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RADIO TEST REPORT

REPORT NUMBER: M2302021-11

TEST STANDARD: (PARTIAL)

FCC PART 15 SUBPART C SECTION 15.247

ISED RSS-247 SECTION 5.0

CLIENT: REDARC TECHNOLOGIES PTY LTD

DEVICE: SMART BATTERY MONITOR

MODEL: SU6

FCC ID: 2BAH6-SU601

IC: 30290-SU601

DATE OF ISSUE: 16 OCTOBER 2023

REVISION TABLE

Version	Sec/Para Changed	Change Made	Date
1		Initial issue of document	16/10/2023

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TEST CERTIFICATE

Device:	SMART BATTERY MONITOR
Model:	SU6
Serial Number:	23091170030001
Sample Number:	S01244
PCB Version:	PCB4465-3
Firmware Version:	FW0328-01-01 - Application FW0338-01-01 - Bluetooth
Manufacturer:	REDARC Technologies Pty Ltd
Radio:	Bluetooth Low Energy (Nordic nRF52833)
FCC ID:	2BAH6-SU601
IC:	30290-SU601
Tested for:	REDARC Technologies Pty Ltd
Address:	23 Brodie Rd, Lonsdale SA 5160, Australia
Contact:	Matthew Rankine
Phone Number:	+61 8 8322 4848
Email:	mrankine@redarc.com.au
Standard:	FCC Part 15, Subpart C, Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz – Partial, §15.203, §15.209 and §15.247(d). ISED RSS-247, Issue 2, Section 5 Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz –Partial, RSS-Gen 6.8, RSS-Gen 8.9 and RSS-247 5.5.
Result:	The SMART BATTERY MONITOR complied with the applicable requirements of the above standards. Refer to Report M2302021-11 for full details.
Test Date(s):	4-5 October 2023
Issue Date:	16 October 2023
Test Engineer(s):	Ashish Nath Ian Paul Ng
Attestation:	*I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*
Authorised Signatory:	Digitally signed by Shabbir Ahmed Date: 2023.10.16 11:31:16 +11'00' Shabbir Ahmed Technical Director

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RADIO TEST REPORT

1 TEST SUMMARY

Sec.	Description	FCC	ISED	Result(s)
6.1	Antenna Requirement	§15.203	RSS-Gen 6.8	Complied
6.2	Radiated emission limits; general requirements	§15.209	RSS-Gen 8.9	Complied
6.3	Out-of-Band/Spurious Emissions	§15.247(d)	RSS-247 5.5	Complied

2 TEST FACILITY

2.1 General

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

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

2.2 Test Laboratory/Accreditations

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

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

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

3 TEST EQUIPMENT CALIBRATION

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

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yyyy	Due Date dd/mm/yyyy	Cal. Interval
Chamber	Frankonia SAC-3-2 (R-144)	01/09/2023	01/09/2026	3 Year*1
EMI Receiver	R&S ESW26 Sn: 101306 (R-143)	02/08/2023	02/08/2024	1 Year*2
Antennas	EMCO 6502 Active Loop Antenna Sn: 2021 (A-310)	20/09/2022	20/09/2024	2 Year*2
	SUNOL JB6 Sn. A061917 (A-434)	14/03/2023	14/03/2025	2 Year*2
	EMCO 3115 Horn Antenna Sn: 8908-3282 (A-004)	13/01/2022	13/01/2025	3 Year*1
	ETS-Lindgren 3160-09 Horn Antenna Sn: 66032 (A307)	30/04/2021	30/04/2024	3 Year*1
Cables*3	Huber & Suhner Sucoflex 104A Sn: 503061/4A (CL131123)	25/11/2022	25/11/2023	1 Year*1
	Huber & Suhner Sucoflex 104A Sn: 27319 (C-273)	25/11/2022	25/11/2023	1 Year*1

Note *1. Internal NATA calibration.
Note *2. External NATA / A2LA calibration.
Note *3. Cables are verified before measurements are taken.

4 MEASUREMENT UNCERTAINTY

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

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
	18 GHz to 40 GHz	±4.6 dB
Peak Output Power:		±1.5 dB

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

Application of measurement uncertainty for this report:

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

5 Device Details

(Information supplied by the Client)

The device is Smart battery monitoring system (SU6)

5.1 EUT (Transmitter) Details

Radio:	Nordic Semiconductor nRF52833
Type:	Bluetooth Low Energy (BLE)
Frequency band:	2402 – 2480 MHz
Number of Channels:	40
Operating Frequency:	Low Channel: 2402 MHz Mid Channel: 2440 MHz High Channel: 2480 MHz
Modulation:	Gaussian Frequency Shift Modulation (GFSK)
Nominal Bandwidth:	2 MHz
Data Rate:	2Mbit/s
Antenna:	2.4GHz SMT MID Chip Antenna
	Molex 479480001 monopole
Antenna Peak Gain:	3.7 dBi

5.2 EUT (Host) Details

Test Sample:	SMART BATTERY MONITOR
Model:	SU6
Serial Number:	23091170030001
Sample Number:	S01244
PCB Version:	PCB4465-3
Firmware Version:	FW0328-01-01 - Application
	FW0338-01-01 - Bluetooth
Supply Rating:	DC Input: 9-32V

5.3 Test Configuration

Testing was performed with the EUT's Transceiver set to transmit continuously at Low Channel (2402 MHz), Mid Channel (2440 MHz) and High Channel (2480 MHz).

5.4 Modifications

No modifications were required to achieve compliance.

5.5 Deviations from the Standard

No deviation from the standard.

6 RESULTS

6.1 §15.203/ RSS-Gen 6.8 Antenna Requirement

The test sample's Bluetooth Transceiver incorporates a surface mount Antenna and cannot be replaced by another type.

Antenna Brand: Molex
Antenna Type: 2.4GHz SMT MID Chip Antenna (479480001)
Antenna Peak Gain: 3.7 dBi
Connector: Not Applicable

The above installation will prevent any unauthorised switching of antennas.

6.2 §15.209/ RSS-Gen 8.9 Radiated Emission Limits; General Requirements

The provisions of the §15.205/ RSS-Gen 8.10/ RSS-247 3.3 restricted bands of operation and §15.209/ RSS-Gen 8.9 radiated emissions limits have been met, refer to section 6.3.

6.3 §15.247(d)/ RSS-247 5.5 Out-of-Band/Spurious Emissions

6.3.1 Test procedure

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

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

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

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

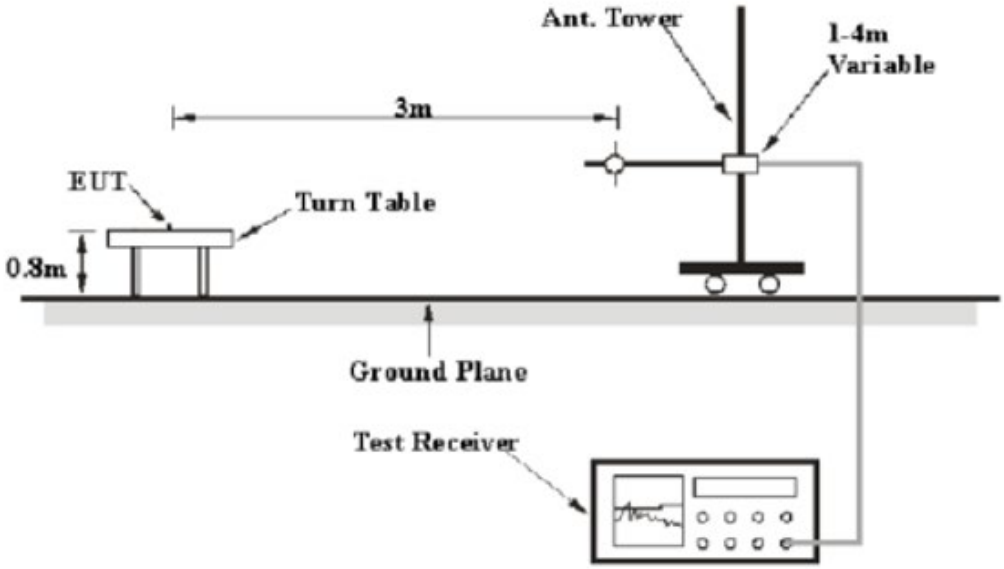
The sample was slowly rotated with the spectrum analyser set to Max-Hold. This was performed for at least two antenna heights. When an emission was located, it was positively identified, and its maximum level was found by rotating the automated turntable and by varying the antenna height. For below 1000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

Measurements on the worst axis are presented.

