

Electromagnetic Compatibility

Test Report

Tested to FCC Part 15C & RSS-210 Issue 9 and ANSI C63.10:2013

On

GPS Reporting Unit

OSCRSNSR

L-Tron
7911 Lehigh Crossing
Victor, NY 14564

Prepared by:

TUV Rheinland of North America, Inc.

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Report No.:
31753819.001
Page 2 of 27

Client:	 L-TRON CORPORATION	L-Tron 7911 Lehigh Crossing Victor, NY 14564	Kenneth Gravenstede Ph: 585 383 0050 x121 Ken.gravenstede@l-tron.com		
Identification:	GPS Reporting Unit	Serial No.:	Production Prototype		
Test item:	OSCRSNSR	Date tested:	23 January 2018		
Testing location:	TUV Rheinland of North America 710 Resende Road Webster, NY 14580 U.S.A.	Tel: (585) 645-0125 Fax: N/A			
Test specification:	Emissions: FCC Part 15, Subpart C, RSS-210 Issue 9:2016: FCC Parts 15.207(a):2018 and RSS-GEN I4 clause 8.8, FCC Parts 15.249(d), 15.209, 15.215(c), RSS-210 I9 clause B.10, RSS-GEN I4 clauses 8.9 and 8.10, FCC Part 15.249:2018 and RSS-210 Annex B.10, FCC Parts 15.249(a):2018, 15.249(c):2017, RSS-210 B.10(a), FCC Part 2.1093:2018 and RSS-102, Issue 4				
Test Result	The above product was found to be Compliant to the above test standard(s)				
tested by: Richard Decker	reviewed by: Mark Ryan				
16 February 2018 <i>Signature</i>	16 February 2018 <i>Signature</i>				
Other Aspects:	None				
Abbreviations: OK, Pass, Compliant, Complies = passed Fail, Not Compliant, Does Not Comply = failed N/A = not applicable					
			Industry Canada	VCCI	BSMI
US5253	Testing Cert #3331.08	482B-1	A-0203	SL2-IN-E-050R	

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TABLE OF CONTENTS

1	GENERAL INFORMATION	4
1.1	SCOPE	4
1.2	PURPOSE	4
1.3	REVISION HISTORY	4
1.1	SUMMARY OF TEST RESULTS	5
2	LABORATORY INFORMATION	6
2.1	ACCREDITATIONS & ENDORSEMENTS	6
2.2	EXPANDED MEASUREMENT UNCERTAINTY	8
2.3	MEASUREMENT EQUIPMENT USED	9
3	PRODUCT INFORMATION	10
3.1	PRODUCT DESCRIPTION	10
3.2	EQUIPMENT MODIFICATIONS	10
3.3	EQUIVALENT MODELS	10
3.4	TEST PLAN	10
4	RADIATED EMISSIONS IN TRANSMIT MODE	11
4.1	RADIATED EMISSIONS - FCC PARTS 15.249, RSS-210 B.10	11
4.2	BAND EDGE REQUIREMENTS - FCC PART 15.249(D), RSS-GEN	19
4.1	CONDUCTED EMISSIONS ON AC MAINS – FCC 207(A) AND RSS-GEN 8.8	22
4.2	99% POWER BANDWIDTH	23
5	TEST DOCUMENTATION REQUIREMENTS - TRANSMITTERS	27
5.1	GENERAL INFORMATION	27

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the standard(s), based on the results of testing performed on 23 January 2018 on the GPS Reporting Unit, OSCRSNSR, manufactured by L-Tron Inc. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Revision History

Rev.	Date	Description of Revision
.001	1/23/2018	Initial Release

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1.1 Summary of Test Results

Applicant	L-Tron 7911 Lehigh Crossing Victor, NY 14564	Tel	585 383 0050 x121	Contact	Kenneth Gravenstede
		Fax	N/A	e-mail	Ken.gravenstede@l-tron.com
Description	GPS Reporting Unit	Model	OSCRSNSR		
Serial Number	Production Prototype	Test Voltage/Freq.	2.8 VDC		
Test Date Completed:	23 January 2018	Test Engineer	Richard Decker		
Standards	Description	Severity Level or Limit		Worst-case Values	Test Result
FCC Part 15, Subpart C Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out parts below		See Below	Complies
RSS-210 Issue 9:2016 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out parts below		See Below	Complies
FCC Part 15.249:2018 and RSS-210 Annex B.10	Operation within the band 2400 to 2483.5 MHz	See called out parts below		See Below	Complies
FCC Parts 15.249(a):2018, 15.249(c):2017, RSS-210 B.10(a)	Radiated Output Power for Fundamental and Harmonic Frequencies	Fund: Shall not exceed 50 mV/m at 3m Harmonics: Shall not exceed 500 μ V/m (0.5 mV/m) at 3m, (unrestricted bands)		30 mV/m 150 μ V/m -	Complies
FCC Parts 15.249(d):2018, 15.209, 15.215(c):2018, RSS-210 I9 clause B.10, RSS-GEN I4 clauses 8.9 and 8.10	Out-of-Band Spurious Emissions and Band Edges (EUT in Transmit Mode)	Below the applicable limits		43.50 dB μ V	Complies
FCC Parts 15.207(a):2018 and RSS-GEN I4 clause 8.8	Conducted Emissions on AC Mains	NA, The EUT is battery operated only		NA	NA
RSS-GEN I4 clause 6.6	Occupied Bandwidth	99% BW \leq 0.5% of center freq.		1.9977 MHz	Complies
FCC Part 2.1093:2018 and RSS-102, Issue 4	RF Exposure and Antenna Gain Calculation	SAR or MPE Requirements		0.318 mW	Complies

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2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at, 710 Resende Road, Building 199, Webster, NY 14580 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90575). The laboratory scope of accreditation includes: Title 47 Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 ILAC/A2LA

This is a program which is administered under the auspices of A2LA. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Certificate Number: 3331.08). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 VCCI

VCCI Accredited test lab. Registration numbers A-0203

2.1.4 Industry Canada

(Registration No.: 482B-1) The 10M SEMI-ANECHOIC CHAMBER has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2009.

