



Shenzhen Global Test Service Co.,Ltd.

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

TEST REPORT

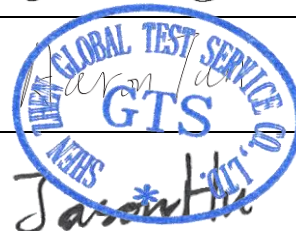
FCC PART 15 SUBPART C 15.247

Report Reference No.....: GTS20211120007-1-4

FCC ID..... : XR3-LEAF

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Date of issue.....: Nov. 20, 2021

Representative Laboratory Name .: Shenzhen Global Test Service Co., Ltd.

Address.....: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

Applicant's name.....: ONYX INTERNATIONAL INC.

Address: Room 301-6, 10 Honglou Street, Liwan District, Guangzhou City, Guangdong Province, China

Test specification

Standard.....: **FCC Part 15.247**

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF.....: Dated 2014-12

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Test item description E Ink Tablet, Smart E Ink Tablet, ePaper Tablet, E-bag Tablet, E-book Tablet, E-reader Tablet, Eyes protection E Ink Tablet, E-paper Tablet, Color E Ink Tablet, Color ePaper Tablet

Trade Mark.....: BOOX

Manufacturer.....: ONYX INTERNATIONAL INC.

Model/Type reference.....: Leaf

Listed Models: Leaf Lite, Leaf Plus, Leaf Pro, Leaf Color, Leaf Color Plus, Leaf Color Pro, Leaf S, Leaf C

Ratings.....: DC 3.8V from battery; Charging input: 5V---3A

Modulation.....: GFSK

Hardware version.....: BOOX_M2_LEAF_V01

Software version.....: V1.0

Frequency.....: From 2402MHz to 2480MHz

Result.....: **PASS**

TEST REPORT

Test Report No. :	GTS20211120007-1-4	Nov. 20, 2021
		Date of issue

Equipment under Test : E Ink Tablet, Smart E Ink Tablet, ePaper Tablet, E-bag Tablet, E-book Tablet, E-reader Tablet, Eyes protection E Ink Tablet, E-paper Tablet, Color E Ink Tablet, Color ePaper Tablet

Model /Type : Leaf

Listed Models : Leaf Lite, Leaf Plus, Leaf Pro, Leaf Color, Leaf Color Plus, Leaf Color Pro, Leaf S, Leaf C

Applicant : **ONYX INTERNATIONAL INC.**

Address : Room 301-6, 10 Honglou Street, Liwan District, Guangzhou City, Guangdong Province, China

Manufacturer : **ONYX INTERNATIONAL INC.**

Address : Building 4, 202 Shiyu Road, Dongchong Town, Nansha District, Guangzhou City, Guangdong Province, China

Test Result:	PASS
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The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

[KDB558074 D01 V05r02](#): Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Sep. 25, 2021
Testing commenced on	:	Sep. 26, 2021
Testing concluded on	:	Oct. 24, 2021

2.2 Product Description

Product Description:	E Ink Tablet, Smart E Ink Tablet, ePaper Tablet, E-bag Tablet, E-book Tablet, E-reader Tablet, Eyes protection E Ink Tablet, E-paper Tablet, Color E Ink Tablet, Color ePaper Tablet
Model/Type reference:	Leaf
Power supply:	DC 3.8V from battery
Sample ID:	GTS20211120007-1-1#/ GTS20211120007-1-2#
Bluetooth BLE	
Supported type:	Bluetooth low Energy
Modulation:	GFSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	40
Channel separation:	2 MHz
Antenna type:	FPC antenna
Antenna gain:	-0.85dBi

2.3 Test Sample

The application provides 2 samples to meet requirement.

Sample Number	Description
GTS20211120007-1-1#	Engineer sample – continuous transmit
GTS20211120007-1-2#	Normal sample – Intermittent transmit

2.4 Equipment Under Test

Power supply system utilised

Power supply voltage	:	<input type="radio"/> 230V / 50 Hz	<input type="radio"/> 120V / 60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 3.8V from battery

2.5 Short description of the Equipment under Test (EUT)

This is a Smart E Ink Tablet.

For more details, refer to the user's manual of the EUT.

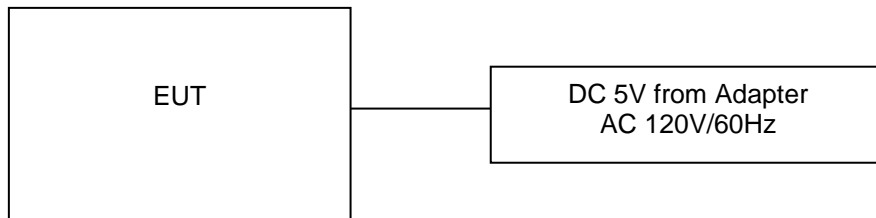
2.6 EUT operation mode

The Applicant provides communication tools software(QRCT) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 40 channels provided to the EUT and Channel 00/19/39 were selected to test.

Operation Frequency:

Channel	Frequency (MHz)
00	2402
01	2404
02	2406
:	:
19	2440
:	:
37	2476
38	2478
39	2480

2.7 Block Diagram of Test Setup



2.8 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
AC-DC Adapter	MOSO	EP-TA20CBC	Input:AC100-240V-50/60Hz, 0.5A Output:DC 5V,3A	FCC	Laboratory
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/

2.9 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.10 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 165725 Designation Number: CN1234

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

Test Specification clause	Test case	Test Sample	Test Mode	Test Channel	Recorded In Report		Test result
§15.247(e)	Power spectral density	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	complies
§15.247(a)(2)	Spectrum bandwidth – 6 dB bandwidth	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	complies
§15.247(b)(3)	Maximum Peak output power	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	complies
§15.247(d)	Band edge compliance conducted	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	complies
§15.205	Band edge compliance radiated	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	complies
§15.247(d)	TX spurious emissions conducted	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	complies
§15.209(a)	TX spurious emissions Radiated above 1GHz	GTS202111200 07-1-1#	BLE 1&2Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	BLE 1Mbps	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	complies
§15.209(a)	TX spurious Emissions radiated Below 1GHz	GTS202111200 07-1-2#	BLE 1&2Mbps	-/-	BLE 1Mbps	-/-	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GTS202111200 07-1-2#	BLE 1&2Mbps	-/-	BLE 1Mbps	-/-	complies

Remark:

1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6 Equipments Used during the Test

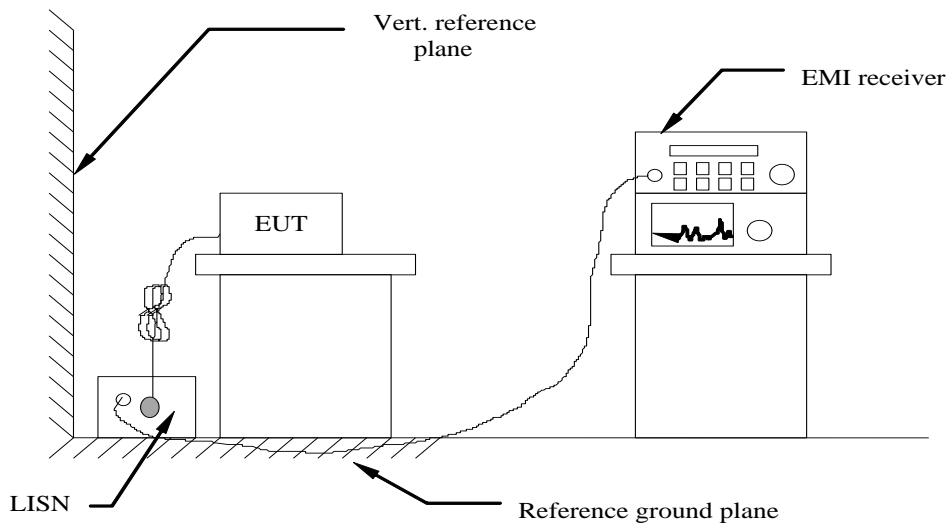
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	CYBERTEK	EM5040A	E1850400105	2021/07/23	2022/07/22
LISN	R&S	ESH2-Z5	893606/008	2021/07/23	2022/07/22
EMI Test Receiver	R&S	ESPI3	101841-cd	2021/07/23	2022/07/22
EMI Test Receiver	R&S	ESCI7	101102	2021/09/19	2022/09/18
Spectrum Analyzer	Agilent	N9020A	MY48010425	2021/09/19	2022/09/18
Spectrum Analyzer	R&S	FSV40	100019	2021/07/23	2022/07/22
Vector Signal generator	Agilent	N5181A	MY49060502	2021/07/23	2022/07/22
Spectrum Analyzer	Agilent	E4421B	3610AO1069	2021/09/19	2022/09/18
Climate Chamber	ESPEC	EL-10KA	A20120523	2021/09/19	2022/09/18
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2020/11/08	2021/11/07
Active Loop Antenna	Beijing Da Ze Technology Co.,Ltd.	ZN30900C	15006	2021/10/10	2022/10/09
Bilog Antenna	Schwarzbeck	VULB9163	000976	2021/07/23	2022/07/22
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2020/11/08	2021/11/07
Amplifier	Schwarzbeck	BBV 9743	#202	2021/07/23	2022/07/22
Amplifier	Schwarzbeck	BBV9179	9719-025	2021/07/23	2022/07/22
Amplifier	EMCI	EMC051845B	980355	2021/07/23	2022/07/22
Temperature/Humidity Meter	Gangxing	CTH-608	02	2021/07/23	2022/07/22
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2021/07/23	2022/07/22
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2021/07/23	2022/07/22
RF Cable(below 1GHz)	HUBER+SUHNER	RG214	RE01	2021/07/23	2022/07/22
RF Cable(above 1GHz)	HUBER+SUHNER	RG214	RE02	2021/07/23	2022/07/22
Data acquisition card	Agilent	U2531A	TW53323507	2021/07/23	2022/07/22
Power Sensor	Agilent	U2021XA	MY5365004	2021/07/23	2022/07/22
Test Control Unit	Tonscend	JS0806-1	178060067	2021/07/23	2022/07/22
Automated filter bank	Tonscend	JS0806-F	19F8060177	2021/07/23	2022/07/22
EMI Test Software	Tonscend	JS1120-1	Ver 2.6.8.0518	/	/
EMI Test Software	Tonscend	JS1120-3	Ver 2.5.77.0418	/	/
EMI Test Software	Tonscend	JS32-CE	Ver 2.5	/	/
EMI Test Software	Tonscend	JS32-RE	Ver 2.5.1.8	/	/

