TEST REPORT

Report No. :	**HST201604-1851-FCC**
Product description:	**Bluetooth Speaker**
Model/Type :	**BS-551, BS-552, BS-553, BS-555, BS-556, BS-557, BS-558, BS-559, BS-560, BS-561, BS-562, BS-563, BS-565, BS-566, BS-567, BS-568, BS-569, BS-570, BS-571, BS-572, BS-573, BS-575, BT-80, BT-81, BT-82, BT-90, BT-91, BT-92, LI-S88BT, LI-S90BT**
Applicant's name:	**ENPING CITY SHUANGYI ELECTRONICS INDUSTRIAL CO., LTD**

Lab: Guangdong Huesent Testing & Inspection Technology Co., Ltd
Add: No. 91, Dongguanzhuang Road, Guangzhou, Guangdong, China.
Http://www.hst.org.cn E-mail:hst@hst.org.cn
Tel: +86-20-28263230 Fax: +86-20-28263237

TEST REPORT

FCC Part 15.247: 2014

FCCID: 2AHWHBS-561

Report Reference No. .....:	HST201604-1851-FCC	
Tested by (+ signature) .....:	Lemon Fu	Lemon Fu
Review by (+ signature) .....:	Sandy Yu	Sandy Yu
Approved by (+ signature).....	Zeng	Robin Peng
Date of Sample Receive ..... …...:	Apr. 1, 2016	
Date of Test.....:	Apr. 1, 2016 to Apr. 30, 2016	
Date of issue .....:	May 3, 2016	
Total number of pages .....:	82 Pages	
Testing Laboratory……..:	I-Test Laboratory (Accredited by CNAS, Accredited Number: L4957) FCC- Registration No: 935596 Renewal on April. 19, 2012	
Address .....:	1-2 floor, South Block, Building A2 No3 Keyan Lu, Science City, Guangzhou, Guangdong, China	
Applicant's name .....:	ENPING CITY SHUANGYI ELECTRONICS INDUSTRIAL CO., LTD	
Address .....:	B1 Foreign and Private Capital Industry, Enping, Guangdong, China	
Manufacturer's name .....:	ENPING CITY SHUANGYI ELECTRONICS INDUSTRIAL CO., LTD	
Address .....:	B1 Foreign and Private Capital Industry, Enping, Guangdong, China	
Test specification……:	Entrusted testing	
Standard.....:	FCC Part 15.247: 2014	
Non-standard test method……...:	N/A	
Test item description.....:	Bluetooth Speaker	
Trade Mark.....:	Ridgeway, Nutek, Rider, QFX, LAX-MAX®	
Model/Type reference .....:	BS-561	
Ratings .....:	5.0Vdc charger with USB port, Rechaegeable lithium ion battery: 1200mA, 3.5-4.7V. Output power: 3W	

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1 TEST SUMMARY

Test	Test Requirement	Test method	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	FCC PART 15 C section 15.247 (c) and Section 15.203	PASS
Occupied Bandwidth	FCC PART 15 C section 15.247 (a)(1)	ANSI C63.10: Clause 6.9 & DA 00-705	PASS
Carrier Frequencies Separated	FCC PART 15 C section 15.247(a)(1)	DA 00-705	PASS
Hopping Channel Number	FCC PART 15 C section 15.247(a)(1)(iii)	DA 00-705	PASS
Dwell Time	FCC PART 15 C section 15.247(a)(1)(iii)	DA 00-705	PASS
Pseudorandom Frequency Hopping Sequence	FCC PART 15 C section 15.247(a)(1)	DA 00-705	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1)	ANSI C63.10: Clause 6.10 & DA 00-705	PASS
Conducted Spurious Emission (30 MHz to 25 GHz)	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.7 & DA 00-705	PASS
Radiated Spurious Emission (9 kHz to 25 GHz)	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.4, 6.5 and 6.6 & DA 00-705	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: Clause 6.9 & DA 00-705	PASS
Conducted Emissions at Mains Terminals	FCC PART 15 C section 15.207	ANSI C63.10: Clause 6.2 & DA 00-705	PASS

Remark:

N/A: not applicable. Refer to the relative section for the details.
EUT: In this whole report EUT means Equipment Under Test.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.
ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.
DA 00-705: “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems”

Model No.: BS-551, BS-552, BS-553, BS-555, BS-556, BS-557, BS-558, BS-559, BS-560, BS-561, BS-562, BS-563, BS-565, BS-566, BS-567, BS-568, BS-569, BS-570, BS-571, BS-572, BS-573, BS-575, BT-80, BT-81, BT-82, BT-90, BT-91, BT-92, LI-S88BT, LI-S90BT

According to the confirmation from the applicant, all models are totally the same in and electrical and mechanical construction, except model No., speaker’s size.

Therefore only one model BS-561 was tested in this report.

2 GENERAL INFORMATION

2.1 Client Information

Applicant:	ENPING CITY SHUANGYI ELECTRONICS INDUSTRIAL CO., LTD
Address of Applicant:	B1 Foreign and Private Capital Industry, Enping, Guangdong, China

2.2 General Description of E.U.T.

Name:	
Model No.:	BS-551, BS-552, BS-553, BS-555, BS-556, BS-557, BS-558, BS-559, BS-560, BS-561, BS-562, BS-563, BS-565, BS-566, BS-567, BS-568, BS-569, BS-570, BS-571, BS-572, BS-573, BS-575, BT-80, BT-81, BT-82, BT-90, BT-91, BT-92, LI-S88BT, LI-S90BT
Trade Mark:	/
Operating Frequency:	2402 MHz to 2480 MHz
Channels:	79 channels with 1MHz step
Type of Modulation	GFSK,(π/4) DQPSK，8DPSK
Dwell time	Per channel is less than 0.4s.
Antenna Type	PCB Layout
Antenna gain:	0dBi
Speciality:	Bluetooth 2.1with EDR
Function:	Speaker with BT function to receive audio signal.

2.3 Details of E.U.T.

EUT Power Supply:	Rechaegeable lithium ion battery: 1200mA, 3.5-4.7V. Output power: 3W
Rated power:	5.0Vdc charger with USB port
Test mode:	The program used to control the EUT for staying in continuous transmitting mode is programmed. Channel lowest (2402MHz), middle (2441MHz) and highest (2480MHz) are chosen for full testing. Normal mode: the Bluetooth has been tested on the Modulation of GFSK; EDR mode: the Bluetooth has been tested on the Modulation of (π/4)DQPSK and 8DPSK, compliance test and record the worst case on 8DPSK.
Power cord/ signal cord:	51.5 cm USB cable, the USB port is only for charging.

2.4 Description of Support Units

The EUT has been tested as an independent unit for fixed frequency by testing lab.

2.5 Test Location

Guangzhou ITL Co., Ltd.

1-2 floor, South Block, Building A2 , No 3 Keyan Lu, Science City, Guangzhou, Guangdong Province, P.R. China

Tel: 86-20-32209330 Email: itl@i-testlab.com

CNAS(Lab code:L4957) FCC (Registration No.:935596) IC (Registration NO.:8368A)

2.6 Deviation from Standards

Biconical and log periodic antennas were used instead of dipole antennas.

2.7 Abnormalities from Standard Conditions

None.

2.8 Other Information Requested by the Customer

None.

2.9 Measurement Uncertainty

Parameter	Uncertainty
Radio frequency	$\pm 1.06 \times 10^{-7}$
total RF power, conducted	1.37 dB
RF power density , conducted	2.89 dB
All emissions, radiated	±3.35 dB
Temperature	±0.23 °C
Humidity	±0.3 %
DC and low frequency voltages	±0.3 %

3 TEST RESULTS

3.1 E.U.T. test conditions

Test Voltage:	Input: AC 120V, 60 Hz
Temperature:	20.0 -25.0 °C
Humidity:	38-50 % RH
Atmospheric Pressure:	1000 -1010 mbar
Test frequencies and frequency range:	According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table: According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	11	2413	22	2424
1	2403	12	2414	23	2425
2	2404	13	2415	24	2426
3	2405	14	2416	25	2427
4	2406	15	2417	26	2428
5	2407	16	2418	27	2429
6	2408	17	2419	28	2430
7	2409	18	2420	29	2431
8	2410	19	2421	30	2432
9	2411	20	2422	31	2433
10	2412	21	2423	32	2434
33	2435	49	2451	65	2467
34	2436	50	2452	66	2468
35	2437	51	2453	67	2469
36	2438	52	2454	68	2470
37	2439	53	2455	69	2471
38	2440	54	2456	70	2472
39	2441	55	2457	71	2473
40	2442	56	2458	72	2474
41	2443	57	2459	73	2475
42	2444	58	2460	74	2476
43	2445	59	2461	75	2477
44	2446	60	2462	76	2478
45	2447	61	2463	77	2479
46	2448	62	2464	78	2480
47	2449	63	2465		
48	2450	64	2466		

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 39 channel(2441 MHz) and highest channel: 78 channel(2480 MHz)

3.2 Antenna equirement

Standard requirement

15.203 requirement:

For intentional device. According to 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.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi 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 6 dBi.

EUT Antenna

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.

Test result: The unit does meet the FCC requirements.

3.3 Occupied Bandwidth

Test Requirement: FCC Part 15 C section 15.247

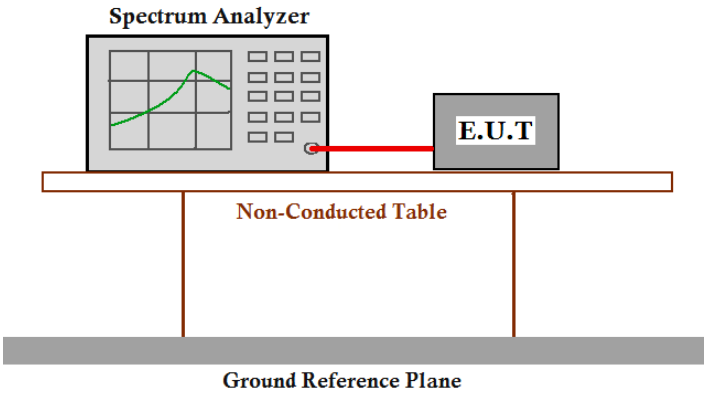
(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Method: ANSI C63.10: Clause 6.9 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402

MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data package. Compliance test in normal mode (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20dB bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW >= 1% of the 20dB bandwidth VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20dB points bandwidth.

Test result:

Normal mode:

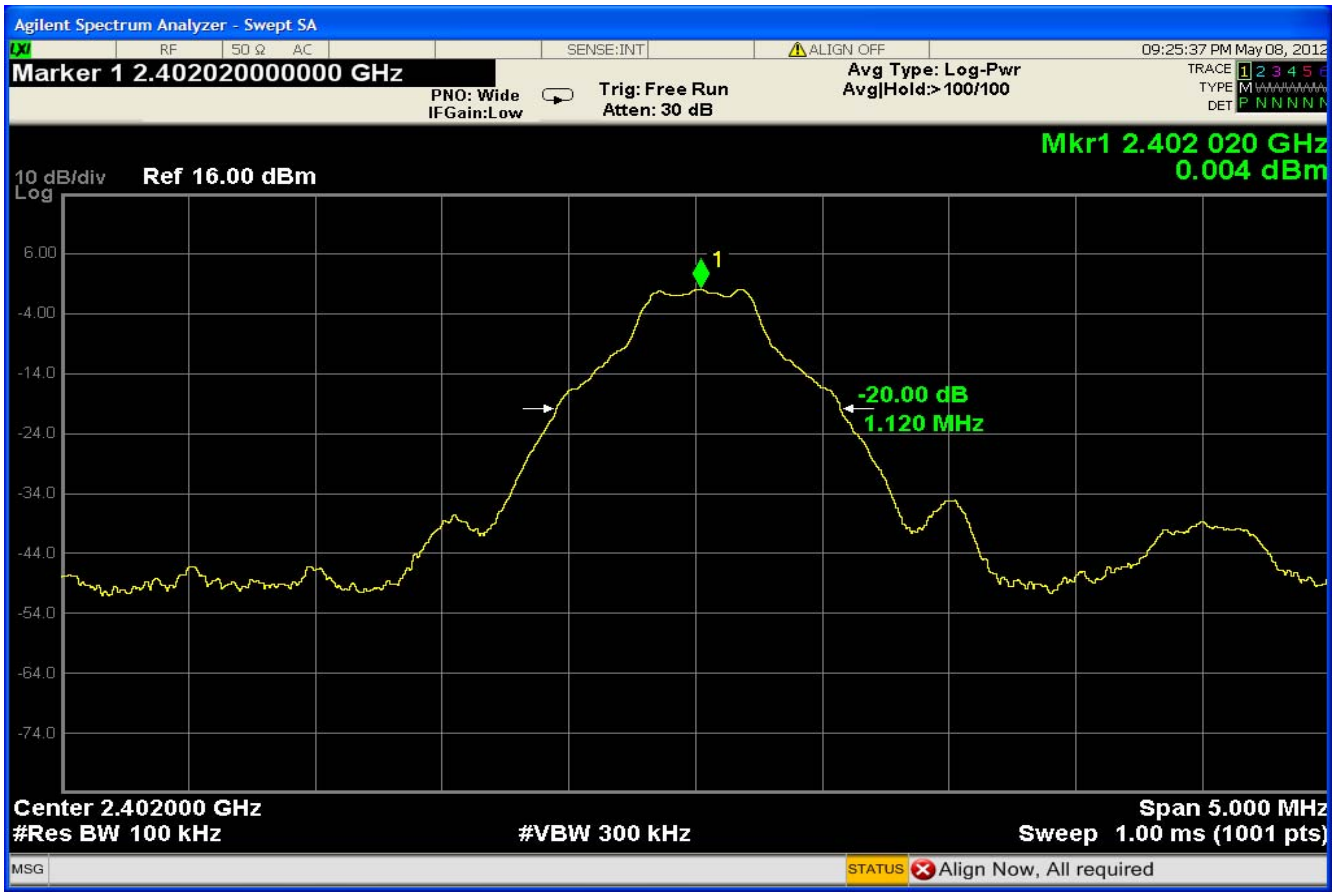
Test Channel	20dB Bandwidth(MHz)	2/3 bandwidth(MHz)	Output power (dBm)	Limit of Output power
Lowest	1.120	0.747	**0.004**	**125mW=20.97dBm**
Middle	1.122	0.748	**0.314**	**125mW=20.97dBm**
Highest	1.098	0.732	**0.367**	**125mW=20.97dBm**

EDR mode:

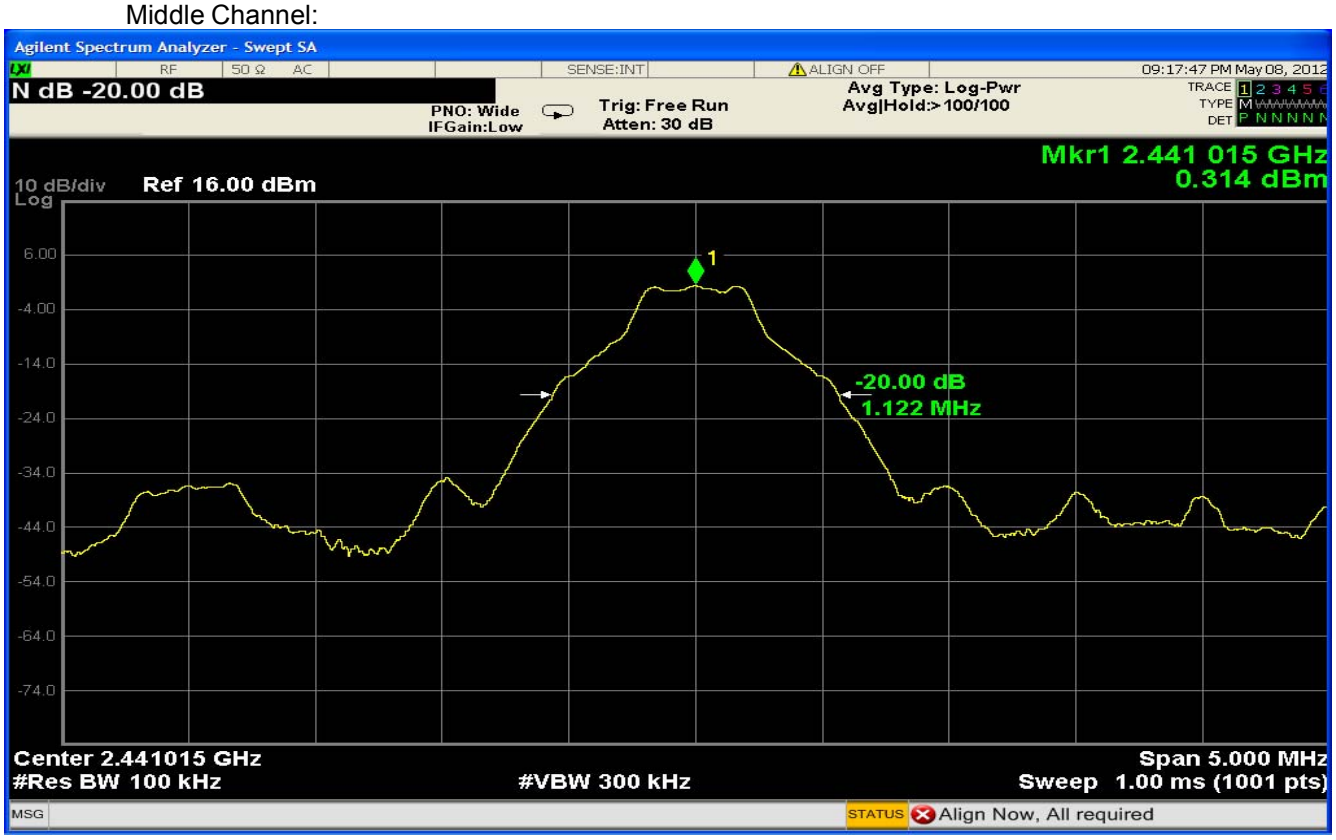
Test Channel	20dB Bandwidth(MHz)	2/3 bandwidth(MHz)	Output power (dBm)	Limit of Output power
Lowest	1.396	0.931	**-1.185**	**125mW=20.97dBm**
Middle	1.398	0.932	**-0.719**	**125mW=20.97dBm**
Highest	1.395	0.930	**-0.701**	**125mW=20.97dBm**

Result plot as follows: DH5:

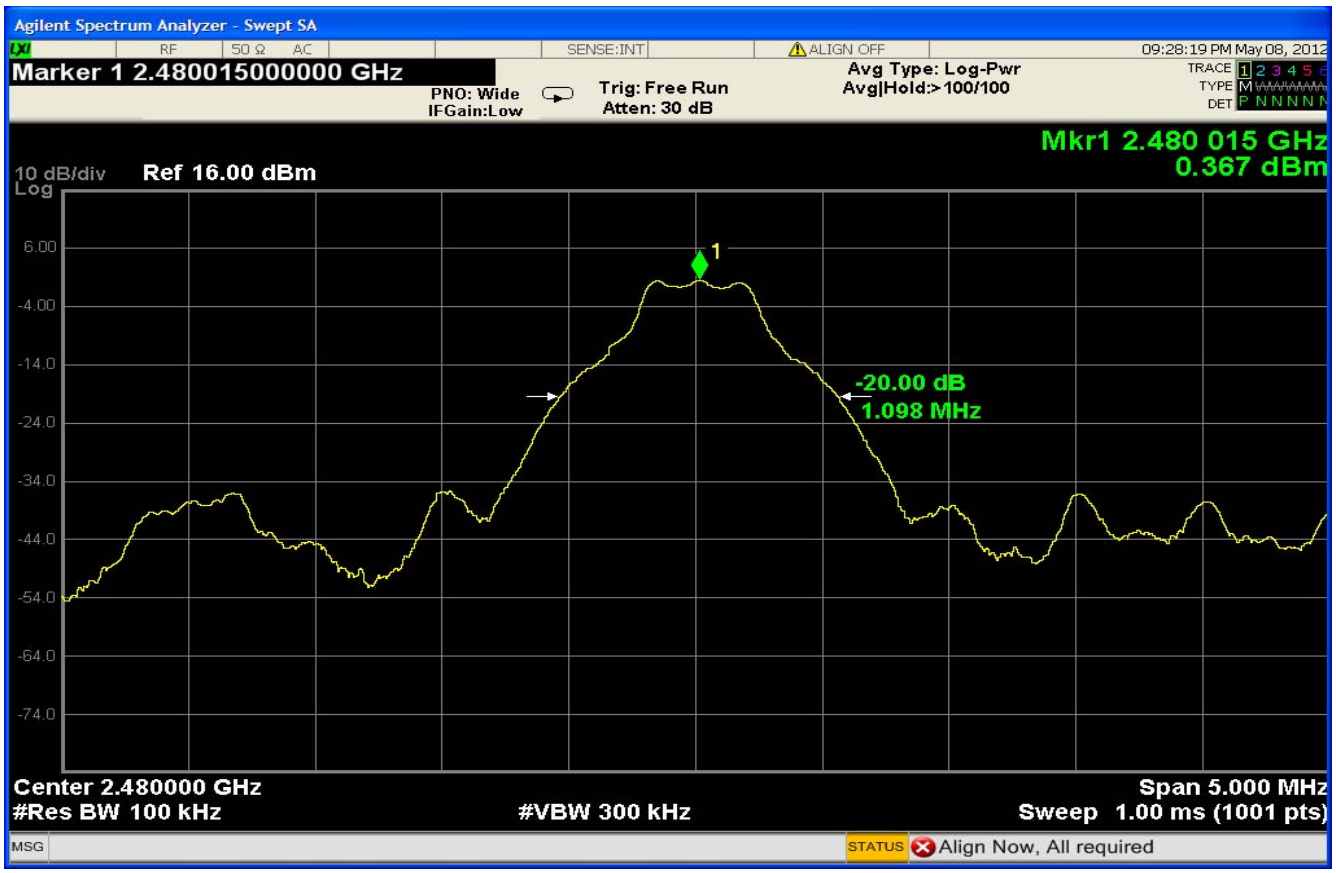
Lowest Channel:



Middle Channel:



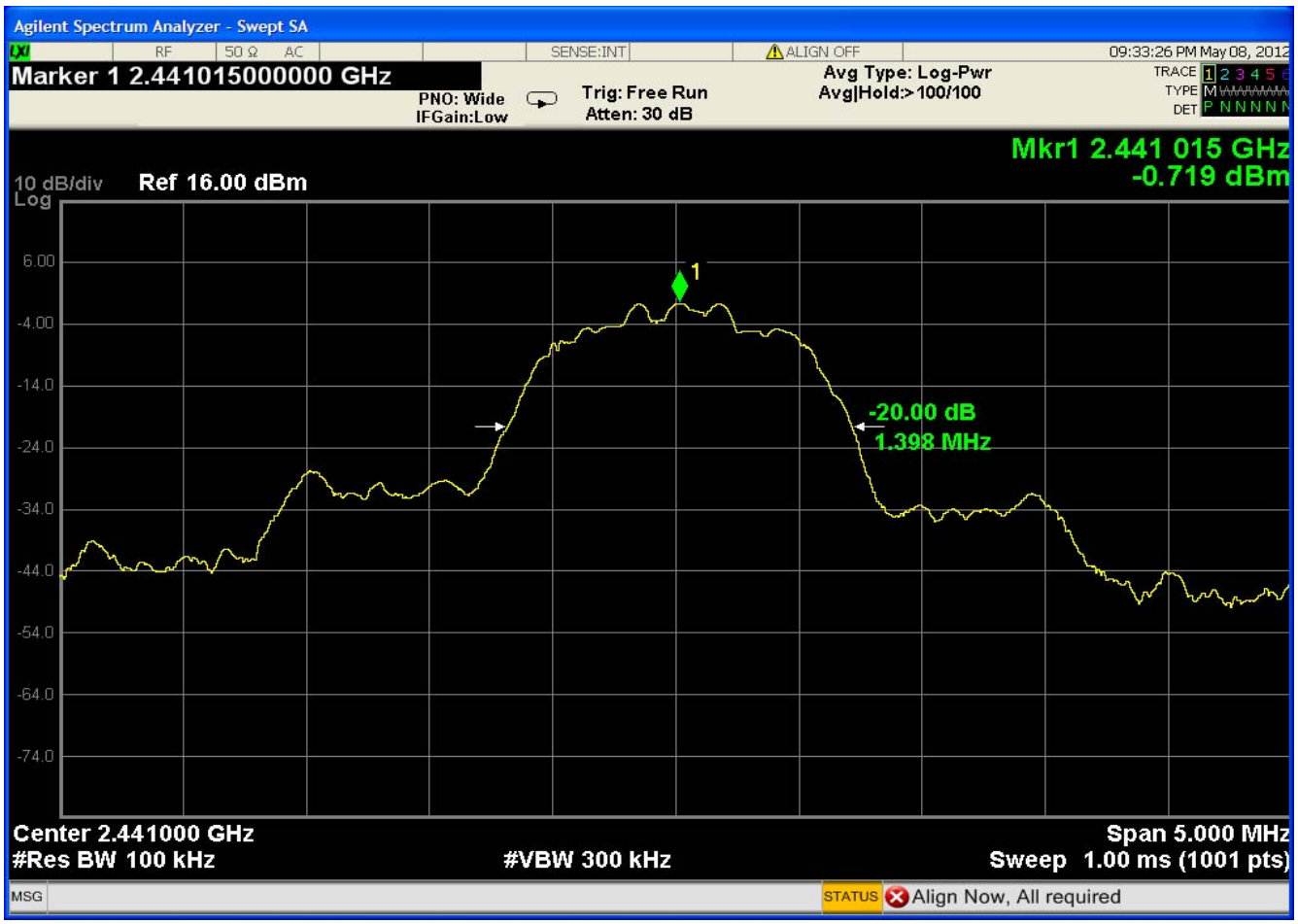
Highest Channel:



3DH5:

Lowest channel:

Middle channel:



Highest channel:

3.4 Carrier Frequencies Separated

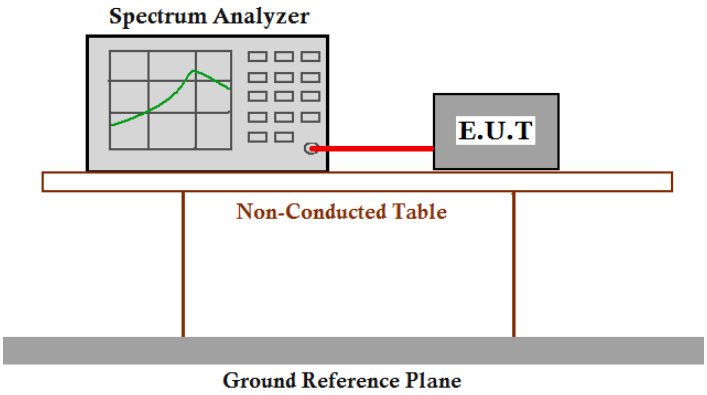
Test Requirement: FCC Part 15 C section 15.247

(a),(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Method: DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in hopping with normal mode (DH5) as the worst case was found.

