Estech Co., Ltd.
97-1, Hoeeok-ri, Majang-myun, Ichion-city, Gyonggi-do, South Korea
TEL : +82 31 6318037 FAX : +82 31 6318039 www.estech.co.kr

Test Report for FCC

FCC ID : X59-H3G-800

Report Number		ESTF151504-002		
Applicant	Company name	H3 SYSTEM Co., Ltd.		
	Address	(Tamnip-dong), 283, Baeul 1-ro, Yuseong-gu, Daejeon, South Korea		
	Telephone	82-42-862-9314		
	Contack person	Sung-Dae Lim		
Product	Product name	CDMA Gateway		
	Model No.	H3G-800	Manufacturer	H3 SYSTEM Co., Ltd.
	Serial No.	NONE	Country of origin	KOREA
Test date	2015-04-20 ~ 2015-04-27		Date of issue	30-Apr-15
Testing location	ESTECH Co., Ltd. 97-1, Hoeeok-ri, Majang-myun, Ichion-city, Gyonggi-do, South Korea			
Standard	FCC PART 15 Subpart C (15.247), ANSI C 63.4(2009) , DA 00-705			
Measurement facility registration number	659627			
Tested by	Engineer S.Y.Lee	(Signature)		
Reviewed by	Engineering Manager J.M.Yang	(Signature)		
Abbreviation	OK, Pass = Passed, Fail = Failed, N/A = not applicable			

* Note

- This test report is not permitted to copy partly without our permission
- This test result is dependent on only equipment to be used
- This test result based on a single evaluation of one sample of the above mentioned

Contents 1

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1. Laboratory Information

1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.
ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.
ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

Head Office : Suite 1015 World Meridian III , 123 Gasan Digital 2-ro, Geumcheon-gu, Seoul 153-759, R.O. Kore

EMC/Telecom/Safety Test Lab : 97-1, Hoeeok-ri, Majang-myun, Ichion-city, Gyonggi-do, R.O. Korea

1.3 Official Qualification(s)

MSIP : Granted Accreditation from Ministry of Information & Communication for EMC, Safety and Telecommunication
KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements
FCC : Conformity Assessment Body(CAB) with registration number 659627 under APEC TEL MRA between the RRA and the FCC
VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

2. Description of EUT

2.1 Summary of Equipment Under Test (Bluetooth)

Modulation Type	: GFSK(FHSS) , 8DPSK
Transfer Rate	: 3 Mbps
Number of Channel	: 79 ch
Channel Spacing	: 1 MHz
PEAK Output Power	: GFSK : 0.343 mW 8DPSK : 0.2398 mW
Rating	: INPUT : AC (100 - 240) V, (50 - 60) Hz , 0.5 A DC OUTPUT : DC 5.0 V, 3.0 A
Receipt Date	: 25-Mar-15

2.2 General descriptions of EUT

Product Specifications

DE910 Specifications	
Air Interface	• CDMA 1xRTT • CDMA 1xEV-DO Rev. A
Frequency Bands	• DE910-DUAL: 800/1900MHz • DE910-SC: 800MHz
Data Service	• CDMA 1xRTT: 153.6 Kbps (full-duplex) • CDMA 1xEV-DO Rev. A: 3.1Mbps (F/L), 1.8Mbps (R/L)
Location solution	gpsOne
Max. RF out power	• CDMA BC0: Power class 3 (24.4dBm) for 1xRTT, Power class 3 (24dBm) for 1xEV-DO • CDMA BC1: Power class 2 (24.4dBm) for 1xRTT, Power class 2 (24dBm) for 1xEV-DO
Typical conducted sensitivity	a. CDMA • 1xRTT: Better than –108dBm • 1xEV-DO: Better than –109dBm b. GNSS • Acquisition sensitivity: –145dBm • Navigation sensitivity: –160dBm • Tracking sensitivity: –161dBm • Cold-start sensitivity: –145dBm • TTFF: 32 sec @–130dBm
Device dimensions	28.2mm(L) x 28.2mm(W) x 2.05mm(T)
Weight	3.8g
Storage and Operating Temperature Range	–40 ~ +85°C
Normal operating voltage range	3.4 ~ 4.2V
IO voltage	1.8V
Hardware design	• RX diversity on all band
Interface	• 144 Land-Grid-Array interface • 10 general I/O ports maximum including multi-functional I/Os • State LED output • 1 A/D converter • 1 D/A converter (PDM output) • Full RS232 CMOS UART: baud rate up to 4Mbps • Reserved two wires CMOS UART for debugging • USB 2.0: baud rate up to 480Mbps
Antenna	• Primary antenna • RX Diversity antenna • GPS&GLONASS antenna

3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247)

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

Test Method : ANSI C 63.4 (2009) & DA 00-705

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain decides that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment These method apply to the measurement of individual units or systems comprised of multiple units

Summary of Test Results

Applied Satandard : 47 CFR Part 15 Subpart C				remark
FCC Standard	Test Type	Result	Remark	Limit
15.207	AC Power Conducted Emission	Pass	Meet the requirement	
15.205 & 15.209	Intentional Radiated Emission	Pass	Meet the requirement	
15.247(a)(1)	Carrier Frequency Separation & 20 Bandwidth ,99% Bandwidth	Pass	Meet the requirement	>25 kHz
15.247(b)	Maximum Peak ouput power	Pass	Meet the requirement	30dBm(1W)
15.247(a)(1)(ii)	Number of Hopping Frequency	Pass	Meet the requirement	>75
15.247(c)	Transmitter Radiated Emission	Pass	Meet the requirement	
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Pass	Meet the requirement	<400ms
15.247(d)	Band Edge Measurement	Pass	Meet the requirement	

4. Measurement Condition

4.1 EUT Operation

a. Channel

Ch.	Frequency	Ch.	Frequency
0	2402 MHz	40	2442 MHz
1	2403 MHz	41	2443 MHz
2	2404 MHz	42	2444 MHz
3	2405 MHz	43	2445 MHz
4	2406 MHz	…	…
…	…	78	2480 MHz
39	2441 MHz		

b. Measurement Channel : Low (2402 MHz), Middle (2441 MHz), High (2480 MHz)

c. Test Mode : 8DPSK, GFSK (worst case)

d. Test rate : 3 Mbps

4.2 EUT Operation.

* The EUT was in the following operation mode during all testing

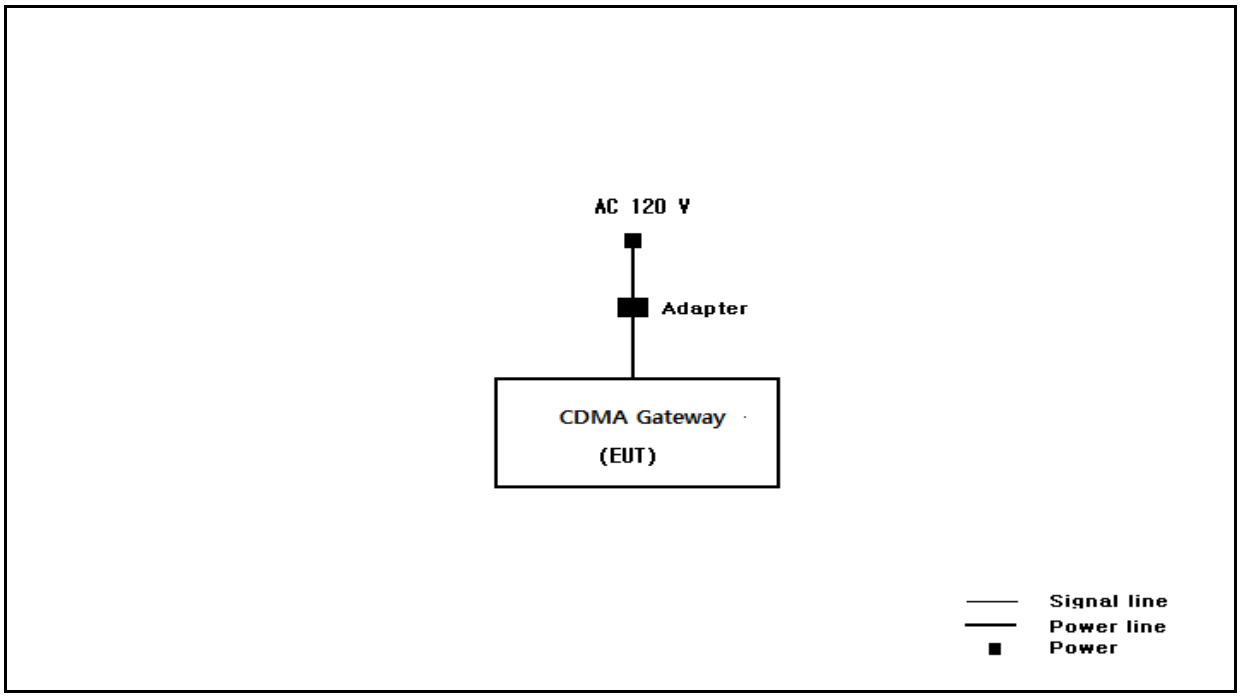
* The operational conditions of the EUT was determined by the manufacturer according to emission

* Execute a RF test program to enable EUT under transmission/receiving condition continuously at specific channel frequency.

* Transmit mode was each test. Each channel (low, middle, high), also set the test after

* The EUT was measured up to tenth harmonic or 40 GHz of the highest operating frequencies.

4.3 Configuration and Peripherals



4.4 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark (FCC ID)
CDMA Gateway	H3G-800	NONE	H3 SYSTEM Co., Ltd.	EUT
Adapter	BPI020S05N04	NONE	BridgePower Corp.	

4.5 Cable Connecting

Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
CDMA Gateway	Power	Adapter	-	2.0	Unshielded	

5. Carrier Frequency Separation

5.1 Test procedure

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

5.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 30 KHz

. VBW= 300 KHz

. Span= 3 MHz

. Sweep= suitable duration based on the EUT specification.

20dB Bandwidth Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4407B	US40241281	2016-01-15
-Spectrum Analyzer <=> EUT	Loss: 1.0dB	-	

5.3 Measurement results

EUT	CDMA Gateway	MODEL	H3G-800
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	22 ℃, 40 % R.H .
INPUT POWER	DC 5 V		

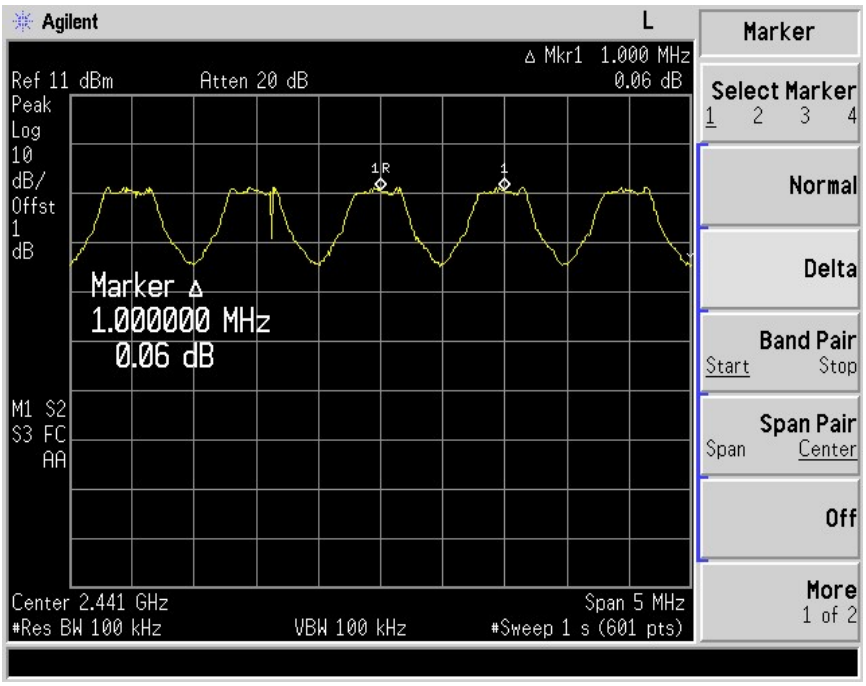
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (kHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	968	964	1000	643	PASS
39	2441	941	1043	1000	695	PASS
78	2480	917	941	1000	627	PASS

(8DPSK)

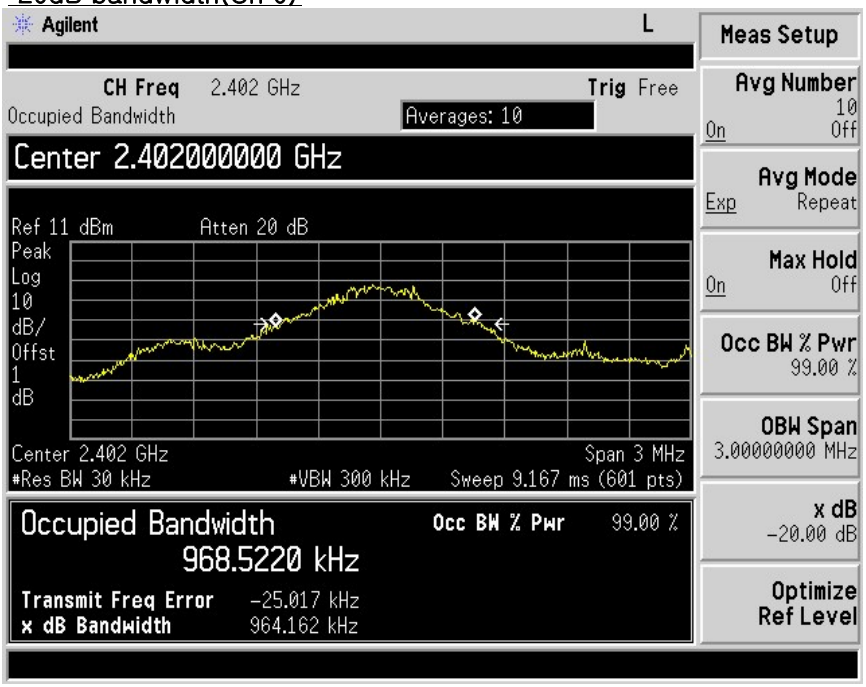
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (MHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	1.183	1295	1000	863	PASS
39	2441	1.204	1287	1000	858	PASS
78	2480	1.187	1274	1000	849	PASS

5.4 Trace data (GFSK)

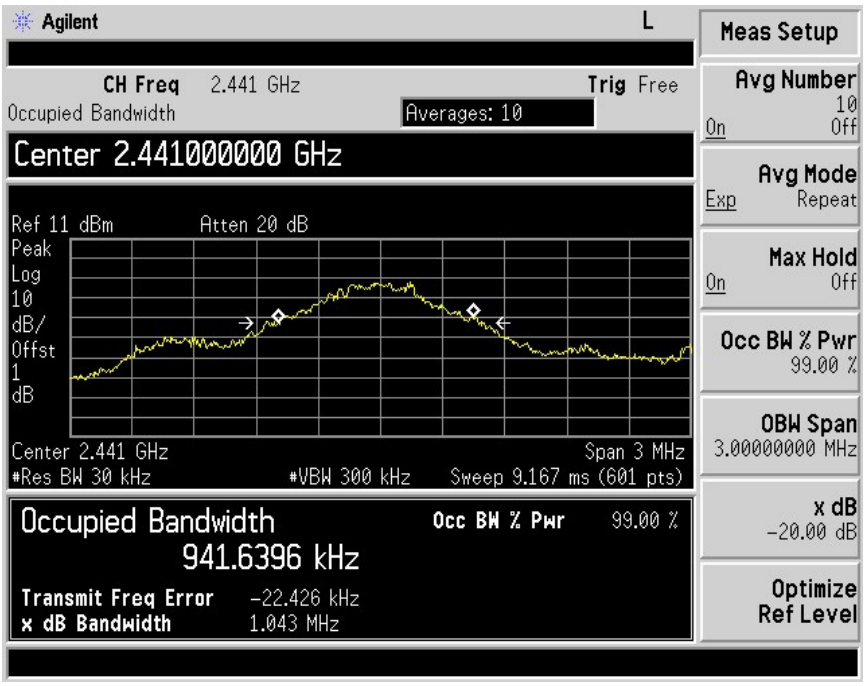
Channel Separation



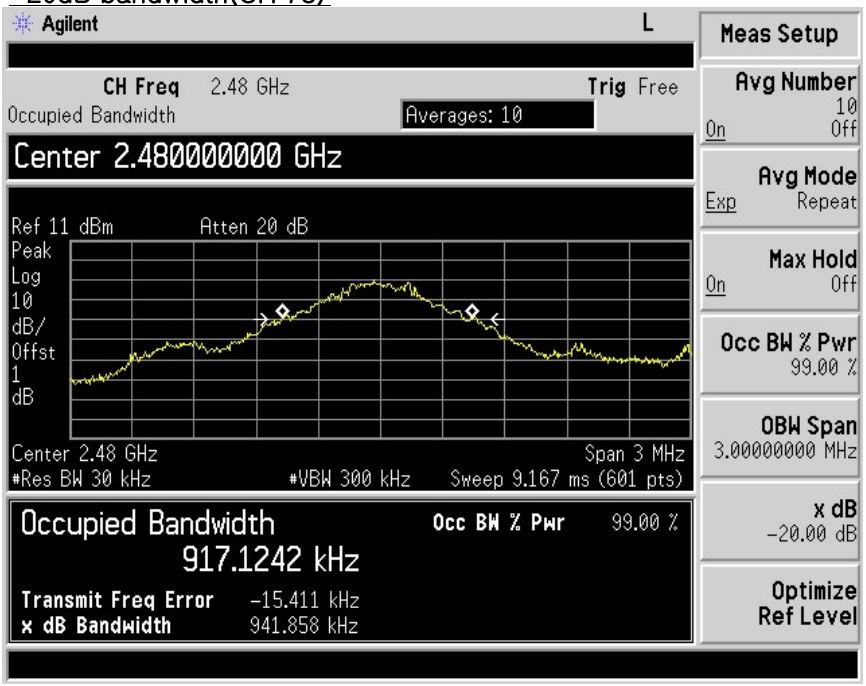
20dB bandwidth(Ch 0)



20dB bandwidth(CH 39)

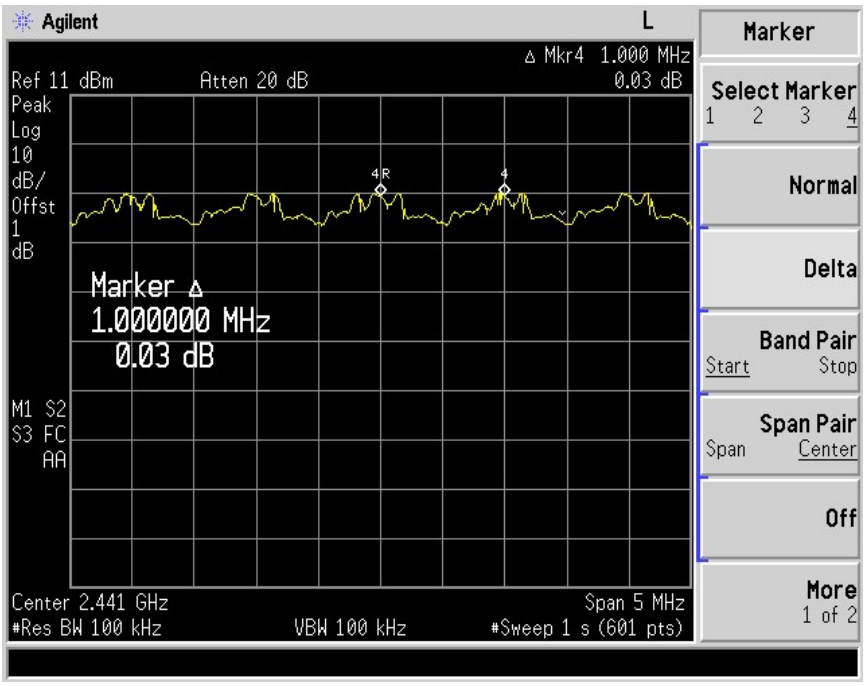


20dB bandwidth(CH 78)

