# FCC PART 15.231

# TEST REPORT

For

# FUZHOU SWELL ELECTRONIC CO., LTD

BLDG. 4, NO. 6, ZHIHUI AVENUE, NANYU TOWN, FUZHOU, China

## FCC ID: 2AU98S657PD

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Outdoor Temperature Sensor |

| | |
|---|---|
| **Project Engineer:** | Stone Zhang |
| **Report Number:** | RXM210601054-00B |
| **Report Date:** | 2021-07-12 |
| **Reviewed By:** | Oscar Ye<br>EMC Manager |
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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Applicant: | FUZHOU SWELL ELECTRONIC CO., LTD |
| Tested Model: | S657PD |
| Series Model: | S692 |
| Model Difference | See Declaration letter |
| Product Type: | Outdoor Temperature Sensor |
| Power Supply: | DC 3V from battery |
| RF Function: | SRD |
| Operating Band/Frequency: | 433.92MHz |
| Field strength of fundamental: | 75.61dBμV/m@3m |
| Channel Number: | 1 |
| Modulation Type: | OOK |
| Antenna Type: | Spring Antenna |
| *Maximum Antenna Gain: | 0 dBi |

**Note: The maximum antenna gain is provided by the applicant.*

**All measurement and test data in this report was gathered from production sample serial number: RXM210601054-1. (Assigned by the BACL. The EUT supplied by the applicant was received on 2021-06-01)*

## Objective

This test report is prepared on behalf of *FUZHOU SWELL ELECTRONIC CO., LTD* All the test measurements were performed according to the measurement procedure described in ANSI C63.10 - 2013.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.209, 15.35(c) and 15.231 rules.

## Related Submittal(s)/Grant(s)

No related submittal/grant.

## Test Methodology

All measurements contained in this report were conducted with ANSI C63.10 - 2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

| Item | | Uncertainty |
|---|---|---|
| AC Power Lines Conducted Emissions | | 3.19 dB |
| RF conducted test with spectrum | | 0.9dB |
| Radiated emission | 30MHz~1GHz | 6.11dB |
| | 1GHz~6GHz | 4.45dB |
| | 6GHz ~18GHz | 5.23dB |
| Occupied Bandwidth | | 0.5kHz |
| Temperature | | 1.0℃ |
| Humidity | | 6% |

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

# SYSTEM TEST CONFIGURATION

## Justification

Channel List:

| Channel | Frequency (MHz) |
|---|---|
| 1 | 433.92 |

## EUT Exercise Software

For radiated emission testing:
Engineering mode which can continue transmit.

## Equipment Modifications

No modification was made to the EUT.

## Support Equipment List and Details

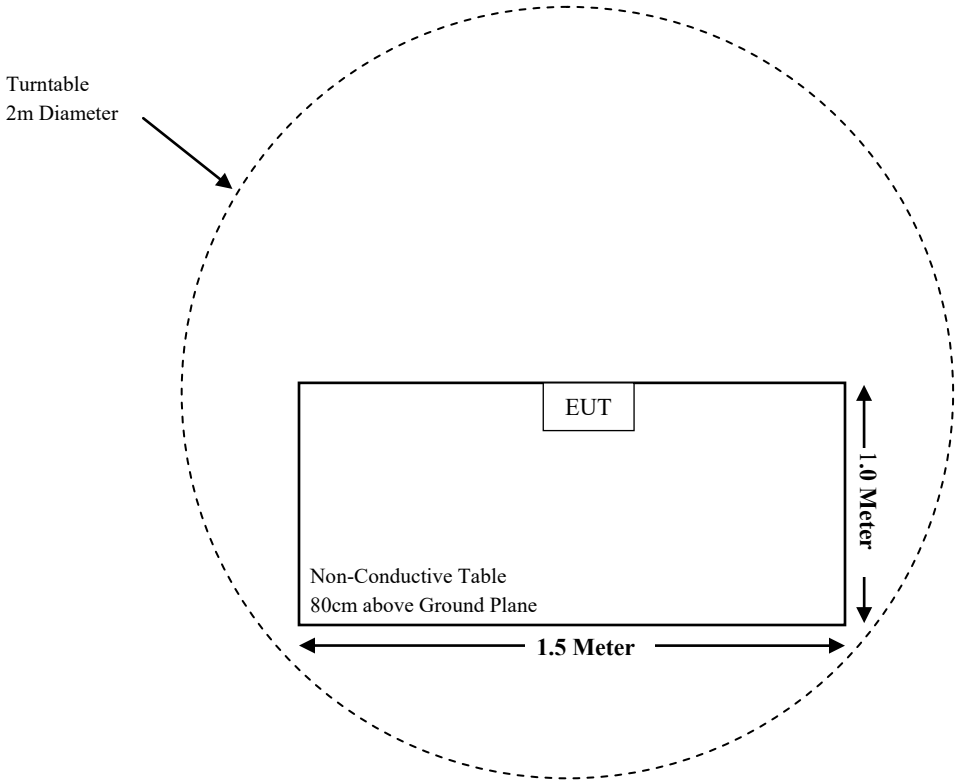
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| / | / | / | / |