Test Configuration:



Test Procedure:

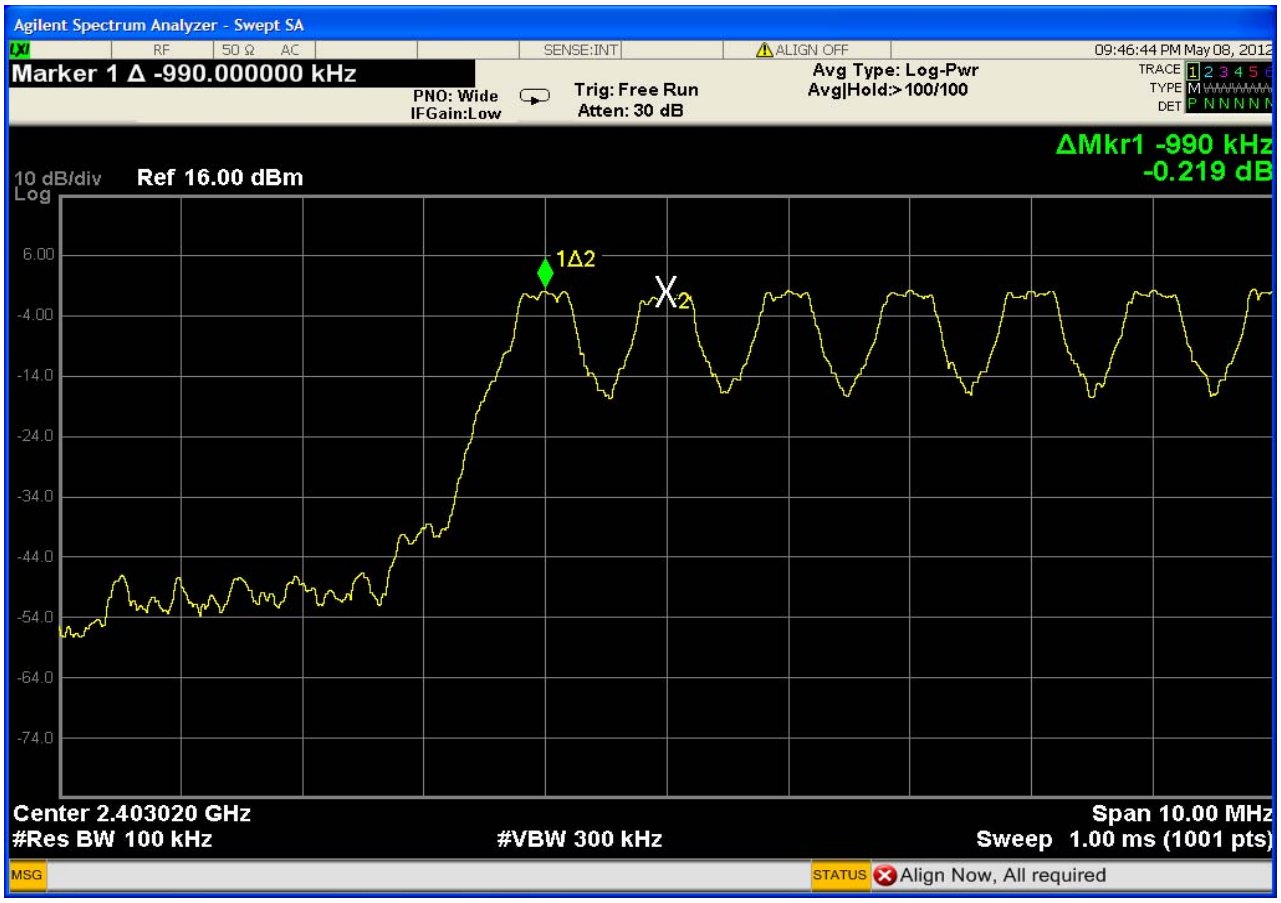
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW >= 1% of the span, VBW >= RBW,. Sweep = auto; Detector
   Function = Peak. Trace = Max, hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test result:

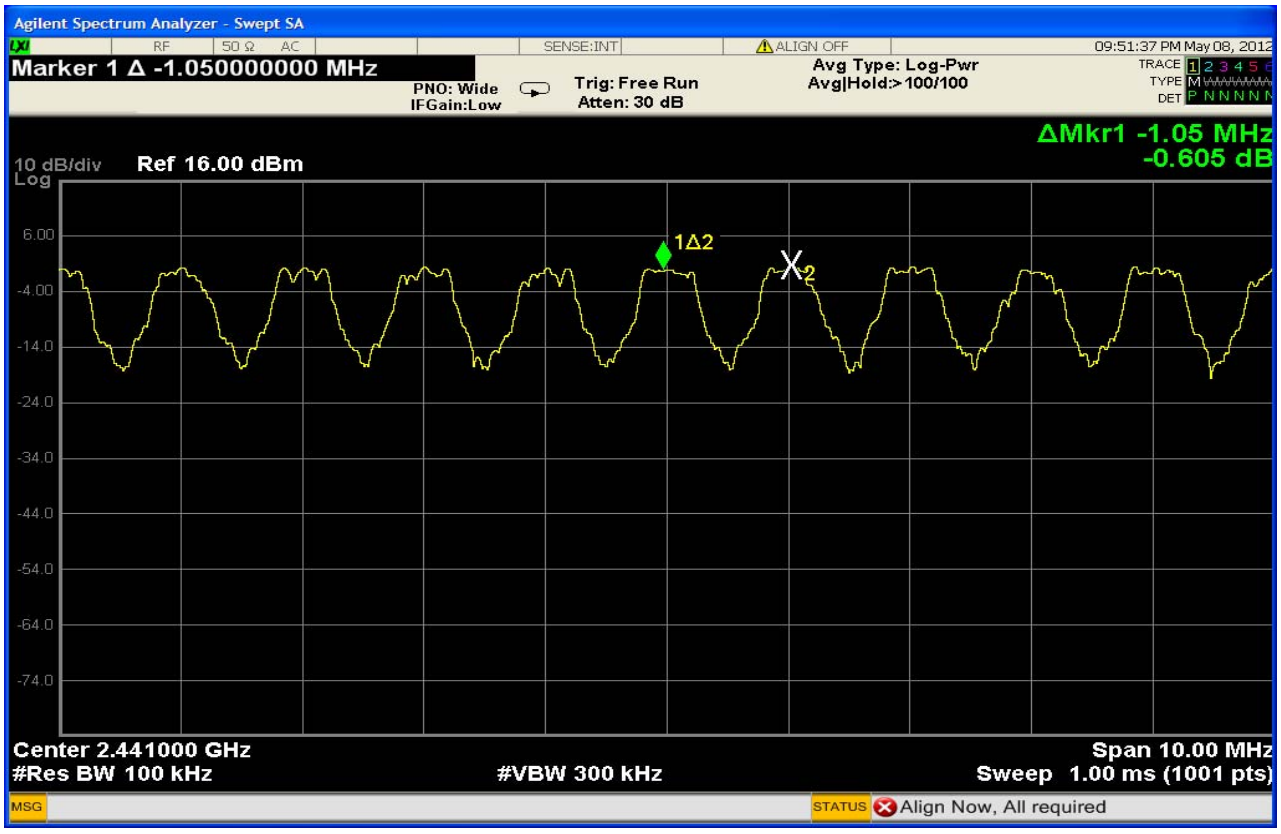
Test Channel	Carrier Frequencies Separated	Pass/Fail
Lower Channels (channel 0 and channel 1)	0.99MHz	Pass
Middle Channels (channel 39 and channel 40)	1.05MHz	Pass
Upper Channels (channel 77 and channel 78)	1.01MHz	Pass
Remark: The limit is maximum two-thirds of the 20 dB bandwidth: 0.932 MHz		

Carrier Frequencies Separated plot:

1. Lowest Channels:



2. Middle Channels:



3. Highest Channels

3.5 Hopping Channel Number

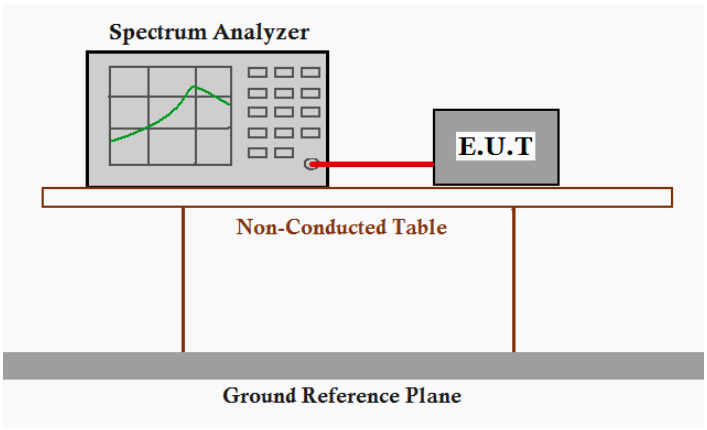
Test Requirement: FCC Part15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Method: DA 00-705

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with normal mode (DH5) as the worst case was found.

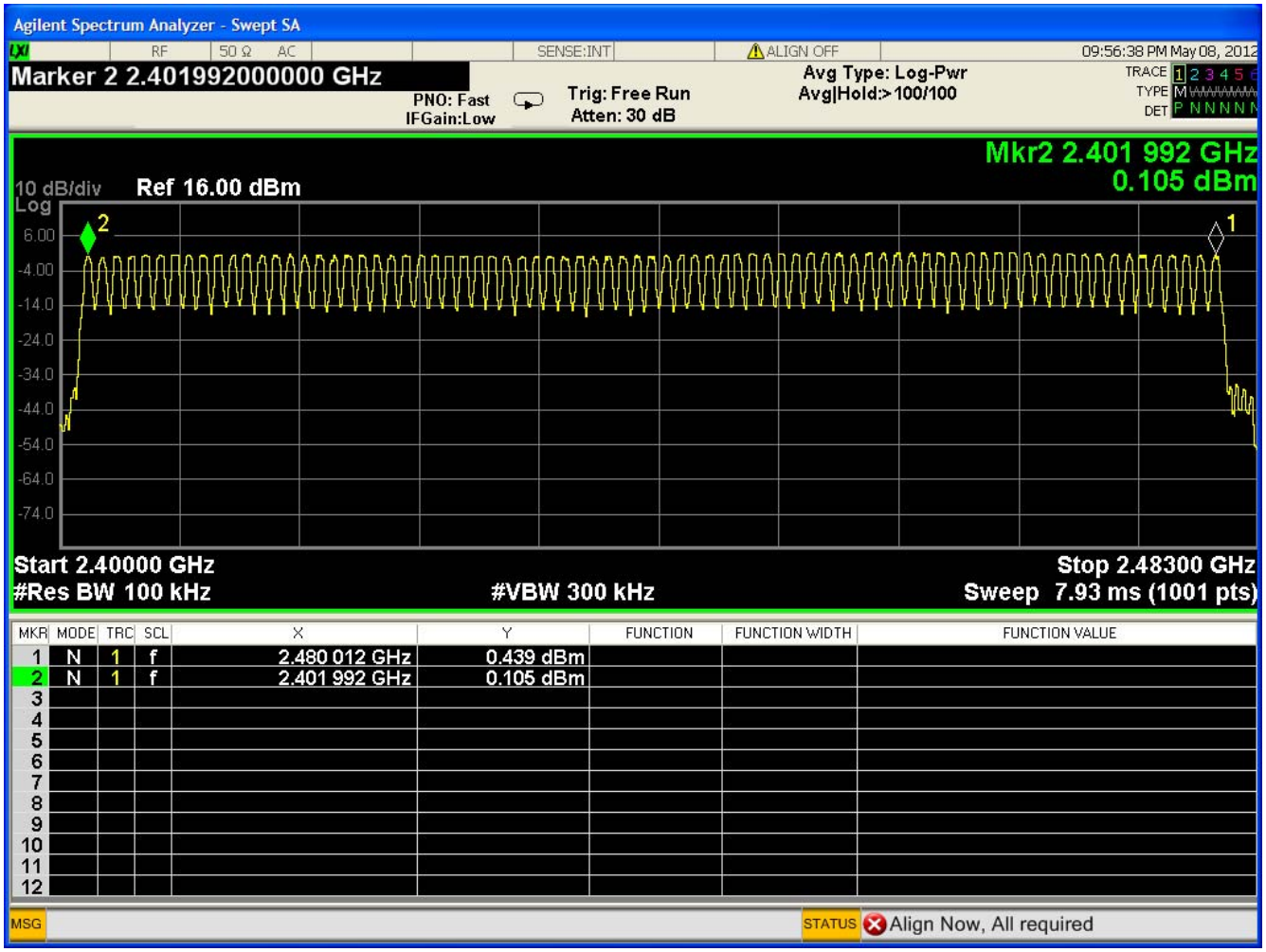
Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 2400 MHz. stop frequency = 2483.5 MHz. Submit the test result graph.

Test result: Total channels are 79 channels.



Test result: The unit does meet the FCC requirements.

3.6 Dwell Time

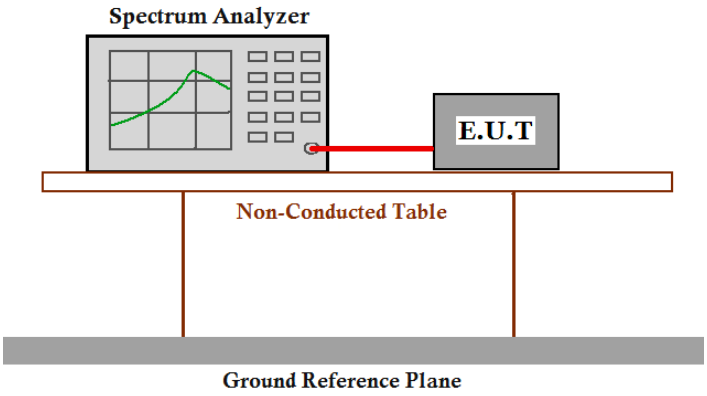
Test Requirement: FCC Part 15 C section 15.247

(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.

Test Method: DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in hopping with EDR mode (3DH1, 3DH3 and 3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. centered on a hopping channel;
3. Set RBW = 1 MHz and VBW = 1 MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = View;
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). Repeat this test for each variation.

The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

Test Result:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

1. **Channel 0:** 2.402GHz

3DH1 time slot = 0.40(ms) * (1600/(2*79)) * 31.6 = 128.0ms

3DH3 time slot = 1.64 (ms) * (1600/(4*79)) * 31.6 = 262.4ms

3DH5 time slot = 2.92 (ms) * (1600/(6*79)) * 31.6 = 311.5ms

2. **Channel 39:** 2.441GHz

3DH1 time slot = 0.40 (ms) * (1600/(2*79)) * 31.6 = 128.0ms

3DH3 time slot = 1.62 (ms) * (1600/(4*79)) * 31.6 = 259.2ms

3DH5 time slot = 2.90 (ms) * (1600/(6*79)) * 31.6 = 309.3ms

3. **Channel 78:** 2.480GHz

3DH1 time slot = 0.41 (ms) * (1600/(2*79)) * 31.6 = 131.2ms

3DH3 time slot = 1.66 (ms) * (1600/(4*79)) * 31.6 = 265.6ms

3DH5 time slot = 2.92(ms) * (1600/(6*79)) * 31.6 = 311.5ms

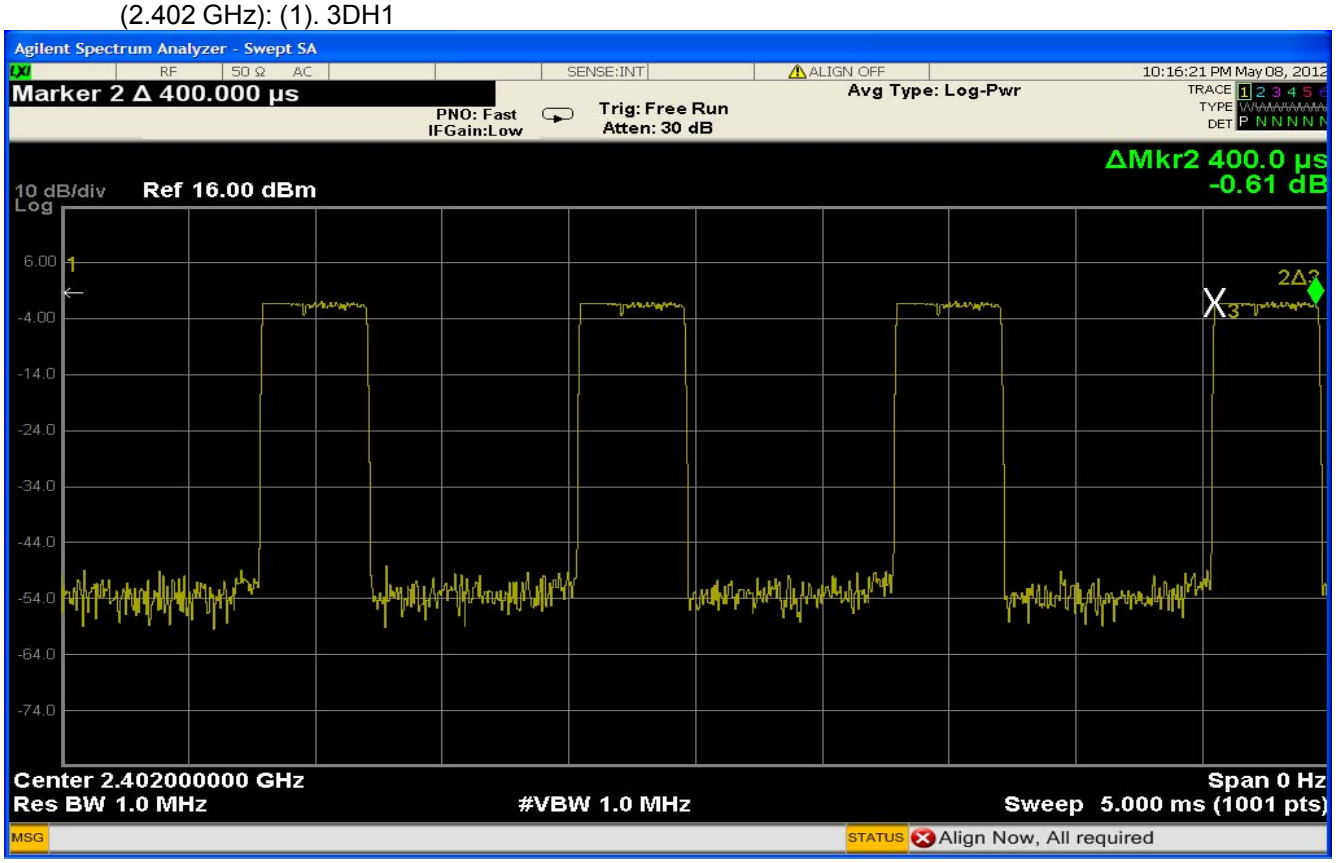
The results are not greater than 0.4 seconds

The unit does meet the FCC requirements.

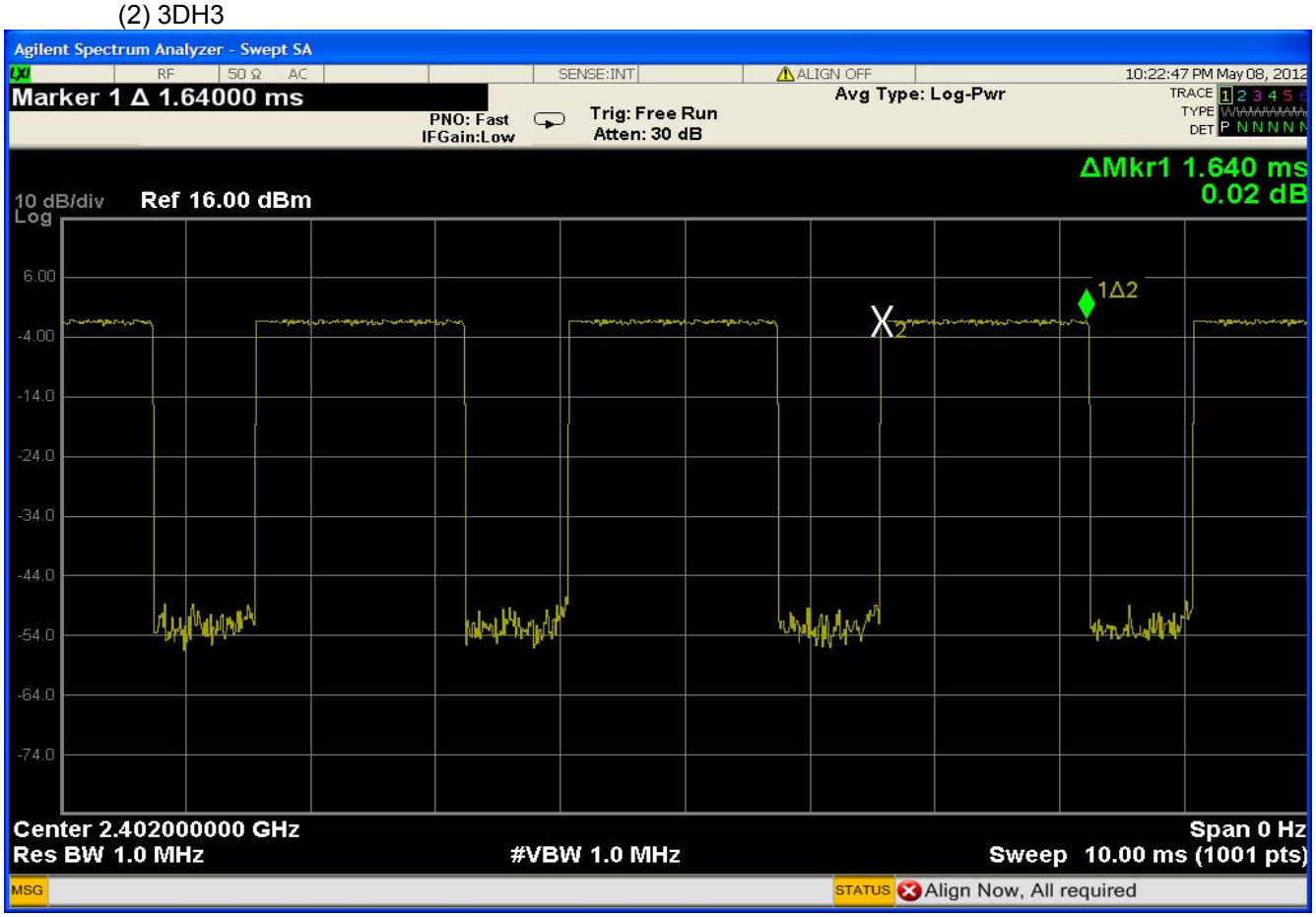
Please refer the graph as below:

