# FCC Test Report

| | | |
|---|---|---|
| **FCC ID** | : | **2AK2I-APEN-D2-M3** |
| **Equipment** | : | **Active Pen** |
| **Model No.** | : | **APEN-D2-M3** |
| **Brand Name** | : | **Flatfrog** |
| **Applicant** | : | **FlatFrog Laboratories AB** |
| **Address** | : | **Scheelevägen 15 A, Alfa 2,223 63 Lund,Sweden** |
| **Manufacturer** | : | **Solidyear Co., Ltd.** |
| **Address** | : | **18F., Building B, No.97, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan R.O.C.** |
| **Standard** | : | **47 CFR FCC Part 15.249** |
| **Received Date** | : | **Jan. 20, 2017** |
| **Tested Date** | : | **Mar. 02 ~ Mar. 17, 2017** |

**We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.**

**Reviewed by:** **Approved by:**

**Along Chen / Assistant Manager** **Gary Chang / Manager**

Testing Laboratory 2732

# Table of Contents


**1 GENERAL DESCRIPTION ..... 5**

1.1 Information ..... 5
1.2 Test Setup Chart ..... 7
1.3 The Equipment List ..... 8
1.4 Test Standards ..... 9
1.5 Measurement Uncertainty ..... 9

**2 TEST CONFIGURATION ..... 10**

2.1 Testing Condition ..... 10
2.2 The Worst Test Modes and Channel Details ..... 10

**3 TRANSMITTER TEST RESULTS ..... 11**

3.1 Radiated Emission ..... 11
3.2 20dB and Occupied Bandwidth ..... 23

**4 TEST LABORATORY INFORMATION ..... 24**

# Release Record

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| FR712001 | Rev. 01 | Initial issue | Ang. 17, 2017 |

# Summary of Test Results

| FCC Rules | Test Items | Measured | Result |
|---|---|---|---|
| 15.207 | AC Power Line Conducted Emissions | Note | N/A |
| 15.249(a) | Field Strength of Fundamental | Meet the requirement of limit | Pass |
| 15.249(a)(d) | Field Strength of Harmonics and Emissions Radiated outside of the Specified Frequency Bands | Meet the requirement of limit | Pass |
| 15.215(c) | 20dB bandwidth | Meet the requirement of limit | Pass |
| 15.203 | Antenna Requirement | Meet the requirement of limit | Pass |
| Note: The EUT consumes DC power from battery, therefore this test is not required. | | | |

# 1 General Description

## 1.1 Information

### 1.1.1 Specification of the Equipment under Test (EUT)

| RF General Information | | | | |
|---|---|---|---|---|
| Frequency Range (MHz) | Modulation | Ch. Freq. (MHz) | Channel Number | Channel Bandwidth (MHz) |
| 2400-2483.5 | GFSK | 2402-2480 | 0-78 [79] | 2 |

### 1.1.2 Antenna Details

| Ant. No. | Type | Gain (dBi) | Connector |
|---|---|---|---|
| 1 | SMD | 5.19 | N/A |

### 1.1.3 EUT Operational Condition

| | |
|---|---|
| **Power Supply Type** | 1.5Vdc AAAAbattery |

Note: The equipment tests are performed using a new battery.

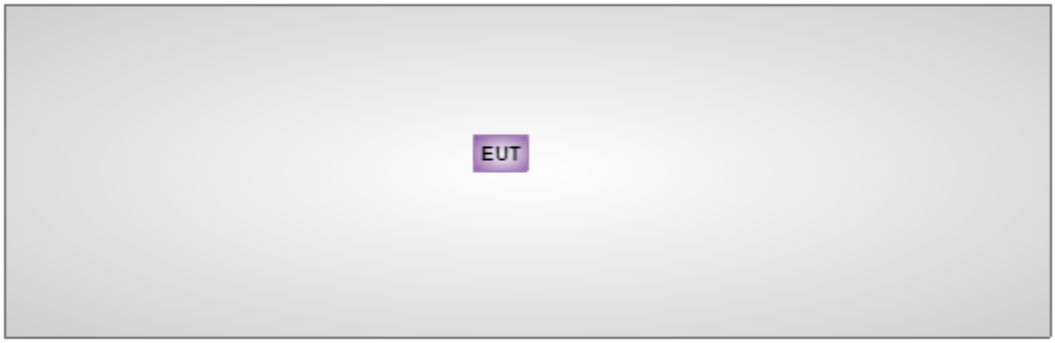
### 1.1.4 Accessories

| Accessories | | |
|---|---|---|
| **No.** | **Equipment** | **Description** |
| 1 | Dry cell | Power Rating: 1.5Vdc |

### 1.1.5 Channel List

| Frequency band (MHz) | | | | 2400~2483.5 | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 0 | 2402 | 20 | 2422 | 40 | 2442 | 60 | 2462 |
| 1 | 2403 | 21 | 2423 | 41 | 2443 | 61 | 2463 |
| 2 | 2404 | 22 | 2424 | 42 | 2444 | 62 | 2464 |
| 3 | 2405 | 23 | 2425 | 43 | 2445 | 63 | 2465 |
| 4 | 2406 | 24 | 2426 | 44 | 2446 | 64 | 2466 |
| 5 | 2407 | 25 | 2427 | 45 | 2447 | 65 | 2467 |
| 6 | 2408 | 26 | 2428 | 46 | 2448 | 66 | 2468 |
| 7 | 2409 | 27 | 2429 | 47 | 2449 | 67 | 2469 |
| 8 | 2410 | 28 | 2430 | 48 | 2450 | 68 | 2470 |
| 9 | 2411 | 29 | 2431 | 49 | 2451 | 69 | 2471 |
| 10 | 2412 | 30 | 2432 | 50 | 2452 | 70 | 2472 |
| 11 | 2413 | 31 | 2433 | 51 | 2453 | 71 | 2473 |
| 12 | 2414 | 32 | 2434 | 52 | 2454 | 72 | 2474 |
| 13 | 2415 | 33 | 2435 | 53 | 2455 | 73 | 2475 |
| 14 | 2416 | 34 | 2436 | 54 | 2456 | 74 | 2476 |
| 15 | 2417 | 35 | 2437 | 55 | 2457 | 75 | 2477 |
| 16 | 2418 | 36 | 2438 | 56 | 2458 | 76 | 2478 |
| 17 | 2419 | 37 | 2439 | 57 | 2459 | 77 | 2479 |
| 18 | 2420 | 38 | 2440 | 58 | 2460 | 78 | 2480 |
| 19 | 2421 | 39 | 2441 | 59 | 2461 | --- | --- |