2.1.5 BSMI

Registration No.: SL2-IN-E-050R. The BSMI accreditation was obtained by NIST MRA with the BSMI.

2.1.6 Korea

Recognized by Radio Research Agency as an accredited Conformity Assessment Body (CAB) under the terms of Phase I of the APEC TEL.

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2.1.7 Test Software

- Agilent MXE Receiver A.10.04
(The installed EMC software in the MXE has p/n N6141A-2FP and version 1.3.50510.18099)
- CIGUI 32 Version 1.4 for California Instruments AC power source
- HP software E7415A Version A.01.45
- National Instruments “Measurement & Automation Employer” Version 4.6.2f1
- TILE version 3.4.K.28
- Voltech PM 6000 Firmware 1.22.07RC6, Software IEC61000-3 for PM6000 Release 1.24.12
- California Instruments AC power source MXHCL
- Rohde & Schwarz EMI Measurement software EMC32 version 8.50.0
- TILE version 4.0.B
- Keytek CEWare 2.10

2.1.8 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V/m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dB μ V/m)

$$25 \text{ dB}\mu\text{V/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dB}\mu\text{V/m}$$

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2.2 Expanded Measurement Uncertainty

The accumulated measurement uncertainties of the test system in use for the parameters measured were expected not exceed the values given in the following tables.

Per CISPR 16-4-2:2011		U₉₅
Radiated Disturbance @ 3m, 10m		
30 MHz – 1,000 MHz (Horizontal Polarity)		3m = 4.52 dB,
1.0 GHz – 6.0 GHz		3m = 4.25 dB
> 6.0 GHz		3m = 4.93 dB

U₉₅= Expanded Uncertainty.

Note:

Expanded measurement uncertainty numbers are shown in the table above. Compliance criteria are not based on measurement uncertainty. The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2 (U₉₅).

Per ETSI TR 100 028 and ETSI TR 100 273		U₉₅
Frequency Accuracy		
30 MHz – 1000 MHz (Band 1)		1.44 Hz
1.0 GHz – 6.0 GHz (Band 2)		1.78 Hz
> 6.0 GHz (Band 3)		3.13 Hz
Carrier Power Measurement		
Total		1.59 dB
Adjacent Channel Power Measurement		
Total		1.47 dB
Conducted Spurious Emissions Measurement		
Total		4.01 dB
Frequency Deviation Measurement		
Total		1.30 dB
Total Response Measurement		
Total		0.46 dB

U₉₅= Expanded Uncertainty.

Notes:

Expanded measurement uncertainty numbers are shown in the table above. The given uncertainty figures are valid to a confidence level of 95 % (k=2), calculated according to the methods described in ETSI TR 100 028 and ETSI TR 100 273.

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2.2.1 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.3 Measurement Equipment Used

Equipment	Manufacturer	Model #	Ref.	Serial #	Last Cal	Next Cal
Radiated Emissions						
BiLog	Chase	CBL6111	C017	1169	17-Nov-17	17-Nov-19
Horn(1-18 GHz)	ETS	3117		040361	4-Feb-16	4-Feb-18
Horn(18-26.5 GHz)	ETS	3160-09		1275	4-Feb-16	4-Feb-18
Horn(26.5-40 GHz)	ETS	3160-10		1180	4-Feb-16	4-Feb-18
Receiver (20Hz-40GHz)	Rohde & Schwarz	ESI(B) 40		100090	1-Aug-17	1-Aug-18
N9038A	Agilent Technologies	MXE		MY52130004	1-Aug-17	1-Aug-18
Signal Generator	R&S	SMR 40		100195	1-Aug-17	1-Aug-18
General Laboratory Equipment						
Multimeter	Fluke	87		59890224	1-Aug-17	1-Aug-18
Pressure/Temperature/RH	Davis	Perception II		PB00217A27	13-Apr-17	13-Apr-18

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3 Product Information

3.1 Product Description

The OSCRSNSR is a GPS Reporting Unit for Tilt/Pan/Roll/ GPS reporting which reports data via Bluetooth low energy. BTLE module is purchased from vendor but not certified. The EUT uses the NRF51822 Nordic chipset.

Two sets of the EUT were provided for testing. One is normal a configuration for unintentional cabinet radiation. The second was modified with test firmware to allow the low, medium and high hopping channels to continuously transmit with modulation. External batteries were included on the modified devices to allow long-term transmissions. Fresh batteries were installed frequently.

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

3.3 Equivalent Models

No additional models covered by test report.

3.4 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in appendix A of this report.

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4 Radiated Emissions in Transmit mode

4.1 Radiated emissions - FCC Parts 15.249, RSS-210 B.10

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

Fundamental Frequency: 2400 to 2483.5 MHz – 50 mV/m (94 dB μ V/m) at 3m.

Harmonic Frequencies: 500 μ V/m (54 dB μ V/m) at 3m.

Spurious Emissions: To the limits of FCC Part 15.209 and RSS-GEN 7.2.1.

