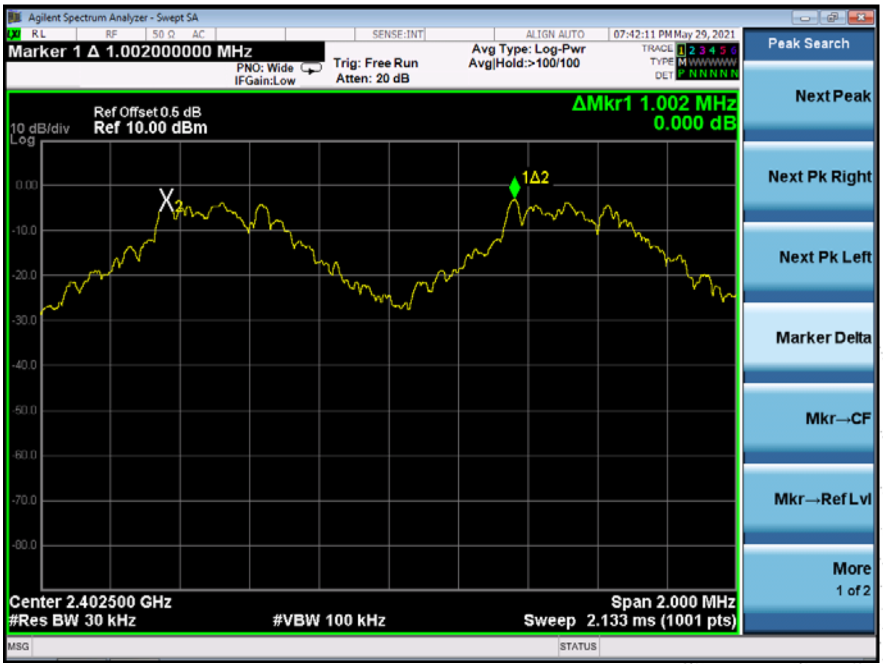
12.4 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1.002	0.575	PASS
GFSK	Middle	1.002	0.583	PASS
GFSK	High	1.000	0.585	PASS
Pi/4 DQPSK	Low	1.000	0.838	PASS
Pi/4 DQPSK	Middle	0.998	0.837	PASS
Pi/4 DQPSK	High	1.002	0.839	PASS

Test plots

GFSK Low Channel



Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC SENSE:INT ALIGN AUTO 07:42:11 PM May 29, 2021

Marker 1 Δ 1.002000000 MHz

PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100

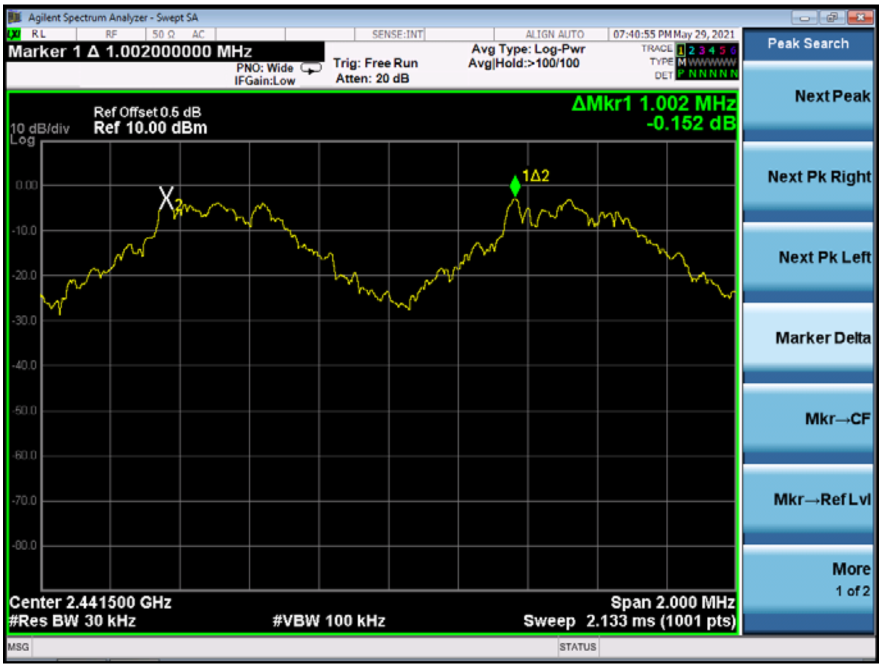
ΔMkr1 1.002 MHz
0.000 dB

Ref Offset 0.5 dB
Ref 10.00 dBm

Center 2.402500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2.000 MHz
Sweep 2.133 ms (1001 pts)

TRACE 1 2 3 4 5 6
TYPE M W W W W W
DET P N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

GFSK Middle Channel


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE M W W W W W
DET P N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2
MSG
STATUS

07:40:55 PM May 29, 2021

Marker 1 Δ 1.002000000 MHz

PNO: Wide
IFGain:Low

Trig: Free Run
Atten: 20 dB

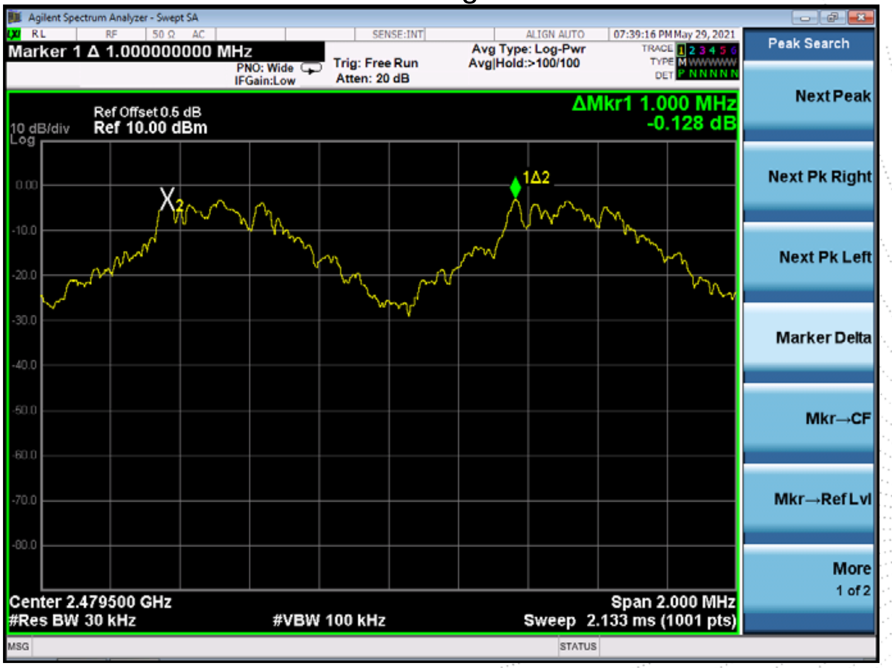
Avg Type: Log-Pwr
Avg|Hold:>100/100

Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 1.002 MHz
-0.152 dB

Center 2.441500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2.000 MHz
Sweep 2.133 ms (1001 pts)