## 1.2 Test Setup Chart

| Test Setup Diagram |
| --- |
|   |

## 1.3 The Equipment List

| Test Item | Radiated Emission | | | | |
|---|---|---|---|---|---|
| **Test Site** | 966 chamber1 / (03CH01-WS) | | | | |
| **Instrument** | **Manufacturer** | **Model No.** | **Serial No.** | **Calibration Date** | **Calibration Until** |
| Spectrum Analyzer | R&S | FSV40 | 101498 | Nov. 25, 2016 | Nov. 24, 2017 |
| Receiver | R&S | ESR3 | 101658 | Nov. 24, 2016 | Nov. 23, 2017 |
| Bilog Antenna | SCHWARZBECK | VULB9168 | VULB9168-522 | Aug. 04, 2016 | Aug. 03, 2017 |
| Horn Antenna 1G-18G | SCHWARZBECK | BBHA 9120 D | BBHA 9120 D 1096 | Dec. 21, 2016 | Dec. 20, 2017 |
| Horn Antenna 18G-40G | SCHWARZBECK | BBHA 9170 | BBHA 9170517 | Oct. 25, 2016 | Oct. 24, 2017 |
| Loop Antenna | R&S | HFH2-Z2 | 100330 | Nov. 10, 2016 | Nov. 09, 2017 |
| Loop Antenna Cable | KOAX KABEL | 101354-BW | 101354-BW | Dec. 09, 2016 | Dec. 08, 2017 |
| Preamplifier | EMC | EMC02325 | 980225 | Aug. 05, 2016 | Aug. 04, 2017 |
| Preamplifier | Agilent | 83017A | MY39501308 | Oct. 06, 2016 | Oct. 05, 2017 |
| Preamplifier | EMC | EMC184045B | 980192 | Aug. 24, 2016 | Aug. 23, 2017 |
| RF Cable | HUBER+SUHNER | SUCOFLEX104 | MY16014/4 | Dec. 09, 2016 | Dec. 08, 2017 |
| RF Cable | HUBER+SUHNER | SUCOFLEX104 | MY16019/4 | Dec. 09, 2016 | Dec. 08, 2017 |
| RF Cable | HUBER+SUHNER | SUCOFLEX104 | MY16139/4 | Dec. 09, 2016 | Dec. 08, 2017 |
| LF cable 1M | EMC | EMCCFD400-NM-NM-1000 | 16052 | Dec. 09, 2016 | Dec. 08, 2017 |
| LF cable 3M | Woken | CFD400NL-LW | CFD400NL-001 | Dec. 09, 2016 | Dec. 08, 2017 |
| LF cable 10M | Woken | CFD400NL-LW | CFD400NL-002 | Dec. 09, 2016 | Dec. 08, 2017 |
| Measurement Software | AUDIX | e3 | 6.120210g | NA | NA |
| Note: Calibration Interval of instruments listed above is one year. | | | | | |

| Test Item | RF Conducted | | | | |
|---|---|---|---|---|---|
| **Test Site** | (TH01-WS) | | | | |
| **Instrument** | **Manufacturer** | **Model No.** | **Serial No.** | **Calibration Date** | **Calibration Until** |
| Spectrum Analyzer | R&S | FSV40 | 101499 | Dec. 16, 2016 | Dec. 15, 2017 |
| Power Meter | Anritsu | ML2495A | 1241002 | Oct. 06, 2016 | Oct. 05, 2017 |
| Power Sensor | Anritsu | MA2411B | 1207366 | Oct. 06, 2016 | Oct. 05, 2017 |
| DC POWER SOURCE | GW INSTEK | GPC-6030D | EM892433 | Oct. 20, 2016 | Oct. 19, 2017 |
| Measurement Software | Sporton | Sporton_1 | 1.3.30 | NA | NA |
| Note: Calibration Interval of instruments listed above is one year. | | | | | |

## 1.4 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.249
ANSI C63.10-2013

## 1.5 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

| Measurement Uncertainty | |
|---|---|
| **Parameters** | **Uncertainty** |
| Bandwidth | ±34.134 Hz |
| AC conducted emission | ±2.90 dB |
| Radiated emission ≤ 1GHz | ±3.66 dB |
| Radiated emission > 1GHz | ±5.63 dB |

# 2 Test Configuration

## 2.1 Testing Condition

| Test Item | Test Site | Ambient Condition | Tested By |
|---|---|---|---|
| Radiated Emissions | 03CH01-WS | 22°C / 62% | Vincent Yeh<br>Kevin Lee |
| RF Conducted | TH01-WS | 22°C / 62% | Vincent Yeh |

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- IC site registration No.: 10807A-1

## 2.2 The Worst Test Modes and Channel Details

| Test item | Mode | Test Frequency (MHz) | Test Configuration |
|---|---|---|---|
| Field Strength of Fundamental | GFSK | 2402, 2440, 2480 | --- |
| Radiated Emissions (below 1GHz) | GFSK | 2480 | --- |
| Radiated Emissions (Above 1GHz) | GFSK | 2402, 2440, 2480 | --- |
| 20dB bandwidth | GFSK | 2402, 2440, 2480 | --- |

# 3 Transmitter Test Results

## 3.1 Radiated Emission

This section includes field strength of fundamental, field strength of harmonics and emissions radiated outside of the operating frequency bands.

### 3.1.1 Limit of field strength of fundamental and field strength of harmonics

| Fundamental Frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|---|---|---|
| 2400–2483.5 MHz | 50 | 500 |

### 3.1.2 Limit of Unwanted Emissions

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in below table, whichever is the lesser attenuation.

| Radiated emission limits | | | |
|---|---|---|---|
| **Frequency Range (MHz)** | **Field Strength (uV/m)** | **Field Strength (dBuV/m)** | **Measure Distance (m)** |
| 0.009~0.490 | 2400/F(kHz) | 48.5 - 13.8 | 300 |
| 0.490~1.705 | 24000/F(kHz) | 33.8 - 23 | 30 |
| 1.705~30.0 | 30 | 29 | 30 |
| 30~88 | 100 | 40 | 3 |
| 88~216 | 150 | 43.5 | 3 |
| 216~960 | 200 | 46 | 3 |
| Above 960 | 500 | 54 | 3 |

**Note 1:**
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
**Note 2:**
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

