# TEST REPORT

of

# JAPAN MIC

| | |
|---|---|
| Product: | **Bluetooth 5.1 Module** |
| Brand: | **Fanstel** |
| Main Model: | **BT40** |
| Series Model: | **BT40E; BT40F** |
| Model Difference: | **Antenna difference** |
| Applicant: | **Fanstel Corporation, Taipei** |
| Address | **10F-10, No. 79, Sec. 1, Hsin Tai Wu Rd., Hsi-Chih, New Taipei City 221 Taiwan** |

Test Performed by:

**International Standards Laboratory Corp. LT Lab.**
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No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan

Report No.: **ISL-21LR066JAP-R1**
Issue Date : **November 18, 2022**

ilac-MRA TAF Testing Laboratory 0997

# VERIFICATION OF COMPLIANCE

| | |
|---|---|
| **Applicant:** | Fanstel Corporation, Taipei |
| **Equipment Under Test:** | Bluetooth 5.1 Module |
| **Brand:** | Fanstel |
| **Main Model:** | BT40 |
| **Series Model:** | BT40E; BT40F |
| **Model Difference:** | Antenna difference |
| **Date of Test:** | November 4, 2022 ~ November 18, 2022 |
| **Date of EUT Received:** | November 4, 2022 |

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULT** |
| ARIB STD-T66 | Complied |

The above equipment was tested by International Standards Laboratory Corp. for compliance with the requirements in the Radio equipment stipulated in the certification ordinance Item 19, Paragraph 1, Article 2. The results of testing in this report apply to the product/system that was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties. The antenna specification is provided by the applicant, and ISL does not bear the relevant responsibility.

***Test By:*** Weitin Chen ***Date:*** November 18, 2022

***Weitin Chen / Senior Engineer***

***Prepared By:*** Gigi yeh ***Date:*** November 18, 2022

***Gigi Yeh / Senior Engineer***

***Approved By:*** Jerry Liu ***Date:*** November 18, 2022

***Jerry Liu / Assistant Manager***

# *Version*

| Version No. | Date | Description |
|---|---|---|
| 00 | 2021/04/09 | Initial creation of document |
| 01 | 2022/11/18 | The load capacitor is removed with the intents in application for class II change with respect to Telec. Some delta tests have been done. |

# TABLE OF CONTENTS

# 1. Description of Equipment under Test (EUT)

## 1.1 General Information

General:

| | |
|---|---|
| Product Name | Bluetooth 5.1 Module |
| Brand Name | Fanstel |
| Model Name | BT40; BT40F; BT40E |
| Model Difference | Antenna difference |
| Power Supply | 5Vdc from USB (JIG) |
| USB port | one (JIG) |

Model Summaries:

| module | BT40F (PCB Ant.) | BT40 | BT40E (Dipole Ant.) |
|---|---|---|---|
| SoC | nRF5340 QKAA | nRF5340 QKAA | nRF5340 QKAA |
| Size | 15x20.8x1.9mm | 14x16x1.9mm | 14x16x1.9mm |
| 32 MHz and 32.768 kHz crystals | Integrated | Integrated | Integrated |
| DC converter inductors, VDD,VDDH | Integrated | Integrated | Integrated |
| BT Antenna | PCB ANT 0.88dBi | PCB ANT -3.37dBi | Dipole ANT 6dBi |
| Max TX | | | |
| Operating temp. | -40ºC to +105ºC | -40ºC to +105ºC | -40ºC to +105ºC |
| Availability | Sample | Sample 1Q21 | Sample |

BLE:

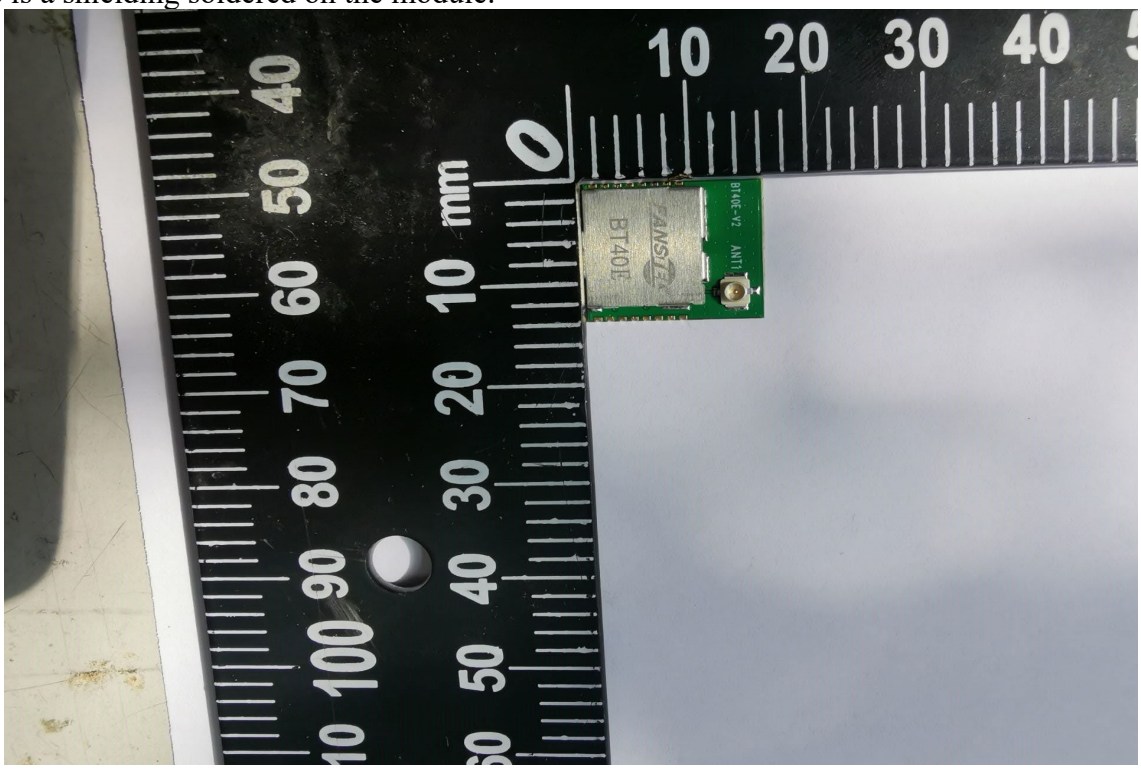
| | |
|---|---|
| Bluetooth Version | 5.1 |
| Rated Transmit Power | 2 mW |
| Frequency Range | 2.402GHz – 2.480GHz |
| Modulation Technique | GFSK |
| Channel number | 40 channels |
| Dwell Time | N/A |
| Antenna | BT40E : Dipole Antenna, 6dBi<br>BT40F : PCB Antenna, 0.88dBi<br>BT40 : PCB Antenna, -3.37dBi |

## 1.2 Antenna Specification

| | |
|---|---|
| Antenna Type | Dipole / PIFA Antenna |
| Peak Gain | BT40E : Dipole Antenna, 6dBi<br>BT40F : PCB Antenna, 0.88dBi<br>BT40 : PCB Antenna, -3.37dBi |
| Impedance | 50.0 ohms |
| Radiation pattern | Omni |

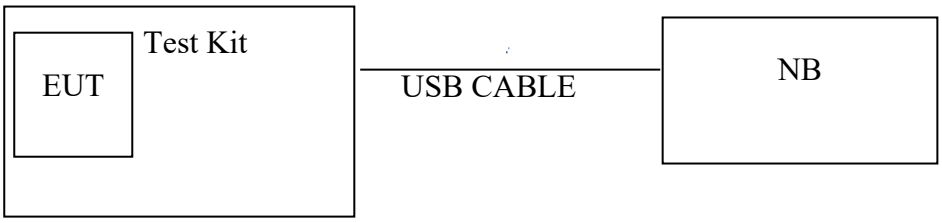
## 1.3 Assemble

There is a shielding soldered on the module.



