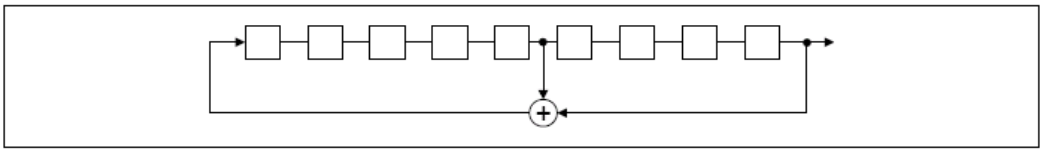
## 6.8. Pseudorandom Frequency Hopping Sequence

| Test Requirement: | FCC Part15 C Section 15.247 (a)(1) requirement: |
|---|---|

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 2400-2483.5 MHz 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 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

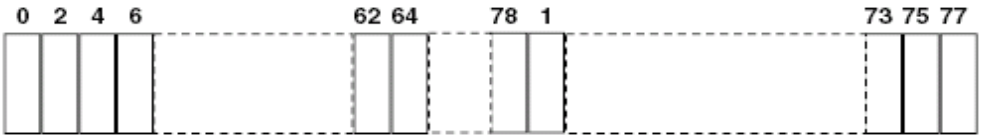
**EUT Pseudorandom Frequency Hopping Sequence**

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones; i.e. the shift register is initialized with nine ones.
• Number of shift register stages: 9
• Length of pseudo-random sequence: $2^9$ -1 = 511 bits
• Longest sequence of zeros: 8 (non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

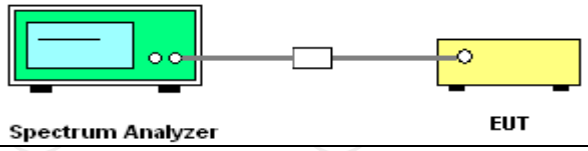
An example of Pseudorandom Frequency Hopping Sequence as follow:




Each frequency used equally on the average by each transmitter.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## 6.9. Conducted Band Edge Measurement

### 6.9.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (d) |
| **Test Method:** | ANSI C63.10:2013 |
| **Limit:** | In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits. |
| **Test Setup:** |  |
| **Test Mode:** | Transmitting mode with modulation |
| **Test Procedure:** | 1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of ANSI C63.10:2013 Measurement Guidelines.<br>2. Set to the maximum power setting and enable the EUT transmit continuously.<br>3. Set RBW = 100 kHz (≥1% span=10MHz), VBW = 300 kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.<br>4. Enable hopping function of the EUT and then repeat step 2 and 3.<br>5. Measure and record the results in the test report. |
| **Test Result:** | PASS |

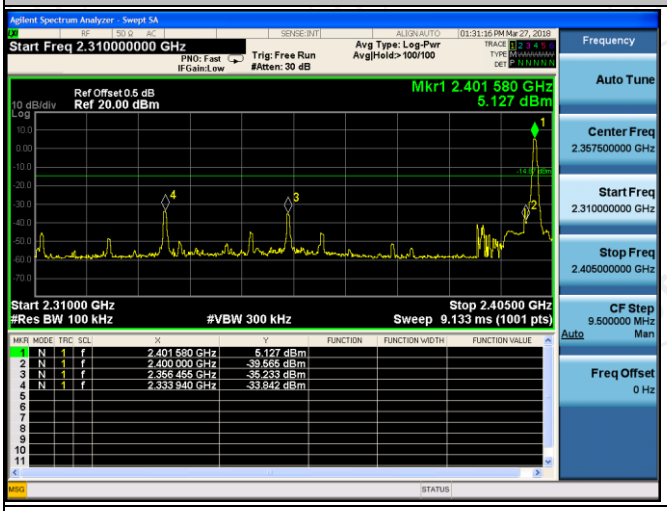
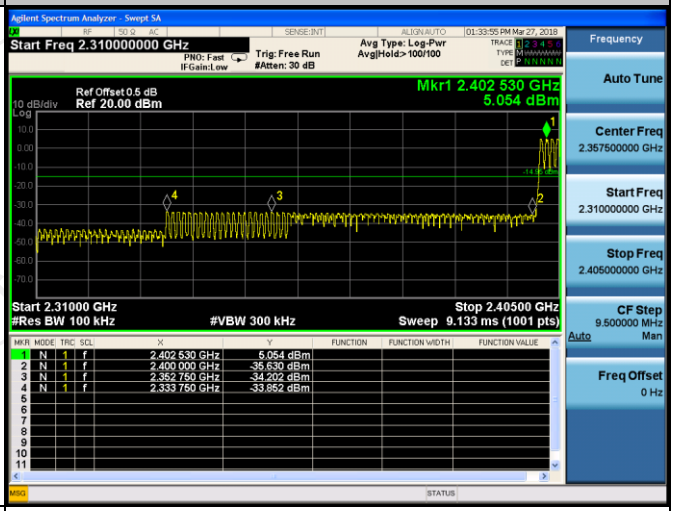
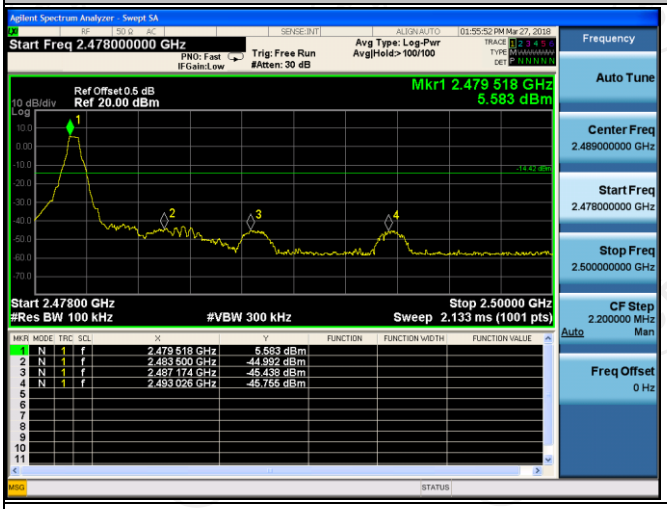
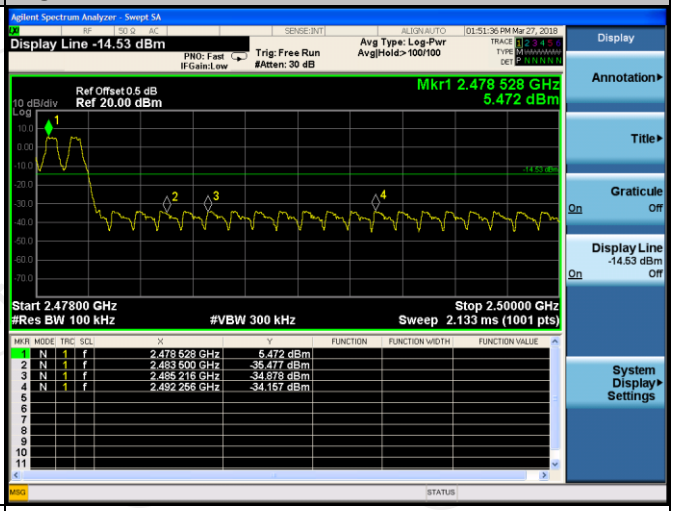
### 6.9.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100060 | Sep. 27, 2018 |
| RF Cable (9KHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 27, 2018 |

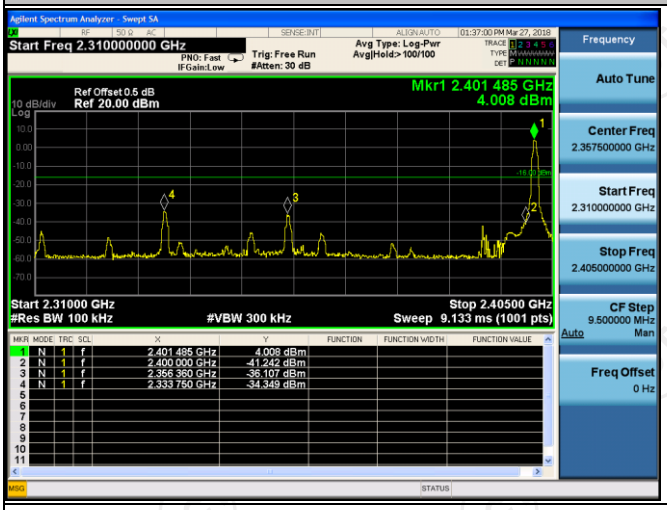
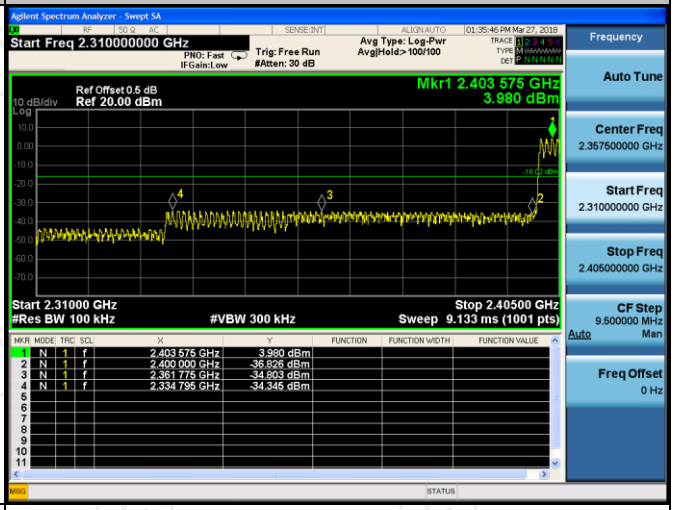
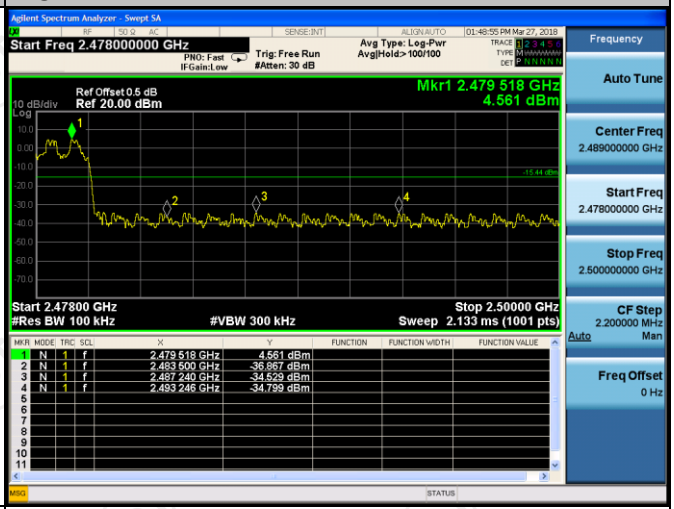
***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

