

# RADIO TEST REPORT

**No. 1511404STO-001, Ed. 2****RF Performance****EQUIPMENT UNDER TEST**

Equipment: Defibrillator Training System with Bluetooth Low  
Energy communication  
Type/Model: Shocklink  
Manufacturer: Laerdal Medical  
Tested by request of: Laerdal Medical

**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 the following standards:

47 CFR Part 15 (2014);, Subpart C: Intentional radiators. Section 15.247

For details, see clause 2 – 4.

Date of issue: 2015-07-01

Tested by:



Daniel Nilsson

Approved by:



Matti Virkki

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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

**Revision History**

| Edition | Date       | Description                        | Changes                                                                 |
|---------|------------|------------------------------------|-------------------------------------------------------------------------|
| 1       | 2015-06-22 | First release                      |                                                                         |
| 2       | 2015-07-01 | Inclusion of additional test data. | Measurement results for Average detector has been added to section 5.5. |
|         |            |                                    |                                                                         |

Version 1.00

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## 1 CLIENT INFORMATION

The EUT has been tested by request of

Company Laerdal Medical  
 Tanke Svilandsgt. 30  
 POB 377  
 4002 Stavanger  
 Norway  
 Name of contact Arild Eikefjord

## 2 EQUIPMENT UNDER TEST (EUT)

### 2.1 Identification of the EUT

Equipment: Defibrillator Training System with Bluetooth Low Energy communication  
 Type/Model: Shocklink  
 Brand name: Laerdal Shocklink  
 Serial number: 16 & 29  
 Manufacturer: Laerdal Medical  
 Transmitter frequency range: 2402-2480 MHz  
 Receiver frequency range: 2402-2480 MHz

Frequency agile or hopping: ☐ Yes ☒ No  
 Antenna: ☒ Internal antenna ☐ External antenna  
 Antenna connector: ☒ None, internal antenna ☐ Yes  
 Antenna gain: 0.5 dBi  
 Rating RF output power: -5.14 dBm (measured conducted)  
 Type of modulation: GFSK  
 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: 0°C to +40°C

Transmitter stand by mode supported: ☒ Yes ☐ No

### 2.2 Additional information about the EUT

The EUT consists of the following units:

| Equipment                            | Type / Model | Serial no. |
|--------------------------------------|--------------|------------|
| Unit with internal antenna           | Shocklink    | 29         |
| Unit modified with antenna connector | Shocklink    | 16         |

During the tests the EUT supported following software:

| Software                  | Version | Comment |
|---------------------------|---------|---------|
| Direct Test Mode Software | V1.0    |         |

The EUT was tested with the following cables:

| Port:                          | Type:      | Length:<br>[m] | Specifications: |
|--------------------------------|------------|----------------|-----------------|
| Trainee electrode cable        | Unshielded | 0.8            | Two-core        |
| Defibrillator connection cable | Unshielded | 0.9            | Two-core        |

### 2.3 Peripheral equipment

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

| Equipment       | Type / Model | Manufacturer | Serial no.    |
|-----------------|--------------|--------------|---------------|
| Defibrillator   | FST 1880     | Laerdal      | WO06390700268 |
| Mannequin board | MRx          | Philips      | US00214279    |

### 2.4 Modifications made during the tests

No modifications have been made during the tests.

### 2.5 Test signals and operation modes

Through manufacturer supplied test software the EUT it was possible to control channel and duty cycle.

The EUT was tested on channels 0 (2402 MHz), 19 (2440 MHz) and 39 (2480 MHz).

All tests were performed with modulated carrier at maximum duty cycle.

### 3 TEST SPECIFICATIONS

#### 3.1 Standards

Requirements:

47 CFR Part 15: Radio frequency device, Subpart C: Unintentional radiators (2014).

Test methods:

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 FCC accredited conformity assessment body with designation number SE0002

Intertek Semko AB is an Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

| Measurement Chamber | Type of chamber               | IC Site filing # |
|---------------------|-------------------------------|------------------|
| STORA HALLEN        | Semi-anechoic<br>10 m and 3 m | 2042G-2          |

#### 4 TEST SUMMARY

The results in this report apply only to sample tested:

| Requirement                | Description                                                                                                          | Result      |
|----------------------------|----------------------------------------------------------------------------------------------------------------------|-------------|
| FCC §15.203                | <b>Antenna requirement</b>                                                                                           | <b>PASS</b> |
|                            | The EUT has integrated non detachable antenna which can't be remove without breaking EUT                             |             |
| FCC §15.247 (b)(4), (d),   | <b>Field strength of fundamental and antenna gain</b>                                                                | <b>PASS</b> |
|                            | The EUT complies with the limits.                                                                                    |             |
| FCC §15.247 (d), 15.209(a) | <b>Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz</b>                              | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit was at least 17.9 dB at 932.523 MHz<br>See section 6.5. |             |
| FCC §15.247(d), 15.209(a)  | <b>Radiated emission of electromagnetic fields in the frequency range above 1 GHz</b>                                | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit was at least 13.5 dB at 4960 MHz<br>See section 6.6     |             |
| FCC §15.247(a)(2)          | <b>Occupied bandwidth</b>                                                                                            | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit is at least 160.850 kHz                                 |             |
| FCC §15.247(b)             | <b>Conducted output power</b>                                                                                        | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit was at least 35.1 dB at 2439.738 MHz                    |             |
| FCC §15.247(e)             | <b>Power spectral density</b>                                                                                        | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit was at least 14.68 dB at 2439.991 MHz                   |             |
| FCC §15.247(e)             | <b>Band edge</b>                                                                                                     | <b>PASS</b> |
|                            | The EUT complies with the limits.<br>The margin to the limit was at least 8.6 dB at 2483.500 MHz                     |             |

## 5 FIELD STRENGTH OF FUNDAMENTAL AND RADIATED BAND EDGE

### 5.1 Operating environment

|               |              |                    |
|---------------|--------------|--------------------|
| Date of test: | Temperature: | Relative Humidity: |
| 2015-05-21    | 21 [°C]      | 36 [%]             |

### 5.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10 and ANSI C63.4.

The EUT was set up in order to emit maximum disturbances.

The EUT was placed on an insulating support 0.8 m above the turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak detector activated in the frequency-range 30 – 1000 MHz.

Above 1 GHz additionally the average detector was activated.

### 5.3 Test conditions

#### Test set-up:

Test receiver set-up:

Preview test:

Final test:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

#### 30 MHz to 1000 MHz

Peak, RBW 120 kHz. VBW 1 MHz

Peak, RBW 120 kHz. VBW 1 MHz

10 m

0 – 359°

1 – 4 m

Vertical and Horizontal

Bilog

#### Test set-up:

Test receiver set-up:

Preview test:

Final test:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

Antenna tilt:

#### 1 GHz – 26.5 GHz

Peak, RBW 1 MHz. VBW 3 MHz

Peak, RBW 1 MHz

Average Peak value + 20 x LOG (Duty cycle)

3 m

0 – 359°

1 – 4 m

Vertical and Horizontal

Horn

Activated

## 5.4 Requirement

The EUT shall meet the following limits.

Reference:

Outside the restricted bands:

§15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

Within restricted bands:

§15.209

Field strength of emissions must comply with limits shown in table below

| Frequency range<br>[MHz] | Field strength<br>at 3 m<br>(dB $\mu$ V/m) | Field strength<br>at 10 m<br>(dB $\mu$ V/m) | Detector<br>(dB $\mu$ V/m) |
|--------------------------|--------------------------------------------|---------------------------------------------|----------------------------|
| 30 – 88                  | 40.0                                       | 29.5                                        | Quasi Peak                 |
| 88 – 216                 | 43.5                                       | 33.0                                        | Quasi Peak                 |
| 216 – 960                | 46.0                                       | 35.5                                        | Quasi Peak                 |
| 960 – 1000               | 54.0                                       | 43.5                                        | Quasi Peak                 |
| Above 1000               | 54.0 / 74.0                                | 43.5 / 63.5                                 | Average / Peak             |

## 5.5 Test results

## Measurement results, Peak, Channel 0

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT Orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2402.0          | 95.9           | -              | -               | H                | -           |
| 2400.0          | 58.1           | 75.9           | -               | H                | 17.8        |
| 2398.0          | 58.7           | 75.9           | -               | H                | 17.2        |
| 2396.0          | 55.3           | 75.9           | -               | H                | 20.6        |
| 2394.2          | 58.6           | 75.9           | -               | H                | 17.3        |
| 2392.3          | 54.1           | 75.9           | -               | H                | 21.8        |

## Measurement results, Average, Channel 0

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT Orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2402.0          | 75.9           | -              | -               | H                | -           |
| 2400.0          | 38.1           | -              | -               | H                | 17.8        |
| 2398.0          | 38.7           | -              | -               | H                | 17.2        |
| 2396.0          | 35.3           | -              | -               | H                | 20.6        |
| 2394.2          | 38.6           | -              | -               | H                | 17.3        |
| 2392.3          | 34.1           | -              | -               | H                | 21.8        |

## Measurement results, Peak, Channel 39

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT Orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2480.0          | 94.4           | -              | -               | H                | -           |
| 2483.5          | 65.4           | 74             | -               | H                | 8.6         |
| 2486.9          | 59.0           | 74             | -               | H                | 15.0        |
| 2492.5          | 55.3           | 74             | -               | H                | 18.7        |
| 2500.0          | 59.9           | 74             | -               | H                | 14.1        |

## Measurement results, Average, Channel 39

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT Orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2480.0          | 74.4           | -              | -               | H                | -           |
| 2483.5          | 45.4           | 54             | -               | H                | 8.6         |
| 2486.9          | 39.0           | 54             | -               | H                | 15.0        |
| 2492.5          | 35.3           | 54             | -               | H                | 18.7        |
| 2500.0          | 39.9           | 54             | -               | H                | 14.1        |

## 6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 26.5 GHZ

### 6.1 Operating environment

|               |              |                    |
|---------------|--------------|--------------------|
| Date of test: | Temperature: | Relative Humidity: |
| 2015-05-21    | 21 [°C]      | 36 [%]             |

### 6.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10 and ANSI C63.4.

The EUT was set up in order to emit maximum disturbances.

The EUT was placed on an insulating support 0.8 m above the turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak detector activated in the frequency-range 30 – 1000 MHz.

Above 1 GHz additionally the average detector was activated.

