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## **RADIO TEST REPORT**

**REPORT NUMBER: M2004026-10**

**TEST STANDARD: SPOT CHECK EVALUATION TO**

**FCC PART 15 SUBPART C SECTION  
15.247**

**ISED RSS-247 SECTION 5.0**

**FOR BLUETOOTH LOW ENERGY**

**CLIENT: RUBICON GLOBAL PTY. LTD.**

**DEVICE: FERIT SOLAR NODE - LORA**

**MODEL: 81342**

**FCC ID: 2AWYU-81342**

**DATE OF ISSUE: 17 AUGUST 2020**

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Equipment Under Test (EUT): FERIT SOLAR NODE - LORA

## REVISION TABLE

| Version | Sec/Para Changed | Change Made               | Date       |
|---------|------------------|---------------------------|------------|
| 1       |                  | Initial issue of document | 17/08/2020 |
|         |                  |                           |            |
|         |                  |                           |            |
|         |                  |                           |            |

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## RADIO TEST REPROT

### FOR SPOT CHECK EVALUALTION

Device: FERIT SOLAR NODE - LORA  
Model: 81342  
Variant Model: FERIT SOLAR NODE – P400 (Model: 81343)  
Manufacturer: Rubicon Global Pty. Ltd.

Radio Module: Bluetooth Low Energy (Nrf52840)  
FCC ID: 2AWYU-81342

Tested for: Rubicon Global Pty. Ltd.  
Address: 1 Cato Street, Hawthorn East, 3123  
Phone Number: +61 3 9832 3031  
Contact: Paul Spooner  
Email: paul.spooner@rubiconwater.com

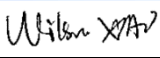
Test: Spot Check Evaluation for Bluetooth Low Energy (Nrf52840)

Standard: FCC Part 15, Subpart C, Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz  
  
ISED RSS-247, Issue 2, Section 5 Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

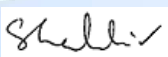
Result: The FERIT SOLAR NODE - LORA complied with the applicable requirements above standards. Refer to Report M2004026-10 for full details.

Test Date(s): 9 -15 and 18 June, 2020

Issue Date: 17 August 2020

Test Engineer(s):   
Wilson Xiao

Attestation: *I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*

Authorised Signatory:   
Shabbir Ahmed  
Lead Engineer - RF & Wireless

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## RADIO REPORT FOR SPOT CHECK EVALUATION

### 1 TEST SUMMARY

| Section | Description                                    | FCC           | ISED            | Test Mode*  | Result(s) |
|---------|------------------------------------------------|---------------|-----------------|-------------|-----------|
| 6.1     | Restricted Bands of Operation                  | §15.205       | §RSS-Gen 8.10   | Test Mode 1 | Complied  |
| 6.3     | Radiated emission limits; general requirements | §15.209       | §RSS-Gen 8.9    | Test Mode 1 | Complied  |
| 6.3     | Peak Output Power                              | §15.247(b)(3) | §RSS-247 5.4(d) | Test Mode 3 | Complied  |
| 6.4     | Out-of-Band/Spurious Emissions                 | §15.247(d)    | §RSS-247 5.5    | Test Mode 1 | Complied  |
| 6.5     | Band-Edge Emission Measurements                | §15.247(d)    | §RSS-247 5.5    | Test Mode 2 | Complied  |
| 6.6     | Power spectral density                         | §15.247(e)    | §RSS-247 5.2(b) | Test Mode 3 | Complied  |
| 6.7     | Maximum Permissible Exposure                   | §15.247(i)    | §RSS-102        | Test Mode 3 | Complied  |

\*Test modes were selected based on worst case performance as reported By EMC Technologies Pty. Ltd., Test Report No: M2004026-9, Date of Issue: 17/08/2020

| Test Mode 1             | Test Mode 2                                       | Test Mode 3                                                                 |
|-------------------------|---------------------------------------------------|-----------------------------------------------------------------------------|
| High Channel (2480 MHz) | Low Channel (2402 MHz)<br>High Channel (2480 MHz) | Low Channel (2402 MHz)<br>Mid Channel (2440 MHz)<br>High Channel (2480 MHz) |

### 2 TEST FACILITY

#### 2.1 General

EMC Technologies Pty Ltd is accredited by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies Pty Ltd has also been designated as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 and 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies Pty Ltd is also an ISED Canada recognized testing laboratory – **ISED company number: 3569B and CAB identifier number: AU0001.**

#### 2.2 Test Laboratory/Accreditations

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system similar to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A<sup>2</sup>LA).

All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation to ISO 17025 for both testing and calibration and ISO 17020 for Inspection – **Accreditation Number 5292.**

The current full scope of accreditation can be found on the NATA website: [www.nata.com.au](http://www.nata.com.au)

### 3 TEST EQUIPMENT CALIBRATION

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Keysight Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI) or in-house. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

| Equipment Type       | Make/Model/Serial Number                                                       | Last Cal. dd/mm/yyyy | Due Date dd/mm/yyyy | Cal. Interval        |
|----------------------|--------------------------------------------------------------------------------|----------------------|---------------------|----------------------|
| Chamber              | Frankonia SAC-3-2 (R-144)                                                      | 17/07/2017           | 17/07/2020          | 3 Year <sup>*1</sup> |
| EMI Receiver         | R&S ESU40<br>Sn: 100392 (R-140)                                                | 28/04/2020           | 28/04/2021          | 1 Year <sup>*2</sup> |
| Antennas             | EMCO 6502 Active Loop Antenna<br>Sn: 9311-2801 (A-231)                         | 16/11/2018           | 16/11/2020          | 2 Year <sup>*2</sup> |
|                      | SUNOL JB1<br>Sn: A061917 (A-425)                                               | 04/09/2019           | 04/09/2021          | 2 Year <sup>*2</sup> |
|                      | EMCO 3115 Horn Antenna<br>Sn: 8908-3282 (A-004)                                | 16/01/2019           | 16/01/2022          | 3 Year <sup>*1</sup> |
|                      | ETS-Lindgren 3160-09 Horn Antenna<br>Sn: 66032 (A-307)                         | 12/06/2018           | 12/06/2021          | 3 Year <sup>*2</sup> |
| Cables <sup>*3</sup> | Huber & Suhner Sucoflex 104A<br>Sn: 503055 (C-457)                             | 04/06/2020           | 04/06/2021          | 1 Year <sup>*1</sup> |
|                      | Huber & Suhner Sucoflex 104A<br>Sn: 800448 (C-520)                             | 04/06/2020           | 04/06/2021          | 1 Year <sup>*1</sup> |
|                      | Huber & Suhner Sucoflex 102<br>DC - 40 GHz Sucoflex 102<br>Sn: 27319/2 (C-273) | 09/07/2019           | 09/07/2020          | 1 Year <sup>*1</sup> |

Note \*1. Internal NATA calibration.