4.1.1 Over View of Test

Results	Complies (as tested per this report)			Date	10 January 2018			
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.249(a), 15.249(c), 15.249(d) RSS-210 B.10, and RSS-GEN							
Product Model	OSCRSNSR		Serial#	Production Prototype				
Test Set-up	Tested in a 10m Semi Anechoic chamber, placed on a .8m x 1.5m non-conductive table above the ground plane on a turn-table.							
EUT Powered By	2.8 VDC	Temp	72° F	Humidity	35%	Pressure		
Perf. Criteria	(Below Limit)		Perf. Verification	Readings Under Limit				
Mod. to EUT	None		Test Performed By	Richard Decker				

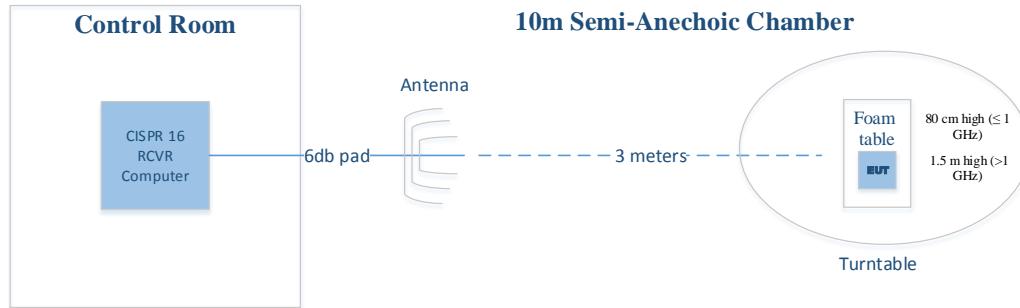
4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2013, RSS-GEN Issue 4. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

Since all emissions outside the band are within the limits of FCC Part 15.209 and RSS-GEN 7.2.1, the emissions shown below are also compliant with FCC Parts 15.205, 15.215(c), 15.249(d), RSS-210 B,10.

4.1.4 Test Setup



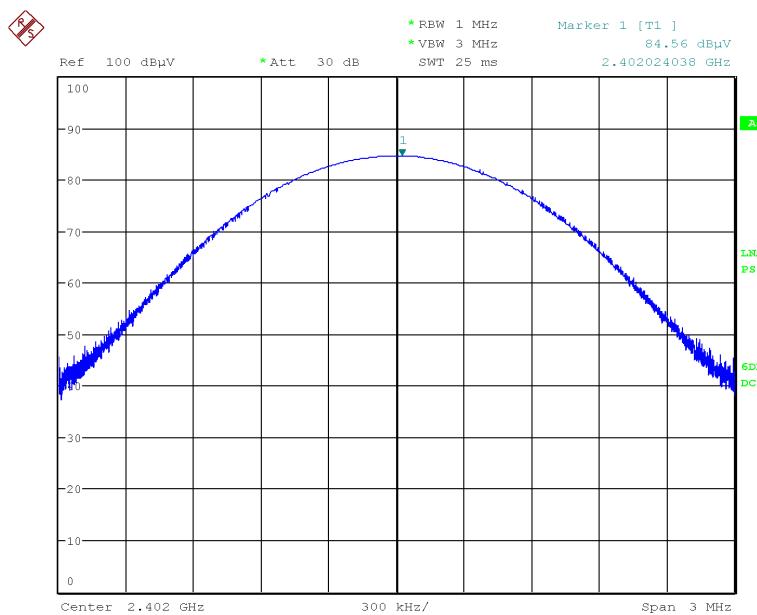
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4.1.5 Final Test Data

All final radiated spurious emissions measurements were below (in compliance) the limits. The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

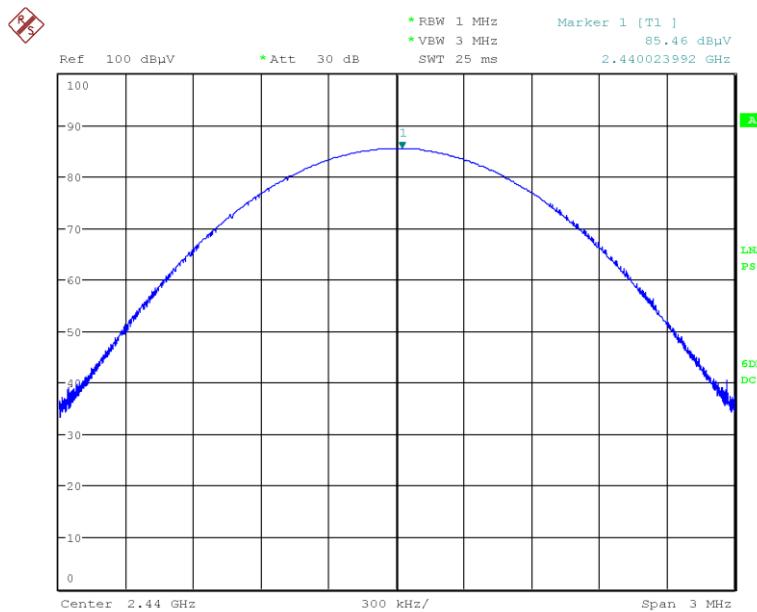
Worst Case Emissions inside the Frequency Band				
Operating Channel (MHz)	Polarity	Measured Power	Limit (dB μ V/m)	Margin (dB)
Orientation X				
2402.0	Horizontal	84.56	94.00	-9.44
2440.0	Horizontal	85.46	94.00	-8.54
2480.0	Horizontal	90.14*	94.00	-3.86
Orientation Y				
2402.0	Horizontal	79.28	94.00	-14.72
2440.0	Horizontal	79.62	94.00	-14.38
2480.0	Horizontal	80.33	94.00	-13.67
Orientation Z				
2402.0	Horizontal	84.15	94.00	-9.85
2440.0	Horizontal	85.43	94.00	-8.57
2480.0	Horizontal	89.00	94.00	-5
* Worst Case Emission				

