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# RADIO REPORT FOR CERTIFICATION
# to
# 47 CFR Part 15 Subpart C (Section 15.247) and RSS-247 Issue 2, February 2017

| | |
|---|---|
| FCC ID: | X4K-WBSNT0102M |
| IC: | 8880A-WBSNT0102M |
| Device under Test / PMN: | Wireless WBS-1V1 |
| Model Number / HVIN: | WBS-1V1 |
| Tested For: | Automatic Technology Australia Pty. Ltd. |
| Report Number: | M160737-1R2 (superseding Report Number M160737-1R1) |
| Issue Date: | 04 July 2017 |

# RADIO REPORT
# FOR CERTIFICATION

## 47 CFR Part 15 Subpart C (Section 15.247) and
## RSS-247 Issue 2, February 2017

## CONTENTS

# RADIO REPORT FOR CERTIFICATION

**Issued by: EMC TECHNOLOGIES PTY. LTD.**
176 Harrick Road, Keilor Park, Victoria 3042, AUSTRALIA.
**Phone:** +61 3 9365 1000, **E-mail:** sales@emctech.com.au, **Web:** www.emctech.com.au
FCC registration number: 494713 and ISED Canada Company number: IC 3569B

| | |
|---|---|
| **Product / PMN:** | Wireless WBS-1V1 |
| **Model / HVIN:** | WBS-1V1 |
| **Manufacturer:** | Automatic Technology Australia Pty. Ltd. |
| **FCC ID:** | FCC ID X4K-WBSNT0102M |
| **IC:** | IC: 8880A-WBSNT0102M |

| | |
|---|---|
| **Tested for:** | Automatic Technology Australia Pty. Ltd. |
| **Address:** | 6-8 Fiveways Boulevard, Keysborough<br>Victoria 3173, AUSTRALIA |
| **Phone:** | +61 (0)3 9791 0200 |
| **Contact:** | Nikolai Klepikov |
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**Standards:**

**47 CFR Part 15 –** Radio Frequency Devices
**Subpart C –** Intentional Radiators
**Section 15.247 –** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

**RSS-247 Issue 2, February 2017** - *Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices*
**RSS-Gen Issue 4, November 2014** - *General Requirements for Compliance of Radio Apparatus*
**RSS-102 Issue 5, March 2015** - *Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)*

| | |
|---|---|
| **Test Dates:** | 20 April to 7th July 2017 |
| **Issue Date:** | 04 July 2017 |

**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.

**Test Engineer:**

Rob Weir
Wireless Certification Manager

**Authorised Signatory:**

Chris Zombolas
Technical Director

# RADIO REPORT FOR CERTIFICATION
# to
# 47 CFR Part 15 Subpart C (section 15.247) and
# RSS-247 Issue 2, February 2017

## 1.0 INTRODUCTION

Radio tests were performed on the Wireless WBS-1V1, Model (HVIN) WBS-1V1 in accordance with the applicable requirements of 47 CFR, Part 15 Subpart C – Section 15.247 and RSS-247 Issue 2 for a Digital Transmission System (DTS) operating within the band: 2400 MHz to 2483.5 MHz.

## 1.1 Test Procedure

Radio measurements were performed in accordance with the appropriate procedures of ANSI C63.10: 2013 and KDB 558074 v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

The measurement instrumentation conformed to the requirements of ANSI C63.2: 2009.

## 1.2 Summary of 47 CFR Part 15 Subpart C Results

| FCC Part 15 Subpart C | Test Performed | Results |
|---|---|---|
| **15.203** | Antenna requirement | **Complied** |
| **15.205** | Restricted bands of operation | **Complied** |
| **15.207** | Conducted limits | **Complied** |
| **15.209** | Radiated emissions limits; general requirements | **Complied** |
| **15.247 (a)** | DTS Bandwidth | **Complied – 864 kHz** |
| **15.247 (b)** | Peak Output Power | **Complied – 0.007 W** |
| **15.247 (c)** | Antenna Gain > 6 dBi | **Not Applicable.** Antenna gain < 6 dBi |
| **15.247 (d)** | Out of Band Emissions | **Complied** |
| **15.247 (e)** | Peak Power Spectral Density | **Complied – -10.4 dBm/3kHz** |
| **15.247 (f)** | Hybrid Systems | **Not Applicable.** Did not employ a hybrid system |
| **15.247 (g)** | Frequency Hopping System with Transmitter and Receiver | **Not Applicable.** Did not employ frequency hopping |
| **15.247 (h)** | Simultaneous occupancy of individual hopping frequencies | **Not Applicable.** Did not employ frequency hopping |
| **15.247 (i)** | Radio Frequency Hazard | **Complied** Evaluation exempt |
| | | |
| **2.1049** | Occupied Bandwidth | **1.870 MHz** |

## 1.3 Summary of RSS-247 Results

| RSS | Test Performed | Results |
|---|---|---|
| RSS-Gen (8.3) | Antenna requirement | **Complied** |
| RSS-Gen (8.8) | Conducted emissions limits | **Complied** |
| RSS-Gen (8.9) | Radiated Emission Limits (General requirements) | **Complied** |
| RSS-Gen (8.10) | Operation in restricted Band | **Complied** |
| RSS-247 (5.2(a)) | DTS Bandwidth | **Complied – 864 kHz** |
| RSS-247 (5.2(b)) | Power Spectral Density | **Complied – -10.4 dBm/3kHz** |
| RSS-247 (5.4(d)) | Peak Output Power | **Complied – 0.007 W** |
| RSS-247 (5.5) | Out of Band Emissions | **Complied** |
| RSS-Gen (3.2) RSS-102 | Radio Frequency Hazard | **Complied** Evaluation exempt |
| RSS-Gen (6.6) | Occupied Bandwidth | **1.870 MHz** |

## 1.4 Modifications by EMC Technologies

No modifications were performed.

# 2.0 GENERAL INFORMATION

(Information supplied by the Client)

## 2.1 EUT (Transmitter) Details

| | |
|---|---|
| **Product / PMN:** | Wireless WBS-1V1 |
| **Model / HVIN:** | WBS-1V1 |
| **Radio:** | Digital Transmission System |
| **Frequency Band:** | 2400 to 2483.5 MHz |
| **Frequency Range:** | 2405 to 2480 MHz |
| **Modulation:** | GFSK |
| **Emission Designator:** | F1D |
| **Number of Channels:** | 16 |
| **Antenna type and gain:** | ¼ wavelength monopole, soldered to PCB |
| **Rated Supply Voltage:** | 5 V DC (From Host) |

## 2.2 EUT (Host) Details

| | |
|---|---|
| **Host Marketing Name (HMN):** | Auto-Lock |
| **Manufacturer:** | Automatic Technology Australia Pty. Ltd. |

The host device is an automatic garage door opener. The radio communicates with a remote door lock allowing it to change state, locked or unlocked.

## 2.3 Test Configuration

The was configured to operate on each channel individual and transmit a modulated signal continuously. Flying leads with switches were connected to the device under test to change the transmitter parameters.

## 2.4 Test Facility

### 2.4.1 General

EMC Technologies Pty Ltd has also been accredited 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 indoor open are test site (iOATS) have been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen, Issue 8 - **Industry Canada iOATS number - IC 3569B**

Measurements in this report were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

### 2.4.2 NATA Accreditation

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 to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation ($A^2LA$).

EMC Technologies is accredited in Australia by the National Association of Testing Authorities (NATA). All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation.

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au

## 2.6 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent 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.

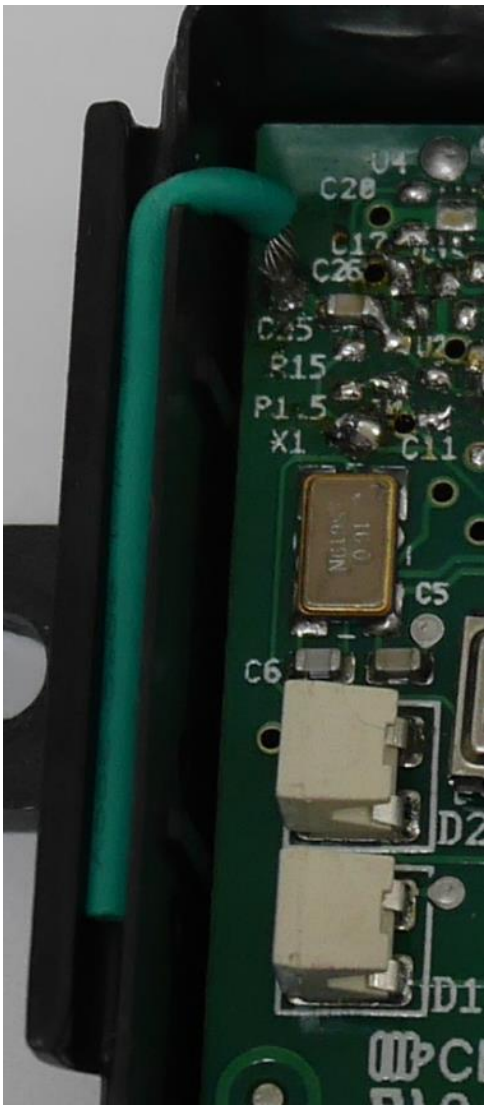
| Equipment Type | Make/Model/Serial Number | Last Cal. dd/mm/yyyy | Due Date dd/mm/yyyy | Cal. Interval |
|---|---|---|---|---|
| **Chamber** | Frankonia SAC-10-2<br>(R-139) | 22/03/2017 | 22/03/2018 | 1 Year, *1 |
| | | | | |
| **EMI Receiver** | R&S ESW26<br>2 Hz – 26.5 GHz<br>Sn: 101306 (R-143) | 31/03/2017 | 31/03/2018 | 1 Year, *2 |
| | R&S ESU40<br>20 Hz – 40 GHz<br>Sn: 100392 (R-140) | 23/02/2017 | 23/02/2018 | 1 Year, *2 |
| | R&S ESCI<br>9 kHz – 3 GHz<br>Sn: 100011 (R-028) | 25/05/2016 | 25/05/2017 | 1 Year, *2, *3 |
| | | | | |
| **Antennas** | EMCO 6502 Active Loop<br>9 kHz – 30 MHz<br>Sn. 9311-2801 (A-231) | 20/07/2015 | 20/07/2018 | 3 Year, *2 |
| | SUNOL JB6 Biconilog<br>30 – 6000 MHz<br>Sn: A012312 (A-363) | 26/05/2016 | 26/05/2018 | 2 Year, *2 |
| | EMCO 3115 Double Ridge Horn<br>1 – 18 GHz<br>Sn: 8908-3282 (A-004) | 15/07/2016 | 15/07/2019 | 3 Year, *1 |
| | ETS-Lindgren 3160-09 Std Gain Horn<br>18 – 26.5 GHz<br>Sn: 66032 (A-307) | 31/05/2016 | 31/05/2019 | 3 Year, *1 |
| | | | | |
| **Cables** | Room 12 inbuilt cable Panel 1 to 10 m<br>(C-422) | 31/05/2017 | 31/05/2018 | 1 Year, *1 |
| | Room 12 inbuilt cable Panel 1 to 3 m<br>(C-421) | 31/05/2017 | 31/05/2018 | 1 Year, *1 |
| | Room 12 Antenna cable<br>(C-437) | 31/05/2017 | 31/05/2018 | 1 Year, *1 |
| | Sucoflex 104 Huber & Suhner<br>18 GHz, 5 m cable (C-337) | 03/01/2017 | 03/01/2018 | 1 Year, *1 |
| | Sucoflex 102 Huber & Suhner<br>40 GHz, 3 m cable (C-273) | 04/01/2017 | 04/01/2018 | 1 Year, *1 |
| | | | | |
| **Pre-amplifier** | PRA1G2-35B Radio Technology<br>30 - 1000 MHz (A-098) | 15/07/2016 | 15/07/2017 | 1 Year, *1, |
| | SG18-B3015 Electronic Development<br>Sales 1-18 GHz (A-288) | 03/08/2016 | 03/08/2017 | 1 Year, *1 |

Note *1. Internal NATA calibration.
Note *2. External NATA / A2LA calibration
Note *3. Testing performed with this equipment was performed when the equipment was within valid calibration period.

# 3.0 TEST RESULTS

## 3.1 §15.203/RSS-Gen 8.3 Antenna Requirement

The antenna was integral to the device ensuring that it could not be replaced. A ¼ wavelength monopole antenna was used and it was soldered directly onto the circuit board.



## 3.2 §15.207/RSS-Gen 8.8 Conducted Limits

### 3.2.1 Test Procedure

The arrangement specified in ANSI C63.10: 2013 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2: 2009 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

### 3.2.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

### 3.2.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$V_{EMI} = V_{Rx} + L$$

Where:
$V_{EMI}$ = The Measured EMI voltage in dBµV to be compared to the limit.
$V_{Rx}$ = The Voltage in dBµV read directly at the EMI receiver.
$L$ = The insertion loss in dB of the LISN, cables and transient Limiter.

### 3.2.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph was subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

### 3.2.5 Test Climatic Conditions

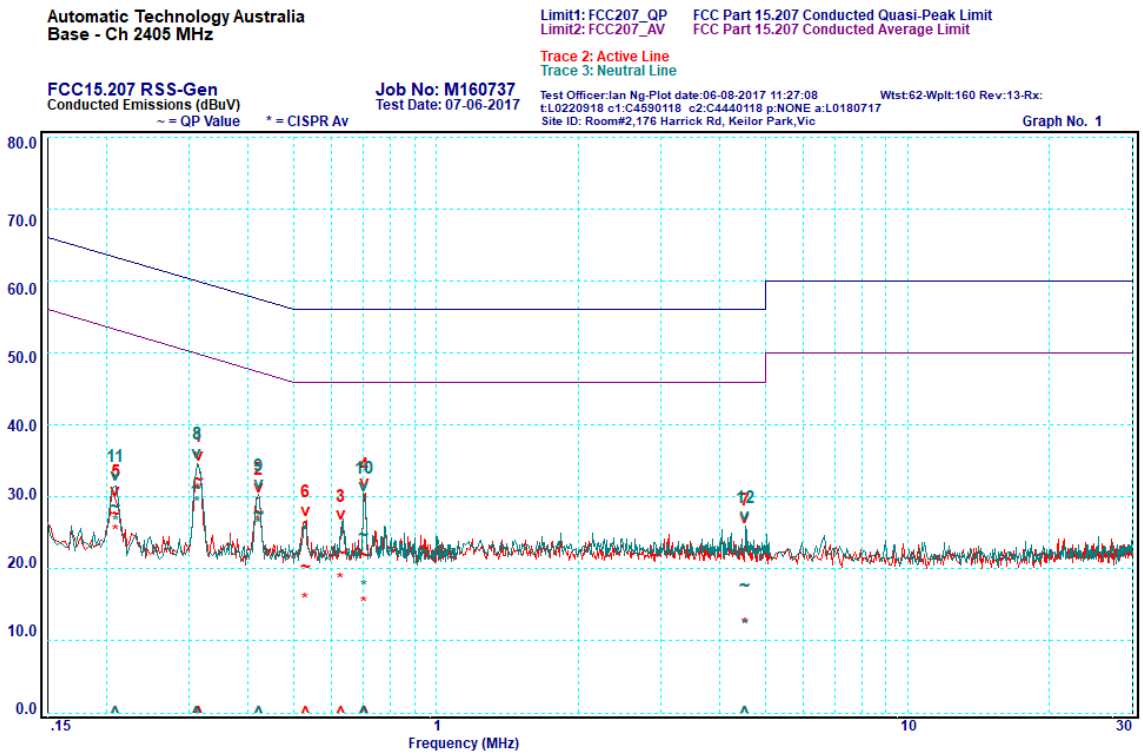
| | |
|---|---|
| Shielded Room Temperature: | 17°C |
| Relative Humidity: | 52% |

### 3.2.6 Conclusion

The sample complied with the applicable spurious emissions of §15.207 and RSS-Gen 8.8. Refer to the following graphs for the results.

