TIMCO ENGINEERING, Inc.

**849 NW State Road 45**
**Newberry, FL 32669 USA**
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**Email: info@timcoengr.com**
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# FCC PART 15.247 & IC RSS-247

# 2.4 GHz DTS TEST REPORT

| | |
|---|---|
| **Applicant** | ONE WORLD TECHNOLOGIES, INC |
| **Address** | 1428 PEARMAN DAIRY ROAD |
| | ANDERSON SOUTH CAROLINA 29625 USA |
| **FCC ID** | VMZES3001 |
| **IC Certification Number** | 9880A-ES3001 |
| **Model Number** | ES3001 |
| **Product Description** | MOISTURE SENSOR WITH BT |
| **Date Sample Received** | 06/13/2018 |
| **Final Test Date** | 06/14/2018 |
| **Tested By** | Tim Royer |
| **Approved By** | Franklin Rose |

| Report Number | Version Number | Description | Issue Date |
|---|---|---|---|
| 851AUT18TestReport | Rev1 | Initial Issue | 06/15/2018 |

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## GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

### Summary

The device under test does:

☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.

☐ Not fulfill the general approval requirements as identified in this test report

### Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

**Timco Engineering Inc.**
**849 NW State Road 45**
**Newberry, FL 32669**

**Tested by:** Sr. EMC Engineer EMC-003838-NE

Name and Title: Tim Royer, Project Manager/Testing Engineer

**Date: 06/15/2018**

**Reviewed and approved by:**

Name and Title: Franklin Rose, Project Manager/EMC Testing Technician

**Date: 06/15/2018**

## GENERAL INFORMATION

### EUT Specification

| | | | |
|---|---|---|---|
| **Regulatory Standards** | FCC Title 47 CFR Part 15.247<br>IC RSS-247 Issue 1<br>IC RSS-GEN Issue 4 | | |
| **FCC ID** | VMZES3001 | | |
| **IC Certification Number** | 9880A-ES3001 | | |
| **Model** | ES3001 | | |
| **EUT Description** | MOISTURE SENSOR WITH BT | | |
| **Modulation Type** | Bluetooth LE (GFSK 1 Mbps) | | |
| **Operating Frequency** | TX: 2400 – 2483.5 MHz | | |
| **EUT Power Source** | ☐ 110–120Vac/50– 60Hz | | |
| | ☐ DC Power | | |
| | ☒ Battery Operated Exclusively | | |
| **Test Item** | ☐ Prototype | ☒ Pre-Production | ☐ Production |
| **Type of Equipment** | ☐ Fixed | ☐ Mobile | ☒ Portable |
| **Antenna Connector** | N/A | | |
| **Antenna** | Integral | | |
| **Test Facility** | Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070 | | |
| **Test Conditions** | Temperature: 24-26ºC<br>Relative humidity: 50-65% | | |
| **Measurement Standard** | ANSI C63.10-2013 (Measurement Procedures)<br>ANSI C63.4-2009 (Radiated Site Validation) | | |
| **Test Exercise** | The EUT was stopped 3 places and tested as a normal operational sample. | | |

### Test Supporting Equipment

| Device | Manufacturer | Model | S/N | Supplied By | Used For |
|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A |

## RESULTS SUMMARY

| FCC Rule Part No. | IC Standard Ref. | Requirement | Test Item | Result |
|---|---|---|---|---|
| 15.215 (c) | RSS-GEN 6.6 | Occupied Bandwidth | 99% Bandwidth | **Pass** |
| | | | 20 dB Bandwidth | **Pass** |
| 15.247(a)(e) | RSS-247 § 5.2 | Digital Transmission Systems | 6 dB Bandwidth | **Pass** |
| | | | Power Spectral Density | **Pass** |
| 15.247(b) | RSS-247 § 5.4 | Transmitter Output Power and Equivalent Isotropically Radiated Power | Peak Power Output (ERP) | **Pass** |
| | | | Antenna Gain (EIRP) | **Pass** |
| 15.247(d) | RSS-247 § 5.5 | Unwanted Emissions | Bandedge | **Pass** |
| | | | Radiated Spurious | **Pass** |

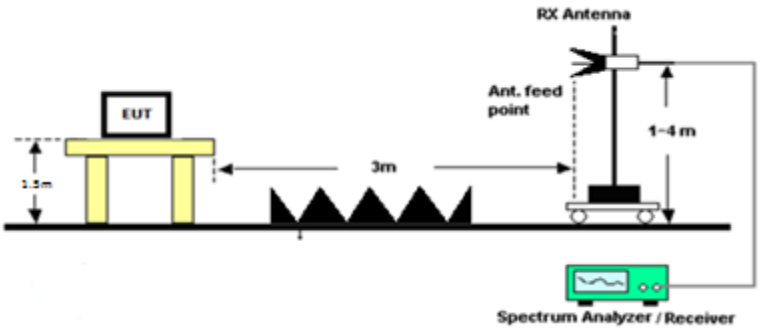
## DTS BANDWIDTH

**Rules Part No.:** FCC 15.247 (a)(2) , IC RSS 247 § 5.2.1

**Requirements:** The minimum 6 dB bandwidth shall be 500 kHz.

**Test Method**: ANSI C63.10 § 11.8.1 DTS Bandwidth Option 1
ANSI C63.10 § 6.3 Radiated Emissions testing- Common

**Setup:**



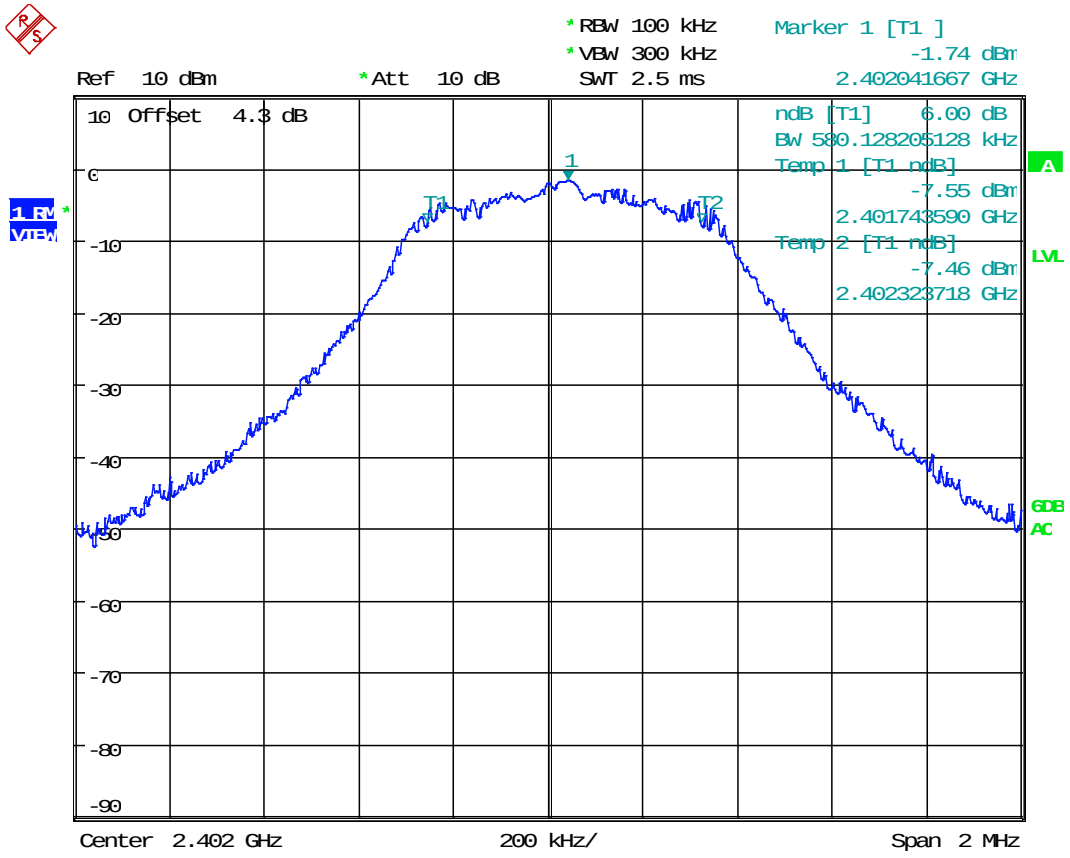

**Test Data: 6 dB Occupied Bandwidth Measurement Table**

| Tuned Frequency (MHz) | 6 dB BW (KHz) | Limit (KHz) | Margin (KHz) |
|---|---|---|---|
| 2402 | 580.13 | ≥ 500 | 80.13 |
| 2440 | 648.21 | ≥ 500 | 148.21 |
| 2480 | 552.95 | ≥ 500 | 52.95 |

