

# **ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT**

# INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND INDUSTRY CANADA RSS 247 REQUIREMENT

|                       | OF  |
|-----------------------|---|
| FCC Applicant:        | Universal Electronics Inc.                                  |
|                       | 201 East Sandpointe Ave 7th Floor Santa Ana CA 92707        |
|                       | USA   |
| IC Applicant:         | Universal Electronics Inc.                                  |
|                       | 201 East Sandpointe Ave 7th Floor Santa Ana CA 92707<br>USA |
| Product Name:         | RF Remote Controller  |
| Flouuct Name.         |   |
| Brand Name:           | Duravit   |
| Model No.:            | Sensowash   |
| Model Difference:     | N/A   |
| Report Number:        | T190429W02-RP   |
| FCC ID:               | MG3-512003  |
| IC:                   | 2575A-512003  |
| FCC Rule Part:        | §15.247, Cat: DTS   |
| IC Rule Part:         | RSS-247 issue 2 Feb 2017                                    |
| Issue Date:           | Jun. 19, 2019   |
| Date of Test:         | May 03, 2019 ~ May 21, 2019                                 |
| Date of EUT Received: | May 03, 2019  |

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Tested By:

Approved By:

Henry Chiang / Engineer

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# **Revision History**

| Report Number | Revision | Description                       | Effected<br>Page | Issue Date    | Revised By |
|---------------|----------|-----------------------------------|------------------|---------------|------------|
| T190429W02-RP | Rev.00   | Initial creation of docu-<br>ment | All              | Jun. 19, 2019 | Elle Chang |

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### **GENERAL INFORMATION** 1

# **1.1 Product Description**

| Product Name:     | RF Remote Controller                 |
|-------------------|--------------------------------------|
| Brand Name:       | Duravit                              |
| Model No.:        | Sensowash                            |
| Model Difference: | N/A                                  |
| Hardware Version: | N/A                                  |
| Software Version: | N/A                                  |
| Power Supply:     | 3V (2 coin cells CR2032 in parallel) |

| Radio Technology:    | Bluetooth Low Energy       |
|----------------------|----------------------------|
| Channel number:      | 40 channels                |
| Modulation type:     | GFSK                       |
| Transmit Power:      | 6.34 dBm                   |
| Frequency Range:     | 2402 – 2480MHz             |
| Antenna Designation: | PCB antenna, Gain: 3.47dBi |

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247 FCC KDB 558074 D01 15.247 Meas. Guidance v05r02 RSS-Gen. issue 5 Apr. 2018 RSS-247 issue 2 Feb. 2017 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 1109) FCC Designation number: TW1309 Canada Registration number: 2324G

## **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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### SYSTEM TEST CONFIGURATION 2

# 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 a 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 30MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50uH/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 a 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.

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## 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 Configuration of Tested System Fig. 2-1 Conducted (Antenna Port) Emission Configuration

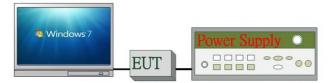
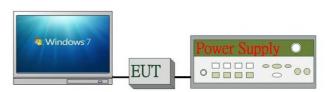


Fig 2-2 Radiated Emission



# Table 2-1 Equipment Used in Tested System

| ltem | Equipment                  | Mfr/Brand | Model/Type No. | Series No. | Data Ca-<br>ble | Power<br>Cord |
|------|----------------------------|-----------|----------------|------------|-----------------|---------------|
| 1    | Bluetooth Test<br>Software | N/A       | N/A            | N/A        | N/A             | N/A           |
| 2    | Notebook                   | Lenovo    | L420           | LR-6MEX0   | Shielded        | Un-Shielded   |
| 3.   | DC Power Supply            | Lenovo    | T440P          | PC-089AH5  | Shielded        | Unshielded    |

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### SUMMARY OF TEST RESULTS 3

| FCC Rules             | IC Rules   | Description Of Test                          |           |
|-----------------------|--|--|-----------|
| §15.207(a)            | RSS-Gen §8.8   | AC Power Line Conducted Emission             | N/A       |
| §15.247(b) (3)        | RSS-247 §5.4(4)  | Peak Output Power                            | Compliant |
| §15.247(a)(2)         | RSS-247 §5.1 (1)<br>RSS-Gen §6.7                               | 6dB & 99% Emission Bandwidth                 | Compliant |
| §15.247(d)            | RSS-247 §5.5<br>RSS-Gen §8.10                                  | Conducted Band Edge<br>and Spurious Emission | Compliant |
| §15.247(d)            | RSS-247 §5.5<br>RSS-Gen §8.9<br>RSS-Gen §8.10<br>RSS-Gen §6.13 | Radiated Band Edge<br>and Spurious Emission  | Compliant |
| §15.247(e)            | RSS-247 §5.2(2)  | Peak Power Density                           | Compliant |
| §15.203<br>§15.247(b) | RSS- Gen §6.8  | Antenna Requirement                          | Compliant |

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### **DESCRIPTION OF TEST MODES** 4

# 4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

| ITEM | FREQUENCY | ITEM | FREQUENCY | ITEM | FREQUENCY |
|------|-----------|------|-----------|------|-----------|
| 1    | 2402 MHz  | 15   | 2430 MHz  | 29   | 2458 MHz  |
| 2    | 2404 MHz  | 16   | 2432 MHz  | 30   | 2460 MHz  |
| 3    | 2406 MHz  | 17   | 2434 MHz  | 31   | 2462 MHz  |
| 4    | 2408 MHz  | 18   | 2436 MHz  | 32   | 2464 MHz  |
| 5    | 2410 MHz  | 19   | 2438 MHz  | 33   | 2466 MHz  |
| 6    | 2412 MHz  | 20   | 2440 MHz  | 34   | 2468 MHz  |
| 7    | 2414 MHz  | 21   | 2442 MHz  | 35   | 2470 MHz  |
| 8    | 2416MHz   | 22   | 2444 MHz  | 36   | 2472 MHz  |
| 9    | 2418 MHz  | 23   | 2446 MHz  | 37   | 2474 MHz  |
| 10   | 2420 MHz  | 24   | 2448 MHz  | 38   | 2476 MHz  |
| 11   | 2422 MHz  | 25   | 2450 MHz  | 39   | 2478 MHz  |
| 12   | 2424 MHz  | 26   | 2452 MHz  | 40   | 2480 MHz  |
| 13   | 2426 MHz  | 27   | 2454 MHz  |      |           |
| 14   | 2428 MHz  | 28   | 2456 MHz  |      |           |

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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:**

| MODE  | AVAILABLE<br>FREQUENCY<br>(MHz)      | TESTED<br>FREQUENCY (MHz) | MODULATION | DATA RATE<br>(Mbps) |  |
|---|--------------------------------------|---------------------------|------------|---------------------|--|
|   | RADIATED EMISSION TEST (BELOW 1 GHz) |                           |            |                     |  |
| Bluetooth LE  | 2402 to 2480                         | 2442                      | GFSK       | 1                   |  |
|   | RADIATED EMISSION TEST (ABOVE 1 GHz) |                           |            |                     |  |
| Bluetooth LE  | 2402 to 2480                         | 2402, 2442, 2480          | GFSK       | 1                   |  |
| <b>Note:</b><br>The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the |                                      |                           |            |                     |  |

worst case E2 position was reported.

