COMPLIANCE ENGINEERING
EMC - Shielding - Environmental

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EMC Compliance Test Report

CFR 47, Chapter 1, Subpart A,
Part 15, Subpart B (class A limits)
Report Number: CE3229A-Rev2

FCC ID: 2A5W4 EWS-SWTI-000

E.W.S (Australia) Pty Ltd
Switch

The results detailed in this test report relate only to the specific sample/s tested. It is the Manufacturer's responsibility to ensure that all production units are manufactured with equivalent EMC characteristics. This report is not to be reproduced except in full, without written approval from Compliance Engineering Pty

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COMPLIANCE CERTIFICATE

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Client Details:	E.W.S (Australia) Pty Ltd Unit 8 / 4, Focal Way Bayswater, 6053, VIC, Australia
Contact Person:	Brad Phillips Phone: 0408 578 312 Email: brad@ewsaustralia.com
Device:	Switch
Reference Standard:	CFR 47 - Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart B Unintentional Radiators
Test Method:	ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
Summary Result:	Radiated RF emission measurements (Class A) **Complied**
Test Date:	16th to 18th November 2021
Tests Performed by:	Bo Yang Compliance Engineering Pty Ltd 90 Indian Drive, Keysborough, Victoria, Australia 3173. Telephone: +61 3 9763 3079 Email: info@compeng.com.au

The **Switch** complied with the radiated RF emission requirements detailed in CFR 47, Chapter 1, Subpart A, Part 15, Subpart B (class A limits)

Bo. Yang		22nd April 2022
Prepared: *Bo Yang* *Test Engineer* *Compliance Engineering Pty Ltd*	***Approved:*** *Andrew Burden* *Technical Manager* *Compliance Engineering Pty Ltd*	***Date***

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Revision History			
Revision	**Issue Date**	**Remarks**	**Revised by**
0	22-02-2022	Initial release	-
1	5-4-2022	Revision of contact details, test and test site parameters	Matthew Grimwood
2	20-4-2022	10 to 13 GHz radiated emission results were added in.	Bo

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1. INTRODUCTION

Electromagnetic compatibility (EMC) measurements were performed on the Switch, in accordance with the requirements detailed in CFR 47, Chapter 1, Subpart A, Part 15, Subpart B (class A limits).

2. RESULTS SUMMARY

CFR 47, Chapter 1, Subpart A, Part 15, Subpart B

FCC Rule	Description	Class	Result	Remark
15.109	Radiated emissions	A	Pass	-

3. TEST SAMPLE

Equipment Under Test (*Information supplied by client*):	
Product Name	Switch
Model Number:	NL
Serial Number:	NL
Highest Operating Frequency:	2480 MHz
Input Supply	Internal battery and external battery pack or solar panel
Intentional Transmitter	Iridium Satellite LLC IMEI: 300434066415630 Operating frequency – 1616 to 1626.5 MHz
	Bluetooth module: Fanstel BM832A Operating frequency – 2400 to 2480 MHz

Note: The information provided on the EUT above was declared by the manufacturer. Please refer to the specifications/user manual for more details.

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4. CONFIGURATION

The Switch was tested powered from an internal battery with an external battery acting as a charger and connected to a Piezometer sensor.

Each device was configured to "Force Transmission", with no Iridium signal present. Bluetooth communication was not operating during measurements.

4.1 Supporting Equipment Used During Testing

Type	Device	Manufacturer	Model No:	Comments
AE	External Battery	EWS AUSTRALIA	ER34615 (3.6 V, 19 Ah)	-
AE	Sensor	-	1200	-
AE: Auxiliary/Associated Equipment				

4.2 Test Modes

Mode	Description	
DC-Powerline	General conditions:	EUT powered from an internal battery with an external battery acting as a charger and connected to a Piezometer sensor

5. MODIFICATIONS

No modification was performed on the above sample by Compliance Engineering.

6. STANDARD DEVIATIONS

No deviation from the standard were performed by Compliance Engineering.

7. TEST FACILITY

All measurements were performed inside Compliance Engineering's, 3m Semi-Anechoic (iOATS) enclosure located at 90 Indian Drive, Keysborough, Victoria, Australia.

A2LA (ISO 17025-2017) – Certificate No: 2829.01
Compliance Engineering Pty Ltd, is accredited to ISO 17025-2017 by American Association for Laboratory Accreditation (A2LA) which is an ILAC member and has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP)

All tests within this report have been conducted in accordance with Compliance Engineering's scope of A2LA accreditation.

The current full scope of accreditation can be found on the A2LA website: www.a2la.org

FCC – Registration No: 982700
Compliance Engineering Pty Ltd, has been recognized and is listed as an FCC part 47 CFR 2.948 measurement facility to perform compliance testing on equipment under Parts 15 and 18. The Designation Number is AU0006 and the Test Firm Registration Number is 982700.

