

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

**Applicant:** Sigma Sport USA LLC  
1860B Dean St., St. Charles, Illinois, United States 60174

**Product Name:** iD.FREE, iD.TRI

**Brand Name:** SIGMA

**Model No.:** iD.FREE, iD.TRI

**Model Difference:** For Marketing Purpose

**Report Number:** T190305W06-RP2

**FCC ID:** M5LID4546

**FCC Rule Part:** §15.249

**Issue Date:** May 02, 2019

**Date of Test:** Mar. 05, 2019 ~ Apr. 10, 2019

**Date of EUT Received:** Mar. 05, 2019

**Issued by:** Compliance Certification Services Inc. Wugu Lab.  
No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891,  
Taiwan. (R.O.C.)  
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The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report  
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

**Tested By:**

*Jerry Lu*

**Jerry Lu / Sr. Engineer**

**Approved By:**

*Kevin Tsai*

**Kevin Tsai / Deputy Manager**



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## Revision History

| Report Number  | Revision | Description                  | Effected Page | Issue Date    | Revised By    |
|----------------|----------|------------------------------|---------------|---------------|---------------|
| T190305W06-RP2 | Rev.00   | Initial creation of document | All           | Apr. 15, 2019 | Violetta Tang |
| T190305W06-RP2 | Rev.01   | Update chapter 9             | 32            | May 02, 2019  | Violetta Tang |

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## 1 GENERAL INFORMATION

### 1.1 Product Description

|                   |                                             |                                       |
|-------------------|---------------------------------------------|---------------------------------------|
| Product Name:     | iD.FREE, iD.TRI                             |                                       |
| Brand Name:       | SIGMA                                       |                                       |
| Model No.:        | iD.FREE, iD.TRI                             |                                       |
| Model difference: | For Marketing Purpose                       |                                       |
| Hardware Version: | N/A                                         |                                       |
| Software Version: | N/A                                         |                                       |
| Power Supply:     | 3.7Vdc from Rechargeable Li-Polymer Battery |                                       |
|                   | Battery:                                    | Model No.: SH362027, Supplier: USRICH |

|                      |                                            |
|----------------------|--------------------------------------------|
| Radio Technology:    | 2.4GHz Short Range Radio                   |
| Frequency Range:     | 2457MHz                                    |
| Channel number:      | 1 channel                                  |
| Modulation type:     | GFSK                                       |
| Transmit Power:      | 93.41dBμV/m                                |
| Antenna Designation: | Multilayer Chip Antenna, Peak Gain: 0.5dBi |

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.249

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

## 1.3 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,

Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)

FCC Designation number: TW1309

## 1.4 Special Accessories

There are no special accessories used while test was conducted.

## 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 µH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

#### 2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

### 2.4 Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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## 2.5 Limitation

### (1) Conducted Emission

Conducted Emission Limits is as following.

| Frequency (MHz) | Conducted Limit (dBuV) |         |
|-----------------|------------------------|---------|
|                 | Quasi-Peak             | Average |
| 0.15 – 0.5      | 66 - 56                | 56 - 46 |
| 0.5 – 5         | 56                     | 46      |
| 5 - 30          | 60                     | 50      |

### (2) Radiated Emission

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following.

| Frequency (MHz)  | Field strength of Fundamental | Field strength of Harmonics | Distance (m) |
|------------------|-------------------------------|-----------------------------|--------------|
| 902 – 928        | 50 mV/m<br>(94dBuV/m)         | 500 uV/m<br>(54dBuV/m)      | 3            |
| 2400 – 2483.5    | 50 mV/m<br>(94dBuV/m)         | 500 uV/m<br>(54dBuV/m)      | 3            |
| 5725 – 5875      | 50 mV/m<br>(94dBuV/m)         | 500 uV/m<br>(54dBuV/m)      | 3            |
| 24.0 – 24.25 GHz | 250 mV/m<br>(107.95dBuV/m)    | 2500 uV/m<br>(67.95dBuV/m)  | 3            |

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### (3) Radiated Emission

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

| Frequency (MHz) | Field strength $\mu\text{V/m}$ | Distance (m) | Field strength at 3m dB $\mu\text{V/m}$ |
|-----------------|--------------------------------|--------------|-----------------------------------------|
| 1.705-30        | 30                             | 30           | 69.54                                   |
| 30-88           | 100                            | 3            | 40                                      |
| 88-216          | 150                            | 3            | 43.5                                    |
| 216-960         | 200                            | 3            | 46                                      |
| Above 960       | 500                            | 3            | 54                                      |

### (4) Radiated Emission

For frequencies above 1000MHz, the above field strength limits are based on average limits. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

- Re-mark:
1. Emission level in dB $\mu\text{V/m}$ =20 log ( $\mu\text{V/m}$ )
  2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
  3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of  $\xi$  15.205.
  4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of  $\xi$  15.205, then the general radiated emission limits in  $\xi$  15.209 apply.

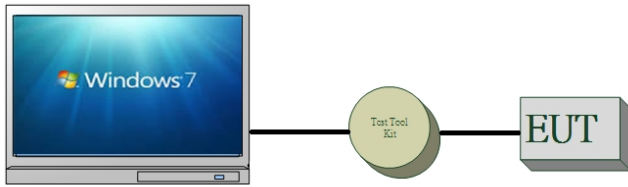
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## 2.6 Configuration of Tested System

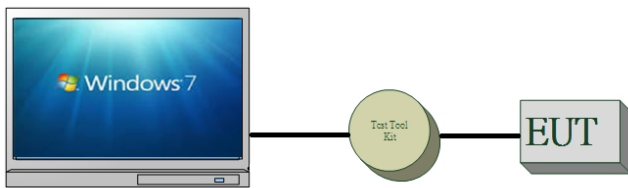
**Fig. 2-1 Conducted (Antenna Port) Emission**



**Fig 2-3 Conduction (AC Power Line) Emission**



**Fig 2-2 Radiated Emission**



**Table 2-1 Equipment Used in Tested System**

| Item | Equipment          | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|--------------------|-----------|----------------|------------|------------|------------|
| 1    | ANT+ Test Software | N/A       | N/A            | N/A        | N/A        | N/A        |
| 2    | Notebook           | Lenovo    | T470           | P0001293   | Shielded   | Unshielded |
| 3    | Test Tool Kit      | N/A       | N/A            | N/A        | N/A        | N/A        |

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### 3 SUMMARY OF TEST RESULTS

| FCC Rules          | Description Of Test                                               | Result    |
|--------------------|-------------------------------------------------------------------|-----------|
| §15.207(a)         | AC Power Line Conducted Emission                                  | Compliant |
| §15.249(a)(e)      | Field Strength of the Fundamental signal                          | Compliant |
| §15.249(a), 15.209 | Spurious Emission                                                 | Compliant |
| 15.249(a), 15.205  | Restricted bands around fundamental frequency (Radiated Emission) | Compliant |
| §15.215(c)         | 20dB Bandwidth Measurement                                        | Compliant |
| 15.249(b)(2)       | Frequency Stability                                               | Compliant |

### 4 DESCRIPTION OF TEST MODES

#### 4.1 Operated in 2457MHz Band

1 channel are provided.

| Channel | Frequency |
|---------|-----------|
| 1       | 2457      |

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## 4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

### RADIATED EMISSION TEST:

| RADIATED EMISSION TEST (BELOW 1 GHz) |                   |                  |            |                  |              |
|--------------------------------------|-------------------|------------------|------------|------------------|--------------|
| MODE                                 | AVAILABLE CHANNEL | TESTED FREQUENCY | MODULATION | DATA RATE (Mbps) | ANTENNA PORT |
| 2.4G                                 | 1                 | 2457             | GFSK       | N/A              | MAIN         |
| RADIATED EMISSION TEST (ABOVE 1 GHz) |                   |                  |            |                  |              |
| MODE                                 | AVAILABLE CHANNEL | TESTED FREQUENCY | MODULATION | DATA RATE (Mbps) | ANTENNA PORT |
| 2.4G                                 | 1                 | 2457             | GFSK       | N/A              | MAIN         |

### Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 2.4GHz Wireless Transmitter for channel Low, Mid and High, the worst case H position was reported.