### 6.3 Test conditions

#### Test set-up:

Test receiver set-up:

Preview test:

Final test:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

#### 30 MHz to 1000 MHz

Peak,

RBW 120 kHz. VBW 1 MHz

Peak,

RBW 120 kHz. VBW 1 MHz

10 m

0 – 359°

1 – 4 m

Vertical and Horizontal

Bilog

#### Test set-up:

Test receiver set-up:

Preview test:

Final test:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

Antenna tilt:

#### 1 GHz – 40 GHz

Peak,

RBW 1 MHz. VBW 3 MHz

Peak,

RBW 1 MHz

Average

Peak value + 20 x LOG (Duty cycle)

3 m

0 – 359°

1 – 4 m

Vertical and Horizontal

Horn

Activated

## 6.4 Radiated Emission requirements

### Outside restricted bands

#### §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

### Within restricted bands

#### §15.209

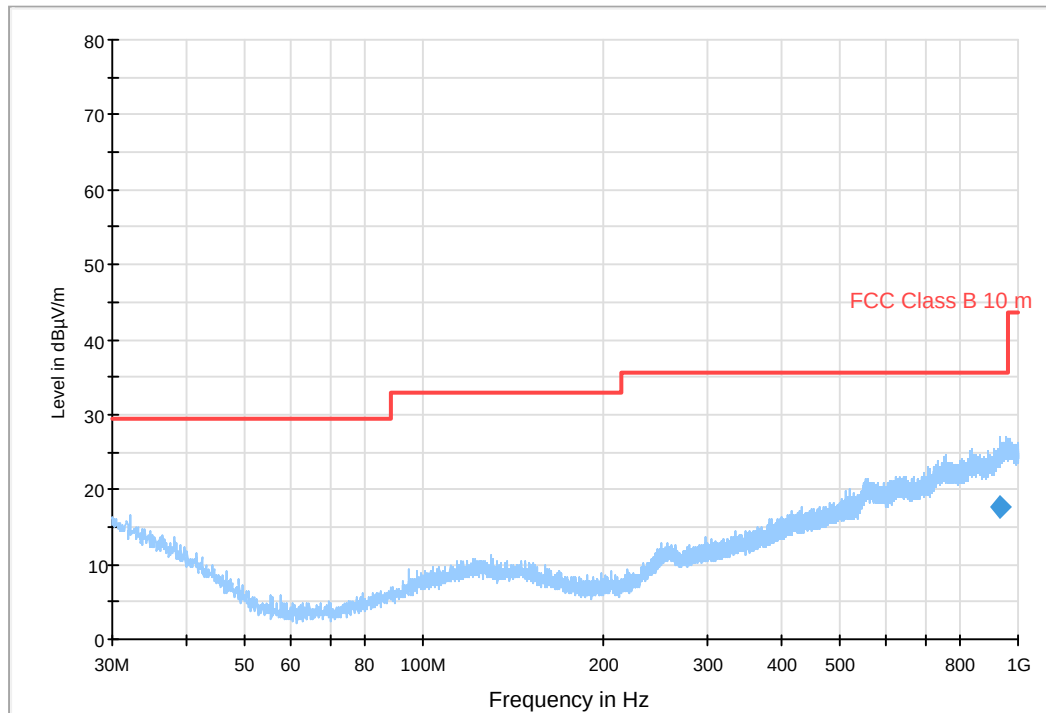
Field strength of emissions must comply with limits shown in table below

| Frequency range [MHz] | Field strength at 3 m (dB $\mu$ V/m) | Field strength at 10 m (dB $\mu$ V/m) | Detector (dB $\mu$ V/m) |
|-----------------------|--------------------------------------|---------------------------------------|-------------------------|
| 30 – 88               | 40.0                                 | 29.5                                  | Quasi Peak              |
| 88 – 216              | 43.5                                 | 33.0                                  | Quasi Peak              |
| 216 – 960             | 46.0                                 | 35.5                                  | Quasi Peak              |
| 960 – 1000            | 54.0                                 | 43.5                                  | Quasi Peak              |
| Above 1000            | 54.0 / 74.0                          | 43.5 / 63.5                           | Average / Peak          |

The values for 10 m measuring distance are calculated by subtracting 10.5 dB from the 3 m limit. (i.e. an extrapolation factor of 20 dB/decade according to §15.31(f)(1)) and RSS-Gen section 6.5.

## 6.5 Test results 30 MHz – 1000 MHz

FCC 30 - 1000 MHz FCC class B 10m



Diagram, Peak overview sweep, 30 – 1000 MHz at 10 m distance.

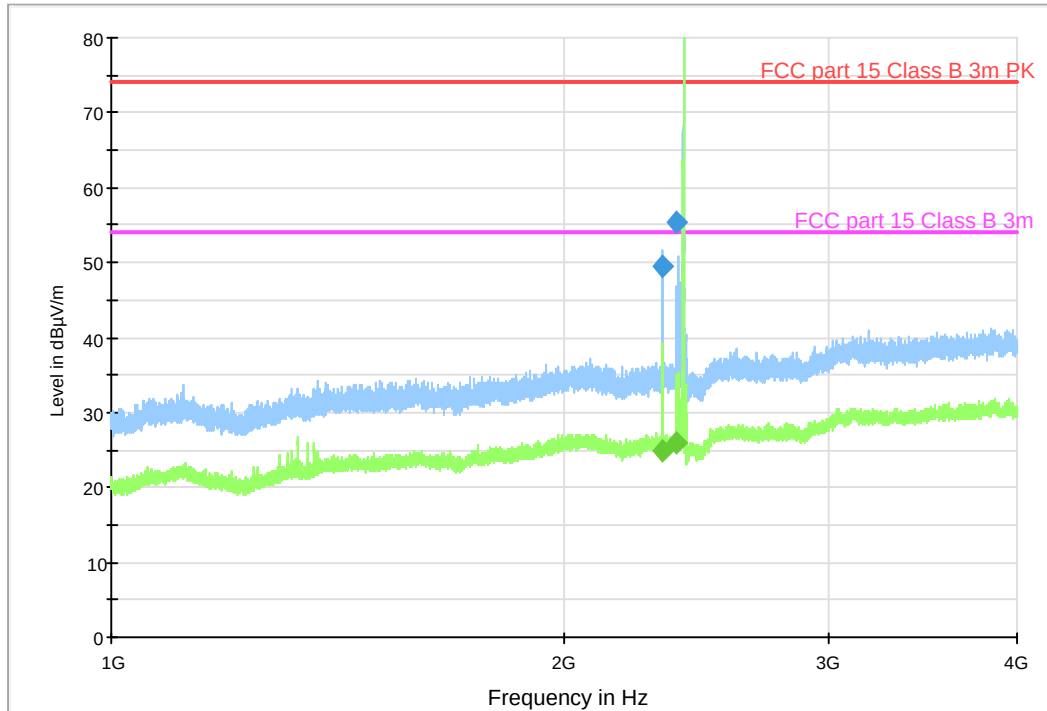
### Measurement results, Quasi Peak

No disturbances were found above noise floor.

The measured noise floor (quasi-peak) has a lowest margin at 932.523 MHz of 17.9 dB to the limit.

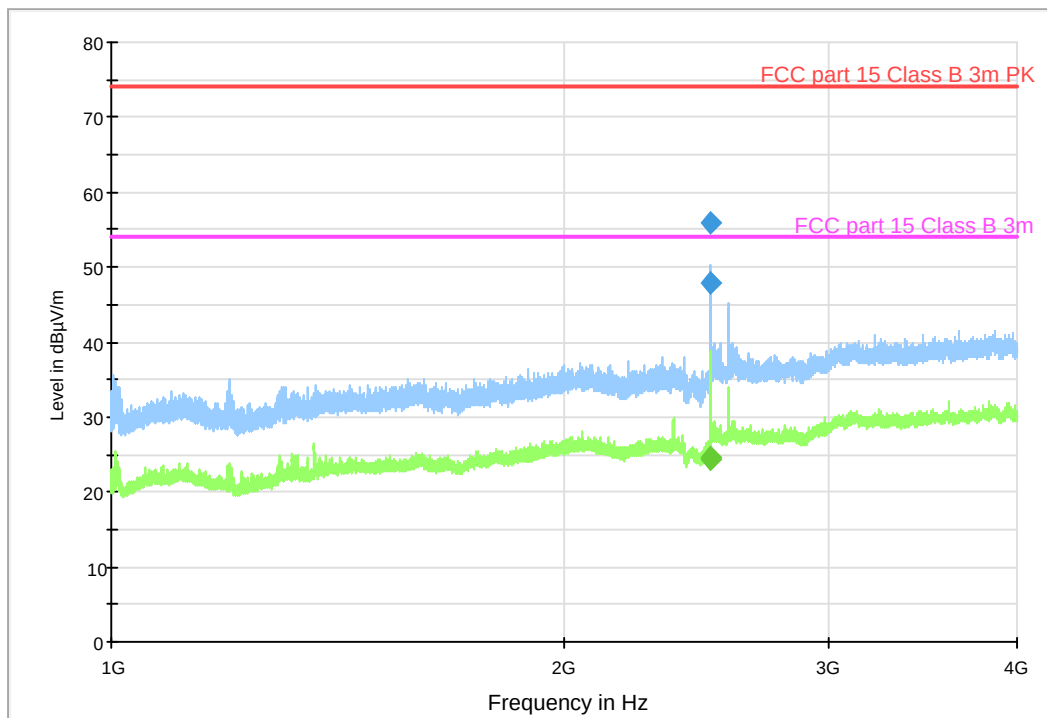
## 6.6 Test results 1 GHz – 26.5 GHz

FCC 1 G - 4 G class B 3m ESU40



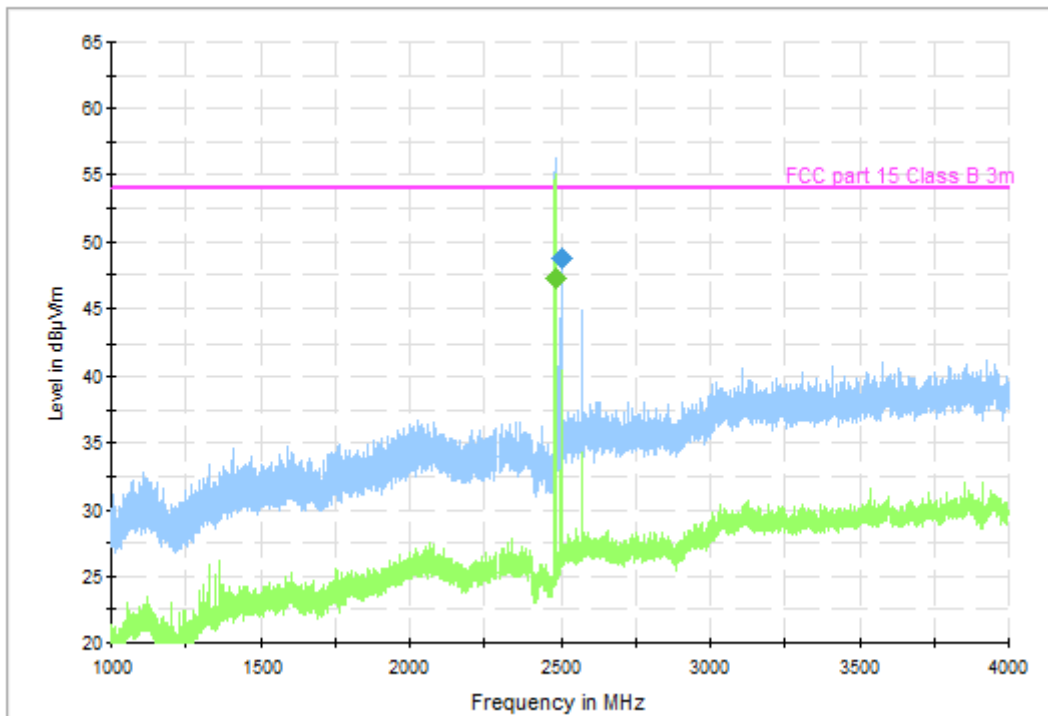
Diagram, Peak overview sweep, 1 – 4 GHz at 3 m distance. Channel 0