## External I/O Cable

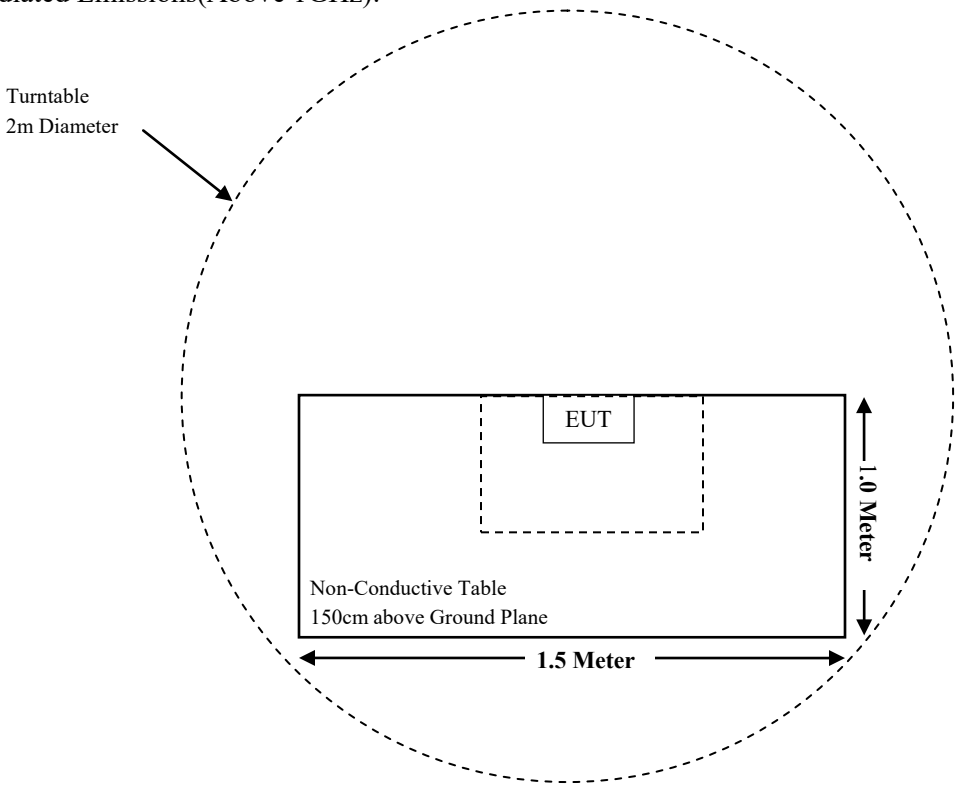
| Cable Description | Length (m) | From Port | To Port |
|---|---|---|---|
| / | / | / | / |

## Block Diagram of Test Setup

For Radiated Emissions(Below 1GHz):




For Radiated Emissions(Above 1GHz):



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.203 | Antenna Requirement | Compliant |
| §15.207(a) | Conducted Emissions | Not applicable (See Note) |
| §15.205, §15.209, §15.231(e) | Radiated Emissions | Compliant |
| §15.231 (e) | Deactivation | Compliant |
| §15.231 (c) | 20dB Emission Bandwidth | Compliant |

Note: The EUT is powered by battery.

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **Radiated Emission Test (Chamber 1#)** | | | | | |
| Rohde & Schwarz | EMI Test Receiver | ESCI | 100195 | 2020-11-27 | 2021-11-26 |
| Rohde & Schwarz | Signal Analyzer | FSV40 | 101116 | 2020-08-15 | 2021-08-14 |
| Sunol Sciences | Broadband Antenna | JB3 | A090314-1 | 2020-08-05 | 2023-08-04 |
| Sonoma Instrument | Pre-amplifier | 310N | 171205 | 2020-08-14 | 2021-08-13 |
| Rohde & Schwarz | Auto Test Software | EMC32 | 100361 | N/A | N/A |
| MICRO-COAX | Coaxial Cable | Cable-8 | 008 | 2020-08-15 | 2021-08-14 |
| MICRO-COAX | Coaxial Cable | Cable-9 | 009 | 2020-08-15 | 2021-08-14 |
| MICRO-COAX | Coaxial Cable | Cable-10 | 010 | 2020-08-15 | 2021-08-14 |
| **Radiated Emission Test (Chamber 2#)** | | | | | |
| Rohde & Schwarz | EMI Test Receiver | ESU40 | 100207/040 | 2021-03-16 | 2022-03-15 |
| ETS-LINDGREN | Horn Antenna | 3115 | 9207-3900 | 2020-07-15 | 2023-07-14 |
| A.H.Systems, inc | Amplifier | PAM-0118P | 512 | 2021-02-20 | 2022-02-19 |
| Narda | Attenuator | 10dB | 010 | 2020-08-15 | 2021-08-14 |
| Rohde & Schwarz | Auto test Software | EMC32 | 100361 | N/A | N/A |
| MICRO-COAX | Coaxial Cable | Cable-6 | 006 | 2020-08-15 | 2021-08-14 |
| MICRO-COAX | Coaxial Cable | Cable-11 | 011 | 2020-08-15 | 2021-08-14 |
| MICRO-COAX | Coaxial Cable | Cable-12 | 012 | 2020-08-15 | 2021-08-14 |
| MICRO-COAX | Coaxial Cable | Cable-13 | 013 | 2020-08-15 | 2021-08-14 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

# FCC§15.203 - ANTENNA REQUIREMENT

## Applicable Standard

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

## Antenna Connected Construction

The EUT has a Spring antenna which was permanently attached and the antenna gain is 0dBi; fulfill the requirement of this section. Please refer to EUT photos.

