

# RADIO TEST REPORT

No. 1312855-2 Ed. 2

## RF performance

### EQUIPMENT UNDER TEST

Equipment : Soap dispenser sensor  
Type / model : S4  
Manufacturer : SCA hygiene products AB  
Tested by request of : SCA hygiene products 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 15.247  
47 CFR Part 15, Subpart B, Unintentional radiators  
RSS-GEN Issue 4 (2014)  
RSS-247 Issue 1 (2015)

Test methods according to ANSI C63.10 (2013)

Date of issue: 2015-08-28

Tested by:



Matti Virkki

Approved by:



Stefan Andersson

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**Revision History**

<b>Edition</b>	<b>Date</b>	<b>Description</b>
<b>1</b>	<b>2013-11-19</b>	<b>First release</b>
<b>2</b>	<b>2015-08-28</b>	<b>Report update to RSS-Gen issue 4 RSS-247 Issue 1 and ANSI C63.10 (2013). Re-measurement of transmitter radiated emissions &gt; 1GHz and duty cycle.</b>

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## 1 CLIENT INFORMATION

The EUT has been tested by request of

Company: SCA Hygiene products AB  
Bäckstensgatan 5  
405 03 Gothenburg  
Sweden

Name of contact: Allan Elfström

## 2 EQUIPMENT UNDER TEST (EUT)

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

Equipment: Soap dispenser sensor

Type/Model: S4

Brand name: SCA Hygiene products AB

Serial number: 130 / 044

Manufacturer: SCA Hygiene products AB  
Bäckstensgatan 5  
405 03 Gothenburg  
Sweden

Transmitter frequency range: 2405 MHz

Receiver frequency range: 2405 MHz

Frequency agile or hopping: ☐ Yes ☒ No

Antenna: ☒ Internal antenna ☐ External antenna

Antenna connector: ☒ None, internal antenna ☐ Yes, type

Antenna gain: 1 dBi

Rating RF output power: 2 dBm

Type of modulation: O-QPSK

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 standby mode supported: ☒ Yes ☐ No

## 2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Part number	Serial number	Note
Soap dispenser sensor S4	561600	130	Internal antenna
Soap dispenser sensor S4	561600	044	SMA connector

## 2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

- TX continuous modulated signal
- RX mode
- Normal operation

## 2.4 Peripheral equipment

Peripheral equipment is defined as equipment needed for correct operation of the EUT during the tests, but not included as a part of the testing and evaluation of the EUT.

Equipment	Manufacturer / Type	Serial number
-		

## 2.5 Test signals

All transmitter tests were made with continuous modulated signal.

## 2.6 Modification during the tests

No modifications were made during the tests.

### 3 TEST SPECIFICATIONS

#### 3.1 Standards

47 CFR Part 15, Subpart C, Intentional radiators, section 15.247

47 CFR Part 15, Subpart B, Unintentional radiators

RSS-GEN Issue 4

RSS-247 Issue 1

Test methods in:

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

#### 3.2 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	--

Test site radiohallen is CISPR 16-1-4 (2010) compliant on > 1 GHz frequencies.

#### 3.3 Test set-up

If not stated otherwise EUT was connected to spectrum analyser with coaxial cable.

#### 3.4 Test conditions

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

Parameter	Normal
Supplying voltage, V	6 (battery)
Air temperature, °C	20-24

#### 4 TEST SUMMARY

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

Test	Result	Section in report	Note
<b>Standard test methods</b>			
AC power-line conducted tests	N/A		
Radiated test below 30 MHz	N/A		
Radiated emissions measurements from 30 to 1000 MHz	Pass	5, 7	
Determination of radiated and antenna conducted emissions above 1 GHz	Pass	6, 7	1
Frequency Stability Test	N/A		
Occupied bandwidth and band-edge tests	Pass	8, 9, 11	
Output Power average symbol envelope power	NA		
Power Spectral Density < 40 GHz	Pass	12	
Power Spectral Density > 40 GHz	NA		
In-situ measurements	NA		
Polar plot, main lobe and variation on radiated emissions test	NA		
<b>Device-specific tests</b>			
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	PASS	8	
Determination of peak conducted output unlicensed wireless device power [15.247(b), 15.255]	PASS	10	
Determination of maximum conducted output power (15.247, 15-E)	PASS	10	
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)	PASS	2	
Determination of compliance with RF exposure limits	PASS	10	
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		

NT = Not Tested, by request of the Client

NA = Not Applicable



**Notes:**

1. The measured result is below the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance

**5 TRANSMITTER RADIATED EMISSIONS MEASUREMENTS FROM 30 TO 1000MHZ**

Date of test:	2013-11-11	Test location:	Big Chamber
EUT Serial:	130	Ambient temp.	20 °C
Tested by:	Kajsa From	Relative humidity	25 %
Test result:	Pass	Margin:	26.6

**5.1 Requirement**

Reference: FCC §15.209, FCC §15.247(d), IC RSS-GEN Table 5, RSS 247 5.5

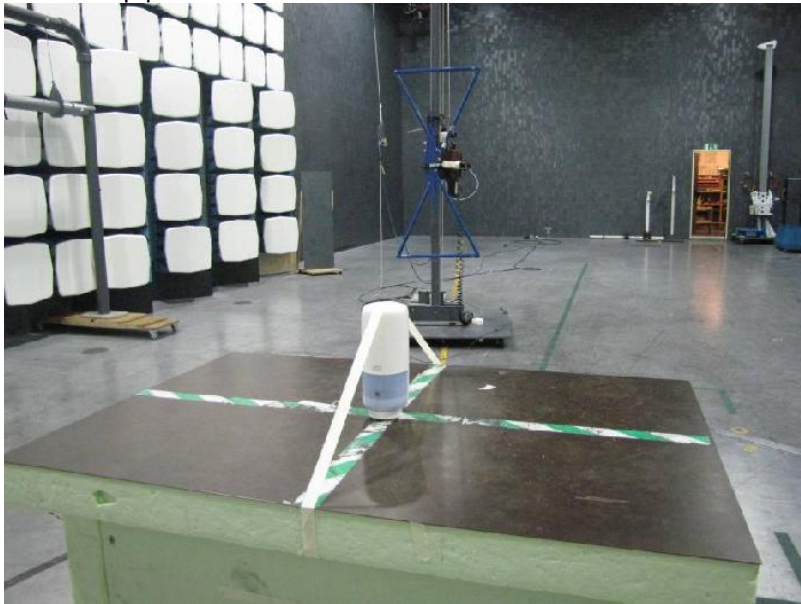
Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

**5.2 Test setup details**

Operation mode: continuous transmission, modulating.

