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**FCC PART 15.249 & IC RSS-210 (i8) ANNEX A2.9
UNLICENSED INTENTIONAL RADIATOR
COMBINED TEST REPORT**

Applicant	LUTRON ELECTRONICS CO., INC.
Address	7200 SUTER ROAD COOPERSBURG PA 18036 USA
FCC ID	JPZ0109
IC Certification Number	2851A-JPZ0109
Model Number	0109
Product Description	802.15.14 ZIGBEE TX
FCC Standard Applied	47 CFR §15.249
Industry Canada Standard Applied	RSS-210 Issue 8 Annex A2.9
Date Sample Received	12/9/2014
Date Tested	12/9/2014
Tested By	Cory Leverett
Approved By	Sid Sanders
Report Number	2239AUT14TestReport.docx
Test Results	☒ PASS ☐ FAIL

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

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APPLICANT: LUTRON ELECTRONICS CO., INC.

IC: 2851A-JPZ0109

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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
☐ 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: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

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

Authorized Signatory Name:

Cory Leverett
Engineering Project Manager
Date: 12/5/2014



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GENERAL INFORMATION

EUT Specification

The test results relate only to the items tested.			
Applicable Standards	FCC Part 15.249 & IC RSS-210 (i8), RSS-GEN (i3)		
EUT Description	802.15.14 ZIGBEE TX		
FCC ID	JPZ0109		
IC Certification Number	2851A-JPZ0109		
Model Number	0109		
Operating Frequency	TX: 2405 - 2480 MHz	RX: Same	
No. of Channels	15	Modulations	CQPSK
EUT Power Source	☐ 110–120Vac/50– 60Hz when Charging		
	☐ DC Power		
	☒ CR 2032 Coin Cell Battery Operated Exclusively		
Test Item	☐ Prototype	☒ Pre-Production	☒ Production
Type of Equipment	☐ Fixed	☐ Mobile	☒ Portable
Antenna Connector	FCC Rules require that the antenna connector be unique. There is no antenna connector, it has an integrated PCB antenna		
Test Facility	Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.		
Conditions in the Test laboratory	Temperature: 24-26°C Relative humidity: 50-65%		
Test Exercise	100% Duty Cycle Tuned to Low, Middle, and High End of 2.4 GHz Band		
Revision History of EUT	None		

TEST RESULTS SUMMARY

FCC Rules Part No.	Industry Canada Rules	RESULTS – Pass/Fail/NA
15.249 Fundamental Emission	RSS-210 (i8) ANNEX A2.9, RSS-GEN (i3)	PASS
15.249 & 15.209 Harmonics & Spurious	RSS-210 (i8) ANNEX A2.9, RSS-GEN (i3)	PASS
15.205 & 2.202 Occupied Bandwidth	RSS-GEN (i3), 4.6	PASS
15.249 & 15.205 Bandedge Compliance	RSS-GEN (i3), 4.6	PASS
15.207 Power Line Emissions	RSS-GEN (i3), 7.2.4	NA

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TEST PROCEDURES

Radiation Interference: ANSI C63.4-2003 using a spectrum analyzer, a preselector, a quasi-peak adapter, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worst case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental. Emissions were scanned from 30MHz to the tenth harmonic of the fundamental frequency at three places in the band. All emissions greater than 20 dB from the limit are not reported.

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 dBuV) to the antenna correction factor supplied by the antenna manufacturer. 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 dBuV	+ 10.36 dB	+ 0.5	= 30.86 dBuV/m @ 3m

Power Line Conducted Interference: The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

Occupied Bandwidth: A small sample of the transmitter output was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to -10 dBm per division.

ANSI C63.4-2003 10.1 Measurement Procedures: The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The EUT was placed in the center of the table (1.5m side). 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. Emissions attenuated more than 20 dB below the permissible value are not reported.

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RADIATION INTERFERENCE

Rules Part No.: FCC 15.249, 15.209 & IC RSS-210 (i8) ANNEX A2.9, RSS-GEN (i3)

Requirements:

Frequency	Limits
Part 15.209 & RSS-GEN (i3)	
9 to 490 kHz	2400/F (kHz) $\mu\text{V/m}$ @ 300 meters
490 to 1705 kHz	24000/F (kHz) $\mu\text{V/m}$ @ 30 meters
1705 kHz to 30 MHz	29.54 dB $\mu\text{V/m}$ @ 30 meters
30 – 88	40.0 dB $\mu\text{V/m}$ @ 3 meters
80 – 216	43.5 dB $\mu\text{V/m}$ @ 3 meters
216 – 960	46.0 dB $\mu\text{V/m}$ @ 3 meters
Above 960	54.0 dB $\mu\text{V/m}$ @ 3 meters
Part 15.249 & RSS-210 (i8) ANNEX A.2.9	
Fundamental 902 – 928 MHz	94.0 dB $\mu\text{V/m}$ @ 3 meters
Fundamental 2.4 – 2.4835 GHz	94.0 dB $\mu\text{V/m}$ @ 3 meters
Harmonics	54.0 dB $\mu\text{V/m}$ @ 3 meters

Remarks:

The EUT maximized EUT position was flat on the table, horizontal to the measuring antenna. The spectrum was scanned from 30 MHz to the Tenth harmonic of each fundamental frequency. No emissions were found past the first harmonic.