FCC 1 G - 4 G class B 3m ESU40



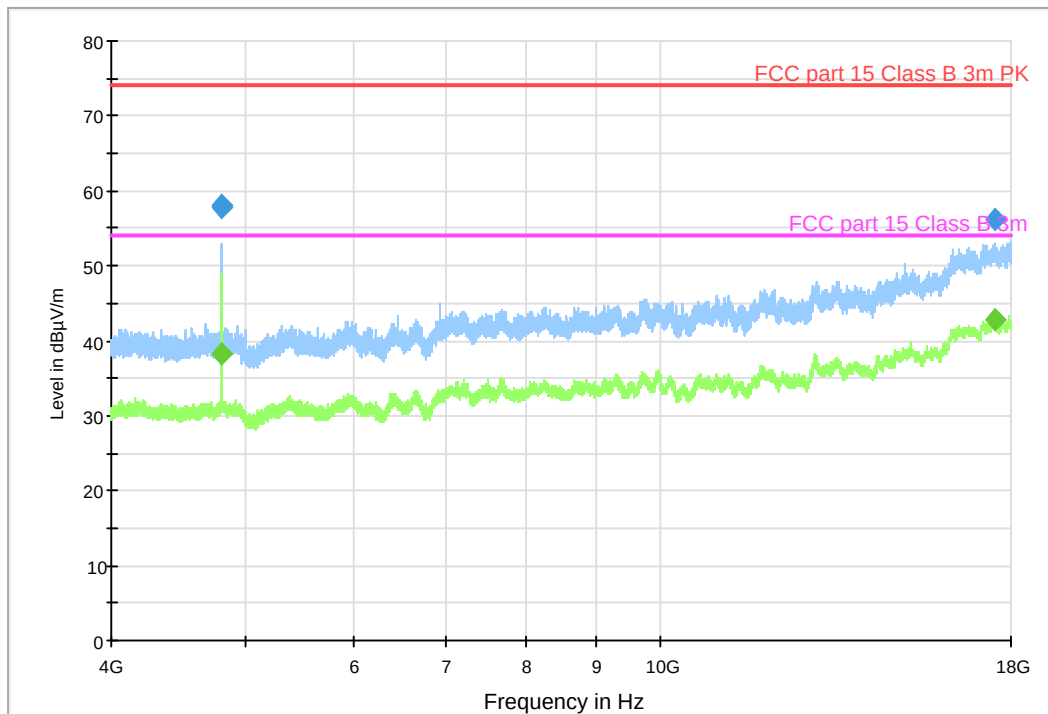
Diagram, Peak overview sweep, 1 – 4 GHz at 3 m distance. Channel 19

FCC 1 G - 4 G class B 3m ESU40



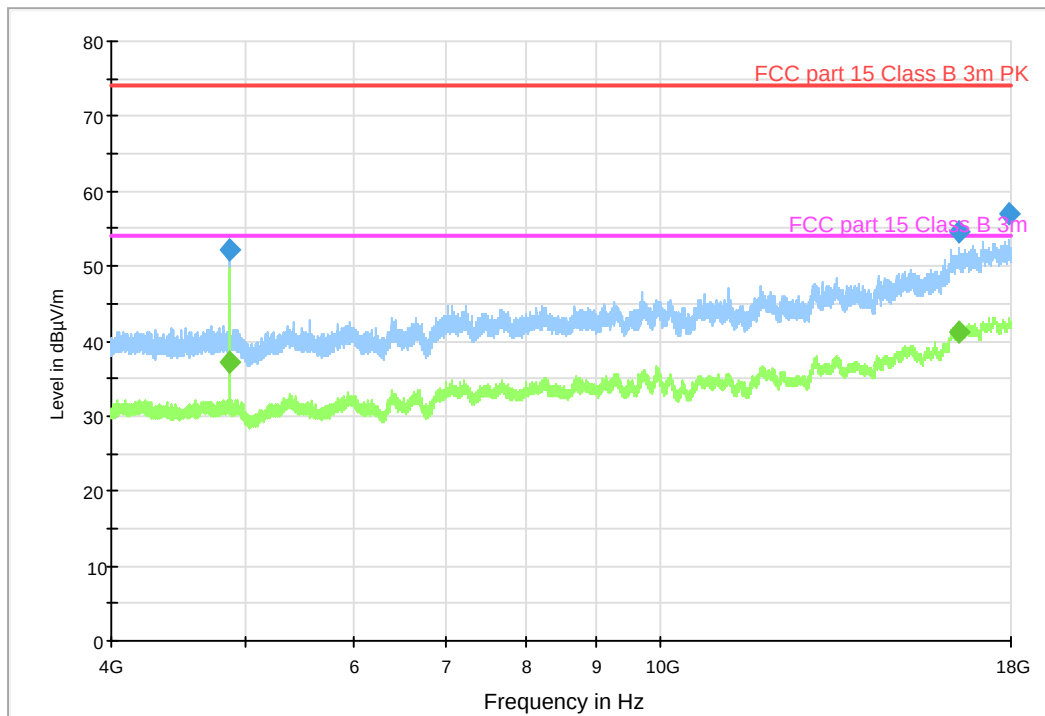
Diagram, Peak overview sweep, 1 – 4 GHz at 3 m distance. Channel 39

FCC 4 - 18 G class B 3m ESU40



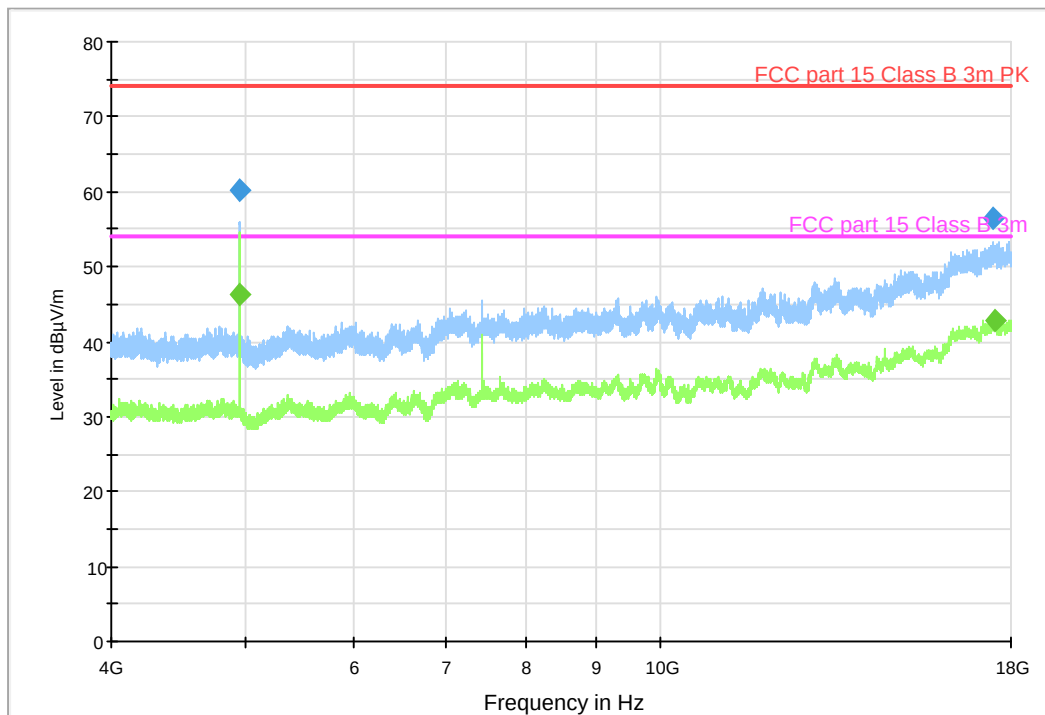
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. Channel 0

## FCC 4 - 18 G class B 3m ESU40



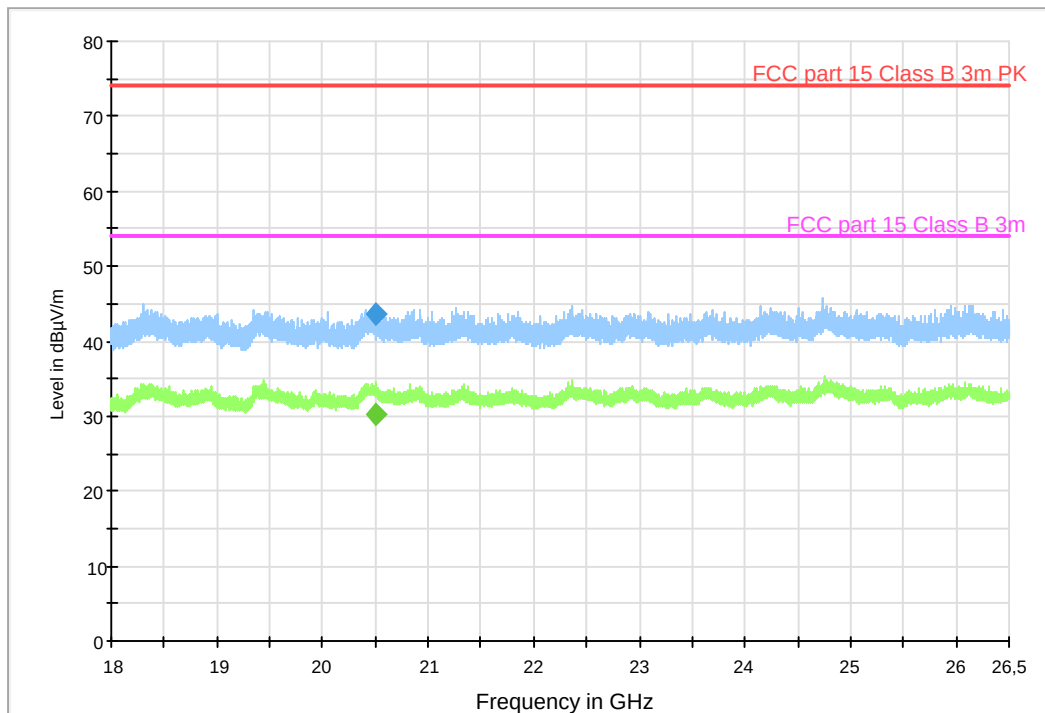
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. Channel 19

