

# Test report

**312742-7TRFWL**

Date of issue: November 24, 2016

Applicant:

**Seiko Epson Corporation**

Product:

**Smart Glasses**

Model:

**H756A (BT-300)**

FCC ID:

**SKSH756A**

IC Registration number:

**1052D-H756A**

Specifications:

◆ **FCC 47 CFR Part 15 Subpart C, §15.247**

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

◆ **RSS-247, Issue 1, May 2015, Section 5**

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs)  
and Licence-Exempt Local Area Network (LE-LAN) Devices

#### Test location

|              |                                                      |
|--------------|------------------------------------------------------|
| Company name | Nemko Canada Inc.                                    |
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| City         | Pointe-Claire                                        |
| Province     | QC                                                   |
| Postal code  | H9R 5L8                                              |
| Country      | Canada                                               |
| Telephone    | +1 514 694 2684                                      |
| Facsimile    | +1 514 694 3528                                      |
| Toll free    | +1 800 563 6336                                      |
| Website      | www.nemko.com                                        |
| Site number  | FCC: 722545; IC: 2040G-5 (3 m semi anechoic chamber) |

|                    |                                                                                     |
|--------------------|-------------------------------------------------------------------------------------|
| Tested by          | Yong Huang, Wireless/EMC Specialist                                                 |
| Reviewed by        | Andrey Adelberg, Senior Wireless/EMC Specialist                                     |
| Review date        | November 24, 2016                                                                   |
| Reviewer signature |  |

#### Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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## Section 1. Report summary

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### 1.1 Applicant and manufacturer

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|              |                                                            |
|--------------|------------------------------------------------------------|
| Company name | Seiko Epson Corporation                                    |
| Address      | 6925 Tazawa, Toyoshina, Azumino-shi, Nagano 399-8285 Japan |

### 1.2 Test specifications

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|                                              |                                                                                                                              |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| FCC 47 CFR Part 15, Subpart C, Clause 15.247 | Operation in the 902–928 MHz, 2400–2483.5 MHz                                                                                |
| RSS-247, Issue 1, May 2015, Section 5        | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |

### 1.3 Test methods

---

|                                                      |                                                                                                               |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 558074 D01 DTS Meas Guidance v03 r05 (April 8, 2016) | Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 |
| ANSI C63.10 v2013                                    | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices                |

### 1.4 Statement of compliance

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In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard except as noted in section 1.5 below.. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

### 1.5 Exclusions

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None

### 1.6 Test report revision history

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| Revision # | Details of changes made to test report |
|------------|----------------------------------------|
| TRF        | Original report issued                 |

## Section 2. Summary of test results

### 2.1 FCC Part 15 Subpart C, general requirements test results

| Part       | Test description          | Verdict           |
|------------|---------------------------|-------------------|
| §15.207(a) | Conducted limits          | Pass <sup>1</sup> |
| §15.31(e)  | Variation of power source | Pass <sup>1</sup> |
| §15.203    | Antenna requirement       | Pass <sup>2</sup> |

Notes: <sup>1</sup> Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed  
<sup>2</sup> The antenna is located within the enclosure of EUT and not user accessible.

### 2.2 FCC Part 15 Subpart C, intentional radiators test results

| Part               | Test description                                                                                                           | Verdict        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------|----------------|
| §15.247(a)(1)(i)   | Frequency hopping systems operating in the 902–928 MHz band                                                                | Not applicable |
| §15.247(a)(1)(ii)  | Frequency hopping systems operating in the 5725–5850 MHz band                                                              | Not applicable |
| §15.247(a)(1)(iii) | Frequency hopping systems operating in the 2400–2483.5 MHz band                                                            | Not applicable |
| §15.247(a)(2)      | Minimum 6 dB bandwidth for systems using digital modulation techniques                                                     | Pass           |
| §15.247(b)(1)      | Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band        | Not applicable |
| §15.247(b)(2)      | Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band                                   | Not applicable |
| §15.247(b)(3)      | Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands | Pass           |
| §15.247(c)(1)      | Fixed point-to-point operation with directional antenna gains greater than 6 dBi                                           | Not applicable |
| §15.247(c)(2)      | Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams                                    | Not applicable |
| §15.247(d)         | Spurious emissions                                                                                                         | Pass           |
| §15.247(e)         | Power spectral density for digitally modulated devices                                                                     | Pass           |
| §15.247(f)         | Time of occupancy for hybrid systems                                                                                       | Not applicable |

### 2.3 IC RSS-GEN, Issue 4, test results

| Part  | Test description                                                         | Verdict        |
|-------|--------------------------------------------------------------------------|----------------|
| 7.1.2 | Receiver radiated emission limits                                        | Not applicable |
| 7.1.3 | Receiver conducted emission limits                                       | Not applicable |
| 8.8   | Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus | Pass           |

Notes: <sup>1</sup> According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

## 2.4 IC RSS-247, Issue 1, test results

| Part    | Test description                                                                       | Verdict        |
|---------|----------------------------------------------------------------------------------------|----------------|
| 5.1     | Frequency Hopping Systems (FHSs)                                                       |                |
| 5.1 (1) | Bandwidth of a frequency hopping channel                                               | Not applicable |
| 5.1 (2) | Minimum channel spacing for frequency hopping systems                                  | Not applicable |
| 5.1 (3) | Frequency hopping systems operating in the 902–928 MHz band                            | Not applicable |
| 5.1 (4) | Frequency hopping systems operating in the 2400–2483.5 MHz band                        | Not applicable |
| 5.1 (5) | Frequency hopping systems operating in the 5725–5850 MHz band                          | Not applicable |
| 5.2     | Digital Transmission Systems (DTSs)                                                    |                |
| 5.2 (1) | Minimum 6 dB bandwidth                                                                 | Pass           |
| 5.2 (2) | Maximum power spectral density                                                         | Pass           |
| 5.3     | Hybrid Systems                                                                         |                |
| 5.3 (1) | Digital modulation turned off                                                          | Not applicable |
| 5.3 (2) | Frequency hopping turned off                                                           | Not applicable |
| 5.4     | Transmitter output power and e.i.r.p. requirements                                     |                |
| 5.4 (1) | Frequency hopping systems operating in the 902–928 MHz band                            | Not applicable |
| 5.4 (2) | Frequency hopping systems operating in the 2400–2483.5 MHz band                        | Not applicable |
| 5.4 (3) | Frequency hopping systems operating in the 5725–5850 MHz                               | Not applicable |
| 5.4 (4) | Systems employing digital modulation techniques                                        | Pass           |
| 5.4 (5) | Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band                       | Not applicable |
| 5.4 (6) | Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams | Not applicable |
| 5.5     | Out-of-band emissions                                                                  | Pass           |

Notes: None

## Section 3. Equipment under test (EUT) details

### 3.1 Sample information

|                        |                                                                |
|------------------------|----------------------------------------------------------------|
| Receipt date           | October 4, 2016                                                |
| Nemko sample ID number | 133-003152 (Conducted sample) and 133-003139 (Radiated sample) |

### 3.2 EUT information

|               |                |
|---------------|----------------|
| Product name  | Smart Glasses  |
| Model         | H756A (BT-300) |
| Serial number | TCW27560112    |

### 3.3 Technical information

|                                         |                                                                                                                                |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Applicant IC company number             | 1052D                                                                                                                          |
| IC UPN number                           | H756A                                                                                                                          |
| All used IC test site(s) Reg. number    | 2040G-5                                                                                                                        |
| RSS number and Issue number             | RSS-247 Issue 1, May 2015                                                                                                      |
| Frequency band                          | 2400–2483.5 MHz                                                                                                                |
| Frequency Min (MHz)                     | 2402                                                                                                                           |
| Frequency Max (MHz)                     | 2480                                                                                                                           |
| RF power Min (W), Conducted             | N/A                                                                                                                            |
| RF power Max (W), Conducted             | 4.6 dBm(0.0029)                                                                                                                |
| Field strength, Units @ distance        | N/A                                                                                                                            |
| Measured BW (kHz) (6 dB)                | 720.7                                                                                                                          |
| Calculated BW (kHz), as per TRC-43      | N/A                                                                                                                            |
| Type of modulation                      | GFSK                                                                                                                           |
| Emission classification (F1D, G1D, D1D) | W7D                                                                                                                            |
| Transmitter spurious, Units @ distance  | 55 dBμV @ 3m, peak                                                                                                             |
| Power requirements                      | 5 VDC (Powered via external AC-DC adapter 100–240 VAC 50–60 Hz) and via battery                                                |
| Antenna information                     | The EUT uses a non-detachable antenna to the intentional radiator. As per customer the antenna gain is 2.1 dBi at 2.4 GHz band |

3.4 Product description and theory of operation

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EUT is a smart glass with see-through lenses, which allows to overlay images on actual view. The virtual images were provided by a controller.