**RESULTS: Meets Requirements**

## DTS BANDWIDTH

**Test Data:** **6dB Bandwidth Plot Low End of Band**

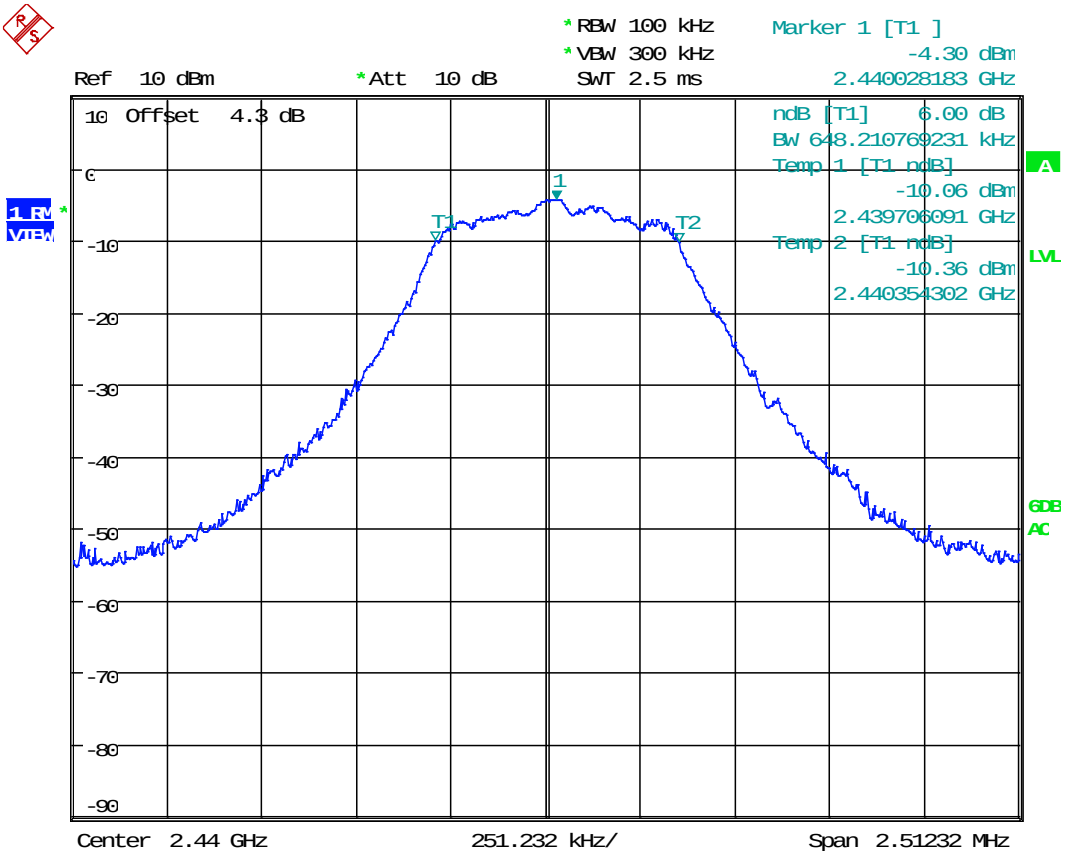



Date: 13.JUN.2018 14:58:47

**RESULTS: Meets Requirements**

## DTS BANDWIDTH

**Test Data:** **6dB Bandwidth Plot Middle of Band**

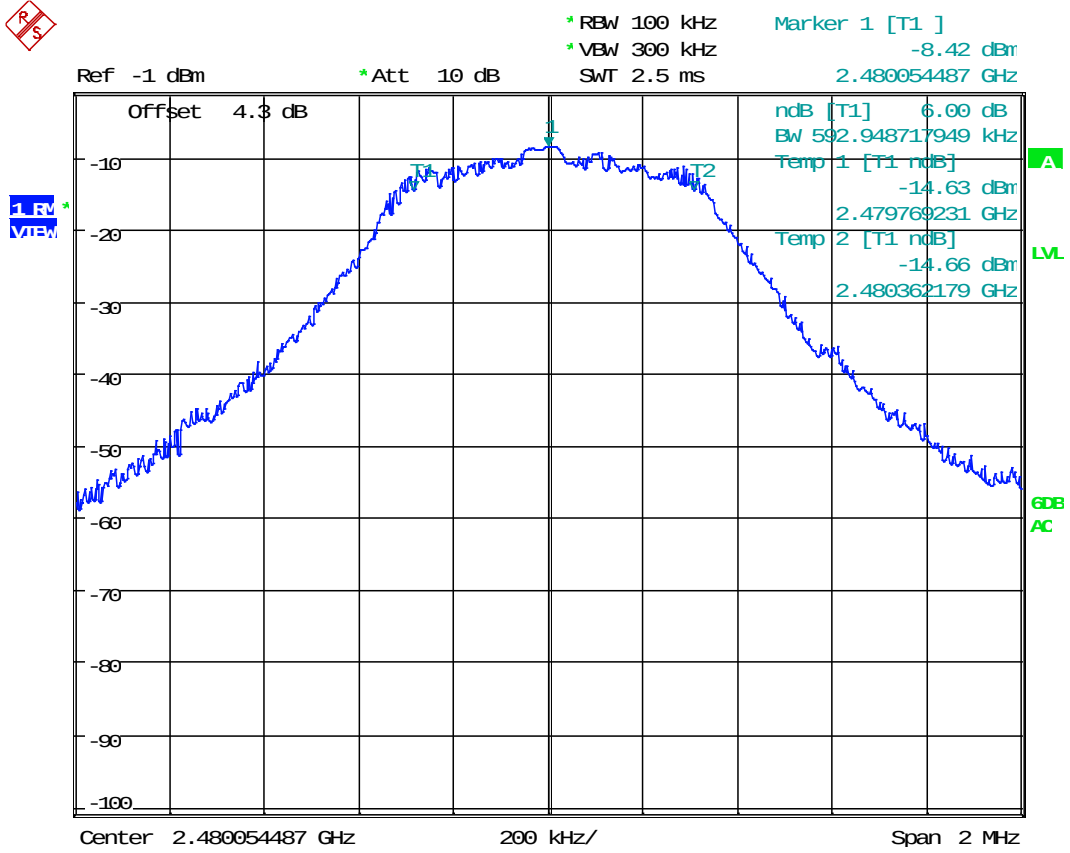



Date: 13.JUN.2018 15:10:22

**RESULTS: Meets Requirements**

## DTS BANDWIDTH

**Test Data:** **6dB Bandwidth Plot High end of Band**




Date: 13.JUN.2018 14:56:02

**RESULTS: Meets Requirements**

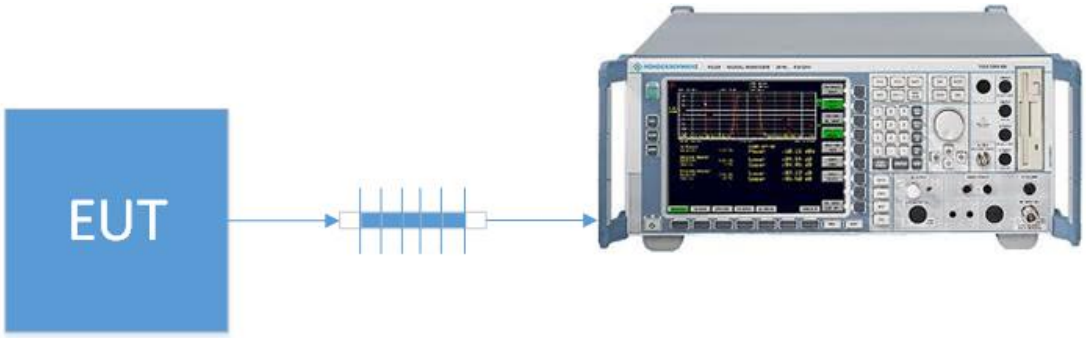
## PEAK POWER OUTPUT

**Rules Part No.:** FCC 15.247(b) (3) (4), IC RSS 247 § 5.4.4

**Requirements:** Maximum Conducted Peak Power Output shall not exceed 1 Watt
Also the Peak Power Output shall not exceed 4 Watts EIRP

**Test Method**: ANSI C63.10 § 11.2 Power Limits, definitions, and device configuration
ANSI C63.10 § 11.9.1.1 Fundamental Output Power RBW ≥ DTS Bandwidth
ANSI C63.10 § Annex G Relationship among Field Strength and ERP/EIRP

**Setup:**



## PEAK POWER OUTPUT

**Test Data:** **Peak Conducted Power Output Measurement Table**

| Peak Conducted Power Output Measurement | | | | |
|---|---|---|---|---|
| Tuned Frequency (MHz) | $P_{Conducted}$ (dBm) | $P_{Conducted}$ (W) | Limit (W) | Margin (W) |
| 2402 | -5.79 | 0.00026 | 1.00 | 0.99974 |
| 2442 | -3.91 | 0.00041 | 1.00 | 0.99959 |
| 2480 | -4.17 | 0.00038 | 1.00 | 0.99962 |

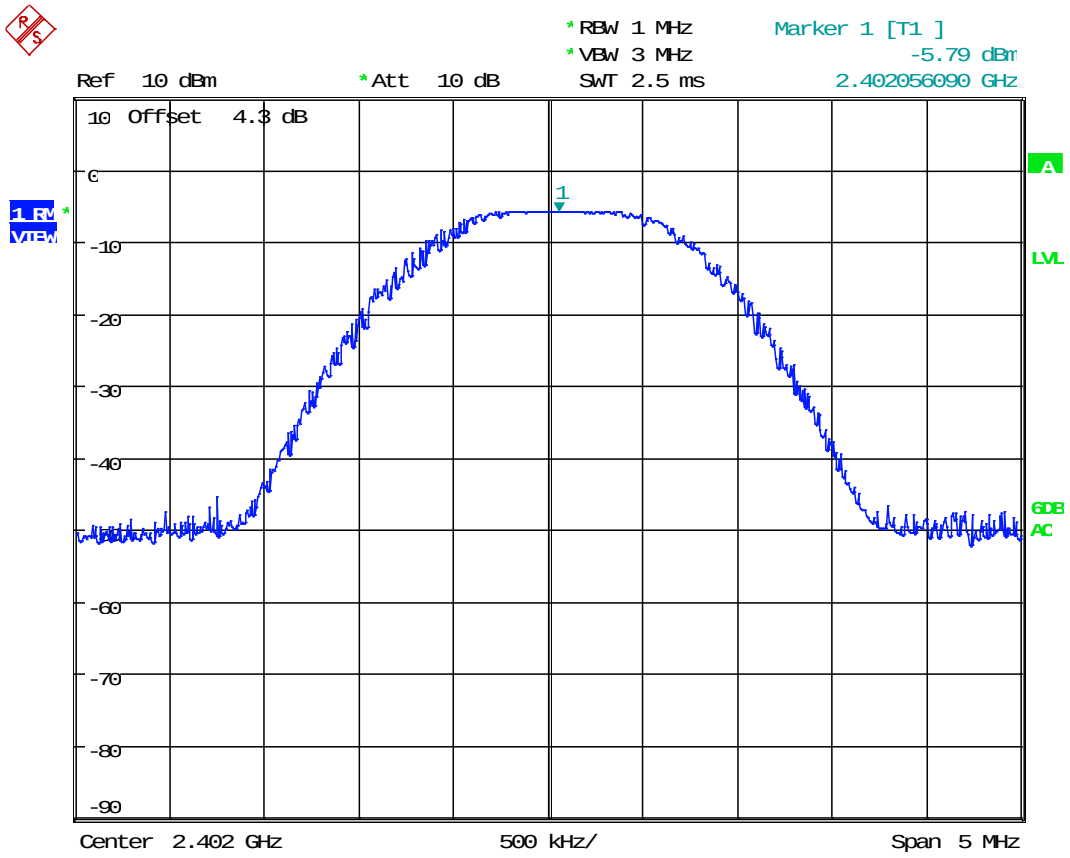
**ERP to EIRP Conversion formula: EIRP = ERP + 2.15 dB**