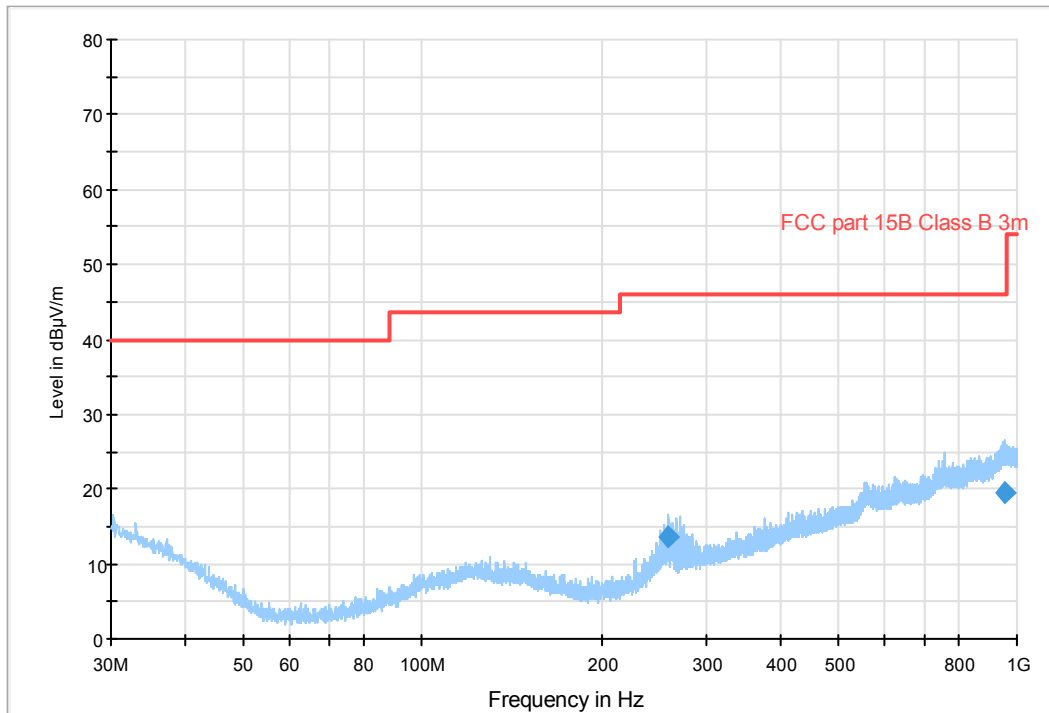
The test set up is according to ANSI C63.10 (2013) 6.3 and 6.5

Test set-up photo:



### 5.3 Test data

Overview sweeps performed with peak detectors,



Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP	Limit dBµV/m	Pol.	Azimuth deg	Antenna height cm	Margin dB
260.15	13.7	120	QP	46.0	V	44	162	32.3
951.42	19.4	120	QP	46.0	H	-24	400	26.6

Measured level [dBµV/m] = Analyser reading [dBµV] + cable 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	--
Rf-cables			40036, 9511, 9506, 9957, 5181	--

## 6 TRANSMITTER RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ

Date of test:	2015-08-21	Test location:	Big chamber and Radio chamber
EUT Serial:	-	Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	46 %
Test result:	Pass	Margin:	15.7 dB

### 6.1 Requirement

Reference: FCC §15.209, FCC §15.247(d), IC RSS-GEN Table 4, RSS 247 5.5

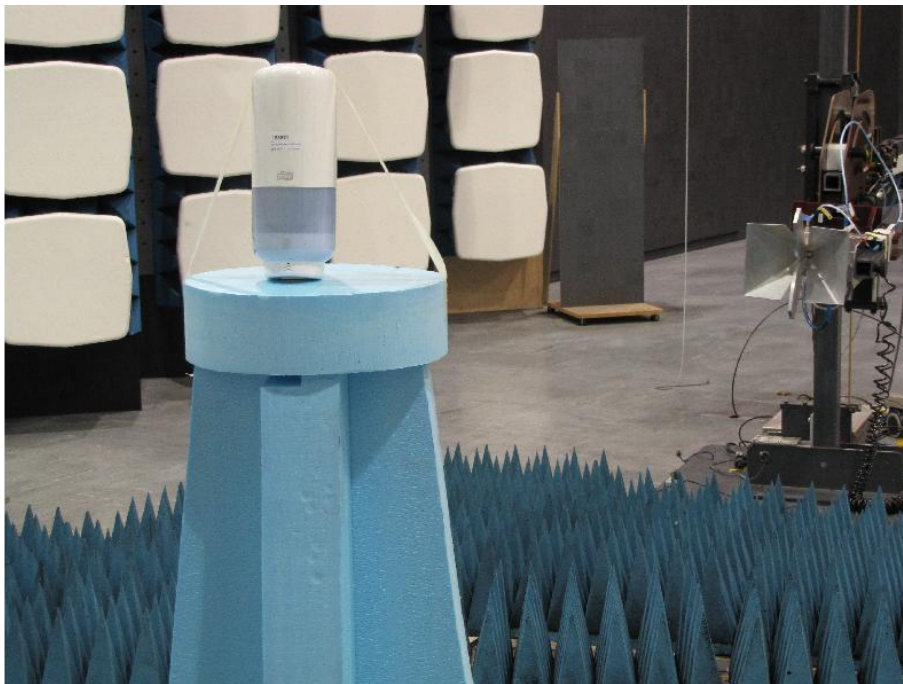
Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

### 6.2 Test setup details

Operation mode: continuous transmission, modulating.