3.5 EUT exercise details

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EUT was set to test modes during tests, by software drivers provided by customer.

3.6 EUT setup diagram

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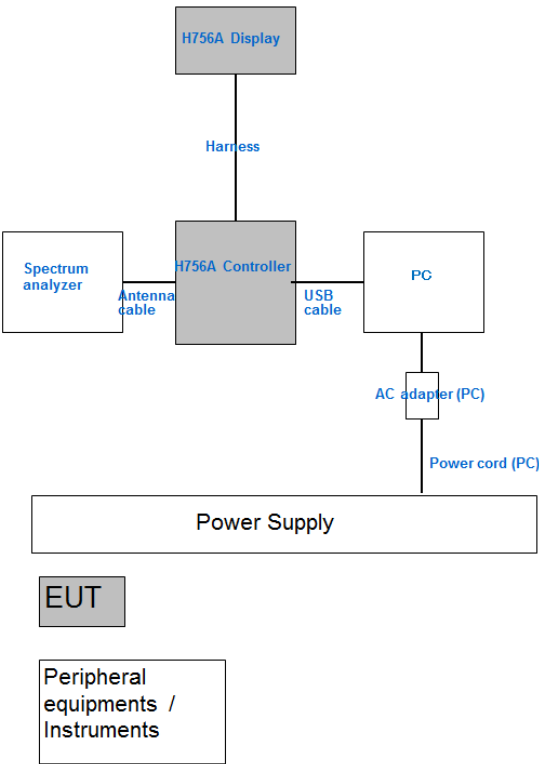


Figure 3.6-1: Setup diagram

**Section 4.** Engineering considerations

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**4.1** Modifications incorporated in the EUT

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There were no modifications performed to the EUT during this assessment.

**4.2** Technical judgment

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None

**4.3** Deviations from laboratory tests procedures

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No deviations were made from laboratory procedures.

# Section 5. Test conditions

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## 5.1 Atmospheric conditions

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|                   |               |
|-------------------|---------------|
| Temperature       | 15–30 °C      |
| Relative humidity | 20–75 %       |
| Air pressure      | 860–1060 mbar |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

## 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages  $\pm 5\%$ , for which the equipment was designed.



**Section 6.**    Measurement uncertainty

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**6.1**    Uncertainty of measurement

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Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of  $K = 2$  with 95% certainty.

| Test name                         | Measurement uncertainty, dB |
|-----------------------------------|-----------------------------|
| All antenna port measurements     | 0.55                        |
| Conducted spurious emissions      | 1.13                        |
| Radiated spurious emissions       | 3.78                        |
| AC power line conducted emissions | 3.55                        |

## Section 7. Test equipment

### 7.1 Test equipment list

*Table 7.1-1: Equipment list*

| Equipment                   | Manufacturer           | Model no.    | Asset no. | Cal cycle | Next cal.  |
|-----------------------------|------------------------|--------------|-----------|-----------|------------|
| Flush mount turntable       | Sunol                  | FM2022       | FA002550  | —         | NCR        |
| Controller                  | Sunol                  | SC104V       | FA002551  | —         | NCR        |
| Antenna mast                | Sunol                  | TLT2         | FA002552  | —         | NCR        |
| spectrum analyzer           | Rohde & Schwarz        | FSV 40       | FA002731  | 1 year    | Apr 06/17  |
| 50 $\Omega$ coax cable      | C.C.A.                 | None         | FA002603  | —         | VOU        |
| 50 $\Omega$ coax cable      | C.C.A.                 | None         | FA002605  | —         | VOU        |
| 50 $\Omega$ coax cable      | C.C.A.                 | None         | FA002607  | —         | VOU        |
| Bilog antenna (20–2000 MHz) | Sunol                  | JB1          | FA002517  | 1 year    | Oct. 5/17  |
| Horn antenna (1–18 GHz)     | EMCO                   | 3115         | FA001451  | 1 year    | Feb. 22/17 |
| Horn antenna (18–40 GHz)    | EMCO                   | 3116         | FA002487  | 2 year    | Aug. 16/17 |
| Pre-amplifier (0.5–18 GHz)  | COM-POWER              | PAM-118A     | FA002561  | 1 year    | May 6/17   |
| Pre-amplifier (18–40 GHz)   | COM-POWER              | PAM-840      | FA002508  | 1 year    | May 6/17   |
| 2400-2483 MHz Notch Filter  | Microwave Circuits     | N0324413     | FA002693  | —         | VOU        |
| 50 $\Omega$ coax cable      | HUBER+SUHNER           | SUCOFLEX 100 | FA002564  | —         | VOU        |
| LISN                        | Rohde & Schwarz        | ENV216       | FA002514  | 1 year    | Nov. 20/16 |
| Power source                | California Instruments | 5001ix       | FA002494  | 1 year    | Apr 29/17  |

Note: NCR - no calibration required, VOU - verify on use

## Section 8. Testing data

### 8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

#### 8.1.1 Definitions and limits

**FCC §15.207 (a):**

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Omega$  line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

**RSS-GEN, Clause 8.8:**

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

**Table 8.1-1: AC power line conducted emissions limits**

| Frequency of emission,<br>MHz | Conducted limit, dB $\mu$ V |           |
|-------------------------------|-----------------------------|-----------|
|                               | Quasi-peak                  | Average** |
| 0.15–0.5                      | 66 to 56*                   | 56 to 46* |
| 0.5–5                         | 56                          | 46        |
| 5–30                          | 60                          | 50        |

Notes: \* - The level decreases linearly with the logarithm of the frequency.  
\*\* - A linear average detector is required.

