

Report on the FCC and IC Testing of:
Frontier Smart Technologies Limited
Minuet 2 Module (FS5352) and Minuet 2 Voice Reference Platform
(FS6626)
In accordance with FCC 47 CFR Part 15C,
ISED C RSS-247 and ISED C RSS-GEN (Bluetooth BR/EDR)

Prepared for: Frontier Smart Technologies Limited
Ashwell Point
Babraham Road
Sawston
Cambridge
CB22 3LJ
UNITED KINGDOM

FCC ID: YYX-FS5352 IC: 11458A-FS5352



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Document Number: 75946124-07 | Issue: 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	05 September 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, ISED C RSS-247 and ISED C RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR
Nandhini Mathivanan	Test Engineer	Testing
Graeme Lawler	Test Engineer	Testing

FCC Accreditation ISED C Accreditation
90987 Octagon House, Fareham Test Laboratory IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2018, ISED C RSS-247: Issue 2 (2017-02) and ISED C RSS-GEN: Issue 5 (2018-04) for the tests detailed in section 1.3.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	05 September 2019

Table 1

1.2 Introduction

Applicant	Frontier Smart Technologies Limited
Manufacturer	Frontier Smart Technologies Limited
Model Number(s)	Minuet 2 Module FS5352
Serial Number(s)	RAD113239 - Minuet 2 Module (FS5352) Conducted Test Sample RAD113254 – Minuet 2 Module (FS5352) Radiated FCC Test Sample RAD113219 - Minuet 2 Module (FS5352) FCC Radiated Test Sample
Hardware Version(s)	Minuet 2 Module: Rev4 Minuet 2 Voice Reference Platform: ES1
Software Version(s)	NS2
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2018 ISEDC RSS-247: Issue 2 (2017-02) ISEDC RSS-GEN: Issue 5 (2018-04)
Order Number	FS190532
Date	22-May-2019
Date of Receipt of EUT	11-June-2019, 14-June-2019 and 01-July-2019
Start of Test	12-June-2019
Finish of Test	03-July-2019
Name of Engineer(s)	Nandhini Mathivanan and Graeme Lawler
Related Document(s)	ANSI C63.10 (2013) KDB 662911 D01 v02r02



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISEDC RSS-247 and ISEDC RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: Bluetooth						
2.1	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.5	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013) KDB 662911 D01 v02r02
2.6	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.7	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.8	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)

Table 2



1.4 Application Form

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment)</i>	Minuet 2 is a module, which when installed in a consumer audio product enables high-quality audio streaming over Wi-Fi, Bluetooth, Ethernet and can be activated via voice commands. Where appropriate the Minuet 2 module is tested in the Minuet 2 Voice Reference Platform.
Manufacturer:	Frontier Smart Technologies Limited
Model:	Minuet 2 module (FS5352)
Part Number:	Minuet 2 module: HA-FS5352-xxxxxx (where xxxxxxx denotes the customer variant e.g. HA-FS5352-000001)
Hardware Version:	Minuet 2 module: Rev4
Software Version:	NS2
FCC ID (if applicable)	YYX-FS5352
IC ID (if applicable)	11458A-FS5352

Intentional Radiators

Technology	Bluetooth	WLAN 2.4GHz	WLAN 5GHz
Frequency Band (MHz)	2400-2483.5	2402-2482	5150-5350, 5470-5825
Conducted Declared Output Power (dBm)	6.5	16.5	16.5
Antenna Gain (dBi)	2.3	2.3	2.2 (5150-5250) 3.5 (5250-5350 MHz) 4.6 (5470-5725 MHz) 3.1 (5725-5825 MHz)
Supported Bandwidth(s) (MHz)	1, 2	20	20,40, 80
Modulation Scheme(s)	GFSK, DQPSK, 8-DPSK	BPSK, QPSK, 16-QAM, 64-QAM	BPSK, QPSK, 16-QAM, 64-QAM
ITU Emission Designator	1M00D, 2M00D	20M00D	20M00D, 40M00D, 80M00D
Bottom Frequency (MHz)	2400	2412	5180
Middle Frequency (MHz)	2441	2437	5500
Top Frequency (MHz)	2480	2472	5825

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	5825 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	2402 MHz
Class A Digital Device (Use in commercial, industrial or business environment) <input checked="" type="checkbox"/>	
Class B Digital Device (Use in residential environment only) <input checked="" type="checkbox"/>	



AC Power Source

AC supply frequency: 50 or 60 (Hz)	
100 - 240 V	Max current: 0.8 A
Single Phase <input checked="" type="checkbox"/> Three Phase <input type="checkbox"/>	

DC Power Source

Nominal voltage: 5 V
Extreme upper voltage: 5.25 V
Extreme lower voltage: 4.75 V
Max current: 2 A

Battery Power Source

Voltage: 11.1 V
End-point voltage: 8.1 V (<i>Point at which the battery will terminate</i>)
Alkaline <input type="checkbox"/> Leclanche <input type="checkbox"/> Lithium <input type="checkbox"/> Nickel Cadmium <input type="checkbox"/> Lead Acid* <input type="checkbox"/> * <i>(Vehicle regulated)</i>
Other <input checked="" type="checkbox"/> Please detail: Lithium-ion Polymer

Charging

Can the EUT transmit whilst being charged	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
---	---

Temperature

Minimum temperature: 0 °C	Maximum temperature: 70 °C
---------------------------	----------------------------

Antenna Characteristics

Antenna connector <input checked="" type="checkbox"/> State impedance 50 Ohm
Temporary antenna connector <input type="checkbox"/> State impedance N/A Ohm
Integral antenna <input type="checkbox"/> Type N/A State impedance N/A Ohm
External antenna <input checked="" type="checkbox"/> Type PCB antenna State impedance 50 Ohm

Ancillaries (if applicable)

Manufacturer: Southstar	Part Number: N12-2128-R0A
Model: SW700M (SW750M)	Country of Origin: China

I hereby declare that the information supplied is correct and complete.

Name: Abdul Wahed Dewan
Position held: Principal RF Engineer
Date: 29/08/2019



1.5 Product Information

1.5.1 Technical Description

Minuet 2 is a module, which when installed in a consumer audio product enables high-quality audio streaming over Wi-Fi, Bluetooth and Ethernet can be activated via voice commands. Where appropriate the Minuet 2 module is tested in the Minuet 2 Voice Reference Platform.

1.6 Test Set up Diagrams

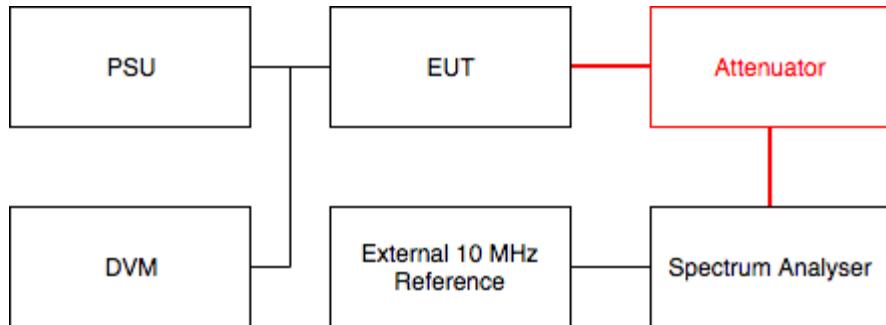


Figure 1 - Conducted Lab Testing

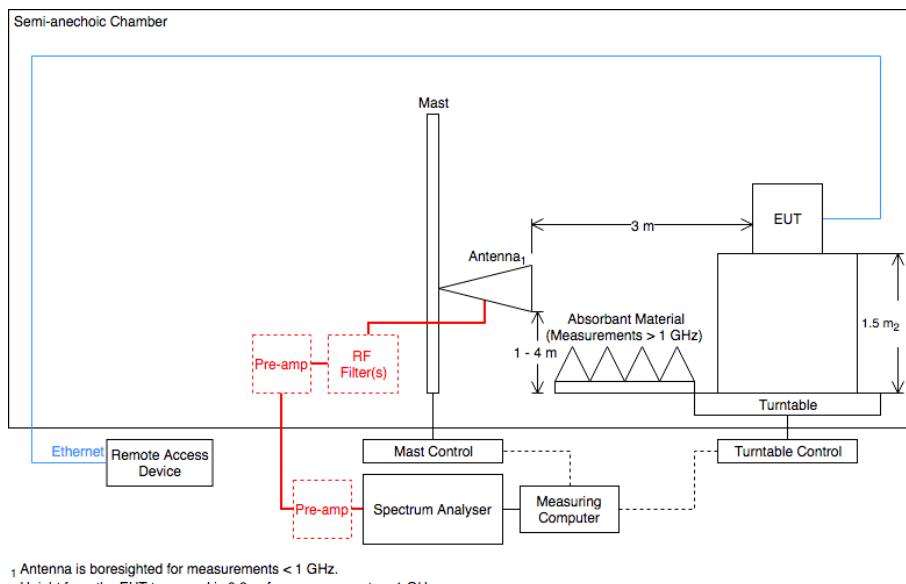


Figure 2- Radiated Emissions Test Setup Diagram

1.7 Deviations from the Standard

No deviations from the applicable test standard were made during testing.



1.8 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: RAD113219			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: RAD113254			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: RAD113239			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3



1.9 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Bluetooth		
Frequency Hopping Systems - 20 dB Bandwidth	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Channel Separation	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Nandhini Mathivanan	UKAS
Maximum Conducted Output Power	Nandhini Mathivanan	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Restricted Band Edges	Graeme Lawler	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Frequency Hopping Systems - 20 dB Bandwidth

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISEDC RSS-247, Clause 5.1
ISEDC RSS-GEN, Clause 6.7

2.1.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

2.1.3 Date of Test

03-July-2019

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.2.

2.1.5 Environmental Conditions

Ambient Temperature 21.7 °C
Relative Humidity 48.1 %

2.1.6 Test Results

Bluetooth

Frequency (MHz)	20 dB Bandwidth (kHz)		
	GFSK	$\pi/4$ DQPSK	8-DPSK
2402	957	1335	1295
2441	958	1335	1295
2480	958	1335	1295

Table 5



Figure 3 - 2402 MHz - GFSK

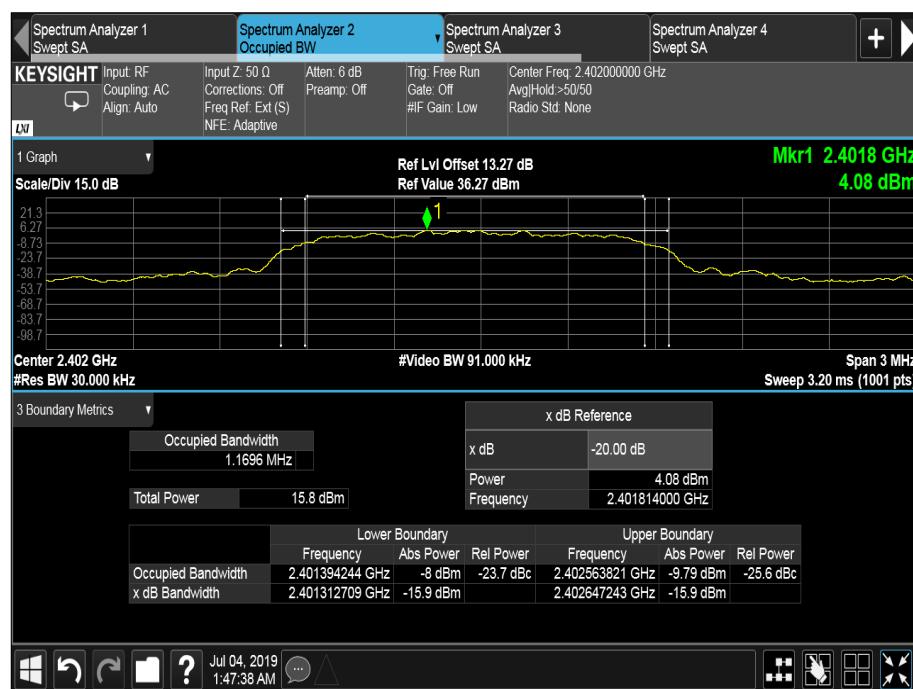


Figure 4 - 2402 MHz - $\pi/4$ DQPSK



Figure 5 - 2402 MHz - 8-DPSK



Figure 6 - 2441 MHz - GFSK



Figure 7 - 2441 MHz - $\pi/4$ DQPSK



Figure 8 - 2441 MHz - 8-DPSK

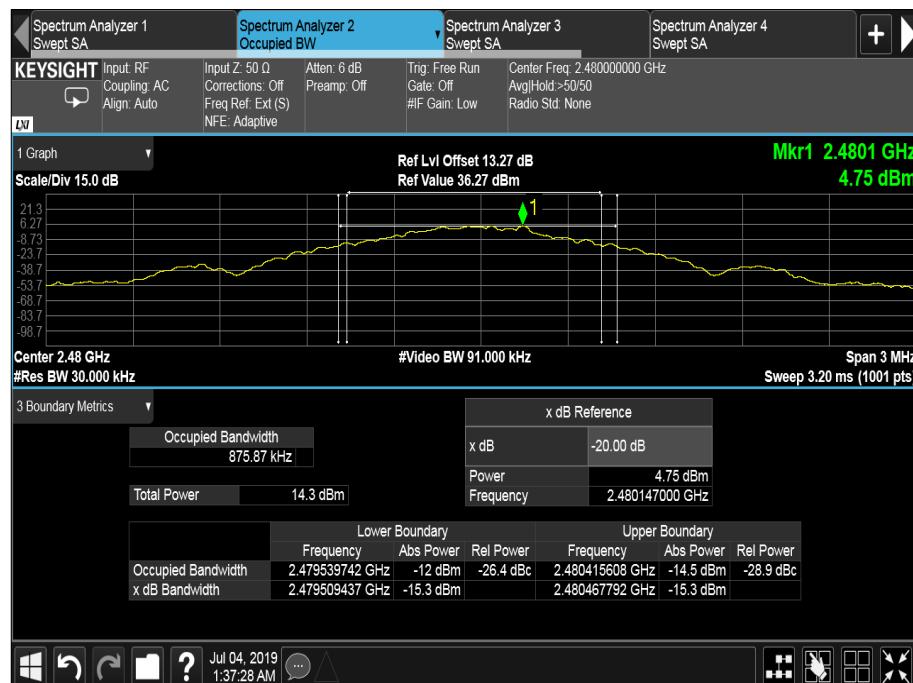


Figure 9 - 2480 MHz - GFSK



Figure 10 - 2480 MHz - $\pi/4$ DQPSK



Figure 11 - 2480 MHz - 8-DPSK

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	16-May-2020
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4101	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
EXA	Keysight Technologies	N9010B	4968	24	21-Dec-2019
Attenuator 10 dB 2W	Telegartner	01156A0031	N/S	-	O/P Mon

Table 6

O/P Mon – Output Monitored using calibrated equipment
 N/S – Not serialised



2.2 Frequency Hopping Systems - Number of Hopping Channels

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISEDC RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

2.2.3 Date of Test

03-July-2019

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.2.5 Environmental Conditions

Ambient Temperature 21.7 °C

Relative Humidity 48.1 %

2.2.6 Test Results

Bluetooth

Number of Hopping Channels: 79

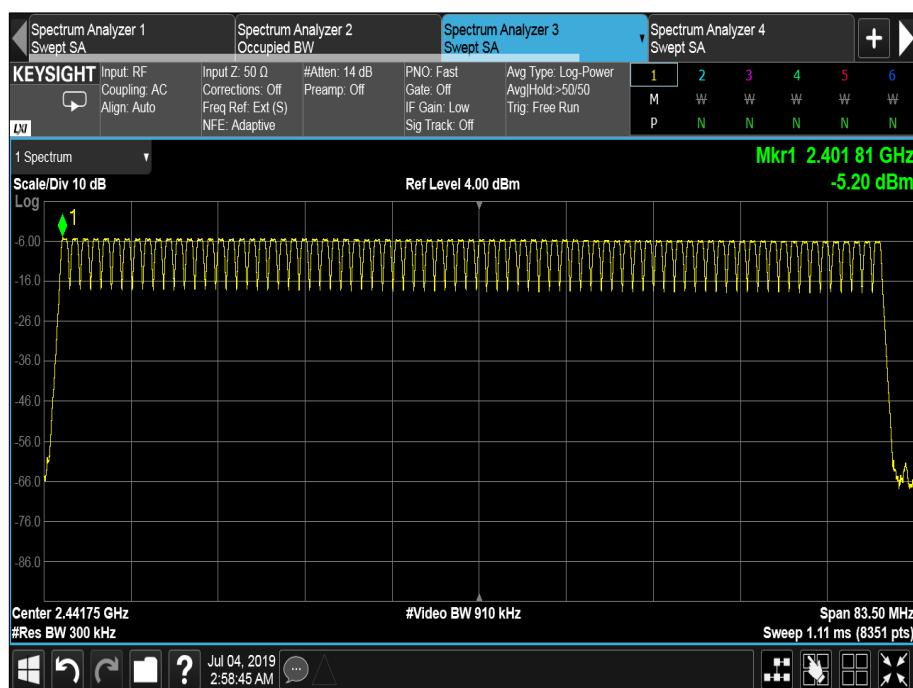


Figure 12 - Measurement Frequency Range: 2400 MHz to 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

≥ 15 channels

ISEDC RSS-247, Limit Clause 5.1 (d)

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	16-May-2020
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4101	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
EXA	Keysight Technologies	N9010B	4968	24	21-Dec-2019
Attenuator 10 dB 2W	Telegartner	01156A0031	N/S	-	O/P Mon

Table 7

O/P Mon – Output Monitored using calibrated equipment

N/S – Not serialised



2.3 Frequency Hopping Systems - Channel Separation

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISEDC RSS-247, Clause 5.1

2.3.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

2.3.3 Date of Test

03-July-2019

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.3.5 Environmental Conditions

Ambient Temperature 21.7 °C

Relative Humidity 48.1 %

2.3.6 Test Results

Bluetooth

Modulation	Channel Separation (MHz)
GFSK	0.995
$\pi/4$ DQPSK	1.260
8-DPSK	1.000

Table 8

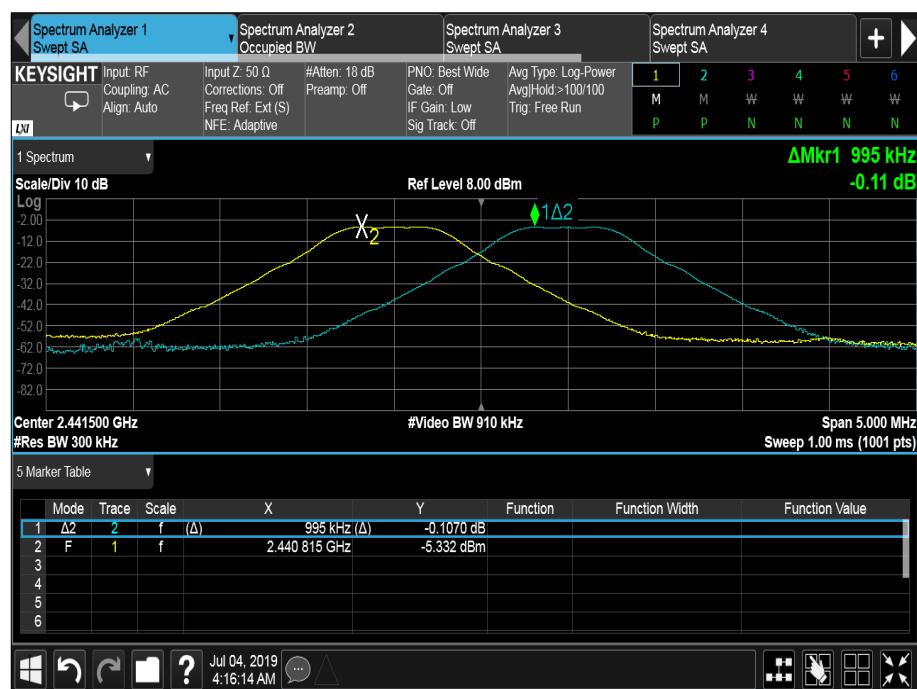


Figure 13 - GFSK



Figure 14 - $\pi/4$ DQPSK



Figure 15 - 8-DPSK



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

ISEDC RSS-247, Limit Clause 5.1 (b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	16-May-2020
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4101	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
EXA	Keysight Technologies	N9010B	4968	24	21-Dec-2019
Attenuator 10 dB 2W	Telegartner	01156A0031	N/S	-	O/P Mon

Table 9

O/P Mon – Output Monitored using calibrated equipment

N/S – Not serialised



2.4 Frequency Hopping Systems - Average Time of Occupancy

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISEDC RSS-247, Clause 5.1

2.4.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

2.4.3 Date of Test

03-July-2019

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.4.5 Environmental Conditions

Ambient Temperature 21.7 °C
Relative Humidity 48.1 %

2.4.6 Test Results

Bluetooth

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
DH5	2.904	91	78.792
DH3	1.652	129	213.108
DH1	0.402	196	264.264

Table 10

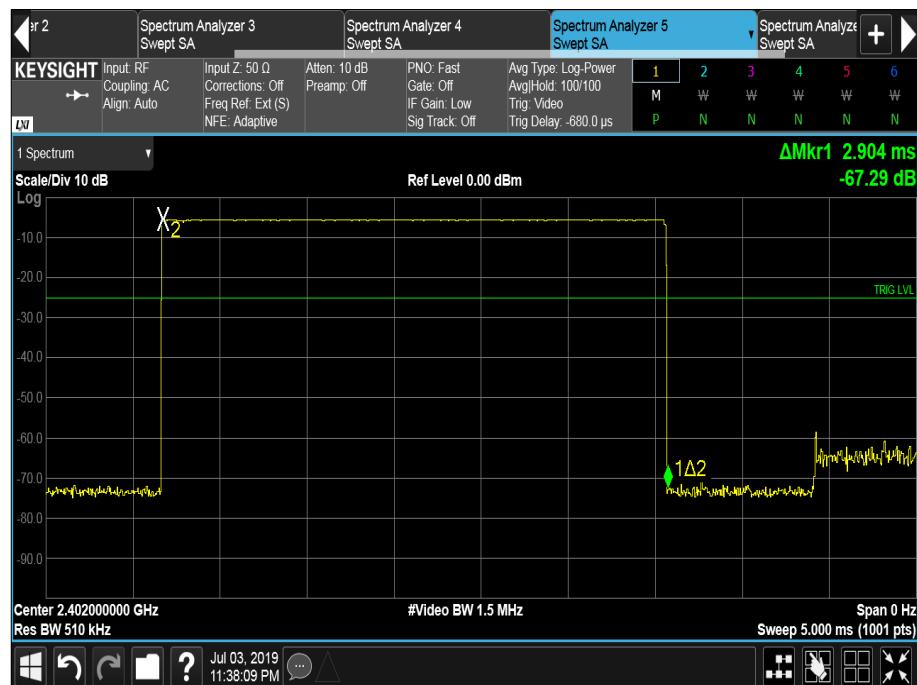


Figure 16 - DH5, Dwell Time



Figure 17 - DH5, Total Average Time of Occupancy

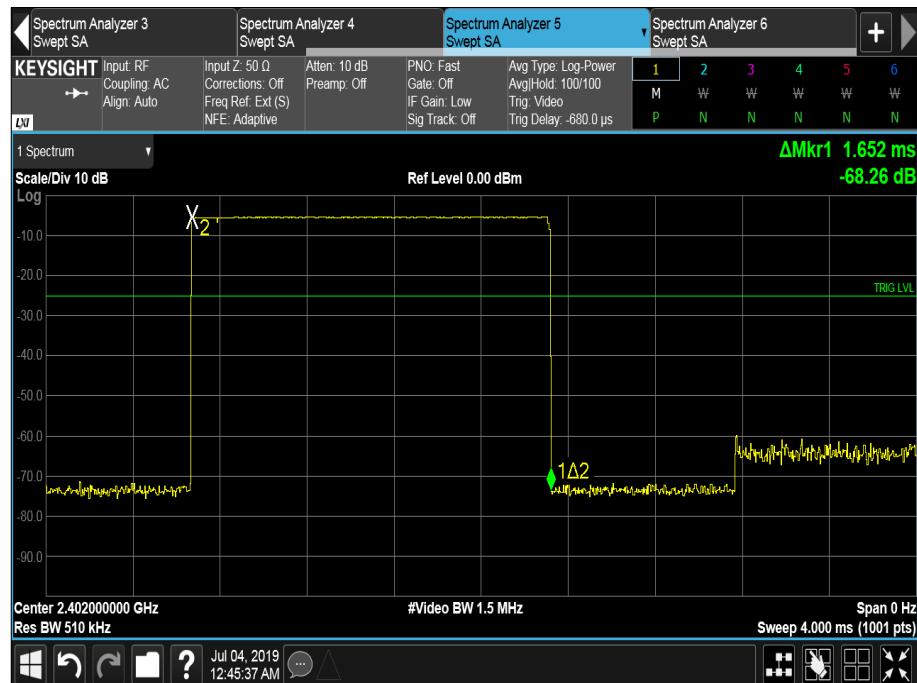


Figure 18 - DH3, Dwell Time



Figure 19 - DH3, Total Average Time of Occupancy

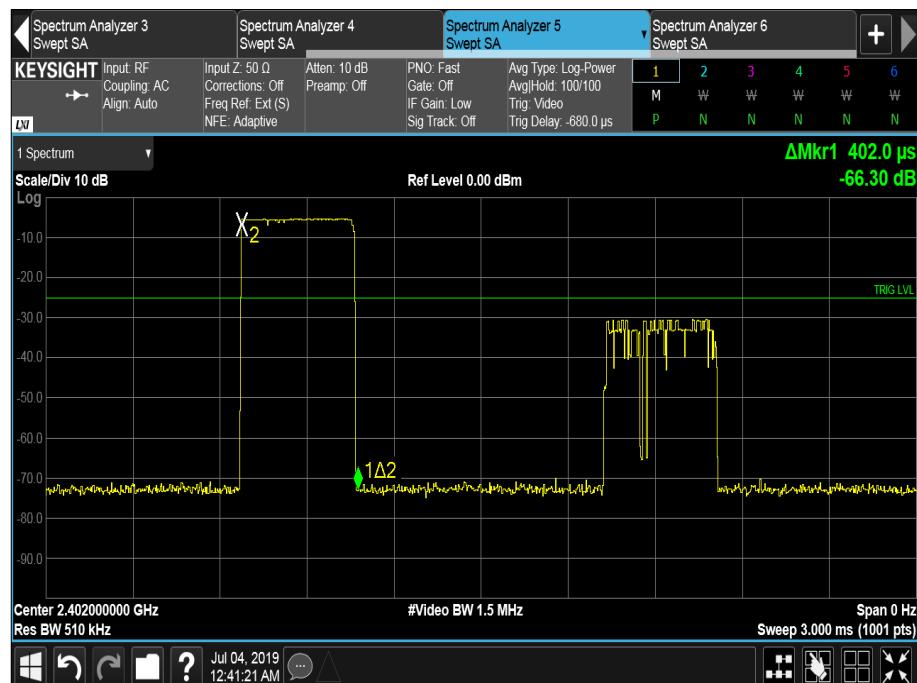


Figure 20 - DH1, Dwell Time



Figure 21 - DH1, Total Average Time of Occupancy



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

ISEDC RSS-247, Limit Clause 5.1 (d)

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.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	16-May-2020
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4101	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
EXA	Keysight Technologies	N9010B	4968	24	21-Dec-2019
Attenuator 10 dB 2W	Telegartner	01156A0031	N/S	-	O/P Mon

Table 11

O/P Mon – Output Monitored using calibrated equipment

N/S – Not serialised



2.5 Maximum Conducted Output Power

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISEDC RSS-247, Clause 5.4
ISEDC RSS-GEN, Clause 6.12

2.5.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

2.5.3 Date of Test

03-July-2019

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.5

2.5.5 Environmental Conditions

Ambient Temperature 21.7 °C
Relative Humidity 48.1 %

2.5.6 Test Results

Bluetooth

Testing was performed on the modulation/packet type with the highest conducted output power.
This modulation/packet type was GFSK/DH5.

