



# TEST REPORT

## RADIOCOMMUNICATIONS

### FCC TITLE 47 PART 15C (DTS)

Client:	Cooltrax Asia Pacific Pty Ltd
Address:	138b Thistlethwaite St. South Melbourne, Vic, 3205
Report Number:	0529GLO_WT-V4_FCC15C
Date of Testing:	28 <sup>th</sup> September 2022 to 23 <sup>rd</sup> January 2023
File Number:	GLO220422-B
Equipment Name:	Cooltrax Wireless Sensor
Model Number	WT-V4
FCC ID:	WSB-WT-V4
Description:	Wireless Environmental Monitoring Sensor
<b>Result:</b>	The sample tested <b>COMPLIED</b> with the applicable requirements of the standard. (Refer to Compliance Summary page for details).
Tested by:	Steven Garnham Test Engineer 
Approved by:	Richard Turner Assessment Engineer 
Date of Issue:	29 <sup>th</sup> May 2023
Results appearing herein relate only to the sample(s) tested.	
This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion.	

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## TABLE OF CONTENTS

1	REPORT REVISION HISTORY .....	3
2	REFERENCES .....	3
3	COMPLIANCE SUMMARY .....	4
4	CONDITIONS FOR COMPLIANCE .....	4
5	EQUIPMENT UNDER TEST INFORMATION .....	5
6	TEST SETUP AND EUT CONFIGURATION .....	6
7	TEST SPECIFICATIONS .....	7
8	ANTENNA REQUIREMENT, §15.203.....	9
9	RESTRICTED BANDS OF OPERATION, §15.205.....	9
10	RADIATED EMISSIONS §15.209, RESTRICTED BANDS .....	9
11	DTS BANDWIDTH, §15.247(a)(2) .....	20
12	PEAK CONDUCTED OUTPUT POWER, §15.247(b)(3).....	21
13	POWER SPECTRAL DENSITY, §15.247(e) .....	22
14	OUT OF BAND EMISSIONS – §15.247(d).....	23
15	FCC Part 2J, §2.1049 – 99% BANDWIDTH .....	26
	APPENDIX A – EXTERNAL PHOTOGRAPHIC RECORD OF SAMPLE .....	27
	APPENDIX B – INTERNAL PHOTOGRAPHIC RECORD OF SAMPLE .....	29
	APPENDIX C – PCB PHOTOGRAPHIC RECORD OF SAMPLE.....	31
	APPENDIX D – TEST SETUP PHOTOGRAPHS .....	35

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## 1 REPORT REVISION HISTORY

Date	Report Number	Changes
28/03/2023	0328GLO_WT-V4_FCC15C	Original Report.
29/05/23	0529GLO_WT-V4_FCC15C	Address TCB points: Duty cycle statement Separate Appendices

## 2 REFERENCES

Document		Issue/ Amended
FCC Title 47	FCC Title 47 Part 15 – Radio Frequency Devices	Current as of March 2023
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
558074 D01	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under Section 15.247 of the FCC rules	v05r02 April 2, 2019
ANSI C63.4	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	2014
Compliance Test Plan	Compliance Test Plan Doc. R220602-1	8th August 2022

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



### 3 COMPLIANCE SUMMARY

**DISCLAIMER:** Austest Laboratories makes no claim regarding the consistency of production versions of the EUT. The results in this report apply only to the sample tested, as described in Section 5 of this report.

FCC Part 15, Subpart C – Intentional Radiators		Result	Notes
15.203	Antenna Requirement	N.A.	-
15.205	Restricted Bands of Operation	Complied	-
15.207	Conducted Limits	N.A.	(ii)
15.209	Radiated Emission Limits, General Requirements	Complied	-
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	Complied	(i)
15.247(a)(1)	Channel Separation, Frequency Hopping Systems	N.A.	(iii)
15.247(a)(1)(iii)	Number of Hopping Channels	N.A.	-(iii)
15.247(a)(1)(iii)	Time of Occupancy	N.A.	-(iii)
15.247(a)(2)	Digital Modulation – 6 dB bandwidth ( $\geq 500\text{kHz}$ )	Complied	
15.247(b)(3)	Maximum Peak Conducted Output Power: (1 Watt)	Complied	-
15.247(d)	Out of Band Unwanted Emissions (non-restricted)– 100kHz BW ( $\geq -20\text{dBc}$ )	Complied	-
15.247(e)	Digital Modulation – Power Spectral Density: ( $< 8\text{dBm}/3\text{kHz}$ )	Complied	
2.1049	99% Bandwidth	Noted	-

**Notes**

- (i) The EUT operated only in the band 2400 – 2483.5MHz.
- (ii) Not applicable as the EUT Sensor was powered by an internal battery.
- (iii) The EUT was assessed as DTS equipment.

### 4 CONDITIONS FOR COMPLIANCE

The upper operating channel must be restricted to 2478MHz to achieve compliance with the Band Edge requirements within the restricted band 2483.5MHz to 2500MHz.

This document shall not be reproduced in any form except in full.


This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## 5 EQUIPMENT UNDER TEST INFORMATION

### 5.1 EUT summary

EUT Name:	Cooltrax Wireless Sensor	
Model:	WT-V4	
FCC ID:	WSB-WT-V4	
Serial Numbers:	"Emissions" and "Radio" samples	
Supply Rating:	Internal 3.6V Li battery	
Frequency Range:	2402 MHz to 2478 MHz	
Transmit Power:	+8dBm	
Modulation Technique / Data Rate:	BLE: DTS / 1Mbit	
Number of Channels:	40	
Antenna Specifications:	Internal Chip Antenna – PCB labelled as ANT1.	

### 5.2 EUT description

The EUT was an environmental sensor tag, with BLE wireless functions, intended to be primarily used in a commercial environment.

The EUT was powered by an internal, non-rechargeable 3.6V Li battery, model EVE, EF702338, LTC-16PN 3.6V.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## 6 TEST SETUP AND EUT CONFIGURATION

### 6.1 EUT Configurations

Refer to the photographs in APPENDIX D for the EUT test setup and physical configuration.

The client advised that the “emissions” sample (#1) was configured to excite sensors and constantly advertise via BLE.

The “Radio” sample (#2), with internal antenna, was supplied with PCB header pins configured to be controlled by a serial / USB adaptor and a laptop using the supplied commands.

The sample (#3) was modified with an external antenna port for connection of test equipment for conducted RF measurements. This sample also had a PCB header fitted for connection of a laptop.

The supplied software commands configured both samples #2 and #3 for modulated continuous, 100% duty cycle transmission on all tested channels.

The EUT was subjected to a preliminary assessment for RSE in three orthogonal positions to determine the worst-case emission levels. Final testing was then performed in that orientation.

Details of operating modes, supporting equipment and cables used are listed as follows:

### 6.2 EUT Operating Modes

Mode No.	Operating Mode Description
Sample 1	Manufacturer supplied pre-programmed “Emissions” normal mode sample with a fully charged, non-rechargeable, battery.
Sample 2 Internal Antenna	Manufacturer supplied “Radio” sample fitted with a PCB header to allow connection of a laptop for control of the wireless functions
Sample 3 Fitted with a modified antenna port	Fitted with a modified antenna port to allow connection of test equipment for conducted RF measurements.

### 6.3 Supporting Equipment

Equipment	Brand & Model
1.8 m Serial / USB converter cable	TTL-232R-3V3
Laptop	Lenovo Thinkpad T430

### 6.4 Cables / Ports

The normal sample (1) had no cable connections.