**Result**: Compliant.

# FCC §15.205, §15.209, §15.231 (e) - RADIATED EMISSIONS

## Applicable Standard

FCC §15.205, §15.209, §15.231 (e)

According to FCC §15.231(e), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

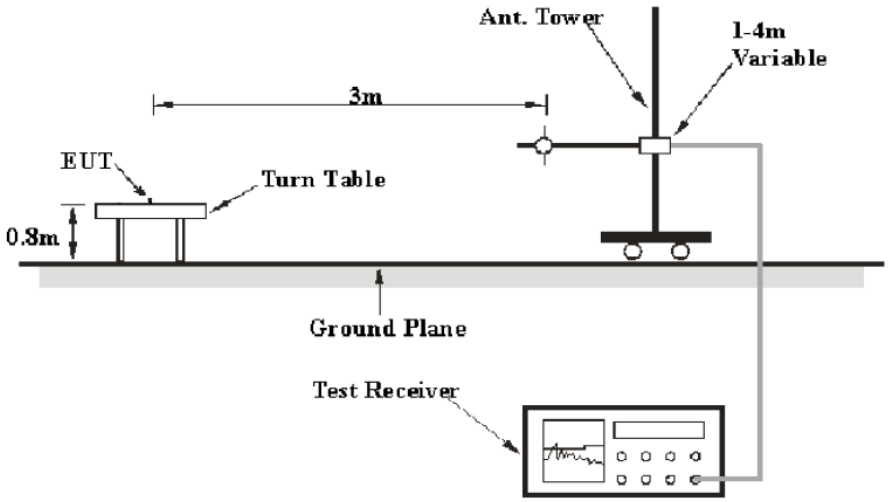
| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emission (microvolts/meter) |
|---|---|---|
| 40.66-40.70 | 1,000 | 100 |
| 70-130 | 500 | 50 |
| 130-174 | 500 to 1,500 * | 50 to 150 * |
| 174-260 | 1,500 | 150 |
| 260-470 | 1,500 to 5,000 * | 150 to 500* |
| Above 470 | 5,000 | 500 |

*Linear interpolations.

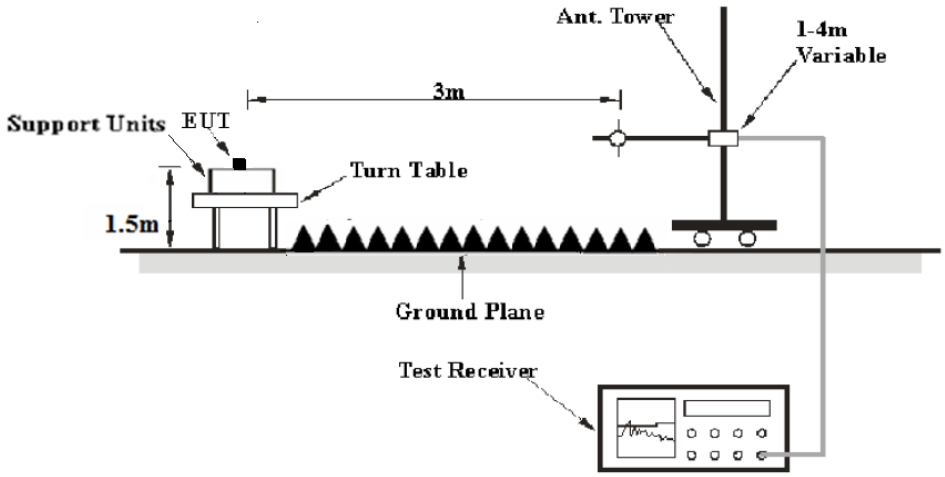
The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

## EUT Setup

**Below 1GHz:**



**Above 1 GHz:**




The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10 - 2013. The specification used was the FCC § 15.209, 15.205 and 15.231.

## EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

During the radiated emission test, the EMI test Receiver was set with the following configurations:

| Frequency Range | RBW | Video B/W | Detector |
|---|---|---|---|
| 30 MHz – 1000 MHz | 120 kHz | 300 kHz | PK |
| 1000MHz – 5000MHz | 1MHz | 3MHz | PK |

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude (dBµV /m) = Meter Reading (dBµV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB)

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV /m)

## Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.205, §15.209, §15.231 (e).

