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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-WBSNT0102M2
IC:	8880A-WBSNT0102M2
Device under Test / PMN:	Wireless WBS-1V2
Model Number / HVIN:	WBS-1V2
Tested For:	Automatic Technology Australia Pty. Ltd.
Report Number:	M160737-3R2 (Supersedes report M160737-3R1)
Issue Date:	06 February 2018

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, inferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.

RADIO REPORT
FOR CERTIFICATION

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

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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-1V2
Model / HVIN:	WBS-1V2
Manufacturer:	Automatic Technology Australia Pty. Ltd.
FCC ID:	FCC ID X4K-WBSNT0102M2
IC:	IC: 8880A-WBSNT0102M2

Tested for:	Automatic Technology Australia Pty. Ltd.
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Contact:	Nikolai Klepikov
Email:	nikolai.klepikov@ata-aust.com.au

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:	06 February 2018

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-1V2, Model (HVIN) WBS-1V2 in accordance with the applicable requirements of 47 CFR, Part 15 Subpart C – Section 15.247 and RSS-247 Issue 2 for a Frequency Hopping Spread Spectrum transceiver (FHSS) 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.

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 (a1)	Channel Separation	**Complied – 5 MHz**
15.247 (a1)	Number of channels and time of occupancy	**Complied – 16 channels**
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	**Not Applicable**
15.247 (f)	Hybrid Systems	**Not Applicable** Did not employ a hybrid system
15.247 (g)	Frequency hopping channel selection	**Complied**
15.247 (h)	Simultaneous occupancy of individual hopping frequencies	**Not Applicable**
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 (5.1)	Frequency hopping channel selection	**Complied**
RSS-247 (5.1)	Simultaneous occupancy of individual hopping frequencies	**Not Applicable**
RSS-247 (5.1(b))	Channel Separation	**Complied**
RSS-247 (5.1(d))	Number of channels and time of occupancy	**Complied**
RSS-247 (5.2)	Digital transmission systems	**Not Applicable**
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-1V2
Model / HVIN:	WBS-1V2
Radio:	Frequency Hopping Spread Spectrum
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. The radio had two transmitting modes having the same GFSK modulation, declared as mode 0 and mode 1 by the manufacturer.

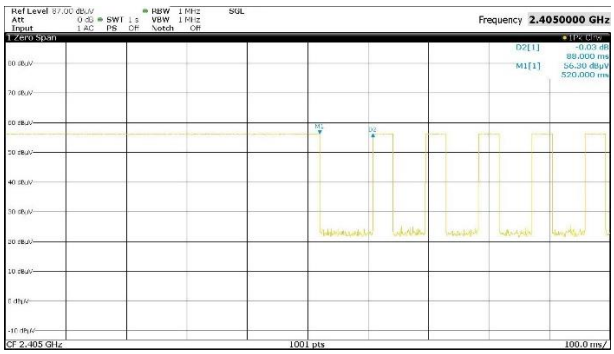
2.2.1 Hopping Channel List

Channel Centre Frequency [MHz]
2405
2410
2415
2420
2425
2430
2435
2440
2445
2450
2455
2460
2465
2470
2475
2480

2.2.2 Transition period

The customer advised that it may be possible for a transmission to occur in a transition period when switching between the modes. A synchronisation line was provided with the sample that triggered when the modes changed. Emissions were observed on a receiver triggered by the sample to determine the output during transition period.

Result: Any transmissions were investigated and conformed with applicable requirements**.**



Transition Mode 0 to 1

Transition Mode 1 to 0

2.2.3 Hopping frequency selection

The selection of hopping frequency was in a pseudo-random order. The following is an example provided by the customer. Each number represents the frequency of the channel, e.g. 2.4xx GHz, where xx is the number in the table.

65 20 15 20 75 65 60 65 45 35 70 55 80 20 20 10 55
05 25 80 70 25 25 15 15 25 30 15 20 30 50 55 20 55
15 35 80 75 25 10 65 80 20 45 60 45 45 45 35 05 75
45 35 35 75 55 40 15 65 75 60 55 45 20 35 15 70 55
60 50 25 20 50 35 70 40 30 15 50 35 05 70 35 20 65
55 45 30 80 05 60 55 45 05 75 15 70 15 50 10 15 50
25 80 30 55 35 25 60 15 25 25 65 50 80 75 30 75 25
20 20 55 55 75 10 30 60 30 40 60 05 20 35 80 10 20
30 45 45 10 75 45 20 20 60 70 05 55 10 35 55 55 50
60 15 30 20 05 60 75 10 65 05 50 15 45 15 55 40 65

```
25  80  65  35  70  35  10  70  70  75  25  15  10  15  40  05  10
80  55  20  60  55  75  35  75  60  05  60  25  05  80  50  20  05
45  35  25  05  35  20  80  55  05  60  45  20  35  30  55  50  15
50  45  45  25  80  30  15  50  55  75  15  05  60  05  45  65  75
80  65  25  10  35  65  55  50  15  65  35  15  05  40  60  25  20
55  50  10  20  10  55  25  20  35  05  50  50  10  60  05  35  75
20  10  70  40  60  40  70  45  20  75  65  70  45  75  35  55  50
30  60  35  15  80  60  20  60  35  25  20  75  75  80  75  40  20
30  05  55  70  40  70  05  55  15  30  75  50  35  55  20  65  45
50  75  30  30  30  20  80  35  25  30  05  10  75  15  45  15  35
35  15  05  35  50  25  25  75  10  55  10  70  ……
```

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

2.5 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.

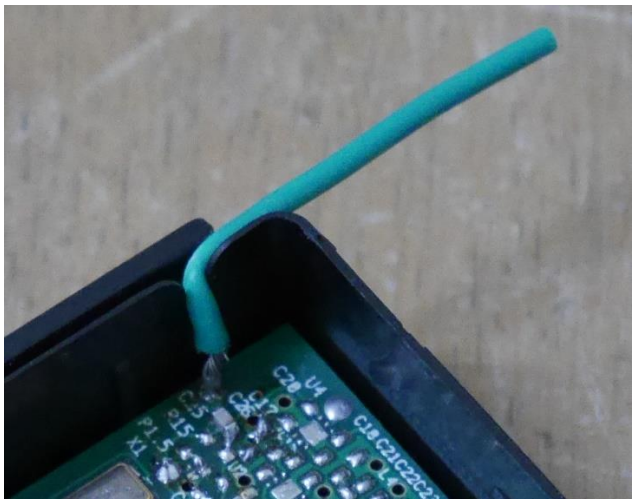
Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yyyy	Due Date dd/mm/yyyy	Cal. Interval
Chamber	Frankonia SAC-10-2 (R-139)	22/03/2017	22/03/2018	1 Year, *1
EMI Receiver	R&S ESW26 2 Hz – 26.5 GHz Sn: 101306 (R-143)	31/03/2017	31/03/2018	1 Year, *2
	R&S ESU40 20 Hz – 40 GHz Sn: 100392 (R-140)	23/02/2017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

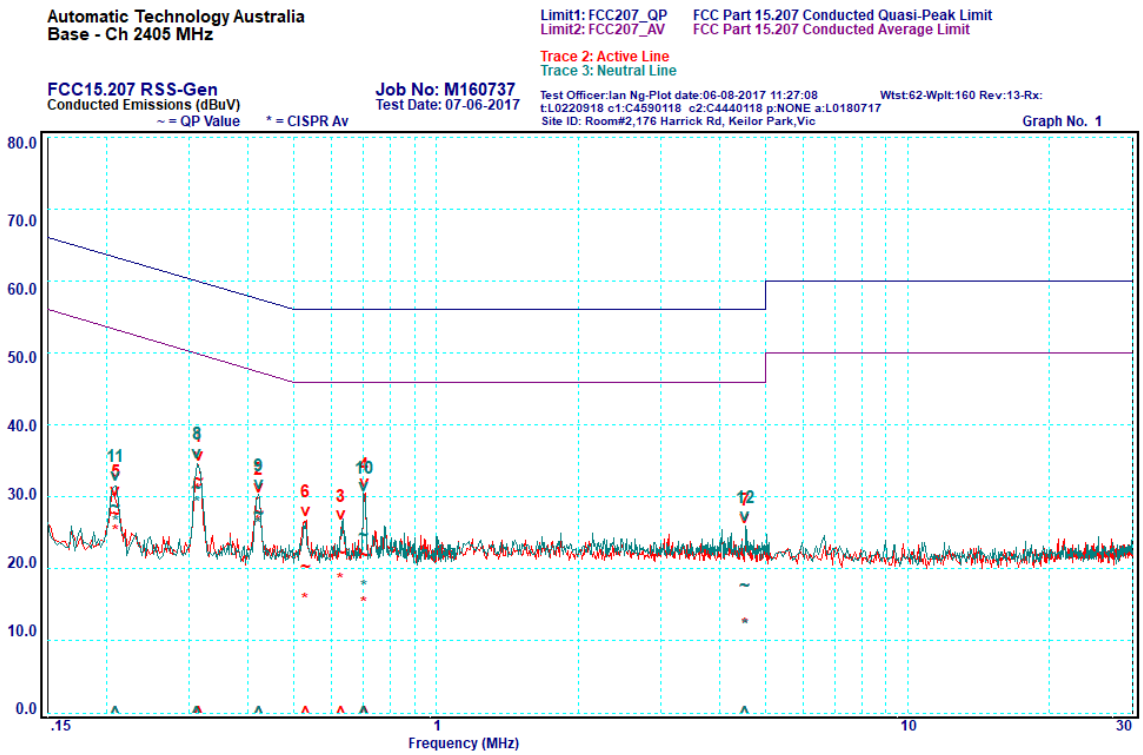
Shielded Room Temperature:	17°C
Relative Humidity:	52%

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.

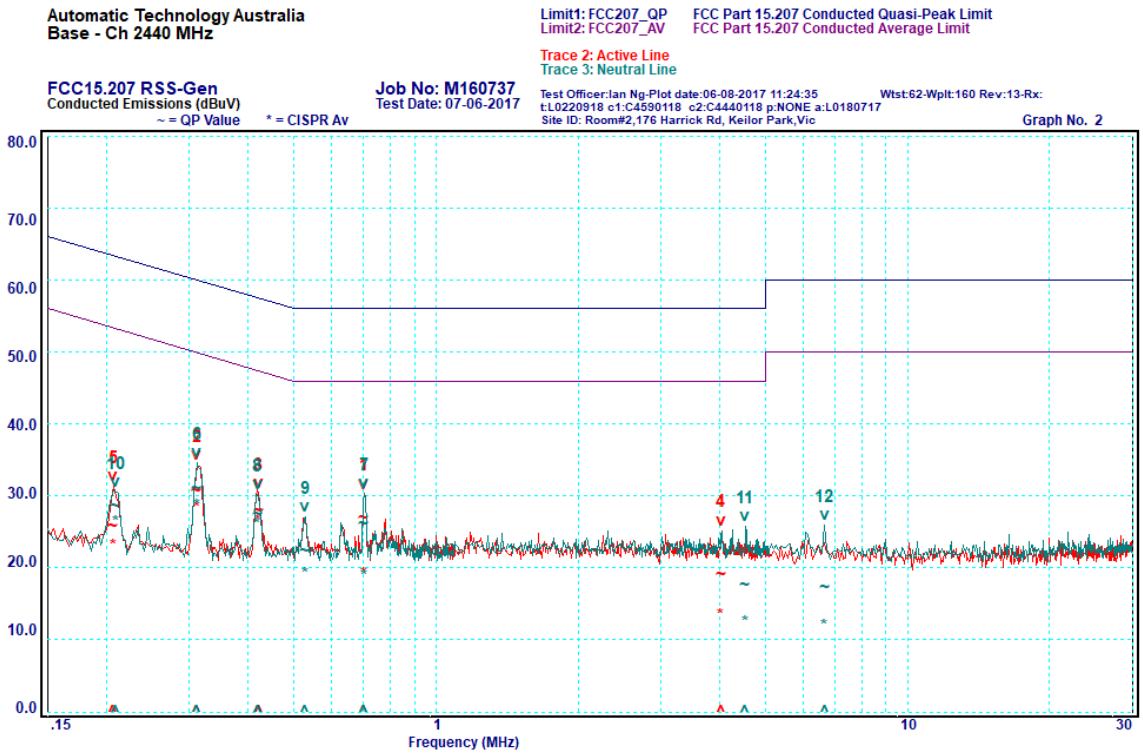
3.2.7 Results of Conducted Emission Measurements

Channel 2405 MHz, 0.15 - 30 MHz



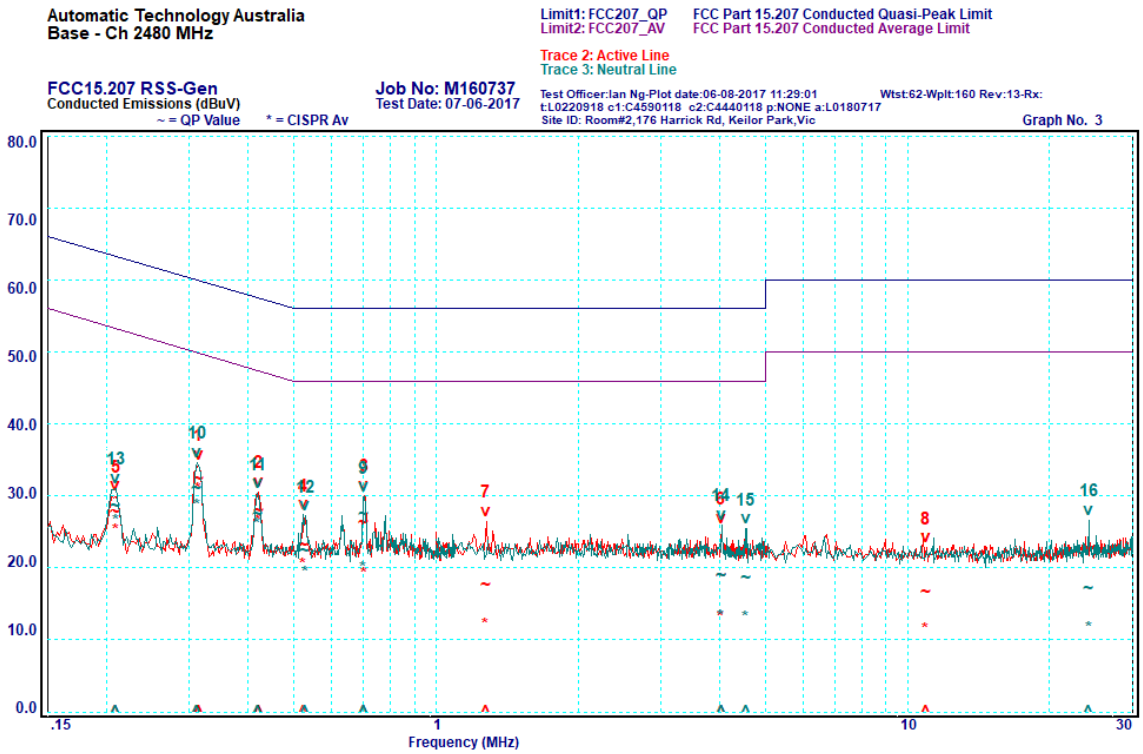
Peak	Frequency [MHz]	Line	Quasi-Peak			Average		
			Level [dBµV]	Limit [dBµV]	Margin [±dB]	Level [dBµV]	Limit [dBµV]	Margin [±dB]
1	0.314	Active	32.3	59.9	-27.6	30.8	49.9	-19.1
2	0.421	Active	27.8	57.4	-29.6	26.4	47.4	-21.0
3	0.630	Active	22.2	56.0	-33.8	18.5	46.0	-27.5
4	0.706	Active	21.8	56.0	-34.2	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