The test set up is according to ANSI C63.10 (2013) 6.3 and 6.6

Test set-up photos:



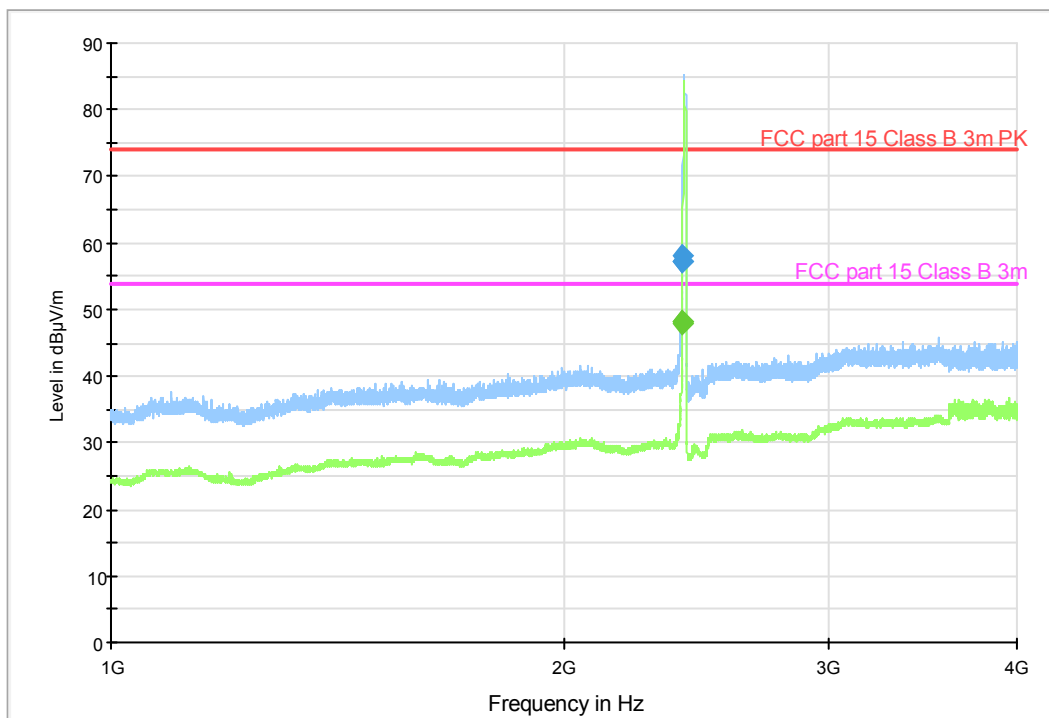
Big chamber, 1 – 18 GHz



Radio chamber, 18 – 26,5 GHz

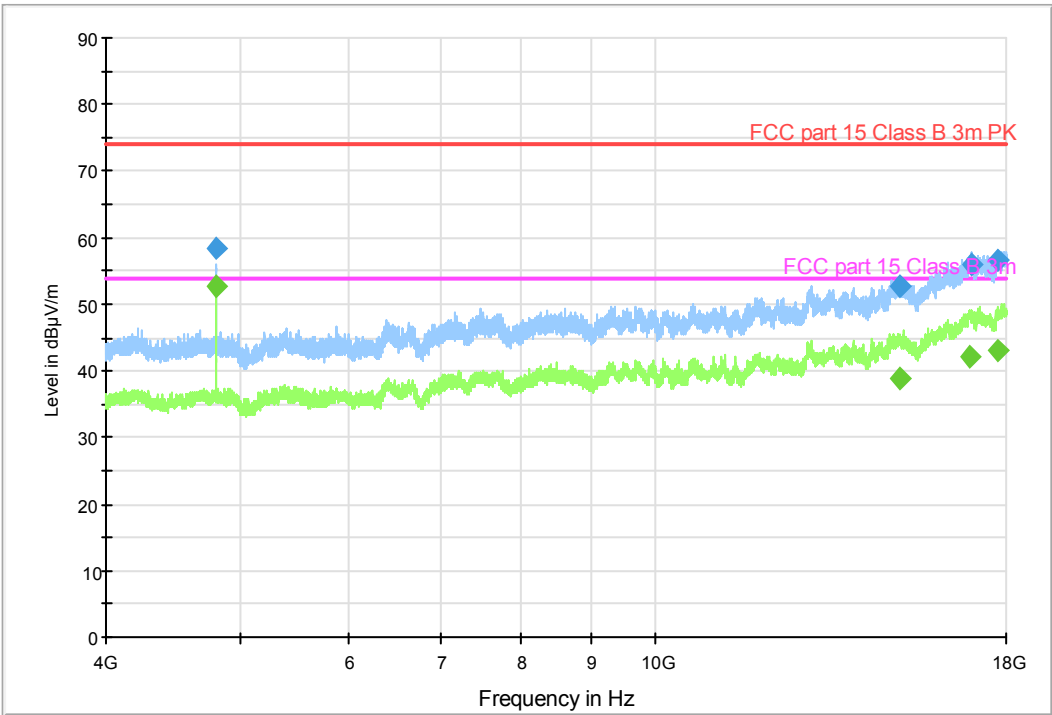
### 6.3 Test data

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation

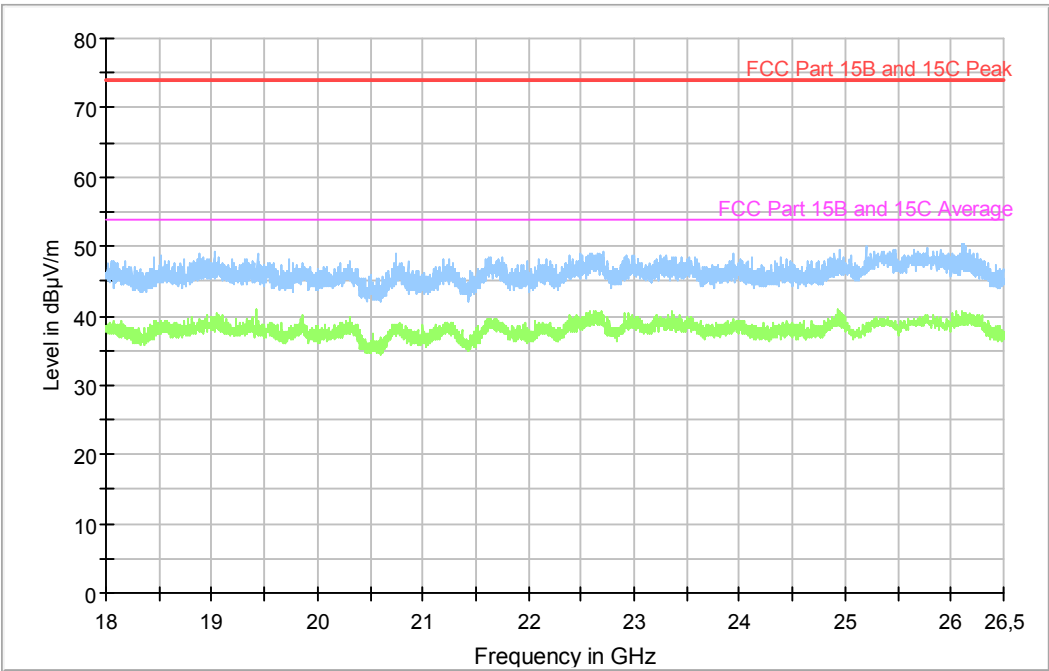


Overview sweeps performed with peak and average detectors, frequency range 1 – 4GHz  
Emissions between 2400 and 2500 MHz are attenuated by band reject filter K&L M/W S/N 1

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



Overview sweeps performed with peak and average detectors, frequency range 4 – 18GHz  
Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0  
Full Spectrum



Overview sweeps performed with peak detectors, frequency range 18 – 26.5 GHz

Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP / AVG / Peak	Limit dBµV	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
2400.0	57.1	1000	Peak	74	16.9	31	169	V
2400.1	58.1	1000	Peak	-		31	145	V
4811.0	58.3	1000	Peak	74	15.7	151	194	V
15095.2	52.7	1000	Peak	74	21.3	311	294	H
16976.5	55.8	1000	Peak	74	18.2	136	100	H
17742.7	56.7	1000	Peak	74	17.3	63	300	V

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

Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP / AVG / Peak	Limit dBµV	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
2400.0	28.2	1000	AVG	54	25.8	31	169	V