## Test Data

### Environmental Conditions

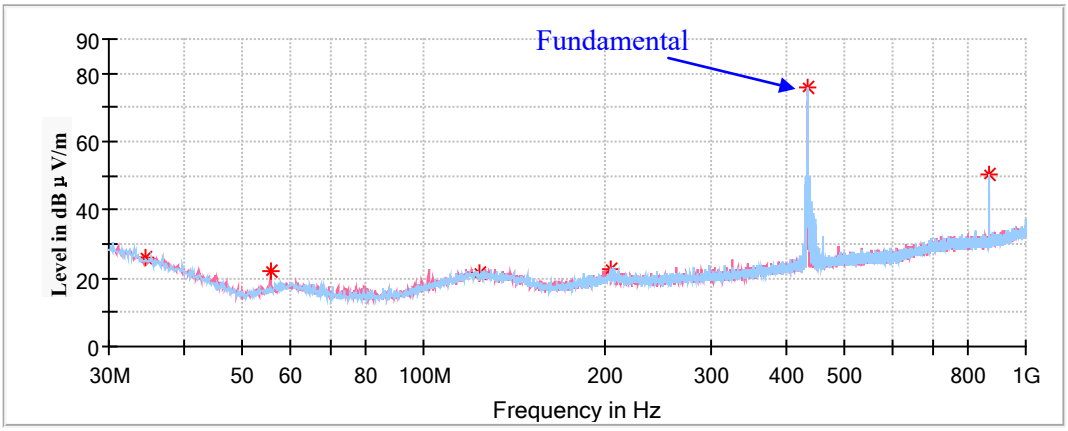
| | |
|---|---|
| **Temperature:** | 24.5~24.8 ℃ |
| **Relative Humidity:** | 50~52 % |
| **ATM Pressure:** | 101.3~102 kPa |

*The testing was performed by Jack Jiang from 2021-07-05 to 2021-07-12.*

*Test mode: Transmitting*

**30MHz-1GHz (OOK modulation)**

*(Pre-scan in the X,Y and Z axes of orientation, the worst case **Y-axis of orientation** was recorded.)*




| Frequency (MHz) | Corrected Amplitude Max Peak (dBµV/m) | Rx Antenna | | Turntable Degree | Corrected Factor (dB/m) | QP/Average Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | | Height (cm) | Polar (H/V) | | | | |
| 34.49 | 26.00 | 200 | H | 92 | -4 | 52.87 | 26.87 |
| 55.58 | 22.31 | 200 | H | 110 | -14.5 | 52.87 | 30.56 |
| 123.97 | 21.74 | 100 | V | 75 | -11 | 43.50 | 21.76 |
| 204.96 | 22.60 | 200 | V | 130 | -12 | 52.87 | 30.27 |
| 867.84 | 50.13 | 100 | V | 31 | -0.3 | 52.87 | 2.74 |

| Frequency (MHz) | Corrected Amplitude | Rx Antenna | | Turntable Degree | Corrected Factor (dB/m) | Peak Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | Max Peak (dBµV/m) | Height (cm) | Polar (H/V) | | | | |
| 433.92 | 75.61 | 200 | V | 27 | -7.2 | 92.87 | 17.26 |

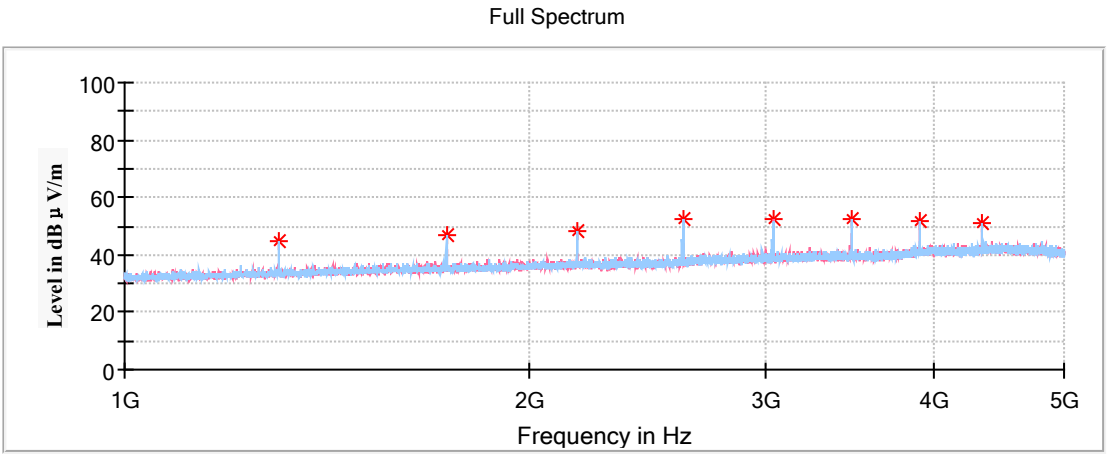
Note: If the spurious emissions maximized peak measured value complies with the QP/Average limit, it is unnecessary to perform QP/Average measurement.

