FCC TEST REPORT(Bluetooth)

for

Loud Technologies Inc.

MULTIMEDIA MONITORS w/ BLUETOOTH

Model Number: CR4BT
Serial Model: CR5BT

FCC ID: 2AD4XCR4BTCR5BT
IC: 12714A-CR4BTCR5BT

Prepared for	:	Loud Technologies Inc.
Address	:	16220 Wood-Red Rd. NE ,Woodinville,WA 98072,USA
Prepared by	:	Keyway Testing Technology Co., Ltd.
Address	:	Building 1, Baishun Industrial Zone, Zhangmutou Town, Dongguan, Guangdong, China
		Tel: 86-769-8718 2258
		Fax: 86-769-8718 1058

Report No.	:	15KWE082919F
Date of Test	:	Aug.17-25, 2015
Date of Report	:	Aug.26, 2015

TABLE OF CONTENTS

Test Report Declaration Page

1. TEST SUMMARY 4

2. GENERAL PRODUCT INFORMATION 5

2.1. Product Function 5
2.2. Description of Device (EUT) 5
2.3. Difference between Model Numbers 5
2.4. Independent Operation Modes 5
2.5. Test Supporting System 5
2.6. Product Version 5
2.7. Test Facilities 6
2.8. List of Test and Measurement Instruments 7

3. TEST SET-UP AND OPERATION MODES 8

3.1. Principle of Configuration Selection 8
3.2. Block Diagram of Test Set-up 8
3.3. Test Operation Mode and Test Software 8
3.4. Special Accessories and Auxiliary Equipment 8
3.5. Countermeasures to Achieve EMC Compliance 8
3.6. Test Environment: 8

4. MAXIMUM PEAK OUTPUT POWER 9

4.1. Limits 9
4.2. Test setup 9

5. EMISSION TEST RESULTS 10

5.1. Conducted Emission at the Mains Terminals Test 10
5.2. Radiated Emission Test 13

6. 20DB & 99% OCCUPY BANDWIDTH 20

6.1. Limits 20
6.2. Test setup 20

7. FREQUENCY SEPARATION 26

7.1. Limits 26
7.2. Test setup 26

8. NUMBER OF HOPPING FREQUENCY 33

8.1. Limits 33
8.2. Test setup 33

9. DWELL TIME 35

9.1. Limits 35
9.2. Test setup 35

10. BAND EDGE COMPLIANCE TEST 41

10.1. Limits 41
10.2. Test setup 41

11. ANTENNA REQUIREMENTS 41

11.1. Limits 41
11.2. Result 41

12. PHOTOGRAPHS OF TEST SET-UP 41

13. PHOTOGRAPHS OF THE EUT 41

Keyway Testing Technology Co., Ltd.

Applicant: **Address:**	Loud Technologies Inc. 16220 Wood-Red Rd. NE ,Woodinville,WA 98072,USA		
Manufacturer: **Address:**	Loud Technologies Inc. 16220 Wood-Red Rd. NE ,Woodinville,WA 98072,USA		
E.U.T:	MULTIMEDIA MONITORS w/ BLUETOOTH		
Model Number:	CR4BT,CR5BT		
Trade Name:		**Serial No.:**	------
Date of Receipt:	Aug.16, 2015	**Date of Test:**	Aug.17-25, 2015
Test Specification:	FCC Part 15, Subpart C Section 15.247: 2014 ANSI C63.10:2013 RSS-247 Issue 1 May 2015 RSS-Gen Issue 4 November 2014		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied. **Issue Date: Aug. 26, 2015**		

Tested by:	Reviewed by:	Approved by:
Keven Wu/ Engineer	Andy Gao / Supervisor	Jade Yang / Supervisor

Other Aspects:
None.

Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested

1. TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207/ RSS-Gen §8.8	PASS
Radiated Emissions	15.205(a)/15.209 15.247(d) / RSS-Gen §6.13	PASS
20dB Bandwidth	15.247(a)(1) / RSS-247 §5.1(1) &RSS-Gen§6.6	PASS
99% Bandwidth	RSS-247 §5.1(1) &RSS-Gen§6.6	PASS
Frequency Separation	15.247(a)(1) / RSS-247 §5.1(2)	PASS
Maximum Peak Output Power	15.247(b)(1) / RSS-247§5.4(2) &RSS-Gen§6.12	PASS
Number of Hopping Frequency	15.247(a)(1)(iii) / RSS-247 §5.1(4)	PASS
Dwell time	15.247(a)(1)(iii) / RSS-247 §5.1(4)	PASS
Emissions from out of band	15.247(d) / RSS-247 §5.5	PASS
Antenna Requirement	15.203/ RSS-Gen§8.3	PASS

2.GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	MULTIMEDIA MONITORS w/ BLUETOOTH
Model No.:	CR4BT,CR5BT
Operation Frequency:	2402MHz ~2480MHz
Channel numbers:	79 Channels
Channel spacing	1MHz
Modulation technology:	GFSK, Pi/4DQPSK, 8-DPSK
Antenna Type:	Permanently fixed antenna
Antenna gain:	1.53dBi
Power supply:	AC 120V/50Hz

2.3. Difference between Model Numbers

Note: CR4BT,CR5BT are identical to each other except the horn size, box size and the model name.

2.4. Independent Operation Modes

The basic operation modes are:

2.4.1. EUT work continues TX mode and frequency as below:

Modulation	Channel	Frequency
GFSK	Low	2402MHz
	Middle	2441MHz
	High	2480MHz

Note: Bluetooth signal has 3 packages DH1, DH3, DH5, DH5 package is largest;

2.5. Test Supporting System

None.

2.6. Product Version

Product SW version	Rev_3
Product HW version	Rev_3
Radio SW version	SPKV002
Radio HW version	SPKV002
Test SW Version	Rev_1
RF power setting in TEST SW	2dBm

Note: SW means software, HW means hardware.

2.7. Test Facilities

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.
Registration No.: UA 50207153
Date of registration: July 13, 2011

Certificated by UL, USA
Registration No.: 100567-237
Date of registration: September 1, 2011

Certificated by Intertek
Registration No.: 2011-RTL-L1-31
Date of registration: October 11, 2011

Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Building 1, Baishun Industrial Zone, Zhangmutou Town, Dongguan, Guangdong, China

2.8. List of Test and Measurement Instruments

2.8.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,15	Apr. 27,16
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 27,15	Apr. 27,16
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	Apr. 27,15	Apr. 27,16
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 27,15	Apr. 27,16

2.8.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,15	Apr. 27,16
System Simulator	Agilent	E5515C	GB43130245	Apr. 27,15	Apr. 27,16
Power Splitter	Weinschel	1506A	NW425	Apr. 27,15	Apr. 27,16
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 27,15	Apr. 27,16
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 27,15	Apr. 27,16
Signal Amplifier	SONOMA	310	187016	Apr. 27,15	Apr. 27,16
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 27,15	Apr. 27,16
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	DAZE	ZN30701	11003	Apr. 27,15	Apr. 27,16
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	8593E	3911A04271	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 27,15	Apr. 27,16
Signal Amplifier	DAZE	ZN3380C	11001	Apr. 27,15	Apr. 27,16
High Pass filter	Micro	HPM50111	324216	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C836.5-25-X	KW032	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C1747.5-75-X2	KW035	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C1880-60-X2	KW037	Apr. 27,15	Apr. 27,16
DC Power Supply	LongWei	PS-305D	010964729	Apr. 27,15	Apr. 27,16
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 27,15	Apr. 27,16
Universal radio communication tester	Rohde&Schwarz	CMU200	3215420	Apr. 27,15	Apr. 27,16
Splitter	Agilent	11636B	0025164	Apr. 27,15	Apr. 27,16

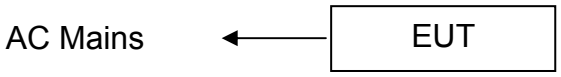
3. TEST SET-UP AND OPERATION MODES

3.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

3.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



(EUT: MULTIMEDIA MONITORS w/ BLUETOOTH*)*

3.3. Test Operation Mode and Test Software

None.

3.4. Special Accessories and Auxiliary Equipment

None.

3.5. Countermeasures to Achieve EMC Compliance

None.

3.6. Test Environment:

Ambient conditions in the test laboratory:

Items	Actual
Temperature (℃)	21~23
Humidity (%RH)	50~65

4. MAXIMUM PEAK OUTPUT POWER

4.1. Limits

According to FCC Section 15.247(b)(1), For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

4.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter, during the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

Test data:

	Channel Frequency (MHz)	**Peak output Power dBm**	**Limit dBm**	**Result**
GFSK	2402	1.41	30.00	Pass
	2441	1.52	30.00	Pass
	2480	1.69	30.00	Pass
Pi/4DQPSK	2402	1.18	21.00	Pass
	2441	1.21	21.00	Pass
	2480	1.25	21.00	Pass
8-DPSK	2402	1.12	21.00	Pass
	2441	1.15	21.00	Pass
	2480	1.19	21.00	Pass

5. EMISSION TEST RESULTS

5.1. Conducted Emission at the Mains Terminals Test

5.1.1. Limit 15.207 limits

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

5.1.2. Test Setup

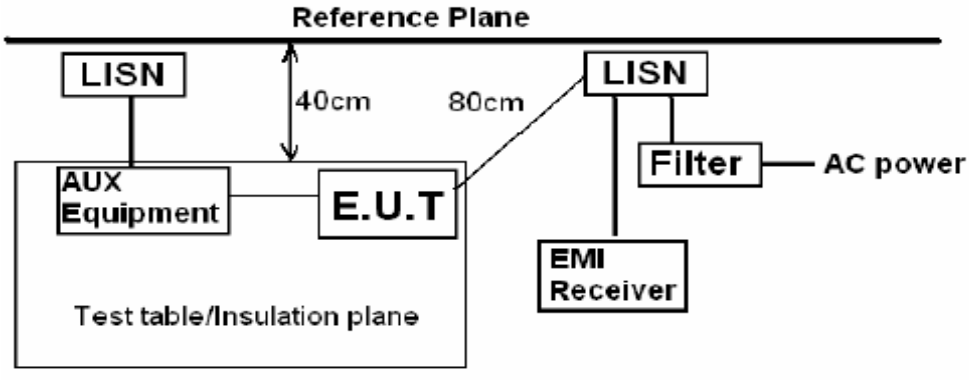
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the center so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The test data of the worst case condition(s) was reported on the following page.

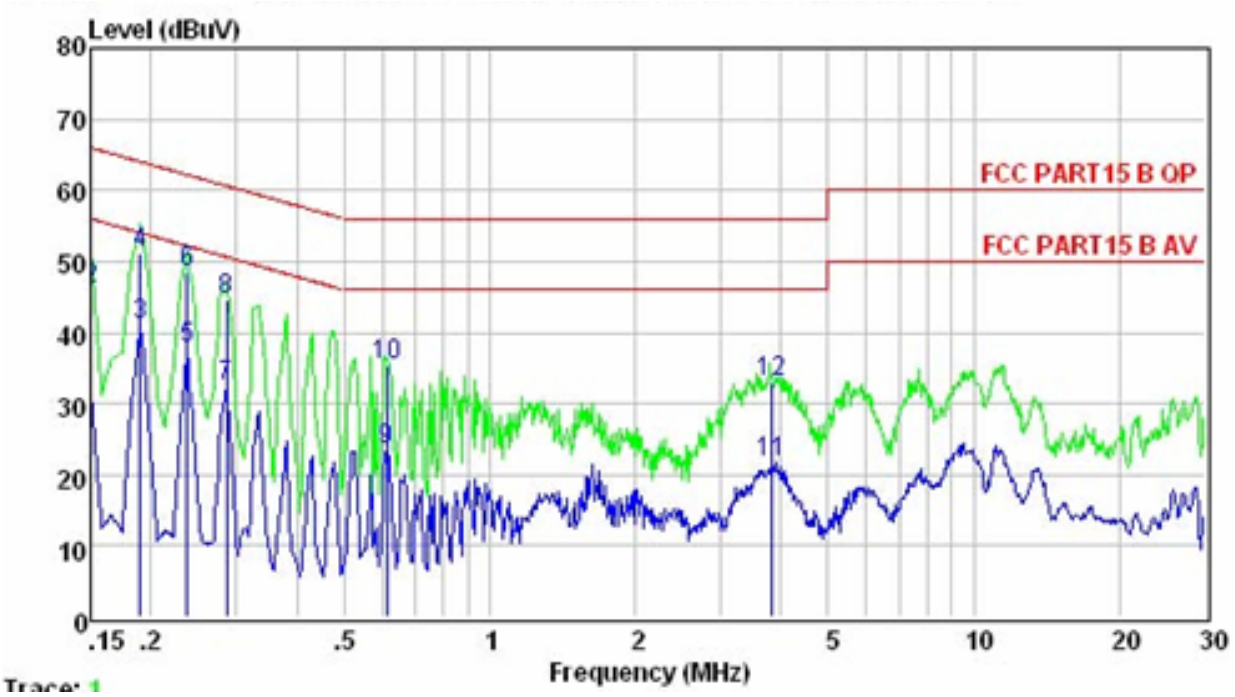


Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

5.1.3. Test Mode

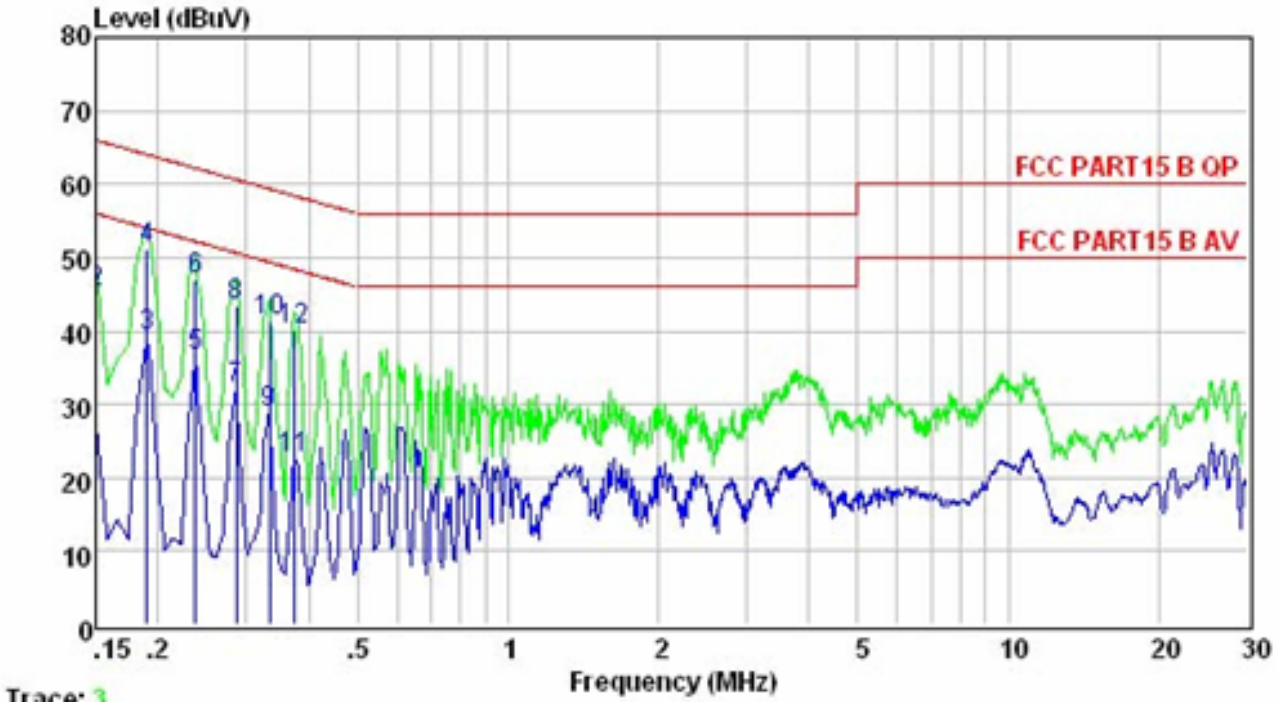
Set EUT in TX mode.

Line:



	Freq	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	
1	0.150	31.28	56.00	-24.72	Average
2	0.150	46.12	66.00	-19.88	QP
3	0.190	40.95	54.02	-13.07	Average
4	0.190	51.24	64.02	-12.78	QP
5	0.238	37.90	52.17	-14.27	Average
6	0.238	48.36	62.17	-13.81	QP
7	0.286	32.38	50.63	-18.25	Average
8	0.286	44.66	60.63	-15.97	QP
9	0.614	23.62	46.00	-22.38	Average
10	0.614	35.40	56.00	-20.60	QP
11	3.820	21.84	46.00	-24.16	Average
12	3.820	33.11	56.00	-22.89	QP

Neutral



	Freq	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	
1	0.150	26.88	56.00	-29.12	Average
2	0.150	45.33	66.00	-20.67	QP
3	0.190	39.13	54.02	-14.89	Average
4	0.190	51.06	64.02	-12.96	QP
5	0.238	36.51	52.17	-15.66	Average
6	0.238	47.12	62.17	-15.05	QP
7	0.286	32.16	50.63	-18.47	Average
8	0.286	43.28	60.63	-17.35	QP
9	0.334	28.94	49.35	-20.41	Average
10	0.334	41.36	59.35	-17.99	QP
11	0.373	22.52	48.43	-25.91	Average
12	0.373	40.22	58.43	-18.21	QP

5.2. Radiated Emission Test

5.2.1. Limit 15.209 limits

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

5.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

5.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz, the EUT was placed on a turn table which was 1.5 m above the ground, for all test, used peak detector.

The frequency range from 30MHz to 10^{th} harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

2. Measurement Uncertainty: ±3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

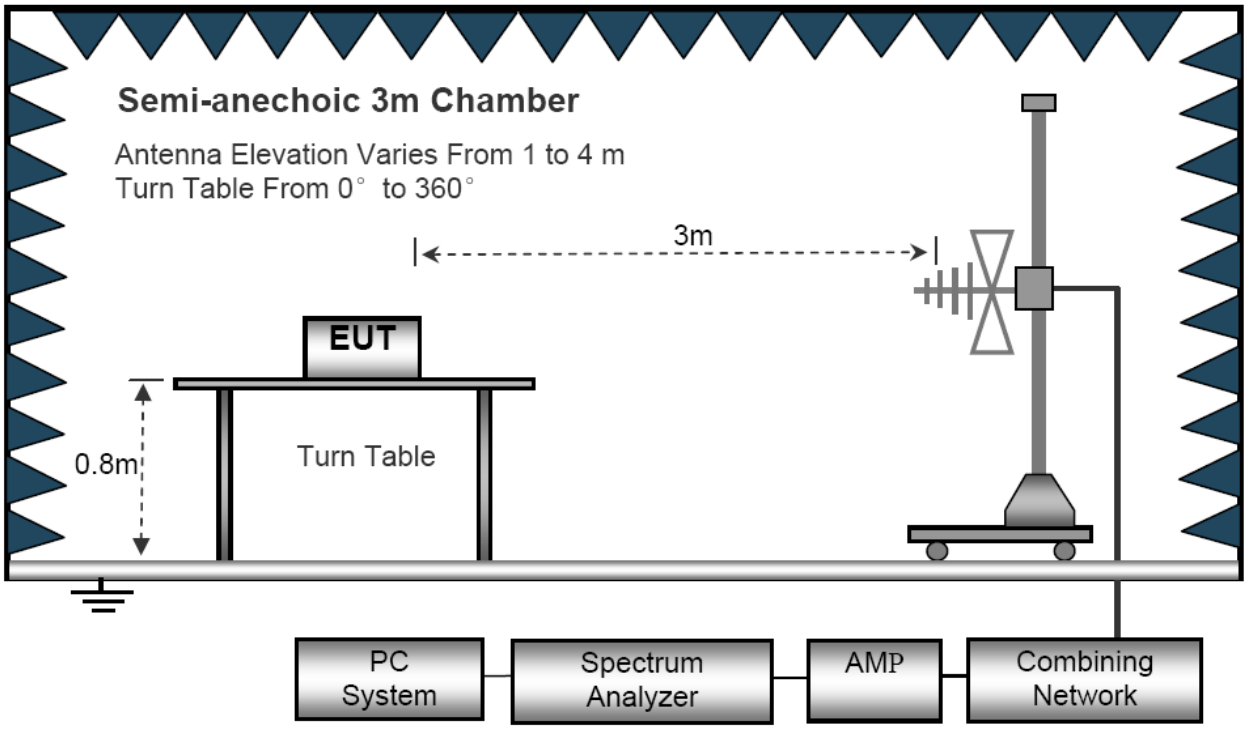
4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

5: we pretest 3 packages DH1, DH3, DH5, package DH5 is largest; we are testing DH5 in the report.

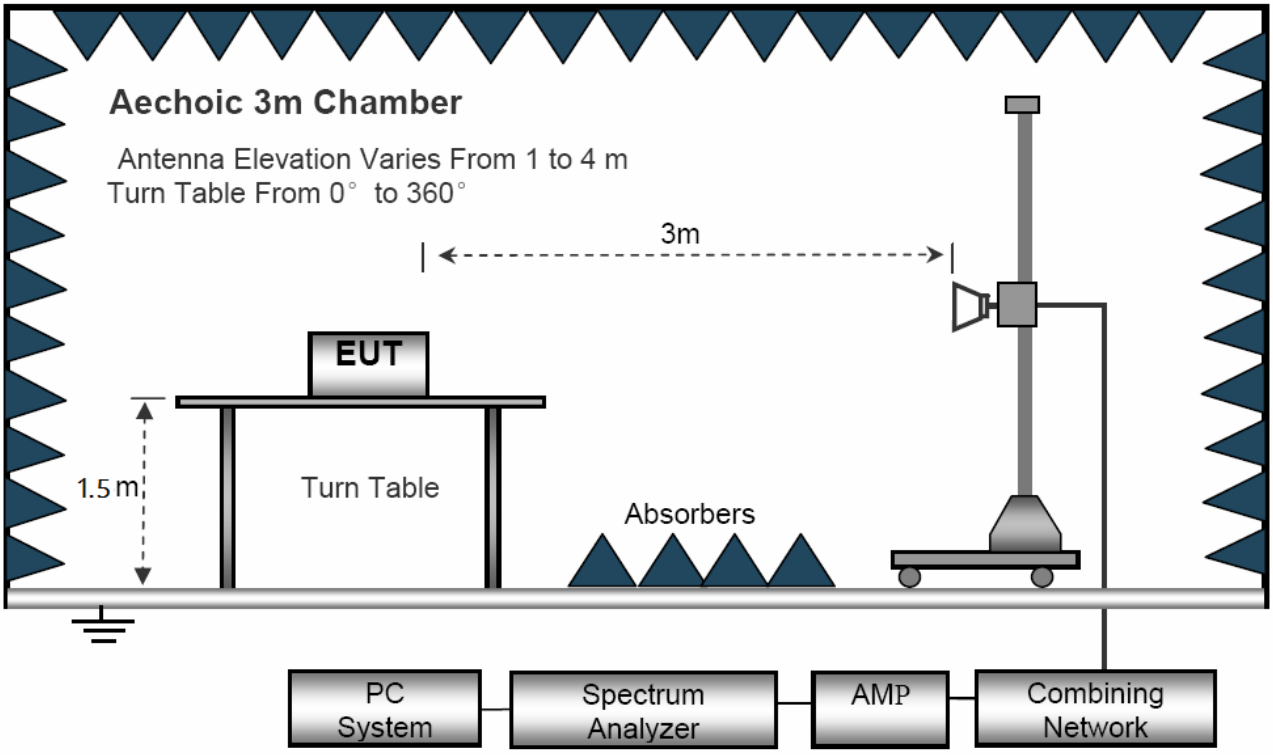
6:Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

7：We pretest all modulation, The worst was 8-DPSK, the worst data was show in the report.