The modified sample (3) had a 18cm long coax fitted with an SMA female connector as an RF output port.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

## 7 TEST SPECIFICATIONS

### 7.1 Test Facility

Testing was performed at Austest Laboratories located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing was performed at an OATS, where some ambient signals may have exceeded the continuous disturbance limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements.

### 7.2 Accreditations and Listings

Test facilities at Austest Laboratories are accredited by A2LA, Certificate Number 2765.02. The tests reported herein have been performed in accordance with its terms of accreditation.

Austest Laboratories Yarramalong and Castle Hill test facilities are accredited with the FCC under the ACMA-FCC APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

### 7.3 Deviations from Standards and/or Accreditations

No deviations to the standard or Austest accreditation was required.

### 7.4 Test Witnesses

None.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990





## 7.5 Test Equipment

All critical items are maintained on a scheduled calibration recall program or verified with equipment maintained on a scheduled calibration program. Emission measurements are traceable to Australian National standards or international equivalents.

ID	Brand/Model	Description	Calibration due
72	HP8574B	Spectrum Analyser / EMI Rx	07/11/2023
74	HP8447x	RF Preamp	07/04/2023
83	OATS 1 / FSOATS 1	3m/10m Open Area Test Site NSA, Svswr compliant	16/04/2023
225	EM6876	Active Loop Antenna 9kHz – 30MHz	29/03/2024
1101	AH Systems SAS-200/571	DRG Horn 1-18GHz	03/05/2024
1132	AH Systems SAS-200/574	DRG Horn 18-40GHz	03/05/2024
1241	Com-Power PAM-118A	RF Preamp	20/05/2024
1385	FSP40	Spectrum analyser 38GHz	16/02/2025
1844	Ametek CBL6141B	Bilog Antenna	09/08/2023
-	Huber + Suhner	Coax Cables	14/04/2024
-	HP85869C	Test Software	Verified
-	Rohde & Schwarz	RS Commander Capture Software	Verified

## 7.6 Measurement Uncertainty

Measurement uncertainty  $U_{Lab}$  was calculated for a 95% level of confidence and based on a coverage factor of  $k=2$ .

Measurement	Uncertainty	
	$U_{CISPR}$	$U_{Lab}$
RF Frequency	-	$\pm 5$ part in $10^{10}$
RF power conducted	-	$\pm 1.3$ dB
Radiated Emissions – 30 MHz to 1000 MHz	6.3 dB	$\pm 4.7$ dB
Radiated Emissions – 1 GHz to 6 GHz	5.2 dB	$\pm 4.8$ dB
Radiated Emissions – 6 GHz to 18 GHz	5.5 dB	$\pm 5.3$ dB

## 7.7 Emission test criteria

The laboratory expanded MIU ( $U_{Lab}$ ) is less than the CISPR 16-4-2 criterion for the expanded MIU ( $U_{CISPR}$ ) and therefore:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit.
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990





## 8 ANTENNA REQUIREMENT, §15.203

The requirement of this Section was not applicable, since a normal EUT will be supplied with an internal PCB trace antenna without any external antenna port.

## 9 RESTRICTED BANDS OF OPERATION, §15.205

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation. Out of band emissions falling within the Restricted Bands of Operation were below the limits specified in FCC section 15.209.

## 10 RADIATED EMISSIONS §15.209, RESTRICTED BANDS

### 10.1 EUT Operating Mode

- a. Refer to section 6 of this report.
- b. New Battery voltage – 3.6VDC

Preliminary measurements with the EUT oriented in 3 orthogonal axes were made to determine the orientation of the EUT that would generate the highest emission levels. Final measurements were then performed in that orientation.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## 10.2 Test Method

- a. Measurements were performed in accordance with ANSI C63.10-2013, KDB 558074. Average measurements were made with an average detector, video averaging was not employed.
- b. The measuring receiver BW settings were:

Frequency Range	Antenna	Measurement	Detector	RBW	VBW
0.15 to 30 MHz	60 cm Loop	Pre-scan	Peak	9 kHz	30 kHz
		Final Quasi-Peak	Quasi-Peak	9 kHz	-
30 to 1000 MHz	Hybrid (bicon/log)	Pre-scan Peak	Peak	120 kHz	300 kHz
		Final Quasi-Peak	Quasi-Peak	120 kHz	-
Above 1000 MHz	Double-ridged guide horn	Pre-scan Peak	Peak	1 MHz	3 MHz
		Pre-scan Average	Average	1 MHz	3 MHz
		Final Peak	Peak	1 MHz	3 MHz
		Final Average	Average	1 MHz	3 MHz

- c. The EUT was setup on a non-conductive turntable:-
  - i. For measurement below 1GHz at a height of 0.8m above the OATS conductive ground plane and at the indicated test distance away from the measuring antenna.
  - ii. For measurements above 1GHz at a height of 1.5m above the OATS conductive ground plane with RF absorber placed between the test table and measuring antenna.
- d. To maximise emissions, the EUT was rotated through 360° and the measuring antenna height adjusted between 1m to 4m in the following antenna orientations:
  - i. Loop antenna (9kHz to 30MHz) over a non-metallic ground plane, – Coaxial, coplanar orientations and horizontal (parallel to ground) orientations were investigated as the EUT antenna can have both vertical and horizontal positions.
  - ii. Bilog antenna (30MHz to 1GHz) - Both vertical and horizontal polarizations.
  - iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- e. The maximised emission level was measured and the above repeated for all measurement frequencies.
- f. Average level measurements were not made where the peak level did not exceed the average limit.
- g. Linearity of the measuring system was checked, reducing gain when required.
- h. Test distances: Where the actual test distance used was different to that specified, then the test data results shown in any tables were extrapolated to the required distance using the formula specified within ANSI C63.10:2013. For simplicity, the test data plots have the limit lines adjusted to reflect any different test distance giving a visual indication of the relative margins.
- i. **Ambient Emissions:** Measurements were performed at an Open Area Test Site (OATS), where some ambient signals may exceed the limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements. The ambient emissions are indicated as a '1' or 'A' on the scans, refer to the notes after the graphs.

## 10.3 Sample Calculation Example

The final field strength levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

Calculation	Example	
$E = V + AF + L_{cbl} - G_{pre}$	V = 40.0 dBμV AF = 12.0 dB/m	L <sub>cbl</sub> = 2.9 dB G <sub>pre</sub> = 22.5 dB E = 40 + 12 + 2.9 – 22.5 = 32.4 dBμV/m

Where

- E = Radiated Electric Field Strength in dBμV/m,
- V = EMI Receiver measured signal input voltage in dBμV,
- AF = Antenna Factor of the measuring antenna in dB/m,
- L<sub>cbl</sub> = Total cable insertion loss in dB and
- G<sub>pre</sub> = Pre-amplifier gain in dB.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

## 10.4 Test Results

### 10.4.1 Radiated Emissions: 9kHz to 30MHz.

Test Date:	28 <sup>th</sup> September 2022	Temperature:	24°C
Test Officer:	Steven Garnham	Humidity:	59%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

As the measurements were performed at 10 meters for frequencies below 150kHz and at 3 meters for frequencies between 150kHz and 30MHz, the test data was extrapolated to the distance defined by limits (300m for 9-490kHz and 30m for 490kHz – 30MHz), with reference to ANSI C63.10 Clause 6.4.4.1.

