

RADIO TEST REPORT

No. 1311812-1 Ed. 3

RF performance

EQUIPMENT UNDER TEST

Equipment : PressureWire™ Aeris
Type / model : PressureWire™ Aeris ZMOD C12058
Manufacturer : St Jude medical Systems AB
Tested by request of : St Jude medical Systems AB

SUMMARY

Referring to the emission limits and the operating mode during the tests specified in this report the equipment complies with the requirements according to

47 CFR Part 15, Subpart C, Intentional radiators, section 15.249
RSS-210, Issue 8 (Dec 2010)
RSS-GEN, Issue 3 (Dec 2010)

Test methods according to ANSI C63.10-2009

Date of issue: 2013-12-19

Tested by: 

Kajsa From
Åke Carlson

Approved by: 
Matti Virkki

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Revision History

Edition	Date	Description
1	2013-09-25	First release
2	2013-11-27	Tests are not made according to 47 CFR Part 15, Subpart B since EUT is transmitter only. Part 15 B is removed from section 3.1
3	2013-12-19	Additional information regarding calibration status of cables and preamplifiers has been added to the report.

CONTENTS

	Page
1 CLIENT INFORMATION.....	4
2 EQUIPMENT UNDER TEST (EUT).....	4
2.1 IDENTIFICATION OF THE EUT ACCORDING TO THE MANUFACTURER/CLIENT DECLARATION	4
2.2 ADDITIONAL HARDWARE INFORMATION ABOUT THE EUT	5
2.3 ADDITIONAL SOFTWARE INFORMATION ABOUT THE EUT.....	5
2.4 MODIFICATION DURING THE TESTS	5
3 TEST SPECIFICATIONS.....	6
3.1 STANDARDS.....	6
3.2 ADDITIONS, DEVIATIONS AND EXCLUSIONS FROM STANDARDS AND ACCREDITATION	6
3.3 TEST SITE	6
3.4 TEST CONDITIONS.....	6
4 TEST SUMMARY	7
5 RADIATED EMISSIONS MEASUREMENTS FROM 30 MHZ TO 1000MHZ.....	8
5.1 REQUIREMENT	8
5.2 TEST SETUP DETAILS	8
5.3 TEST DATA.....	9
5.4 TEST EQUIPMENT	10
6 RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ.....	11
6.1 REQUIREMENT	11
6.2 TEST SETUP DETAILS	12
6.3 TEST DATA.....	13
6.4 TEST EQUIPMENT	17
7 TRANSMITTER FIELD STRENGTH.....	18
7.1 REQUIREMENT	18
7.2 TEST SETUP DETAILS	18
7.3 TEST DATA.....	19
7.4 TEST EQUIPMENT	19
8 BAND-EDGE COMPLIANCE	20
8.1 REQUIREMENT	20
8.2 TEST SETUP DETAILS	20
8.3 TEST DATA.....	20
8.4 TEST EQUIPMENT	22
9 DUTY CYCLE TEST.....	23
9.1 TEST DATA.....	23
9.2 TEST EQUIPMENT	24
10 99% OCCUPIED BANDWIDTH.....	25
10.1 REQUIREMENT	25
10.2 TEST SETUP DETAILS	25
10.3 TEST DATA.....	25
10.4 TEST EQUIPMENT	26
11 UNCERTAINTIES SUMMARY	27
12 PHOTOS OF THE EUT	28

1 CLIENT INFORMATION

The EUT has been tested by request of

Company: St Jude Medical Systems AB
Palmbladsgatan 10, Box 6350
751 35 Uppsala
SWEDEN

Name of contact: Mattias Tullberg

2 EQUIPMENT UNDER TEST (EUT)

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

Equipment: PressureWire™ Aeris
Type/Model: PressureWire™ Aeris ZMOD C12058
Brand name: PressureWire™ Aeris
Serial number: No serial number
Manufacturer: St Jude Medical Systems AB
Transmitter frequency range: 2402 – 2480 MHz
Receiver frequency range: No receiver
Frequency agile or hopping: ☒ Yes ☐ No
Antenna: ☒ Internal antenna ☐ External antenna
Antenna connector: ☒ None, internal antenna ☐ Yes, type
Peak antenna gain: 0.5 dBi
Type of modulation: FHSS
Temperature range: ☐ Category I (General): -20°C to +55°C
☐ Category II (Portable equipment): -10°C to +55°C
☒ Category III (Equipment for normal indoor use): +5°C to +35°C
☐ Other:
Transmitter stand by mode supported: ☐ Yes ☒ No

2.2 Additional hardware information about the EUT

Four units with different test modes according to the table below were used during the tests.

Unit No.	Test mode	Markings
1	Normal operation	"N"
2	Fixed frequency channel 2 = 2.402 GHz	"ch2"
3	Fixed frequency channel 41 = 2.441 GHz	"ch41"
4	Fixed frequency channel 80 = 2.480 GHz	"ch80"

The same guidewire is used for all units.

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:
PAL Firmware 23314 version D

2.4 Modification during the tests

No modifications have been made during the tests.

3 TEST SPECIFICATIONS

3.1 Standards

47 CFR Part 15, Subpart C, Intentional radiators, section 15.249

RSS-210, Issue 8 (Dec 2010)

RSS-GEN, Issue 3 (Dec 2010)

Test methods in:

ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices

3.2 Additions, deviations and exclusions from standards and accreditation

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

3.3 Test site

Measurements were performed at:

Intertek Semko AB.
Torshamnsgatan 43,
P.O. Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
STORA HALLEN a.k.a. BIG CHAMBER	Semi-anechoic 10m and 3m	2042G-2
RADIOHALLEN	Fully-anechoic 3m	--