Note \*2. External NATA / A2LA calibration.

Note \*3. Cables are verified before measurements are taken.

### 4 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

|                            |                     |         |
|----------------------------|---------------------|---------|
| <b>Radiated Emissions:</b> | 9 kHz to 30 MHz     | ±4.1 dB |
|                            | 30 MHz to 300 MHz   | ±5.1 dB |
|                            | 300 MHz to 1000 MHz | ±4.7 dB |
|                            | 1 GHz to 18 GHz     | ±4.6 dB |
|                            | 18 GHz to 40 GHz    | ±4.6 dB |
| <b>Peak Output Power:</b>  |                     | ±1.5 dB |

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

#### Application of measurement uncertainty for this report:

The referenced uncertainty standard specifies that determination of compliance shall be based on measurements without taking into account measurement instrumentation uncertainty. However, the measurement uncertainty shall appear in the test report.

## 5 Device Details

(Information supplied by the Client)

FERIT SOLAR NODE – LORA is FERIT NODE – LORA inside a box w/ Solar panel, battery, and power control module.

FERIT SOLAR NODE – P400 is FERIT NODE – PICO inside a box w/ Solar panel, battery, and power control module.

### 5.1 EUT (Transmitter) Details

|                             |                                                                      |
|-----------------------------|----------------------------------------------------------------------|
| <b>Radio:</b>               | Bluetooth Low Energy (Nrf52840)                                      |
| <b>Manufacturer:</b>        | Nordic Semiconductor                                                 |
| <b>Frequency band:</b>      | 2400 - 2483.5 MHz                                                    |
| <b>Number of Channels:</b>  | 40                                                                   |
| <b>Operating Frequency:</b> | 2402 MHz to 2480 MHz<br>Low: 2402 MHz, Mid: 2440 MHz, High: 2480 MHz |
| <b>Nominal Bandwidth:</b>   | 2 MHz ( <i>declared by client</i> )                                  |
| <b>Modulation:</b>          | GFSK                                                                 |
| <b>Antenna:</b>             | PCB 2.4 GHz Inverted F Antenna                                       |
| <b>Antenna Peak Gain:</b>   | 3 dBi                                                                |

### 5.2 EUT (Host) Details

|                       |                                               |
|-----------------------|-----------------------------------------------|
| <b>Test Sample:</b>   | FERIT SOLAR NODE - LORA (VAR3)                |
| <b>Model:</b>         | 81342                                         |
| <b>Variant Model:</b> | FERIT SOLAR NODE – P400 (Model: 81343) (VAR4) |
| <b>Supply Rating:</b> | 12 V DC, 1.5A                                 |
| <b>Manufacturer:</b>  | Rubicon Global Pty. Ltd.                      |

### 5.3 Test Configuration

Testing was performed with the Bluetooth transceiver set to transmit continuously (100% Duty cycle) at Low channel (2402 MHz), Mid Channel (2440 MHz) and High Channel (2480 MHz).

The following commands were used to set up the transceiver via Putty:

“ bt cancel ”

“ bt start\_channel 2 ” / “ bt start\_channel 40 ” / “ bt start\_channel 80 ”

“ bt output\_power neg4dBm ”

“ bt start\_tx\_modulated\_carrier ”

### 5.4 Modifications

No modifications were required to achieve compliance.

### 5.5 Deviations from the Standard

Note any deviations to the standard

## 6 RESULTS

### 6.1 §15.205/ RSS-Gen 8.10/ RSS-247 3.3 Restricted Bands of Operation

The provisions of the §15.205 restricted bands of operation and §15.209 radiated emissions limits have been met, refer to section 6.4

### 6.2 §15.209 Radiated emission limits; general requirements

The provisions of the §15.205 restricted bands of operation and §15.209 radiated emissions limits have been met, refer to section 6.4

### 6.3 §15.247(b)(3)/ RSS-247 5.4(d) Peak Output Power

#### 6.3.1 Test Procedure

The field strength of the fundamental transmitted frequency was measured inside a semi-anechoic chamber compliant with ANSI C63.4: 2014 in accordance to ANSI C63.10: 2013 clause 11.9.1.1.

The EUT was positioned on a test turn-table and rotated through 360° to determine the highest emissions. The measurement antenna was also varied between 1 and 4 metres height. Different orientations of the EUT (x, y and z-axis) and measurement antenna polarisations (vertical and horizontal) were investigated to produce the highest emission EIRP.

All measurements were made at a distance of 3 metres.

#### 6.3.2 Limits

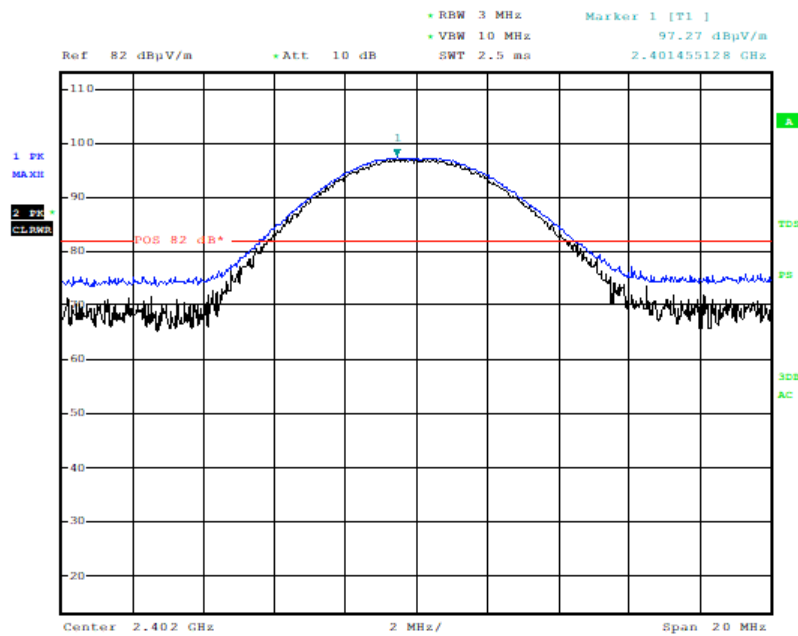
The maximum peak conducted output power at 2400-2483.5 MHz is 1 Watts or 30 dBm.

