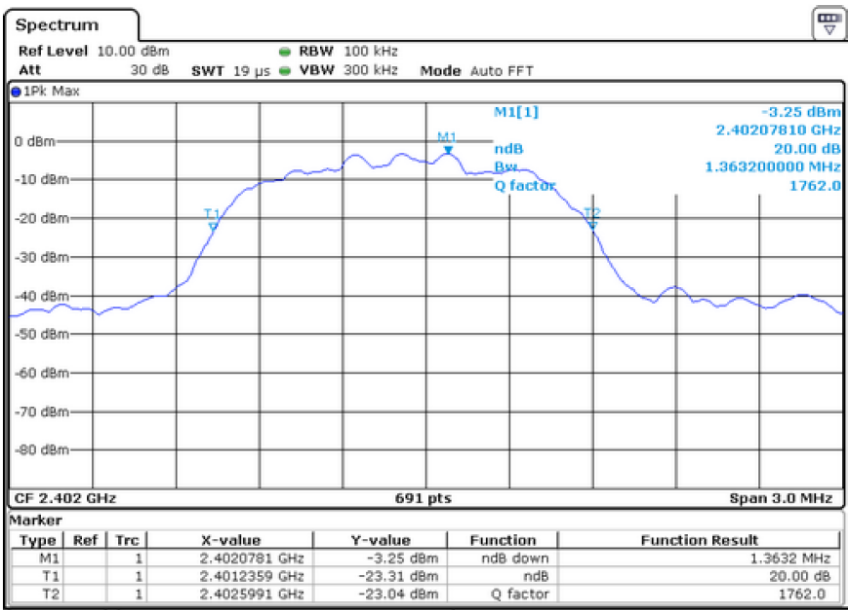
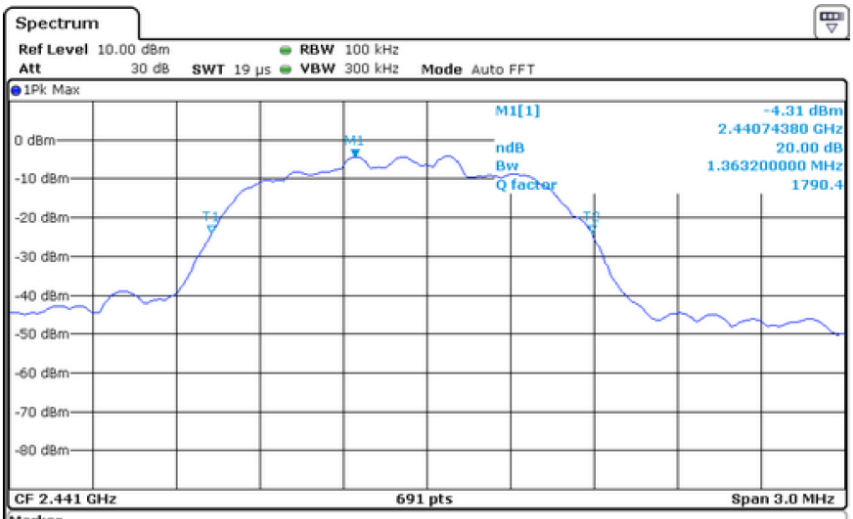
Test Mode: CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

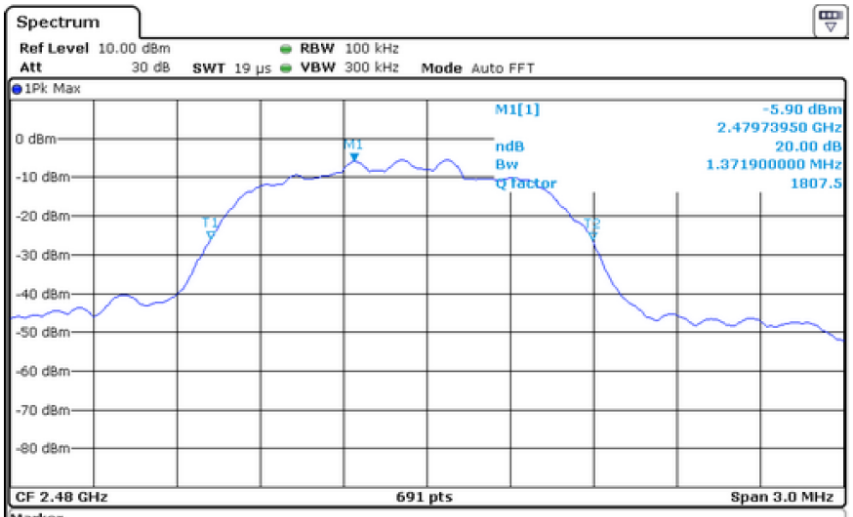
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1363
39	2441	1363
78	2480	1372





Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4407438 GHz	-4.31 dBm	ndB down	1.3632 MHz
T1		1	2.4402272 GHz	-24.11 dBm	ndB	20.00 dB
T2		1	2.4415904 GHz	-24.06 dBm	Q factor	1790.4



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4797395 GHz	-5.90 dBm	ndB down	1.3719 MHz
T1		1	2.4792229 GHz	-25.91 dBm	ndB	20.00 dB
T2		1	2.4805948 GHz	-26.21 dBm	Q factor	1807.5

10 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band eploying at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Refer to the result “Number of Hopping Frequency” of this document. The 0.125watts (20.97 dBm) limit applies.

10.1Test Procedure

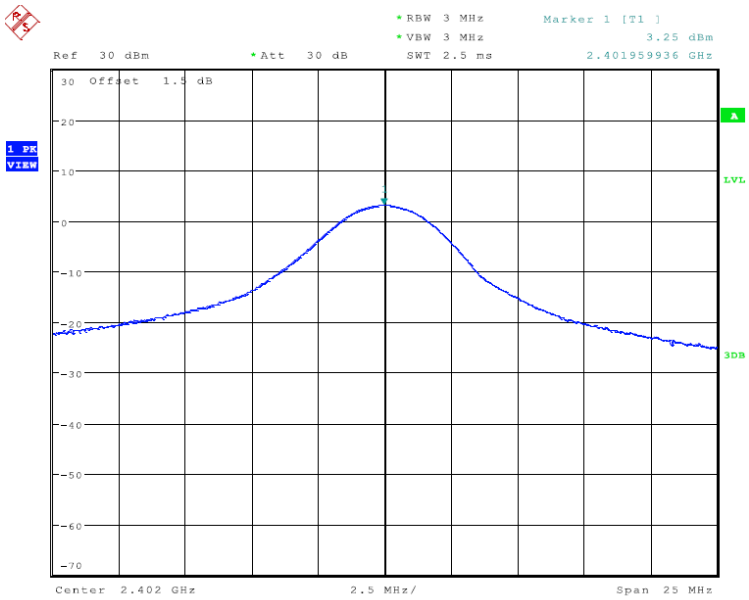
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

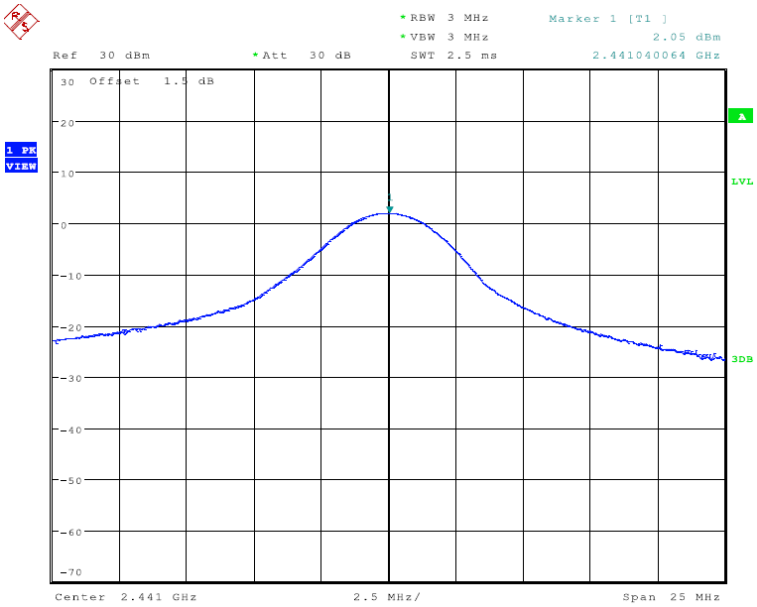
2. Set the spectrum analyser: RBW = 3 MHz. VBW =10 MHz. Sweep = auto; Detector Function = Peak.