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	5.85	3.846
2441	5.52	3.565
2480	5.04	3.192

Table 12 - Maximum Conducted Output Power Results

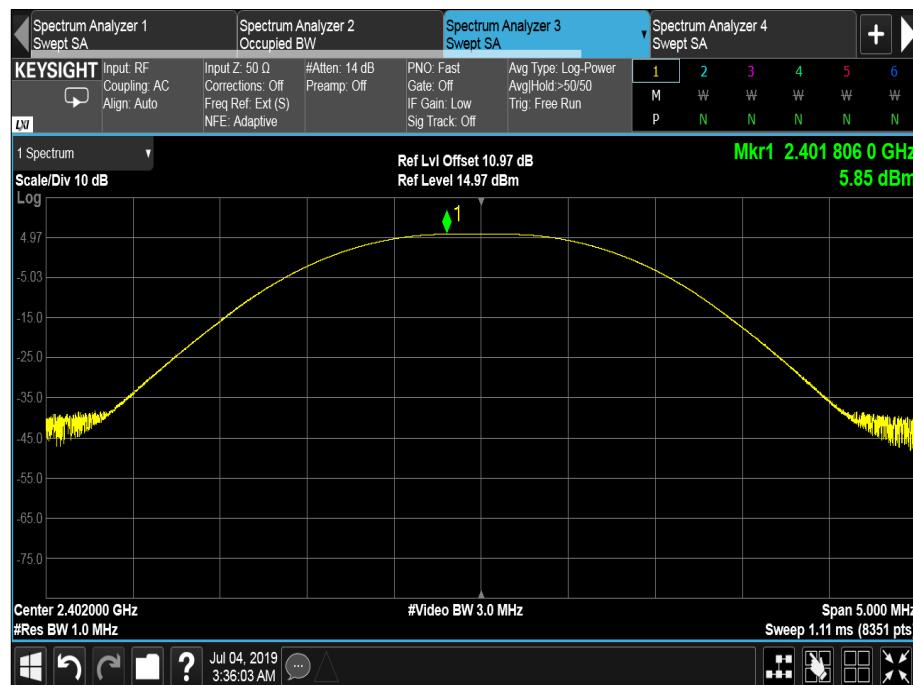


Figure 22 - 2402 MHz - Maximum Output Power

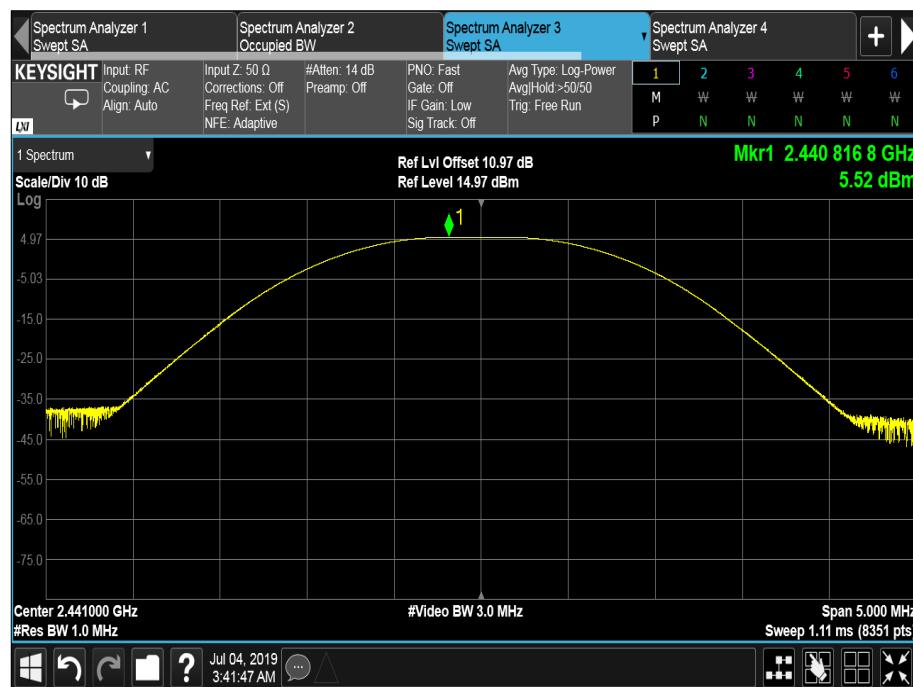


Figure 23 - 2441 MHz - Maximum Output Power

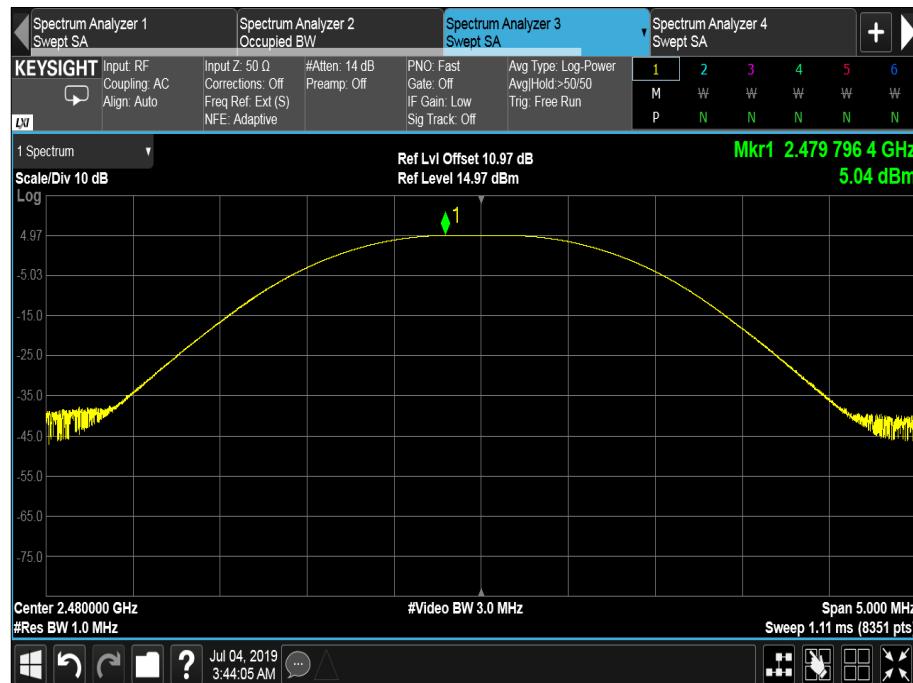


Figure 24 - 2480 MHz - Maximum Output Power

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

ISEDC RSS-247, Limit Clause 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channel; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channel. The e.i.r.p. shall not exceed 4 W except as provided in section 5.4(e) of the specification.

ISEDC RSS-247, Limit Clause 5.4 (a)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.



2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	16-May-2020
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4101	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
EXA	Keysight Technologies	N9010B	4968	24	21-Dec-2019
Attenuator 10 dB 2W	Telegartner	01156A0031	N/S	-	O/P Mon

Table 13

O/P Mon – Output Monitored using calibrated equipment

N/S – Not serialised



2.6 Spurious Radiated Emissions

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
ISEDC RSS-247, Clause 5.5
ISEDC RSS-GEN, Clause 6.13

2.6.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113254 - Modification State 0

2.6.3 Date of Test

16-June-2019 to 30-June-2019

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10-2013 clause 6.3, 6.5 and 6.6. The EUT was placed on the non-conducting platform in a manner typical of a normal installation. For an EUT which could reasonable be used in multiple planes, pre-scans were performed with the EUT orientated in X, Y and Z planes with reference to the ground plane.

Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4. For EUT's with multiple connectors of the same type, additional interconnecting cables were connected, and pre-scans performed to determine whether the level of the emissions were increased by >2 dB. For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dB μ V/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{(Field\ Strength\ in\ dB\mu V/m/20)}$.

For frequencies > 18 GHz, the measurement distance was reduced to 1 meter and the limit line was increased by $20 \times \text{LOG}(3/1) = 9.54$ dB.

To determine the emission characteristic of the EUT above 18 GHz, the test antenna was swept over all faces of the EUT whilst observing a spectral display. The frequency of any emissions of interest was noted for formal measurement at the correct measurement distance of 1m. This procedure was repeated for all relevant transmit operating channels.

2.6.5 Environmental Conditions

Ambient Temperature 23.0 °C
Relative Humidity 57.5 %

2.6.6 Test Results

Bluetooth

Testing was performed on the modulation and packet type which resulted in the highest conducted output power. The Modulation/Packet type was GFSK/DH5.

Frequency (MHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)		Polarisation	EUT Orientation
	Peak	Average	Peak	Average	Peak	Average		
*								

Table 14 - Radiated Emissions Results, 30 MHz to 1 GHz - 2402 MHz

*No emissions were detected within 10 dB of the limit.

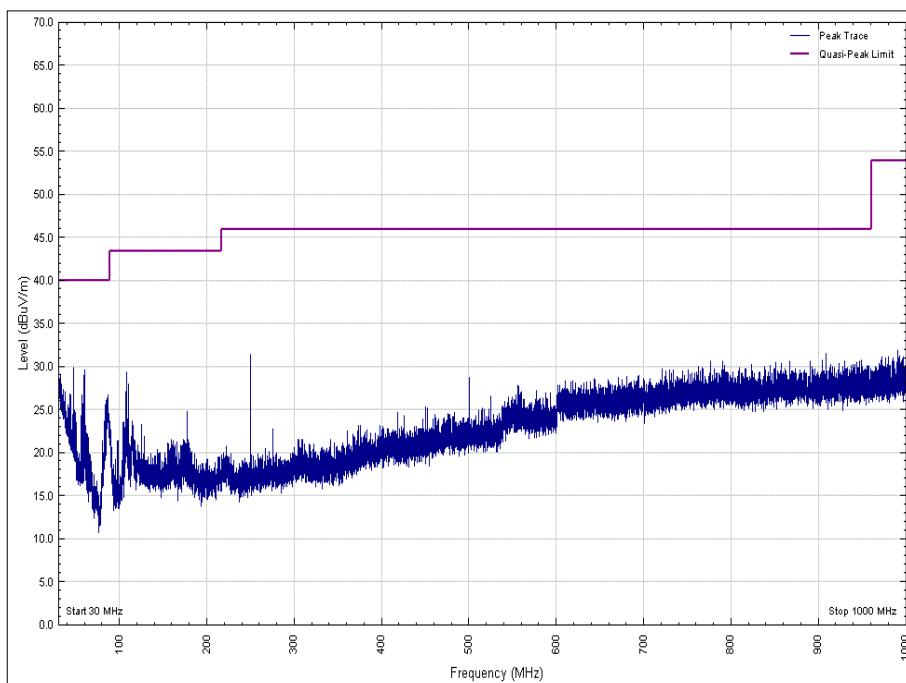


Figure 25 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Vertical, EUT Orientation X

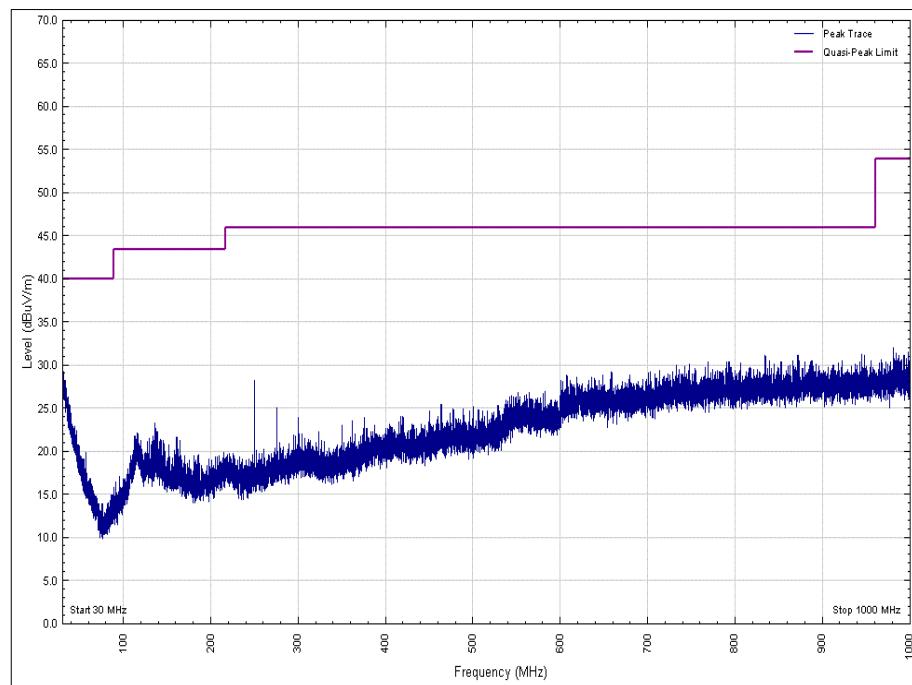


Figure 26 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Horizontal, EUT Orientation X

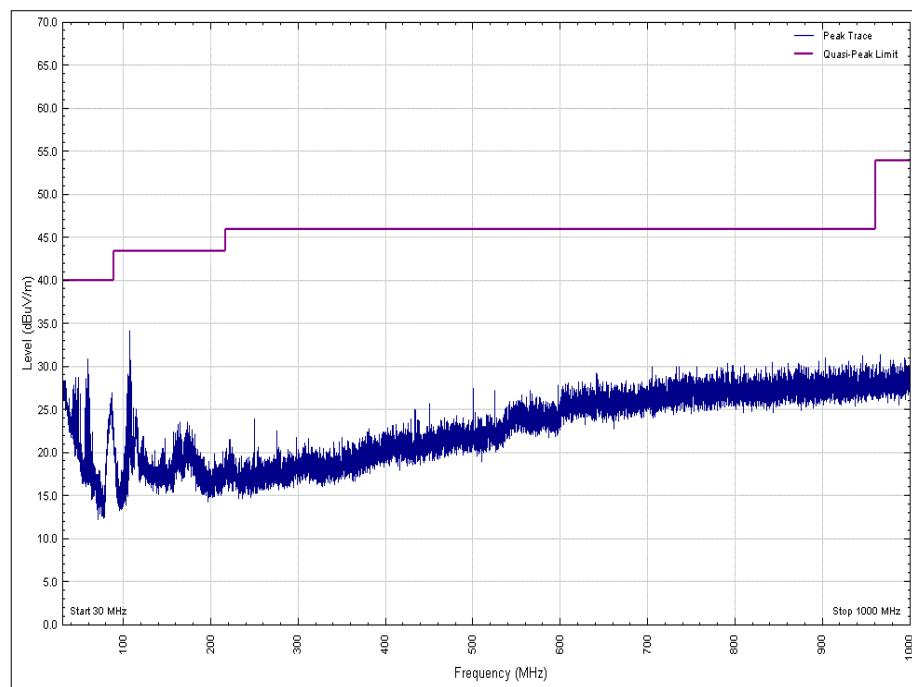


Figure 27 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Vertical, EUT Orientation Y

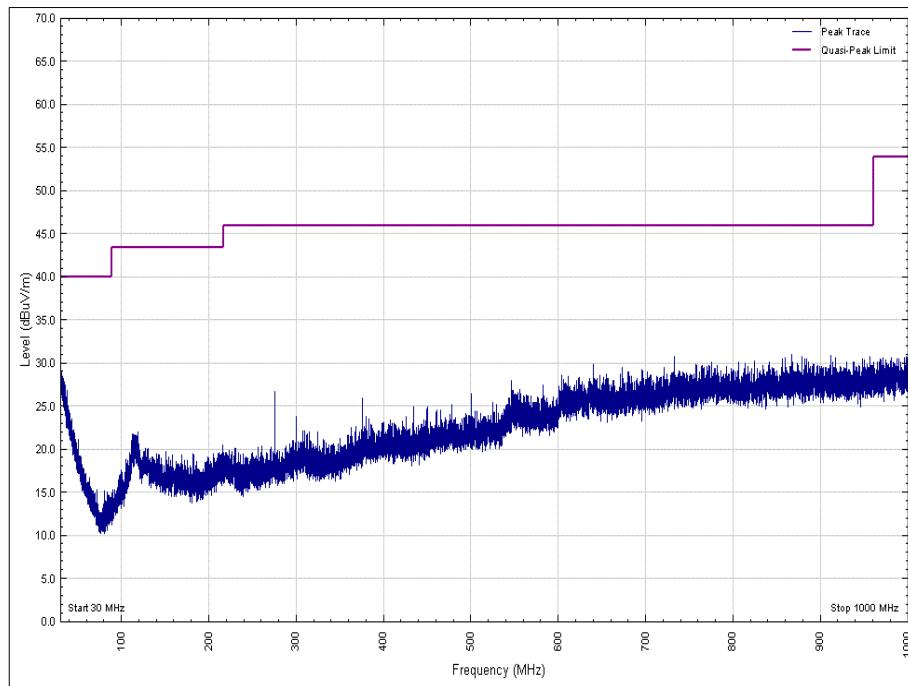


Figure 28 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Horizontal, EUT Orientation Y

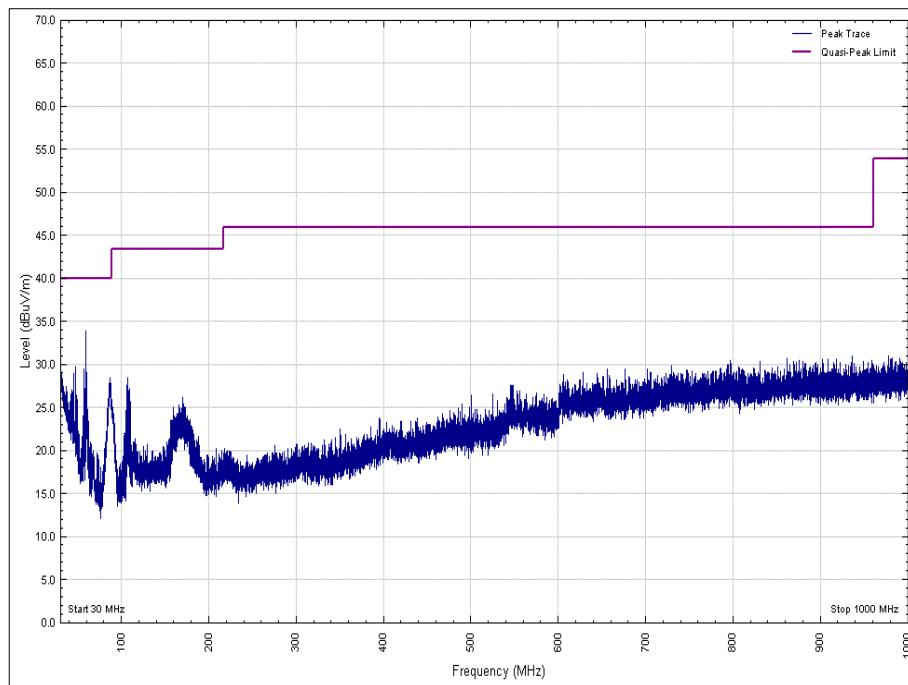


Figure 29 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Vertical, EUT Orientation Z

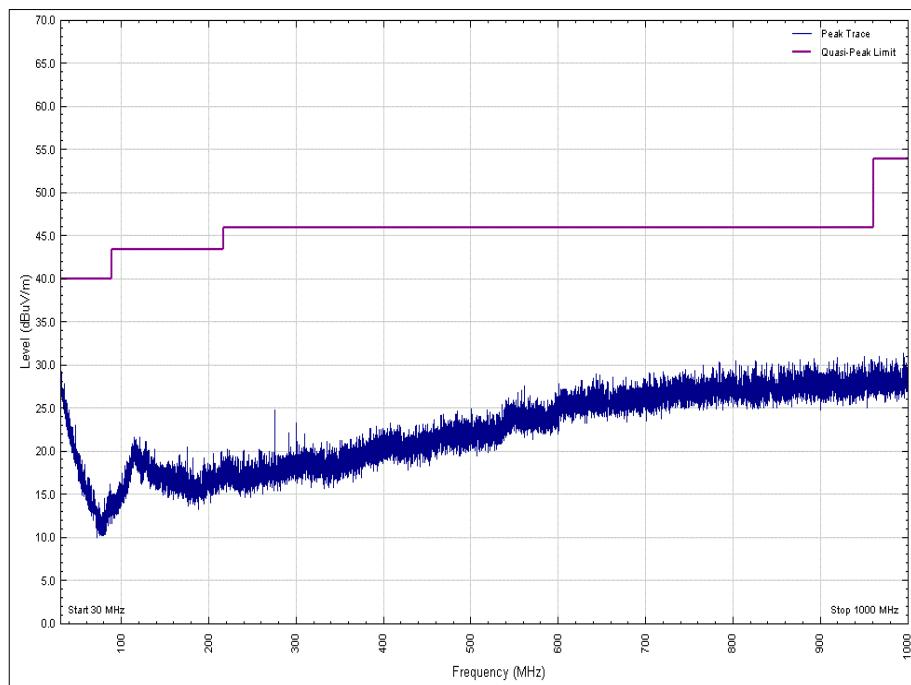


Figure 30 - 30 MHz to 1 GHz, 2402 MHz, Polarity: Horizontal, EUT Orientation Z

Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 15 - 2402 MHz - 1 GHz to 25 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

