

# EMC TEST REPORT

**Report No. : TS12040012-EME**

**Model No. : F21-6S-TX**

**Issued Date : May 04, 2012**

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**Test Method/ Standard: 47 CFR FCC Part 15.231 & ANSI C63.4 2003**

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## Summary of Tests

| Test Item                                           | Reference         | Results |
|-----------------------------------------------------|-------------------|---------|
| Timing requirement of manually operated transmitter | 15.231(a)(1)      | Pass    |
| Radiated Emission test                              | 15.231(b), 15.209 | Pass    |
| Measured bandwidth                                  | 15.231(c)         | Pass    |
| Conducted Emission test                             | 15.231(b), 15.207 | N/A     |

## 1. General information

### 1.1 Identification of the EUT

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product:                   | Industrial Radio Remote Control Transmitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Model No.:                 | F21-6S-TX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| FCC ID.:                   | JI9-F21-6S-001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Frequency Range:           | 310.0325 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Channel Number:            | Single channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Frequency of Each Channel: | 310.0325 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Access scheme:             | AFSK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Power Supply:              | DC 3 V from battery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Power Cord:                | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Sample Received:           | Apr. 03, 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Test Date(s):              | Apr. 16, 2012 ~ May 04, 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Note 2:                    | When determining the test conclusion, the Measurement Uncertainty of test has been considered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

### 1.2 Additional information about the EUT

The EUT is Industrial Radio Remote Control Transmitter, and was defined as information technology equipment.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"



### 1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain :  $\leq 1.5$  dBi

Antenna Type : Helical antenna

Connector Type : N/A

## 2. Test specifications

### 2.1 Test standard

The EUT was performed according to the procedures in FCC Part 2.1053 and the requirement in FCC Part 15 Subpart C Section 15.231.

### 2.2 Operation mode

The EUT was supplied with DC 3 V from battery and transmitted continuously during the test.

### 2.3 Test equipment

| Equipment                         | Brand           | Model No.                     | Serial No.  | Calibration Date | Next Calibration Date |
|-----------------------------------|-----------------|-------------------------------|-------------|------------------|-----------------------|
| EMI Test Receiver                 | Rohde & Schwarz | ESCI                          | 100018      | 2011/12/6        | 2012/12/4             |
| Spectrum Analyzer                 | Rohde&schwarz   | FSP30                         | 100137      | 2011/6/29        | 2012/6/28             |
| Spectrum Analyzer                 | Rohde&schwarz   | FSEK30                        | 100186      | 2012/2/6         | 2013/2/5              |
| Horn Antenna (1-18G)              | Schwarzbeck     | BBHA 9120 D                   | 9120D-456   | 2010/8/31        | 2012/8/30             |
| Horn Antenna (14-42G)             | SHWARZBECK      | BBHA 9170                     | BBHA9170159 | 2010/9/3         | 2012/9/2              |
| Broadband Antenna                 | SCHWARZBECK     | VULB 9168                     | 9168-172    | 2011/7/26        | 2013/7/25             |
| Pre-Amplifier                     | MITEQ           | AFS44-00102650<br>--42-10P-44 | 1495287     | 2011/10/27       | 2013/10/26            |
| Pre-Amplifier                     | MITEQ           | JS4-26004000--2<br>7-8A       | 828825      | 2010/9/8         | 2012/9/7              |
| Power Meter                       | Anritsu         | ML2495A                       | 0844001     | 2011/10/13       | 2012/10/12            |
| Power Sensor                      | Anritsu         | MA2411B                       | 0738452     | 2011/10/13       | 2012/10/12            |
| Temperature&Humidity Test Chamber | TERCHY          | MHU-225LRU(S<br>A)            | 950838      | 2011/6/17        | 2012/6/16             |
| Two-Line V-Network                | Rohde&schwarz   | ESH3-Z5                       | 838979/014  | 2011/10/19       | 2012/10/18            |

Note: The above equipments are within the valid calibration period.

