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Test Report for FCC

FCC ID : X59-BA-110-IR

Report Number		ESTRFC1707-004		
Applicant	Company name	H3 SYSTEM Co., Ltd.		
	Address	1F, 283, Baeul 1-ro, Yuseong-gu, Daejeon, Korea		
	Telephone	+82-42-862-9314		
	Contack person	Sung-Dae Lim		
Product	Product name	Bluetooth Adapter		
	Model No.	BA-110_IR	Manufacturer	H3 SYSTEM Co., Ltd.
	Serial No.	NONE	Country of origin	KOREA
Test date	2017-07-04 ~ 2017-07-7		Date of issue	7-Jul-17
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 63.10(2013)			
Measurement facility registration number	659627			
Tested by	Senior Engineer K.I. Hong	(Signature)		
Reviewed by	Engineering Manager K.B. Lee	(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

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Contents 2

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. Korea
EMC/Telecom/Safety Test Lab : 347-69, Jungbu-daero 147beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do 467-811, 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 : 6.07 mW 8DPSK : 4.87 mW
Rating	: Power supply : DC 3V (Battery)
Receipt Date	: 4-Jul-17

2.2 General descriptions of EUT

Specifications

Function: It receives blood glucose data measured from a glucometer and transmits to a pre-determined target device via Bluetooth.
Usable devices: Accu-chek Aviva
Bluetooth 2.0 Class 2, SPP.
Connectivity to smart phones: Connectivity to Android smart phones is generally available. But the adapter does not support communication with iPhones.
Maximum storage: 500 readings.
Power supply: Dry cells AAA 2 EA
Battery life: More than 1,000 tests or 3 months (For normal use)
Size: 70 × 47 × 16 mm
Weight (other than the batteries): 28 g

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 63.10 (2013)

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
15.205 & 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)

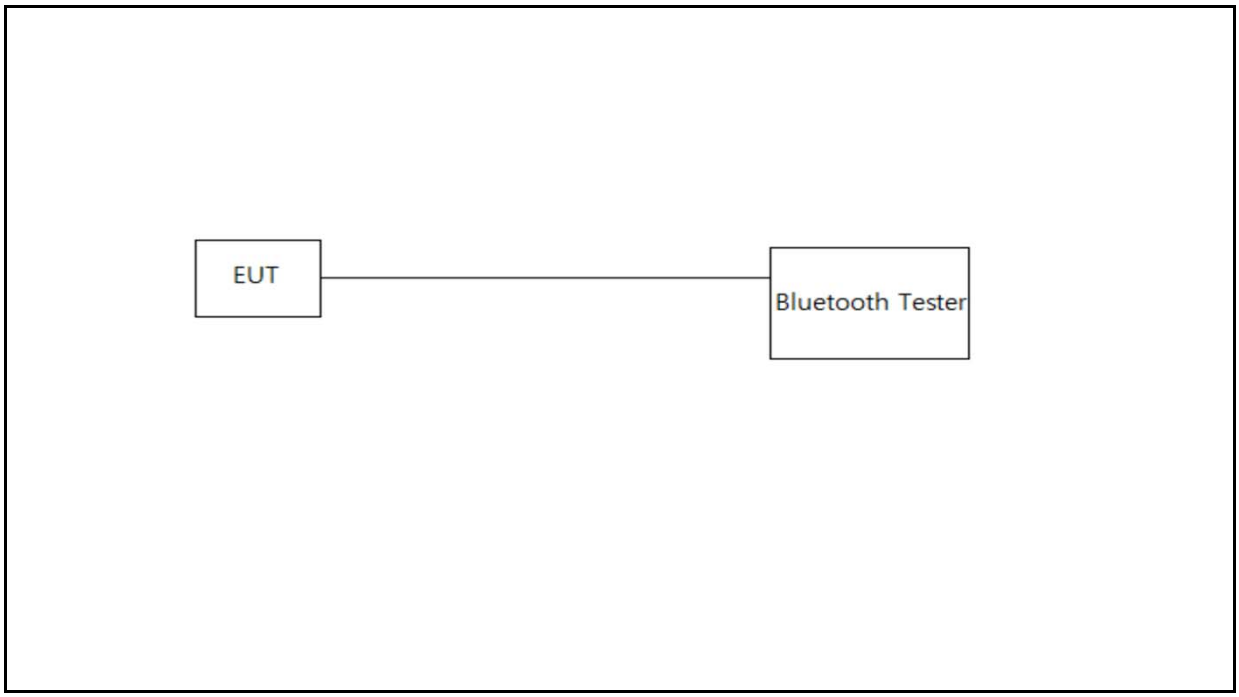
c. Test Mode : 8DPSK, GFSK (worst case)

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)
Bluetooth Adapter	BA-110_IR	NONE	H3 SYSTEM Co., Ltd.	EUT

4.5 Cable Connecting

Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
Bluetooth Adapter	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	E4440A	US42041291	2018-01-04
BLUETOOTH TESTER	TC-3000A	3000A5B0298	2018-01-04
-Spectrum Analyzer <=> EUT	Loss: 21.0dB	-	

5.3 Measurement results

EUT	Bluetooth Adapter	MODEL	BA-110_IR
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	22 ℃, 40 % R.H .
INPUT POWER	DC 3 V		

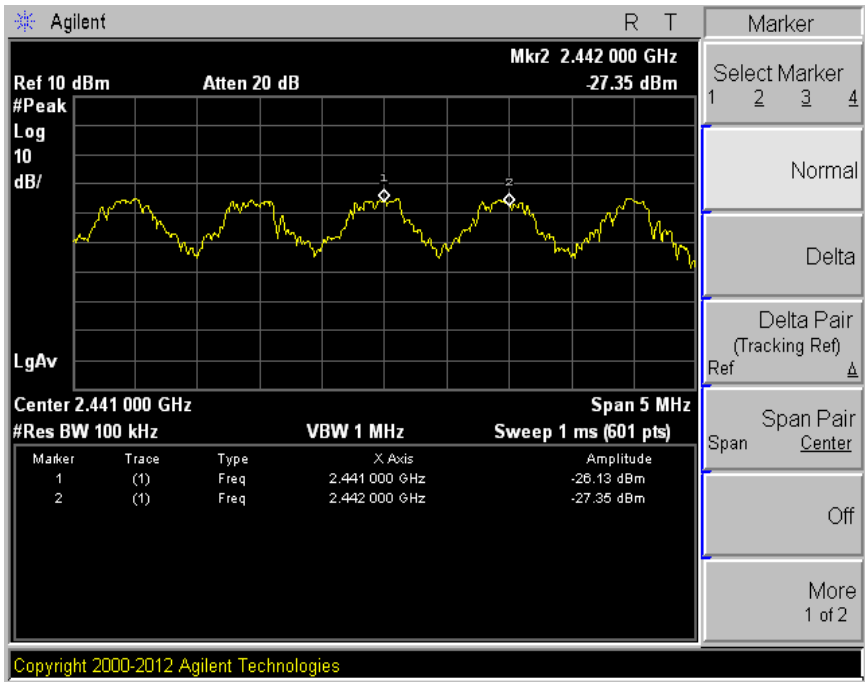
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (kHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	990	1024	1000	683	PASS
39	2441	959	961	1000	641	PASS
78	2480	942	1044	1000	696	PASS

(8DPSK)

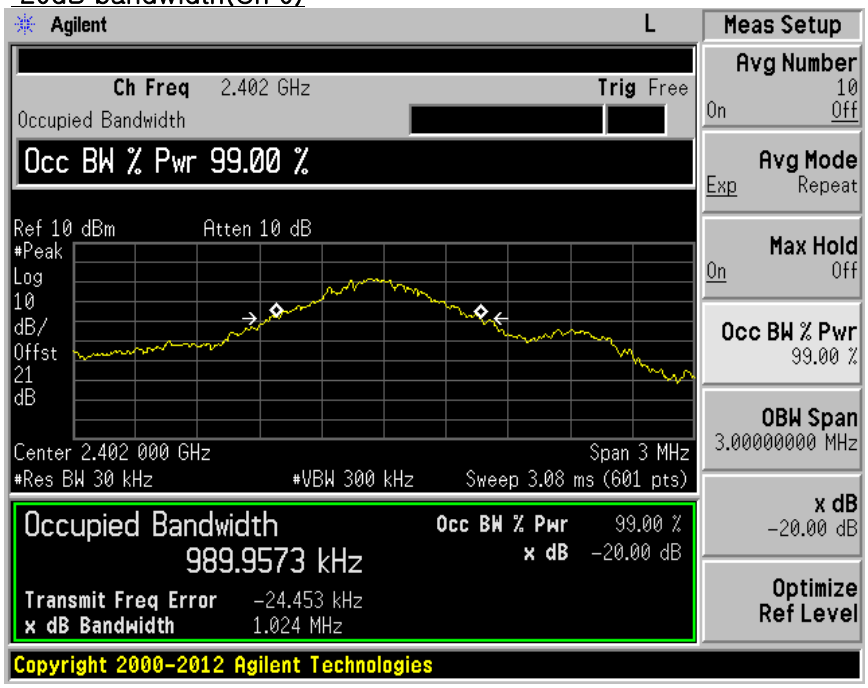
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (MHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	1.215	1346	1000	897	PASS
39	2441	1.206	1290	1000	860	PASS
78	2480	1.221	1325	1000	883	PASS

5.4 Trace data (GFSK)

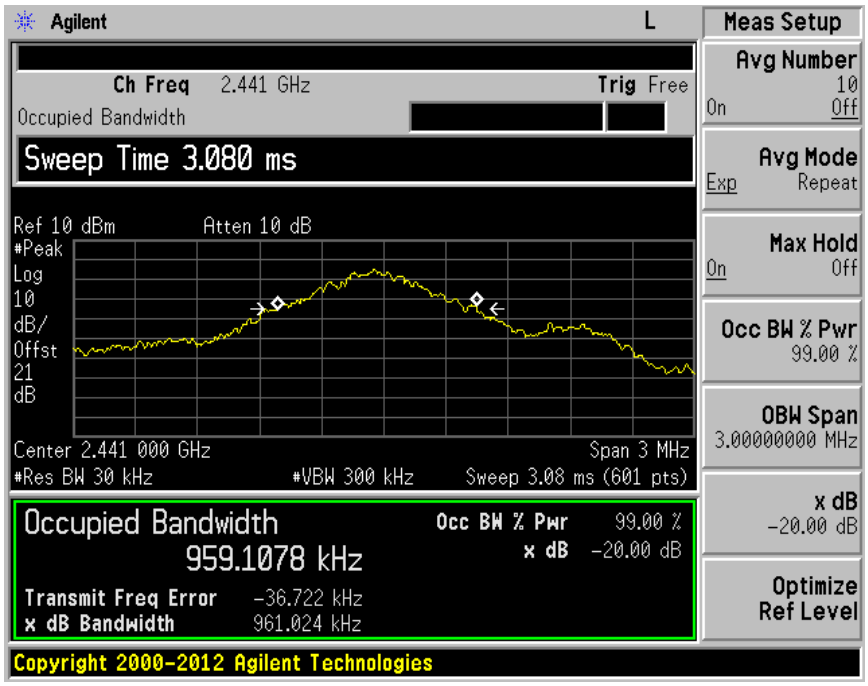
Channel Separation



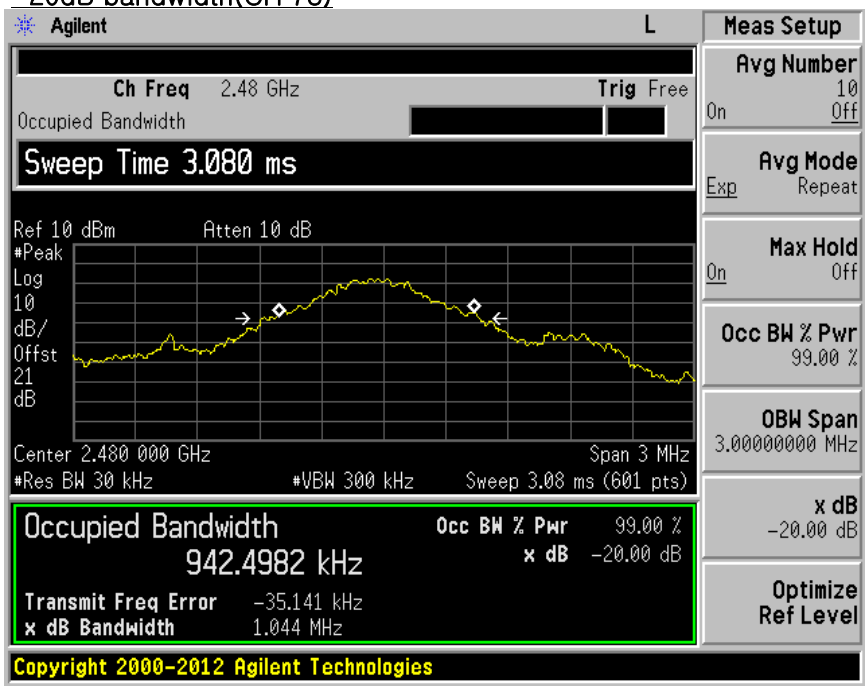
20dB bandwidth(Ch 0)



20dB bandwidth(CH 39)

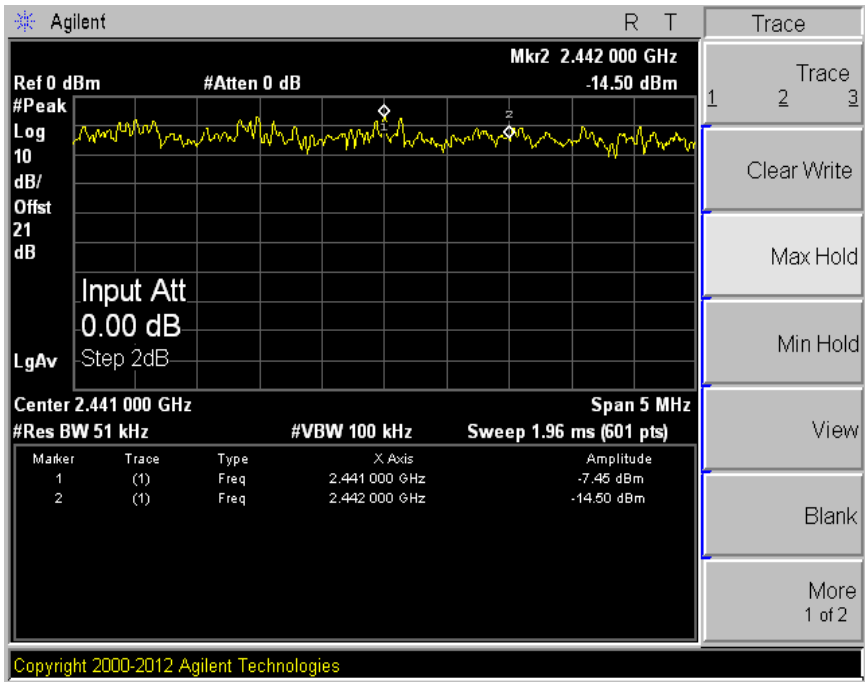


20dB bandwidth(CH 78)