## 6.9.3. Test Data

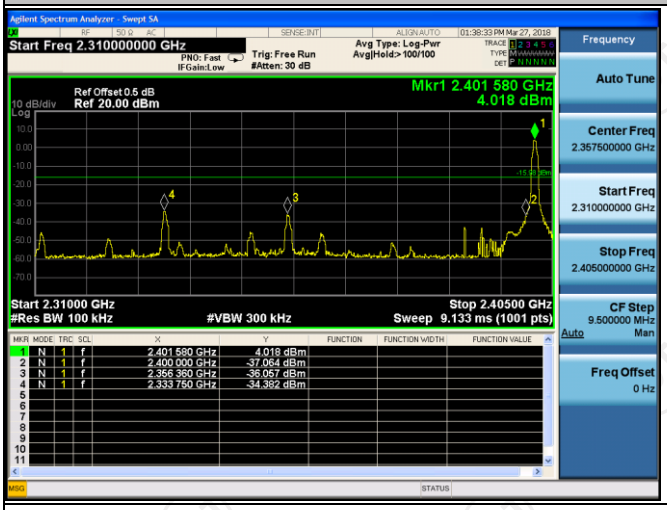
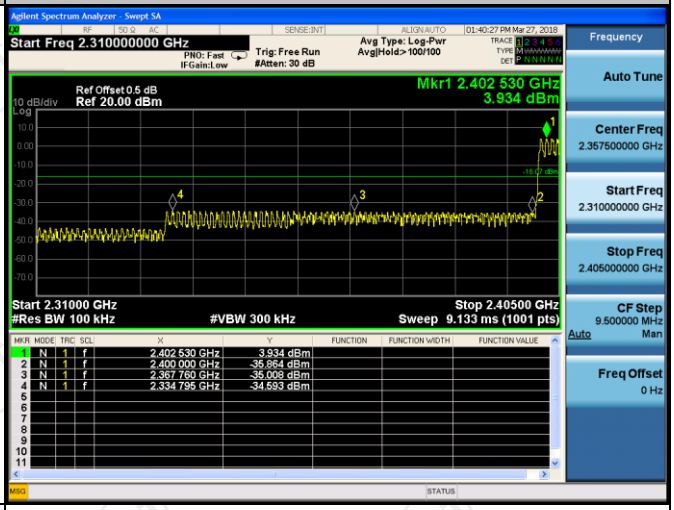
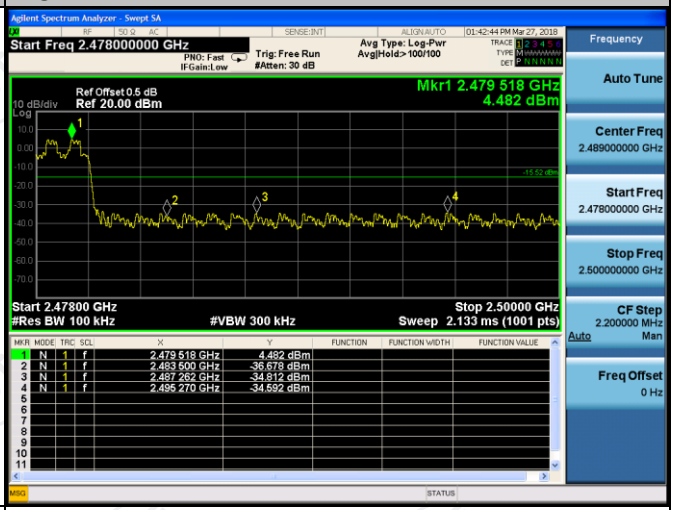
### GFSK Modulation

| Test channel: | Lowest channel |
|---|---|
|  |  |
| No-hopping mode | Hopping mode |
| Test channel: | Highest channel |
|  |  |
| No-hopping mode | Hopping mode |

**Pi/4DQPSK Modulation**

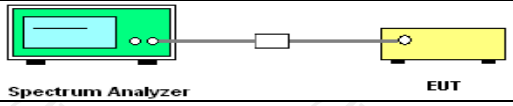
| Test channel: | Lowest channel |
|---|---|
|  |  |
| No-hopping mode | Hopping mode |
| **Test channel:** | **Highest channel** |
|  |  |
| No-hopping mode | Hopping mode |

**8DPSK Modulation**

| Test channel: | Lowest channel |
|---|---|
|  |  |
| No-hopping mode | Hopping mode |
| Test channel: | Highest channel |
|  |  |
| No-hopping mode | Hopping mode |

## 6.10. Conducted Spurious Emission Measurement

### 6.10.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (d) |
| **Test Method:** | ANSI C63.10:2013 |
| **Limit:** | In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits. |
| **Test Setup:** |  |
| **Test Mode:** | Transmitting mode with modulation |
| **Test Procedure:** | 1. The testing follows the guidelines in Spurious RF Conducted Emissions of ANSI C63.10:2013 Measurement Guidelines<br>2. 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.<br>3. Set to the maximum power setting and enable the EUT transmit continuously.<br>4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.<br>5. Measure and record the results in the test report.<br>6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band. |
| **Test Result:** | PASS |

### 6.10.2. Test Instruments

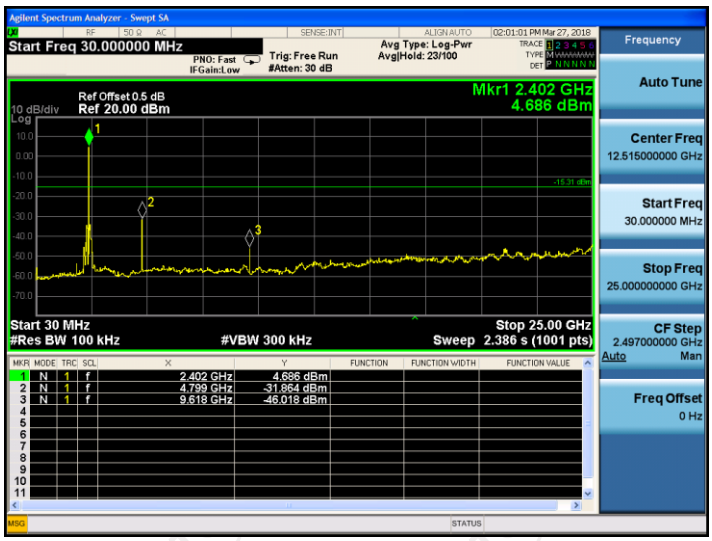
| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100060 | Sep. 27, 2018 |
| Spectrum Analyzer | ROHDE&SCHWARZ | FSQ | 200061 | Sep. 27, 2018 |
| RF Cable (9KHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 27, 2018 |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