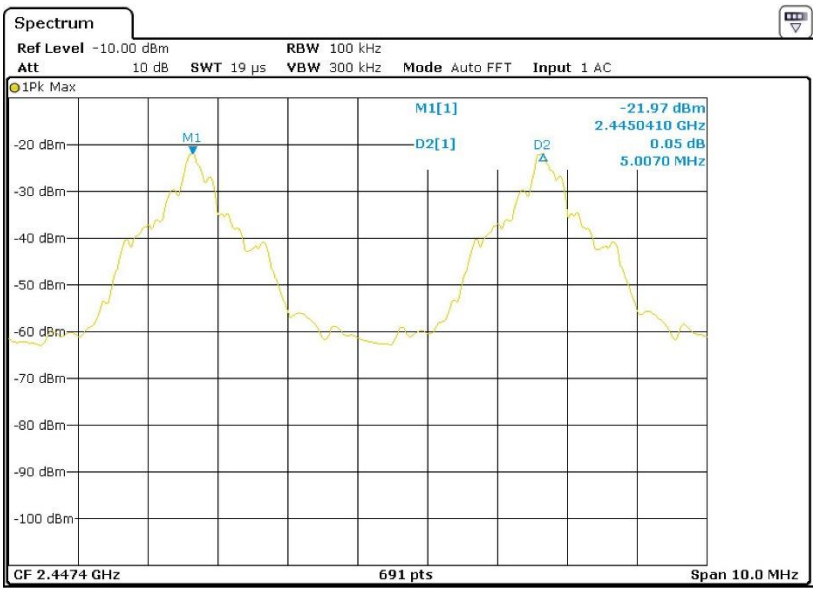
3.3 §15.247(a1)/RSS-247 5.1(b) Channel Separation

In the band 2400.0 – 2483.5 MHz, the channel separation must be greater than 25 kHz or the 20 dB bandwidth, which ever is greater.

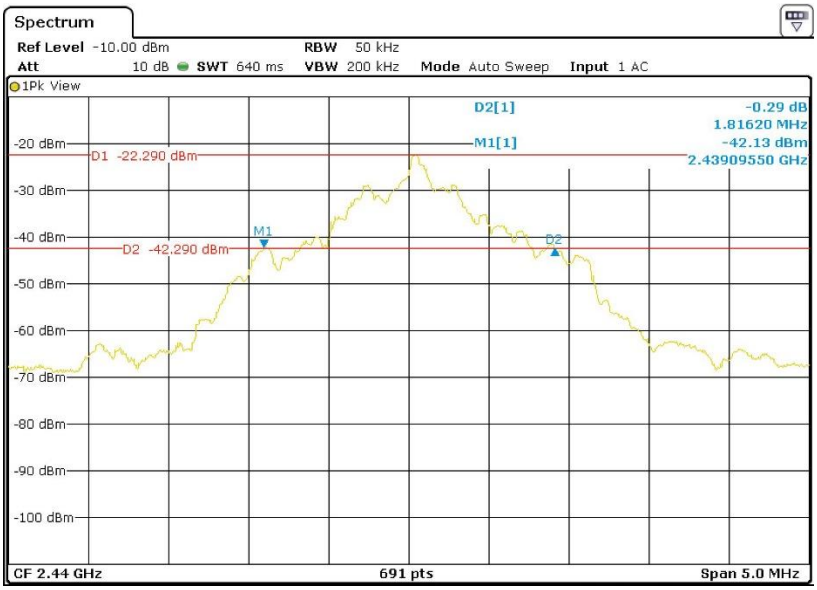
Mode 0:
20 dB Emission Bandwidth = 1.520 MHz

Channel Separation

Channel Separation [kHz]	Limit [kHz]	Result
5007	1520	Complied

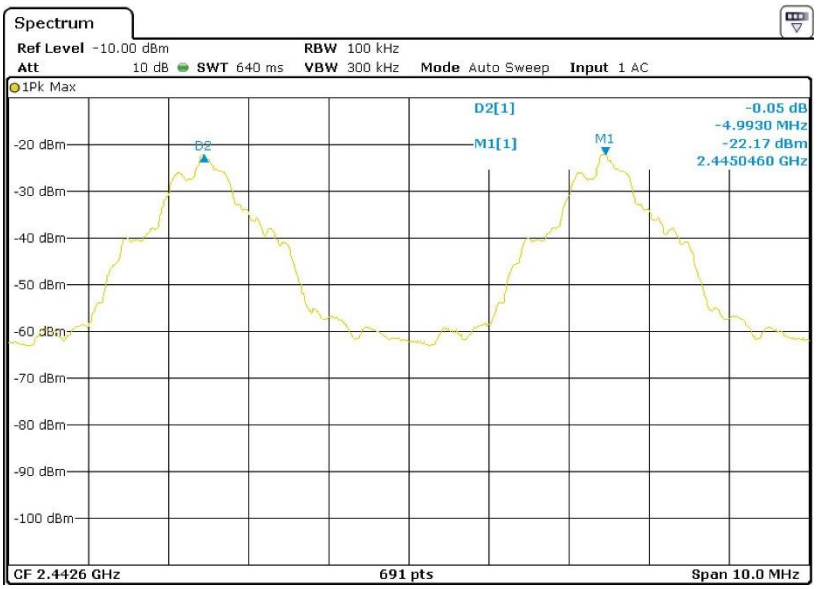


Mode 1:
20 dB Emission Bandwidth = 1.816 MHz



Channel Separation

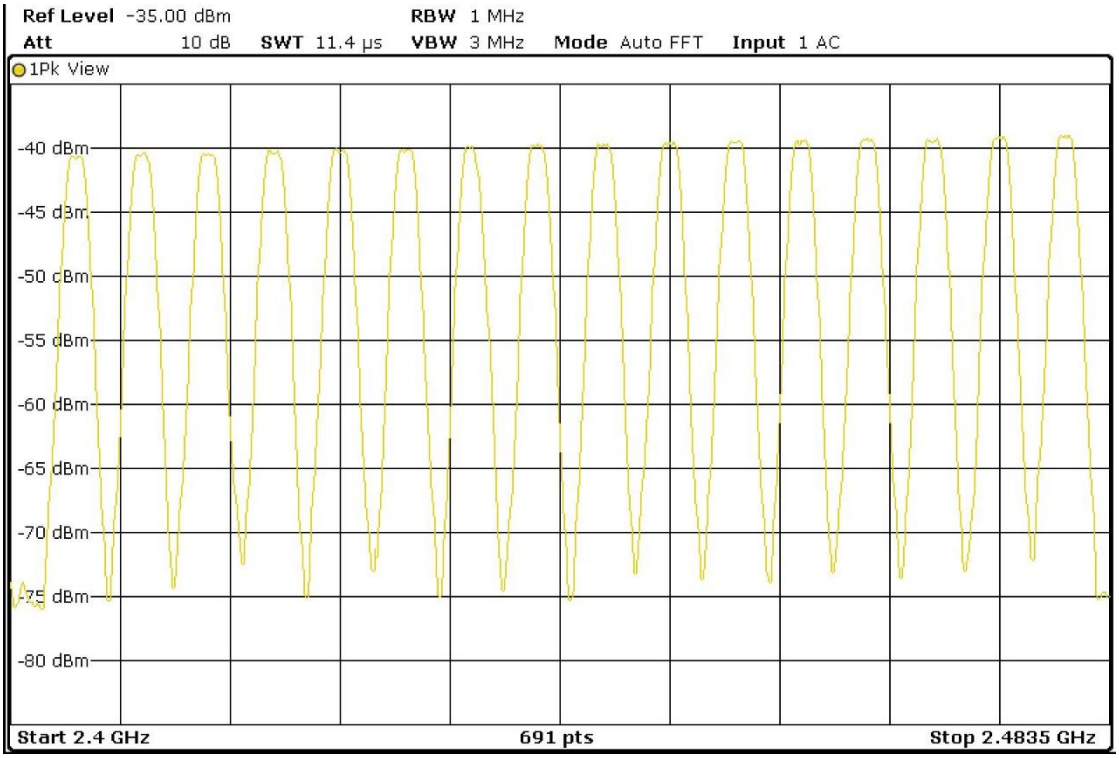
Channel Separation [kHz]	Limit [kHz]	Result
5007	1816	Complied



3.4 §15.247(a1)/RSS-247 5.1(d) Number of channels and time of occupancy

There must be at least 15 hopping channels employed by devices operating in the band 2400-2483.5 MHz.

The WBS-1V2 utilised 16 channels:



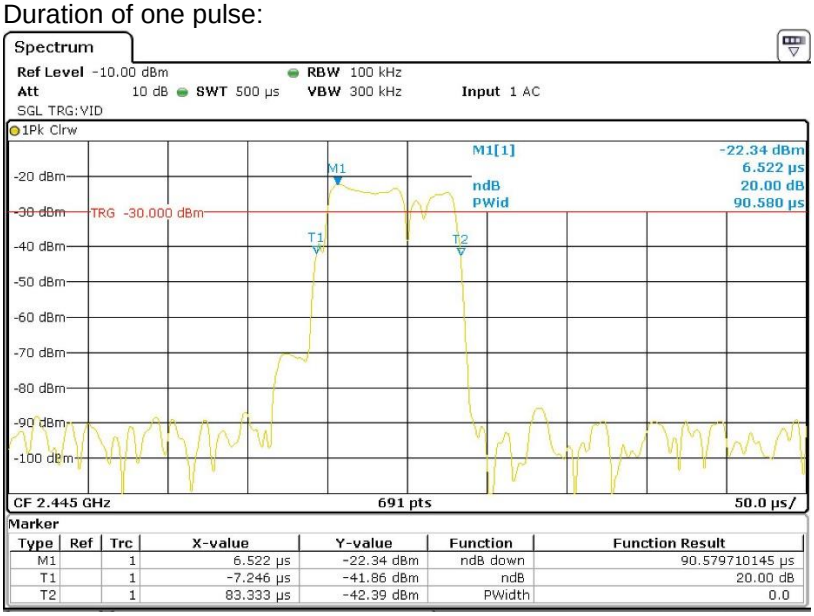
Mode 0 Time of Occupancy

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

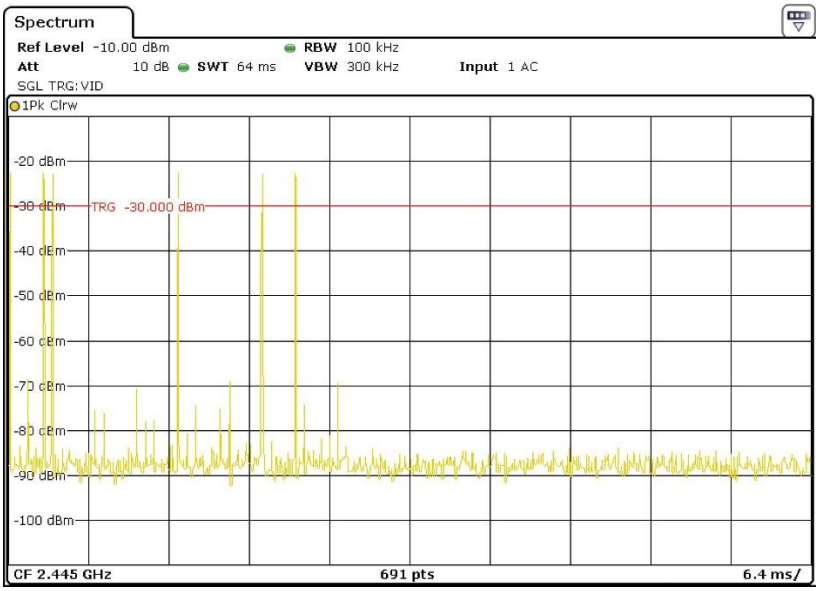
Time of occupancy in 0.4 × 16 = 6.4 seconds ≤ 0.4 seconds.

