

# **REGULATORY COMPLIANCE TEST REPORT**

FCC Part 15 Subpart F 15.519 UWB Device

Report No.: CATA10-U6 Rev A

Company: Catapult Sports Pty Ltd

Model Name: T7001



# **REGULATORY COMPLIANCE TEST REPORT**

Company: Catapult Sports Pty Ltd

Model Name: T7001

To: FCC CFR 47 Part 15 Subpart F 15.519,

Test Report Serial No.: CATA10-U6 Rev A

This report supersedes: NONE

Applicant: Catapult Sports Pty Ltd Company 75-83 High St, Prahran Melbourne, Victoria 3181 Australia

Issue Date: 23rd December 2021

# This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA Phone: +1 (925) 462-0304 Fax: +1 (925) 462-0306 www.micomlabs.com



MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



# **Table of Contents**

| 1. ACCREDITATION, LISTINGS & RECOGNITION   | 4  |
|--|--|
| 1.1. TESTING ACCREDITATION   | 4  |
| 1.2. RECOGNITION   | 5  |
| 1.3. PRODUCT CERTIFICATION   | 6  |
| 2. DOCUMENT HISTORY  | 7  |
| 3. TEST RESULT CERTIFICATE   | 8  |
| 4. REFERENCES AND MEASUREMENT UNCERTAINTY  | 9  |
| 4.1. Normative References  | 9  |
| 4.2. Test and Uncertainty Procedure  | 10   |
| 5. PRODUCT DETAILS AND TEST CONFIGURATIONS   | 11   |
| 5.1. Technical Details   | 11   |
| 5.2. Scope Of Test Program   | 12   |
| 5.3. Equipment Model(s) and Serial Number(s)   | 13   |
| 5.4. Antenna Details   | 13   |
| 5.5. Cabling and I/O Ports   | 13   |
| 5.6. Test Conligurations   | 13   |
| 5.7. Equipment Modifications   | 13   |
| 5.0. Deviations from the rest Standard   | 14   |
|  | 15   |
| 6. TEST SUMMARY  | 15   |
| 6. TEST SUMMARY<br>7. TEST EQUIPMENT CONFIGURATION(S)<br>7.1 Radiated Emissions - 3m Chamber   | 15<br>16   |
| 6. TEST SUMMARY     7. TEST EQUIPMENT CONFIGURATION(S)     7.1. Radiated Emissions - 3m Chamber     8. MEASUREMENT AND PRESENTATION OF TEST DATA   | 15<br>16<br>16<br>19   |
| 6. TEST SUMMARY<br>7. TEST EQUIPMENT CONFIGURATION(S)<br>7.1. Radiated Emissions - 3m Chamber<br>8. MEASUREMENT AND PRESENTATION OF TEST DATA<br>9. TEST RESULTS   | 15<br>16<br>16<br>19<br>20   |
| <ol> <li>TEST SUMMARY</li></ol>  | 15<br>16<br>16<br>19<br>20<br>20   |
| 6. TEST SUMMARY     7. TEST EQUIPMENT CONFIGURATION(S)     7.1. Radiated Emissions - 3m Chamber     8. MEASUREMENT AND PRESENTATION OF TEST DATA     9. TEST RESULTS     9.1. USB Bandwidth     9.2. Transmit Power  | 15<br>16<br>16<br>19<br>20<br>20<br>24   |
| <ul> <li>6. TEST SUMMARY</li></ul>   | 15<br>16<br>19<br>20<br>20<br>24<br>28   |
| <ul> <li>6. TEST SUMMARY</li></ul>   | 15<br>16<br>16<br>19<br>20<br>20<br>24<br>28<br>32   |
| <ul> <li>6. TEST SUMMARY</li></ul>   | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34   |
| <ul> <li>6. TEST SUMMARY.</li> <li>7. TEST EQUIPMENT CONFIGURATION(S)</li></ul>  | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34   |
| <ul> <li>6. TEST SUMMARY</li></ul>   | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>43                               |
| 6. TEST SUMMARY<br>7. TEST EQUIPMENT CONFIGURATION(S)<br>7.1. Radiated Emissions - 3m Chamber<br>8. MEASUREMENT AND PRESENTATION OF TEST DATA<br>9. TEST RESULTS<br>9.1. USB Bandwidth<br>9.2. Transmit Power<br>9.3. Peak Power Density<br>9.4. Transmitter Spurious Band Emissions<br>9.4.1. Transmitter Spurious Emissions<br>9.4.1.1. 3993.6 MHz<br>9.4.1.2. 4492.6 MHz<br>9.4.1.3. 6489.6 MHz | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>43<br>52                         |
| <ul> <li>6. TEST SUMMARY</li></ul>   | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>43<br>52<br>61                   |
| 6. TEST SUMMARY<br>7. TEST EQUIPMENT CONFIGURATION(S)  | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>52<br>61<br>61                   |
| <ul> <li>6. TEST SUMMARY.</li> <li>7. TEST EQUIPMENT CONFIGURATION(S)</li></ul>  | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>43<br>52<br>61<br>61<br>61       |
| <ul> <li>6. TEST SUMMARY.</li> <li>7. TEST EQUIPMENT CONFIGURATION(S)</li></ul>  | 15<br>16<br>16<br>20<br>20<br>24<br>28<br>32<br>34<br>34<br>34<br>43<br>52<br>61<br>63<br>63<br>65 |



# 1. ACCREDITATION, LISTINGS & RECOGNITION

# 1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) <u>www.a2la.org</u> test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <u>http://www.a2la.org/scopepdf/2381-01.pdf</u>





# Accredited Laboratory

A2LA has accredited

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for technical competence in the field of

# **Electrical Testing**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 24th day of February 2020.

Vice President, Accreditation Services For the Accreditation Council Certificate Number 2381.01 Valid to February 28, 2022 Revised November 16, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.



# 1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM test reports. MiCOM Labs test reports are accepted globally.

| Country           | Recognition Body  | Status | MRA Phase    | Identification No.                        |
|-------------------|---|--------|--------------|---|
| USA               | Federal Communications<br>Commission (FCC)  | тсв    | -            | US0159<br>Test Site Designation #: US1084 |
| Canada            | Industry Canada (ISED)  | FCB    | APEC MRA 2   | US0159<br>Test Company #: 4143A           |
| Japan             | MIC (Ministry of Internal Affairs<br>and Communication)<br>Japan Approvals Institute for<br>Telecommunication Equipment<br>(JATE) | CAB    | Japan MRA 2  | RCB 210                                   |
|                   | VCCI  |        |              | A-0012                                    |
| Europe            | European Commission   | NB     | EU MRA 2     | NB 2280                                   |
| United<br>Kingdom | Department for Business, Energy<br>& Industrial Strategy (BEIS)   | AB     | UK MRA 2     | AB 2280                                   |
| Mexico            | Instituto Federal de<br>Telecomunicaciones (IFT)  | CAB    | Mexico MRA 1 | US0159                                    |
| Australia         | Australian Communications and Media Authority (ACMA)  |        |              |   |
| Hong Kong         | Office of the Telecommunication<br>Authority (OFTA)   |        |              |   |
| Korea             | Ministry of Information and<br>Communication Radio Research<br>Laboratory (RRL)   | CAR    |              | 1100450                                   |
| Singapore         | Infocomm Development Authority (IDA)  | CAD    | APEC MRA 1   | 030139                                    |
| Taiwan            | National Communications<br>Commission (NCC)<br>Bureau of Standards, Metrology<br>and Inspection (BSMI)                            |        |              |   |
| vietnam           | winistry of Communication (MIC)   |        |              |   |

TCB- Telecommunications Certification Bodies (TCB)

FCB - Foreign Certification Body

CAB – Conformity Assessment Body

NB – Notified Body;

AB – Approved Body

MRA – Mutual Recognition Agreement

### MRA Phases

Phase I - recognition for product testing Phase II – recognition for both product testing and certification



# 1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) <u>www.a2la.org</u> test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <u>http://www.a2la.org/scopepdf/2381-02.pdf</u>



# **Accredited Product Certification Body**

A2LA has accredited

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This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 Requirements for bodies certifying products, processes and services. This product certification body also meets the A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements and A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.



