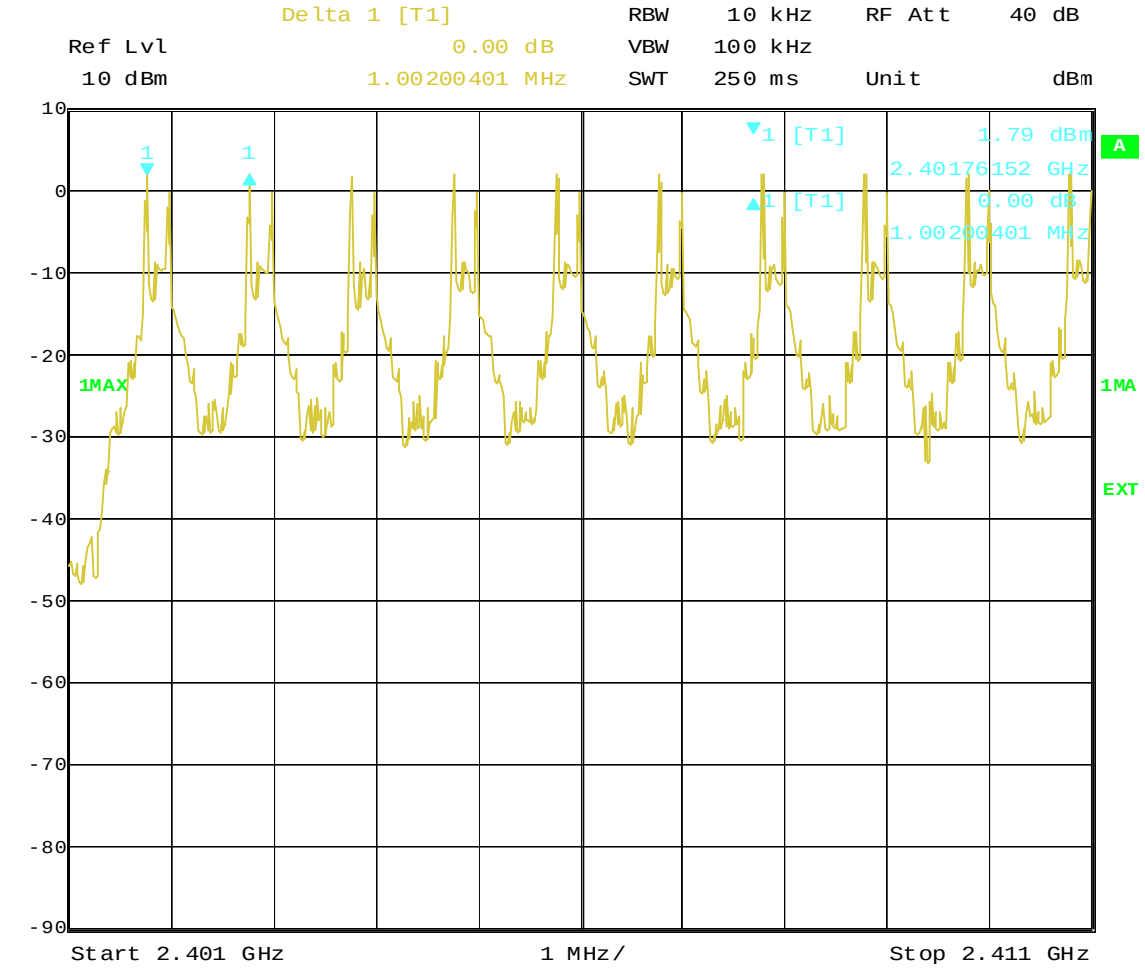
EUT mode of operation: continuous TX. FHSS on

Spectrum analyzer settings:

Span: 60 MHz
RBW: 100 kHz
VBW: 100 kHz
Sweep time: 250 ms
Detector: Peak
Trace: Max Hold

Mode	Plot	Results	Limit (kHz)
FHSS	P6.1	PASS	≥ 25

Plot P6.1



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7. DWELL TIME OF EACH FREQUENCY

7.1 Test protocol

Date of test: 2012-02-22

EUT mode of operation: continuous TX. FHSS on

Spectrum analyzer settings:

Span: 0 kHz
RBW: 10 kHz
VBW: 100 kHz
Sweep time: 5 ms, 1 s

Frequency (MHz)	Plot	Dwell time Measured (s)	Result
2402	P7.1 – P7.2	0.396	PASS
2459	P7.3 - P7.4	0.204	PASS

Dwell time = pulse time * number of pulses
(Measured time = 0.4 * number of hopping channels)

7.2 Limit

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

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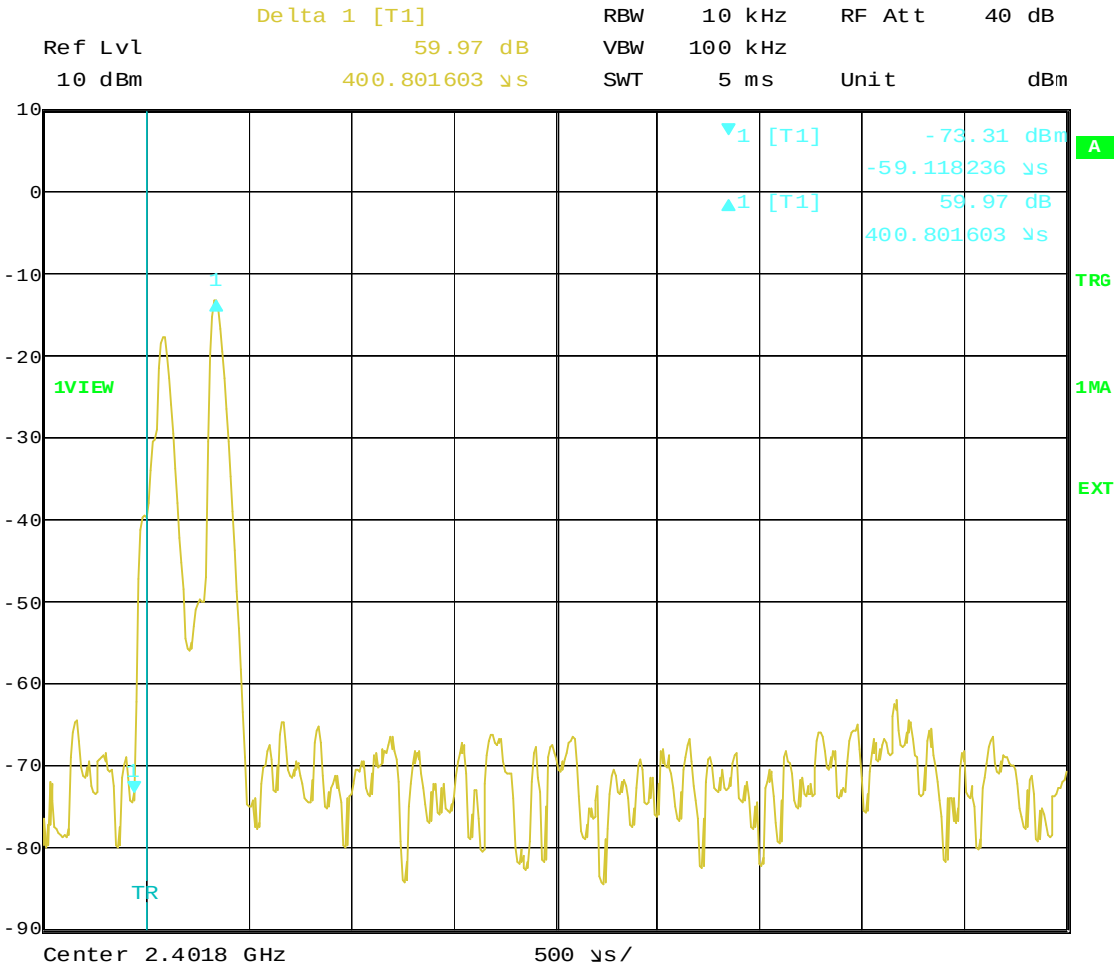
Plot P7.1



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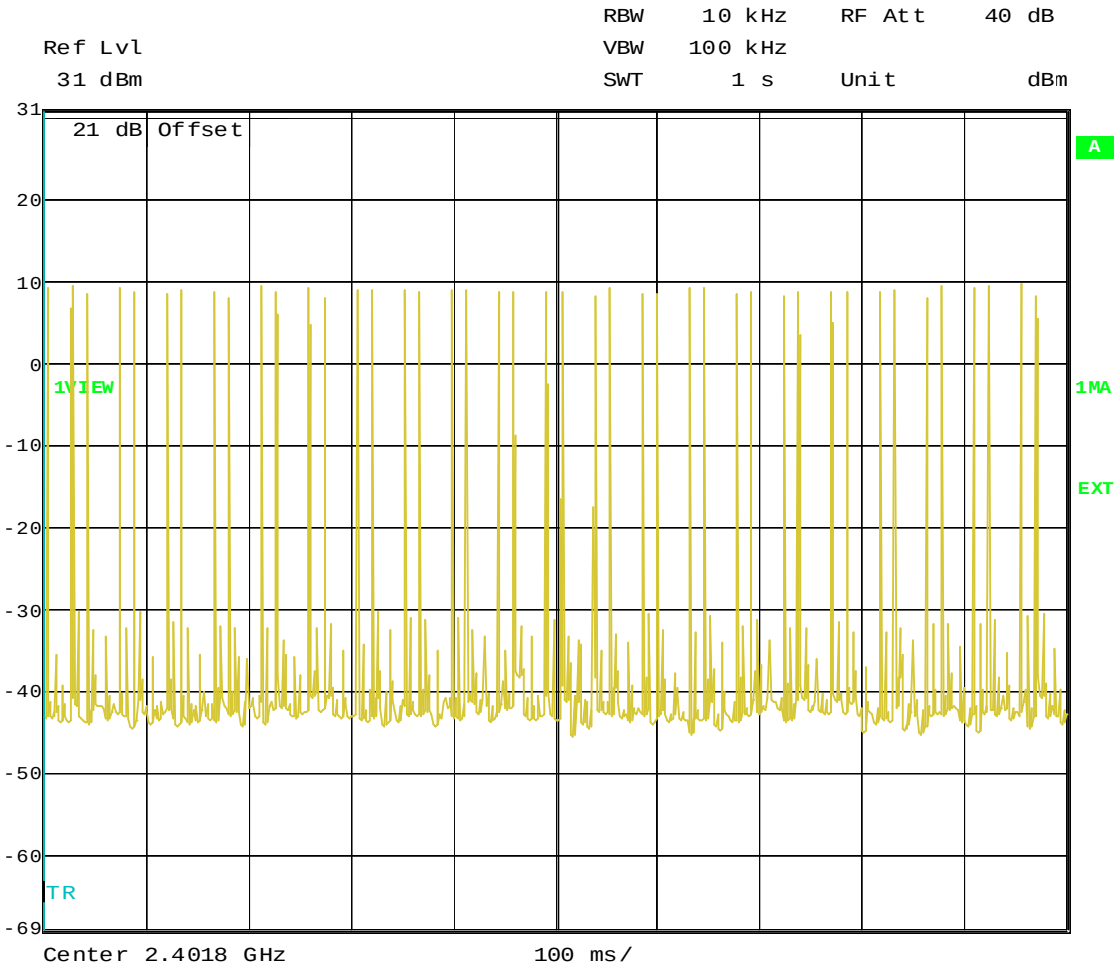
Plot P7.2



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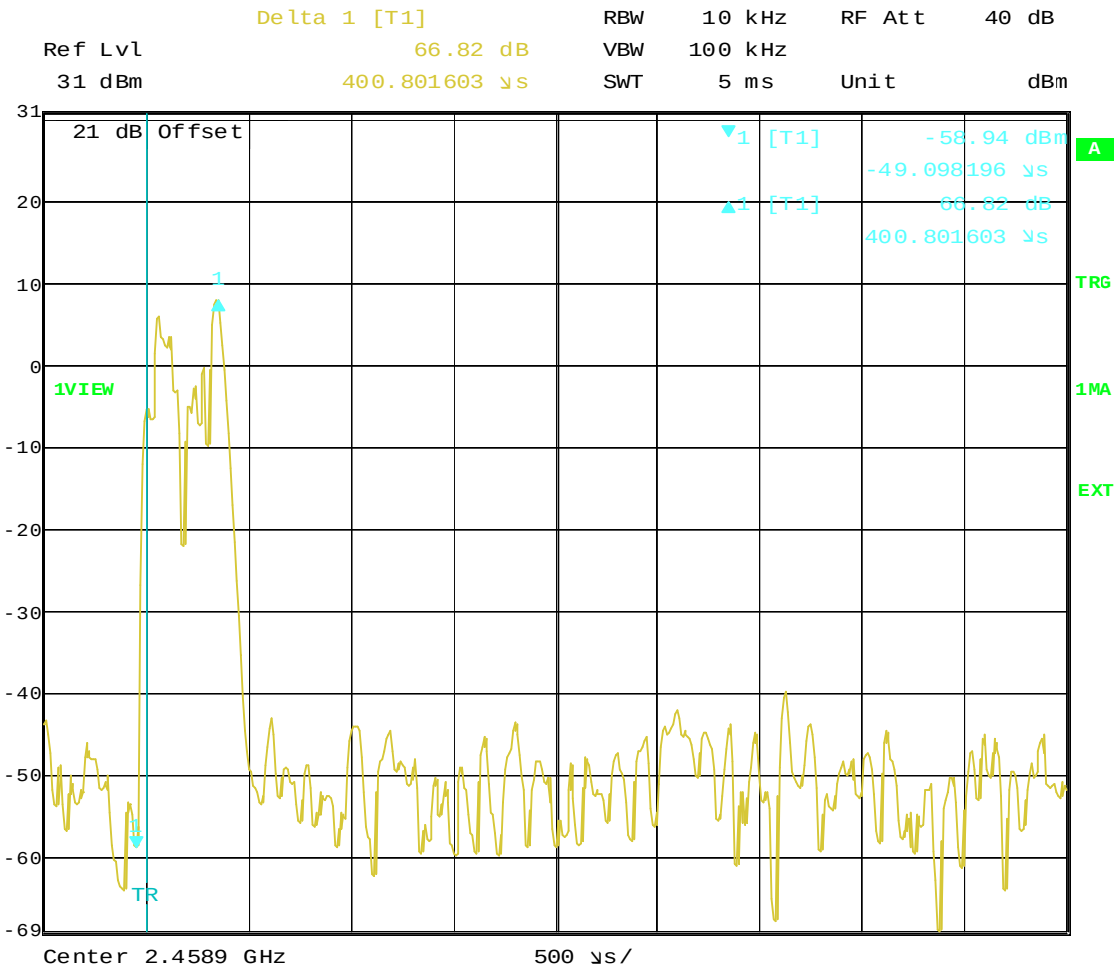
Plot P7.3



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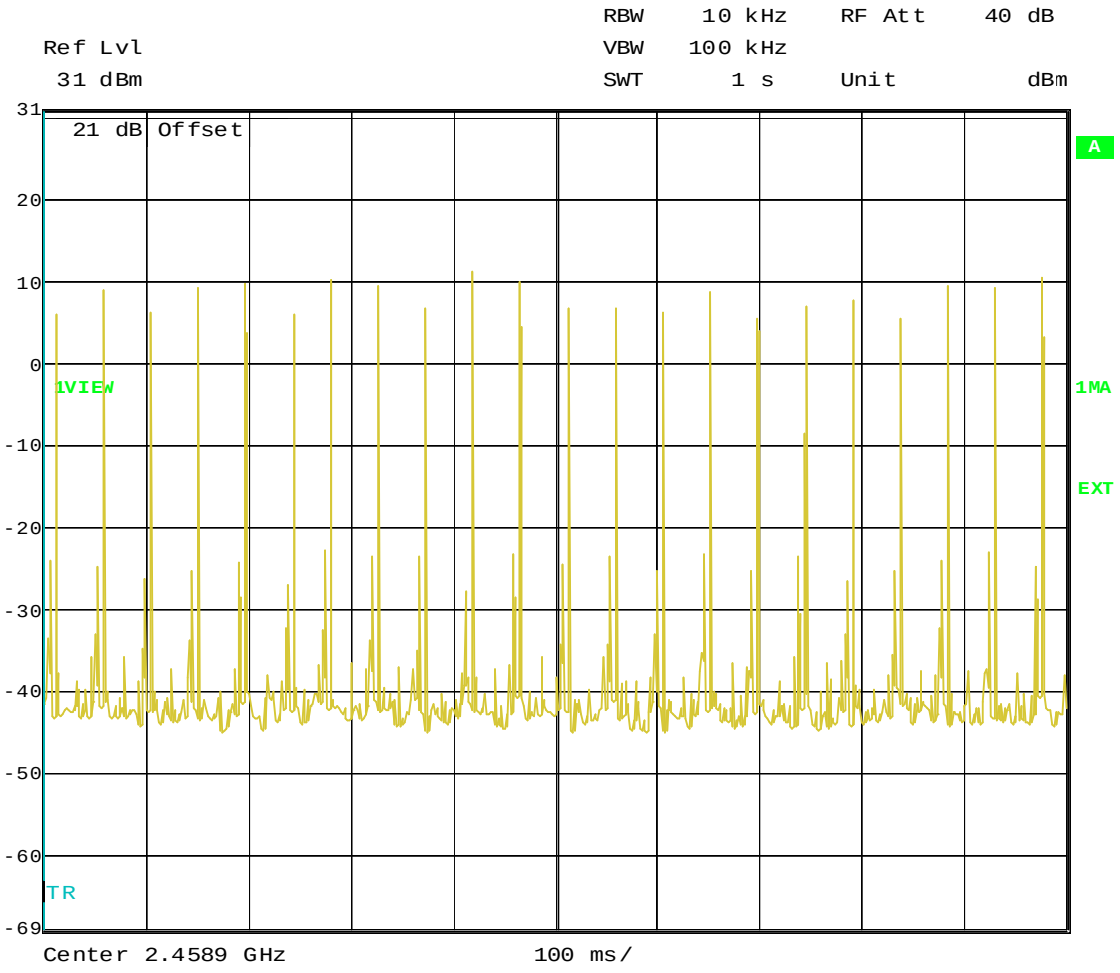
Plot
P7.4



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8. PEAK OUTPUT POWER

8.1 Test protocol

Date of test: 2012-02-22

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	Plot	Measured (dBm)	Limit value (dBm)
low	P8.1	15.81	
mid	P8.2	18.09	21
high	P8.3	19.29	

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]

