



# FCC RADIO TEST REPORT

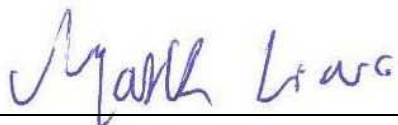
Applicant : SteelSeries ApS.  
Address : 656 W Randolph St., Suite 3E Chicago,  
IL 60661, USA  
Equipment : Transceiver  
Model No. : M-00010TX  
Trade Name :   
FCC ID. : ZHK-M00010TX

## I HEREBY CERTIFY THAT :

The sample was received on Jun. 14, 2018 and the testing was carried out on Jul. 09, 2018 at Cerpass Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of Cerpass Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Tested by:



Mark Liao / Assistant Manager



Spree Yei / Engineer

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory





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### History of this test report

| Report No.  | Issue Date    | Description |
|-------------|---------------|-------------|
| TEFC1802108 | Jul. 17, 2018 | Original.   |
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## 1. Summary of Test Procedure and Test Results

### 1.1. Applicable Standards

ANSI C63.4:2014

FCC Rules and Regulations Part 15 Subpart C §15.249

| FCC Rule         | Description of Test | Result |
|------------------|---------------------|--------|
| 15.207           | Conducted Emission  | PASS   |
| 15.209<br>15.249 | Radiated Emission   | PASS   |



## 2. Test Configuration of Equipment under Test

### 2.1. Feature of Equipment under Test

| Item            | Spec.             |
|-----------------|-------------------|
| Frequency Range | 2402MHz ~ 2480MHz |
| Modulation      | FSK               |
| Antenna Type    | Monopole          |
| Antenna Gain    | 2.21 dB           |

### 2.2. Carrier Frequency of Channels

| Channel    | Frequency (MHz) |
|------------|-----------------|
| <b>*01</b> | <b>2402</b>     |
| 02         | 2429            |
| <b>*03</b> | <b>2439</b>     |
| 04         | 2450            |
| <b>*05</b> | <b>2479</b>     |

Note: Channels remarked “\*” are selected to perform test.



### 2.3. Test Mode and Test Software

- a. During testing, the interface cables and equipment positions were varied according to ANSI C63.4.
- b. The complete test system included Notebook and EUT for RF test.
- c. An executive program, "MWP383-PXG RF Lab Test V1.0.0.2" was executed to transmit and receive data.
- c. The test modes of RF test as follow:

| Conducted Emissions from the AC mains power ports |                       |
|---------------------------------------------------|-----------------------|
| Test Mode                                         | Operating Description |
| 1                                                 | TX, CH01              |
| Radiation Fundamental                             |                       |
| Test Mode                                         | Operating Description |
| 1                                                 | TX, CH01              |
| 2                                                 | TX, CH03              |
| 3                                                 | TX, CH05              |
| Radiation (30MHz ~ 1GHz)                          |                       |
| Test Mode                                         | Operating Description |
| 1                                                 | TX, CH01              |
| Radiation (1GHz ~ 25GHz)                          |                       |
| Test Mode                                         | Operating Description |
| 1                                                 | TX, CH01              |
| 2                                                 | TX, CH03              |
| 3                                                 | TX, CH05              |

### 2.4. Description of Test System

| Device   | Manufacturer | Model No.   | Description                    |
|----------|--------------|-------------|--------------------------------|
| Notebook | DELL         | VOSTRO 3560 | Power Cable, Unshielding, 1.8m |



## 2.5. General Information of Test

|                               |                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                              |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Site                     | <b>Cerpass Technology Corporation Test Laboratory</b><br>Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.)<br>Tel:+886-3-3226-888<br>Fax:+886-3-3226-881<br>Address: No.68-1, Shihbachongsi, Shihding Township, New Taipei City 223, Taiwan, R.O.C.<br>Tel: +886-2-2663-8582 |                                                                                                                                                                              |
|                               | FCC                                                                                                                                                                                                                                                                                                            | TW1079, TW1061, TW1439                                                                                                                                                       |
|                               | IC                                                                                                                                                                                                                                                                                                             | 4934E-1, 4934E-2                                                                                                                                                             |
|                               | VCCI                                                                                                                                                                                                                                                                                                           | T-2205 for Telecommunication Test<br>C-4663 for Conducted emission test<br>R-3428, R-4218 for Radiated emission test<br>G-10812, G-10813 for radiated disturbance above 1GHz |
| Frequency Range Investigated: | Conducted: from 150kHz to 30 MHz<br>Radiation: from 30 MHz to 25,000MHz                                                                                                                                                                                                                                        |                                                                                                                                                                              |
| Test Distance:                | The test distance of radiated emission from antenna to EUT is 3 M.                                                                                                                                                                                                                                             |                                                                                                                                                                              |

## 2.6. Measurement Uncertainty

| Measurement Item                         | Uncertainty |
|------------------------------------------|-------------|
| Radiated Spurious Emission(9KHz~30MHz)   | ±5.007dB    |
| Radiated Spurious Emission(30MHz~1GHz)   | ±5.157dB    |
| Radiated Spurious Emission(1GHz~18GHz)   | ±6.383dB    |
| Radiated Spurious Emission(18GHz~40GHz)  | ±6.648dB    |
| Conducted Spurious Emission              | ±1.253dB    |
| 6dB Bandwidth                            | ±6.89%      |
| Power Spectral Density                   | ±0.630dB    |
| 26 dB Occupied Bandwidth                 | ±6.10%      |
| Frequency Stability                      | ±375KHz     |
| Channel Frequencies Separation           | ±6.10%      |
| 20dB Bandwidth                           | ±6.12%      |
| Dwell Time                               | ±1.34%      |
| Peak Output Power(Conducted Power Meter) | ±0.86dB     |
| Temperature                              | ±1.2oC      |
| Humidity                                 | ±2.7%       |
| Channel Move Time                        | ±4.53%      |
| Channel Closing Transmission Time        | ±6.61%      |
| Threshold                                | ±0.631dB    |
| Non occupancy period                     | ±1.17%      |



### 3. Test Equipment and Ancillaries Used for Tests

| Instrument                     | Manufacturer    | Model No.                | Serial No.  | Calibration Date | Valid Date |
|--------------------------------|-----------------|--------------------------|-------------|------------------|------------|
| EMI Receiver                   | R&S             | ESCI3                    | 100821      | 2017/09/08       | 2018/09/07 |
| LISN                           | Schwarzbeck     | NSLK 8127                | 8127-568    | 2018/02/26       | 2019/02/25 |
| Pulse Limiter                  | R&S             | ESH3-Z2                  | 101934      | 2018/02/22       | 2019/02/21 |
| Bilog Antenna                  | Schwarzbeck     | VULB9168                 | 275         | 2017/08/31       | 2018/08/30 |
| Active Loop Antenna            | EMCO            | 6507                     | 40855       | 2018/05/22       | 2019/05/21 |
| Horn Antenna                   | EMCO            | 3115                     | 31601       | 2017/09/11       | 2018/09/10 |
| Horn Antenna                   | EMCO            | 3116                     | 31970       | 2018/03/23       | 2019/03/22 |
| Preamplifier                   | EM              | EM330                    | 60658       | 2017/09/08       | 2018/09/07 |
| Preamplifier                   | EMC INSTRUMENTS | EMC051845SE              | 980333      | 2017/09/20       | 2018/09/19 |
| Preamplifier                   | EMC INSTRUMENTS | EMC184045                | 980065      | 2017/11/10       | 2018/11/09 |
| MXG MW Analog Signal Generator | KEYSIGHT        | N5183A                   | MY50142931  | 2018/04/10       | 2019/04/09 |
| Spectrum Analyzer              | R&S             | FSP40                    | 100047      | 2018/03/20       | 2019/03/19 |
| BLUETOOTH TESTER               | R&S             | CBT                      | 101133      | 2018/04/02       | 2019/04/01 |
| Attenuator                     | KEYSIGHT        | 8491B                    | MY39250705  | 2017/09/04       | 2018/09/03 |
| Rotary Attenuator              | Agilent         | 8495B                    | MY42146680  | 2018/03/29       | 2019/03/28 |
| Temp & Humi chamber            | T-MACHINE       | TMJ-9712                 | T-12-040111 | 2017/09/04       | 2018/09/03 |
| Series Power Meter             | Anritsu         | ML2495A                  | 1224005     | 2018/03/23       | 2019/03/22 |
| Power Sensor                   | Anritsu         | MA2411B                  | 1207295     | 2018/03/23       | 2019/03/22 |
| Software                       | Farad           | Ez-EMC                   | ver.ct3a1   | N/A              | N/A        |
| Software                       | AUDIX           | E3                       | V8.2014-8-6 | N/A              | N/A        |
| Software                       | Keysight        | N7607B Signal Studio     | V3.0.0.0    | N/A              | N/A        |
| Software                       | Keysight        | Inservice MonitorUtility | N/A         | N/A              | N/A        |



## 4. Test of Conducted Emission

### 4.1. Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz, according to the methods defined in ANSI C63.4-2014. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

| Frequency<br>(MHz) | Quasi Peak<br>(dB $\mu$ V) | Average<br>(dB $\mu$ V) |
|--------------------|----------------------------|-------------------------|
| 0.15 – 0.5         | 66-56*                     | 56-46*                  |
| 0.5 – 5.0          | 56                         | 46                      |
| 5.0 – 30.0         | 60                         | 50                      |