#### 8.1.2 Test summary

|               |                 |                   |           |
|---------------|-----------------|-------------------|-----------|
| Test date     | October 7, 2016 | Temperature       | 24 °C     |
| Test engineer | Yong Huang      | Air pressure      | 1001 mbar |
| Verdict       | Pass            | Relative humidity | 53 %      |

#### 8.1.3 Notes

None

#### 8.1.4 Setup details

---

|                         |                                                                                                                                                                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port under test         | AC input (External adapter)                                                                                                                                                                                                                      |
| EUT setup configuration | Table top                                                                                                                                                                                                                                        |
| Measurement details     | A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement. |

Receiver settings:

|                      |                                                                                                                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resolution bandwidth | 9 kHz                                                                                                                                                                                          |
| Video bandwidth      | 30 kHz                                                                                                                                                                                         |
| Detector mode        | <ul style="list-style-type: none"><li>– Peak and Average (Preview measurement)</li><li>– Quasi-peak and CAverage (Final measurement)</li></ul>                                                 |
| Trace mode           | Max Hold                                                                                                                                                                                       |
| Measurement time     | <ul style="list-style-type: none"><li>– 100 ms (Peak and Average preview measurement)</li><li>– 1000 ms (Quasi-peak final measurement)</li><li>– 160 ms (CAverage final measurement)</li></ul> |

8.1.5 Test data

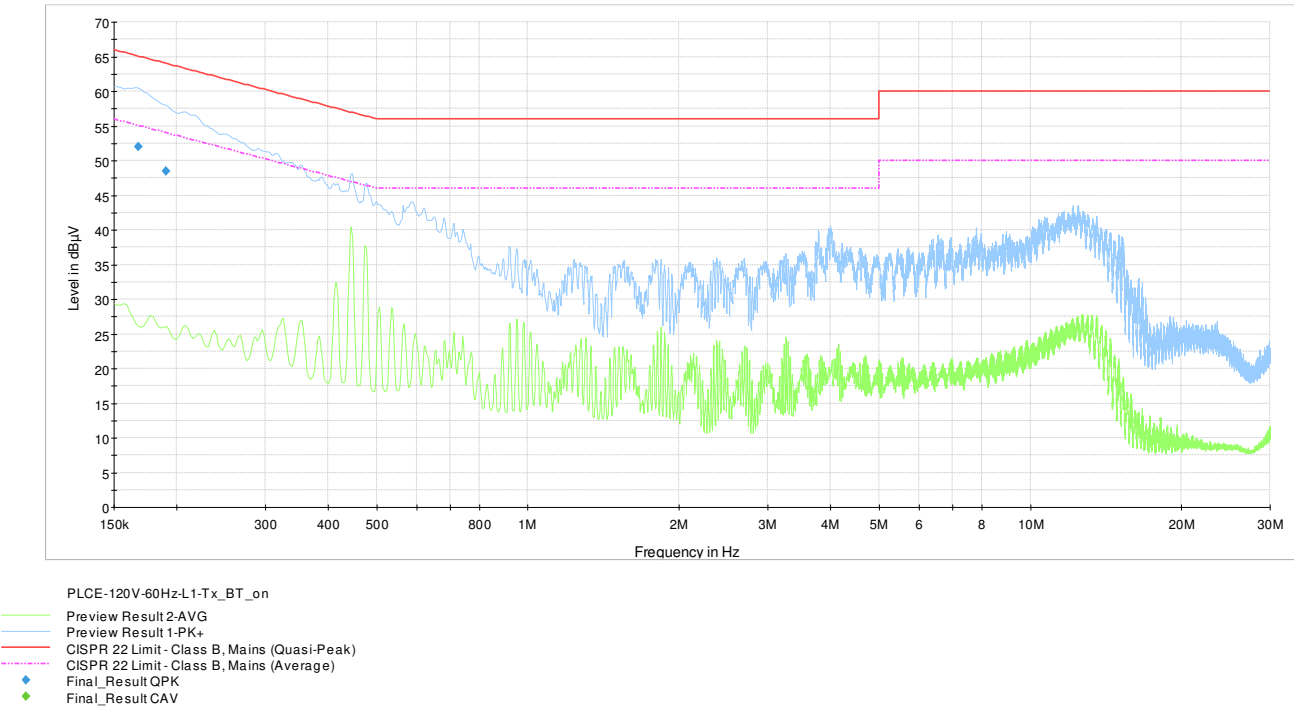


Figure 8.1-1: AC power line conducted emissions limits – phase line

Table 8.1-2: Quasi-Peak results AC power line conducted emissions limits – phase line

| Frequency (MHz) | Quasi-Peak result <sup>1 and 3</sup><br>(dBµV) | Quasi-Peak limit<br>(dBµV) | Margin<br>(dB) | Measurement<br>time (ms) | Bandwidth<br>(kHz) | Conductor | Filter | Correction<br>factor <sup>2</sup> (dB) |
|-----------------|------------------------------------------------|----------------------------|----------------|--------------------------|--------------------|-----------|--------|----------------------------------------|
| 0.168000        | 52.1                                           | 65.1                       | 13.0           | 100.0                    | 9                  | L1        | ON     | 10.2                                   |
| 0.190500        | 48.5                                           | 64.0                       | 15.5           | 100.0                    | 9                  | L1        | ON     | 10.1                                   |

Notes:

<sup>1</sup> Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

<sup>2</sup> Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

<sup>3</sup> The maximum measured value observed over a period of 15 seconds was recorded.

Sample calculation: 48.5 dBµV (result) = 38.4 dBµV (receiver reading) + 10.1 dB (Correction factor)

8.1.5 Test data, continued

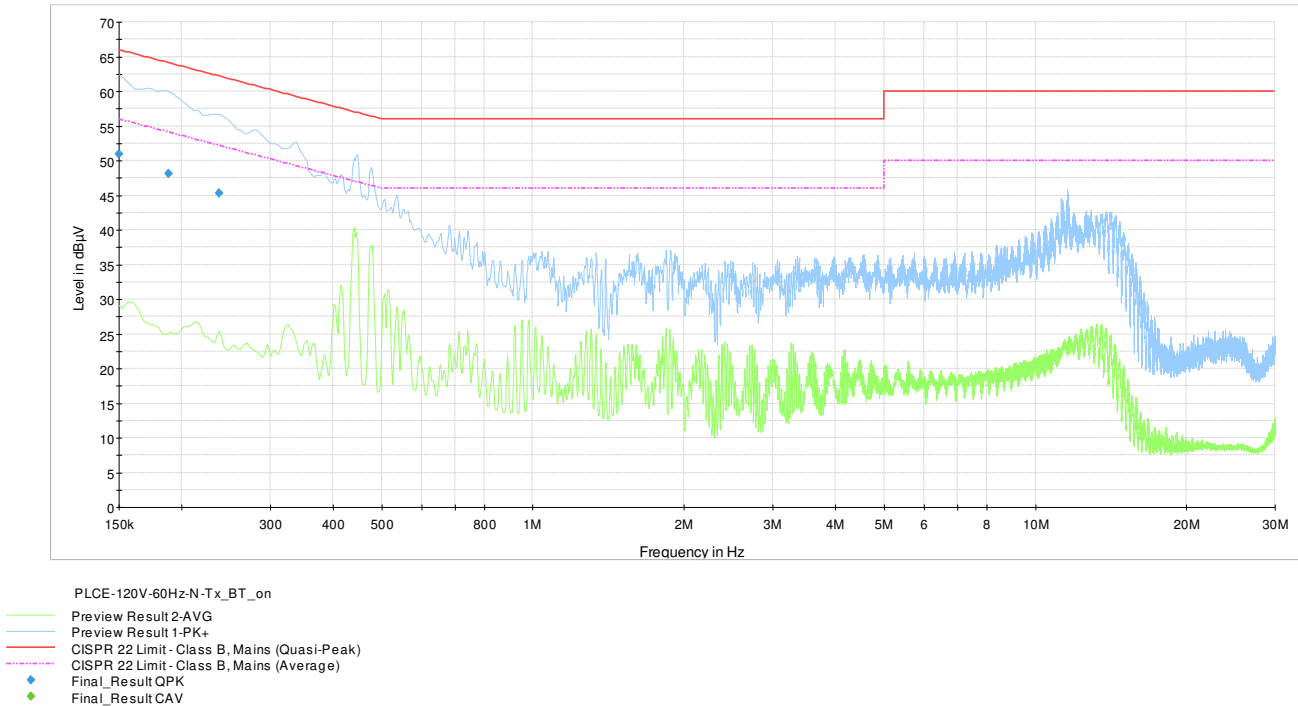


Figure 8.1-2: AC power line conducted emissions limits – neutral line

Table 8.1-3: Quasi-Peak results AC power line conducted emissions limits – neutral line

| Frequency (MHz) | Quasi-Peak result <sup>1 and 3</sup> (dBµV) | Quasi-Peak limit (dBµV) | Margin (dB) | Measurement time (ms) | Bandwidth (kHz) | Conductor | Filter | Correction factor <sup>2</sup> (dB) |
|-----------------|---------------------------------------------|-------------------------|-------------|-----------------------|-----------------|-----------|--------|-------------------------------------|
| 0.150000        | 51.0                                        | 66.0                    | 15.1        | 100.0                 | 9               | N         | ON     | 9.9                                 |
| 0.188250        | 48.1                                        | 64.1                    | 16.0        | 100.0                 | 9               | N         | ON     | 10.1                                |
| 0.237750        | 45.3                                        | 62.2                    | 16.9        | 100.0                 | 9               | N         | ON     | 9.8                                 |

Notes: <sup>1</sup> Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)  
<sup>2</sup> Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)  
<sup>3</sup> The maximum measured value observed over a period of 15 seconds was recorded.