# ANTENNA PORT CONDUCTED MEASUREMENT:

| CONDUCTED TEST |                                 |                           |            |                     |
|----------------|---------------------------------|---------------------------|------------|---------------------|
| MODE           | AVAILABLE<br>FREQUENCY<br>(MHz) | TESTED<br>FREQUENCY (MHz) | MODULATION | DATA RATE<br>(Mbps) |
| Bluetooth LE   | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 1                   |

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### **MEASUREMENT UNCERTAINTY** 5

| PARAMETER                                 | UNCERTAINTY   |
|---|---------------|
| AC Powerline Conducted Emission           | +/- 1.2575 dB |
| Peak Output Power                         | +/- 1.92 dB   |
| 6dB Bandwidth                             | +/- 61.248 Hz |
| 100 kHz Bandwidth of Frequency Band Edges | +/- 1.92 dB   |
| Peak Power Density                        | +/- 1.996 dB  |
| 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. Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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### CONDUCTED EMISSION TEST 6

# 6.1 Standard Applicable:

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

| Frequency range |            | nits<br>(uV) |
|-----------------|------------|--------------|
| MHz             | 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           |
| Note            |            |              |

1. The lower limit shall apply at the transition frequencies 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:

N/A

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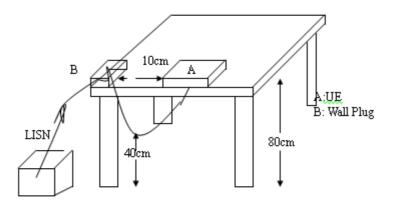
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# 6.4 Test SET-UP (Block Diagram of Configuration)



## 6.5 Measurement Procedure:

- 1. The EUT was placed on a table which is 0.8m above ground plan.
- 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:

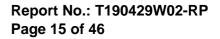
N/A; Powered from AAA battery.

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# 7 PEAK OUTPUT POWER MEASUREMENT

# 7.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

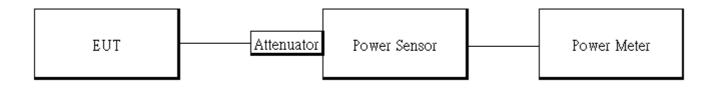
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

# 7.2 Measurement Equipment Used:

| Conducted Emission Test Site |         |                 |                  |              |            |  |  |  |  |  |  |
|------------------------------|---------|-----------------|------------------|--------------|------------|--|--|--|--|--|--|
| EQUIPMENT<br>TYPE            | MFR     | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |  |  |  |  |  |  |
| Power Meter                  | Anritsu | ML2496A         | 1326001          | 08/03/2018   | 08/02/2019 |  |  |  |  |  |  |
| Power Sensor                 | Anritsu | MA2411B         | 1315048          | 08/03/2018   | 08/02/2019 |  |  |  |  |  |  |
| Power Sensor                 | Anritsu | MA2411B         | 1315049          | 08/03/2018   | 08/02/2019 |  |  |  |  |  |  |
| DC Power Supply              | Agilent | E3640A          | MY53130054       | 09/03/2018   | 09/02/2019 |  |  |  |  |  |  |

# 7.3 Test Set-up:



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# 7.4 Measurement Procedure:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas Guidance & ANSI C63.10..
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

## **Power Meter:**

It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Power Meter.

5. Repeat above procedures until all test default channel measured was complete.

# Formula:

Duty Cycle = Ton / (Ton+Toff)

# **Duty Factor:**

|  | Duty Cycle (%)                               | Duty Factor<br>(dB) | 1/T<br>(kHz)  | VBW<br>setting<br>(kHz)                    |
|--|--|---------------------|---|--|
| BLE  | 100.00                                       | 0.00                | 0.00  | 0.01                                       |
| Keysight Spectrum Analyzer - Swept SA      | GHz<br>PNO: Fast<br>IFGein:Low #Atten: 30 dB | Avg Type: Voltage   | 4:29 PM May 03, 2019<br>TRACE 1 2 3 4 5 6<br>TYPE WWWWWW<br>DET P N N N N N | Frequency<br>Auto Tune                     |
| Ref Offset 1 dB<br>10 dB/div Ref 20.00 dBm |  | ΔMk                 | r1105.0 µs<br>7.08 dB   |  |
| 10.0 <b>1</b><br>0.00 <b>1</b><br>-10.0    |  |                     |   | Center Freq<br>2.442000000 GHz             |
| -20.0                                      |  |                     |   | <b>Start Freq</b><br>2.442000000 GHz       |
| -50.0                                      |  |                     |   | <b>Stop Freq</b><br>2.442000000 GHz        |
| Center 2.442000000 GHz<br>Res BW 8 MHz     | #VBW 8.0 MHz                                 | Sweep 5.000         | Span 0 Hz<br>ms (1001 pts)  | CF Step<br>8.000000 MHz<br><u>Auto</u> Man |
|  | 105.0 µs 7.08 dBm                            |                     | E   | Freq Offset<br>0 Hz                        |
| 7<br>8<br>9<br>10                          |  |                     |   | Scale Type                                 |
| 11 MSG                                     | III  | STATUS              | •   |  |

# Duty Cycle Factor:10\*log(1/(99.9999/100))=0

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### 7.5 **Measurement Result:**

## BLE mode:

| СН     | Frequency<br>(MHz) | Peak Power Output<br>(dBm)                                   | Required Limit  |
|--------|--------------------|--|-----------------|
| Low    | 2402               | 6.34   | 1 Watt = 30 dBm |
| Mid    | 2442               | 6.23   | 1 Watt = 30 dBm |
| High   | 2480               | 6.12   | 1 Watt = 30 dBm |
| BLE mo | de:                |  |                 |
| СН     | Frequency<br>(MHz) | Max. Avg. Output include<br>tune up tolerance Power<br>(dBm) | Required Limit  |
| Low    | 2402               | 6.28   | 1 Watt = 30 dBm |
| Mid    | 2442               | 6.17   | 1 Watt = 30 dBm |
| High   | 2480               | 6.05   | 1 Watt = 30 dBm |

\*Note: Measured by power meter, cable loss as 1 dB that offsets on the power meter in Peak \*Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter \*Note: Max. Output include tune up tolerance Power is average power

| СН   | Frequency<br>(MHz) | Max. Avg. Output include<br>tune up tolerance Power<br>(dBm) | Antenna<br>Gain<br>(dBi) | EIRP<br>(dBm) | I   | Limit | :   |
|------|--------------------|--|--------------------------|---------------|-----|-------|-----|
| Low  | 2402               | 6.28   | 3.47                     | 9.75          | 4W= | 36    | dBm |
| Mid  | 2442               | 6.17   | 3.47                     | 9.64          | 4W= | 36    | dBm |
| High | 2480               | 6.05   | 3.47                     | 9.52          | 4W= | 36    | dBm |

\* Note: EIRP = Average Power + Gain

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# 8 6DB & 99% BANDWIDTH MEASUREMENT

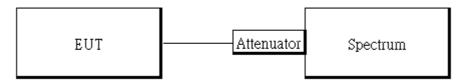
# 8.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

## 8.2 Measurement Equipment Used

| Conducted Emission Test Site |            |                 |                  |              |            |  |  |  |  |  |  |
|------------------------------|------------|-----------------|------------------|--------------|------------|--|--|--|--|--|--|
| EQUIPMENT<br>TYPE            | MFR        | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |  |  |  |  |  |  |
| Spectrum Analyzer            | Agilent    | N9010A          | MY53400256       | 11/21/2018   | 11/20/2019 |  |  |  |  |  |  |
| DC Power Supply              | Agilent    | E3640A          | MY53130054       | 09/03/2018   | 09/02/2019 |  |  |  |  |  |  |
| DC Block                     | PASTERNACK | PE8210          | RF256            | 02/26/2019   | 02/25/2020 |  |  |  |  |  |  |

# 8.3 Test Set-up:



## **8.4 Measurement Procedure:**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. For 6dB Bandwidth:

Set the spectrum analyzer as RBW=100 kHz, VBW= 3\*RBW, Span = 5MHz, Detector=Peak, Sweep=auto.

- 5. Mark the peak frequency and –6dB (upper and lower) frequency.
- 6. For 99% Bandwidth:

Set the spectrum analyzer as RBW=1%, VBW=3\*RBW, Span = 2MHz, Detector=Sample, Sweep=auto.

- 7. Turn on the 99% bandwidth function, max reading.
- 8. Repeat above procedures until all test default channel is completed

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## 8.5 Measurement Result:

### **BLE mode**

| Frequency | 6dB<br>BW | BW    | Result | BLE mode        |                    |
|-----------|-----------|-------|--------|-----------------|--------------------|
| (MHz)     | (MHz)     | (MHz) | Result | Frequency (MHz) | 99%Bandwidth (MHz) |
| 2402      | 1.032     | > 0.5 | PASS   |                 |                    |
|           | 1.002     | 2 0.0 |        | 2402            | 1.4107             |
| 2442      | 1.038     | > 0.5 | PASS   | 2442            | 1.4076             |
| 2400      | 1.05      | . 0 F |        |                 |                    |
| 2480      | 1.05      | > 0.5 | PASS   | 2480            | 1.4039             |

Note: Refer to next page for plots.