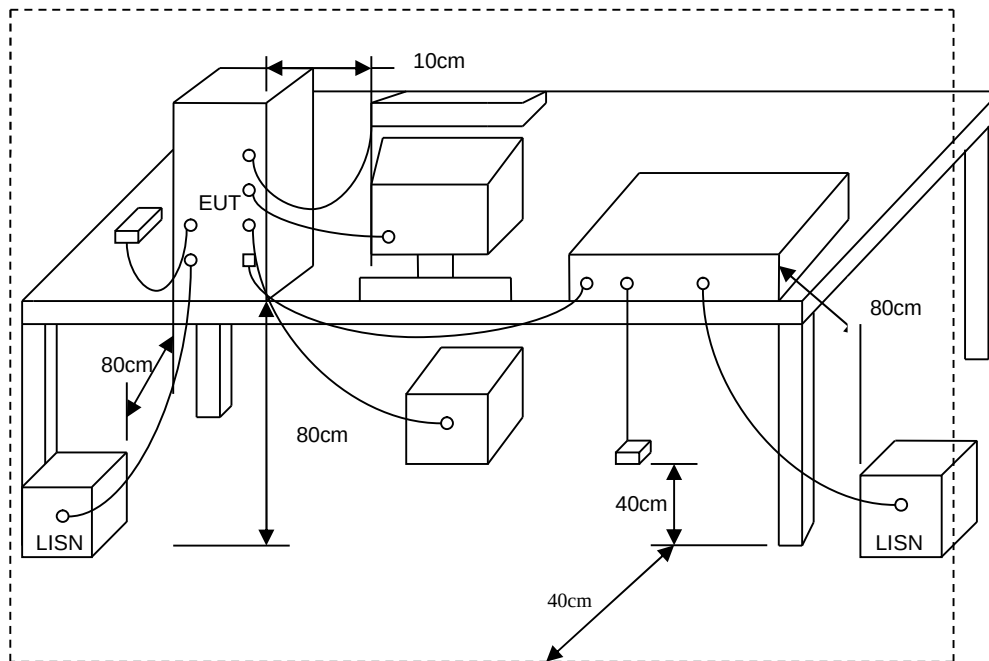
\*Decreases with the logarithm of the frequency.

### 4.2. Test Procedures

- The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.



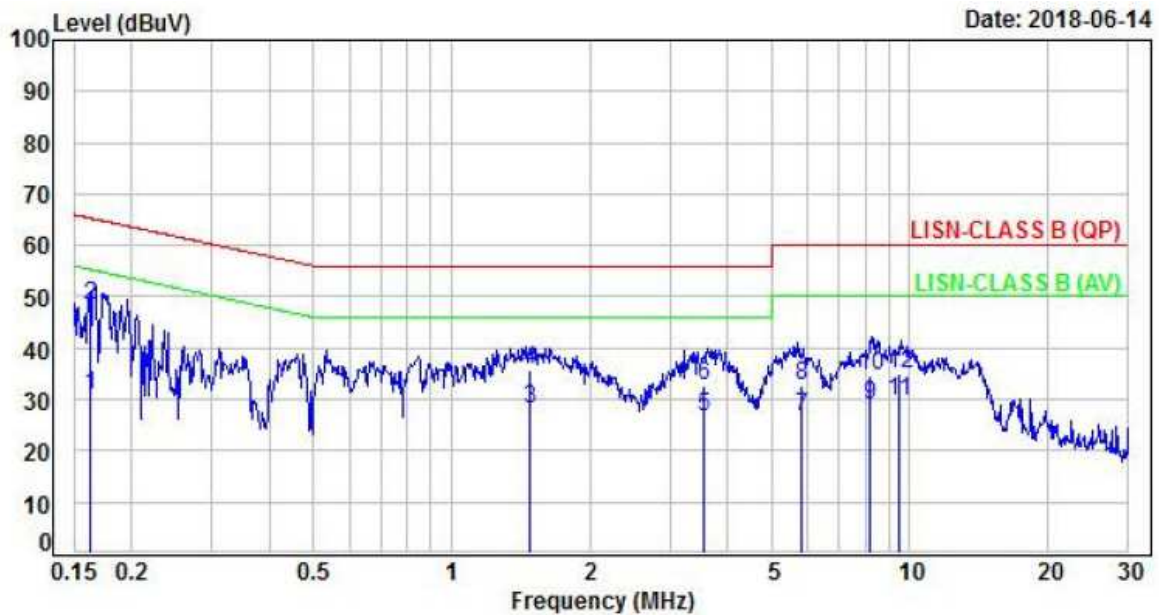
### 4.3. Typical Test Setup





## 4.4. Test Result and Data

|           |   |               |             |   |       |
|-----------|---|---------------|-------------|---|-------|
| Power     | : | From System   | Pol/Phase   | : | LINE  |
| Test Mode | : | Mode 1        | Temperature | : | 20 °C |
| Test Date | : | Jun. 14, 2018 | Humidity    | : | 40 %  |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-----|
| 1   | 0.16            | 9.94        | 20.99          | 30.93        | 55.29        | -24.36      | Average  | P   |
| 2   | 0.16            | 9.94        | 38.24          | 48.18        | 65.29        | -17.11      | QP       | P   |
| 3   | 1.49            | 10.03       | 18.25          | 28.28        | 46.00        | -17.72      | Average  | P   |
| 4   | 1.49            | 10.03       | 25.64          | 35.67        | 56.00        | -20.33      | QP       | P   |
| 5   | 3.56            | 10.12       | 16.39          | 26.51        | 46.00        | -19.49      | Average  | P   |
| 6   | 3.56            | 10.12       | 22.71          | 32.83        | 56.00        | -23.17      | QP       | P   |
| 7   | 5.78            | 10.22       | 16.40          | 26.62        | 50.00        | -23.38      | Average  | P   |
| 8   | 5.78            | 10.22       | 22.62          | 32.84        | 60.00        | -27.16      | QP       | P   |
| 9   | 8.18            | 10.27       | 18.44          | 28.71        | 50.00        | -21.29      | Average  | P   |
| 10  | 8.18            | 10.27       | 24.52          | 34.79        | 60.00        | -25.21      | QP       | P   |
| 11  | 9.46            | 10.31       | 19.22          | 29.53        | 50.00        | -20.47      | Average  | P   |
| 12  | 9.46            | 10.31       | 24.82          | 35.13        | 60.00        | -24.87      | QP       | P   |

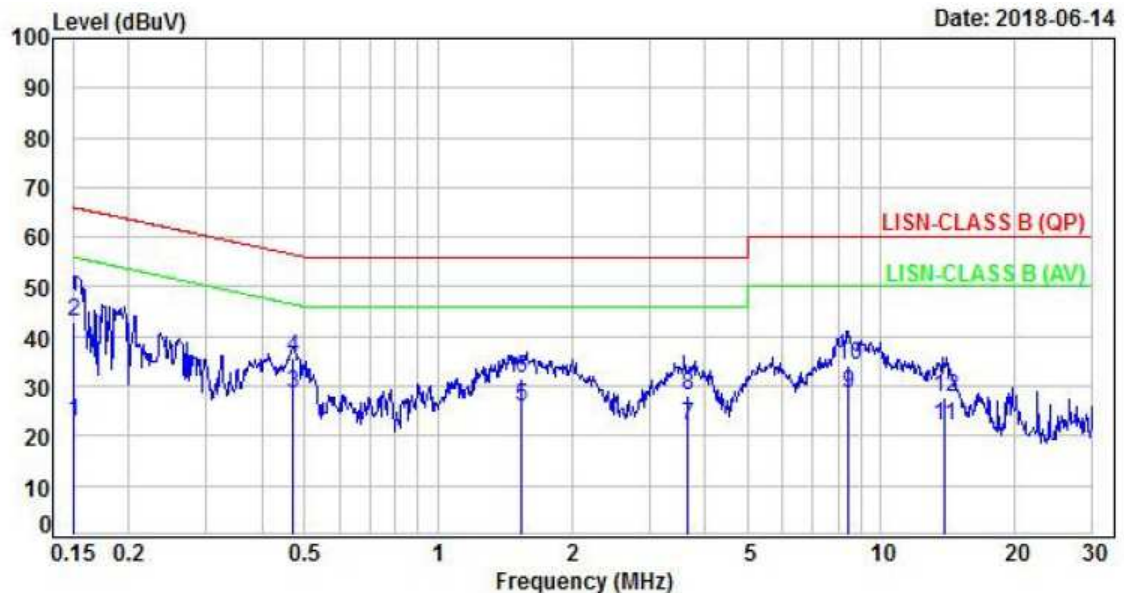
Note: Level = Reading + Factor

Margin = Level – Limit

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss



|           |                 |             |           |
|-----------|-----------------|-------------|-----------|
| Power     | : From System   | Pol/Phase   | : NEUTRAL |
| Test Mode | : Mode 1        | Temperature | : 20 °C   |
| Test Date | : Jun. 14, 2018 | Humidity    | : 40 %    |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-----|
| 1   | 0.15            | 9.94        | 12.89          | 22.83        | 55.96        | -33.13      | Average  | P   |
| 2   | 0.15            | 9.94        | 32.98          | 42.92        | 65.96        | -23.04      | QP       | P   |
| 3   | 0.47            | 9.95        | 18.41          | 28.36        | 46.48        | -18.12      | Average  | P   |
| 4   | 0.47            | 9.95        | 25.77          | 35.72        | 56.48        | -20.76      | QP       | P   |
| 5   | 1.54            | 10.01       | 15.72          | 25.73        | 46.00        | -20.27      | Average  | P   |
| 6   | 1.54            | 10.01       | 21.37          | 31.38        | 56.00        | -24.62      | QP       | P   |
| 7   | 3.66            | 10.13       | 11.94          | 22.07        | 46.00        | -23.93      | Average  | P   |
| 8   | 3.66            | 10.13       | 18.07          | 28.20        | 56.00        | -27.80      | QP       | P   |
| 9   | 8.41            | 10.27       | 18.20          | 28.47        | 50.00        | -21.53      | Average  | P   |
| 10  | 8.41            | 10.27       | 24.06          | 34.33        | 60.00        | -25.67      | QP       | P   |
| 11  | 13.88           | 10.46       | 11.67          | 22.13        | 50.00        | -27.87      | Average  | P   |
| 12  | 13.88           | 10.46       | 17.22          | 27.68        | 60.00        | -32.32      | QP       | P   |