Sample calculation: 48.5 dBµV (result) = 38.4 dBµV (receiver reading) + 10.1 dB (Correction factor)

## 8.2 FCC 15.247(a)(2) and RSS-247 5.2(1) Minimum 6 dB bandwidth for systems using digital modulation techniques

### 8.2.1 Definitions and limits

**FCC and IC:**

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 8.2.2 Test summary

|               |                  |                   |           |
|---------------|------------------|-------------------|-----------|
| Test date     | October 24, 2016 | Temperature       | 24 °C     |
| Test engineer | Yong Huang       | Air pressure      | 1001 mbar |
| Verdict       | Pass             | Relative humidity | 53 %      |

### 8.2.3 Observations, settings and special notes

Spectrum analyser settings:

|                      |                            |
|----------------------|----------------------------|
| Resolution bandwidth | 100 kHz                    |
| Video bandwidth      | $\geq 3 \times \text{RBW}$ |
| Frequency span       | 3 MHz                      |
| Detector mode        | Peak                       |
| Trace mode           | Max Hold                   |

### 8.2.4 Test data

**Table 8.2-1: 6 dB bandwidth results**

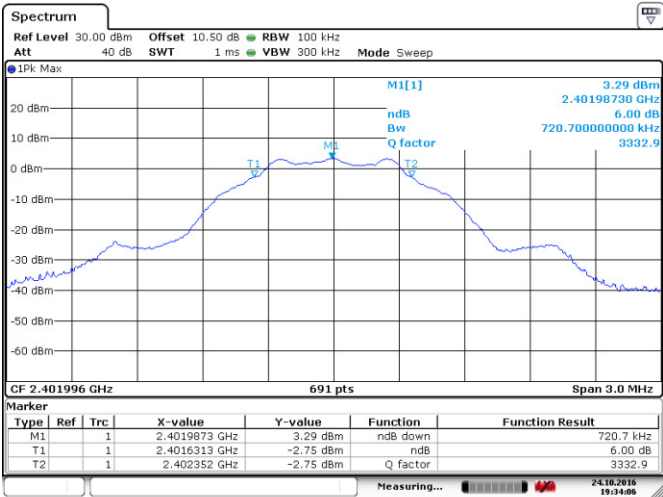
| Frequency, MHz | 6 dB bandwidth, kHz | Minimum Limit, kHz | Margin, kHz |
|----------------|---------------------|--------------------|-------------|
| 2402           | 720.7               | 500                | 220.7       |
| 2442           | 716.4               | 500                | 216.4       |
| 2480           | 712.0               | 500                | 212.0       |

Section 8

Test name

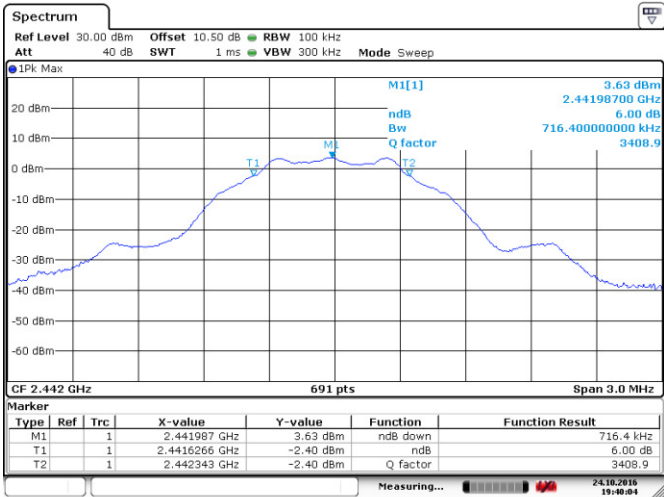
Specification

Testing data  
FCC 15.247(a)(2) and RSS-247 5.2(1) Minimum 6 dB bandwidth for systems using digital modulation techniques  
FCC Part 15 Subpart C and RSS-247, Issue 1



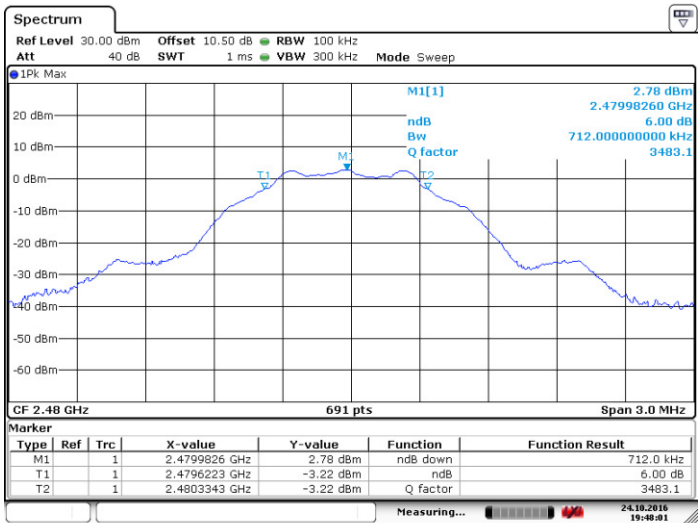
Date: 24.OCT.2016 19:34:06

Figure 8.2-1: 6 dB bandwidth on Low Channel



Date: 24.OCT.2016 19:40:04

Figure 8.2-2: 6 dB bandwidth on Mid Channel



Date: 24.OCT.2016 19:48:02

Figure 8.2-3: 6 dB bandwidth on High Channel

## 8.3 FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements

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### 8.3.1 Definitions and limits

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**FCC:**

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). 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.
  - (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
    - (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

- (c) Operation with directional antenna gains greater than 6 dBi.
- (2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:
    - (i) Different information must be transmitted to each receiver.
    - (ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:
      - (A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or staff having the highest gain.

**IC:**

For DTSs employing digital modulation techniques operating in the bands 902–928 MHz and 2400–2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

Fixed point-to-point systems in the bands 2400–2483.5 MHz and 5725–5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

**Section 8**  
**Test name**  
**Specification**

Testing data  
FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements  
FCC Part 15 Subpart C and RSS-247, Issue 1



8.3.2 Test summary

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|               |                  |                   |           |
|---------------|------------------|-------------------|-----------|
| Test date     | October 24, 2016 | Temperature       | 24 °C     |
| Test engineer | Yong Huang       | Air pressure      | 1001 mbar |
| Verdict       | Pass             | Relative humidity | 53 %      |

8.3.3 Observations, settings and special notes

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The test was performed according to DTS guidelines section 9.1.1: Measurement using a spectrum analyzer (SA) with the EUT transmitting at full power throughout.