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Date: 10.JAN.2018 09:06:09

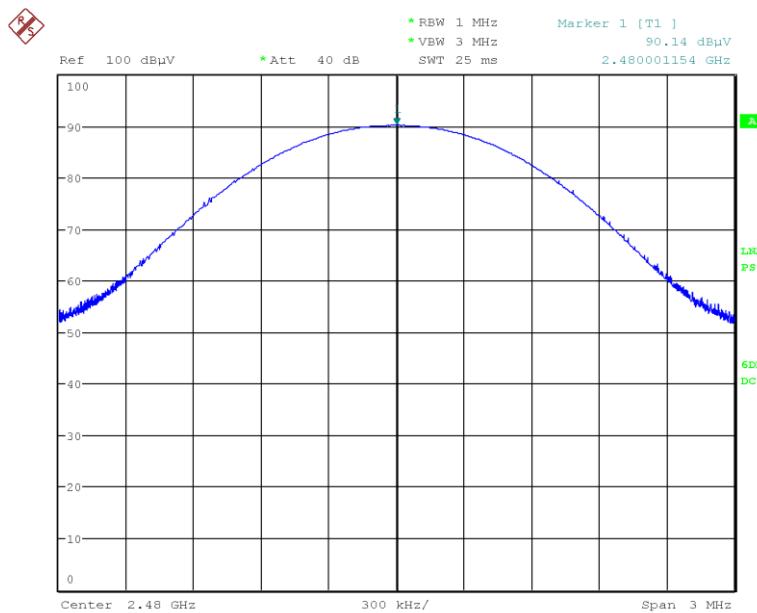
Figure 1 : Maximum peak radiated output power, 2402MHz



Date: 10.JAN.2018 08:08:40

Figure 2 : Maximum peak radiated output power, 2440MHz

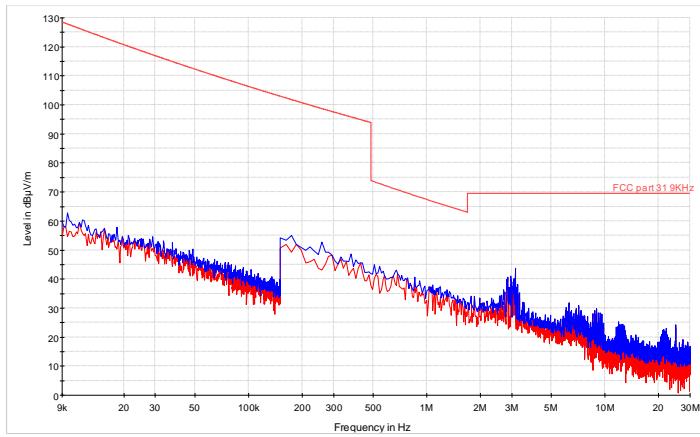
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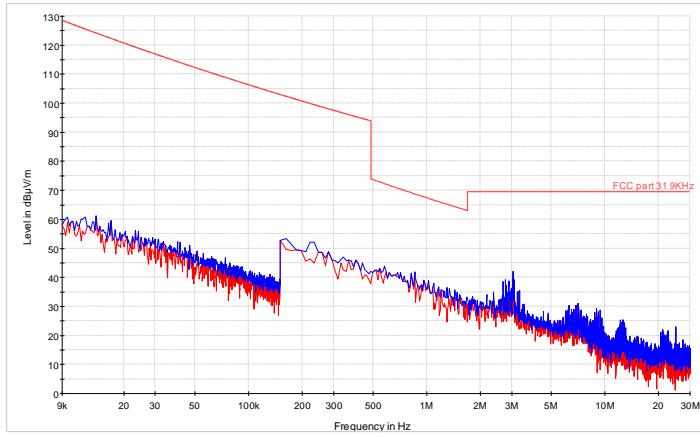
Date: 10.JAN.2018 07:07:27

Figure 3 : Maximum peak radiated output power, 2480MHz

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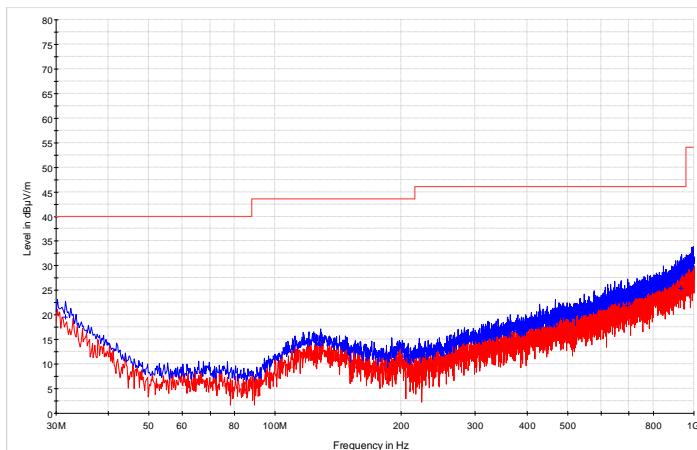
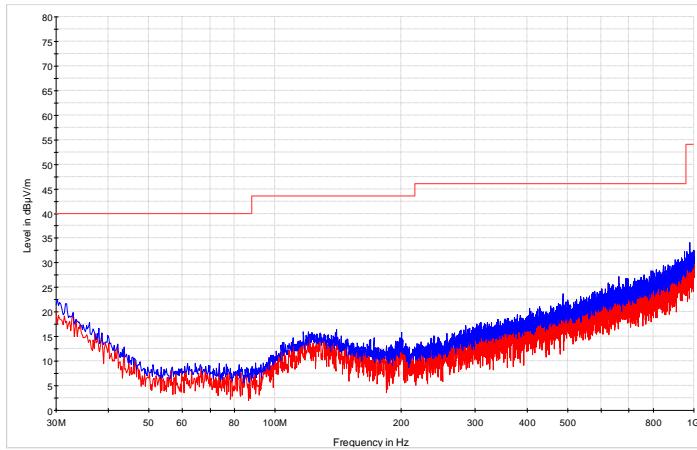
Radiated Emissions
9kHz – 30MHz**Figure 4** : Loop antenna orientation 0 degrees

No measurable data

**Figure 5** : Loop antenna orientation 90 degrees

No measurable data

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Report No.:
31753819.001
Page 16 of 27
Radiated Emissions 30MHz – 1000MHz