| Peak EIRP Power Output Calculation | | | | |
|---|---|---|---|---|
| Tuned Frequency (MHz) | $P_{Conducted}$ (dBm) | EIRP (W) | Limit (W) | Margin (W) |
| 2402 | -5.79 | 0.00043 | 4.00 | 3.99957 |
| 2442 | -3.91 | 0.00067 | 4.00 | 3.99933 |
| 2480 | -4.17 | 0.00063 | 4.00 | 3.99937 |

**RESULTS: Meets Requirements**

## PEAK POWER OUTPUT

**Test Data:** **Peak Power Output Plot Low End of Band**

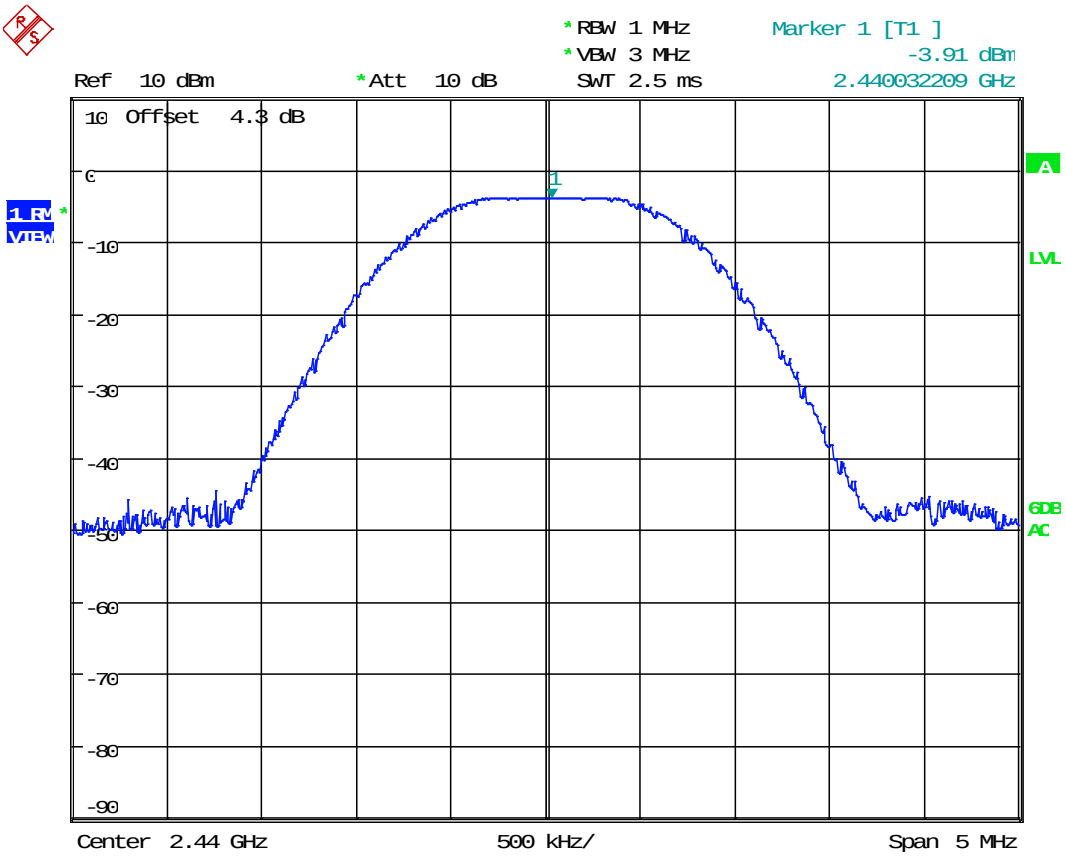



Date: 13.JUN.2018 15:26:14

**RESULTS: Meets Requirements**

## PEAK POWER OUTPUT

**Test Data:** **Peak Power Output Plot Middle of Band**

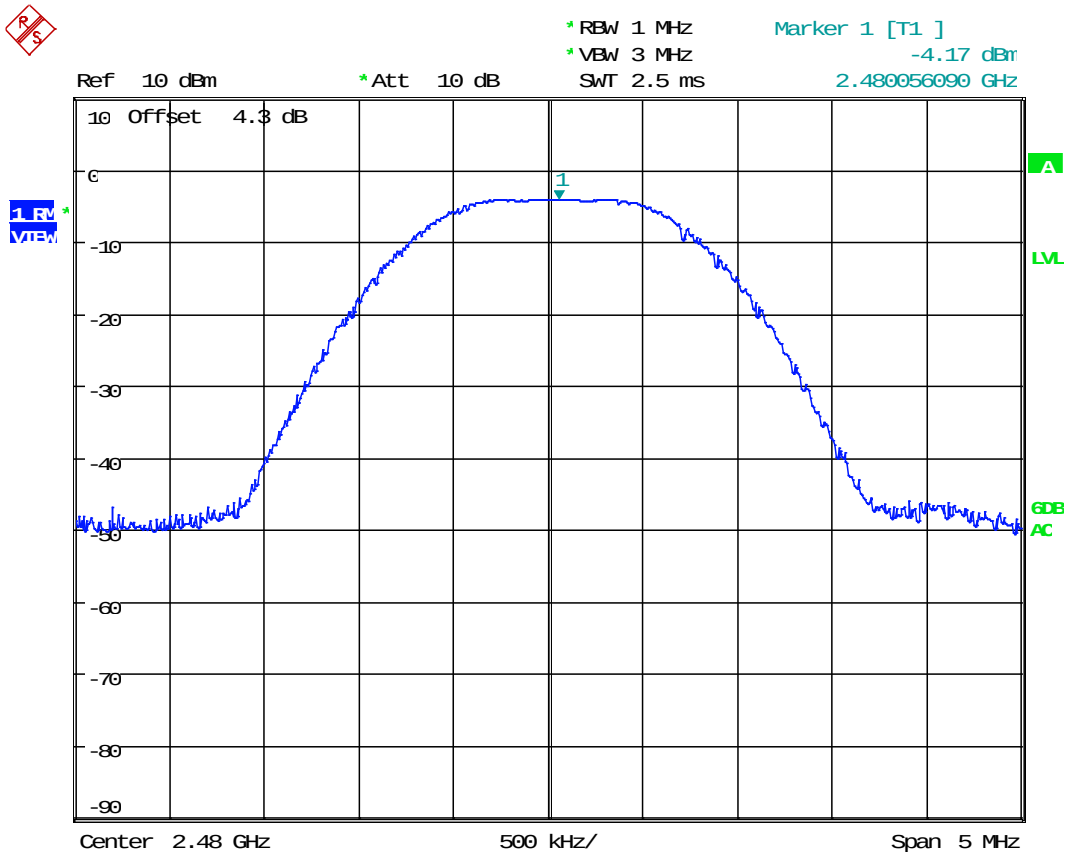



Date: 13.JUN.2018 15:24:41

**RESULTS: Meets Requirements**

## PEAK POWER OUTPUT

**Test Data:** **Peak Power Output High End of Band**




Date: 13.JUN.2018 15:28:06

**RESULTS: Meets Requirements**

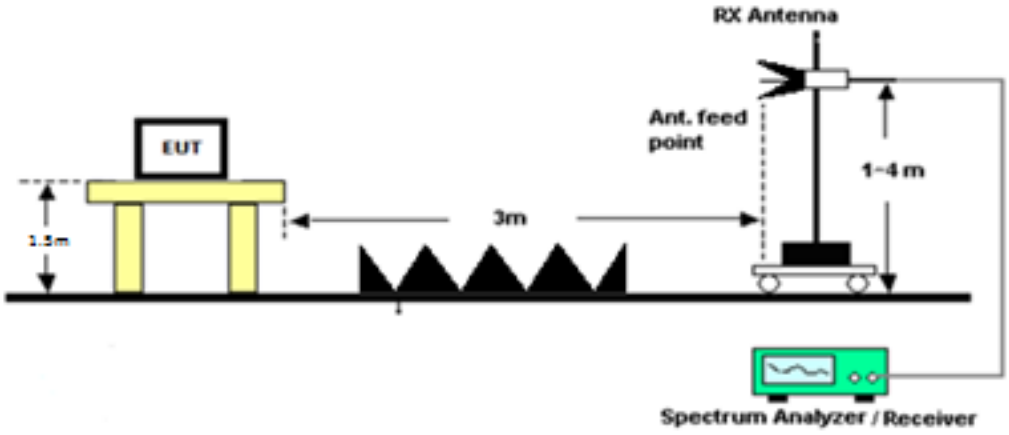
## POWER SPECTRAL DENSITY

**Rules Part No.:** FCC 15.247(e), IC RSS 247 § 5.2.2

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

**Test Method**: ANSI C63.10 § 11.2 Power Limits, definitions, and device configuration
ANSI C63.10 § 11.10.2 Maximum PSD in the fundamental- Method PKPSD
ANSI C63.10 § 6.3 Radiated Emissions testing- Common
ANSI C63.10 § Annex G Relationship among Field Strength and ERP/EIRP