3.4 Test conditions

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

Parameter

Supplying voltage, V	3
Air temperature, °C	20-25

4 TEST SUMMARY

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

Test	Result	Section in report	Note
Standard test methods			
AC power-line conducted tests	NA		Class A / B
Radiated test below 30 MHz	NA		
Radiated emissions measurements from 30 to 1000 MHz	Pass	5	
Determination of radiated and antenna conducted emissions above 1 GHz	Pass	6	
Frequency Stability Test	NA		
Occupied bandwidth and band-edge tests	Pass	8, 10	
Output Power average symbol envelope power	NA		
Power Spectral Density < 40 GHz	NA		
Power Spectral Density > 40 GHz	NA		
In-situ measurements	NA		
Polar plot, main lobe and variation on radiated emissions test	NA		
Device-specific tests			
Radiated field strength of fundamental per 15.249(a)	Pass	7	
Measurement of cable locating equipment	NA		
Determining of cordless telephone handset security code	NA		
Determination of total input power	NA		
Procedure determining compliance for periodic operation [15.231, 15.240(b)]	NA		
Determining the average value of pulsed emissions per 15.35(c)	NA		
Comparison of limits per 15.231(b)(3)	NA		
Procedure to determine compliance of frequency pairing for 47 CFR 15.233(b)(2)	NA		
Determination of frequency hopping compliance per 47 CFR 15.247	NA		
Determination of digital modulation compliance per 47 CFR 15.247	NA		
Determination of peak conducted output unlicensed wireless device power [15.247(b), 15.255]	NA		
Determination of maximum conducted output power (15.247, 15-E)	NA		
Determination of MIMO compliance (2nd edition)	NA		
Determination of Smart antenna compliance (2nd edition)	NA		
Determination of antenna gains, including those emitting in multiple directions (15.247)	NA		
Determination of compliance with RF exposure limits	NA		
Millimeter wave test procedures for systems operating at 54GHz and greater	NA		
Determination of EIRP (15-F)	NA		
Determination Transmitter Etiquette FCC Part 15.255	NA		
Determination of Dynamic Frequency Selection (DFS) including Channel Move Time and In Service Monitoring	NA		
Determination of channel availability	NA		
Determination of Dynamic Frequency Selection including Channel Move Time	NA		
Determination of transmitter power control (TPC) (15-E)	NA		
Peak excursion measurement for UNII devices	NA		
Determination of UWB bandwidth	NA		
Determination of the center frequency, f _C , and highest radiated emissions, f _M (15-F)	NA		

NA = Not Applicable

Intertek Semko AB

Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

Telephone +46 8 750 00 00, Fax +46 8 750 60 30

www.intertek.se

Registered in Sweden: No: SE556024059901, Registered office: As address

5 RADIATED EMISSIONS MEASUREMENTS FROM 30 MHZ TO 1000MHZ

Date of test:	2013-09-11	Test location:	Big Chamber
EUT unit no:	2, 3 ,4	Ambient temp.	21°C
Tested by:	Kajsa From	Relative humidity	61%
Test result:	Pass	Margin:	>17 dB

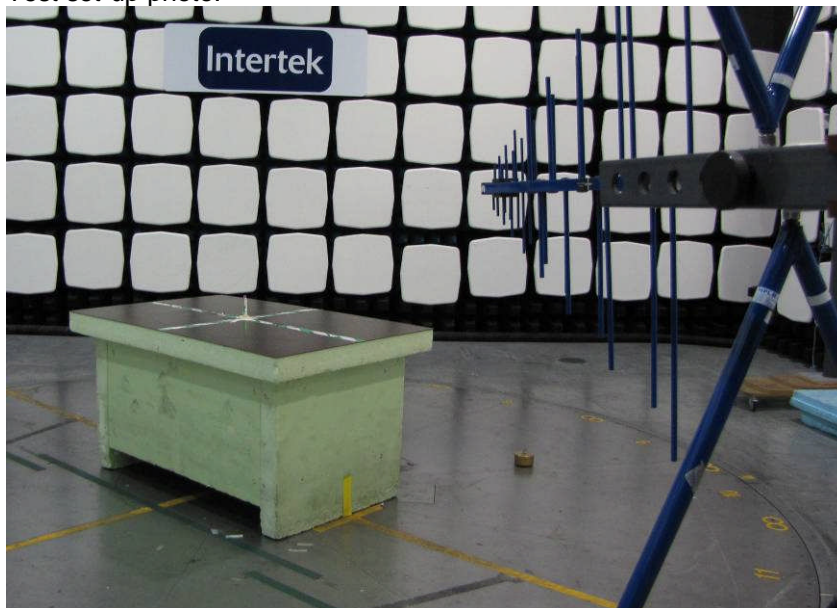
5.1 Requirement

Reference: FCC §15.209, IC RSS-210 Table 3

Frequency (MHz)	Field strength (dB μ V/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

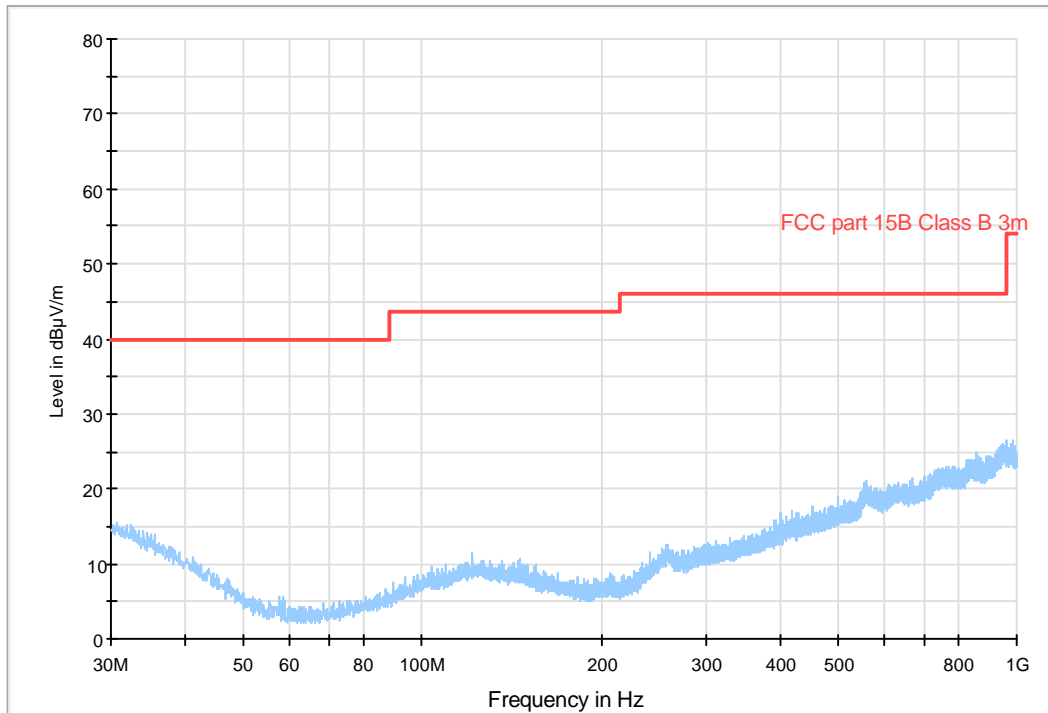
5.2 Test setup details

Test set-up photo:

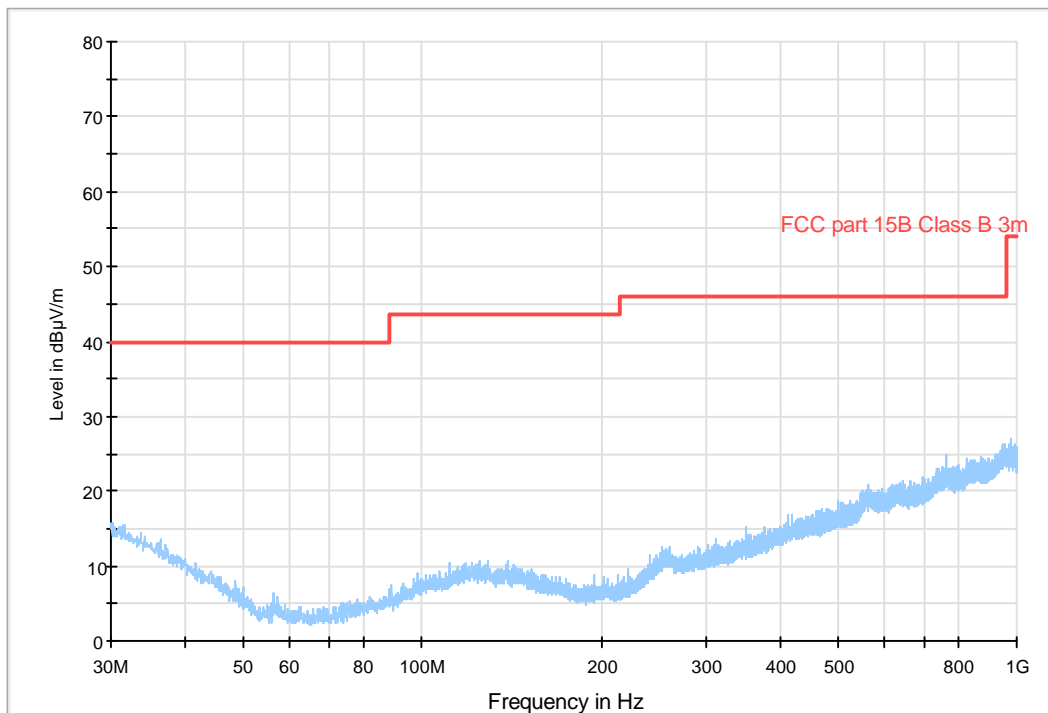


5.3 Test data

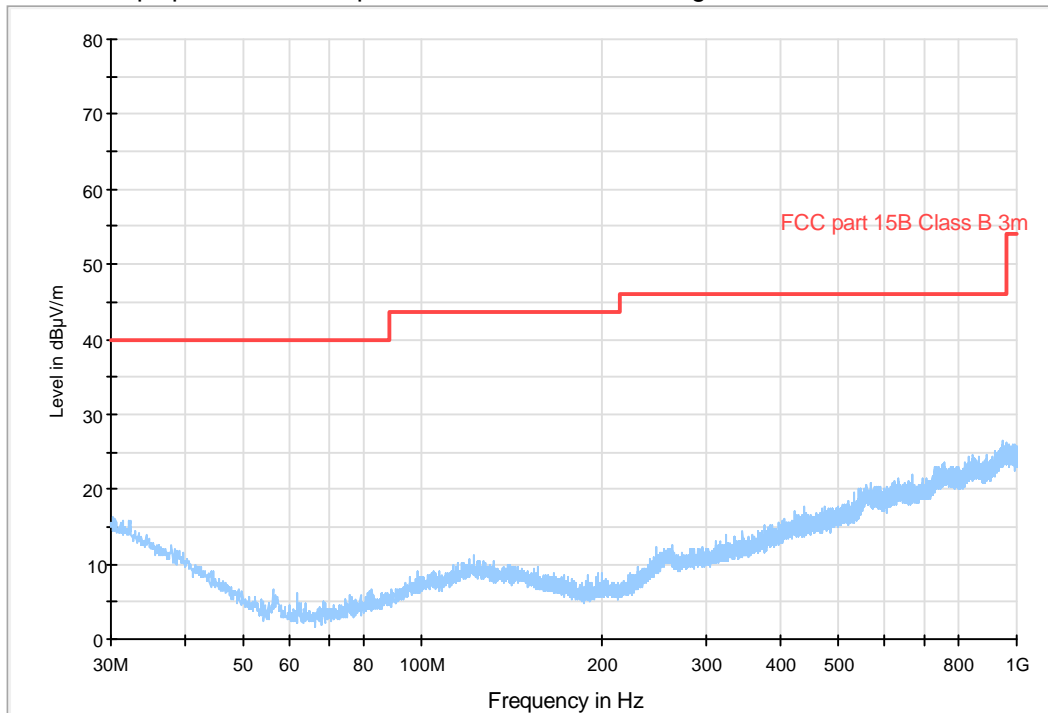
Overview sweeps performed with peak detectors, unit no. 2, low channel.



Overview sweeps performed with peak detectors, unit no. 3, middle channel.



Overview sweeps performed with peak detectors, unit no. 4, high channel.



No peaks above noise floor are found for frequencies 30-1000 MHz.

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

5.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESU 8	12866	7-2014
Logperiodic antenna	Chase	CBL6111A	971	9-2015
Pre amplifier		AM-1331	7992	7-2014
Rf-cables			40036, 9511, 9506, 9957, 5181	7-2014

6 RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ

Date of test:	2013-09-10 , 2013-09-11	Test location:	Radio chamber, Big chamber
EUT unit no:	2, 3 ,4	Ambient temp.	22-23°C
Tested by:	Kajsa From	Relative humidity	52-60%
Test result:	Pass	Margin:	12.0 dB

6.1 Requirement

Reference: FCC §15.209, IC RSS-GEN Table 2 RSS-210 A2.9b

Frequency (MHz)	Field strength (dB μ V/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

Transmitter harmonics outside the restricted bands:

Reference: FCC §15.249, IC RSS-210 A2.9a

Field strength (dB μ V/m) Average	Field strength (dB μ V/m) Peak
54.0	74.0

6.2 Test setup details

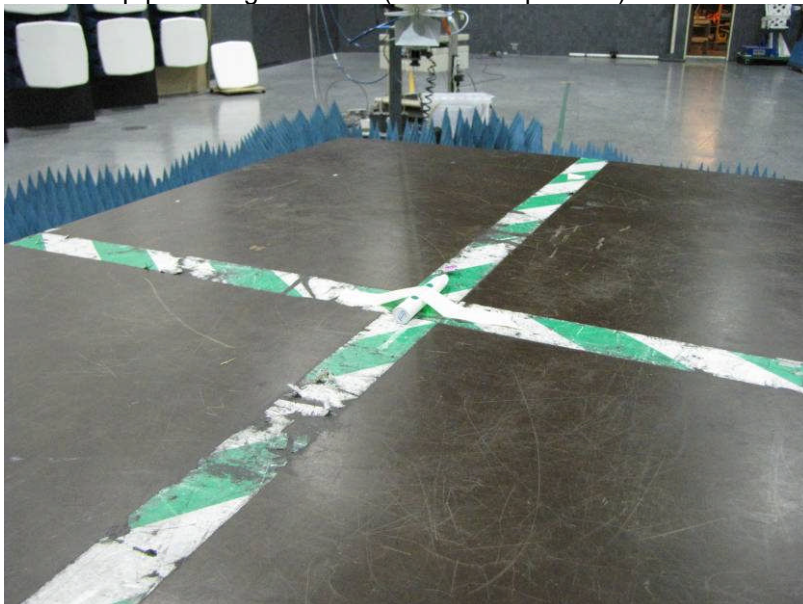
Preview sweeps were made in the Radio chamber and the final measurements were made in the Big Chamber. Three different positions of the EUT were evaluated on one frequency on one unit. The rest of the measurements were made with the EUT in position where the highest output power was found. Peak detector was used to measure peak levels.