2400.1	29.2	1000	AVG	-		31	145	V
4811.0	29.4	1000	AVG	54	24.6	151	194	V
15095.2	23.8	1000	AVG	54	30.2	311	294	H
16976.5	26.9	1000	AVG	54	27.1	136	100	H
17742.7	27.8	1000	AVG	54	26.2	63	300	V

Level is calculated from peak level using 20 LOG (Ton/100ms) = -28.87 dB correction factor.

## 6.4 Test equipment

### Radio chamber

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Software:	Rohde & Schwarz	EMC32	-	-
Signal analyzer:	Rohde & Schwarz	FSIQ 40	12793	07-2016
Preamplifier:	MITEQ	AFS6/AFS44	12335	-
Horn antenna:	EMCO	3115	4936	02-2017
High pass filter:	K&L MICROWAVE INC	4410- X4500/18000 - 0/0	5133	07-2016
RF cables			5179, 5191, 5192	

### Big chamber

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Measurement receiver	Rohde & Schwarz	ESU 40	13178	07-2016
Pre-amplifier	BONN Elektronik	BLMA 0118-M	31246	07-2016
Horn antenna	Rohde & Schwarz	HF907	31245	11-2016
Horn antenna + Pre-amplifier	BONN Elektronik	BLMA 1826-5A	31247	12-2016
Band reject filter:	K&L MICROWAVE INC	6N45-2450/T 100-0/0	12389	07-2016
RF cables			39049, 39004	--



## 7 RECEIVER RADIATED EMISSIONS

Date of test:	2013-11-11	Test location:	Big chamber
EUT Serial:	130	Ambient temp.	20 – 21 °C
Tested by:	Kajsa From	Relative humidity	25 – 32 %
Test result:	Pass	Margin:	2.5 dB

### 7.1 Requirement

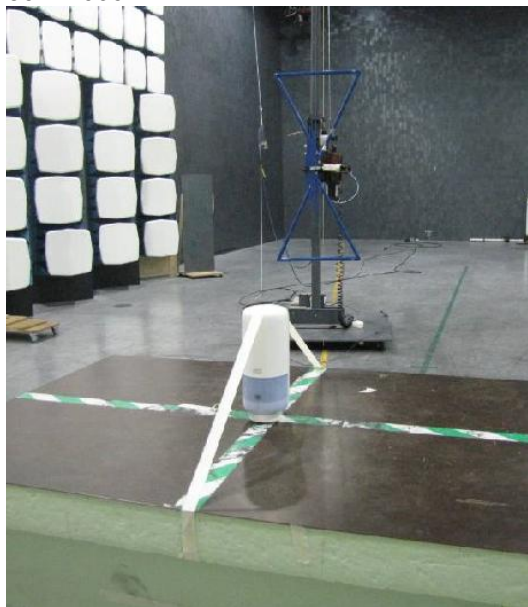
Reference: FCC §15.109, IC RSS-GEN Table 2