The Transmitter uses a diversity antenna system, antenna chain 1 & antenna chain 2. Before transmission it calculates which antenna it will use and only transmits from one antenna at a time. The results found on the following pages show results for each antenna chain.

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RADIATION INTERFERENCE

Test Data: Averaged power Field Strength table.

Peak detector used for all read levels

ANT CHAIN 1

Tuned Freq MHz	Emission Freq MHz	Read Level dBuV	Ant Polarity	Coax Loss dB	Correction Factor dB / m	Duty Cycle	Field Strength dBuV / m	Margin dB
2,405.00	2,405.00	65.92	H	3.18	32.15	20	81.25	12.75
2,405.00	2,405.00	59.02	V	3.18	32.15	20	74.35	19.65
2,405.00	4,810.00	7.1	H	4.91	34.13	20	26.14	27.86
2,405.00	4,810.00	7.3	V	4.91	34.13	20	26.34	27.66
2,440.00	2,440.00	59.81	V	3.21	32.22	20	75.24	18.76
2,440.00	2,440.00	65.36	H	3.21	32.22	20	80.79	13.21
2,440.00	4,880.00	8	H	4.94	34.14	20	27.08	26.92
2,440.00	4,880.00	8.1	V	4.94	34.14	20	27.18	26.82
2,480.00	2,480.00	59.21	V	3.24	32.3	20	74.75	19.25
2,480.00	2,480.00	64.13	H	3.24	32.3	20	79.67	14.33
2,480.00	4,960.00	7.3	H	4.98	34.16	20	26.44	27.56
2,480.00	4,960.00	7.3	V	4.98	34.16	20	26.44	27.56

RESULTS: MEETS REQUIREMENTS

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RADIATION INTERFERENCE

Test Data: Averaged power Field Strength table.

Peak detector used for all read levels

ANT CHAIN 2

Tuned Freq MHz	Emission Freq MHz	Read Level dBuV	Ant Polarity	Coax Loss dB	Correction Factor dB / m	Duty Cycle	Field Strength dBuV / m	Margin dB
2,405.00	2,405.00	65.81	H	3.18	32.15	20	81.14	12.86
2,405.00	2,405.00	60.37	V	3.18	32.15	20	75.7	18.3
2,405.00	4,810.00	7.1	H	4.91	34.13	20	26.14	27.86
2,405.00	4,810.00	7.3	V	4.91	34.13	20	26.34	27.66
2,440.00	2,440.00	61.51	V	3.21	32.22	20	76.94	17.06
2,440.00	2,440.00	65.21	H	3.21	32.22	20	80.64	13.36
2,440.00	4,880.00	8	H	4.94	34.14	20	27.08	26.92
2,440.00	4,880.00	8.1	V	4.94	34.14	20	27.18	26.82
2,480.00	2,480.00	59.41	V	3.24	32.3	20	74.95	19.05
2,480.00	2,480.00	63.54	H	3.24	32.3	20	79.08	14.92
2,480.00	4,960.00	7.3	H	4.98	34.16	20	26.44	27.56
2,480.00	4,960.00	7.3	V	4.98	34.16	20	26.44	27.56