### ANTENNA PORT CONDUCTED MEASUREMENT:

| CONDUCTED TEST |                   |                  |            |                  |              |
|----------------|-------------------|------------------|------------|------------------|--------------|
| MODE           | AVAILABLE CHANNEL | TESTED FREQUENCY | MODULATION | DATA RATE (Mbps) | ANTENNA PORT |
| 2.4G           | 1                 | 2457             | GFSK       | N/A              | MAIN         |

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## 5 MEASUREMENT UNCERTAINTY

| PARAMETER                             | UNCERTAINTY    |
|---------------------------------------|----------------|
| AC Powerline Conducted Emission       | +/- 1.2575 dB  |
| 20dB Bandwidth                        | +/- 147.256 Hz |
| Frequency Stability                   | +/- 147.256 Hz |
| 3M Semi Anechoic Chamber / 30M~200M   | +/- 4.12 dB    |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 4.68 dB    |
| 3M Semi Anechoic Chamber / 1G~8G      | +/- 5.18 dB    |
| 3M Semi Anechoic Chamber / 8G~18G     | +/- 5.47 dB    |
| 3M Semi Anechoic Chamber / 18G~26G    | +/- 3.81 dB    |
| 3M Semi Anechoic Chamber / 26G~40G    | +/- 3.87 dB    |

### Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.
3. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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## 6 CONDUCTED EMISSION TEST

### 6.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

| Frequency range<br>MHz                                                                                                                                                              | Limits<br>dB(uV) |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
|                                                                                                                                                                                     | Quasi-peak       | Average  |
| 0.15 to 0.50                                                                                                                                                                        | 66 to 56         | 56 to 46 |
| 0.50 to 5                                                                                                                                                                           | 56               | 46       |
| 5 to 30                                                                                                                                                                             | 60               | 50       |
| <b>Note</b><br>1.The lower limit shall apply at the transition frequencies<br>2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz. |                  |          |

### 6.2 Measurement Equipment Used:

| Conducted Emission Test Site |                    |                 |                  |              |            |
|------------------------------|--------------------|-----------------|------------------|--------------|------------|
| EQUIPMENT<br>TYPE            | MFR                | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |
| CABLE                        | EMCI               | CFD300-NL       | CERF             | 06/29/2018   | 06/28/2019 |
| EMI Test Receiver            | R&S                | ESCI            | 100064           | 07/24/2018   | 07/23/2019 |
| LISN                         | SCHWARZBECK        | NSLK 8127       | 8127-541         | 01/31/2019   | 01/30/2020 |
| LISN                         | SCHAFFNER          | NNB 41          | 03/10013         | 02/13/2019   | 02/12/2020 |
| Software                     | EZ-EMC(CCS-3A1-CE) |                 |                  |              |            |

### 6.3 EUT Setup:

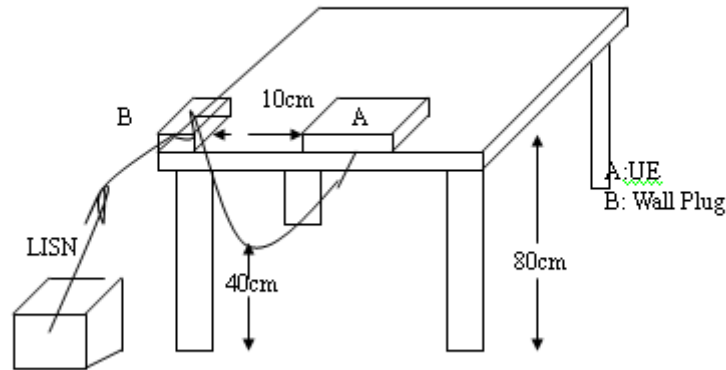
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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## 6.4 Test SET-UP (Block Diagram of Configuration)



## 6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

## 6.6 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The \* reveals the worst-case results that closet to the limit.

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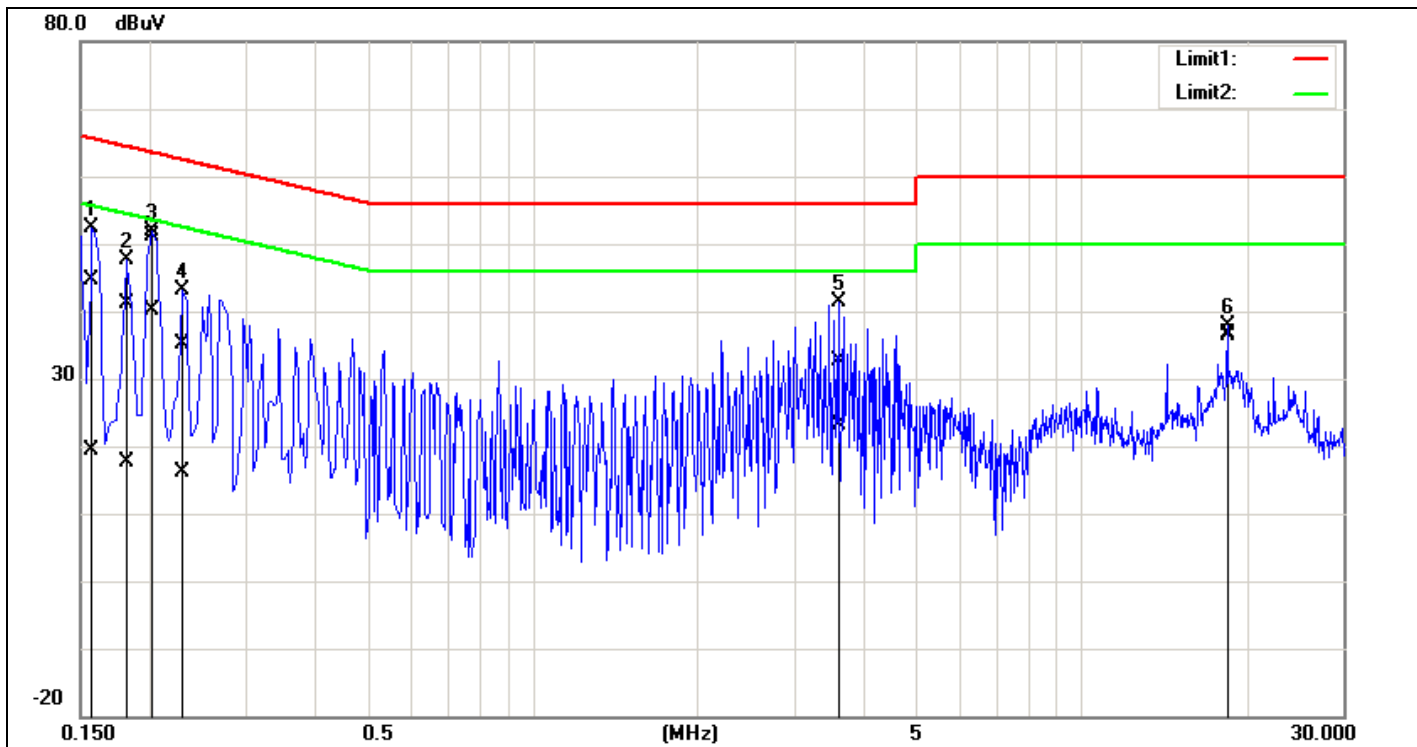
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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Description: Operation  
Line: L1  
Test Voltage: AC 120V/60Hz

