FCC Test Report

Report No.: AGC04246150302FE03

FCC ID	:	NMCHBCR001
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	HBC Remote
BRAND NAME	:	UCLEAR DIGITAL
MODEL NAME	:	HBCR001
CLIENT	:	Bitwave Private Limited
DATE OF ISSUE	:	Jun.27,2015
STANDARD(S)	:	FCC Part 15 Rules
REPORT VERSION	:	V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Jun.27,2015	Valid	Original Report

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1. VERIFICATION OF CONFORMITY

Applicant	Bitwave Private Limited
Address	11, Serangoon North Ave 5 , #05-03 Singapore 554809
Manufacturer	Bitwave Private Limited
Address	11, Serangoon North Ave 5 , #05-03 Singapore 554809
Product Designation	HBC Remote
Brand Name	UCLEAR DIGITAL
Test Model	HBCR001
Date of test	Jun.24,2015 to Jun.26,2015
Deviation	None
Condition of Test Sample	Normal
Report Template	AGCRT-US-BR/RF (2013-03-01)

We hereby certify that:

The above equipment was tested by Compliance Certification Service(Shenzhen) Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2009) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247.

Prepared By	Water Zuo	Jun.27,2015
Checked By	Forrest Lei	Jun.27,2015
Authorized By	Solger Zhang	Jun.27,2015

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is “HBC Remote” designed as a “Communication Device”. It is designed by way of utilizing the FHSS technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	2.402 GHz to 2.480GHz
RF Output Power	7.76dBm(Max)
Bluetooth Version	V4.1
Modulation	GFSK, π /4-DQPSK, 8DPSK
Number of channels	79
Hardware Version	1.01
Software Version	1.00
Antenna Designation	fixed antenna
Antenna Gain	4dBi
Power Supply	DC3.7V by Battery

Note: The EUT support BLE and BR function. About the test report of BLE function, Please refer to test report:AGC04246150302FE08.

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
2402~2480MHZ	0	2402MHZ
	1	2403MHZ
	:	:
	38	2440 MHZ
	39	2441 MHZ
	40	2442 MHZ
	:	:
	77	2479 MHZ
	78	2480 MHZ

2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHZ,In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection(e.g. single of multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.
Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a 79 hopping sequence in data mode:
40,21,44,23,42,53,46,55,48,33,52,35,50,65,54,67
56,37,60,39,58,69,62,71,64,25,68,27,66,57,70,59
72,29,76,31,74,61,78,63,01,41,05,43,03,73,07,75
09,45,13,47,11,77,15,00,64,49,66,53,68,02,70,06
01, 51, 03, 55, 05, 04

2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values:
1. LAP/UAP of the master of the connection.
2. Internal master clock
The LAP(lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP(upper address part) are the 24MSB's of the 48BD_ADDRESS
The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For ehavior zation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us.The clock has a cycle of about one day(23h30).In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire. LAP(24 bits),4LSB's(4bits)(Input 1) and the 27MSB's of the clock(Input 2) are used. With this input values different mathematical procedures(permutations, additions, XOR-operations)are performed to generate te Sequence. This will be done at the beginning of every new transmission.
Regarding short transmissions the Bluetooth system has the following ehavior:
The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended.
The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer(and it Cannot be shorter) than the minimum resolution of the clock(312.5us).The hopping sequence will always Differ from the first one.

2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: NMCHBCR001** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2009).
Radiated testing was performed at an antenna to EUT distance 3 meters.
Test has been referenced to the DA 00-705

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

3. MEASUREMENT UNCERTAINTY

Conducted measurement: +/- 2.75dB
Radiated measurement: +/- 3.2dB

4. DESCRIPTION OF TEST MODES

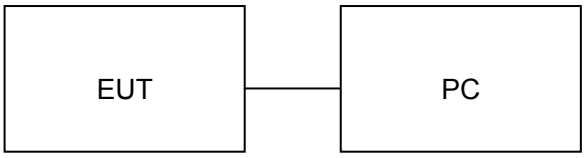
NO.	TEST MODE DESCRIPTION
1	Low channel TX
2	Middle channel TX
3	High channel TX
4	Normal Operation (BT)

Note:
1. Only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

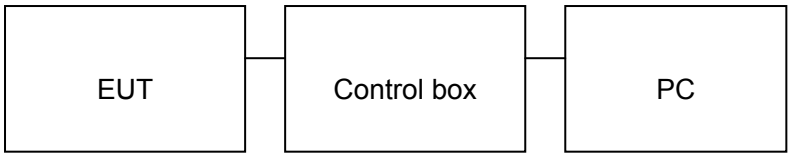
5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Configure 1: (Normal hopping)



Configure 2: (Control continuous TX)



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Mfr/Brand	Model/Type No.	Remark
1	HBC Remote	UCLEAR DIGITAL	HBCR001	EUT
2	PC	Dell	INSPIRON	A.E
3	Control box	N/A	N/A	A.E

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247	Peak Output Power	Compliant
§15.247	20 dB Bandwidth	Compliant
§15.247	Spurious Emission	Compliant
§15.209	Radiated Emission	Compliant
§15.247	Band Edges	Compliant
§15.207	Conduction Emission	Compliant
§15.247	Number of Hopping Frequency	Compliant
§15.247	Time of Occupancy	Compliant
§15.247	Frequency Separation	Compliant

6. TEST FACILITY

Site	Compliance Certification Service(Shenzhen) Inc.
Location	No.10-1 Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town,Baoan Distr
FCC Registration No.	441872
Description	The test site is constructed and calibrated to meet the FCC requirements in documents ANSI C63.10:2009.

ALL TEST EQUIPMENT LIST

Description	Manufacturer	Model	S/N	Cal. Date	Cal. Due
Power Probe	R&S	NRP-Z23	100323	07/16/2014	07/15/2015
RF attenuator	N/A	RFA20db	68	N/A	N/A
Spectrum Analyzer	Agilent	E4440A	US41421290	07/16/2014	07/15/2015
EXA Signal Analyzer	Agilent	N9010A	--	02/28/2015	02/27/2016
Amplifier	EM	EM30180	0607030	02/28/2015	02/27/2016
Horn Antenna	EM	EM-AH-10180	67	04/19/2015	04/18/2016
Horn Antenna	A.H. Systems Inc.	SAS-574	--	07/16/2014	07/15/2015
EMI Test Receiver	Rohde & Schwarz	ESCI	100694	07/16/2014	07/15/2015
Bilogical Antenna	A.H. Systems Inc.	SAS-521-4	26	06/06/2015	06/05/2016
LISN	R&S	ESH3-Z5	8389791009	07/16/2014	07/15/2015
Loop Antenna	Daze	ZN30900N	SEL0097	07/16/2014	07/15/2015
Isolation Transformer	LETEAC	LTBK	--	07/16/2014	07/15/2015
Radiation Cable 1	Sat	RE1	R003	06/04/2015	06/03/2016
Radiation Cable 2	Sat	RE2	R002	06/04/2015	06/03/2016
Conduction Cable	Sat	CE1	C001	06/04/2015	06/03/2016

7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, middle and the bottom operation frequency individually.
3. RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW.
4. Record the maximum power from the Spectrum Analyzer.

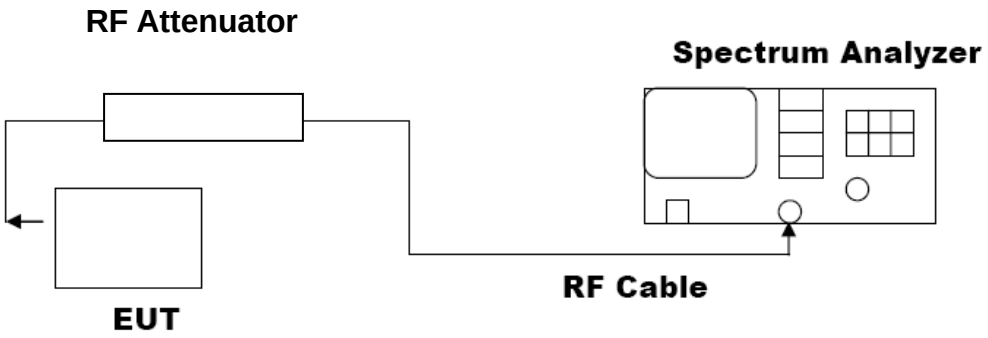
For average power test:

1. Connect EUT RF output port to power probe through an RF attenuator.
2. Connect the power probe to the PC.
3. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
4. Record the maximum power from the software.
5. The maximum peak power shall be less 125mW (21dBm).

Note：The EUT was tested according to DA000705 for compliance to FCC 47CFR 15.247 requirements.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

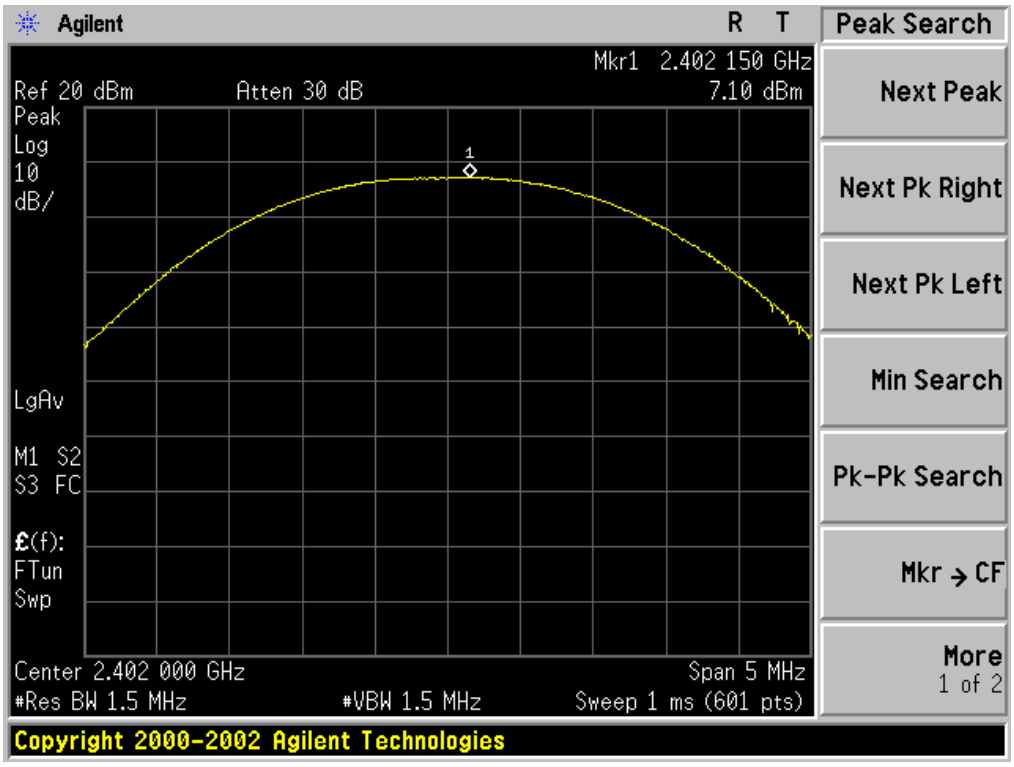
PEAK POWER TEST SETUP



7.3. LIMITS AND MEASUREMENT RESULT

PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION			
Frequency (GHz)	**Peak Power (dBm)**	**Applicable Limits (dBm)**	**Pass or Fail**
2.402	7.1	21	Pass
2.441	7.46	21	Pass
2.480	7.76	21	Pass

CH0



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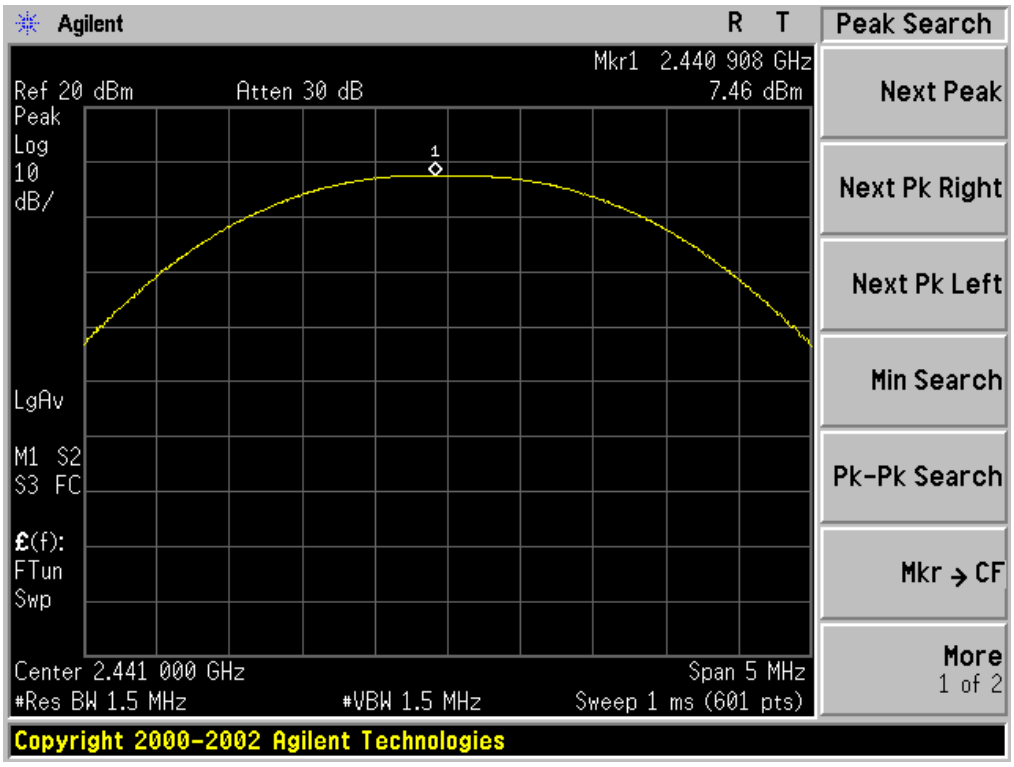
Agilent
R T
Peak Search
Mkr1 2.440 908 GHz
Ref 20 dBm
Atten 30 dB
7.46 dBm
Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
£(f):
FTun
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.441 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
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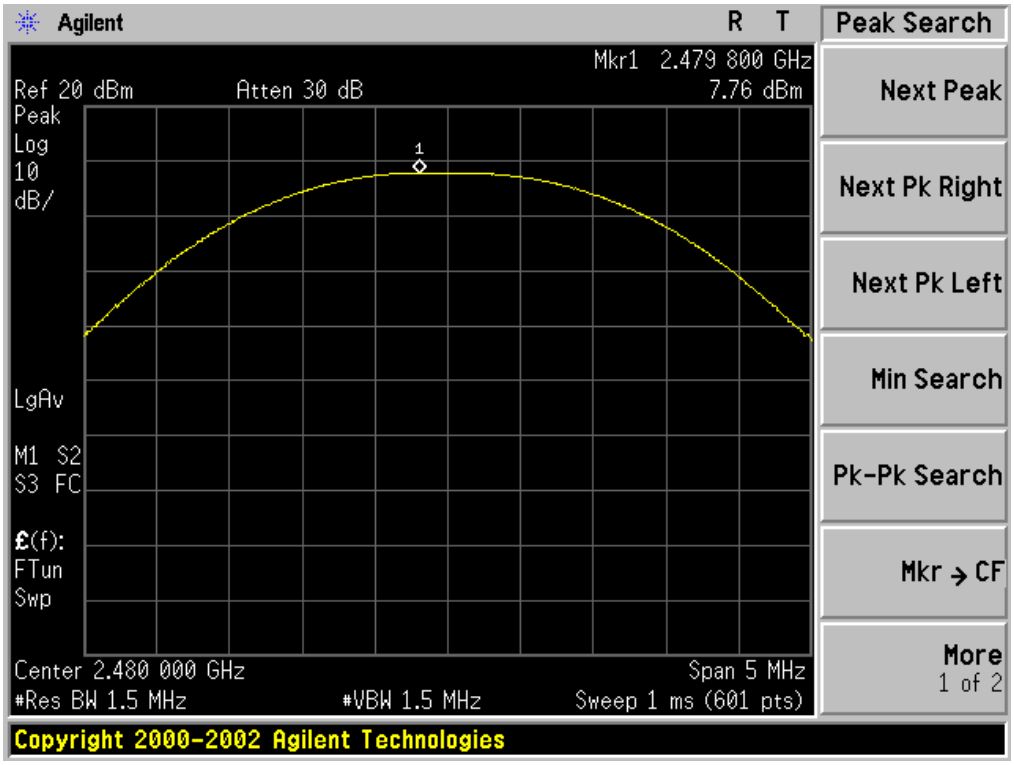
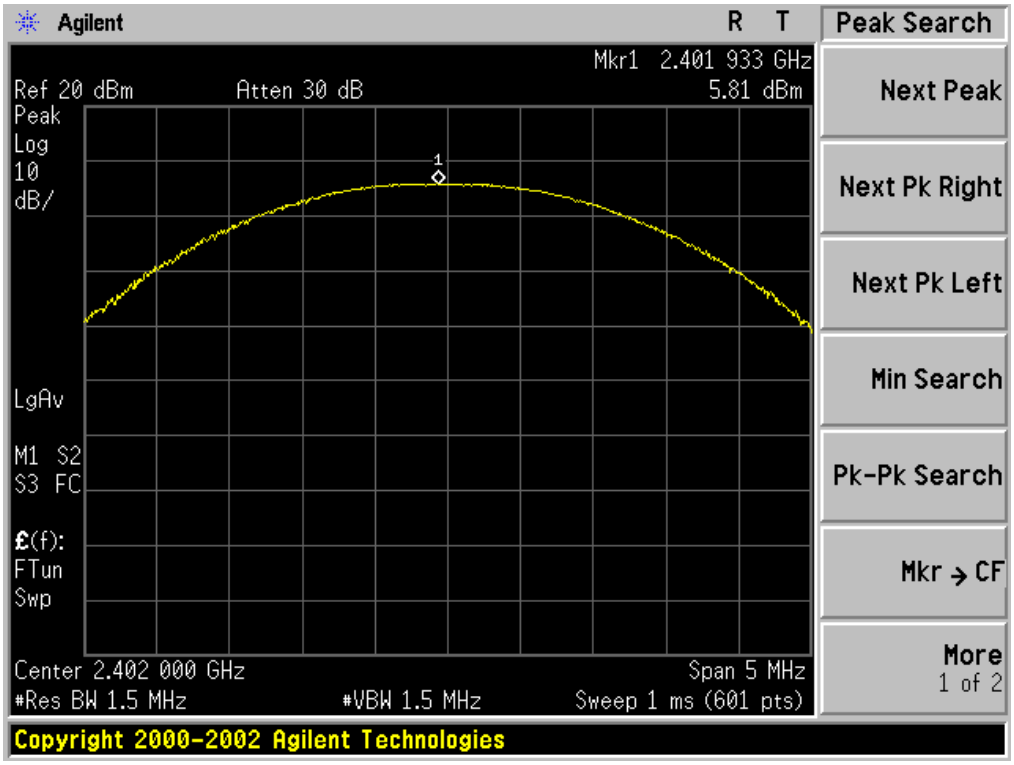

Agilent
R T
Peak Search
Mkr1 2.479 800 GHz
Ref 20 dBm
Atten 30 dB
7.76 dBm
Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
£(f):
FTun
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.480 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
Copyright 2000-2002 Agilent Technologies

PEAK OUTPUT POWER MEASUREMENT RESULT FOR Π /4-DQPSK MODULATION			
Frequency (GHz)	**Peak Power (dBm)**	**Applicable Limits (dBm)**	**Pass or Fail**
2.402	5.81	21	Pass
2.441	6.77	21	Pass
2.480	7.05	21	Pass