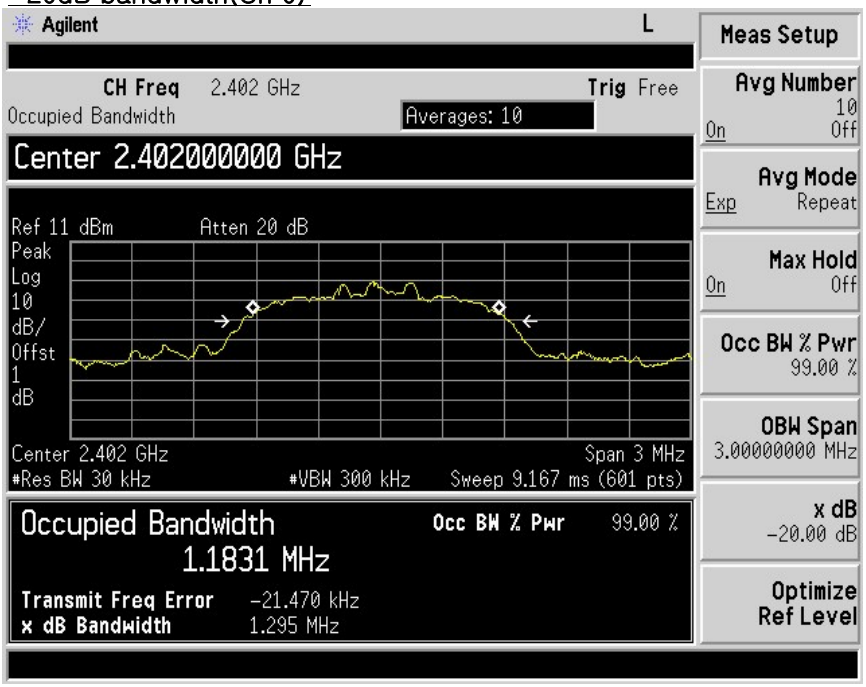


(8DPSK)

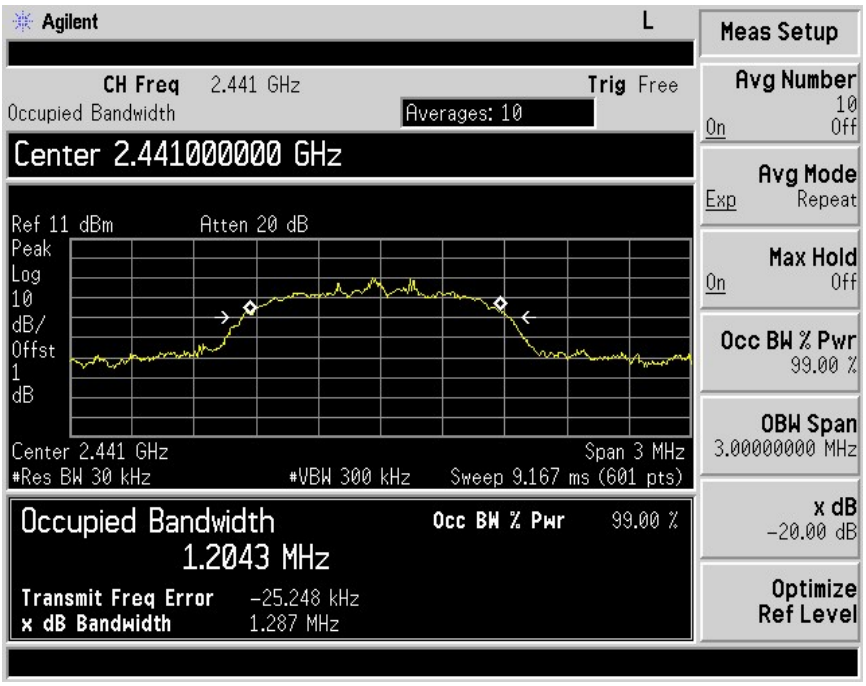
Channel Separation



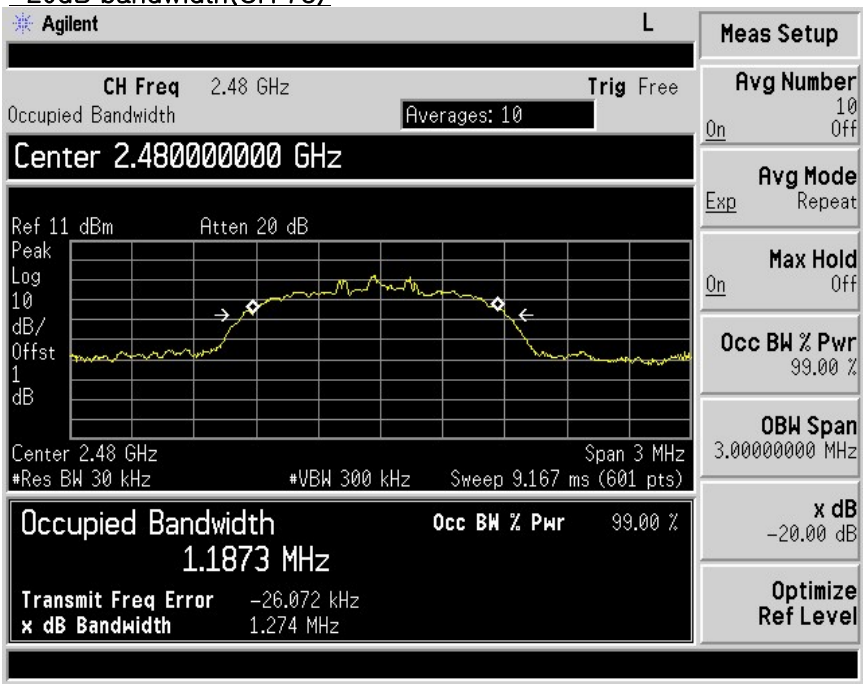
20dB bandwidth(Ch 0)



20dB bandwidth(CH 39)



20dB bandwidth(CH 78)



6. MAXIMUM PEAK OUTPUT POWER

6.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30 dBm.

Description	Model	Serial Number	Cal. Due Date
Power Meter	NRVS	849622/045	2016-01-14
Power Sensor	NRV-251	325948/013	2016-01-14
Power Meter <=> EUT	Loss: 1.0dB	-	

6.2 Measurement results

EUT	CDMA Gateway	MODEL	H3G-800
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 41 % R.H.
INPUT POWER	DC 5 V		

GFSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	-6.40	0.2291	125	PASS
39	2441	-5.82	0.2618	125	PASS
78	2480	-4.65	0.3430	125	PASS

8DPSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	-7.94	0.1608	125	PASS
39	2441	-7.28	0.1871	125	PASS
78	2480	-6.20	0.2398	125	PASS

Note : 8DPSK mode is max power in three different modulations.

7. Number of Hopping Frequency

7.1 Test procedure

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2 400 MHz – 2 483.5 MHz bands shall use at least 15 hopping frequencies.

7.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz

. VBW= 100 KHz

. Span= the frequency band of operation

. Sweep= suitable duration based on the EUT specification.

The Number of Hopping Frequency Test Instruments

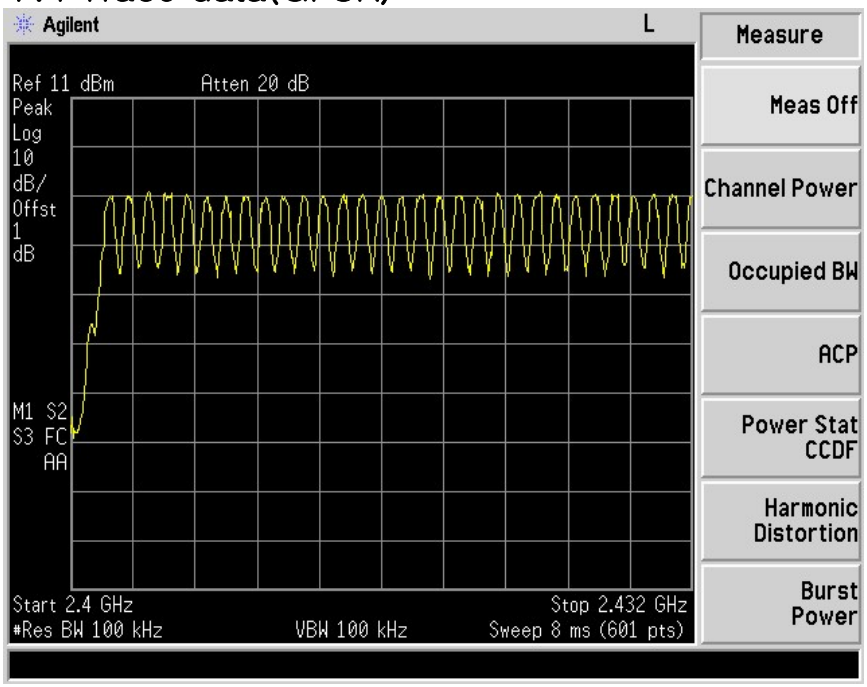
Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4407B	US40241281	2016-01-15
-Spectrum Analyzer <=> EUT	Loss: 1.0dB		

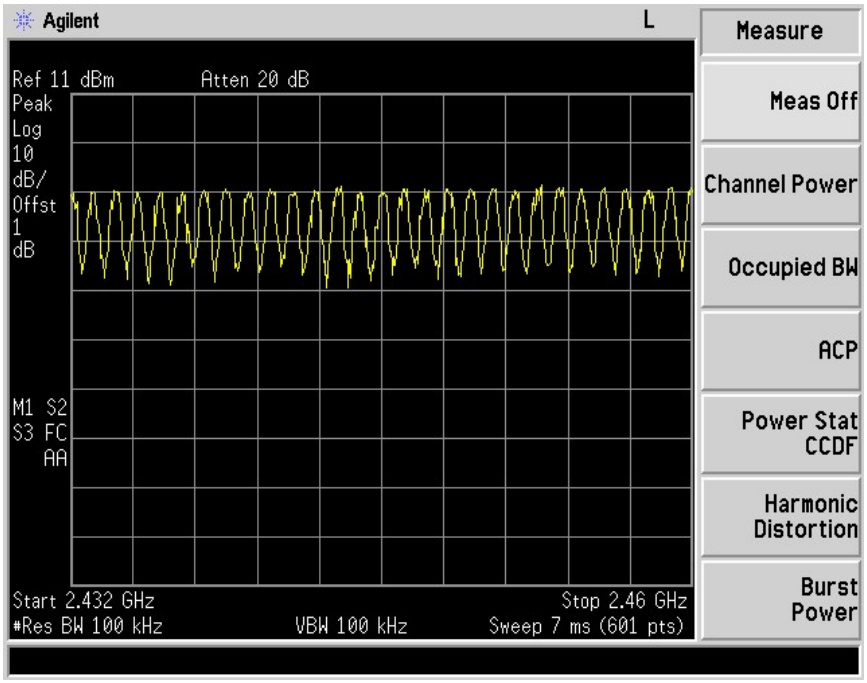
7.3 Measurement results

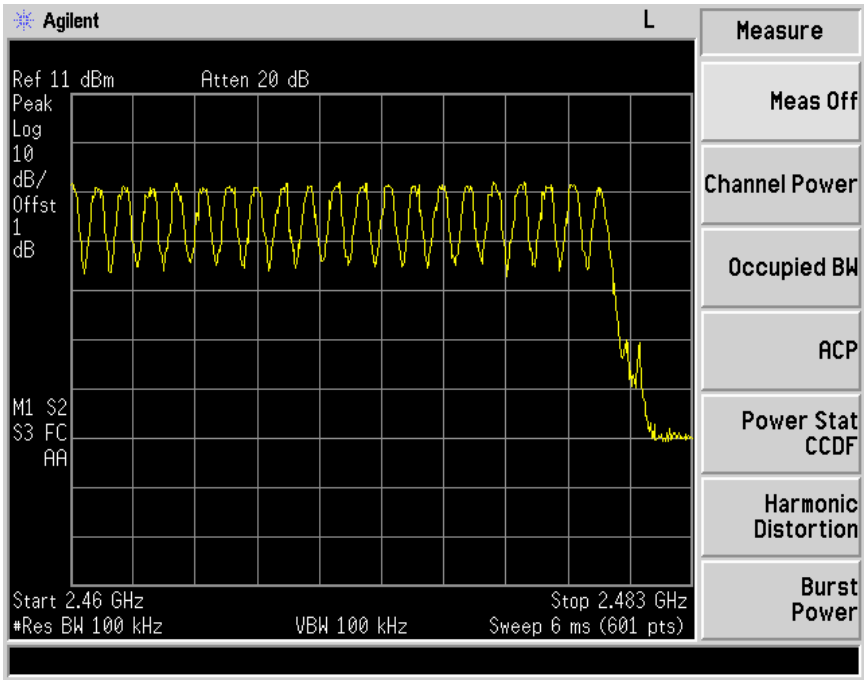
EUT	CDMA Gateway	MODEL	H3G-800
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 5 V		

Number of CH	Limit (Number of CH)	PASS/FAIL
79	>15	PASS

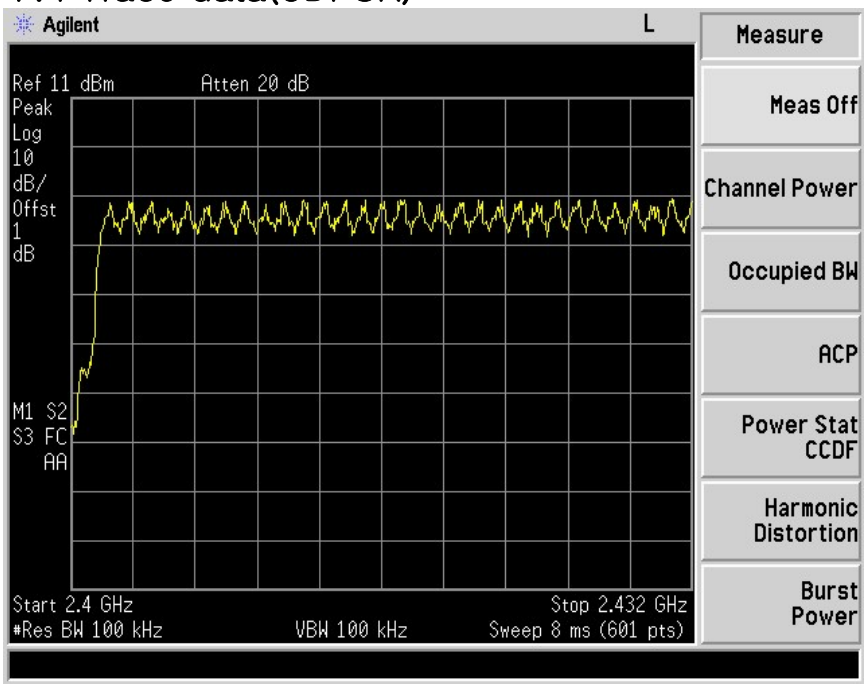
7.4 Trace data(GFSK)

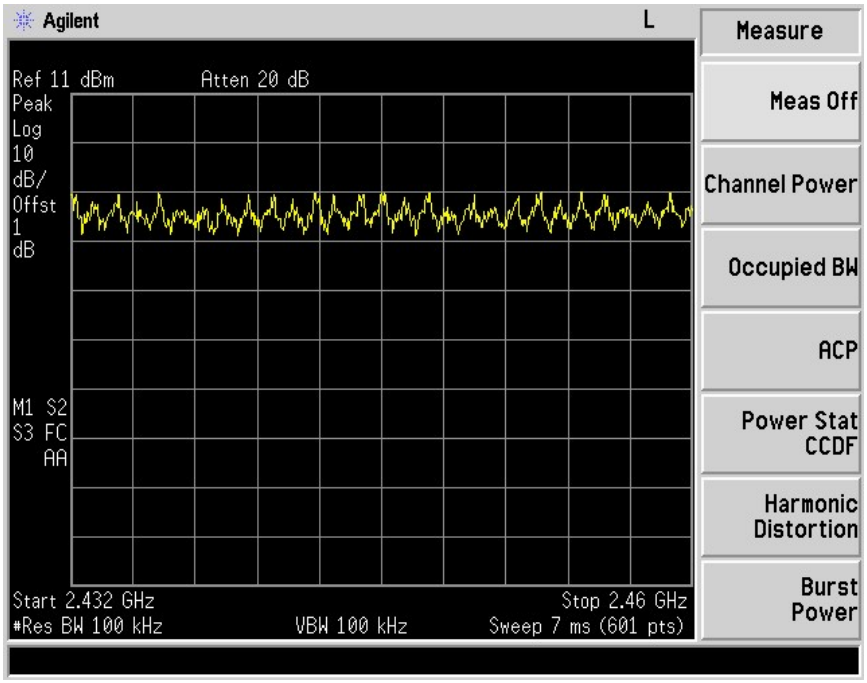


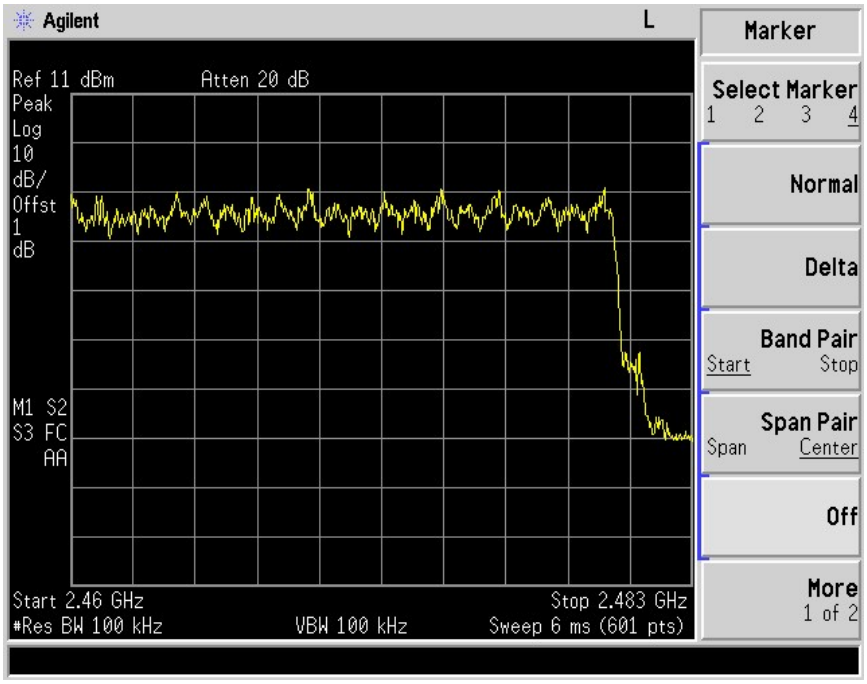



Agilent
L
Ref 11 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
1
dB
M1 S2
S3 FC
AA
Start 2.46 GHz
#Res BW 100 kHz
VBW 100 kHz
Stop 2.483 GHz
Sweep 6 ms (601 pts)
Measure
Meas Off
Channel Power
Occupied BW
ACP
Power Stat CCDF
Harmonic Distortion
Burst Power

7.4 Trace data(8DPSK)






Agilent
L
Ref 11 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
1
dB
M1 S2
S3 FC
AA
Start 2.46 GHz
#Res BW 100 kHz
VBW 100 kHz
Stop 2.483 GHz
Sweep 6 ms (601 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2

8. Time of Occupancy (Dwell Time)

8.1 Test procedure

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2 400 MHz – 2 483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

8.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 1 MHz

. VBW= 1 MHz

. Span= zero span, centered on a hoppong channel

. Sweep = as necessary to capture the entire dwell time per hoppong channel

. Detector function = Peak

. Trace = Max hold

The Time of Occupancy Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	FSV	100939	2016-01-19
-Spectrum Analyzer <=> EUT	Loss: 0.5 dB		

8.3 Measurement results

EUT	CDMA Gateway	MODEL	H3G-800
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 43 % R.H.
INPUT POWER	DC 5 V		

A. DH1 Mode
One peiod for each particular channel : 0.5507 ms X 320.1 = 176.28 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	176.28	400	PASS

Calculation:The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH1 data rate operates on a one-slot transmission and one-slot receiving basis. Thus there are 1600/(1+1)=800 transmissions per second. In one period for each particular channel there are 10.13x31.6=320.1 times of tramsmissions.