Date: 2019/3/13  
Temp.(°C)/Hum.(%): 26(°C)/60%  
Test By: Henry



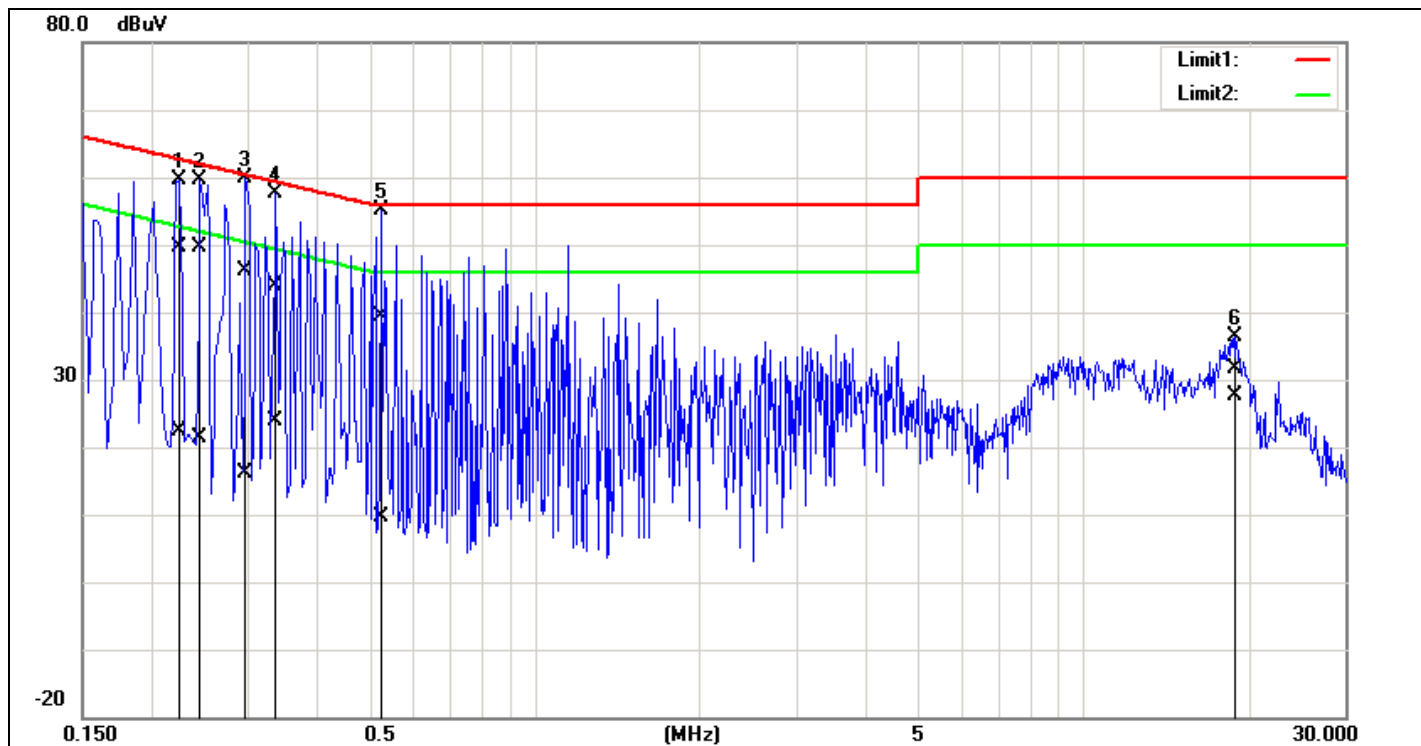
| No. | Frequency<br>(MHz) | QuasiPeak<br>reading<br>(dBuV) | Average<br>reading<br>(dBuV) | Correction<br>factor<br>(dB) | QuasiPeak<br>result<br>(dBuV) | Average<br>result<br>(dBuV) | QuasiPeak<br>limit<br>(dBuV) | Average<br>limit<br>(dBuV) | QuasiPeak<br>margin<br>(dB) | Average<br>margin<br>(dB) | Remark |
|-----|--------------------|--------------------------------|------------------------------|------------------------------|-------------------------------|-----------------------------|------------------------------|----------------------------|-----------------------------|---------------------------|--------|
| 1   | 0.1580             | 44.38                          | 19.26                        | 0.16                         | 44.54                         | 19.42                       | 65.56                        | 55.57                      | -21.02                      | -36.15                    | Pass   |
| 2   | 0.1819             | 40.89                          | 17.52                        | 0.15                         | 41.04                         | 17.67                       | 64.39                        | 54.40                      | -23.35                      | -36.73                    | Pass   |
| 3*  | 0.2020             | 51.08                          | 39.88                        | 0.15                         | 51.23                         | 40.03                       | 63.52                        | 53.53                      | -12.29                      | -13.50                    | Pass   |
| 4   | 0.2300             | 34.87                          | 16.01                        | 0.15                         | 35.02                         | 16.16                       | 62.45                        | 52.45                      | -27.43                      | -36.29                    | Pass   |
| 5   | 3.6100             | 32.32                          | 22.77                        | 0.26                         | 32.58                         | 23.03                       | 56.00                        | 46.00                      | -23.42                      | -22.97                    | Pass   |
| 6   | 18.4340            | 35.89                          | 35.83                        | 0.66                         | 36.55                         | 36.49                       | 60.00                        | 50.00                      | -23.45                      | -13.51                    | Pass   |

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|               |              |                    |            |
|---------------|--------------|--------------------|------------|
| Description:  | Operation    | Date:              | 2019/3/13  |
| Line:         | N            | Temp.(°C)/Hum.(%): | 26(°C)/60% |
| Test Voltage: | AC 120V/60Hz | Test By:           | Henry      |



| No. | Frequency<br>(MHz) | QuasiPeak<br>reading<br>(dBUV) | Average<br>reading<br>(dBUV) | Correction<br>factor<br>(dB) | QuasiPeak<br>result<br>(dBUV) | Average<br>result<br>(dBUV) | QuasiPeak<br>limit<br>(dBUV) | Average<br>limit<br>(dBUV) | QuasiPeak<br>margin<br>(dB) | Average<br>margin<br>(dB) | Remark |
|-----|--------------------|--------------------------------|------------------------------|------------------------------|-------------------------------|-----------------------------|------------------------------|----------------------------|-----------------------------|---------------------------|--------|
| 1   | 0.2260             | 49.62                          | 22.21                        | 0.10                         | 49.72                         | 22.31                       | 62.59                        | 52.60                      | -12.87                      | -30.29                    | Pass   |
| 2*  | 0.2460             | 49.55                          | 21.20                        | 0.10                         | 49.65                         | 21.30                       | 61.89                        | 51.89                      | -12.24                      | -30.59                    | Pass   |
| 3   | 0.2980             | 46.11                          | 16.04                        | 0.10                         | 46.21                         | 16.14                       | 60.30                        | 50.30                      | -14.09                      | -34.16                    | Pass   |
| 4   | 0.3379             | 43.69                          | 23.72                        | 0.11                         | 43.80                         | 23.83                       | 59.25                        | 49.25                      | -15.45                      | -25.42                    | Pass   |
| 5   | 0.5260             | 39.22                          | 9.61                         | 0.11                         | 39.33                         | 9.72                        | 56.00                        | 46.00                      | -16.67                      | -36.28                    | Pass   |
| 6   | 18.9500            | 31.14                          | 27.17                        | 0.54                         | 31.68                         | 27.71                       | 60.00                        | 50.00                      | -28.32                      | -22.29                    | Pass   |