## FCC 4 - 18 G class B 3m ESU40



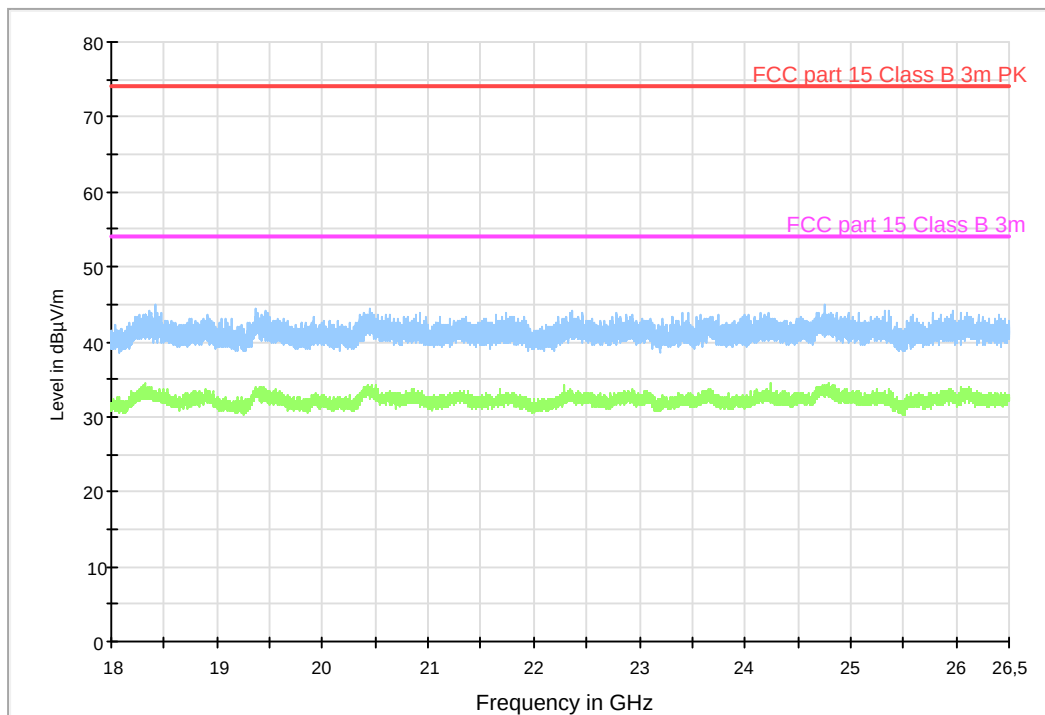
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. Channel 39

## FCC 18 G - 26.5 G class B 3m ESU40



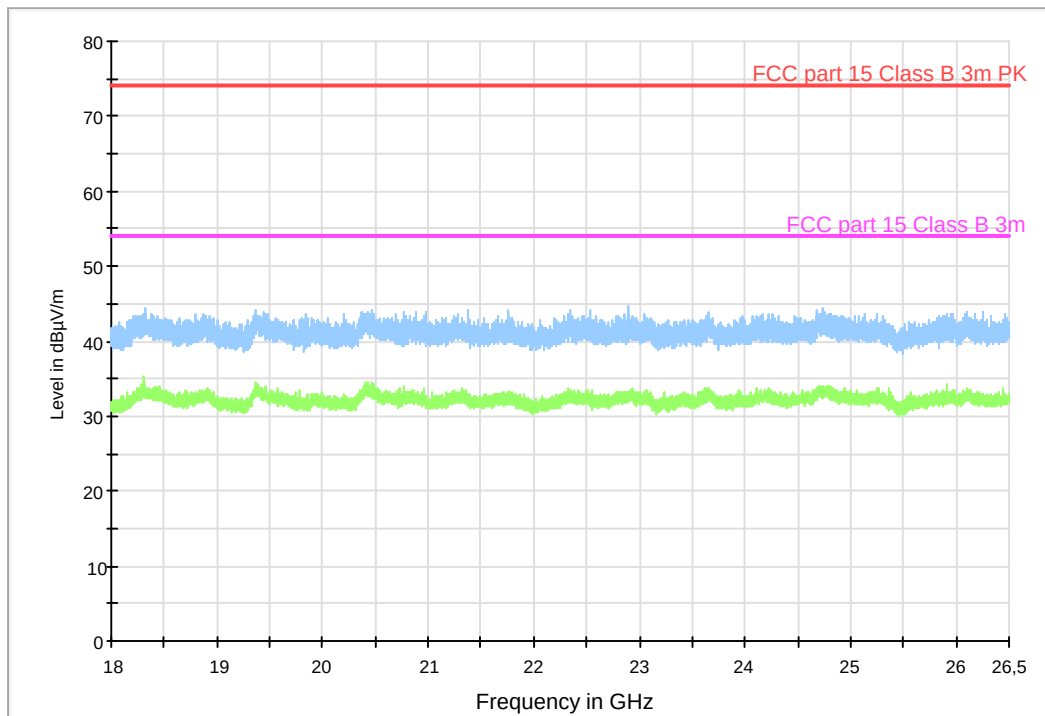
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. Channel 0

## FCC 18 G - 26.5 G class B 3m ESU40



Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. Channel 19

## FCC 18 G - 26.5 G class B 3m ESU40



Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. Channel 39

**Measurement results, Peak, Channel 0**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2322.761        | 50.4           | 74.0           | -               | H                | 23.6        |
| 2378.146        | 56.5           | 74.0           | -               | H                | 17.5        |
| 4804.000        | 58.6           | 74.0           | -               | H                | 15.4        |

**Measurement results, Average, Channel 0**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2322.761        | 30.4           | 54.0           | -               | H                | 23.6        |
| 2378.146        | 36.5           | 54.0           | -               | H                | 17.5        |
| 4804.000        | 38.6           | 54.0           | -               | H                | 15.4        |

**Measurement results, Peak, Channel 19**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2500.591        | 50.4           | 75.6           | -               | H                | 25.2        |
| 2500.619        | 58.4           | 75.6           | -               | H                | 17.2        |
| 4880.000        | 52.6           | 74.0           | -               | H                | 21.4        |

**Measurement results, Average, Channel 19**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2500.591        | 30.4           | -              | -               | H                | -           |
| 2500.619        | 38.4           | -              | -               | H                | -           |
| 4880.000        | 32.6           | 54.0           | -               | H                | 21.4        |

**Measurement results, Peak, Channel 39**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2500.493        | 51.3           | 74.4           | -               | H                | 23.1        |
| 4960.000        | 60.5           | 74.0           | -               | H                | 13.5        |

**Measurement results, Average, Channel 39**

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 2500.493        | 31.3           | -              | -               | H                | -           |
| 4960.000        | 40.5           | 54             | -               | H                | 13.5        |

Level [dBμV/m] = Analyser reading [dBμV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

## 7 OCCUPIED BANDWIDTH

### 7.1 Operating environment

|               |              |                    |
|---------------|--------------|--------------------|
| Date of test: | Temperature: | Relative Humidity: |
| 2015-05-26    | 23 [°C]      | 30 [%]             |

### 7.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10.

### 7.3 Test conditions

Detector: Peak  
RBW 1 – 5 % of span  
VBW 3 x RBW  
Span 1.5 x OBW

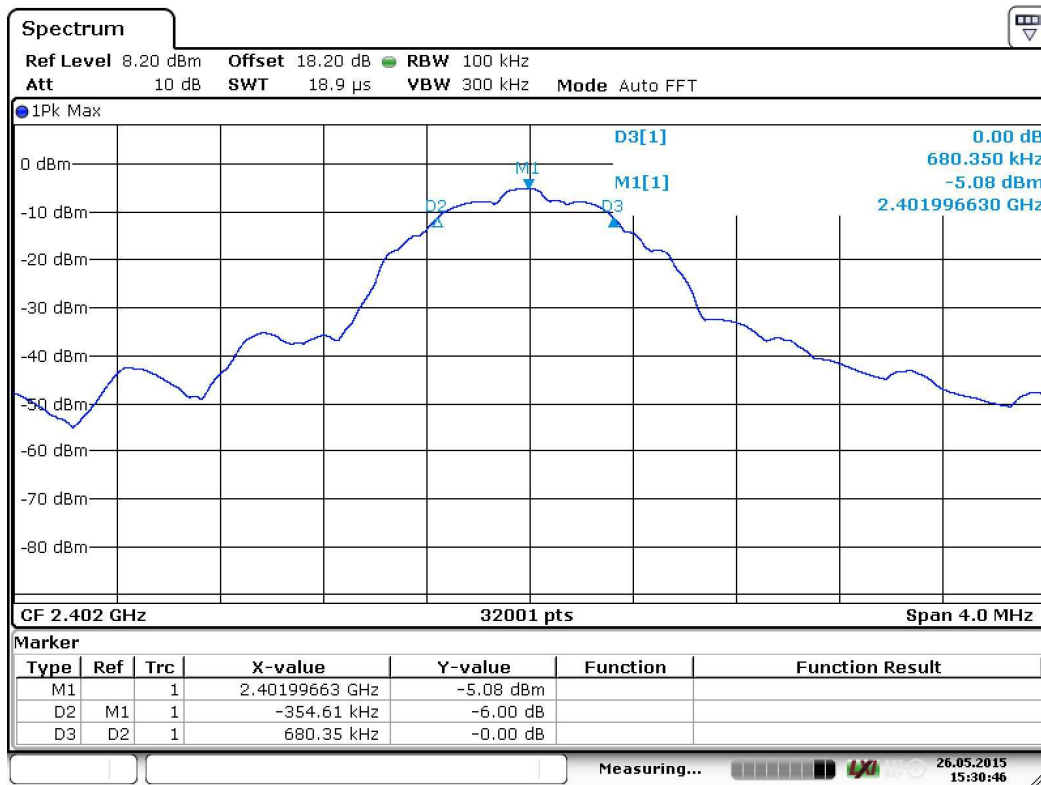
The EUT was set up in order to emit maximum disturbances.