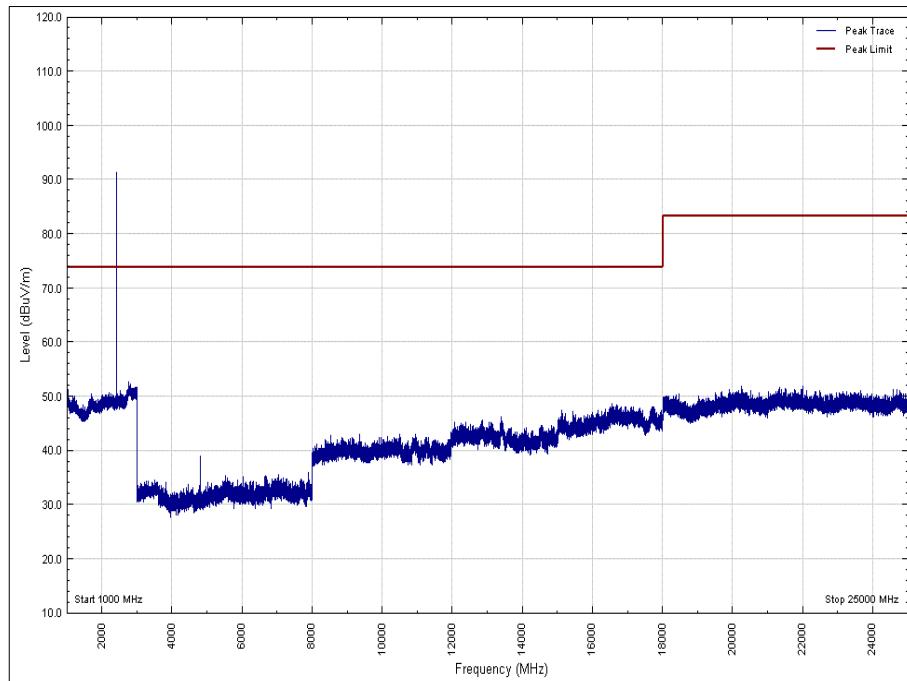


Figure 31 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Peak

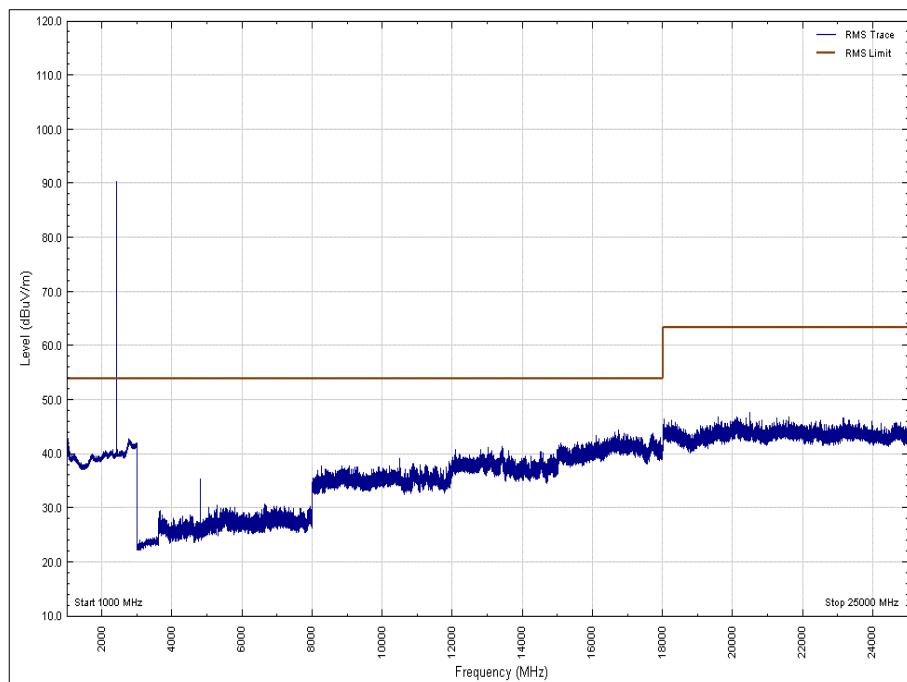


Figure 32 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Average

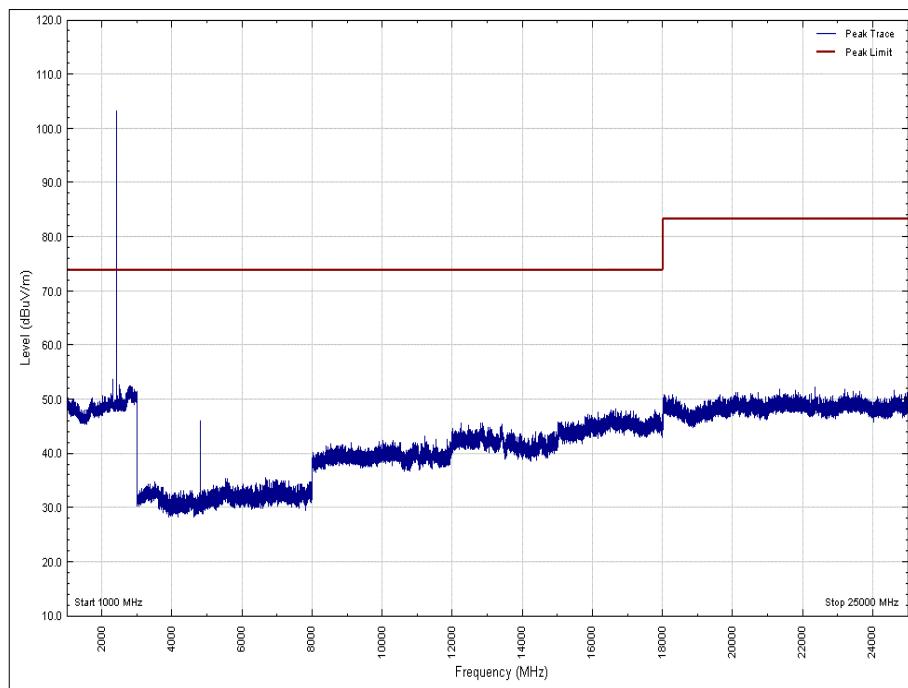


Figure 33 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Peak

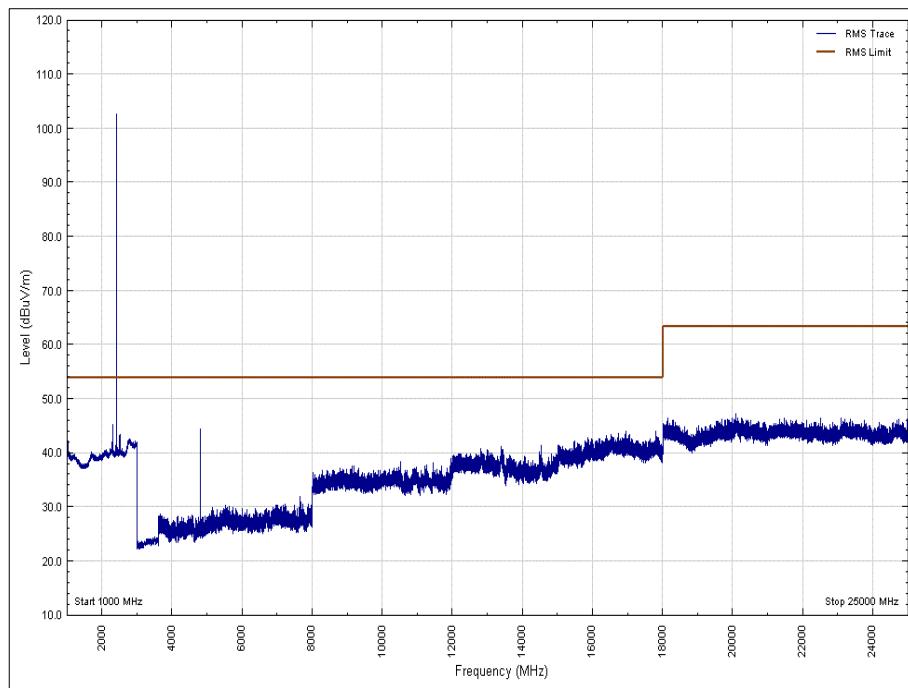


Figure 34 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Average

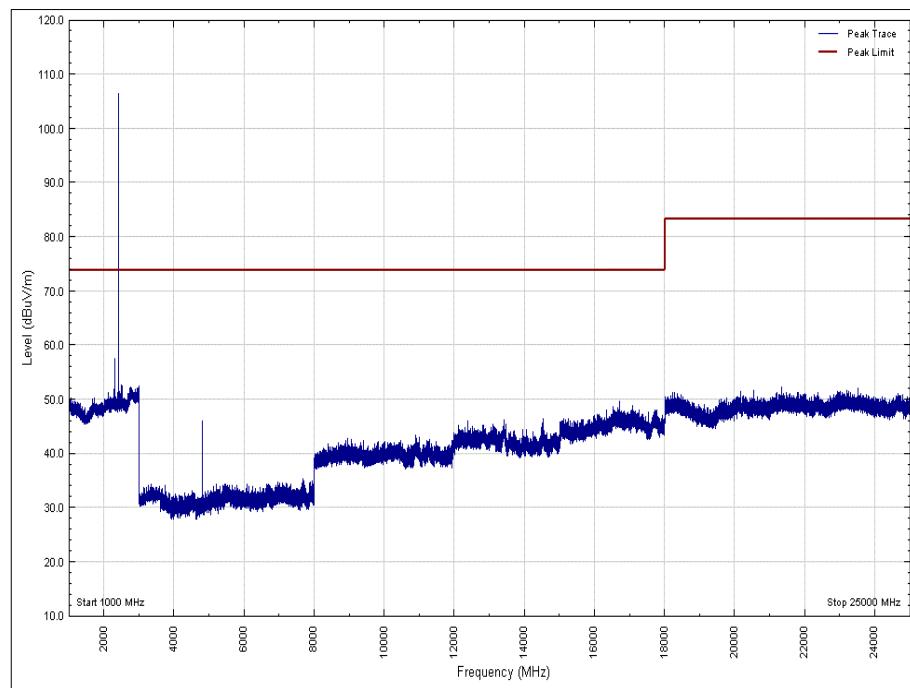


Figure 35 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Peak

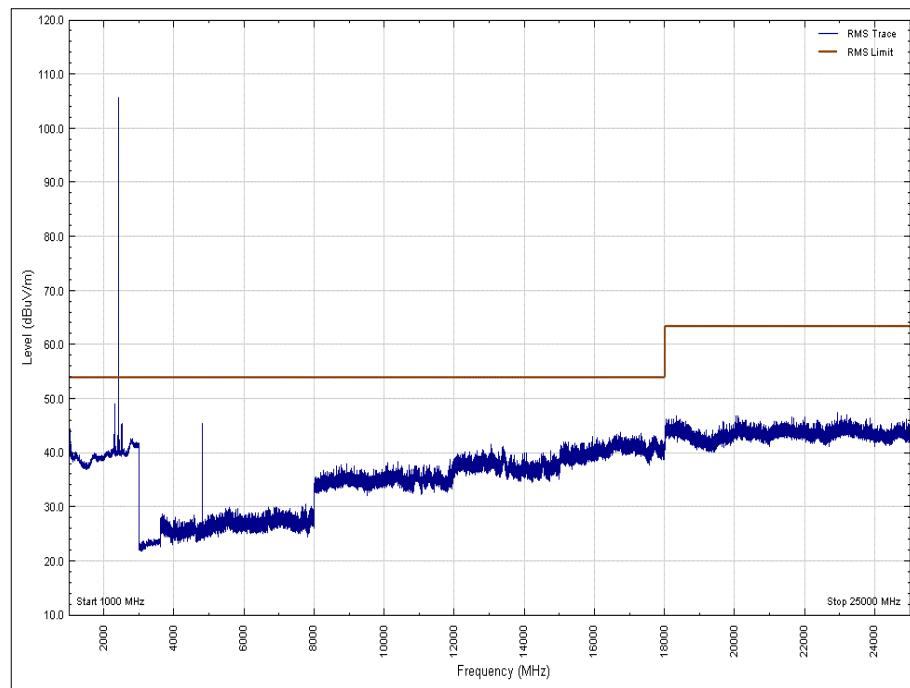


Figure 36 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Average

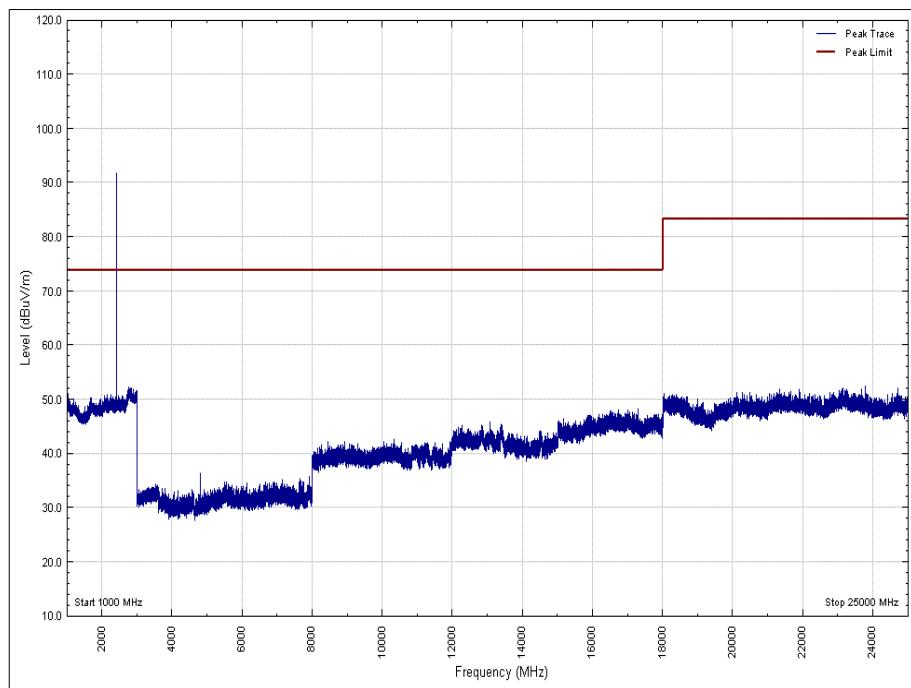


Figure 37 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Peak

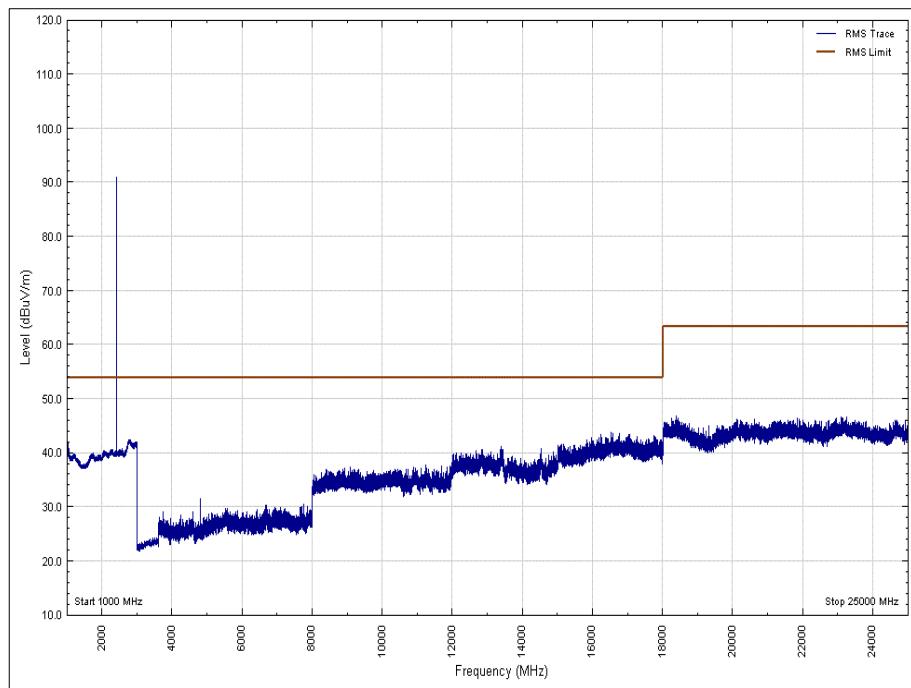


Figure 38 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Average

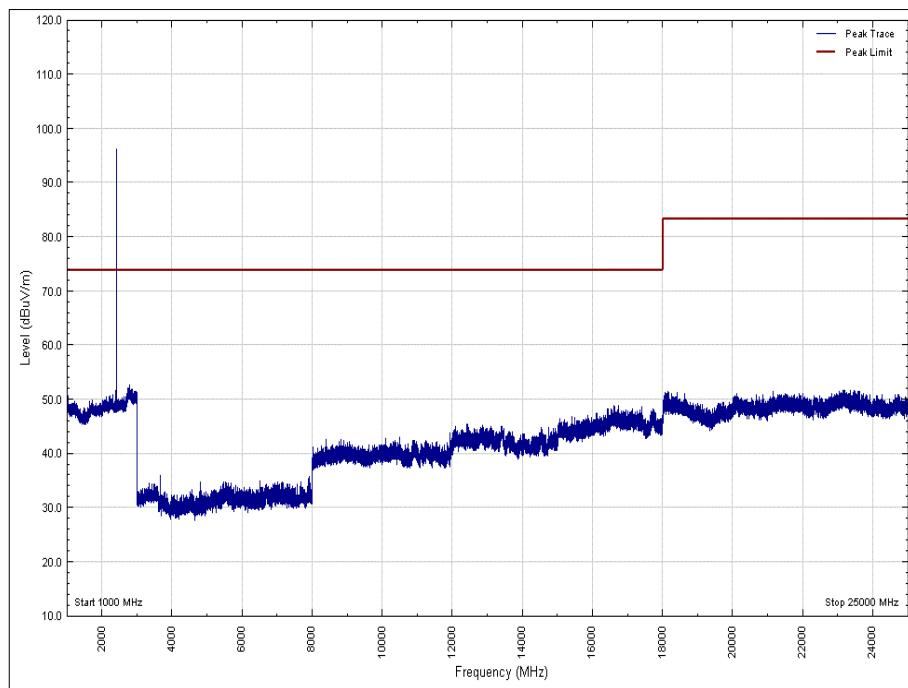


Figure 39 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Peak

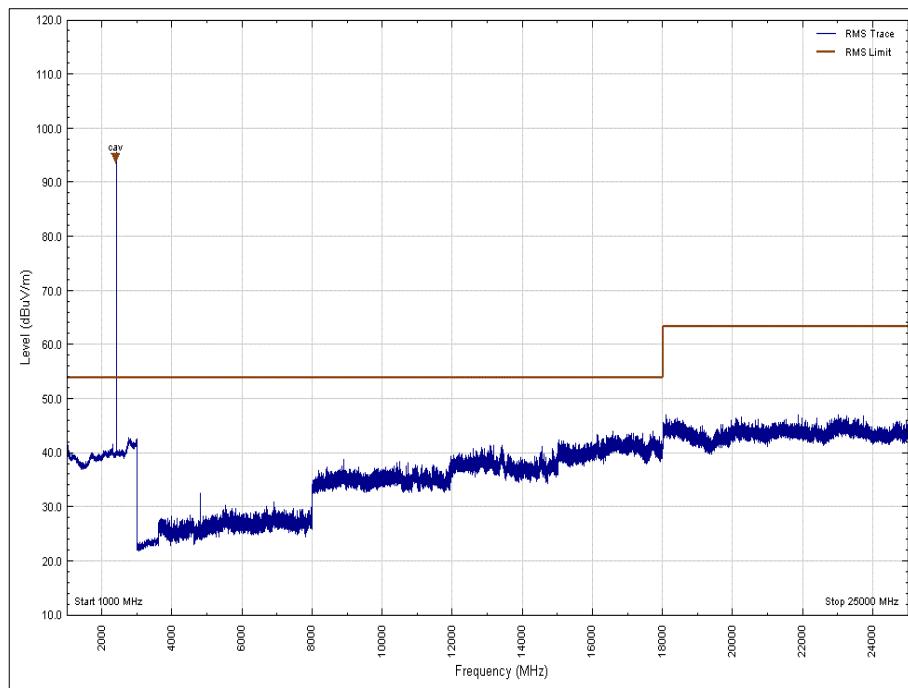


Figure 40 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Average

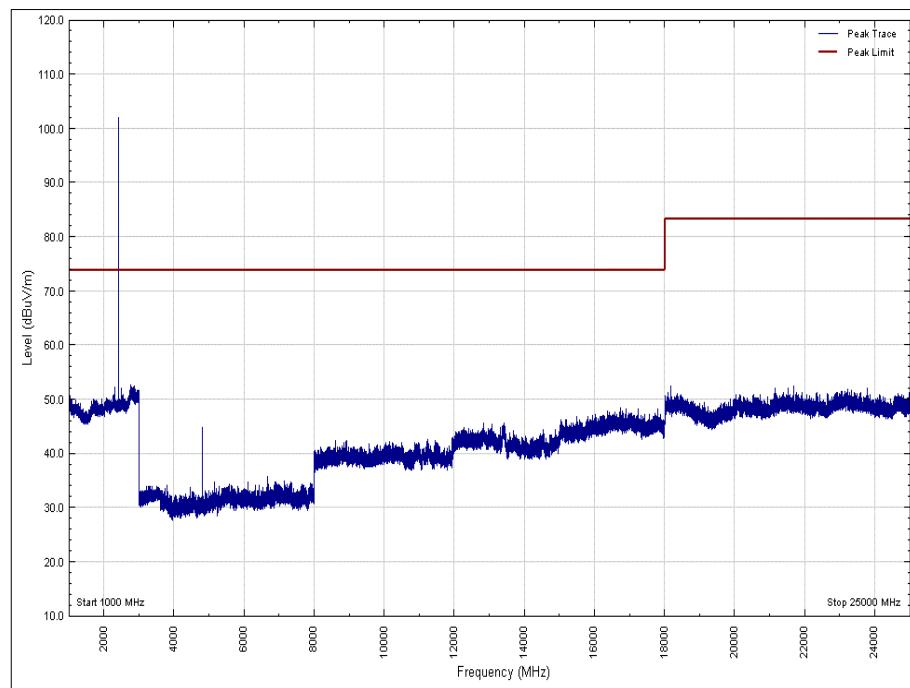


Figure 41 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Peak

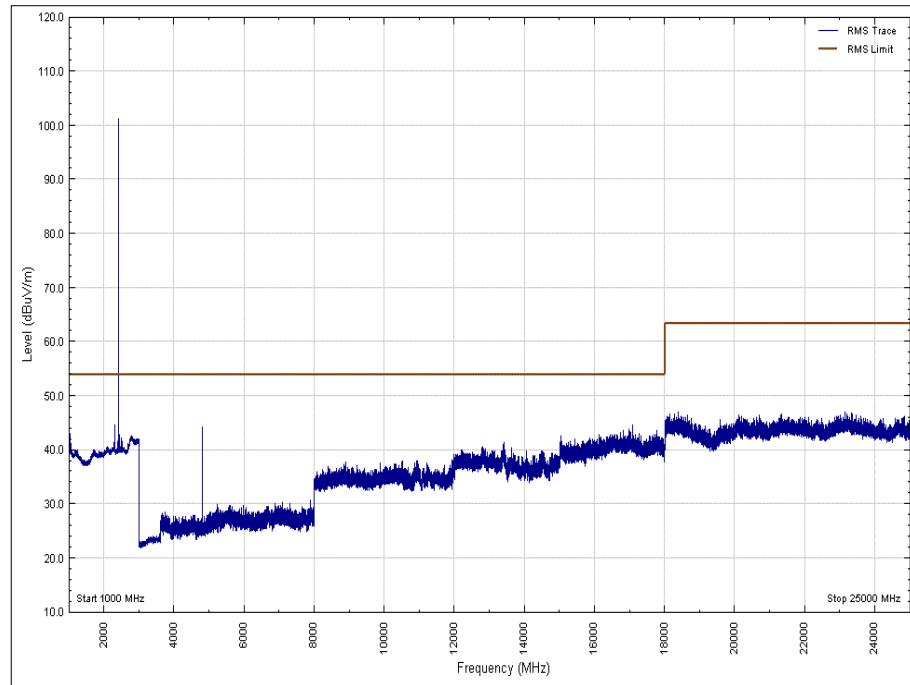


Figure 42 - 2402 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Average

Frequency (MHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)		Polarisation	EUT Orientation
	Peak	Average	Peak	Average	Peak	Average		
*								

Table 16 - Radiated Emissions Results, 30 MHz to 1 GHz - 2441 MHz

*No emissions were detected within 10 dB of the limit.

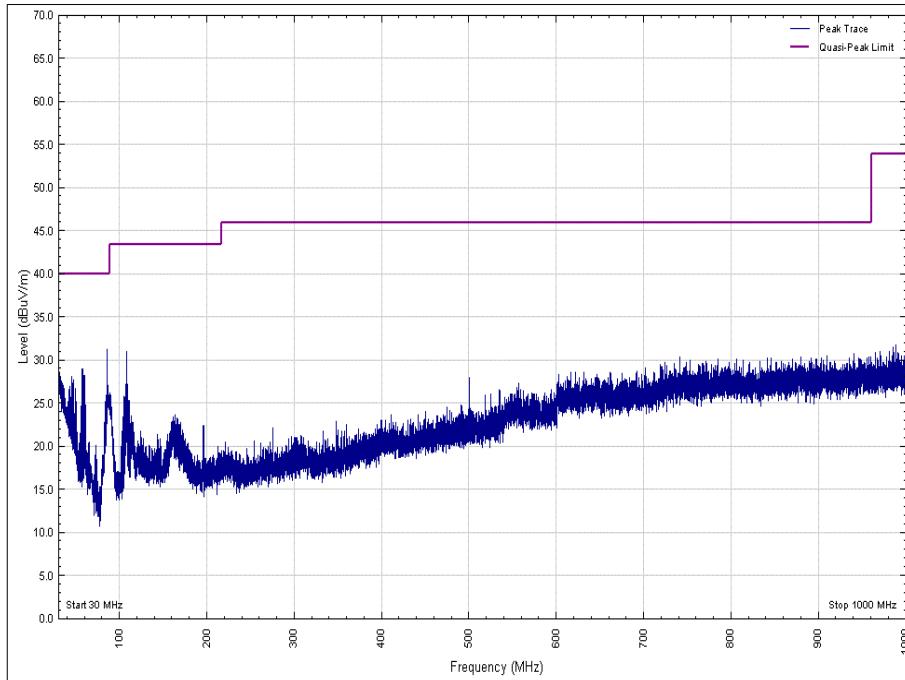


Figure 43 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Vertical, EUT Orientation X

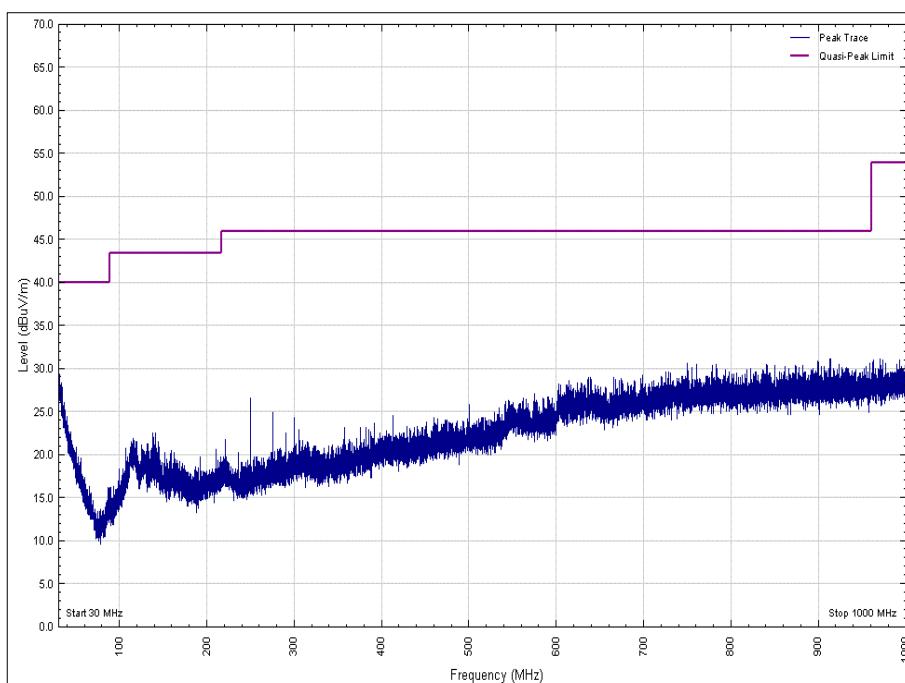


Figure 44 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Horizontal, EUT Orientation X

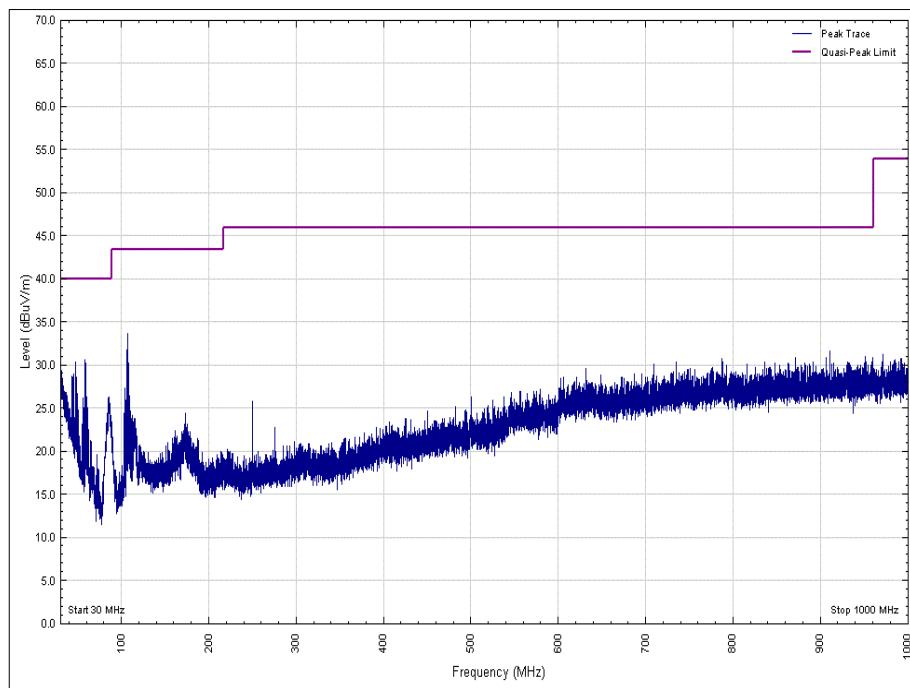


Figure 45 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Vertical, EUT Orientation Y

