



## FCC PART 15.247 2.4 GHz DTS Test Report

APPLICANT	BRIGHTLOT, INC.	
ADDRESS	85 BROAD STREET, 27TH FLOOR NEW YORK NEW YORK 10004 USA	
FCC ID	2ARCB-INVERNESS	
MODEL NUMBER	J2B	
PRODUCT DESCRIPTION	ZIGBEE TRANSMITTER	
DATE SAMPLE RECEIVED	10/15/2018	
FINAL TEST DATE	10/15/2018	
TESTED BY	Franklin Rose	
APPROVED BY	Tim Royer	
TEST RESULTS	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL

Report Number	Report Version	Description	Issue Date
1578AZUT18_TestReport_	Rev1	Initial Issue	10/15/2018
1578AZUT18_TestReport_	Rev2	Corrected Test Procedure	11/8/2018
1578AZUT18_TestReport_	Rev3	Removed photos	12/10/2018

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE  
WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

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## GENERAL REMARKS

### 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**  
**Designation #: US1070**

### Tested by:


**Name and Title** Franklin Rose, Project Manager / EMC Testing Technician  
**Date** 10/15/2018

### Reviewed and Approved by:


**Name and Title** Tim Royer, Project Manager / EMC Testing Engineer  
**Date** 10/15/2018

## GENERAL INFORMATION

### EUT Information

<b>FCC ID</b>	<b>2ARCB-INVERNESS</b>		
<b>Model</b>	J2B		
<b>EUT Description</b>	ZIGBEE TRANSMITTER		
<b>EUT Power Source</b>	<input type="checkbox"/> 110–120Vac, 50–60Hz	<input checked="" type="checkbox"/> DC Power	<input type="checkbox"/> Battery Operated
<b>Test Item</b>	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
<b>Type of Equipment</b>	<input type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Mobile	<input type="checkbox"/> Portable
<b>Antenna Connector</b>	SMA		
<b>Test Conditions</b>	The temperature was 26°C Relative humidity of 50%.		
<b>Modification to the EUT</b>	No Modification to EUT.		
<b>Applicable Standards</b>	FCC CFR 47 Part 2, Part 15, Referring to ANSI C63.10 for Test Procedures and KDB 558074 D01 v05.		
<b>Test Facility</b>	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070 ISED Test Site Registration: 2056-A		

### Peripherals Used in Testing

<b>Description</b>	<b>Type</b>	<b>Connector</b>	<b>Length</b>
n/a	n/a	n/a	n/a

## Test Results Summary

FCC Rule Part No.	Requirement	Test Item	Result
15.215(c)	Occupied Bandwidth	20 dB Bandwidth	<b>Pass</b>
15.247(a), (e)	Digital Transmission Systems	6 dB Bandwidth	<b>Pass</b>
		Power Spectral Density	<b>Pass</b>
15.247(b)	Transmitter Output Power and Equivalent Isotropically Radiated Power	Peak Power Output (ERP)	<b>Pass</b>
		Antenna Gain (EIRP)	<b>Pass</b>
15.247(d)	Unwanted Emissions	Bandedge	<b>Pass</b>
		Radiated Spurious	<b>Pass</b>

## Frequency Range(s) of EUT

<b>Operating Frequency Band 1</b>	2405 – 2480 MHz
<b>Test Frequencies</b>	2405, 2440, 2480 MHz

## Definition of EUT

**RULE PART NO.:** FCC PART 15.3

(l) *Class B digital device.* A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

**Note:** The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

(k) *Digital device.* (Previously defined as a computing device). An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. A radio frequency device that is specifically subject to an emanation requirement in any other FCC Rule part or an intentional radiator subject to subpart C of this part that contains a digital device is not subject to the standards for digital devices, provided the digital device is used only to enable operation of the radio frequency device and the digital device does not control additional functions or capabilities.

**Note:** Computer terminals and peripherals that are intended to be connected to a computer are digital devices.

(o) *Intentional radiator.* A device that intentionally generates and emits radio frequency energy by radiation or induction.

## MEASUREMENT STANDARDS

### RULE PART NO.: FCC PART 15.31

(a) The following measurement procedures are used by the Commission to determine compliance with the technical requirements in this part. Except where noted, copies of these procedures are available from the Commission's current duplicating contractor whose name and address are available from the Commission's Consumer and Governmental Affairs Bureau at 1-888-CALL-FCC (1-888-225-5322).

(2) Unlicensed Personal Communications Service (UPCS) devices are to be measured for compliance using ANSI C63.17-2013: "American National Standard Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices" (incorporated by reference, see §15.38).

(3) Other intentional radiators are to be measured for compliance using the following procedure: ANSI C63.10-2013 (incorporated by reference, see §15.38).

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(l) Measurements of radio frequency emissions conducted to the public utility power lines shall be performed using a 50 ohm/50 uH line-impedance stabilization network (LISN).

(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle.
1 to 10 MHz	2	1 near top and 1 near bottom.
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom.

(o) The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

## FREQUENCY RANGE OF RADIATED MEASUREMENTS

**RULE PART NO.:** FCC PART 15.33

### **§15.33 Frequency range of radiated measurements.**

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

## METHOD OF MEASUREMENT

**RULE PART NO.:** FCC PART 15.35

### **§15.35 Measurement detector functions and bandwidths.**

The conducted and radiated emission limits shown in this part are based on the following, unless otherwise specified in this part:

(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long as the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

(c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

## DTS BANDWIDTH

Rules Part No.: FCC 15.247 (a)(2)

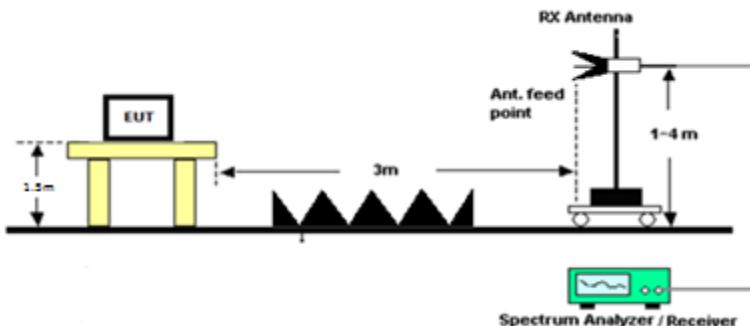
### Requirements:

**§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

(2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

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

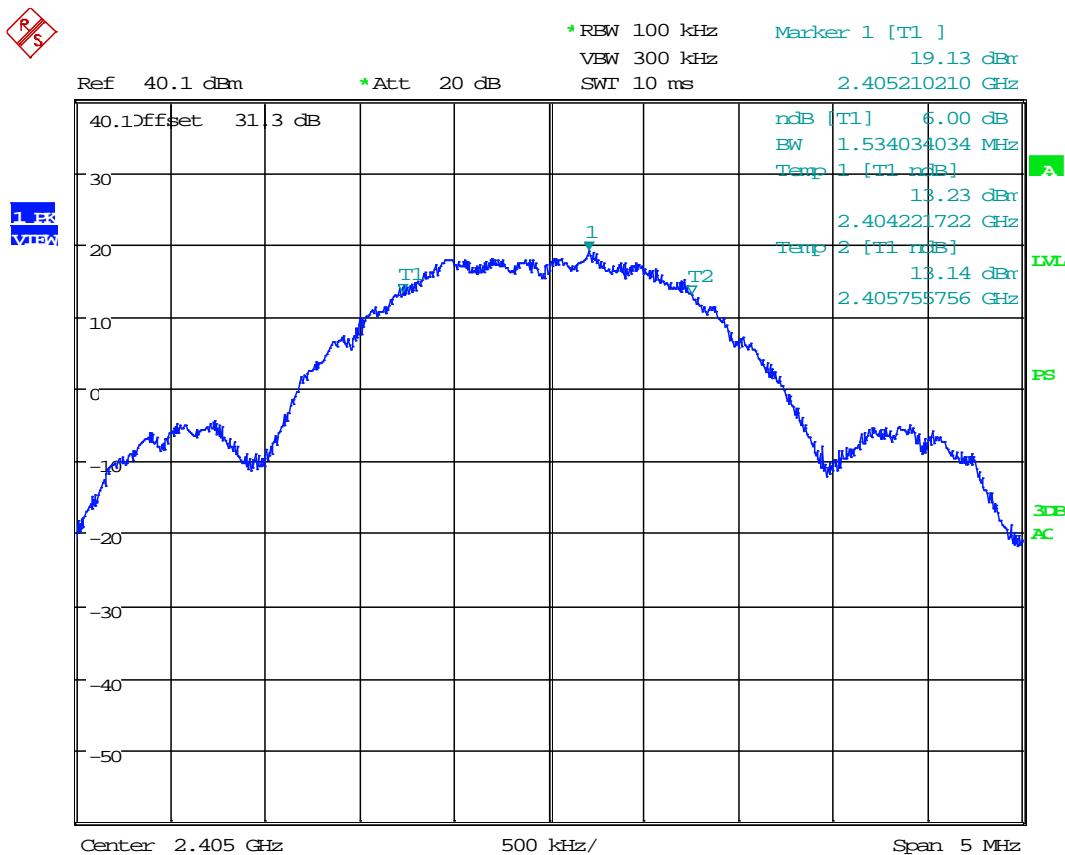
### Test Setup:



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

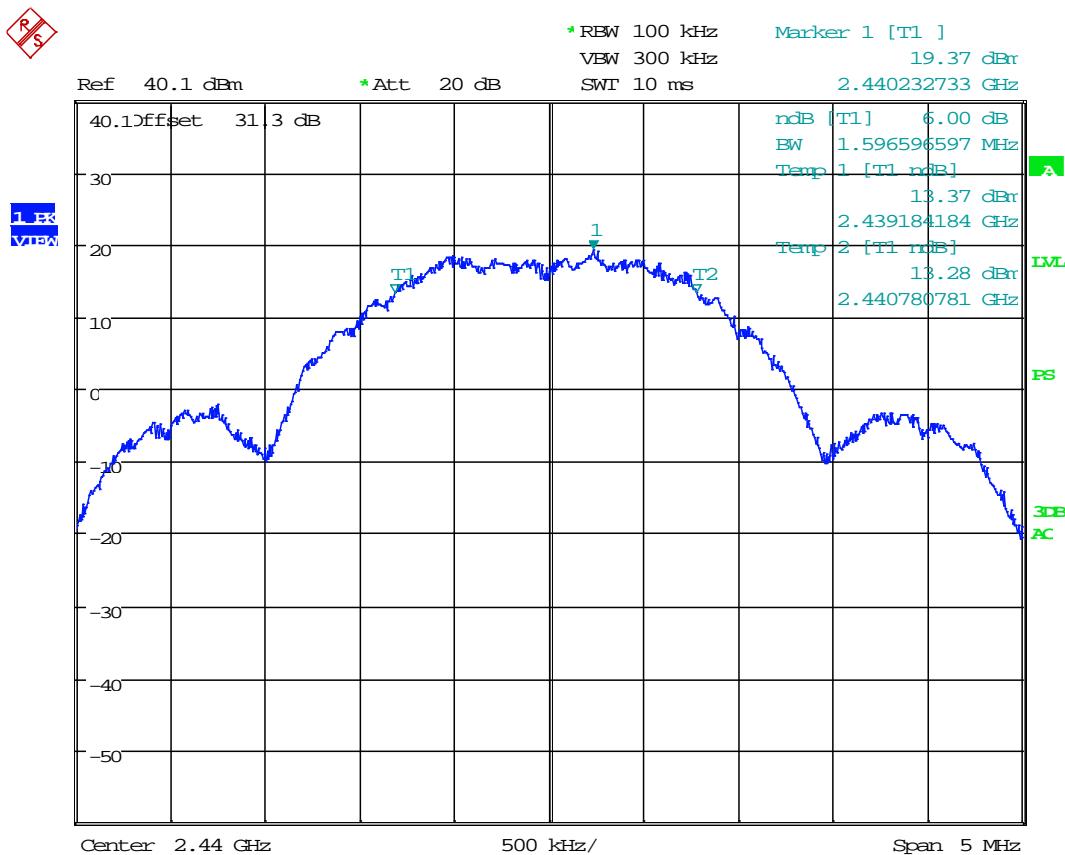
Tuned Frequency (MHz)	6 dB BW (KHz)	Limit (KHz)	Margin (KHz)
2403	1530	$\geq 500$	1030
2440	1590	$\geq 500$	1090
2480	1570	$\geq 500$	1070

**RESULT: Meets Requirements**

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


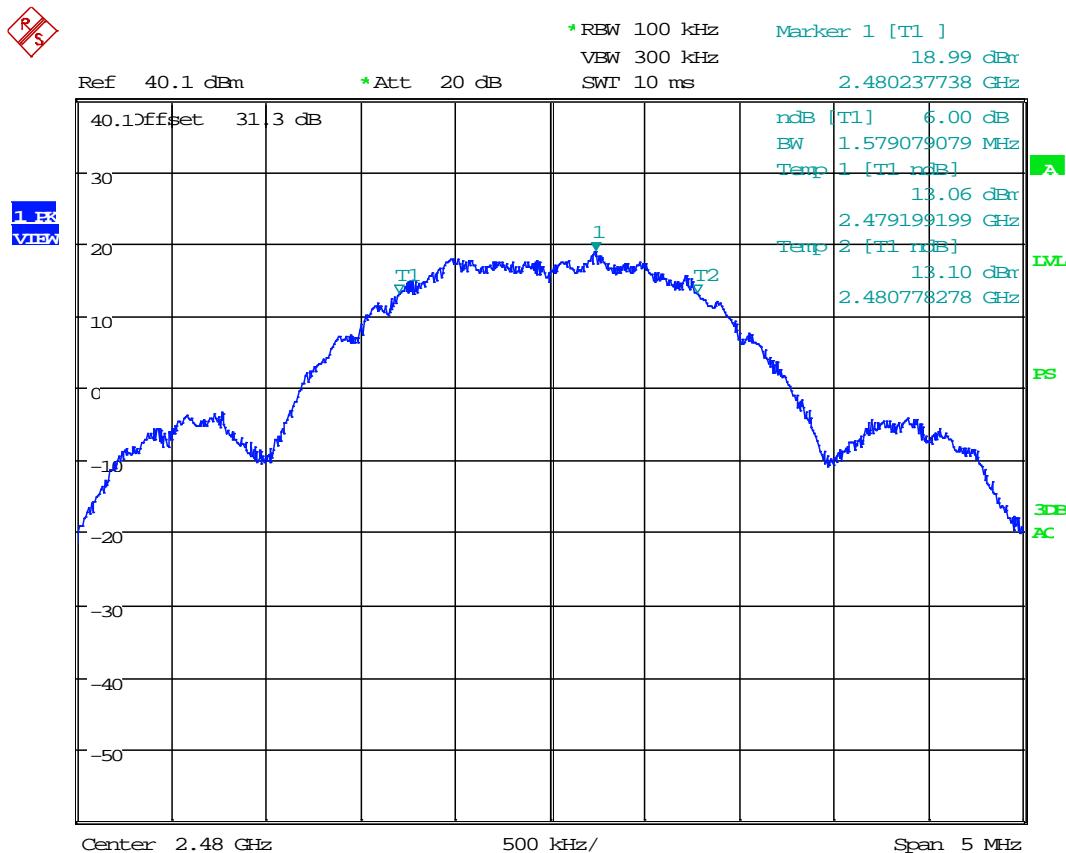
Date: 15.OCT.2018 15:53:30

**RESULT: 6 dB BW = 1.53 MHz**

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


Date: 15.OCT.2018 15:55:18

**RESULT: 6 dB BW = 1.59 MHz**

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


Date: 15.OCT.2018 15:23:33

**RESULT: 6 dB BW = 1.57 MHz**

## PEAK POWER OUTPUT

**Rules Part No.:** FCC 15.247(b) (3) (4)

### Requirements:

#### **§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

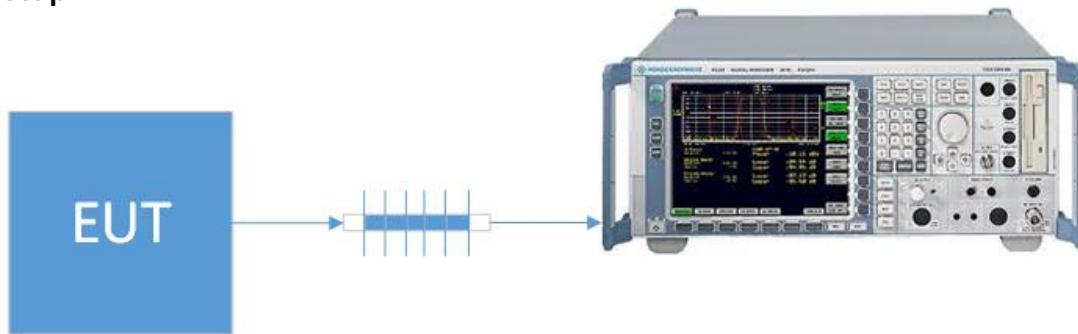
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

### Test Setup:



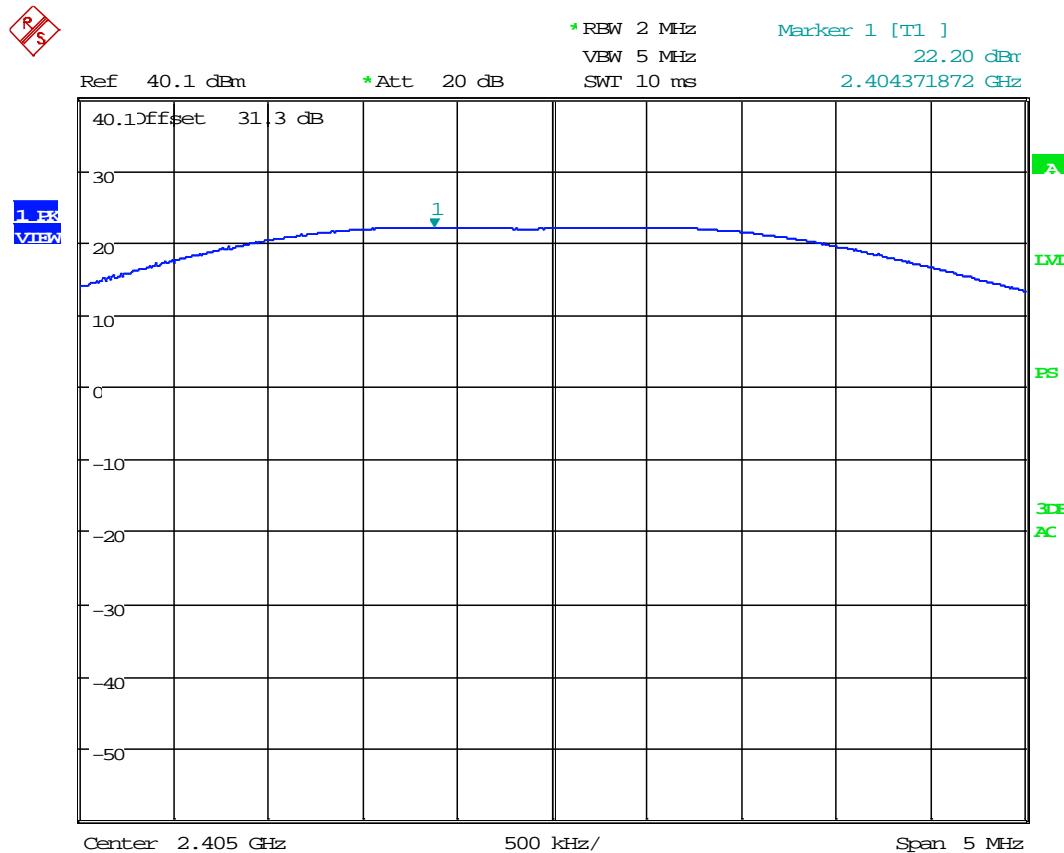
**PEAK POWER OUTPUT**
**Test Data: Peak Conducted Power Output Measurement Table**