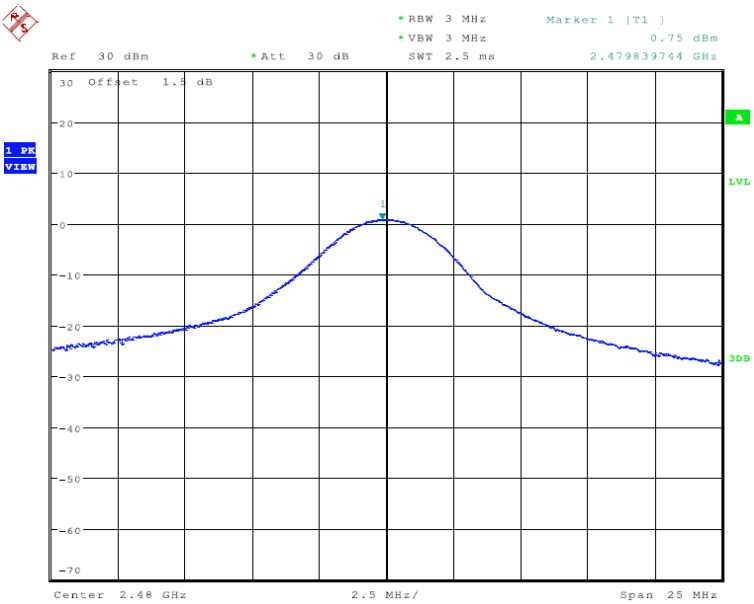
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.2Test Result

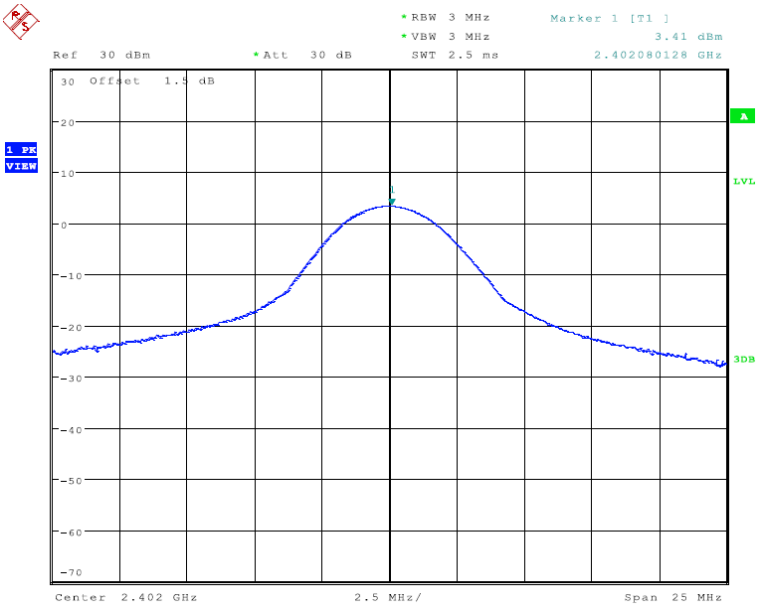
GFSK(1Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	3.25	0.00211	1	Pass
CH39	2441	2.05	0.00160	1	Pass
CH78	2480	0.75	0.00119	1	Pass

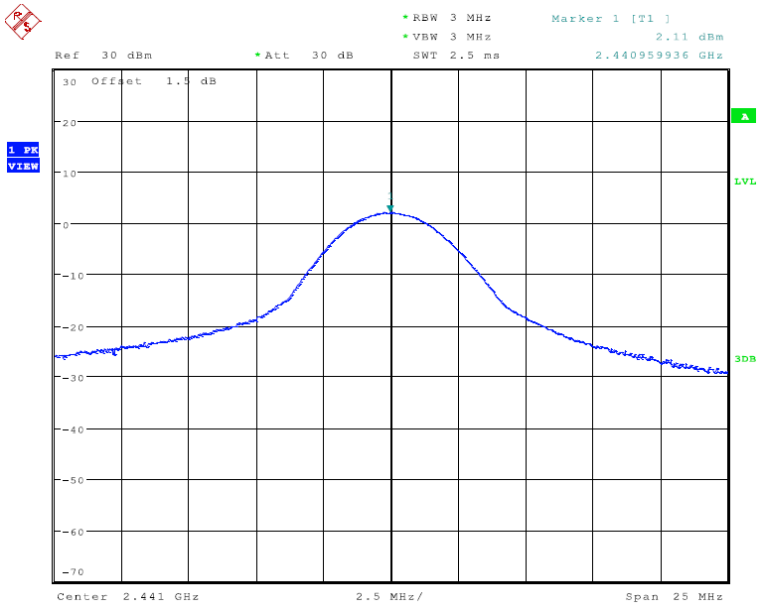

RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
3.25 dBm
2.401959936 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.402 GHz
2.5 MHz/
Span 25 MHz

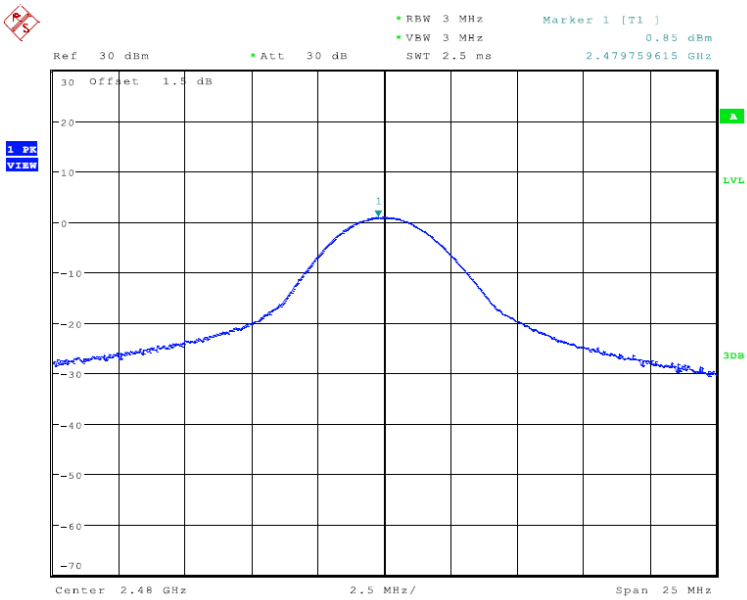

RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
2.05 dBm
2.441040064 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.441 GHz
2.5 MHz/
Span 25 MHz



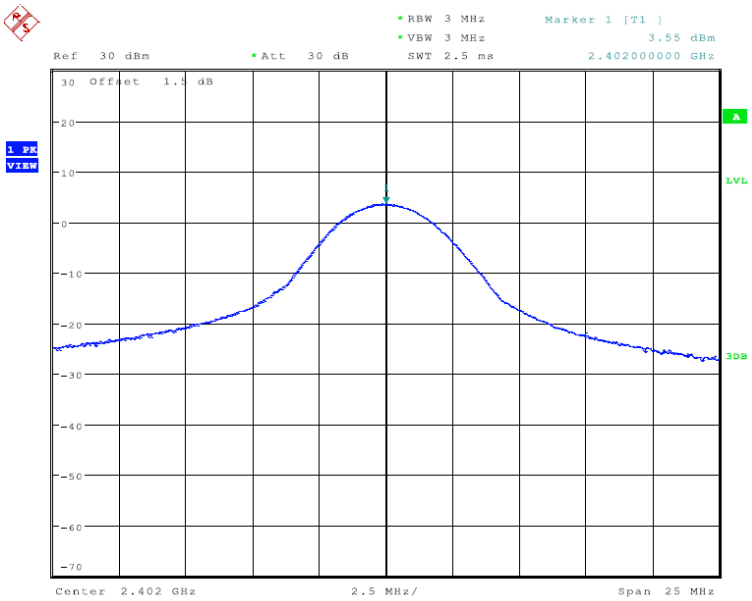
π/4-QPSK(2Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	3.41	0.00219	0.125	Pass
CH39	2441	2.11	0.00163	0.125	Pass
CH78	2480	0.85	0.00122	0.125	Pass

