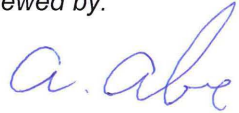


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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------|
| <b>Prüfbericht - Nr.:</b> 50094007 001                                                                                                                                                                                                           |                                                                        | Seite 1 von 39                                                                                       |                      |
| Test Report No.:                                                                                                                                                                                                                                 |                                                                        | Page 1 of 39                                                                                         |                      |
| <b>Auftraggeber:</b> CATEYE Co., Ltd.                                                                                                                                                                                                            |                                                                        |                                                                                                      |                      |
| Client:                                                                                                                                                                                                                                          |                                                                        | 2-8-25, Kuwazu, Higashi-Sumiyoshi-Ku, Osaka, 546-0041 Japan                                          |                      |
| <b>Gegenstand der Prüfung:</b> Speed Cadence Sensor                                                                                                                                                                                              |                                                                        |                                                                                                      |                      |
| Test Item:                                                                                                                                                                                                                                       |                                                                        |                                                                                                      |                      |
| <b>Bezeichnung:</b> ISC-12                                                                                                                                                                                                                       | <b>Serien-Nr.:</b>                                                     | <b>Refer to section 4.3</b>                                                                          |                      |
| Identification:                                                                                                                                                                                                                                  | Serial No.:                                                            |                                                                                                      |                      |
| <b>Wareneingangs-Nr.:</b> A000608321                                                                                                                                                                                                             | <b>Eingangsdatum:</b> 2017-08-09                                       |                                                                                                      |                      |
| Receipt No.:                                                                                                                                                                                                                                     | Date of Receipt:                                                       |                                                                                                      |                      |
| <b>Zustand des Prüfgegenstandes bei Anlieferung:</b> Good                                                                                                                                                                                        |                                                                        |                                                                                                      |                      |
| Condition of Test Item at Delivery:                                                                                                                                                                                                              |                                                                        |                                                                                                      |                      |
| <b>Prüfört:</b> TÜV Rheinland Japan Ltd. – Global Technology Assessment Center                                                                                                                                                                   |                                                                        |                                                                                                      |                      |
| Testing Location:                                                                                                                                                                                                                                | 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan               |                                                                                                      |                      |
| <b>Prüfgrundlage:</b> FCC 47 CFR Part 15, Subpart C, Section 15.249 (October 1, 2016)                                                                                                                                                            |                                                                        |                                                                                                      |                      |
| Test Specification:                                                                                                                                                                                                                              | RSS-210 (Issue 9): 2016<br>RSS-Gen (Issue 4): 2014<br>ANSI C63.10-2013 |                                                                                                      |                      |
| <b>Prüfresultat:</b> Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).                                                                                                                                                              |                                                                        |                                                                                                      |                      |
| Test Result: The test item passed the test specification(s).                                                                                                                                                                                     |                                                                        |                                                                                                      |                      |
| <b>Prüflaboratorium:</b> TÜV Rheinland Japan Ltd. – Global Technology Assessment Center                                                                                                                                                          |                                                                        |                                                                                                      |                      |
| Testing Laboratory: 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan                                                                                                                                                                     |                                                                        |                                                                                                      |                      |
| <b>geprüft/ tested by:</b>                                                                                                                                                                                                                       |                                                                        | <b>kontrolliert/ reviewed by:</b>                                                                    |                      |
|                                                                                                                                                               |                                                                        |                 |                      |
| 2017-10-06                                                                                                                                                                                                                                       | P. Zhang / Inspector                                                   | 2017-10-06                                                                                           | A. Abe / Reviewer    |
| <b>Datum</b>                                                                                                                                                                                                                                     | <b>Name/Stellung</b>                                                   | <b>Datum</b>                                                                                         | <b>Name/Stellung</b> |
| Date                                                                                                                                                                                                                                             | Name/Position                                                          | Date                                                                                                 | Name/Position        |
|                                                                                                                                                                                                                                                  | <b>Unterschrift</b>                                                    |                                                                                                      | <b>Unterschrift</b>  |
|                                                                                                                                                                                                                                                  | Signature                                                              |                                                                                                      | Signature            |
| <b>Sonstiges / Other Aspects:</b>                                                                                                                                                                                                                |                                                                        |                                                                                                      |                      |
|                                                                                                                                                                                                                                                  |                                                                        |                                                                                                      |                      |
| <b>Abkürzungen:</b> P(ass) = entspricht Prüfgrundlage<br>F(ail) = entspricht nicht Prüfgrundlage<br>N/A = nicht anwendbar<br>N/T = nicht getestet                                                                                                |                                                                        | <b>Abbreviations:</b> P(ass) = passed<br>F(ail) = failed<br>N/A = not applicable<br>N/T = not tested |                      |
| <b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b>                         |                                                                        |                                                                                                      |                      |
| This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products. |                                                                        |                                                                                                      |                      |

## TEST SUMMARY

### **5.1.1 SUPPLY VOLTAGE REQUIREMENTS**

*RESULT: PASS*

### **5.1.2 ANTENNA REQUIREMENTS**

*RESULT: PASS*

### **5.1.3 RESTRICTED BANDS OF OPERATION**

*RESULT: PASS*

### **5.2.1 CONDUCTED OUTPUT POWER**

### **5.3.1 DUTY CYCLE**

### **5.3.2 20dB BANDWIDTH**

*RESULT: PASS*

### **5.3.3 99% BANDWIDTH**

### **5.3.4 FIELD STRENGTH OF FUNDAMENTAL**

*RESULT: Pass*

### **5.3.5 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER**

*RESULT: PASS*

### **5.4.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER**

*RESULT: N/A*

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## 1. General Remarks

### 1.1 Complementary Materials

There is no attachment to this test report.

## 2. Test Sites

### 2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center  
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

Innovation, Science and Economic Development Canada has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with Canadian requirements. The description of the test facility is listed under OATS filing number 3466B-1.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005.



TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

## 2.2 List of Test and Measurement Instruments

**Table 1: List of Test and Measurement Equipment**

| Kind of Equipment                                     | Manufacturer     | Model Name       | Serial Number | Equip. ID | Cal. Interval | Cal. Date  | Next Cal.  |
|-------------------------------------------------------|------------------|------------------|---------------|-----------|---------------|------------|------------|
| <b>For Antenna Port Conducted Emission</b>            |                  |                  |               |           |               |            |            |
| RF Power Meter                                        | Agilent          | N1911A           | MY45101737    | RF-0393   | 1 year        | 2016-10-14 | 2017-10-14 |
| RF Peak Power Sensor                                  | Agilent          | N1921A           | MY45242228    | RF-0394   | 1 year        | 2016-10-14 | 2017-10-14 |
| <b>For Radiated Emission</b>                          |                  |                  |               |           |               |            |            |
| Radiated Emission Measurement Soft-ware (below 30MHz) | Toyo Corporation | EP5/ME           | Ver. 5.0.10   | RF-0172   | 1 year        | 2017-03-31 | 2018-03-31 |
| Radiated Emission Measurement Soft-ware (above 30MHz) | Toyo Corporation | EP7/RE           | Ver. 5.0.2    | RF-0026   | 1 year        | 2017-03-31 | 2018-03-31 |
| Receiver                                              | Rohde & Schwarz  | ESU 8            | 100025        | RF-0020   | 1 year        | 2017-07-11 | 2018-07-11 |
| Receiver                                              | Rohde & Schwarz  | ESU 40           | 100029        | RF-0021   | 1 year        | 2017-07-03 | 2018-07-03 |
| RF Selector (10m Chamber)                             | Toyo Corporation | NS4900           | 0703-182      | RF-0029   | 1 year        | 2017-03-31 | 2018-03-31 |
| Loop Antenna with Amplifier, 9kHz-30MHz               | Rohde & Schwarz  | HFH2-Z2          | 100139        | RF-0048   | 1 year        | 2017-05-29 | 2018-05-29 |
| Trilog Antenna No. 2, 30-1000MHz                      | Schwarzbeck      | VULB 9168        | 9168-475      | RF-0462   | 1 year        | 2017-04-04 | 2018-04-04 |
| 5dB Attenuator                                        | Pasternack       | PE7047-5         | -             | RF-0731   | 1 year        | 2017-03-01 | 2018-03-01 |
| Low Noise Preamplifier, 9kHz-1GHz                     | TSJ              | MLA-10K01-B01-35 | 1370750       | RF-0253   | 1 year        | 2017-01-18 | 2018-01-18 |
| Low Pass Filter, DC-1GHz                              | R&K              | LP1000CH 3       | 12104001      | RF-0515   | 1 year        | 2017-01-18 | 2018-01-18 |
| Horn Antenna, 1-8GHz                                  | Schwarzbeck      | BBHA 9120 D      | 1059          | RF-0553   | 1 year        | 2017-06-20 | 2018-06-20 |
| Microwave Preamplifier, 1-8GHz                        | Toyo Corporation | TPA0108-40       | 0634          | RF-0052   | 1 year        | 2017-01-25 | 2018-01-25 |
| Band Reject Filter, 1-8GHz                            | Nitsuki          | NF-49BT          | 027           | RF-0131   | 1 year        | 2017-01-26 | 2018-01-26 |
| Horn Antenna with Preamplifier, 8-18GHz               | Toyo Corporation | HAP06-18W        | 00000025      | RF-0065   | 1 year        | 2017-06-20 | 2018-06-20 |
| High Pass Filter, 8-18GHz                             | Micro-Tronics    | HPM50107         | 006           | RF-0334   | 1 year        | 2017-06-20 | 2018-06-20 |
| Horn Antenna with Preamplifier, 18-26.5GHz            | Toyo Corporation | HAP18-26N        | 00000010      | RF-0070   | 1 year        | 2017-06-21 | 2018-06-21 |

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| Kind of Equipment                                                            | Manufacturer | Model Name | Serial Number  | Equip. ID | Cal. Interval | Cal. Date  | Next Cal.  |
|------------------------------------------------------------------------------|--------------|------------|----------------|-----------|---------------|------------|------------|
| <b>Constant Voltage Constant Frequency Stabilizers and Power Accessories</b> |              |            |                |           |               |            |            |
| DC Power Supply                                                              | Agilent      | E3646A     | MY503500<br>07 | RF-0412   | N/A           | N/A        | N/A        |
| True RMS Multimeter                                                          | Fluke        | 87V        | 97680445       | RF-0281   | 1 year        | 2017-02-02 | 2018-02-02 |

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

## 2.3 Measurement Uncertainty

**Table 2: Emission Measurement Uncertainty**

| Measurement Type                | Frequency      | Uncertainty |
|---------------------------------|----------------|-------------|
| Antenna Port Conducted Emission | 20Hz - 40GHz   | ±1.5dB      |
| Radiated Emission               | 150kHz - 30MHz | ±4.7dB      |
|                                 | 30MHz - 1GHz   | ±4.7dB      |
|                                 | > 1GHz         | ±4.7dB      |

### 3. General Product Information

#### 3.1 Product Function and Intended Use

The EUT (Equipment Under Test) model ISC-12 is a speed cadence sensor with Bluetooth Low Energy wireless communication feature. It is intended to be used by a driver of a bicycle and is attached on a frame of the bicycle to monitor driving a speed and a cadence. The EUT can communicate with a CATEYE's cyclocomputer.

#### 3.2 System Details

|                        |                                                                               |
|------------------------|-------------------------------------------------------------------------------|
| Radio standard:        | Bluetooth 4.0 Low Energy                                                      |
| Measured output power: | +3.56dBm (Conducted, Peak)                                                    |
| Antenna gain:          | -2.59dBi                                                                      |
| Antenna type:          | Pattern antenna                                                               |
| Antenna mounting type: | Internal                                                                      |
| Frequency range:       | 2402-2480MHz                                                                  |
| Number of channels:    | 40 ( $f = 2402\text{MHz} + k \cdot 2\text{MHz}$ , where $k=0, 1, \dots, 39$ ) |
| Channel spacing:       | 2MHz                                                                          |
| Modulation type:       | GFSK                                                                          |
| FCC classification:    | DTS                                                                           |
| IC classification:     | Bluetooth Device                                                              |
| Emission designator:   | 1M27F1D                                                                       |

|                   |                        |
|-------------------|------------------------|
| Rated voltage:    | DC 3.0V (Li coin cell) |
| Rated current:    | Max. 1.0mA             |
| Protection class: | III                    |

|               |         |
|---------------|---------|
| Test voltage: | DC 3.0V |
|---------------|---------|

#### 3.3 Clock Frequencies

The highest frequency generated or used by the EUT is 16MHz for the radio portion, and is 4MHz for the digital interface portion.

#### 3.4 Noise Suppressing Parts

Refer to schematics.

## **4. Test Set-up and Operation Modes**

### **4.1 Test Methodology**

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and 15.249.

The test methods, which have been used, are based on ANSI C63.10 and RSS-Gen. For details, see under each test item.

### **4.2 Operation Modes**

Testing was performed at the lowest operating frequency (2402MHz), at the operating frequency in the middle of the specified frequency band (2442MHz) and at the highest operating frequency (2480MHz).

The basic operation modes used for testing are:

- A. EUT transmits (TX mode), with full power, at lowest channel (2402MHz), a continuous modulated signal streaming with the maximum duty cycle.
- B. EUT transmits (TX mode), with full power, at middle channel (2442MHz), a continuous modulated signal streaming with the maximum duty cycle.
- C. EUT transmits (TX mode), with full power, at highest channel (2480MHz), a continuous modulated signal streaming with the maximum duty cycle.

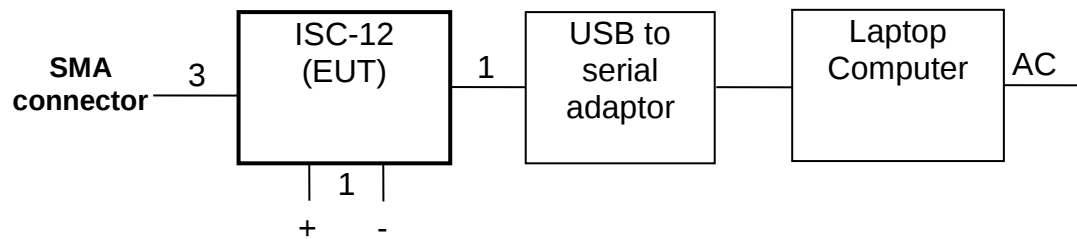
### **4.3 Physical Configuration for Testing**

The test system was configured in a typical fashion (as a customer would normally use it).

