



FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No......: **GTSR16050040-BLE**

FCC ID. : **2AIOU-MINIPC**

Compiled by

(position+printed name+signature)...: File administrators Jimmy Wang

Supervised by

(position+printed name+signature)...: Test Engineer Peter Xiao

Approved by

(position+printed name+signature)...: Manager Sam Wang

Date of issue: Jun. 6, 2016

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

Address: 1F, Building No. 13A, Zhonghaixin Science and Technology City,
No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District,
Shenzhen, Guangdong

Applicant's name.....: **Shenzhen Cenovo Technology Co.,Ltd.**

Address: No.103, the first alley, 108# Buyong South Road, Shajing Street,
Bao'an District, Shenzhen City, Guangdong

Test specification :

Standard.....: **FCC Part 15.247: Operation within the bands 902-928 MHz,
2400-2483.5 MHz and 5725-5850 MHz**

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

Master TRF: Dated 2014-12

Shenzhen Global Test Service Co.,Ltd. All rights reserved.

This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen Global Test Service Co.,Ltd. is acknowledged as copyright owner and source of the material. Shenzhen Global Test Service Co.,Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Test item description : **Cenovo**

Trade Mark.....: /

Manufacturer: **Shenzhen Cenovo Technology Co.,Ltd.**

Model/Type reference: MiniPC1

Listed Models: MiniPC2,king, MiniPCS,storg

Modulation Type.....: GFSK

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

EUT Type.....: Production Unit

Hardware Version: AP6212V1.1

Software Version: CX-S-V1.1

Rating.....: Input:AC100-240V,50/60Hz,0.6A

Output:DC5V,4A

Result: **PASS**

TEST REPORT

Test Report No. : GTSR16050040- BLE	Jun. 6, 2016 Date of issue
---	-------------------------------

Equipment under Test : **Cenovo**

Model /Type : MiniPC1

Listed Models : MiniPC2,king, MiniPCS,storg

Applicant : **Shenzhen Cenovo Technology Co.,Ltd.**

Address : No.103, the first alley, 108# Buyong South Road, Shajing Street, Bao'an District, Shenzhen City, Guangdong

Manufacturer : **Shenzhen Cenovo Technology Co.,Ltd.**

Address : NO.202A,2F,Building A, Jiepeng Commerce Square, Fuyong Town, Bao'an District, Shenzhen City, Guangdong

Test Result:	PASS
---------------------	-------------

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.

Contents

<u>1.</u>	<u>TEST STANDARDS</u>	<u>4</u>
<u>2.</u>	<u>SUMMARY.....</u>	<u>5</u>
2.1.	General Remarks	5
2.2.	Product Description	5
2.3.	Equipment Under Test	5
2.4.	Short description of the Equipment under Test (EUT)	5
2.5.	EUT operation mode	5
2.6.	Block Diagram of Test Setup	6
2.7.	Related Submittal(s) / Grant (s)	6
2.8.	EUT configuration	6
2.9.	Modifications	7
2.10.	NOTE	7
<u>3.</u>	<u>TEST ENVIRONMENT</u>	<u>8</u>
3.1.	Address of the test laboratory	8
3.2.	Test Facility	8
3.3.	Environmental conditions	8
3.4.	Test Description	9
3.5.	Statement of the measurement uncertainty	9
3.6.	Equipments Used during the Test	10
<u>4.</u>	<u>TEST CONDITIONS AND RESULTS.....</u>	<u>11</u>
4.1.	AC Power Conducted Emission.....	11
4.2.	Radiated Emission.....	14
4.3.	Maximum Peak Output Power	19
4.4.	Power Spectral Density.....	20
4.5.	6dB Bandwidth.....	22
4.6.	Band Edge Compliance of RF Emission	24
4.7.	Spurious RF Conducted Emission	26
4.8.	Antenna Requirement.....	33
<u>5.</u>	<u>TEST SETUP PHOTOS OF THE EUT</u>	<u>34</u>
<u>6.</u>	<u>EXTERNAL AND INTERNAL PHOTOS OF THE EUT</u>	<u>36</u>

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 V03r05](#): 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	:	May 15, 2016
Testing commenced on	:	May 15, 2016
Testing concluded on	:	Jun. 6, 2016

2.2. Product Description

Name of EUT	Cenovo
Trade Mark	/
Model Number	MiniPC1
List Model	MiniPC2,king, MiniPCS,storg
FCC ID	2AIOU-MINIPC
Antenna Type	Internal
Bluetooth FCC Operation frequency	2402MHz-2480MHz
Bluetooth Modulation	GFSK
Bluetooth	Supported BT4.0
Remark: The products are identical in interior structure, electrical circuits and components, just model names and color are different.	

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	☐ 230V / 50 Hz	☐ 120V / 60Hz
		☐ 12 V DC	☐ 24 V DC
		☒ Other (specified in blank below)	

DC 5.0V from Adapter AC 120V/60Hz

2.4. Short description of the Equipment under Test (EUT)

This is a Cenovo.

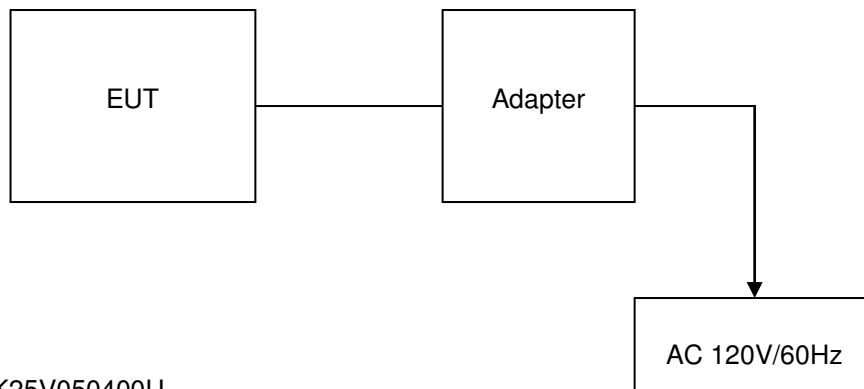
For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

The Applicant provides communication tools software 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. Channel 00/19/39 was selected to test.

Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

2.6. Block Diagram of Test Setup



Adapter:

Model: K25V050400U
 Input: 100-240V~50/60Hz 0.6A
 Output: 5.0V DC 4.0A
 Power Cable: 120cm
 ◇ Shielded ◆ Unshielded

2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AIOU-MINIPC** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - Supplied by the lab

☐	LED Display	M/N:	AH-IPS
		Manufacturer :	HP
☐	Mouse	M/N:	8115
		Manufacturer :	DELL
☐	Keyboard	M/N:	KB212
		Manufacturer :	DELL

2.9. Modifications

No modifications were implemented to meet testing criteria.

2.10. NOTE

	Test Standards	Reference Report
Bluetooth-BLE	FCC Part 15 Subpart C	GTSR16050040-BLE
WLAN	FCC Part 15 Subpart C	GTSR16050040-WLAN
EMF	FCC Per 47 CFR 2.1093(d)	GTSR16050040-MPE

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.

1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

Shenzhen CTL Testing Technology Co., Ltd.

1/F.-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, Guangdong, China

3.2. Test Facility

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

FCC-Registration No.: 964637

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. Registration 964637, Jul 24, 2015.

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, 2018.

FCC-Registration No.: 970318

Shenzhen CTL Testing Technology 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. Registration 970318, December 19, 2013.