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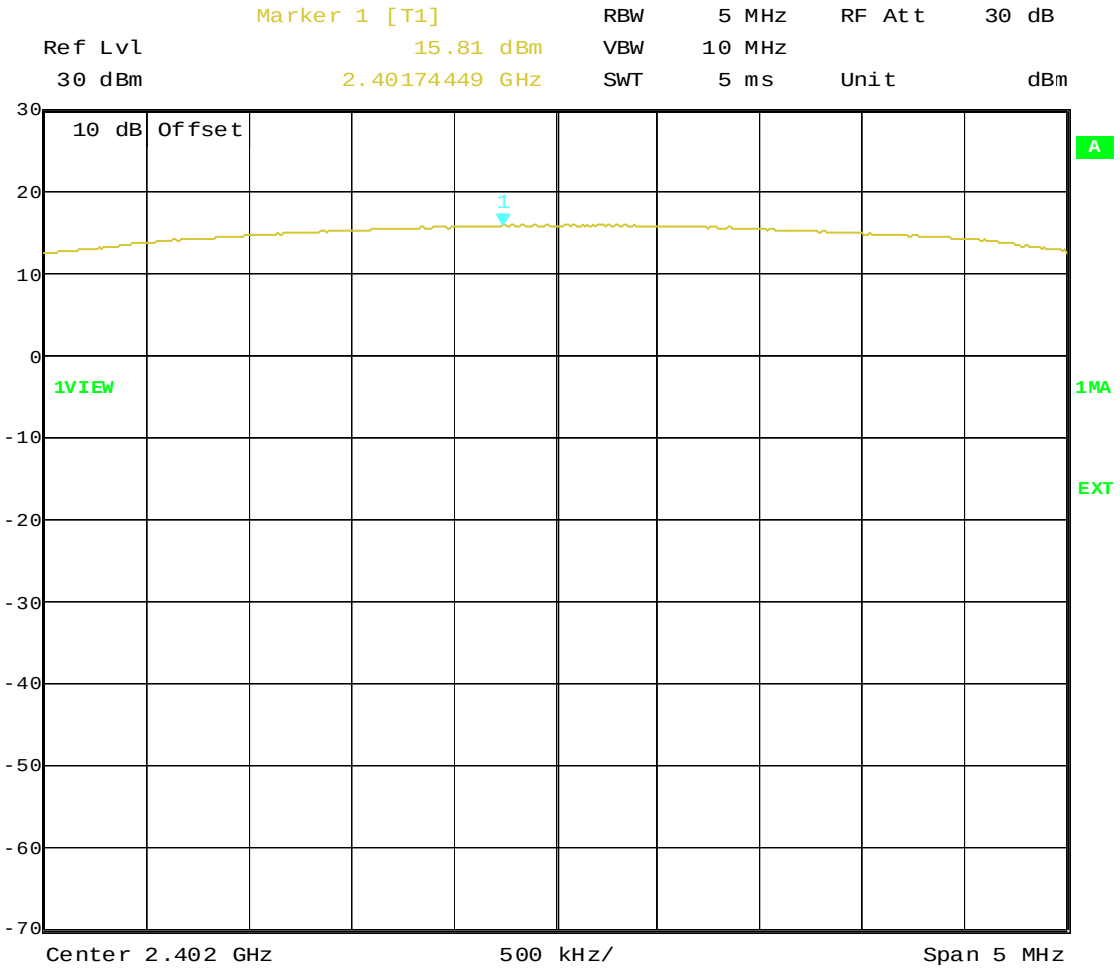
Plot P8.1



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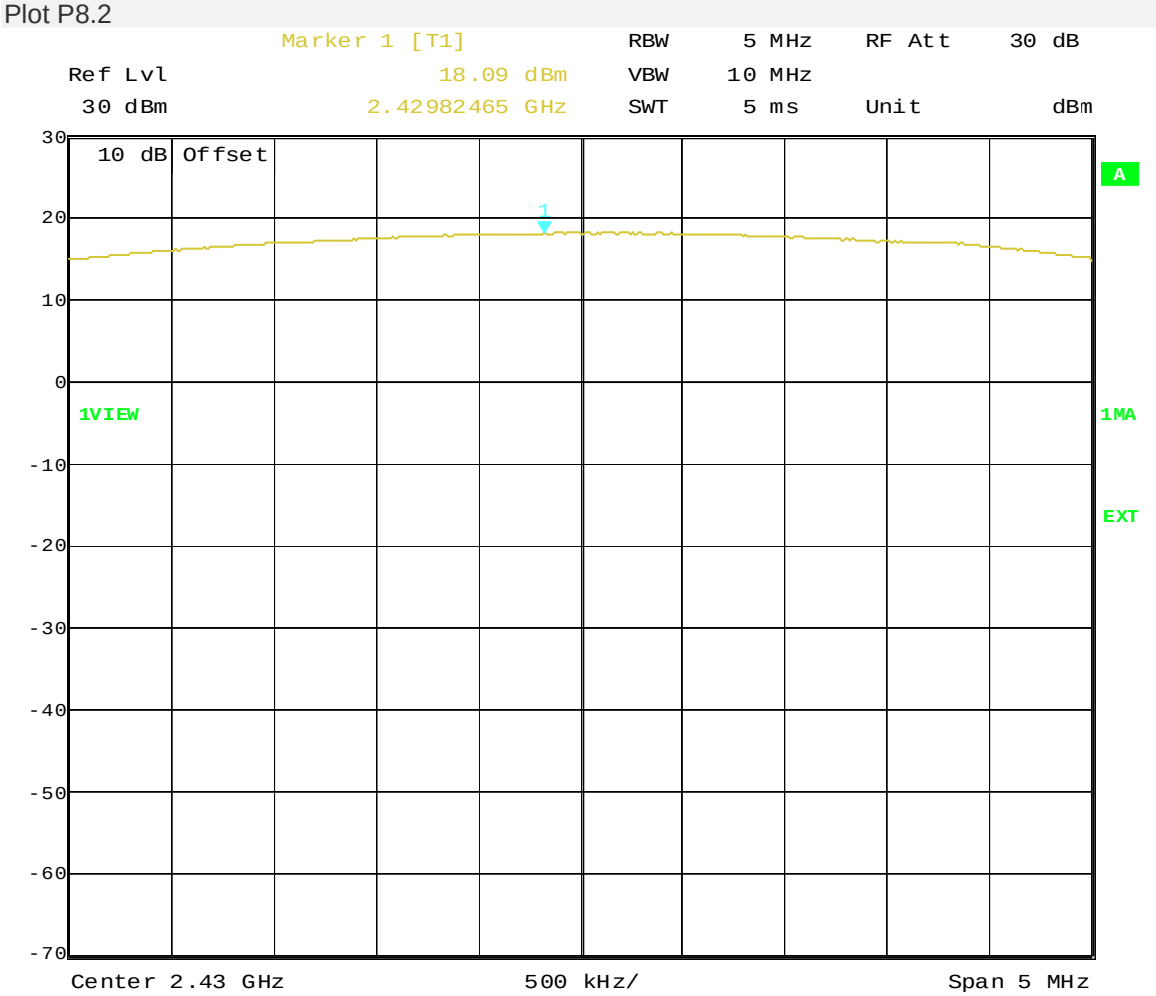
Plot P8.2



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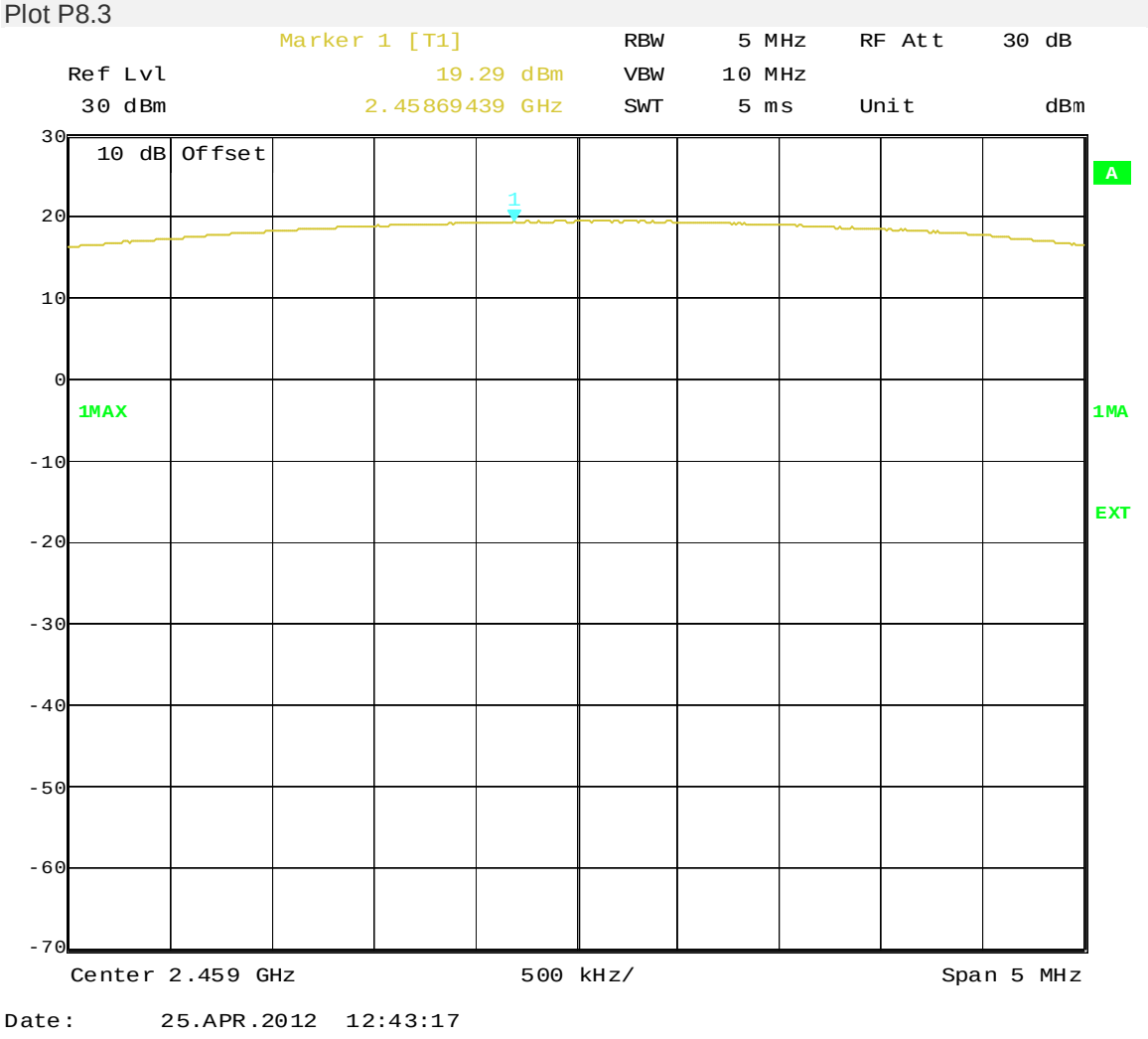
Plot P8.3



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9. BAND EDGE COMPLIANCE

9.1 Test protocol

Date of test: 2012-02-23

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	Measured	Results	Limit value (dBc)
Low	plot P9.1	PASS	20
High	Band 2483.5 – 2485.3 ; Peak: ≤ 57.3 dB(μV/m) AV: ≤ 49.5 dB(μV/m) Note 1	PASS	Peak: 74.0 dB(μV/m) AV: 54 dB(μV/m)

Note 1
Measured according to ANSI C63.10-2009 paragraph 6.9.3.

a) Measured output level = 109.3 dBμV/m
b) Δ = 52 dB
c) Peak level = measured output level – Δ, (109.3 – 52.0 = 57.3 dBμV/m)

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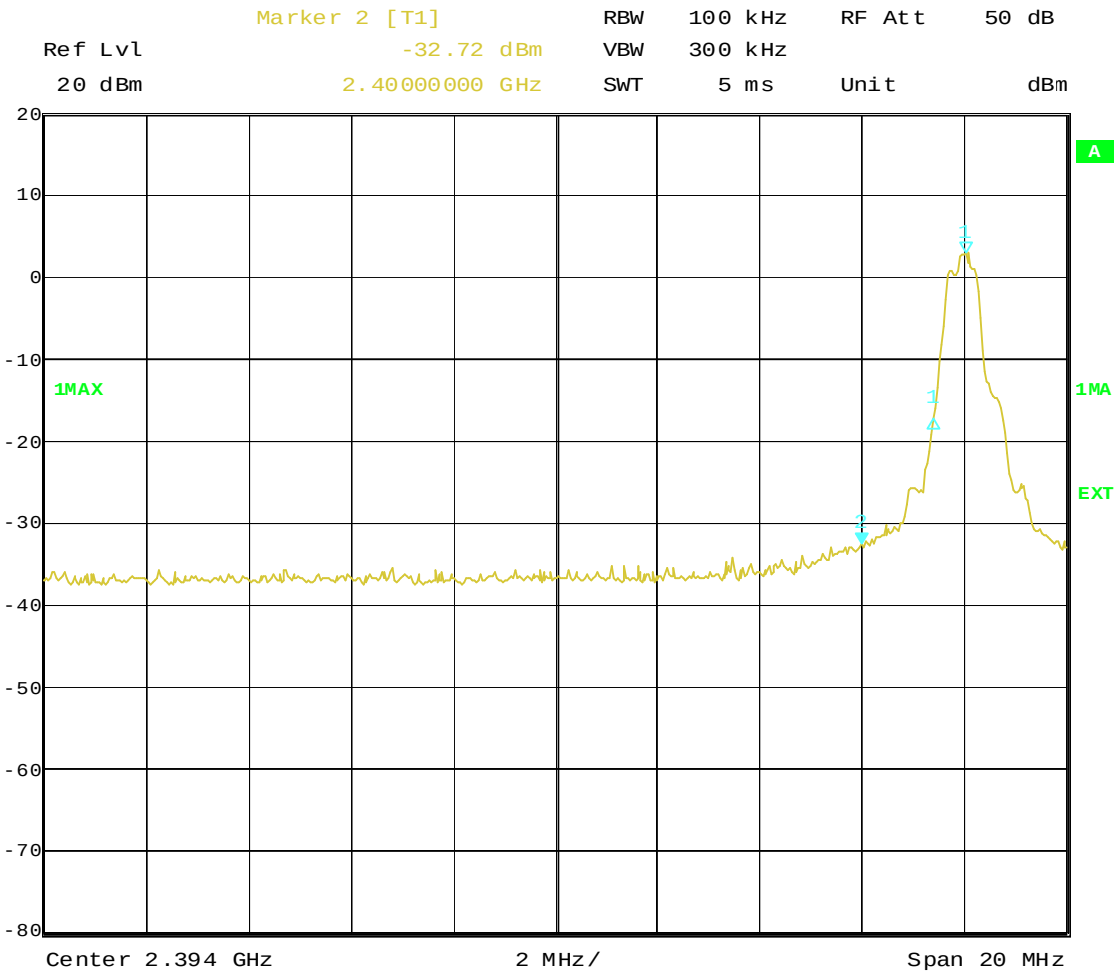
Plot P9.1



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10. RADIATED SPURIOUS EMISSIONS

10.1 Operating environment

Temperature: 20-25 °C (10 – 40 °C)
Relative Humidity: 25-40 % (10 - 90 %)

10.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: ± 4,6 dB
Radiated disturbance electric field intensity, 1000 – 26000 MHz: ± 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%.

10.3 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
Equipment	Manufacturer	Type	SEMKO No.
Test site: Semi-anechoic shielded chamber			30300
Software:	Rohde & Schwarz	EMC 32	
Measurement receiver:	Rohde & Schwarz	ESU 8	12866
Antenna, bilog:	Chase	CBL6111B	12474
Test site: Radio anechoic shielded chamber			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

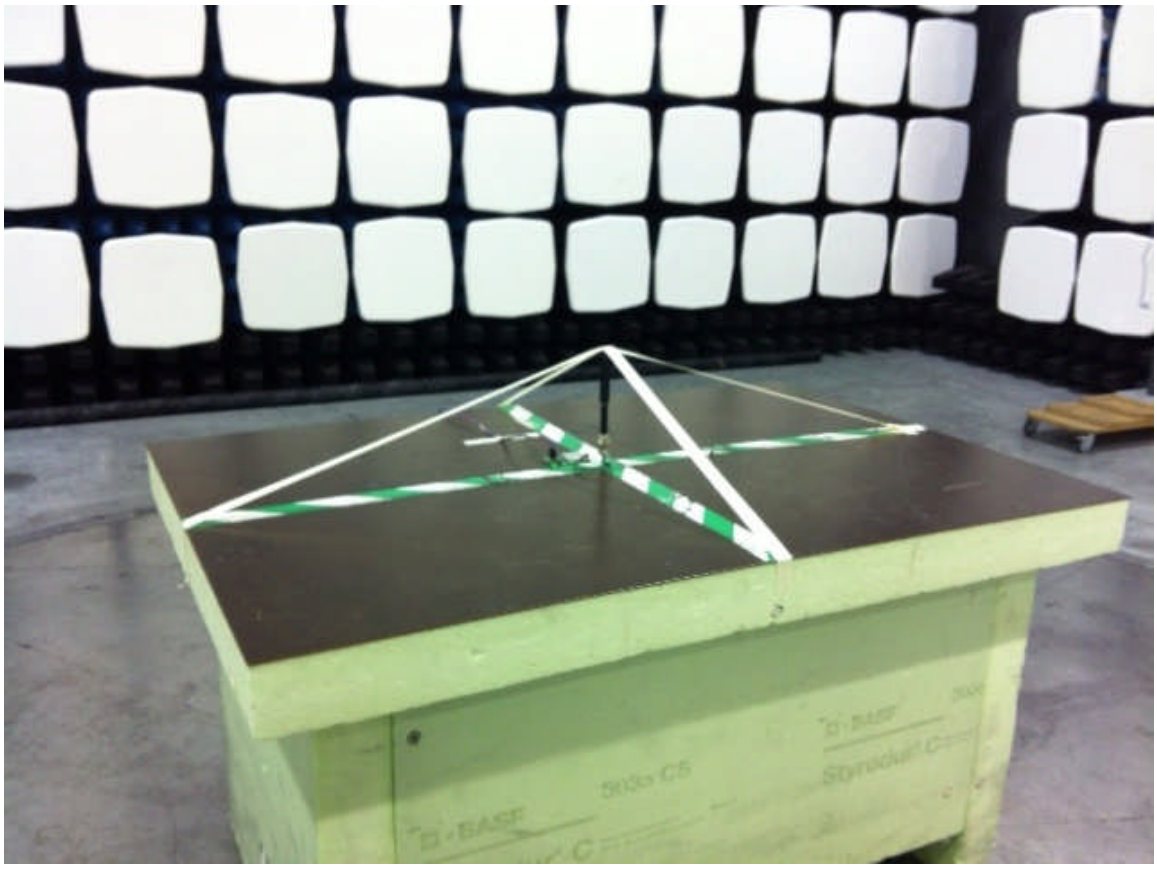
10.4 Measurement set-up

Test site: Big semi anechoic shielded chamber (30 – 1000 MHz)

The EUT was placed on a non-metallic table, 0.8 m above the floor. The radiated field strength was measured at a distance of 3 m. An overview sweep with peak detection was performed with the measurement receiver in max-hold and with the antenna placed 1.5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 45-degree steps. The specified test mode was enabled.

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 quasi peak measurements were carried out.