Note: Level = Reading + Factor

Margin = Level – Limit

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss



## 5. Test of Radiated Spurious Emission

### 5.1. Test Limit

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 § 15.209, whichever is the lesser attenuation.

| Frequency (MHz) | Distance | Limit ( $\mu\text{V}/\text{m}$ ) |
|-----------------|----------|----------------------------------|
| 0.09 ~ 0.490    | 300m     | 2400/F(kHz)                      |
| 0.490 ~ 1.705   | 30m      | 24000/ F(kHz)                    |
| 1.705 ~ 30      | 30m      | 30                               |
| 30 ~ 88         | 3m       | 100                              |
| 88 ~ 216        | 3m       | 150                              |
| 216 ~ 960       | 3m       | 200                              |
| Above 960       | 3m       | 500                              |

#### Fundamental Frequency:

| Fundamental Frequency (MHz) | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|-----------------------------|--------------------------------------------------|------------------------------------------------|
| 902-928                     | 50                                               | 500                                            |
| 2400-2483.5                 | 50                                               | 500                                            |
| 5725-5875                   | 50                                               | 500                                            |
| 24000-24250                 | 250                                              | 2500                                           |

#### 15.215 Additional provisions to the general radiated emission limitations.:

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.



## 5.2. Test Procedures

- a. The EUT was placed on a rotatable table top 0.8 meter above ground.
- b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- i. "Cone of radiation" has been considered to be 3dB beamwidth of the measurement antenna.

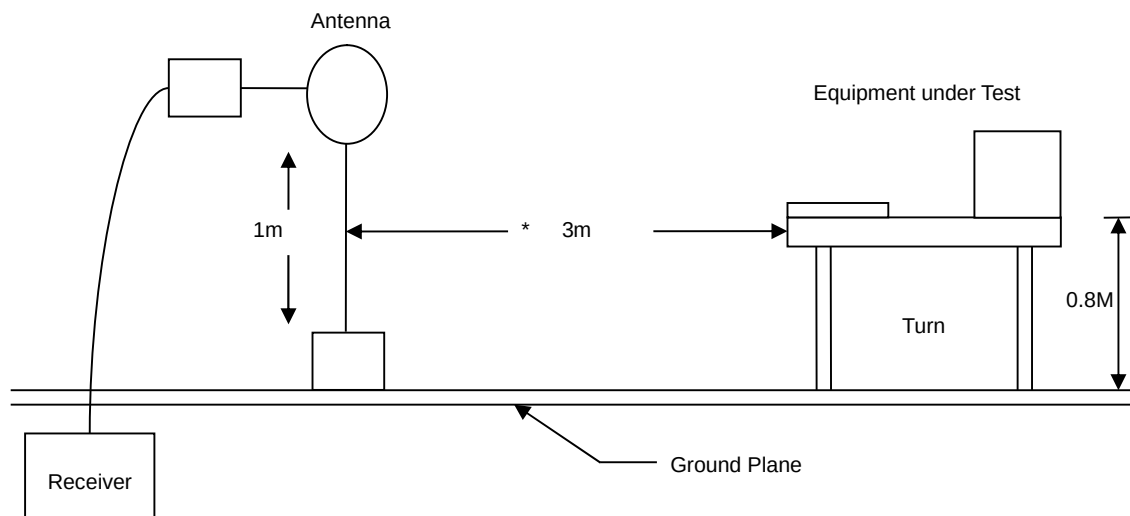
### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1GHz.

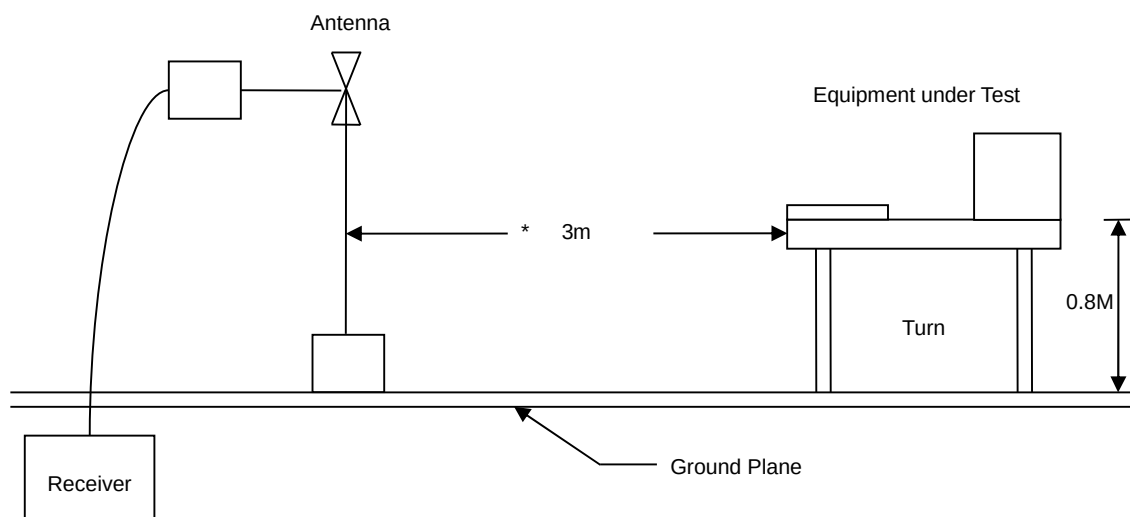


### 5.3. Typical Test Setup Layout of Radiated Emission

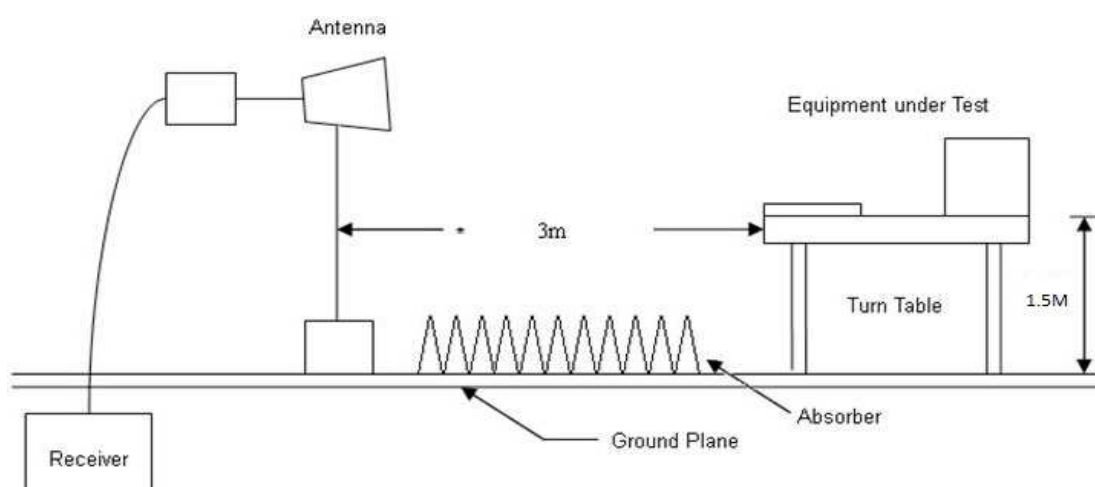
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup

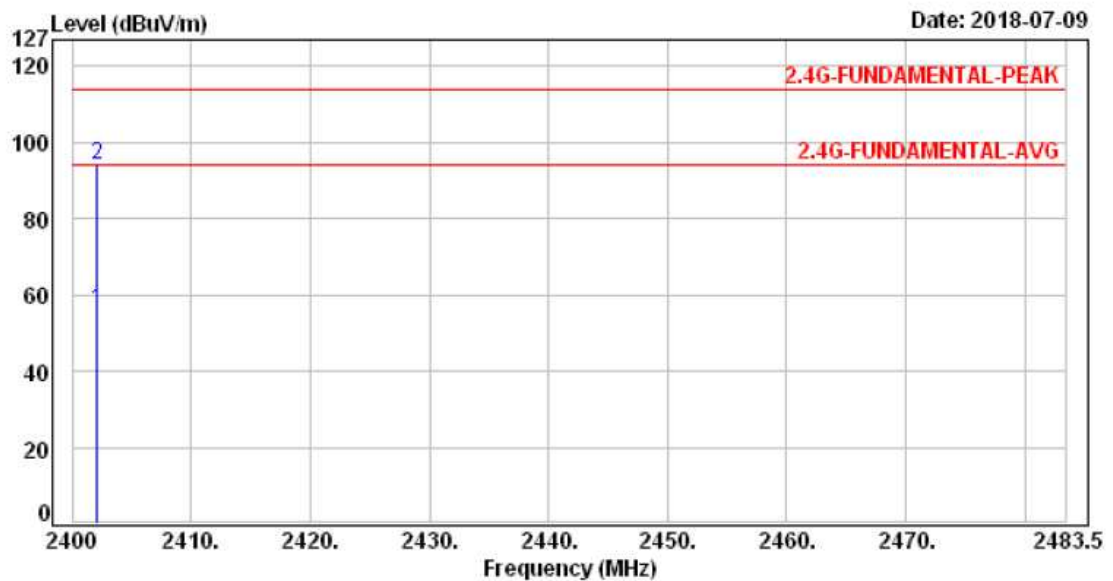




## 5.4. Test Result and Data

### 5.4.1. Test Result of Fundamental Emission

|           |   |               |             |   |          |
|-----------|---|---------------|-------------|---|----------|
| Power     | : | DC 5V         | Pol/Phase   | : | VERTICAL |
| Test Mode | : | Mode 1, CH01  | Temperature | : | 24°C     |
| Test Date | : | Jul. 09, 2018 | Humidity    | : | 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2402.00         | -15.92      | 71.96          | 56.04        | 94.00        | -37.96      | Average  | 100         | 145           | P   |
| 2   | 2402.00         | -15.92      | 110.05         | 94.13        | 114.00       | -19.87      | Peak     | 100         | 145           | P   |