1. Lowest channel

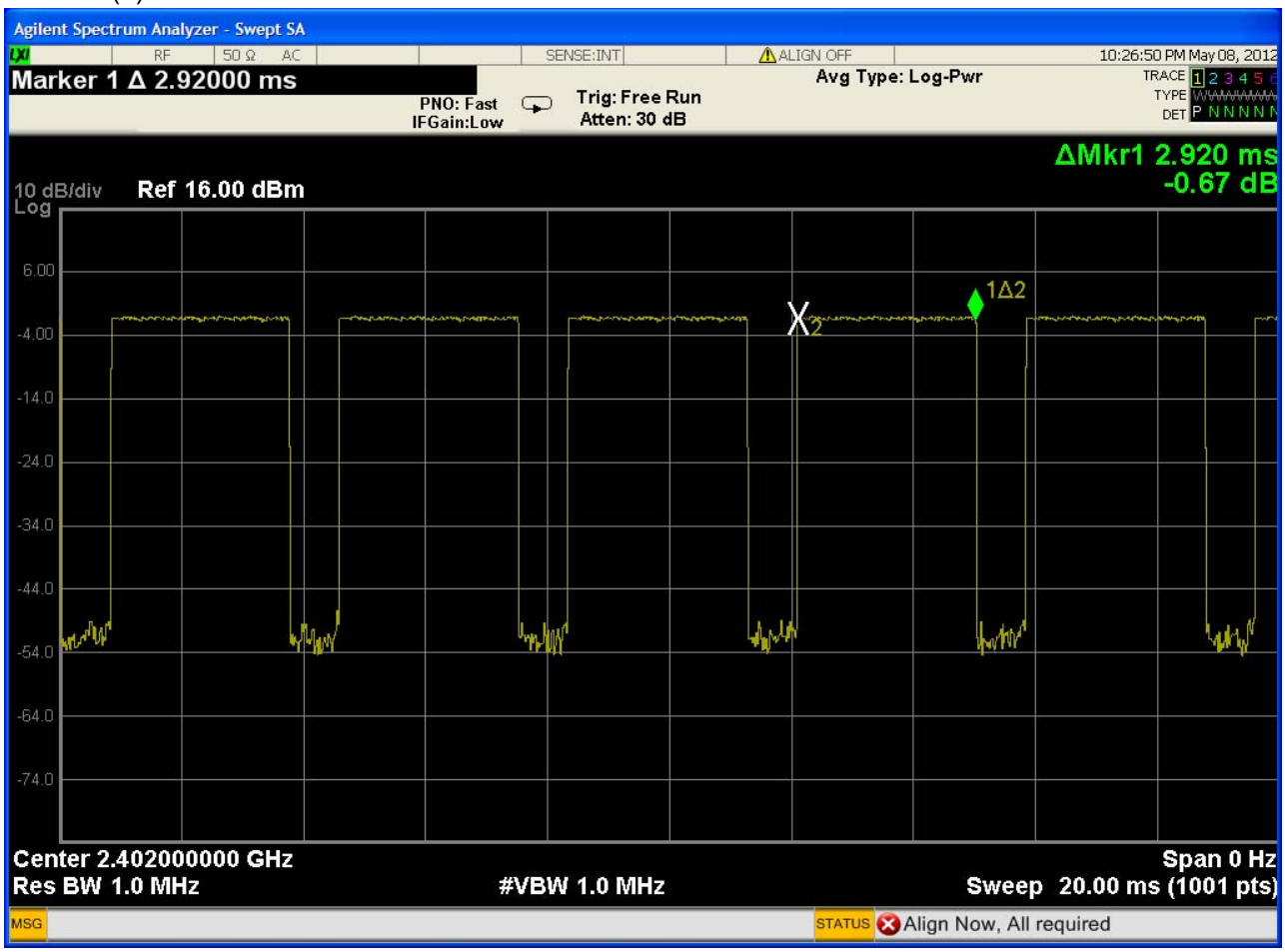
(2.402 GHz): (1). 3DH1



(2) 3DH3

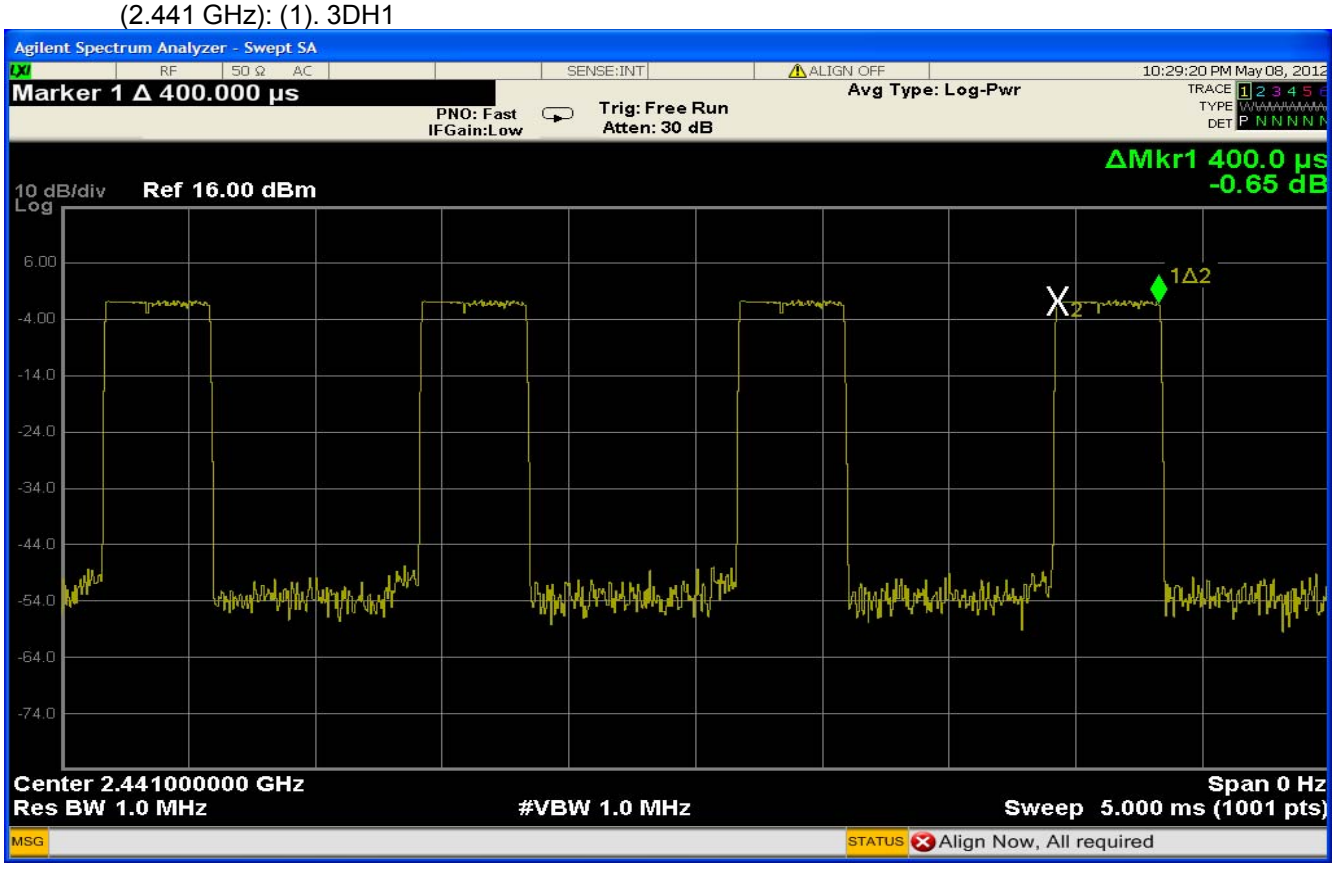


(3) 3DH5

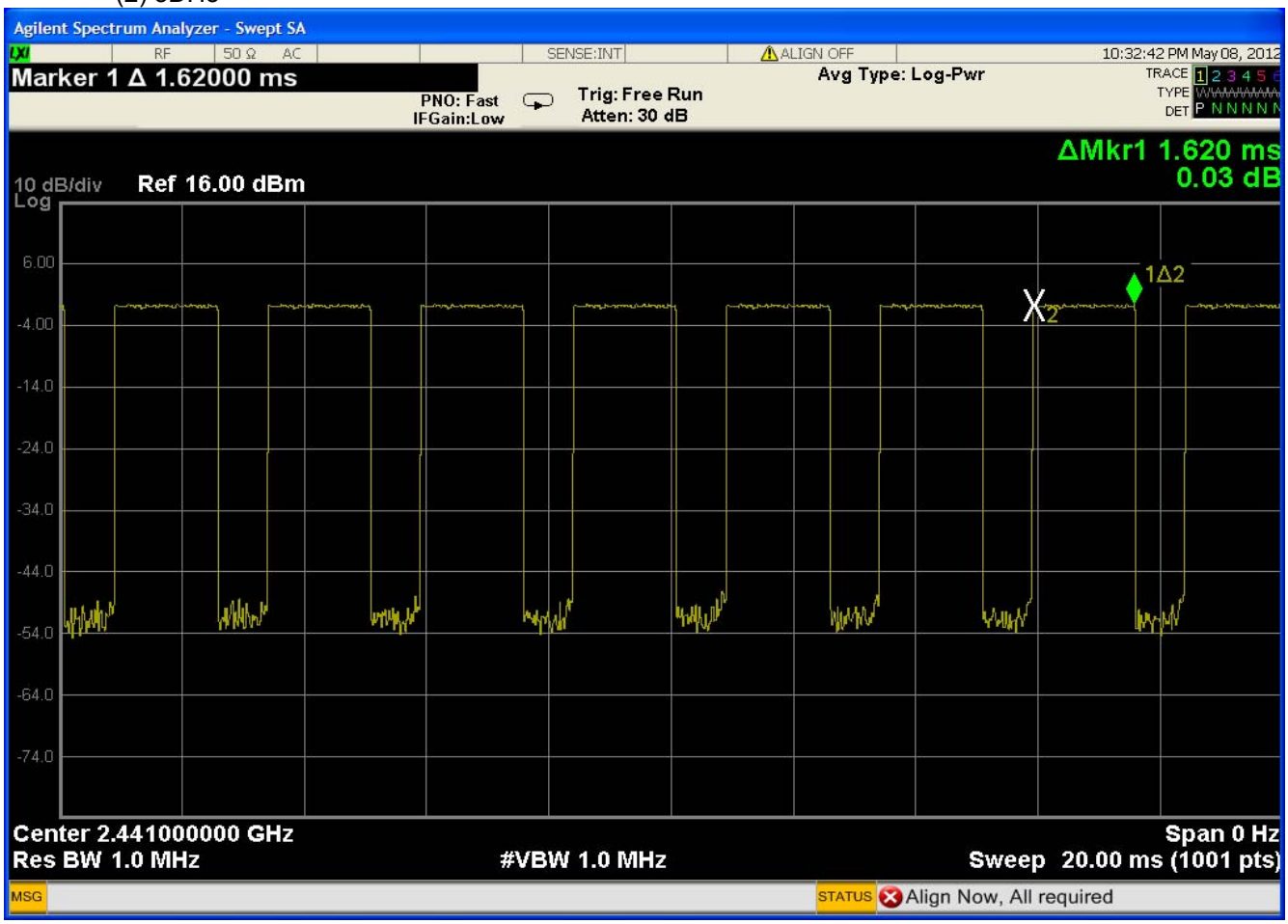


2. Middle channel

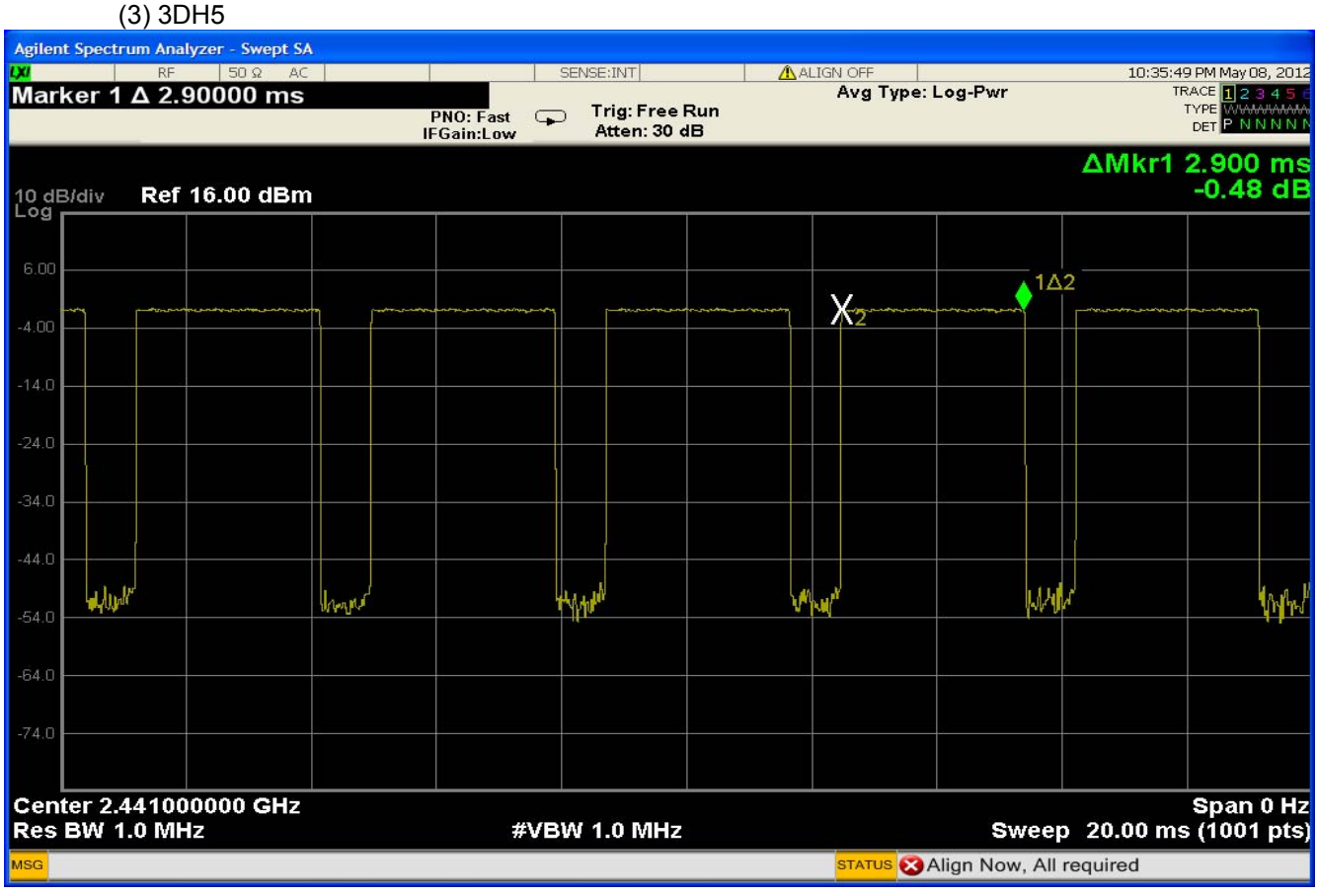
(2.441 GHz): (1). 3DH1



(2) 3DH3

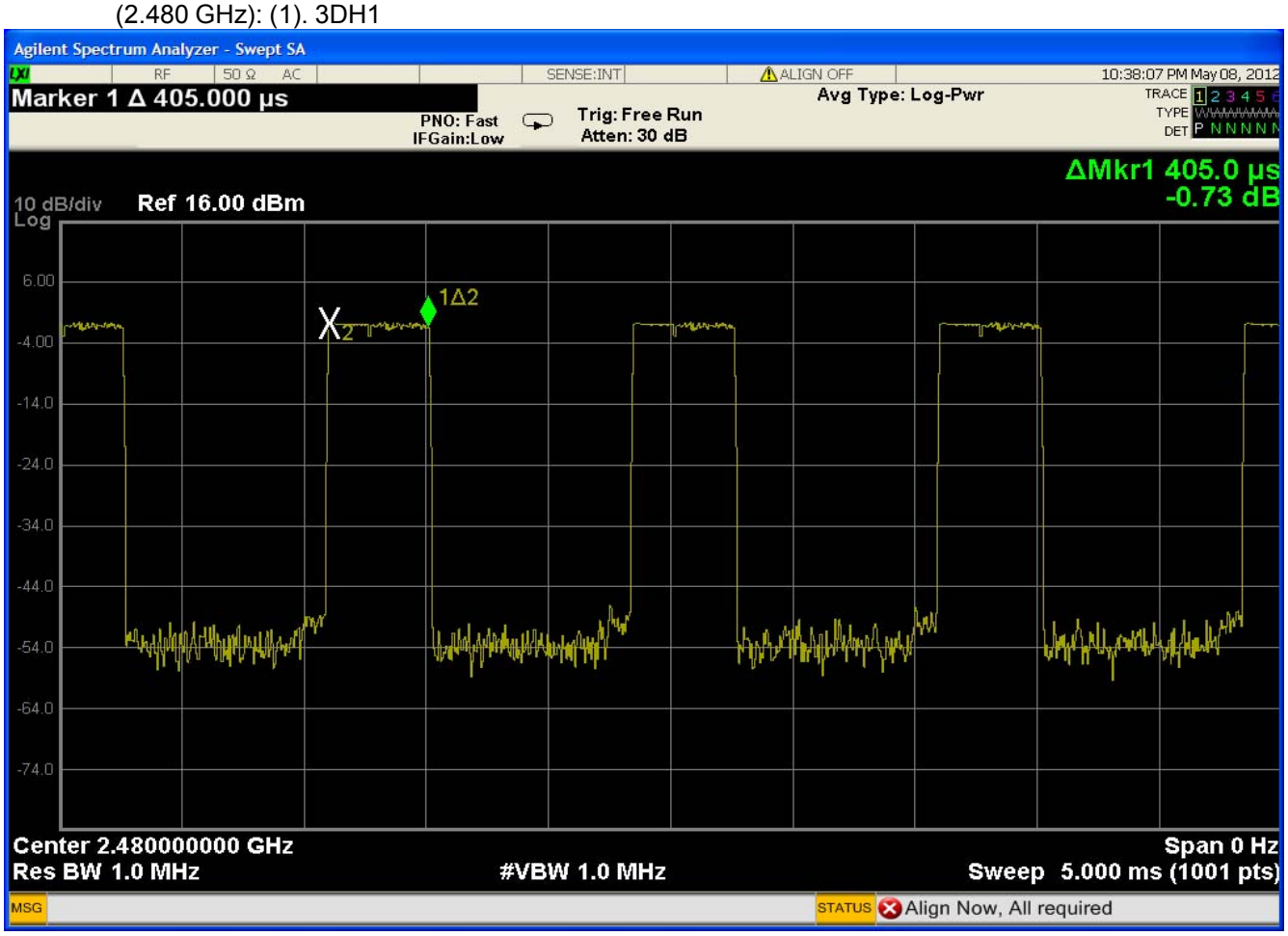

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN OFF
10:32:42 PM May 08, 2012
Marker 1 Δ 1.62000 ms
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE
DET P N N N N N
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
ΔMkr1 1.620 ms
0.03 dB
10 dB/div
Log
Ref 16.00 dBm
6.00
-4.00
-14.0
-24.0
-34.0
-44.0
-54.0
-64.0
-74.0
1Δ2
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 ms (1001 pts)
MSG
STATUS
Align Now, All required

(3) 3DH5

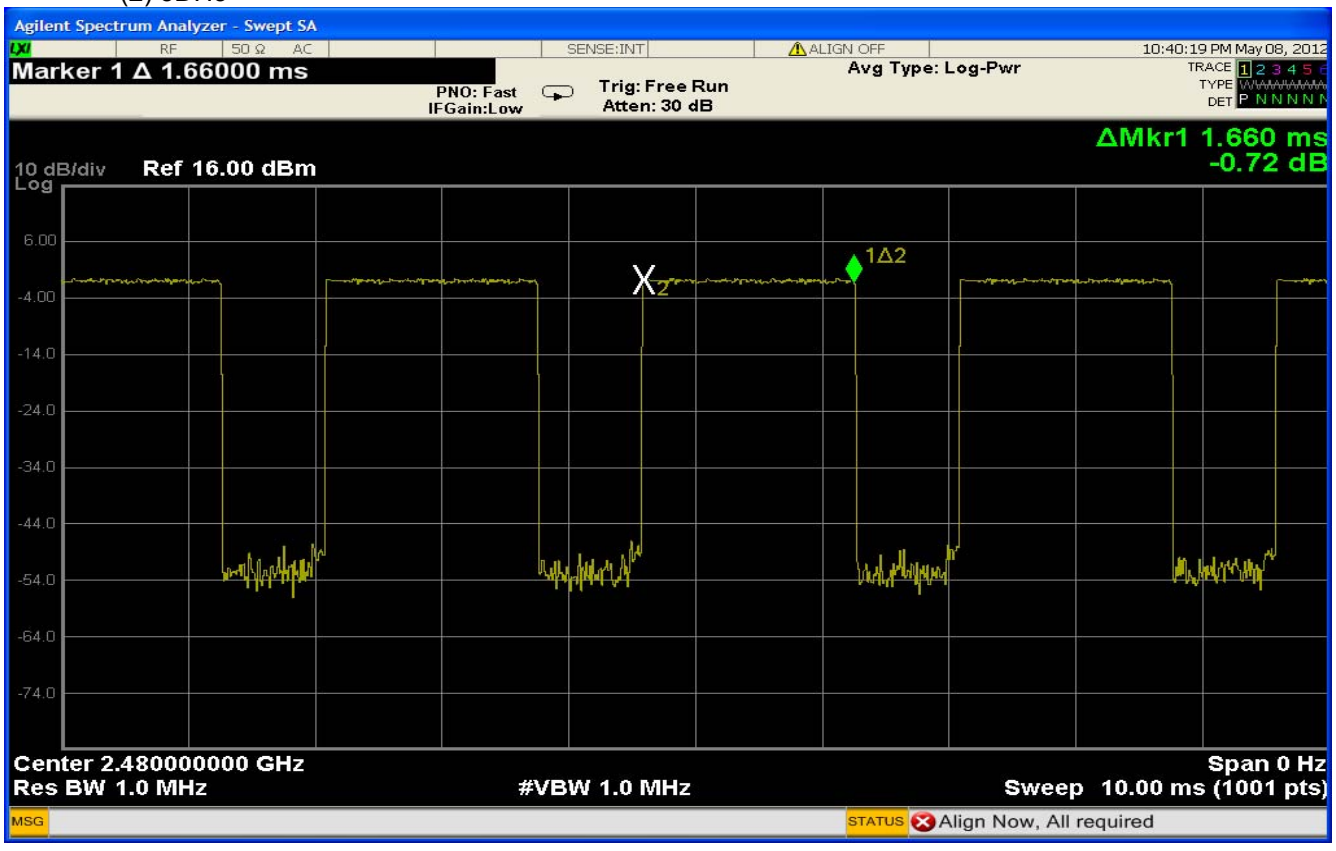

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN OFF
10:35:49 PM May 08, 2012
Marker 1 Δ 2.90000 ms
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE
DET P N N N N N
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
ΔMkr1 2.900 ms
-0.48 dB
10 dB/div
Log
Ref 16.00 dBm
6.00
-4.00
-14.0
-24.0
-34.0
-44.0
-54.0
-64.0
-74.0
1Δ2
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 ms (1001 pts)
MSG
STATUS
Align Now, All required

3. Highest channel

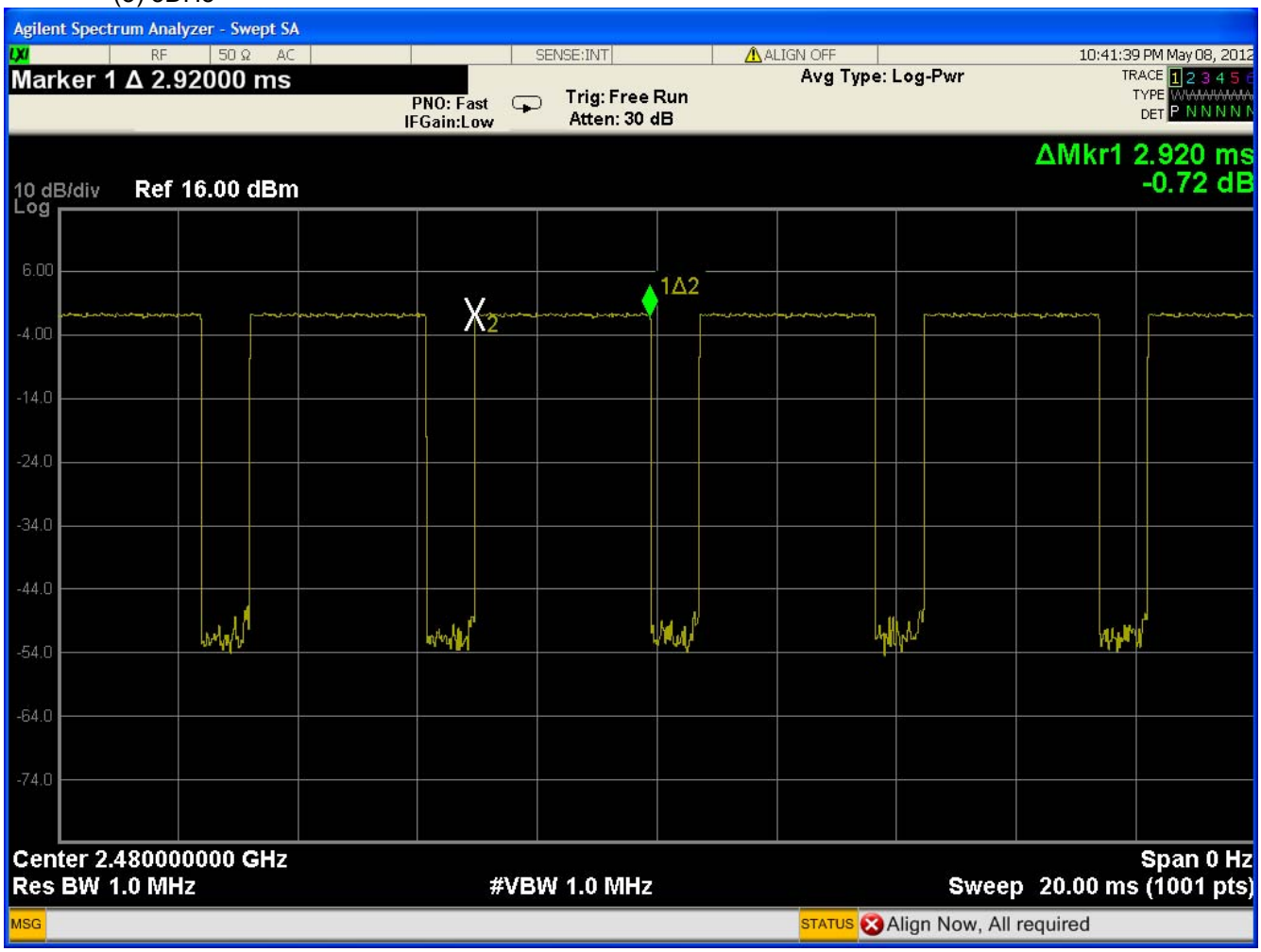
(2.480 GHz): (1). 3DH1



(2) 3DH3



(3) 3DH5


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN OFF
10:41:39 PM May 08, 2012
Marker 1 Δ 2.92000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE
DET P N N N N N
ΔMkr1 2.920 ms
-0.72 dB
10 dB/div
Log
Ref 16.00 dBm
6.00
-4.00
-14.0
-24.0
-34.0
-44.0
-54.0
-64.0
-74.0
1Δ2
X2
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 ms (1001 pts)
MSG
STATUS
Align Now, All required

Remark:

In communication data link mode (expect inquiry or page mode) the hopping rate is 1600 per second, the 79 channels will be randomly selected for RF channel, and each channel have equal probability to be selected. The hop selection scheme is defined in Clause 2.6 of Part B of Volume

2 of core specification of Bluetooth.

The Dwell time must be calculated via following formula:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

Period = 0.4 (seconds/ channel) x 79 (channel) = 31.6 seconds

So

Dwell time DH1= slot time * (1600/2/79) * 31.6

Dwell time DH3= slot time * (1600/4/79) * 31.6

Dwell time DH5= slot time * (1600/6/79) * 31.6

The RF channel will remain fixed for duration of a packet, that means for DH3 packet the RF frequency will remain unchanged during 3 slots (1slot=1/1600=625us), and for DH5 packet the RF frequency will remain unchanged during 5 slots, illustrated the principle as below:

BLUETOOTH SPECIFICATION Version 2.0 + EDR [vol 3] page 85 of 814

Baseband Specification

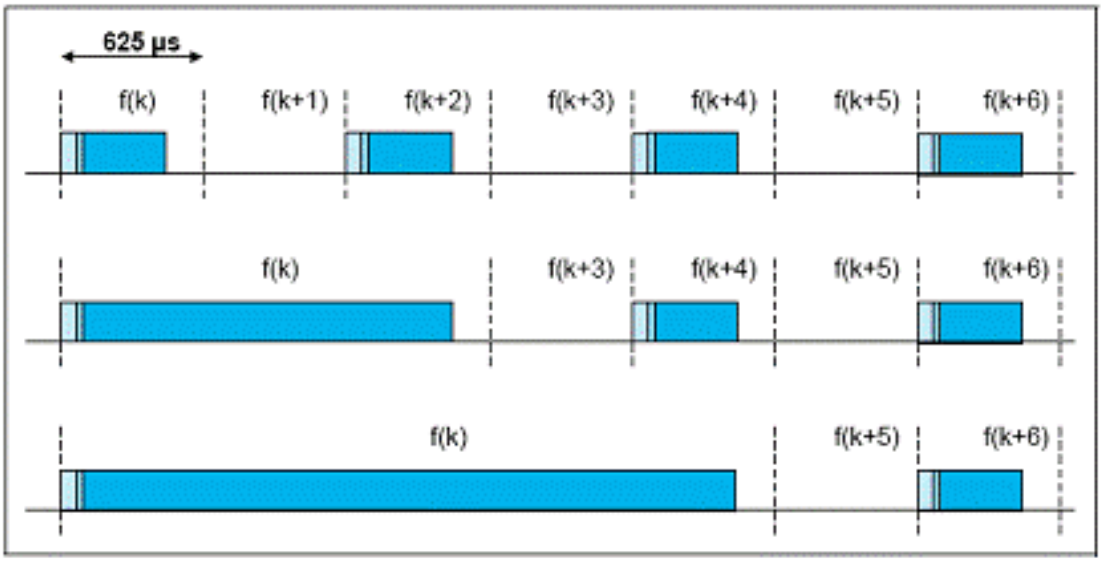


Figure 2.14: Single- and multi-slot packets.

Therefore, in a certain period for different packet types, the quantities of hops (not hopping rate

1600) are different, accurately, the quantity of hops for DH1 is double of DH3's and triple of DH5's. "for DH1 packet, 1 hop in 1 slot; for DH3 packet, ½ hop in 1 slot; for DH5 packet, 1/3 hop in 1 slot.", explained as below:

From the illustrated hopping scheme:

For DH1, in two slots, there are two hops, i.e. f(k) in Slot(k), f(k+1) in Slot(k+1), means DH1 1 hop in 1 slot;

For DH3, in four slots, there are two hops, i.e. f(k) in Slot(k) & Slot(k+1) & Slot(k+2), f(k+3) in
Slot(k+3), means DH3 2 hops in four slots -> ½ hop
in 1 slot;
For DH5, in six slots, there are two hops, i.e. f(k) in Slot(k) & Slot(k+1) & Slot(k+2) & Slot(k+3) & Slot(k+4), f(k+5) in Slot(k+5), means DH3 2 hops in six slots -> 1/3 hop in 1 slot.