Test setup photo,



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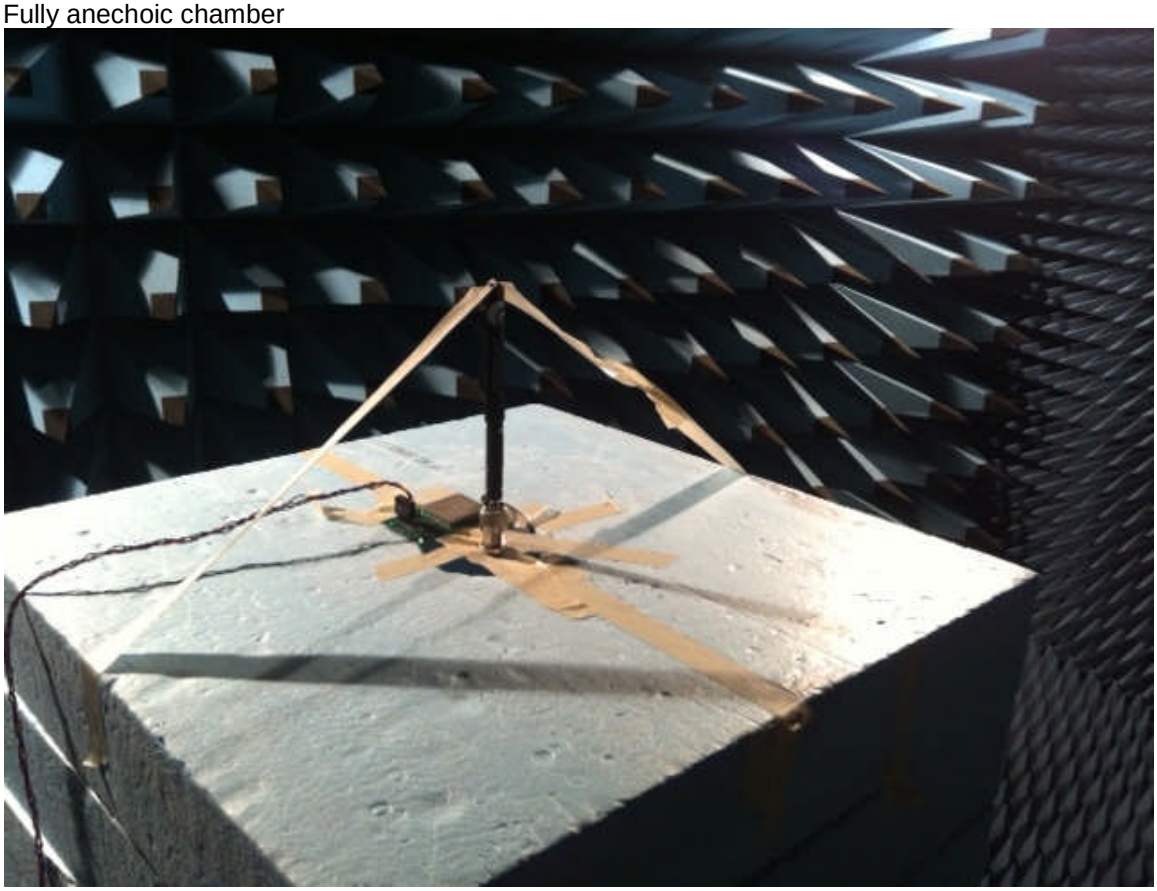
Test site: Big anechoic shielded chamber (1 – 10 GHz)

The overview sweep where made in a fully anechoic shielded chamber. In the fully anechoic shielded chamber the EUT was placed on a non-metallic table, 1.5 m above the floor. The radiated field strength was measured at a distance of 3 m. An overview sweep with peak detection was performed with the measurement receiver in max-hold and with the antenna placed 1.5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps. The specified test mode was enabled.

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 peak measurements were carried out in a semi anechoic chamber

Test set-up photo,
Fully anechoic chamber



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Semi anechoic chamber

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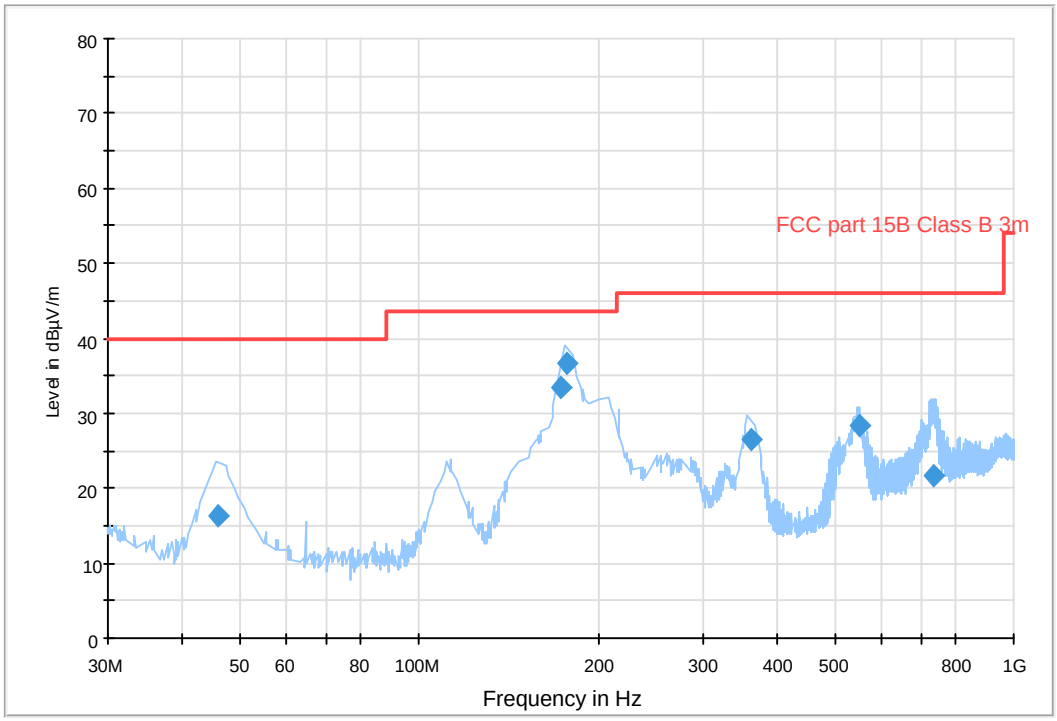
10.5 Test protocol

Semi-anechoic shielded chamber

Date of test: 2012-02-08

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

FCC 30 - 1000 MHz FCC class B 3m



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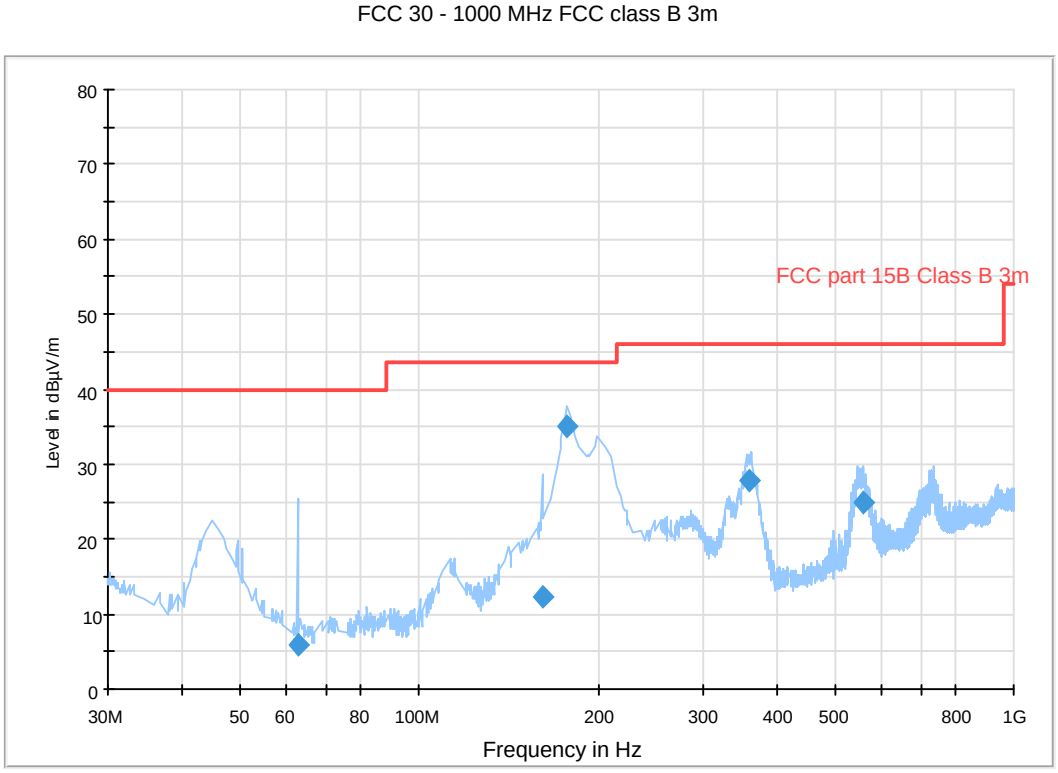
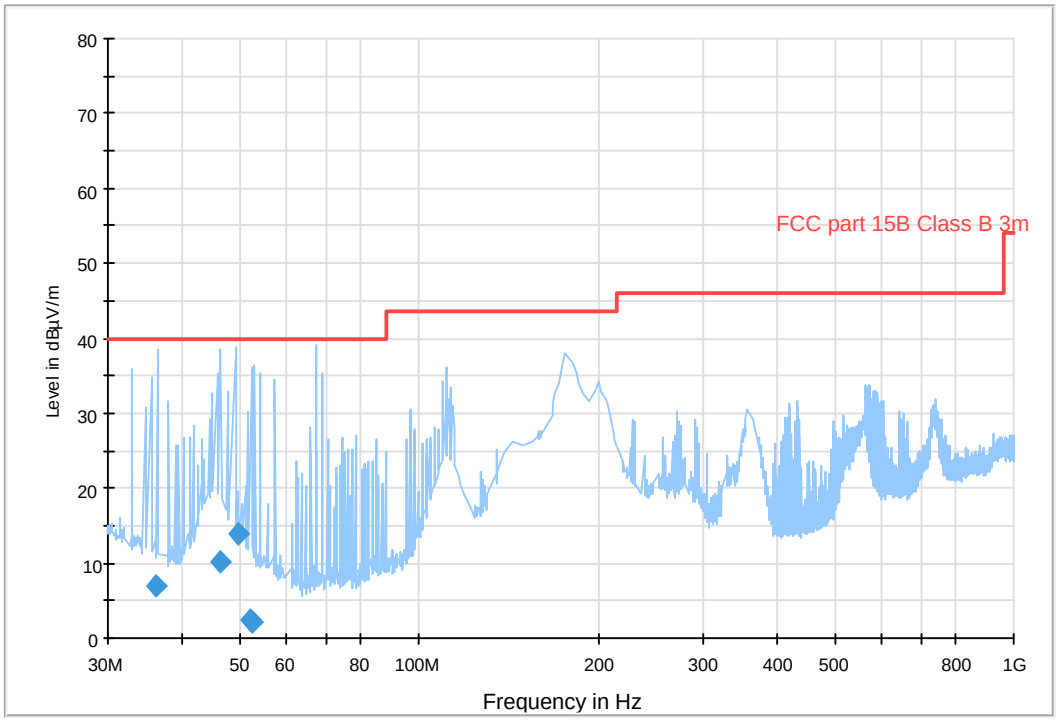
30 – 1000 MHz, max peak at a distance of 3 m on the middle TX channel



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



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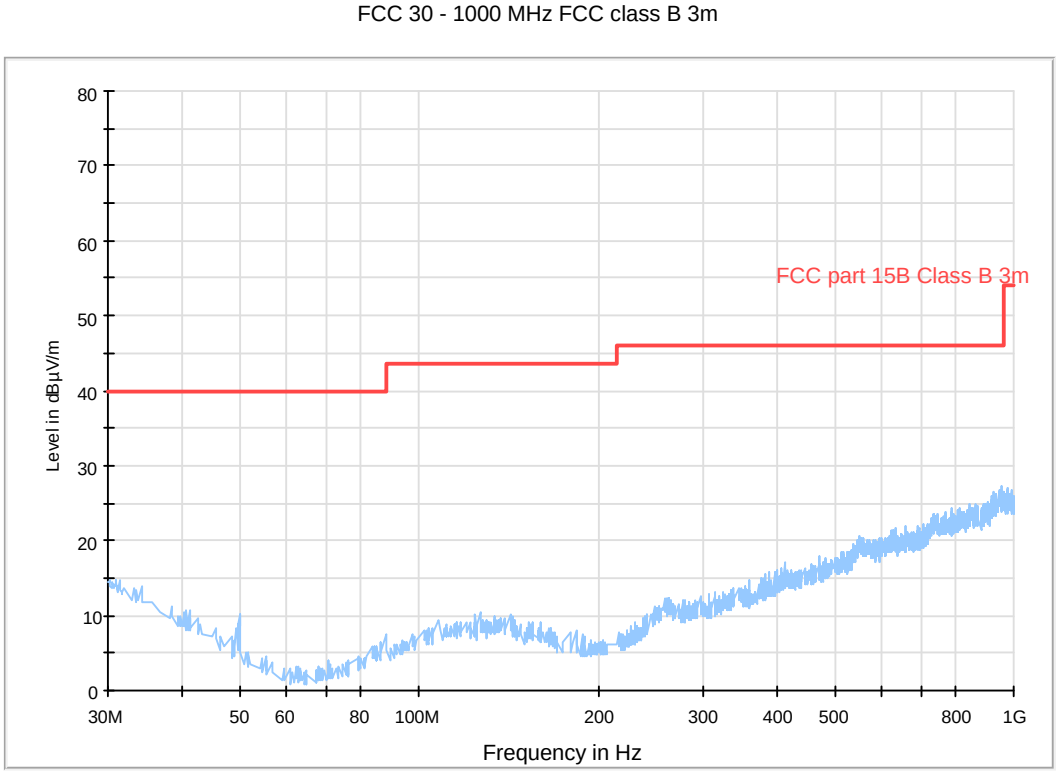
30 – 1000 MHz, max peak at a distance of 3 m in the RX mode



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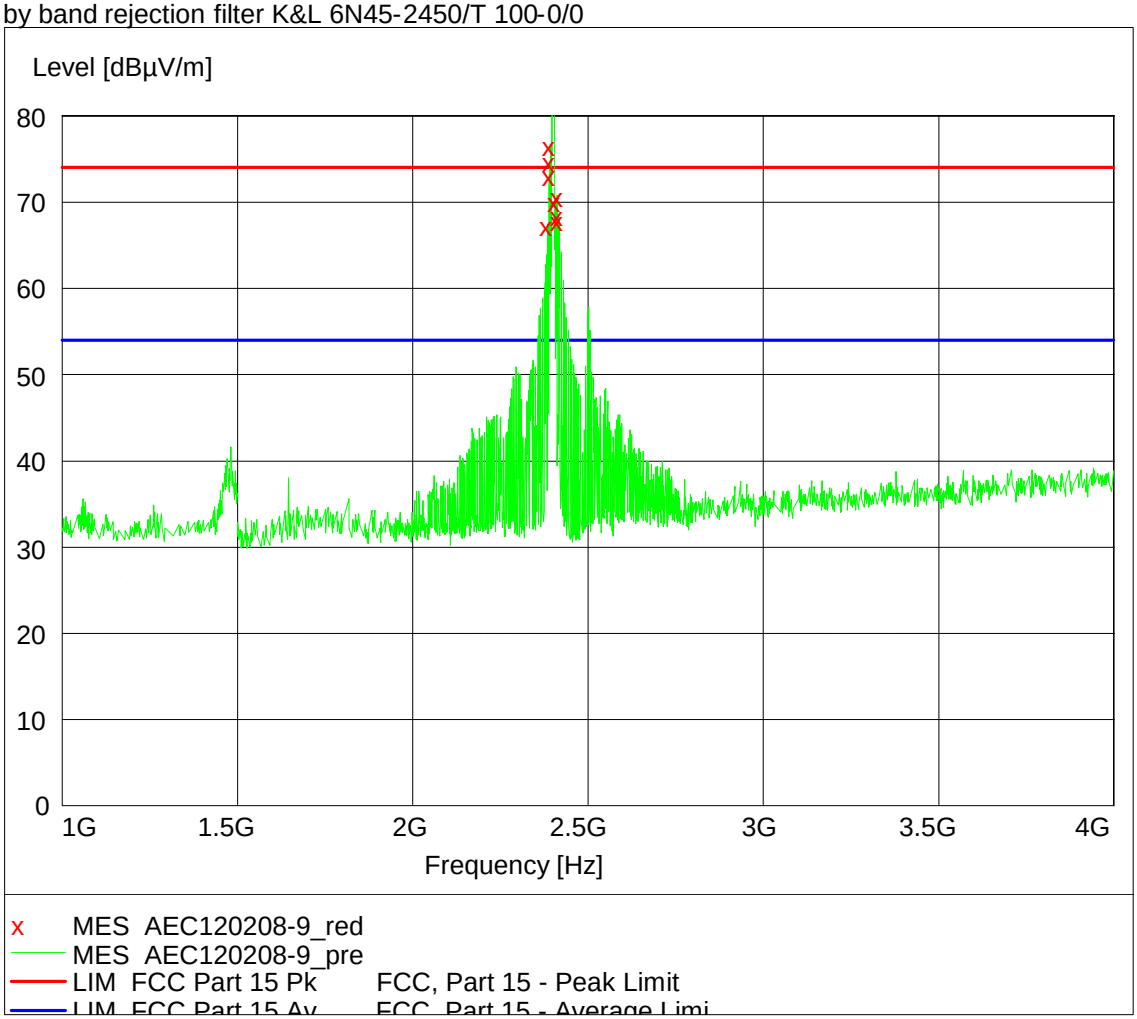
Radio anechoic shielded chamber

Date of test: 2012-02-08

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



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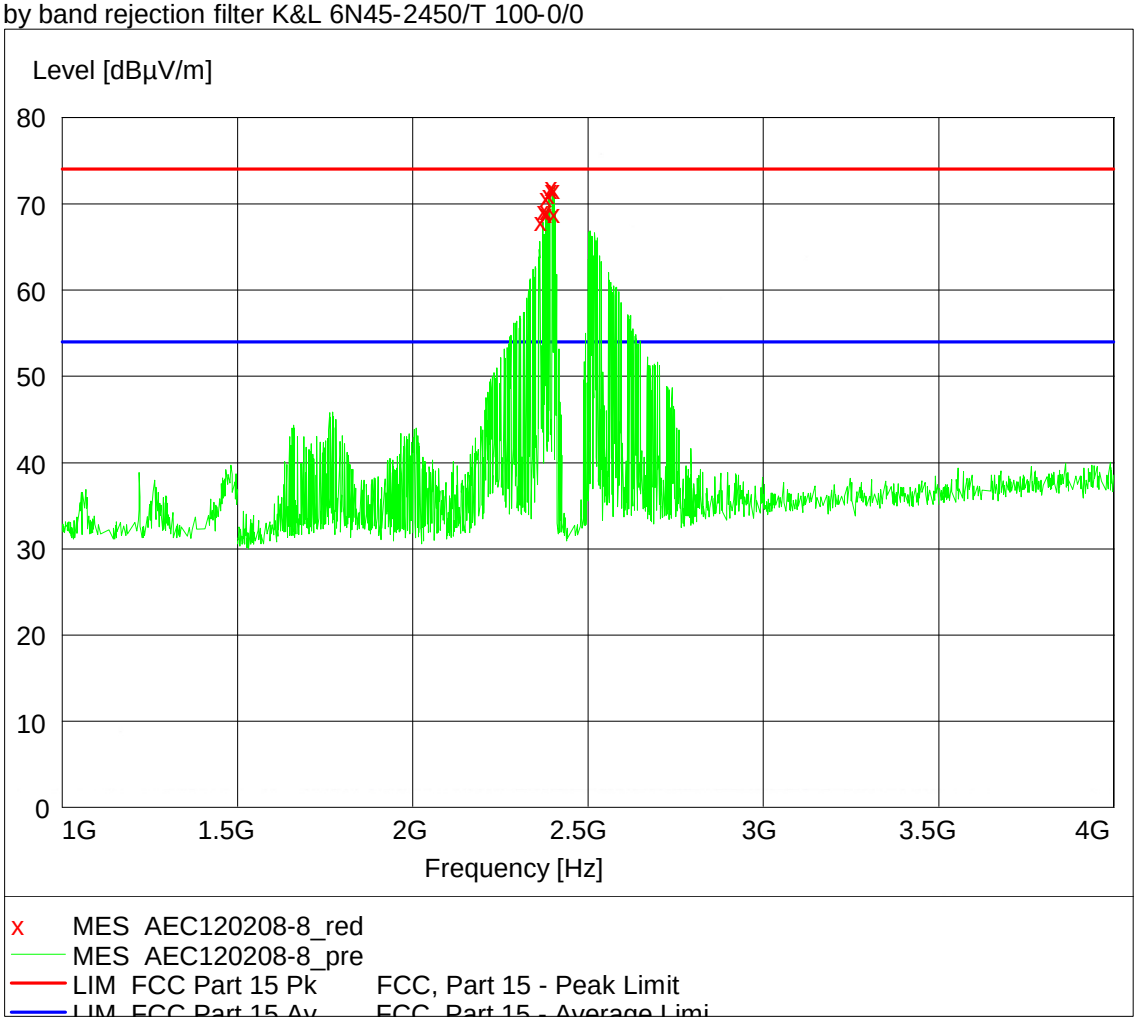
1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



