

5.6 Carrier Frequency Separation

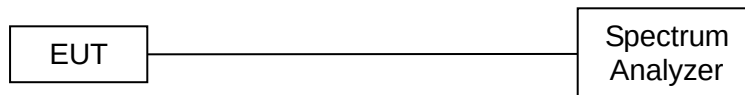
5.6.1 Limit

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(a)(1)	Channel Separation	>25kHz or >two-thirds of the 20 dB bandwidth (Which is greater)	2400-2483.5

5.6.2 Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) Spectrum Setting:
RBW=30 kHz, VBW=100 kHz, detector= Peak, Sweep Time =auto.
- (3) The EUT was set to the Hopping Mode for Channel Separation Test and continuously transmitting for the Test.

5.6.3 Test Setup

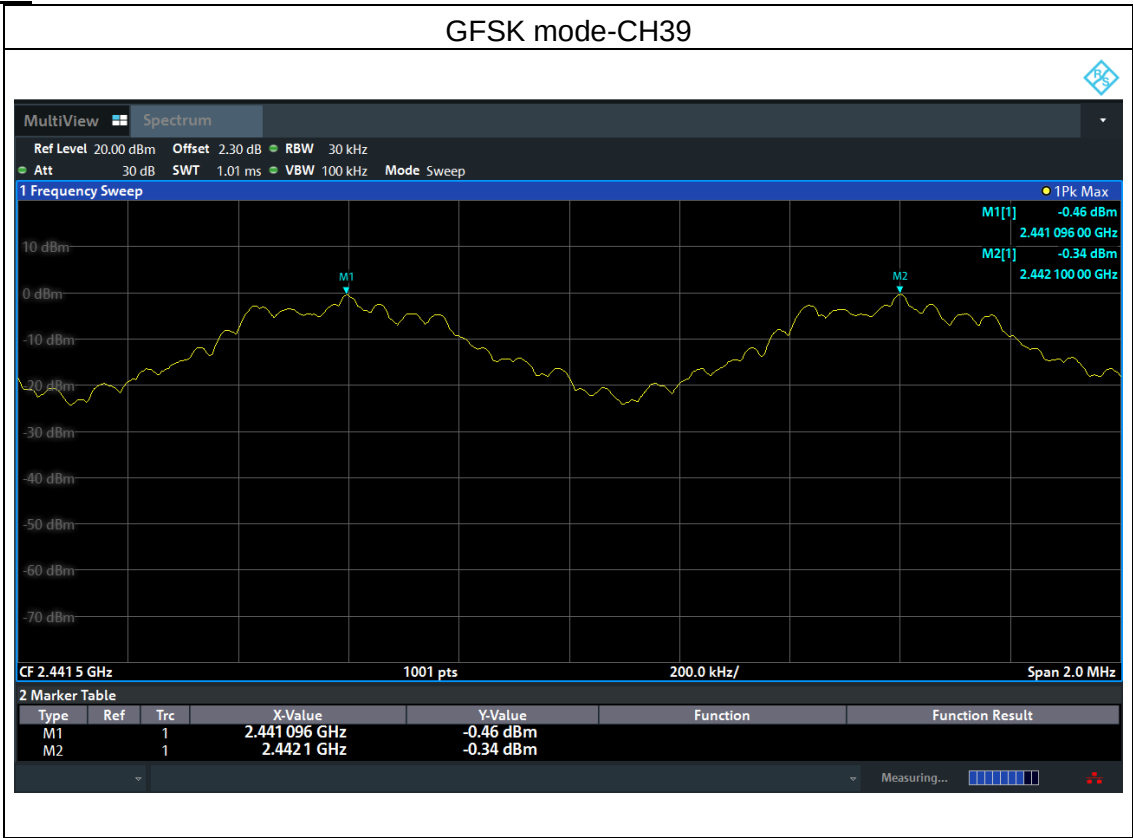


5.6.4 Test Results

EUT:	Wireless charging Bluetooth speaker	Model Name:	AC211
Pressure:	1012 hPa	Test Voltage:	DC 3.7V from battery
Test Mode:	GFSK, $\pi/4$ -DQPSK, 8DPSK /CH00, CH39, CH78		

Mode	Channel	Frequency (MHz)	Test Result (MHz)	Limit (MHz)		Result
GFSK	Middle	2441	1.004	0.926	20dB BW	Pass
$\pi/4$ -DQPSK	Middle	2441	1.002	0.845	2/3 of 20dB BW	Pass
8DPSK	Middle	2441	1.000	0.873	2/3 of 20dB BW	Pass

Test plots





5.7 Hopping Channel Number

5.7.1 Limit

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

5.7.2 Test Procedure

The testing follows IEEE / ANSI C63.10-2020 clause 7.8.3

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously.

The EUT must have its hopping function enabled.

Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW : To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

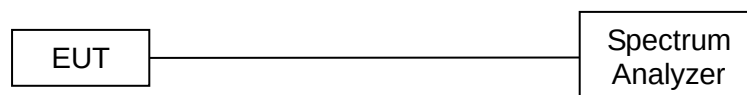
VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

5.7.3 Test Setup



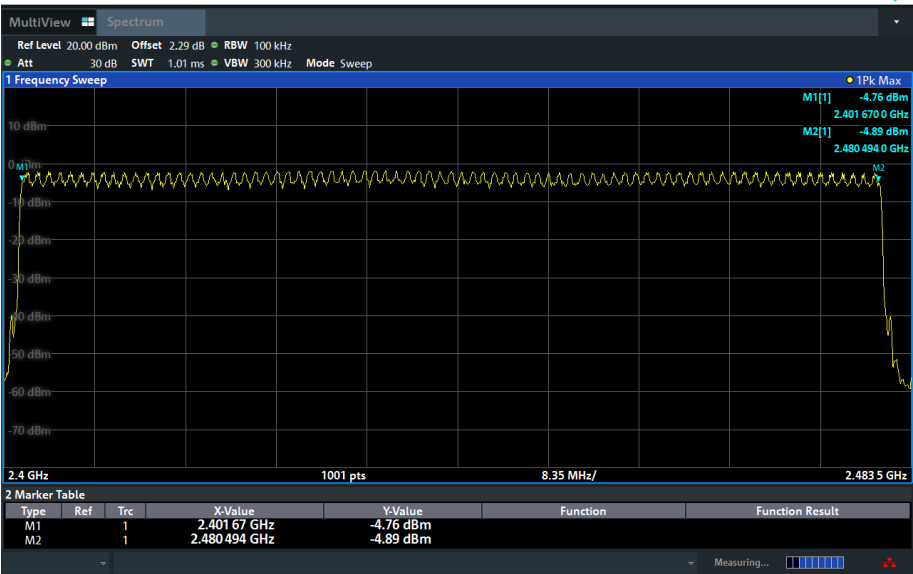
5.7.4 Test Results

Mode	Quantity of Hopping Channel	Limit	Results
GFSK, $\pi/4$ -DQPSK, 8DPSK	79	>15	Pass

Test plots



8DPSK mode



5.8 Dwell Time

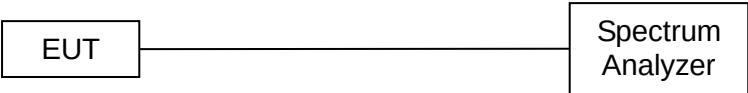
5.8.1 Limit

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(a)(1)	Dwell time	0.4 sec	2400-2483.5

5.8.2 Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) Spectrum Setting: RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak
- (3) Use video trigger with the trigger level set to enable triggering only on full pulses.
- (4) Sweep Time is more than once pulse time.
- (5) Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- (6) Measure the maximum time duration of one single pulse.
- (7) Set the EUT for packet transmitting.
- (8) Measure the maximum time duration of one single pulse.
- (9) The EUT was set to the Hopping Mode for Dwell Time Test.

5.8.3 Test Setup



5.8.4 Test Results

EUT:	Wireless charging Bluetooth speaker	Model Name:	AC211
Pressure:	1012 hPa	Test Voltage:	DC 3.7V from battery
Test Mode:	GFSK, $\pi/4$ -DQPSK, 8DPSK /CH39		

Mode	Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit(s)	Conclusion
GFSK	DH1	2441	0.410	130.79	<0.4	Pass
	DH3	2441	1.665	286.38	<0.4	Pass
	DH5	2441	2.913	311.691	<0.4	Pass
$\pi/4$ DQPSK	2DH1	2441	0.420	134.4	<0.4	Pass
	2DH3	2441	1.671	252.321	<0.4	Pass
	2DH5	2441	2.919	324.009	<0.4	Pass
8DPSK	3DH1	2441	0.421	133.878	<0.4	Pass
	3DH3	2441	1.671	269.031	<0.4	Pass
	3DH5	2441	2.922	327.264	<0.4	Pass

Note:

1. A period time = 0.4 (s) * 79 = 31.6(s)

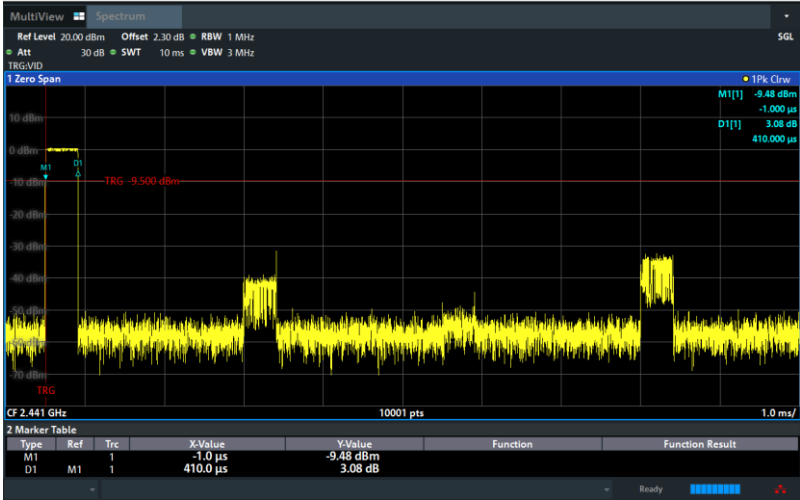
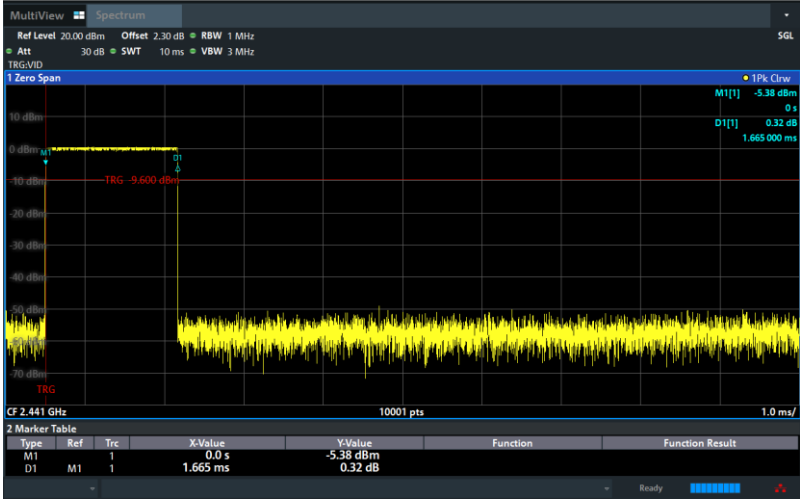
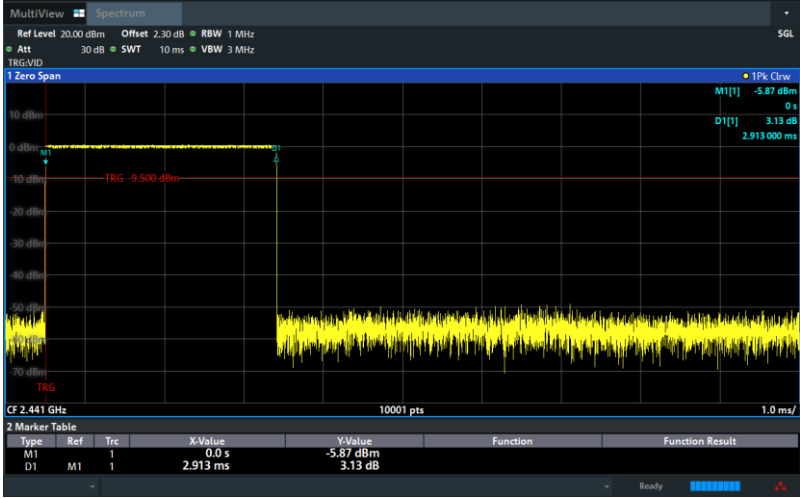
2. DH1 time slot = Pulse Duration * (1600/(2*79)) * A period time