B. DH3 Mode
One peiod for each particular channel : 1.7971 ms X 159.9 = 287.36 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	287.36	400	PASS

Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH3 data rate operates on a three-slot transmission and one-slot receiving basis. Thus there are 1600/(3+1)=400 transmissions per second. In one period for each particular channel there are 5.06x31.6=159.9 times of tramsmissions.

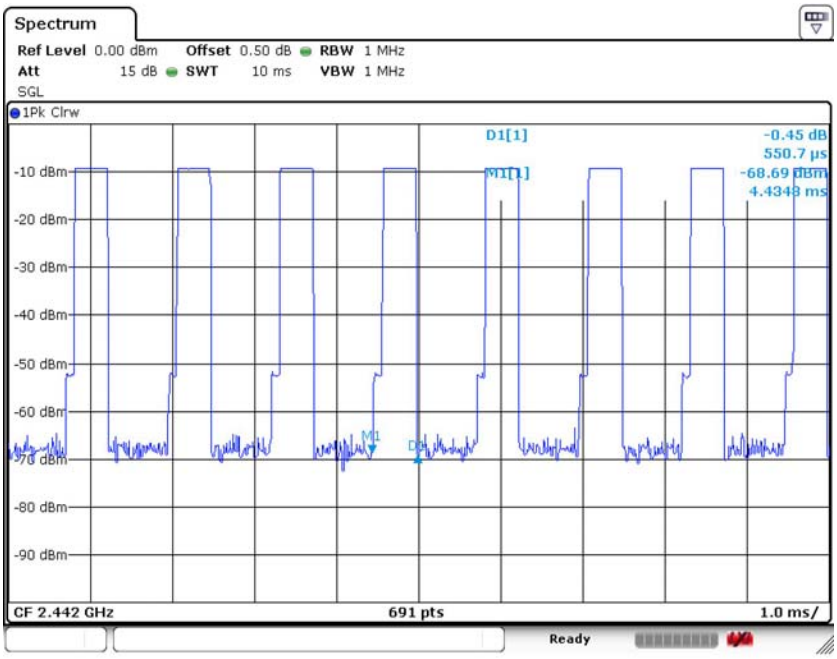
C. DH5 Mode
One peiod for each particular channel : 3.058 ms X 106.81 = 326.62 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	326.62	400	PASS

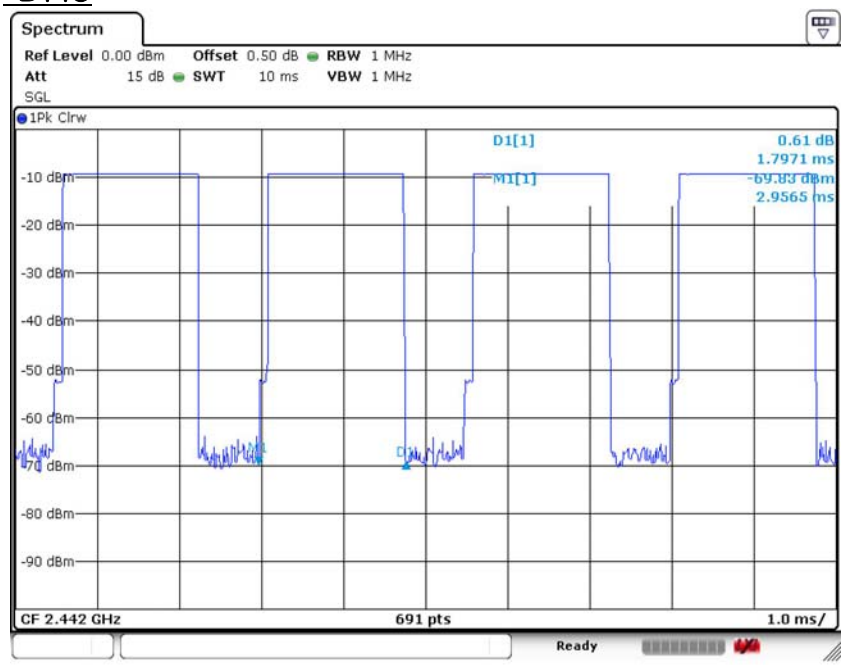
Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH5 data rate operates on a five-slot transmission and one-slot receiving basis. Thus there are 1600/(5+1)=266.7 transmissions per second. In one period for each particular channel there are 3.38x31.6=106.81 times of tramsmissions.

8.4 Trace data

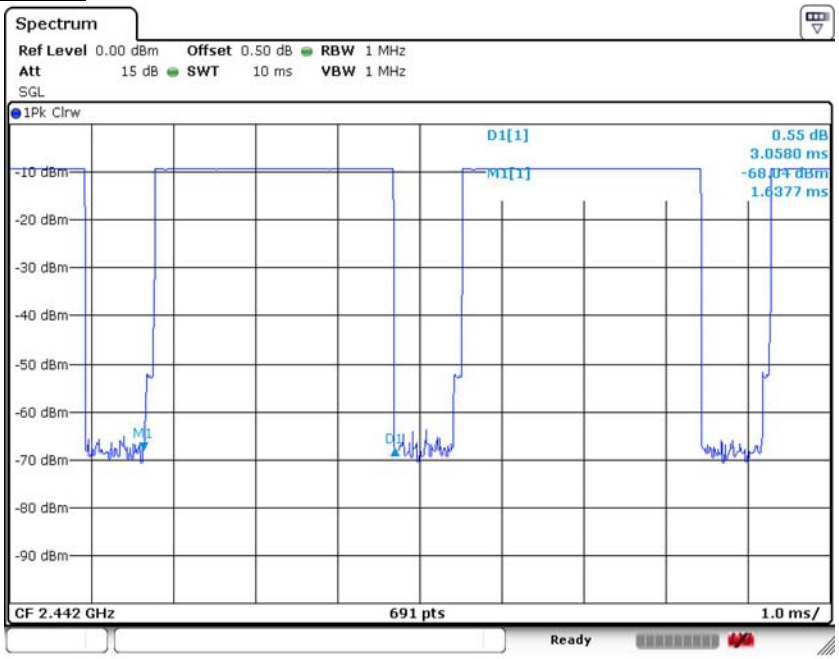
DH1



DH3


Spectrum
Ref Level 0.00 dBm Offset 0.50 dB RBW 1 MHz
Att 15 dB SWT 10 ms VBW 1 MHz
SGL
1Pk Clrw
D1[1] 0.61 dB
1.7971 ms
M1[1]
2.9565 ms
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.442 GHz
691 pts
1.0 ms/
Ready

DH5


Spectrum
Ref Level 0.00 dBm Offset 0.50 dB RBW 1 MHz
Att 15 dB SWT 10 ms VBW 1 MHz
SGL
1Pk Clrw
D1[1] 0.55 dB
3.0580 ms
M1[1]
1.6377 ms
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.442 GHz
691 pts
1.0 ms/
Ready

8DPSK

A. DH1 Mode

One peiod for each particular channel : 0.5652 ms X 320.1 = 180.92 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	180.92	400	PASS

B. DH3 Mode

One peiod for each particular channel : 1.8116 ms X 159.9 = 289.67 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	289.67	400	PASS

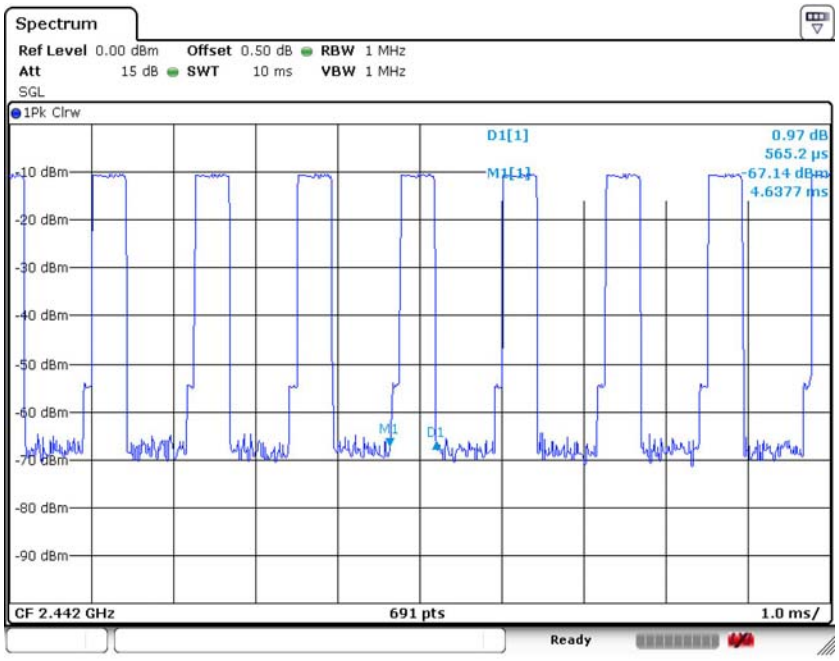
C. DH5 Mode

One peiod for each particular channel : 3.058 ms X 106.81 = 326.62 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	326.62	400	PASS

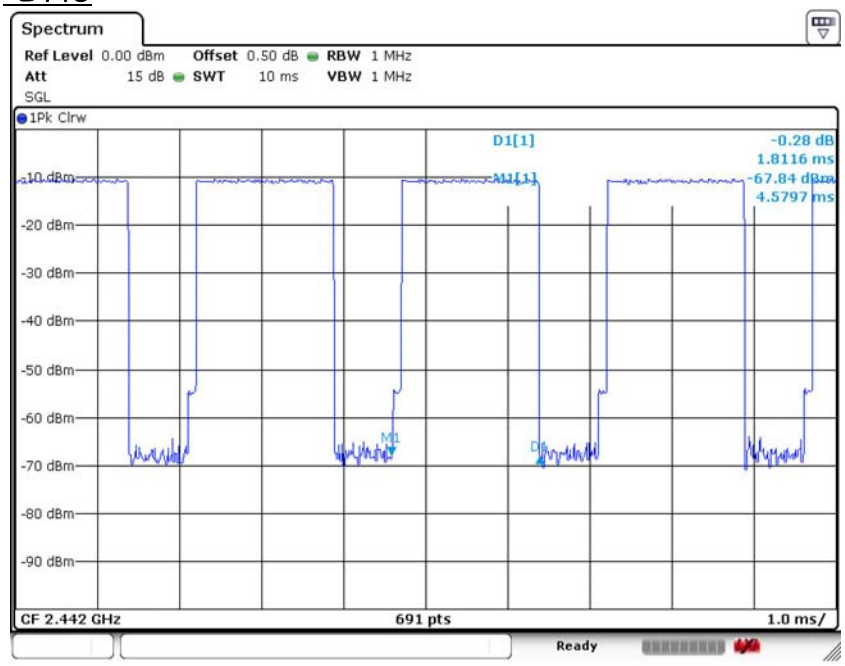
8.5 Trace data

DH1

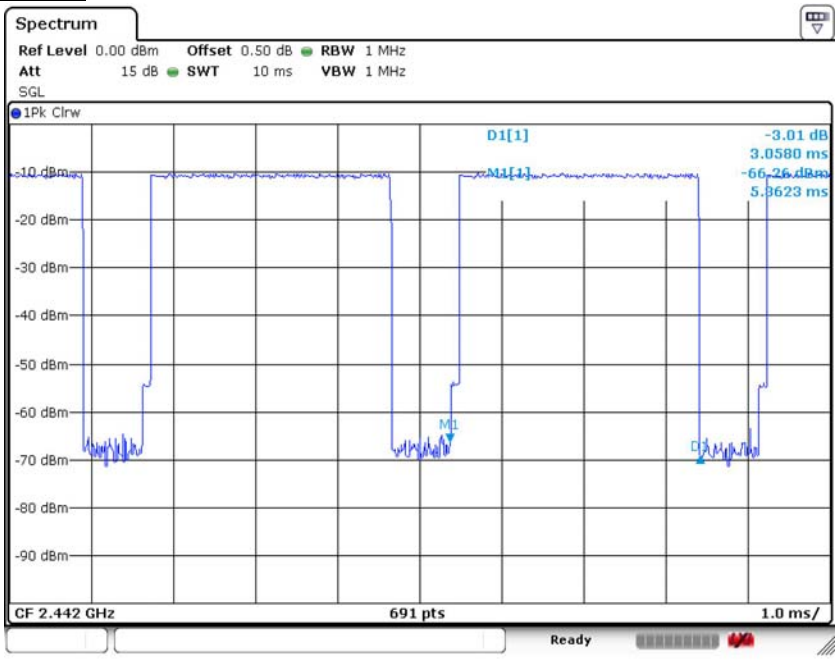


8DPSK

DH3



DH5



9. band-edge and out of band emissions.

9.1 Test procedure

The radio frequecy power at 20dB down from the highest inband power level is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The band edge&out of band emission shall be at least 20dB below of the highest inband power level.

9.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz

. VBW= >100 KHz

. Span= suitable frequency span

. Sweep= suitable duration based on the EUT specification.

Band Edge&Out of Emission Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	FSV	100939	2016-01-19
-Spectrum Analyzer <=> EUT	Loss: 1.0dB		

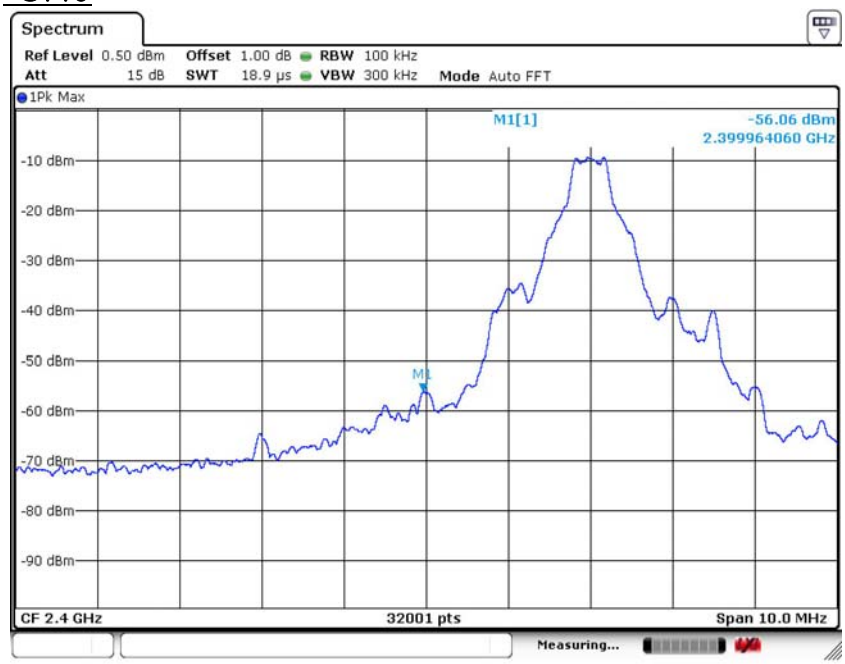
9.3 Measurement results of band-edge & out of emission

EUT	CDMA Gateway	MODEL	H3G-800
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 5 V		

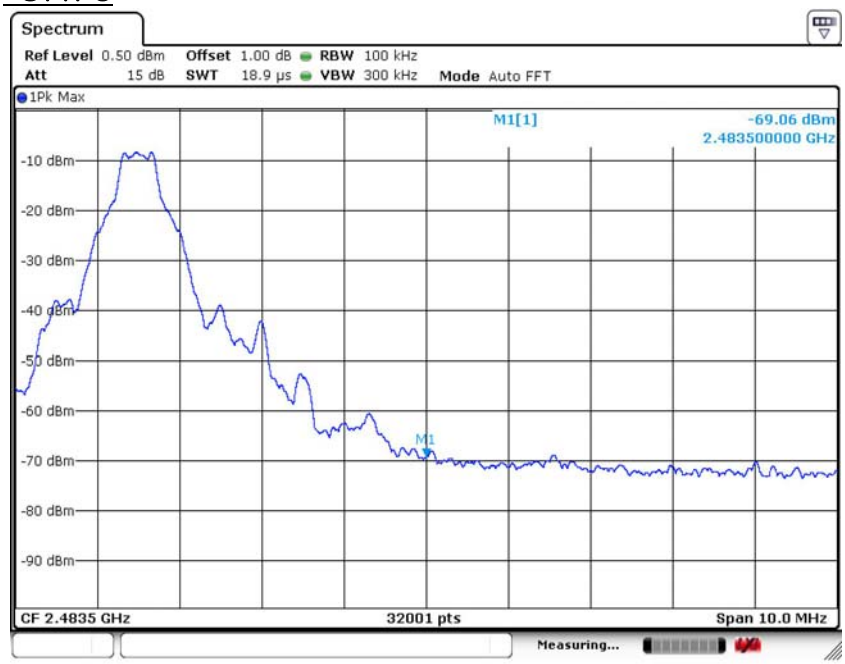
* Refer to attach spectrum analyzer data chart.

