Choose Scandinavian trust

# RADIO TEST REPORT

Report ID:
REP108507-1

Project number:
PRJ0097142

Type of assessment:
Final product testing

Applicant:
SAMSARA Inc.

Description of product:
Worker Safety Wearable

Model/HVIN:
080-00001

Product marketing name (PMN):
HW-CW21

ISED certification number:
IC: 21492-2521

FCC ID:
2AIHD-2521

Specifications:

- FCC 47 CFR Part 15, Subpart F, §15.519
- RSS-220, Clause 5.3, Issue 1, Amendment 1, July 2018

Date of issue: February 26, 2026

Alvin Liu, EMC/RF Specialist
Tested by

Signature

David Duchesne, EMC/RF Lab Manager
Reviewed by

Signature

Nemko Canada Inc., a testing laboratory, is accredited by ANSI National Accreditation Board (ANAB).
The tests included in this report are within the scope of this accreditation.
The ANAB symbol is an official symbol of the ANSI National Accreditation Board, used under licence.

ANAB File Number: AT-3195 (Ottawa); AT-3193 (Pointe-Claire); AT-3194 (Cambridge)

## Lab locations

| | |
|---|---|
| Company name | Nemko Canada Inc. |
| Facilities | **Ottawa site:**<br>303 River Road, Ottawa, ON, Canada, K1V 1H2<br>Tel: +1 613 737 9680<br>Test site registration number: CA2040<br><br>**Montréal site:**<br>292 Labrosse Avenue, Pointe-Claire, QC, Canada, H9R 5L8<br>Tel: +1 514 694 2684<br>Test site registration number: CA2041<br><br>**Cambridge site:**<br>1-130 Saltsman Drive, Cambridge, ON, Canada, N3E 0B2<br>Tel: +1 519 650 4811<br>Test site registration number: CA0101 |
| Website | www.nemko.com |

## Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

## Copyright notification

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.
Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.
Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
© Nemko Canada Inc.

# Table of contents


**Table of contents** ..... **3**

**Section 1. Report summary** ..... **4**

1.1 Test specifications ..... 4

1.2 Test methods ..... 4

1.3 Exclusions ..... 4

1.4 Statement of compliance ..... 4

1.5 Test report revision history ..... 4

**Section 2. Engineering considerations** ..... **5**

2.1 Modifications incorporated in the EUT for compliance ..... 5

2.2 Technical judgment ..... 5

2.3 Model variant declaration ..... 5

2.4 Deviations from laboratory tests procedures ..... 5

**Section 3. Test conditions** ..... **6**

3.1 Atmospheric conditions ..... 6

3.2 Power supply range ..... 6

**Section 4. Information provided by the applicant** ..... **7**

4.1 Disclaimer ..... 7

4.2 Applicant/Manufacturer ..... 7

4.3 EUT information ..... 7

4.4 Technical information ..... 7

4.5 EUT setup details ..... 8

**Section 5. Summary of test results** ..... **9**

5.1 Testing period ..... 9

5.2 Sample information ..... 9

5.3 FCC Part 15 Subpart F test results ..... 9

5.4 ISED RSS test results ..... 9

**Section 6. Test equipment** ..... **10**

6.1 Test equipment list ..... 10

**Section 7. Testing data** ..... **11**

7.1 Variation of power source ..... 11

7.2 Number of frequencies ..... 12

7.3 Antenna requirement ..... 13

7.4 Operational requirements for hand held UWB systems ..... 14

7.5 Emission bandwidth ..... 16

7.6 Field strength of emissions ..... 18

7.7 Peak emissions within 50 MHz band ..... 23

**Section 8. Test setup diagrams** ..... **25**

8.1 Radiated emissions set-up for frequencies below 1 GHz ..... 25

8.2 Radiated emissions set-up for frequencies above 1 GHz ..... 25

8.3 Antenna port set-up ..... 26

# Section 1. Report summary

## 1.1 Test specifications

| | |
|---|---|
| FCC 47 CFR Part 15, Subpart F, Clause §15.519 | Technical requirements for hand held UWB systems. |
| RSS-220, Clause 5.3, Issue 1, July 2018 | Devices Using Ultra-Wideband (UWB) Technology – Hand-held Communication Devices |

## 1.2 Test methods

| | |
|---|---|
| ANSI C63.10 v2020 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| KDB 393764 D01 v02 Jan 2018 | Ultra-Wide Band (UWB) Devices – Frequently asked questions |
| RSS-Gen, Issue 5, February 2021 | General Requirements for Compliance of Radio Apparatus |

## 1.3 Exclusions

None

## 1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies In full with the requirements tested. The test results relate only to the items tested.

*See "Summary of test results" for full details.*

## 1.5 Test report revision history

***Table 1.5-1:*** *Test report revision history*

| Revision # | Date of issue | Details of changes made to test report |
|---|---|---|
| REP108507 | September 18, 2025 | Original report issued |
| REP108507-1 | February 26, 2026 | FCC ID added |

# **Section 2.** Engineering considerations

## 2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

## 2.2 Technical judgment

None

## 2.3 Model variant declaration

There were no model variants declared by the applicant.

## 2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

# **Section 3.** Test conditions

## 3.1 Atmospheric conditions

| | |
|---|---|
| Temperature | 15 °C – 35 °C |
| Relative humidity | 20 % – 75 % |
| Air pressure | 86 kPa (860 mbar) – 106 kPa (1060 mbar) |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

## 3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

# **Section 4.** Information provided by the applicant

## 4.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

## 4.2 Applicant/Manufacturer

| | |
|---|---|
| Applicant name | SAMSARA Inc. |
| Applicant address | 1 De Haro St, San Francisco, CA, USA 94103 |
| Manufacturer name | Wistron NeWeb Corp |
| Manufacturer address | 20 park Avenue II, Hsinchu Science Park, Hsinchu 300, Taiwan |

## 4.3 EUT information

| | |
|---|---|
| Product | HW-CW21 |
| Model | 080-00001 |
| Serial number | GUHH-6HF-N39 |
| Power supply requirements | Battery: 3 V(DC) |
| Product description and theory of operation | The CW21 Samsara Wearable supports real-time SOS alerting for workers operating in the field. It provides a simple way to report emergencies and send location data to the Samsara dashboard using nearby relay devices. When a worker presses the SOS button, the wearable transmits the alert through the closest powered Asset Gateway (AG), Vehicle Gateway (VG), or mobile device running the Samsara Driver App. |

## 4.4 Technical information

| | |
|---|---|
| Operation location | ☒ Indoor operation |
| | ☒ Outdoor operation |
| Frequency band | 6000 – 9000 MHz |
| Channel Frequency (MHz) | 6489.6 MHz, 7987.2 MHz |
| Channel numbers | 5, 9 |
| RF power Max (W), EIRP | 0.0009 W and (-0.6 dBm) |
| Measured BW (MHz), 10 dB BW | 581 MHz |
| Type of modulation | BPM-BPSK |
| Emission classification | 581MG2DN |
| Transmitter spurious, dBµV/m @ 3 m | 32.8 dBµV/m @ 12.980 GHz |
| Antenna information | Type: internal PCB trace antenna, manufacturer: WNC, gain 5.0 dBi |