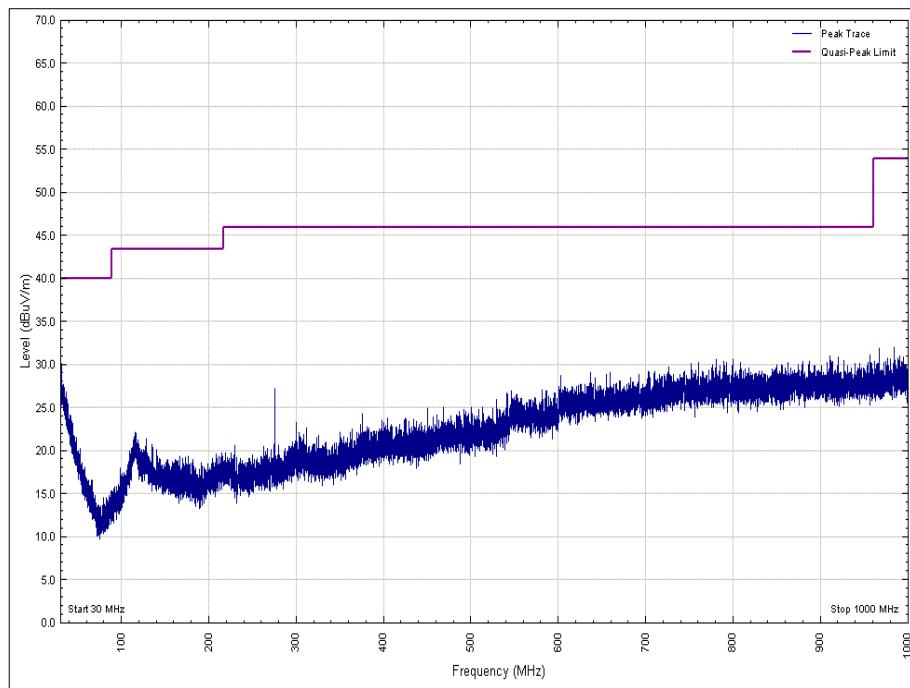


Figure 46 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Horizontal, EUT Orientation Y

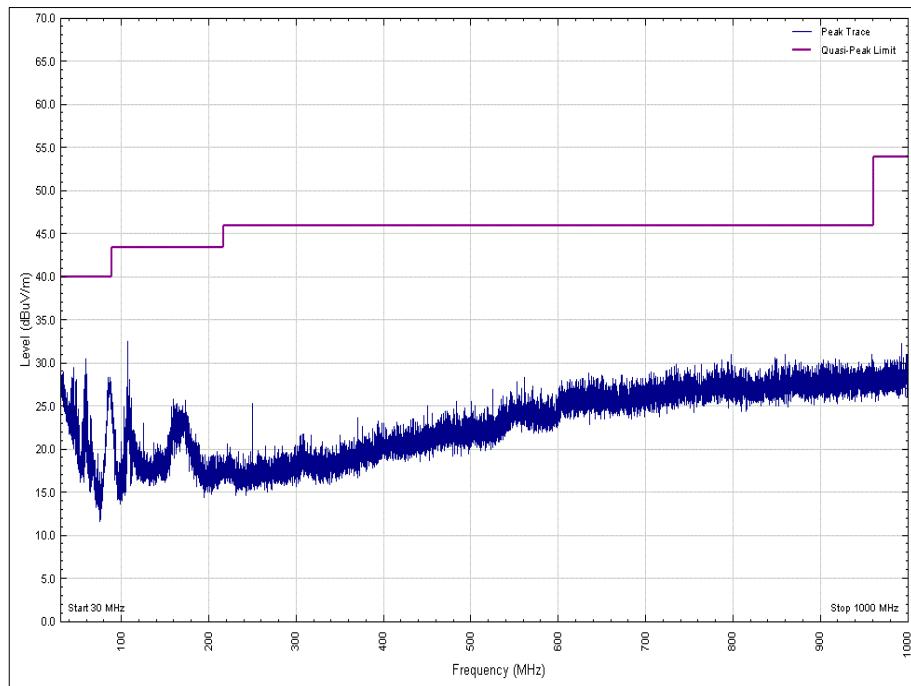


Figure 47 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Vertical, EUT Orientation Z

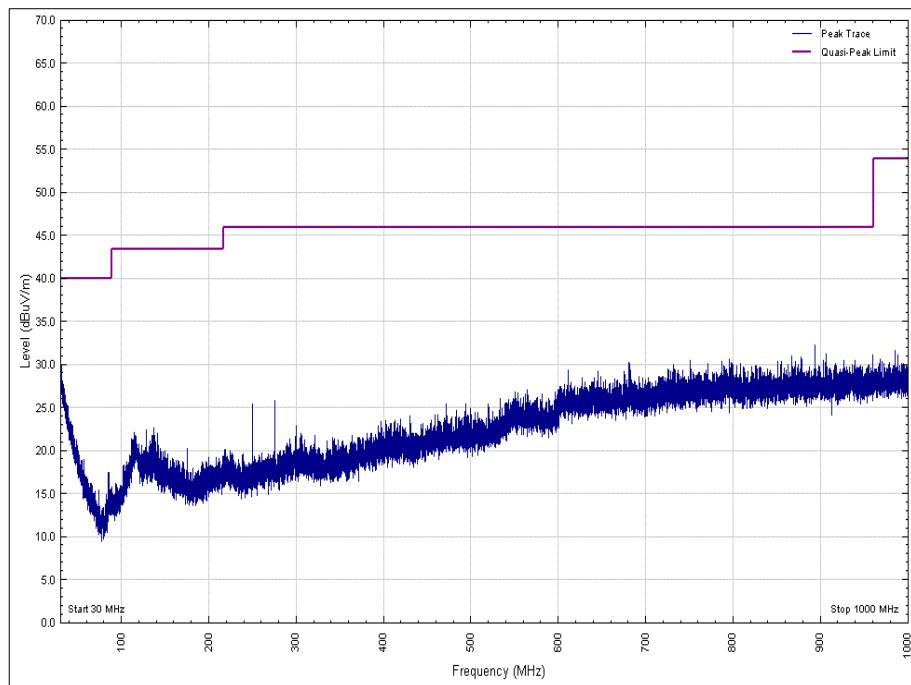


Figure 48 - 30 MHz to 1 GHz, 2441 MHz, Polarity: Horizontal, EUT Orientation Z



Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB μ V/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 17 - 2441 MHz - 1 GHz to 25 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