**Setup:**



## POWER SPECTRAL DENSITY

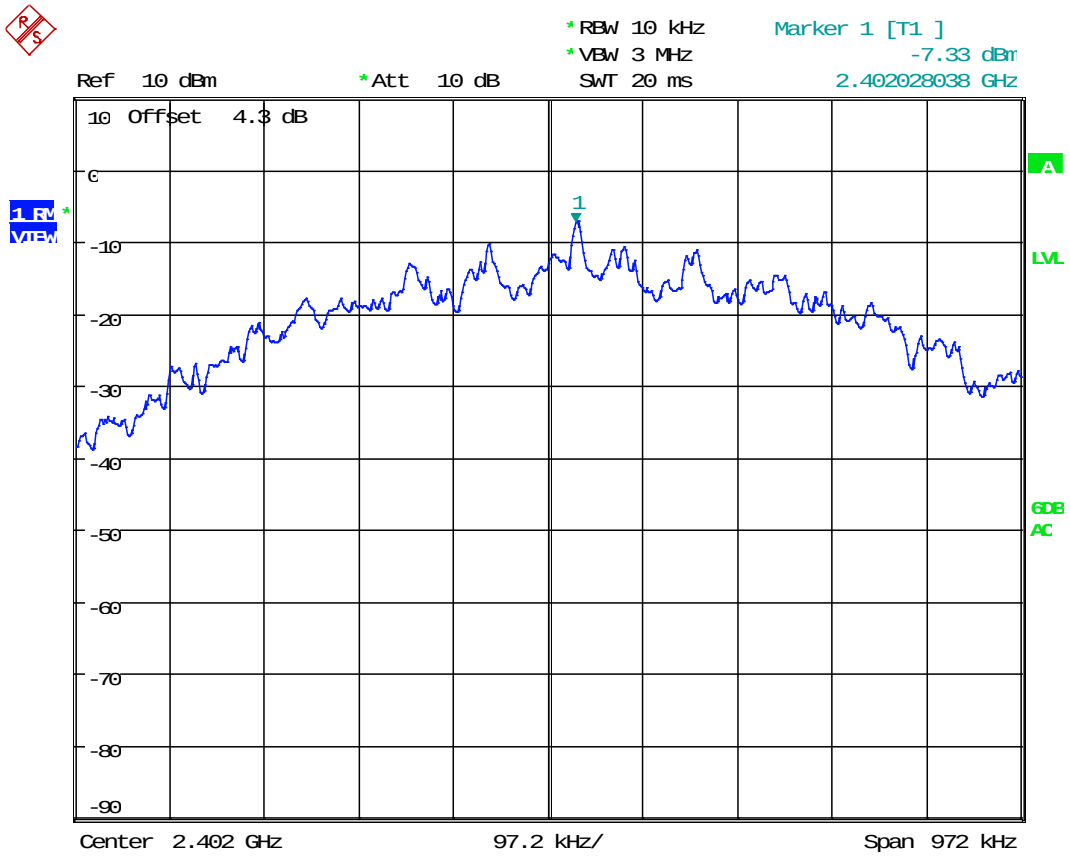
**Test Data:** **Power Spectral Density Measurement Table**

| Peak Power Spectral Density | | | | |
|---|---|---|---|---|
| Tuned Frequency (MHz) | 3M Field Strength (dBuV/m) | Calcualted PSD (dBm/100KHz) | Limit (dBm/3KHz) | Margin (dB) |
| 2402 | 133.86 | 4.44915 | 8.00000 | 3.55085 |
| 2440 | 135.31 | 6.21266 | 8.00000 | 1.78734 |
| 2480 | 134.31 | 4.93489 | 8.00000 | 3.06511 |