Prescan results were used to identify the orientation that produced the highest measured emissions in the three antenna positions, Coaxial, Coplanar and Parallel.  
Final measurements were performed over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

All intentional radiation was >20dB below the limits specified in section 15.209.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

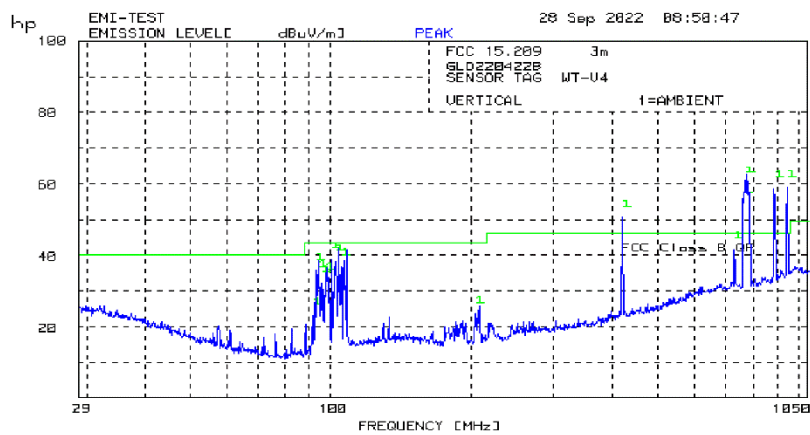
Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



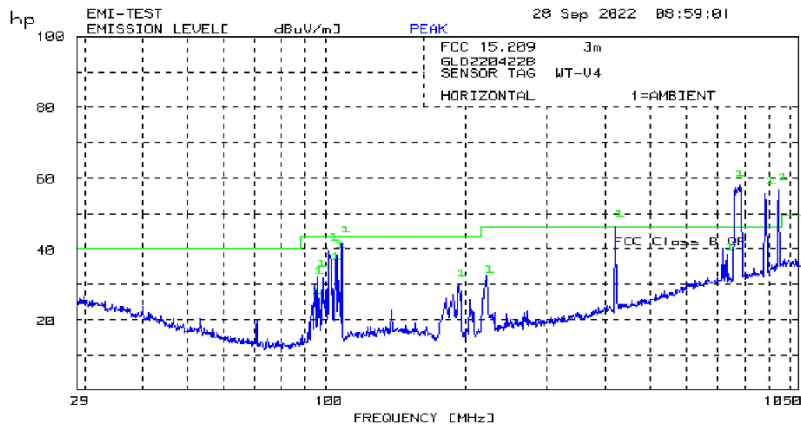
**10.4.2 Radiated Emissions: 30MHz to 1000MHz at 3m distance.**

Test Date:	28 <sup>th</sup> September 2022	Temperature:	22°C
Test Officer:	Steven Garnham	Humidity:	63%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

Frequency (MHz)	Channel	Antenna Polarity	Quasi-Peak (dBµV/m)		
			Level	Limit	Margin
All measured out of band emissions were greater than 20 dB below the limits specified in section FCC15.209					



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz - Horizontal)

**Note:** A Green '1' indicates an ambient emission and was not from the EUT.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



**10.4.3 Radiated Emissions: 1 GHz to 18 GHz at 3m distance.**

Test Dates:	23rd January 2023	Temperature:	30°C	Humidity:	41%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

Channel Frequency MHz	Harmonic / Spurious MHz	Antenna Pol.	Pk Level dBµV/m	Pk Limit dBµV/m	Margin dB	Avg Level dBµV/m	Avg Limit dBµV/m	Margin dB
2402	*7206	Vertical	49.9	74.0	>-20	43.1	54.0	-10.9
2402	*7206	Horiz.	49.2	74.0	>-20	43.0	54.0	-11.0
2440	7320	Vertical	47.1	74.0	>-20	42.9	54.0	-11.1
2440	7320	Horiz.	49.4	74.0	>-20	44.1	54.0	-9.9
2478	7434	Vertical	52.8	74.0	>-20	47.8	54.0	-6.2
2478	7434	Horiz.	53.9	74.0	>-20	49.1	54.0	-4.9

\* This emission was not within the listed 15.205 restricted bands and was therefore only required to be >-20dBc but has been included for reference purposes.

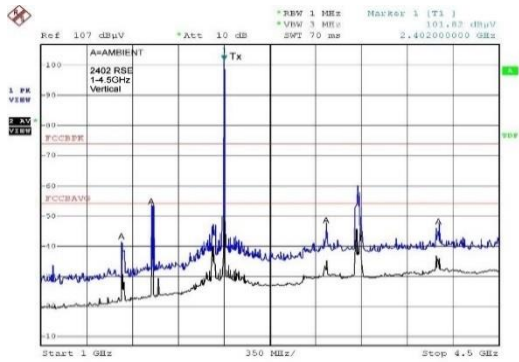
This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



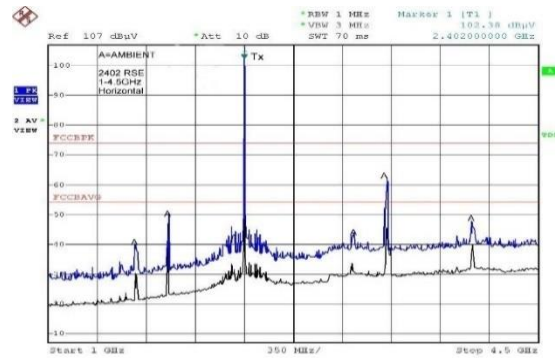
**2402MHz**



**GLO220422B**

Date: 23.JAN.2023 09:37:48

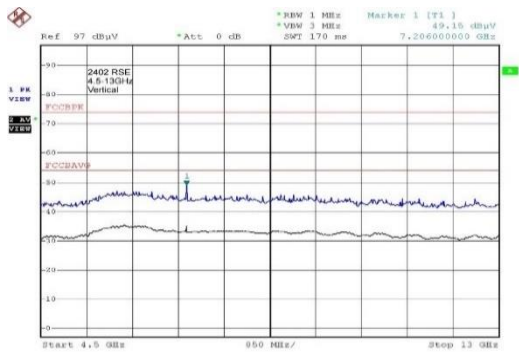
2402MHz–Peak / Avg Vertical 1-4.5GHz



**GLO220422B**

Date: 23.JAN.2023 09:32:13

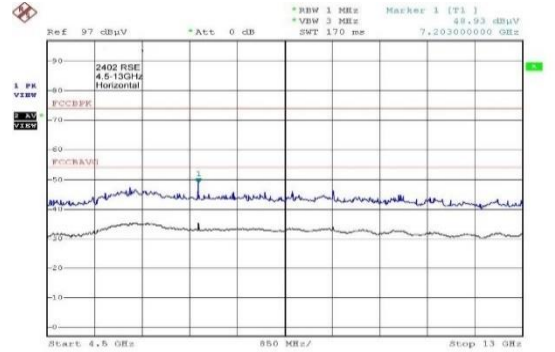
2402MHz–Peak / Avg Horizontal 1-4.5GHz



**GLO220422B**

Date: 23.JAN.2023 14:40:40

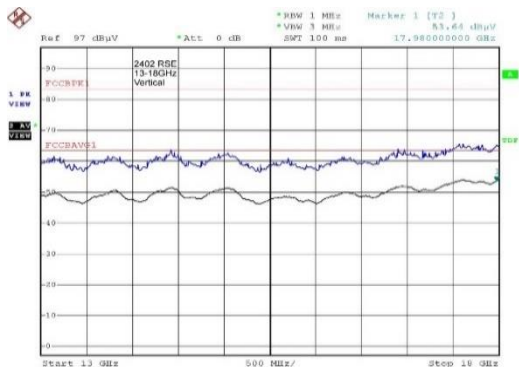
2402MHz–Peak / Avg Vertical 4.5 – 13GHz



**GLO220422B**

Date: 23.JAN.2023 14:44:12

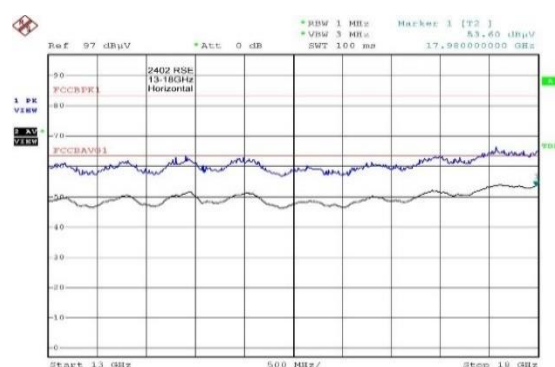
2402MHz–Peak / Avg Horizontal 4.5 – 13GHz



**GLO220422B**

Date: 23.JAN.2023 12:01:31

2402MHz–Peak / Avg Vertical 13 – 18GHz (1m)



**GLO220422B**

Date: 23.JAN.2023 11:58:45

2402MHz–Peak / Avg Horizontal 13 – 18GHz (1m)

Note: 'A' indicates an ambient emission.  
Note: 'Tx' indicates an intentional transmitter emission.