GFSK High Channel


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE M W W W W W
DET P N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2
MSG
STATUS

07:39:16 PM May 29, 2021

Marker 1 Δ 1.000000000 MHz

PNO: Wide
IFGain:Low

Trig: Free Run
Atten: 20 dB

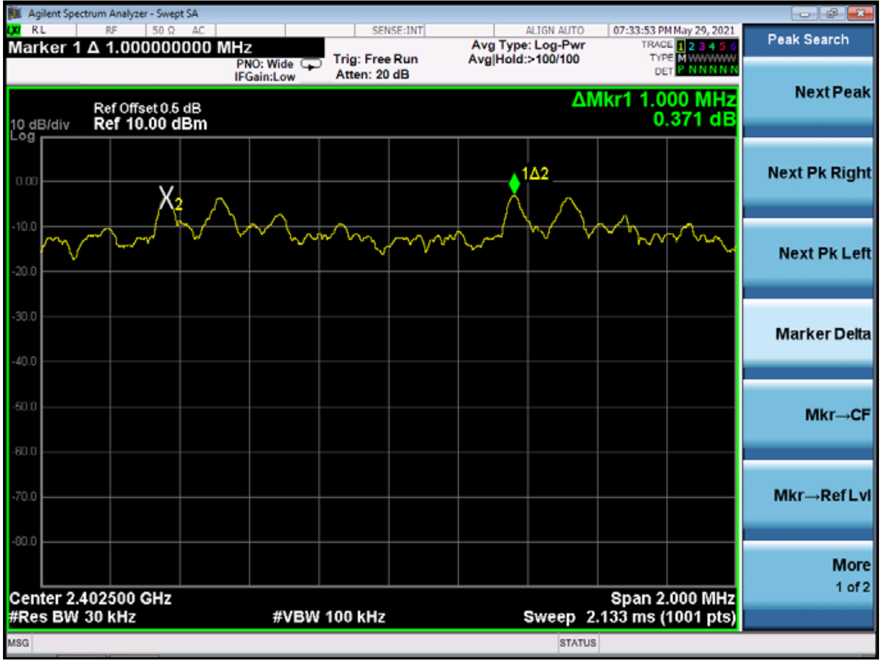
Avg Type: Log-Pwr
Avg|Hold:>100/100

Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 1.000 MHz
-0.128 dB

Center 2.479500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2.000 MHz
Sweep 2.133 ms (1001 pts)

Pi/4 DQPSK Low Channel



Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC SENSE:INT ALIGN AUTO 07:33:53 PM May 29, 2021

Marker 1 Δ 1.000000000 MHz

PNO: Wide IFGain:Low

Trig: Free Run Atten: 20 dB

Avg Type: Log-Pwr Avg|Hold:>100/100

TRACE 1 2 3 4 5 6 TYPE M WWWWW DET P N N N N N

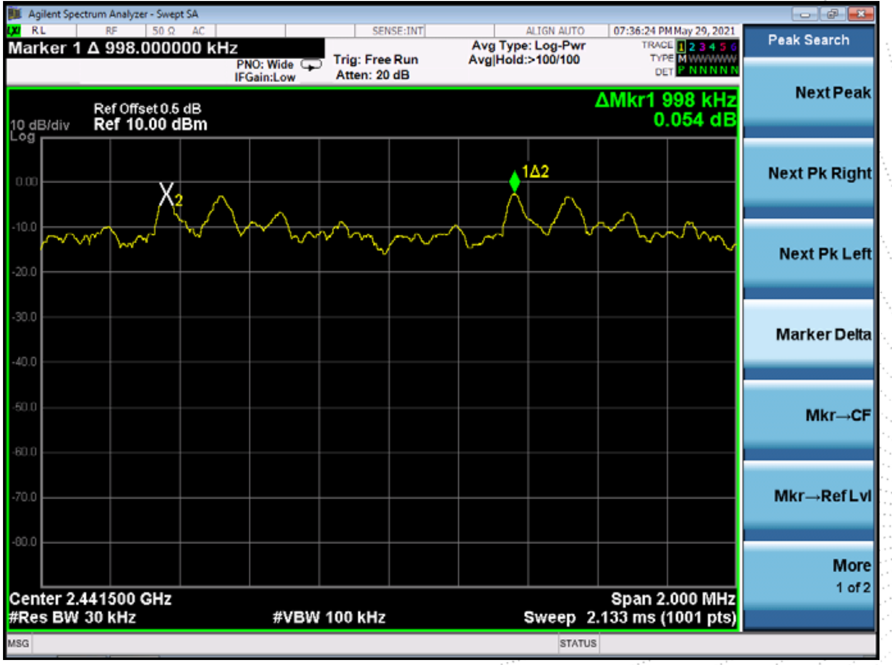
Ref Offset 0.5 dB Ref 10.00 dBm

ΔMkr1 1.000 MHz 0.371 dB

Center 2.402500 GHz #Res BW 30 kHz #VBW 100 kHz Span 2.000 MHz Sweep 2.133 ms (1001 pts)

10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2
MSG
STATUS

Pi/4 DQPSK Middle Channel



Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC SENSE:INT ALIGN AUTO 07:36:24 PM May 29, 2021