Note: The Cal.Interval was one year.

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST RESULTS

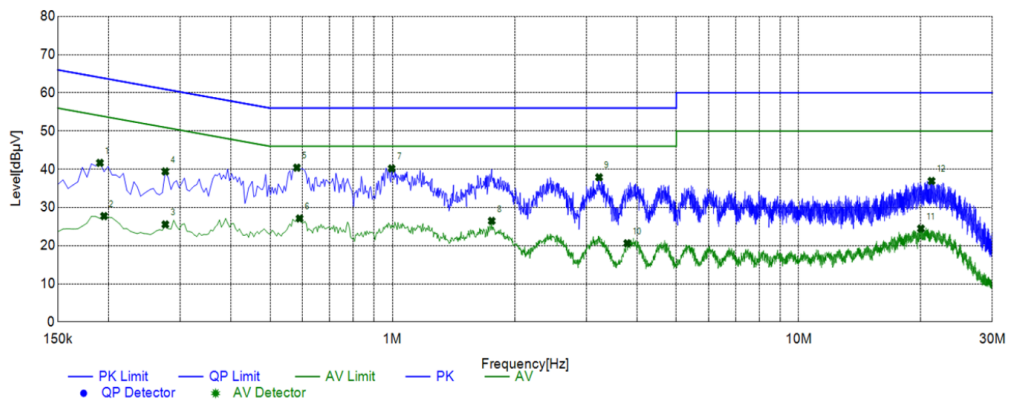
Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

Remark:

- Both modes of BLE 1Mbps and 2Mbps were tested at Low, Middle, and High channel; only the worst result of BLE 1Mbps was reported as below:
- Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply(charge from adapter)have been tested, only the worst result of 120 VAC, 60 Hz with BLE middle channel was reported as below:

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	L
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Test Graph



Suspected List

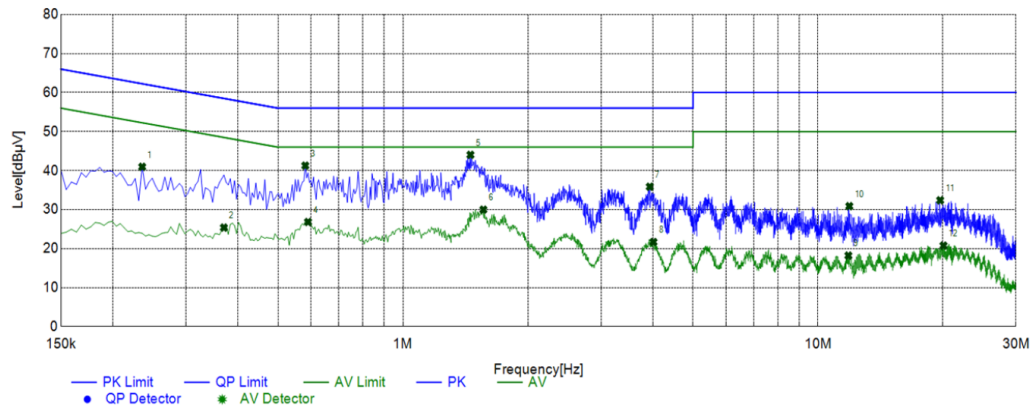
NO.	Frequency [MHz]	Reading [dBµV]	Factor [dB]	Result [dBµV]	Limit [dBµV]	Margin [dB]	Detector	Line	Remark
1	0.1905	31.60	10.06	41.66	64.01	22.35	PK	L1	PASS
2	0.1950	17.67	10.06	27.73	53.82	26.09	AV	L1	PASS
3	0.2760	15.56	9.99	25.55	50.94	25.39	AV	L1	PASS
4	0.2760	29.41	9.99	39.40	60.94	21.54	PK	L1	PASS
5	0.5820	30.35	10.06	40.41	56.00	15.59	PK	L1	PASS
6	0.5910	17.04	10.06	27.10	46.00	18.90	AV	L1	PASS
7	0.9960	30.12	10.07	40.19	56.00	15.81	PK	L1	PASS
8	1.7565	16.34	10.13	26.47	46.00	19.53	AV	L1	PASS
9	3.2280	27.58	10.31	37.89	56.00	18.11	PK	L1	PASS
10	3.7860	10.24	10.37	20.61	46.00	25.39	AV	L1	PASS
11	20.0220	12.98	11.50	24.48	50.00	25.52	AV	L1	PASS
12	21.2595	25.37	11.55	36.92	60.00	23.08	PK	L1	PASS

Note:1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	N
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Test Graph



Suspected List									
NO.	Frequency [MHz]	Reading [dBµV]	Factor [dB]	Result [dBµV]	Limit [dBµV]	Margin [dB]	Detector	Line	Remark
1	0.2355	30.92	10.03	40.95	62.25	21.30	PK	N	PASS
2	0.3705	15.37	10.01	25.38	48.49	23.11	AV	N	PASS
3	0.5820	31.20	10.06	41.26	56.00	14.74	PK	N	PASS
4	0.5910	16.75	10.06	26.81	46.00	19.19	AV	N	PASS
5	1.4550	33.92	10.11	44.03	56.00	11.97	PK	N	PASS
6	1.5630	19.86	10.12	29.98	46.00	16.02	AV	N	PASS
7	3.9345	25.45	10.40	35.85	56.00	20.15	PK	N	PASS
8	4.0155	11.27	10.41	21.68	46.00	24.32	AV	N	PASS
9	11.8410	7.39	10.82	18.21	50.00	31.79	AV	N	PASS
10	11.9040	20.05	10.82	30.87	60.00	29.13	PK	N	PASS
11	19.7025	21.01	11.37	32.38	60.00	27.62	PK	N	PASS
12	20.0715	9.36	11.40	20.76	50.00	29.24	AV	N	PASS

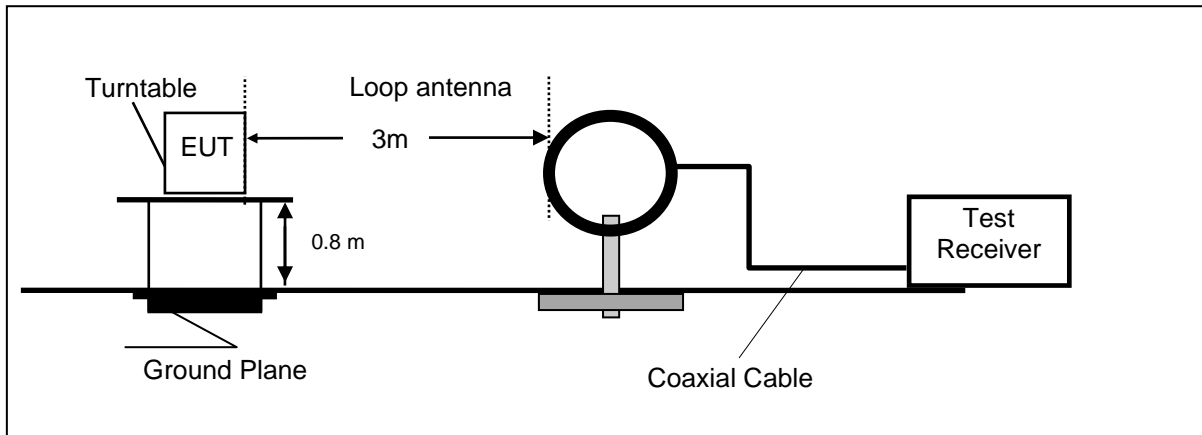
Note:1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