Below 1GHz

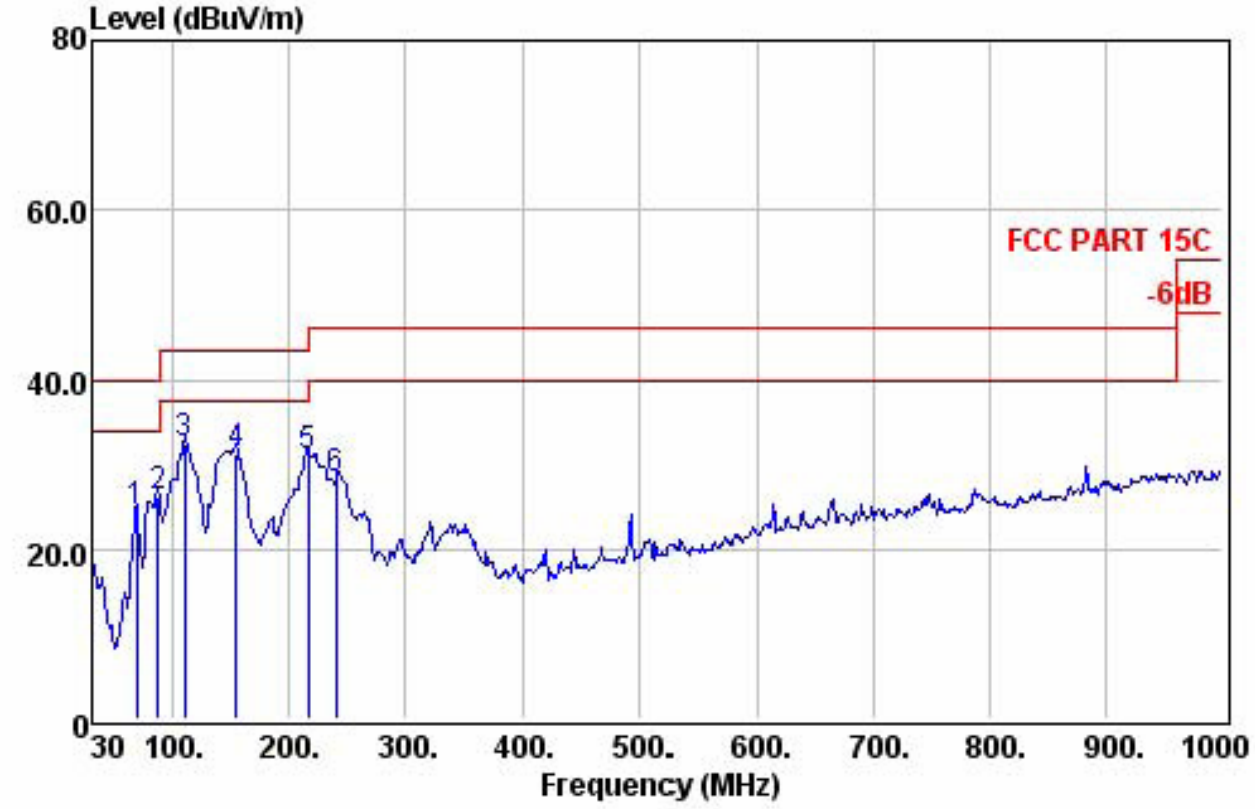


Above 1GHz



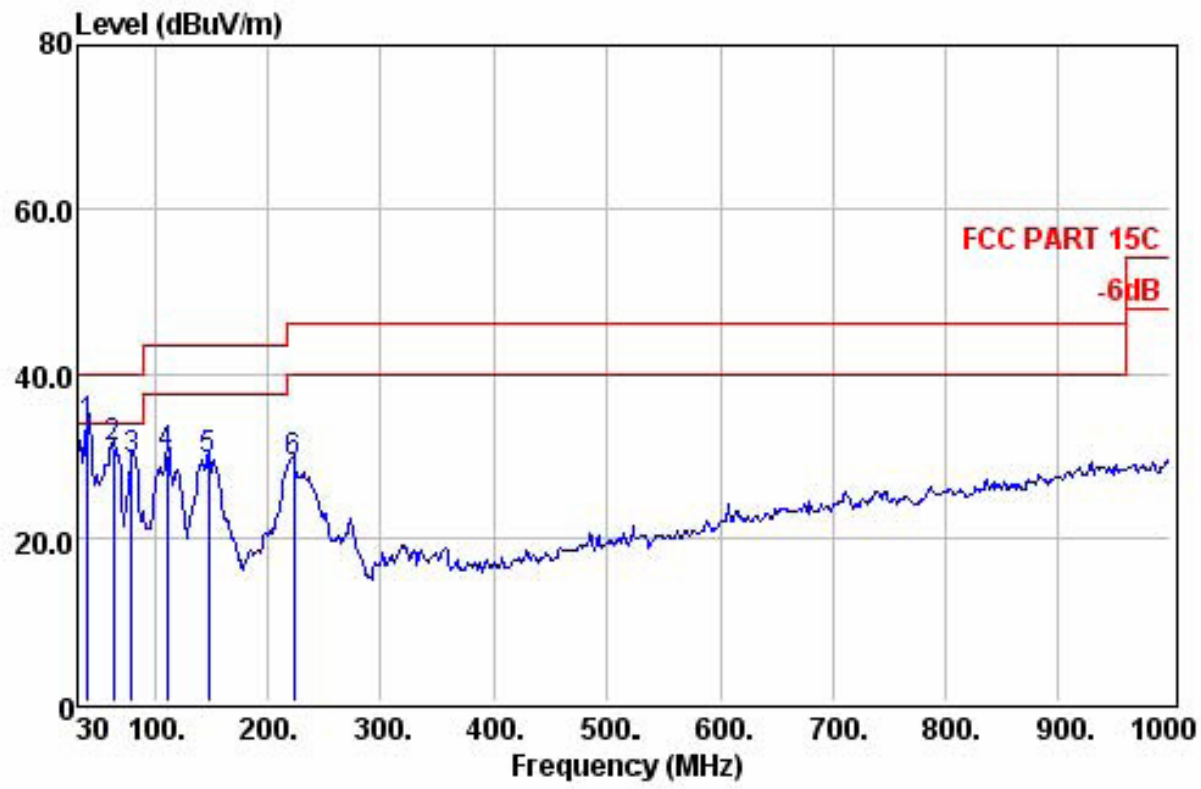
Below 1GHz

BT Mode Horizontal polarizations



	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	68.80	31.32	47.36	0.85	24.37	40.00	-15.63	QP
2	87.23	31.35	47.72	0.94	26.11	40.00	-13.89	QP
3	109.54	31.31	53.41	1.03	32.44	43.50	-11.06	QP
4	154.16	31.25	52.31	1.22	31.36	43.50	-12.14	QP
5	216.24	31.02	48.71	1.53	31.00	46.00	-15.00	QP
6	240.49	30.95	45.05	1.61	28.34	46.00	-17.66	QP

BT Mode Vertical polarizations



	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	39.70	31.37	51.35	0.56	33.62	40.00	-6.38	QP
2	62.01	31.33	54.08	0.75	30.84	40.00	-9.16	QP
3	78.50	31.34	52.14	0.85	29.58	40.00	-10.42	QP
4	109.54	31.31	51.10	1.03	30.13	43.50	-13.37	QP
5	146.40	31.23	50.53	1.22	29.30	43.50	-14.20	QP
6	222.06	30.96	46.40	1.53	29.03	46.00	-16.97	QP

Above 1GHz

2402MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	32.59	11.96	50.00	74.00	-24.00	Peak
2	7215.00	27.94	23.55	16.61	49.51	74.00	-24.49	Peak
3	8293.00	28.19	24.96	16.72	50.12	74.00	-23.88	Peak
4	12237.00	29.05	20.63	17.56	48.59	74.00	-25.41	Peak
5	14719.00	29.51	18.34	19.83	48.35	74.00	-25.65	Peak
6	17320.00	30.23	13.49	21.62	49.99	74.00	-24.01	Peak

2402MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	22.40	11.96	39.81	74.00	-34.19	Peak
2	7215.00	27.94	13.68	16.61	39.64	74.00	-34.36	Peak
3	9092.00	28.43	19.06	16.89	45.02	74.00	-28.98	Peak
4	10350.00	28.84	18.40	17.04	45.56	74.00	-28.44	Peak
5	12271.00	29.05	17.26	17.59	45.26	74.00	-28.74	Peak
6	14821.00	29.52	16.87	19.88	46.50	74.00	-27.50	Peak

2441MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	32.45	12.14	50.17	74.00	-23.83	Peak
2	7317.00	27.96	23.13	16.62	49.12	74.00	-24.88	Peak
3	8973.00	28.39	21.72	16.87	47.56	74.00	-26.44	Peak
4	11353.00	28.94	19.71	17.24	47.79	74.00	-26.21	Peak
5	13869.00	29.37	15.97	19.20	49.17	74.00	-24.83	Peak
6	15756.00	29.66	18.33	20.48	48.53	74.00	-25.47	Peak

2441MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	32.85	12.14	50.57	74.00	-23.43	Peak
2	7317.00	27.96	24.03	16.62	50.02	74.00	-23.98	Peak
3	9517.00	28.61	21.39	16.92	47.71	74.00	-26.29	Peak
4	10843.00	28.88	19.41	17.13	47.07	74.00	-26.93	Peak
5	13495.00	29.30	16.88	18.77	49.35	74.00	-24.65	Peak
6	16861.00	30.05	13.74	21.23	49.19	74.00	-24.81	Peak

2480MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	32.05	12.36	50.15	74.00	-23.85	Peak
2	7425.00	27.98	23.54	16.62	49.55	74.00	-24.45	Peak
3	10163.00	28.82	17.57	17.00	44.42	74.00	-29.58	Peak
4	12305.00	29.06	18.07	17.62	46.09	74.00	-27.91	Peak
5	14821.00	29.52	16.35	19.88	45.98	74.00	-28.02	Peak
6	17388.00	30.26	11.70	21.69	48.34	74.00	-25.66	Peak

2480MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	32.16	12.36	50.26	74.00	-23.74	Peak
2	7425.00	27.98	23.57	16.62	49.58	74.00	-24.42	Peak
3	10129.00	28.81	20.30	16.99	47.09	74.00	-26.91	Peak
4	11693.00	28.97	19.25	17.30	47.29	74.00	-26.71	Peak
5	13903.00	29.38	13.36	19.24	46.62	74.00	-27.38	Peak
6	16521.00	29.91	14.07	21.00	48.60	74.00	-25.40	Peak

6. 20DB & 99% OCCUPY BANDWIDTH

6.1. Limits

According to FCC Section 15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth(10*log1%=20dB)taking the RF output power

6.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software.

2. Set the spectrum analyzer:

Span: approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW ≥1% of the 20dB bandwidth

VBW ≥ RBW

Sweep=auto

Detector function=peak

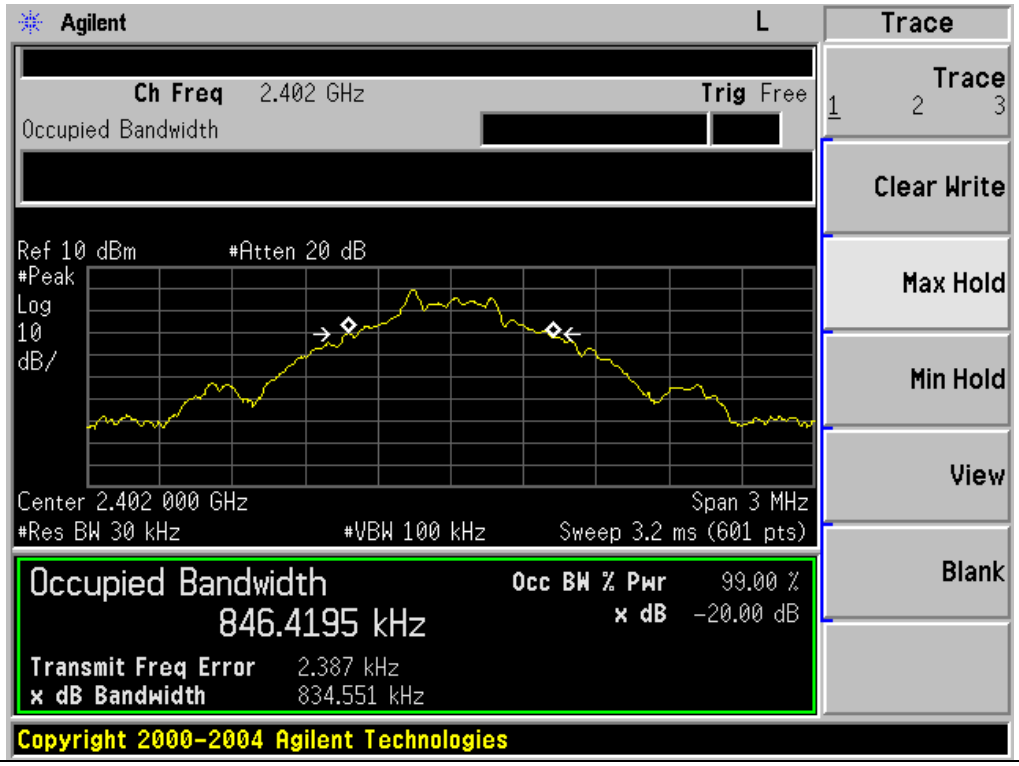
Trace=max hold

Test data:

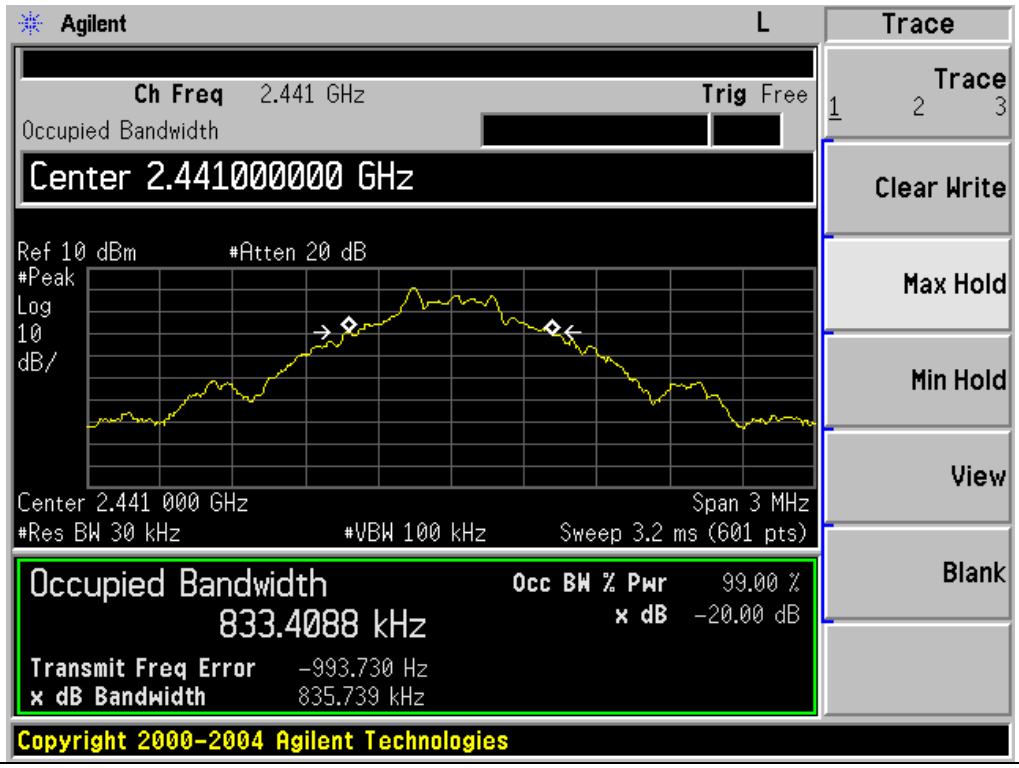
Frequency	20dB Bandwidth (kHz)	99% Bandwidth (KHz)	Result
GFSK			
2402 MHz	834.551	846.420	PASS
2441 MHz	835.739	833.409	PASS
2480 MHz	836.830	842.530	PASS
Frequency	**20dB Bandwidth (MHz)**	**99% Bandwidth (MHz)**	**Result**
Pi/4DQPSK			
2402 MHz	1.132	1.064	PASS
2441 MHz	1.131	1.064	PASS
2480 MHz	1.130	1.066	PASS
8-DPSK			
2402 MHz	1.166	1.086	PASS
2441 MHz	1.161	1.087	PASS
2480 MHz	1.159	1.089	PASS

Test plot as follows:

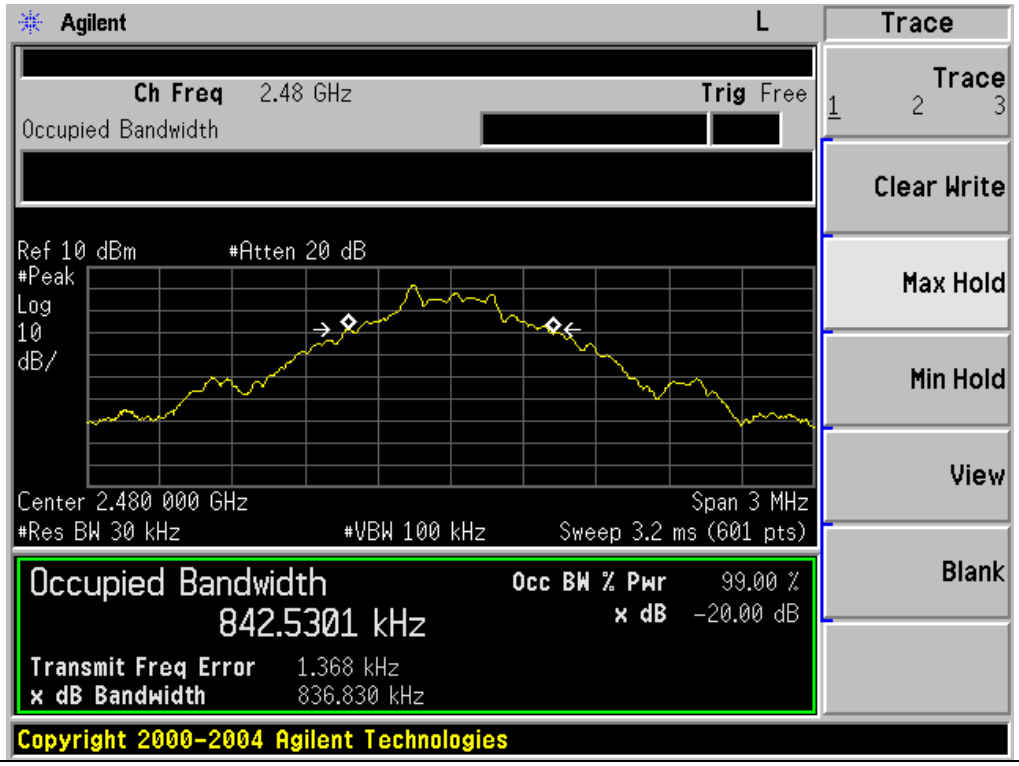
2402 MHz - GFSK



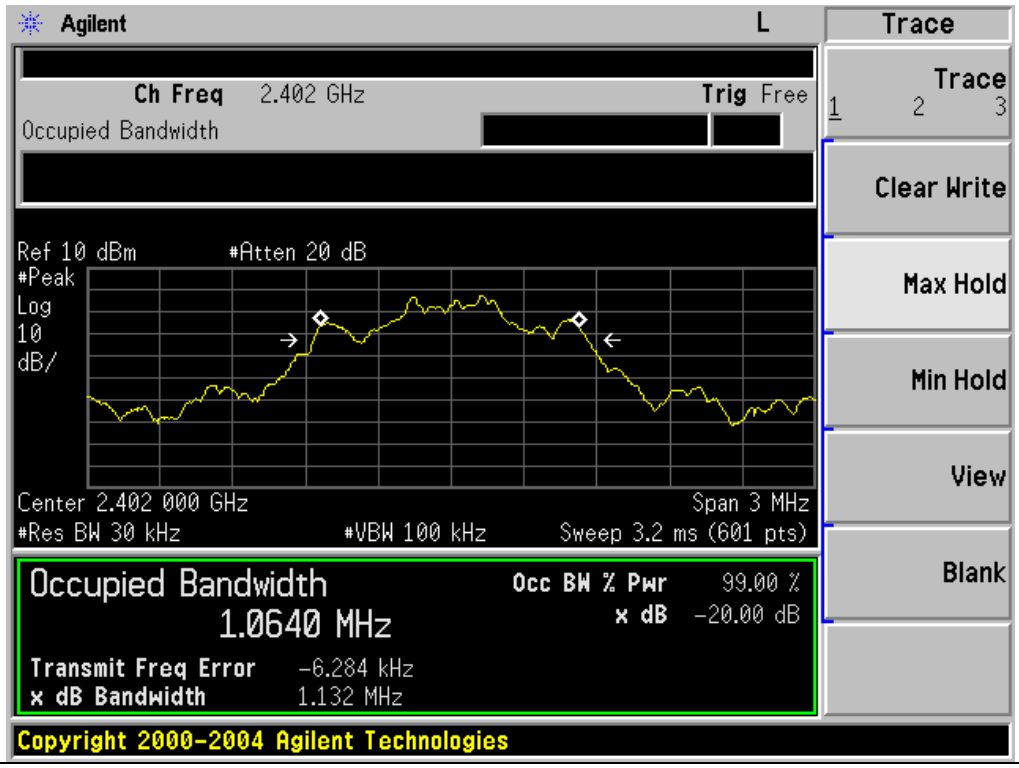
2441 MHz - GFSK



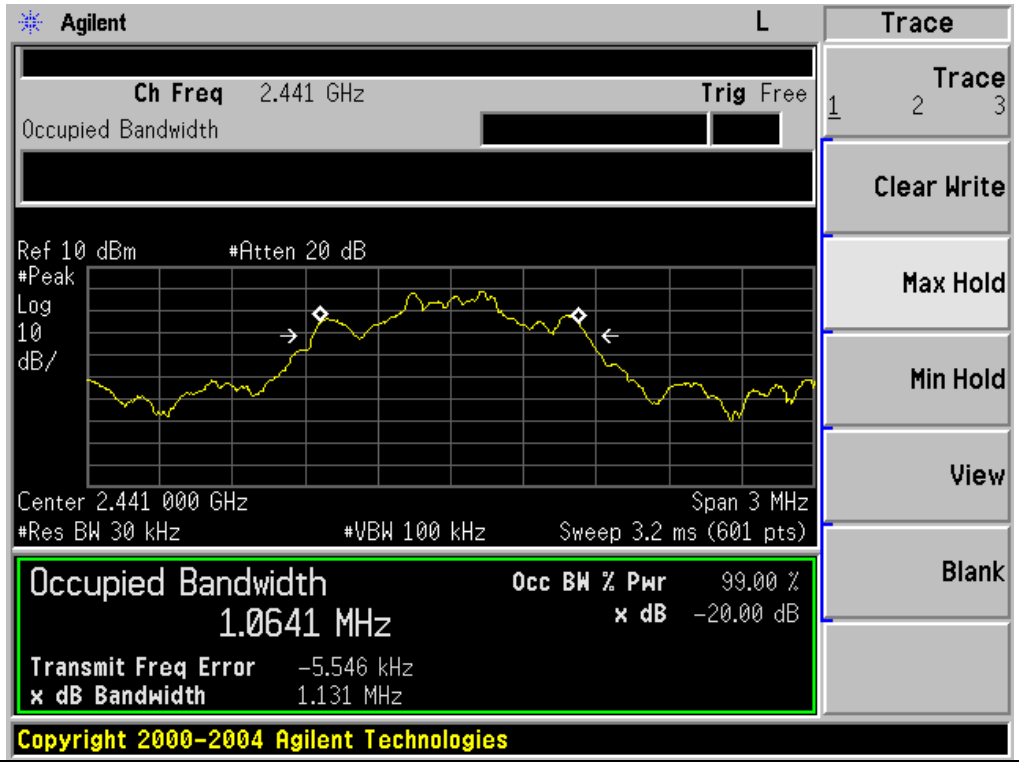
2480 MHz - GFSK



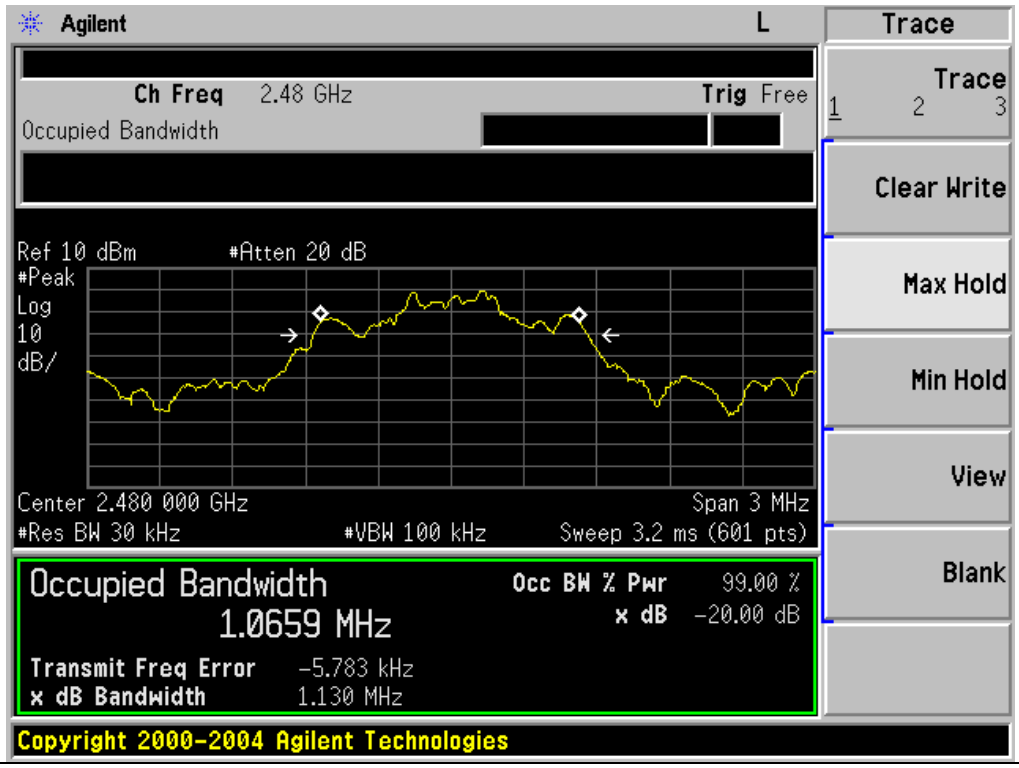
2402 MHz - Pi/4DQPSK



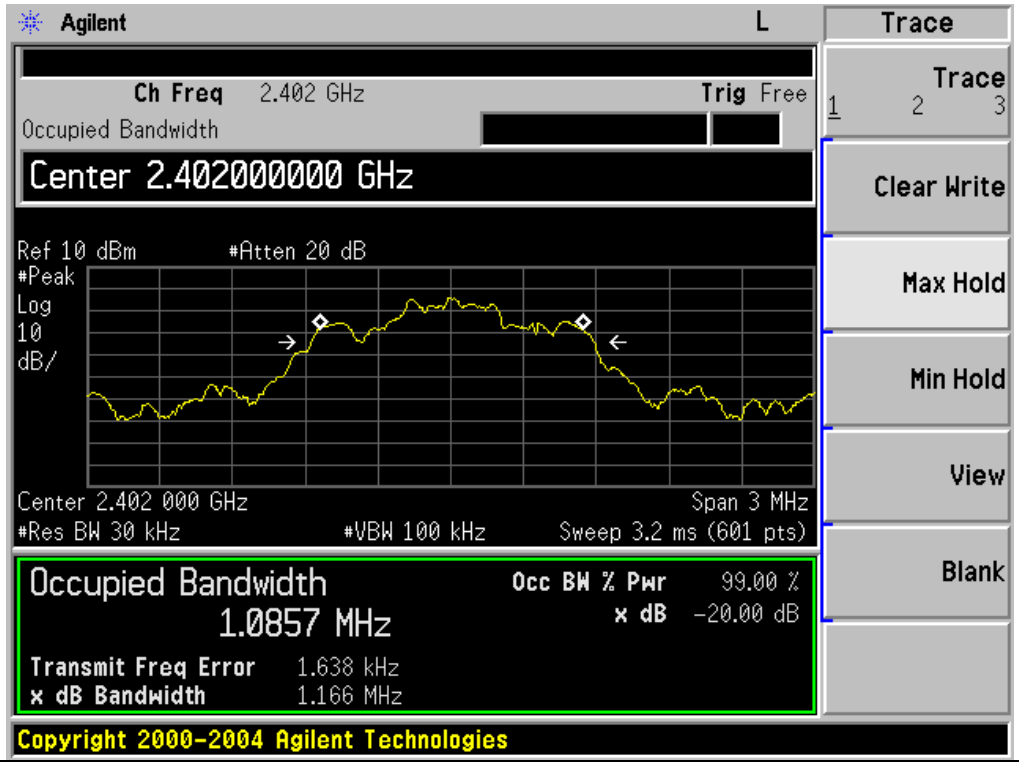
2441 MHz - Pi/4DQPSK



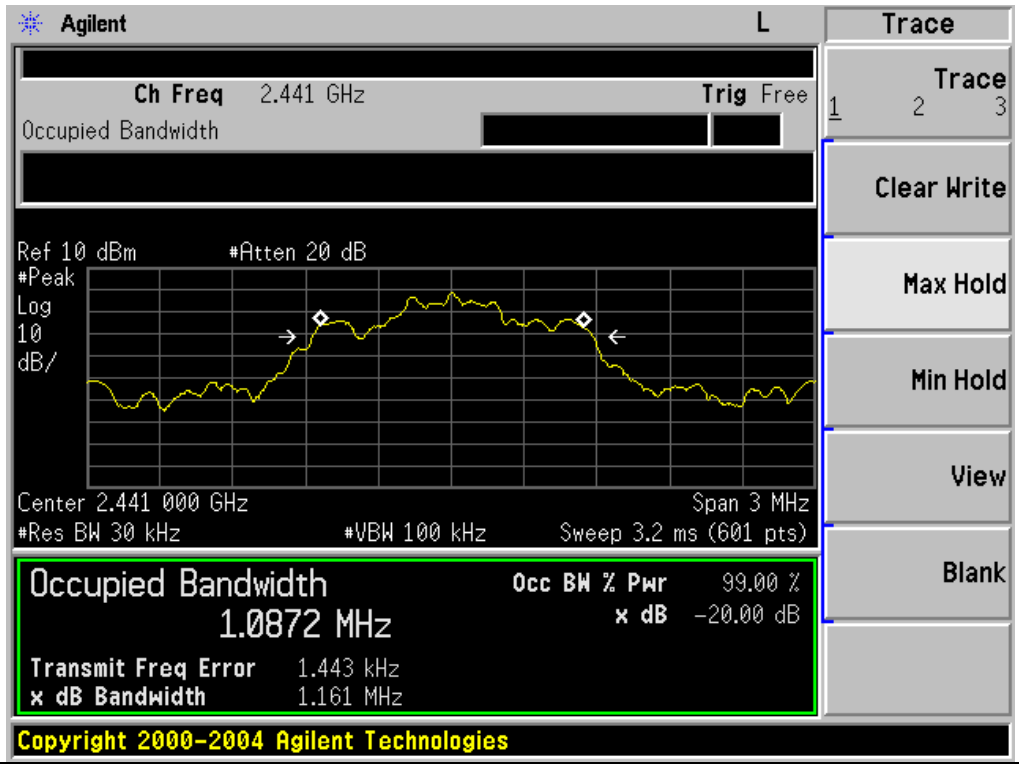
2480 MHz - Pi/4DQPSK



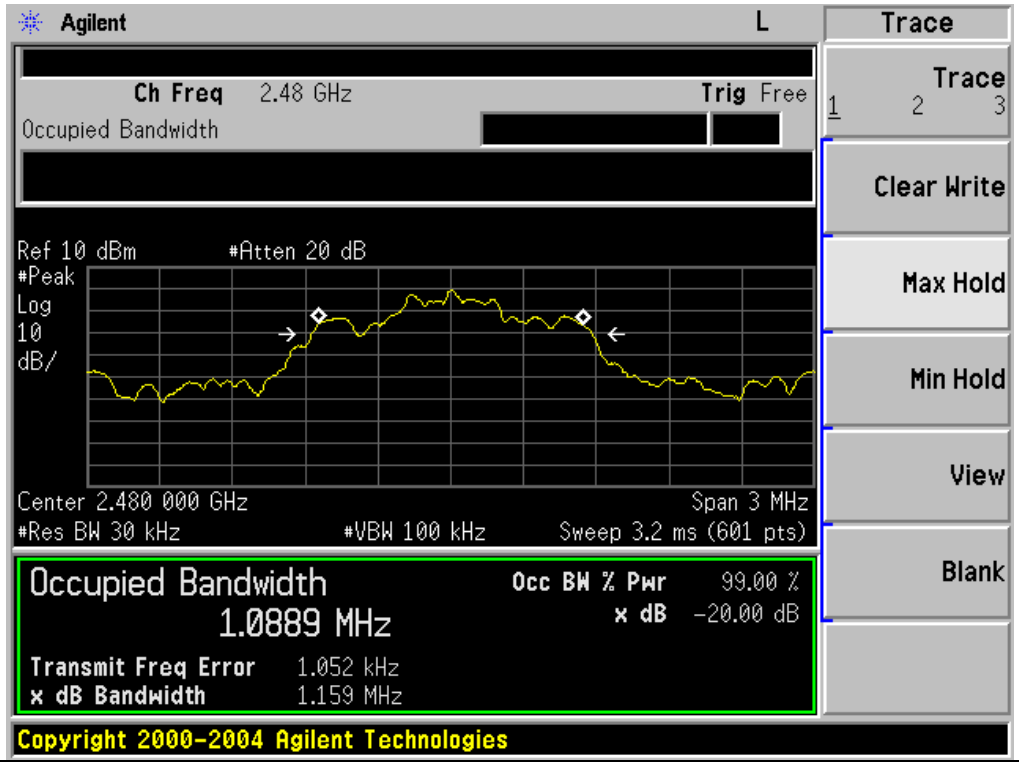
2402 MHz -8-DPSK



2441 MHz -8-DPSK



2480 MHz -8-DPSK



7. FREQUENCY SEPARATION

7.1. Limits

According to FCC Section 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

7.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the softwarer.

2. Set the spectrum analyzer:

Span: wide enough to capture the peaks of two adjacent channels

RBW ≥1% of the span

VBW ≥ RBW

Sweep=auto

Detector function=peak

Trace=max hold

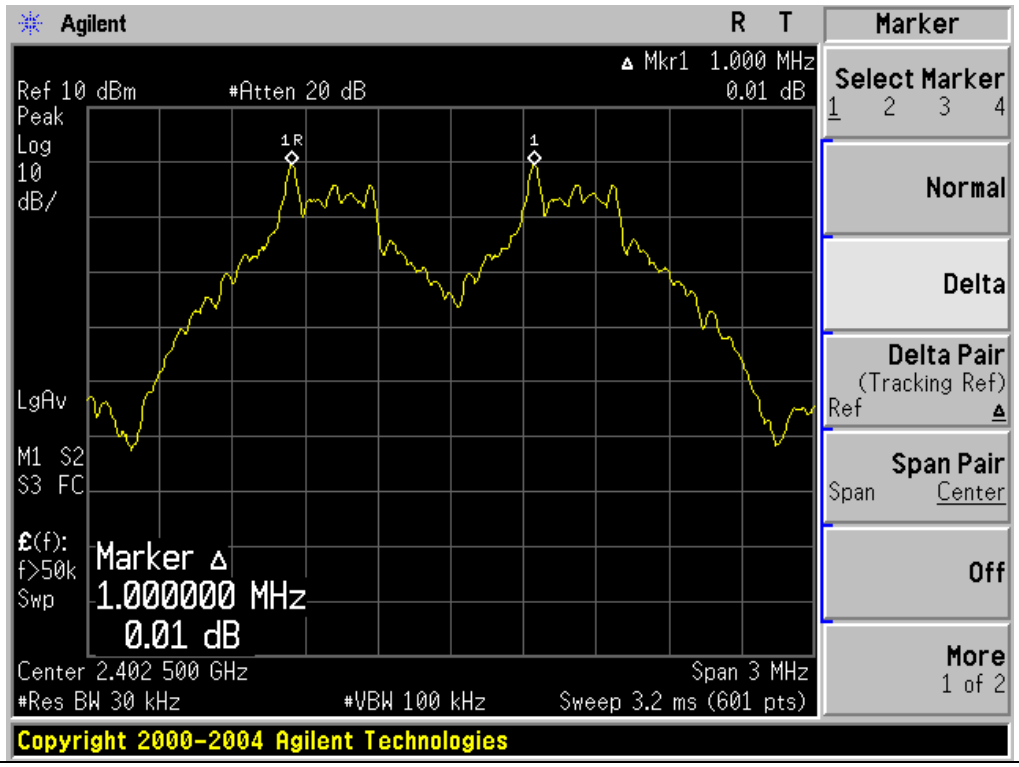
Test data:

Frequency	Ch. Separation (MHz)	Result
GFSK		
2402 MHz	1.000	**Complies**
2441 MHz	1.000	**Complies**
2480 MHz	1.000	**Complies**

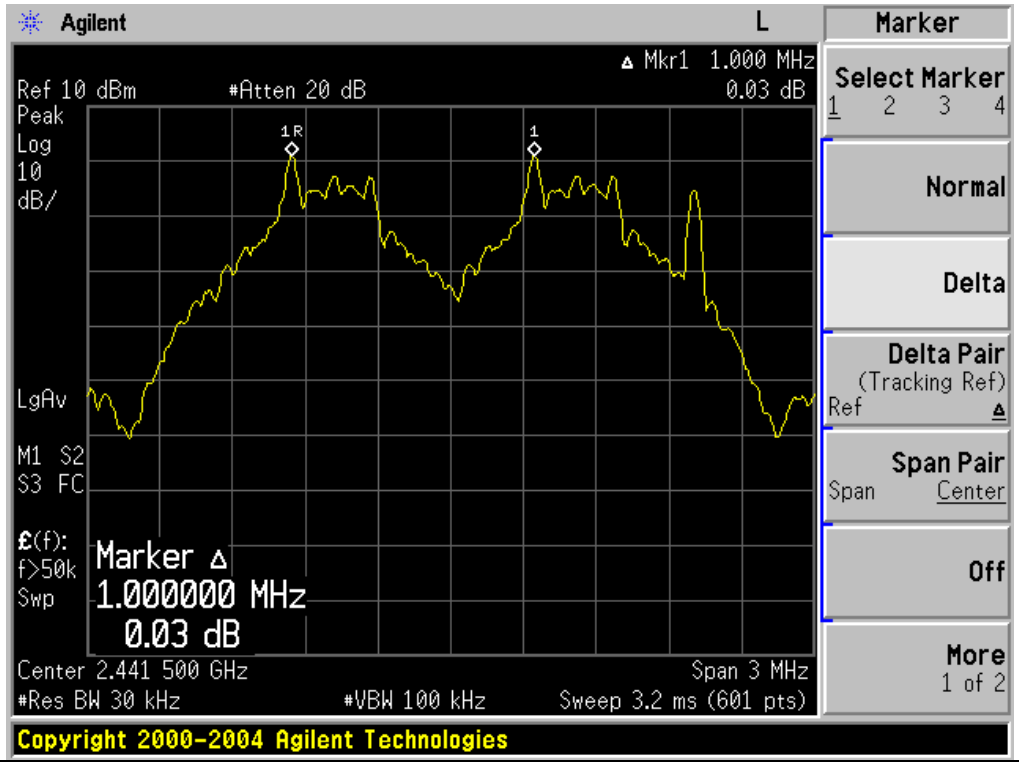
Ch. Separation Limits: > 20dB bandwidth

Test plot as follows:

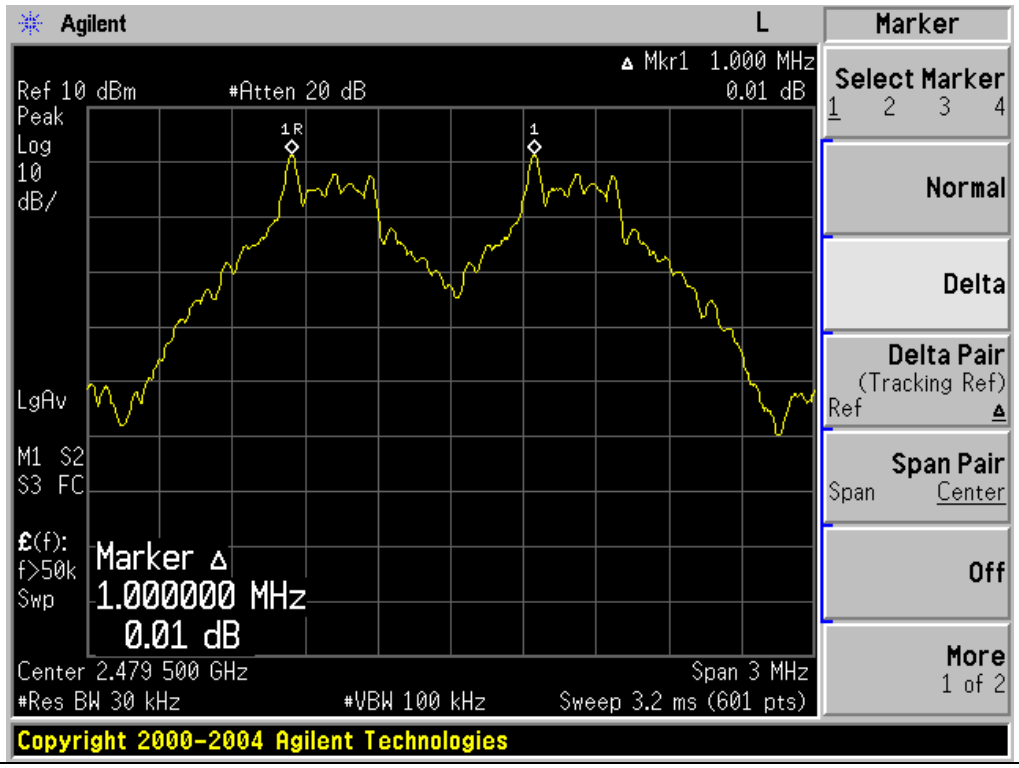
2402 MHz



2441 MHz



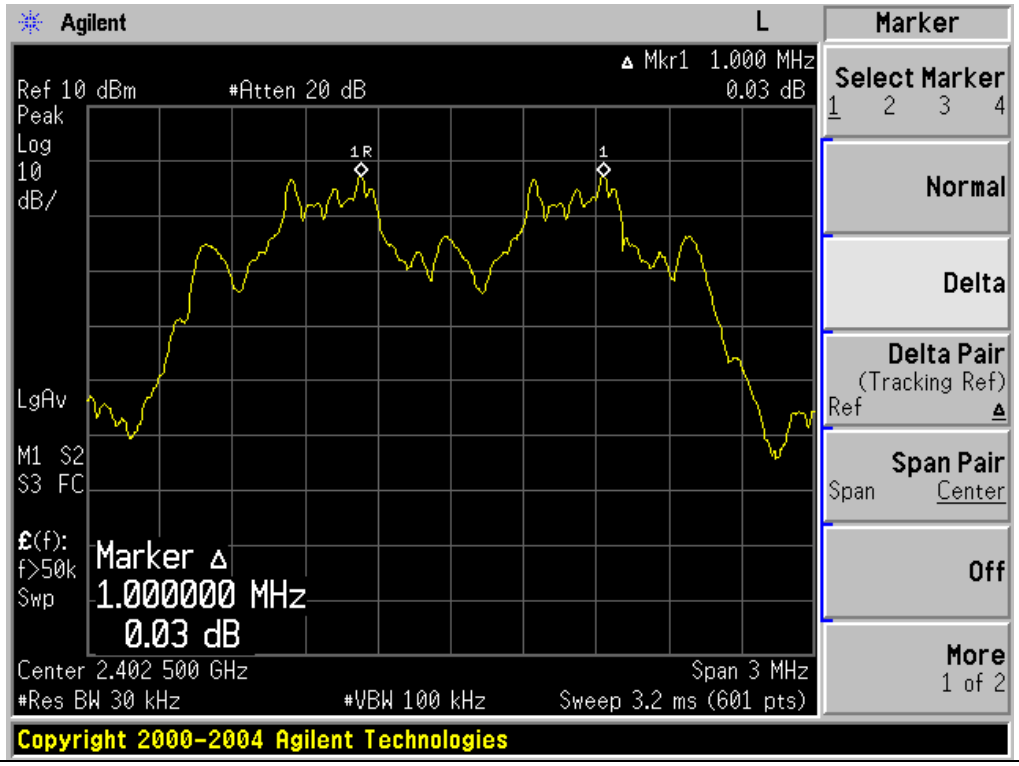
2480 MHz



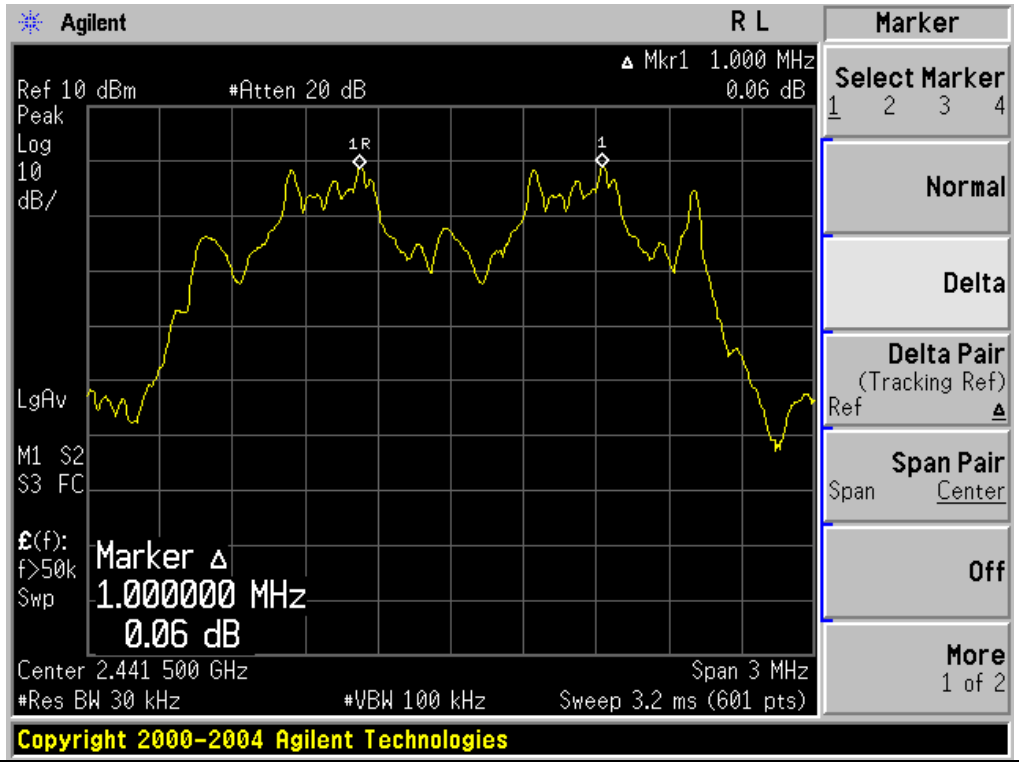
Frequency	Ch. Separation (MHz)	Result
Pi/4DQPSK		
2402 MHz	1.000	**Complies**
2441 MHz	1.000	**Complies**
2480 MHz	1.000	**Complies**

Ch. Separation Limits: >2/3 of 20dB bandwidth

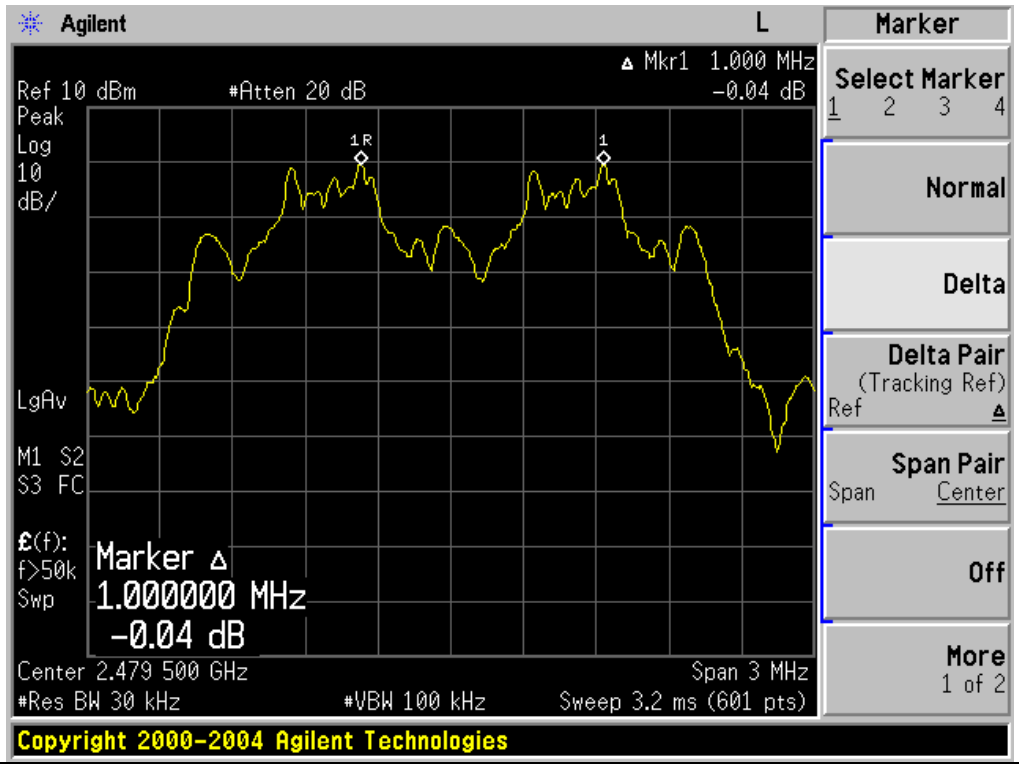
2402 MHz



2441 MHz



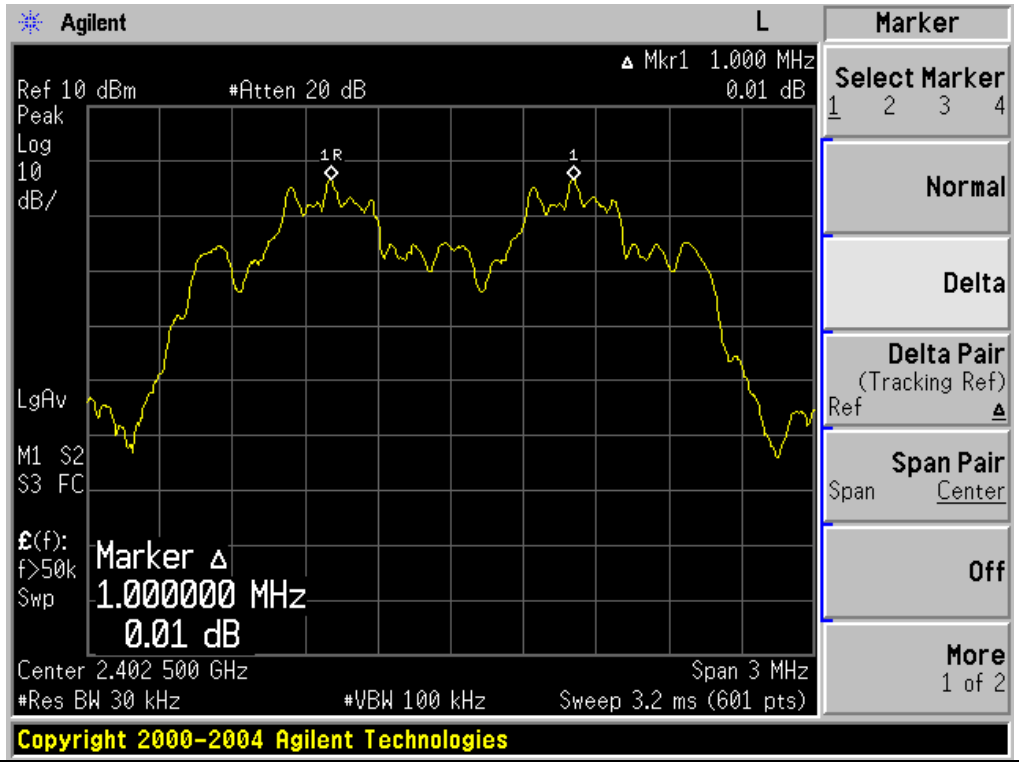
2480 MHz



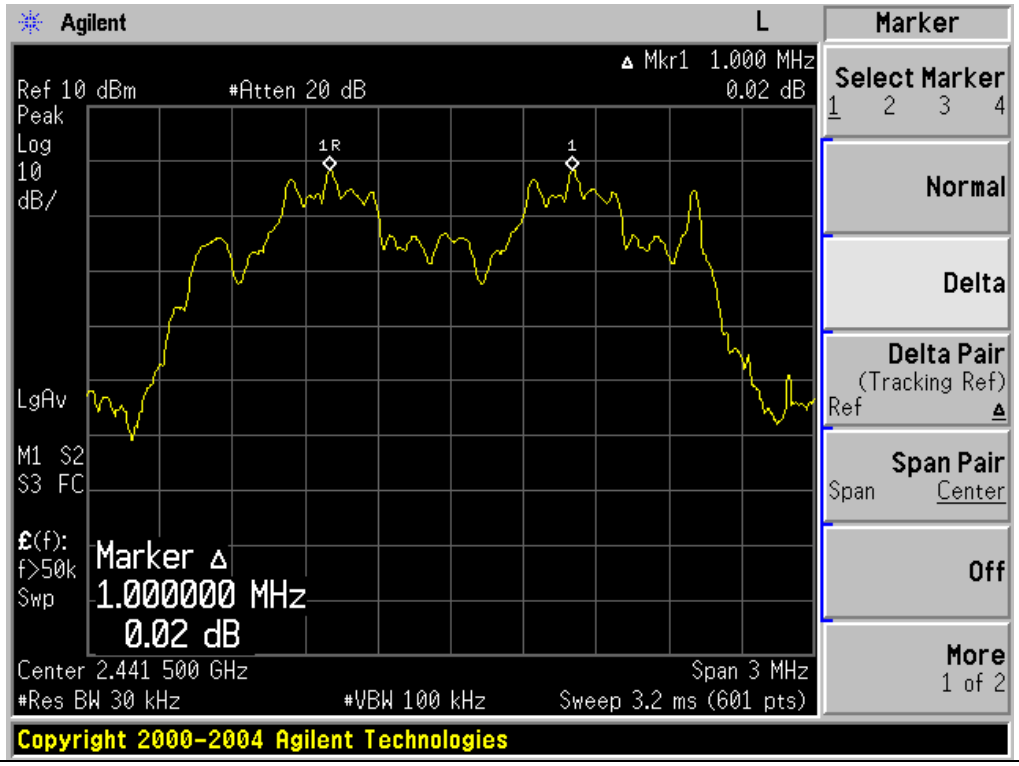
Frequency	Ch. Separation (MHz)	Result
8-DPSK		
2402 MHz	1.000	**Complies**
2441 MHz	1.010	**Complies**
2480 MHz	1.000	**Complies**

Ch. Separation Limits: >2/3 of 20dB bandwidth

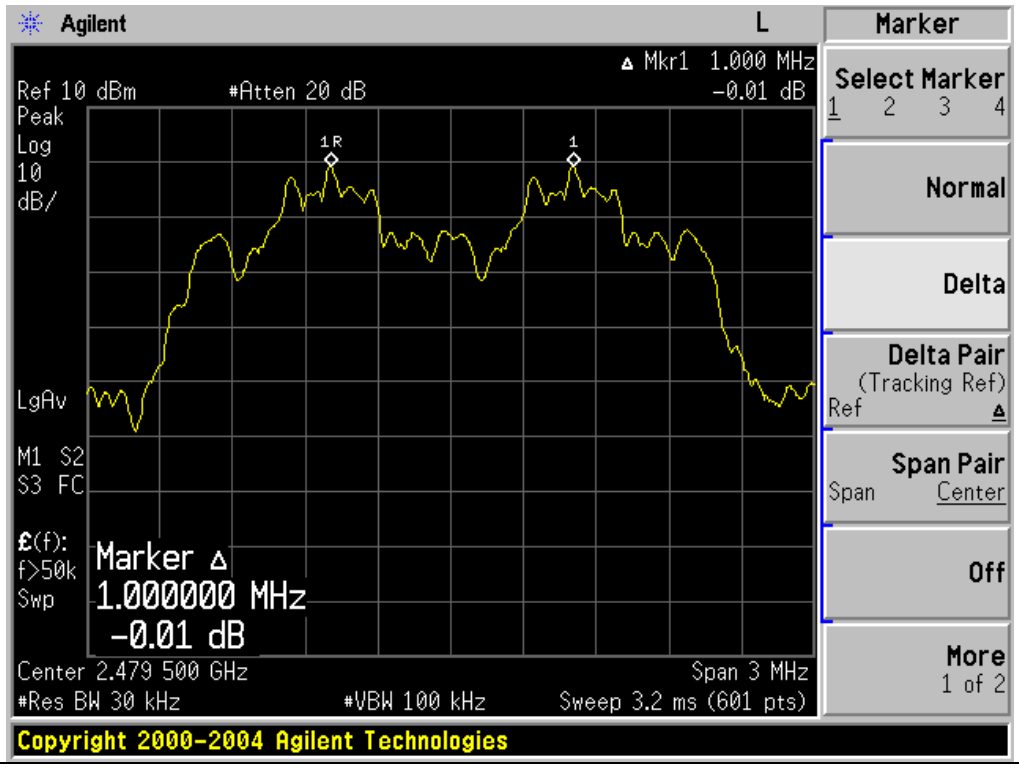
2402 MHz



2441 MHz



2480 MHz



8. NUMBER OF HOPPING FREQUENCY

8.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

8.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: the frequency band of operation

RBW ≥1% of the span

VBW ≥ RBW

Sweep=auto

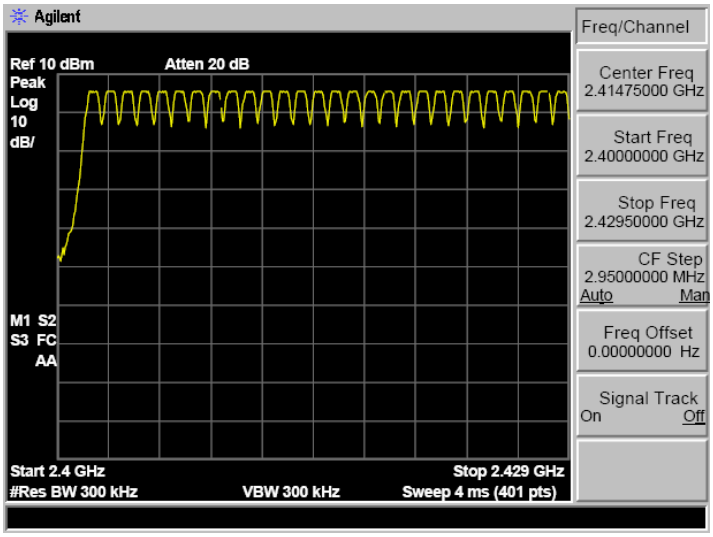
Detector function=peak

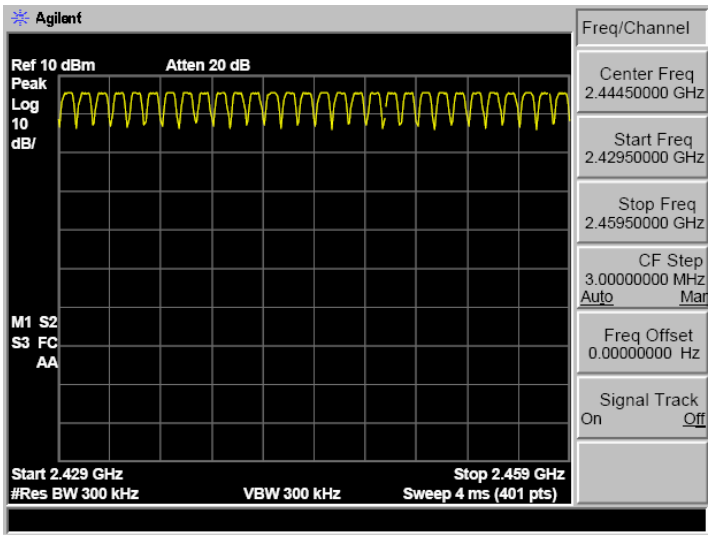
Trace=max hold

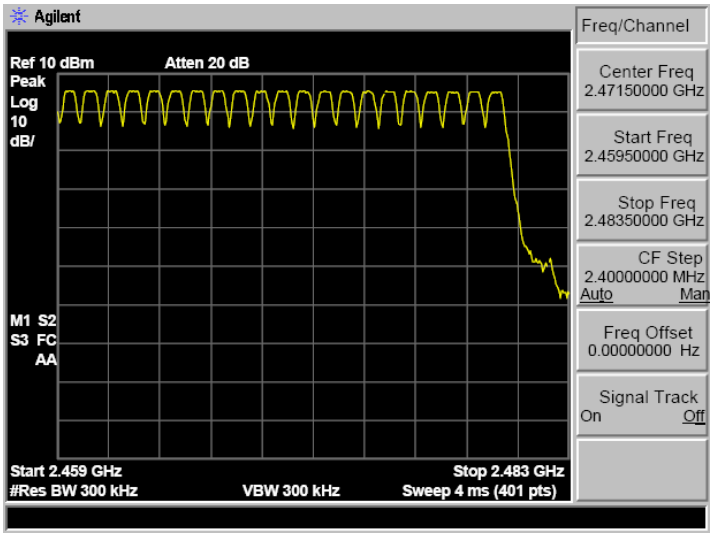
Test data:

Measured channel numbers	Limit	Result
79	>15	PASS

Test plot as follows:


Agilent
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 2.4 GHz
#Res BW 300 kHz
VBW 300 kHz
Stop 2.429 GHz
Sweep 4 ms (401 pts)
Freq/Channel
Center Freq
2.41475000 GHz
Start Freq
2.40000000 GHz
Stop Freq
2.42950000 GHz
CF Step
2.95000000 MHz
Auto
Man
Freq Offset
0.00000000 Hz
Signal Track
On
Off


Agilent
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 2.429 GHz
#Res BW 300 kHz
VBW 300 kHz
Stop 2.459 GHz
Sweep 4 ms (401 pts)
Freq/Channel
Center Freq
2.44450000 GHz
Start Freq
2.42950000 GHz
Stop Freq
2.45950000 GHz
CF Step
3.00000000 MHz
Auto
Man
Freq Offset
0.00000000 Hz
Signal Track
On
Off


Agilent
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 2.459 GHz
#Res BW 300 kHz
VBW 300 kHz
Stop 2.483 GHz
Sweep 4 ms (401 pts)
Freq/Channel
Center Freq
2.47150000 GHz
Start Freq
2.45950000 GHz
Stop Freq
2.48350000 GHz
CF Step
2.40000000 MHz
Auto
Man
Freq Offset
0.00000000 Hz
Signal Track
On
Off

9. DWELL TIME

9.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

9.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode power.

2. Set the spectrum analyzer:

Span= 0Hz,RBW =1000 kHz,VBW = 1000 kHz

Use a video trigger with the trigger level set to enable triggering only on full pulses.

Detector function=peak, Sweep Time is more than once pulse time.

Set the EUT for DH5, DH3 and DH1 packet transmitting

Measure the maximum time duration of one single pulse.

