Estech
your best partner

Test Report for FCC

FCC ID : 2AL5DBBCT2018-N60

Report Number		ESTRFC1908-001		
Applicant	Company name	M.I.J		
	Address	882 Baksa-ro, Seo-myeon, Chuncheon-si, Gangwon-do, Republic of Korea		
	Telephone	+82-33-252-8995		
	Contack person	Jinsuk Hur		
Product	Product name	ETEREO N60		
	Model No.	BBCT2018-N60	Manufacturer	M.I.J
	Serial No.	None	Country of origin	KOREA
Test date	05-Aug-19 ~ 09-Aug-19		Date of issue	16-Aug-19
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 H.G. Lee (Signature)			
Reviewed by	Engineering Manager I.K. Hong (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
- Additional Model Name : ETEREO ONE
- does not have a voice-collecting microphone.

Estech
your best partner

Contents 1

Estech
your best partner

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	: M.I.J
Channel Spacing	: 1 MHz
PEAK Output Power	: GFSK : 2.03 mW 8DPSK : 3.21 mW
Rating	: Micro USB C - Type 5 V
Receipt Date	: 17-Jun-19
X-tal list(s) or Frequencies generated	The highest operating frequency is 2480 MHz(Bluetooth) Blutooth : 2.4 GHz

2.2 General descriptions of EUT

Version	Bluetooth 5.0
Wireless	10 m
Chip Set	CSR8670
Profile	HSP,HFP, A2DP and AVRCP
Weight	50 g
Speaker Type	Stereo Bone Conduction Transducer
Frequency Response	20 Hz ~ 20 kHz
Speaker Sensitivity	100 ± 3 dB
Mic Sensitivity	Omni Directional (-42 dB ±3 dB)
Power supply	Lithium Polymer Battery 210 mAH
Charger	Micro USB C - Type 5 V
Hearing Aid Usable Time	12 Hour
Music Usable Time	8 Hour
Waiting Time	100 Hour
Charging Time	3 Hour

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
15.207	AC Power Conducted Emission	N/A	use battery	
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
38	2440 MHz		

b. Measurement Channel : Low (2402 MHz), Middle (2440 MHz), High (2480 MHz)

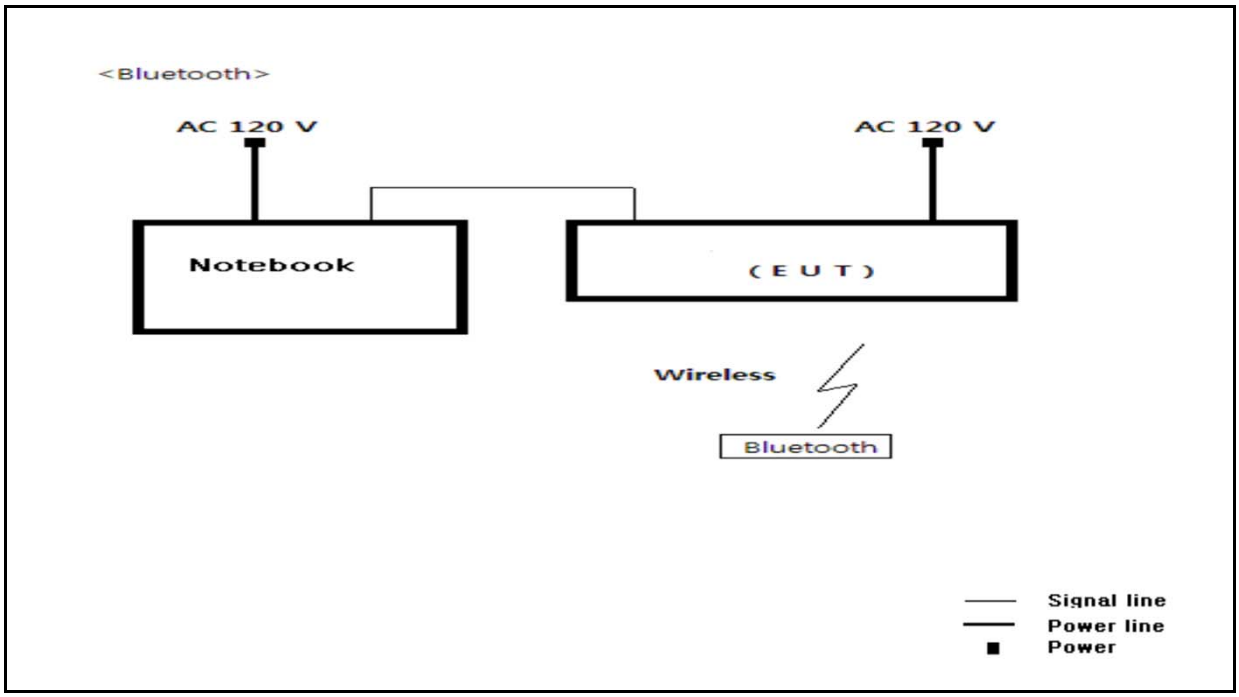
c. Test Mode : 8DPSK, GFSK (worst case)

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)
ETEREO N60	BBCT2018-N60	None	M.I.J	EUT
Notebook	80XL	None	LCFC(Hefei) Electronics Technology Co.,Ltd.	

4.5 Cable Connecting

Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
ETEREO N60	Power	-	-	2.0	Unshielded	
Notebook	Power	-	-	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	2019-Dec-19
-Spectrum Analyzer <=> EUT	Loss: 1 dB	-	

5.3 Measurement results

EUT	ETEREO N60	MODEL	BBCT2018-N60
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	22 ℃, 40 % R.H .
INPUT POWER	DC 3.7 V		

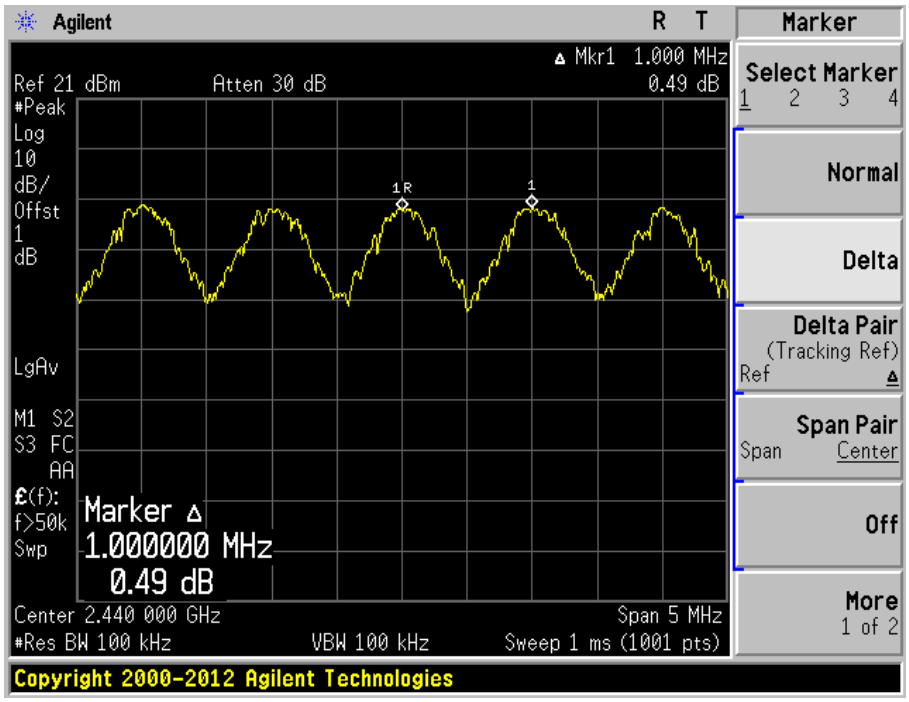
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (kHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	899	1013	1000	675	PASS
38	2440	893	1018	1000	679	PASS
78	2480	898	1026	1000	684	PASS

(8DPSK)

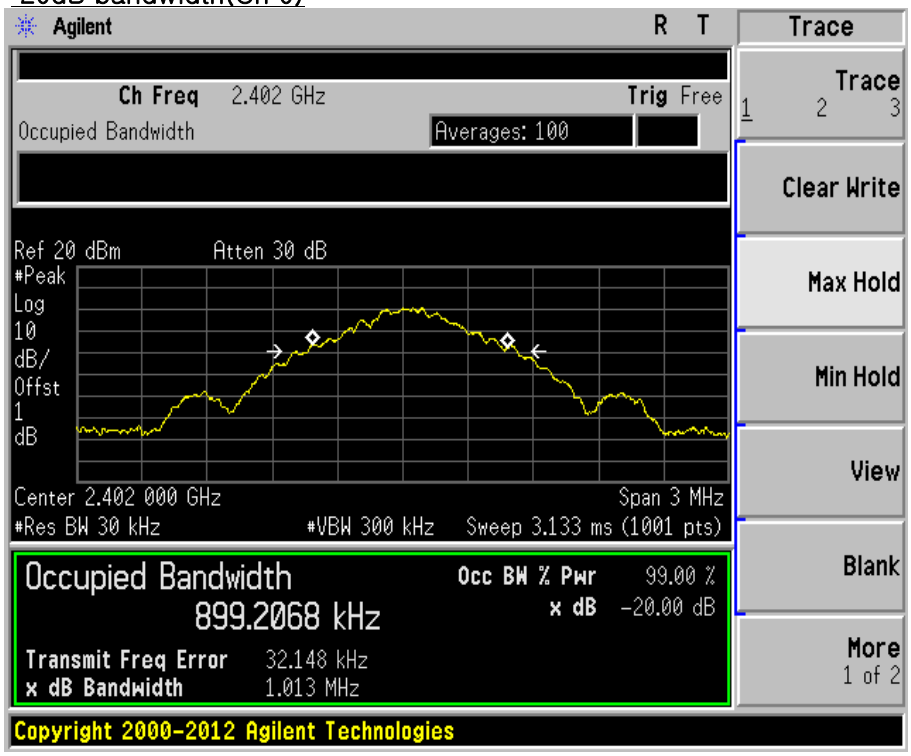
CHANNEL	Channel Frequency (MHz)	Bandwidth at 99% (MHz)	Bandwidth at 20dB below(kHz)	Channel Separation (kHz)	Limit (kHz)	PASS/FAIL
0	2402	1.202	1315	1000	877	PASS
38	2440	1.206	1352	1000	901	PASS
78	2480	1.208	1344	1000	896	PASS

5.4 Trace data (GFSK)

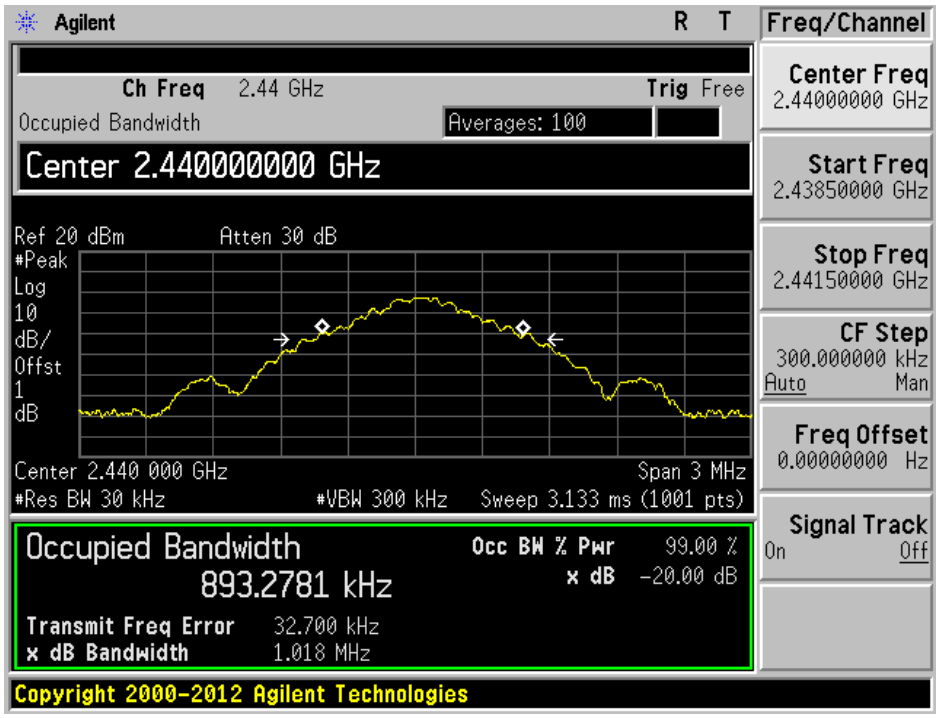
Channel Separation



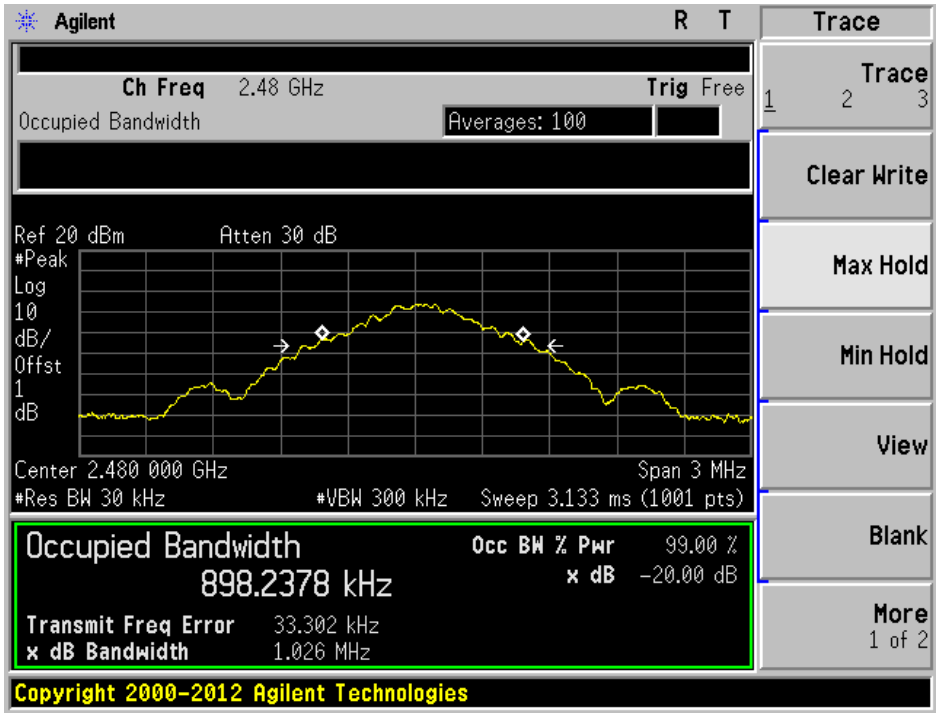
20dB bandwidth(Ch 0)



20dB bandwidth(CH 38)

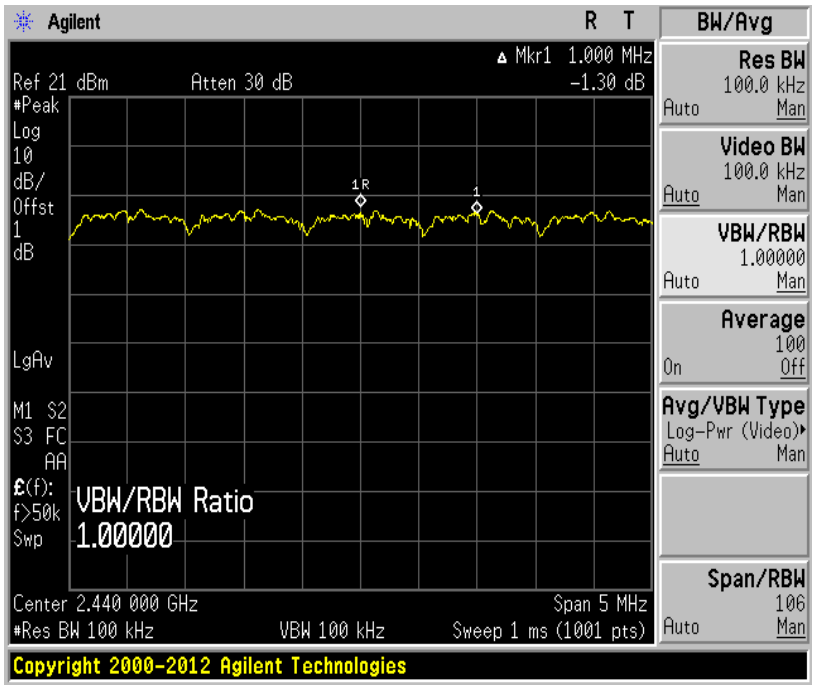


20dB bandwidth(CH 78)