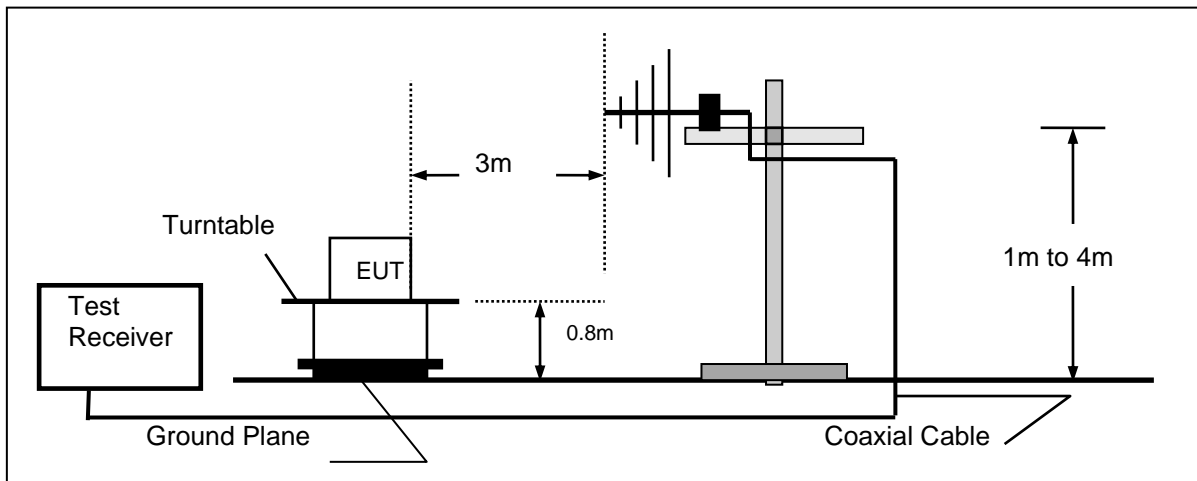
4.2 Radiated Emissions and Band Edge

TEST CONFIGURATION

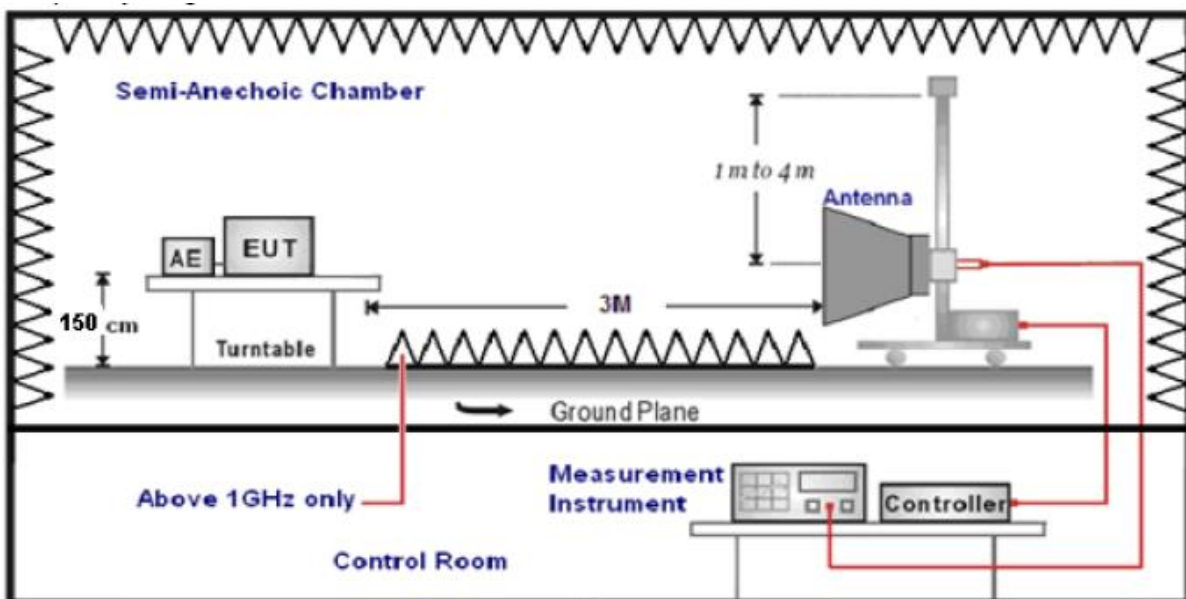
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBµV/m)	Radiated (µV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