### 3.1.3 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

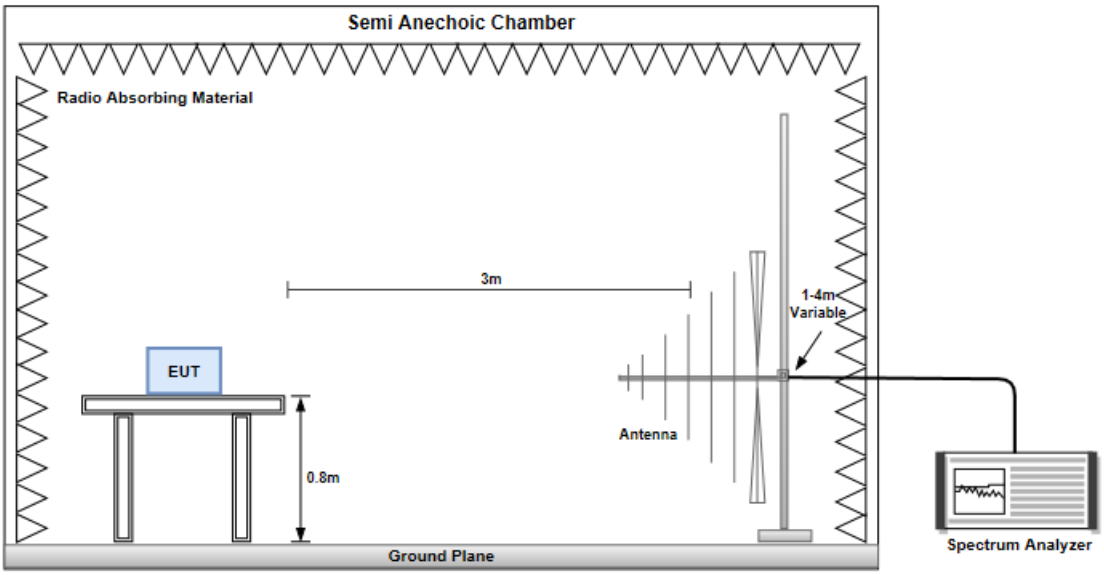
1. Radiated emission below 1GHz
   120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission above 1GHz / Peak value except fundamental
   RBW=1MHz, VBW=3MHz and Peak detector
3. Radiated emission above 1GHz / Average value
   The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula:

   $$20\log(\text{Duty cycle}) = 20\log\frac{45 * 0.28261\ \text{ms}}{100\ \text{ms}} = -17.91\text{dB}$$

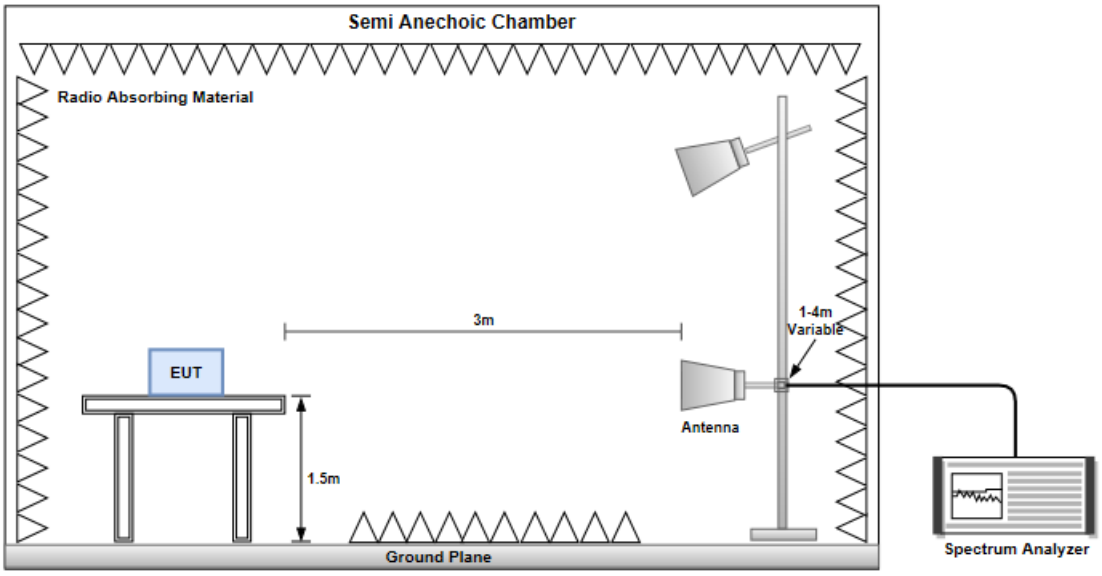
   Please see page 22 for plotted duty
4. Radiated emission above 1GHz / Average value for other emissions
   RBW=1MHz, VBW=10Hz and Peak detector
5. Radiated emission Peak value for fundamental
   RBW=3MHz, VBW=10MHz and Peak detector