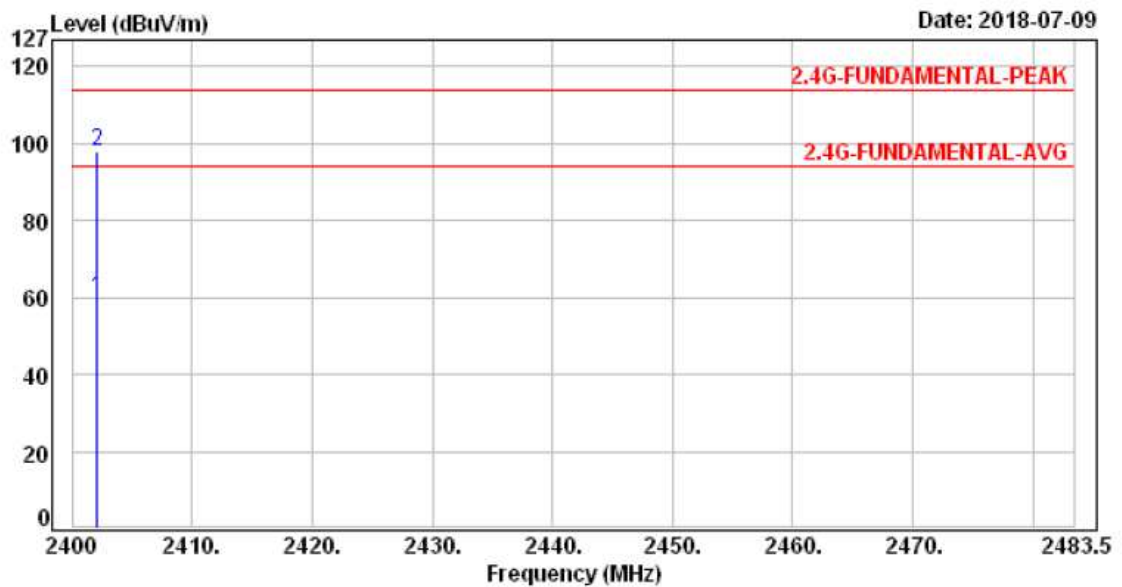
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |              |
|-----------|-----------------|-------------|--------------|
| Power     | : DC 5V         | Pol/Phase   | : HORIZONTAL |
| Test Mode | : Mode 1, CH01  | Temperature | : 24°C       |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2402.00         | -15.92      | 75.66          | 59.74        | 94.00        | -34.26      | Average  | 235         | 83            | P   |
| 2   | 2402.00         | -15.92      | 113.75         | 97.83        | 114.00       | -16.17      | Peak     | 235         | 83            | P   |

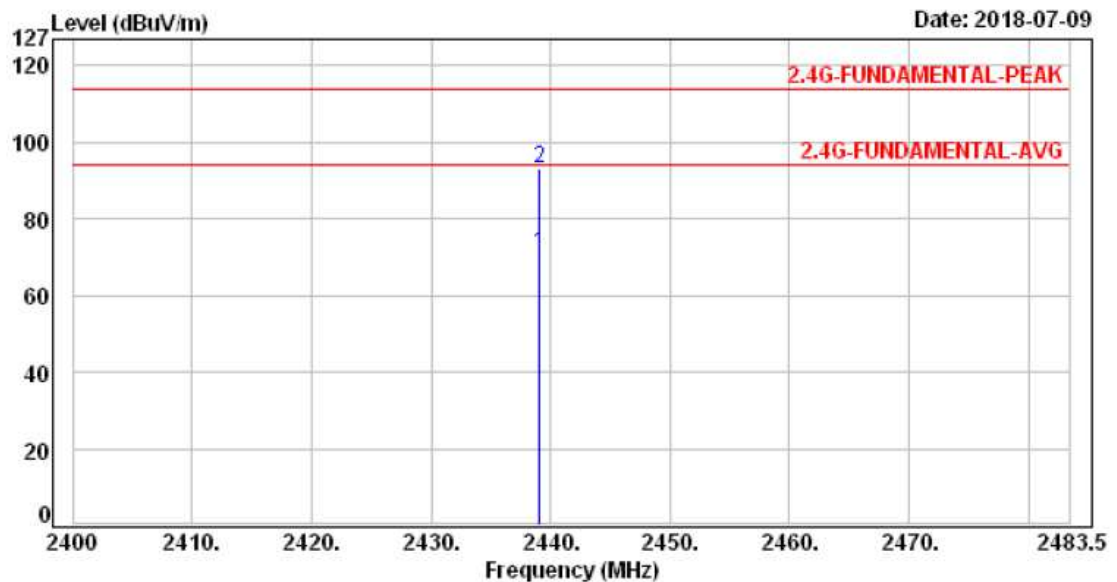
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |            |
|-----------|-----------------|-------------|------------|
| Power     | : DC 5V         | Pol/Phase   | : VERTICAL |
| Test Mode | : Mode 1, CH03  | Temperature | : 24°C     |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2439.00         | -15.80      | 86.88          | 71.08        | 94.00        | -22.92      | Average  | 100         | 144           | P   |
| 2   | 2439.00         | -15.80      | 109.17         | 93.37        | 114.00       | -20.63      | Peak     | 100         | 144           | P   |

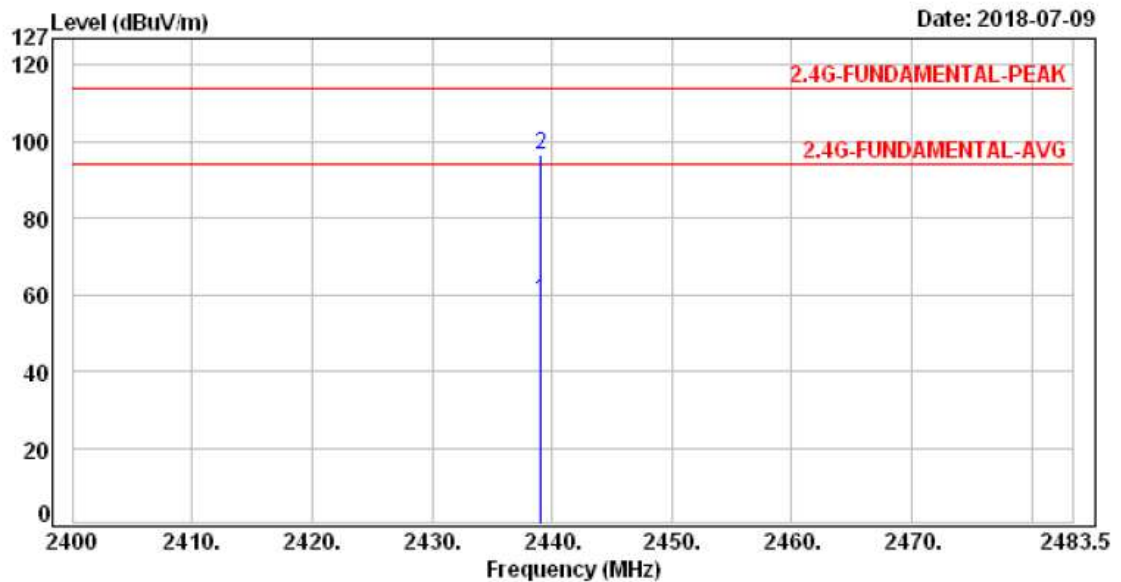
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |   |               |             |   |            |
|-----------|---|---------------|-------------|---|------------|
| Power     | : | DC 5V         | Pol/Phase   | : | HORIZONTAL |
| Test Mode | : | Mode 1, CH03  | Temperature | : | 24°C       |
| Test Date | : | Jul. 09, 2018 | Humidity    | : | 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2439.00         | -15.80      | 74.09          | 58.29        | 94.00        | -35.71      | Average  | 229         | 79            | P   |
| 2   | 2439.00         | -15.80      | 112.18         | 96.38        | 114.00       | -17.62      | Peak     | 229         | 79            | P   |