The Hopping rate in the formula should not be fixed value, for DH1, it is 1600/2; for DH3, it is 1600/4; for DH5, it is 1600/6.
To calculate Dwell time of data transmission of Bluetooth system, the worst case is for Bluetooth PICONET that contains two devices only (although Bluetooth PICONET can support up to eight devices), and for Bluetooth data transmission, after device A sending a packet to device B, device A must get response packet from device B to continue data transmission;

For DH1 packet: assume device A is EUT, the worst case is after device A sending a DH1 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 1 time slot for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is half of 1600, i.e. 800 hops per second for EUT;

For DH3 packet: assume device A is EUT, the worst case is after device A sending a DH3 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 3 time slots for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is quarter of 1600, i.e. 400 hops per second for EUT;

For DH5 packet: assume device A is EUT, the worst case is after device A sending a DH5 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 5 time slots for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is sixth of 1600, i.e. 1600/6=266.7 hops per second for EUT;

3.7 Pseudorandom Frequency Hopping Sequence

Standard requirement

15.247(a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively. Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

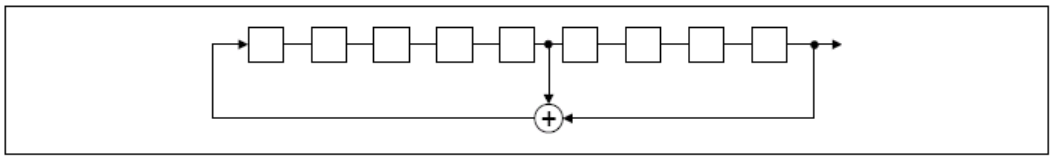
EUT Pseudorandom Frequency Hopping Sequence

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9^{th} stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

• Number of shift register stages: 9

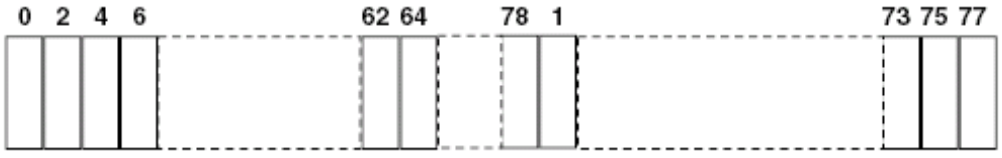
• Length of pseudo-random sequence: 29 -1 = 511 bits

• Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

3.8 Maximum Peak Output Power

Test Requirement: FCC Part 15 C 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.

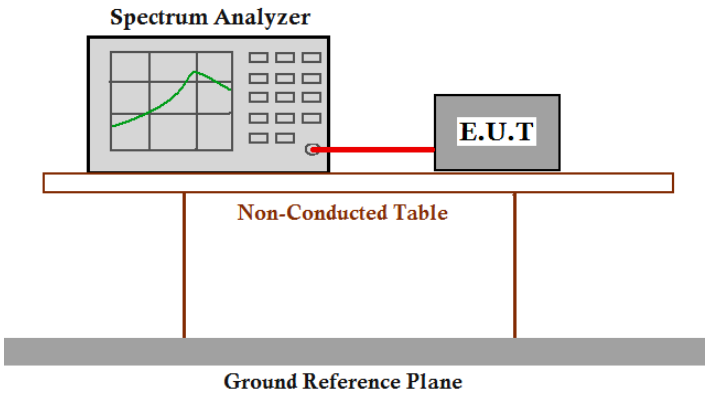
Refer to the result “Hopping channel number” of this document. The 1 watt (30.0 dBm) limit applies.

Test Method: ANSI C63.10: Clause 6.10 & DA 00-705

Test Limit:

Test mode: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2 MHz. VBW = 2 MHz. Sweep = auto; Detector Function =Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Result:

Normal mode:

Test Channel	Fundamental Frequency (MHz)	Reading value Output Power(dBm)	cable lose	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	-0.059	2.8	2.741	30.0	Pass
Middle	2441	0.197	2.8	2.997	30.0	Pass
Highest	2480	0.249	2.8	3.049	30.0	Pass

EDR mode:

Test Channel	Fundamental Frequency (MHz)	Reading value Output Power(dBm)	cable lose	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	-0.607	2.8	2.193	30.0	Pass
Middle	2441	-0.252	2.8	2.548	30.0	Pass
Highest	2480	-0.213	2.8	2.587	30.0	Pass

Remark:

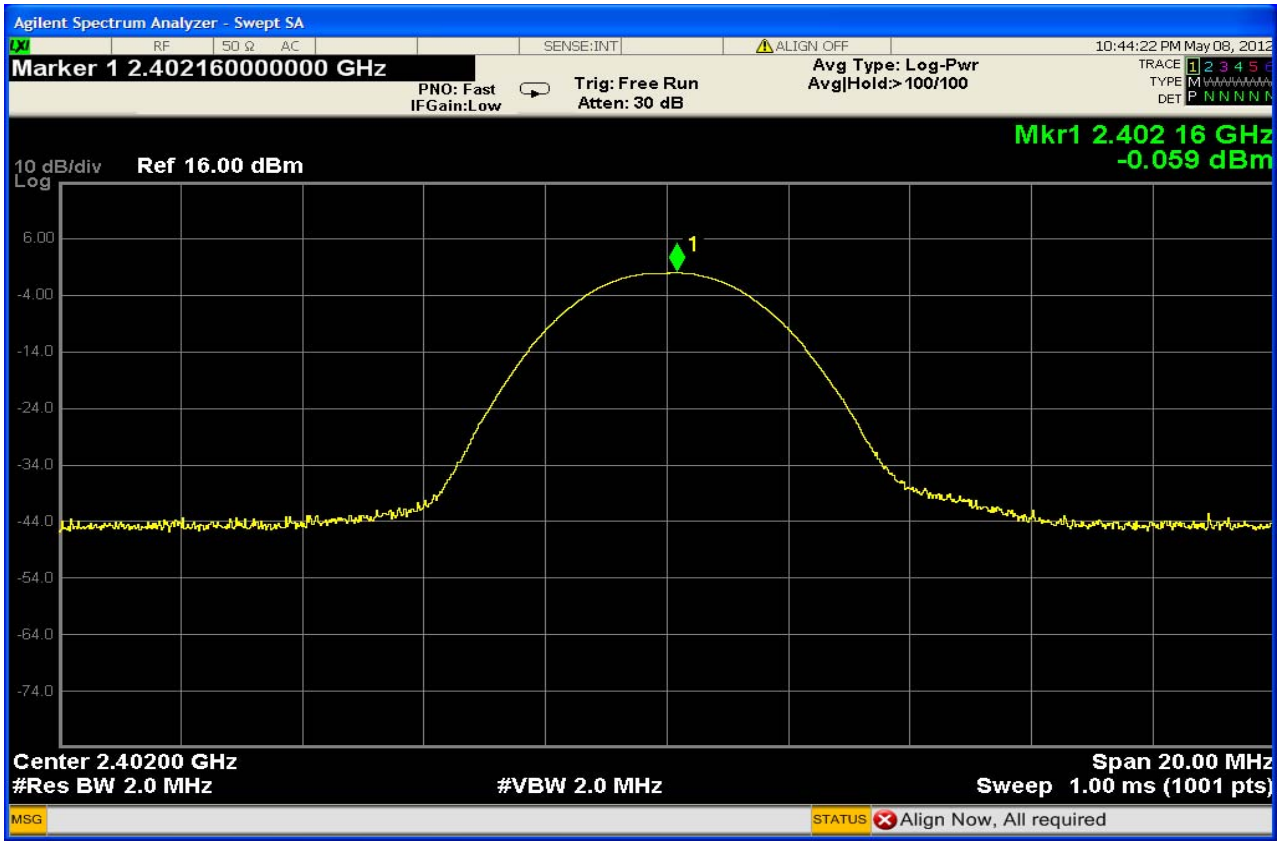
cable lose=2.8dB

Test result: The unit does meet the FCC requirements.

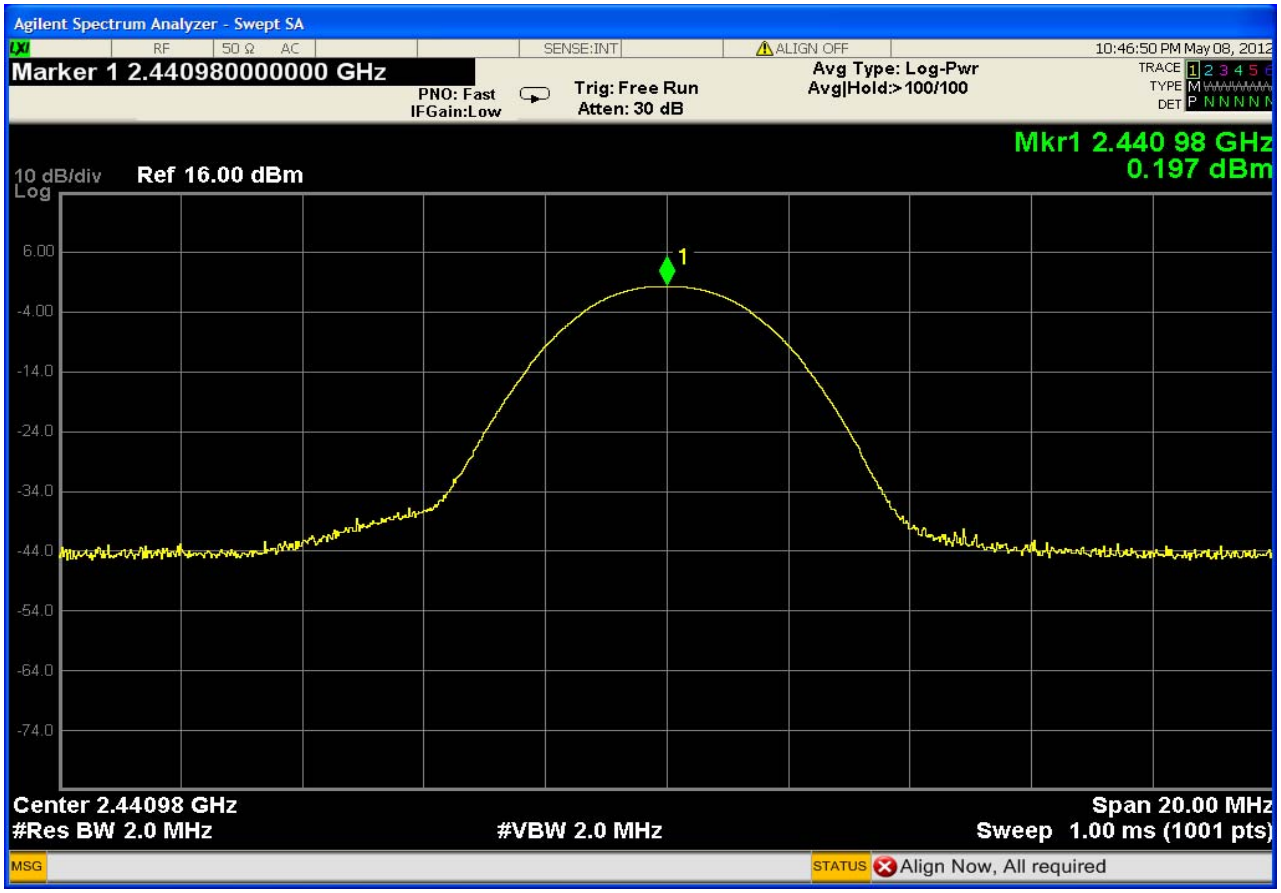
Test result plot as follows:

Normal mode:

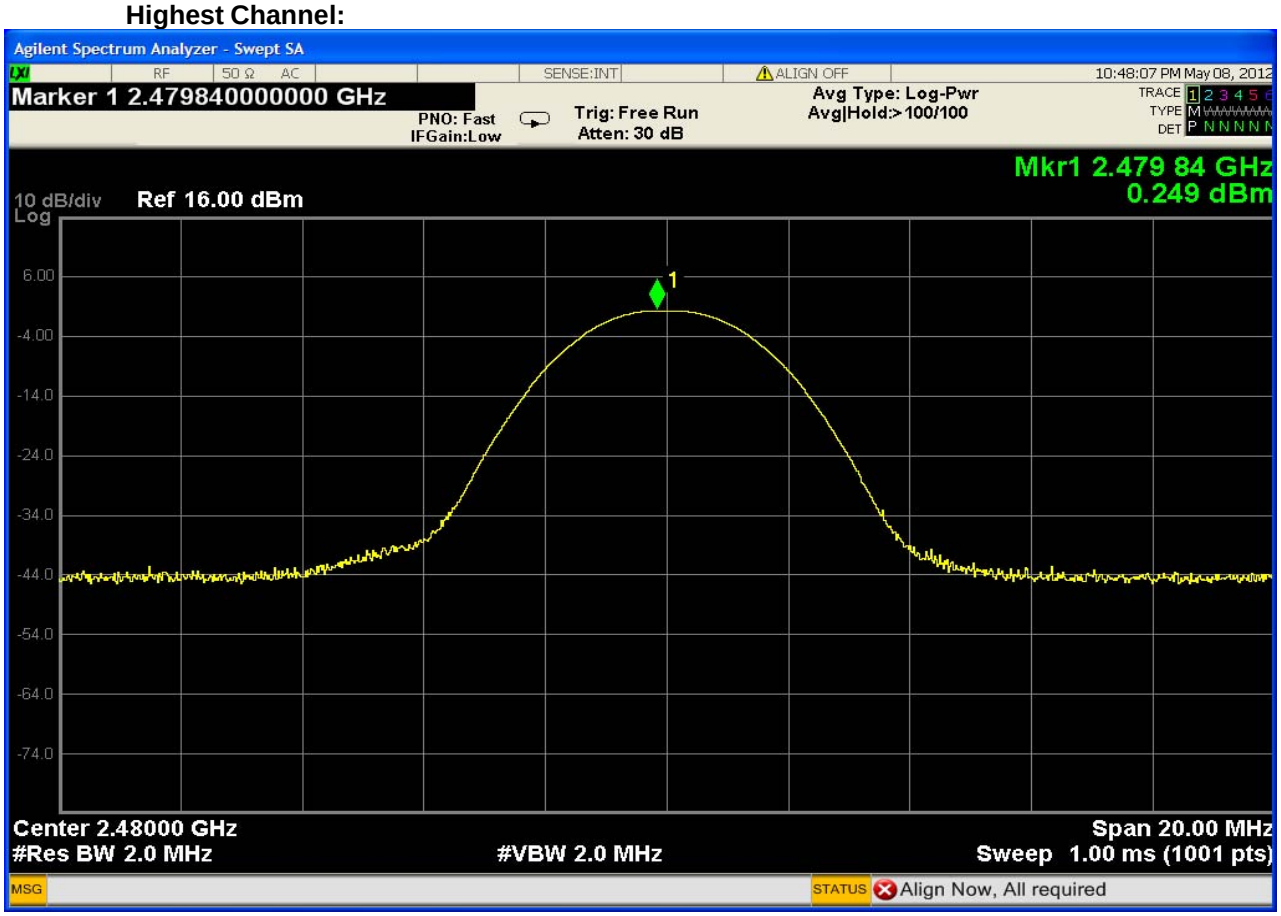
Lowest Channel:



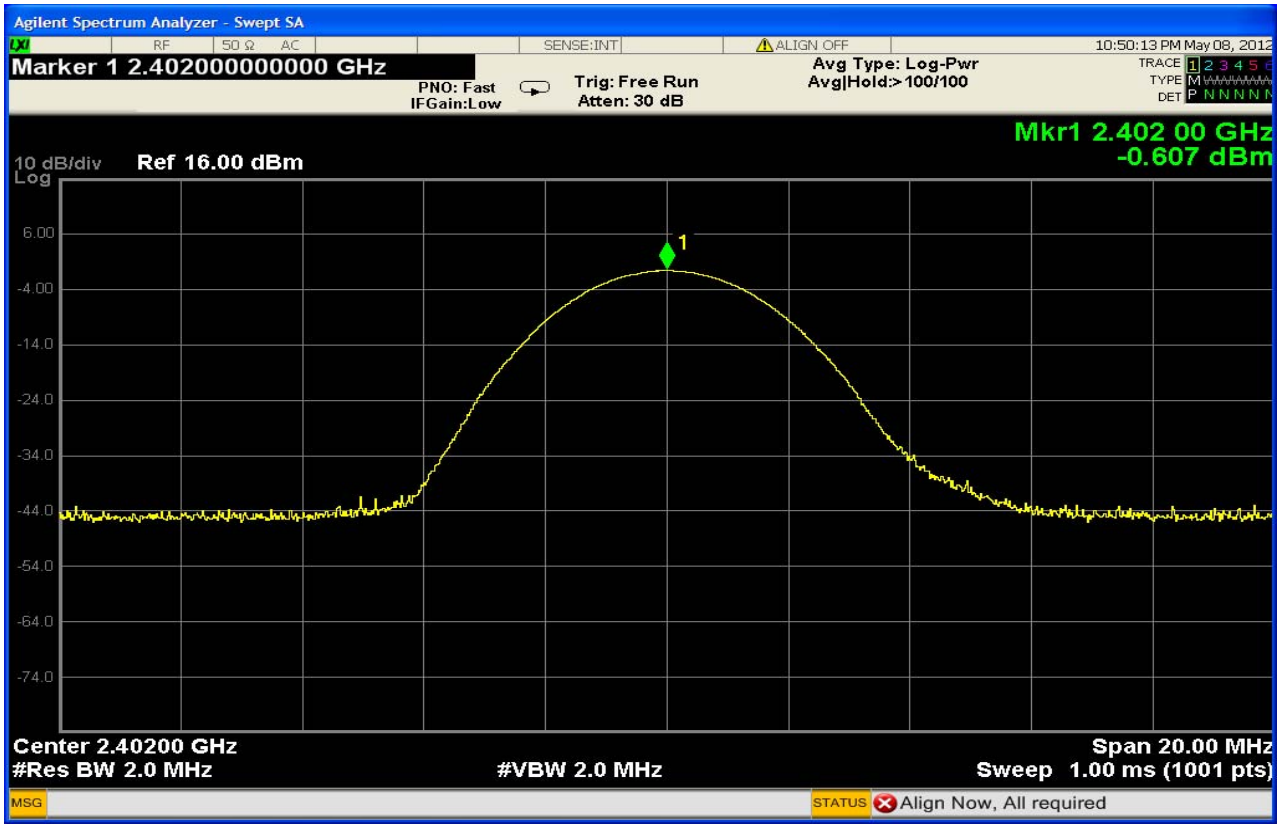
Middle Channel:



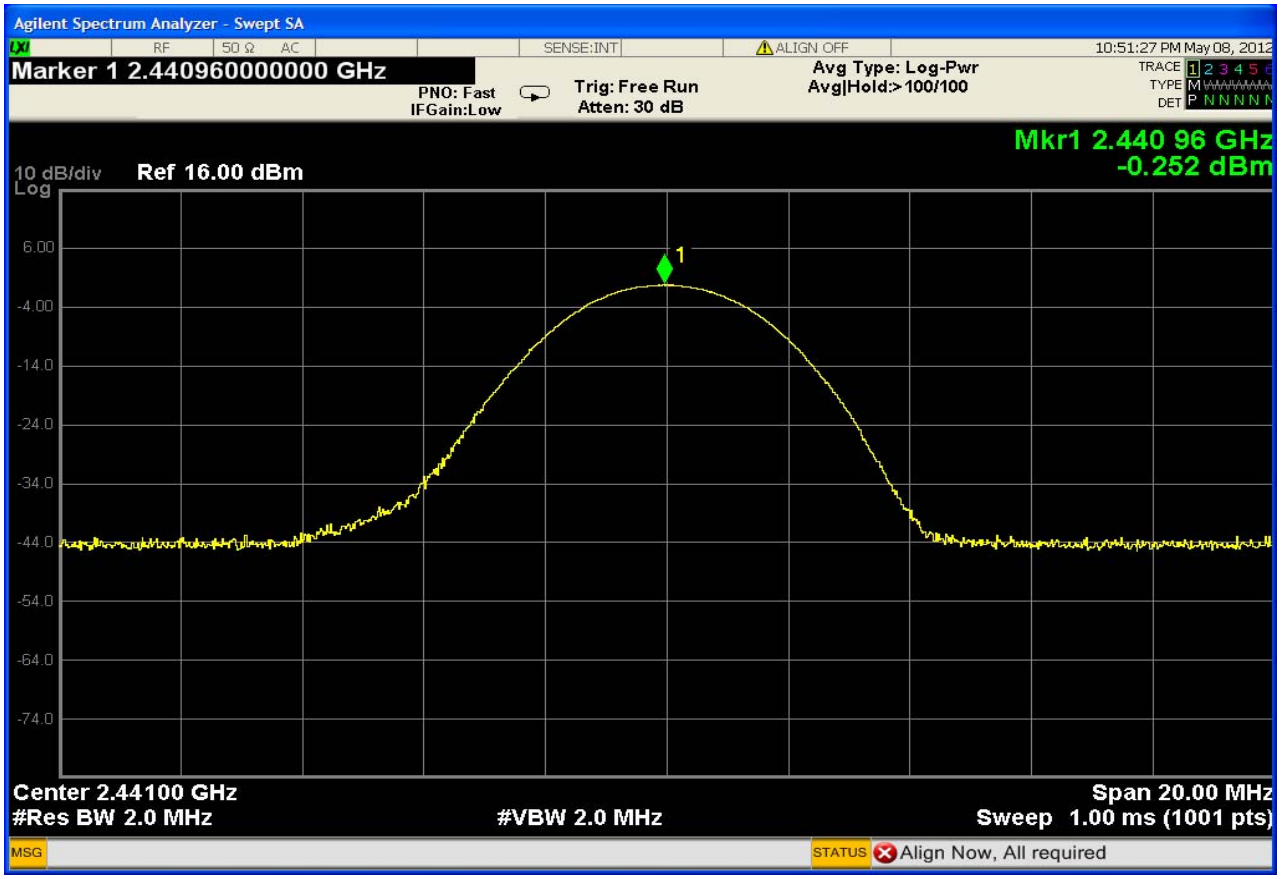
Highest Channel:



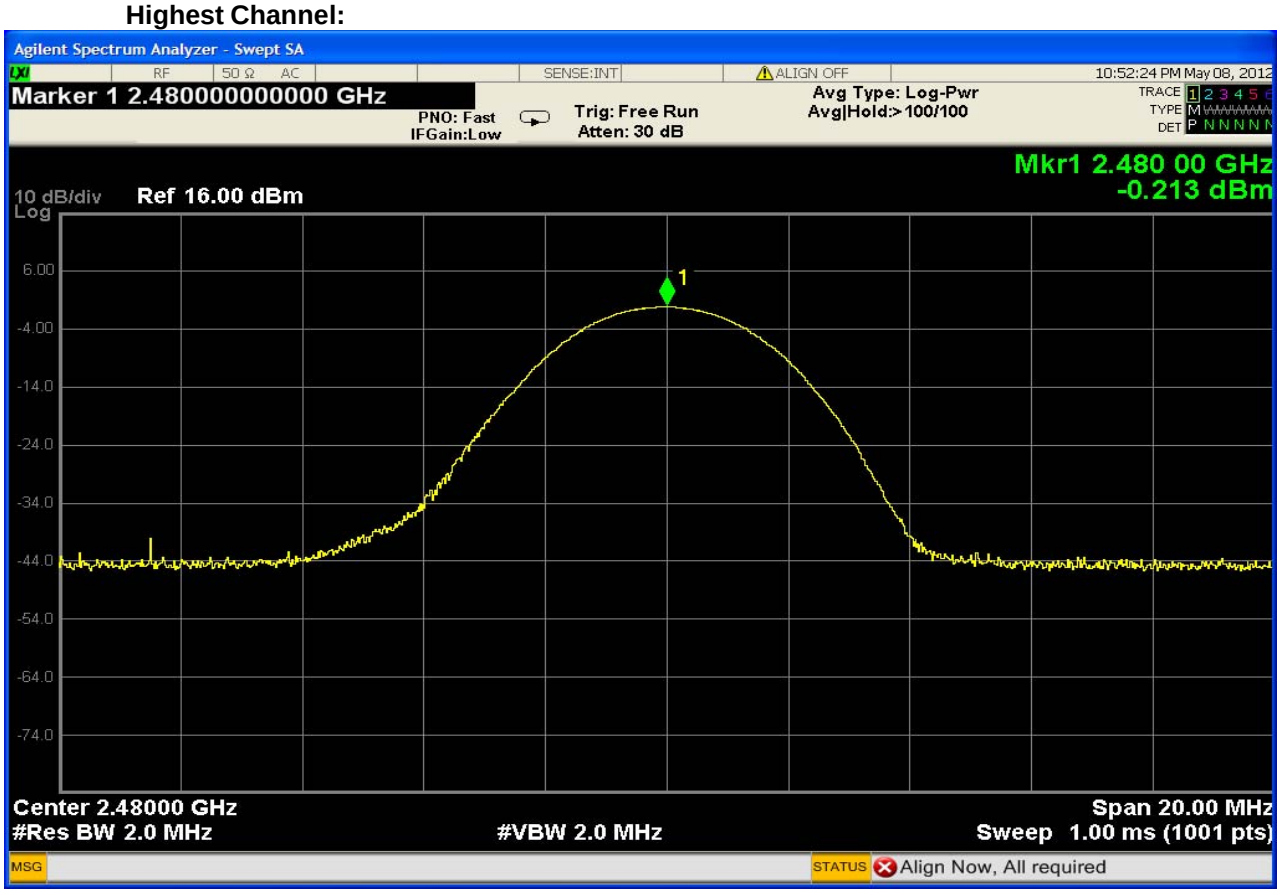
EDR mode: Lowest Channel:



Middle Channel:



Highest Channel:



3.9 Conducted Spurious Emissions

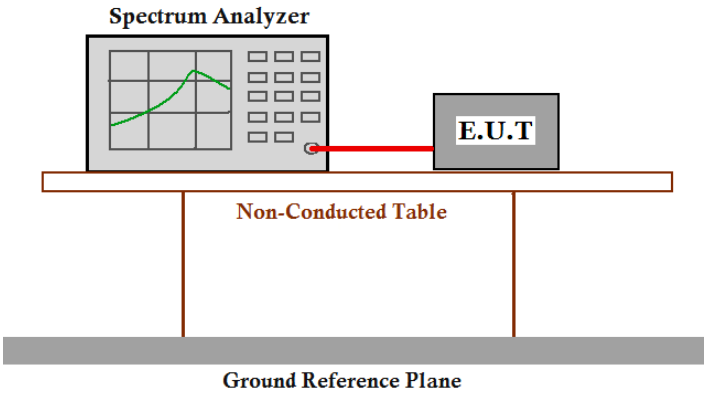
Test Requirement: FCC Part15 C section 15.247

(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 conducted or radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method: ANSI C63.10: Clause 6.7 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Test Configuration:



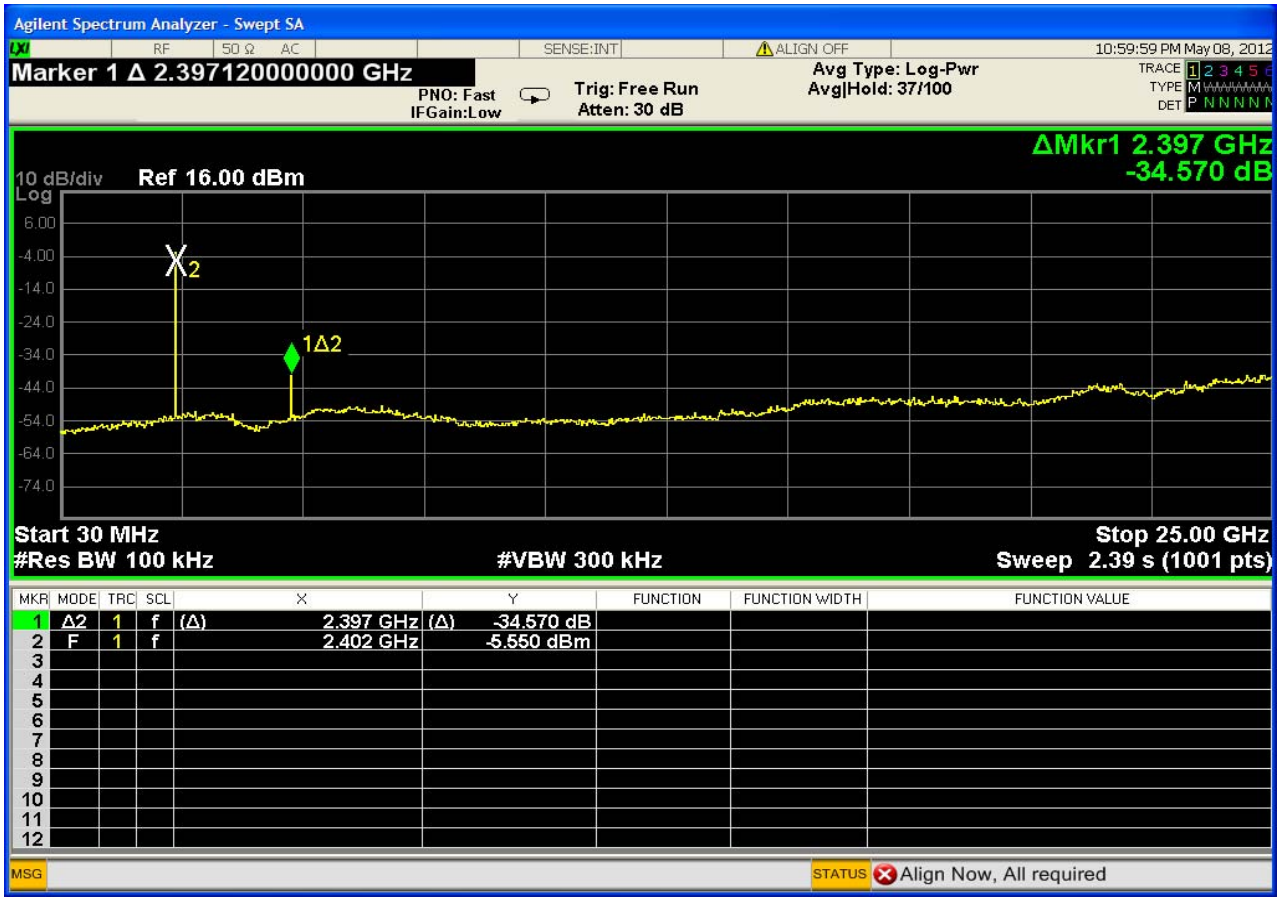
Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

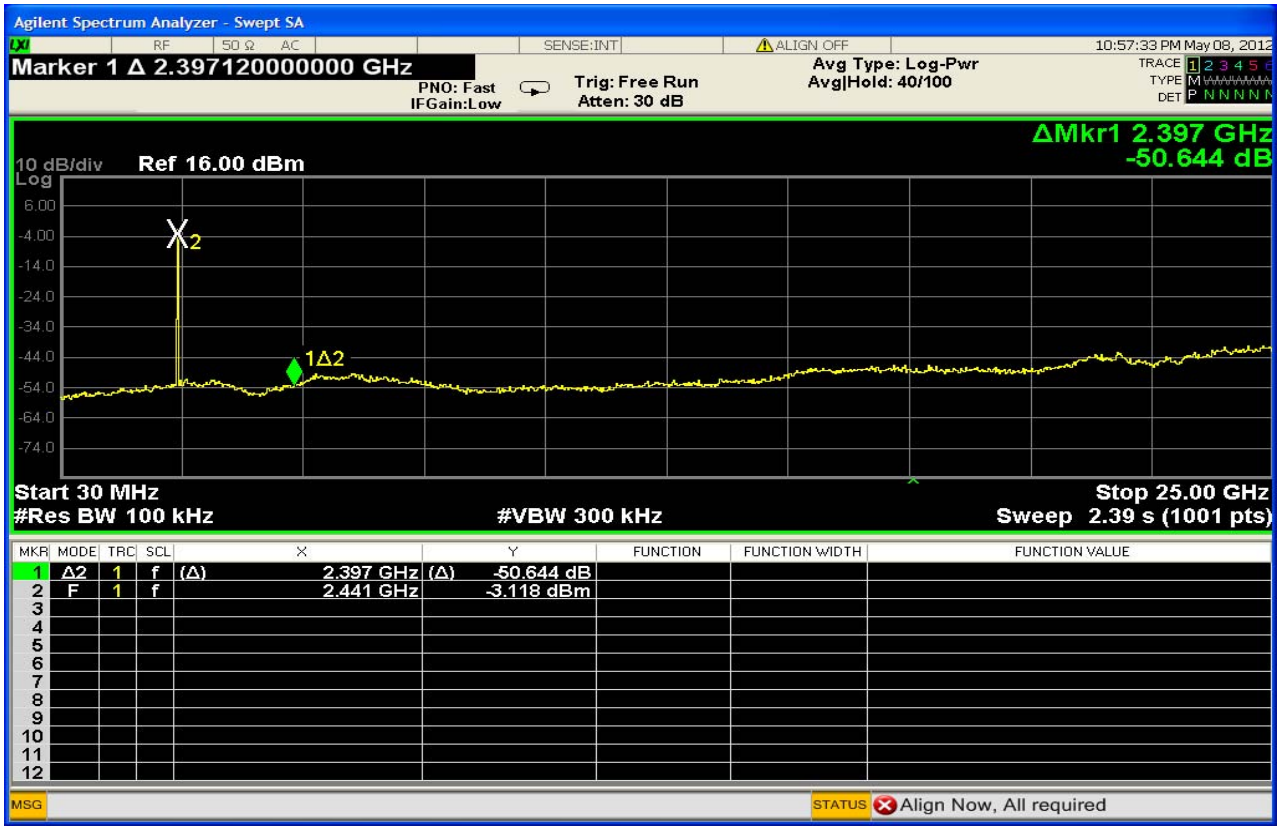
2. Set the spectrum analyzer: RBW = 100 kHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

Test result plot as follows:

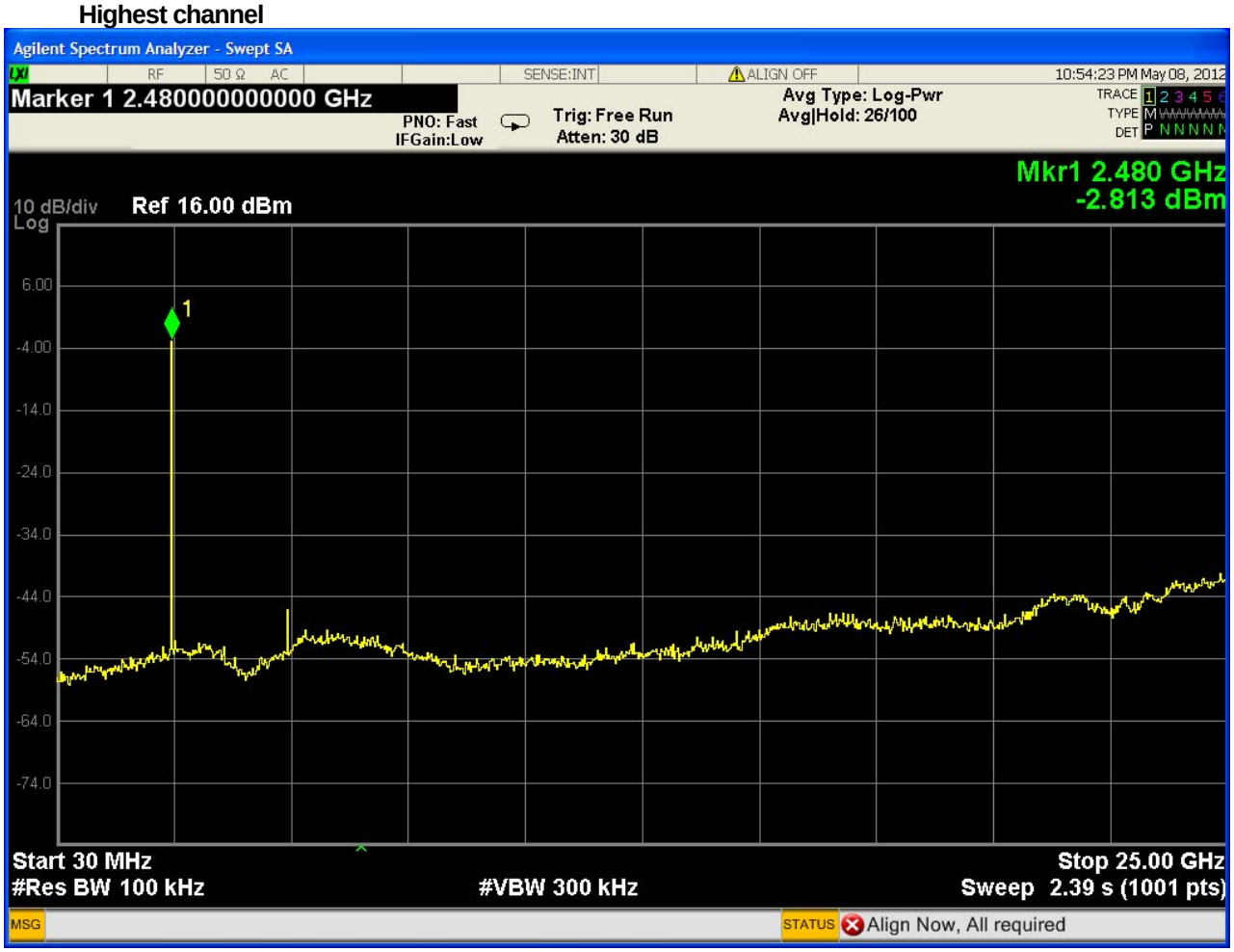
Lowest Channel:



Middle Channel



Highest channel



3.10 Radiated Spurious Emissions

Test Requirement: FCC Part15 C 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 conducted or a radiated measurement, and provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method: ANSI C63.10: Clause 6.4, 6.5 and 6.6 & DA 00-705

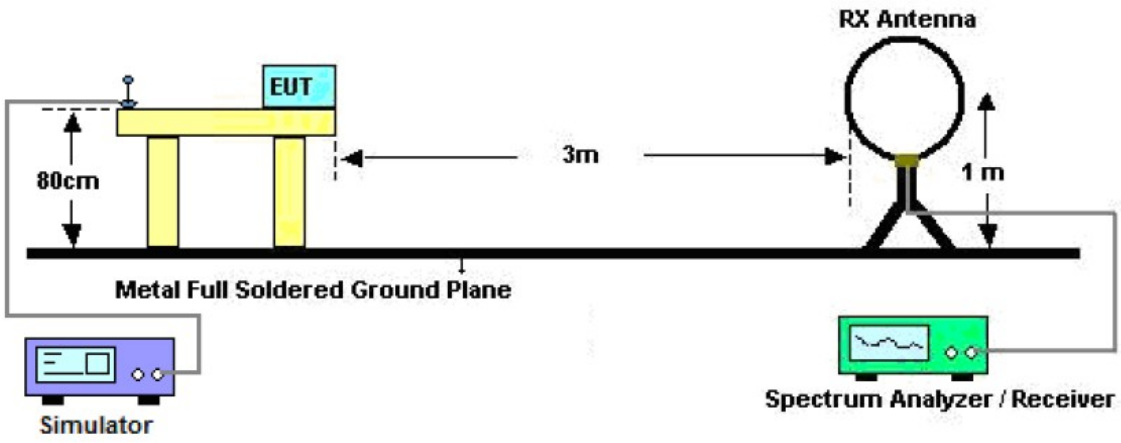
Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Detector: For PK value:
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9kHz for <30MHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
For AV value:
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9kHz for <30MHz
VBW =10 Hz
Sweep = auto
Detector function = peak
Trace = max hold

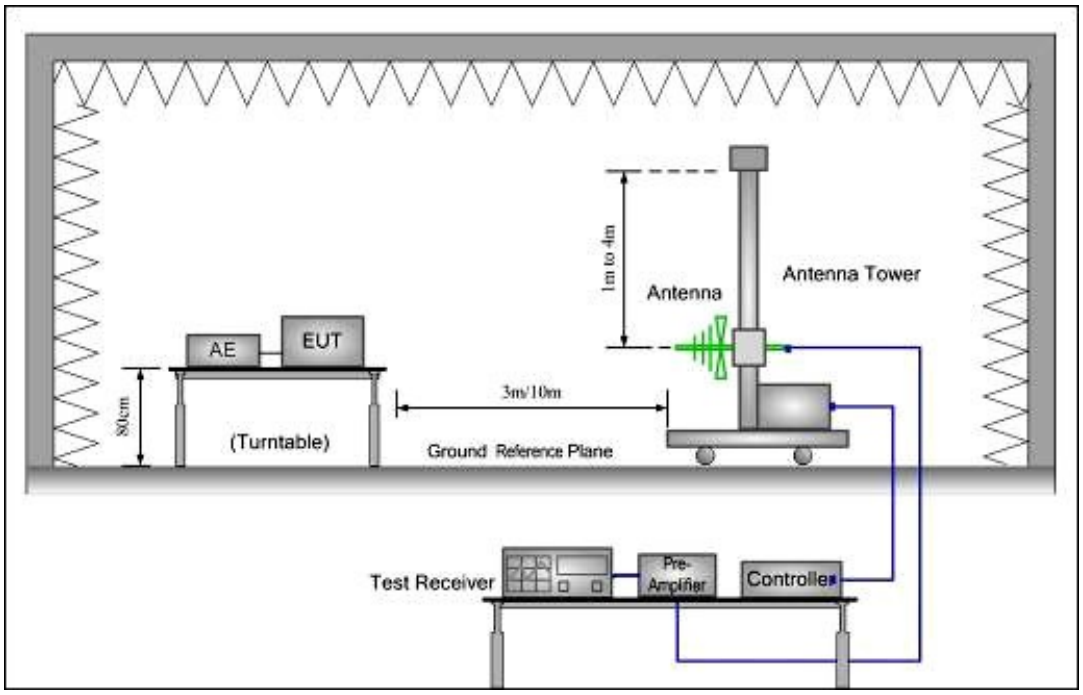
15.209 Limit: 40.0 dBμV/m between 30MHz & 88MHz
43.5 dBμV/m between 88MHz & 216MHz
46.0 dBμV/m between 216MHz & 960MHz
54.0 dBμV/m above 960MHz

Test Configuration:

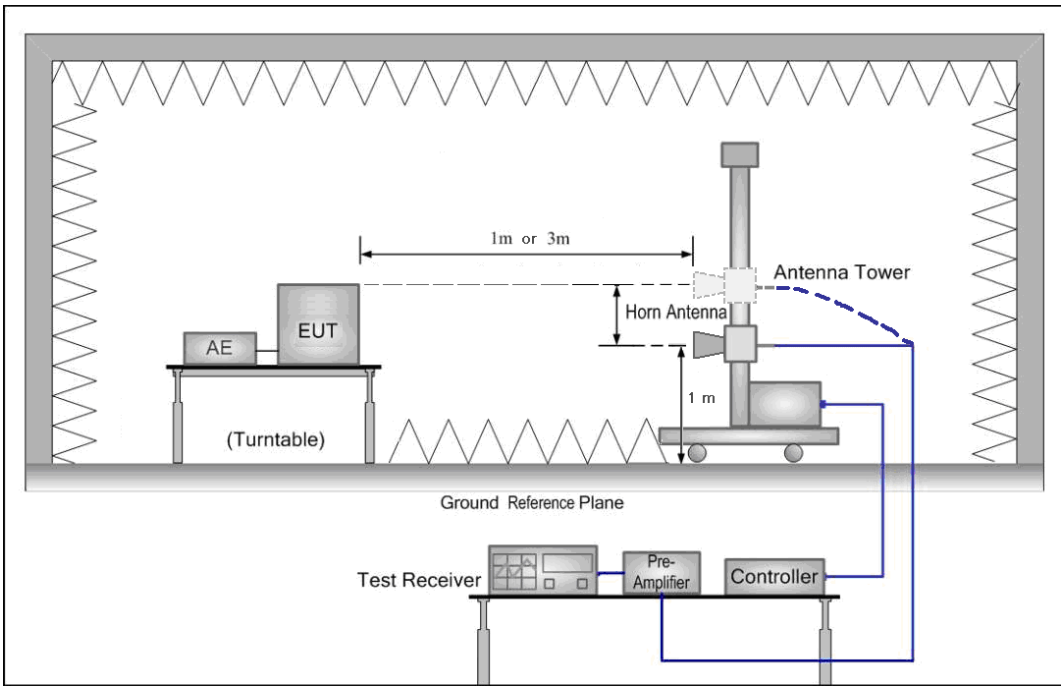
1) 9kHz to 30MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure: The procedure used was ANSI Standard C63.4:2003. The receiver was scanned from 30MHz to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Harmonic and other spurious emissions

Test at low Channel in transmitting status

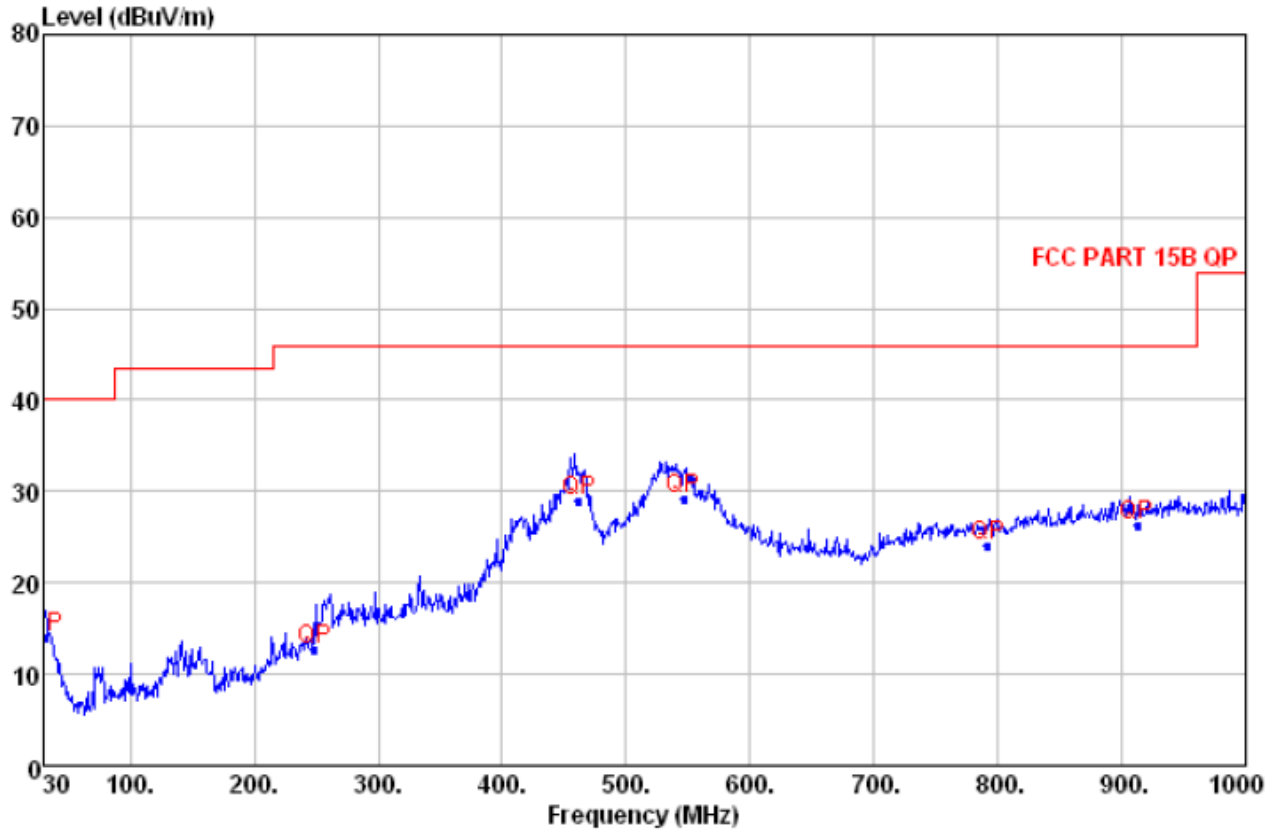
9kHz~30MHz Test result

The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan



No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	32.330	13.96	QP	16.60	0.65	40.00	-26.04	150	302
2	248.300	12.73	QP	11.60	1.92	46.00	-33.27	150	300
3	462.300	29.07	QP	17.46	2.66	46.00	-16.93	100	296
4	546.200	29.27	QP	19.61	2.91	46.00	-16.73	150	301
5	792.180	23.99	QP	22.52	3.55	46.00	-22.01	200	298
6	912.600	26.36	QP	23.78	3.82	46.00	-19.64	200	302

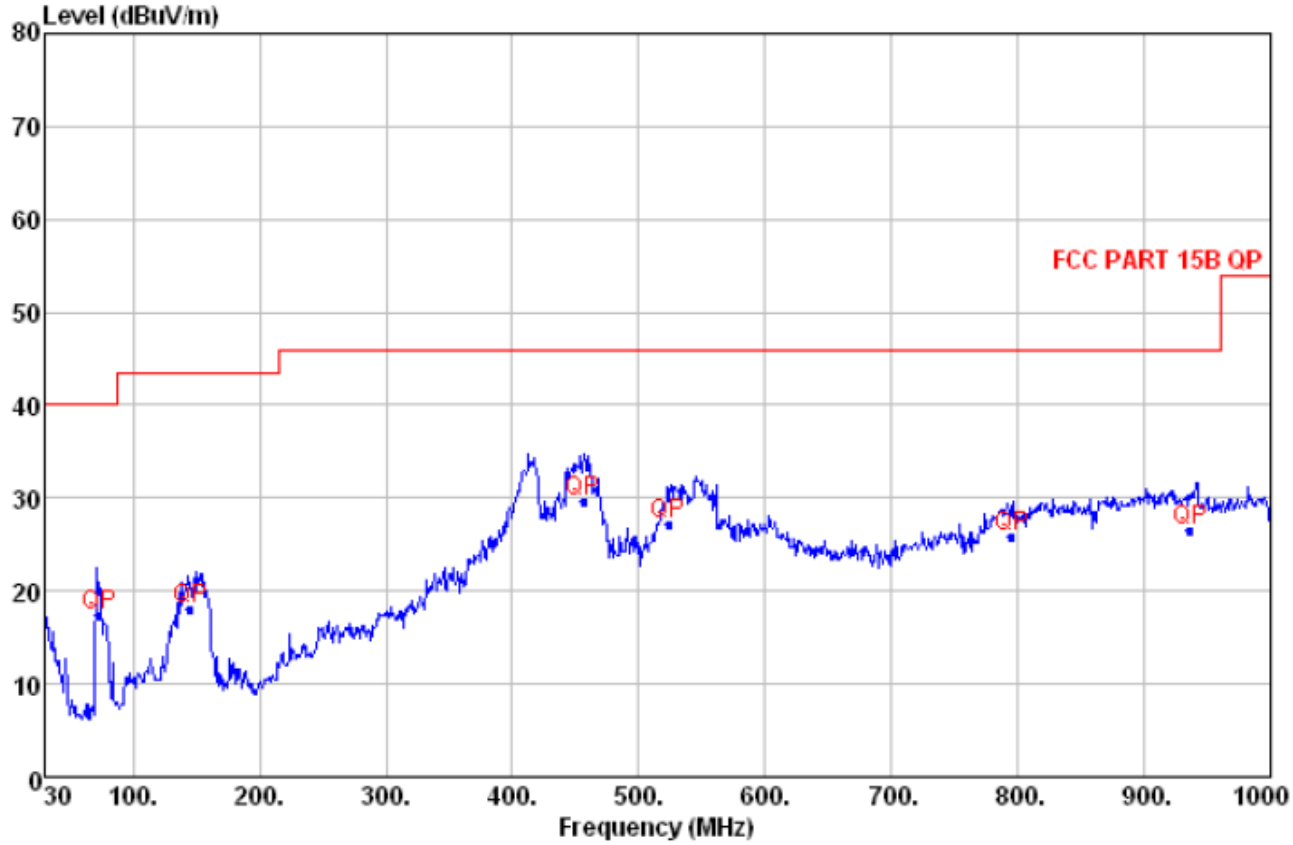
Level=Read Level + Antenna Factor + Cable Loss

Test at low Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan



No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	73.200	17.46	QP	7.26	1.00	40.00	-22.54	100	302
2	145.200	18.05	QP	7.39	1.44	43.50	-25.45	100	319
3	456.300	29.70	QP	17.12	2.64	46.00	-16.30	150	296
4	523.600	27.27	QP	19.09	2.84	46.00	-18.73	200	309
5	795.300	25.81	QP	22.55	3.55	46.00	-20.19	100	326
6	936.000	26.61	QP	24.12	3.88	46.00	-19.39	150	316

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.000	31.53	6.20	33.48	59.61	63.86	74.00	V
7206.000	36.47	7.20	32.76	49.21	60.12	74.00	V
9608.000	38.08	8.56	34.08	48.22	60.78	74.00	V
4804.000	31.53	6.20	33.48	59.45	63.7	74.00	H
7206.000	36.47	7.20	32.76	48.28	59.19	74.00	H
9608.000	38.08	8.56	34.08	48.43	60.99	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.000	31.53	6.20	33.48	44.61	48.86	54.00	V
7206.000	36.47	7.20	32.76	39.18	50.09	54.00	V
9608.000	38.08	8.56	34.08	36.23	48.79	54.00	V
4804.000	31.53	6.20	33.48	43.79	48.04	54.00	H
7206.000	36.47	7.20	32.76	38.75	49.66	54.00	H
9608.000	38.08	8.56	34.08	36.86	49.42	54.00	H

Test at Middle Channel in transmitting status

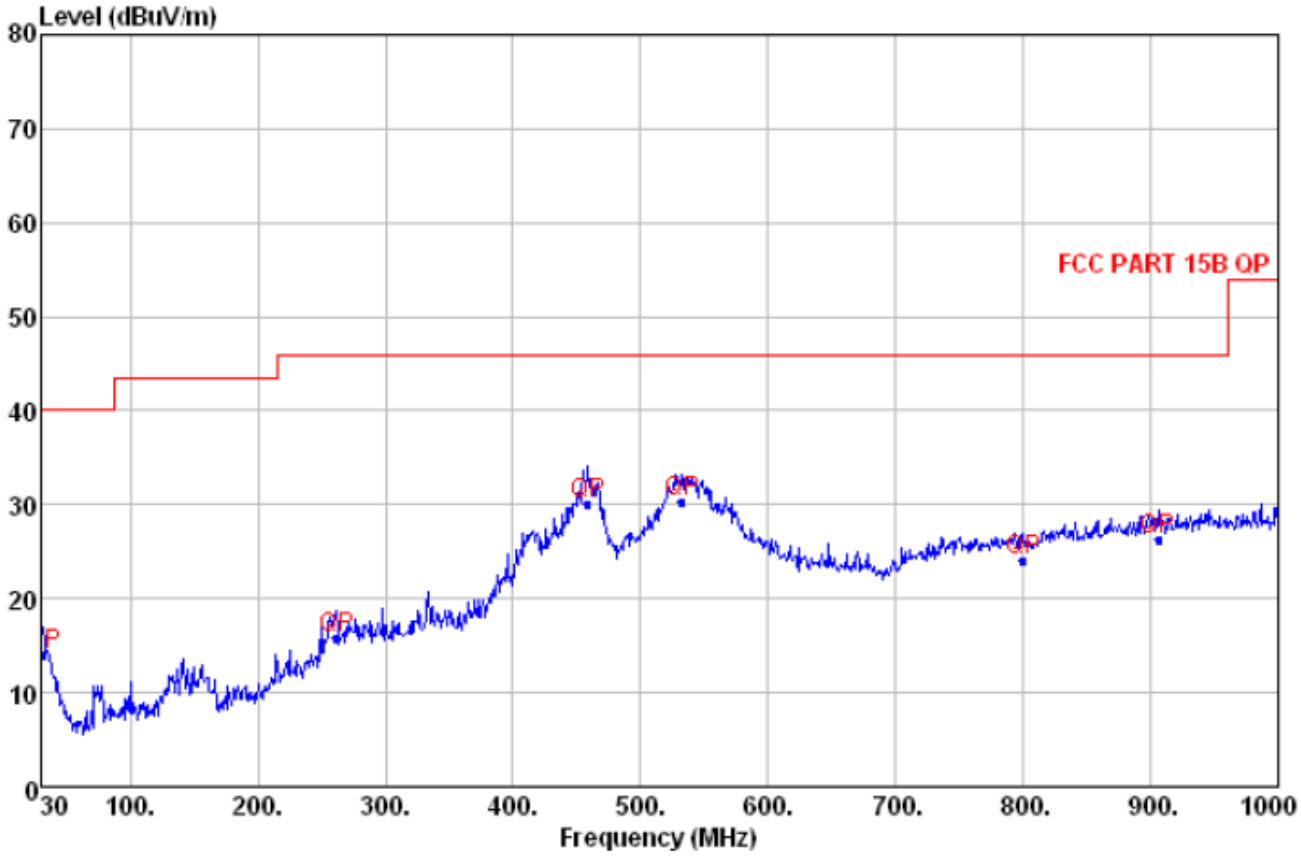
9kHz~30MHz Test result

The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan



No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	31.940	13.96	QP	16.83	0.65	40.00	-26.04	150	302
2	261.830	15.73	QP	12.46	1.98	46.00	-30.27	150	300
3	458.740	30.07	QP	17.24	2.65	46.00	-15.93	100	296
4	532.460	30.27	QP	19.53	2.87	46.00	-15.73	150	301
5	800.180	23.99	QP	22.60	3.57	46.00	-22.01	200	298
6	905.910	26.36	QP	23.72	3.81	46.00	-19.64	200	302