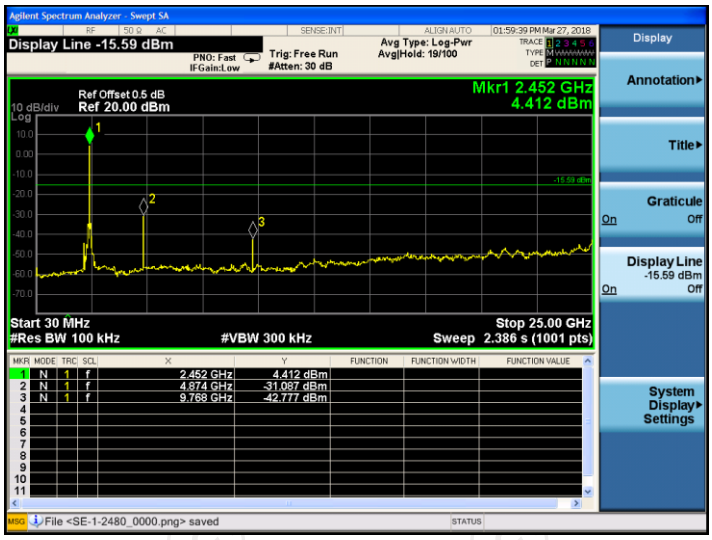
### 6.10.3. Test Data

GFSK mode

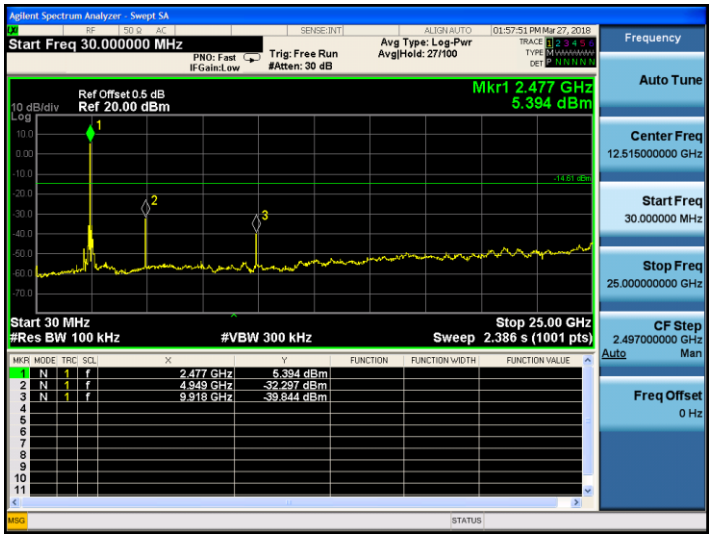
Lowest Channel



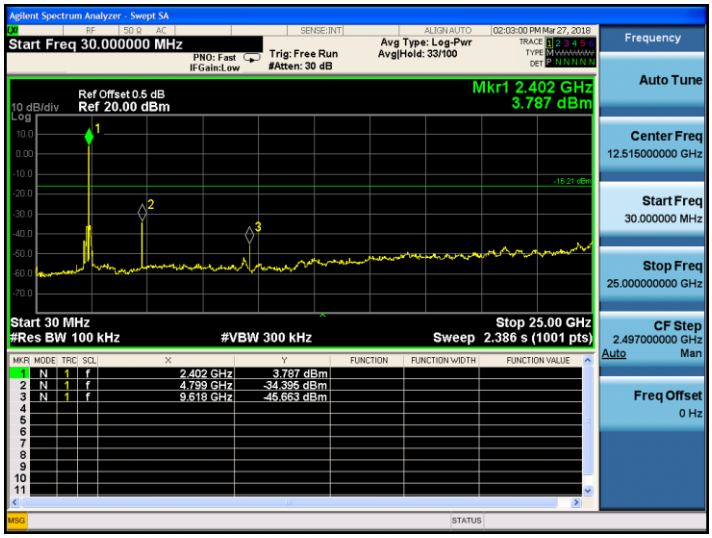

Middle Channel



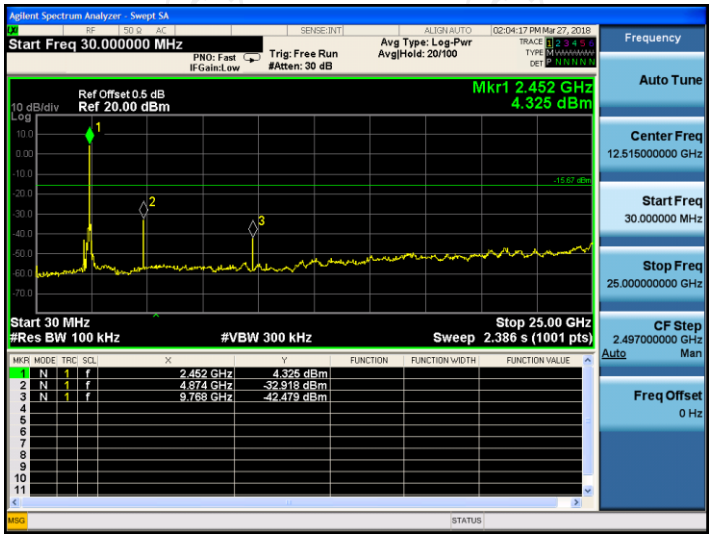

Highest Channel



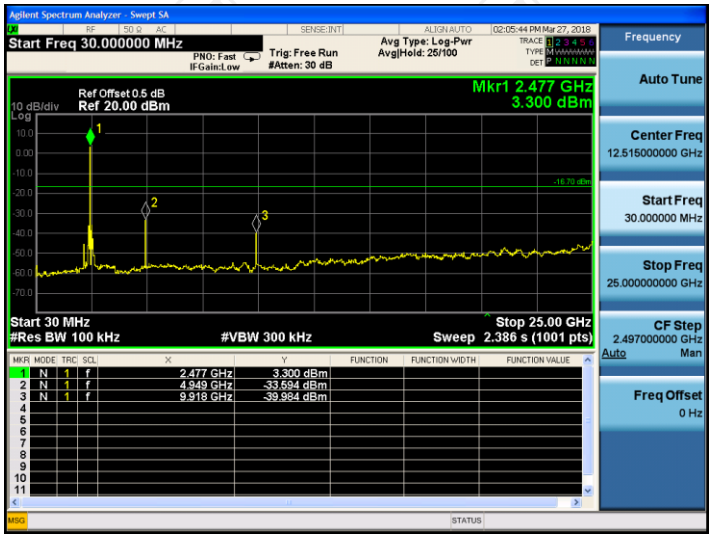
Pi/4DQPSK mode Lowest Channel




Middle Channel

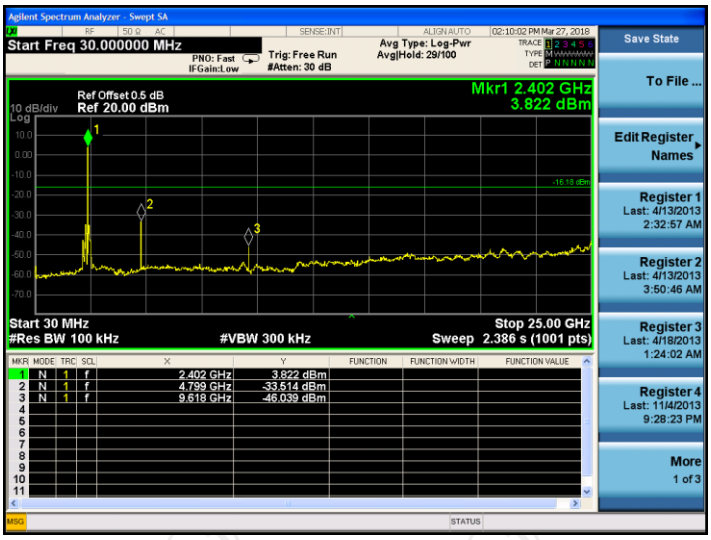



Highest Channel

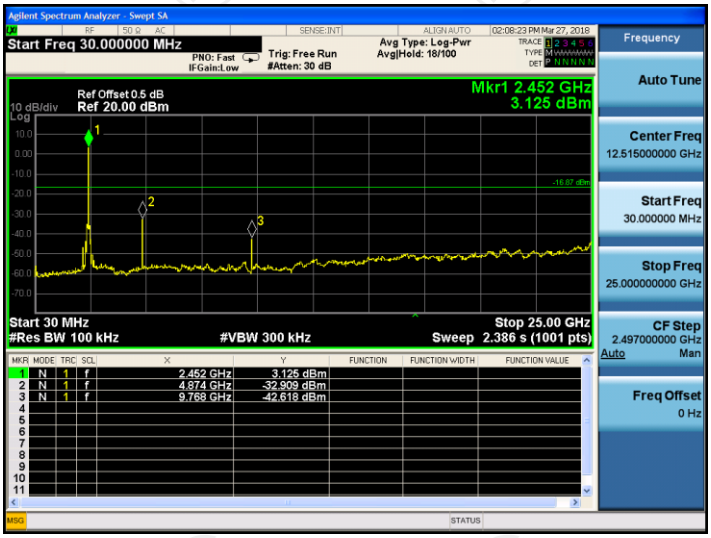


8DPSK mode

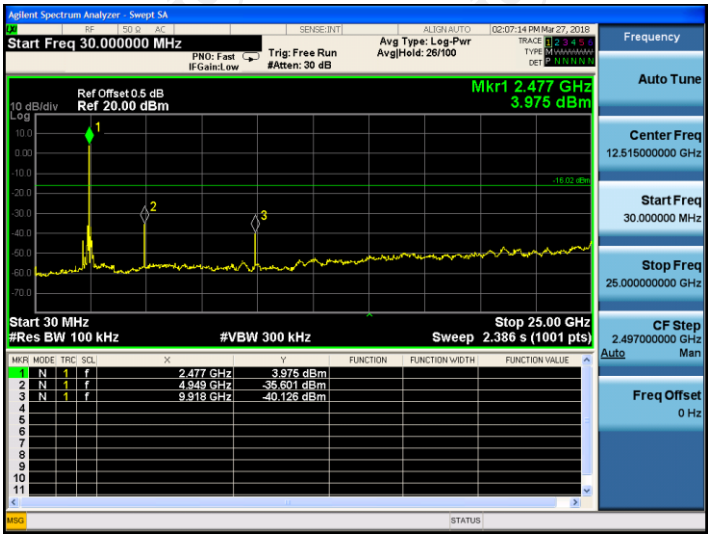
Lowest Channel




Middle Channel

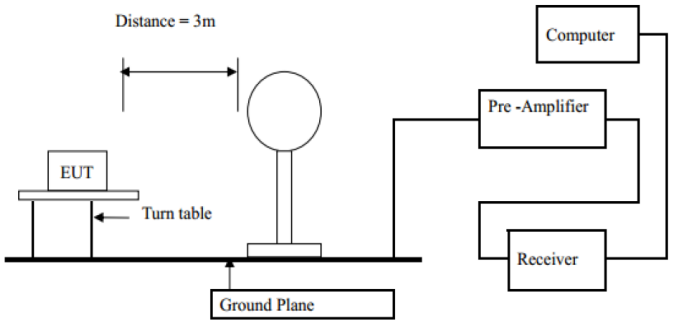



Highest Channel

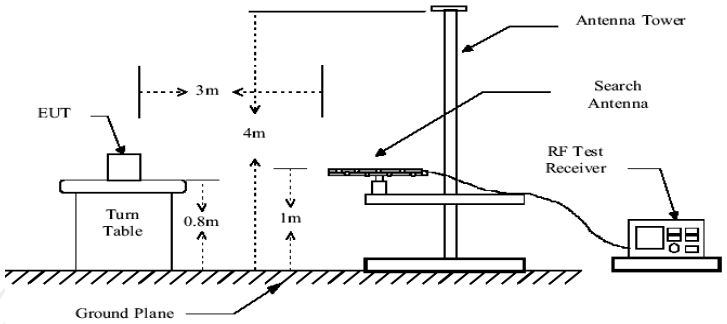


## 6.11. Radiated Spurious Emission Measurement

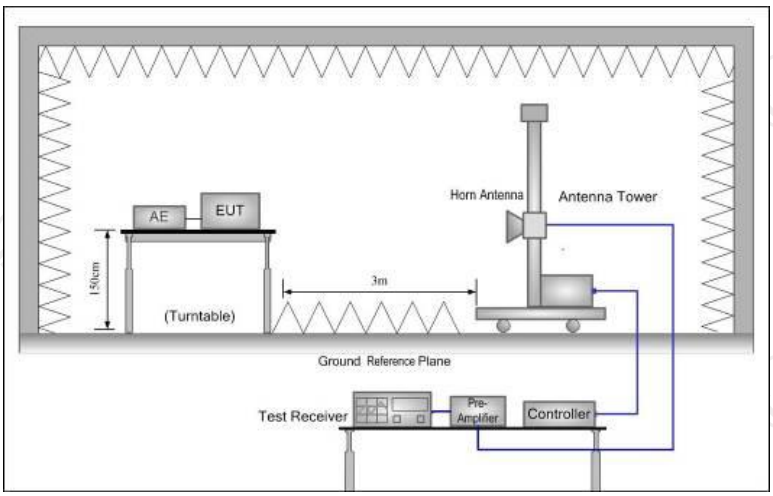
### 6.11.1. Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013</td></tr>
<tr><td>Frequency Range:</td><td>9 kHz to 25 GHz</td></tr>
<tr><td>Measurement Distance:</td><td>3 m</td></tr>
<tr><td>Antenna Polarization:</td><td>Horizontal & Vertical</td></tr>
<tr><td>Receiver Setup:</td><td>
<table>
<tr><td>Frequency</td><td>Detector</td><td>RBW</td><td>VBW</td><td>Remark</td></tr>
<tr><td>9kHz- 150kHz</td><td>Quasi-peak</td><td>200Hz</td><td>1kHz</td><td>Quasi-peak Value</td></tr>
<tr><td>150kHz-30MHz</td><td>Quasi-peak</td><td>9kHz</td><td>30kHz</td><td>Quasi-peak Value</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>100KHz</td><td>300KHz</td><td>Quasi-peak Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak Value</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average Value</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><td>Frequency</td><td>Field Strength (microvolts/meter)</td><td>Measurement Distance (meters)</td></tr>
<tr><td>0.009-0.490</td><td>2400/F(KHz)</td><td>300</td></tr>
<tr><td>0.490-1.705</td><td>24000/F(KHz)</td><td>30</td></tr>
<tr><td>1.705-30</td><td>30</td><td>30</td></tr>
<tr><td>30-88</td><td>100</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>3</td></tr>
</table>
<table>
<tr><td>Frequency</td><td>Field Strength (microvolts/meter)</td><td>Measurement Distance (meters)</td><td>Detector</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>500</td><td>3</td><td>Average</td></tr>
<tr><td>5000</td><td>3</td><td>Peak</td></tr>
</table>
</td></tr>
<tr><td>Test setup:</td><td>For radiated emissions below 30MHz<br> 

<br>30MHz to 1GHz</td></tr>
</table>




Above 1GHz




| | |
|---|---|
| **Test Mode:** | Transmitting mode with modulation |
| **Test Procedure:** | 1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10:2013 Measurement Guidelines.<br>2. For the radiated emission test below 1GHz:<br>The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.<br>For the radiated emission test above 1GHz:<br>Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, |