Presented this 24<sup>th</sup> day of February 2020

Vice President, Accreditation Services For the Accreditation Council Certificate Number 2381.02 Valid to February 28, 2022 Revised November 16, 2021

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB) Industry Canada – Certification Body, CAB Identifier – US0159 Europe – Notified Body (NB), NB Identifier – 2280 UK – Approved Body (AB), AB Identifier - 2280 Japan – Recognized Certification Body (RCB), RCB Identifier - 210



# 2. DOCUMENT HISTORY

| Document History |                    |                                 |  |  |  |
|------------------|--------------------|---------------------------------|--|--|--|
| Revision         | Date               | Comments                        |  |  |  |
| Draft            | 21st December 2021 | Draft report for client review. |  |  |  |
| Rev A            | 23rd December 2021 | Initial release.                |  |  |  |
|                  |                    |                                 |  |  |  |
|                  |                    |                                 |  |  |  |
|                  |                    |                                 |  |  |  |
|                  |                    |                                 |  |  |  |
|                  |                    |                                 |  |  |  |
|                  |                    |                                 |  |  |  |

In the above table the latest report revision will replace all earlier versions.



# 3. TEST RESULT CERTIFICATE

# Manufacturer: Catapult Sports Pty Ltd 75-83 High St Prahran Melbourne, Victoria 3181 Australia

Model: T7001

Equipment Type: Mobile & Portable Client Device

**S/N's:** 000112

Test Date(s): 8th & 9th December 2021

Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA

Telephone: +1 925 462 0304

Fax: +1 925 462 0306

Website: www.micomlabs.com

# STANDARD(S)

## FCC CFR 47 Part 15 Subpart F 15.519

TEST RESULTS

**EQUIPMENT COMPLIES** 

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

# Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested.

# Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve Quality Manager MiCOM Labs, Inc.

TESTING CERT #2381.01

Gordon Hurst President & CEO MiCOM Labs, Inc.



# 4. REFERENCES AND MEASUREMENT UNCERTAINTY

# 4.1. Normative References

| REF. | PUBLICATION                   | YEAR               | TITLE  |
|------|-------------------------------|--------------------|--|
| I    | FCC 47 CFR Part F             | 2018               | Radio Frequency Devices; Subpart F – Ultra Wide Band Devices   |
| п    | A2LA                          | 5th Oct 2020       | R105 - Requirement's When Making Reference to A2LA Accreditation Status  |
| ш    | ANSI C63.10                   | 2013               | American National Standard for Testing Unlicensed<br>Wireless Devices  |
| IV   | ANSI C63.4                    | 2014               | American National Standards for Methods of<br>Measurement of Radio-Noise Emissions from Low-<br>Voltage Electrical and Electronic Equipment in the Range<br>of 9 kHz to 40 GHz |
| V    | ETSI TR 100 028               | 2001-12            | Parts 1 and 2 Electromagnetic compatibility and Radio<br>Spectrum Matters (ERM); Uncertainties in the<br>measurement of mobile radio equipment characteristics                 |
| VI   | M 3003                        | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in<br>Measurements  |
| VII  | FCC 47 CFR Part<br>2.1033     | 2016               | FCC requirements and rules regarding photographs and test setup diagrams.  |
| VIII | KDB 393764 D01<br>UWB FAQ v02 | January 29, 2018   | Ultra-Wideband (UWB) Devices frequently asked<br>questions   |
| IX   | ISED RSS-220                  | July 2018          | Devices Using Ultra-Wideband (UWB) Technology  |



# 4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.



# 5. PRODUCT DETAILS AND TEST CONFIGURATIONS

# 5.1. Technical Details

| Details                              | Description   |
|--------------------------------------|---|
| Purpose:                             | Test of the Catapult Sports Pty Ltd Tag T7001 to FCC CFR 47 |
|                                      | Part 15 Subpart F 15.519.& ISED RSS-220                     |
| Applicant:                           | Catapult Sports Pty Ltd                                     |
|                                      | 75-83 High St, Prahran                                      |
|                                      | Melbourne, Victoria 3181                                    |
| NA fast see                          | Australia   |
| Manufacturer:                        | As applicant  |
| Laboratory performing the tests:     | MICOM Labs, Inc.  |
|                                      | 575 Boulder Court   |
| Test report reference number         | Pleasanton California 94506 USA                             |
| Test report reference number:        |   |
| Date EUT received:                   | 25 October 2021   |
| Standard(s) applied:                 | FCC Part 15 Subpart F 15.519                                |
| Dates of test (from - to):           | 8" & 9" December 2021                                       |
| No of Units Tested:                  | 1   |
| Product Family Name:                 | Tag T7001   |
| Model(s):                            | T7001   |
| Location for use:                    | Indoors and Outdoors  |
| Declared Frequency Range(s):         | 3993.6 MHz, 4492.8 MHz, and 6489.60 MHz;                    |
| Type of Modulation:                  | BPM/BPSK  |
| EUT Modes of Operation:              | UWB   |
| Declared Nominal Output Power (dBm): | -41.3 dBm   |
| Rated Input Voltage and Current:     | DC: 4.2VDC  |
| Operating Temperature Range:         | $0^{\circ}$ C to +45 $^{\circ}$ C                           |
| Equipment Dimensions:                | 5.4 cm (L) x 3.5 cm (W) x 0.82 cm (H)                       |
| Weight:                              | 22 grams  |
| Hardware Rev:                        | 1.0.0   |
| Software Rev:                        | 1.0.0   |
| Product Application:                 | Mobile & Portable Client Device                             |



# 5.2. Scope Of Test Program

## Catapult Sports Pty Ltd Company

The scope of the test program was to test the Catapult Sports Pty Ltd Company Tag T7001 for compliance against the following specifications:

### FCC CFR 47 Part 15 Subpart F – Ultra-Wideband Operation; 15.519, 15.521

Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 3100 - 10600 MHz bands.

15.519 Technical requirements for hand-held UWB systems.

15.521 Technical requirements applicable to all UWB devices.



# 5.3. Equipment Model(s) and Serial Number(s)

| Type (EUT/<br>Support) | Equipment Description              | Manufacturer               | Model No. | Serial No. |
|------------------------|------------------------------------|----------------------------|-----------|------------|
| EUT                    | Mobile & Portable Client<br>Device | Catapult Sports Pty<br>Ltd | T7001     | 000112     |

# 5.4. Antenna Details

| Туре                           | Manufacturer               | Model | Family | Gain<br>(dBi) | BF Gain | Dir BW | X-Pol | Frequency<br>Band (MHz) |
|--------------------------------|----------------------------|-------|--------|---------------|---------|--------|-------|-------------------------|
| integral                       | Catapult<br>Sports Pty Ltd | -     | Patch  | 1.37          |         |        |       | 3750 – 4250             |
| Integral                       | Catapult<br>Sports Pty Ltd | -     | Patch  | 4.33          |         |        |       | 4250 – 4750             |
| Integral                       | Catapult<br>Sports Pty Ltd | -     | Patch  | 6.55          |         |        | -     | 6250 – 6750             |
| BF Gain - Beamforming Gain     |                            |       |        |               |         |        |       |                         |
| Dir BW - Directional BeamWidth |                            |       |        |               |         |        |       |                         |
| X-Pol - Cro                    | oss Polarization           |       |        |               |         |        |       |                         |

# 5.5. Cabling and I/O Ports

| Port Type | Max Cable<br>Length | # of Ports | Screened | Connector Type | Data Type | Data Rate(s) |
|-----------|---------------------|------------|----------|----------------|-----------|--------------|
| USB       | 5m                  | 1          | Yes      | USB            | Digital   | Unknown      |

# 5.6. Test Configurations

Results for the following configurations are provided in this report:

| Operational    | Data Rate with<br>Highest Power | Channel Frequency<br>(MHz) |        |         |  |
|----------------|---------------------------------|----------------------------|--------|---------|--|
| Mode(s)        | MBit/s                          | Low                        | Mid    | High    |  |
| 3100-10600 MHz |                                 |                            |        |         |  |
| UWB            |                                 | 3993.6                     | 4492.8 | 6489.60 |  |