Marker 1 Δ 998.000000 kHz

PNO: Wide IFGain:Low

Trig: Free Run Atten: 20 dB

Avg Type: Log-Pwr Avg|Hold:>100/100

TRACE 1 2 3 4 5 6 TYPE M WWWWW DET P N N N N N

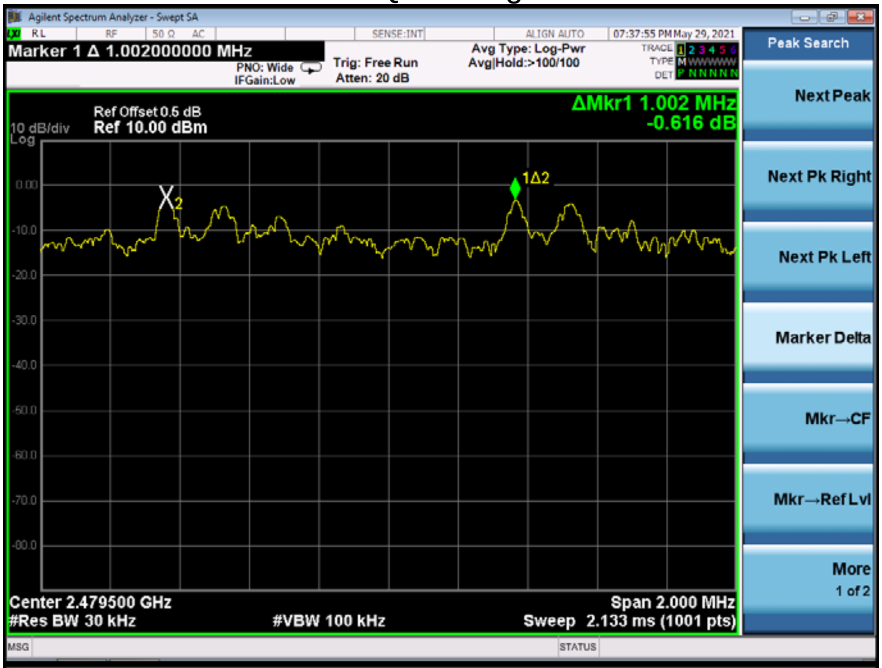
Ref Offset 0.5 dB Ref 10.00 dBm

ΔMkr1 998 kHz 0.054 dB

Center 2.441500 GHz #Res BW 30 kHz #VBW 100 kHz Span 2.000 MHz Sweep 2.133 ms (1001 pts)

10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2
MSG
STATUS

Pi/4 DQPSK High Channel



Agilent Spectrum Analyzer - Swept SA

Marker 1 Δ 1.002000000 MHz

PNO: Wide IFGain:Low

Trig: Free Run Atten: 20 dB

SENSE:INT ALIGN AUTO

07:37:55 PM May 29, 2021

Avg Type: Log-Pwr Avg|Hold:>100/100

Ref Offset 0.6 dB

10 dB/div Log Ref 10.00 dBm

ΔMkr1 1.002 MHz -0.616 dB

Center 2.479500 GHz

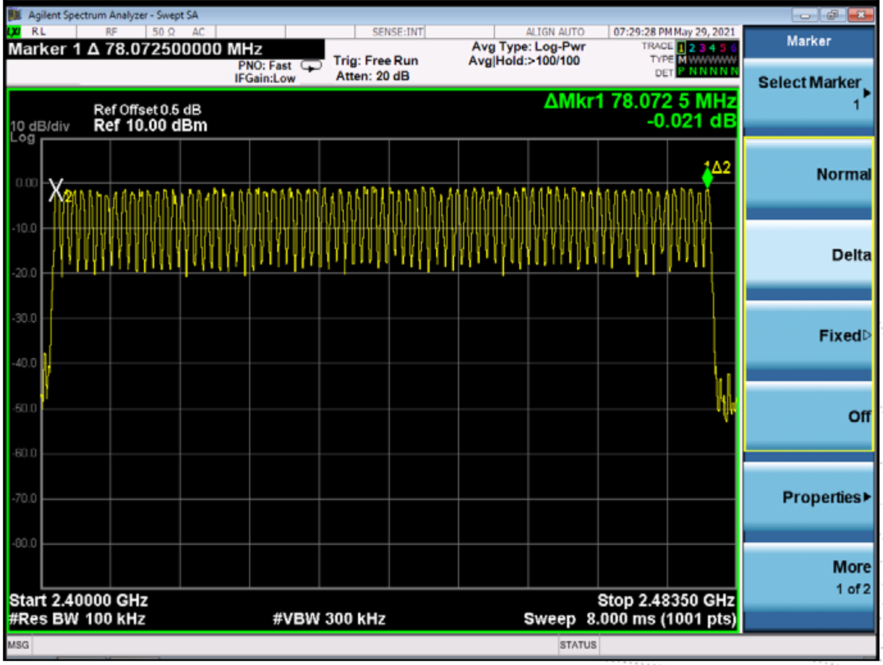
#Res BW 30 kHz

#VBW 100 kHz

Span 2.000 MHz

Sweep 2.133 ms (1001 pts)

0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
1Δ2
X2
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More 1 of 2
MSG
STATUS



Agilent Spectrum Analyzer - Swept SA

Marker 1 Δ 78.072500000 MHz

PNO: Fast IFGain:Low

Trig: Free Run Atten: 20 dB

SENSE:INT ALIGN AUTO

07:29:28 PM May 29, 2021

Avg Type: Log-Pwr Avg|Hold:>100/100

Ref Offset 0.6 dB

10 dB/div Log Ref 10.00 dBm

ΔMkr1 78.072 5 MHz -0.021 dB

Start 2.40000 GHz

#Res BW 100 kHz

#VBW 300 kHz

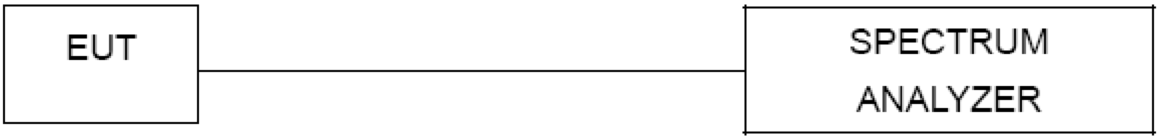
Stop 2.48350 GHz

Sweep 8.000 ms (1001 pts)

0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
1Δ2
X2
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