### 3.1.4 Test Setup

**Radiated Emissions below 1 GHz**

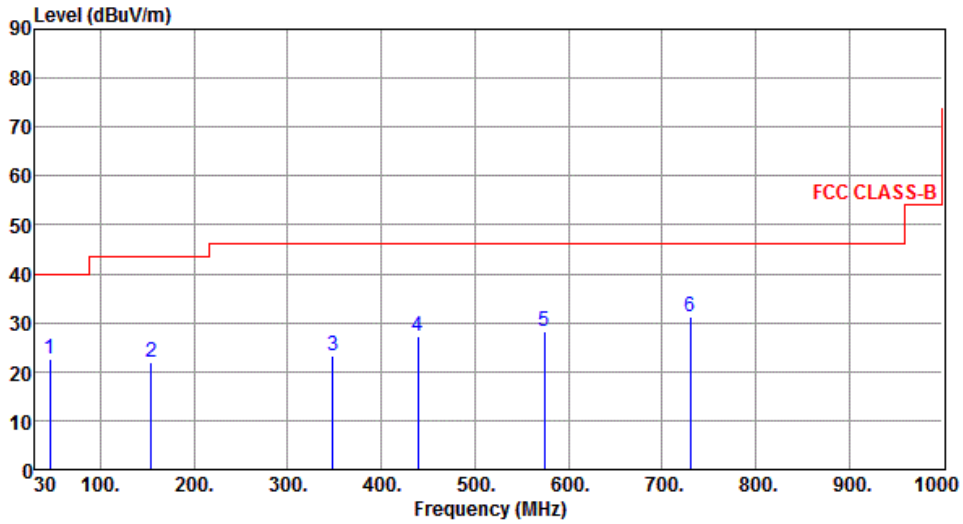



**Radiated Emissions above 1 GHz**



### 3.1.5 Transmitter Radiated Unwanted Emissions (Below 1GHz)

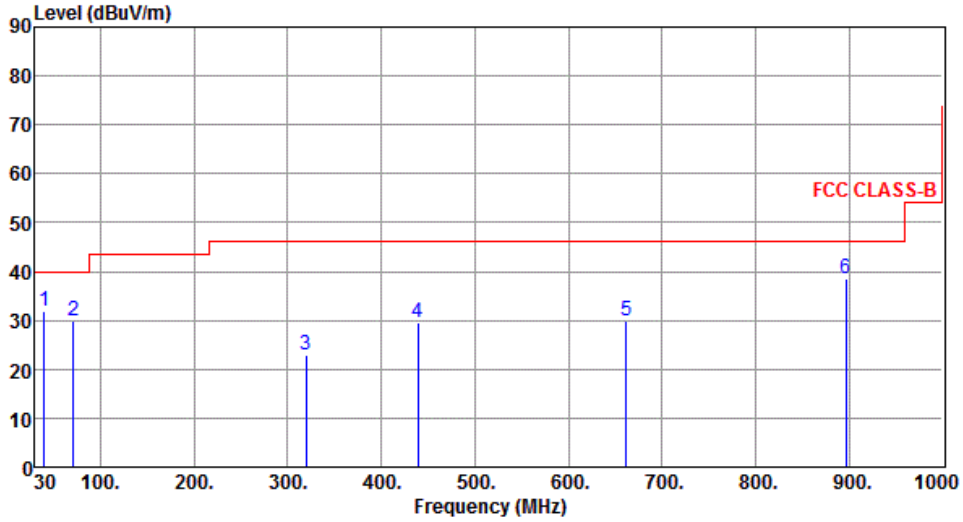
| **Modulation** | GFSK | **Test Freq. (MHz)** | 2480 |
|---|---|---|---|
| **Polarization** | Horizontal | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 45.52 | 22.73 | 40.00 | -17.27 | 30.30 | -7.57 | Peak | --- | --- |
| 2 | 154.16 | 21.87 | 43.50 | -21.63 | 30.01 | -8.14 | Peak | --- | --- |
| 3 | 348.16 | 23.26 | 46.00 | -22.74 | 29.55 | -6.29 | Peak | --- | --- |
| 4 | 439.34 | 27.24 | 46.00 | -18.76 | 31.25 | -4.01 | Peak | --- | --- |
| 5 | 574.17 | 28.23 | 46.00 | -17.77 | 29.51 | -1.28 | Peak | --- | --- |
| 6 | 730.34 | 31.09 | 46.00 | -14.91 | 29.66 | 1.43 | Peak | --- | --- |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

| Modulation | GFSK | Test Freq. (MHz) | 2480 |
|---|---|---|---|
| Polarization | Vertical | | |

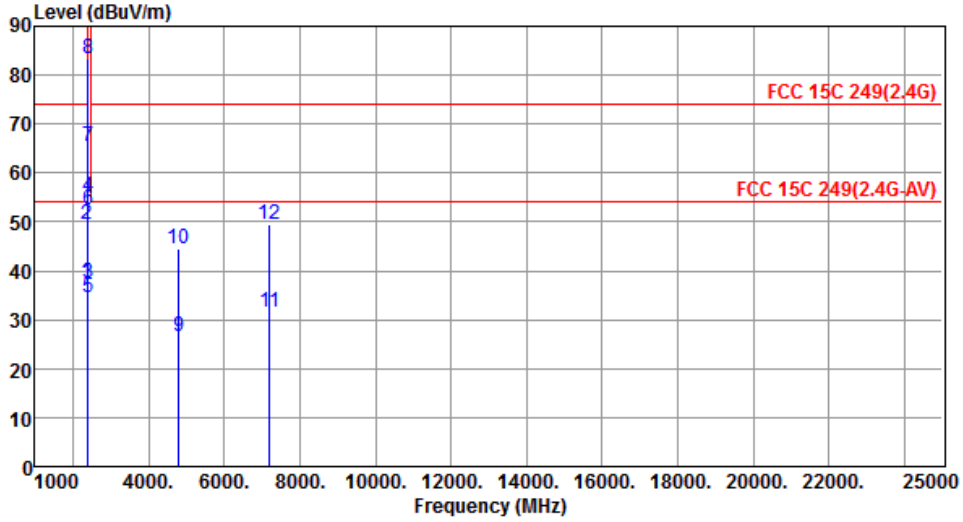



| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.70 | 32.01 | 40.00 | -7.99 | 39.86 | -7.85 | Peak | --- | --- |
| 2 | 70.74 | 29.79 | 40.00 | -10.21 | 40.62 | -10.83 | Peak | --- | --- |
| 3 | 320.03 | 22.86 | 46.00 | -23.14 | 29.87 | -7.01 | Peak | --- | --- |
| 4 | 439.34 | 29.41 | 46.00 | -16.59 | 33.42 | -4.01 | Peak | --- | --- |
| 5 | 661.47 | 29.88 | 46.00 | -16.12 | 29.73 | 0.15 | Peak | --- | --- |
| 6 | 896.21 | 38.42 | 46.00 | -7.58 | 34.22 | 4.20 | Peak | --- | --- |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