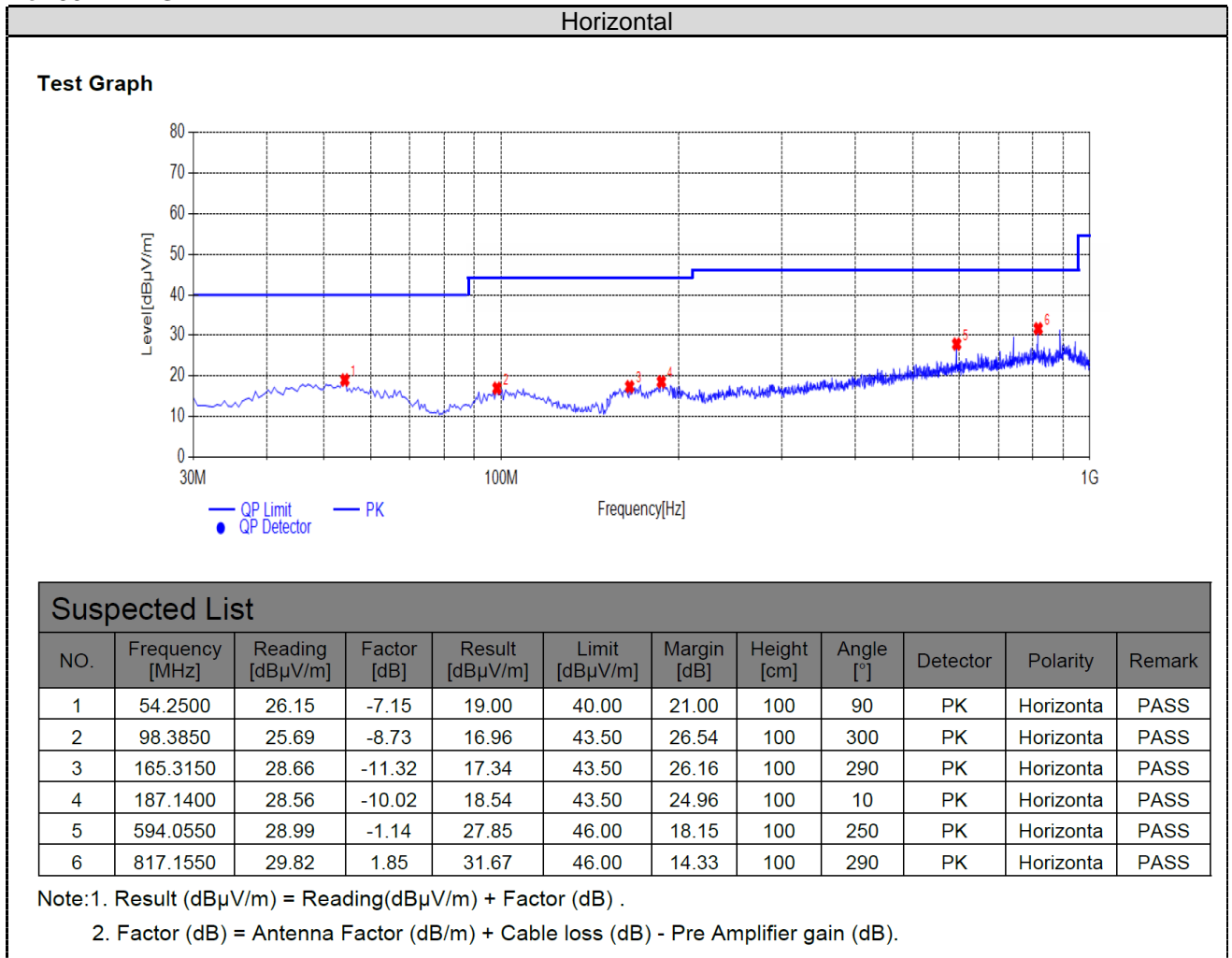
TEST RESULTS

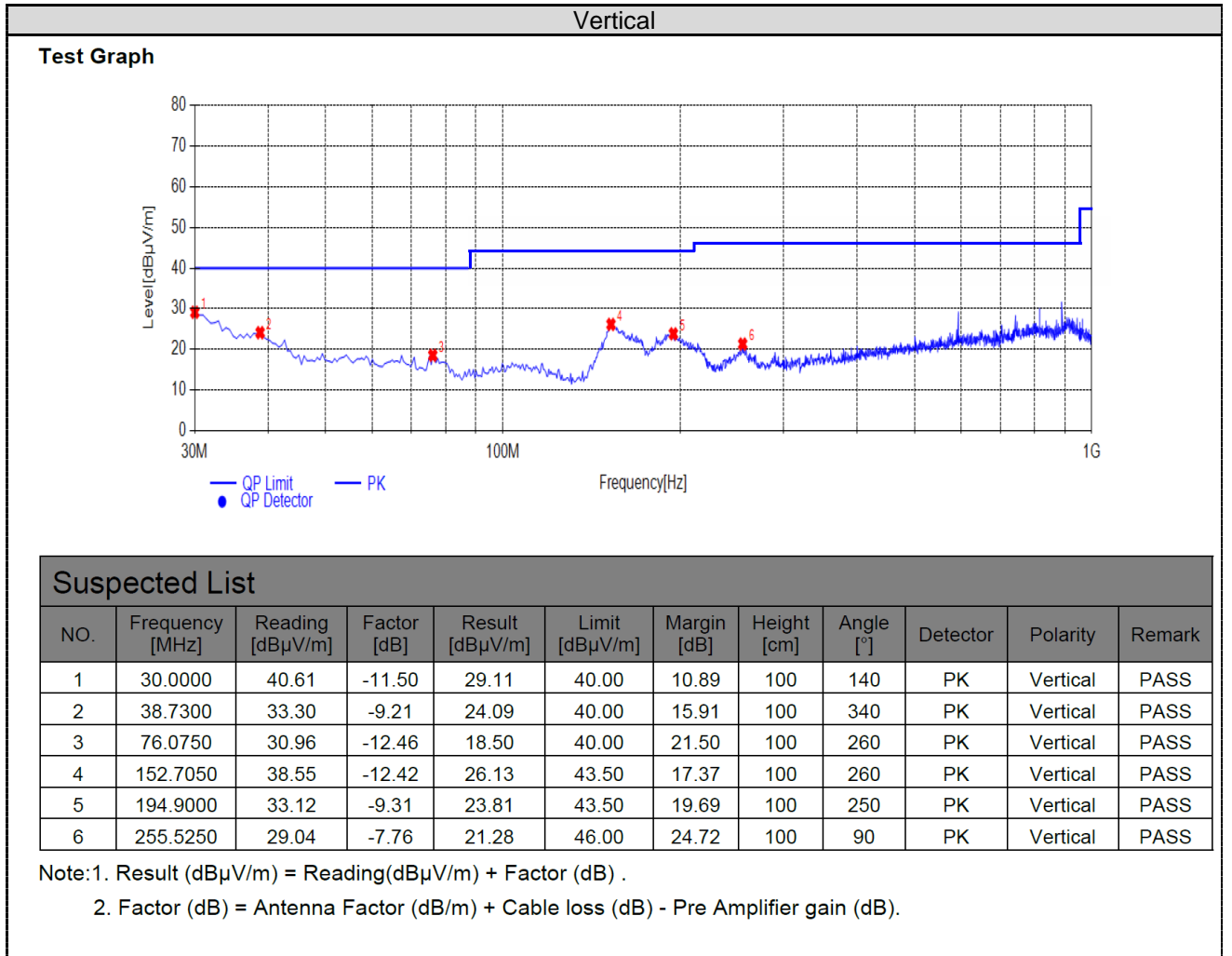
Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

Remark:

1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. Both modes of BLE 1Mbps and 2Mbps were tested at Low, Middle, and High channel and recorded worst mode at BLE 1Mbps.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz





For 1GHz to 25GHz

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	47.53	PK	74	26.47	45.63	31.42	6.98	36.50	1.90
4804.00	--	AV	54	--	--	--	--	--	--
7206.00	46.05	PK	74	27.95	35.45	37.03	8.87	35.30	10.60
7206.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	48.77	PK	74	25.23	46.87	31.42	6.98	36.50	1.90
4804.00	--	AV	54	--	--	--	--	--	--
7206.00	47.06	PK	74	26.94	36.46	37.03	8.87	35.30	10.60
7206.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):			2440		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	47.50	PK	74	26.50	45.44	30.98	7.58	36.50	2.06
4880.00	--	AV	54	--	--	--	--	--	--
7320.00	45.54	PK	74	28.46	34.62	37.66	8.56	35.30	10.92
7320.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):			2440		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	48.99	PK	74	25.01	46.93	30.98	7.58	36.50	2.06
4880.00	--	AV	54	--	--	--	--	--	--
7320.00	46.19	PK	74	27.81	35.27	37.66	8.56	35.30	10.92
7320.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	48.16	PK	74	25.84	45.09	31.47	7.80	36.20	3.07
4960.00	--	AV	54	--	--	--	--	--	--
7440.00	47.78	PK	74	26.22	36.04	38.32	8.72	35.30	11.74
7440.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	49.23	PK	74	24.77	46.16	31.47	7.80	36.20	3.07
4960.00	--	AV	54	--	--	--	--	--	--
7440.00	49.17	PK	74	24.83	37.43	38.32	8.72	35.30	11.74
7440.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

Results of Band Edges Test (Radiated)

GFSK

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	47.25	PK	74.00	26.75	52.66	27.49	3.32	36.22	-5.41
2390.00	--	AV	54.00	--	--	--	--	--	--
Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	49.04	PK	74.00	24.96	54.45	27.49	3.32	36.22	-5.41
2390.00	--	AV	54.00	--	--	--	--	--	--
Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	45.69	PK	74.00	28.31	51.20	27.45	3.38	36.34	-5.51
2483.50	--	AV	54.00	--	--	--	--	--	--
Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	47.88	PK	74.00	26.12	53.39	27.45	3.38	36.34	-5.51
2483.50	--	AV	54.00	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.

4.3 Maximum Peak Output Power

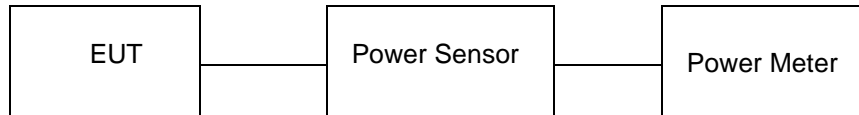
Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK 1Mbps	00	-0.10	30.00	Pass
	19	-0.10		
	39	1.44		
GFSK 2Mbps	00	0.04	30.00	Pass
	19	0.09		
	39	1.60		

Note: 1.The test results including the cable lose.

4.4 Power Spectral Density

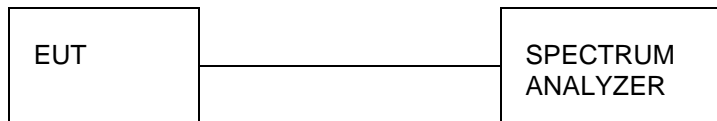
Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW \geq 3 kHz.
3. Set the VBW \geq 3 \times RBW.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8dBm.

Test Configuration



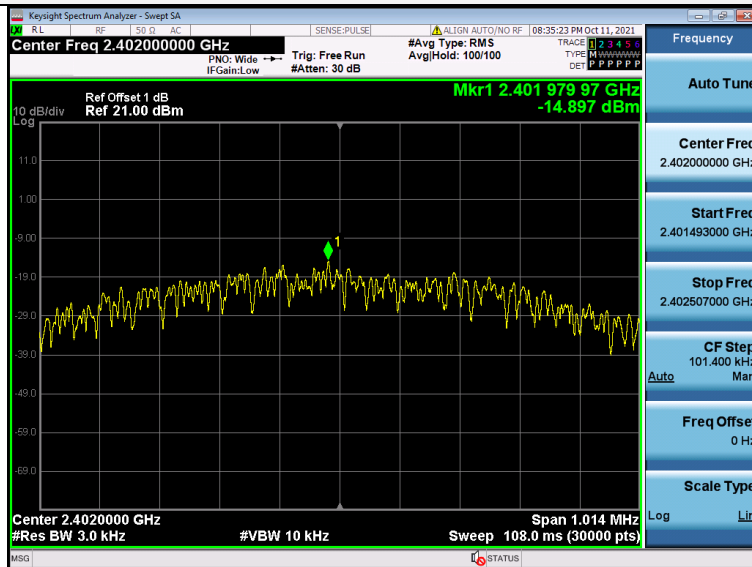
Test Results

Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

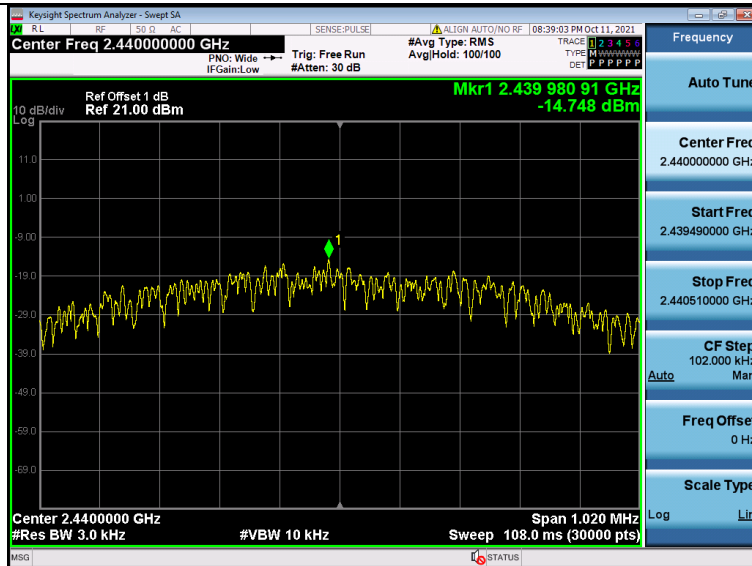
Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
GFSK 1Mbps	00	-14.90	8.00	Pass
	19	-14.75		
	39	-13.17		
GFSK 2Mbps	00	-18.28	8.00	Pass
	19	-18.19		
	39	-16.68		