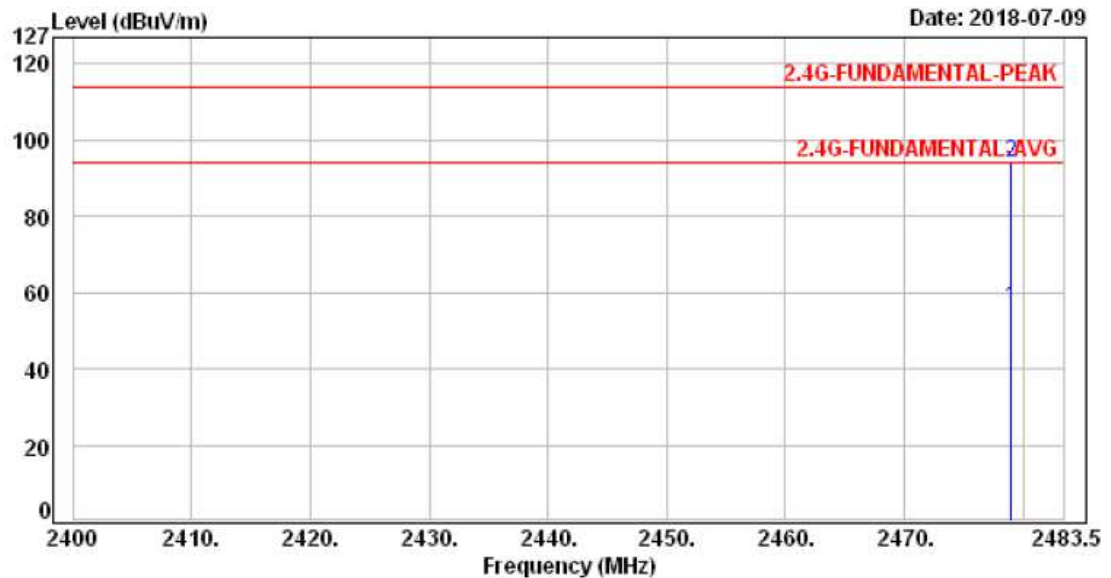
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |            |
|-----------|-----------------|-------------|------------|
| Power     | : DC 5V         | Pol/Phase   | : VERTICAL |
| Test Mode | : Mode 1, CH05  | Temperature | : 24 °C    |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2479.00         | -15.67      | 71.76          | 56.09        | 94.00        | -37.91      | Average  | 100         | 149           | P   |
| 2   | 2479.00         | -15.67      | 109.85         | 94.18        | 114.00       | -19.82      | Peak     | 100         | 149           | P   |

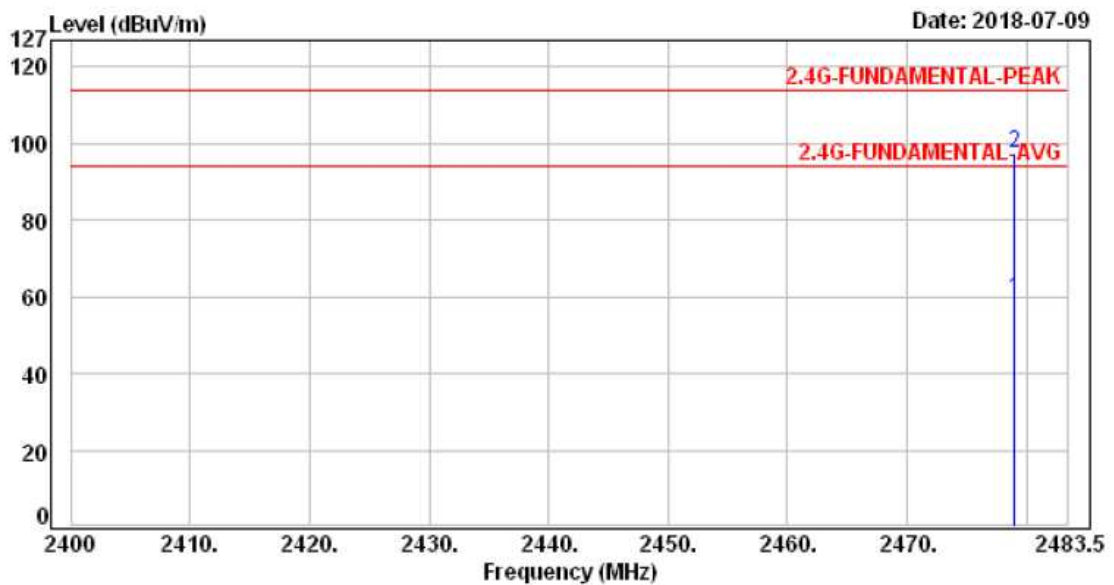
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |   |               |             |   |            |
|-----------|---|---------------|-------------|---|------------|
| Power     | : | DC 5V         | Pol/Phase   | : | HORIZONTAL |
| Test Mode | : | Mode 1, CH05  | Temperature | : | 24°C       |
| Test Date | : | Jul. 09, 2018 | Humidity    | : | 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2479.00         | -15.67      | 74.88          | 59.21        | 94.00        | -34.79      | Average  | 224         | 69            | P   |
| 2   | 2479.00         | -15.67      | 112.97         | 97.30        | 114.00       | -16.70      | Peak     | 224         | 69            | P   |

Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor

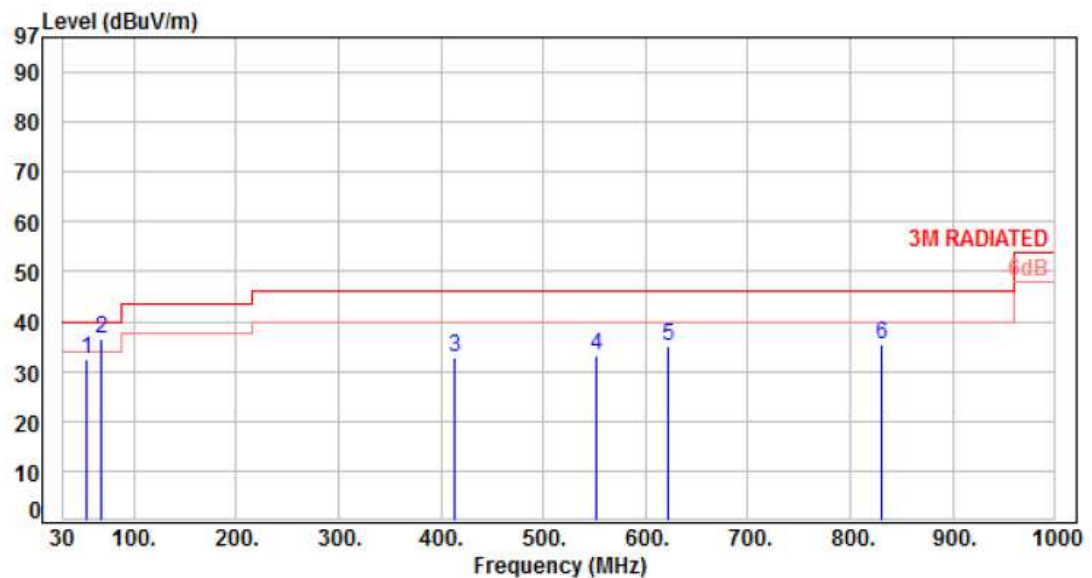
#### 5.4.2. Test Result of 9KHz ~ 30MHz

The 9kHz - 30MHz spurious emission is under limit 20dB more.



## 5.4.3. Test Result of Unwanted Spurious emission (30MHz ~ 1GHz)

|           |                 |             |            |
|-----------|-----------------|-------------|------------|
| Power     | : DC 5V         | Pol/Phase   | : VERTICAL |
| Test Mode | : Mode 1        | Temperature | : 24°C     |
| Test Date | : Jun. 17, 2018 | Humidity    | : 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 53.28           | -10.81      | 43.40          | 32.59        | 40.00        | -7.41       | Peak     | 100         | 0             | P   |
| 2   | 68.80           | -12.70      | 49.15          | 36.45        | 40.00        | -3.55       | Peak     | 100         | 0             | P   |
| 3   | 414.12          | -6.74       | 39.58          | 32.84        | 46.00        | -13.16      | Peak     | 100         | 0             | P   |
| 4   | 551.86          | -4.04       | 37.26          | 33.22        | 46.00        | -12.78      | Peak     | 100         | 0             | P   |
| 5   | 621.70          | -2.52       | 37.64          | 35.12        | 46.00        | -10.88      | Peak     | 100         | 0             | P   |
| 6   | 831.22          | 0.76        | 34.50          | 35.26        | 46.00        | -10.74      | Peak     | 100         | 0             | P   |

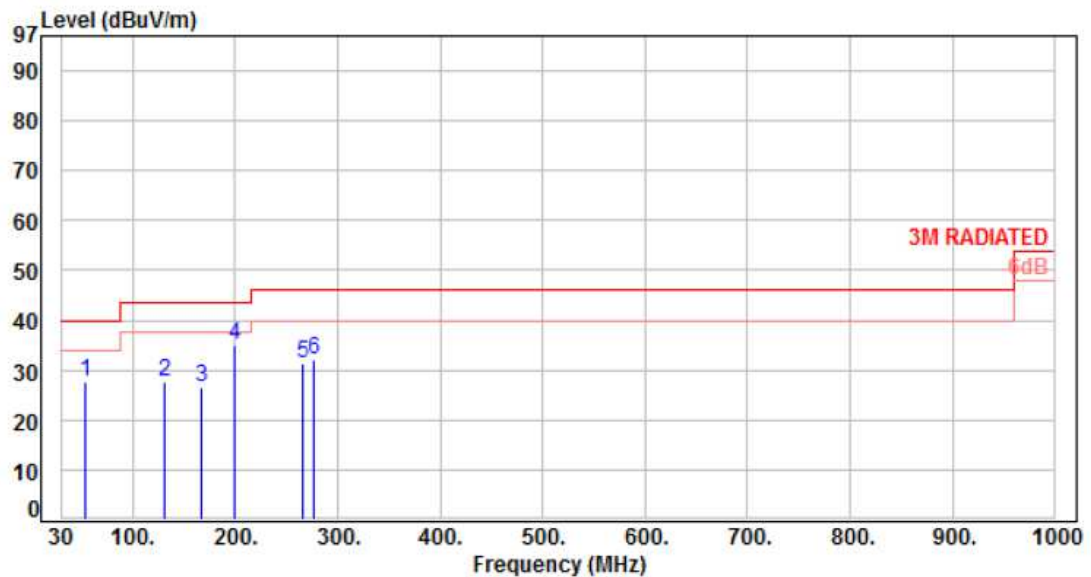
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |              |
|-----------|-----------------|-------------|--------------|
| Power     | : DC 5V         | Pol/Phase   | : HORIZONTAL |
| Test Mode | : Mode 1        | Temperature | : 24°C       |
| Test Date | : Jun. 17, 2018 | Humidity    | : 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBUV) | Level (dBUV) | Limit (dBUV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 53.28           | -10.81      | 38.56          | 27.75        | 40.00        | -12.25      | Peak     | 100         | 0             | P   |
| 2   | 130.88          | -12.33      | 40.09          | 27.76        | 43.50        | -15.74      | Peak     | 100         | 0             | P   |
| 3   | 167.74          | -11.01      | 37.56          | 26.55        | 43.50        | -16.95      | Peak     | 100         | 0             | P   |
| 4   | 198.78          | -13.02      | 47.93          | 34.91        | 43.50        | -8.59       | Peak     | 100         | 0             | P   |
| 5   | 266.68          | -10.97      | 42.19          | 31.22        | 46.00        | -14.78      | Peak     | 100         | 0             | P   |
| 6   | 276.38          | -10.55      | 42.72          | 32.17        | 46.00        | -13.83      | Peak     | 100         | 0             | P   |