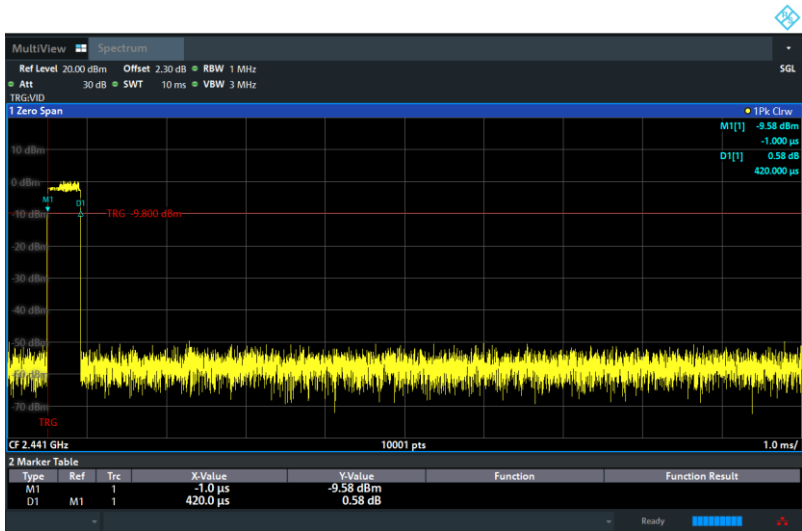
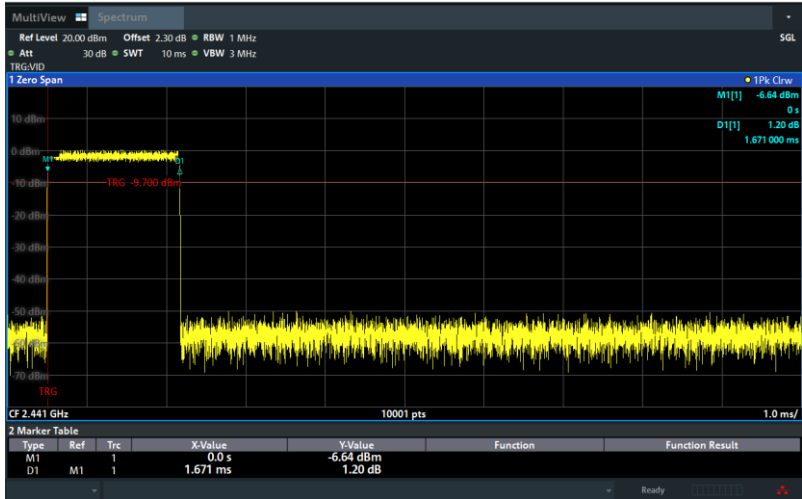
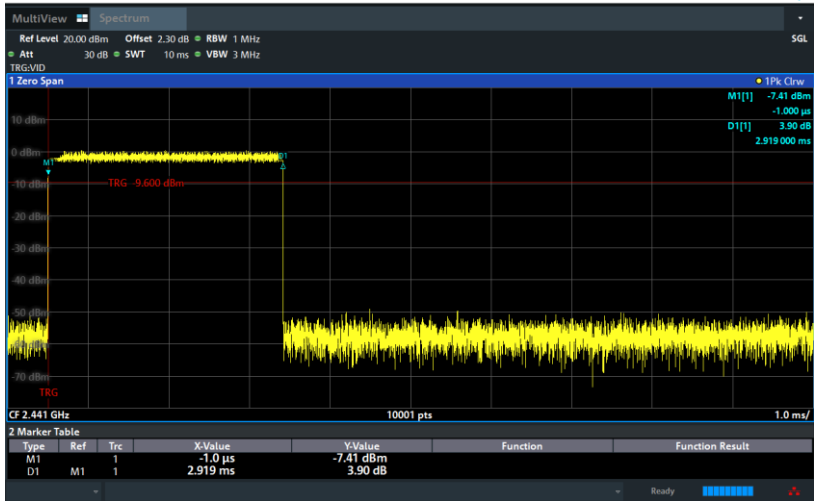
DH3 time slot = Pulse Duration * (1600/(4*79)) * A period time

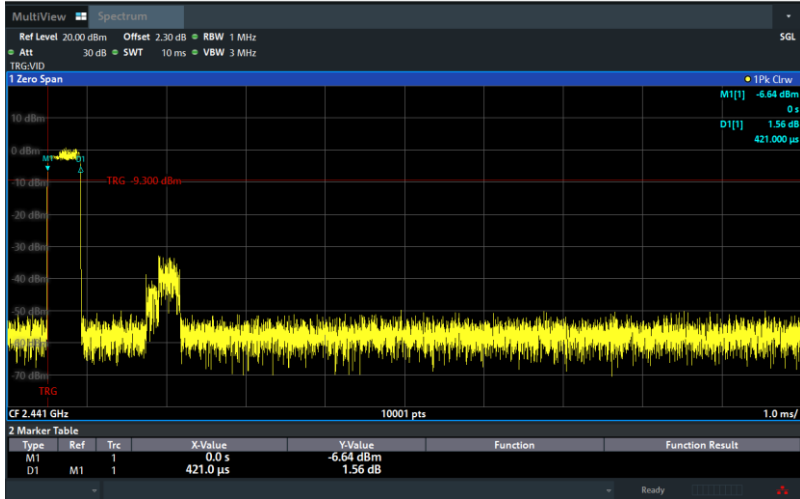
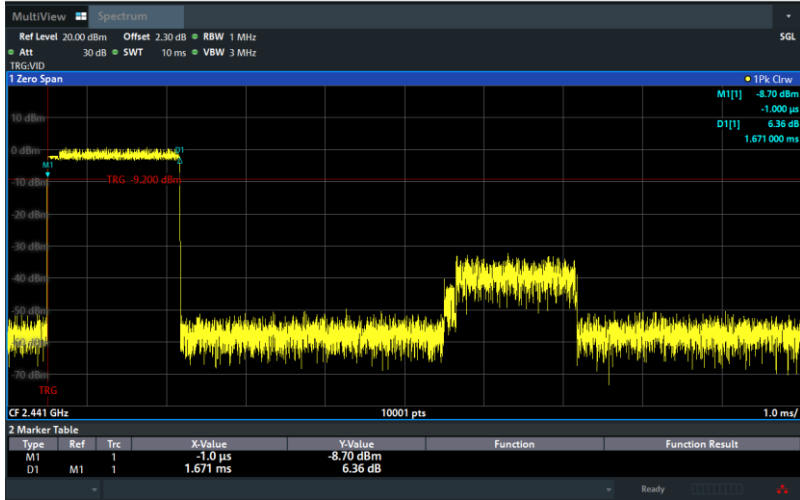
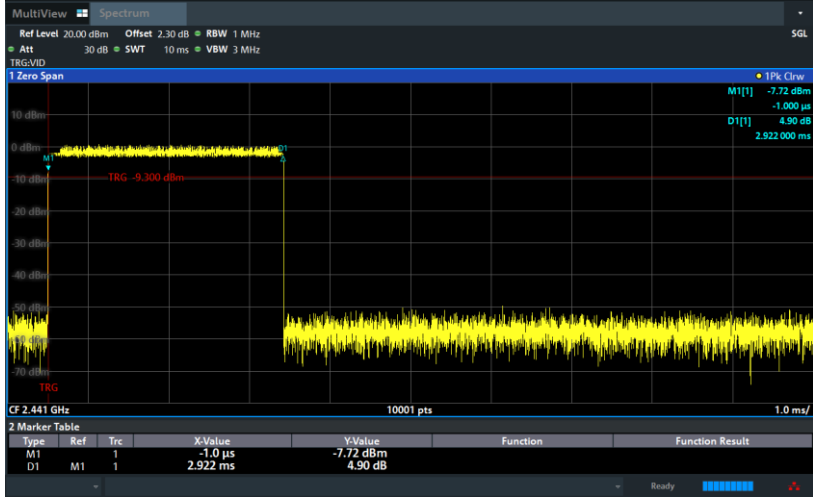
DH5 time slot = Pulse Duration * (1600/(6*79)) * A period time

3. For GFSK, $\pi/4$ -DQPSK and 8DPSK: The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test plots

Modulation mode	GFSK mode
DH1	 The plot shows a signal at 2.441 GHz. The peak level is -9.48 dBm. The duration is 410.000 μs. The signal is shown in a 10001 pts window with a 1.0 ms scale.
DH3	 The plot shows a signal at 2.441 GHz. The peak level is -5.38 dBm. The duration is 1.665 ms. The signal is shown in a 10001 pts window with a 1.0 ms scale.
DH5	 The plot shows a signal at 2.441 GHz. The peak level is -5.87 dBm. The duration is 2.913 ms. The signal is shown in a 10001 pts window with a 1.0 ms scale.

Modulation mode		$\pi/4$ -DQPSK mode																					
2-DH1	 MultiView Spectrum Ref Level 20.00 dBm Offset 2.30 dB RBW 1 MHz Att 30 dB SWT 10 ms VBW 3 MHz TRG:VID 1 Zero Span CF 2.441 GHz 10001 pts 1.0 ms/ 2 Marker Table <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td>1</td><td>-1.0 μs</td><td>-9.58 dBm</td><td></td><td></td></tr><tr><td>D1</td><td>M1</td><td>1</td><td>420.0 μs</td><td>0.58 dB</td><td></td><td></td></tr></table>		Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1	1	-1.0 μ s	-9.58 dBm			D1	M1	1	420.0 μ s	0.58 dB		
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result																	
M1	1	1	-1.0 μ s	-9.58 dBm																			
D1	M1	1	420.0 μ s	0.58 dB																			
2-DH3	 MultiView Spectrum Ref Level 20.00 dBm Offset 2.30 dB RBW 1 MHz Att 30 dB SWT 10 ms VBW 3 MHz TRG:VID 1 Zero Span CF 2.441 GHz 10001 pts 1.0 ms/ 2 Marker Table <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td>1</td><td>0.0 s</td><td>-6.64 dBm</td><td></td><td></td></tr><tr><td>D1</td><td>M1</td><td>1</td><td>1.671 ms</td><td>1.20 dB</td><td></td><td></td></tr></table>		Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1	1	0.0 s	-6.64 dBm			D1	M1	1	1.671 ms	1.20 dB		
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result																	
M1	1	1	0.0 s	-6.64 dBm																			
D1	M1	1	1.671 ms	1.20 dB																			
2-DH5	 MultiView Spectrum Ref Level 20.00 dBm Offset 2.30 dB RBW 1 MHz Att 30 dB SWT 10 ms VBW 3 MHz TRG:VID 1 Zero Span CF 2.441 GHz 10001 pts 1.0 ms/ 2 Marker Table <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td>1</td><td>-1.0 μs</td><td>-7.41 dBm</td><td></td><td></td></tr><tr><td>D1</td><td>M1</td><td>1</td><td>2.919 ms</td><td>3.90 dB</td><td></td><td></td></tr></table>		Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1	1	-1.0 μ s	-7.41 dBm			D1	M1	1	2.919 ms	3.90 dB		
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result																	
M1	1	1	-1.0 μ s	-7.41 dBm																			
D1	M1	1	2.919 ms	3.90 dB																			

Modulation mode		8DPSK mode
3-DH1		
3-DH3		
3-DH5		

5.9 Conducted Band Edge

5.9.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

5.9.2 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- Repeat above procedures until all measured frequencies were complete.