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## 7 RADIATED EMISSION TEST

### 7.1. Measurement Procedure

1. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

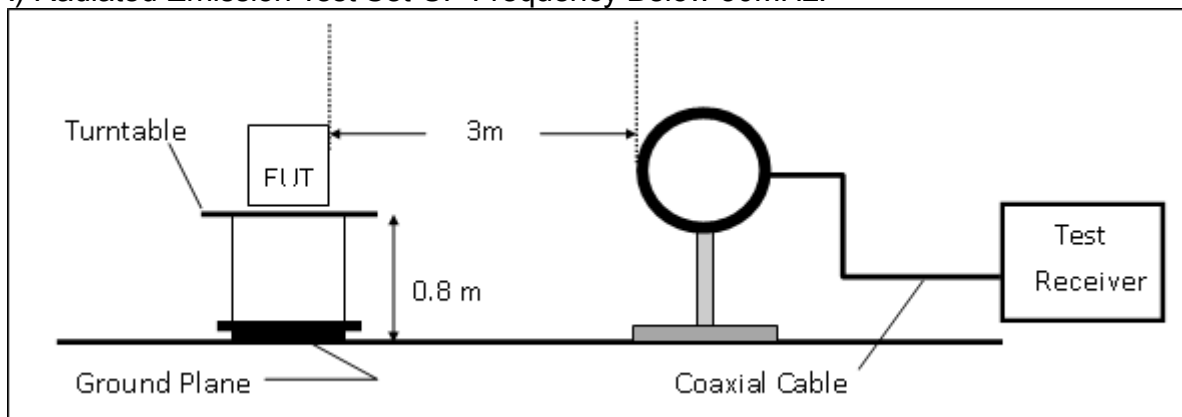
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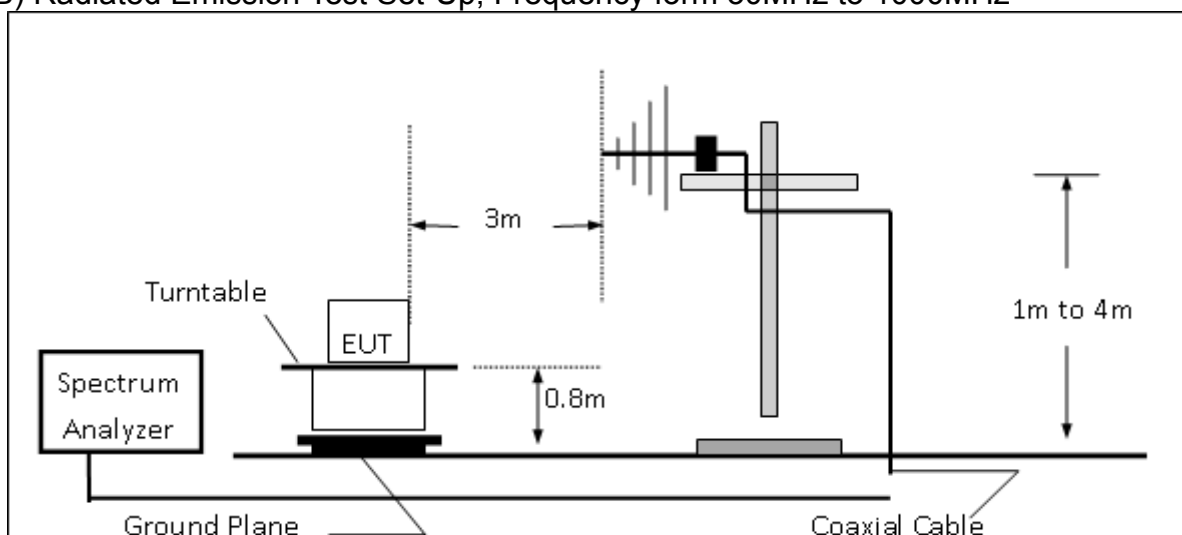
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## 7.2. Test SET-UP (Block Diagram of Configuration)

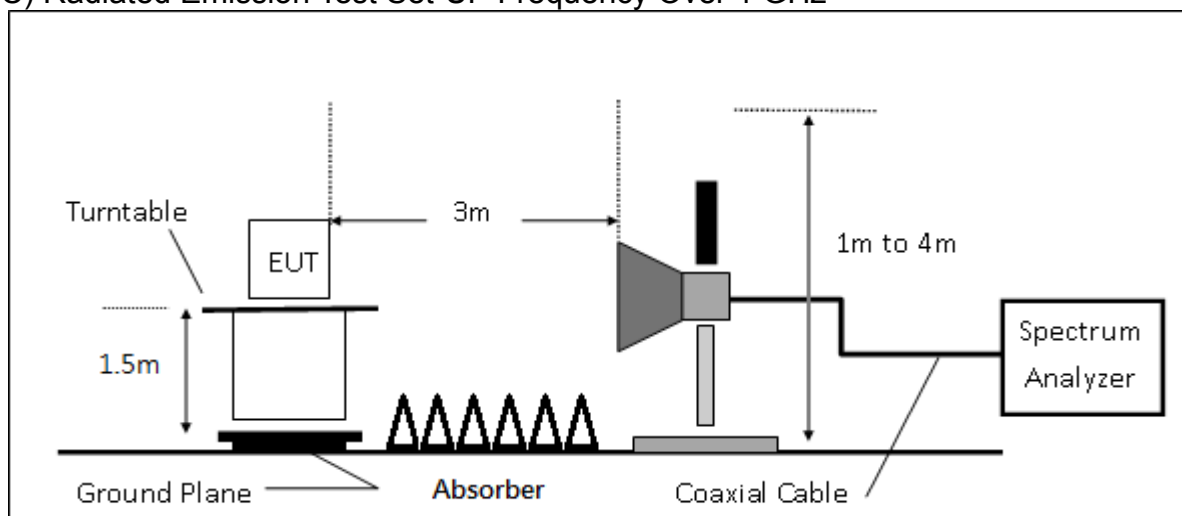
### (A) Radiated Emission Test Set-UP Frequency Below 30MHz.



### (B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



### (C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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### 7.3. Measurement Equipment Used:

| 966A Chamber                     |                   |                 |               |            |            |
|----------------------------------|-------------------|-----------------|---------------|------------|------------|
| EQUIPMENT TYPE                   | MFR               | MODEL NUMBER    | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
| Band Reject Filters              | MICRO TRONICS     | BRM 50702       | 120           | 02/26/2019 | 02/25/2020 |
| Bilog Antenna                    | Sunol Sciences    | JB3             | A030105       | 07/13/2018 | 07/12/2019 |
| Cable                            | HUBER SUHNER      | SUCOFLEX 104PEA | 25157         | 02/26/2019 | 02/25/2020 |
| Cable                            | HUBER SUHNER      | SUCOFLEX 104PEA | 20995         | 02/26/2019 | 02/25/2020 |
| Digital Ther-mo-Hygro Meter      | WISEWIND          | 1206            | D07           | 01/30/2019 | 01/29/2020 |
| double Ridged Guide Horn Antenna | ETC               | MCTD 1209       | DRH13M02003   | 08/20/2018 | 08/19/2019 |
| Loop Antenna                     | ETS.LINDGREN      | 6502            | 148045        | 10/08/2018 | 10/07/2019 |
| Pre-Amplifier                    | EMEC              | EM330           | 060609        | 02/26/2019 | 02/25/2020 |
| Pre-Amplifier                    | HP                | 8449B           | 3008A00965    | 02/26/2019 | 02/25/2020 |
| PSA Series Spectrum Analyzer     | Agilent           | E4446A          | MY46180323    | 05/31/2018 | 05/30/2019 |
| Antenna Tower                    | CCS               | CC-A-1F         | N/A           | N.C.R      | N.C.R      |
| Controller                       | CCS               | CC-C-1F         | N/A           | N.C.R      | N.C.R      |
| Turn Table                       | CCS               | CC-T-1F         | N/A           | N.C.R      | N.C.R      |
| Software                         | e3 V6.11-20180413 |                 |               |            |            |

NOTE: N.C.R refers to Not Calibrated Required.

### 7.4. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

|                           |                                            |
|---------------------------|--------------------------------------------|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude    | AG = Amplifier Gain                        |
| AF = Antenna Factor       |                                            |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)