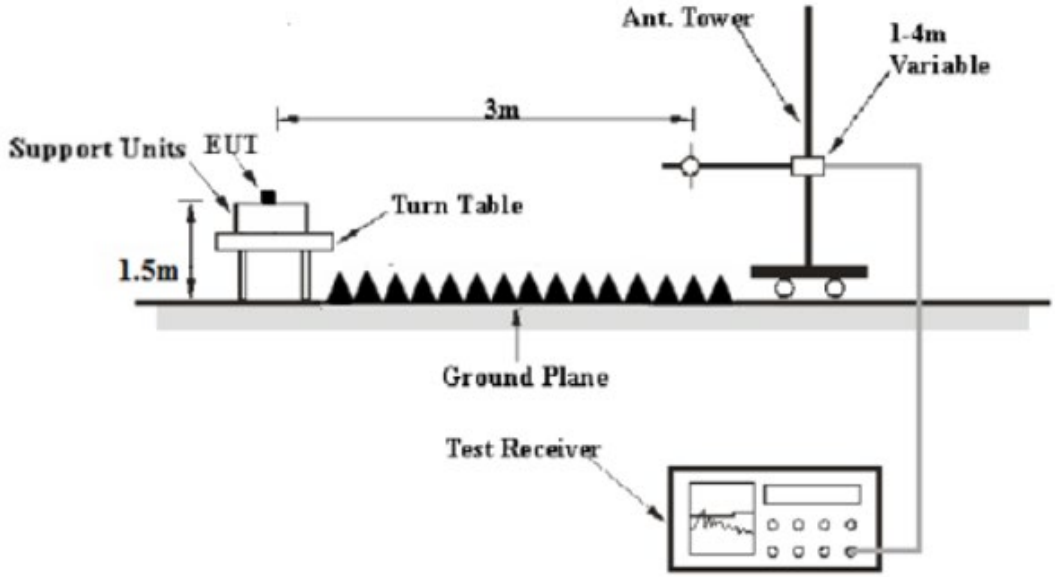
The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical polarisations of the measurement antenna.

6.3.2 Test setup

Below 1 GHz:



Above 1GHz:



6.3.3 Evaluation of field strength

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

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

Where: *E* = Radiated Field Strength in dBμV/m.
V = EMI Receiver Voltage in dBμV.
AF = Antenna Factor in dB/m (stored as a data array).
G = Preamplifier Gain in dB (stored as a data array).
L = Cable loss in dB (stored as a data array of Insertion Loss versus frequency).

6.3.4 Limits

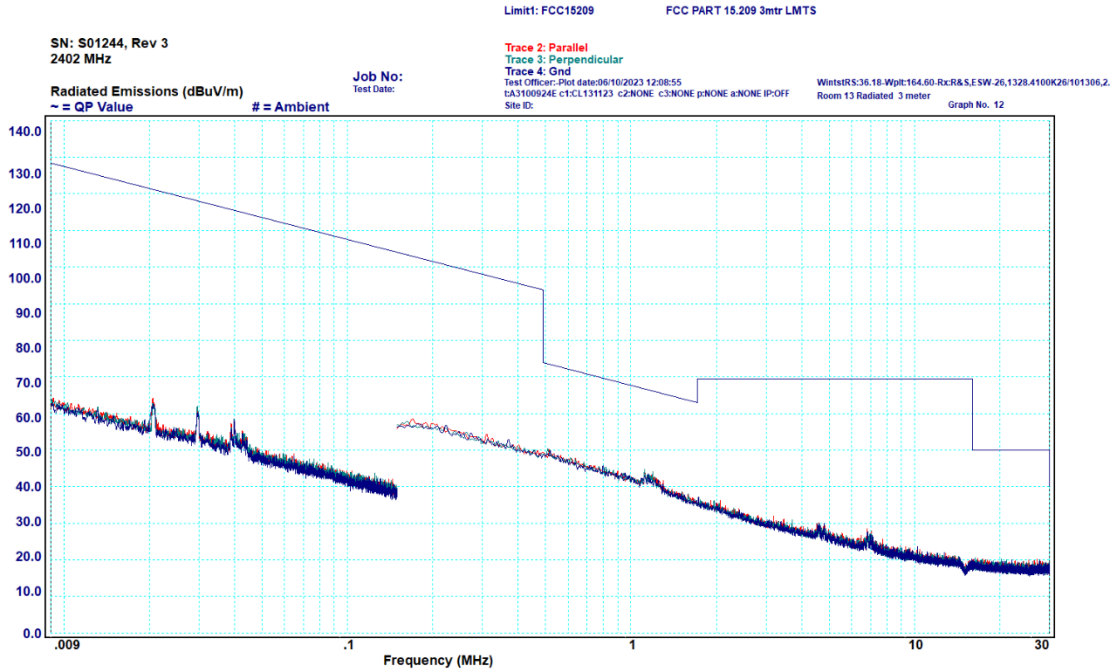
The limit applied is in accordance with the out-of-band/spurious emissions limit defined in §15.247(d).

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The in-band peak PSD in 100 kHz bandwidth were measured on all three channels. The maximum PSD level was used to establish the limit. However, the general limits of §15.209 apply for the restricted bands of operation defined in §15.205.

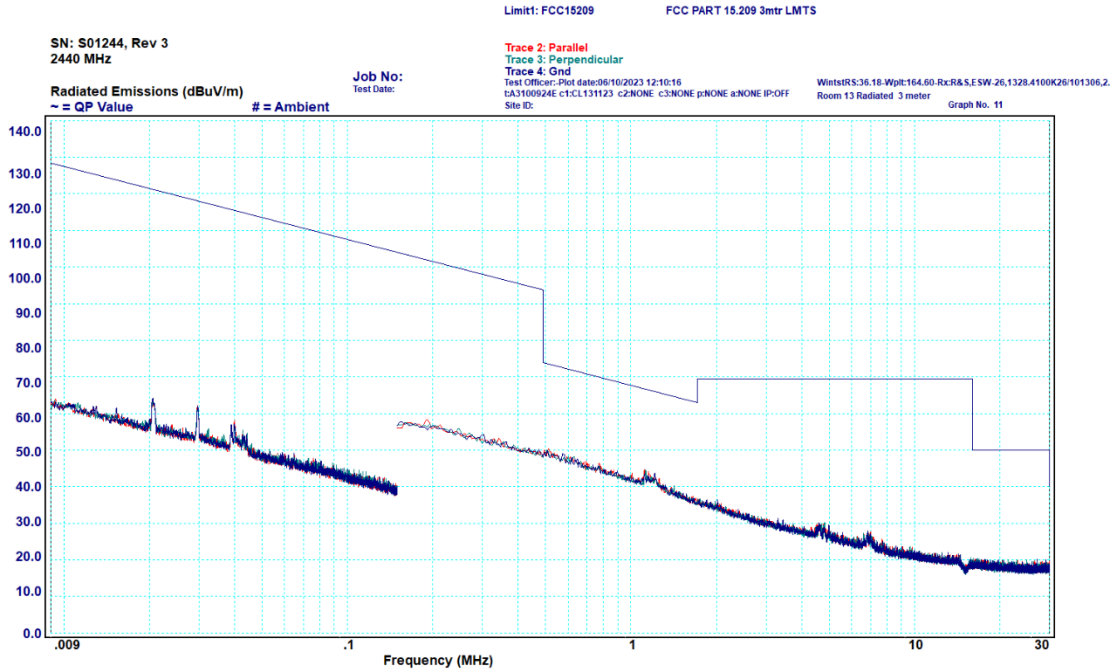
6.3.5 Transmitter Spurious Emissions: 9 kHz to 30 MHz