## 1.4 Support Equipment

**Configuration of Tested System**




**Equipment Used in Tested System**

| Item | Equipment | Mrf/Brand | Model name | Series No | Data Cable | Power Cable |
|---|---|---|---|---|---|---|
| 1 | Notebook | Lenovo | X220i | N/A | N/A | Non-shielded |
| 2 | Test Kit | N/A | N/A | N/A | N/A | N/A |

## 2. Description of Test Modes

The EUT has been tested at continuous TX and RX modes. And software was used to control the EUT for staying in above description test modes.
The EUT has 14 channels. Channel low, mid and High with lowest data rate was chosen for testing.

The settings for Bluetooth will be influenced by the throughput and the modulation. Most common settings are:

**est channels in BT 5.1 LE mode**

| | TX |
|---|---|
| Channel Low | 2402MHz |
| Channel Mid | 2442MHz |
| Channel High | 2480MHz |

**Test conditions**

| | |
|---|---|
| Temperature & humidity | Normal |
| Normal voltage | 5.0 Vdc |
| Lower extreme voltage | 5.5 Vdc |
| Higher extreme voltage | 4.5 Vdc |

## 3. General Description of Applied Standards

The EUT According to the Specifications, it must comply with the requirements of the following standards:

Radio equipment stipulated in the certification ordinance Item 19, Paragraph 1, Article 2.

## 4. Summary of Tests

| Article reference | Parameter | Status (Note 1) |
|---|---|---|
| General provisions | | |
| 5 | Frequency tolerance | C |
| 6 | Occupied bandwidth | C |
| 7 | Spurious emission | C |
| Transmitting equipment | | |
| 14 | Antenna Power | C |
| 14.2 | SAR | N/A |
| 15 | Frequency stabilization | C |
| Transmitting equipment | | |
| 20 | Type configuration etc of transmitting antenna | C |
| 22 | Directional pattern of transmitting antenna | C |
| Receiving equipment | | |
| 24 | Spurious emission of receiver | C |
| 26 | Refer to all articles for transmitting antenna | C |
| Operating frequency 2400-2483.5MHz | | |
| 49.20(1); a | High Frequency/modulation section cannot be operated easily | C |
| 49.20(1); b | Communication method | C |
| 49.20(1); c | Communication method | C |
| 49.20(1); d | Spread Spectrum method | C |
| 49.20(1); e | Antenna Power | C |
| 49.20(1); f(1) | Absolute gain of transmitting antenna | C |
| 49.20(1); f(2) | Angular width of principal radiation (AWPR) | C |
| 49.20(1); g | Number of carriers within 1MHz bandwidth in OFDM | C |
| 49.20(1); h | Diffusion bandwidth | C |
| 49.20(1); i | Spreading factor | C |
| 49.20(1); j | Frequency retention time (FH employed) | C |
| Note 1: C=Confirm NC=Not Confirm NT=Not Tested NA= Not Applicable | | |

**BLE**
**Test Mode: Normal mode / Channel Low**

Note: Test item list below has been re-verifying:

All mode has been pre-scanned, and only the cast of the worst is presented in the report.

1. Antenna Power and Tolerance
2. Transmitter Spurious Emissions
3. Limitation of Collateral Emission of Receiver

## 4.1 Antenna Power and Tolerance

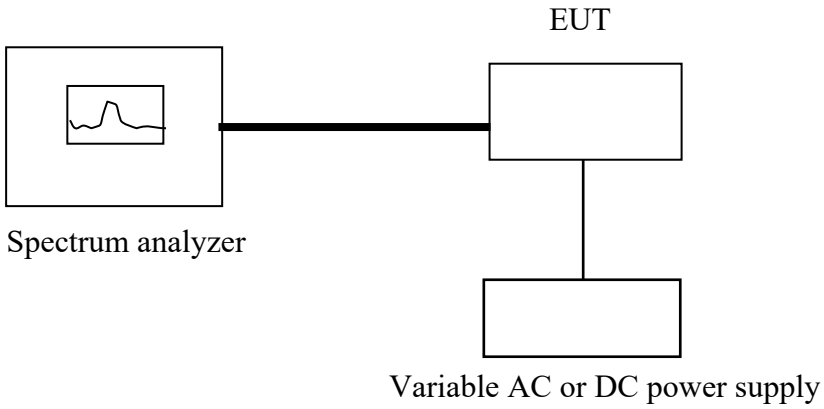
### 4.1.1 Limit

BT: 3mW/MHz
BLE: 10mW/MHz
Wifi: 10mW/MHz (for OBW < 26MHz)
Wifi: 5mW/MHz (for 26MHz ≤ OBW < 38MHz)
Antenna power tolerance: + 20% to – 80%

### 4.1.2 Measurement Equipment Used

Refer to section Appendix A: Equipment List for detail.