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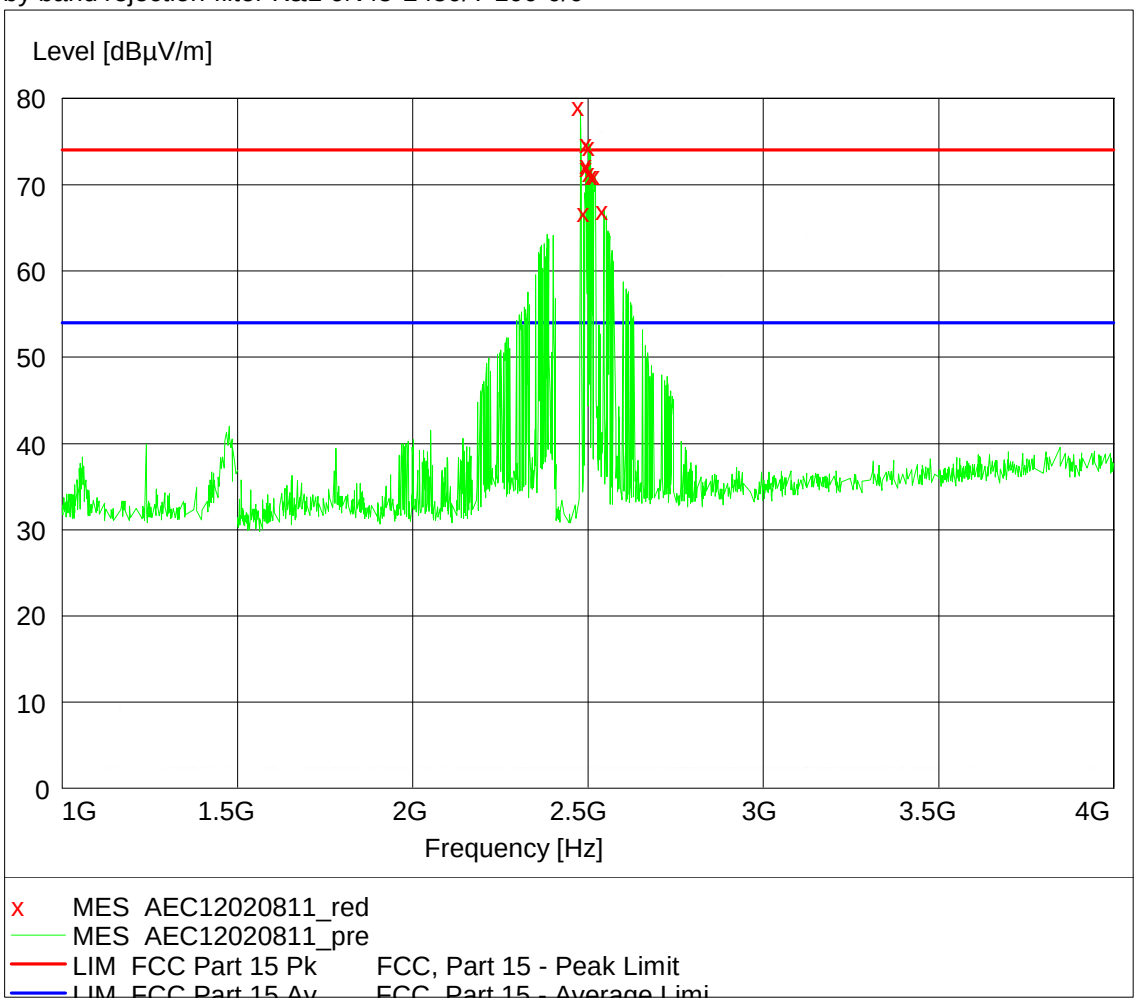
1000 – 4000 MHz, max peak at a distance of 3 m on the higher TX channel. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



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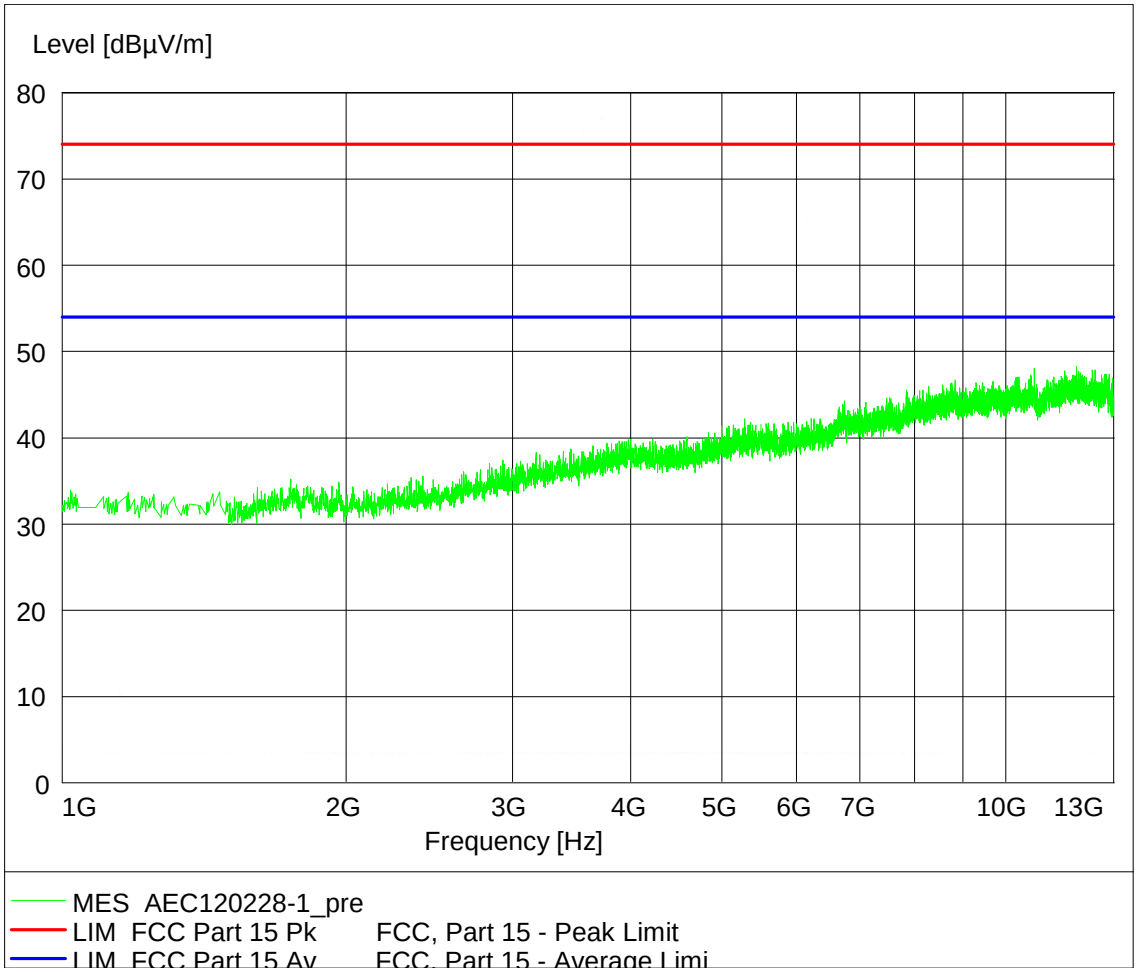
1000 – 13000 MHz, max peak at a distance of 3 m on RX mode



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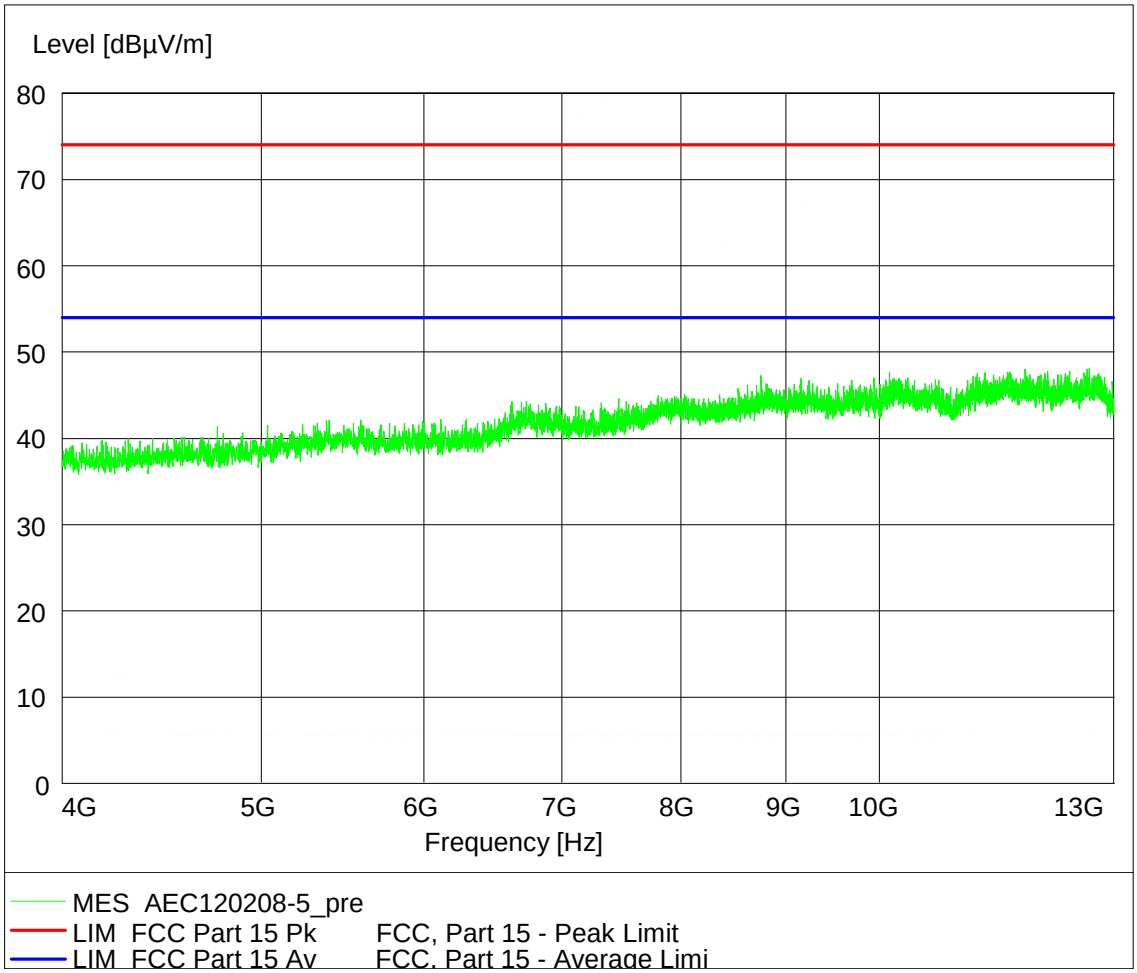
4000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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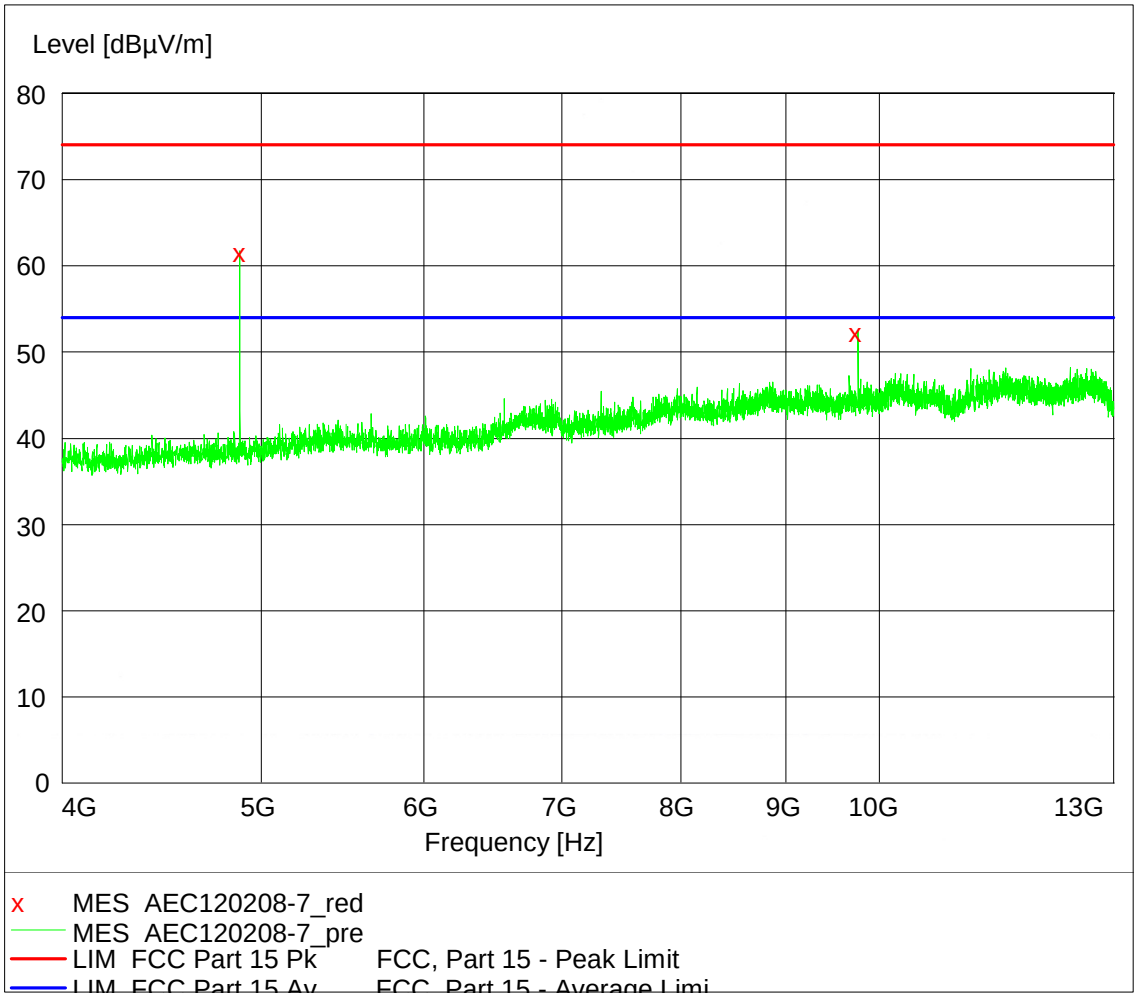
4000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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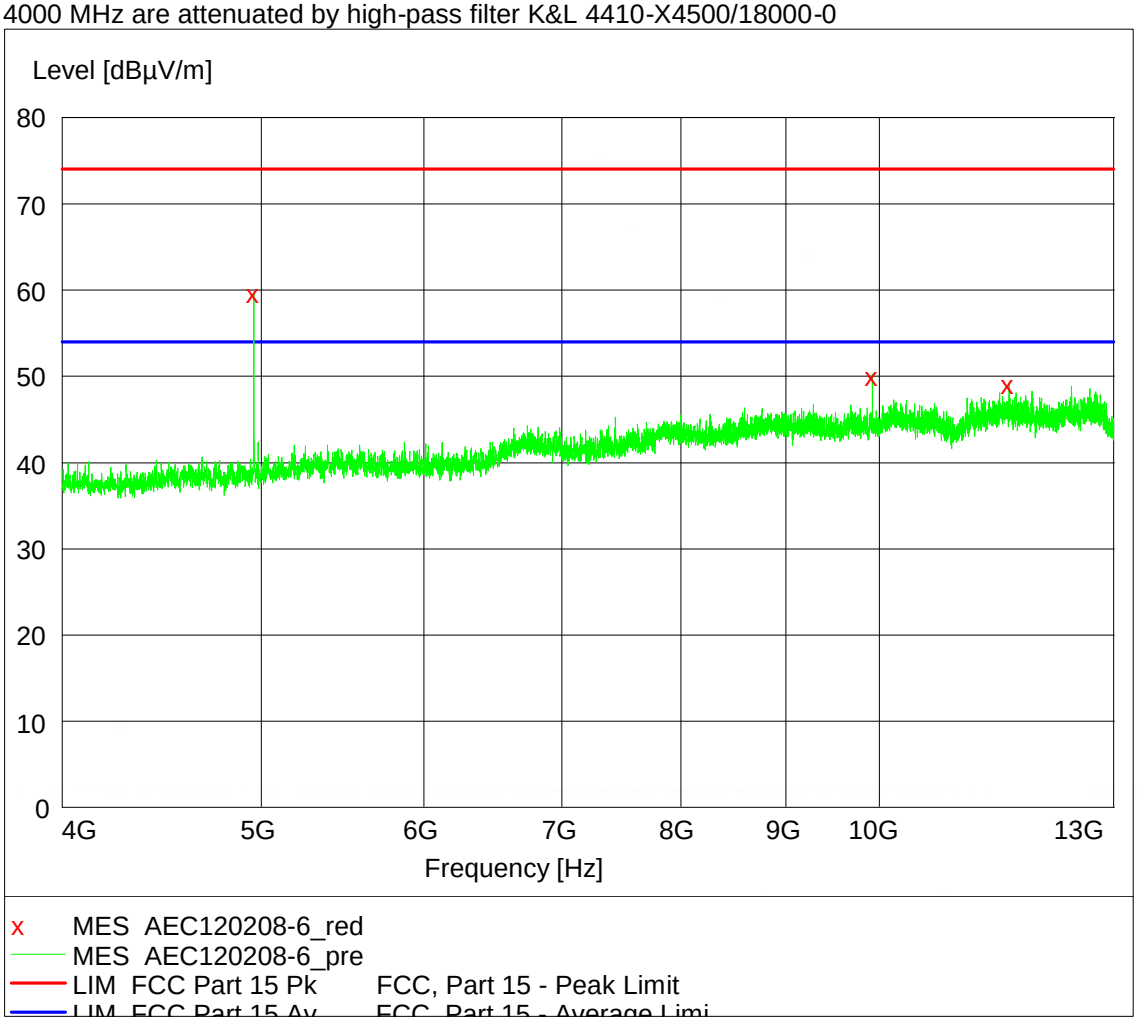
4000 – 13000 MHz, max peak at a distance of 3 m on the higher TX channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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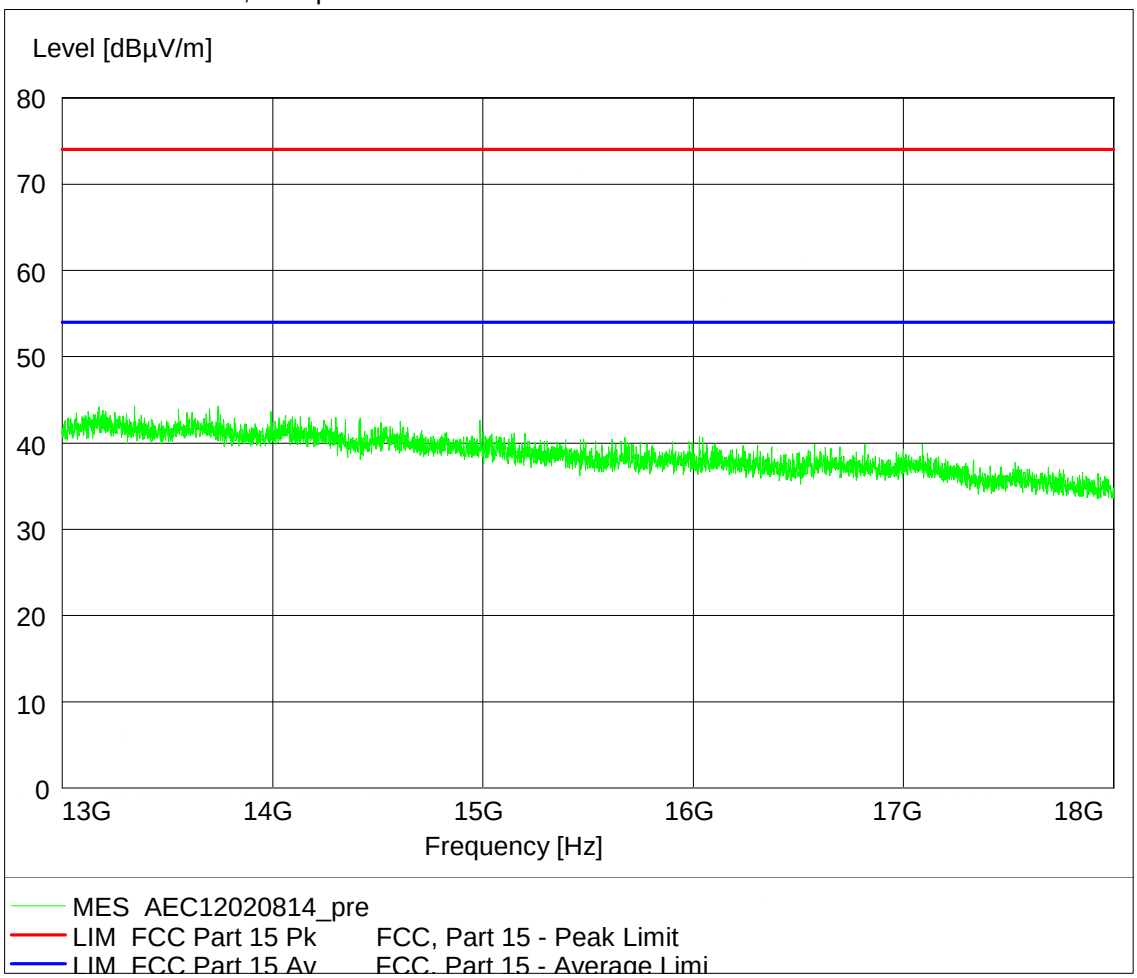
13000 – 18000 MHz, max peak at a distance of 3 m on the lower TX channel