### 7.4 Requirement

§15.247 (a)(2)

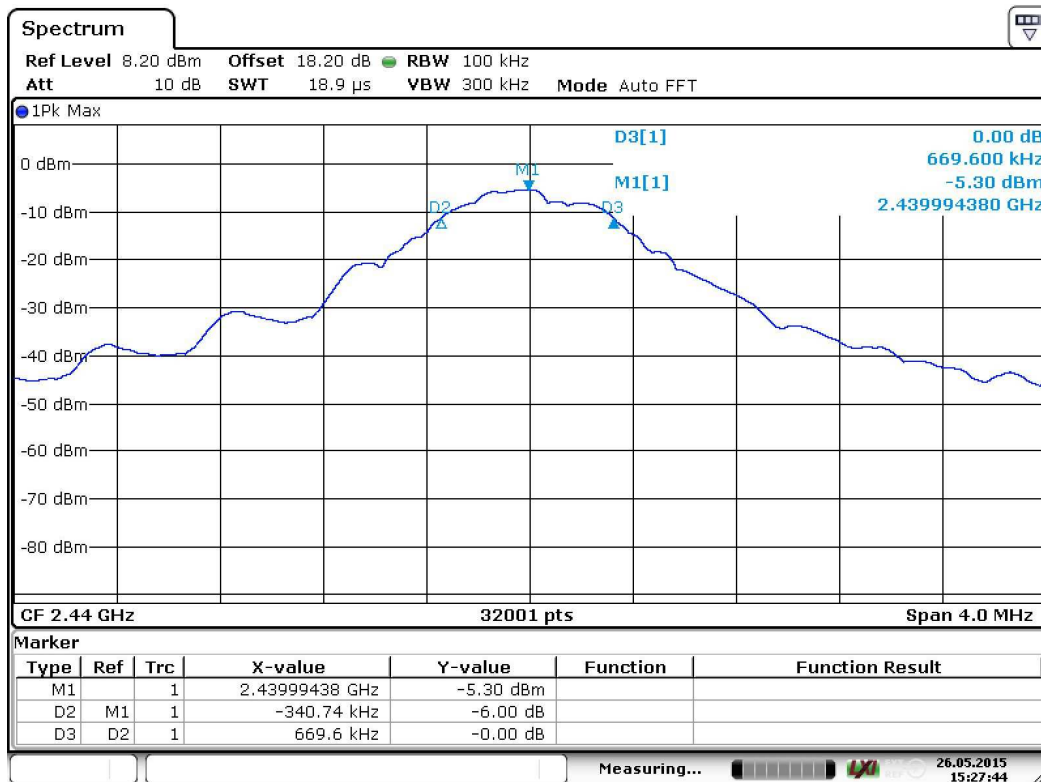
The minimum 6 dB bandwidth shall be at least 500 kHz.

## 7.5 Test results



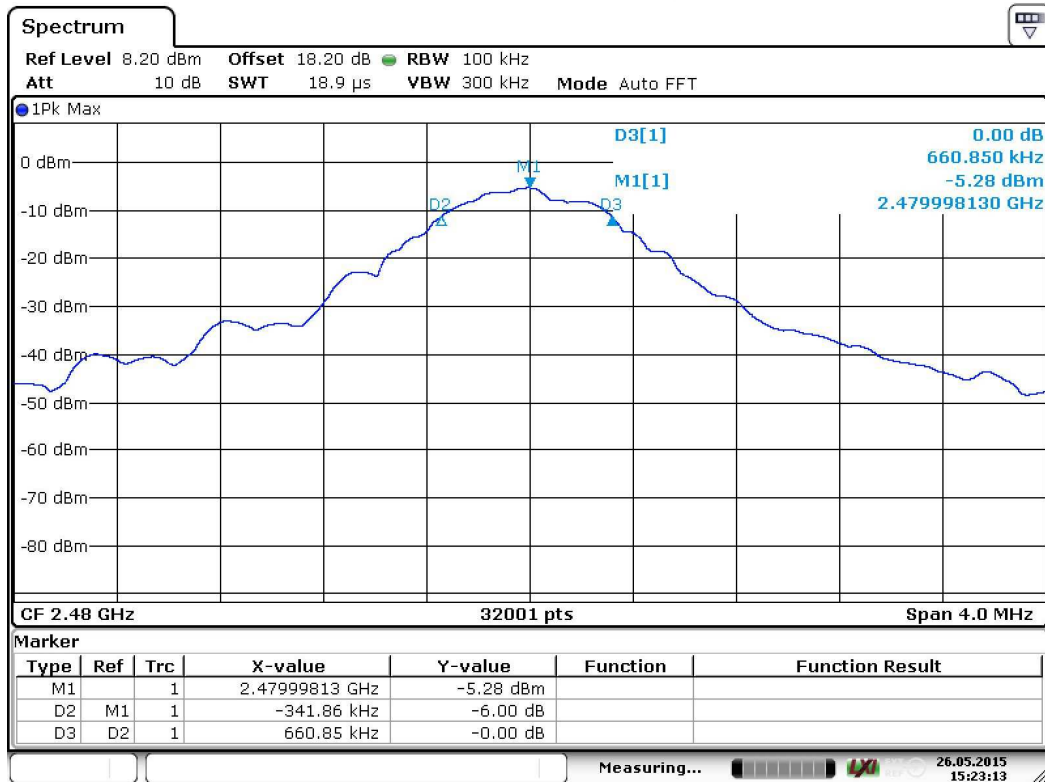
Date: 26.MAY.2015 15:30:46

Screenshot: Occupied bandwidth measurement, channel 0



Date: 26.MAY.2015 15:27:45

Screenshot: Occupied bandwidth measurement, channel 19



Date: 26.MAY.2015 15:23:13

**Screenshot: Occupied bandwidth measurement, channel 39****Measurement results, Occupied bandwidth**

| Frequency<br>[MHz] | Bandwidth<br>[kHz] | Limit<br>[kHz] | Margin<br>[kHz] |
|--------------------|--------------------|----------------|-----------------|
| 2402.000           | 680.350            | 500.000        | 180.350         |
| 2440.000           | 669.600            | 500.000        | 169.600         |
| 2480.000           | 660.850            | 500.000        | 160.850         |

## 8 MAXIMUM PEAK CONDUCTED OUTPUT POWER

### 8.1 Operating environment

| Date of test:          | Temperature: | Relative Humidity: |
|------------------------|--------------|--------------------|
| 2015-05-26, 2015-05-28 | 23 [°C]      | 30 [%]             |

### 8.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10.

### 8.3 Test conditions

Detector: Peak,  
Trace Max hold  
RBW > OBW  
VBW 3 x RBW  
Span 1.5 x OBW  
Marker was used to detect peak power.

The EUT was set up in order to emit maximum disturbances.

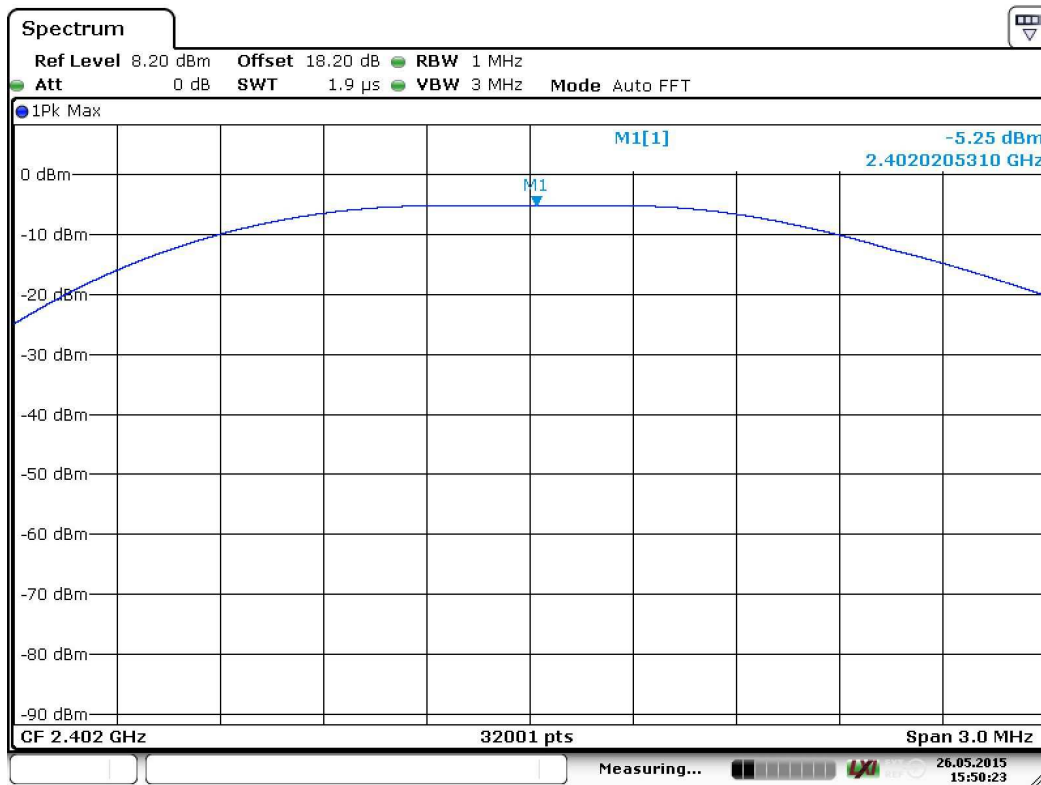
The spectrum analyzer reference level offset was used to compensate for cable and attenuator losses.