On time of one pulse	= 91 µs
Number of pulses in 64 ms	= 6
Number of pulses in 6.4 seconds	= 600
Total on time in 6.4 seconds	= 600 × 0.091 ms
	= **54.6 ms** (limit = 400 ms)

Duration of one pulse:



Pulses in 64 ms:



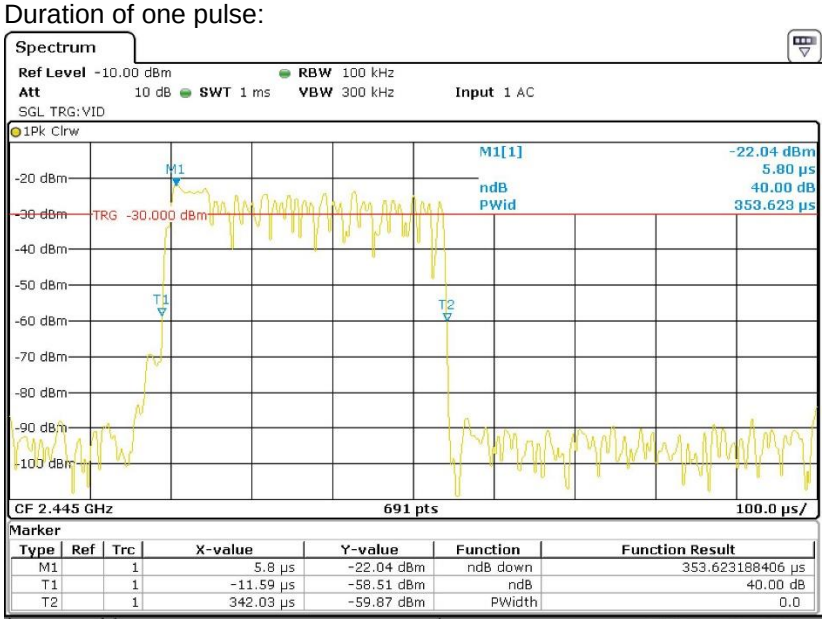
Mode 1 Time of Occupancy

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

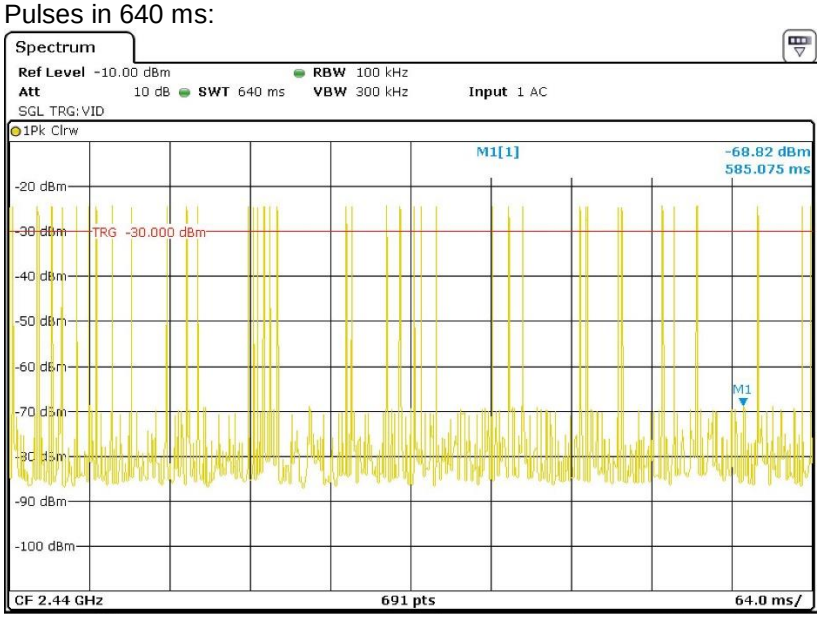
Time of occupancy in 0.4 × 16 = 6.4 seconds ≤ 0.4 seconds.

On time of one pulse	= 354 µs
Number of pulses in 640 ms	= 39
Number of pulses in 6.4 seconds	= 390
Total on time in 6.4 seconds	= 390 × 0.354 ms
	= **138 ms** (limit = 400 ms)

Duration of one pulse:

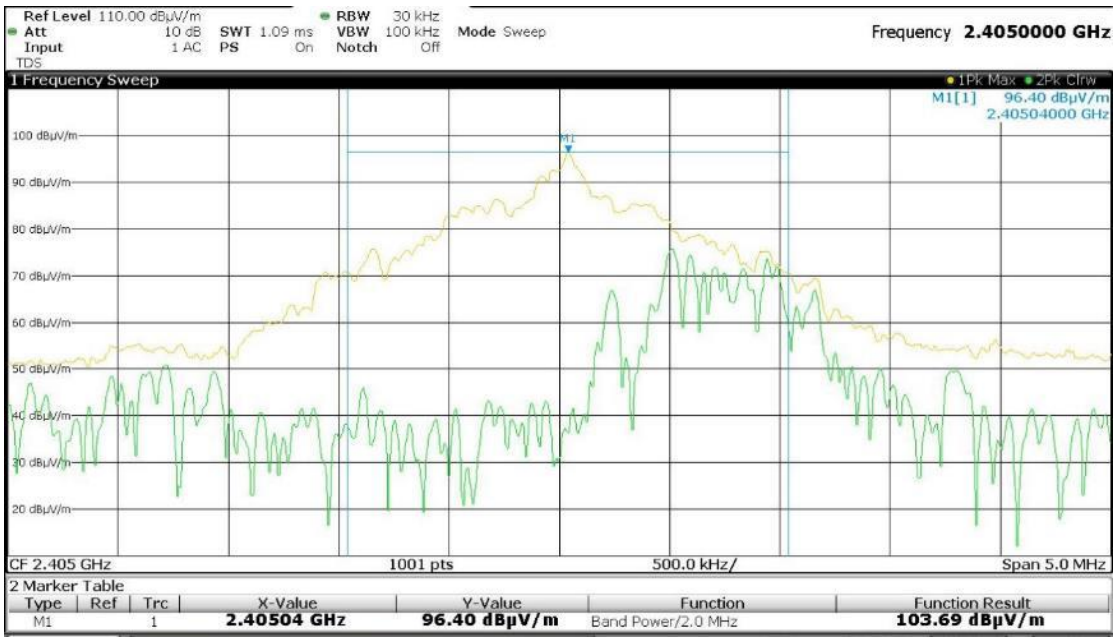


Pulses in 640 ms:

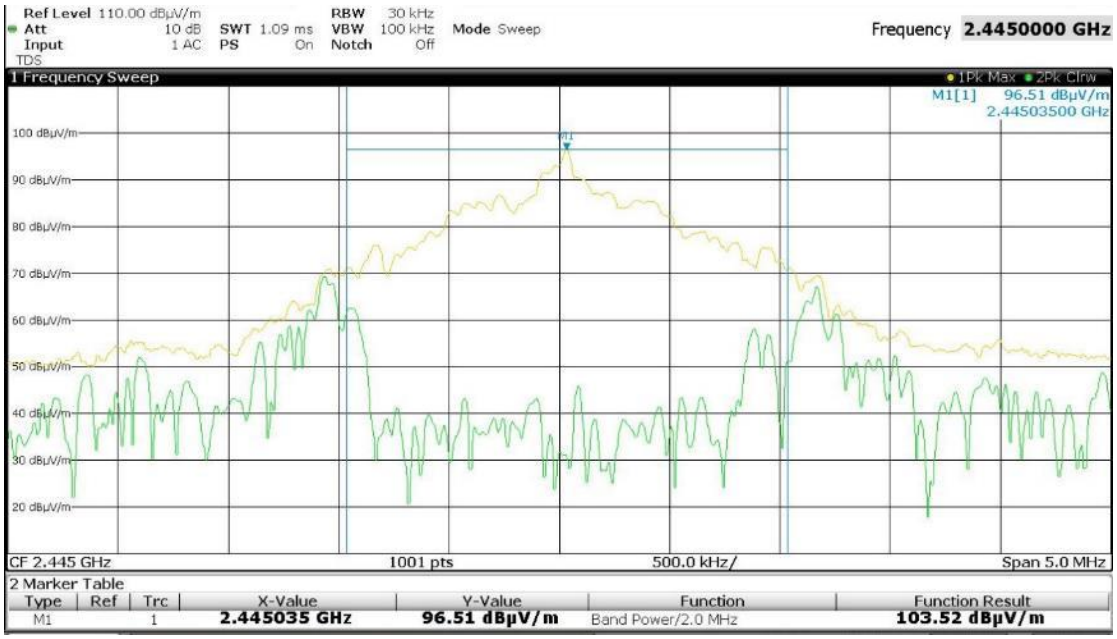


3.5 §15.247(b)/RSS-247 5.4(d) Peak Output power

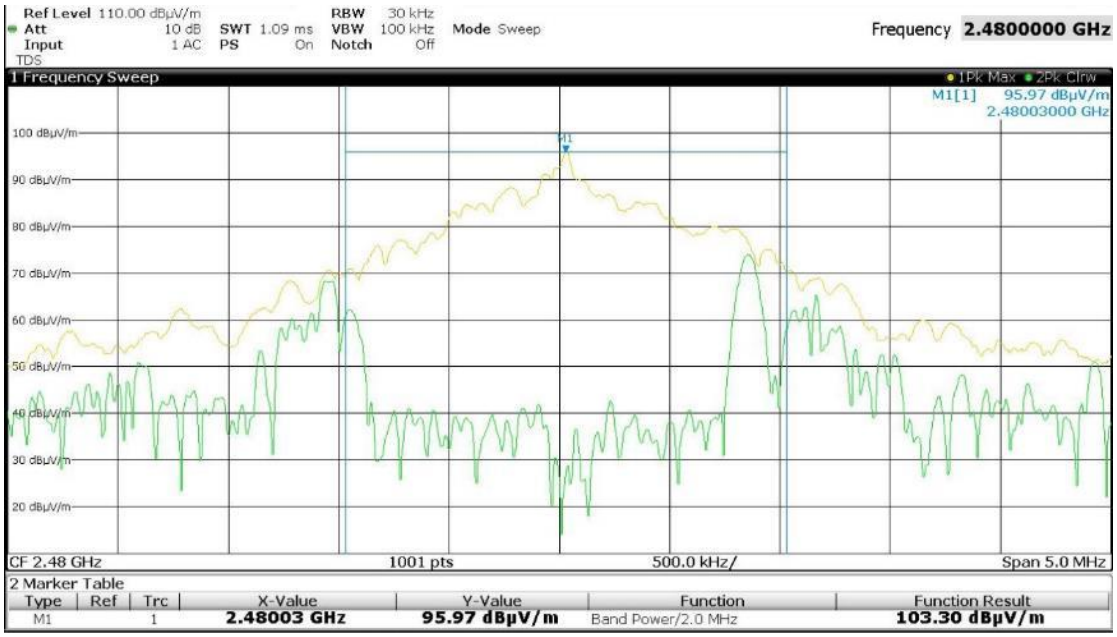
Testing was performed in a semi-anechoic chamber at a distance of 3 metres. Different configurations of EUT and antenna polarization were investigated to produce highest emission EIRP and the EUT was set to transmit in continuous transmission mode 1 as it had the highest duty cycle.



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	0.500	0.125	0.118	Complied
2445	103.5	8.3	0.007	0.500	0.125	0.118	Complied
2480	103.3	8.1	0.006	0.500	0.125	0.119	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

3.6 §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.

3.7 §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.

3.8 §15.247(d)/RSS-247 5.5 Out of Band Emissions

3.8.1 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

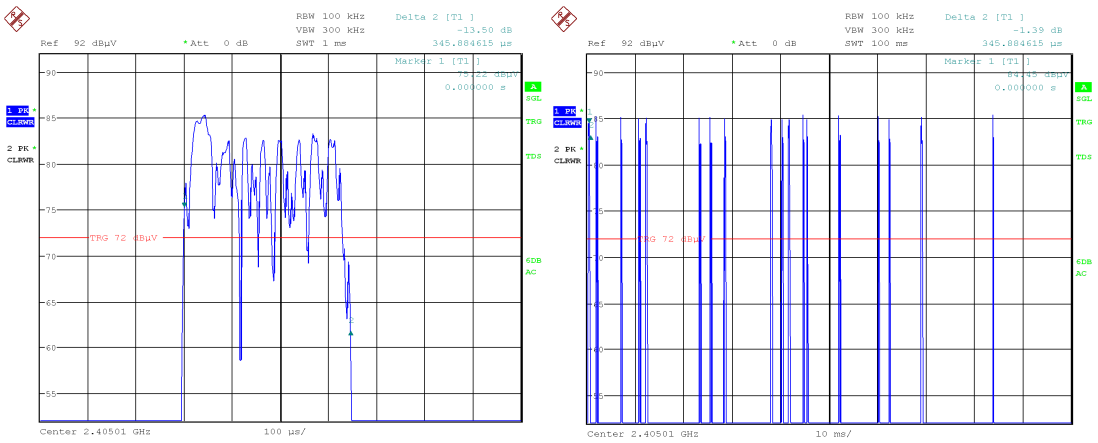
The transmitted signal was pulsed. Transmission mode 1 was applied as it had the highest duty cycle.The following duty cycle correction was applied to the peak levels to calculate average emissions at frequcncies above 1 GHz.

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

δ = duty cycle correction factor
Δ = duty cycle

Duty cycle:

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



Duty cycle correction:

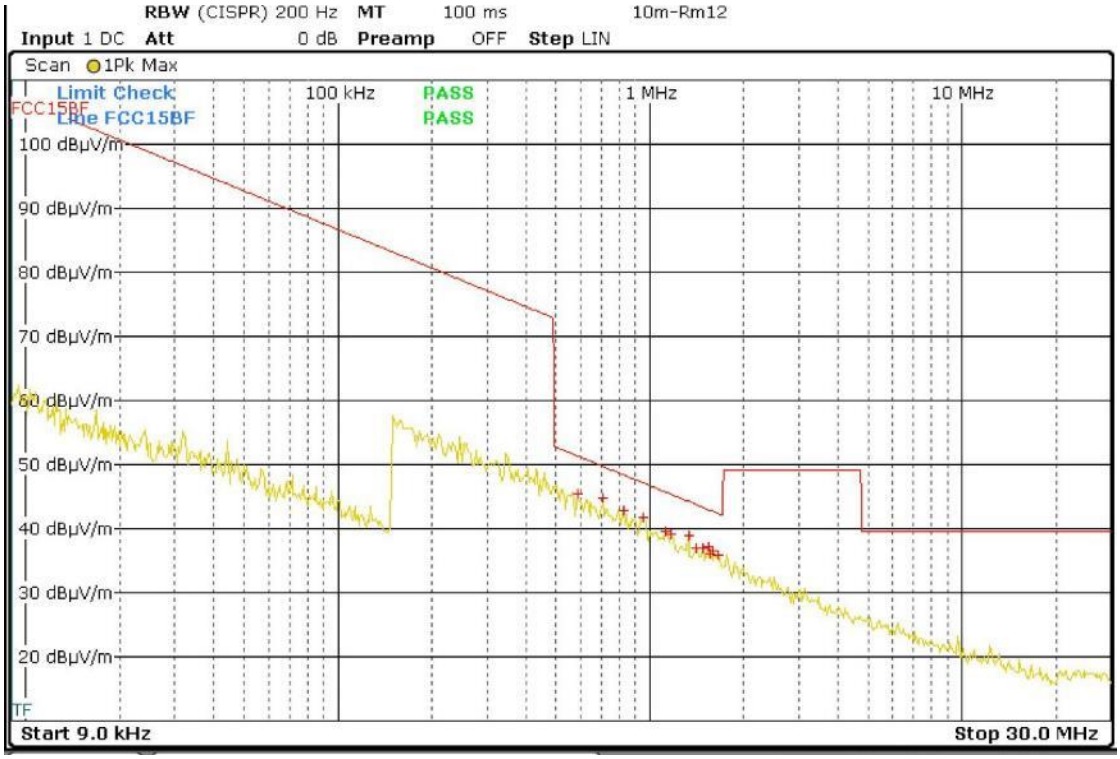
$$\delta = 20\log(0.063)$$
$$\delta = -24.0\ dB$$