5.9.3 Test Setup

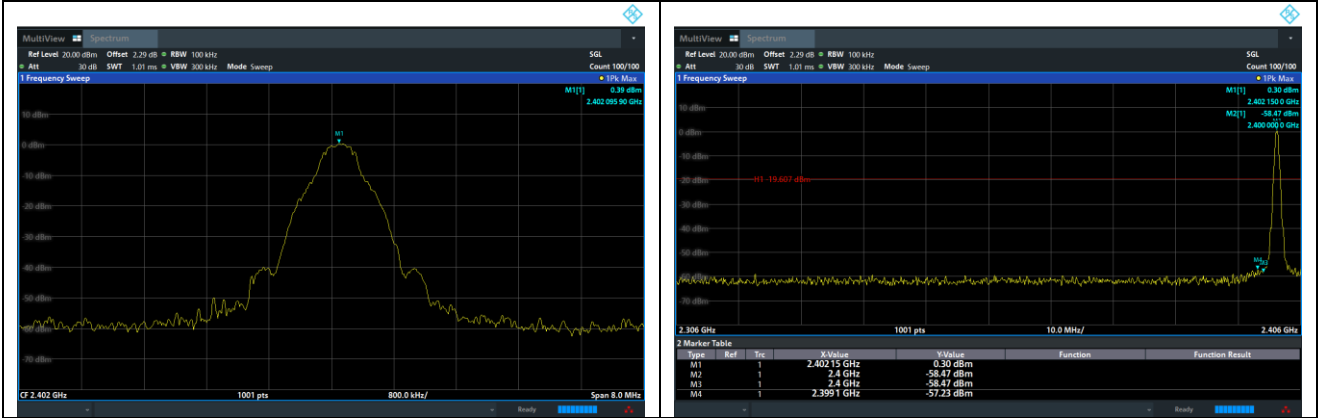


5.9.4 Test Results

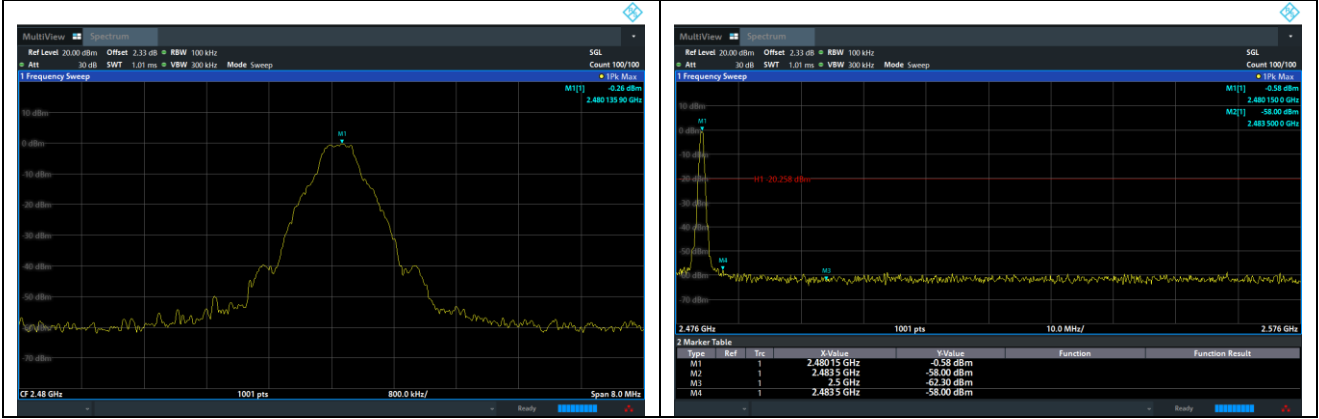
EUT:	Wireless charging Bluetooth speaker	Model Name:	AC211
Pressure:	1012 hPa	Test Voltage:	DC 3.7V from battery