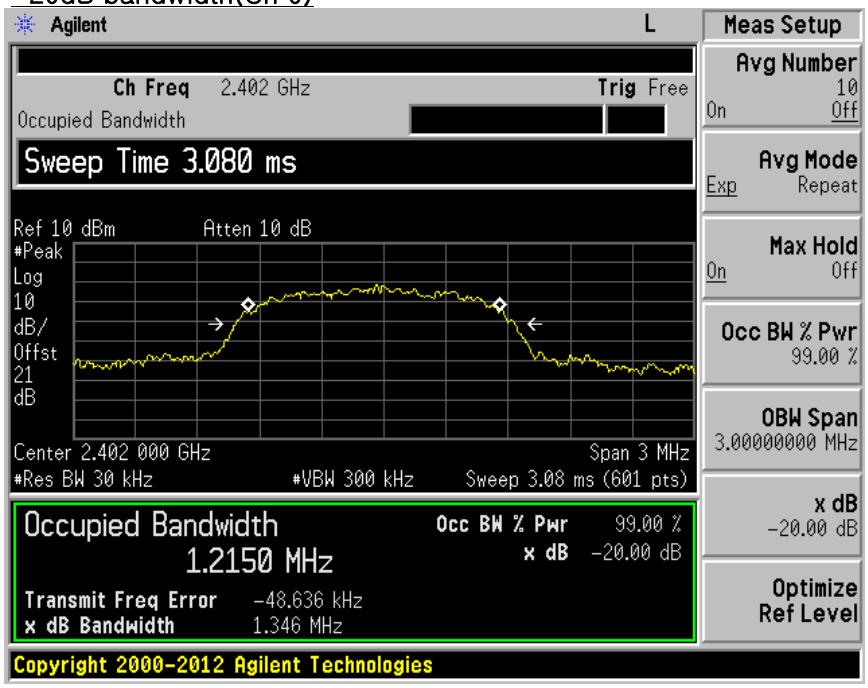


(8DPSK)

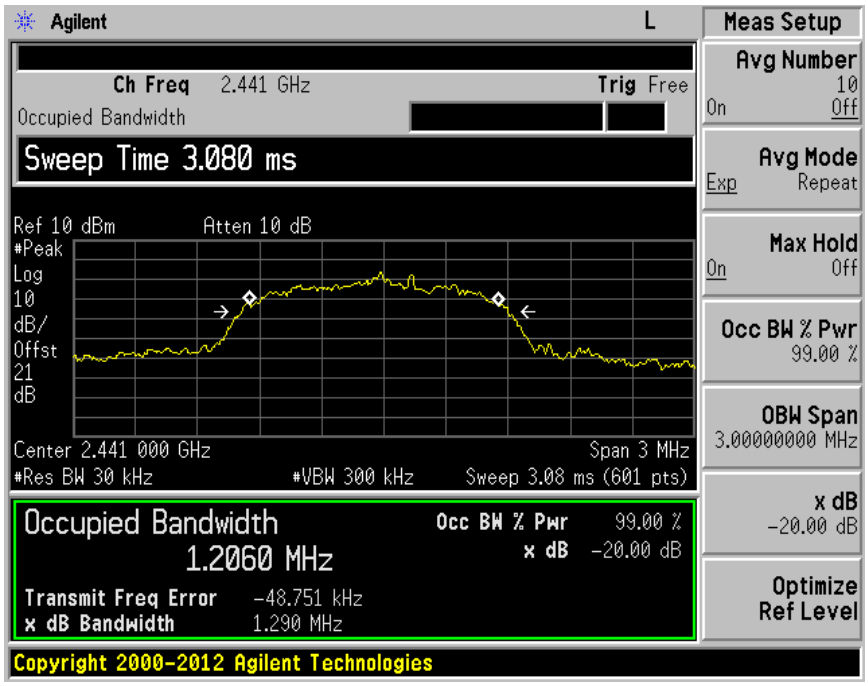
Channel Separation



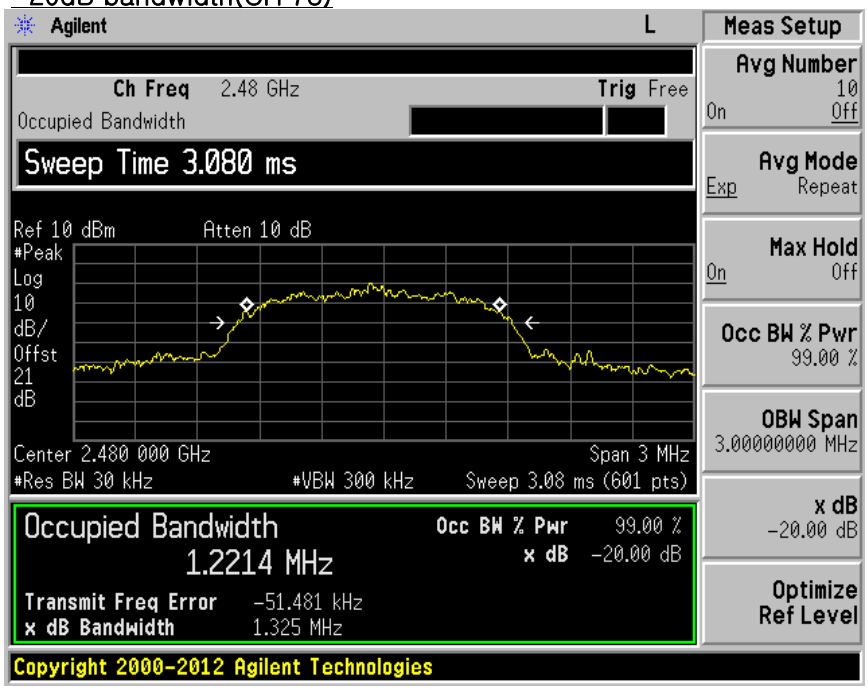
20dB bandwidth(Ch 0)



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	2017-11-15
Power Sensor	NRV-251	325948/013	2017-11-15
BLUETOOTH TESTER	TC-3000A	3000A5B0298	2018-01-04
Power Meter <=> EUT	Loss: 21.0dB	-	

6.2 Measurement results

EUT	Bluetooth Adapter	MODEL	BA-110_IR
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 41 % R.H.
INPUT POWER	DC 3 V		

GFSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	-2.21	0.60	125	PASS
39	2441	-3.67	0.43	125	PASS
78	2480	-3.80	0.42	125	PASS

8DPSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	-3.04	0.50	125	PASS
39	2441	-4.35	0.37	125	PASS
78	2480	-4.62	0.35	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

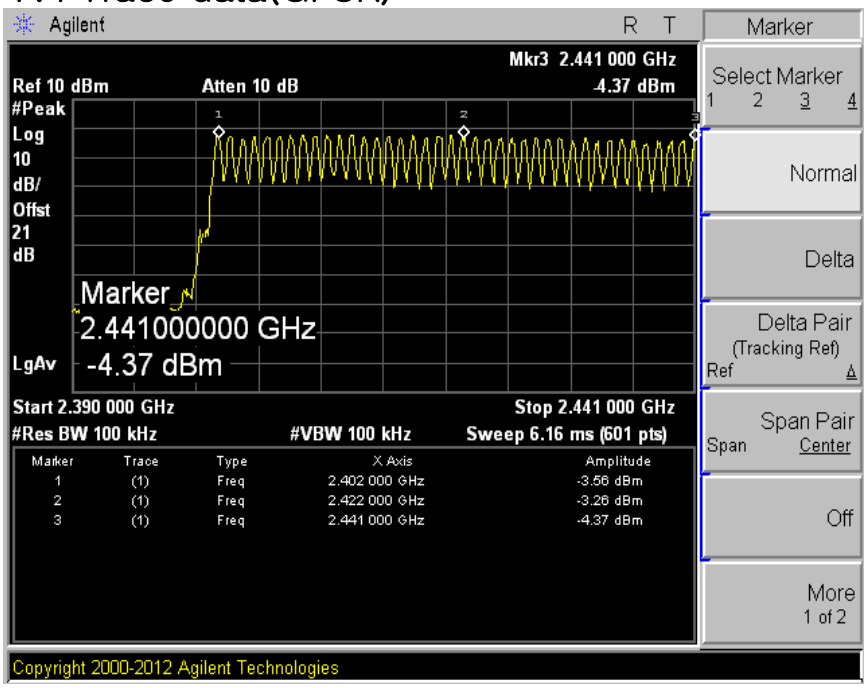
Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	2018-01-04
BLUETOOTH TESTER	TC-3000A	3000A5B0298	2018-01-04
-Spectrum Analyzer <=> EUT	Loss: 21.0dB		

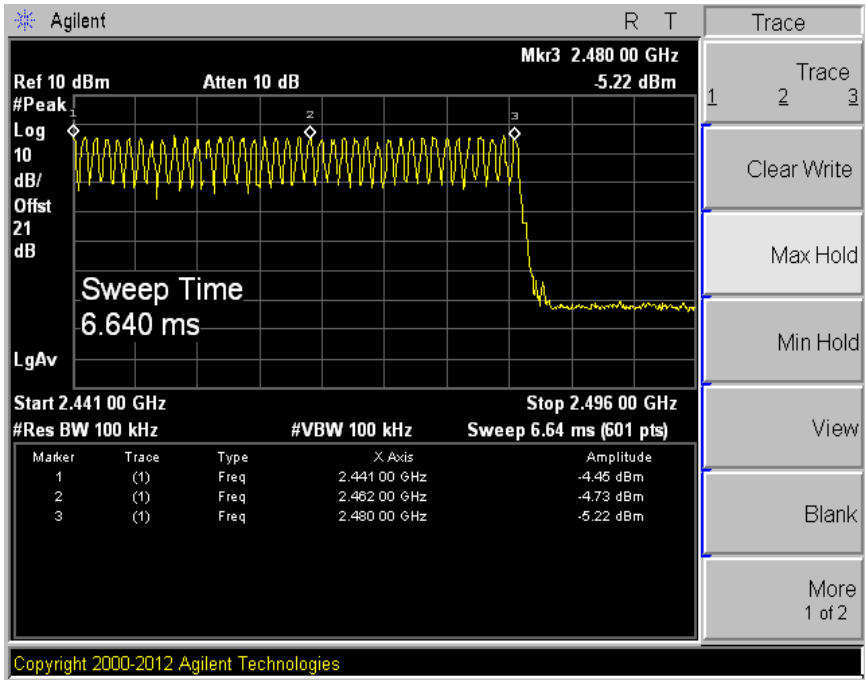
7.3 Measurement results

EUT	Bluetooth Adapter	MODEL	BA-110_IR
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 3 V		

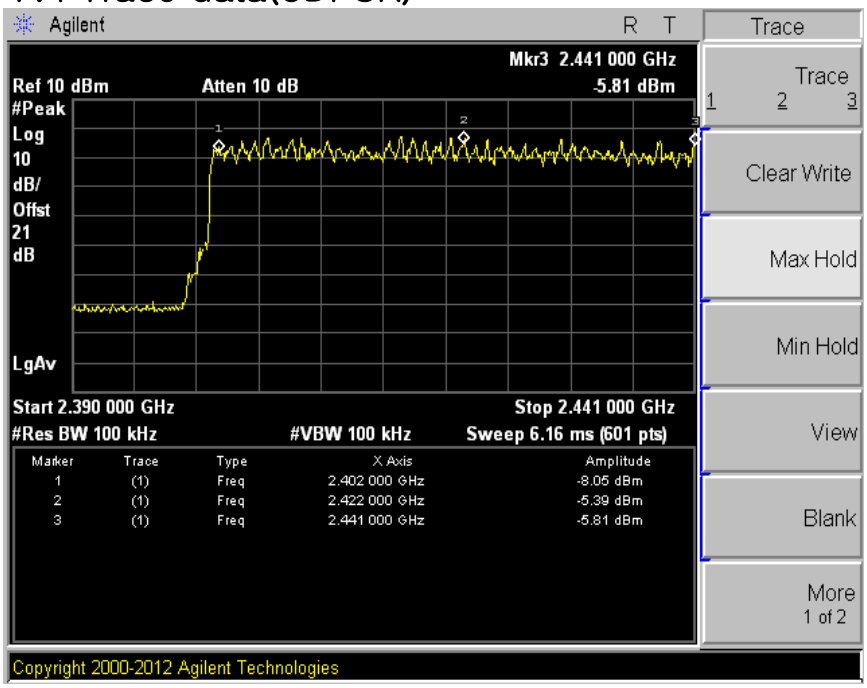
Number of CH	Limit (Number of CH)	PASS/FAIL
79	>15	PASS

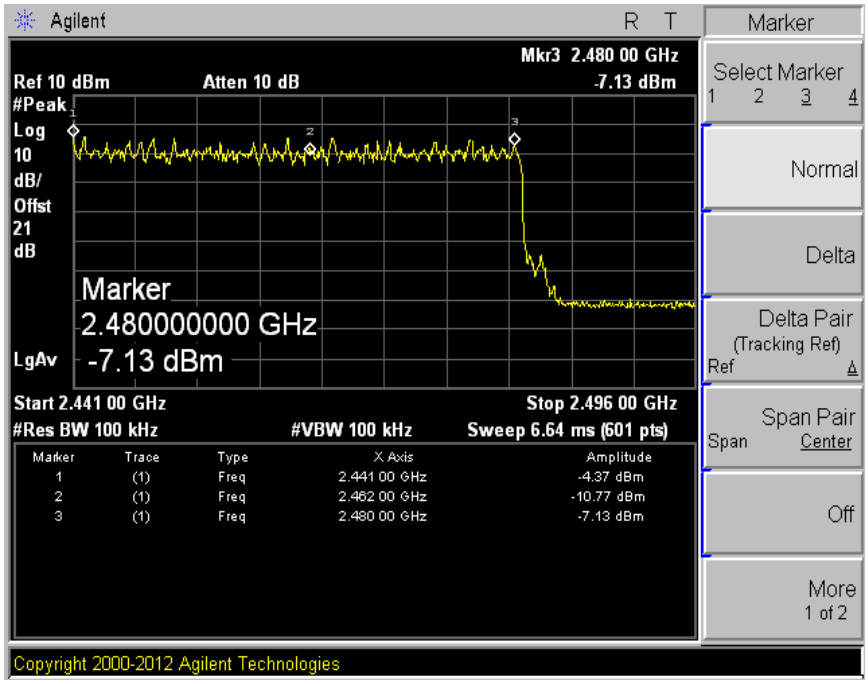
7.4 Trace data(GFSK)




Agilent
R T
Trace
Mkr3 2.480 00 GHz
Ref 10 dBm
Atten 10 dB
-5.22 dBm
#Peak
Log
10
dB/
Offst
21
dB
Sweep Time
6.640 ms
LgAv
Start 2.441 00 GHz
Stop 2.496 00 GHz
#Res BW 100 kHz
#VBW 100 kHz
Sweep 6.64 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 00 GHz -4.45 dBm
2 (1) Freq 2.462 00 GHz -4.73 dBm
3 (1) Freq 2.480 00 GHz -5.22 dBm
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
More
1 of 2
Copyright 2000-2012 Agilent Technologies

7.4 Trace data(8DPSK)




Agilent
R T
Marker
Mkr3 2.480 00 GHz
Ref 10 dBm
Atten 10 dB
-7.13 dBm
#Peak
Log
10
dB/
Offst
21
dB
Marker
2.480000000 GHz
-7.13 dBm
LgAv
Start 2.441 00 GHz
Stop 2.496 00 GHz
#Res BW 100 kHz
#VBW 100 kHz
Sweep 6.64 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 00 GHz -4.37 dBm
2 (1) Freq 2.462 00 GHz -10.77 dBm
3 (1) Freq 2.480 00 GHz -7.13 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

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	E4440A	US42041291	2018-01-04
BLUETOOTH TESTER	TC-3000A	3000A5B0298	2018-01-04
-Spectrum Analyzer <=> EUT	Loss: 21 dB		

8.3 Measurement results

EUT	Bluetooth Adapter	MODEL	BA-110_IR
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 43 % R.H.
INPUT POWER	DC 3 V		

A. DH1 Mode
One peiod for each particular channel : 0.429 ms X 320.1 = 137.32 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	137.32	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 : 1.699 ms X 159.9 = 271.67 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	271.67	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.