# 5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance: 1. NONE



# 5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program: 1. NONE



# 6. TEST SUMMARY

| List of Measurements                     |          |           |
|--|----------|-----------|
| Test Header                              | Result   | Data Link |
| UWB Bandwidth                            | Complies | View Data |
| Peak Power                               | Complies | View Data |
| Peak Power Density                       | Complies | View Data |
| Spurious Radiated Emissions              | Complies | View Data |
| Spurious Radiated Emissions in GPS Bands | Complies | View Data |
| Shutoff Timing Requirements              | Complies | View Data |
| Comments: None                           |          |           |
|  |          |           |



Title: Catapult Sports Pty Ltd T7001 To: FCC Part 15.519 Serial #: CATA10-U6 Rev A

# 7. TEST EQUIPMENT CONFIGURATION(S)

# 7.1. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below. Radiated emissions above and below 1GHz.



Radiated Emissions Above 1GHz Test Setup

# Radiated Emissions Below 1GHz Test Setup



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A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

| Asset# | Description   | Manufacturer            | Model#  | Serial#     | Calibration<br>Due Date |
|--------|---|-------------------------|---|-------------|-------------------------|
| 170    | Video System Controller<br>for Semi Anechoic<br>Chamber | Panasonic               | WV-CU101                                      | 04R08507    | Not Required            |
| 287    | Rohde & Schwarz 40<br>GHz Receiver                      | Rhode &<br>Schwarz      | ESIB40  | 100201      | 8 Oct 2022              |
| 330    | Variac 0-280 Vac  | Staco Energy<br>Co      | 3PN1020B                                      | 0546        | Cal when<br>used        |
| 336    | Active loop Ant 10kHz to 30 MHz                         | EMCO                    | EMCO 6502                                     | 00060498    | 29 Nov 2022             |
| 338    | Sunol 30 to 3000 MHz<br>Antenna                         | Sunol                   | JB3   | A052907     | 29 Sep 2023             |
| 373    | 26III RMS Multimeter                                    | Fluke                   | Fluke 26 series<br>III                        | 76080720    | 29 Sep 2022             |
| 396    | 2.4 GHz Notch Filter                                    | Microtronics            | BRM50701                                      | 001         | 6 Oct 2022              |
| 397    | Amp 10 - 2500MHz  | MiCOM Labs              | Amp 10 - 2500<br>MHz                          | NA          | 27 Oct 2022             |
| 399    | ETS 1-18 GHz Horn<br>Antenna                            | ETS                     | 3117  | 00154575    | 30 Sep 2023             |
| 406    | Amplifier for Radiated<br>Emissions                     | MiCOM Labs              | 40dB 1 to<br>18GHz Amp                        | 0406        | 2 Nov 2022              |
| 410    | Desktop Computer  | Dell                    | Inspiron 620                                  | WS38        | Not Required            |
| 411    | Mast/Turntable<br>Controller                            | Sunol Sciences          | SC98V   | 060199-1D   | Not Required            |
| 412    | USB to GPIB Interface                                   | National<br>Instruments | GPIB-USB HS                                   | 11B8DC2     | Not Required            |
| 413    | Mast Controller   | Sunol Science           | TWR95-4                                       | 030801-3    | Not Required            |
| 414    | DC Power Supply 0-60V                                   | HP                      | 6274  | 1029A01285  | Cal when<br>used        |
| 415    | Turntable Controller                                    | Sunol Sciences          | Turntable<br>Controller                       | None        | Not Required            |
| 416    | Gigabit ethernet filter                                 | ETS-Lingren             | Gigafoil 260366                               | None        | Not Required            |
| 447    | MiTest Rad Emissions<br>Test Software                   | MiCOM                   | Rad Emissions<br>Test Software<br>Version 1.0 | 447         | Not Required            |
| 462    | Schwarzbeck cable from Antenna to Amplifier.            | Schwarzbeck             | AK 9513                                       | 462         | 27 Oct 2022             |
| 463    | Schwarzbeck cable from Amplifier to Bulkhead.           | Schwarzbeck             | AK 9513                                       | 463         | 27 Oct 2022             |
| 464    | Schwarzbeck cable from Bulkhead to Receiver             | Schwarzbeck             | AK 9513                                       | 464         | 27 Oct 2022             |
| 465    | Low Pass Filter DC-<br>1000 MHz                         | Mini-Circuits           | NLP-1200+                                     | VUU01901402 | 6 Oct 2022              |
| 480    | Cable - Bulkhead to Amp                                 | SRC Haverhill           | 157-3050360                                   | 480         | 23 Jun 2022             |
| 481    | Cable - Bulkhead to Receiver                            | SRC Haverhill           | 151-3050787                                   | 481         | 23 Jun 2022             |
| 510    | Barometer/Thermometer                                   | Digi Sense              | 68000-49                                      | 170871375   | 20 Dec 2022             |

Issue Date: 23rd December 2021

Page: /17 of 70

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personnel. All changes will be noted in the Document History section of the report.

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| 554 | Precision SMA Cable   | Fairview           | SCE18060101- | 554         | 23 Jun 2022      |
|-----|---|--------------------|--------------|-------------|------------------|
|     |   | wicrowave          | 400CM        |             |                  |
| 555 | Rhode & Schwarz<br>Receiver<br>(Firmware Version : 2.00<br>SP1) | Rhode &<br>Schwarz | ESW 44       | 101893      | 28 Jun 2023      |
| 87  | Uninterruptible Power<br>Supply                                 | Falcon Electric    | ED2000-1/2LC | F3471 02/01 | Cal when<br>used |



# 8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using stateof-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by <u>MiTest</u>. <u>MiTest</u> is an automated test system developed by MiCOM Labs. <u>MiTest</u> is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.





The MiCOM Labs "MiTest" Automated Test System" (Patent Pending)



# 9. TEST RESULTS

# 9.1. UWB Bandwidth

| Conducted Test Conditions for UWB Bandwidth     |                          |                     |             |
|---|--------------------------|---------------------|-------------|
| Standard:                                       | FCC CFR 47:15.519(b)     | Ambient Temp. (ºC): | 24.0 - 27.5 |
| Test Heading:                                   | UWB Bandwidth            | Rel. Humidity (%):  | 32 - 45     |
| Standard Section(s):                            | ANSI C63.10 Section 10.1 | Pressure (mBars):   | 999 - 1001  |
| Reference Document(s): See Normative References |                          |                     |             |

15.519 (b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

#### Test Procedure for UWB Bandwidth Measurement

The spectrum analyzer is configured with a 1 MHz RBW and RMS trace capture.

In order to clearly identify the required limits and thus measurement procedures it is essential to define the operating bandwidth of the UWB DUT, the operating bandwidth of the UWB DUT test shall be the -10 dBc bandwidth of the intended UWB signal under normal operational conditions. The Resolution Bandwidth was set to 1MHz RBW IAW ANSI C63.10.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document.



### Equipment Configuration for UWB Bandwidth

| Variant:                | UWB            | Duty Cycle (%):            | 100            |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 1.37           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |



Measurement Uncertainty: ±2.81 dB

The above values are representative of the worst-case value between polarities and based on the power measurements.



### Equipment Configuration for UWB Bandwidth

| Variant:                | UWB            | Duty Cycle (%):            | 100            |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 4.33           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |



The above values are representative of the worst-case value between polarities and based on the power measurements.



### Equipment Configuration for UWB Bandwidth

| Variant:                | UWB            | Duty Cycle (%):            | 100            |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 6.55           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |



Measurement Uncertainty: ±2.81 dB

The above values are representative of the worst-case value between polarities and based on the power measurements.



# 9.2. Transmit Power

| Conducted Test Conditions for Maximum Radiated Output Power |  |                     |             |
|---|--|---------------------|-------------|
| Standard:   | FCC CFR 47:15.519 (c)                  | Ambient Temp. (ºC): | 24.0 - 27.5 |
| Test Heading:   | Radiated Emissions UWB<br>Transmission | Rel. Humidity (%):  | 32 - 45     |
| Standard Section(s):  | ANSI C63.10 Section 10.3.5             | Pressure (mBars):   | 999 - 1001  |
| Reference Document(s):                                      | None                                   |                     |             |

Test Procedure for UWB Transmission

Testing was performed under ambient conditions at nominal voltage.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document.