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Innovation, Science & Economic Development Canada (ISED) - Registration No: 27266
Compliance Engineering's 3m indoor semi-anechoic chamber (iOATS) has been accepted by Innovation, Science & Economic Development Canada (ISED) for performing radiated measurements in accordance with RSS-102, RSS-GEN, RSS-210, RSS-247, RSS-248 – ISED Canada Registration No: 27266

8. FIELD STRENGTH CALCULATION

All emission measurements are automatically calculated via the dedicated EMC software using the pre-stored calibration factors. The following equation simplifies the actual calculation performed;

$$\textbf{Corr.Ampl} = V_{RAW} + AF - G + L$$

Where:

Corr.Ampl = Corrected amplitude in dBµV/m (for radiated) & dBµV (for conducted)
V_{RAW} = Raw voltage receiver/analyser reading in dBµV
AF = Antenna Factor in dB (stored as a data array of factor vs frequency)
G = Preamplifier Factor in dB ((stored as a data array of gain vs frequency)
L = Cable Loss Factor in dB (stored as a data array of insertion loss vs frequency)

Limit:

The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m.

Limit (dBµV/m) = 20*log(µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

A peak emission is observed at 100 MHz at 21.5 dBµV. An antenna factor for that frequency is 10 dB. The preamplifier gain factor is 30 dB and the cable loss at that same frequency 1.5 dB. Hence the overall Correction Amplitude is as follows;

$V_{RAW} + AF - G + L$	:	Corr.Amp – FCC Limit	= Margin
31.5 + 10 – 20 + 1.5	:	23 dBµV/m – 57.0 dBµV/m	= -34 dB

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9. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

Measurement	Frequency / Range	Uncertainty (k=2)
Temperature	15.5°C to 24°C	0.5°C
Humidity	15% to 60%	2%
Conducted Emissions (using a 50Ω/50µH + 5µH LISN)	0.09 MHz to 30 MHz	± 4.79
Conducted Emissions (using a Voltage Probe)	0.15 MHz to 30 MHz	± 5.07
Conducted Emissions (using a 50Ω/50µH LISN)	0.15 MHz to 30 MHz	± 4.35
Radiated Emissions (Horizontal Polarisation)	30 MHz to 200 MHz	± 4.98
Radiated Emissions (Vertical Polarisation)	30 MHz to 200 MHz	± 5.23
Radiated Emissions (Horizontal Polarisation)	200 MHz to 1000 MHz	± 5.21
Radiated Emissions (Vertical Polarisation)	200 MHz to 1000 MHz	± 5.89
Radiated Emissions (STLP)	1 GHz to 6 GHz	± 5.14
Radiated Emissions (STLP)	6 GHz to 18 GHz	± 6.11
Radiated Emissions (SGH)	18 GHz to 26 GHz	± 6.11
Radiated Emissions (SGH)	26 GHz to 40 GHz	± 6.11

Note 1: These uncertainties represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Note 2: The reference uncertainty standard specifies that although the measurement uncertainty shall be documented within the test report, the actual determination of compliance shall be based on measurements without taking into account the measurement uncertainty.

10. RADIATED RF EMISSION MEASUREMENTS

10.1 REQUIREMENTS

Frequency Range Required: Highest operating frequency of 2480 MHz testing shall be performed to at least 2480 GHz.
Frequency Range Tested: 30 MHz to 13 GHz
Measurement Distance: 3 metres
Limit: FCC Part 15B (Class A)

10.2 TEST EQUIPMENT

Asset	Equipment	Model No	Serial No	Cal Due
644	EMI Receiver	ESIB7	100338	Jul 22
520	Spectrum Analyser	HP8563EC	4317A02822	Oct 22
731	Biconical Antenna	VHBB9124	9124-1461	Aug 22
733	Log Periodic Antenna	USLP 9143B	USLP 9143B 136	Aug 22
734	Stacked Log Periodic	STLP 9148	176	Aug 22
797	18-26 GHz STGH	LB-42-10-C-KF	-	n/a
798	26-40 GHz STGH	LB-28-10-C-KF	-	n/a
466	Preamplifier	ABL0600-01-3440	35401	Sep 23
278	Preamplifier	LA1018N4009	J1012090727001	Dec 22
760	Semi-Anechoic Chamber iOATS (11m x 7m x 6m)	CE-iOATS	2021	Oct 23
TER-S004	Measurement Software	RadiMation	Rev: 2021.1.9	-

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10.3 ENVIRONMENTAL CONDITIONS

Environment	Range	Uncertainty (k=2)	Actual	Comment
Temperature	15.5°C to 24°C	0.5°C	22°C	Ok
Humidity	15% to 60%	2%	52%	Ok

10.4 PROCEDURE

Measurements below 1 GHz:

Measurements are performed inside a semi-anechoic chamber that incorporates a turntable allowing the EUT to rotate a full 360°.

