



# Retlif Testing Laboratories

101 New Boston Road, Goffstown, NH 03045  
603-497-4600 - Fax: 603-497-5281

CORPORATE OFFICE  
795 Marconi Avenue  
Ronkonkoma, NY 11779  
631-737-1500 Fax 631-737-1497  
(A NY Corporation)

BRANCH LABORATORIES  
3131 Detwiler Road  
Harleysville, PA 19438  
215-256-4133 Fax 215-256-4130

WASHINGTON  
REGULATORY OFFICE  
703-533-1614 Fax 703-533-1612

MEMBER  
ACIL

## FCC PART 15/INDUSTRY CANADA REPORT of MEASUREMENTS on Temperature Recorder & Wireless Transmitter Data Logger

<b>Company Name:</b>	Madgetech
<b>Customer P.O.:</b>	104778
<b>Date of Report:</b>	February 9, 2009
<b>Test Report No.:</b>	R-5138N
<b>Test Start Date:</b>	February 6, 2009
<b>Test Finish Date:</b>	February 6, 2009
<b>Test Technician:</b>	Matthew Seamans
<b>Laboratory Supervisor:</b>	Todd Hannemann
<b>Manager:</b>	Scott Wentworth
<b>Results Prepared By:</b>	Jamie Ramsey
<b>Government Source Inspection:</b>	N/A

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We certify that these Test Results are true results obtained from the tests of the equipment stated, and relates only to the equipment tested. We further certify that the measurements shown in this Test Results package were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.



Todd Hannemann  
Laboratory Supervisor



Scott Wentworth  
Branch Manager

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### Non-Endorsement

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**Retlif Testing Laboratories**  
Test Report No. R-5138N  
FCC ID: RUYBOARDJ & IC: 4953A-BOARDJ

## Revision History

Revisions to this document are listed below; the latest revised document supersedes all previous issues of this document.

<b>Revision</b>	<b>Date</b>	<b>Pages Affected</b>
-	February 9, 2009	Original Release



**Retlif Testing Laboratories**

Test Report No. R-5138N  
FCC ID: RUYBOARDJ & IC: 4953A-BOARDJ

## Test Program Summary

**Job Number:** R-5138N  
**Applicant:** Madgetech  
**Address:** 201 Route 103 West  
 Warner, NH 03278  
**Test Sample:** Temperature Recorder & Wireless Transmitter Data Logger  
**Part Number:** N/A  
**Model Number:** RFOT  
**Serial Number:** Eng Prototype  
**Brand Name:** Madgetech  
**Power Requirements:** 3.6 VDC via internal battery  
**Frequency of Operation:** 418.0MHz  
**Modulation:** OOK (on/off keying)  
**Type of Transmission:** Pulsed emission containing Manchester encoded data bits  
**Application:** Wireless Transmission of Environmental Data  
**Frequencies Tested:** 418.0MHz

**Test Specification:**

FCC Rules and Regulations Part 15, Subpart C, Paragraph 15.231 RSS 210, Issue 7

**Test Procedure:**

ANSI C3.4:2003/RSS-210, Issue 7

**Purpose:**

The purpose of this test program was to demonstrate compliance of the Temperature Recorder & Wireless Transmitter Data Logger to the requirements of FCC Part 15.231 and RSS 210, Issue 7.

**Test Methods:**

The following table depicts the test methods that were performed on the EUT and the corresponding test results:

Testing Date(s)	Test Method	Test Results
2/6/09	15.231(e)/RSS-210 Annex 1, Spurious Radiated Emissions (30 MHz to 4.2 GHz)	Complied
2/6/09	15.231(e)/RSS-210 Annex 1, Field Strength of Fundamental	Complied
2/6/09	15.231(c) Occupied Bandwidth, 0.25% of Fundamental Frequency	Complied
2/6/09	RSS-210, Annex 1, A1.1.3, 99% Bandwidth, 0.25% of Center Frequency	Complied
2/6/09	Duty Cycle Determination	N/A



**Retlif Testing Laboratories**

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**Test Sample Operation:**

The device is automatically operated and is intended to transmit environmental test data such as temperature at a user defined interval (30 seconds to 12 hours). Normal operation of the EUT complies with the parameters required in Part 15, Subpart C, Section 15.231 and RSS 210 for momentary operated devices which transmit data. Operation is limited so that the duration of each transmission is less than 1 second (.937sec) and the minimum silent period between is 30 seconds which is more than 30 times the duration of the transmission and over ten seconds per the requirements of 15.231 (e). For testing purposes only, the EUT was configured to continuously transmit at maximum duty cycle.

**Test Sample/Test Program:**

- The device is not employed for RC purposes involving security.
- The device uses an internal antenna with no provisions for connection of an external antenna.
- The device is powered by internal battery with no connections to the AC mains.
- The fundamental field strength did not exceed the specified limit at a test distance of 3.0 meters.
- The peak value of fundamental emissions did not exceed a peak field strength limit corresponding to 20dB above the maximum permitted average limit.
- The field strength of harmonic and spurious emissions did not exceed the applicable limit. No harmonic or spurious emissions were observed within 10dB of the specified limit at test distances of 1 or 3 meters.
- Radiated Emissions from the EUT were measured in all three axis. The attached Radiated Emissions test data is representative of the worst case orientation.
- The 20dB bandwidth and 99% bandwidth of fundamental emissions did not exceed 0.25% of the center operating frequency and were determined as follows:

Fundamental Frequency	=	418.0MHz
0.25% of Center Frequency	=	1.045MHz
1.045 divided by 2	=	0.5225MHz
Bandwidth Range	=	Fundamental Frequency + and – .5225MHz
418.0MHz – 0.5225MHz	=	417.4775MHz
418.0MHz + 0.5225MHz	=	418.5225MHz
<b>Bandwidth Range</b>	<b>=</b>	<b>417.4775MHz – 418.5225MHz</b>



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### Determination of Field Strength Limits:

The field strength limits shown below were calculated as instructed in Section 15.231 (e).

#### Fundamental Frequency: 418.0MHz

Where F is the frequency in MHz, the formula for calculating the maximum permitted fundamental field strength for the band 260-470MHz,  $\mu$ V/m at 3 meters is as follows:

$$\begin{aligned} 16.6667(F) - 2083.3333 &= \text{Field Strength Limit } (\mu\text{V/m}) \\ 16.6667 \times 418.0 &= 6966.68 \\ 6966.68 - 2833.3333 &= 4133.35 \\ \text{Field Strength Limit} &= 4133\mu\text{V/m} = 72.32\text{dBuV/M} \end{aligned}$$

The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level which equals  $413\mu\text{V/m} = 52.32\text{dBuV/M}$ .

### Determination of Duty Cycle:

The transmitter controls were adjusted to maximize the transmitted duty cycle. The analyzer was set for a frequency span of 0Hz. The sweep time was then adjusted in order to display one full pulse train. The transmitter on time was then summed and compared to the time for one full cycle in order to obtain the duty cycle. The pulse train exceeded 100msec so 100msec was used as the cycle time and the period with the "worst case" on time was used to calculate the duty cycle. The on times were determined as follows:

Within the 100msec there were a total of 11 pulses (9 pulses with on times of 1002usec duration and 2 pulses with on times of 981.46usec duration) resulting in a total on time of 10.837msec.

$$\begin{aligned} \text{Transmitter On Time} &= 10.837\text{milliseconds} \\ \text{Transmitter Cycle Time} &= 100\text{milliseconds} \\ \text{Transmitter Duty Cycle} &= 10.837\% \\ \text{On Time divided by Cycle Time} &= \text{Duty Cycle Factor} \\ 10.837 \text{ divided by } 100 &= 0.10837 \\ 0.10837 \text{ converted to dB } (\text{LOG}_{10} 0.10837)20 &= -19.30 \\ \textbf{Duty Cycle Factor} &= \textbf{-19.30dB} \end{aligned}$$

Duty Cycle Factor Determination Plots are included with this application as a separate attachment.