Peak Conducted Power Output Measurement				
Tuned Frequency (MHz)	Power Output (dBm)	Power Output (W)	Limit (W)	Margin (W)
2403	22.2	0.17	1.00	0.83
2440	22.47	0.18	1.00	0.82
2475	21.65	0.15	1.00	0.85

**RESULT: Meets Requirements**

## PEAK POWER OUTPUT

Test Data: Peak Power Output Plot Low End of Band

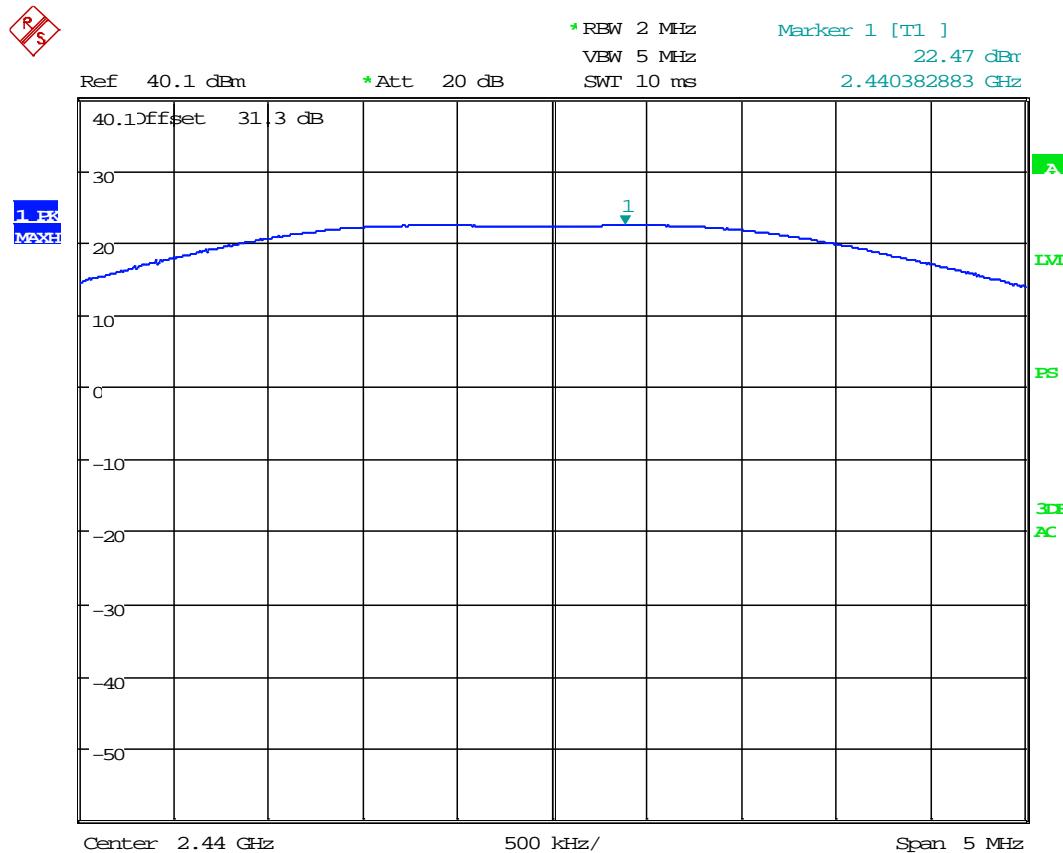


Date: 15.OCT.2018 15:20:53

**RESULT: Power Output = 22.2 dBm**

## PEAK POWER OUTPUT

Test Data: Peak Power Output Plot Middle of Band

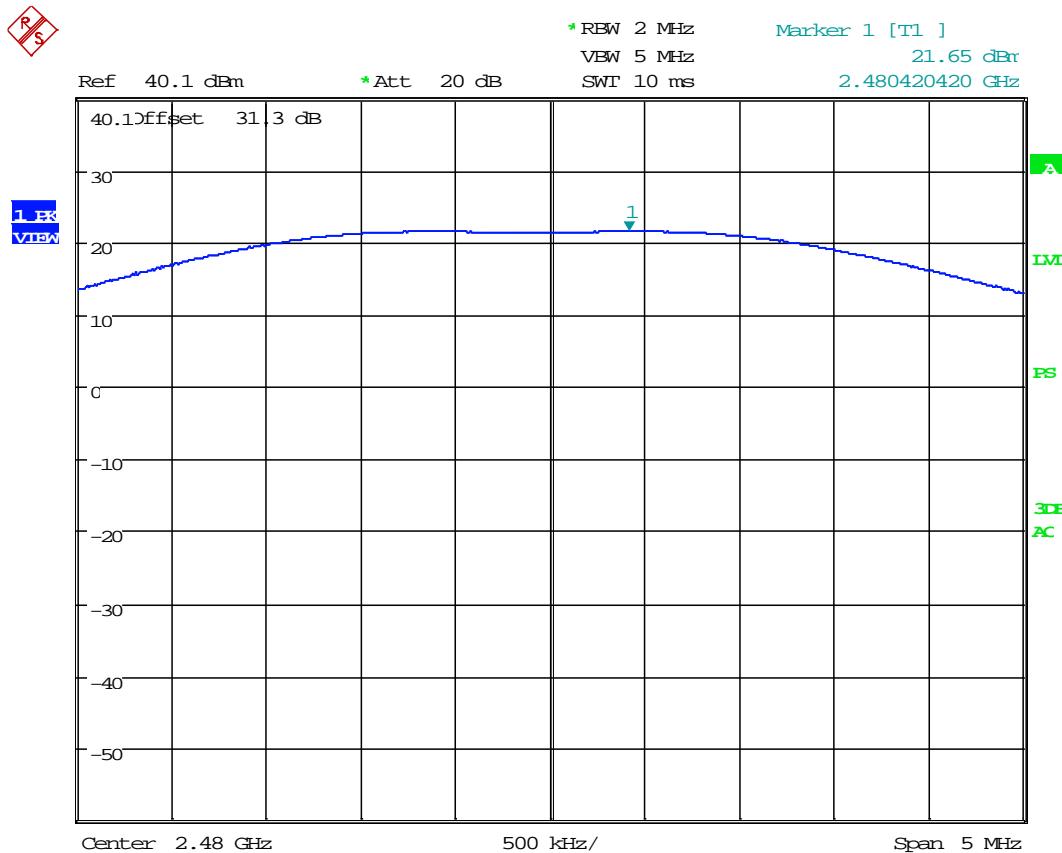


Date: 15.OCT.2018 15:15:39

**RESULT: Power Output = 22.47 dBm**

## PEAK POWER OUTPUT

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



Date: 15.OCT.2018 15:37:11

**RESULT: Power Output = 21.65 dBm**

## PEAK POWER OUTPUT

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

Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Distance (m)	Field Strength (dB $\mu$ V/m)	ERP (dBm)
2405.00	67.31	PK	V	3.000	105.155	7.778
2440.00	67.31	PK	V	3.000	105.720	8.343
2480.00	61.27	PK	V	3.000	99.970	2.593

Peak Radiated EIRP Power Output Calculation					
Tuned Frequency (MHz)	ERP Power Output (dBm)	EIRP Power Output (dBm)	EIRP Power Output (W)	Limit (W)	Margin (W)
2405	7.778	9.93	0.01	4.00	3.99
2440	8.343	10.49	0.01	4.00	3.99
2480	2.59	4.74	0.00	4.00	4.00