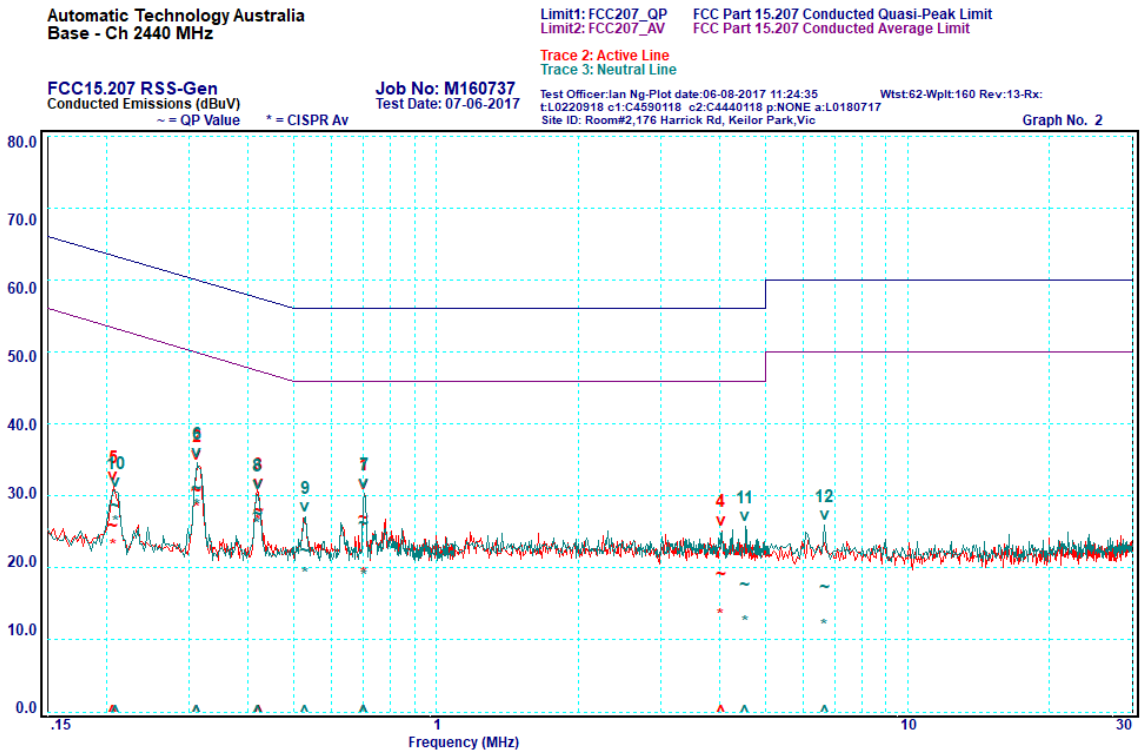
## 3.2.7 Results of Conducted Emission Measurements

### Channel 2405 MHz, 0.15 - 30 MHz



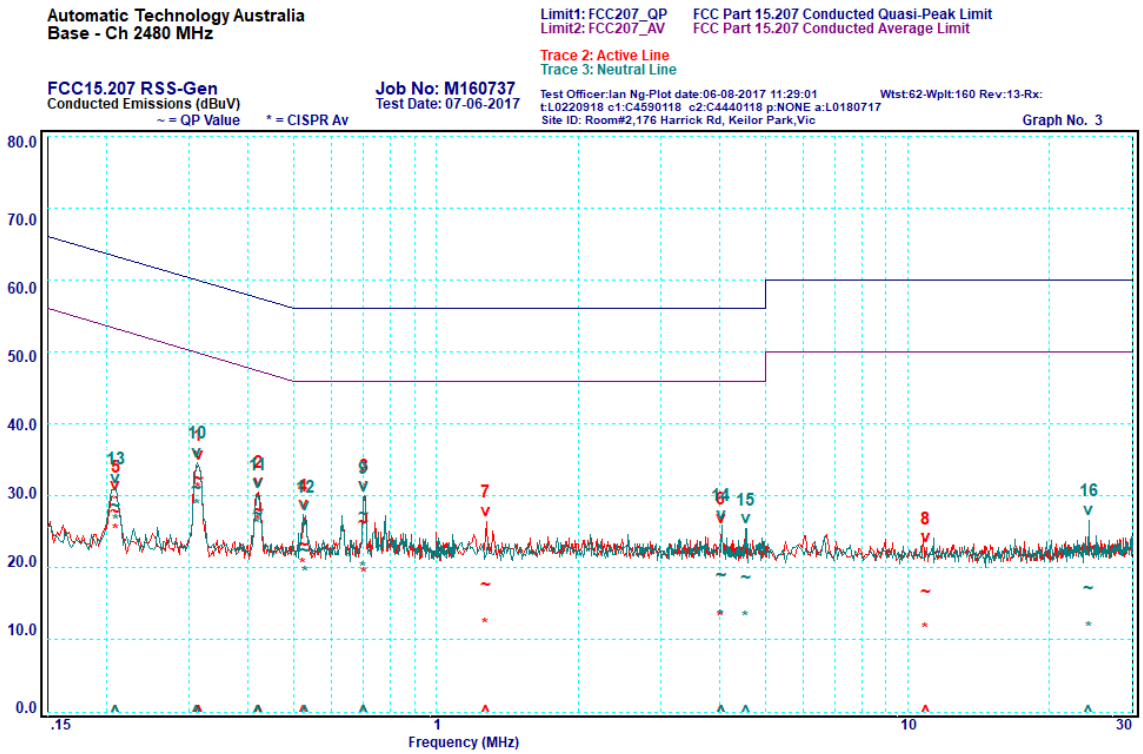

| Peak | Frequency [MHz] | Line | Quasi-Peak | | | Average | | |
|---|---|---|---|---|---|---|---|---|
| | | | Level [dBµV] | Limit [dBµV] | Margin [±dB] | Level [dBµV] | Limit [dBµV] | Margin [±dB] |
| 1 | 0.314 | Active | 32.3 | 59.9 | -27.6 | 30.8 | 49.9 | -19.1 |
| 2 | 0.421 | Active | 27.8 | 57.4 | -29.6 | 26.4 | 47.4 | -21.0 |
| 3 | 0.630 | Active | 22.2 | 56.0 | -33.8 | 18.5 | 46.0 | -27.5 |
| 4 | 0.706 | Active | 21.8 | 56.0 | -34.2 | 15.1 | 46.0 | -30.9 |
| 5 | 0.209 | Active | 27.6 | 63.2 | -35.6 | 25.1 | 53.2 | -28.1 |
| 6 | 0.530 | Active | 20.2 | 56.0 | -35.8 | 15.6 | 46.0 | -30.4 |
| 7 | 4.526 | Active | 17.5 | 56.0 | -38.5 | 12.2 | 46.0 | -33.8 |
| 8 | 0.312 | Neutral | 31.3 | 59.9 | -28.6 | 29.1 | 49.9 | -20.8 |
| 9 | 0.421 | Neutral | 27.5 | 57.4 | -29.9 | 26.1 | 47.4 | -21.3 |
| 10 | 0.703 | Neutral | 24.7 | 56.0 | -31.3 | 17.4 | 46.0 | -28.6 |
| 11 | 0.209 | Neutral | 28.6 | 63.2 | -34.6 | 26.4 | 53.2 | -26.8 |
| 12 | 4.526 | Neutral | 17.6 | 56.0 | -38.4 | 12.0 | 46.0 | -34.0 |

**Channel 2440 MHz, 0.15 - 30 MHz**




| Peak | Frequency [MHz] | Line | Quasi-Peak | | | Average | | |
|---|---|---|---|---|---|---|---|---|
| | | | Level [dBµV] | Limit [dBµV] | Margin [±dB] | Level [dBµV] | Limit [dBµV] | Margin [±dB] |
| 1 | 0.703 | Active | 27.0 | 56.0 | -29.0 | 19.0 | 46.0 | -27.0 |
| 2 | 0.312 | Active | 30.8 | 59.9 | -29.1 | 28.3 | 49.9 | -21.6 |
| 3 | 0.421 | Active | 27.9 | 57.4 | -29.5 | 26.5 | 47.4 | -20.9 |
| 4 | 4.024 | Active | 19.1 | 56.0 | -36.9 | 13.3 | 46.0 | -32.7 |
| 5 | 0.207 | Active | 25.9 | 63.3 | -37.4 | 23.0 | 53.3 | -30.3 |
| 6 | 0.312 | Neutral | 31.1 | 59.9 | -28.8 | 28.6 | 49.9 | -21.3 |
| 7 | 0.703 | Neutral | 26.1 | 56.0 | -29.9 | 18.8 | 46.0 | -27.2 |
| 8 | 0.418 | Neutral | 27.4 | 57.5 | -30.1 | 25.9 | 47.5 | -21.6 |
| 9 | 0.528 | Neutral | 22.4 | 56.0 | -33.6 | 19.1 | 46.0 | -26.9 |
| 10 | 0.209 | Neutral | 28.6 | 63.2 | -34.6 | 26.3 | 53.2 | -26.9 |
| 11 | 4.526 | Neutral | 17.6 | 56.0 | -38.4 | 12.4 | 46.0 | -33.6 |
| 12 | 6.660 | Neutral | 17.2 | 60.0 | -42.8 | 11.8 | 50.0 | -38.2 |

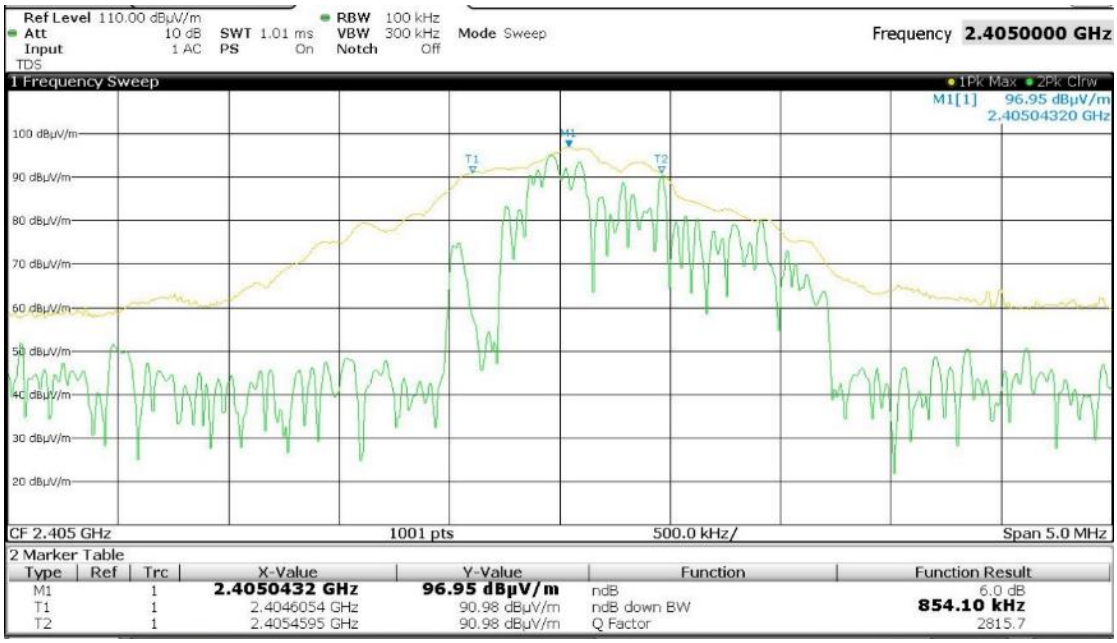
**Channel 2480 MHz, 0.15 - 30 MHz**



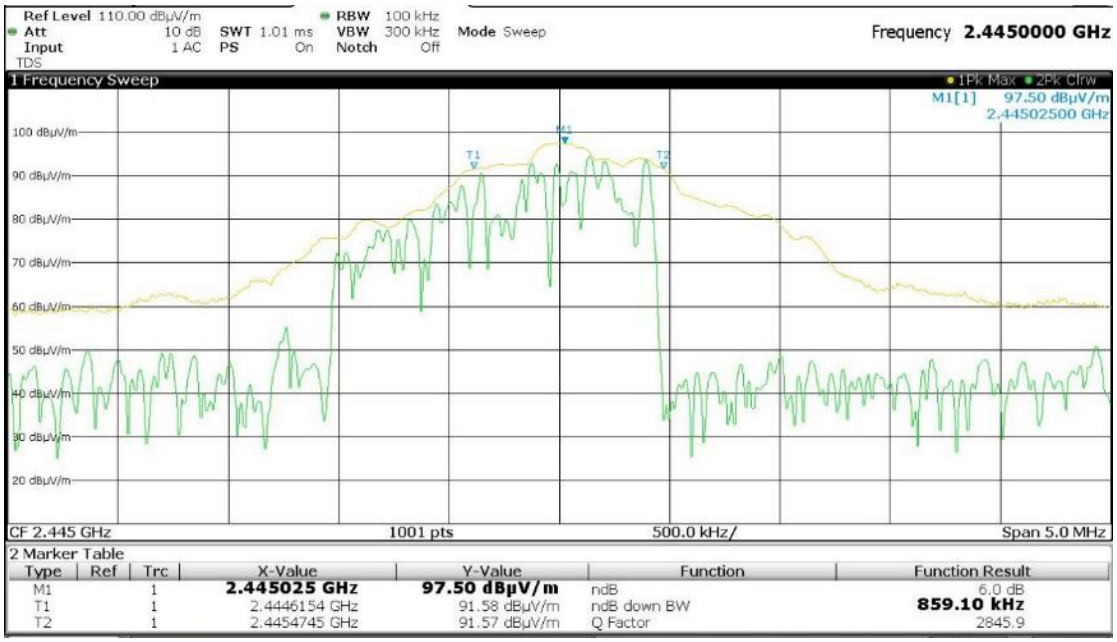

| Peak | Frequency [MHz] | Line | Quasi-Peak | | | Average | | |
|---|---|---|---|---|---|---|---|---|
| | | | Level [dBµV] | Limit [dBµV] | Margin [±dB] | Level [dBµV] | Limit [dBµV] | Margin [±dB] |
| 1 | 0.314 | Active | 32.4 | 59.9 | -27.5 | 30.9 | 49.9 | -19.0 |
| 2 | 0.421 | Active | 27.9 | 57.4 | -29.5 | 26.5 | 47.4 | -20.9 |
| 3 | 0.703 | Active | 26.3 | 56.0 | -29.7 | 19.0 | 46.0 | -27.0 |
| 4 | 0.523 | Active | 23.2 | 56.0 | -32.8 | 20.4 | 46.0 | -25.6 |
| 5 | 0.209 | Active | 27.7 | 63.2 | -35.5 | 25.2 | 53.2 | -28.0 |
| 6 | 4.024 | Active | 18.9 | 56.0 | -37.1 | 13.0 | 46.0 | -33.0 |
| 7 | 1.277 | Active | 17.6 | 56.0 | -38.4 | 12.0 | 46.0 | -34.0 |
| 8 | 10.93 | Active | 16.7 | 60.0 | -43.3 | 11.3 | 50.0 | -38.7 |
| 9 | 0.701 | Neutral | 27.4 | 56.0 | -28.6 | 19.9 | 46.0 | -26.1 |
| 10 | 0.312 | Neutral | 31.1 | 59.9 | -28.8 | 28.6 | 49.9 | -21.3 |
| 11 | 0.418 | Neutral | 27.4 | 57.5 | -30.1 | 25.9 | 47.5 | -21.6 |
| 12 | 0.528 | Neutral | 22.4 | 56.0 | -33.6 | 19.2 | 46.0 | -26.8 |
| 13 | 0.209 | Neutral | 28.6 | 63.2 | -34.6 | 26.4 | 53.2 | -26.8 |
| 14 | 4.024 | Neutral | 18.9 | 56.0 | -37.1 | 13.2 | 46.0 | -32.8 |
| 15 | 4.536 | Neutral | 18.5 | 56.0 | -37.5 | 13.0 | 46.0 | -33.0 |
| 16 | 24.19 | Neutral | 17.0 | 60.0 | -43.0 | 11.6 | 50.0 | -38.4 |

## 3.3 §15.247(a)/RSS-247 5.2(a) DTS Bandwidth

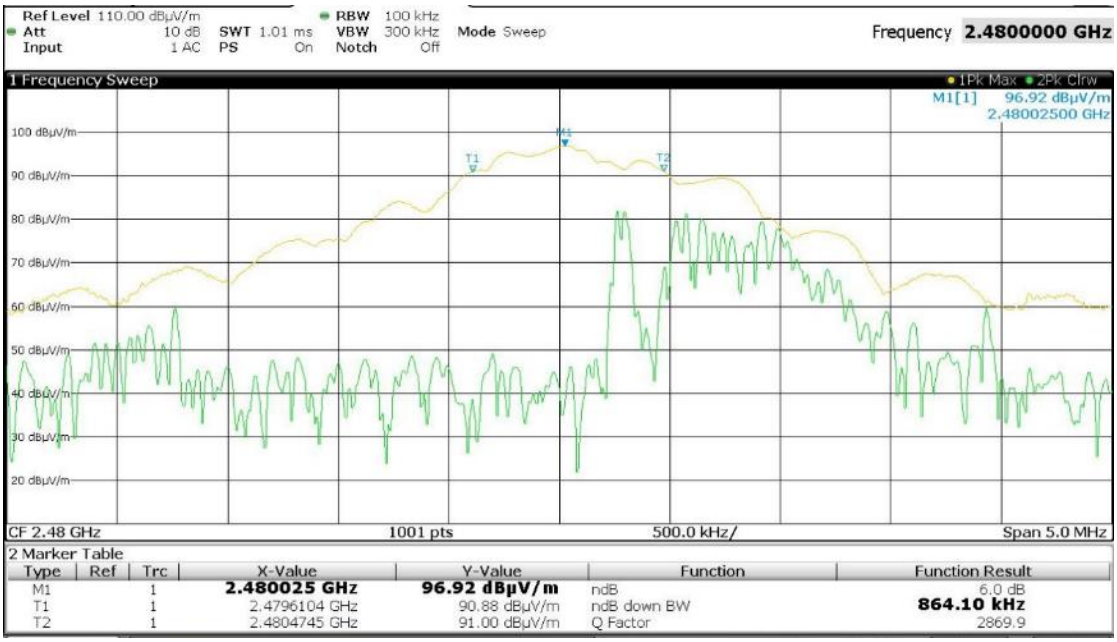
In the band 2400.0 – 2483.5 MHz, the minimum 6 dB bandwidth is to be at least 500 kHz. The 6 dB bandwidth was measured while the device was transmitting with typical modulation applied. The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised when measuring the bandwidth.