#### 6.3.3 Results

Table 6-1: Maximum Peak Power

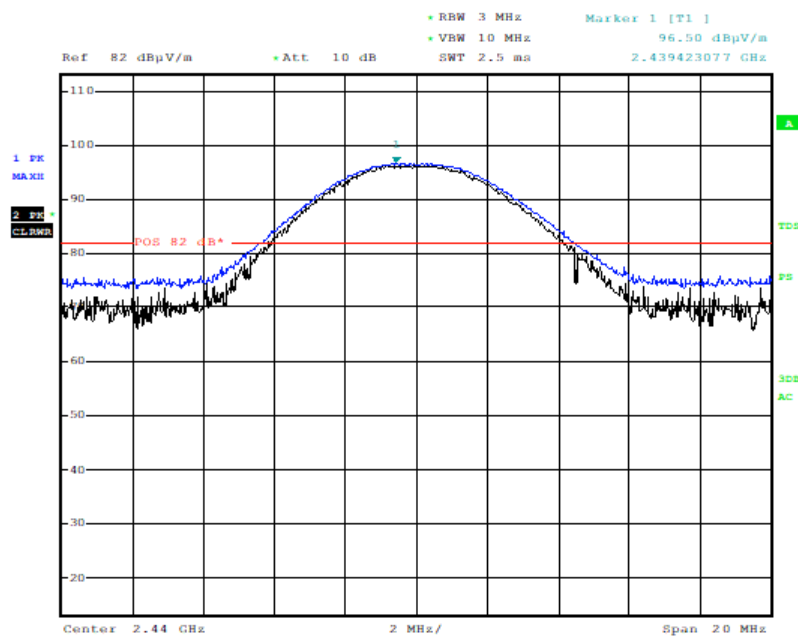
| Freq. [MHz] | E-Field@ 3 m dBuV/m | EIRP (dBm) | Antenna Gain (dBi) | Equivalent Conducted Output Power (dBm) | Limit (dBm) | Results  |
|-------------|---------------------|------------|--------------------|-----------------------------------------|-------------|----------|
| 2402        | 97.27               | 2.04       | 3                  | -1.04                                   | 30          | Complied |
| 2440        | 96.50               | 1.27       | 3                  | -2.27                                   | 30          | Complied |
| 2480        | 95.92               | 0.69       | 3                  | -3.69                                   | 30          | Complied |

The measured radiated field strength is converted to equivalent conducted output power for checking compliance (KDB 558074 D01 Section 3).



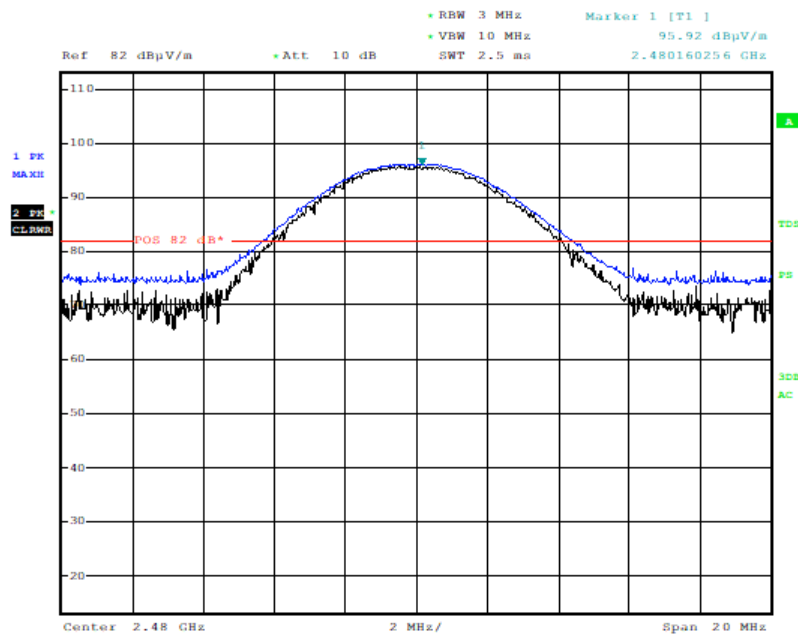
Date: 11. JUN. 2020 09:42:18

Graph 6-1: Max EIRP, 2402 MHz



Date: 11. JUN. 2020 09:35:49

Graph 6-2: Max EIRP, 2440 MHz



Date: 11 JUN 2020 09:31:18

Graph 6-3: Max EIRP, 2480 MHz

## 6.4 §15.247(d)/ RSS-247 5.5 Out-of-Band/Spurious Emissions

### 6.4.1 Test procedure

Radiated out-of-band/spurious emissions measurements were performed in a semi-anechoic chamber compliant with ANSI C63.4: 2014.

The test frequency range was sub-divided into smaller bands with the defined resolution bandwidths to permit reliable display and identification of emissions.

| Frequency range [MHz] | Measurement Bandwidth [kHz] | Measurement Distance [m] | Antenna                         |
|-----------------------|-----------------------------|--------------------------|---------------------------------|
| 0.009 to 0.150        | 0.2                         | 3                        | 0.6 metre loop antenna          |
| 0.150 to 30           | 9                           | 3                        |                                 |
| 30 to 1000            | 120                         | 3                        | Biconilog hybrid                |
| 1000 to 18 000        | 1000                        | 3                        | Standard gain or broadband horn |
| 18 000 to 40 000      | 1000                        | 1                        |                                 |

EUT was set at a height of 0.8 m for measurements below 1000 MHz and set at a height of 1.5 m for measurements above 1000 MHz.

The sample was slowly rotated with the spectrum analyser set to Max-Hold. This was performed for at least two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. For below 1000 MHz the emissions were measured with a Quasi-Peak detector, and for above 1000 MHz the emissions were measured with Peak and Average detectors.

EUT was investigated on all three axes (x, y, and z). Measurements on the worst axis are presented below.

The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical polarisations of the measurement antenna.

### 6.4.2 Evaluation of field strength

Field strengths were calculated automatically by the software using pre-stored calibration data. The method of calculation is shown below:

$$E = V + AF - G + L$$

Where:  $E$  = Radiated Field Strength in dBμV/m.

$V$  = EMI Receiver Voltage in dBμV/m.

$AF$  = Antenna Factor in dB (stored as a data array).

$G$  = Preamplifier Gain in dB (stored as a data array).

$L$  = Cable loss in dB (stored as a data array of Insertion Loss versus frequency).