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



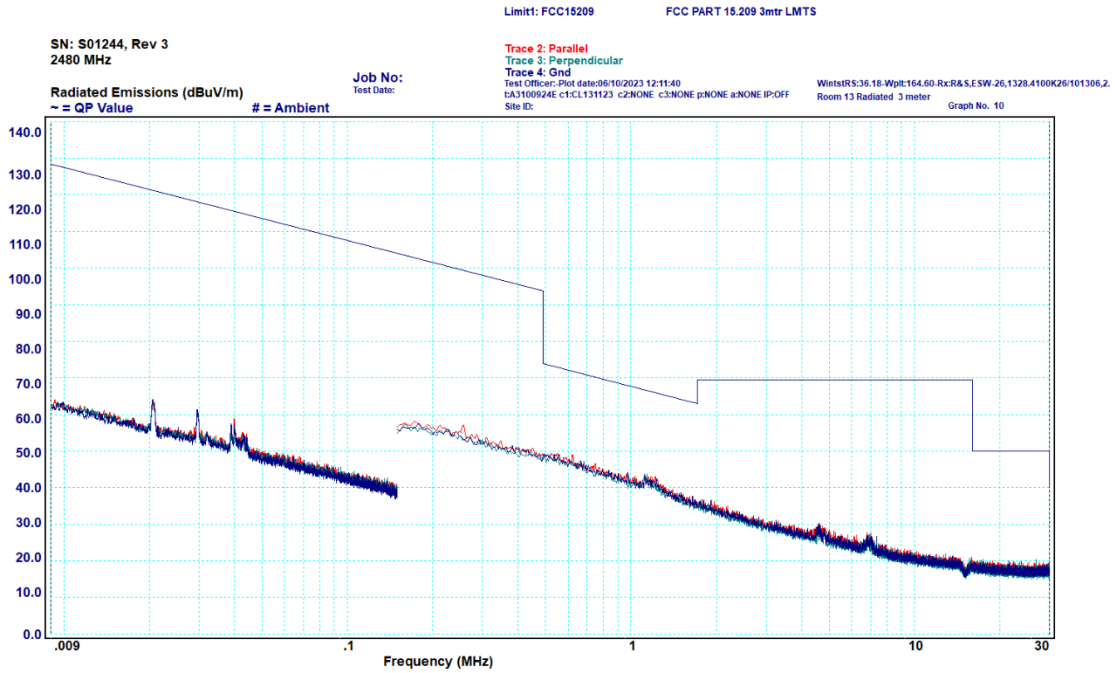
Graph 6-1: Transmitter Spurious Emissions, 9 kHz – 30 MHz, 2402 MHz

No peaks were measured within 10 dB of the limit.



Graph 6-2: Transmitter Spurious Emissions, 9 kHz – 30 MHz, 2440 MHz

No peaks were measured within 10 dB of the limit.

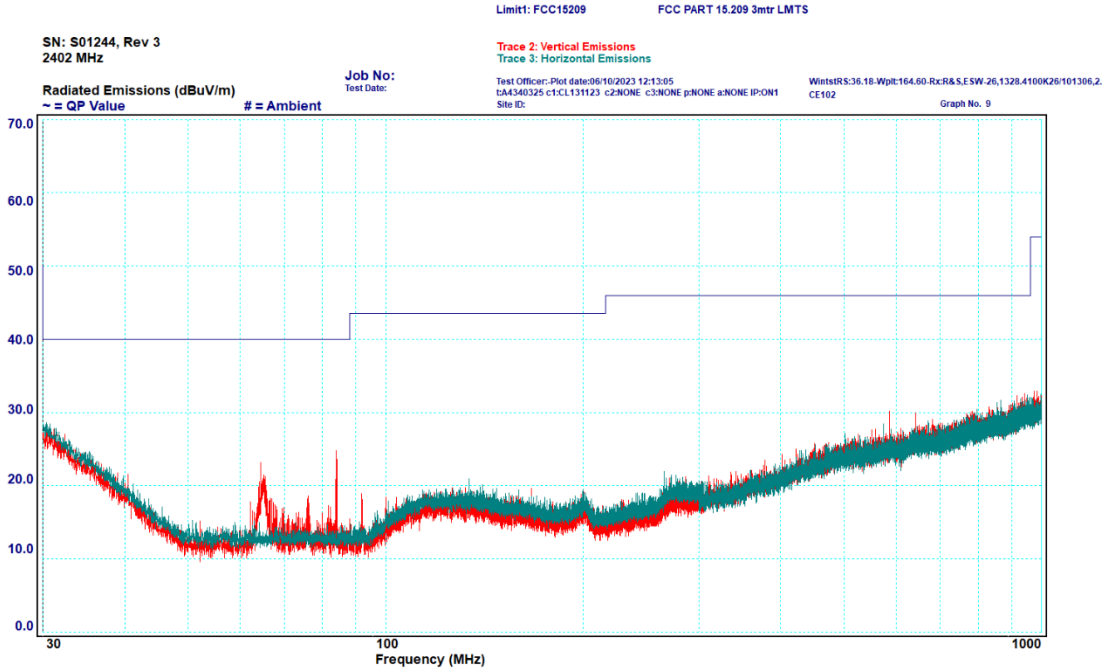


Graph 6-3: Transmitter Spurious Emissions, 9 kHz – 30 MHz, 2480 MHz

No peaks were measured within 10 dB of the limit.

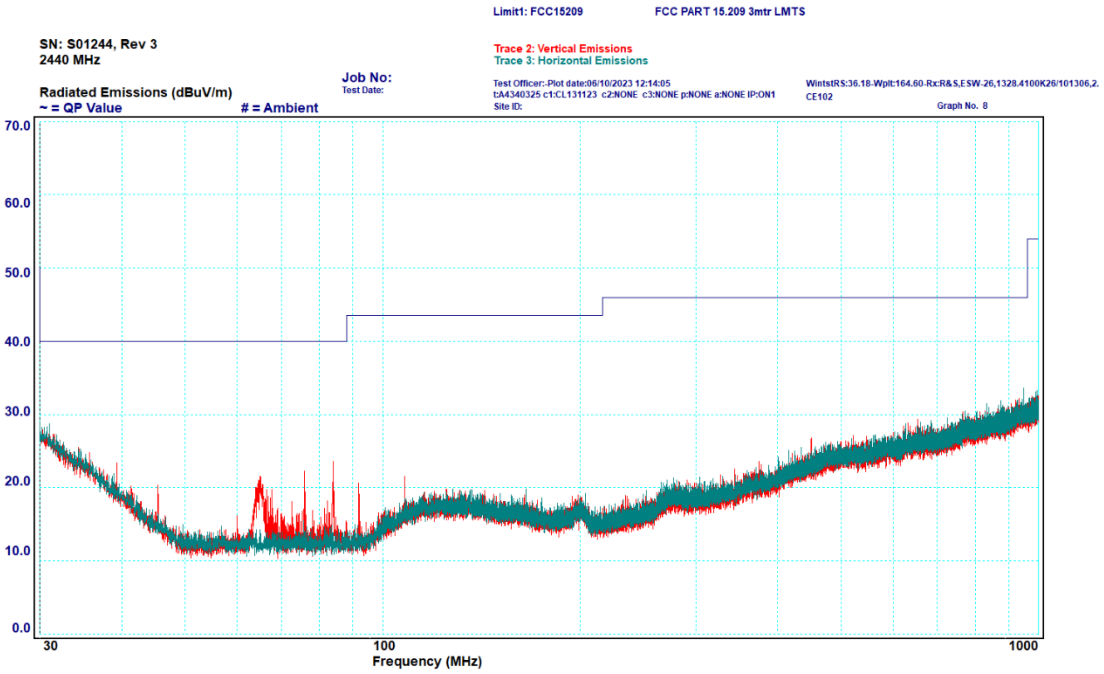
6.3.6 Transmitter Spurious Emissions: 30 - 1000 MHz