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

## POWER SPECTRAL DENSITY

**Rules Part No.:** FCC 15.247(e)

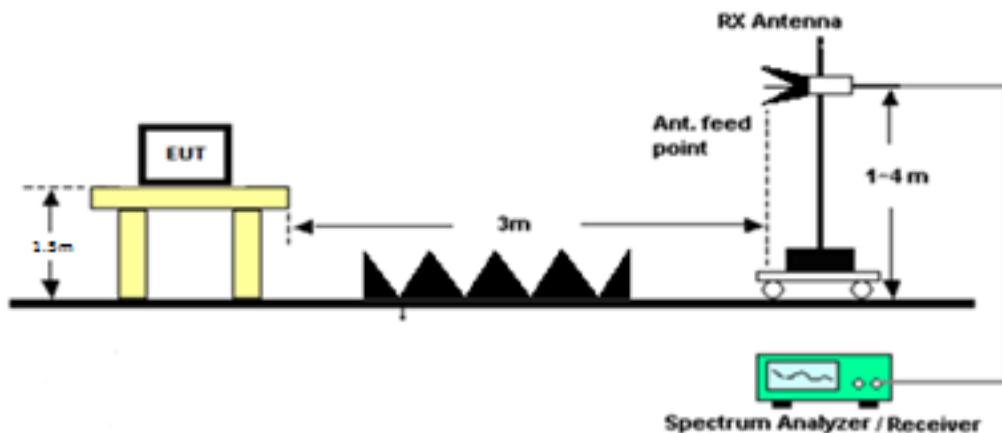
### Requirements:

#### **§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

**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:



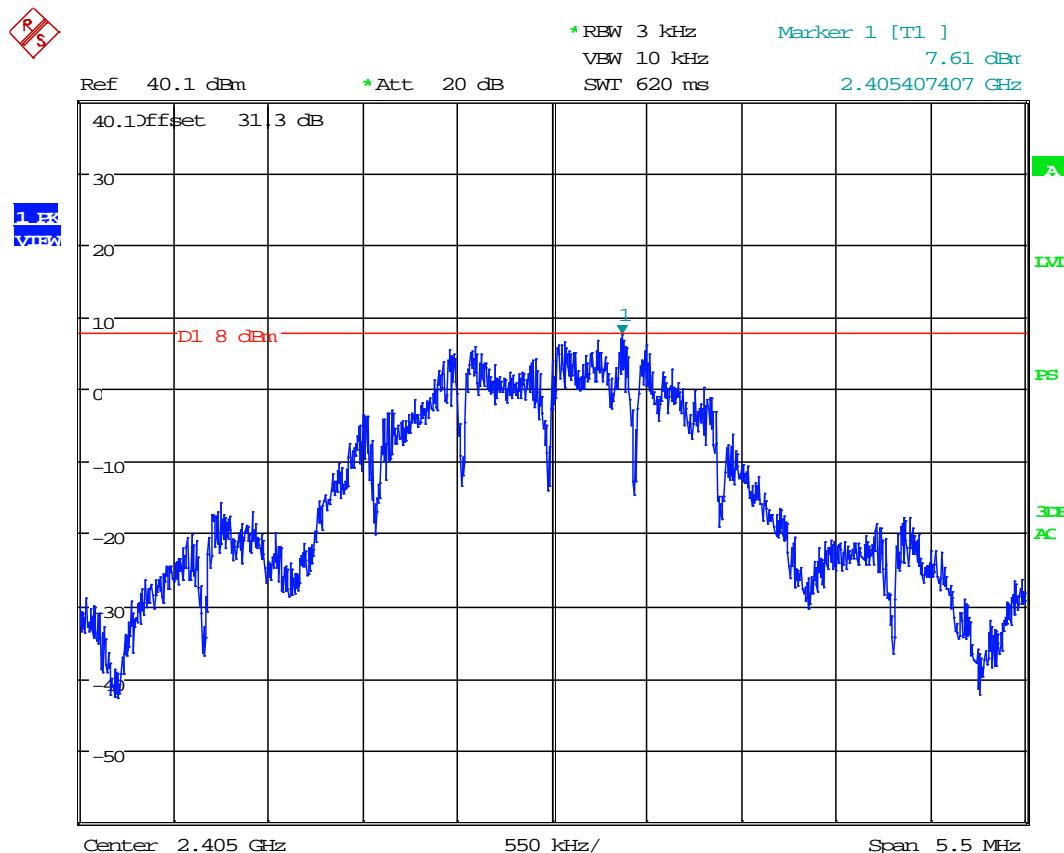
**POWER SPECTRAL DENSITY**
**Test Data: Power Spectral Density Measurement Table**

Peak Power Spectral Density			
Tuned Frequency (MHz)	PSD (dBm/3KHz)	Limit (dBm/3KHz)	Margin (dB)
2403	7.61	8.00	0.39
2440	7.10	8.00	0.90
2475	6.41	8.00	1.59

**RESULT: Meets Requirements**

## POWER SPECTRAL DENSITY

Test Data: Power Spectral Density Plot Low End of Band



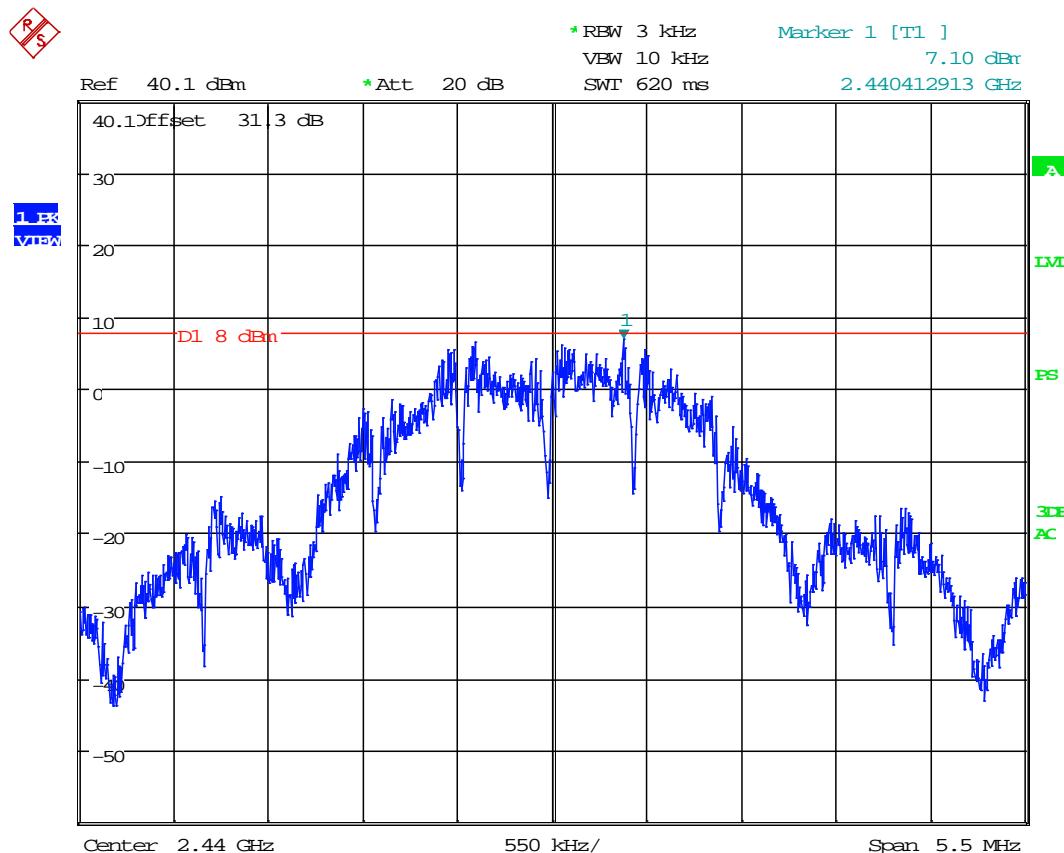
Date: 15.OCT.2018 14:53:00

**RESULT: PSD = 7.61 dBm**

Applicant: BRIGHTLOT, INC.  
 FCC ID: 2ARCB-INVERNESS  
 Report: 1578AZUT18\_TestReport\_Rev1