### 6.4.3 Limits

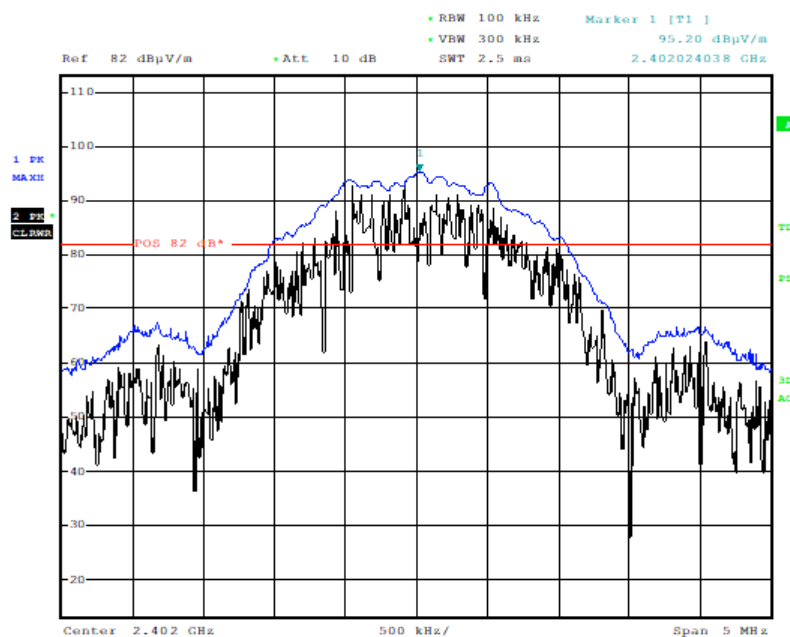
The limit applied is in accordance with the out-of-band/spurious emissions limit defined in §15.247(d).

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.

The in-band peak PSD in 100 kHz bandwidth were measured on all channels according to ANSI C63.10-2013 clause 11.11.2. The maximum PSD level was used to establish the limit for nonrestricted frequency bands. However, the general limits of §15.209 apply for the restricted bands of operation defined in §15.205.

Table 6-2: 100 kHz reference level measurement

| Freq.<br>(MHz) | Peak at 3 m<br>(dBμV/m) | Limit at 3m<br>(dBμV/m) |
|----------------|-------------------------|-------------------------|
| 2402           | 95.20                   | 75.20                   |

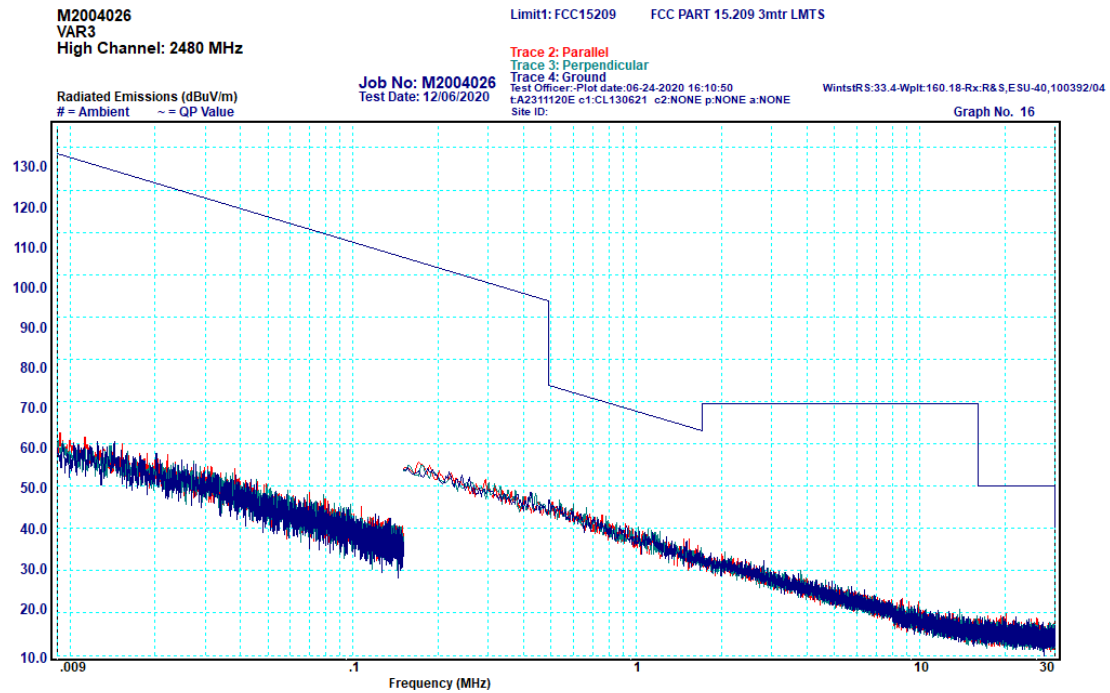


Date: 11. JUN. 2020 09:44:42

Graph 6-4: 100 kHz bandwidth reference level

#### 6.4.4 Transmitter Spurious Emissions: 9 kHz to 30 MHz

All emissions measured in the frequency band 9kHz - 30MHz complied with the requirements of the standard.