### 8.4 Requirement

#### §15.247 (b)(3)

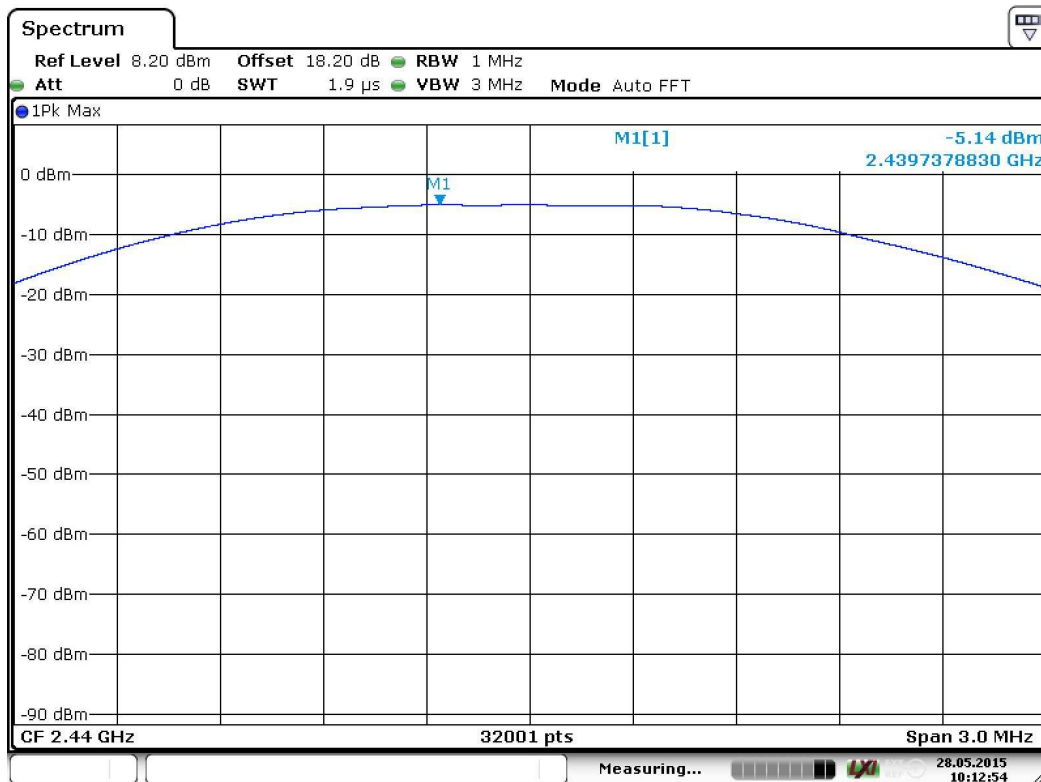
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

## 8.5 Test results



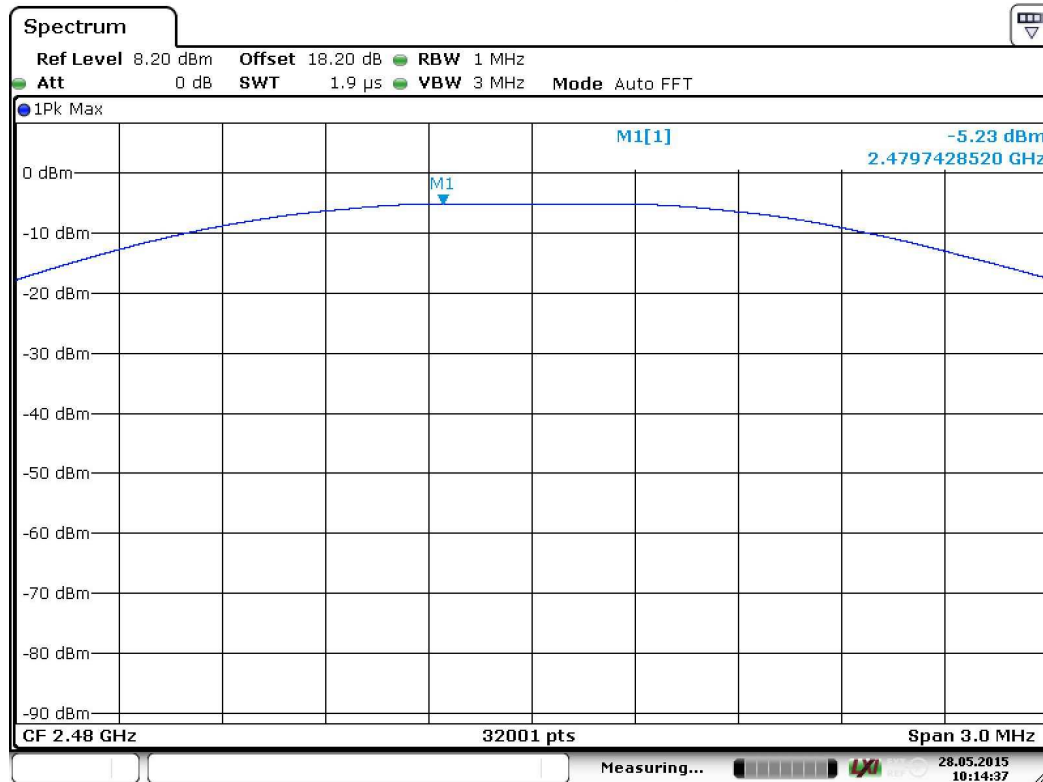
Date: 26.MAY.2015 15:50:23

Screenshot: Maximum peak conducted output power measurement, channel 0



Date: 28.MAY.2015 10:12:54

Screenshot: Maximum peak conducted output power measurement, channel 19



Date: 28.MAY.2015 10:14:38

Screenshot: Maximum peak conducted output power measurement, channel 39

## Measurement results, Maximum peak conducted output power

| Frequency<br>[MHz] | Maximum peak<br>conducted output<br>power<br>[dBm] | Limit<br>[dBm] | Margin<br>[dB] |
|--------------------|----------------------------------------------------|----------------|----------------|
| 2402.021           | -5.25                                              | 30.00          | 35.25          |
| 2439.738           | -5.14                                              | 30.00          | 35.14          |
| 2479.743           | -5.23                                              | 30.00          | 35.23          |

## 9 POWER SPECTRAL DENSITY

### 9.1 Operating environment

|               |              |                    |
|---------------|--------------|--------------------|
| Date of test: | Temperature: | Relative Humidity: |
| 2015-05-28    | 23 [°C]      | 30 [%]             |

### 9.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10.

### 9.3 Test conditions

#### Waveform

Detector: Peak  
Trace Max hold  
RBW 3 kHz  
VBW 3 x RBW  
Span 20 MHz

#### Power density

Detector Peak  
Trace Max hold  
RBW 3 kHz  
VBW 3 x RBW  
Span 300 kHz

The EUT was set up in order to emit maximum disturbances.

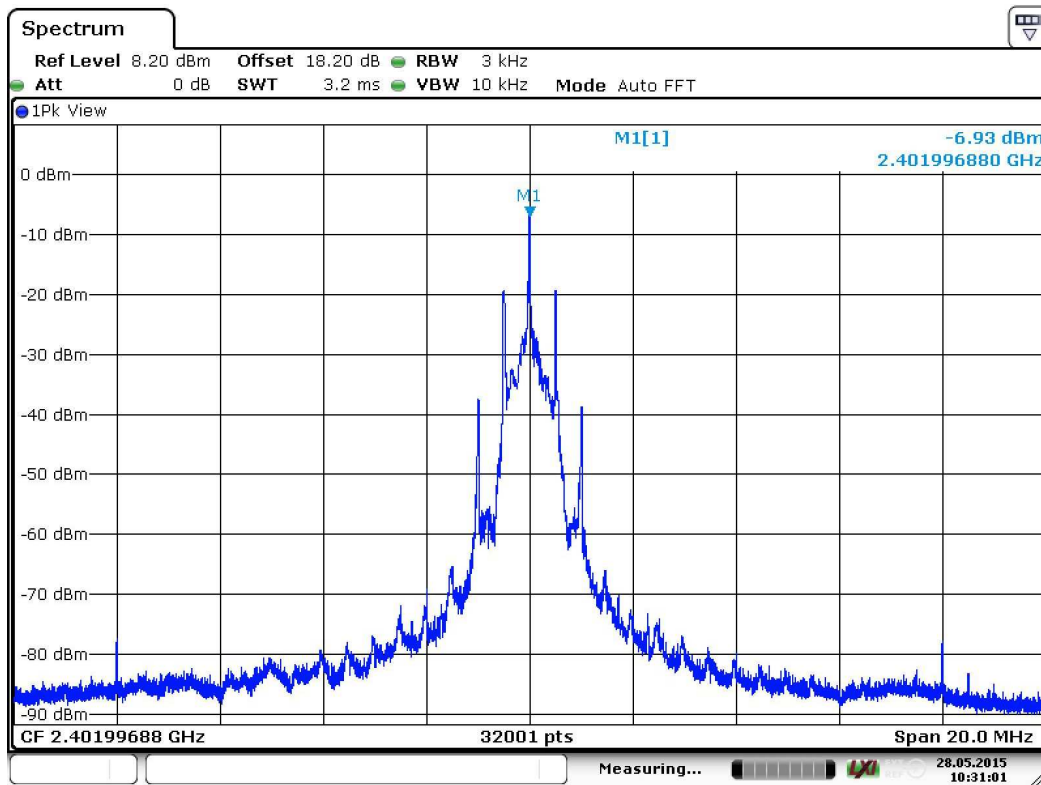
The spectrum analyzer reference level offset was used to compensate for cable and attenuator losses.

### 9.4 Requirement

#### §15.247 (e)

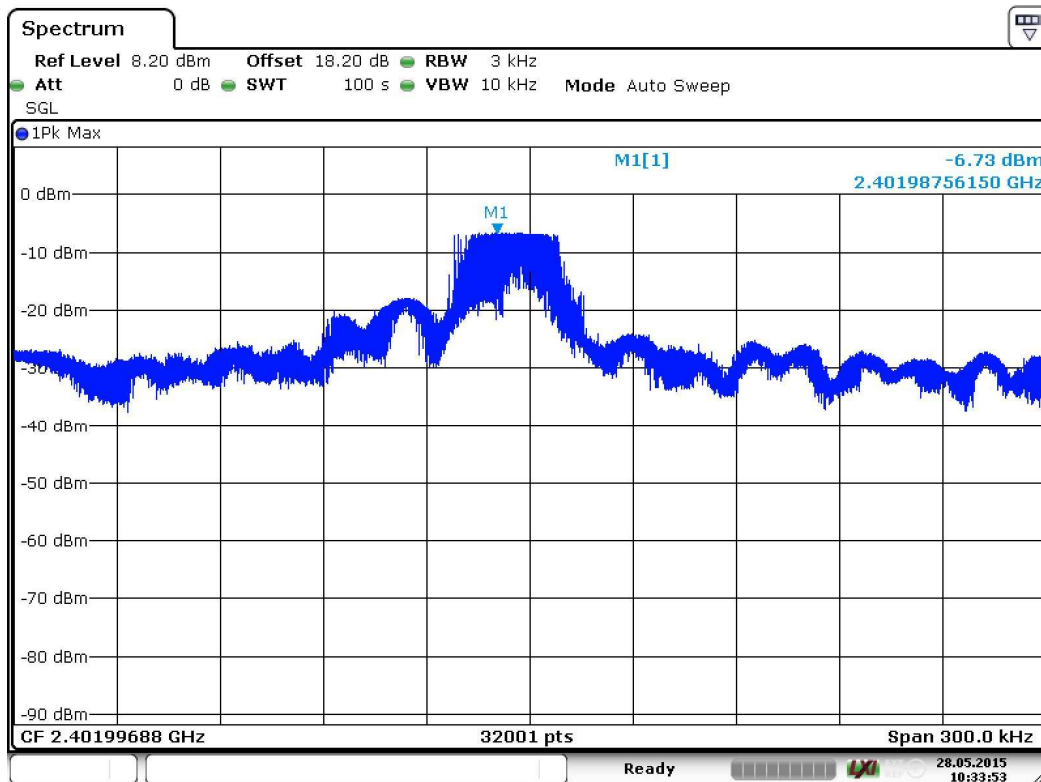
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