13. NUMBER OF HOPPING FREQUENCY

13.1 Block Diagram Of Test Setup



13.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

13.3 Test procedure

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

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

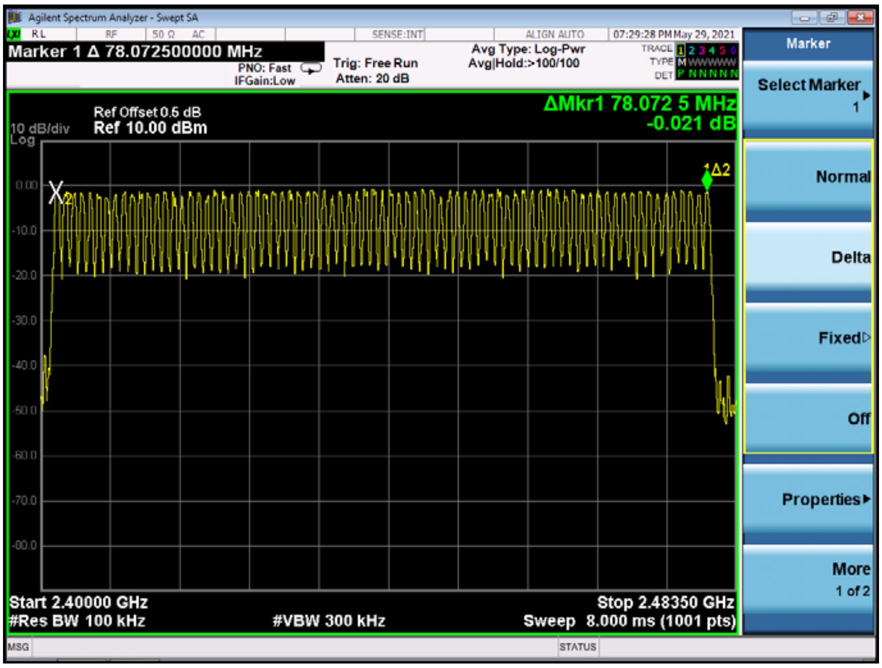
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

13.4 Test Result

Test Plots:

79 Channels in total

GFSK


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
MSG
STATUS

07:29:28 PM May 29, 2021

Marker 1 Δ 78.072500000 MHz

PNO: Fast
IFGain:Low

Trig: Free Run
Atten: 20 dB

Avg Type: Log-Pwr
Avg|Hold:>100/100

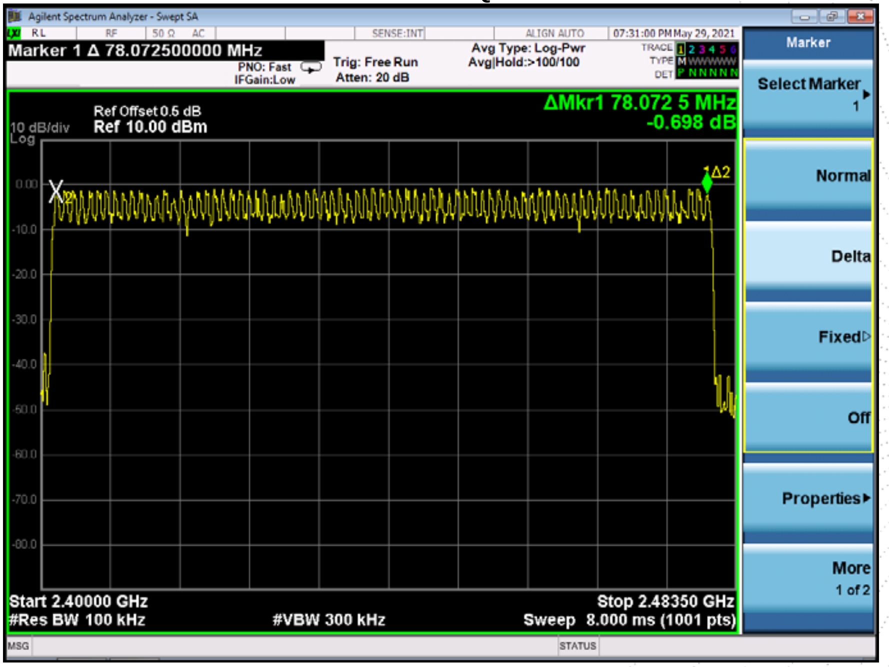
10 dB/div
Log

Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 78.072 5 MHz
-0.021 dB

Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)

Pi/4 DQPSK


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
X2
1Δ2
MSG
STATUS

07:31:00 PM May 29, 2021

Marker 1 Δ 78.072500000 MHz

PNO: Fast
IFGain:Low

Trig: Free Run
Atten: 20 dB

Avg Type: Log-Pwr
Avg|Hold:>100/100

10 dB/div
Log

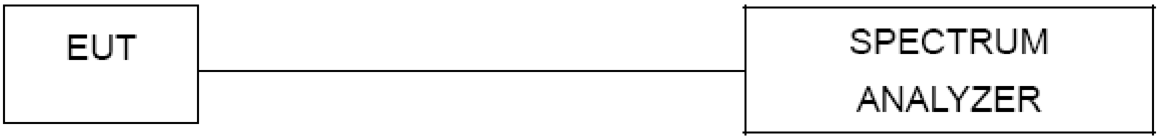
Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 78.072 5 MHz
-0.698 dB

Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)

14. DWELL TIME

14.1 Block Diagram Of Test Setup



14.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

14.3 Test procedure

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

2. Set spectrum analyzer span = 0.   Centred on a hopping channel;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

14.4 Test Result

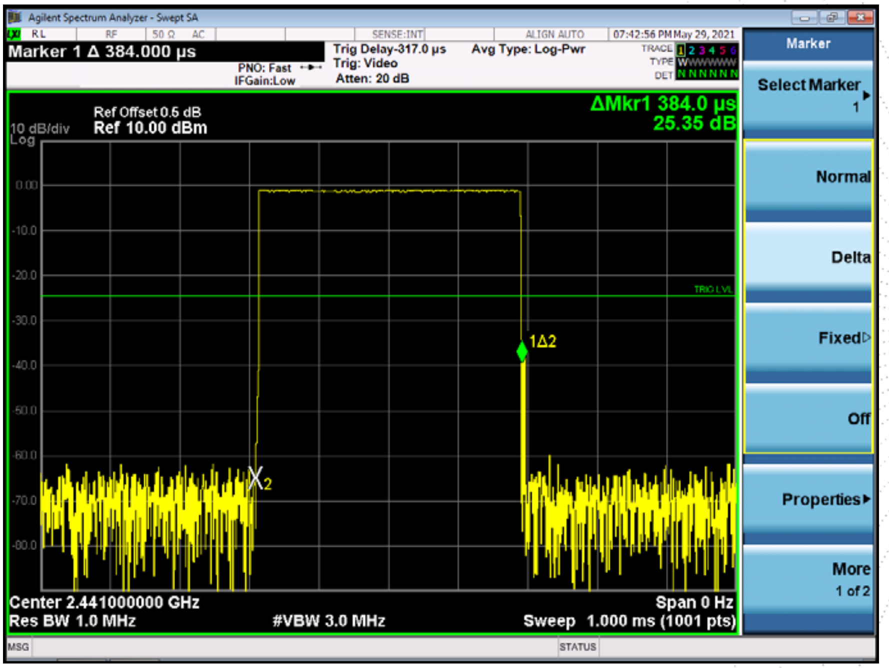
DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

DH5:1600/79/6*0.4*79*(MkrDelta)/1000
DH3:1600/79/4*0.4*79*(MkrDelta)/1000
DH1:1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Delta is once pulse time.