Channel 2405 MHz




Channel 2445 MHz



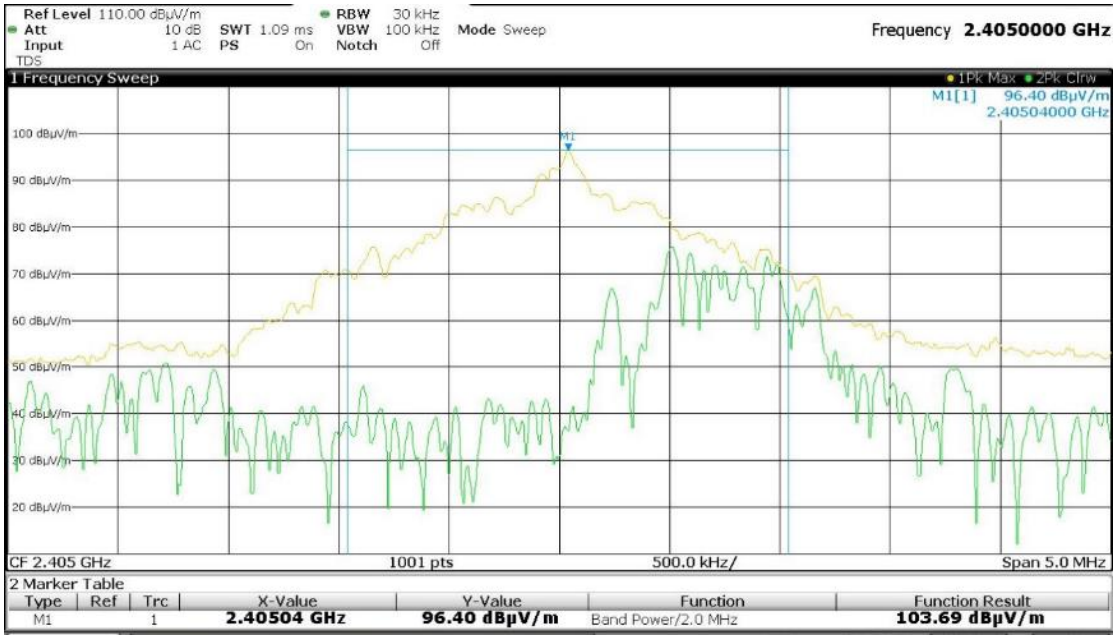

Channel 2480 MHz

**Results:**

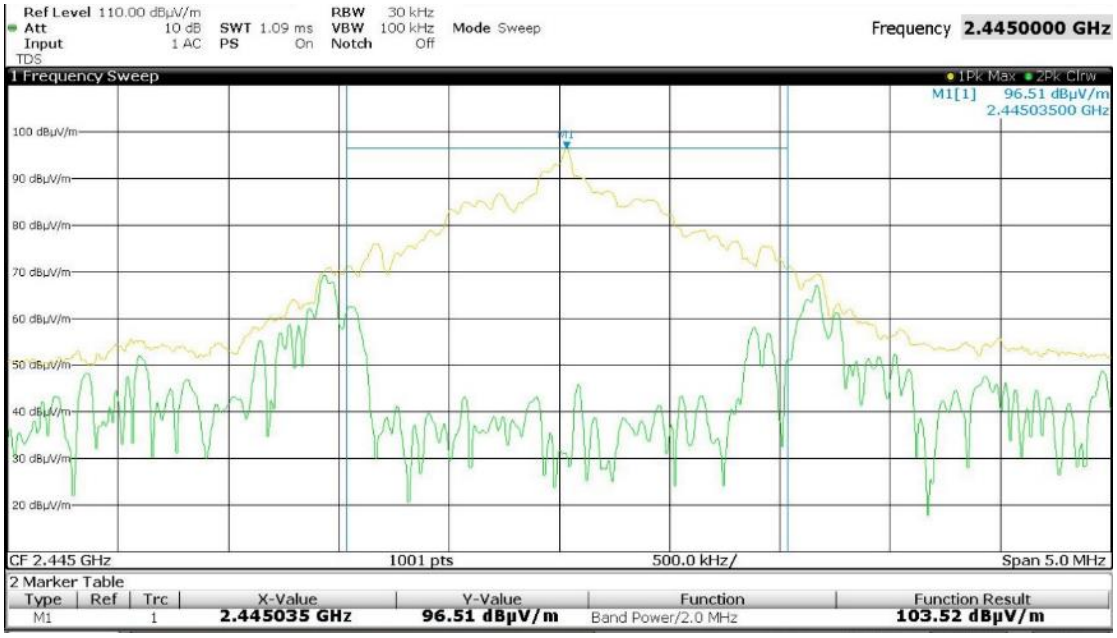
| Centre Frequency [MHz] | Measured 6 dB Bandwidth [kHz] | Limit [kHz] | Result |
|---|---|---|---|
| 2405 | 854 | > 500 | Complied |
| 2445 | 859 | > 500 | Complied |
| 2480 | 864 | > 500 | Complied |

## 3.4 §15.247(b)/RSS-247 5.4(d) Peak Output power

Testing was performed in a semi-anechoic chamber at a distance of 3 metres. Different configurations of EUT and antenna polarization were investigated to produce highest emission EIRP and the EUT was set to transmit in continuous transmission mode.




Channel 2405 MHz




Channel 2445 MHz


Channel 2480 MHz

**Results:**

| Frequency (MHz) | Measured EIRP | | | EIRP Limit (W) | Conducted Limit (W) | Margin (W) | Result |
|---|---|---|---|---|---|---|---|
| | (dBµV/m) | (dBm) | (W) | | | | |
| 2405 | 103.7 | 8.5 | 0.007 | 4 | 1 | 0.993 | Complied |
| 2445 | 103.5 | 8.3 | 0.007 | 4 | 1 | 0.993 | Complied |
| 2480 | 103.3 | 8.1 | 0.006 | 4 | 1 | 0.994 | Complied |

The radiated power was compared directly to the conducted power limit as a worse case condition. As the measured EIRP did not exceed the conducted limit the antenna gain was not considered.

The antenna gain of an ideal ¼ wave monopole is 5.1 dBi and therefore the gain of the sample's antenna would not exceed 6 dBi.

Electric field to power conversion:

$$E = 20log\left(\frac{\sqrt{30P}}{d}\right) + 120$$

Where:
$E$ = electric field strength (dBµV/m)
$P$ = EIRP in Watts
$d$ = measurement distance in metres

## 3.5 §15.205/RSS-Gen 8.10 Restricted Bands of Operation

The restricted band limits were applied across the applicable spectrum and therefore complied with the restricted band requirements.

## 3.6 §15.209/RSS-Gen 8.9 Radiated emission limits; general requirements

The limits given in §15.247 and RSS-247 applied, however attenuation below the general levels was not required.

## 3.7 §15.247(d)/RSS-247 5.5 Out of Band Emissions

### 3.7.1 Radiated Spurious Measurements

Radiated spurious emission 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 sufficient frequency resolution 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 | 10 | 0.6 metre loop antenna |
| 0.150 to 30 | 9 | 10 | |
| 30 to 1000 | 120 | 10 | Biconilog hybrid |
| 1000 to 18 000 | 1000 | 3 | Standard gain or broad band horns |
| 18 000 to 40 000 | 1000 | 1 | |

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. Devices design for a fixed position were tested in that position, portable devices were tested in three orthogonal orientations.

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 antenna polarisations.

**Calculation of field strength**

The field strength was calculated automatically by 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. (measured value)
**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)

**Average value of pulsed emissions**

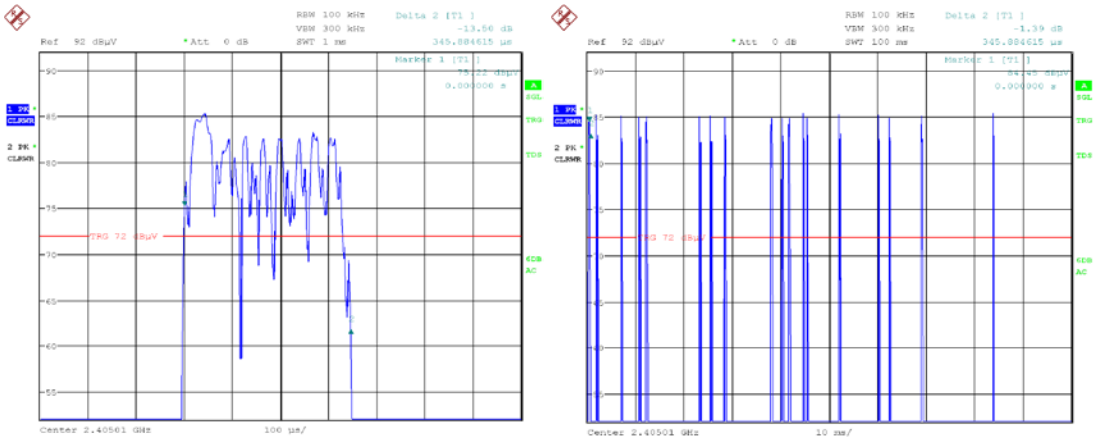
The transmitted signal was pulsed. The following duty cycle correction was applied to the peak levels to calculate average emissions at frequcncies above 1 GHz.

$$\delta\ (dB) = 20\log(\Delta)$$

$\delta$ = duty cycle correction factor
Δ = duty cycle

Duty cycle:

On time = 350 µs
Pulses in 100 ms = 18
Δ = 0.063



Duty cycle correction:

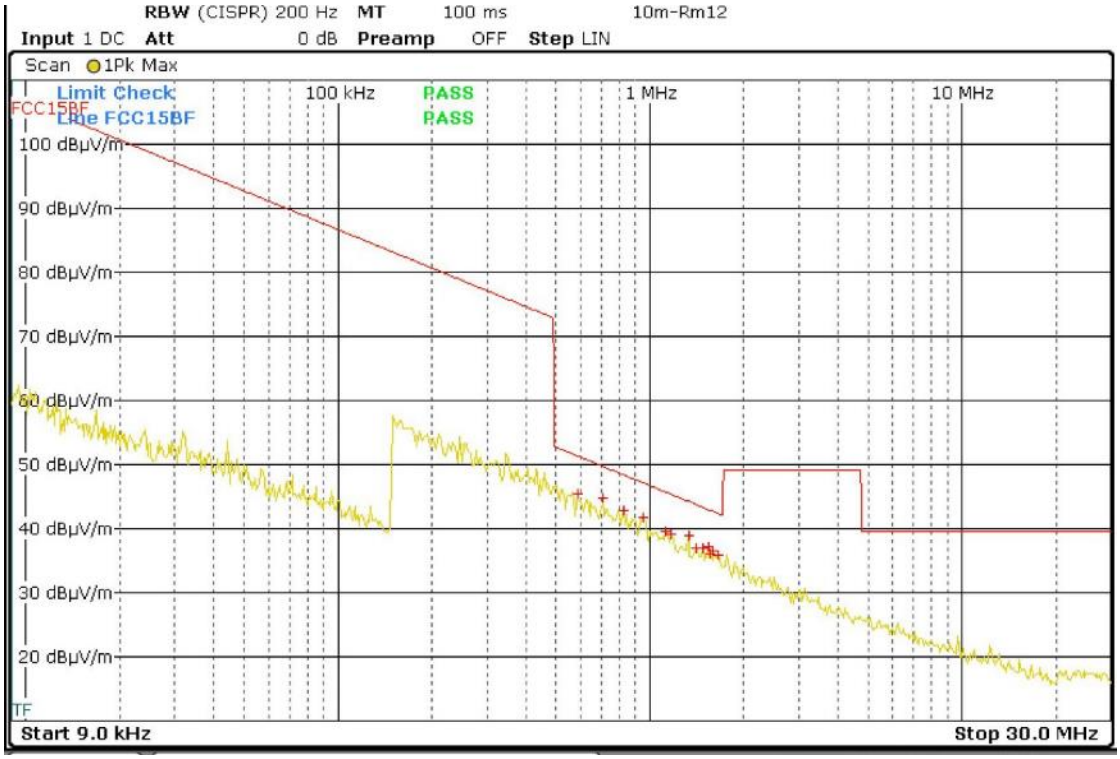
$\delta = 20\log(0.063)$
$\delta = -24.0\ dB$

### 3.7.2 Conclusion

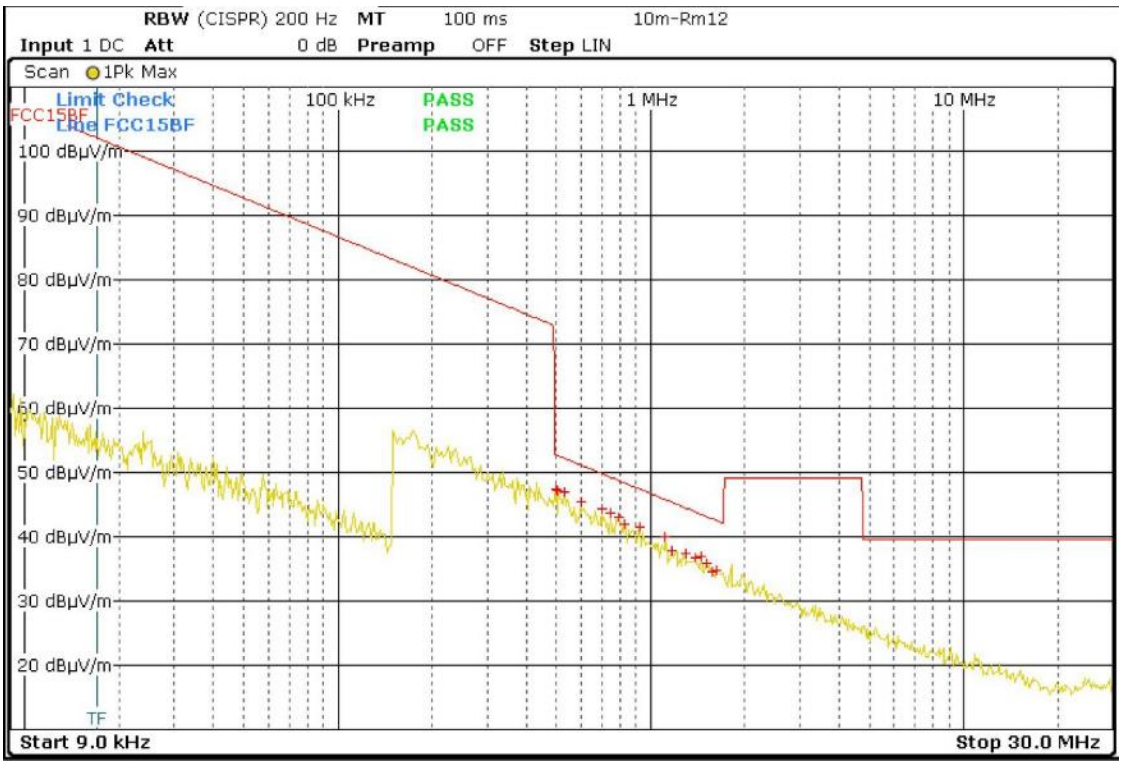
The sample complied with the applicable radiated spurious emission limits §15.247 and RSS-247. Refer to the following graphs for the results.