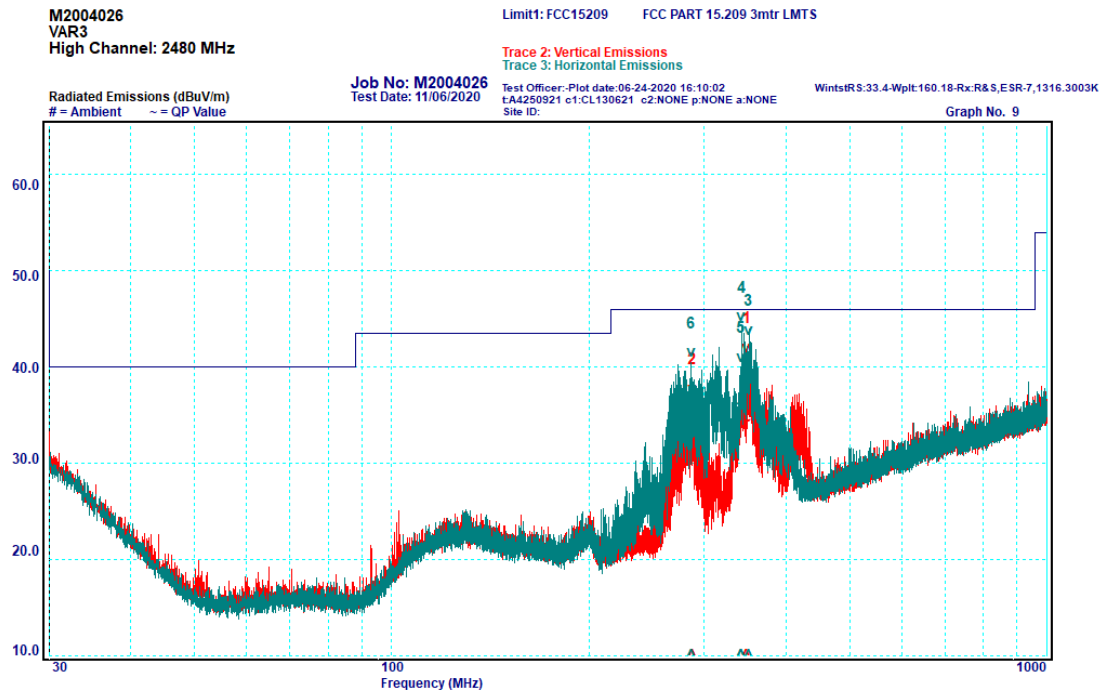


Graph 6-5: Transmitter Spurious Emissions, 9kHz – 30 MHz, 2480 MHz

No peaks were measured within 10 dB of the limit.

### 6.4.5 Transmitter Spurious Emissions: 30 - 1000 MHz

All emissions measured in the frequency band 30 – 1000 MHz complied with the requirements of the standard.



Graph 6-6: Transmitter Spurious Emissions, 30 – 1000 MHz, 2480 MHz

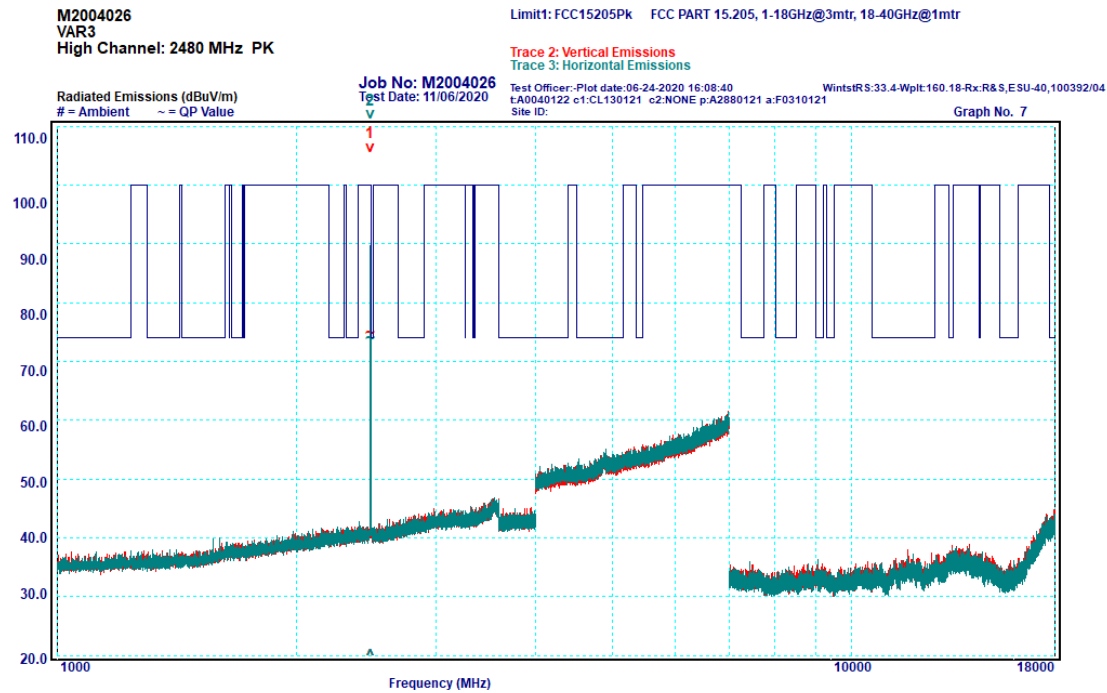
Table 6-3: Transmitter Spurious Emissions, 30 – 1000 MHz, 2480 MHz

| Peak | Frequency [MHz] | Polarisation | Quasi Peak     |                |             |
|------|-----------------|--------------|----------------|----------------|-------------|
|      |                 |              | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] |
| 1    | 348.54          | Vertical     | 34.3           | 46             | -11.7       |
| 2    | 287.72          | Vertical     | 31.4           | 46             | -14.6       |
| 3    | 350.76          | Horizontal   | 38.3           | 46             | -7.7        |
| 4    | 342.17          | Horizontal   | 36.1           | 46             | -9.9        |
| 5    | 341             | Horizontal   | 35             | 46             | -11         |
| 6    | 286.45          | Horizontal   | 34.6           | 46             | -11.4       |

### 6.4.6 Transmitter Spurious Emissions: 1 - 18 GHz

All emissions measured in the frequency band 1 – 18 GHz complied with the requirements of the standard.

#### Peak Measurement:



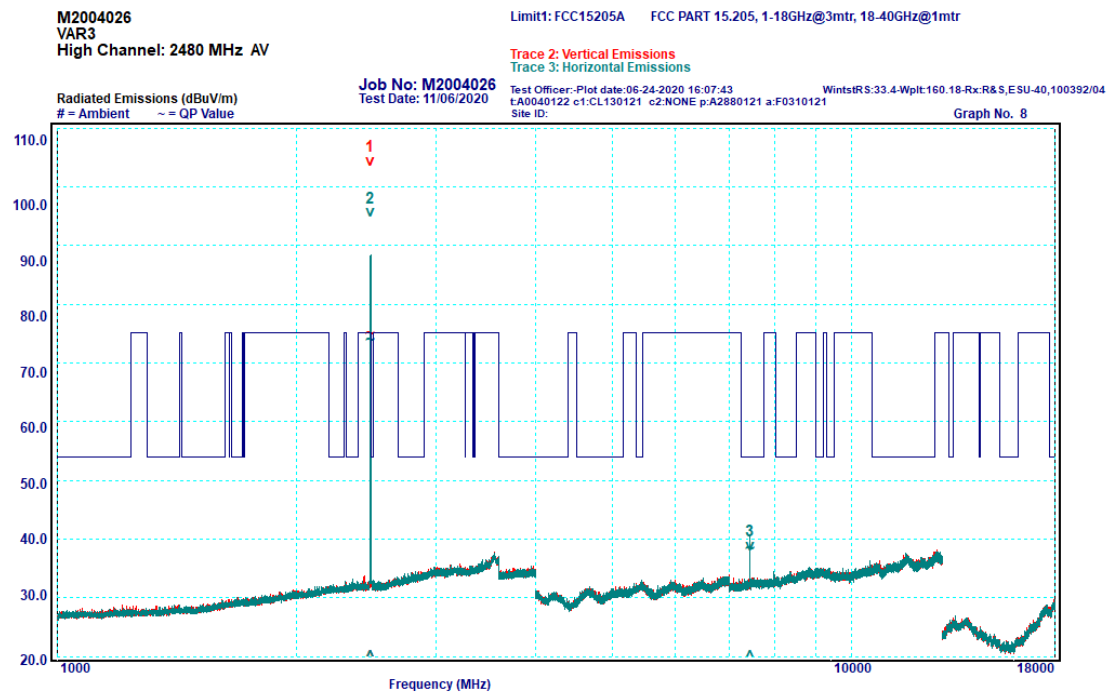
Graph 6-7: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Peak

