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FCC PART 15.231 TEST REPORT

LOW POWER UNLICENSED TRANSMITTER

Applicant	JL MARINE SYSTEMS INC.
Address	9010 PALM RIVER RD TAMPA FL 33619 USA
FCC ID	A7FEA056
Product Description	FOOT SWITCH TRANSMITTER
Date Sample Received	5/12/2014
Date Tested	5/15/2014
Tested By	NAM NGUYEN
Approved By	Sid Sanders
Timco Report No.	769AUT14TestReport
Test Results	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail

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

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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 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:

Nam Nguyen
Engineering Project Manager

Date: May 27, 2014

APPLICANT: JL MARINE SYSTEMS INC.
FCC ID: A7FEA056
REPORT: J\JL MARINE\769AUT14\769AUT14TestReport.docx

REPORT SUMMARY

Disclaimer	The test results only relate to the item tested.
Applicable Rule(s)	FCC Pt 15.231, Pt 15.209, Pt 15.207, ANSI C63.4: 2003

TEST ENVIRONMENT

Test Facility	The test sites are located at 849 NW State Road 45 Newberry, FL 32669 USA.
Test Condition:	Temperature: 26°C Relative humidity: 50%

TEST SETUP

Test Exercise (e.g software description, test signal, etc.):	The EUT was operated in a normal mode to determine the duty cycle and occupied bandwidth and then placed in continuous transmit mode of operation for the radiated emissions. The EUT was tested without its plastic case because tooling was not finished.
Deviation from the standard(s)	No deviation from the standard(s)
Modification to the EUT:	No modification was made to the EUT.
Supporting Peripheral Equipment	Not applicable. The device is a stand-alone remote control radio.

EUT SPECIFICATION

Applicant	JL MARINE SYSTEMS INC.		
Description	FOOT SWITCH TRANSMITTER		
FCC ID	A7FEA056		
Model Number	CM-FS-std-PP		
Frequency Range	433.95 MHz		
EUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz		
	<input type="checkbox"/> DC Power		
	<input checked="" type="checkbox"/> Battery Operated Exclusively		
Test Item	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
Type of Equipment	<input type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Mobile	<input type="checkbox"/> Portable



MANUFACTURE DECLARATION OF COMPLIANCE WITH PART 15.231(A)

Item	Description	Yes	No
1	Does this device transmit a signal that is only used to control another device?	x	
2	Does this device send data with this control signal?		x
3	Does this device send data? Data is, things like: temperature, wind direction, fluid amount, rate of flow, etc.		x
4	Does this device transmit continuously or automatically?		x
5	If manually operated does this device stop transmitting within 5 seconds of releasing the button?	x	
6	If automatically operated does it deactivate 5 seconds after activation?	NA	
7	Does it transmit at regular predetermined intervals?		x
8	Does it poll or send supervisory information?		x
	If yes does it do a system integrity check? How often?		NA
9	Is this a fire, security or safety of life device?		x
	If YES does the device stop transmitting after the alarm condition is satisfied?		NA
10	Duty cycle: Maximum on-time?	x	
	If YES, on-time in 100 ms? If Other, please specify here	68/100ms	
	On time in 68 ms max.		
11	Modulation technique: Please specify the modulation of the test sample, FM, or AFSK, or FSK, or on-off keying(OOK), or others?	OOK	

TEST EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical	Eaton	94455-1	1057	06/14/13	06/14/15
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1243	05/31/13	05/31/15
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	10/05/12	10/05/14
Hygro-Thermometer	Extech	445703	0602	06/20/13	06/20/15
Digital Multimeter	Fluke	77	35053830	08/22/13	08/22/15
Notch Filter	Microlab	HA-10N	NA	5/17/13	5/17/15
Notch Filter	Microlab	HA-20N	NA	5/17/13	5/17/15
Notch Filter	Eagle	TNF-200	NA	NA	NA
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
EMI Test Receiver	Rohde & Schwarz	ESIB40	100274	2/15/13	2/15/15
EMI Test Receiver	Rohde & Schwarz	ESU40	100320	3/21/13	3/21/15
Software: Field Strength Program	Timco	N/A	Version 4.0	NA	NA

EMI TEST RECEIVER FIRMWARE VERSION USED

Manufacturer	Model	Receiver Firmware	BIOS Ver
Rohde & Schwarz	ESU40	4.43 SP3	V5.1-24-3
Rohde & Schwarz	ESIB40	4.34.3	3.3

TEST PROCEDURES

Power line conducted Emissions: The test procedure used was ANSI C63.4-2003.