A Period Time = (channel number)*0.4

DH1 Time Slot: Reading * (1600/2)*31.6/(channel number)

DH3 Time Slot: Reading * (1600/4)*31.6/(channel number)

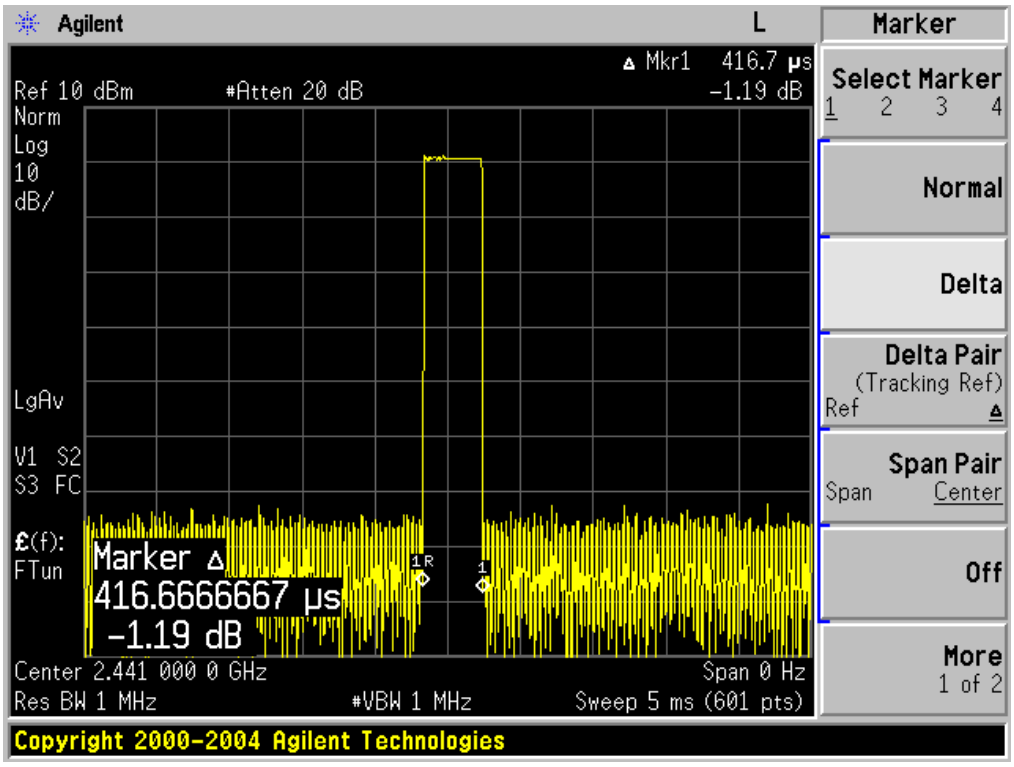
DH5 Time Slot: Reading * (1600/6)*31.6/(channel number)

Test data:

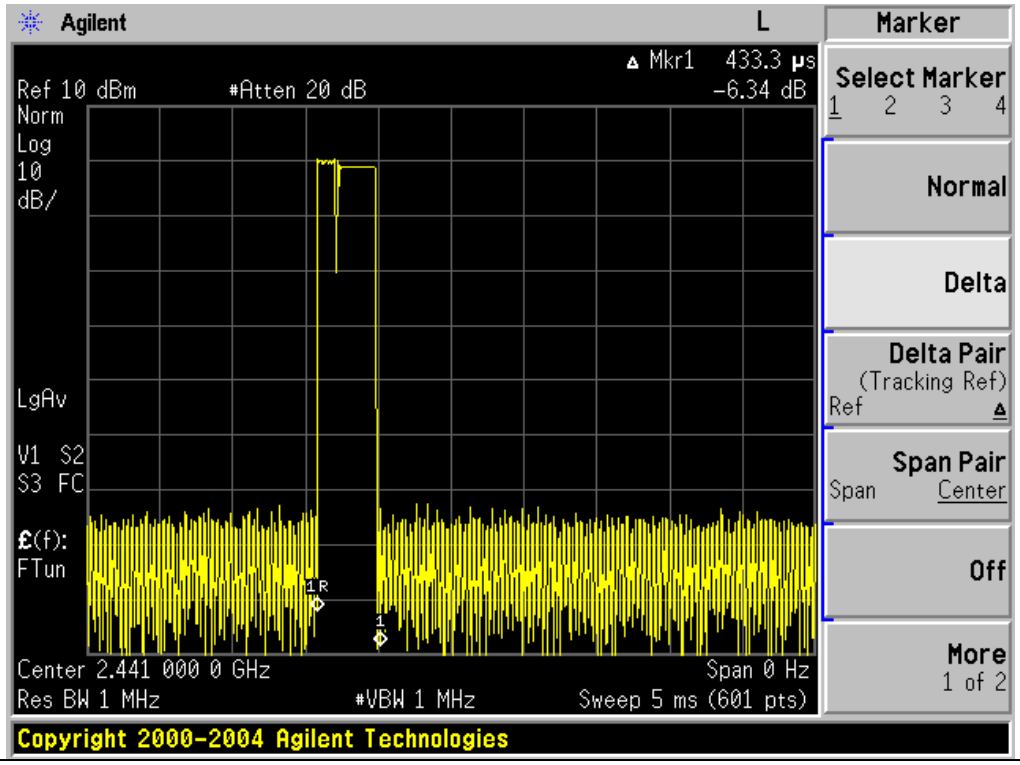
Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH1	2441 MHz	0.42	0.13	0.4
2DH1	2441 MHz	0.43	0.14	0.4
3DH1	2441 MHz	0.43	0.14	0.4

Test plot as follows as below:

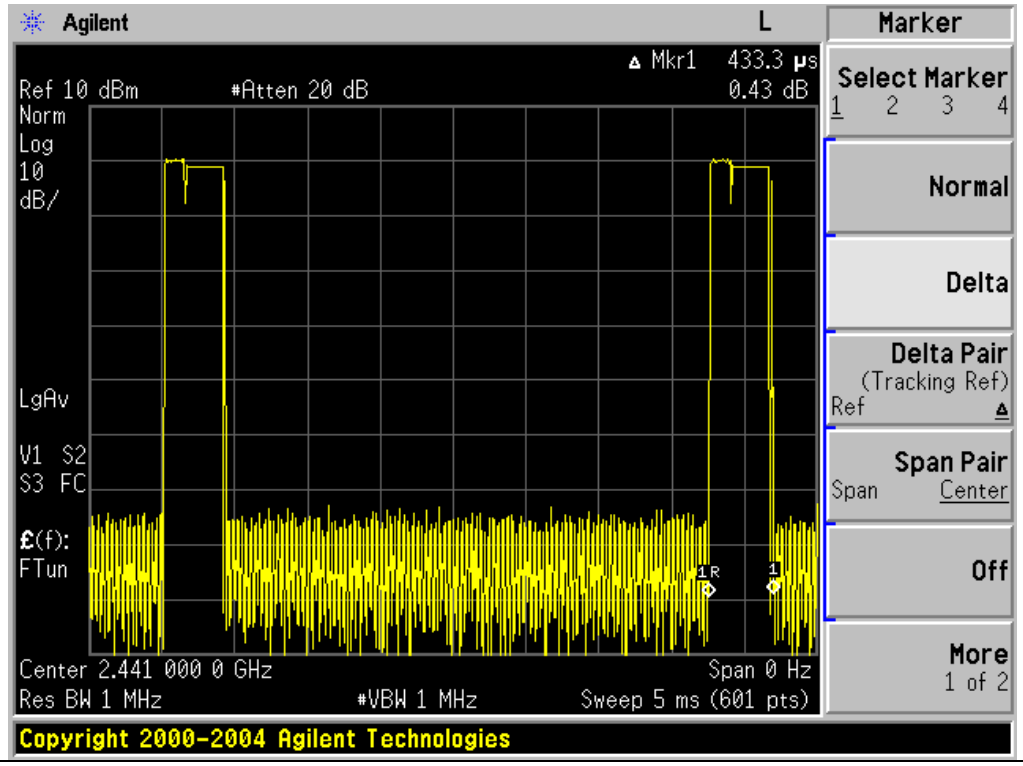
DH1



2DH1

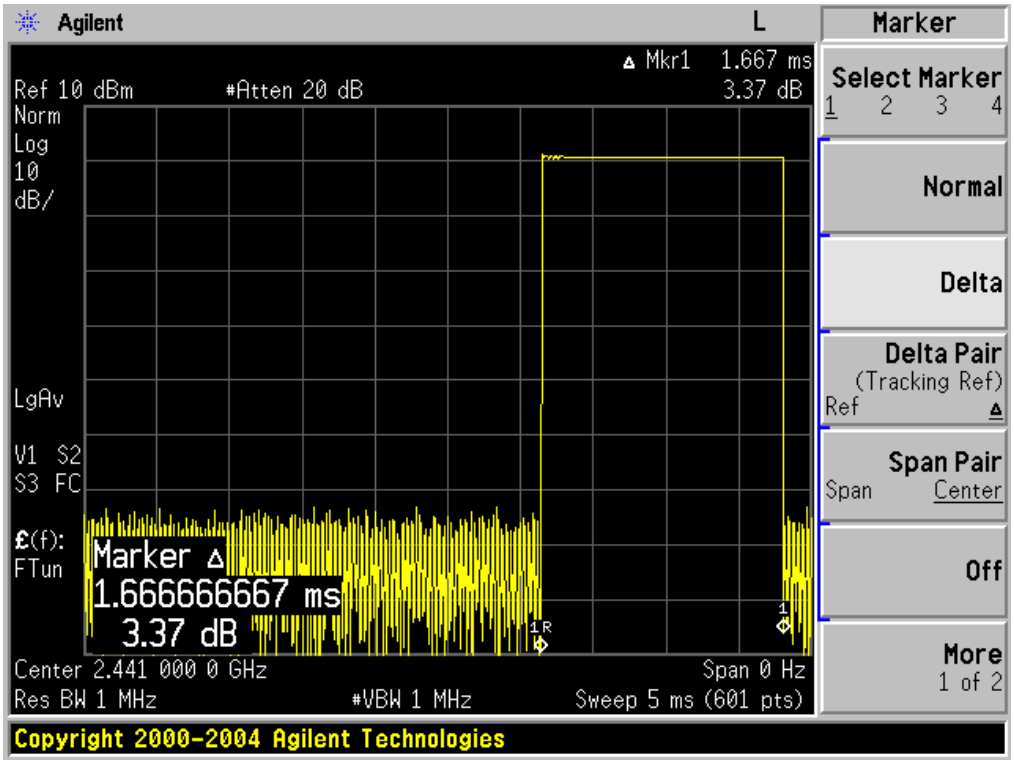

Agilent
L
Marker
Δ Mkr1 433.3 µs
-6.34 dB
Ref 10 dBm
#Atten 20 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Copyright 2000-2004 Agilent Technologies

3DH1

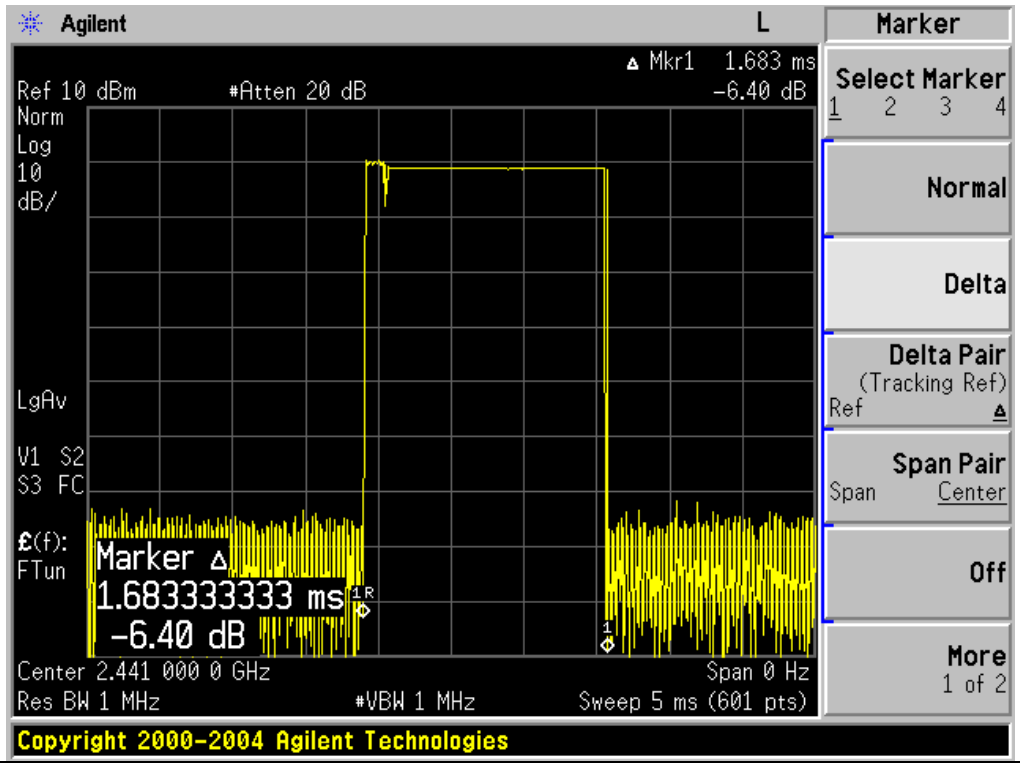

Agilent
L
Marker
Δ Mkr1 433.3 µs
0.43 dB
Ref 10 dBm
#Atten 20 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Copyright 2000-2004 Agilent Technologies

Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH3	2441 MHz	1.67	0.27	0.4
2DH3	2441 MHz	1.68	0.27	0.4
3DH3	2441 MHz	1.68	0.27	0.4

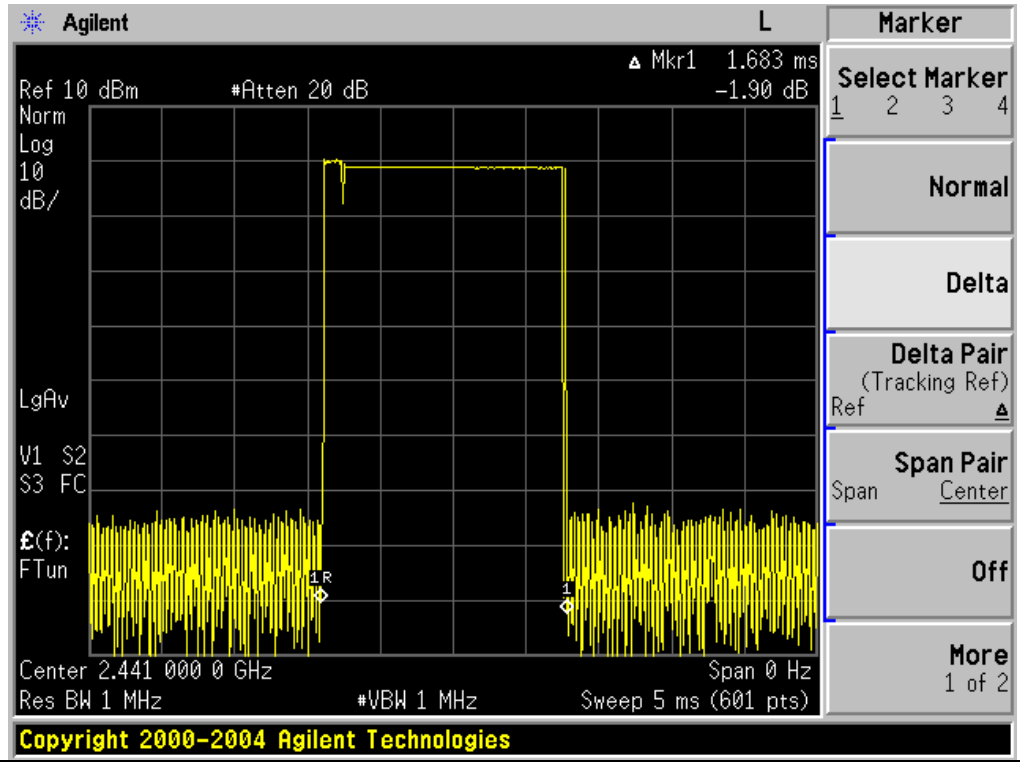
DH3



2DH3

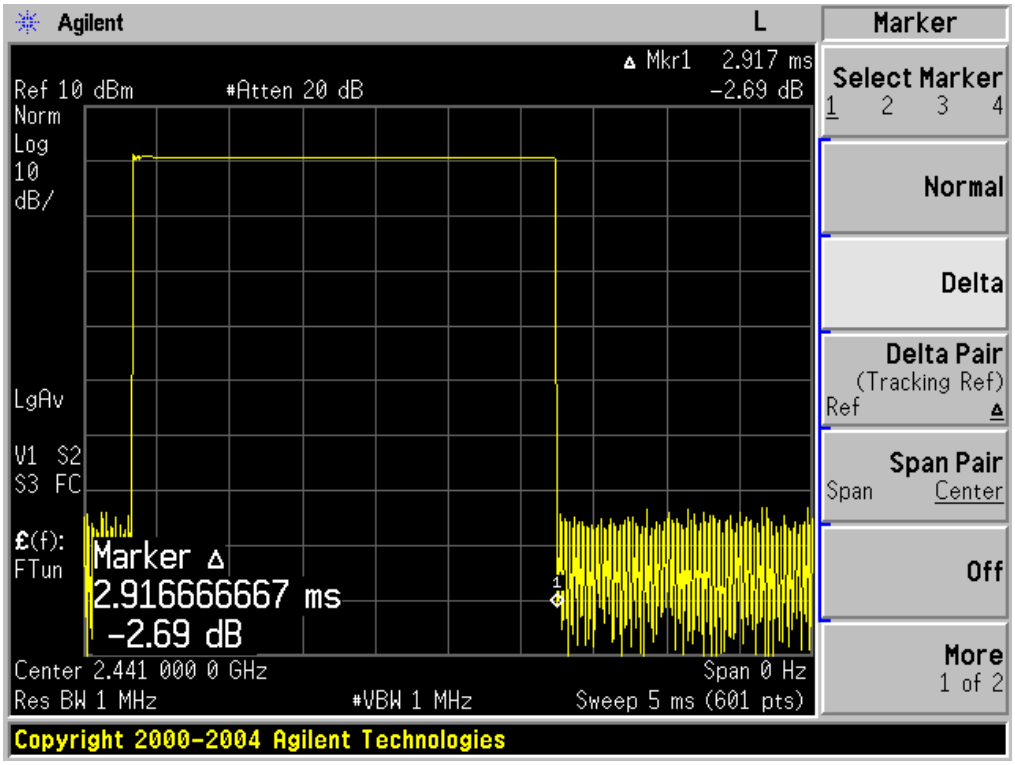

Agilent
L
Marker
Mkr1 1.683 ms
Ref 10 dBm
#Atten 20 dB
-6.40 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Marker Δ
1.683333333 ms
-6.40 dB
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Copyright 2000-2004 Agilent Technologies

3DH3

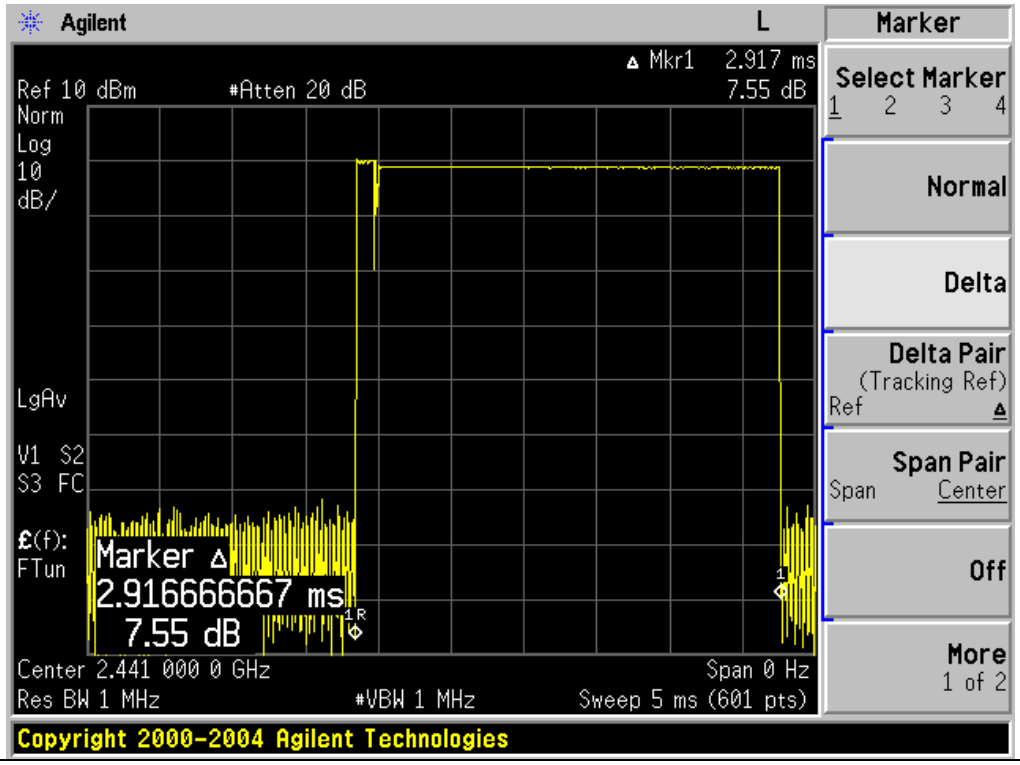

Agilent
L
Marker
Mkr1 1.683 ms
Ref 10 dBm
#Atten 20 dB
-1.90 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Copyright 2000-2004 Agilent Technologies

Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH5	2441 MHz	2.92	0.31	0.4
2DH5	2441 MHz	2.92	0.31	0.4
3DH5	2441 MHz	2.92	0.31	0.4

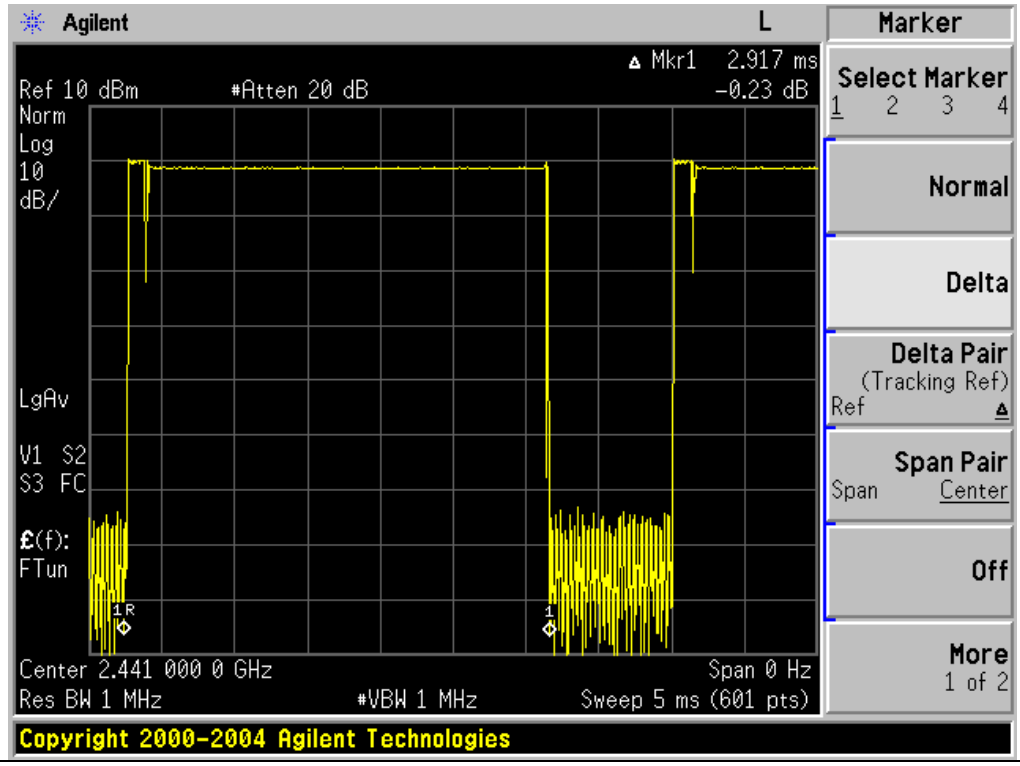
DH5



2DH5


Agilent
L
Marker
Δ Mkr1 2.917 ms
7.55 dB
Ref 10 dBm
#Atten 20 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Marker Δ
2.916666667 ms
7.55 dB
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2004 Agilent Technologies

3DH5


Agilent
L
Marker
Δ Mkr1 2.917 ms
-0.23 dB
Ref 10 dBm
#Atten 20 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
£(f):
FTun
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 1 MHz
Sweep 5 ms (601 pts)
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2004 Agilent Technologies

10. BAND EDGE COMPLIANCE TEST

10.1. Limits

According to FCC Section 15.247(d), 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 con-ducted or a radiated measurement

10.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set to span from the lowest frequency generated in the device up to and including the tenth harmonic of the highest fundamental frequency

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure. For all test, used peak detector.