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## Test Methods:

### 15.231 (b) Fundamental & Spurious Radiated Emissions

The test sample was placed on a 80cm high wooden test stand which was located 3 meters from the test antenna on an FCC listed open area test site. Emissions from the EUT were maximized by rotating the test sample and adjusting the test sample orientation and antenna polarization. The maximized peak field strength of each emission was measured and recorded and compared to the limit specified in 15.35 (b) (peak limit corresponds to 20dB above the maximum permitted average limit). The duty cycle factor was applied to the peak readings in order to determine the average field strength of the emissions for comparison to the specified average limits.

**Test Results:** The worst case maximum peak field strength of the fundamental frequency at 418.0MHz was 89.99dB<sub>UV</sub>/M which met the peak limit of 92.32dB<sub>UV</sub>. The maximum average field strength at 418.0MHz was 70.69dB<sub>UV</sub> which met the specified average limit of 72.32dB<sub>UV</sub>. No harmonic/spurious frequencies were observed above the noise floor of the test equipment which was a minimum of 10dB below the specified limit.

### 15.231 (c) Occupied Bandwidth

The test sample was placed on a test bench and configured to transmit its normal modulated signal at maximum power. The spectrum analyzers resolution bandwidth, sweep rate and span were adjusted for the frequency being measured. The upper and lower frequency points corresponding to levels 20dB down from the peak of the modulated carrier frequency were used to determine the occupied bandwidth.

**Test Results:** The bandwidth of the emission at 418.0MHz was less than 0.25% of the center frequency and met the requirements of 15.231 (c).

### RSS 210, A1.1.3, 99% Bandwidth

The test sample was placed on a test bench and configured to transmit its normal modulated signal at maximum power. The spectrum analyzers resolution bandwidth, sweep rate and span were adjusted for the frequency being measured. Using the spectrum analyzer 99% bandwidth function the 99% bandwidth of the modulated carrier frequency was measured and recorded.

**Test Results:** The 99% bandwidth of the emission at 418.0MHz was less than 0.25% of the center frequency and met the requirements of RSS-210.



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## **Test Setup Photographs**



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## Test Photographs Spurious Radiated Emissions



Test Setup, Horizontal Antenna Polarization



Test Setup, Vertical Antenna Polarization



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## Test Photographs Spurious Radiated Emissions



Test Setup, Horizontal Antenna Polarization



Test Setup, Vertical Antenna Polarization



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**Test Photograph  
Field Strength of Fundamental**



Test Setup, Horizontal Antenna Polarization



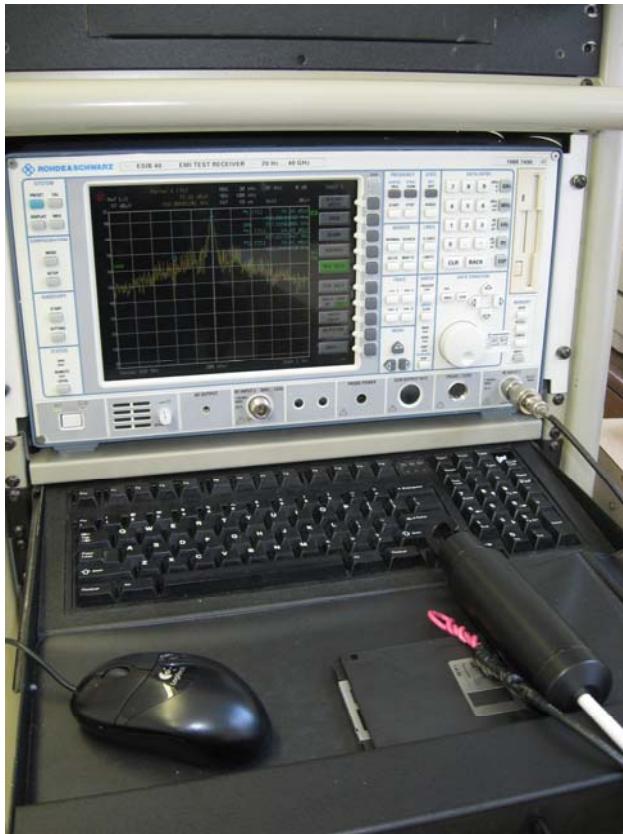
Test Setup, Vertical Antenna Polarization



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**Test Photograph  
Occupied Bandwidth & Duty Cycle**



Test Setup



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## Equipment Lists

### Fundamental & Spurious Radiated Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	7/21/2008	7/21/2009
5053	Biconilog	EMCO	26 MHz - 3 GHz	3142C	10/4/2008	11/4/2009
5070	EMI Test Receiver	Rohde & Schwarz	20 Hz - 40 GHz	ESIB40	1/14/2009	1/14/2010
3116	Pre-Amplifier	Miteq	0.1 GHz - 18 GHz	AFS42-35	1/21/2009	1/21/2010
3117	Power Supply	B&K Precision	0-30 Vdc, 3.0 A	1630	1/31/2009	1/31/2010
3258	Double Ridge Guide	EMCO	1 - 18 GHz	3115	8/20/2008	8/20/2009
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	7/21/2008	7/21/2009

### Occupied Bandwidth/99% Bandwidth

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
5070	EMI Test Receiver	Rohde & Schwarz	20 Hz - 40 GHz	ESIB40	1/14/2009	1/14/2010

### Duty Cycle

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
5070	EMI Test Receiver	Rohde & Schwarz	20 Hz - 40 GHz	ESIB40	1/14/2009	1/14/2010



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## **Test Data**



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## RETLIF TESTING LABORATORIES

## TABULAR DATA SHEET

<b>Test Method:</b>	Fundamental Field Strength		
<b>Customer:</b>	MadgeTech	<b>Job No:</b>	R-5138N
<b>Test Sample:</b>	Temperature Recorder and Wireless Transmitter Data Logger		
<b>Model No:</b>	RFOT	<b>Serial No:</b>	Eng. Prototype
<b>Test Specification:</b>	FCC Part 15, Subpart C Paragraph: 15.231(e)		
<b>Operating Mode:</b>	Transmitting signal at 418MHz		
<b>Technician:</b>	M.Seamans	<b>Date:</b>	February 6, 2009
<b>Notes:</b>	Corrected peak readings meet peak limit (20dB above average limit) per 15.35		

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## RETLIF TESTING LABORATORIES