### 8.3.4 Test data

Table 8.3-1: Output power measurements results

| Frequency, MHz | Conducted output power, dBm |       | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB |
|----------------|-----------------------------|-------|------------|-------------------|-----------|-----------------|-----------------|
|                | Measured                    | Limit |            |                   |           |                 |                 |
| 2402           | 4.4                         | 30    | 25.6       | 2.1               | 6.5       | 36              | 29.5            |
| 2442           | 4.6                         | 30    | 25.4       | 2.1               | 6.7       | 36              | 29.3            |
| 2480           | 3.8                         | 30    | 26.2       | 2.1               | 5.9       | 36              | 30.1            |

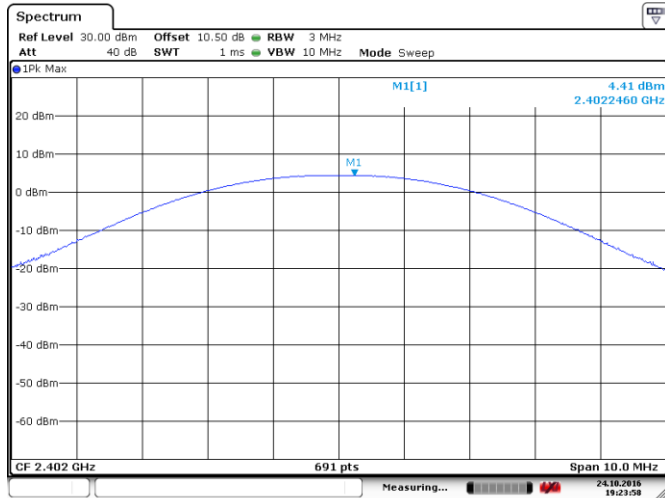


Figure 8.3-1: Low Channel

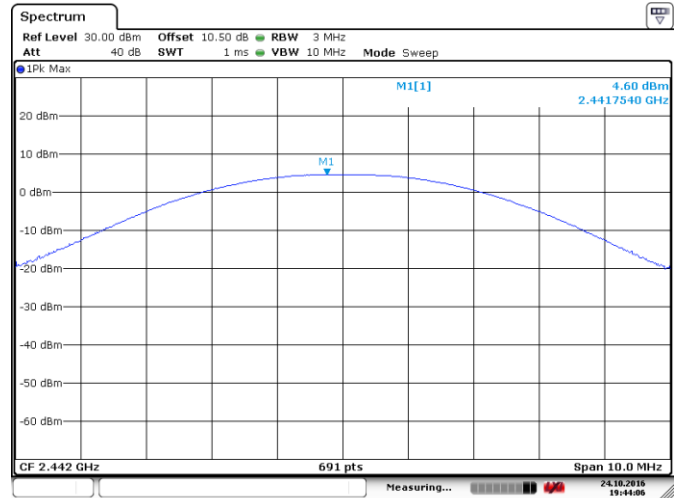


Figure 8.3-2: Mid Channel

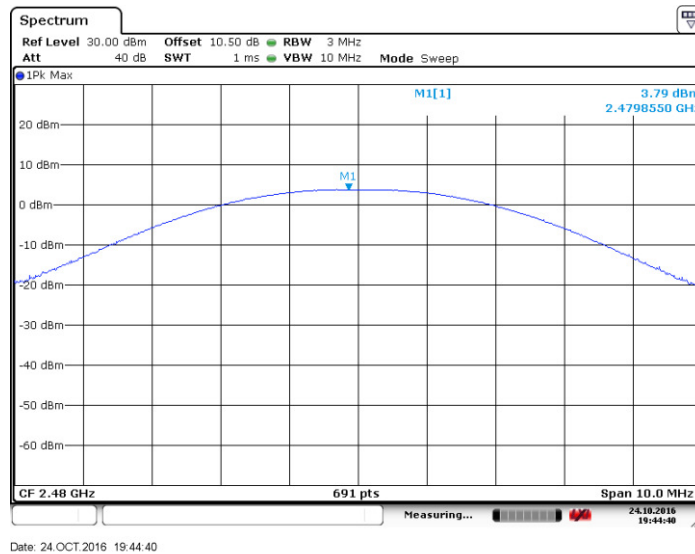


Figure 8.3-3: High Channel

## 8.4 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) emissions

### 8.4.1 Definitions and limits

#### FCC:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

#### IC:

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 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

**Table 8.4-1: FCC §15.209 and RSS-Gen – Radiated emission limits**

| Frequency,<br>MHz | Field strength of emissions |                                 | Measurement distance, m |
|-------------------|-----------------------------|---------------------------------|-------------------------|
|                   | µV/m                        | dBµV/m                          |                         |
| 0.009–0.490       | 2400/F                      | $67.6 - 20 \times \log_{10}(F)$ | 300                     |
| 0.490–1.705       | 24000/F                     | $87.6 - 20 \times \log_{10}(F)$ | 30                      |
| 1.705–30.0        | 30                          | 29.5                            | 30                      |
| 30–88             | 100                         | 40.0                            | 3                       |
| 88–216            | 150                         | 43.5                            | 3                       |
| 216–960           | 200                         | 46.0                            | 3                       |
| above 960         | 500                         | 54.0                            | 3                       |

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

**Table 8.4-2: IC restricted frequency bands**

| MHz             | MHz                 | MHz           | GHz         |
|-----------------|---------------------|---------------|-------------|
| 0.090–0.110     | 12.51975–12.52025   | 399.9–410     | 5.35–5.46   |
| 2.1735–2.1905   | 12.57675–12.57725   | 608–614       | 7.25–7.75   |
| 3.020–3.026     | 13.36–13.41         | 960–1427      | 8.025–8.5   |
| 4.125–4.128     | 16.42–16.423        | 1435–1626.5   | 9.0–9.2     |
| 4.17725–4.17775 | 16.69475–16.69525   | 1645.5–1646.5 | 9.3–9.5     |
| 4.20725–4.20775 | 16.80425–16.80475   | 1660–1710     | 10.6–12.7   |
| 5.677–5.683     | 25.5–25.67          | 1718.8–1722.2 | 13.25–13.4  |
| 6.215–6.218     | 37.5–38.25          | 2200–2300     | 14.47–14.5  |
| 6.26775–6.26825 | 73–74.6             | 2310–2390     | 15.35–16.2  |
| 6.31175–6.31225 | 74.8–75.2           | 2655–2900     | 17.7–21.4   |
| 8.291–8.294     | 108–138             | 3260–3267     | 22.01–23.12 |
| 8.362–8.366     | 156.52475–156.52525 | 3332–3339     | 23.6–24.0   |
| 8.37625–8.38675 | 156.7–156.9         | 3345.8–3358   | 31.2–31.8   |
| 8.41425–8.41475 | 240–285             | 3500–4400     | 36.43–36.5  |
| 12.29–12.293    | 322–335.4           | 4500–5150     | Above 38.6  |

Note: Certain frequency bands listed in Table 8.4-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

**Table 8.4-3: FCC restricted frequency bands**

| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090–0.110       | 16.42–16.423        | 399.9–410     | 4.5–5.15    |
| 0.495–0.505       | 16.69475–16.69525   | 608–614       | 5.35–5.46   |
| 2.1735–2.1905     | 16.80425–16.80475   | 960–1240      | 7.25–7.75   |
| 4.125–4.128       | 25.5–25.67          | 1300–1427     | 8.025–8.5   |
| 4.17725–4.17775   | 37.5–38.25          | 1435–1626.5   | 9.0–9.2     |
| 4.20725–4.20775   | 73–74.6             | 1645.5–1646.5 | 9.3–9.5     |
| 6.215–6.218       | 74.8–75.2           | 1660–1710     | 10.6–12.7   |
| 6.26775–6.26825   | 108–121.94          | 1718.8–1722.2 | 13.25–13.4  |
| 6.31175–6.31225   | 123–138             | 2200–2300     | 14.47–14.5  |
| 8.291–8.294       | 149.9–150.05        | 2310–2390     | 15.35–16.2  |
| 8.362–8.366       | 156.52475–156.52525 | 2483.5–2500   | 17.7–21.4   |
| 8.37625–8.38675   | 156.7–156.9         | 2690–2900     | 22.01–23.12 |
| 8.41425–8.41475   | 162.0125–167.17     | 3260–3267     | 23.6–24.0   |
| 12.29–12.293      | 167.72–173.2        | 3332–3339     | 31.2–31.8   |
| 12.51975–12.52025 | 240–285             | 3345.8–3358   | 36.43–36.5  |
| 12.57675–12.57725 | 322–335.4           | 3600–4400     | Above 38.6  |
| 13.36–13.41       |                     |               |             |