Figure 6 : 30-1000MHz Vertical

Figure 7 : 30-1000MHz Horizontal

Frequency MHz	QuasiPeak dBµV/m	Height cm	Polarization	Azimuth deg	QuasiPeak Limit	QuasiPeak Margin
31.6	19.6	118.0	V	2.0	40.0	-20.4
128.6	13.8	118.0	V	30.0	43.5	-29.7
364.4	15.7	118.0	V	155.0	46.0	-30.3
466.3	17.8	118.0	V	60.0	46.0	-28.2
695.6	21.9	118.0	V	250.0	46.0	-24.1
930.6	25.4	118.0	V	45.0	46.0	-20.6

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Radiated Emissions 1GHz – 18GHz

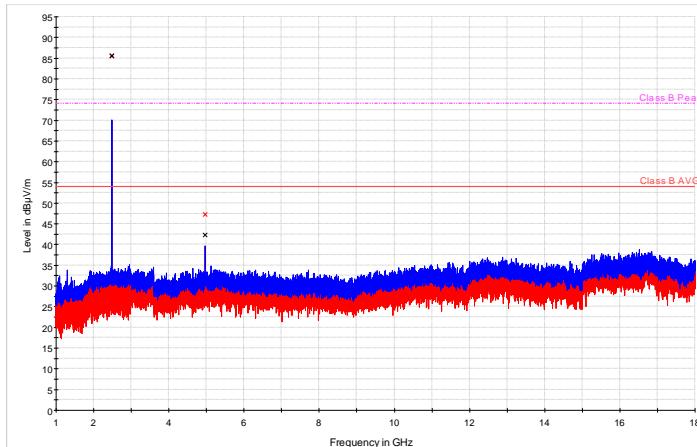


Figure 8 : 1-18GHz Vertical

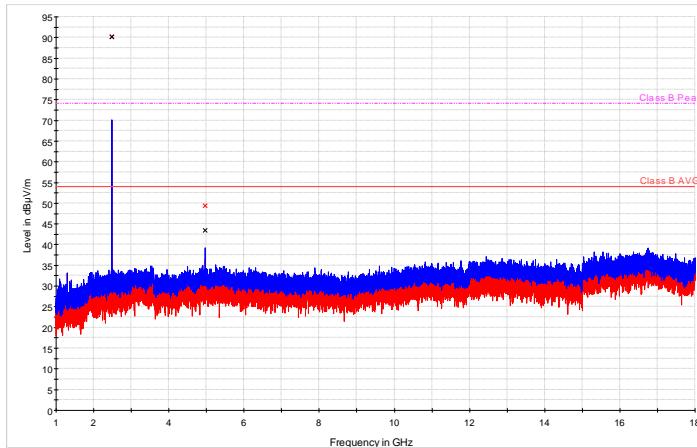


Figure 9 : 1-18GHz Horizontal

Frequency MHz	MaxPeak dBμV/m	CAverage dBμV/m	Height cm	Polarizatio n	Azimuth deg	MaxPeak Limit	CAverage Limit	MaxPeak Margin	CAverage Margin
2480.0	90.2	90.2	3.0	H	83.0	94.0	94.0	-3.8	-3.8
4960.3	49.4	43.5	2.8	H	1.0	74.0	54	-24.6	-10.5
2480.0	85.6	85.5	1.5	V	-2.0	94.0	94.0	-8.4	-8.4
4960.3	47.3	42.3	1.5	V	120.0	74.0	54	-26.7	-11.7

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Radiated Emissions 18GHz – 26.5GHz

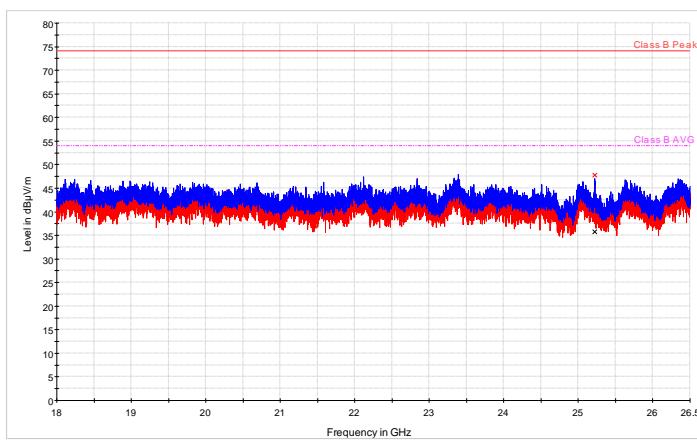


Figure 10 : 18-26.5GHz Vertical

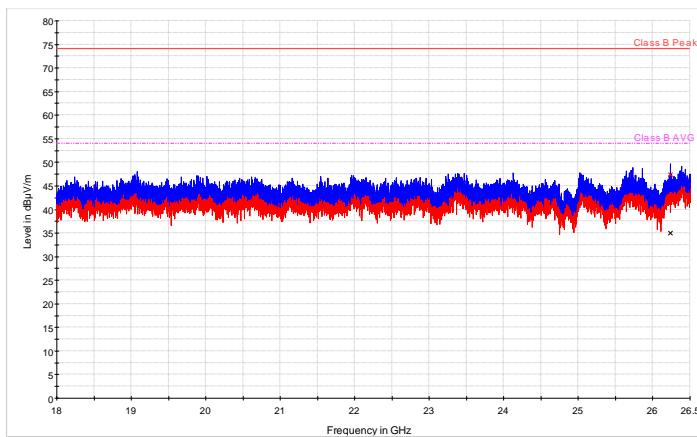


Figure 11 : 18-26.5GHz Horizontal

Frequency MHz	MaxPeak dBμV/m	CAverage dBμV/m	Height cm	Polarizatio n	Azimuth deg	MaxPeak Limit	CAverage Limit	MaxPeak Margin	CAverage Margin
25220.8	47.8	35.8	0.0	V	200.0	74.0	54	-26.2	-18.2
26239.0	47.4	35.0	0.0	H	150.0	74.0	54	-26.6	-19.0

