TEST REPORT

of

Australian/New Zealand Standard AS/NZS 4268:2017

Product :	**Bluetooth 5.0, 802.15.4 module**
Brand:	**Fanstel**
Model:	**BT840, BT840F, BT840E, BT840H**
Model Difference:	**Antenna. Please see page 5 for detail**
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.>
*Site Registration No.
BSMI: SL2-IN-E-0013; MRA TW1036; TAF: 0997
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No. 120, Lane 180, Hsin Ho Rd.,
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Report No.: **ISL-19LR205ANZ**

Issue Date : **2019/09/02**

VERIFICATION OF COMPLIANCE

Applicant:	Fanstel Corporation, Taipei
Product Description:	Bluetooth 5.0, 802.15.4 module
Brand Name:	Fanstel
Model No.:	BT840, BT840F, BT840E, BT840H
Model Difference:	Antenna. Please see page 5 for detail
Date of test:	2019/8/6 ~2019/8/27
Date of EUT Received:	2019/8/5

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
AS/NZS 4268:2017, Row 59 Row 21	Complied

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory Corp.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By:	Weitin Chen	***Date:***	2019/09/02
	Weitin Chen / Senior Engineer		
Prepared By:	Elisa Chen	***Date:***	2019/09/02
	Elisa Chen / Senior Engineer		
Approved By:	Jerry Liu	***Date:***	2019/09/02
	Jerry Liu / Technical Manager		

Version

Version No.	Date	Description
00	2019/09/02	Initial creation of document

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1 Description of Equipment Under Test (EUT)

General:

Product Name:	Bluetooth 5.0, 802.15.4 module
Brand Name:	Fanstel
Model Name:	BT840, BT840F, BT840E, BT840H
Model Difference:	Antenna. Please see table below for detail.
Type of Equipment:	Stand-alone equipment
Temperature Range:	-40°C to +85°C
Simultaneous transmissions:	Yes
Geo-location capability:	No
Power Supply	5Vdc by USB port

Model Summaries

module	BT840F	BT840	BT840E	BT840H
SoC	nRF52840-QIAA	nRF52840-QIAA	nRF52840-QIAA	nRF52840-QIAA
Size	15x20.8x1.9mm	14x16x1.9mm	14x16x1.9mm	14x16x1.9mm
BT Antenna	PCB trace	PCB trace	u.FL	MHF4
BT range at 1Mbps	510 meters	180 M, estimated		
BT range at 125 Kbps	930 meters		>1000 M	>1000 M

	BT 4.0	IEEE 802.15.4 (Thread, Zigbee)
Frequency Range:	2402 – 2480MHz	2405 – 2480MHz
Channel number:	40 channels	16 channels
Modulation type:	Wide band Modulation	Wide band Modulation
Transmit Power: (EIRP)	BT840E : 8.20 dBi BT840F : 8.20 dBi	BT840E : 8.30 dBi BT840F : 8.30 dBi
Dwell Time	N/A	
Operating Mode	Point-to-Point	
Adaptive/ Non-Adaptive	Non-Adaptive	
LBT (Listen Before Talk)	Yes	
	■ Adaptive Frequency Hopping using LBT based DAA ☐ Adaptive Frequency Hopping using other forms of DAA (non-LBT based) ☐ Short Control Signaling Transmissions	
Occupied Channel Bandwidth	Within 2400-2483.5MHz	
Duty Cycle	N/A	
Antenna Beam forming	No	
Antenna Designation:	Type: PCB Antenna, BT840F : 0.34 dBi Type: PCB Antenna, BT840: -3.52 dBi Type: Dipole Antenna,BT840E : 0 dBi Type: Dipole Antenna,BT840H : 0 dBi	

This test report applies for Bluetooth BLE and IEEE 802.15.4 (Thread, Zigbee).

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

2 Description of Test Modes and Test Condition

The EUT has been tested under Operating and standby condition. And used to control the EUT for staying in continuous transmitting and receiving mode is programmed. Channel lower, mid and higher of Bluetooth BLE modes were chosen for testing.

Normal test conditions:

Temperature : -20℃ to 55℃
Relative humidity: 20 % to 75 %
5Vdc Voltage

Extreme Temperatures

For test at extreme temperatures, measurements shall be in accordance with the procedures specified in section 5.3 of AS/NZS 4268 at upper value of +85 degree and at a lower value of -40 degree.

Extreme Test Source Voltages

Low voltage is 4.5Vdc and 5.5Vdc for high voltage nominal voltage 5Vdc

3 General Description of Apply Standards

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

AS/NZS 4268:2017, – Radio equipment and systems – Short range devices – Limits and methods of measurement.

Row 59: Digital modulation transmitters
Row 21: All transmitters

EN 300 440 V1.6.1 – Part 1: Technical characteristics and test method.

4 Test Facility

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

A fully anechoic chamber was used for the radiated spurious emissions test.

TAF Accreditation Lab. Lab number: 0997

NEMKO Laboratory Authorization No.: ELA 113B

5 Support Equipment

Fig. 5-1 Configuration of Tested System

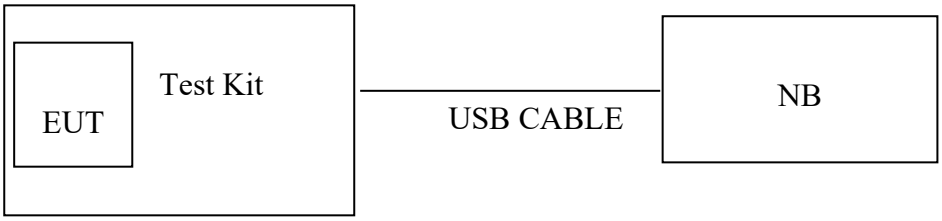


Table 5-1 Equipment Used in Tested System

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

6 Maximum EIRP Measurement

6.1. Limit:

4W(36dBm) for Row 59

10W(20dBm) for Row 21

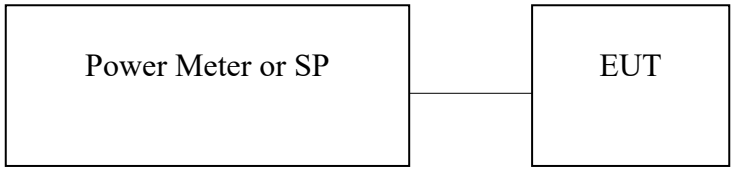
According to AS/NZS 4268:2017, Table 1, row 59: Digital modulation transmitters

According to AS/NZS 4268:2017, Table 1, row 21: All transmitters

6.2. Measurement Equipment Used:

Conducted Emission Test Site					
Equipment Type	**Manufacturer**	**Model Number**	**Serial Number**	**Last Cal.**	**Cal. Due.**
Power Sensor 06	DARE	RPR3006W	13I00030SNO33	01/11/2019	01/10/2020
Power Sensor 07	DARE	RPR3006W	13I00030SNO34	01/11/2019	01/10/2020
Temperature Chamber	KSON	THS-B4H100	2287	02/19/2019	02/18/2020
DC Power supply	ABM	8185D	N/A	01/10/2019	01/09/2020
AC Power supply	EXTECH	CFC105W	NA	N/A	N/A
Attenuator	Woken	Watt-65m3502	11051601	NA	NA
Splitter	MCLI	PS4-199	12465	12/26/2017	12/25/2019
Spectrum analyzer	keysight	N9010A	MY56070257	10/15/2018	10/14/2019
Spectrum analyzer	R&S	FSP40	100116	01/10/2019	01/09/2020
Test Software	DARE	Radiation Ver:2013.1.23	NA	NA	NA

6.3. Test Setup:



6.4. Test Procedure:

Refer to ETSI EN 300 440-1 V1.6.1, clause 7.1.

Refer to ETSI EN 300 328 V2.1.1,

See Sub-Clause 5.3.2.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.3.2.2.1.1 of ETSI EN 300 328 for conducted method.