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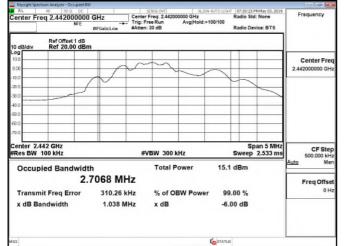
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# 6dB Band Width Test Data CH-Low

| Center Fre                          | re 30 g DC<br>eq 2.402000000<br>NFE |                       | SENSE:DVT<br>Center Freq: 2,4020<br>Trig: Free Run<br>#Atten: 30 dB |          | Radio S             | a PMMay (01, 2019)<br>td: None<br>levice: BTS | Frequency                    |
|-------------------------------------|-------------------------------------|-----------------------|---|----------|---------------------|---|------------------------------|
| 0 dB/div                            | Ref Offset 1 dB<br>Ref 20.00 dBm    |                       |   |          |                     |   |                              |
| .00<br>10.0<br>10.0<br>20.0<br>30.0 |                                     |                       | ~~~   | ~        |                     |   | Center Fre<br>2.402000000 GH |
| 40 0<br>50 0<br>70 0                |                                     |                       |   |          |                     |   |                              |
| Res BW                              |                                     |                       | #VBW 300  | kHz      | Swee                | ipan 5 MHz<br>5 2.533 ms                      | CF Ste<br>500.000 kH         |
| Occupi                              | ied Bandwidti<br>2.1                | 220 MH                | Total I   | Power    | 15.2 dBm            |   | Auto Ma                      |
|                                     | it Freq Error<br>ndwidth            | 316.00 kH<br>1.032 MH |   | BW Power | 99.00 %<br>-6.00 dB |   | OH                           |
| -                                   |                                     |                       |   |          | STATIS              |   |                              |

## 6dB Band Width Test Data CH-Mid



# 6dB Band Width Test Data CH-High

|            | trum Analyzer - Occupied BV      | 1                        |  |                                     |                               |
|------------|----------------------------------|--------------------------|--|-------------------------------------|-------------------------------|
| Center Fre | eq 2.480000000<br>NFE            | Trig                     | sense:m/i Aug<br>er Freq: 2,480000000 GHz<br>Free Run Avg/Hold: /<br>en: 30 dB | Radio Std: None<br>Radio Device: BT | Frequency                     |
| 15 dB/div  | Ref Offset 1 dB<br>Ref 20.00 dBn | 1                        |  |                                     |                               |
| -10.0      |                                  |                          |  |                                     | Center Free<br>2,48000000 GHz |
| 40.0       |                                  |                          |  |                                     |                               |
| 100        |                                  |                          |  |                                     | _                             |
| -115       |                                  |                          |  |                                     |                               |
| Res BW     |                                  |                          | #VBW 300 kHz   | Span 5 M<br>Sweep 2.533             | ms 500.000 kH                 |
| Occup      | ied Bandwidt<br>2.               | <sup>h</sup><br>7339 MHz | Total Power  | 15.1 dBm                            | Auto Man<br>Freg Offset       |
|            | iit Freq Error<br>Indwidth       | 317.95 kHz<br>1.050 MHz  | % of OBW Power<br>x dB   | -6.00 dB                            | OH                            |
| 53         |                                  |                          |  | Costatus                            |                               |

# 99% Band Width Test Data CH-Low

| Frequency                    | 1: None<br>vice: BTS |          |         | itse:n/T<br>req: 2,40200<br>e Run<br>0 dB |     | GHz<br>#FGain:Low | 2000000<br>NFE          |                   | anter Fi |
|------------------------------|----------------------|----------|---------|---|-----|-------------------|-------------------------|-------------------|----------|
|                              |                      |          |         |   |     |                   | ffset 1 dB<br>20,00 dBm |                   | dB/div   |
| Center Fre<br>2,402000000 GH |                      |          | ~       |   | ww  | w                 | -                       | -                 |          |
|                              |                      | ~        |         |   |     | ~                 | 1                       |                   |          |
|                              |                      |          |         |   |     |                   |                         |                   |          |
|                              |                      |          |         |   |     |                   |                         |                   | 10       |
| CF Ste<br>200.000 kł         | an 2 MHz<br>15.13 ms |          |         | 5W 62 kH                                  | #\  |                   |                         | 402 GHz<br>20 kHz |          |
| <u>Auto</u> Ma               |                      | 3.4 dBm  | wer     | Total P                                   | H7  | 1<br>107 M        | andwidth<br>1           | pied Ba           | Occu     |
| Freq Offs<br>0 H             |                      | 99.00 %  | V Power | % of OE                                   |     | 54.609            |                         | nit Freq          | Transr   |
|                              |                      | -6.00 dB |         | x dB                                      | kHz | 268.6             | th                      | andwid            | x dB B   |

# 99% Band Width Test Data CH-Mid

| 100       |  | Run  | Trig: Fri   | -+  | NFE   |  | ter Fre  |
|-----------|--|--|---|---|---|--|--|
|           |  |  |   |   |   |  | B/div  |
|           | ~~   |  | ~~~   | ~~~~  |   |  |  |
| <br>m     |  |  |   |   | - mark  | $\checkmark$   |  |
|           |  |  |   |   |   |  | Ŷ  |
|           |  |  |   |   |   |  |  |
|           | z  | BW 62 kH   | #V  | _   |   |  | ter 2,44<br>s BW 2   |
| 13.2 dBm  | ower   | Total P  | Hz  | 76 M  |   | ed Ban   | ccupi  |
| 99.00 %   | W Power  | % of Of  | kHz   | 19.040  | rror  | t Freq E   | ransmi   |
| -6.00 dB  |  | x dB   | kHz   | 302.8   |   | ndwidth  | dB Bar   |
| vice: BTS | Radio Device: BTS<br>Span 2 MHz<br>Sweep 15.13 ms<br>13.2 dBm<br>99.00 % | Avg Hold>100/100<br>Radio Device: BTS<br>Avg Hold >100/100<br>Radio Device: BTS<br>Span 2 MHz<br>Span 2 MHz<br>Sweep 15.13 ms<br>ower 13.2 dBm<br>SW Power 99.00 % | Avg Hold>100100<br>Radio Device: BT5<br>Radio Device: BT5<br>Radio Device: BT5<br>Span 2 MHz<br>BW 62 kHz<br>Sweep 15.13 ms<br>Total Power<br>13.2 dBm<br>% of OBW Power<br>99.00 % | Trig: Fire Run         Avg/Hold:>100/100           #Atten: 30 dB         Radio Device: BT5           #Atten: 30 dB         Radio Device: BT5           #Atten: 30 dB         Span 2 MHz           #VBW 62 kHz         Sweep 15.13 ms           Total Power         13.2 dBm           Hz         % of OBW Power         99.00 % | Faint-Live Trig: Free Run<br>Faint-Live Trig: Free Run<br>Braint-Live Autors and the second seco | NEE         Trig:         Free Run<br>#Atten: 30 dB         Avg(Hold>100/100           et 1 dB<br>00 dBm | ME     Trig: Free Run<br>#Artgin: Low     Arg/Hold:>100/100       Ref Offset 1 dB<br>Ref 20.00 dBm     Radio Device: BTS       Ref Offset 1 dB<br>Ref 20.00 dBm     Image: Comparison of the second secon |