**Frequency Band: 9 kHz - 30 MHz**

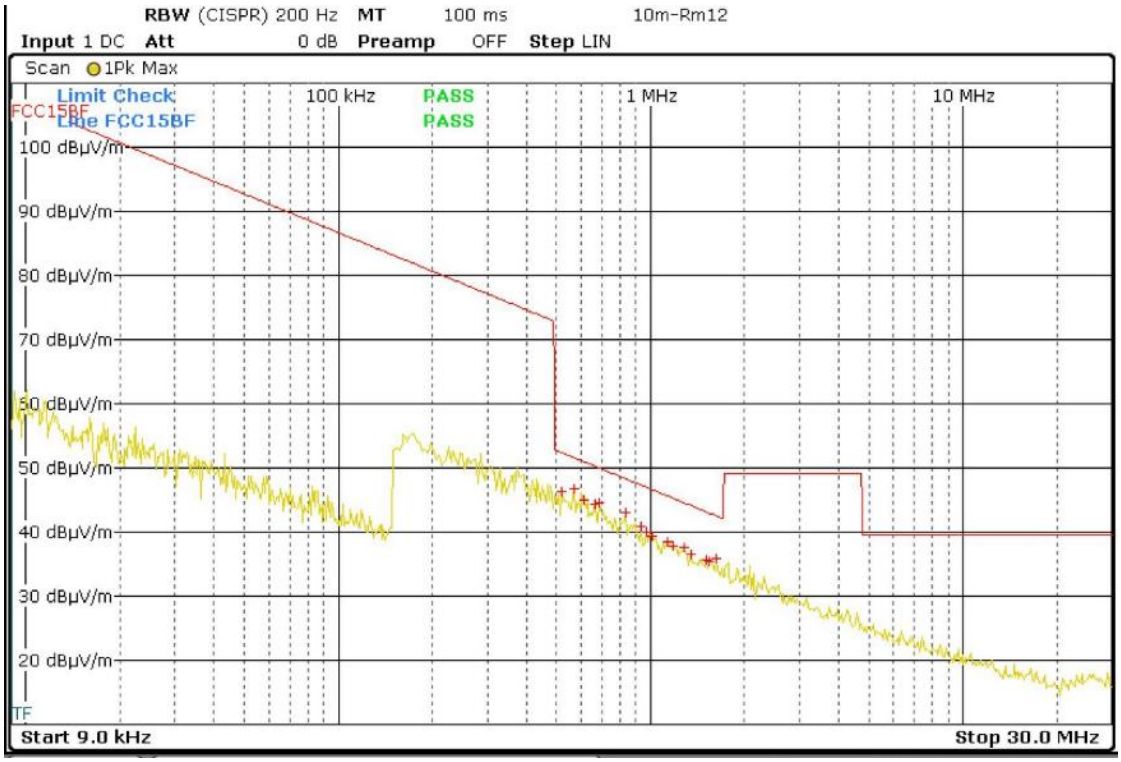
Measurements were made at a distance of 10 metres. The measurement of emissions between 9 kHz – 150 kHz were made with a resolution bandwidth (RBW) of 200 Hz and the video bandwidth (VBW) of 3 kHz, 150 kHz – 30 MHz were measured with the resolution bandwidth (RBW) of 9 kHz and the video bandwidth (VBW) of 30 kHz.




Channel 2405 MHz




Channel 2445 MHz




Channel 2480 MHz

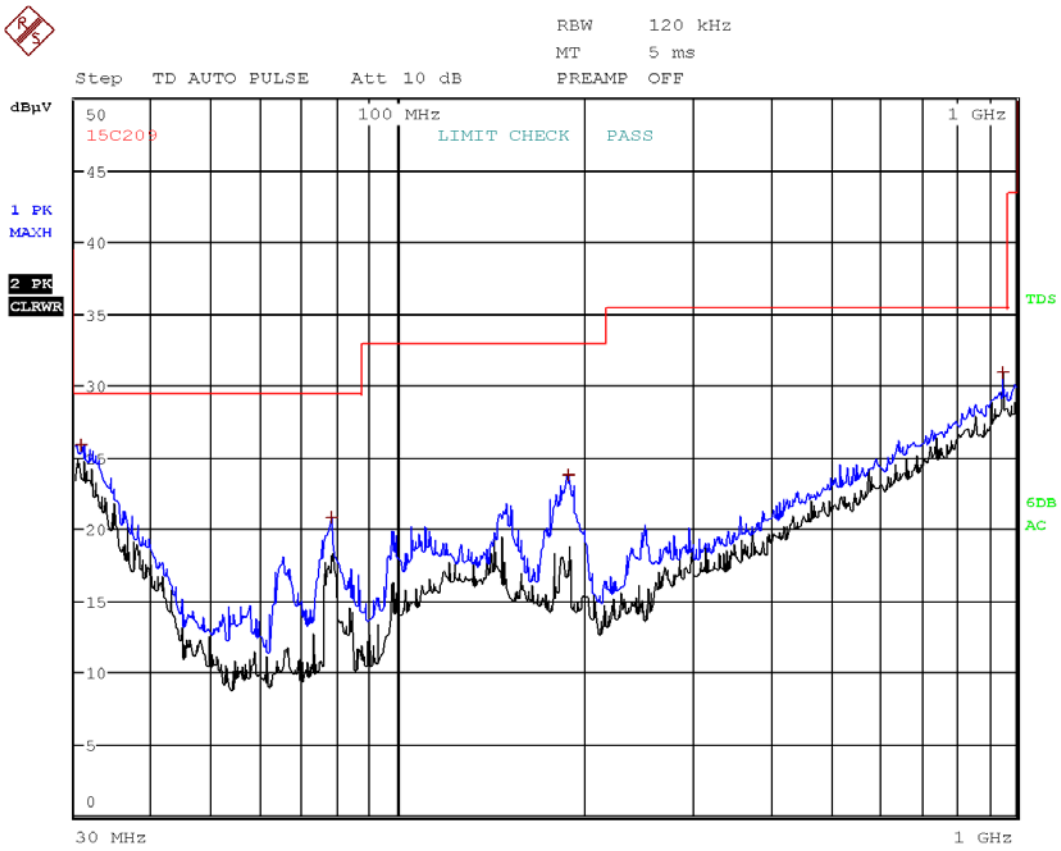
**Frequency Band: 30 - 1000 MHz**

Measurements were made at a distance of 10 metres. The measurement of emissions between 30 - 1000 MHz were made with a resolution bandwidth (RBW) of 120 kHz and the video bandwidth (VBW) of 300 kHz.

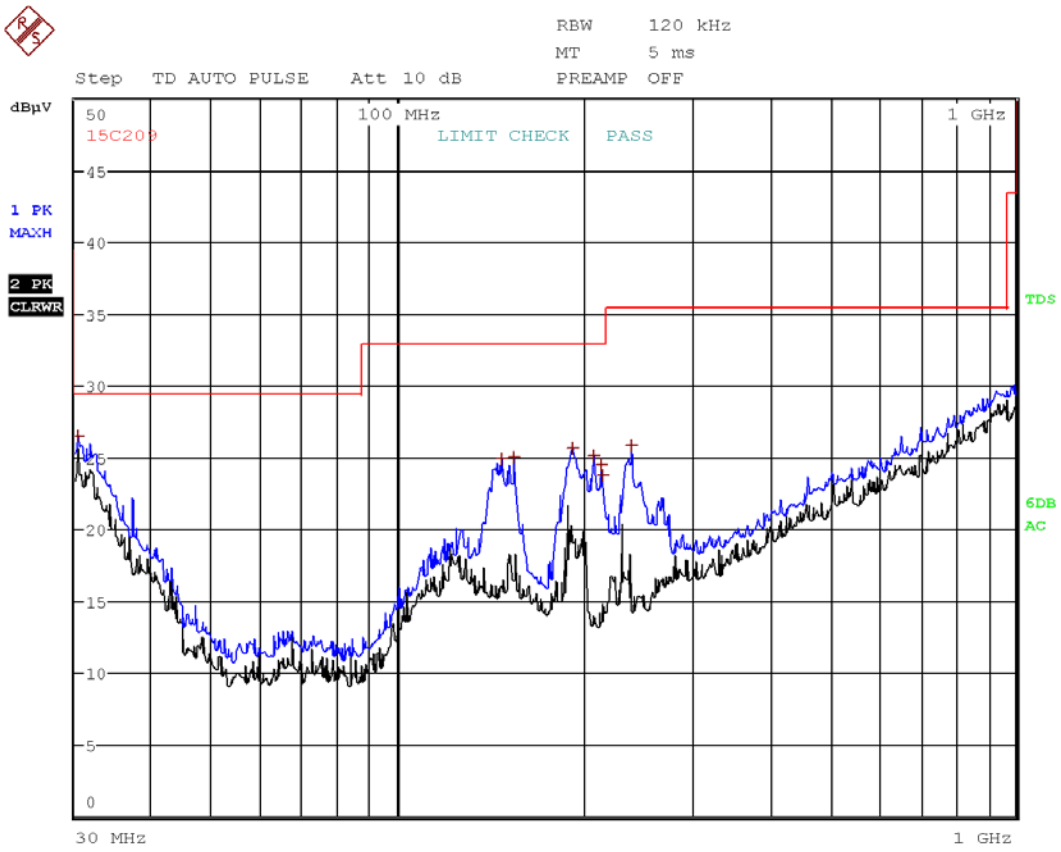
The §15.209 and RSS-Gen 8.10 limits were applied.

Maximum Results:

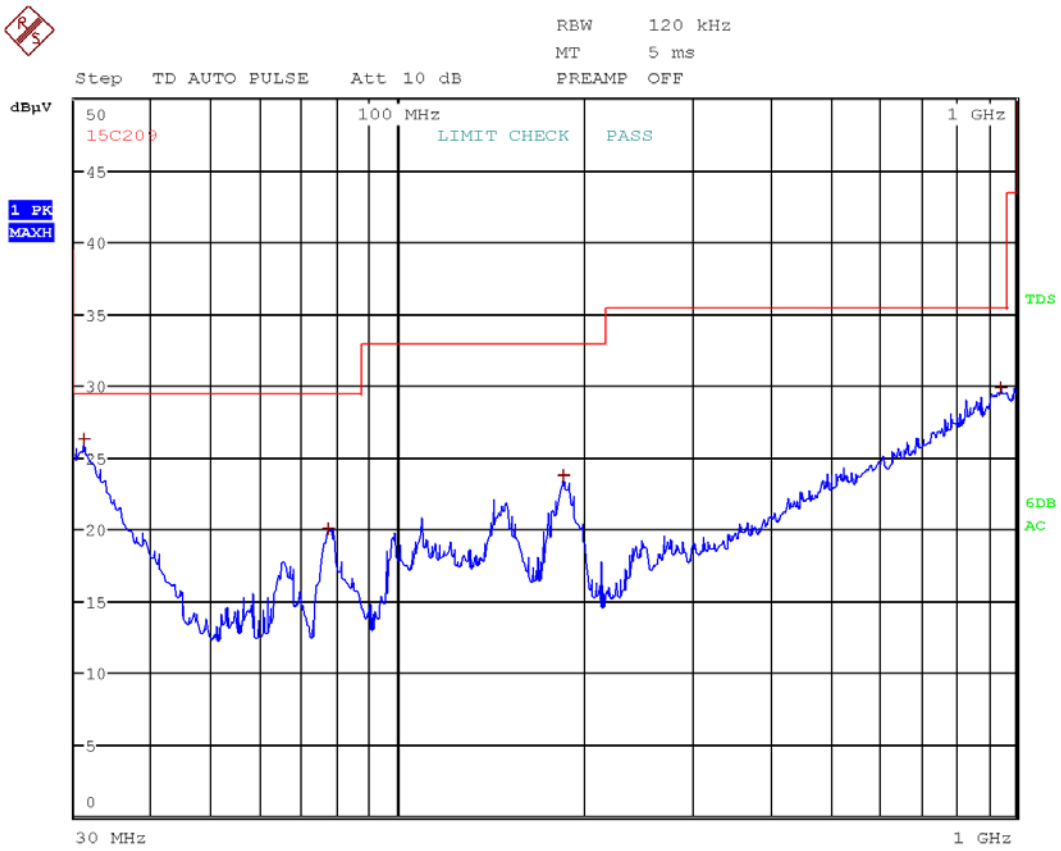
| Frequency [MHz] | Quasi-Peak [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|
| 147.540 | 17.2 | 33.0 | -15.8 |
| 191.190 | 17.0 | 33.0 | -16.0 |
| 191.318 | 14.6 | 33.0 | -18.4 |
| 207.750 | 14.7 | 33.0 | -18.3 |