**Field Strength of Average Emission**

| Frequency (MHz) | Peak Measurement@3m (dBµV/m) | Height (cm) | Polar (H/V) | Duty Cycle Corrected Factor (dB) | Corrected Amplitude (dBµV/m) | FCC Part 15.231(e)/205/209 | |
|---|---|---|---|---|---|---|---|
| | | | | | | Limit (dBµV/m) | Margin (dB) |
| 433.92 | 75.61 | 200 | V | -11.99 | 63.62 | 72.87 | 9.25 |

**1GHz-5 GHz (OOK modulation)**

*(Pre-scan in the X,Y and Z axes of orientation, the worst case **Y-axis of orientation** was recorded.)*




| Frequency (MHz) | Corrected Amplitude MaxPeak (dBµV /m) | Rx Antenna | | Turntable Degree | Corrected Factor (dB/m) | Average Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | | Height (cm) | Polar (H/V) | | | | |
| 1301.76 | 44.66 | 200.0 | H | 139.0 | -7.5 | 54.00 | 9.34 |
| 1735.68 | 47.13 | 200.0 | H | 292.0 | -5.7 | 54.00 | 6.87 |
| 2169.60 | 48.23 | 200.0 | H | 160.0 | -4.6 | 54.00 | 5.77 |
| 2603.52 | 52.20 | 200.0 | H | 292.0 | -3.6 | 54.00 | 1.80 |
| 3037.44 | 52.13 | 200.0 | V | 334.0 | -2.0 | 54.00 | 1.87 |
| 3471.36 | 52.57 | 150.0 | H | 0.0 | -1.7 | 54.00 | 1.43 |
| 3905.28 | 51.69 | 150.0 | V | 316.0 | 0.0 | 54.00 | 2.31 |
| 4339.20 | 51.35 | 200.0 | H | 180.0 | 1.0 | 54.00 | 2.65 |

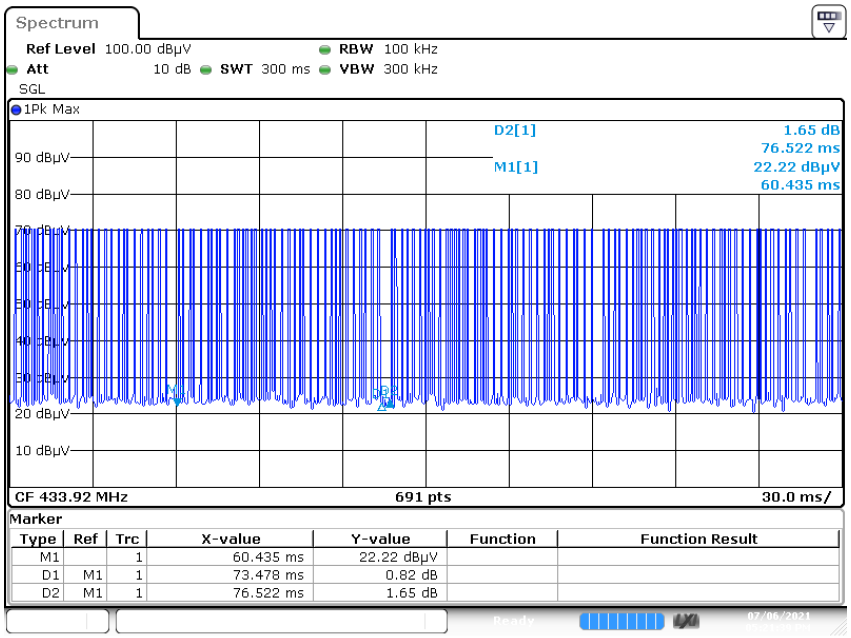
Note: If the spurious emissions maximized peak measured value complies with the QP/Average limit, it is unnecessary to perform QP/Average measurement.

Note 1:
Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV/m)

Note 2:
Calculate Average value based on Duty Cycle correction factor:
Tp=76.812ms
Ton=0.522*37=19.314ms
Duty Cycle Corrected Factor =20*log (Ton/Tp) =20*log (19.314ms/76.812ms) =-11.99dB
Average value = Peak value + Duty Cycle Corrected Factor

**This duty cycle is the worst case for the EUT**

**Duty Cycle**

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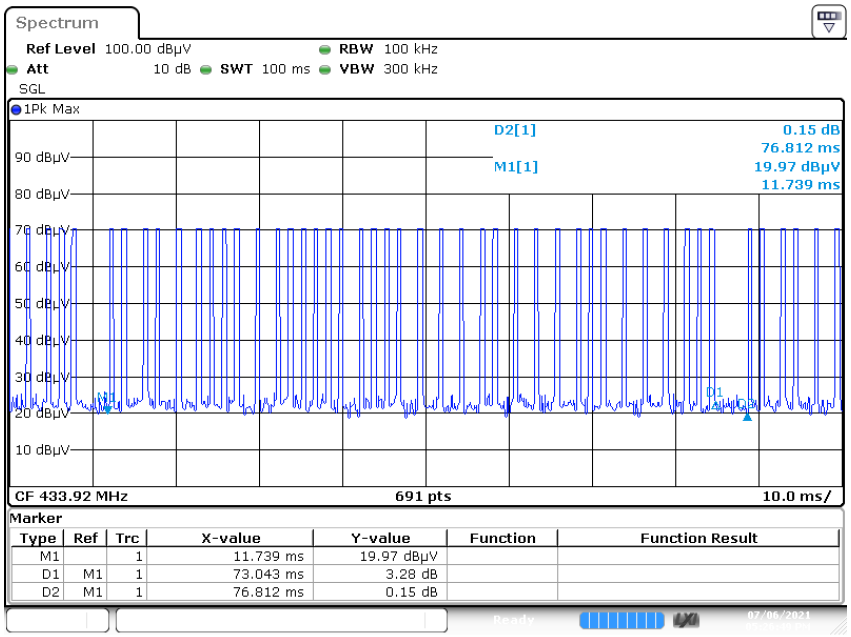
**Zoom in Pulse Train**