## TABULAR DATA SHEET

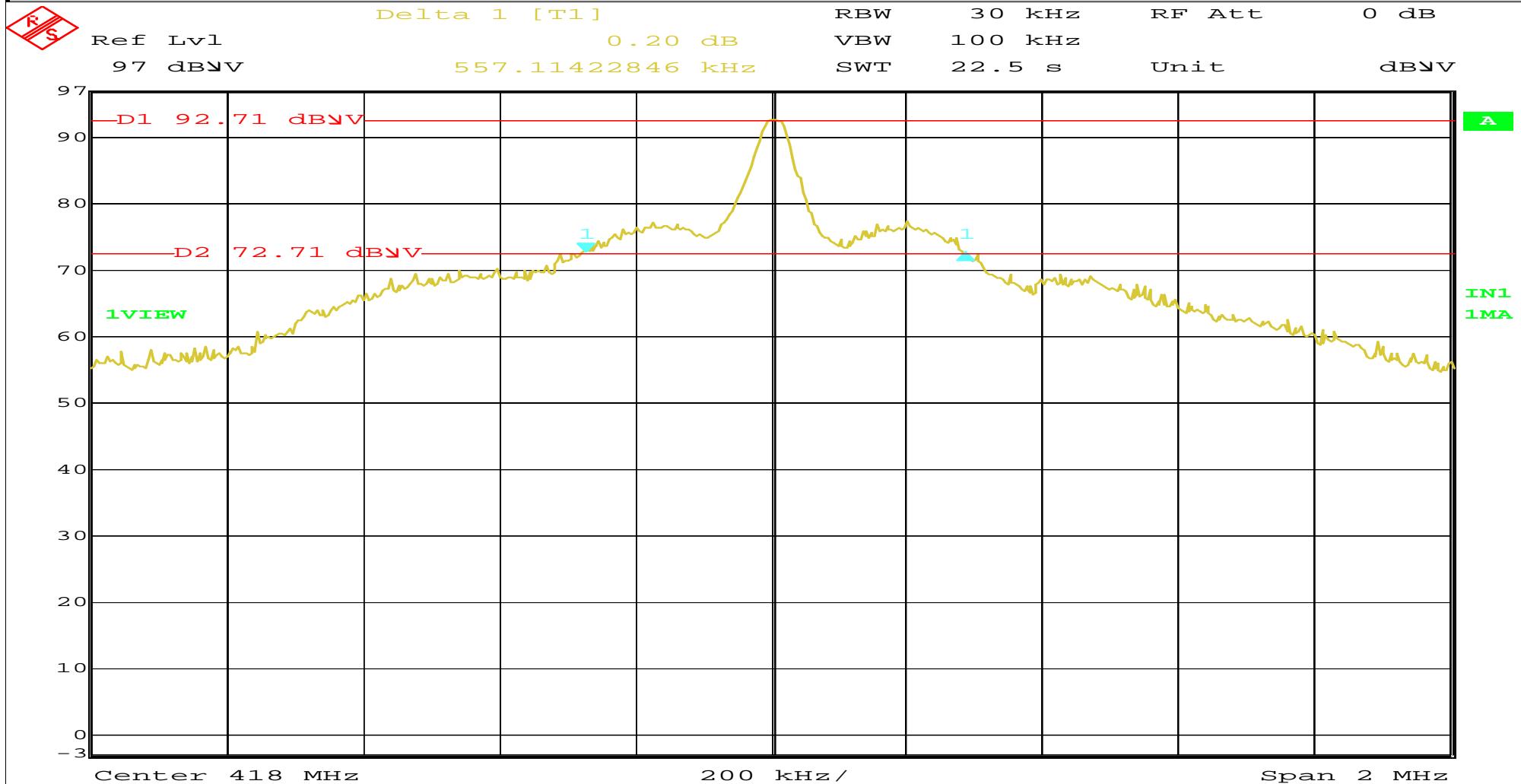
Data Sheet 1 of 1

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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Occupied Bandwidth		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( c )	
Operating Mode:	Continuously Transmitting		
Notes:	Transmit Frequency 418 MHz Occupied Bandwidth: 557.1142 kHz		



Date: 6.FEB.2009 10:32:35

Data Sheet 1 of 1

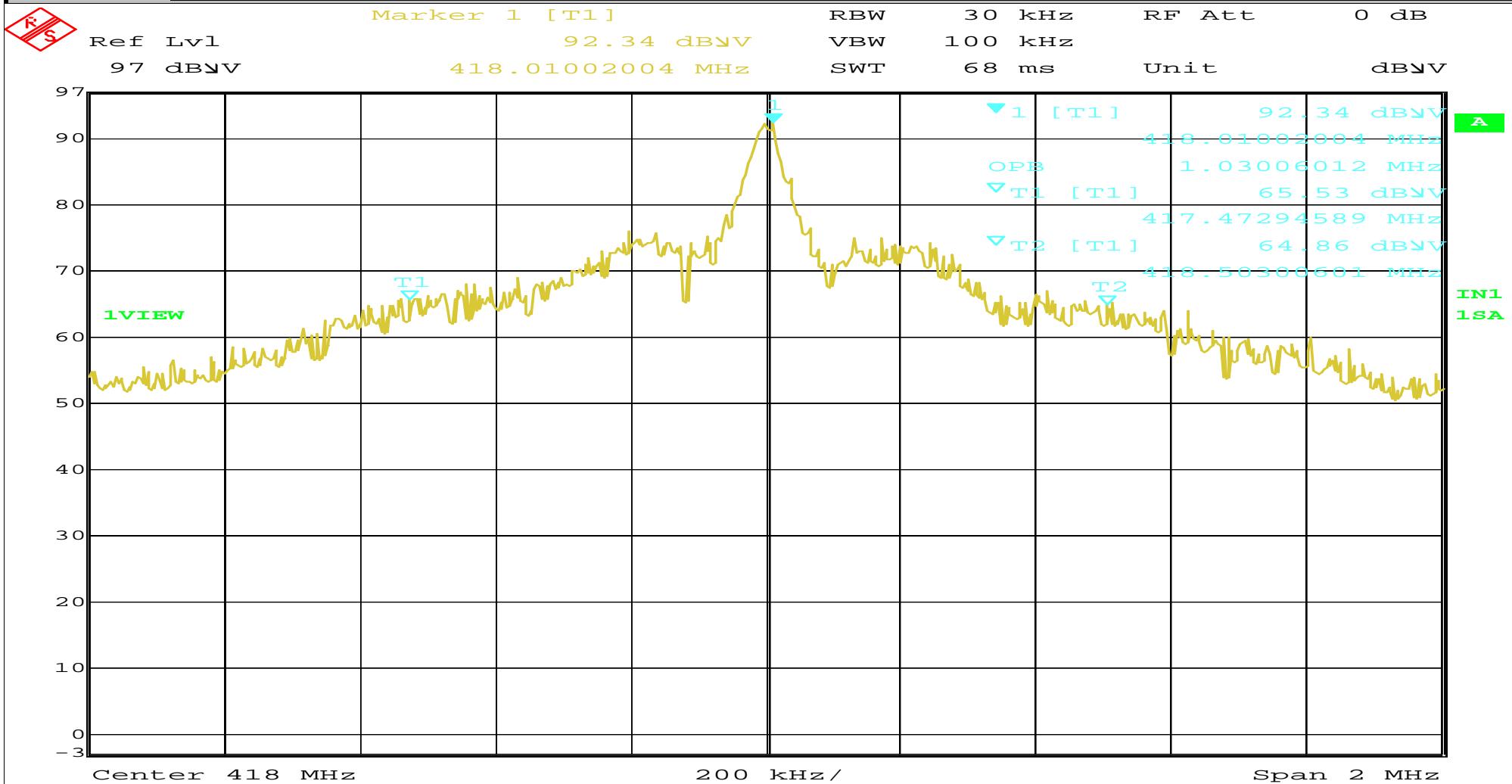
R-5138N

# RETLIF TESTING LABORATORIES

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## EMISSIONS DATA SHEET

Test Method:	99% Bandwidth		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No.:	RFOT	Serial No.:	Eng. Prototype
Test Specification:	RSS-210		Date: 2/6/2009
Operating Mode:	Continuously Transmitting		
Notes:	Transmit Frequency 418 MHz, 99% BW 1.03006MHz RSS Limit 1.045MHz		