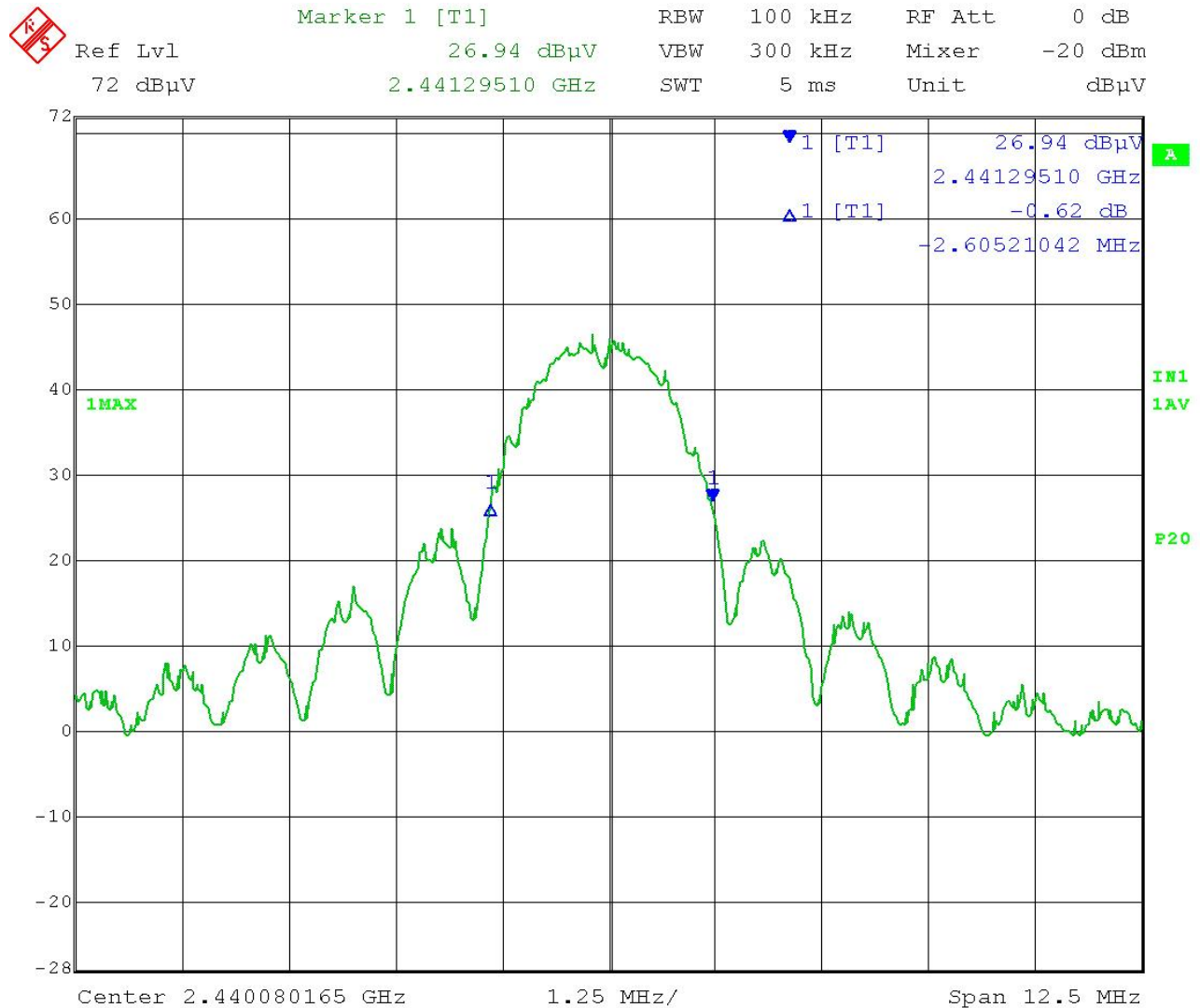
RESULTS: MEETS REQUIREMENTS

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20 dB BANDWIDTH

Test Data:

Measured 20 dB OCC BW = 2.6 MHz



Date: 8.DEC.2014 09:19:20

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BAND EDGE

Rules Part No.: 15.249 (d) & RSS-GEN (i3), 4.6

Requirements: The field strength of any emissions appearing outside the band edges and up to 10 kHz above and below the band edges shall be attenuated at least 50 dB below the level of the carrier or to the general limits of 15.249 whichever is the lesser attenuation.

Remarks: The EUT meets the general limits of 15.209, this was the lesser attenuation

Test Data: Field Strength Table

Lower Band Edge

Tuned Freq MHz	Emission Freq MHz	ReadLevel dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB / m	Duty Cycle	Field Strength dBuV / m	Margin dB
ANTENNA CHAIN 1								
2,405.00	2,398.00	8	V	3.18	32.14	20	23.32	30.68
2,405.00	2,398.00	18.9	H	3.18	32.14	20	34.22	19.78
2,405.00	2,400.00	10.2	V	3.18	32.14	20	25.52	28.48
2,405.00	2,400.00	20.4	H	3.18	32.14	20	35.72	18.28
ANTENNA CHAIN 2								
2,405.00	2,398.00	17.7	H	3.18	32.14	20	33.02	20.98
2,405.00	2,398.00	18.9	V	3.18	32.14	20	34.22	19.78
2,405.00	2,400.00	19.3	V	3.18	32.14	20	34.62	19.38
2,405.00	2,400.00	21.4	H	3.18	32.14	20	36.72	17.28

Upper Band Edge

ANTENNA CHAIN 1								
Tuned Freq MHz	Emission Freq MHz	ReadLevel dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB / m	Duty Cycle	Field Strength dBuV / m	Margin dB
2,480.00	2,483.50	12.1	V	3.24	32.31	20	27.65	26.35
2,480.00	2,483.50	21.8	H	3.24	32.31	20	37.35	16.65
2,480.00	2,485.00	9.6	V	3.24	32.31	20	25.15	28.85
2,480.00	2,485.00	18.7	H	3.24	32.31	20	34.25	19.75
ANTENNA CHAIN 2								
2,480.00	2,483.50	11.4	V	3.24	32.31	20	26.95	27.05
2,480.00	2,483.50	20.8	H	3.24	32.31	20	36.35	17.65
2,480.00	2,485.00	8.3	V	3.24	32.31	20	23.85	30.15
2,480.00	2,485.00	16.4	H	3.24	32.31	20	31.95	22.05