9.4 Trace data of band-edge & Out of Emission

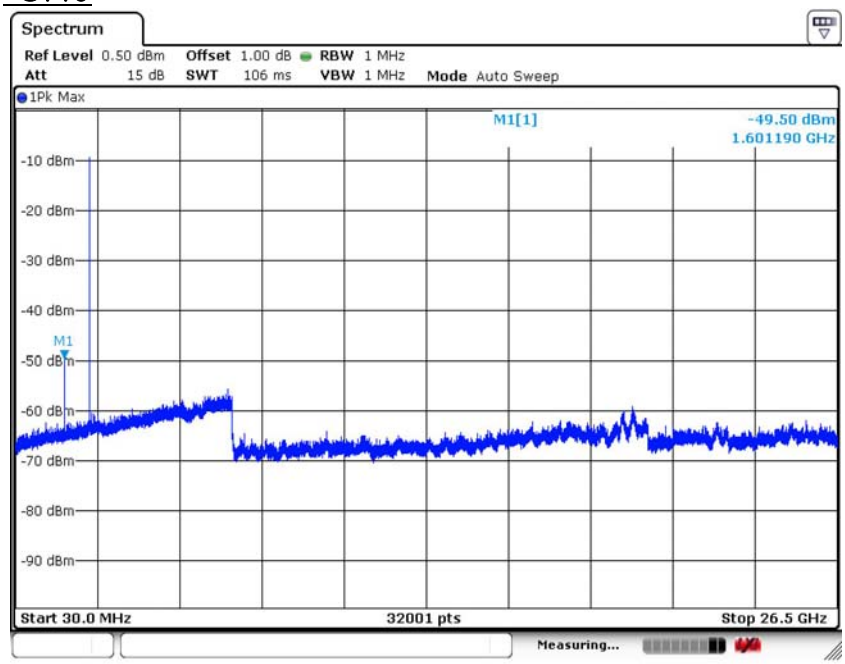
CH0



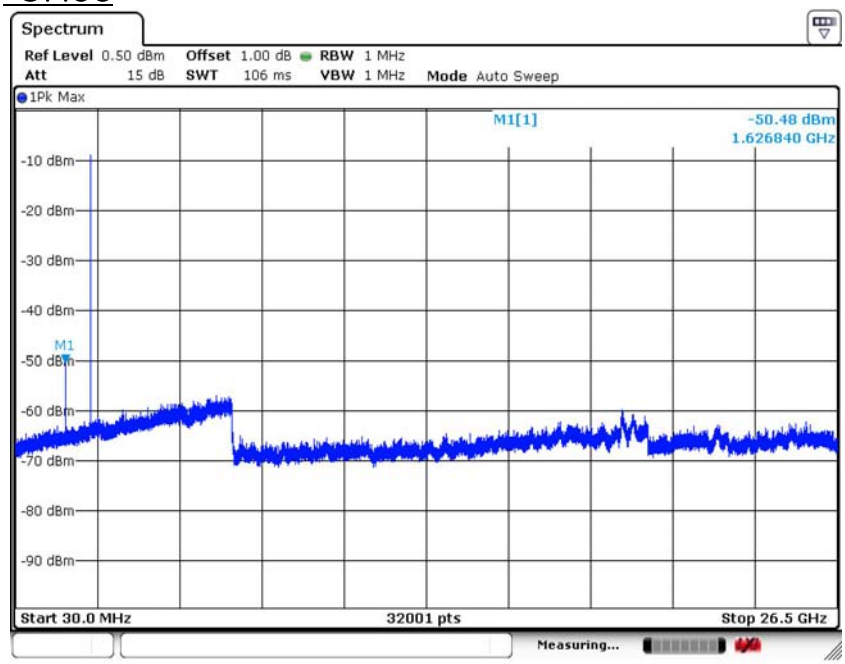
CH78



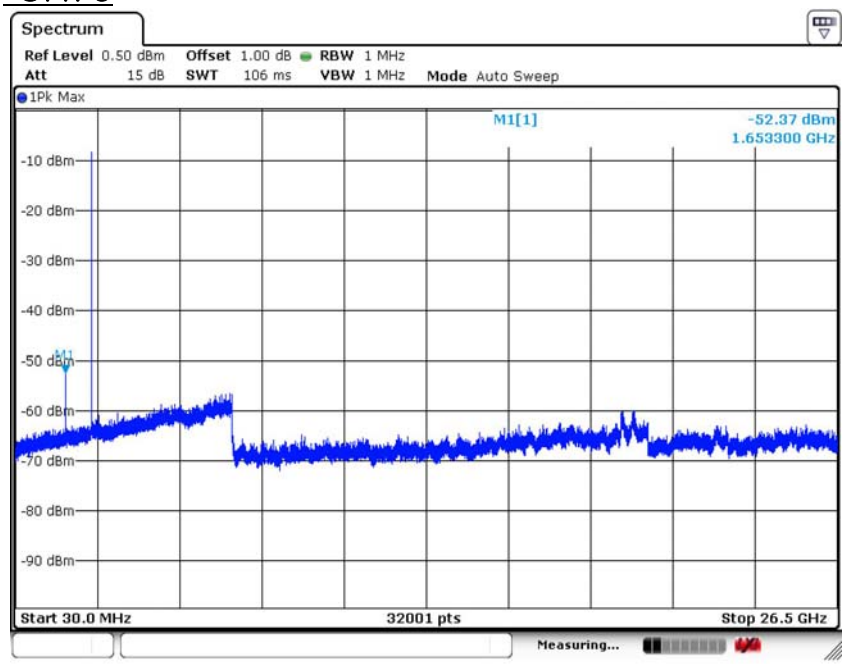
CH0


Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-49.50 dBm
1.601190 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

CH38

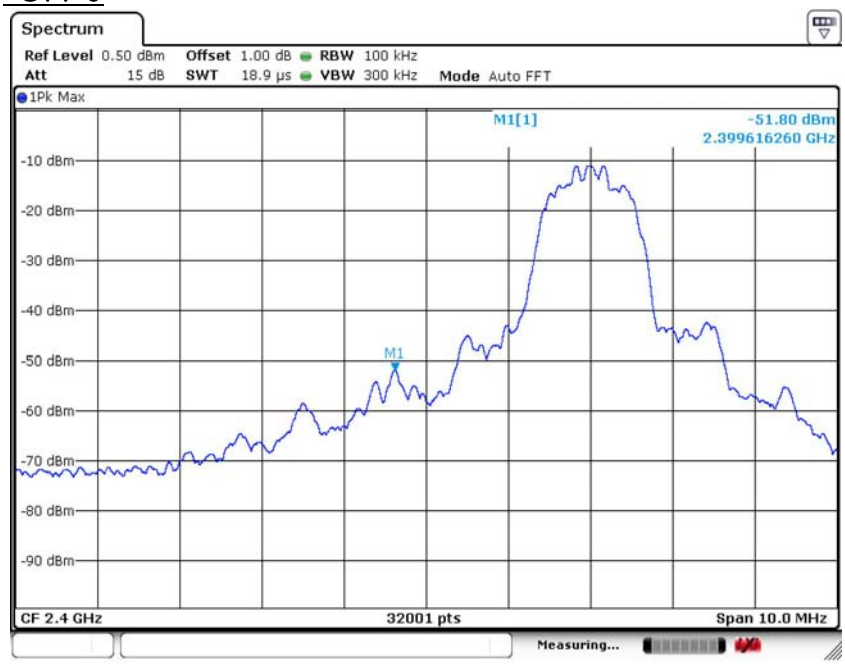

Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-50.48 dBm
1.626840 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

CH79

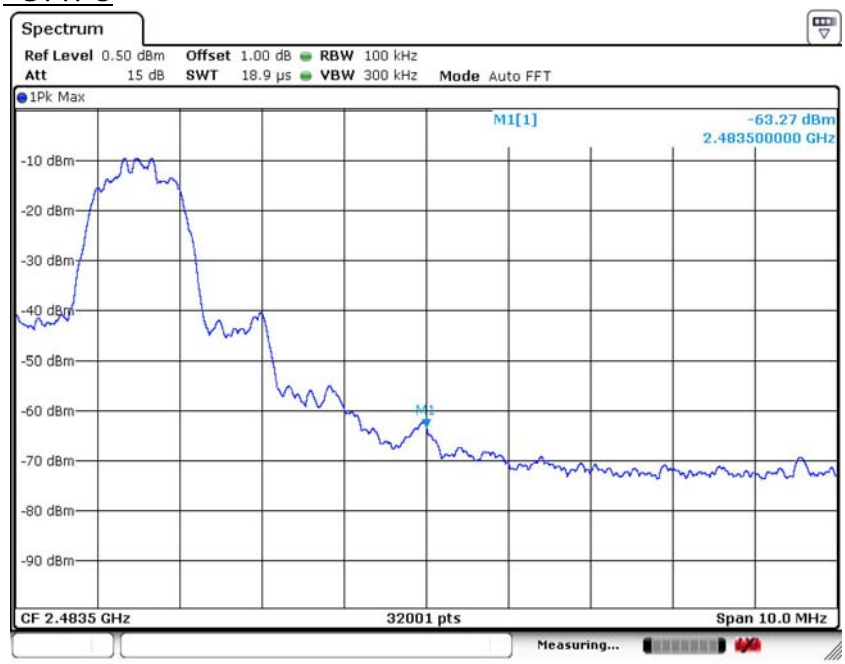

Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-52.37 dBm
1.653300 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

8DPSK

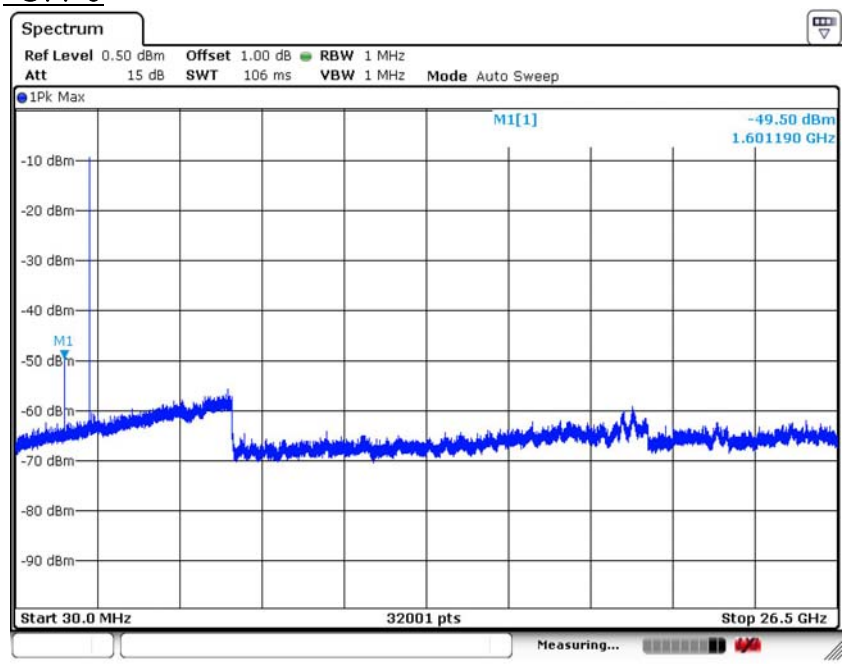
CH 0



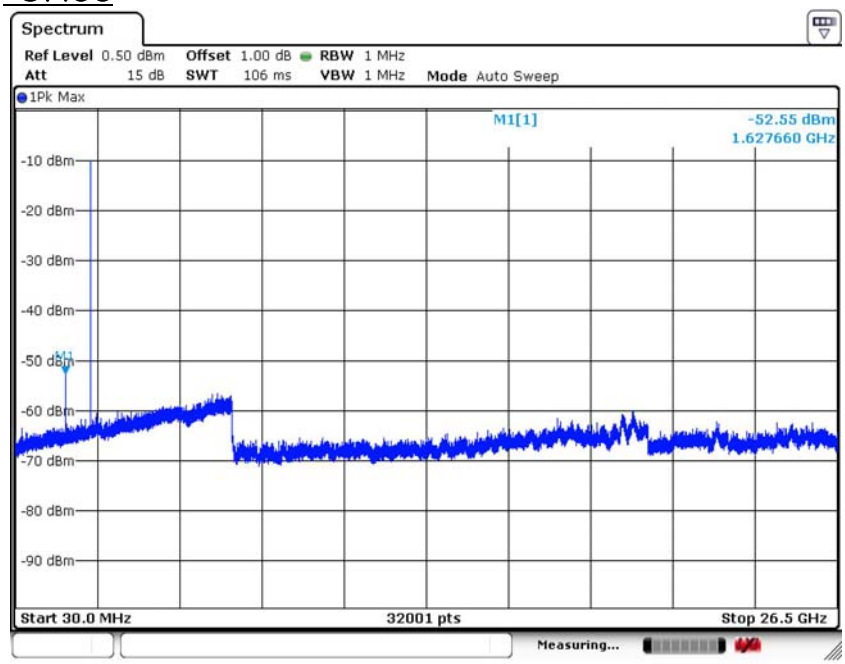
CH78



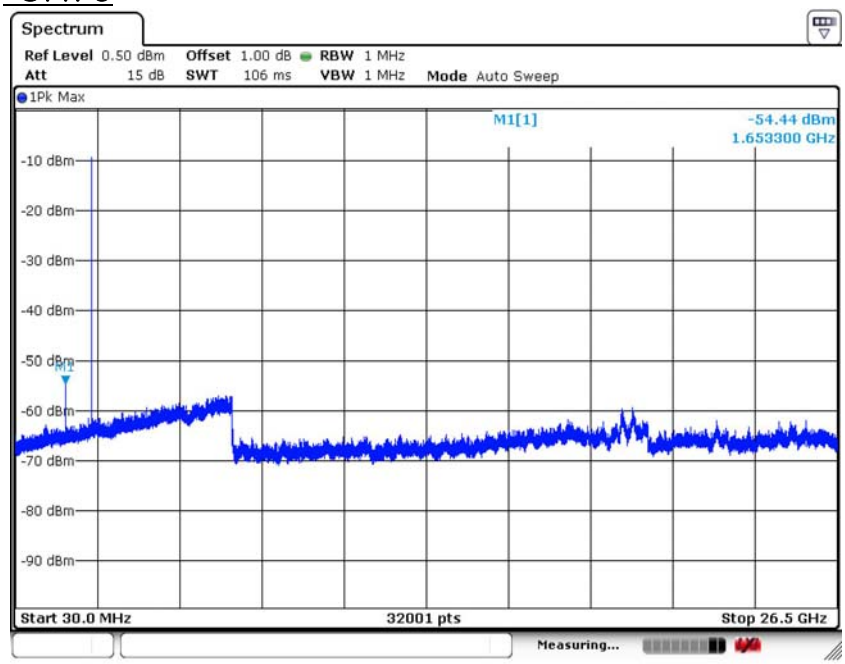
CH 0


Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-49.50 dBm
1.601190 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

CH38


Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-52.55 dBm
1.627660 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

CH79


Spectrum
Ref Level 0.50 dBm Offset 1.00 dB RBW 1 MHz
Att 15 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1]
-54.44 dBm
1.653300 GHz
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

10. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC PART 15.205, 15.209. The test setup was made according to ANSI C 63.4 (2009) & DA 00-705 Semi-anechoic chamber, which allows a 3 m distance measurement. The EUT was placed in the center of styrofoam turntable. The height of this table was 0.8 m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

10.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESCI7	ROHDE & SCHWARZ	100916	13-Jan-16
Logbicon Antenna	VULB 9168	SCHWARZBECK	193	18-Sep-15
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	AGILENT	3008A00595	13-Jan-16
Horn Antenna	BBHA9120D	SCHWARZBECK	469	16-Oct-15
Test Receiver	ESPI7	ROHDE & SCHWARZ	100185	13-Jan-16
Spectrum Analyzer	R3273	ADVANTEST	110600592	13-Jan-16
Turn Table	DT1500-S	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
Pyramidal Horn Antenna	3160-09-01	EST-LINDGREN	102642	22-Oct-15
Antenna Master & Turn table controller	CO2000-P	Innco System GmbH	CO2000/642 /28051111/L	-

10.2 Environmental Condition

Below 1 GHz -Test Place : 10 m Semi-anechoic chamber

BT Basic Rate Mode
Temperature (°C) : 22.4 ℃
Humidity (% R.H.) : 43.5 % R.H.

BT EDR Mode
Temperature (°C) : 22.4 ℃
Humidity (% R.H.) : 47.0 % R.H.

Above 1 GHz-Test Place : 3 m Semi-anechoic chamber

BT Basic Rate Mode
Temperature (°C) : 20.1 ℃
Humidity (% R.H.) : 53.0 % R.H.

BT EDR Mode
Temperature (°C) : 20.4 ℃
Humidity (% R.H.) : 51.5 % R.H.