Test plot as follows:

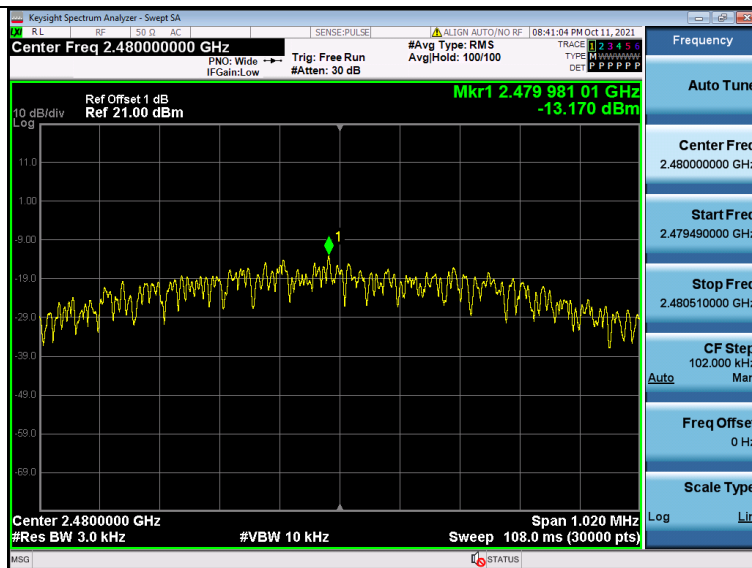
BLE GFSK 1Mbps



CH00

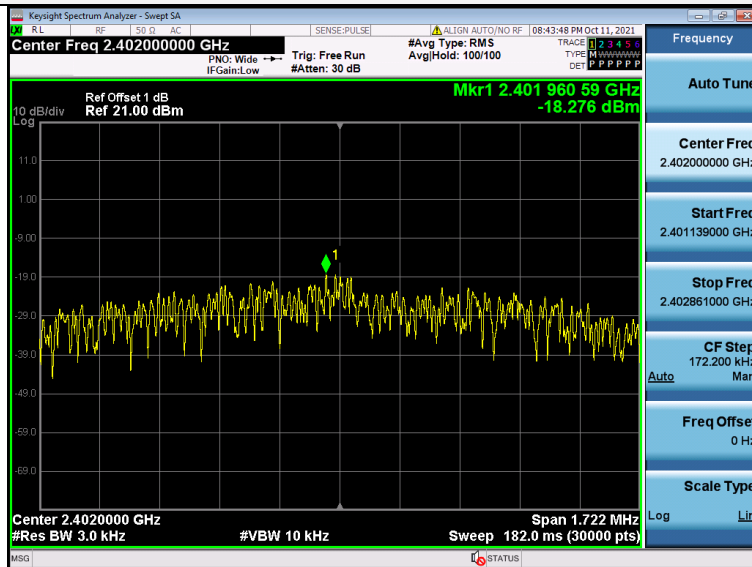


CH19

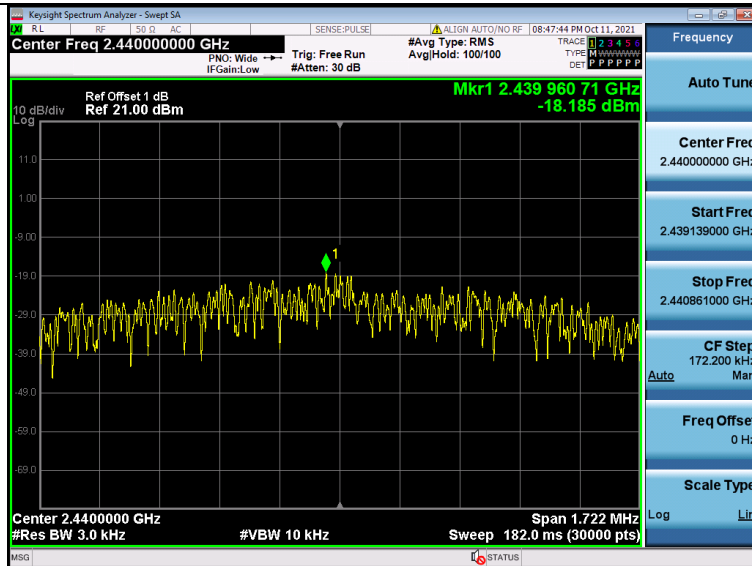


CH39

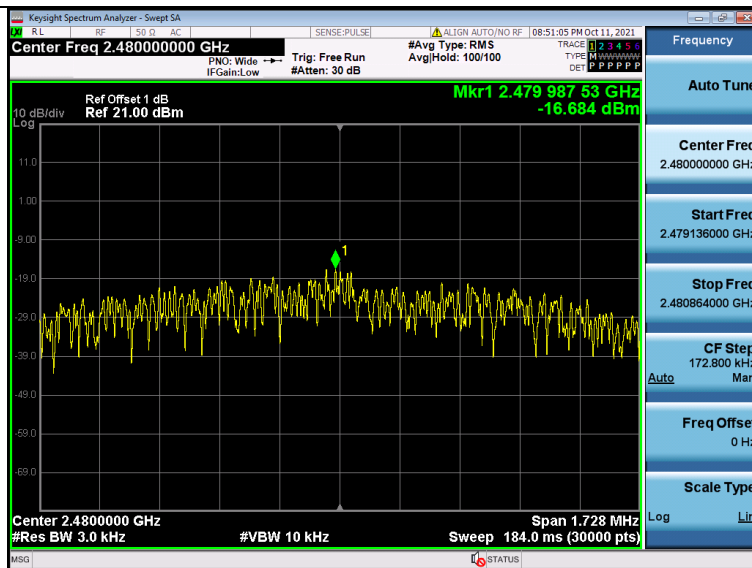
BLE GFSK 2Mbps



CH00



CH19



CH39

4.5 6dB Bandwidth

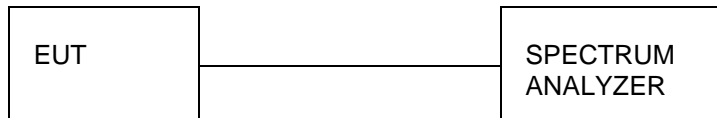
Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

Test Configuration



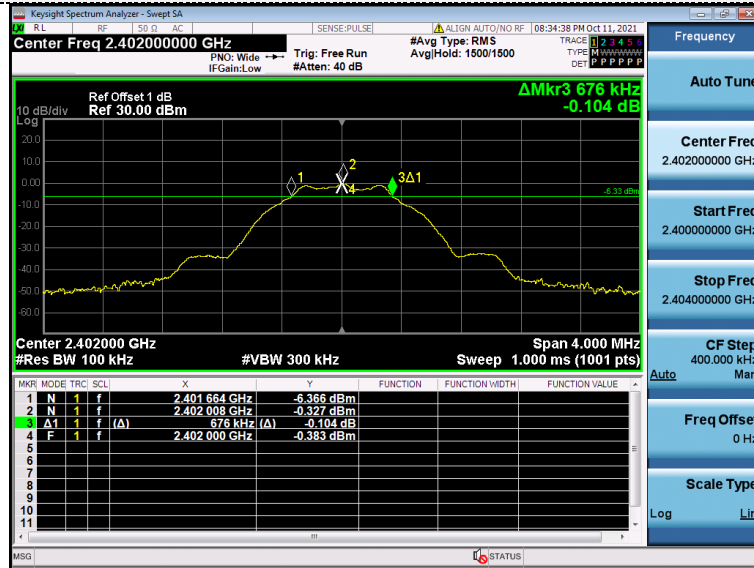
Test Results

Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

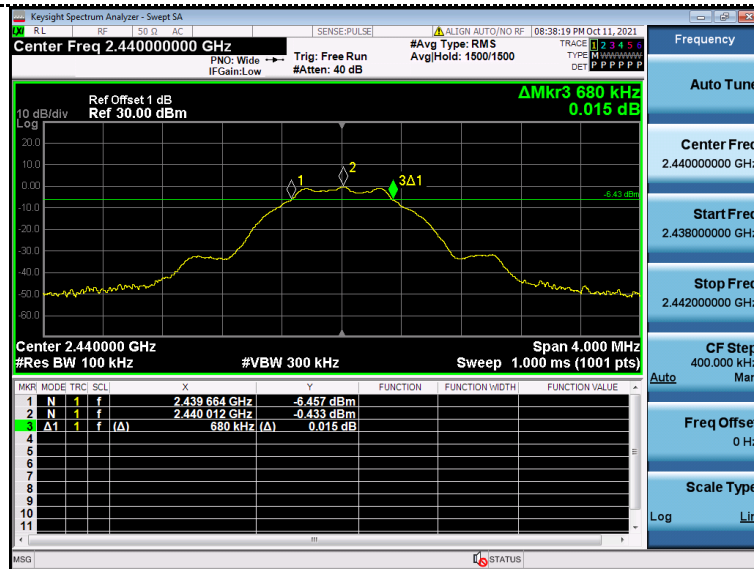
Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
GFSK 1Mbps	00	0.676	≥500	Pass
	19	0.680		
	39	0.680		
GFSK 2Mbps	00	1.148	≥500	Pass
	19	1.148		
	39	1.152		