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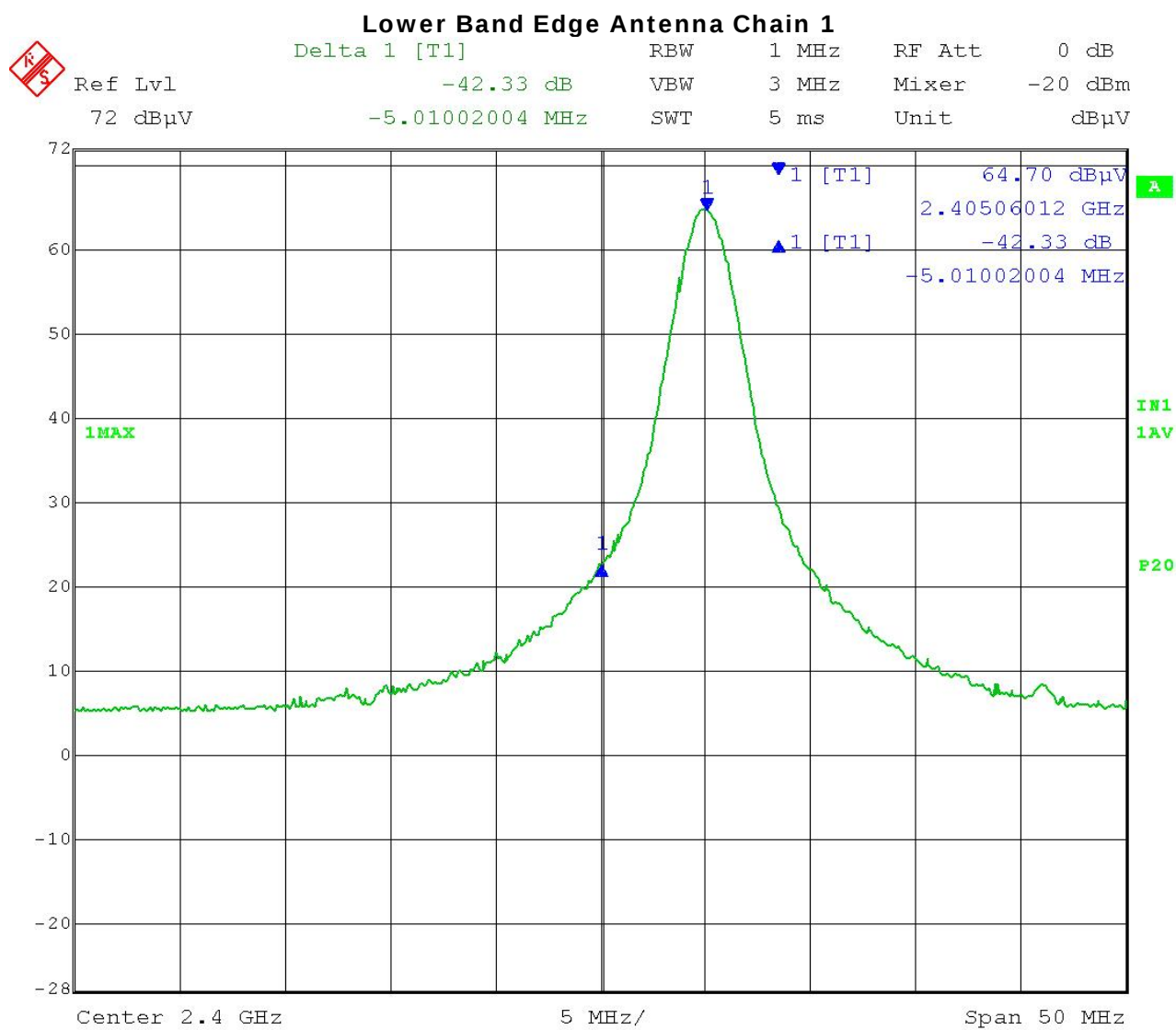
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BAND EDGE