3.8.2 Conclusion

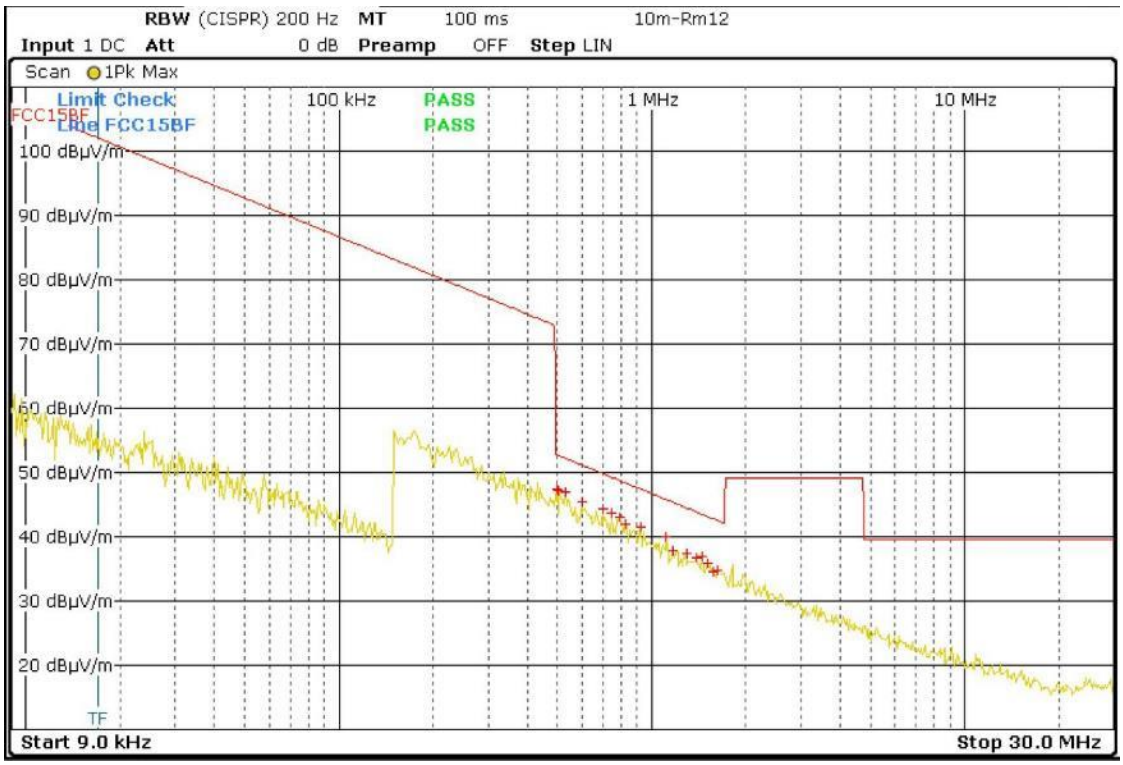
The sample complied with the applicable radiated spurious emission limits §15.247 and RSS-247. Refer to the following graphs for the results.

Frequency Band: 9 kHz - 30 MHz

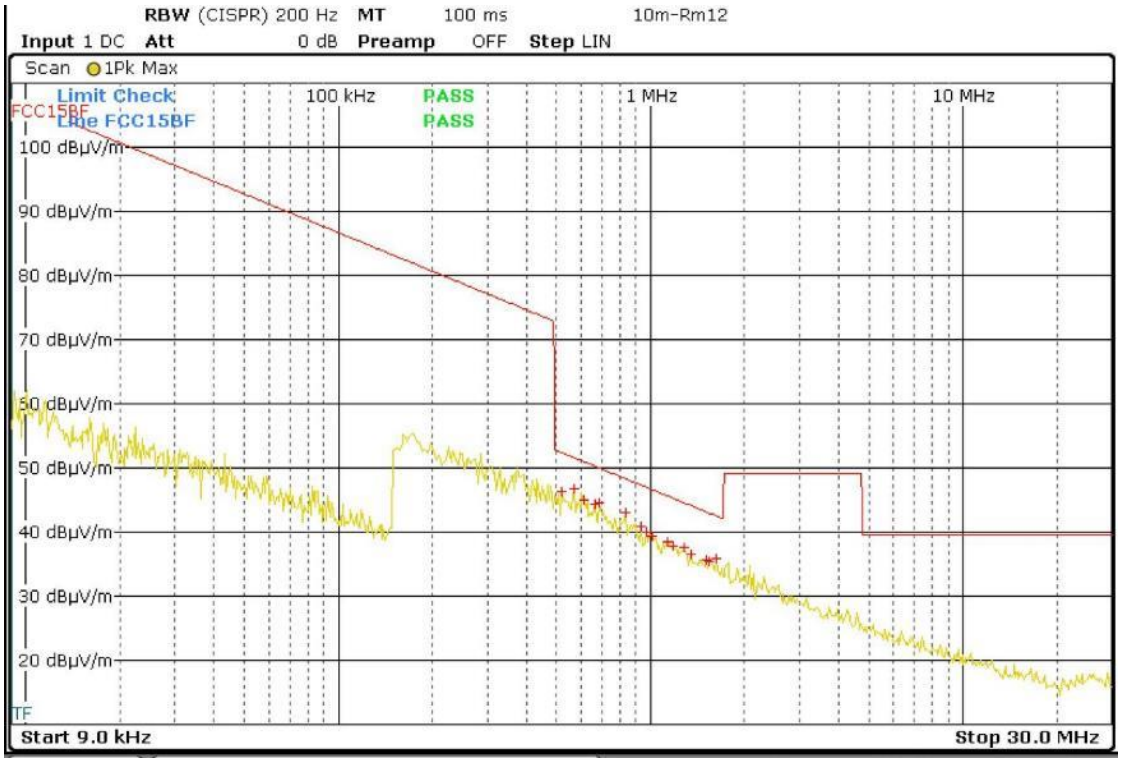
Measurements were made at a distance of 10 metres. The measurement of emissions between 9 kHz – 150 kHz were made with a resolution bandwidth (RBW) of 200 Hz and the video bandwidth (VBW) of 3 kHz, 150 kHz – 30 MHz were measured with the resolution bandwidth (RBW) of 9 kHz and the video bandwidth (VBW)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



Channel 2405 MHz



Channel 2445 MHz



Channel 2480 MHz

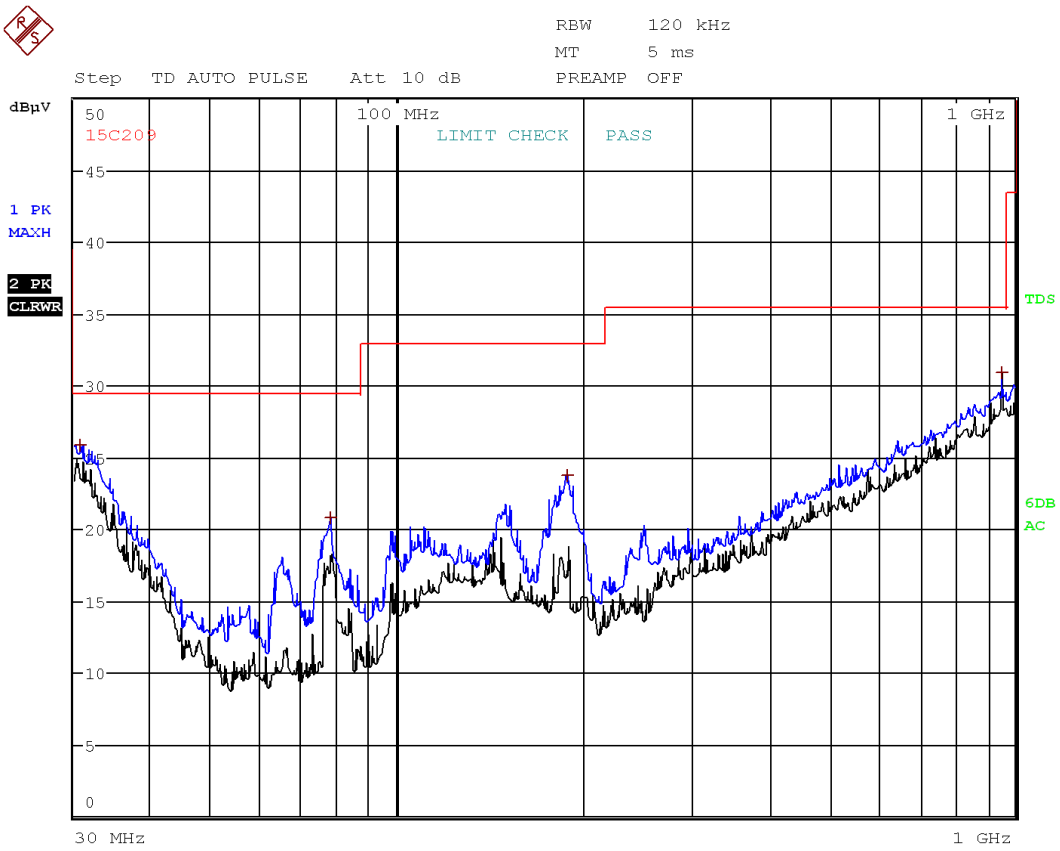
Frequency Band: 30 - 1000 MHz

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.

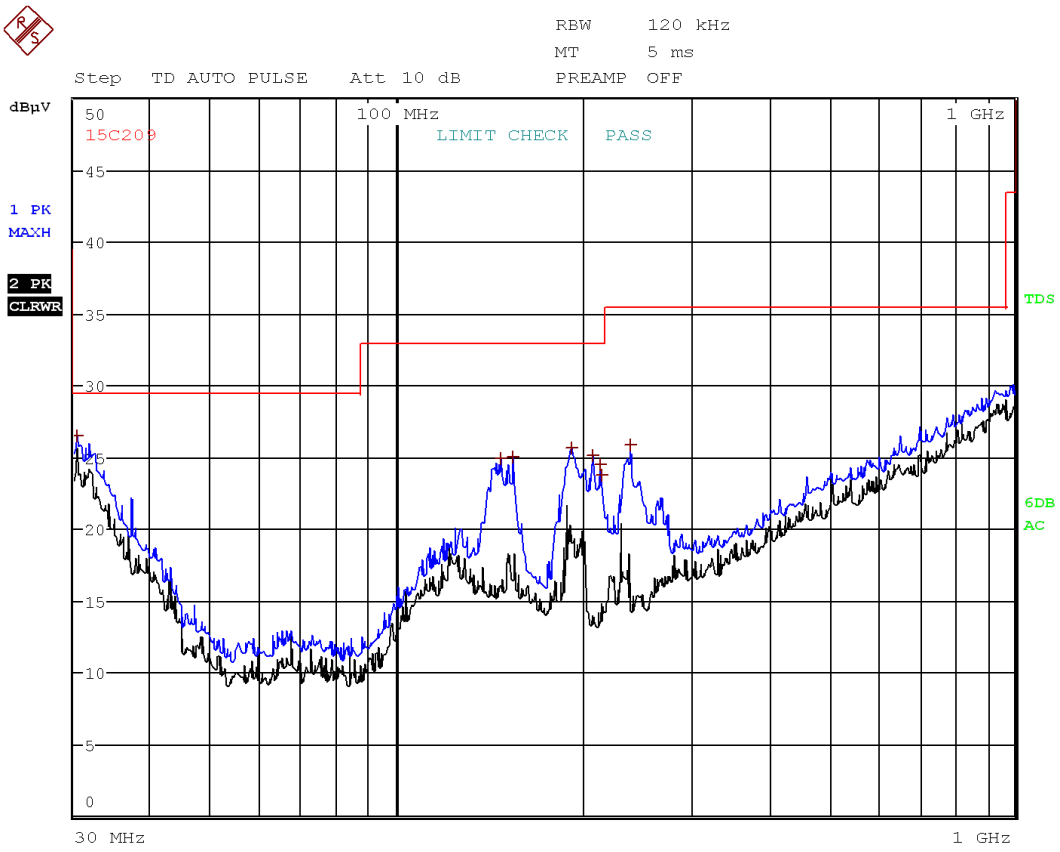
The §15.209 and RSS-Gen 8.10 limits were applied.

Maximum Results:

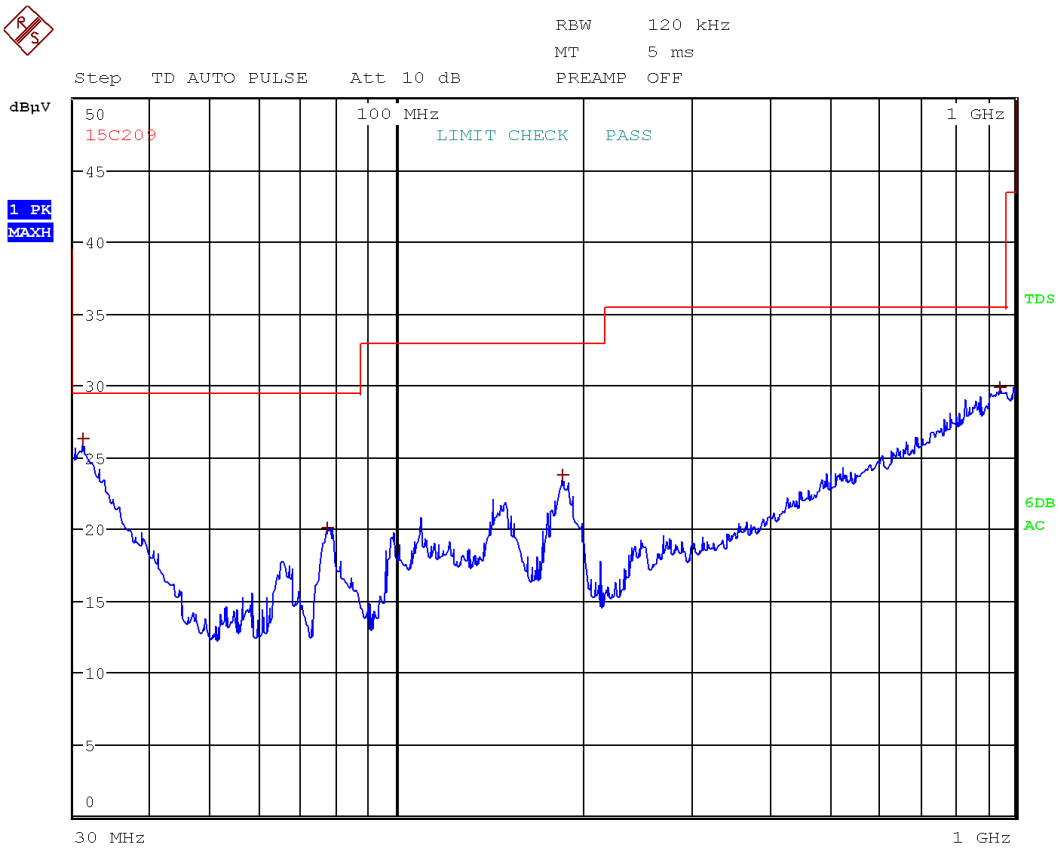
Frequency [MHz]	Quasi-Peak [dBµV/m]	Limit [dBµV/m]	Margin [dB]
147.540	17.2	33.0	-15.8
191.190	17.0	33.0	-16.0
191.318	14.6	33.0	-18.4
207.750	14.7	33.0	-18.3