This document shall not be reproduced in any form except in full.

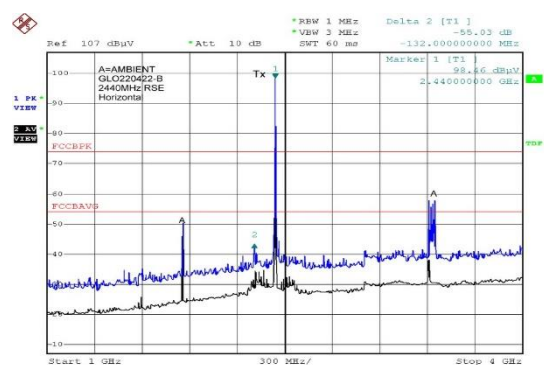
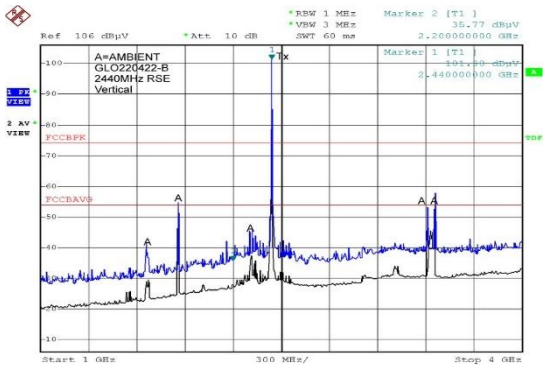
This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



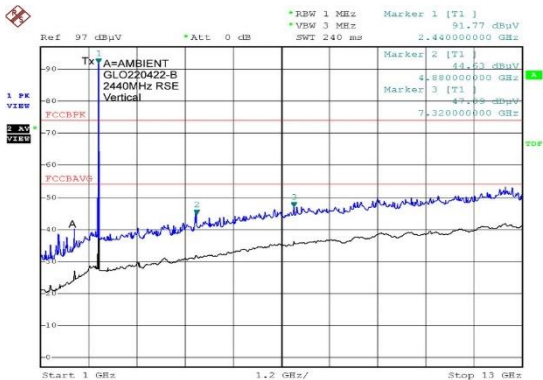


**2440MHz**



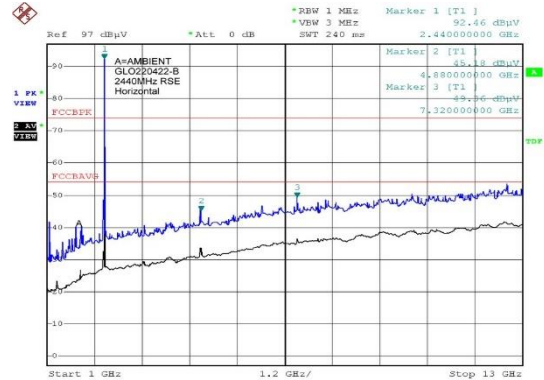
**GLO220422B**

**2440MHz–Peak / Avg Vertical 1-4GHz**



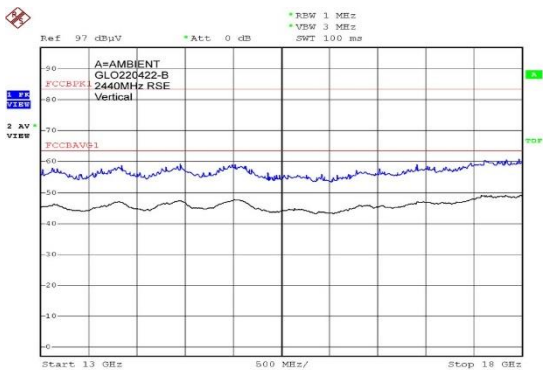
**GLO220422B**

**2440MHz–Peak / Avg Horizontal 1-4GHz**



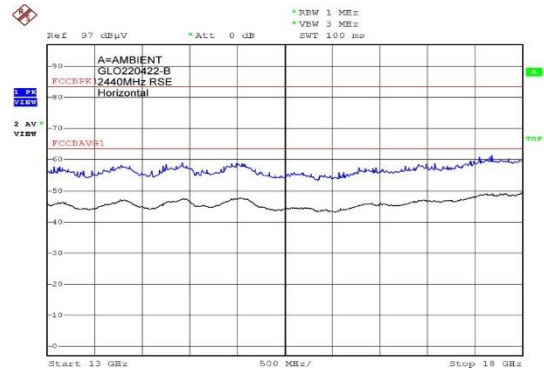
**GLO220422B**

**2440MHz–Peak / Avg Vertical 1 – 13GHz**



**GLO220422B**

**2440MHz–Peak / Avg Horizontal 1 – 13GHz**



**GLO220422B**

**2440MHz–Peak / Avg Vertical 13 – 18GHz (1m)**

**GLO220422B**

**2440MHz–Peak / Avg Horizontal 13 – 18GHz (1m)**

Note: 'A' indicates an ambient emission.  
Note: 'Tx' indicates an intentional transmitter emission.

This document shall not be reproduced in any form except in full.

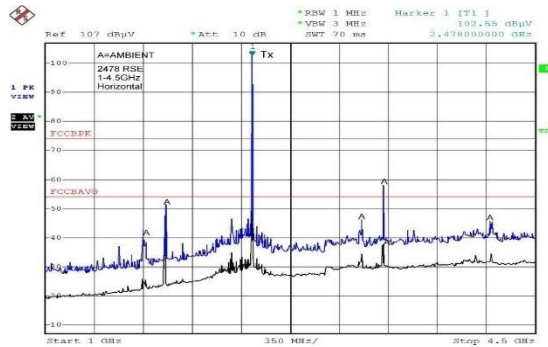
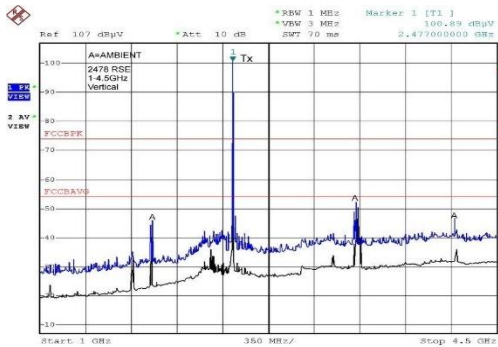
This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990