Test plots

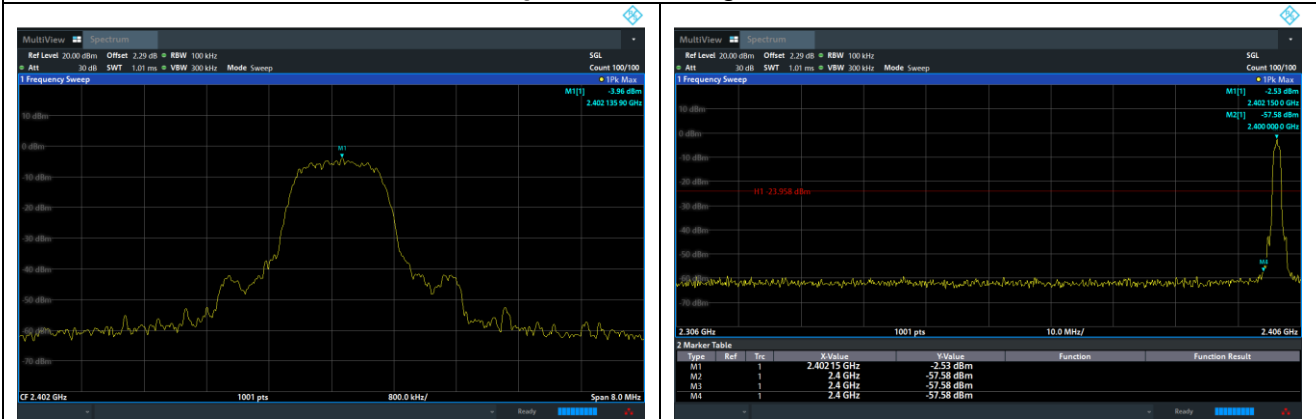
GFSK: Band Edge, Left Side



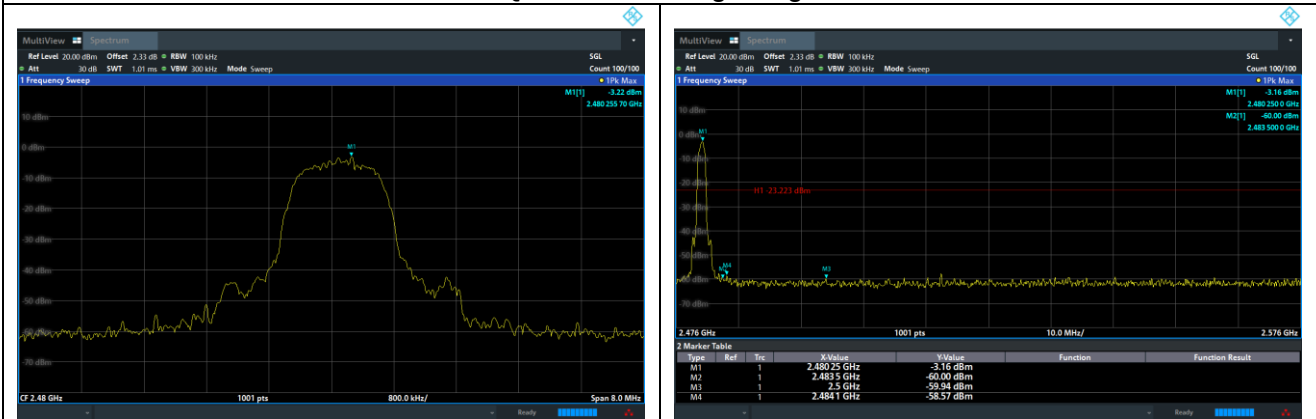
GFSK: Band Edge, Right Side



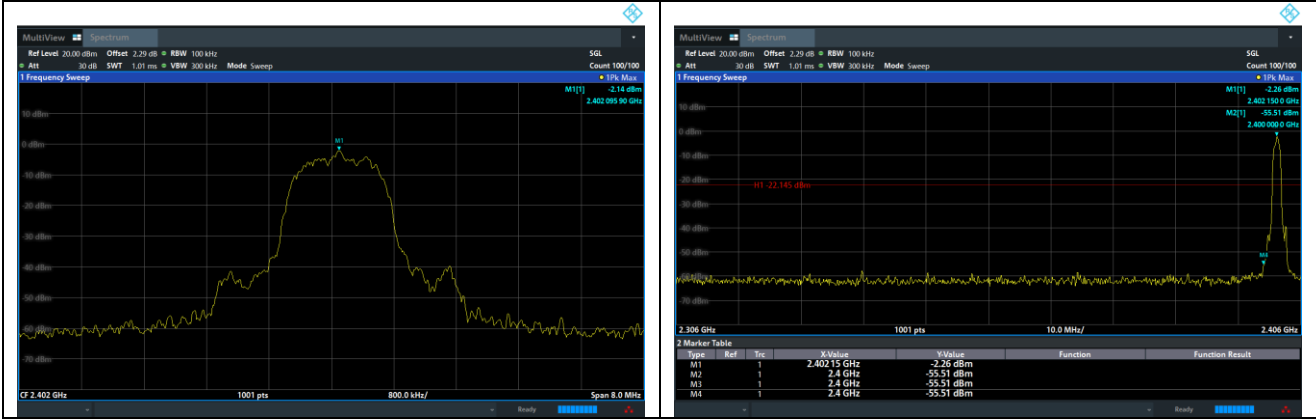
$\pi/4$ -DQPSK: Band Edge, Left Side



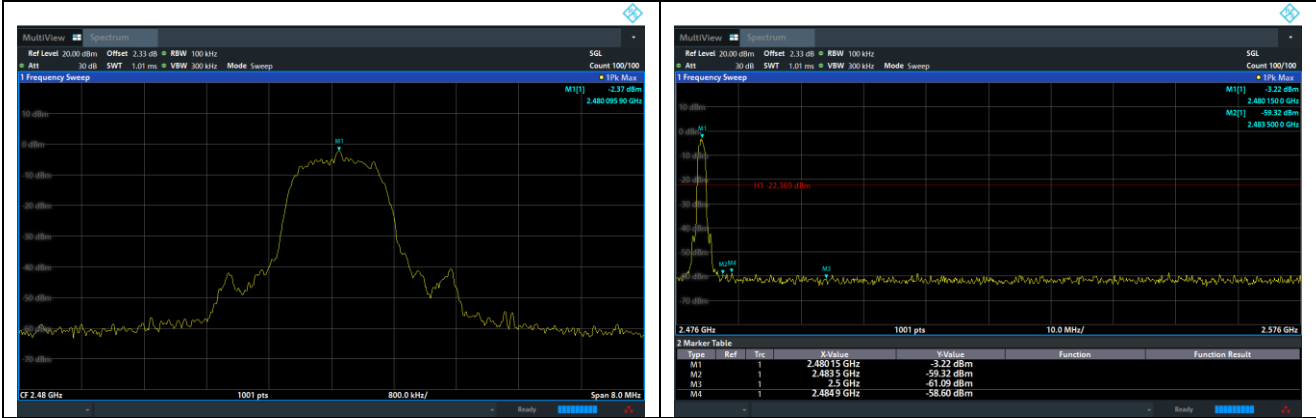
$\pi/4$ -DQPSK: Band Edge, Right Side



8DPSK: Band Edge, Left Side



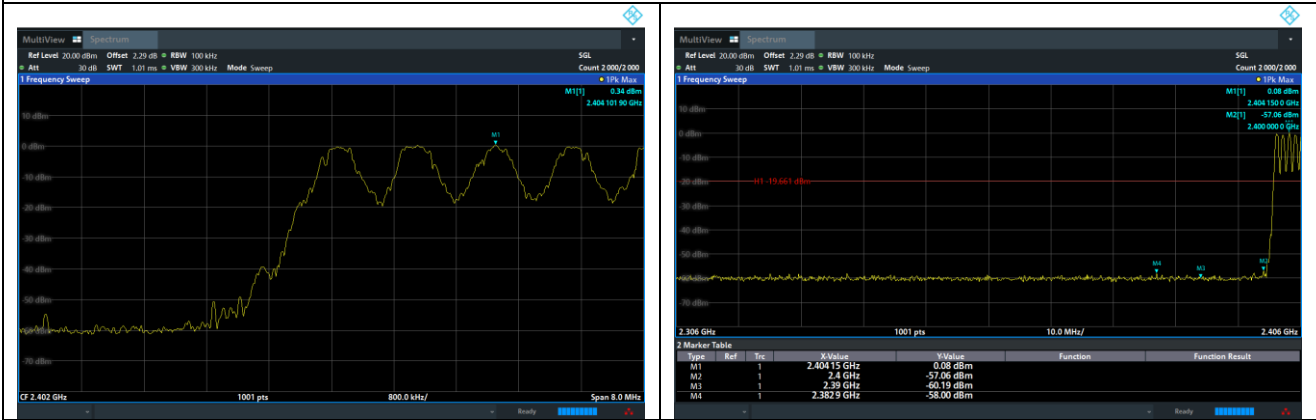
8DPSK: Band Edge, Right Side



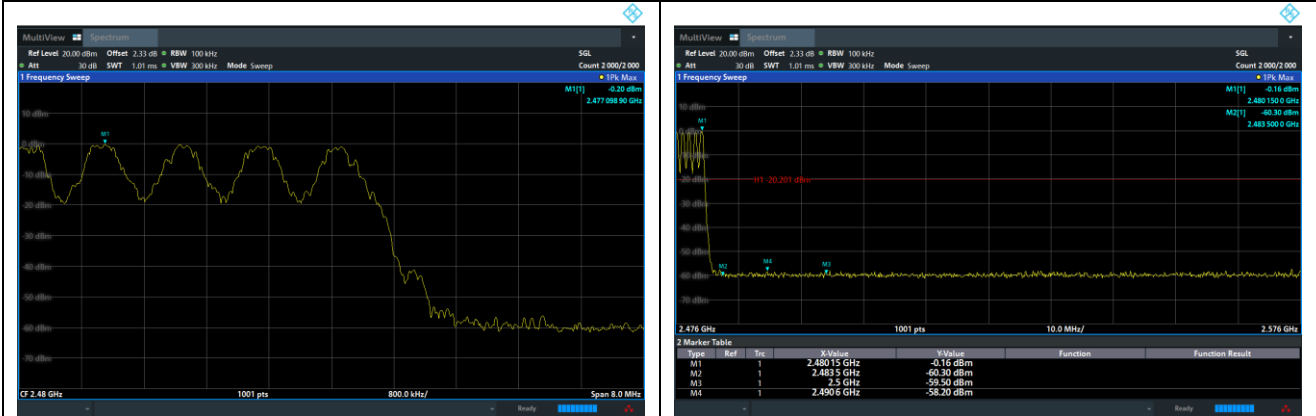
Hopping Mode

Test plots

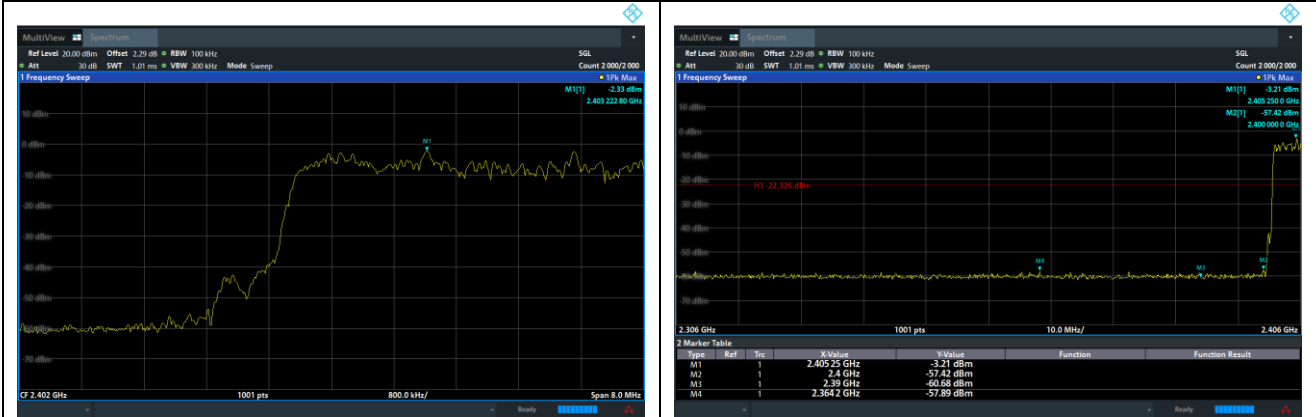
GFSK: Band Edge, Left Side



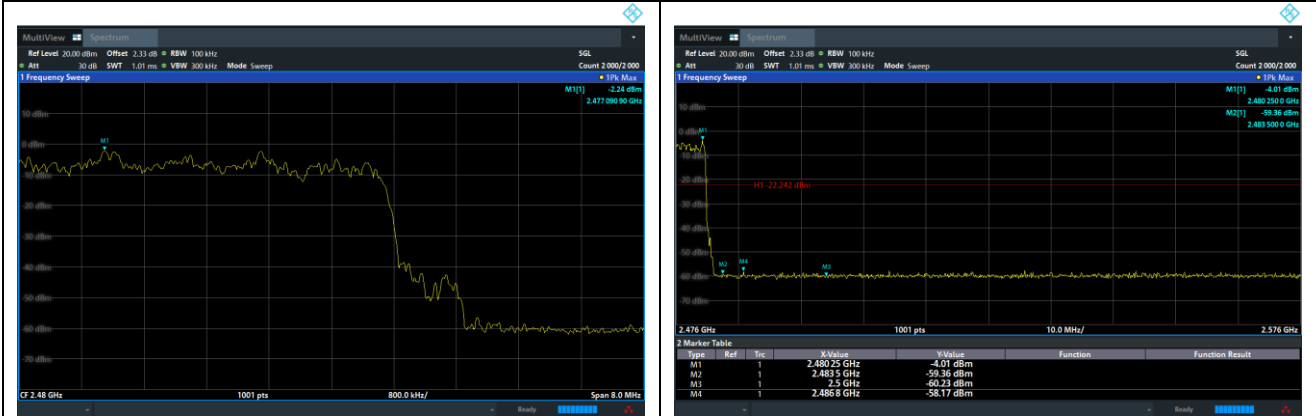
GFSK: Band Edge, Right Side



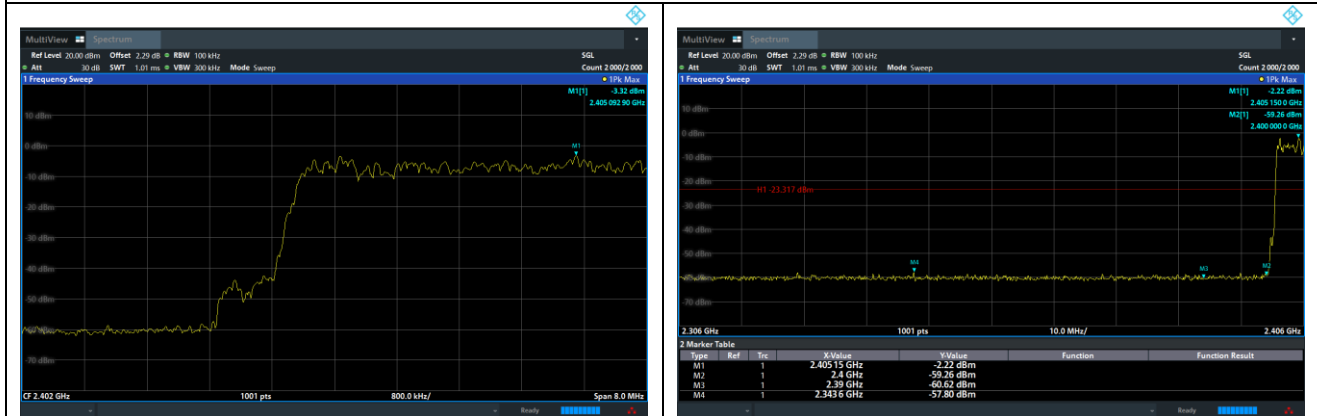
$\pi/4$ -DQPSK: Band Edge, Left Side



$\pi/4$ -DQPSK: Band Edge, Right Side



8DPSK: Band Edge, Left Side



8DPSK: Band Edge, Right Side



5.10 Spurious RF Conducted Emissions

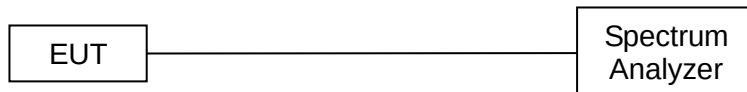
5.10.1 Limit

Below -20dB of the highest emission level in operating band.

5.10.2 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2020 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW=300kHz to measure the peak field strength, and measure frequency range from 9kHz to 26.5GHz.

5.10.3 Test Setup

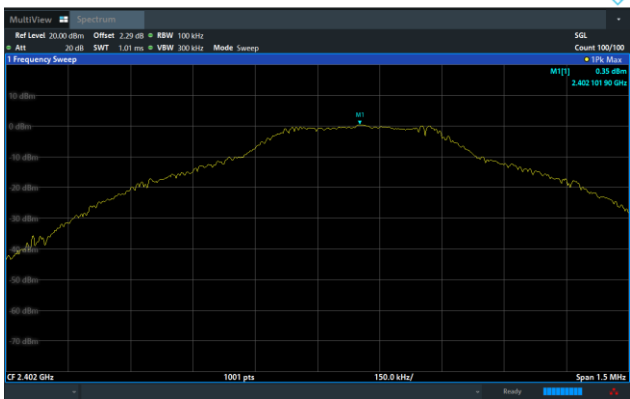


5.10.4 Test Results

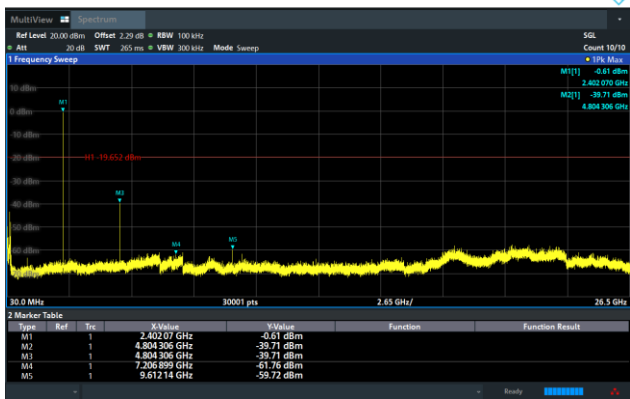
Note:

- 1: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and band edge measurement data.
- 2: The worst mode is GFSK mode, and the report only show the worst mode data.