CH0



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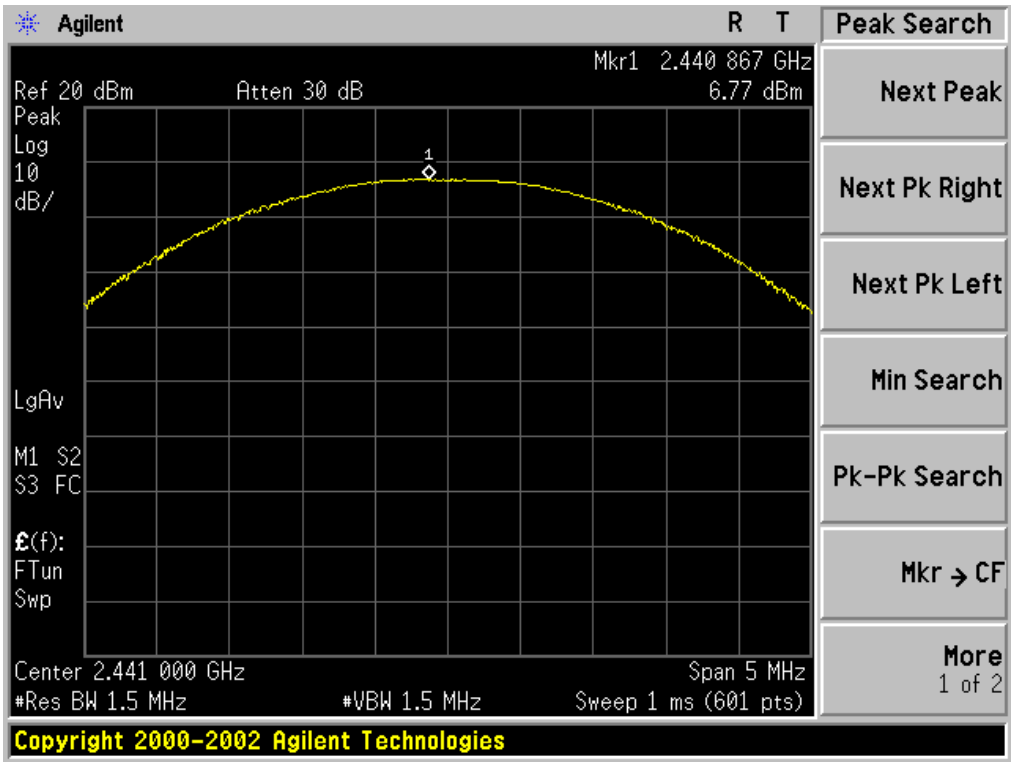
Agilent
R T
Peak Search
Mkr1 2.440 867 GHz
Ref 20 dBm
Atten 30 dB
6.77 dBm
Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
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FTun
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.441 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
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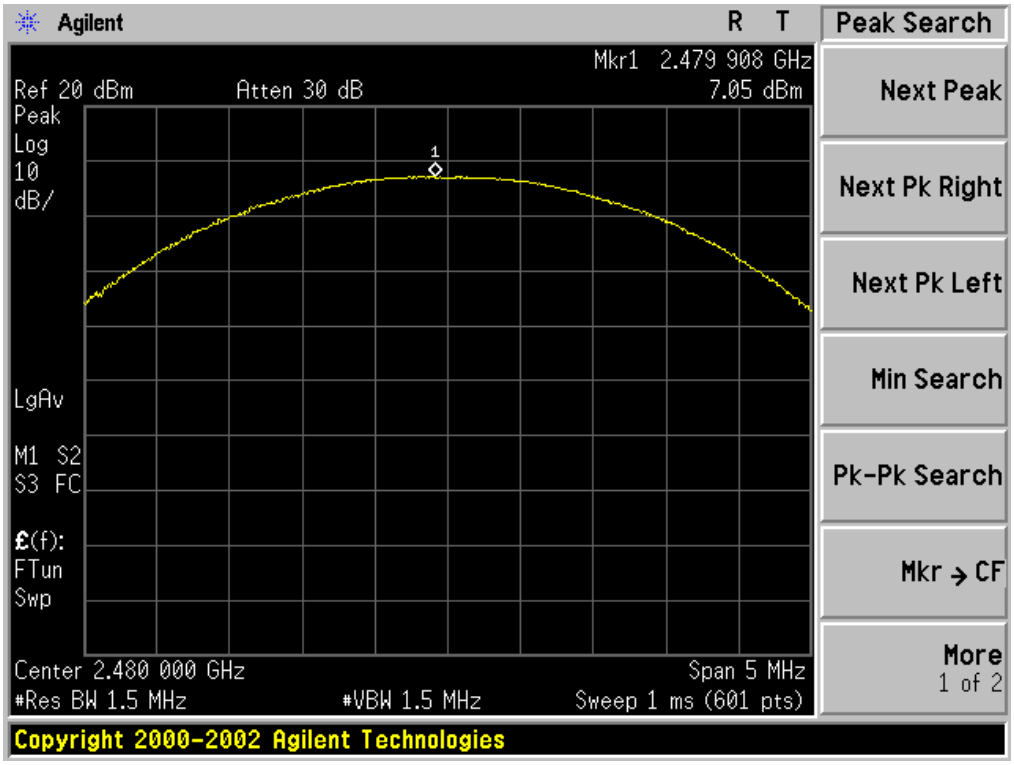
Agilent
R T
Peak Search
Mkr1 2.479 908 GHz
Ref 20 dBm
Atten 30 dB
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dB/
LgAv
M1 S2
S3 FC
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Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.480 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
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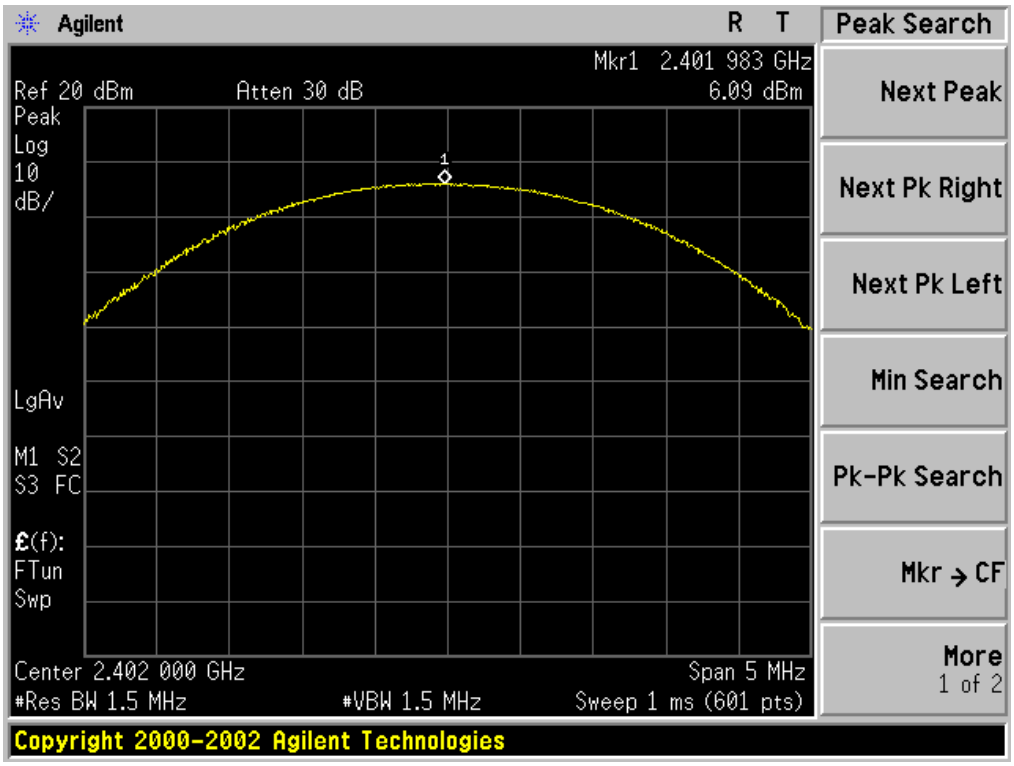
PEAK OUTPUT POWER MEASUREMENT RESULT FOR 8-DPSK MODULATION			
Frequency (GHz)	**Peak Power (dBm)**	**Applicable Limits (dBm)**	**Pass or Fail**
2.402	6.09	21	Pass
2.441	6.89	21	Pass
2.480	7.18	21	Pass

CH0



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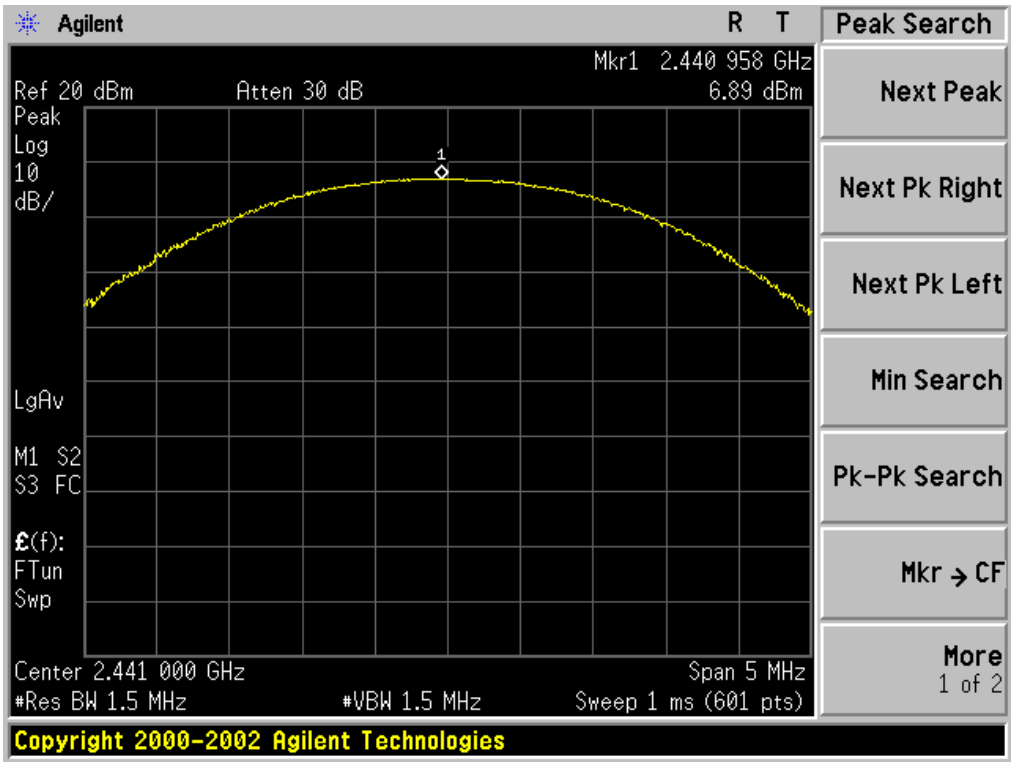
Agilent
R T
Peak Search
Mkr1 2.440 958 GHz
Ref 20 dBm
Atten 30 dB
6.89 dBm
Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
£(f):
FTun
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.441 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
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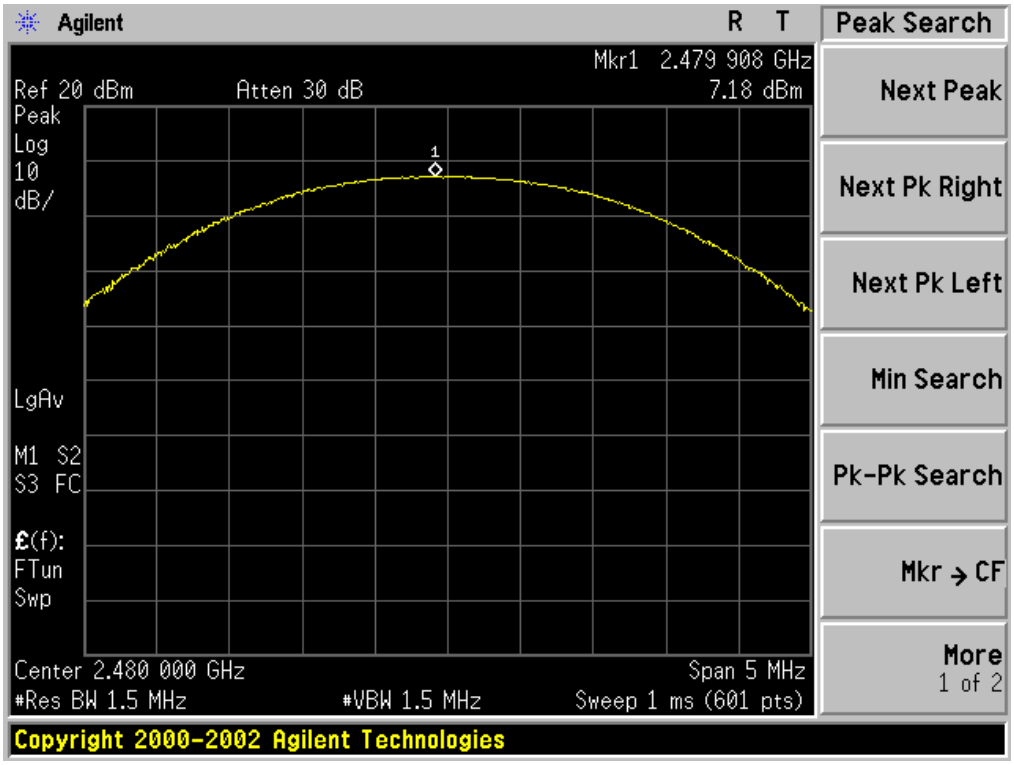
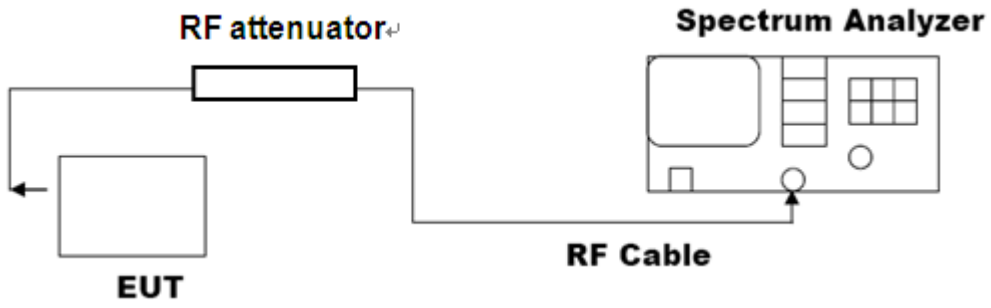

Agilent
R T
Peak Search
Mkr1 2.479 908 GHz
Ref 20 dBm
Atten 30 dB
7.18 dBm
Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
£(f):
FTun
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.480 000 GHz
Span 5 MHz
#Res BW 1.5 MHz
#VBW 1.5 MHz
Sweep 1 ms (601 pts)
Copyright 2000-2002 Agilent Technologies

8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hoping channel
   RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

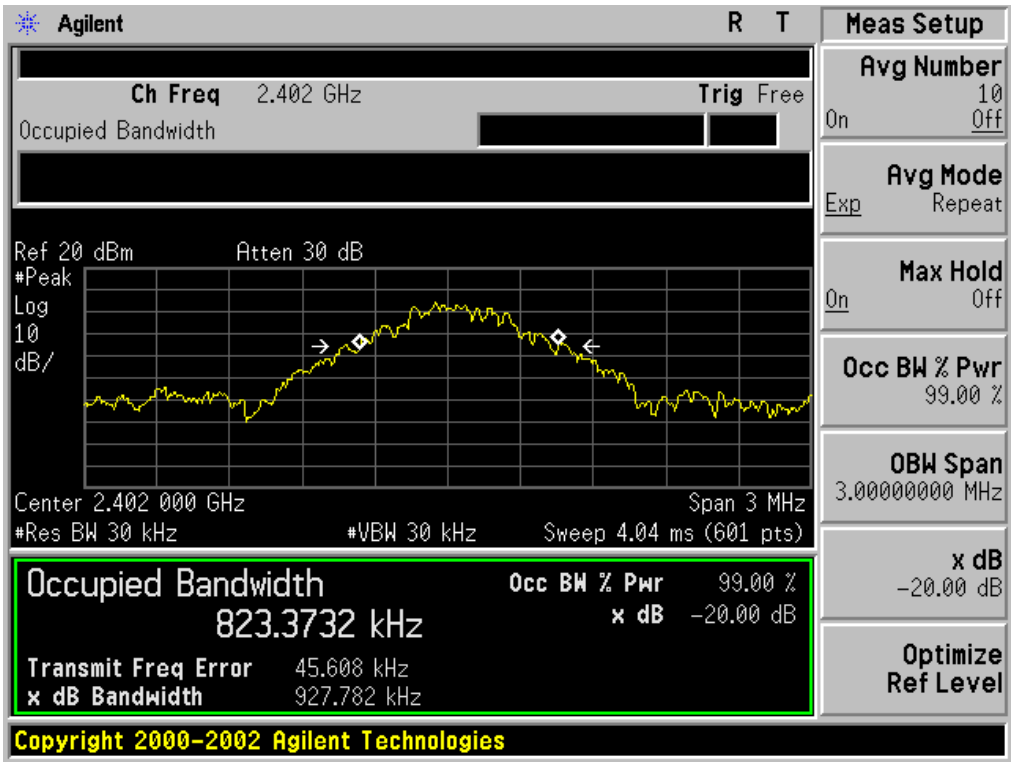
8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



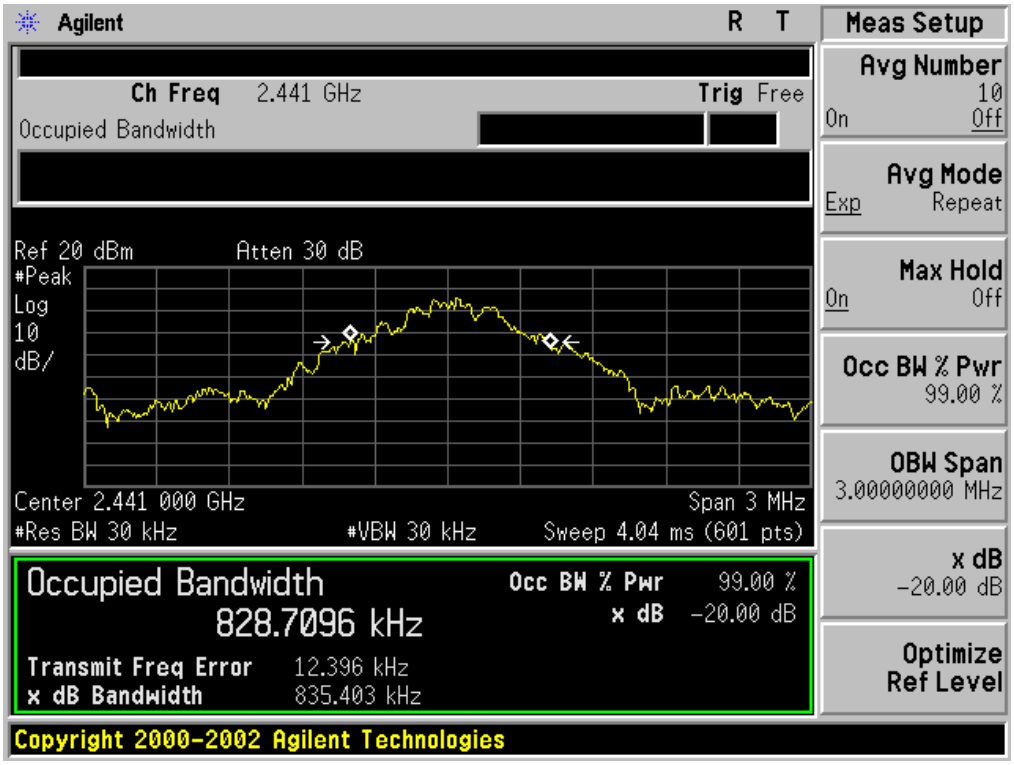
8.3. LIMITS AND MEASUREMENT RESULTS

BLUETOOTH 1MBPS LIMITS AND MEASUREMENT RESUL			
Applicable Limits	Measurement Result		
	Test Data (MHz)		Criteria
N/A	Low Channel	0.928	PASS
	Middle Channel	0.835	PASS
	High Channel	0.884	PASS

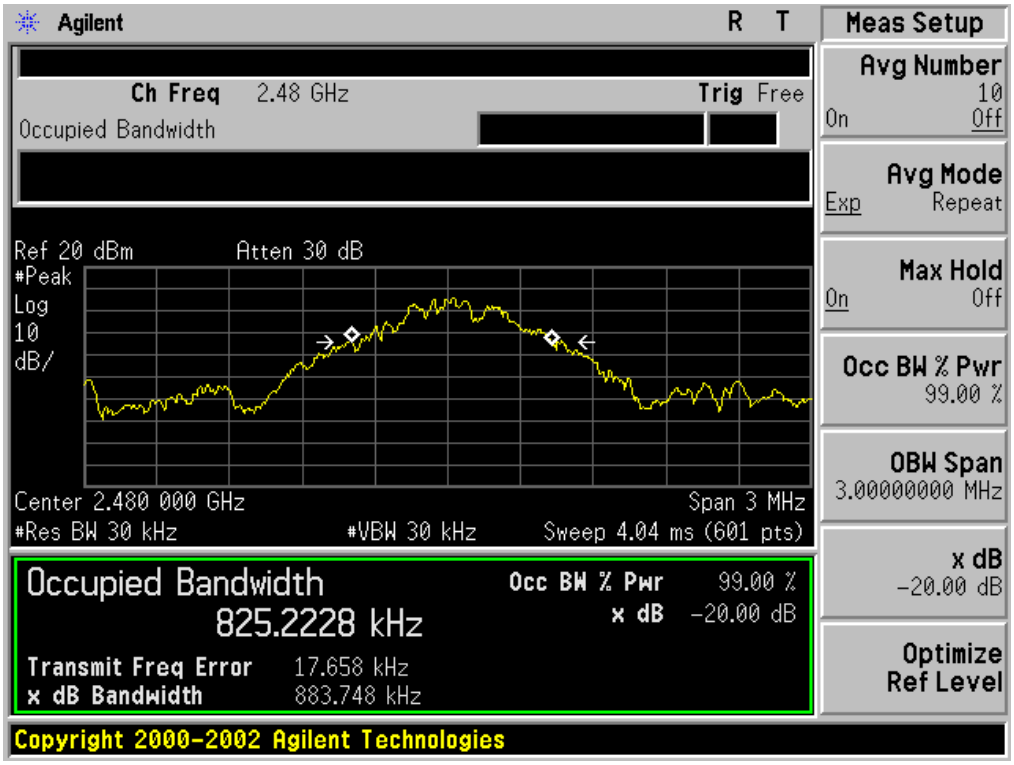
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

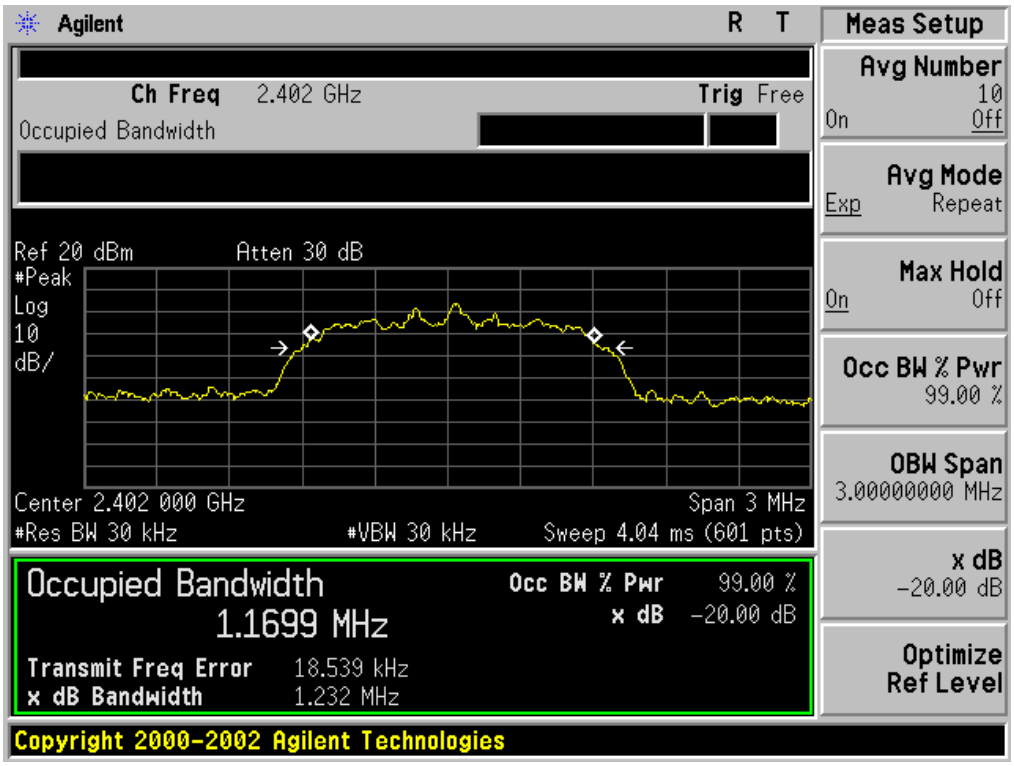


TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

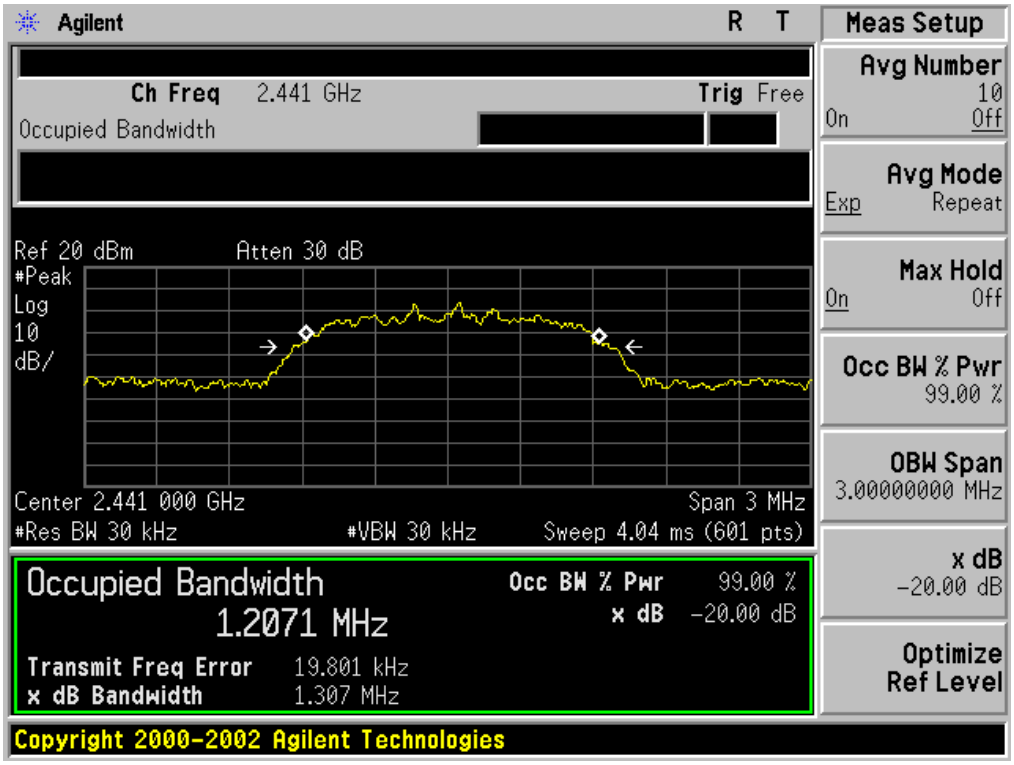


BLUETOOTH 2MBPS LIMITS AND MEASUREMENT RESUL			
Applicable Limits	**Measurement Result**		
	Test Data (MHz)		**Criteria**
N/A	Low Channel	1.232	PASS
	Middle Channel	1.307	PASS
	High Channel	1.232	PASS

