

# TEST REPORT

of

## JAPAN MIC

Product: **Bluetooth 5.1 Module**  
Brand: **Fanstel**  
Main Model: **BC40C**  
Series Model: **BC40M; BC40P**  
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.**

TEL: +886-3-263-8888 FAX: +886-3-263-8899

No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan

Report No.: **ISL-21LR190JAP-R1**  
Issue Date : **November 18, 2022**



Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein. The uncertainty of the measurement does not include in consideration of the test result unless the customer required the determination of uncertainty via the agreement, regulation or standard document specification. This test report shall not be reproduced except in full, without the written approval of International Standards Laboratory Corp.

## VERIFICATION OF COMPLIANCE

**Applicant:** Fanstel Corporation, Taipei  
**Equipment Under Test:** Bluetooth 5.1 Module  
**Brand:** Fanstel  
**Main Model:** BC40C  
**Series Model:** BC40M; BC40P  
**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:** Weitn Chen **Date:** November 18, 2022

Weitn 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	2021/07/15	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

<b>1.</b>	<b>Description of Equipment under Test (EUT)</b>	<b>5</b>
1.1	GENERAL INFORMATION	5
1.2	ANTENNA SPECIFICATION	6
1.3	ASSEMBLE	6
1.4	SUPPORT EQUIPMENT	7
<b>2.</b>	<b>Description of Test Modes</b>	<b>8</b>
<b>3.</b>	<b>General Description of Applied Standards</b>	<b>8</b>
<b>4.</b>	<b>Summary of Tests</b>	<b>9</b>
4.1	ANTENNA POWER AND TOLERANCE	10
4.2	TRANSMITTER SPURIOUS EMISSIONS	12
4.3	LIMITATION OF COLLATERAL EMISSION OF RECEIVER	14
<b>5.</b>	<b>Appendix</b>	<b>16</b>
5.1	APPENDIX A: EQUIPMENT LIST	16
5.2	APPENDIX B: UNCERTAINTY OF MEASUREMENT	17
5.3	APPENDIX C: PHOTOGRAPHS OF SETUP	18
5.4	APPENDIX D: PHOTOGRAPHS OF EUT	19

## 1. Description of Equipment under Test (EUT)

### 1.1 General Information

General:

Product Name:	Bluetooth 5.1 Module
Brand Name:	Fanstel
Model Name:	BC40C; BC40M; BC40P
Model Difference:	Antenna difference
Power Supply:	5Vdc from USB (JIG)
USB port	one (JIG)

Model Summaries:

module	BC40C	BC40M	BC40P
SoC	nRF5340 CLAA	nRF5340 CLAA	nRF5340 CLAA
Size	8.4x11.5x1.5 mm	8.4(10.1)x12.7x1.5mm	8.4x9x1.5mm
32 MHz and 32.768 kHz crystals	Integrated	Integrated	Integrated
DC converter inductors, VDD,VDDH	Integrated	Integrated	Integrated
BT Antenna	Chip	PCB trace	Pads for external
Max TX			
Operating temp.	-40°C to +105°C	-40°C to +105°C	-40°C to +105°C
Availability	Sample 05/2021	Sample 05/2021	Sample 06/2021

BLE:

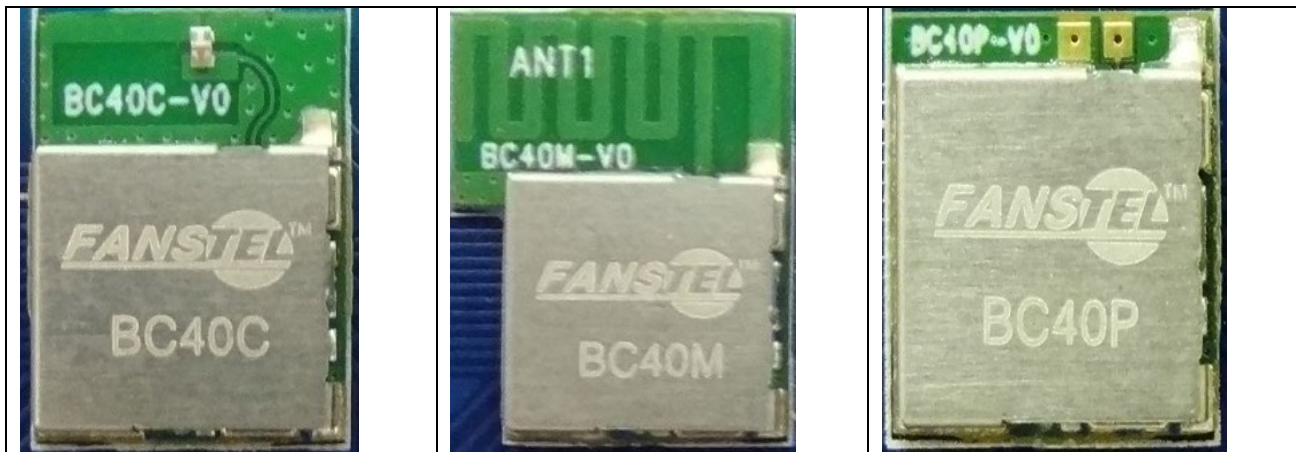
Bluetooth Version	5.1
Rated Transmit Power	2.2 mW
Frequency Range	2.402GHz – 2.480GHz
Modulation Technique	GFSK
Channel number	40 channels
Dwell Time	N/A
Operating Mode	Point-to-Point