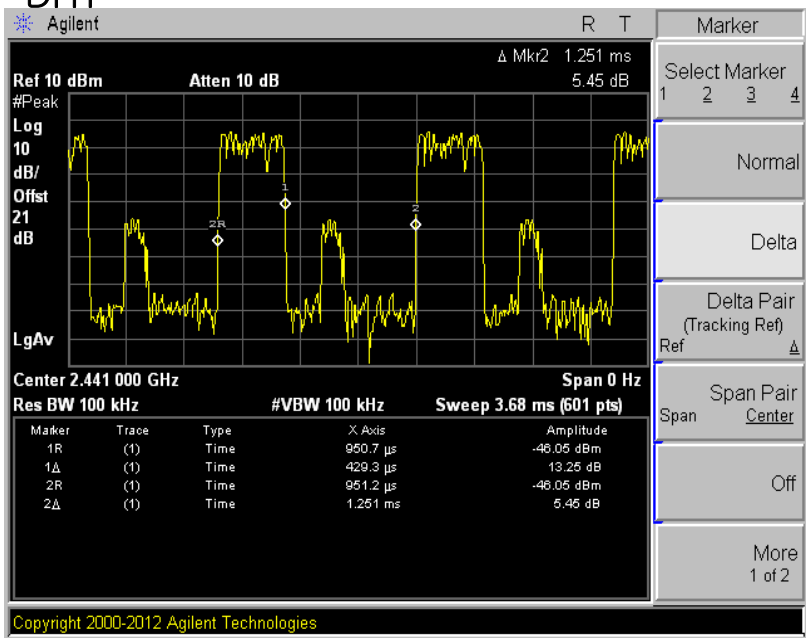
C. DH5 Mode
One peiod for each particular channel : 2.975 ms X 106.81 = 317.76 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	317.76	400	PASS

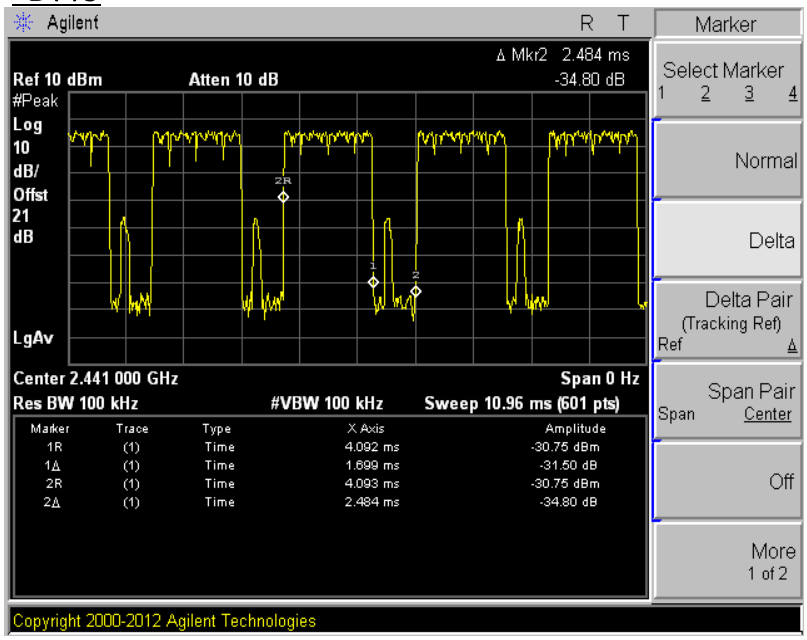
Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH5 data rate operates on a five-slot transmission and one-slot receiving basis. Thus there are 1600/(5+1)=266.7 transmissions per second. In one period for each particular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

8.4 Trace data

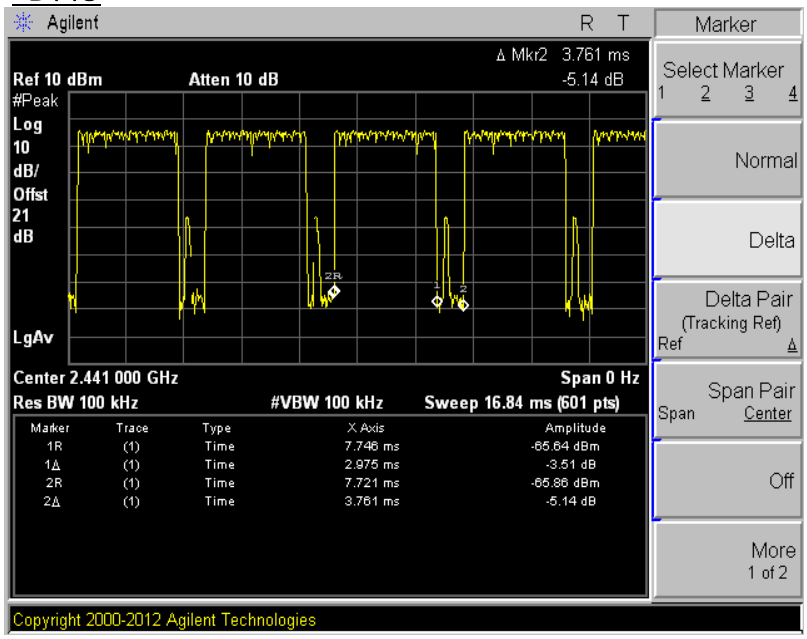
DH1



DH3


Agilent
R T
Marker
Δ Mkr2 2.484 ms
-34.80 dB
Ref 10 dBm
Atten 10 dB
#Peak
Log
10
dB/
Offst
21
dB
LgAv
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Center 2.441 000 GHz
Span 0 Hz
Res BW 100 kHz
#VBW 100 kHz
Sweep 10.96 ms (601 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 4.092 ms -30.75 dBm
1Δ (1) Time 1.699 ms -31.50 dB
2R (1) Time 4.093 ms -30.75 dBm
2Δ (1) Time 2.484 ms -34.80 dB
Copyright 2000-2012 Agilent Technologies

DH5


Agilent
R T
Marker
Δ Mkr2 3.761 ms
-5.14 dB
Ref 10 dBm
Atten 10 dB
#Peak
Log
10
dB/
Offst
21
dB
LgAv
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Center 2.441 000 GHz
Span 0 Hz
Res BW 100 kHz
#VBW 100 kHz
Sweep 16.84 ms (601 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 7.746 ms -65.64 dBm
1Δ (1) Time 2.975 ms -3.51 dB
2R (1) Time 7.721 ms -65.86 dBm
2Δ (1) Time 3.761 ms -5.14 dB
Copyright 2000-2012 Agilent Technologies

8DPSK

A. DH1 Mode

One peiod for each particular channel : 0.456 ms X 320.1 = 145.97 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	145.97	400	PASS

B. DH3 Mode

One peiod for each particular channel : 1.743 ms X 159.9 = 278.71 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	278.71	400	PASS

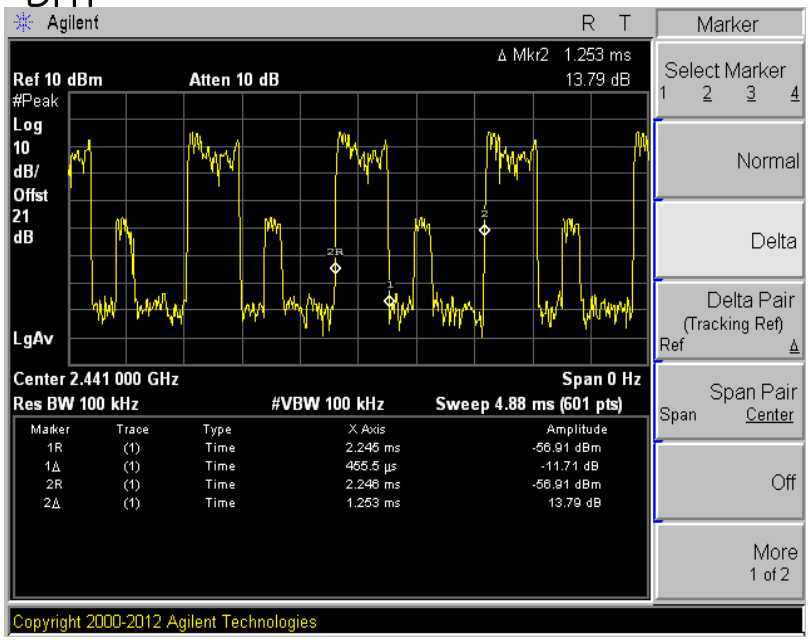
C. DH5 Mode

One peiod for each particular channel : 3.012 ms X 106.81 = 326.62 ms

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

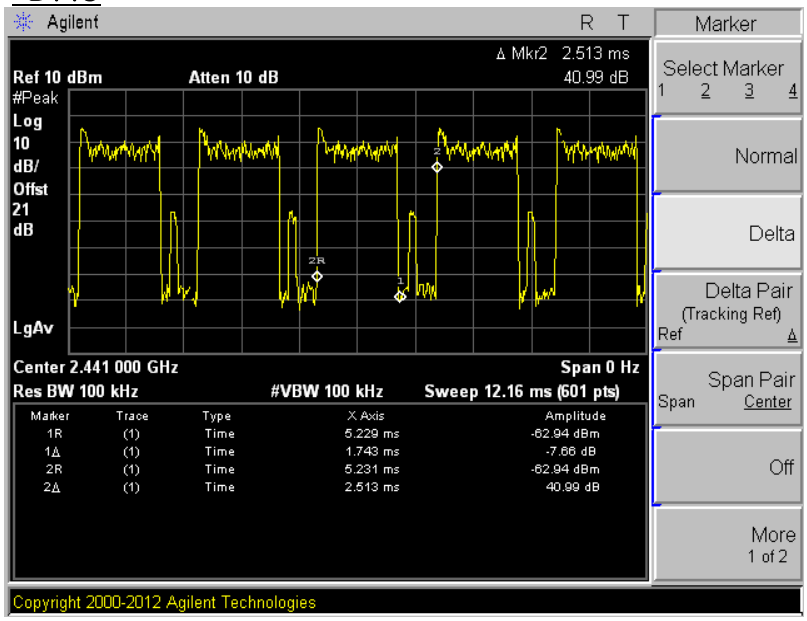
8.5 Trace data

DH1

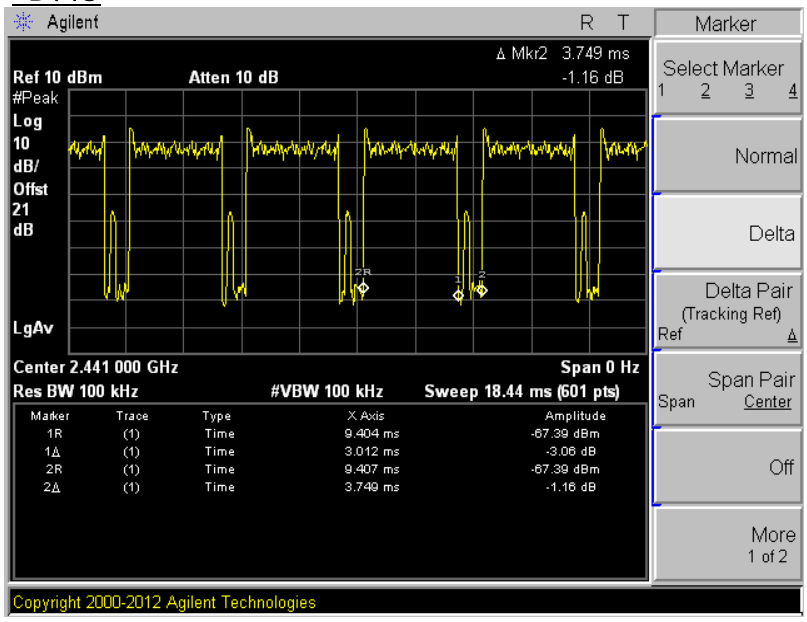


8DPSK

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	E4440A	US42041291	2018-01-04
BLUETOOTH TESTER	TC-3000A	3000A5B0298	2018-01-04
-Spectrum Analyzer <=> EUT	Loss: 21.0dB		

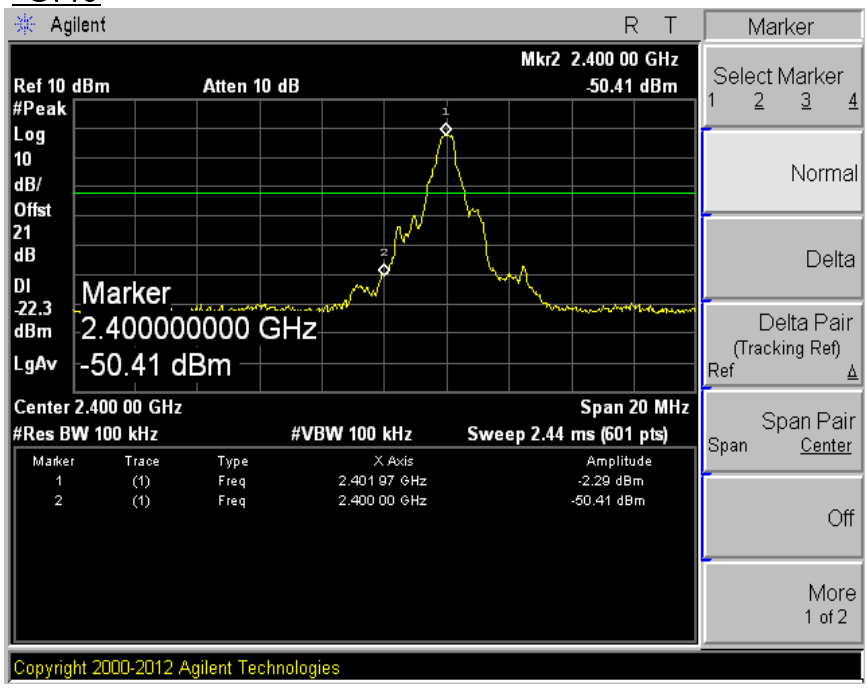
9.3 Measurement results of band-edge & out of emission

EUT	Bluetooth Adapter	MODEL	BA-110_IR
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 3 V		

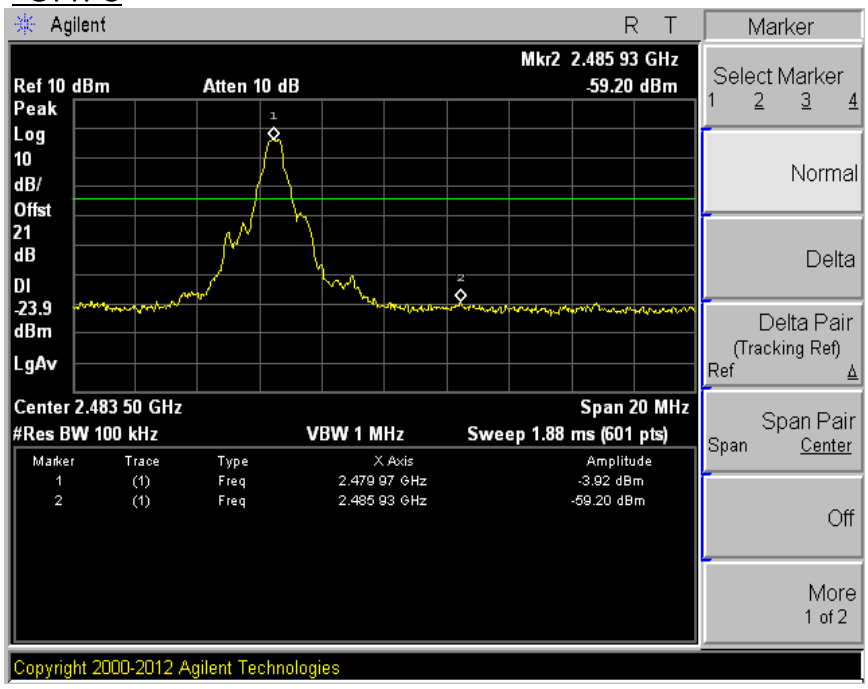
* Refer to attach spectrum analyzer data chart.