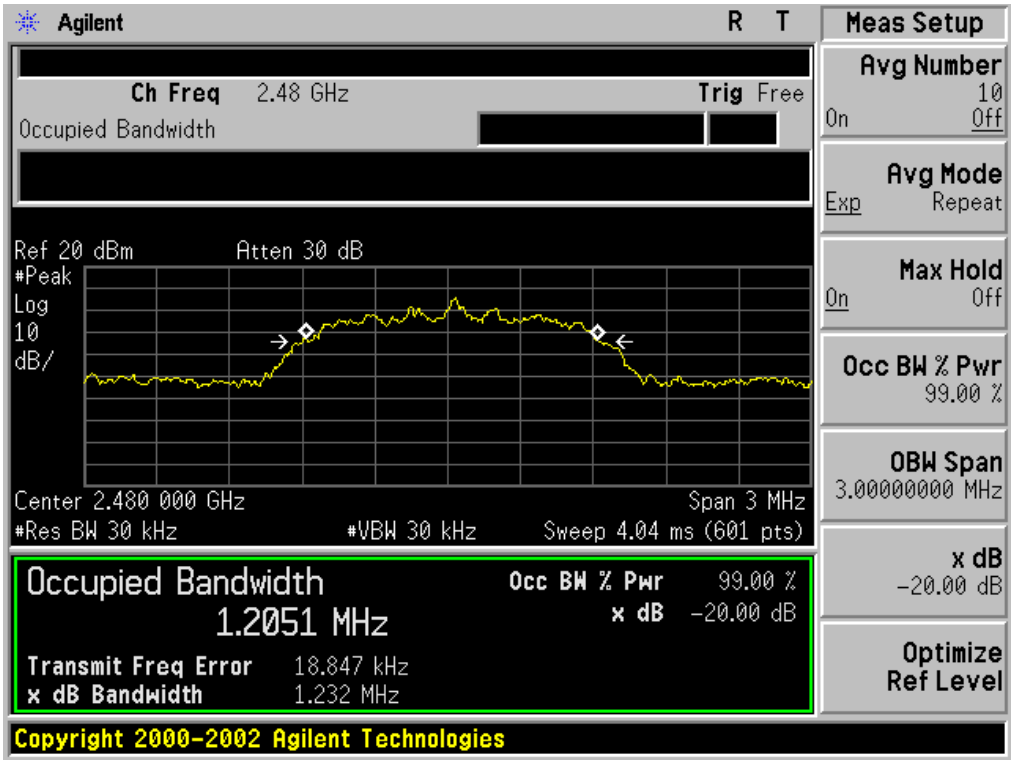
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

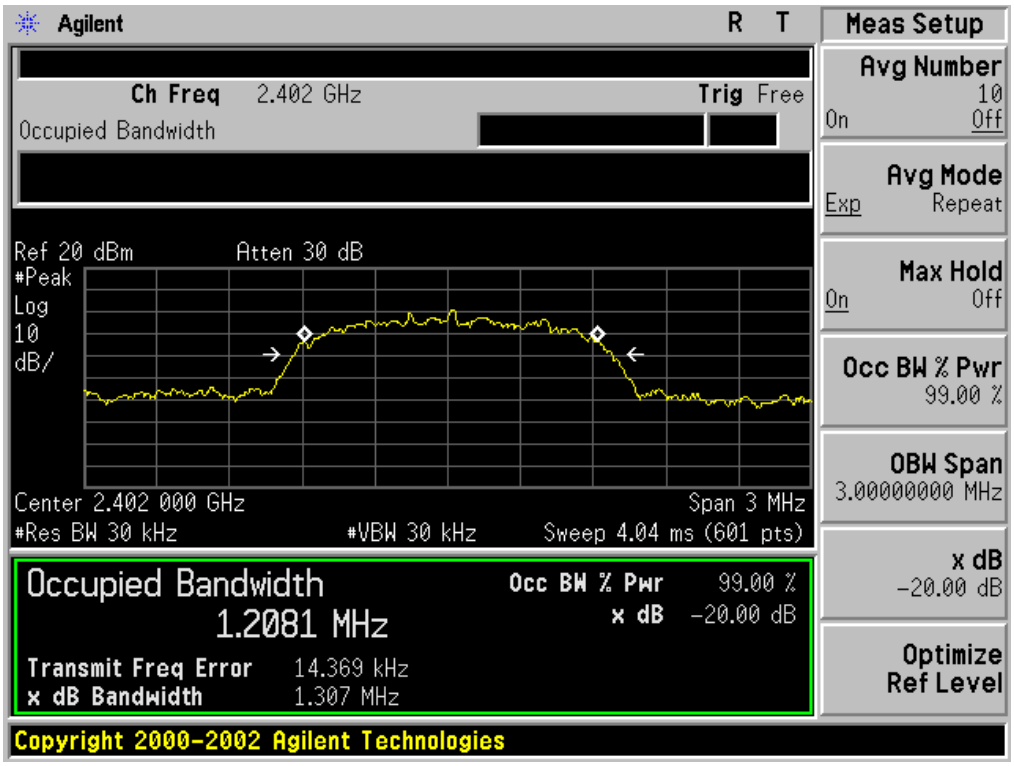


TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

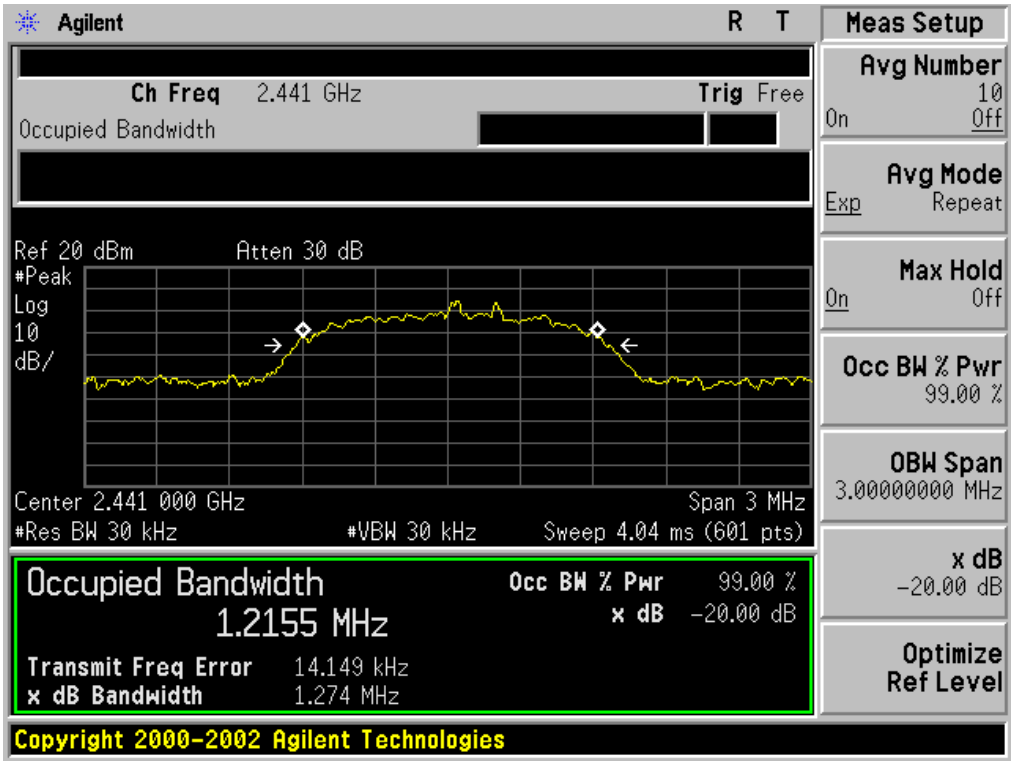


BLUETOOTH 3MBPS LIMITS AND MEASUREMENT RESUL			
Applicable Limits	Measurement Result		
	Test Data (MHz)		Criteria
N/A	Low Channel	1.307	PASS
	Middle Channel	1.274	PASS
	High Channel	1.296	PASS

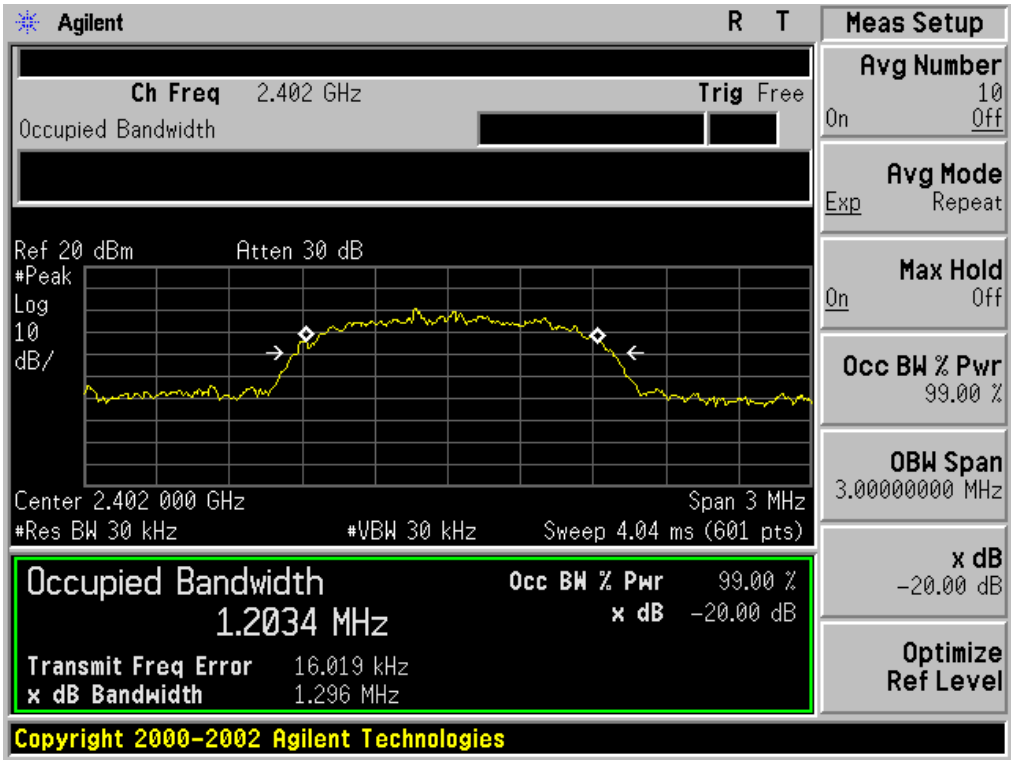
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL



9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
   RBW = 100 kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

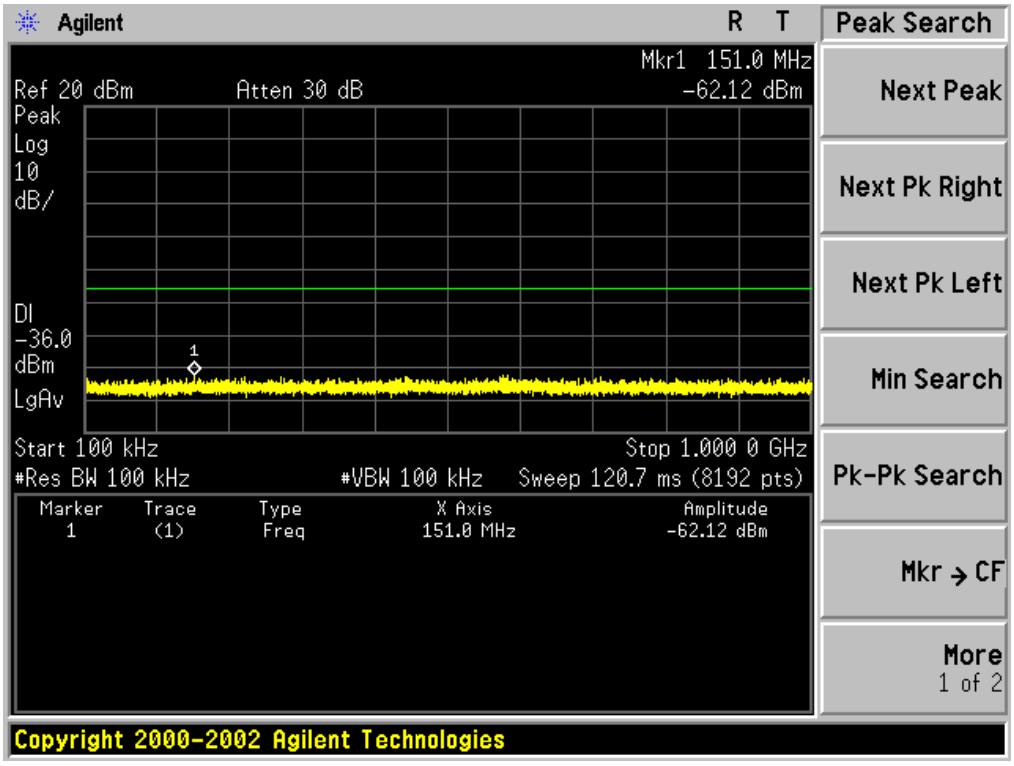
9.3. MEASUREMENT EQUIPMENT USED

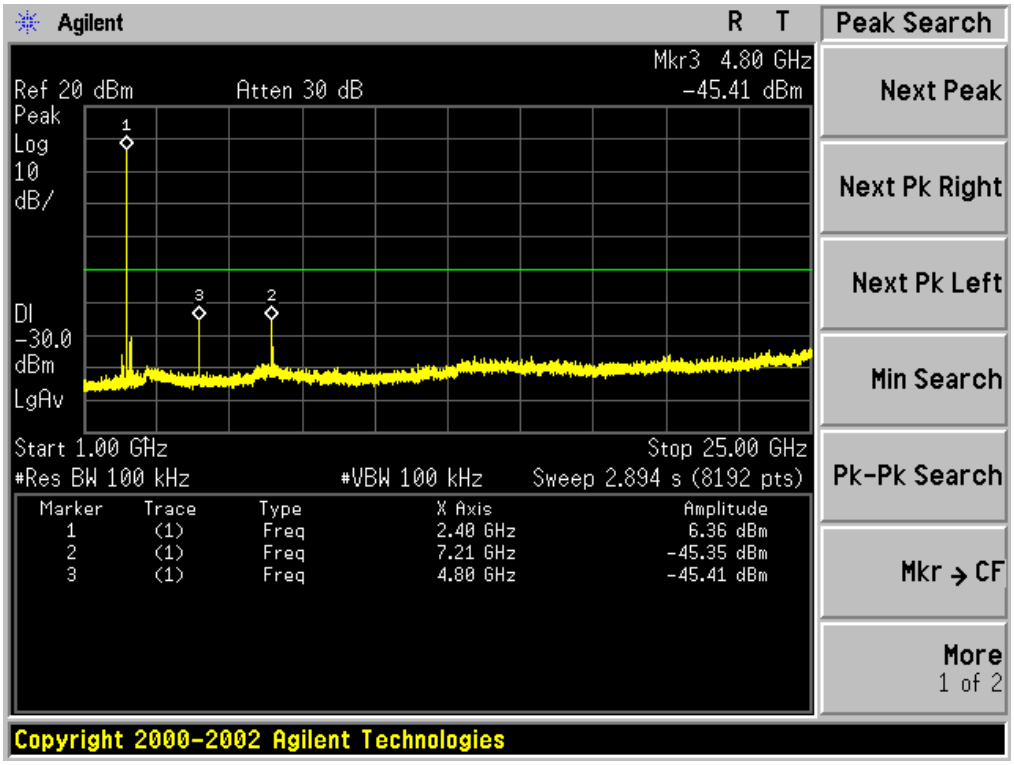
The same as described in section 6

9.4. LIMITS AND MEASUREMENT RESULT

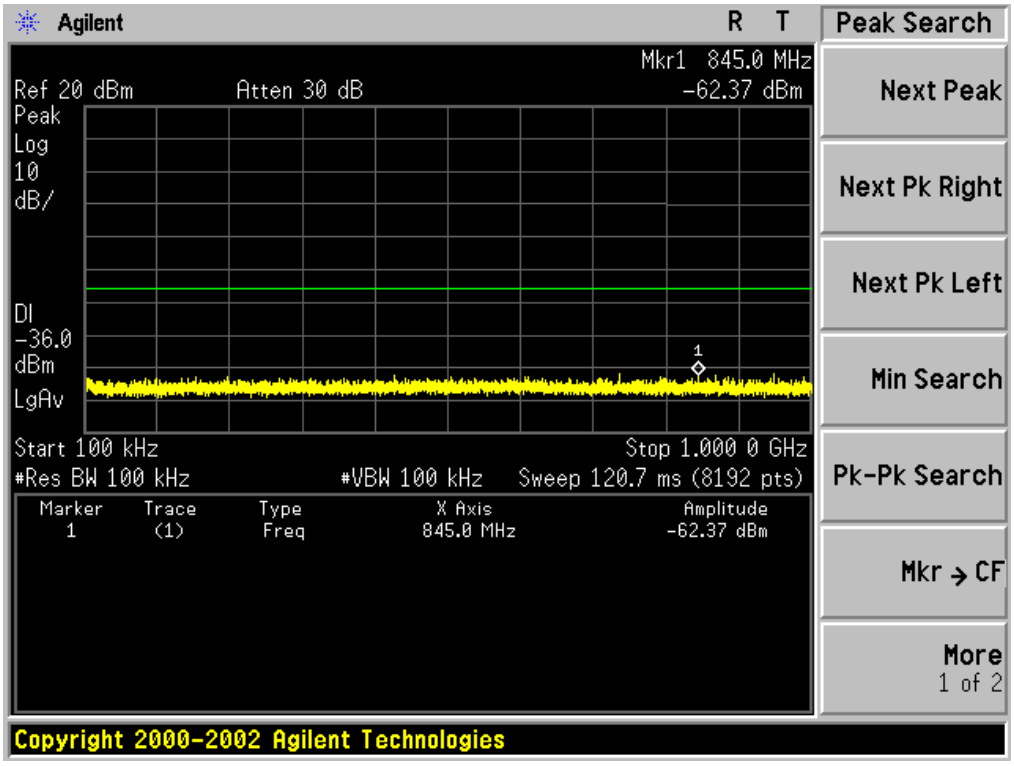
LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

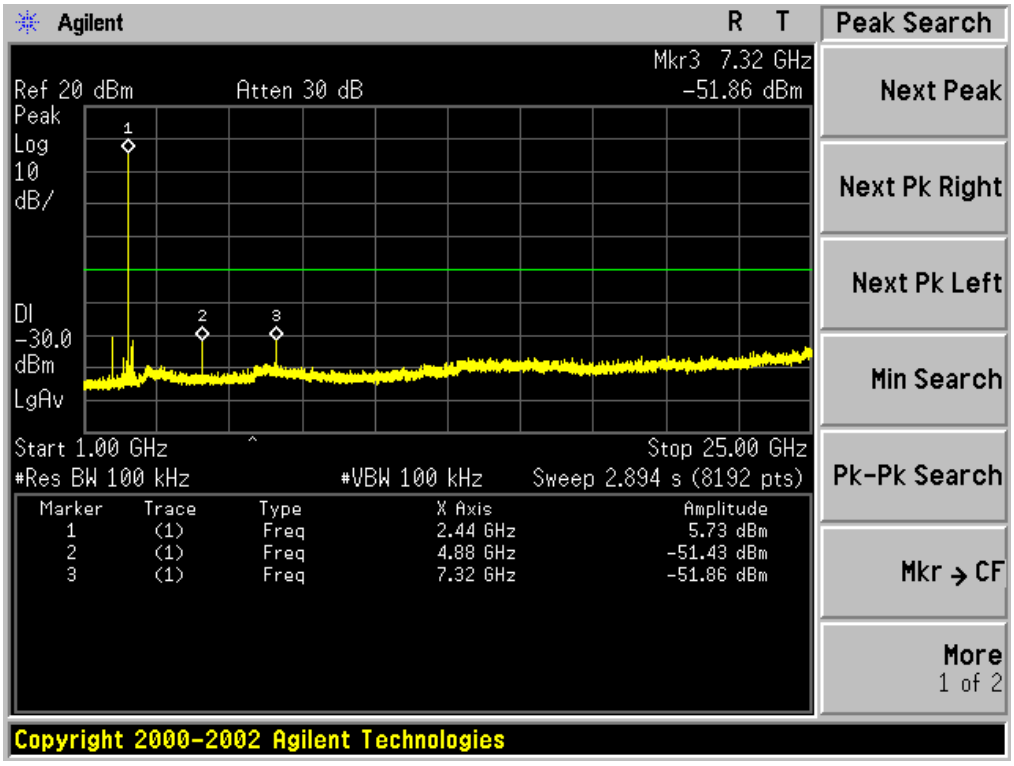
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF GFSK MODULATION IN LOW CHANNEL



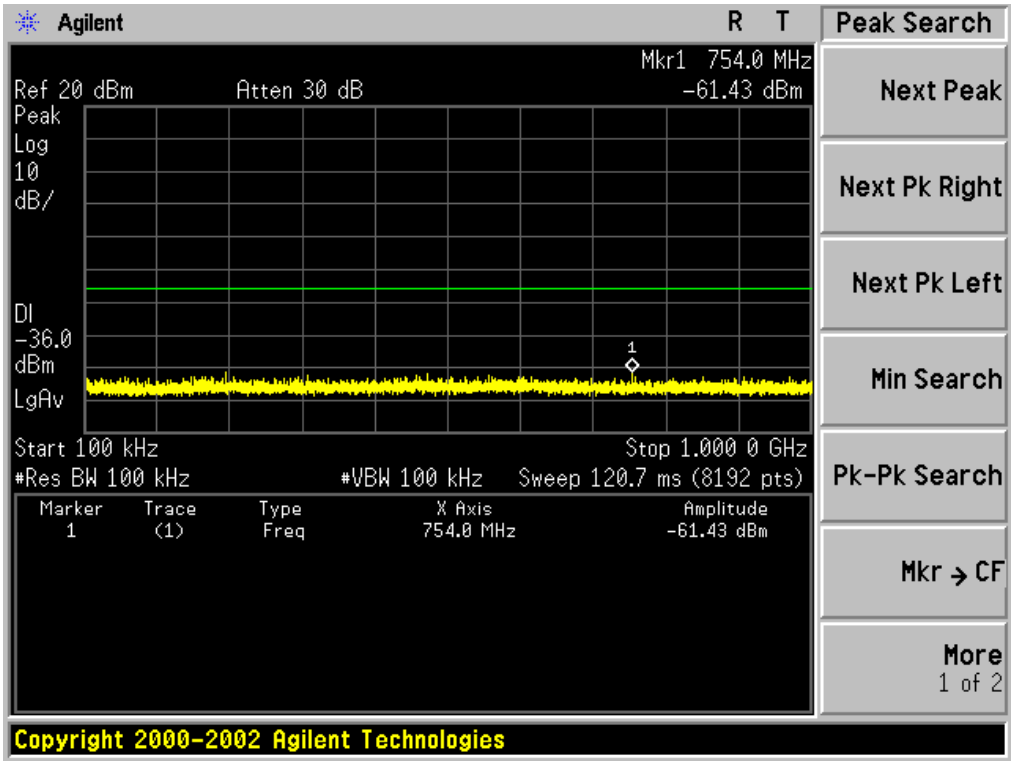


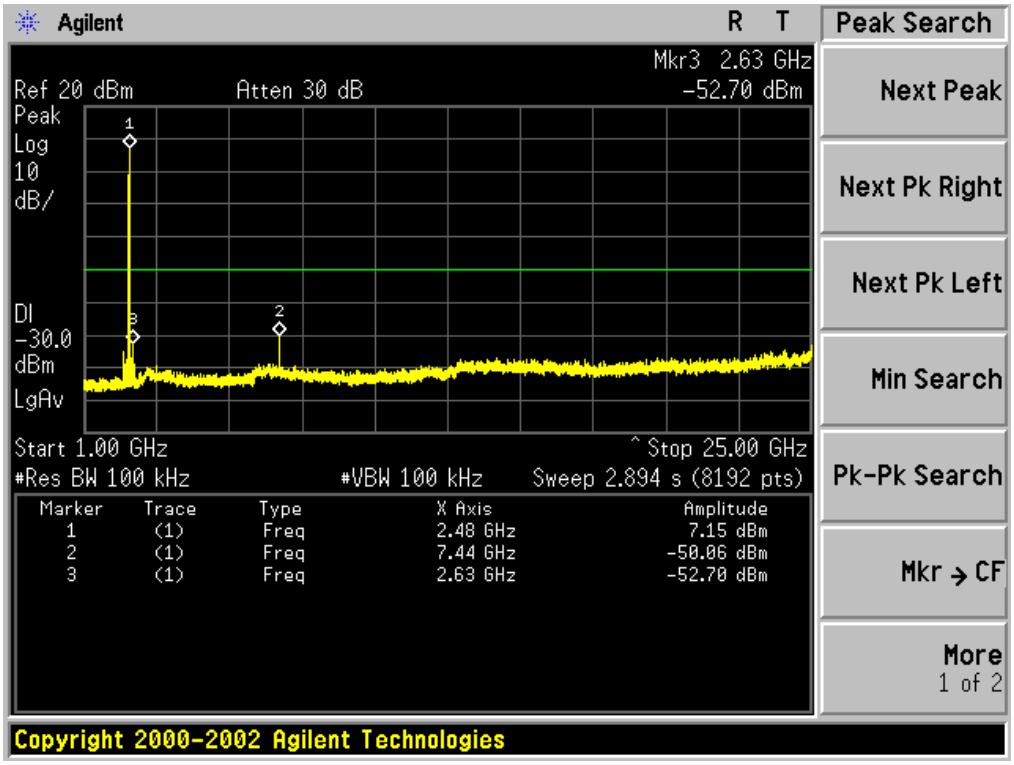
TEST PLOT OF OUT OF BAND EMISSIONS
OF GFSK MODULATION IN MIDDLE CHANNEL





TEST PLOT OF OUT OF BAND EMISSIONS
OF GFSK MODULATION IN HIGH CHANNEL





10. RADIATED EMISSION

10.1. MEASUREMENT PROCEDURE

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground. EUT is placed in the middle of the desk, and opposite the horn antenna.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:

(1) Span shall wide enough to fully capture the emission being measured;
(2) Set RBW=100 kHz for f < 1 GHz, RBW=1.5MHz for f>1GHz ; VBW ⩾ RBW; Sweep = auto;
Detector function = peak; Trace = max hold for peak
(3) For average measurement: use duty cycle correction factor method per 15.35(c).
Duty cycle = On time/100 milliseconds
On time = N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln
Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + 20*log(Duty cycle)

6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

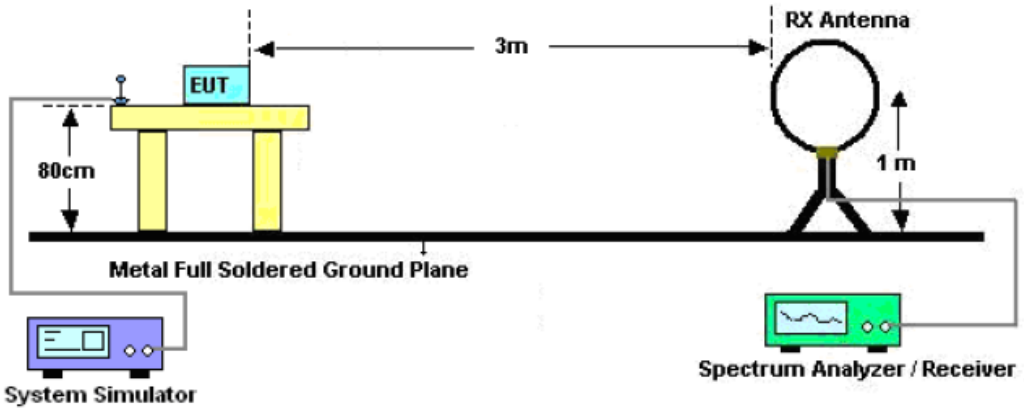
The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/1MHz for Peak, 1MHz/10Hz for Average

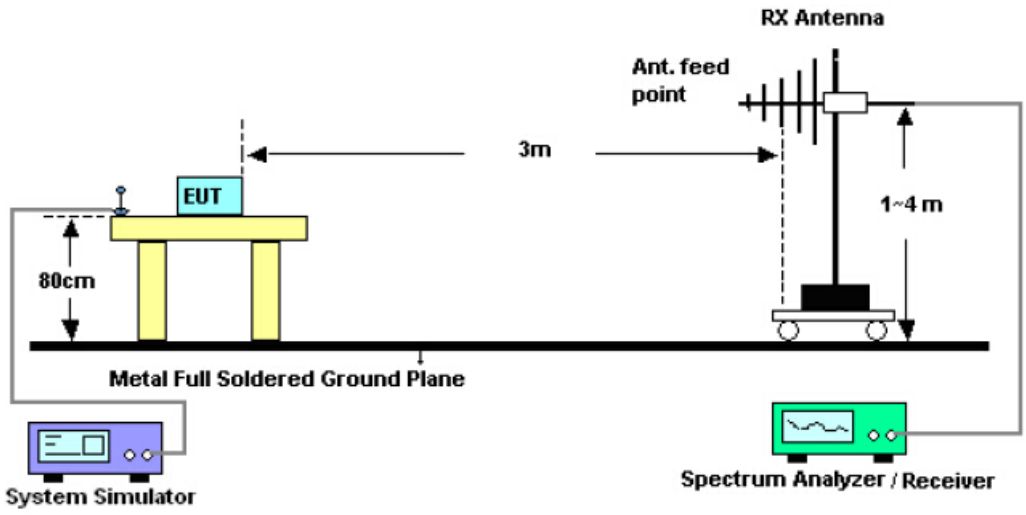
Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

10.2. TEST SETUP

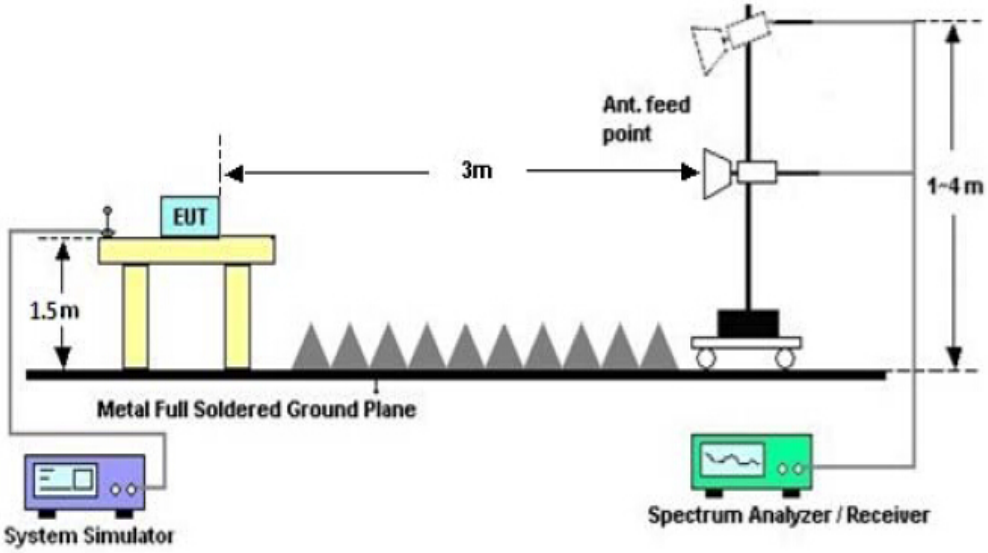
RADIATED EMISSION TEST SETUP BELOW 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



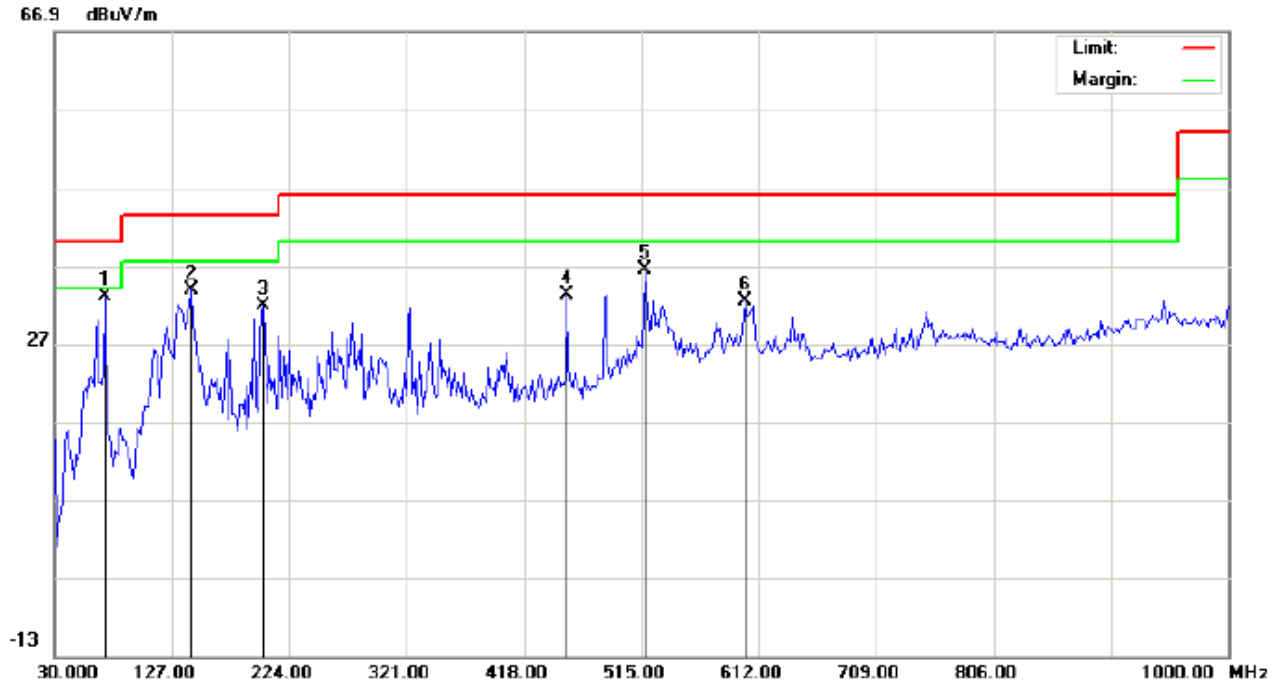
10.3. TEST RESULT (Worst Modulation: GFSK)

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION BELOW 1GHZ

RADIATED EMISSION TEST- (30MHZ-1GHZ)-LOW CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: Low Channel TX
Note:

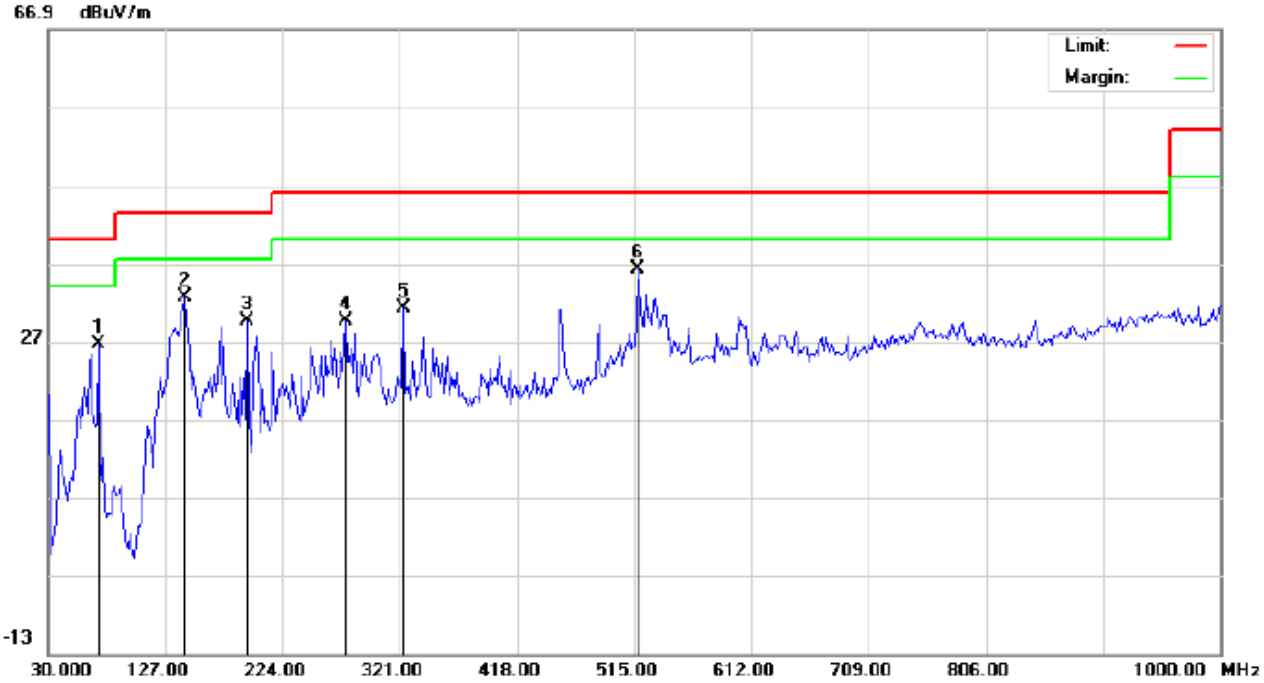
Polarization: *Horizontal*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	72.0333	22.77	10.17	32.94	40.00	-7.06	peak			
2		143.1667	18.68	15.22	33.90	43.50	-9.60	peak			
3		202.9833	19.62	12.11	31.73	43.50	-11.77	peak			
4		453.5667	12.50	20.63	33.13	46.00	-12.87	peak			
5		518.2333	14.69	21.62	36.31	46.00	-9.69	peak			
6		600.6833	8.60	23.73	32.33	46.00	-13.67	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ)-LOW CHANNEL -VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: Low Channel TX
Note:

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

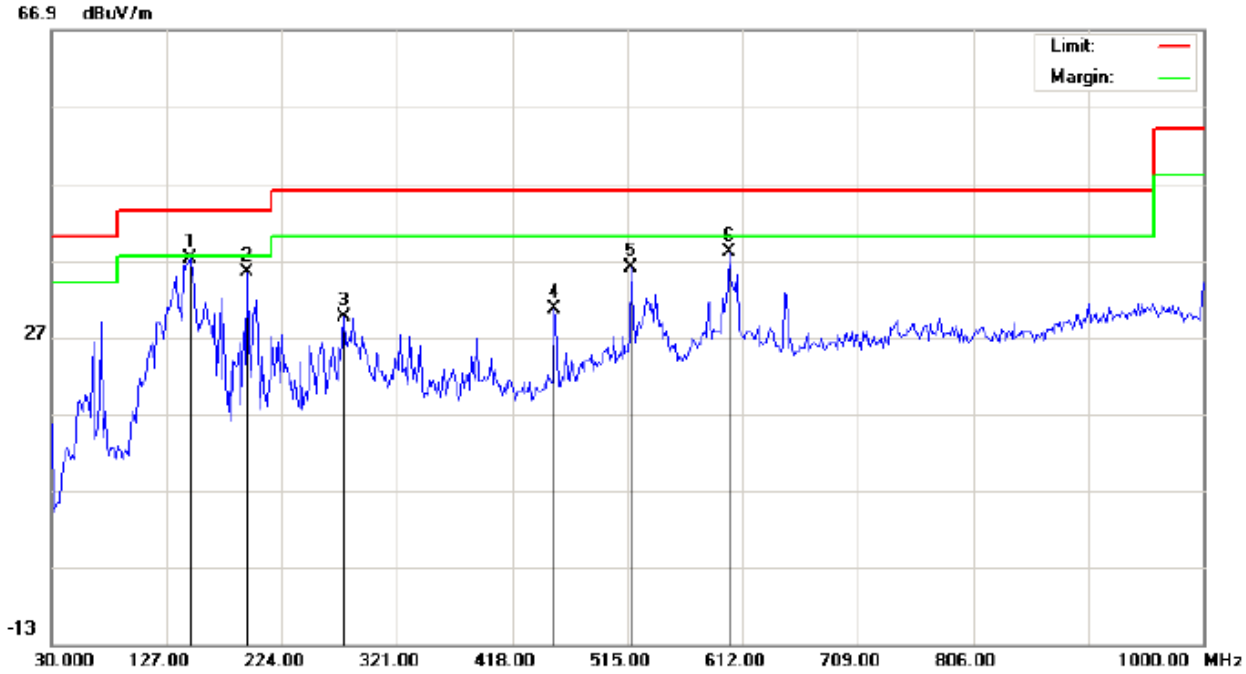
No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		72.0333	22.78	3.76	26.54	40.00	-13.46	peak			
2		143.1667	17.32	15.22	32.54	43.50	-10.96	peak			
3		194.9000	19.41	10.29	29.70	43.50	-13.80	peak			
4		275.7333	14.92	14.68	29.60	46.00	-16.40	peak			
5		324.2333	14.24	17.02	31.26	46.00	-14.74	peak			
6	*	518.2333	14.67	21.62	36.29	46.00	-9.71	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

RADIATED EMISSION TEST- (30MHZ-1GHZ)-MIDDLE CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: Middle Channel TX
Note:

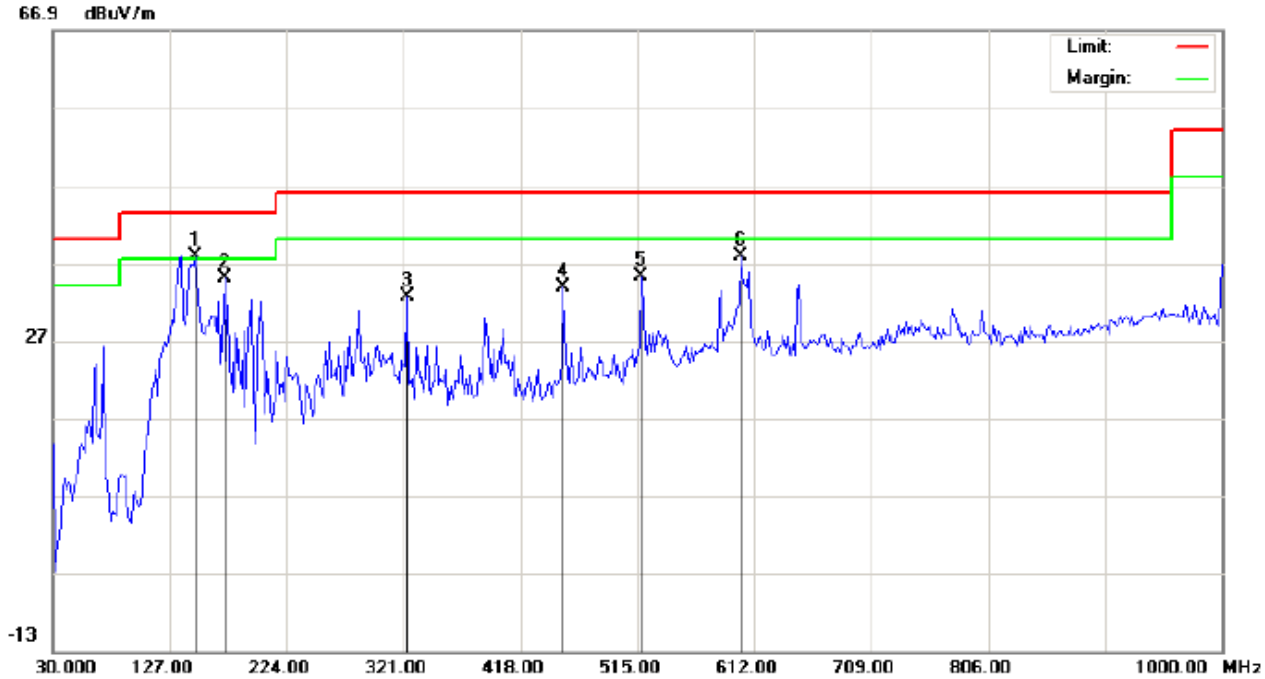
Polarization: *Horizontal*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	146.4000	21.90	15.24	37.14	43.50	-6.36	peak			
2		194.9000	23.59	11.76	35.35	43.50	-8.15	peak			
3		275.7333	15.01	14.68	29.69	46.00	-16.31	peak			
4		453.5667	10.05	20.63	30.68	46.00	-15.32	peak			
5		518.2333	14.47	21.62	36.09	46.00	-9.91	peak			
6		600.6833	14.21	23.73	37.94	46.00	-8.06	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ)- MIDDLE CHANNEL -VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: Middle Channel TX
Note:

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

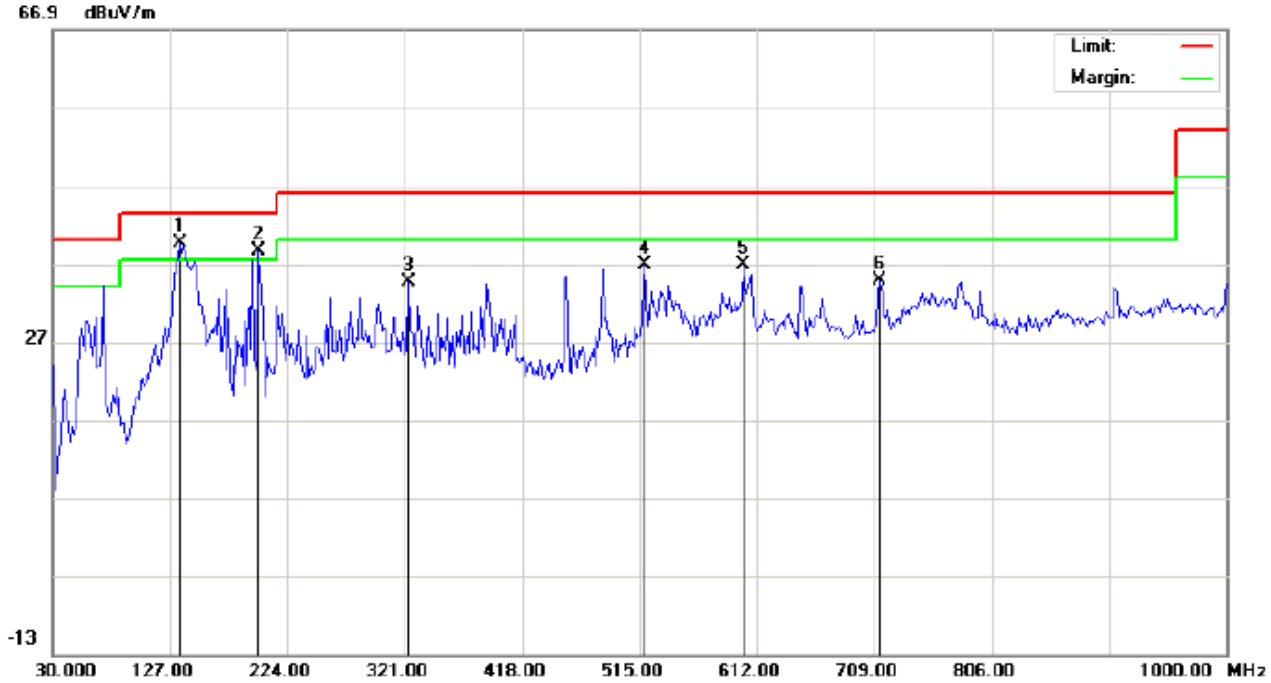
No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	148.0167	22.54	15.25	37.79	43.50	-5.71	peak			
2		172.2667	20.35	14.56	34.91	43.50	-8.59	peak			
3		324.2333	15.49	17.02	32.51	46.00	-13.49	peak			
4		453.5667	13.24	20.63	33.87	46.00	-12.13	peak			
5		518.2333	13.57	21.62	35.19	46.00	-10.81	peak			
6		600.6833	15.08	22.75	37.83	46.00	-8.17	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