## 1.2 Antenna Specification

Antenna Type	BC40C: Chip Antenna BC40M: PCB trace Antenna BC40P: Pads for external Antenna
Peak Gain	BC40C: 1dBi BC40M: 1.53dBi BC40P: 0.54dBi
Impedance	50.0 ohms
Radiation pattern	Omni

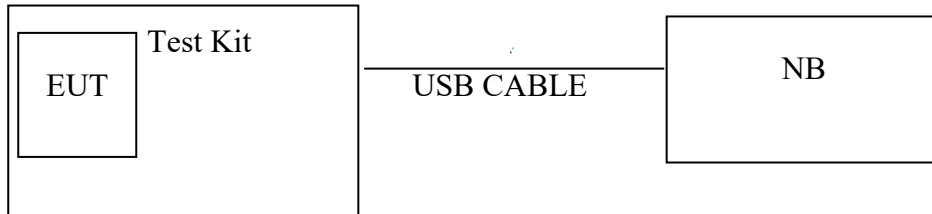
## 1.3 Assemble

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

**Note:** All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.

**Grounding:** Grounding was in accordance with the manufacturer's requirements and conditions for the intended use.

## 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.

A software tool or a built-in test-mode needs to be reported with the parameter settings for creating the appropriate selection. The software settings shall be reported because of the traceability requirement of the measurements. The settings are depending upon the IEEE standard & mode and the applied modulation. Most common settings are:

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

### Test channels in BT 5.01LE 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  $OBW < 26\text{MHz}$ )

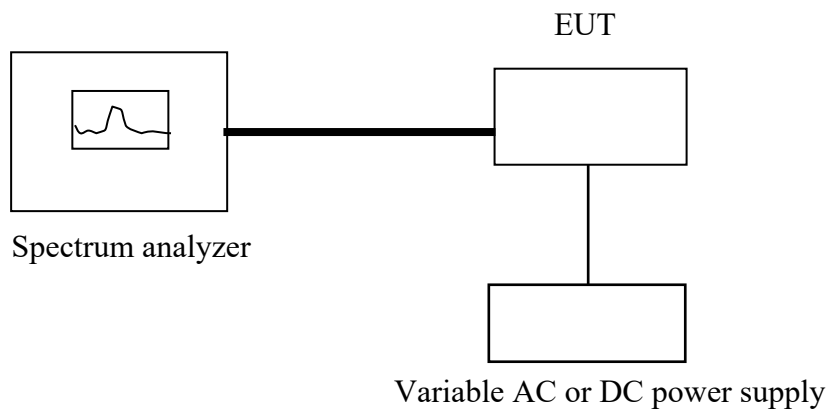
Wifi: 5mW/MHz (for  $26\text{MHz} \leq OBW < 38\text{MHz}$ )

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 EUT 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°C

Relative humidity: 67%

Test Date: 2022/11/11

##### BLE

Rated Power =2

Antenna Gain=1.53

		Channel Low	Channel Mid	Channel High	Limit
Normal Voltage 5 V	Conducted Power (dBm)	3.37	3.403	3.342	N/A
	Conducted Power (mW)	2.173	2.189	2.159	10mW
	Power Tolerance	8.635	9.464	7.937	+20% to -80%
Upper Voltage 5.5 V	Conducted Power (dBm)	3.418	3.441	3.333	N/A
	Conducted Power (mW)	2.197	2.209	2.154	10mW
	Power Tolerance	9.842	10.426	7.713	+20% to -80%
Lower Voltage 4.5 V	Conducted Power (dBm)	3.393	3.437	3.295	N/A
	Conducted Power (mW)	2.184	2.206	2.136	10mW
	Power Tolerance	9.212	10.324	6.775	+20% to -80%

Remark:

1. Conducted Power (mW/MHz)=  $10^{(\text{Conducted Power(dBm/MHz)}/10)}$

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.