Spurious Emissions: The test procedure used was ANSI C63.4-2003 using a spectrum analyzer with a preselector. The bandwidth of the spectrum analyzer was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz and the video bandwidth was always greater than the RBW.

Occupied Bandwidth: A small sample of the transmitter output was fed into the spectrum analyzer and a was generated. The vertical scale is set to 10 dB per division.

Formula Of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB/m. The gain of the preselector was accounted for in the spectrum analyzer reading.

Example:

Freq MHz	Meter Reading dB μ V	ACF dB/m	Cable Loss dB	Field Strength dB μ V/m @ 3 m
33	20	+10.36	+1.2	= 31.56

ANSI C63.4-2003 Measurement: 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. The table used for radiated measurements is capable of continuous rotation. The spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental.

Peak readings were taken in three (3) orthogonal planes when necessary and the highest readings were converted to average readings based on the duty cycle.

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.

RADIATION INTERFERENCE

Rules Part No.: 15.231

Requirements:

Fundamental Frequency (MHz)	Field Strength of Fundamental (dB μ V/m)	Field Strength of Harmonics and Spurious Emissions (dB μ V/m @ 3m)
40.66 to 40.70	67.04	47.04
70 to 130	61.94	41.94
130 to 174	61.94 to 71.48	41.94 to 51.48
174 to 260	71.48	51.48
260 to 470	71.48 to 81.94	51.48 to 61.94
470 and above	81.94	61.94

No fundamental frequency is allowed in the restricted bands.

Spurious emissions in the restricted bands must be less than 54 dB μ V/m or to the limits of 15.209.

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

- 1) for the band 130-174 MHz, μ V/m at 3 meters = $56.81818(F) - 6136.3636$;
- 2) for the band 260-470 MHz, μ V/m at 3 meters = $41.6667(F) - 7083.3333$.

Sample calculation of limit @ 315 MHz:

$$41.6667 (315) - 7083.3333 = 6041.68 \text{ uV/m}$$

$$20\log(6041.68) = 75.62\text{dBuV/m limit @ 315 MHz}$$

Sample calculation of limit @ 433.92 MHz:

$$41.6667 (433.9) - 7083.3333 = 10,995.85 \text{ uV/m}$$

$$20\log(10,995.85) = 80.82 \text{ dBuV/m limit @ 433.9 MHz}$$

FOR THIS EUT:

The limit for average field strength in dBuV/m for the fundamental frequency is 80.82 dB μ V/m.

The limit for average field strength in dBuV/m for the harmonics and other spurious frequencies is 60.82 dB μ V/m unless it is in a restricted band.



Test Data: The EUT has been tested in three different dimensions: X,Y, and Z. The following data table is the worst case:

Tuned Frequency MHz	Emission Frequency MHz	*	Meter Reading dBμV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Duty Cycle Factor dB	Field Strength dBμV/m	Margin dB
434	433.98		59.8	H	1.44	15.84	3.35	73.7	7.13
434	433.98		62.7	V	1.44	15.84	3.35	76.61	4.22
434	867.9		19.3	V	2.21	23.06	3.35	41.17	19.66
434	867.9		24.2	H	2.21	23.06	3.35	46.08	14.75
434	1,301.85	**	30.3(P)	V	3.26	28.42	3.35	58.58	15.42
434	1,301.85	**	17.3(A)	V	3.26	28.42	3.35	45.61	8.39
434	1,301.85	**	33.4(P)	H	3.26	28.42	3.35	61.73	12.27
434	1,301.85	**	19.4(A)	H	3.26	28.42	3.35	47.73	6.27
434	1,735.80		16.4	V	2.91	30.17	3.35	46.09	14.74
434	1,735.80		28.9	V	2.91	30.17	3.35	58.6	2.23
434	1,735.80		30.7(P)	H	2.91	30.17	3.35	60.42	13.58
434	1,735.80		17.5(A)	H	2.91	30.17	3.35	47.18	13.65
434	2,169.75		25.2	V	3.02	31.97	3.35	56.83	4.0
434	2,169.75		28.9	H	3.02	31.97	3.35	60.51	0.32
434	2,603.70		20.3	V	3.32	32.87	3.35	53.14	7.68
434	2,603.70		20.9	H	3.32	32.87	3.35	53.72	7.1
434	3,037.65		18.7	V	3.63	33.48	3.35	52.46	8.36
434	3,037.65		22.7	H	3.63	33.48	3.35	56.44	4.38
434	3,471.60		19.7	V	4.02	33.22	3.35	53.54	7.28
434	3,471.60		20.9	H	4.02	33.22	3.35	54.78	6.04
434	3,905.55	**	9.4	H	4.41	33.77	3.35	44.21	9.79
434	3,905.55	**	12	V	4.41	33.77	3.35	46.81	7.19
434	4,339.50	**	10.2	V	4.67	34.04	3.35	45.56	8.44
434	4,339.50	**	10.3	H	4.67	34.04	3.35	45.66	8.34