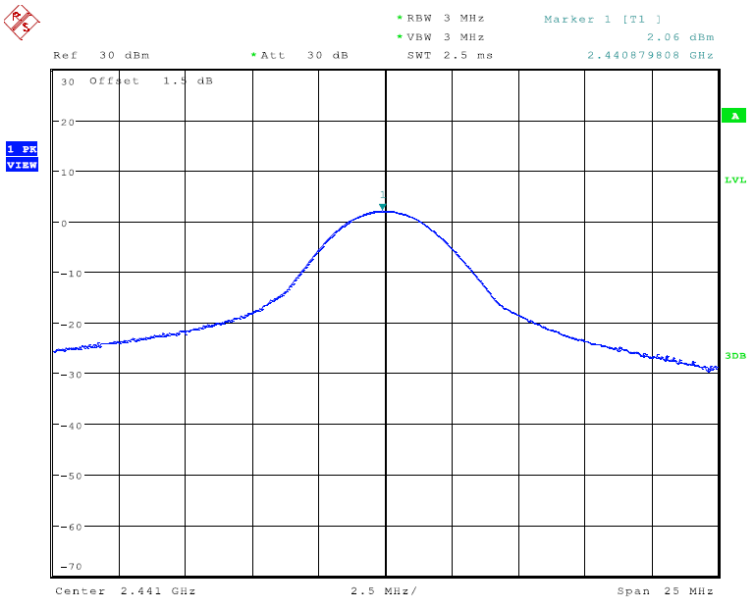

RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
3.41 dBm
2.402080128 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.402 GHz
2.5 MHz/
Span 25 MHz

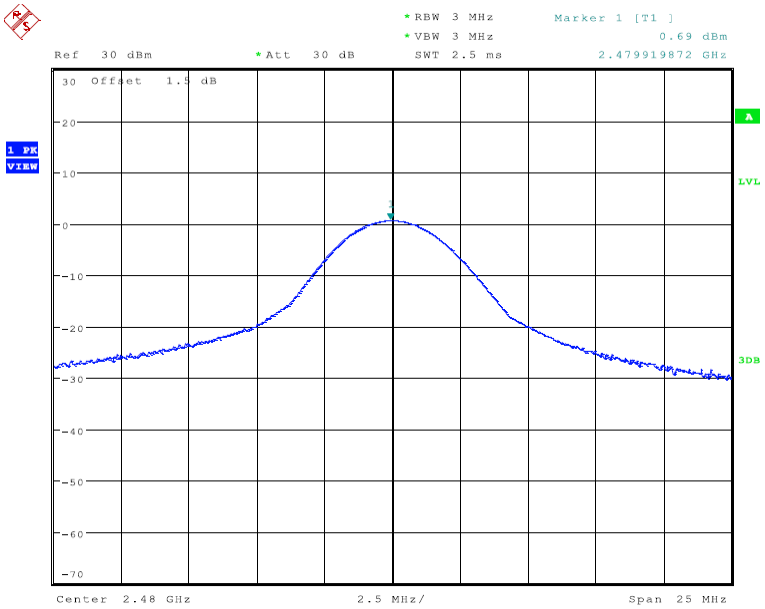

RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
2.11 dBm
2.440959936 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.441 GHz
2.5 MHz/
Span 25 MHz



8DPSK(3Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	3.55	0.00226	0.125	Pass
CH39	2441	2.06	0.00161	0.125	Pass
CH78	2480	0.69	0.00117	0.125	Pass


RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
3.55 dBm
2.402000000 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.402 GHz
2.5 MHz/
Span 25 MHz


RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
2.06 dBm
2.440879808 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK VIEW
A
LVL
3DB
Center 2.441 GHz
2.5 MHz/
Span 25 MHz


RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
0.69 dBm
2.479919872 GHz
Ref 30 dBm
Att 30 dB
Offset 1.5 dB
1 PK
VIEW
A
LVL
3DB
Center 2.48 GHz
2.5 MHz/
Span 25 MHz

11 Hopping Channel Separation

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W.
Test Mode	:	Hopping

11.1 Test Procedure

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

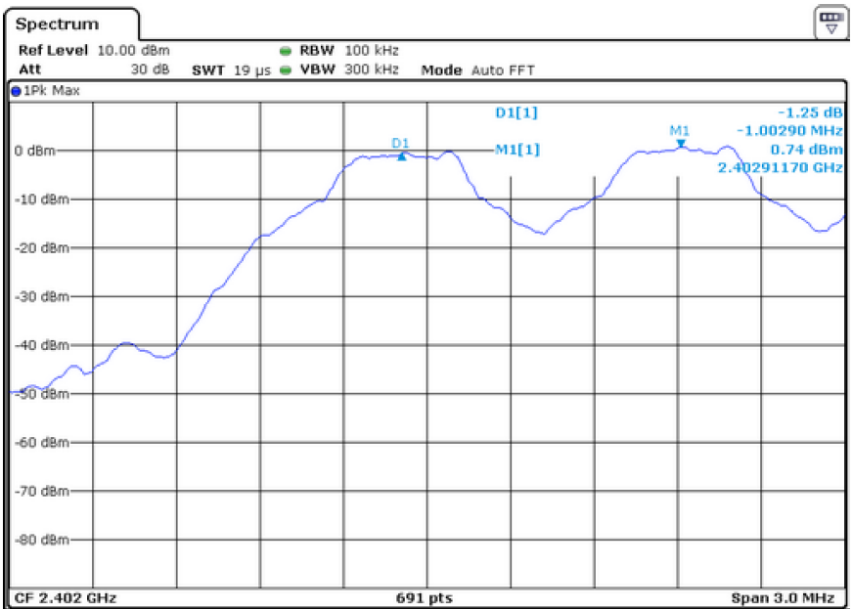
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz, Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

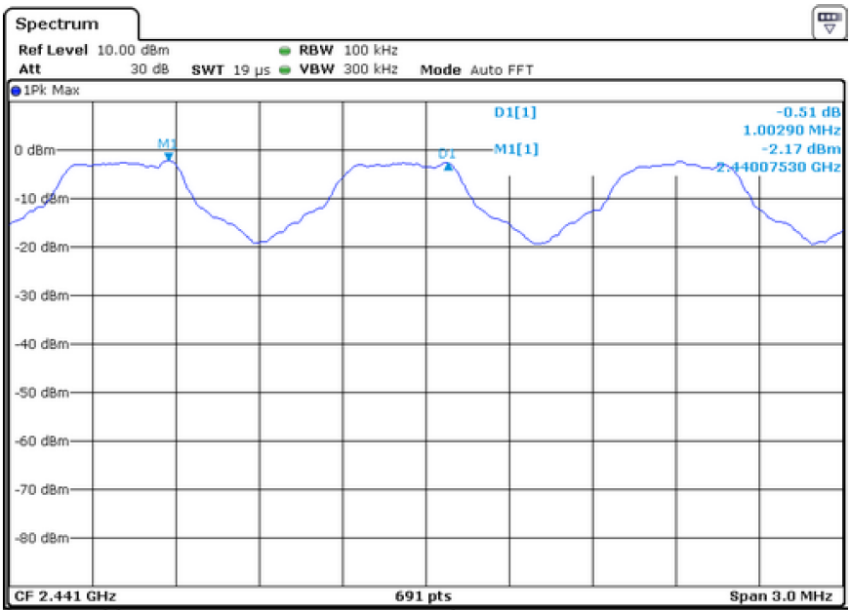
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