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

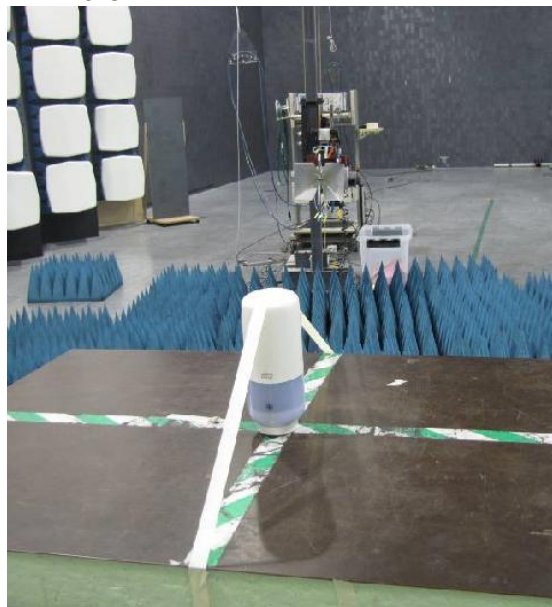
### 7.2 Test setup details

Operation mode: Receiver active

Test setup photo:  
30 – 1000 MHz

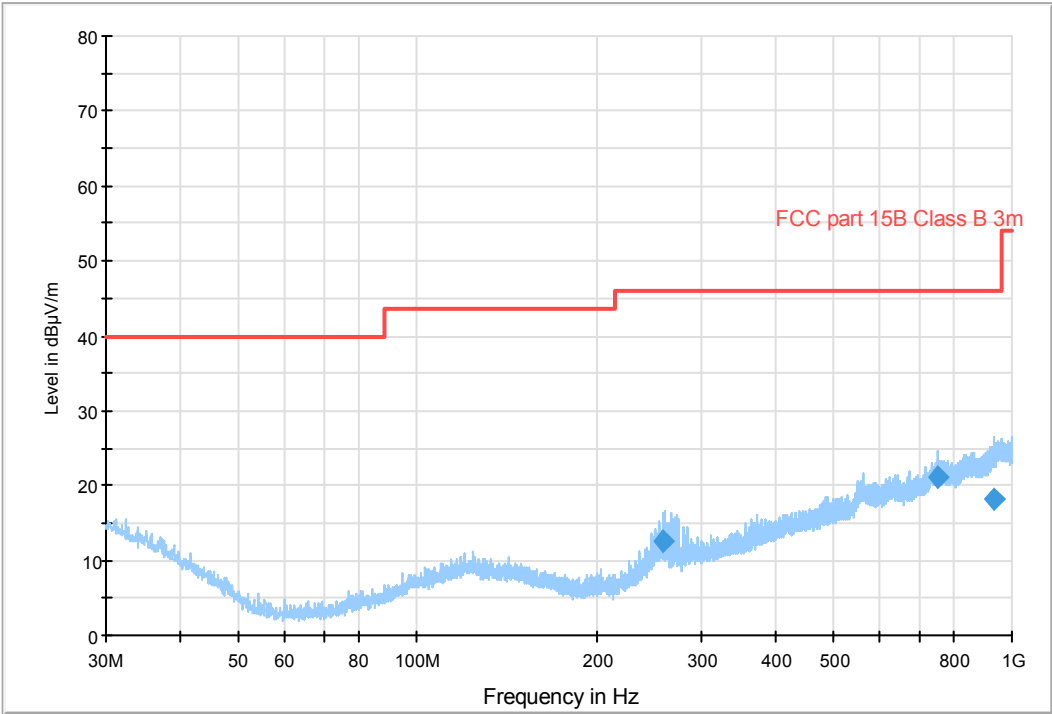


1 – 13 GHz

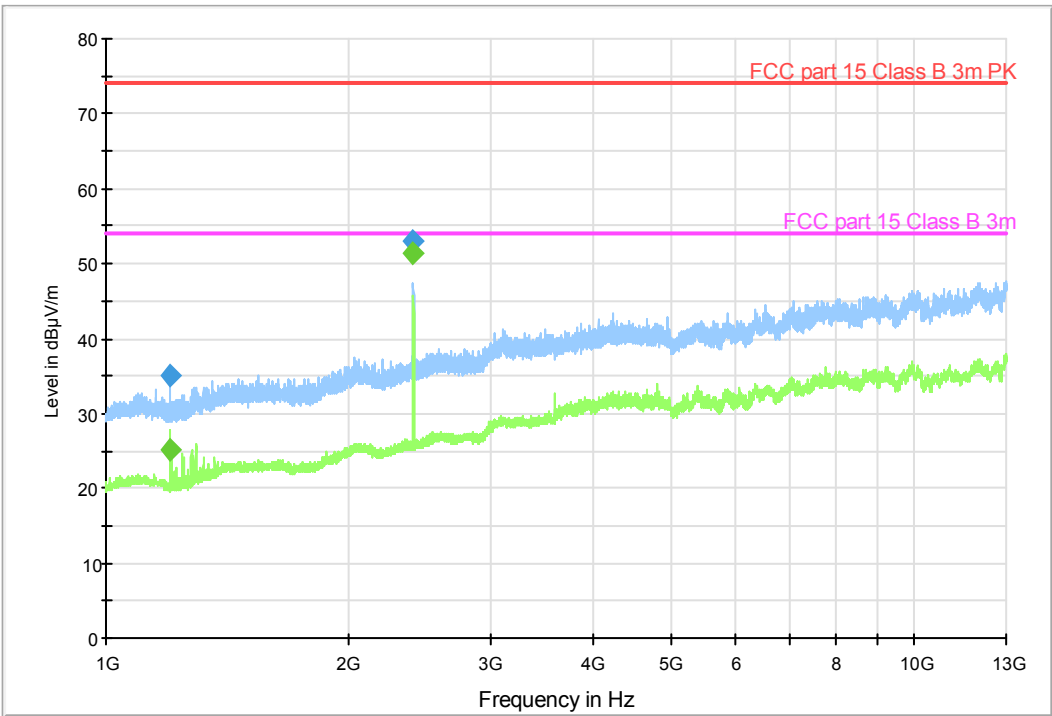


7.3 Test data

Overview sweeps performed with peak and average detectors, frequency range 30 – 1000 MHz



Overview sweeps performed with peak and average detectors, frequency range 1 – 13 GHz  
FCC 1 G - 18 G class B 3m ESU40



Frequency MHz	Disturbance Level dB $\mu$ V/m	RBW kHz	Detector QP / AVG / Peak	Limit dB $\mu$ V	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
260.21	12.6	120	QP	46.0	33.4	0	188	V
750.00	21.1	120	QP	46.0	24.9	302	100	V
932.86	18.3	120	QP	46.0	27.7	164	268	V
1199.69	25.1	1000	AVG	54.0	28.9	90	143	V
2402.93	51.5*	1000	AVG	54.0	2.5*	121	194	H
1199.69	35.1	1000	Peak	74.0	38.9	90	143	V
2402.93	57.1	1000	Peak	74.0	21.1	121	194	H

\* The measured result is below the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance.