The EUT is supported 0.8 metres above the ground reference plane on a large polystyrene block which in turn rests on top of the turntable.

Measurements are made with the antenna positioned in both the horizontal and vertical polarisations. The measurement antenna is raised and lowered in height (1m to 4m) above the reference ground plane to obtain the maximum emission.

The distance between the EUT and the antenna is 3 metres.

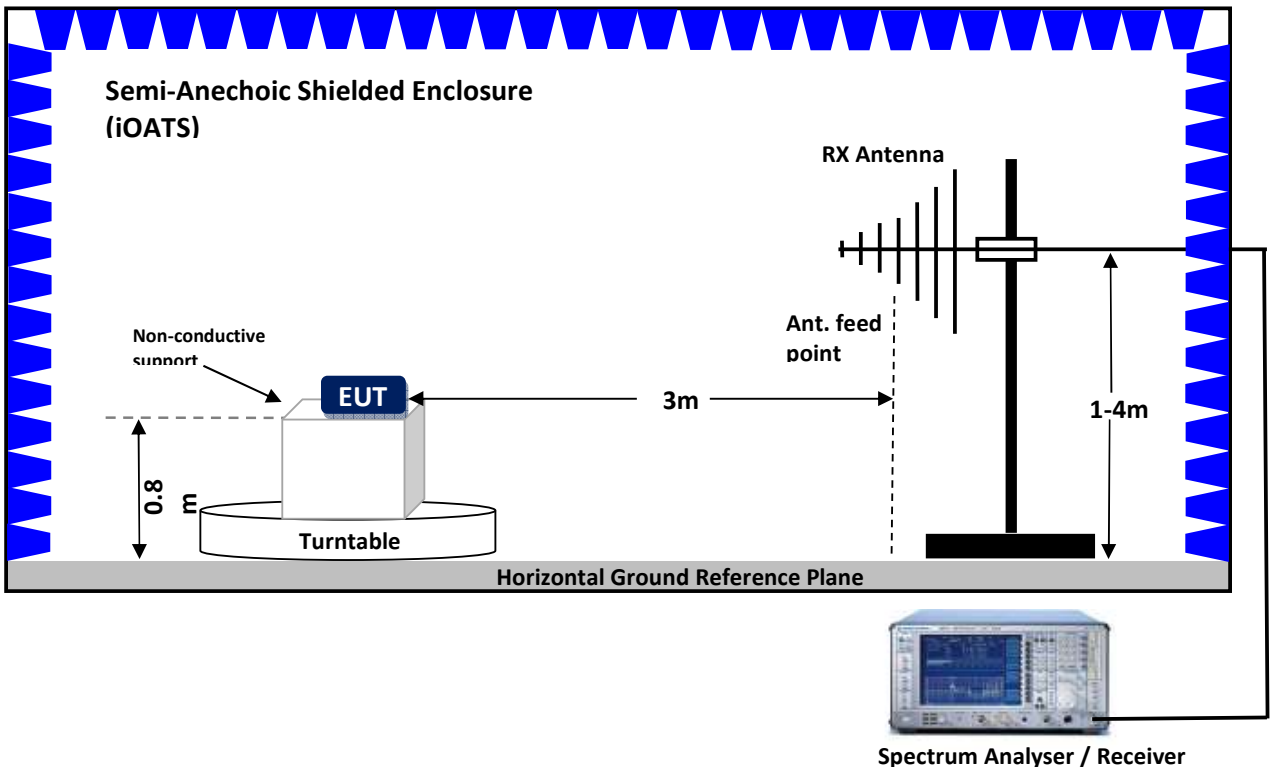
A measurement scan is performed with the EUT rotated 360°, the antenna height is scanned between 1 m and 4 m and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarization.

The receiver/spectrum analyser was configured to Max Hold whilst on Peak Detect using the following bandwidth:

- *RWB = 120 kHz & VBW = 300 kHz for frequencies below 1 GHz.*

Plots of the accumulated measurement data, including all transducer correction factors are then produced and stored on file.

Radiated emission measurements 30 MHz to 1 GHz



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Measurements above 1 GHz:

Same test setup and test analyser settings as below 1 GHz above.

The EUT is set 3 metres from the interference-receiving antenna which is mounted on the top of a variable height antenna tower.

RF absorber is placed on the ground reference plane between the EUT and the measuring antenna and its location size should allow the test site area comply with the CISPR16-1-4 requirements.

The turntable is then rotated 360° to determine the position of the highest emission signal.