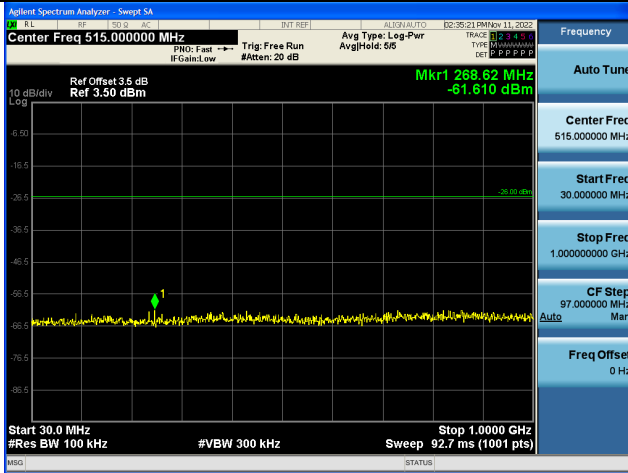
### **4.2.4 Test Procedure**

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.

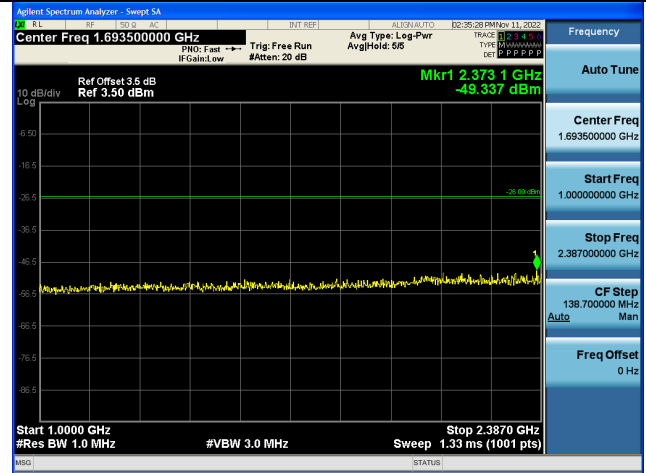
## 4.2.5 Test Results

Test Data: BLE\2442MHz

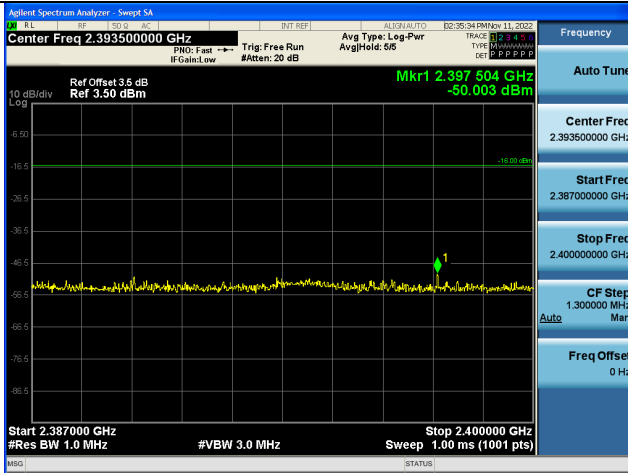
10MHz – 1000MHz



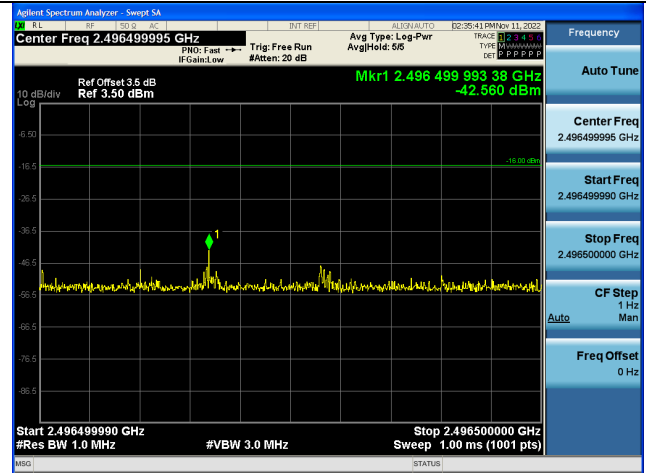
1000MHz – 2387MHz



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**

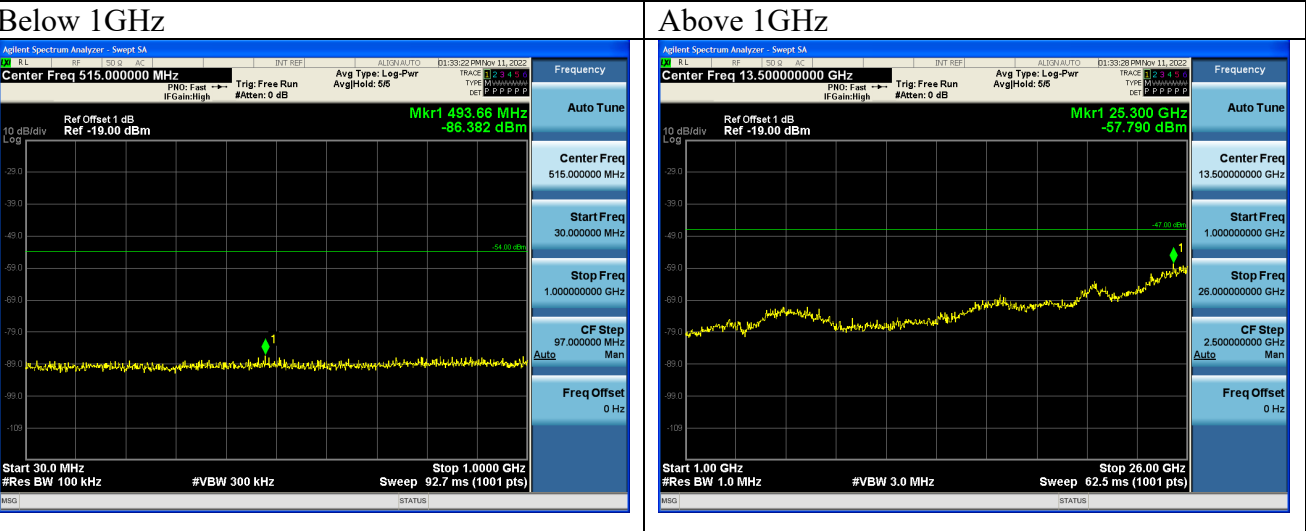
Refer to section 4.1.3 for detail.

#### **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\2442MHz



## 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	11/18/2022