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. Test Description

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth – 6 dB bandwidth	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

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

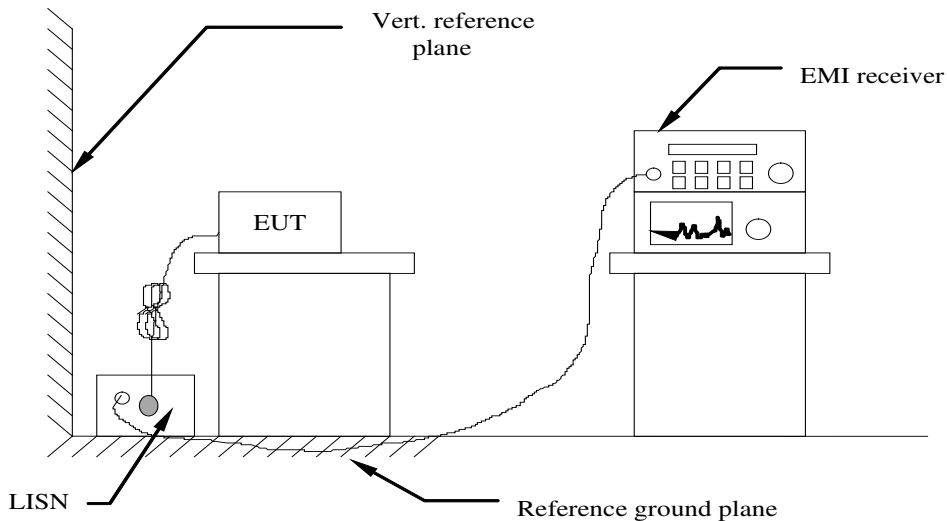
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2016/05/28	2017/05/27
LISN	R&S	ESH2-Z5	893606/008	2016/05/27	2017/05/26
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2016/06/02	2017/06/01
EMI Test Receiver	R&S	ESCI	101102	2015/06/26	2016/06/25
Spectrum Analyzer	Agilent	N9020A	MY48010425	2015/06/17	2016/06/16
Controller	EM Electronics	Controller EM 1000	N/A	2016/05/21	2017/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2016/05/19	2017/05/18
Active Loop Antenna	SCHWARZBEC K	FMZB1519	1519-037	2016/05/19	2017/05/18
Amplifier	Agilent	8349B	3008A02306	2016/05/19	2017/05/18
Amplifier	Agilent	8447D	2944A10176	2016/05/19	2017/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2016/05/20	2017/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2016/05/20	2017/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2016/05/20	2017/05/19
RF Cable	HUBER+SUHNER	RG214	N/A	2016/05/20	2017/05/19

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 DC5V power from PC, the adapter of PC received AC120V/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

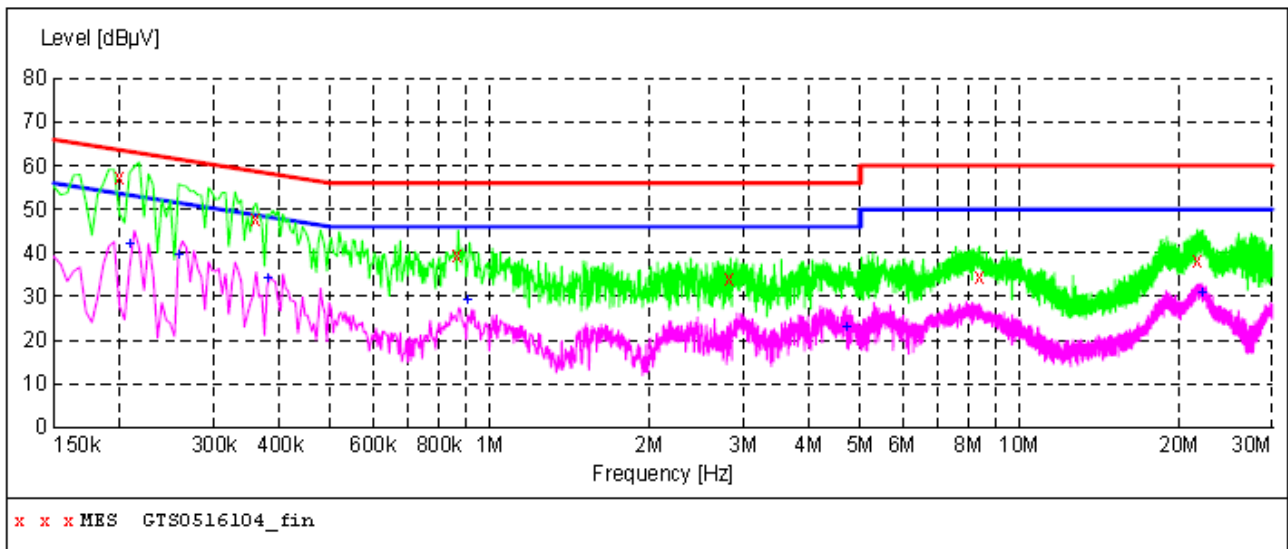
Remark: We tested in AC 120V/60Hz and AC 240V/60Hz, the worst case was recorded .

Power supply:

DC 5V from Adapter

Polarization

L

**MEASUREMENT RESULT: "GTS0516104_fin"**

5/16/2016 10:25AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.199500	57.20	10.0	64	6.4	QP	L1	GND
0.361500	47.70	9.9	59	11.0	QP	L1	GND
0.870000	39.50	9.6	56	16.5	QP	L1	GND
2.823000	34.30	9.5	56	21.7	QP	L1	GND
8.398500	34.70	9.0	60	25.3	QP	L1	GND
21.619500	38.40	7.0	60	21.6	QP	L1	GND

MEASUREMENT RESULT: "GTS0516104_fin2"

5/16/2016 10:25AM

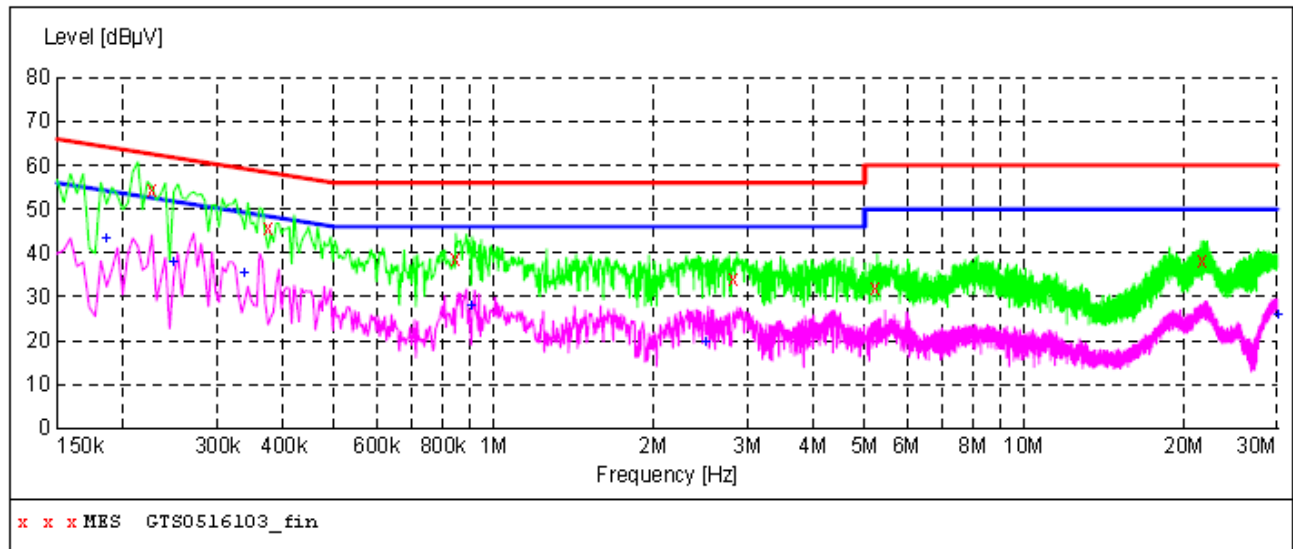
Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.208500	42.20	10.0	53	11.1	AV	L1	GND
0.258000	39.40	9.9	52	12.1	AV	L1	GND
0.379500	34.30	9.8	48	14.0	AV	L1	GND
0.906000	29.20	9.6	46	16.8	AV	L1	GND
4.726500	22.80	9.3	46	23.2	AV	L1	GND
22.110000	30.70	7.0	50	19.3	AV	L1	GND

Power supply:

DC 5V from Adapter

Polarization

N

**MEASUREMENT RESULT: "GTS0516103_fin"**

5/16/2016 10:22AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.226500	54.40	10.0	63	8.2	QP	N	GND
0.375000	45.90	9.8	58	12.5	QP	N	GND
0.847500	38.50	9.6	56	17.5	QP	N	GND
2.836500	34.00	9.5	56	22.0	QP	N	GND
5.248500	32.20	9.3	60	27.8	QP	N	GND
21.615000	38.30	7.0	60	21.7	QP	N	GND