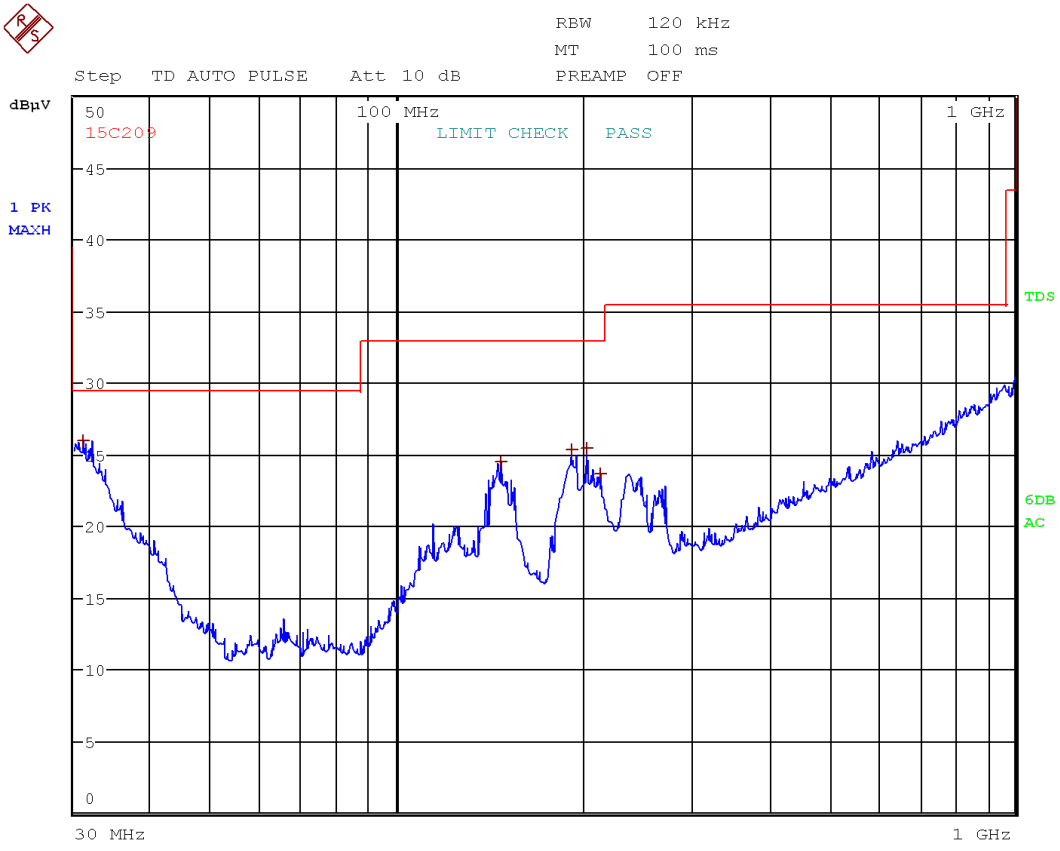
Channel 2405, Vertical Polarisation



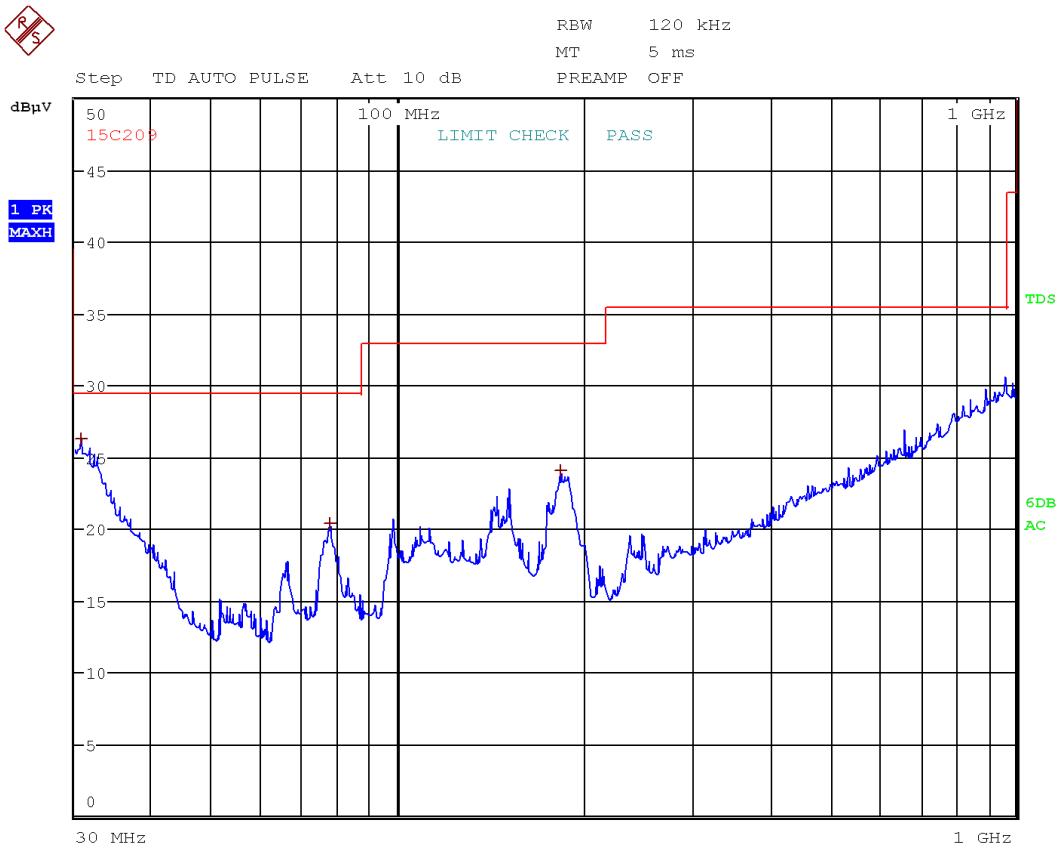
Channel 2405, Horizontal Polarisation



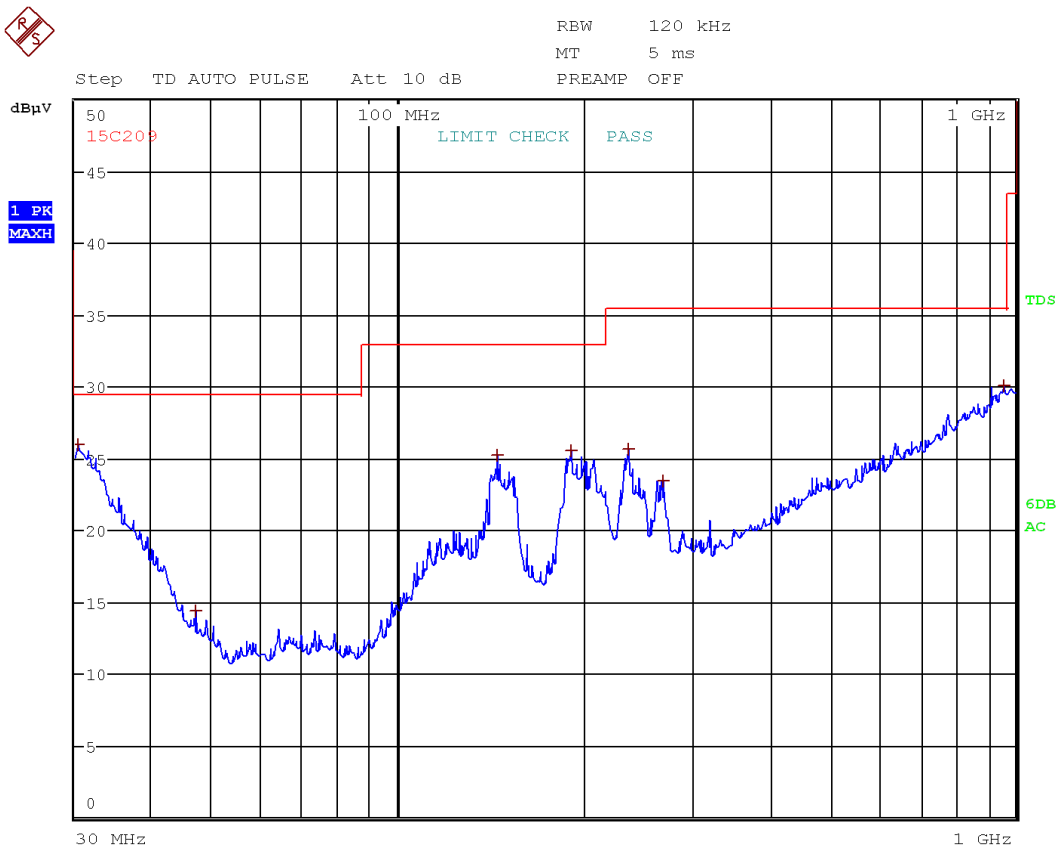
Channel 2445, Vertical Polarisation



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.

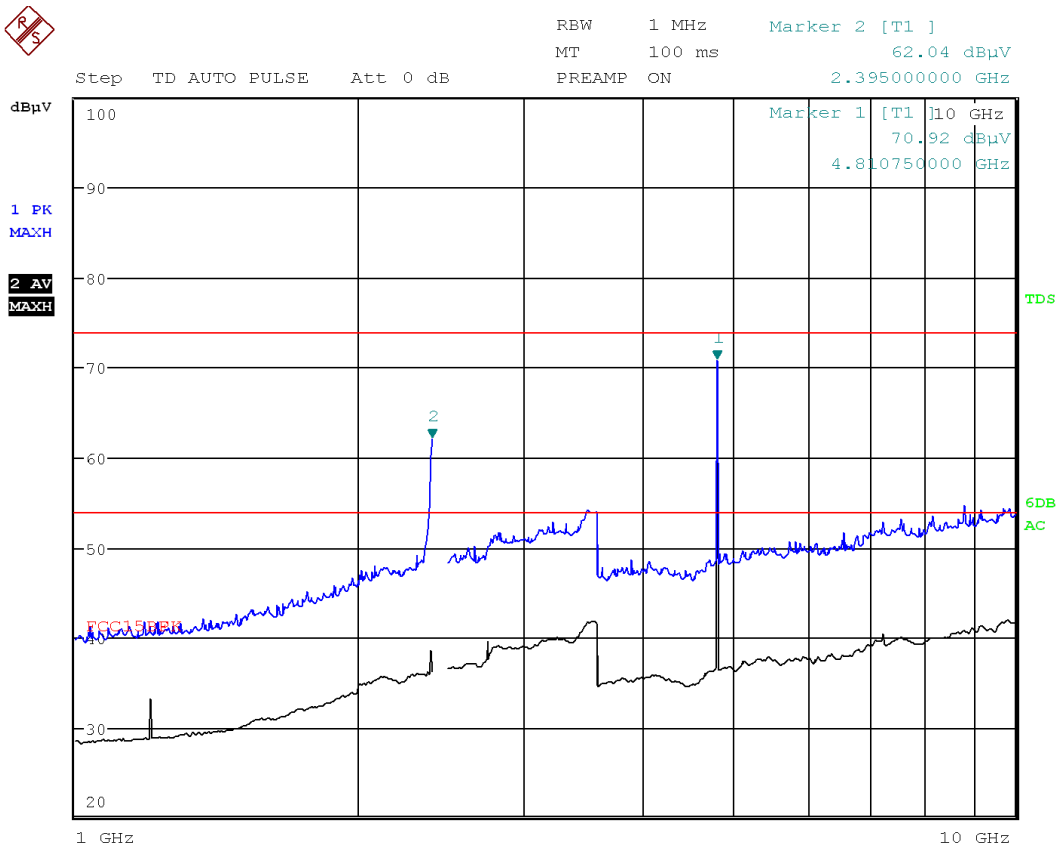
Maximum Peak Results:

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

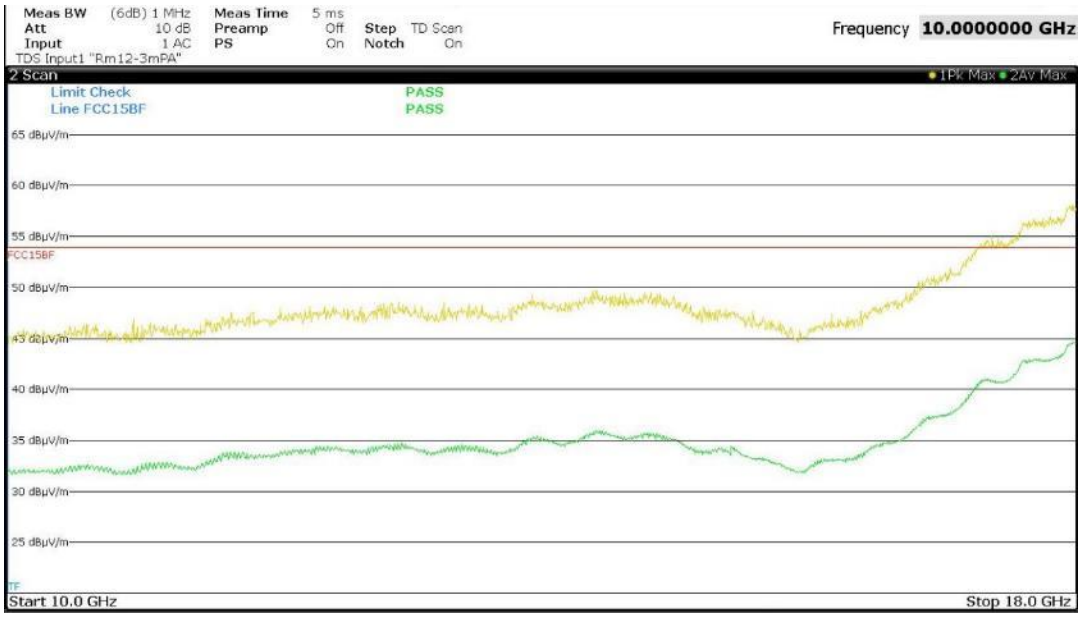
Maximum Average Results, correction factor of -24.0 dB to peak:

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

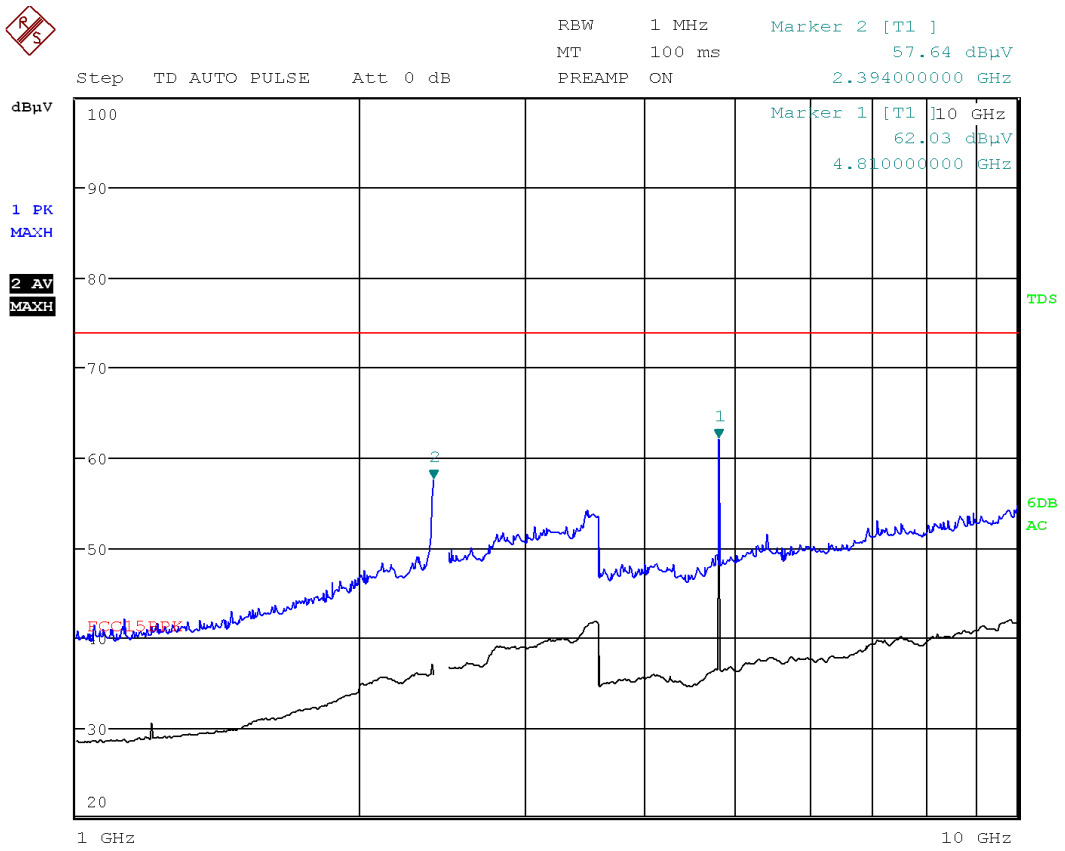


1 to 10 GHz

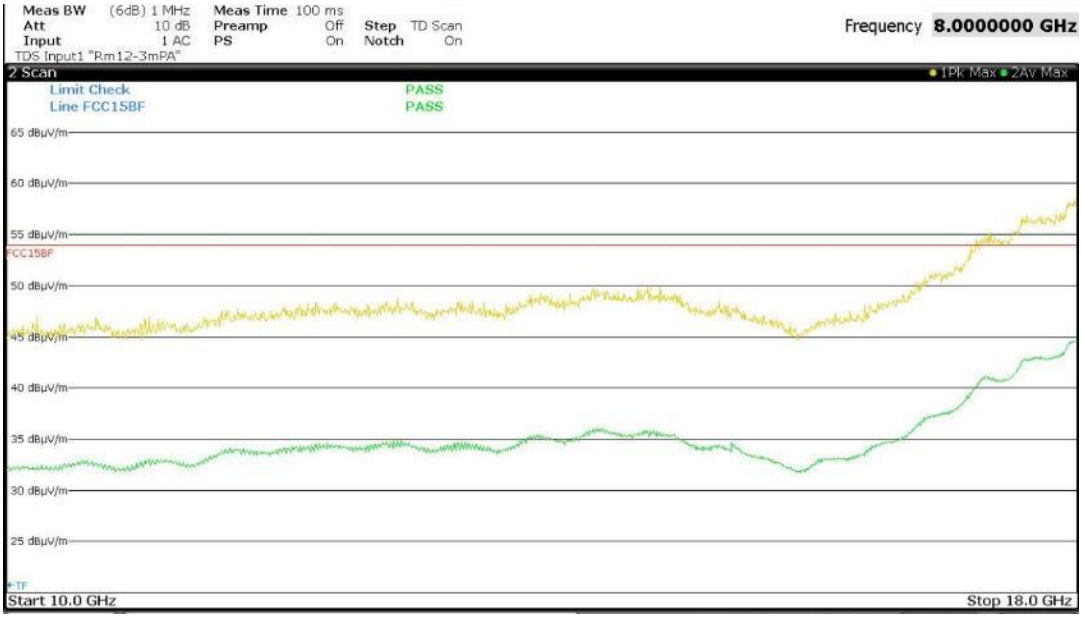


10 to 18 GHz

Channel 2405 MHz – Horizontal, 1 to 18 GHz

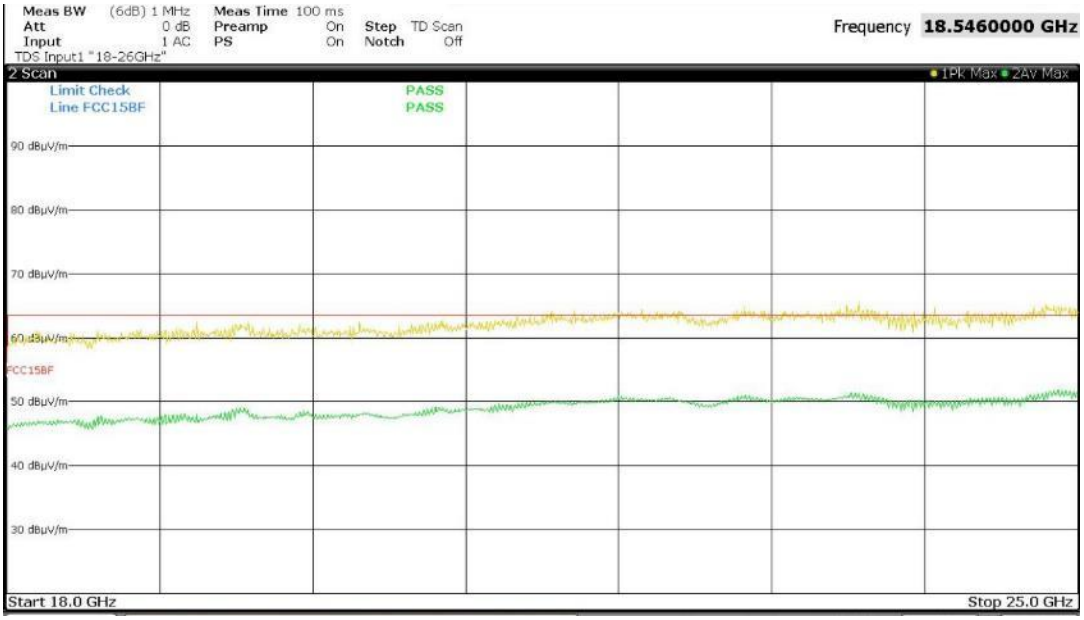


1 to 10 GHz

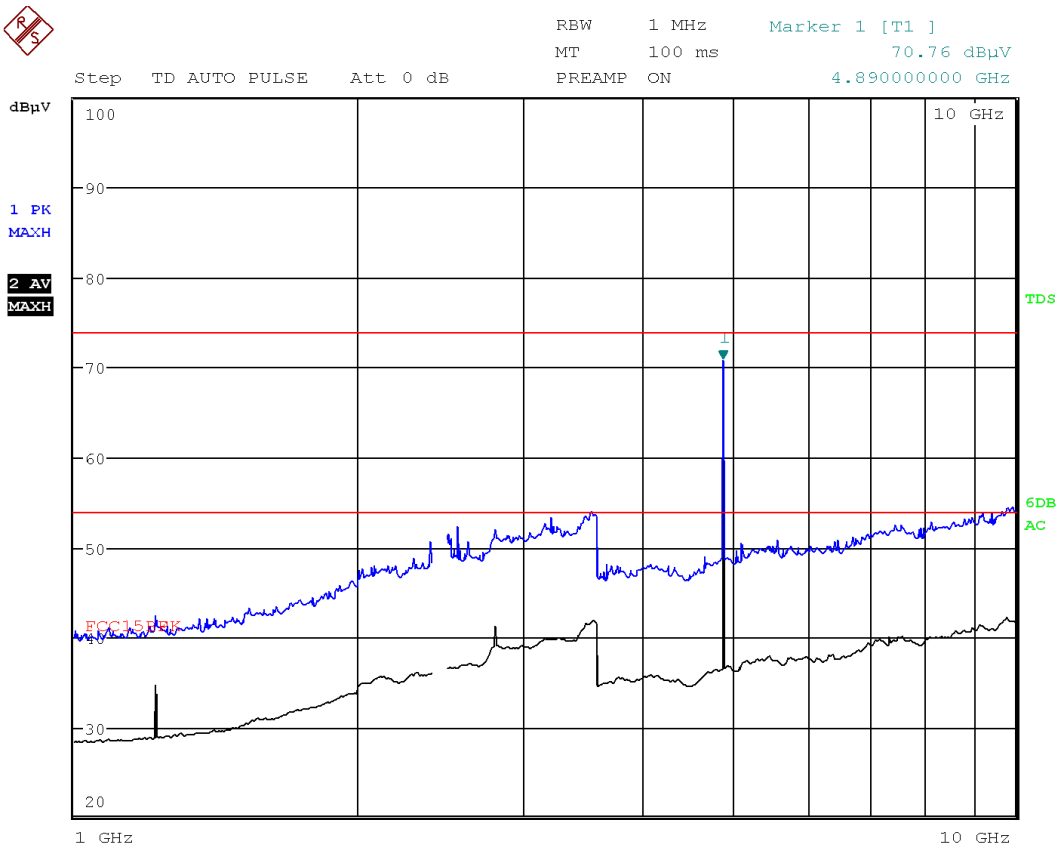


10 to 18 GHz

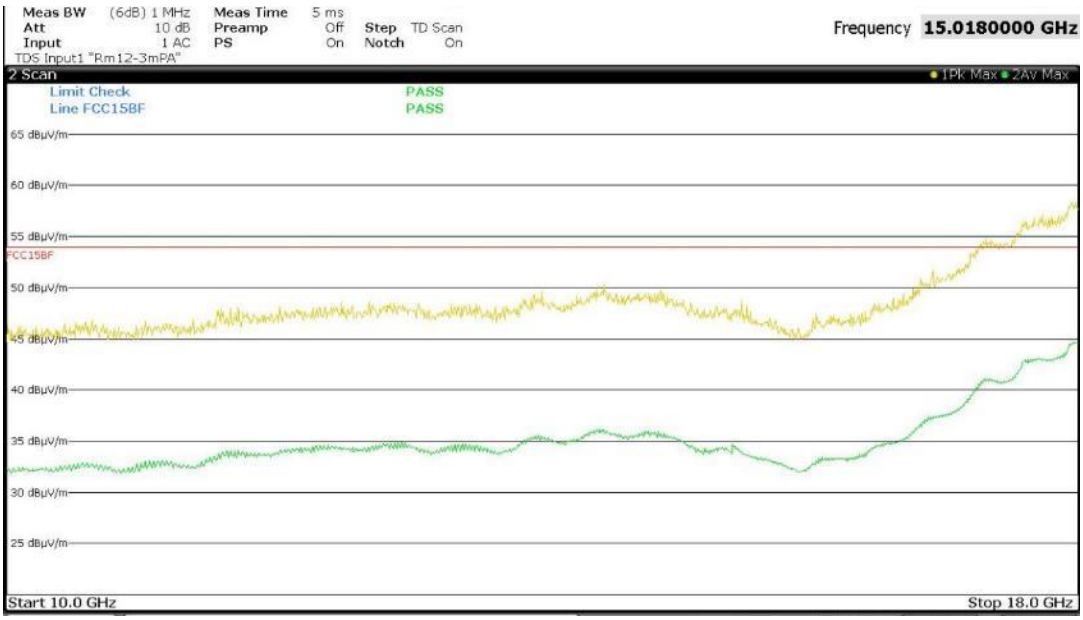
Channel 2405 MHz – Vertical and Horizontal Combined 18 to 25 GHz