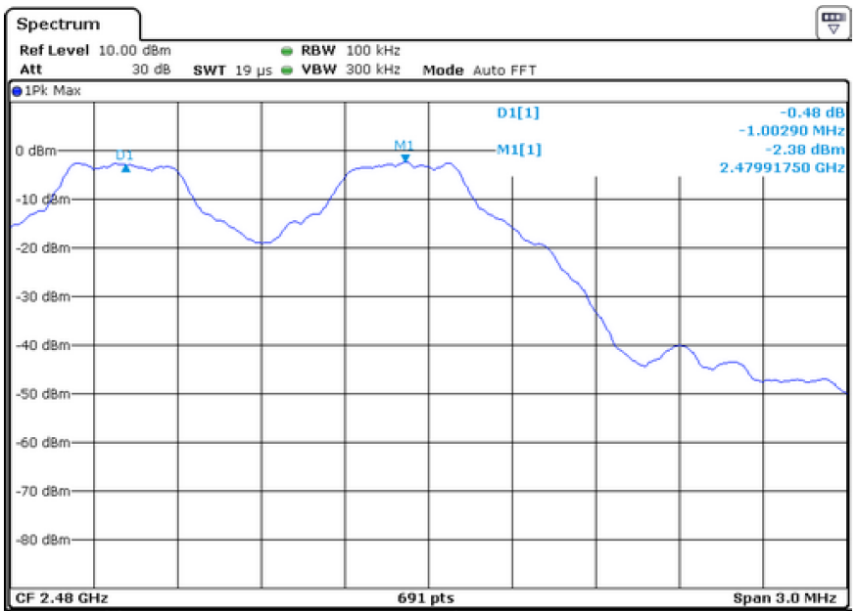
11.2 Test Result

Test Mode:	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1003	>743
39	2441	1003	>738
78	2480	1003	>732

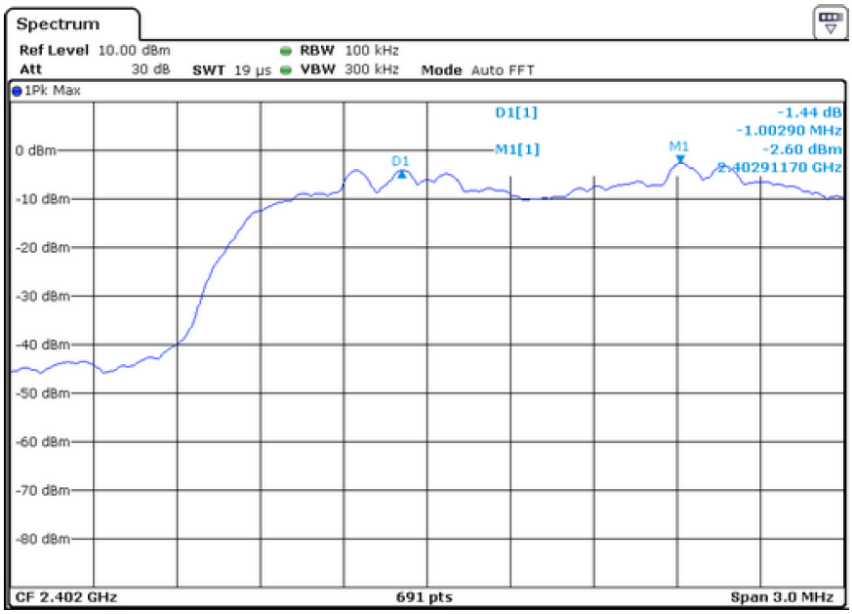


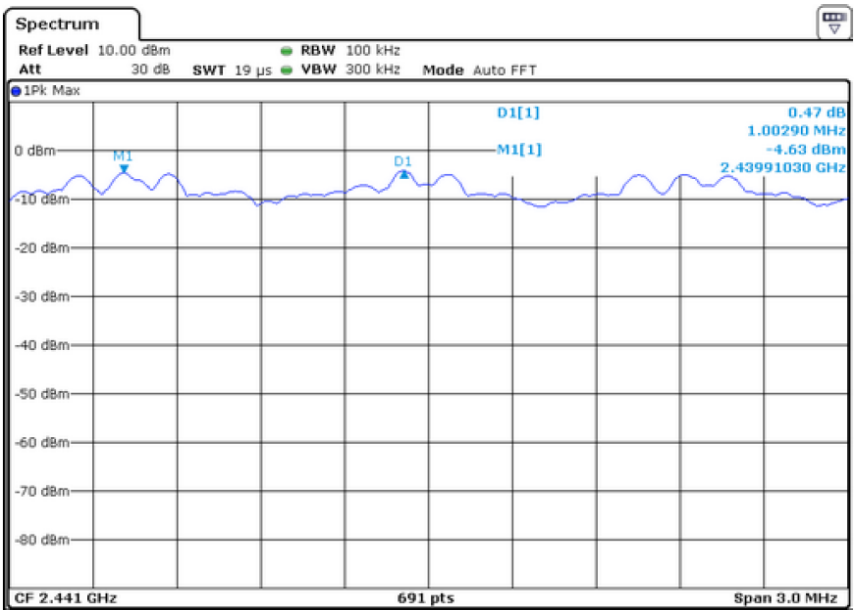

Spectrum
Ref Level 10.00 dBm
Att 30 dB
SWT 19 µs
RBW 100 kHz
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
-0.51 dB
1.00290 MHz
M1[1]
-2.17 dBm
2.44007530 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz

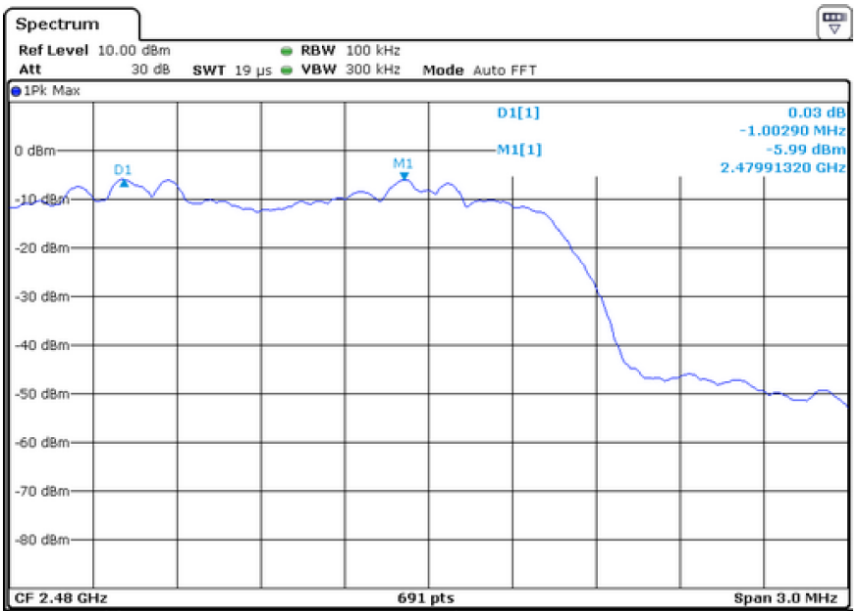

Spectrum
Ref Level 10.00 dBm
Att 30 dB
SWT 19 µs
RBW 100 kHz
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
-0.48 dB
-1.00290 MHz
M1[1]
-2.38 dBm
2.47991750 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz

Test Mode:	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1003	>909
39	2441	1003	>909
78	2480	1003	>909