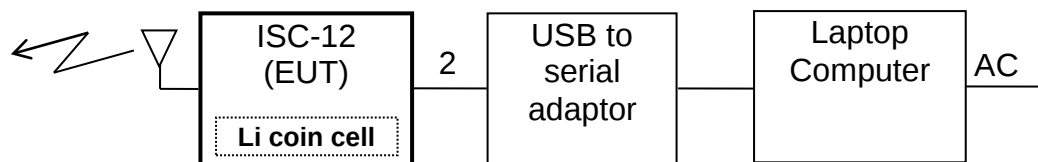
The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

### Figure 1: Block Diagram

#### 1) Test Setup of Conducted Radio Testing



#### 2) Test Setup of Radiated Testing



Note: A laptop computer and USB to serial adaptor were only used for an initial setup of radio operation. They were disconnected to the EUT during conducted and radiated radio testing.

**Table 3: Interfaces present on the EUT**

| No. | Interface                                           | Cable Length for Testing, Shielding | Interface Classification          |
|-----|-----------------------------------------------------|-------------------------------------|-----------------------------------|
| 1.  | Signal line<br>(Between the EUT and Serial Adaptor) | 8cm, Un-Shielded                    | DC Input Power and<br>Signal Port |
| 2.  |                                                     | 4cm, Un-Shielded                    |                                   |
| 3.  | RF Cable (Conducted Radio test only)                | 6cm, Shielded                       | RF Port                           |

Note:

The EUT does not have any user accessible interface ports. However, above-mentioned interface ports were used for testing purpose.

The following test samples were available;

- Sample No. 121 was used for antenna conducted radio measurements,
- Sample No. 122 was used for radiated radio measurements

For more details, refer to section: Photographs of the Test Set-Up.

## 4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required modes.

Software used for testing: nRFgo Studio version 1.16.1.3119 by Nordic Semiconductor ASA.

Before starting radio testing, special software mentioned above was running on a laptop computer connected to the EUT through a converter for an initial setting purpose. It was used to enable the test operation modes listed in section 4.2 as appropriate.

## 4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop Computer  
Manufacturer: Panasonic  
Model: CF-T9JWFCPS  
Rated Voltage: DC 16V  
Protection Class: III  
Serial Number: 0DKSA02735
2. Product: AC Adapter for Laptop Computer  
Manufacturer: Panasonic  
Model: CF-AA6372A M3  
Rated Voltage: AC 100V-240V  
Input Current: 1.5A  
Frequency: 50-60Hz  
Protection Class: II  
Serial Number: 6372AM310201996J
3. Product: USB to Serial Adapter  
Manufacturer: IO DATA  
Model: USB-RSAQ3  
Rated Voltage: 5V (USB bus powered)  
Protection Class: III  
Serial Number: V1E0035358BT

## 4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

## 5. Test Results RADIO

### 5.1 Technical Requirements

#### 5.1.1 Supply Voltage Requirements

**RESULT:** **PASS**

Requirements:

FCC 15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT is battery operated and it was tested with a new battery. Hence it complies with the supply voltage requirements.

#### 5.1.2 Antenna Requirements

**RESULT:** **PASS**

Requirements:

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The EUT has an internal antenna which is not user accessible. Hence it complies with the antenna requirements.

### 5.1.3 Restricted Bands of Operation

**RESULT:**

**PASS**

Requirements:

FCC 15.205 and RSS-Gen §8.10

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 2402 - 2480MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

## 5.2 Conducted Measurements at Antenna Port

### 5.2.1 Conducted Output Power

Date of testing: 2017-09-20

Ambient temperature: 24°C

Relative humidity: 48%

Atmospheric pressure: 1000hPa

Requirements:

N/A

(This test item was performed for RF exposure evaluation.)

Test procedure:

RSS-Gen (Issue 4) §6.12

The maximum Peak Output Power (conducted) was measured at the antenna connector with a power meter.

**Table 4: Conducted Output Power**

| Operating Frequency<br>[MHz] | Peak Output Power |       |
|------------------------------|-------------------|-------|
|                              | [dBm]             | [mW]  |
| 2402                         | 3.33              | 2.153 |
| 2442                         | 3.48              | 2.228 |
| 2480                         | 3.56              | 2.270 |

Note: Grey shading area shows the highest power in the test result.

## 5.3 Radiated Measurements

### 5.3.1 Duty Cycle

Date of testing: 2017-08-18

Ambient temperature: 20°C  
Relative humidity: 53%  
Atmospheric pressure: 1006hPa

Requirements:

N/A (This test item was performed as reference.)

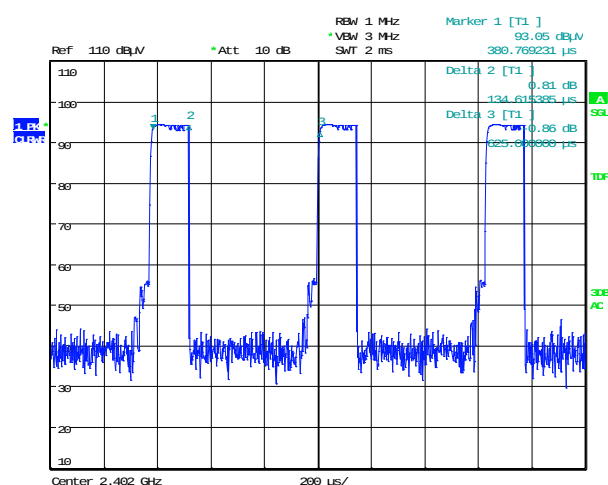
Test procedure:

ANSI C63.10-2013

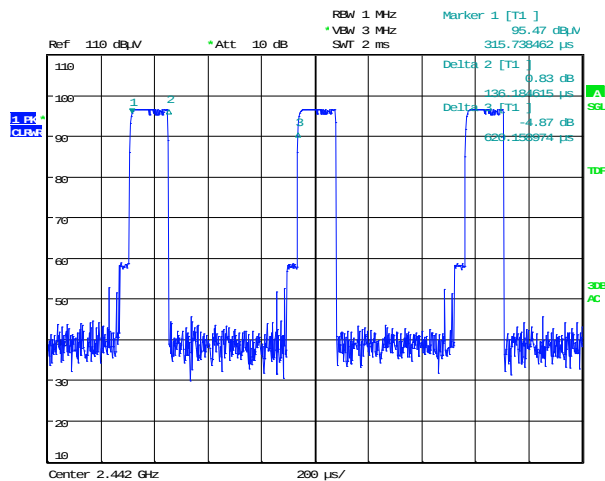
Table 5: Duty Cycle

| Operating Frequency [MHz] | On Time Duration [us] | Period of the Pulse Train [us] | Total On Time [%] |
|---------------------------|-----------------------|--------------------------------|-------------------|
| 2402                      | 134.615385            | 625.000000                     | 21.5              |
| 2442                      | 136.184615            | 620.158974                     | 22.0              |
| 2480                      | 140.512821            | 627.692308                     | 22.4              |