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



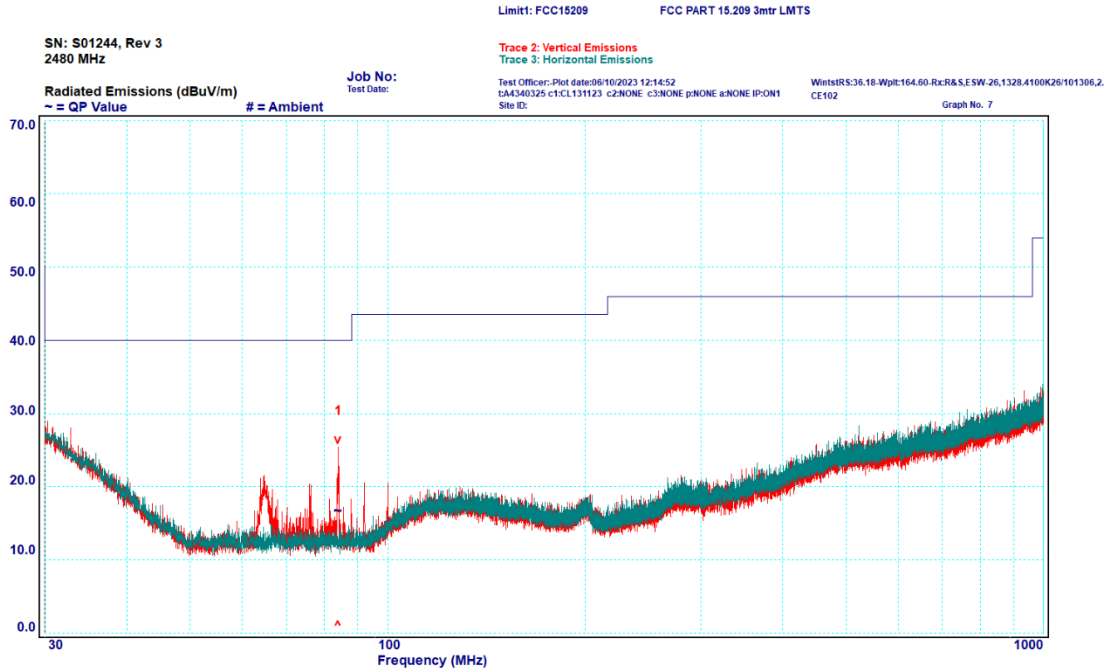
Graph 6-4: Transmitter Spurious Emissions, 30 – 1000 MHz, 2402 MHz

No peaks were measured within 10 dB of the limit.



Graph 6-5: Transmitter Spurious Emissions, 30 – 1000 MHz, 2440 MHz

No peaks were measured within 10 dB of the limit.



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

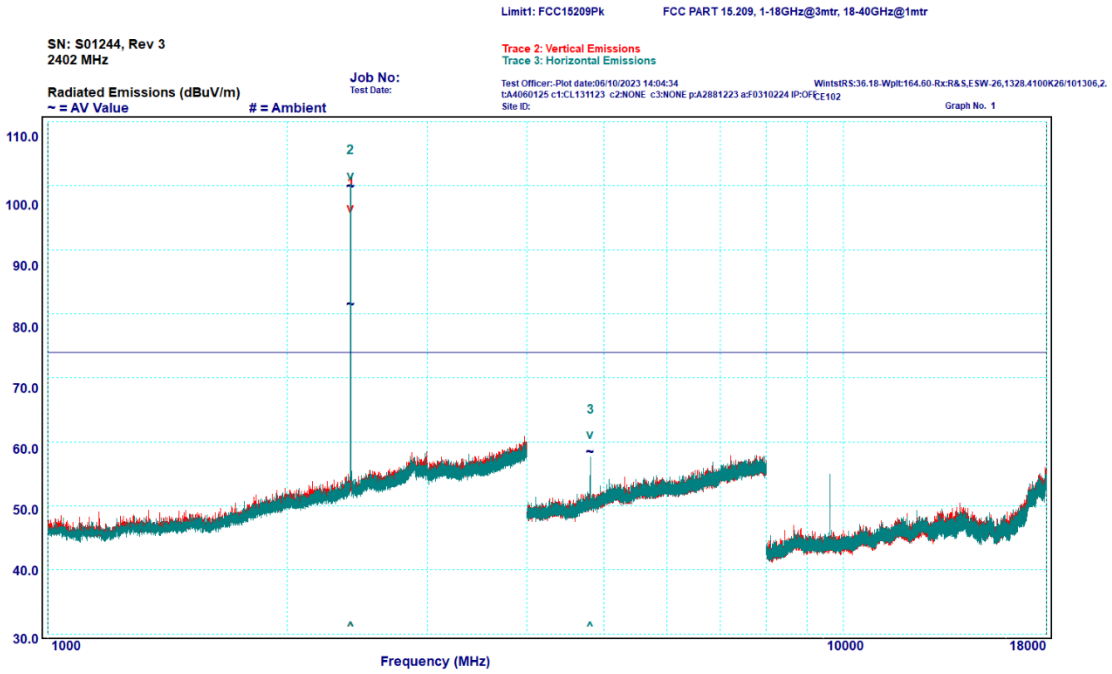
Table 6-1: Transmitter Spurious Emissions, 30 – 1000 MHz, 2480 MHz

Peak	Frequency (MHz)	Polarisation	Quasi-Peak		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	84	Vertical	17.1	40	-22.9

6.3.7 Transmitter Spurious Emissions: 1 - 18 GHz

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

Peak Measurement:

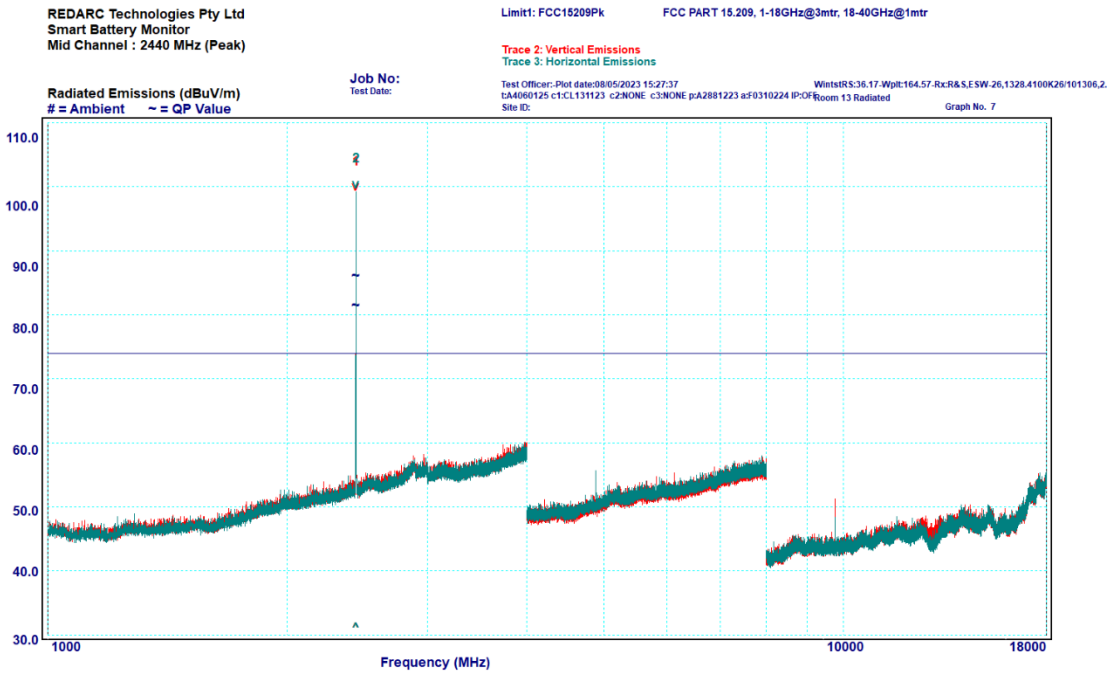


Graph 6-7: Transmitter Spurious Emissions, 1 – 18 GHz, 2402 MHz, Peak

Table 6-2: Transmitter Spurious Emissions, 1 – 18 GHz, 2402 MHz, Peak

Peak	Frequency (MHz)	Polarisation	Peak		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2402.6	Vertical	N/A	N/A	N/A
2*	2401.6	Horizontal	N/A	N/A	N/A
3	4804	Horizontal	58.9	74	-15.1

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard

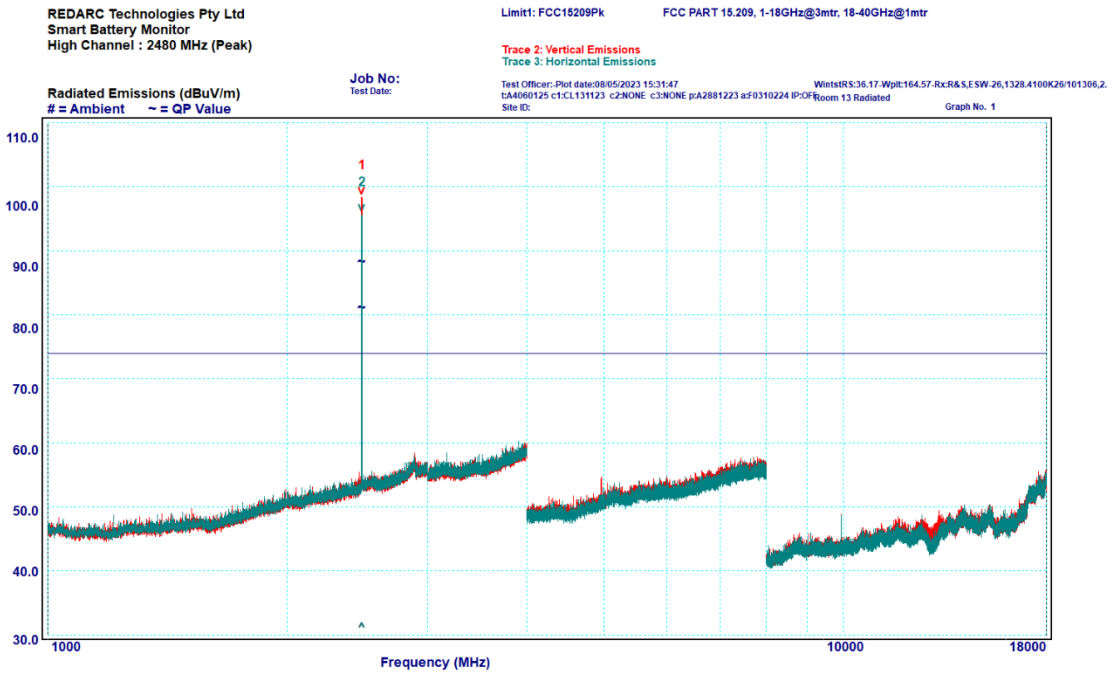


Graph 6-8: Transmitter Spurious Emissions, 1 – 18 GHz, 2440 MHz, Peak

Table 6-3: Transmitter Spurious Emissions, 1 – 18 GHz, 2440 MHz, Peak

Peak	Frequency (MHz)	Polarisation	Peak		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2440.56	Vertical	N/A	N/A	N/A
2*	2440.56	Horizontal	N/A	N/A	N/A

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard



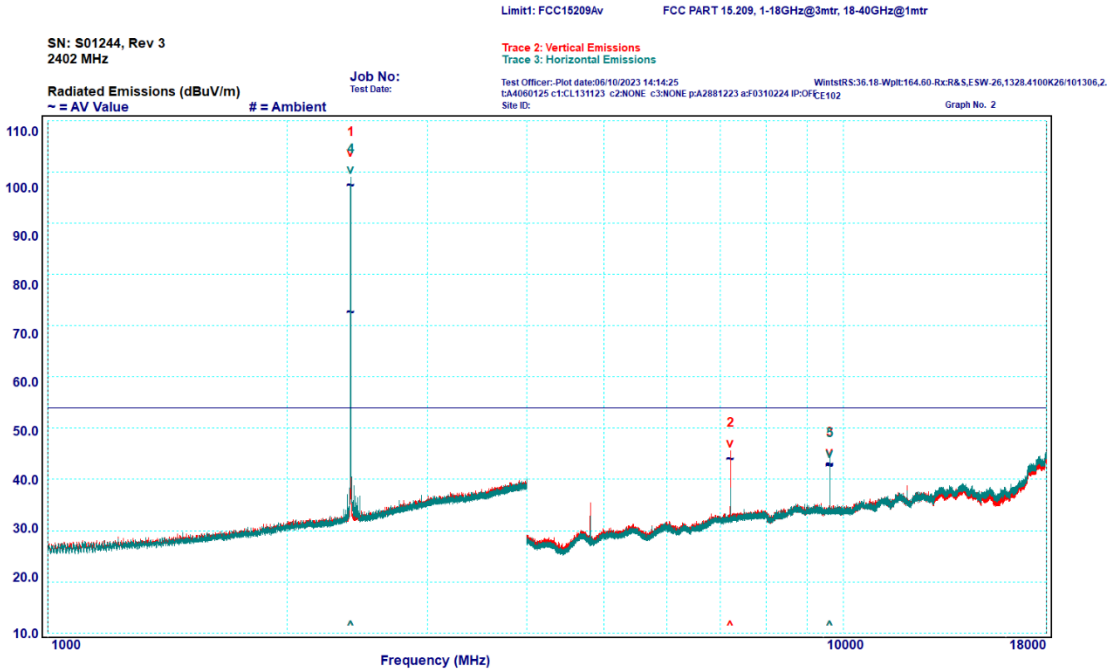
Graph 6-9: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Peak

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

Peak	Frequency (MHz)	Polarisation	Peak		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2480.59	Vertical	N/A	N/A	N/A
2*	2479.62	Horizontal	N/A	N/A	N/A