## 4.5 EUT setup details

### 4.5.1 Radio exercise details

| | |
|---|---|
| Operating conditions | – EUT was connected to the debug board kit and a laptop.<br>– Execute the UWB test script and input UWB parameters.<br>• For CH5 the Tx power gain number is 44. (this is the max power of CH5)<br>• For CH9 the Tx power gain number is 42. (this is the max power of CH9)<br>– After setting of UWB, EUT was disconnected from the board and laptop. |
| Transmitter state | Transmitter set into continue transmitting mode. |

### 4.5.2 EUT setup configuration

***Table 4.5-1:*** *Support equipment*

| Description | Brand name | Model, Part number, Serial number, Revision level |
|---|---|---|
| Laptop | DELL | MN: LATITUDE E6440, FA003070 |
| Debug board kit | SAMSARA | PN: CW-DBG |
| UWB module development kit (SR150) | Murata | MN: Type2BP EVK |

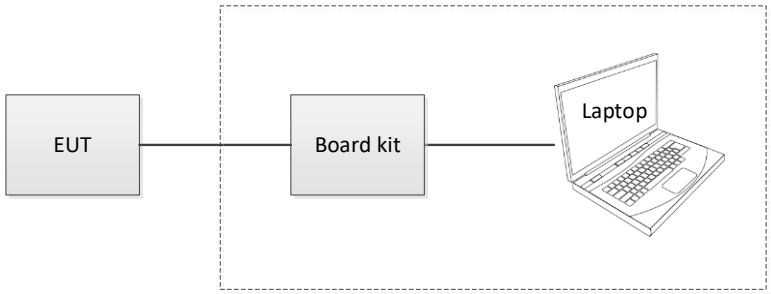



***Figure 4.5-1:*** *Block diagram*

# Section 5. Summary of test results

## 5.1 Testing period

| | | | |
|---|---|---|---|
| Test start date | July 11, 2025 | Test end date | August 5, 2025 |

## 5.2 Sample information

| | | | |
|---|---|---|---|
| Receipt date | June 26, 2025 | Nemko sample ID number(s) | PRJ00814030006 |

## 5.3 FCC Part 15 Subpart F test results

***Table 5.3-1:*** *FCC general requirements results*

| Part | Test description | Verdict |
|---|---|---|
| §15.207(a) | Conducted limits | Not applicable |
| §15.31(e) | Variation of power source | Pass |
| §15.31(m) | Number of tested frequencies | Pass |
| §15.203 | Antenna requirement | Pass |

Notes: EUT is a battery operated device, the testing was performed using fresh batteries.

***Table 5.3-2:*** *FCC 15.519 requirements results*

| Part | Test description | Verdict |
|---|---|---|
| §15.519(a) | Operational Requirements | Pass |
| §15.519(b) | Emission bandwidth | Pass |
| §15.519(c) | Field strength of emissions | Pass |
| §15.519(d) | Field Strength of emissions within 1164–1240 and 1559–1610 MHz | Pass |
| §15.519(e) | Peak emissions within 50 MHz band | Pass |

## 5.4 ISED RSS test results

***Table 5.4-1:*** *RSS-Gen requirements results*

| Part | Test description | Verdict |
|---|---|---|
| 7.3 | Receiver radiated emission limits | Not applicable[1] |
| 7.4 | Receiver conducted emission limits | Not applicable[1] |
| 6.9 | Operating bands and selection of test frequencies | Pass |
| 8.8 | AC power-line conducted emissions limits | Not applicable[2] |

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
[2] EUT is a battery operated device, the testing was performed using fresh batteries.

***Table 5.4-2:*** *RSS-220 requirements results*

| Section | Test description | Verdict |
|---|---|---|
| 5.3.1 (a) | Antenna requirements | Pass |
| 5.3.1 (b) | Operational requirements | Pass |
| 5.3.1 (c) and (d) | Field strength of emissions | Pass |
| 5.3.1 (e) | Field strength of emissions within 1164–1240 and 1559–1610 MHz band | Pass |
| 5.3.1 (g) | Peak emissions within 50 MHz bandwidth | Pass |
| 5.1 (b) | Emission bandwidth | Pass |

# Section 6. Test equipment

## 6.1 Test equipment list

***Table 6.1-1:*** *Equipment list*

| Equipment | Manufacturer | Model no. | Asset no. | Cal cycle | Next cal. |
|---|---|---|---|---|---|
| 3 m EMI test chamber | TDK | SAC-3 | FA003012 | 1 year | March 9, 2026 |
| Receiver/spectrum analyzer | Rohde & Schwarz | ESR26 | FA002969 | 1 year | May 28, 2026 |
| Spectrum analyzer | Rohde & Schwarz | FSW43 | FA002971 | 1 year | November 30, 2025 |
| Bilog antenna (20–2000 MHz) | Sunol | JB3 | FA002108 | 1 year | April 8, 2026 |
| Horn antenna (1–18 GHz) | ETS Lindgren | 3117 | FA002911 | 1 year | June 2, 2026 |
| Preamp (1–18 GHz) | ETS Lindgren | 124334 | FA002956 | 1 year | April 11, 2026 |
| Horn antenna (18–40 GHz) | EMCO | 3116B | FA002948 | 3 year | May 3, 2027 |
| Preamp (18-40 GHz) | None | None | FA003323 | 1 year | April 11, 2026 |
| 50 Ω coax cable | Huber + Suhner | None | FA003047 | 1 year | July 29, 2025 |
| 50 Ω coax cable | Huber + Suhner | None | FA003402 | 1 year | July 29, 2025 |
| 50 Ω SMA coax cable | Huber + Suhner | None | FA003056 | 1 year | July 29, 2025 |
| 50 Ω SMA coax cable | Huber + Suhner | None | FA003055 | 1 year | July 29, 2025 |

Note: All equipment related to the contribution of measurement has been included in this list. Such items include, but are not limited to, cables, attenuators, directional couplers, and pre-amps.