Date: 6.FEB.2009 12:02:27

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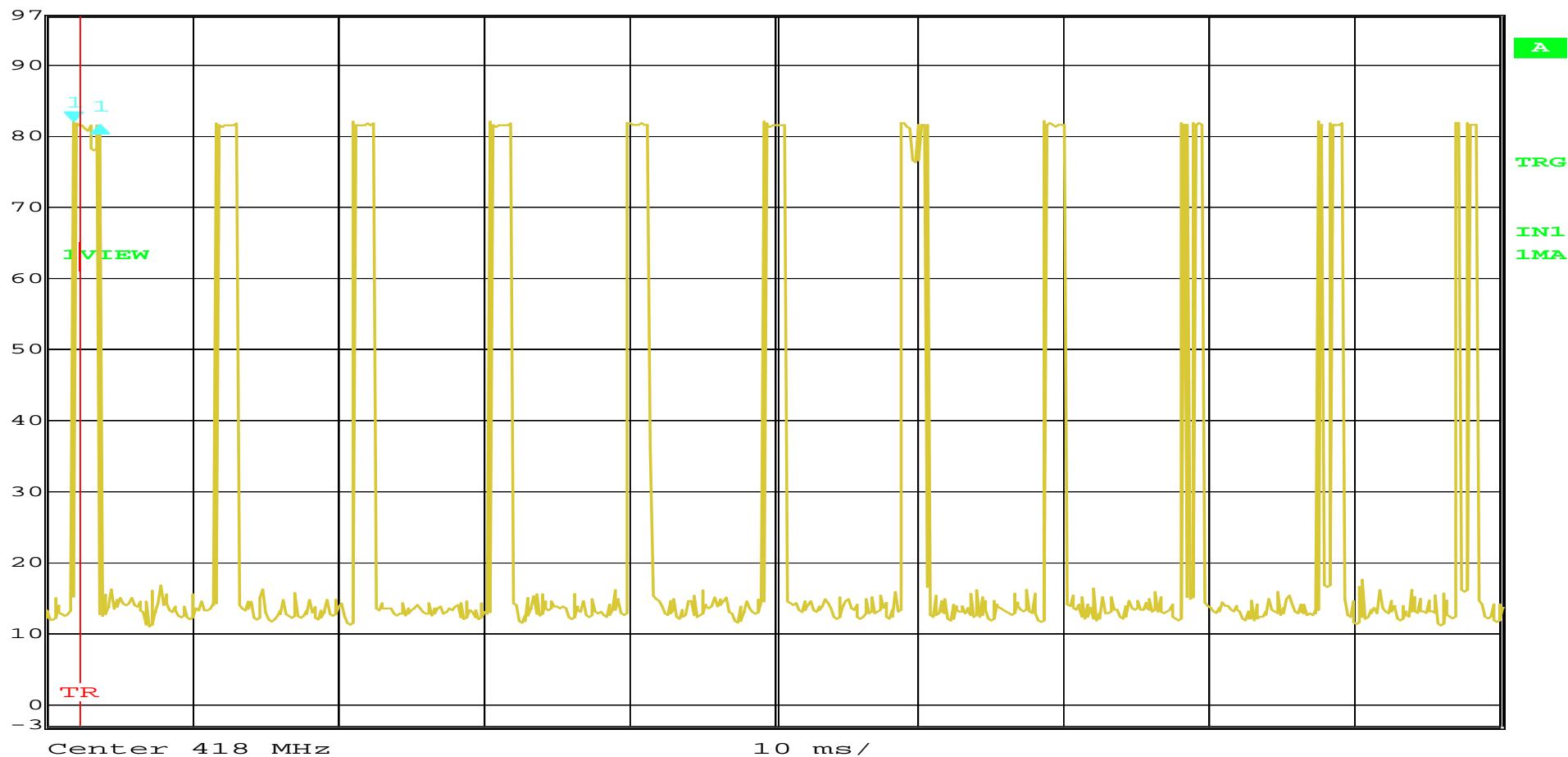
# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Maximum Duty Cycle		



**Delta 1 [T1]**      RBW      100 kHz      RF Att      0 dB  
 Ref Lvl      VBW      100 kHz  
 97 dB $\mu$ V      SWT      100 ms      Unit      dB $\mu$ V  
 -0.55 dB      1.803607 ms



Date: 6.FEB.2009 09:44:42

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# RETLIF TESTING LABORATORIES

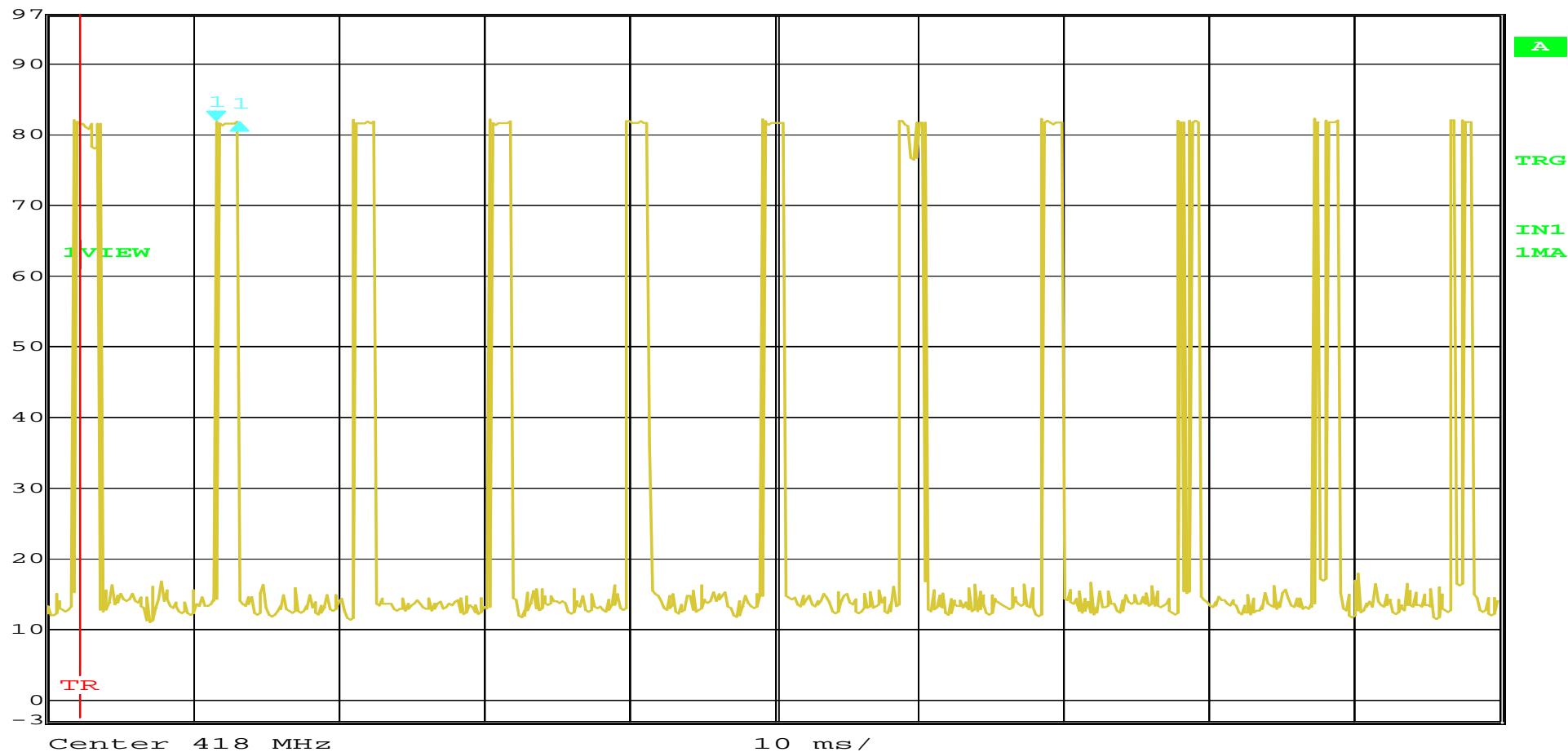
## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Maximum Duty Cycle	Date:	2/6/2009



Ref Lvl  
97 dB<sub>UV</sub>

Delta 1 [T1]      RBW 100 kHz      RF Att 0 dB  
-0.41 dB      VBW 100 kHz  
1.603206 ms      SWT 100 ms      Unit dB<sub>UV</sub>