## 9.5 Test results



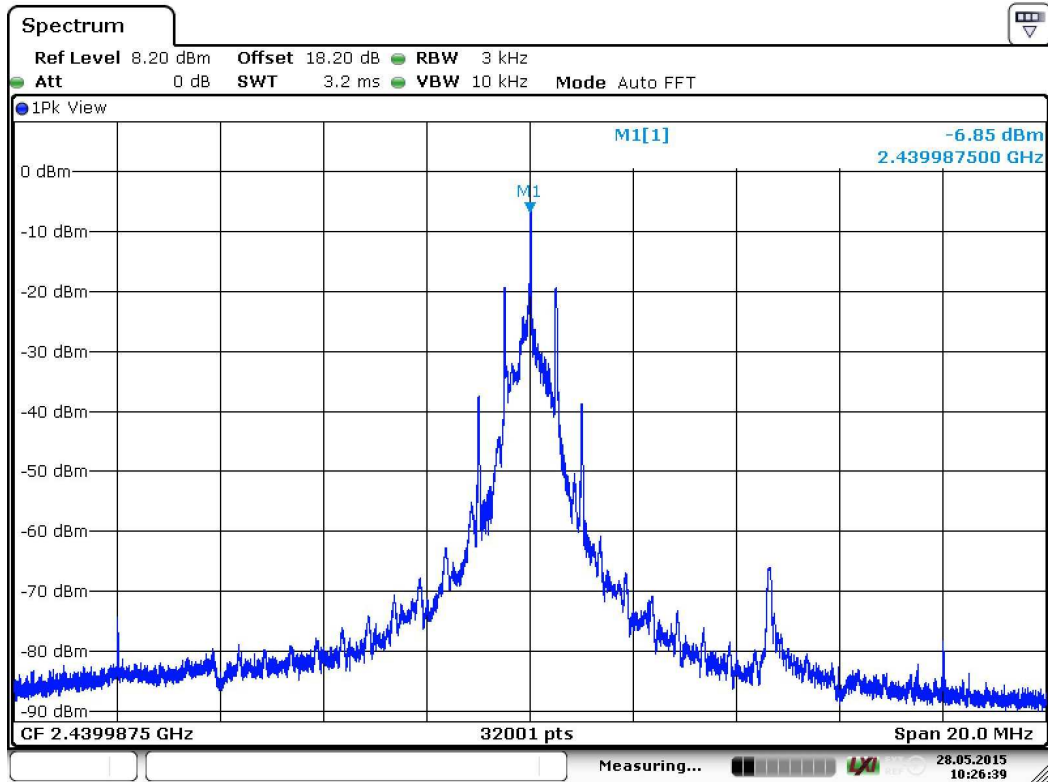
Date: 28.MAY.2015 10:31:02

Screenshot: Waveform, channel 0



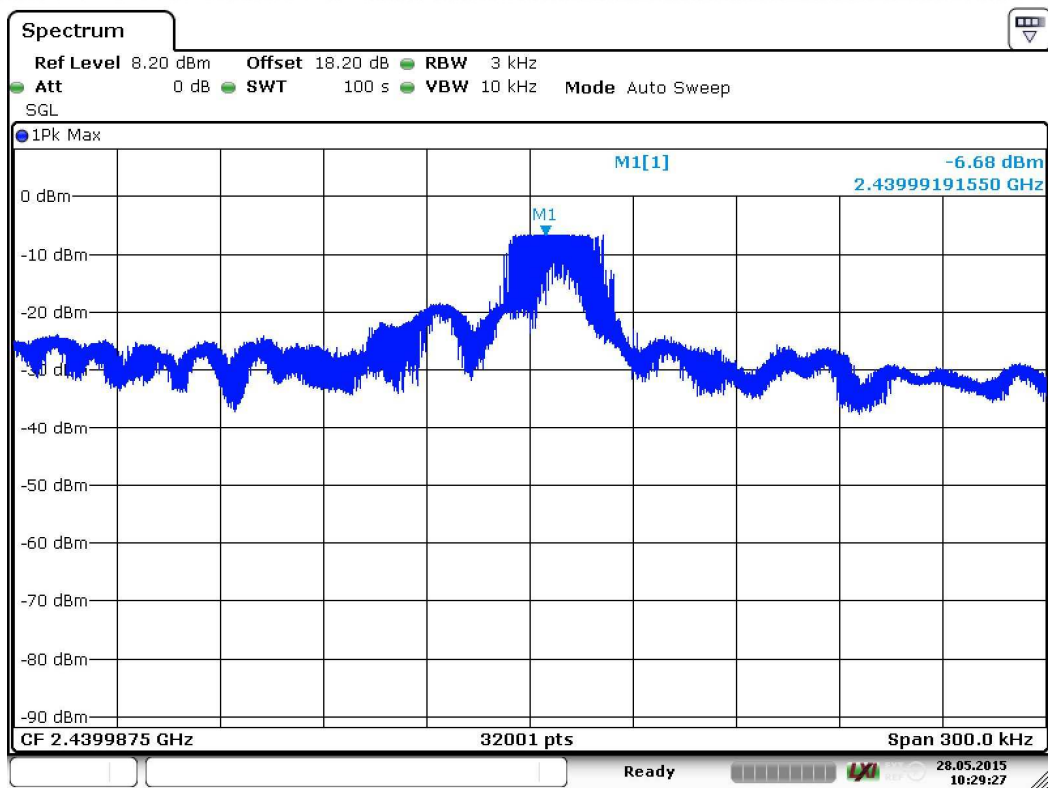
Date: 28.MAY.2015 10:33:53

Screenshot: Power spectral density measurement, channel 0



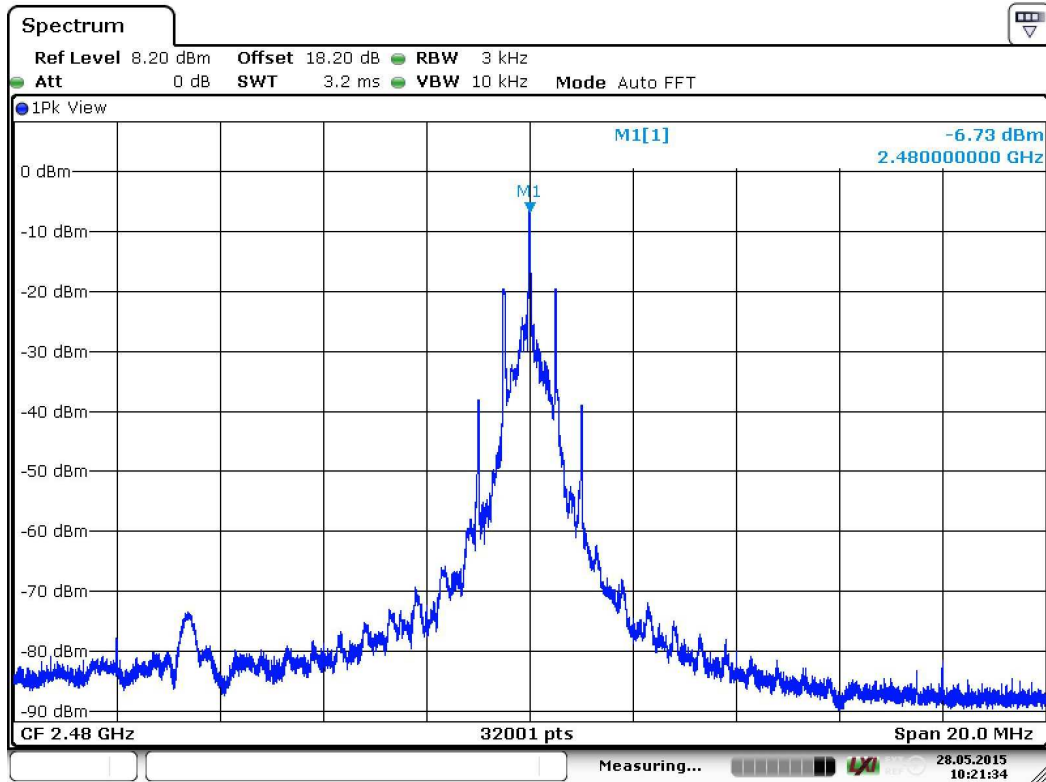
Date: 28.MAY.2015 10:26:39

Screenshot: Waveform, channel 19



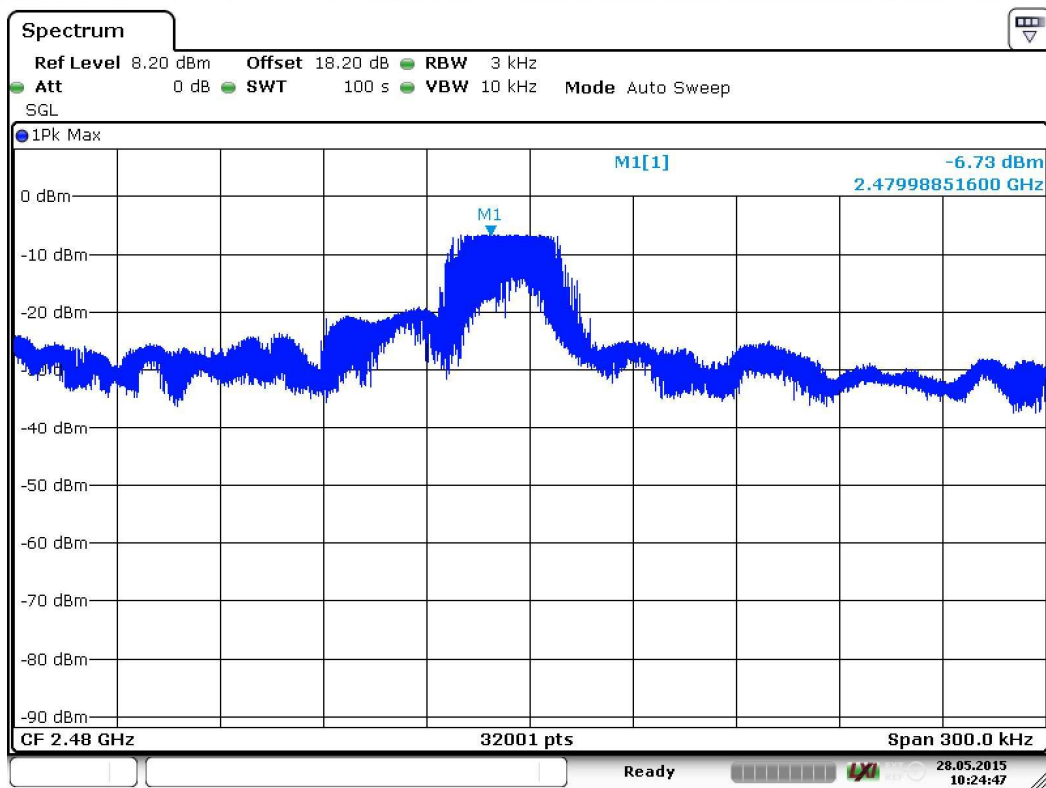
Date: 28.MAY.2015 10:29:27

Screenshot: Power spectral density measurement, channel 19



Date: 28.MAY.2015 10:21:35

Screenshot: Waveform, channel 39



Date: 28.MAY.2015 10:24:47

Screenshot: Power spectral density measurement, channel 39

**Measurement results, Power spectral density**

| <b>Frequency</b><br><b>[MHz]</b> | <b>Power spectral<br/>density</b><br><b>[dBm]</b> | <b>Limit</b><br><b>[dBm]</b> | <b>Margin</b><br><b>[dB]</b> |
|----------------------------------|---------------------------------------------------|------------------------------|------------------------------|
| 2401.988                         | -6.73                                             | 8.00                         | 14.73                        |
| 2439.991                         | -6.68                                             | 8.00                         | 14.68                        |
| 2479.989                         | -6.73                                             | 8.00                         | 14.73                        |

## 10 TRANSMITTER DUTY CYCLE FOR PULSED TRANSMISSIONS

### 10.1 Operating environment

|               |              |                    |
|---------------|--------------|--------------------|
| Date of test: | Temperature: | Relative Humidity: |
| 2015-06-04    | 22 [°C]      | 35 [%]             |

### 10.2 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10.section 7.5

Spectrum analyser is used to determine the transmitter duty cycle.

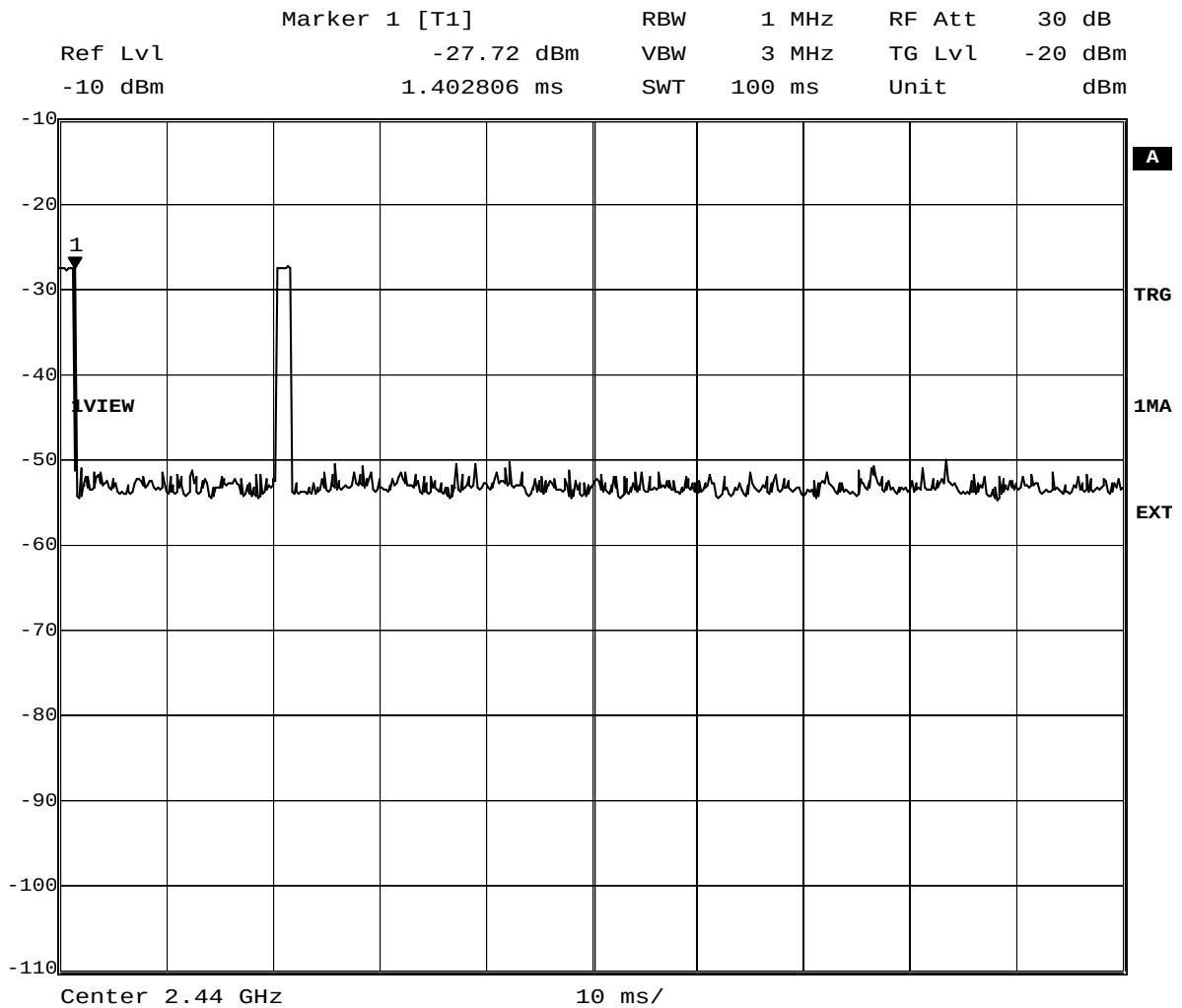
### 10.3 Test conditions

Detector: Peak  
RBW 1 MHz  
VBW 3 x RBW  
Span 0 Hz  
Sweep time 100 ms

### 10.4 Requirement

CFR 47 15.35(c)

## 10.5 Test results



Date: 4.JUN.2015 10:11:44

Screenshot: Duty cycle measurement

Duty cycle is calculated  $2 \times 1,402 \text{ ms} / 100 \text{ ms} < 0.1$ Peak to average correction factor  $0.1 = 20 \text{ LOG}(0.1) = -20$

**11 TEST EQUIPMENT**

## Stora hallen

| Equipment type              | Manufacturer      | Model                | Inv. No. | Last Cal. date | Cal. interval |
|-----------------------------|-------------------|----------------------|----------|----------------|---------------|
| Measurement software        | Rohde & Schwarz   | EMC32 - V8.51.0      | --       | --             | --            |
| Receiver                    | Rohde & Schwarz   | ESU 8                | 12866    | 7 / 2014       | 1 year        |
| Receiver                    | Rohde & Schwarz   | ESU 40               | 13187    | 7 / 2014       | 1 year        |