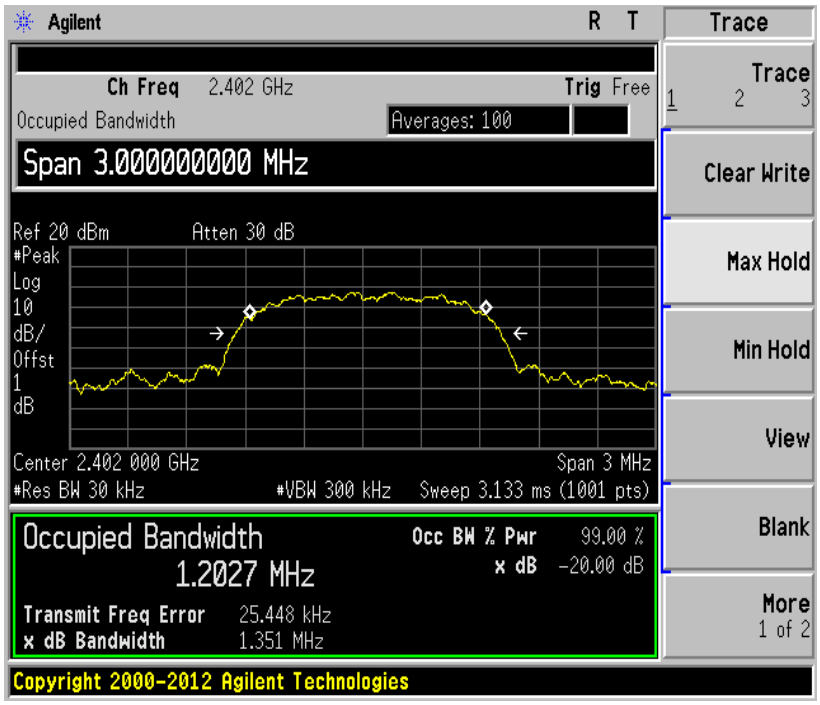


(8DPSK)

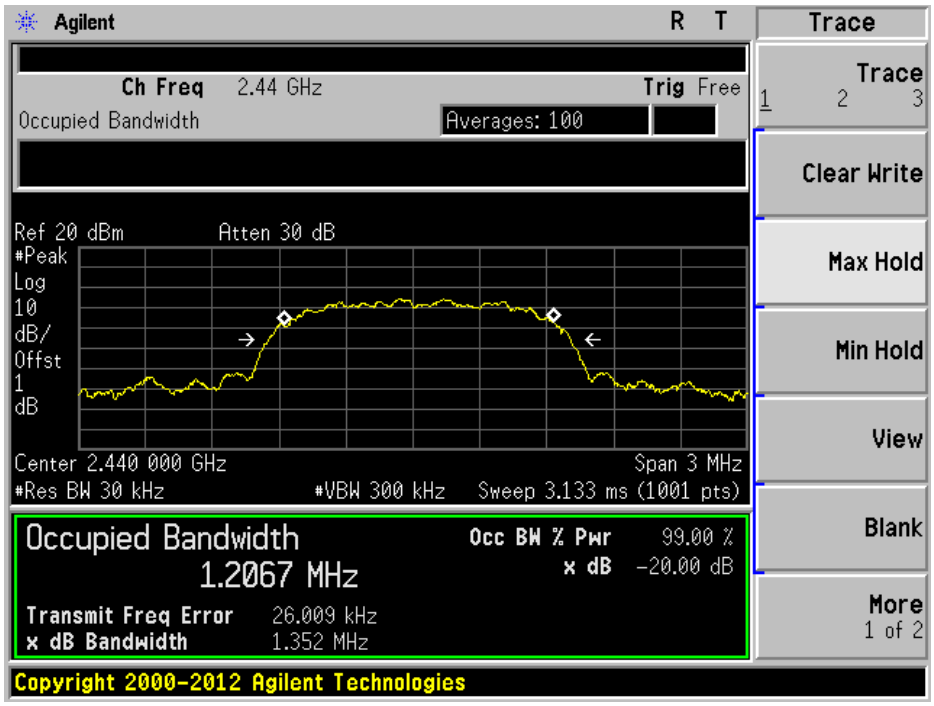
Channel Separation



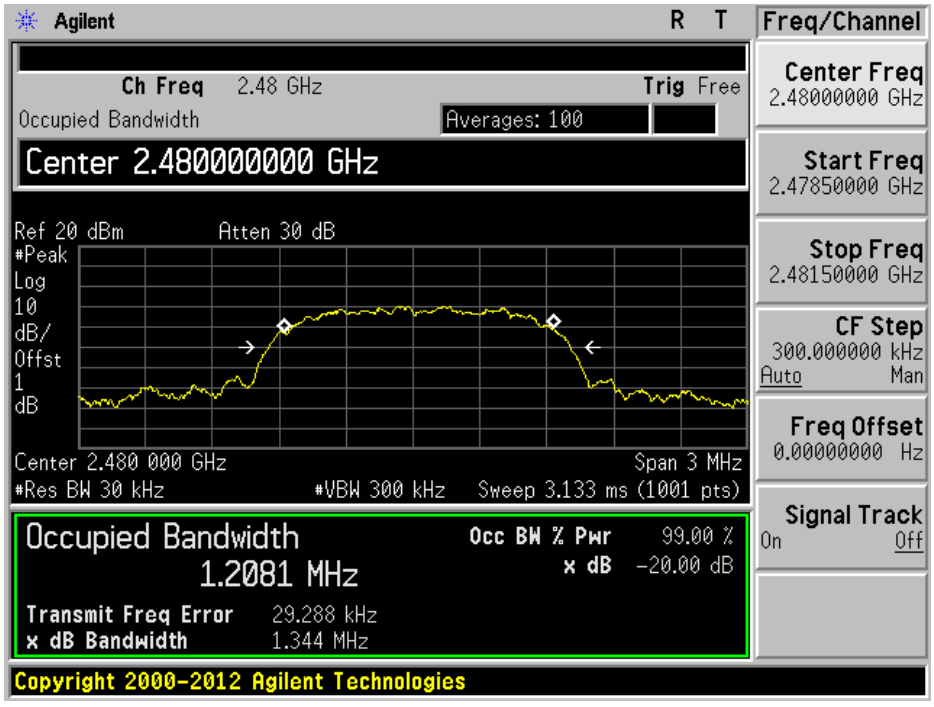
20dB bandwidth(Ch 0)



20dB bandwidth(CH 38)



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	N1921A	MY45100570	2019-12-19
Power Sensor	N1921A	MY45240427	2019-12-19
Power Meter <=> EUT	Loss: 1 dB	-	

6.2 Measurement results

EUT	ETEREO N60	MODEL	BBCT2018-N60
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 41 % R.H.
INPUT POWER	DC 3.7 V		

GFSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	3.08	2.03	125	PASS
38	2440	0.03	1.01	125	PASS
78	2480	-3.91	0.41	125	PASS

8DPSK

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[mW]	PASS/ FAIL
		(dBm)	(mW)		
0	2402	5.07	3.21	125	PASS
38	2440	2.05	1.60	125	PASS
78	2480	-1.87	0.65	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

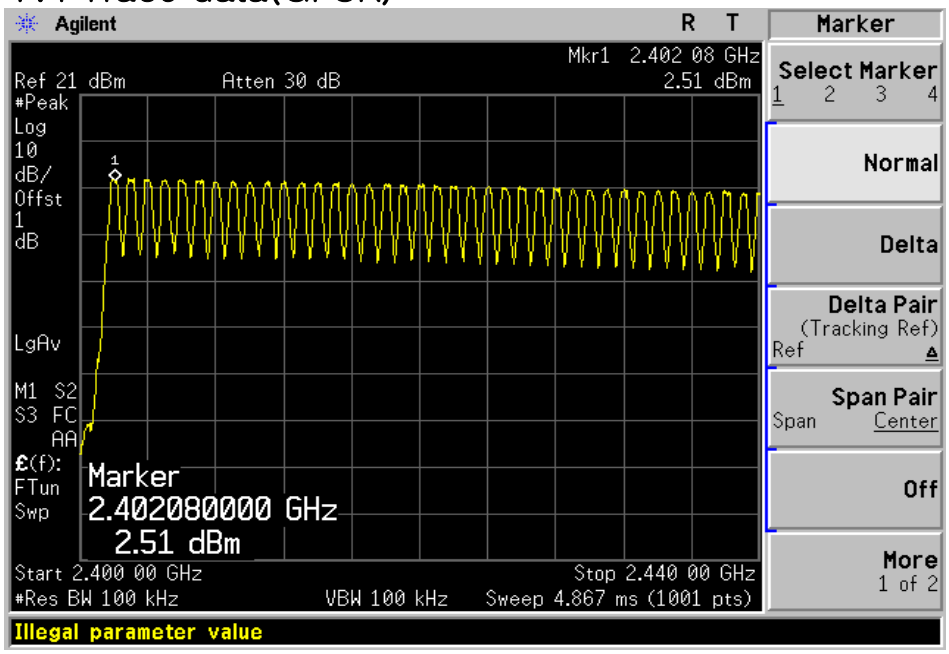
Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	2019-12-19
-Spectrum Analyzer <=> EUT	Loss: 1 dB		

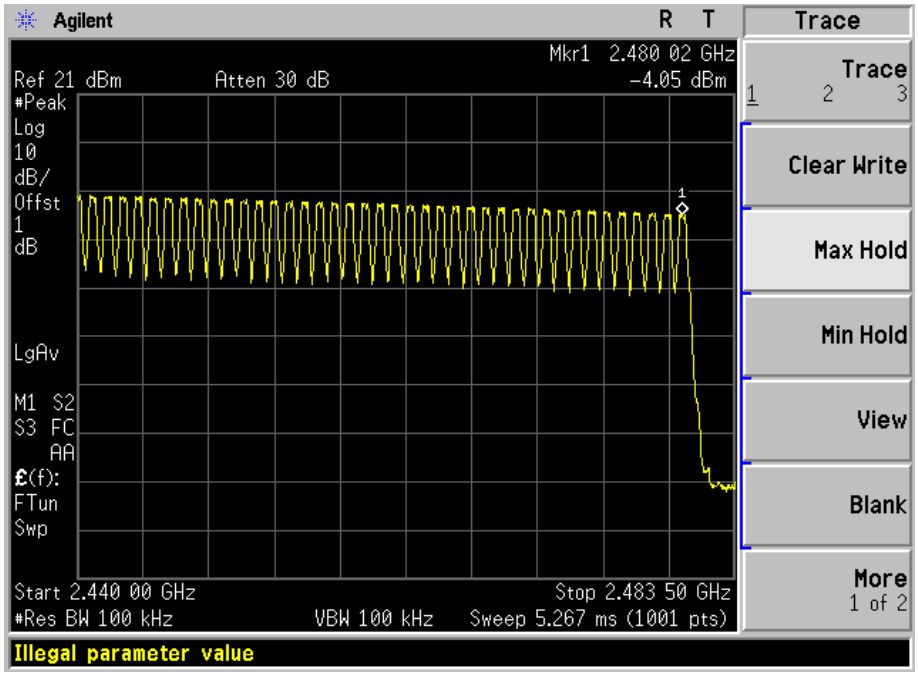
7.3 Measurement results

EUT	ETEREO N60	MODEL	BBCT2018-N60
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 3.7 V		

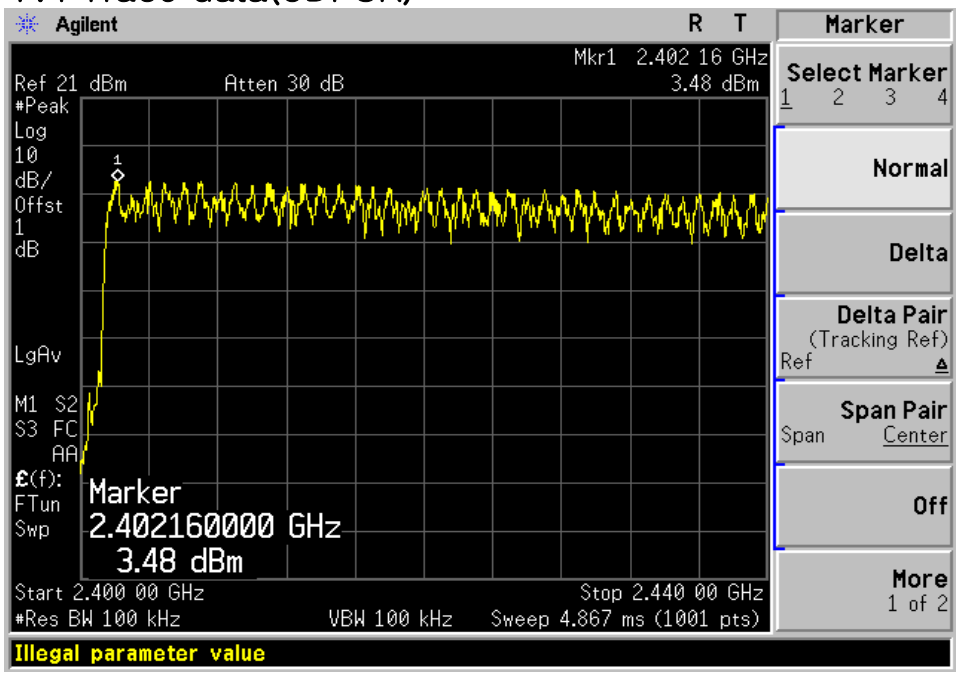
Number of CH	Limit (Number of CH)	PASS/FAIL
79	>15	PASS

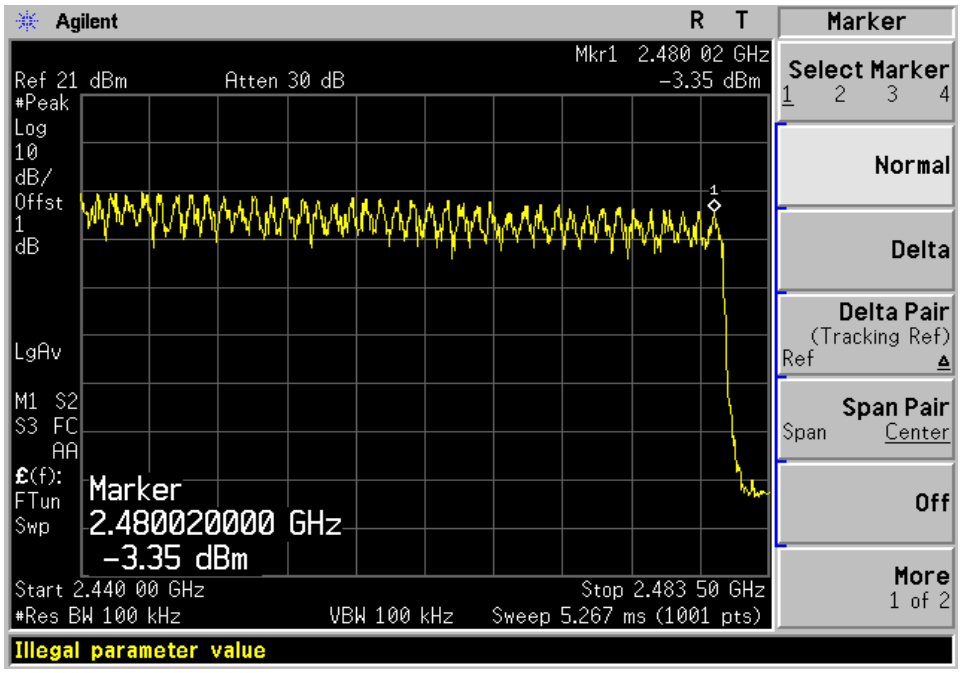
7.4 Trace data(GFSK)




Agilent
R T
Trace
Mkr1 2.480 02 GHz
Ref 21 dBm
Atten 30 dB
-4.05 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
More
1 of 2
Start 2.440 00 GHz
Stop 2.483 50 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 5.267 ms (1001 pts)
Illegal parameter value

7.4 Trace data(8DPSK)




Agilent
R T
Marker
Mkr1 2.480 02 GHz
Ref 21 dBm
Atten 30 dB
-3.35 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Marker
2.480020000 GHz
-3.35 dBm
Start 2.440 00 GHz
Stop 2.483 50 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 5.267 ms (1001 pts)
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
Illegal parameter value

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	2019-12-19
-Spectrum Analyzer <=> EUT	Loss: 1 dB		

8.3 Measurement results

EUT	ETEREO N60	MODEL	BBCT2018-N60
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 43 % R.H.
INPUT POWER	DC 3.7 V		

A. DH1 Mode
One peiod for each particular channel : 0.374 ms X 320.1 = 119.72 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	119.72	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.