***Table 6.1-2:*** *Automation software details*

| Test description | Manufacturer of Software | Details |
|---|---|---|
| Radiated spurious emissions | Rohde & Schwarz | EMC32, Software for EMC Measurements, Version 10.60.00 |

***Table 6.1-3:*** *Measurement uncertainty calculations based on equipment list*

| Measurement | Measurement uncertainty, ±dB |
|---|---|
| Radiated spurious emissions (30 MHz to 1 GHz) | 4.27 |
| Radiated spurious emissions (1 GHz to 6 GHz) | 4.74 |
| Radiated spurious emissions (6 GHz to 18 GHz) | 5.04 |
| Radiated spurious emissions (18 GHz to 26 GHz) | 4.47 |
| Radiated spurious emissions (18 GHz to 40 GHz) | 4.78 |
| Occupied bandwidth | 2.43 % |
| Signal path calibration (Insertion loss) | 0.07 |

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

# Section 7. Testing data

## 7.1 Variation of power source

### 7.1.1 References, definitions and limits

**FCC §15.31:**

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

### 7.1.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 14, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 980 mbar |
| Test location | Cambridge | Relative humidity | 45 % |

### 7.1.3 Observations, settings and special notes

None

### 7.1.4 Test data

| | | | |
|---|---|---|---|
| EUT Power requirements: | ☐ AC | ☐ DC | ☒ Battery |
| If EUT is an AC or a DC powered, was the noticeable output power variation observed? | ☐ YES | ☐ NO | ☒ N/A |
| If EUT is battery operated, was the testing performed using fresh batteries? | ☒ YES | ☐ NO | ☐ N/A |
| If EUT is rechargeable battery operated, was the testing performed using fully charged batteries? | ☐ YES | ☐ NO | ☒ N/A |

## 7.2 Number of frequencies

### 7.2.1 References, definitions and limits

**FCC §15.31:**

(m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

**RSS-Gen, Clause 6.9:**

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

***Table 7.2-1:*** *Frequency Range of Operation*

| Frequency range over which the device operates (in each band) | Number of test frequencies required | Location of measurement frequency inside the operating frequency range |
|---|---|---|
| 1 MHz or less | 1 | Center (middle of the band) |
| 1–10 MHz | 2 | 1 near high end, 1 near low end |
| Greater than 10 MHz | 3 | 1 near high end, 1 near center and 1 near low end |

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

### 7.2.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 14, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 980 mbar |
| Test location | Cambridge | Relative humidity | 45 % |

### 7.2.3 Observations, settings and special notes

None

### 7.2.4 Test data

This EUT has only two channels of operation:

- CH 5, 6489.6 MHz
- CH 9, 7987.2 MHz

## 7.3 Antenna requirement

### 7.3.1 References, definitions and limits

**FCC §15.203:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

**FCC §15.519:**

(a)(2) The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

**RSS-Gen, Clause 6.8:**

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

**RSS-220, Clause 5.3.1:**

(a) The device shall be designed so as to prevent its connection to antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure.

### 7.3.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 14, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 980 mbar |
| Test location | Cambridge | Relative humidity | 45 % |

### 7.3.3 Observations, settings and special notes

- The Antenna is mounted only on handheld UWB device
- The Antenna will not be mounted on the outside of a building or on telephone pole or any fixed outdoor infrastructure
- The Antenna is designed to prevent its connection to antennas mounted on outdoor structures

### 7.3.4 Test data

| | | | |
|---|---|---|---|
| Must the EUT be professionally installed? | ☐ YES | ☐ NO | ☒ N/A |
| Does the EUT have detachable antenna(s)? | ☐ YES | ☒ NO | |
| If detachable, is the antenna connector(s) non-standard? | ☐ YES | ☐ NO | ☒ N/A |

## 7.4 Operational requirements for hand held UWB systems

### 7.4.1 References, definitions and limits

**FCC §15.519:**

(a) UWB devices operating under the provisions of this section must be hand held, i.e., they are relatively small devices that are primarily hand held while being operated and do not employ a fixed infrastructure.

(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.

(3) UWB devices operating under the provisions of this section may operate indoors or outdoors.

**FCC §15.521:**

Technical requirements applicable to all UWB devices.

(a) UWB devices may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.

**RSS-220, Clause 5.3:**

Hand-held communications device: a device used to transfer voice or data information or designed to detect the location of tags.

5.3.1 Standard Specifications

(b) The device is to transmit only when it is sending information to an associated receiver. The device shall cease transmission of information 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 device at least every 10 seconds or the UWB device shall cease transmitting any information other than periodic signals used for the establishment or re-establishment of a communication link with an associated receiver.

### 7.4.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | August 5, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 990 mbar |
| Test location | Cambridge | Relative humidity | 43 % |

### 7.4.3 Observations, settings and special notes

None

## 7.4.4 Test data

Customer provided description of operation as below,

- EUT shall cease transmission within 10 seconds.
- EUT shall continuously receive an acknowledgment of reception at least once every 10 seconds, otherwise the UWB device shall cease transmitting.
- EUT may operate indoors or outdoors.
- EUT is not employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.

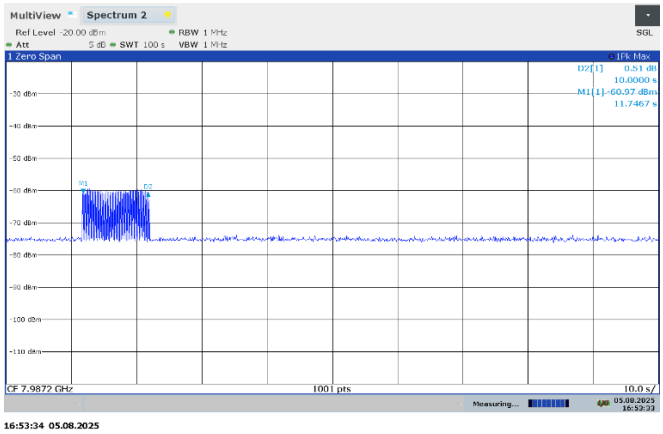



***Figure 7.4-1:*** *Transmission ceased within 10 seconds – without acknowledgement from the associated receiver*

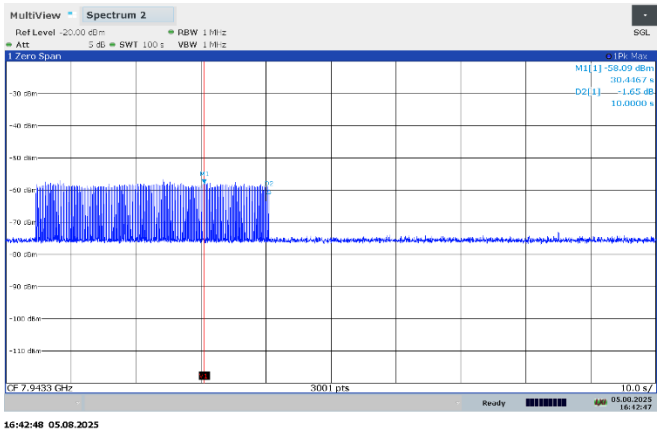



***Figure 7.4-2:*** *Transmission ceased within 10 seconds – with acknowledgement from the associated receiver*

# 7.5 Emission bandwidth

## 7.5.1 References, definitions and limits

**FCC §15.519:**

(b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3.1–10.6 GHz.