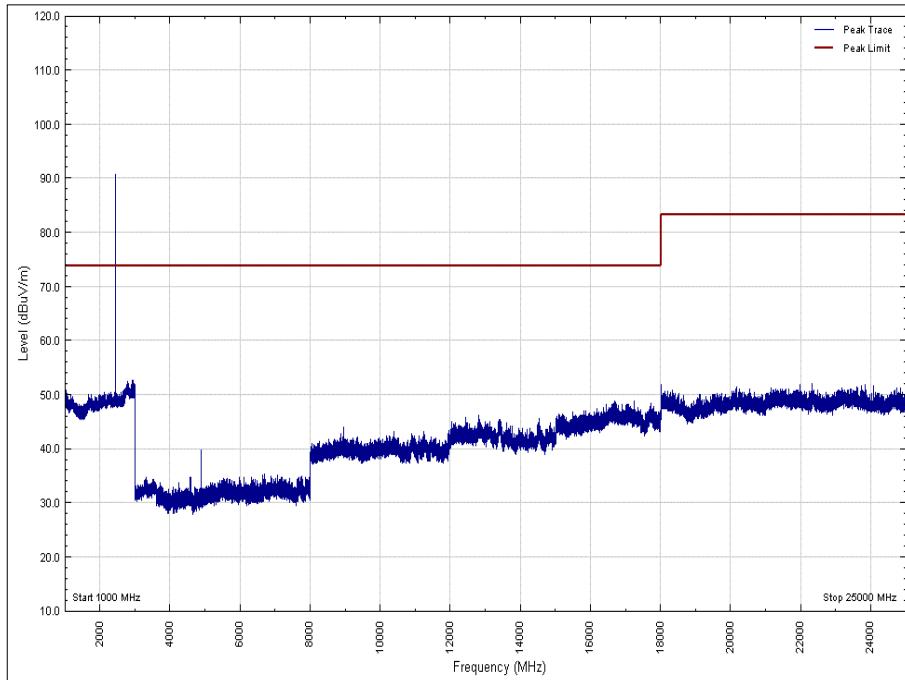


Figure 49 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Peak

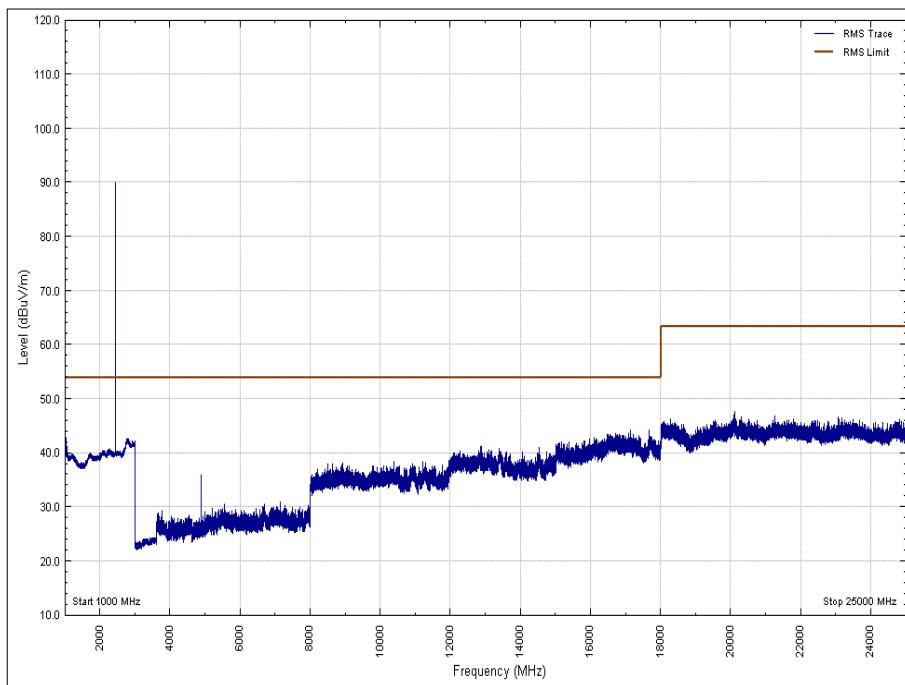


Figure 50 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Average

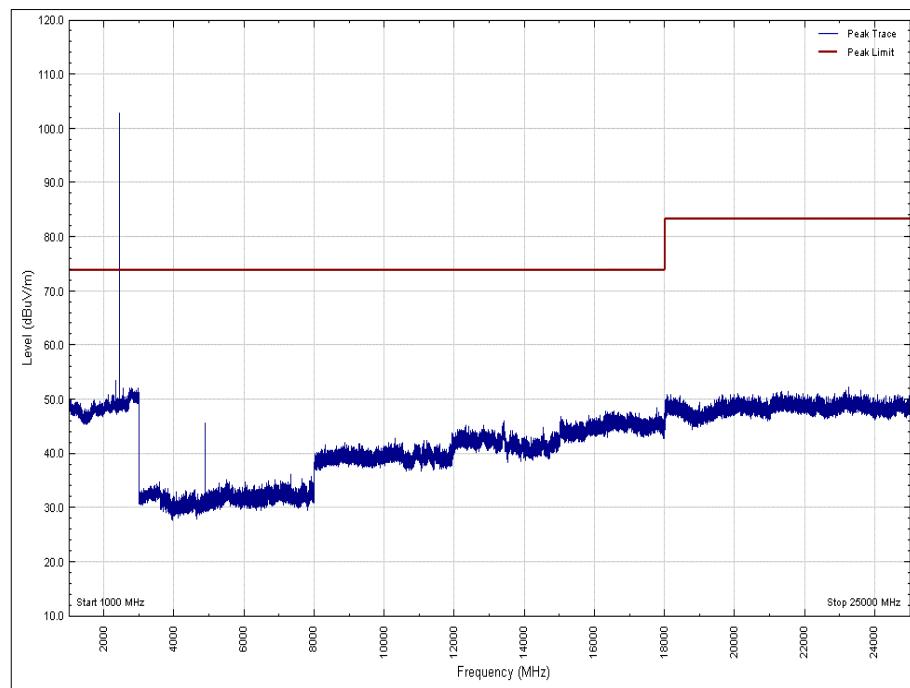


Figure 51 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Peak

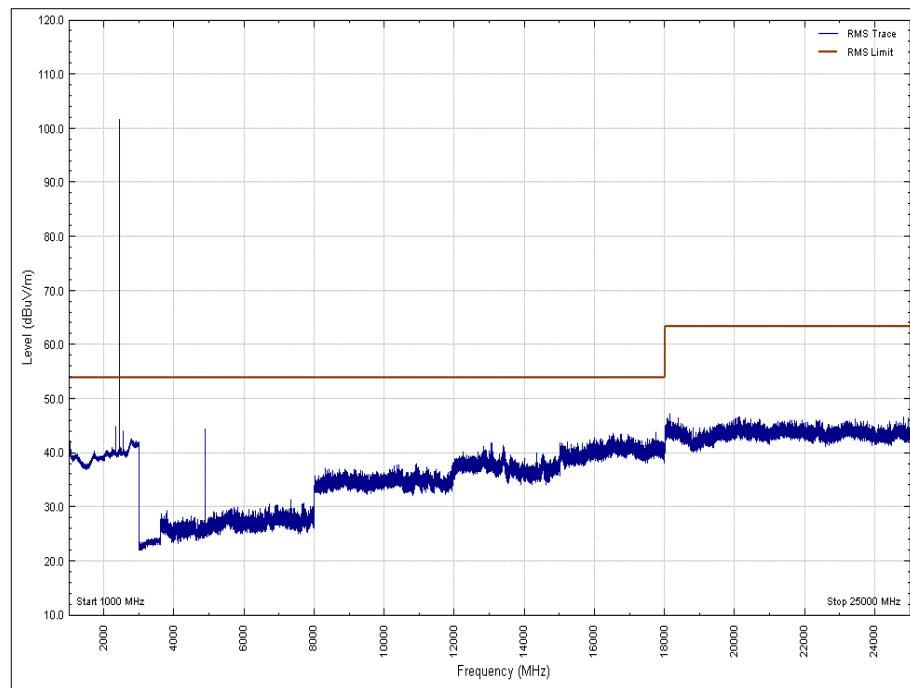


Figure 52 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Average

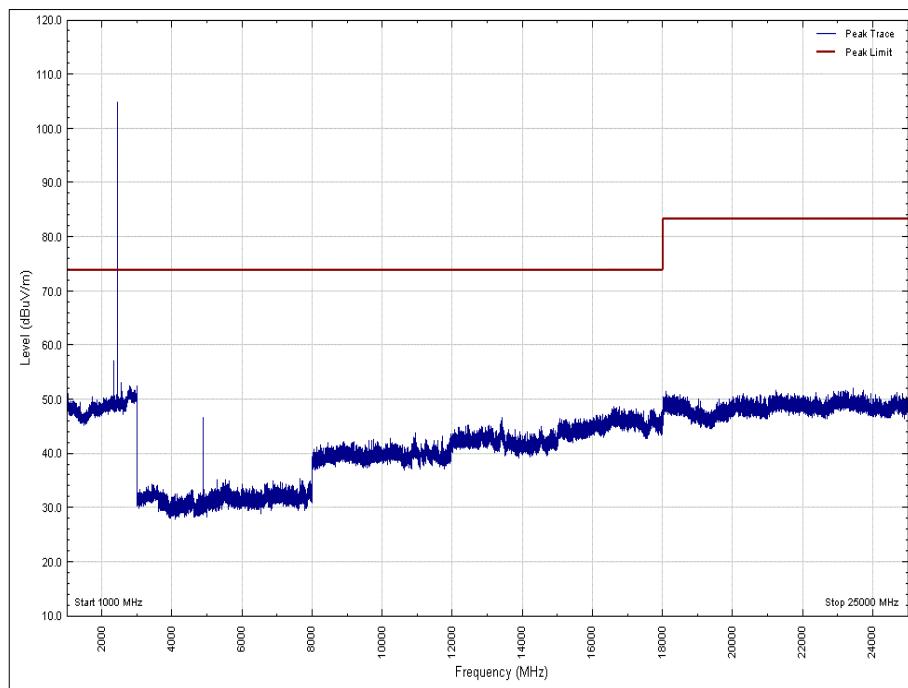


Figure 53 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Peak

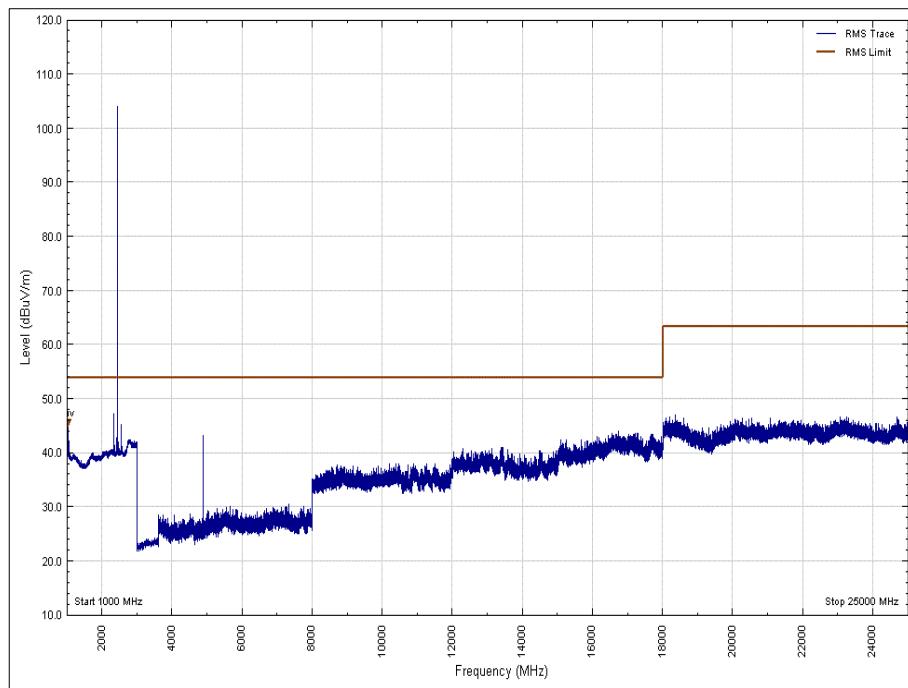


Figure 54 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Average

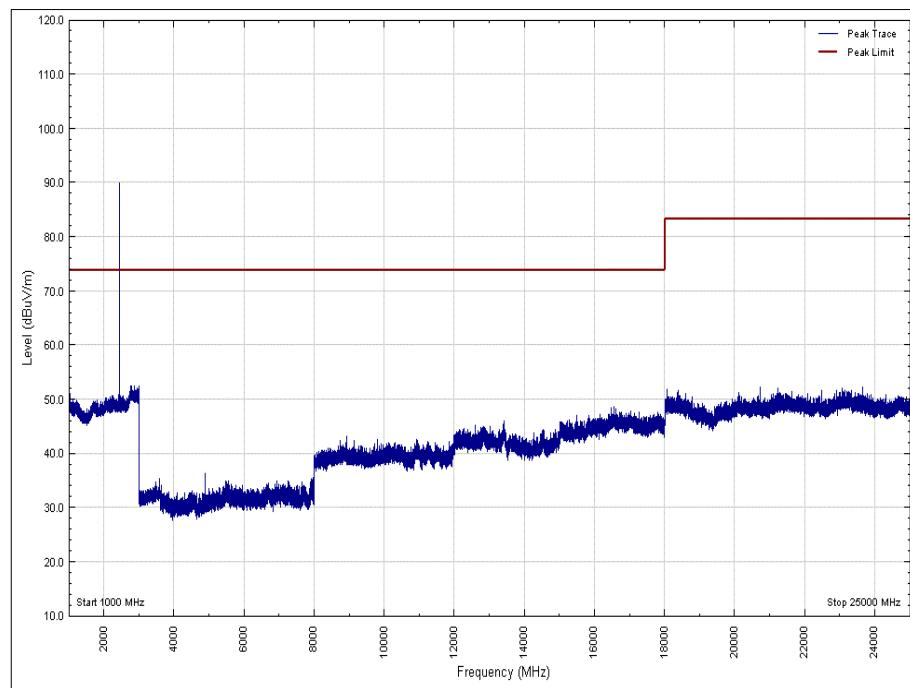


Figure 55 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Peak

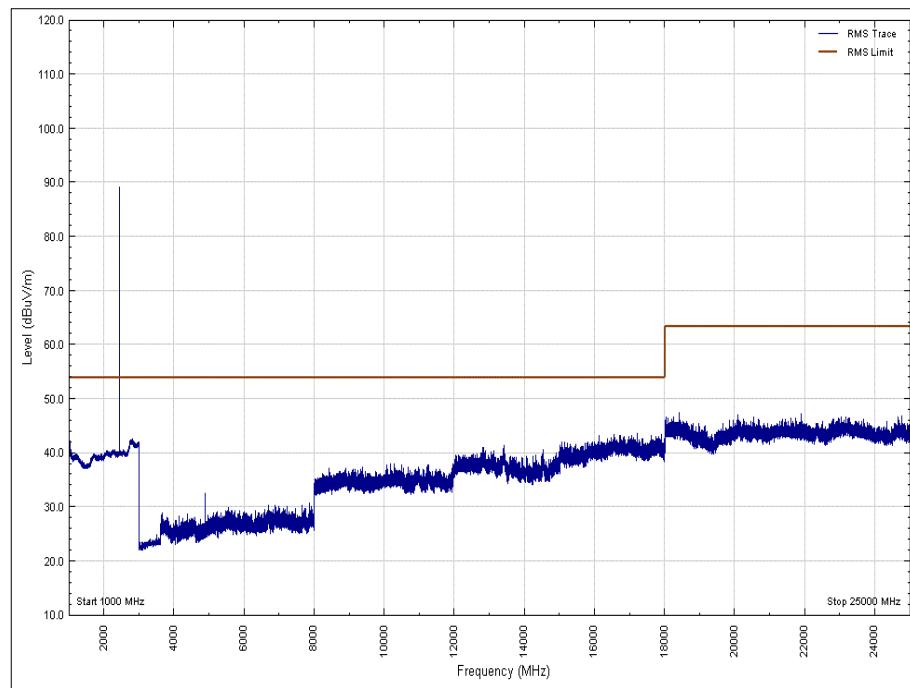


Figure 56 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Average

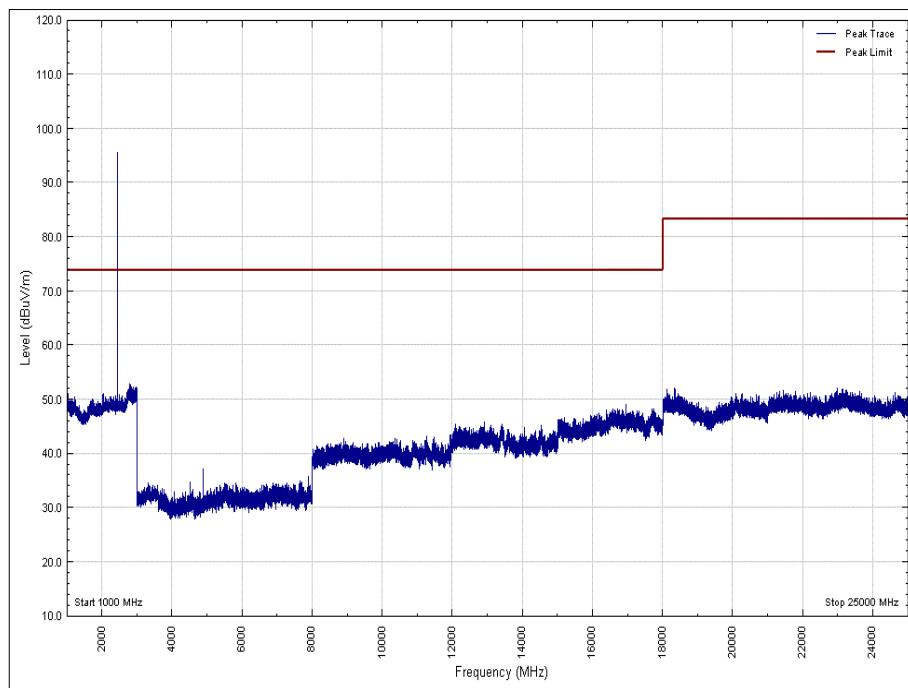


Figure 57 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Peak

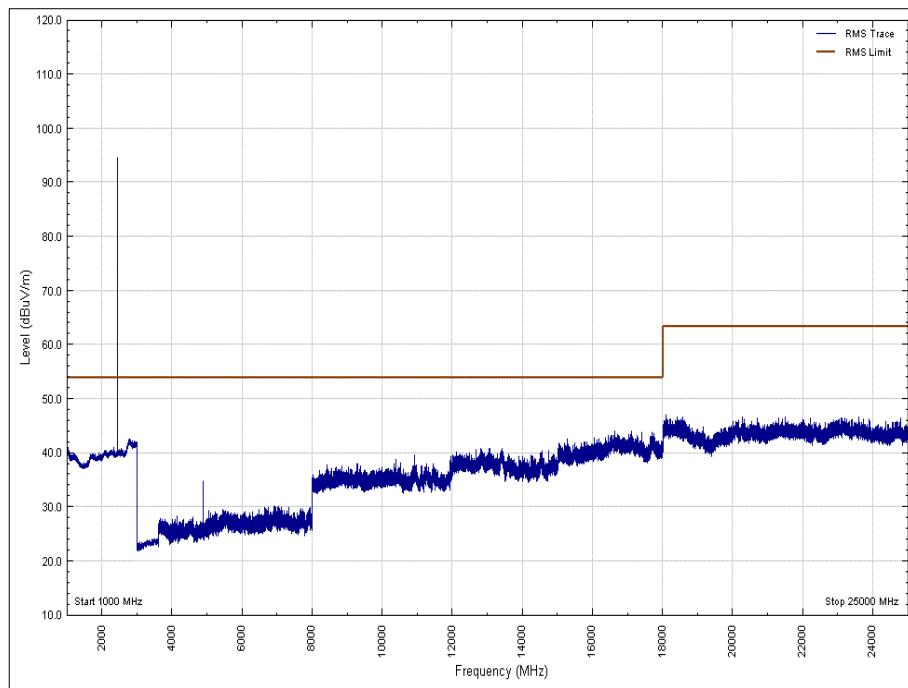


Figure 58 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Average

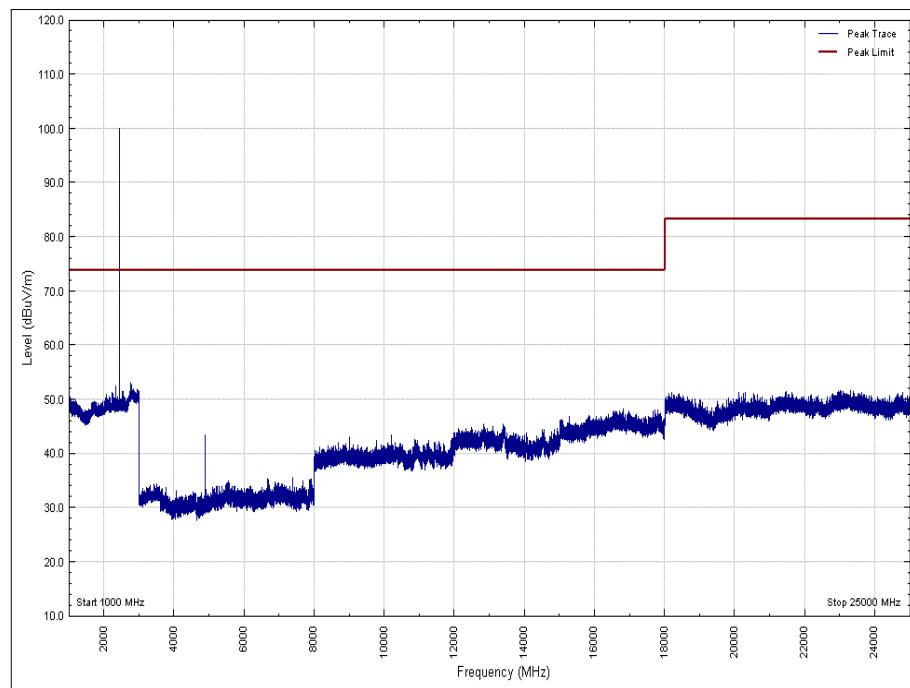


Figure 59 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Peak

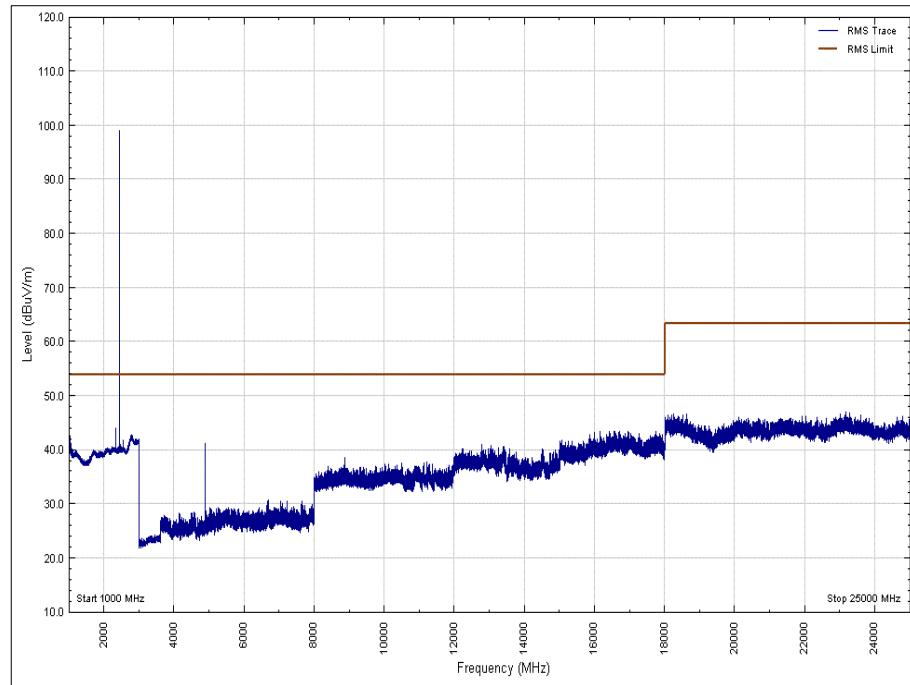


Figure 60 - 2441 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Average

Frequency (MHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)		Polarisation	EUT Orientation
	Peak	Average	Peak	Average	Peak	Average		
*								

Table 18 - Radiated Emissions Results, 30 MHz to 1 GHz - 2480 MHz

*No emissions were detected within 10 dB of the limit.

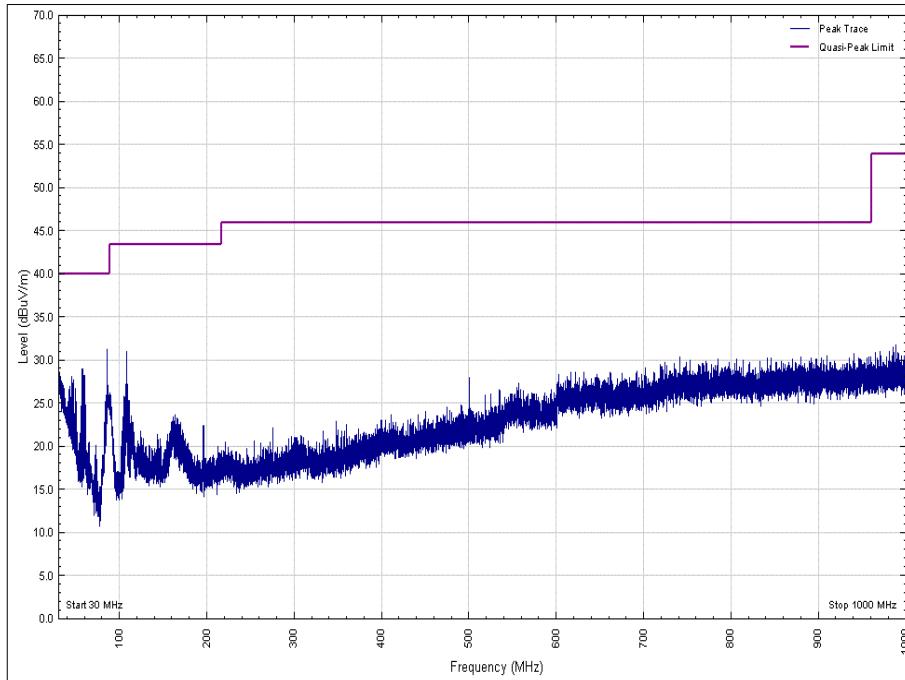


Figure 61 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Vertical, EUT Orientation X

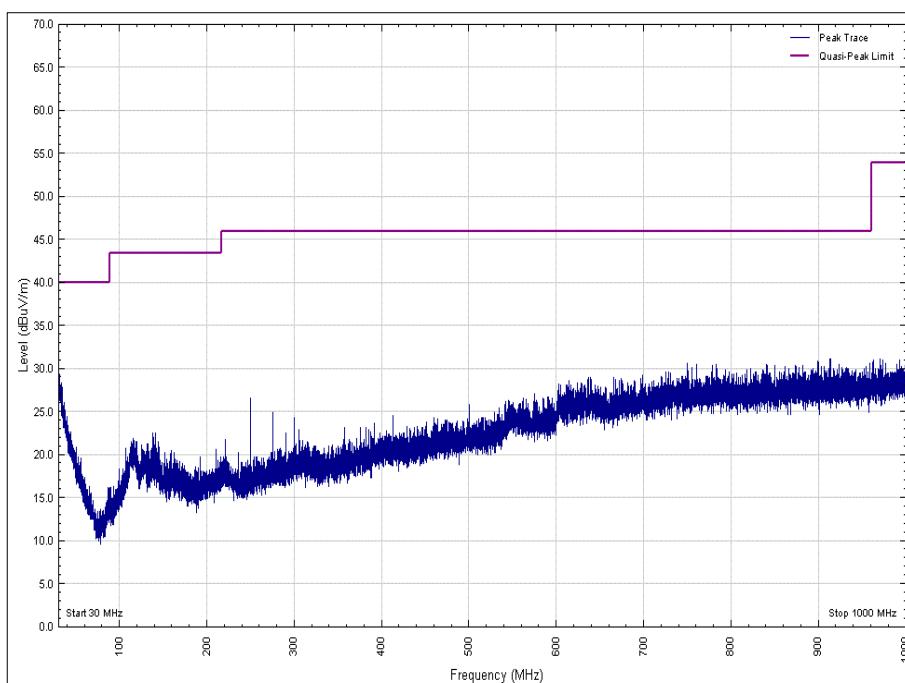


Figure 62 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Horizontal, EUT Orientation X

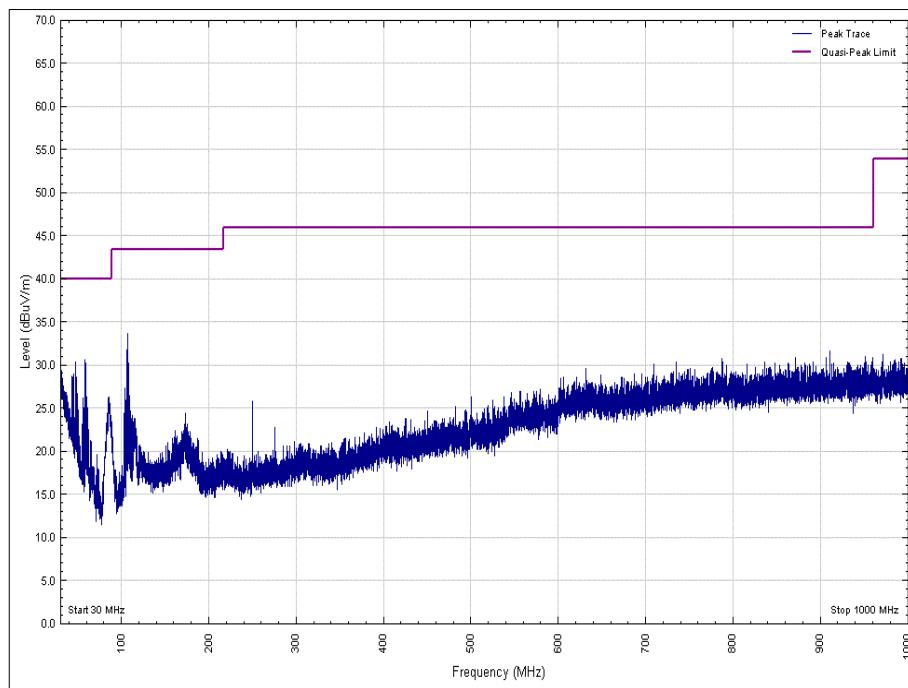


Figure 63 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Vertical, EUT Orientation Y

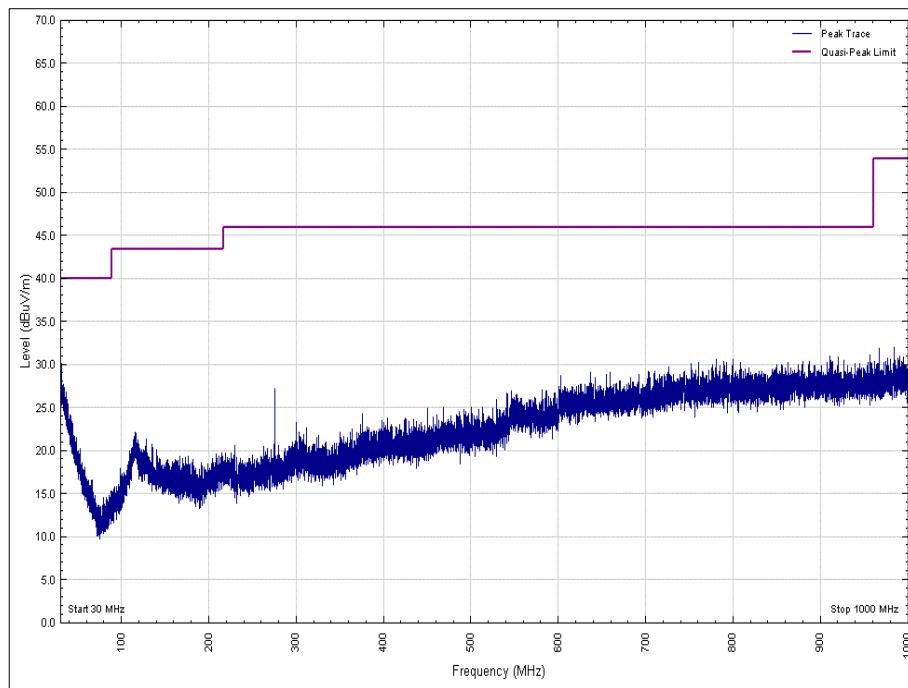


Figure 64 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Horizontal, EUT Orientation Y

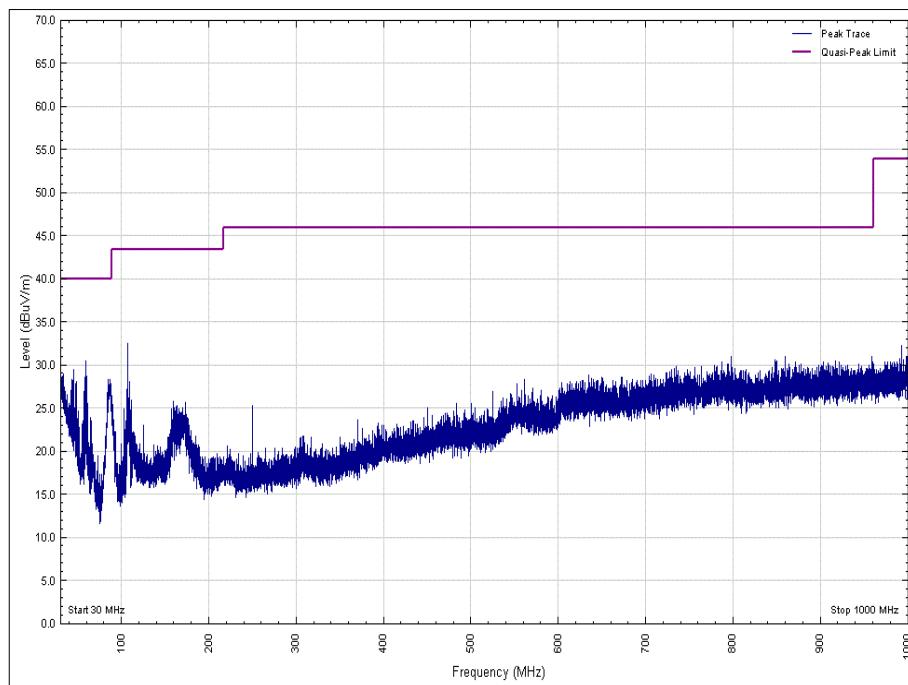


Figure 65 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Vertical, EUT Orientation Z

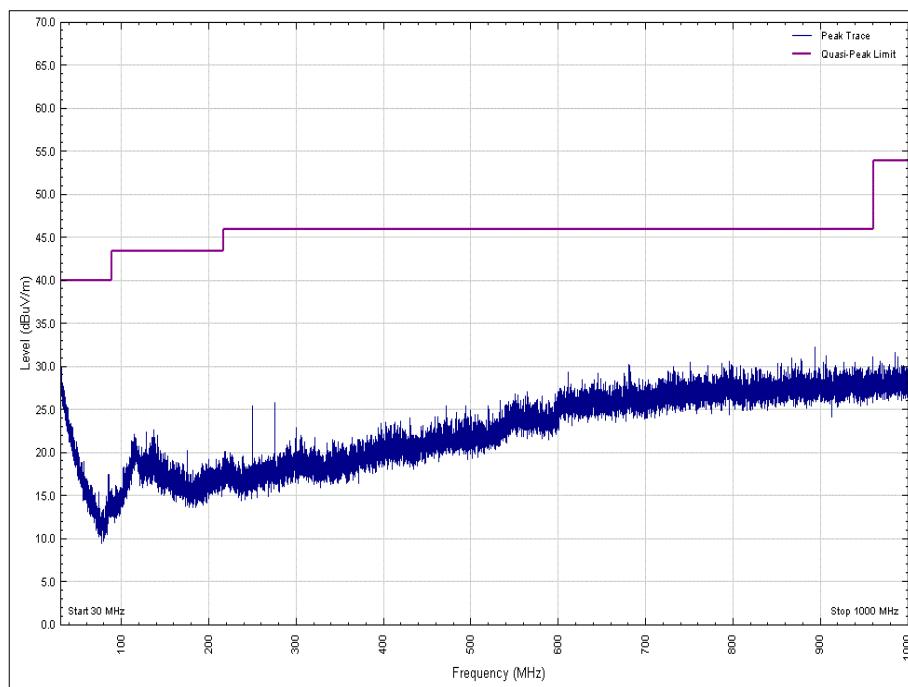


Figure 66 - 30 MHz to 1 GHz, 2480 MHz, Polarity: Horizontal, EUT Orientation Z



Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB μ V/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 19 - 2480 MHz - 1 GHz to 25 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