| | |
|---|---|
| | depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.<br>3. Set to the maximum power setting and enable the EUT transmit continuously.<br>4. Use the following spectrum analyzer settings:<br>(1) Span shall wide enough to fully capture the emission being measured;<br>(2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW≥RBW;<br>Sweep = auto; Detector function = peak; Trace = max hold for peak<br>(3) For average measurement: use duty cycle correction factor method per<br>15.35(c). Duty cycle = On time/100 milliseconds<br>On time =N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln<br>Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.<br>Average Emission Level = Peak Emission Level + 20*log(Duty cycle)<br>Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level |
| **Test results:** | PASS |

### 6.11.2. Test Instruments

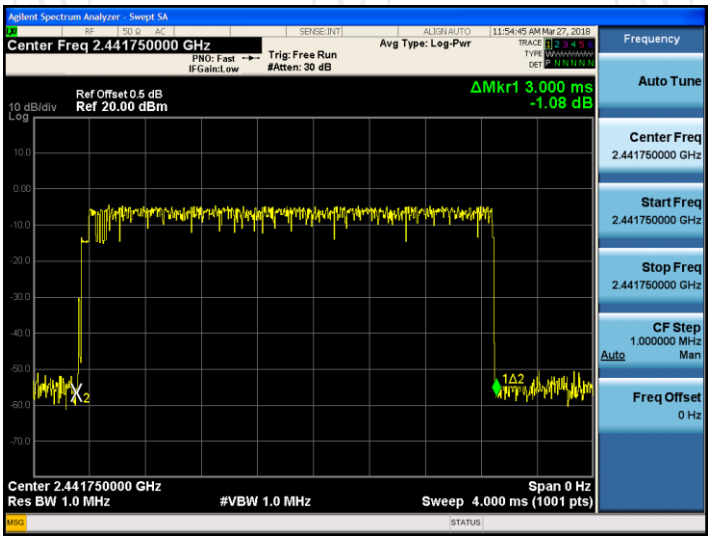
| Radiated Emission Test Site (966) | | | | |
|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Due** |
| Test Receiver | ROHDE&SCHWARZ | ESVD | 100008 | Sep. 27, 2018 |
| Spectrum Analyzer | ROHDE&SCHWARZ | FSQ | 200061 | Sep. 27, 2018 |
| Pre-amplifier | EM Electronics Corporation CO.,LTD | EM30265 | 07032613 | Sep. 27, 2018 |
| Pre-amplifier | HP | 8447D | 2727A05017 | Sep. 27, 2018 |
| Loop antenna | ZHINAN | ZN30900A | 12024 | Sep. 27, 2018 |
| Broadband Antenna | Schwarzbeck | VULB9163 | 340 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 631 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBH 9170 | 582 | Jun. 07, 2018 |
| Antenna Mast | Keleto | CC-A-4M | N/A | N/A |
| Coax cable (9KHz-1GHz) | TCT | RE-low-01 | N/A | Sep. 27, 2018 |
| Coax cable (9KHz-40GHz) | TCT | RE-high-02 | N/A | Sep. 27, 2018 |
| Coax cable (9KHz-1GHz) | TCT | RE-low-03 | N/A | Sep. 27, 2018 |
| Coax cable (9KHz-40GHz) | TCT | RE-high-04 | N/A | Sep. 27, 2018 |
| EMI Test Software | Shurple Technology | EZ-EMC | N/A | N/A |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

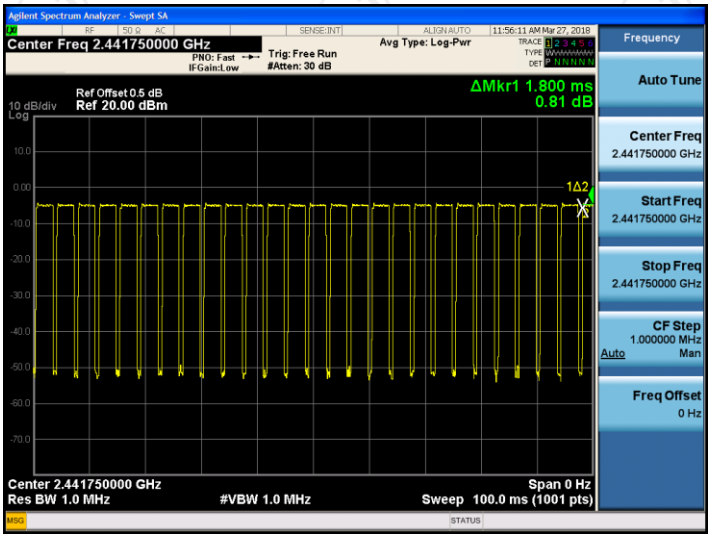
### 6.11.3. Test Data

**Duty cycle correction factor for average measurement**

3DH5 on time (One Pulse) Plot on Channel 39




3DH5 on time (Count Pulses) Plot on Channel 39



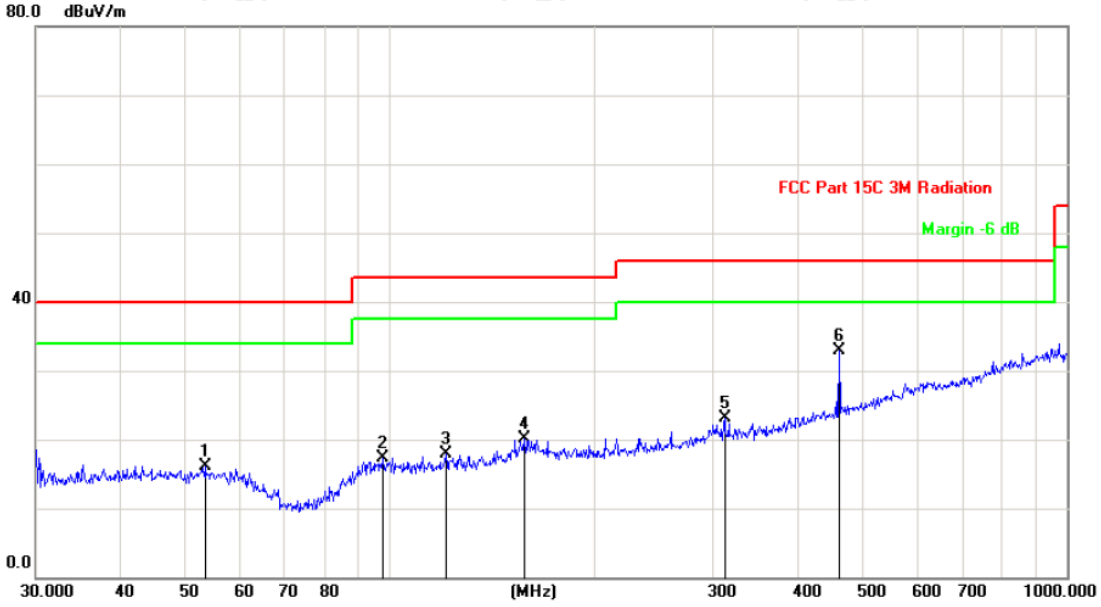

***Note:***

*1. Worst case Duty cycle = on time/100 milliseconds = (3.000*26+1.800)/100=0.7980*
*2. Worst case Duty cycle correction factor = 20*log (Duty cycle) = -1.96dB*
*3. 3DH5 has the highest duty cycle worst case and is reported.*
*4. The average levels were calculated from the peak level corrected with duty cycle correction factor (-1.96dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.*