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## 7.5. Measurement Result

### Field Strength of the Fundamental Signal

Operation Band :Ant+

Fundamental Frequency :2457 MHz

Operation Mode :Main CH MID

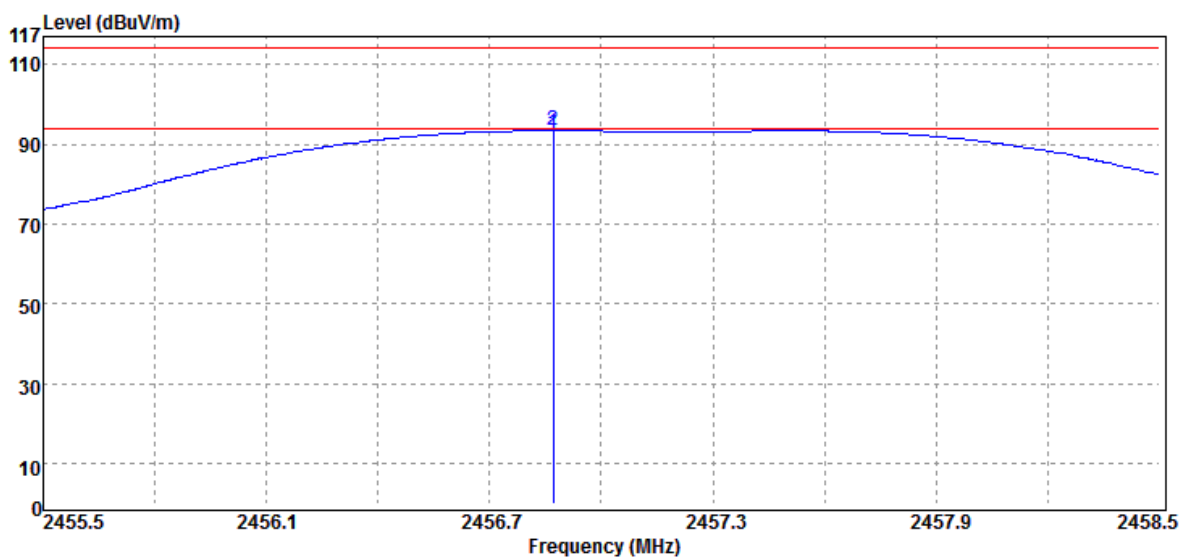
EUT Pol. :H Plane

Test Date :2019-03-08

Temp./Humi. :21 deg\_C / 51 RH

Engineer :Jerry

Measurement Antenna Pol. :VERTICAL



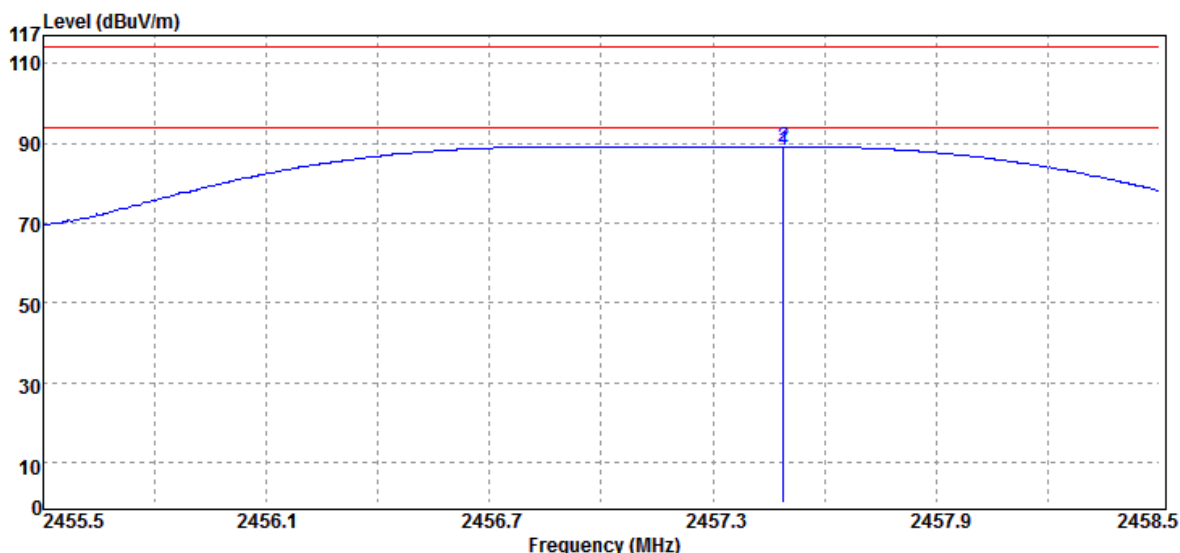
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2456.87      | Average                      | 95.64                             | -3.12        | 92.52                  | 93.98                  | -1.46        |
| 2456.87      | Peak                         | 96.53                             | -3.12        | 93.41                  | 114.00                 | -20.59       |

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|                       |              |                          |                   |
|-----------------------|--------------|--------------------------|-------------------|
| Operation Band        | :Ant+        | Test Date                | :2019-03-08       |
| Fundamental Frequency | :2457 MHz    | Temp./Humi.              | :21 deg_C / 51 RH |
| Operation Mode        | :Main CH MID | Engineer                 | :Jerry            |
| EUT Pol.              | :H Plane     | Measurement Antenna Pol. | :HORIZONTAL       |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz     | Mode     | Reading Level |        | FS           | @3m          |        |
|         | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 2457.49 | Average  | 91.35         | -3.11  | 88.24        | 93.98        | -5.74  |
| 2457.49 | Peak     | 92.25         | -3.11  | 89.14        | 114.00       | -24.86 |

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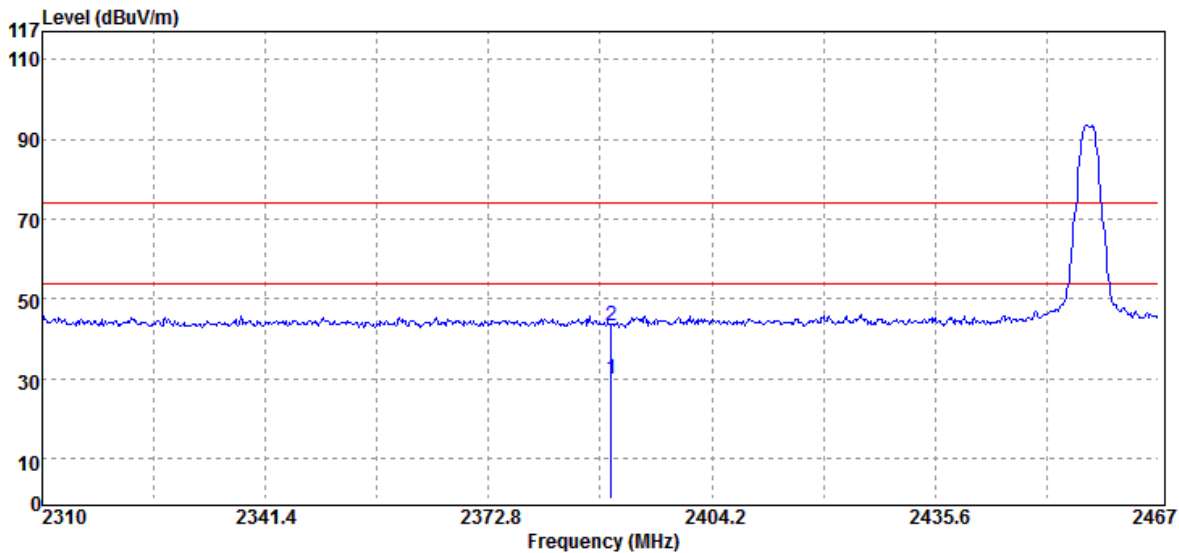
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### Restricted bands around fundamental frequency

Operation Band :Ant+  
Fundamental Frequency :2457 MHz  
Operation Mode :Bandedge CH LOW  
EUT Pol. :E1 Plane

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :VERTICAL



| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz     | Mode     | Reading Level |        | FS     | @3m    |        |
|         | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 2390.00 | Average  | 33.45         | -3.33  | 30.12  | 54.00  | -23.88 |
| 2390.00 | Peak     | 46.74         | -3.33  | 43.41  | 74.00  | -30.59 |