Test Data: Band Edge Plots



Date: 8.DEC.2014 10:32:22

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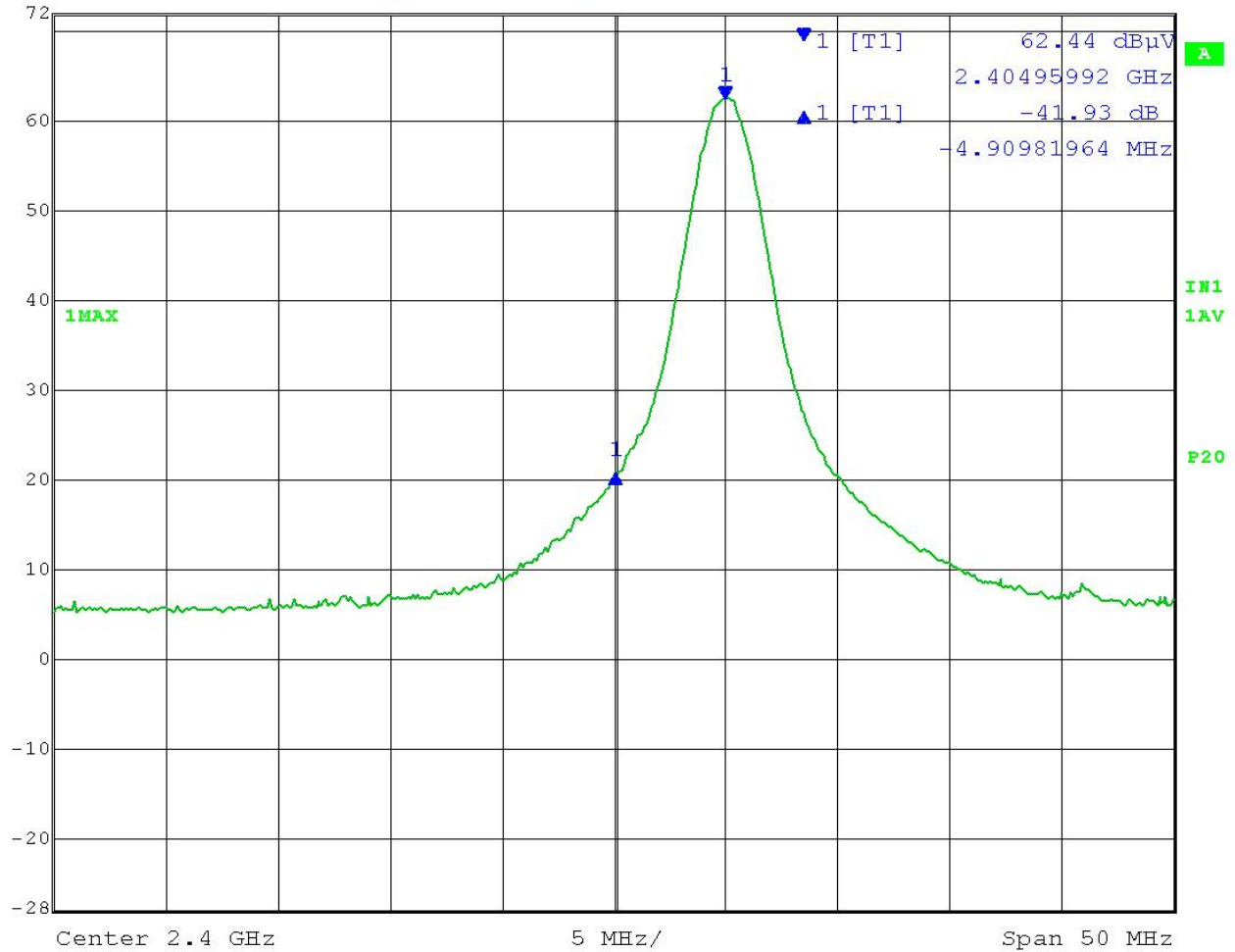
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BAND EDGE

Test Data: Band Edge Plots

Lower Band Edge Antenna Chain 2

	Ref Lvl	Delta 1 [T1]	RBW	1 MHz	RF Att	0 dB
	72 dBμV	-41.93 dB	VBW	3 MHz	Mixer	-20 dBm
		-4.90981964 MHz	SWT	5 ms	Unit	dBμV



Date: 8.DEC.2014 09:44:51

APPLICANT: LUTRON ELECTRONICS CO., INC.

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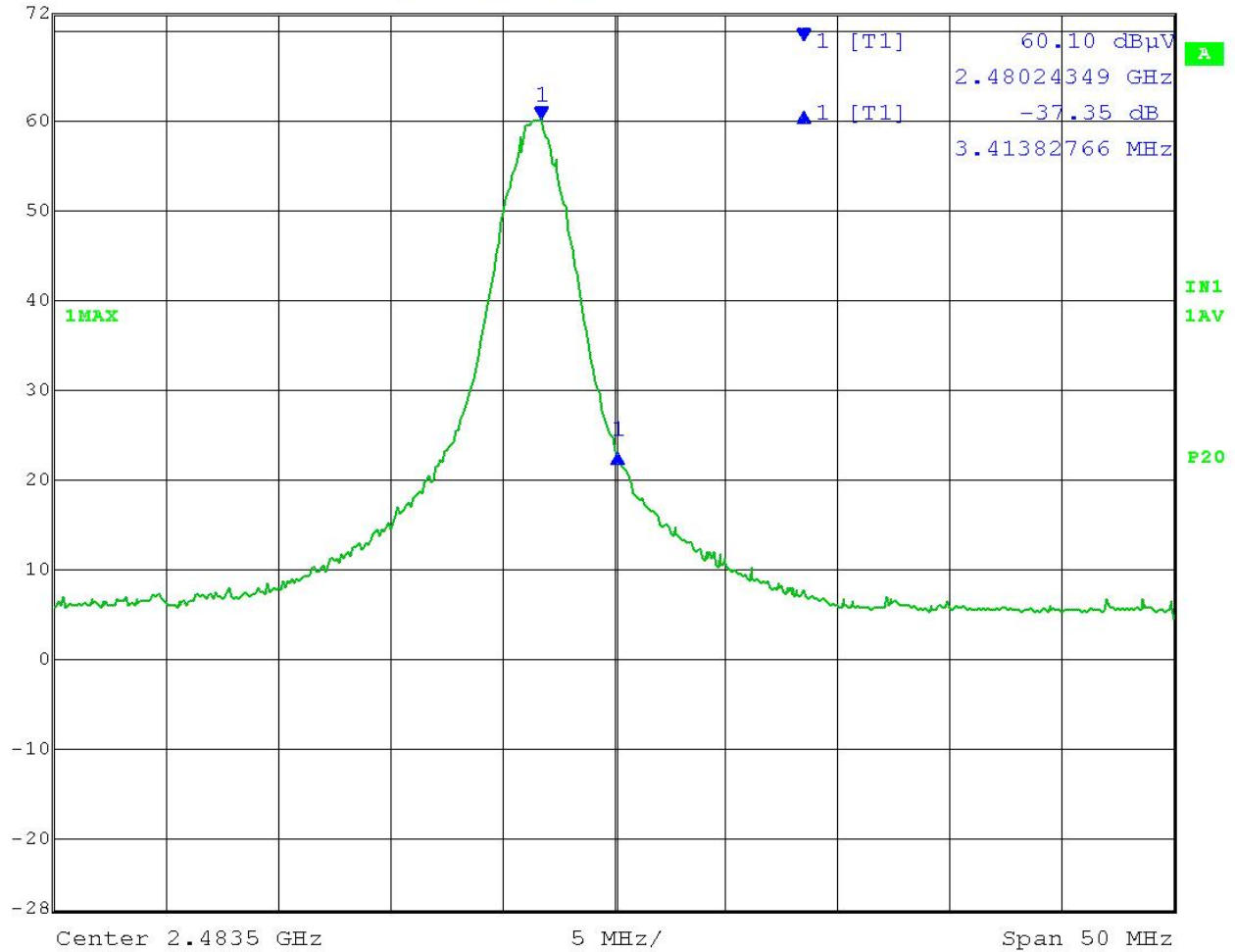
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BAND EDGE