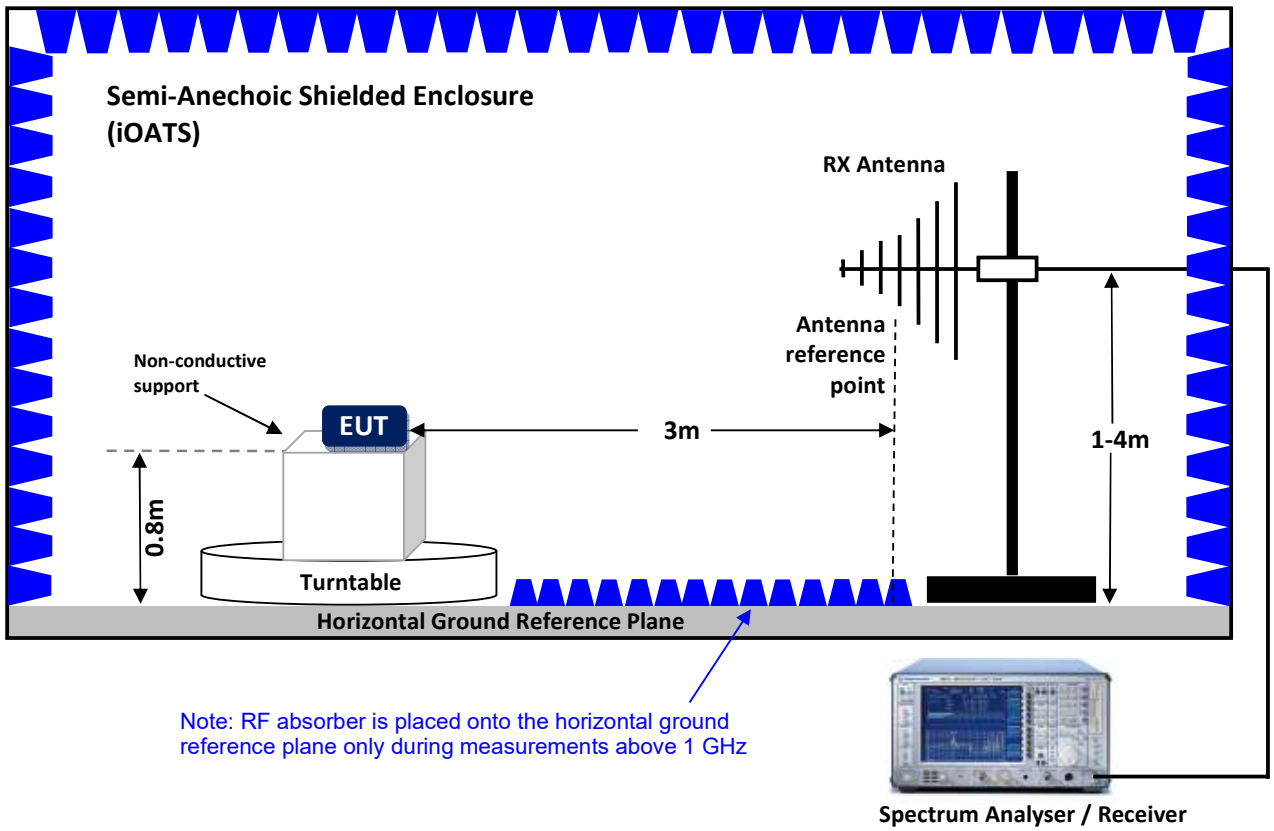
The measuring horn is set at a height of 1 metre and the turntable is run to capture the maximum emission measurements in both the horizontal and vertical polarisations.

The receiver/spectrum analyser was configured to Max Hold whilst on Peak Detect using the following bandwidth;

- *RWB = 1 MHz & VBW = 3 MHz for frequencies above 1 GHz.*

Plots of the accumulated measurement data, including all transducer correction factors are then produced and stored on file.