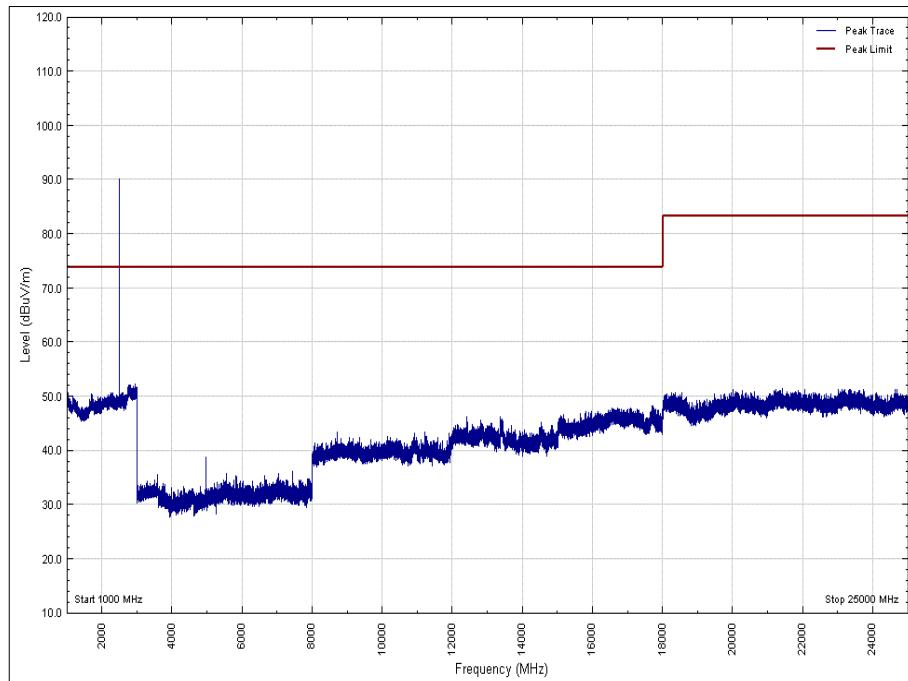


Figure 67 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Peak

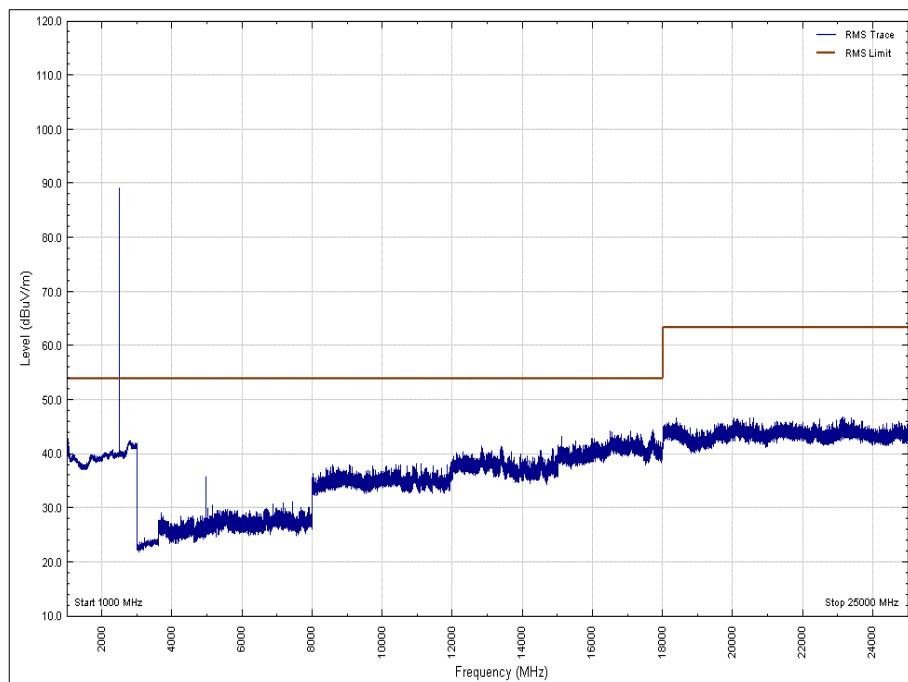


Figure 68 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: X, Average

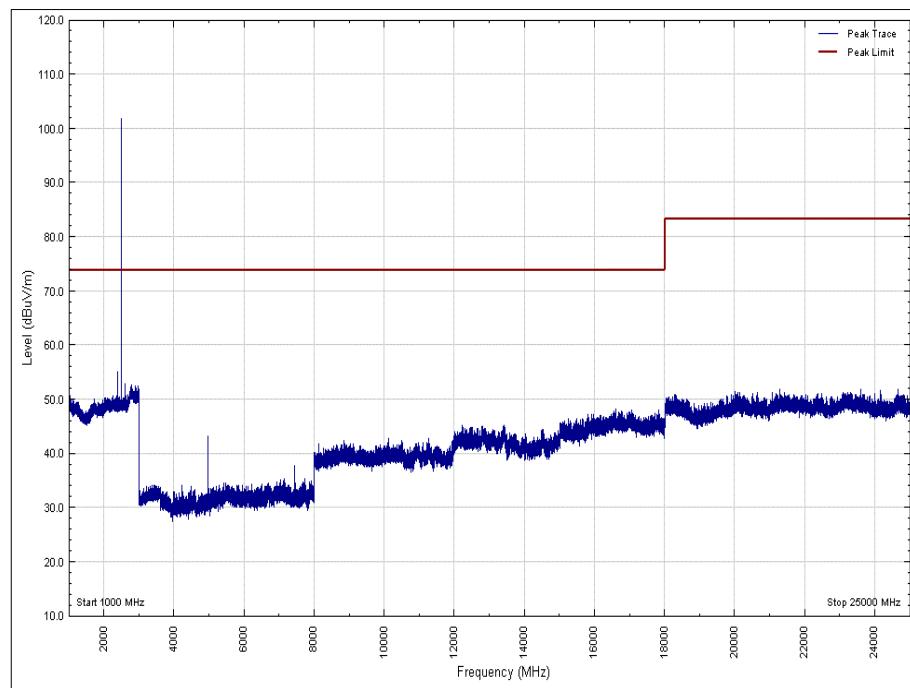


Figure 69 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Peak

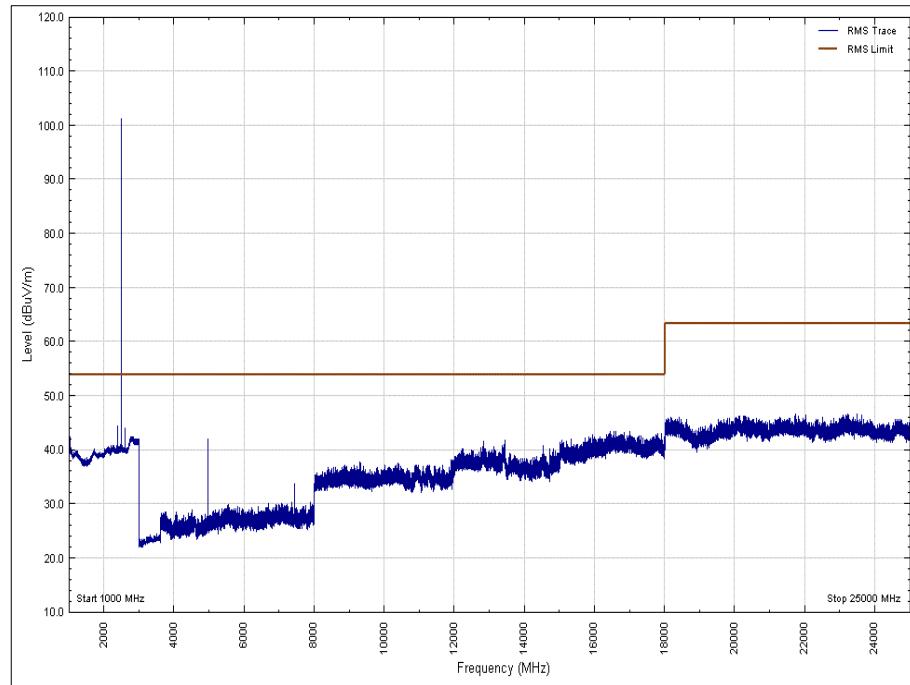


Figure 70 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: X, Average

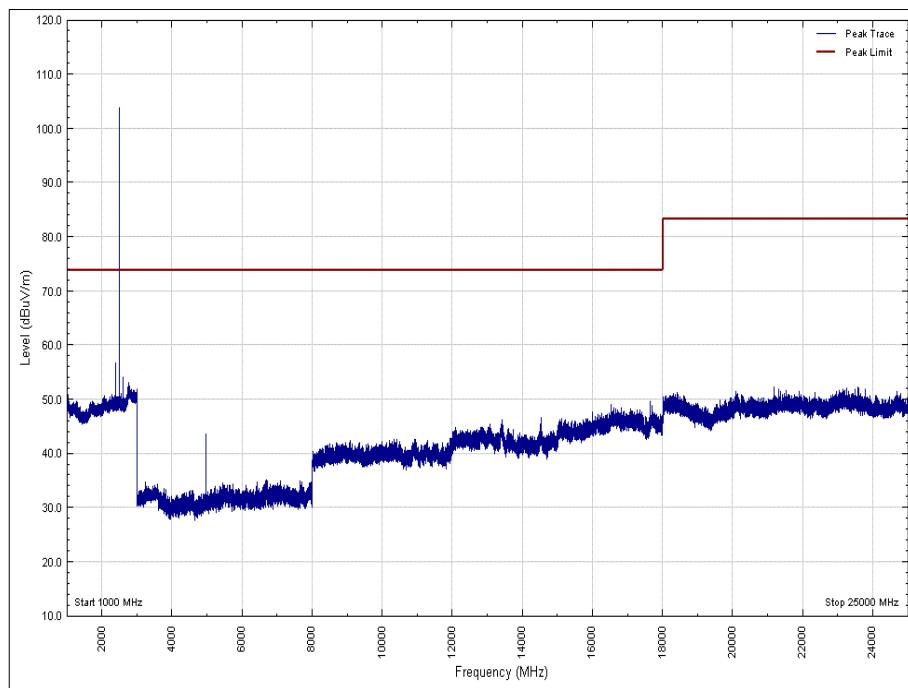


Figure 71 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Peak

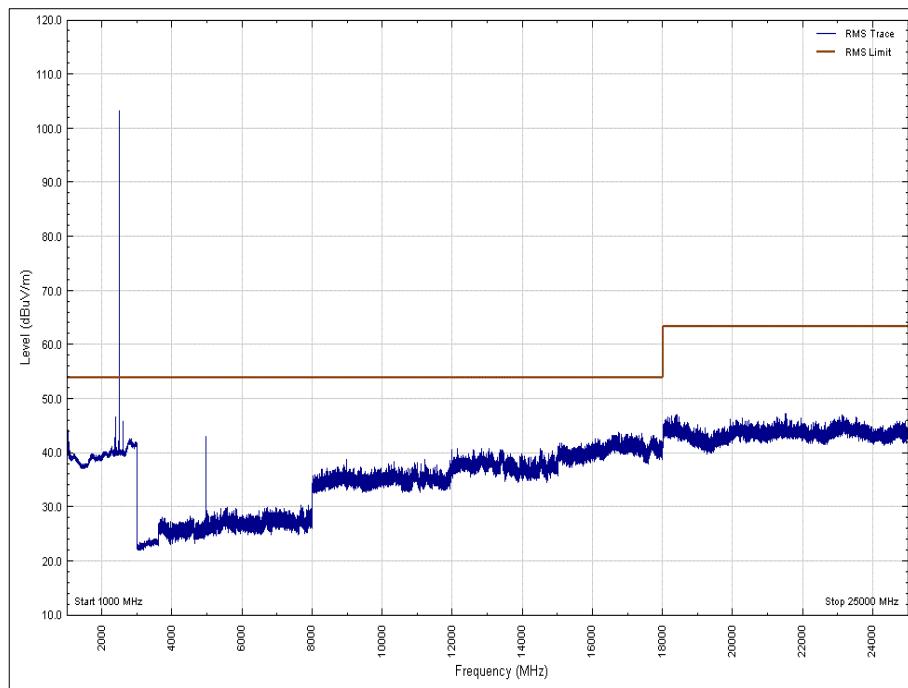


Figure 72 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Y, Average

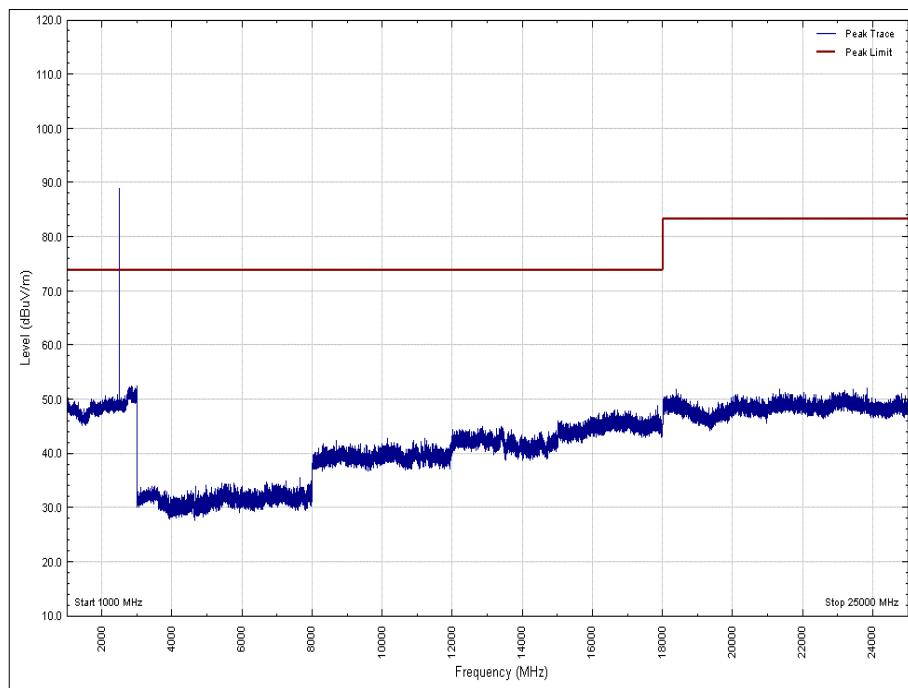


Figure 73 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Peak

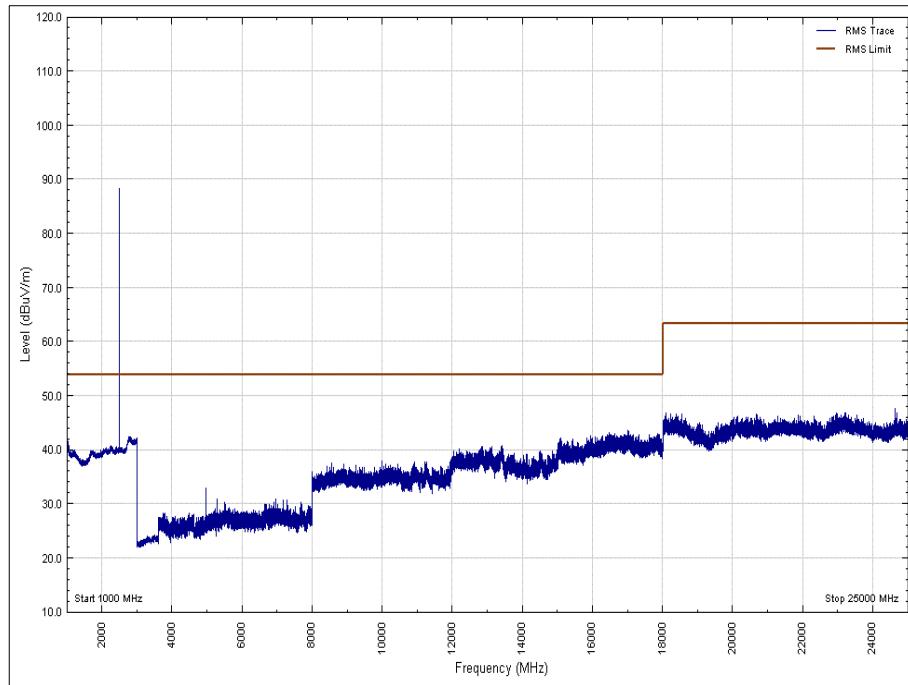


Figure 74 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Y, Average

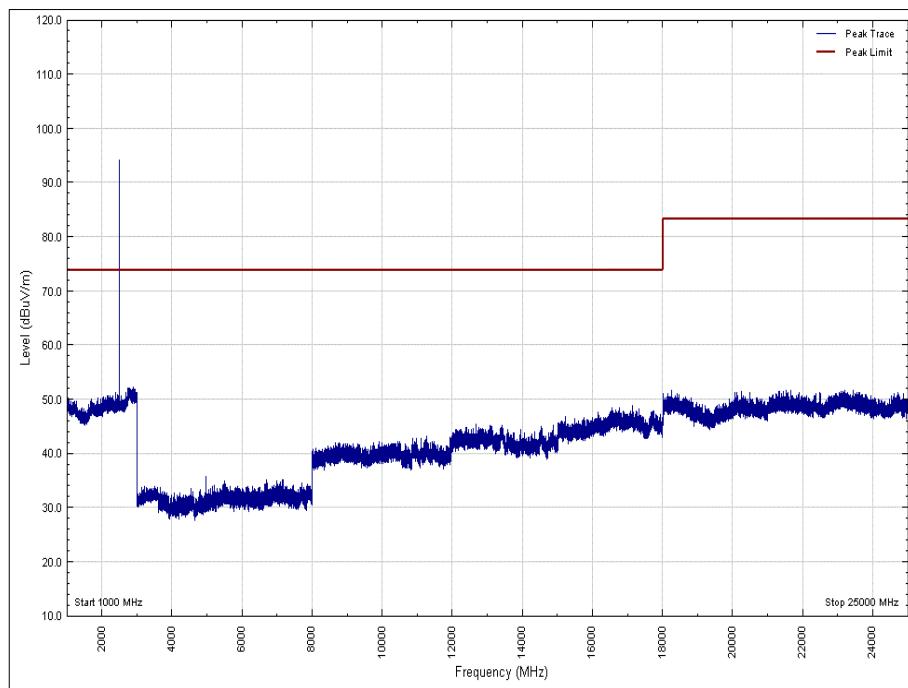


Figure 75 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Peak

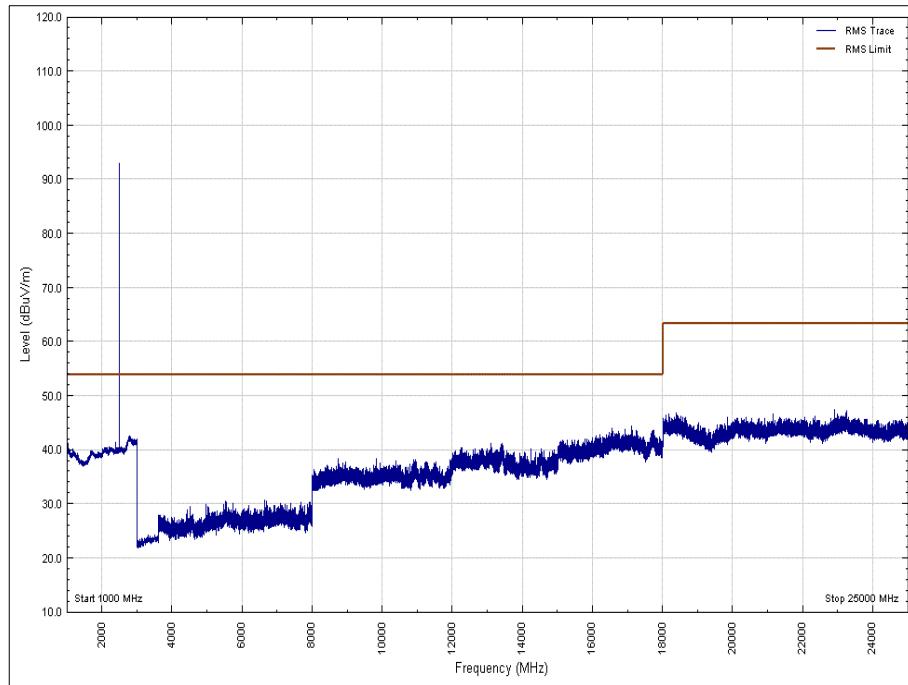


Figure 76 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Average

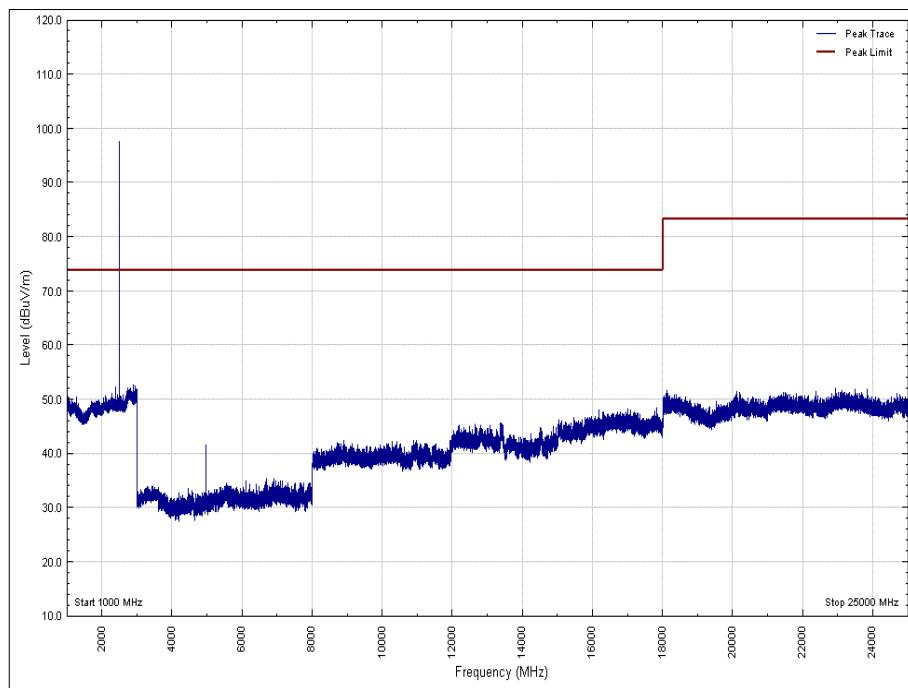


Figure 77 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Peak

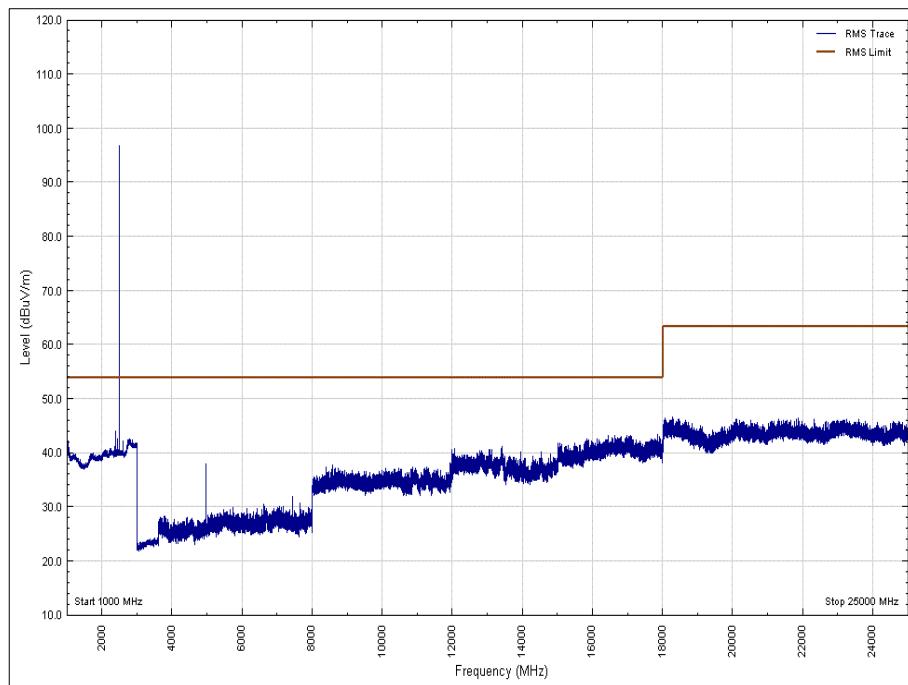


Figure 78 - 2480 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Average



FCC 47 CFR Part 15, Limit Clause 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.6.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	05-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2677	12	20-Feb-2020
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	26-Oct-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	25-Oct-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	05-Mar-2020
1 - 18GHz DRG Antenna	ETS-Lindgren	3117	4738	12	05-Mar-2020
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	05-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5109	12	05-Oct-2019
EmX Software	TÜV SUD	EmX	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
3 GHz High pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	5220	12	15-Feb-2020

Table 20

TU - Traceability Unscheduled



2.7 Authorised Band Edges

2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d),
ISEDC RSS-247, Clause 5.5

2.7.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113219 - Modification State 0

2.7.3 Date of Test

12-June-2019 to 16-June-2019

2.7.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.7.5 Environmental Conditions

Ambient Temperature 19.2 °C

Relative Humidity 61.1 %

2.7.6 Test Results

Bluetooth

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
Static	GFSK	DH5	2402	2400.0	-58.44
Static	$\pi/4$ DQPSK	2DH5	2402	2400.0	-56.01
Static	8-DPSK	3DH5	2402	2399.7	-53.13
Static	GFSK	DH5	2480	2483.5	-59.88
Static	$\pi/4$ DQPSK	2DH5	2480	2483.5	-58.05
Static	8-DPSK	3DH5	2480	2483.5	-58.70
Hopping	GFSK	DH5	2402	2400.0	-58.57
Hopping	$\pi/4$ DQPSK	2DH5	2402	2395.3	-57.62
Hopping	8-DPSK	3DH5	2402	2394.3	-59.20
Hopping	GFSK	DH5	2480	2483.5	-58.92
Hopping	$\pi/4$ DQPSK	2DH5	2480	2483.5	-59.47
Hopping	8-DPSK	3DH5	2480	2483.5	-58.78

Table 21 - Authorised Band Edge Results

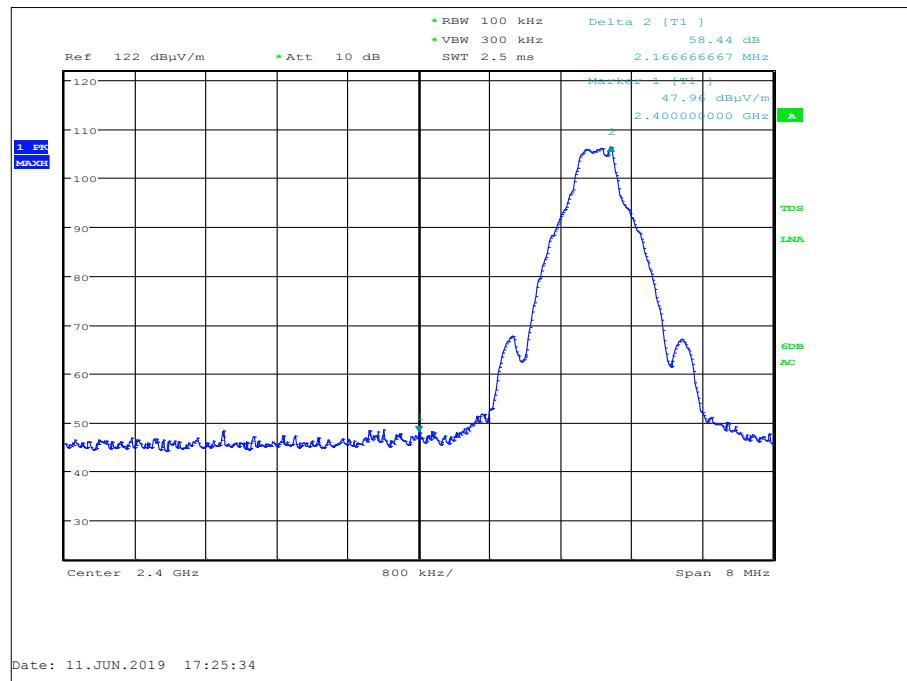


Figure 79 - Static - GFSK/DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

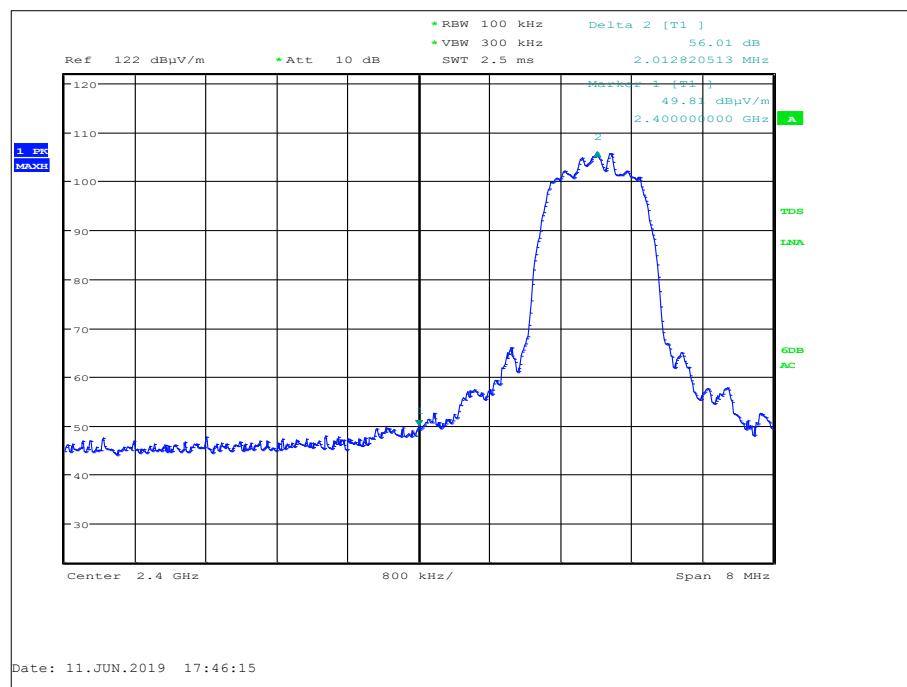


Figure 80 - Static - π/4 DQPSK/2DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