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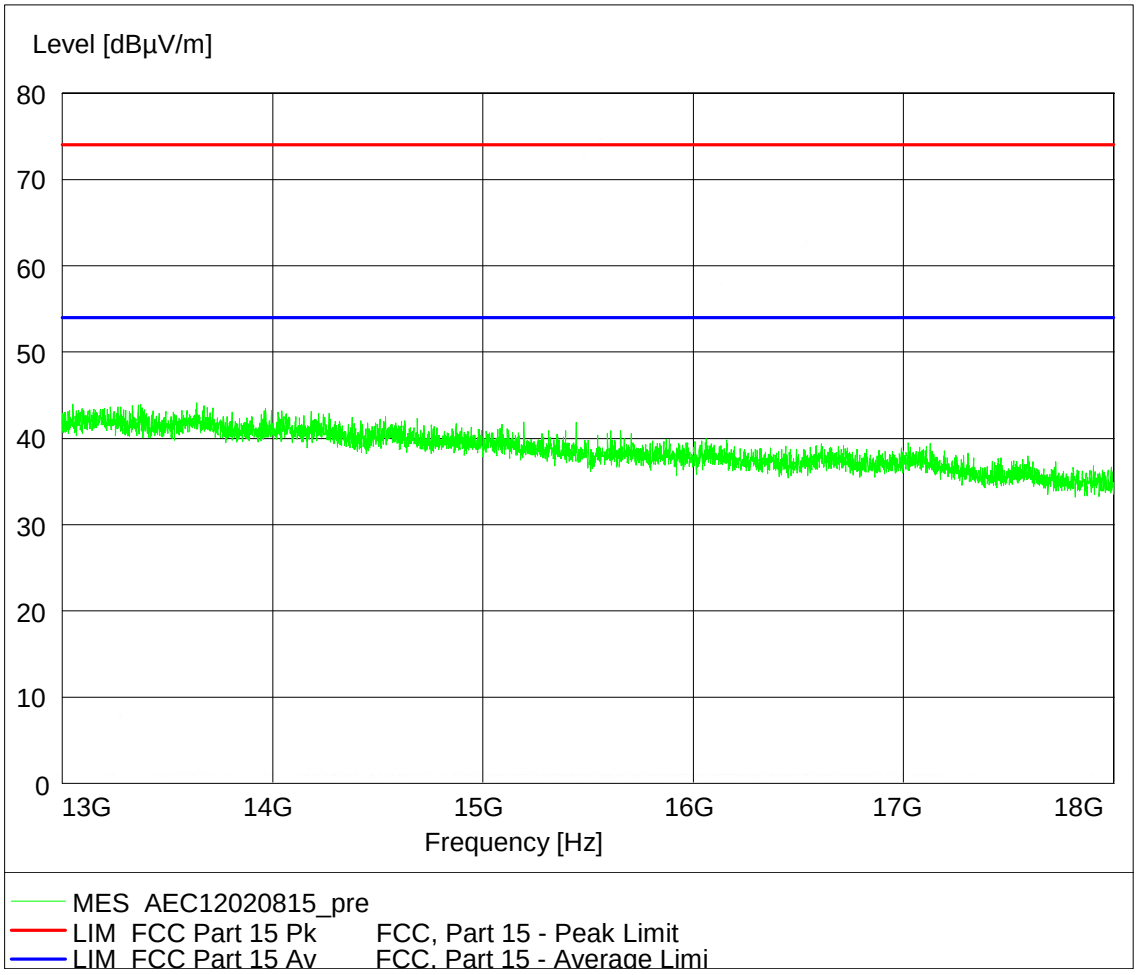
13000 – 18000 MHz, max peak at a distance of 3 m on the middle TX



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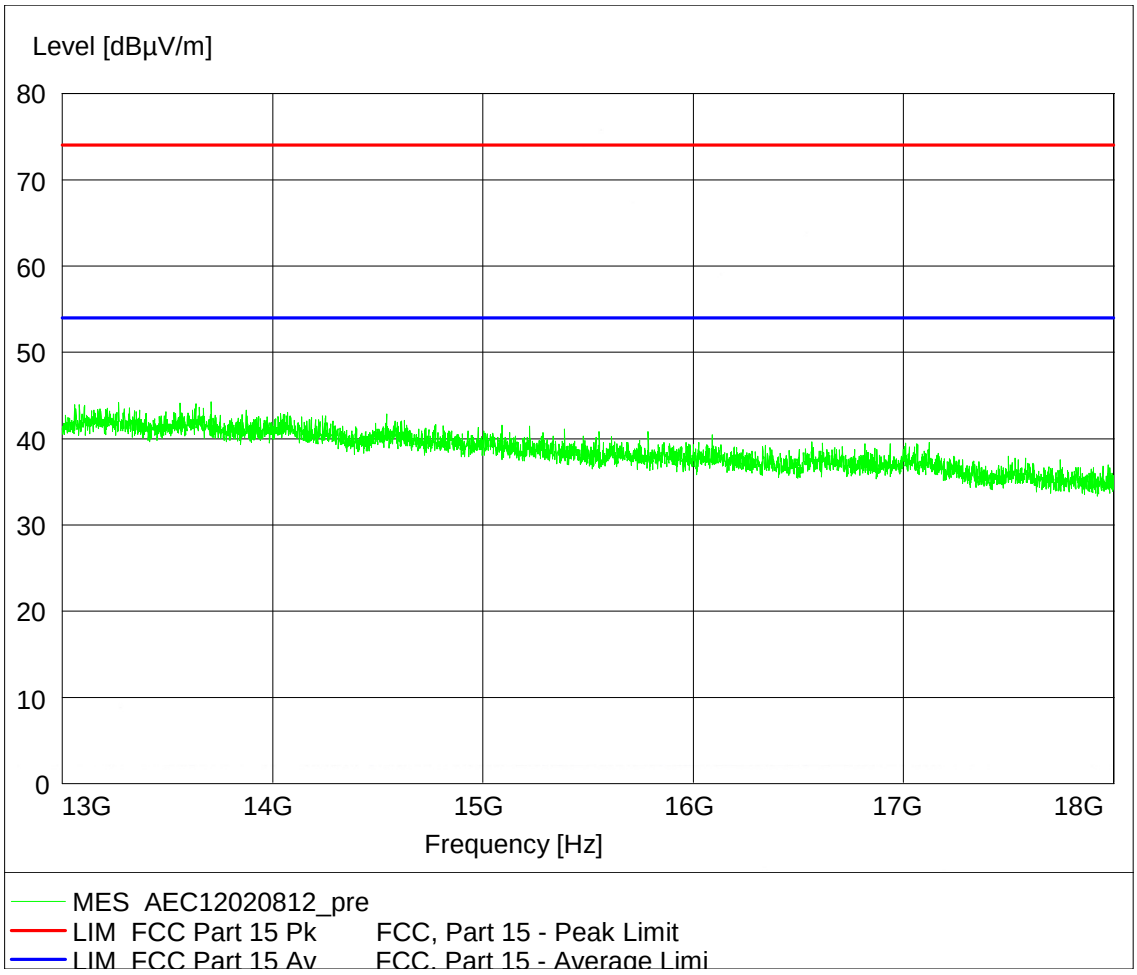
13000 – 18000 MHz, max peak at a distance of 3 m on the higher TX channel



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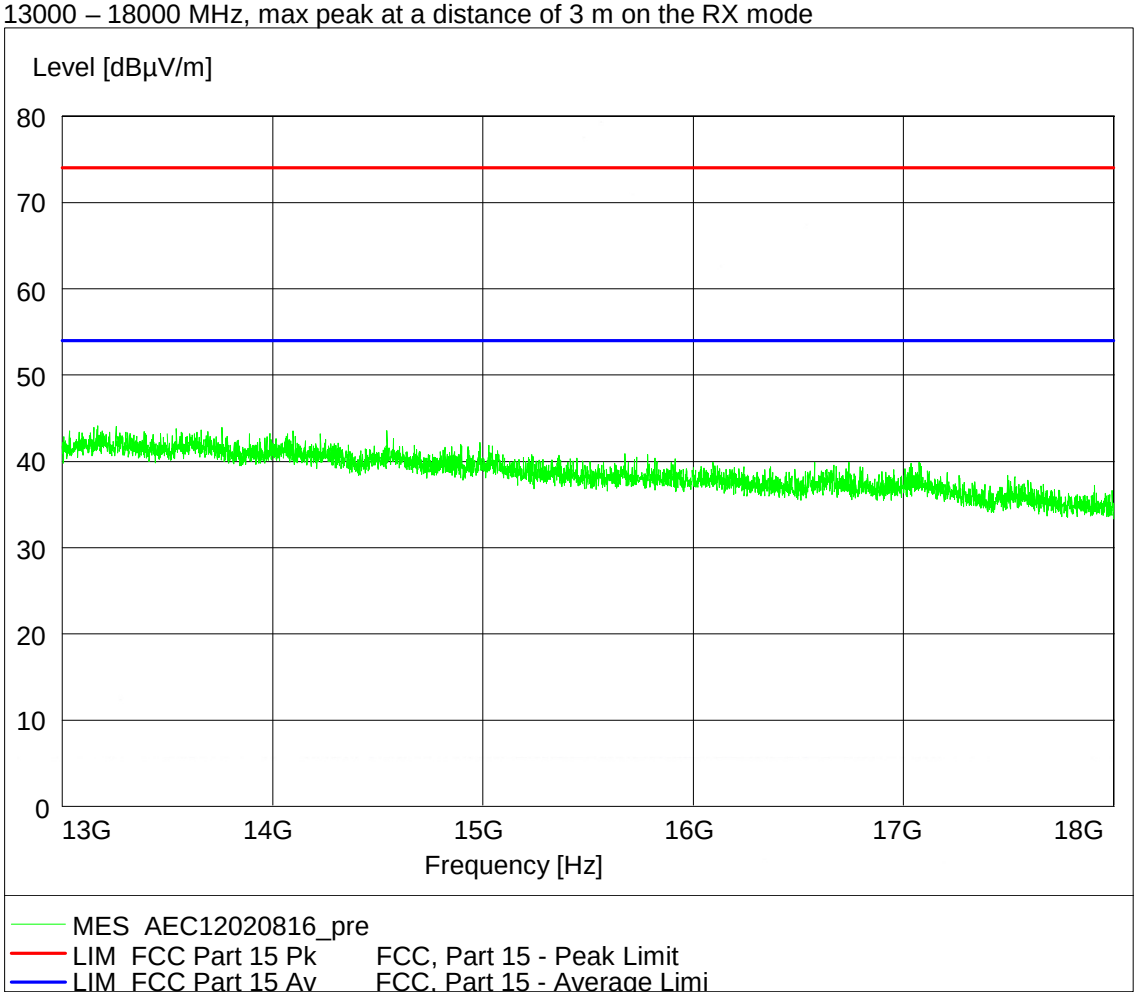
13000 – 18000 MHz, max peak at a distance of 3 m on the RX mode



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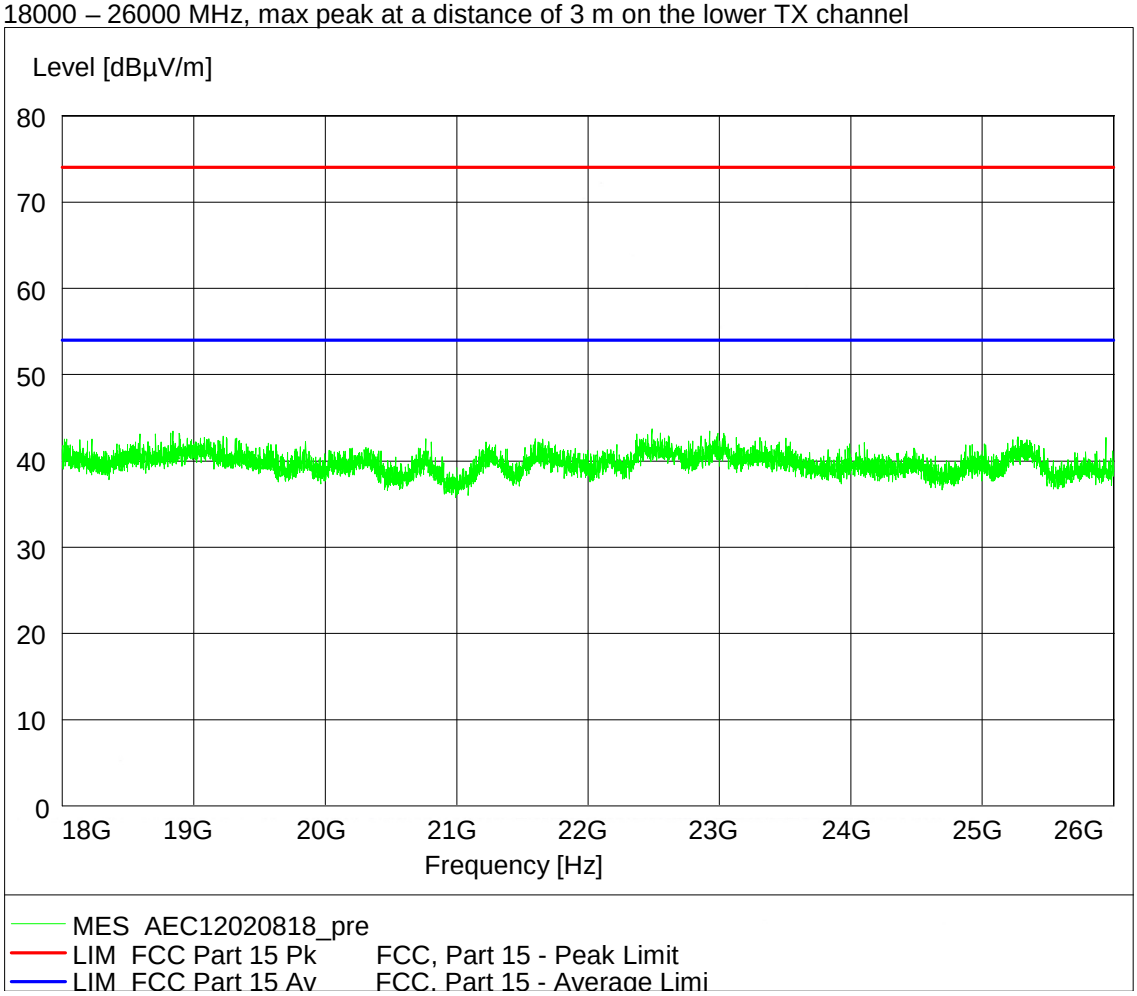
18000 – 26000 MHz, max peak at a distance of 3 m on the lower TX channel



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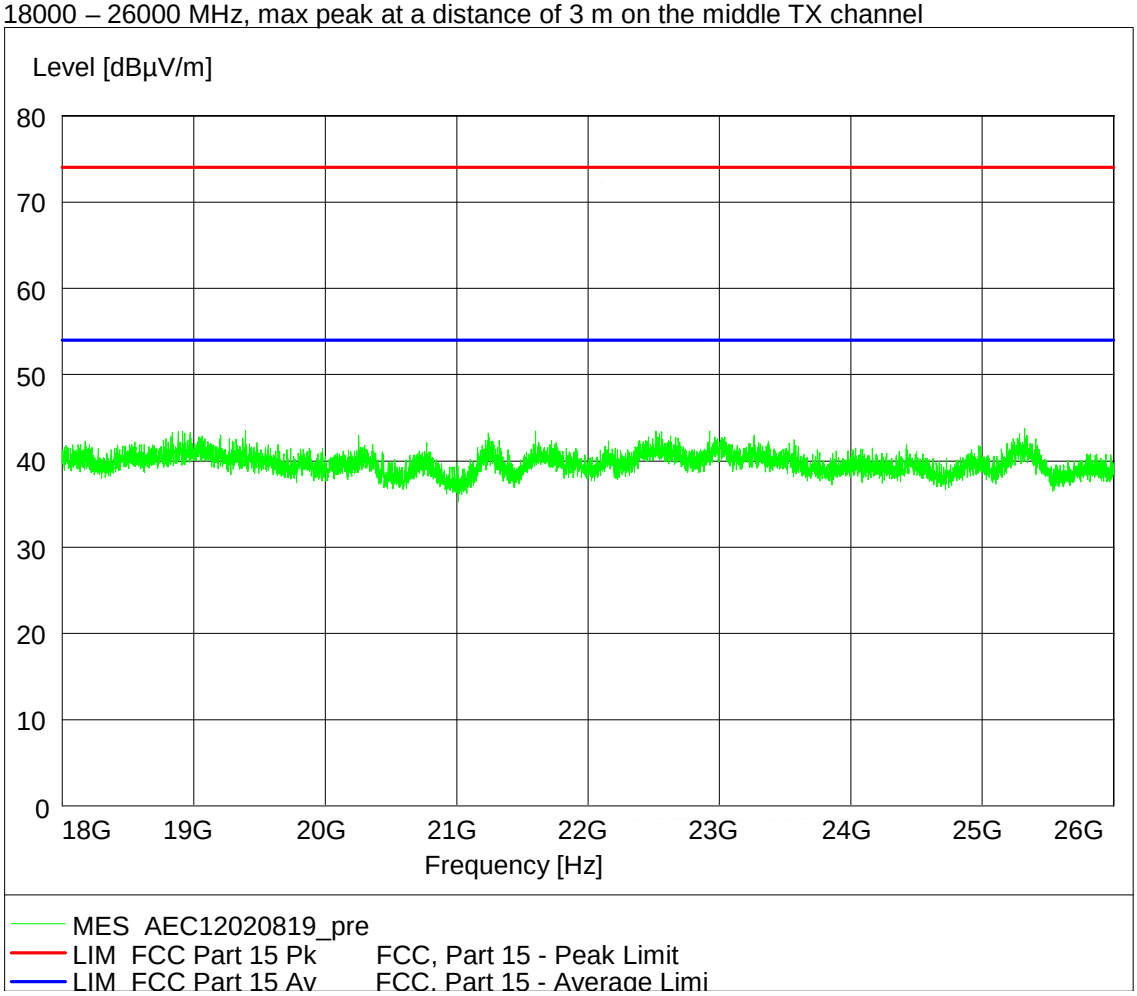
18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