Test Data: Band Edge Plots

Upper Band Edge Antenna Chain 1

	Ref Lvl	Delta 1 [T1]	RBW	1 MHz	RF Att	0 dB
	72 dBμV	-37.35 dB	VBW	3 MHz	Mixer	-20 dBm
		3.41382766 MHz	SWT	5 ms	Unit	dBμV



Date: 8.DEC.2014 10:47:09

APPLICANT: LUTRON ELECTRONICS CO., INC.

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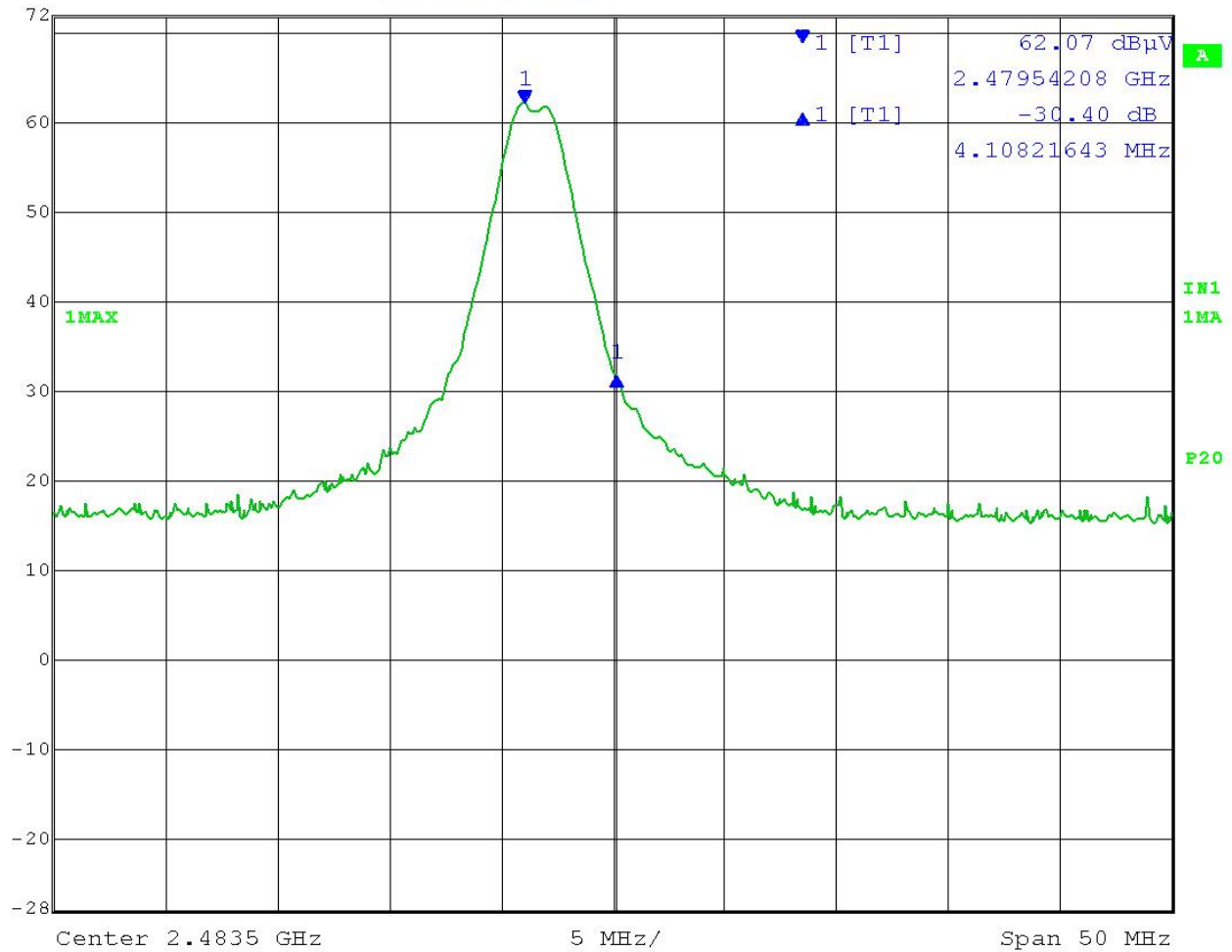
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BAND EDGE