6.5. Measurement Result: Refer to next page for the details.

6.5.1. Test Results:

Dipole Antenna

Example Calculation:

Pburst values (A) = Reading + Cable Loss

RF output power (P) = A+G+Y

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: BT BLE

Pburst values (value "A" in dBm)	
antenna assembly gain "G" in dBi	0.00 dBi
beamforming gain "Y" in dB	0.00 dB
Cable Loss=	21.00 dB

TEST CONDITIONS		TRANSMITTER POWER (dBm)		
		Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	Vmin 4.5 V	P 8.20 dBm	P 8.20 dBm	P 8.20 dBm
		A 8.20 dBm	A 8.20 dBm	A 8.20 dBm
		Reading -12.80 dBm	Reading -12.80 dBm	Reading -12.80 dBm
	Vmax 5.5 V	P 8.20 dBm	P 8.20 dBm	P 8.20 dBm
		A 8.20 dBm	A 8.20 dBm	A 8.20 dBm
		Reading -12.80 dBm	Reading -12.80 dBm	Reading -12.80 dBm
Temp 25 °C	Vnom 5 V	P 7.40 dBm	P 7.40 dBm	P 7.40 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
Temp 80 °C	Vmin 4.5 V	P 7.40 dBm	P 7.40 dBm	P 7.40 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
	Vmax 5.5 V	P 7.40 dBm	P 7.40 dBm	P 7.40 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
Limit(P)		36dBm		
Measurement uncertainty		+ 0.28dB / - 0.30dB		

Dipole Antenna

Example Calculation:

Pburst values (A) = Reading + Cable Loss

RF output power (P) = A+G+Y

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee)

Pburst values (value "A" in dBm)

antenna assembly gain "G" in dBi	0.00 dBi
beamforming gain "Y" in dB	0.00 dB
Cable Loss=	21.00 dB

TEST CONDITIONS		TRANSMITTER POWER (dBm)		
		Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	Vmin 4.5 V	P 8.30 dBm	P 8.30 dBm	P 8.30 dBm
		A 8.30 dBm	A 8.30 dBm	A 8.30 dBm
		Reading -12.70 dBm	Reading -12.70 dBm	Reading -12.70 dBm
	Vmax 5.5 V	P 8.30 dBm	P 8.30 dBm	P 8.30 dBm
		A 8.30 dBm	A 8.30 dBm	A 8.30 dBm
		Reading -12.70 dBm	Reading -12.70 dBm	Reading -12.70 dBm
Temp 25 °C	Vnom 5 V	P 7.80 dBm	P 7.70 dBm	P 7.80 dBm
		A 7.80 dBm	A 7.70 dBm	A 7.80 dBm
		Reading -13.20 dBm	Reading -13.30 dBm	Reading -13.20 dBm
Temp 80 °C	Vmin 4.5 V	P 7.80 dBm	P 7.80 dBm	P 7.80 dBm
		A 7.80 dBm	A 7.80 dBm	A 7.80 dBm
		Reading -13.20 dBm	Reading -13.20 dBm	Reading -13.20 dBm
	Vmax 5.5 V	P 7.80 dBm	P 7.80 dBm	P 7.80 dBm
		A 7.80 dBm	A 7.80 dBm	A 7.80 dBm
		Reading -13.20 dBm	Reading -13.20 dBm	Reading -13.20 dBm
Limit(P)		36dBm		
Measurement uncertainty		+ 0.28dB / - 0.30dB		

PCB Antenna

Example Calculation:

Pburst values (A) = Reading + Cable Loss

RF output power (P) = A+G+Y

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: BT BLE

Pburst values (value "A" in dBm)

antenna assembly gain "G" in dBi 0.34 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 21.00 dB

TEST CONDITIONS		TRANSMITTER POWER (dBm)		
		Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	Vmin 4.5 V	P 8.54 dBm	P 8.54 dBm	P 8.54 dBm
		A 8.20 dBm	A 8.20 dBm	A 8.20 dBm
		Reading -12.80 dBm	Reading -12.80 dBm	Reading -12.80 dBm
	Vmax 5.5 V	P 8.54 dBm	P 8.54 dBm	P 8.54 dBm
		A 8.20 dBm	A 8.20 dBm	A 8.20 dBm
		Reading -12.80 dBm	Reading -12.80 dBm	Reading -12.80 dBm
Temp 25 °C	Vnom 5 V	P 7.74 dBm	P 7.74 dBm	P 7.74 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
Temp 80 °C	Vmin 4.5 V	P 7.74 dBm	P 7.74 dBm	P 7.74 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
	Vmax 5.5 V	P 7.74 dBm	P 7.74 dBm	P 7.74 dBm
		A 7.40 dBm	A 7.40 dBm	A 7.40 dBm
		Reading -13.60 dBm	Reading -13.60 dBm	Reading -13.60 dBm
Limit(P)		36dBm		
Measurement uncertainty		+ 0.28dB / - 0.30dB		

PCB Antenna

Example Calculation:

Pburst values (A) = Reading + Cable Loss

RF output power (P) = A+G+Y

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee)

Pburst values (value "A" in dBm)

antenna assembly gain "G" in dBi 0.34 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 21.00 dB

TEST CONDITIONS		TRANSMITTER POWER (dBm)		
		Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	Vmin 4.5 V	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm
	Vmax 5.5 V	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm	P 8.64 dBm A 8.30 dBm Reading -12.70 dBm
Temp 25 °C	Vnom 5 V	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm	P 8.04 dBm A 7.70 dBm Reading -13.30 dBm	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm
Temp 80 °C	Vmin 4.5 V	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm
	Vmax 5.5 V	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm	P 8.14 dBm A 7.80 dBm Reading -13.20 dBm
Limit(P)		36dBm		
Measurement uncertainty		+ 0.28dB / - 0.30dB		

7 Transmitter Spurious Emissions Measurement

7.1. Limit:

According to AS/NZS 4268:2017, Table 1, row 59: Digital modulation transmitters

According to AS/NZS 4268:2017, Table 1, row 21: All transmitters

7.2. Measurement Equipment Used:

Refer to section 6.2 of present report.

7.3. Test Setup:

Refer to section 6.3 of present report.

7.4. Test Procedure:

Refer to ETSI EN 300 440-1 V1.6.1, clause 7.3.

7.5. Measurement Result:

Refer to next page for the details.

7.5.1. Test Results: (Radiated)

Ambient temperature: 25 ℃ Relative humidity: 60 % Test Date: 2019/08/15

Test Mode: BLE mode, TX CH Low (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.00	-72.01	8.27	-63.74	-40.00	-23.74	VERTICAL
2	96.93	-66.49	-0.23	-66.72	-40.00	-26.72	VERTICAL
3	571.26	-81.51	9.45	-72.06	-40.00	-32.06	VERTICAL
4	739.07	-82.47	13.75	-68.72	-40.00	-28.72	VERTICAL
5	809.88	-82.69	13.72	-68.97	-40.00	-28.97	VERTICAL
6	933.07	-82.42	17.39	-65.03	-40.00	-25.03	VERTICAL
7	4804.00	-79.43	15.71	-63.72	-40.00	-23.72	VERTICAL
8	6299.00	-77.19	19.19	-58.00	-40.00	-18.00	VERTICAL
1	30.97	-77.33	10.48	-66.85	-40.00	-26.85	HORIZONTAL
2	106.63	-73.57	1.11	-72.46	-40.00	-32.46	HORIZONTAL
3	476.20	-81.68	8.39	-73.29	-40.00	-33.29	HORIZONTAL
4	595.51	-82.70	11.13	-71.57	-40.00	-31.57	HORIZONTAL
5	671.17	-81.68	12.03	-69.65	-40.00	-29.65	HORIZONTAL
6	741.98	-82.65	14.01	-68.64	-40.00	-28.64	HORIZONTAL
7	4804.00	-79.18	15.63	-63.55	-40.00	-23.55	HORIZONTAL
8	6481.00	-78.67	23.69	-54.98	-40.00	-14.98	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25 ℃ Relative humidity: 60 % Test Date: 2019/08/15