**ANSI C6.10, Clause 10:**

10.1 Evaluation of −10 dB bandwidth

The frequency at which the maximum power level is measured with the peak detector is designated $f_M$. The peak power measurements shall be made using a spectrum analyzer or EMI receiver with a 1 MHz resolution bandwidth and a video bandwidth of 1 MHz or greater. The instrument shall be set to peak detection using the maximum-hold trace mode. The outermost 1 MHz segments above and below $f_M$, where the peak power falls by 10 dB relative to the level at $f_M$, are designated as $f_H$ and $f_L$, respectively:

a. For the lowest frequency bound $f_L$, the emission is searched from a frequency lower than $f_M$ that has, by inspection, a peak power much lower than 10 dB less than the power at $f_M$ and increased toward $f_M$ until the peak power indicates 10 dB less than the power at $f_M$. The frequency of that segment is recorded.

b. This process is repeated for the highest frequency bound $f_H$, beginning at a frequency higher than $f_M$ that has, by inspection, a peak power much lower than 10 dB below the power at $f_M$. The frequency of that segment is recorded.

c. The two recorded frequencies represent the highest $f_H$ and lowest $f_L$ bounds of the UWB transmission, and the −10 dB bandwidth (B – 10) is defined as $(f_H - f_L)$ The center frequency ($f_c$) is mathematically determined from $(f_H - f_L) / 2$

d. The fractional bandwidth is defined as $2(f_H - f_L) / (f_H + f_L)$.

e. Determine whether the −10 dB bandwidth $(f_H - f_L)$ is 500 MHz, or whether the fractional bandwidth $2(f_H - f_L) / (f_H + f_L)$ is 0.2.

**RSS-220, Clause 5.1:**

The following general provisions apply to both indoor and hand-held communication devices.

a. The −10 dB bandwidth of the device shall be totally contained in the band 3.1–10.6 GHz.

**RSS-220, Annex Section 2:**

"−10 dB bandwidth $B_{-10}$" and "−10 dB fractional bandwidth $\mu_{-10}$" are defined as follows:

$B_{-10} = f_H - f_L$

$\mu_{-10} = B_{-10}/f_C$

where:

$f_M$ is the frequency of maximum UWB transmission;

$f_H$ is the highest frequency at which the power spectral density of the UWB transmission is −10 dB relative to $f_M$;

$f_L$ is the lowest frequency at which the power spectral density of the UWB transmission is −10 dB relative to $f_M$; and

$f_C = (f_H + f_L)/2$ is the centre frequency of the −10 dB bandwidth.

## 7.5.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 14, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 980 mbar |
| Test location | Cambridge | Relative humidity | 45 % |

## 7.5.3 Observations, settings and special notes

Spectrum analyser settings:

| | |
|---|---|
| Resolution bandwidth | ≥ 1 % of emission bandwidth |
| Video bandwidth | ≥ 3 × RBW |
| Frequency span | Wider than emission bandwidth |
| Detector mode | Peak |

## 7.5.4 Test data

***Table 7.5-1:*** *−10 dB bandwidth measurement result*

| Channel Frequency, MHz | −10 dB bandwidth, MHz | Minimum limit, MHz | Margin, MHz |
|---|---|---|---|
| 6489.6 | 581 | 500 | 81 |
| 7898.2 | 547 | 500 | 47 |

***Table 7.5-2:*** *Frequency lower band edge measurement result*

| Lower Frequency $f_L$, MHz | Limit, MHz | Margin, MHz |
|---|---|---|
| 6196 | 3100 | 3096 |

***Table 7.5-3:*** *Frequency upper band edge measurement result*

| Upper Frequency $f_H$, MHz | Limit, MHz | Margin, MHz |
|---|---|---|
| 8240 | 10600 | 2360 |

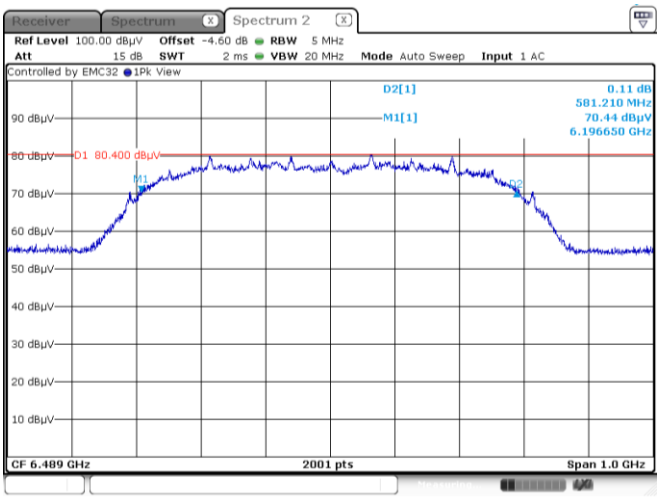



***Figure 7.5-1:*** *−10 dB bandwidth, CH 5*

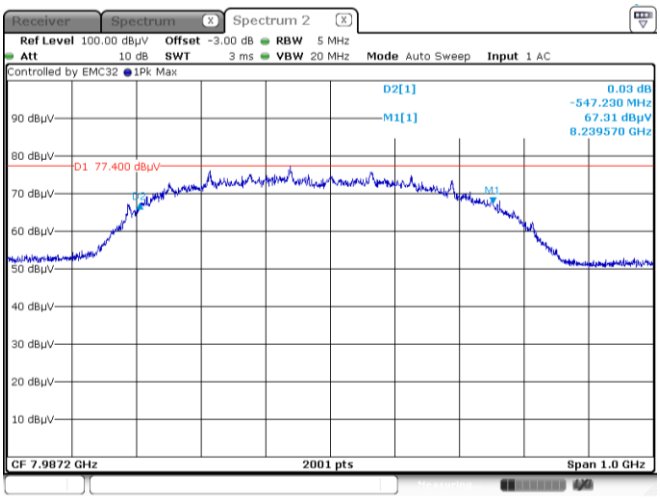



***Figure 7.5-2:*** *−10 dB bandwidth, CH 9*

## 7.6 Field strength of emissions

### 7.6.1 References, definitions and limits

**FCC §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 the average limits when measured using a resolution bandwidth of 1 MHz in the following table.

(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: −85.3 dBm/kHz EIRP within 1164–1240 MHz and 1559–1610 MHz bands.

**FCC §15.521:**

Technical requirements applicable to all UWB devices.

(d) Radiated emission levels at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Radiated emission levels above 960 MHz are based on RMS average measurements over a 1 MHz resolution bandwidth. The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time. Unless otherwise stated, if pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on. Alternative measurement procedures may be considered by the Commission.

**RSS-220, Clause 5.3:**

Hand-held communications device: a device used to transfer voice or data information or designed to detect the location of tags.