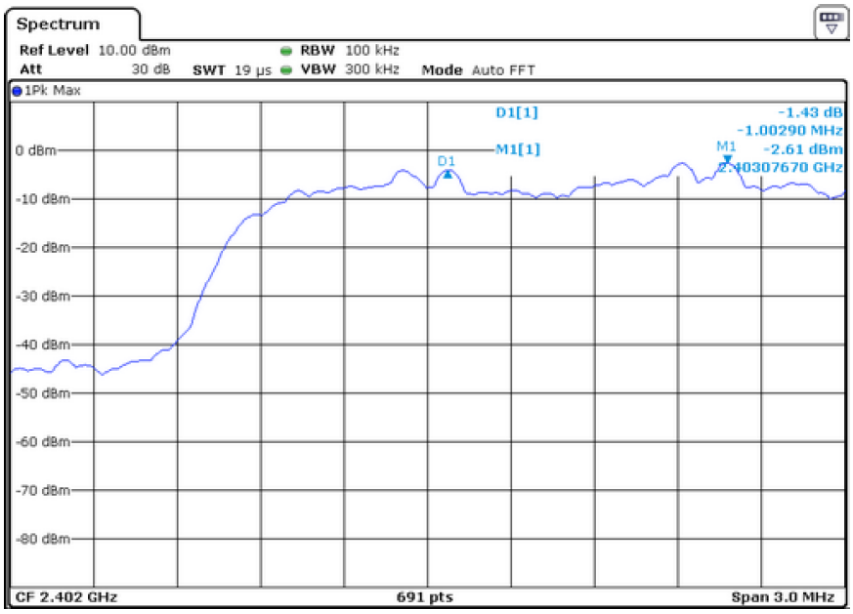


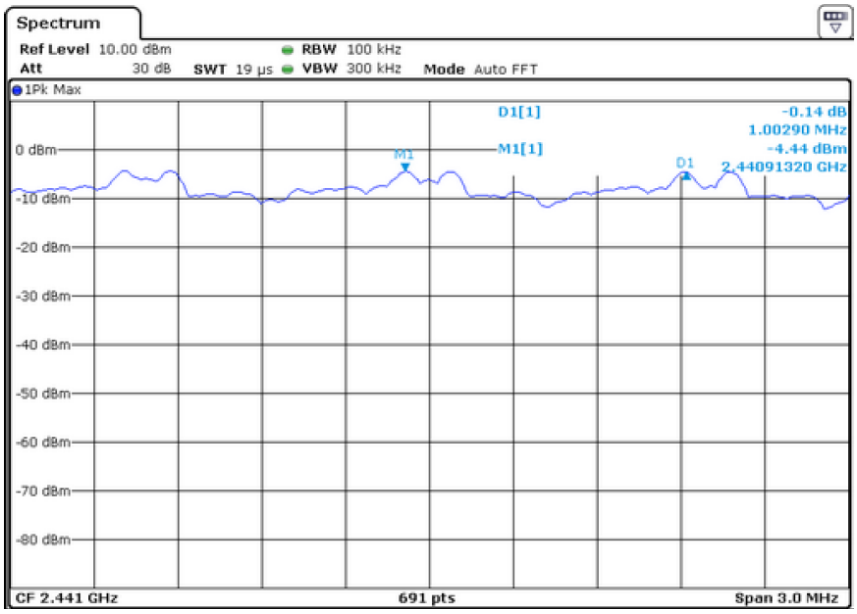

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 30 dB
SWT 19 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
0.47 dB
1.00290 MHz
-4.63 dBm
2.43991030 GHz
M1[1]
M1
D1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz

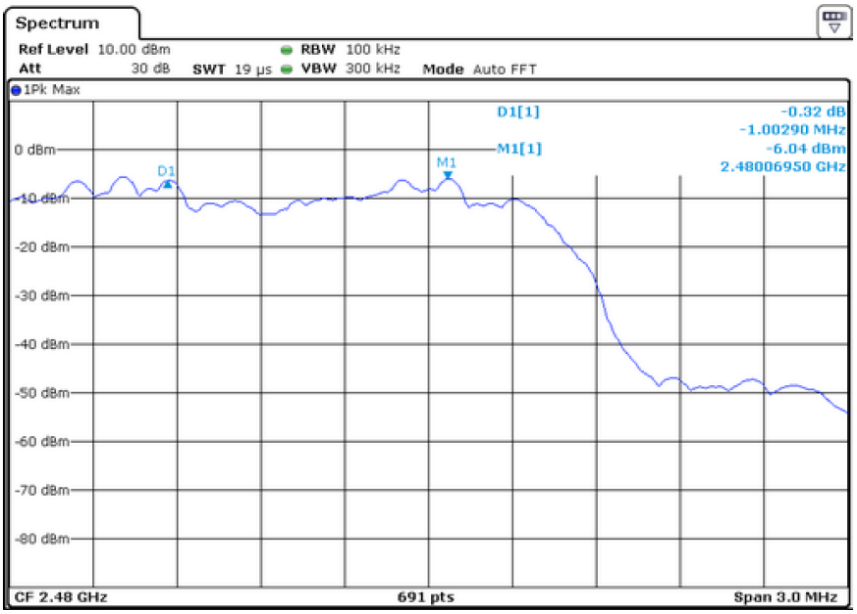

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 30 dB
SWT 19 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
0.03 dB
-1.00290 MHz
-5.99 dBm
2.47991320 GHz
M1[1]
D1
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz

Test Mode:	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1003	>909
39	2441	1003	>909
78	2480	1003	>915




Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 30 dB
SWT 19 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
-0.14 dB
1.00290 MHz
M1[1]
-4.44 dBm
2.44091320 GHz
M1
D1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz


Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 30 dB
SWT 19 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D1[1]
-0.32 dB
-1.00290 MHz
M1[1]
-6.04 dBm
2.48006950 GHz
D1
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz

12 Number of Hopping Frequency

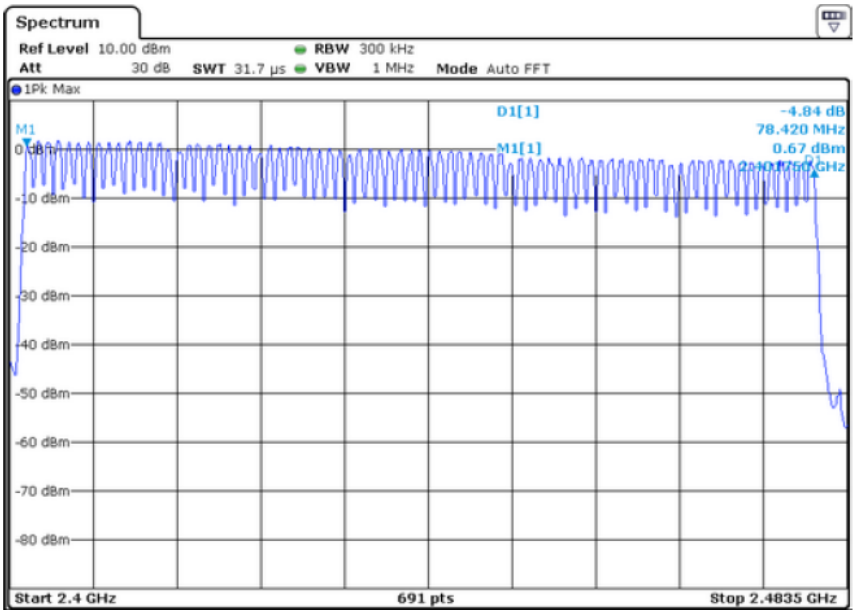
Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode	:	Hopping(GFSK)

12.1 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 = 100KHz. 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 = 2.483GHz. Sweep=auto;

12.2 Test Result

Channel Number	Limit
79	≥15



13 Dwell Time

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247(a)(1)(iii) 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.
Test Mode	:	The worst case(π/4-DQPSK) was recorded

13.1 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;

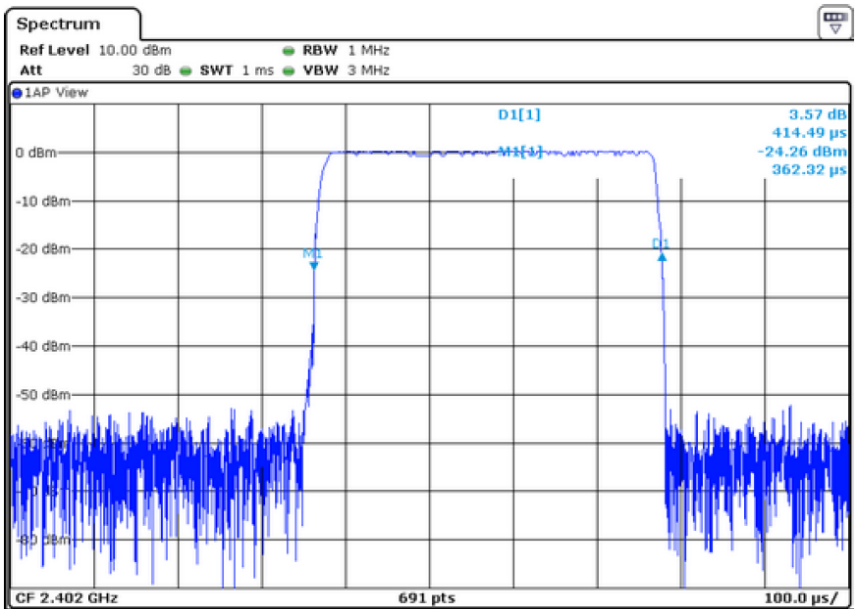
3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

