

# RADIO TEST REPORT

Type of assessment:

**MPE Calculation report**

Manufacturer:

**GSI Electronics Inc**

Equipment description:

**2.4GHz Wi-Fi & BT IoT Module**

Hardware Version Identification Number (HVIN):

**ESP32-S3-WROOM-1U**

FCC ID:

**2AFLZSPS3WROOM1U**

ISED certification number:

**11880A-ESPS3WROOMU**

Specification:

- ◆ FCC 47 CFR Part 1 Subpart I, §§1.1307, 1.1310
- ◆ FCC 47 CFR Part 2 Subpart J, §2.1091
- ◆ KDB 447498 D01 General RF Exposure Guidance v06
- ◆ RSS-102 Issue 5 Amendment 1, (February 2021) – Annex A and B

## Annex B - Declaration of RF Exposure Compliance

ATTESTATION: I attest that the information provided in Annex A is correct; that the Technical Brief was prepared and the information contained therein is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed; and that the device meets the SAR and/or RF field strength limits of RSS-102.

Date of issue: April 5, 2023

**Andrey Adelberg, Senior EMC/RF Specialist**

Prepared by



Signature

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The tests included in this report are within the scope of this accreditation.  
The SCC Accreditation Symbol is an official symbol of the Standards Council of Canada, used under licence.

SCC File Number: 15064 (Ottawa/Almonte); 151100 (Montreal); 151097 (Cambridge)



## Lab locations

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|              |   |  |   |   |
|--------------|---|--|---|---|
| Company name | Nemko Canada Inc.   |  |   |   |
| Facilities   | <i>Ottawa site:</i><br>303 River Road<br>Ottawa, Ontario<br>Canada<br>K1V 1H2<br><br>Tel: +1 613 737 9680<br>Fax: +1 613 737 9691 | <i>Montréal site:</i><br>292 Labrosse Avenue<br>Pointe-Claire, Québec<br>Canada<br>H9R 5L8<br><br>Tel: +1 514 694 2684<br>Fax: +1 514 694 3528 | <i>Cambridge site:</i><br>1-130 Saltsman Drive<br>Cambridge, Ontario<br>Canada<br>N3E 0B2<br><br>Tel: +1 519 650 4811 | <i>Almonte site:</i><br>1500 Peter Robinson Road<br>West Carleton, Ontario<br>Canada<br>K0A 1L0<br><br>Tel: +1 613 256-9117 |
|              | Test site identifier  | <b>Organization</b>  | <b>Ottawa/Almonte</b>   | <b>Montreal</b>   |
|              | FCC:  | CA2040   | CA2041  | CA0101  |
|              | ISED:   | 2040A-4  | 2040G-5   | 24676   |
| Website      | <a href="http://www.nemko.com">www.nemko.com</a>  |  |   |   |

## Limits of responsibility

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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.

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## Section 1 Evaluation summary

### 1.1 MPE calculation for standalone transmission

#### 1.1.1 References, definitions and limits

##### FCC §2.1091(d)

- (2) (2) For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b) of this part, except for portable devices as defined in §2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in §2.1093.

**Table 1.1-1: Table 1 to §1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)**

| Frequency range (MHz)   | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(i) Limits for Occupational/Controlled Exposure</b>          |                               |                               |                                     |                          |
| 0.3–3.0   | 614                           | 1.63                          | *(100)                              | ≤6                       |
| 3.0–30  | 1842 / f                      | 4.89 / f                      | *(900 / f <sup>2</sup> )            | <6                       |
| 30–300  | 61.4                          | 0.163                         | 1.0                                 | <6                       |
| 300–1500  |                               |                               | f / 300                             | <6                       |
| 1500–100000   |                               |                               | 5                                   | <6                       |
| <b>(ii) Limits for General Population/Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 0.3–1.34  | 614                           | 1.63                          | *(100)                              | <30                      |
| 1.34–30   | 824 / f                       | 2.19 / f                      | *(180 / f <sup>2</sup> )            | <30                      |
| 30–300  | 27.5                          | 0.073                         | 0.2                                 | <30                      |
| 300–1500  |                               |                               | f / 1500                            | <30                      |
| 1500–100000   |                               |                               | 1.0                                 | <30                      |

Notes: f = frequency in MHz. \* = Plane-wave equivalent power density.

##### RSS-102, Section 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device’s radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $4.49/f^{0.5}$  W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $0.0131 f^{0.6834}$  W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

References, definitions and limits, continued

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (mW/cm<sup>2</sup> or W/m<sup>2</sup>)  
 P = power input to the antenna (mW or W)  
 G = power gain of the antenna in the direction of interest relative to an isotropic radiator  
 R = distance to the center of radiation of the antenna (cm or m)

1.1.2 EUT technical information

|                                     |                    |
|-------------------------------------|--------------------|
| Prediction frequency                | 2412 MHz           |
| Antenna gain                        | 2.33 dBi           |
| Maximum transmitter conducted power | 25.11 dBm (324 mW) |
| Prediction distance                 | 20 cm              |