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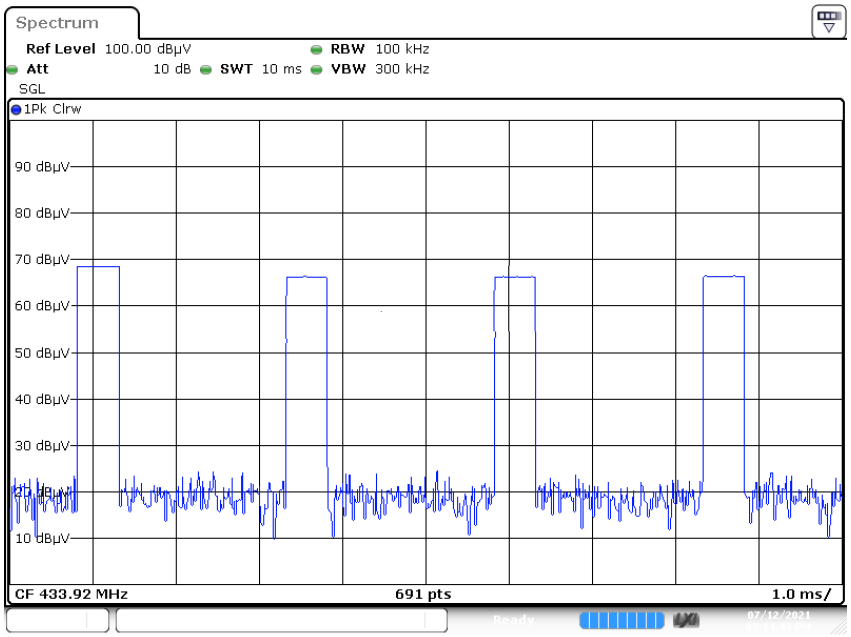
**Burst, N=37**

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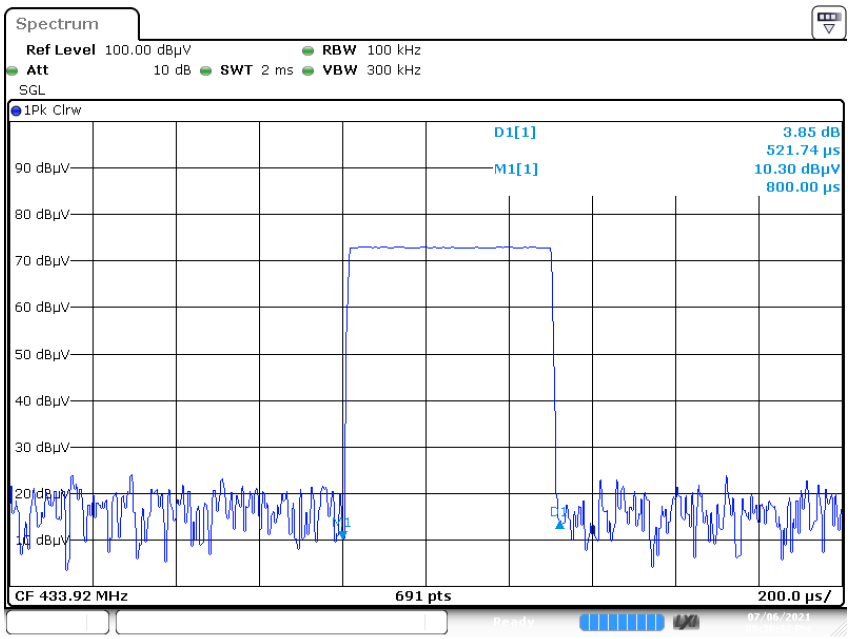