9.4 Trace data of band-edge & Out of Emission

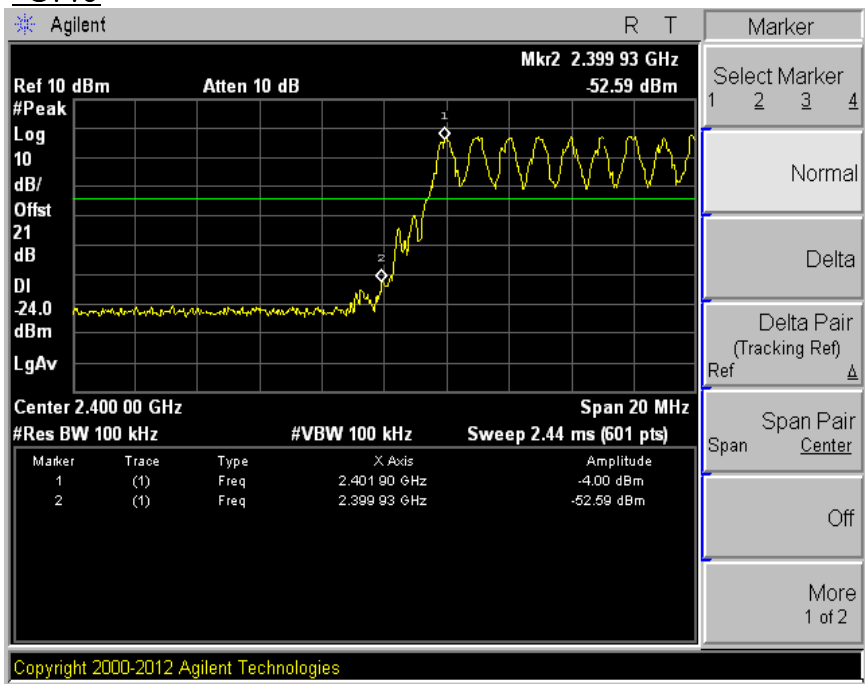
CH0



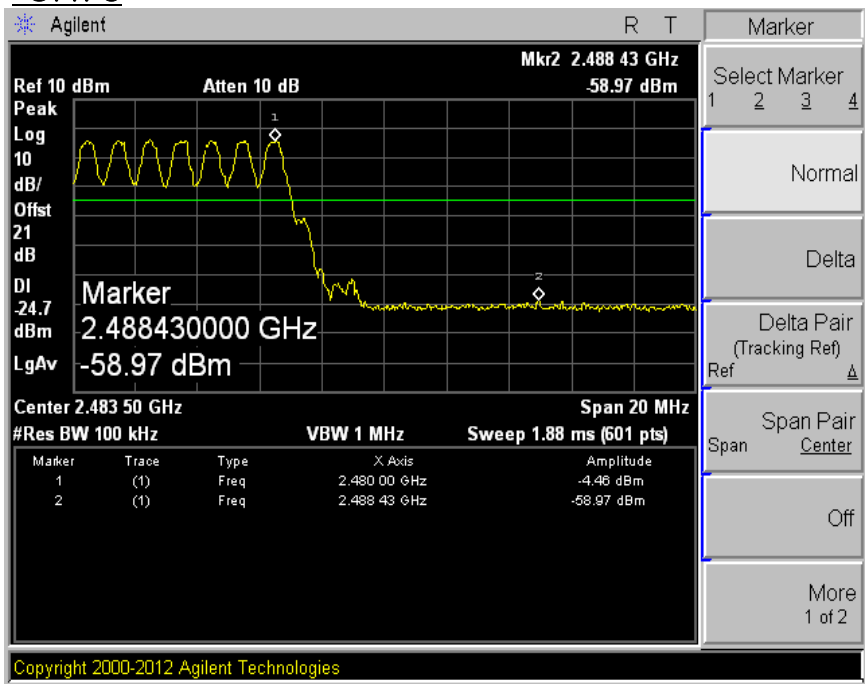
CH78



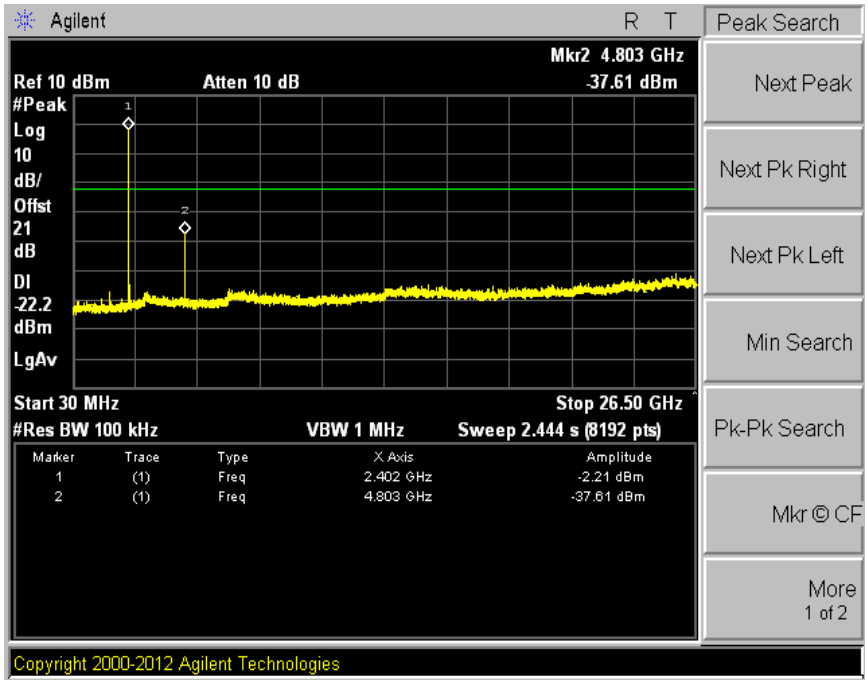
CH0


Agilent
R T
Marker
Mkr2 2.399 93 GHz
Ref 10 dBm
Atten 10 dB
-52.59 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-24.0
dBm
LgAv
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
Center 2.400 00 GHz
Span 20 MHz
#Res BW 100 kHz
#VBW 100 kHz
Sweep 2.44 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.401 90 GHz -4.00 dBm
2 (1) Freq 2.399 93 GHz -52.59 dBm
Copyright 2000-2012 Agilent Technologies

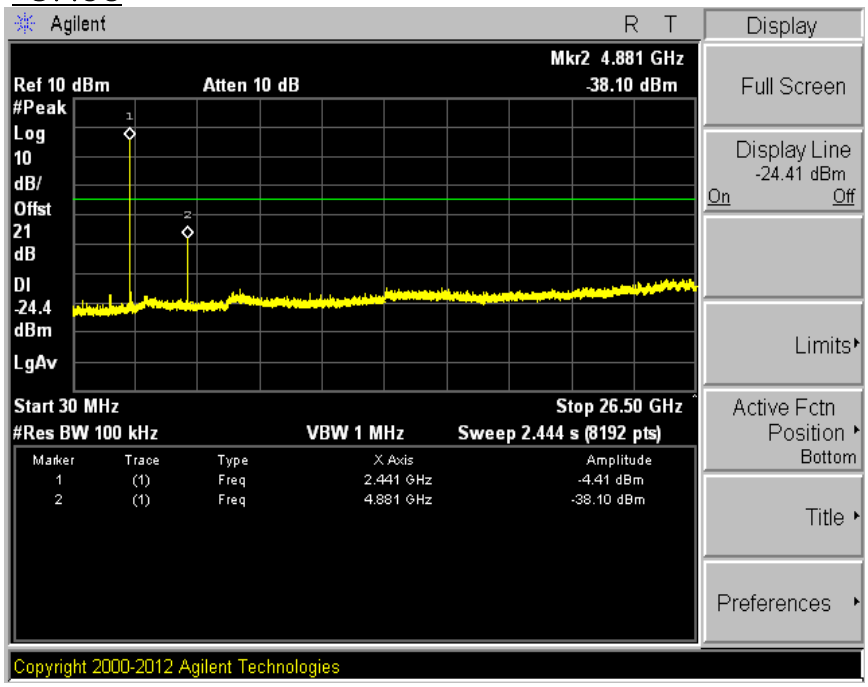
CH78


Agilent
R T
Marker
Mkr2 2.488 43 GHz
Ref 10 dBm
Atten 10 dB
-58.97 dBm
Peak
Log
10
dB/
Offst
21
dB
Dl
-24.7
dBm
LgAv
Marker
2.488430000 GHz
-58.97 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
Center 2.483 50 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 1.88 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 00 GHz -4.46 dBm
2 (1) Freq 2.488 43 GHz -58.97 dBm
Copyright 2000-2012 Agilent Technologies

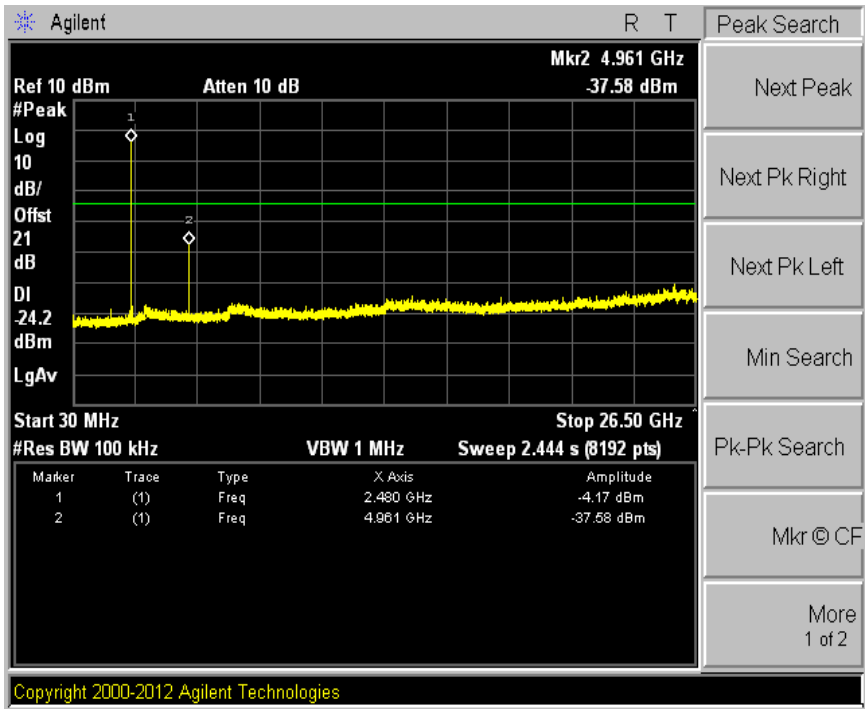
CH0


Agilent
R T
Peak Search
Mkr2 4.803 GHz
Ref 10 dBm
Atten 10 dB
-37.61 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-22.2
dBm
LgAv
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.402 GHz -2.21 dBm
2 (1) Freq 4.803 GHz -37.61 dBm
Copyright 2000-2012 Agilent Technologies

CH38

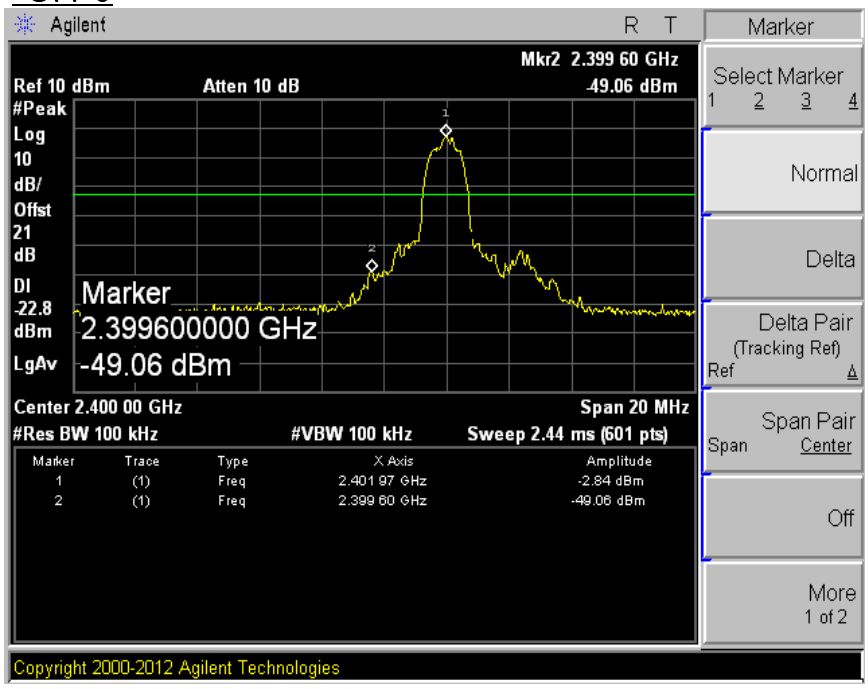

Agilent
R T
Display
Mkr2 4.881 GHz
Ref 10 dBm
Atten 10 dB
-38.10 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-24.4
dBm
LgAv
Full Screen
Display Line
-24.41 dBm
On
Off
Limits
Active Fctn
Position
Bottom
Title
Preferences
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 GHz -4.41 dBm
2 (1) Freq 4.881 GHz -38.10 dBm
Copyright 2000-2012 Agilent Technologies