Average result was calculated from Peak level using duty cycle correction factor $20 \log(0.008) = -41.9 \text{ dB}$. -20dB factor is used

Test set-up photo Radio Chamber:



Test set-up photo Big Chamber (worst case position):



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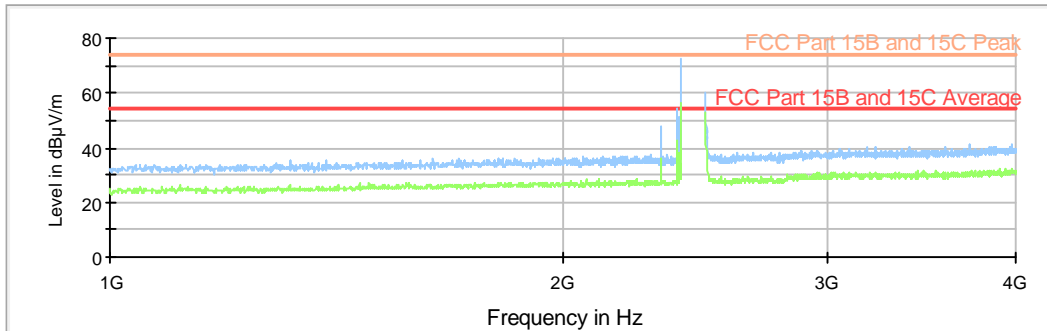
Telephone +46 8 750 00 00, Fax +46 8 750 60 30

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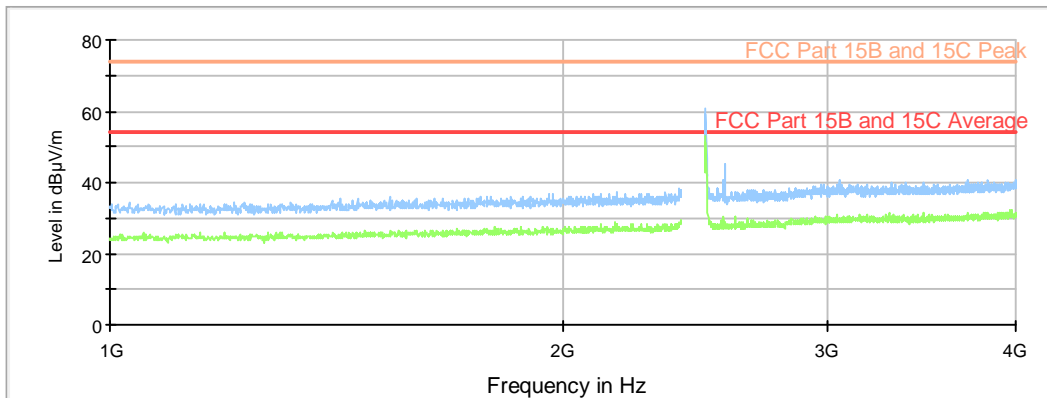
Registered in Sweden: No: SE556024059901, Registered office: As address

6.3 Test data

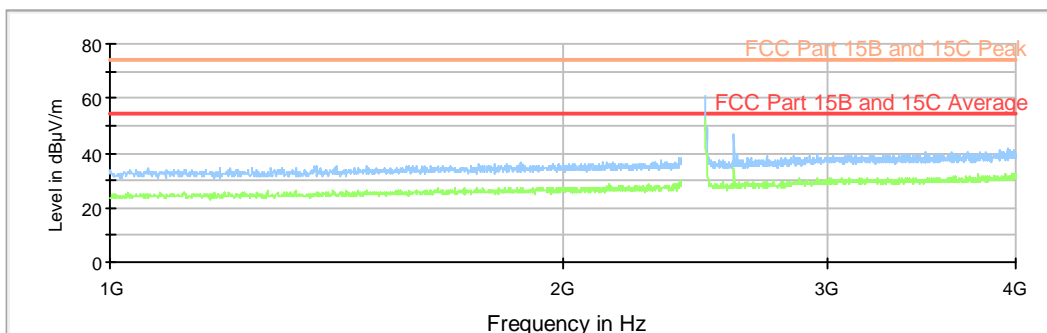
Overview sweeps performed with peak and average detectors, frequency range 1 – 4 GHz, unit no. 2, low channel. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.



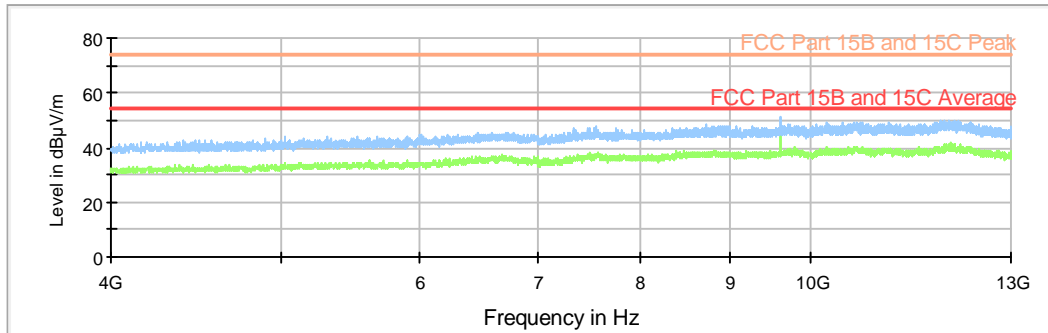
Overview sweeps performed with peak and average detectors, frequency range 1 – 4 GHz, unit no. 3, middle channel. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.



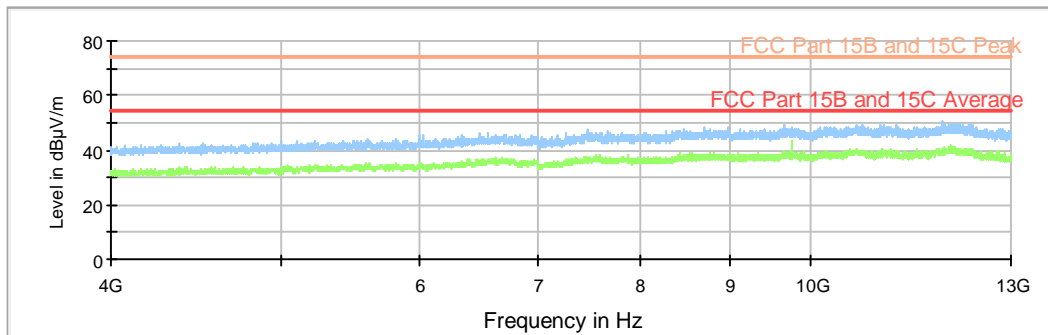
Overview sweeps performed with peak and average detectors, frequency range 1 – 4 GHz, unit no. 4, high channel. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.