| BiLog antenna               | Chase             | CBL6110A             | 971      |                |               |
| Preamplifier                | Semko             | AM1331               | 7992     | 07 / 2014      | 1 year        |
| Horn antenna                | Rohde & Schwarz   | HF907                | 31245    | 11 / 2013      | 3 years       |
| Preamplifier                | Bonn              | BLMA 0118-M          | 31246    | 7 / 2014       | 1 year        |
| Horn antenna                | Bonn              |                      | 31247    | 1 / 2014       | 3 years       |
| 2,4 GHz band reject filter: | K&L MICROWAVE INC | 6N45-2450/T100-0/0   | 12389    | 7 / 2014       | 1 year        |
| 4 GHz high pass filter      | K&L MICROWAVE INC | 4410-X4500/18000-0/0 | 5133     | 7 / 2014       | 1 year        |

## Wireless Center

| Equipment type                    | Manufacturer      | Model                | Inv. No. | Last Cal. date | Cal. interval |
|-----------------------------------|-------------------|----------------------|----------|----------------|---------------|
| Measurement software              | Rohde & Schwarz   | EMC32 - V9.15.0      | --       | --             | --            |
| Signal analyzer:                  | Rohde & Schwarz   | FSV                  | 32594    | 7 / 2014       | 1 year        |
| Open switch and control platform: | Rohde & Schwarz   | OSP-B157             | 32595    | 7 / 2014       | 1 year        |
| Signal generator:                 | Rohde & Schwarz   | SMB100A              | 32592    | 7 / 2014       | 1 year        |
| 2,4 GHz band reject filter:       | K&L MICROWAVE INC | 6N45-2450/T100-0/0   | 12389    | 7 / 2014       | 1 year        |
| 4 GHz high pass filter            | K&L MICROWAVE INC | 4410-X4500/18000-0/0 | 5133     | 7 / 2014       | 1 year        |
| Temperature chamber:              | Vötsch            | VC4018               | 12282    | 2 / 2014       | 1 year        |
| 10 dB Attenuator:                 | Huber+Suhner      | 5910_N-50-010        | 32696    | 7 / 2014       | 1 year        |

## 12 MEASUREMENT UNCERTAINTY

Measurement uncertainty for radiated disturbance

|                                                            |              |
|------------------------------------------------------------|--------------|
| Uncertainty for the frequency range 30 to 1000 MHz at 10 m | $\pm 4.8$ dB |
| Uncertainty for the frequency range 1.0 to 18 GHz at 3 m   | $\pm 5.4$ dB |
| Uncertainty for the frequency range 18 to 26 GHz at 3 m    | $\pm 5.5$ dB |
| Uncertainty for the frequency range 26 to 40 GHz at 3 m    | $\pm 5.6$ dB |

Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2011.  
The measurement uncertainty is given with a confidence of 95 %.

## 13 TEST SET UP AND EUT PHOTOS

Test set up photos are in a separate document: 1511404STO-001, Ed. 1 Annex 1