** -Denotes restricted bands

(P) : Quasi Peak detector

(A) : Average detector

Note: Emissions that are 20 dB below the limit are not required to be reported.

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CALCULATION OF EUTY CYCLE

The period of the pulse train is determined by observing it on an oscilloscope or a spectrum analyzer with zero (0) frequency span. A plot is then made of the pulse train with a sweep time of 100 milliseconds. This sweep determines the duration of the pulse train. This sweep allows the determination of the number of and type of pulses, i.e. long & short. Plots are then made showing the duration of each type of pulse and its duration. From the 100-millisecond plot, the number of a given type of pulse is then multiplied by the duration of that type pulse. This allows the calculation of the amount of time the EUT is on within 100 ms.

Long Pulse	1.002 ms (14)
Short Pulse	0.601 ms (66)
On Time	53.785 ms in the pulse train.
Length of Pulse Train	78.957ms
Total	68/100ms

$$dB = 20 * \log(\text{ON TIME}) / \text{PERIOD}$$

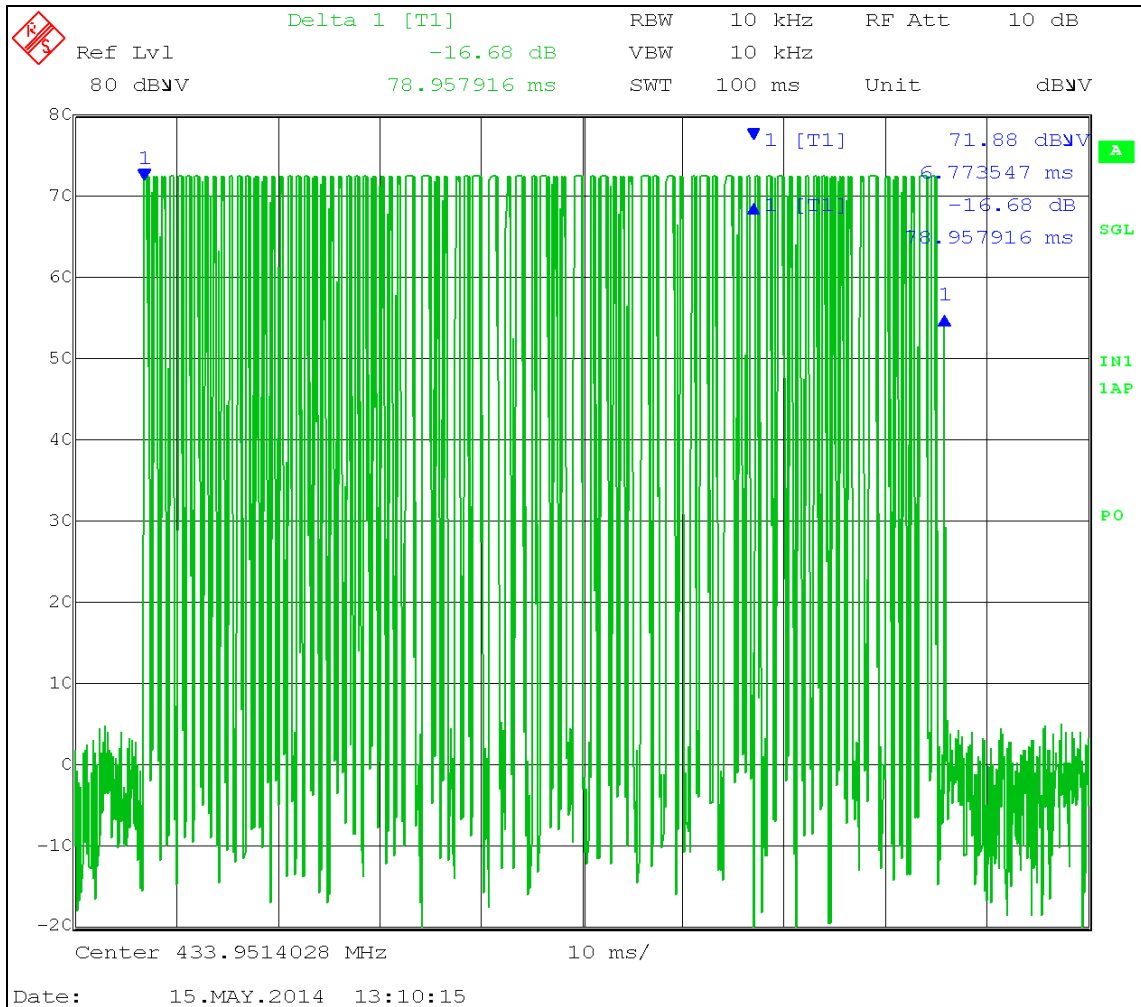
$$dB = 20 * \log(68/100)$$

$$dB = 20 * \log(0.68)$$

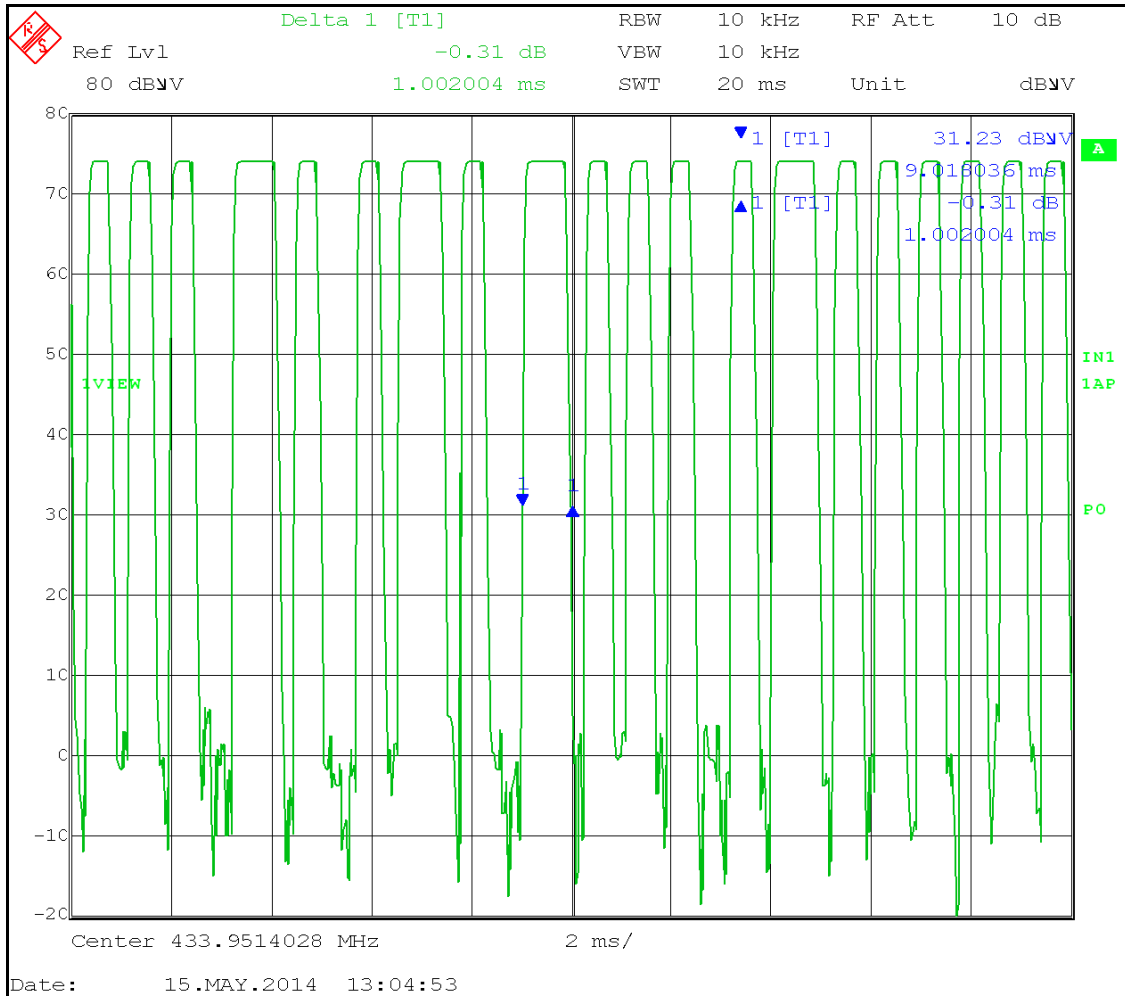
$$dB = -3.35$$

See the following plots.