Figure 2: Duty Cycle, Mode A (2402MHz)

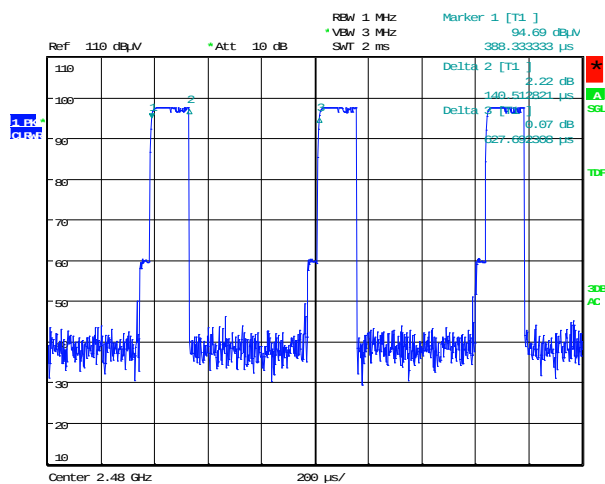


### Figure 3: Duty Cycle, Mode B (2442MHz)



Date: 18.AUG.2017 17:23:21

**Figure 4: Duty Cycle, Mode C (2480MHz)**



Date: 18.AUG.2017 16:04:04

### 5.3.2 20dB Bandwidth

**RESULT:**

**PASS**

Date of testing: 2017-08-18

Ambient temperature: 20°C

Relative humidity: 53%

Atmospheric pressure: 1006hPa

**Requirements:**

FCC 15.215(c) and FCC 15.249

The 20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

**Test procedure:**

ANSI C63.10 §6.9.2

The EUT was placed on a nonconductive turntable 1.5m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a horn antenna connected to a spectrum analyzer using a peak detector.

Final measurements were performed using a spectrum analyzer with the resolution bandwidth (RBW) set to in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately  $3 \times \text{RBW}$ . Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

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**Table 6: 20dB Bandwidth Edge Frequencies**

| 20dB Bandwidth Edge Side | Operating Frequency [MHz] | Edge Frequency [MHz] | Limit [MHz] | Margin [MHz] |
|--------------------------|---------------------------|----------------------|-------------|--------------|
| Lower freq.              | 2402MHz                   | 2401.423128          | 2400.0      | 1.423128     |
| Upper freq.              | 2480MHz                   | 2480.512871          | 2483.5      | 2.987129     |

Note: EUT / Antenna Orientation was Y / V.

**Table 7: 20dB Bandwidth**

| Operating Frequency [MHz] | EUT / Antenna Orient. | 20dB Bandwidth [MHz] |
|---------------------------|-----------------------|----------------------|
| 2402                      | Y / V                 | 1.258012821          |
| 2442                      | Y / V                 | 1.049679487          |
| 2480                      | Y / V                 | 1.057692308          |

Note: Grey shading area shows the widest bandwidth in this test result.

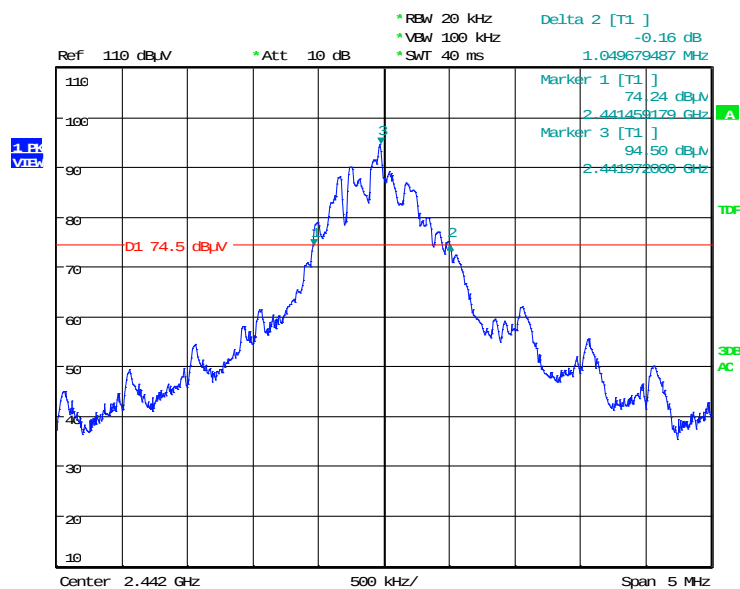
**Figure 5: 20dB Bandwidth, Mode A (2402MHz)**



Date: 18.AUG.2017 17:56:39

Note: RBW was set to 1.59% of the observed OBW.  $(20 \text{ kHz} / 1258 \text{ kHz}) \times 100 = 1.59 \%$

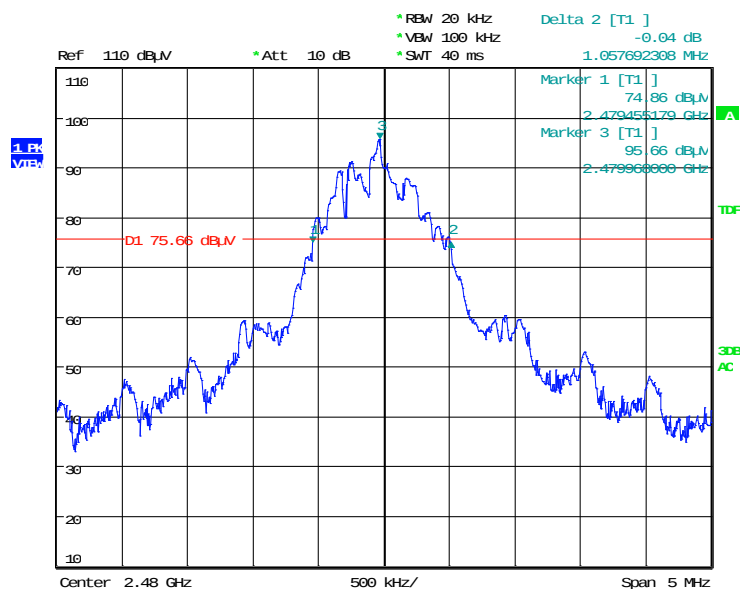
**Figure 6: 20dB Bandwidth, Mode B (2442MHz)**



Date: 18.AUG.2017 17:19:18

Note: RBW was set to 1.90% of the observed OBW.  $(20 \text{ kHz} / 1050 \text{ kHz}) \times 100 = 1.90 \%$

**Figure 7: 20dB Bandwidth, Mode C (2480MHz)**



Date: 18.AUG.2017 15:54:24

Note: Frequency of the marker 2 is calculated.  $2479.455179 + 1.057692308 = 2480.512871 \text{ MHz}$   
RBW was set to 1.89% of the observed OBW.  $(20 \text{ kHz} / 1058 \text{ kHz}) \times 100 = 1.89 \%$

### 5.3.3 99% Bandwidth

Date of testing: 2017-08-18

Ambient temperature: 20°C

Relative humidity: 53%

Atmospheric pressure: 1006hPa

Requirements:

RSS-Gen §6.6 and 8.11

The 99% bandwidth shall be reported and shall lie entirely outside the restricted bands and the prohibited TV bands of 54-72MHz, 76-88MHz, 174-216MHz, 470-608MHz and 614-806MHz.