Test Mode: BLE mode, TX CH High (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	90.14	-66.05	0.59	-65.46	-40.00	-25.46	VERTICAL
2	205.57	-73.07	1.98	-71.09	-40.00	-31.09	VERTICAL
3	528.58	-81.98	8.93	-73.05	-40.00	-33.05	VERTICAL
4	640.13	-82.24	11.71	-70.53	-40.00	-30.53	VERTICAL
5	718.70	-82.14	13.82	-68.32	-40.00	-28.32	VERTICAL
6	833.16	-81.10	14.39	-66.71	-40.00	-26.71	VERTICAL
7	4960.00	-76.22	16.40	-59.82	-40.00	-19.82	VERTICAL
8	7545.00	-79.24	23.35	-55.89	-40.00	-15.89	VERTICAL
1	70.74	-75.08	4.38	-70.70	-40.00	-30.70	HORIZONTAL
2	200.72	-72.47	1.28	-71.19	-40.00	-31.19	HORIZONTAL
3	480.08	-80.38	8.39	-71.99	-40.00	-31.99	HORIZONTAL
4	583.87	-82.05	10.86	-71.19	-40.00	-31.19	HORIZONTAL
5	679.90	-81.56	12.18	-69.38	-40.00	-29.38	HORIZONTAL
6	784.66	-81.78	14.20	-67.58	-40.00	-27.58	HORIZONTAL
7	4960.00	-78.64	16.15	-62.49	-40.00	-22.49	HORIZONTAL
8	6404.00	-77.97	22.98	-54.99	-40.00	-14.99	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25 ℃ Relative humidity: 60 % Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee) mode, TX CH Low (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	149.31	-81.97	6.12	-75.85	-40.00	-35.85	VERTICAL
2	362.71	-82.79	5.67	-77.12	-40.00	-37.12	VERTICAL
3	505.30	-82.51	8.95	-73.56	-40.00	-33.56	VERTICAL
4	644.01	-82.93	11.86	-71.07	-40.00	-31.07	VERTICAL
5	728.40	-80.44	13.78	-66.66	-40.00	-26.66	VERTICAL
6	866.14	-82.19	15.49	-66.70	-40.00	-26.70	VERTICAL
7	1840.00	-70.77	3.82	-66.95	-40.00	-26.95	VERTICAL
8	4810.00	-82.15	15.74	-66.41	-40.00	-26.41	VERTICAL
1	164.83	-80.77	3.46	-77.31	-40.00	-37.31	HORIZONTAL
2	272.50	-82.59	4.17	-78.42	-40.00	-38.42	HORIZONTAL
3	468.44	-83.13	8.38	-74.75	-40.00	-34.75	HORIZONTAL
4	596.48	-82.78	11.15	-71.63	-40.00	-31.63	HORIZONTAL
5	703.18	-82.49	12.64	-69.85	-40.00	-29.85	HORIZONTAL
6	827.34	-81.43	14.61	-66.82	-40.00	-26.82	HORIZONTAL
7	1588.00	-69.60	2.81	-66.79	-40.00	-26.79	HORIZONTAL
8	4810.00	-83.47	15.65	-67.82	-40.00	-27.82	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25 ℃ Relative humidity: 60 % Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee) mode, TX CH High (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	149.31	-81.39	6.12	-75.27	-40.00	-35.27	VERTICAL
2	361.74	-82.49	5.66	-76.83	-40.00	-36.83	VERTICAL
3	525.67	-80.99	8.93	-72.06	-40.00	-32.06	VERTICAL
4	652.74	-82.46	12.18	-70.28	-40.00	-30.28	VERTICAL
5	748.77	-81.79	13.71	-68.08	-40.00	-28.08	VERTICAL
6	925.31	-82.93	17.25	-65.68	-40.00	-25.68	VERTICAL
7	1994.00	-68.01	4.60	-63.41	-40.00	-23.41	VERTICAL
8	4960.00	-80.87	16.40	-64.47	-40.00	-24.47	VERTICAL
1	68.80	-79.59	4.66	-74.93	-40.00	-34.93	HORIZONTAL
2	172.59	-81.28	2.93	-78.35	-40.00	-38.35	HORIZONTAL
3	430.61	-83.68	7.80	-75.88	-40.00	-35.88	HORIZONTAL
4	579.02	-81.41	10.74	-70.67	-40.00	-30.67	HORIZONTAL
5	740.04	-82.09	13.94	-68.15	-40.00	-28.15	HORIZONTAL
6	868.08	-82.96	15.25	-67.71	-40.00	-27.71	HORIZONTAL
7	1896.00	-71.79	4.32	-67.47	-40.00	-27.47	HORIZONTAL
8	4960.00	-84.47	16.15	-68.32	-40.00	-28.32	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

8 Emission Bandwidth Measurement

8.1. Limit:

99% power emission bandwidth shall within 2400MHz and 2483.5MHz.

According to AS/NZS 4268:2017, section 6.5.

8.2. Measurement Equipment Used:

Refer to section 6.2 of present report.

8.3. Test Setup:

Refer to section 6.3 of present report.

8.4. Test Procedure:

Refer to section 6.5 of AS/NZS 4268 for the details.

8.5. Measurement Result:

Ambient temperature: 25 ℃ Relative humidity: 60 % Test Date: 2019/08/15

	Channel	Measured Frequency (MHz)	Limit (MHz)
BLE	Upper Frequency	2401.501	>2400
	Lower Frequency	2480.583	<2483.5

	Channel	Measured Frequency (MHz)	Limit (MHz)
IEEE 802.15.4 (Thread, Zigbee)	Upper Frequency	2401.501	>2400
	Lower Frequency	2480.583	<2483.5

9 Operating Frequencies Measurement

9.1. Limit:

2400MHz and 2483.5MHz.

According to AS/NZS 4268:2017 section 6.6.

9.2. Measurement Equipment Used:

Refer to section 6.2 of present report.

9.3. Test Setup:

Refer to section 6.3 of present report.

9.4. Test Procedure:

Refer to ETSI EN 300 440-1 V1.6.1, clause 7.2.2 and 7.2.3.

Refer to ETSI EN 300 328 V2.1.1, clause 4.3.2.7

9.5. Measurement Result:

Dipole Antenna

Test Results: BT BLE mode

Ambient temperature: 25 ℃ Relative humidity: 60% Test Date: 2019/08/15

antenna assembly gain "G" in dBi	0.00	dBi
beamforming gain "Y" in dB	0.00	dB
Cable Loss=	1.00	dB

TEST CONDITIONS				FREQUENCY (MHz)	
				Lowest	Highest
Temp -40 °C	V_{min}	4.50	V	2402.0017	2480.0012
	V_{max}	5.50	V	2402.0017	2480.0013
Temp 25 °C	V_{nom}	5.00	V	2402.0018	2480.0013
Temp 80 °C	V_{min}	4.50	V	2402.0015	2480.0012
	V_{max}	5.50	V	2402.0014	2480.0014
Measured frequencies (lowest and highest)				f_L = 2402.0014 MHz	fH= 2480.0014 MHz
Limit				2400.0000 MHz	2483.5000 MHz
Measurement Uncertainty				+/- 120kHz	

Dipole Antenna

Test Results: IEEE 802.15.4 (Thread, Zigbee) mode

Ambient temperature: 25 ℃ Relative humidity: 60% Test Date: 2019/08/15

antenna assembly gain "G" in dBi	0.00	dBi
beamforming gain "Y" in dB	0.00	dB
Cable Loss=	1.00	dB

TEST CONDITIONS				FREQUENCY (MHz)	
				Lowest	Highest
Temp -40 °C	V_{min}	4.50	V	2405.0016	2480.0015
	V_{max}	5.50	V	2405.0015	2480.0012
Temp 25 °C	V_{nom}	5.00	V	2405.0015	2480.0014
Temp 80 °C	V_{min}	4.50	V	2405.0017	2480.0014
	V_{max}	5.50	V	2405.0016	2480.0012
Measured frequencies (lowest and highest)				f_L = 2405.0015 MHz	fH= 2480.0015 MHz
Limit				2400.0000 MHz	2483.5000 MHz
Measurement Uncertainty				+/- 120kHz	

PCB Antenna

Test Results: BT BLE mode

Ambient temperature: 25 ℃ Relative humidity: 60% Test Date: 2019/08/15

antenna assembly gain "G" in dBi	0.34	dBi
beamforming gain "Y" in dB	0.00	dB
Cable Loss=	1.00	dB