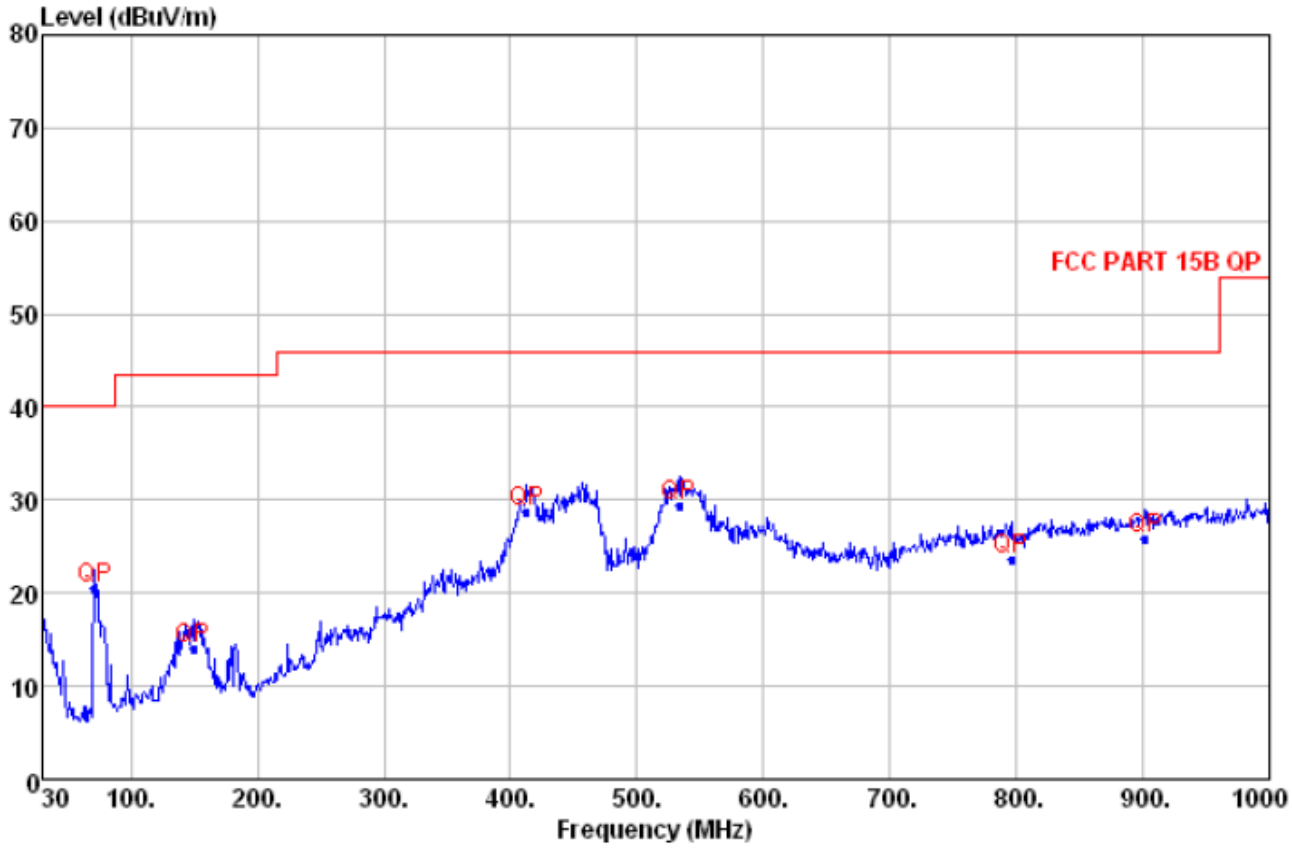
Level=Read Level + Antenna Factor + Cable Loss

Test at Middle Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan



No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	71.710	20.46	QP	7.14	0.99	40.00	-19.54	150	332
2	149.310	14.05	QP	7.14	1.46	43.50	-29.45	150	341
3	413.150	28.70	QP	16.26	2.50	46.00	-17.30	200	309
4	533.430	29.49	QP	19.50	2.87	46.00	-16.51	100	321
5	796.300	23.73	QP	22.56	3.56	46.00	-22.27	100	306
6	902.030	25.88	QP	23.84	3.80	46.00	-20.12	200	316

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4882.000	31.57	6.27	33.15	49.78	54.47	74.00	V
7323.000	36.50	7.68	32.61	49.45	61.02	74.00	V
9764.000	38.51	8.66	34.17	45.32	58.32	74.00	V
4882.000	31.57	6.27	33.15	48.13	52.82	74.00	H
7323.000	36.50	7.68	32.61	47.62	59.19	74.00	H
9764.000	38.51	8.66	34.17	45.39	58.39	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4882.000	31.57	6.27	33.15	37.62	42.31	54.00	V
7323.000	36.50	7.68	32.61	38.46	50.03	54.00	V
9764.000	38.51	8.66	34.17	35.69	48.69	54.00	V
4882.000	31.57	6.27	33.15	38.32	43.01	54.00	H
7323.000	36.50	7.68	32.61	38.77	50.34	54.00	H
9764.000	38.51	8.66	34.17	35.31	48.31	54.00	H

Test at high Channel in transmitting status

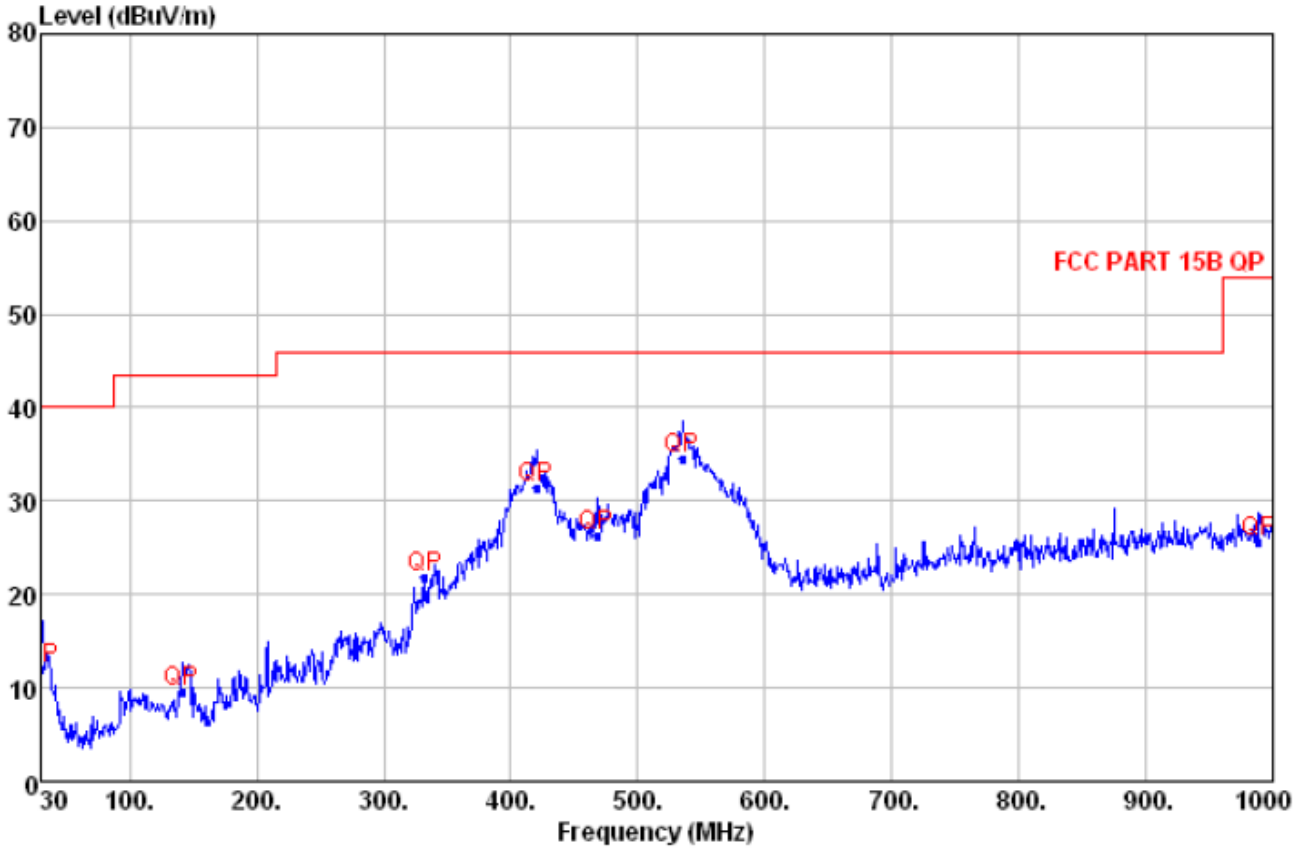
9kHz~30MHz Test result

The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan



No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	30.600	12.06	QP	17.56	0.64	40.00	-27.94	100	356
2	141.550	9.66	QP	7.40	1.42	43.50	-33.84	150	320
3	332.640	21.92	QP	13.92	2.23	46.00	-24.08	100	326
4	419.940	31.38	QP	16.60	2.52	46.00	-14.62	200	334
5	467.470	26.22	QP	17.82	2.68	46.00	-19.78	150	316
6	535.370	34.52	QP	19.44	2.88	46.00	-11.48	200	306
7	989.330	25.68	QP	23.89	3.98	54.00	-28.32	100	332

Level=Read Level + Antenna Factor + Cable Loss

Test at High Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	35.600	13.46	QP	14.63	0.68	40.00	-26.54	100	302
2	156.800	17.05	QP	7.67	1.49	43.50	-26.45	100	319
3	457.600	30.70	QP	17.18	2.65	46.00	-15.30	150	296
4	576.900	24.27	QP	19.74	2.99	46.00	-21.73	200	309
5	846.300	26.81	QP	23.28	3.68	46.00	-19.19	100	326
6	900.000	26.61	QP	23.90	3.79	46.00	-19.39	150	316

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.000	31.70	6.20	32.82	50.62	55.70	74.00	V
7440.000	36.60	7.47	32.46	45.05	56.66	74.00	V
9920.000	38.68	8.75	34.26	45.39	58.56	74.00	V
4960.000	31.70	6.20	32.82	49.42	54.50	74.00	H
7440.000	36.60	7.47	32.46	45.88	57.49	74.00	H
9920.000	38.68	8.75	34.26	46.38	59.55	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.000	31.70	6.20	32.82	37.38	42.46	54.00	V
7440.000	36.60	7.47	32.46	38.03	49.64	54.00	V
9920.000	38.68	8.75	34.26	36.72	49.89	54.00	V
4960.000	31.70	6.20	32.82	39.32	44.40	54.00	H
7440.000	36.60	7.47	32.46	38.67	50.28	54.00	H
9920.000	38.68	8.75	34.26	36.02	49.19	54.00	H

Remark:

1). The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.

2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

Test result: The unit does meet the FCC requirements.

3.11 Radiated Emissions which fall in the restricted bands

Test Requirement: FCC Part15 C Section 15.247

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

Test Method: ANSI C63.10: Clause 6.4, 6.5 and 6.6 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402

MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Measurement Distance: 3m (Semi-Anechoic Chamber)

Limit: Section 15.209(a)

40.0 dBμV/m between 30MHz & 88MHz;

43.5 dBμV/m between 88MHz & 216MHz;

46.0 dBμV/m between 216MHz & 960MHz;

54.0 dBμV/m above 960MHz.

Detector: For PK value:
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW
≥
RBW
Swee
p =
auto
Detector function = peak
Trace = max hold
For AV value:
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW =10 Hz
Sweep = auto
Detector function = peak
Trace = max hold

Test Result:

1. Low Channel

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	48.16	37.89	44.72	34.45
2390.000	27.61	4.30	35.60	49.37	38.21	45.68	34.52
2500.000	27.55	4.40	35.60	47.33	37.66	43.68	34.01
2483.500	27.55	4.40	35.60	48.18	37.99	44.53	34.34

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	48.52	37.22	45.08	33.78
2390.000	27.61	4.30	35.60	48.63	38.23	44.94	34.54
2500.000	27.55	4.40	35.60	49.55	39.24	45.90	35.59
2483.500	27.55	4.40	35.60	48.30	39.38	44.65	35.73

2. Middle Channel

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	47.38	38.17	43.94	34.73
2390.000	27.61	4.30	35.60	48.47	38.26	44.78	34.57
2500.000	27.55	4.40	35.60	48.74	39.74	45.09	36.09
2483.500	27.55	4.40	35.60	50.19	38.89	46.54	35.24

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	49.61	37.69	46.17	34.25
2390.000	27.61	4.30	35.60	48.65	38.07	44.96	34.38
2500.000	27.55	4.40	35.60	48.15	39.16	44.50	35.51
2483.500	27.55	4.40	35.60	49.39	37.31	45.74	33.66

3. High Channel

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	49.05	37.28	45.61	33.84
2390.000	27.61	4.30	35.60	49.44	37.18	45.75	33.49
2500.000	27.55	4.40	35.60	50.17	39.27	46.52	35.62
2483.500	27.55	4.40	35.60	50.24	39.34	46.59	35.69

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	27.93	4.23	35.60	49.17	39.17	45.73	35.73
2390.000	27.61	4.30	35.60	50.26	38.57	46.57	34.88
2500.000	27.55	4.40	35.60	49.23	37.12	45.58	33.47
2483.500	27.55	4.40	35.60	48.24	37.63	44.59	33.98

Remark: No any other emission which falls in restricted bands can be detected and be reported.

Test result: The unit does meet the FCC requirements.

Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section. Only spurious emissions are permitted in any of the frequency bands listed below:

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	2655 - 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	
13.36 - 13.41			

3.12 Band Edges Requirement

Test Requirement: FCC Part15 C section 15.247

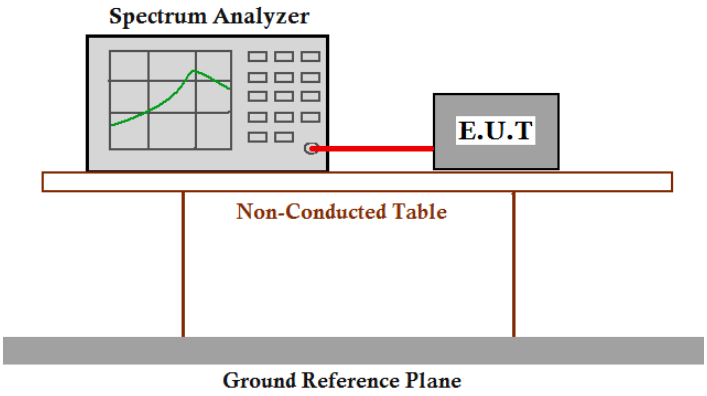
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency Band: 2400 MHz to 2483.5 MHz

Test Method: ANSI C63.10: Clause 6.9 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure: Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 100 kHz with suitable frequency span including 100 kHz bandwidth from band edge.

The band edges was measured and recorded Result:

The Lower Edges attenuated more than 20dB.

The Upper Edges attenuated more than 20dB.

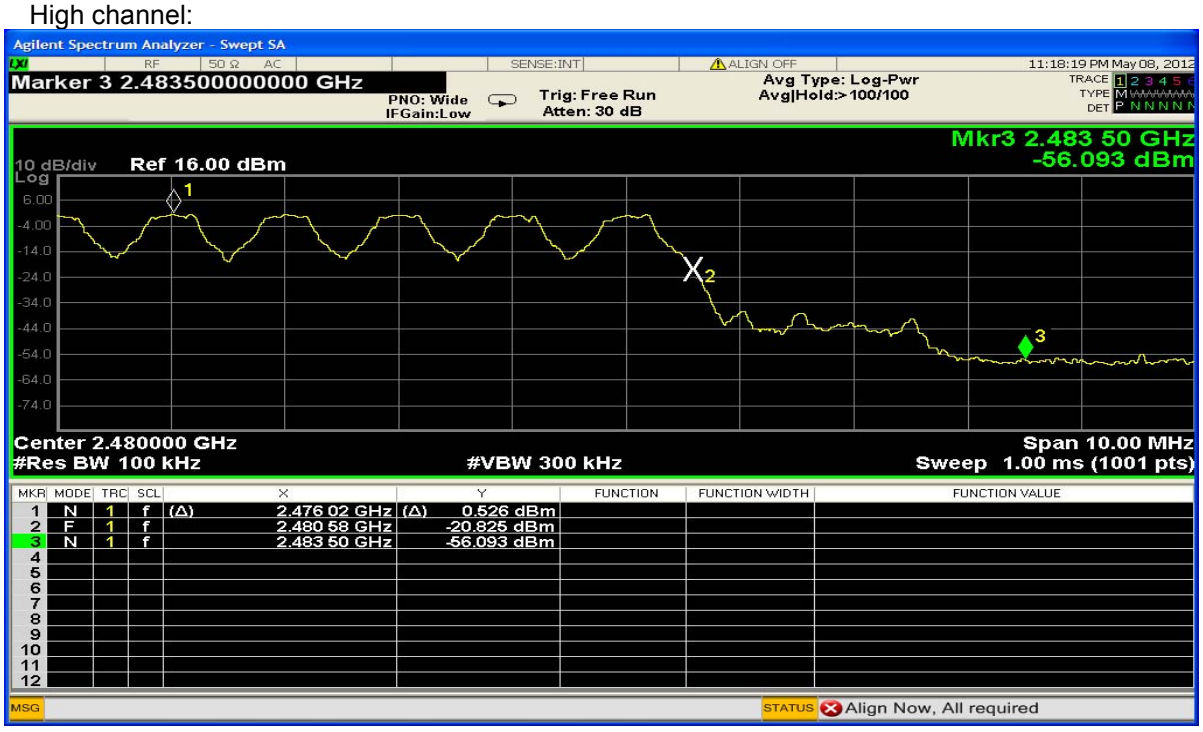
The graph as below. Represents the emissions take for this device.

DH5:

Low channel:

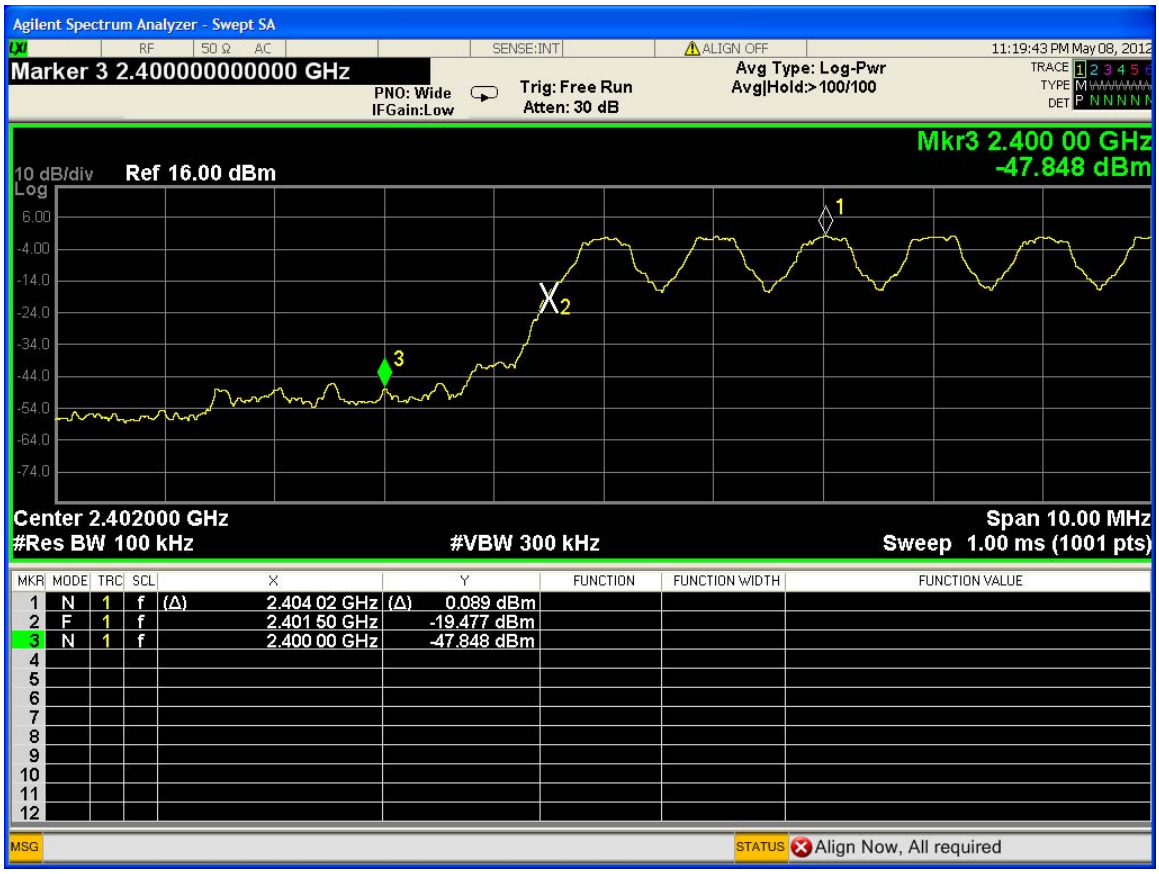
DH5:

High channel:



3DH5:

Low channel:



High channel:

Test result: The unit does meet the FCC requirements.

3.13 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

Test Requirement: FCC Part 15 C section 15.207

Test Method: ANSI C63.10: Clause 6.2 & DA 00-705

Frequency Range: 150 kHz to 30 MHz

Detector: Peak for pre-scan (9 kHz Resolution Bandwidth)

Test Limit

Limits for conducted disturbance at the mains ports of class B

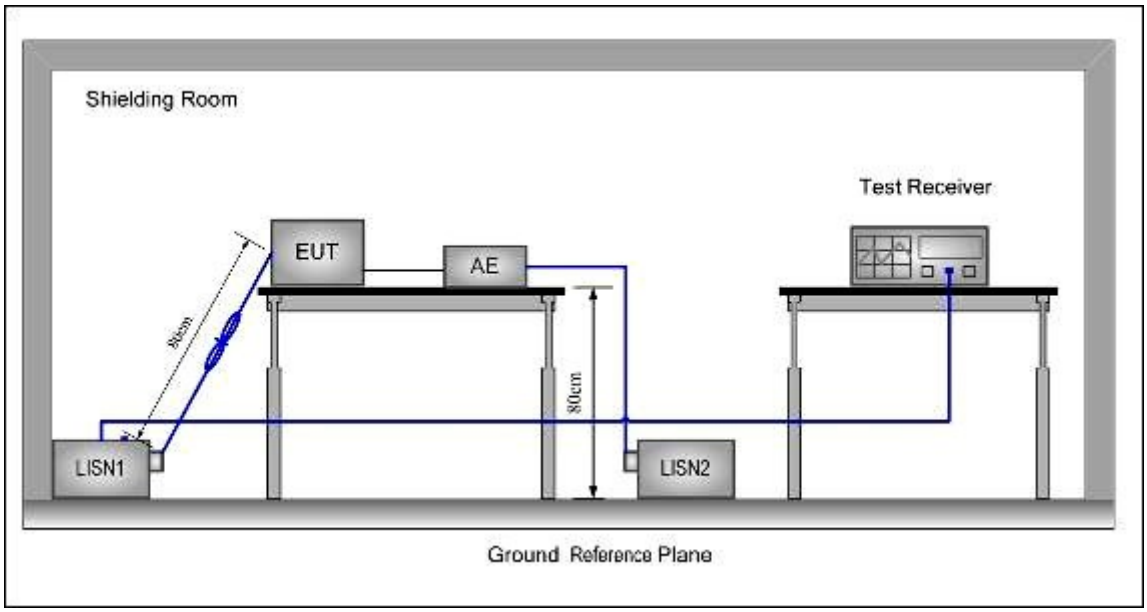
Frequency Range	Class B Limit dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

EUT Operation:

Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Configuration:



Test procedure:

1. The mains terminal disturbance voltage test was conducted in a shielded room.

2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.

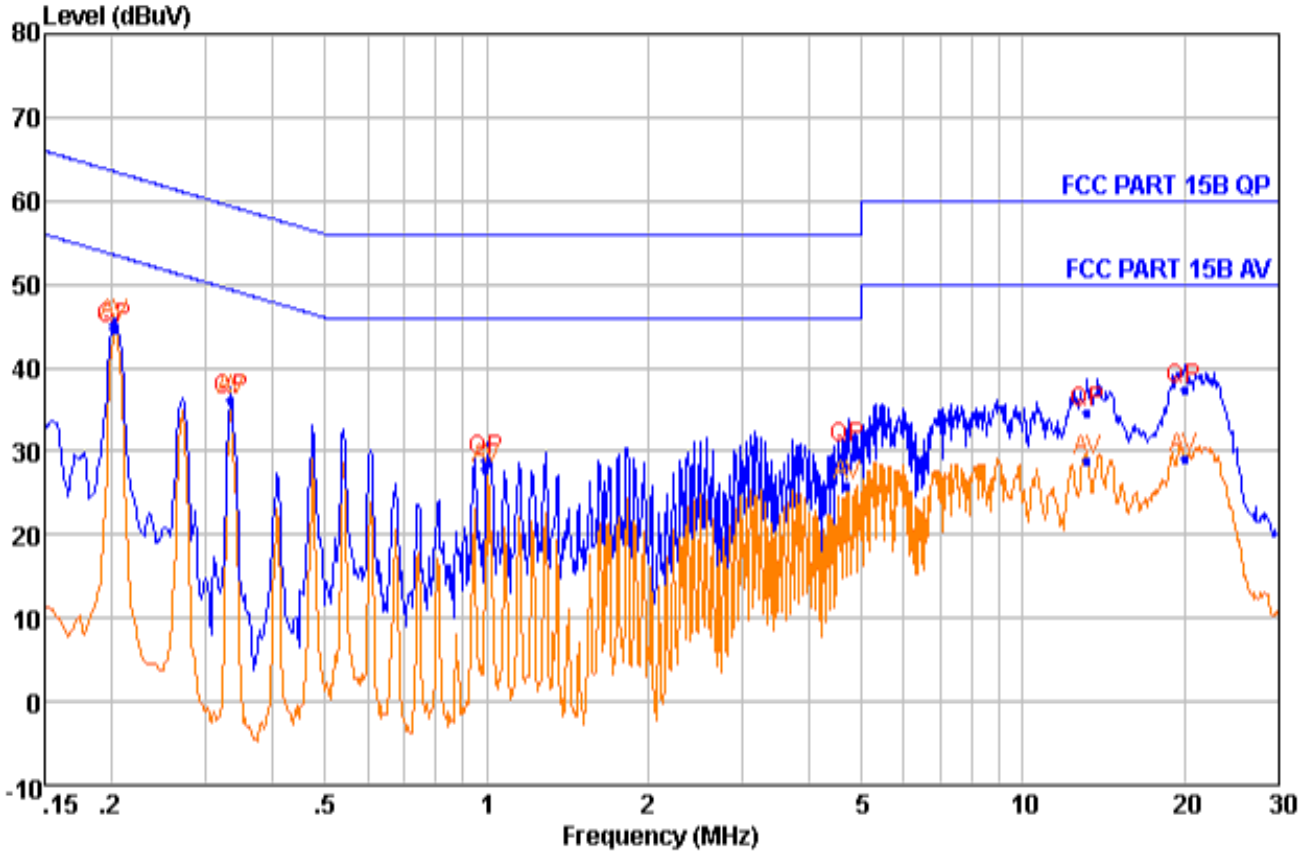
4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected. For EUT the communicating was worst case mode.