Table 6-4: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Peak

| Peak | Frequency [MHz] | Polarisation | Peak           |                |             |
|------|-----------------|--------------|----------------|----------------|-------------|
|      |                 |              | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] |
| 1*   | 2480.02         | Vertical     | N/A            | N/A            | N/A         |
| 2*   | 2480.02         | Horizontal   | N/A            | N/A            | N/A         |

\*Peaks 1 and 2 are the fundamental transmissions and are not subject to the spurious emissions limit of the standard

## Average Measurement:



Graph 6-8: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Average

Table 6-5: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Average

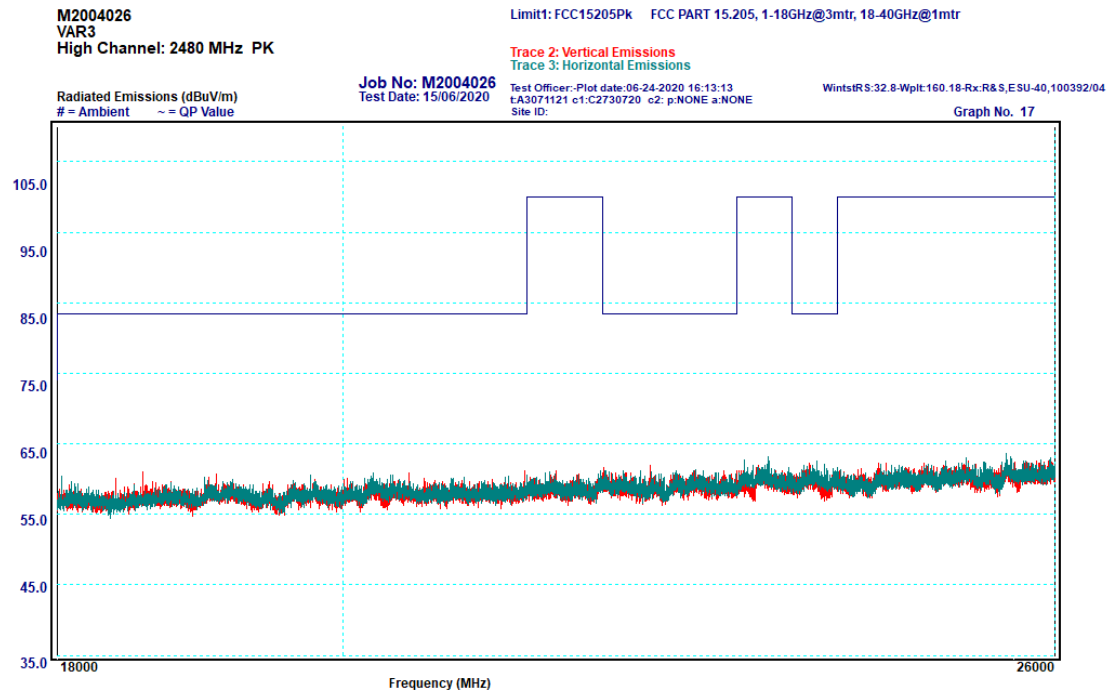
| Peak | Frequency [MHz] | Polarisation | Peak           |                |             |
|------|-----------------|--------------|----------------|----------------|-------------|
|      |                 |              | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] |
| 1*   | 2480.04         | Vertical     | N/A            | N/A            | N/A         |
| 2*   | 2479.98         | Vertical     | N/A            | N/A            | N/A         |
| 3    | 7440.01         | Horizontal   | 38.4           | 54             | -15.6       |

\*Peaks 1 and 2 are the fundamental transmissions and are not subject to the spurious emissions limit of the standard

### 6.4.7 Transmitter Spurious Emissions: 18 – 26 GHz

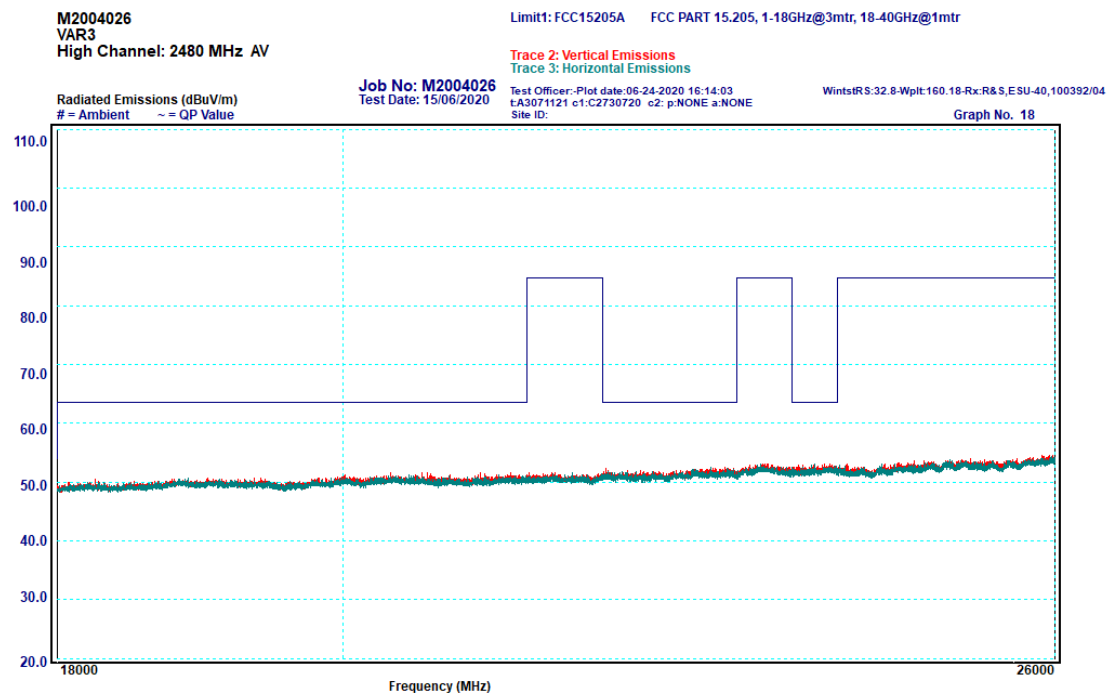
All emissions measured in the frequency band 18 – 26 GHz complied with the requirements of the standard.