## POWER SPECTRAL DENSITY

Test Data: Power Spectral Density Plot Middle of Band



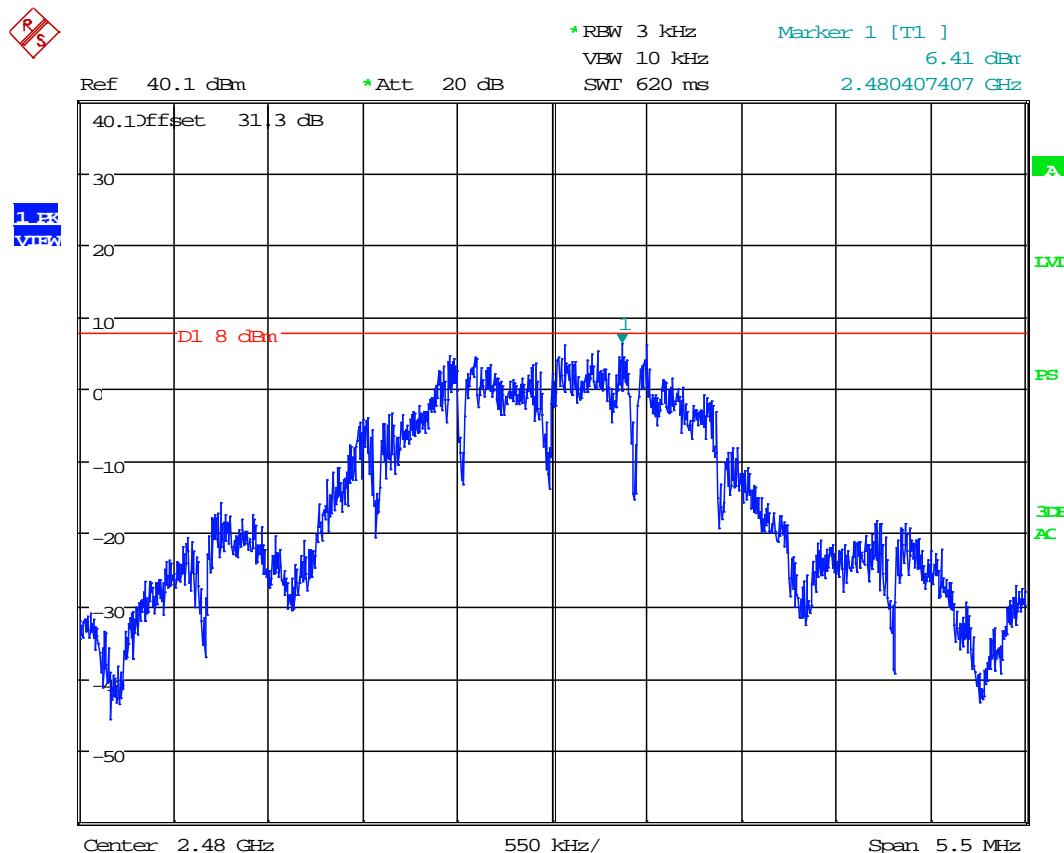
Date: 15.OCT.2018 15:17:14

**RESULT: PSD = 7.1 dBm**

Applicant: BRIGHTLOT, INC.  
 FCC ID: 2ARCB-INVERNESS  
 Report: 1578AZUT18\_TestReport\_Rev1

## POWER SPECTRAL DENSITY

Test Data: Power Spectral Density Plot High End of Band



Date: 15.OCT.2018 15:38:37

**RESULT: PSD = 6.41 dBm**

Applicant: BRIGHTLOT, INC.  
 FCC ID: 2ARCB-INVERNESS  
 Report: 1578AZUT18\_TestReport\_Rev1

## OCCUPIED BANDWIDTH

**Rules Part No.:** FCC 15.215(c)

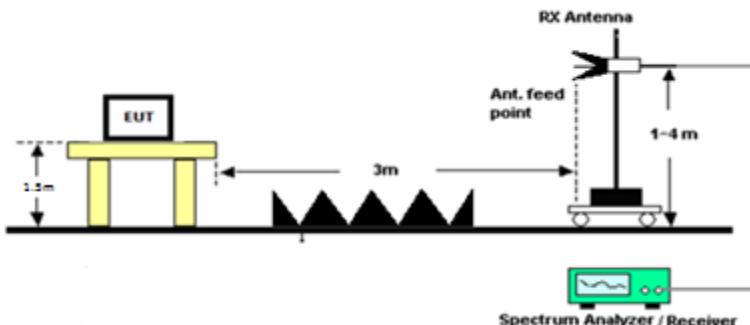
**Requirements:** The 99% Bandwidth is for reporting only.

### **§15.215 Additional provisions to the general radiated emission limitations.**

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

**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:**



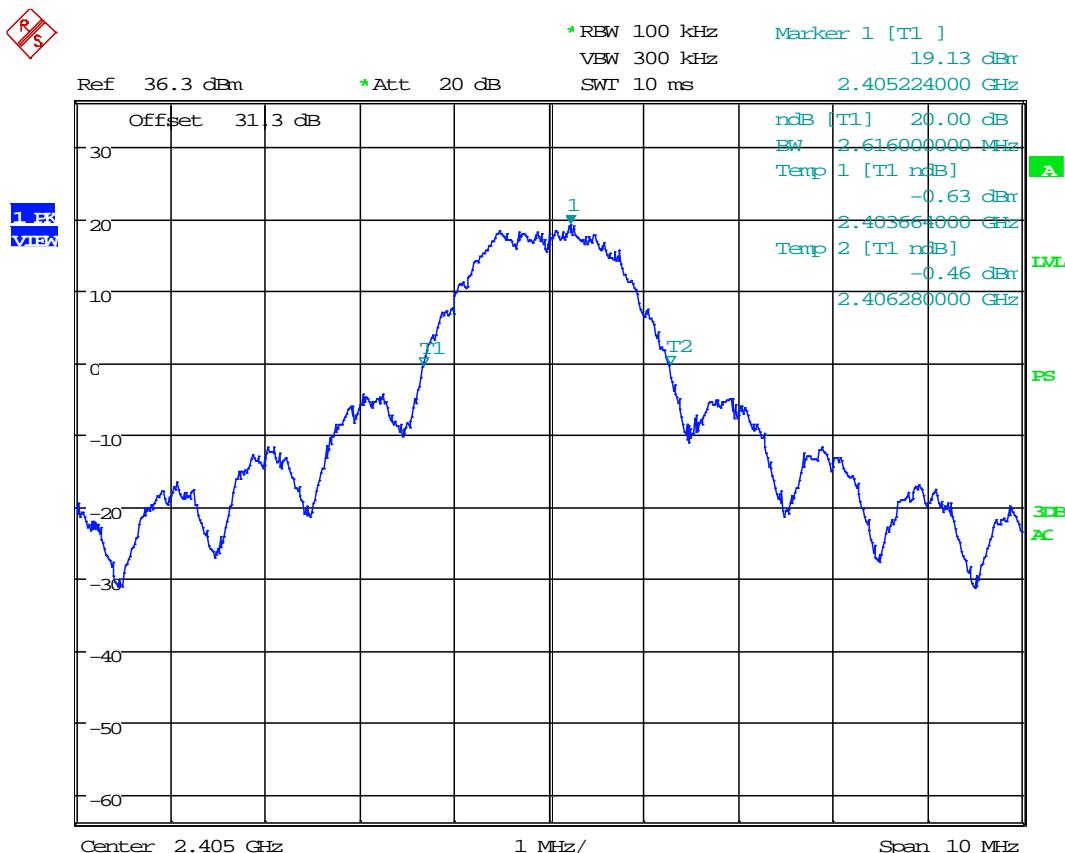
**Test Data: Occupied Bandwidth Measurement Table**

Tuned Frequency (MHz)	20 dB BW (MHz)	99% BW (MHz)
2403	2.61	2.36
2440	2.65	2.44
2480	2.62	2.41