15.519 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in <u>§ 15.209</u>. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

**Operating Frequency Band:** 3100-10600 MHz

#### Limits Maximum EIRP (dBm)

| Frequency    | EIRP Limit | EIRP at 1 Meters |
|--------------|------------|------------------|
| (MHz)        | (dBm)      | (dBuv/m)         |
| 3100 - 10600 | -41.3      | 63.4             |



#### **Equipment Configuration for RF Output Power**

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 1.37           |
| Modulation:             | -              | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |





#### **Equipment Configuration for RF Output Power**

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 4.33           |
| Modulation:             | -              | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |





#### **Equipment Configuration for RF Output Power**

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 6.55           |
| Modulation:             | -              | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |





# 9.3. Peak Power Density

| Test Conditions for Maximum Peak Power Density |  |                     |             |
|--|--|---------------------|-------------|
| Standard:                                      | FCC CFR 47:15.519 (e)                  | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading:                                  | Radiated Emissions UWB<br>Transmission | Rel. Humidity (%):  | 32 - 45     |
| Standard Section(s):                           | ANSI C63.10 Section 10.3.6             | Pressure (mBars):   | 999 - 1001  |
| Reference Document(s):                         | None                                   |                     |             |

#### Test Procedure for UWB Transmission

15.519 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs,  $f_{M}$ . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

Testing was performed under ambient conditions at nominal voltage.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document. Supporting KDB's referenced below.

### Operating Frequency Band:

3100-10600 MHz

#### Limits Maximum EIRP (dBm)

| Frequency    | EIRP Limit  | EIRP Limit |
|--------------|-------------|------------|
| (MHz)        | (dBm/50MHz) | (dBm/1MHz) |
| 3100 - 10600 | 0           | -34        |



### Equipment Configuration for Peak Power Density

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 1.37           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |

#### **Test Measurement Results**

| Test Frequency<br>MHz | Measured Peak<br>Power Density<br>(dBm) | EIRP + Duty Cycle<br>Correction Factor<br>(99%) | Limit (dBm) | Margin (dB) | EUT Power Setting |
|-----------------------|---|---|-------------|-------------|-------------------|
| 3993.6                | -21.88                                  | -20.51  | 0.0         | -20.51      | 18.0              |

| Init Check         PASS         MI[1]         2           0 dbm         PASS         MI[1]         2           -10 dbm         -10 dbm         -10 dbm         -10 dbm         -10 dbm           -20 dbm         -10 dbm         -10 dbm         -10 dbm         -10 dbm           -20 dbm         -10 dbm         -10 dbm         -10 dbm         -10 dbm         -10 dbm           -20 dbm         -10 dbm <td< th=""><th>nput 1 AC</th><th>PS</th><th>Off Note</th><th>h Off</th><th></th><th></th><th></th><th></th><th></th><th></th></td<>   | nput 1 AC       | PS                | Off Note | h Off   |          |       |          |                  |         |            |
|--|-----------------|-------------------|----------|---|----------|-------|----------|------------------|---------|------------|
| Limit Check         PASS         M1[1]         -2           0 dBm         3.95         3.95         3.95           10 dBm         M1         40 <t< th=""><th>Frequency Sweep</th><th>10.20</th><th>Ĩ</th><th></th><th>20</th><th>Ϋ́</th><th>17</th><th></th><th></th><th>O1Pk Clrw</th></t<>   | Frequency Sweep | 10.20             | Ĩ        |   | 20       | Ϋ́    | 17       |                  |         | O1Pk Clrw  |
| 0 dBm     3.9       10 dBm     110 dBm       20 dBm     110 dBm       30 dBm     110 dBm       30 dBm     110 dBm       10 dBm     110 dBm   | Limit Check     |                   |          | PA  | 55<br>85 |       |          |                  | M1[1]   | -21.88 dBn |
| 10 dBm     M1     M1     M1       20 dBm     M1     M1     M1       30 dBm     M1     M1     M1       40 dBm     M1     M1     M1       50 dBm     M1     M1     M1       60 dBm     M1     M1     M1  | dBm-            |                   |          |   | 0.0      |       | 2        |                  |         |            |
| 20 dBm   | 0 dBm           | _                 |          |   |          |       | 8        |                  |         |            |
| 30 dBm<br>40 dBm<br>50 dBm<br>60 dBm<br>70 dBm   | 0 d8m           |                   |          | 1923  |          | M1    |          |                  |         | -          |
| 40 dBm<br>40 dBm<br>50 dBm<br>60 dBm<br>70 dBm<br>10 10 10 10 10 10 10 10 10 10 10 10 10 1   | 0 dBm           |                   |          | $\sim$  |          | - how | may      |                  | 0       |            |
| 40 dBm   |                 |                   |          | and the second se |          |       |          | and and a second |         |            |
| 50 dBm-<br>60 dBm-<br>70 dBm-  | water there and | - setwood - water | Muser    |   |          |       |          | and the second   | mathing | musman     |
| 60 dBm 60 dBm 70 | 0 dBm           |                   |          |   |          |       |          |                  |         |            |
| 70 dBm-  | 0 d8m           |                   |          |   |          |       |          |                  |         | -          |
|  | 0 dBm-          |                   |          |   |          |       |          | : 2              |         |            |
| 00 dBm   | 0 dBm           |                   |          |   |          |       |          |                  |         | -          |
| 90 dBm   | 0 dBm           |                   |          |   |          |       |          |                  |         |            |
|  | 1 GHz           |                   |          | 1001 pts  | S        | . 17  | 0.0 MHz/ |                  |         | 4.8 (      |

Date: 7.DEC.2021 23:25:31

| Traceability to Industry Recognized Test Methodologies |                                 |  |  |  |
|--|---------------------------------|--|--|--|
| Work Instruction:                                      | WI-01 MEASURING RF OUTPUT POWER |  |  |  |
| Uncertainty:   | ±1.33 dB                        |  |  |  |



### Equipment Configuration for Peak Power Density

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 4.33           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |

#### **Test Measurement Results**

| Test Frequency<br>MHz | Measured Peak<br>Power Density<br>(dBm) | EIRP + Duty Cycle<br>Correction Factor<br>(99%) | Limit (dBm) | Margin (dB) | EUT Power Setting |
|-----------------------|---|---|-------------|-------------|-------------------|
| 4492.8                | -23.54                                  | -19.21  | 0.0         | -19.21      | 18.0              |

|             |              |                              |                                     |   |     |       | 01Pk Clrw  |
|-------------|--------------|------------------------------|-------------------------------------|---|-----|-------|------------|
| Limit Check |              | PAS                          | S                                   |   |     | M1[1] | -23.54 dBr |
| J-dBm       |              | PAS                          | 8                                   |   |     |       | 4.49350 GH |
| -10 dBm     | 1 J.4        |                              | 4                                   |   |     |       |            |
| 20 dBm      |              |                              |                                     |   | -   |       |            |
| -30 dBm     |              | _                            |                                     |   | Jar | my    | ~          |
|             |              |                              |                                     |   |     |       | No.        |
| 40 dBm      |              |                              |                                     |   |     | ;;    | N.Y.       |
| 40 dBm-<br> | mmontantanta | -de-lynnersonmerige          | monument                            | marching                                    |     |       | N. M.      |
| 40 dBm      |              | - Jan Jan Marco Marcan       | mannana                             | menter                                      |     |       |            |
| 40 dBm      |              | <u>_h_h</u> man              | nanan manana antan ana antan ang sa | manhahar                                    |     |       |            |
| 40 dBm      |              | - Jan Jan Haraman Marana<br> | norman and a strange                | manuhar har har har har har har har har har |     |       |            |

Date: 7.DEC.2021 21:19:11

| Traceability to Industry Recognized Test Methodologies |                                 |  |  |  |
|--|---------------------------------|--|--|--|
| Work Instruction:                                      | WI-01 MEASURING RF OUTPUT POWER |  |  |  |
| Uncertainty:   | ±1.33 dB                        |  |  |  |

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### Equipment Configuration for Peak Power Density

| Variant:                | UWB            | Duty Cycle (%):            | 99             |
|-------------------------|----------------|----------------------------|----------------|
| Data Rate:              | -              | Antenna Gain (dBi):        | 6.55           |
| Modulation:             |                | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC:                    | Not Applicable | Tested By:                 | SB             |
| Engineering Test Notes: |                |                            |                |