**2478MHz**



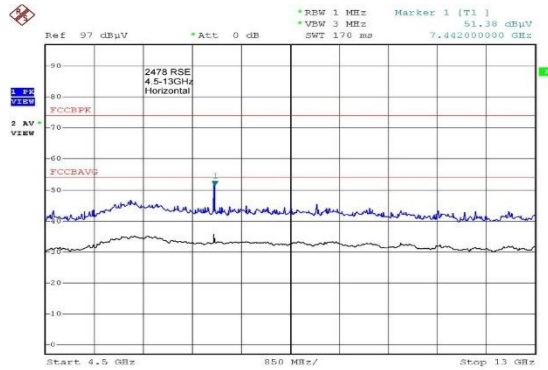
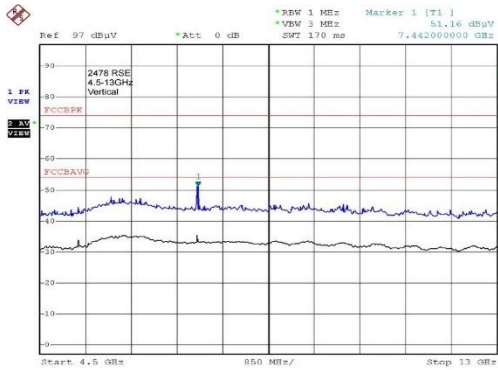
**GLO220422B**

Date: 23.JAN.2023 10:18:38

**GLO220422B**

Date: 23.JAN.2023 08:49:07

**2478MHz–Peak / Avg Vertical 1-4.5GHz**



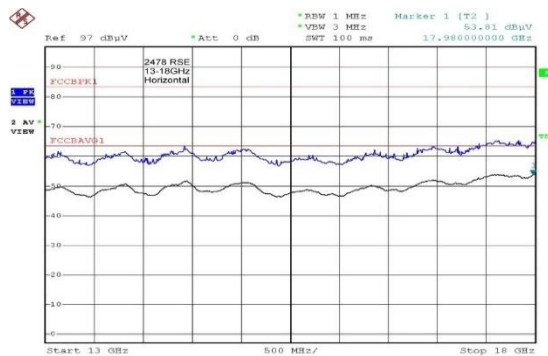
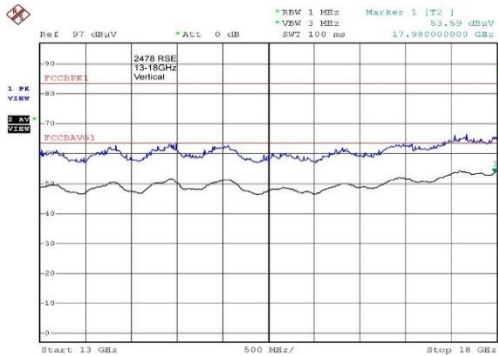
**GLO220422B**

Date: 23.JAN.2023 14:13:53

**GLO220422B**

Date: 23.JAN.2023 14:29:57

**2478MHz–Peak / Avg Vertical 4.5 – 13GHz**



**GLO220422B**

Date: 23.JAN.2023 11:53:17

**GLO220422B**

Date: 23.JAN.2023 11:56:11

**2478MHz–Peak / Avg Vertical 13 – 18GHz (1m)**

**2478MHz–Peak / Avg Horizontal 13 – 18GHz (1m)**

Note: 'A' indicates an ambient emission.  
Note: 'Tx' indicates an intentional transmitter emission.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

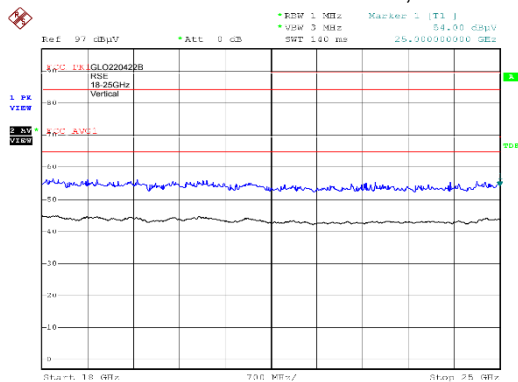


### 10.4.4 Radiated Emissions: 18GHz to 25GHz at 1m distance.

Measured field strength levels performed at a 1 meter distance were extrapolated to a 3 meter distance using the extrapolation factor of 20 dB/decade.

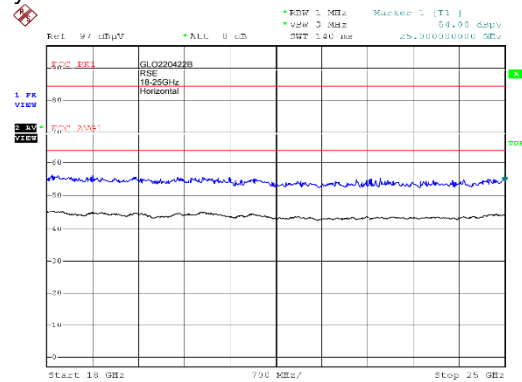
Frequency MHz	Channel Number	Antenna Pol.	Pk Level dB $\mu$ V/m	Pk Limit dB $\mu$ V/m	Margin dB	Avg Level dB $\mu$ V/m	Avg Limit dB $\mu$ V/m	Margin dB
				74.0			54.0	
All measured out of band emissions were greater than 20 dB below the limits specified in section 15.209								
				74.0			54.0	

Following plots indicate limits calculated for a 1m distance and are indicative of all channels. Measured emissions from all channels, were below the system noise floor.



Date:

Peak / Avg Vertical 18 – 25GHz



Date:

Peak / Avg Horizontal 18 – 25GHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



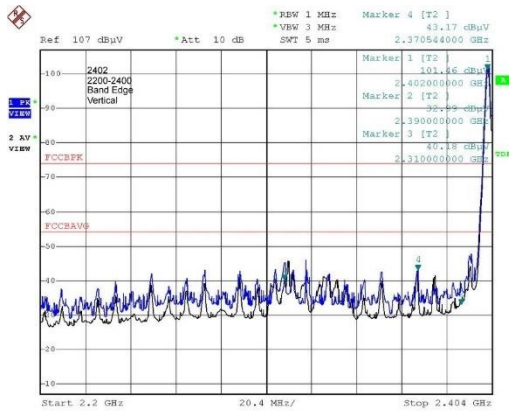
## 10.5 Band edge measurements

### 10.5.1 Restricted bands 2200 – 2300MHz, 2310 to 2390MHz, Radiated at 3m.

The highest emission levels are tabulated below with reference to the restricted band limits indicated in FCC15.209:-

Frequency MHz	Channel Number / Frequency	Antenna Pol.	Pk Level dB $\mu$ V/m	Pk Limit dB $\mu$ V/m	Margin dB	Avg Level dB $\mu$ V/m	Avg Limit dB $\mu$ V/m	Margin dB
2370.5	2402MHz	Vertical	-	74.0	>20	43.2	54.0	-10.8
2370.5	2402MHz	Horizontal	-	74.0	>20	41.2	54.0	-12.8

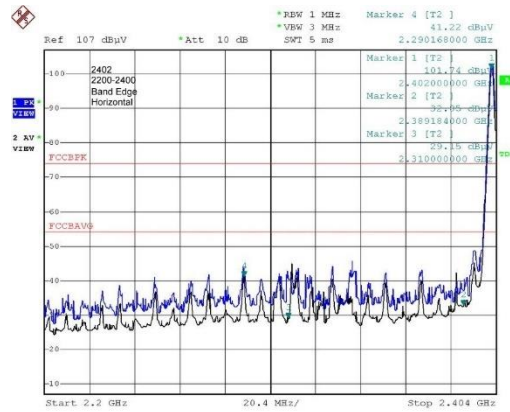
Note: An 'A' on the plot, indicates an ambient emission and was not from the EUT.