1.1.3 MPE calculation

|  |                             |                             |
|--|-----------------------------|-----------------------------|
| Fundamental transmit (prediction) frequency:                 | 2412 MHz                    |                             |
| Maximum measured conducted peak output power:                | 25.11 dBm                   |                             |
| Cable and/or jumper loss:                                    | 0 dB                        |                             |
| Maximum peak power at antenna input terminal:                | 25.11 dBm                   |                             |
| Tx On time:  | 1.000 ms                    |                             |
| Tx period time:  | 1.000 ms                    |                             |
| Average factor:  | 100 %                       |                             |
| Maximum calculated average power at antenna input terminal:  | 324.34 mW                   |                             |
| Single Antenna gain (typical):                               | 2 dBi                       |                             |
| Number of antennae:  | 1                           |                             |
| Total system gain:   | 2.00 dBi                    |                             |
|  | <b>FCC limit:</b>           | <b>ISED limit:</b>          |
| MPE limit for uncontrolled exposure at prediction frequency: | 1.000000 mW/cm <sup>2</sup> | 0.536602 mW/cm <sup>2</sup> |
|  | 10.000000 W/m <sup>2</sup>  | 5.366018 W/m <sup>2</sup>   |
| Minimum calculated prediction distance for compliance:       | 20 cm                       | 20 cm                       |
| Typical (declared) distance:                                 | 20 cm                       | 20 cm                       |
| Average power density at prediction frequency:               | 0.102266 mW/cm <sup>2</sup> | 0.102266 mW/cm <sup>2</sup> |
|  | 1.022657 W/m <sup>2</sup>   | 1.022657 W/m <sup>2</sup>   |
| Margin of Compliance:  | 9.90 dB                     | 7.20 dB                     |
| Maximum allowable antenna gain:                              | 11.90 dBi                   | 9.20 dBi                    |

1.1.4 Verdict

The calculation is below the limit; therefore, the product is passing the RF Exposure requirements for the declared distance.



1.1.5 RSS-102, Annex A - RF technical brief cover sheet

|   |  |
|---|--|
| ISED Certification Number                     | 11880A-ESPS3WROOMU   |
| Product marketing name (PMN)                  | ESP32-S3-WROOM-1U  |
| Hardware version identification number (HVIN) | ESP32-S3-WROOM-1U  |
| Firmware version identification number (FVIN) | v1.1.3.4   |
| Host marketing name (HMN)                     | N/A  |
| Applicant company number                      | 11880A   |
| Applicant name                                | GSI Electronics Inc  |
| SAR/RF exposure test laboratory               | 2040A-4 (3 m semi anechoic chamber)  |
| Type of evaluation                            | <input type="checkbox"/> SAR Evaluation: Device Used in the Vicinity of the Human Head<br><input type="checkbox"/> SAR Evaluation: Body-Worn Device and Body-Supported Device<br><input type="checkbox"/> SAR Evaluation: Limb-Worn Device<br><input checked="" type="checkbox"/> RF Exposure Evaluation<br><input type="checkbox"/> Nerve Stimulation Exposure Evaluation (SPR-002) |
| SAR evaluation                                | Multiple transmitters: <input type="checkbox"/> Yes <input type="checkbox"/> No  |
|   | Evaluated against exposure limits: <input type="checkbox"/> General Public Use <input type="checkbox"/> Controlled Use   |
|   | Duty cycle used in evaluation: N/A %   |
|   | Separation distance: N/A mm  |
|   | Standard used for evaluation: N/A  |
|   | SAR value: N/A W/kg<br><input type="checkbox"/> Measured <input type="checkbox"/> Computed <input type="checkbox"/> Calculated   |
| Nerve Stimulation Evaluation (SPR-002)        | Evaluated against exposure limits: <input type="checkbox"/> General Public Use <input type="checkbox"/> Controlled Use   |
|   | Measurement distance: N/A m  |
|   | Field Strength: N/A <input type="checkbox"/> V/m (electric) <input type="checkbox"/> A/m (magnetic)<br><input type="checkbox"/> Measured <input type="checkbox"/> Computed <input type="checkbox"/> Calculated   |
|   | Exposure condition: <input type="checkbox"/> Whole body/Torso/Head <input type="checkbox"/> Leg<br><input type="checkbox"/> Arm <input type="checkbox"/> Hand/Foot   |
| RF exposure evaluation                        | Evaluated against exposure limits: <input checked="" type="checkbox"/> General Public Use <input type="checkbox"/> Controlled Use  |
|   | Duty cycle used in evaluation: <b>100</b> %  |
|   | Operational frequency: <b>2412</b> MHz   |
|   | Standard used for evaluation: <b>Safety Code 6</b>   |
|   | Measurement distance: <b>0.2</b> m   |
|   | RF value: <b>1.02</b> <input checked="" type="checkbox"/> W/m <sup>2</sup> <input type="checkbox"/> V/m <input type="checkbox"/> A/m<br><input type="checkbox"/> Measured <input type="checkbox"/> Computed <input checked="" type="checkbox"/> Calculated   |

End of the test report