# 99% Band Width Test Data CH-High

| Center Freq                 | 2.48000000<br>NFE               | Trig:                     | er Freg: 2.48000000 GHz | Radio Std: None<br>0/100<br>Radio Device: BTS | Frequency                    |
|-----------------------------|---------------------------------|---------------------------|-------------------------|---|------------------------------|
| 10 dB/div                   | Ref Offset 1 dB<br>Ref 20.00 dB | m                         |                         |   |                              |
| 10.0<br>0.00                |                                 |                           | Among                   |   | Center Free<br>2,48000000 GH |
| 20.0                        |                                 | ~                         |                         | and   | -                            |
| 40.0                        |                                 |                           |                         |   |                              |
| 68.0                        |                                 |                           |                         |   |                              |
| Center 2.48 C<br>#Res BW 20 |                                 |                           | FVBW 62 kHz             | Span 2 M<br>Sweep 15.13                       | ms 200.000 kH                |
| Occupied                    | Bandwid                         | <sup>th</sup><br>4039 MHz | Total Power             | 13.4 dBm                                      | Auto Ma                      |
| Transmit I<br>x dB Band     |                                 | 14.901 kHz<br>267.9 kHz   | % of OBW Power<br>x dB  | 99.00 %<br>-6.00 dB                           | OH                           |
|                             |                                 |                           |                         |   |                              |

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# 9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

## 9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

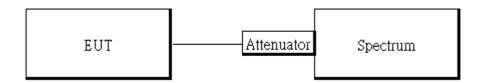
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

| Conducted Emission Test Site |            |                 |                  |              |            |  |  |
|------------------------------|------------|-----------------|------------------|--------------|------------|--|--|
| EQUIPMENT<br>TYPE            | MFR        | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |  |  |
| Spectrum Analyzer            | Agilent    | N9010A          | MY53400256       | _            | 11/20/2019 |  |  |
| DC Power Supply              | Agilent    | E3640A          | MY53130054       | 09/03/2018   | 09/02/2019 |  |  |
| DC Block                     | PASTERNACK | PE8210          | RF256            | 02/26/2019   | 02/25/2020 |  |  |

## 9.2 Measurement Equipment Used:

# 9.3 Test SET-UP:



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# 9.4 Measurement Procedure

# **Reference Level of Emission Limit:**

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 100kHz & VBW = 300 kHz.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level.

# Conducted Band Edge:

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
- 6. Mark the highest reading of the emission as the reference level measurement.
- 7. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
- 8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

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# **Conducted Spurious Emission:**

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
- 4. Allow trace to fully stabilize.
- 5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- 6. Repeat above procedures until all default test channel measured were complete.

## 9.5 Measurement Result

| Frequency<br>(MHz) | RF Power<br>Density (dBm) | Reference Level of Limit<br>= PSD - 20dB<br>(dBm) |
|--------------------|---------------------------|---|
| 2402               | 6.67                      | -13.33  |
| 2442               | 6.60                      | -13.40  |
| 2480               | 6.64                      | -13.36  |

## **Reference Level of Limit**

NOTE: cable loss as 1dB that offsets in the spectrum NOTE: Refer to next page for plots.

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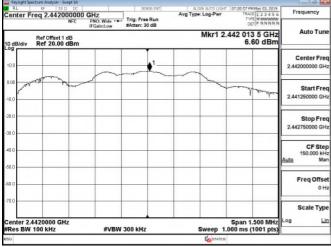
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## **Reference Level of Emission Limit (CH-Low)**

| Keysight Spectrum Analyzer - Swept       |                                |                   |  |                                 |
|--|--------------------------------|-------------------|--|---------------------------------|
| RL RF 302<br>Center Freq 2.402000        | E DND: Wide the Trig: Free Run | Avg Type: Log-Pwr | 07:05:18 PMNay 03, 2019<br>TRACE 1 2 3 4 5 6<br>TVPE N WWWWW | Frequency                       |
|  | IFGain1.ow #Atten: 30 dB       |                   | DET P NNNN N   | Auto Tun                        |
| Ref Offset 1 dB<br>0 dB/div Ref 20.00 dB |                                | Mkr1 2.4          | 02 010 5 GHz<br>6.67 dBm                                     | Auto Tun                        |
| 10.0                                     | 11                             |                   |  | Center Fre<br>2,402000000 GH    |
| 100                                      |                                |                   |  |                                 |
| 18.0                                     |                                |                   |  | Start Fre<br>2.401250000 GH     |
| -20.0                                    |                                |                   |  | Stop Fre                        |
| 30.0                                     |                                |                   |  | 2,402700000 00                  |
| 48.0                                     |                                |                   |  | CF Ste<br>150,000 ki<br>Auto Ma |
| 60.0                                     |                                |                   |  |                                 |
| 0.03                                     |                                |                   | -  | Freq Offs<br>0 H                |
| 70.0                                     |                                |                   |  | Scale Typ                       |
| Center 2.4020000 GHz                     |                                |                   | Span 1.500 MHz   | Log L                           |
| Res BW 100 kHz                           | #VBW 300 kHz                   | Sweep 1.0         | 00 ms (1001 pts)   |                                 |

### **Reference Level of Emission Limit (CH-Mid)**



## **Reference Level of Emission Limit (CH-High)**

| Keysight Spectr | RF 30 S DC                       |              | SENSEINT                        | A TEN AUTO LIGHT  | 07:13:09 PMINay 03, 2019                        |                                 |
|-----------------|----------------------------------|--------------|---------------------------------|-------------------|---|---------------------------------|
| Center Fre      | q 2.48000000                     | PNO: Wide =1 | Trig: Free Run<br>#Atten: 30 dB | Avg Type: Log-Pwr | THACE 1 2 3 4 5 6<br>TYPE MMMMMM<br>DET P NNNNN | Frequency                       |
|                 | Ref Offset 1 dB<br>Ref 20.00 dBm | IFGain:Low   | #Atten: 30 dB                   | Mkr1 2.4          | 80 012 0 GHz<br>6.64 dBm                        | Auto Tune                       |
| 10.0            |                                  | (            |                                 |                   |   | Center Fre<br>2,48000000 GH     |
| 10.00           |                                  |              |                                 |                   |   | Start Fre<br>2.479250000 GH     |
| 30.0            |                                  |              |                                 |                   |   | Stop Fre<br>2.480750000 GH      |
|                 |                                  |              |                                 |                   |   | CF Ste<br>150.000 kF<br>Auto Ma |
| 80              |                                  |              |                                 |                   |   | Freq Offs<br>0 H                |
| 70.0            | 00000 GHz                        |              |                                 |                   | Span 1.500 MHz                                  | Scale Typ                       |
| Res BW 10       |                                  | #VB          | N 300 kHz                       | Sweep 1.0         | 00 ms (1001 pts)                                |                                 |
| 195             |                                  |              |                                 | STATUS            |   |                                 |

## **Band Edges Test Data CH-Low**

|                                   | thim Analyzes - Si  |  |                                      |                        |                                      |                           |
|-----------------------------------|---------------------|--|--------------------------------------|------------------------|--------------------------------------|---------------------------|
| enter Fre                         |                     | 00000 GHz  | Trig: Free Run                       | Avg Type: Log-Pwr      | THACE 1 2 3 4 5 6<br>TVFE N          | Frequency                 |
|                                   | Ref Offset 1        | IFGaintow  | #Atten: 30 dB                        | M                      | Kr3 2.390 0 GHz                      | Auto Tun                  |
| 0 dB/div                          | Ref 20.00           |  |                                      |                        | -52.88 dBm                           |                           |
| 10.0                              |                     |  |                                      |                        | Q1                                   | Center Fre                |
| 00.0                              |                     |  |                                      |                        |                                      | 2,360000000 GH            |
| 00                                |                     |  |                                      |                        | 2                                    | Start Fre                 |
| 10                                | _                   |  |                                      |                        | 3                                    | 2,31000000 GH             |
| 0.0 <b></b> 0.0                   | Account             | and the second state of th | Am                                   |                        |                                      | Stop Fre<br>2.41000000 G8 |
|                                   | 6000 GHz<br>100 kHz | #VBW   | 300 kHz                              | Sweep 1                | Span 100.0 MHz<br>.000 ms (1001 pts) | CF Ste<br>10.000000 M     |
| OR MODE THE                       |                     | x  |                                      | UNCTION FUNCTION WIDTH | FUNCTION WALVE                       | Auto Mi                   |
| 1 N 1<br>2 N 1<br>3 N 1<br>4<br>5 | f (Δ)<br>f (Δ)      | 2.402 0 GHz (Δ)<br>2.395 9 GHz<br>2.390 0 GHz (Δ)  | 6.69 dBm<br>-33.30 dBm<br>-52.88 dBm |                        |                                      | Freq Offs                 |
| 6<br>7<br>8                       |                     |  |                                      |                        |                                      | Scale Typ                 |
| 9                                 |                     |  |                                      |                        |                                      | Log L                     |
|                                   |                     |  |                                      | de state               |                                      |                           |