#### Peak Measurement:



Graph 6-9: Transmitter Spurious Emissions, 18 – 26 GHz, 2480 MHz, Peak

#### Average Measurement:

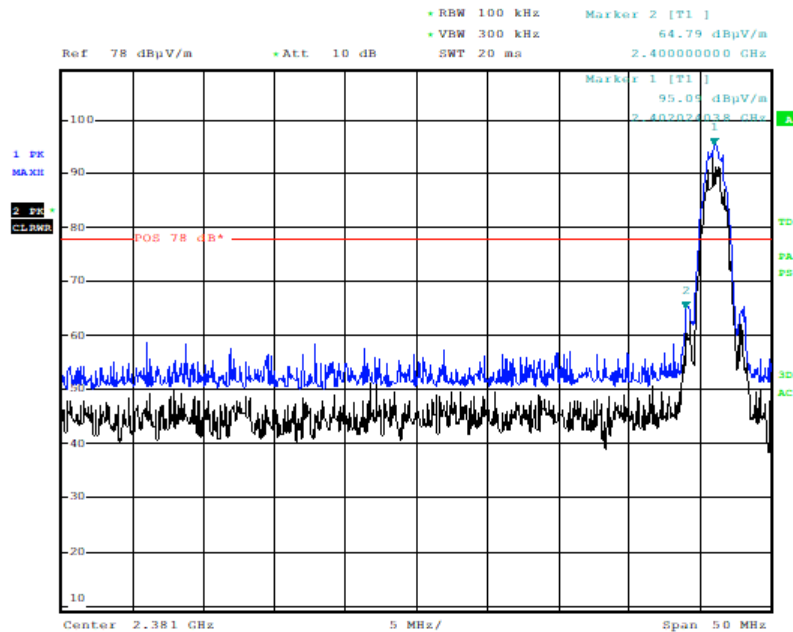


Graph 6-10: Transmitter Spurious Emissions, 18 – 26 GHz, 2480 MHz, Average

No peaks were measured within 10 dB of the limit.

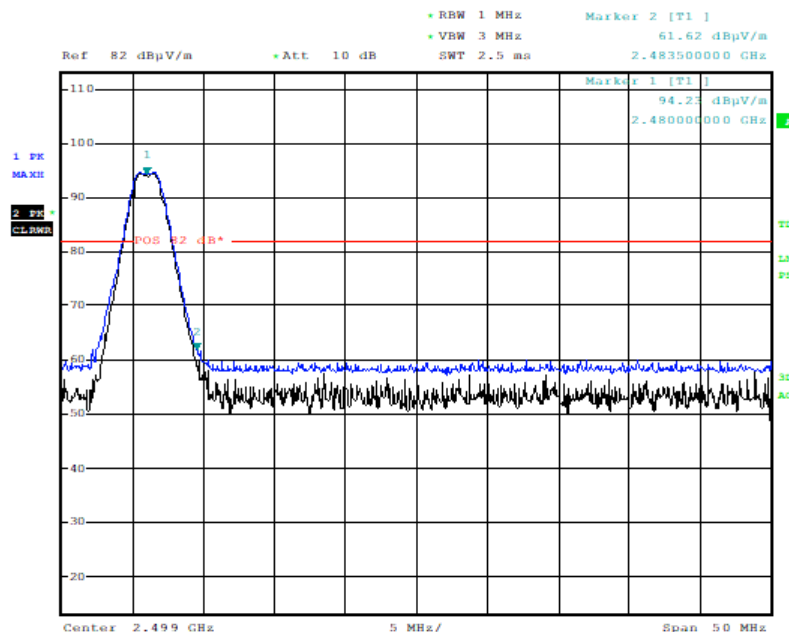
## 6.5 §15.247(d)/ §RSS-247 5.5 Band Edge Emission Measurements

Band-edge measurements were done using radiated in accordance to ANSI C63.10 clause 11.13.1 referring to clause 6.10.4 and 6.10.5. All emissions measured near the lower and higher band edge complied with the requirements of §15.247.



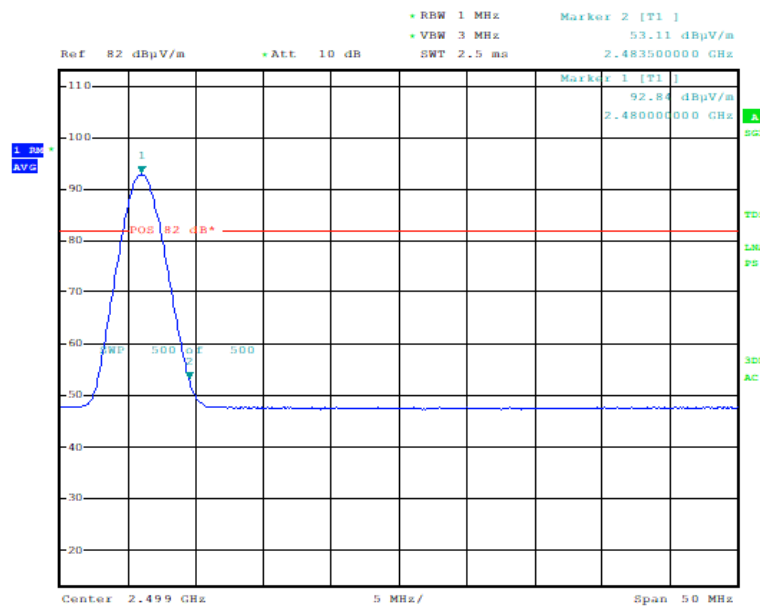
Date: 11.JUN.2020 09:46:25

Graph 6-11: Lower Band edge, Peak



Date: 11.JUN.2020 09:26:21

Graph 6-12: Upper Band edge, Peak



Date: 11. JUN. 2020 09:24:16

Graph 6-13: Upper Band edge, Average

Table 6-6: Band edge Measurement

| Measurement Type | Freq [MHz] | Measurement [dBuV/m] | Limit [dBuV/m] | Result   |
|------------------|------------|----------------------|----------------|----------|
| Peak             | 2400       | 64.79                | 75.2           | Complied |
| Peak             | 2483.5     | 61.62                | 74.0           | Complied |
| Average          | 2483.5     | 53.11                | 54.0           | Complied |

## 6.6 §15.247(e)/ RSS-247 5.2(b) Power Spectral Density

### 6.6.1 Test procedure

The tests were performed in accordance with ANSI C63.10: 2013 Clause 11.10 Maximum power spectral density level in the fundamental emissions.