### 4.1.3 Test Setup




### 4.1.4 Test Procedure

1. Set the EUT at hopping off and modulation on.
2. Set the ETU operates at channel low, mid and high and normal/Upper/Lower voltage.
3. Connect the EUT to power meter.
4. Record the power level.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.

### 4.1.5 Test Results

Ambient temperature: 24℃ Relative humidity: 67% Test Date: 2022/11/11

**BLE**
Rated Power =2 mW
Antenna Gain 6 dBi

| | | Channel Low | Channel Mid | Channel High | Limit |
|---|---|---|---|---|---|
| Normal Voltage 5 V | Conducted Power (dBm) | 3.176 | 3.106 | 3.014 | N/A |
| | Conducted Power (mW) | 2.08 | 2.04 | 2.00 | 10mW |
| | Power Tolerance | 3.89 | 2.23 | 0.09 | +20% to -80% |
| Upper Voltage 5.5V | Conducted Power (dBm) | 3.177 | 3.114 | 3.023 | N/A |
| | Conducted Power (mW) | 2.08 | 2.05 | 2.01 | 10mW |
| | Power Tolerance | 3.91 | 2.42 | 0.29 | +20% to -80% |
| Lower Voltage 4.5 V | Conducted Power (dBm) | 3.103 | 3.110 | 3.018 | N/A |
| | Conducted Power (mW) | 2.04 | 2.05 | 2.00 | 10mW |
| | Power Tolerance | 2.16 | 2.32 | 0.18 | +20% to -80% |

Remark:
1. Conducted Power (mW/MHz)= 10^(Conducted Power(dBm/MHz)/10)
2. P (mW/MHz) = Raw power (in mW, measured by power sensor) / [spreading bandwidth (MHz) x duty-cycle]

## 4.2 Transmitter Spurious Emissions

### 4.2.1 Limit

Frequency below 2.387 and above 2.4965GHz :2.5uW
Frequency between 2.387 – 2.400GHz, 2.4835-2.4965GHz: 25uW

### 4.2.2 Measurement Equipment Used

Refer to section Appendix A: Equipment List for detail.

### 4.2.3 Test Setup

Refer to section 4.1.3 for detail.

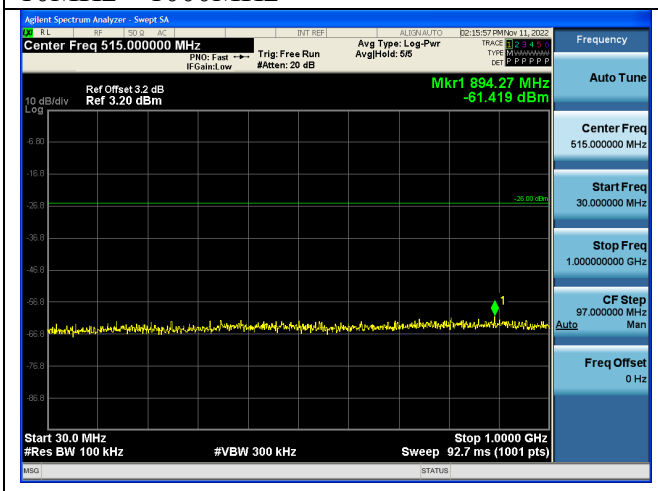
### 4.2.4 Test Procedure

1. Set the EUT at hopping off and modulation on.
2. Set the ETU operate at channel low, mid and high and normal voltage.
3. Set the RBW=100 kHz, VBW=300 kHz for frequency below 1GHz and RBW=1MHz, VBW= 3MHz for frequency above 1GHz.
4. Measured the max. level of the following frequency range:
   10MHz – 1000MHz;
   1000MHz – 2387MHz;
   2387MHz – 2400MHz;
   2483.5MHz – 2496.5MHz;
   2496.5MHz – 26GHz.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.
6. The Worst data was report.