Test Data: Band Edge Plots

Upper Band Edge Antenna Chain 2 (Peak Detector)

	Ref Lvl	Delta 1 [T1]	RBW	1 MHz	RF Att	0 dB
	72 dBμV	-30.40 dB	VBW	3 MHz	Mixer	-20 dBm
		4.10821643 MHz	SWT	5 ms	Unit	dBμV



Date: 8.DEC.2014 10:15:22

APPLICANT: LUTRON ELECTRONICS CO., INC.

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FCC ID: JPZ0109

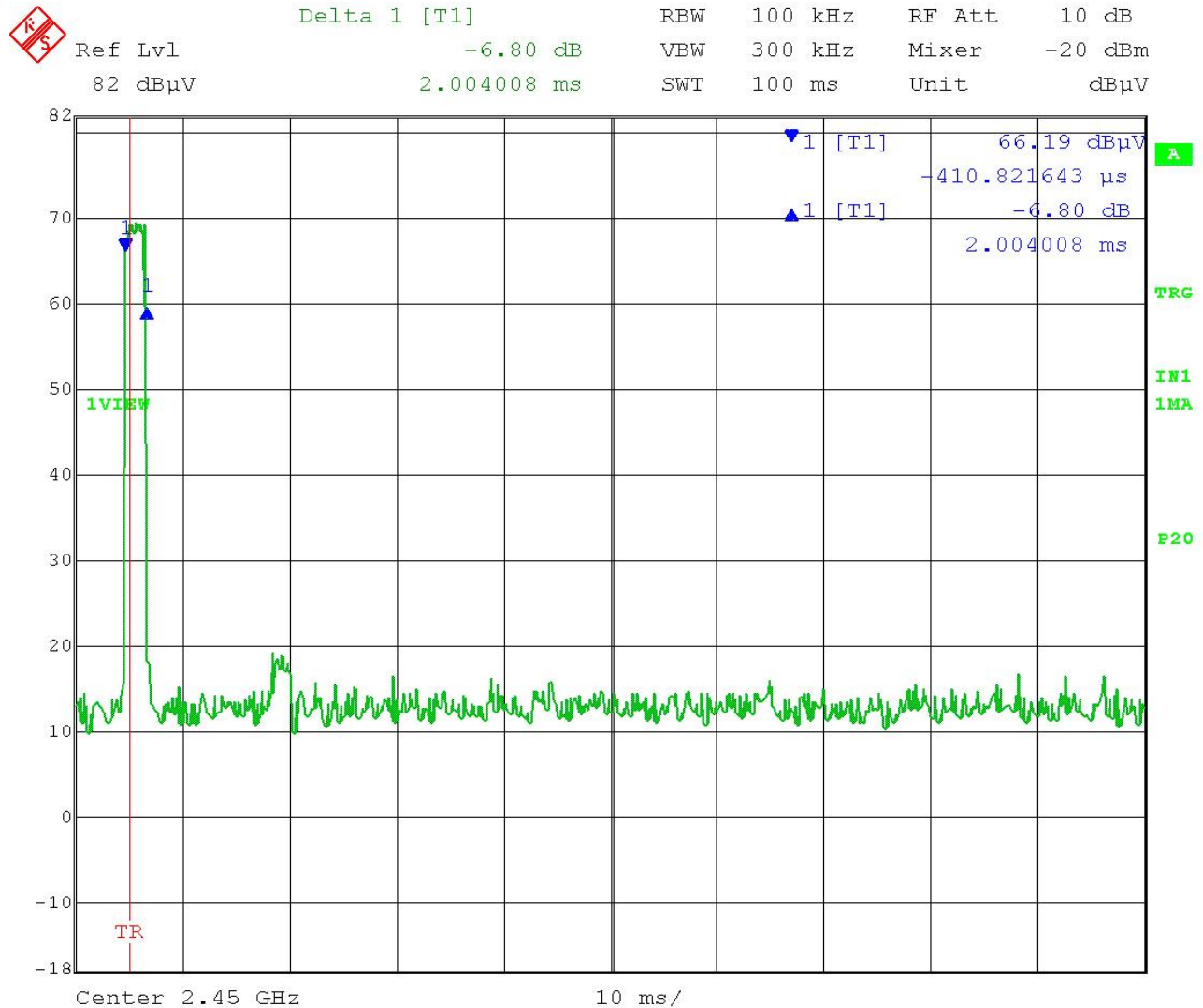
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DUTY CYCLE