**Please refer to following diagram for individual**

**Below 1GHz**

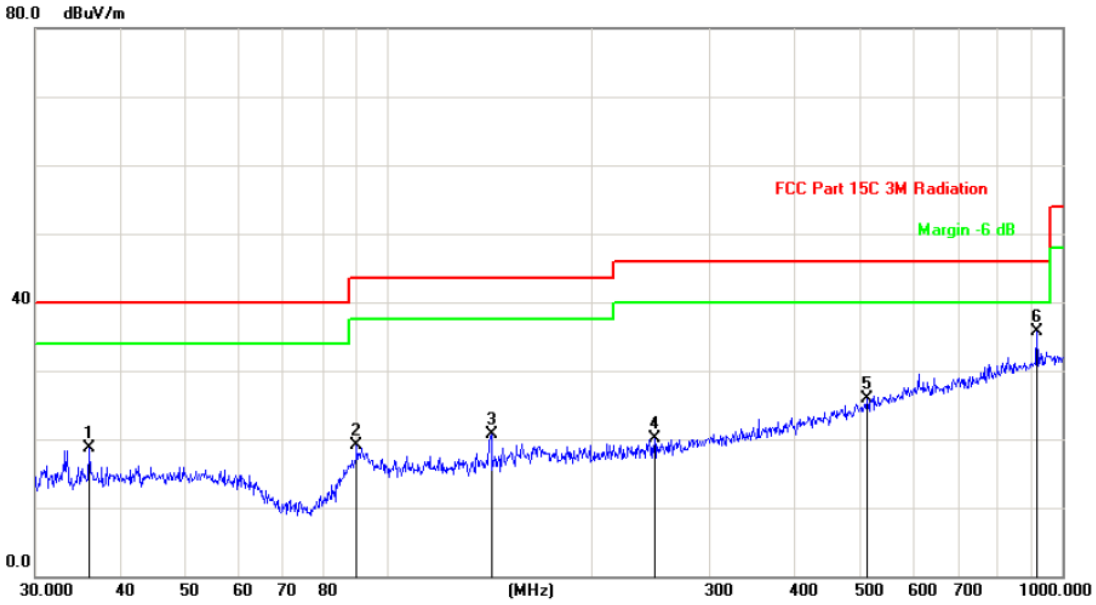
Horizontal:




Site
Limit: FCC Part 15C 3M Radiation
Polarization: *Horizontal*
Power:
Temperature: 25
Humidity: 55 %

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna ...ght | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector | cm | degree | Comment |
| 1 | | 53.3179 | 28.91 | -12.90 | 16.01 | 40.00 | -23.99 | peak | | | |
| 2 | | 97.7983 | 29.55 | -12.28 | 17.27 | 43.50 | -26.23 | peak | | | |
| 3 | | 121.1231 | 32.20 | -14.35 | 17.85 | 43.50 | -25.65 | peak | | | |
| 4 | | 158.1123 | 35.50 | -15.32 | 20.18 | 43.50 | -23.32 | peak | | | |
| 5 | | 312.1794 | 31.46 | -8.33 | 23.13 | 46.00 | -22.87 | peak | | | |
| 6 | * | 460.7271 | 37.06 | -4.16 | 32.90 | 46.00 | -13.10 | peak | | | |

Vertical:




Site

Limit: FCC Part 15C 3M Radiation

Polarization: *Vertical*

Power:

Temperature: 25

Humidity: 55 %

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector | cm | degree | Comment |
| 1 | | 36.0007 | 31.97 | -13.21 | 18.76 | 40.00 | -21.24 | peak | | | |
| 2 | | 89.9047 | 32.74 | -13.70 | 19.04 | 43.50 | -24.46 | peak | | | |
| 3 | | 142.3243 | 36.74 | -15.96 | 20.78 | 43.50 | -22.72 | peak | | | |
| 4 | | 248.5519 | 31.03 | -10.87 | 20.16 | 46.00 | -25.84 | peak | | | |
| 5 | | 513.6331 | 28.73 | -2.78 | 25.95 | 46.00 | -20.05 | peak | | | |
| 6 | * | 916.0687 | 32.31 | 3.48 | 35.79 | 46.00 | -10.21 | peak | | | |

***Note:*** *1.The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported*

*2. Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK) and the worst case Mode (Middle channel and GFSK) was submitted only.*

## Above 1GHz

| Modulation Type: GFSK | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Low channel: 2402 MHz | | | | | | | | | |
| Frequency (MHz) | Ant. Pol. H/V | Peak reading (dBμV) | AV reading (dBuV) | Correction Factor (dB/m) | Emission Level | | Peak limit (dBμV/m) | AV limit (dBμV/m) | Margin (dB) |
| | | | | | Peak (dBμV/m) | AV (dBμV/m) | | | |
| 2390 | H | 44.57 | --- | -8.27 | 36.3 | --- | 74 | 54 | -17.7 |
| 4804 | H | 48.14 | --- | 0.66 | 48.8 | --- | 74 | 54 | -5.2 |
| 7206 | H | 38.38 | --- | 9.5 | 47.88 | --- | 74 | 54 | -6.12 |
| --- | H | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | | | |
| 2390 | V | 43.54 | --- | -8.27 | 35.27 | --- | 74 | 54 | -18.73 |
| 4804 | V | 44.32 | --- | 0.66 | 44.98 | --- | 74 | 54 | -9.02 |
| 7206 | V | 38.46 | --- | 9.5 | 47.96 | --- | 74 | 54 | -6.04 |
| --- | V | --- | --- | --- | --- | --- | --- | --- | --- |

| Middle channel: 2441 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Ant. Pol. H/V | Peak reading (dBμV) | AV reading (dBμV) | Correction Factor (dB/m) | Emission Level | | Peak limit (dBμV/m) | AV limit (dBμV/m) | Margin (dB) |
| | | | | | Peak (dBμV/m) | AV (dBμV/m) | | | |
| 4882 | H | 43.98 | --- | 0.99 | 44.97 | --- | 74 | 54 | -9.03 |
| 7323 | H | 39.46 | --- | 9.87 | 49.33 | --- | 74 | 54 | -4.67 |
| --- | H | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | | | |
| 4882 | V | 44.87 | --- | 0.99 | 45.86 | --- | 74 | 54 | -8.14 |
| 7323 | V | 39.68 | --- | 9.87 | 49.55 | --- | 74 | 54 | -4.45 |
| --- | V | --- | --- | --- | --- | ---- | --- | --- | --- |

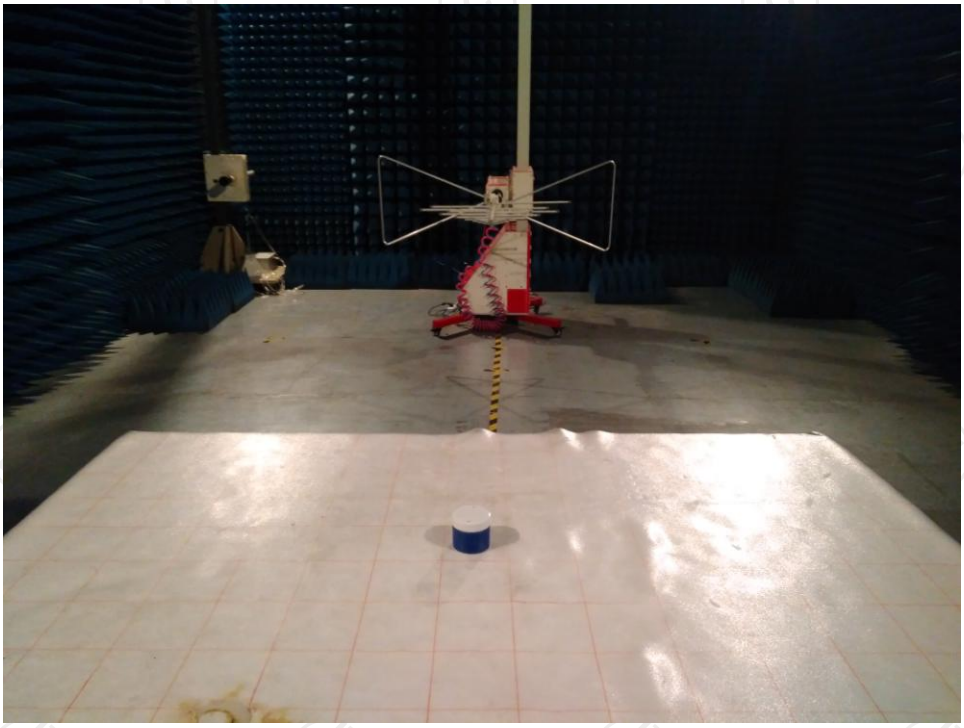
| High channel: 2480 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Ant. Pol. H/V | Peak reading (dBμV) | AV reading (dBμV) | Correction Factor (dB/m) | Emission Level | | Peak limit (dBμV/m) | AV limit (dBμV/m) | Margin (dB) |
| | | | | | Peak (dBμV/m) | AV (dBμV/m) | | | |
| 2483.5 | H | 46.87 | --- | -7.83 | 39.04 | --- | 74 | 54 | -14.96 |
| 4960 | H | 49.61 | --- | 1.33 | 50.94 | --- | 74 | 54 | -3.06 |
| 7440 | H | 40.47 | --- | 10.22 | 50.69 | --- | 74 | 54 | -3.31 |
| --- | H | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | | | |
| 2483.5 | V | 48.82 | --- | -7.83 | 40.99 | --- | 74 | 54 | -13.01 |
| 4960 | V | 49.89 | --- | 1.33 | 51.22 | --- | 74 | 54 | -2.78 |
| 7440 | V | 37.57 | --- | 10.22 | 47.79 | --- | 74 | 54 | -6.21 |
| --- | V | --- | --- | --- | --- | --- | --- | --- | --- |