#### 7.4 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	--
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 cables			40036, 9511, 9506, 9957, 5181, 39049	--

## 8 OCCUPIED 6 DB BANDWIDTH TEST

Date of test:	2013-11-07	Test location:	Radio lab
EUT Serial:	044	Ambient temp.	23 °C
Tested by:	Kajsa From	Relative humidity	27 %
Test result:	Pass	Margin:	994.5 kHz

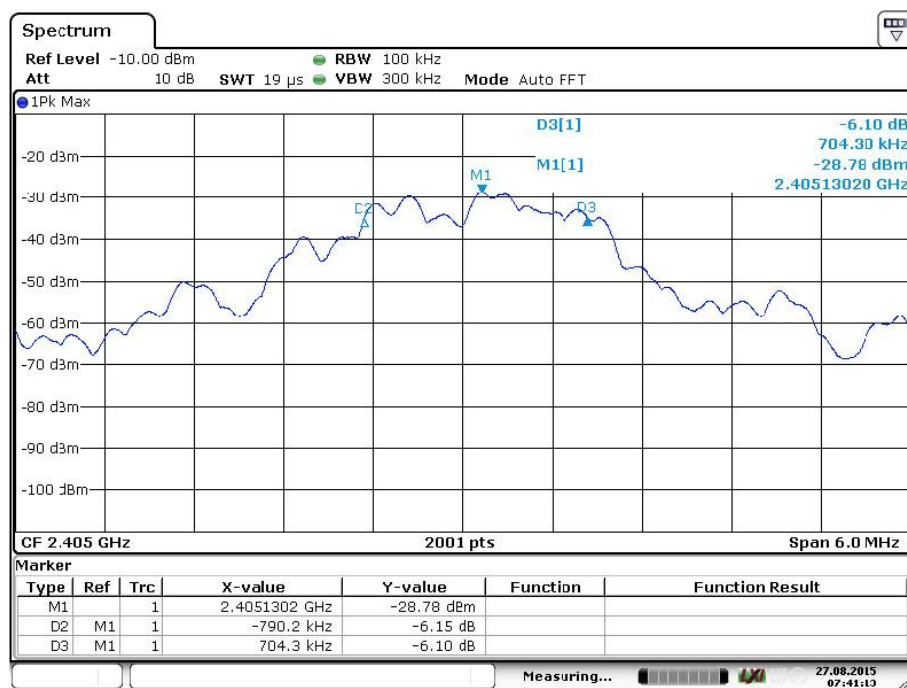
### 8.1 Requirement

The minimum 6 dB bandwidth shall be at least 500 kHz.

Reference: FCC §15.247(a)(2) RSS-247 A5.2(a)

Method: ANSI C63.10-2009: section 6.9.1

### 8.2 Test data



Date: 27.AUG.2015 07:41:13

Result	Limit	Margin
1494.5 kHz	>500 kHz	994.5 kHz

### 8.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSV	32594	07-2016

## 9 OCCUPIED 99% BANDWIDTH TEST

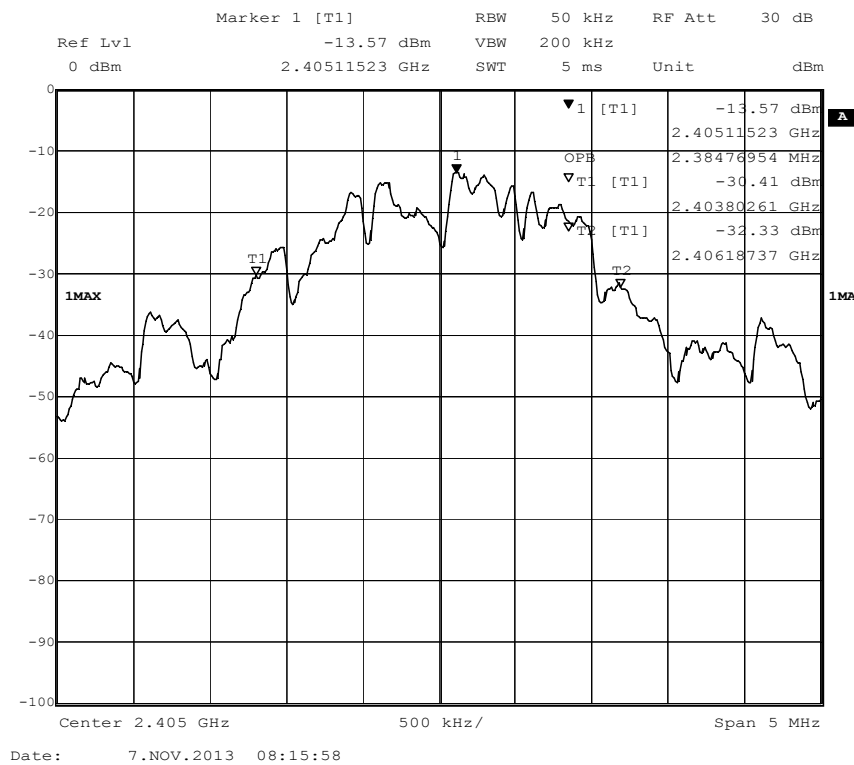
Date of test:	2013-11-07	Test location:	Radio lab
EUT Serial:	044	Ambient temp.	23 °C
Tested by:	Kajsa From	Relative humidity	27 %
Test result:	Pass	Margin:	-

### 9.1 Requirement

Reference: RSS GEN 6.6

Method: Signal analyzer's power bandwidth function was used to calculate 99% bandwidth

### 9.2 Test data



Result	Limit	Margin
2384.77 kHz	-	-

### 9.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	07-2014

## 10 CONDUCTED OUTPUT POWER

Date of test:	2013-11-11	Test location:	Radio lab
EUT Serial:	044	Ambient temp.	23 °C
Tested by:	Kajsa From	Relative humidity	22 %
Test result:	Pass	Margin:	998.47 mW