Date: 6. FEB. 2009 09:45:21

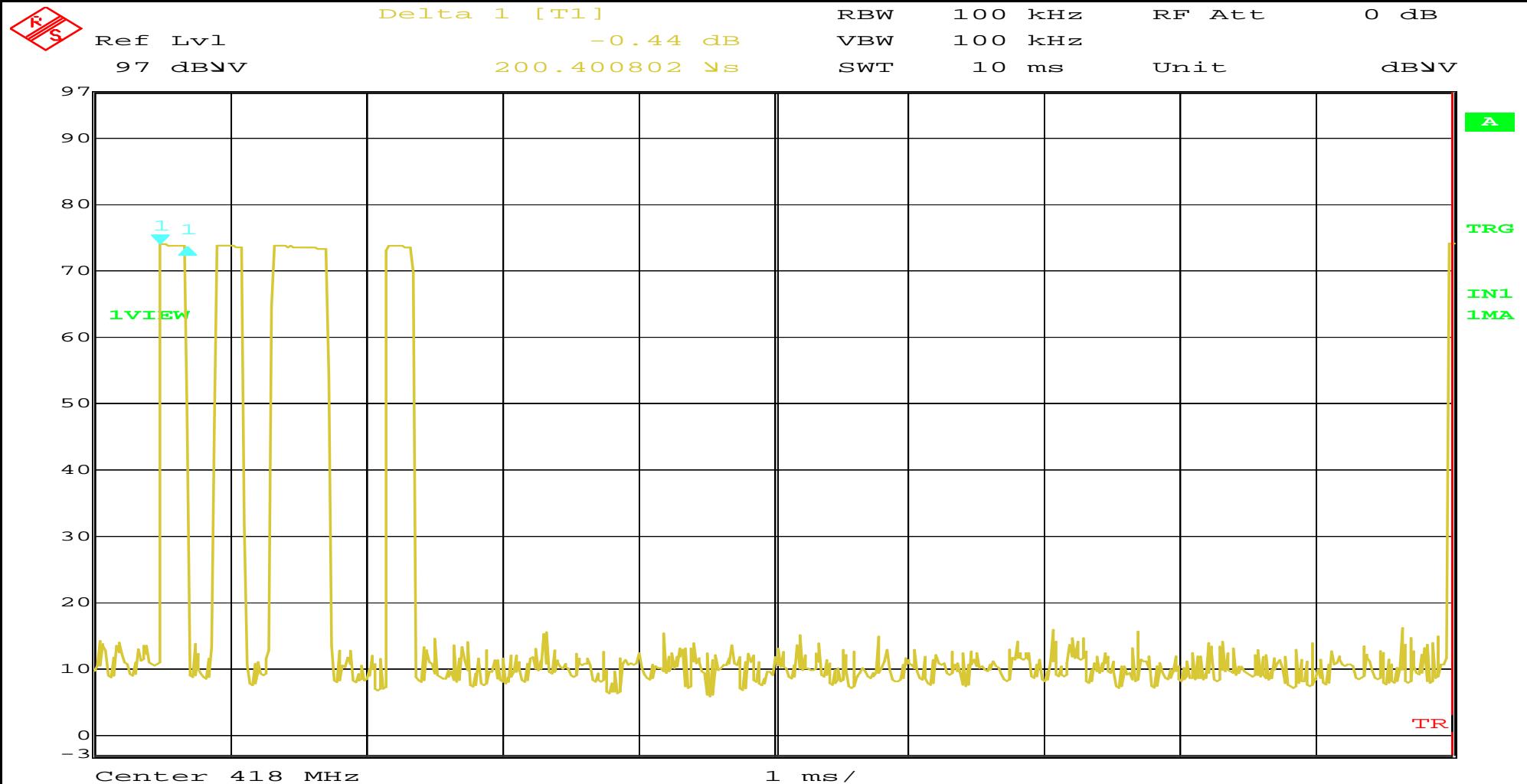
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231(e)	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Maximum Duty Cycle	Date:	2/6/2009



Date: 6.FEB.2009 09:47:29

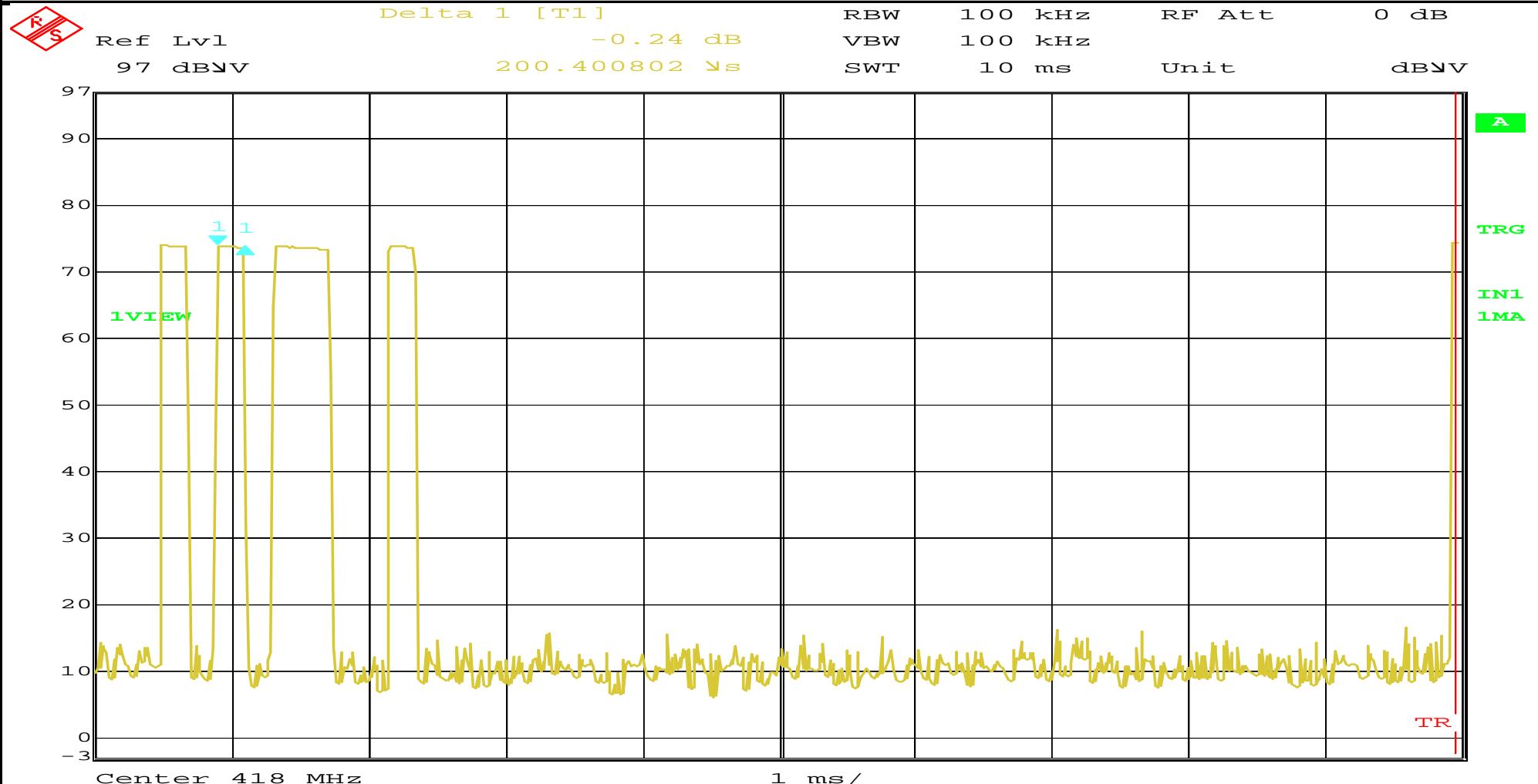
Data Sheet 3 of 11

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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