RADIATED EMISSION TEST- (30MHZ-1GHZ)-HIGH CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: High Channel TX
Note:

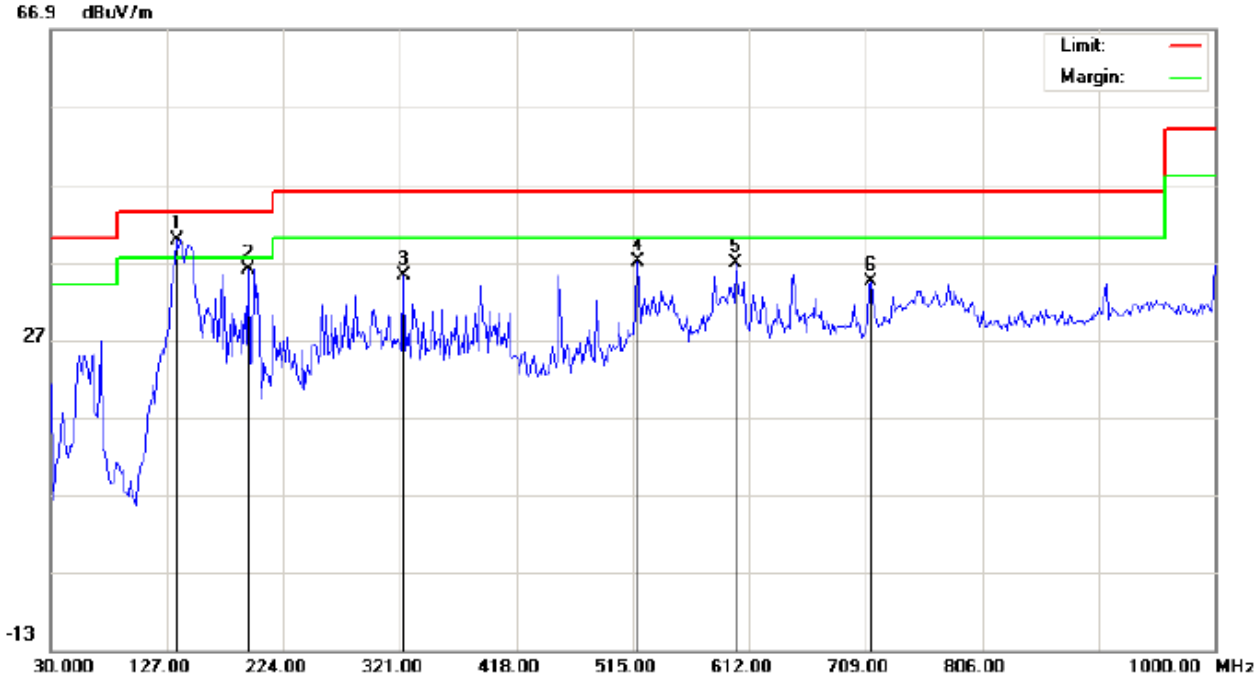
Polarization: *Horizontal*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	135.0833	25.23	14.38	39.61	43.50	-3.89	peak			
2	!	199.7500	26.55	11.99	38.54	43.50	-4.96	peak			
3		324.2333	17.66	17.02	34.68	46.00	-11.32	peak			
4		519.8500	15.09	21.67	36.76	46.00	-9.24	peak			
5		600.6833	13.05	23.73	36.78	46.00	-9.22	peak			
6		713.8500	9.20	25.59	34.79	46.00	-11.21	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ)-HIGH CHANNEL -VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: HBC Remote
M/N: HBCR001
Mode: High Channel TX
Note:

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	135.0833	26.61	13.15	39.76	43.50	-3.74	peak			
2		194.9000	25.72	10.29	36.01	43.50	-7.49	peak			
3		324.2333	18.09	17.02	35.11	46.00	-10.89	peak			
4		519.8500	15.39	21.67	37.06	46.00	-8.94	peak			
5		600.6833	14.13	22.75	36.88	46.00	-9.12	peak			
6		713.8500	8.73	25.59	34.32	46.00	-11.68	peak			

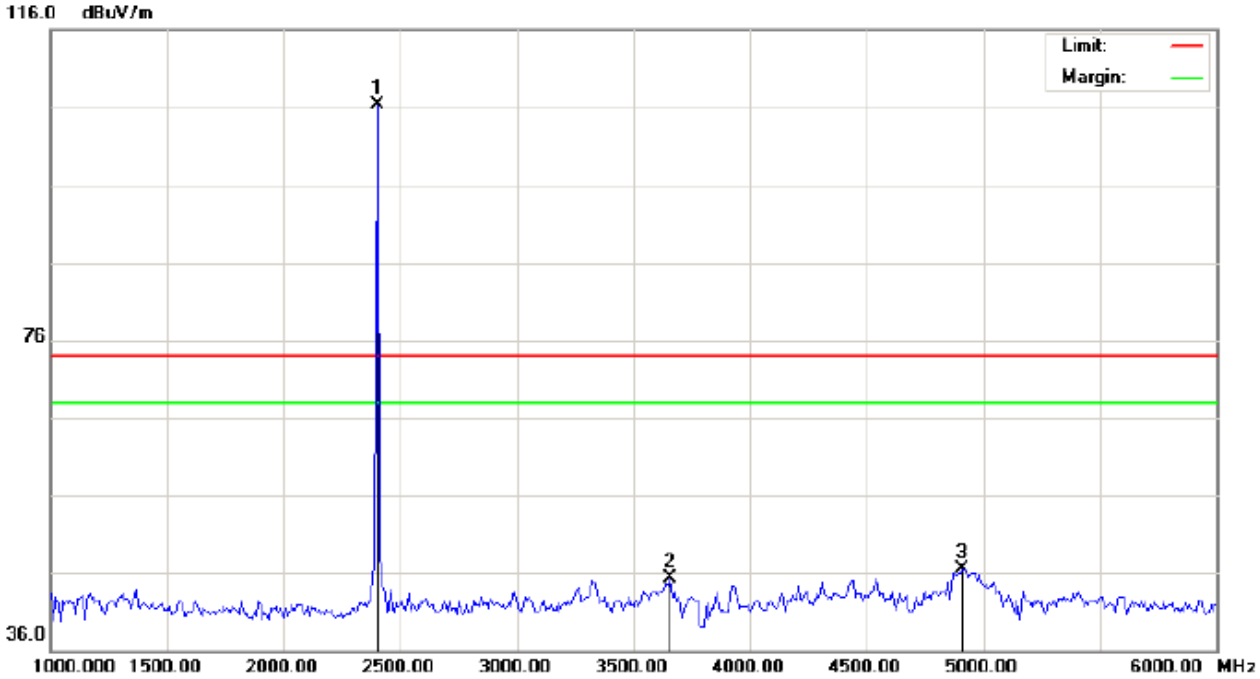
RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

RADIATED EMISSION ABOVE 1GHZ

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics)-LOW CHANNEL-HORIZONTAL

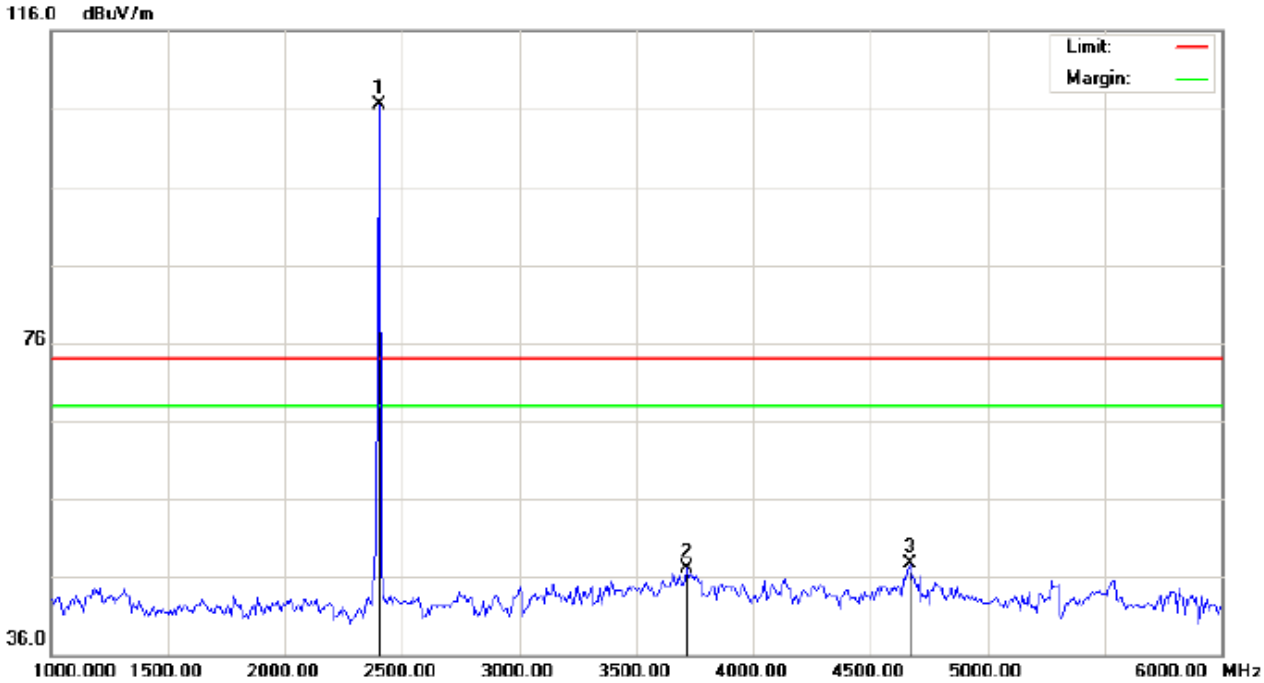


Site: site #1 | Polarization: *Horizontal* | Temperature: 26
Limit: FCC Class B 3M Radiation above 1GHZ(PK) | Power: | Humidity: 60 %
EUT: HBC Remote | Distance:
M/N: HBCR001
Mode: Low Channel TX
Note:

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2402.000	96.07	10.32	106.39	74.00	32.39	peak			
2		3658.333	32.28	13.09	45.37	74.00	-28.63	peak			
3		4908.333	38.53	7.96	46.49	74.00	-27.51	peak			

RESULT: PASS

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics)-LOW CHANNEL –VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: Low Channel TX
Note:

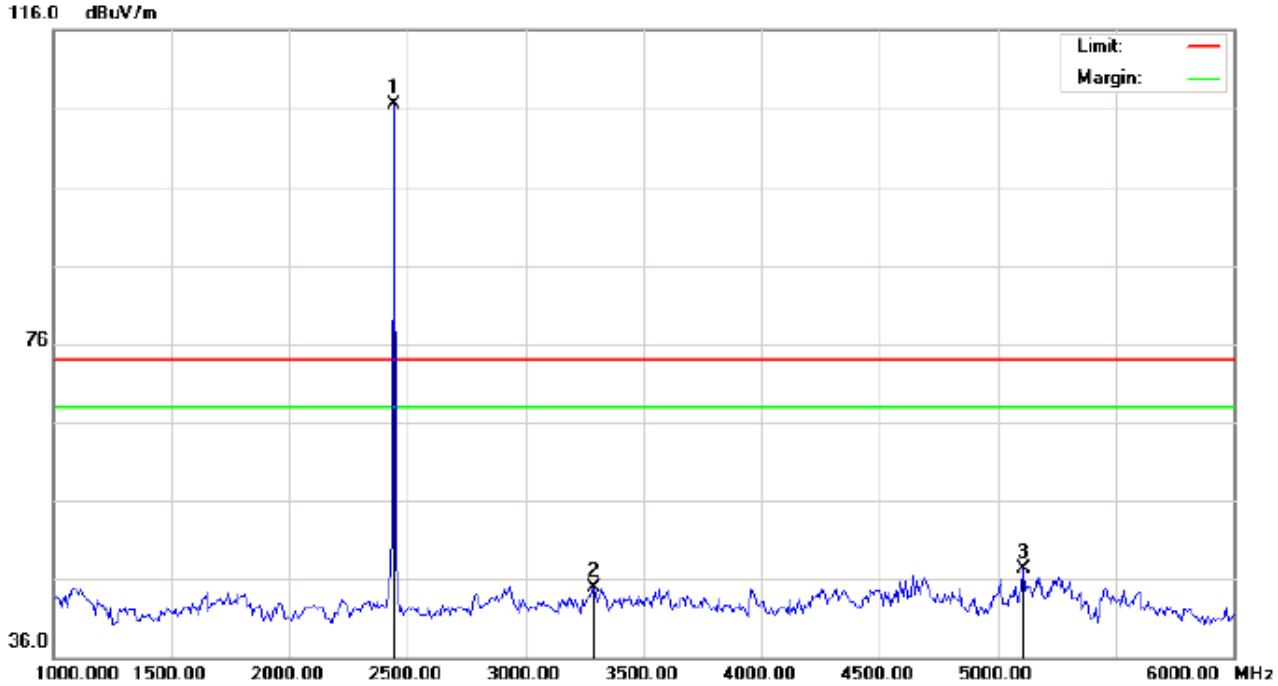
Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2402.000	96.20	10.32	106.52	74.00	32.52	peak			
2		3716.667	33.73	13.44	47.17	74.00	-26.83	peak			
3		4666.667	40.40	7.33	47.73	74.00	-26.27	peak			

RESULT: PASS

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics)-MIDDLE CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: Middle Channel TX
Note:

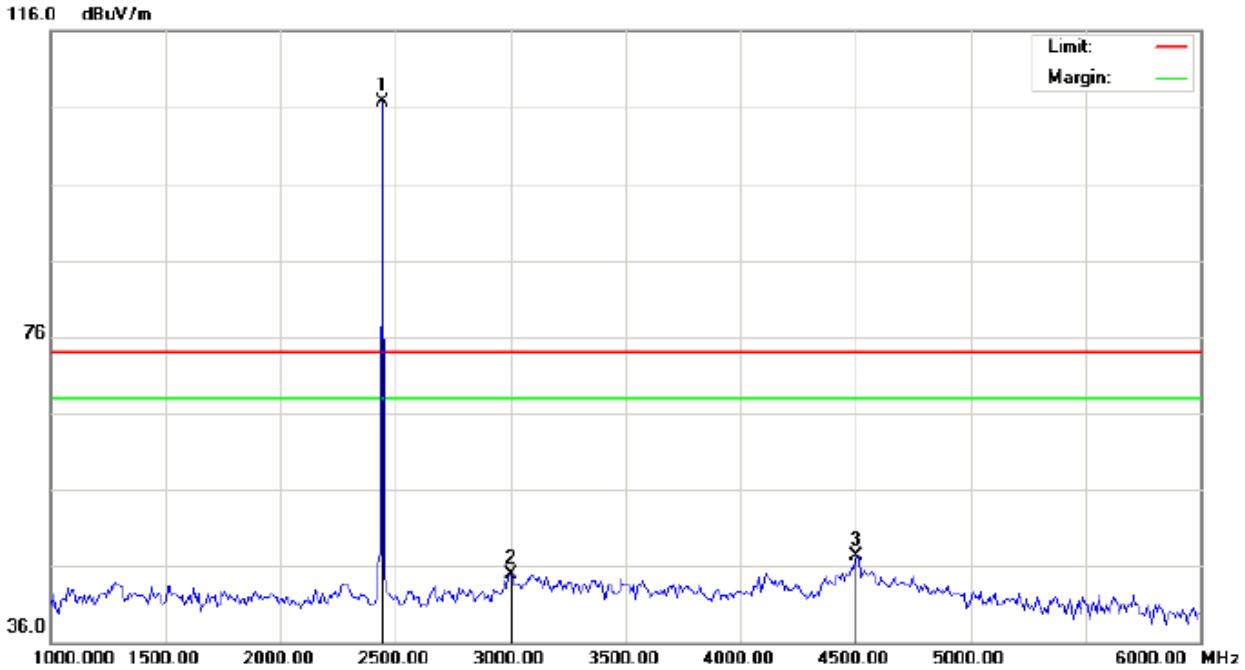
Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2441.000	96.10	10.37	106.47	74.00	32.47	peak			
2		3291.667	32.96	11.91	44.87	74.00	-29.13	peak			
3		5108.333	41.19	6.03	47.22	74.00	-26.78	peak			

RESULT: PASS

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics) - MIDDLE CHANNEL –VERTICAL

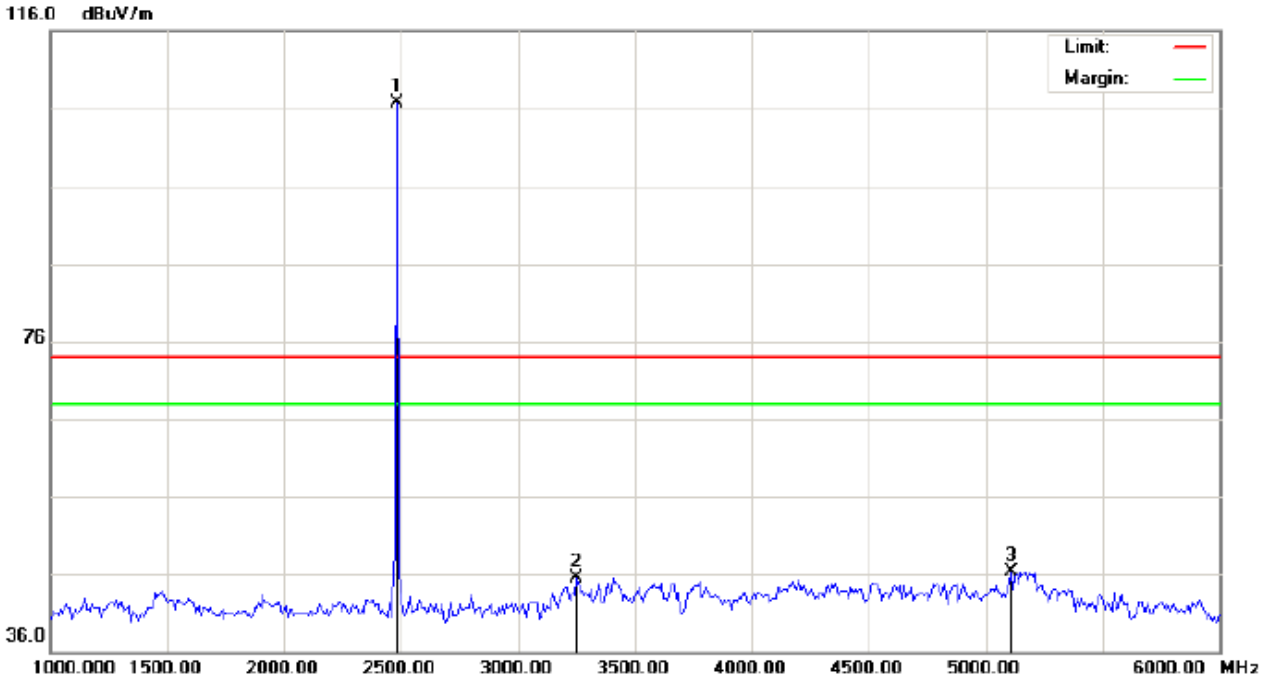


Site: site #1 | Polarization: *Vertical* | Temperature: 26
Limit: FCC Class B 3M Radiation above 1GHZ(PK) | Power: | Humidity: 60 %
EUT: HBC Remote | Distance:
M/N: HBCR001
Mode: Middle Channel TX
Note:

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2441.000	96.40	10.37	106.77	74.00	32.77	peak			
2		3000.000	33.28	11.64	44.92	74.00	-29.08	peak			
3		4500.000	40.39	6.89	47.28	74.00	-26.72	peak			

RESULT: PASS

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics)-HIGH CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: High Channel TX
Note:

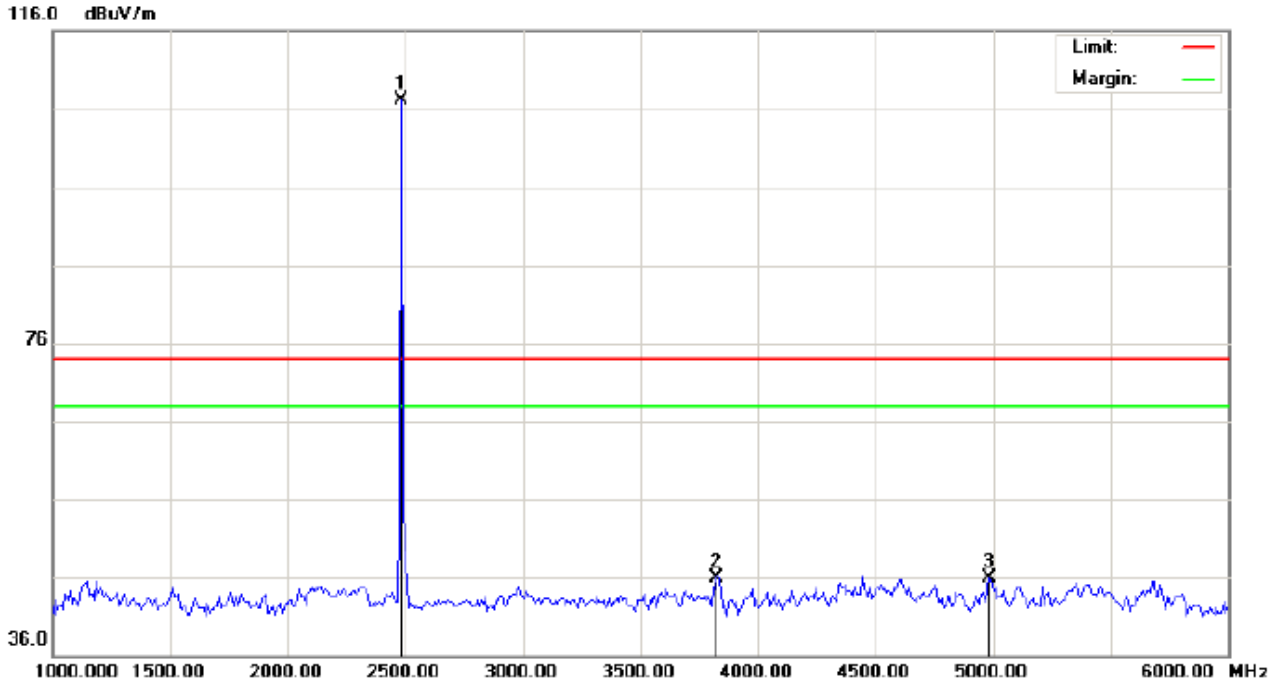
Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	96.39	10.41	106.80	74.00	32.80	peak			
2		3250.000	33.65	11.87	45.52	74.00	-28.48	peak			
3		5108.333	40.27	6.03	46.30	74.00	-27.70	peak			

RESULT: PASS

RADIATED EMISSION ABOVE 1GHZ (1-10th Harmonics)-HIGH CHANNEL –VERTICAL



Site: site #1 | Polarization: *Vertical* | Temperature: 26
Limit: FCC Class B 3M Radiation above 1GHZ(PK) | Power: | Humidity: 60 %
EUT: HBC Remote | Distance:
M/N: HBCR001
Mode: High Channel TX
Note:

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	96.76	10.41	107.17	74.00	33.17	peak			
2		3825.000	31.89	14.11	46.00	74.00	-28.00	peak			
3		4983.333	37.69	8.16	45.85	74.00	-28.15	peak			

RESULT: PASS

Note: 6~25GHz at least have 20dB margin. No recording in the test report.
Factor=Antenna Factor+ Cable loss-Amplifier gain, Margin=Measurement-Limit.
The “Factor” value can be calculated automatically by software of measurement system.