Radiated emission measurements above 1 GHz



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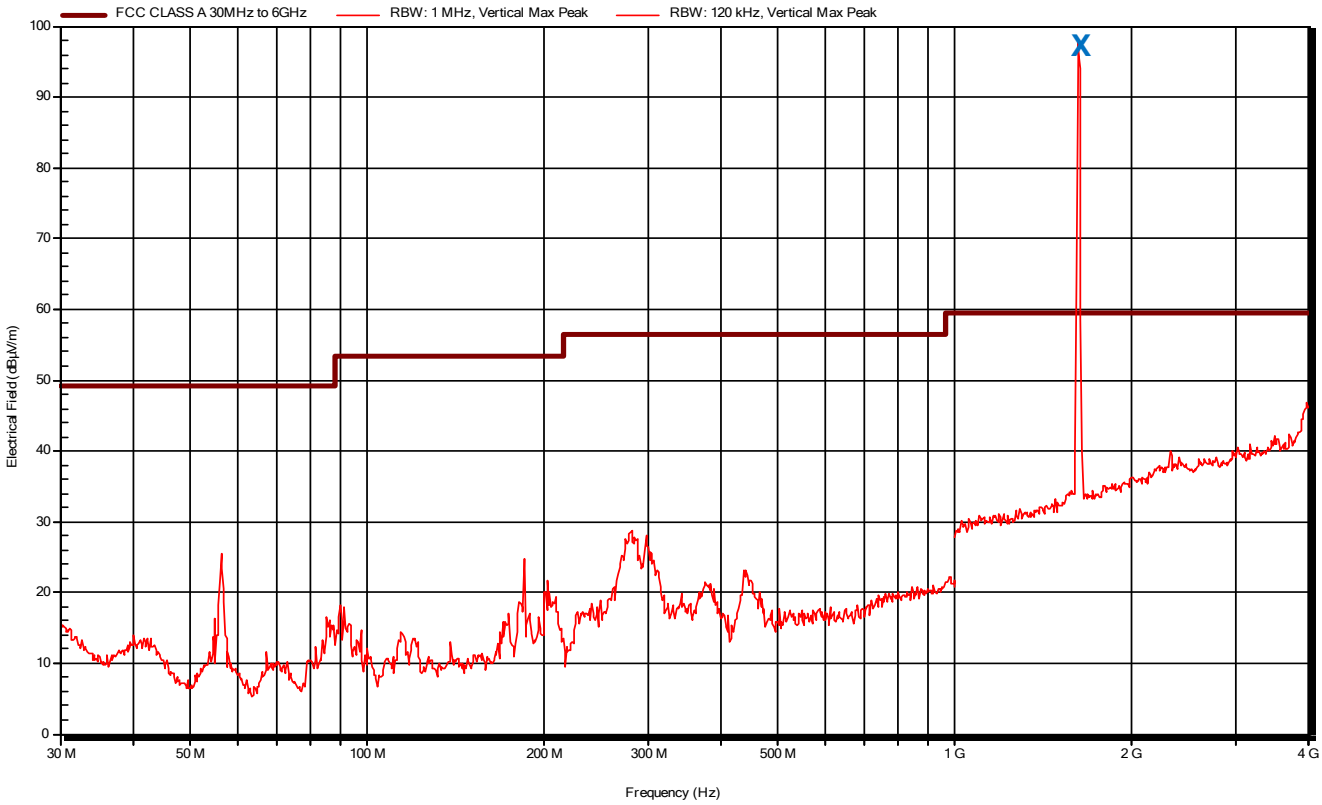
10.5 RESULTS

Radiated RF Emission Measurements – Vertical Polarisation – 30 MHz to 4 GHz - Switch				
Frequency (MHz)	**Quasi-Peak (dBµV/m)**	**Quasi-Peak Limit (3m) (dBµV/m)**	**Delta Limit (dB)**	**Result**
55.455	25.8	49.1	**-23.3**	**Pass**

RadiMation



Note: X is related to the intentional radiating Iridium transmitter at 1626.5MHz and no measurement is required against the FCC Part 15b limit.

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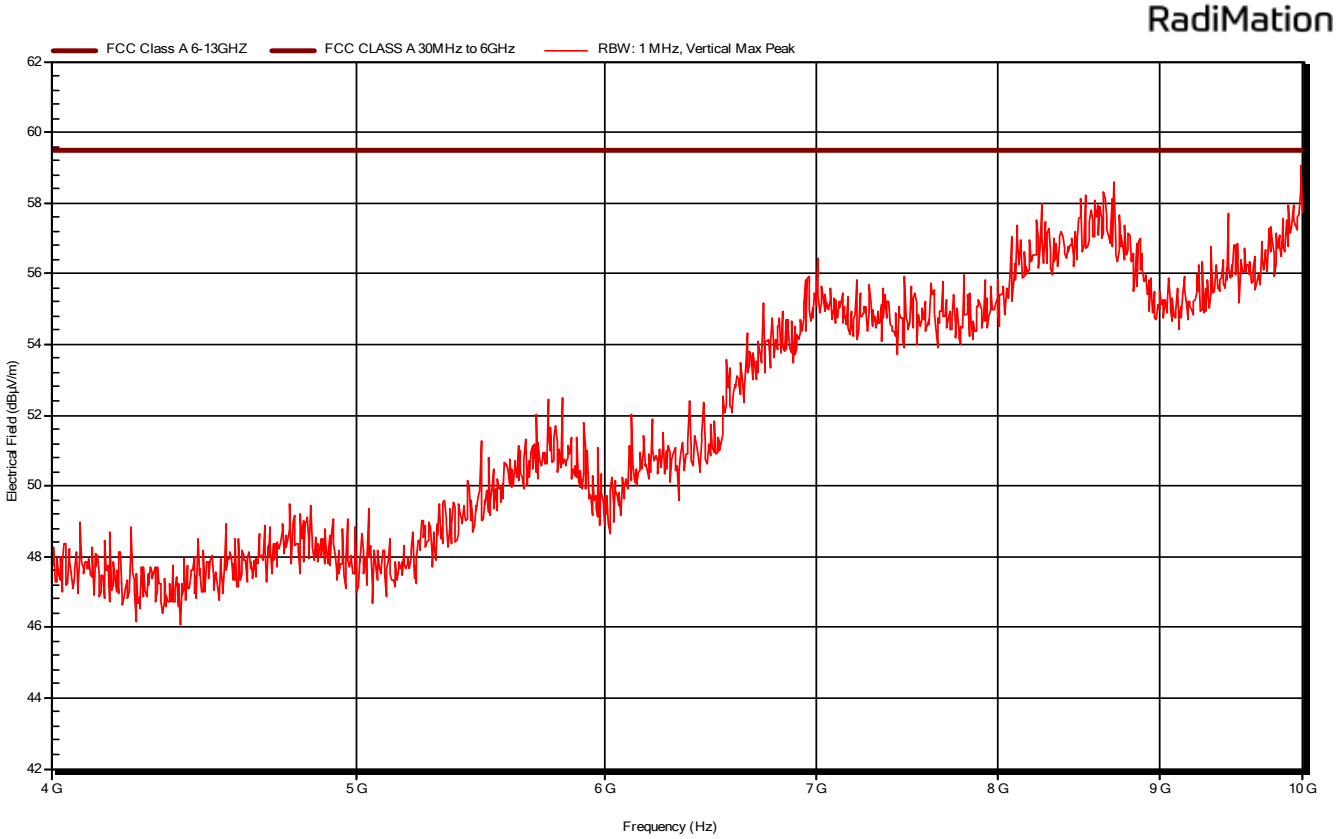
Radiated RF Emission Measurements – Vertical Polarisation - 4 to 10 GHz - Switch							
Frequency (GHz)	Peak (dBµV/m)	Peak Limit (3m) (dBµV/m)	Average (dBµV/m)	Average Limit (3m) (dBµV/m)	Pk Delta Limit (dB)	AV Delta Limit (dB)	Result
Peak emission measurement was below the average limit							