**RESULTS: Meets Requirements**

## POWER SPECTRAL DENSITY

**Test Data:** **Power Spectral Density Plot Low End of Band**

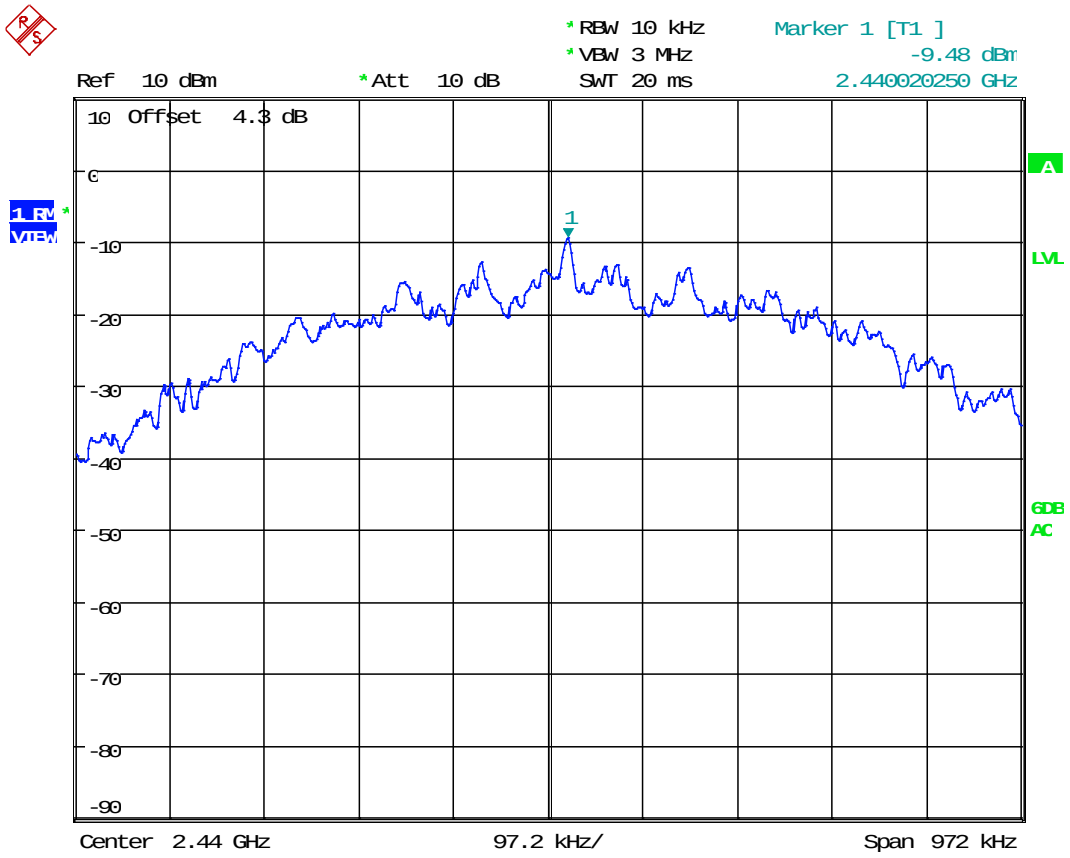



**-7.33dBm = 133.86dBuV/m**

**RESULTS: Meets Requirements**

## POWER SPECTRAL DENSITY

**Test Data:** **Power Spectral Density Plot Middle of Band**



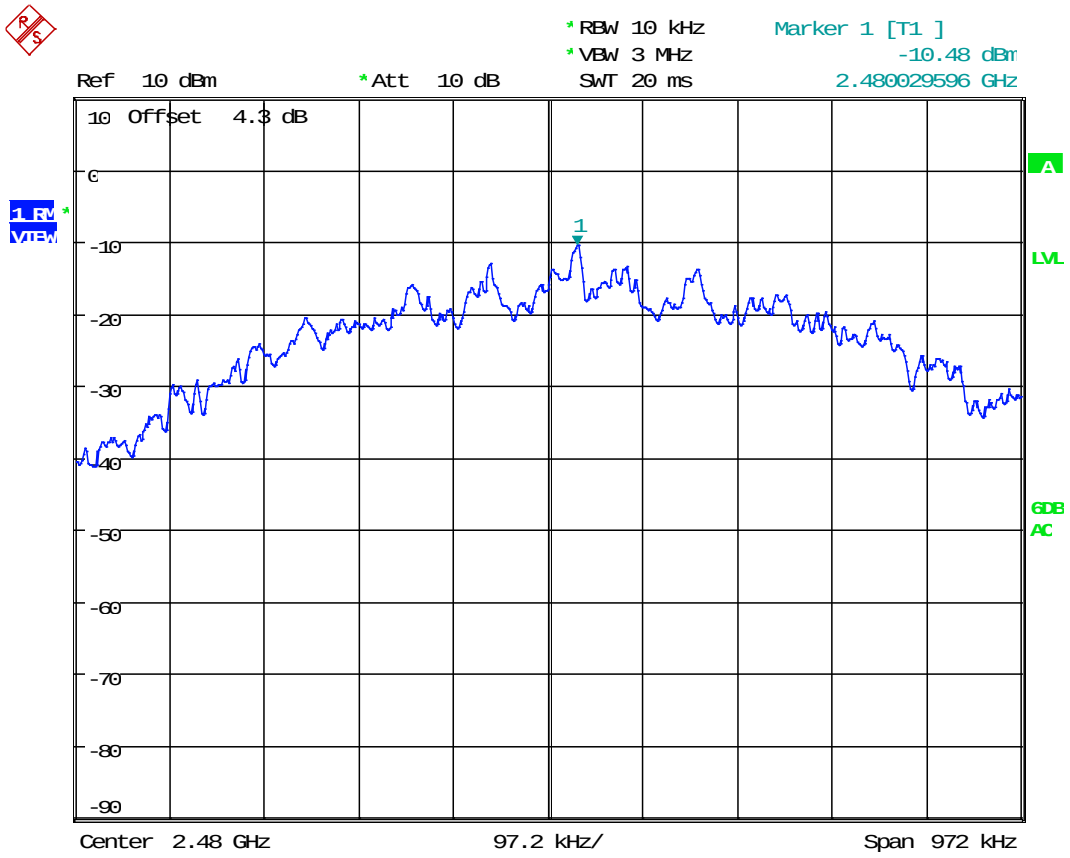

Date: 13.JUN.2018 15:41:08

**-93.48dBm = 135.31dBuV/m**

**RESULTS: Meets Requirements**

## POWER SPECTRAL DENSITY

**Test Data:** **Power Spectral Density Plot High End of Band**




Date: 13.JUN.2018 15:37:19

**-10.48 dBm = 134.31 dBuV/m**

**RESULTS: Meets Requirements**

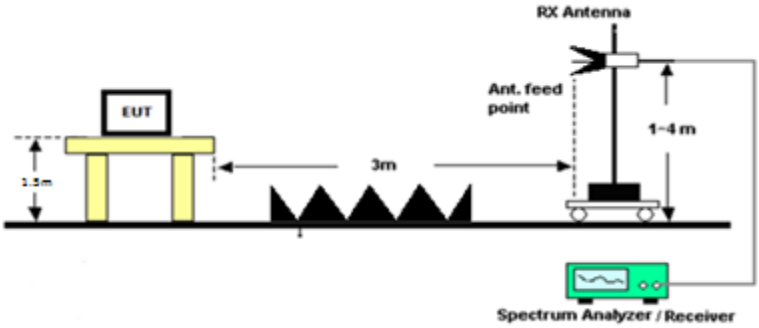
## OCCUPIED BANDWIDTH

**Rules Part No.:** FCC 15.215 (c), IC RSS GEN § 6.6

**Requirements:** The 20 dB Bandwidth shall remain inside the band of operation.
The 99% Bandwidth is for reporting only.

**Test Method**: ANSI C63.10 § 6.9.2 Occupied Bandwidth- Relative procedure
ANSI C63.10 § 6.9.3 Occupied Bandwidth- 99% Power Bandwidth procedure
ANSI C63.10 § 6.3 Radiated Emissions testing- Common

**Setup:**



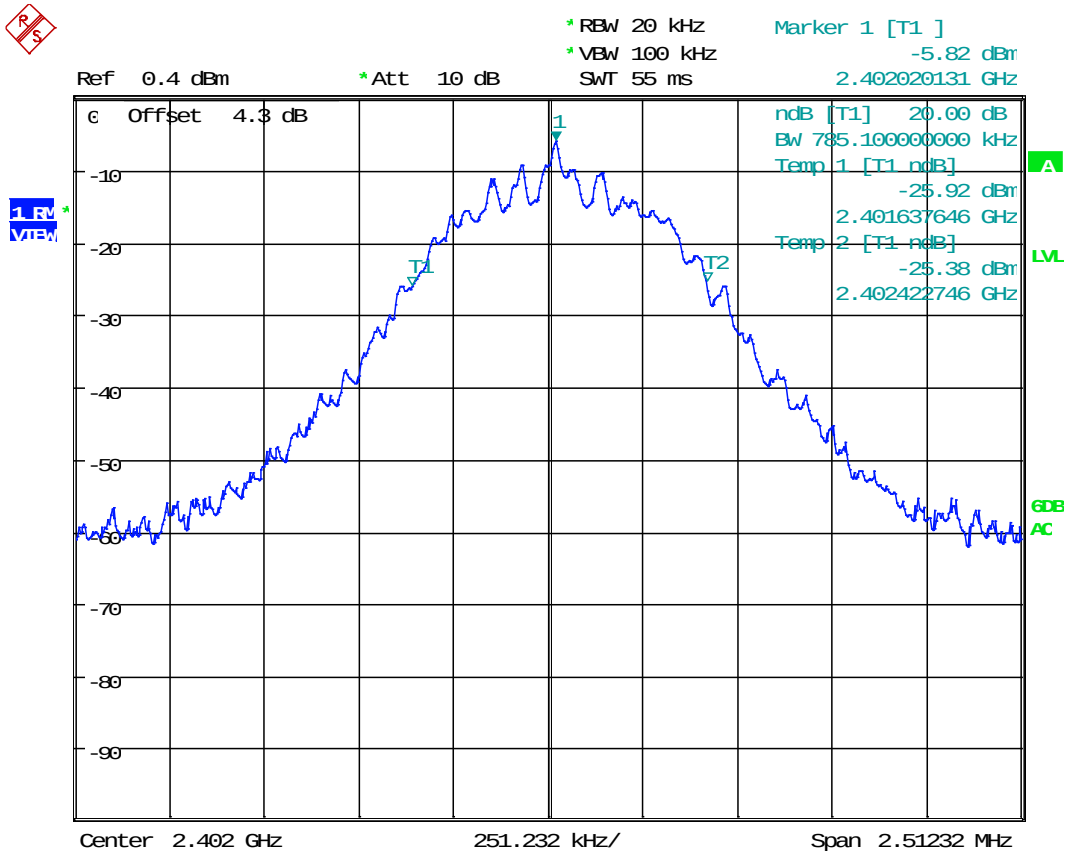

**Test Data:** **Occupied Bandwidth Measurement Table**

| Tuned Frequency (MHz) | 20 dB BW (kHz) | 99% BW (kHz) |
|---|---|---|
| 2402 | 785.1 | 781.07 |
| 2440 | 785.1 | 781.07 |
| 2480 | 782.34 | 786.55 |

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **20 dB Bandwidth Plot Low End of Band**

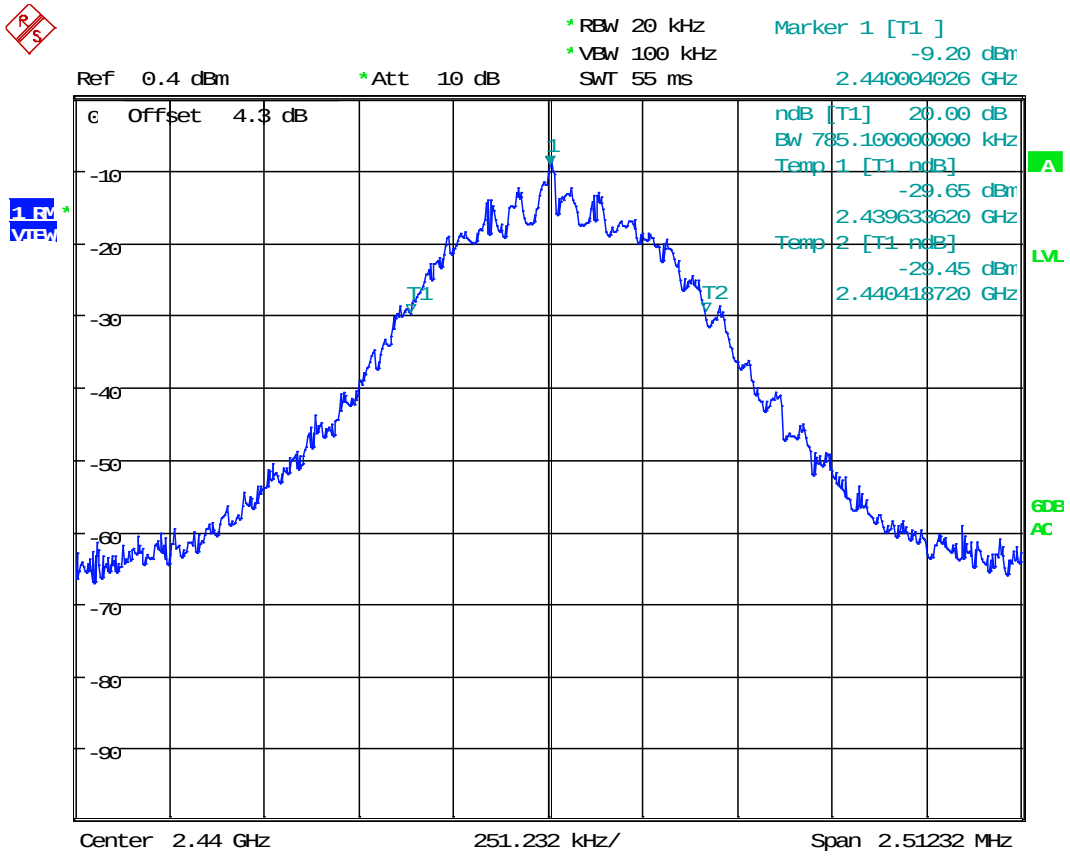



Date: 13.JUN.2018 15:04:36

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **20 dB Bandwidth Plot Middle of Band**