5.3.1 Standard Specifications

c. Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

d. Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz

e. In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits (within 1164–1240 MHz and 1559–1610 MHz bands) when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

***Table 7.6-1:*** *FCC §15.209 and RSS-220, Clause 3.4 – Radiated emission limits below 960 MHz*

| | Field strength limits | | |
|---|---|---|---|
| **Frequency, MHz** | **µV/m** | **dBµV/m** | **Measurement distance, m** |
| 0.009–0.490 | 2400/F | $67.6 - 20 \times \log_{10}(F)$ | 300 |
| 0.490–1.705 | 24000/F | $87.6 - 20 \times \log_{10}(F)$ | 30 |
| 1.705–30.0 | 30 | 29.5 | 30 |
| 30–88 | 100 | 40.0 | 3 |
| 88–216 | 150 | 43.5 | 3 |
| 216–960 | 200 | 46.0 | 3 |

Notes: F in kHz. In the emission table above, the tighter limit applies at the band edges.

***Table 7.6-2:*** *FCC §15.519 (c) – Radiated average emission limits above 960 MHz*

| | EIRP RMS average limits | |
|---|---|---|
| **Frequency, GHz** | **dBm/MHz** | **(dBµV/m)** |
| 0.96–1.61 | −75.3 | 19.93 |
| 1.61–1.99 | −63.3 | 31.93 |
| 1.99–3.1 | −61.3 | 33.93 |
| 3.1–10.6 | −41.3 | 53.93 |
| Above 10.6 | −61.3 | 33.93 |

Notes: In the emission table above, the tighter limit applies at the band edges

References, definitions and limits, continued

***Table 7.6-3:*** *RSS-220, Clause 5.3 – Radiated average emission limits above 960 MHz, Hand-held (Outdoor) Devices*

| | EIRP RMS average limits | |
|---|---|---|
| **Frequency, GHz** | **dBm/MHz** | **(dBµV/m)** |
| 0.96–1.61 | −75.3 | 19.93 |
| 1.61–4.75 | −70.0 | 25.23 |
| 4.75–10.6 | −41.3 | 53.93 |
| Above 10.6 | −61.3 | 33.93 |

Notes: In the emission table above, the tighter limit applies at the band edges

***Table 7.6-4:*** *FCC §15.519 (d) and RSS-220, Clause 5.3 – Radiated average emission limits (RBW no less than 1 kHz)*

| | EIRP RMS average limits (RBW no less than 1 kHz) | |
|---|---|---|
| **Frequency, MHz** | **dBm/kHz** | **(dBµV/m)** |
| 1164–1240 | −85.3 | 9.93 |
| 1559–1610 | −85.3 | 9.93 |

Notes: In the emission table above, the tighter limit applies at the band edges

## 7.6.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 11, 2025 – July 18, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 980–985 mbar |
| Test location | Cambridge | Relative humidity | 42–50 % |

### 7.6.3 Observations, settings and special notes

- The spectrum was searched from 30 MHz to 40 GHz
- Radiated measurements were performed at a distance of 3 m for frequency rand below 1 GHz, and 0.3 m for frequency range above 1 GHz.
- The field strength at the limit distance (3 m) was calculated from the measured field strength at the distance D using the following equations:

$$E_{Limit} = E_{Measured} - 20\ Log_{10}(3/D)$$

Spectrum analyser settings for radiated measurements below 960 MHz:

| | |
|---|---|
| Resolution bandwidth | 100 kHz |
| Video bandwidth | 300 kHz |
| Detector mode | RMS |
| Trace mode | Max Hold |

Spectrum analyser settings for average radiated measurements above 960 MHz:

| | |
|---|---|
| Resolution bandwidth | 1 MHz |
| Video bandwidth | 3 MHz |
| Detector mode | RMS |
| Trace mode | Max Hold or Power averaging |

Spectrum analyser settings for Spectral line measurements within the 1164–1240 MHz and 1559–1610 MHz frequency ranges:

| | |
|---|---|
| Resolution bandwidth | 1 kHz |
| Video bandwidth | 3 × RBW |
| Detector mode | RMS |
| Trace mode | Max Hold or Power averaging |

## 7.6.4 Test data

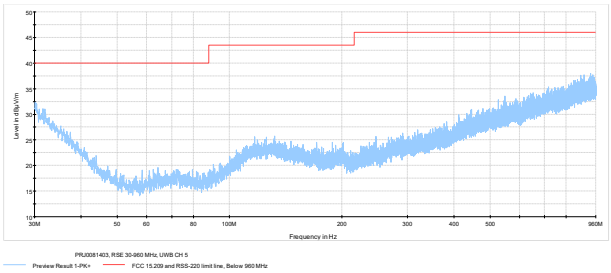


***Figure 7.6-1:*** *Spurious emissions 30–960 MHz on Channel 5*

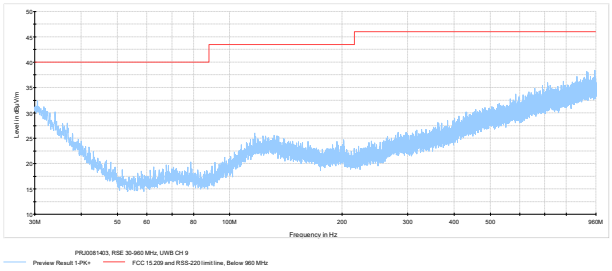
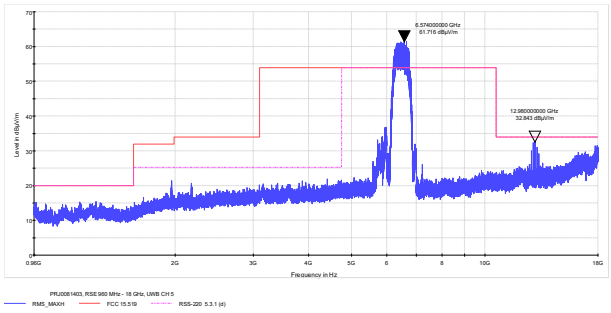
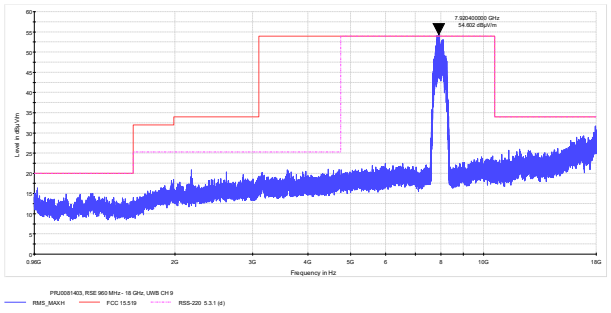


***Figure 7.6-2:*** *Spurious emissions 30–960 MHz on Channel 9*



Note: the emissions over limit line are Tx signal within the UWB bandwidth.