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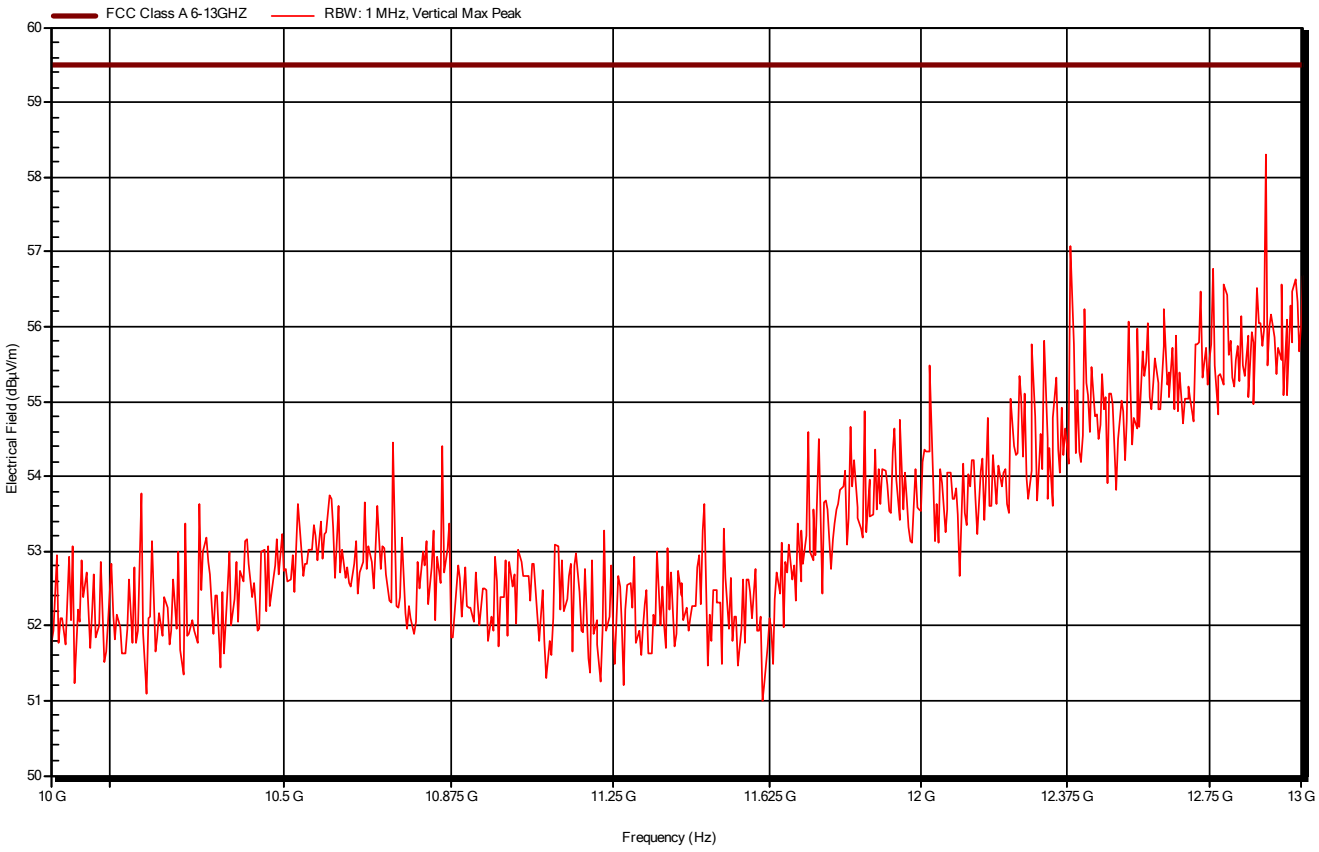
Radiated RF Emission Measurements – Vertical Polarisation - 10 to 13 GHz - Switch							
Frequency (GHz)	Peak (dBµV/m)	Peak Limit (3m) (dBµV/m)	Average (dBµV/m)	Average Limit (3m) (dBµV/m)	Pk Delta Limit (dB)	AV Delta Limit (dB)	Result
Peak emission measurement was below the average limit							