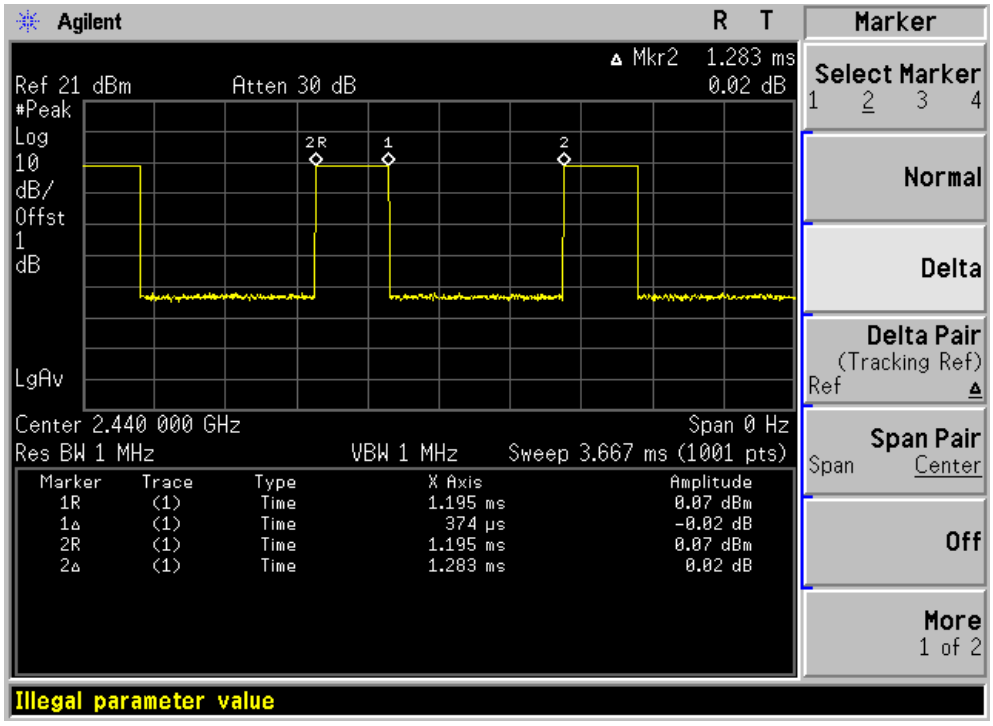
B. DH5 Mode
One peiod for each particular channel : 2.879 ms X 106.81 = 307.51 ms

Channel	Pulse Time(ms)	Limit(ms)	PASS/FAIL
39	307.51	400	PASS

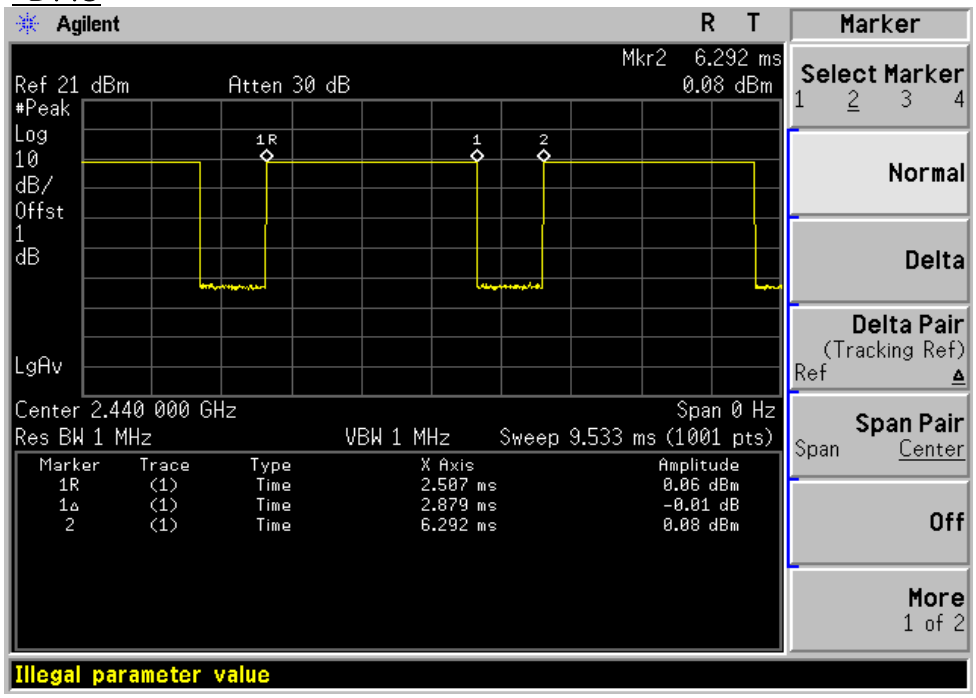
Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH5 data rate operates on a five-slot transmission and one-slot receiving basis. Thus there are 1600/(5+1)=266.7 transmissions per second. In one period for each particular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

8.4 Trace data

DH1



DH5


Agilent
R T
Marker
Mkr2 6.292 ms
Ref 21 dBm
Atten 30 dB
0.08 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
1R
1
2
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Center 2.440 000 GHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 9.533 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 2.507 ms 0.06 dBm
1Δ (1) Time 2.879 ms -0.01 dB
2 (1) Time 6.292 ms 0.08 dBm
Illegal parameter value

8DPSK

A. 1DH5 Mode

One peiod for each particular channel : 0.388 ms X 320.1 = 124.2 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	124.20	400	PASS

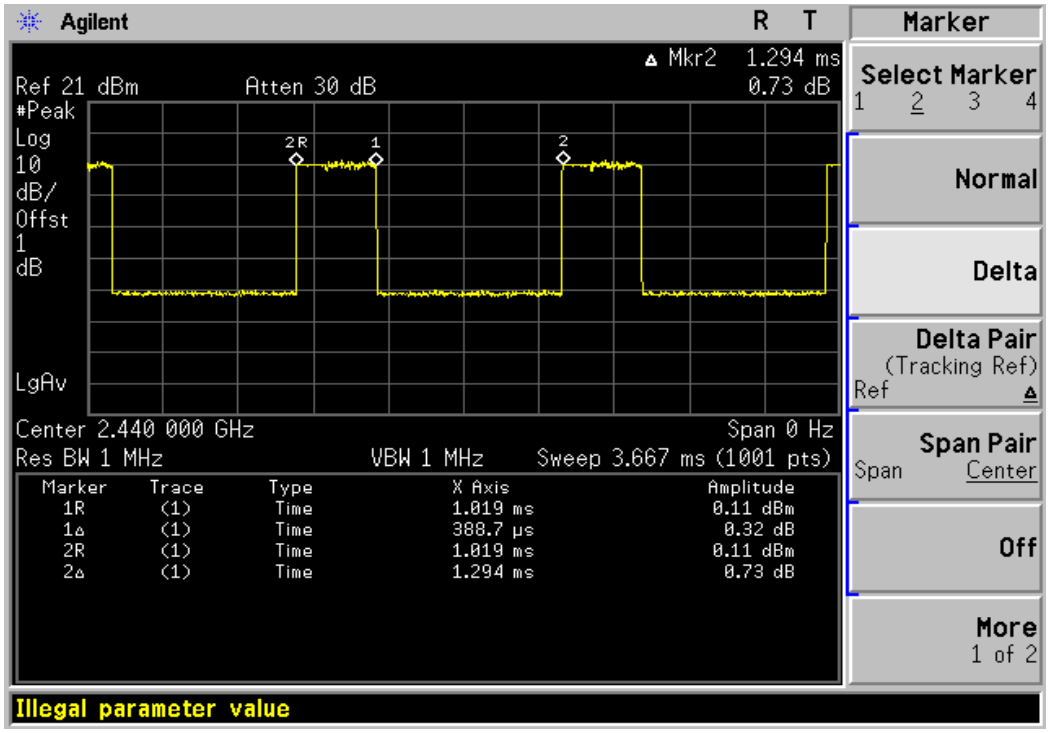
B. 3DH5 Mode

One peiod for each particular channel : 2.882 ms X 106.81 = 307.83 ms

Channel	Pulse Time(ms)	Limit (ms)	PASS/FAIL
39	307.83	400	PASS

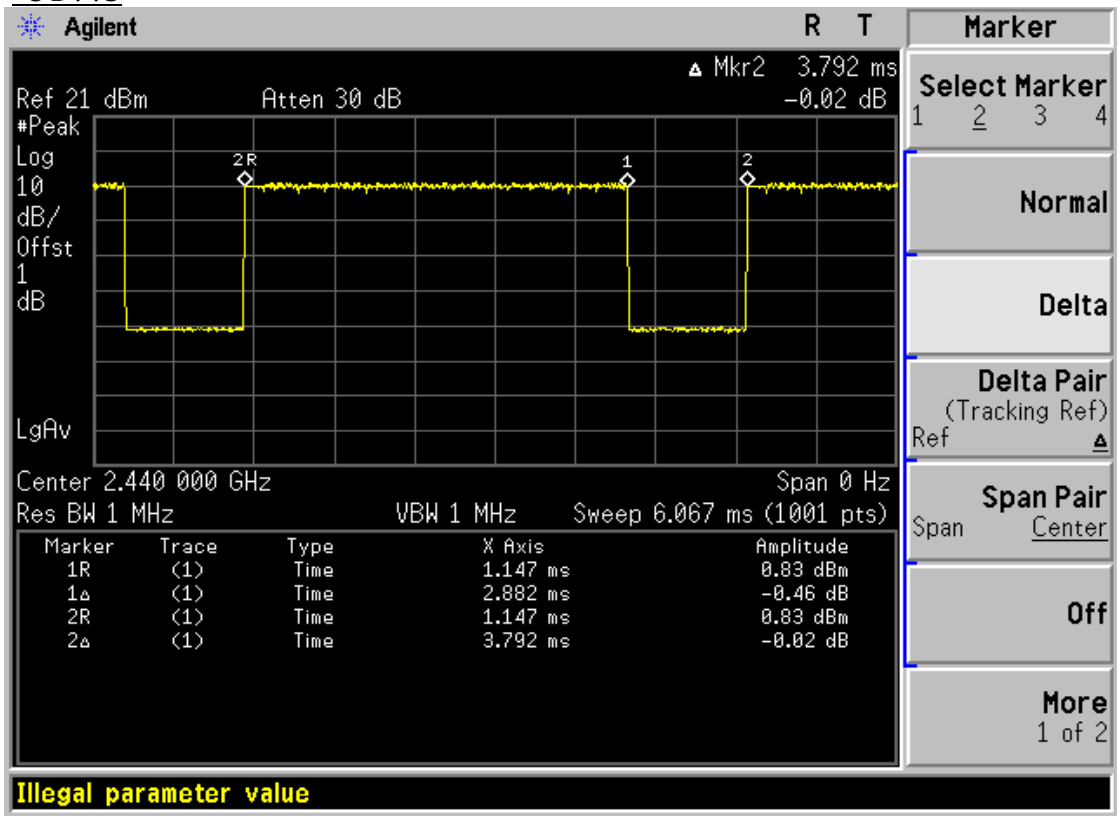
8.5 Trace data

1DH5



8DPSK

3DH5


Agilent
R T
Marker
Mkr2 3.792 ms
Ref 21 dBm
Atten 30 dB
-0.02 dB
#Peak
Log
10
dB/
Offst
1
dB
2R
1
2
LgAv
Center 2.440 000 GHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 6.067 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 1.147 ms 0.83 dBm
1Δ (1) Time 2.882 ms -0.46 dB
2R (1) Time 1.147 ms 0.83 dBm
2Δ (1) Time 3.792 ms -0.02 dB
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Illegal parameter value

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	2019-12-19
Spectrum Analyzer	FSV40	100939	2019-12-21
-Spectrum Analyzer <=> EUT	Loss: 1 dB		

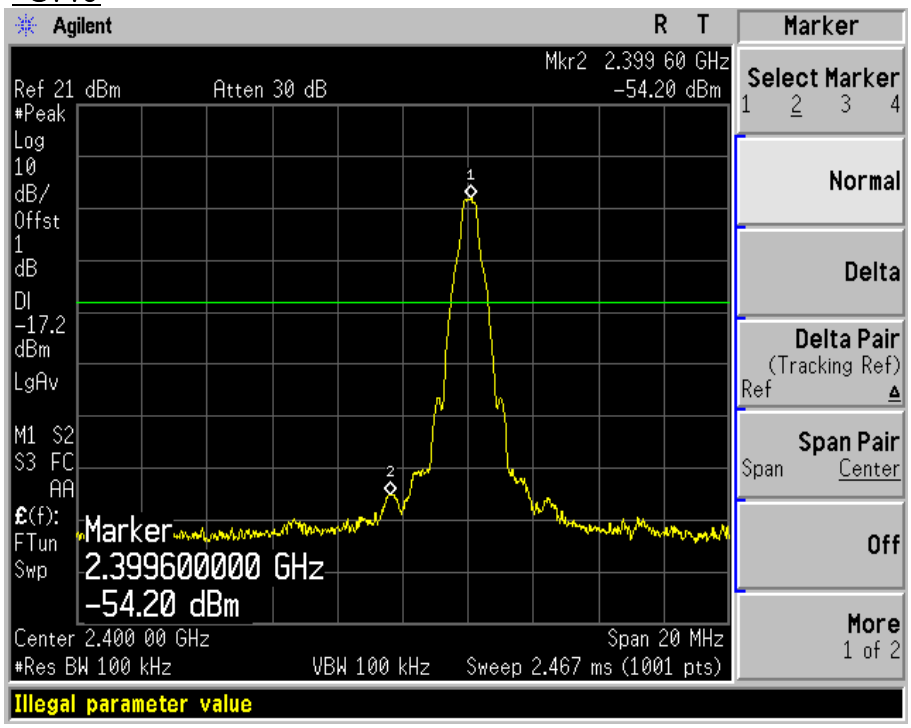
9.3 Measurement results of band-edge & out of emission

EUT	ETEREO N60	MODEL	BBCT2018-N60
MODE	GFSK,8DPSK	ENVIRONMENTAL CONDITION	23 ℃, 42 % R.H.
INPUT POWER	DC 3.7 V		

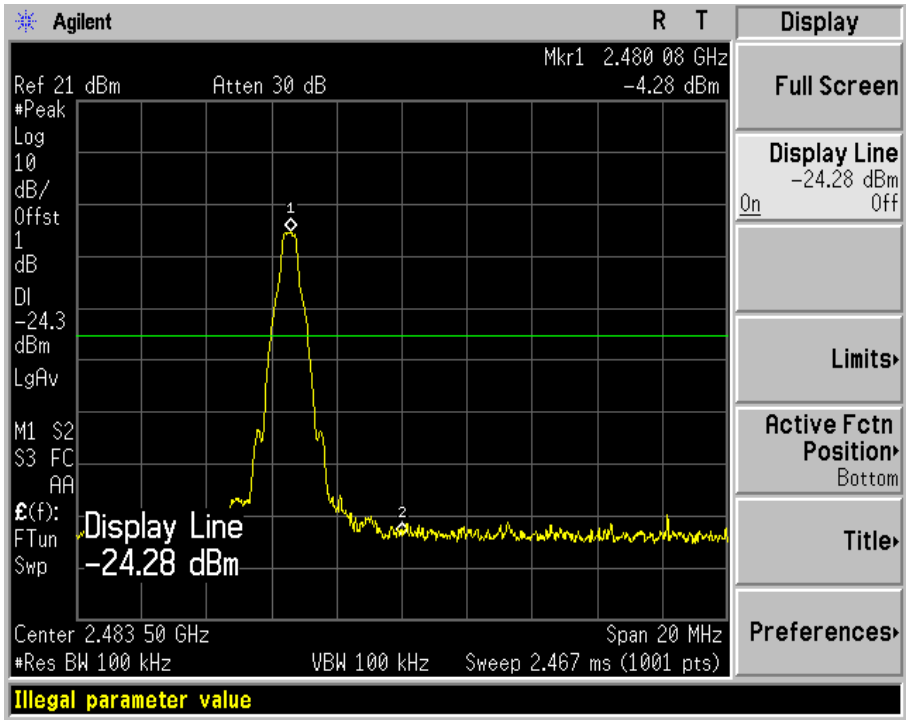
* Refer to attach spectrum analyzer data chart.