Channel 2445 MHz – Vertical, 1 to 18 GHz

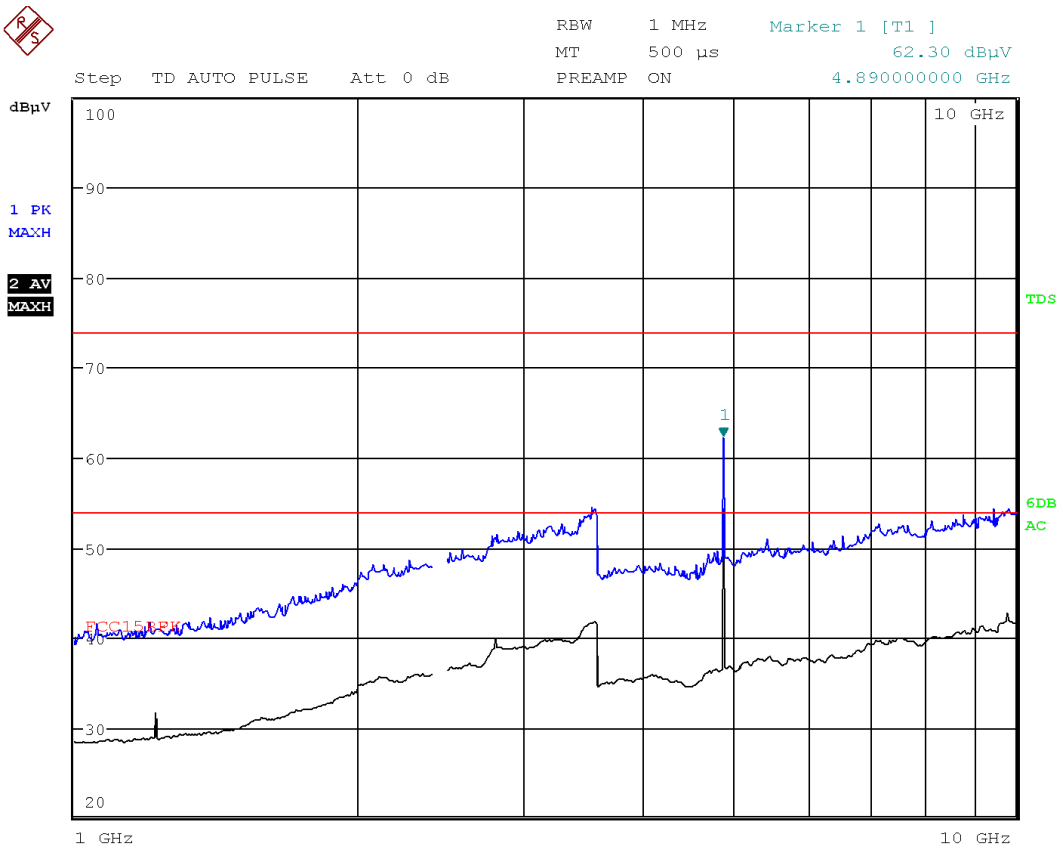


1 to 10 GHz

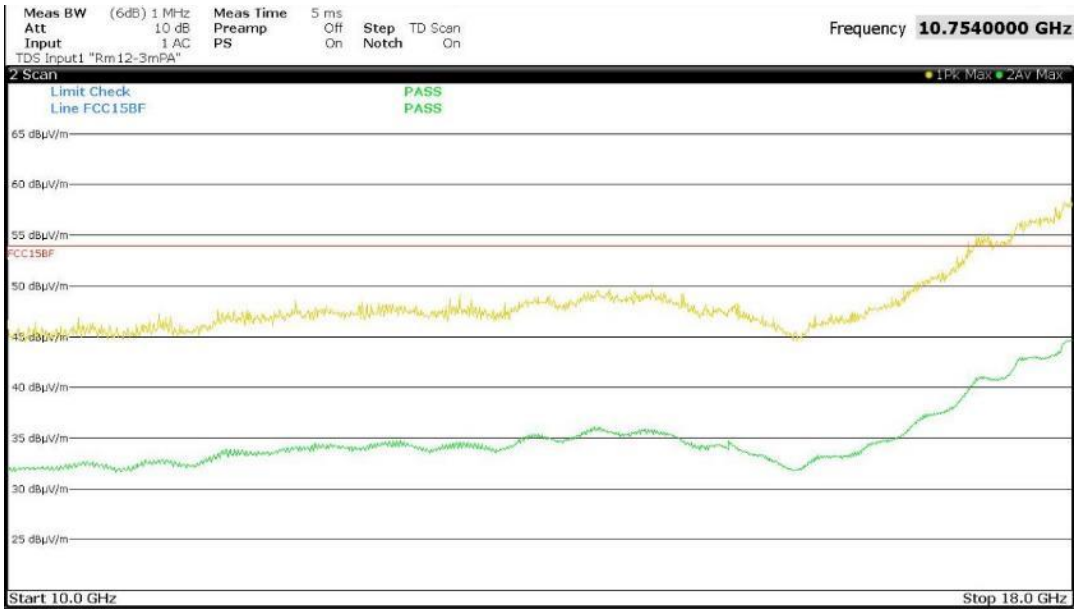


10 to 18 GHz

Channel 2445 MHz – Horizontal, 1 to 18 GHz

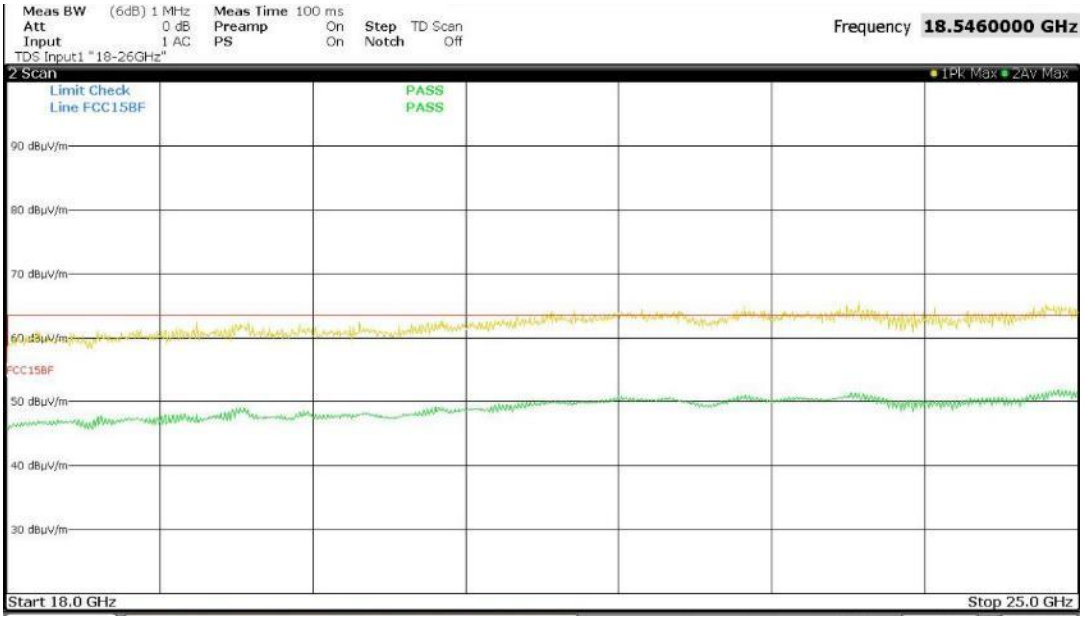


1 to 10 GHz

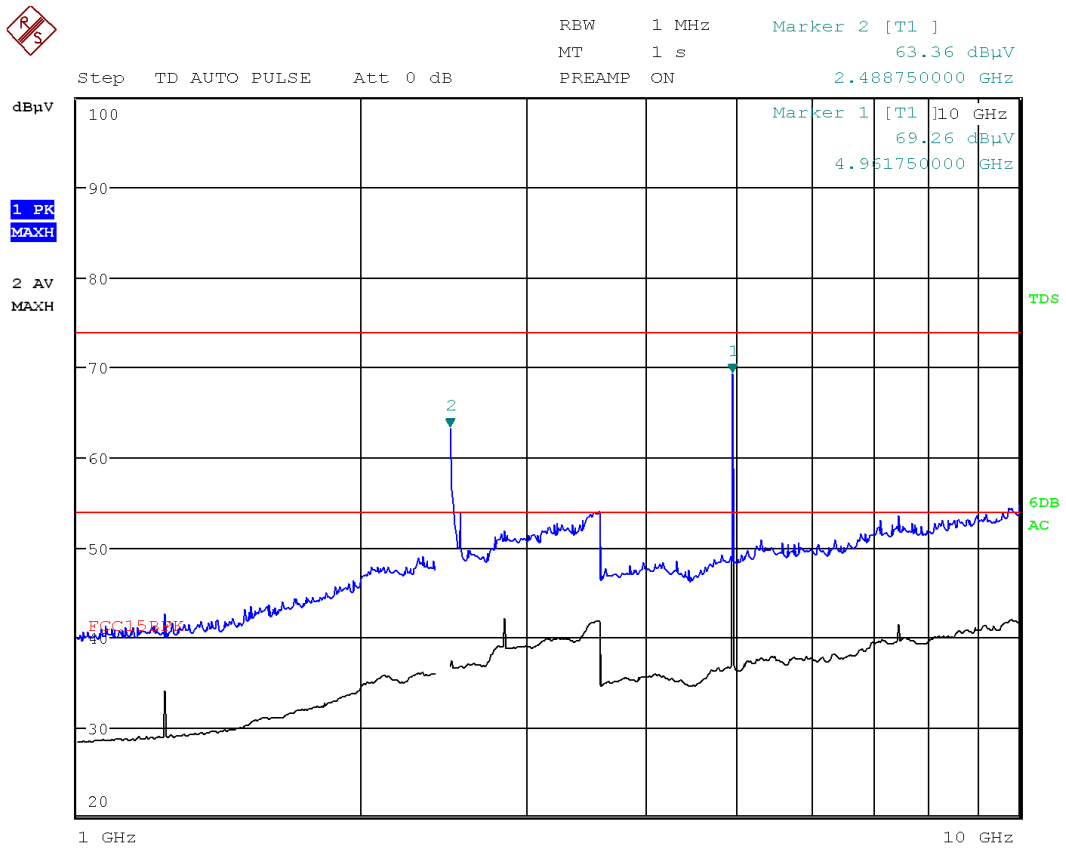


10 to 18 GHz

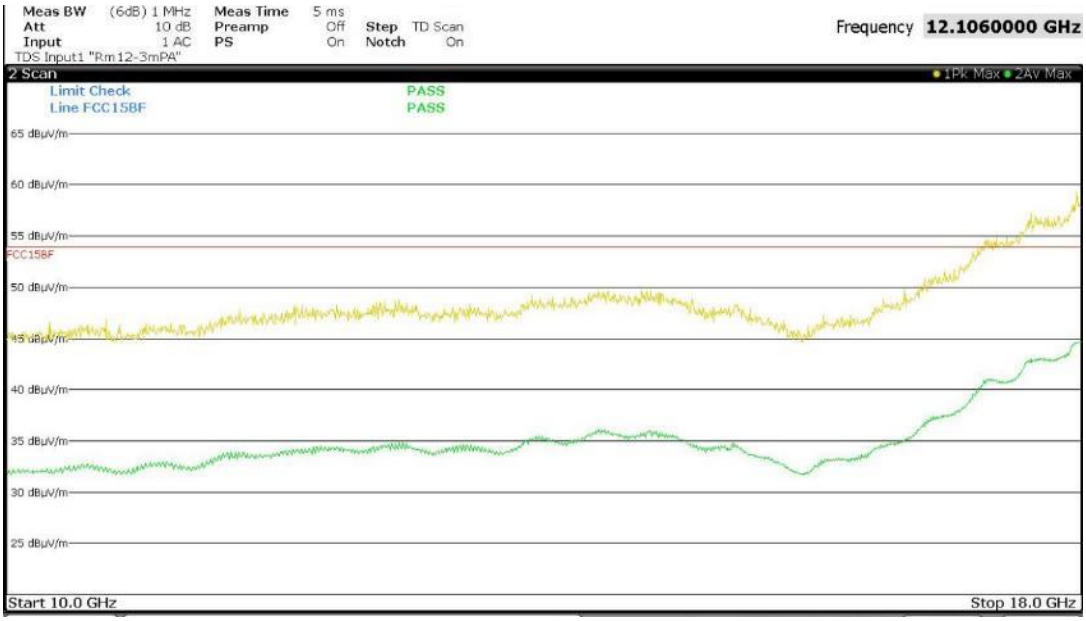
Channel 2445 MHz – Vertical and Horizontal Combined 18 to 25 GHz