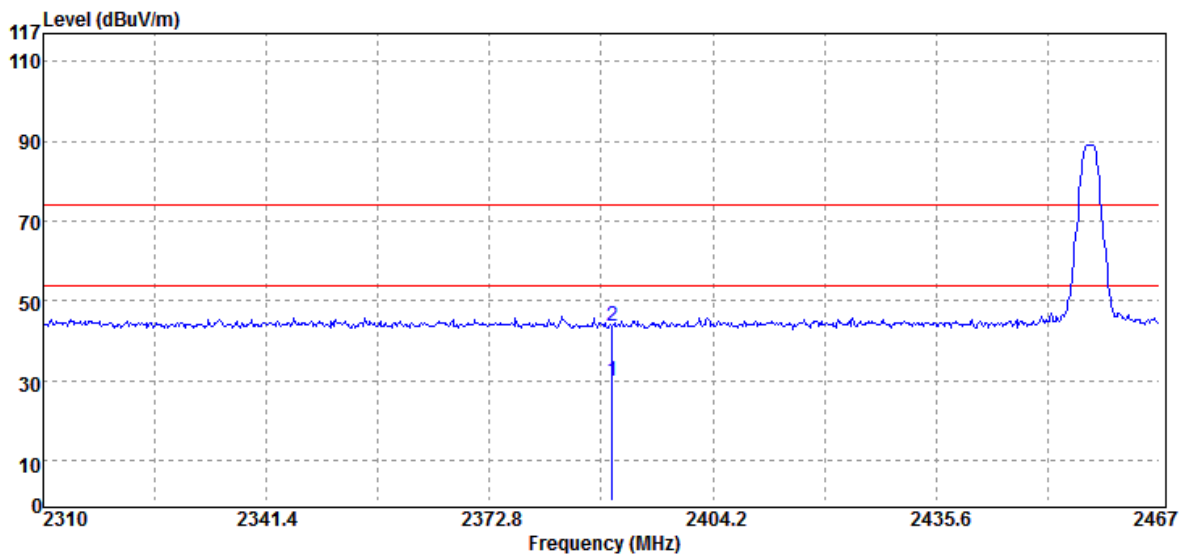
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Operation Band :Ant+  
Fundamental Frequency :2457 MHz  
Operation Mode :Bandedge CH LOW  
EUT Pol. :E1 Plane

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :HORIZONTAL



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00      | Average                      | 33.23                             | -3.33        | 29.90                  | 54.00                  | -24.10       |
| 2390.00      | Peak                         | 46.88                             | -3.33        | 43.55                  | 74.00                  | -30.45       |

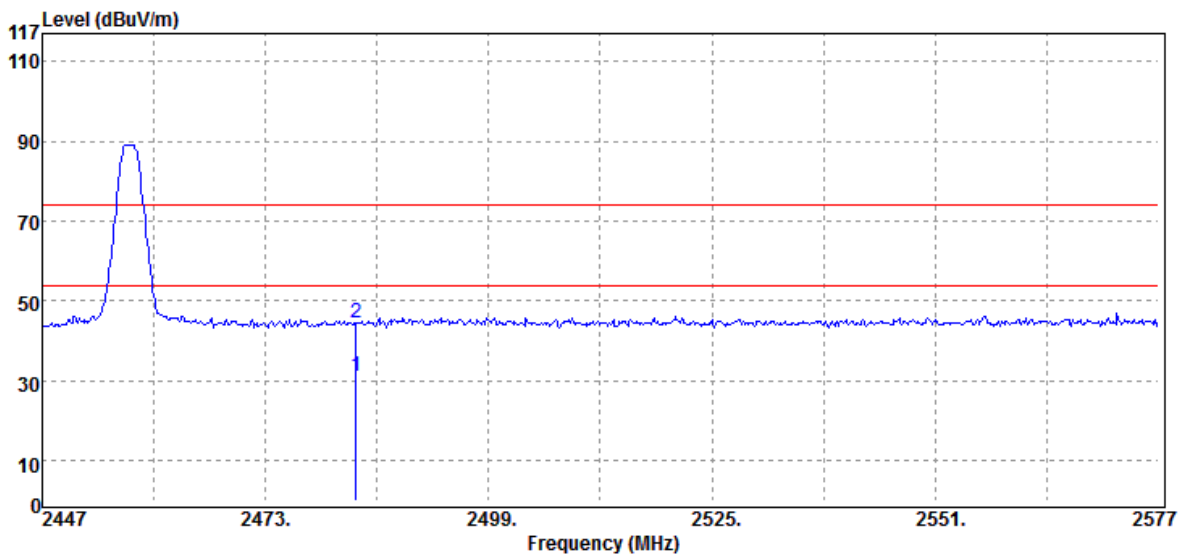
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Operation Band :Ant+  
Fundamental Frequency :2457 MHz  
Operation Mode :Bandedge CH HIGH  
EUT Pol. :H Plane

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :VERTICAL



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 33.79                             | -2.72        | 31.07                  | 54.00                  | -22.93       |
| 2483.50      | Peak                         | 47.20                             | -2.72        | 44.48                  | 74.00                  | -29.52       |

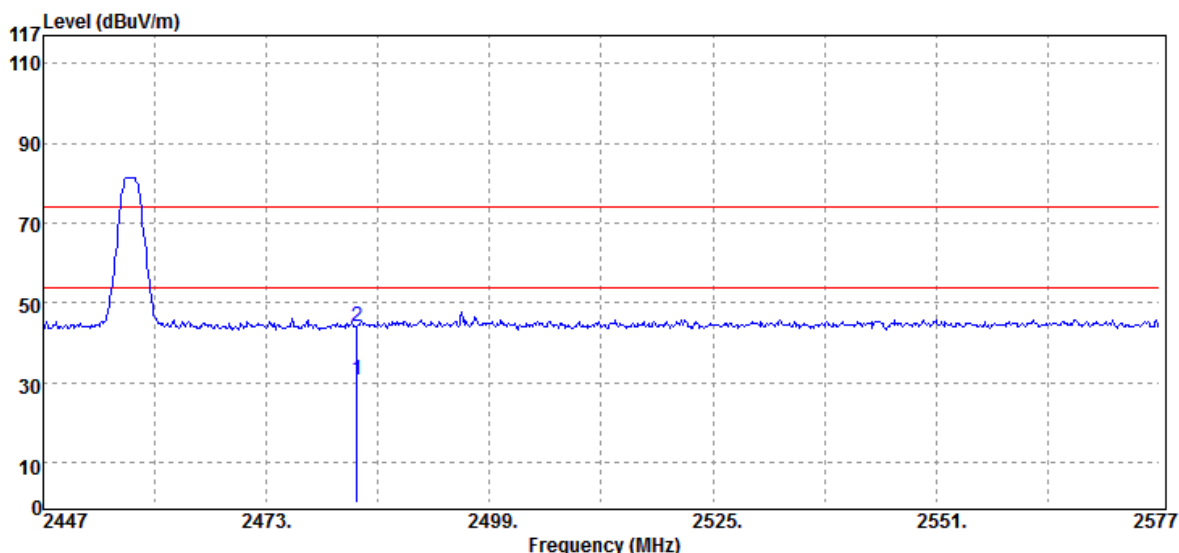
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Operation Band :Ant+  
Fundamental Frequency :2457 MHz  
Operation Mode :Bandedge CH HIGH  
EUT Pol. :H Plane

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :HORIZONTAL



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 33.44                             | -2.72        | 30.72                  | 54.00                  | -23.28       |
| 2483.50      | Peak                         | 47.03                             | -2.72        | 44.31                  | 74.00                  | -29.69       |

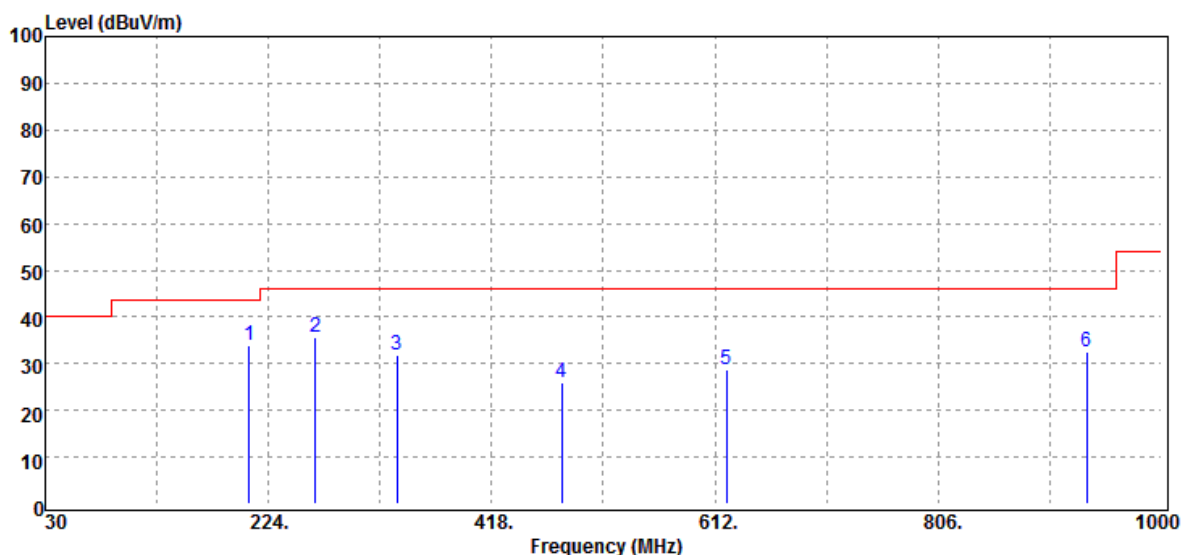
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## Radiated Spurious Emission Measurement Result (Below 1GHz)