TEST CONDITIONS				FREQUENCY (MHz)	
				Lowest	Highest
Temp -40 °C	V_{min}	4.50	V	2402.0017	2480.0012
	V_{max}	5.50	V	2402.0017	2480.0013
Temp 25 °C	V_{nom}	5.00	V	2402.0018	2480.0013
Temp 80 °C	V_{min}	4.50	V	2402.0015	2480.0012
	V_{max}	5.50	V	2402.0014	2480.0014
Measured frequencies (lowest and highest)				f_L = 2402.0014 MHz	fH= 2480.0014 MHz
Limit				2400.0000 MHz	2483.5000 MHz
Measurement Uncertainty				+/- 120kHz	

PCB Antenna

Test Results: IEEE 802.15.4 (Thread, Zigbee) mode

Ambient temperature: 25 ℃ Relative humidity: 60% Test Date: 2019/08/15

antenna assembly gain "G" in dBi	0.34	dBi
beamforming gain "Y" in dB	0.00	dB
Cable Loss=	1.00	dB

TEST CONDITIONS				FREQUENCY (MHz)	
				Lowest	Highest
Temp -40 °C	V_{min}	4.50	V	2405.0016	2480.0015
	V_{max}	5.50	V	2405.0015	2480.0012
Temp 25 °C	V_{nom}	5.00	V	2405.0015	2480.0014
Temp 80 °C	V_{min}	4.50	V	2405.0017	2480.0014
	V_{max}	5.50	V	2405.0016	2480.0012
Measured frequencies (lowest and highest)				f_L = 2405.0015 MHz	fH= 2480.0015 MHz
Limit				2400.0000 MHz	2483.5000 MHz
Measurement Uncertainty				+/- 120kHz	

10 Receiver Emissions Measurement

10.1. Limit:

According to section 7.2 of AS/NZS 4268:2017

25MHz to 1 GHz 2 nW ERP (-57 dBm).

1GHz to 40 GHz 20 nW ERP (-47 dBm).

10.2. Measurement Equipment Used:

Refer to section 6.2 of present report.

10.3. Test Setup:

Refer to section 6.3 of present report.

10.4. Test Procedure:

Refer to ETSI EN 300 440-1 V1.6.1, clause 8.4.

10.5. Measurement Result:

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: BLE mode, RX CH Low (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-72.32	7.94	-64.38	-54.82	-9.56	VERTICAL
2	90.14	-68.37	0.59	-67.78	-54.82	-12.96	VERTICAL
3	226.91	-73.07	3.44	-69.63	-54.82	-14.81	VERTICAL
4	422.85	-78.51	7.52	-70.99	-54.82	-16.17	VERTICAL
5	588.72	-80.77	9.87	-70.90	-54.82	-16.08	VERTICAL
6	751.68	-80.53	13.70	-66.83	-54.82	-12.01	VERTICAL
7	3268.00	-72.77	8.41	-64.36	-44.84	-19.52	VERTICAL
8	7160.00	-78.69	22.33	-56.36	-44.84	-11.52	VERTICAL
1	30.97	-75.95	10.48	-65.47	-54.82	-10.65	HORIZONTAL
2	106.63	-73.37	1.11	-72.26	-54.82	-17.44	HORIZONTAL
3	167.74	-73.46	3.25	-70.21	-54.82	-15.39	HORIZONTAL
4	372.41	-79.52	5.98	-73.54	-54.82	-18.72	HORIZONTAL
5	532.46	-81.38	9.49	-71.89	-54.82	-17.07	HORIZONTAL
6	705.12	-81.71	12.71	-69.00	-54.82	-14.18	HORIZONTAL
7	4955.00	-74.29	16.13	-58.16	-44.84	-13.32	HORIZONTAL
8	7034.00	-79.44	23.55	-55.89	-44.84	-11.05	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: BLE mode, RX CH High (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-73.45	7.94	-65.51	-54.82	-10.69	VERTICAL
2	90.14	-66.31	0.59	-65.72	-54.82	-10.90	VERTICAL
3	154.16	-79.06	5.76	-73.30	-54.82	-18.48	VERTICAL
4	399.57	-79.08	6.14	-72.94	-54.82	-18.12	VERTICAL
5	512.09	-81.36	8.94	-72.42	-54.82	-17.60	VERTICAL
6	741.98	-82.48	13.74	-68.74	-54.82	-13.92	VERTICAL
7	4955.00	-75.02	16.38	-58.64	-44.84	-13.80	VERTICAL
8	7503.00	-80.15	23.20	-56.95	-44.84	-12.11	VERTICAL
1	30.00	-76.53	10.91	-65.62	-54.82	-10.80	HORIZONTAL
2	106.63	-72.56	1.11	-71.45	-54.82	-16.63	HORIZONTAL
3	246.31	-75.14	4.38	-70.76	-54.82	-15.94	HORIZONTAL
4	399.57	-79.66	6.86	-72.80	-54.82	-17.98	HORIZONTAL
5	567.38	-81.50	10.47	-71.03	-54.82	-16.21	HORIZONTAL
6	754.59	-81.75	14.27	-67.48	-54.82	-12.66	HORIZONTAL
7	4955.00	-74.19	16.13	-58.06	-44.84	-13.22	HORIZONTAL
8	6670.00	-79.31	23.76	-55.55	-44.84	-10.71	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee) mode, RX CH Low (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	155.13	-80.78	5.66	-75.12	-54.82	-20.30	VERTICAL
2	258.92	-82.56	4.76	-77.80	-54.82	-22.98	VERTICAL
3	438.37	-82.79	8.41	-74.38	-54.82	-19.56	VERTICAL
4	643.04	-82.50	11.82	-70.68	-54.82	-15.86	VERTICAL
5	716.76	-82.07	13.82	-68.25	-54.82	-13.43	VERTICAL
6	844.80	-82.60	14.72	-67.88	-54.82	-13.06	VERTICAL
7	2386.00	-71.76	5.56	-66.20	-44.84	-21.36	VERTICAL
8	5879.00	-80.07	18.44	-61.63	-44.84	-16.79	VERTICAL
1	68.80	-79.55	4.66	-74.89	-54.82	-20.07	HORIZONTAL
2	139.61	-81.11	3.82	-77.29	-54.82	-22.47	HORIZONTAL
3	261.83	-81.13	4.37	-76.76	-54.82	-21.94	HORIZONTAL
4	412.18	-82.27	7.25	-75.02	-54.82	-20.20	HORIZONTAL
5	589.69	-82.94	10.99	-71.95	-54.82	-17.13	HORIZONTAL
6	791.45	-81.32	14.18	-67.14	-54.82	-12.32	HORIZONTAL
7	3268.00	-72.71	8.54	-64.17	-44.84	-19.33	HORIZONTAL
8	6565.00	-80.21	23.82	-56.39	-44.84	-11.55	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2019/08/15

Test Mode: IEEE 802.15.4 (Thread, Zigbee) mode, RX CH High (worst case model: BT840F)

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	148.34	-81.12	6.01	-75.11	-54.82	-20.29	VERTICAL
2	262.80	-82.40	4.71	-77.69	-54.82	-22.87	VERTICAL
3	450.01	-83.16	9.05	-74.11	-54.82	-19.29	VERTICAL
4	616.85	-81.60	10.81	-70.79	-54.82	-15.97	VERTICAL
5	741.98	-81.10	13.74	-67.36	-54.82	-12.54	VERTICAL
6	844.80	-81.24	14.72	-66.52	-54.82	-11.70	VERTICAL
7	3261.00	-72.96	8.38	-64.58	-44.84	-19.74	VERTICAL
8	7167.00	-79.60	22.35	-57.25	-44.84	-12.41	VERTICAL
1	69.77	-80.62	4.73	-75.89	-54.82	-21.07	HORIZONTAL
2	152.22	-80.92	4.37	-76.55	-54.82	-21.73	HORIZONTAL
3	413.15	-83.82	7.28	-76.54	-54.82	-21.72	HORIZONTAL
4	549.92	-81.60	10.04	-71.56	-54.82	-16.74	HORIZONTAL
5	681.84	-81.56	12.22	-69.34	-54.82	-14.52	HORIZONTAL
6	790.48	-80.92	14.18	-66.74	-54.82	-11.92	HORIZONTAL
7	2316.00	-70.94	5.73	-65.21	-44.84	-20.37	HORIZONTAL
8	6614.00	-80.40	23.79	-56.61	-44.84	-11.77	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm) + Aux (dB)
5. Measurement Range upto 12.75GHz.