**RESULT: Meets Requirements**

## OCCUPIED BANDWIDTH

Test Data: 20 dB Bandwidth Plot Low End of Band

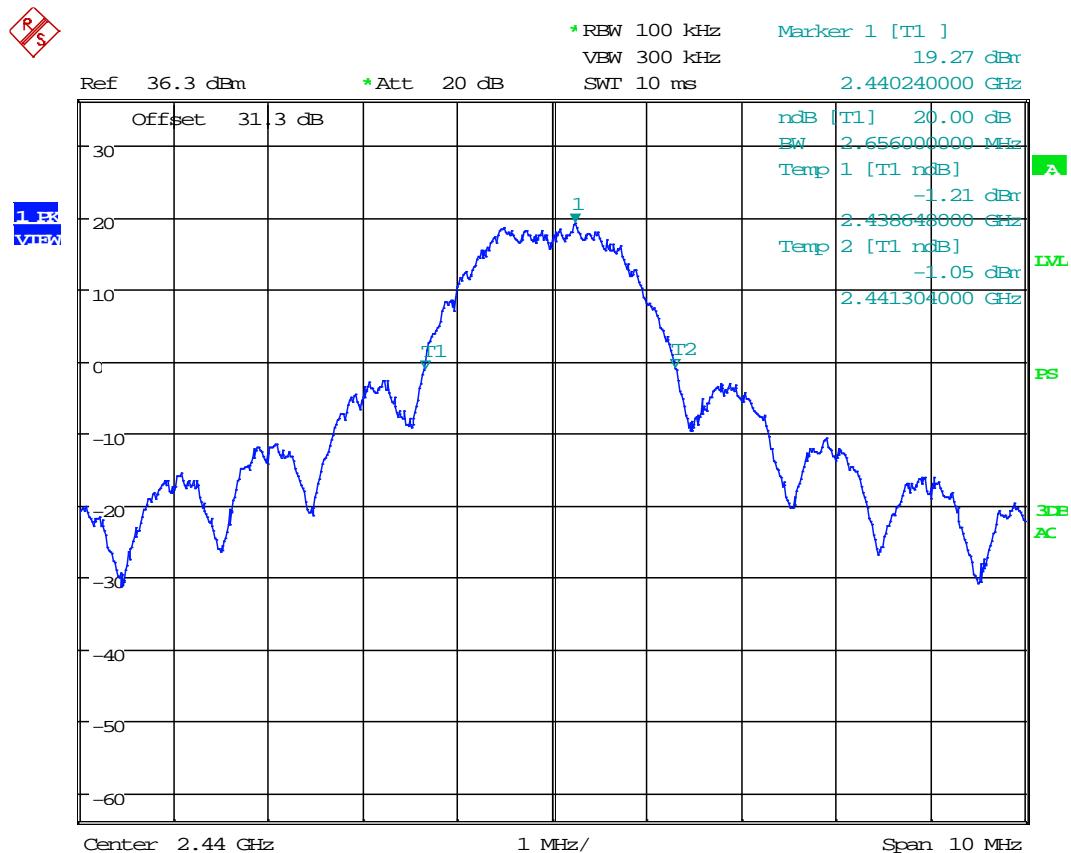


Date: 15.OCT.2018 15:48:37

**RESULT: 20 dB OBW = 2.61 MHz**

## OCCUPIED BANDWIDTH

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



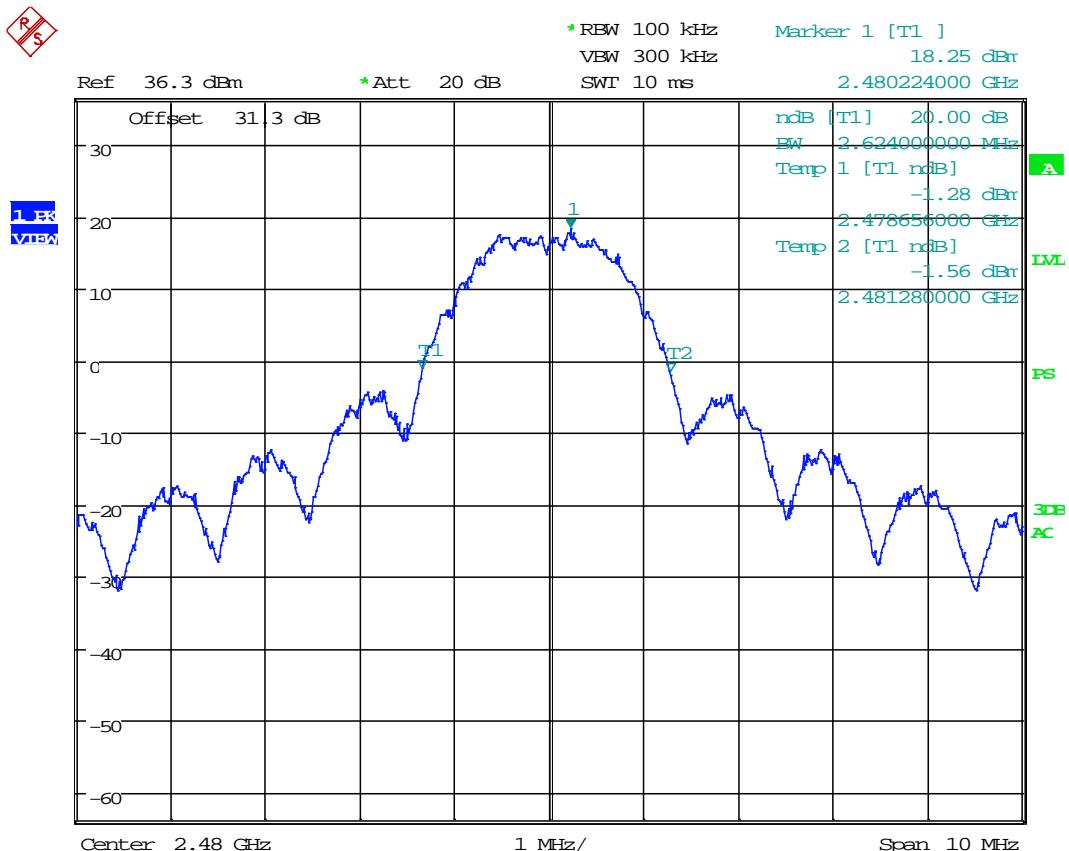
Date: 15.OCT.2018 15:45:30

## RESULT: 20 dB OBW = 2.65 MHz

Applicant: BRIGHTLOT, INC.  
FCC ID: 2ARCB-INVERNESS  
Report: 1578AZUT18\_TestReport\_Rev1

## OCCUPIED BANDWIDTH

Test Data: 20 dB Bandwidth Plot High end of Band

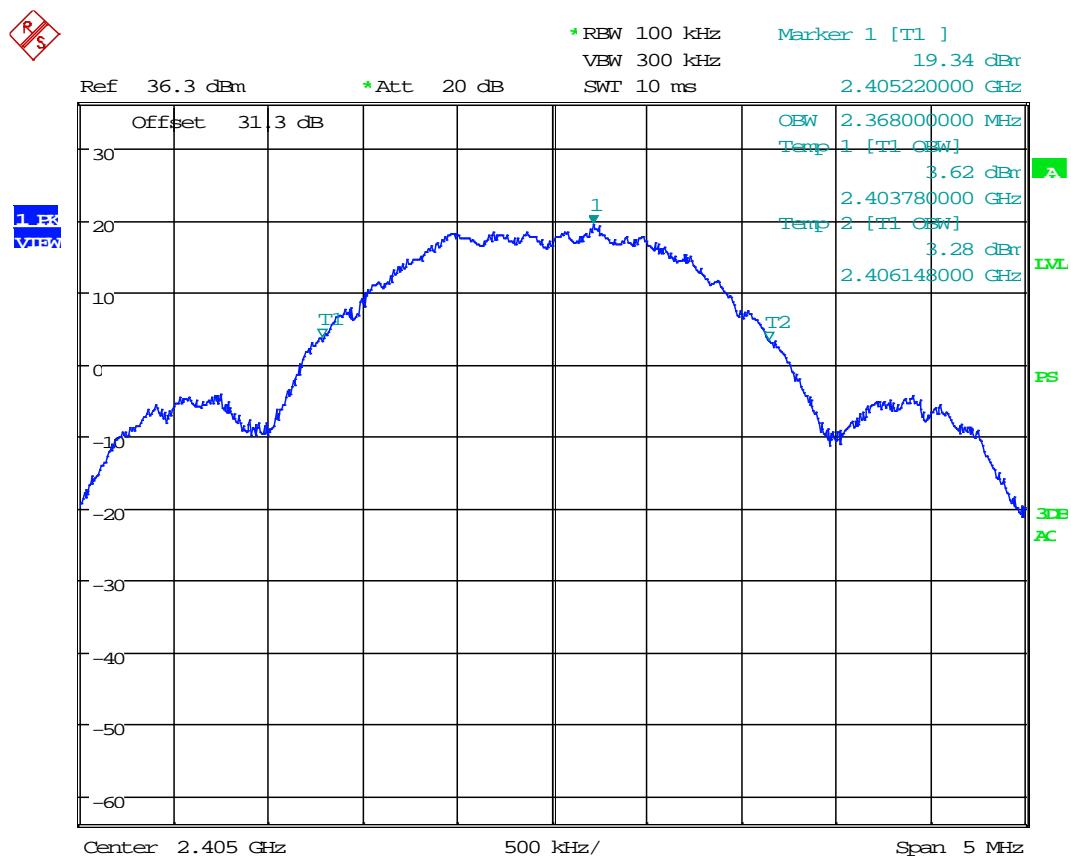


Date: 15.OCT.2018 15:43:56

**RESULT: 20 dB OBW = 2.62 MHz**

## OCCUPIED BANDWIDTH

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



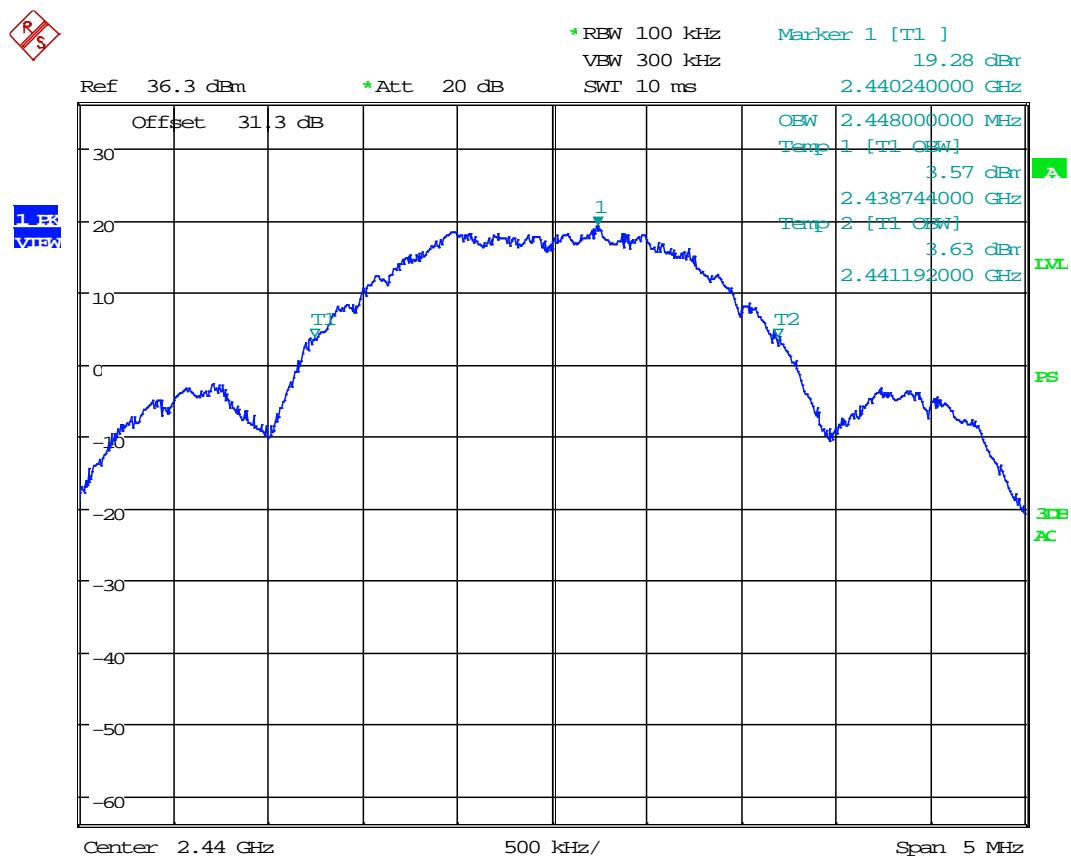
Date: 15.OCT.2018 15:19:43

## RESULT: 99% OBW = 2.36 MHz

Applicant: BRIGHTLOT, INC.  
FCC ID: 2ARCB-INVERNESS  
Report: 1578AZUT18\_TestReport\_Rev1