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :ANT+      | Test Date                | :2019-03-08       |
| Fundamental Frequency | :2457 MHz  | Temp./Humi.              | :21 deg_C / 51 RH |
| Operation Mode        | :Tx CH MID | Engineer                 | :Jerry            |
| EUT Pol.              | :H Plan    | Measurement Antenna Pol. | :VERTICAL         |



| Freq.  | Detector | Spectrum      | Factor | Actual | Limit | Margin |
|--------|----------|---------------|--------|--------|-------|--------|
| MHz    | PK/QP/AV | Reading Level | dB     | FS     | @3m   | dB     |
| 207.51 | Peak     | 44.62         | -10.84 | 33.78  | 43.50 | -9.72  |
| 264.74 | Peak     | 43.80         | -8.25  | 35.55  | 46.00 | -10.45 |
| 335.55 | Peak     | 38.47         | -6.48  | 31.99  | 46.00 | -14.01 |
| 479.11 | Peak     | 27.97         | -2.02  | 25.95  | 46.00 | -20.05 |
| 621.70 | Peak     | 28.28         | 0.44   | 28.72  | 46.00 | -17.28 |
| 935.01 | Peak     | 27.46         | 5.06   | 32.52  | 46.00 | -13.48 |

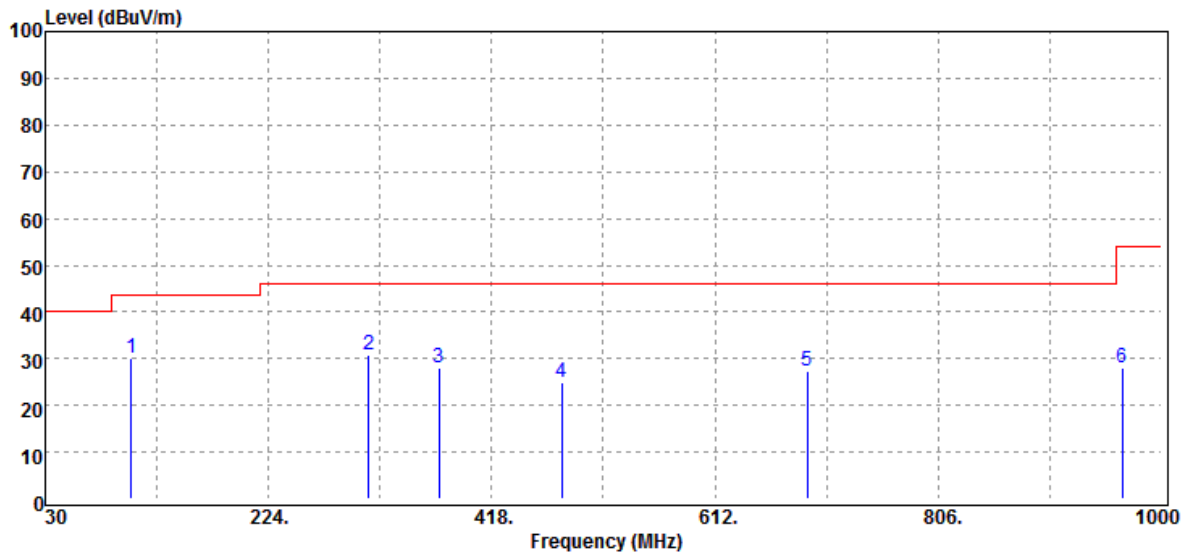
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Operation Band :ANT+  
Fundamental Frequency :2457 MHz  
Operation Mode :Tx CH MID  
EUT Pol. :H Plan

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :HORIZONTAL



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 104.69       | Peak                         | 40.61                             | -10.61       | 30.00                  | 43.50                  | -13.50       |
| 311.30       | Peak                         | 38.08                             | -7.12        | 30.96                  | 46.00                  | -15.04       |
| 372.41       | Peak                         | 33.75                             | -5.59        | 28.16                  | 46.00                  | -17.84       |
| 479.11       | Peak                         | 26.91                             | -2.02        | 24.89                  | 46.00                  | -21.11       |
| 692.51       | Peak                         | 26.20                             | 1.02         | 27.22                  | 46.00                  | -18.78       |
| 966.05       | Peak                         | 21.87                             | 6.26         | 28.13                  | 54.00                  | -25.87       |

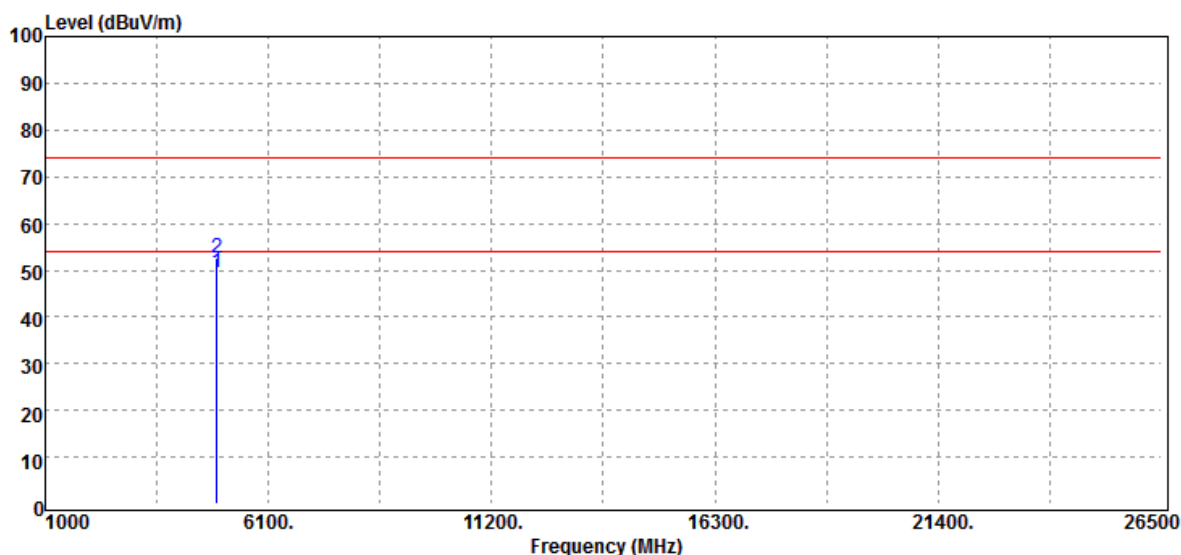
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# Radiated Spurious Emission Measurement Result (Above 1GHz)

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :Ant+      | Test Date                | :2019-03-08       |
| Fundamental Frequency | :2457 MHz  | Temp./Humi.              | :21 deg_C / 51 RH |
| Operation Mode        | :Tx CH Mid | Engineer                 | :Jerry            |
| EUT Pol.              | :H Plan    | Measurement Antenna Pol. | :VERTICAL         |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz     | Mode     | Reading Level |        | FS           | @3m          |        |
|         | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4914.00 | Average  | 45.70         | 3.77   | 49.47        | 54.00        | -4.53  |
| 4914.00 | Peak     | 48.67         | 3.77   | 52.44        | 74.00        | -21.56 |