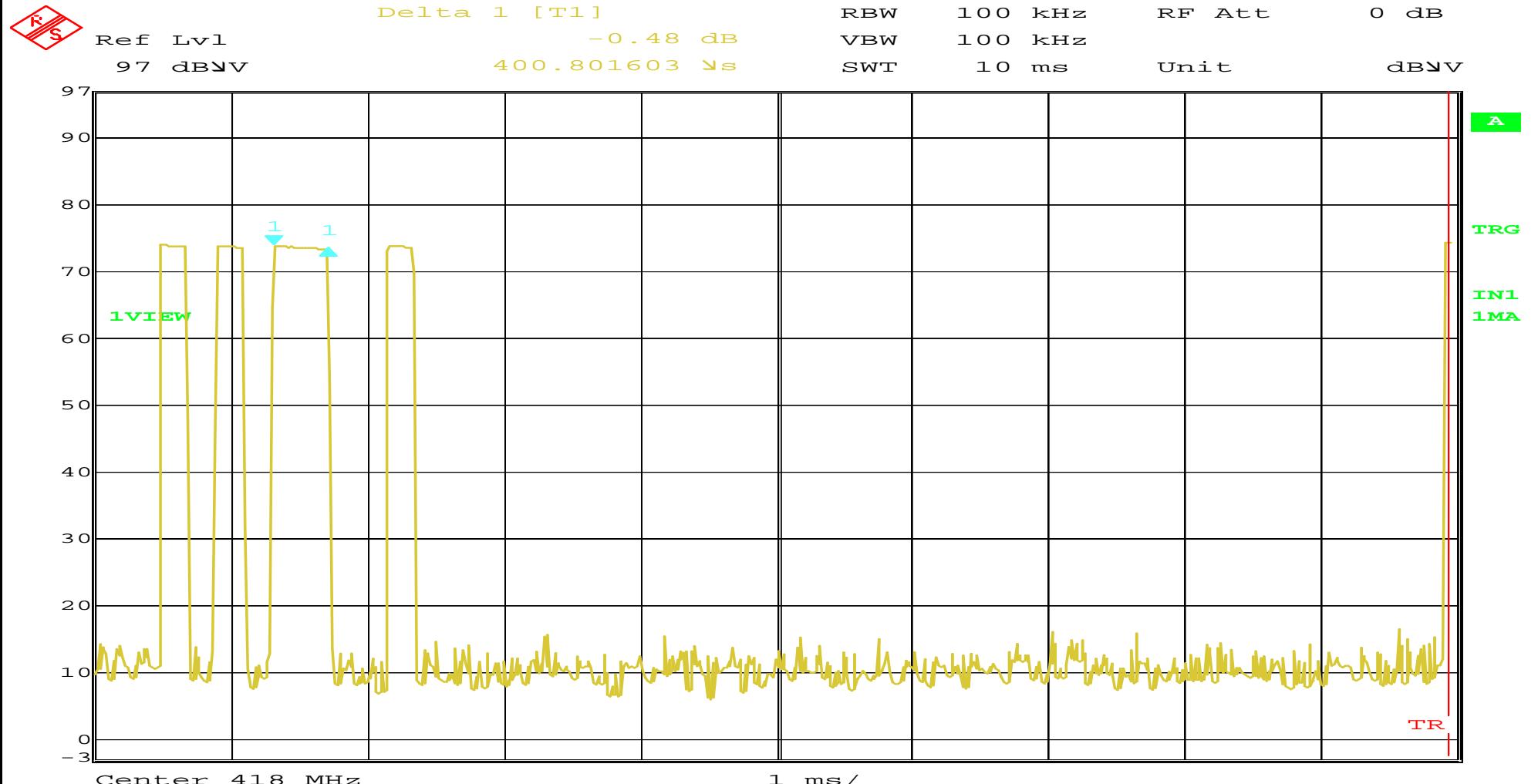
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Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Maximum Duty Cycle	Date:	2/6/2009



# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Maximum Duty Cycle		



Date: 6.FEB.2009 09:48:13

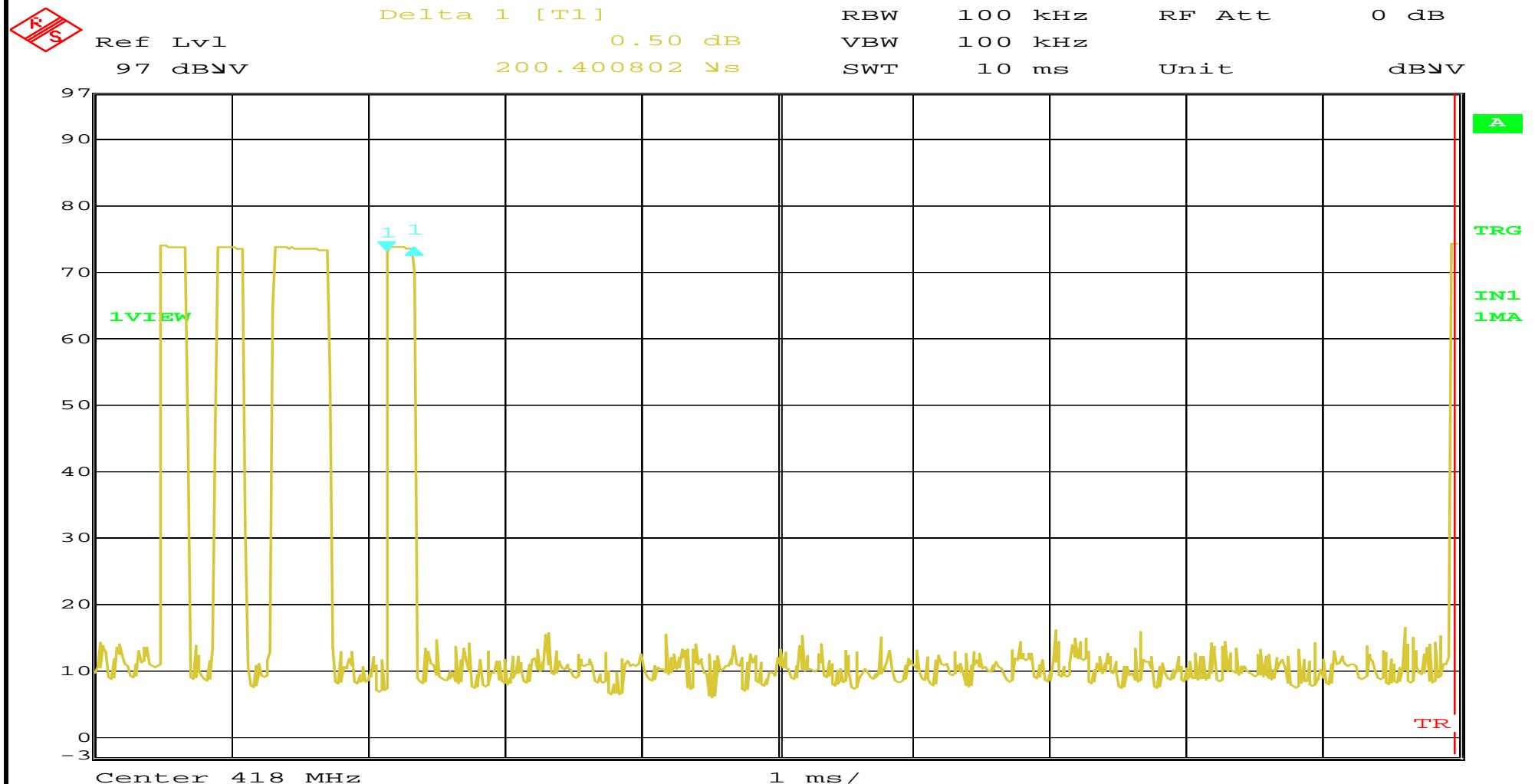
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Date: 2/6/2009
Operating Mode:	Continuously Transmitting		
Notes:	Fundamental Frequency: 340 MHz		