### 3.1.1 Transmitter Radiated Unwanted Emissions (Above 1GHz)

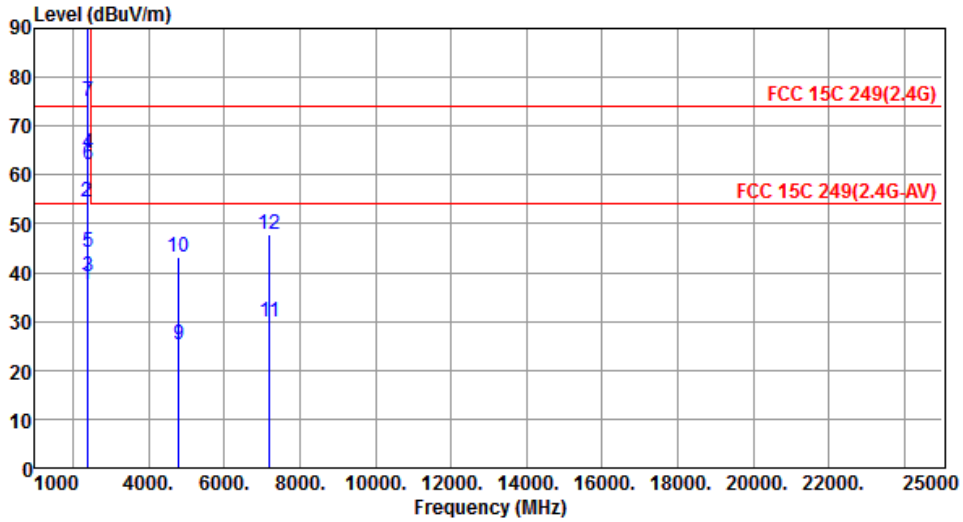
| **Modulation** | GFSK | **Test Freq. (MHz)** | 2402 |
|---|---|---|---|
| **Polarization** | Horizontal | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.00 | 37.36 | 54.00 | -16.64 | 40.54 | -3.18 | Average | 360 | 6 |
| 2 | 2390.00 | 49.37 | 74.00 | -24.63 | 52.55 | -3.18 | Peak | 360 | 6 |
| 3 | 2398.00 | 37.49 | 54.00 | -16.51 | 40.64 | -3.15 | Average | 360 | 6 |
| 4 | 2398.00 | 54.97 | 74.00 | -19.03 | 58.12 | -3.15 | Peak | 360 | 6 |
| 5 | 2400.00 | 34.48 | 54.00 | -19.52 | 37.62 | -3.14 | Average | 360 | 6 |
| 6 | 2400.00 | 52.39 | 74.00 | -21.61 | 55.53 | -3.14 | Peak | 360 | 6 |
| 7 | 2402.00 | 65.32 | 94.00 | -28.68 | 68.45 | -3.13 | Average | 360 | 6 |
| 8 | 2402.00 | 83.23 | 114.00 | -30.77 | 86.36 | -3.13 | Peak | 360 | 6 |
| 9 | 4804.00 | 26.58 | 54.00 | -27.42 | 22.84 | 3.74 | Average | 245 | 5 |
| 10 | 4804.00 | 44.49 | 74.00 | -29.51 | 40.75 | 3.74 | Peak | 245 | 5 |
| 11 | 7206.00 | 31.61 | 54.00 | -22.39 | 23.24 | 8.37 | Average | 100 | 244 |
| 12 | 7206.00 | 49.52 | 74.00 | -24.48 | 41.15 | 8.37 | Peak | 100 | 244 |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

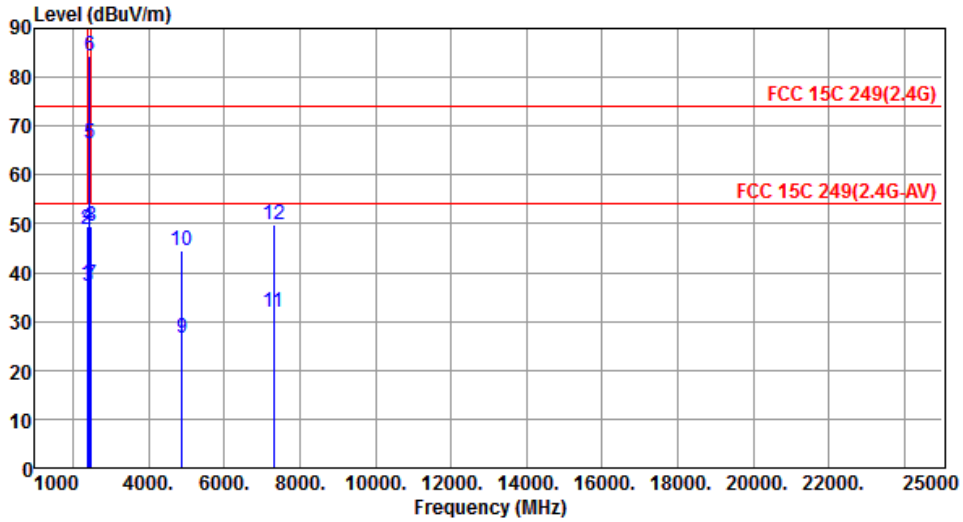
| Modulation | GFSK | Test Freq. (MHz) | 2402 |
|---|---|---|---|
| Polarization | Vertical | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.00 | 37.61 | 54.00 | -16.39 | 40.79 | -3.18 | Average | 100 | 220 |
| 2 | 2390.00 | 54.32 | 74.00 | -19.68 | 57.50 | -3.18 | Peak | 100 | 220 |
| 3 | 2398.00 | 39.04 | 54.00 | -14.96 | 42.19 | -3.15 | Average | 100 | 220 |
| 4 | 2398.00 | 64.59 | 74.00 | -9.41 | 67.74 | -3.15 | Peak | 100 | 220 |
| 5 | 2400.00 | 44.30 | 54.00 | -9.70 | 47.44 | -3.14 | Average | 100 | 220 |
| 6 | 2400.00 | 62.21 | 74.00 | -11.79 | 65.35 | -3.14 | Peak | 100 | 220 |
| 7 | 2402.00 | 75.14 | 94.00 | -18.86 | 78.27 | -3.13 | Average | 100 | 220 |
| 8 | 2402.00 | 93.05 | 114.00 | -20.95 | 96.18 | -3.13 | Peak | 100 | 220 |
| 9 | 4804.00 | 25.25 | 54.00 | -28.75 | 21.51 | 3.74 | Average | 100 | 324 |
| 10 | 4804.00 | 43.16 | 74.00 | -30.84 | 39.42 | 3.74 | Peak | 100 | 324 |
| 11 | 7206.00 | 29.87 | 54.00 | -24.13 | 21.50 | 8.37 | Average | 100 | 257 |
| 12 | 7206.00 | 47.78 | 74.00 | -26.22 | 39.41 | 8.37 | Peak | 100 | 257 |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