## OCCUPIED BANDWIDTH

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

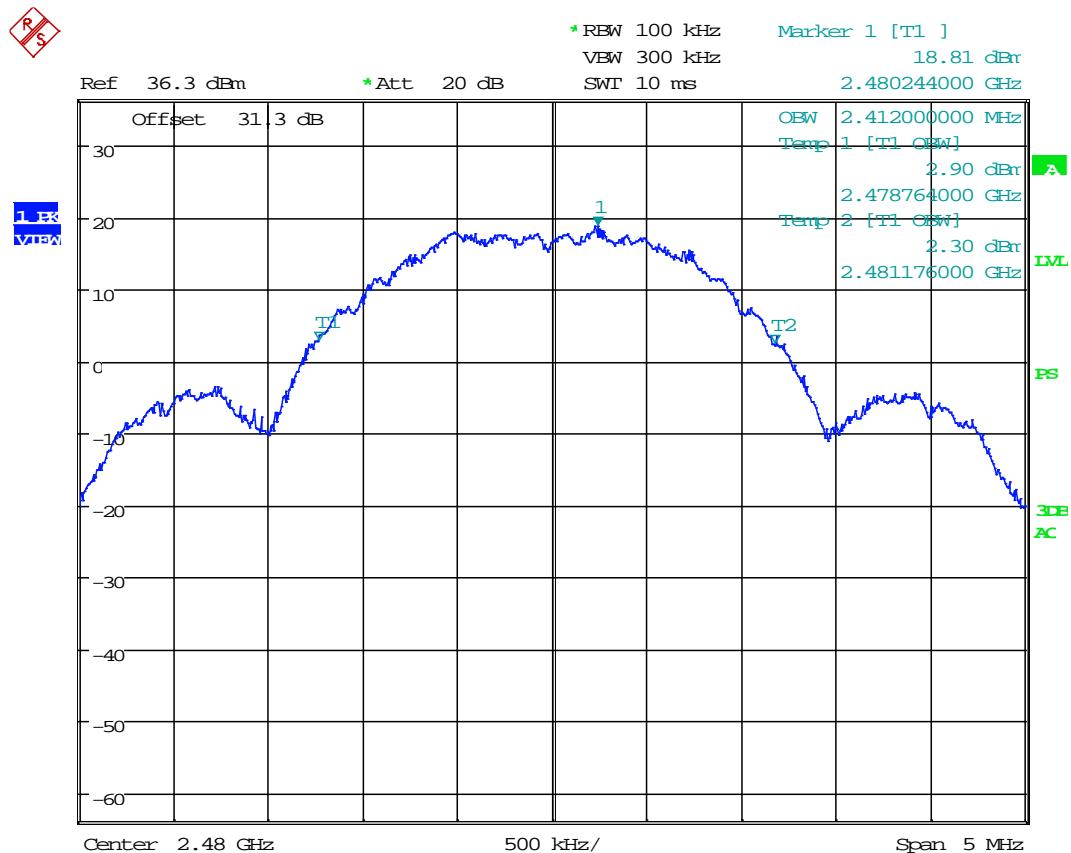


Date: 15.OCT.2018 15:56:40

**RESULT: 99% OBW = 2.44 MHz**

## OCCUPIED BANDWIDTH

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



Date: 15.OCT.2018 15:36:19

**RESULT: 99% OBW = 2.41 MHz**

## BANDEDGE

**Rule Part No.:** FCC 15.247(d)

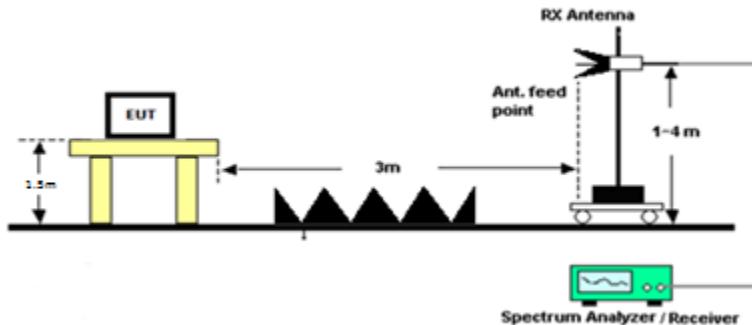
### Requirements:

#### **§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

(d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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

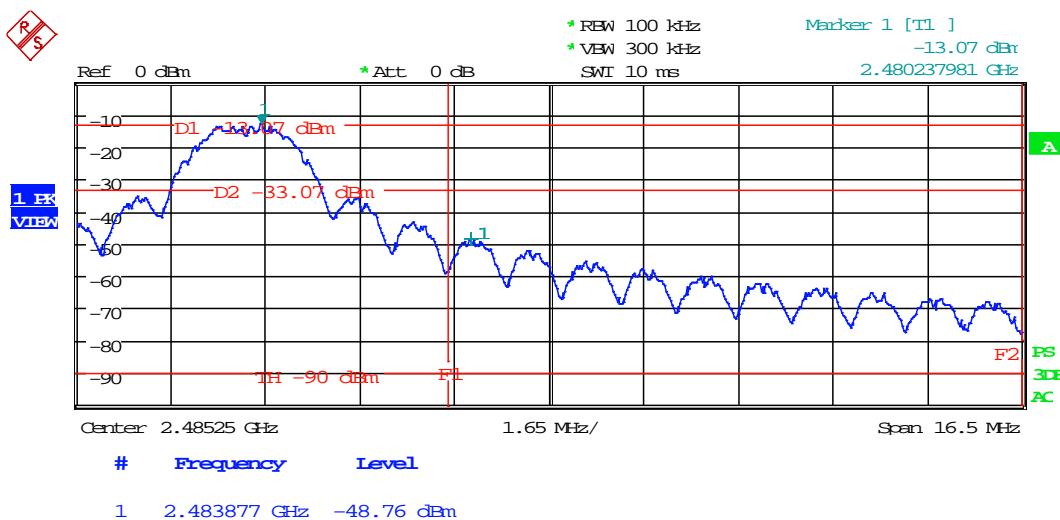
### Setup:



## BANDEDGE

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

Measurement Detector	Antenna Polarization	Field Strength of Carrier (dBuV/m)	UBE Emission Level (dBc)	Field Strength of Emission (dBuV/m)	Emission Limit (dBuV/m)	Margin (dB)
PK	V	77.79	35.69	42.1	74.00	31.9
AV	V	73.41	35.69	37.72	54.00	16.28



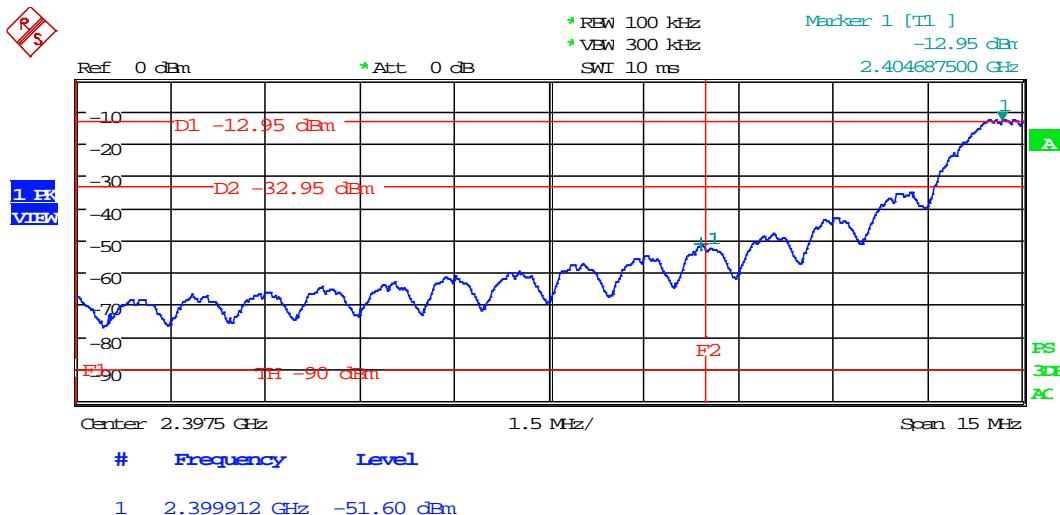
Date: 15.OCT.2018 15:40:19

### RESULT: Meets Requirements

Applicant: BRIGHTLOT, INC.  
 FCC ID: 2ARCB-INVERNESS  
 Report: 1578AZUT18\_TestReport\_Rev1

## BANDEDGE

### Test Data: Lower Band Edge Plot



Date: 15.OCT.2018 15:05:56

**RESULT: Meets Requirements**

## RADIATED SPURIOUS EMISSIONS

**RULE PART NO.:** FCC part 15.247 (d) & 15.209

### Requirements:

#### **§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

(d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

#### **§15.209 Radiated emission limits; general requirements.**

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Limit ( $\mu$ V/m)	Limit (dB $\mu$ V/m)
0.009 – 0.490	2400/F(in kHz) @ 300m	-
0.490 – 1.705	24000/F(in kHz) @ 30m	-
1.705 kHz – 30	30.0 @ 30 m	29.54 @ 30m
30 – 88	100.0	40.0
88 – 216	150.0	43.5
216 – 960	200.0	46.0
Above 960	500.0	54.0

#### **§15.35 Measurement detector functions and bandwidths.**

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

## RADIATED SPURIOUS EMISSIONS

**Test Procedure:**    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

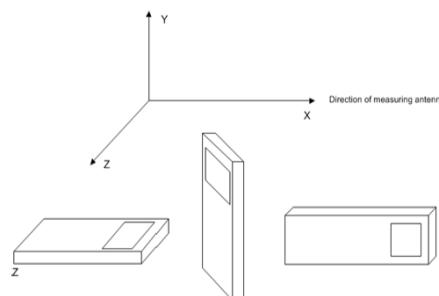
### Radiated Emissions Test Setup:

EUT setup and arrangement was completed as described in ANSI C63.4. Exploratory measurements were taken following different peripheral placement and cable manipulations as described in ANSI C63.4. A photo is provided of the Test setup to record the exact peripheral equipment and cable manipulation arrangement found to produce the highest possible level of radiated emissions.