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4.2 Band Edge requirements - FCC Part 15.249(d), RSS-GEN

4.2.1 Test Over View

Results	Complies (as tested per this report)				Date	23 January 2018	
Standard	FCC Part 15.249(d), RSS-GEN						
Product Model	OSCRSNSR			Serial#	Production Prototype		
Test Set-up	Tested in a 10m Semi Anechoic chamber, placed on a 1.5m non-conductive table above the ground plane on a turn-table.						
EUT Powered By	2.8 VDC	Temp	72° F	Humidity	35%	Pressure	1024 mbar
Perf. Criteria	(Below Limit)		Perf. Verification	Readings Under Limit			
Mod. to EUT	None		Test Performed By	Richard Decker			

4.2.2 Test Procedure

Sec. 15.249 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Sec. 15.209, whichever is the lesser attenuation.

4.2.3 Deviations

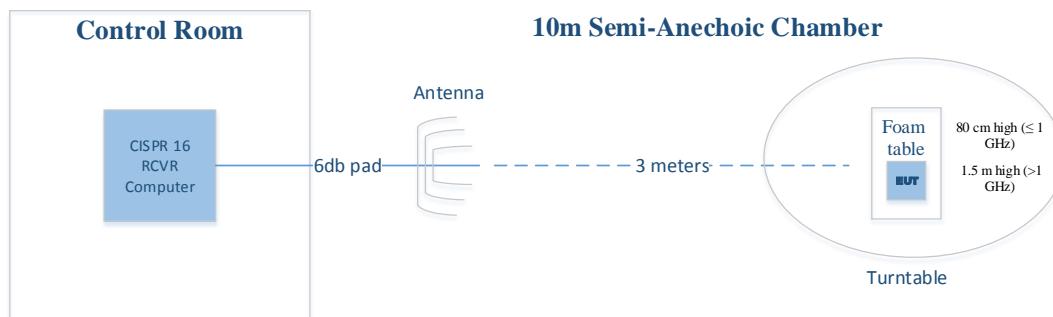
There were no deviations from the test methodology listed in the test plan.

4.2.4 Final Test

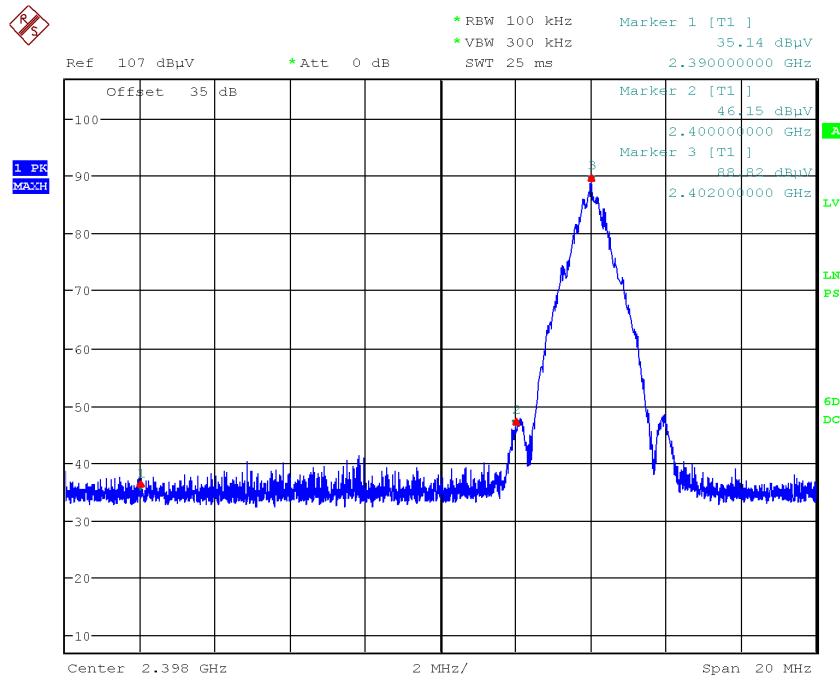
The EUT met the performance criteria requirement as specified in the standards.

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

4.2.1 Test Setup Block Diagram



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Date: 23.JAN.2018 07:55:16

Figure 1 2 : Lower Band Edge Measurement (Radiated Emission)

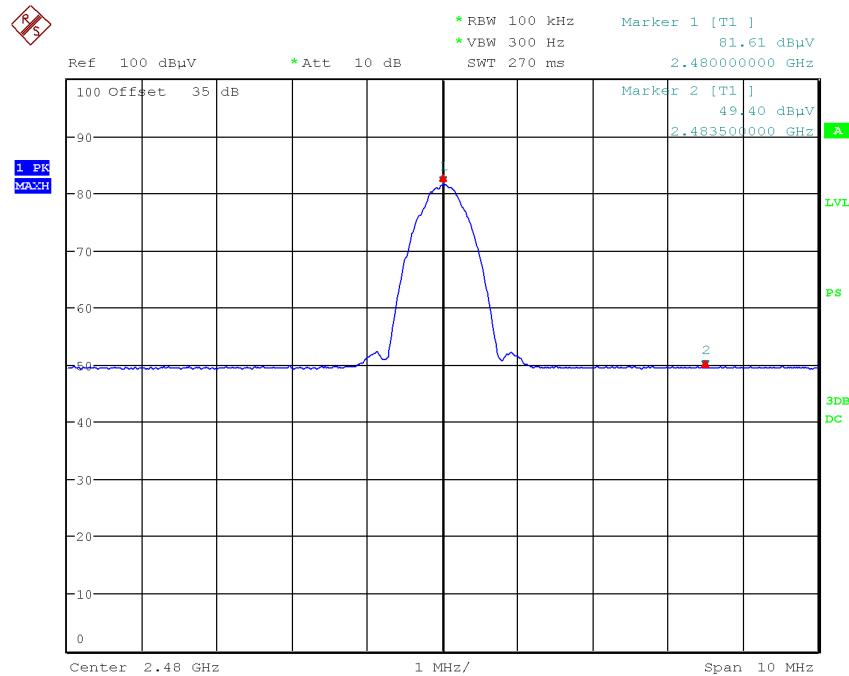
Notes:

- Measured using the Peak detector
- RBW of 100 kHz was chosen as it is within 1% to 5% of the total span. (4.8%)
- VBW of 300 kHz was chosen as it is 3 times the 100 kHz RBW
- Sweep time was set to Auto

The nearest restricted band (2390MHz) is 10 MHz below the band edge.