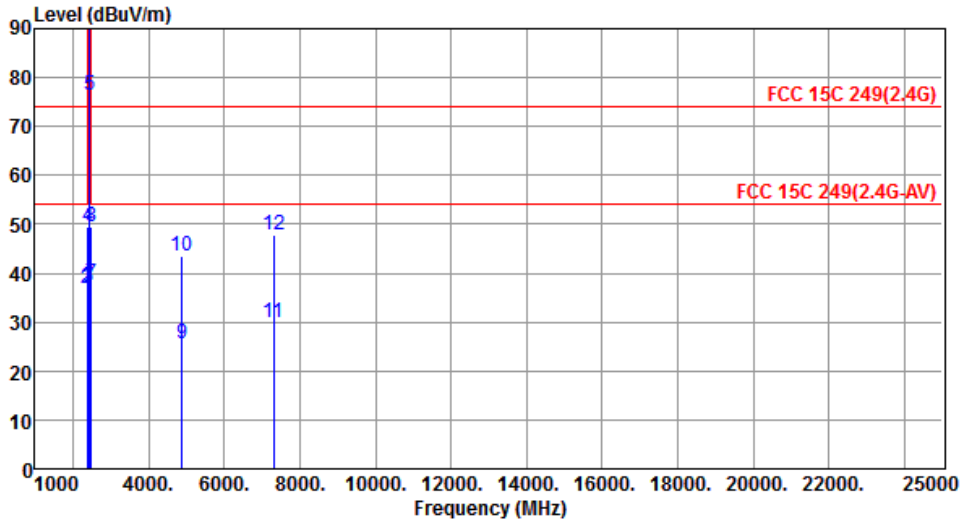
| Modulation | GFSK | Test Freq. (MHz) | 2440 |
|---|---|---|---|
| Polarization | Horizontal | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.00 | 37.42 | 54.00 | -16.58 | 40.60 | -3.18 | Average | 348 | 2 |
| 2 | 2390.00 | 48.93 | 74.00 | -25.07 | 52.11 | -3.18 | Peak | 348 | 2 |
| 3 | 2400.00 | 37.26 | 54.00 | -16.74 | 40.40 | -3.14 | Average | 348 | 2 |
| 4 | 2400.00 | 49.32 | 74.00 | -24.68 | 52.46 | -3.14 | Peak | 348 | 2 |
| 5 | 2440.00 | 66.41 | 94.00 | -27.59 | 69.39 | -2.98 | Average | 348 | 2 |
| 6 | 2440.00 | 84.32 | 114.00 | -29.68 | 87.30 | -2.98 | Peak | 348 | 2 |
| 7 | 2483.50 | 37.51 | 54.00 | -16.49 | 40.31 | -2.80 | Average | 348 | 2 |
| 8 | 2483.50 | 49.49 | 74.00 | -24.51 | 52.29 | -2.80 | Peak | 348 | 2 |
| 9 | 4880.00 | 26.70 | 54.00 | -27.30 | 22.74 | 3.96 | Average | 235 | 8 |
| 10 | 4880.00 | 44.61 | 74.00 | -29.39 | 40.65 | 3.96 | Peak | 235 | 8 |
| 11 | 7320.00 | 31.82 | 54.00 | -22.18 | 23.41 | 8.41 | Average | 100 | 238 |
| 12 | 7320.00 | 49.73 | 74.00 | -24.27 | 41.32 | 8.41 | Peak | 100 | 238 |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

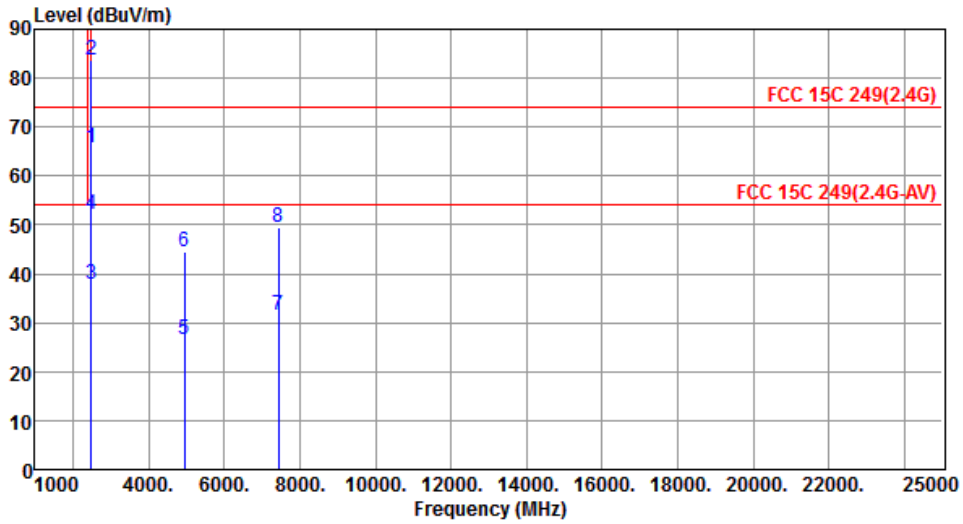
| Modulation | GFSK | Test Freq. (MHz) | 2440 |
|---|---|---|---|
| Polarization | Vertical | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.00 | 37.25 | 54.00 | -16.75 | 40.43 | -3.18 | Average | 100 | 133 |
| 2 | 2390.00 | 36.93 | 74.00 | -37.07 | 40.11 | -3.18 | Peak | 100 | 133 |
| 3 | 2400.00 | 37.19 | 54.00 | -16.81 | 40.33 | -3.14 | Average | 100 | 133 |
| 4 | 2400.00 | 49.60 | 74.00 | -24.40 | 52.74 | -3.14 | Peak | 100 | 133 |
| 5 | 2440.00 | 76.28 | 94.00 | -17.72 | 79.26 | -2.98 | Average | 100 | 133 |
| 6 | 2440.00 | 94.19 | 114.00 | -19.81 | 97.17 | -2.98 | Peak | 100 | 133 |
| 7 | 2483.50 | 37.91 | 54.00 | -16.09 | 40.71 | -2.80 | Average | 100 | 133 |
| 8 | 2483.50 | 49.32 | 74.00 | -24.68 | 52.12 | -2.80 | Peak | 100 | 133 |
| 9 | 4880.00 | 25.43 | 54.00 | -28.57 | 21.47 | 3.96 | Average | 100 | 314 |
| 10 | 4880.00 | 43.34 | 74.00 | -30.66 | 39.38 | 3.96 | Peak | 100 | 314 |
| 11 | 7320.00 | 29.92 | 54.00 | -24.08 | 21.51 | 8.41 | Average | 100 | 266 |
| 12 | 7320.00 | 47.83 | 74.00 | -26.17 | 39.42 | 8.41 | Peak | 100 | 266 |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