CH79

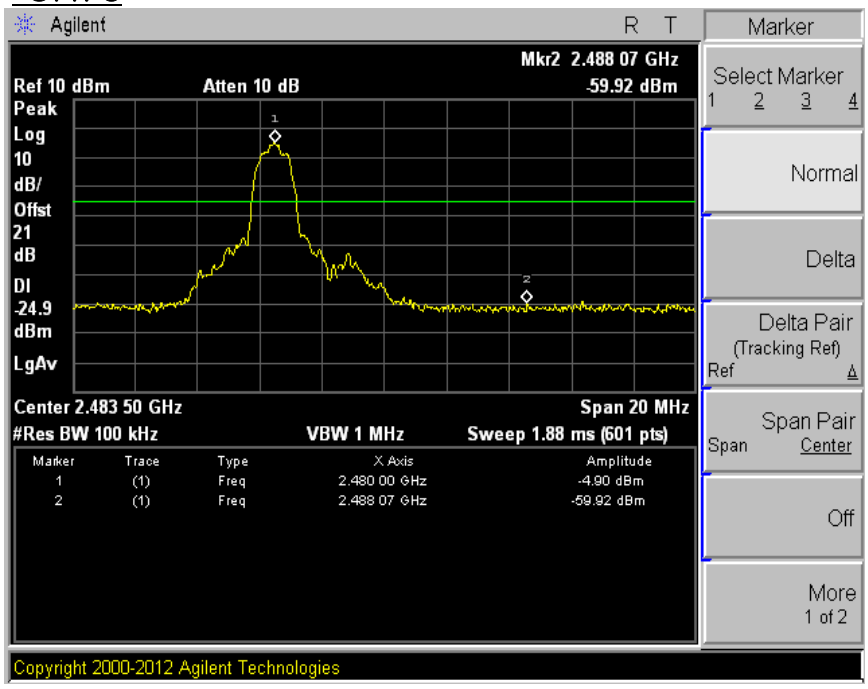

Agilent
R T
Peak Search
Mkr2 4.961 GHz
Ref 10 dBm
Atten 10 dB
-37.58 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-24.2
dBm
LgAv
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 GHz -4.17 dBm
2 (1) Freq 4.961 GHz -37.58 dBm
Copyright 2000-2012 Agilent Technologies

8DPSK

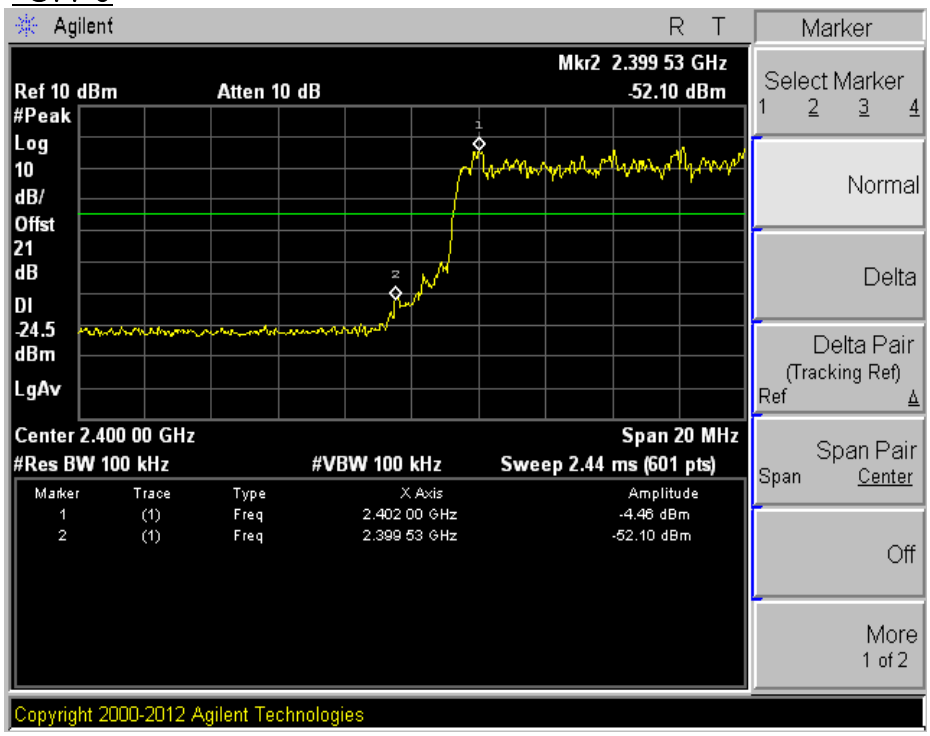
CH 0



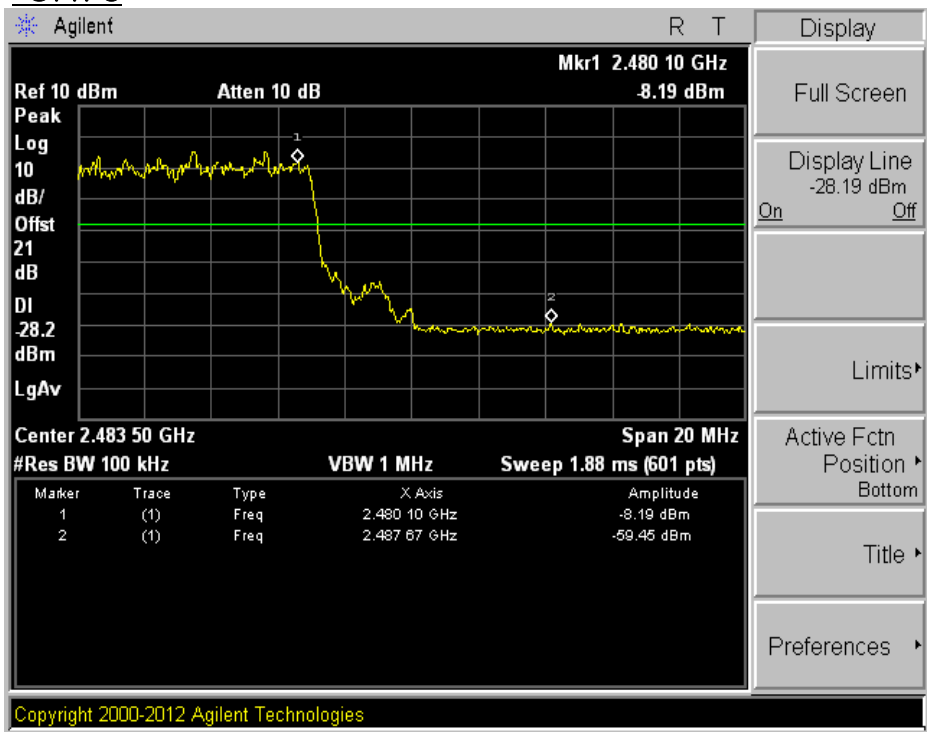
CH78



CH 0


Agilent
R T
Marker
Mkr2 2.399 53 GHz
Ref 10 dBm
Atten 10 dB
-52.10 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-24.5
dBm
LgAv
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Center 2.400 00 GHz
Span 20 MHz
#Res BW 100 kHz
#VBW 100 kHz
Sweep 2.44 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.402 00 GHz -4.46 dBm
2 (1) Freq 2.399 53 GHz -52.10 dBm
Copyright 2000-2012 Agilent Technologies

CH78


Agilent
R T
Display
Mkr1 2.480 10 GHz
Ref 10 dBm
Atten 10 dB
-8.19 dBm
Peak
Log
10
dB/
Offst
21
dB
Dl
-28.2
dBm
LgAv
Full Screen
Display Line
-28.19 dBm
On Off
Limits
Active Fctn
Position
Bottom
Title
Preferences
Center 2.483 50 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 1.88 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 10 GHz -8.19 dBm
2 (1) Freq 2.487 67 GHz -59.45 dBm
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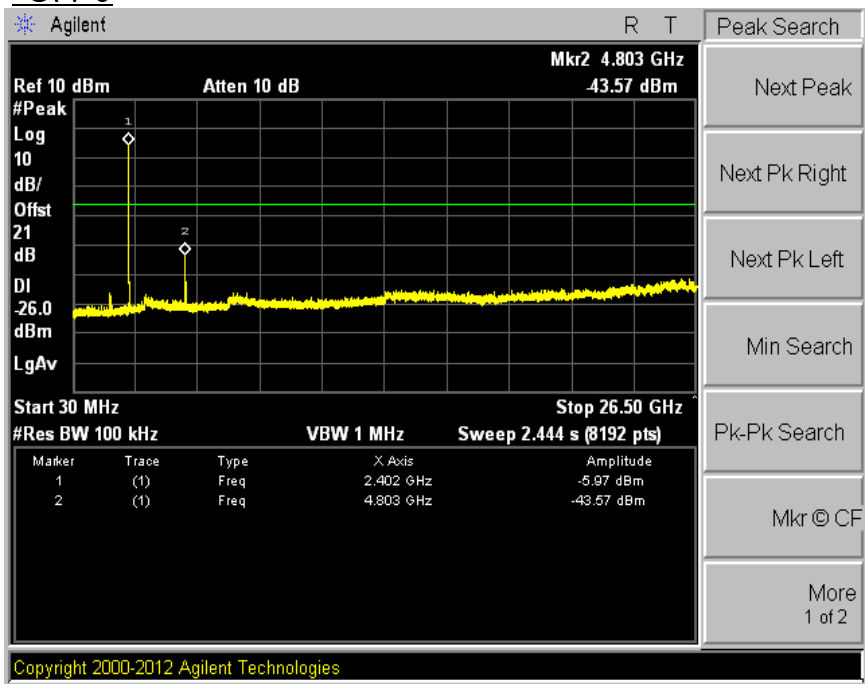
CH 0


Agilent
R T
Peak Search
Mkr2 4.803 GHz
Ref 10 dBm
Atten 10 dB
-43.57 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-26.0
dBm
LgAv
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.402 GHz -5.97 dBm
2 (1) Freq 4.803 GHz -43.57 dBm
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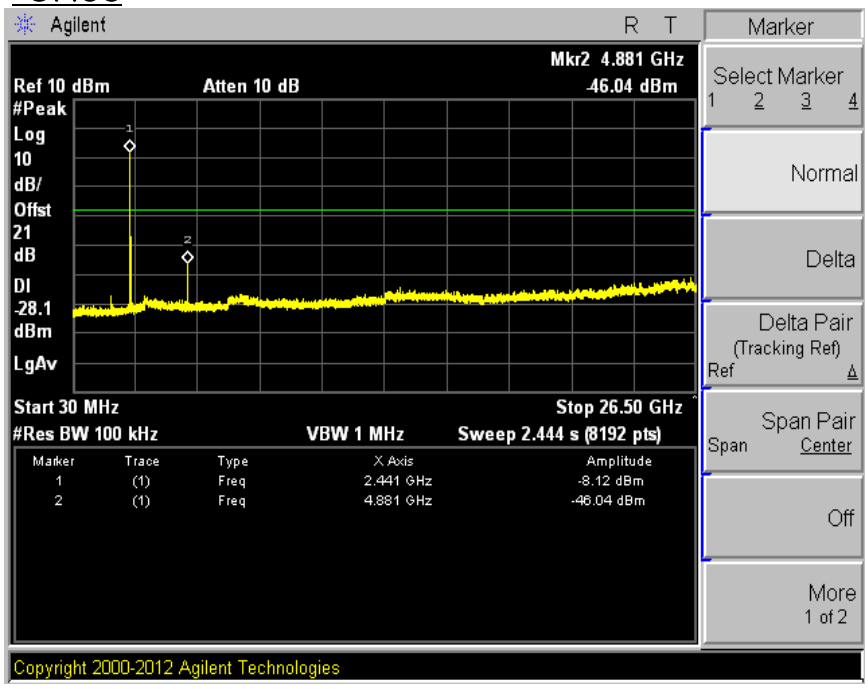
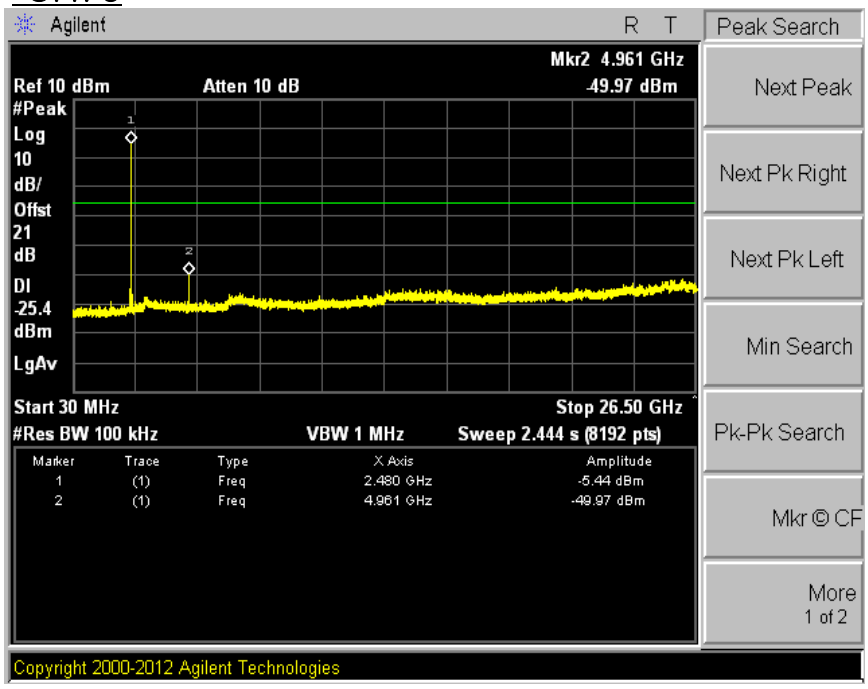
CH38


Agilent
R T
Marker
Mkr2 4.881 GHz
Ref 10 dBm
Atten 10 dB
-46.04 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-28.1
dBm
LgAv
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 GHz -8.12 dBm
2 (1) Freq 4.881 GHz -46.04 dBm
Copyright 2000-2012 Agilent Technologies

CH79


Agilent
R T
Peak Search
Mkr2 4.961 GHz
Ref 10 dBm
Atten 10 dB
-49.97 dBm
#Peak
Log
10
dB/
Offst
21
dB
Dl
-25.4
dBm
LgAv
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.444 s (8192 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 GHz -5.44 dBm
2 (1) Freq 4.961 GHz -49.97 dBm
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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 63.10 (2013) 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	15-Nov-17
Logbicon Antenna	VULB 9168	SCHWARZBECK	193	11-Mar-17
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	AGILENT	3008A00581	15-Nov-17
Horn Antenna	BBHA9120D	SCHWARZBECK	469	25-Aug-17
Test Receiver	ESPI7	ROHDE & SCHWARZ	100185	15-Nov-17
Spectrum Analyzer	R3273	ADVANTEST	121200664	21-Oct-17
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	25-Aug-17
BLUETOOTH TESTER	TC-3000A	TESCOM	3000A5B0298	4-Jan-18
Antenna Master & Turn table controller	C02000-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 : 7-Jul-17 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)
40.40	16.89	H	1.0	13.12	1.12	40.00	31.12	8.88
50.10	14.87	H	1.0	13.64	1.24	40.00	29.75	10.25
68.90	18.10	V	1.0	11.93	1.44	40.00	31.47	8.53
75.20	14.07	V	1.0	10.55	1.50	40.00	26.12	13.88
125.30	8.57	H	1.0	11.48	1.92	43.50	21.97	21.53
450.00	7.04	V	3.0	16.96	3.65	46.00	27.64	18.36