11. BAND EDGE EMISSION

11.1. MEASUREMENT PROCEDURE

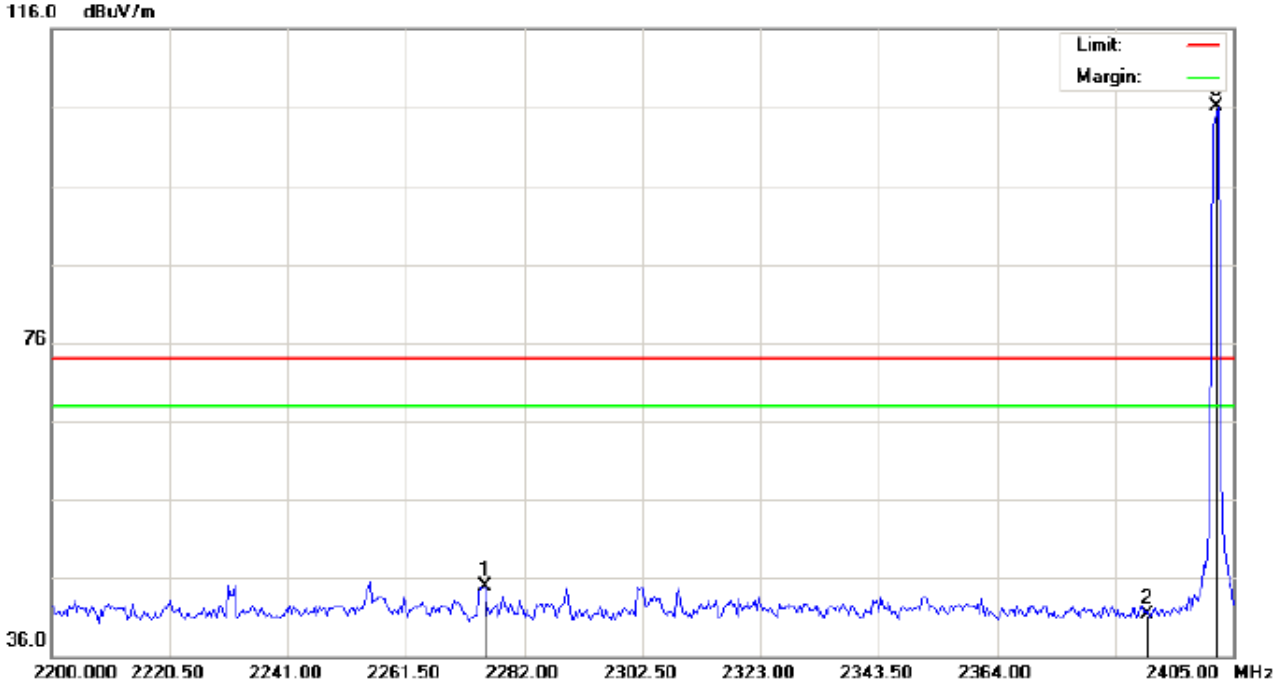
1. Set the EUT Work on the top, the bottom operation frequency individually.
2. Set SPA Start or Stop Frequency=Operation Frequency, RBW>=100kHz, VBW>=3*RBW, Center frequency =Operation frequency
3. The band edges was measured and recorded.

11.2. TEST SET-UP

Radiated same as 10.2

11.3. TEST RESULT (Worst Modulation: GFSK)

TEST PLOT OF BAND EDGE FOR LOW CHANNEL (1Mbps)-Horizontal



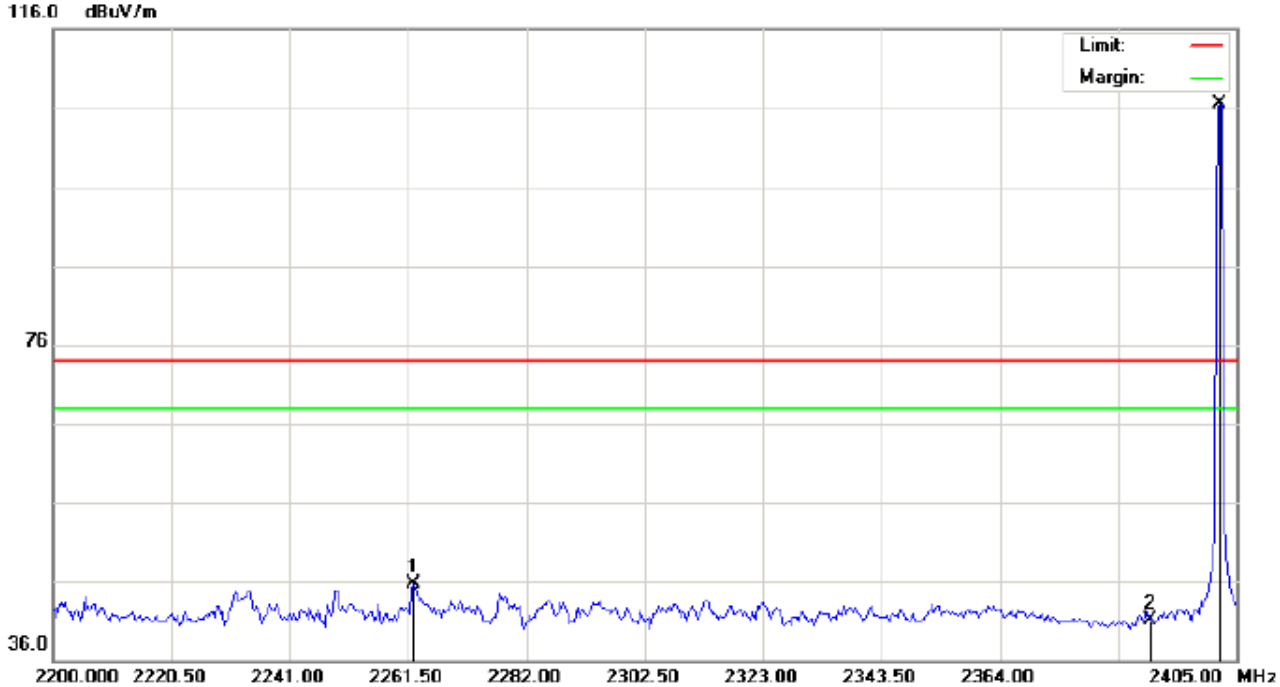
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: Low Channel TX
Note:

Polarization: ***Horizontal***
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2275.167	34.72	10.18	44.90	74.00	-29.10	peak			
2		2390.000	31.00	10.31	41.31	74.00	-32.69	peak			
3	*	2402.000	95.72	10.32	106.04	74.00	32.04	peak			

TEST PLOT OF BAND EDGE FOR LOW CHANNEL (1Mbps)-Vertical



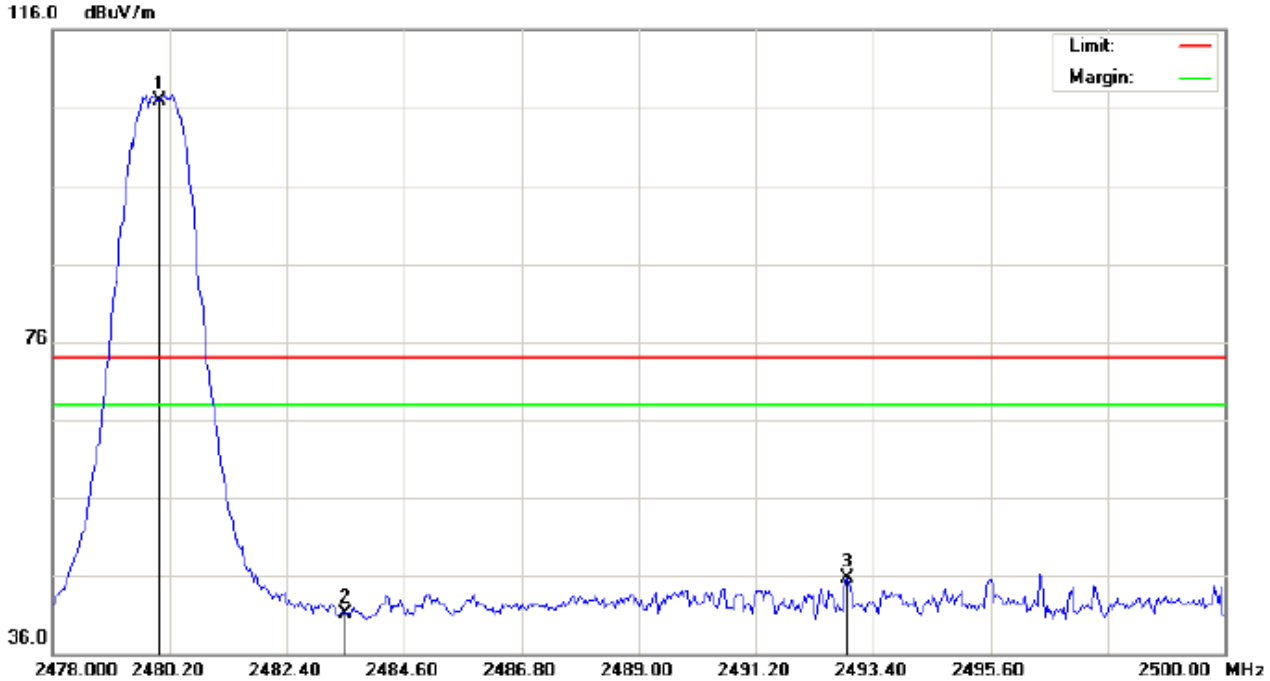
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: Low Channel TX
Note:

Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2262.525	35.52	10.17	45.69	74.00	-28.31	peak			
2		2390.000	30.71	10.31	41.02	74.00	-32.98	peak			
3	*	2402.000	96.09	10.32	106.41	74.00	32.41	peak			

TEST PLOT OF BAND EDGE FOR HIGH CHANNEL (1Mbps)-Horizontal



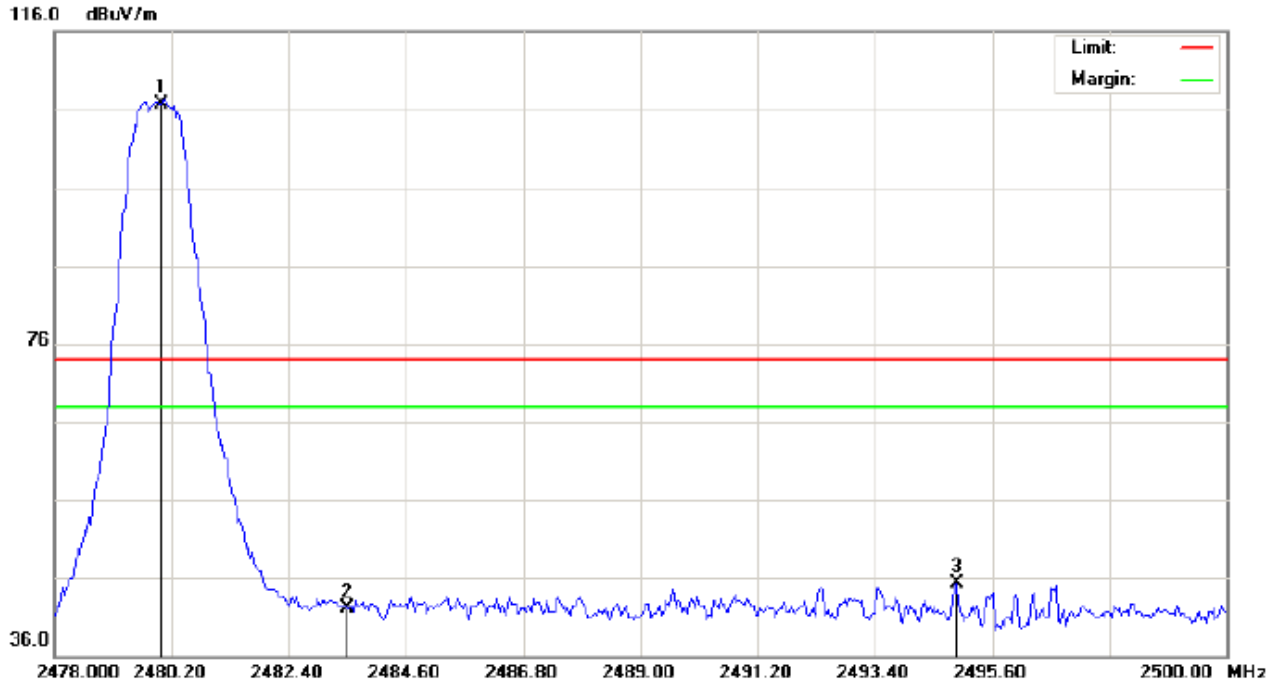
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: High Channel TX
Note:

Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	96.55	10.41	106.96	74.00	32.96	peak			
2		2483.500	30.69	10.41	41.10	74.00	-32.90	peak			
3		2492.923	35.33	10.42	45.75	74.00	-28.25	peak			

TEST PLOT OF BAND EDGE FOR HIGH CHANNEL (1Mbps)-Vertical



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: HBC Remote
M/N: HBCR001
Mode: High Channel TX
Note:

Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	96.32	10.41	106.73	74.00	32.73	peak			
2		2483.500	31.76	10.41	42.17	74.00	-31.83	peak			
3		2494.940	34.85	10.42	45.27	74.00	-28.73	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

3. Hopping off and Hopping on have been tested and only worst case recorded

12. NUMBER OF HOPPING FREQUENCY

12.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer Start = 2.4GHz Stop = 2.4835GHz
4. Set the Spectrum Analyzer as RBW>=1%span, VBW>=RBW.

12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

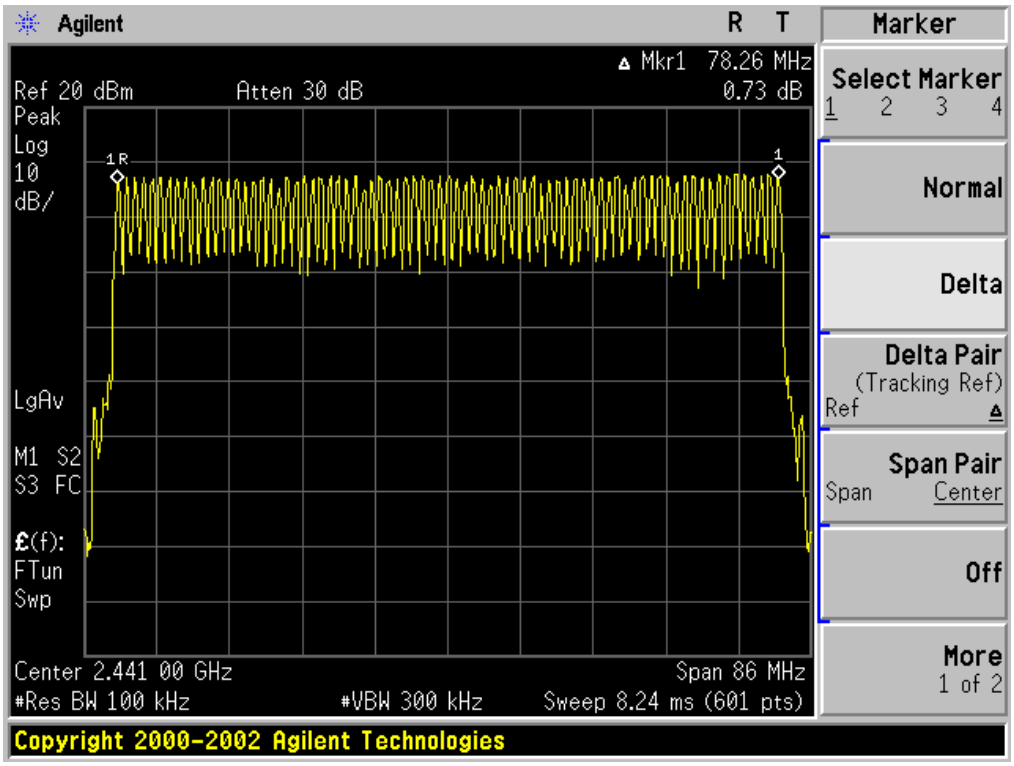
12.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

12.4. LIMITS AND MEASUREMENT RESULT

TOTAL NO. OF HOPPING CHANNEL	LIMIT (NO. OF CH)	MEASUREMENT (NO. OF CH)	RESULT
	>=15	79	PASS

TEST PLOT FOR NO. OF TOTAL CHANNELS



13. TIME OF OCCUPANCY (DWELL TIME)

13.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
3. Set Span = zero span, centered on a hoping channel
4. Set the spectrum analyzer as RBW=1MHz, VBW>=RBW, Span = 0 Hz

13.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

13.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

13.4. LIMITS AND MEASUREMENT RESULT

The Worst Case (3Mbps)

Channel	Time of Pulse for DH5 (ms)	Period Time (s)	Sweep Time (ms)	Limit (ms)
Low	2.878	31.6	306.99	400
Middle	2.878	31.6	306.99	400
High	2.878	31.6	306.99	400

Low Channel Time

2.878*(1600/6)/79*31.6=306.99ms

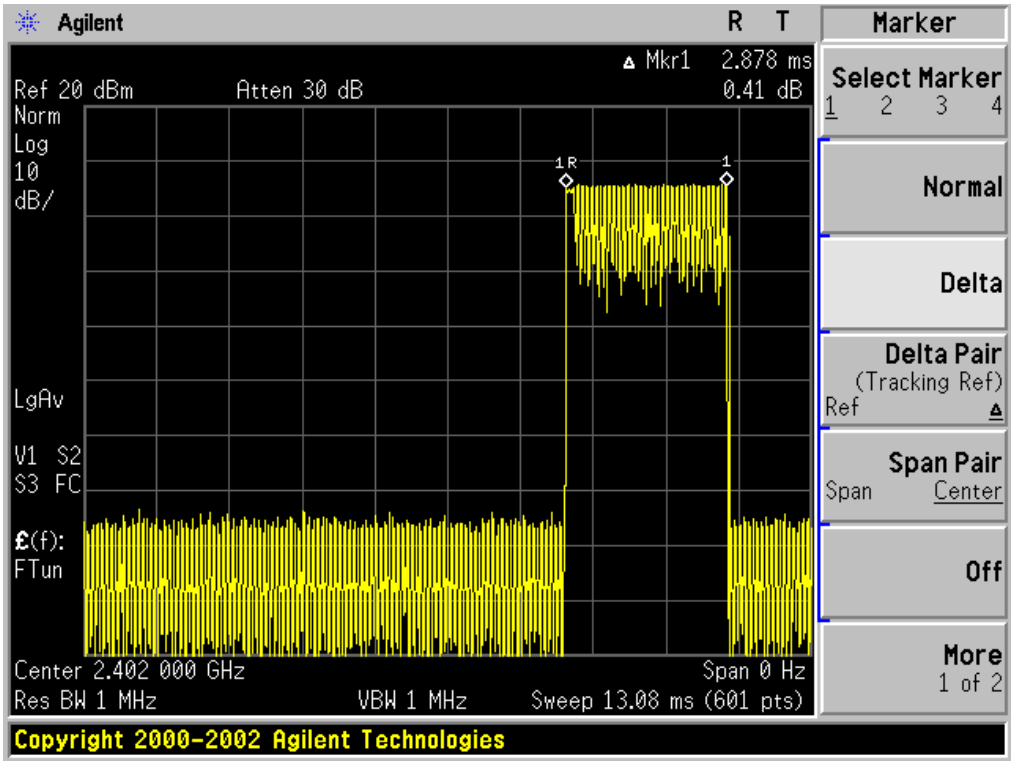
Middle Channel Time

2.878*(1600/6)/79*31.6=306.99ms

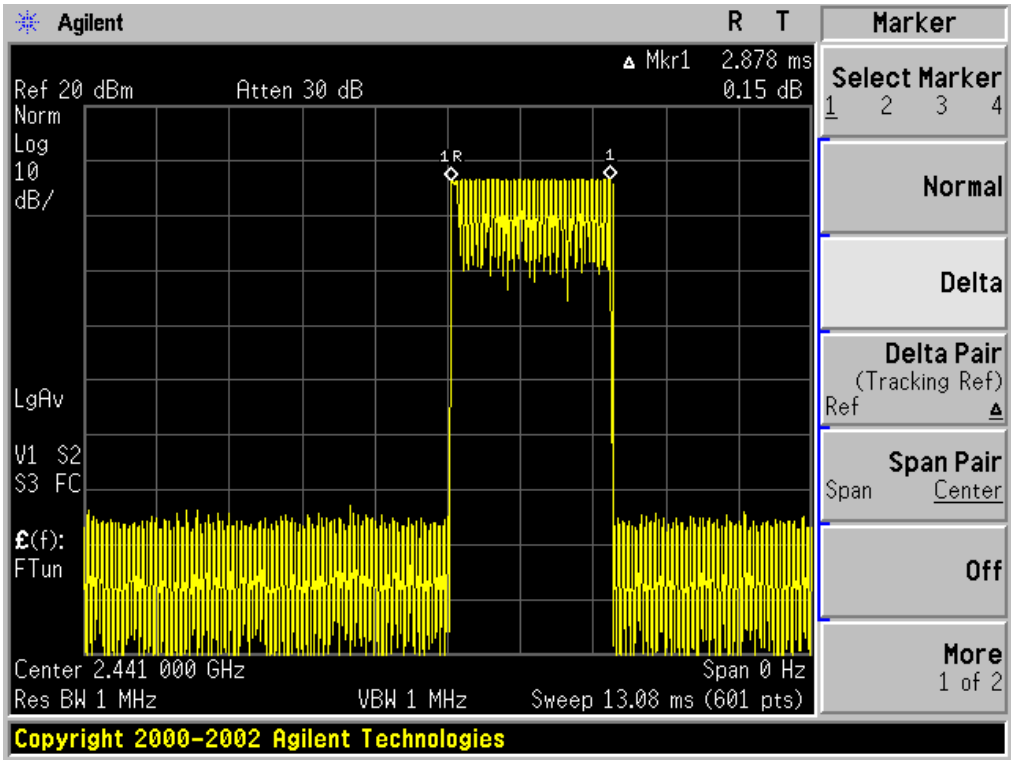
High Channel Time

2.878*(1600/6)/79*31.6=306.99ms

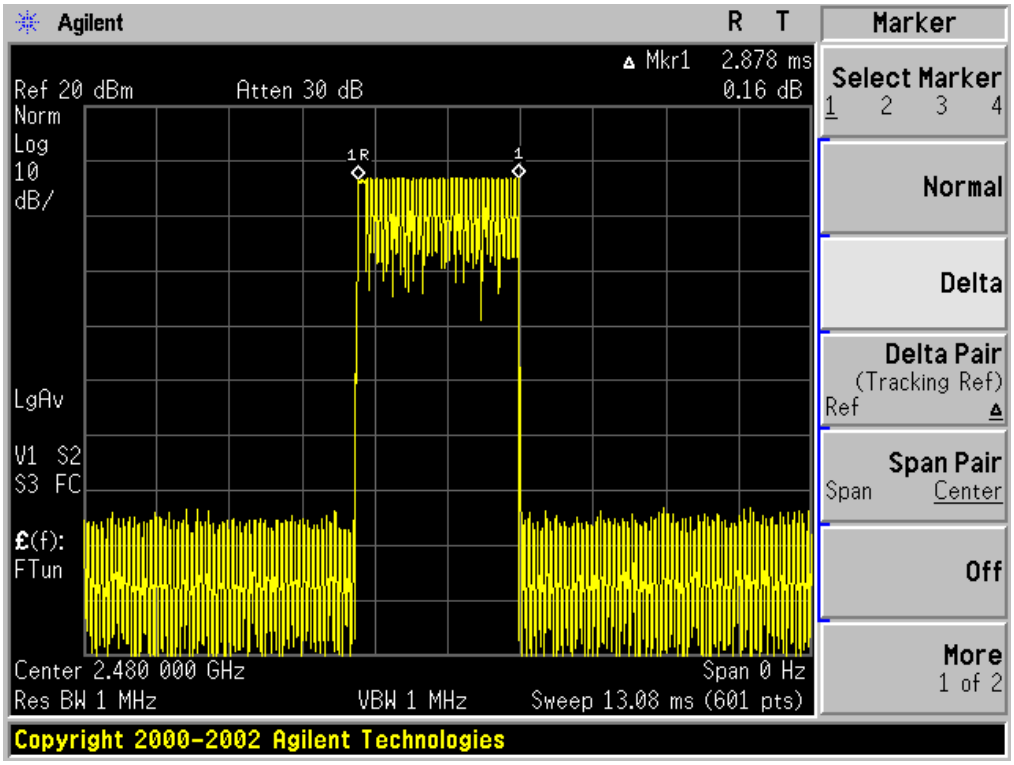
TEST PLOT OF LOW CHANNEL



TEST PLOT OF MIDDLE CHANNEL



TEST PLOT OF HIGH CHANNEL



14. FREQUENCY SEPARATION

14.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer
3. Set Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold

14.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 6.2

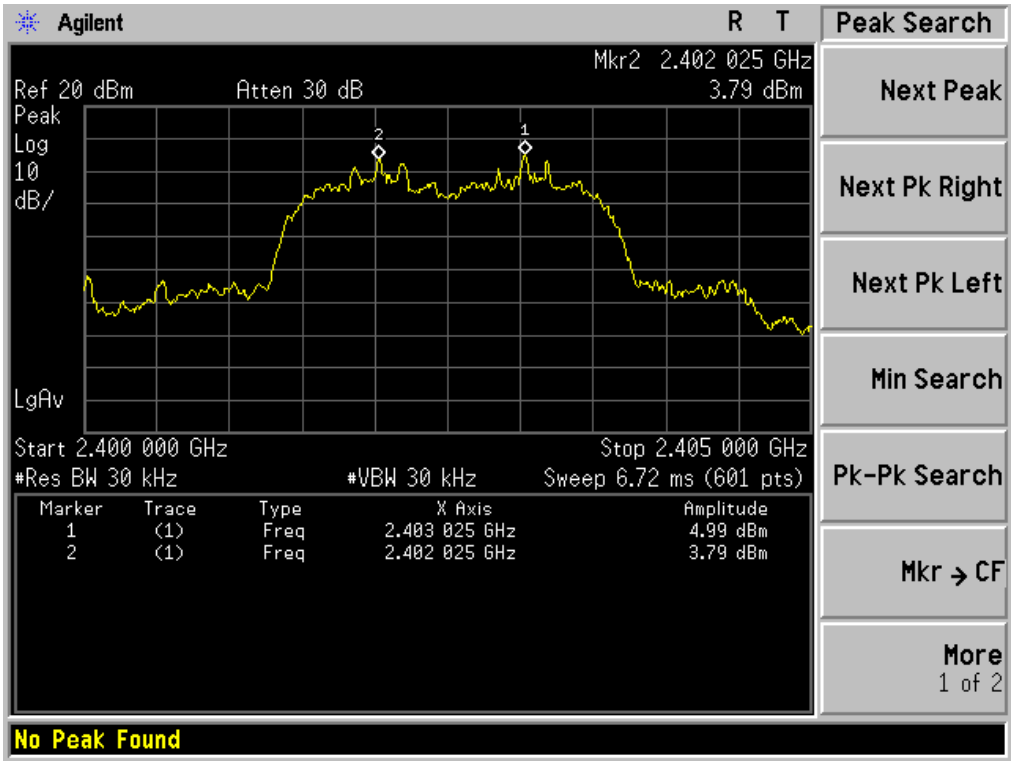
14.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6.3

14.4. LIMITS AND MEASUREMENT RESULT

CHANNEL	CHANNEL SEPARATION	LIMIT	RESULT
	MHz	KHz	Pass
CH00-CH01	1	>=25 KHz or 2/3 20 dB BW	

TEST PLOT FOR FREQUENCY SEPARATION（3Mbps）



15. FCC LINE CONDUCTED EMISSION TEST

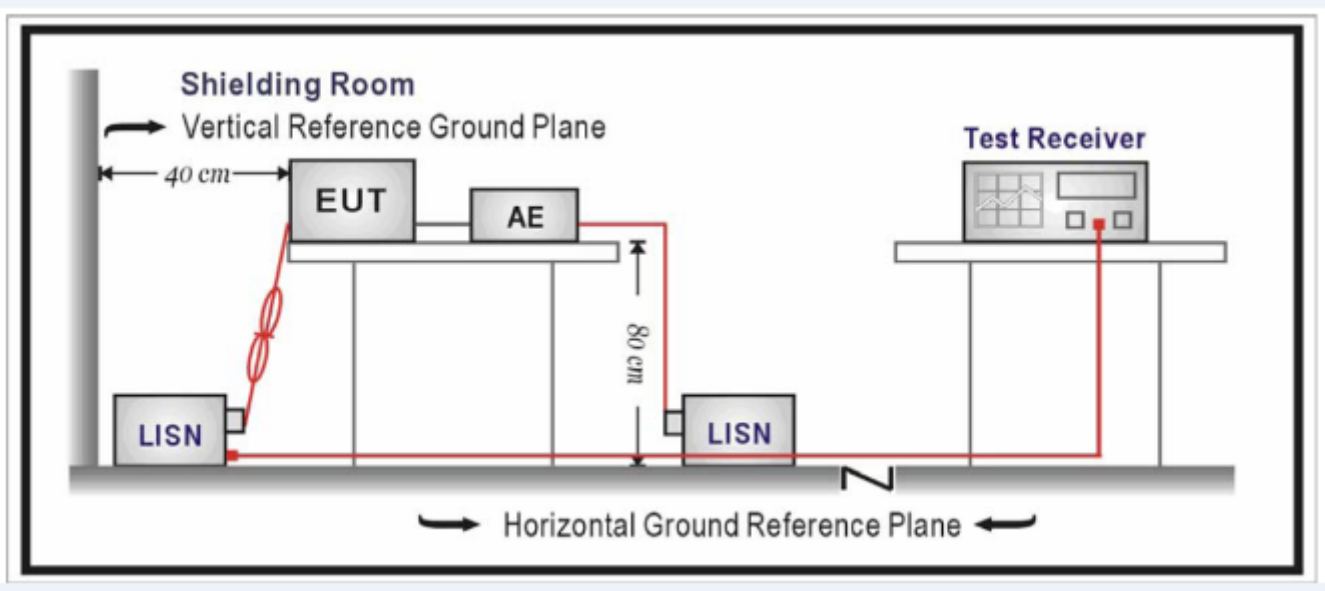
15.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

15.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



15.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipments received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC charging voltage by PC which received 120V/60Hzpower by a LISN..
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

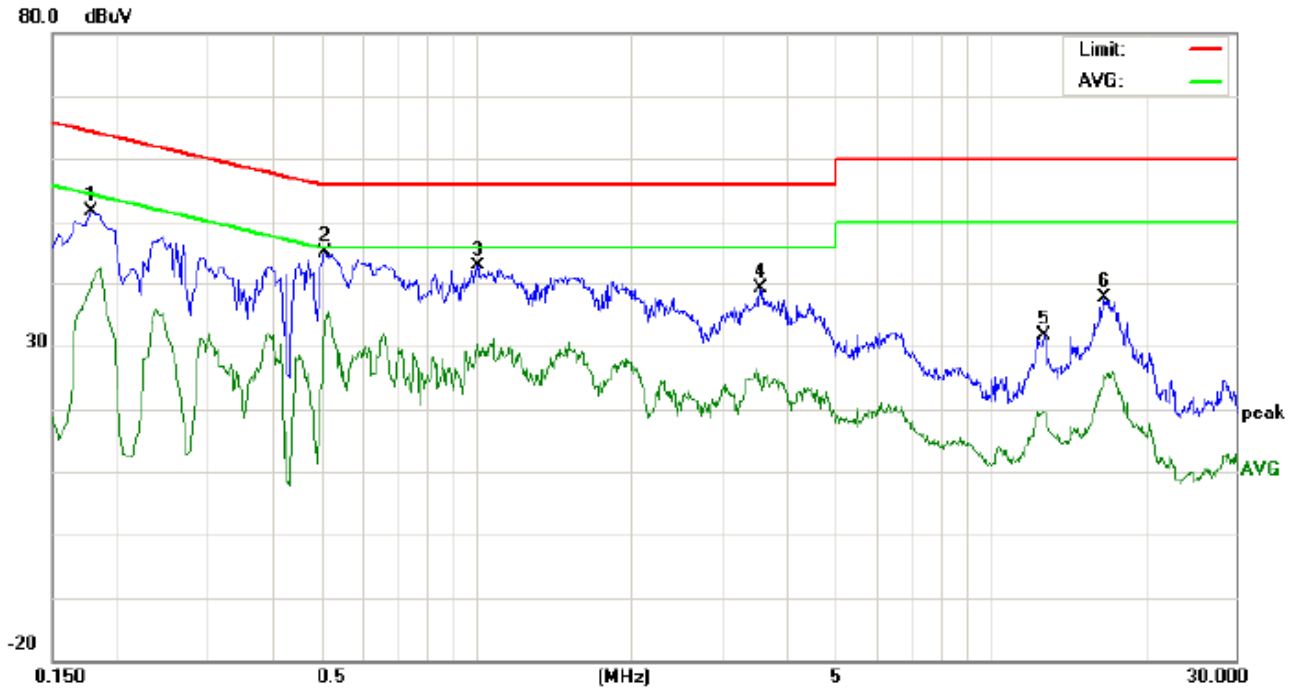
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

15.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

15.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

Line Conducted Emission Test Line 1-L



Site: Conduction | Phase: *L1* | Temperature: 26
Limit: FCC Class B Conduction(QP) | Power: | Humidity: 60 %
EUT: HBC Remote
M/N: HBCR001
Mode: Normal operation
Note:

No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.1780	41.49		29.24	10.19	51.68		39.43	64.57	54.57	-12.89	-15.14	P	
2	0.5100	34.66		23.84	10.39	45.05		34.23	56.00	46.00	-10.95	-11.77	P	
3	1.0060	32.47		19.90	10.37	42.84		30.27	56.00	46.00	-13.16	-15.73	P	
4	3.5740	28.73		14.04	10.50	39.23		24.54	56.00	46.00	-16.77	-21.46	P	
5	12.7580	21.37		9.31	10.14	31.51		19.45	60.00	50.00	-28.49	-30.55	P	
6	16.6540	27.40		14.29	10.12	37.52		24.41	60.00	50.00	-22.48	-25.59	P	

Line Conducted Emission Test Line 2-N

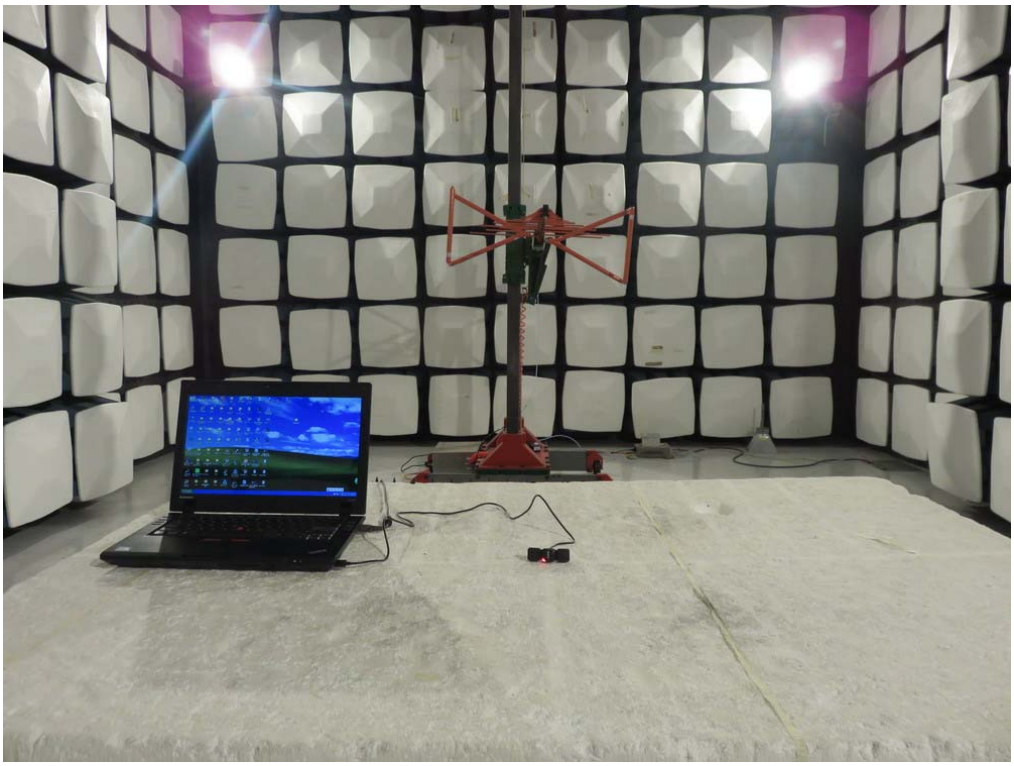
Site: Conduction | Phase: *N* | Temperature: 26
Limit: FCC Class B Conduction(QP) | Power: | Humidity: 60 %
EUT: HBC Remote
M/N: HBCR001
Mode: Normal operation
Note:

No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.1900	43.10		22.95	10.20	53.30		33.15	64.03	54.03	-10.73	-20.88	P	
2	0.2580	35.08		17.75	10.27	45.35		28.02	61.49	51.49	-16.14	-23.47	P	
3	0.4500	31.03		16.82	10.37	41.40		27.19	56.87	46.87	-15.47	-19.68	P	
4	0.7180	24.93		12.41	10.34	35.27		22.75	56.00	46.00	-20.73	-23.25	P	
5	3.2420	30.46		16.65	10.53	40.99		27.18	56.00	46.00	-15.01	-18.82	P	
6	17.1700	26.00		13.28	10.13	36.13		23.41	60.00	50.00	-23.87	-26.59	P	