MEASUREMENT RESULT: "GTS0516103_fin2"

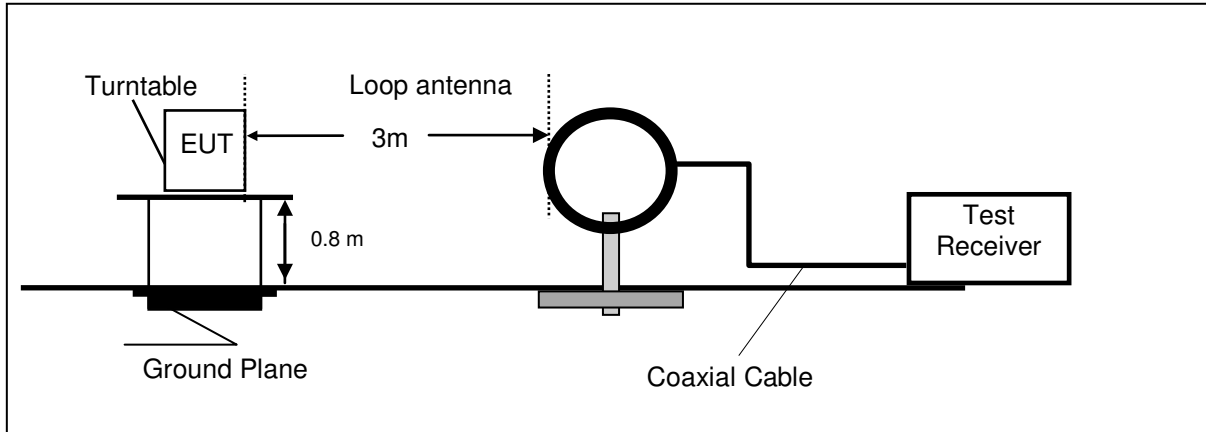
5/16/2016 10:22AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.186000	43.40	10.0	54	10.8	AV	N	GND
0.249000	37.70	10.0	52	14.1	AV	N	GND
0.339000	35.50	9.9	49	13.7	AV	N	GND
0.906000	27.80	9.6	46	18.2	AV	N	GND
2.508000	19.50	9.5	46	26.5	AV	N	GND
29.998500	26.00	6.9	50	24.0	AV	N	GND

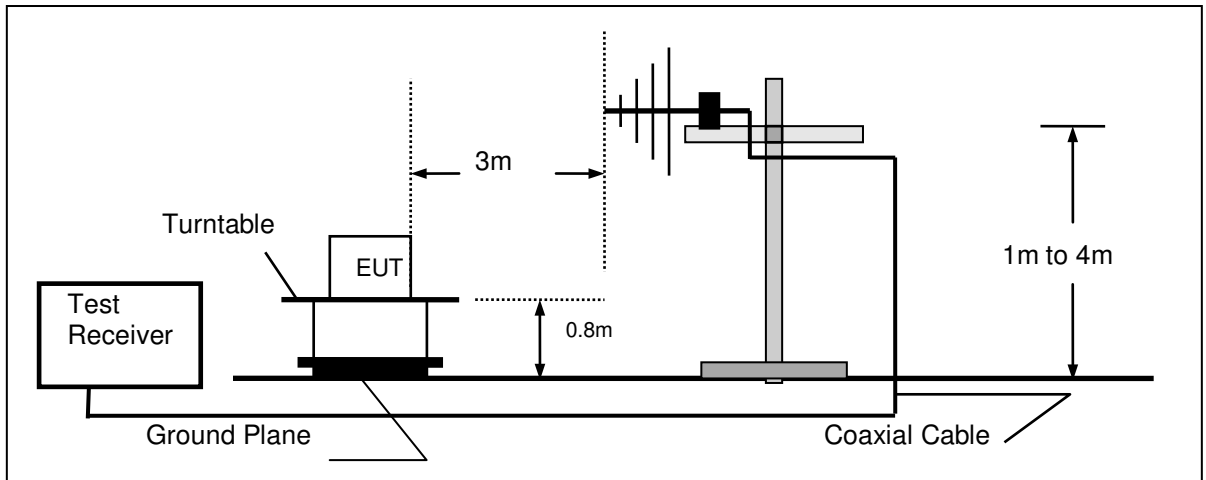
4.2. Radiated Emission

TEST CONFIGURATION

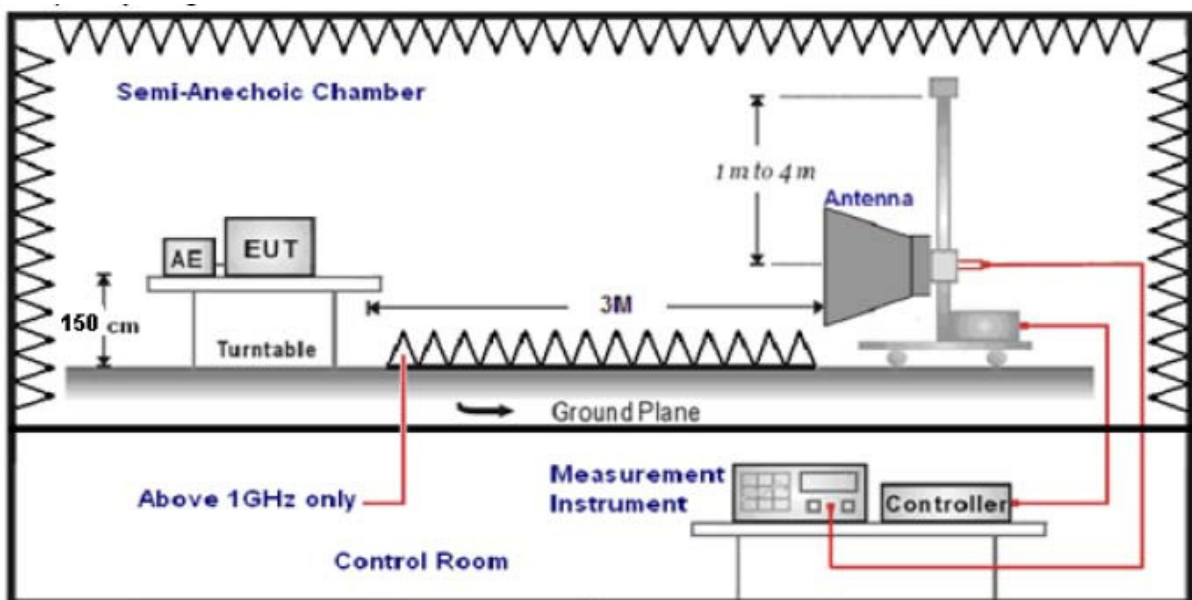
Frequency range 9 KHz – 30MHz



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° to 360° 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	

$$\text{Transd}=AF +CL-AG$$

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 the 100kHz 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	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	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