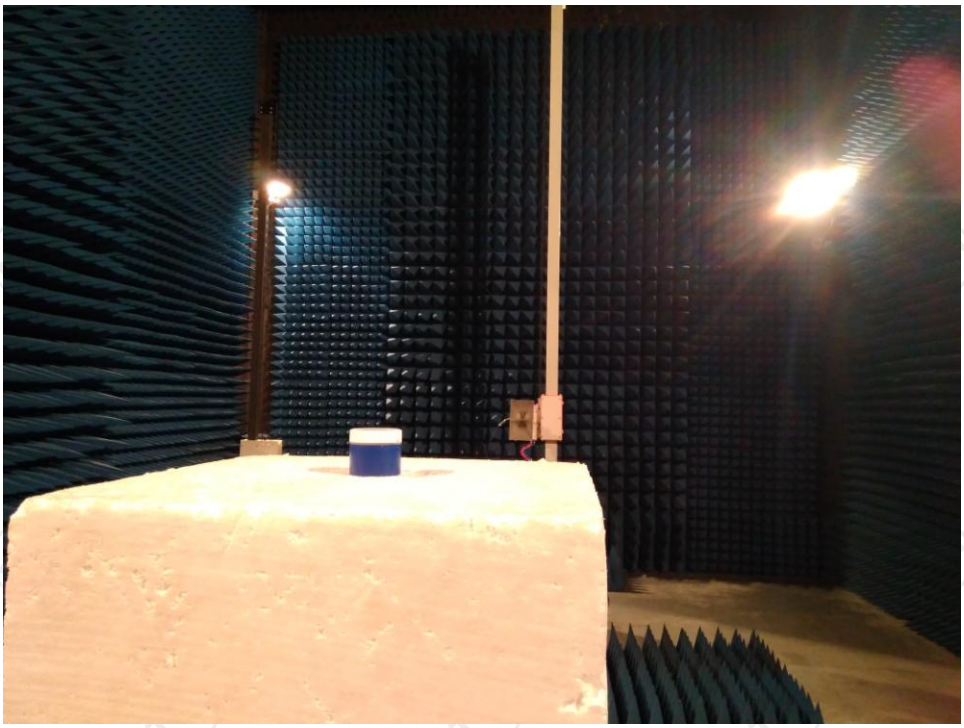
***Note:***

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *Measurements were conducted in all three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (GFSK) was submitted only.*

# Appendix A: Photographs of Test Setup

Product: SV Speaker
Model: THY-S07
Radiated Emission







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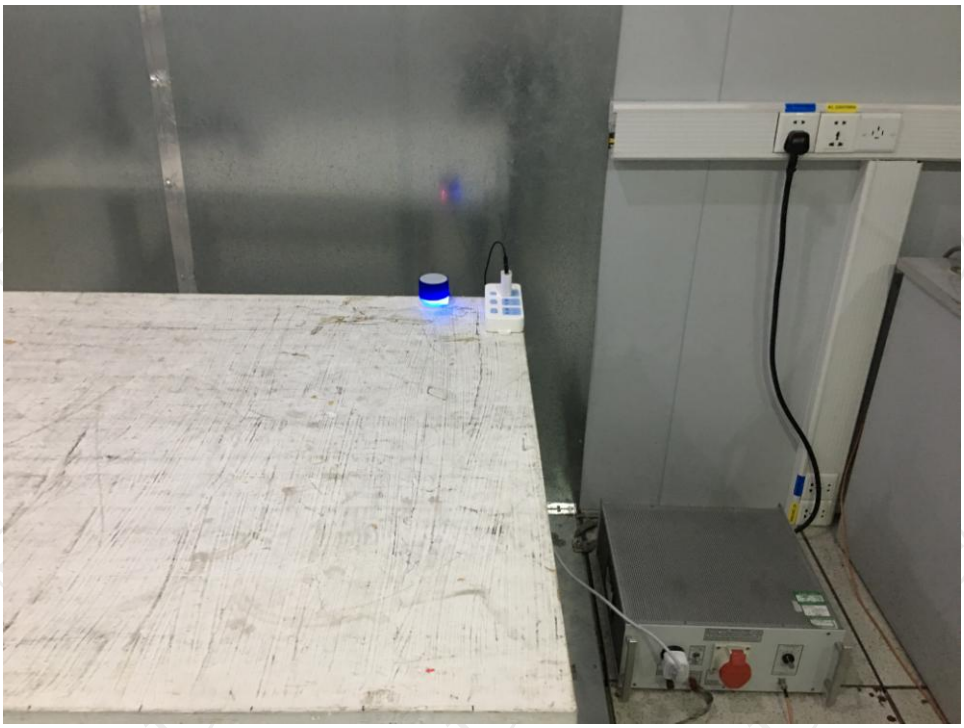
Conducted Emission





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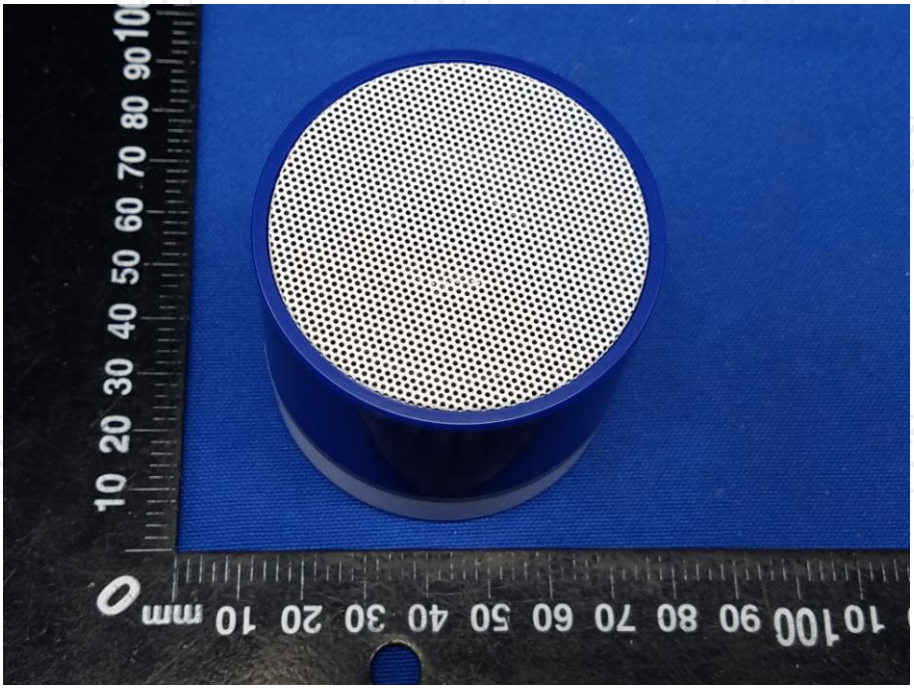
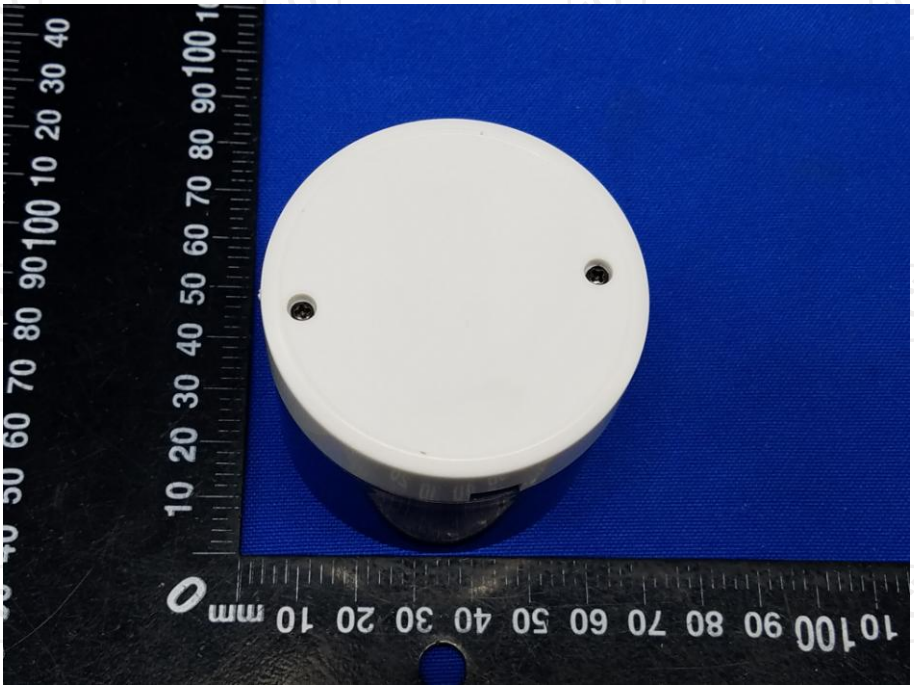
# Appendix B: Photographs of EUT