Channel 2480 MHz – Vertical, 1 to 18 GHz

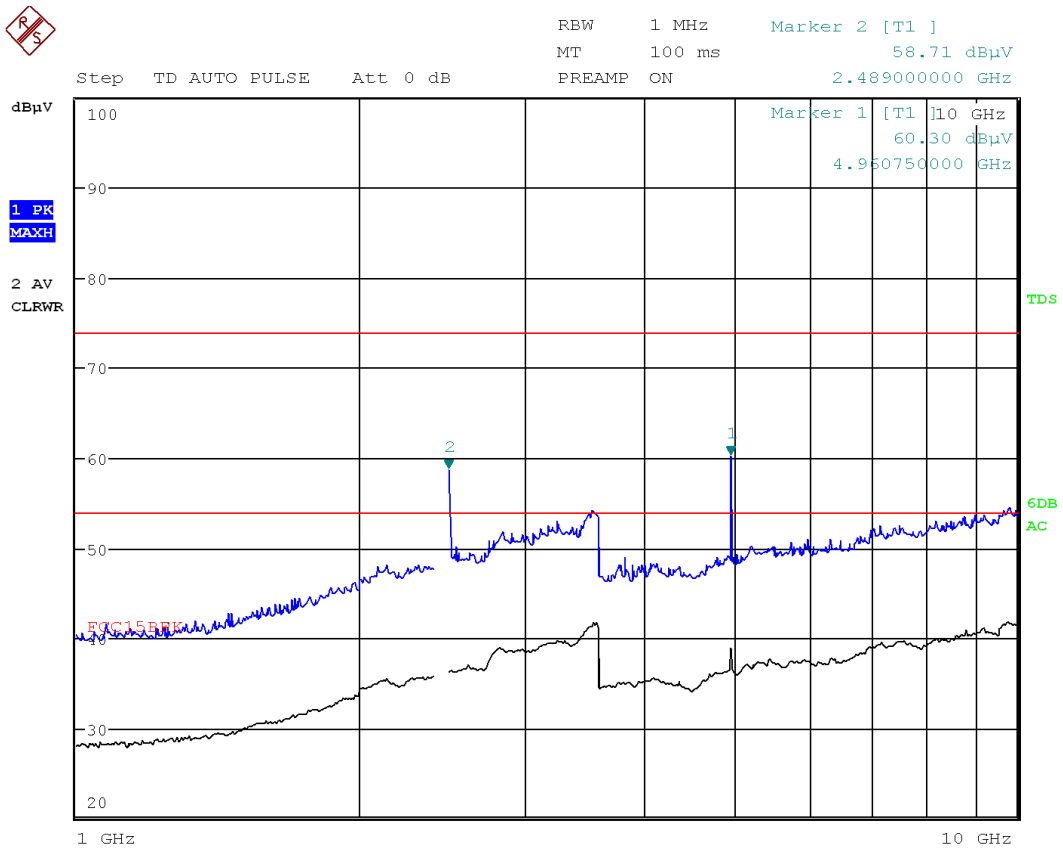


1 to 10 GHz

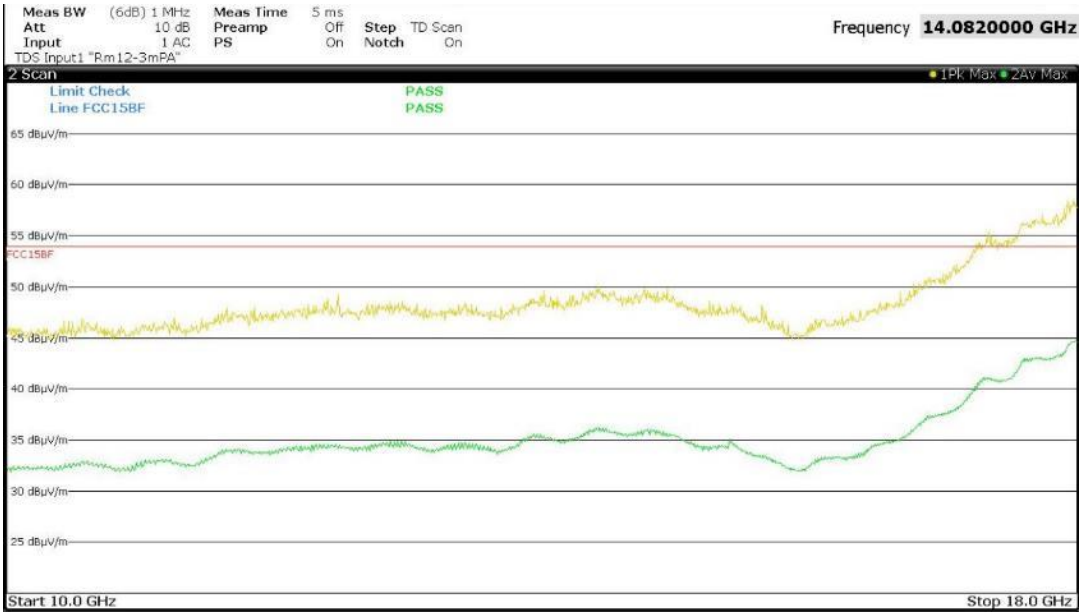


10 to 18 GHz

Channel 2480 MHz – Horizontal, 1 to 18 GHz

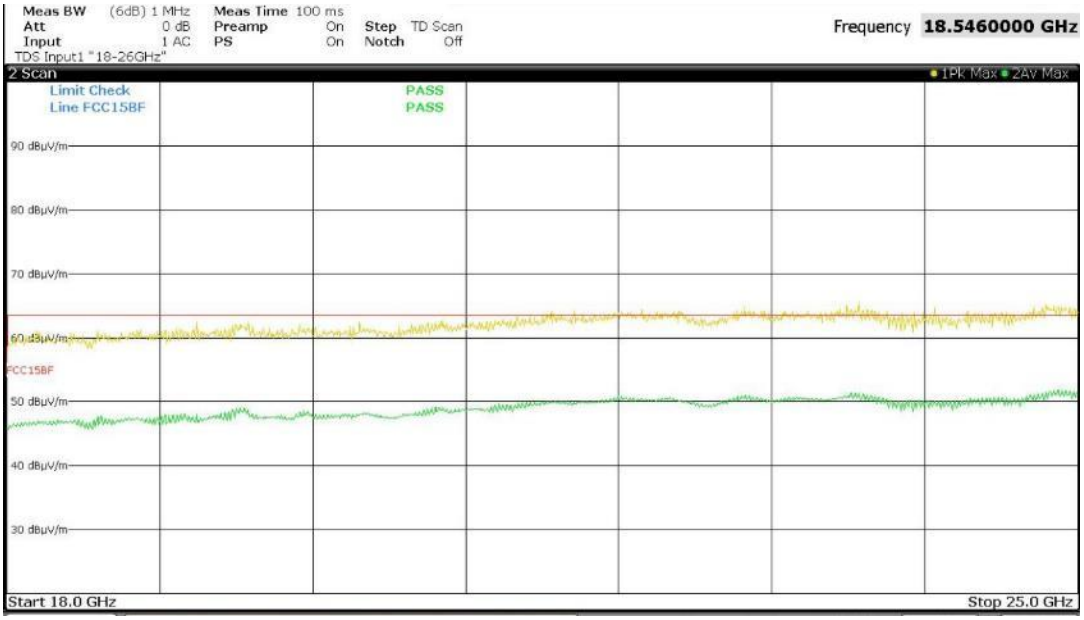


1 to 10 GHz



10 to 18 GHz

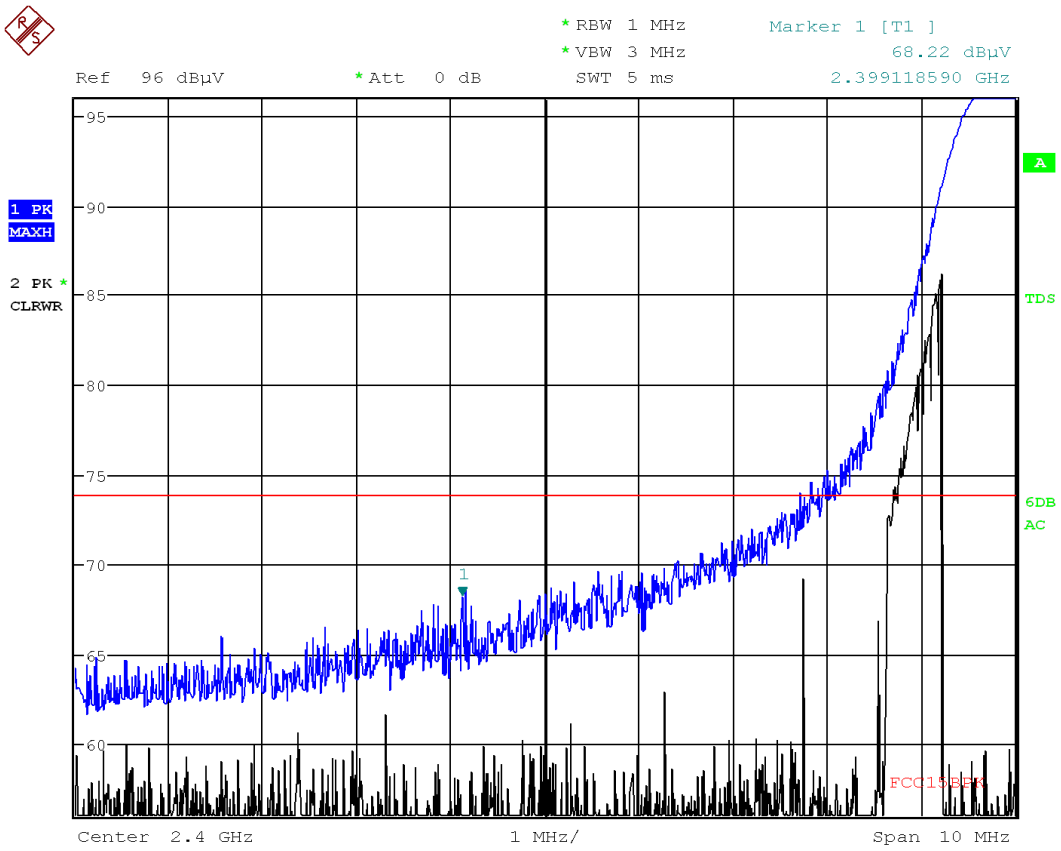
Channel 2480 MHz – Vertical and Horizontal Combined 18 to 25 GHz



3.8.3 Band-Edge Emission Measurements

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

Channel 2405 MHz, Lower Band Edge:



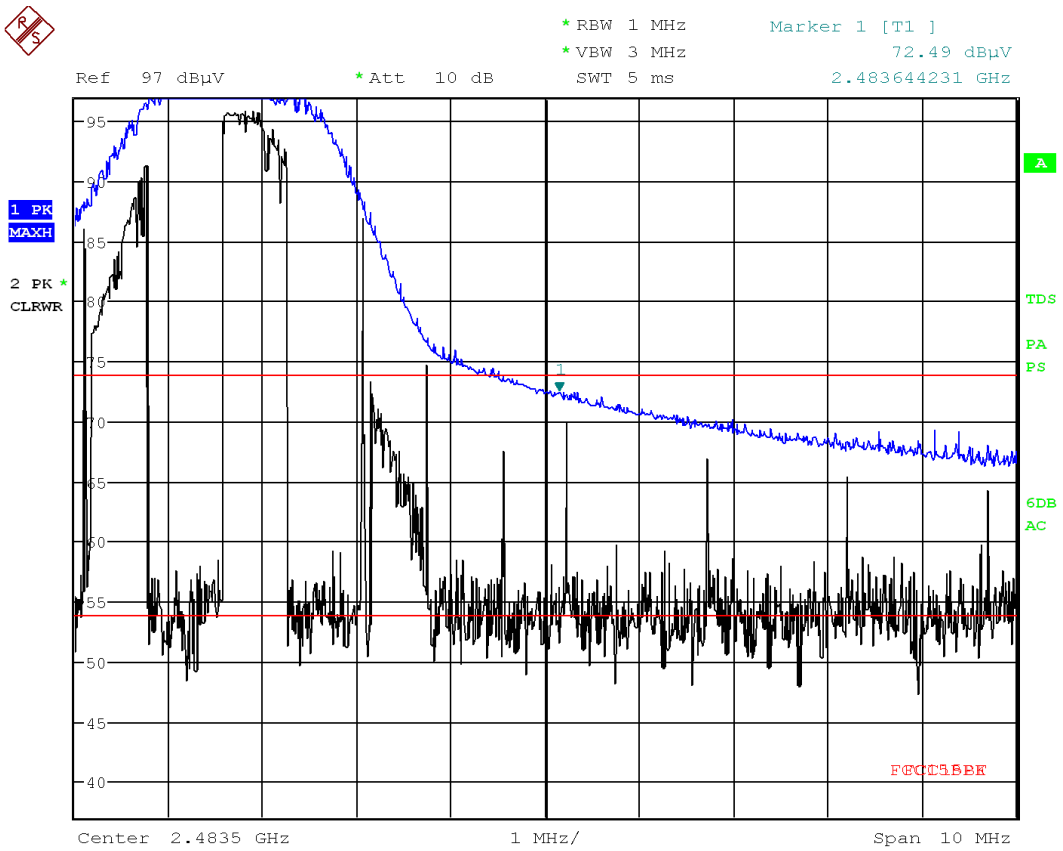
Maximum Peak Results:

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

3.9 §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-1V2, Model (HVIN) WBS-1V2 is deemed to comply with the radio frequency exposure requirements.

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

The Wireless WBS-1V2, Model (HVIN) WBS-1V2 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**

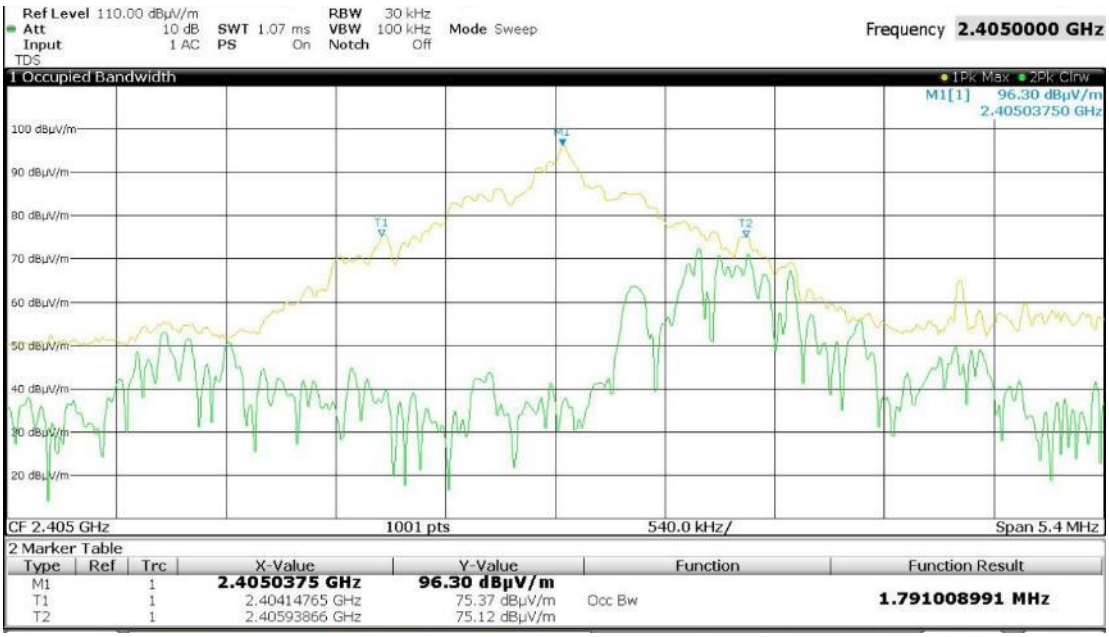
The measured e.i.r.p. (not time averaged) was **0.007 W**

As the radiated power generated by the transmitter was less than the limit the Wireless WBS-1V2, Model (HVIN) WBS-1V2 is deemed to comply with the radio frequency exposure requirements.

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

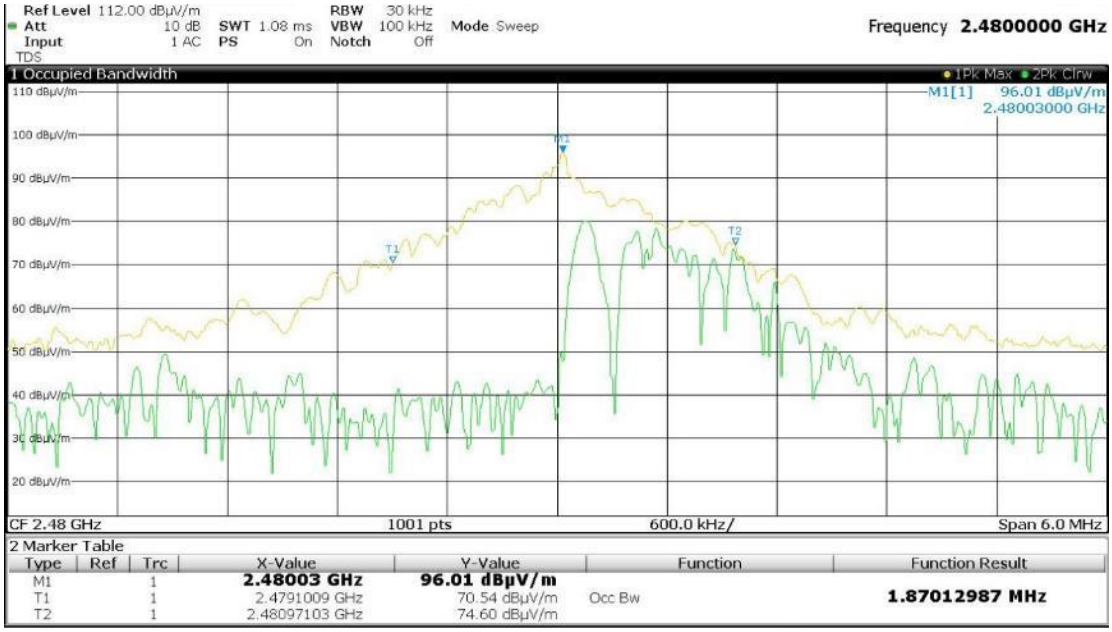
The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 section 6.9. Transmission mode 1 as it had the highest 20 dB bandwidth measured in section 3.3.

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-1V2, Model (HVIN) WBS-1V2 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 Frequency Hopping Spread Spectrum transceiver (FHSS) operating within the band: 2400 MHz to 2483.5 MHz.