***Figure 7.6-3:*** *Spurious emissions 960 MHz – 18 GHz on Channel 5*



Note: the emissions over limit line are Tx signal within the UWB bandwidth.

***Figure 7.6-4:*** *Spurious emissions 960 MHz – 18 GHz on Channel 5*

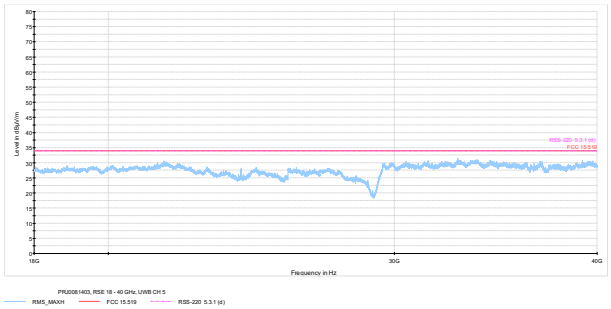


***Figure 7.6-5:*** *Spurious emissions 18–40 GHz on Channel 5*

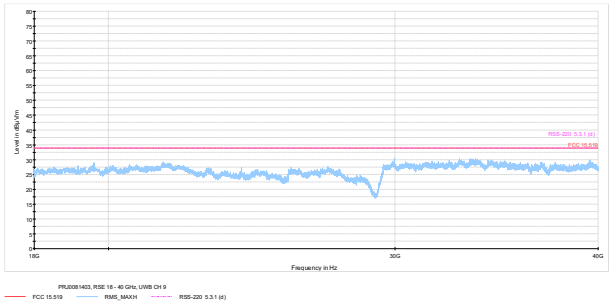


***Figure 7.6-6:*** *Spurious emissions 18–40 GHz on Channel 9*

Test data, continued

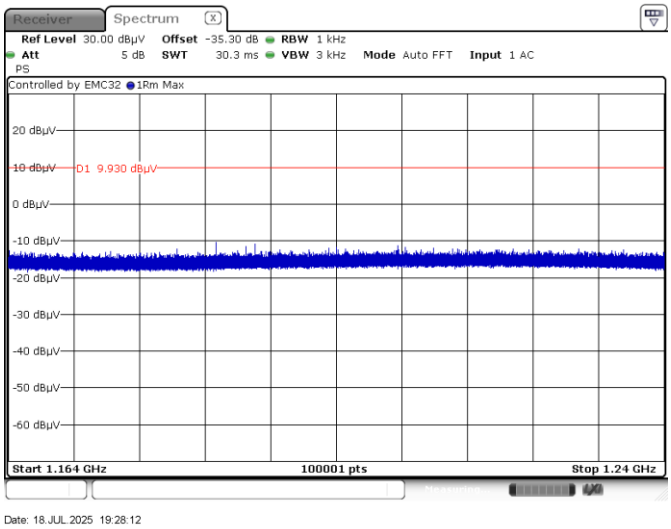



***Figure 7.6-7:*** *Spurious emissions within 1164–1240 MHz on Channel 5*

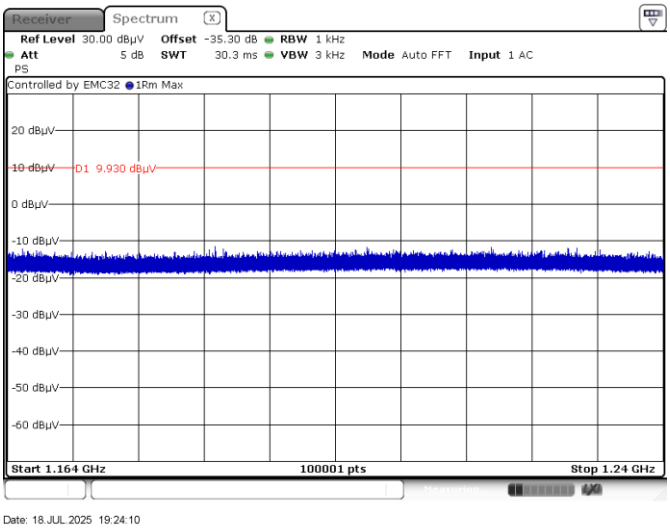



***Figure 7.6-8:*** *Spurious emissions within 1164–1240 MHz on Channel 9*

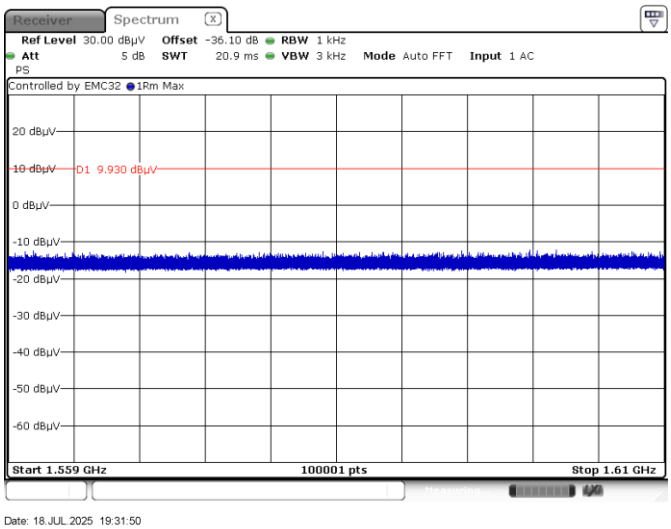



***Figure 7.6-9:*** *Spurious emissions within 1559–1610 MHz on Channel 5*

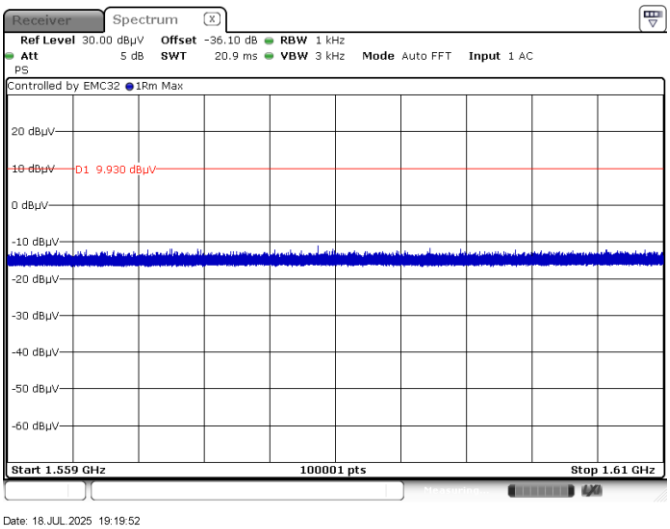



***Figure 7.6-10:*** *Spurious emissions within 1559–1610 MHz on Channel 9*

## 7.7 Peak emissions within 50 MHz band

### 7.7.1 References, definitions and limits

**FCC §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.

**FCC §15.521:**

Technical requirements applicable to all UWB devices.