**Product: SV Speaker**

**Model: THY-S07**

**External Photos**







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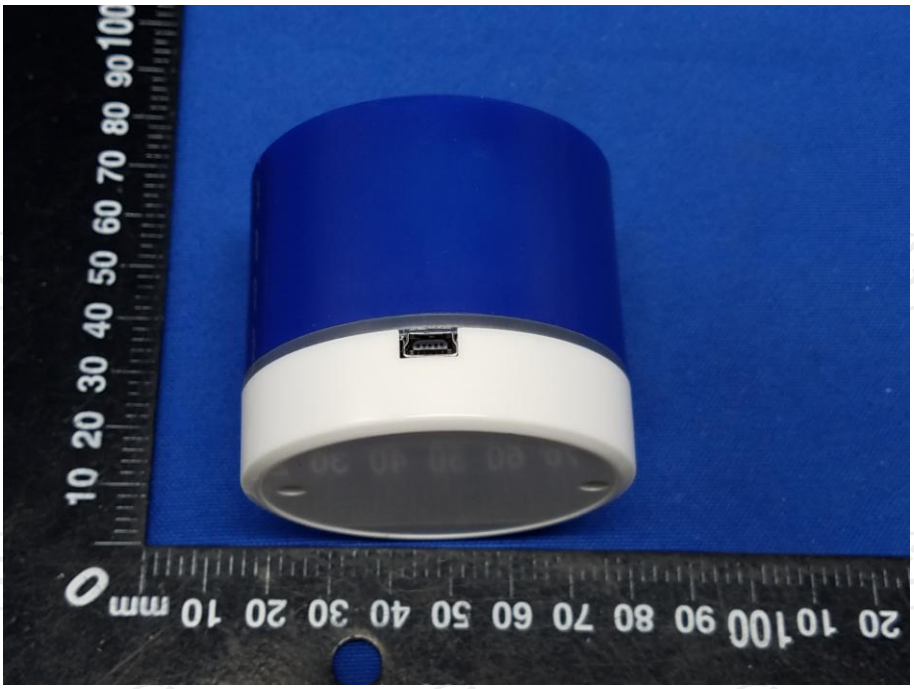
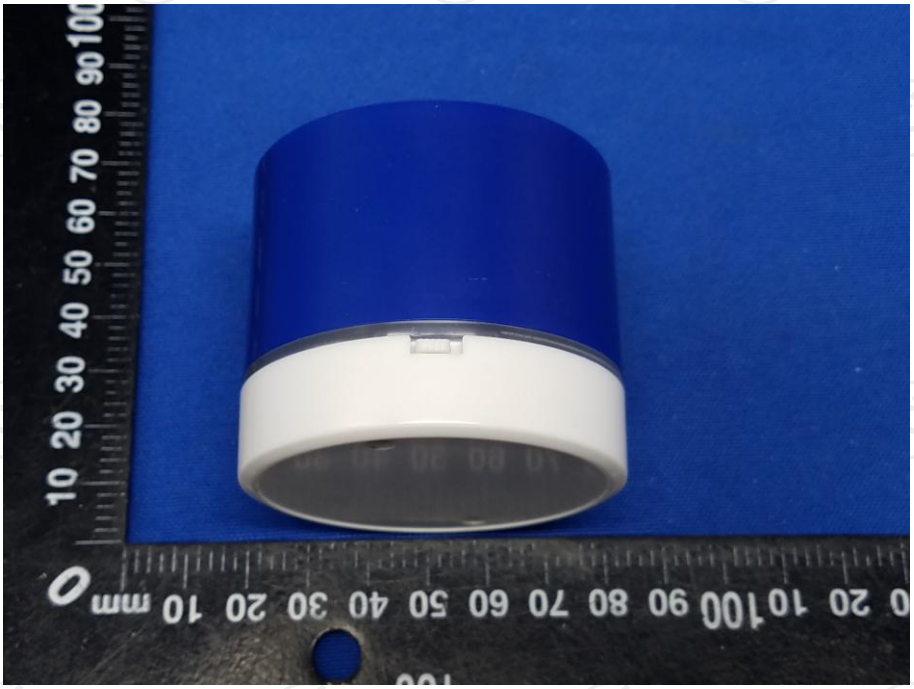
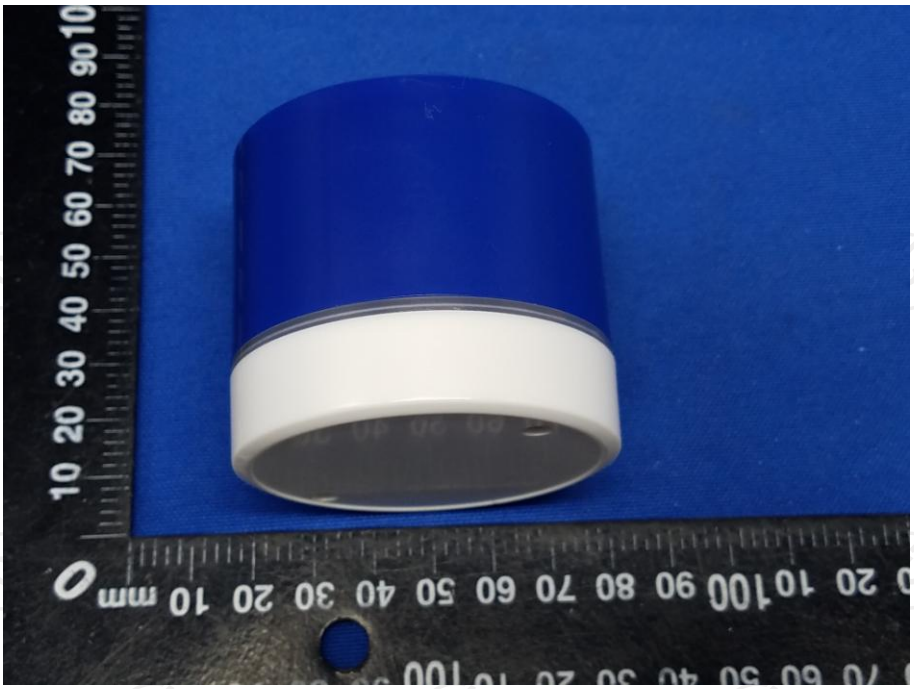
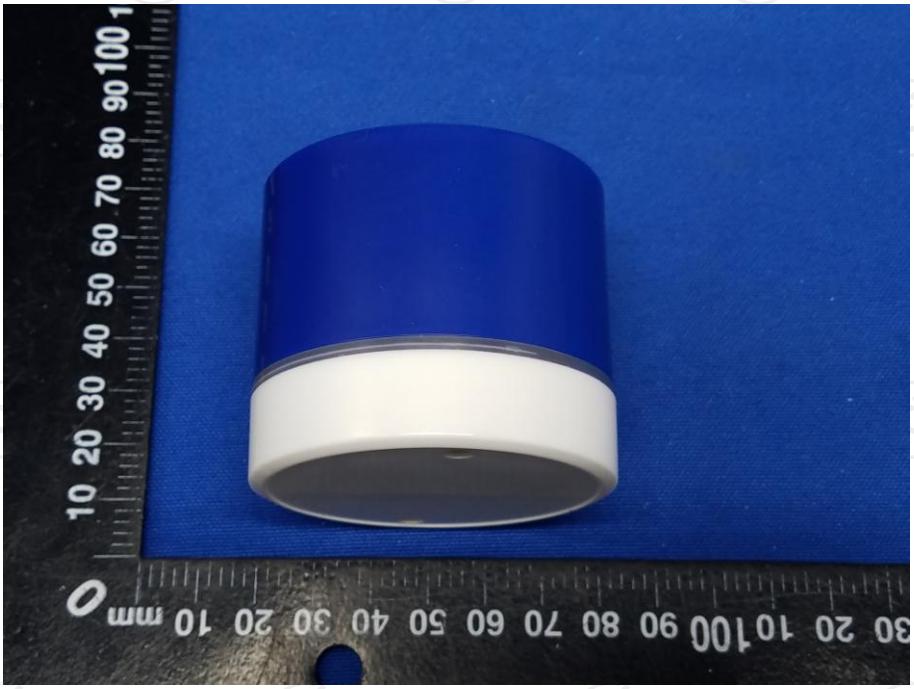
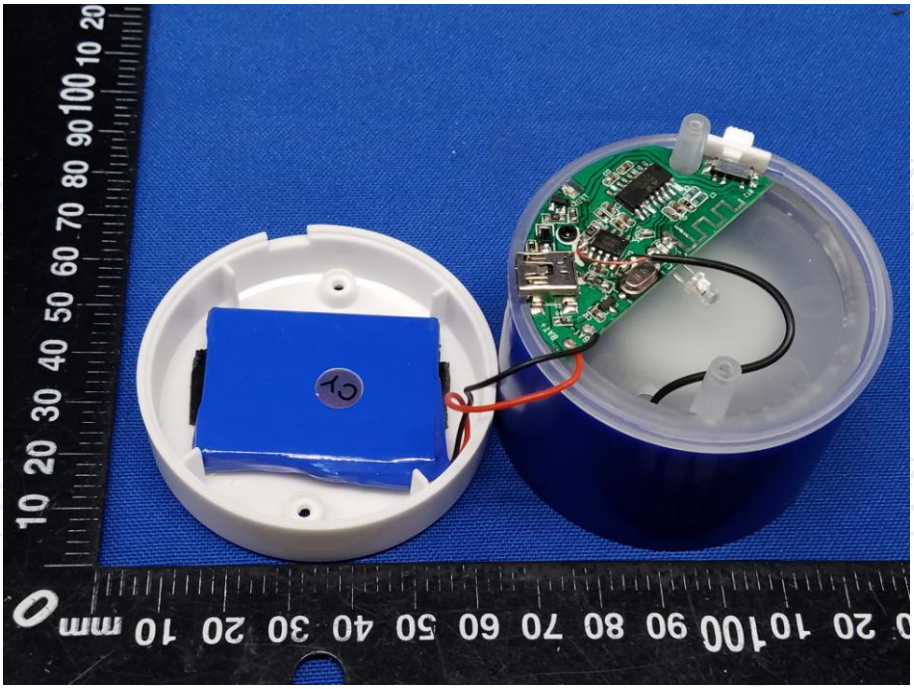