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)	Cable	Draka	NA	NA	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

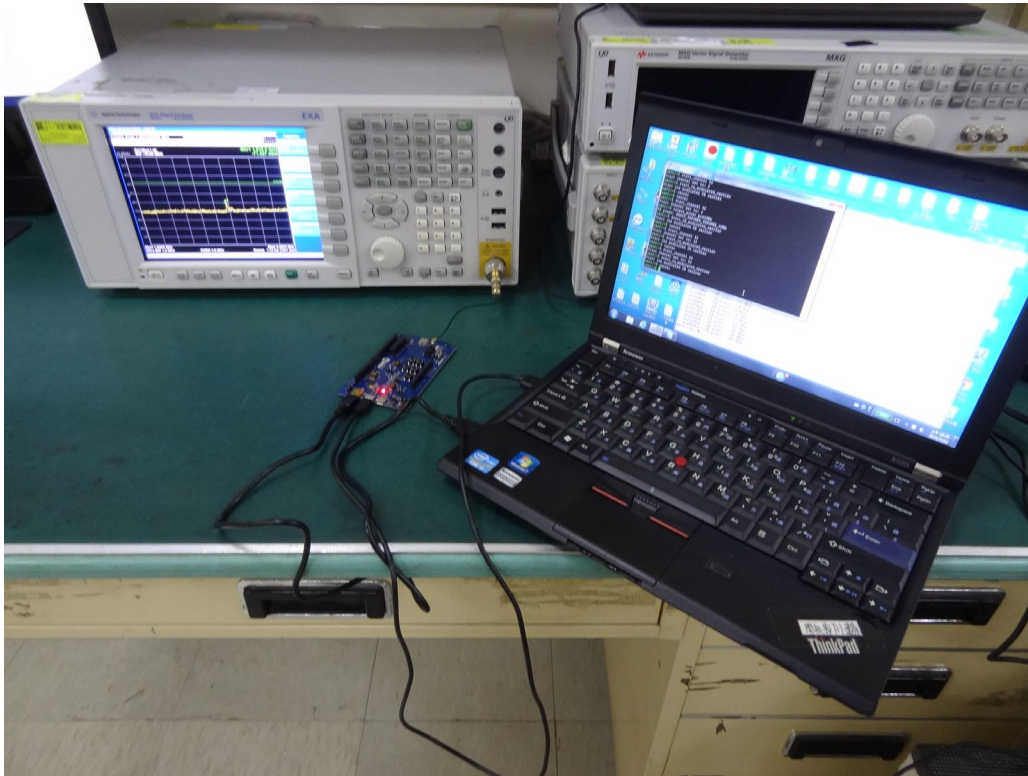


## 5.2 Appendix B: Uncertainty of Measurement

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	$\pm 0.03$ ppm
RF power, conducted	$\pm 1.386$ dB
Power Spectral Density, conducted	$\pm 1.432$ dB
Occupied Bandwidth	$\pm 0.46$ %
Spurious emission, conducted	$\pm 0.852$ dB
Temperature	$\pm 0.826$ °C

### 5.3 Appendix C: Photographs of Setup



#### **5.4 Appendix D: Photographs of EUT**

Please refer to the File of **ISL-21LR190P-R1**

--- END ---