Modulation	Channel Data	Packet	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	Middle	DH1	0.384	0.123	0.4
		DH3	1.650	0.264	0.4
		DH5	2.900	0.309	0.4
Pi/4DQPSK	Middle	2DH1	0.392	0.125	0.4
		2DH3	1.656	0.265	0.4
		2DH5	2.910	0.310	0.4

Test Plots

GFSK DH1 Middle Channel



Agilent Spectrum Analyzer - Swept SA

Marker 1 Δ 384.000 µs

PNO: Fast
IFGain:Low
Trig Delay-317.0 µs
Trig: Video
Atten: 20 dB
Avg Type: Log-Pwr

07:42:56 PM May 29, 2021

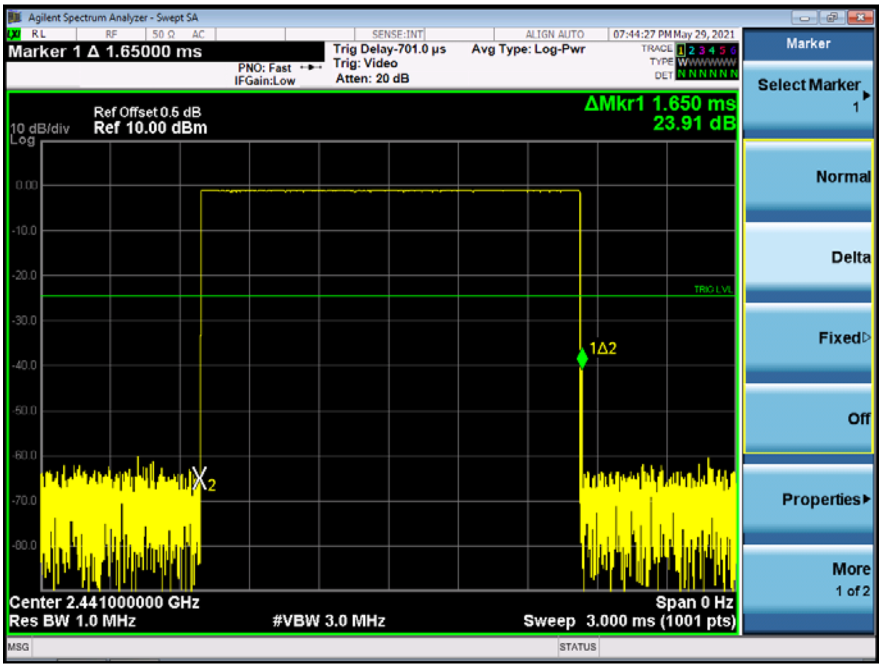
Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 384.0 µs
25.35 dB

Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 1.000 ms (1001 pts)

RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE WWWWWW
DET N N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
1Δ2
X2
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

GFSK DH3 Middle Channel


Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC SENSE:INT ALIGN AUTO 07:44:27 PM May 29, 2021

Marker 1 Δ 1.65000 ms

PNO: Fast IFGain:Low Trig Delay-701.0 µs Trig: Video Atten: 20 dB Avg Type: Log-Pwr

TRACE 1 2 3 4 5 6 TYPE WWWWWW DET N N N N N N

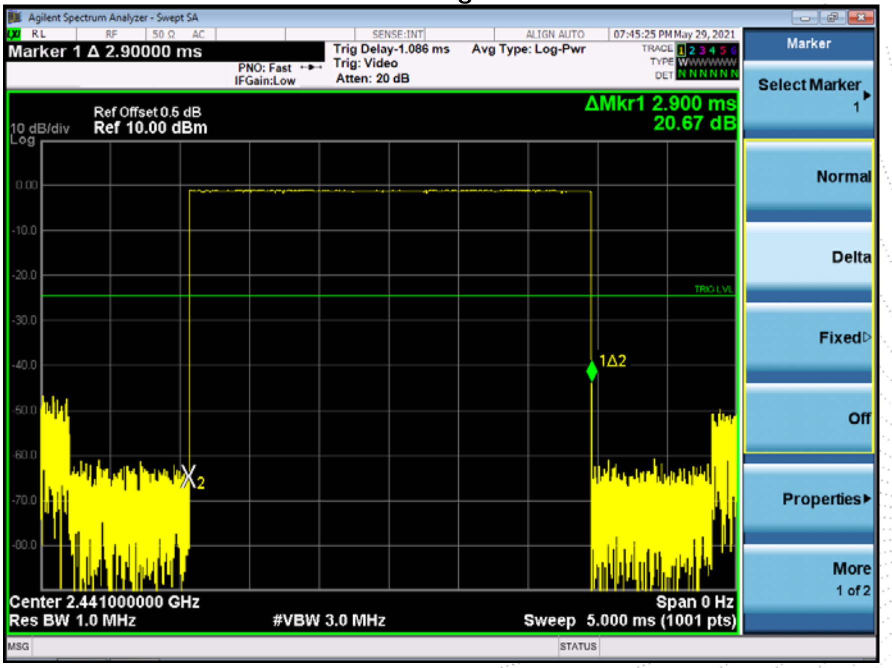
Ref Offset 0.6 dB
10 dB/div Log Ref 10.00 dBm

ΔMkr1 1.650 ms 23.91 dB

Center 2.441000000 GHz Span 0 Hz
Res BW 1.0 MHz #VBW 3.0 MHz Sweep 3.000 ms (1001 pts)

0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
1Δ2
X2
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

GFSK DH5 High Middle Channel


Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC SENSE:INT ALIGN AUTO 07:45:25 PM May 29, 2021

Marker 1 Δ 2.90000 ms

PNO: Fast IFGain:Low Trig Delay-1.086 ms Trig: Video Atten: 20 dB Avg Type: Log-Pwr