#### 8.4.2 Test summary

|               |                  |                   |           |
|---------------|------------------|-------------------|-----------|
| Test date     | October 16, 2016 | Temperature       | 24 °C     |
| Test engineer | Yong Huang       | Air pressure      | 1001 mbar |
| Verdict       | Pass             | Relative humidity | 53 %      |

### 8.4.3 Observations, settings and special notes

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The spectrum was searched from 30 MHz to the 10<sup>th</sup> harmonic.  
 EUT was set to transmit with 100 % duty cycle.  
 Since fundamental power was tested using peak method, the spurious emissions limit is -20 dBc/100 kHz

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 100 kHz  |
| Video bandwidth:      | 300 kHz  |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 1 MHz    |
| Video bandwidth:      | 3 MHz    |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 1 MHz    |
| Video bandwidth:      | 10 Hz    |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

Spectrum analyser settings for conducted spurious emissions measurements:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 100 kHz  |
| Video bandwidth:      | 300 kHz  |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

8.4.4      Test data

*Table 8.4-4: Radiated field strength measurement results*

| Channel | Frequency,<br>MHz | Peak Field strength, dBμV/m |       | Margin,<br>dB | Average Field strength, dBμV/m |       | Margin,<br>dB |
|---------|-------------------|-----------------------------|-------|---------------|--------------------------------|-------|---------------|
|         |                   | Measured                    | Limit |               | Measured                       | Limit |               |
| Low     | 2390              | 43.1                        | 74    | 30.9          | 31.9                           | 54    | 22.1          |
| High    | 2483.5            | 37.1                        | 74    | 36.9          | 30.6                           | 54    | 23.4          |