RadiMation



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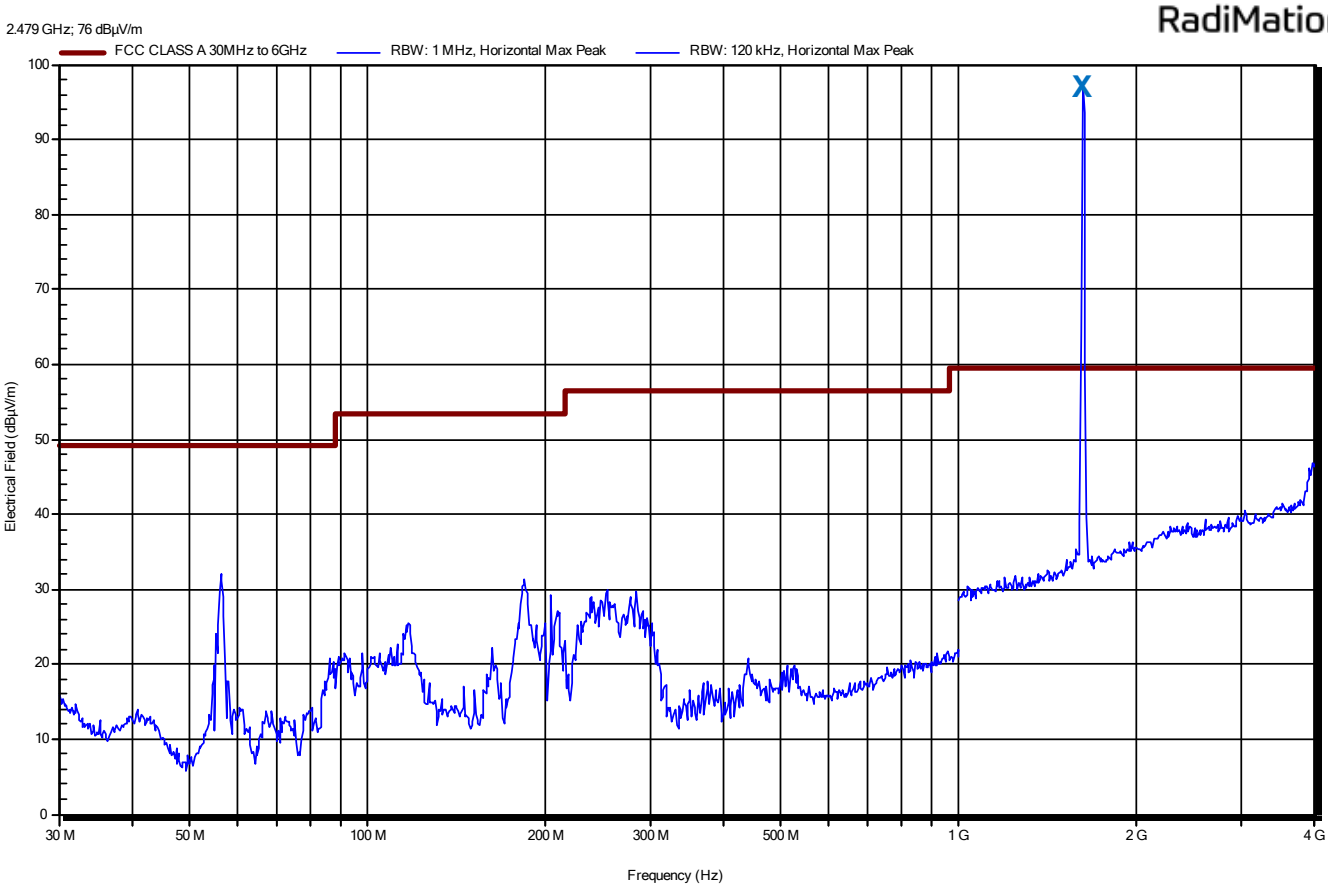
Radiated RF Emission Measurements – Horizontal Polarisation – 30 MHz to 1 GHz - Switch				
Frequency (MHz)	**Quasi-Peak (dBµV/m)**	**Quasi-Peak Limit (3m) (dBµV/m)**	**Delta Limit (dB)**	**Result**
55.455	25.8	49.1	**-23.3**	**Pass**