Power spectral density measurements were made at 3 metres. The measurement resolution bandwidth was 3 kHz. The orientation of the EUT and the measurement antenna height and polarisation that produced the highest EIRP was used.

Power spectral density measurements were done at radiated method. The measurement resolution bandwidth was 3 kHz.

### 6.6.2 Limits

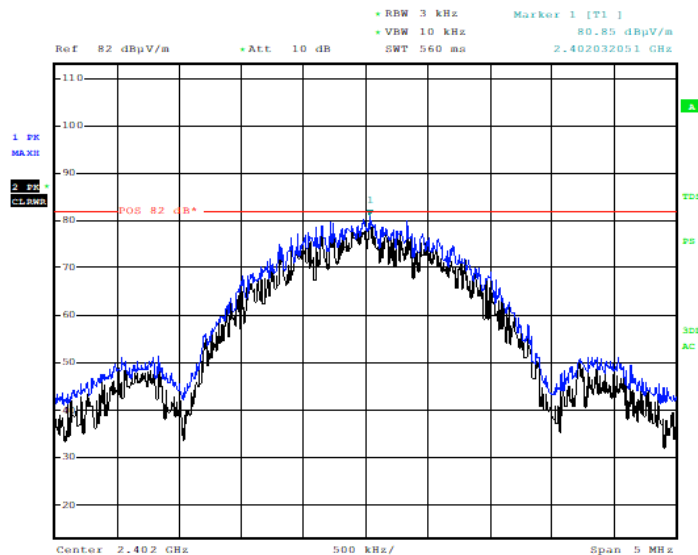
The maximum peak conducted power spectral density (PSD) is 8 dBm per 3 kHz.

### 6.6.3 Results

The measured radiated field strength is converted to equivalent conducted output power spectral density for checking compliance (KDB 558074 D01 Section 3).

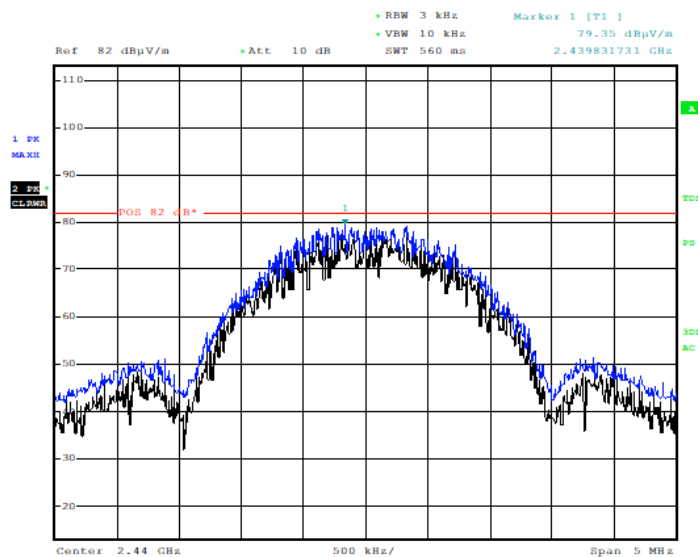
Table 6-7: Power spectral density

| Freq.<br>[MHz] | E-Field@ 3 m |        | Antenna<br>Gain<br>(dBi) | Equivalent<br>Conducted Output<br>PSD (dBm) | Limit<br>(dBm) | Results  |
|----------------|--------------|--------|--------------------------|---------------------------------------------|----------------|----------|
|                | dBuV/m       | dBm    |                          |                                             |                |          |
| 2402           | 80.85        | -14.38 | 3                        | -17.38                                      | 8              | Complied |
| 2440           | 79.35        | -15.88 | 3                        | -18.88                                      | 8              | Complied |
| 2480           | 79.46        | -15.77 | 3                        | -18.77                                      | 8              | Complied |



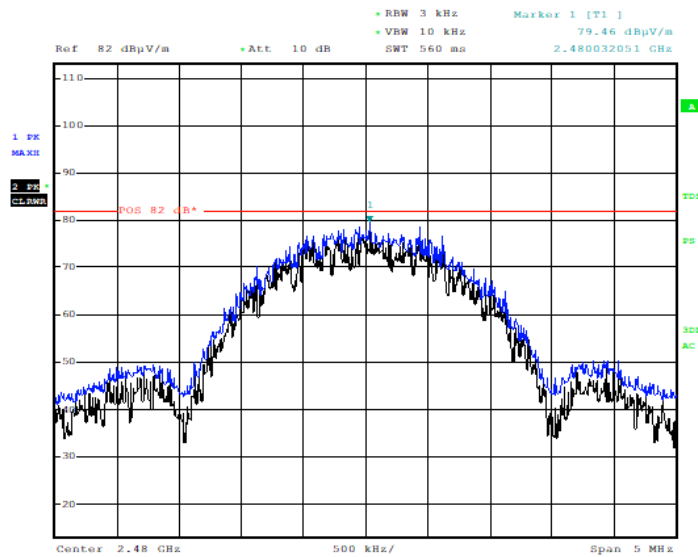
Date: 11. JUN. 2020 09:43:19

Graph 6-14: Radiated Power Spectral Density, 2402 MHz



Date: 11. JUN. 2020 09:35:08

Graph 6-15: Radiated Power Spectral Density, 2440 MHz



Date: 11.JUN.2020 09:33:29

Graph 6-16: Radiated Power Spectral Density, 2480 MHz

## 6.7 §15.247(i)/ §RSS-Gen 3.4/§RSS-102 Maximum Permissible Exposure

The EUT complied with the applicable maximum permissible exposure levels. Refer to EMC Technologies report M2004026-3 and M2004026-4.

**END OF REPORT**



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