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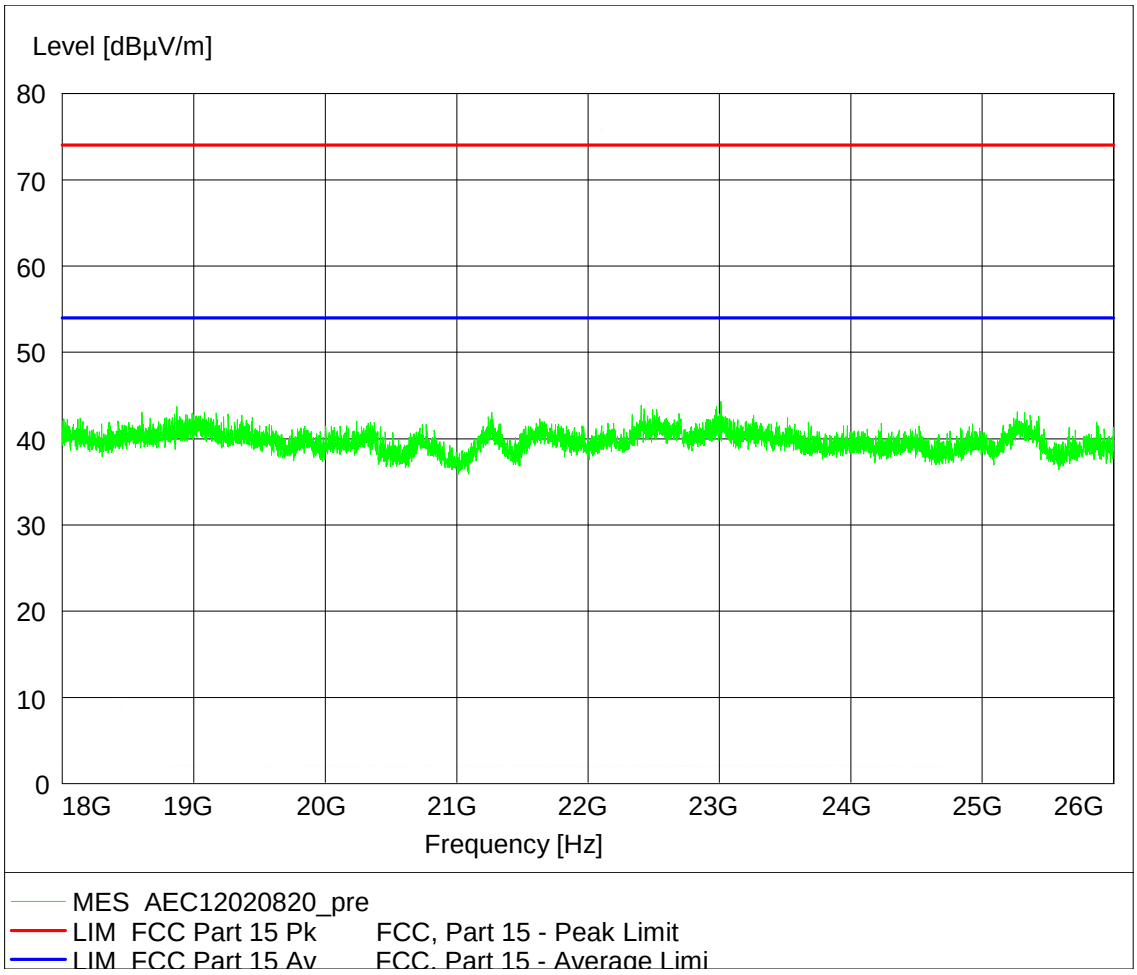
18000 – 26000 MHz, max peak at a distance of 3 m on the higher TX channel



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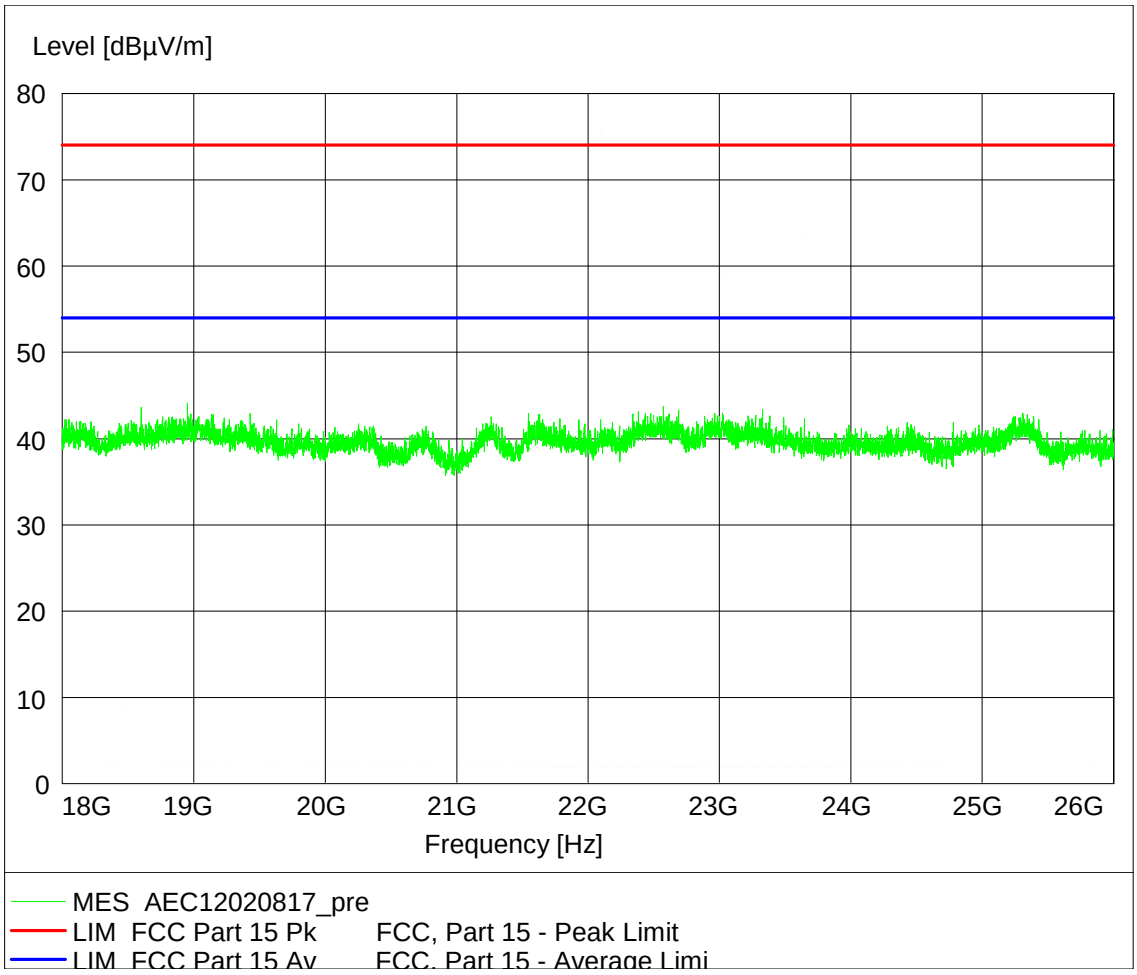
18000 – 26000 MHz, max peak at a distance of 3 m on the RX mode



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Data summary

Field strength of spurious emissions low channel						
Frequency	RBW	Measured level		Limit		Note
		QP/Peak	AV	QP/Peak	AV	
[MHz]	[kHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	
45.85	120		-	43.5	-	
173.69	120		-	46	-	
177.75	120		-	46	-	
361.32	120		-	46	-	
549.43	120		-	46	-	
732.13	120		-	46	-	

Field strength of spurious emissions middle channel						
Frequency	RBW	Measured level		Limit		Note
		QP/Peak	AV	QP/Peak	AV	
[MHz]	[kHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	
62.71	120	6.0	-	43.5	-	
161.84	120	12.2	-	46	-	
177.80	120	35.2	-	46	-	
360.01	120	27.7	-	46	-	
557.45	120	24.8	-	46	-	
4962.60	1000	43.0		74	54	
7440.00	1000	52.4		74	54	1

Field strength of spurious emissions high channel						
Frequency	RBW	Measured level		Limit		Note
		QP/Peak	AV	QP/Peak	AV	
[MHz]	[kHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	
36.06	120	7.0	-	43.5	-	
46.13	120	10.3	-	46	-	
4951	120	14.0	-	46	-	
51.99	120	2.4	-	46	-	
52.40	120	2.1	-	46	-	
67.26	120	-1.8	-	46	-	
4917.80	1000	60.3	52.2	74	54	
9835.80	1000	56.0	48.7	74	54	
12294.20	1000	55.4	48.1	74	54	

Field strength of spurious emissions RX mode						
Frequency	RBW	Measured level		Limit		Note
		QP/Peak	AV	Peak	AV	
[MHz]	[kHz]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	
30-1000	120	-	-	-	-	No significant peaks above noise floor
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]

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

11.1 Test protocol

Date of test: 2012-02-23

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	P11.1 – P11.4	PASS	20
Middle	P11.5 – P11.8	PASS	20
High	P11.9 – P11.12	PASS	20

11.2 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.

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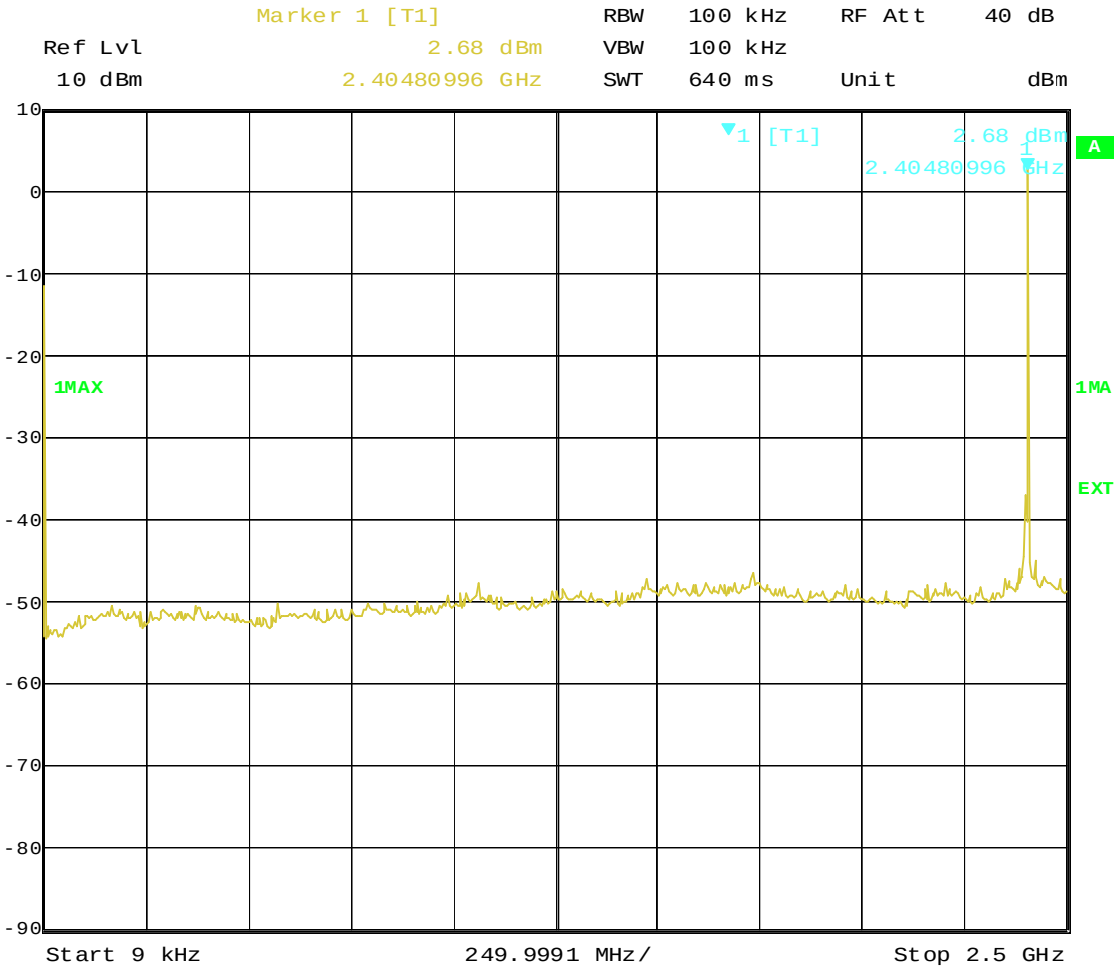
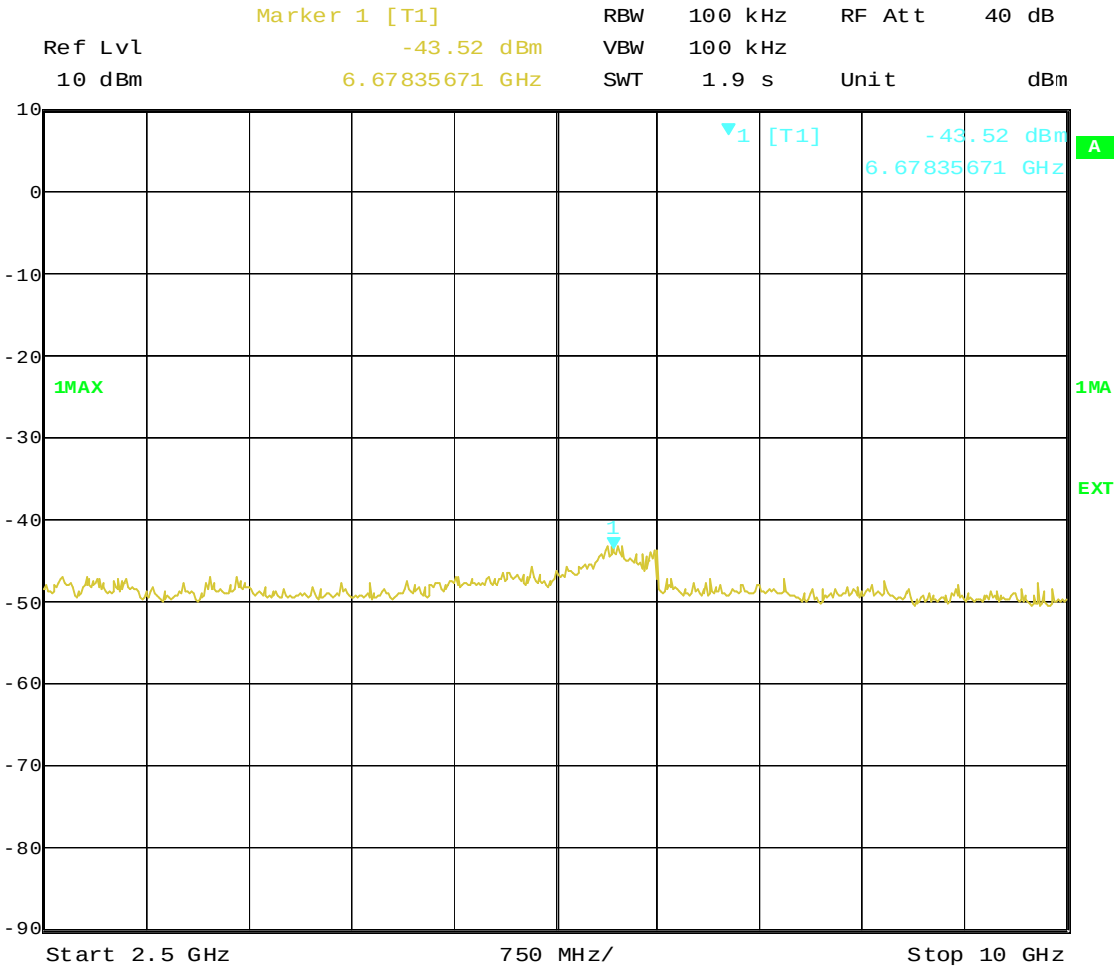
Plot P11.1



Date: 21.FEB.2012 13:06:01

Plot P11.2



Date: 21.FEB.2012 13:07:26

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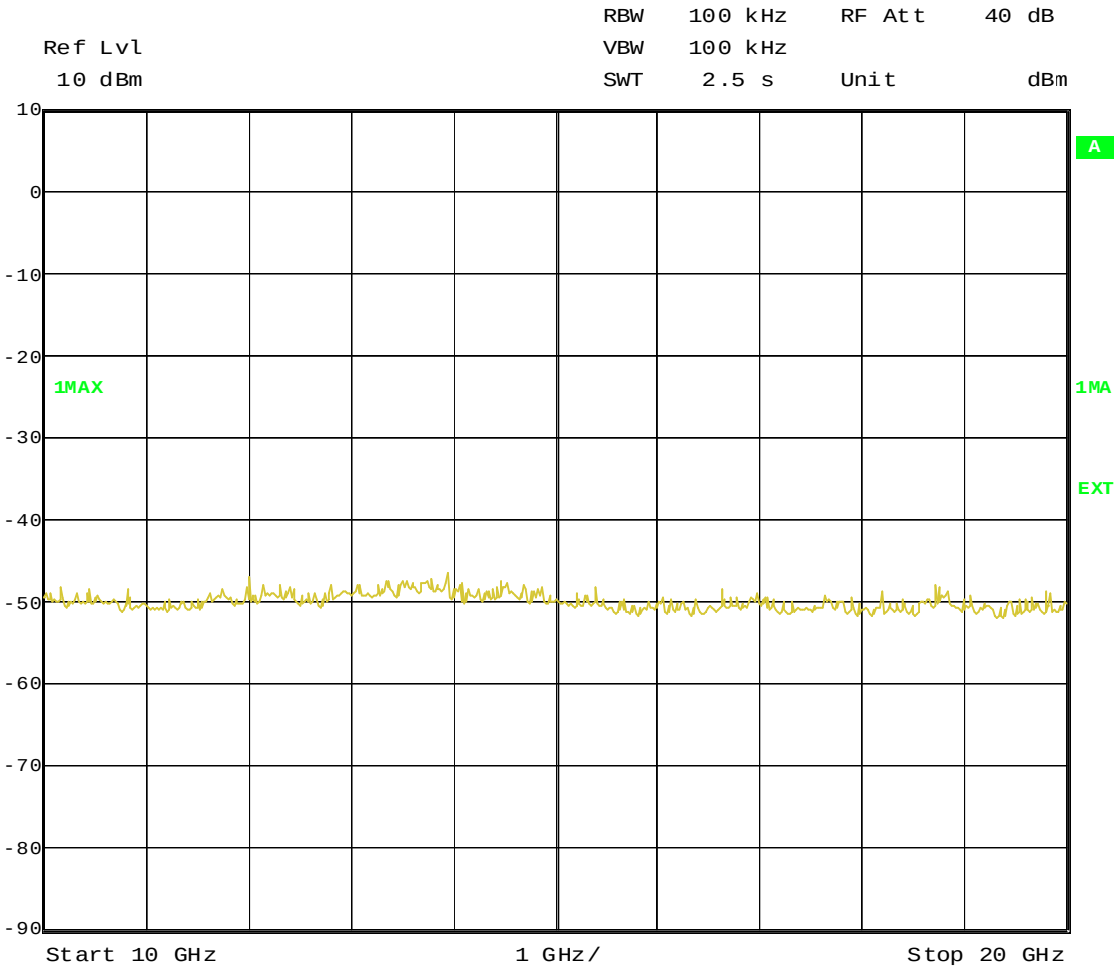
Plot P11.3