Test Data: Plot of 100 ms span

Normal Operational duty cycle (Rx Acknowledgment received)



Date: 8.DEC.2014 14:54:57

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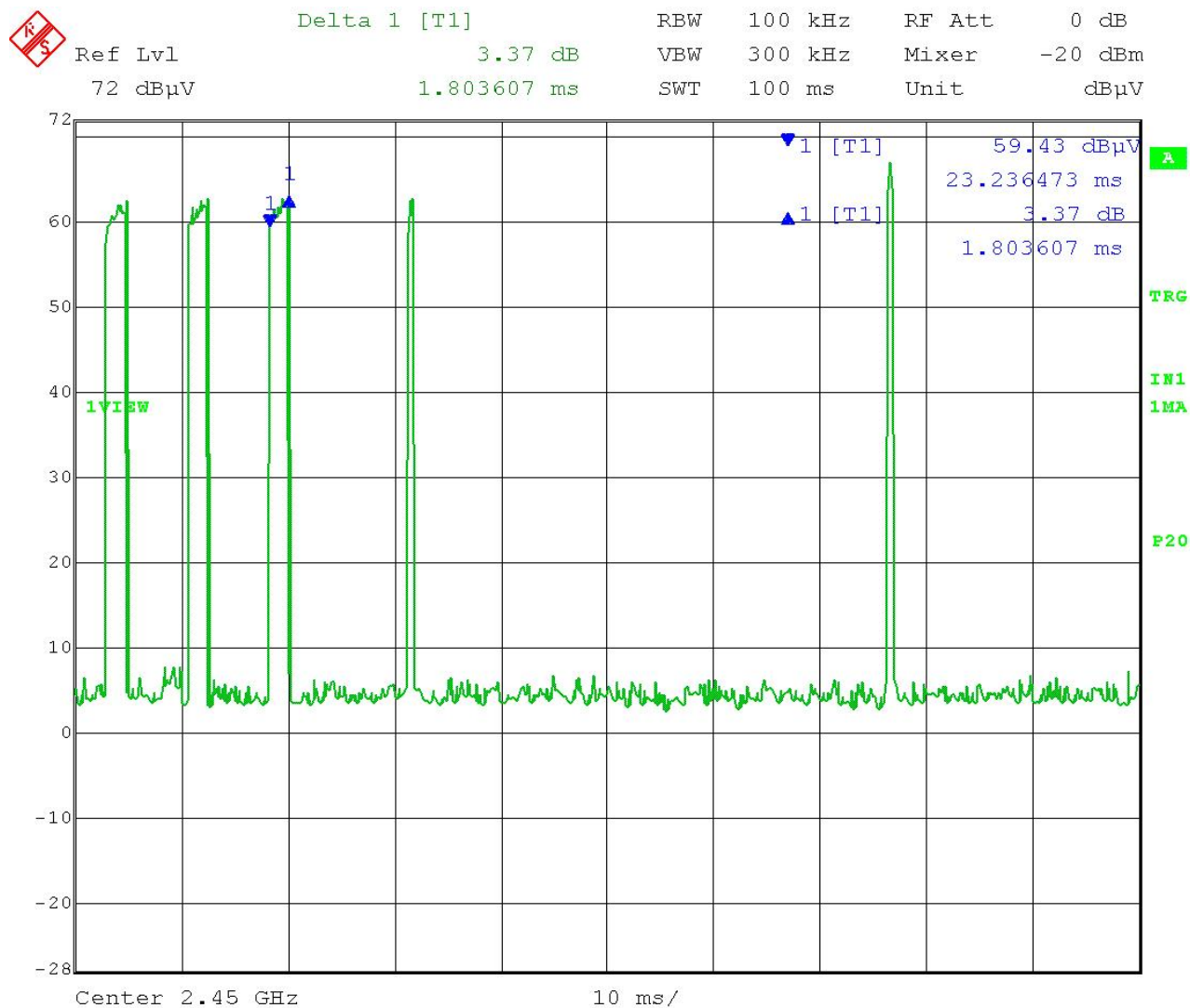
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DUTY CYCLE

Test Data: Plot of 100 ms span

Worst Case Reattempt mode (Rx Acknowledgment not received)



Date: 8.DEC.2014 14:48:09

Duty Cycle Calculation:

Total # of pulses in 100 ms: 5

Duration of pulse: .2 ms maximum duration of pulse according to manufacturer.

$20 \cdot \log((5 \times 2) / 100) = 20 \cdot \log(.1) = -20 \text{ dB}$

Duty Cycle applied = 20 dB

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	06/14/15
Antenna: Log- Periodic Chamber	Eaton	96005	1243	05/31/13	05/31/15
3-Meter Semi- Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Antenna: Double- Ridged Horn/ETS Horn 1	ETS-Lindgren Chamber	3117	00035923	06/13/14	06/13/16
EMI Test Receiver R & S ESIB 40	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16

*EMI RECEIVER SOFTWARE VERSION

*EMI Test Receiver Firmware Version: 4.73 Service Pack 1

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