TRACE 1 2 3 4 5 6 TYPE WWWWWW DET N N N N N N

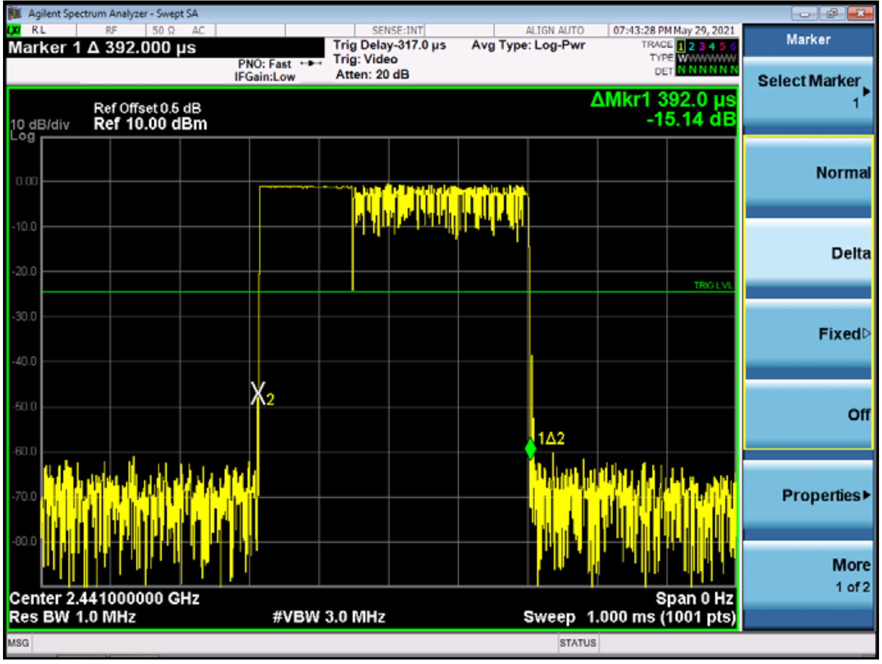
Ref Offset 0.6 dB
10 dB/div Log Ref 10.00 dBm

ΔMkr1 2.900 ms 20.67 dB

Center 2.441000000 GHz Span 0 Hz
Res BW 1.0 MHz #VBW 3.0 MHz Sweep 5.000 ms (1001 pts)

0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
1Δ2
X2
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

Pi/4DQPSK DH1 Middle Channel



Marker 1 Δ 392.000 µs

PNO: Fast
IFGain:Low

Trig Delay-317.0 µs
Trig: Video
Atten: 20 dB

Avg Type: Log-Pwr

07:43:28 PM May 29, 2021

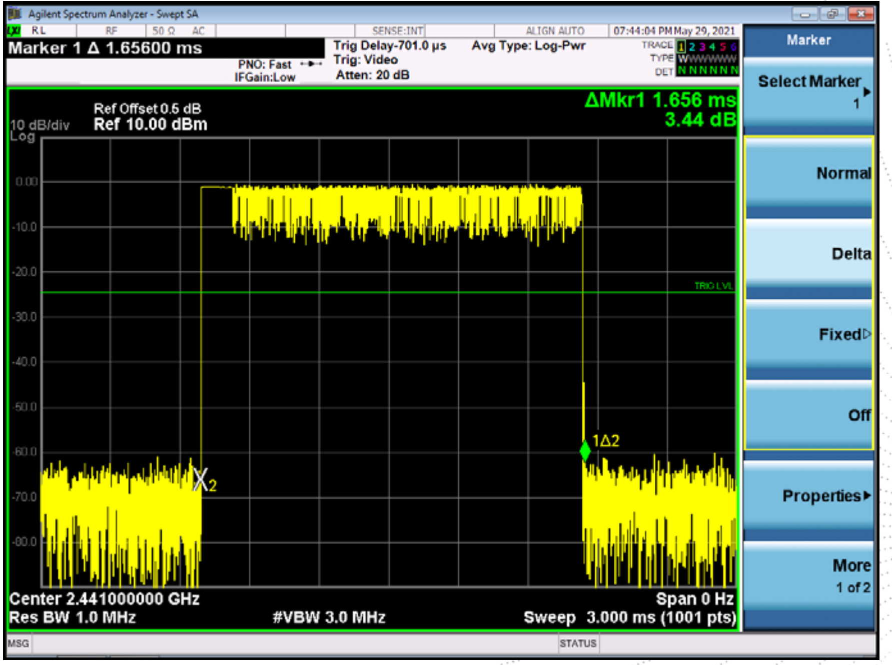
Ref Offset 0.6 dB
Ref 10.00 dBm

ΔMkr1 392.0 µs
-15.14 dB

Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 1.000 ms (1001 pts)

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE WWWWWW
DET N N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
X2
1Δ2
MSG
STATUS
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2

Pi/4DQPSK DH3 Middle Channel



Marker 1 Δ 1.65600 ms

PNO: Fast
IFGain:Low

Trig Delay-701.0 µs
Trig: Video
Atten: 20 dB

Avg Type: Log-Pwr

07:44:04 PM May 29, 2021

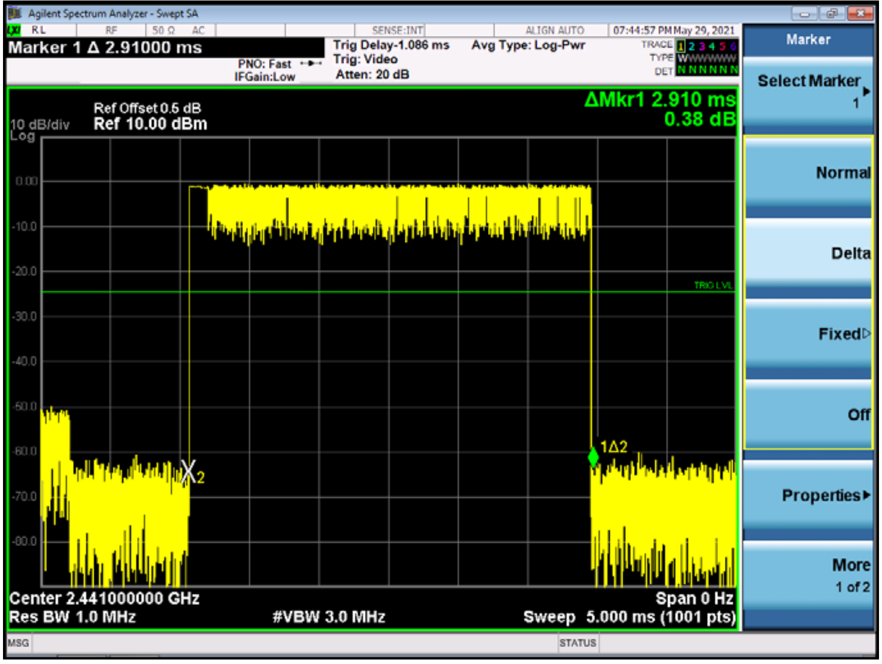
Ref Offset 0.6 dB
Ref 10.00 dBm

ΔMkr1 1.656 ms
3.44 dB

Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 3.000 ms (1001 pts)