APPENDIX A: PHOTOGRAPHS OF TEST SETUP

FCC LINE CONDUCTED EMISSION TEST SETUP

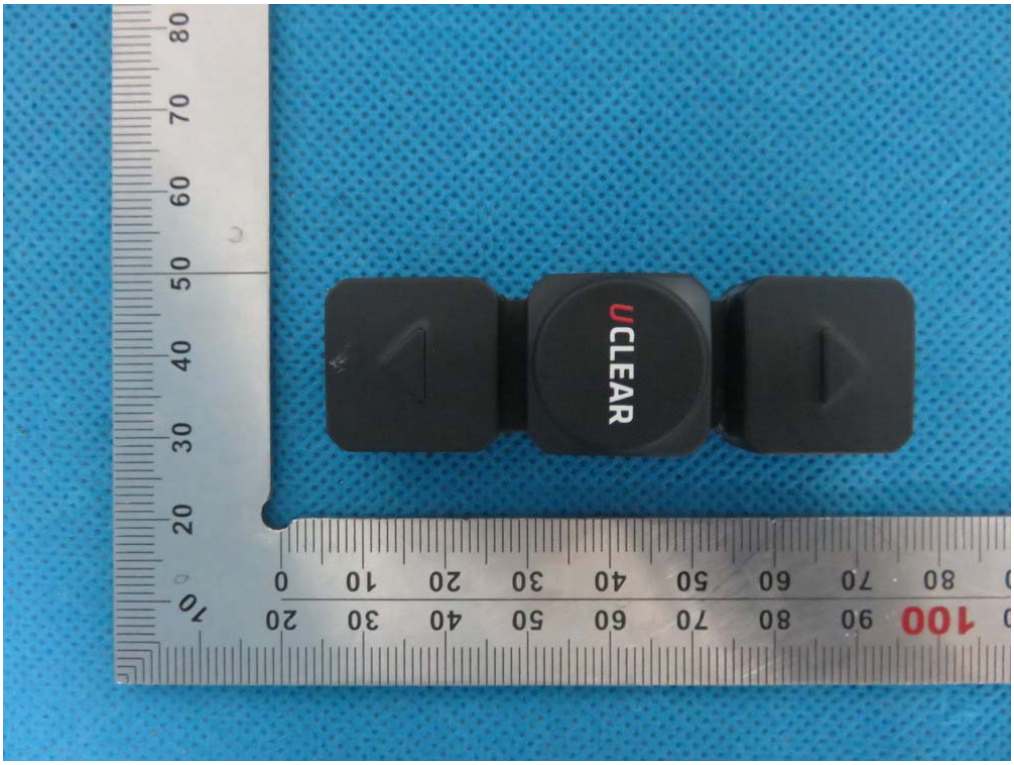
FCC RADIATED EMISSION TEST SETUP



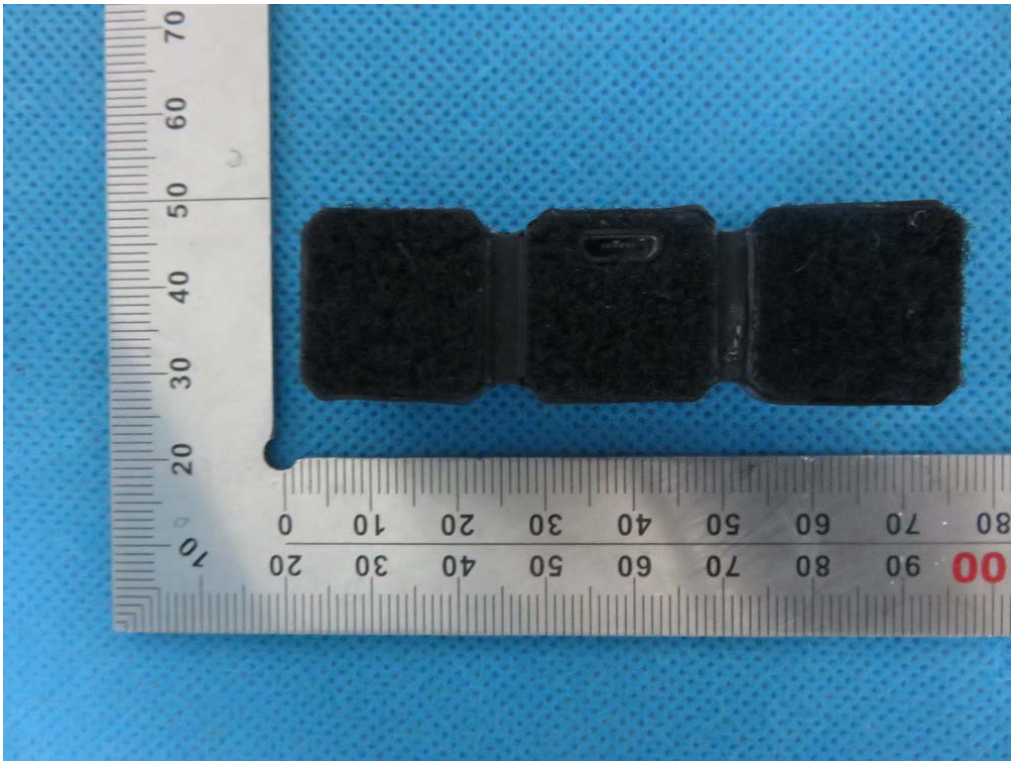
APPENDIX B: PHOTOGRAPHS OF EUT

TOTAL VIEW OF EUT

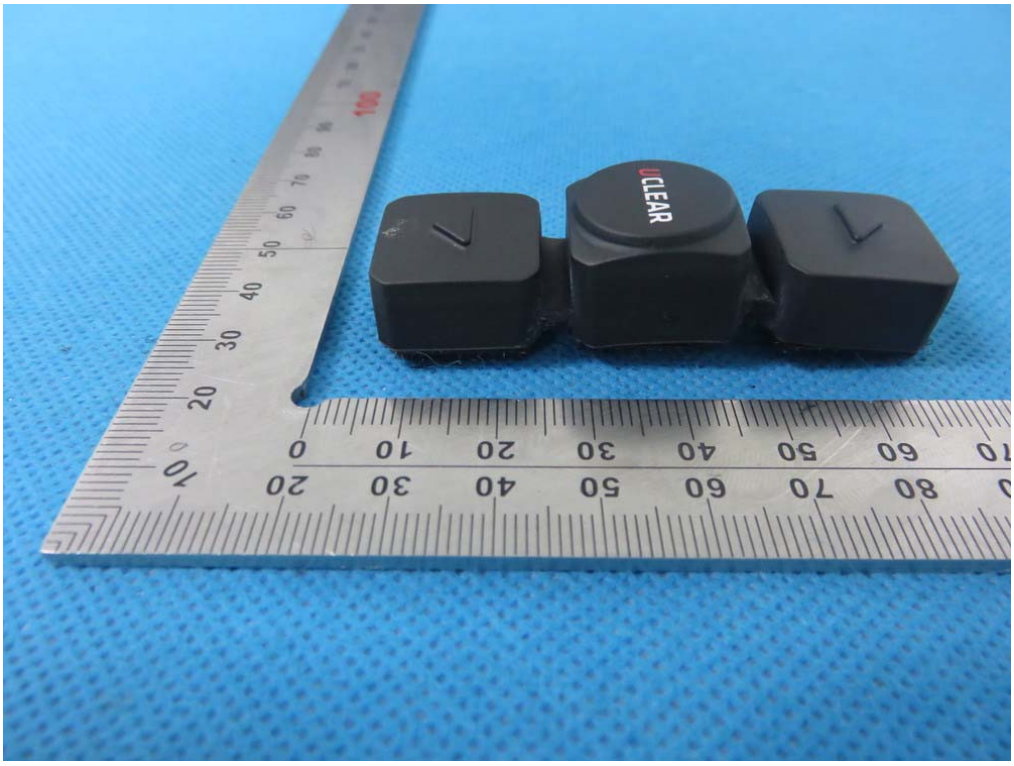
TOP VIEW OF EUT



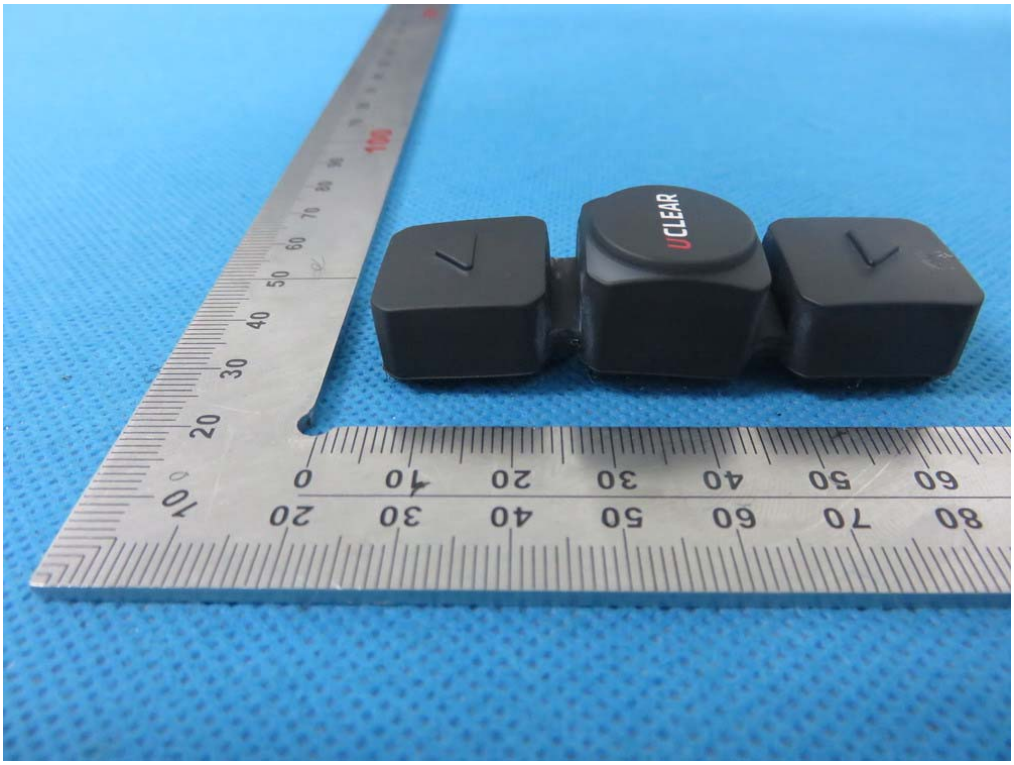
BOTTOM VIEW OF EUT



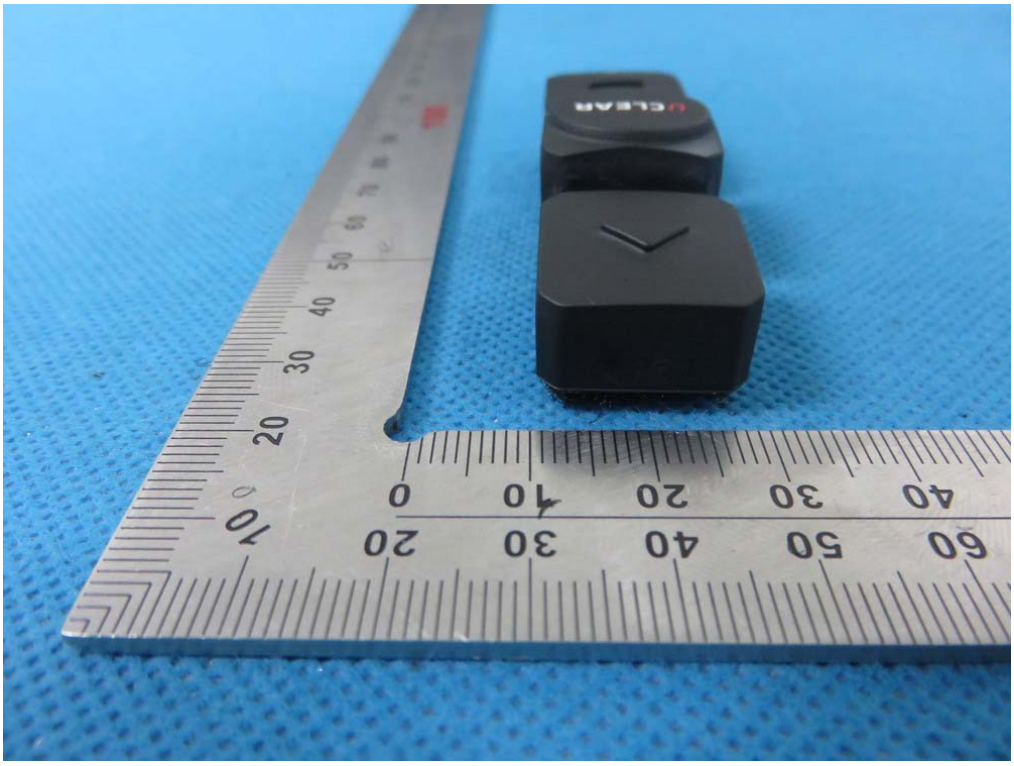
FRONT VIEW OF EUT



BACK VIEW OF EUT

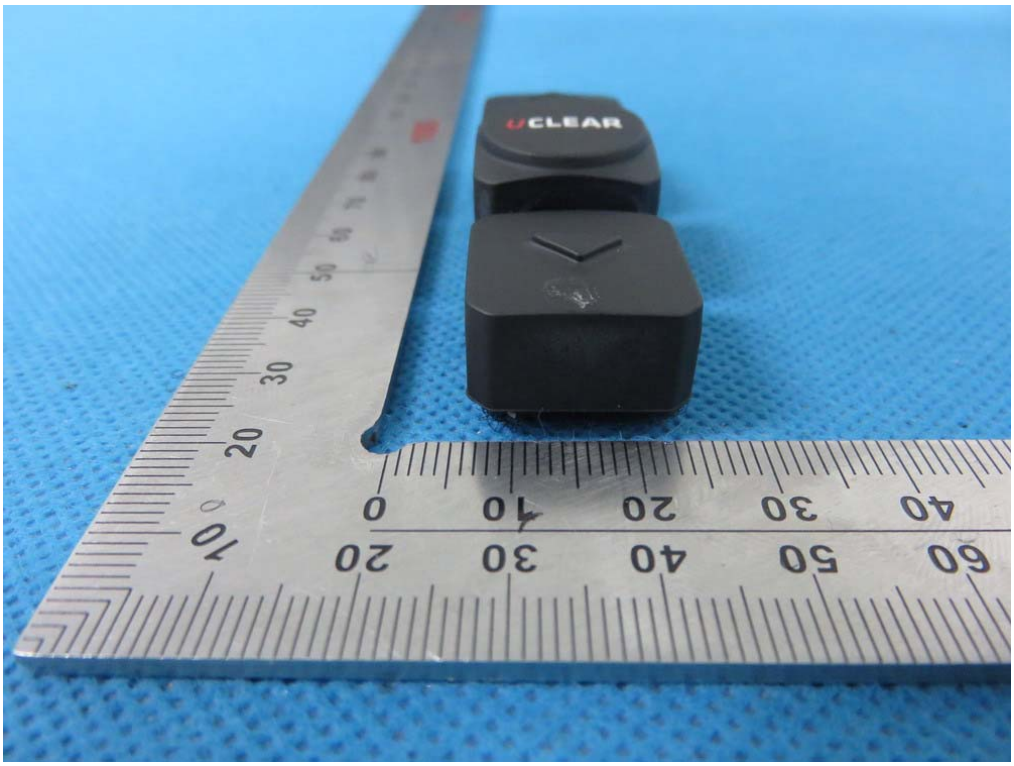


LEFT VIEW OF EUT

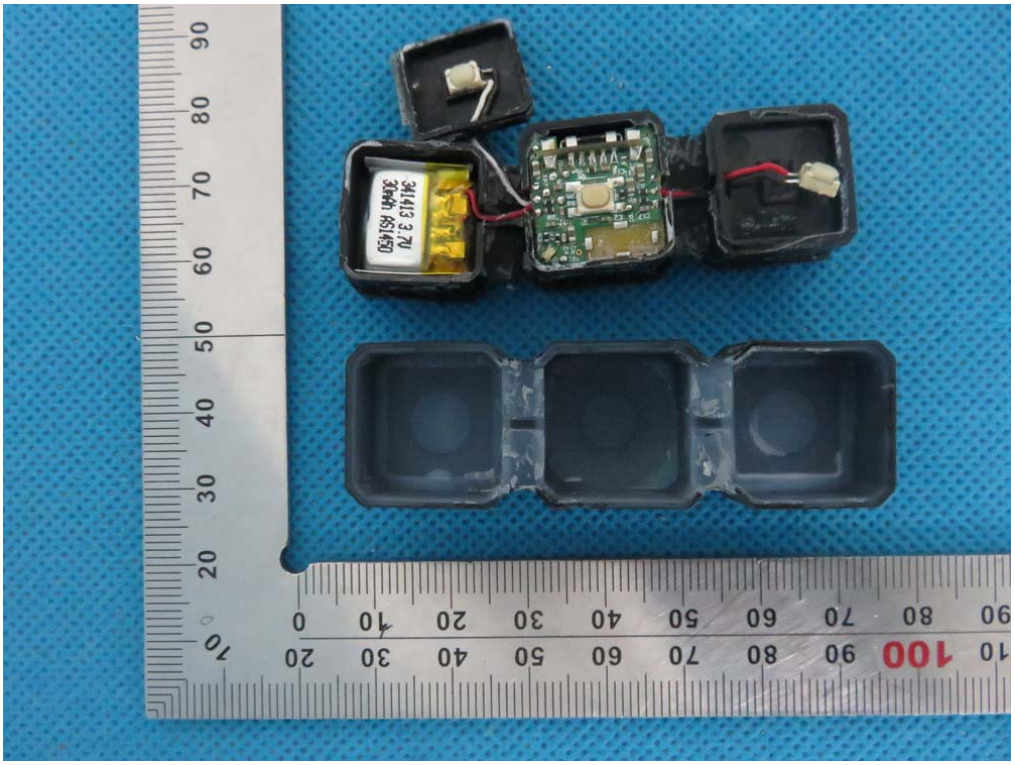


VIEW OF EUT-port

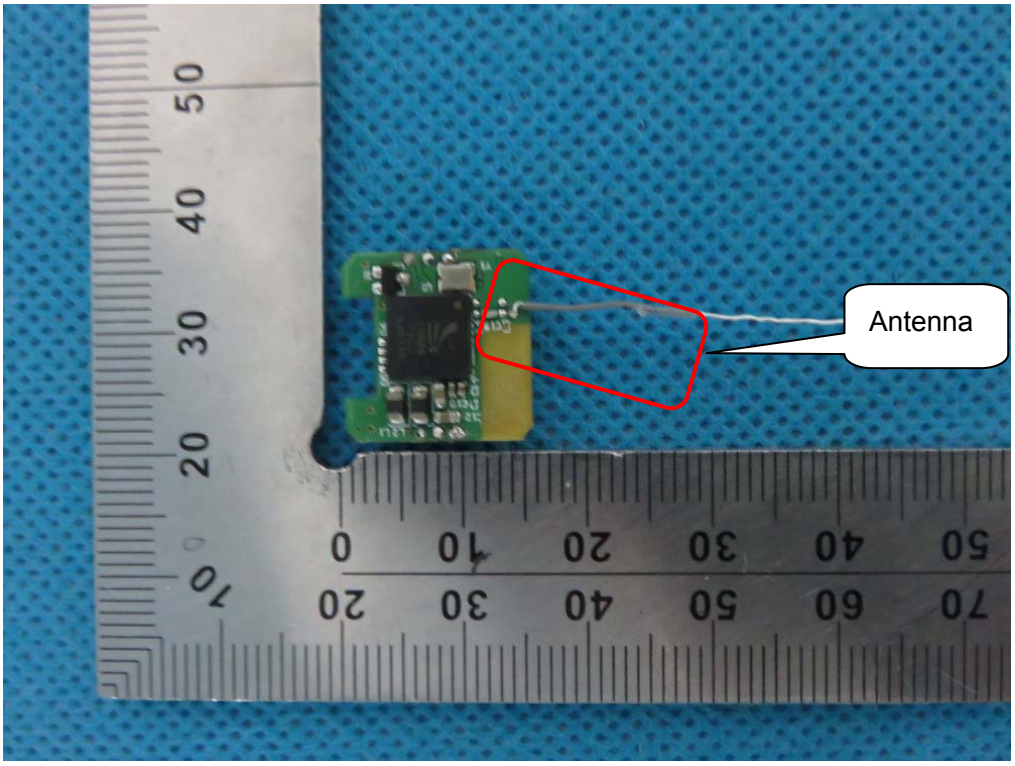
RIGHT VIEW OF EUT



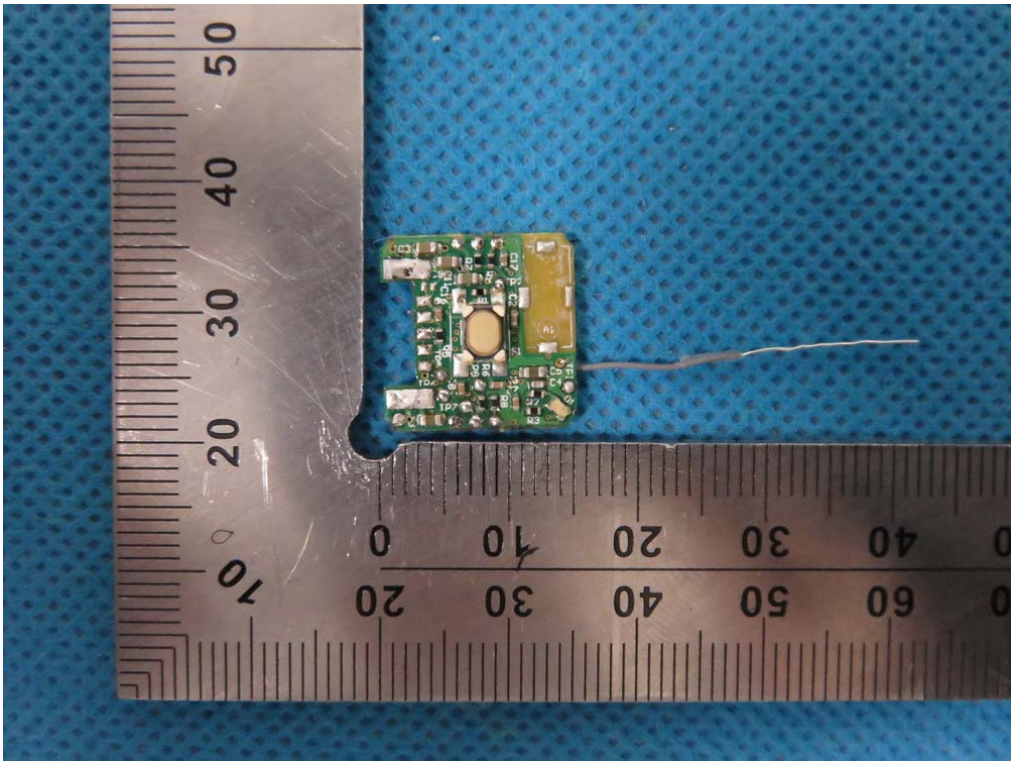
OPEN VIEW OF EUT



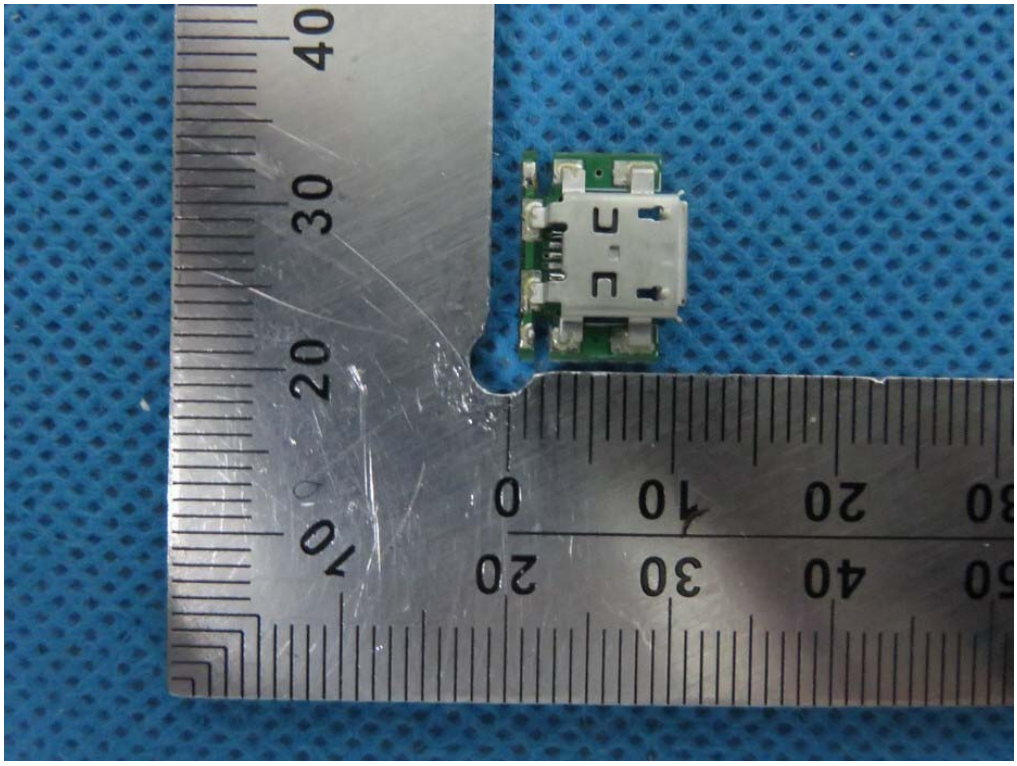
INTERNAL VIEW OF EUT-1



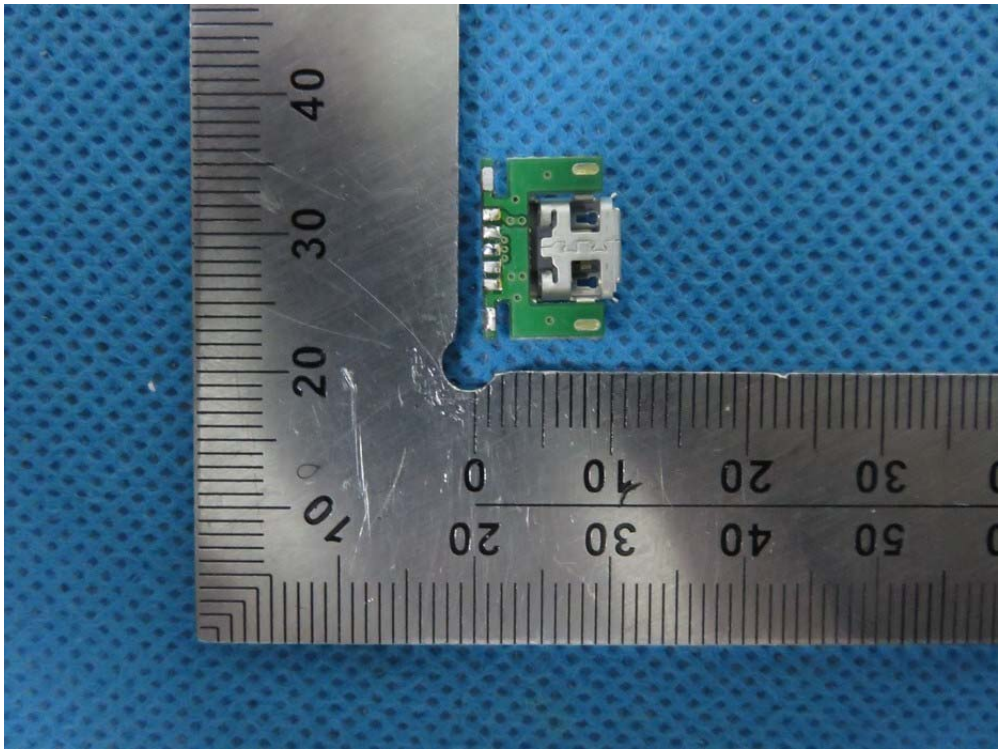
INTERNAL VIEW OF EUT-2



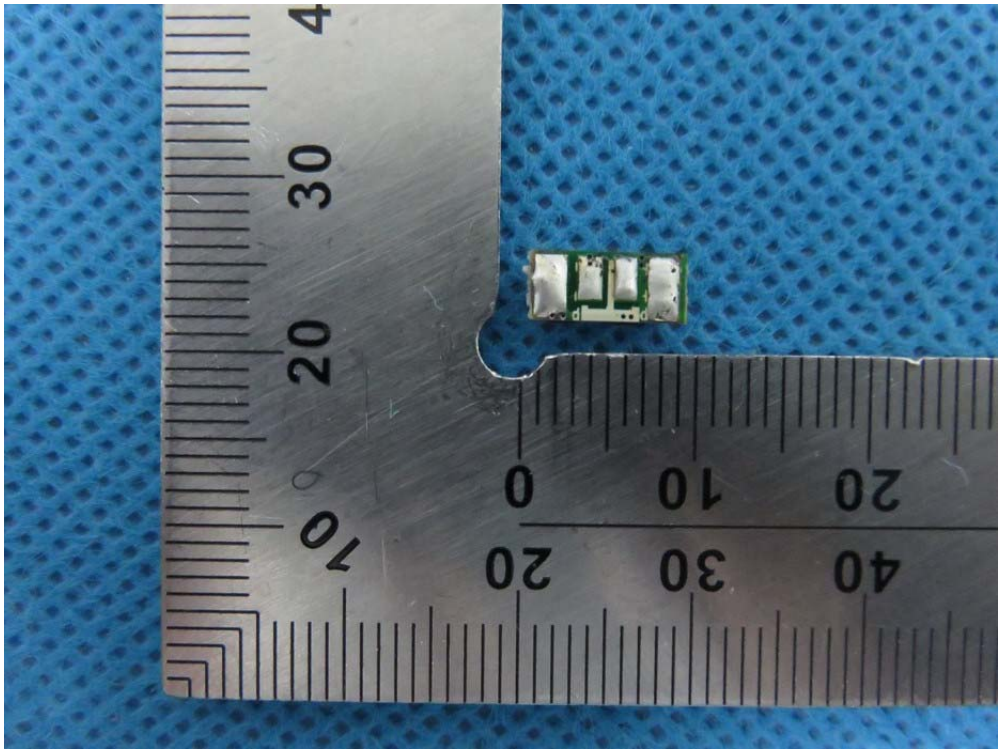
INTERNAL VIEW OF EUT-3



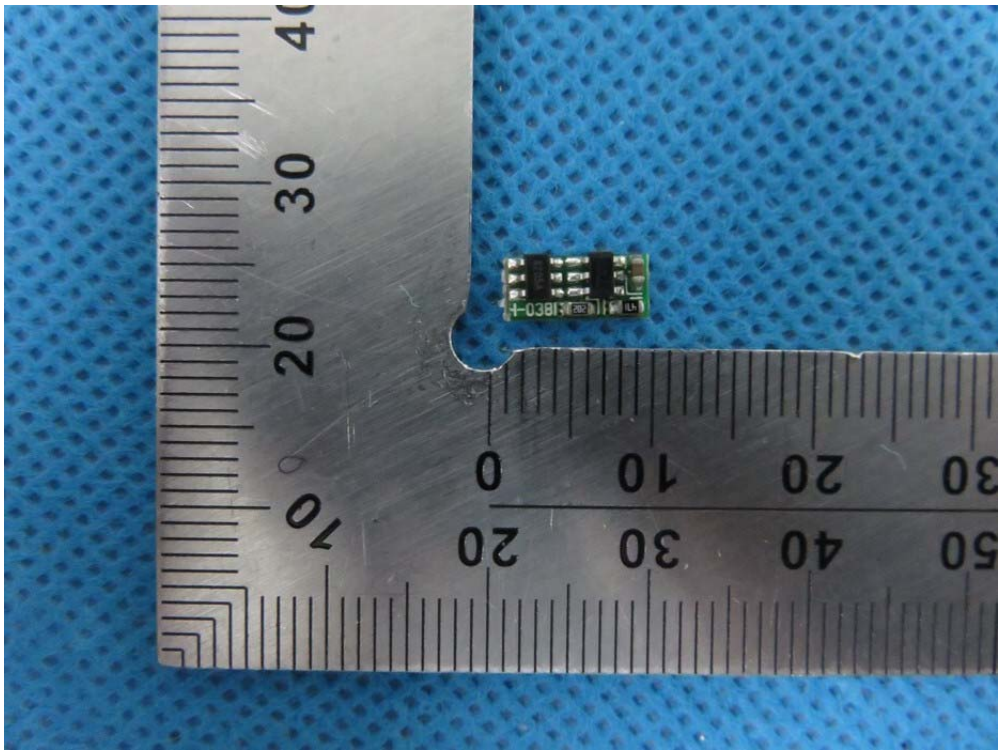
INTERNAL VIEW OF EUT-4



INTERNAL VIEW OF EUT-5



INTERNAL VIEW OF EUT-6



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