11 Radiated Peak Power Spectral Density Measurement

11.1. Limit:

According to AS/NZS 4268:2017, Table 1, Note 2.

The radiated peak power spectral density in any 3kHz is limited to 25mW per 3kHz.

11.2. Measurement Equipment Used:

Refer to section 11.2.

11.3. Test Setup:

Refer to section 11.3.

11.4. Test Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 1.5MHz, Sweep=100s, Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

11.5. Measurement Result:

Dipole Antenna

BT 4.0LE

Channel	Power Density Reading (dBm)	Maximum Limit (dBm)
Low	7.65	13.97
Mid	7.91	13.97
High	7.82	13.97

IEEE 802.15.4 (Thread, Zigbee)

Channel	Power Density Reading (dBm)	Maximum Limit (dBm)
Low	7.65	13.97
Mid	7.91	13.97
High	7.82	13.97

PCB Antenna

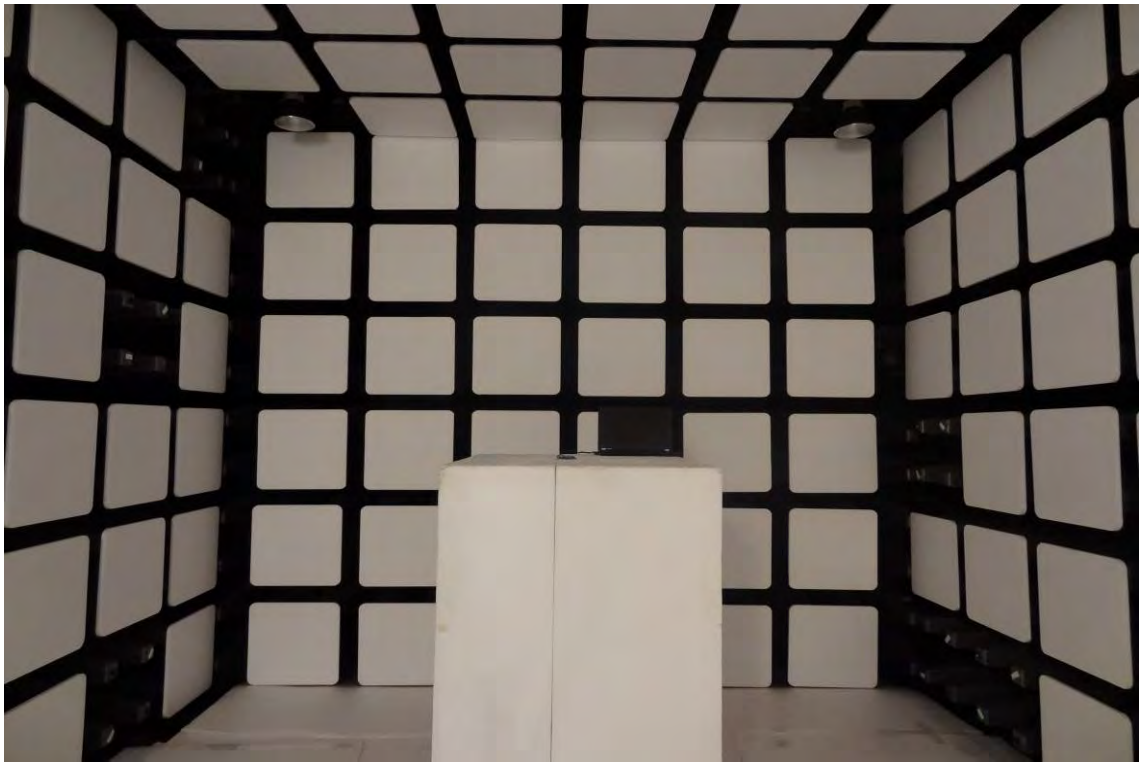
BT 4.0LE

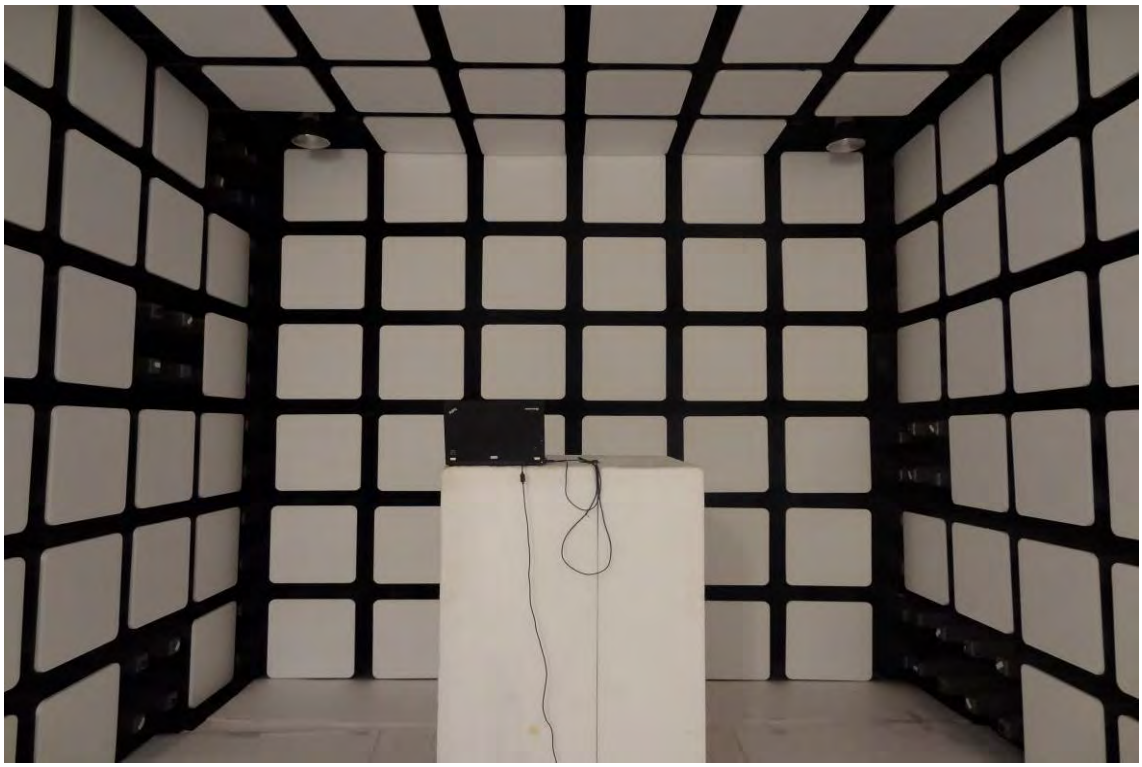
Channel	Power Density Reading (dBm)	Maximum Limit (dBm)
Low	9.77	13.97
Mid	9.61	13.97
High	9.70	13.97