Test plot as follows:

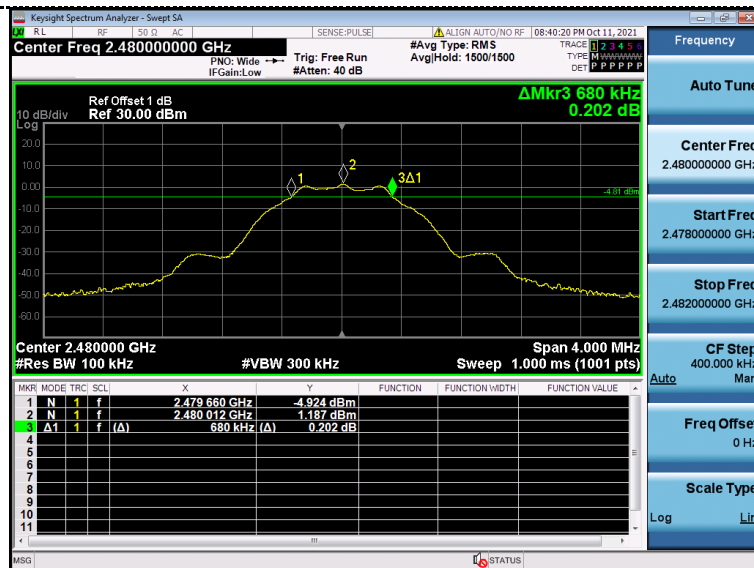
BLE GFSK 1Mbps



CH00

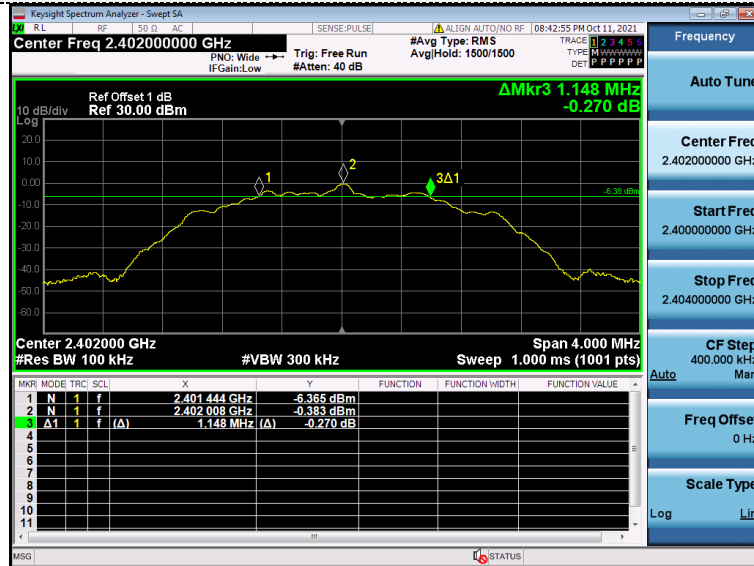


CH19

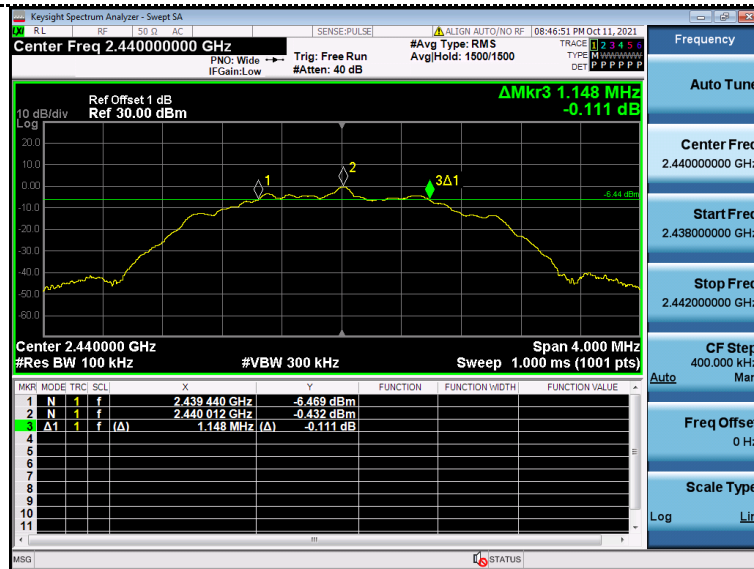


CH39

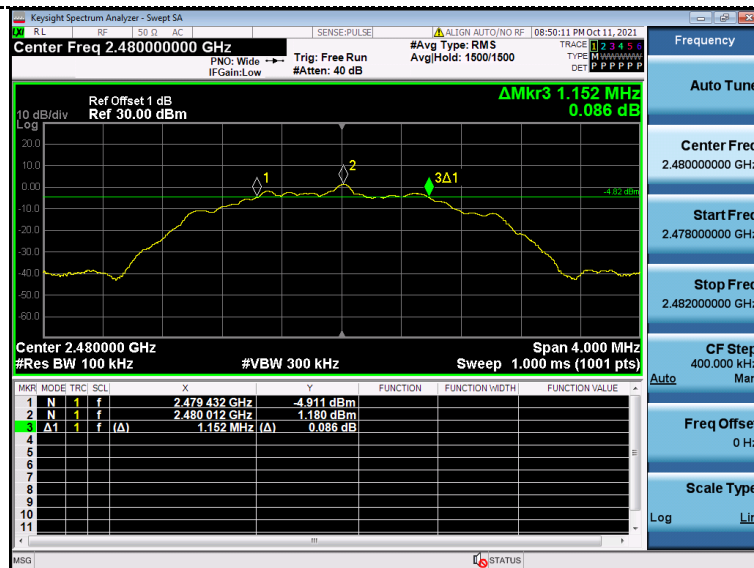
BLE GFSK 2Mbps



CH00



CH19



CH39

4.6 Out-of-band Emissions

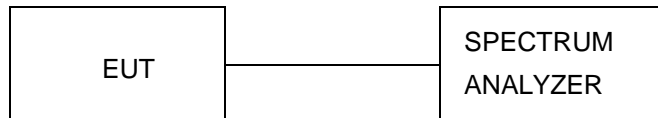
Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

Test Configuration

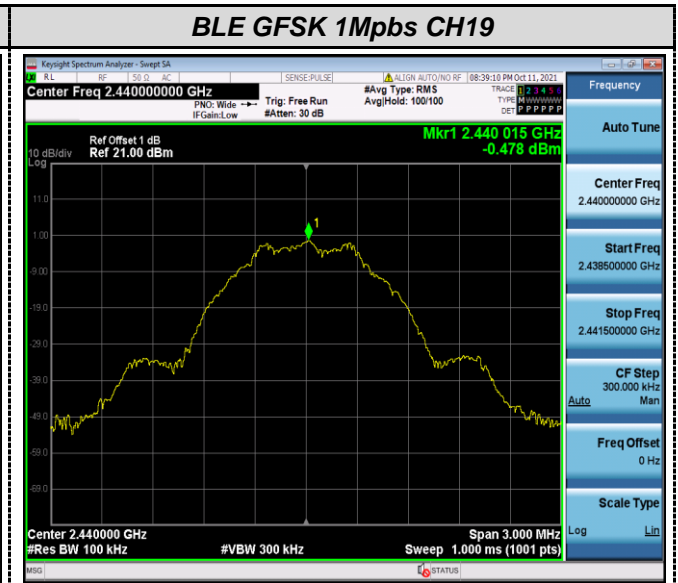
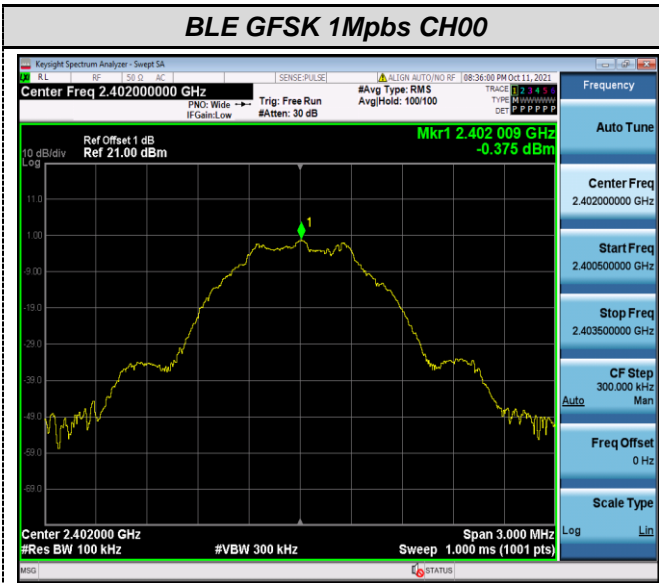