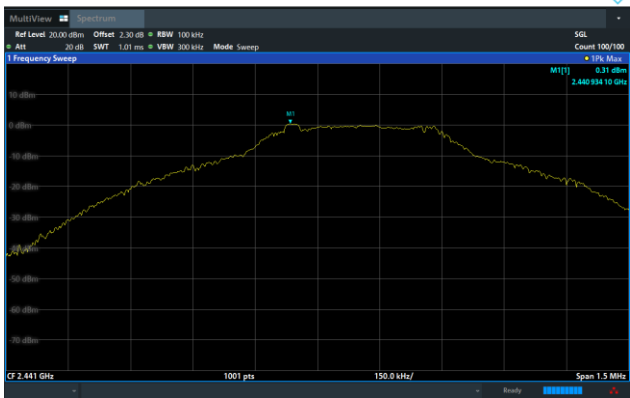
GFSK on Channel 00



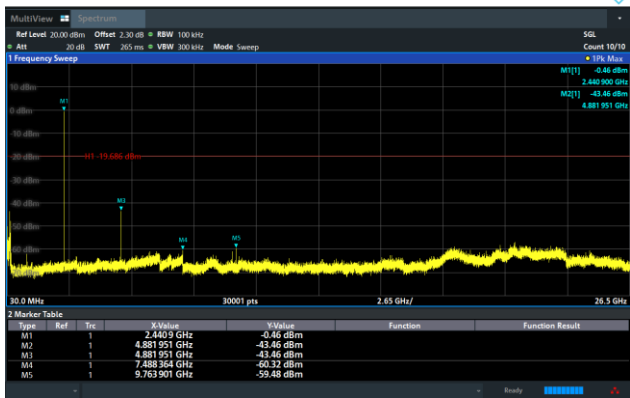
GFSK on Channel 00



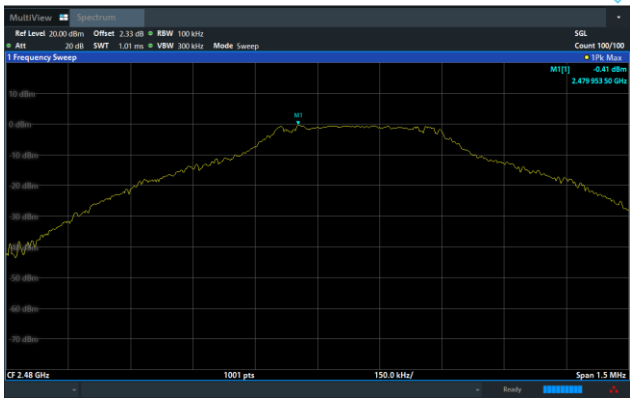
GFSK on Channel 39



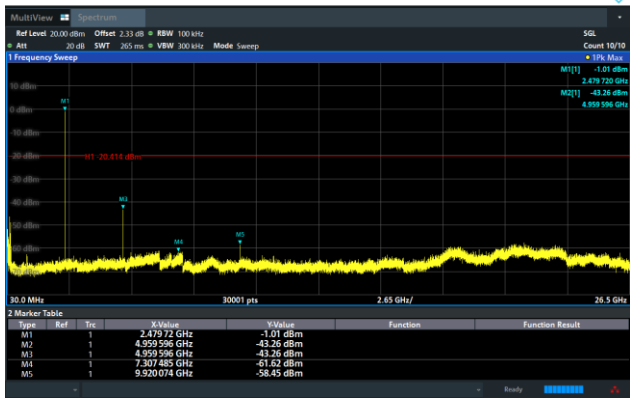
GFSK on Channel 39



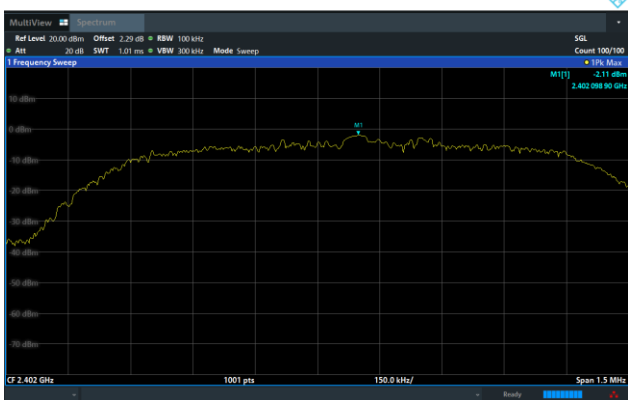
GFSK on Channel 78



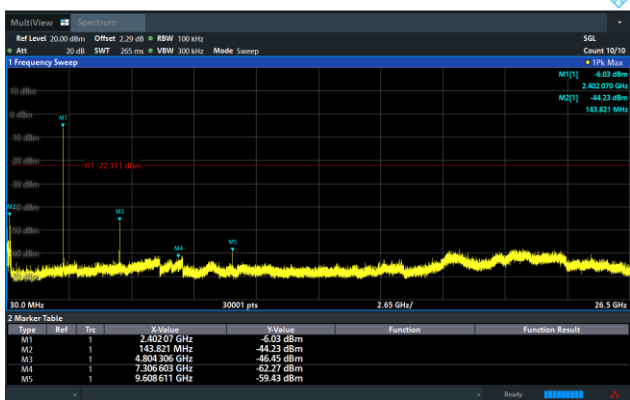
GFSK on Channel 78



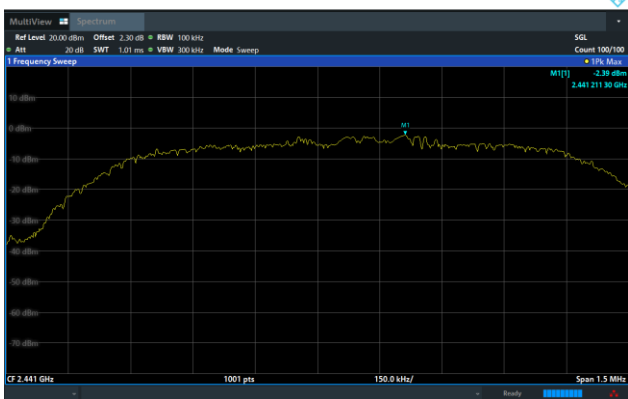
$\pi/4$ -DQPSK on Channel 00



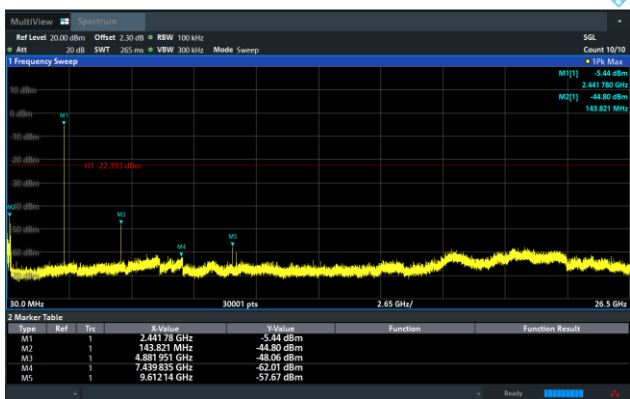
$\pi/4$ -DQPSK on Channel 00



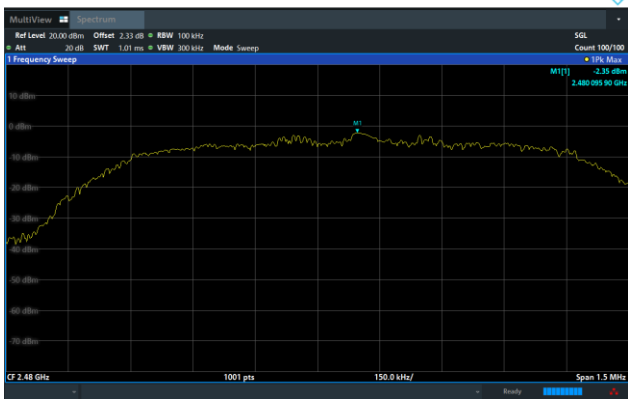
$\pi/4$ -DQPSK on Channel 39



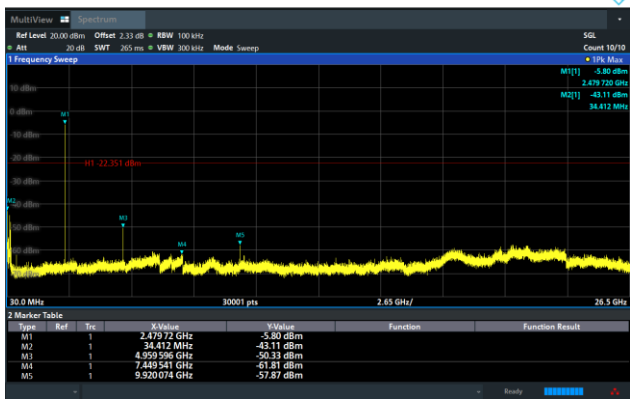
$\pi/4$ -DQPSK on Channel 39



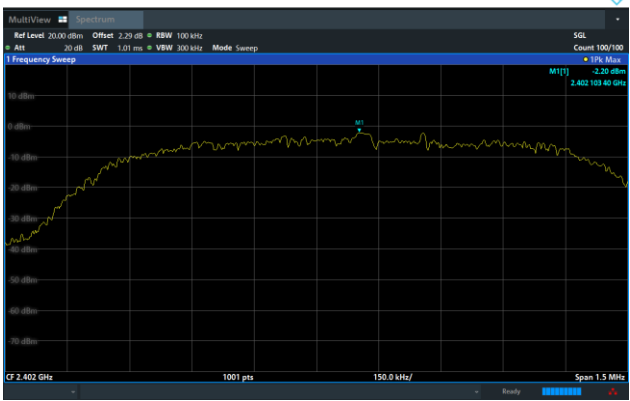
$\pi/4$ -DQPSK on Channel 78



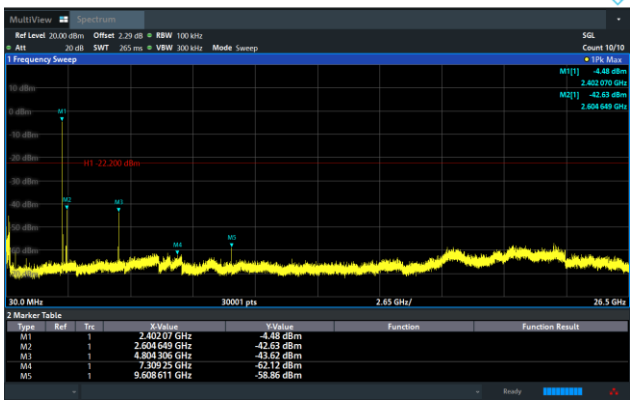
$\pi/4$ -DQPSK on Channel 78



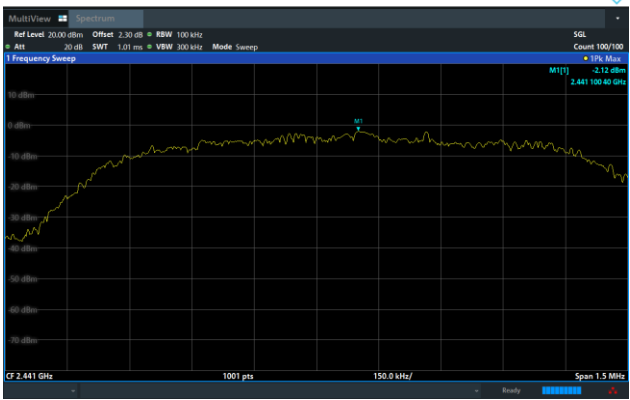
8DPSK on Channel 00



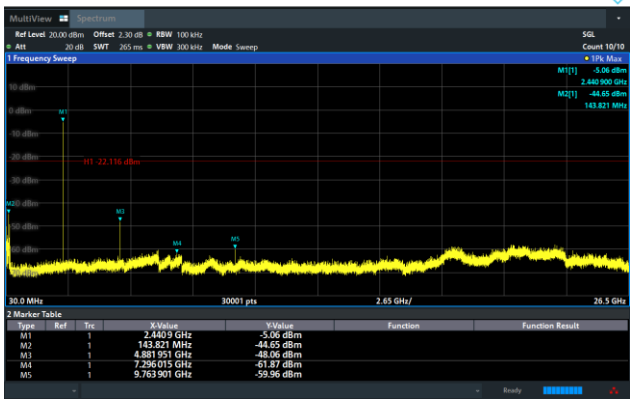
8DPSK on Channel 00



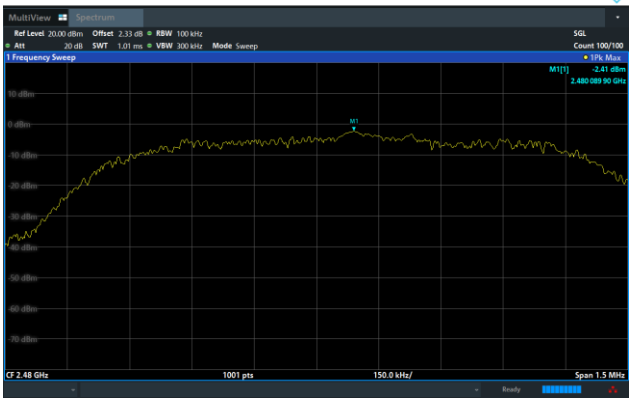
8DPSK on Channel 39



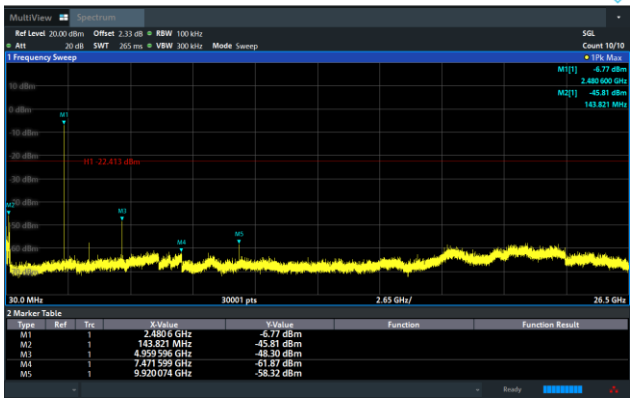
8DPSK on Channel 39



8DPSK on Channel 78

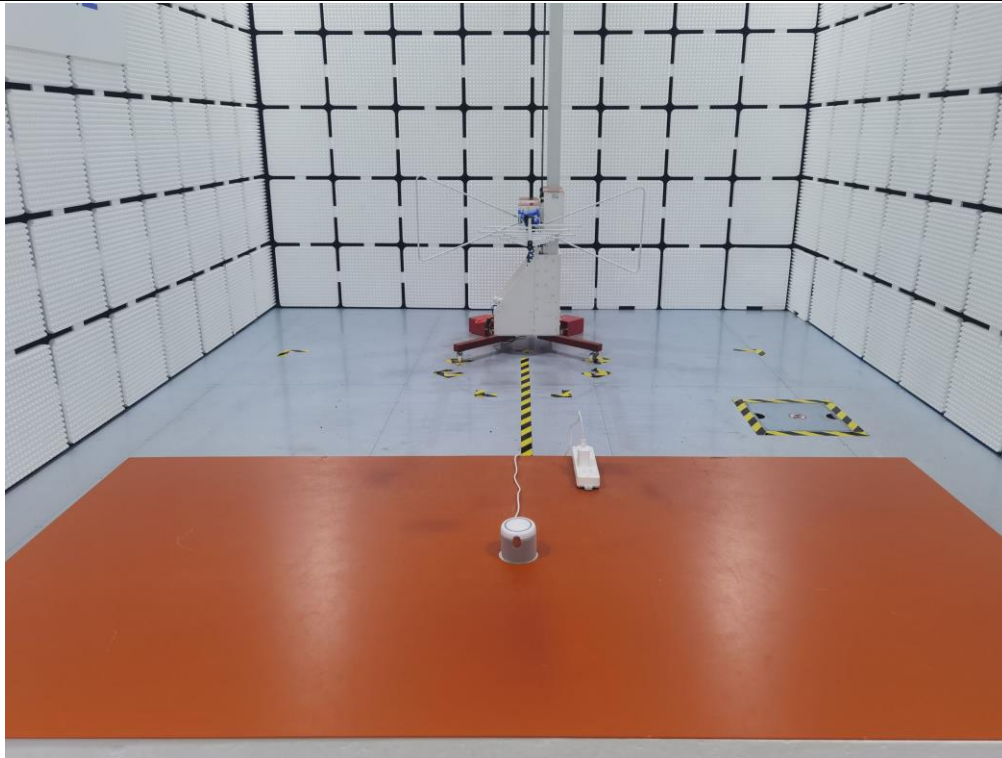


8DPSK on Channel 78



6 Photographs of the Test Setup

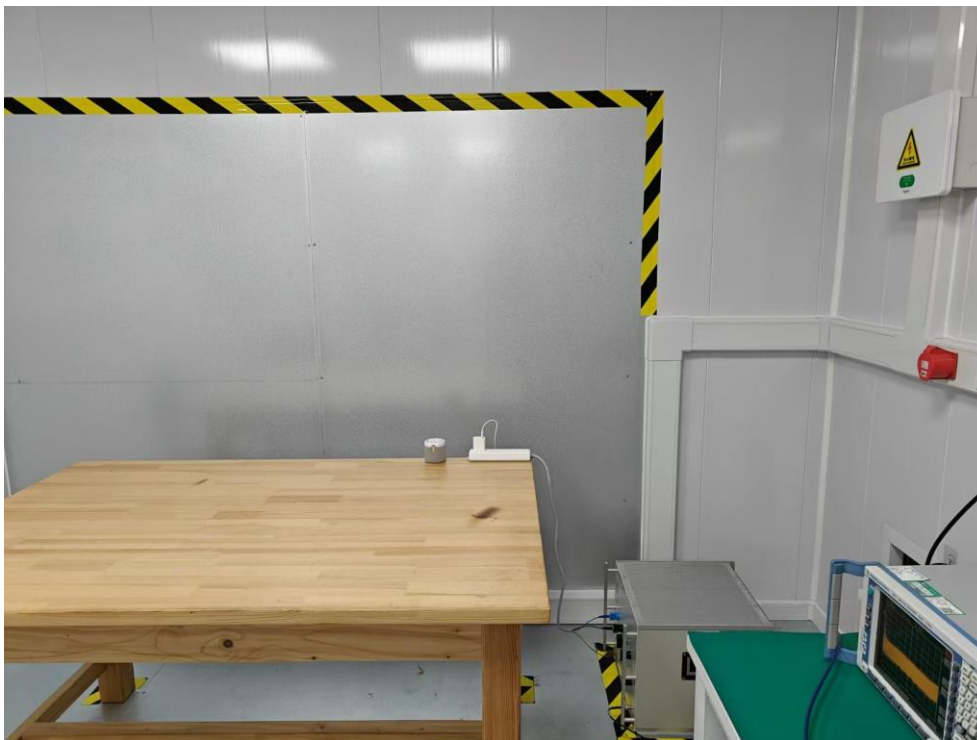
Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