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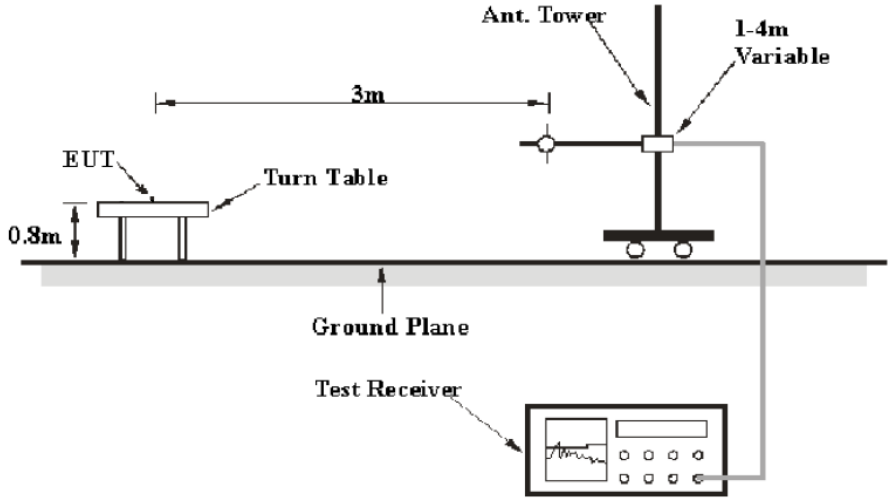
# FCC §15.231(e) - DEACTIVATION TESTING

## Applicable Standard

Per 15.231(e), devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

## EUT Setup




The deactivation test was performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10- 2013. The specification used was the FCC 15.231(e) limits.

## Test Procedure

1. With the EUT's antenna attached, the waveform was received by the test antenna which was connected to the spectrum analyzer.
2. Set center frequency of spectrum analyzer=operating frequency.
3. Set the spectrum analyzer as RBW=100kHz VBW=300kHz Span=0Hz.
4. Repeat above procedures until all frequency measured was complete.

# Test Data

## Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24.1~24.3 °C |
| **Relative Humidity:** | 51~53 % |
| **ATM Pressure:** | 101~101.2 kPa |

*The testing was performed by Jack Jiang from 2021-07-05 to 2021-07-08.*

*Test mode: Transmitting*

Deactivation

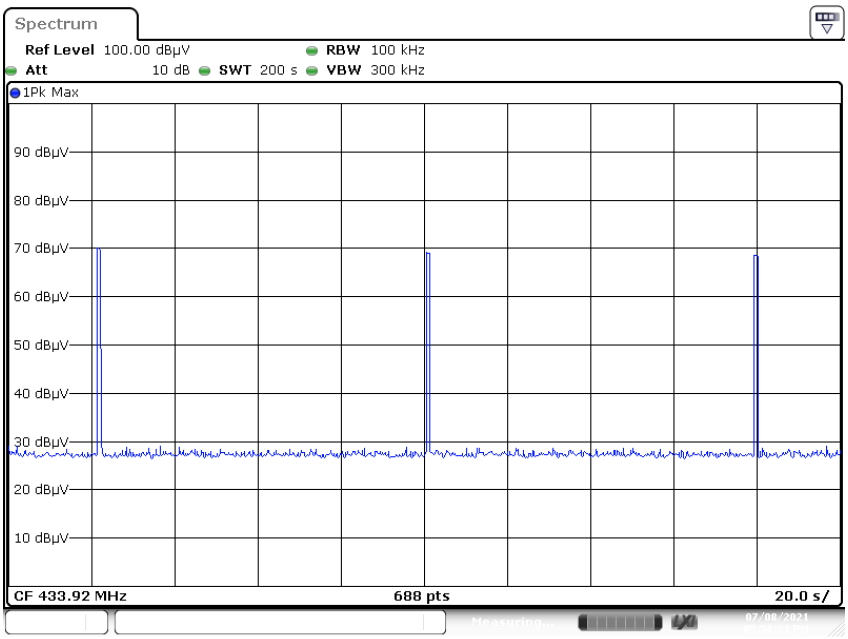
| Transmission period (s) | Limit (s) | Result |
|---|---|---|
| 0.88168 | < 1 | Pass |

Silent period

| Silent period (s) | Limit (s) | Result |
|---|---|---|
| 65.948 | >26.4504 | Pass |

**Note:**
**The silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.**
*The duration time is 0.88168s, 0.88168×30 =26.4504s.*

## Transmission period

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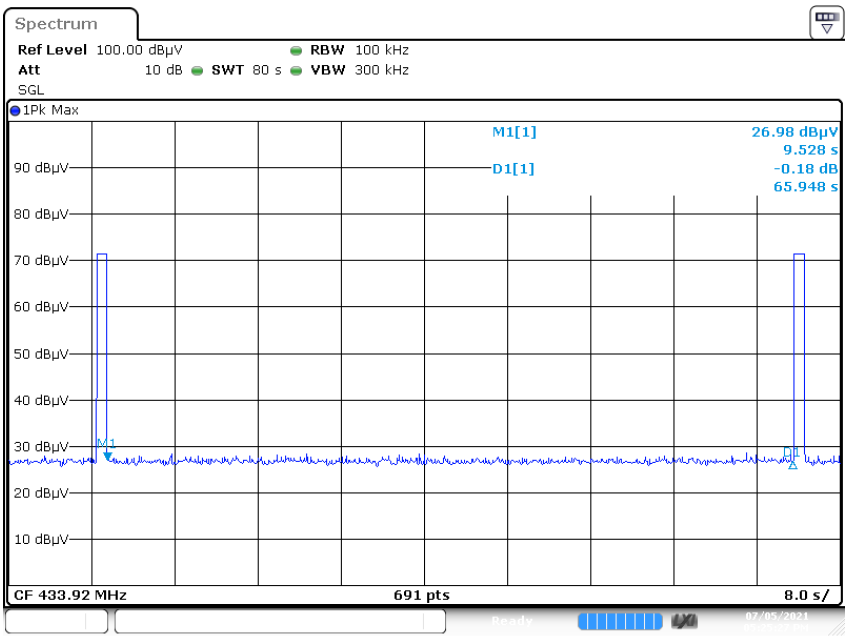
## Silent period