**GLO220422B**

Date: 23.JAN.2023 09:45:39

Ch. 2402MHz–Peak/Average Vertical Polarisation



**GLO220422B**

Date: 23.JAN.2023 10:07:25

Ch. 2402MHz–Peak/Avg Horizontal Polarisation

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

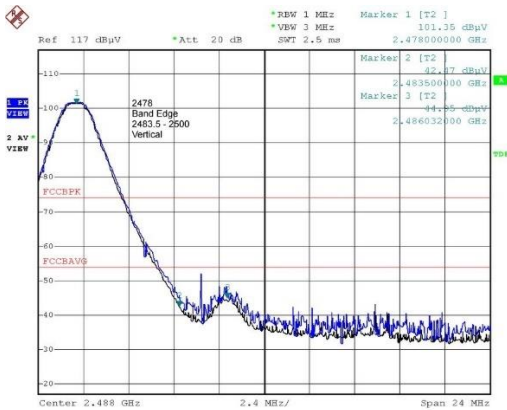


### 10.5.2 Restricted band 2483.5 – 2500MHz, Radiated at 3m.

The highest emission levels are tabulated below with reference to the restricted band limits indicated in FCC15.209:-

Frequency MHz	Channel Number / Frequency	Antenna Pol.	Pk Level dBμV/m	Pk Limit dBμV/m	Margin dB	Avg Level dBμV/m	Avg Limit dBμV/m	Margin dB
2483.5	2478MHz	Vertical	-	74.0	>20	42.5	54.0	-11.5
2486.03	2478MHz	Vertical	-	74.0	>20	45.0	54.0	-9.0
2483.5	2478MHz	Horizontal	-	74.0	>20	44.0	54.0	-10.0
2486.03	2478MHz	Horizontal	-	74.0	>20	46.1	54.0	-7.9

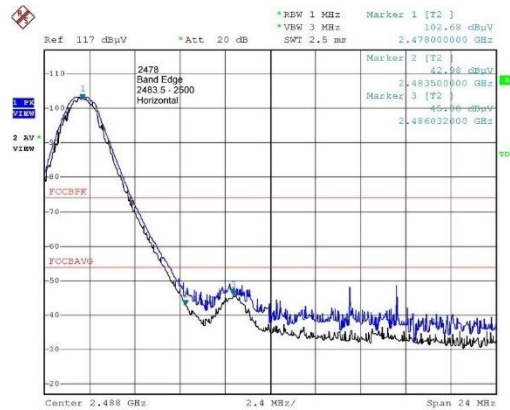
Note: An 'A' on the plot, indicates an ambient emission and was not from the EUT.



**GLO220422B**

Date: 23.JAN.2023 08:32:29

Ch. 2478MHz – Peak/Avg Vertical Polarisation



**GLO220422B**

Date: 23.JAN.2023 08:37:39

Ch. 2478MHz – Peak/Avg Horizontal Polarisation

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

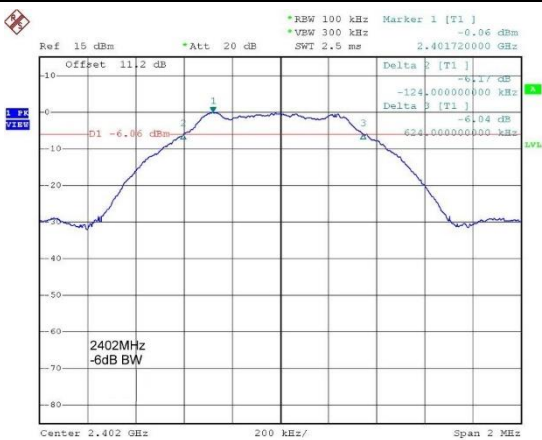


## 11 DTS BANDWIDTH, §15.247(a)(2)

A conducted measurement was performed using the modified EUT sample with an antenna port, refer to C63.10 clause 11.3 and applying the procedures detailed in Clause 11.8.1.DTS Bandwidth Option 1.

The 6 dB bandwidth was measured using the analyser ndB down marker function.

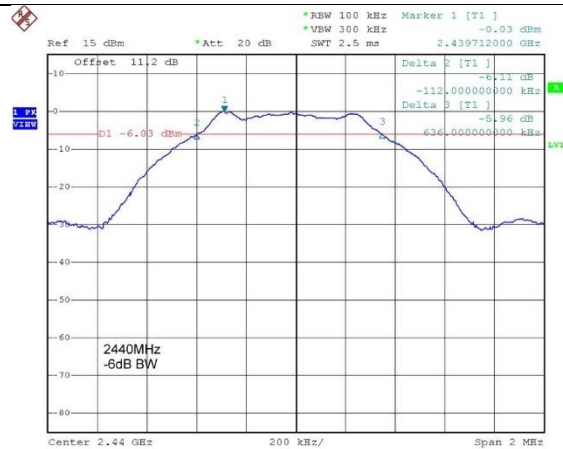
Channel	Frequency MHz	6 dB Bandwidth (kHz) (limit >500kHz)
37	2402	748
17	2440	748
36	2478	740



**GLO220422B**

Date: 18.JAN.2023 13:12:55

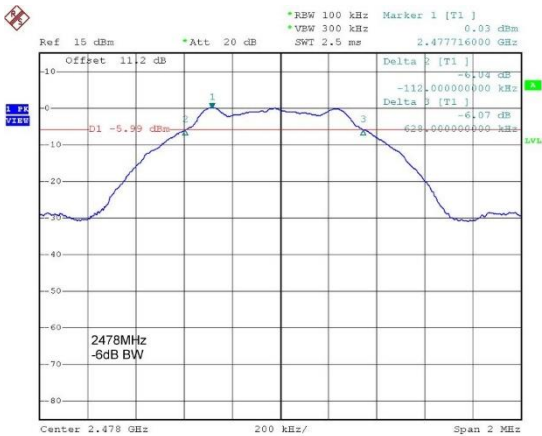
DTS Bandwidth – 2402MHz



**GLO220422B**

Date: 18.JAN.2023 13:09:56

DTS Bandwidth – 2440MHz



**GLO220422B**

Date: 18.JAN.2023 13:35:34

DTS Bandwidth – 2478MHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

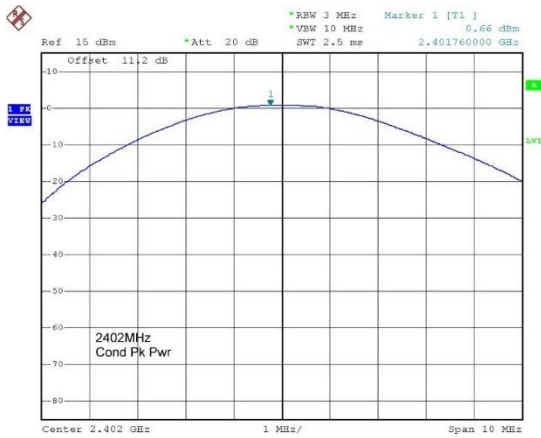




## 12 PEAK CONDUCTED OUTPUT POWER, §15.247(b)(3)

A conducted measurement was performed using the modified EUT sample with an antenna port, refer to C63.10 clause 11.3 and applying the procedure detailed in ANSI C63.10, Clause 11.9.1.1 RBW ≥ DTS Bandwidth.