Note: If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

Test plot as follows:

For radiated test as follows:

	Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)	Band edge Limit (dBuV/m)		Result
			PK	PK	AV	Pass
Hopping	<2400	H	50.28	74.00	54.00	Pass
	<2400	V	51.12	74.00	54.00	Pass
	>2483.5	H	51.36	74.00	54.00	Pass
	>2483.5	V	50.15	74.00	54.00	Pass
Unhopping	<2400	H	50.17	74.00	54.00	Pass
	<2400	V	50.29	74.00	54.00	Pass
	>2483.5	H	50.49	74.00	54.00	Pass
	>2483.5	V	50.38	74.00	54.00	Pass

If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

11. ANTENNA REQUIREMENTS

11.1. Limits

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 (b), 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.

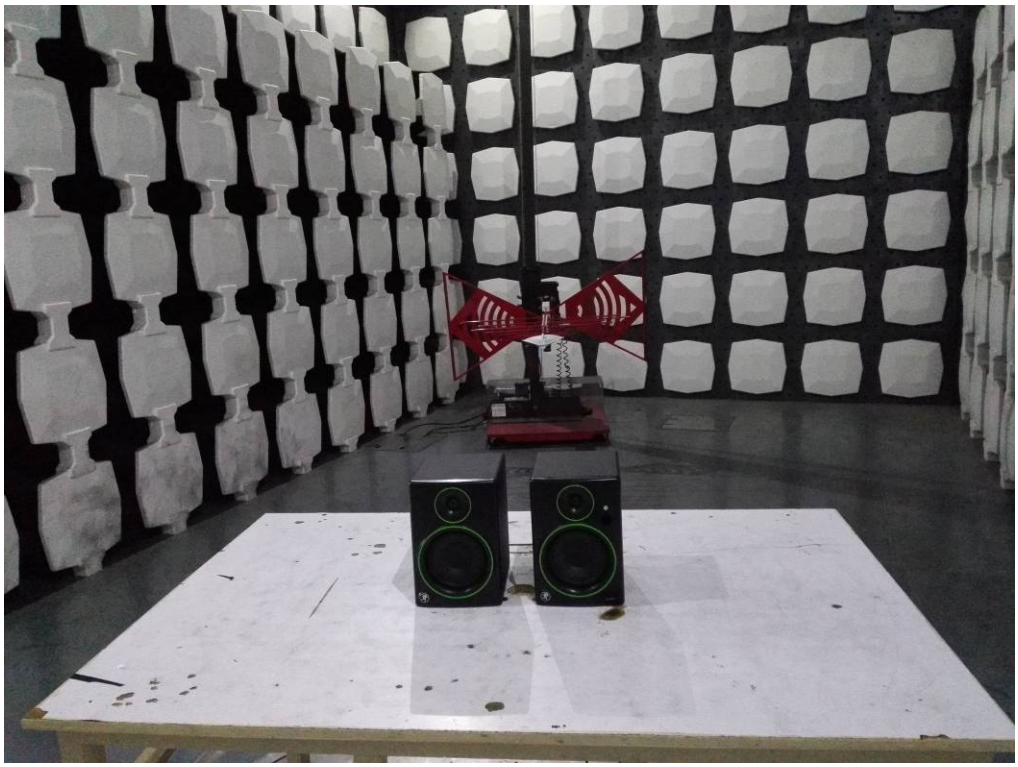
11.2. Result

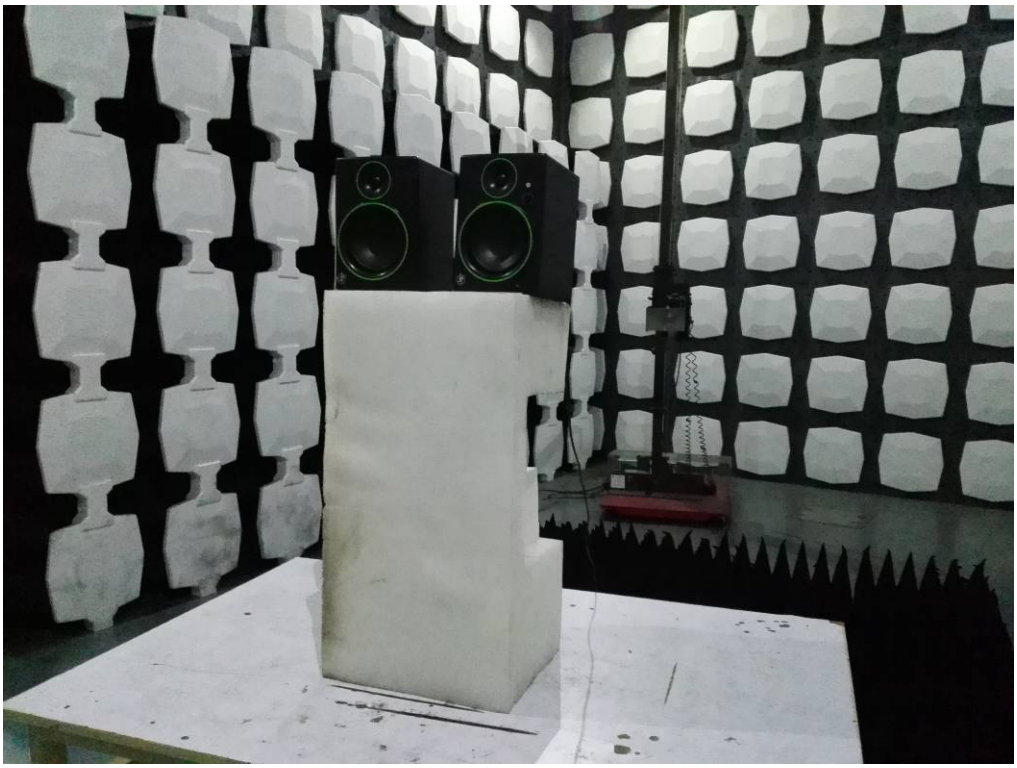
The antennas used for this product are Permanently fixed antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.53dBi.

12. PHOTOGRAPHS OF TEST SET-UP

Conducted Emission at the Mains Terminals Test

Radiated Emission Test





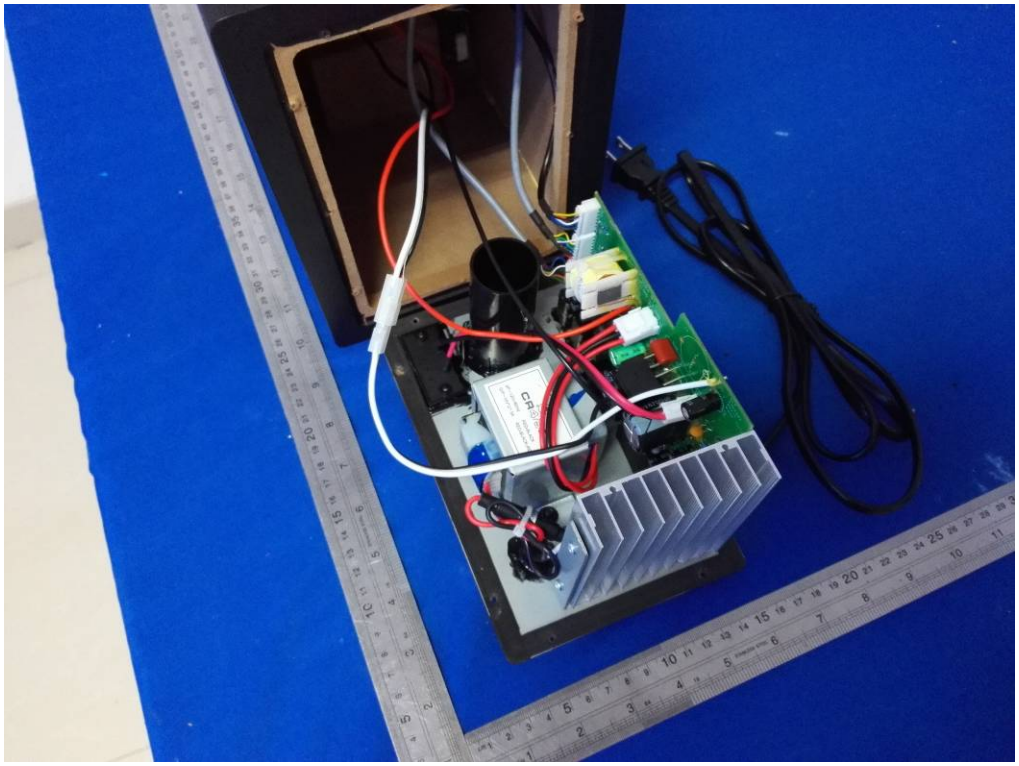
13. PHOTOGRAPHS OF THE EUT

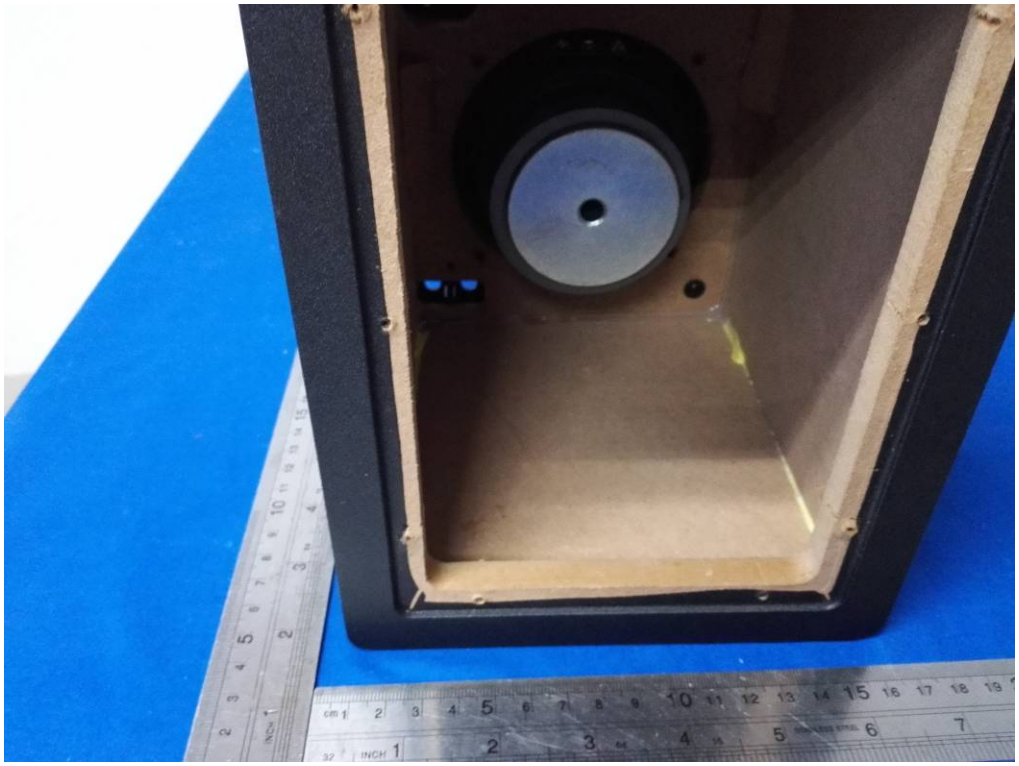
CR4BT

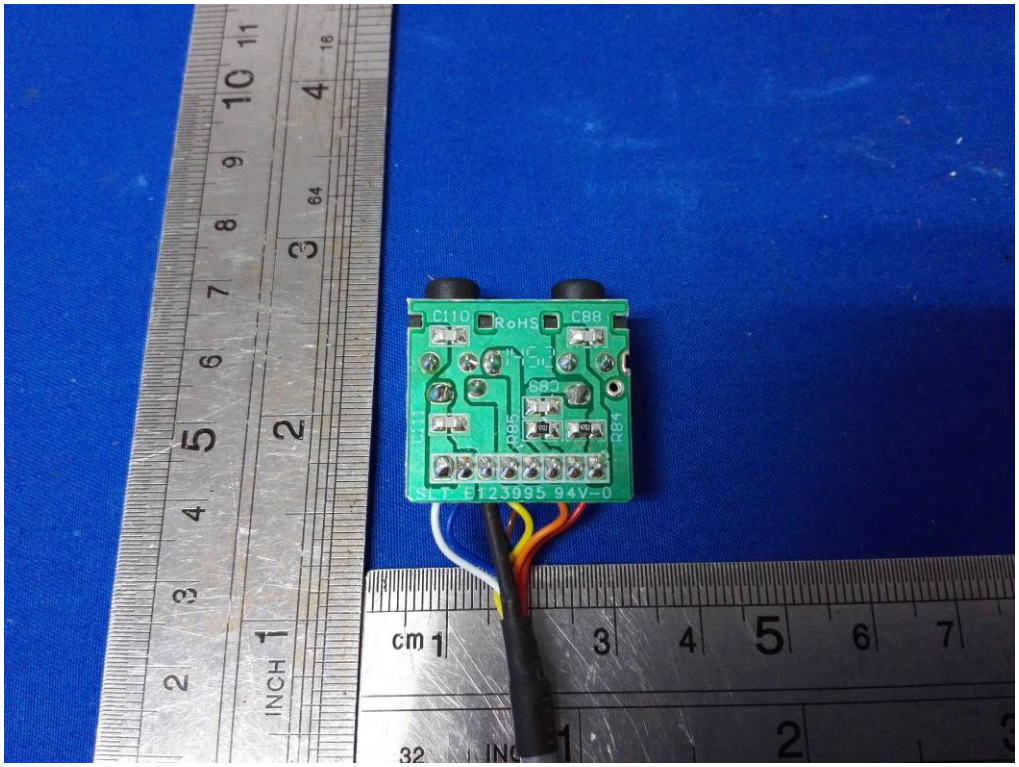
CR5BT

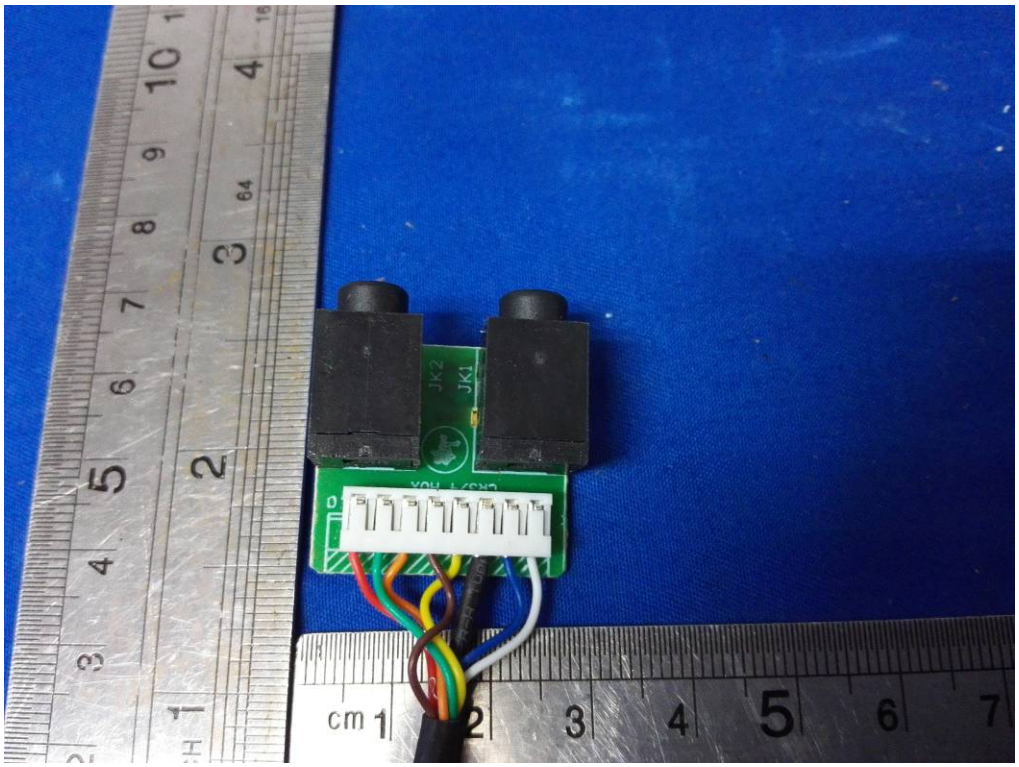

POWERED SPEAKER
INPUTS
OUTPUT TO PASSIVE SPEAKER
CR5
POWER

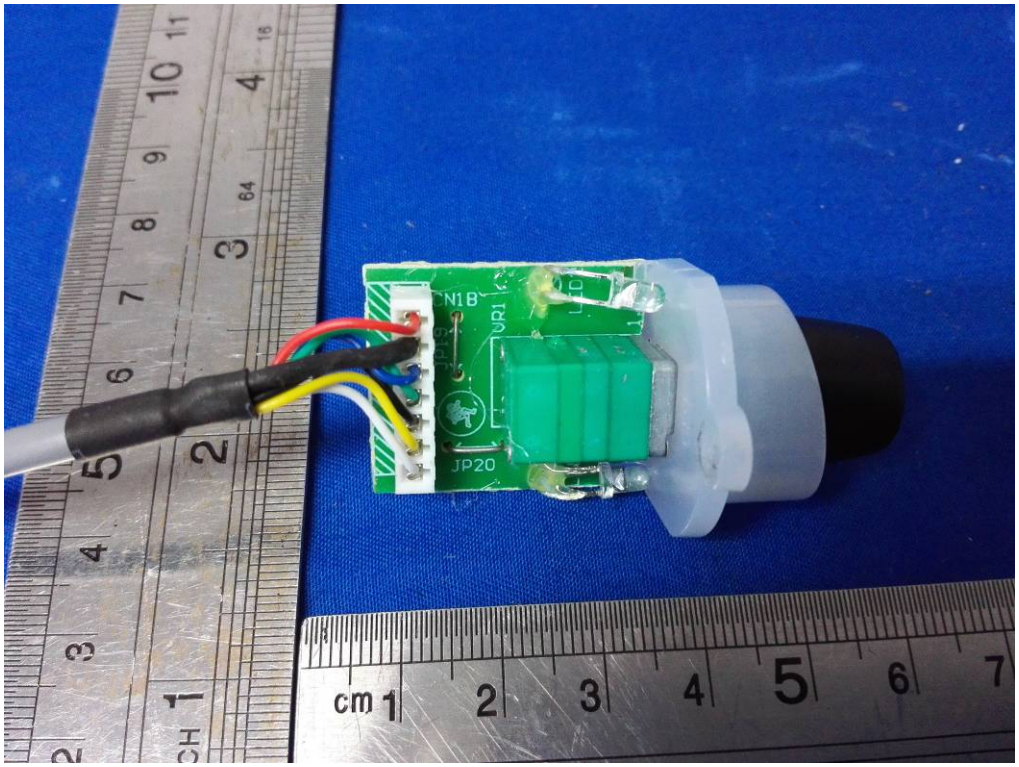
CR4BT

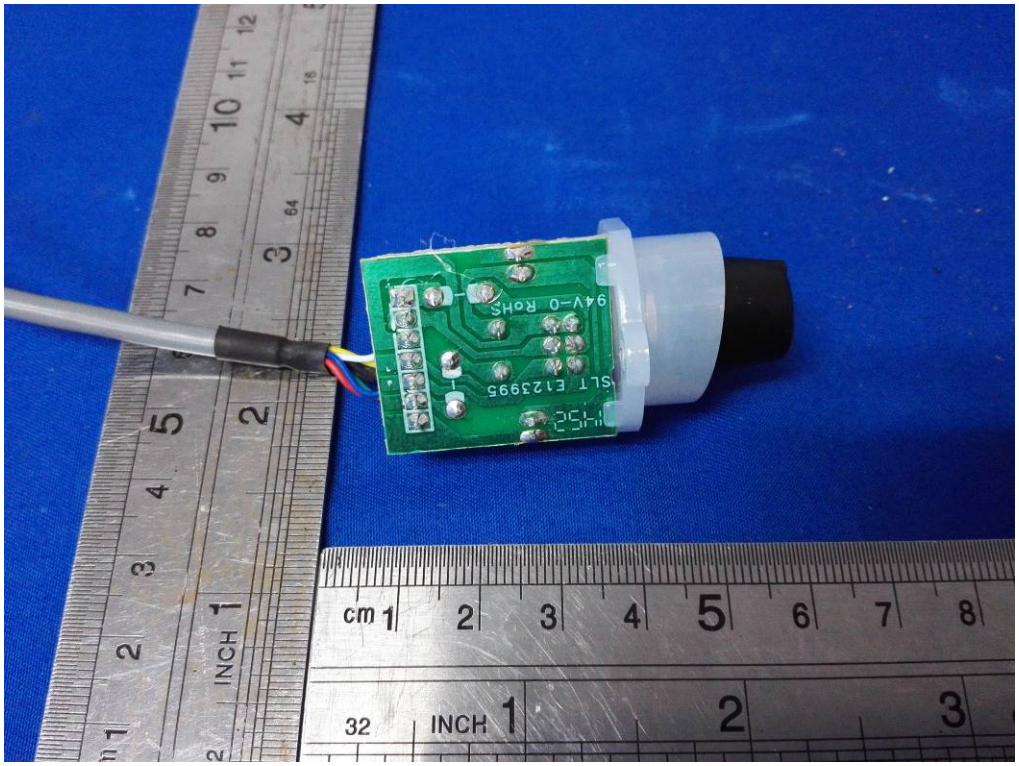


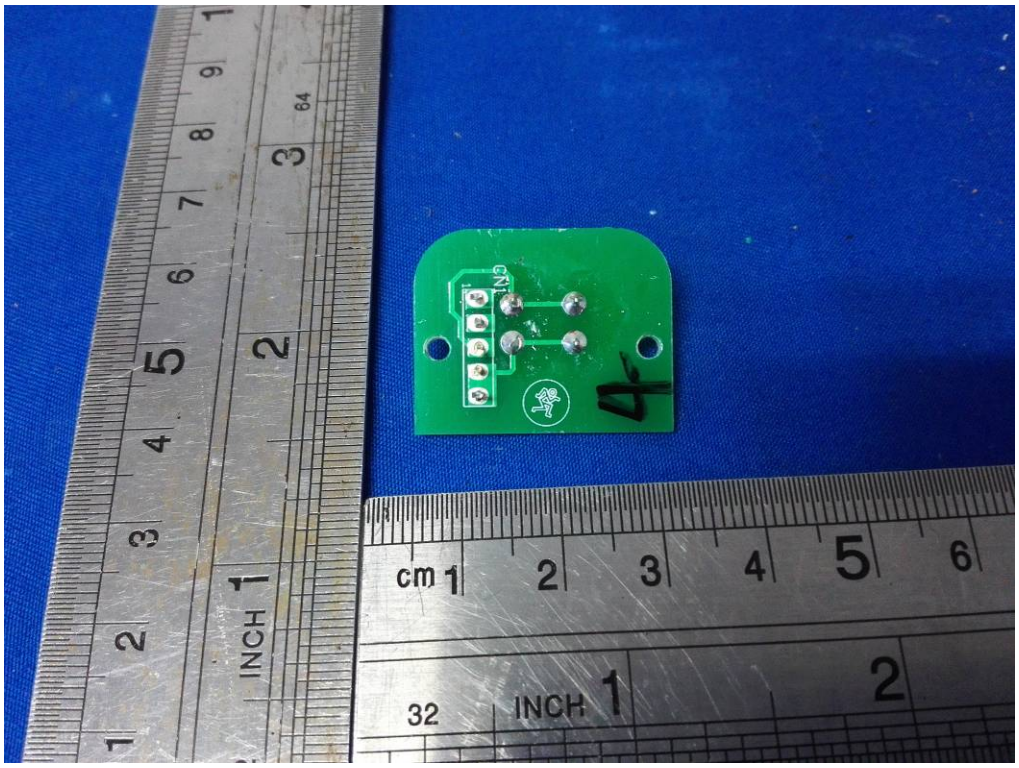


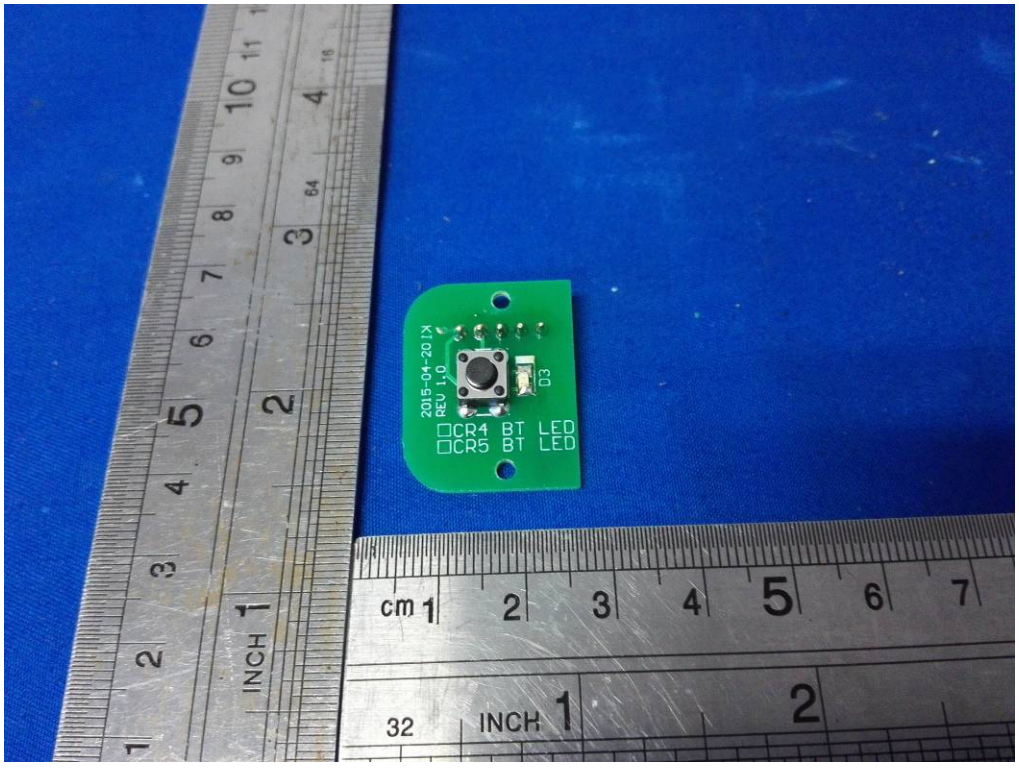

C110
RoHS
C88
R85
R84
E123995 94V-0
INCH
cm

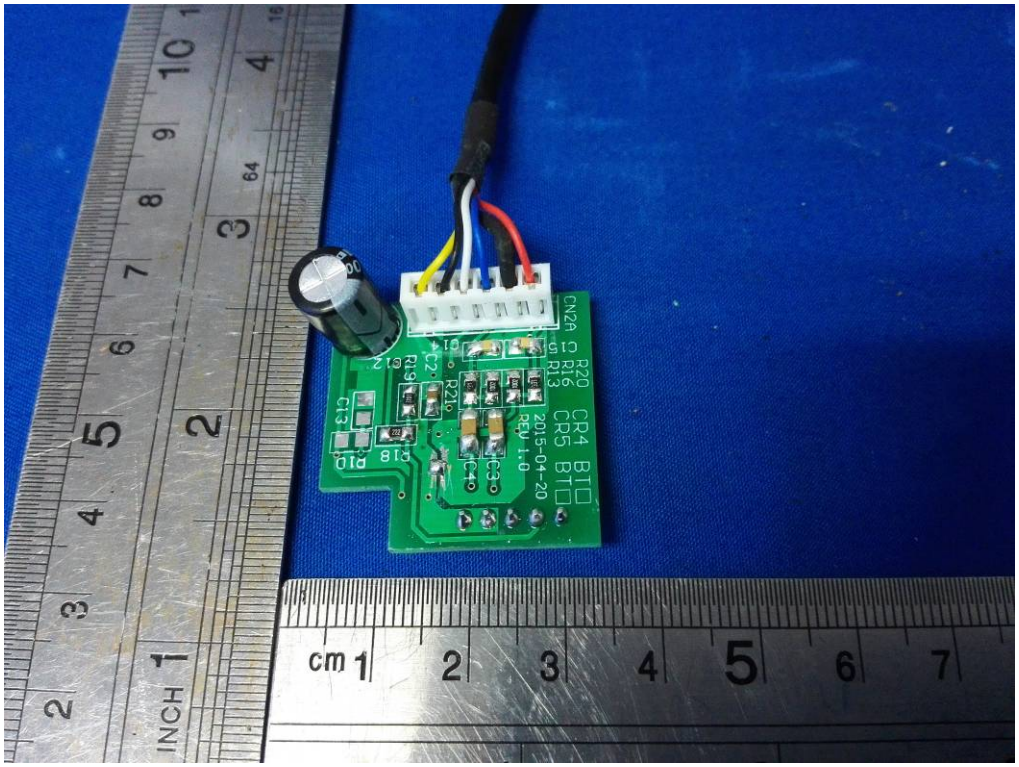

JK2
JK1
cm

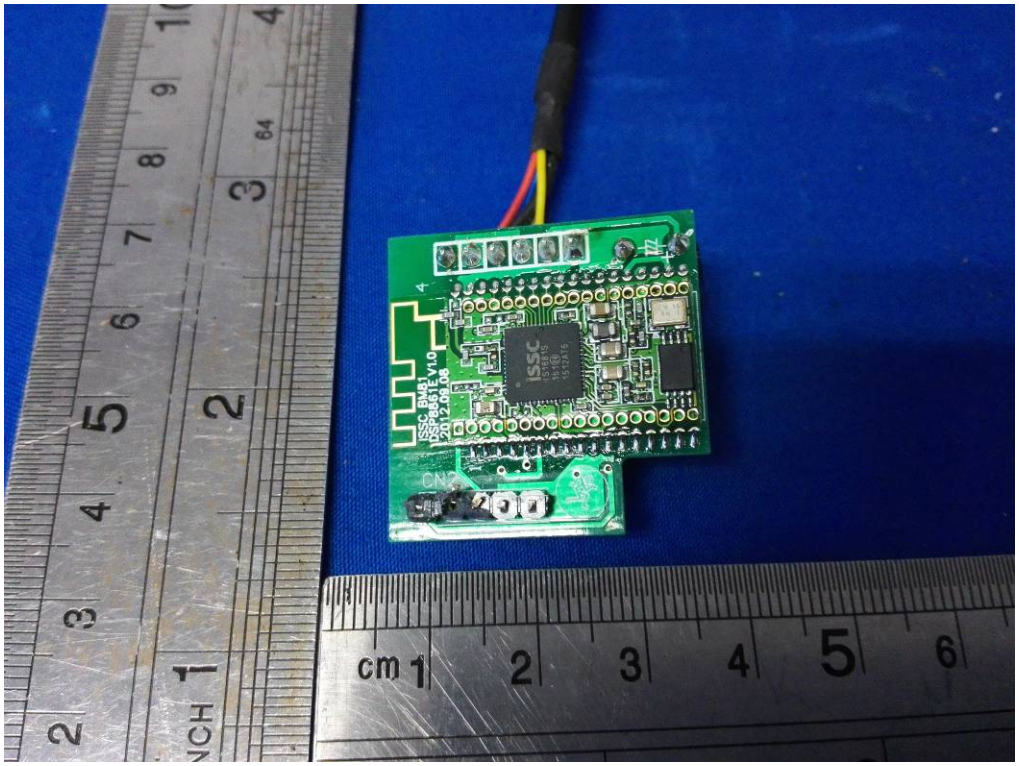

CN1B
JP20
cm 1 2 3 4 5 6 7

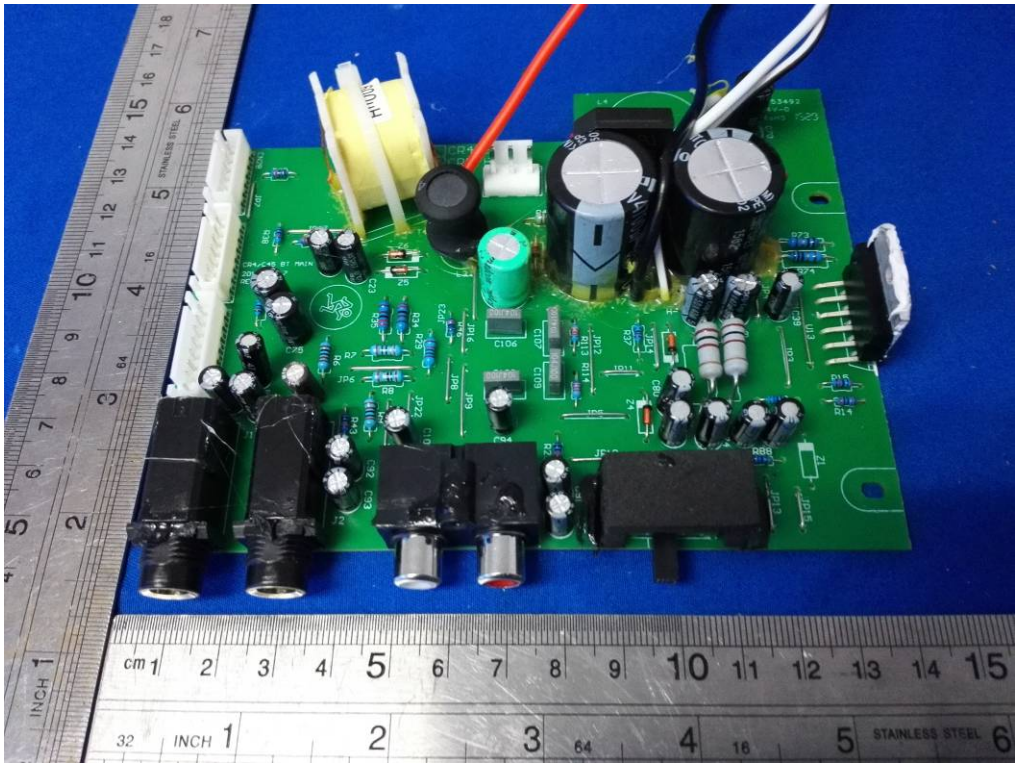

94V-0 RoHS
SLT E123995
cm 1 2 3 4 5 6 7 8
32 INCH 1 2 3

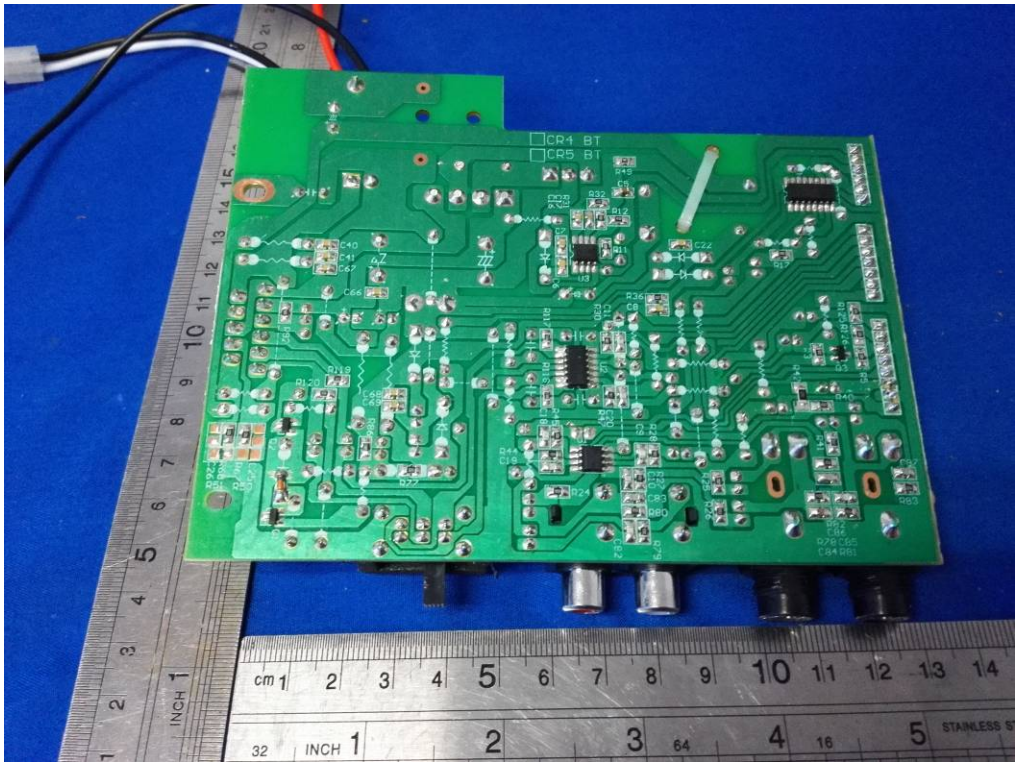

4
cm
INCH
32
INCH


2015-04-20
REV 1.0
D3
CR4 BT LED
CR5 BT LED
cm
INCH
32
INCH

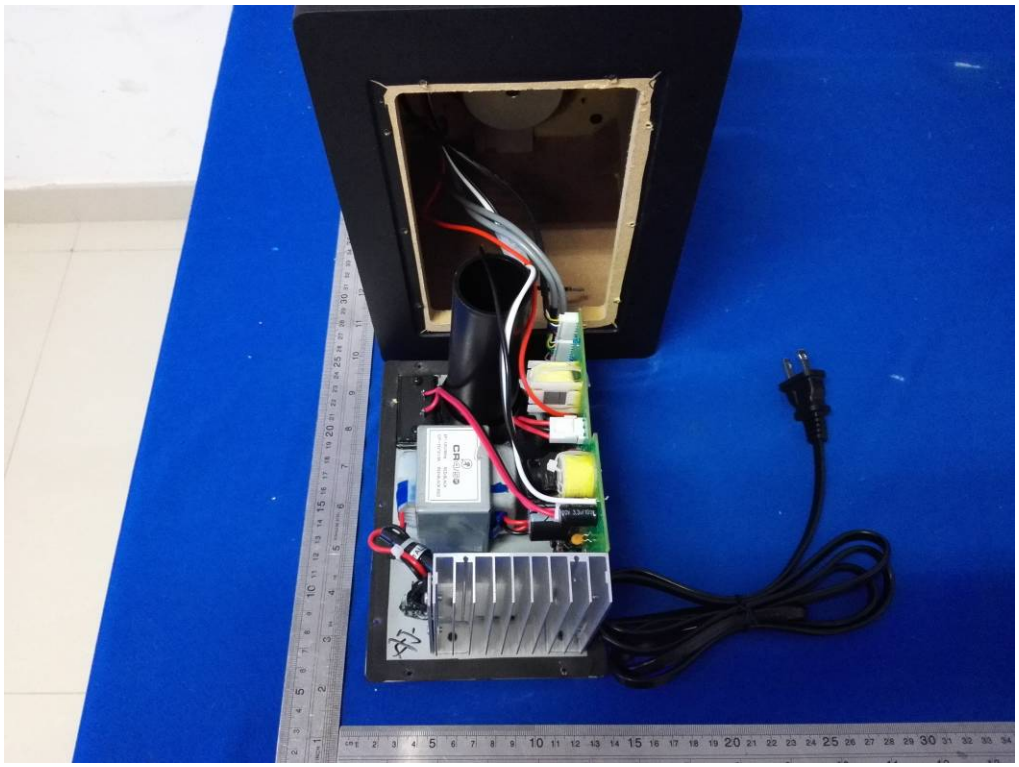

CN2A
R20
R16
R13
CR4 BT
CR5 BT
2015-04-20
REV 1.0
cm 1 2 3 4 5 6 7
INCH

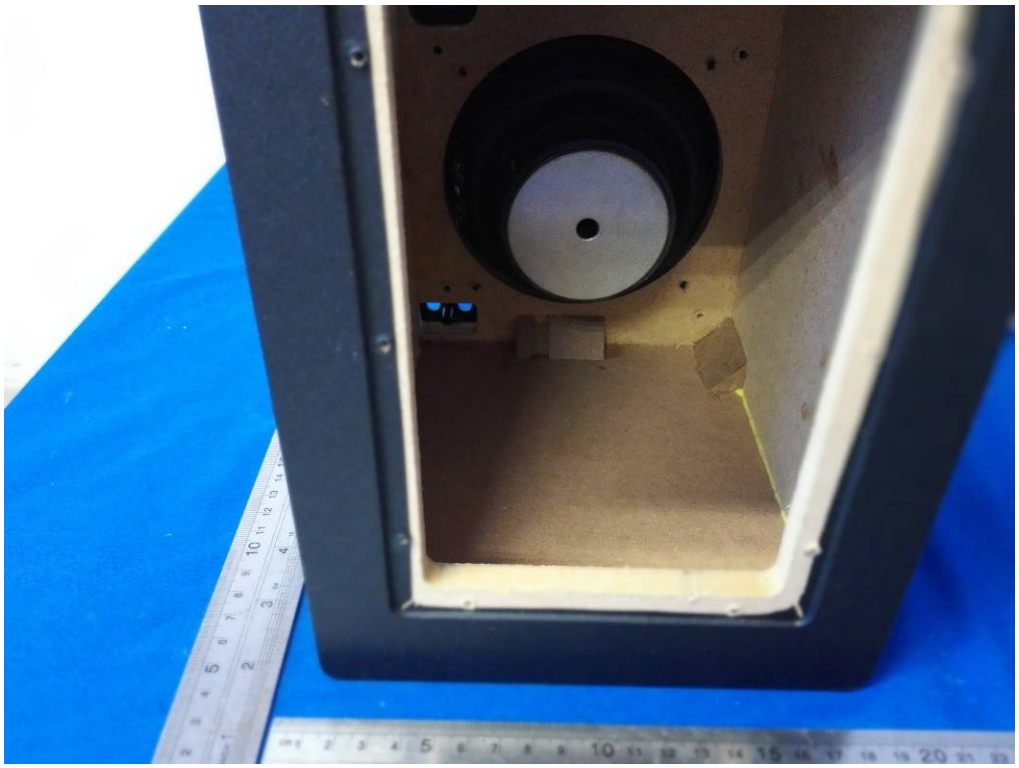

cm 1 2 3 4 5 6
INCH

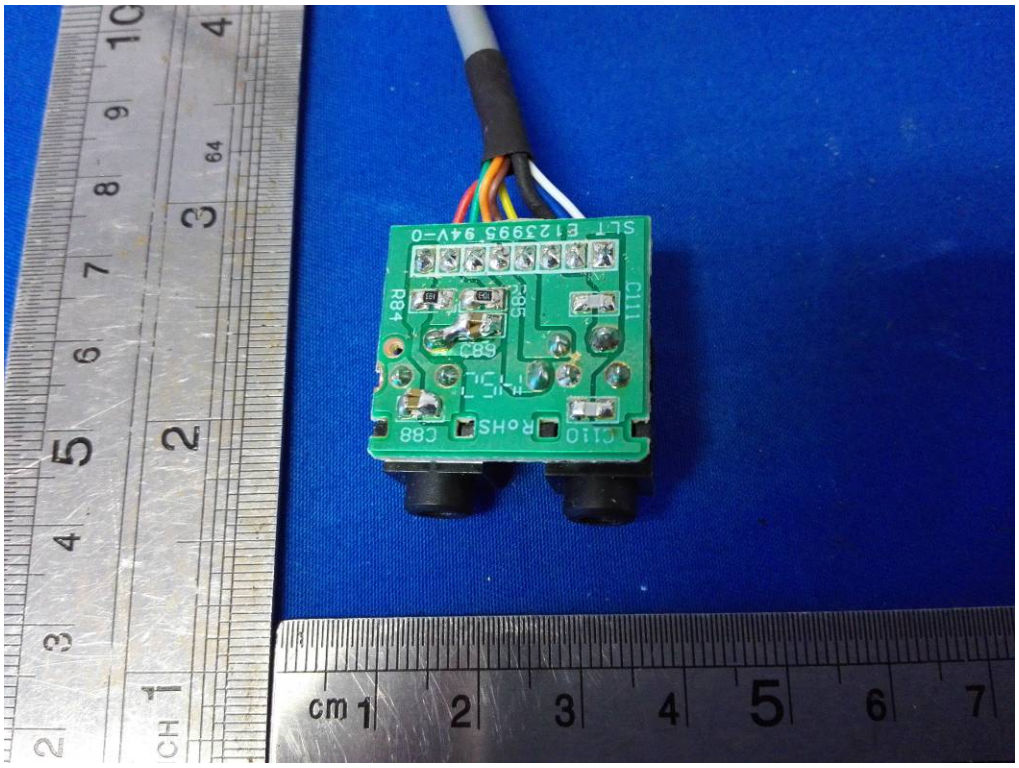


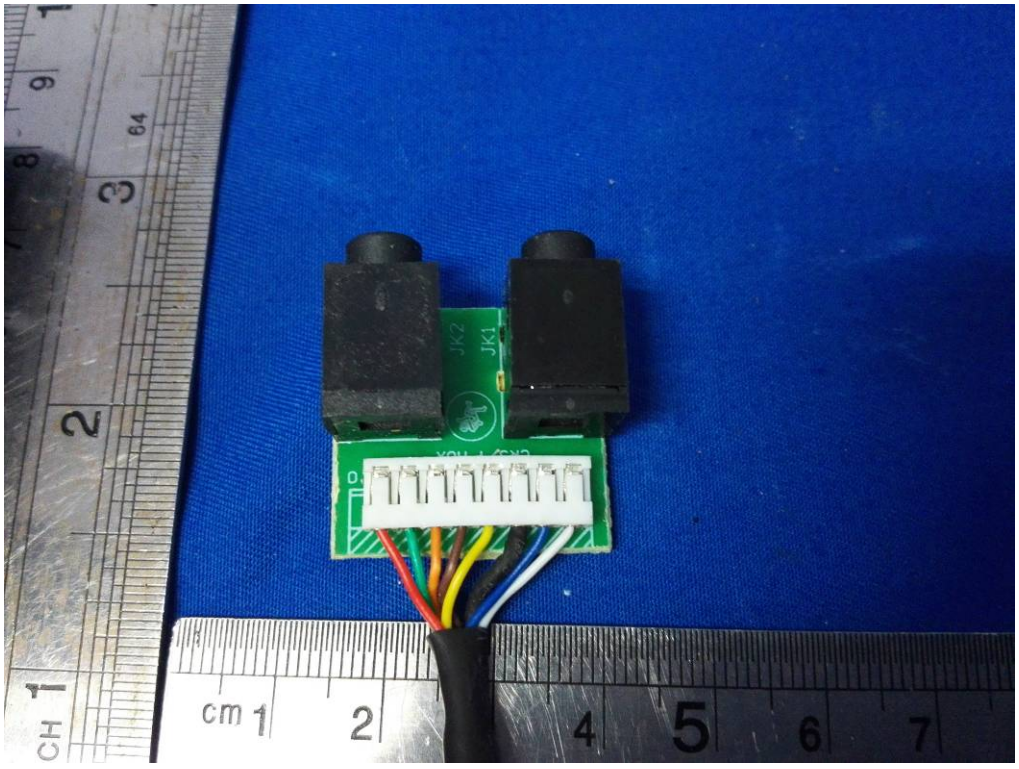

CR4 BT
CR5 BT

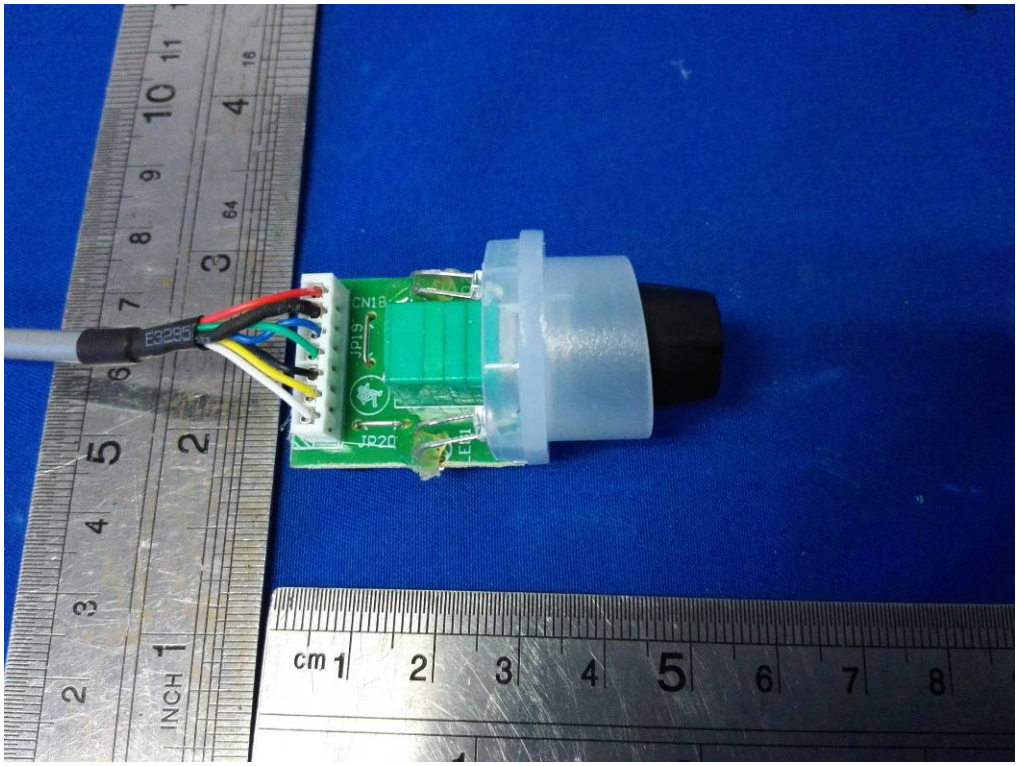
CR5BT

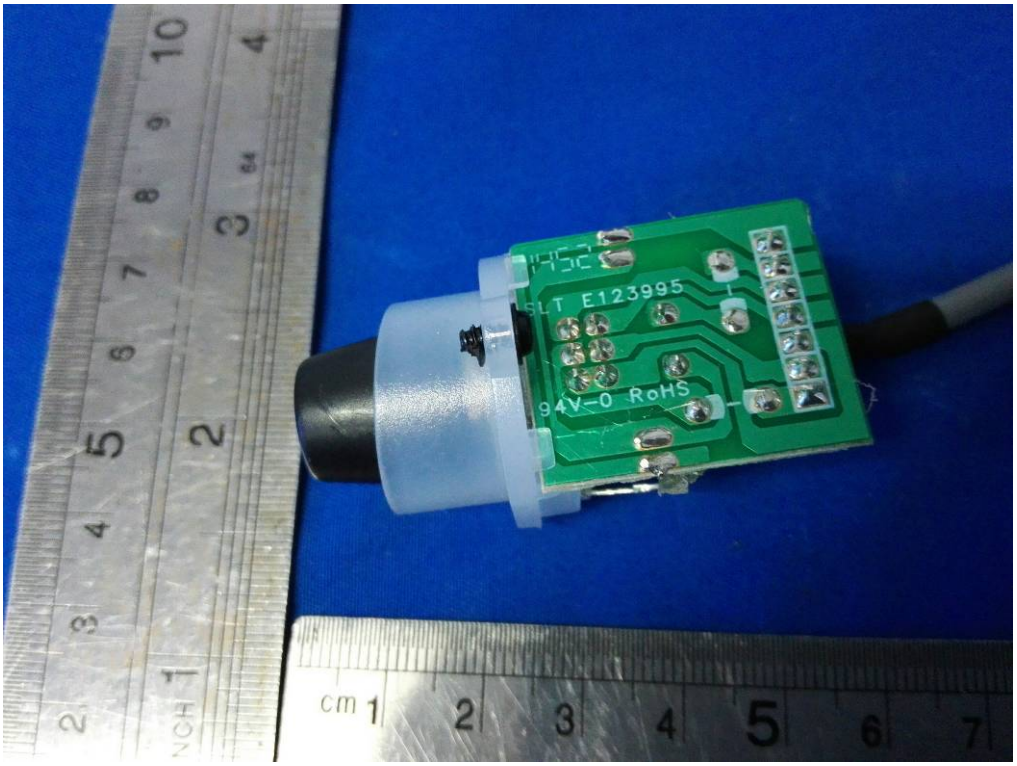


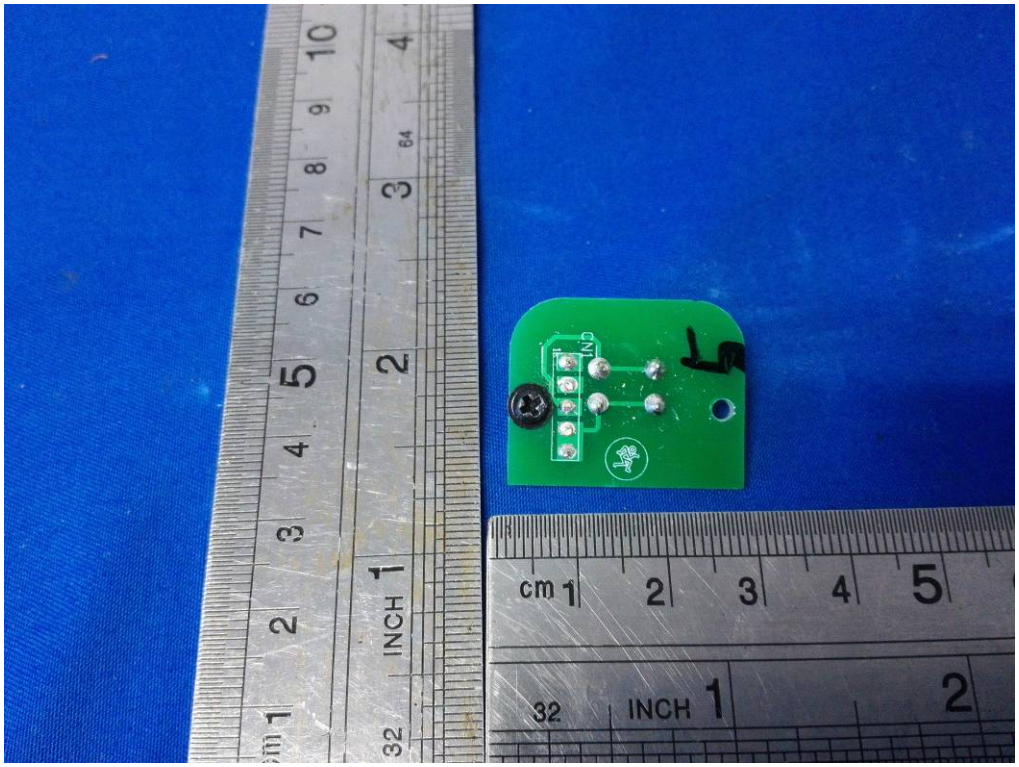


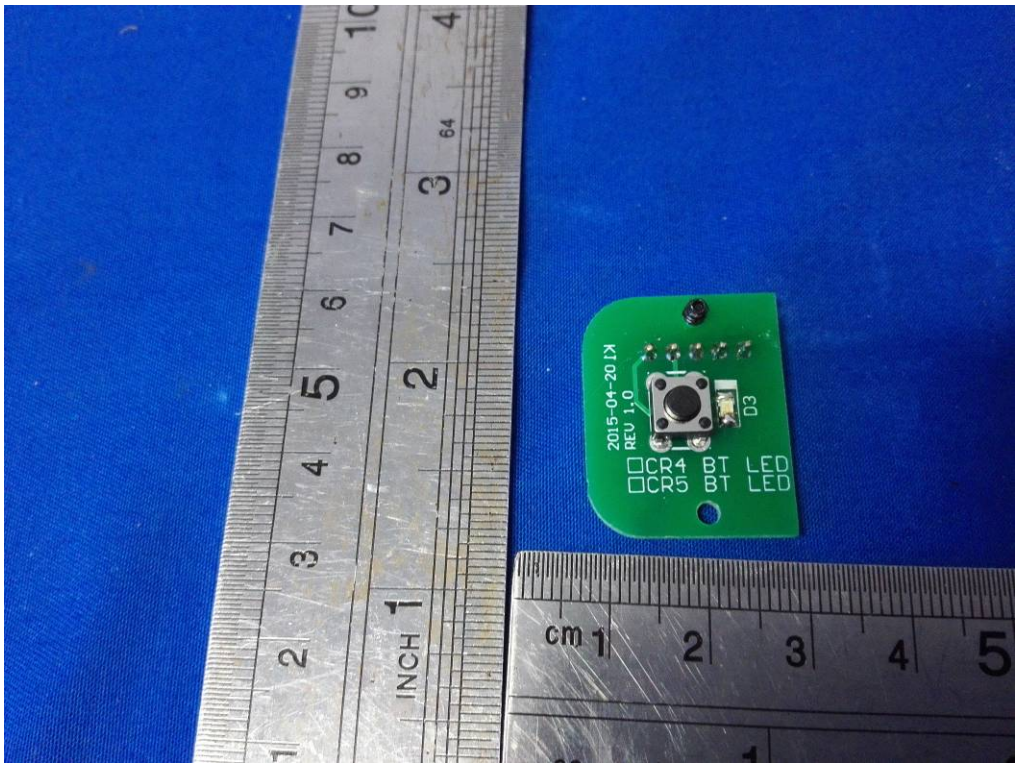


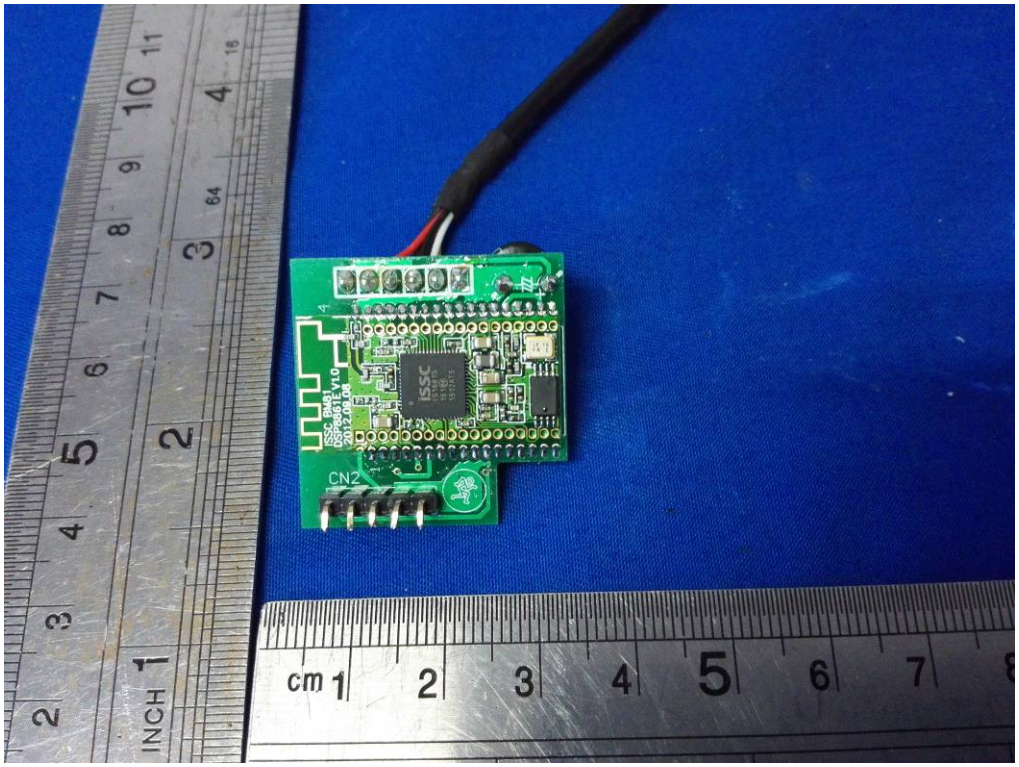


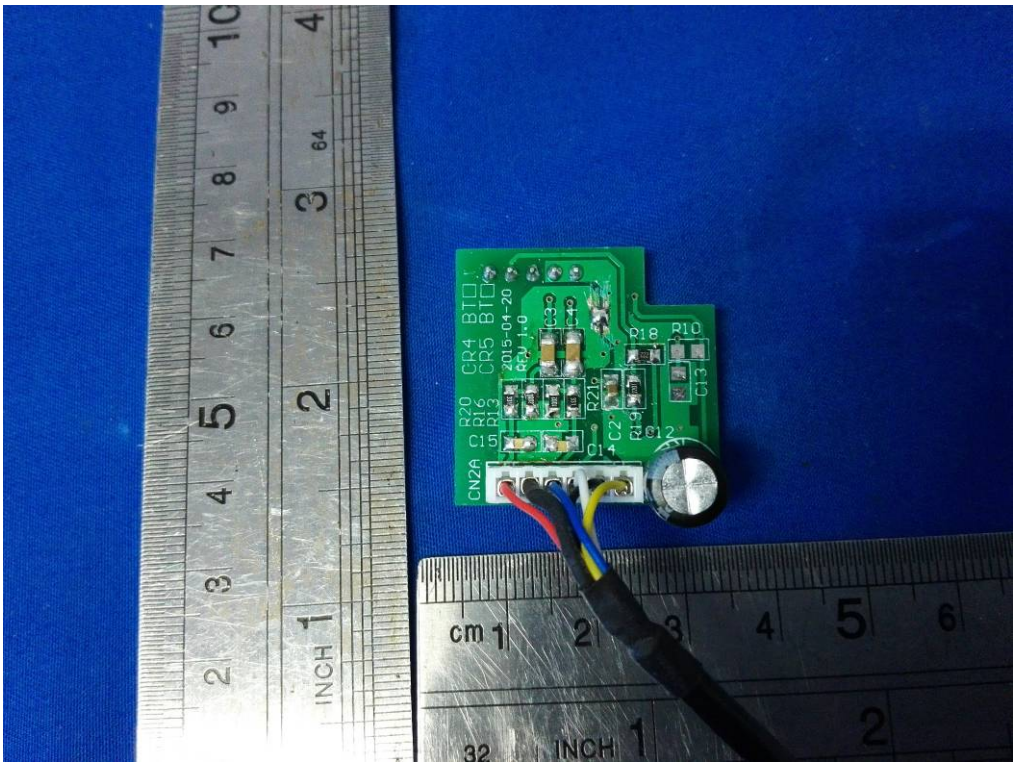

CN1B
JP20
INCH
cm

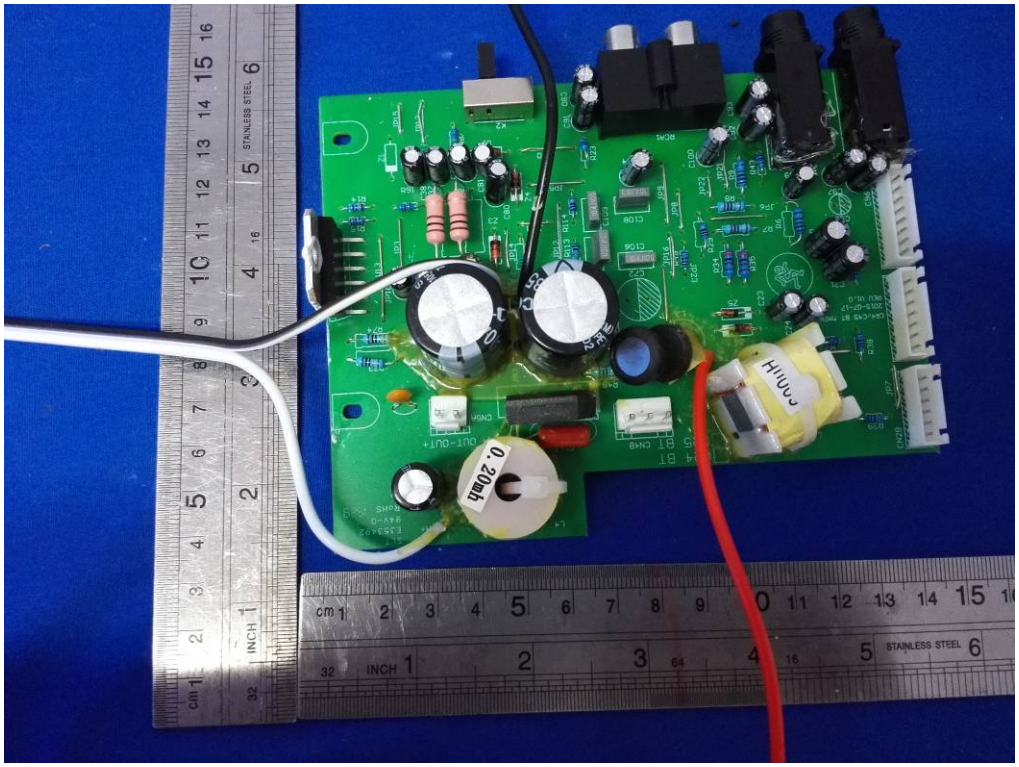

E123995
94V-0 RoHS
INCH
cm

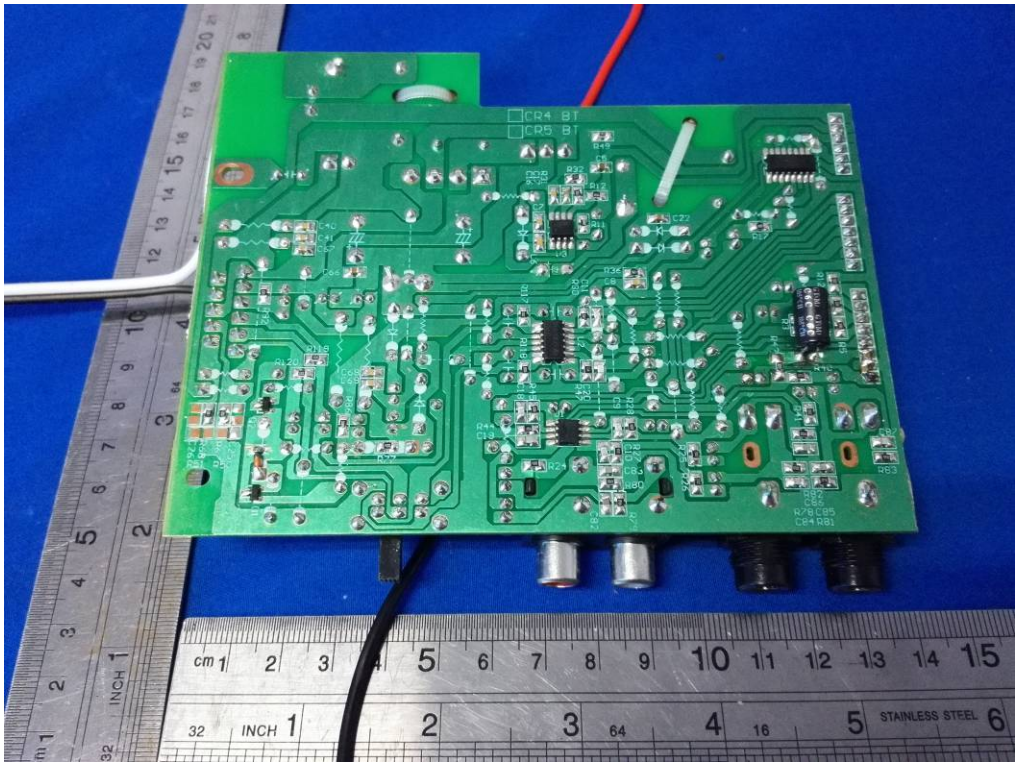

cm 1 2 3 4 5
INCH 1 2
32


2015-04-20 KI
REV 1.0
D3
CR4 BT LED
CR5 BT LED
cm 1 2 3 4 5
INCH 1


CN2
cm 1 2 3 4 5 6 7
INCH 1 2 3 4 5 6 7 8 9 10 11


CR4 BTD
CR5 BTD
2015-04-20
CN2A
cm 1 2 3 4 5 6
INCH 1 2 3 4 5 6 7 8 9 10
32 INCH 1 2





------End------