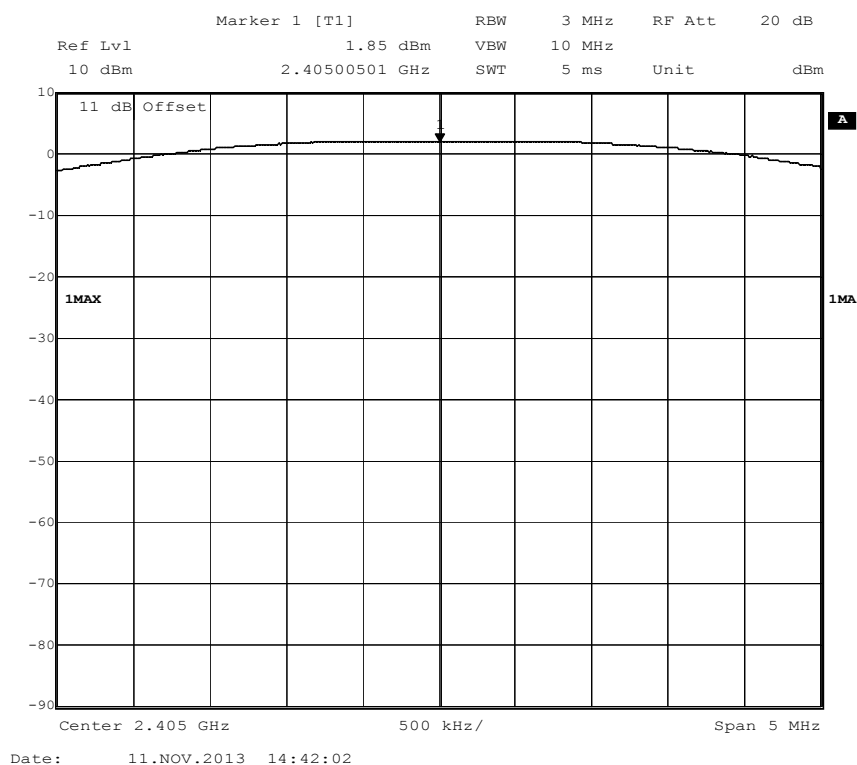
### 10.1 Requirement

The maximum peak conducted output power of the intentional radiator shall not exceed 1 watt.

Reference: FCC §15.247(b)(3) RSS-210 A8.4

Method: ANSI C63.10-2009: sections 6.10.2.1

### 10.2 Test data



Result	Limit	Margin
1.85 dBm = 1.53 mW	30 dBm = 1 W	998.47 mW

### 10.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	07-2014

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	7/2013

## 12 POWER SPECTRAL DENSITY

Date of test:	2013-11-11	Test location:	Radio lab
EUT Serial:	044	Ambient temp.	23 °C
Tested by:	Kajsa From	Relative humidity	22 %
Test result:	Pass	Margin:	15.43 dB

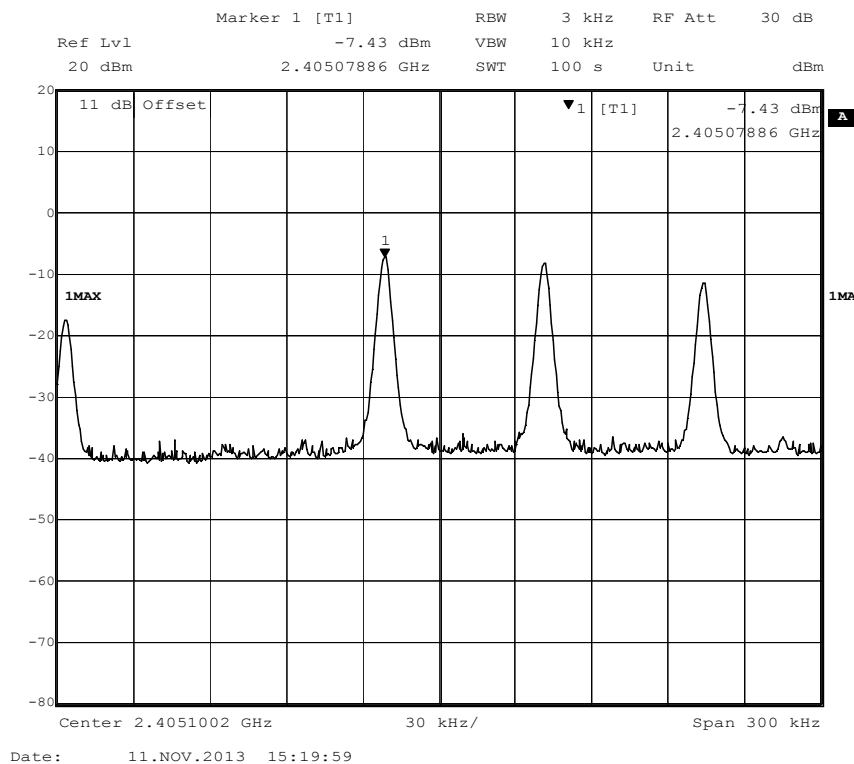
### 12.1 Requirement

Power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Reference: FCC §15.247(e) RSS-210 A8.2

Method: ANSI C63.10-2009: section 6.11.2.3

### 12.2 Test data



Result	Limit	Margin
-7.43 dBm / 3kHz	8dBm / 3kHz	15.43 dB

### 12.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	07-2014



### 13 DUTY CYCLE MEASUREMENT

Date of test:	2015-08-27	Test location:	Radio lab
EUT Serial:	-	Ambient temp.	23 °C
Tested by:	Matti Virkki	Relative humidity	22 %
Test result:	Pass	Margin:	-