Conducted emission



7 Photographs of the EUT

Photo 1



Photo 2



Photo 3

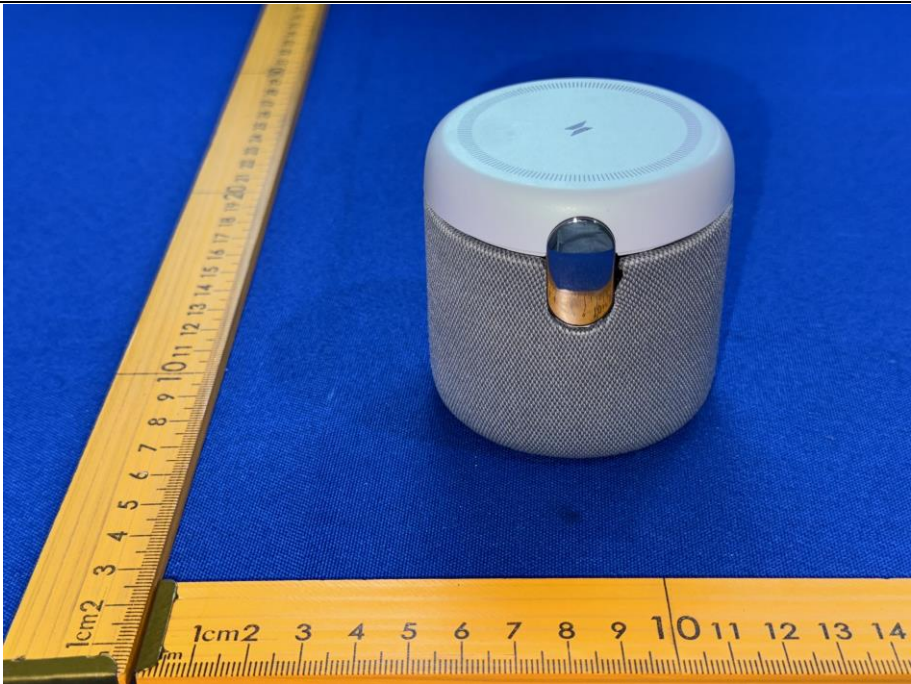


Photo 4

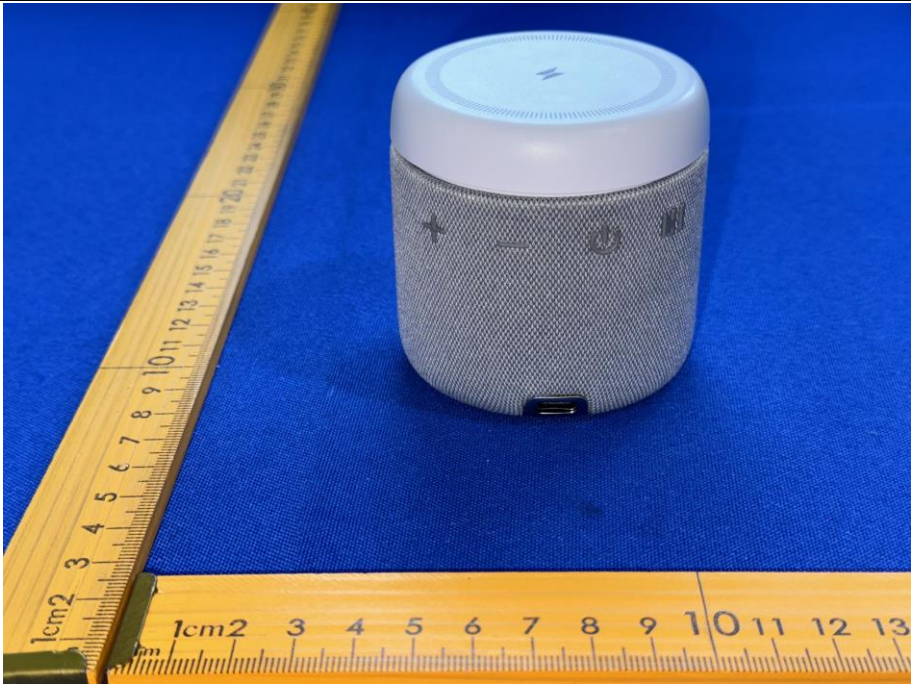


Photo 5

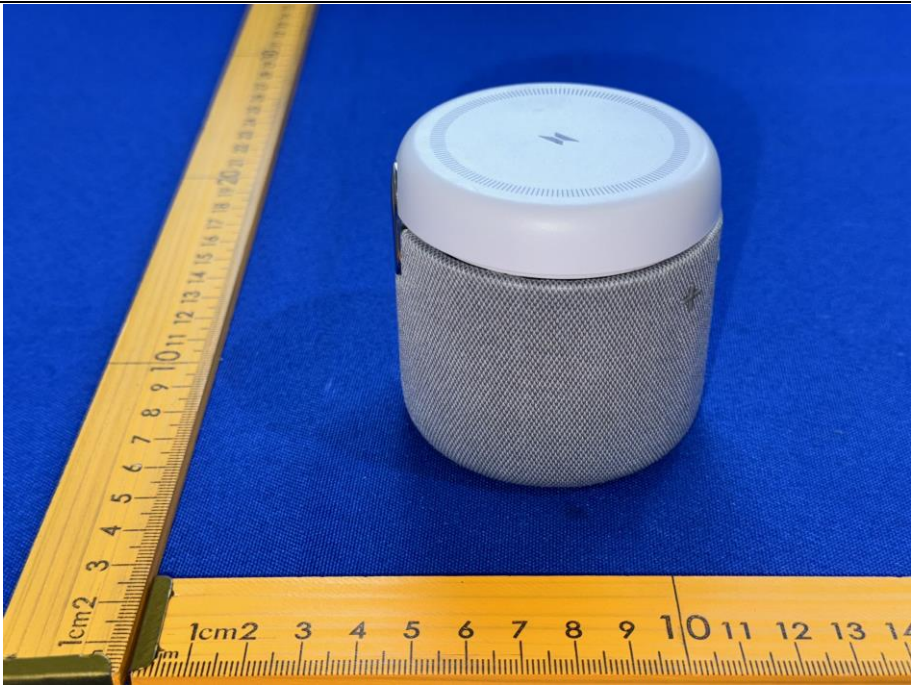


Photo 6

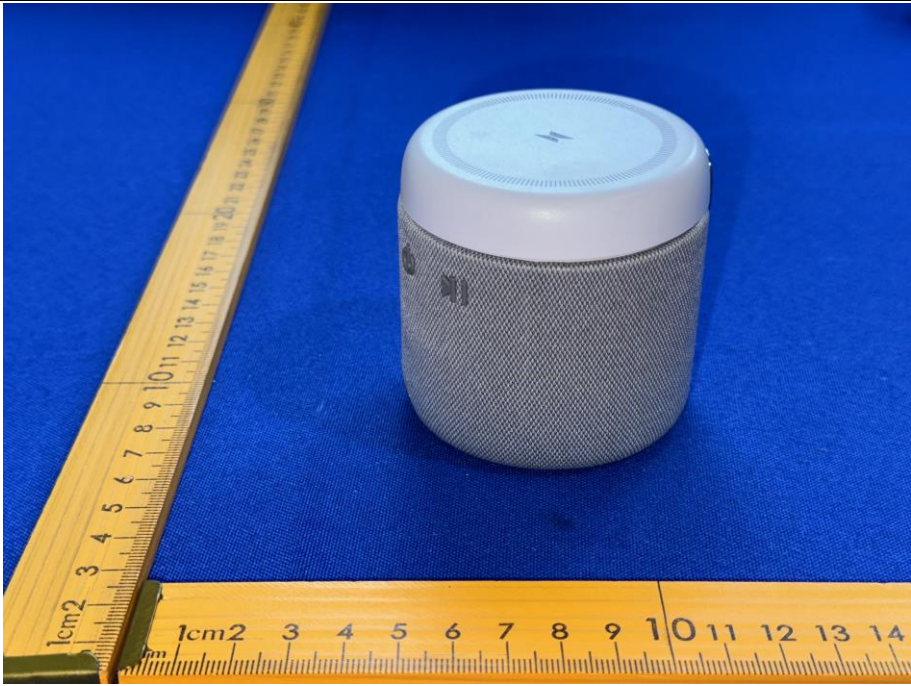