Test procedure:

ANSI C63.10 §6.9.3 and RSS-Gen §6.6

The EUT was placed on a nonconductive turntable 1.5m above the ground plane in a semi-anechoic chamber.

Final measurements were performed using a spectrum analyzer with the resolution bandwidth (RBW) set to in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately  $3 \times \text{RBW}$ . The 99% bandwidth was measured by using the OBW function of the analyzer with a 99% coverage setting. Sample detector was used at this test item.

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**Table 8: 99% Bandwidth Edge Frequencies**

| 99% Bandwidth Edge Side | Operating Frequency [MHz] | Edge Frequency [MHz] | Limit [MHz] | Margin [MHz] |
|-------------------------|---------------------------|----------------------|-------------|--------------|
| Lower freq.             | 2402MHz                   | 2401.400000          | 2390        | 11.400000    |
| Upper freq.             | 2480MHz                   | 2480.472000          | 2655        | 174.528000   |

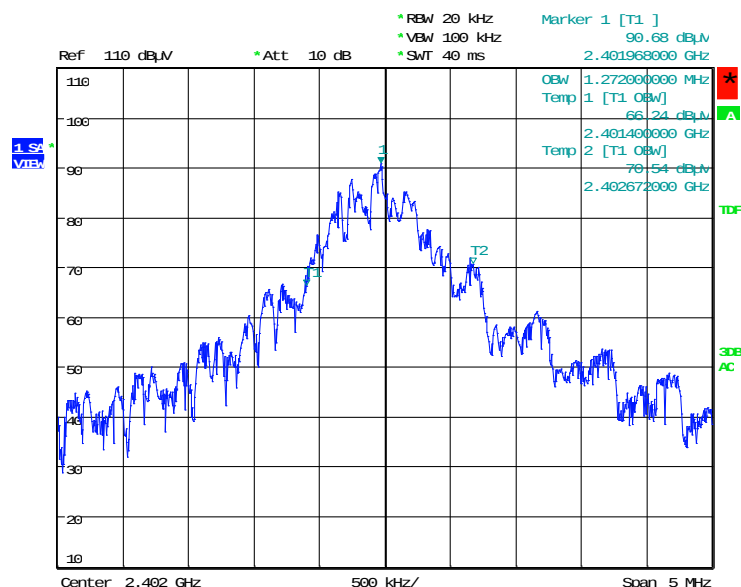
Note: EUT / Antenna Orientation was Y / V.

**Table 9: 99% Bandwidth**

| Operating Frequency [MHz] | EUT / Antenna Orient. | 99% Bandwidth [MHz] |
|---------------------------|-----------------------|---------------------|
| 2402                      | Y / V                 | 1.272               |
| 2442                      | Y / V                 | 1.036               |
| 2480                      | Y / V                 | 0.996               |

Note: Grey shading area shows the widest bandwidth in this test result.

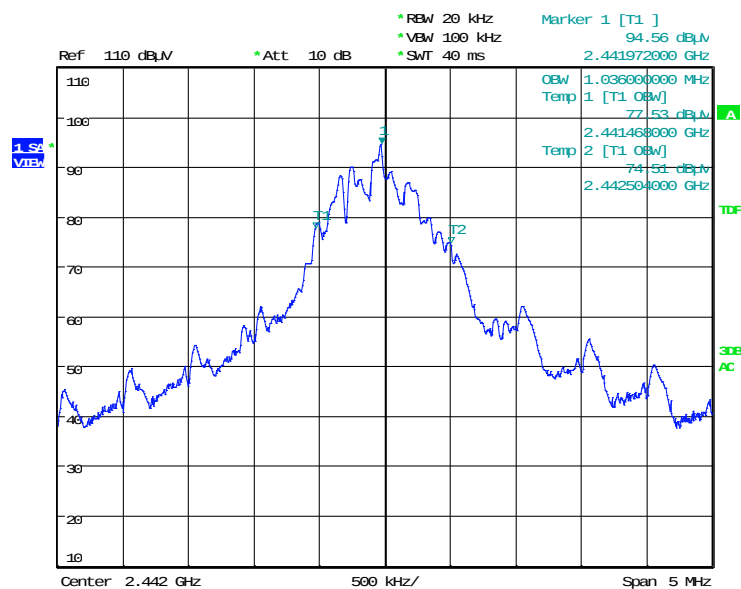
**Figure 8: 99% Bandwidth, Mode A (2402MHz)**



Date: 18.AUG.2017 18:01:06

Note: RBW was set to 1.57% of the observed OBW.  $(20 \text{ kHz} / 1272 \text{ kHz}) \times 100 = 1.57 \%$

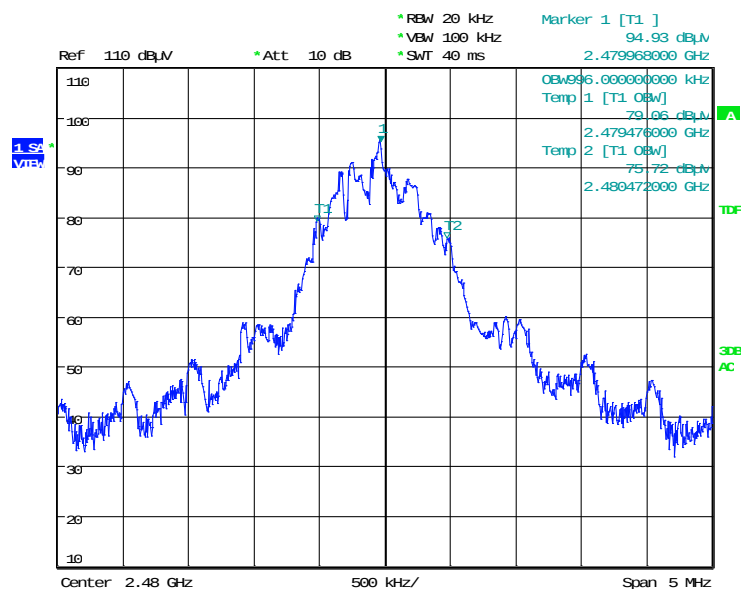
Figure 9: 99% Bandwidth, Mode B (2442MHz)



Date: 18.AUG.2017 17:15:04

Note: RBW was set to 1.93% of the observed OBW.  $(20 \text{ kHz} / 1036 \text{ kHz}) \times 100 = 1.93 \%$

Figure 10: 99% Bandwidth, Mode C (2480MHz)



Date: 18.AUG.2017 15:57:07

Note: RBW was set to 2.00% of the observed OBW.  $(20 \text{ kHz} / 996 \text{ kHz}) \times 100 = 2.00 \%$

### 5.3.4 Field Strength of Fundamental

**RESULT:**

**Pass**

Date of testing: 2017-08-16, 2017-08-17, 2017-08-18

Ambient temperature: 20, 20, 20°C

Relative humidity: 51, 53, 53%

Atmospheric pressure: 1003, 1006, 1006hPa

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

**Requirements:**

FCC 15.249 (a) (c) (e) and RSS-210 §B.10 (a)

The field strength of fundamental shall not exceed the level specified in FCC 15.249 (a) (e) and RSS-210 §B.10 (a).