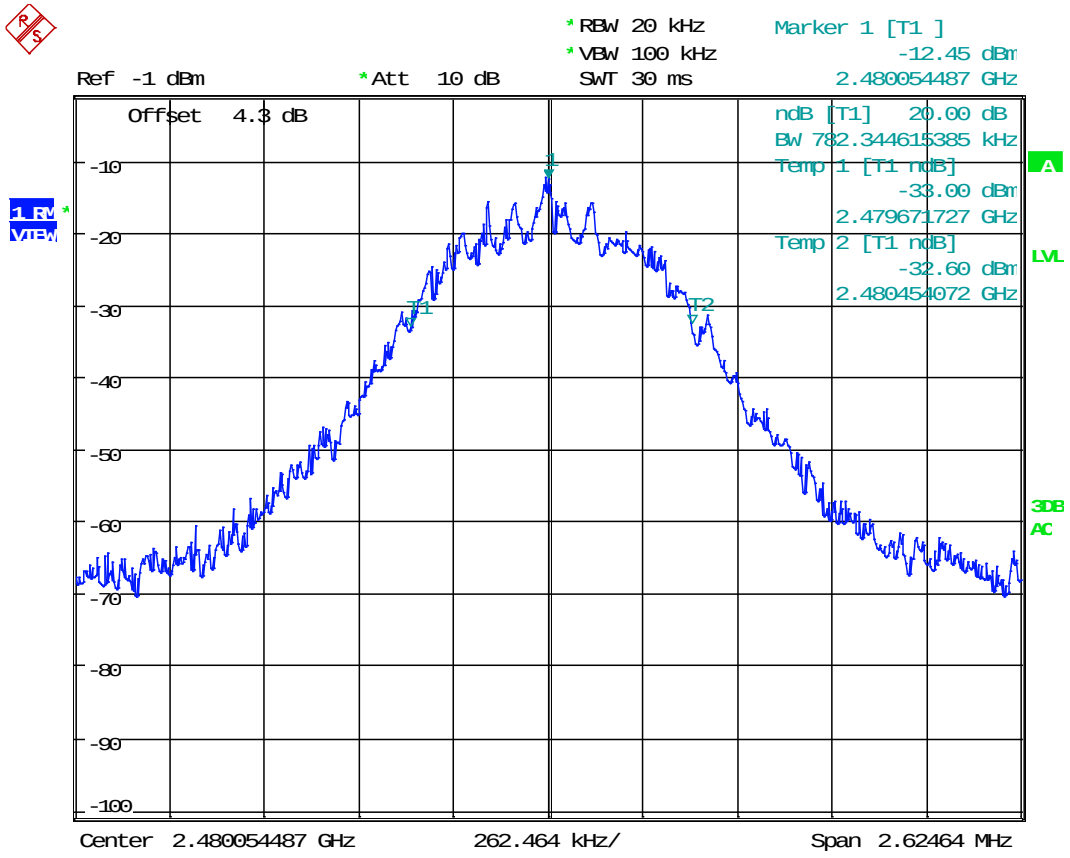



Date: 13.JUN.2018 15:06:40

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **20 dB Bandwidth Plot High end of Band**

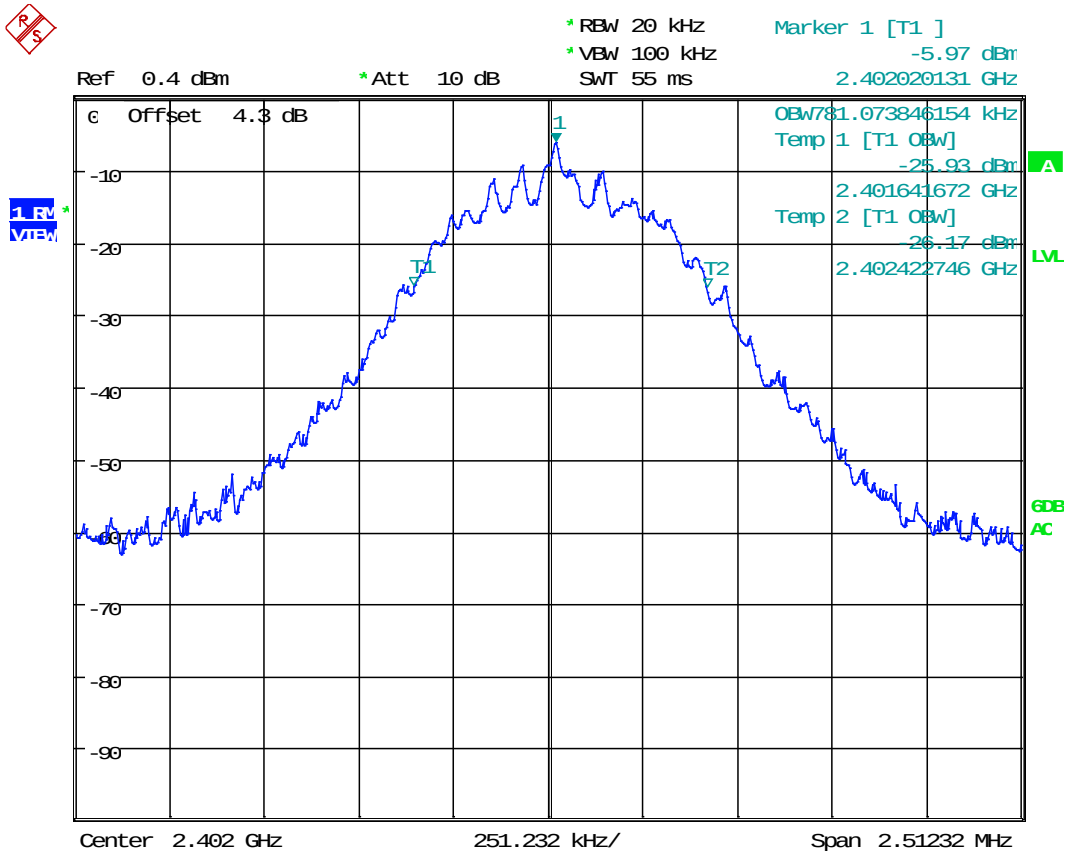



Date: 13.JUN.2018 14:48:53

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **99% Bandwidth Low End of Band**

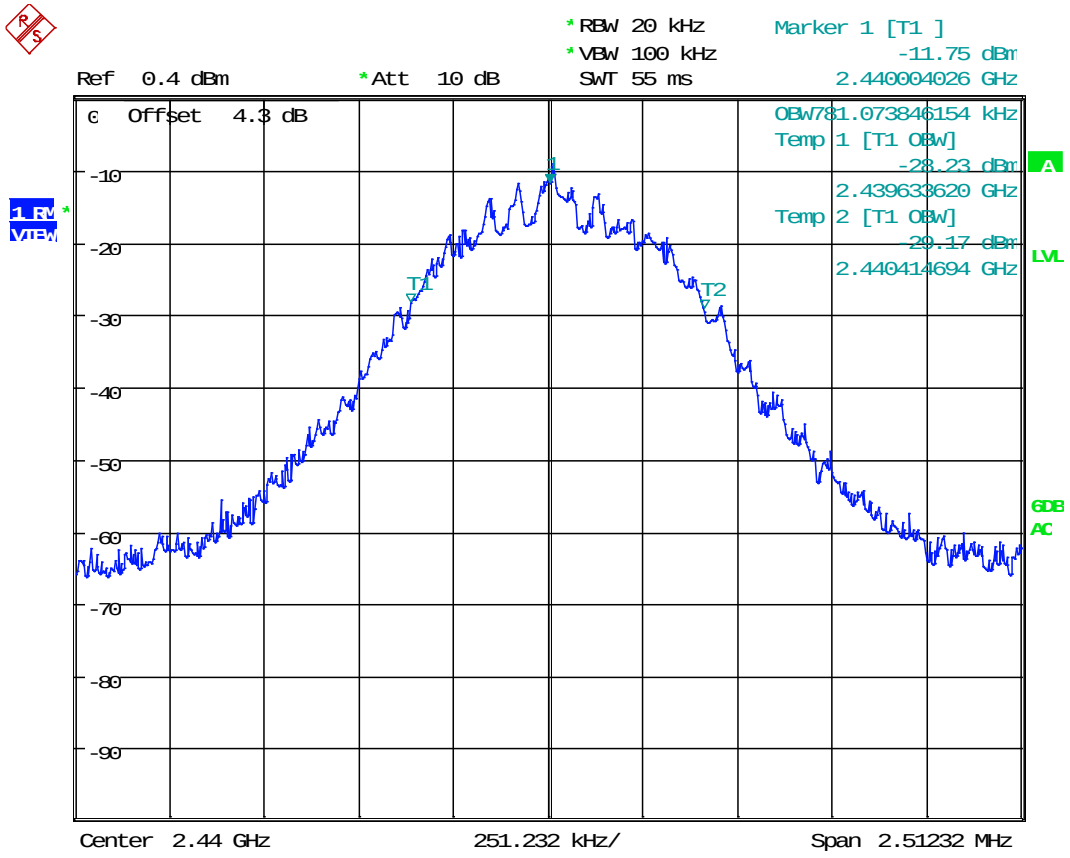



Date: 13.JUN.2018 15:00:04

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **99% Bandwidth Middle of Band**