Date: 6.FEB.2009 09:48:39

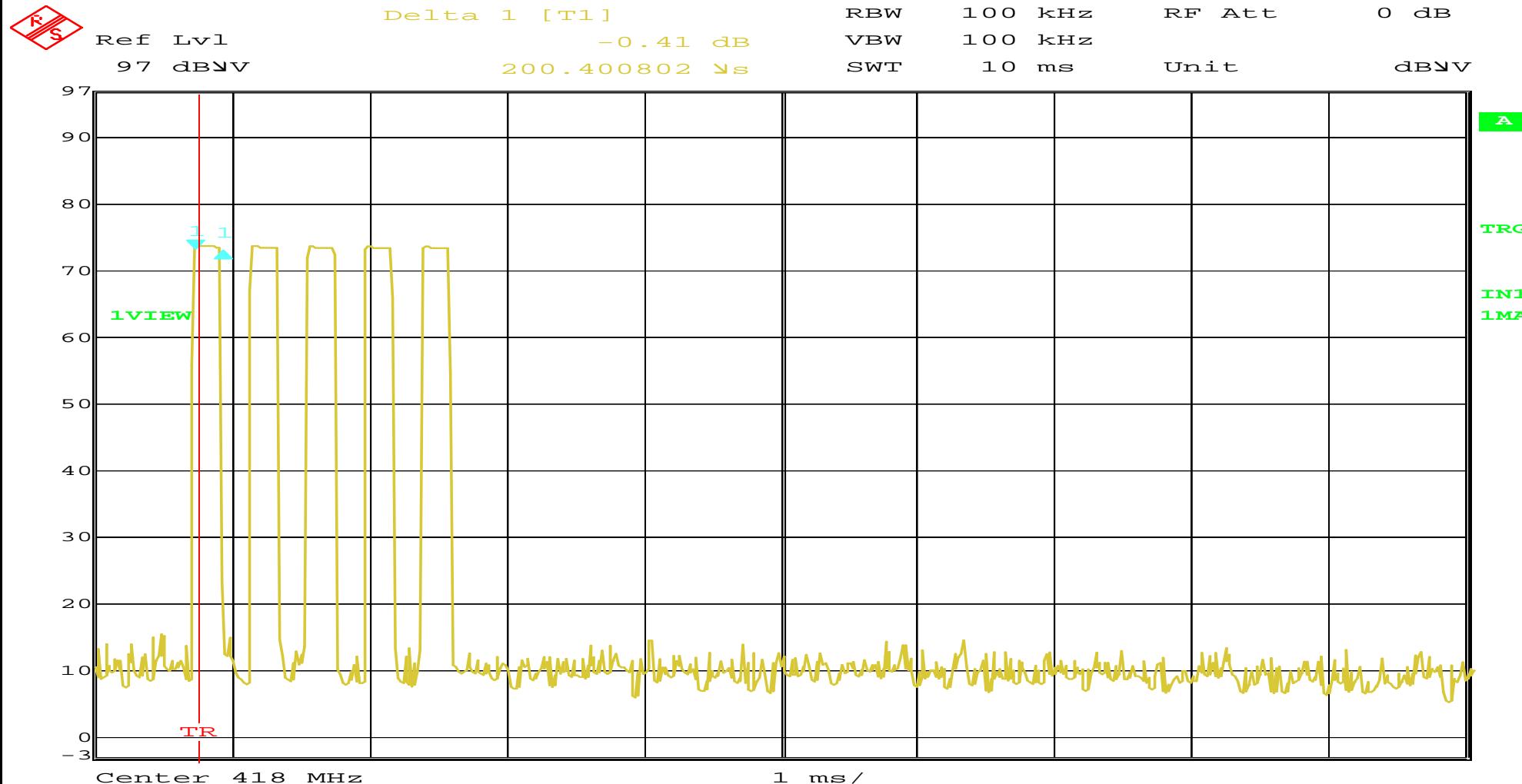
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Fundamental Frequency: 340 MHz		



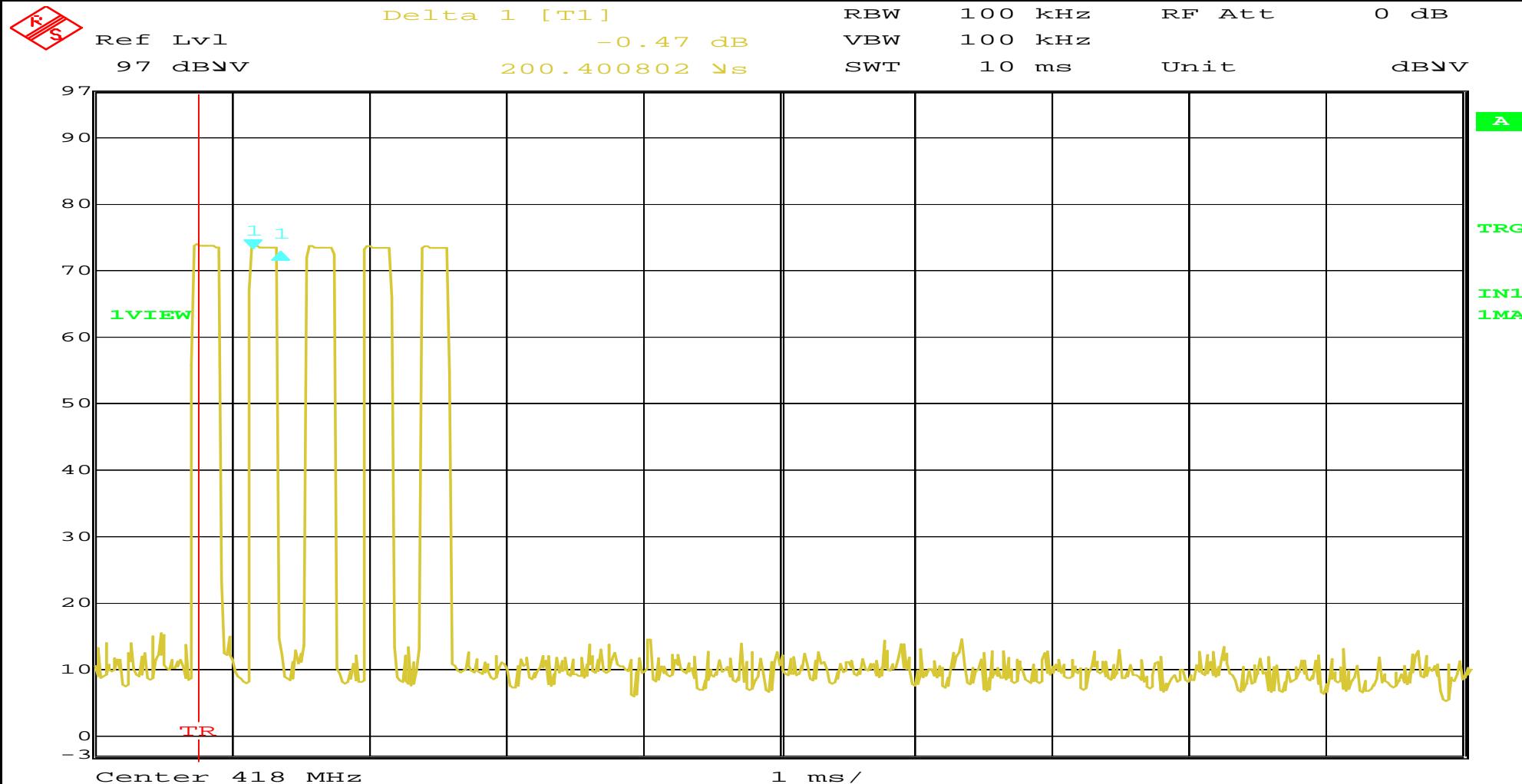
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Fundamental Frequency: 340 MHz		