#### **Test Measurement Results**

| Test Frequency<br>MHz | Measured Peak<br>Power Density<br>(dBm) | EIRP + Duty Cycle<br>Correction Factor<br>(99%) | Limit (dBm) | Margin (dB) | EUT Power Setting |
|-----------------------|---|---|-------------|-------------|-------------------|
| 6489.60               | -20.57                                  | -14.02  | 0.0         | -12.27      | 22.0              |

| Input         Area         PA         Off         Notion         Off           I Frequency Sweep         PASS         M1[1]         -2         6.4           -10 dBm         PASS         M1         6.4           -20 dBm         M1         -         -         -           -30 dBm         -         -         -         -         -           -30 dBm         -         -         -         -         -         -           -50 dBm         -         -         -         -         -         -         -  | Att 22 dB • SWT | 5 s VBW 50 MH | z Mode Auto Swee         | p            |          | Frequence  | cy 7.00000 | 00 GH:   |
|--|-----------------|---------------|--------------------------|--------------|----------|------------|------------|----------|
| Limit Check         PASS         M1[1]         -2           0 dem         PASS         6.4           10 dBm         6.4           -20 dBm         6.4           -30 dBm         -40 dBm           -50 dBm         -50 dBm  | Frequency Sween | Uff Notch U   | П                        |              |          |            | A          | Pk Clrw  |
| 0. dem     PASE     6.4       10. dem     M1   | Limit Check     |               | PASS                     | 1            |          |            | M1[1] -2   | 0.57 dBm |
| 10 dBm M1<br>20 dBm M1<br>30 dBm M1<br>40 dBm M1<br>50 dBm M1 | d9m             |               | PASS                     |              |          |            | 6.48       | 8650 GHz |
| 20 dBm   | 10 dBm          |               |                          |              |          |            |            |          |
| 20 dBm<br>30 dBm<br>40 dBg<br>50 dBm<br>60 dBm<br>60 dBm   | 10              | MI            |                          |              |          |            |            |          |
| 30 dBm   | 20 dBm          | min           |                          | 2            |          |            |            |          |
| 40 dBm   | 30 dBm          |               | $\overline{\mathcal{A}}$ |              |          |            |            |          |
| 50 dBm   | 40 demtan       |               | N.                       |              |          |            |            |          |
| 50 dBm 60 dBm 61 d 61  | and the second  |               | mark                     | mananementer | mashina  | Antermonor | manne      | mann     |
| 60 dBm   | 50 dBm-         |               |                          | ->           | 5        |            |            |          |
|  | 60 dBm          |               |                          |              | 2        |            |            |          |
|  |                 |               |                          |              |          |            |            |          |
|  | 70 d8m-         |               |                          |              |          |            |            |          |
| 80 dBm   | 80 dBm          |               |                          |              |          |            |            |          |
| 90 dBm   | 90 dBm-         |               |                          |              |          |            |            |          |
|  | 0 GHz           | 10            | 001 pts                  | 20           | 0.0 MHz/ | а — "Д     |            | 8.0 G    |

Date: 8.DEC.2021 17:54:34

| Traceability to Industry Recognized Test Methodologies |                                 |  |  |  |
|--|---------------------------------|--|--|--|
| Work Instruction:                                      | WI-01 MEASURING RF OUTPUT POWER |  |  |  |
| Uncertainty:   | ±1.33 dB                        |  |  |  |



# 9.4. Transmitter Spurious Band Emissions

| Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions  |  |                     |                              |  |  |  |  |
|---|--|---------------------|------------------------------|--|--|--|--|
| Standard:   | FCC CFR 47 15.519                            | Ambient Temp. (ºC): | 20.0 - 24.5                  |  |  |  |  |
| Test Heading:   | Radiated Spurious and Band-Edge<br>Emissions | Rel. Humidity (%):  | 32 - 45                      |  |  |  |  |
| Standard Section(s):  | ANSI C63.10 Section 10.2 + 10.3              | Pressure (mBars):   | 999 - 1001                   |  |  |  |  |
| Reference Document(s):         See Normative References   |  |                     |                              |  |  |  |  |
| Test Procedure for Radiated Spurious and Band-Edge Emissions         Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in max hold mode. Depending on the frequency band spanned a notch filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.         Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.         Limits for Restricted Bands (15.205, 15.209)         Peak emission: 68.23 dBuV/m         Average emission: 54 dBuV/m |  |                     |                              |  |  |  |  |
| <b>Field Strength Calculation</b><br>The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.<br>FS = R + AF + CORR - FO  |  |                     |                              |  |  |  |  |
| where:<br>FS = Field Strength<br>R = Measured Spectrum analyzer Input Amplitude<br>AF = Antenna Factor<br>CORR = Correction Factor = CL - AG + NFL<br>CL = Cable Loss<br>AG = Amplifier Gain<br>FO = Distance Falloff Factor<br>NFL = Notch Filter Loss   |  |                     |                              |  |  |  |  |
| <ul> <li>FCC 15.519(c) Measurements made at 1 meter to meet noise floor to limit requirements.</li> <li>Radiated Spurious Emissions in the GPS Bands 15.519 (c), 15.521 (d)</li> <li>15.519 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:</li> </ul>   |  |                     |                              |  |  |  |  |
| Frequ   | ency Range                                   | Average             | Limit                        |  |  |  |  |
| MHz   | MHz  | EIRP<br>(dBm)       | EIRP at 1 Meters<br>(dBuV/m) |  |  |  |  |
| 960   | 1610   | -75.3               | 29.4                         |  |  |  |  |
| 1610  | 1990   | -63.3               | 41.4                         |  |  |  |  |
| 1990  | 3100   | -61.3               | 43.4                         |  |  |  |  |
| 3100  | 10600  | -41.3               | 63.4                         |  |  |  |  |
| 10600   | 18000  | -61.3               | 43.4                         |  |  |  |  |



#### Radiated Spurious Emissions in the GPS Bands FCC 15.519 (d)

15.519 (d) In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

| Frequency F | Range | Average Limit |                              |  |  |
|-------------|-------|---------------|------------------------------|--|--|
| MHz         | MHz   | EIRP<br>(dBm) | EIRP at 1 Meters<br>(dBuV/m) |  |  |
| 1164        | 1240  | -85.3         | 19.47                        |  |  |
| 1559        | 1610  | -85.3         | 19.47                        |  |  |

#### 50 MHz Peak Emissions FCC 15.519 (e)

15.519 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs,  $f_M$ . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521

Within 50 MHz bandwidth centered on highest radiated emissions  $f_{M_s}$  Limit is 0.0 dBm EIRP. At 1-meter distance the equivalent level is 104.77 dBuV/m



# 9.4.1. Transmitter Spurious Emissions

## 9.4.1.1. 3993.6 MHz

| Equipment Configuration for Radiated Digital Emissions |                  |                 |                |  |  |  |  |  |  |
|--|------------------|-----------------|----------------|--|--|--|--|--|--|
|  |                  |                 |                |  |  |  |  |  |  |
| Antenna: Integral Variant: UWB                         |                  |                 |                |  |  |  |  |  |  |
| Antenna Gain (dBi):                                    | 1.37             | Modulation:     | -              |  |  |  |  |  |  |
| Beam Forming Gain (Y):                                 | Not Applicable   | Duty Cycle (%): | 99             |  |  |  |  |  |  |
| Channel Frequency (MHz):                               | 3993.6 to 6489.6 | Data Rate:      | Not Applicable |  |  |  |  |  |  |
| Power Setting:   | 18               | Tested By:      | SB             |  |  |  |  |  |  |

#### **Test Measurement Results**



#### 20.00 1000 00 MH-

|     | 30.00 - 1000.00 Mili2 |             |                     |            |                 |                     |            |           |            |                 |              |               |
|-----|-----------------------|-------------|---------------------|------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num | Frequency<br>MHz      | Raw<br>dBµV | Cable<br>Loss<br>dB | AF<br>dB/m | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1   | 60.15                 | 56.23       | 3.82                | -23.59     | 36.46           | MaxQP               | Vertical   | 100       | 160        | 40.0            | -3.5         | Pass          |
| 2   | 60.15                 | 34.64       | 3.82                | -23.59     | 14.87           | MaxQP               | Horizontal | 98        | 253        | 40.0            | -25.1        | Pass          |
| 3   | 107.99                | 40.74       | 4.13                | -19.21     | 25.66           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 4   | 202.22                | 46.17       | 4.61                | -19.67     | 31.11           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 5   | 350.77                | 34.45       | 5.19                | -16.76     | 22.88           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 6   | 371.89                | 32.62       | 5.26                | -16.01     | 21.87           | Peak (NRB)          | Vertical   | 100       | 0          | /               |              | Pass          |