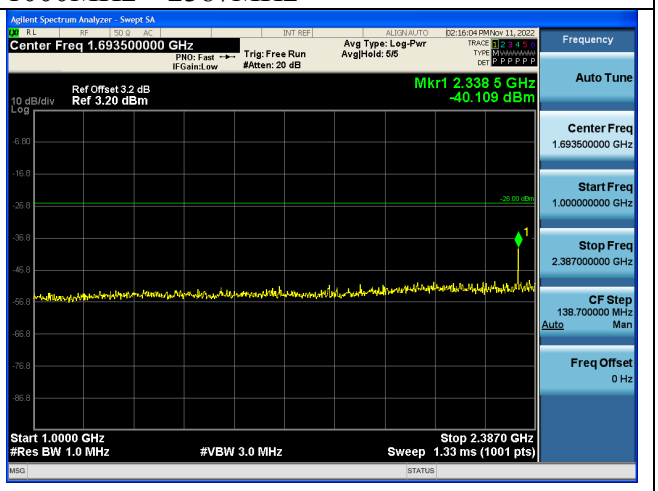
### 4.2.5 Test Results

Test Data: BLE\2402MHz

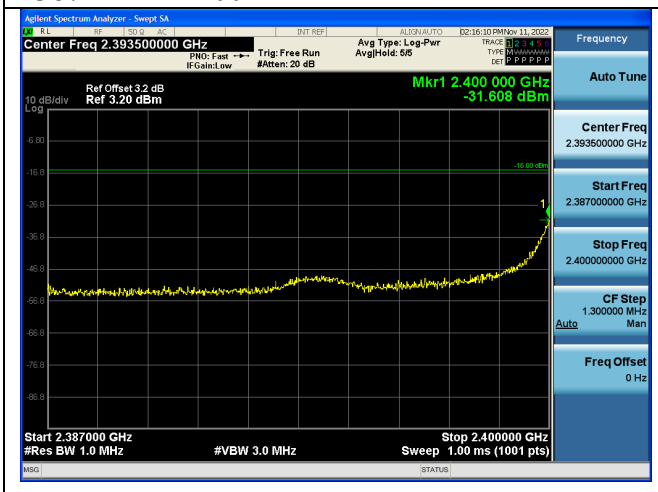
10MHz – 1000MHz



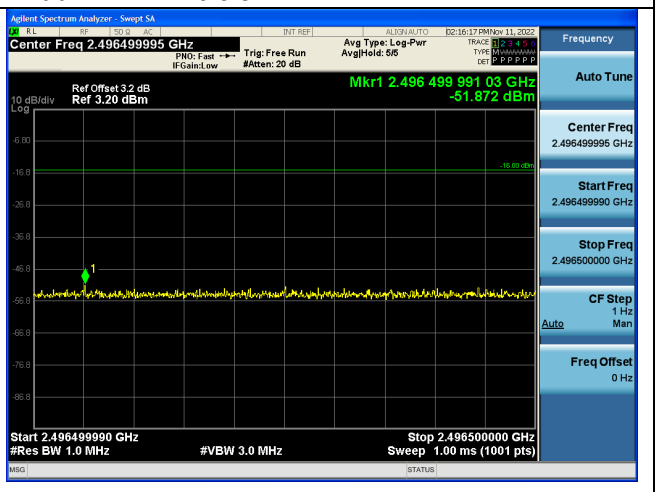

1000MHz – 2387MHz




2387MHz – 2400MHz




2400MHz – 2496.5MHz




2496.5MHz – 26GHz

## 4.3 Limitation of Collateral Emission of Receiver

### 4.3.1 Limit

Frequency below 1GHz : 4nW
Frequency above 1GHz : 20nW

### 4.3.2 Measurement Equipment Used

Refer to section Appendix A: Equipment List for detail.