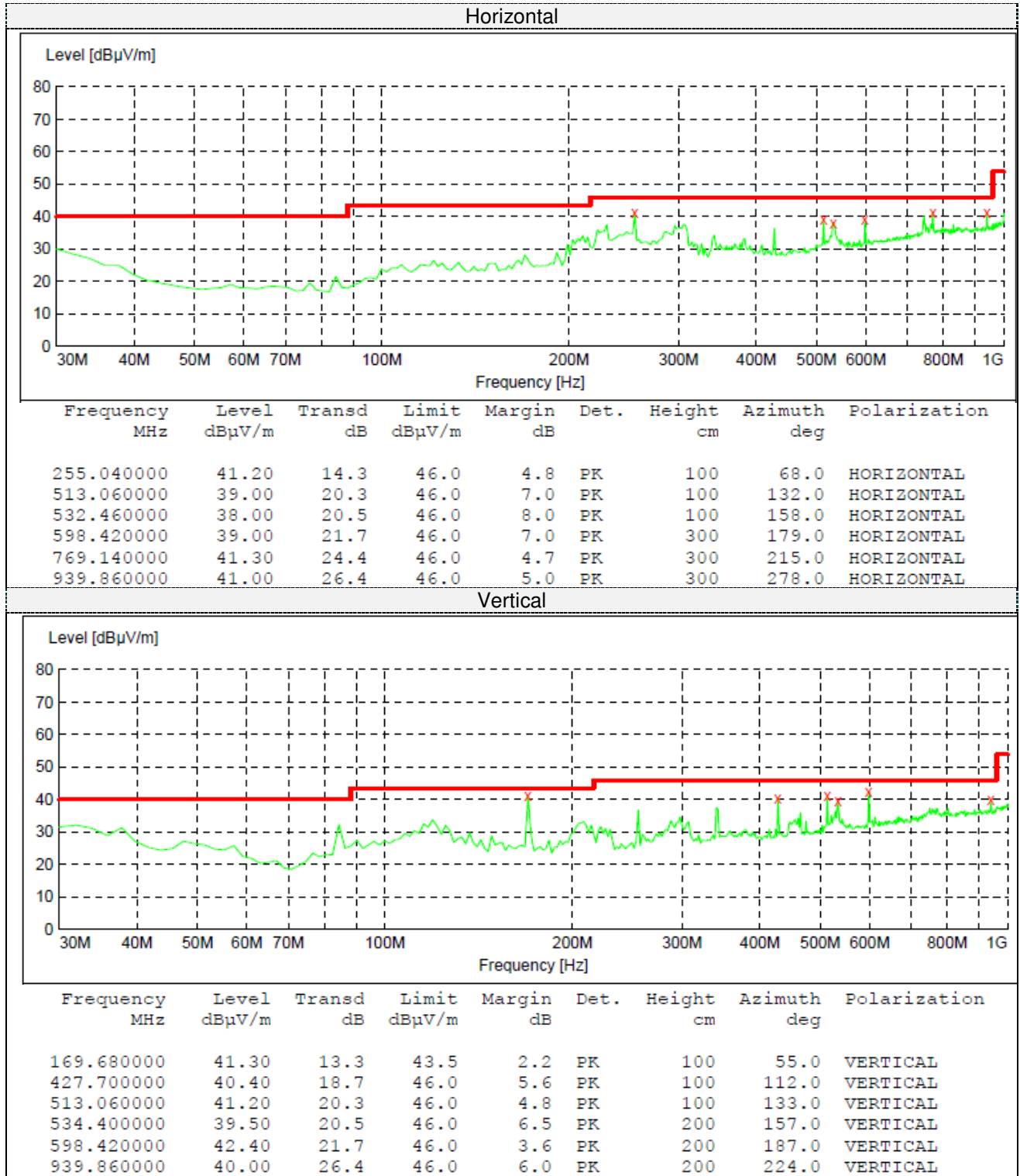
TEST RESULTS

Remark: We tested in AC 120V/60Hz and AC 240V/60Hz, the worst case was recorded.

Test site: Shenzhen CTL Testing Technology Co., Ltd

For 9KHz to 30MHz

Frequency (MHz)	Corrected Reading (dBuV/m)@3m	FCC Limit (dBuV/m) @3m	Margin (dB)	Detector	Result
0.36	47.17	96.48	49.31	QP	PASS
1.65	46.53	63.25	16.72	QP	PASS
20.51	45.48	69.54	24.06	QP	PASS
25.77	46.44	69.54	23.10	QP	PASS

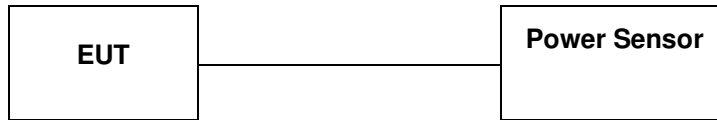
For 30MHz to 1000MHz

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 Factor
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.

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power,9.1.2.

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

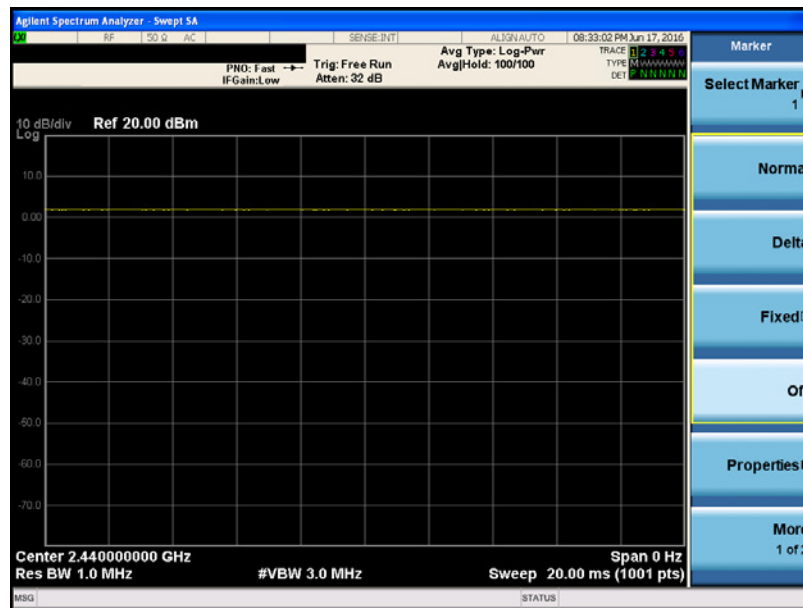
The Maximum Peak Output Power Measurement is 30dBm.

TEST RESULTS

Type	Channel	Peak Output power (dBm)	Average Output power (dBm)	Limit (dBm)	Result
GFSK	0	2.42	1.08	30	Pass
	19	1.85	0.92		
	39	2.37	1.25		

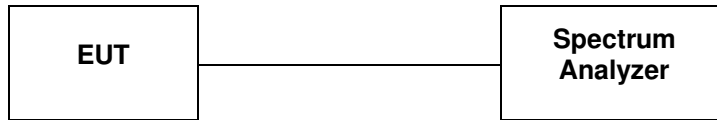
Note: 1.The test results including the cable lose.

Duty cycle used in all test items: 100%



4.4. Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

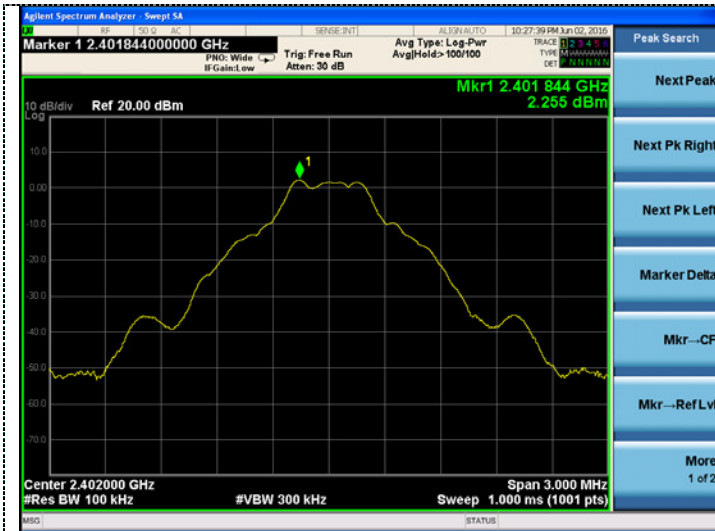
1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW = 300 KHz.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = 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 8 dBm.

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 RESULTS

Type	Channel	Power Spectral Density (dBm/100KHz)	Limit (dBm/3KHz)	Result
GFSK	0	2.25	8.00	Pass
	19	1.72		
	39	2.12		



CH0



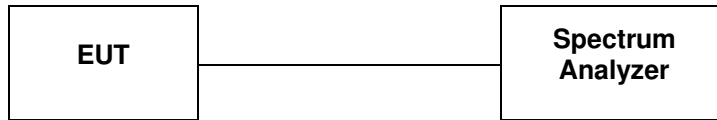
CH19



CH39

4.5. 6dB Bandwidth

TEST CONFIGURATION



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 RBW=100 KHz and VBW=300KHz. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB. According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.