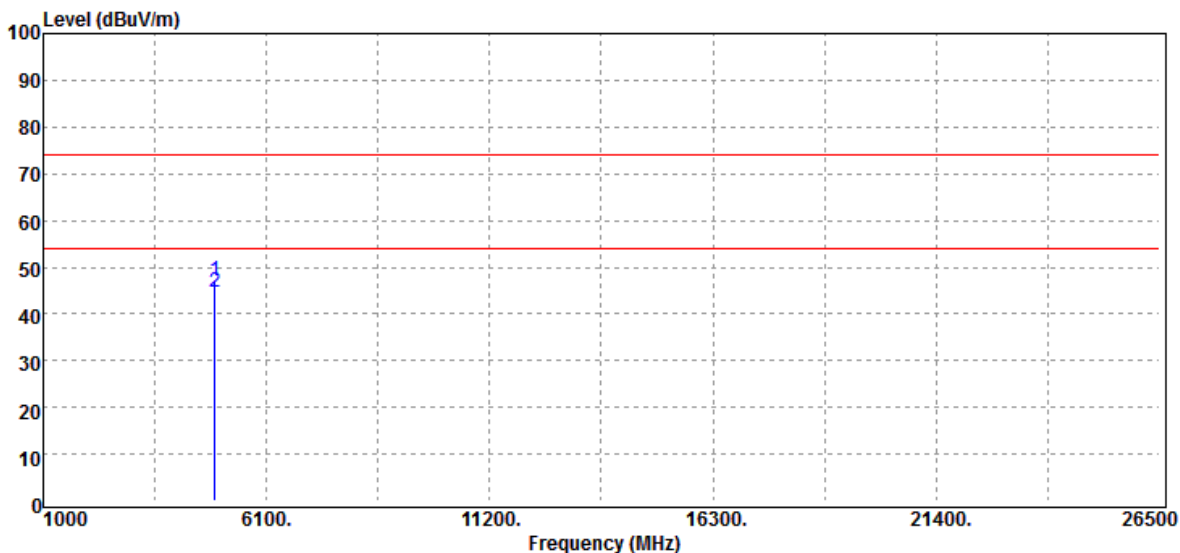
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Operation Band :Ant+  
Fundamental Frequency :2457 MHz  
Operation Mode :Tx CH Mid  
EUT Pol. :H Plan

Test Date :2019-03-08  
Temp./Humi. :21 deg\_C / 51 RH  
Engineer :Jerry  
Measurement Antenna Pol. :HORIZONTAL



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4914.00      | 48.53                        | 43.13                             | 3.77         | 46.90                  | 74.00                  | -27.10       |
| 4914.00      | Average                      | 41.03                             | 3.77         | 44.80                  | 54.00                  | -9.20        |

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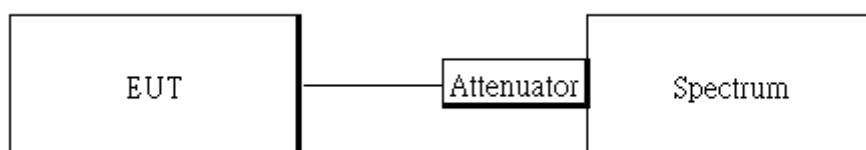
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## 8 20 DB BANDWIDTH MEASUREMENT

### 8.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW = 100kHz, VBW = 300kHz, Span = 5MHz.
4. Set SPA Max hold. Mark peak, -20dB.

### 8.2 Test SET-UP (Block Diagram of Configuration)



### 8.3 Measurement Equipment Used:

| EQUIPMENT TYPE    | MFR       | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Agilent   | N9010A       | MY53400256    | 11/21/2018 | 11/20/2019 |
| DC Block          | PASTERNAK | PE8210       | RF29          | 02/26/2019 | 02/25/2020 |
| Attenuator        | Marvelous | MVE2213-10   | RF80          | 02/26/2019 | 02/25/2020 |

### 8.4 Measurement Results:

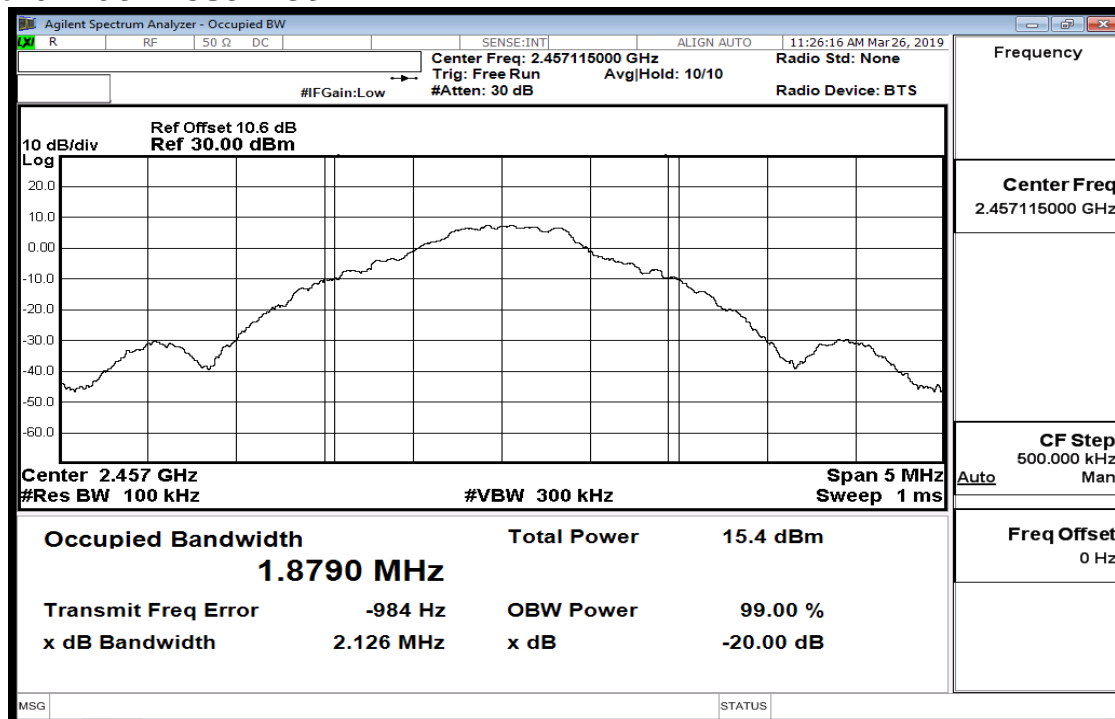
| Frequency (MHz) | 20dB Bandwidth (MHz) |
|-----------------|----------------------|
| 2457            | 2.126                |

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## 20dB Bandwidth Test Plot



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## 9 FREQUENCY STABILITY

### 9.1 Standard Applicable

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.001\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

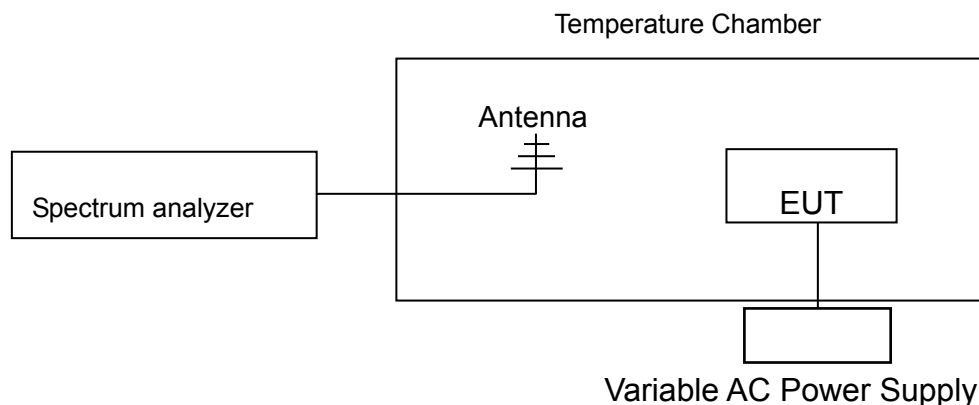
### 9.2 Measurement Procedure

1. The EUT was placed inside temperature chamber and powered and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.

### 9.3 Measurement Equipment Used:

N/A

### 9.4 Test SET-UP (Block Diagram of Configuration)



### 9.5 Measurement Results:

N/A, only the point to point device in the frequency band 24.05-24.25GHz according to 15.249 b(2) is need to apply this test item.

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## 10 ANTENNA REQUIREMENT

### 10.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

### 10.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

*~ End of Report ~*

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