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

#### **Test Measurement Results**



|         | 960.00– 1000.00 MHz  |       |         |            |     |   |      |       |               |  |
|---------|--|-------|---------|------------|-----|---|------|-------|---------------|--|
| Num     | Num         Frequency<br>MHz         Level<br>dBµV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit<br>dBµV/m         Margin<br>dB         Pass<br>/Fail |       |         |            |     |   |      |       | Pass<br>/Fail |  |
| 1       | 994.62   | 28.01 | Average | Horizontal | 150 | 0 | 29.4 | -1.39 | Pass          |  |
| 2       | 2 994.78 28.02 Average Vertical 150 0 29.4 -1.38 Pass  |       |         |            |     |   |      |       |               |  |
| Test No | tes: None  |       |         |            |     |   |      |       |               |  |

 Issue Date:
 23rd December 2021
 Page:
 35 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

RADIATED SPURIOUS EMISSIONS 1.0-1.61GHz

#### **Test Measurement Results**



Date: 7.DEC.2021 10:38:22

|  | 1000.00– 1610.00 MHz |       |         |            |     |   |      |       |               |  |  |
|--|----------------------|-------|---------|------------|-----|---|------|-------|---------------|--|--|
| Num         Frequency<br>MHz         Level<br>dBµV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit<br>dBµV/m         Margin<br>dB         Pass<br>/Fail |                      |       |         |            |     |   |      |       | Pass<br>/Fail |  |  |
| 1  | 1952.30              | 27.95 | Average | Horizontal | 150 | 0 | 29.4 | -1.45 | Pass          |  |  |
| 2  | 1978.09              | 27.83 | Average | Vertical   | 150 | 0 | 29.4 | -1.57 | Pass          |  |  |
| Test No  | tes: None            |       | •       |            |     |   |      | /     |               |  |  |

Issue Date:23rd December 2021Page:36 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

#### **Test Measurement Results**



|   | 1610.00 – 1990.00 MHz |       |         |            |     |   |       |        |               |
|---|-----------------------|-------|---------|------------|-----|---|-------|--------|---------------|
| Num         Frequency<br>MHz         Level<br>dBµV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt         Limit         Margin<br>dBµV/m |                       |       |         |            |     |   |       |        | Pass<br>/Fail |
| 1   | 1949.63               | 27.93 | Average | Horizontal | 150 | 0 | 41.40 | -13.47 | Pass          |
| 2   | 1952.68               | 27.99 | Average | Vertical   | 150 | 0 | 41.40 | -13.41 | Pass          |
| Test No   | tes: None             |       |         |            |     |   |       |        |               |

 Issue Date:
 23rd December 2021
 Page:
 37 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

#### **Test Measurement Results**



#### RADIATED SPURIOUS EMISSIONS 1.99-3.1GHz



|         | 1990.00 – 3100.00 MHz  |       |         |            |     |   |       |        |      |  |
|---------|--|-------|---------|------------|-----|---|-------|--------|------|--|
| Num     | Num         Frequency         Level         Measurement         Pol         Hgt         Azt         Limit         Margin         Pass           MHz         dBμV/m         Type         Pol         cm         Deg         dBμV/m         dB         /Fail |       |         |            |     |   |       |        |      |  |
| 1       | 2637.31  | 29.01 | Average | Horizontal | 150 | 0 | 43.40 | -14.39 | Pass |  |
| 2       | 2 3073.30 29.06 Average Vertical 150 0 43.40 -14.34 Pass   |       |         |            |     |   |       |        |      |  |
| Test No | tes: None  |       |         |            |     |   |       |        |      |  |

Issue Date:23rd December 2021Page:38 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, <a href="https://www.micomlabs.com">www.micomlabs.com</a>



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

RADIATED SPURIOUS EMISSIONS 3.1-10.6GHz

#### **Test Measurement Results**



Date: 7.DEC.2021 10:33:00

|         | 3100.00 – 10600.00 MHz  |       |         |            |     |   |      |       |      |  |  |  |
|---------|---|-------|---------|------------|-----|---|------|-------|------|--|--|--|
| Num     | Num         Frequency<br>MHz         Level<br>dBμV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit         Margin         Pass |       |         |            |     |   |      |       |      |  |  |  |
| 1       | 3971.74   | 61.74 | Average | Horizontal | 150 | 0 | 63.4 | -1.66 | Pass |  |  |  |
| 2       | 3941.68   | 61.16 | Average | Vertical   | 150 | 0 | 63.4 | -2.25 | Pass |  |  |  |
| Test No | Fest Notes: None  |       |         |            |     |   |      |       |      |  |  |  |

Issue Date:23rd December 2021Page:39 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

### **Test Measurement Results**



#### RADIATED SPURIOUS EMISSIONS 10.6-18GHz



|  | 10600.00 – 18000.00 MHz |       |         |            |     |   |               |       |      |  |  |
|--|-------------------------|-------|---------|------------|-----|---|---------------|-------|------|--|--|
| Num         Frequency         Level         Measurement         Pol         Hgt         Azt         Limit         Margin         P           MHz         dBµV/m         Type         Pol         cm         Deg         dBµV/m         dB         // |                         |       |         |            |     |   | Pass<br>/Fail |       |      |  |  |
| 1  | 17896.19                | 40.48 | Average | Vertical   | 150 | 0 | 43.4          | -2.92 | Pass |  |  |
| 2  | 17896.19                | 40.41 | Average | Horizontal | 150 | 0 | 43.4          | -2.99 | Pass |  |  |
| Test No  | Test Notes: None        |       |         |            |     |   |               |       |      |  |  |

 Issue Date:
 23rd December 2021
 Page:
 40 of 70

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#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 21.543 GHz : 47.303 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

Page: 41 of 70



#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18.0           | Tested By:      | SB  |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 39.811 GHz : 53.379 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

42 of 70



## 9.4.1.2. 4492.6 MHz

|                          |                  | =               |                |
|--------------------------|------------------|-----------------|----------------|
|                          |                  |                 |                |
| Antenna:                 | Integral         | Variant:        | UWB            |
| Antenna Gain (dBi):      | 4.33             | Modulation:     | -              |
| Beam Forming Gain (Y):   | Not Applicable   | Duty Cycle (%): | 99             |
| Channel Frequency (MHz): | 3993.6 to 6489.6 | Data Rate:      | Not Applicable |
| Power Setting:           | 18               | Tested By:      | SB             |

Equipment Configuration for Radiated Digital Emissions



|     | 30.00 - 1000.00 MHz |             |                     |            |                 |                     |            |           |            |                 |              |               |  |
|-----|---------------------|-------------|---------------------|------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|--|
| Num | Frequency<br>MHz    | Raw<br>dBµV | Cable<br>Loss<br>dB | AF<br>dB/m | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |  |
| 1   | 60.15               | 56.23       | 3.82                | -23.59     | 36.46           | MaxQP               | Vertical   | 100       | 160        | 40.0            | -3.5         | Pass          |  |
| 2   | 60.15               | 34.64       | 3.82                | -23.59     | 14.87           | MaxQP               | Horizontal | 98        | 253        | 40.0            | -25.1        | Pass          |  |
| 3   | 107.99              | 40.74       | 4.13                | -19.21     | 25.66           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |  |
| 4   | 202.22              | 46.17       | 4.61                | -19.67     | 31.11           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |  |
| 5   | 350.77              | 34.45       | 5.19                | -16.76     | 22.88           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |  |
| 6   | 371.89              | 32.62       | 5.26                | -16.01     | 21.87           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |  |