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard

Average Measurement:

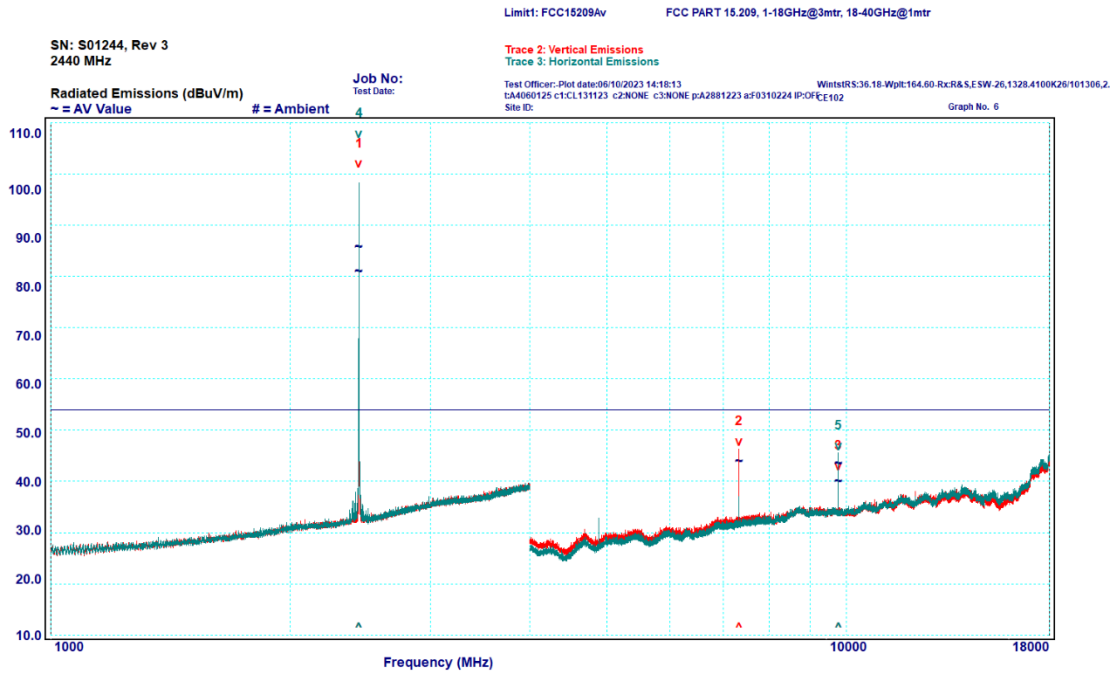


Graph 6-10: Transmitter Spurious Emissions, 1 – 18 GHz, 2402 MHz, Average

Table 6-5: Transmitter Spurious Emissions, 1 – 18 GHz, 2402 MHz, Average

Peak	Frequency (MHz)	Polarisation	Average		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2402.16	Vertical	N/A	N/A	N/A
2	7207.41	Vertical	44.4	54	-9.6
3	9606.42	Vertical	43.4	54	-10.6
4*	2402.17	Horizontal	N/A	N/A	N/A
5	9606.44	Horizontal	43.1	54	-10.9

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard

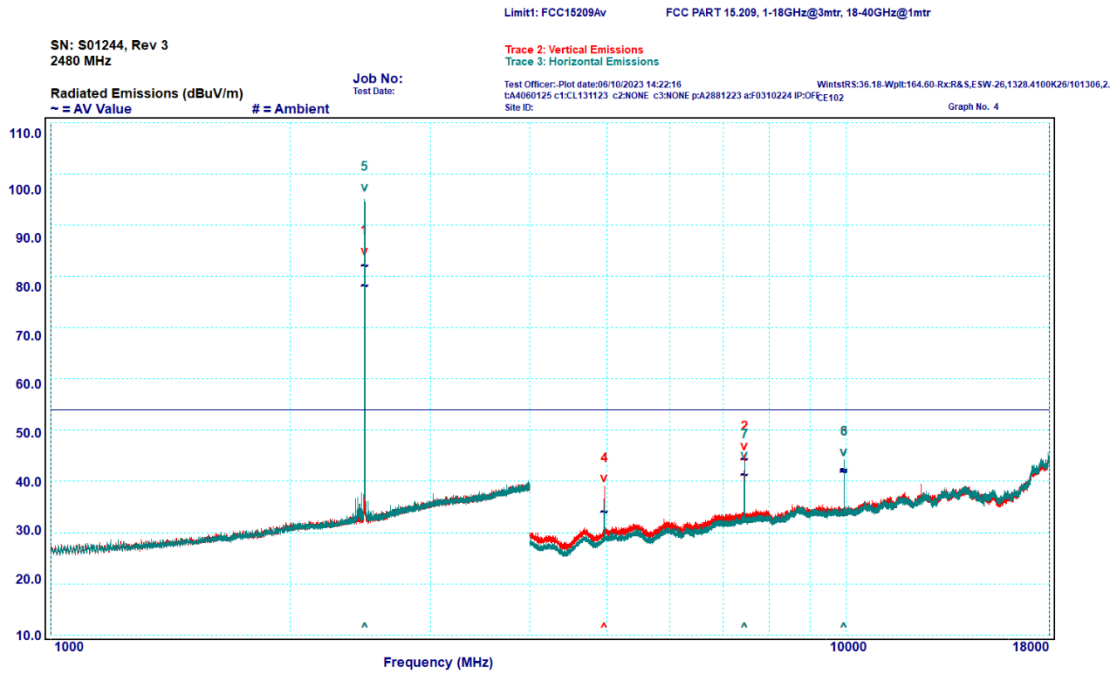


Graph 6-11: Transmitter Spurious Emissions, 1 – 18 GHz, 2440 MHz, Average

Table 6-6: Transmitter Spurious Emissions, 1 – 18 GHz, 2440 MHz, Average

Peak	Frequency (MHz)	Polarisation	Average		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2440.19	Vertical	N/A	N/A	N/A
2	7321.34	Vertical	44.4	54	-9.6
3	9762.4	Vertical	40.5	54	-13.5
4*	2440.18	Horizontal	N/A	N/A	N/A
5	9762.39	Horizontal	44	54	-10