The test procedure used for radiated emissions is described ANSI C63.4 using a spectrum analyzer. The resolution bandwidth used was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. All cable loss and antenna factors were calibrated to provide plots with correction factors applied to results using the formula and example described below. The video bandwidth of the analyzer was always greater than or equal to the resolution bandwidth, and a peak detector with max hold was used.

The unit under test was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The table used for radiated measurements is capable of continuous rotation. When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. The frequency was scanned from 30 MHz to 1.0 GHz. The EUT was measured in three parts of the tunable band of EUT and (3) orthogonal planes when necessary.

### EUT Orientation(s):



## RADIATED SPURIOUS EMISSIONS

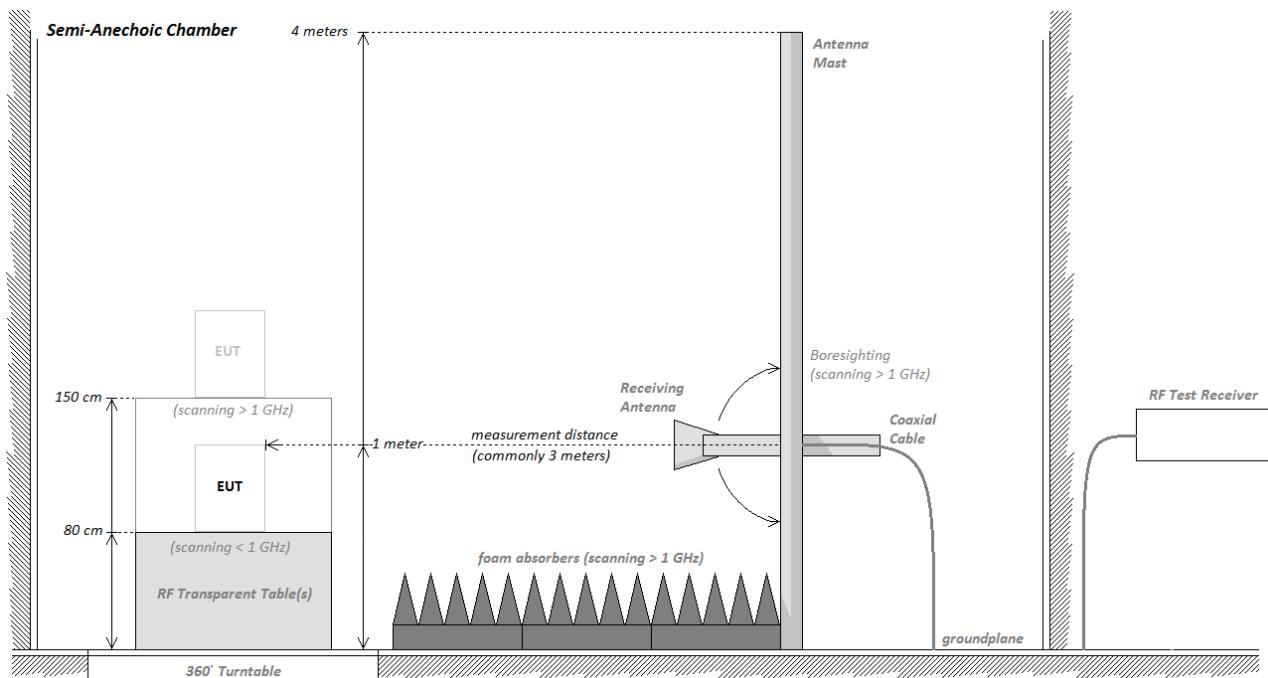
### Formula of Conversion Factors:

The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB $\mu$ V) 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.

### Field Strength Correction Factor Conversion Example:

Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB $\mu$ V	+ 10.36 dB/m	+0.40 dB	=30.76 dB $\mu$ V/m @ 3m

### Test Setup:



## RADIATED SPURIOUS EMISSIONS

**Notes:** The spectrum was measured from 9 KHz to 25 GHz. Six or more of the Spurious Emissions equal to or less than 20 dB from the limits are required to be reported, therefore the worst case data rate and output power which produced emissions within 30 dB of the limit are reported below.

Restricted Bands, per 15.209(a). The measurement of restricted bands were taken in Peak Hold, and shown to comply with the average limit of 15.209. In cases where the Peak measurement does not meet or exceed the Average limit of 15.209, the Average detector was used, and the peak is to then meet the level of 15.35(b), 20 dB higher than the limit of 15.209.

For all other emissions (in non-restricted bands) they are shown to comply with the limit of 15.247(d). The Radiated Fundamental Power Output is taken below, using a Peak detector.

### Test Data: 2405 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin dB
2405	319.23	9.47	PK	V	2.09	13.80	25.36	20.64
2405	319.23	15.22	PK	H	2.09	13.80	31.11	14.89
2405	400.00	13.93	PK	V	2.29	15.40	31.62	14.38
2405	400.00	10.44	PK	H	2.29	15.40	28.13	17.87
2405	560.25	8.40	PK	H	2.84	18.80	30.04	15.96
2405	720.51	10.69	PK	V	3.15	20.10	33.94	12.06
2405	1214.70	16.55	PK	V	4.04	29.27	49.86	4.14
2405	1743.60	17.24	PK	H	4.88	29.68	51.80	2.20
2405	8259.30	-1.03	PK	V	10.91	35.78	45.66	8.34
2405	12499.90	-8.04	PK	H	13.52	39.35	44.83	9.17

## RADIATED SPURIOUS EMISSIONS

### Test Data: 2440 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin dB
2440	79.85	17.45	PK	V	1.08	8.56	27.09	12.91
2440	103.55	5.68	PK	H	1.17	10.80	17.65	25.85
2440	103.83	7.37	PK	V	1.18	10.80	19.35	24.15
2440	1388.20	14.23	PK	V	4.35	29.08	47.66	6.34
2440	1668.40	15.34	PK	H	4.73	28.65	48.72	5.28
2440	5435.80	0.84	PK	H	8.84	34.47	44.15	9.85
2440	9056.30	1.07	PK	V	11.26	36.12	48.45	5.55

### Test Data: 2475 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin dB
2480	79.85	11.65	PK	H	1.08	8.56	21.29	18.71
2480	79.85	10.42	PK	H	1.08	8.56	20.06	19.94
2480	79.86	20.61	PK	V	1.08	8.56	30.25	9.75
2480	103.55	6.20	PK	V	1.17	10.80	18.17	25.33
2480	103.55	5.54	PK	H	1.17	10.80	17.51	25.99
2480	319.23	8.40	PK	V	2.09	13.80	24.29	21.71
2480	400.00	12.04	PK	V	2.29	15.40	29.73	16.27
2480	400.00	8.14	PK	V	2.29	15.40	25.83	20.17
2480	560.25	13.24	PK	V	2.84	18.80	34.88	11.12
2480	1342.90	15.72	PK	V	4.31	29.73	49.76	4.24
2480	5268.40	1.26	PK	V	8.70	34.38	44.34	9.66
2480	9241.90	1.38	PK	H	11.42	36.26	49.06	4.94

### Result: Meets Requirements

**TEST EQUIPMENT LIST**

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconical 1057	Eaton	94455-1	1057	12/13/2017	12/13/2019
Antenna: Log- Periodic 1122	Electro-Metrics	LPA-25	1122	7/26/2017	7/26/2019
CHAMBER	Panashield	3M	N/A	5/5/2017	5/5/2019
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	4/1/2016	4/1/2019
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	41534	3/1/2017	3/1/2019
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Coaxial Cable #103 - KMMK- 0180-01_Aqua	Micro-Coax	UFB142A-0- 0720-200200	225363-002 (#103)	8/5/2015	8/5/2019
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMMK-0244-01 KMMK-0670-00 KFKF-0198-01	8/9/2016	8/9/2019
Band Reject Filter 2.4 GHz	Micro-Tronics	BRM50702-02	0	9/27/2016	9/27/2019
Pre-amp	RF-LAMBDA	RLNA00M45GA	N/A	1/4/2016	1/4/2019
Antenna: Double-Ridged Horn 18-40 GHz	EMCO	3116	9011-2145	12/8/2017	12/8/2019
Attenuator SMA 30dB 5W DC- 18G	Pasternack	PE7013-30	#23	11/19/2017	11/19/2019

**\*EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3

**END OF REPORT**