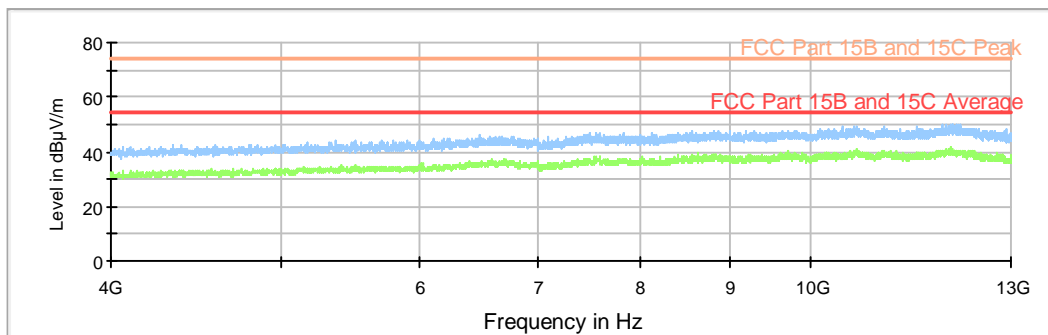
Overview sweeps performed with peak and average detectors, frequency range 4 – 13 GHz, unit no. 2, low channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.



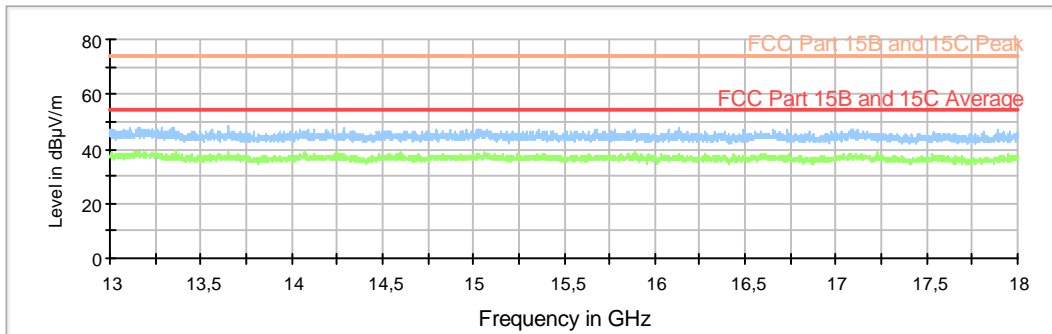
Overview sweeps performed with peak and average detectors, frequency range 4 – 13 GHz, unit no. 3, middle channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.



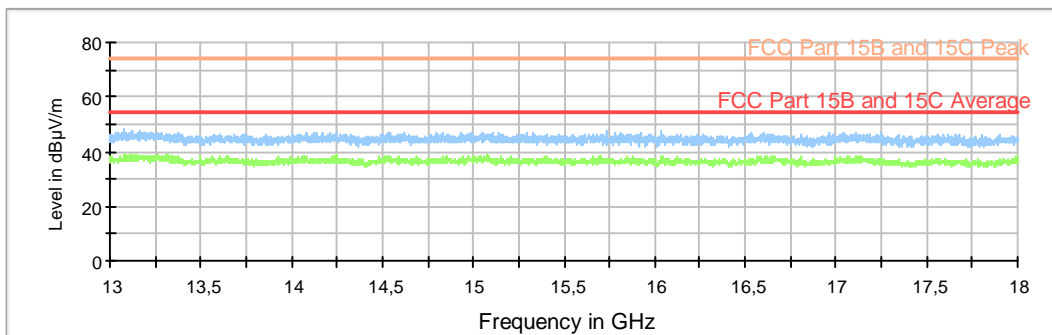
Overview sweeps performed with peak and average detectors, frequency range 4 – 13 GHz, unit no. 4, high channel. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.



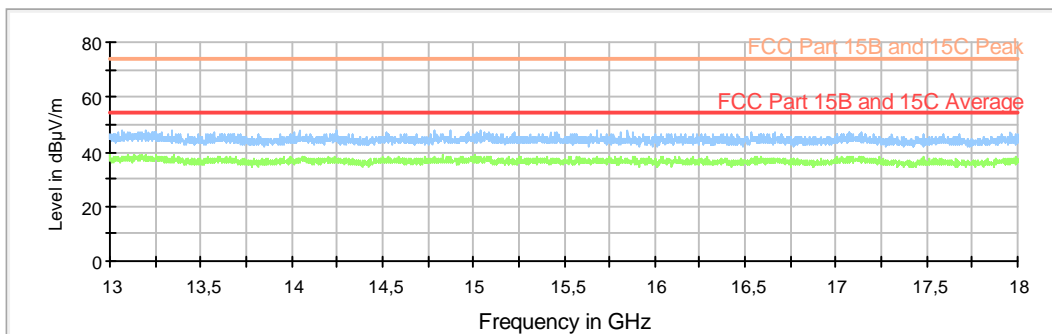
Overview sweeps performed with peak and average detectors, frequency range 13 – 18 GHz, unit no. 2, low channel.



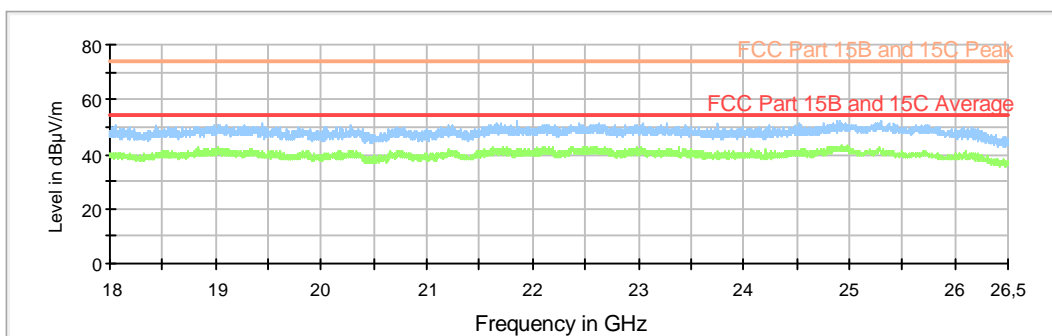
Overview sweeps performed with peak and average detectors, frequency range 13 – 18 GHz, unit no. 3, middle channel.