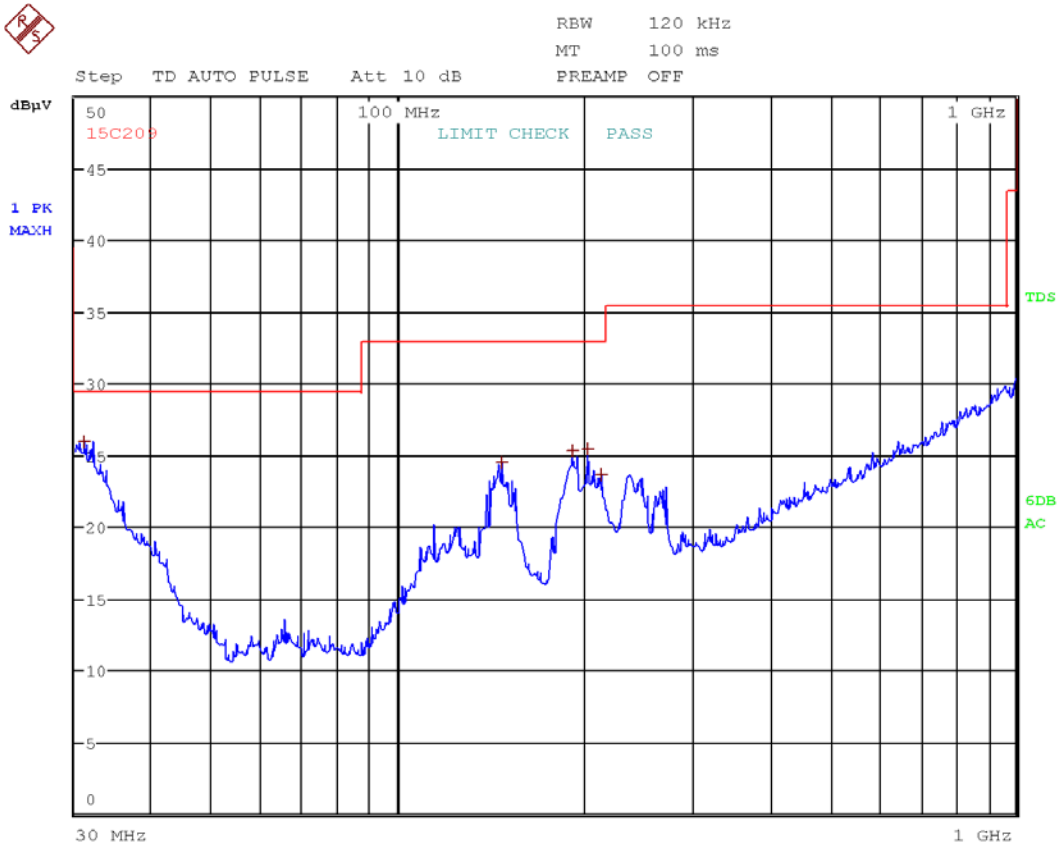

Channel 2405, Vertical Polarisation



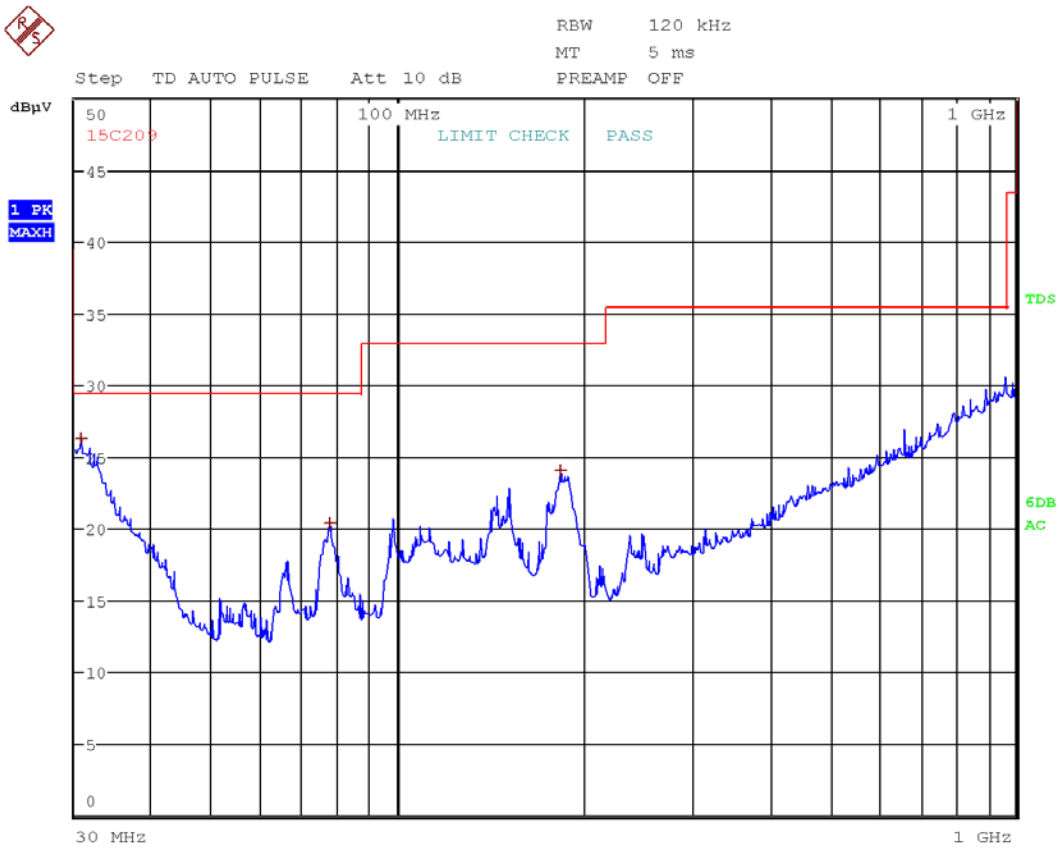

Channel 2405, Horizontal Polarisation



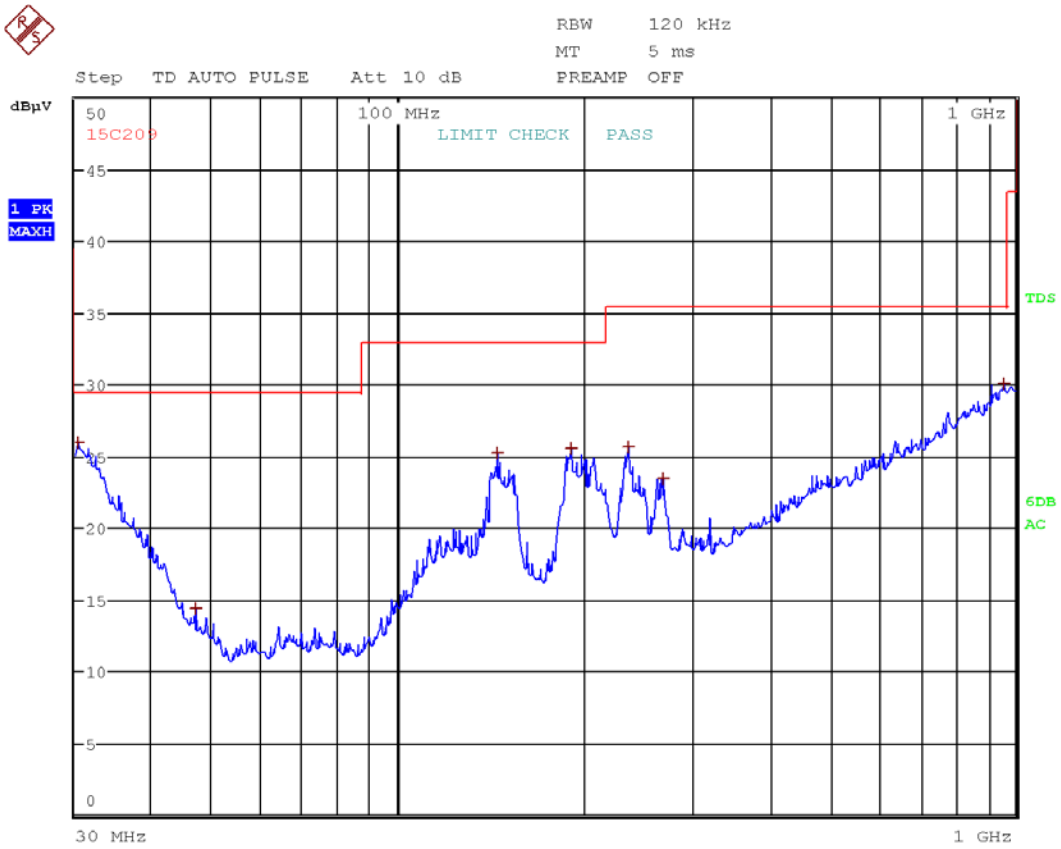

Channel 2445, Vertical Polarisation




Channel 2445, Horizontal Polarisation




Channel 2480, Vertical Polarisation




Channel 2480, Horizontal Polarisation

**Frequency Band: 1 000 – 25 000 MHz**

Measurements to 18 GHz were made at a distance of 3 metres and 18 to 25 GHz at 1 metre. The measurements were made with a resolution bandwidth (RBW) of 1000 kHz and the video bandwidth (VBW) of 1000 kHz.

The §15.209 and RSS-Gen 8.10 limits were applied.

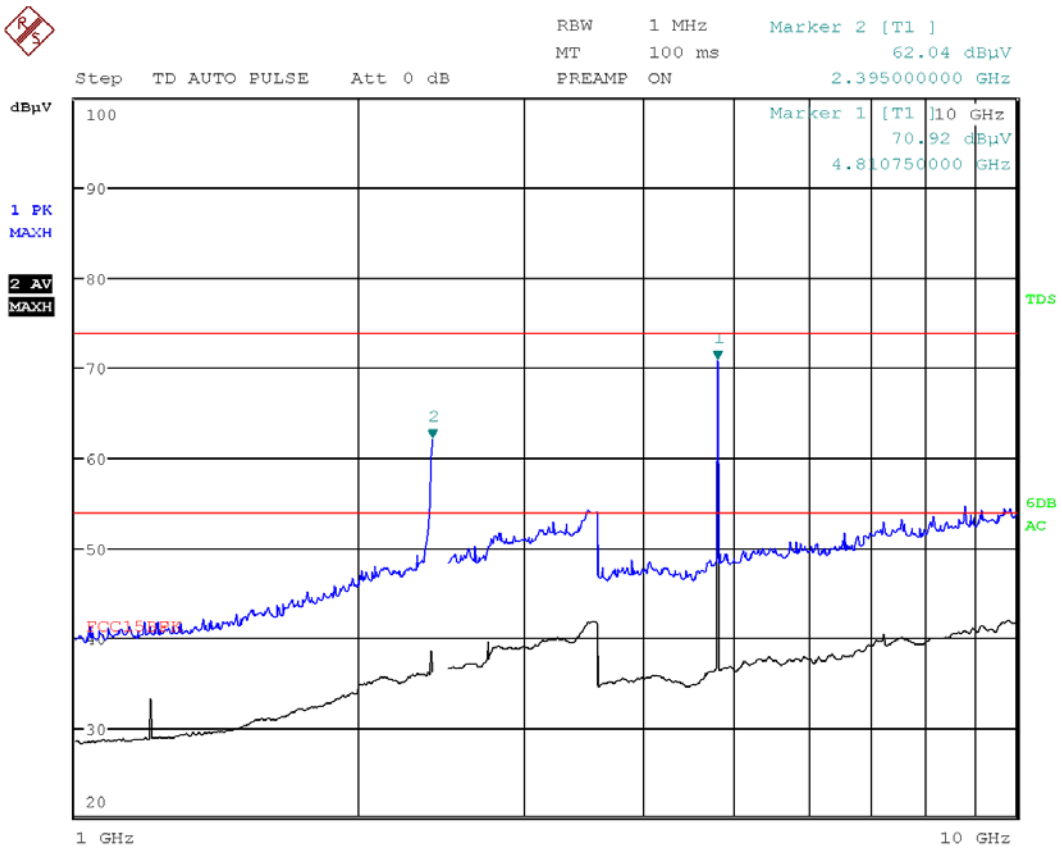
Maximum Peak Results:

| Channel | Frequency [MHz] | Peak [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|
| 2405 MHz | 2395.00 | 61.7 | 74.0 | -12.3 |
| | 4810.00 | 71.3 | 74.0 | -2.7 |
| 2445 MHz | 4890.00 | 62.0 | 74.0 | -12.0 |
| 2480 MHz | 2488.75 | 64.5 | 74.0 | -9.5 |
| | 4960.00 | 69.5 | 74.0 | -4.5 |

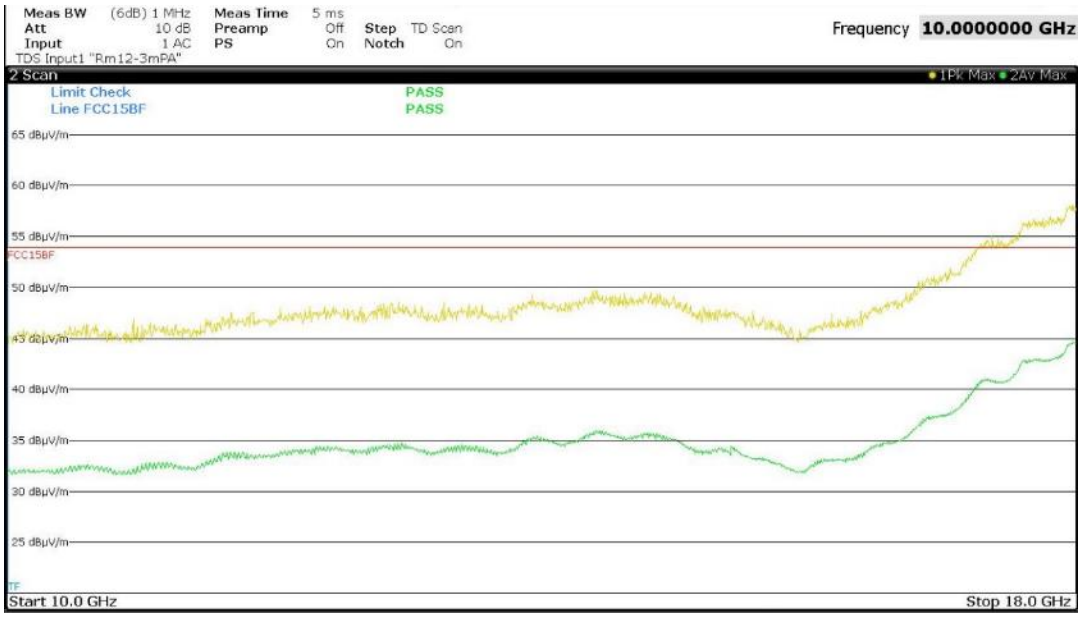
Maximum Average Results, correction factor of -24.0 dB to peak:

| Channel | Frequency [MHz] | Peak [dBµV/m] | Average [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|
| 2405 MHz | 2395.00 | 61.7 | 37.7 | 54.0 | -16.3 |
| | 4810.00 | 71.3 | 47.3 | 54.0 | -6.7 |
| 2445 MHz | 4890.00 | 62.0 | 38.0 | 54.0 | -16.0 |
| 2480 MHz | 2488.75 | 64.5 | 40.5 | 54.0 | -13.5 |
| | 4960.00 | 69.5 | 45.5 | 54.0 | -8.5 |