10.3 Test Data for Bluetooth (Basic Rate)

Test Date : 20-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
38.20	17.47	V	1.0	12.92	1.09	40.00	31.48	8.52
51.20	14.95	V	1.0	13.58	1.25	40.00	29.79	10.21
116.60	16.27	V	1.0	10.67	1.85	43.50	28.79	14.71
132.90	16.35	V	1.0	12.09	1.98	43.50	30.41	13.09
165.10	11.40	V	1.0	12.90	2.20	43.50	26.50	17.00
189.40	7.50	H	3.0	10.91	2.35	43.50	20.76	22.74
296.70	8.08	H	2.8	13.40	2.93	46.00	24.41	21.59
432.00	11.12	H	2.0	16.34	3.53	46.00	30.99	15.01
Remark	H : Horizontal, V : Vertical Bluetooth (Basic Rate , 39 CH , 2 441 MHz) *CL = Cable Loss (In case of below 1 000 MHz) *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. *Result Value = Reading + Ant Factor + Cable loss *Margin = Limit - Result							

10.3-1 Test Data for Bluetooth(Basic Rate)

Test Date : 20-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2350.60	26.86	H	1.0	26.53	5.62	0.00	74.00	59.01	14.99
2384.20	27.12	V	1.0	26.58	5.62	0.00	74.00	59.32	14.68
2390.00	24.82	H	1.0	26.59	5.62	0.00	74.00	57.03	16.97
2390.00	25.90	V	1.0	26.59	5.62	0.00	74.00	58.11	15.89
4804.00	52.03	H	1.0	30.72	-24.20	0.00	74.00	58.55	15.45
4804.00	52.08	V	1.0	30.72	-24.20	0.00	74.00	58.60	15.40
Average (RBW:1 MHz VBW:1 kHz)									
2350.60	13.51	H	1.0	26.53	5.62	-30.29	54.00	15.37	38.63
2384.20	13.51	V	1.0	26.58	5.62	-30.29	54.00	15.42	38.58
2390.00	13.54	H	1.0	26.59	5.62	-30.29	54.00	15.46	38.54
2390.00	13.44	V	1.0	26.59	5.62	-30.29	54.00	15.36	38.64
4804.00	47.32	H	1.0	30.72	-24.20	-30.29	54.00	23.55	30.45
4804.00	47.51	V	1.0	30.72	-24.20	-30.29	54.00	23.74	30.26

Remark

H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH0 (2 402 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.
FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

10.3-2 Test Data for Bluetooth(Basic Rate)

Test Date : 20-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
4882.00	50.31	H	1.0	30.85	-23.97	0.00	74.00	57.19	16.81
4882.00	51.44	V	1.0	30.85	-23.97	0.00	74.00	58.32	15.68
Average (RBW:1 MHz VBW:1 kHz)									
4882.00	44.08	H	1.0	30.85	-23.97	-30.29	54.00	20.67	33.33
4882.00	45.49	V	1.0	30.85	-23.97	-30.29	54.00	22.08	31.92
Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH39 (2 441 MHz) *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result *The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz. FYI : Duty Cycle Correction Factor (79 channel hopping) a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1 c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB								

10.3-3 Test Data for Bluetooth(Basic Rate)

Test Date : 20-Apr-15 Measurement Distance : 3 m

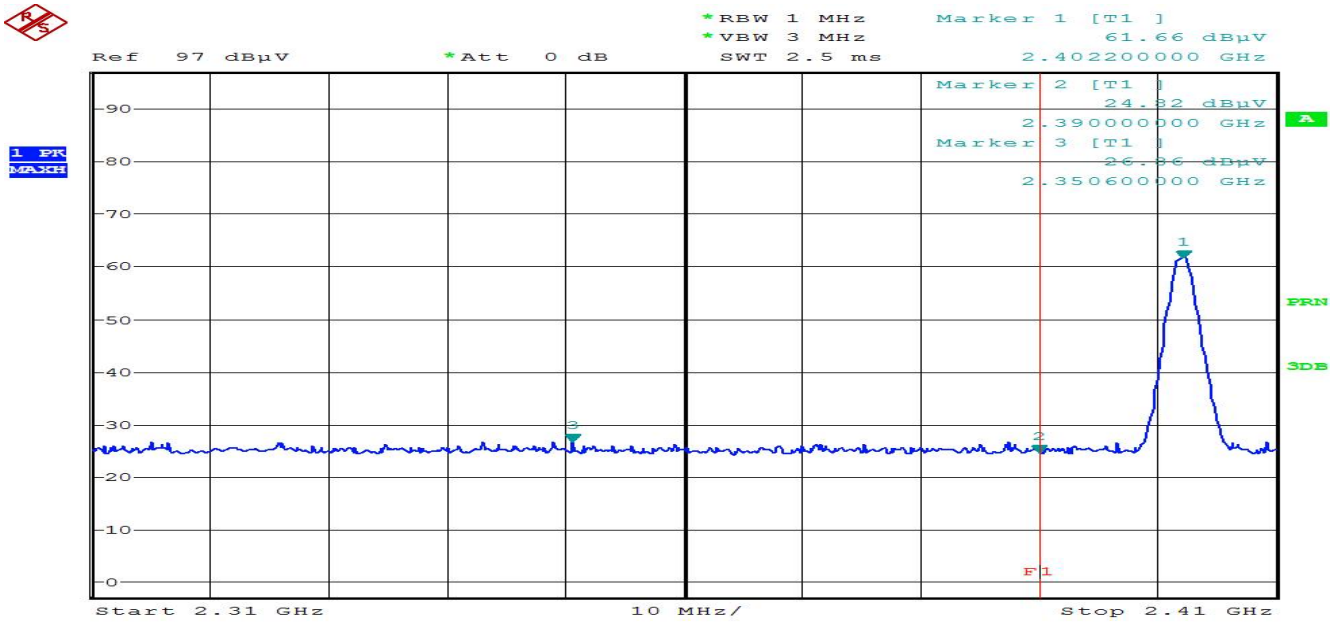
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	29.57	H	1.0	26.74	5.80	0.00	74.00	56.31	17.69
2483.50	25.94	V	1.0	26.74	5.80	0.00	74.00	58.48	15.52
2489.30	26.52	H	1.0	26.75	5.80	0.00	74.00	59.07	14.93
2491.90	26.43	V	1.0	26.76	5.80	0.00	74.00	58.99	15.01
4960.00	48.13	H	1.0	30.98	-23.87	0.00	74.00	55.24	18.76
4960.00	48.32	V	1.0	30.98	-23.87	0.00	74.00	55.43	18.57
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	24.61	H	1.0	26.74	5.80	-30.29	54.00	26.86	27.14
2483.50	15.79	V	1.0	26.74	5.80	-30.29	54.00	18.04	35.96
2489.30	13.28	H	1.0	26.75	5.80	-30.29	54.00	15.54	38.46
2491.90	13.30	V	1.0	26.76	5.80	-30.29	54.00	15.57	38.43
4960.00	39.72	H	1.0	30.98	-23.87	-30.29	54.00	16.54	37.46
4960.00	40.55	V	1.0	30.98	-23.87	-30.29	54.00	17.37	36.63

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic rate-CH78 (2 480 MHz) *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result *The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz. FYI : Duty Cycle Correction Factor (79 channel hopping) a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1 c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

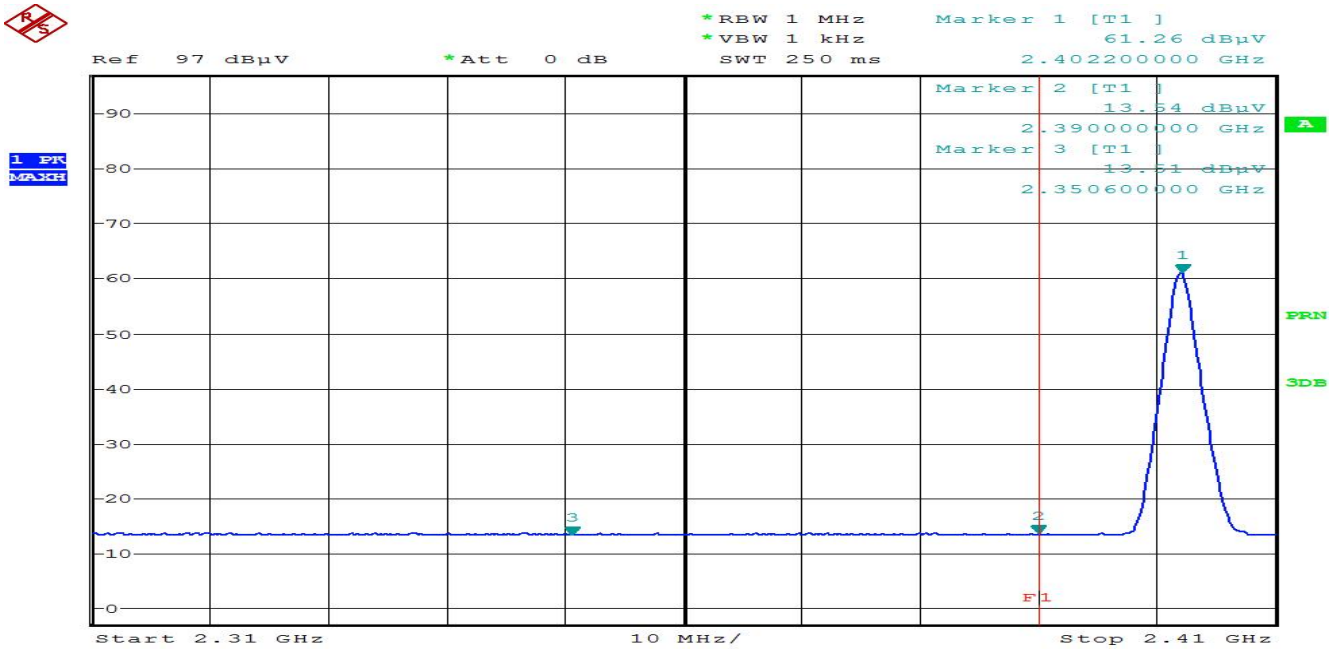
10.4 Restricted Band Edges for BT(Basic Rate)

Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal

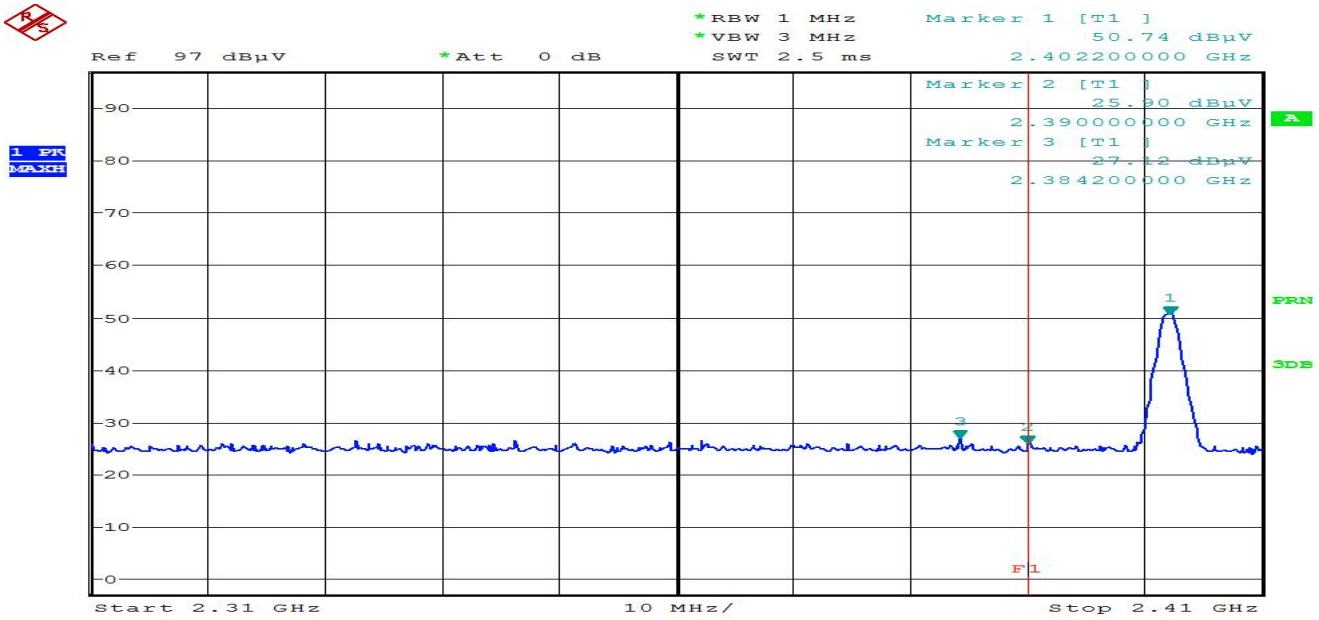


Detector mode:Average Polarity:Horizontal

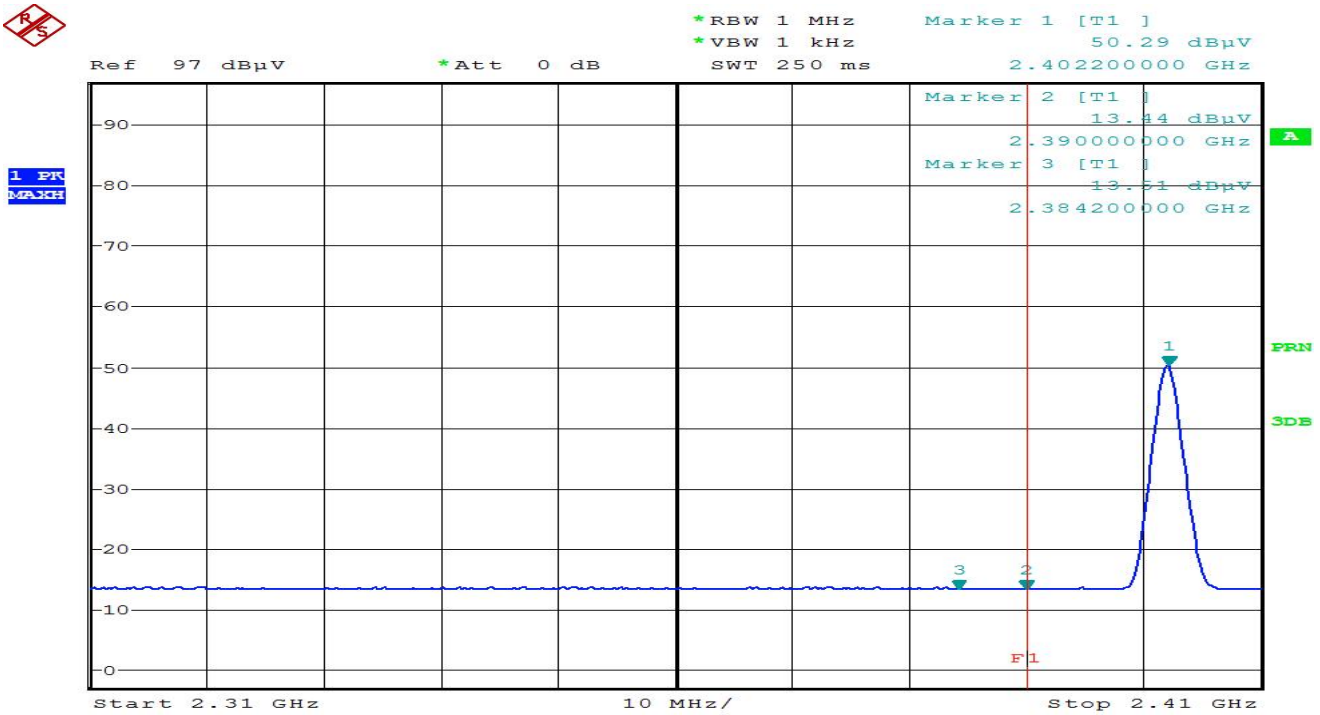


Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical

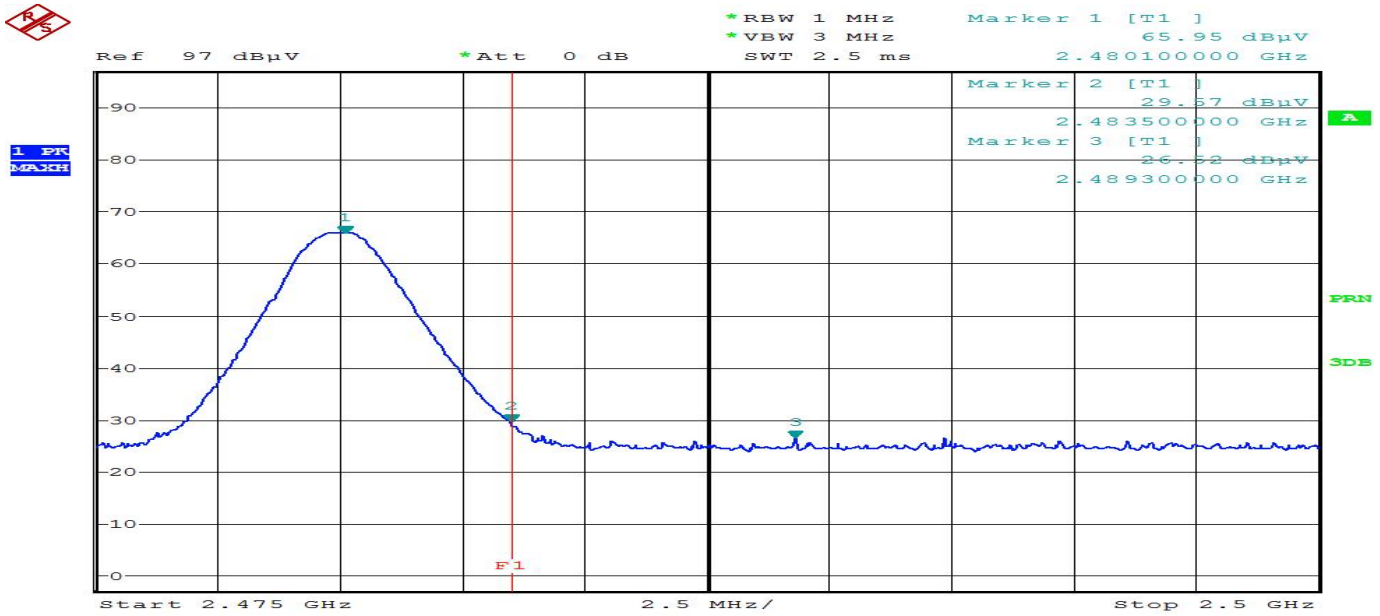


Detector mode:Average Polarity:Vertical

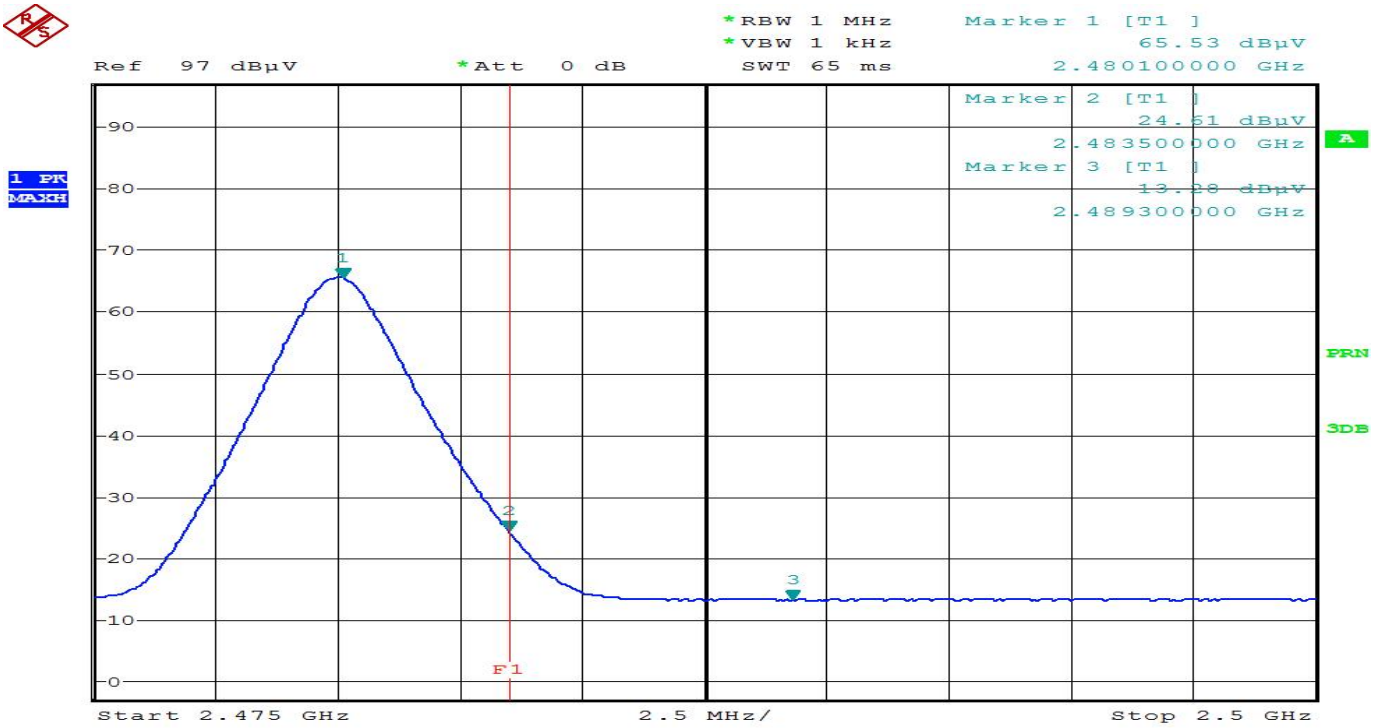


Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal

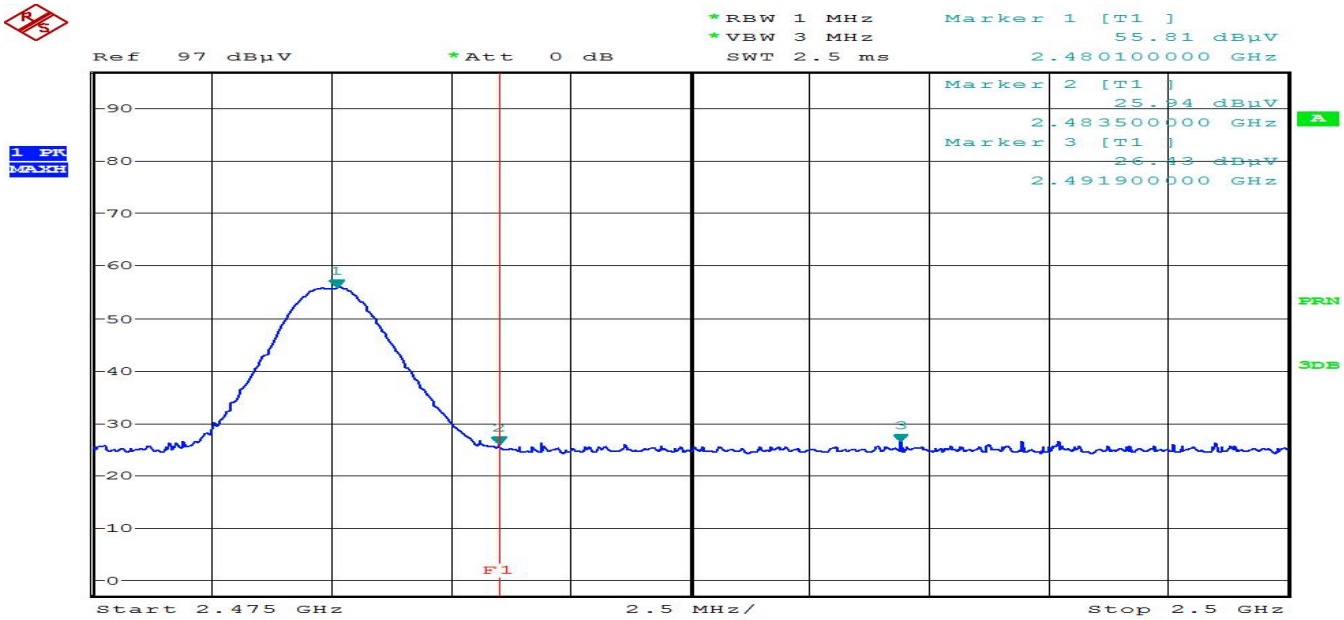


Detector mode:Average Polarity:Horizontal

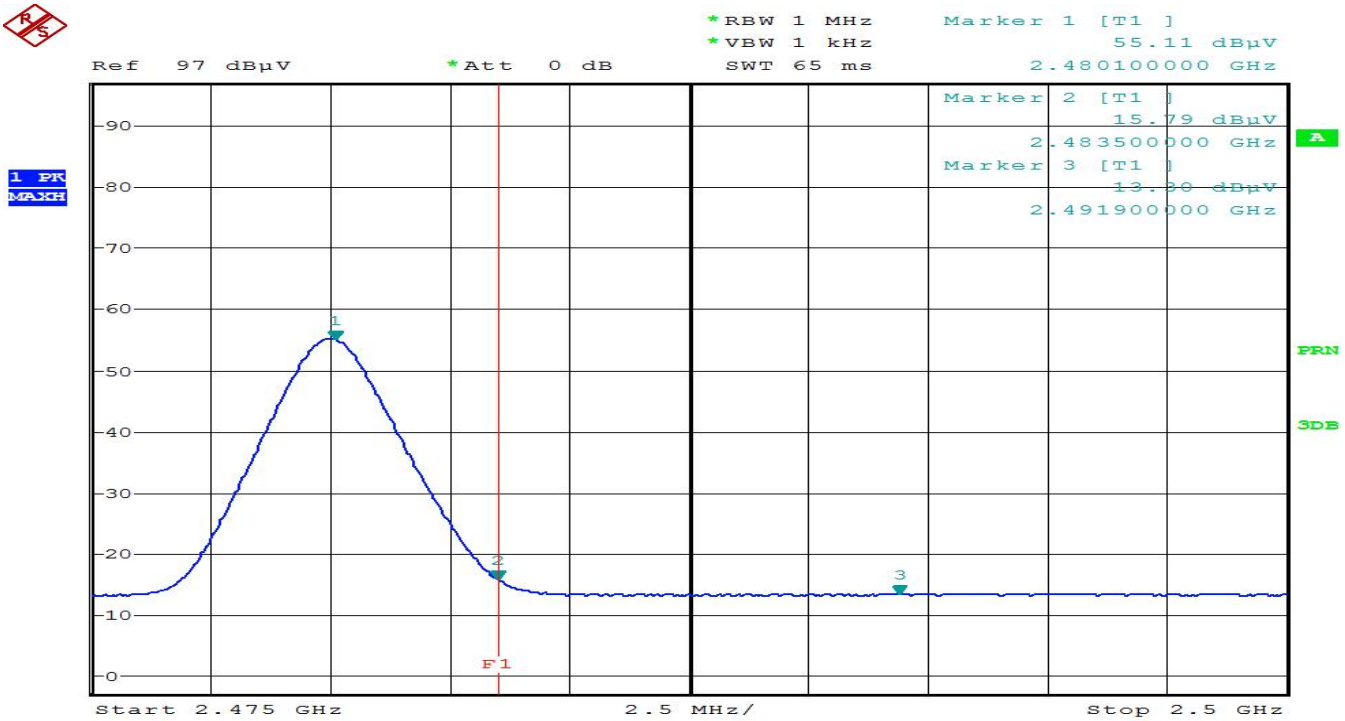


Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Detector mode:Average Polarity:Vertical



10.5 Test Data for Bluetooth (EDR)

Test Date : 21-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
37.70	16.14	V	1.0	12.88	1.08	40.00	30.10	9.90
51.40	16.26	V	1.0	13.57	1.26	40.00	31.09	8.91
72.00	5.91	H	3.0	11.31	1.47	40.00	18.69	21.31
120.00	17.65	V	1.0	11.06	1.88	43.50	30.59	12.91
132.20	19.19	V	1.0	12.03	1.97	43.50	33.19	10.31
141.80	14.24	V	1.0	12.71	2.04	43.50	28.99	14.51
251.00	10.10	H	3.3	11.83	2.71	46.00	24.64	21.36
294.70	6.90	H	3.0	13.33	2.92	46.00	23.15	22.85
432.00	10.69	H	2.0	16.34	3.53	46.00	30.56	15.44

Remark	H : Horizontal, V : Vertical Bluetooth (EDR , 39 CH , 2 441 MHz) *CL = Cable Loss(In case of below 1 000 MHz) *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. *Result Value = Reading + Ant Factor + Cable loss *Margin = Limit - Result

10.5-1 Test Data for Bluetooth(EDR)

Test Date : 21-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2376.40	26.72	H	1.0	26.57	5.62	0.00	74.00	58.91	15.09
2390.00	25.39	H	1.0	26.59	5.62	0.00	74.00	57.60	16.40
2390.00	24.85	V	1.0	26.59	5.62	0.00	74.00	57.06	16.94
2341.20	26.70	V	1.0	26.51	5.62	0.00	74.00	58.83	15.17
4804.00	45.65	H	1.0	30.72	-24.20	0.00	74.00	52.17	21.83
4804.00	44.55	V	1.0	30.72	-24.20	0.00	74.00	51.07	22.93
Average (RBW:1 MHz VBW:1 kHz)									
2376.40	13.62	H	1.0	26.57	5.62	-30.29	54.00	15.52	38.48
2390.00	13.48	H	1.0	26.59	5.62	-30.29	54.00	15.40	38.60
2390.00	13.44	V	1.0	26.59	5.62	-30.29	54.00	15.36	38.64
2341.20	13.49	V	1.0	26.51	5.62	-30.29	54.00	15.33	38.67
4804.00	34.25	H	1.0	30.72	-24.20	-30.29	54.00	10.48	43.52
4804.00	34.49	V	1.0	30.72	-24.20	-30.29	54.00	10.72	43.28

Remark	
	H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH0 (2 402 MHz) *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result *The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz. FYI : Duty Cycle Correction Factor (79 channel hopping) a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1 c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

10.5-2 Test Data for Bluetooth(EDR)

Test Date : 21-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
4882.00	45.86	H	1.0	30.85	-23.97	0.00	74.00	52.74	21.26
4882.00	45.09	V	1.0	30.85	-23.97	0.00	74.00	51.97	22.03
Average(RBW:1 MHz VBW:1 kHz)									
4882.00	33.23	H	1.0	30.85	-23.97	-30.29	54.00	9.82	44.18
4882.00	33.41	V	1.0	30.85	-23.97	-30.29	54.00	10.00	44.00

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH39 (2 441 MHz) *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result *The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz. FYI : Duty Cycle Correction Factor (79 channel hopping) a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1 c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

10.5-3 Test Data for Bluetooth(EDR)

Test Date : 21-Apr-15 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	29.48	H	1.0	26.74	5.60	0.00	74.00	61.82	12.18
2483.50	25.34	V	1.0	26.74	5.60	0.00	74.00	57.68	16.32
2494.35	26.15	H	1.0	26.76	5.60	0.00	74.00	58.51	15.49
2494.55	26.35	V	1.0	26.76	5.60	0.00	74.00	58.71	15.29
4960.00	45.46	H	1.0	30.98	-23.87	0.00	74.00	52.57	21.43
4960.00	45.70	V	1.0	30.98	-23.87	0.00	74.00	52.81	21.19
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	23.75	H	1.0	26.74	5.60	-30.29	54.00	25.80	28.20
2483.50	16.00	V	1.0	26.74	5.60	-30.29	54.00	18.05	35.95
2494.35	13.26	H	1.0	26.76	5.60	-30.29	54.00	15.33	38.67
2494.55	13.35	V	1.0	26.76	5.60	-30.29	54.00	15.42	38.58
4960.00	32.91	H	1.0	30.98	-23.87	-30.29	54.00	9.73	44.27
4960.00	32.93	V	1.0	30.98	-23.87	-30.29	54.00	9.75	44.25

Remark

H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH78 (2 480 MHz)

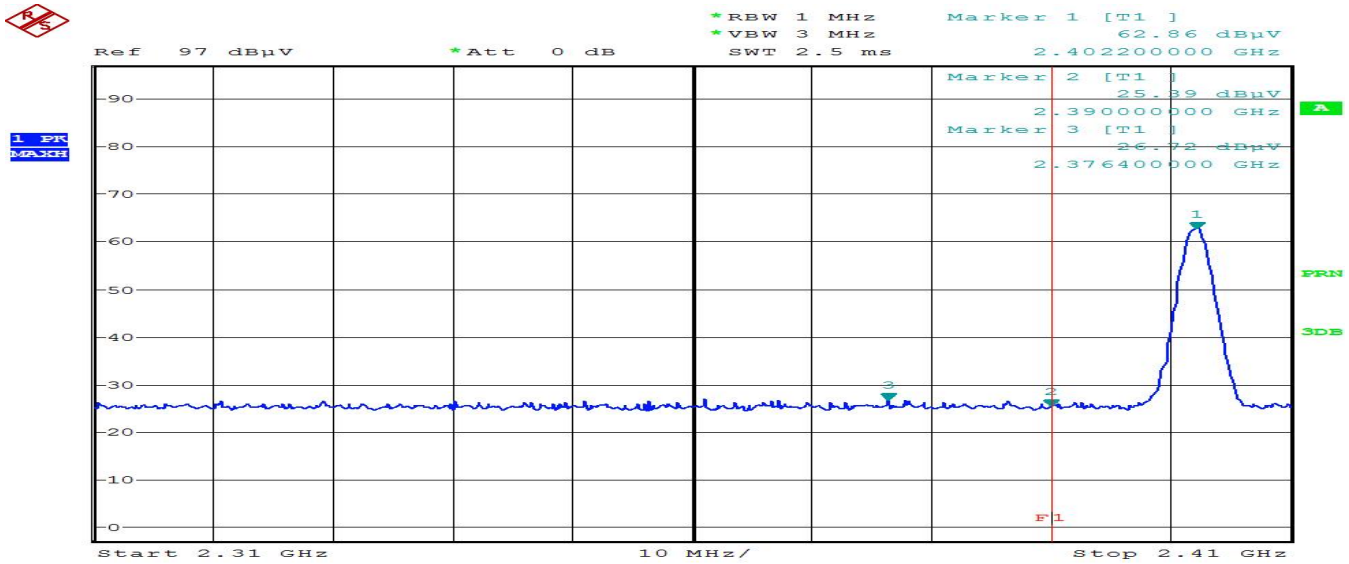
*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.

FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

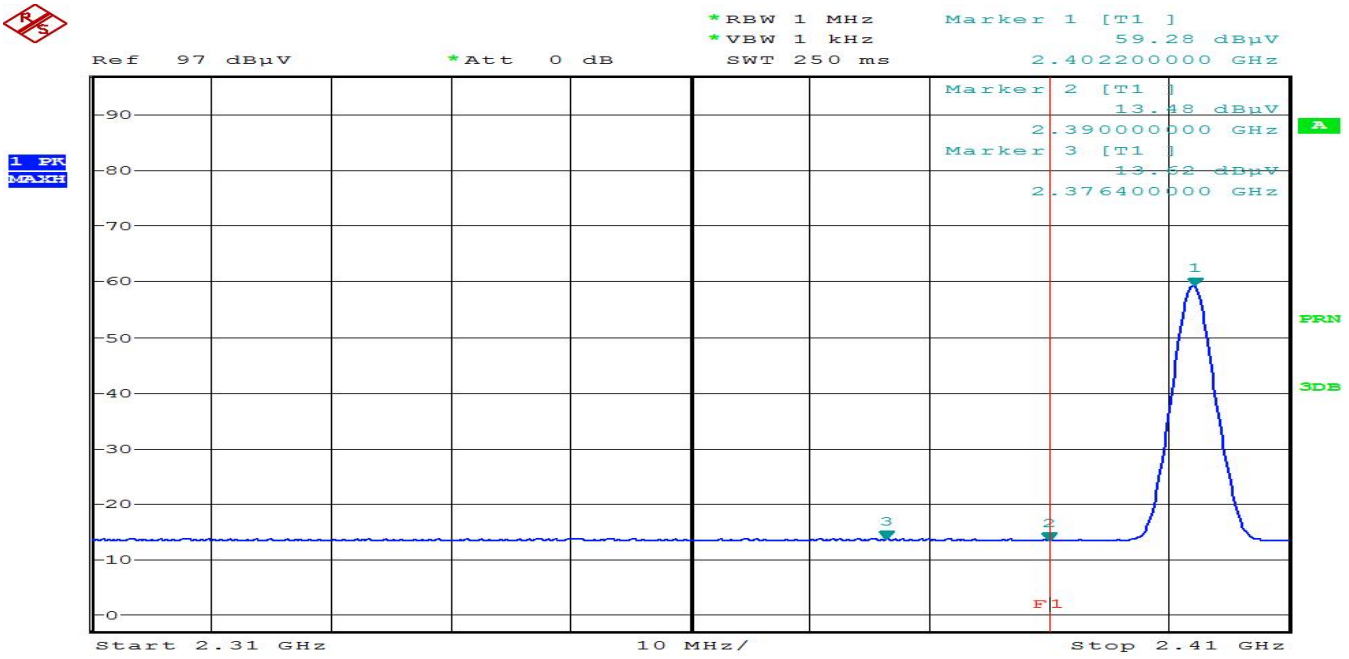
10.6 Restricted Band Edges for BT(EDR)

Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal

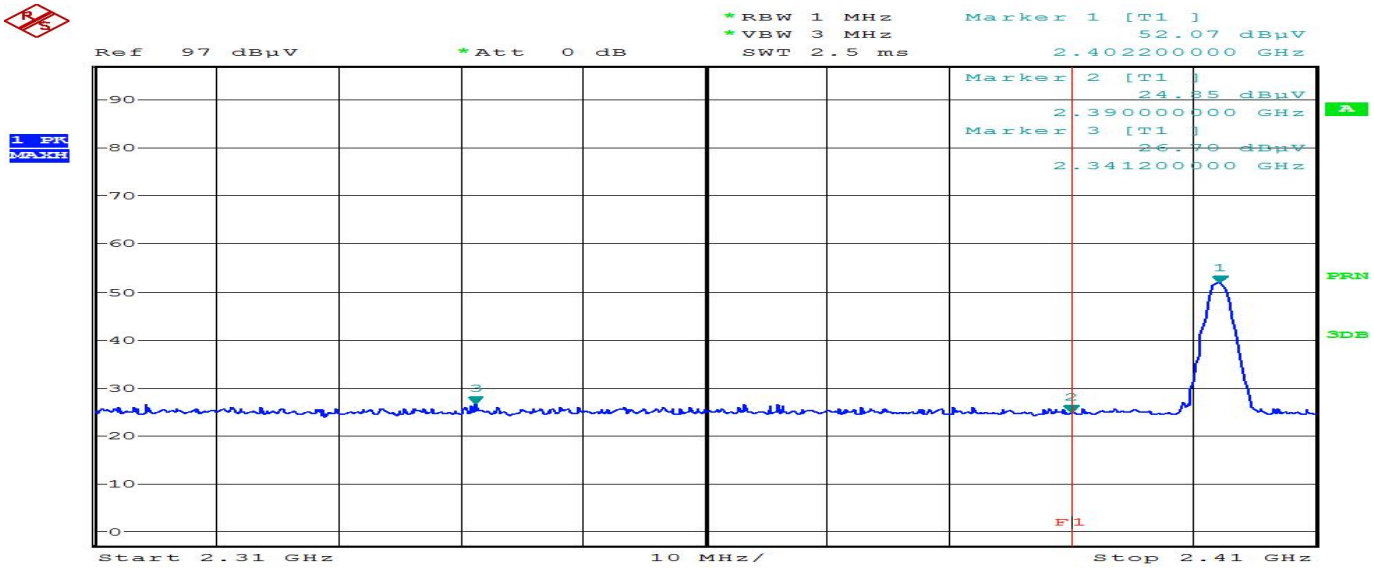


Detector mode:Average Polarity:Horizontal

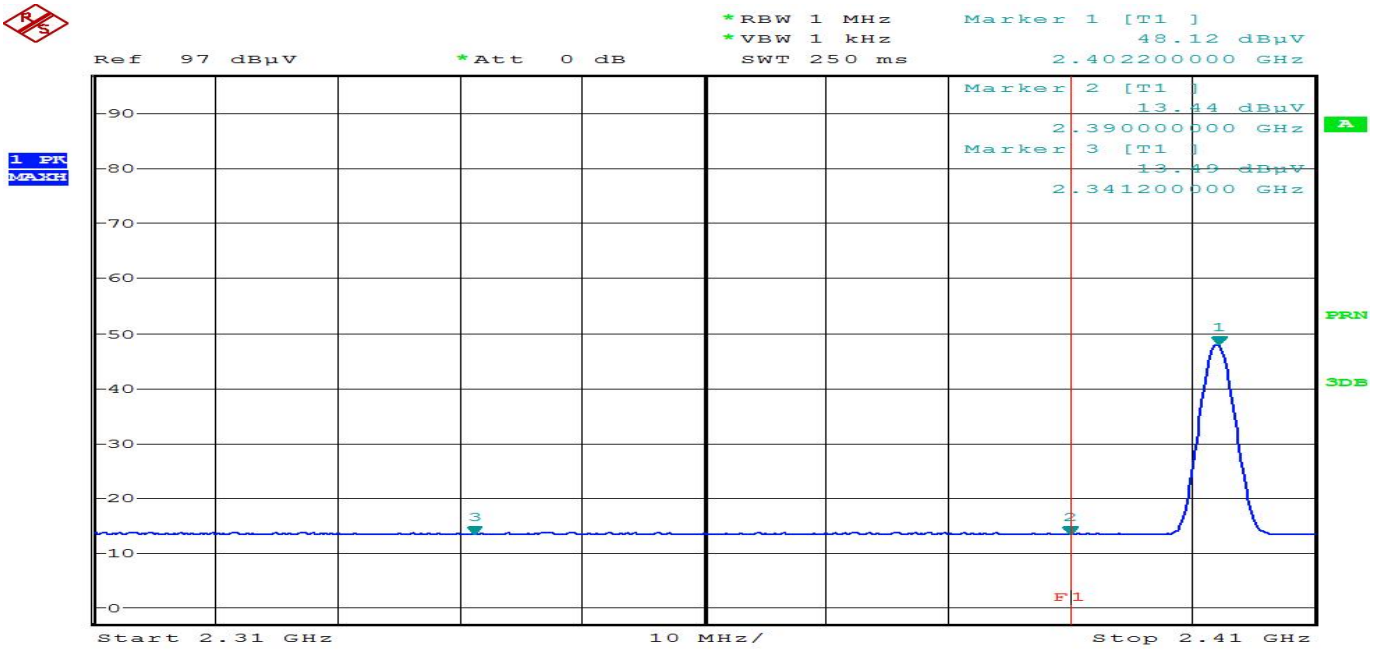


Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical

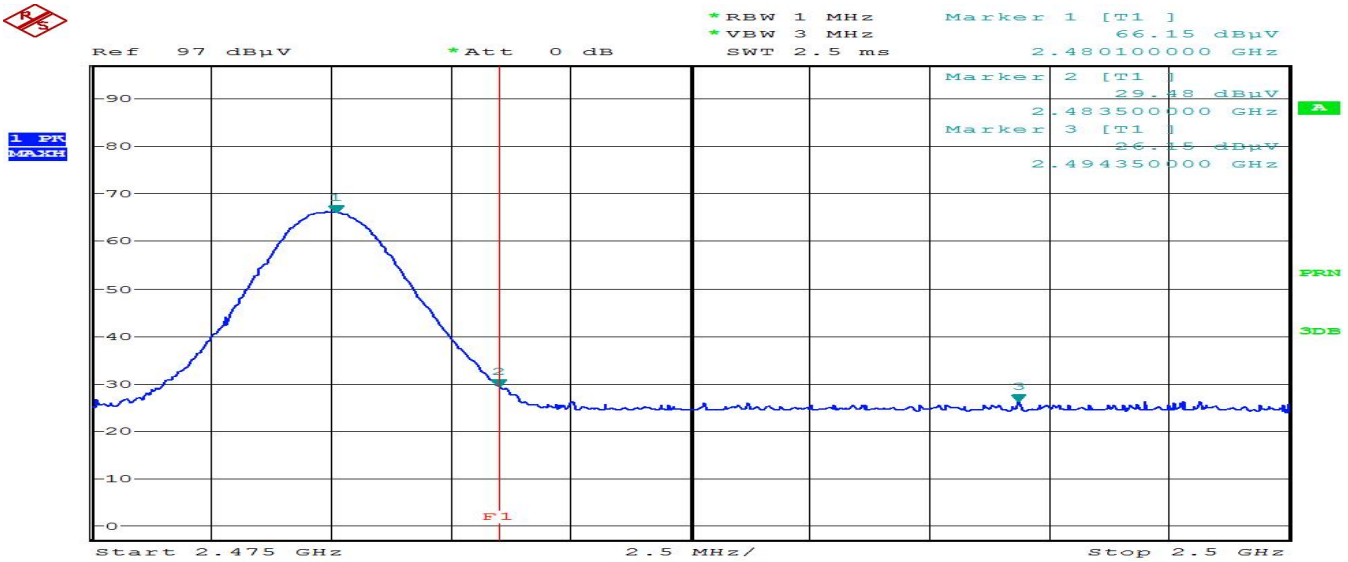


Detector mode:Average Polarity:Vertical

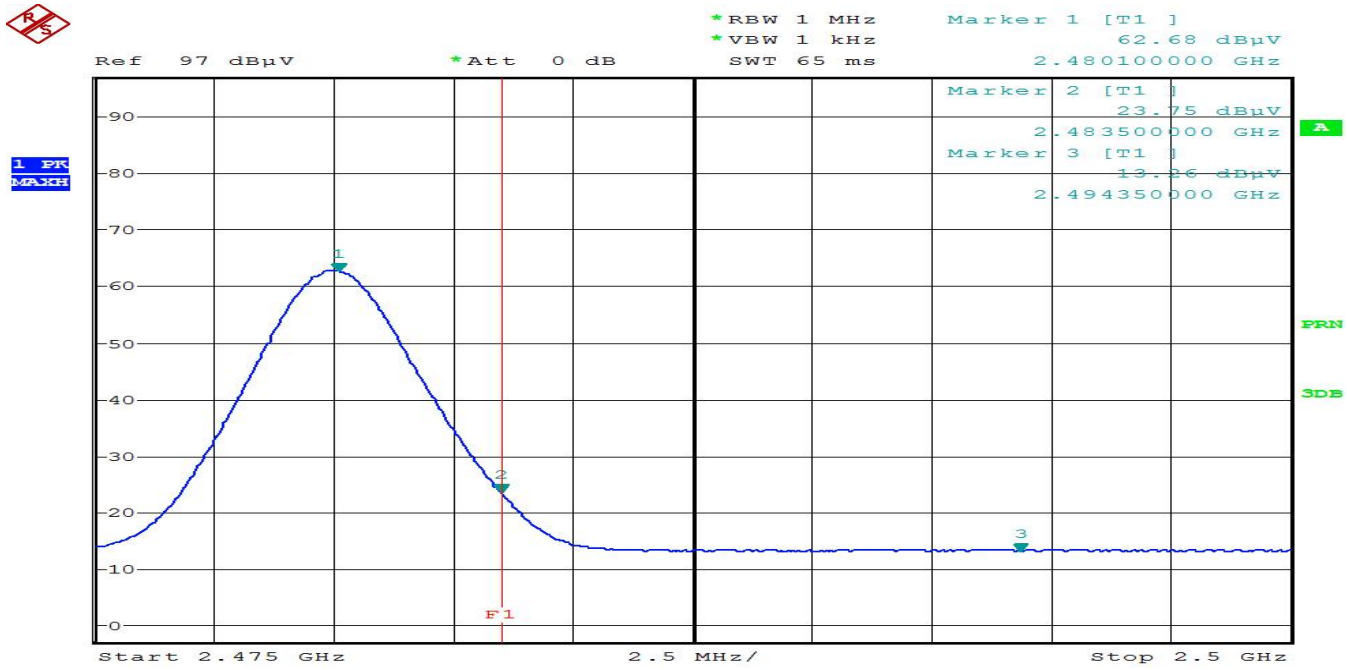


Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal

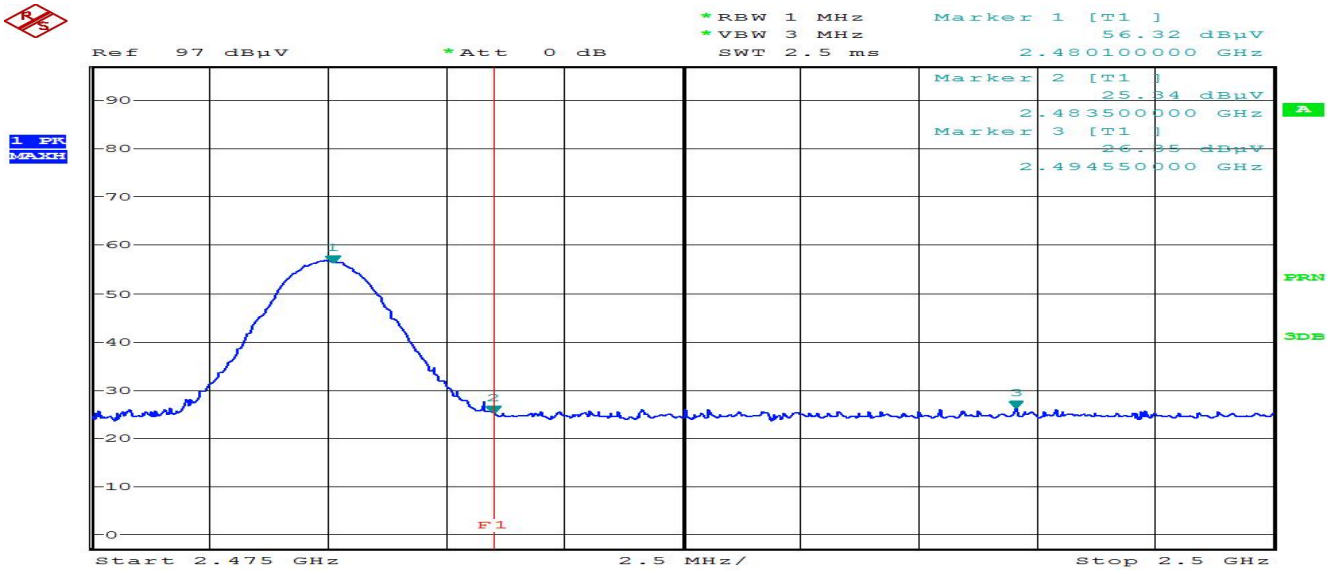


Detector mode:Average Polarity:Horizontal

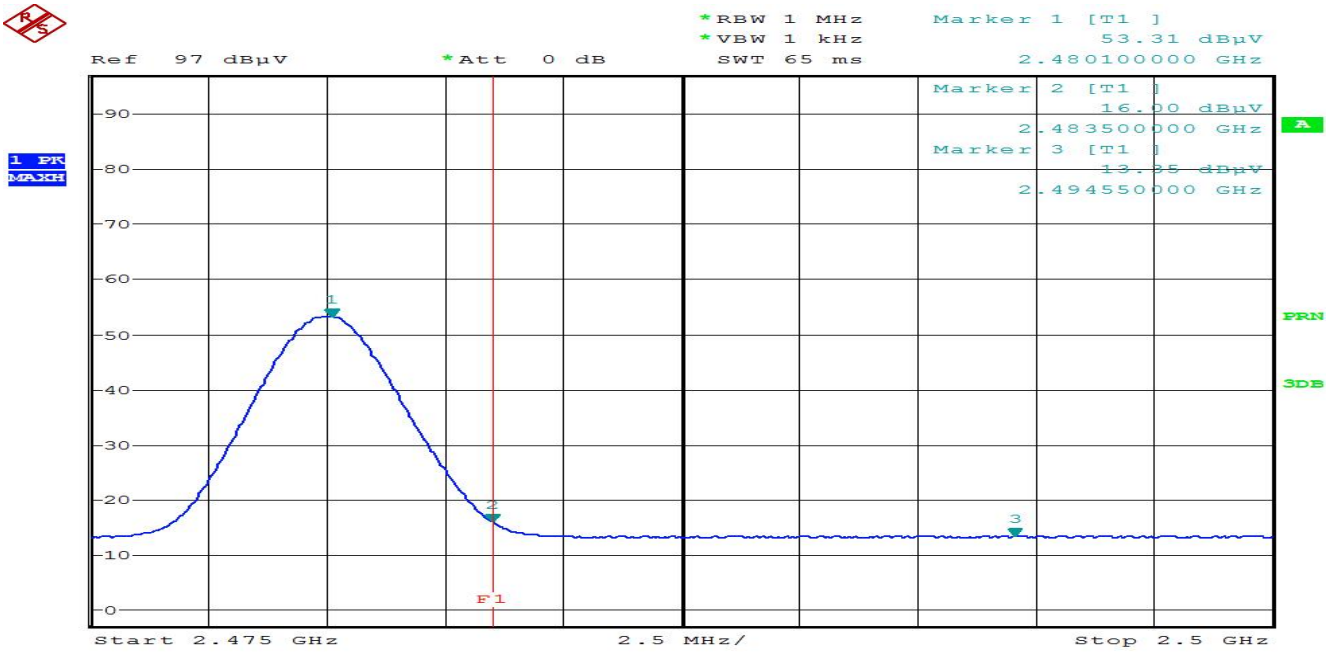


Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Detector mode:Average Polarity:Vertical



11. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 MHz to 30 MHz was measured in accordance to FCC PART 15.207. The test setup was made according to ANSI C 63.4 (2009) in a shielded room. The EUT was placed on a non-conductive table at least 0.8 m above the ground plan. A grounded vertical reference plane was positioned in a distance of 0.4 m from the EUT. The distance from the EUT to other metal surfaces was at least 0.8 m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0 m. The test receiver with Quasi Peak detector complies with CISPR 16.

11.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESPI	Rohde & Schwarz	100005	13-Jan-16
LISN	ENV216	Rohde & Schwarz	101231	18-Aug-15
LISN	ESH3-Z5	Rohde & Schwarz	836679/025	13-Jan-16
Pulse Limiter	ESH3Z2	Rohde & Schwarz	NONE	13-Jan-16

11.2 Environmental Condition

Test Place : Shielded Room

BT Basic Mode

Temperature (°C) : 22.5 ℃

Humidity (% R.H.) : 43.6 % R.H.

BT EDR Mode

Temperature (°C) : 22.3 ℃

Humidity (% R.H.) : 47.1 % R.H.

11.3-1 Test Data for Bluetooth (Basic Rate)

Test Date : 20-Apr-15

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dBμV)	Reading (dBμV)	Result (dBμV)	Limit (dBμV)	Reading (dBμV)	Result (dB)
0.15	0.10	0.12	N	66.00	51.12	51.34	56.00		
0.17	0.12	0.12	H	64.96	47.91	48.15	54.96		
0.19	0.11	0.13	H	64.04	45.46	45.70	54.04		
0.21	0.11	0.13	H	63.21	42.82	43.06	53.21		
0.36	0.12	0.14	H	58.73	33.55	33.81	48.73		
0.38	0.12	0.14	H	58.28	38.42	38.68	48.28		
Remark	H : Hot Line, N : Neutral Line TEST MODE : Bluetooth Basic Rate CH39 (2 441 MHz) *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

11.3-2 Test Data for Bluetooth (EDR)

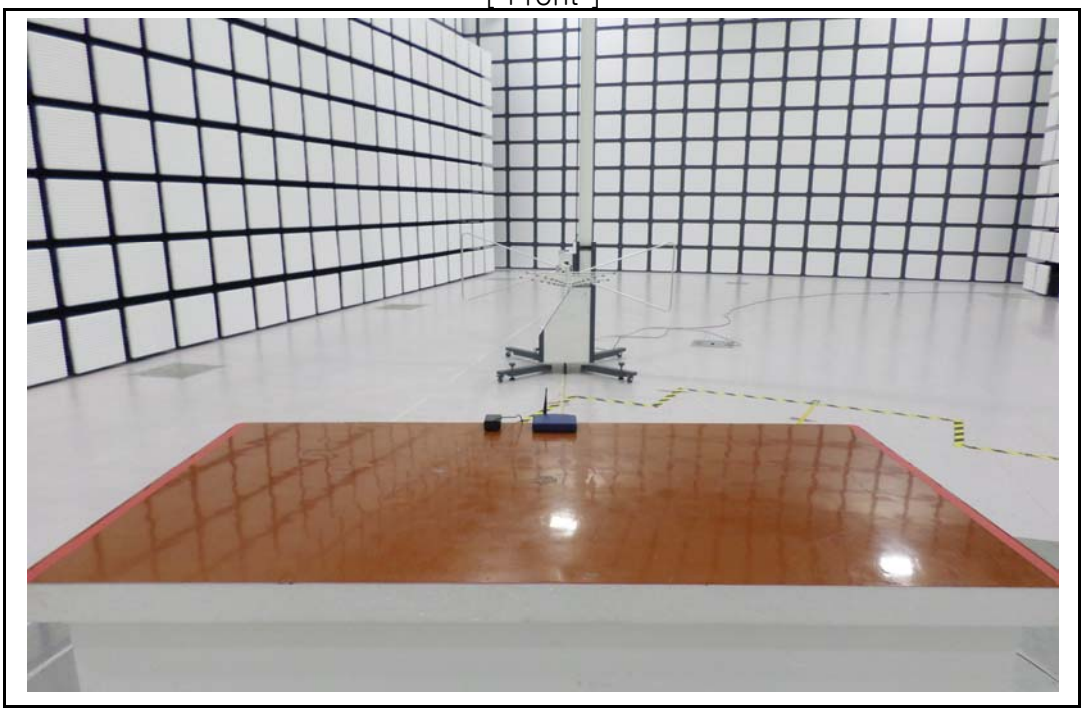
Test Date : 21-Apr-15

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dBμV)	Reading (dBμV)	Result (dBμV)	Limit (dBμV)	Reading (dBμV)	Result (dB)
0.15	0.10	0.12	N	66.00	51.03	51.25	56.00		
0.17	0.10	0.12	N	64.96	47.96	48.18	54.96		
0.19	0.10	0.13	N	64.04	44.93	45.16	54.04		
0.21	0.10	0.13	N	63.21	42.17	42.40	53.21		
0.38	0.12	0.14	H	58.28	38.41	38.67	48.28		
0.63	0.12	0.13	H	56.00	33.43	33.68	46.00		
Remark	H : Hot Line, N : Neutral Line TEST MODE : Bluetooth EDR-CH39 (2 441 MHz) *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