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE WWWWWW
DET N N N N N N
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
X2
1Δ2
MSG
STATUS
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2

Pi/4DQPSK DH5 Middle Channel



Agilent Spectrum Analyzer - Swept SA

Marker 1 Δ 2.91000 ms

PNO: Fast
IFGain:Low

Trig Delay-1.086 ms
Trig: Video
Atten: 20 dB

Avg Type: Log-Pwr

07:44:57 PM May 29, 2021

Ref Offset 0.5 dB
Ref 10.00 dBm

ΔMkr1 2.910 ms
0.38 dB

Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
TRACE 1 2 3 4 5 6
TYPE WWWWWW
DET NNNNNN
10 dB/div
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
TRIG LVL
X2
1Δ2
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

15. ANTENNA REQUIREMENT

15.1 Limit

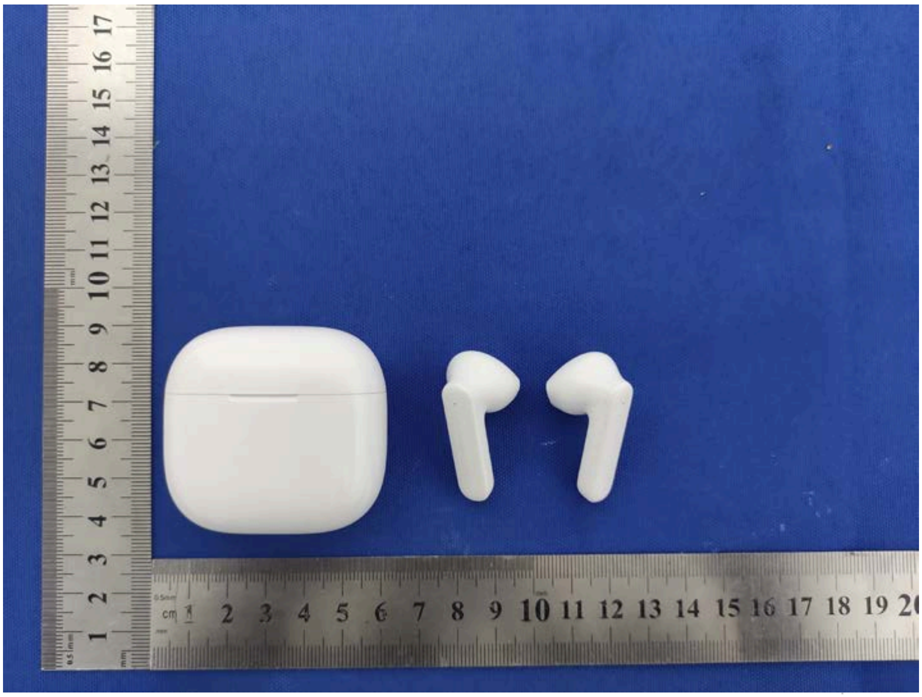
15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall
be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.2 Test Result

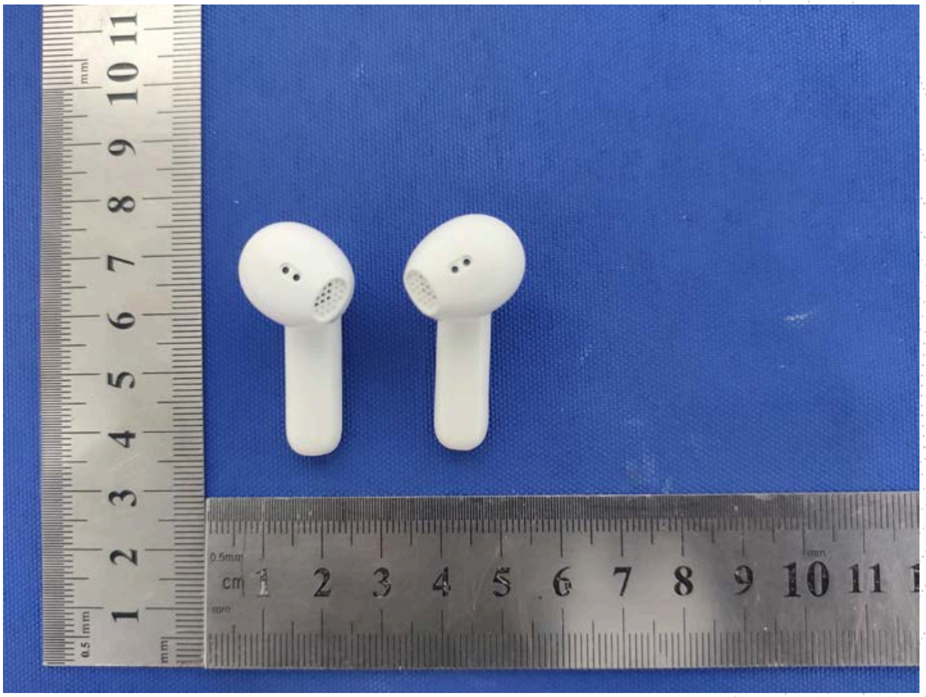
The EUT antenna is chip antenna, fulfill the requirement of this section.