9.4 Trace data of band-edge & Out of Emission

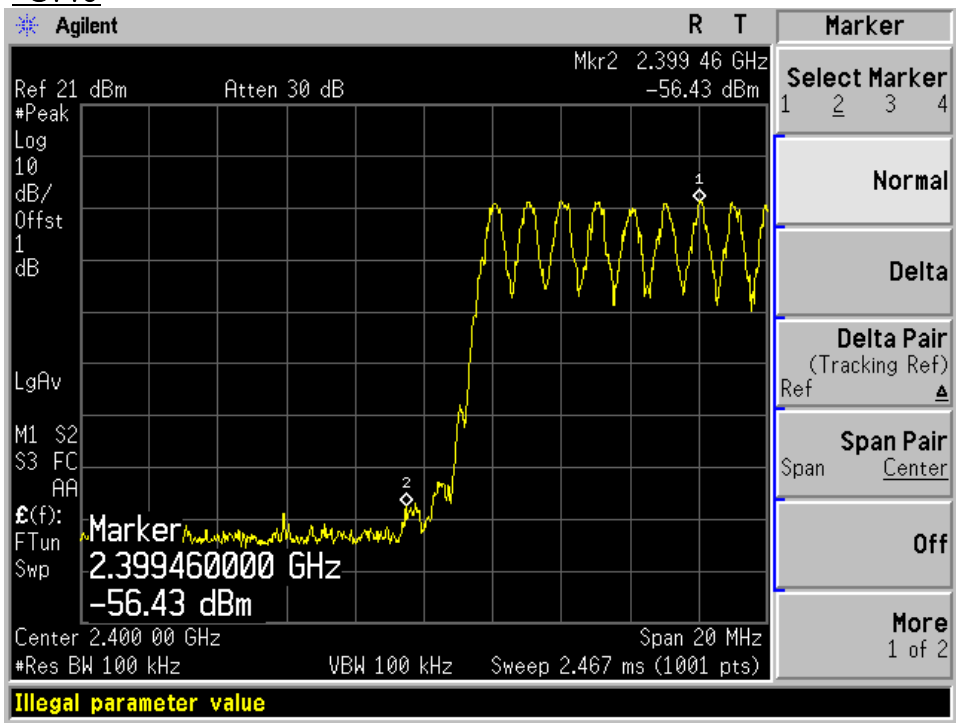
CH0



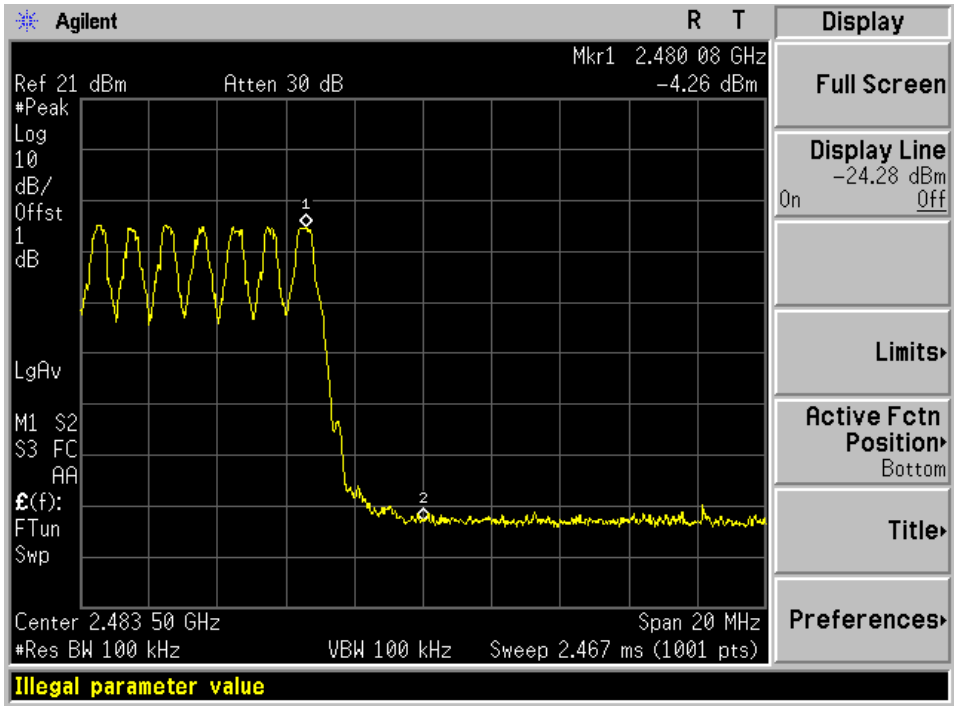
CH78



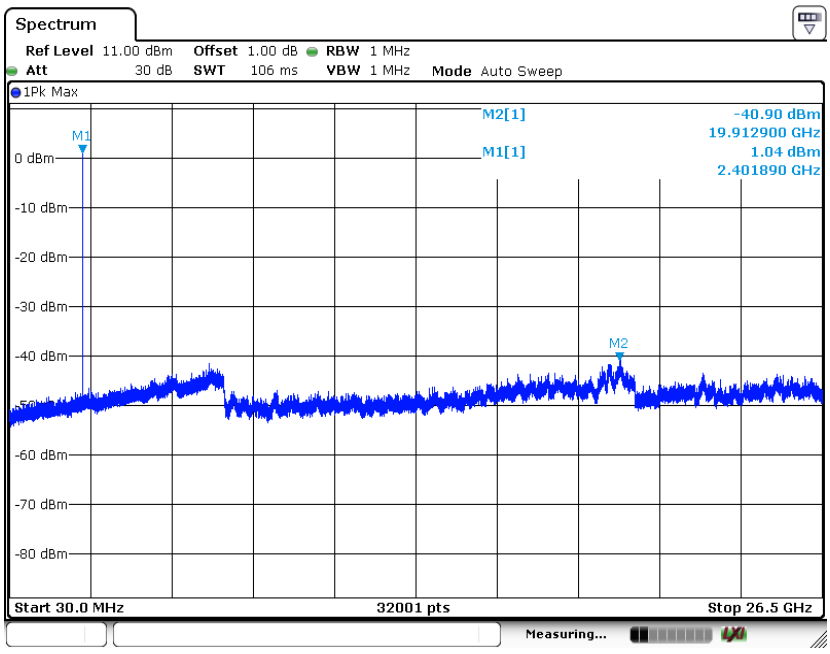
CH0


Agilent
R T
Marker
Mkr2 2.399 46 GHz
Ref 21 dBm
Atten 30 dB
-56.43 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Marker
2.399460000 GHz
-56.43 dBm
Center 2.400 00 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 2.467 ms (1001 pts)
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Illegal parameter value

CH78

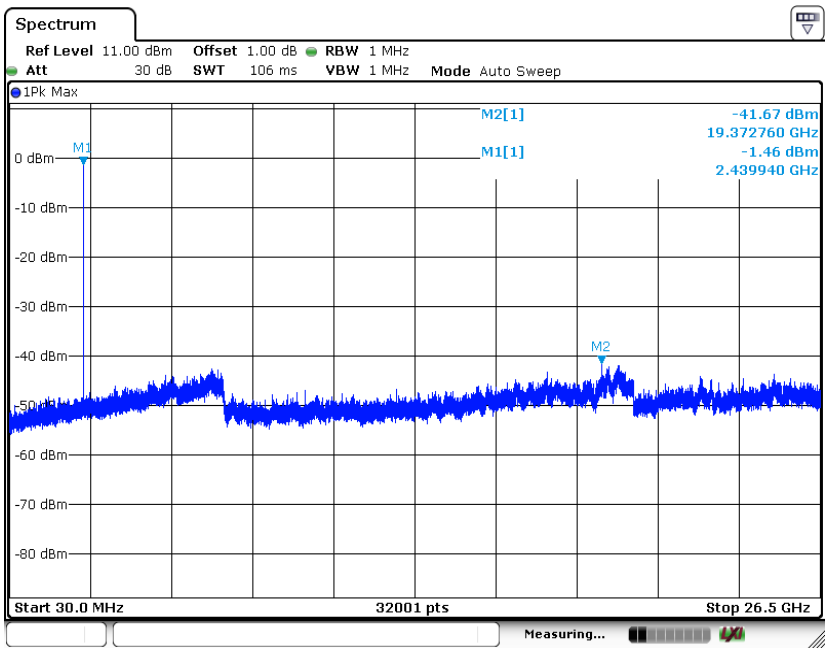

Agilent
R T
Display
Mkr1 2.480 08 GHz
Ref 21 dBm
Atten 30 dB
-4.26 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Center 2.483 50 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 2.467 ms (1001 pts)
Full Screen
Display Line
-24.28 dBm
On Off
Limits
Active Fctn
Position
Bottom
Title
Preferences
Illegal parameter value

CH0



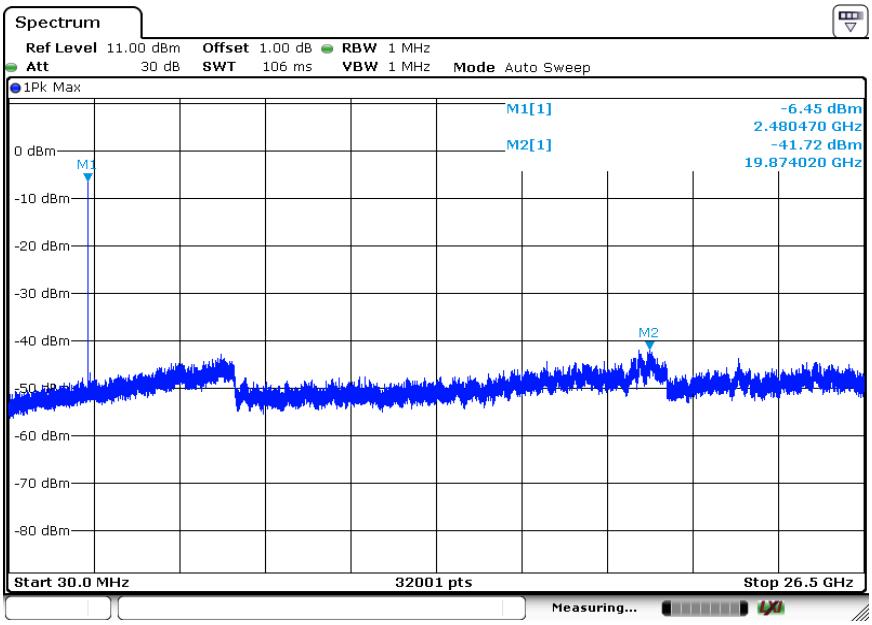
00211

CH38



00211

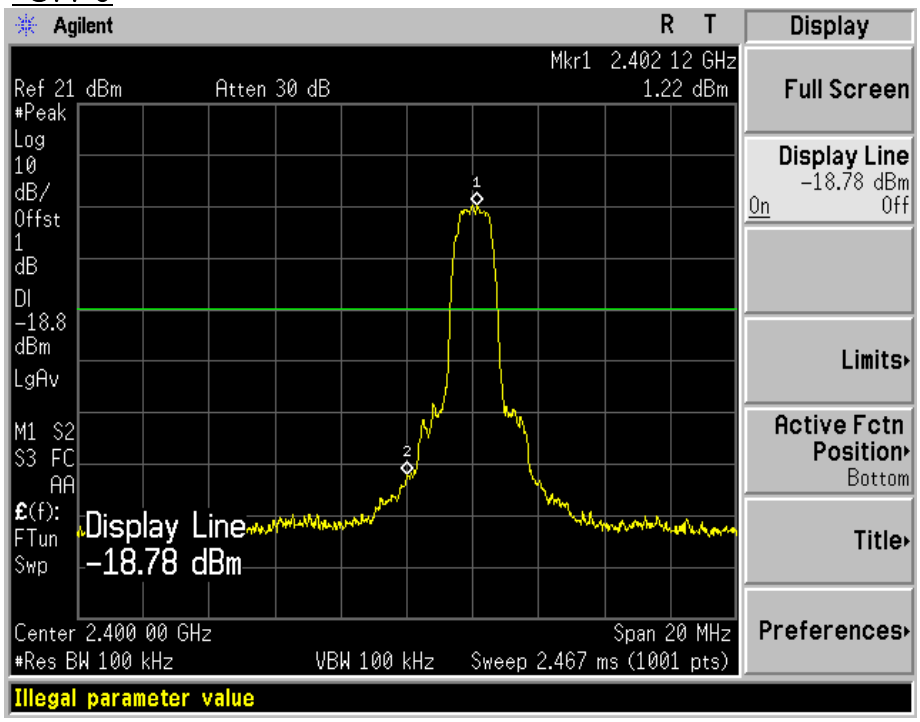
CH79


Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 1 MHz
Att 30 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M1[1] -6.45 dBm
2.480470 GHz
M2[1] -41.72 dBm
19.874020 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
M2
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