## **Band Edges Test Data CH-High**



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# **Conducted Spurious Emission Measurement Re**sult

| Keydight Spectnam Analyzer - Swept   |   | SENSE INT                            | L a trib a   | ma una milana | :04 PMMay 01, 2019                              | - ii -   |
|--|---|--------------------------------------|--------------|---------------|---|--|
| Center Freq 13.01500   | E PNO: Fast   |                                      | Avg Type: Lo |               | TRACE 1 2 3 4 5 6<br>TVFE M WWWWW<br>DET P NNNN | Frequency  |
| Ref Offset 1 dB  |   | EADEN: 30 GB                         |              |               | 803 3 GHz<br>47.81 dBm                          | Auto Tun   |
| 10 dB/div Ref 20.00 dB   | -m  | 1                                    | 1            |               | 1.01 0.011                                      |  |
| 10.0   |   |                                      |              |               |   | Center Fre   |
| -10.0  |   |                                      |              |               | D.1-1553 abr                                    | 13,015000000 GH  |
| -30.0  |   |                                      |              |               |   | Start Fre<br>30.000000 Mil-  |
| -400   | A3  | under the second second second       |              |               |   | Stop Fre   |
|  |   |                                      |              |               |   |  |
| Center 13.02 GHz<br>#Res BW 100 kHz  | #VBV  | V 300 kHz                            |              | p 86,00 m     | n 25.97 GHz<br>s (30001 pts)                    | 26.00000000 GF<br>CF Ste<br>2.597000000 GF                         |
| -710<br>Center 13.02 GHz<br>#Res BW 100 kHz<br>1 N 1 f (Δ)<br>2 N 1 f<br>3 N 1 f (Δ)   | #VBV<br>2.4019 GHz [Δ]<br>4.804 0 GHz<br>7.205 0 GHz [Δ]<br>4.803 3 GHz | 6.52 dBm<br>-48.90 dBm               | Swee         | p 86,00 m     | an 25.97 GHz<br>s (30001 pts)<br>Wetton Wate    | 26.00000000 GH<br>CF Ste<br>2.59700000 GH                          |
| TOD         Center 13.02 GHz           #Res BW 100 kHz         100 kHz           100 L1202 bits for the fill         1           1         1         f           3         N         1           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f           0         1         f | 2,401 9 GHz (Δ)<br>4,804 0 GHz<br>7,206 0 GHz (Δ)                       | 6.52 dBm<br>-43.90 dBm<br>-58.50 dBm |              | p 86,00 m     | s (30001 pts)                                   | 26,00000000 GF<br>CF Ste<br>2,597000000 GF<br>Auto Ma              |
| -70 0 Center 13.02 GHz #Res BW 100 kHz Utilitizet File 1. N 1 f (Δ) 2. N 1 f 3. N 1 f 5 6  | 2,401 9 GHz (Δ)<br>4,804 0 GHz<br>7,206 0 GHz (Δ)                       | 6.52 dBm<br>-43.90 dBm<br>-58.50 dBm |              | p 86,00 m     | s (30001 pts)                                   | 26.00000000 GH<br>2.59700000 GH<br><u>Auto</u><br>Freq Offs<br>0 H |

### CH-Mid

|                                     |                         |              |               |  |          |  |     |  | Bytes-Sam             | nm A | t Spect    |      |                               |
|-------------------------------------|-------------------------|--------------|---------------|--|----------|--|-----|--|-----------------------|------|------------|------|-------------------------------|
| Frequency                           | E123456                 | THAT         | ELOG-PW       |  | NSE:IN   |  |     | 0000 GHz   |                       | q 1  | Fre        |      | Cer                           |
| Auto Tur                            | 4 7 GHz<br>98 dBm       | r4 4.884     | Mk            |  | 10 dB    | #Atten: 3                                      |     |  | offset 1 d<br>20,00 d |      |            | B/dh |                               |
| Center Fre<br>13,015000000 GH       |                         |              |               |  | -        |  |     |  |                       |      | _          |      | 10.0<br>0,00                  |
| Start Fre<br>30.000000 MH           | 0.1 -1540 dbr           |              |               |  |          |  |     |  |                       |      |            |      | -10.0<br>20.0<br>30.0<br>40.0 |
| Stop Fre<br>26.00000000 GH          | -                       | يو، دانچر مي |               | vin er | -        | Maria di Ja                                    |     | waa Alimaa   |                       |      | -          | -    | -511 D<br>-610 O<br>-711 O    |
| CF Ste<br>2,597000000 GH<br>Auto Ma | 25.97 GHz<br>10001 pts) | .00 ms (3    |               |  |          | 300 kHz  | VBW |  |                       | 00   | 13.<br>W 1 | s B  | Re                            |
| Freq Offs                           | SN WALLIE +             | FUNCTI       | ACTION MIDTH! | UNCTION                                    | Bm<br>Bm | 6.68 di<br>-48.48 di<br>-58.50 di<br>-47.98 di | (Δ) | 2,441 7 GHz<br>4,884 0 GHz<br>7,326 0 GHz<br>4,884 7 GHz | Δ)<br>Δ)              | 1    | 1          | NNNN | 1 2 3 4 5 6                   |
| Scale Typ                           | _                       |              |               |  |          |  |     |  |                       |      |            |      | 7 8 9                         |
|                                     |                         |              | Gestatus.     |  |          | π  |     |  |                       |      |            |      | 8<br>9<br>10<br>11            |

## **CH-High**

| Center Free                           | 13.015                    | 000000 GHz<br>NFE PNO: Feet<br>IFGainston                | Trig: Freel              | Run       | Type: Log-Pwr   | THACE 1 2 3 4 5 6<br>THACE 1 2 3 4 5 6<br>TYPE MMMMMM<br>DET P NNNNN | Frequency                           |
|---------------------------------------|---------------------------|--|--------------------------|-----------|---|--|-------------------------------------|
| 10 dB/div                             | tef Offset 1<br>tef 20.00 |  |                          |           | Mk  | r4 2.484 2 GHz<br>-46.12 dBm   | Auto Tun                            |
| 10.0                                  |                           |  |                          |           |   |  | Center Fre<br>13,015000000 GH       |
| -10.0                                 | 4                         |  |                          |           |   | 0:1-1531 dBr   | Start Fre<br>30.000000 Mit          |
| 410<br>4510<br>-60.0                  | -                         |  |                          |           | ان دو ویا <sup>ر</sup> در نور و و و و و و و و و و و و و و و و و |  | Stop Fre<br>26.00000000 GH          |
| Center 13.0<br>#Res BW 10             | 0 kHz                     | #\   | /BW 300 kHz              | P BICTORI | Sweep 86  | Span 25.97 GHz<br>.00 ms (30001 pts)                                 | CF Ste<br>2.597000000 GH<br>Auto Ma |
| 1 N 1<br>2 N 1<br>3 N 1<br>4 N 1<br>5 |                           | 2.479 8 GHz<br>4.960 0 GHz<br>7.440 0 GHz<br>2.484 2 GHz | (Δ) 6.67 dB<br>-50.64 dB | n<br>n    |   | FOR TOWNED F   | Freq Offse<br>0 H                   |
| 6<br>7<br>8<br>9                      |                           |  |                          |           |   |  | Scale Typ                           |
| 11                                    |                           |  | π.                       |           |   |  |                                     |

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# **10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT**

## 10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the RSS-Gen §8.10 Table 7.

And according to 15.33(a)(1) & RSS-Gen §6.13(a) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