Note: Level=Reading+Factor

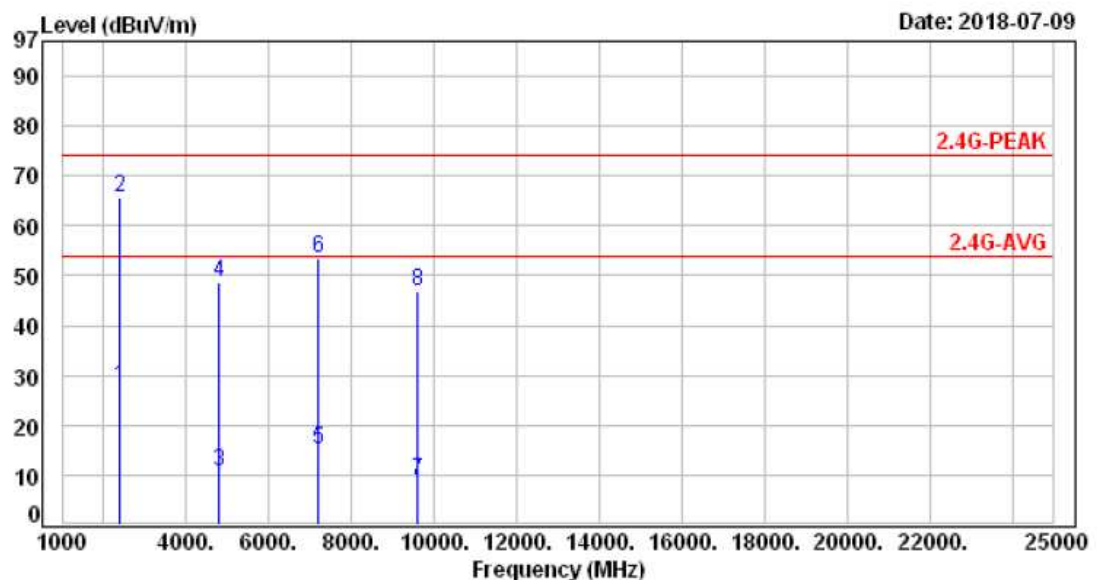
Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



## 5.4.4. Test Result of Unwanted Spurious emission (1GHz ~ 25GHz)

|           |   |               |             |   |          |
|-----------|---|---------------|-------------|---|----------|
| Power     | : | DC 5V         | Pol/Phase   | : | VERTICAL |
| Test Mode | : | Mode 1, CH01  | Temperature | : | 24°C     |
| Test Date | : | Jul. 09, 2018 | Humidity    | : | 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2400.00         | -15.92      | 43.51          | 27.59        | 54.00        | -26.41      | Average  | 100         | 145           | P   |
| 2   | 2400.00         | -15.92      | 81.60          | 65.68        | 74.00        | -8.32       | Peak     | 100         | 145           | P   |
| 3   | 4804.00         | -8.87       | 19.46          | 10.59        | 54.00        | -43.41      | Average  | 303         | 171           | P   |
| 4   | 4804.00         | -8.87       | 57.55          | 48.68        | 74.00        | -25.32      | Peak     | 303         | 171           | P   |
| 5   | 7206.00         | -5.00       | 20.26          | 15.26        | 54.00        | -38.74      | Average  | 293         | 177           | P   |
| 6   | 7206.00         | -5.00       | 58.35          | 53.35        | 74.00        | -20.65      | Peak     | 293         | 177           | P   |
| 7   | 9608.00         | -1.83       | 10.68          | 8.85         | 54.00        | -45.15      | Average  | 100         | 239           | P   |
| 8   | 9608.00         | -1.83       | 48.77          | 46.94        | 74.00        | -27.06      | Peak     | 100         | 239           | P   |

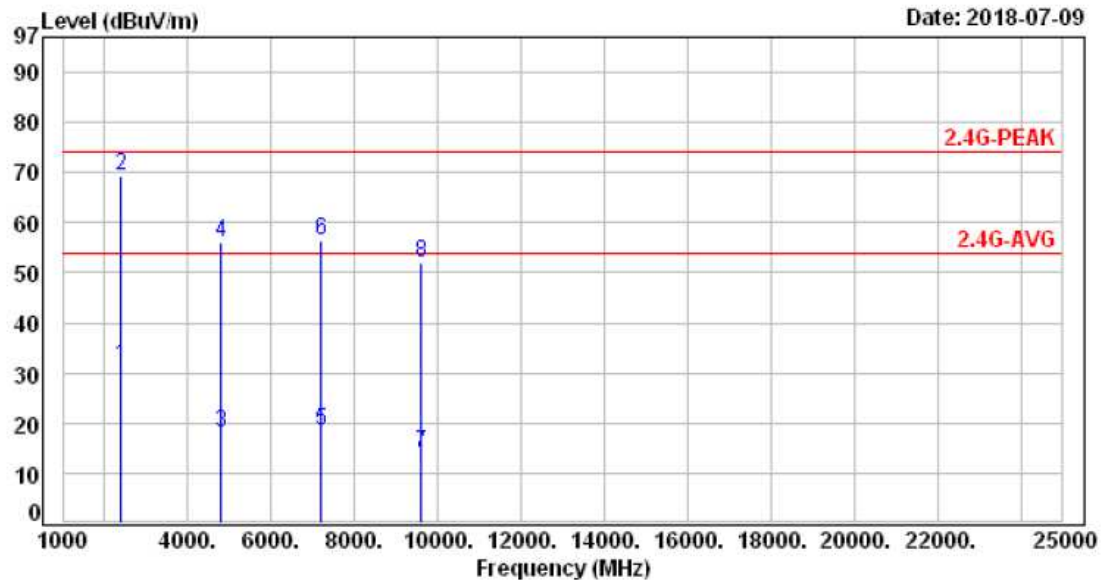
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |              |
|-----------|-----------------|-------------|--------------|
| Power     | : DC 5V         | Pol/Phase   | : HORIZONTAL |
| Test Mode | : Mode 1, CH01  | Temperature | : 24°C       |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2400.00         | -15.92      | 47.28          | 31.36        | 54.00        | -22.64      | Average  | 235         | 83            | P   |
| 2   | 2400.00         | -15.92      | 85.37          | 69.45        | 74.00        | -4.55       | Peak     | 235         | 83            | P   |
| 3   | 4804.00         | -8.87       | 26.76          | 17.89        | 54.00        | -36.11      | Average  | 100         | 199           | P   |
| 4   | 4804.00         | -8.87       | 64.85          | 55.98        | 74.00        | -18.02      | Peak     | 100         | 199           | P   |
| 5   | 7206.00         | -5.00       | 23.51          | 18.51        | 54.00        | -35.49      | Average  | 101         | 158           | P   |
| 6   | 7206.00         | -5.00       | 61.60          | 56.60        | 74.00        | -17.40      | Peak     | 101         | 158           | P   |
| 7   | 9608.00         | -1.83       | 15.69          | 13.86        | 54.00        | -40.14      | Average  | 100         | 117           | P   |
| 8   | 9608.00         | -1.83       | 53.78          | 51.95        | 74.00        | -22.05      | Peak     | 100         | 117           | P   |