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard



Graph 6-12: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Average

Table 6-7: Transmitter Spurious Emissions, 1 – 18 GHz, 2480 MHz, Average

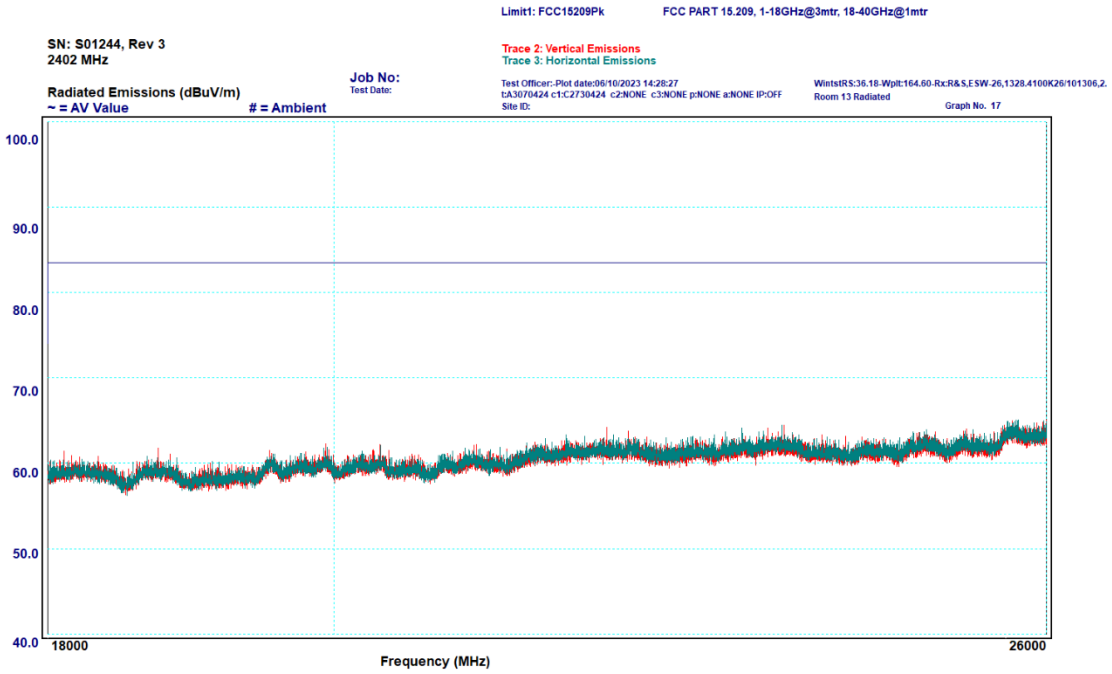
Peak	Frequency (MHz)	Polarisation	Average		
			Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1*	2480.21	Vertical	N/A	N/A	N/A
2	7441.62	Vertical	44.6	54	-9.4
3	9922.39	Vertical	42.6	54	-11.4
4	4961.13	Vertical	34.4	54	-19.6
5*	2480.2	Horizontal	N/A	N/A	N/A
6	9922.35	Horizontal	42.3	54	-11.7
7	7441.63	Horizontal	41.7	54	-12.3

*Note: Peaks above the limit are the fundamental transmission and not subject to the spurious emissions limit of the standard

6.3.8 Transmitter Spurious Emissions: 18 – 26 GHz

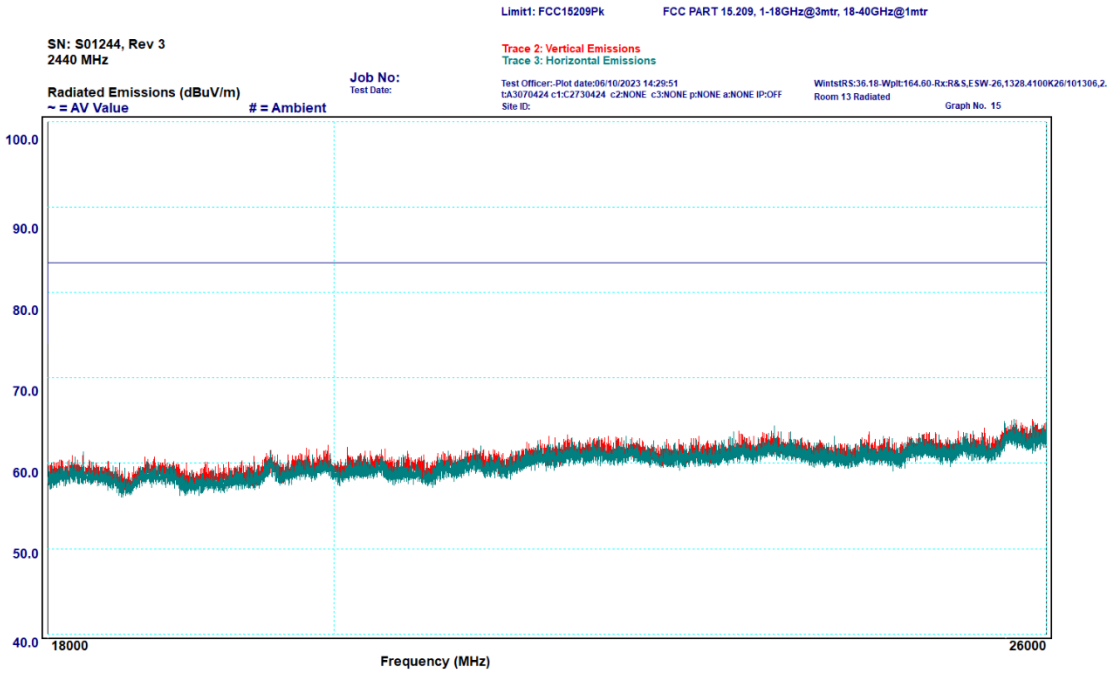
All emissions measured in the frequency band 18 – 26 GHz complied with the requirements of the standard.

Peak Measurement:



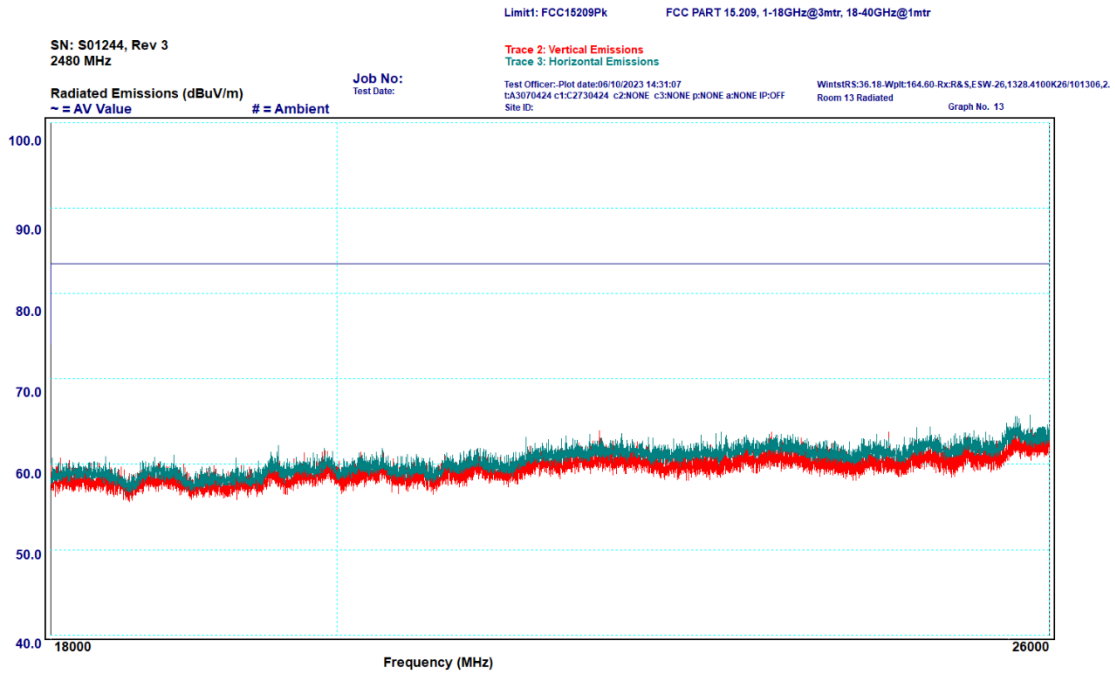
Graph 6-13: Transmitter Spurious Emissions, 18 – 26 GHz, 2402 MHz, Peak

No peaks were measured within 10 dB of the limit.