According to RSS-Gen §8.9 Table 5 & 6 Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission

| Frequency<br>(MHz) | Field strength<br>(microvolts/meter) | Distance<br>(meters) |
|--------------------|--------------------------------------|----------------------|
| 0.009-0.490        | 2400/F(kHz)                          | 300                  |
| 0.490-1.705        | 24000/F(kHz)                         | 30                   |
| 1.705-30           | 30                                   | 30                   |
| 30-88              | 100                                  | 3                    |
| 88-216             | 150                                  | 3                    |
| 216-960            | 200                                  | 3                    |
| Above 960          | 500                                  | 3                    |

Note:

1. The lower limit shall apply at the transition frequencies.

2. Emission level ( $dB\mu V/m$ ) = 20 log Emission level ( $dB\mu V/m$ )

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#### 10.2 **Measurement Equipment Used**

|                                     |                | 966A Chamber       |                  |              |            |
|-------------------------------------|----------------|--------------------|------------------|--------------|------------|
| EQUIPMENT<br>TYPE                   | MFR            | MODEL<br>NUMBER    | SERIAL<br>NUMBER | LAST<br>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<br>104PEA | 25157            | 02/26/2019   | 02/25/2020 |
| Cable                               | HUBER SUHNER   | SUCOFLEX<br>104PEA | 20995            | 02/26/2019   | 02/25/2020 |
| Digital Thermo-Hygro<br>Meter       | WISEWIND       | 1206               | D07              | 01/30/2019   | 01/29/2020 |
| double Ridged Guide<br>Horn Antenna | ETC            | MCTD 1209          | DRH13M0200<br>3  | 08/20/2018   | 08/19/2019 |
| Loop Antenna                        | COM-POWER      | AL-130             | 121051           | 03/22/2019   | 03/21/2020 |
| 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<br>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      |
| DC Power Supply                     | Agilent        | E3640A             | KR93300208       | 08/15/2018   | 08/14/2019 |
| Turn Table                          | CCS            | CC-T-1F            | N/A              | N.C.R        | N.C.R      |
| Software                            |                | e3 V6.1            | 1-20180413       |              |            |

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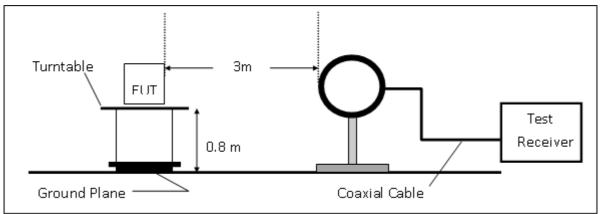
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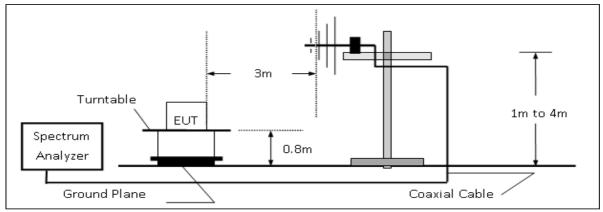
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# 10.3 Test SET-UP

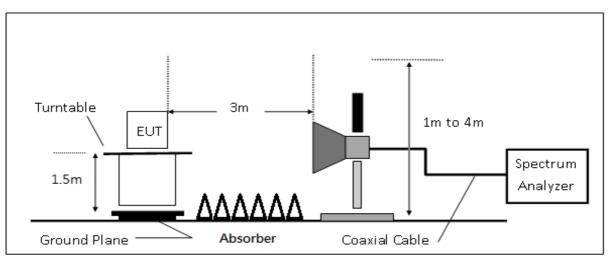
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



# (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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## **10.4 Measurement Procedure**

- 1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plan.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.</li>
- 8. When 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.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 11. Repeat above procedures until all default test channel measured were complete.

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# 10.5 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(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

 $Factor(dB) = Antenna Factor(dB\mu V/m) + Cable Loss(dB) - Pre_Amplifier Gain(dB)$ 

# 10.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

## 10.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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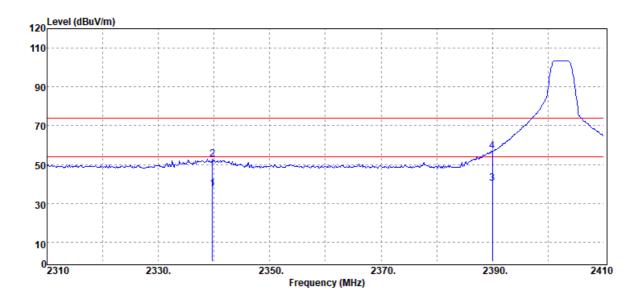


## **Radiated Band Edge Measurement Result**

| Project Number        |
|-----------------------|
| Operation Band        |
| Fundamental Frequency |
| Operation Mode        |
| EUT Pol.              |

:T190429W02 :BLE 1M :2402 MHz :BE CH Low :E2 Plan

| Test Date                | :2019-05-03 |
|--------------------------|-------------|
| Temp./Humi.              | :20/51      |
| Engineer                 | :Jerry      |
| Measurement Antenna Pol. | :VERTICAL   |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 2339.70 | Average          | 40.73                     | -3.29  | 37.44        | 54.00        | -16.56 |
| 2339.70 | Peak             | 56.01                     | -3.29  | 52.72        | 74.00        | -21.28 |
| 2390.00 | Average          | 43.74                     | -3.38  | 40.36        | 54.00        | -13.64 |
| 2390.00 | Peak             | 60.24                     | -3.38  | 56.86        | 74.00        | -17.14 |

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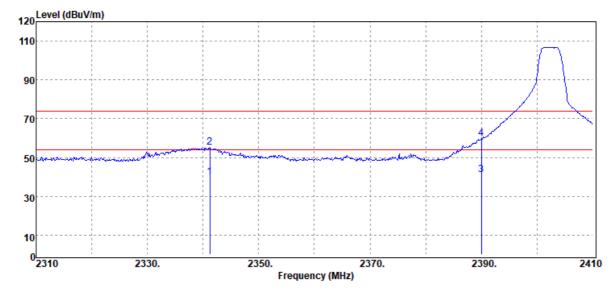
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2402 MHz<br>:BE CH Low<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-03<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|---|--|--|
|   |   |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 2341.20 | Average          | 43.31                     | -3.29  | 40.02        | 54.00        | -13.98 |
| 2341.20 | Peak             | 58.40                     | -3.29  | 55.11        | 74.00        | -18.89 |
| 2390.00 | Average          | 44.34                     | -3.38  | 40.96        | 54.00        | -13.04 |
| 2390.00 | Peak             | 63.01                     | -3.38  | 59.63        | 74.00        | -14.37 |

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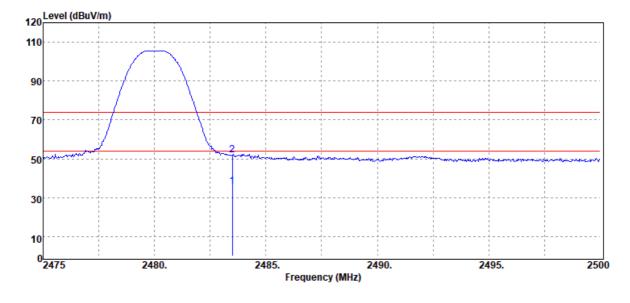
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2480 MHz<br>:BE CH High<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-09<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|--|--|--|
|   |  |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 2483.50 | Average          | 38.53                     | -2.83  | 35.70        | 54.00        | -18.30 |
| 2483.50 | Peak             | 54.54                     | -2.83  | 51.71        | 74.00        | -22.29 |