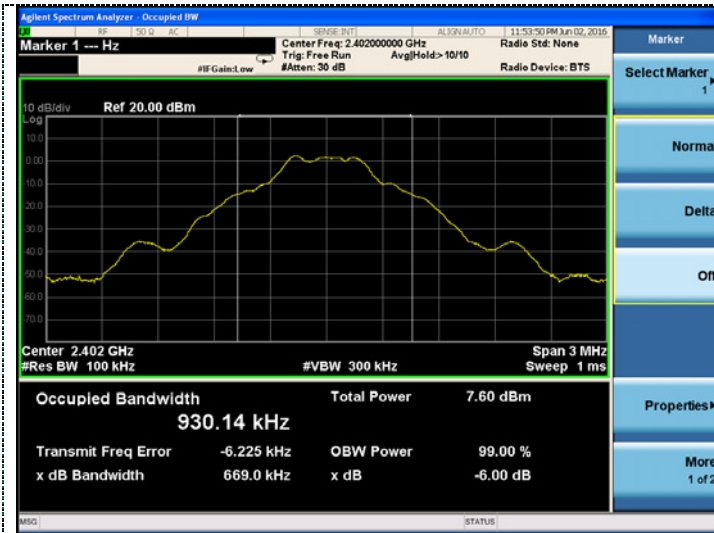
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

LIMIT

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

TEST RESULTS

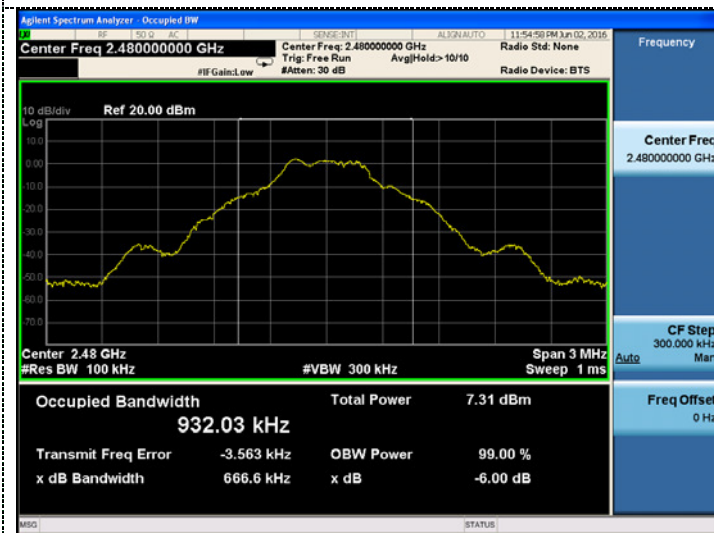
Type	Channel	6dB Bandwidth (KHz)	Limit (KHz)	Result
GFSK	0	669.0	≥ 500	Pass
	19	666.3		
	39	666.6		



CH0



CH19



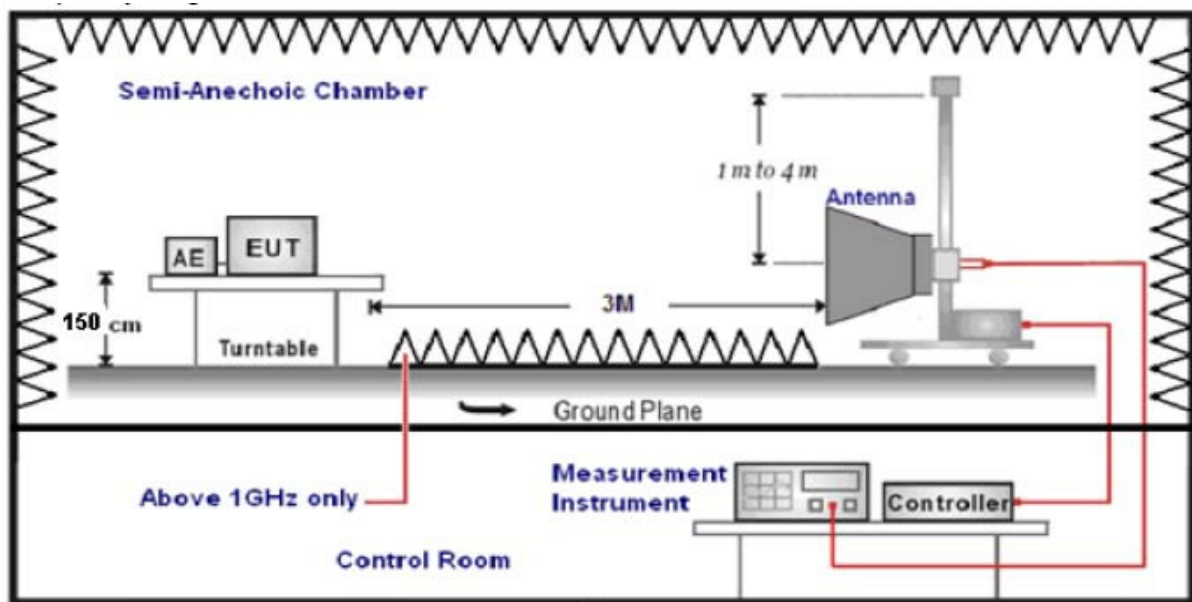
CH39

4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° 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 distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.

Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

TEST RESULTS

Remark: Test site: Shenzhen CTL Testing Technology Co., Ltd.

4.6.1 For Radiated Bandedge Measurement

Frequency(MHz):			2402			Polarity:			HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	54.54	PK	74.00	19.46	1.00	167	59.85	27.49	3.32	36.12	-5.31
2390.00	40.23	AV	54.00	13.77	1.00	167	45.54	27.49	3.32	36.12	-5.31
Frequency(MHz):			2402			Polarity:			VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	53.46	PK	74.00	20.54	1.00	214	58.77	27.49	3.32	36.12	-5.31
2390.00	41.44	AV	54.00	12.56	1.00	214	46.75	27.49	3.32	36.12	-5.31
Frequency(MHz):			2480			Polarity:			HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	53.64	PK	74.00	20.36	1.00	256	59.36	27.45	3.38	36.55	-5.72
2483.50	40.29	AV	54.00	13.71	1.00	256	46.01	27.45	3.38	36.55	-5.72
Frequency(MHz):			2480			Polarity:			VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	57.49	PK	74.00	16.51	1.00	127	63.21	27.45	3.38	36.55	-5.72
2483.50	40.58	AV	54.00	13.42	1.00	127	46.30	27.45	3.38	36.55	-5.72

4.6.2 For Conducted Bandedge Measurement

Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
2400.00	-68.83	-20	PASS
2483.50	-62.39	-20	PASS

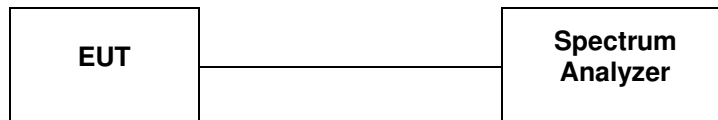
Agilent Spectrum Analyzer - Swept SA
Marker 3 2.400000000 GHz
Ref 20.00 dBm
Mkr3 2.400 00 GHz -56.702 dBm
Start 2.30000 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 10.53 ms (1001 pts)
Function table:
1 N 1 f 2.401 86 GHz 2.131 dBm
2 N 1 f 2.390 00 GHz -60.733 dBm
3 N 1 f 2.400 00 GHz -56.702 dBm

Agilent Spectrum Analyzer - Swept SA
Marker 3 2.511280000 GHz
Ref 20.00 dBm
Mkr3 2.511 28 GHz -57.993 dBm
Start 2.47000 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 7.667 ms (1001 pts)
Function table:
1 N 1 f 2.479 84 GHz 2.302 dBm
2 N 1 f 2.483 50 GHz -60.096 dBm
3 N 1 f 2.511 28 GHz -57.993 dBm

2402	2480
------	------

4.7. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength, and measure frequency range from 9KHz to 25GHz.

LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

TEST RESULTS

Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and band edge measurement data.