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



|         | 960.00– 1000.00 MHz   |       |         |            |     |   |      |       |      |  |  |  |
|---------|---|-------|---------|------------|-----|---|------|-------|------|--|--|--|
| Num     | Num Frequency Level Measurement Pol Hgt Azt Limit Margin Pass<br>MHz dBμV/m Type Pol cm Deg dBμV/m dB /Fail |       |         |            |     |   |      |       |      |  |  |  |
| 1       | 989.41  | 28.10 | Average | Horizontal | 150 | 0 | 29.4 | -1.30 | Pass |  |  |  |
| 2       | 995.99  | 28.00 | Average | Vertical   | 150 | 0 | 29.4 | -1.40 | Pass |  |  |  |
| Test No | iest Notes: None  |       |         |            |     |   |      |       |      |  |  |  |

 Issue Date:
 23rd December 2021
 Page:
 44 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| 1000.00– 1610.00 MHz                                   |                  |                 |                     |            |           |            |                 |              |               |
|--|------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num  | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1  | 1312.94          | 26.44           | Average             | Horizontal | 150       | 0          | 29.4            | -2.96        | Pass          |
| 2 1064.78 26.30 Average Vertical 150 0 29.4 -3.10 Pass |                  |                 |                     |            |           |            |                 |              |               |
| Test No  | Test Notes: None |                 |                     |            |           |            |                 |              |               |

 Issue Date:
 23rd December 2021
 Page:
 45 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



Date: 7.DEC.2021 14:36:05

| 1610.00 – 1990.00 MHz |  |                 |                     |            |           |            |                 |              |               |
|-----------------------|--|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num                   | Frequency<br>MHz   | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1                     | 1951.92  | 27.91           | Average             | Horizontal | 150       | 0          | 41.40           | -13.49       | Pass          |
| 2                     | 2 1952.68 27.78 Average Vertical 150 0 41.40 -13.62 Pass |                 |                     |            |           |            |                 |              |               |
| Test No               | Test Notes: None   |                 |                     |            |           |            |                 |              |               |

Issue Date:23rd December 2021Page:46 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, <a href="https://www.micomlabs.com">www.micomlabs.com</a>



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| 1990.00 – 3100.00 MHz |                  |                 |                     |            |           |            |                 |              |               |
|-----------------------|------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num                   | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1                     | 3088.87          | 29.13           | Average             | Horizontal | 150       | 0          | 43.40           | -14.27       | Pass          |
| 2                     | 2646.21          | 28.86           | Average             | Vertical   | 150       | 0          | 43.40           | -14.54       | Pass          |
| Test No               | Test Notes: None |                 |                     |            |           |            |                 |              |               |

 Issue Date:
 23rd December 2021
 Page:
 47 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| 3100.00 – 10600.00 MHz |   |       |         |            |     |   |      |       |      |
|------------------------|---|-------|---------|------------|-----|---|------|-------|------|
| Num                    | Num         Frequency<br>MHz         Level<br>dBμV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit         Margin<br>dBμV/m         Pass<br>dB |       |         |            |     |   |      |       |      |
| 1                      | 4618.03   | 61.84 | Average | Horizontal | 150 | 0 | 63.4 | -1.56 | Pass |
| 2                      | 2 4332.46 58.27 Average Vertical 150 0 63.4 -5.13 Pass  |       |         |            |     |   |      |       |      |
| Test Notes: None       |   |       |         |            |     |   |      |       |      |

 Issue Date:
 23rd December 2021
 Page:
 48 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| 10600.00 – 18000.00 MHz |   |                 |                     |          |           |            |                 |              |               |
|-------------------------|---|-----------------|---------------------|----------|-----------|------------|-----------------|--------------|---------------|
| Num                     | Frequency<br>MHz  | Level<br>dBµV/m | Measurement<br>Type | Pol      | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1                       | 17896.19  | 40.34           | Average             | Vertical | 150       | 0          | 43.4            | -3.06        | Pass          |
| 2                       | 2 17896.19 40.34 Average Horizontal 150 0 43.4 -3.06 Pass |                 |                     |          |           |            |                 |              |               |
| Test Notes: None        |   |                 |                     |          |           |            |                 |              |               |

 Issue Date:
 23rd December 2021
 Page:
 49 of 70

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#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 21.662 GHz : 47.675 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.



#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 39.865 GHz : 52.480 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

51 of 70



### 9.4.1.3. 6489.6 MHz

| Antenna:                 | Integral         | Variant:        | UWB            |
|--------------------------|------------------|-----------------|----------------|
| Antenna Gain (dBi):      | 6.55             | Modulation:     | -              |
| Beam Forming Gain (Y):   | Not Applicable   | Duty Cycle (%): | 99             |
| Channel Frequency (MHz): | 3993.6 to 6489.6 | Data Rate:      | Not Applicable |
| Power Setting:           | 22               | Tested By:      | SB             |

Equipment Configuration for Radiated Digital Emissions



|     | 30.00 - 1000.00 MHz |             |                     |            |                 |                     |            |           |            |                 |              |               |
|-----|---------------------|-------------|---------------------|------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num | Frequency<br>MHz    | Raw<br>dBµV | Cable<br>Loss<br>dB | AF<br>dB/m | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1   | 60.15               | 56.23       | 3.82                | -23.59     | 36.46           | MaxQP               | Vertical   | 100       | 160        | 40.0            | -3.5         | Pass          |
| 2   | 60.15               | 34.64       | 3.82                | -23.59     | 14.87           | MaxQP               | Horizontal | 98        | 253        | 40.0            | -25.1        | Pass          |
| 3   | 107.99              | 40.74       | 4.13                | -19.21     | 25.66           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 4   | 202.22              | 46.17       | 4.61                | -19.67     | 31.11           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 5   | 350.77              | 34.45       | 5.19                | -16.76     | 22.88           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |
| 6   | 371.89              | 32.62       | 5.26                | -16.01     | 21.87           | Peak (NRB)          | Vertical   | 100       | 0          |                 |              | Pass          |



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



| 960.00– 1000.00 MHz |  |       |         |            |     |   |      |       |      |
|---------------------|--|-------|---------|------------|-----|---|------|-------|------|
| Num                 | Num         Frequency<br>MHz         Level<br>dBμV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit<br>dBμV/m         Margin<br>dB         Pass<br>/Fail |       |         |            |     |   |      |       |      |
| 1                   | 994.06   | 27.66 | Average | Horizontal | 150 | 0 | 29.4 | -1.74 | Pass |
| 2                   | 995.11   | 28.03 | Average | Vertical   | 150 | 0 | 29.4 | -1.37 | Pass |
| Test No             | tes: None  |       | •       |            |     |   |      |       |      |

 Issue Date:
 23rd December 2021
 Page:
 53 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



| 1000.00– 1610.00 MHz                                   |  |       |         |            |     |   |      |       |      |
|--|--|-------|---------|------------|-----|---|------|-------|------|
| Num  | Num         Frequency<br>MHz         Level<br>dBµV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit<br>dBµV/m         Margin<br>dB         Pass<br>/Fail |       |         |            |     |   |      |       |      |
| 1  | 1312.94  | 25.56 | Average | Horizontal | 150 | 0 | 29.4 | -3.84 | Pass |
| 2 1312.94 26.16 Average Vertical 150 0 29.4 -3.24 Pass |  |       |         |            |     |   |      |       |      |
| Test No  | tes: None  |       | •       |            |     |   |      |       |      |

 Issue Date:
 23rd December 2021
 Page:
 54 of 70

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| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



Date: 9.DEC.2021 09:45:54

|         | 1610.00 – 1990.00 MHz |                 |                     |            |           |            |                 |              |               |  |  |
|---------|-----------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|--|--|
| Num     | Frequency<br>MHz      | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |  |  |
| 1       | 1980.01               | 27.88           | Average             | Horizontal | 150       | 0          | 41.40           | -13.52       | Pass          |  |  |
| 2       | 1978.57               | 28.05           | Average             | Vertical   | 150       | 0          | 41.40           | -13.35       | Pass          |  |  |
| Test No | tes: None             |                 |                     |            |           |            |                 | /            |               |  |  |