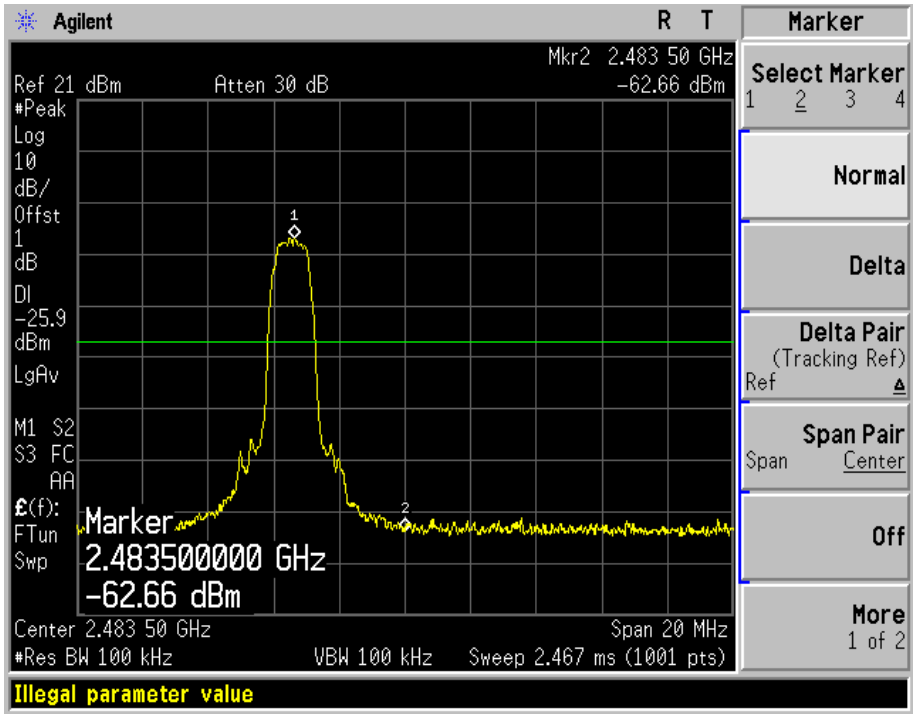
00211

8DPSK

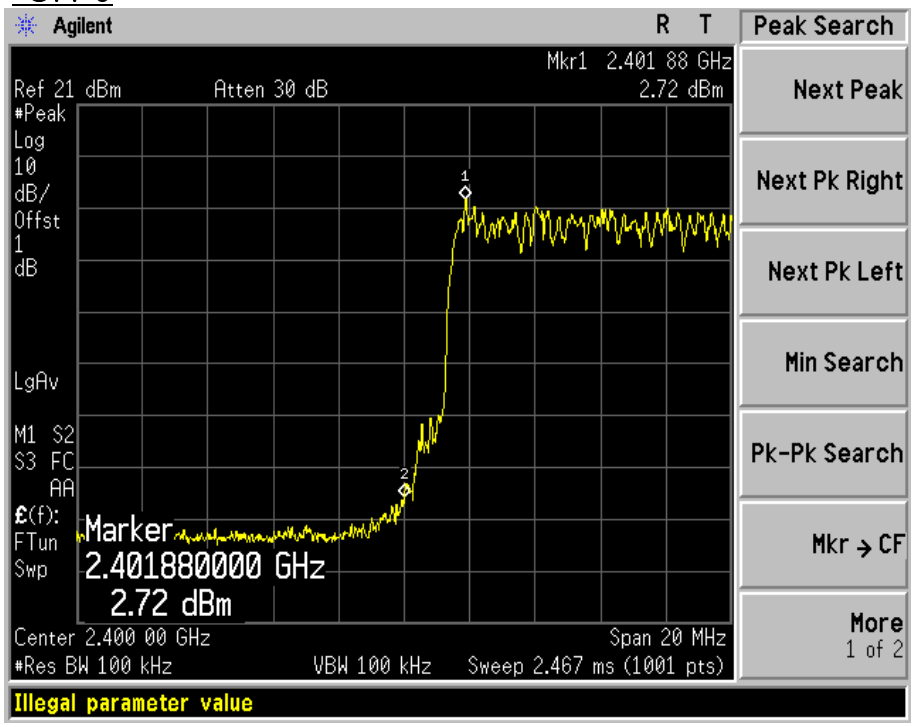
CH 0



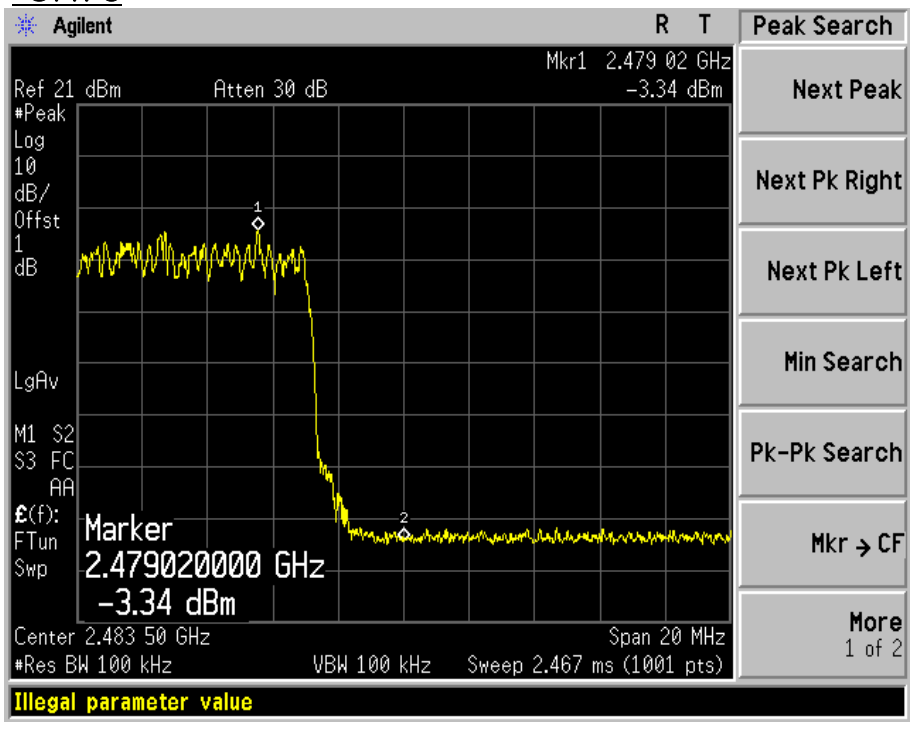
CH78



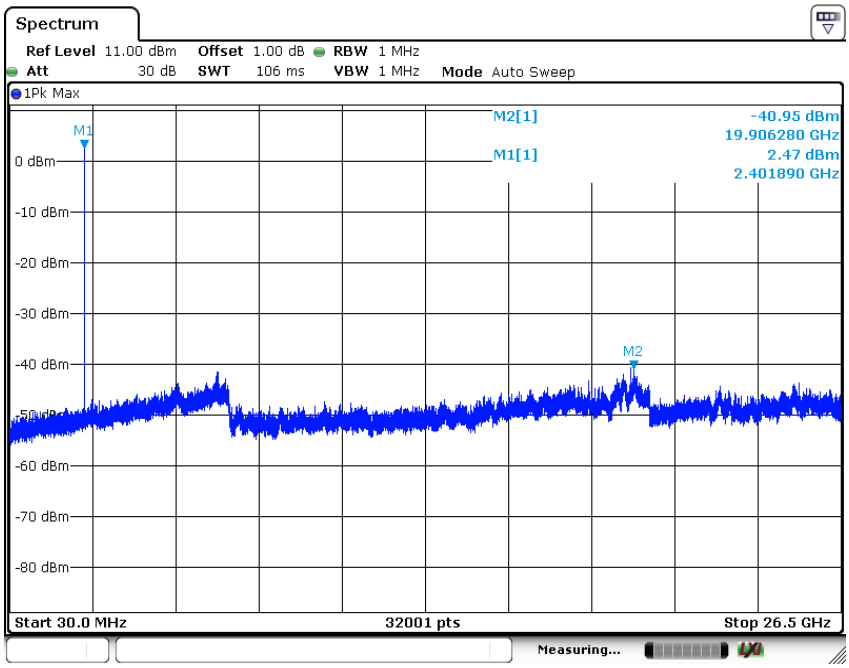
CH 0


Agilent
R T
Peak Search
Mkr1 2.401 88 GHz
Ref 21 dBm
Atten 30 dB
2.72 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Marker
2.401880000 GHz
2.72 dBm
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.400 00 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 2.467 ms (1001 pts)
Illegal parameter value

CH78

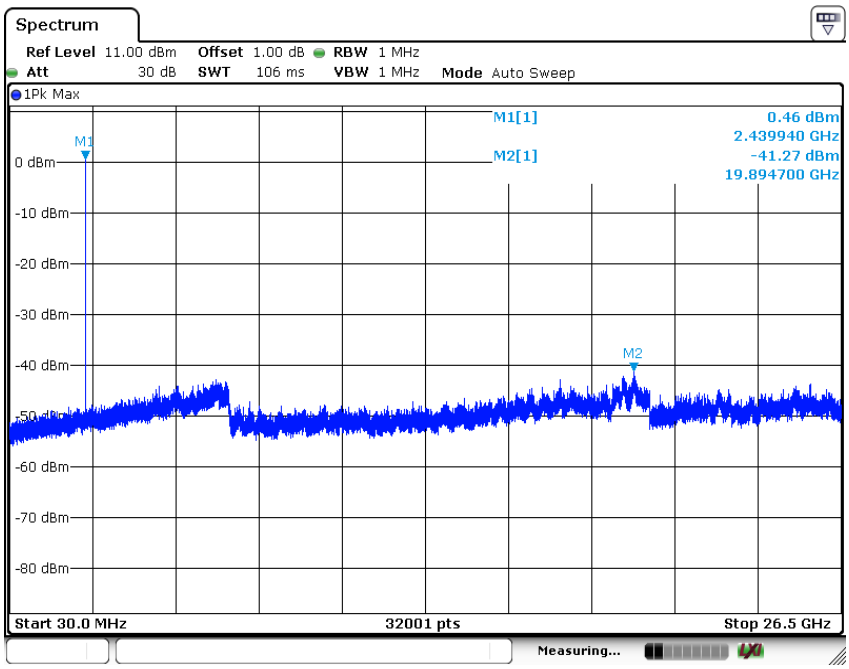

Agilent
R T
Peak Search
Mkr1 2.479 02 GHz
Ref 21 dBm
Atten 30 dB
-3.34 dBm
#Peak
Log
10
dB/
Offst
1
dB
LgAv
M1 S2
S3 FC
AA
£(f):
FTun
Swp
Marker
2.479020000 GHz
-3.34 dBm
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.483 50 GHz
Span 20 MHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 2.467 ms (1001 pts)
Illegal parameter value

CH 0



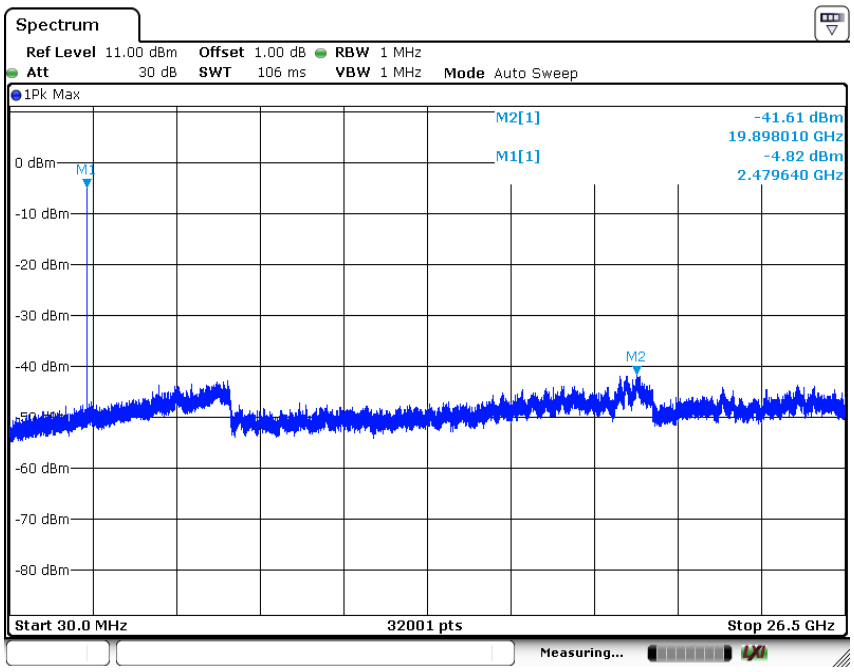
00211

CH38



00211

CH79


Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 1 MHz
Att 30 dB SWT 106 ms VBW 1 MHz Mode Auto Sweep
1Pk Max
M2[1] -41.61 dBm
19.898010 GHz
M1[1] -4.82 dBm
2.479640 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
M2
Start 30.0 MHz
32001 pts
Stop 26.5 GHz
Measuring...

00211

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	19-Oct-19
Logbicon Antenna	VULB 9168	SCHWARZBECK	193	15-Oct-19
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	AGILENT	3008A00581	22-Oct-19
Horn Antenna	BBHA9120D	SCHWARZBECK	469	30-Apr-20
Test Receiver	ESPI7	ROHDE & SCHWARZ	100185	22-Oct-19
Signal Analyzer	FSV40	ROHDE & SCHWARZ	100393	21-Dec-19
Turn Table	DT1500-S	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
Horn Antenna	BBHA 9170	SCHWARZBECK	752	1-Nov-19
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) : 21.4 ℃
Humidity (% R.H.) : 42.5 % R.H.

BT EDR Mode
Temperature (°C) : 21.4 ℃
Humidity (% R.H.) : 43.0 % 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 : 5-Aug-19 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)
34.80	23.84	V	1.0	12.63	1.05	40.00	37.51	2.49
218.20	22.33	H	1.6	10.67	2.52	46.00	35.52	10.48
305.30	17.23	H	1.5	13.62	2.97	46.00	33.83	12.17
408.00	14.70	H	1.4	15.81	3.43	46.00	33.94	12.06
456.00	18.51	V	1.4	17.04	3.66	46.00	39.22	6.78
881.30	7.78	H	1.0	23.32	5.13	46.00	36.23	9.77

Remark	H : Horizontal, V : Vertical Bluetooth (Basic Rate , 38 CH , 2 440 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

Estech
your best partner

10.3-1 Test Data for Bluetooth(Basic Rate)

Test Date : 7-Aug-19 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)									
2390.00	23.26	H	1.5	26.01	6.02		74.00	55.29	18.71
2390.00	23.04	V	1.5	26.01	6.02		74.00	55.07	18.93
4804.00	44.67	H	1.5	30.93	-27.04		74.00	48.56	25.44
4804.00	44.52	V	1.5	30.93	-27.04		74.00	48.41	25.59
Average (RBW:1 MHz VBW:1 kHz)									
2390.00	13.34	H	1.5	26.01	6.02	3.40	54.00	48.77	5.23
2390.00	13.28	V	1.5	26.01	6.02	3.40	54.00	48.71	5.29
4804.00	33.67	H	1.5	30.93	-27.04	3.40	54.00	40.96	13.04
4804.00	33.34	V	1.5	30.93	-27.04	3.40	54.00	40.63	13.37

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH0 (2 402 MHz) *This test was radiated up to 26.5 GHz but no noise was measured. *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 = 296.408 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 ' = 6.292 ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -24.024 dB

10.3-2 Test Data for Bluetooth(Basic Rate)

Test Date : 7-Aug-19 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)									
4880.00	44.32	H	1.5	30.60	-26.82		74.00	48.10	25.90
4880.00	44.18	V	1.5	30.60	-26.82		74.00	47.96	26.04
Average (RBW:1 MHz VBW:1 kHz)									
4880.00	32.77	H	1.5	30.60	-26.82	3.40	54.00	39.95	14.05
4880.00	32.59	V	1.5	30.60	-26.82	3.40	54.00	39.77	14.23

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH38 (2 440 MHz) *This test was radiated up to 26.5 GHz but no noise was measured. *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 = 296.408 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 ' = 6.292 ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -24.024 dB

10.3-3 Test Data for Bluetooth(Basic Rate)