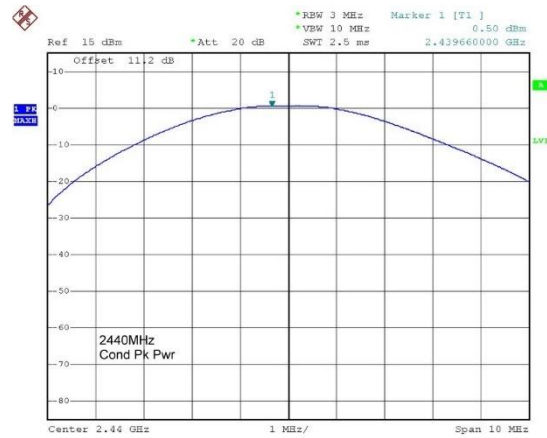
Channel	Frequency MHz	Conducted RF		Limit dBm	Limit W	Margin
		dBm	W			
37	2402	0.66	0.00116	+30.0	1.000	-29.34
17	2440	0.50	0.00112	+30.0	1.000	-29.5
36	2478	0.53	0.00113	+30.0	1.000	-29.47



**GLO220422B**

Date: 18.JAN.2023 13:20:30

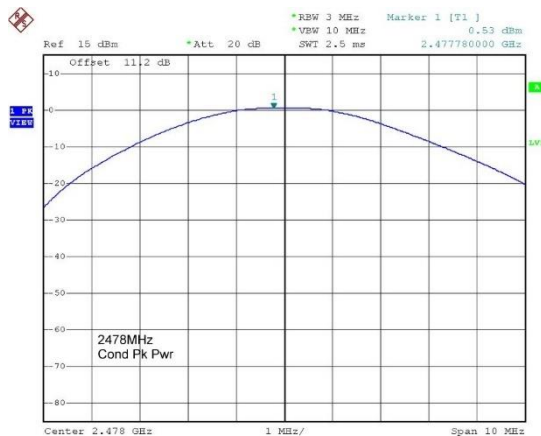
2402MHz



**GLO220422B**

Date: 18.JAN.2023 12:57:04

2440MHz



**GLO220422B**

Date: 18.JAN.2023 13:25:30

2478MHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

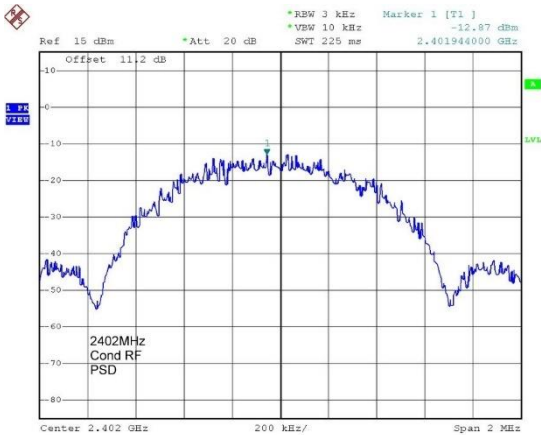
Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



### 13 POWER SPECTRAL DENSITY, §15.247(e)

A conducted measurement was performed using the modified EUT sample with an antenna port by applying the procedure detailed in ANSI C63.10, Clause 11.10.2 Method PKPSD (peak PSD).

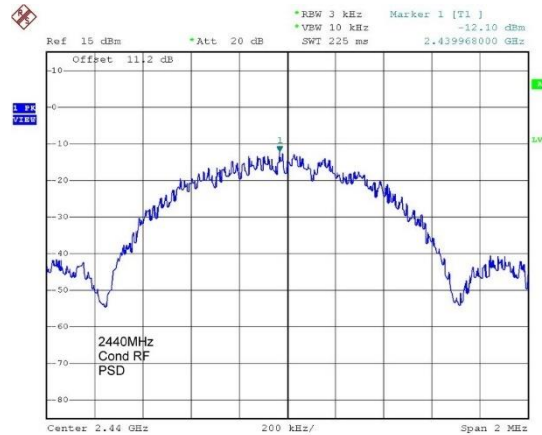
Frequency MHz	Conducted PSD dBm/3 kHz	Conducted Limit dBm/3 kHz	Margin dB
2402	-12.9	8	-20.9
2440	-12.1	8	-20.1
2478	-12.7	8	-20.7



**GLO220422B**

Date: 18.JAN.2023 13:18:10

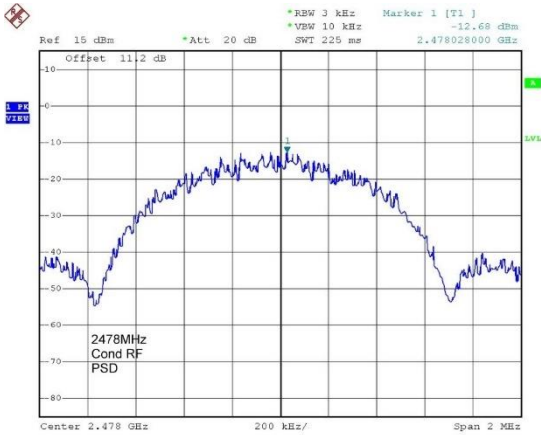
PSD – 2402MHz



**GLO220422B**

Date: 18.JAN.2023 13:00:54

PSD – 2440MHz



**GLO220422B**

Date: 18.JAN.2023 13:28:37

PSD – 2478MHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990





## 14 OUT OF BAND EMISSIONS – §15.247(d)

### 14.1 Non-Restricted Bands

#### 14.1.1 EUT Operating Mode

- a. Refer to section 6 of this report.
- b. New Battery voltage – 3.6VDC

#### 14.1.2 Test Method

Measurements were made using the supplied modified EUT fitted with an external antenna port and PCB header pins for connection of a serial / USB cable and laptop to enable control of the BLE functions – Channel, data rate etc.

- a. Measurements were performed in accordance with ANSI C63.10-2013 and KDB 558074 DTS Meas Guidance.
- b. The EUT antenna port was connected directly to a spectrum analyser via a low loss RF cable, and attenuator.
- c. Spectrum analyser RBW 100kHz, VBW to  $\geq 300$ kHz. (At frequencies below 30MHz the RBW was set lower to reduce influence of the spectrum analysers zero point).
- d. Measurements were made on the low, middle and high channels and the highest in-band level was recorded.
- e. The frequency range was swept up to the 10<sup>th</sup> harmonic to locate the highest out of band emissions.
- f. Any out of band emissions in the non-restricted bands were measured to ensure they were greater than 20dB below the recorded in band level.
- g. Any emissions that fall within the restricted bands specified in section 15.205 shall also meet the radiated emission limits specified in section 15.209.
- h. Measurements were repeated for the low, middle and high channel and across all transmit modes as specified within the client's test plan.

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

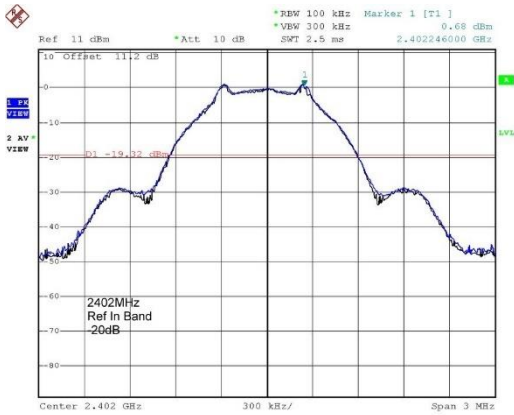
Accredited for compliance with ISO / IEC 17025.  
Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



### 14.1.3 Test Results

#### Reference in-band levels (For Non-Restricted Bands) §15.247(d)

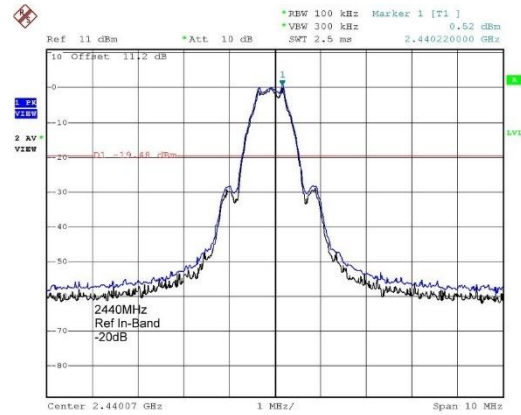
The following measurements were made with a 100 kHz RBW to determine the limit for emissions in the non-restricted bands.