Issue Date:23rd December 2021Page:55 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



| 1990.00 – 3100.00 MHz  |           |       |         |            |     |   |       |        |      |
|--|-----------|-------|---------|------------|-----|---|-------|--------|------|
| Num         Frequency<br>MHz         Level<br>dBµV/m         Measurement<br>Type         Pol         Hgt<br>cm         Azt<br>Deg         Limit<br>dBµV/m         Margin<br>dB         Pass<br>/Fail |           |       |         |            |     |   |       |        |      |
| 1  | 2641.76   | 29.98 | Average | Horizontal | 150 | 0 | 43.40 | -13.42 | Pass |
| 2  | 2643.98   | 29.09 | Average | Vertical   | 150 | 0 | 43.40 | -14.31 | Pass |
| Test No  | tes: None |       | •       |            |     |   |       |        |      |

Issue Date:23rd December 2021Page:56 of 70This test report may be reproduced in full only.The document may only be updated by MiCOM Labs<br/>personnel. All changes will be noted in the Document History section of the report.MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |



| 3100.00 – 10600.00 MHz |                  |                 |                     |            |           |            |                 |              |               |
|------------------------|------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num                    | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1                      | 6602.20          | 62.07           | Average             | Horizontal | 150       | 0          | 63.4            | -1.33        | Pass          |
| 2                      | 6632.06          | 59.84           | Average             | Vertical   | 150       | 0          | 63.4            | -3.56        | Pass          |
| Test No                | Test Notes: None |                 |                     |            |           |            |                 |              |               |



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



| 10600.00 – 18000.00 MHz |                  |                 |                     |            |           |            |                 |              |               |
|-------------------------|------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num                     | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1                       | 17896.19         | 40.34           | Average             | Horizontal | 150       | 0          | 43.4            | -3.06        | Pass          |
| 2                       | 17896.19         | 40.34           | Average             | Vertical   | 150       | 0          | 43.4            | -3.06        | Pass          |
| Test No                 | Test Notes: None |                 |                     |            |           |            |                 |              |               |

 Issue Date:
 23rd December 2021
 Page:
 58 of 70

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#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 21.765 GHz : 47.097 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.



#### Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |
|                          |                |                 |     |

#### **Test Measurement Results**



| Analyzer Setup      | Marker:Frequency:Amplitude    | Test Results |
|---------------------|-------------------------------|--------------|
| Detector = MAX PEAK | M1 : 39.946 GHz : 52.630 dBµV | Pass         |
| Sweep Count = 0     |                               |              |
| RF Atten (dB) = 10  |                               |              |
| Trace Mode = VIEW   |                               |              |

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.



# 9.4.2. GPS Band Emissions

### 9.4.2.4. 3993.6 MHz operation

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

**Equipment Configuration for Spurious Emissions** 



|         | 1164.00-1240.00 MHz |                 |                     |            |           |            |                 |              |               |
|---------|---------------------|-----------------|---------------------|------------|-----------|------------|-----------------|--------------|---------------|
| Num     | Frequency<br>MHz    | Level<br>dBµV/m | Measurement<br>Type | Pol        | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| 1       | 1206.64             | 7.84            | Average             | Horizontal | 150       | 0          | 19.47           | -11.63       | Pass          |
| 2       | 1206.64             | 7.91            | Average             | Vertical   | 150       | 0          | 19.47           | -11.56       | Pass          |
| Test No | Test Notes: None    |                 |                     |            |           |            |                 |              |               |



| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 1.37           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 3993.6         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |



| 1164.00-1240.00 MHz                   |                  |                 |                     |     |           |            |                 |              |               |
|---------------------------------------|------------------|-----------------|---------------------|-----|-----------|------------|-----------------|--------------|---------------|
| Num                                   | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| No Signals Found within 6 dB of Limit |                  |                 |                     |     |           |            |                 |              |               |
| Test Notes: None                      |                  |                 |                     |     |           |            |                 |              |               |
|                                       |                  |                 |                     |     |           |            |                 |              |               |



### 9.4.2.5. 4492.8 MHz operation

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.8         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |

**Equipment Configuration for Spurious Emissions** 





| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 4.33           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 4492.8         | Data Rate:      |     |
| Power Setting:           | 18             | Tested By:      | SB  |



| 1164.00-1240.00 MHz                   |     |        |      |     |    |     |        |    |       |
|---------------------------------------|-----|--------|------|-----|----|-----|--------|----|-------|
| Num                                   | MHz | dBµV/m | Туре | Pol | cm | Deg | dBµV/m | dB | /Fail |
| No Signals Found within 6 dB of Limit |     |        |      |     |    |     |        |    |       |
| Test Notes: None                      |     |        |      |     |    |     |        |    |       |
|                                       |     |        |      |     |    |     |        |    |       |



### 9.4.2.6. 6489.6 MHz operation

| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |

**Equipment Configuration for Spurious Emissions** 





| Antenna:                 | Integral       | Variant:        | UWB |
|--------------------------|----------------|-----------------|-----|
| Antenna Gain (dBi):      | 6.55           | Modulation:     |     |
| Beam Forming Gain (Y):   | Not Applicable | Duty Cycle (%): | 99% |
| Channel Frequency (MHz): | 6489.60        | Data Rate:      |     |
| Power Setting:           | 22             | Tested By:      | SB  |



| 1164.00-1240.00 MHz                   |                  |                 |                     |     |           |            |                 |              |               |
|---------------------------------------|------------------|-----------------|---------------------|-----|-----------|------------|-----------------|--------------|---------------|
| Num                                   | Frequency<br>MHz | Level<br>dBµV/m | Measurement<br>Type | Pol | Hgt<br>cm | Azt<br>Deg | Limit<br>dBµV/m | Margin<br>dB | Pass<br>/Fail |
| No Signals Found within 6 dB of Limit |                  |                 |                     |     |           |            |                 |              |               |
| Test Notes: None                      |                  |                 |                     |     |           |            |                 |              |               |
|                                       |                  |                 |                     |     |           |            |                 |              |               |



# 9.5. Shutoff Timing Requirements

| Radiated Test Conditions for Shutoff Timing Requirements |                             |                                 |             |  |  |  |
|--|-----------------------------|---------------------------------|-------------|--|--|--|
| Standard:  | FCC CFR 47:15.519 (a)(1)    | Ambient Temp. (°C):             | 24.0 - 27.5 |  |  |  |
| Test Heading:  | Shutoff Timing Requirements | Requirements Rel. Humidity (%): |             |  |  |  |
| Standard Section(s):                                     | ANSI C63.10 Section 10.3.6  | Pressure (mBars):               | 999 - 1001  |  |  |  |
| Reference Document(s):                                   | None                        |                                 |             |  |  |  |

Test Procedure for UWB Transmission

15.519 (a) (1) A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

Testing was performed under ambient conditions at nominal voltage.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document.

**Operating Frequency Band:** 3100-10600 MHz

Limits

The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received.



### Equipment Configuration for Shutdown Timing Requirements

| Antenna:               | Integral       | Variant:        | UWB  |
|------------------------|----------------|-----------------|------|
| Antenna Gain (dBi):    | 6.55           | Modulation:     |      |
| Modulation:            | Not Applicable | Duty Cycle (%): | <10% |
| TPC:                   | 6490.60        | Data Rate:      |      |
| Engineering Test Notes |                |                 |      |

| Frequency<br>(MHz) | Marker 2 – Marker 1<br>=<br>Shutdown Time | Limit<br>(Delta Marker 1) | Margin | EUT Power<br>Setting |
|--------------------|---|---------------------------|--------|----------------------|
| ζ, γ               | (s)                                       | (s)                       | (s)    | Numeric              |
| 6489.60            | 0.06                                      | 10                        | -9.94  | 22                   |

| Traceability to Industry Recognized Test Methodologies |                                 |  |  |  |
|--|---------------------------------|--|--|--|
| Work Instruction:                                      | WI-01 MEASURING RF OUTPUT POWER |  |  |  |
| Uncertainty:   | ±1.33 dB                        |  |  |  |



# Title:Catapult Sports Pty Ltd T7001To:FCC Part 15.519Serial #:CATA10-U6 Rev A



#### Operational Markers M1, M2, DM1

The graphical representation above contains 3 markers, marker M1 indicates the start of a 10 second window at the point when the associated receiver is removed from the network. Marker M2 marks when the transmitter ceases transmissions, and delta marker M1 indicates the end of the 10 second window.





575 Boulder Court Pleasanton, California 94566, USA Tel: +1 (925) 462 0304 Fax: +1 (925) 462 0306 www.micomlabs.com