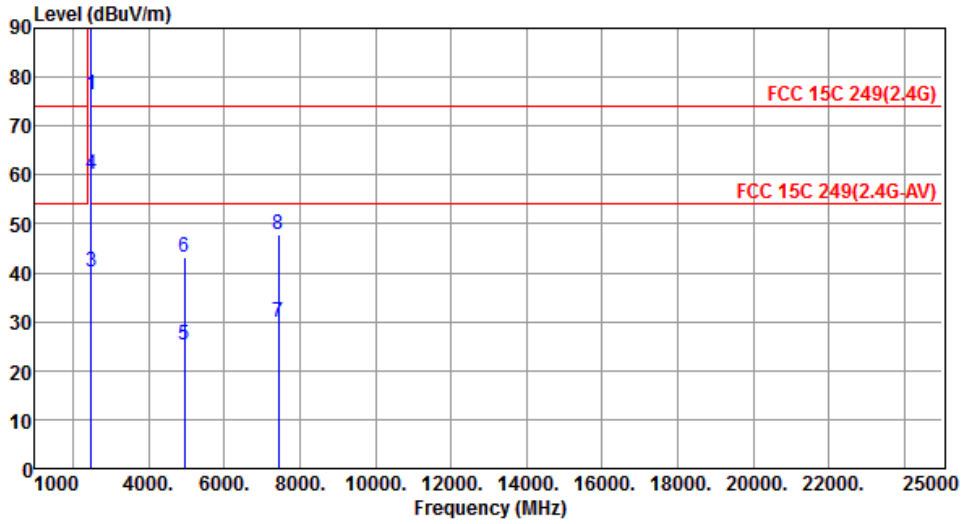
| Modulation | GFSK | Test Freq. (MHz) | 2480 |
|---|---|---|---|
| Polarization | Horizontal | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2480.00 | 65.68 | 94.00 | -28.32 | 68.49 | -2.81 | Average | 390 | 0 |
| 2 | 2480.00 | 83.59 | 114.00 | -30.41 | 86.40 | -2.81 | Peak | 390 | 0 |
| 3 | 2483.50 | 37.82 | 54.00 | -16.18 | 40.62 | -2.80 | Average | 390 | 0 |
| 4 | 2483.50 | 52.00 | 74.00 | -22.00 | 54.80 | -2.80 | Peak | 390 | 0 |
| 5 | 4960.00 | 26.67 | 54.00 | -27.33 | 22.46 | 4.21 | Average | 242 | 7 |
| 6 | 4960.00 | 44.58 | 74.00 | -29.42 | 40.37 | 4.21 | Peak | 242 | 7 |
| 7 | 7440.00 | 31.71 | 54.00 | -22.29 | 23.18 | 8.53 | Average | 100 | 236 |
| 8 | 7440.00 | 49.62 | 74.00 | -24.38 | 41.09 | 8.53 | Peak | 100 | 236 |

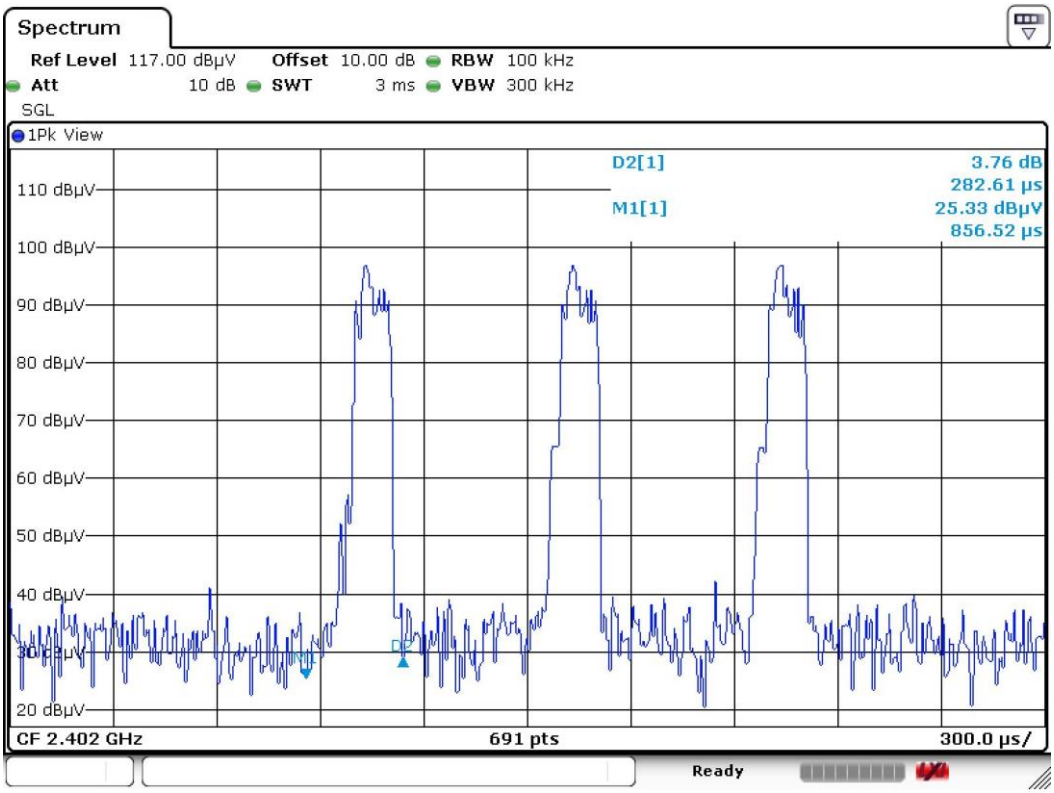
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