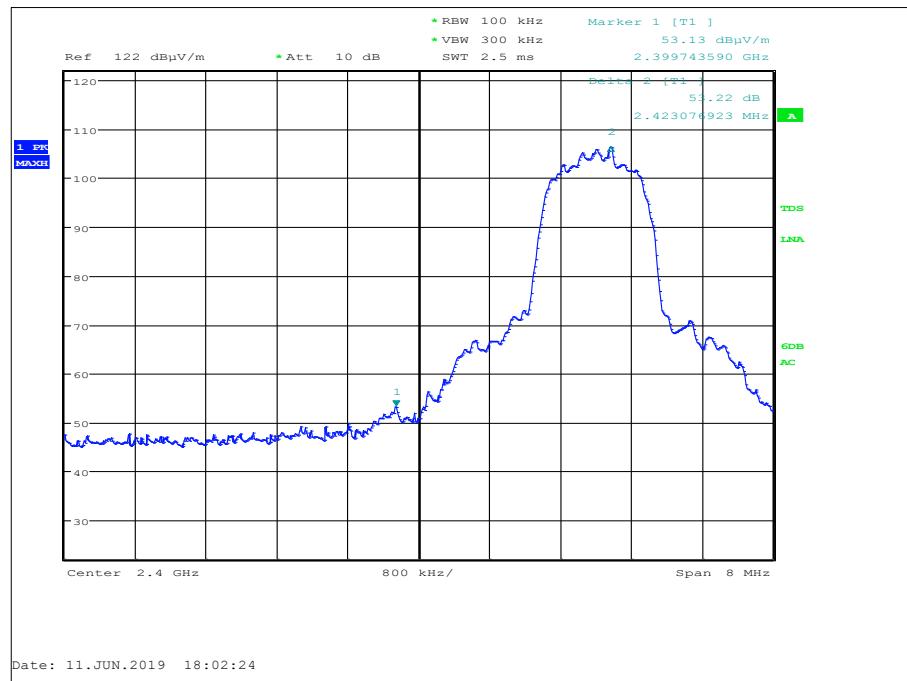


Figure 81 - Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2399.7 MHz

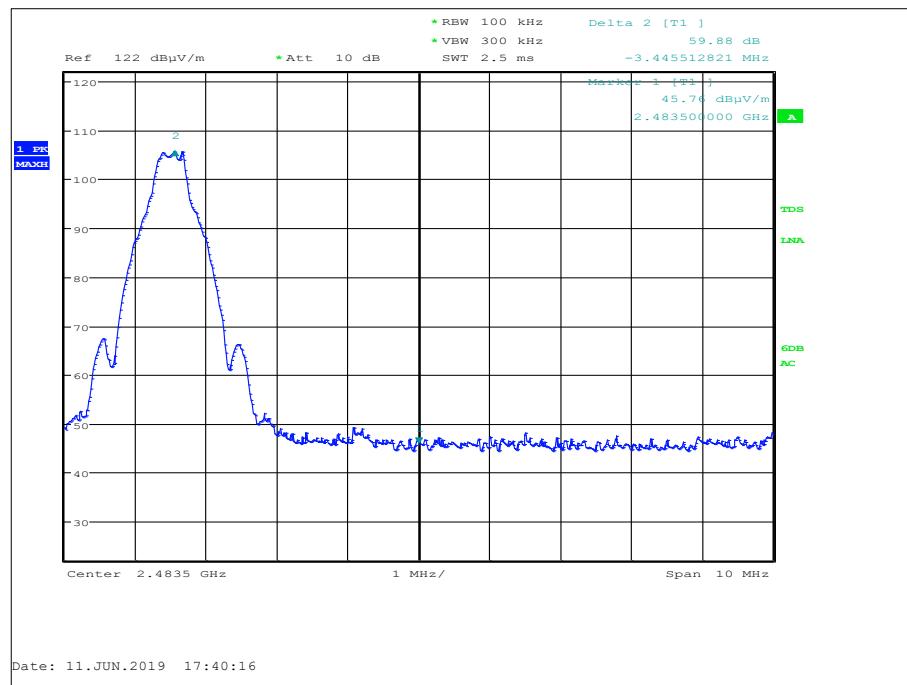


Figure 82 - Static - GFSK/DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

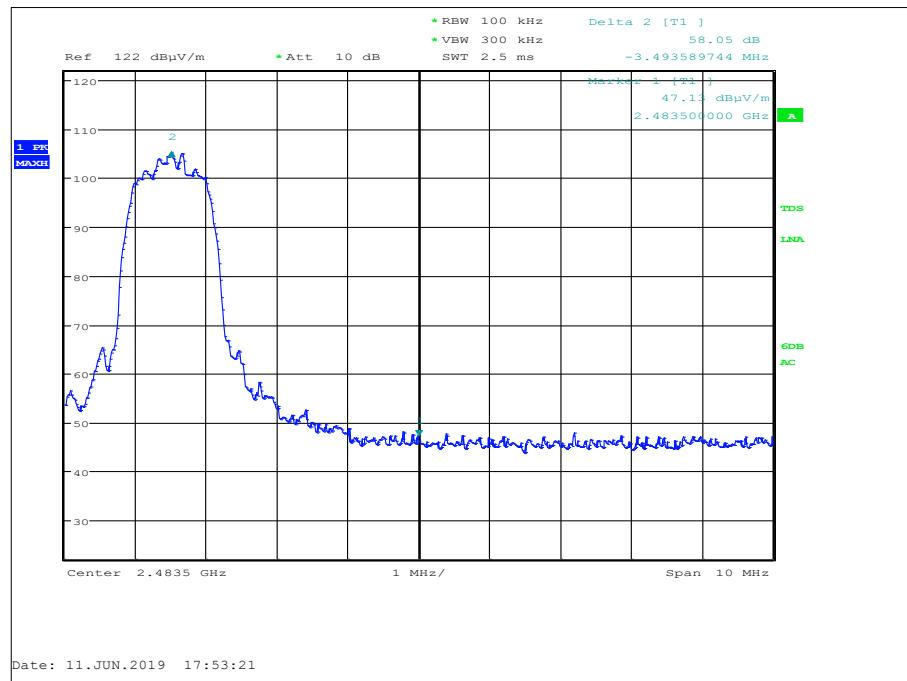


Figure 83 - Static - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

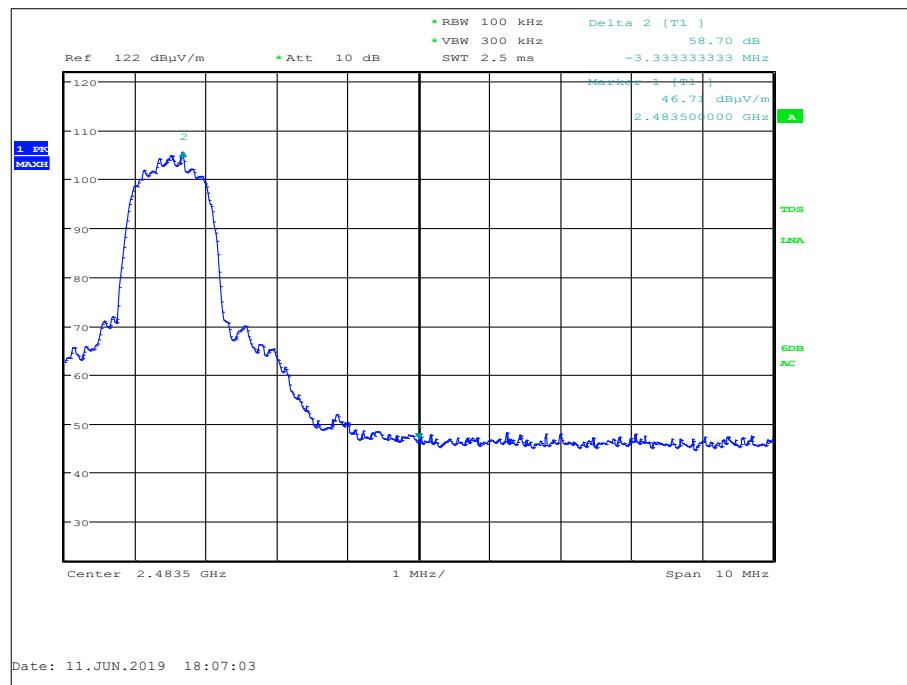


Figure 84 - Static - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

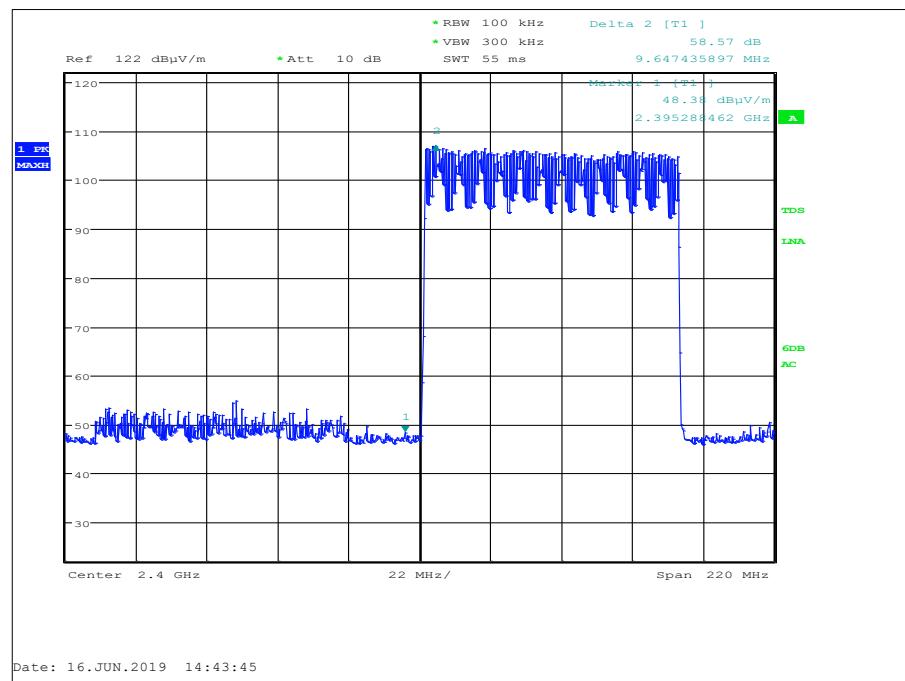


Figure 85 - Hopping - GFSK/DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

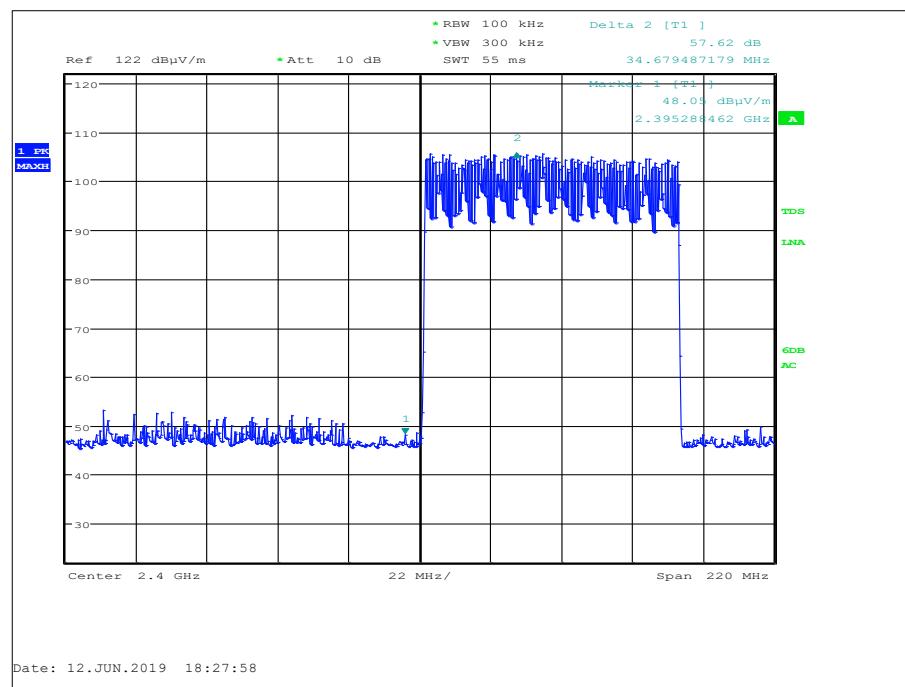


Figure 86 - Hopping - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2395.3 MHz

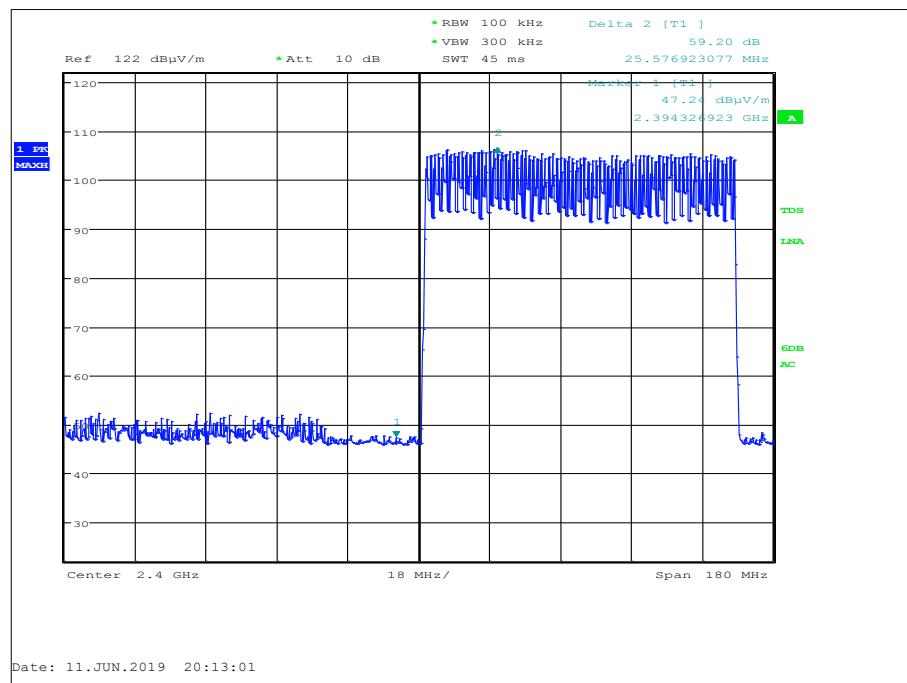


Figure 87 - Hopping - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2394.3 MHz

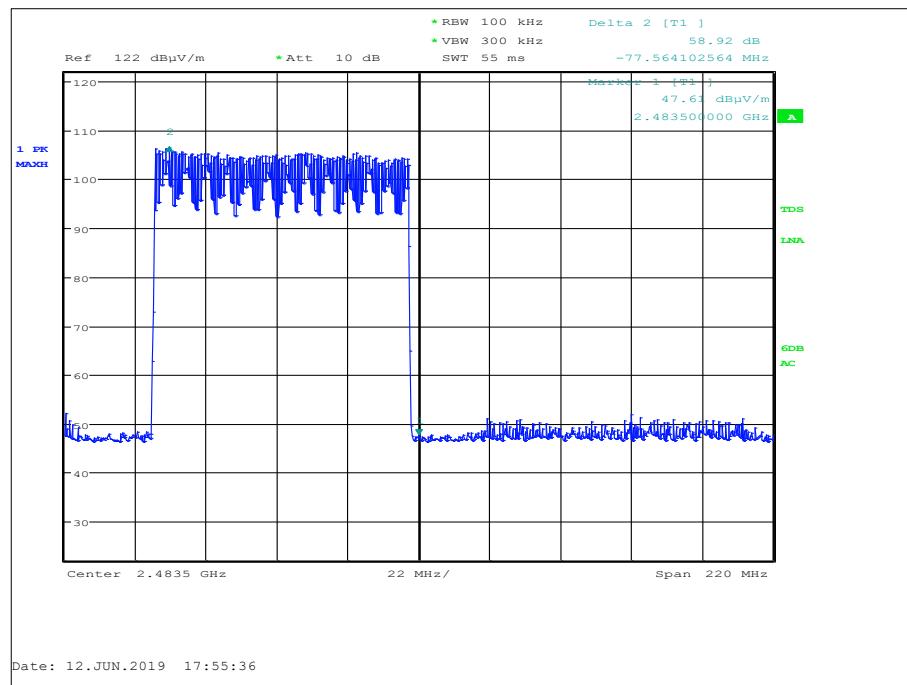


Figure 88 - Hopping - GFSK/DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

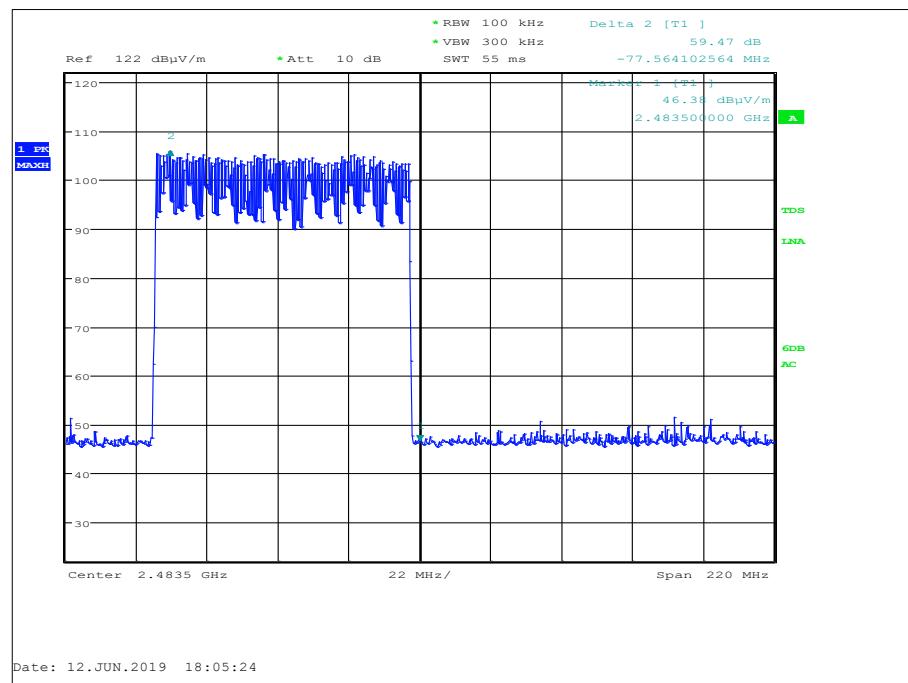


Figure 89 - Hopping - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

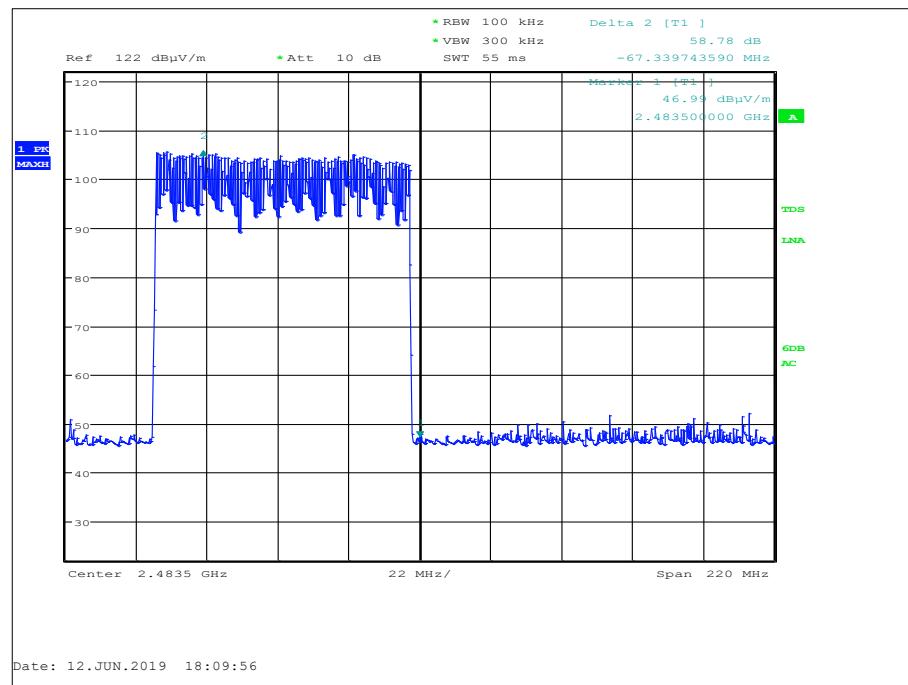


Figure 90 - Hopping - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.7.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2677	12	20-Feb-2020
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5109	12	05-Oct-2019
EmX Software	TÜV SUD	EmX	5125	-	Software

Table 22

TU - Traceability Unscheduled



2.8 Restricted Band Edges

2.8.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
ISEDC RSS-GEN, Clause 18.10

2.8.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113219 - Modification State 0

2.8.3 Date of Test

12-June-2019 to 16-June-2019

2.8.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3.

These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables. The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{\Delta}(\text{Field Strength in } \text{dB}\mu\text{V/m}/20)$.

2.8.5 Environmental Conditions

Ambient Temperature 19.2 °C
Relative Humidity 61.1 %

2.8.6 Test Results

Bluetooth

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
Static	GFSK	DH5	2402	2390.0	54.88	43.43
Static	$\pi/4$ DQPSK	2DH5	2402	2390.0	54.97	42.55
Static	8-DPSK	3DH5	2402	2390.0	53.39	42.27
Static	GFSK	DH5	2480	2483.5	55.47	43.73
Static	$\pi/4$ DQPSK	2DH5	2480	2483.5	58.81	45.81
Static	8-DPSK	3DH5	2480	2483.5	56.74	44.29
Hopping	GFSK	DH5	2402	2390.0	58.34	42.47
Hopping	$\pi/4$ DQPSK	2DH5	2402	2390.0	58.32	42.47
Hopping	8-DPSK	3DH5	2402	2390.0	58.32	42.32
Hopping	GFSK	DH5	2480	2483.5	54.52	43.08
Hopping	$\pi/4$ DQPSK	2DH5	2480	2483.5	54.81	43.34
Hopping	8-DPSK	3DH5	2480	2483.5	53.92	43.14