### 3. Radiated emission test FCC 15.231 (b)

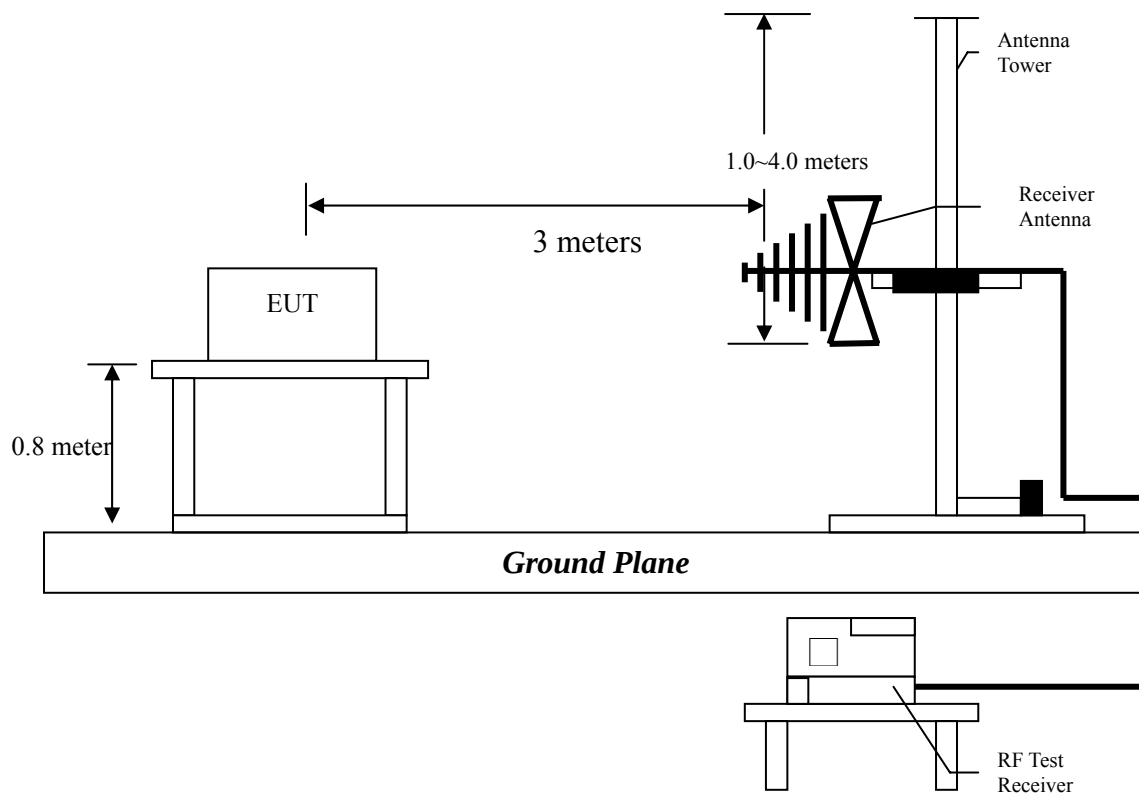
#### 3.1 Operating environment

Temperature: 24 °C  
Relative Humidity: 55 %  
Atmospheric Pressure 1008 hPa

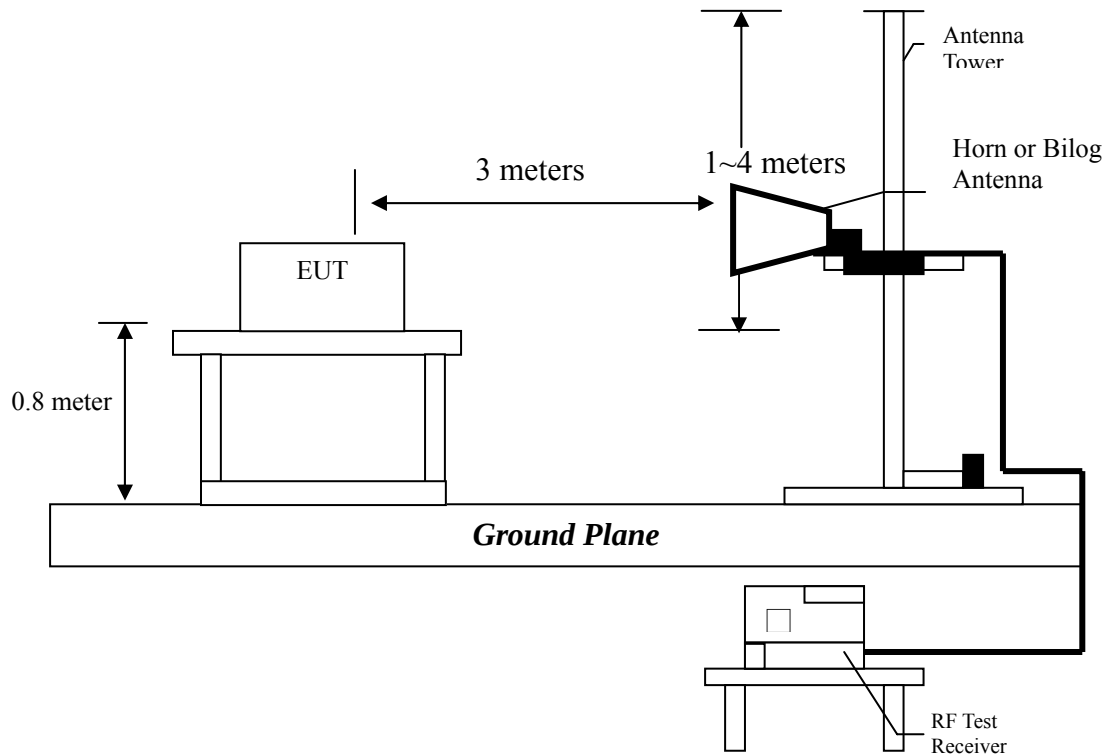
#### 3.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.