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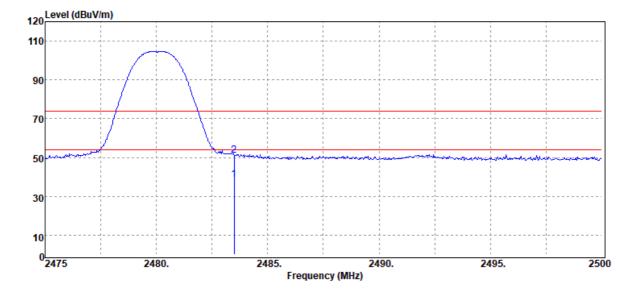
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| Project Number             | :T190429W02             | Test Date                | :2019-05-09 |
|----------------------------|-------------------------|--------------------------|-------------|
| Operation Band             | :BLE 1M                 | Temp./Humi.              | :20/51      |
| Fundamental Frequency      | :2480 MHz               | Engineer                 | :Jerry      |
| Operation Mode<br>EUT Pol. | :BE CH High<br>:E2 Plan | Measurement Antenna Pol. | :VERTICAL   |



| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
|         | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBµV          | dB     | dBµV/m | dBµV/m | dB     |
| 2483.50 | Average  | 41.46         | -2.83  | 38.63  | 54.00  | -15.37 |
| 2483.50 | Peak     | 53.76         | -2.83  | 50.93  | 74.00  | -23.07 |

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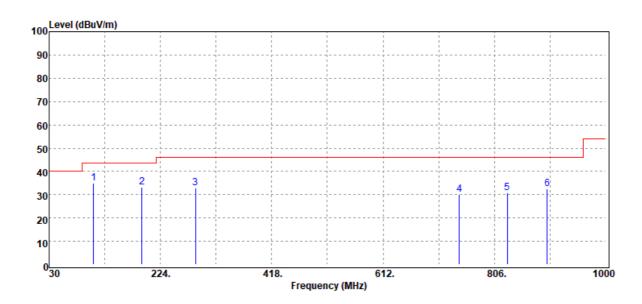
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# **Radiated Spurious Emission Measurement Result**

For Frequency form 30MHz to 1000MHz

| Project Number        | :T190429W02 | Test Date                | :2019-05-03 |
|-----------------------|-------------|--------------------------|-------------|
| Operation Band        | :BLE 1M     | Temp./Humi.              | :20/51      |
| Fundamental Frequency | :2442 MHz   | Engineer                 | :Jerry      |
| Operation Mode        | :Tx CH Mid  | Measurement Antenna Pol. | :VERTICAL   |
| EUT Pol.              | :E2 Plan    |                          |             |
|                       |             |                          |             |



| Freq.  | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|--------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz    | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 107.60 | Peak             | 45.60                     | -10.67 | 34.93        | 43.50        | -8.57  |
| 191.99 | Peak             | 43.92                     | -10.55 | 33.37        | 43.50        | -10.13 |
| 285.11 | Peak             | 41.48                     | -8.46  | 33.02        | 46.00        | -12.98 |
| 744.89 | Peak             | 28.05                     | 1.93   | 29.98        | 46.00        | -16.02 |
| 828.31 | Peak             | 27.38                     | 3.26   | 30.64        | 46.00        | -15.36 |
| 898.15 | Peak             | 28.50                     | 4.15   | 32.65        | 46.00        | -13.35 |

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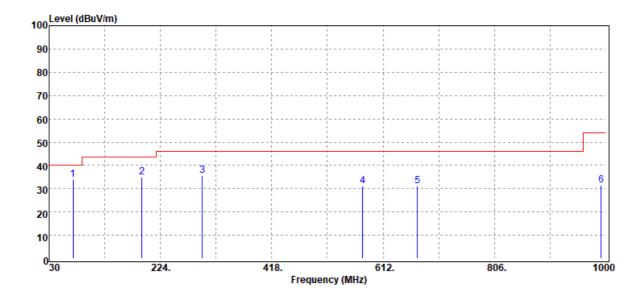
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2442 MHz<br>:Tx CH Mid<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-03<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|---|--|--|
|   |   |  |  |



| Freq.  | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|--------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz    | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 71.71  | Peak             | 48.58                     | -14.74 | 33.84        | 40.00        | -6.16  |
| 191.99 | Peak             | 45.55                     | -10.55 | 35.00        | 43.50        | -8.50  |
| 296.75 | Peak             | 43.85                     | -8.29  | 35.56        | 46.00        | -10.44 |
| 576.11 | Peak             | 32.98                     | -1.82  | 31.16        | 46.00        | -14.84 |
| 672.14 | Peak             | 30.95                     | 0.02   | 30.97        | 46.00        | -15.03 |
| 992.24 | Peak             | 26.43                     | 5.17   | 31.60        | 54.00        | -22.40 |

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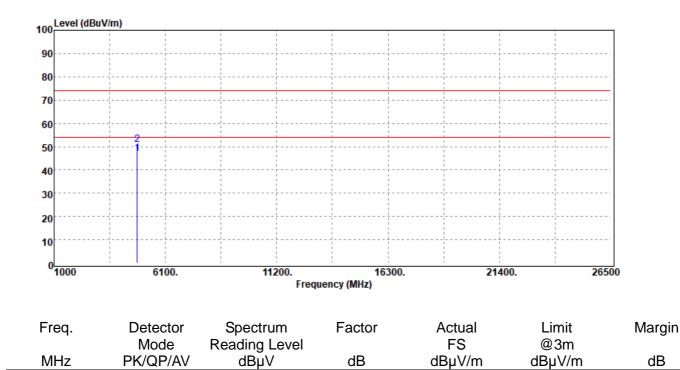
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# **Radiated Spurious Emission Measurement Result** For Frequency above 1GHz

| Project Number        | :T190429W02 | Test Date                | :2019-05-21 |
|-----------------------|-------------|--------------------------|-------------|
| Operation Band        | :BLE 1M     | Temp./Humi.              | :20/51      |
| Fundamental Frequency | :2402 MHz   | Engineer                 | :Jerry      |
| Operation Mode        | :Tx CH Low  | Measurement Antenna Pol. | :VERTICAL   |
| EUT Pol.              | :E2 Plan    |                          |             |
|                       |             |                          |             |



3.05

3.05

47.02

50.94

54.00

74.00

-6.98

-23.06

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43.97

47.89

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4804.00

4804.00

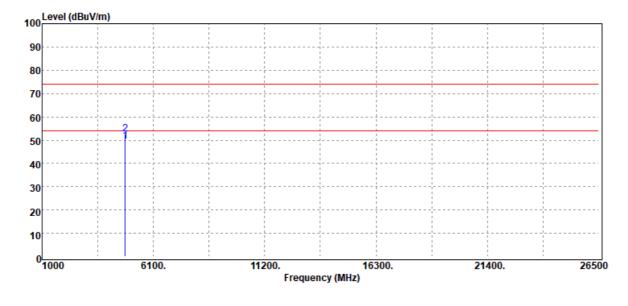
Average

Peak

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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2402 MHz<br>:Tx CH Low<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-21<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|---|--|--|
|   |   |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |  |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|--|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |  |
| 4804.00 | Average          | 46.47                     | 3.05   | 49.52        | 54.00        | -4.48  |  |
| 4804.00 | Peak             | 49.60                     | 3.05   | 52.65        | 74.00        | -21.35 |  |

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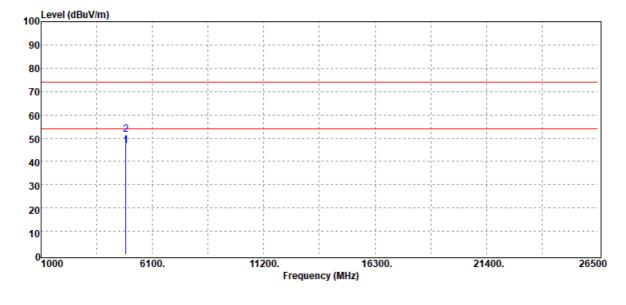
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| Project Number        | :T190429W02 | Test Date                | :2019-05-21 |
|-----------------------|-------------|--------------------------|-------------|
| Operation Band        | :BLE 1M     | Temp./Humi.              | :20/51      |
| Fundamental Frequency | :2442 MHz   | Engineer                 | :Jerry      |
| Operation Mode        | :Tx CH Mid  | Measurement Antenna Pol. | :VERTICAL   |
| EUT Pol.              | :E2 Plan    |                          |             |
|                       |             |                          |             |
|                       |             |                          |             |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 4884.00 | Average          | 43.24                     | 3.41   | 46.65        | 54.00        | -7.35  |
| 4884.00 | Peak             | 48.19                     | 3.41   | 51.60        | 74.00        | -22.40 |