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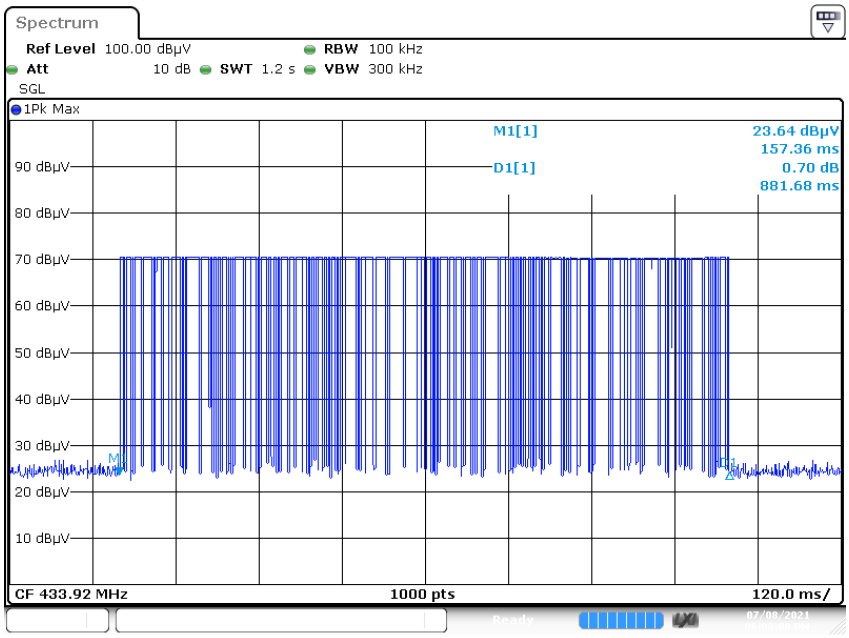
**Duration time**

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# FCC §15.231(c) - 20dB EMISSION BANDWIDTH TESTING

## Applicable Standard

Per 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

## Test Procedure

With the EUT's antenna attached, the waveform was received by the test antenna which was connected to the spectrum analyzer, plot the 20 dB bandwidth.

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24.1 ℃ |
| **Relative Humidity:** | 53 % |
| **ATM Pressure:** | 101.2 kPa |

*The testing was performed by Jack Jiang on 2021-07-05.*

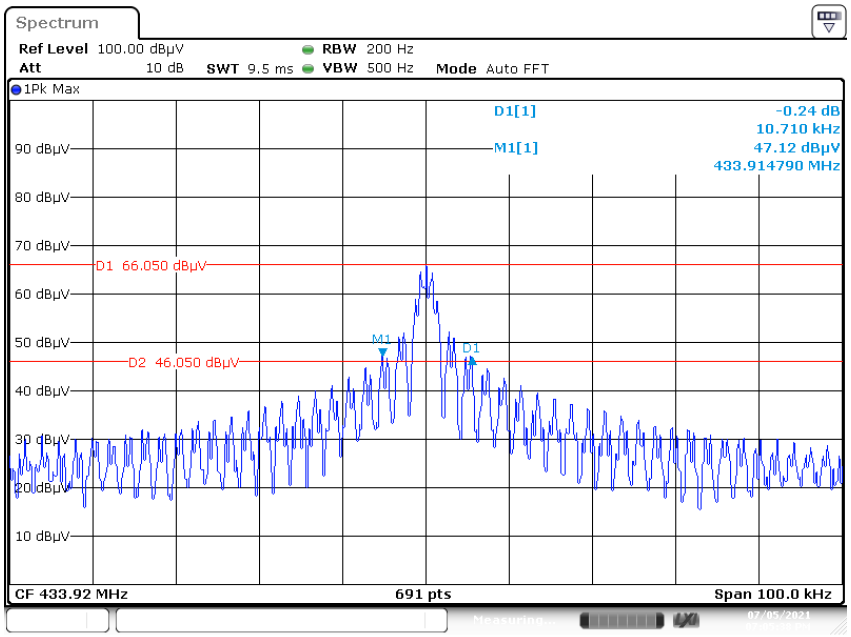
*Test Mode: Transmitting*

**OOK modulation:**

| Channel Frequency (MHz) | 20dB Bandwidth (kHz) | Limit (kHz) | Result |
|---|---|---|---|
| 433.92 | 10.71 | 1084.8 | Pass |

**Note:** Limit = 0.25% * Center Frequency = 0.25% * 433.92 MHz = 1084.8 kHz

**20 dB Emission Bandwidth**

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## Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

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