Date: 21.FEB.2012 13:09:11

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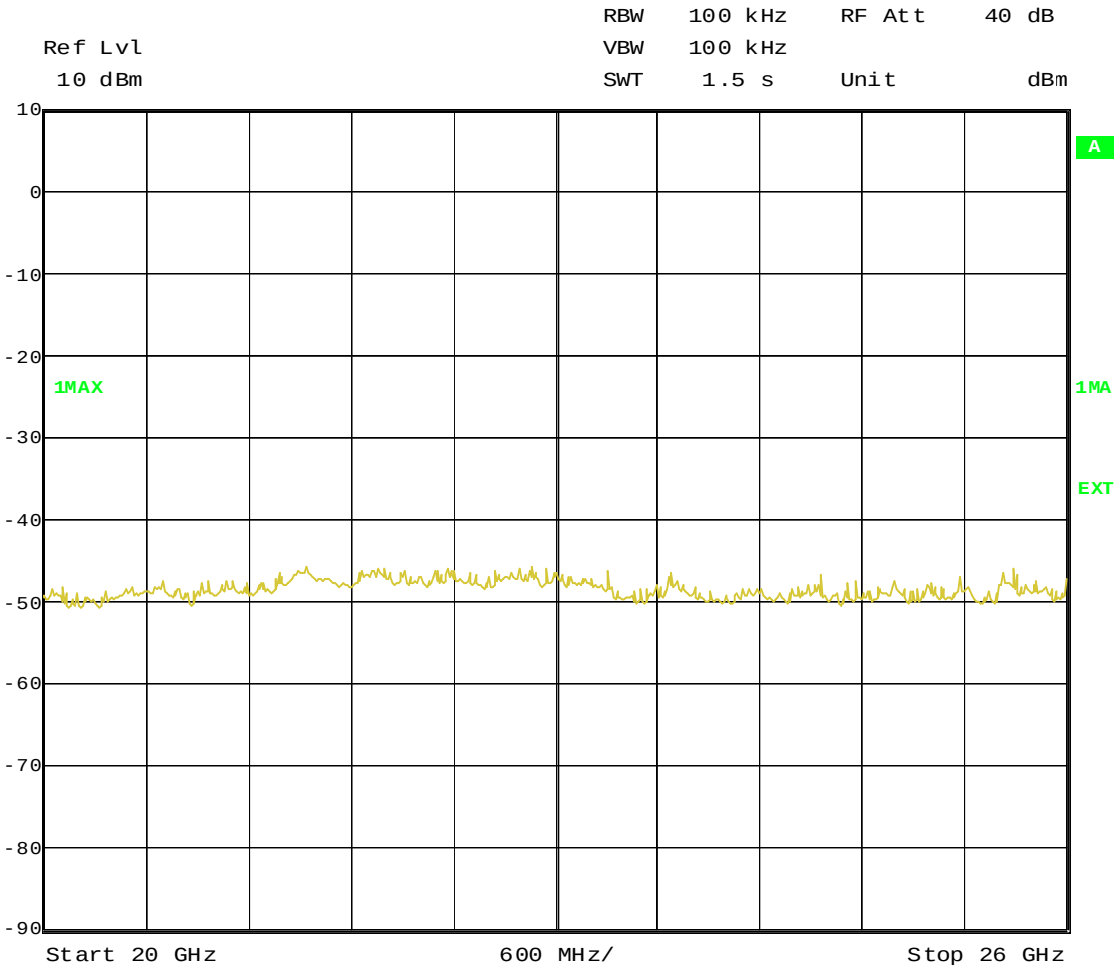
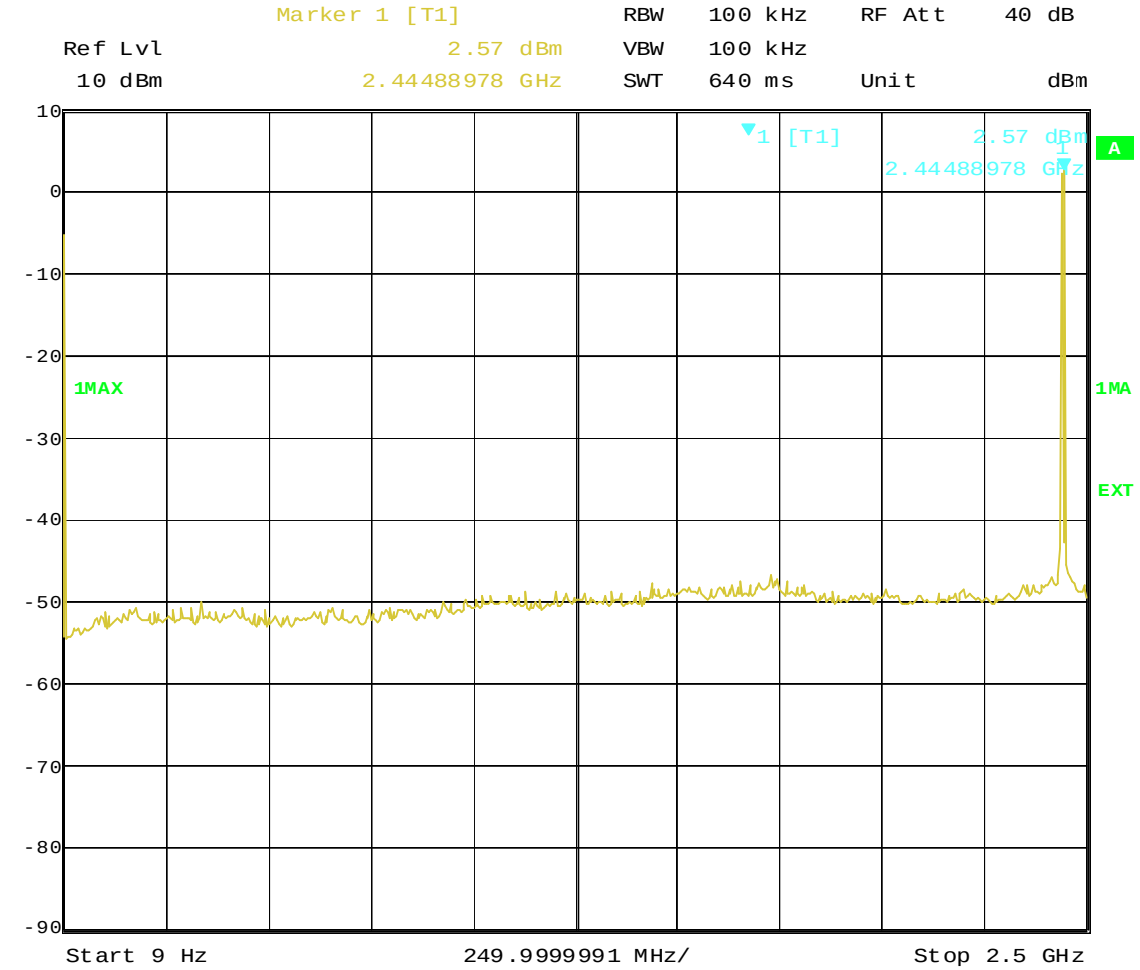
Plot P11.4



Date: 21.FEB.2012 13:09:48

Plot P11.5



Date: 21.FEB.2012 13:17:29

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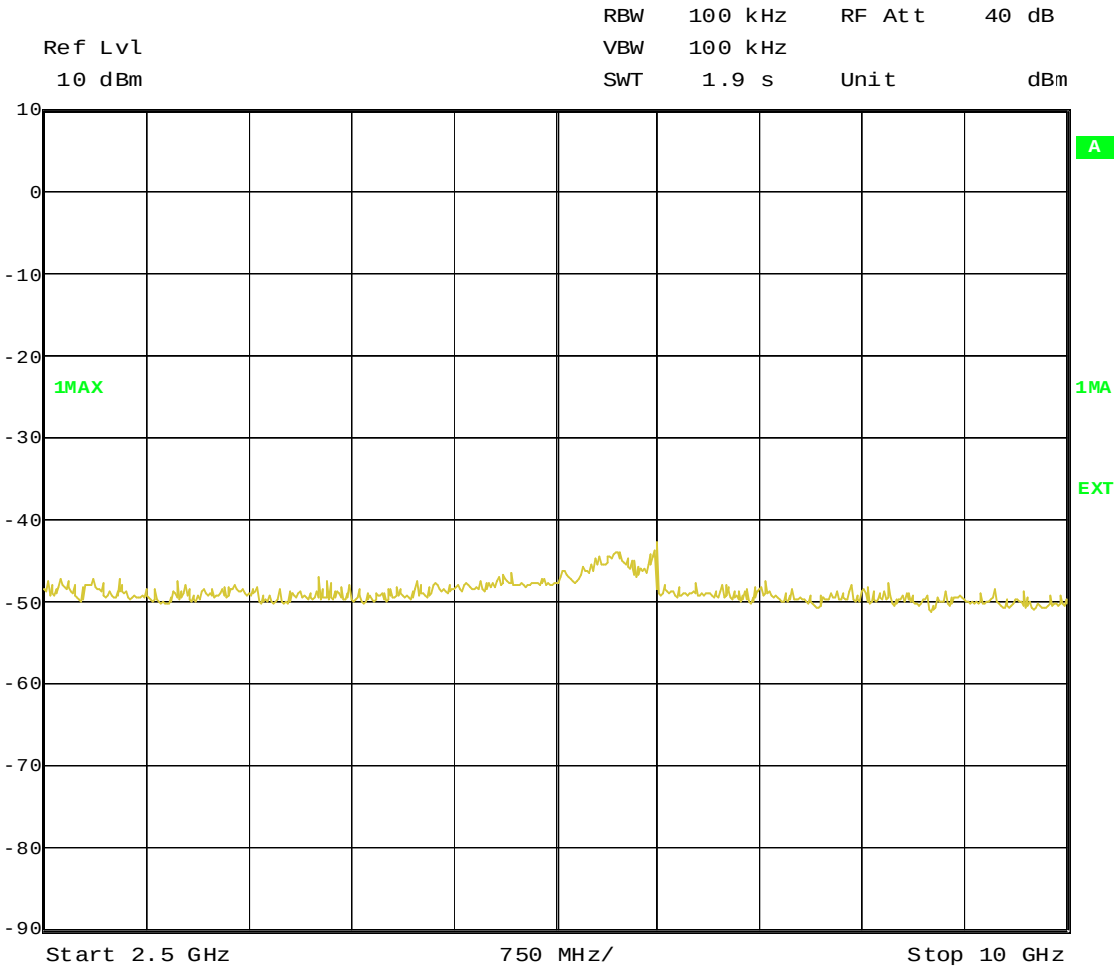
Plot P11.6



Date: 21.FEB.2012 13:18:19

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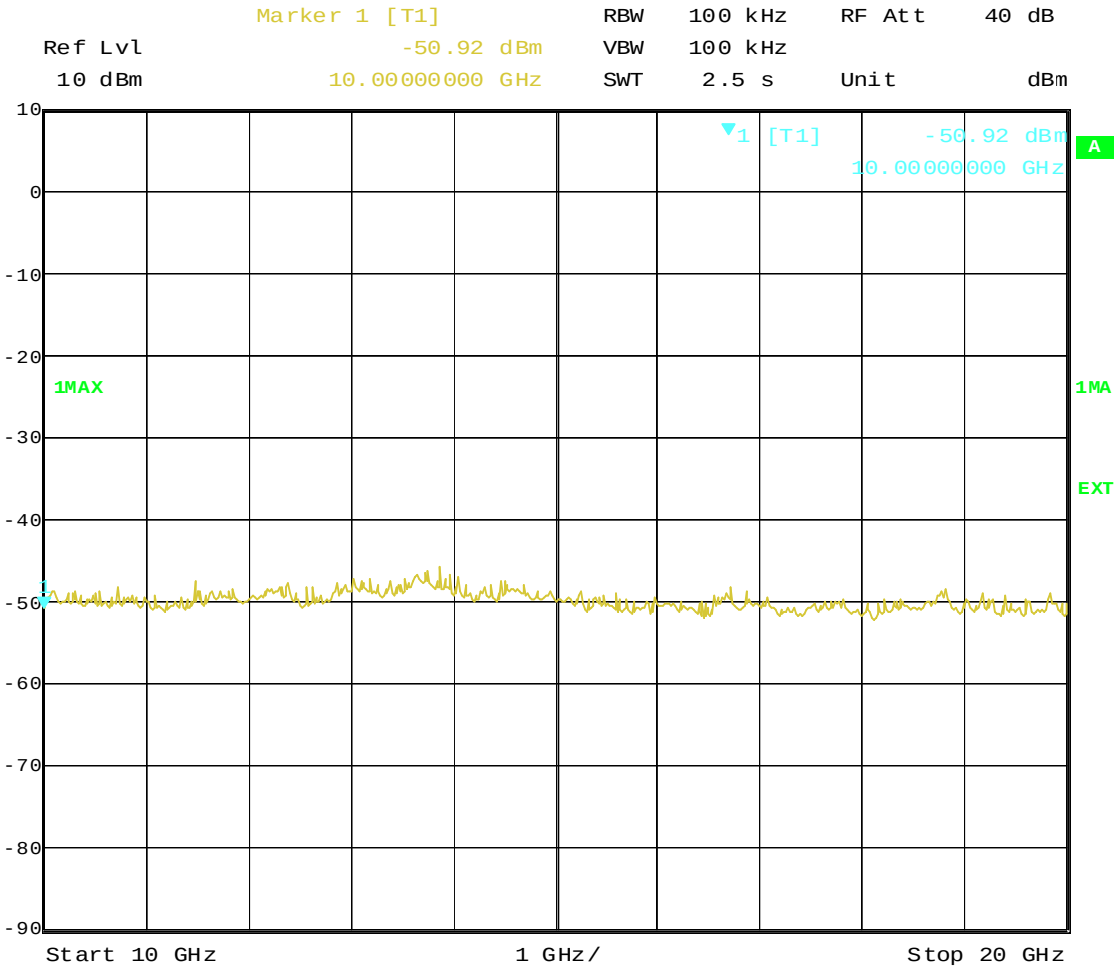
Plot P11.7



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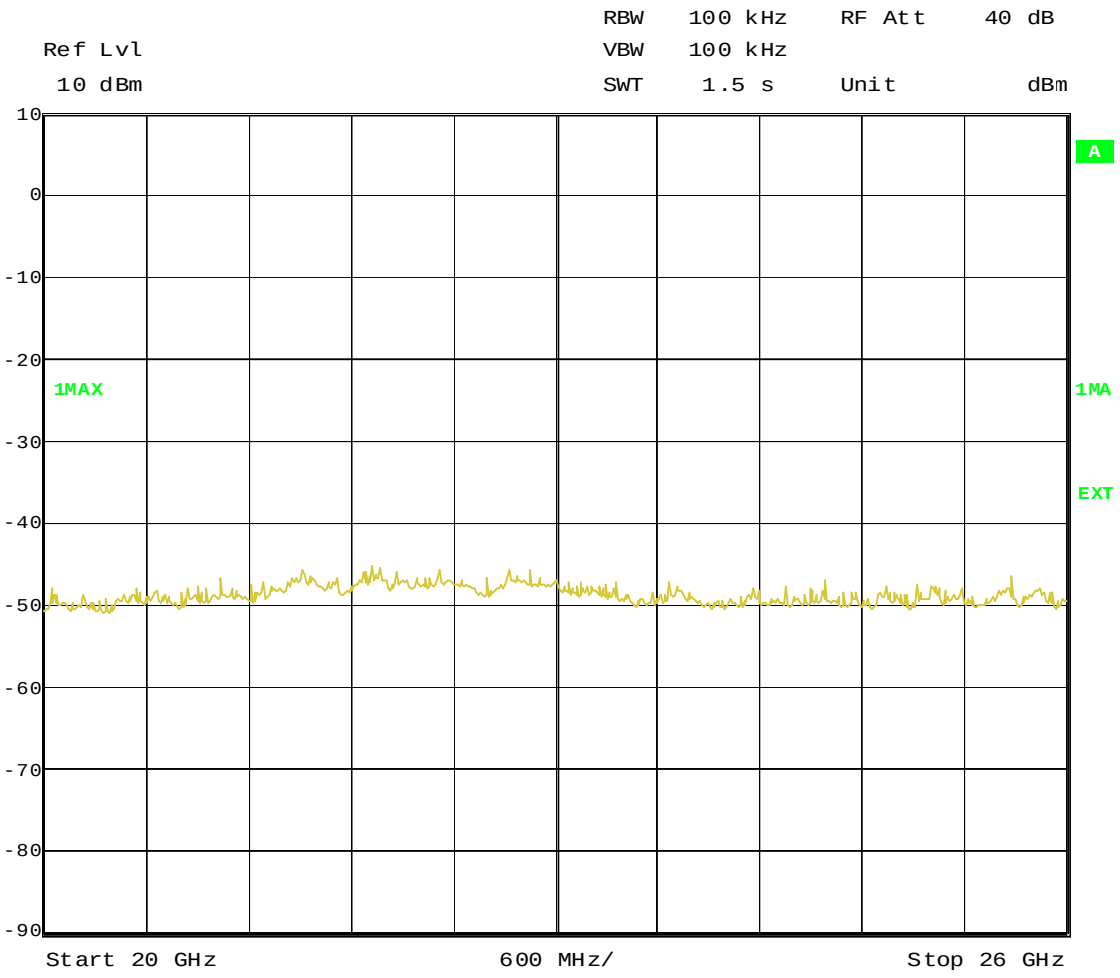
Plot P11.8



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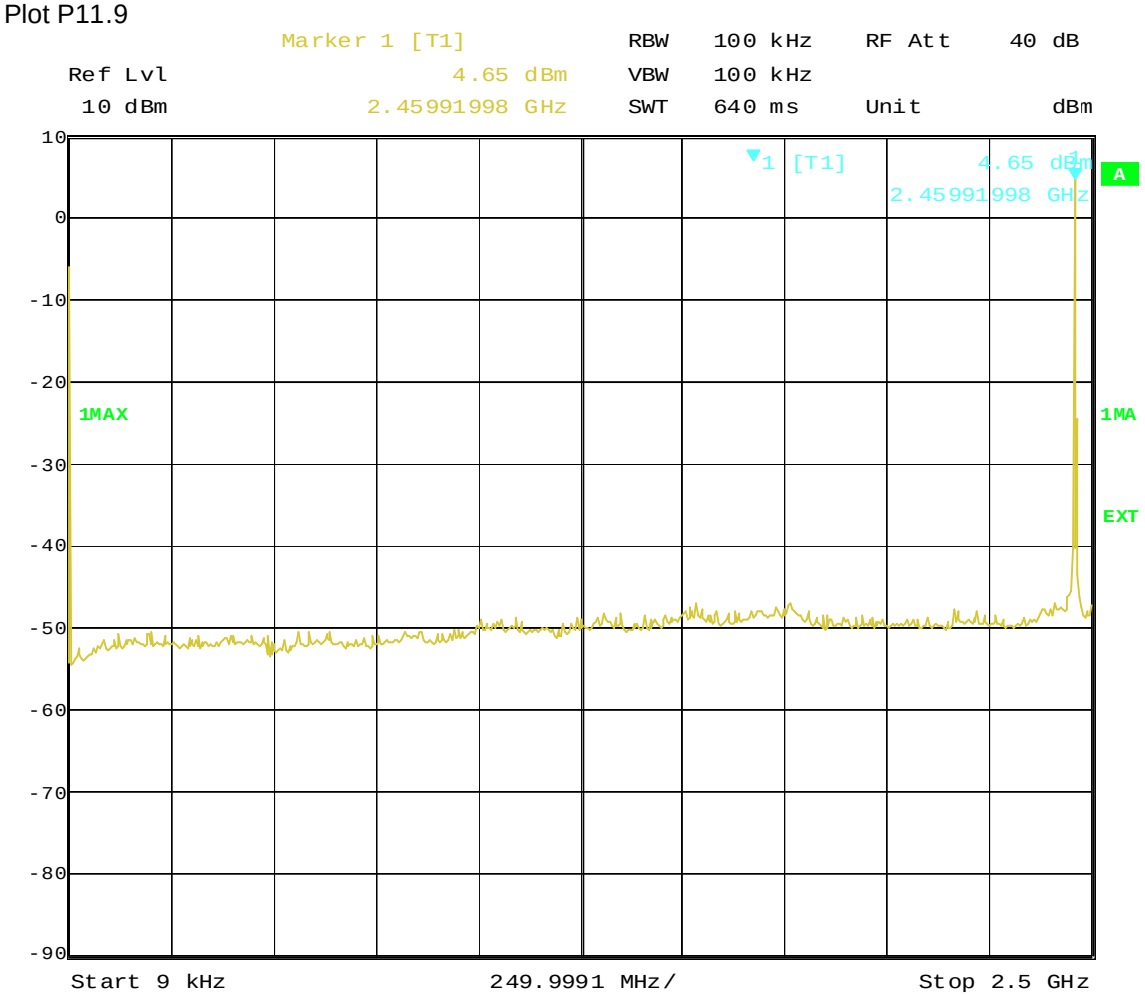
Plot P11.9