(g) When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, $f_M$. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be $20 \times \text{Log}_{10}$ (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using E(dBµV/m) = P(dBm EIRP) + 95.23. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

**RSS-220, Clause 5.3:**

Hand-held communications device: a device used to transfer voice or data information or designed to detect the location of tags.

5.3.1 Standard Specifications

g. The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

**RSS-220, Annex Section 4:**

c. Peak measurements shall be made in addition to average measurements. Transmissions shall not exceed 0 dBm e.i.r.p. in any 50 MHz bandwidth when the average limit is −41.3 dBm/MHz. This is the equivalent peak limit as calculated by combining the 6-dB peak-to-average conversion with a resolution bandwidth (RBW) scaling factor of $20 \times \text{Log}_{10}$ (1 MHz/50 MHz). Only the 50 MHz bandwidth, centred on the frequency $f_M$ where the highest power occurs, needs to be measured to satisfy the peak requirements for all frequencies. A different resolution bandwidth and a correspondingly different peak limit may also be used, in which case the RBW may be set anywhere between 1 MHz and 50 MHz. The peak e.i.r.p. limit is then calculated as $20 \times \text{Log}_{10}$ (RBW/50) dBm where the RBW is in MHz. This may be converted to a peak field strength level at 3 metres using E(dBµV/m) = P(e.i.r.p.(dBm)) + 95.23. If the RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the calibration of the test set-up and the instrumentation used in the testing.

### 7.7.2 Test summary

| | | | |
|---|---|---|---|
| Verdict | Pass | | |
| Test date | July 18, 2025 | Temperature | 24 °C |
| Tested by | Alvin Liu | Air pressure | 985 mbar |
| Test location | Cambridge | Relative humidity | 42 % |

### 7.7.3 Observations, settings and special notes

Spectrum analyser settings for peak radiated measurements above 1 GHz:

| | |
|---|---|
| Resolution bandwidth | 50 MHz |
| Video bandwidth | 50 MHz |
| Detector mode | Peak |
| Trace mode | Max Hold |

Note: The measurement was done at 10 MHz and then integrated to 50 MHz

Spectrum analyser settings for average radiated measurements above 1 GHz:

| | |
|---|---|
| Resolution bandwidth | 1 MHz |
| Video bandwidth | 3 MHz |
| Detector mode | RMS |
| Trace mode | Average |

## 7.7.4 Test data

***Table 7.7-1:*** *Peak emissions measurement results*

| Channel Frequency, MHz | Peak field strength, dBµV/m/50 MHz | Calculated peak EIRP, dBm/50 MHz | EIRP limit, dBm/50 MHz | Margin, dB |
|---|---|---|---|---|
| 6489.6 | 93.8 | –1.4 | 0 | 1.4 |
| 7987.2 | 94.6 | –0.6 | 0 | 0.6 |

The resolution bandwidth RBW=10 MHz was employed, peak power bandwidth correction: 20 × $Log_{10}$ (50 MHz/10 MHz) = 14.0 dB
EIRP was converted from the measured field strength at 3 meters using equation: EIRP (dBm) = E (dBµV/m) − 95.2

***Table 7.7-2:*** *Average emissions measurement results*

| Channel Frequency, MHz | Average field strength, dBµV/m | Calculated average EIRP, dBm | EIRP limit, dBm | Margin, dB |
|---|---|---|---|---|
| 6489.6 | 50.0 | –45.2 | –41.3 | 3.9 |
| 7987.2 | 52.8 | –42.4 | –41.3 | 1.1 |

EIRP was converted from the measured field strength E at 3 meters using equation: EIRP (dBm) = E (dBµV/m) − 95.2