RadiMation



Note: X is related to the intentional radiating Iridium transmitter at 1626.5MHz and no measurement is required against the FCC Part 15b limit.

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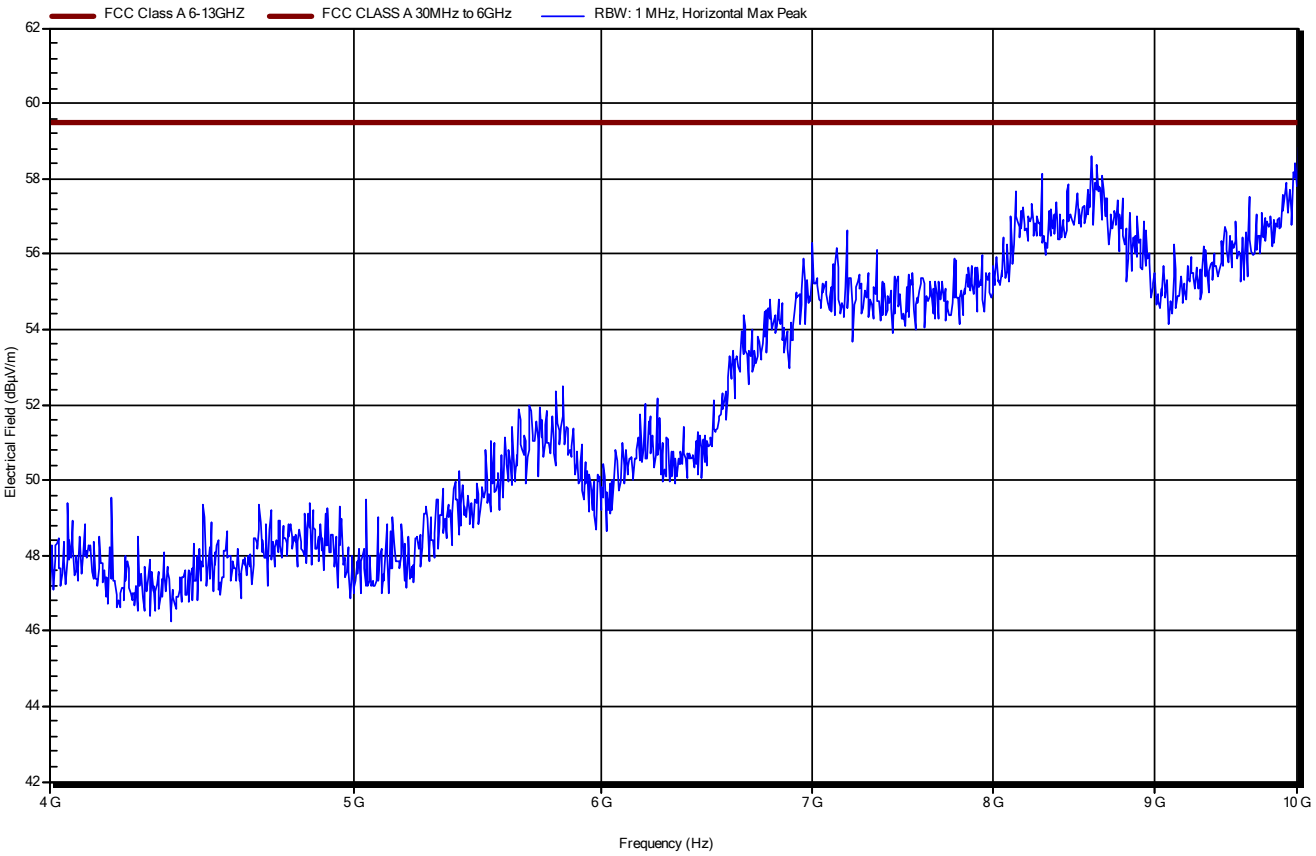
Radiated RF Emission Measurements – Horizontal Polarisation - 4 to 10 GHz - Switch							
Frequency (GHz)	Peak (dBµV/m)	Peak Limit (3m) (dBµV/m)	Average (dBµV/m)	Average Limit (3m) (dBµV/m)	Pk Delta Limit (dB)	AV Delta Limit (dB)	Result
Peak emission measurement was below the average limit							Pass

RadiMation