**Channel 2405 MHz – Vertical, 1 to 18 GHz**

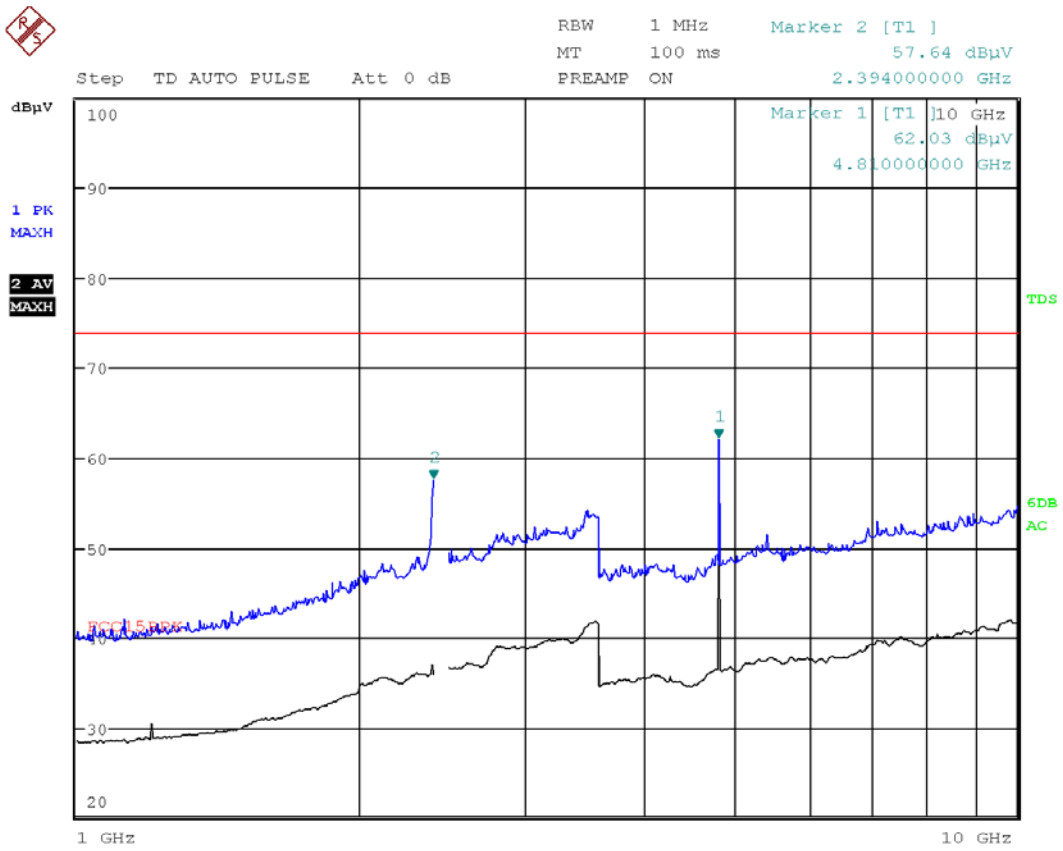



1 to 10 GHz

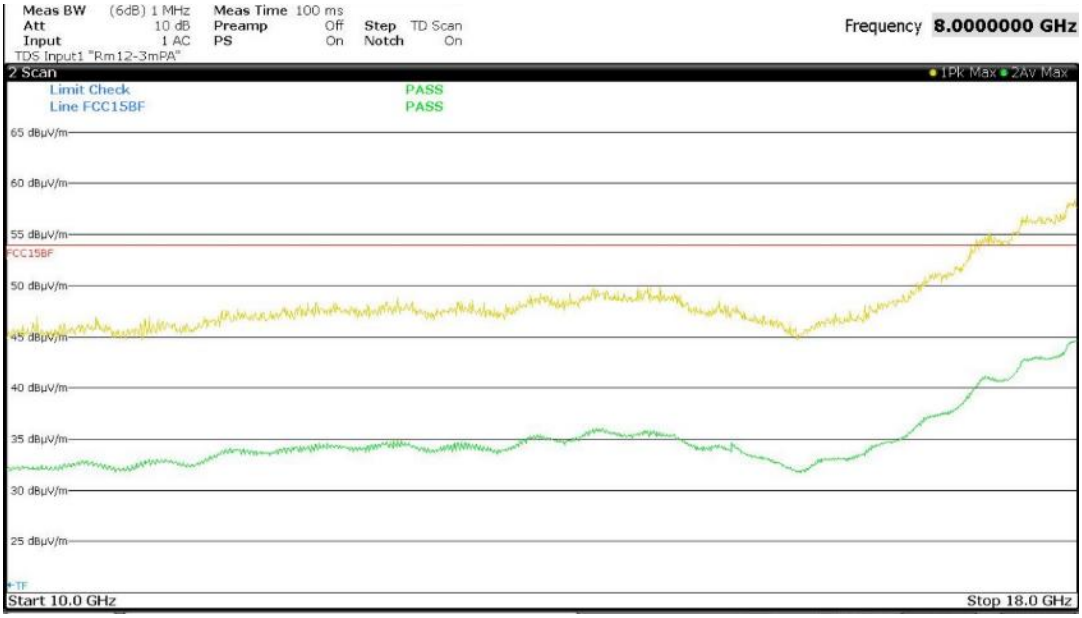



10 to 18 GHz

**Channel 2405 MHz – Horizontal, 1 to 18 GHz**

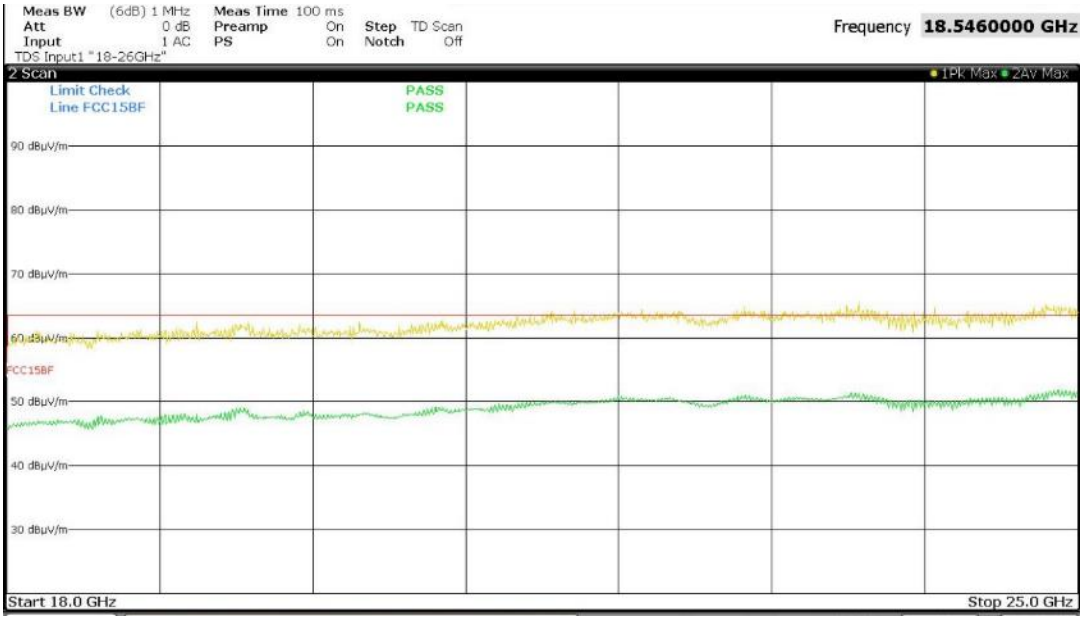



1 to 10 GHz

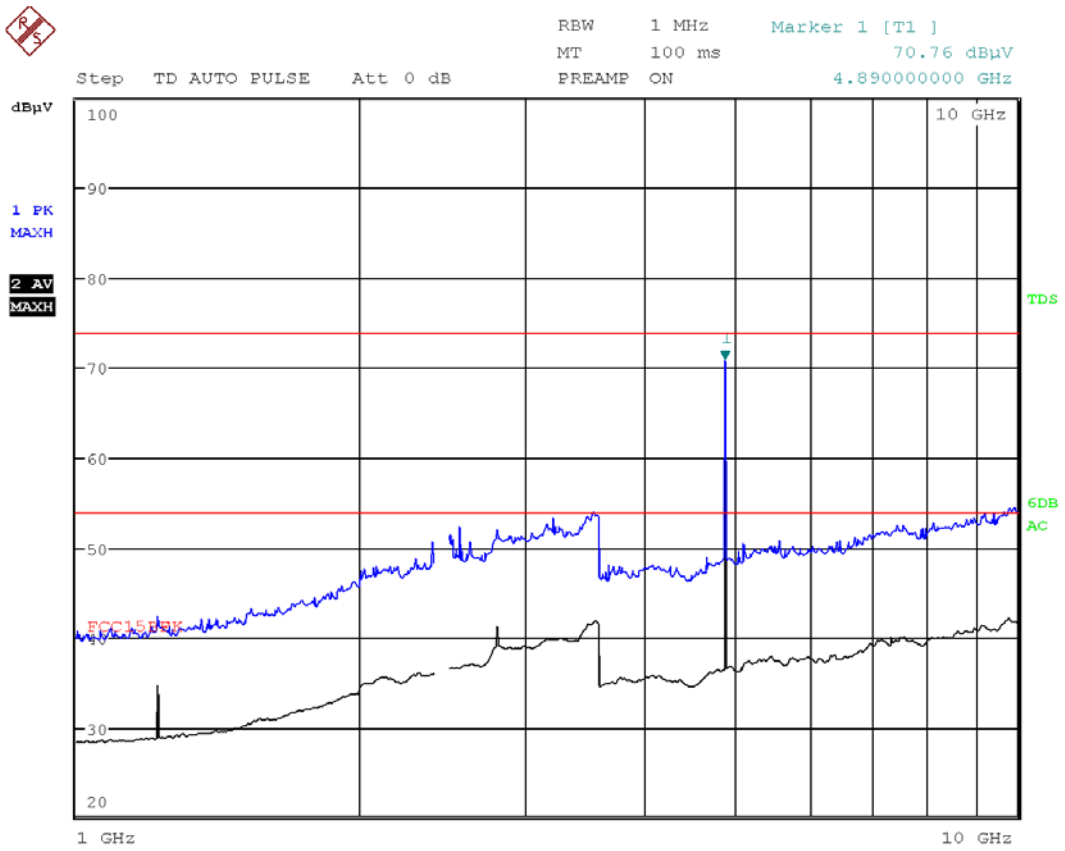



10 to 18 GHz

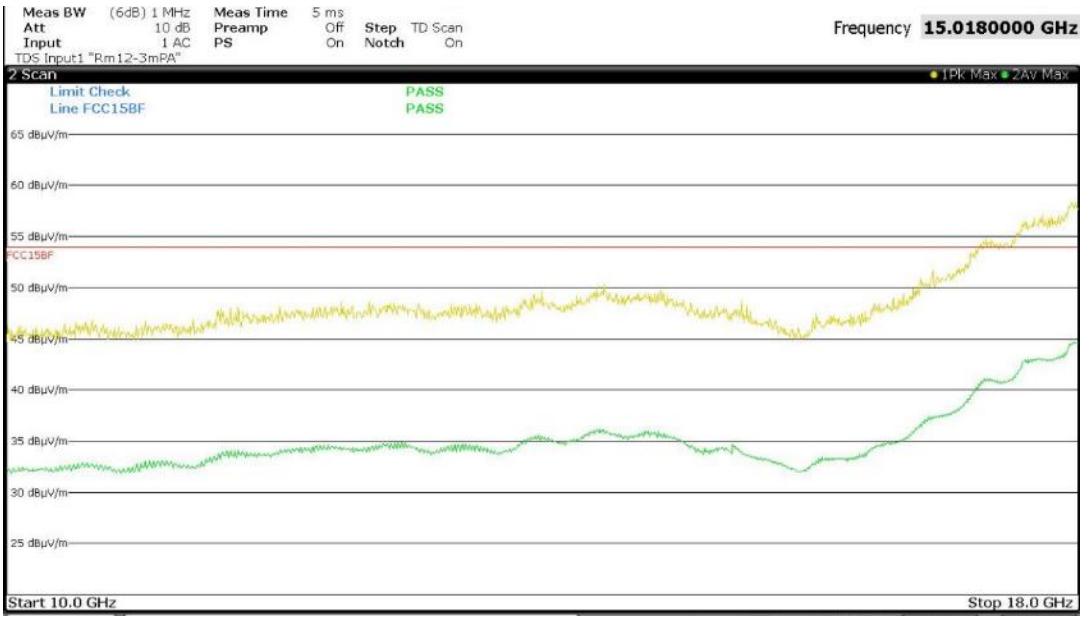
**Channel 2405 MHz – Vertical and Horizontal Combined 18 to 25 GHz**