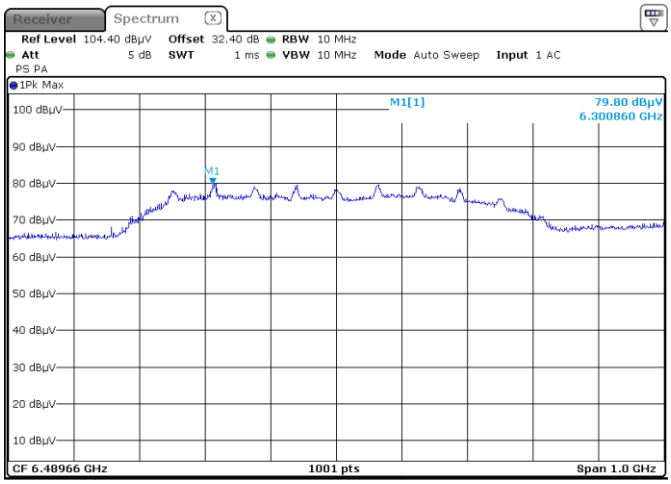



***Figure 7.7-1:*** *Peak emissions on Channel 5*

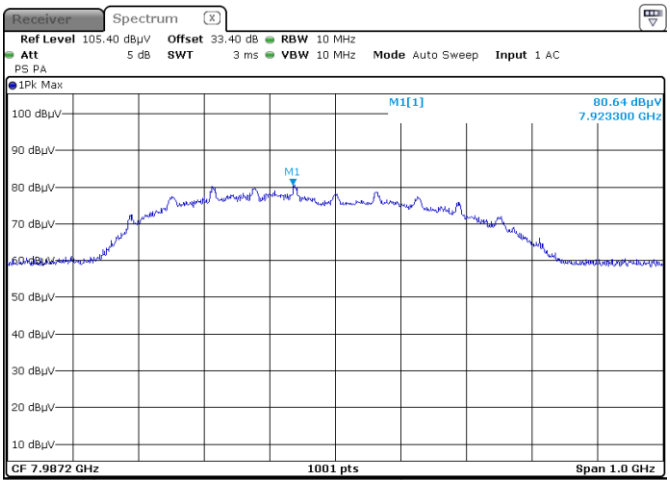



***Figure 7.7-2:*** *Peak emissions on Channel 9*

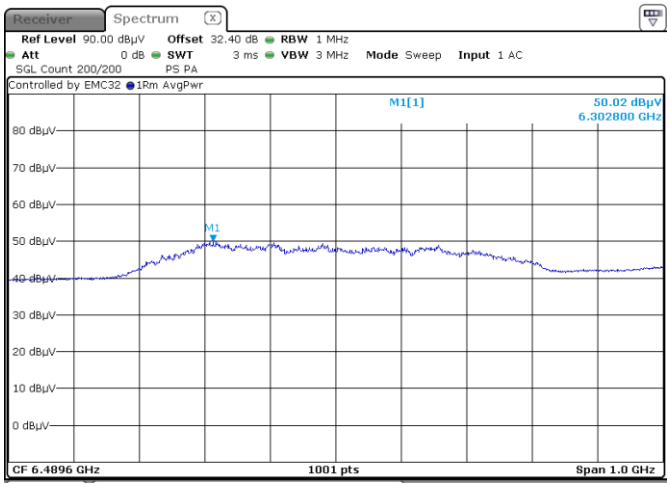



***Figure 7.7-3:*** *Average emissions on Channel 5*

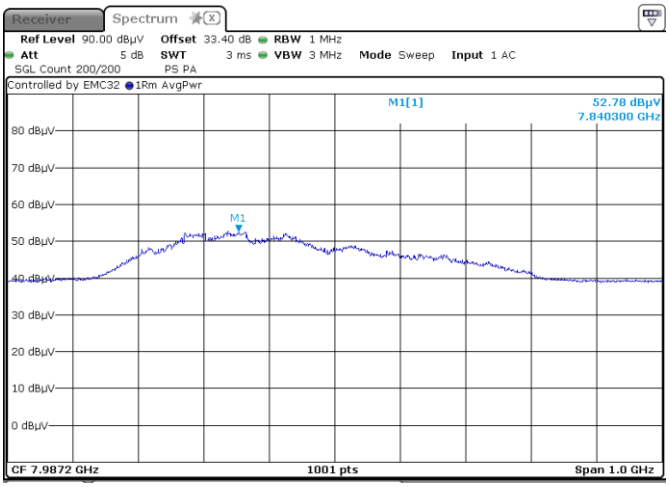
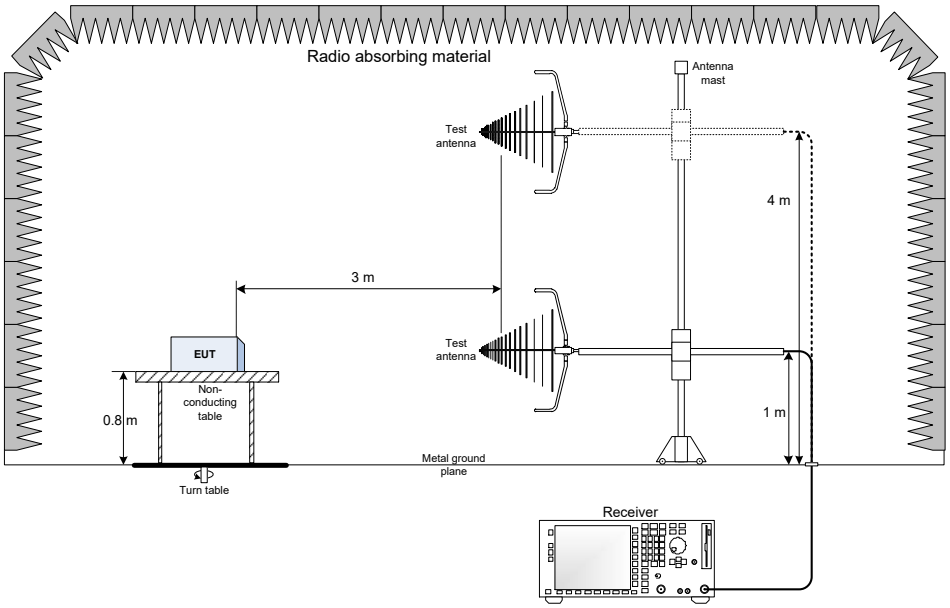


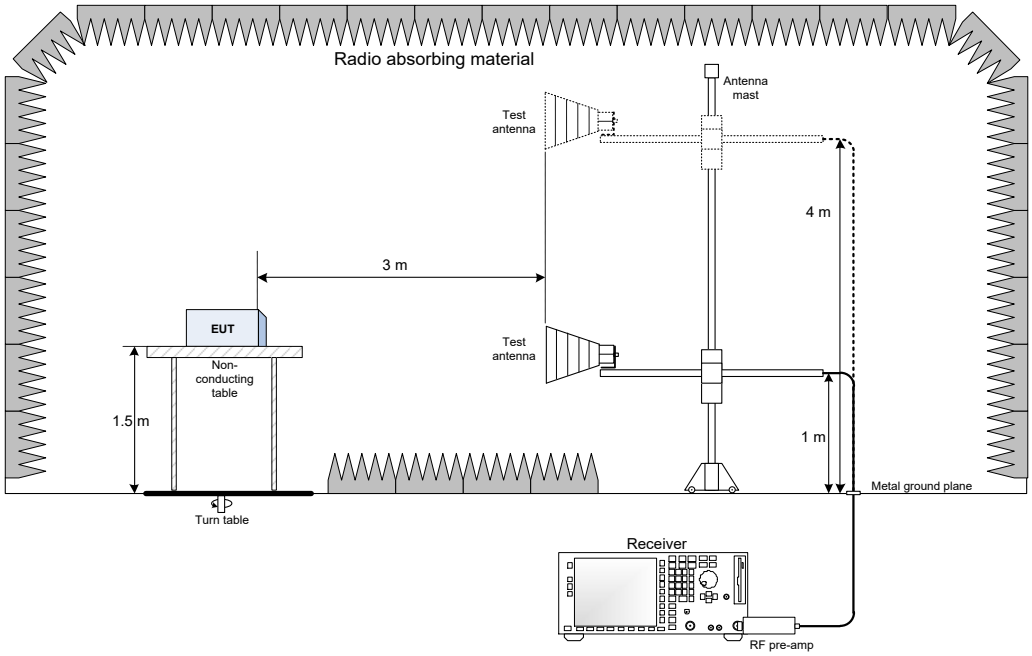

***Figure 7.7-4:*** *Average emissions on Channel 9*

# **Section 8.** Test setup diagrams

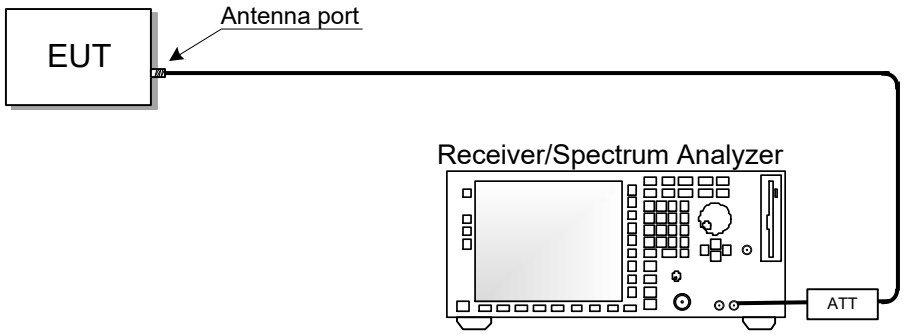
## 8.1 Radiated emissions set-up for frequencies below 1 GHz




## 8.2 Radiated emissions set-up for frequencies above 1 GHz



## 8.3 Antenna port set-up




**End of the test report**