Test Date : 7-Aug-19 Measurement Distance : 3 m

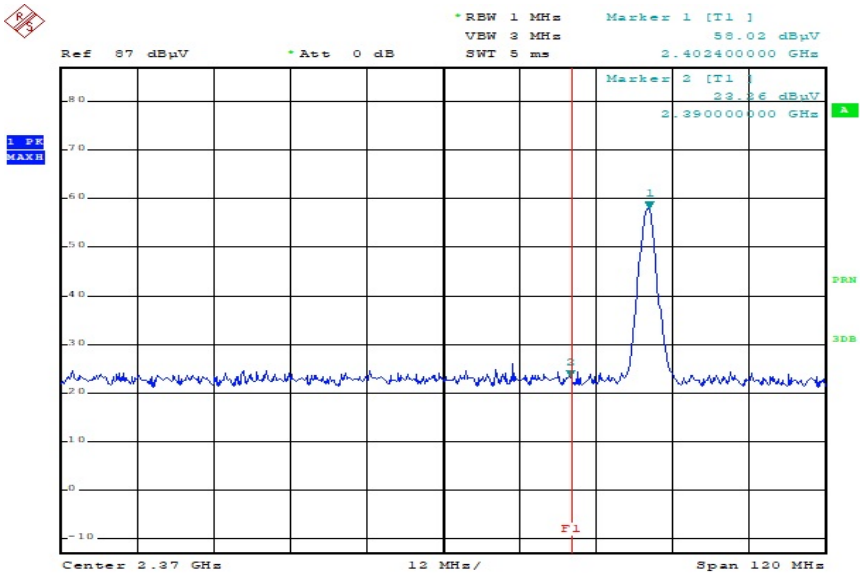
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	24.31	H	1.5	26.30	6.14		74.00	50.61	23.39
2483.50	25.83	V	1.7	26.30	6.14		74.00	58.27	15.73
4960.00	43.77	H	1.5	30.70	-26.70		74.00	47.77	26.23
4960.00	44.13	V	1.7	30.70	-26.70		74.00	48.13	25.87
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	13.38	H	1.5	26.30	6.14	3.40	54.00	49.21	4.79
2483.50	15.82	V	1.7	26.30	6.14	3.40	54.00	51.65	2.35
4960.00	33.43	H	1.5	30.70	-26.70	3.40	54.00	40.83	13.17
4960.00	33.96	V	1.7	30.70	-26.70	3.40	54.00	41.36	12.64

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH78 (2 480 MHz) *This test was radiated up to 26.5 GHz but no noise was measured. *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 = 296.408 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 ' = 6.292 ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -24.024 dB

10.4 Restricted Band Edges for BT(Basic Rate)

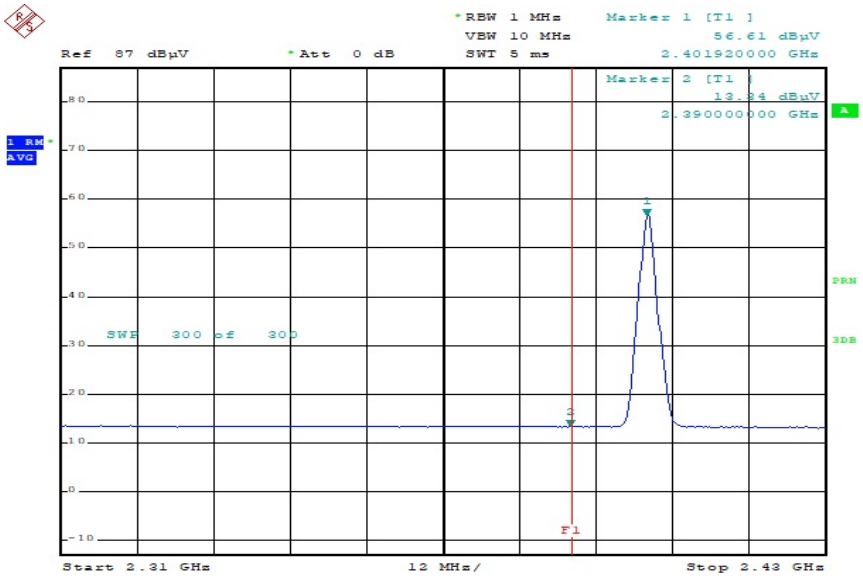
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal



Comment: 00211_BDR_PEAK_CH0_HOR

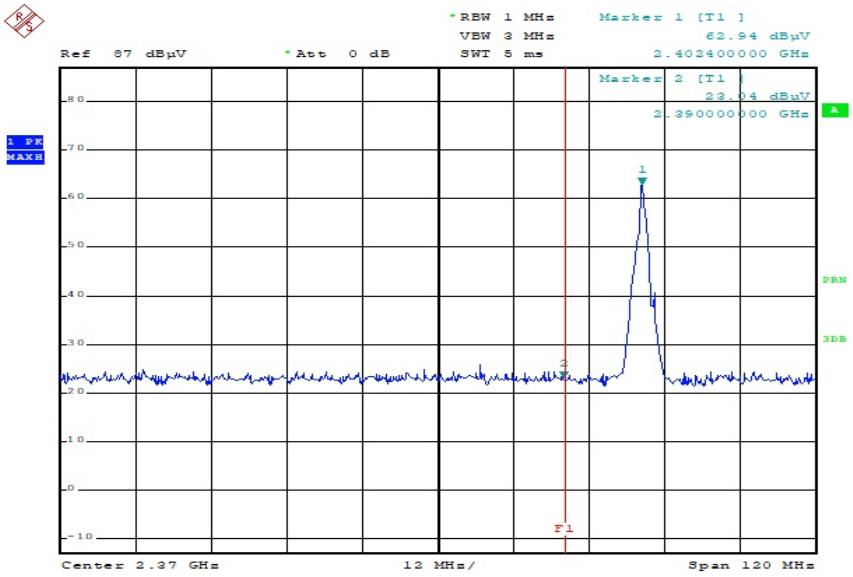
Detector mode:Average Polarity:Horizontal



Comment: 00211_BDR_AV_CH0_HOR

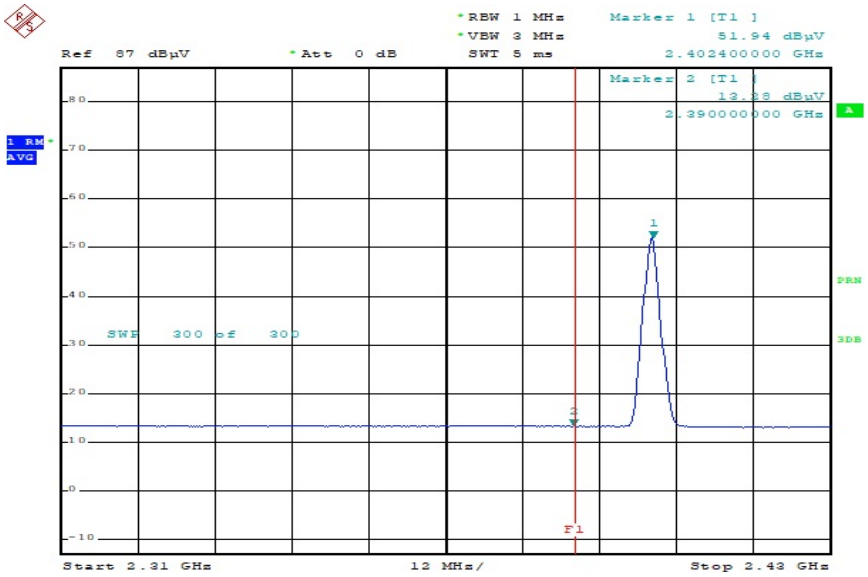
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical



Comment: 00211_BDR_PEAK_CH0_VER

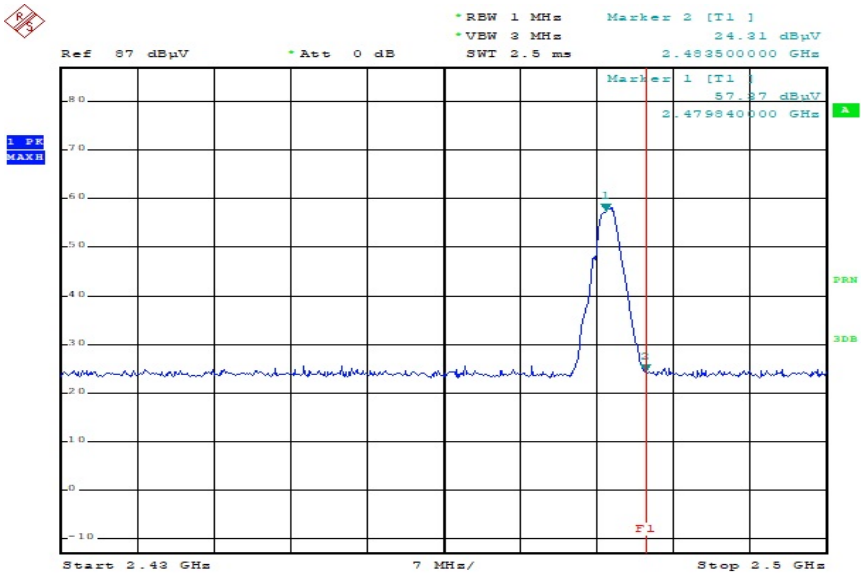
Detector mode:Average Polarity:Vertical



Comment: 00211_BDR_AV_CH0_VER

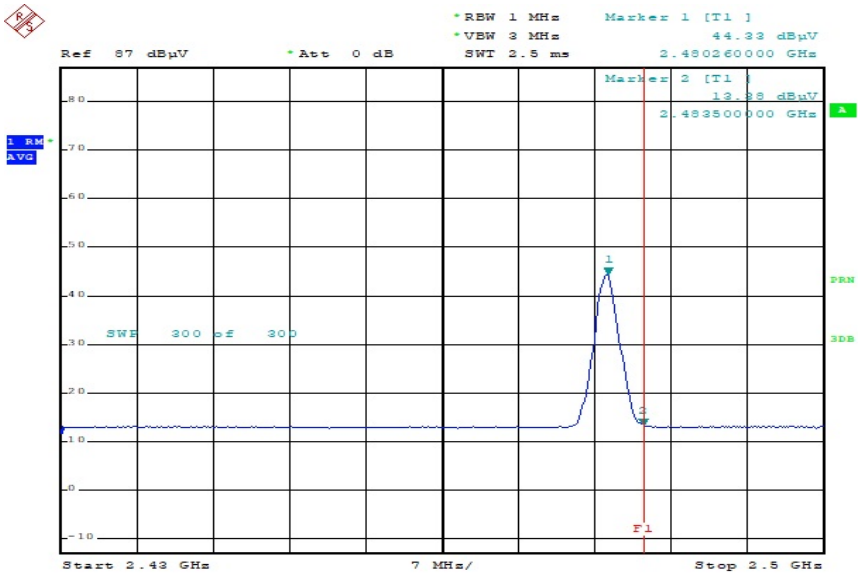
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal



Comment: 00211_BDR_PEAK_CH39_HOR

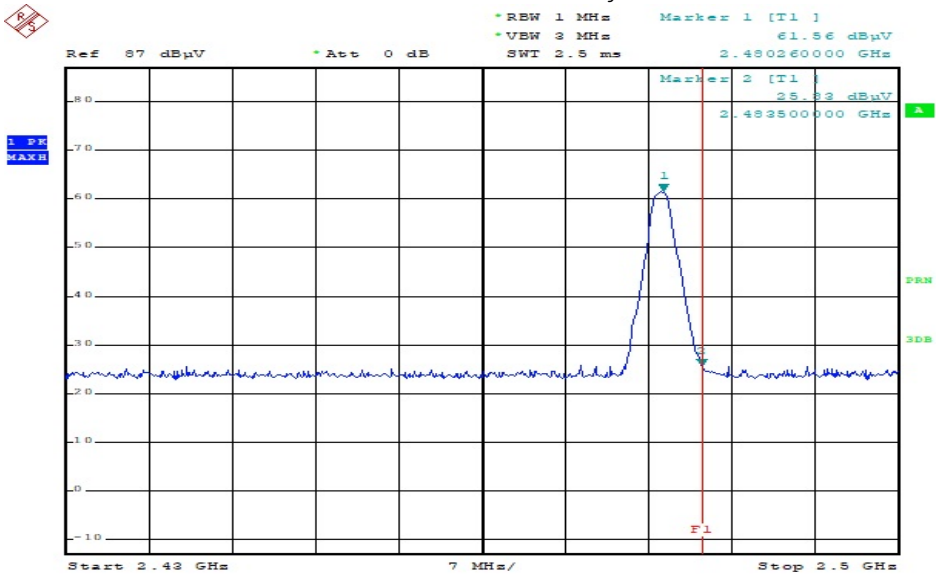
Detector mode:Average Polarity:Horizontal



Comment: 00211_BDR_AV_CH39_HOR

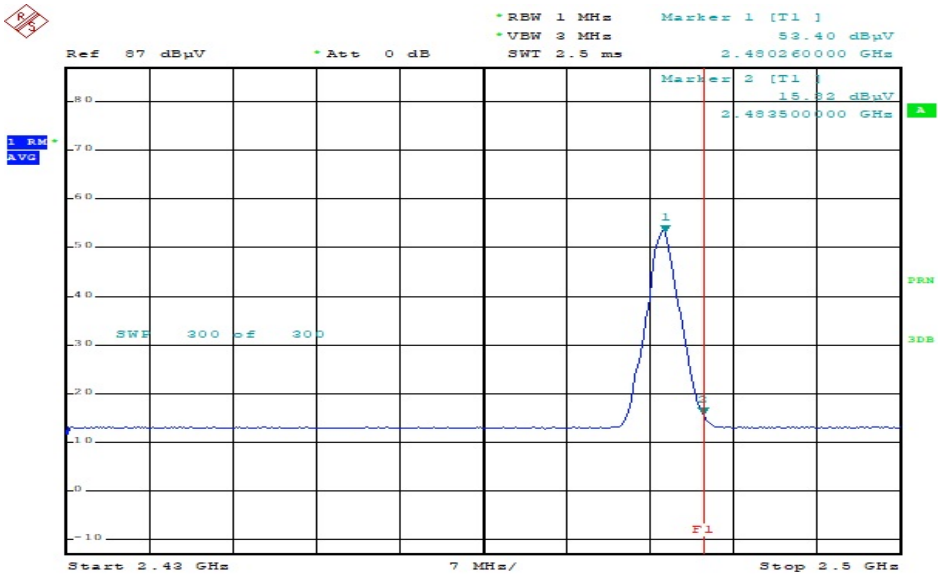
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Comment: 00211_BDR_PEAK_CH39_VER

Detector mode:Average Polarity:Vertical



Comment: 00211_BDR_AV_CH39_VER

10.5 Test Data for Bluetooth (EDR)

Test Date : 5-Aug-19 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)
34.60	22.91	V	1.0	12.62	1.04	40.00	36.57	3.43
85.00	25.89	H	1.6	8.63	1.60	40.00	36.11	3.89
92.20	26.87	H	1.5	8.04	1.66	43.50	36.57	6.93
402.00	17.90	H	1.2	15.67	3.41	46.00	36.98	9.02
456.00	18.73	V	1.4	17.04	3.66	46.00	39.44	6.56
885.10	8.33	H	1.0	23.36	5.15	46.00	36.84	9.16

Remark	H : Horizontal, V : Vertical Bluetooth (EDR , 38 CH , 2 440 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

Estech
your best partner

10.5-1 Test Data for Bluetooth(EDR)