**Test procedure:**

ANSI C63.10 §6.3 and 6.6 and RSS-Gen §8.1

The EUT was placed on a nonconductive turntable 1.5m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for 3 EUT orientations (X, Y and Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: Peak: RBW = 1MHz, VBW = 3MHz. Average: RBW = 1MHz, VBW = 3MHz.

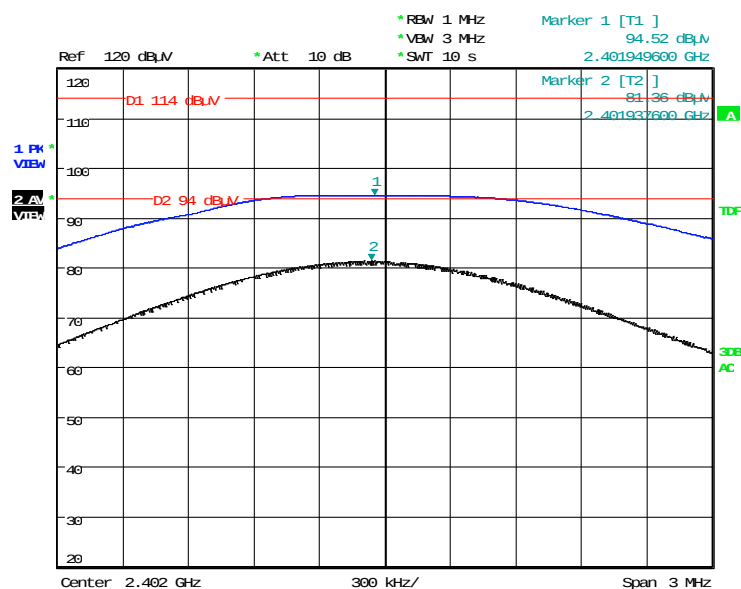
The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. In the spectra here below, the upper trace corresponds to the peak measurement and the lower trace corresponds to the average measurement.

**Table 10: Field Strength of Fundamental**

| Operating Frequency [MHz] | EUT / Antenna Orient. | Average Level [dBμV/m] | Peak Level [dBμV/m] | Average Limit [dBμV/m] | Peak Limit [dBμV/m] | Average Margin [dB] | Peak Margin [dB] |
|---------------------------|-----------------------|------------------------|---------------------|------------------------|---------------------|---------------------|------------------|
| 2402                      | Y / V                 | 81.36                  | 94.52               | 94                     | 114                 | 12.64               | 19.48            |
| 2442                      | Y / V                 | 83.41                  | 96.52               | 94                     | 114                 | 10.59               | 17.48            |
| 2480                      | Y / V                 | 84.60                  | 97.66               | 94                     | 114                 | 9.40                | 16.34            |

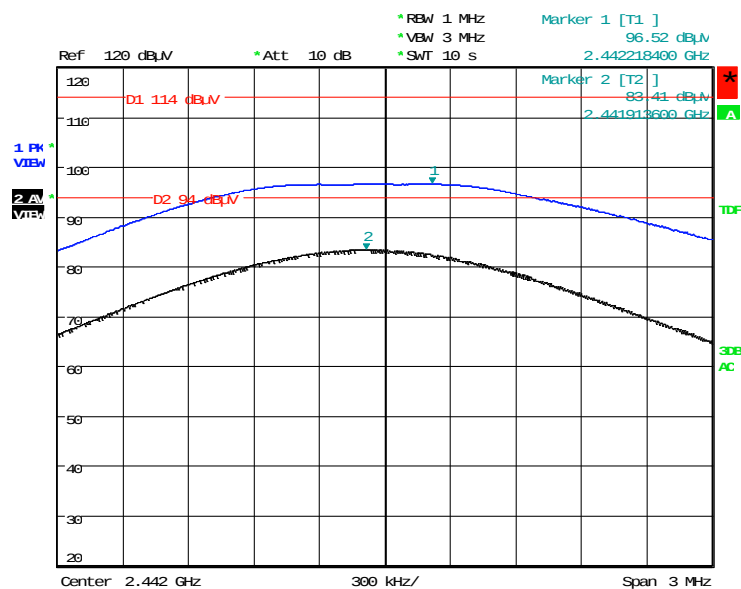
Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.  
Average limit in dBμV/m is calculated as follows: Average limit = 20 x Log<sub>10</sub> (50000μV/m).  
Peak limit in dBμV/m is calculated as follows: Peak limit = Average limit + 20dB.

**Figure 11: Field Strength of Fundamental, Spectral Diagram, Mode A (2402MHz)**



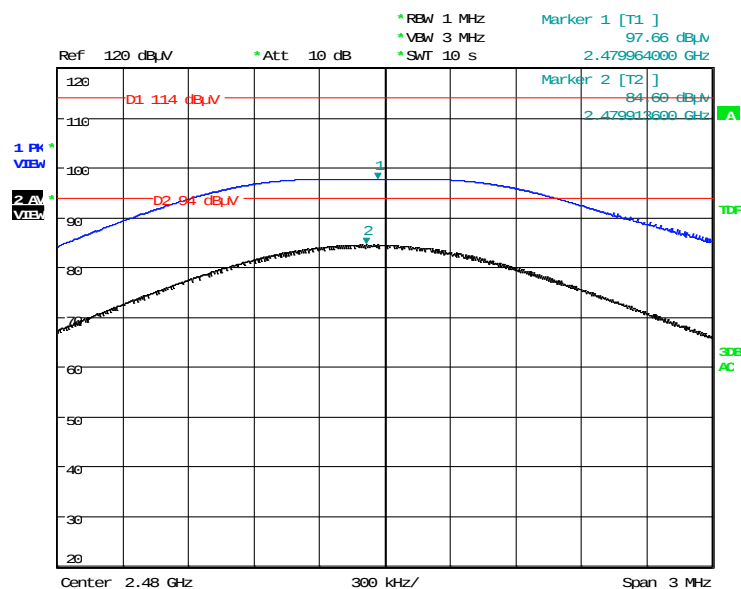
Date: 18.AUG.2017 17:48:45

Figure 12: Field Strength of Fundamental, Spectral Diagram, Mode B (2442MHz)



Date: 18.AUG.2017 17:08:41

Figure 13: Field Strength of Fundamental, Spectral Diagram, Mode C (2480MHz)



Date: 18.AUG.2017 15:46:44

### 5.3.5 Radiated Spurious Emissions of Transmitter

**RESULT:**

**PASS**

Date of testing: 2017-08-17, 2017-08-18, 2017-08-20

Ambient temperature: 20, 20, 19°C

Relative humidity: 53, 54, 41%

Atmospheric pressure: 1006, 1006, 1008hPa

Frequency range: 9kHz - 25GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

**Requirements:**

FCC 15.209, FCC 15.249(a)(c)(d)(e), RSS-Gen §8.9 and 8.10 and RSS-210 §B.10(a)(b)

Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209, FCC 15.249(a)(d)(e), RSS-Gen §8.9 (tables 4 and 5) and RSS-210 §B.10(a)(b).