The frequency spectrum from 30MHz to 1000MHz was investigated.



The frequency spectrum from over 1GHz was investigated.



The signal is maximized through rotation and placement in the three orthogonal axes.

Radiated emission measurements were performed from 30 MHz to 25 GHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1 GHz, 1MHz – for frequencies above 1 GHz.

The EUT for testing is arranged on a fiberglass turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.



The signal is maximized through rotation and placement in the three orthogonal axes.



**X axis**



**Y axis**



**Z axis**

After verifying three axes, we found the maximum electromagnetic field was occurred at Z axis. The final test data was executed under this configuration.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

### 3.3 Radiated emission limit

#### 3.3.1 Fundamental and harmonics emission limits

| Frequency (MHz) | Field Strength of Fundamental |              | Field Strength of Harmonics |              |
|-----------------|-------------------------------|--------------|-----------------------------|--------------|
|                 | (uV/m@3 m)                    | (dBuV/m@3 m) | (uV/m@3 m)                  | (dBuV/m@3 m) |
| 310.0325        | 58344.51                      | 95.32        | 5834.45                     | 75.32        |

#### 3.3.2 General radiated emission limit

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

| Frequency<br>MHz | 15.209 Limits<br>(dBμV/m@3m) |
|------------------|------------------------------|
| 30-88            | 40                           |
| 88-216           | 43.5                         |
| 216-960          | 46                           |
| Above 960        | 54                           |

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Measurement uncertainty was calculated in accordance with TR 100 028-1.

| Parameter          | Uncertainty    |
|--------------------|----------------|
| Radiated Emission  | $\pm 5.056$ dB |
| Conducted Emission | $\pm 2.786$ dB |

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of  $k=2$ .

### 3.4 Calculation of Average Factor

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer in zero span mode at 100 resolution bandwidth.

#### Model: F21-6S-TX

Averaging factor in dB =  $20 \log (\text{duty cycle})$

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 203.4ms. It is greater than 100ms. Use the 100ms for duration of one cycle.