**GLO220422B**

Date: 19.JAN.2023 08:01:22

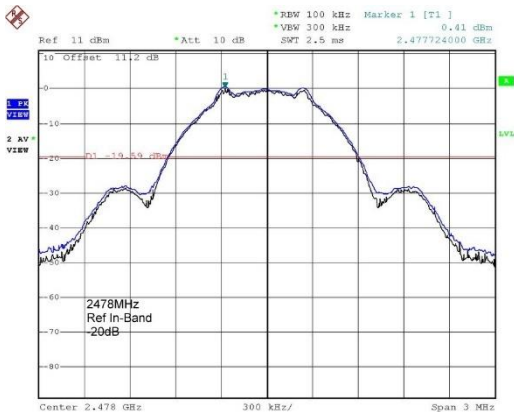
Highest Radiated In-band – 2402MHz



**GLO220422B**

Date: 19.JAN.2023 07:26:29

Highest Radiated In-band – 2440MHz



**GLO220422B**

Date: 19.JAN.2023 07:51:14

Highest Radiated In-band – 2478MHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

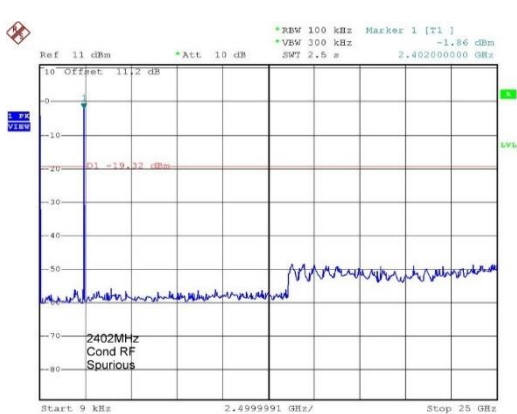


**Frequency range: 9kHz to 25000MHz.**

The highest in-band reference level was at 2402MHz, +0.68dBm, (RBW=100kHz / VBW=300kHz).

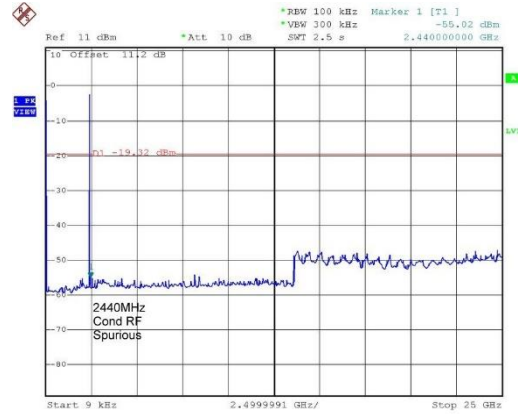
Measurement of peak conducted output power was used to determine compliance limits with section 15.247 (2)(b)(3). Therefore, the out of band emission limit was 20dB below the highest in-band level, or -19.32dBm.

Frequency (MHz)	Channel	Peak Level (dBm)	Out of Band Limit (dBm)	Highest Spurious Levels Below Limit (dB)
2402	37	+0.68	-19.32	>-25
2440	17	+0.52	-19.32	>-25
2478	36	+0.41	-19.32	>-25



**GLO220422B**

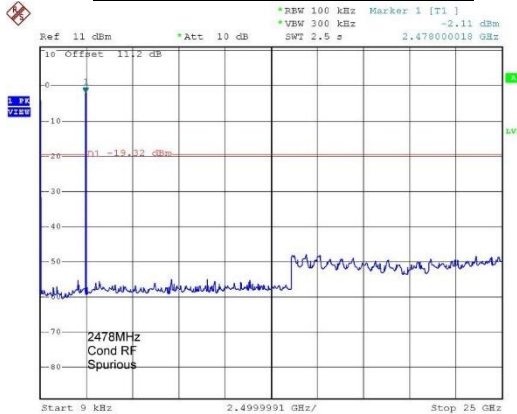
Date: 19.JAN.2023 08:03:03



**GLO220422B**

Date: 19.JAN.2023 07:29:03

**9kHz to 25GHz- Ch.37 -(2402MHz)**



**GLO220422B**

Date: 19.JAN.2023 07:54:37

**9kHz to 25GHz- Ch. 36 -(2478MHz)**

**9kHz to 25GHz- Ch.17 -(2440MHz)**

This document shall not be reproduced in any form except in full.

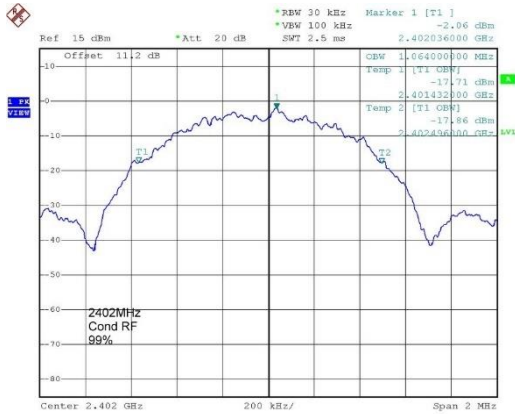
This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



## 15 FCC Part 2J, §2.1049 – 99% BANDWIDTH

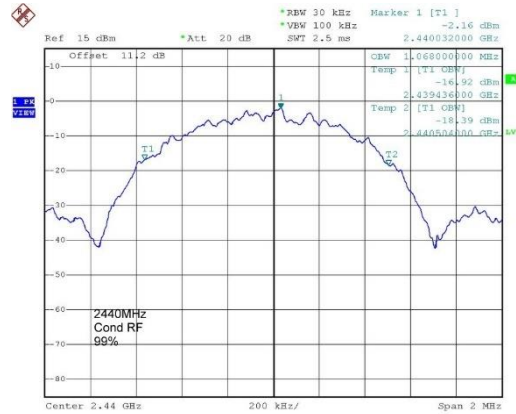
Channel	99% Bandwidth (kHz)
37 (2402MHz)	1064
17 (2442MHz)	1068
36 (2478MHz)	1064



**GLO220422B**

Date: 18.JAN.2023 13:15:40

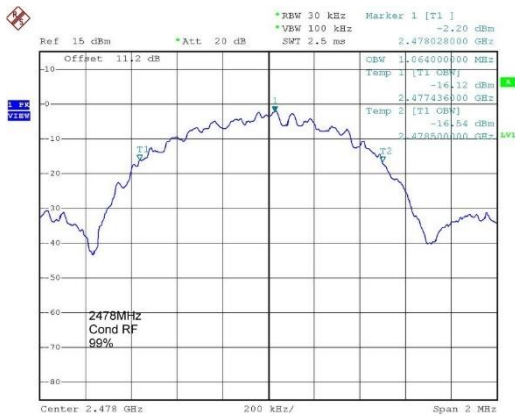
99% Bandwidth – 2402MHz



**GLO220422B**

Date: 18.JAN.2023 13:03:11

99% Bandwidth – 2440MHz



**GLO220422B**

Date: 18.JAN.2023 13:30:35

99% Bandwidth – 2478MHz

This document shall not be reproduced in any form except in full.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.  
 Approval Specialists Pty Ltd (ACN: 094 656 354) Trading as Austest Laboratories  
 2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