**Test procedure:**

ANSI C63.10 §6.3, 6.4, 6.5, 6.6, 6.10 and RSS-Gen §6.13 and 8.1

The EUT was placed on a nonconductive turntable. The table height was 0.8m for measurements below 1GHz and 1.5m for measurements above 1GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y and Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° in order to determine the emission's maximum level. For frequencies above 30MHz, the antenna was raised and lowered from 1 to 4m and measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 120kHz. For emissions above 1GHz, measurements were performed with a spectrum analyzer using the following settings: for peak field strength: RBW = 1MHz & VBW ≥ 1MHz; for average field strength: RBW = 1MHz & VBW = 10Hz.

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Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

No spurious emission was found in the following ranges. 9kHz - 30MHz, 8 – 18GHz and 18 – 25GHz.

**Table 11: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)**

| Frequency [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-----------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 66.210          | X/V                       | 33.6              | -22.2            | 11.4              | 40.0           | 28.6           | 100         | 7         |
| 163.586         | X/H                       | 30.1              | -20.5            | 9.6               | 43.5           | 33.9           | 175         | 313       |
| 857.510         | X/V                       | 31.2              | -8.6             | 22.6              | 46.0           | 23.4           | 170         | 172       |
| 958.823         | X/H                       | 30.4              | -6.4             | 24.0              | 46.0           | 22.0           | 170         | 104       |

Note: Level QP = Reading QP + Factor

**Table 12: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode B (2442MHz)**

| Freq. [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 44.242      | X/V                       | 34.0              | -21.3            | 12.7              | 40.0           | 27.3           | 140         | 167       |
| 167.812     | X/H                       | 30.0              | -20.7            | 9.3               | 43.5           | 34.2           | 331         | 344       |
| 951.774     | X/H                       | 30.8              | -6.6             | 24.2              | 46.0           | 21.8           | 290         | 84        |
| 972.108     | X/V                       | 30.4              | -6.0             | 24.4              | 54.0           | 29.6           | 117         | 303       |

Note: Level QP = Reading QP + Factor

**Table 13: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)**

| Freq. [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 66.280      | X/V                       | 33.5              | -22.2            | 11.3              | 40.0           | 28.7           | 100         | 354       |
| 164.226     | X/H                       | 30.2              | -20.5            | 9.7               | 43.5           | 33.8           | 186         | 97        |
| 364.110     | X/V                       | 29.6              | -17.0            | 12.6              | 46.0           | 33.4           | 383         | 95        |
| 832.496     | X/H                       | 31.0              | -8.8             | 22.2              | 46.0           | 23.8           | 244         | 70        |

Note: Level QP = Reading QP + Factor

**Table 14: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)**

| Freq. [MHz] | EUT /<br>Antenna<br>Orientation | Reading<br>AV [dBμV] | Factor<br>[dB(1/m)] | Level AV<br>[dBμV/m] | Limit<br>[dBμV/m] | Margin<br>AV [dB] | Height<br>[cm] | Angle<br>[°] |
|-------------|---------------------------------|----------------------|---------------------|----------------------|-------------------|-------------------|----------------|--------------|
| 2318.453    | Z/H                             | 40.1                 | -14.4               | 25.7                 | 54.0              | 28.3              | 176            | 182          |
| 2375.314    | Z/H                             | 39.9                 | -14.6               | 25.3                 | 54.0              | 28.7              | 168            | 9            |
| 2436.804    | Z/H                             | 40.5                 | -14.9               | 25.6                 | 54.0              | 28.4              | 138            | 25           |
| 4803.876    | Z/V                             | 40.7                 | -8.4                | 32.3                 | 54.0              | 21.7              | 162            | 180          |
| 7523.020    | Z/H                             | 38.8                 | -1.9                | 36.9                 | 54.0              | 17.1              | 143            | 313          |

Note: Level AV = Reading AV + Factor

**Table 15: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)**

| Freq. [MHz] | EUT /<br>Antenna<br>Orientation | Reading<br>PK [dBμV] | Factor<br>[dB(1/m)] | Level PK<br>[dBμV/m] | Limit<br>[dBμV/m] | Margin<br>PK [dB] | Height<br>[cm] | Angle<br>[°] |
|-------------|---------------------------------|----------------------|---------------------|----------------------|-------------------|-------------------|----------------|--------------|
| 2318.453    | Z/H                             | 69.5                 | -14.4               | 55.1                 | 74.0              | 18.9              | 176            | 182          |
| 2375.314    | Z/H                             | 69.4                 | -14.6               | 54.8                 | 74.0              | 19.2              | 168            | 9            |
| 2436.804    | Z/H                             | 71.9                 | -14.9               | 57.0                 | 74.0              | 17.0              | 138            | 25           |
| 4803.876    | Z/V                             | 58.5                 | -8.4                | 50.1                 | 74.0              | 23.9              | 162            | 180          |
| 7523.020    | Z/H                             | 53.1                 | -1.9                | 51.2                 | 74.0              | 22.8              | 143            | 313          |

Note: Level PK = Reading PK + Factor

**Table 16: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2442MHz)**

| Freq. [MHz] | EUT /<br>Antenna<br>Orientation | Reading<br>AV [dBμV] | Factor<br>[dB(1/m)] | Level AV<br>[dBμV/m] | Limit<br>[dBμV/m] | Margin<br>AV [dB] | Height<br>[cm] | Angle<br>[°] |
|-------------|---------------------------------|----------------------|---------------------|----------------------|-------------------|-------------------|----------------|--------------|
| 2497.263    | Z/H                             | 40.2                 | -15.1               | 25.1                 | 54.0              | 28.9              | 177            | 0            |
| 2572.011    | Z/H                             | 40.0                 | -15.0               | 25.0                 | 54.0              | 29.0              | 187            | 180          |
| 4883.911    | Z/V                             | 39.6                 | -8.6                | 31.0                 | 54.0              | 23.0              | 147            | 197          |
| 7140.489    | Z/H                             | 39.2                 | -2.0                | 37.2                 | 54.0              | 16.8              | 193            | 276          |

Note: Level AV = Reading AV + Factor

**Table 17: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2442MHz)**

| Freq. [MHz] | EUT / Antenna Orientation | Reading PK [dBμV] | Factor [dB(1/m)] | Level PK [dBμV/m] | Limit [dBμV/m] | Margin PK [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 2497.263    | Z/H                       | 74.0              | -15.1            | 58.9              | 74.0           | 15.1           | 177         | 0         |
| 2572.011    | Z/H                       | 73.8              | -15.0            | 58.8              | 74.0           | 15.2           | 187         | 180       |
| 4883.911    | Z/V                       | 57.3              | -8.6             | 48.7              | 74.0           | 25.3           | 147         | 197       |
| 7140.489    | Z/H                       | 53.4              | -2.0             | 51.4              | 74.0           | 22.6           | 193         | 276       |