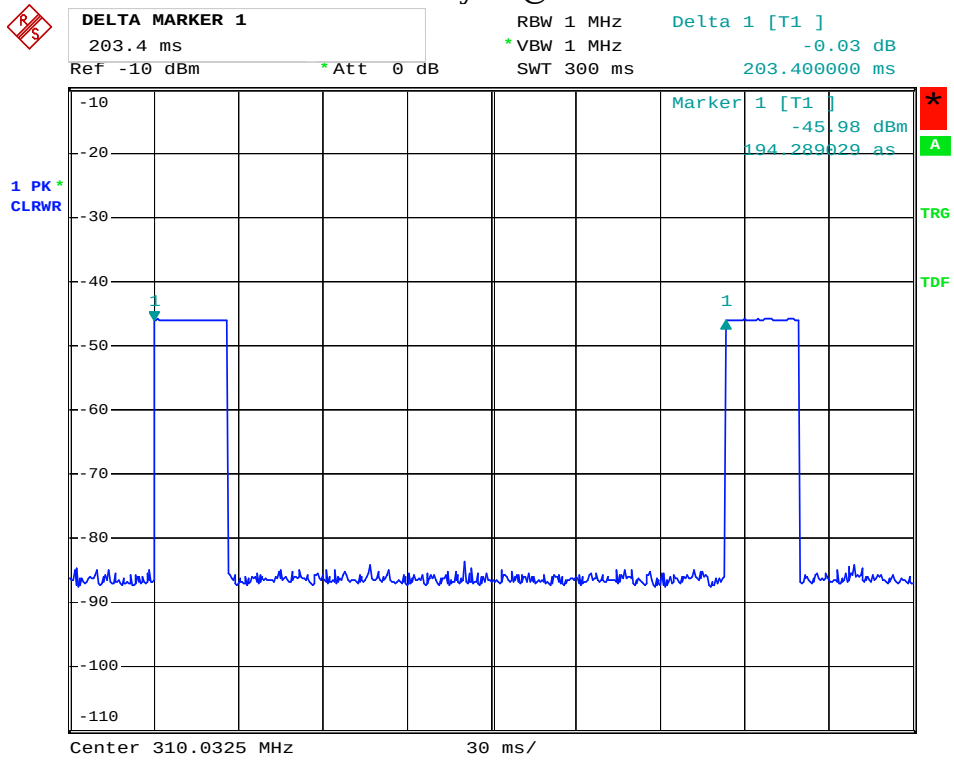
The pulses in each period = 26.2ms

Duty Cycle =  $26.2 \text{ ms} / 100 \text{ ms} = 0.262$

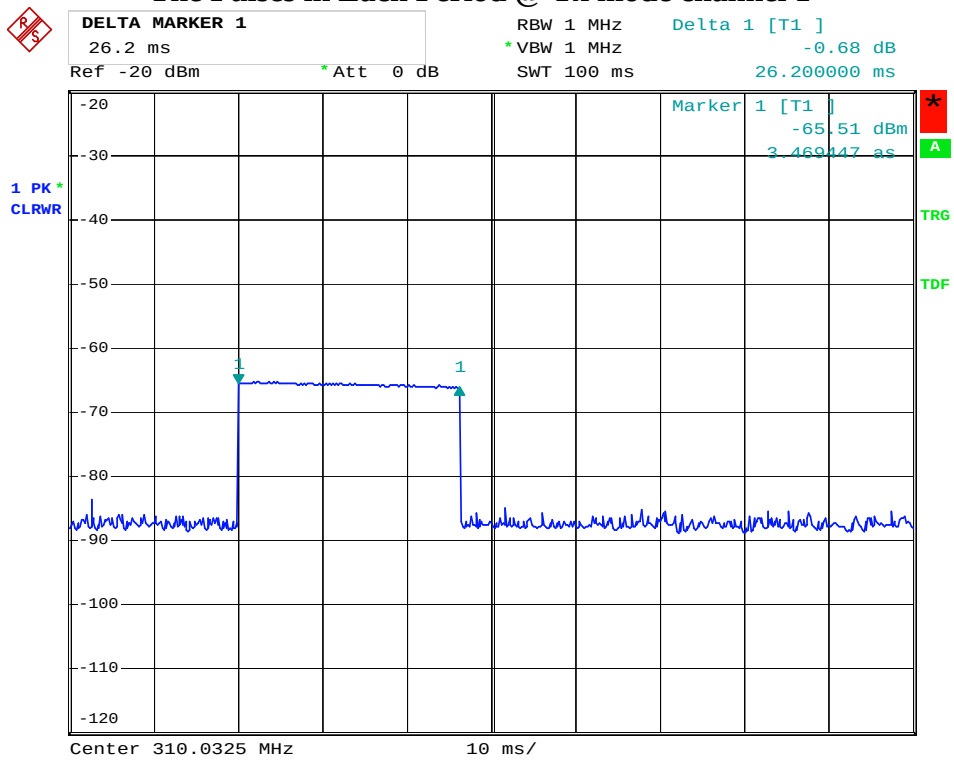
Therefore, the duty cycle correction factor will be  $20 \log_{10} 0.262 = -11.63$  dB

Please see the plot below.