**Channel 2445 MHz – Vertical, 1 to 18 GHz**

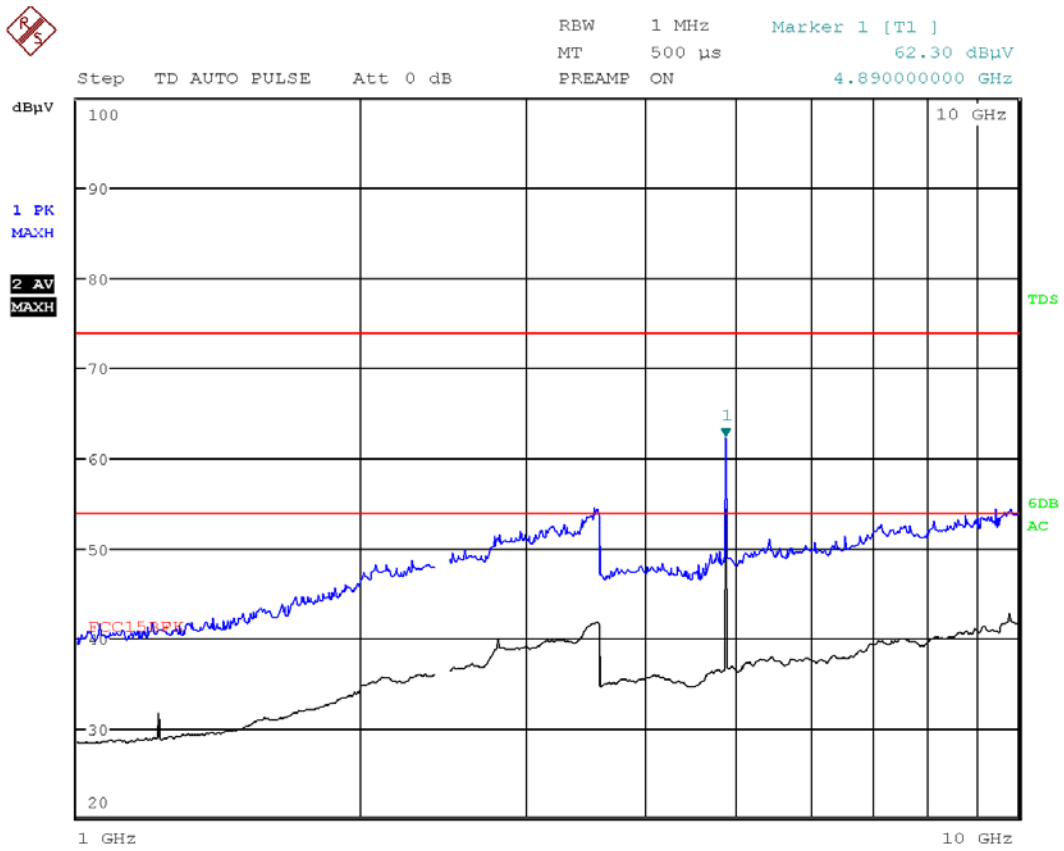



1 to 10 GHz

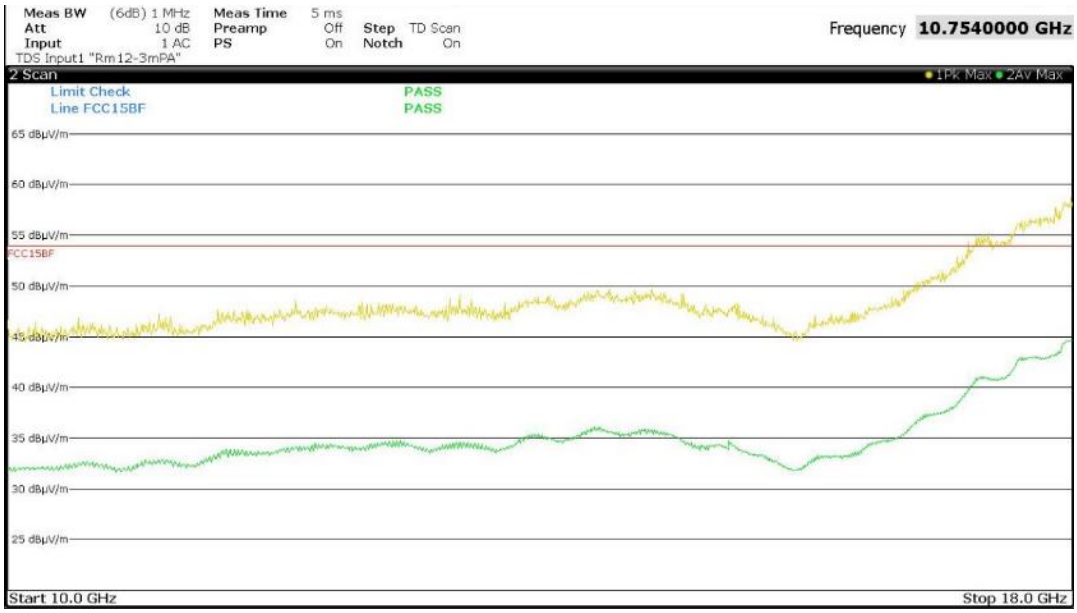



10 to 18 GHz

**Channel 2445 MHz – Horizontal, 1 to 18 GHz**

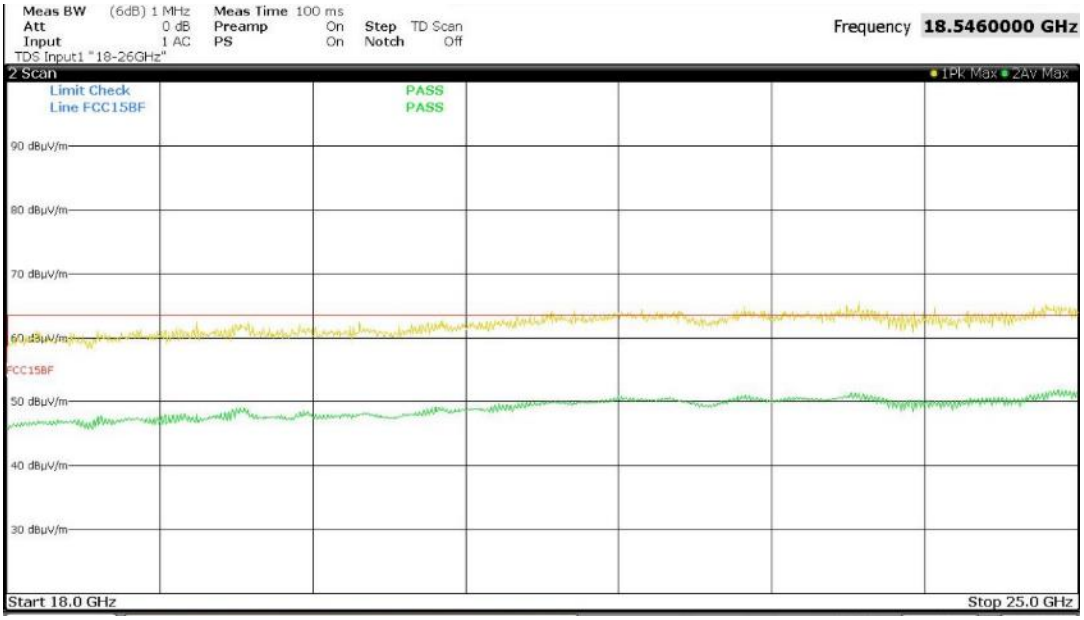



1 to 10 GHz

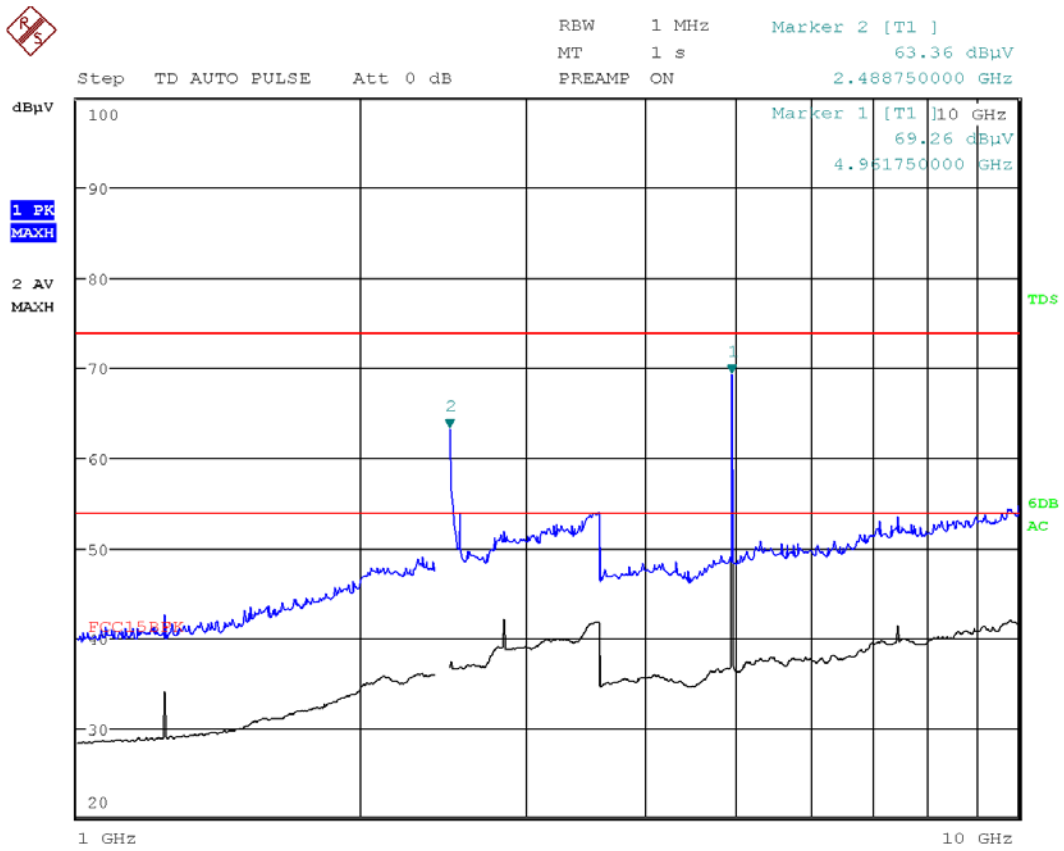



10 to 18 GHz

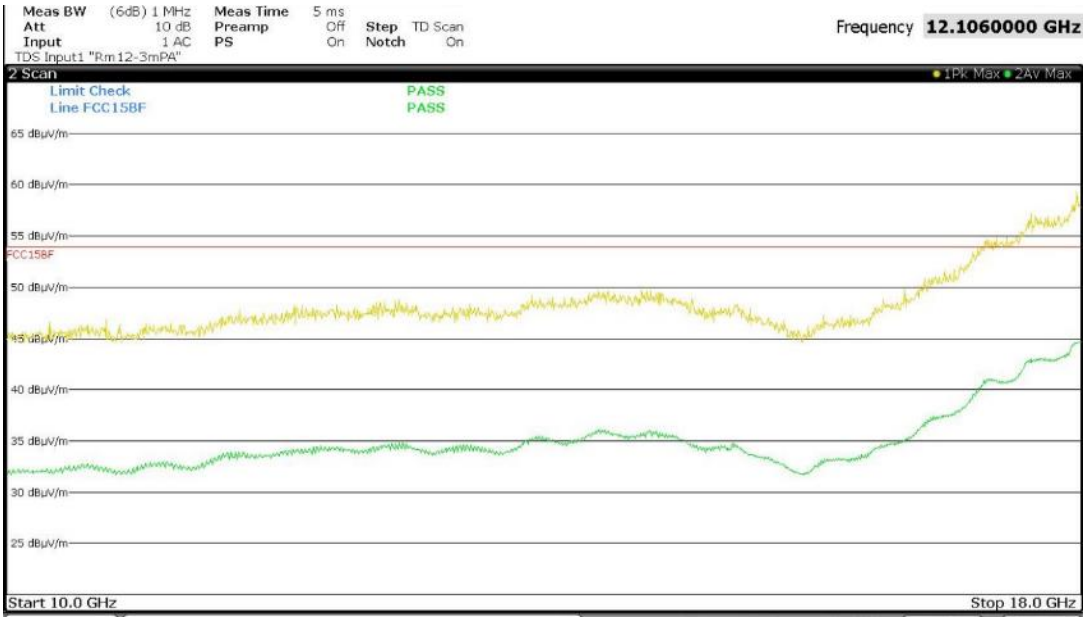
**Channel 2445 MHz – Vertical and Horizontal Combined 18 to 25 GHz**



**Channel 2480 MHz – Vertical, 1 to 18 GHz**

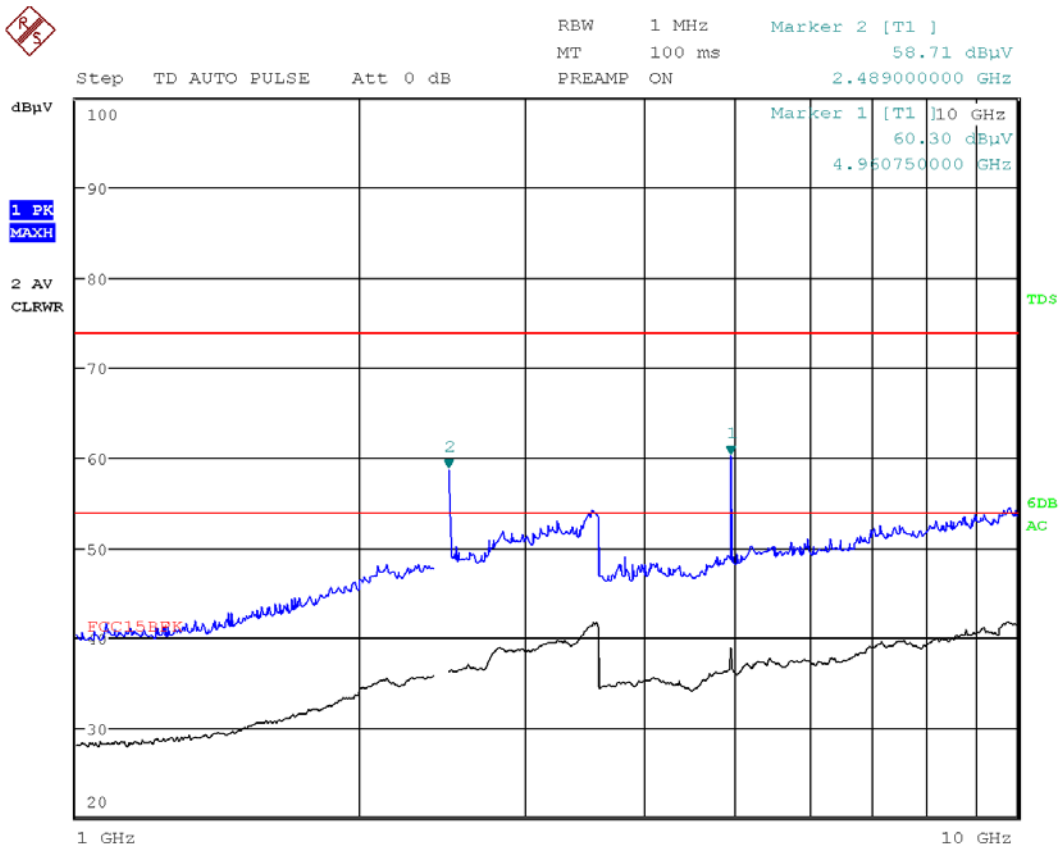



1 to 10 GHz

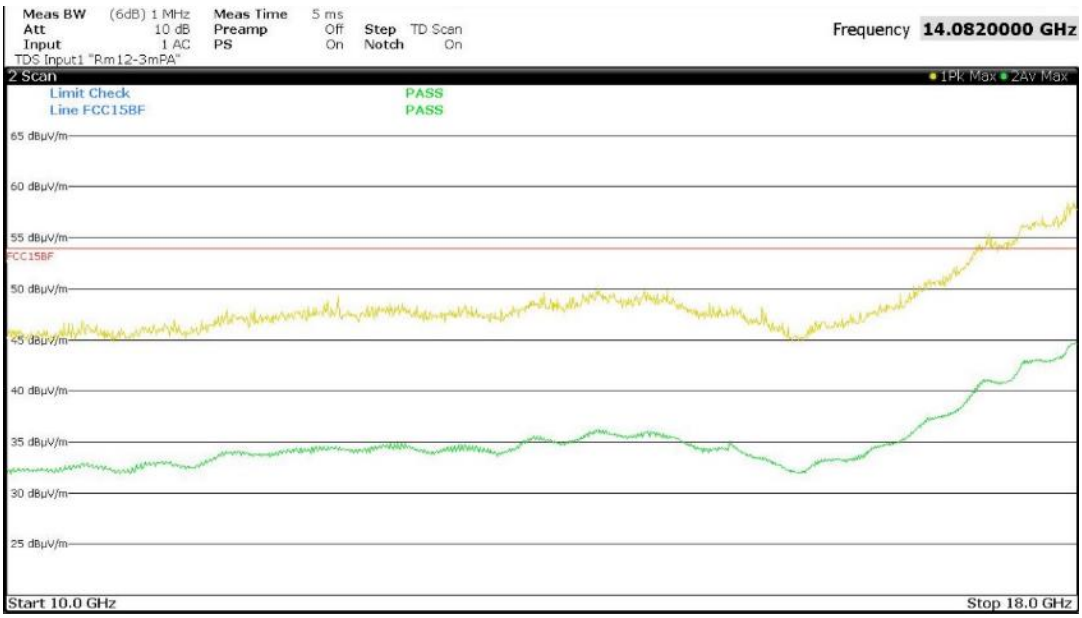



10 to 18 GHz

**Channel 2480 MHz – Horizontal, 1 to 18 GHz**

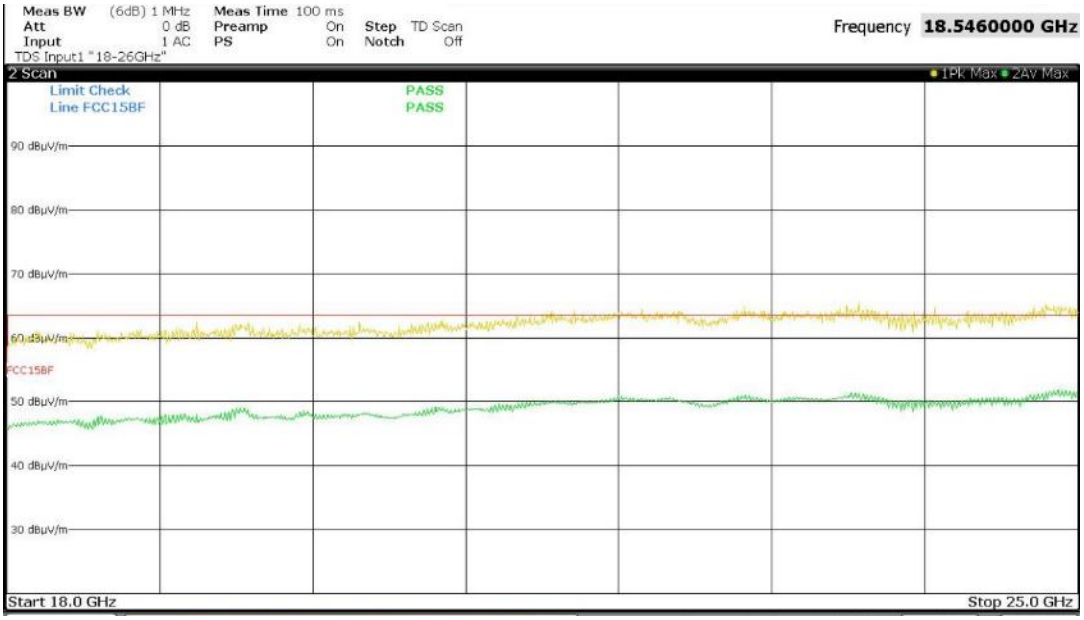



1 to 10 GHz




10 to 18 GHz

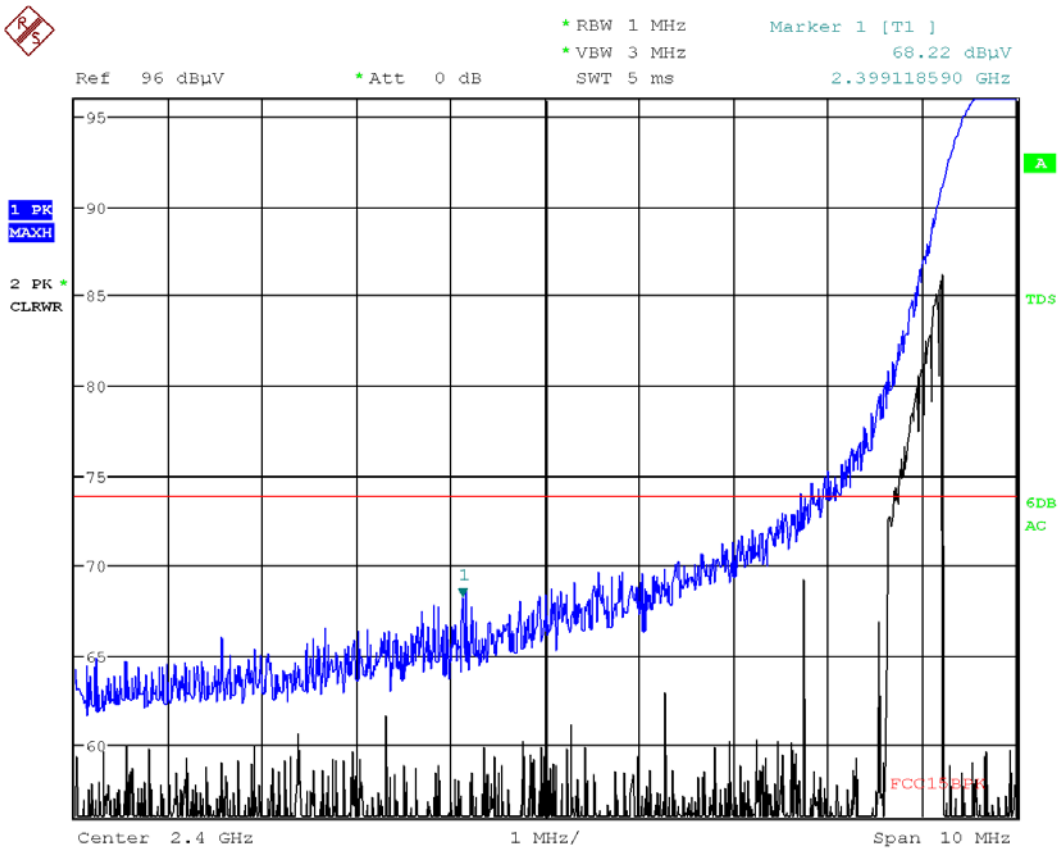
**Channel 2480 MHz – Vertical and Horizontal Combined 18 to 25 GHz**



### 3.7.3 Band-Edge Emission Measurements

Emissions within 5 MHz of an authorised band edge were measured.