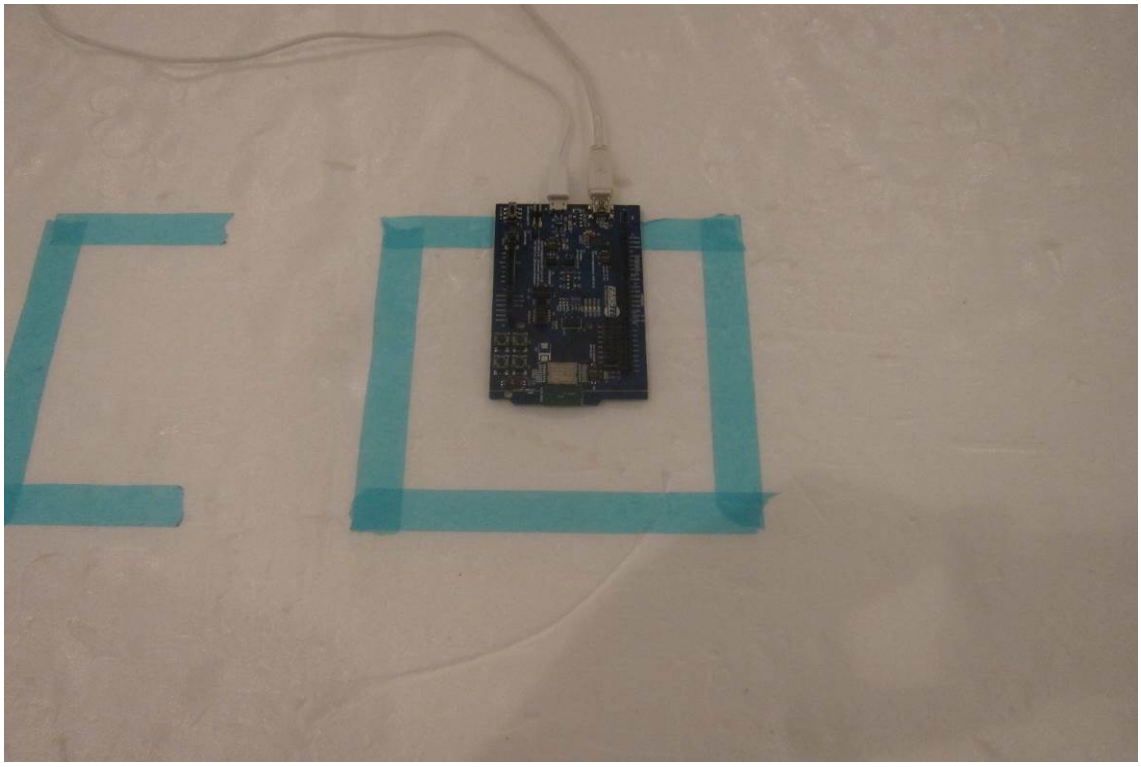
IEEE 802.15.4 (Thread, Zigbee)

Channel	Power Density Reading (dBm)	Maximum Limit (dBm)
Low	7.99	13.97
Mid	8.25	13.97
High	8.16	13.97