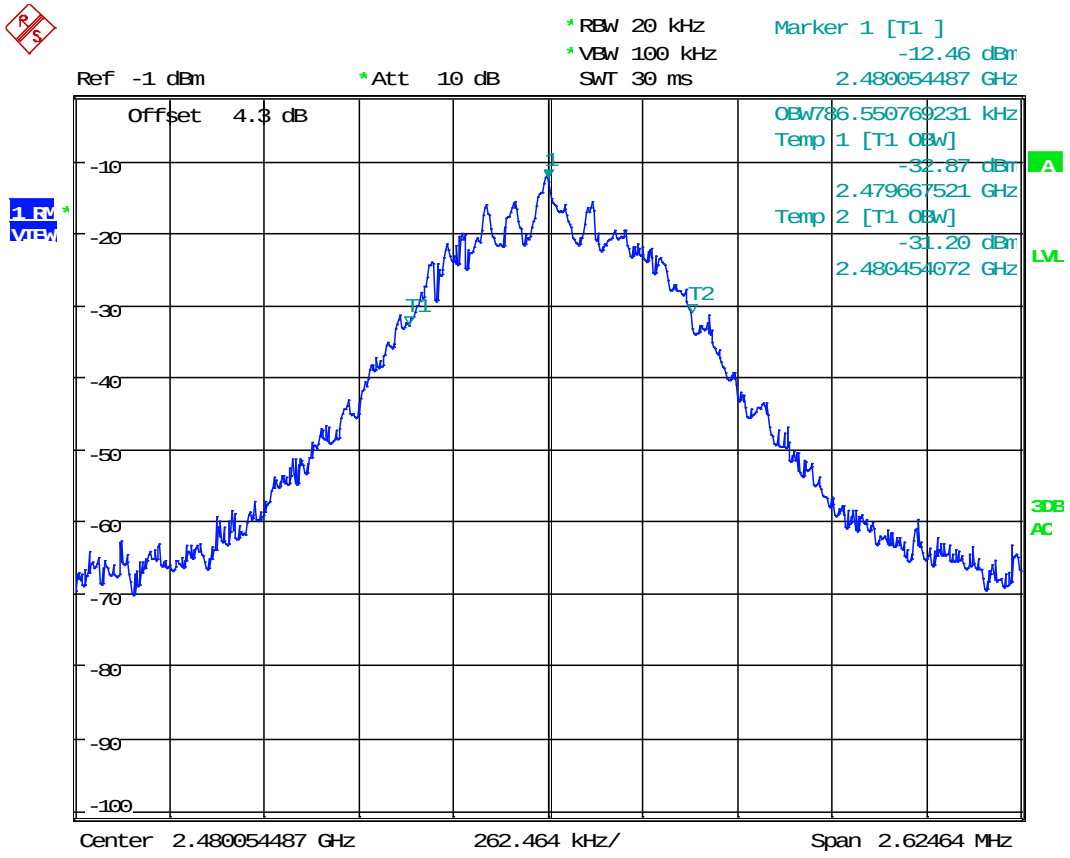



Date: 13.JUN.2018 15:07:34

**RESULTS: Meets Requirements**

## OCCUPIED BANDWIDTH

**Test Data:** **99% Bandwidth High end of Band**




Date: 13.JUN.2018 14:48:03

**RESULTS: Meets Requirements**

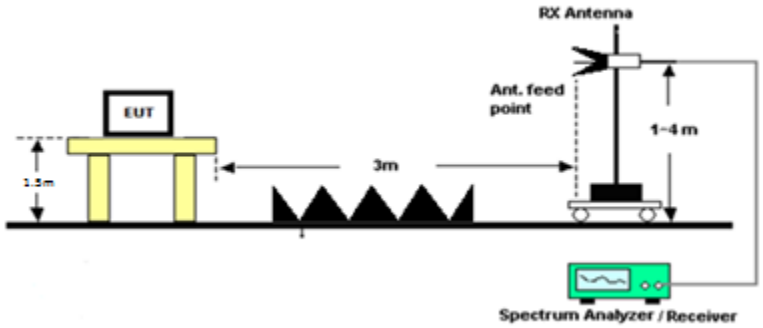
## BANDEDGE

**Rule Part No.:** FCC 15.247(d), IC RSS 247 § 5.5

**Requirements:** Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW.

**Test Method:** ANSI C63.10 § 6.10.4 Authorized band-edge relative method (non-restricted
NSI C63.10 § 6.10.6 Marker Delta Method (restricted band edge)
ANSI C63.10 § 6.3 Radiated Emissions testing- Common

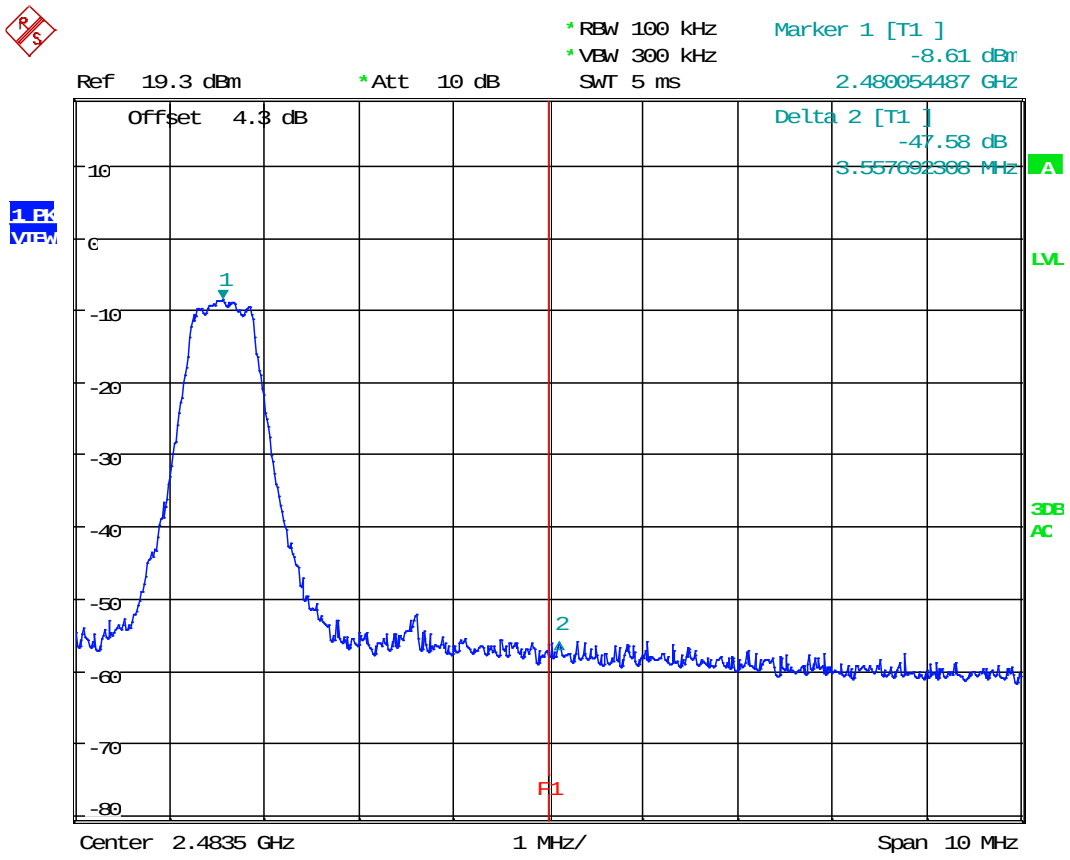
**Setup:**



## BANDEDGE

**Test Data:** **Upper Band Edge Plot Marker Delta Method**

| Field Strength of Carrier (dBuV/m) | Emission Level Below Carrier (dB) | Field Strength of Emission (dBuV/m) | Emission Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|
| 90.65 | 47.58 | 43.07 | 74 | 30.93 |
| 60.34 | 47.58 | 12.76 | 54 | 41.24 |

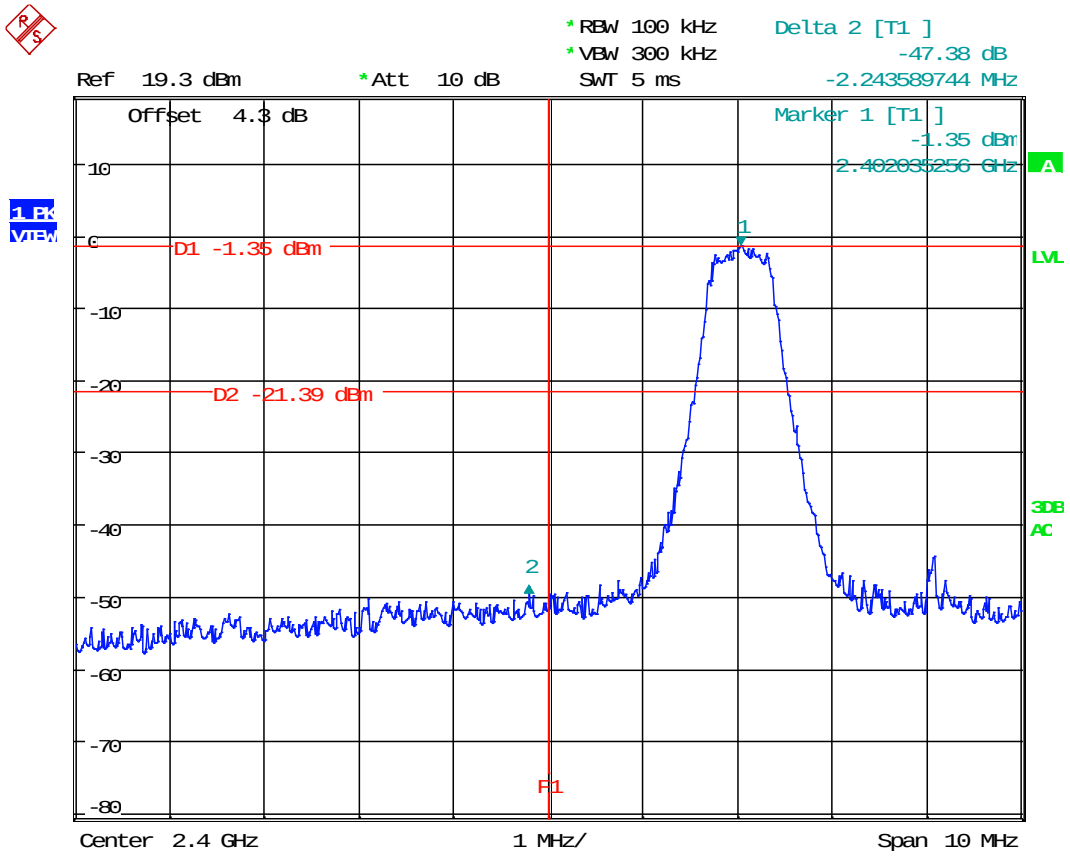



Date: 13.JUN.2018 14:45:09

**RESULTS: Meets Requirements**

## BANDEDGE

**Test Data:** **Lower Band Edge Plot**




Date: 13.JUN.2018 14:39:16

**RESULTS: Meets Requirements**

## RADIATED SPURIOUS EMISSIONS

**Rules Part No.:** FCC part 15.247 (d) & 15.209, IC RSS 247 § 5.5 & RSS GEN § 8.9

**Requirements:** 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

In addition, Emissions found in restricted bands the levels must comply with the general limits found in FCC part 15.209