Test Mode:

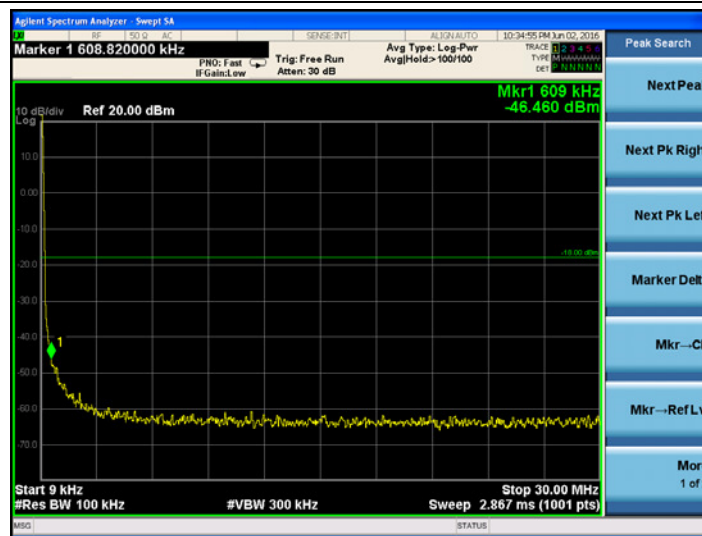
GFSK

Test channel :

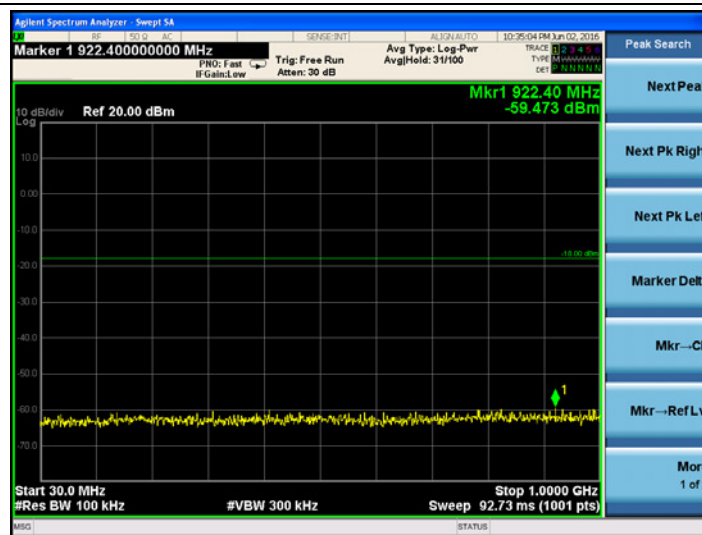
00



Channel 00



9KHz~30MHz



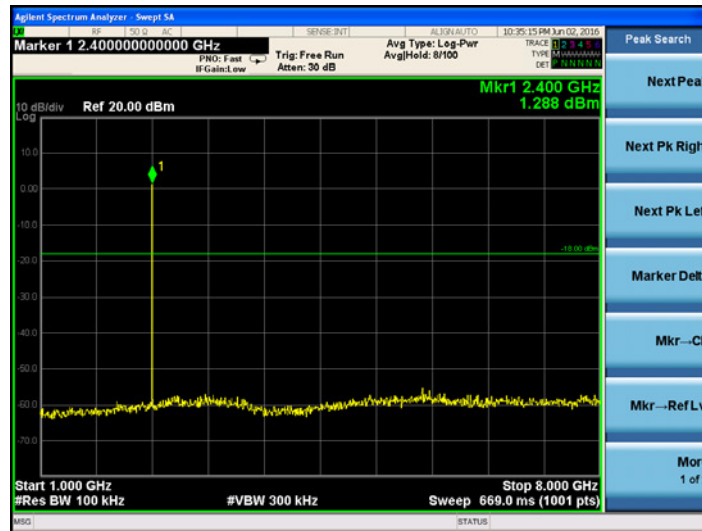
30M Hz~1GHz

Test Mode:

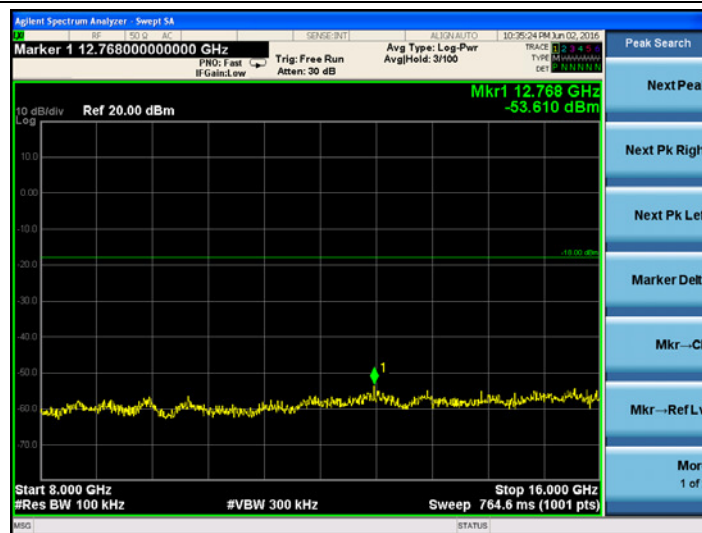
GFSK

Test channel :

0



1GHz~8GHz



8GHz~16GHz



16GHz~25GHz

Test Mode:

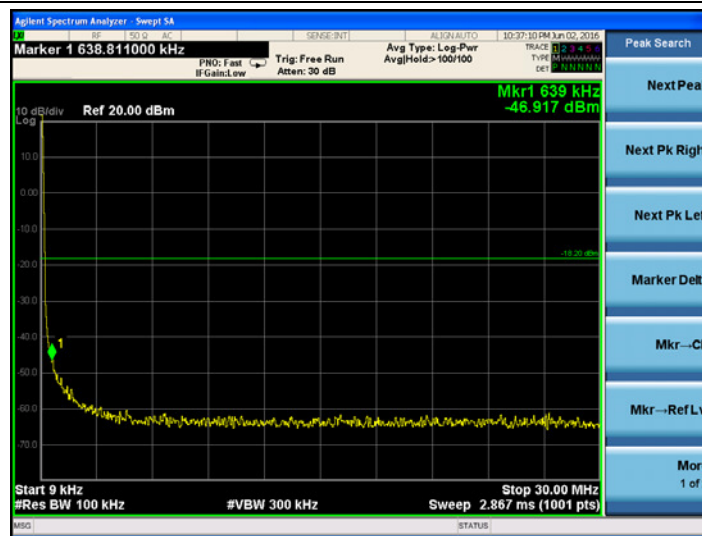
GFSK

Test channel :

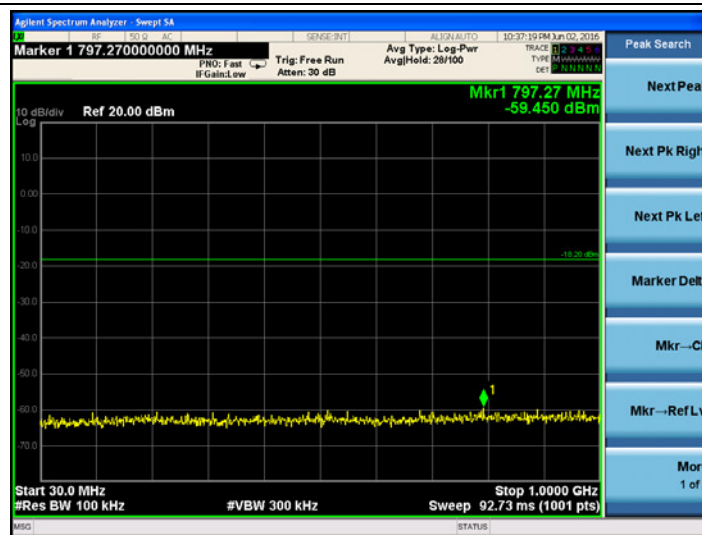
19



Channel 19



9KHz~30MHz



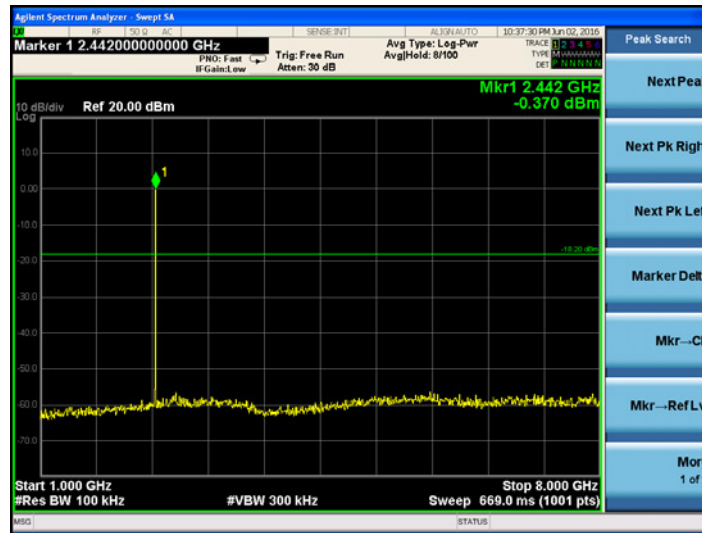
30M Hz~1GHz

Test Mode:

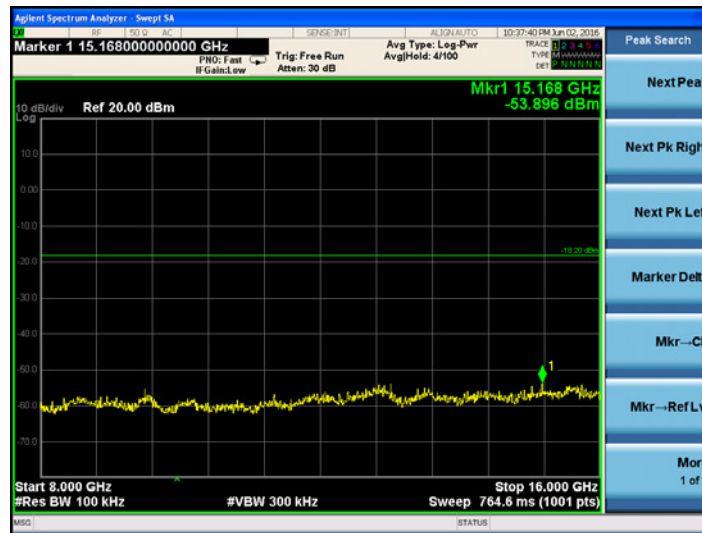
GFSK

Test channel :

19



1GHz~8GHz



8GHz~16GHz



16GHz~25GHz

Test Mode:

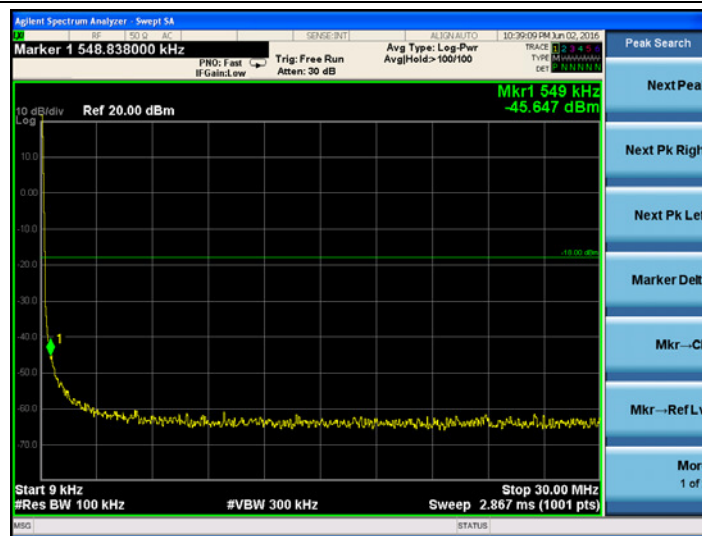
GFSK

Test channel :

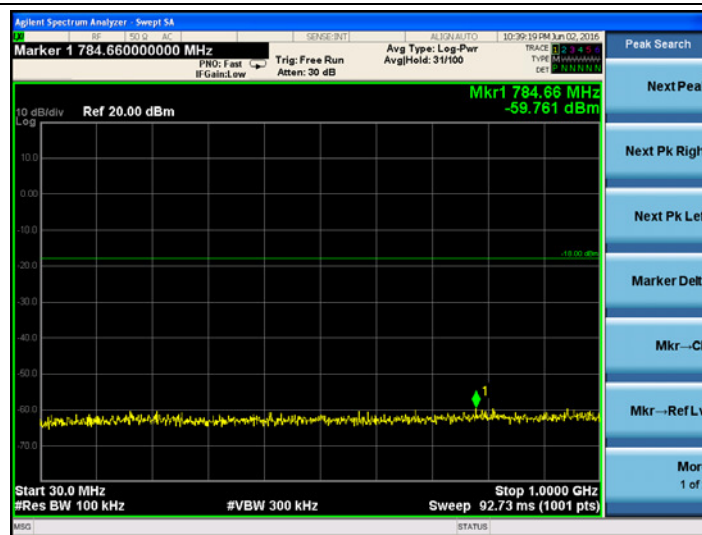
39



Channel 39



9KHz~30MHz



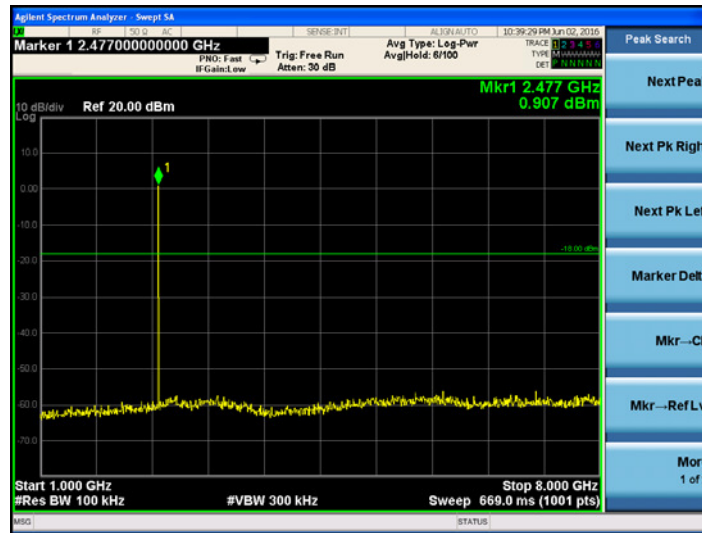
30M Hz~1GHz

Test Mode:

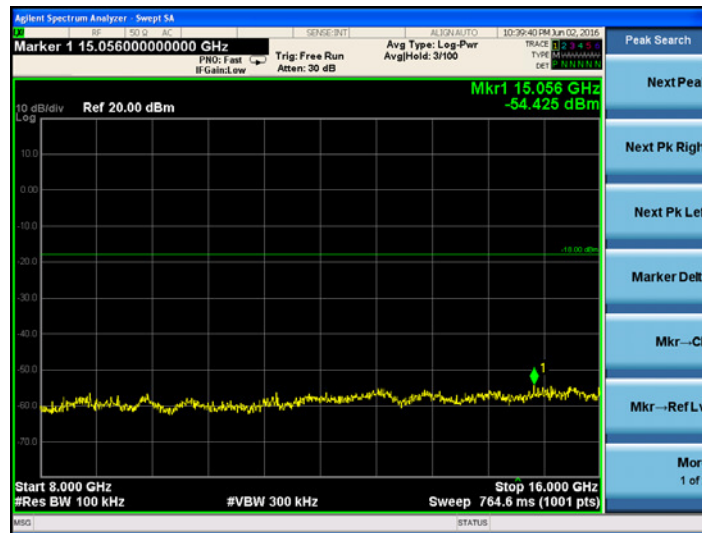
GFSK

Test channel :