Note: Level PK = Reading PK + Factor

**Table 18: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)**

| Freq. [MHz] | EUT / Antenna Orientation | Reading AV [dBμV] | Factor [dB(1/m)] | Level AV [dBμV/m] | Limit [dBμV/m] | Margin AV [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1499.965    | Z/V                       | 39.2              | -16.4            | 22.8              | 54.0           | 31.2           | 202         | 111       |
| 2435.917    | Z/H                       | 40.1              | -14.9            | 25.2              | 54.0           | 28.8           | 100         | 38        |
| 2571.757    | Z/H                       | 40.0              | -15.0            | 25.0              | 54.0           | 29.0           | 184         | 179       |
| 7284.493    | Z/V                       | 38.6              | -1.5             | 37.1              | 54.0           | 16.9           | 181         | 205       |
| 7942.664    | Z/H                       | 38.7              | -0.7             | 38.0              | 54.0           | 16.0           | 112         | 248       |

Note: Level AV = Reading AV + Factor

**Table 19: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)**

| Freq. [MHz] | EUT / Antenna Orientation | Reading PK [dBμV] | Factor [dB(1/m)] | Level PK [dBμV/m] | Limit [dBμV/m] | Margin PK [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1499.965    | Z/V                       | 54.1              | -16.4            | 37.7              | 74.0           | 36.3           | 202         | 111       |
| 2435.917    | Z/H                       | 72.0              | -14.9            | 57.1              | 74.0           | 16.9           | 100         | 38        |
| 2571.757    | Z/H                       | 74.7              | -15.0            | 59.7              | 74.0           | 14.3           | 184         | 179       |
| 7284.493    | Z/V                       | 53.1              | -1.5             | 51.6              | 74.0           | 22.4           | 181         | 205       |
| 7942.664    | Z/H                       | 52.8              | -0.7             | 52.1              | 74.0           | 21.9           | 112         | 248       |

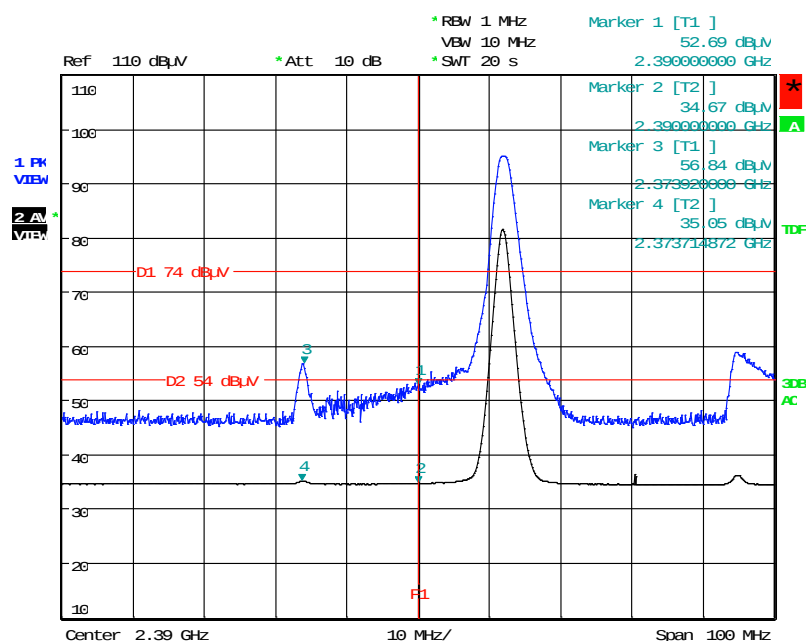
Note: Level PK = Reading PK + Factor

**Table 20: Radiated Emissions at Band Edge, Average and Peak Data, Horizontal and Vertical Antenna Orientations, Modes A (2402MHz) and C (2480MHz)**

| Operating Frequency [MHz] | EUT / Antenna Orientation | Level AV [dBμV/m] | Level PK [dBμV/m] | Limit AV [dBμV/m] | Limit PK [dBμV/m] | Margin AV [dB] | Margin PK [dB] |
|---------------------------|---------------------------|-------------------|-------------------|-------------------|-------------------|----------------|----------------|
| 2402                      | V / Y                     | 35.05             | 56.84             | 54.0              | 74.0              | 18.95          | 17.16          |
| 2480                      | V / Y                     | 41.34             | 63.62             | 54.0              | 74.0              | 12.66          | 10.38          |

Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.  
Average limit in dBμV/m is calculated as follows: Average limit =  $20 \times \log_{10}(500\mu\text{V/m})$ .  
Peak limit in dBμV/m is calculated as follows: Peak limit = Average limit + 20dB.

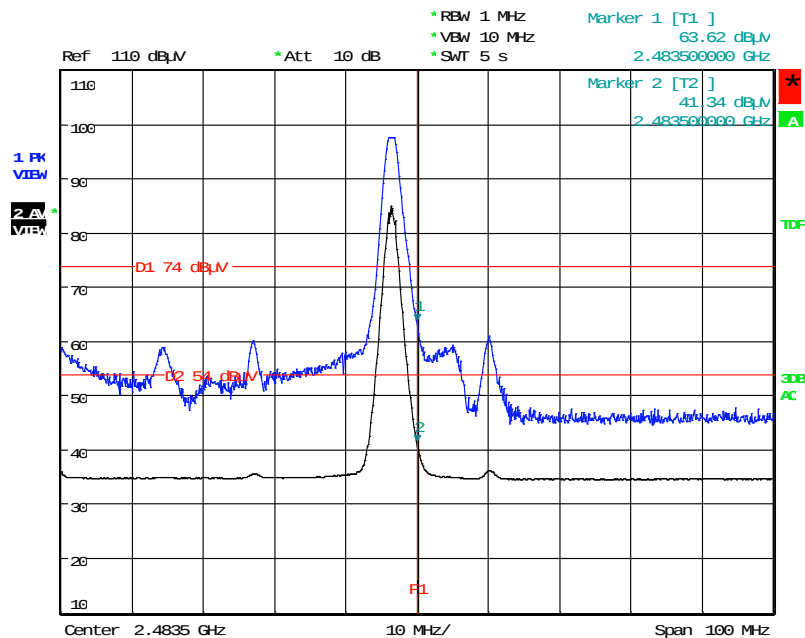
**Figure 14: Radiated Emissions at Band Edge, Spectral Diagram, Mode A (2402MHz)**



Date: 20.AUG.2017 10:25:07

Note: The upper trace shows the peak value and the lower trace shows the average value.

**Figure 15: Radiated Emissions at Band Edge, Spectral Diagram, Mode C (2480MHz)**



Date: 18.AUG.2017 16:24:25

Note: The upper trace shows the peak value and the lower trace shows the average value.

## **5.4 AC Power Line Conducted Measurements**

### **5.4.1 AC Power Line Conducted Emission of Transmitter**

**RESULT:**

**N/A**

Frequency range: 0.15 - 30MHz

Requirements:

FCC 15.207 and RSS-Gen 8.8

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC 15.207 and RSS-Gen 8.8 (Table 3).

Test procedure:

ANSI C63.10-2013

Note:

It is not applicable since the EUT is battery operated.

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