Appendix 1
Photographs of Test Setup

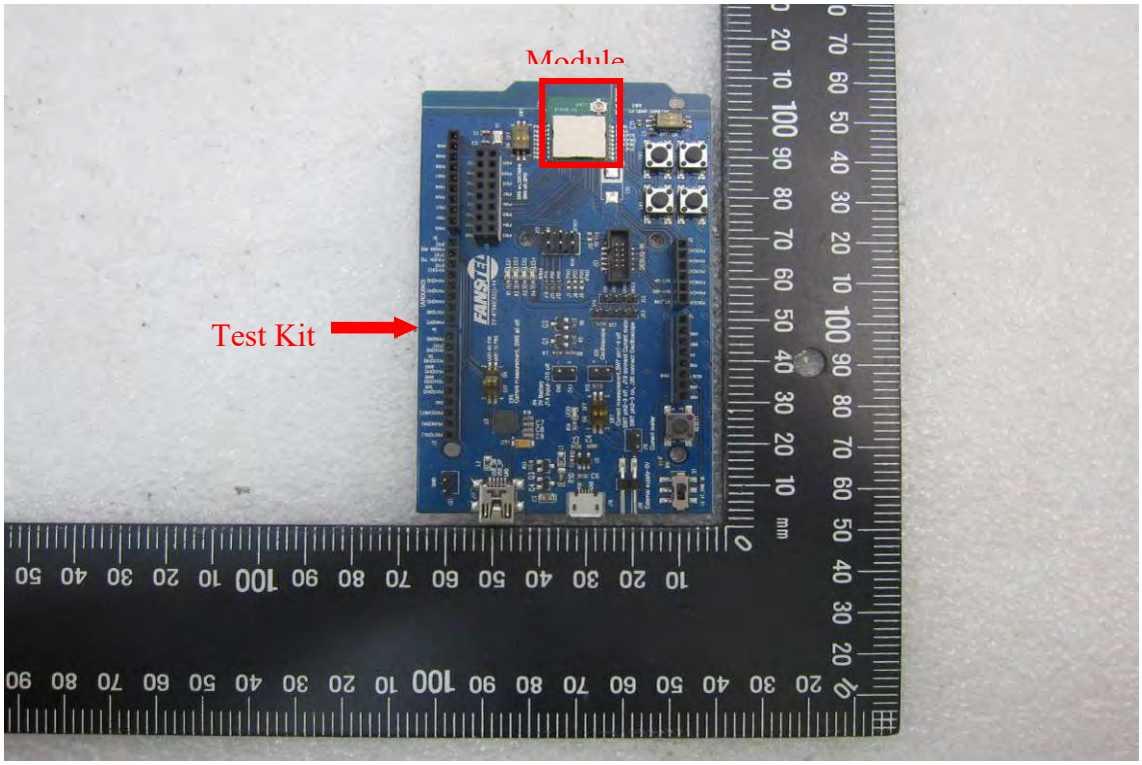






Appendix 2
Photographs of EUT

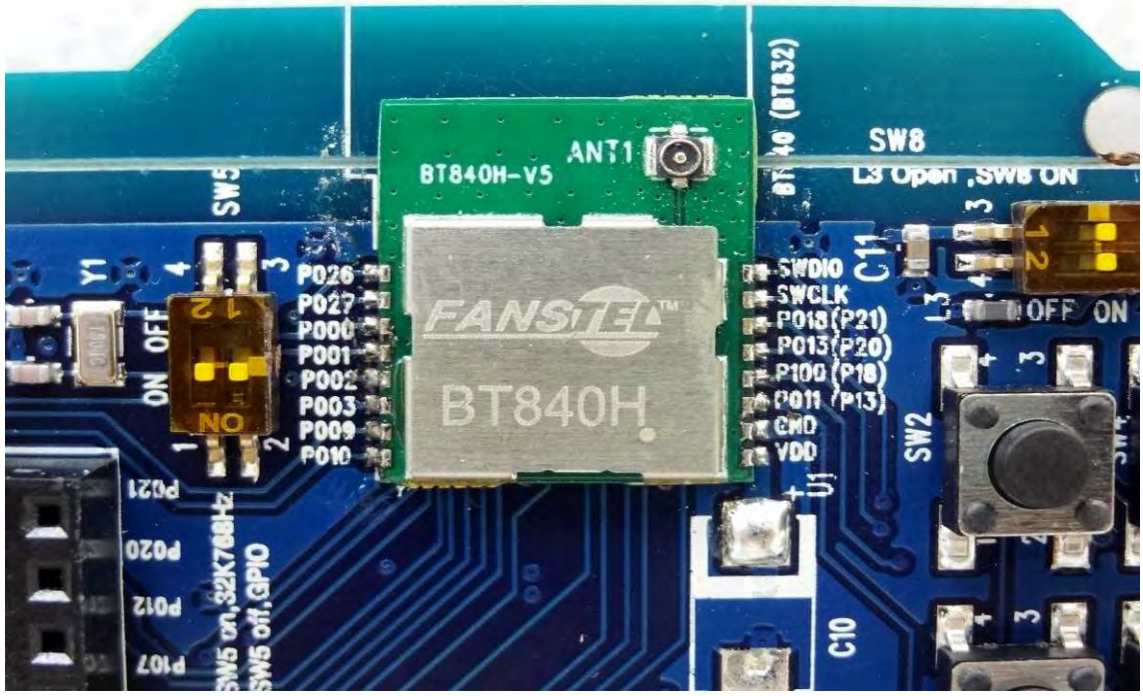
EUT 1



EUT 2 BT840E

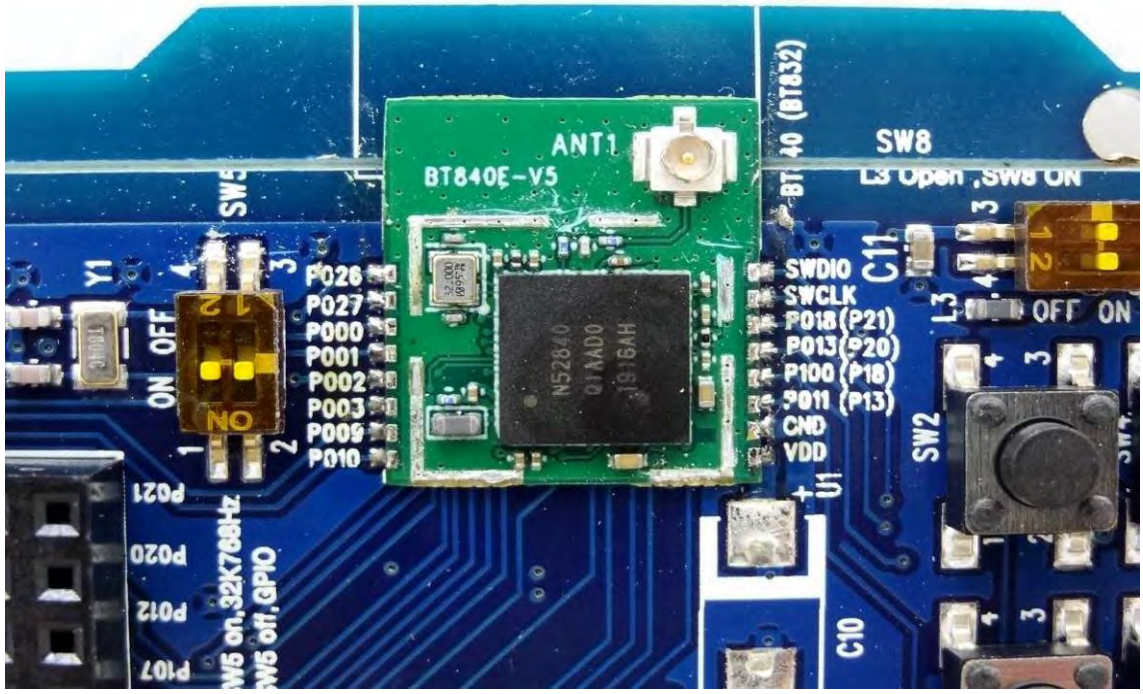
EUT 3 BT840F

EUT 4 BT840H

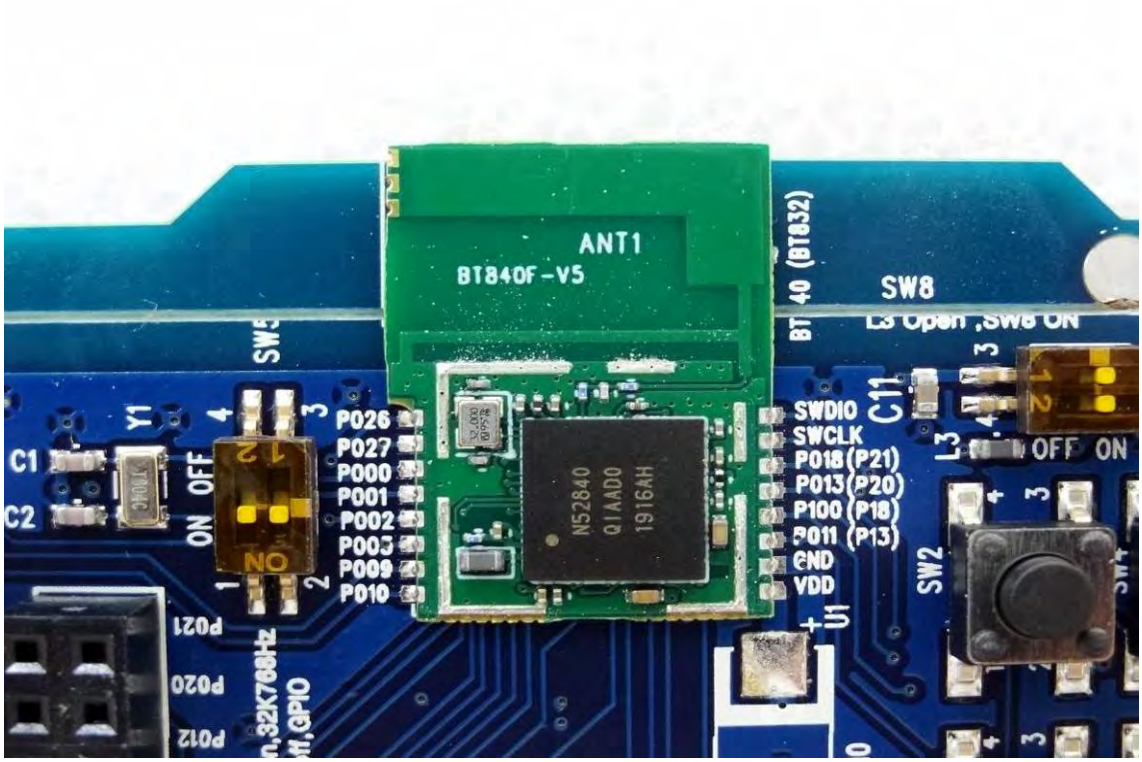