Test Results

Temperature	22.8°C	Humidity	56%
Test Engineer	Moon Tan	Configurations	BLE

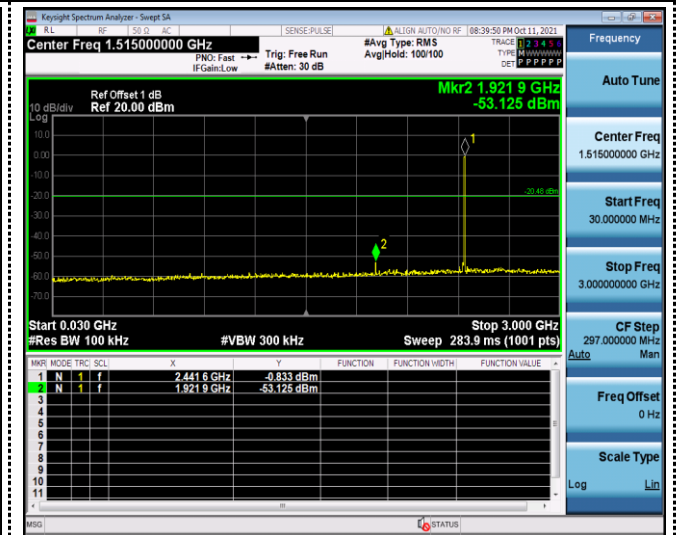
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

Test plot as follows:



Reference

Reference



30MHz-3GHz

30MHz-3GHz



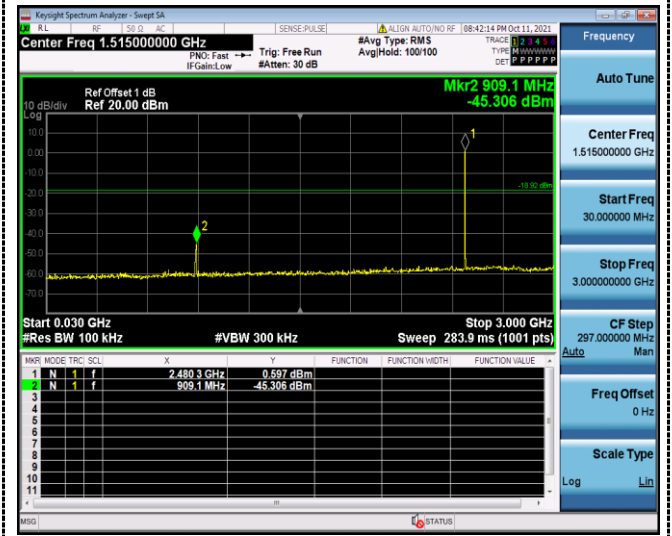
3GHz-25GHz

3GHz-25GHz

BLE GFSK 1Mbps CH39



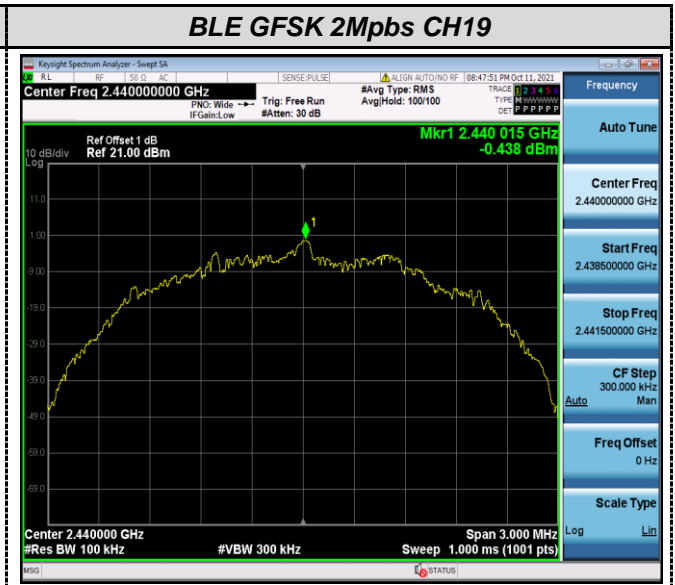
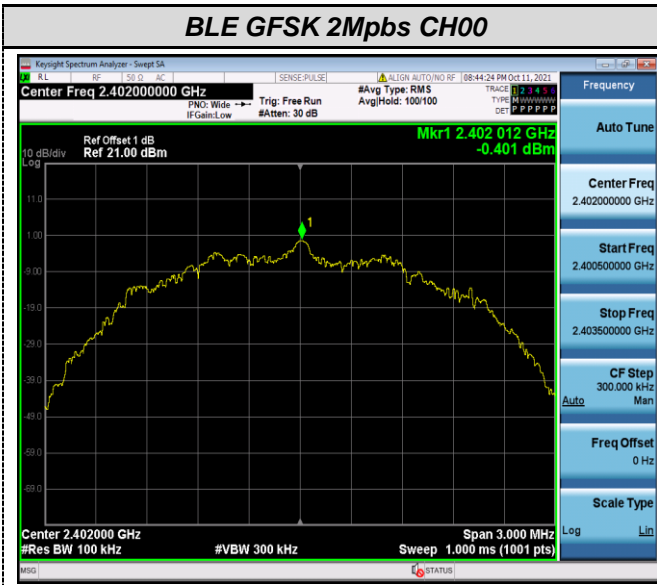
Reference



30MHz-3GHz

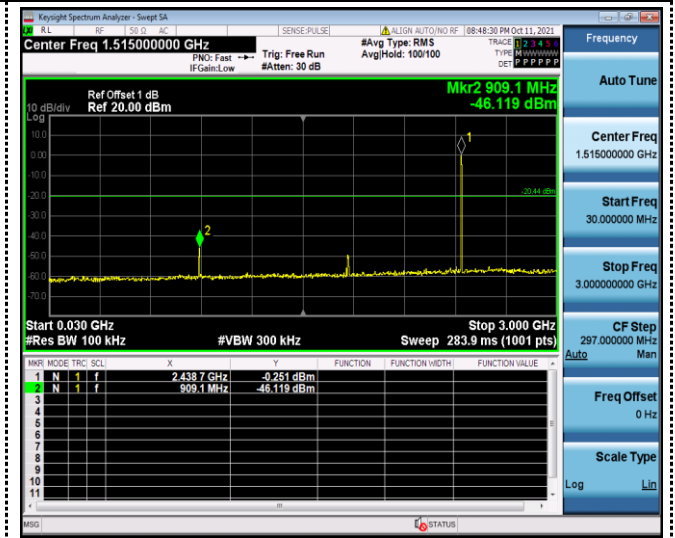
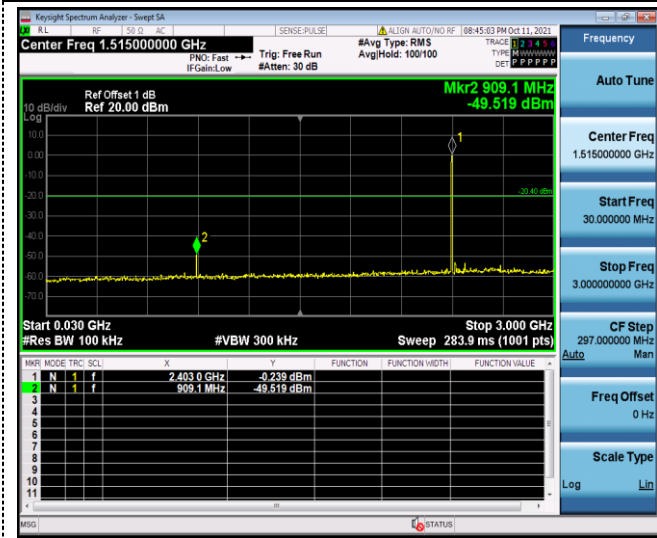