The Highest frequency outside the band is at 35.14 dBµV using the Peak Detector, which is below the Average restricted-band limit.

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AVG WITH 10DB
 Date: 23.JAN.2018 12:01:30

Figure 1 3 : Upper Band Edge Measurement (Radiated Emission)

Note:

- Measured using the Peak detector
- RBW of 100 kHz was chosen as it is within 1% to 5% of the total span. (4.8%)
- VBW of 300 kHz was chosen as it is 3 times the 100 kHz RBW
- Sweep time was set to Auto

Band edge at 2483.5 MHz is also the start of a restricted band, so the restricted band rules apply.

The Highest frequency outside the band is at 49.40 dBµV using the Peak Detector, which is below the Average restricted-band limit.

The EUT is compliant with the standard.

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4.1 Conducted Emissions on AC Mains – FCC 207(a) and RSS-GEN 8.8

This test measures the electromagnetic levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other nearby electronic equipment.

4.1.1 Over View of Test

Results	NA EUT is battery operated only			Date	NA			
Standard	FCC Parts 15.207(a):2018 and RSS-GEN I4 clause 8.8							
Product Model	NA		Serial#	NA				
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details							
EUT Powered By	N/A	Temp	NA	Humidity	NA	Pressure	NA	
Frequency Range	150 kHz – 30 MHz							
Perf. Criteria	(Below Limit)	Perf. Verification	Readings Under Limit for L1 & Neutral					
Mod. to EUT	None	Test Performed By	NA					

4.1.2 Test Procedure

Conducted emissions tests were performed using the procedures of ANSI C64.4: 2009, including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

4.1.3 Deviations

The Test sample is battery operated only. It does not have provision for external power of any kind.

4.1.4 Final Test

This test is not applicable for the device submitted for testing

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4.2 99% Power Bandwidth

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

4.2.1 Test Over View

Results	Complies (as tested per this report)				Date	25 January 2018			
Standard	RSS-GEN Issue 4, Clause 6.6								
Product Model	M328A			Serial#	Production Prototype				
Test Set-up	Radiated								
EUT Powered By	3 V DC	Temp	73° F	Humidity	35%	Pressure	1024 mbar		
Perf. Criteria	(Complies)		Perf. Verification		Readings Within Limit				
Mod. to EUT	None	Test Performed By		Richard Decker					

4.2.2 Test Procedure

Using the procedures of RSS-GEN section 6.6:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

4.2.3 Deviations

There were no deviations from the test methodology.

4.2.4 Final Results

The measured 99% bandwidth is 1.9977 MHz. The EUT is compliant to the requirements of RSS-GEN 6.6.

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

Frequency (MHz)	99% BW (MHz)
2402	1.9721
2440	1.9864
2480	1.9977

99% Power Band Width.