Table 23 - Restricted Band Edge Results

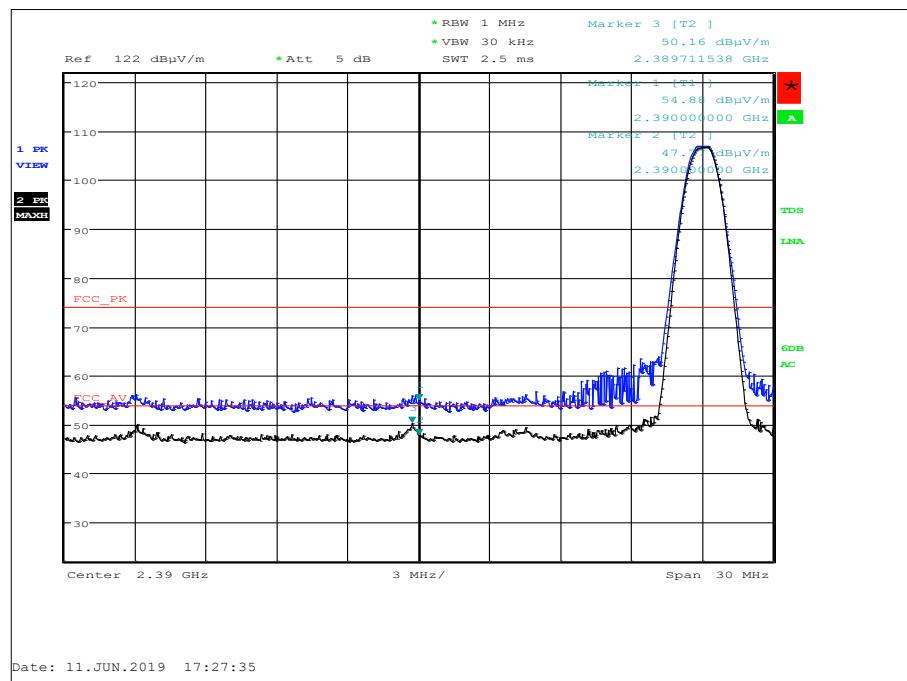


Figure 91 - Static - GFSK/DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

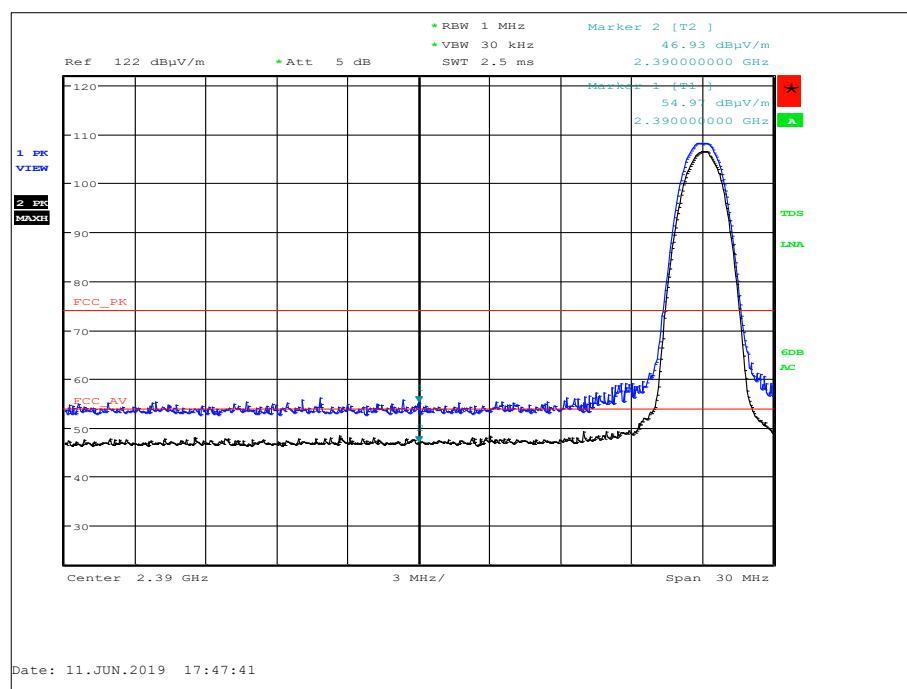


Figure 92 - Static - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

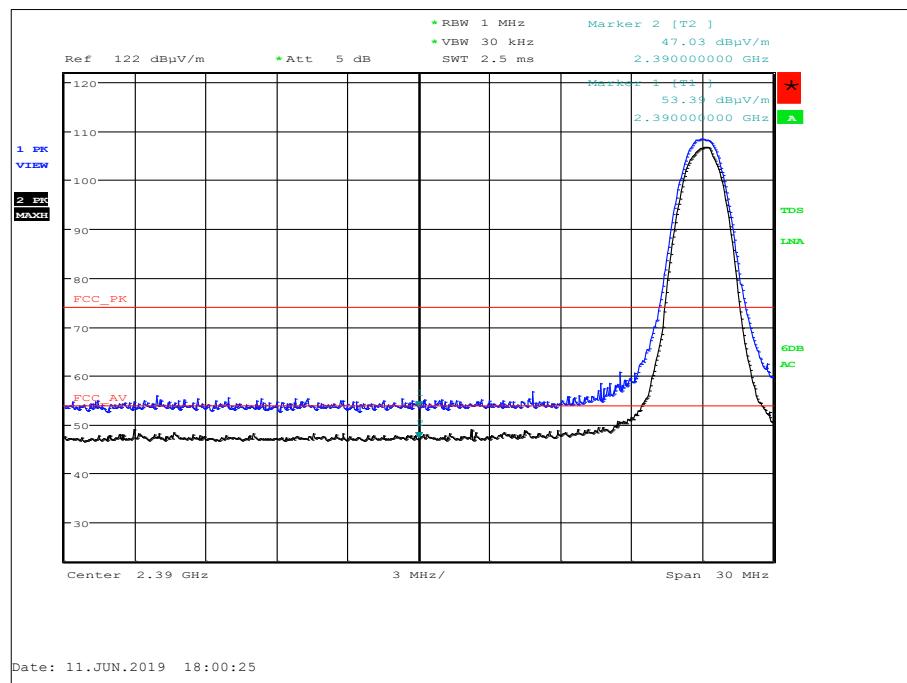


Figure 93 - Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

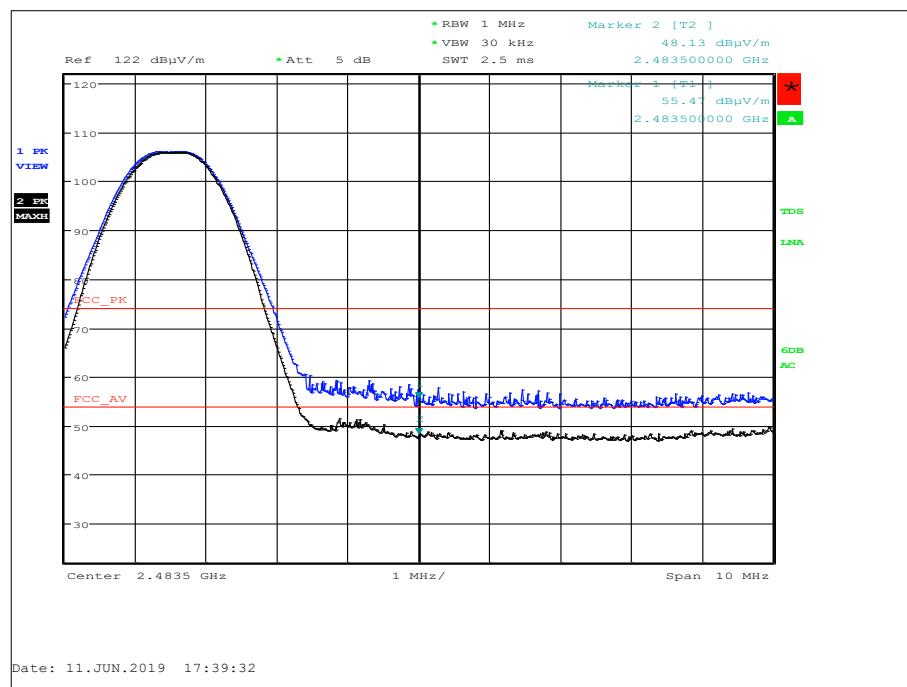


Figure 94 - Static - GFSK/DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

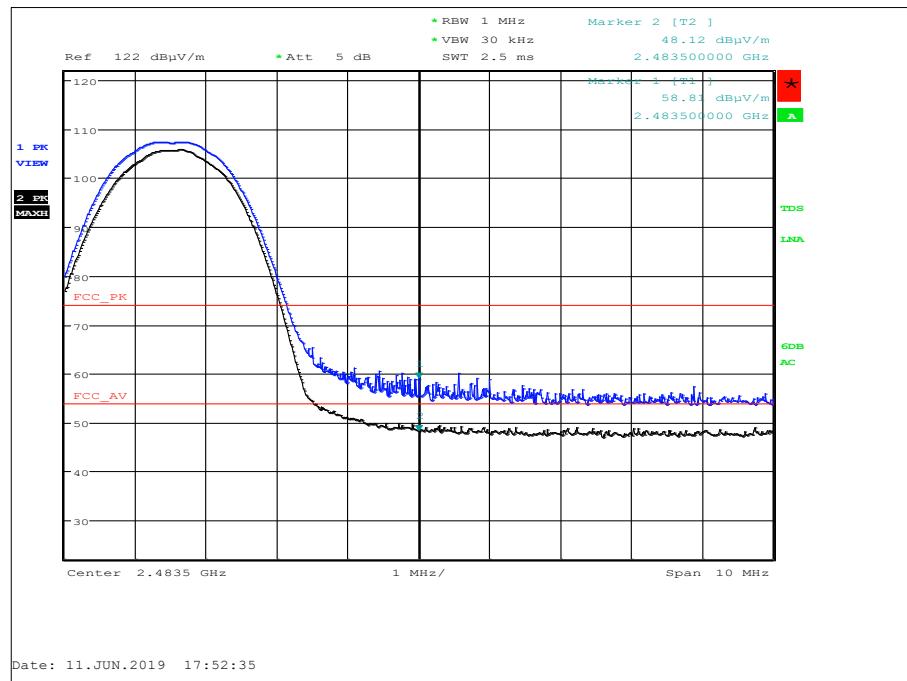


Figure 95 - Static - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

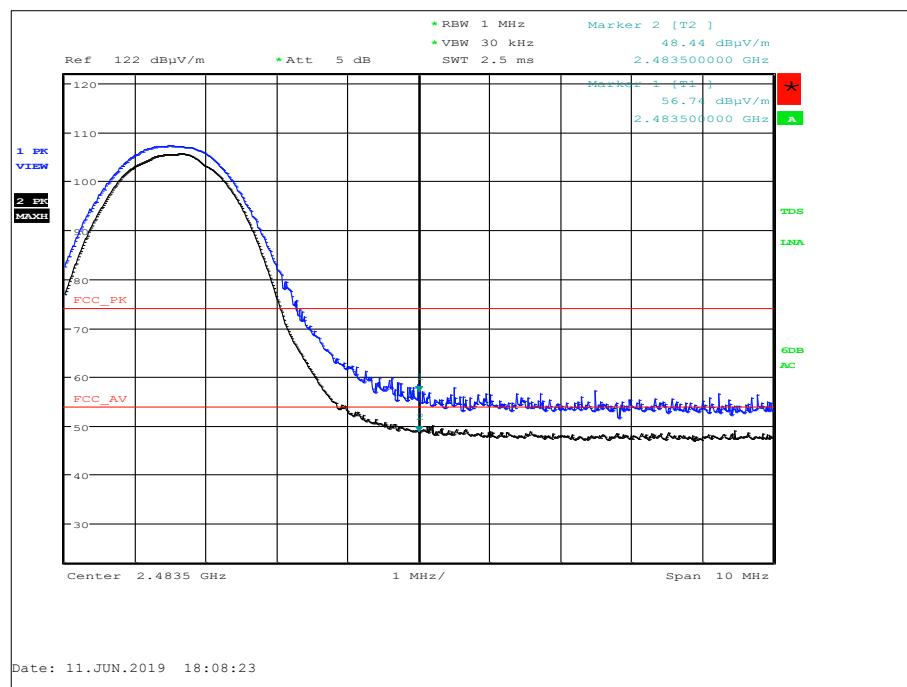


Figure 96 - Static - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

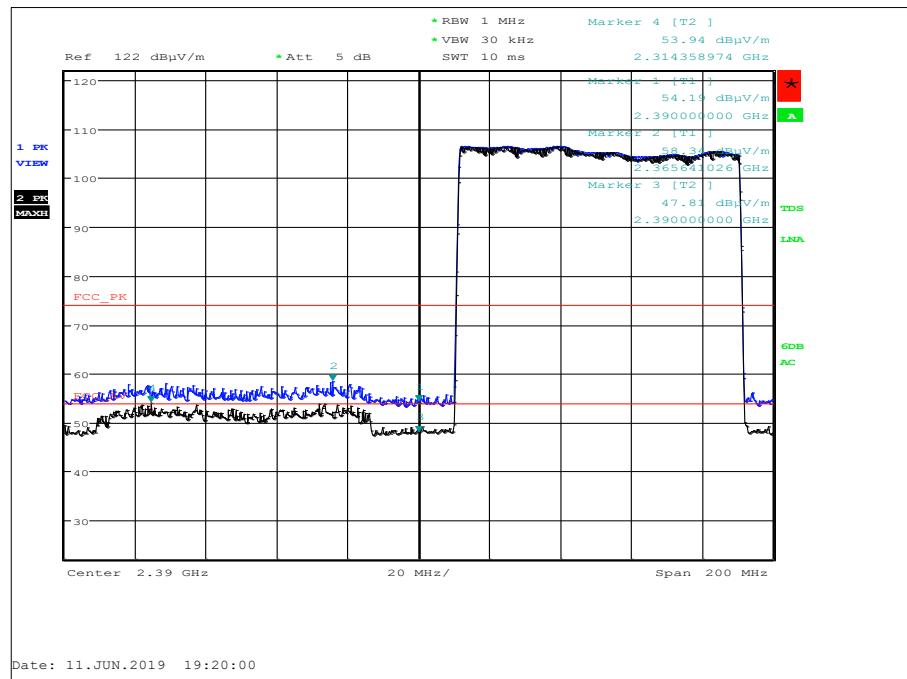


Figure 97 - Hopping - GFSK/DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

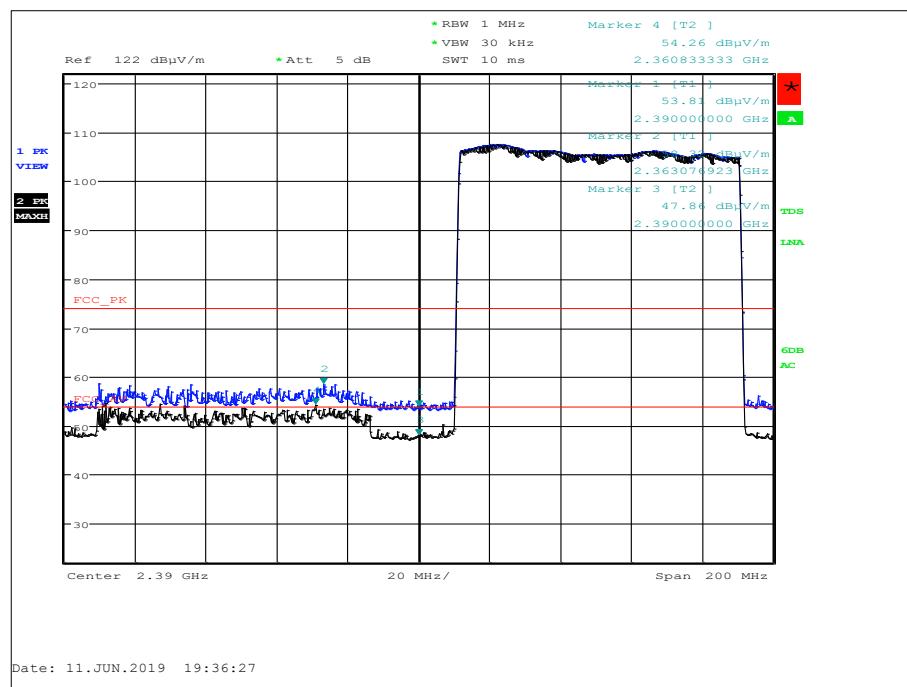


Figure 98 - Hopping - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

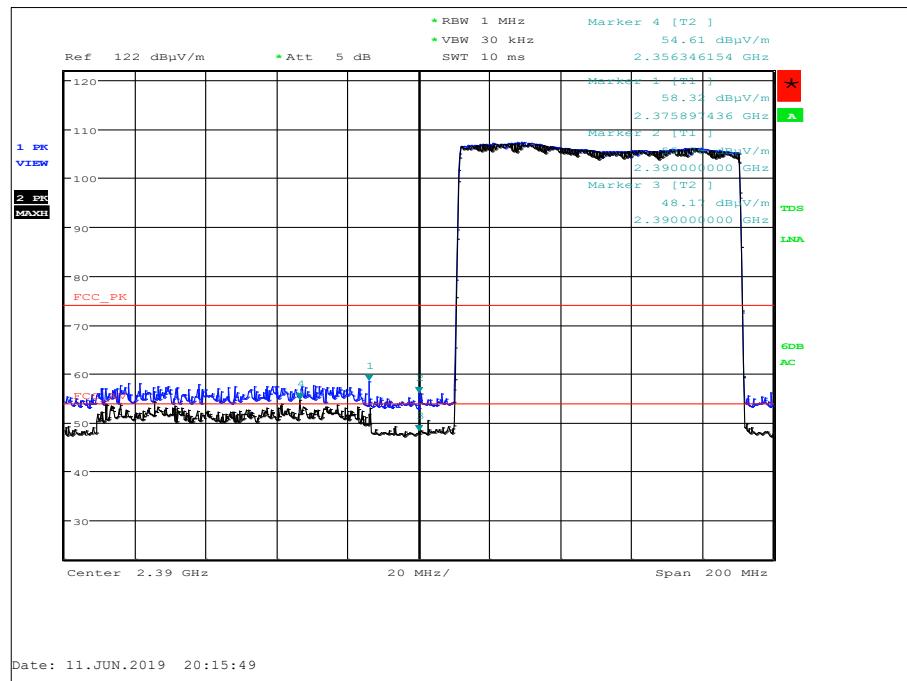


Figure 99 - Hopping - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

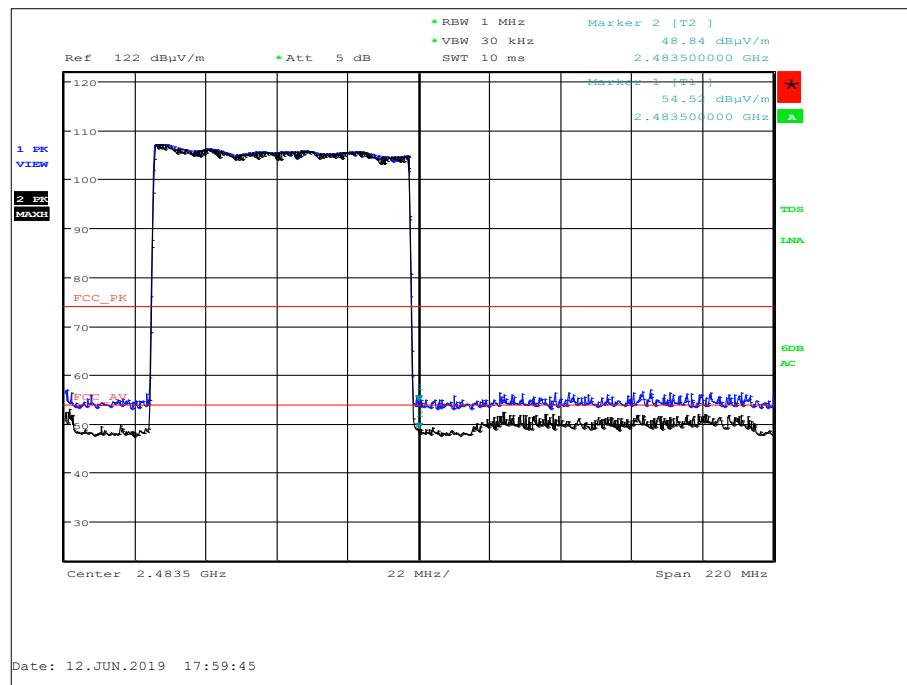


Figure 100 - Hopping - GFSK/DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

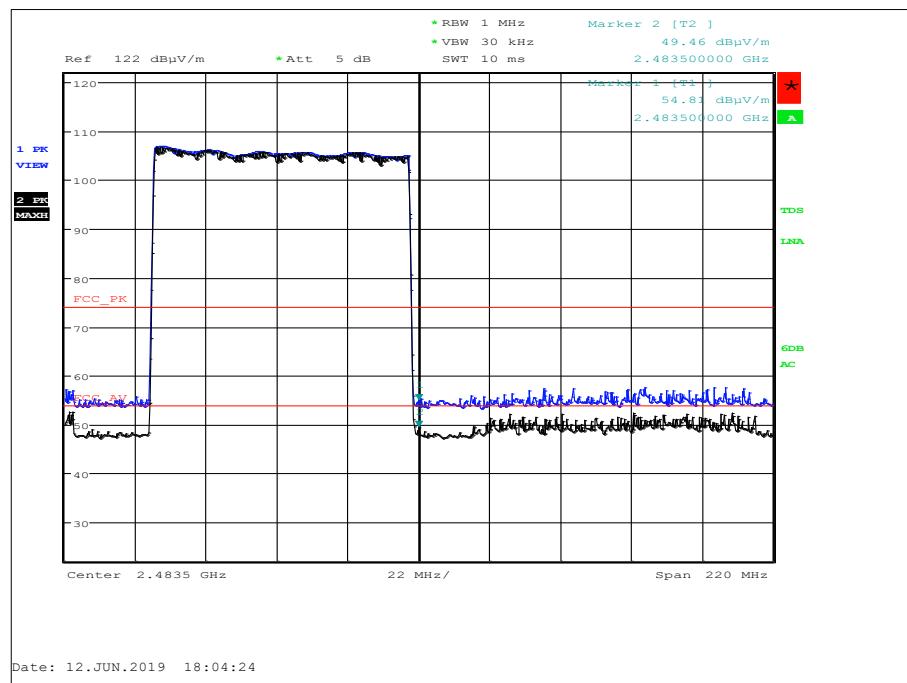


Figure 101 - Hopping - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

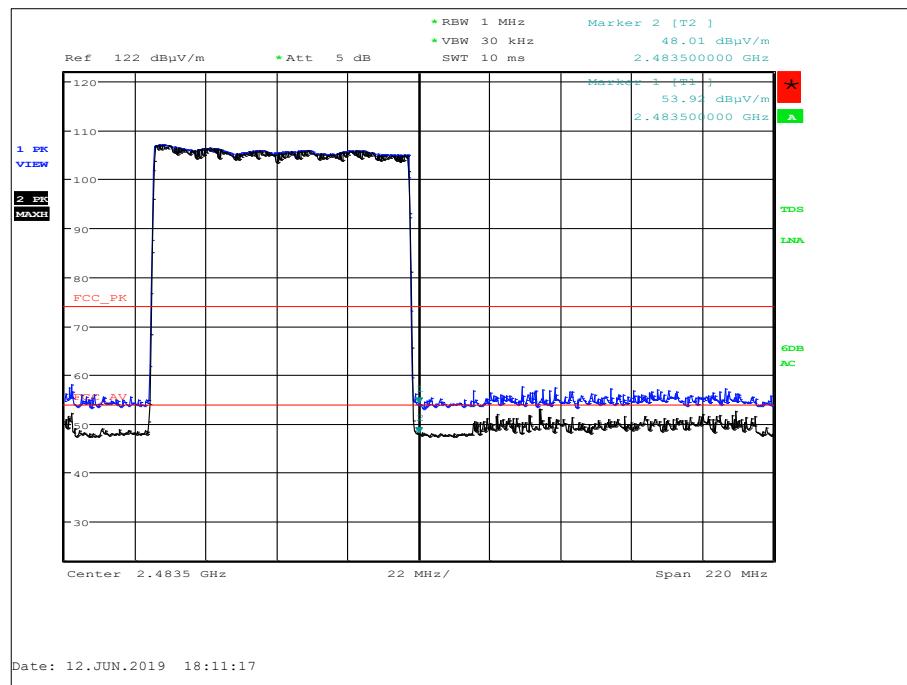


Figure 102 - Hopping - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 24

ISEDC RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 25

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.8.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2677	12	20-Feb-2020
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5109	12	05-Oct-2019
EmX Software	TÜV SUD	EmX	5125	-	Software

Table 26

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs

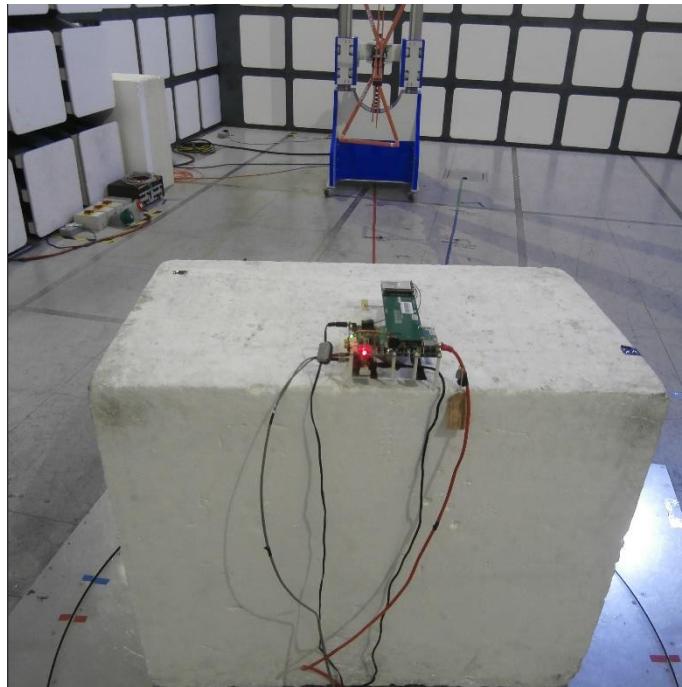


Figure 103 - Spurious Radiated Emissions - 30 MHz to 1 GHz - X Orientation

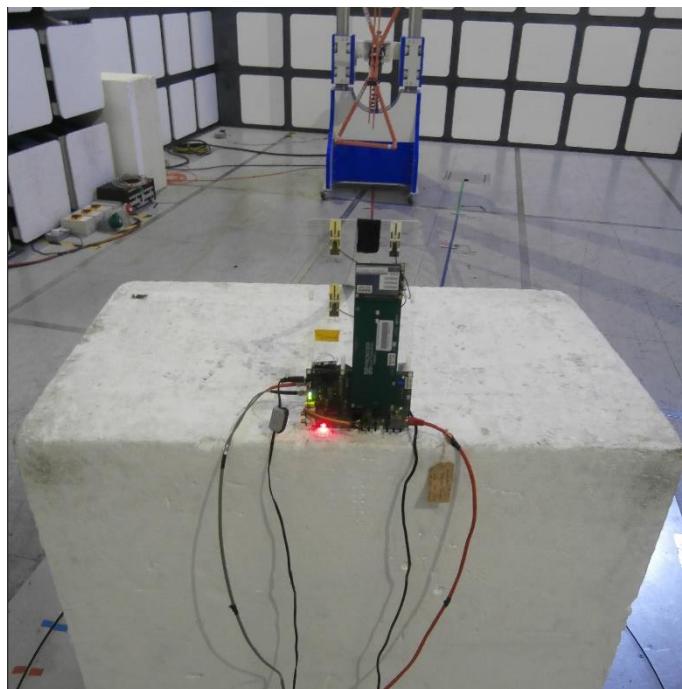


Figure 104 - Spurious Radiated Emissions - 30 MHz to 1 GHz - Y Orientation

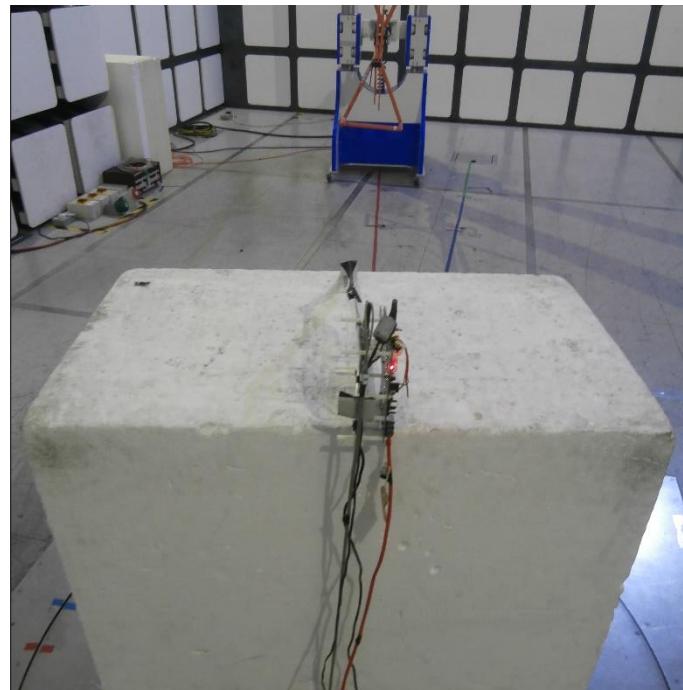


Figure 105 - Spurious Radiated Emissions - 30 MHz to 1 GHz - Z Orientation



Figure 106 - Spurious Radiated Emissions - 1 GHz to 8 GHz - X Orientation

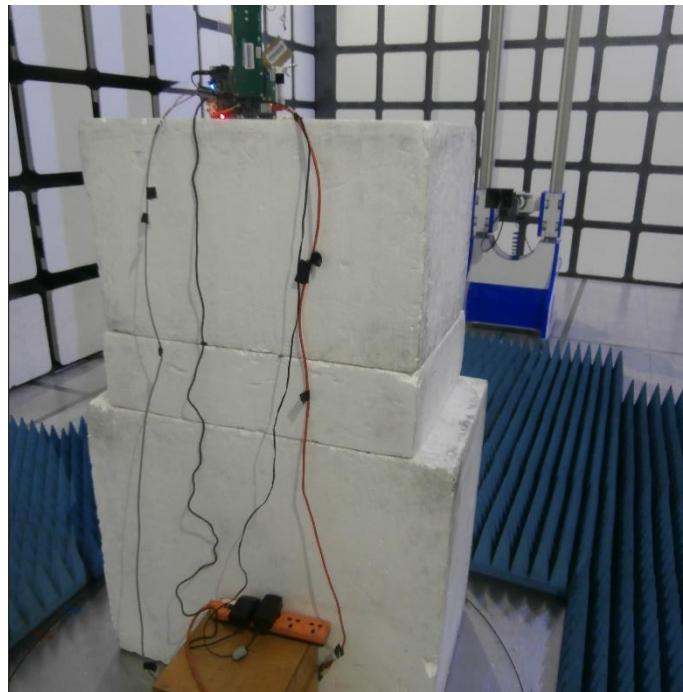


Figure 107 - Spurious Radiated Emissions - 1 GHz to 8 GHz - Y Orientation



Figure 108 - Spurious Radiated Emissions - 1 GHz to 8 GHz - Z Orientation



Figure 109 - Spurious Radiated Emissions - 8 GHz to 18 GHz - X Orientation



Figure 110 - Spurious Radiated Emissions - 8 GHz to 18 GHz - Y Orientation

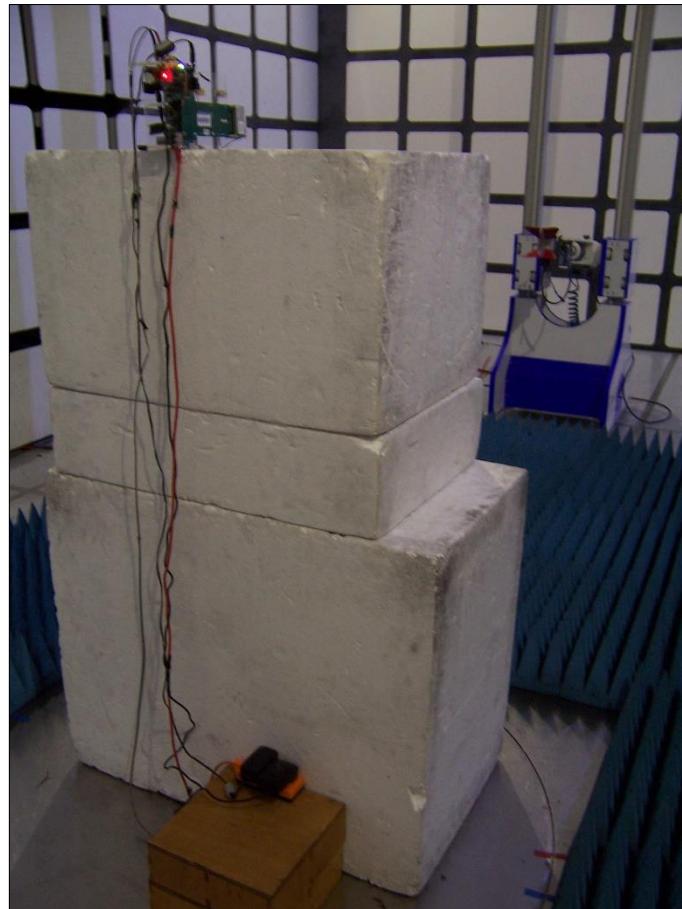


Figure 111 - Spurious Radiated Emissions - 8 GHz to 18 GHz - Z Orientation



Figure 112 - Spurious Radiated Emissions - 18 GHz to 25 GHz - X Orientation



Figure 113 - Spurious Radiated Emissions - 18 GHz to 25 GHz - Y Orientation

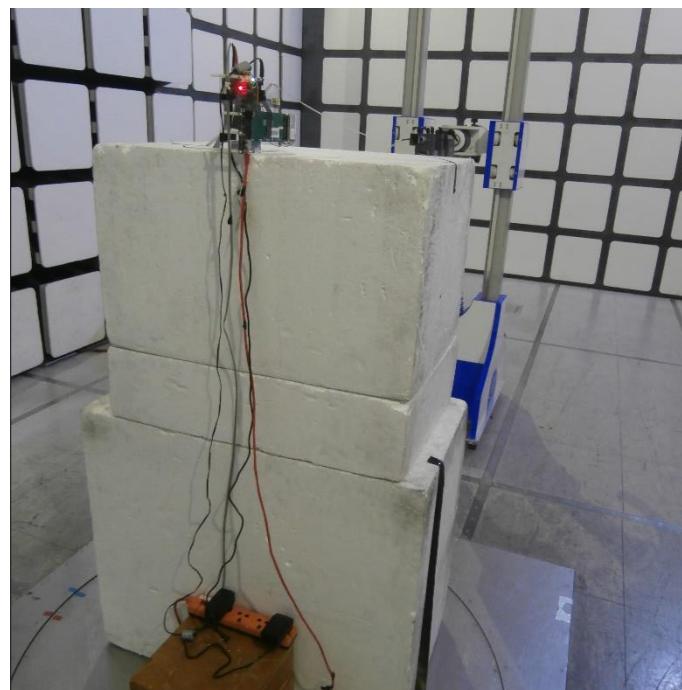


Figure 114 - Spurious Radiated Emissions - 18 GHz to 25 GHz - Z Orientation



4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Frequency Hopping Systems - 20 dB Bandwidth	± 30.426 kHz
Frequency Hopping Systems - Channel Separation	± 30.426 kHz
Frequency Hopping Systems - Number of Hopping Channels	-
Frequency Hopping Systems - Average Time of Occupancy	-
Maximum Conducted Output Power	± 3.2 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 27