Photo 7



Photo 8

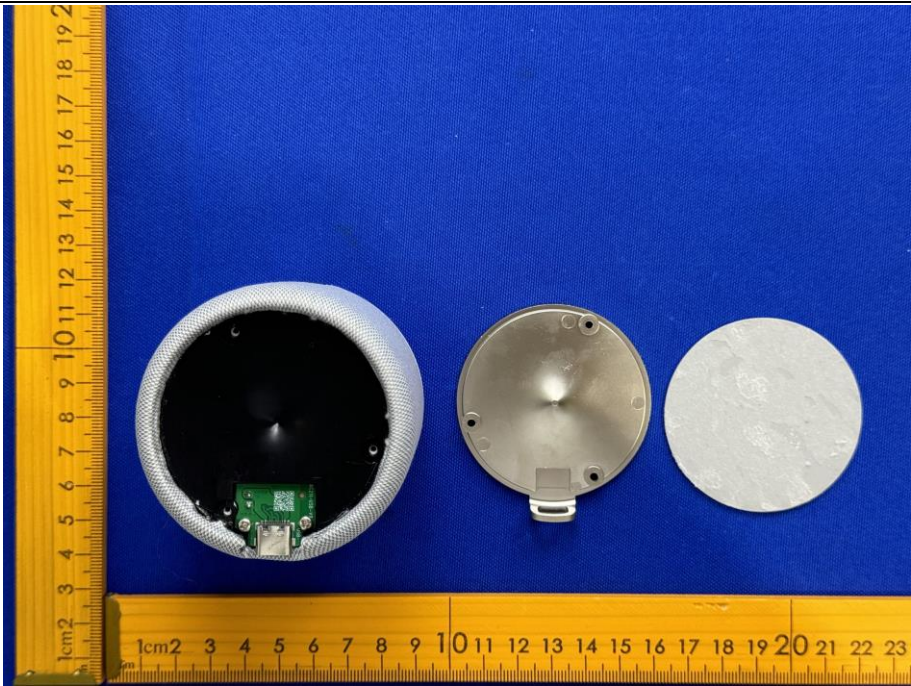


Photo 9

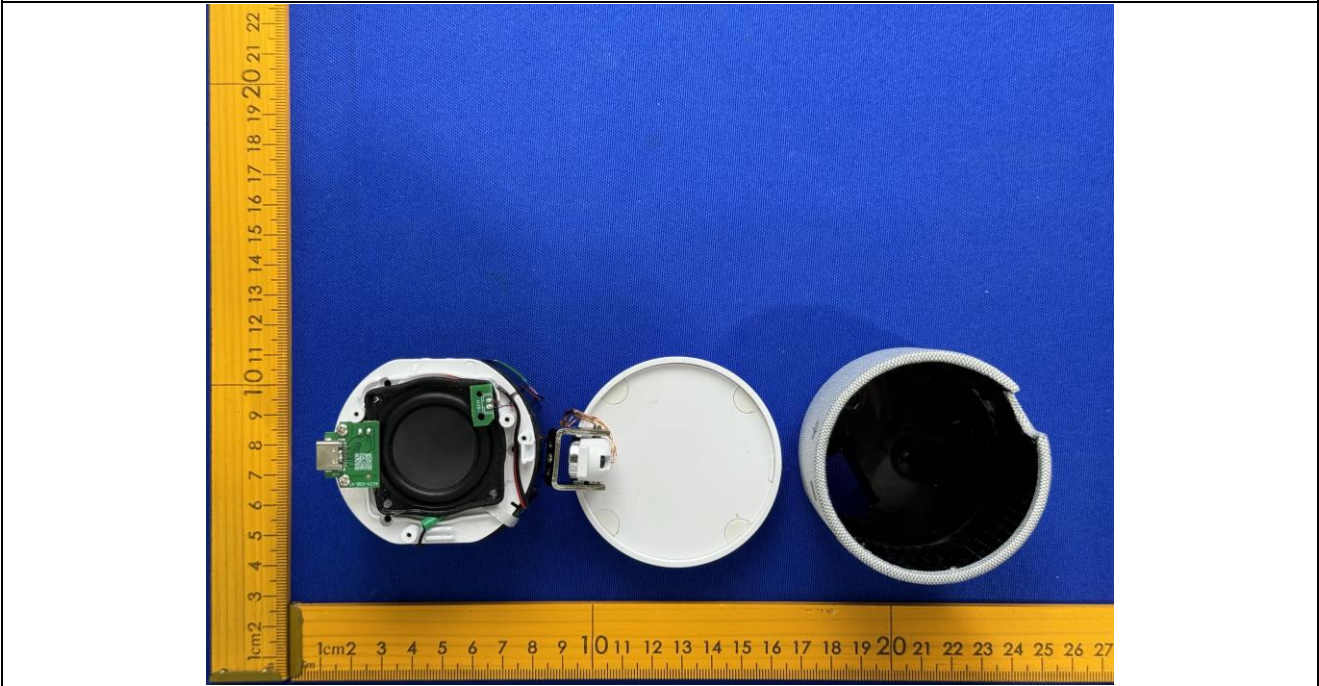


Photo 10

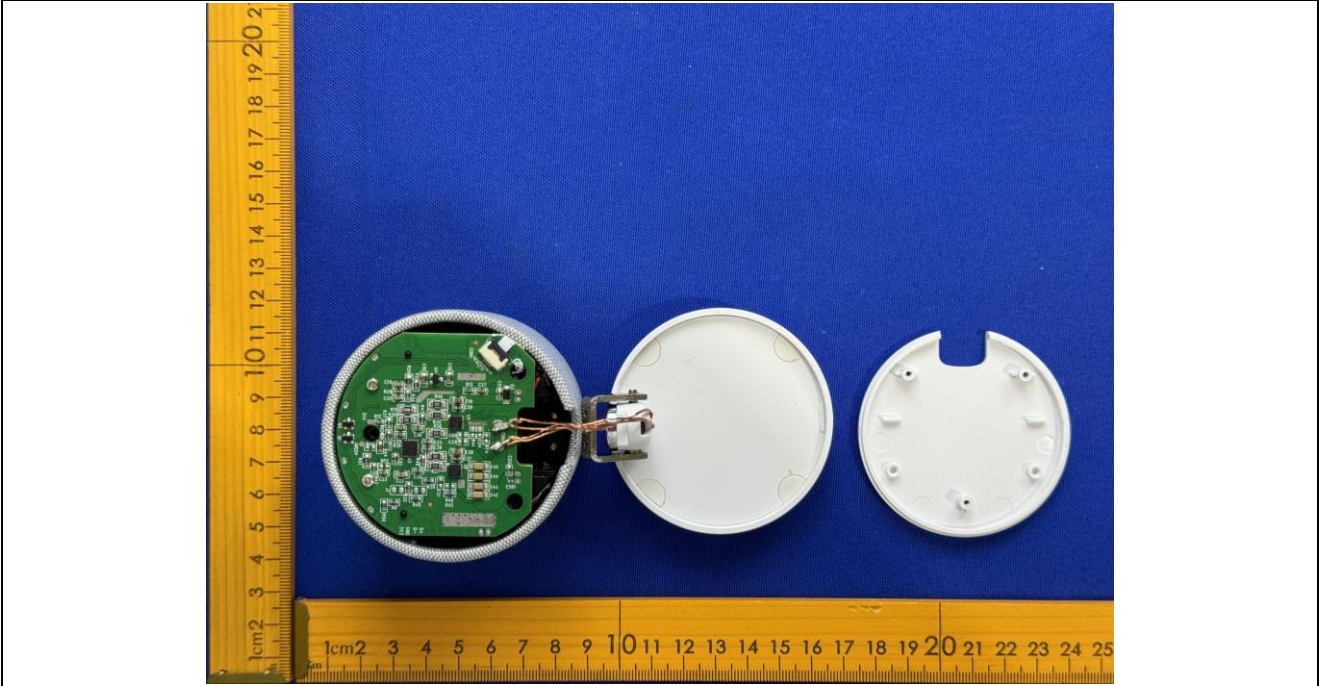


Photo 11

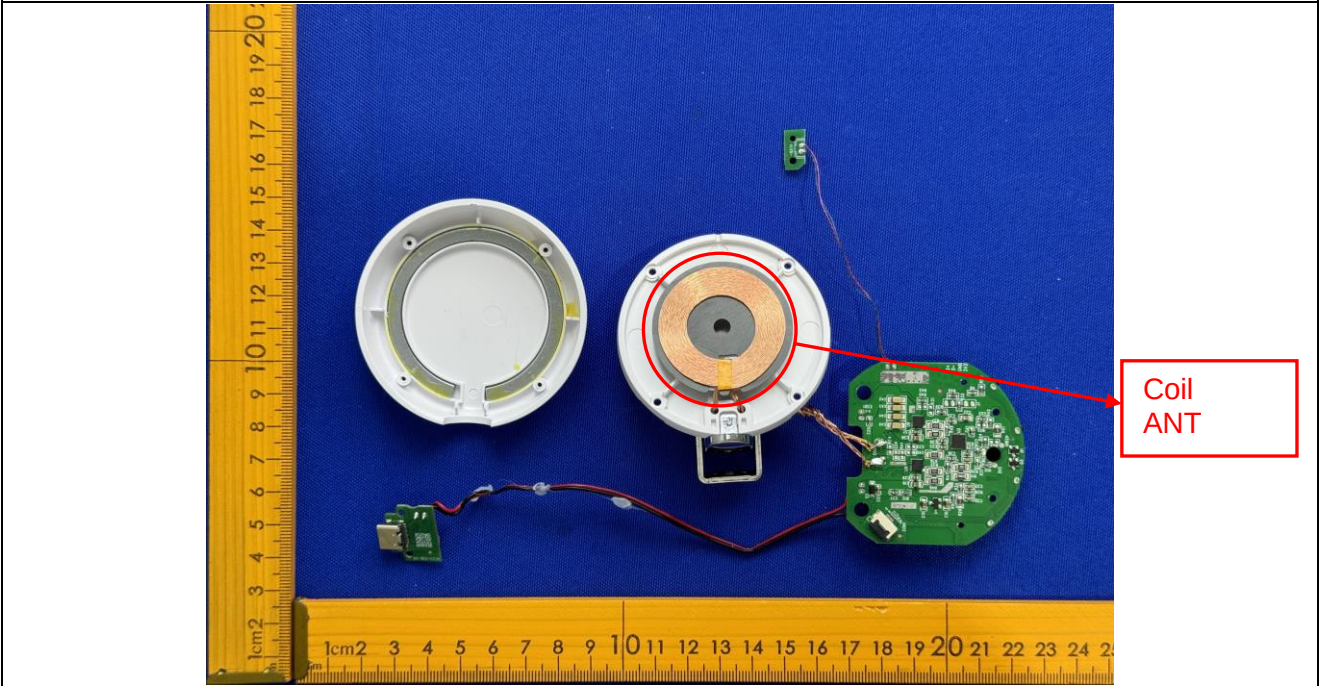


Photo 12

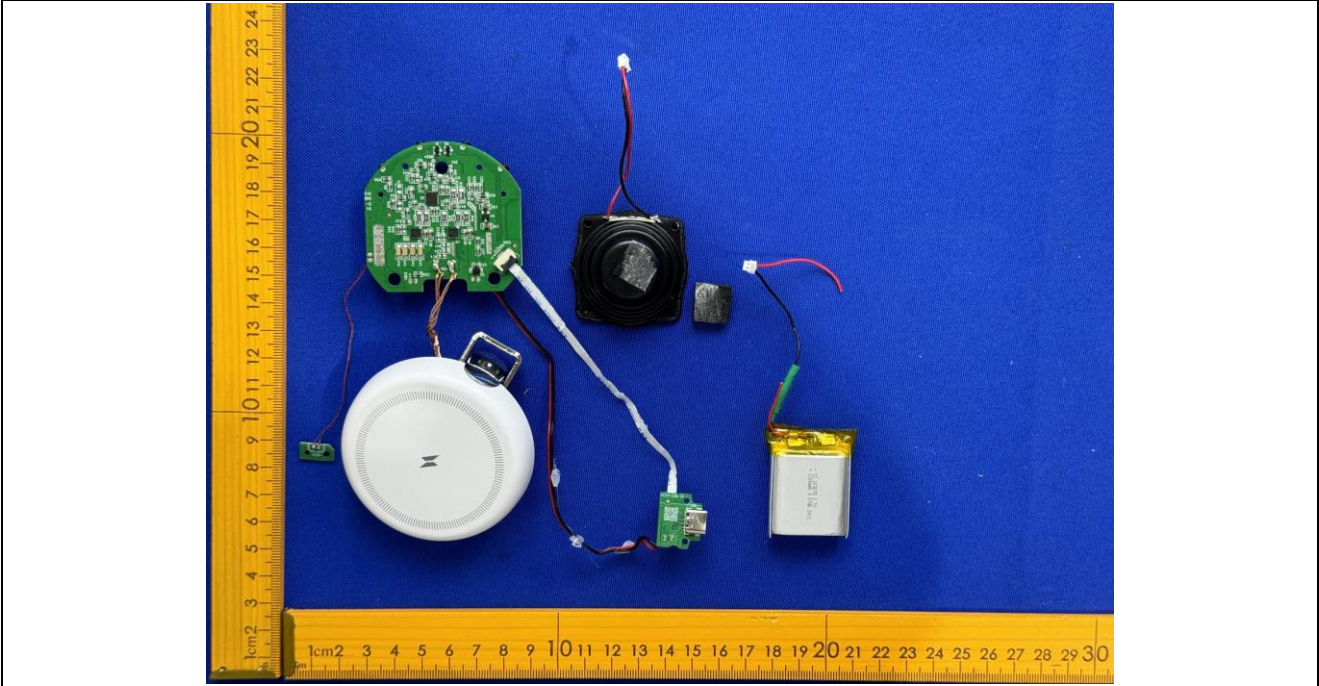