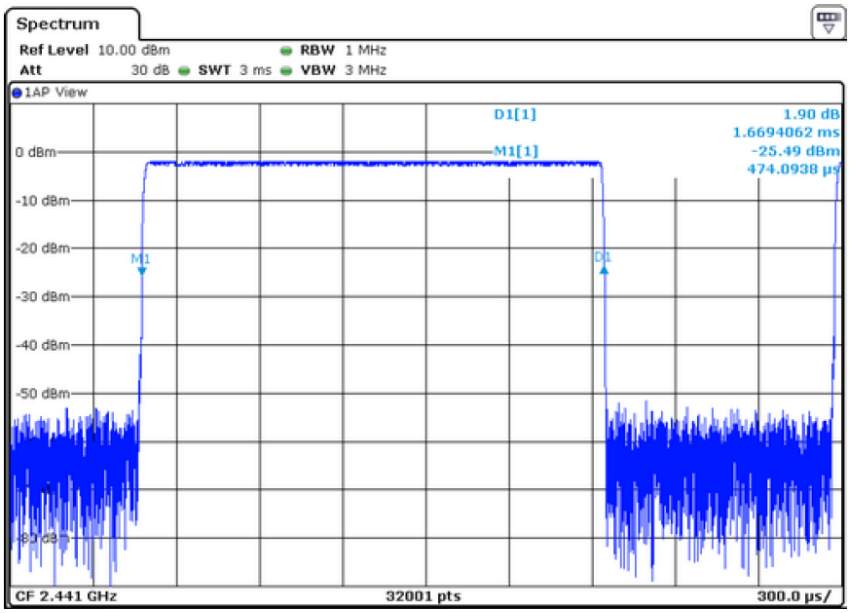
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

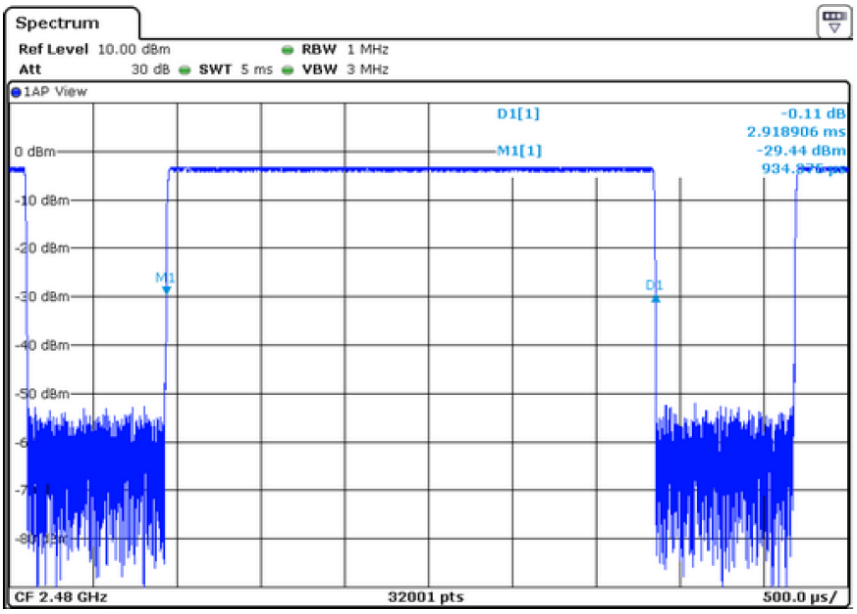
13.2 Test Result

Test Mode:	π/4-DQPSK(2Mbps) –2DH1/2DH3/2DH5

Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
2DH1	1600/(2*79) x 31.6 = 320	0.414	132.48	400
2DH3	1600/(4*79) x 31.6 =160	1.669	267.04	400
2DH5	1600/(6*79) x 31.6 =106.67	2.919	311.36	400


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 30 dB
SWT 1 ms
VBW 3 MHz
1AP View
D1[1]
3.57 dB
414.49 µs
-24.26 dBm
362.32 µs
M1[1]
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
M1
D1
CF 2.402 GHz
691 pts
100.0 µs/


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 30 dB
SWT 3 ms
VBW 3 MHz
1AP View
D1[1]
1.90 dB
1.6694062 ms
-25.49 dBm
474.0938 µs
M1[1]
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
M1
D1
CF 2.441 GHz
32001 pts
300.0 µs/


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 30 dB
SWT 5 ms
VBW 3 MHz
1AP View
D1[1]
-0.11 dB
2.918906 ms
-29.44 dBm
M1[1]
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
M1
D1
CF 2.48 GHz
32001 pts
500.0 µs/

14 Antenna Requirement

14.1 Antenna Requirement

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 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

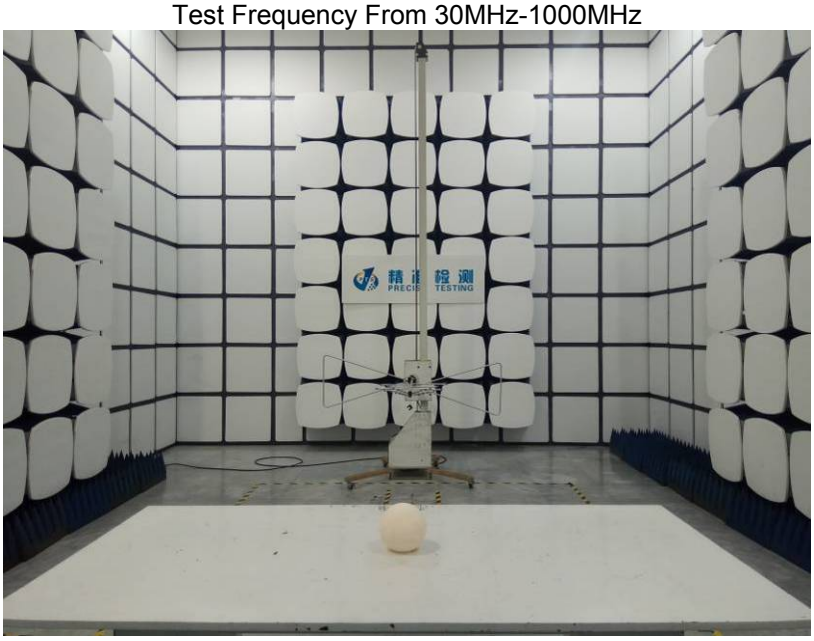
14.2 Result

The EUT'S antenna, permanent attached antenna, is internal antenna. The antenna's gain is -0.58dBi and meets the requirement.