16. EUT PHOTOGRAPHS

EUT Photo 1

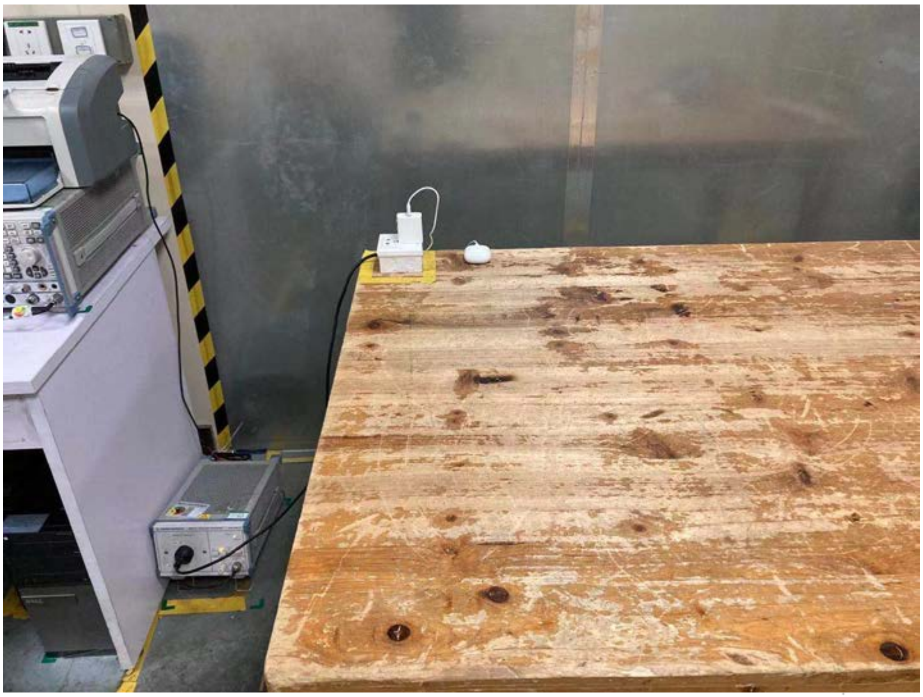


EUT Photo 2

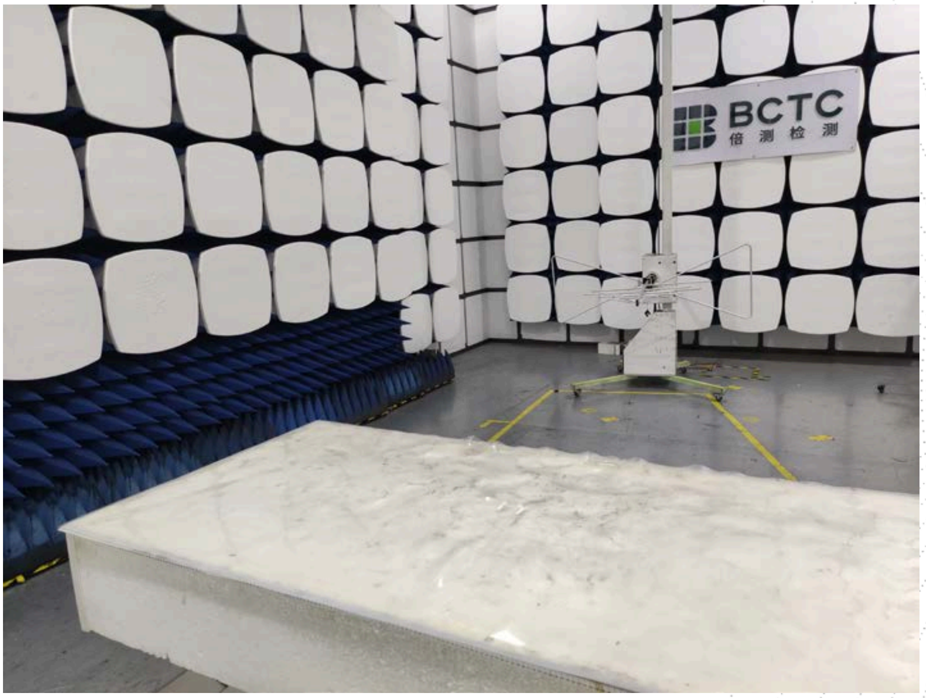


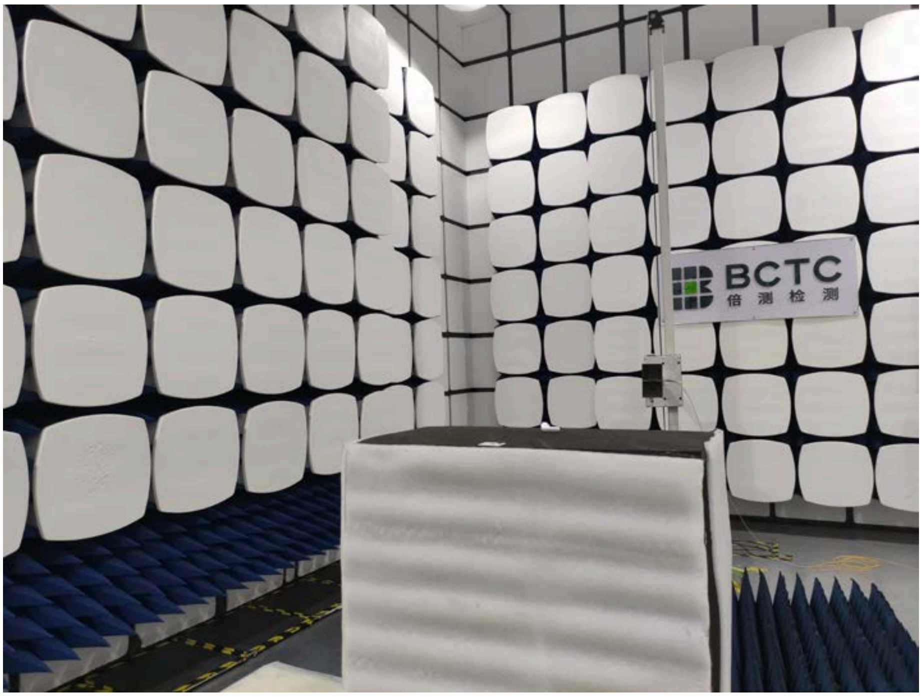
17. EUT TEST SETUP PHOTOGRAPHS

Conducted emissions



Radiated Measurement Photos




BCTC
倍 测 检 测

STATEMENT

1.The equipment lists are traceable to the national reference standards.

2.The test report can not be partially copied unless prior written approval is issued from our lab.

3.The test report is invalid without stamp of laboratory.

4.The test report is invalid without signature of person(s) testing and authorizing.

5.The test process and test result is only related to the Unit Under Test.

6.The quality system of our laboratory is in accordance with ISO/IEC17025.

7.If there is any objection to report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

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