Test Date : 8-Aug-19 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)									
2390.00	22.76	H	1.6	26.01	6.02		74.00	54.79	19.21
2390.00	23.50	V	1.7	26.01	6.02		74.00	55.53	18.47
4804.00	42.96	H	1.6	30.93	-27.04		74.00	46.85	27.15
4804.00	43.50	V	1.7	30.93	-27.04		74.00	47.39	26.61
Average (RBW:1 MHz VBW:1 kHz)									
2390.00	13.80	H	1.6	26.01	6.02	1.19	54.00	47.02	6.98
2390.00	13.18	V	1.7	26.01	6.02	1.19	54.00	46.40	7.60
4804.00	33.23	H	1.6	30.93	-27.04	1.19	54.00	38.31	15.69
4804.00	34.49	V	1.7	30.93	-27.04	1.19	54.00	39.57	14.43

Remark	
	H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH0 (2 402 MHz) *This test was radiated up to 26.5 GHz but no noise was measured. *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 = 296.25 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 ' = 3.79ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 28.427 dB

10.5-2 Test Data for Bluetooth(EDR)

Test Date : 8-Aug-19 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)									
4880.00	44.91	H	1.5	31.15	-26.82		74.00	49.24	24.76
4880.00	44.85	V	1.7	31.15	-26.82		74.00	49.18	24.82
Average(RBW:1 MHz VBW:1 kHz)									
4880.00	33.79	H	1.5	31.15	-26.82	1.19	54.00	39.31	14.69
4880.00	33.60	V	1.7	31.15	-26.82	1.19	54.00	39.12	14.88

Remark

H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH38 (2 440 MHz)
*This test was radiated up to 26.5 GHz but no noise was measured.
*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 = 296.25 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 ' = 3.79ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 28.427 dB

10.5-3 Test Data for Bluetooth(EDR)

Test Date : 8-Aug-19 Measurement Distance : 3 m

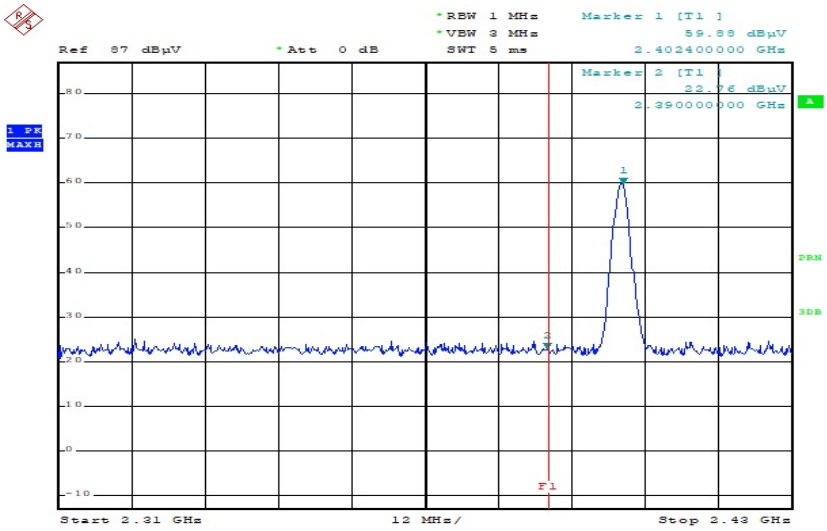
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	26.38	H	1.5	26.30	6.20		74.00	58.88	15.12
2483.50	26.66	V	1.7	26.30	6.20		74.00	59.16	14.84
4960.00	43.22	H	1.5	31.38	-26.70		74.00	47.90	26.10
4960.00	43.65	V	1.7	31.38	-26.70		74.00	48.33	25.67
Average (RBW:1 MHz VBW:1 kHz)									
2483.50	18.71	H	1.5	26.30	6.20	1.19	54.00	52.40	1.60
2483.50	14.86	V	1.7	26.30	6.20	1.19	54.00	48.55	5.45
4960.00	33.15	H	1.5	31.19	-26.70	1.19	54.00	38.83	15.17
4960.00	32.52	V	1.7	31.19	-26.70	1.19	54.00	38.20	15.80

Remark	H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH78 (2 480 MHz) *This test was radiated up to 26.5 GHz but no noise was measured. *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 = 296.25 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 ' = 3.79ms d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 28.427 dB

10.6 Restricted Band Edges for BT(EDR)

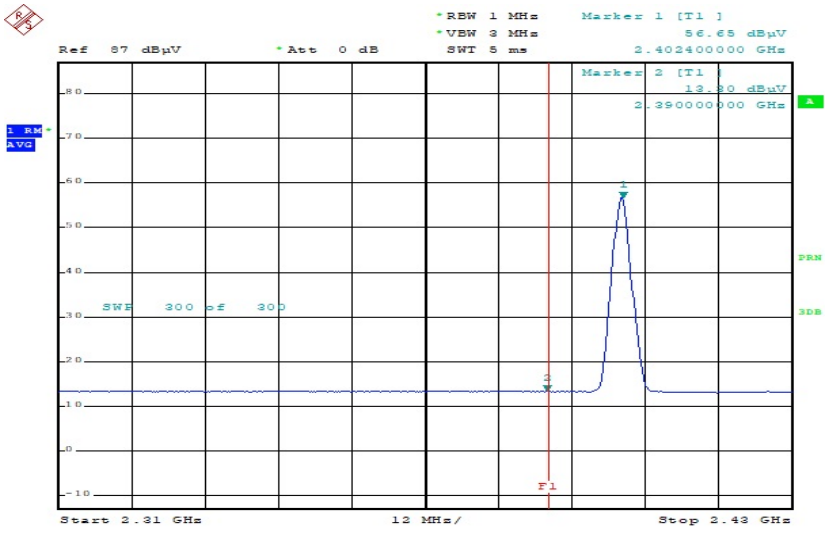
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal



Comment: 00211_EDR_PEAK_CH0_HOR

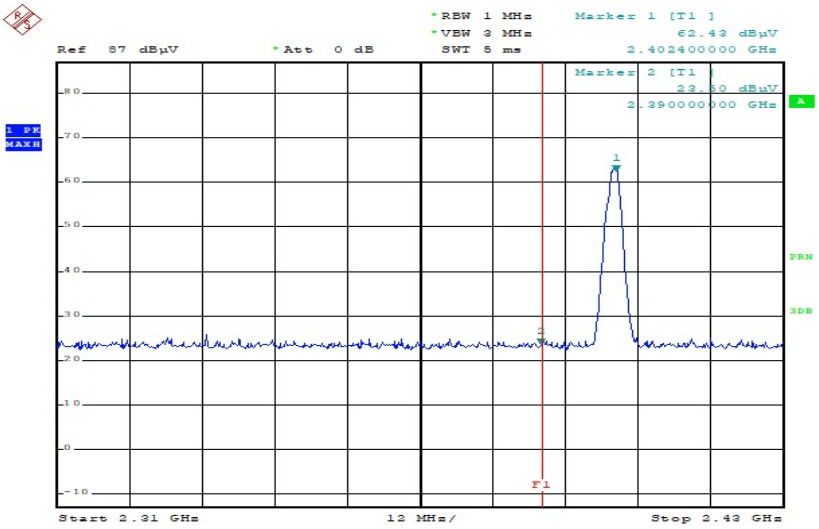
Detector mode:Average Polarity:Horizontal



Comment: 00211_EDR_AV_CH0_HOR

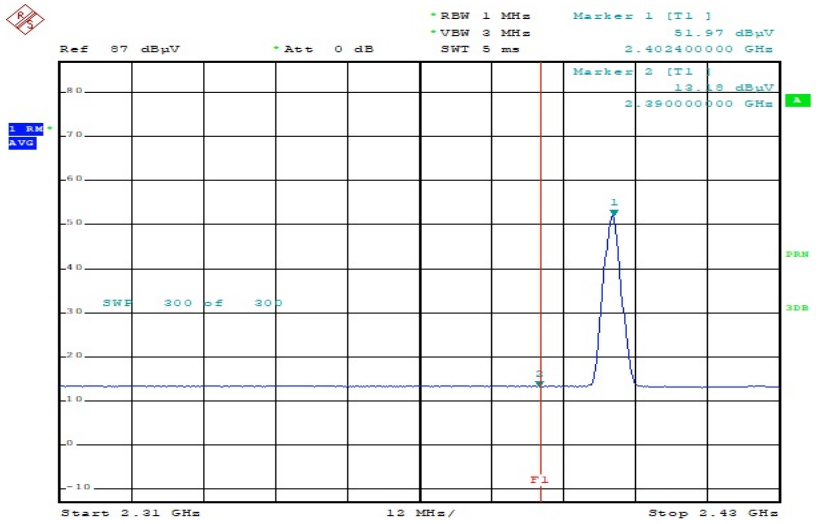
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical



Comment: 00211_EDR_PEAK_CH0_VER

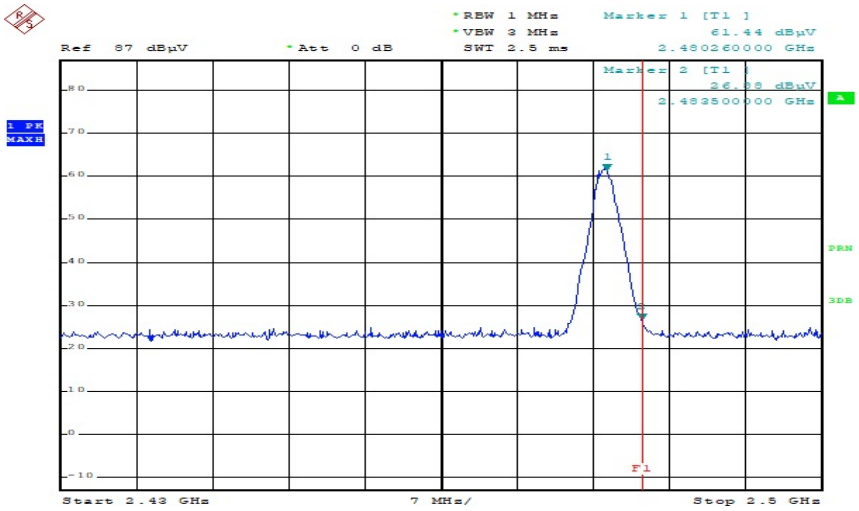
Detector mode:Average Polarity:Vertical



Comment: 00211_EDR_AV_CH0_VER

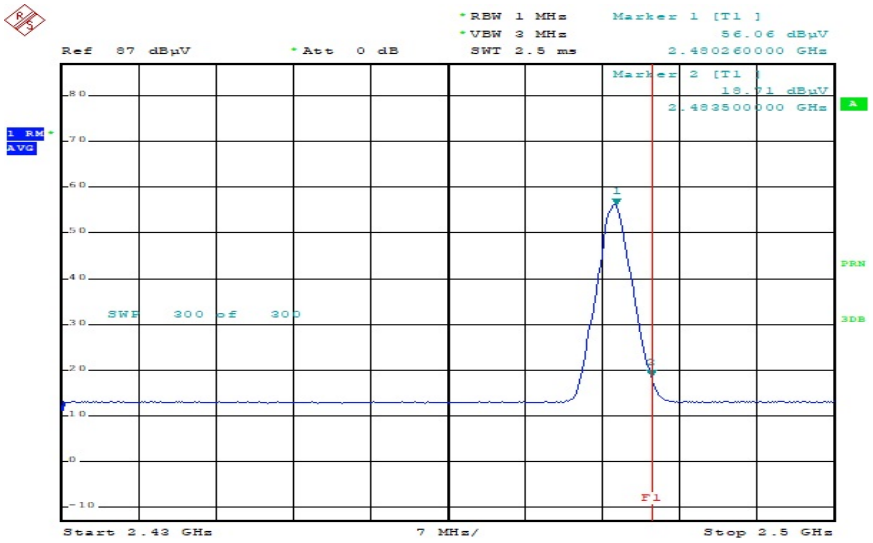
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal



Comment: 00211_EDR_PEAK_CH39_HOR

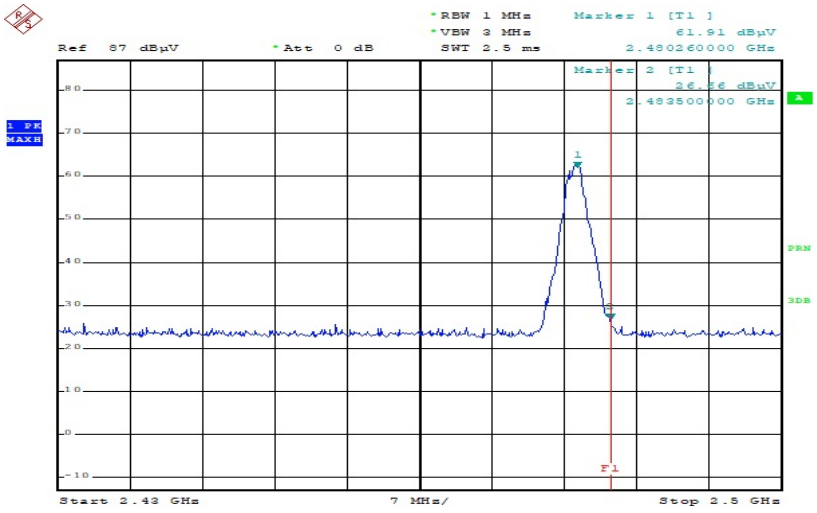
Detector mode:Average Polarity:Horizontal



Comment: 00211_EDR_AV_CH39_HOR

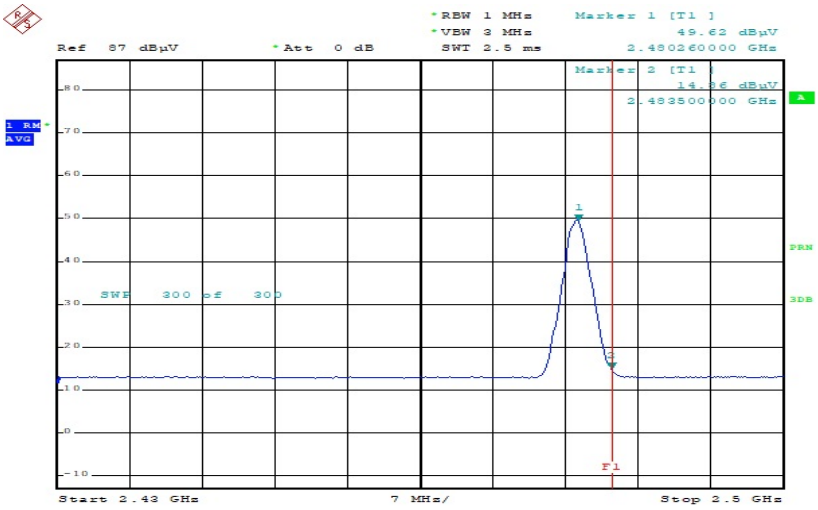
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



Comment: 00211_EDR_PEAK_CH39_VER

Detector mode:Average Polarity:Vertical



Comment: 00211_EDR_AV_CH39_VER

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	24-Oct-19
LISN	ESH3-Z5	Rohde & Schwarz	836679/025	24-Oct-19
Pulse Limiter	ESH3Z2	Rohde & Schwarz	NONE	23-Oct-19

11.2 Environmental Condition

Test Place : Shielded Room

BT Basic Mode

Temperature (°C) : 22.4 ℃

Humidity (% R.H.) : 48.4 % R.H.

BT EDR Mode

Temperature (°C) : 22.4 ℃

Humidity (% R.H.) : 48.4 % R.H.