The following Quasi-Peak and Average measurements were performed on the EUT:

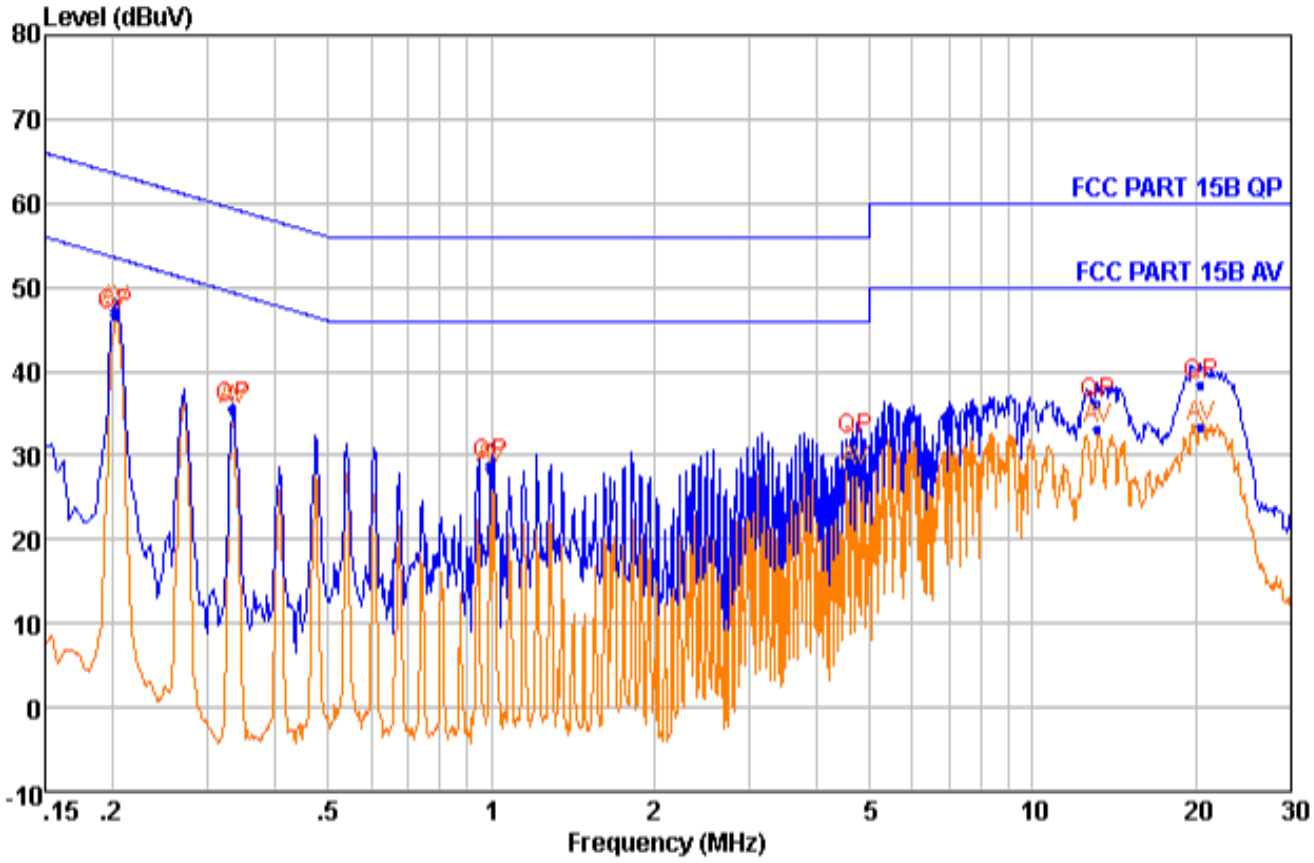
Live line



NO.	Freq MHz	Level dBuV	Remark	LISN Factor dB	Cable Loss dB	Limit Line dBuV	Margin dB
1	0.202	44.77	QP	9.68	0.22	63.54	-18.77
2	0.202	45.25	Average	9.68	0.22	53.54	-8.29
3	0.333	36.18	QP	9.66	0.25	59.37	-23.19
4	0.333	36.09	Average	9.66	0.25	49.37	-13.28
5	0.998	28.76	QP	9.67	0.31	56.00	-27.24
6	0.998	27.97	Average	9.67	0.31	46.00	-18.03
7	4.711	30.25	QP	9.60	0.40	56.00	-25.75
8	4.711	25.78	Average	9.60	0.40	46.00	-20.22
9	13.162	34.68	QP	9.69	0.45	60.00	-25.32
10	13.162	28.84	Average	9.69	0.45	50.00	-21.16
11	20.013	37.48	QP	9.68	0.48	60.00	-22.52
12	20.013	29.16	Average	9.68	0.48	50.00	-20.84

Level=Read Level + Lisn Factor + Cable Loss

Neutral Line



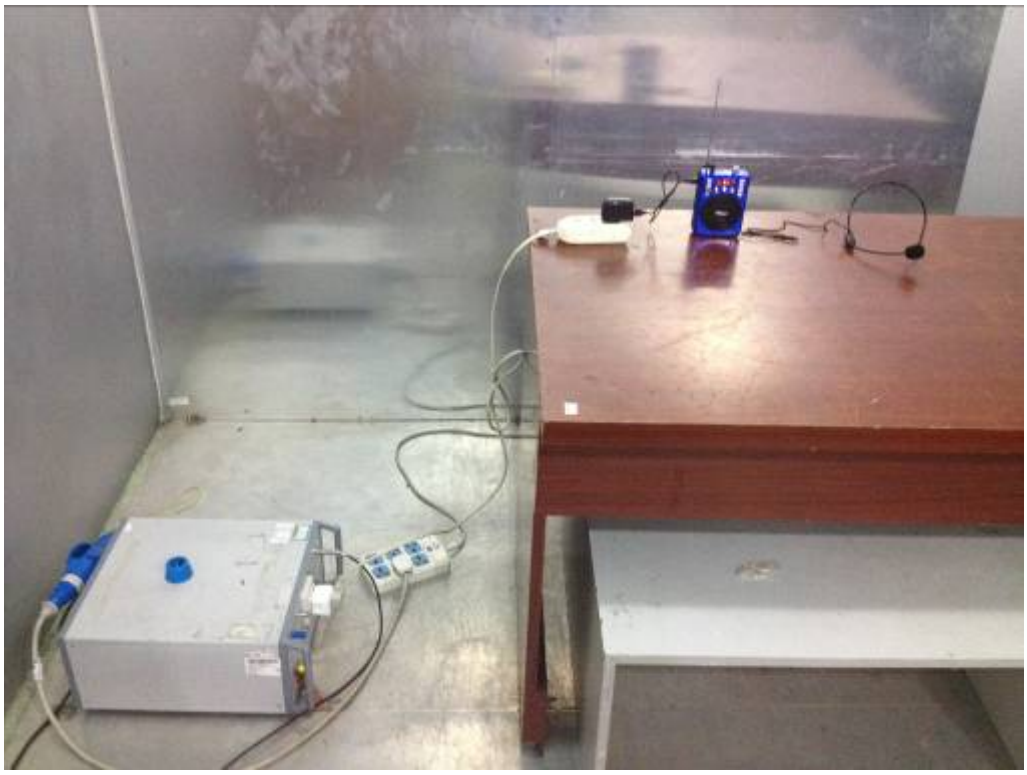
NO.	Freq MHz	Level dBuV	Remark	LISN Factor dB	Cable Loss dB	Limit Line dBuV	Margin dB
1	0.202	46.56	QP	9.63	0.22	63.54	-16.98
2	0.202	47.14	Average	9.63	0.22	53.54	-6.40
3	0.333	35.59	QP	9.65	0.25	59.37	-23.78
4	0.333	35.38	Average	9.65	0.25	49.37	-13.99
5	0.998	28.75	QP	9.63	0.31	56.00	-27.25
6	0.998	28.39	Average	9.63	0.31	46.00	-17.61
7	4.711	31.84	QP	9.62	0.40	56.00	-24.16
8	4.711	28.13	Average	9.62	0.40	46.00	-17.87
9	13.162	36.22	QP	9.63	0.45	60.00	-23.78
10	13.162	33.04	Average	9.63	0.45	50.00	-16.96
11	20.434	38.42	QP	9.62	0.48	60.00	-21.58
12	20.434	33.27	Average	9.62	0.48	50.00	-16.73

Level=Read Level + Lisn Factor + Cable Loss

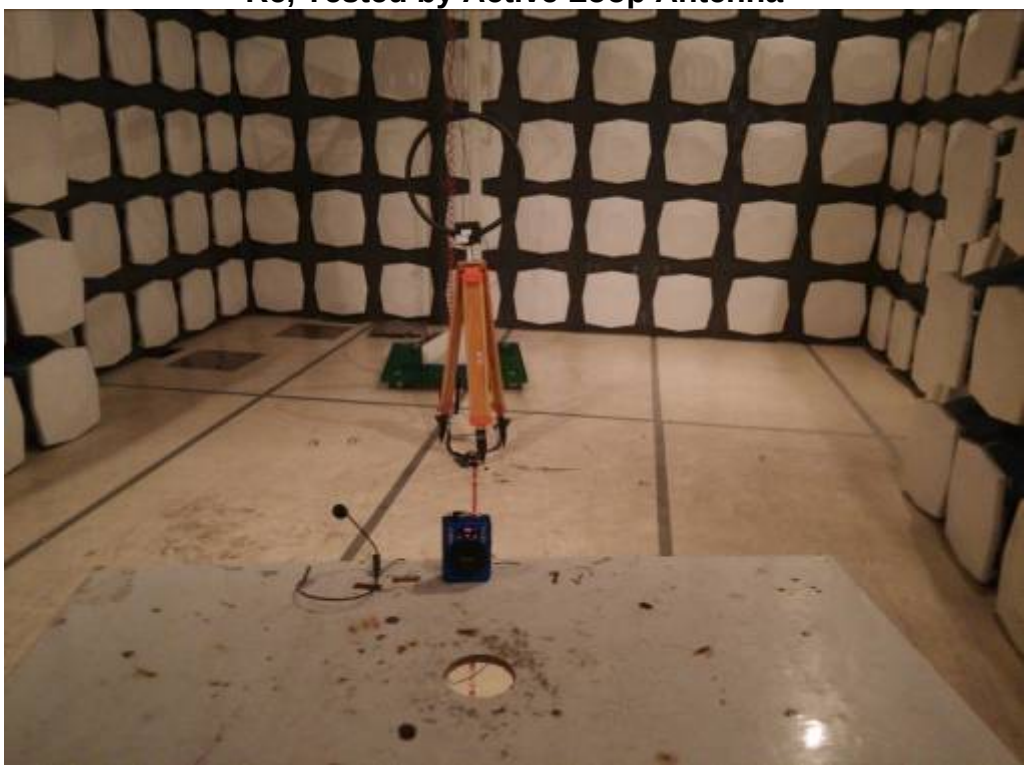
APPENDIX

Photographs of the Test Arrangement

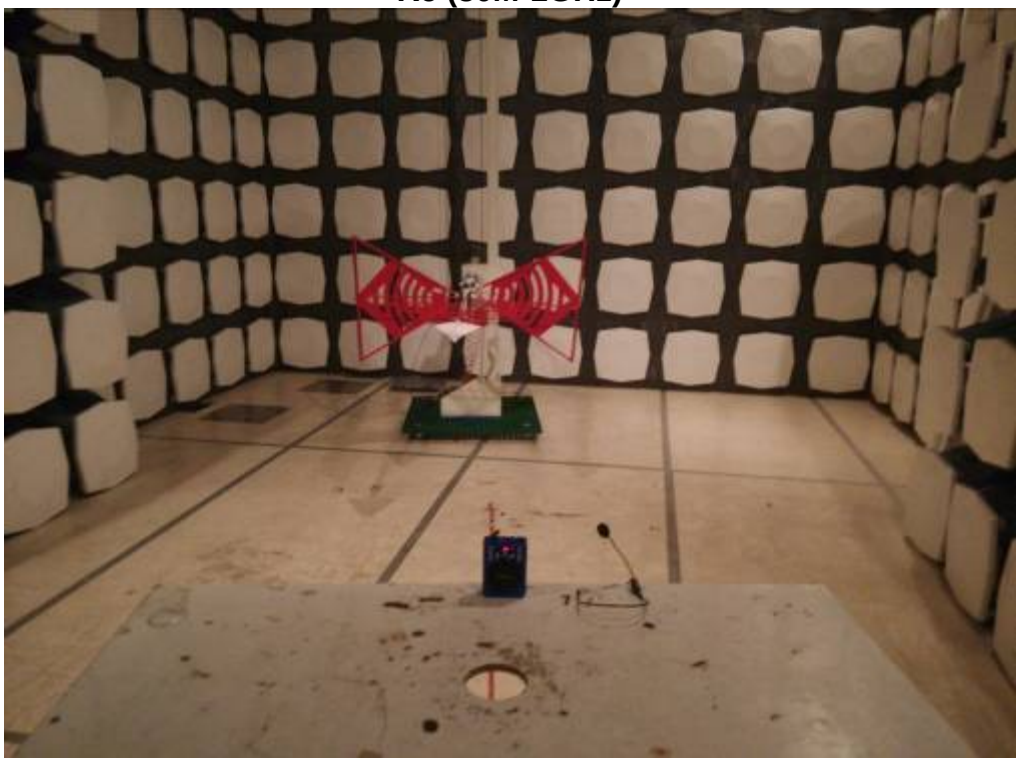
Conducted Emissions



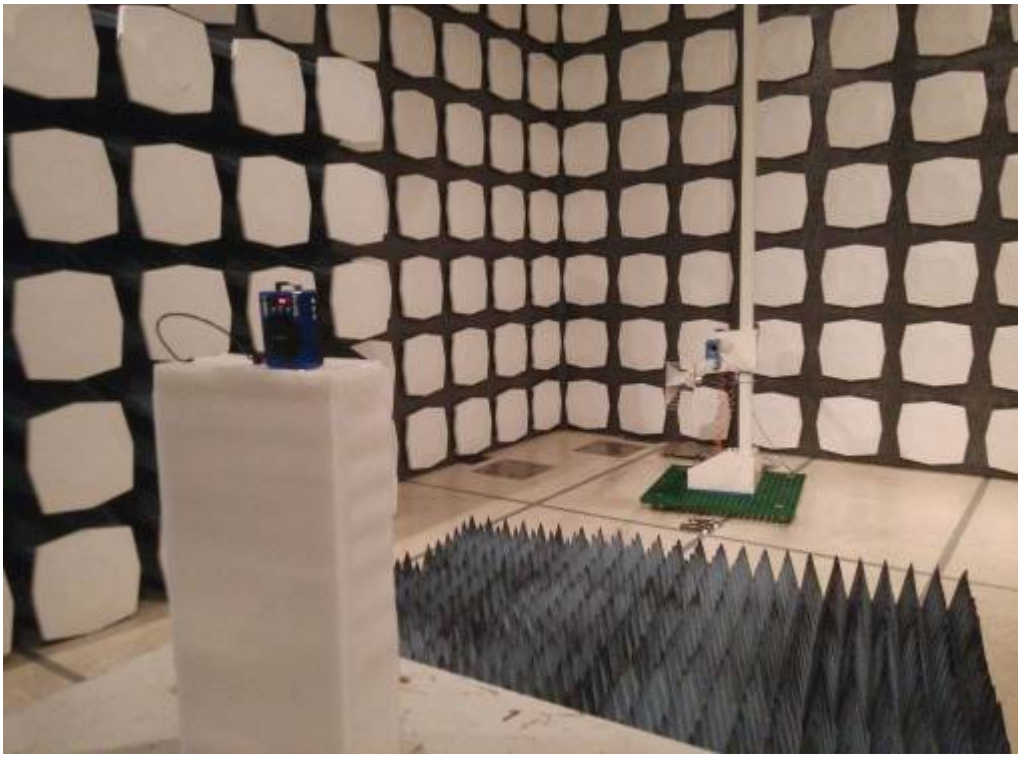
Re, Tested by Active Loop Antenna



Re (30M-1GHz)

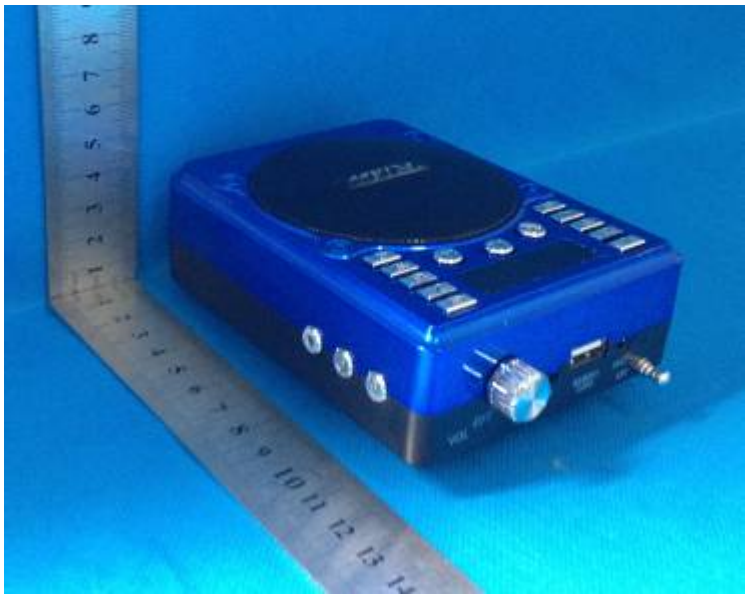


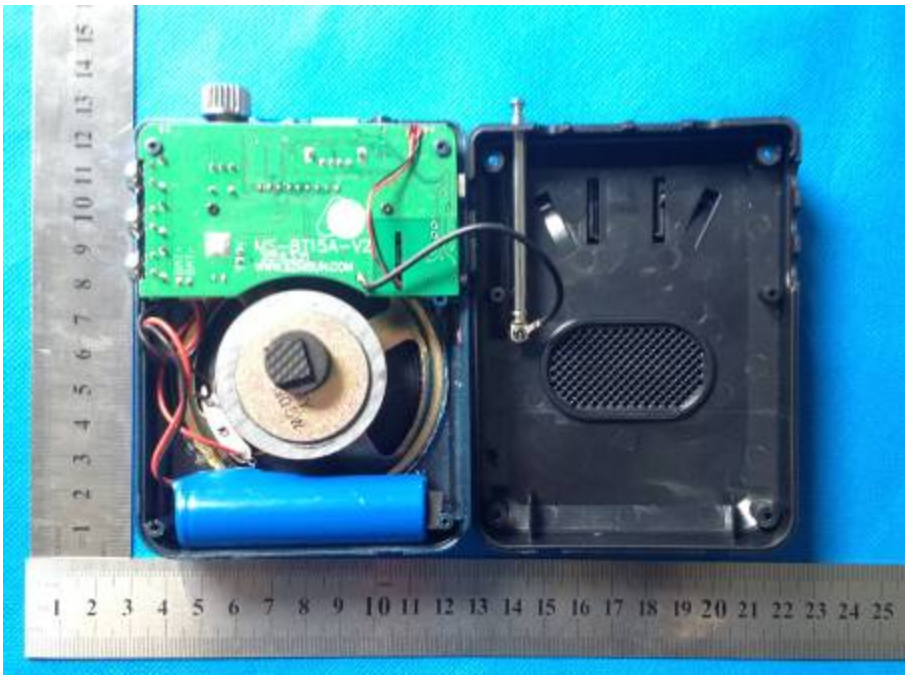
Re (Above1GHz)

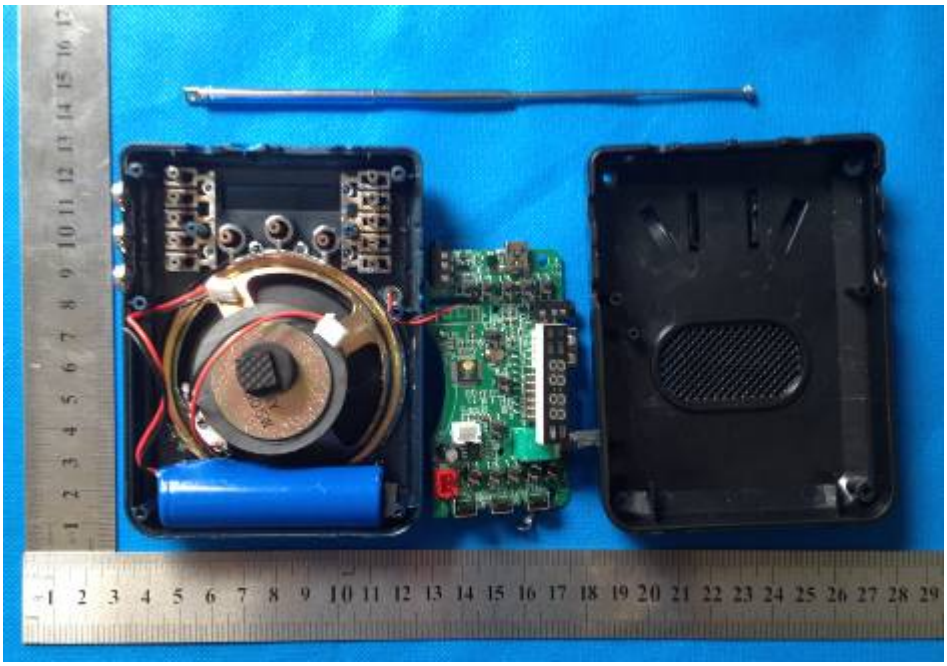


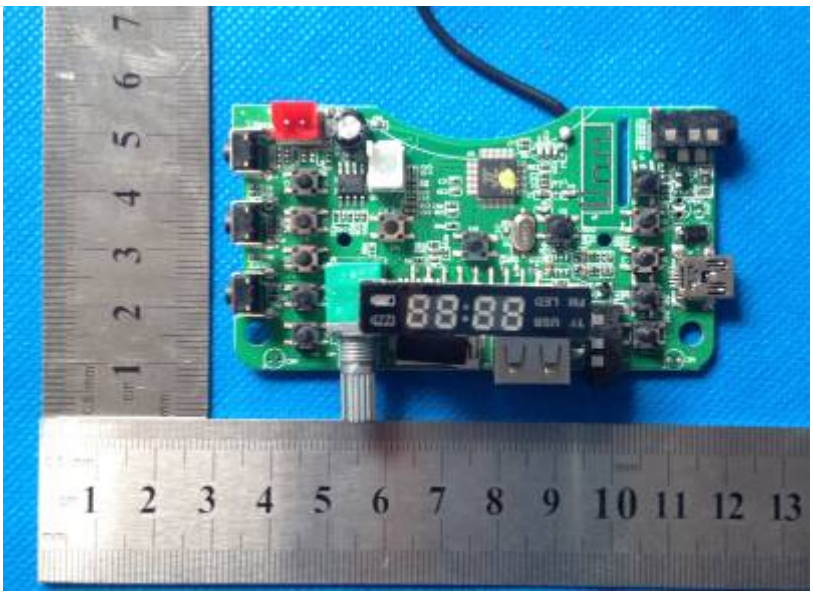
Photographs of EUT Constructional Details