### 4.3.3 Test Setup

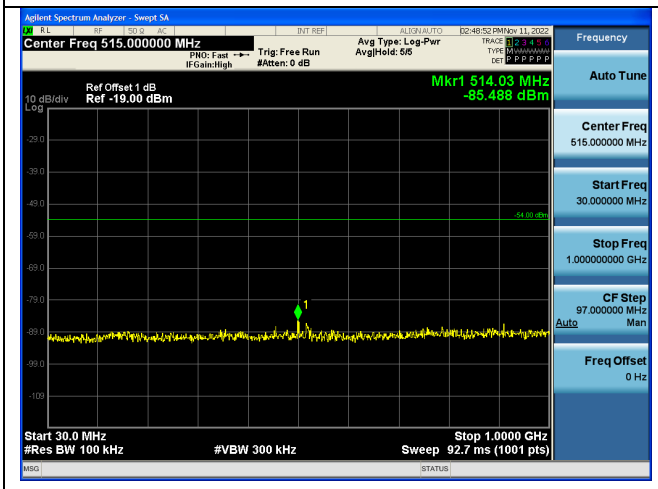
Refer to section 4.1.3 for detail.

### 4.3.4 Test Procedure

1. Setup the EUT at hopping off and modulation on.
2. Setup the ETU operate at channel low, mid and high and normal voltage.
3. Set the RBW=100kHz, VBW=300kHz, Sweep = auto, Start=10MHz, Stop=1GHz. Max hold view, mark highest level.
4. Set the RBW=1MHz, VBW=3MHz, Sweep = auto, Start=1GHz, Stop=26GHz. Max hold view, mark highest level.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.
6. The Worst data was report.