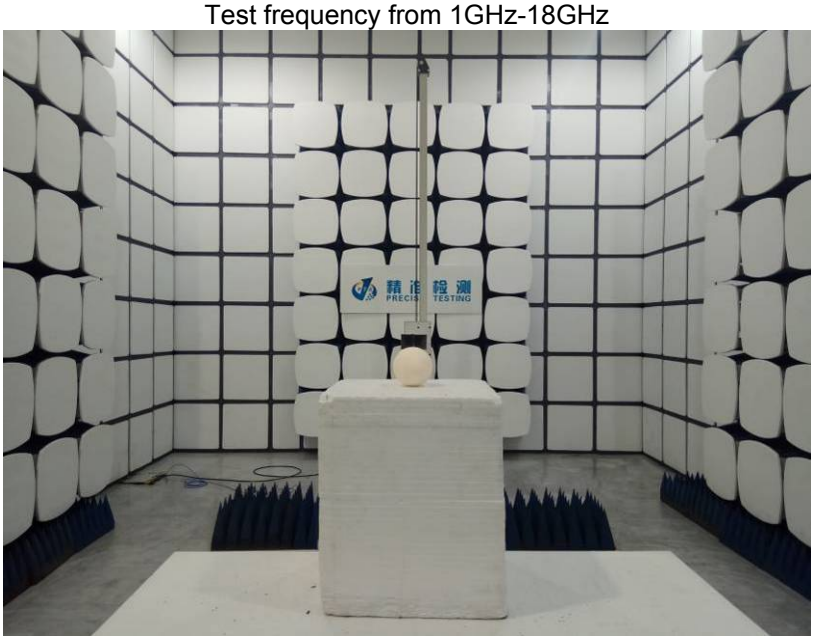
15 TEST PHOTOS

Conducted Emissions

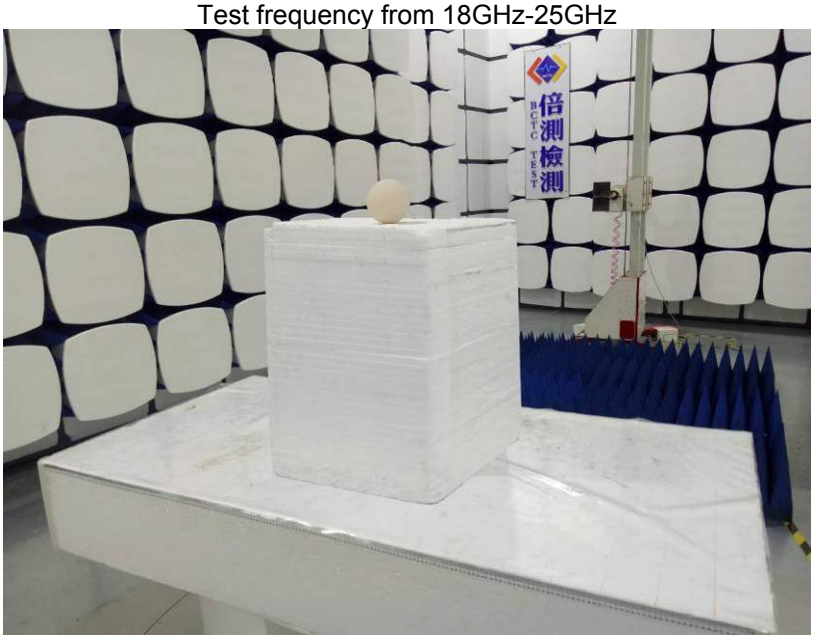
Radiated Spurious Emissions
Test Frequency From 30MHz-1000MHz