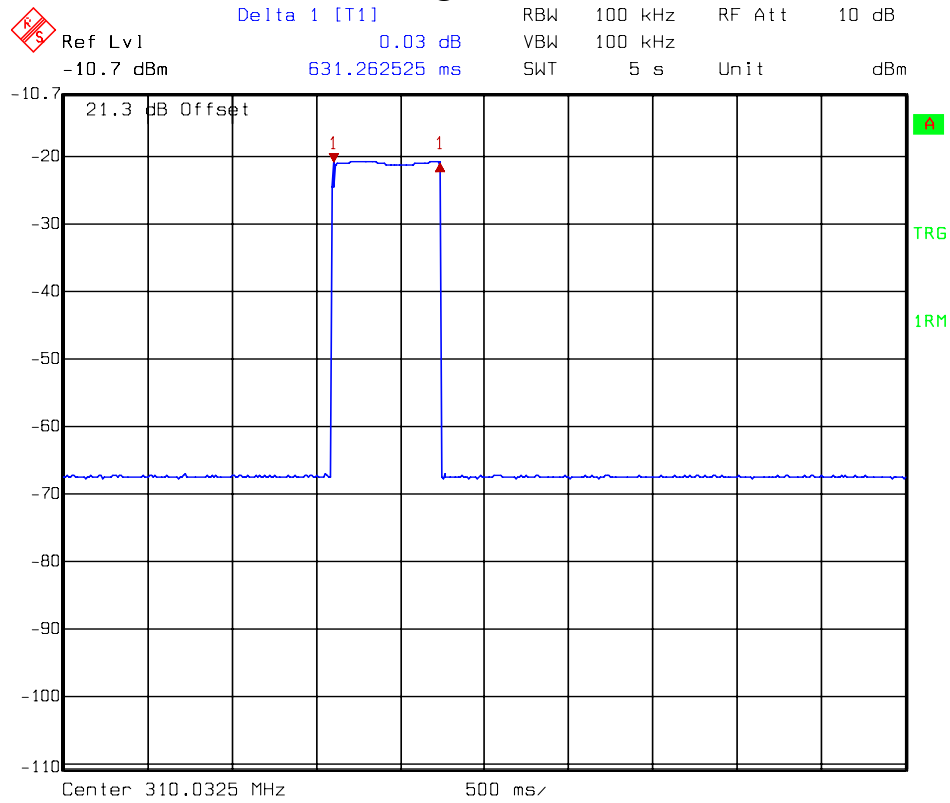
### The Duration of One Cycle @ Tx mode channel 1



### The Pulses in Each Period @ Tx mode channel 1



**Release Time @ Tx mode channel 1**



### 3.5 Radiated emission test data FCC 15.231

#### 3.5.1 Measurement results: Fundamental emission

EUT : F21-6S-TX  
Worst Case : Tx at 310.0325 MHz at Z axis

| Polarization<br>(circle) | Frequency<br>(MHz) | Detector | Corr.<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Average<br>Factor<br>(dB) | Calculated<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|--------------------------|--------------------|----------|---------------------------|-------------------|---------------------------|------------------------|-------------------|----------------|
| Vertical                 | 310.0325           | PK       | 14.10                     | 64.02             | -                         | 78.12                  | 95.32             | -17.20         |
| Vertical                 | 310.0325           | AV       | 14.10                     | 64.02             | -11.63                    | 66.49                  | 75.32             | -8.83          |
| Horizontal               | 310.0325           | PK       | 14.32                     | 56.14             | -                         | 70.45                  | 95.32             | -24.87         |
| Horizontal               | 310.0325           | AV       | 14.32                     | 56.14             | -11.63                    | 58.82                  | 75.32             | -16.50         |

Remark:

1. Calculated = Reading + Corr. Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit

#### 3.5.2 Measurement results: frequencies equal to or less than 1 GHz

EUT : F21-6S-TX  
Worst Case : Tx at 310.0325 MHz at Z axis

| Polarization<br>(circle) | Frequency<br>(MHz) | Detector | Corr.<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Average<br>Factor<br>(dB) | Calculated<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|--------------------------|--------------------|----------|---------------------------|-------------------|---------------------------|------------------------|-------------------|----------------|
| Vertical                 | 280.26000          | QP       | 13.70                     | 31.81             | -                         | 45.50                  | 46.00             | -0.50          |
| Vertical                 | 295.78000          | PK       | 13.95                     | 35.79             | -                         | 49.74                  | 75.32             | -25.58         |
| Vertical                 | 295.78000          | AV       | 13.95                     | 35.79             | -11.63                    | 38.11                  | 55.32             | -17.21         |
| Vertical                 | 561.56000          | PK       | 19.72                     | 33.01             | -                         | 52.73                  | 75.32             | -22.59         |
| Vertical                 | 561.56000          | AV       | 19.72                     | 33.01             | -11.63                    | 41.10                  | 55.32             | -14.22         |
| Vertical                 | 619.76000          | PK       | 20.88                     | 34.33             | -                         | 55.20                  | 75.32             | -20.12         |
| Vertical                 | 619.76000          | AV       | 20.88                     | 34.33             | -11.63                    | 43.57                  | 55.32             | -11.75         |
| Horizontal               | 619.76000          | PK       | 20.88                     | 19.18             | -                         | 40.05                  | 75.32             | -35.27         |
| Horizontal               | 619.76000          | AV       | 20.88                     | 19.18             | -11.63                    | 28.42                  | 55.32             | -26.90         |

Remark:

1. Calculated = Reading + Corr. Factor – Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit

### **3.5.3 Measurement results: frequency above 1GHz**

The emissions were very low against the limit in the frequency range above 1 GHz.

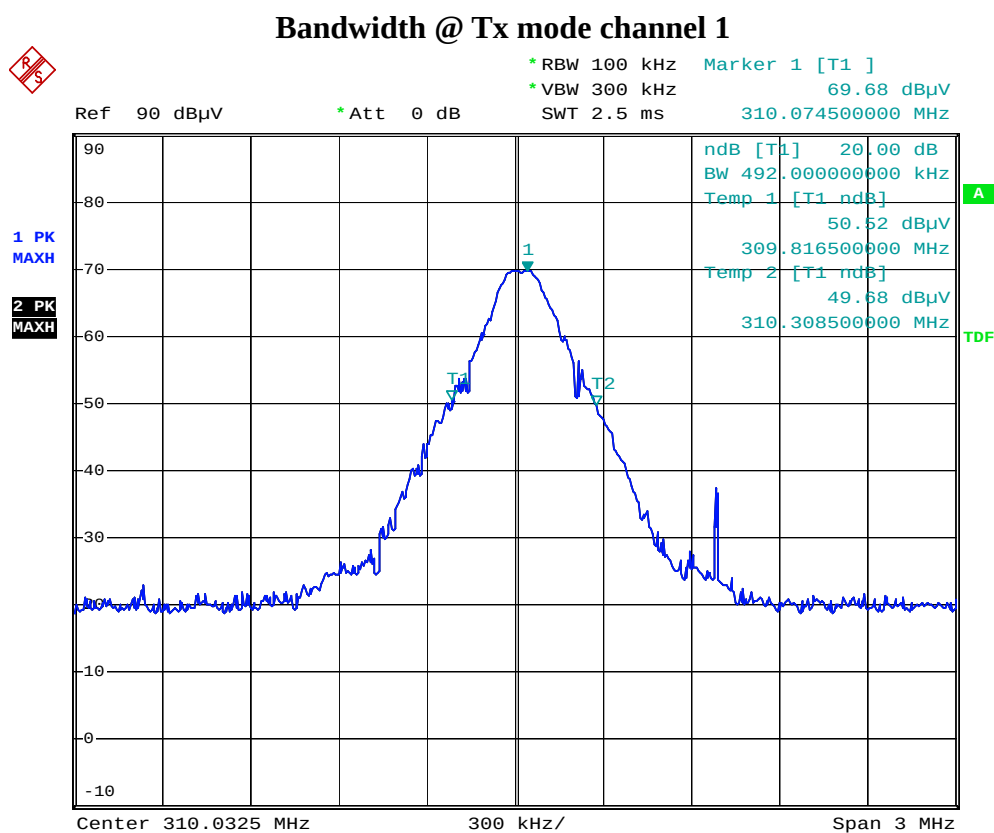
#### 4. Measured bandwidth FCC 15.231(C)

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

$$B.W(20dBc) \text{ Limit} = 0.25\% \times f(\text{MHz}) = 0.25\% \times 310.0325 \text{ MHz} = 0.775 \text{ MHz}$$

From the plot, the bandwidth is observed to be 492.00 kHz, at 20dBc where the bandwidth limit is 0.775 MHz.

Please see the plot below.



## **5. Conducted emission FCC 15.207**

According to FCC 15.207, the EUT only employs battery power for operation and does not operate from the AC power lines. Therefore, the test can be exempted.