### 4.3.5 Test Results

Test Data: BLE\2402MHz

| Below 1GHz | Above 1GHz |
| --- | --- |
|  |  |

# 5. Appendix

## 5.1 Appendix A: Equipment List

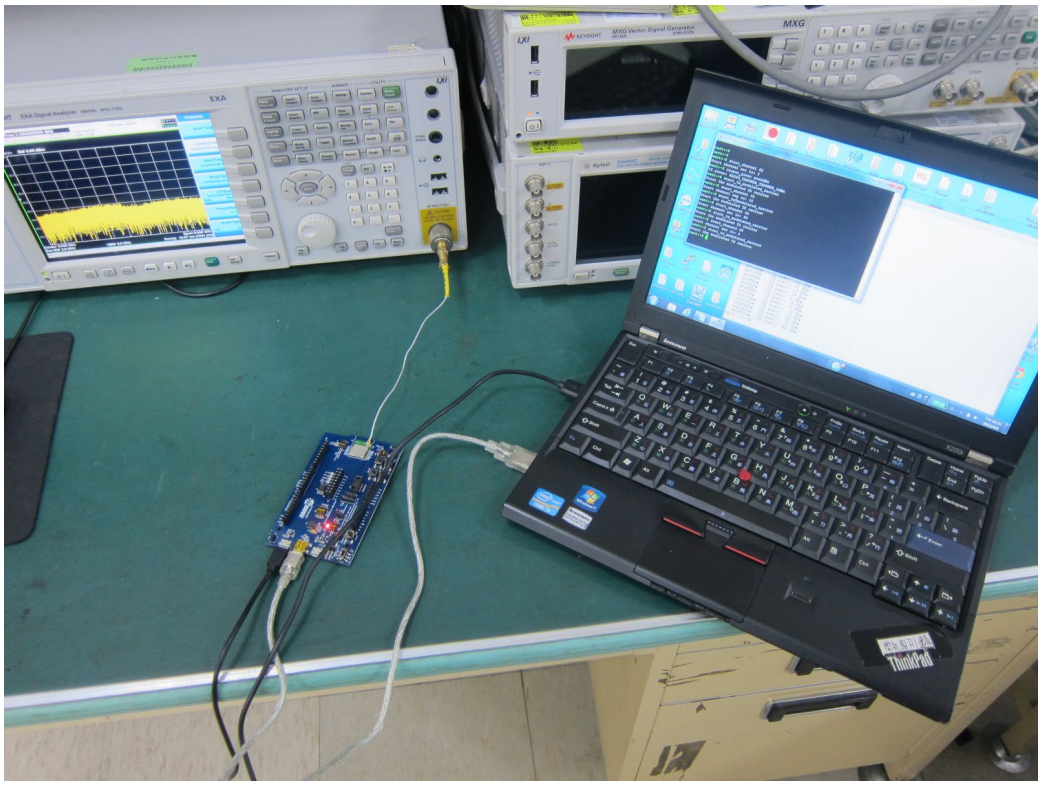
| Location Conducted | Equipment Name | Brand | Model | S/N | Last Cal. Date | Next Cal. Date |
|---|---|---|---|---|---|---|
| Conducted | Power Meter | Anritsu | ML2495A | 1116010 | 09/29/2022 | 09/29/2023 |
| Conducted | Power Sensor | Anritsu | MA2411B | 34NKF50 | 09/29/2022 | 09/29/2023 |
| Conducted | Power Sensor | DARE | RPR3006W | 13I00030SNO33 | 01/07/2022 | 01/07/2023 |
| Conducted | Power Sensor | DARE | RPR3006W | 13I00030SNO34 | 01/07/2022 | 01/07/2023 |
| Conducted | Power Sensor | DARE | RPR3006W | 14I00889SNO35 | 06/29/2022 | 06/29/2023 |
| Conducted | Power Sensor | DARE | RPR3006W | 14I00889SNO36 | 06/29/2022 | 06/29/2023 |
| Conducted | Temperature Chamber | KSON | THS-B4H100 | 2287 | 05/20/2022 | 05/20/2023 |
| Conducted | DC Power supply | ABM | 8185D | N/A | 01/06/2022 | 01/06/2023 |
| Conducted | AC Power supply | EXTECH | CFC105W | NA | N/A | N/A |
| Conducted | Spectrum analyzer | Keysight | N9010A | MY56070257 | 09/28/2022 | 09/28/2023 |
| Conducted | Test Software | DARE | Radiation Ver:2013.1.23 | NA | NA | NA |
| Conducted | Test Software | R&S | CMUGO Ver:2.0.0 | N/A | N/A | N/A |
| Conducted | Universal Digital Radio Communication Tester | R&S | CMU200 | 111968 | 11/18/2022 | 11/18/2023 |
| Conducted | Wideband Radio Communication Tester | R&S | CMW500 | 1201.002K50108793-JG | 10/31/2022 | 10/31/2023 |
| Conducted | BT Simulator | Agilent | N4010A | MY48100200 | NA | NA |
| Conducted | GPS Simulator | Welnavigate | GS-50 | 701523 | NA | NA |
| Conducted (DFS) | Test Software | Keysight | N9607B DFS Radar Profiles | NA | NA | NA |
| Conducted (DFS) | Test Software | Keysight | ETSI Standard test system | NA | NA | NA |
| Conducted (TS8997) | Wideband Radio Communication Tester | R&S | CMW500 | 168811 | 09/22/2022 | 09/22/2023 |
| Conducted (TS8997) | Signal Generator | R&S | SMB100B | 101085 | 09/21/2022 | 09/21/2023 |
| Conducted (TS8997) | Vector Signal Generator | R&S | SMBV100A | 263246 | 09/21/2022 | 09/21/2023 |
| Conducted (TS8997) | Signal analyzer 40GHz | R&S | FSV40 | 101884 | 09/22/2022 | 09/22/2023 |
| Conducted (TS8997) | OSP150 extension unit CAM-BUS | R&S | OSP150 | 101107 | 09/21/2022 | 09/21/2023 |
| Conducted (TS8997) | Test Software | R&S | EMC32 | NA | NA | NA |

## 5.2 Appendix B: Uncertainty of Measurement

ISO/IEC 17025 requires that an estimate of measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

| Parameters | Uncertainty (k=2) |
|---|---|
| Radio frequency | ±0.03 ppm |
| RF power, conducted | ±1.386 dB |
| Power Spectral Density, conducted | ±1.432 dB |
| Occupied Bandwidth | ±0.46 % |
| Spurious emission, conducted | ±0.852 dB |
| Temperature | ±0.826 ℃ |

## 5.3 Appendix C: Photographs of Setup



## 5.4 Appendix D: Photographs of EUT

Please refer to the File of **ISL-21LR066P-R1**

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