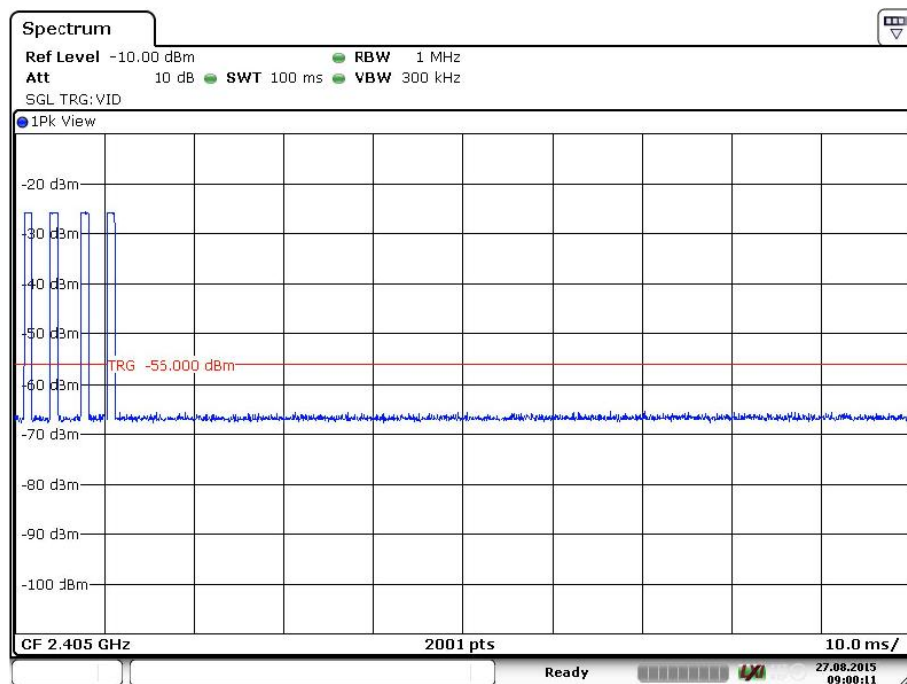
#### 13.1 Requirement

When the field strength (or envelope power) is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train, including blanking intervals within the pulse train, as long as the pulse train does not exceed 0.1 second. In cases where the pulse train exceeds 0.1 second, the average value of field strength or output power shall be determined during a 0.1 second interval during which the field strength or power is at its maximum value.

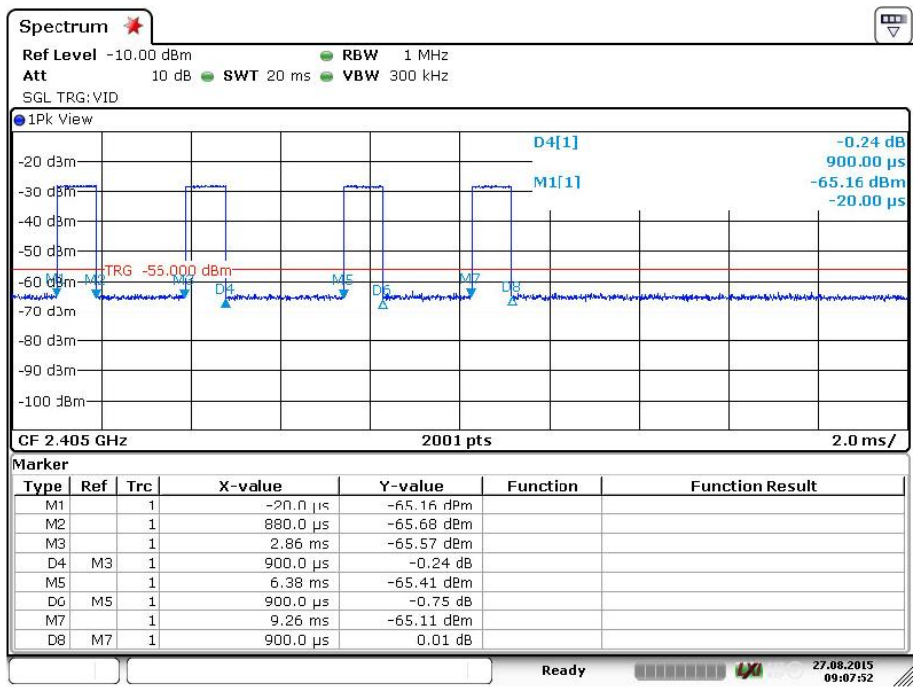
Referenece: FCC §15.35© RSS-GEN 6.10

Test method: ANSI C63.10 (2013) 7.5

#### 13.2 Test data



Date: 27.AUG.2015 09:00:11



Date: 27.AUG.2015 09:07:52

Result Ton / 100 ms	Correction factor
4*900 µs = 3.6 ms	-28.87 dB

13.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	07-2016

## 14 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 1 m and at a fixed height $\leq 1,5$ m	$\pm 5,3$ dB
200 to 1000 MHz at 1 m	$\pm 6,2$ dB
30 to 300 MHz at 3 m	$\pm 4,7$ dB
200 to 1000 MHz at 3 m	$\pm 4,8$ dB
30 to 300 MHz at 10 m	$\pm 4,6$ dB
200 to 1000 MHz at 10 m	$\pm 4,6$ 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	$\pm 5,4$ dB
1 to 18 GHz without filter or attenuator	$\pm 5,2$ dB
18 to 26 GHz without filter or attenuator	$\pm 5,5$ dB
26 to 40 GHz without filter or attenuator	$\pm 5,6$ dB

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

1 to 13 GHz with filter or attenuator	$\pm 5,5$ dB
1 to 13 GHz without filter or attenuator	$\pm 5,3$ dB
13 to 18 GHz with filter or attenuator	$\pm 5,3$ dB
13 to 18 GHz without filter or attenuator	$\pm 5,1$ dB
18 to 26,5 GHz without filter or attenuator	$\pm 5,4$ dB
26,5 to 40 GHz without filter or attenuator	$\pm 5,8$ dB

### Frequency range

R&S FSIQ	$\pm 0,2$ %
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### Output power

Analog signals, conducted:

RF-power meter	$\pm 0,6$ dB
Spectrum analyser	$\pm 3,5$ dB

Analog signals, radiated:

25 MHz - 1000 MHz	$\pm 3,7$ dB
1 GHz - 18 GHz	$\pm 3,4$ dB

Digital signals, conducted

$\pm 0,6$  dB

Digital signals, radiated:

25 MHz - 1000 MHz	$\pm 3,7$ dB
1 GHz - 18 GHz	$\pm 3,4$ dB

### Peak power density

Conducted:

8593E	$\pm 2,5$ dB
8566B	$\pm 2,7$ dB

Radiated:

8593E & 8566B, 25 - 1000 MHz	$\pm 4,5$ dB
8593E & 8566B, 1 - 18 GHz	$\pm 4,7$ dB

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**15 PHOTO OF THE EUT**