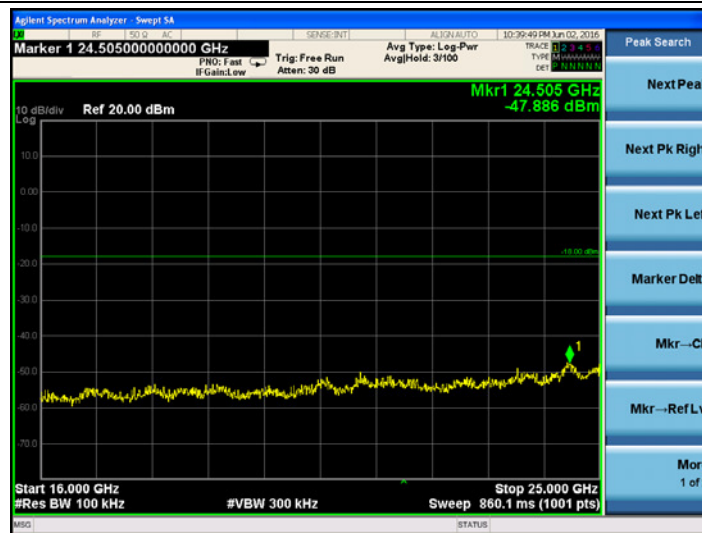
39



1GHz~8GHz



8GHz~16GHz



16GHz~25GHz

4.8. 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.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

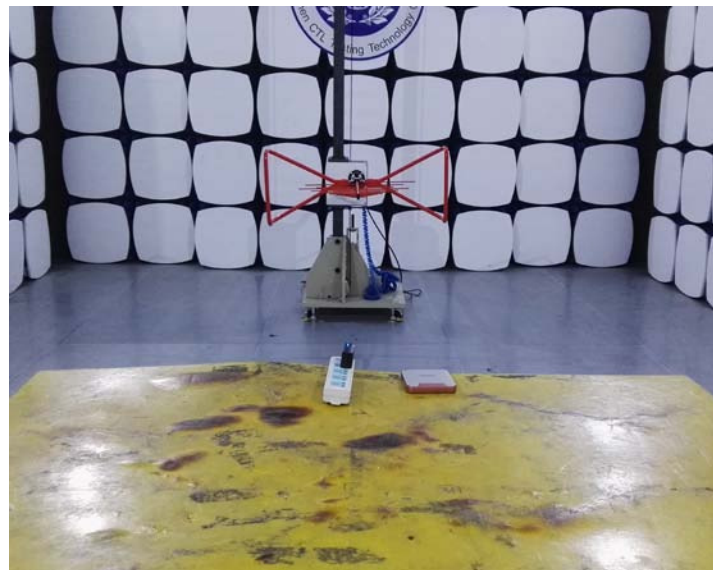
Limits

Antenna Gain	6 dBi
--------------	-------

Results

T_{nom}	V_{nom}	Lowest Channel 2402 MHz	Middle Channel 2440 MHz	Highest Channel 2480 MHz
Conducted power [dBm]		2.42	1.85	2.37
Radiated power [dBm]		3.06	2.67	3.24
Gain [dBi] Calculated		0.64	0.82	0.87
Measurement uncertainty		± 0.6 dB (cond.) / ± 4.32 dB (rad.)		

5. Test Setup Photos of the EUT





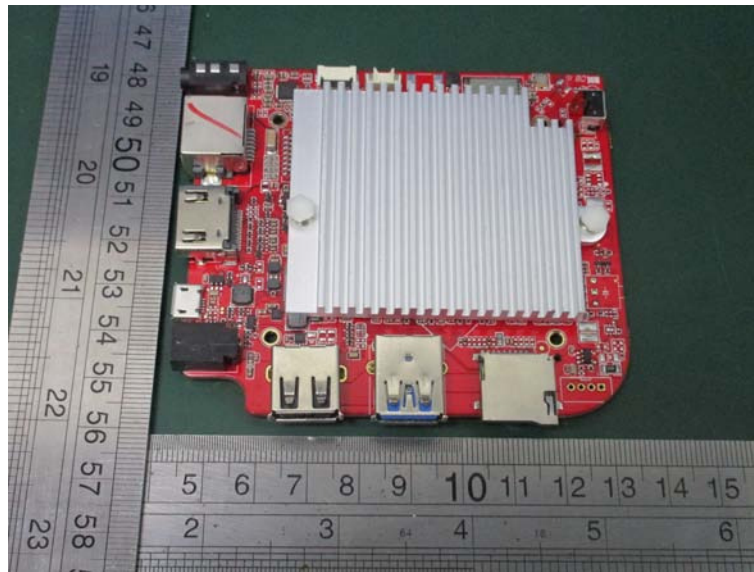
6. External and Internal Photos of the EUT

External Photos

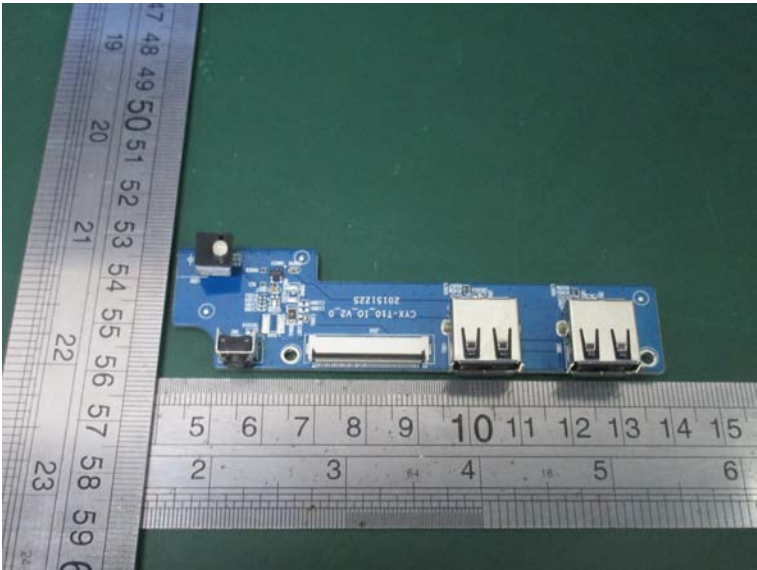
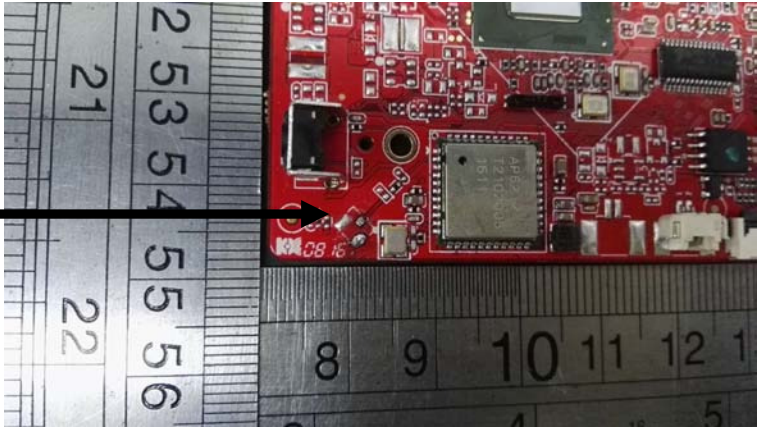


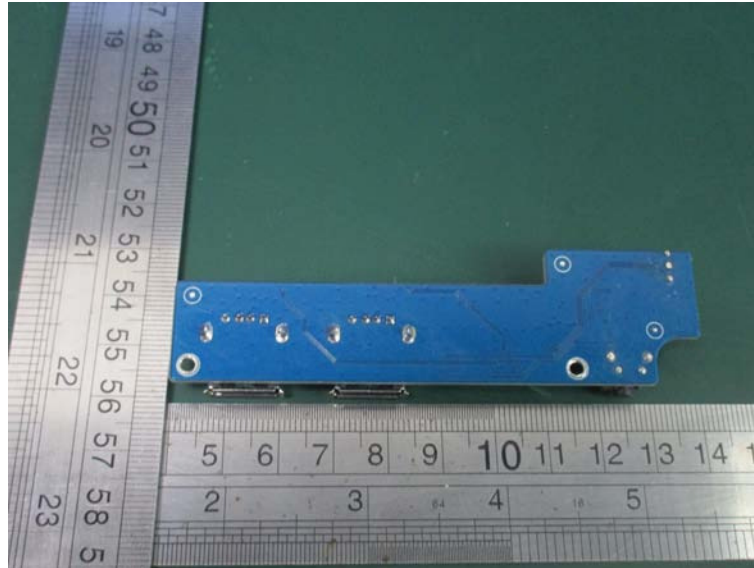


Internal Photos



BT/WiFi
Antenna





.....End of Report.....