Notes:      Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

8.4.4 Test data, continued

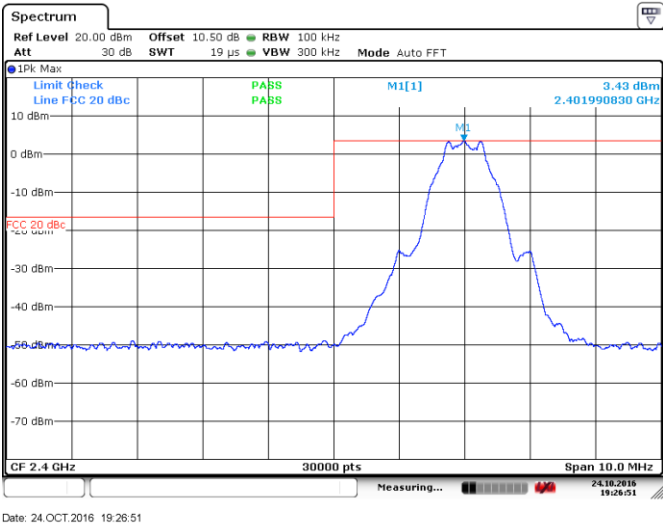


Figure 8.4-1: Conducted spurious emission at band edge, low channel

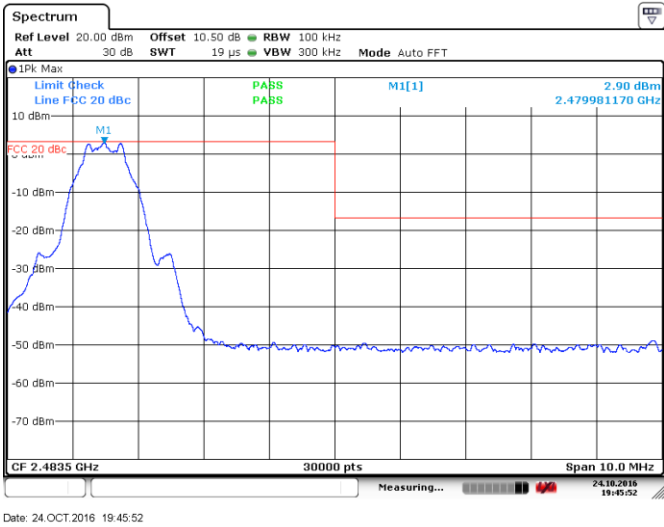


Figure 8.4-2: Conducted spurious emissions at band edge, High channel

8.4.4      Test data, continued

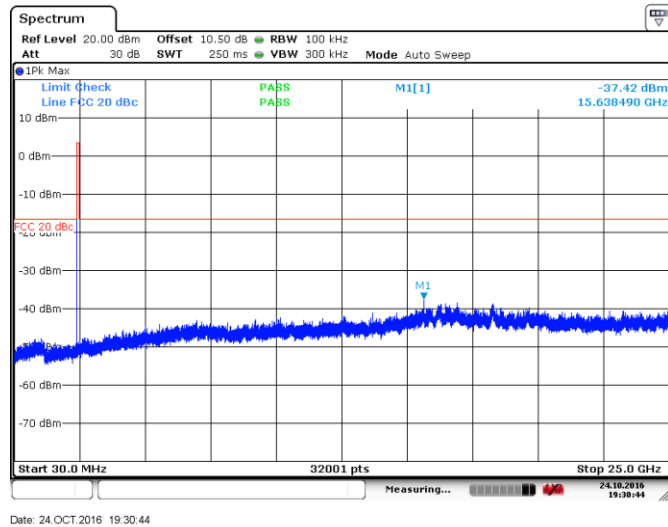


Figure 8.4-3: Conducted spurious emissions, Low channel

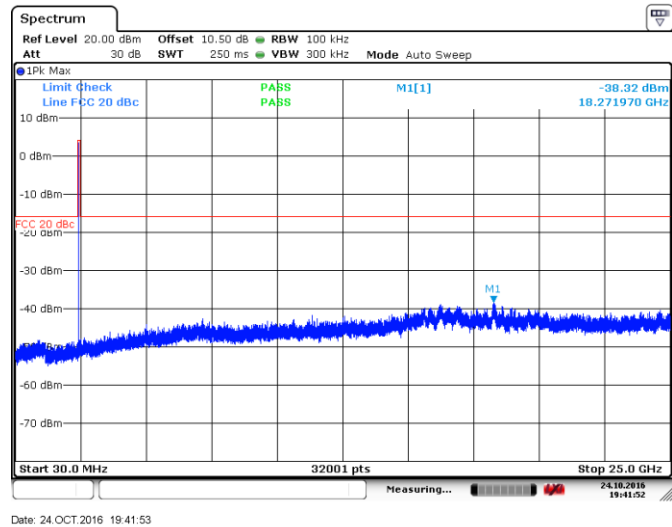


Figure 8.4-4: Conducted spurious emissions, mid channel

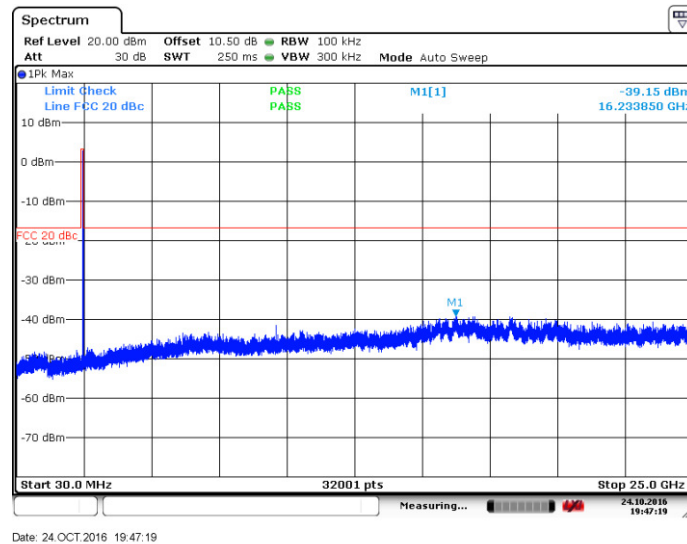


Figure 8.4-5: Conducted spurious emissions, High channel

8.4.1 Test data, continued

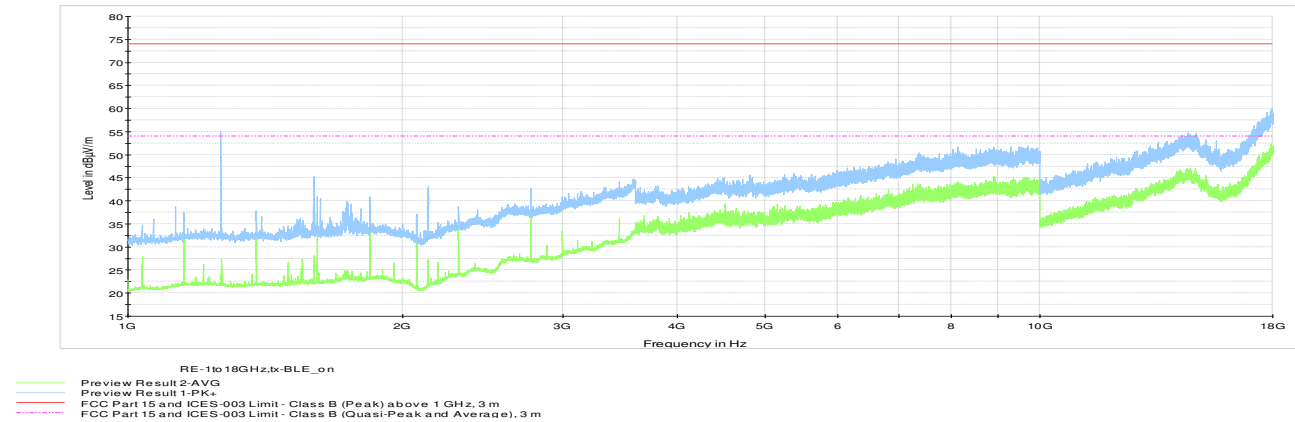


Figure 8.4-6: Radiated spurious emissions 1 to 18 GHz, Low channel

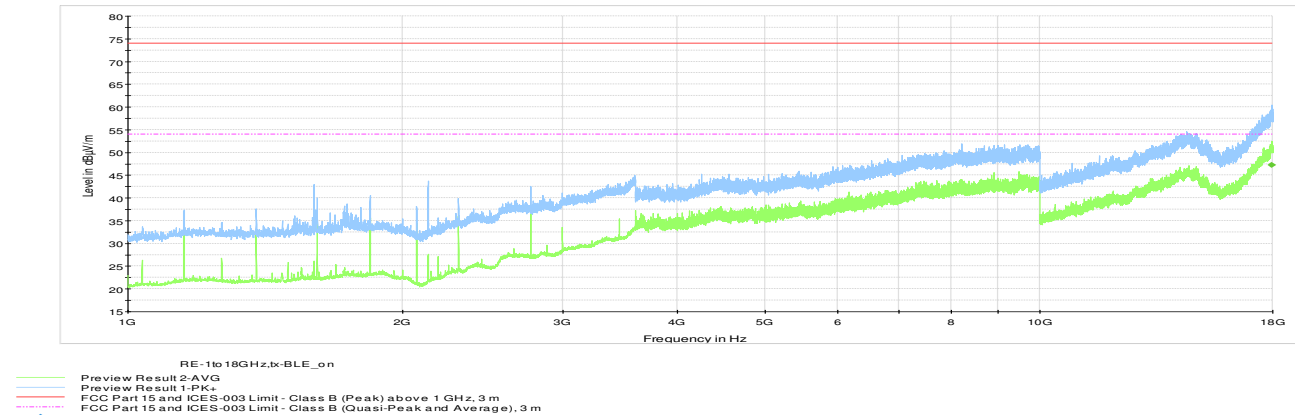


Figure 8.4-7: Radiated spurious emissions 1 to 18 GHz, mid channel

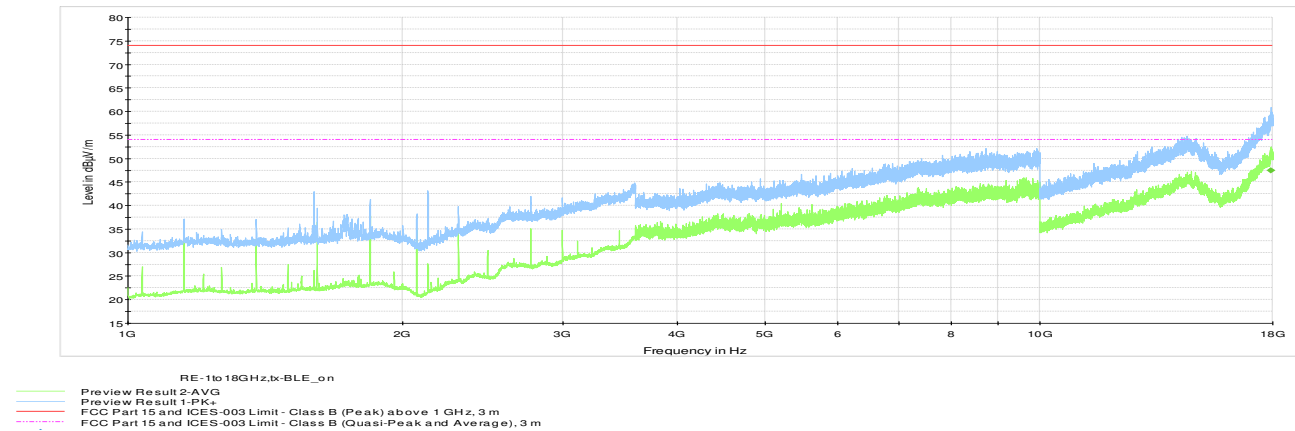


Figure 8.4-8: Radiated spurious emissions 1 to 18 GHz, High channel

Note: Spectrum was investigated from 30 MHz to 25 GHz, below 1 GHz and above 18 GHz, no emission related to RF porting were detected within 6 dB below the limit.

## 8.5 FCC 15.247(e) and RSS-247 5.2(2) Power spectral density for digitally modulated devices

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### 8.5.1 Definitions and limits

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**FCC:**

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.