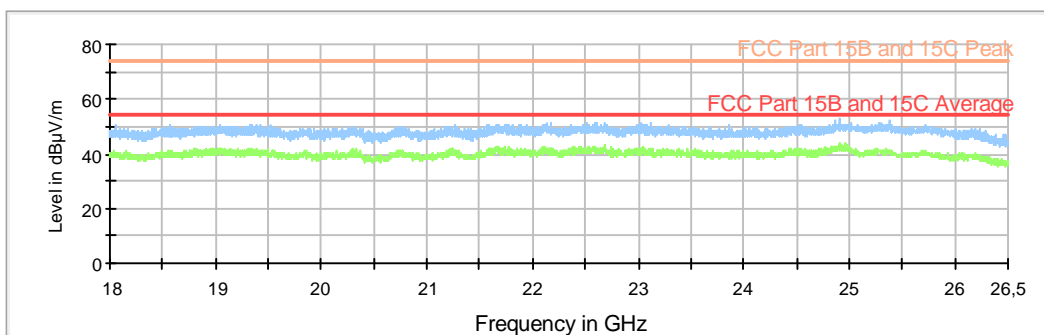
Overview sweeps performed with peak and average detectors, frequency range 13 – 18 GHz, unit no. 4, high channel.



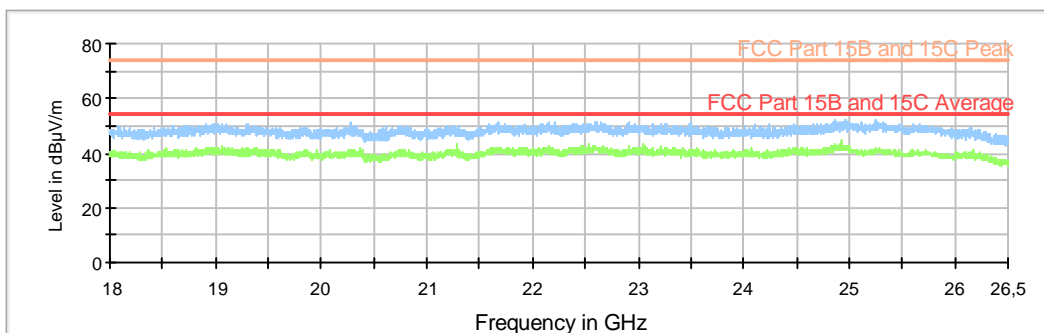
Overview sweeps performed with peak and average detectors, frequency range 18 – 26 GHz, unit no. 2, low channel.



Overview sweeps performed with peak and average detectors, frequency range 18 – 26 GHz, unit no. 3, middle channel.



Overview sweeps performed with peak and average detectors, frequency range 18 – 26 GHz, unit no. 4, high channel.



Summary for EUT unit no. 2, low channel

Frequency	Disturbance Level Peak	Disturbance Level Average	Limit Average	Margin	Azimuth	Antenna height	Pol.
MHz	dBµV/m	dBµV/m	dBµV	dB	deg	cm	V / H
2325.72	59.8	39.8	53.9	14.1	75	100	H

No significant peaks are found above noise floor for frequencies 4 – 26 GHz.

Summary for EUT unit no. 3, middle channel

Frequency	Disturbance Level Peak	Disturbance Level Average	Limit Average	Margin	Azimuth	Antenna height	Pol.
MHz	dBµV/m	dBµV/m	dBµV	dB	deg	cm	V / H
2560.65	61.4	41.4	53.9	12.8	109	100	H

No significant peaks are found above noise floor for frequencies 4 – 26 GHz.

Summary for EUT unit no. 4, high channel

Frequency MHz	Disturbance Level Peak dB μ V/m	Disturbance Level Average dB μ V/m	Limit Average dB μ V	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
2560.65	61.9	41.9	53.9	12.0	102	110	H

No significant peaks are found above noise floor for frequencies 4 – 26 GHz.

Measured level [dB μ V/m] = Analyser reading [dB μ V] + cable loss [dB] + attenuator loss [dB] – preamplifier gain [dB] + antenna factor [dB/m]

6.4 Test equipment

Radio chamber

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Signal analyzer	Rohde & Schwarz	FSIQ 40	12793	07-2014
Preamplifier	MITEQ	AFS6/AFS44	12335	07-2014
Horn antenna	EMCO	3115	4936	02-2014
Horn antenna	EMCO	3160-08	30099	02-2014
Horn antenna	EMCO	3160-09	30101	02-2014
Band reject filter	K&L	6N45-2450/T 100-0/0	12389	07-2014
High pass filter	K&L	440- X4500/18000-0	5133	07-2014
RF cables			5179, 5191, 5192	07-2014

Big Chamber

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Measurement receiver	Rohde & Schwarz	ESU 40	13178	07-2014
Pre-amplifier	BONN Elektronik	BLMA 0118-M	31246	07-2014
Horn antenna	Rohde & Schwarz	HF907	31245	11-2013
RF cable	Rohde & Schwarz	OSP-F	39049	07-2014
Attenuator	Hewlett Packard	8491A	7679	07-2014

7 TRANSMITTER FIELD STRENGTH

Date of test:	2013-09-11	Test location:	Big Chamber
EUT unit no:	2, 3, 4	Ambient temp.	23°C
Tested by:	Kajsa From	Relative humidity	53%
Test result:	Pass	Margin:	6.5 dB

7.1 Requirement

Reference: FCC §15.249

Frequency (MHz)	Field strength (mV/m)	Field strength (dB μ V/m)
2400 – 2483.5	50.0	94.0

7.2 Test setup details

Three different positions of the EUT were evaluated.

Average result was calculated from Peak level using duty cycle correction factor $20 \log (0.008) = -41.9$ dB. -20dB factor is used

Test set-up photo



7.3 Test data

Channel MHz	Field strength Peak dBμV/m	Field strength Average dBμV/m	Limit Average dBμV/m
2402	102.5	82.5	94
2441	102.8	82.8	94
2480	107.5	87.5	94

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

7.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Measurement receiver	Rohde & Schwarz	ESU 40	13178	07-2014
Pre-amplifier	BONN Elektronik	BLMA 0118-M	31246	07-2014
Horn antenna	Rohde & Schwarz	HF907	31245	11-2013
RF cable	Rohde & Schwarz	OSP-F	39049	07-2014
Attenuator	Hewlett Packard	8491A	7679	07-2014
Attenuator	Hewlett Packard	8491A	30088	07-2014

8 BAND-EDGE COMPLIANCE

Date of test:	2013-09-11	Test location:	Big Chamber
EUT unit no:	2, 4	Ambient temp.	21-23°C
Tested by:	Kajsa From	Relative humidity	46-48%
Test result:	Pass	Margin:	9.3 dB

8.1 Requirement

Reference: FCC §15.209, IC RSS-GEN Table 2 RSS-210 A2.9b

Frequency (MHz)	Field strength (dB μ V/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

Limits outside the restricted bands:

Reference: FCC §15.249, IC RSS-210 A2.9a

Field strength (dB μ V/m) Average	Field strength (dB μ V/m) Peak
54.0	74.0

8.2 Test setup details

See section 7.2.

Marker-delta method is used.

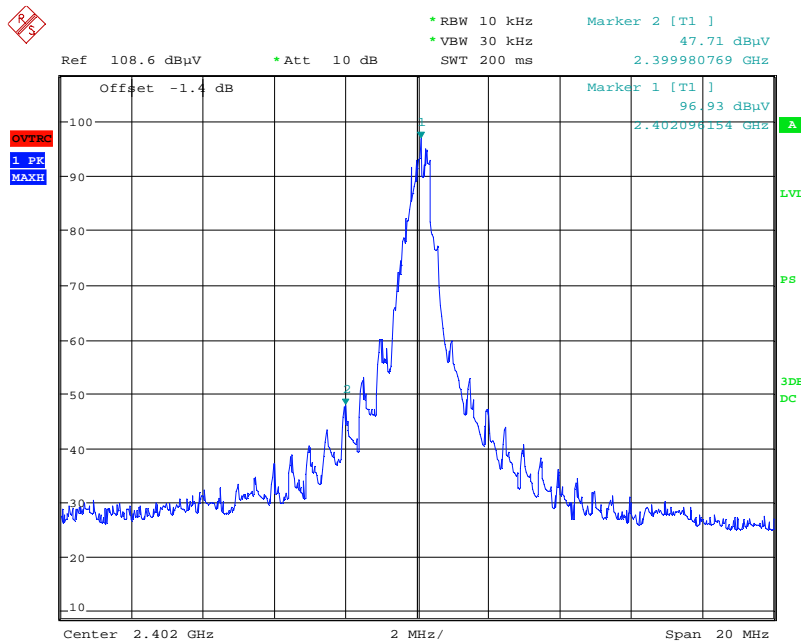
8.3 Test data

Low channel, 2402 MHz

Field strength = 82.5 dB μ V/m, average detector

Delta = 96.9 – 47.7 = 49.2 dB peak

Field strength at band edge 2400 MHz = 82.5 – 49.2 = 33.3 dB μ V/m, average detector



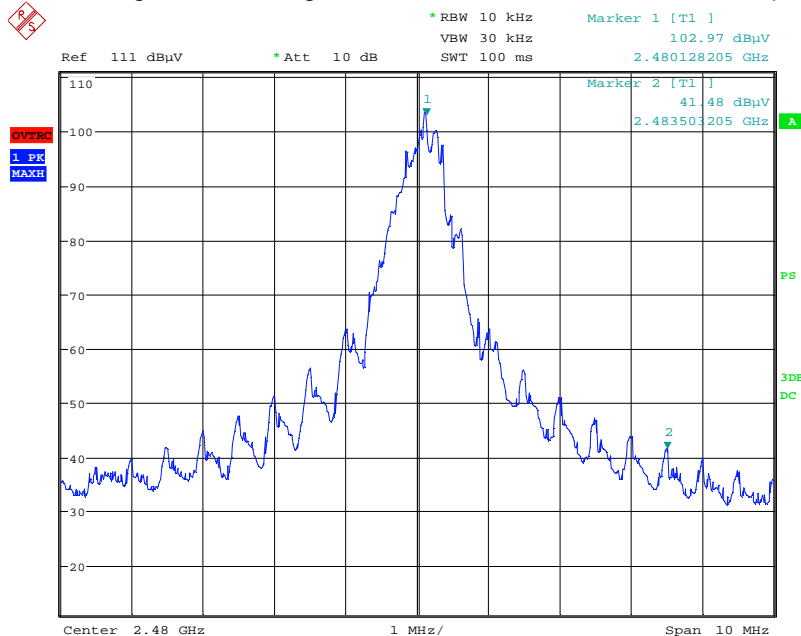
Date: 11.SEP.2013 16:40:00

High channel, 2480 MHz

Field strength = 87.2 dBuV/m, average

Delta = 103.0 – 40.5 = 62.5 dB

Field strength at band edge 2483.5 MHz = 87.2 – 62.5 = 44.7 dBuV/m, average



Date: 11.SEP.2013 15:09:57

8.4 Test equipment

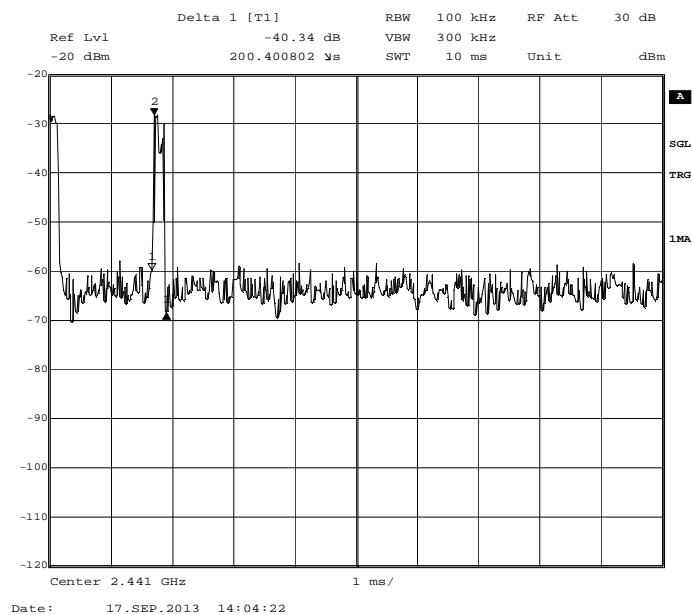
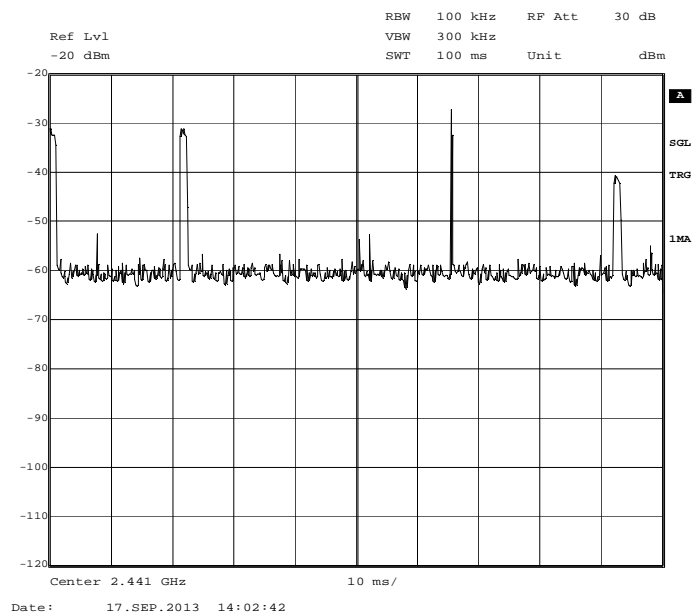
Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
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Pre-amplifier	BONN Elektronik	BLMA 0118-M	31246	07-2014
Horn antenna	Rohde & Schwarz	HF907	31245	11-2013
RF cable	Rohde & Schwarz	OSP-F	39049	07-2014
Attenuator	Hewlett Packard	8491A	7679	07-2014
Attenuator	Hewlett Packard	8491A	30088	07-2014

9 DUTY CYCLE TEST

Date of test:	2013-09-17	Test location:	Radio laboratory
EUT unit no:	1	Ambient temp.	23°C
Tested by:	Kajsa From	Relative humidity	48%
Test result:	Pass	Margin:	-

9.1 Test data

Duty cycle is $(4 \cdot 0.200\text{ms}/100\text{ms}) = 0.008$



9.2 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	S12793	07-2014

10 99% OCCUPIED BANDWIDTH

Date of test:	2013-09-17 – 2013-09-18	Test location:	Radio laboratory
EUT unit no:	2, 3, 4	Ambient temp.	21-23°C
Tested by:	Kajsa From	Relative humidity	46-48%
Test result:	Pass	Margin:	-

10.1 Requirement

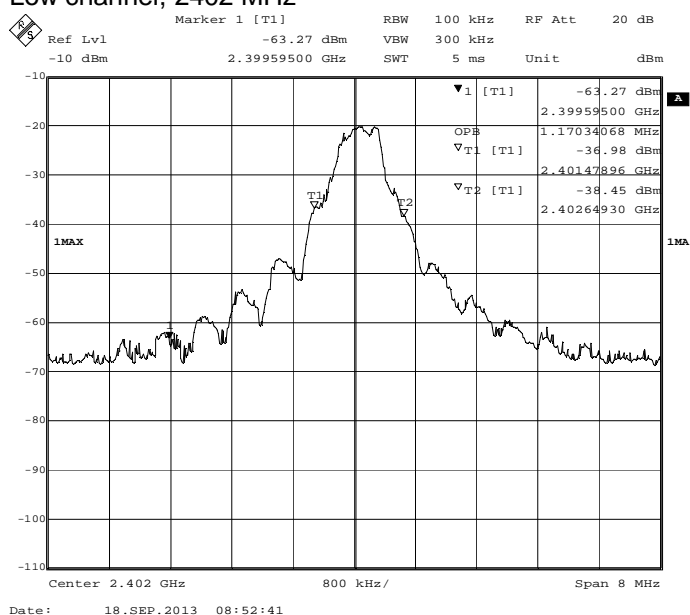
Reference RSS-GEN 4.6

10.2 Test setup details

Spectrum analyser's occupied power bandwidth function was used to calculate the 99% bandwidth

10.3 Test data

Low channel, 2402 MHz



Intertek Semko AB

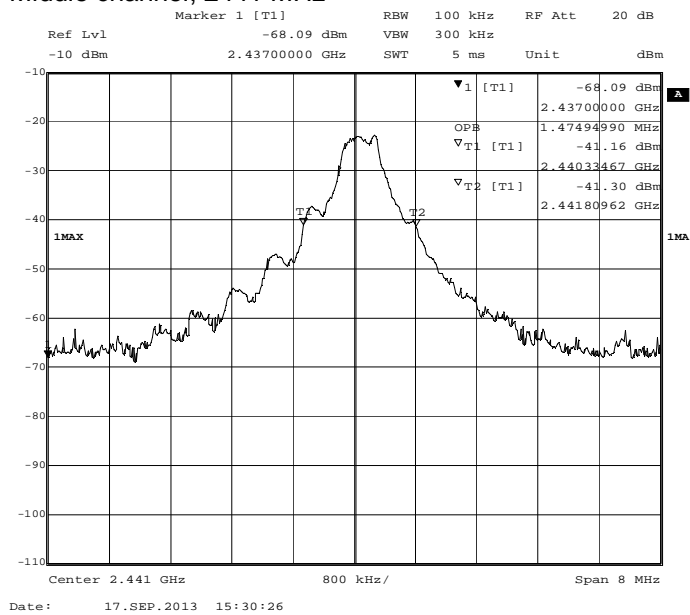
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

Telephone +46 8 750 00 00, Fax +46 8 750 60 30

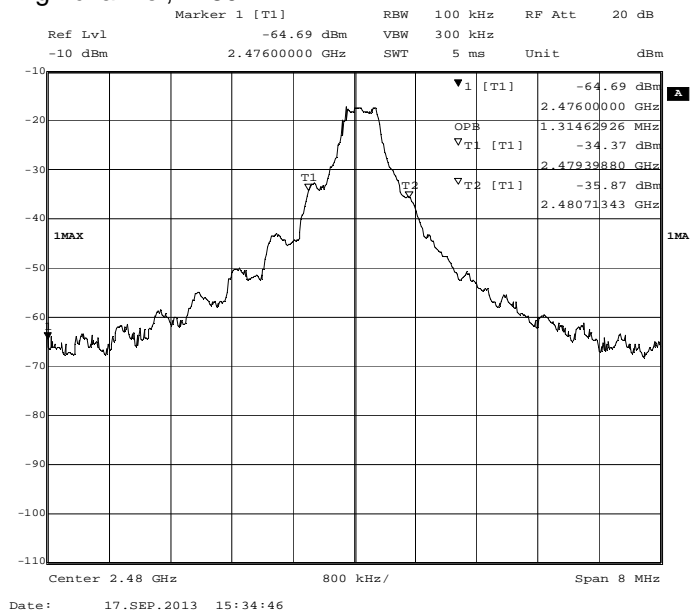
www.intertek.se

Registered in Sweden: No: SE556024059901, Registered office: As address

Middle channel, 2441 MHz



High channel, 2480 MHz



Channel	99% BW
MHz	MHz
2402	1.170
2441	1.475
2480	1.315

10.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	S12793	07-2014

11 UNCERTAINTIES SUMMARY

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% (k=2).

Radiated disturbance, field strength, 30 MHz - 1000 MHz

30 to 300 MHz at 3 m

± 4,7 dB

200 to 1000 MHz at 3 m

± 4,8 dB

Radiated disturbance, field strength, 1 to 40 GHz in Semi Anechoic Chambers "Stora Hallen" and "Björkhallen"

1 to 18 GHz with filter or attenuator

± 5,4 dB

1 to 18 GHz without filter or attenuator

± 5,2 dB

18 to 26 GHz without filter or attenuator

± 5,5 dB

Radiated disturbance, field strength, 1 to 40 GHz in Fully Anechoic Chamber "Radiohallen"

1 to 13 GHz with filter or attenuator

± 5,5 dB

1 to 13 GHz without filter or attenuator

± 5,3 dB

13 to 18 GHz with filter or attenuator

± 5,3 dB

13 to 18 GHz without filter or attenuator

± 5,1 dB

18 to 26,5 GHz without filter or attenuator

± 5,4 dB

12 PHOTOS OF THE EUT

EUT including guidewire



EUT close up