EUT 5 BT840

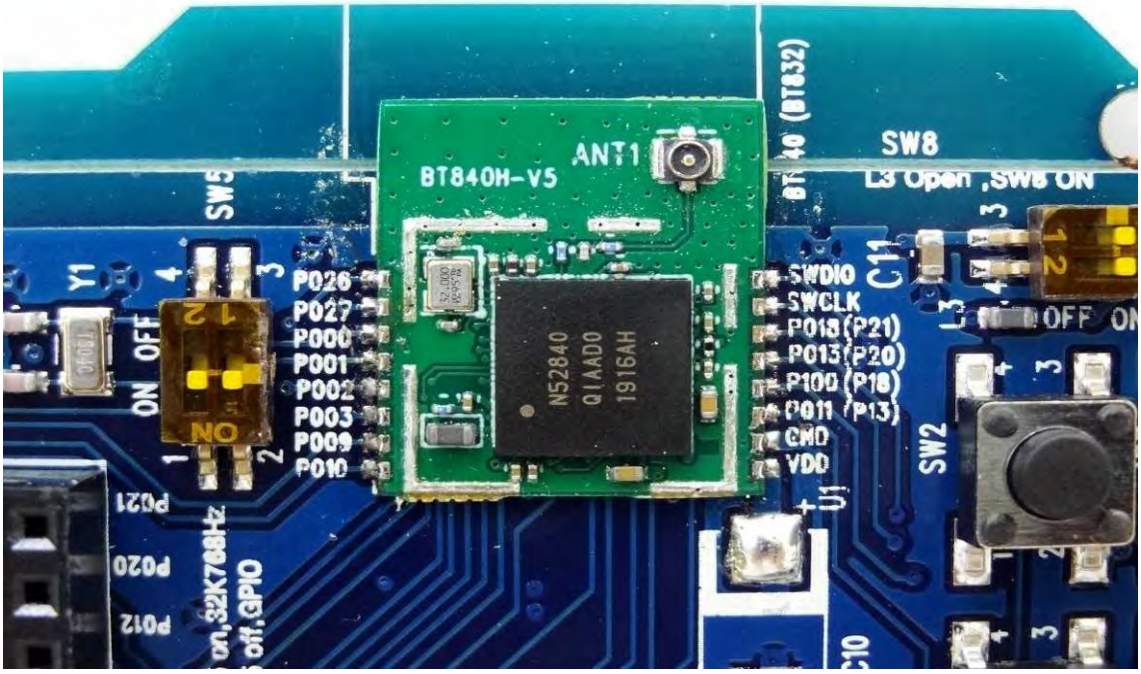
EUT 6 BT840E



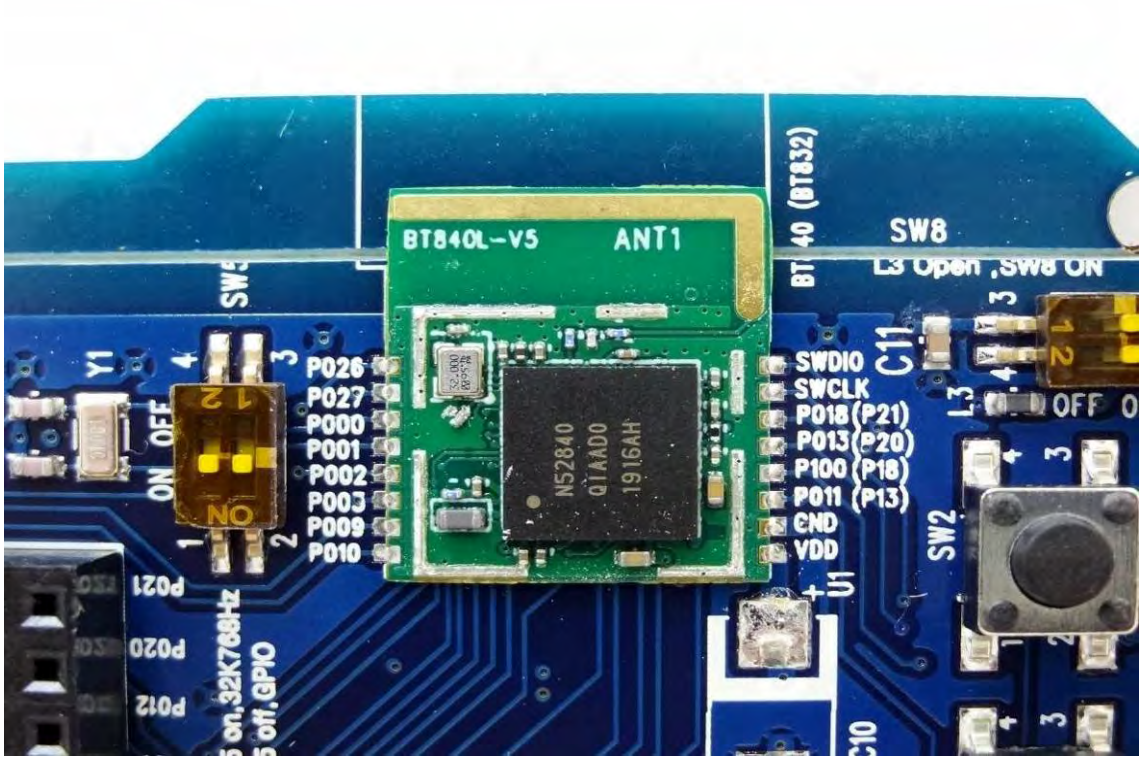
EUT 7 BT840F



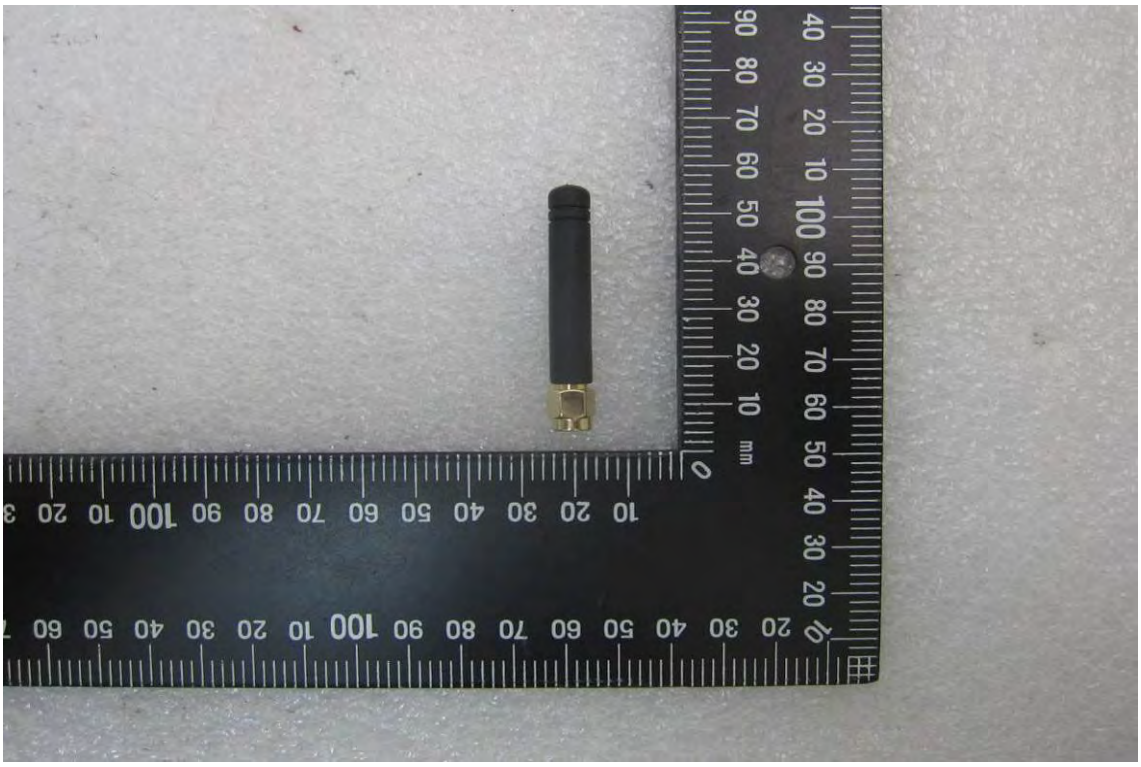
EUT 8 BT840H



EUT 9 BT840

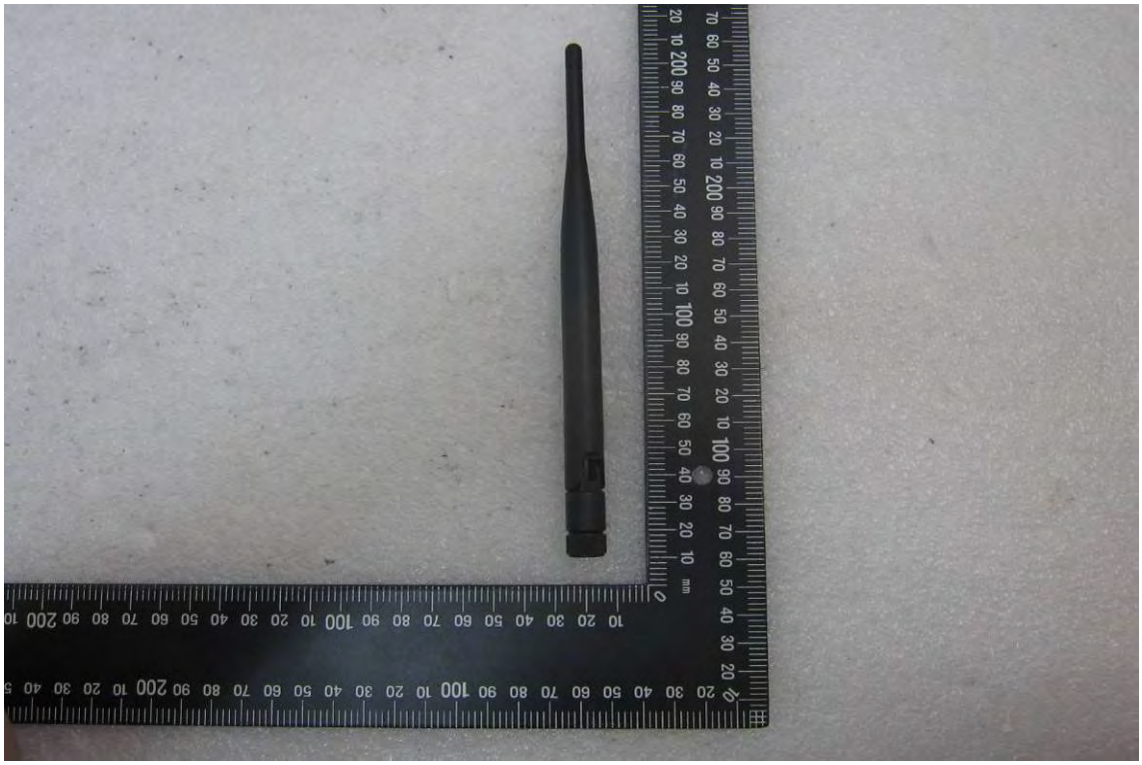


EUT 10



EUT 11

EUT 12



EUT 13

~ End of Report ~