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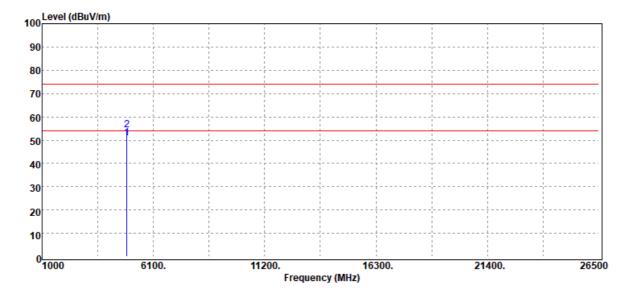
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2442 MHz<br>:Tx CH Mid<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-21<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|---|--|--|
|   |   |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 4884.00 | Average          | 47.51                     | 3.41   | 50.92        | 54.00        | -3.08  |
| 4884.00 | Peak             | 51.05                     | 3.41   | 54.46        | 74.00        | -19.54 |

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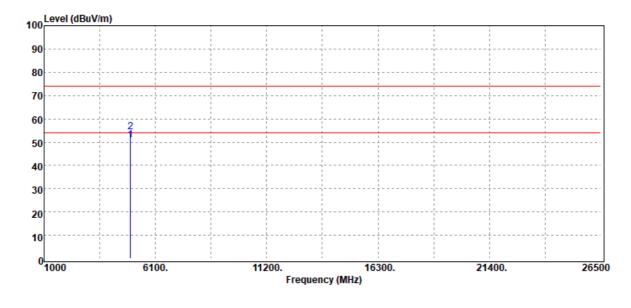
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2480 MHz<br>:Tx CH High<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-21<br>:20/51<br>:Jerry<br>:VERTICAL |
|---|--|--|--|
|   |  |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 4960.00 | Average          | 46.78                     | 4.06   | 50.84        | 54.00        | -3.16  |
| 4960.00 | Peak             | 50.12                     | 4.06   | 54.18        | 74.00        | -19.82 |

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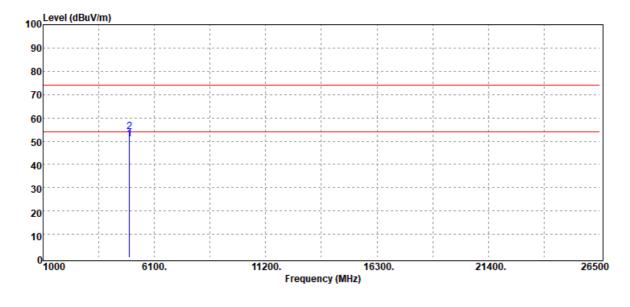
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| Project Number<br>Operation Band<br>Fundamental Frequency<br>Operation Mode<br>EUT Pol. | :T190429W02<br>:BLE 1M<br>:2480 MHz<br>:Tx CH High<br>:E2 Plan | Test Date<br>Temp./Humi.<br>Engineer<br>Measurement Antenna Pol. | :2019-05-21<br>:20/51<br>:Jerry<br>:HORIZONTAL |
|---|--|--|--|
|   |  |  |  |



| Freq.   | Detector<br>Mode | Spectrum<br>Reading Level | Factor | Actual<br>FS | Limit<br>@3m | Margin |
|---------|------------------|---------------------------|--------|--------------|--------------|--------|
| MHz     | PK/QP/AV         | dBµV                      | dB     | dBµV/m       | dBµV/m       | dB     |
| 4960.00 | Average          | 46.81                     | 4.06   | 50.87        | 54.00        | -3.13  |
| 4960.00 | Peak             | 49.95                     | 4.06   | 54.01        | 74.00        | -19.99 |

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# **11 POWER SPECTRAL DENSITY**

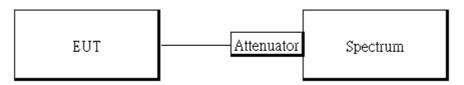
# **11.1 Standard Applicable:**

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

# 11.2 Measurement Equipment Used:

| Conducted Emission Test Site |                                 |        |            |            |            |  |  |  |
|------------------------------|---------------------------------|--------|------------|------------|------------|--|--|--|
| EQUIPMENT                    | EQUIPMENT MFR MODEL SERIAL LAST |        |            |            |            |  |  |  |
| TYPE                         |                                 | NUMBER | NUMBER     | CAL.       |            |  |  |  |
| Spectrum Analyzer            | Agilent                         | N9010A | MY53400256 | 11/21/2018 | 11/20/2019 |  |  |  |
| DC Power Supply              | Agilent                         | E3640A | MY53130054 | 09/03/2018 | 09/02/2019 |  |  |  |
| DC Block                     | PASTERNACK                      | PE8210 | RF256      | 02/26/2019 | 02/25/2020 |  |  |  |

# 11.3 Test Set-up:



# 11.4 Measurement Procedure:

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 3 kHz. & the VBW = 10 kHz
- 5. For defining Restricted Band Edge Limit: Set the RBW = 100kHz & VBW = 300 kHz.
- 6. Detector = peak.
- 7. Sweep time = auto couple.
- 8. Trace mode = max hold.
- 9. Allow trace to fully stabilize.
- 10. Use the peak marker function to determine the maximum amplitude level.

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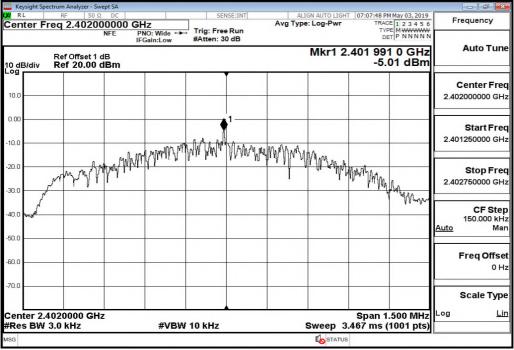
#### 11.5 Measurement Result:

## **BLE mode**

| Frequency<br>(MHz) | RF Power<br>Density (dBm) | Maximum Limit<br>(dBm) | Result |  |
|--------------------|---------------------------|------------------------|--------|--|
| 2402               | -5.01                     | 8                      | PASS   |  |
| 2442               | -5.70                     | 8                      | PASS   |  |
| 2480               | -5.50                     | 8                      | PASS   |  |

NOTE: cable loss as 1dB that offsets in the spectrum

# **BLE mode** Power Spectral Density Test Plot (CH-Low)



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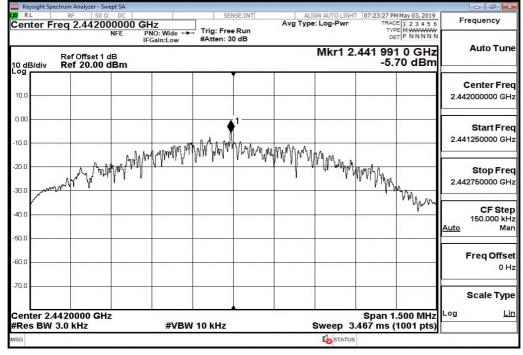
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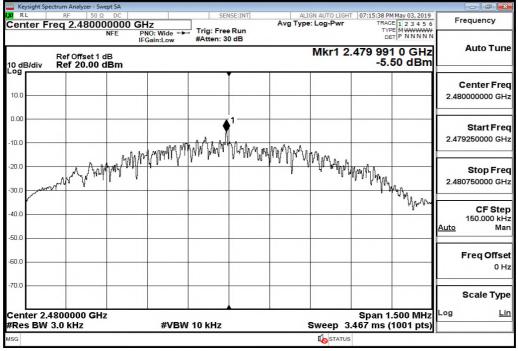
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# Power Spectral Density Test Plot (CH-Mid)



# **Power Spectral Density Test Plot (CH-High)**



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# **12 ANTENNA REQUIREMENT**

# 12.1 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.

# 12.2 Antenna Connected Construction:

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

~ End of Report ~

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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