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

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10.3-1 Test Data for Bluetooth(Basic Rate)

Test Date : 10-Jul-17 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)									
2341.20	49.16	H	1.0	26.01	-30.14	0.00	74.00	45.03	28.97
2362.00	49.17	V	1.0	25.99	-30.15	0.00	74.00	45.01	28.99
4804.00	62.67	H	1.5	30.93	-27.04	0.00	74.00	66.56	7.44
4804.00	56.97	V	1.5	30.93	-27.04	0.00	74.00	60.86	13.14
Average (RBW:1 MHz VBW:1 kHz)									
2376.20	35.73	H	1.5	26.04	-30.12	1.02	54.00	32.67	21.33
2368.80	35.50	V	1.5	26.05	-30.12	1.02	54.00	32.44	21.56
4804.00	43.89	H	1.5	30.93	-27.04	1.02	54.00	48.80	5.20
4804.00	41.69	V	1.5	30.93	-27.04	1.02	54.00	46.60	7.40

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 : 10-Jul-17 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	60.50	H	1.5	31.15	-26.82	0.00	74.00	64.84	9.16
4882.00	56.95	V	1.5	31.15	-26.82	0.00	74.00	61.29	12.71
Average (RBW:1 MHz VBW:1 kHz)									
4882.00	45.97	H	1.5	31.15	-26.82	1.02	54.00	51.33	2.67
4882.00	45.39	H	1.7	31.15	-26.82	1.02	54.00	50.75	3.25
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 : 10-Jul-17 Measurement Distance : 3 m

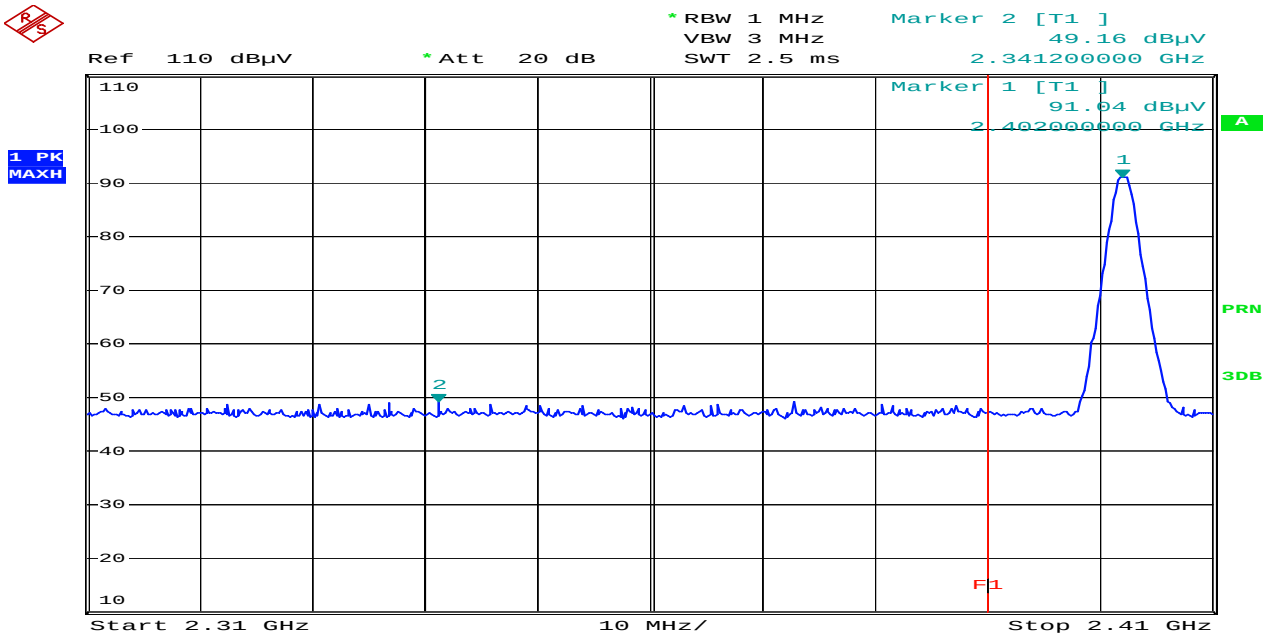
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2487.30	48.83	H	1.5	26.30	-29.93	0.00	74.00	75.13	-1.13
2488.15	49.06	V	1.5	26.30	-29.93	0.00	74.00	45.43	28.57
4960.00	52.44	H	1.5	31.38	-26.70	0.00	74.00	57.12	16.88
4960.00	52.62	V	1.7	31.38	-26.70	0.00	74.00	57.30	16.70
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	47.42	H	1.5	26.30	-29.93	1.02	54.00	44.81	9.19
2483.50	47.42	V	1.5	26.30	-29.93	1.02	54.00	44.81	9.19
4960.00	44.50	H	1.5	31.38	-26.70	1.02	54.00	50.20	3.80
4960.00	44.79	V	1.7	31.38	-26.70	1.02	54.00	50.49	3.51

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

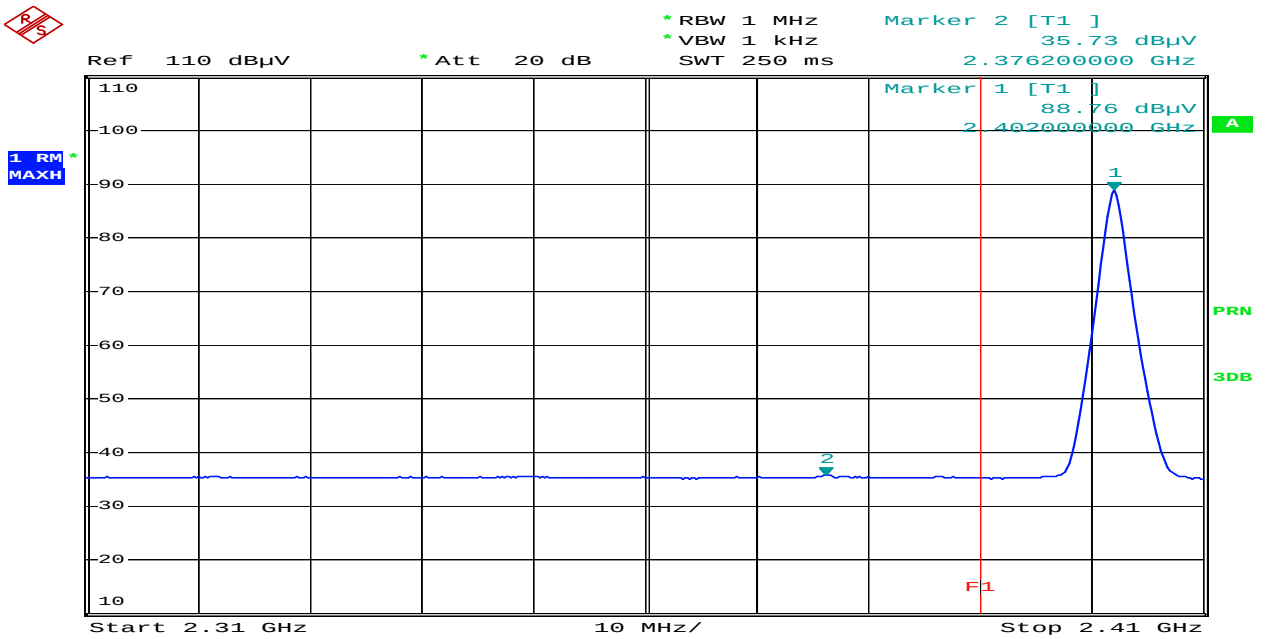
10.4 Restricted Band Edges for BT(Basic Rate)

Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal

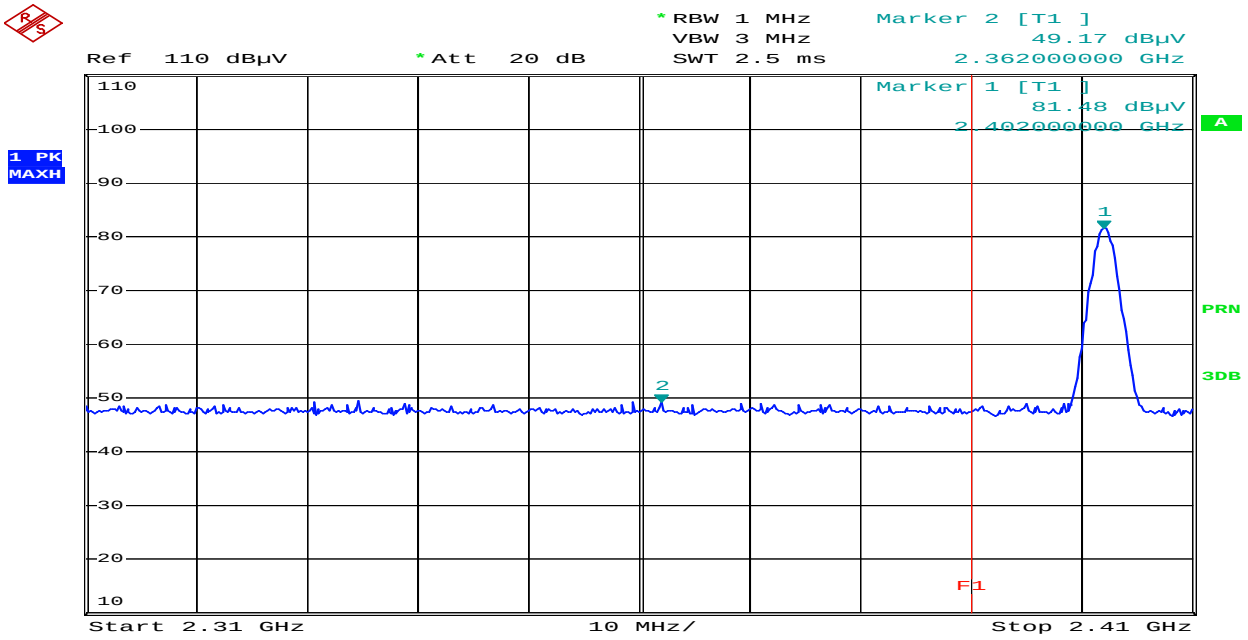


Detector mode:Average Polarity:Horizontal

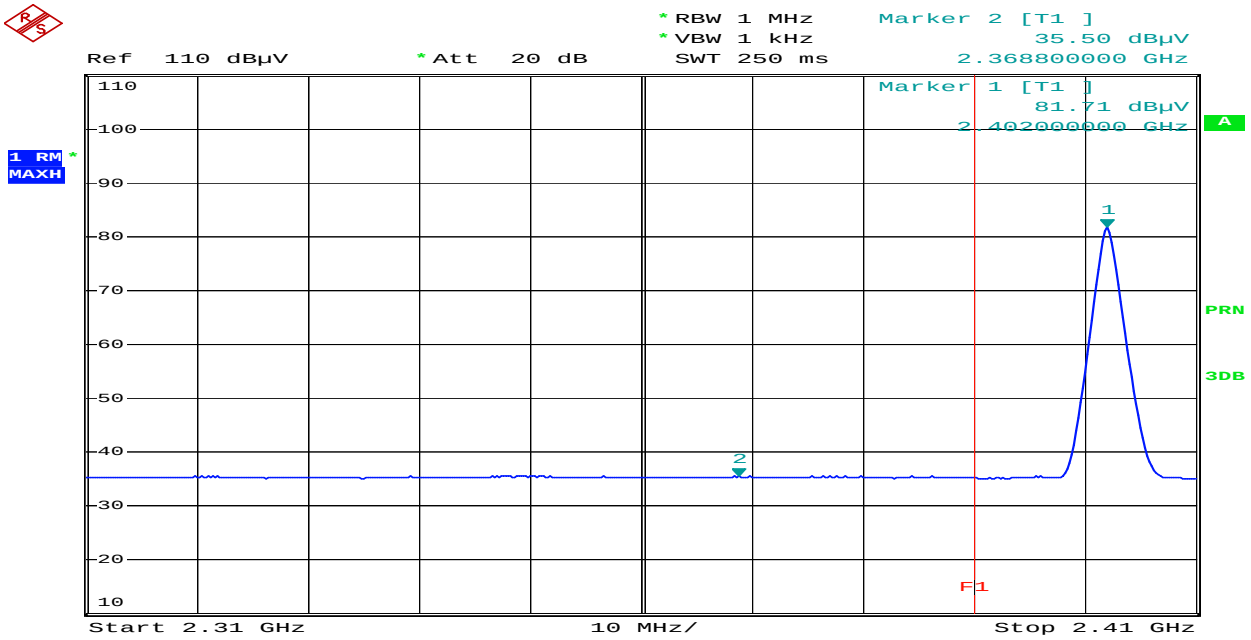


Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical

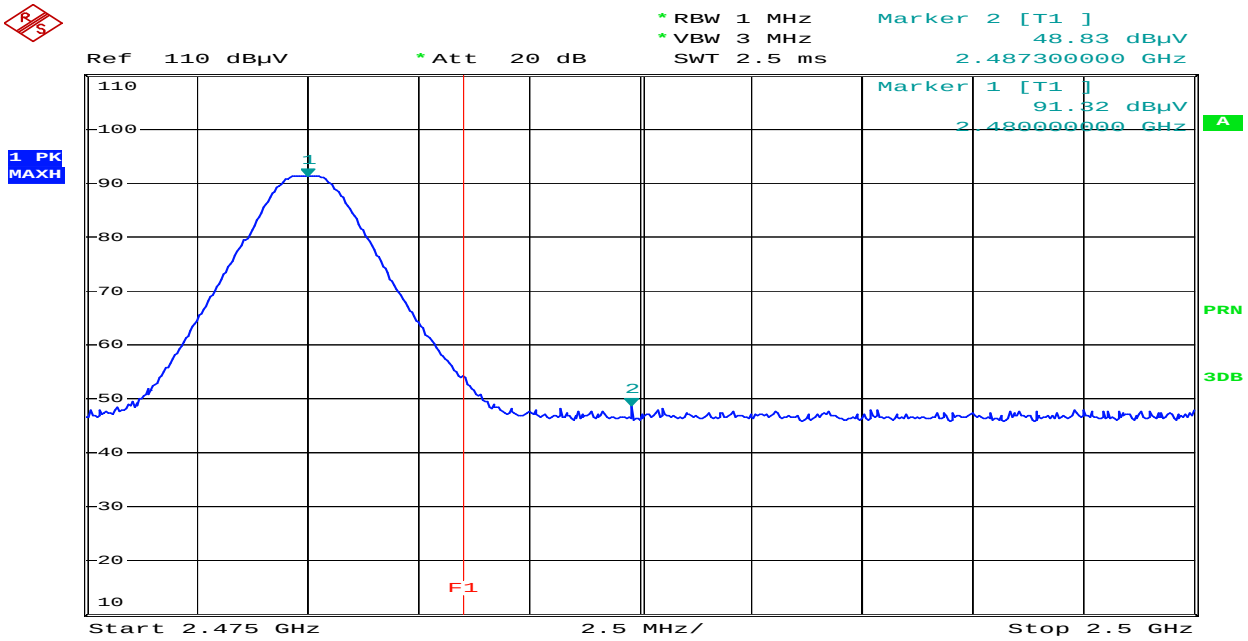


Detector mode:Average Polarity:Vertical

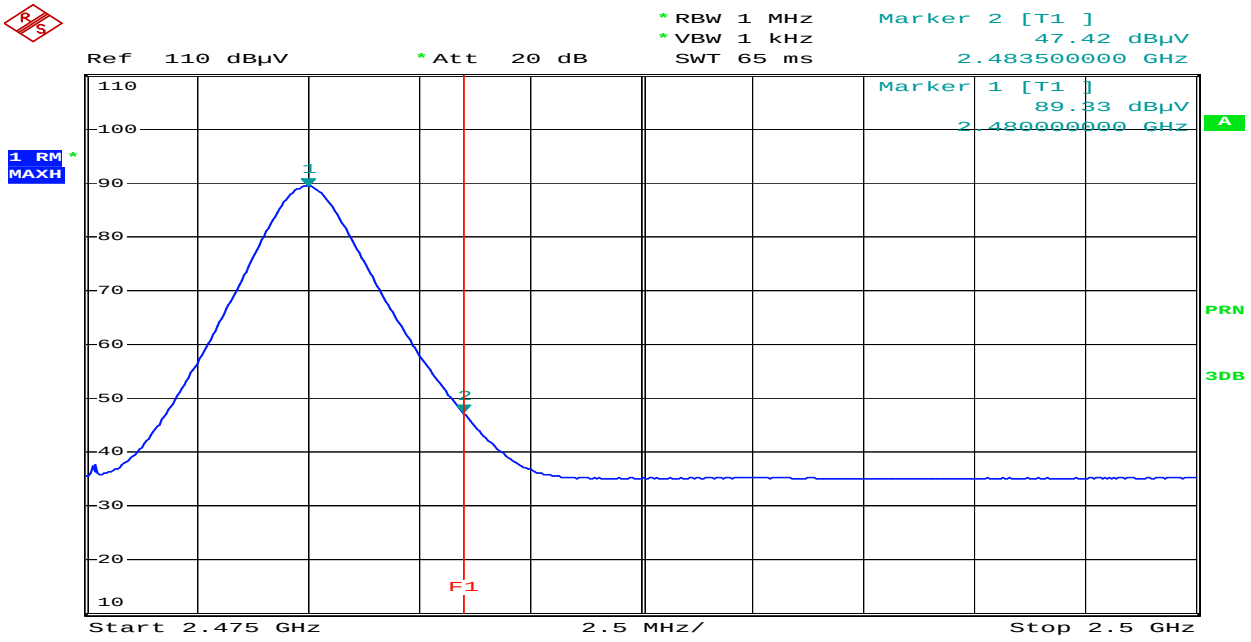


Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal

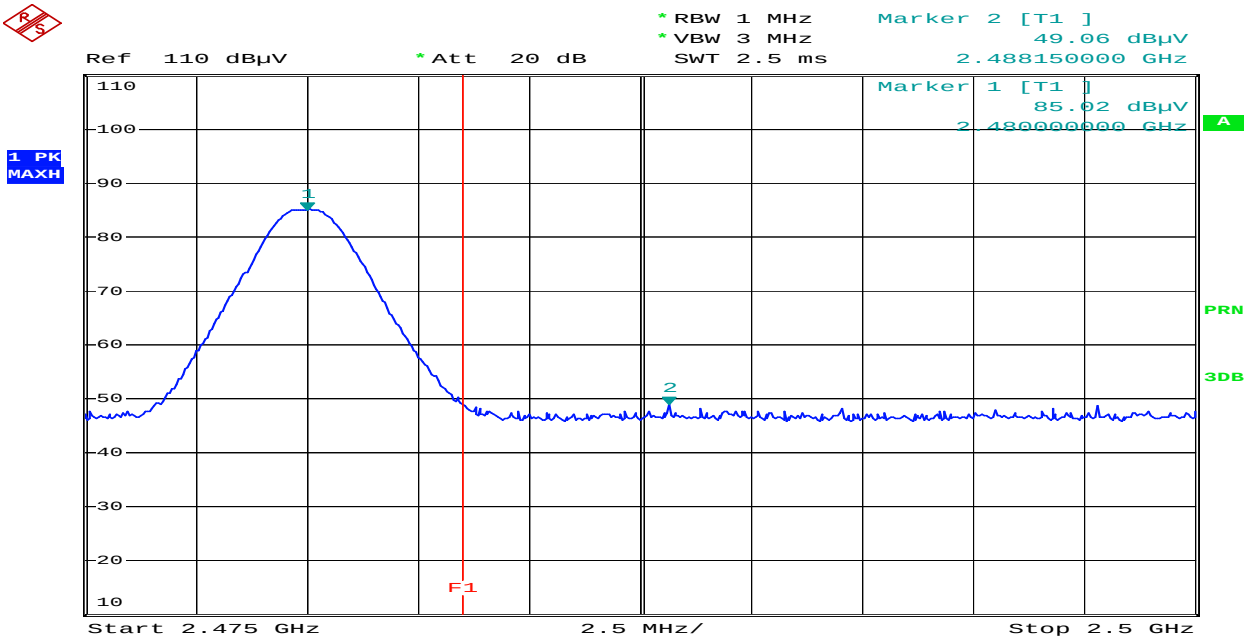


Detector mode:Average Polarity:Horizontal

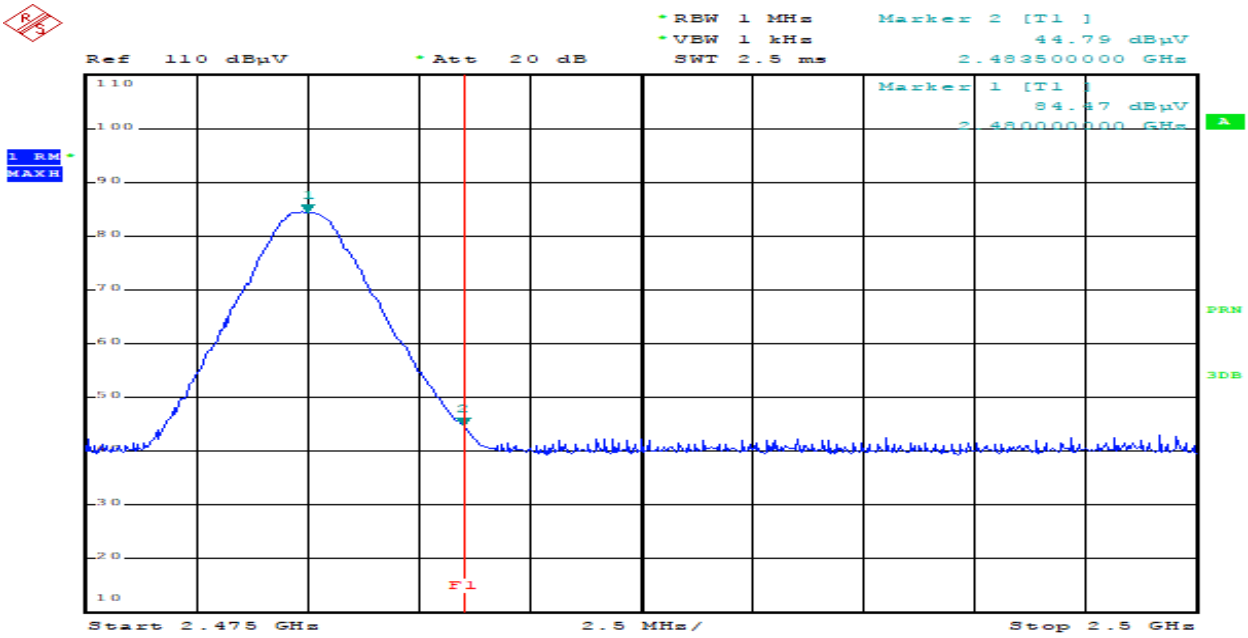


Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Detector mode:Average Polarity:Vertical



10.5 Test Data for Bluetooth (EDR)

Test Date : 7-Jul-17 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)
37.00	16.56	V	1.5	12.82	1.07	40.00	30.45	9.55
50.10	12.55	V	2.0	13.64	1.24	40.00	27.43	12.57
60.00	9.28	H	3.0	13.17	1.35	40.00	23.80	16.20
75.20	10.87	V	1.5	10.55	1.50	40.00	22.92	17.08
125.30	3.70	V	2.0	11.48	1.92	43.50	17.10	26.40

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 : 7-Jul-17 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)									
2365.00	48.33	H	1.5	26.07	-30.11	0.00	74.00	44.29	29.71
2357.40	48.85	V	1.7	26.05	-30.12	0.00	74.00	44.78	29.22
4804.00	58.39	H	1.0	30.72	-24.20	0.00	74.00	64.91	9.09
4804.00	53.54	V	1.0	30.72	-24.20	0.00	74.00	60.06	13.94
Average (RBW:1 MHz VBW:1 kHz)									
2370.00	35.47	H	1.5	26.02	-30.14	1.02	54.00	32.37	21.63
2351.40	35.55	V	1.7	26.08	-30.10	1.02	54.00	32.54	21.46
4804.00	43.14	H	1.5	30.93	-27.04	1.02	54.00	48.05	5.95
4804.00	41.70	V	1.7	30.93	-27.04	1.02	54.00	46.61	7.39

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 : 10-Jul-17 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	55.00	H	1.5	31.15	-26.82	0.00	74.00	59.34	14.66
4882.00	53.31	V	1.7	31.15	-26.82	0.00	74.00	57.65	16.35
Average(RBW:1 MHz VBW:1 kHz)									
4882.00	39.60	H	1.5	31.15	-26.82	1.02	54.00	44.96	9.04
4882.00	40.11	V	1.7	31.15	-26.82	1.02	54.00	45.47	8.53

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 : 10-Jul-17 Measurement Distance : 3 m

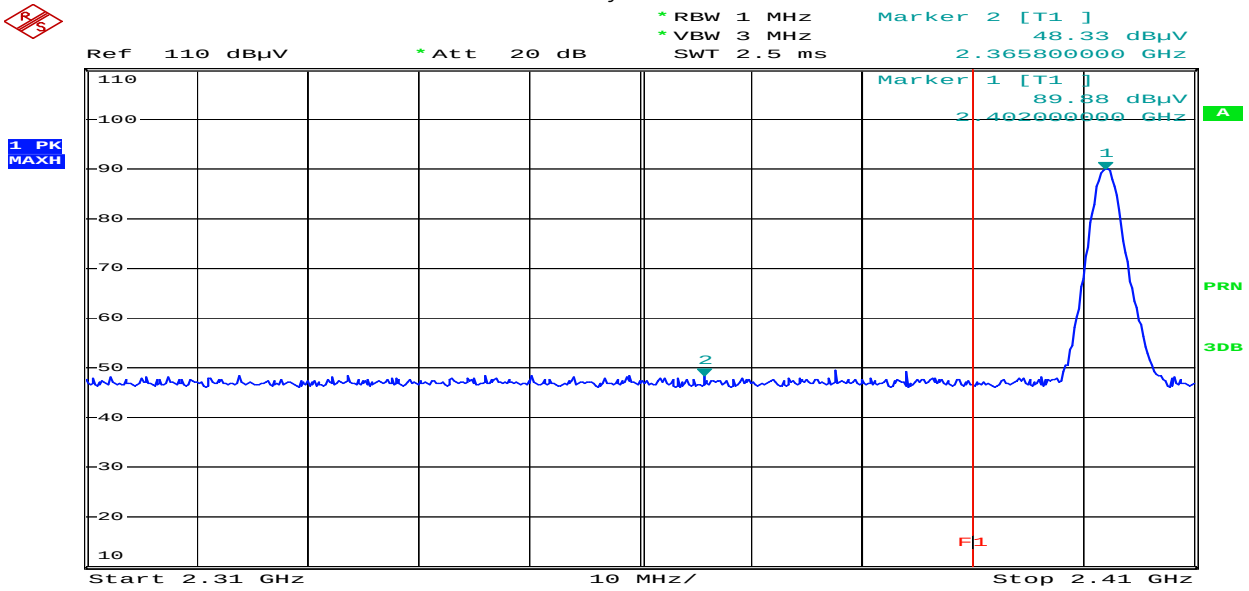
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	55.01	H	1.5	26.30	-29.93	0.00	74.00	51.38	22.62
2483.50	50.38	V	1.7	26.30	-29.93	0.00	74.00	46.75	27.25
4960.00	55.08	H	1.5	31.38	-26.70	0.00	74.00	59.76	14.24
4960.00	53.41	V	1.7	31.38	-26.70	0.00	74.00	58.09	15.91
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	46.03	H	1.5	26.30	-29.93	1.02	54.00	43.42	10.58
2483.50	41.28	V	1.7	26.30	-29.93	1.02	54.00	38.67	15.33
4896.00	43.67	H	1.5	31.19	-26.78	1.02	54.00	49.11	4.89
4896.00	39.62	V	1.7	31.19	-26.78	1.02	54.00	45.06	8.94

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

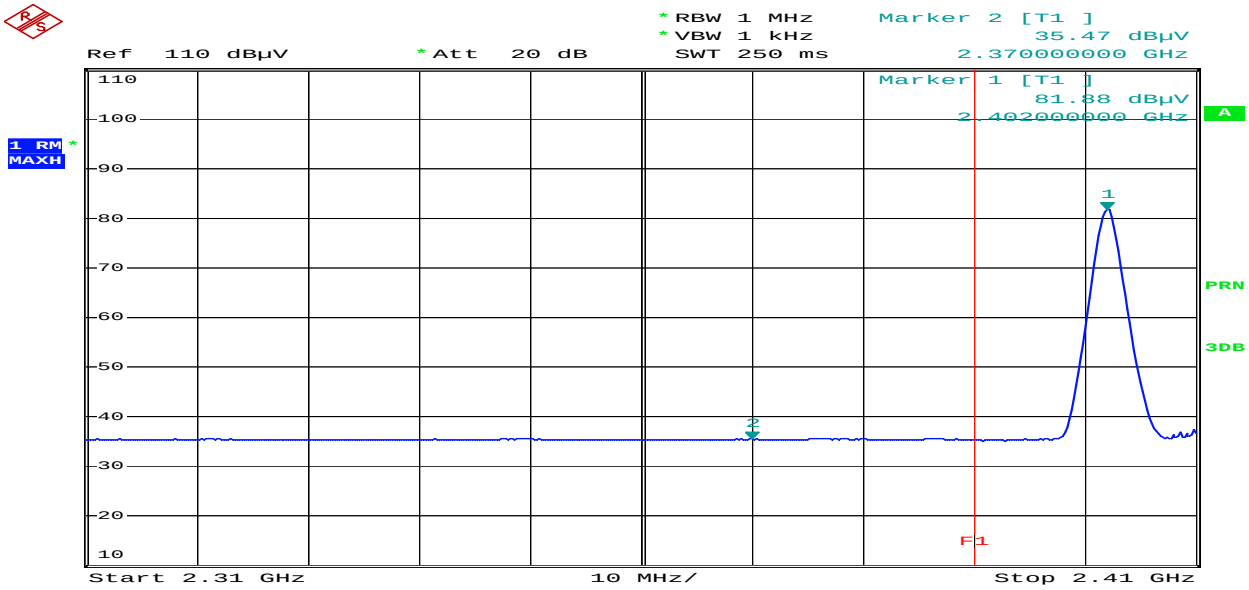
10.6 Restricted Band Edges for BT(EDR)

Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal

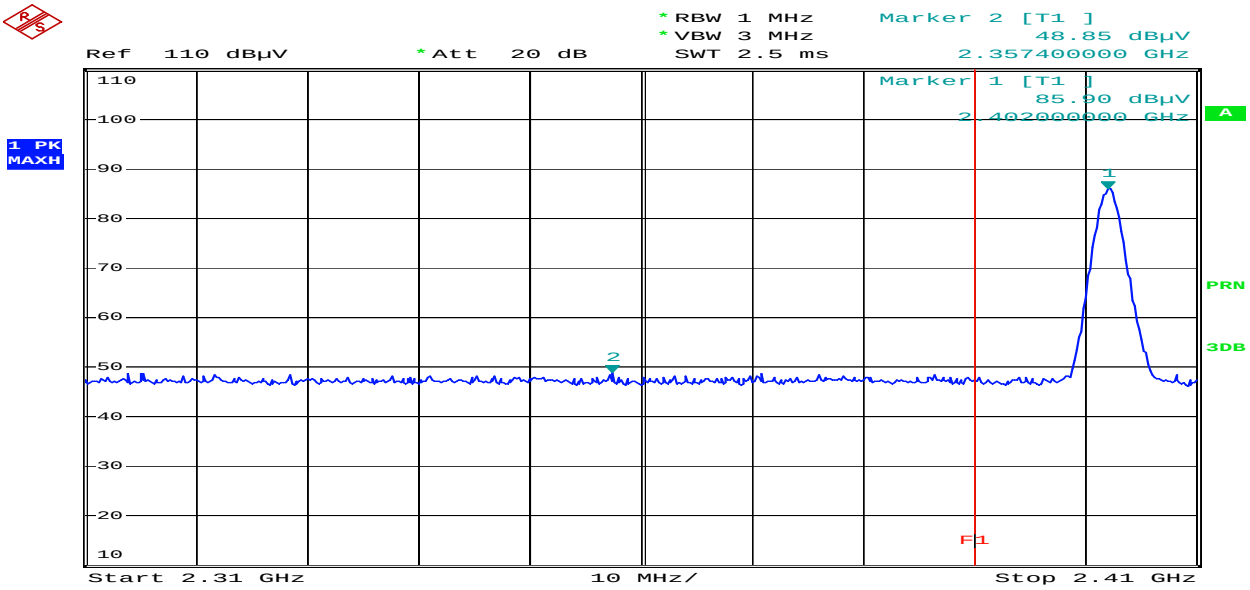


Detector mode:Average Polarity:Horizontal

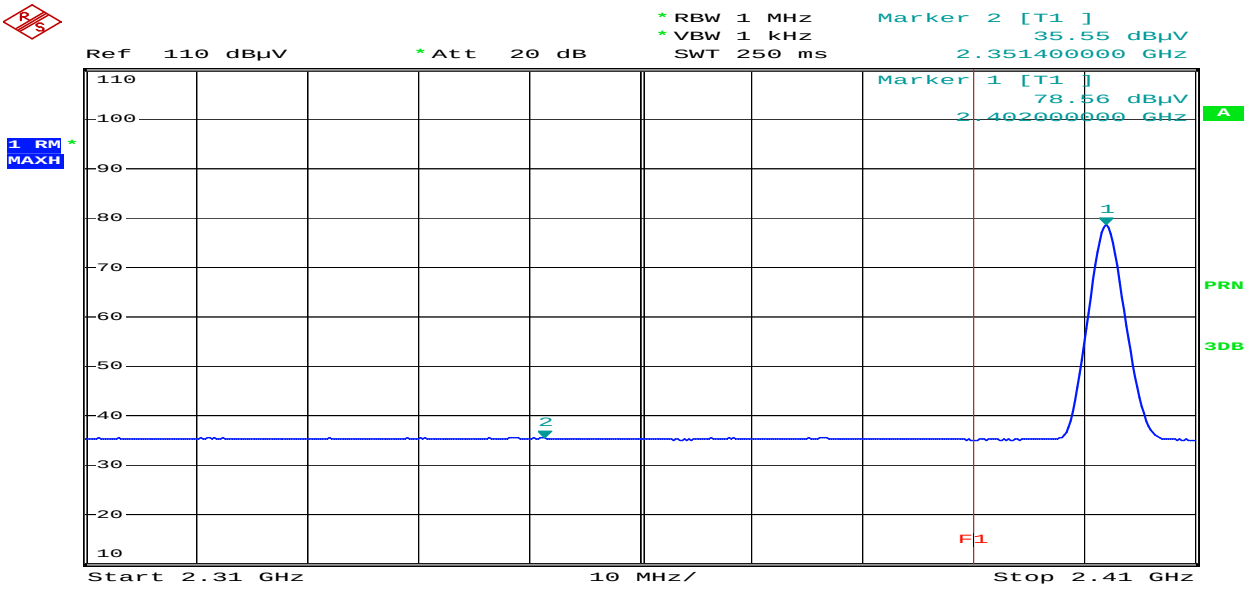


Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical

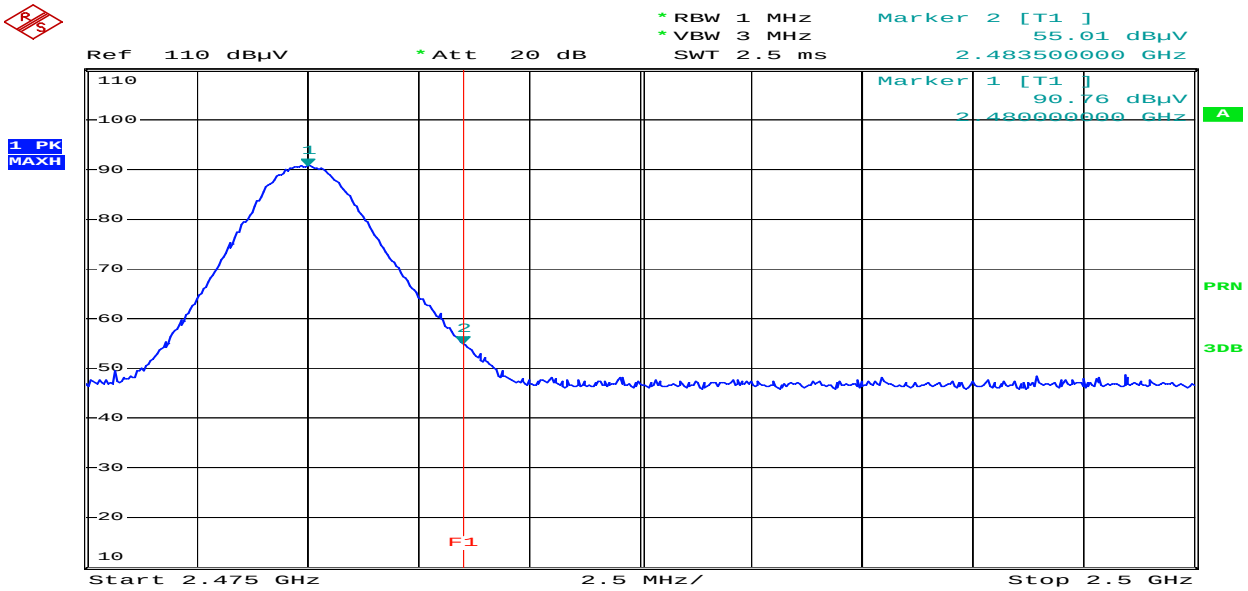


Detector mode:Average Polarity:Vertical

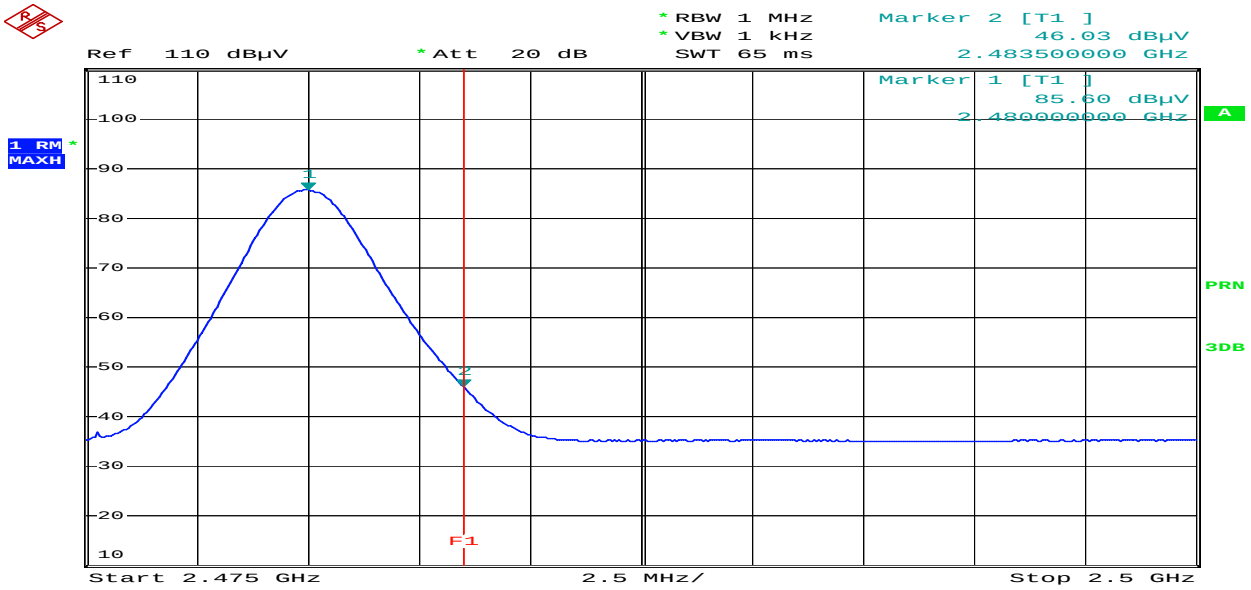


Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal

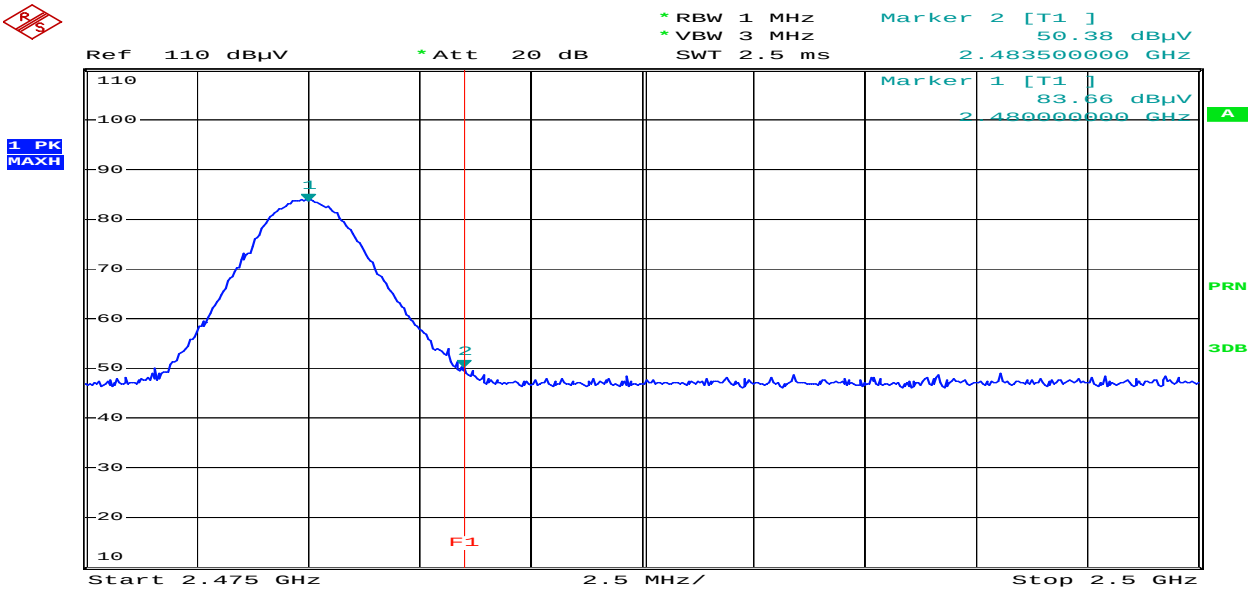


Detector mode:Average Polarity:Horizontal

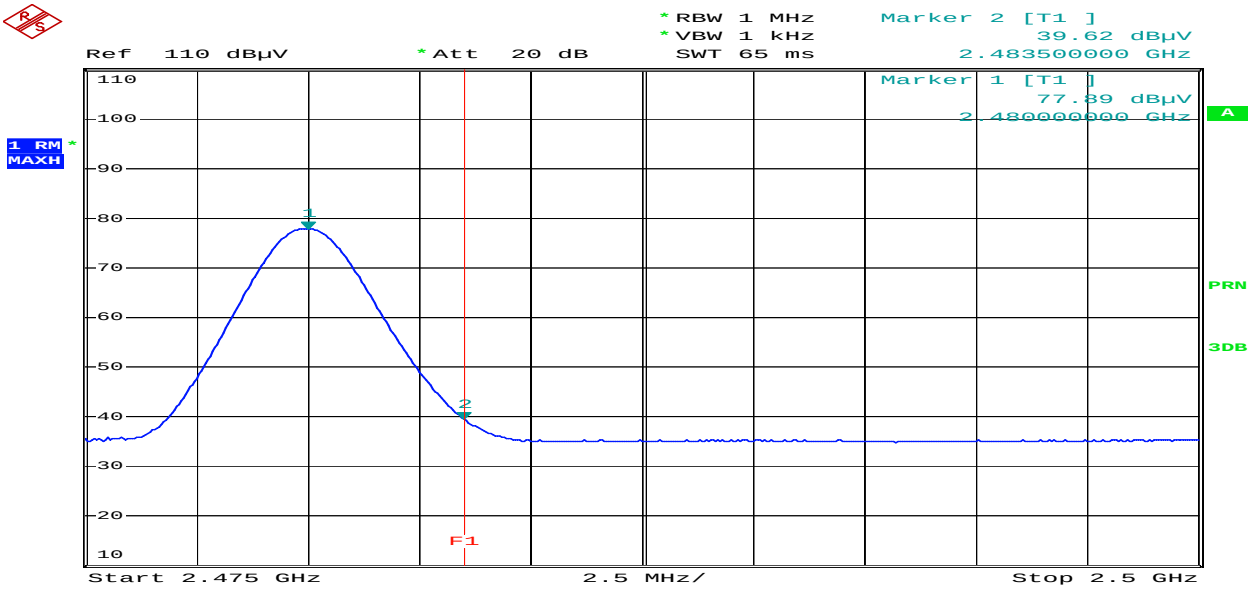


Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Detector mode:Average Polarity:Vertical



11. Photographs of EUT

[Front]

[Rear]

Appendix 1. 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 1.40 dBi.