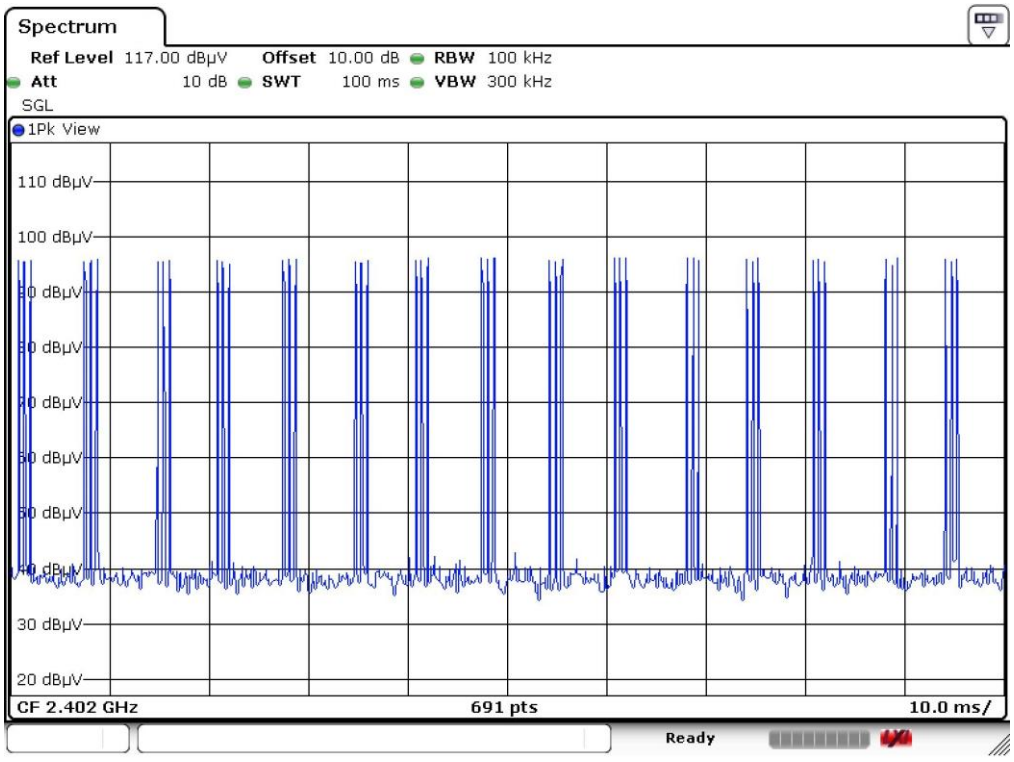
| Modulation | GFSK | Test Freq. (MHz) | 2480 |
|---|---|---|---|
| Polarization | Vertical | | |




| | Freq. MHz | Emission level dBuV/m | Limit dBuV/m | Margin dB | SA reading dBuV | Factor dB | Remark | ANT High cm | Turn Table deg |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2480.00 | 76.37 | 94.00 | -17.63 | 79.18 | -2.81 | Average | 130 | 230 |
| 2 | 2480.00 | 94.28 | 114.00 | -19.72 | 97.09 | -2.81 | Peak | 130 | 230 |
| 3 | 2483.50 | 40.22 | 54.00 | -13.78 | 43.02 | -2.80 | Average | 130 | 230 |
| 4 | 2483.50 | 60.22 | 74.00 | -13.78 | 63.02 | -2.80 | Peak | 130 | 230 |
| 5 | 4960.00 | 25.30 | 54.00 | -28.70 | 21.09 | 4.21 | Average | 100 | 318 |
| 6 | 4960.00 | 43.21 | 74.00 | -30.79 | 39.00 | 4.21 | Peak | 100 | 318 |
| 7 | 7440.00 | 29.95 | 54.00 | -24.05 | 21.42 | 8.53 | Average | 100 | 269 |
| 8 | 7440.00 | 47.86 | 74.00 | -26.14 | 39.33 | 8.53 | Peak | 100 | 269 |

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



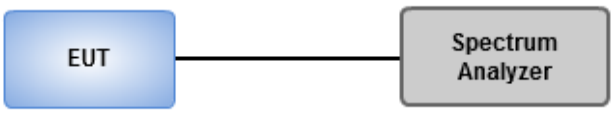

$$20\log(\text{Duty cycle}) = 20\log\frac{45 * 0.28261\ \text{ms}}{100\ \text{ms}} = -17.91\text{dB}$$

## 3.2 20dB and Occupied Bandwidth

### 3.2.1 Test Procedures

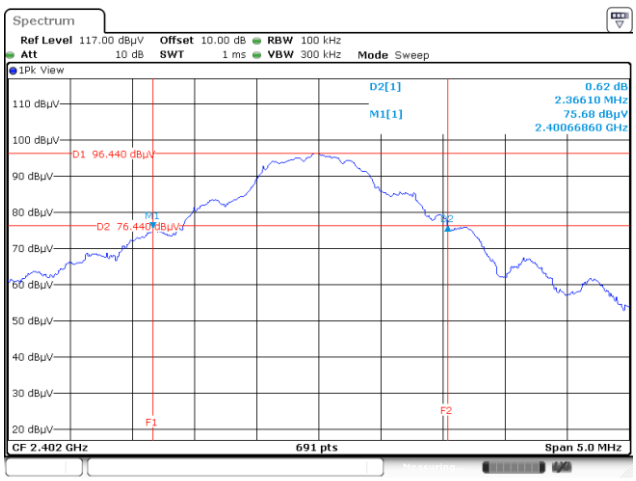
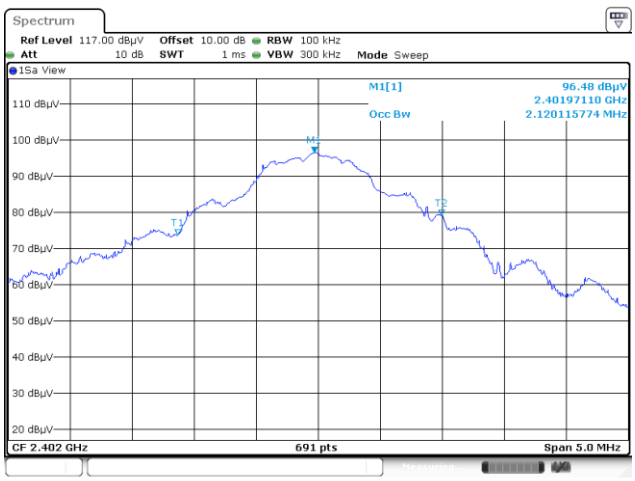
1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak(20 dB bandwidth) / Sample(Occupied bandwidth), Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.
5. Use the occupied measurement function of specturm analyzer to measure 99% occupied bandwidth

### 3.2.2 Test Setup




### 3.2.3 20dB and Occupied Bandwidth

| Freq. (MHz) | 20dB Bandwidth (MHz) | Occupied Bandwidth (MHz) |
|---|---|---|
| 2402 | 2.37 | 2.12 |
| 2440 | 2.00 | 1.80 |
| 2480 | 1.96 | 1.85 |

| Worst Plot of 20dB Bandwidth | Worst Plot of Occupied Bandwidth |
|---|---|
|  |  |

# 4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

| **Linkou** | **Kwei Shan** | **Kwei Shan Site II** |
|---|---|---|
| Tel: 886-2-2601-1640 | Tel: 886-3-271-8666 | Tel: 886-3-271-8640 |
| No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C. | No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C. | No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C. |

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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