| Frequency | Limits |
|---|---|
| FCC Part 15.209, IC RSS-GEN 8.9 | |
| 9 to 490 kHz | 2400/F (kHz) µV/m @ 300 meters |
| 490 to 1705 kHz | 24000/F (kHz) µV/m @ 30 meters |
| 1705 kHz to 30 MHz | 29.54 dBµV/m @ 30 meters |
| 30 – 88 | 40.0 dBµV/m @ 3 meters |
| 80 – 216 | 43.5 dBµV/m @ 3 meters |
| 216 – 960 | 46.0 dBµV/m @ 3 meters |
| Above 960 | 54.0 dBµV/m @ 3 meters |

**Test Method:** ANSI C63.4 § Annex D Validation of radiated emissions standard test sites
ANSI C63.10 § 6.3 Common requirements radiated emissions
ANSI C63.10 § 6.4 Emissions below 30 MHz
ANSI C63.10 § 6.5 Emissions between 30 & 1000 MHz
ANSI C63.10 § 6.6 Emissions above 1 GHz

**Field Strength Calculation:**

The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBµV) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

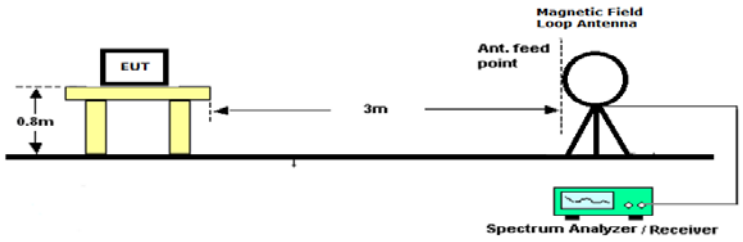
Example:

| Freq (MHz) | Meter Reading | + ACF | + CL = FS |
|---|---|---|---|
| 33 | 20 dBµV | + 10.36 dB | + 0.5 = 30.86 dBµV/m @ 3m |

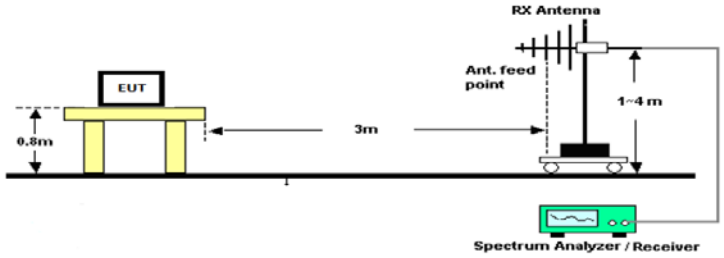
## RADIATED SPURIOUS EMISSIONS

**Setup:**

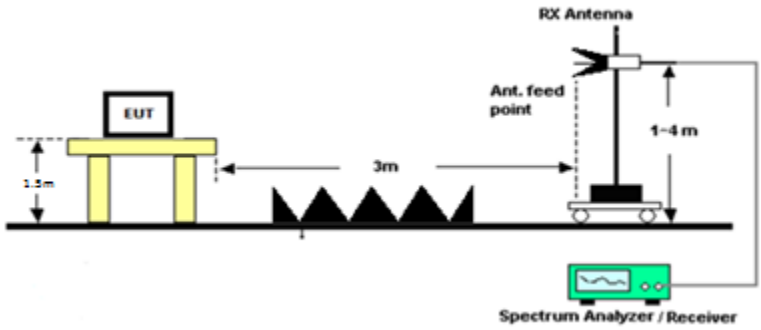
**Emissions below 30 MHz**




**Emissions 30 – 1000 MHz**




**Emissions above 1 GHz**



## RADIATED SPURIOUS EMISSIONS

**Notes:** The EUT was checked in three orthogonal planes as required, a setup photo is provided to show the orientation of the worst case position.

Only the worst case data rate and Output Power which produced emissions within 20dB of the limit are reported.

The spectrum was measured from 9 KHz to 25 GHz

**Test Data: Field Strength table**

| Tuned Freq MHz | Emission Frequency MHz | Meter Reading dBu V | Antenna Polarity | Coax Loss Db | Correction Factor dB/M | Field Strength dBu V/M | Margin |
|---|---|---|---|---|---|---|---|
| 2480 | 2144.20 | 6.93 | H | 5.57 | 31.22 | 43.72 | 10.28 |
| 2480 | 4786.80 | 8.45 | H | 8.25 | 33.92 | 50.62 | 3.38 |
| 2480 | 4786.80 | 9.17 | V | 8.25 | 33.92 | 51.34 | 2.66 |
| 2480 | 7538.50 | -2.72 | H | 10.38 | 35.88 | 43.54 | 10.46 |
| 2440 | 5250.00 | -1.82 | H | 8.68 | 34.29 | 41.15 | 12.85 |
| 2440 | 4868.50 | 8.39 | V | 8.31 | 33.93 | 50.63 | 3.37 |
| 2400 | 4868.50 | 7.24 | V | 8.31 | 33.93 | 49.48 | 4.52 |
| 2400 | 4868.50 | -0.28 | H | 8.31 | 33.93 | 41.96 | 12.04 |
| Normal Sample | 7127.80 | -6.08 | H | 10.10 | 36.35 | 40.37 | 13.63 |
| Normal Sample | 2035.20 | 1.76 | V | 5.44 | 31.08 | 38.28 | 15.72 |

**Results Meet Requirements**

## EMC EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---|---|---|---|---|---|
| Attenuator K 6dB 2W DC-40G | Narda | 4768-6 | 1044-2 | 06/25/15 | 06/25/18 |
| Attenuator K 6dB 2W DC-40G | Narda | 4768-6 | 1044-3 | 10/06/15 | 10/06/18 |
| Antenna: Biconical 1096 | Eaton | 94455-1 | 1096 | 08/01/17 | 08/01/19 |
| Antenna: Log-Periodic 1122 | Electro-Metrics | LPA-25 | 1122 | 07/26/17 | 07/26/19 |
| CHAMBER | Panashield | 3M | N/A | 12/31/17 | 12/31/19 |
| Antenna: Double-Ridged Horn/ETS Horn 2 | ETS-Lindgren | 3117 | 00041534 | 03/01/17 | 03/01/19 |
| Software: Field Strength Program | Timco | N/A | Version 4.10.7.0 | N/A | N/A |
| Antenna: Active Loop | ETS-Lindgren | 6502 | 00062529 | 12/11/17 | 12/11/19 |
| Coaxial Cable #103 - KMKM-0180-01 Aqua | Micro-Coax | UFB142A-0-0720-200200 | 225363-002 (#103) | 08/05/15 | 08/05/18 |
| EMI Test Receiver R & S ESU 40 Chamber | Rohde & Schwarz | ESU 40 | 100320 | 04/01/16 | 04/01/19 |
| Coaxial Cable - Chamber 3 cable set (Primary) | Micro-Coax | Chamber 3 cable set (Primary) | KMKM-0244-01; KMKM-0670-00; KFKF-0198-01 | 08/09/16 | 08/09/18 |
| Band Reject Filter 2.4 GHz | Micro-Tronics | BRM50702-02 | -G042 | 09/27/16 | 09/27/18 |
| Attenuator K 6dB 2W DC-40G | Narda | 4768-6 | 1044-2 | 06/25/15 | 06/25/18 |
| Pre-amp | RF-LAMBDA | RLNA00M45GA | N/A | 01/04/16 | 01/04/19 |

### *EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

## STATE OF THE MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: "Uncertainty in EMC Measurements" and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

| Test Items | Measurement Uncertainty | Notes |
|---|---|---|
| RF Frequency Accuracy | ± 49.5 Hz | (1) |
| RF Conducted Power | ±0.93dB | (1) |
| Conducted spurious emission of transmitter valid up to 40GHz | ±1.86dB | |
| Occupied Bandwidth | ±2.65% | |
| Audio Frequency Response | ±1.86dB | |
| Modulation limiting | ±1.88% | |
| Radiated RF Power | ±1.4dB | |
| Maximum frequency deviation:<br>Within 300 Hz and 6kHz of audio freq.<br>Within 6kHz and 25kHz of audio Freq. | <br><br>±1.88%<br><br>±2.04% | |
| Rad Emissions Sub Meth up to 26.5GHz | ±2.14dB | |
| Adjacent channel power | ±1.47dB | (1) |
| Transient Frequency Response | ±1.88% | |
| Temperature | ±1.0°C | (1) |
| Humidity | ±5.0% | |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

End of REPORT