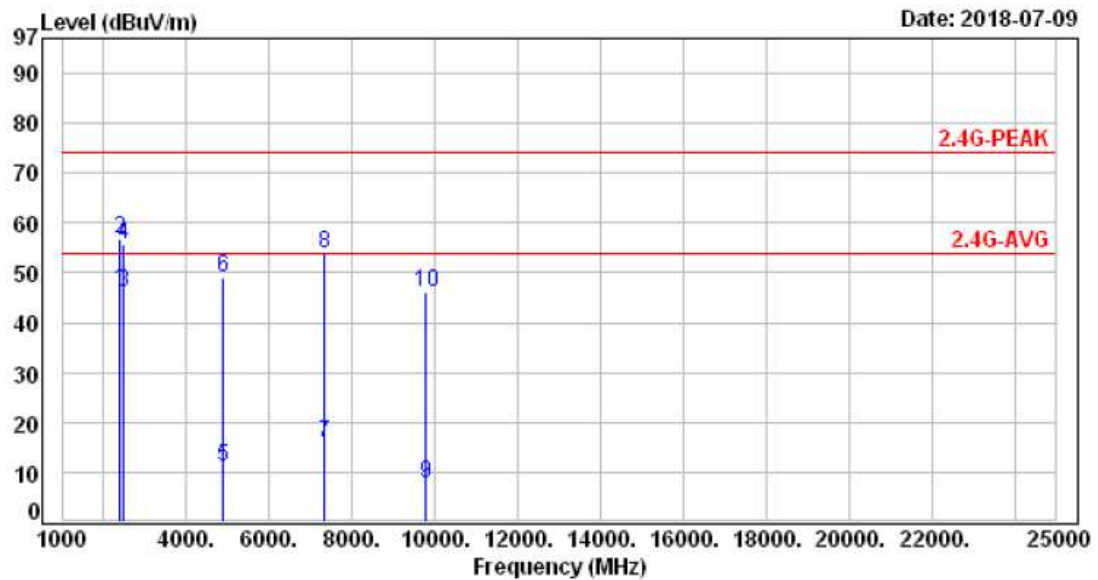
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |            |
|-----------|-----------------|-------------|------------|
| Power     | : DC 5V         | Pol/Phase   | : VERTICAL |
| Test Mode | : Mode 1, CH03  | Temperature | : 24°C     |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2400.00         | -15.92      | 62.43          | 46.51        | 54.00        | -7.49       | Average  | 100         | 144           | P   |
| 2   | 2400.00         | -15.92      | 72.64          | 56.72        | 74.00        | -17.28      | Peak     | 100         | 144           | P   |
| 3   | 2483.50         | -15.65      | 61.90          | 46.25        | 54.00        | -7.75       | Average  | 100         | 144           | P   |
| 4   | 2483.50         | -15.65      | 71.24          | 55.59        | 74.00        | -18.41      | Peak     | 100         | 144           | P   |
| 5   | 4878.00         | -8.63       | 19.58          | 10.95        | 54.00        | -43.05      | Average  | 305         | 172           | P   |
| 6   | 4878.00         | -8.63       | 57.67          | 49.04        | 74.00        | -24.96      | Peak     | 305         | 172           | P   |
| 7   | 7317.00         | -4.68       | 20.53          | 15.85        | 54.00        | -38.15      | Average  | 295         | 179           | P   |
| 8   | 7317.00         | -4.68       | 58.62          | 53.94        | 74.00        | -20.06      | Peak     | 295         | 179           | P   |
| 9   | 9756.00         | -1.60       | 9.46           | 7.86         | 54.00        | -46.14      | Average  | 100         | 236           | P   |
| 10  | 9756.00         | -1.60       | 47.55          | 45.95        | 74.00        | -28.05      | Peak     | 100         | 236           | P   |

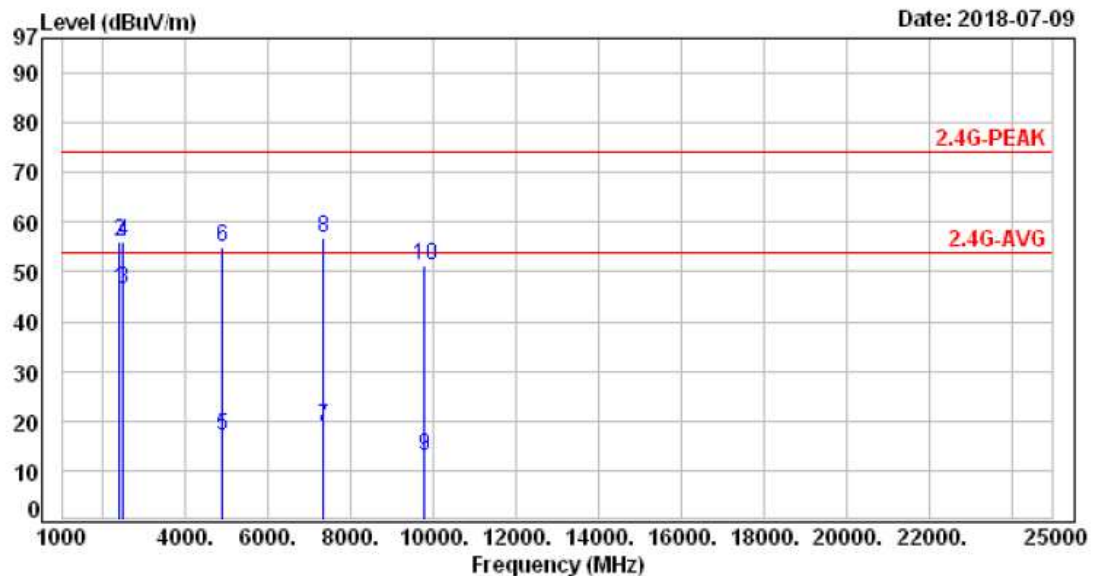
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |              |
|-----------|-----------------|-------------|--------------|
| Power     | : DC 5V         | Pol/Phase   | : HORIZONTAL |
| Test Mode | : Mode 1, CH03  | Temperature | : 24°C       |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2400.00         | -15.92      | 62.34          | 46.42        | 54.00        | -7.58       | Average  | 229         | 79            | P   |
| 2   | 2400.00         | -15.92      | 71.96          | 56.04        | 74.00        | -17.96      | Peak     | 229         | 79            | P   |
| 3   | 2483.50         | -15.65      | 62.02          | 46.37        | 54.00        | -7.63       | Average  | 229         | 79            | P   |
| 4   | 2483.50         | -15.65      | 71.57          | 55.92        | 74.00        | -18.08      | Peak     | 229         | 79            | P   |
| 5   | 4878.00         | -8.63       | 25.67          | 17.04        | 54.00        | -36.96      | Average  | 105         | 198           | P   |
| 6   | 4878.00         | -8.63       | 63.76          | 55.13        | 74.00        | -18.87      | Peak     | 105         | 198           | P   |
| 7   | 7317.00         | -4.68       | 23.47          | 18.79        | 54.00        | -35.21      | Average  | 119         | 157           | P   |
| 8   | 7317.00         | -4.68       | 61.56          | 56.88        | 74.00        | -17.12      | Peak     | 119         | 157           | P   |
| 9   | 9756.00         | -1.60       | 14.60          | 13.00        | 54.00        | -41.00      | Average  | 100         | 143           | P   |
| 10  | 9756.00         | -1.60       | 52.69          | 51.09        | 74.00        | -22.91      | Peak     | 100         | 143           | P   |

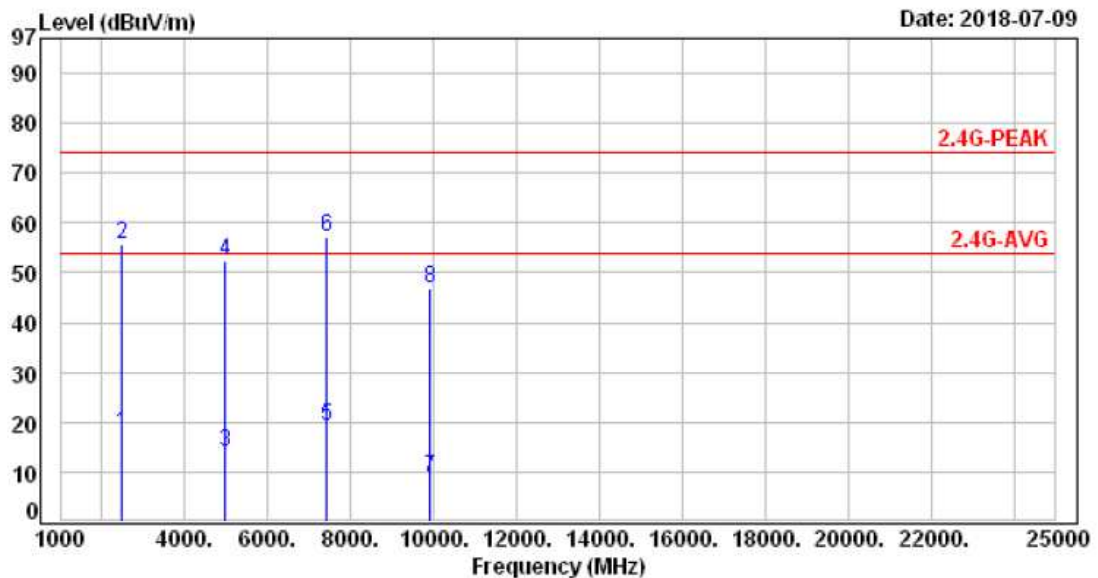
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |            |
|-----------|-----------------|-------------|------------|
| Power     | : DC 5V         | Pol/Phase   | : VERTICAL |
| Test Mode | : Mode 1, CH05  | Temperature | : 24°C     |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %     |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2483.50         | -15.65      | 33.30          | 17.65        | 54.00        | -36.35      | Average  | 100         | 149           | P   |
| 2   | 2483.50         | -15.65      | 71.39          | 55.74        | 74.00        | -18.26      | Peak     | 100         | 149           | P   |
| 3   | 4958.00         | -8.39       | 22.52          | 14.13        | 54.00        | -39.87      | Average  | 299         | 173           | P   |
| 4   | 4958.00         | -8.39       | 60.61          | 52.22        | 74.00        | -21.78      | Peak     | 299         | 173           | P   |
| 5   | 7437.00         | -4.33       | 23.35          | 19.02        | 54.00        | -34.98      | Average  | 291         | 175           | P   |
| 6   | 7437.00         | -4.33       | 61.44          | 57.11        | 74.00        | -16.89      | Peak     | 291         | 175           | P   |
| 7   | 9916.00         | -1.34       | 10.22          | 8.88         | 54.00        | -45.12      | Average  | 100         | 234           | P   |
| 8   | 9916.00         | -1.34       | 48.31          | 46.97        | 74.00        | -27.03      | Peak     | 100         | 234           | P   |