3GHz-25GHz



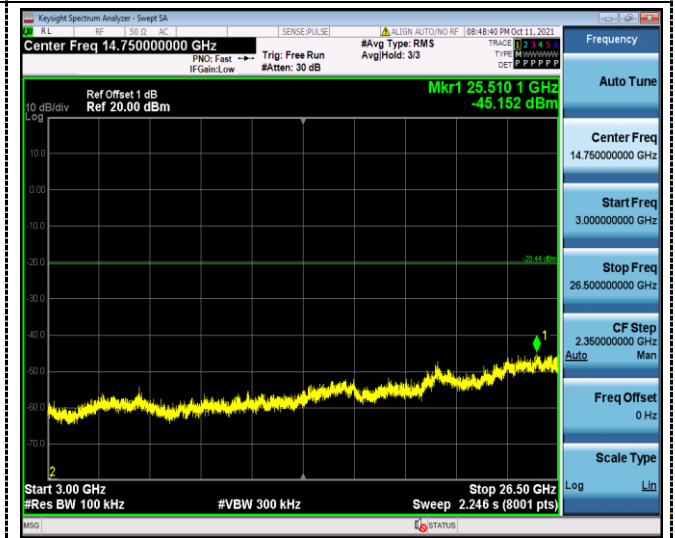
Reference

Reference



30MHz-3GHz

30MHz-3GHz



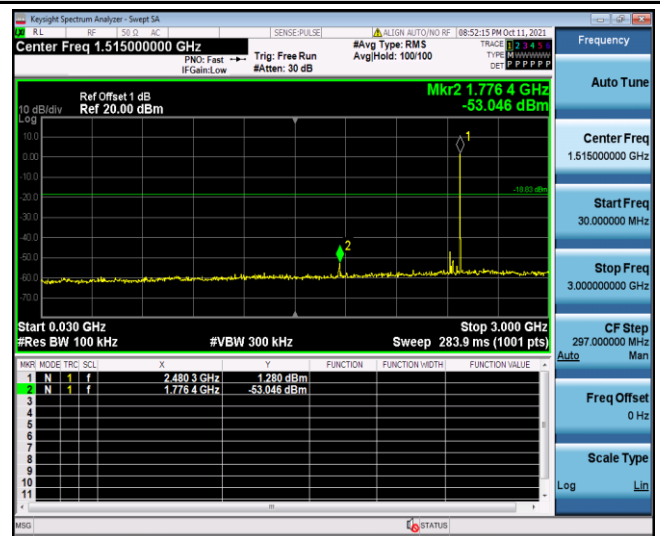
3GHz-25GHz

3GHz-25GHz

BLE GFSK 2Mbps CH39



Reference



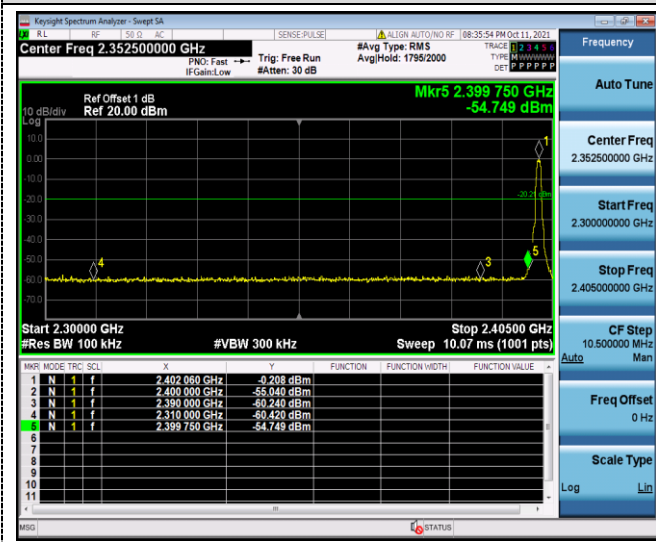
30MHz-3GHz



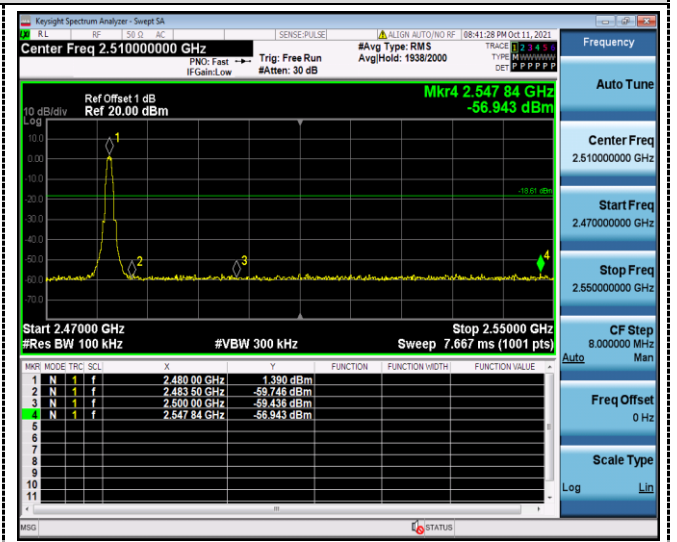
3GHz-25GHz

Band-edge Measurements for RF Conducted Emissions:

BLE GFSK 1Mbps

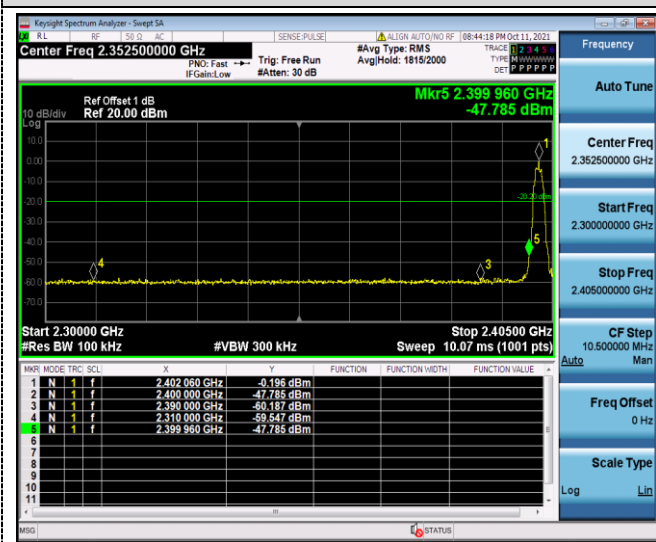


Left bandedge

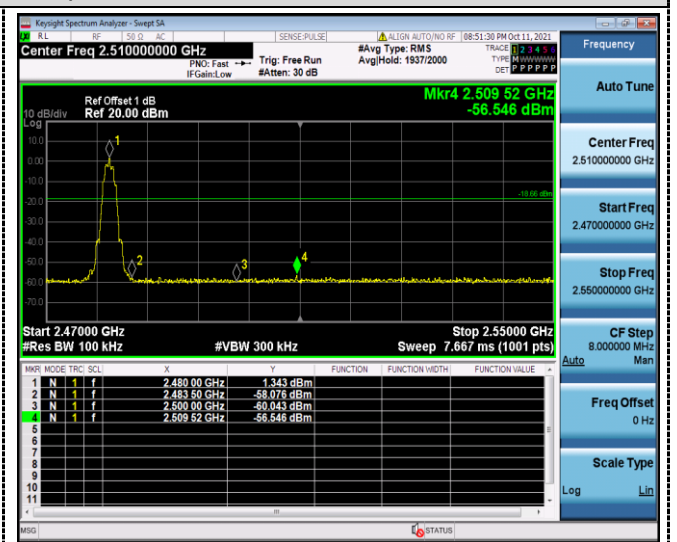


Right bandedge

BLE GFSK 2Mbps



Left bandedge



Right bandedge

4.7 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, 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

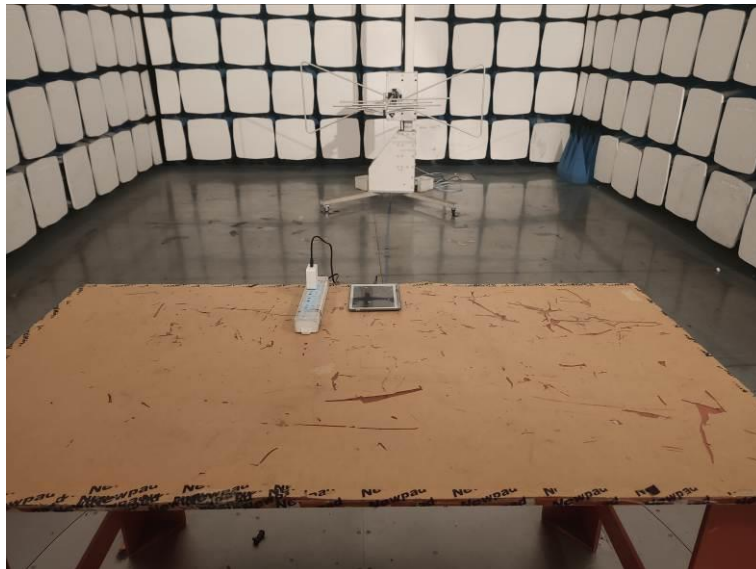
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Antenna Connected Construction

The maximum gain of antenna was -0.86dBi.

5 Test Setup Photos of the EUT



6 Photos of the EUT

Reference to the test report No. GTS20211120007-1-1

***** End of Report *****