Date: 21.FEB.2012 13:21:46

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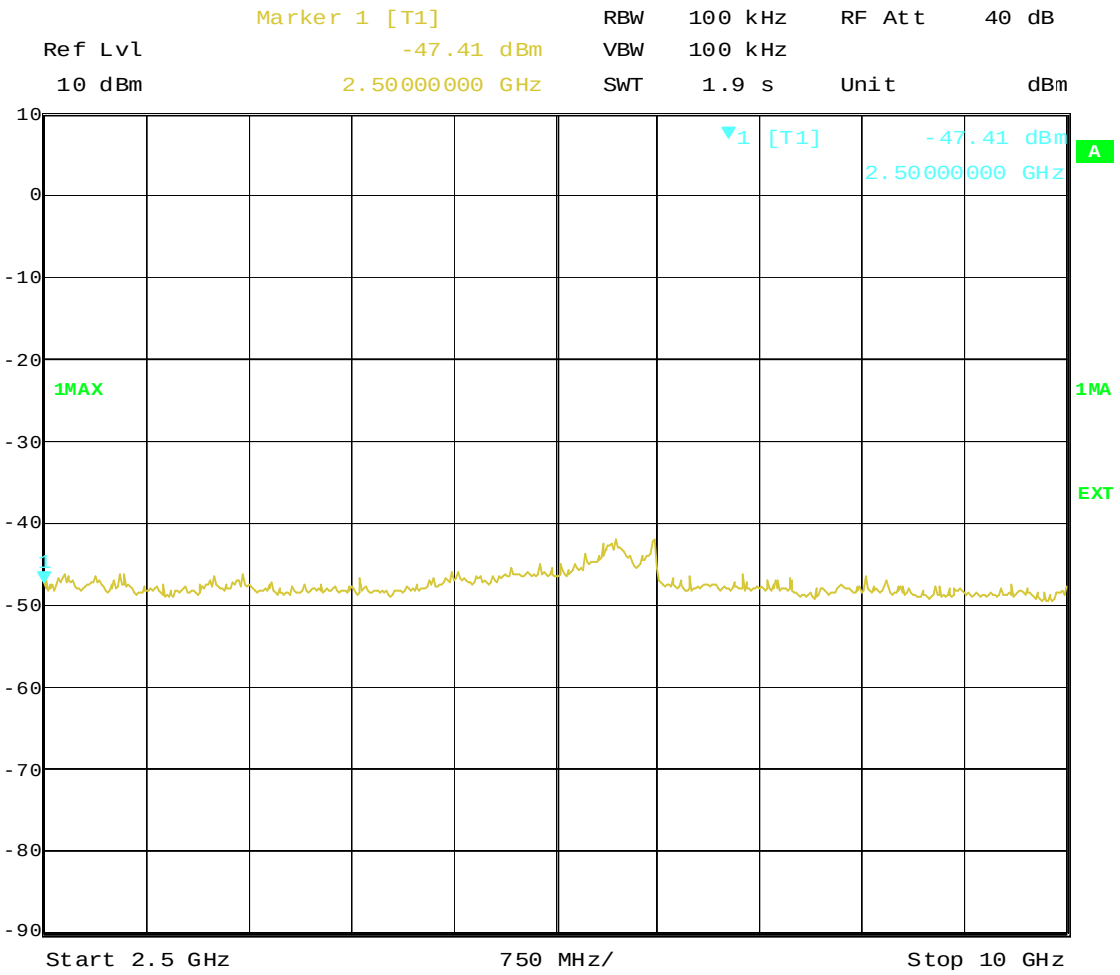
Plot P11.10



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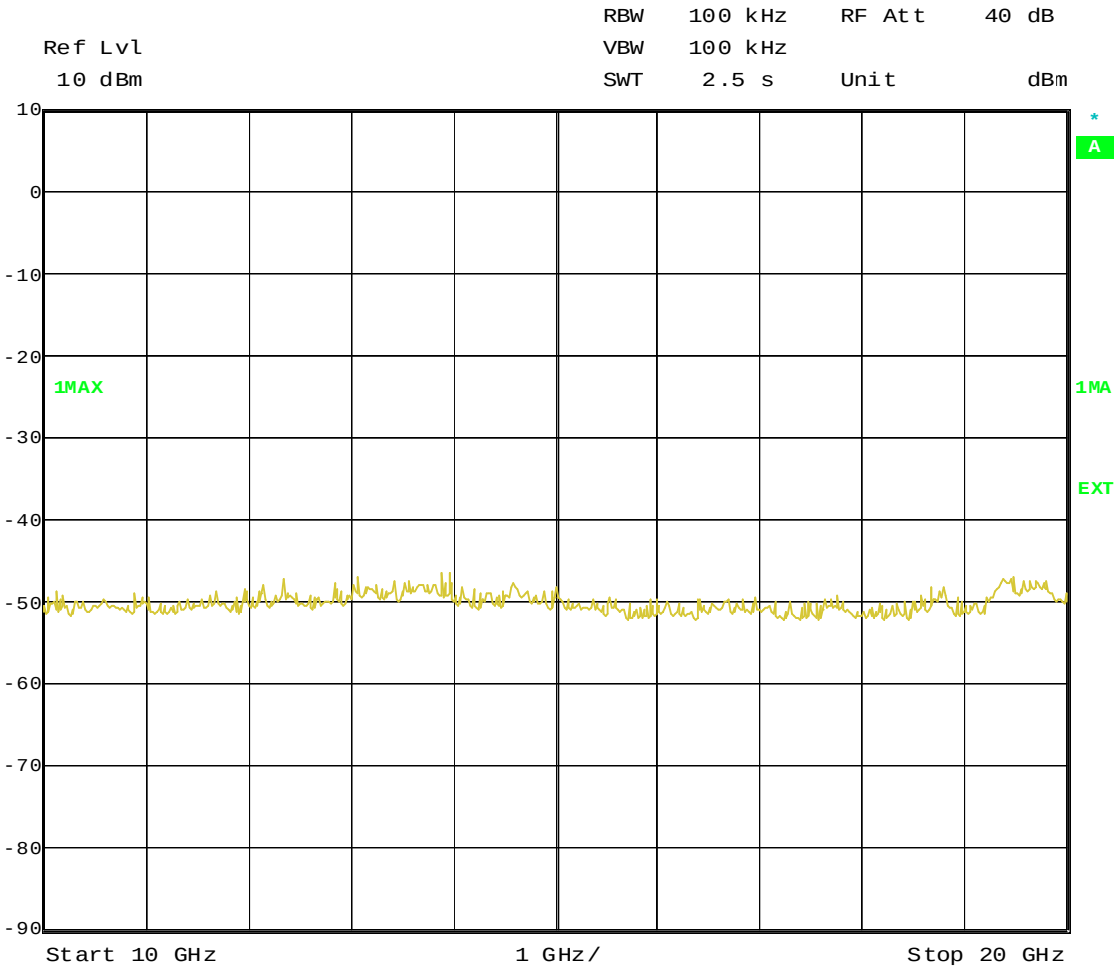
Plot P11.11



Date: 21.FEB.2012 13:30:44

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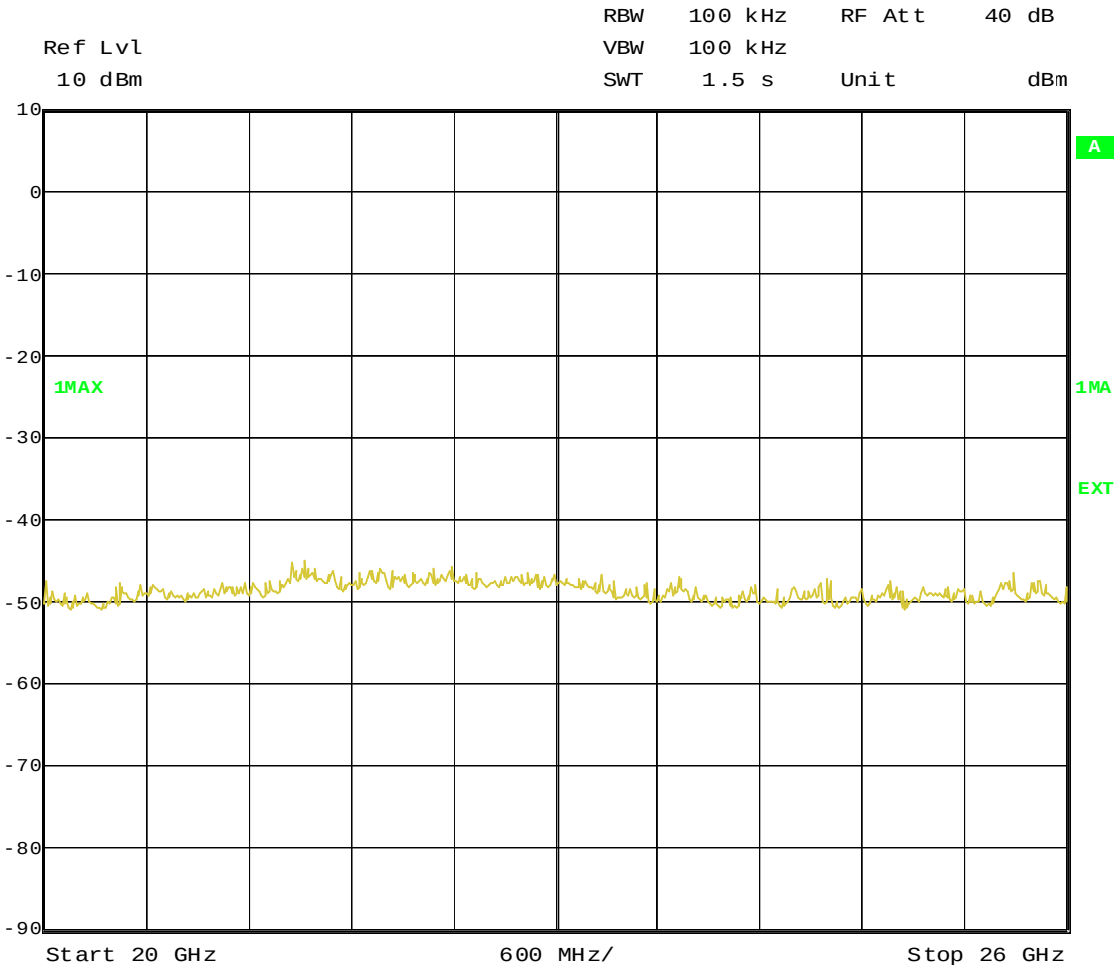
Plot P11.12



Date: 21.FEB.2012 13:31:19

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12. OCCUPIED BANDWIDTH

12.1 Test protocol

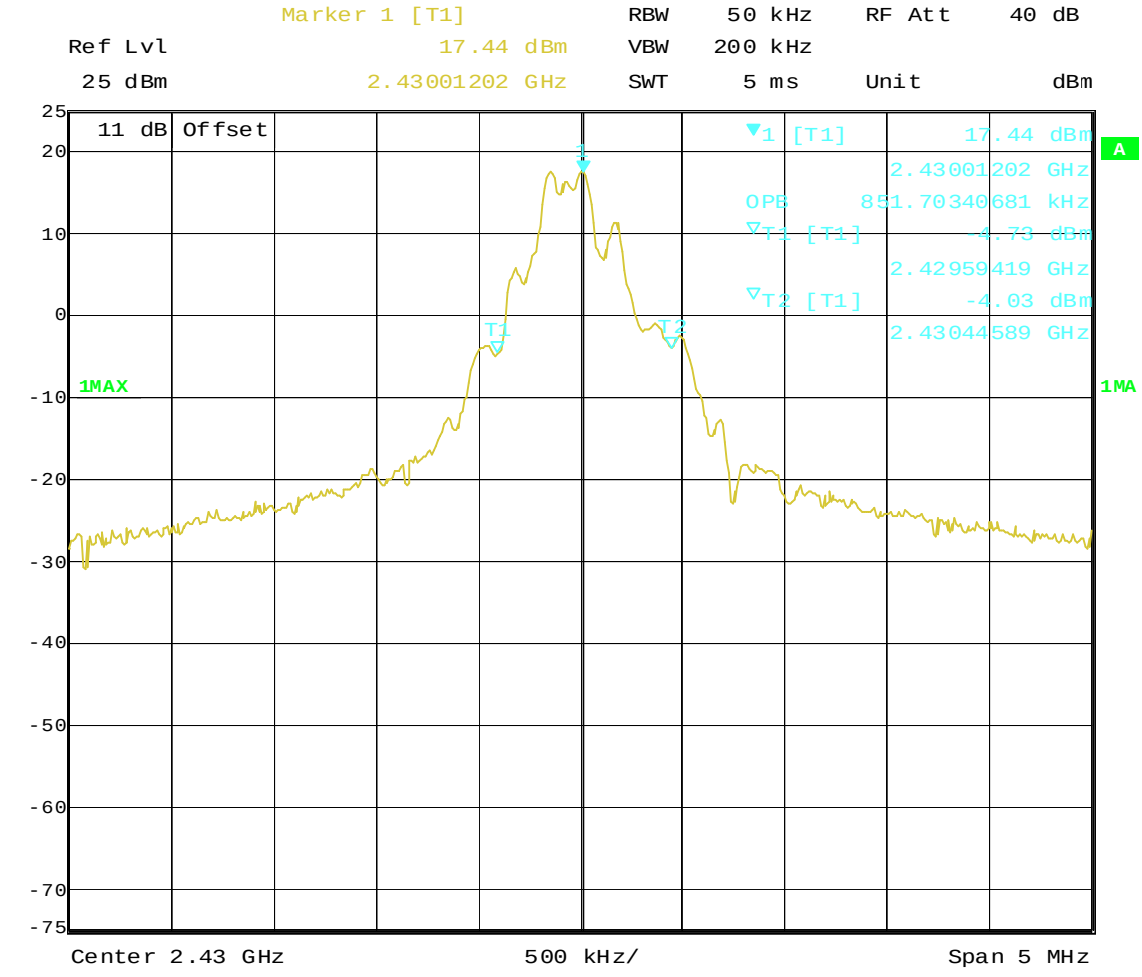
Date of test: 2012-08-29

EUT mode of operation: continuous TX.

Spectrum analyzer settings:

Span: 5 MHz
RBW: 50 kHz
VBW: 200 kHz

99% BW: 851.7 KHZ



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13. TEST EQUIPMENT

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date	Calibration interval
Measurement software	Rohde & Schwarz	EMC 32	--	--	--
Receiver	Rohde & Schwarz	ESU 8	12866	2012-07-31	1 year
Receiver	Rohde & Schwarz	FSIQ 40	4936	2013-07-31	1 year
Receiver	Rohde & Schwarz	ESU 40	13178	2012-07-31	1 year
Amplifier	Sangus	AFS	12335	2012-07-31	1 year
Amplifier	SEMKO	AM1331	7992	2012-07-31	1 year
Power meter	Rohde & Schwarz	NRVD	31741	2012-07-31	1 year
Power sensor	Rohde & Schwarz	NRV Z51	7861	2012-07-31	1 year
Attenuator	Rohde & Schwarz	10 dB	30088	2013-07-31	1 year
Horn antenna 1-18	BONN Elektronik	BLMA 1826-5A	31247	2013-07-31	3 year
Horn antenna 18-26	BONN Elektronik	BLMA 2640-5A	31248	2013-12-31	3 year
Antenna	CHASE Electr. Ltd	CBL 6111A	971	2012-07-31	3 year

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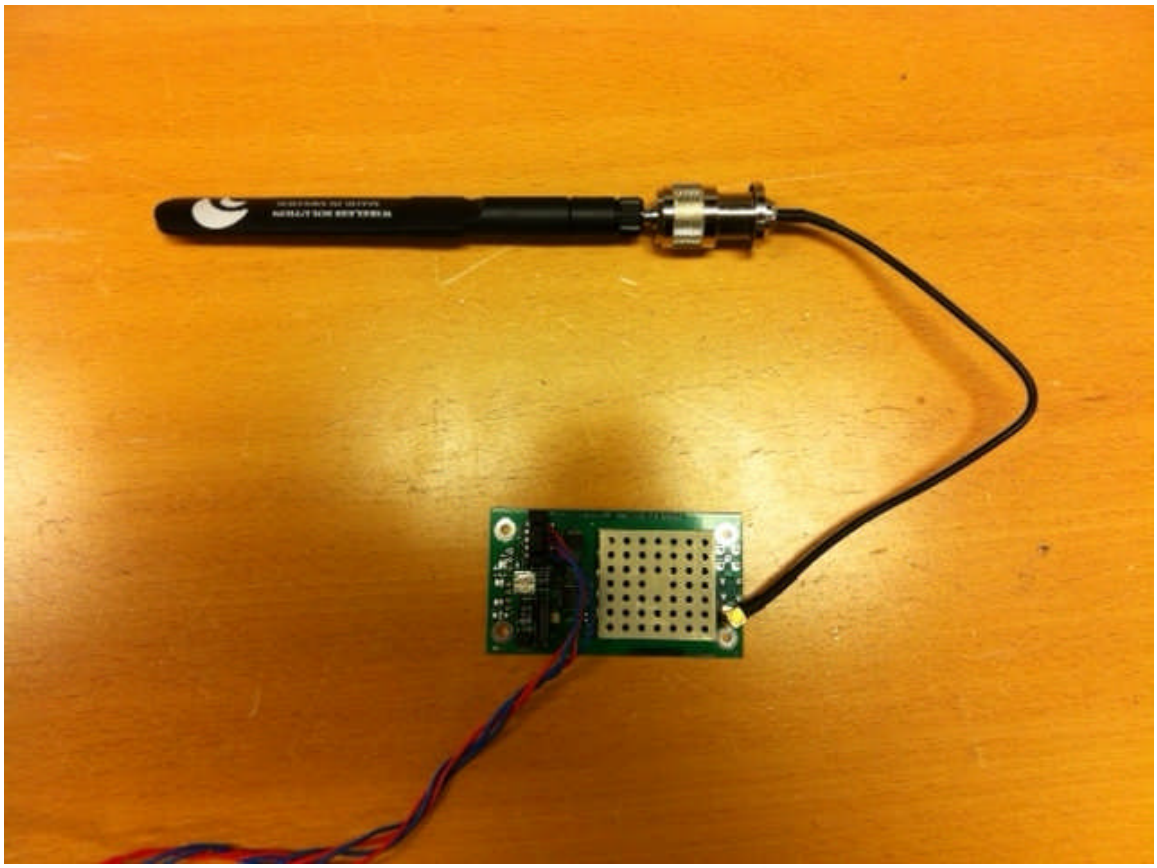
APPENDIX – PHOTOS OF THE EUT



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