**IC:**

The transmitter power spectral density conducted from the transmitter 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 Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

### 8.5.2 Test summary

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|               |                  |                   |           |
|---------------|------------------|-------------------|-----------|
| Test date     | October 24, 2016 | Temperature       | 24 °C     |
| Test engineer | Yong Huang       | Air pressure      | 1001 mbar |
| Verdict       | Pass             | Relative humidity | 53 %      |

### 8.5.3 Observations, settings and special notes

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The test was performed using method described in section 10.2 PKPSD. Spectrum analyzer settings:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 100 kHz  |
| Video bandwidth:      | 300 kHz  |
| Frequency span:       | 1.2 MHz  |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

8.5.1 Test data

Table 8.5-1: PSD measurements results

| Frequency, MHz | PSD, dBm/100 kHz | PSD limit, dBm/3 kHz | Margin, dB |
|----------------|------------------|----------------------|------------|
| 2402           | 3.41             | 8                    | 4.59       |
| 2442           | 3.63             | 8                    | 4.37       |
| 2480           | 2.78             | 8                    | 5.22       |

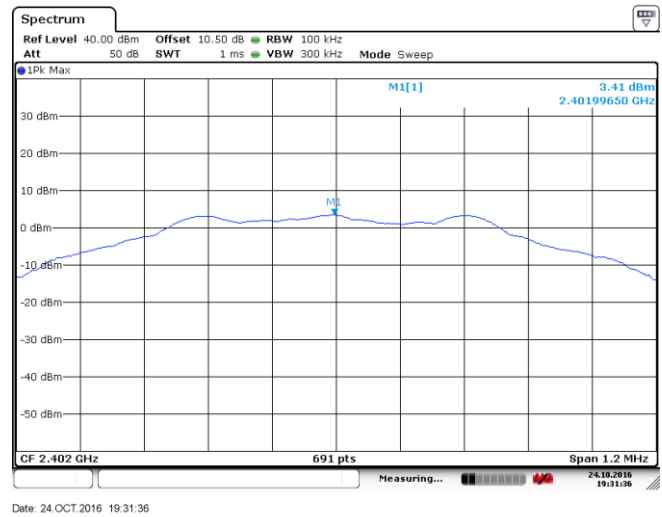


Figure 8.5-1: PSD plot on Low channel

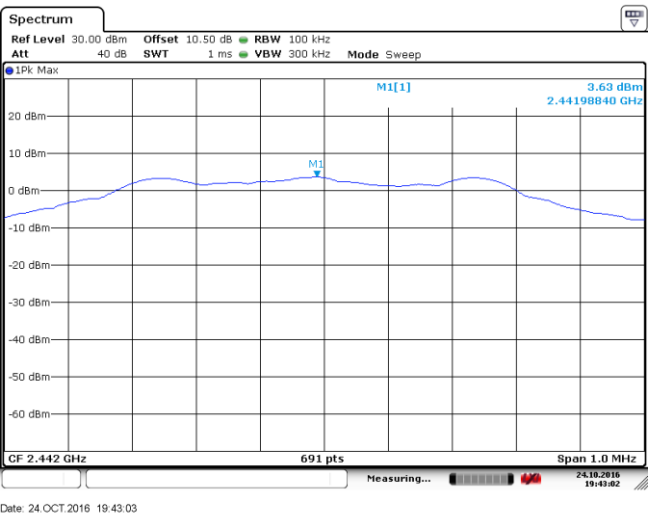


Figure 8.5-2: PSD plot on Mid channel

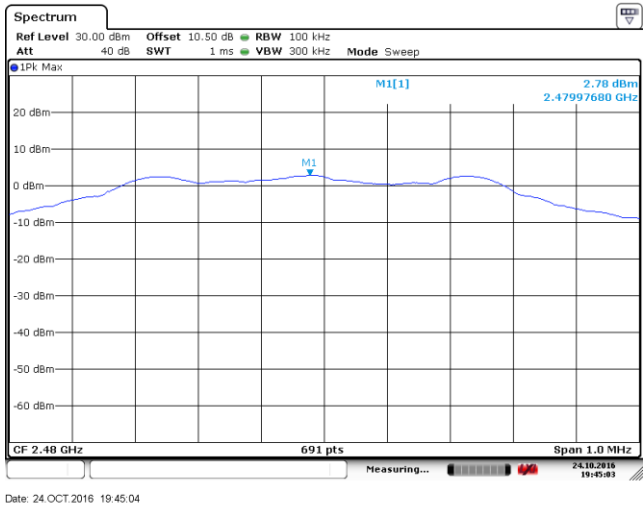
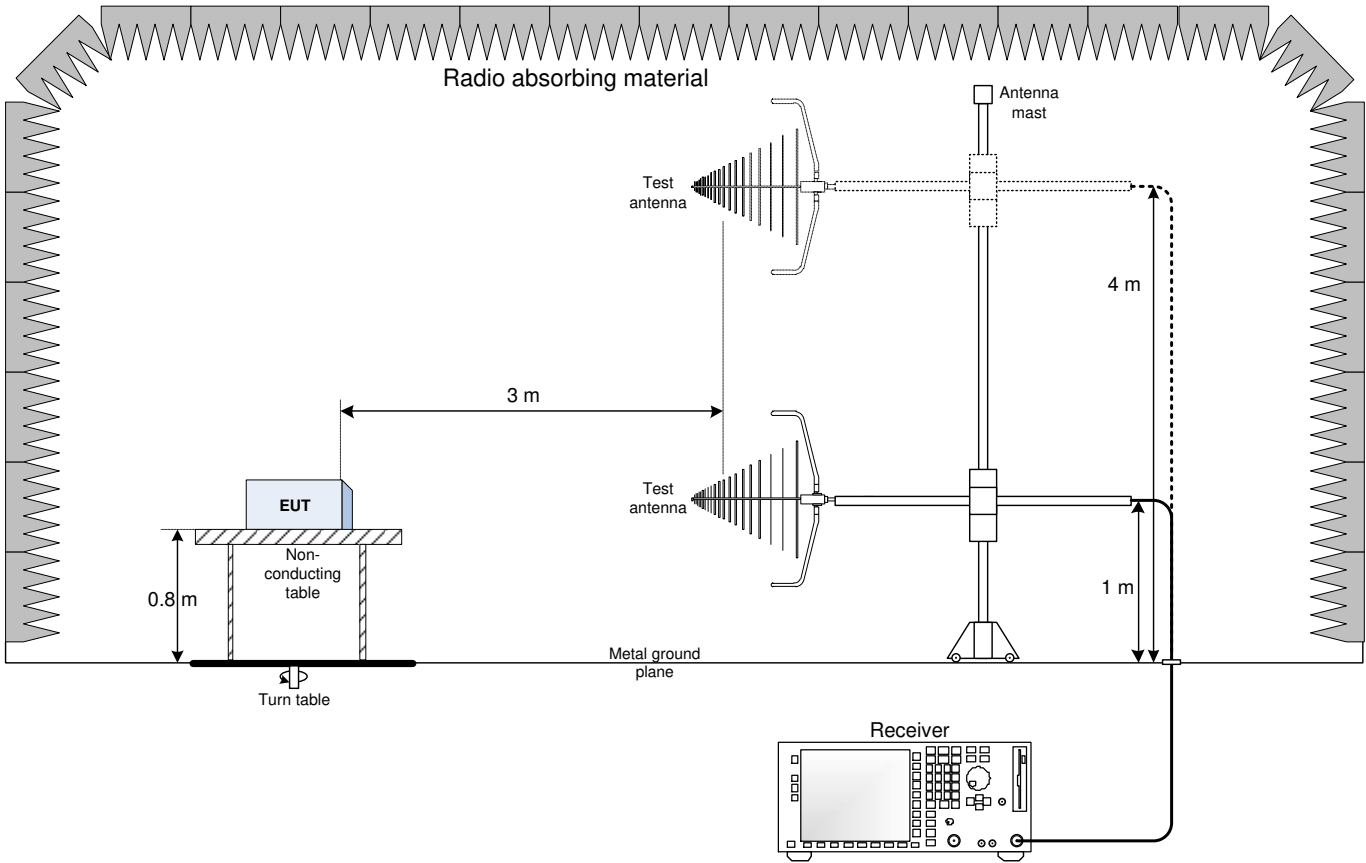


Figure 8.5-3: PSD plot on High channel

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz