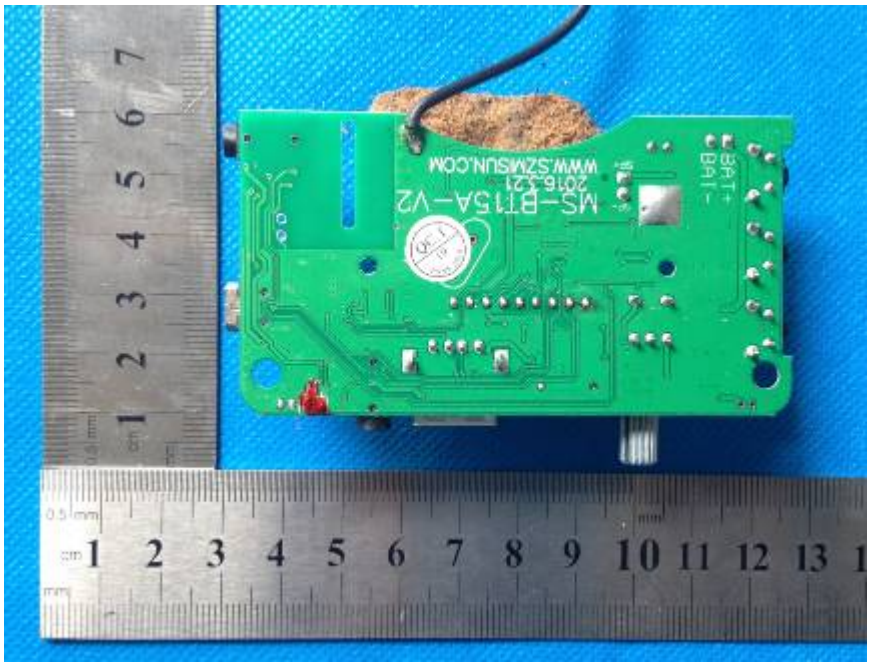
BS-561

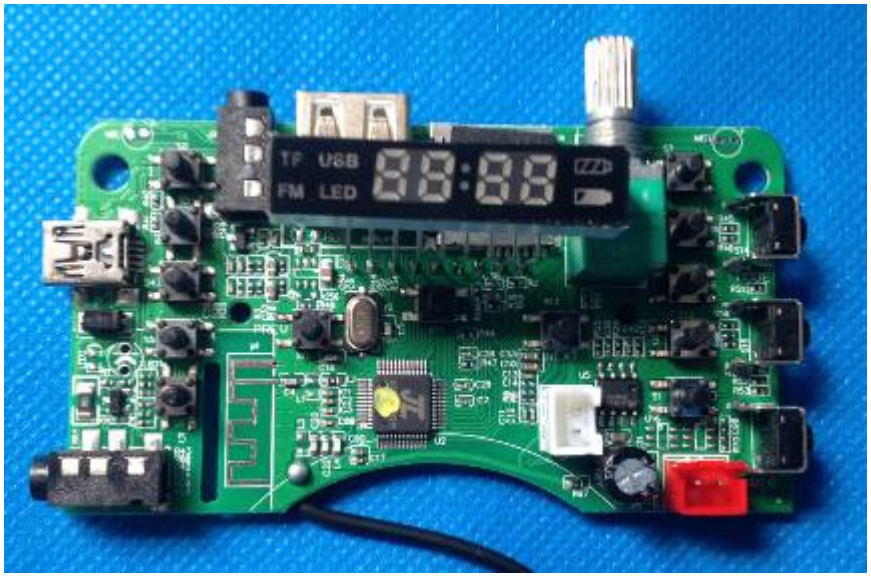




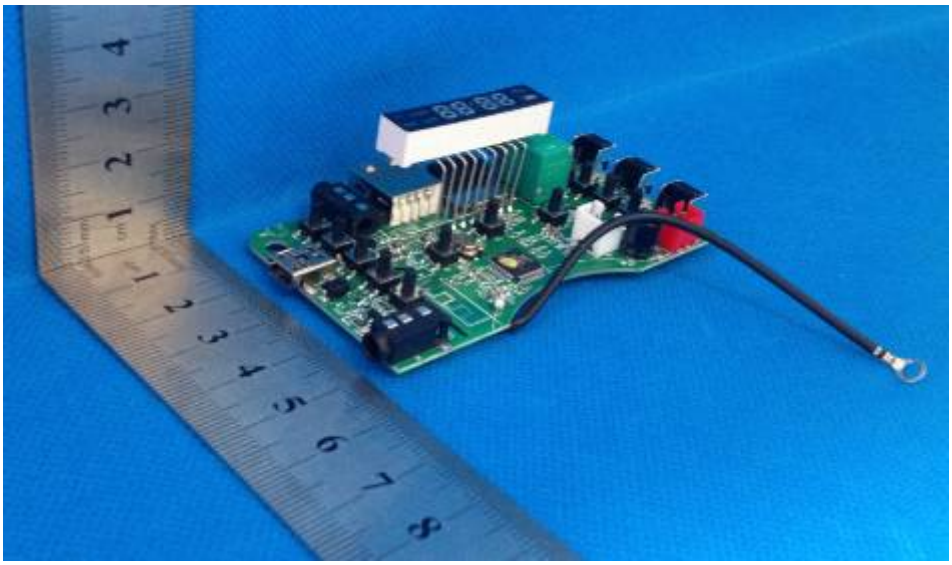


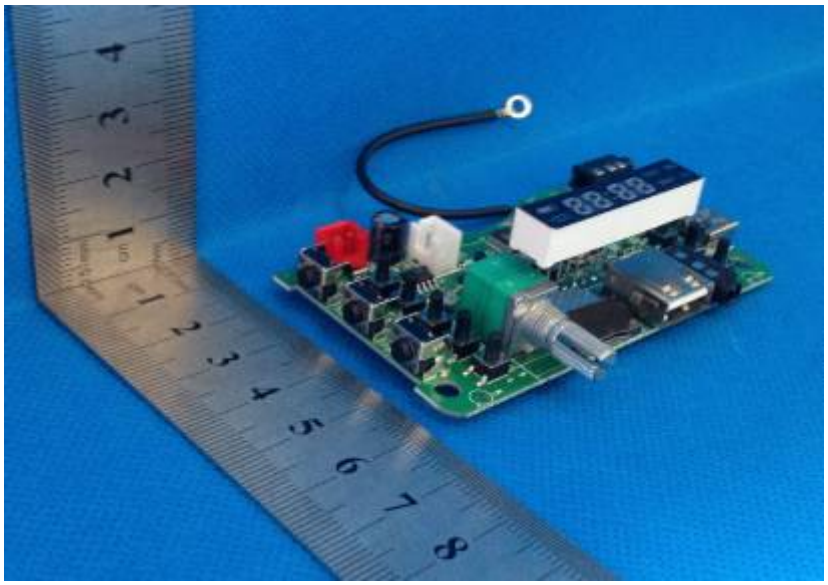


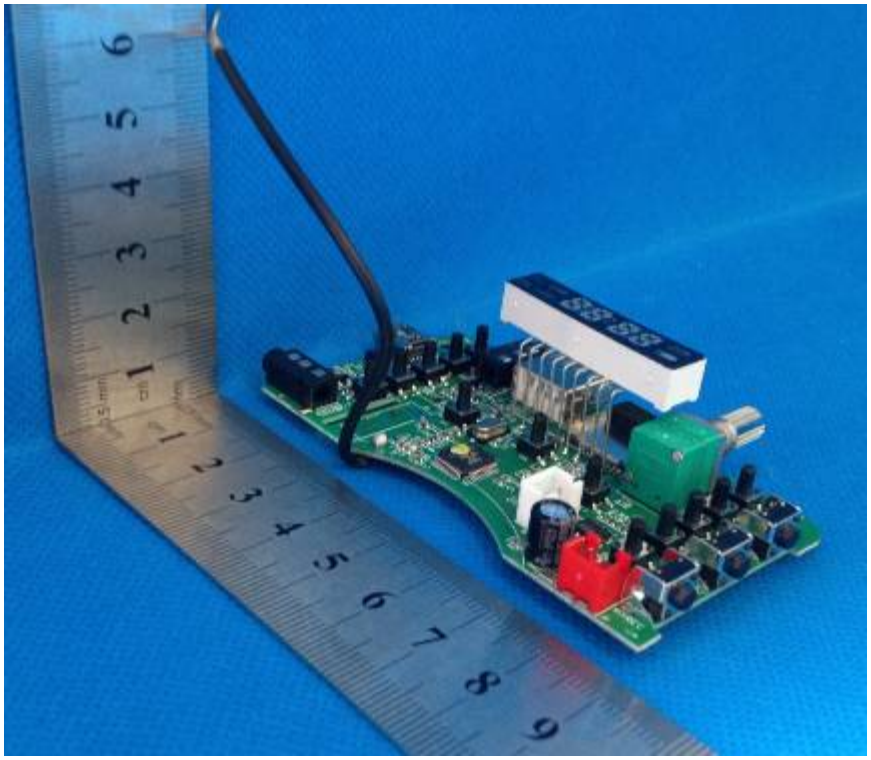

MS-BT15A-V2
WWW.SZMSUN.COM
BAT+
BAT-

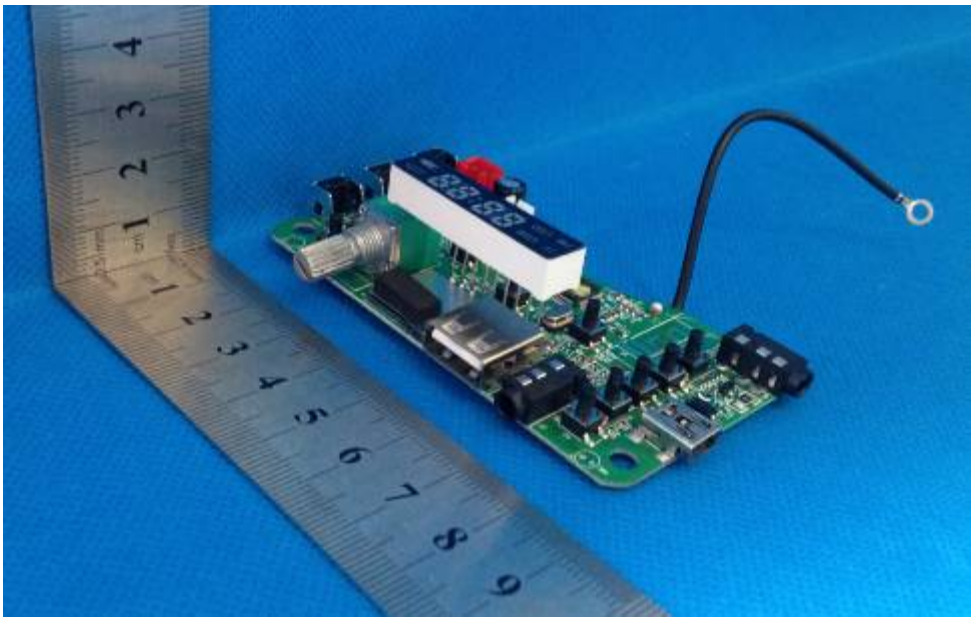

TF USB
FM LED

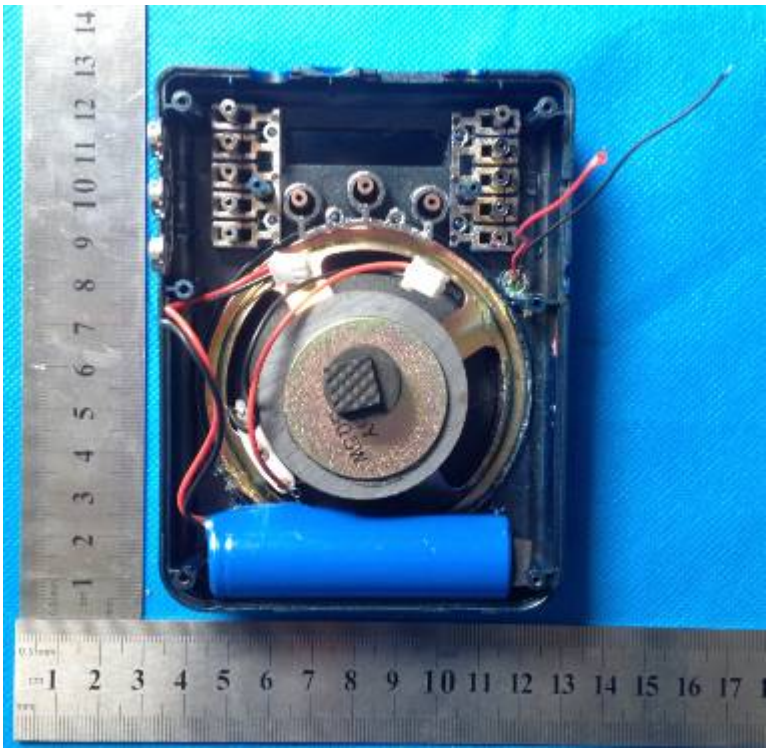
MS-BT15A-V2
2016.3.21
WWW.SZMISUN.COM
BAT+
BAT-
SP-
SP+







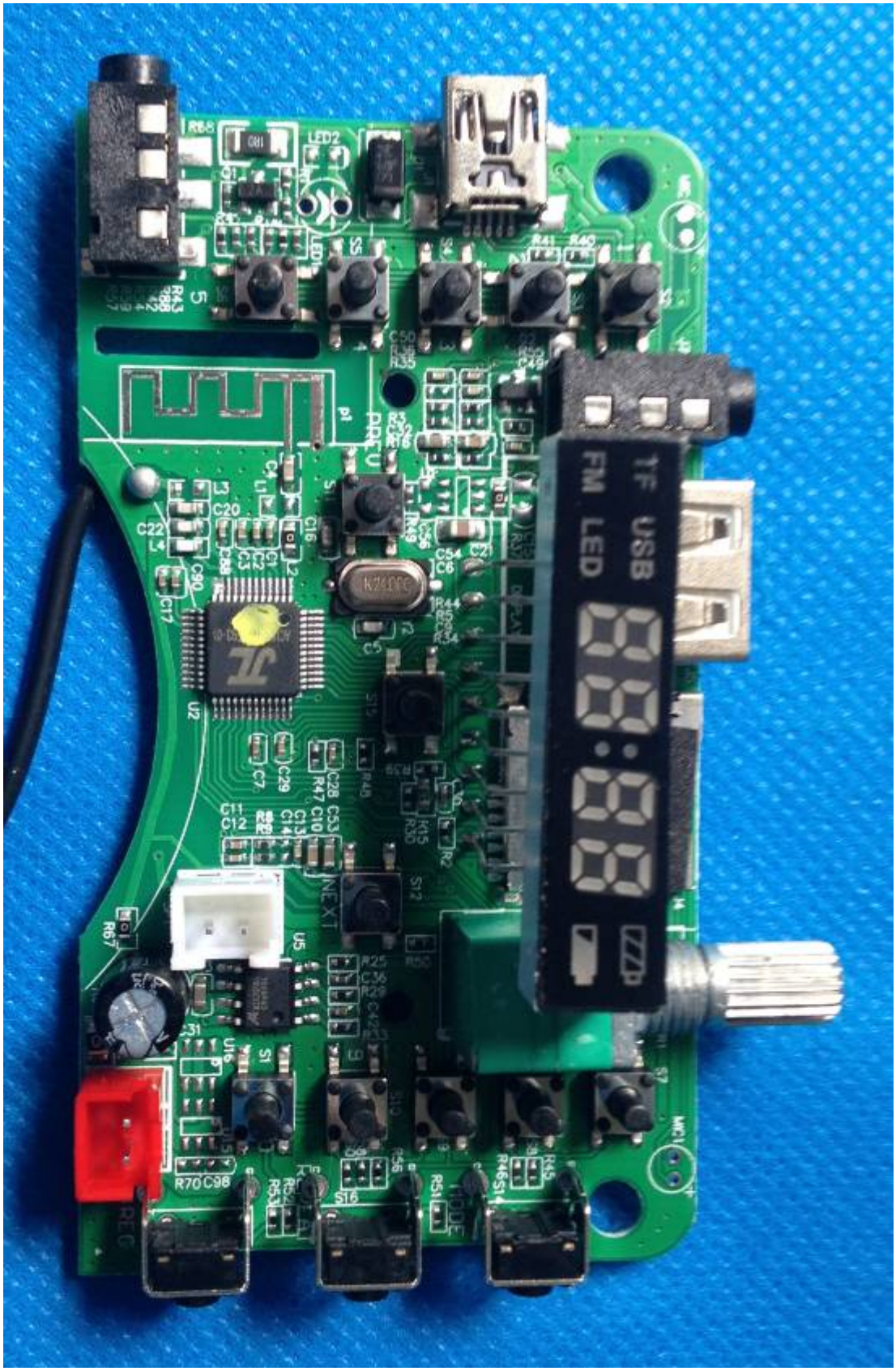


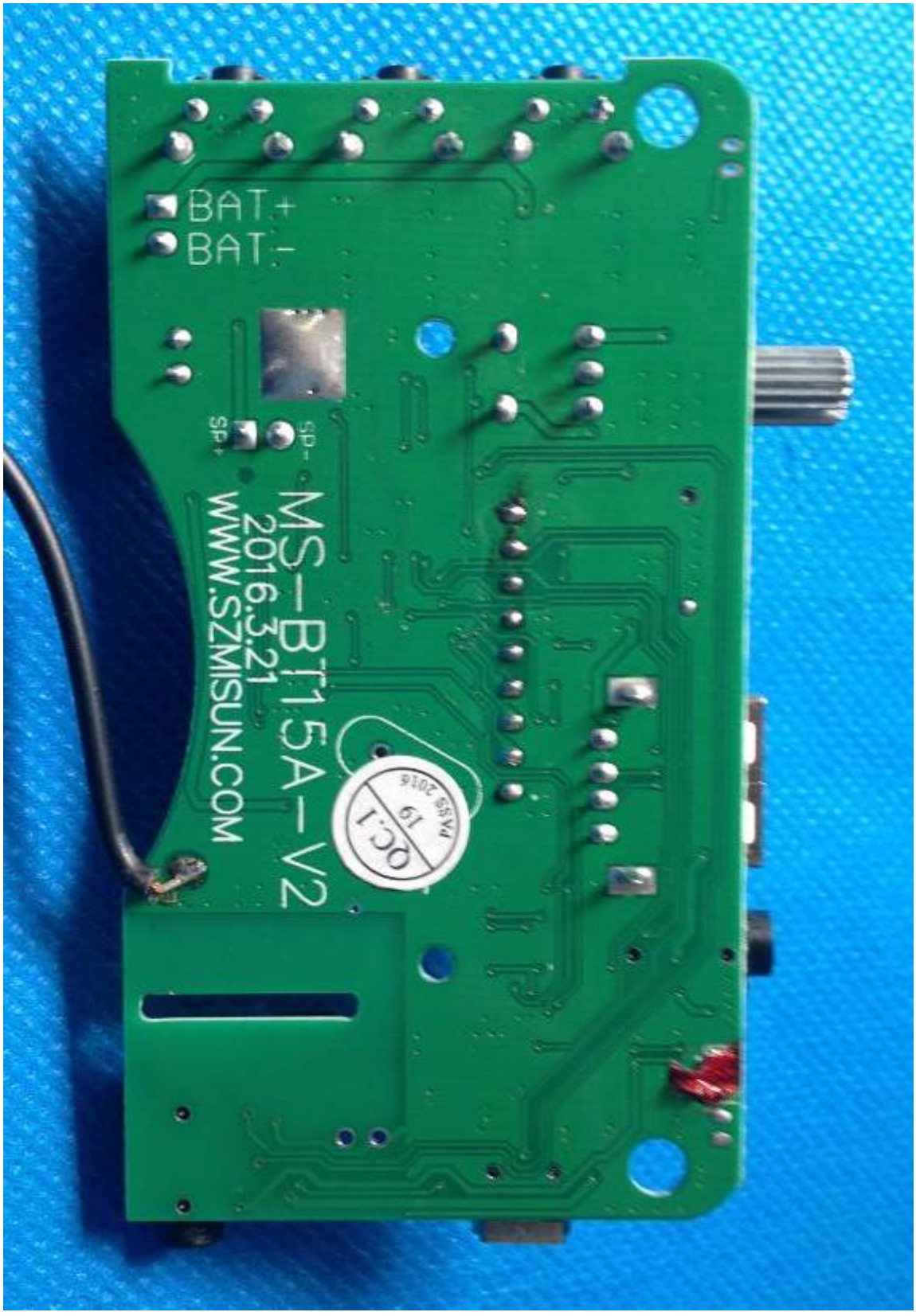


8 19 20 21 22 23

VOL
OFF
ON
MEMORY CARD
MEMORY CARD
MIC
ANT

DC 5V
LED


TF
USB
FM
LED
NEXT


BAT+
BAT-
SP-
SP+
MS-BT15A-V2
2016.3.21
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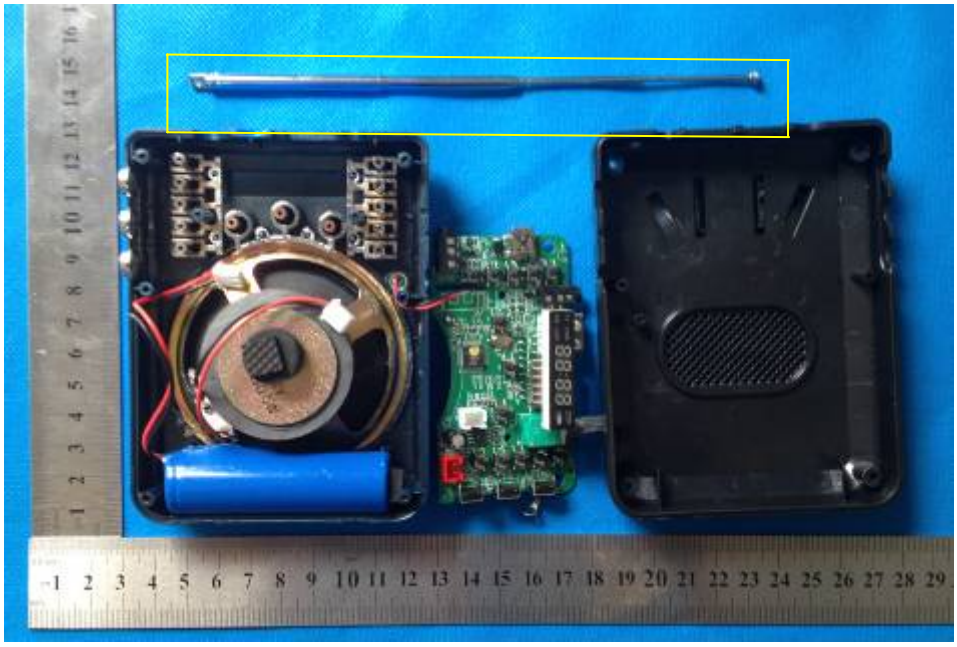
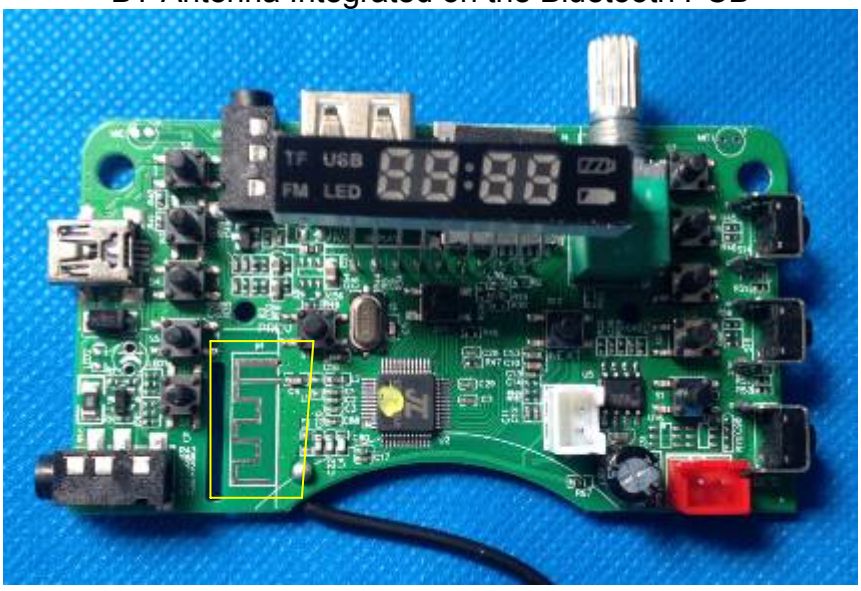
Antenna Photo

WASP1100WBT

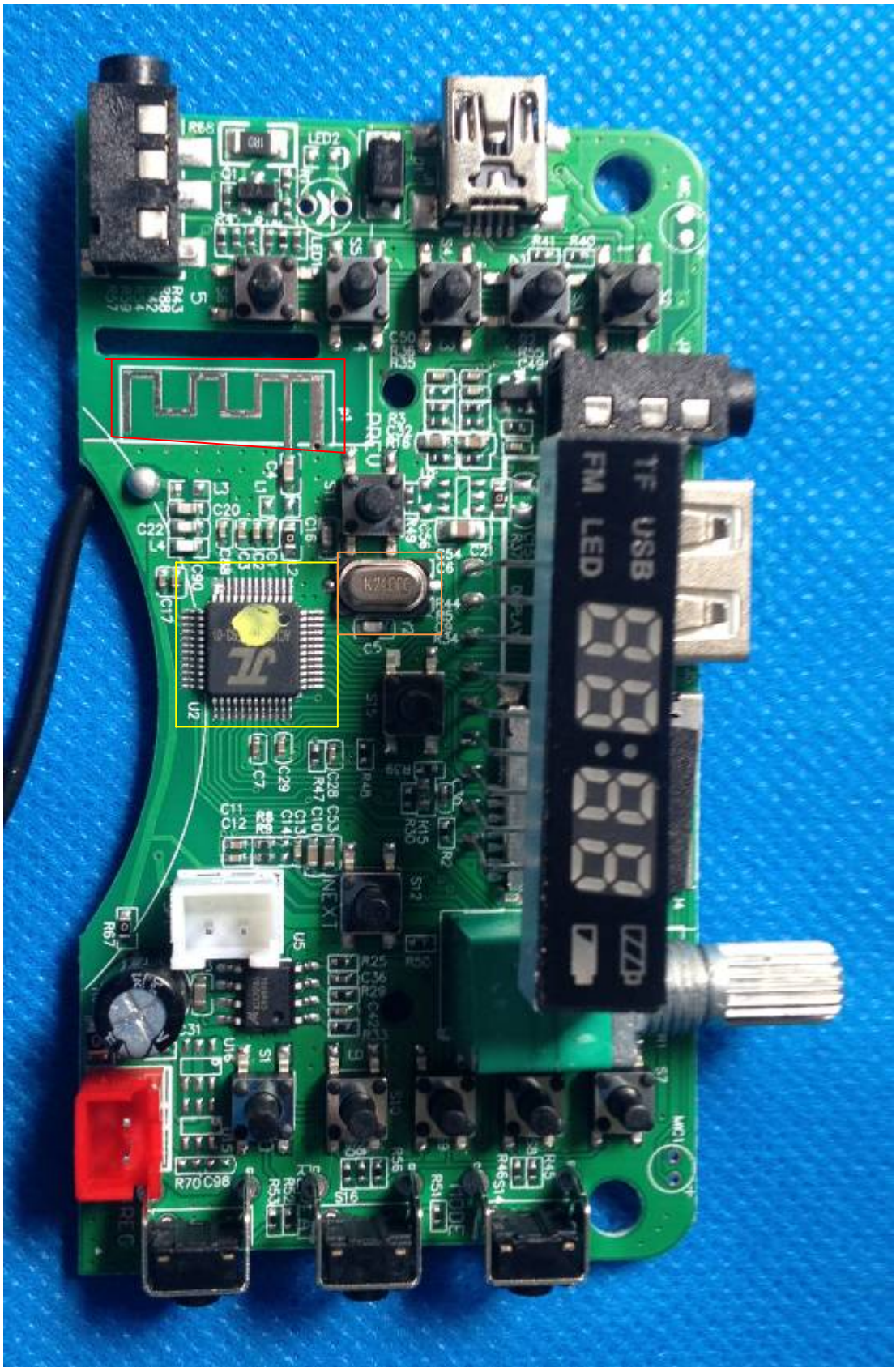
External FM Antenna



BT Antenna Integrated on the Bluetooth PCB



Yellow block: wireless chip, model: AC4601 QFP-48
Orange block: 24MHz crystals, model: 49SS
Red block: BT antenna



4 EQUIPMENTS USED DURING TEST

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
1	Signal Analyzer	Agilent	N9010A	MY51250936	2015.04.16	2016.04.16
					2016.04.16	2017.04.16
2	Low Noise Pre Amplifier	Tsj	MLA-10K01-B01-27	1205323	2015.09.06	2016.09.06
3	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2015.04.07	2016.04.07
					2016.04.07	2017.04.07
4	Biconilog Antenna	ETS•Lindgren	3142D	00108096	2016.01.28	2017.01.28
5	Horn Antenna	EMCO	3115	6124	2015.06.08	2016.06.08
6	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2015.09.06	2016.09.06
7	EMI Test Receiver	R&S	ESCI	100124	2015.06.07	2016.06.07
8	LISN	R&S	ENV216	8-837-4	2015.05.04	2016.05.04
9	LISN	Kyoritsu	KNW-407	8-1789-3	2015.04.06	2016.04.06
					2016.04.06	2017.04.06
10	50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2015.09.06	2016.09.06
11	Loop Antenna	ZHINAN	ZN30900A	002489	2016.01.22	2017.01.22
12	Semi-Anechoic chamber	ETS•Lindgren	FACT3 2.0 ITL-100	/	2015.04.10	2016.04.10
					2016.04.10	2017.04.10
13	Active loop antenna	BJ 2nd Factory	ZN30900A	EMC6001	2005.09.24	2016.09.24
14	Coaxial Cable	Mini-Circuits	CBL-10FT-NMNM+	73027	/	/
15	SMA connector	Mini-Circuits	NM-SF50+	/	/	/

End of report