**Channel 2405 MHz, Lower Band Edge:**



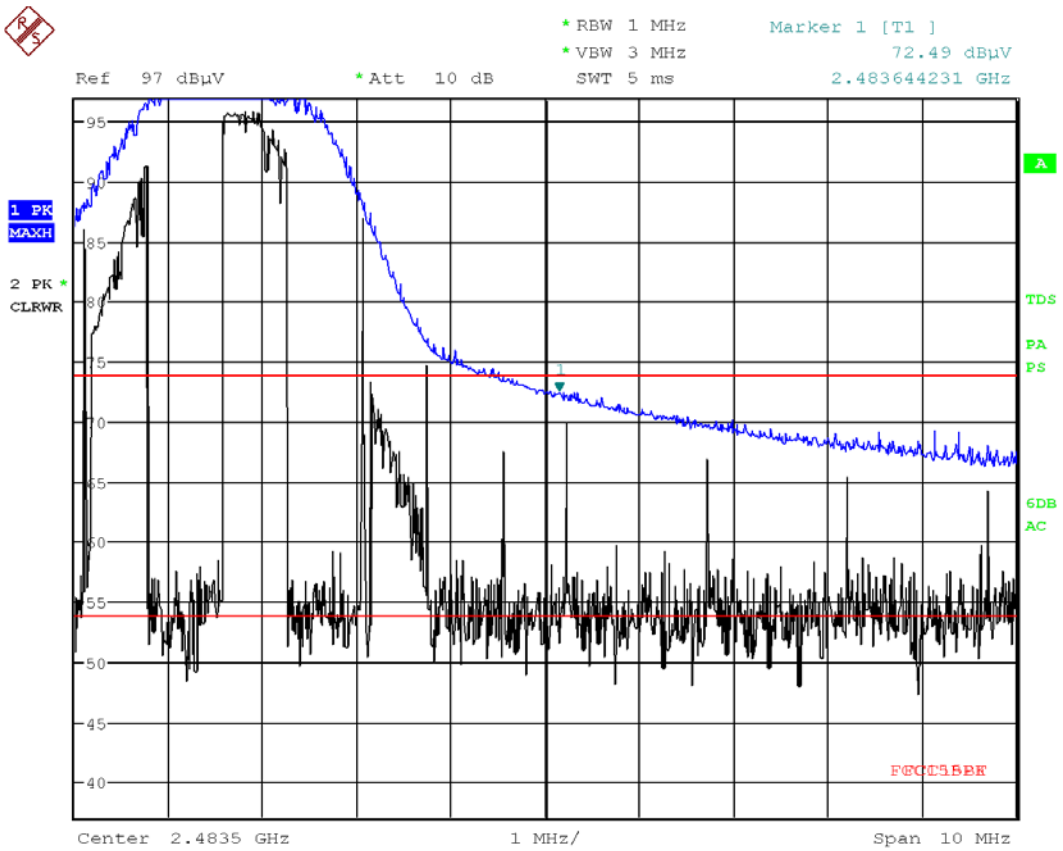

Maximum Peak Results:

| Channel | Frequency [MHz] | Peak [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|
| 2405 MHz | 2399.12 | 68.2 | 74.0 | -5.8 |

Maximum Average Results, correction factor of -24.0 dB to peak:

| Channel | Frequency [MHz] | Peak [dBµV/m] | Average [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|
| 2405 MHz | 2399.12 | 68.2 | 44.2 | 54.0 | -9.8 |

**Channel 2480 MHz, Upper Band Edge:**




Maximum Peak Results:

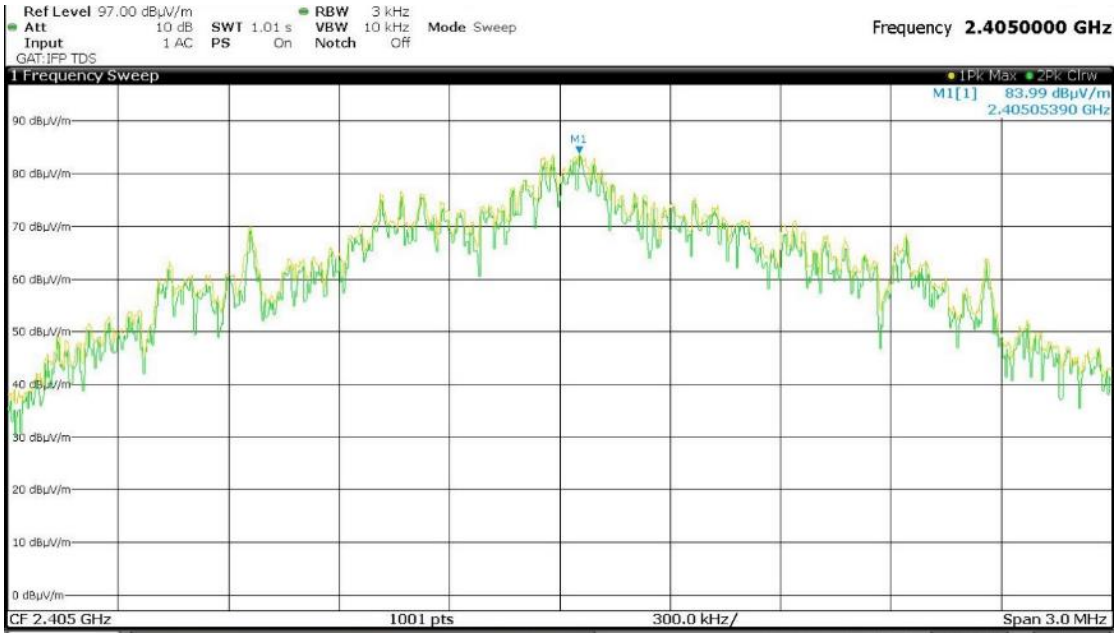
| Channel | Frequency [MHz] | Peak [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|
| 2480 MHz | 2483.64 | 72.5 | 74.0 | -1.5 |

Maximum Average Results, correction factor of -24.0 dB to peak:

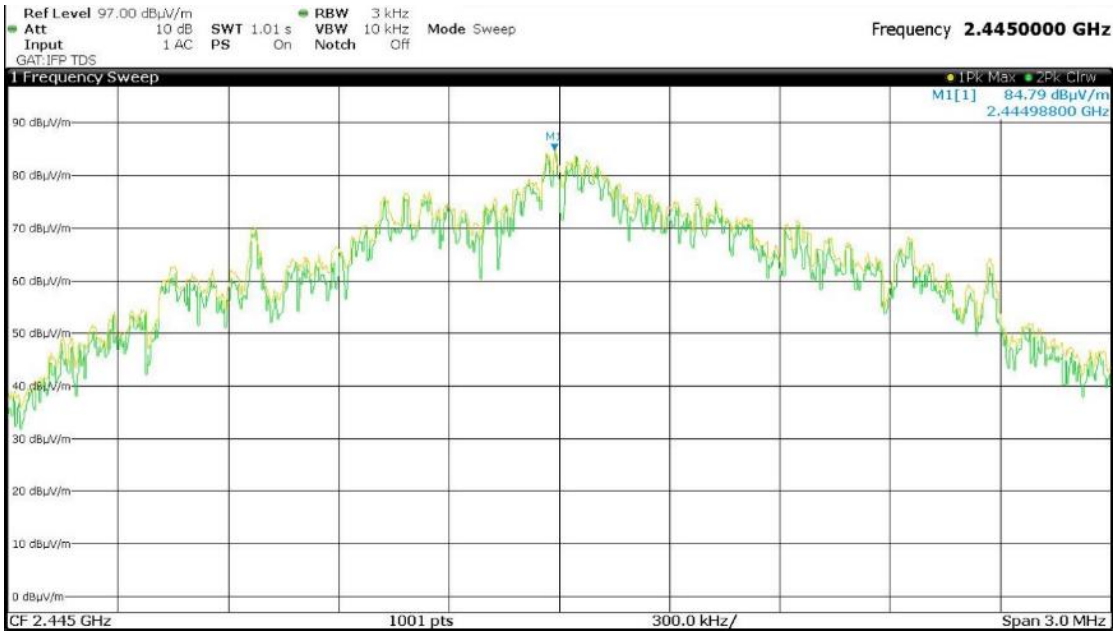
| Channel | Frequency [MHz] | Peak [dBµV/m] | Average [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|
| 2480 MHz | 2483.64 | 72.5 | 48.5 | 54.0 | -5.5 |

## 3.8 §15.247(e)/RSS-247 5.2(b) Power Spectral Density

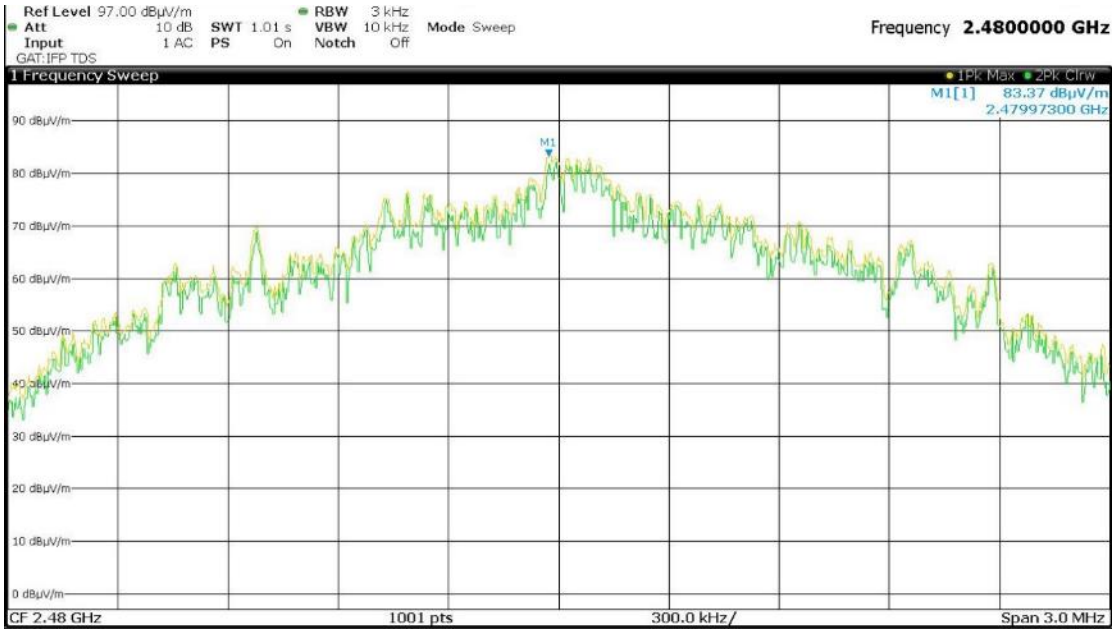
Radiated measurements performed at 3 metres were used to find the power spectral density of the transmitted signals. Different configurations of EUT and antenna polarization were investigated to produce highest emission and the EUT was set to transmit in continuous transmission mode. Power spectral density is shown below, the resolution bandwidth was 3 kHz.




Channel 2405 MHz




Channel 2445 MHz




Channel 2480 MHz

**Results:**

| Channel (MHz) | PSD @ 3 m (dBµV/m) | PSD (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2405 | 84.0 | -11.2 | 8 | -19.2 | Complied |
| 2445 | 84.8 | -10.4 | 8 | -18.4 | Complied |
| 2480 | 83.4 | -11.8 | 8 | -19.8 | Complied |

Electric field to power conversion:

$$E = 20log\left(\frac{\sqrt{30P}}{d}\right) + 120$$

Where:
$E$ = electric field strength (dBµV/m)
$P$ = EIRP in Watts
$d$ = measurement distance in metres

## 3.9 §15.247(i) Maximum Permissible Exposure

The Maximum Permissible Exposure (MPE) limit defined in §1.1310 for a transmitter operating at 2400 MHz is:

MPE limit = 1 mW/cm$^2$
= **1 mW/cm$^2$ = 61.4 V/m** (V/m) = √(1200×π×mW/cm$^2$)

Field strength = [√(30× transmitter EIRP, mW)] ÷ [minimum separation distance, metres] V/m
= [√(30×0.007)] ÷ 0.2 V/m
= **2.3 V/m = 0.001 mW/cm$^2$** (mW/cm$^2$) = (V/m)$^2$ ÷ (1200×π)

As the calculated field strength generated by the transmitter is less than the limit the Wireless WBS-1V1, Model (HVIN) WBS-1V1 is deemed to comply with the radio frequency exposure requirements.

## 3.10 RSS-Gen 3.2/RSS-102 Maximum Permissible Exposure

The Wireless WBS-1V1, Model (HVIN) WBS-1V1 was considered a mobile device and not intended to be operated within 20 cm of user or nearby person.

RF exposure evaluation is exempt if the following criteria is met:

Time averaged e.i.r.p. ≤ $1.31\times10^{-2} \times [f_{(MHz)}]^{0.6834}$ W

$1.31\times10^{-2} \times [f_{(MHz)}]^{0.6834}$ = **2.7 W**

The measured e.i.r.p. (not time averaged) was **0.007 W**

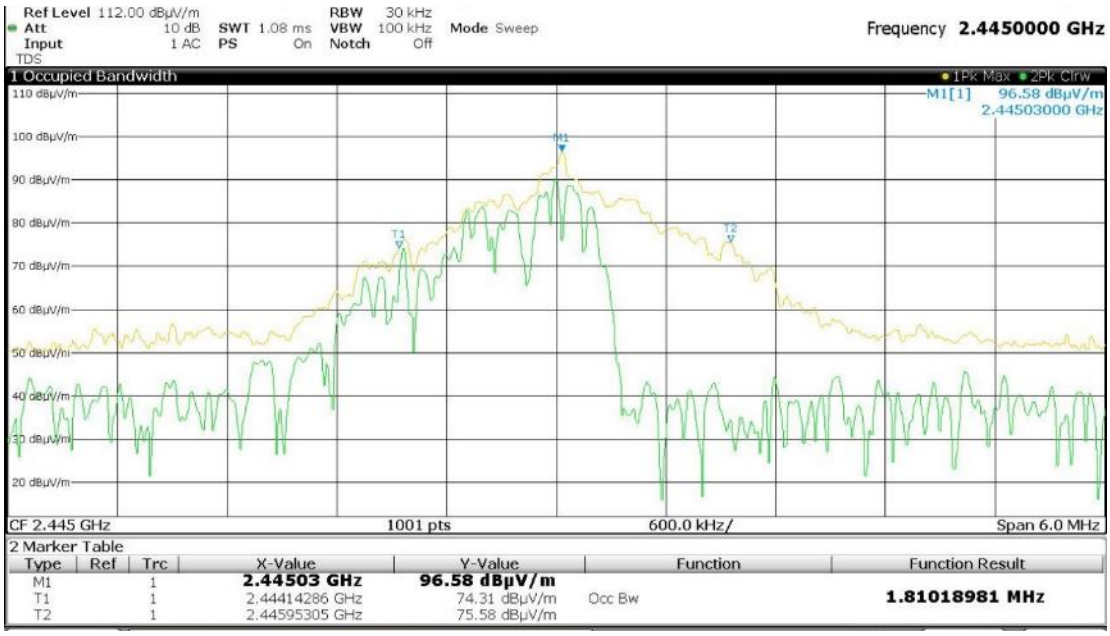
As the radiated power generated by the transmitter was less than the limit the Wireless WBS-1V1, Model (HVIN) WBS-1V1 is deemed to comply with the radio frequency exposure requirements.

## 3.11 §2.1049/RSS-Gen 6.6 Occupied bandwidth – 99% power

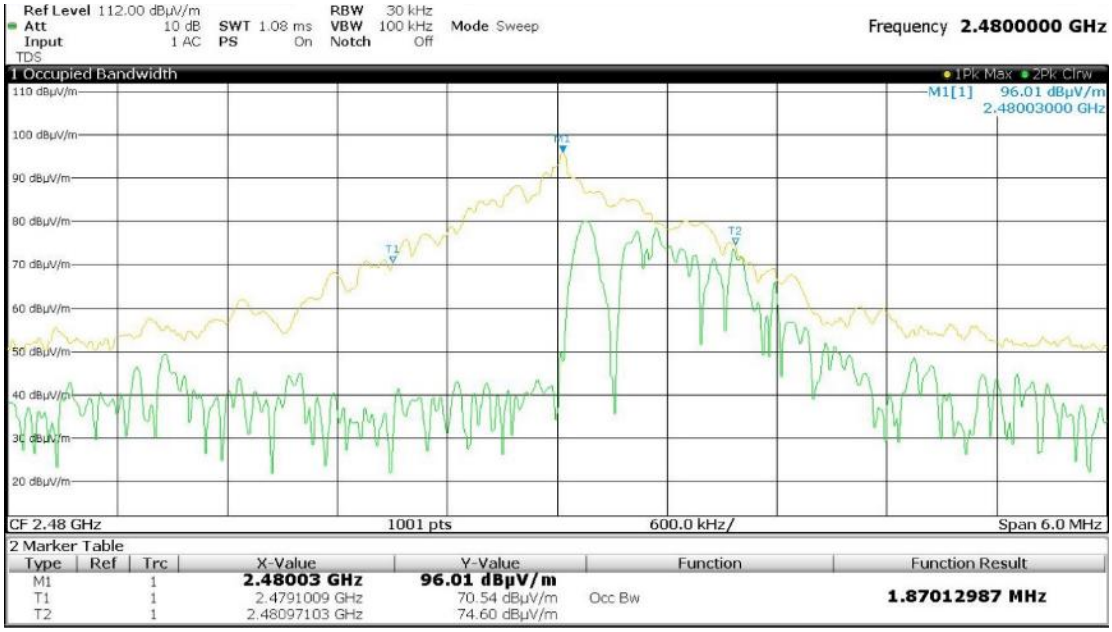
The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 section 6.9.

The 99% power bandwidth was **1.870 MHz**.


Channel 2405 MHz




Channel 2445 MHz




Channel 2480 MHz

## 4.0 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:

| | | |
|---|---|---|
| **Conducted Emissions:** | 9 kHz to 30 MHz | ±3.2 dB |
| **Radiated Emissions:** | 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 |
| **Peak Output Power:** | | ±1.5 dB |
| **Peak Power Spectral Density:** | | ±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%.

## 5.0 COMPLIANCE STATEMENT

The Wireless WBS-1V1, Model (HVIN) WBS-1V1 tested on behalf of Automatic Technology Australia **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators) and RSS-247 Issue 2 for a Digital Transmission System (DTS) operating within the band: 2400 MHz to 2483.5 MHz.