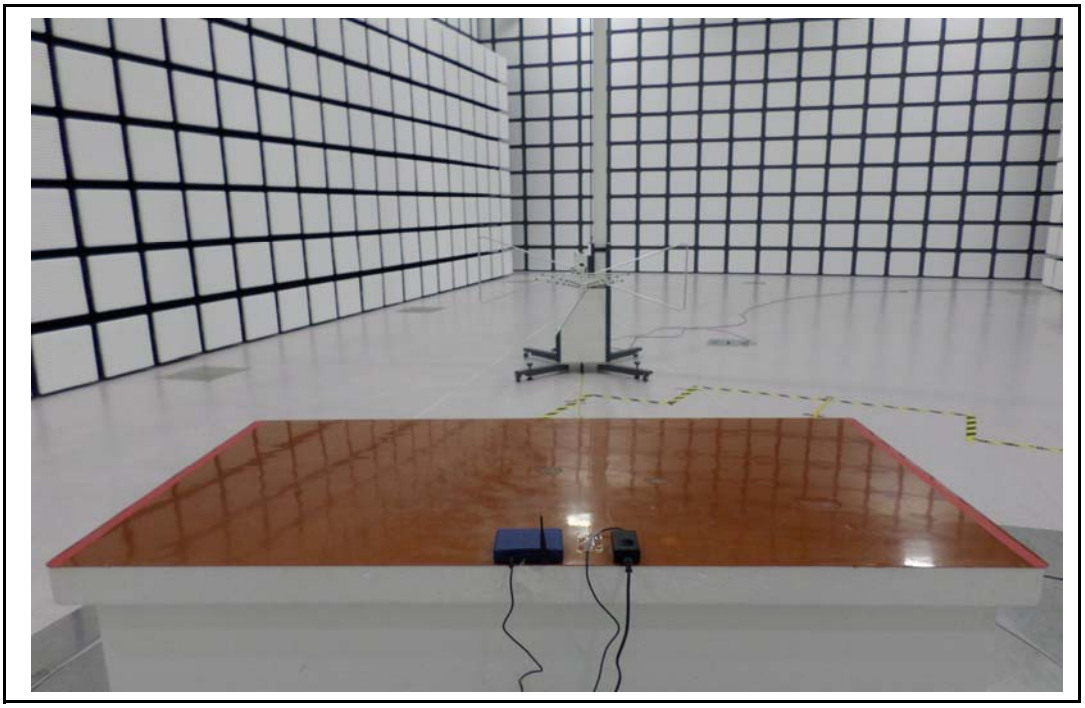
12. Photographs of test setup

12.1.Setup for Radiated Test : (30 ~ 1 000) MHz

[Front]



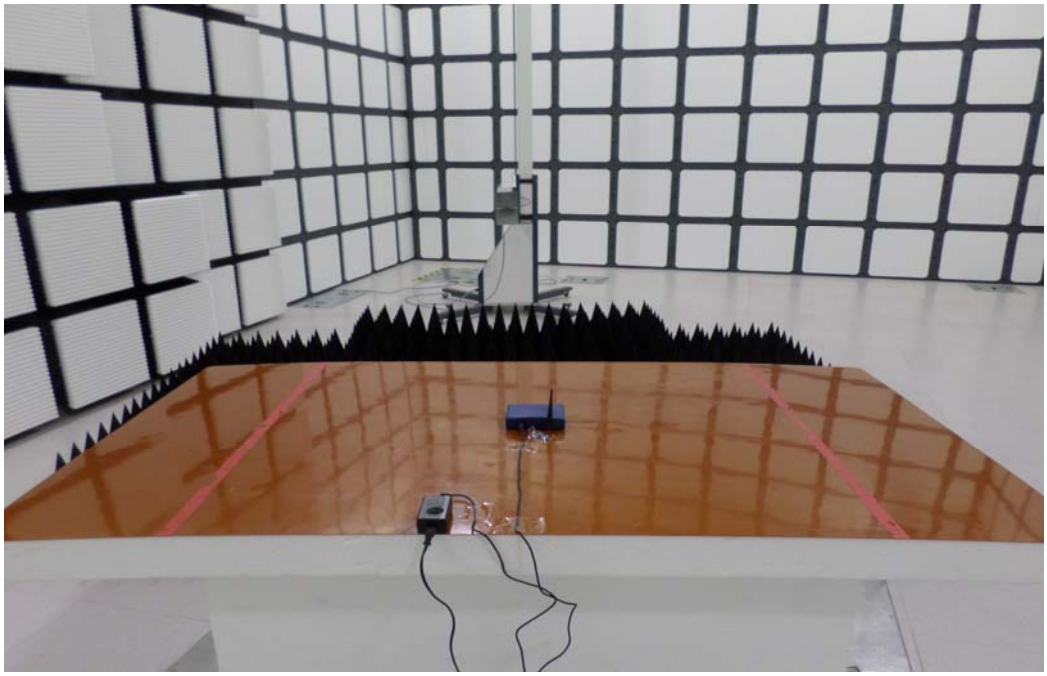
[Rear]



12.2. Setup for Radiated Test : Above 1 000 MHz

[Front]

[Rear]



12.3. Setup for Conducted Test : (0.15 ~ 30) MHz

[Front]

[Rear]

12.4. Photographs of EUT

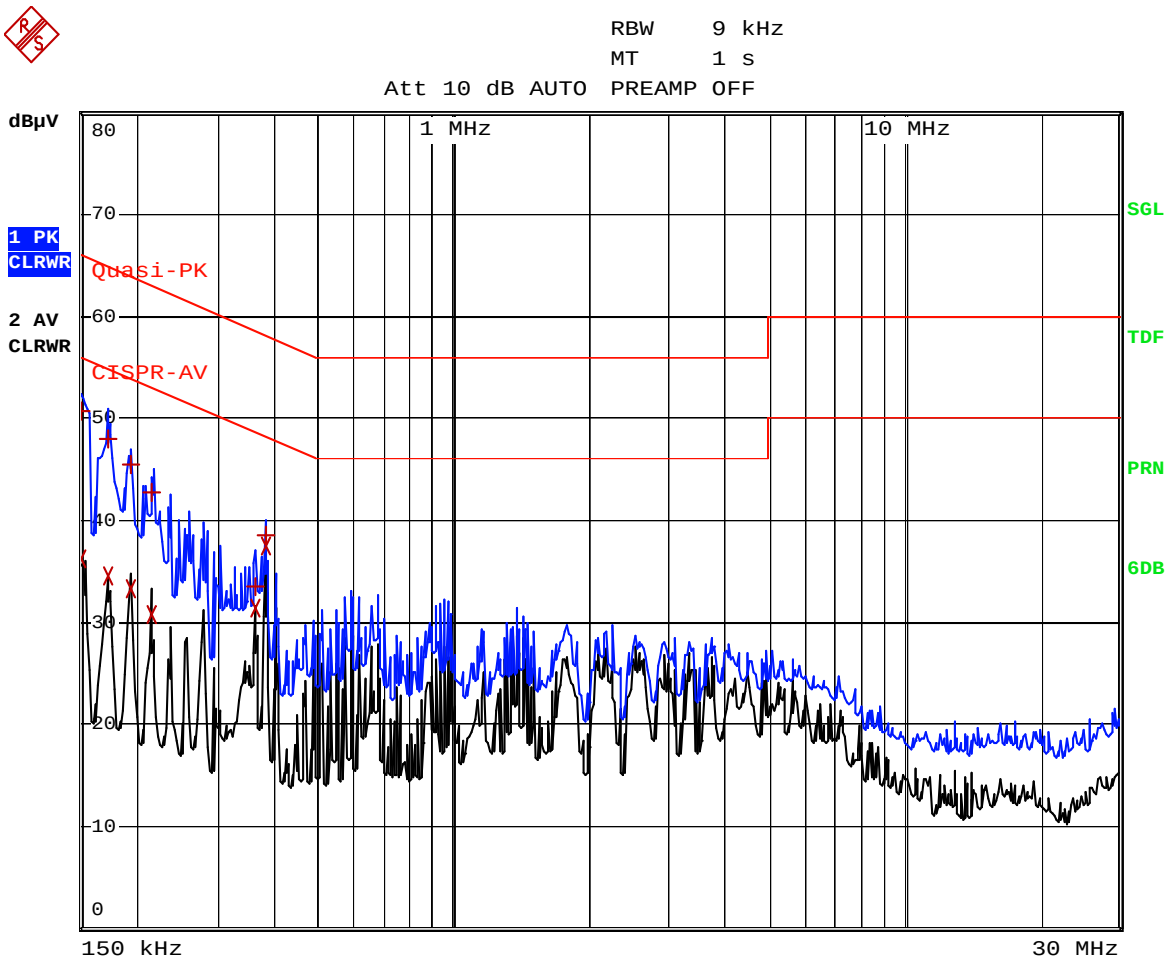
[Front]

[Rear]

Appendix 1. Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 39

*HOT

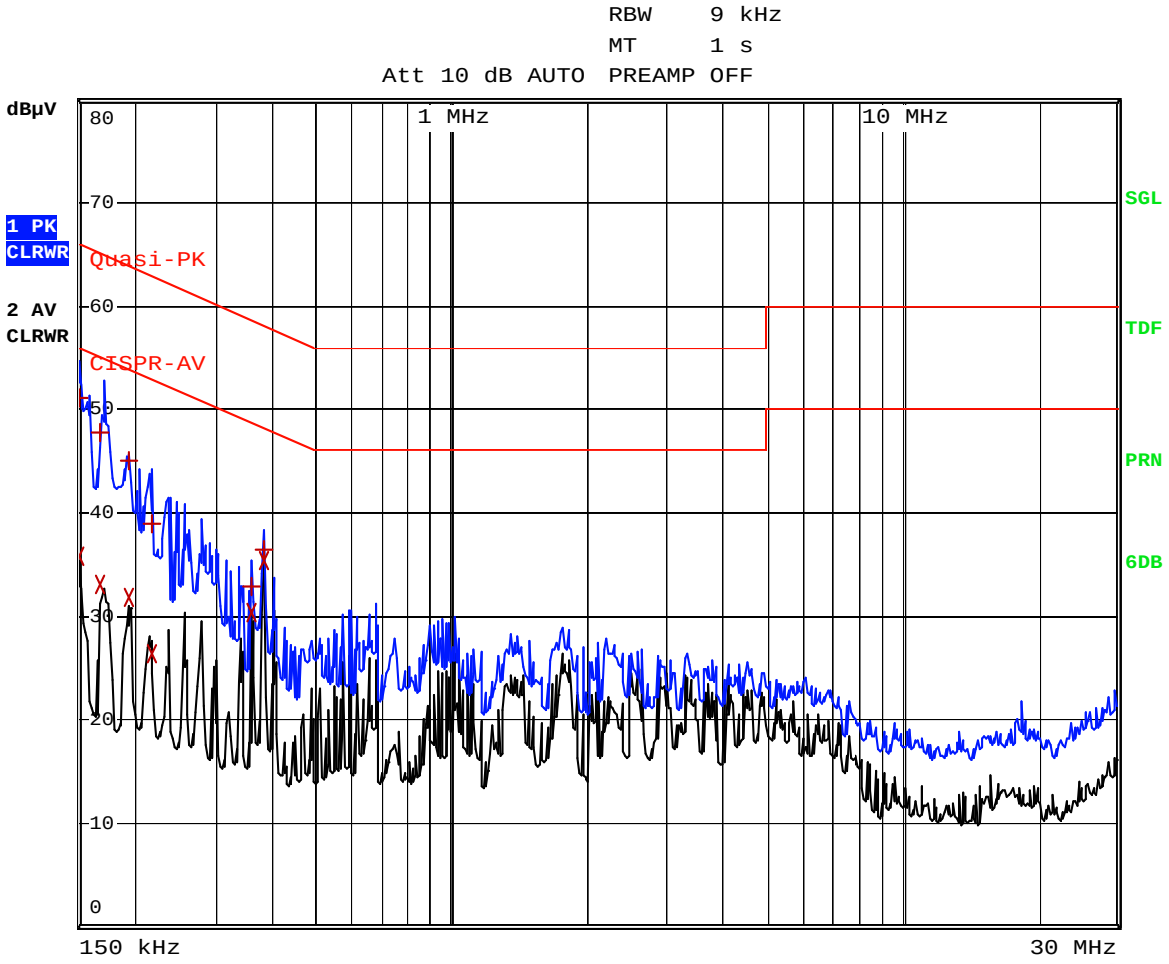


Comment: ESTC-15-00670_HOT_#1.Basic
Date: 20.APR.2015 09:06:31

Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 39

*NEUTRAL

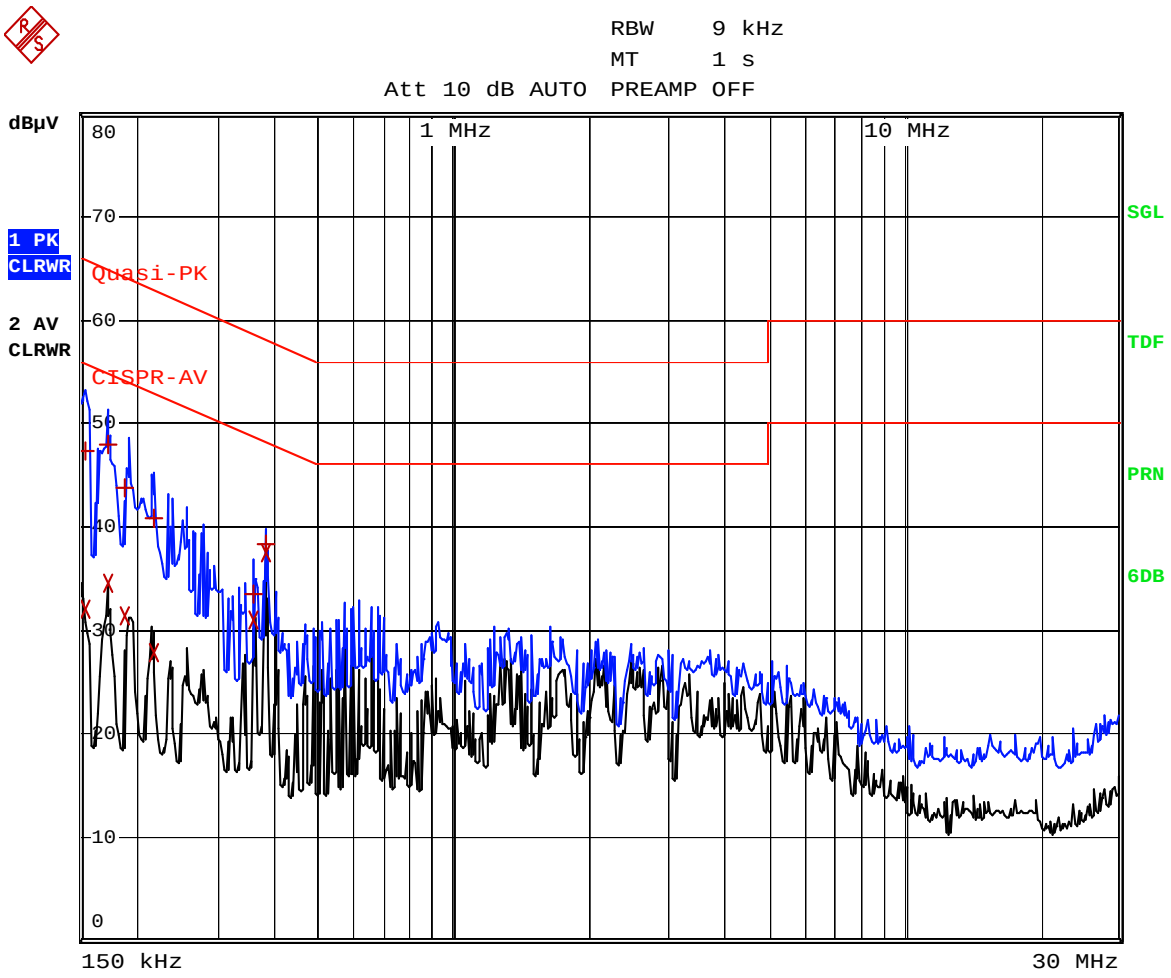


Comment: ESTC-15-00670_NEUTRAL_#1.Basic
Date: 20.APR.2015 09:04:14

Special diagram for Bluetooth EDR

Bluetooth – CH 39

*HOT

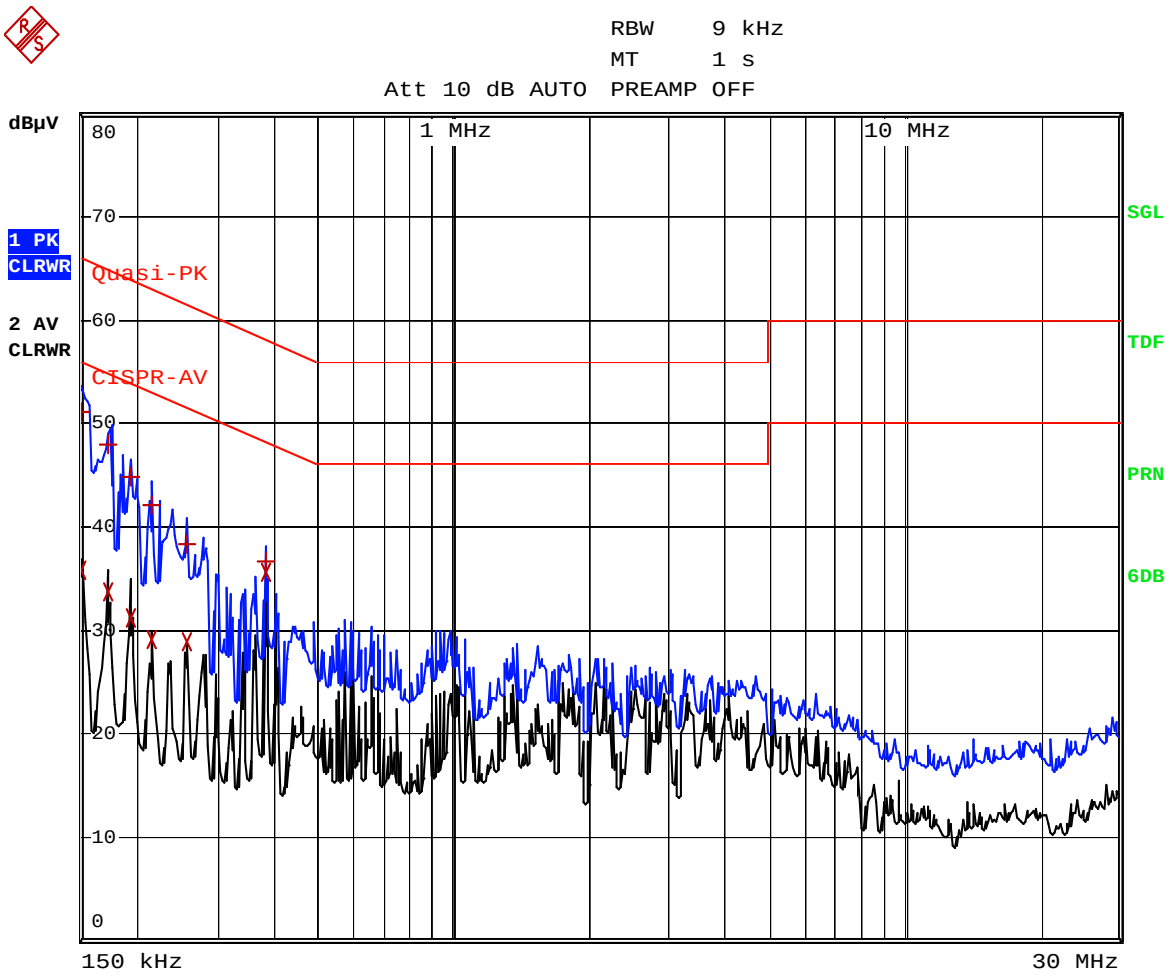


Comment: ESTC-15-00670_HOT_#2.EDR
Date: 21.APR.2015 09:19:37

Special diagram for Bluetooth EDR

Bluetooth – CH 39

*NEUTRAL



Comment: ESTC-15-00670_NEUTRAL_#2.EDR
Date: 21.APR.2015 09:23:09

Appendix 2. Antenna Requirement

1. Antenna Requirement

1.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.24

1.2 Antenna Connected Construction

The antenna types used in this product are Intergrated Sandwich antenna .
The maximum Gain of this antenna is -0.33 dBi.