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4.2.1 Final Data

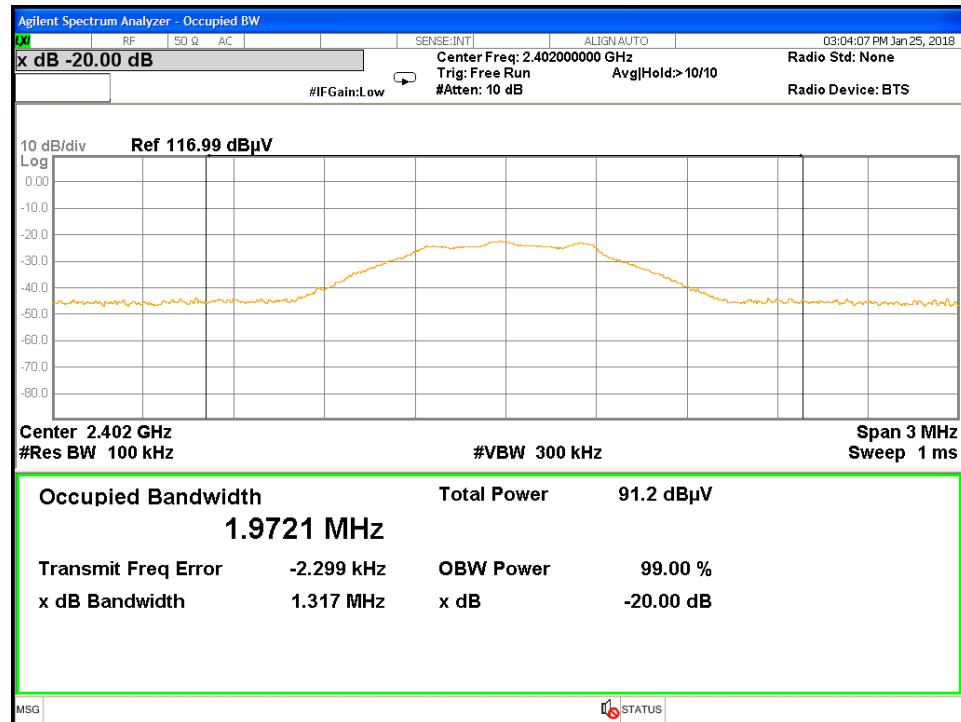


Figure 1 4 : 99% Occupied Bandwidth, 2402MHz

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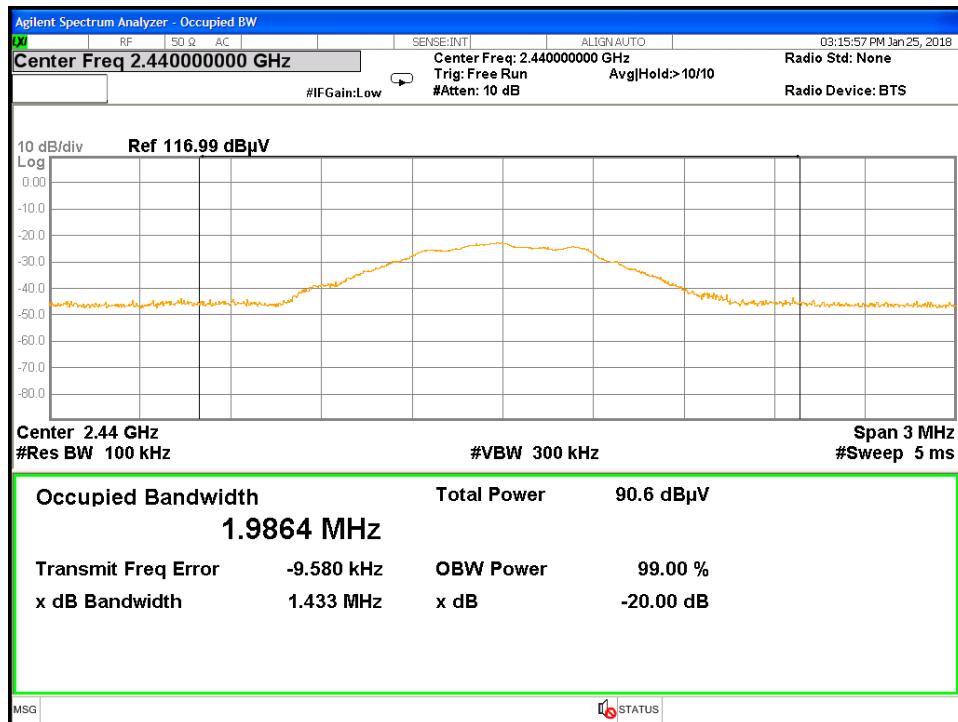
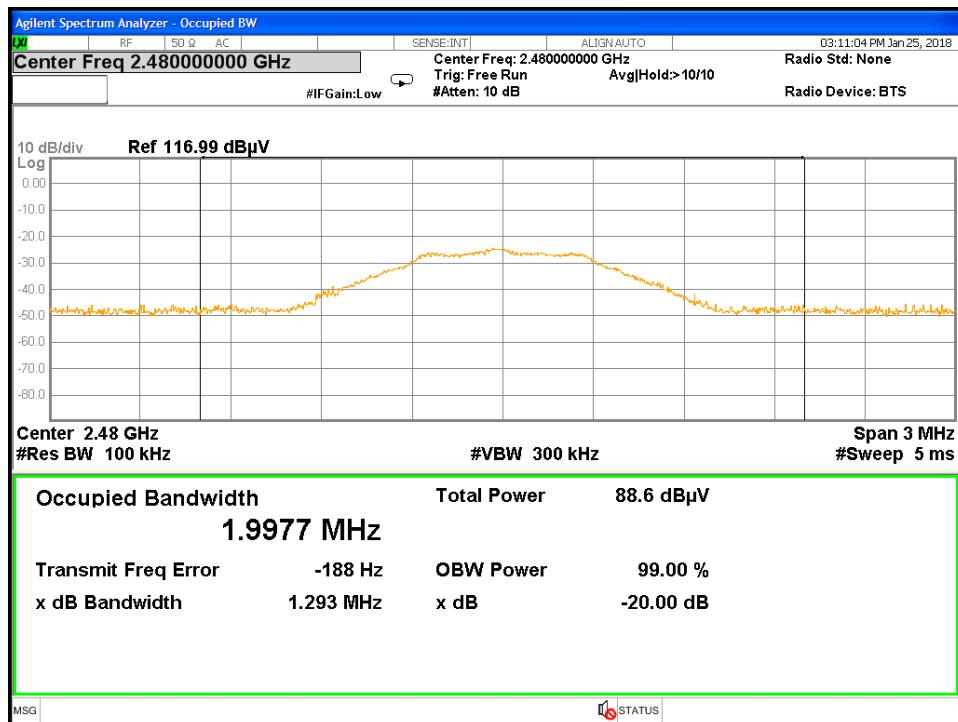


Figure 1 5 : 99% Occupied Bandwidth, 2440MHz

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Report No.:
31753819.001
Page 26 of 27

Figure 1 6 : 99% Occupied Bandwidth, 2480MHz

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5 Test Documentation Requirements - Transmitters

This test report is intended to follow this test plan outlined below unless otherwise stated in this report or quote agreement. The following test plan will give details on product information, test set ups, and product configurations.

5.1 General Information

Client	L-Tron
Address	7911 Lehigh Crossing
Address	Victor, NY 14564
Contact Person	Kenneth Gravenstede
Telephone	585 383 0050 x121
Fax	N/A
e-mail	Ken.gravenstede@l-tron.com

5.1.1 Product Name

GPS Reporting Unit

5.1.2 Model(s) Name

OSCRSNSR

5.1.3 Equipment Under Test (EUT) Description

Tilt/Pan/Roll/GPS reporting unit which reports data via Bluetooth low energy. BTLE module is purchased from vendor but not certified. It uses the NRF51822 Nordic chipset.

5.1.4 Testing Preparation

Only available port is a charging port via micro USB.

There is only one mode of operation.

A tablet communicates with DUT to poll for information.

A tablet with operation software which communicates with the unit will be made available for testing. Instructions will be provided.

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