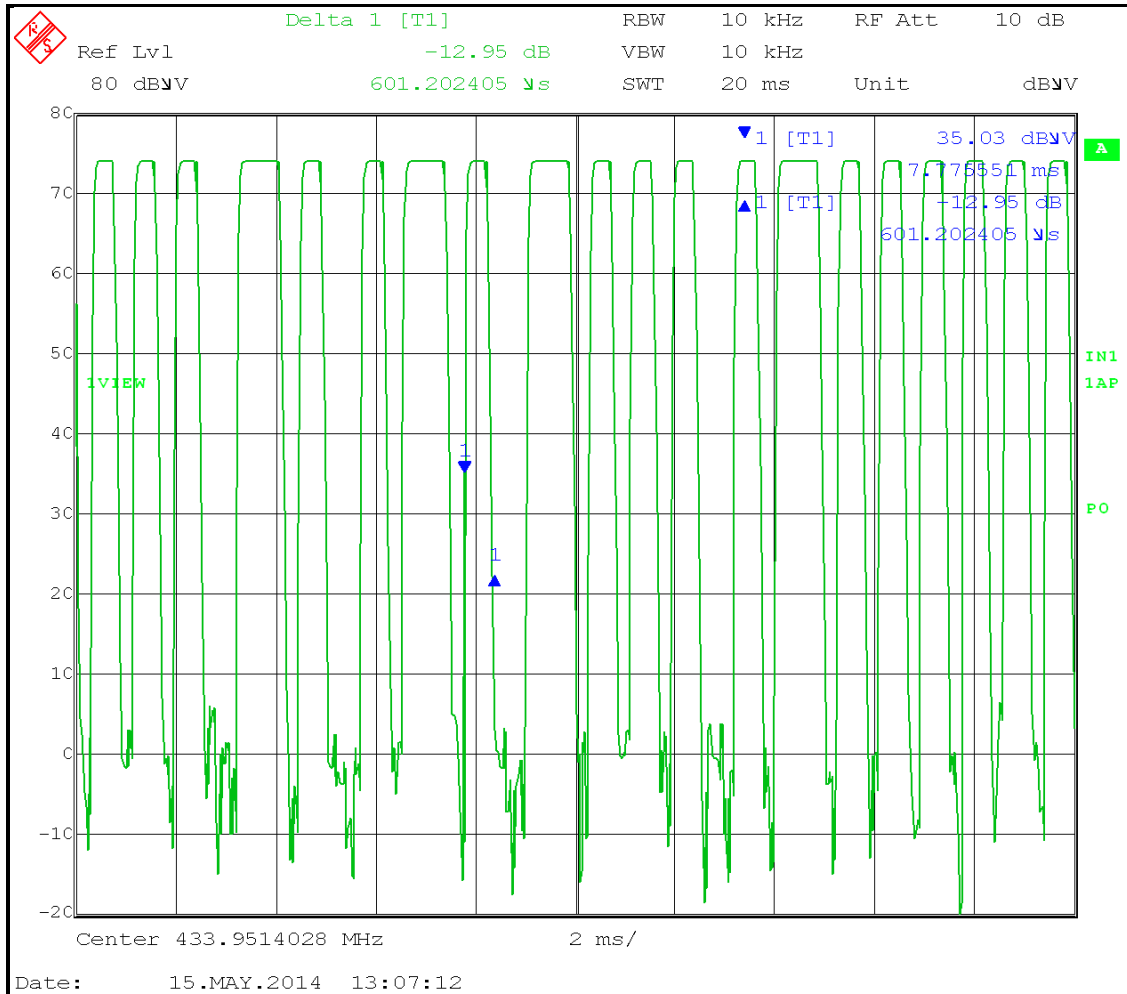
Length of pulse train



Long Pulse



Short pulse

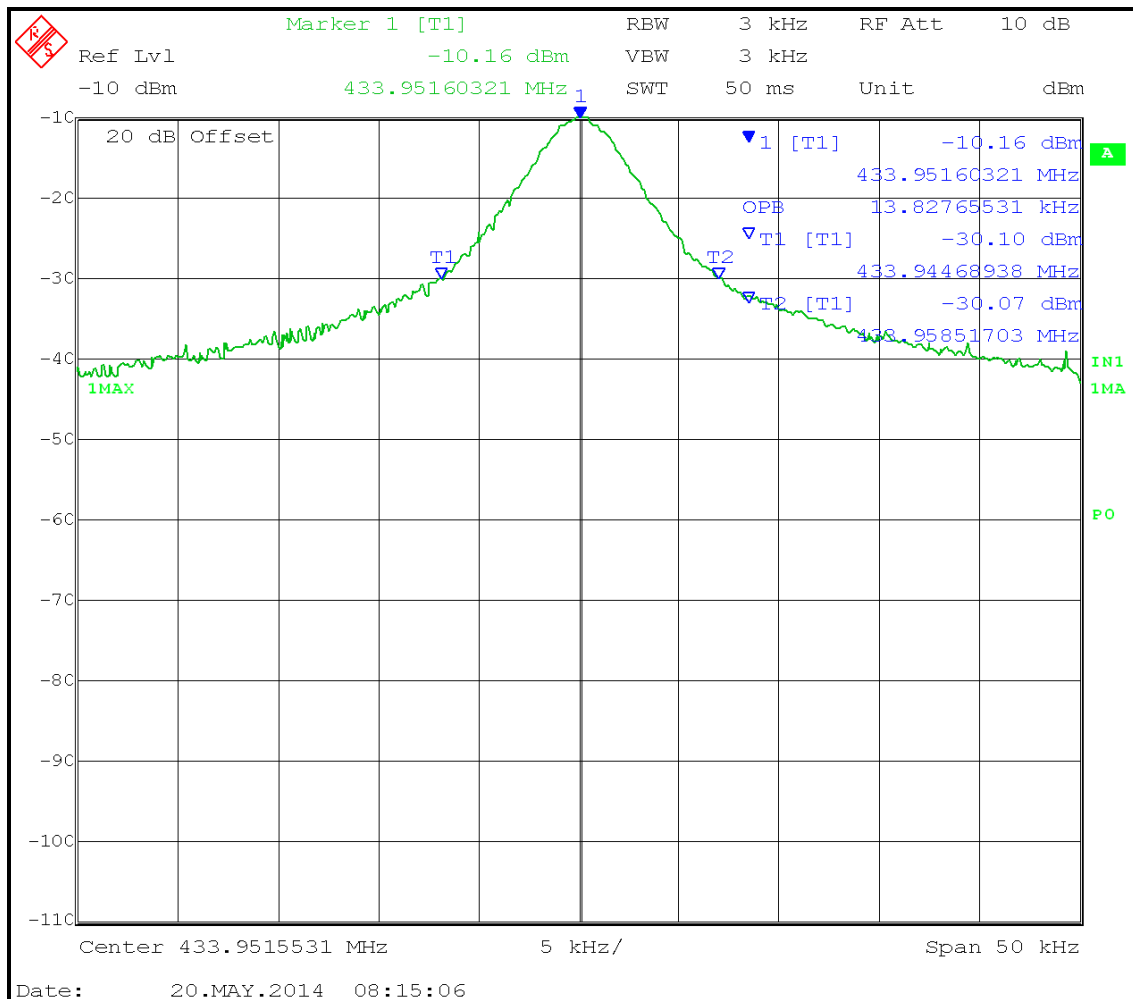


OCCUPIED BANDWIDTH

Rules Part No.: 15.231(C)

Requirements: The bandwidth of the emission shall be no wider than .25% of the center frequency for devices operating between 70 and 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Data: Please refer to the following plots.



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POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Pt 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBuV)	Average Limits (dBuV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5.0 – 30	60	50

Test Data: Not applicable because the EUT is battery operated exclusively.