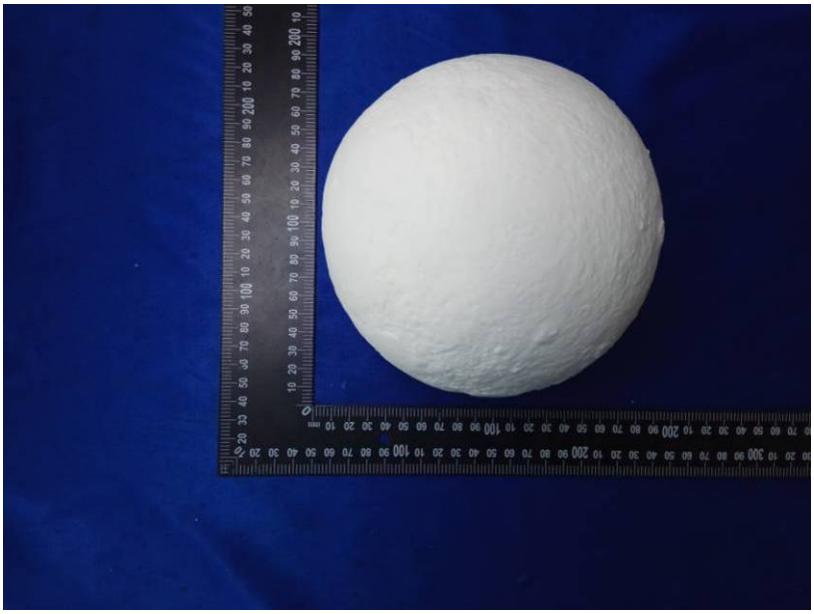
Test frequency from 1GHz-18GHz

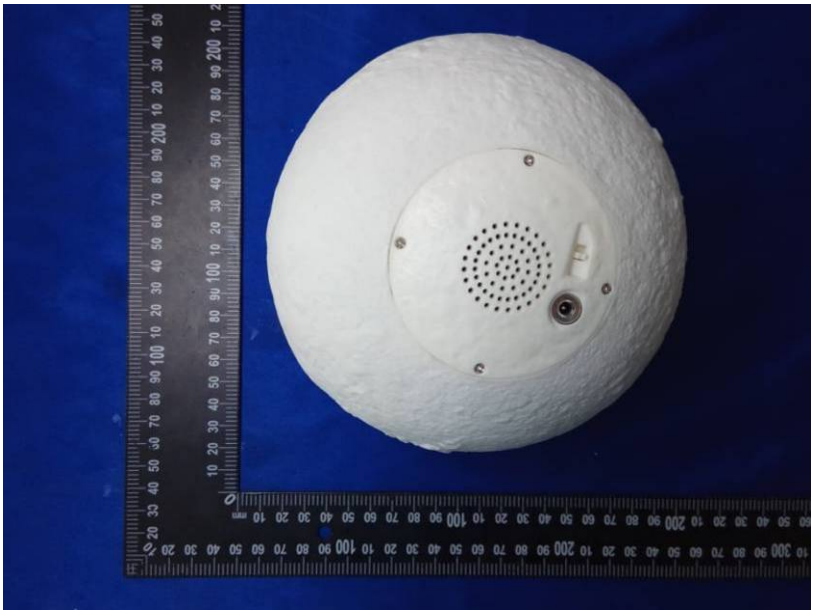


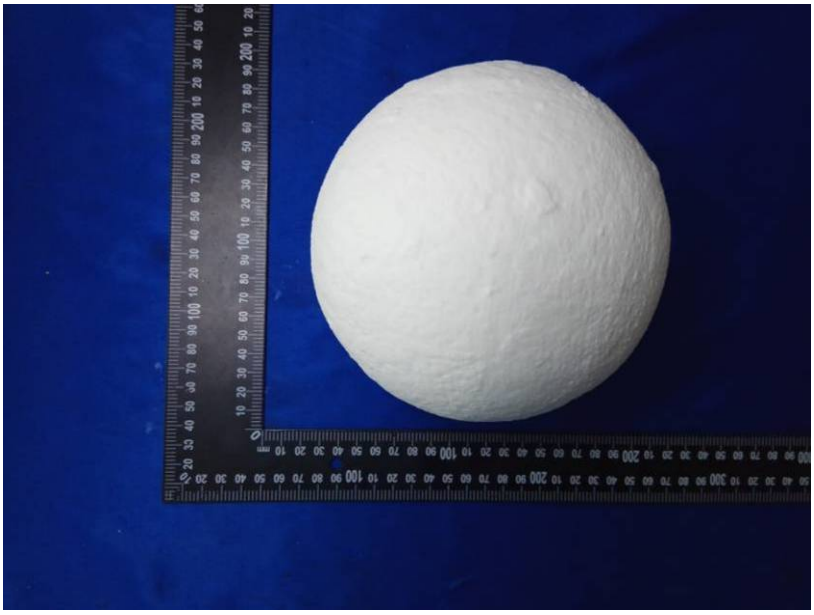
Test frequency from 18GHz-25GHz

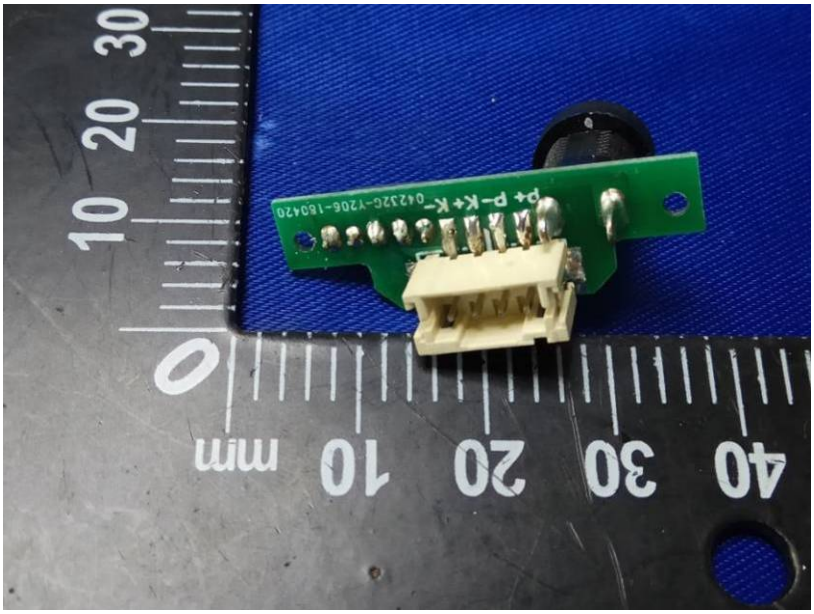


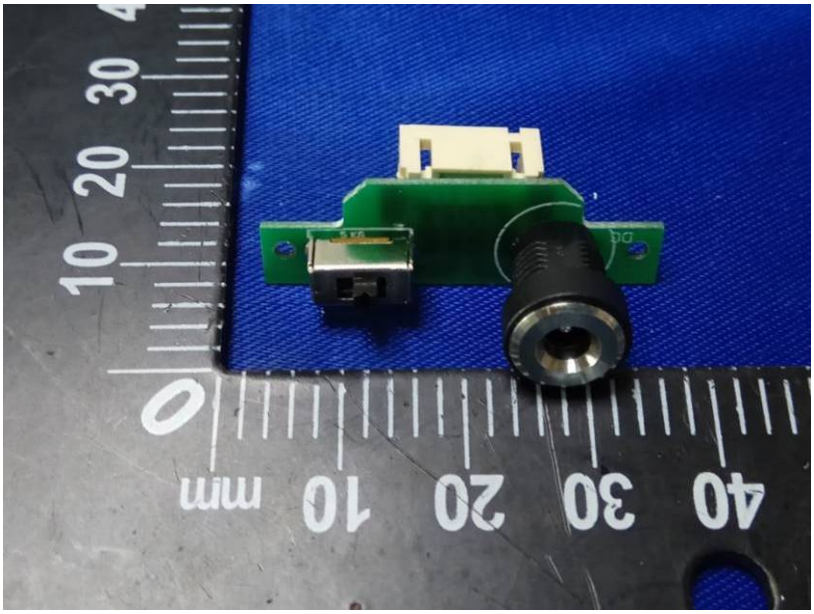
16 EUT PHOTOS

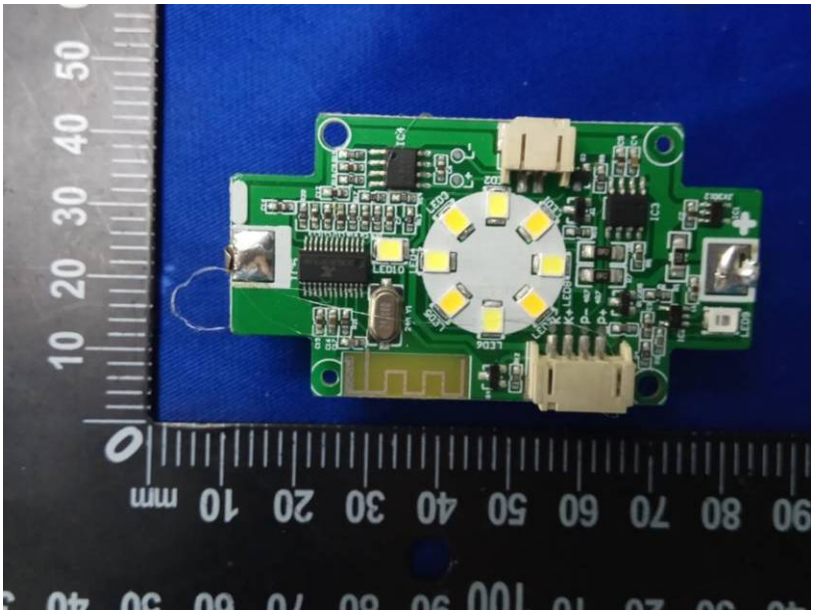


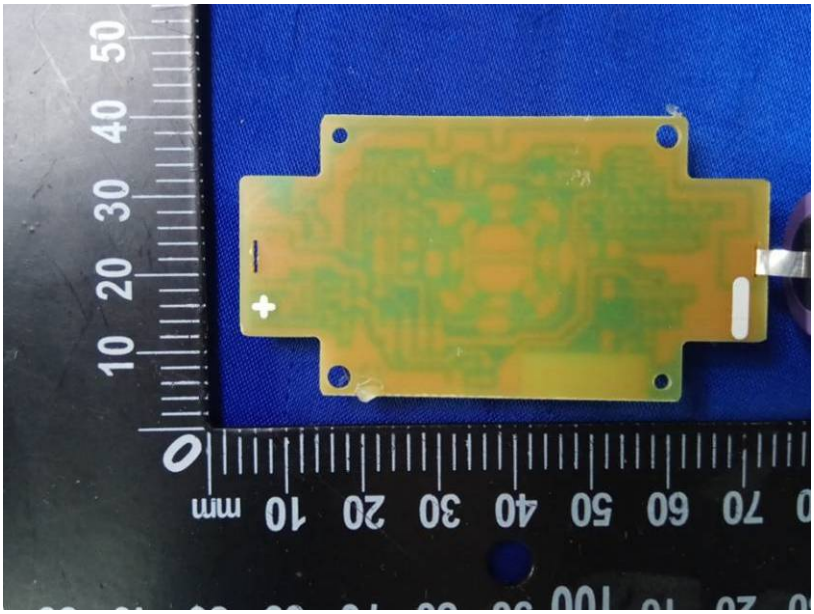


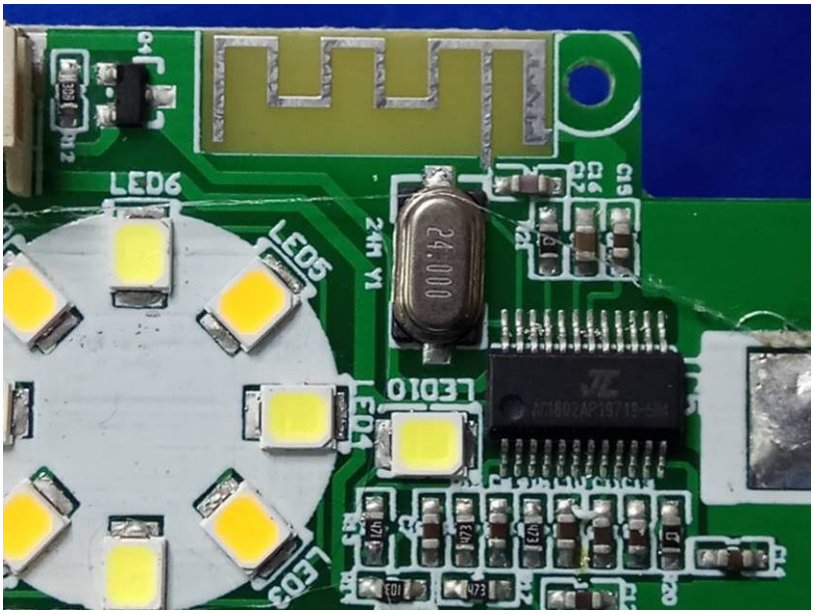


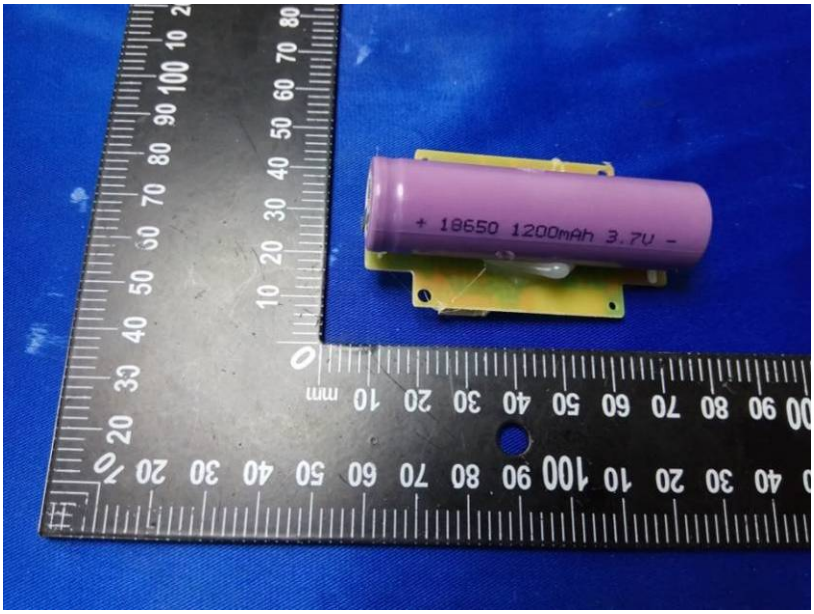

P+ P- K+ K-
mm






mm


LED6
LED5
24M Y1
24.000
LED10
LED4
LED3



********THE END REPORT********