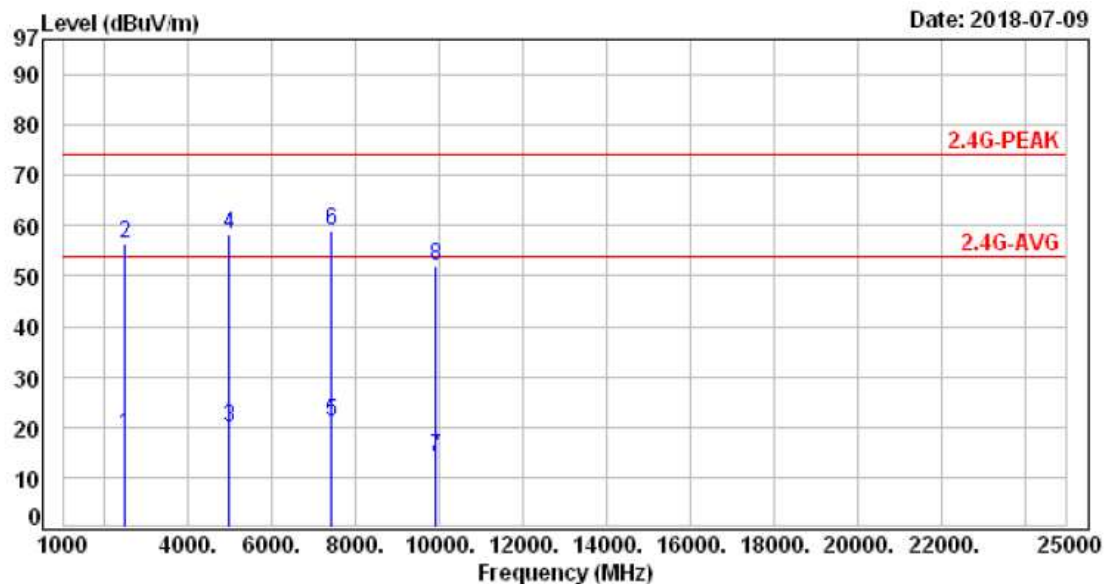
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



|           |                 |             |              |
|-----------|-----------------|-------------|--------------|
| Power     | : DC 5V         | Pol/Phase   | : HORIZONTAL |
| Test Mode | : Mode 1, CH05  | Temperature | : 24°C       |
| Test Date | : Jul. 09, 2018 | Humidity    | : 62 %       |



| No. | Frequency (MHz) | Factor (dB) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | Height (cm) | Azimuth (deg) | P/F |
|-----|-----------------|-------------|----------------|--------------|--------------|-------------|----------|-------------|---------------|-----|
| 1   | 2483.50         | -15.65      | 33.92          | 18.27        | 54.00        | -35.73      | Average  | 224         | 69            | P   |
| 2   | 2483.50         | -15.65      | 72.01          | 56.36        | 74.00        | -17.64      | Peak     | 224         | 69            | P   |
| 3   | 4958.00         | -8.39       | 28.49          | 20.10        | 54.00        | -33.90      | Average  | 100         | 198           | P   |
| 4   | 4958.00         | -8.39       | 66.58          | 58.19        | 74.00        | -15.81      | Peak     | 100         | 198           | P   |
| 5   | 7437.00         | -4.33       | 25.28          | 20.95        | 54.00        | -33.05      | Average  | 104         | 156           | P   |
| 6   | 7437.00         | -4.33       | 63.37          | 59.04        | 74.00        | -14.96      | Peak     | 104         | 156           | P   |
| 7   | 9916.00         | -1.34       | 15.35          | 14.01        | 54.00        | -39.99      | Average  | 100         | 122           | P   |
| 8   | 9916.00         | -1.34       | 53.44          | 52.10        | 74.00        | -21.90      | Peak     | 100         | 122           | P   |

Note: Level=Reading+Factor

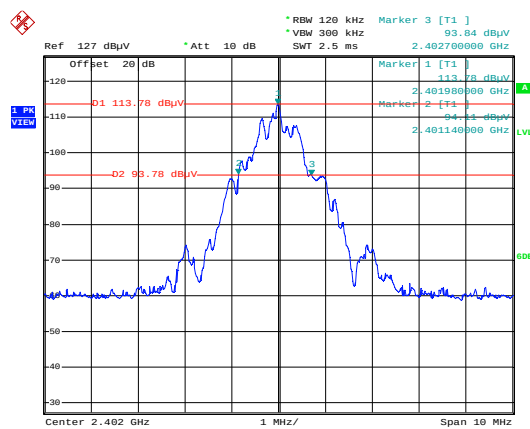
Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor

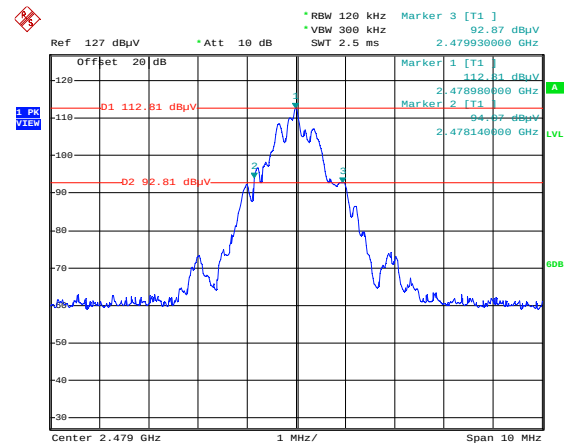


## 5.4.5. 20dB Bandwidth &amp; 99% Occupied BW

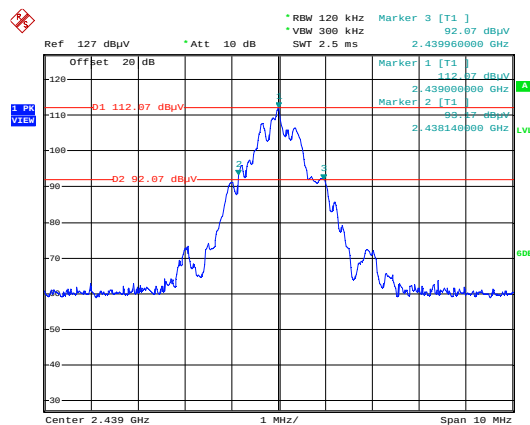
| Frequency (MHz) | 20dB Bandwidth (MHz) | 99% Occupied BW (MHz) | Frequency range MHz (20dB Down) fL > 2400 MHz | Frequency range MHz (20dB Down) fH < 2483.5 MHz |
|-----------------|----------------------|-----------------------|-----------------------------------------------|-------------------------------------------------|
| 2402            | 1.56                 | 1.86                  | 2401.1400                                     | -                                               |
| 2439            | 1.82                 | 1.84                  | -                                             | -                                               |
| 2479            | 1.79                 | 1.84                  | -                                             | 2479.9300                                       |

20dB Bandwidth  
CH01, 2402MHz

CH05, 2479MHz

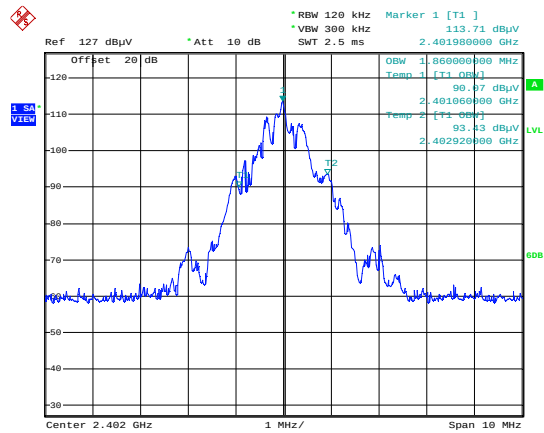


CH03, 2439MHz

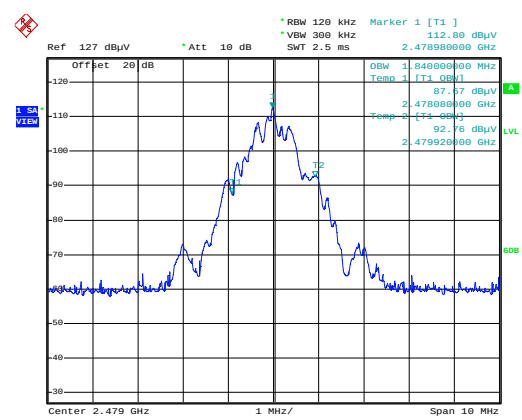




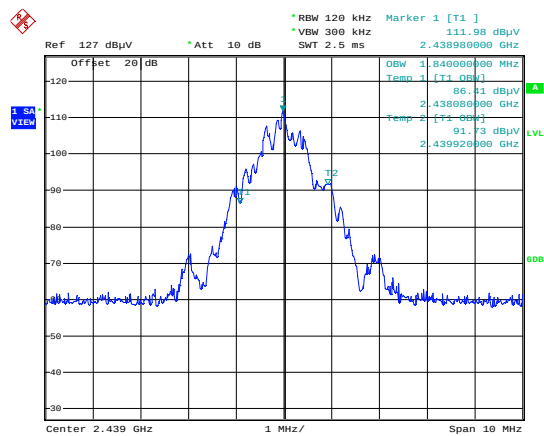
### 99% Occupied BW CH01, 2402MHz



### CH05, 2479MHz



### CH03, 2439MHz



**5.4.6. Maximum Peak and Average Output Power**

| Modulation Type | Channel | Frequency (MHz) | Power Output (dBm) |         | Power Output (mW) |         |
|-----------------|---------|-----------------|--------------------|---------|-------------------|---------|
|                 |         |                 | Peak               | Average | Peak              | Average |
| FSK             | 1       | 2402            | 0.12               | 0.01    | 1.028             | 1.002   |
|                 | 3       | 2439            | 0.27               | 0.19    | 1.064             | 1.045   |
|                 | 5       | 2479            | 0.37               | 0.29    | 1.089             | 1.069   |

\*For reference only