Photo 13

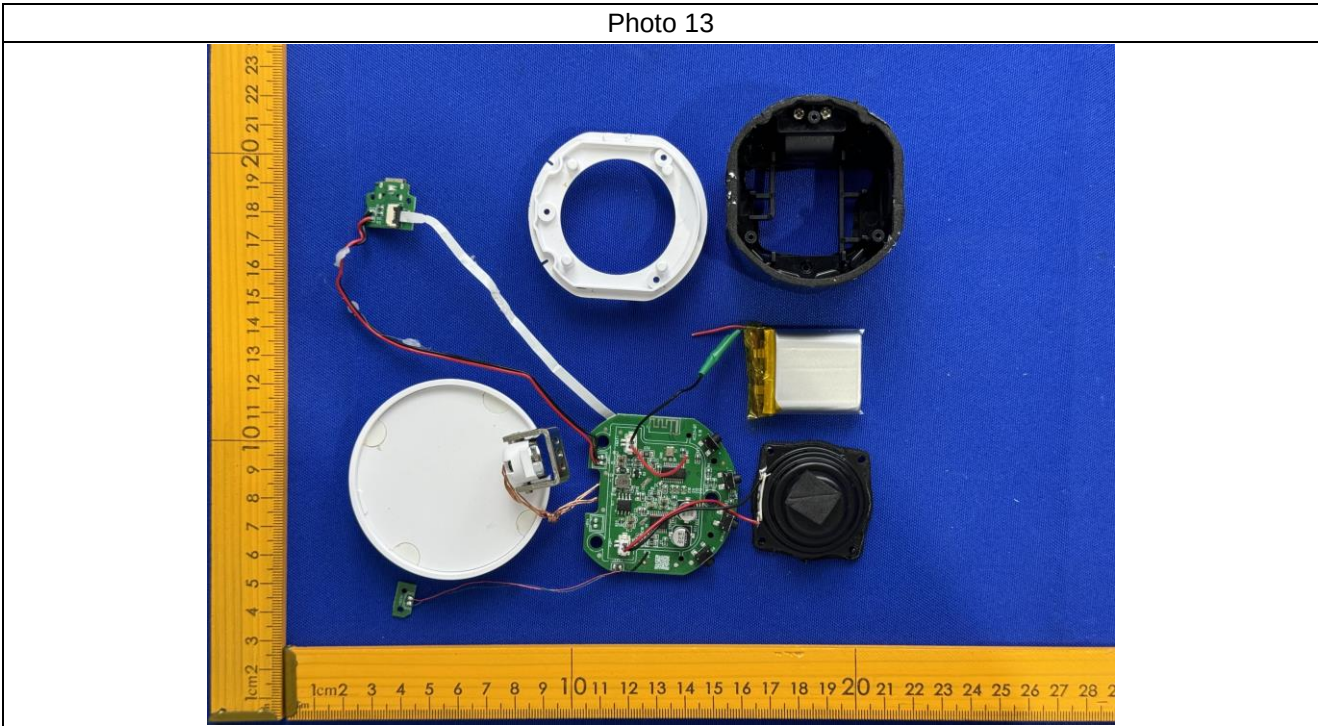


Photo 14

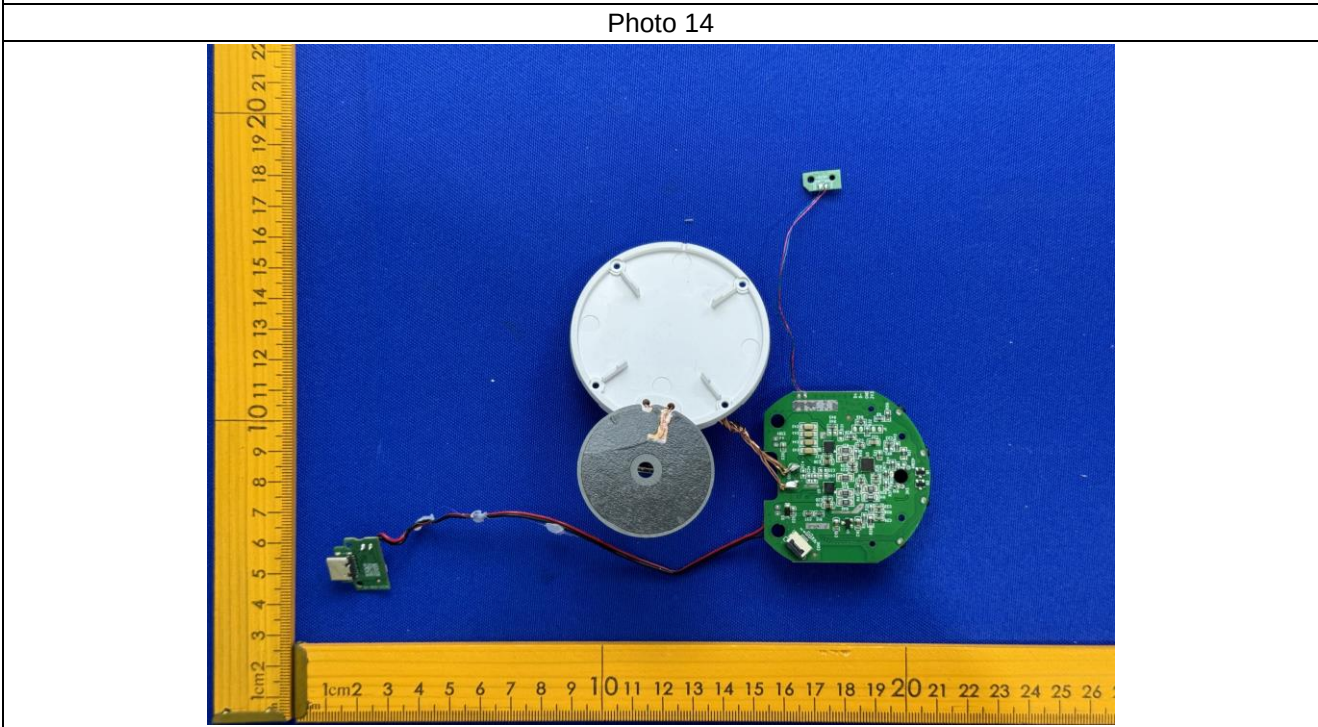


Photo 16



Photo 17

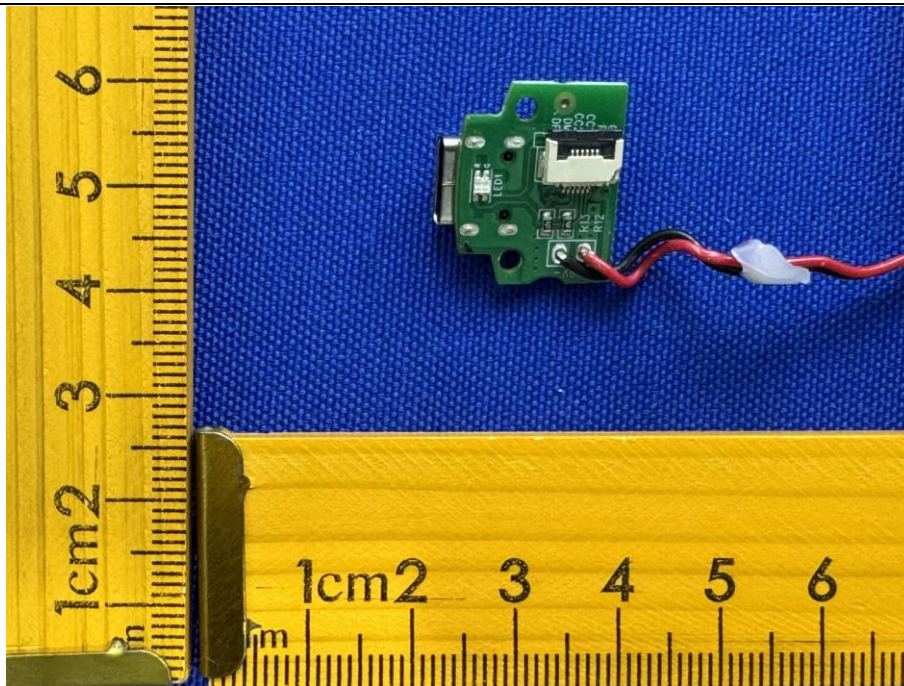
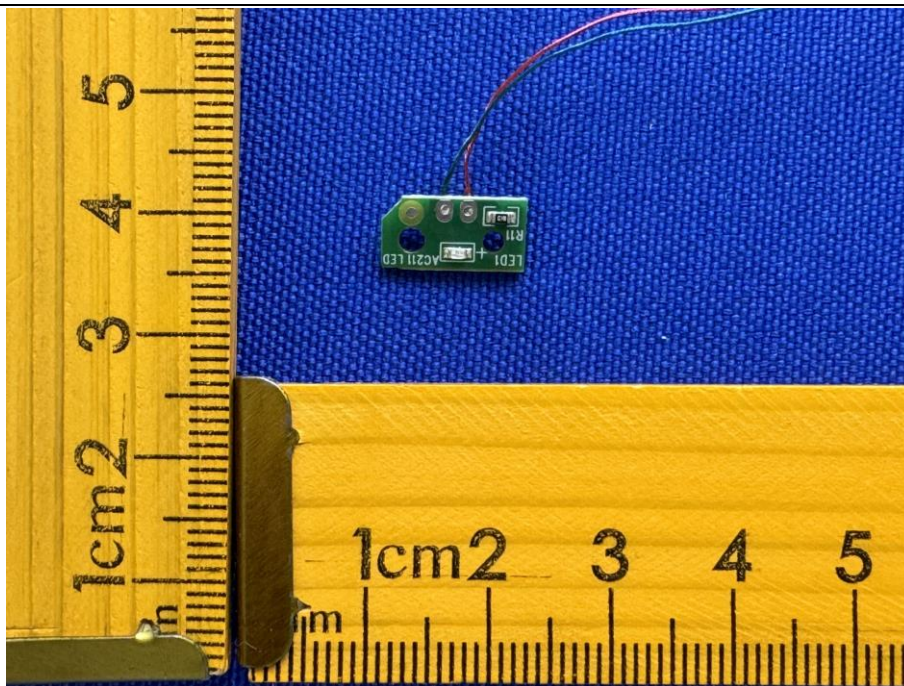


Photo 18



***** END OF REPORT *****