11.3-1 Test Data for Bluetooth (Basic Rate)

Test Date : 9-Aug-19

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	65.84	50.87	51.09	55.84	35.74	35.96
0.23	0.10	0.13	N	62.63	43.40	43.63	52.63	26.61	26.84
0.31	0.10	0.14	N	60.00	34.88	35.12	50.00	22.48	22.72
0.33	0.10	0.14	N	59.38	31.53	31.77	49.38	20.66	20.90
18.07	0.55	0.42	H	60.00	29.72	30.69	50.00	19.98	20.95
29.44	0.55	0.49	H	60.00	34.45	35.49	50.00	26.29	27.33

Remark	H : Hot Line, N : Neutral Line TEST MODE : CH38 (2 440 MHz) *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading

11.3-2 Test Data for Bluetooth (EDR)

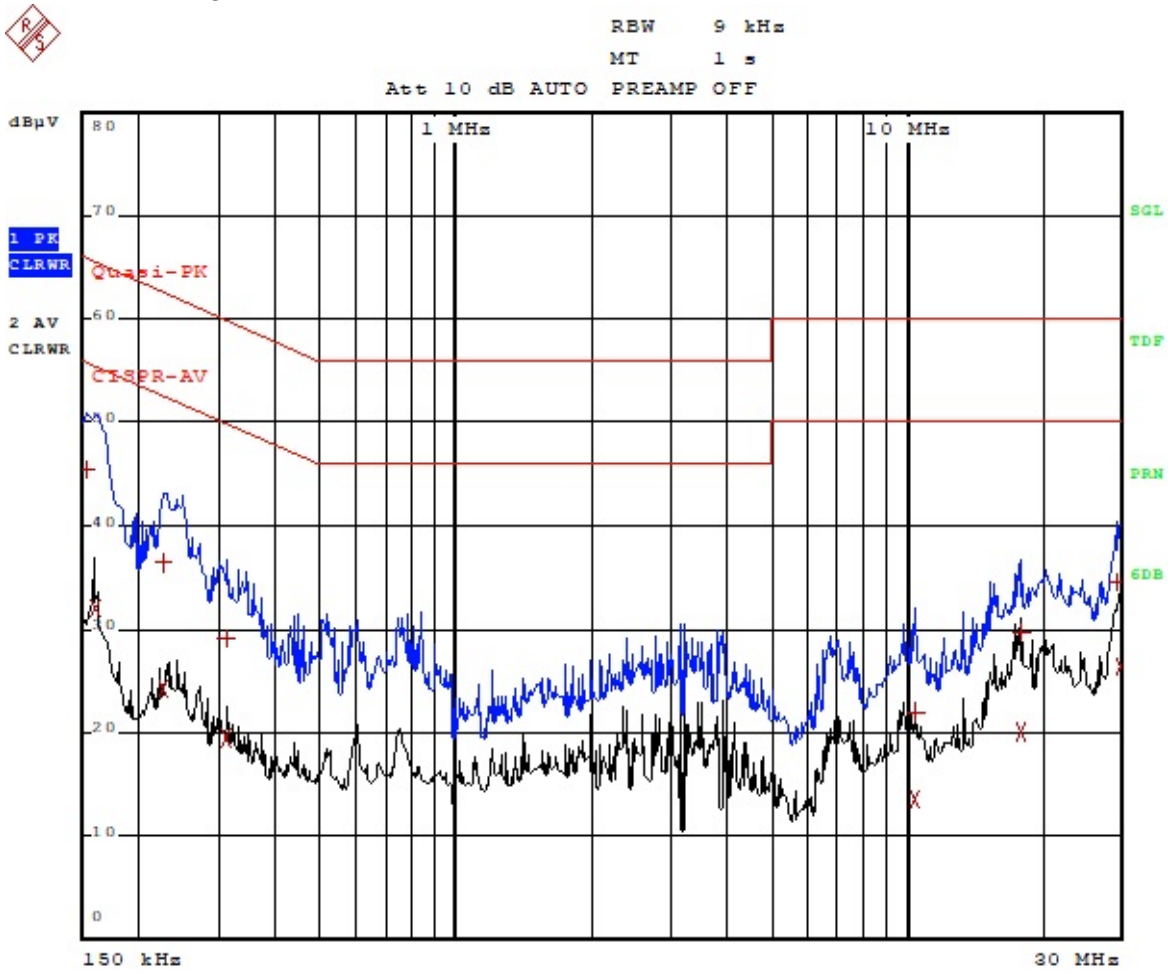
Test Date : 9-Aug-19

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	46.92	47.14	56.00	28.86	29.08
0.19	0.10	0.13	N	64.04	42.31	42.54	54.04	26.12	26.35
0.23	0.10	0.13	H	62.31	32.88	33.11	52.31	23.30	23.53
0.27	0.10	0.13	N	61.12	37.36	37.60	51.12	24.59	24.83
0.29	0.10	0.14	H	60.50	33.27	33.51	50.50	19.18	19.42
0.70	0.11	0.12	H	56.00	27.99	28.22	46.00	24.54	24.77
Remark	H : Hot Line, N : Neutral Line TEST MODE : CH38 (2 440 MHz) *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

Appendix 1. Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 38

*HOT

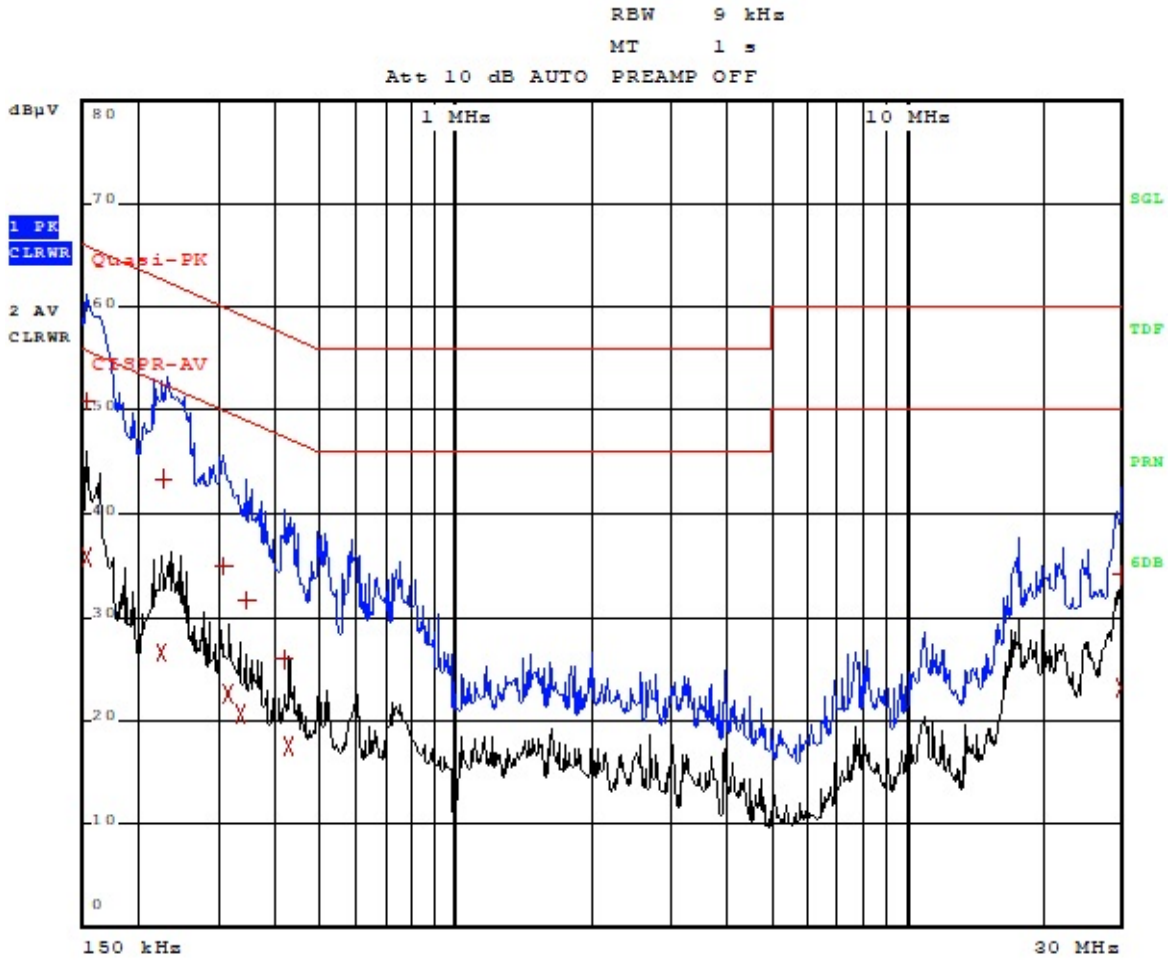


Comment: 00211_HOT

Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 38

*NEUTRAL

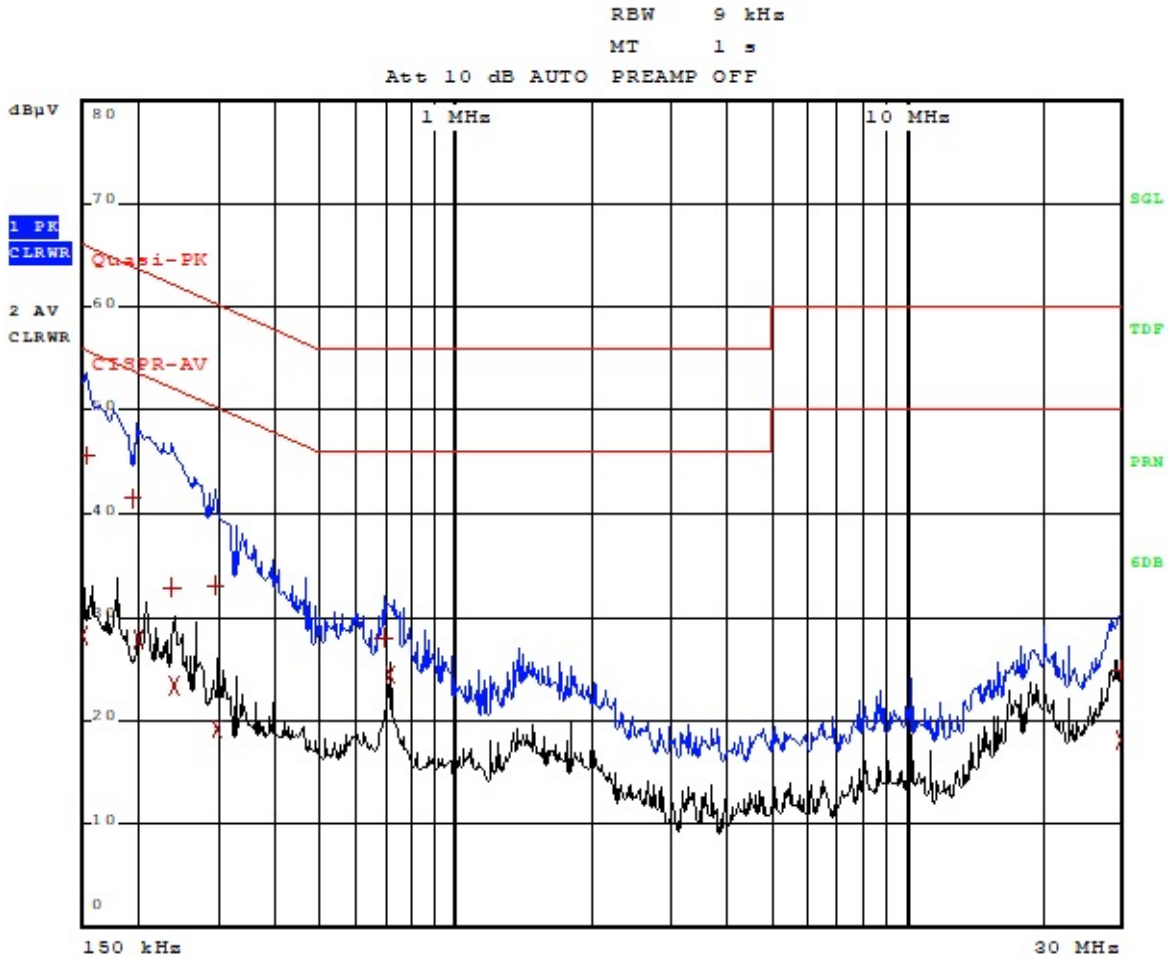


Comment: 00211_NEUTRAL

Special diagram for Bluetooth EDR

Bluetooth – CH 38

*HOT

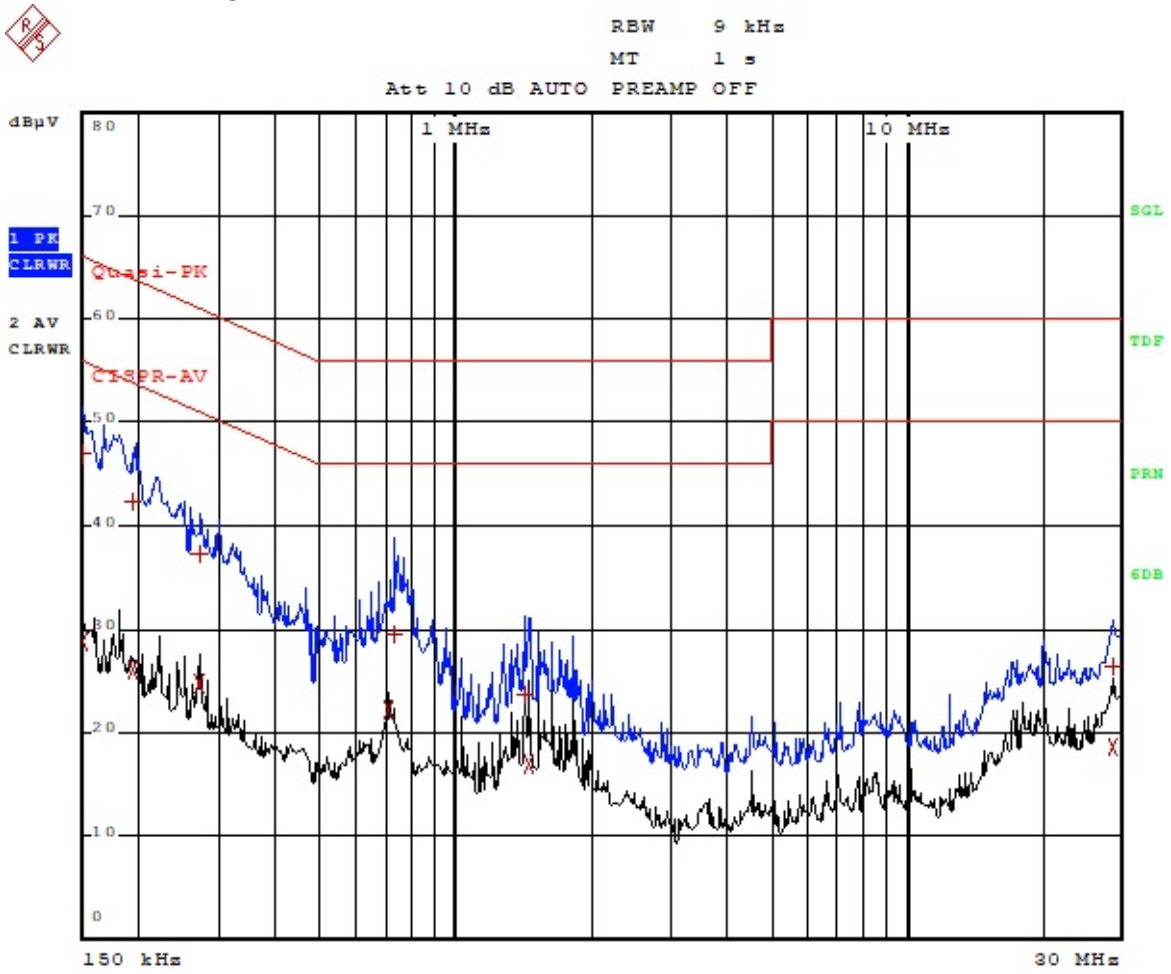


Comment: 00211_EDR

Special diagram for Bluetooth EDR

Bluetooth – CH 38

*NEUTRAL



Comment: 00211_EDR

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 Chip antenna .
The maximum Gain of this antenna is 2.5 dBi.