Graph 6-14: Transmitter Spurious Emissions, 18 – 26 GHz, 2440 MHz, Peak

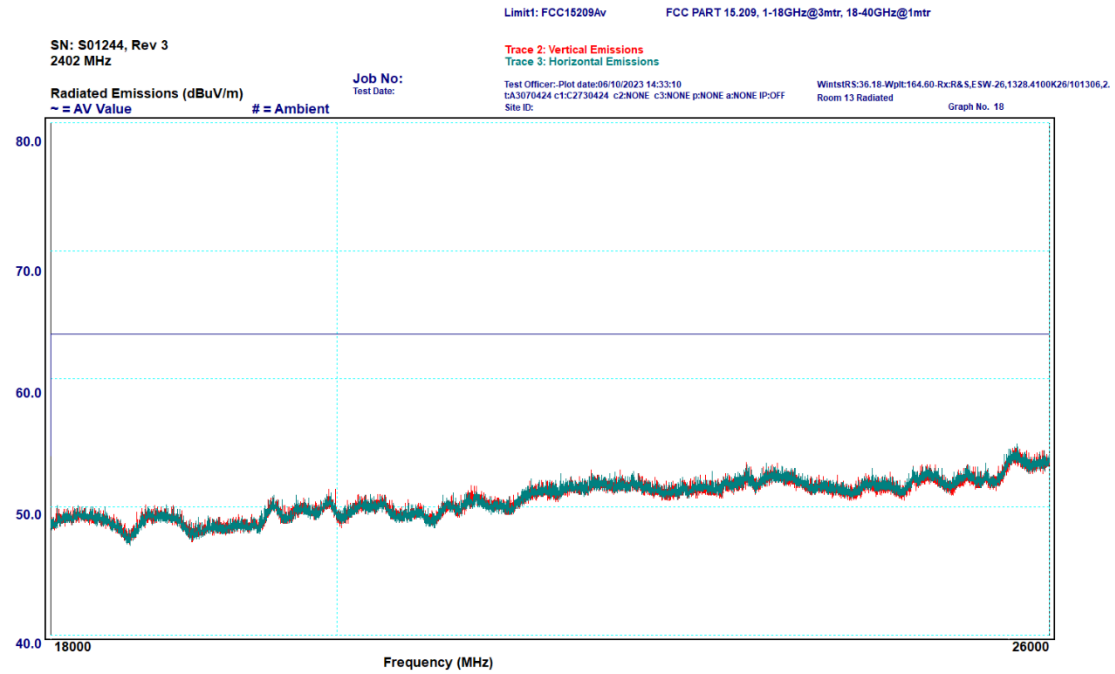
No peaks were measured within 10 dB of the limit.



Graph 6-15: Transmitter Spurious Emissions, 18 – 26 GHz, 2480 MHz, Peak

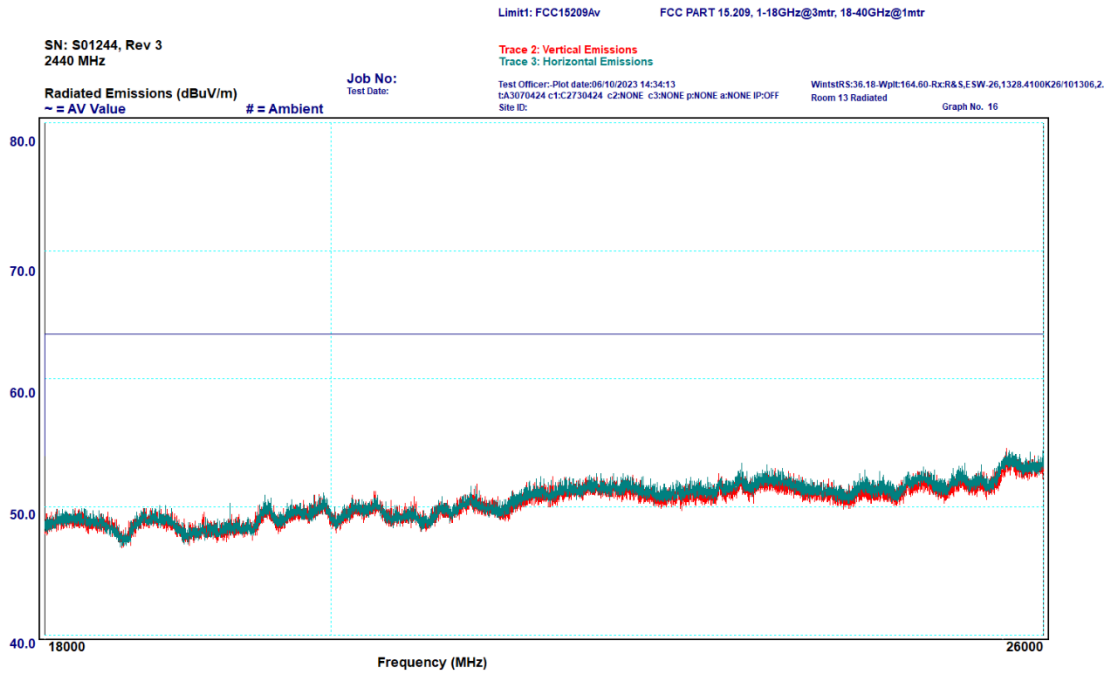
No peaks were measured within 10 dB of the limit.

Average Measurement:



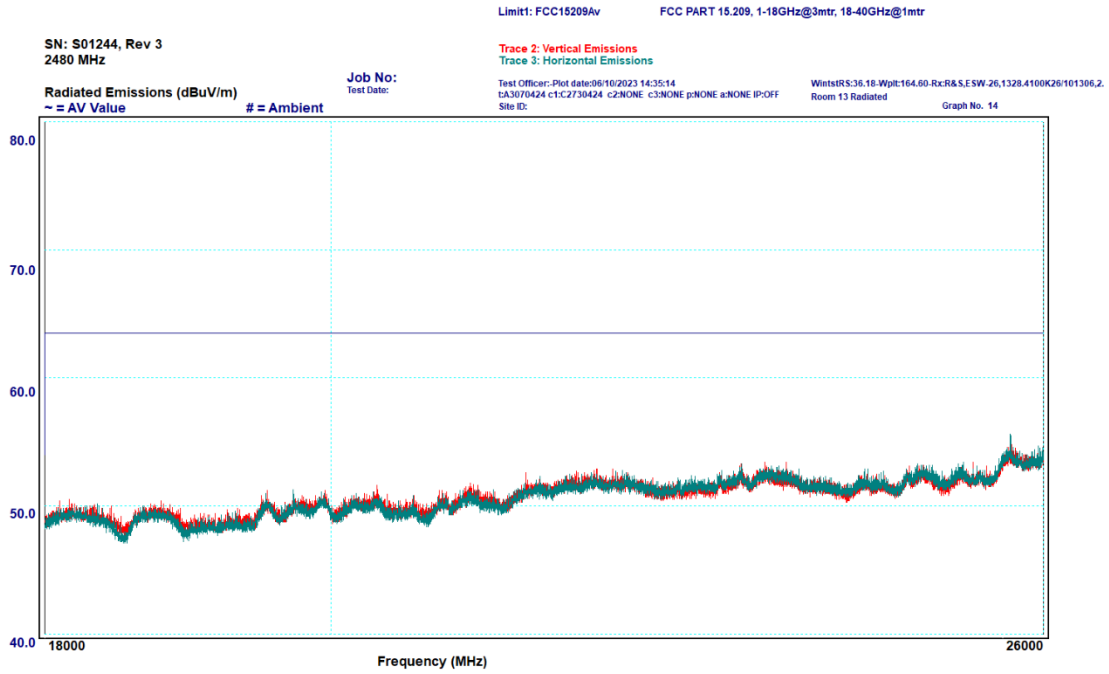
Graph 6-16: Transmitter Spurious Emissions, 18 – 26 GHz, 2402 MHz, Average

No peaks were measured within 10 dB of the limit.



Graph 6-17: Transmitter Spurious Emissions, 18 – 26 GHz, 2440 MHz, Average

No peaks were measured within 10 dB of the limit.



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

No peaks were measured within 10 dB of the limit.

END OF REPORT