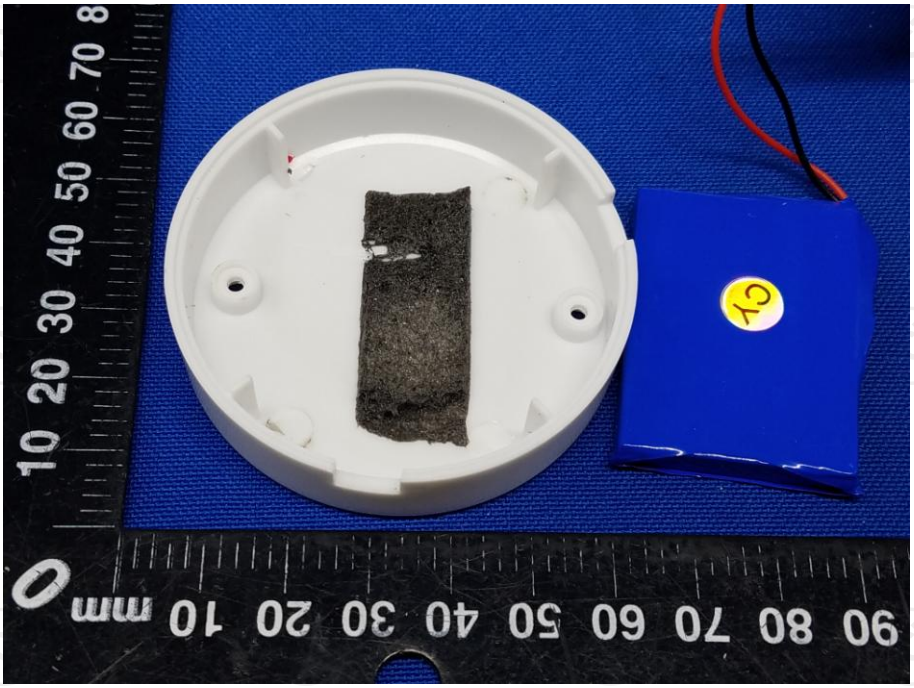


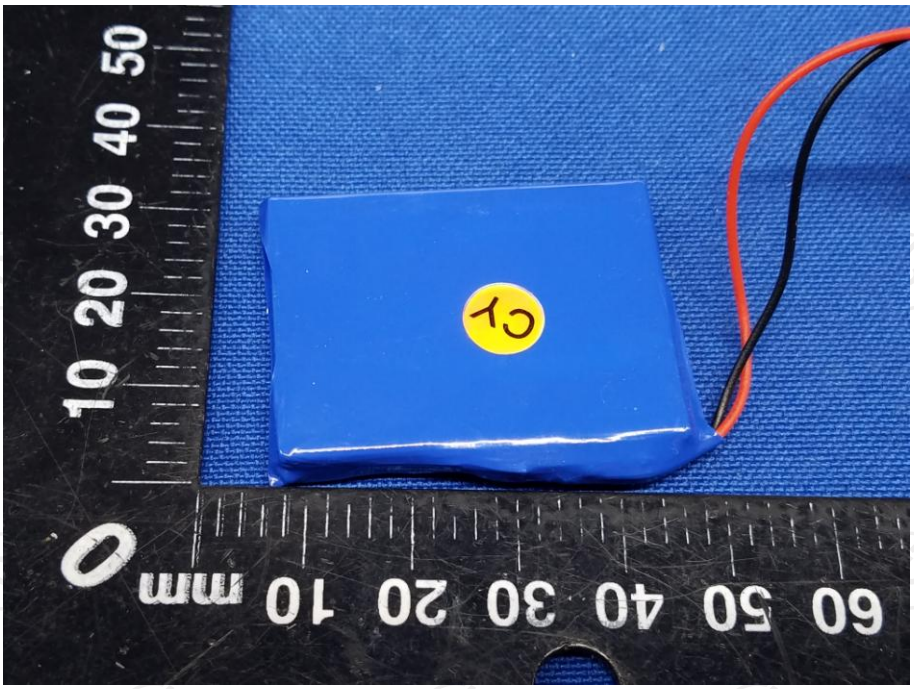


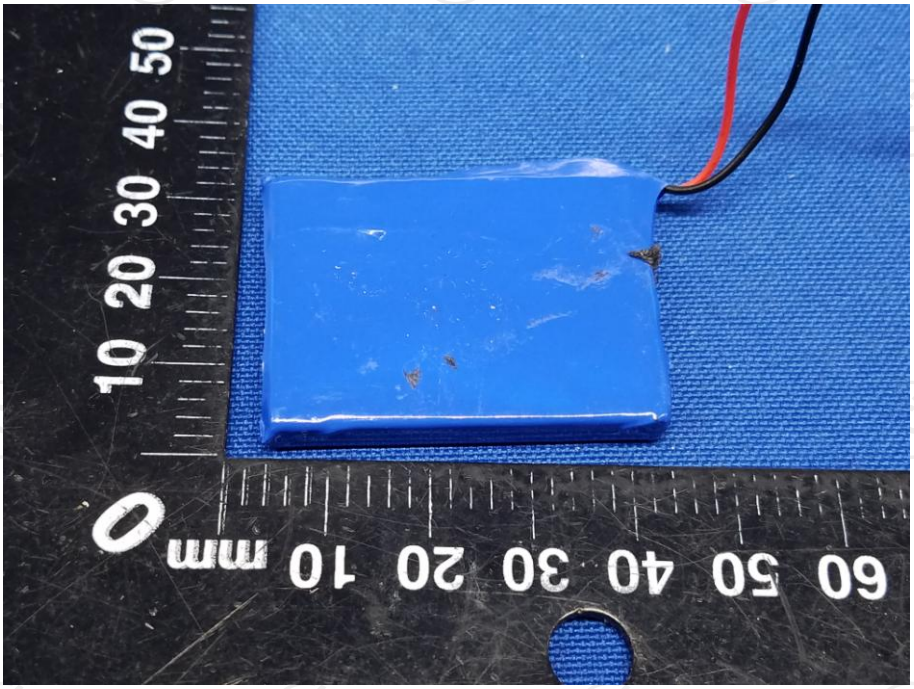


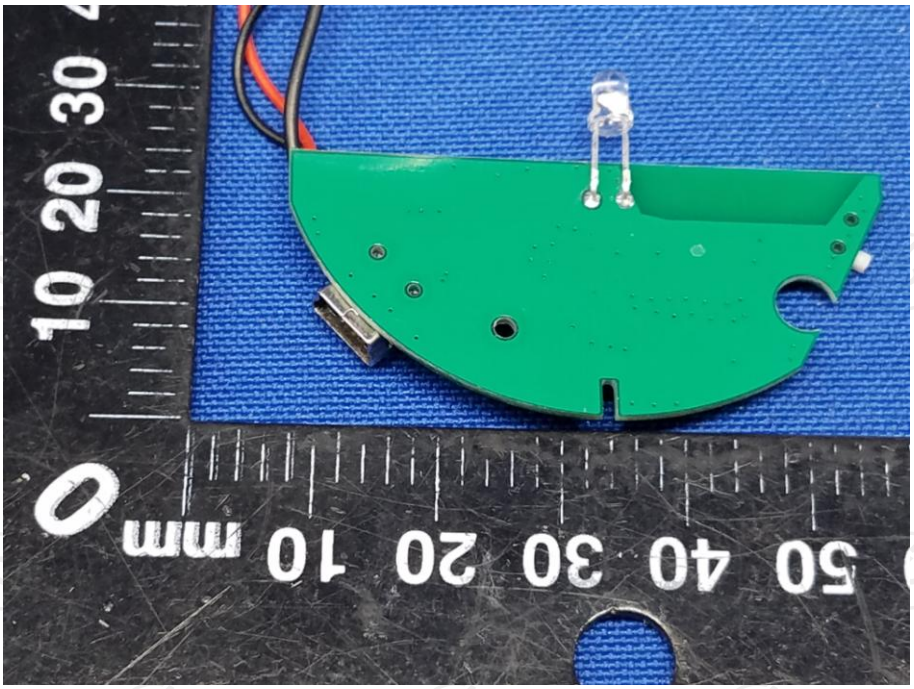
**Product: SV Speaker**
**Model: THY-S07**
**Internal Photos**

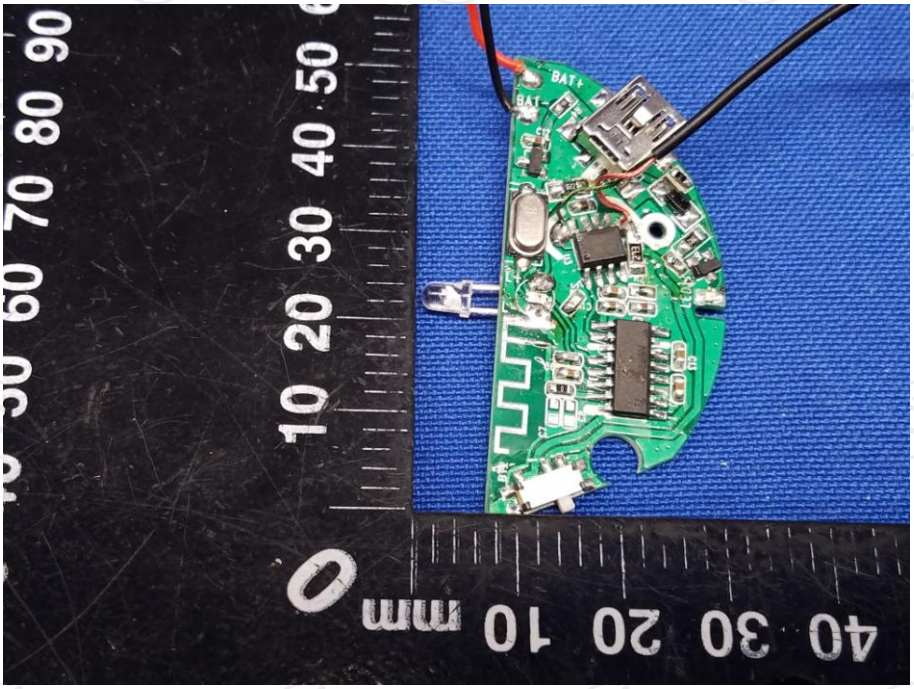





C1
0 mm 10 20 30 40 50 60


0 mm 10 20 30 40 50 60




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



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