Date: 6.FEB.2009 09:51:31

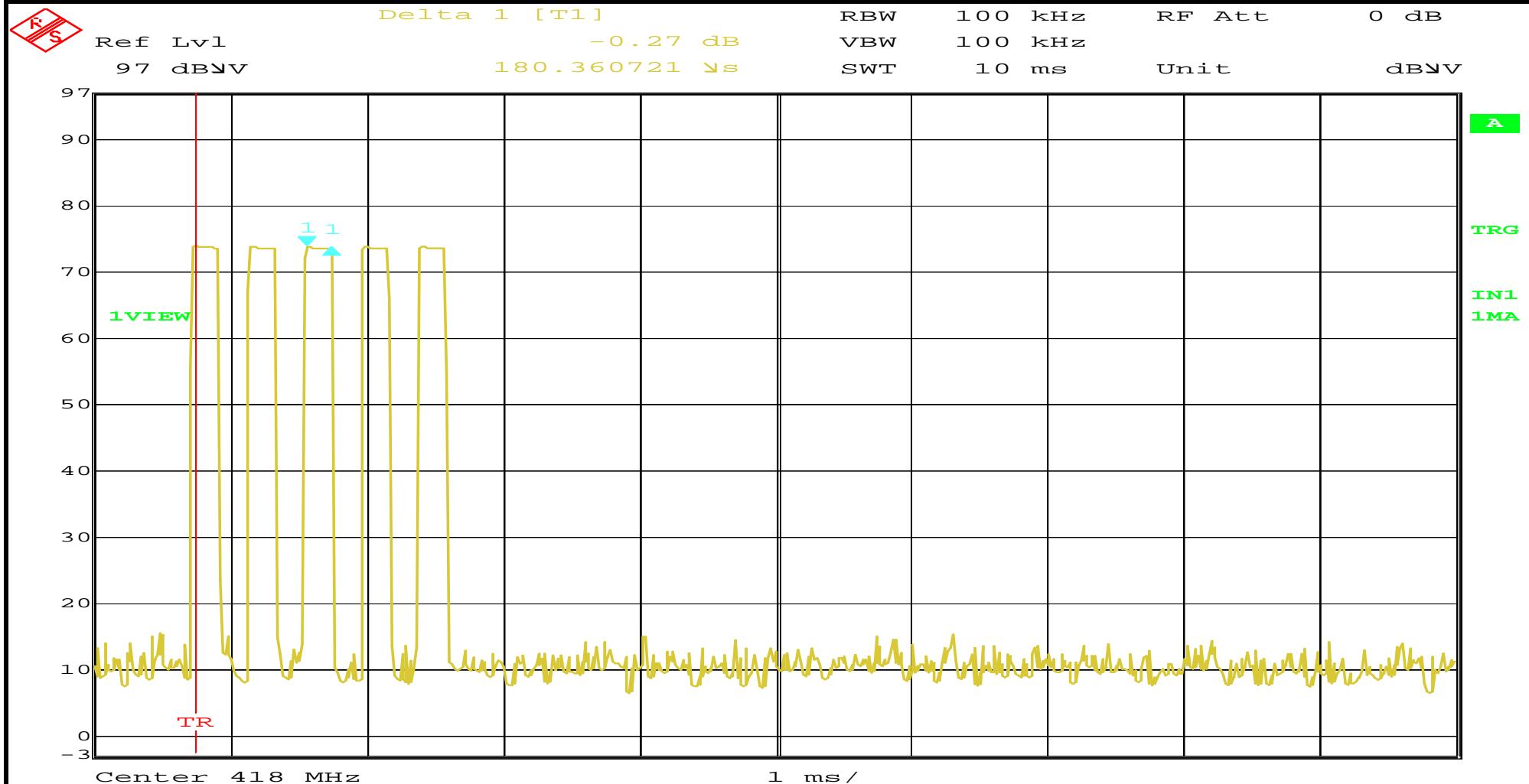
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Fundamental Frequency: 347MHz		



Date: 6. FEB. 2009 09:51:11

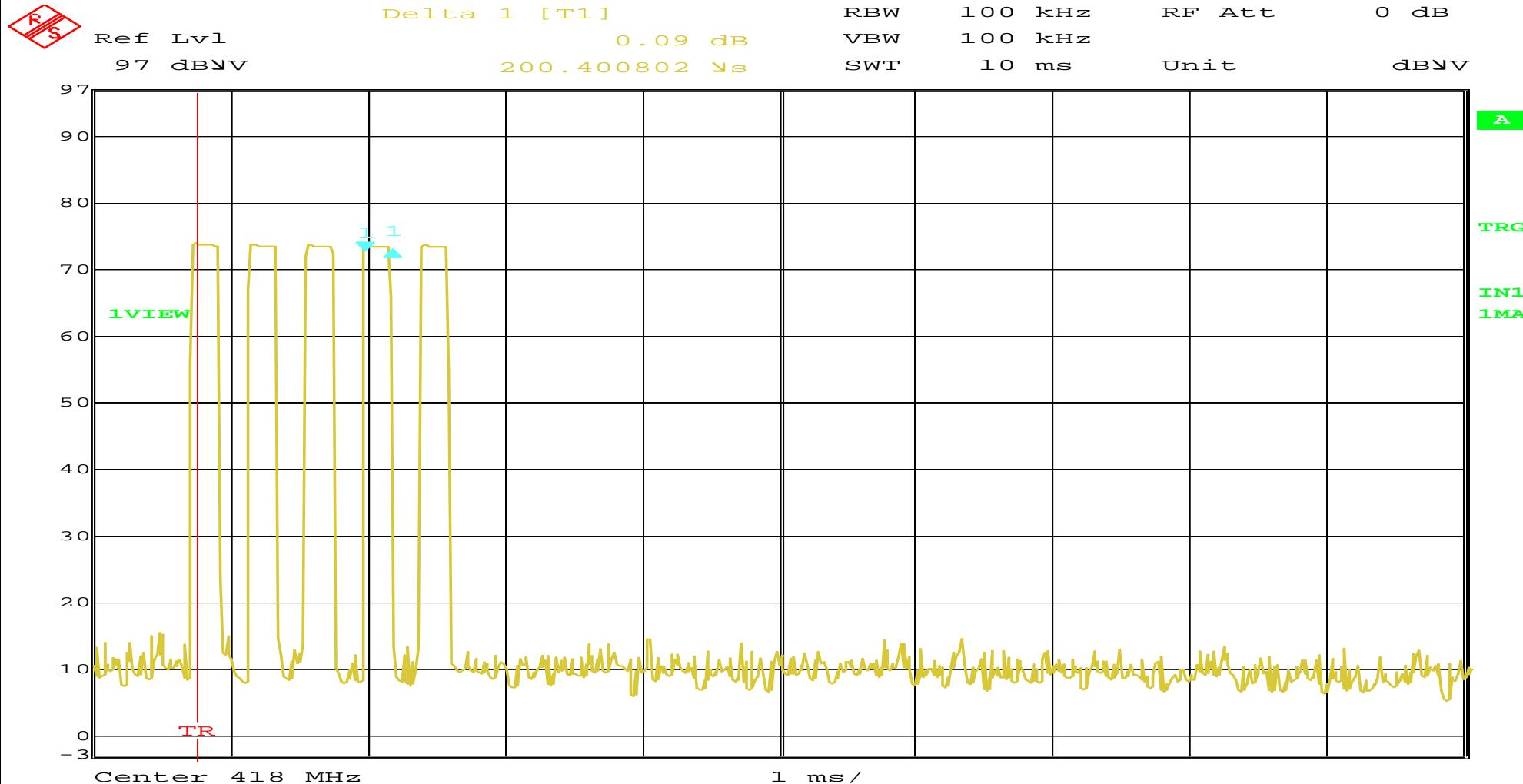
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Fundamental Frequency: 347MHz		



Date: 6.FEB.2009 09:52:06

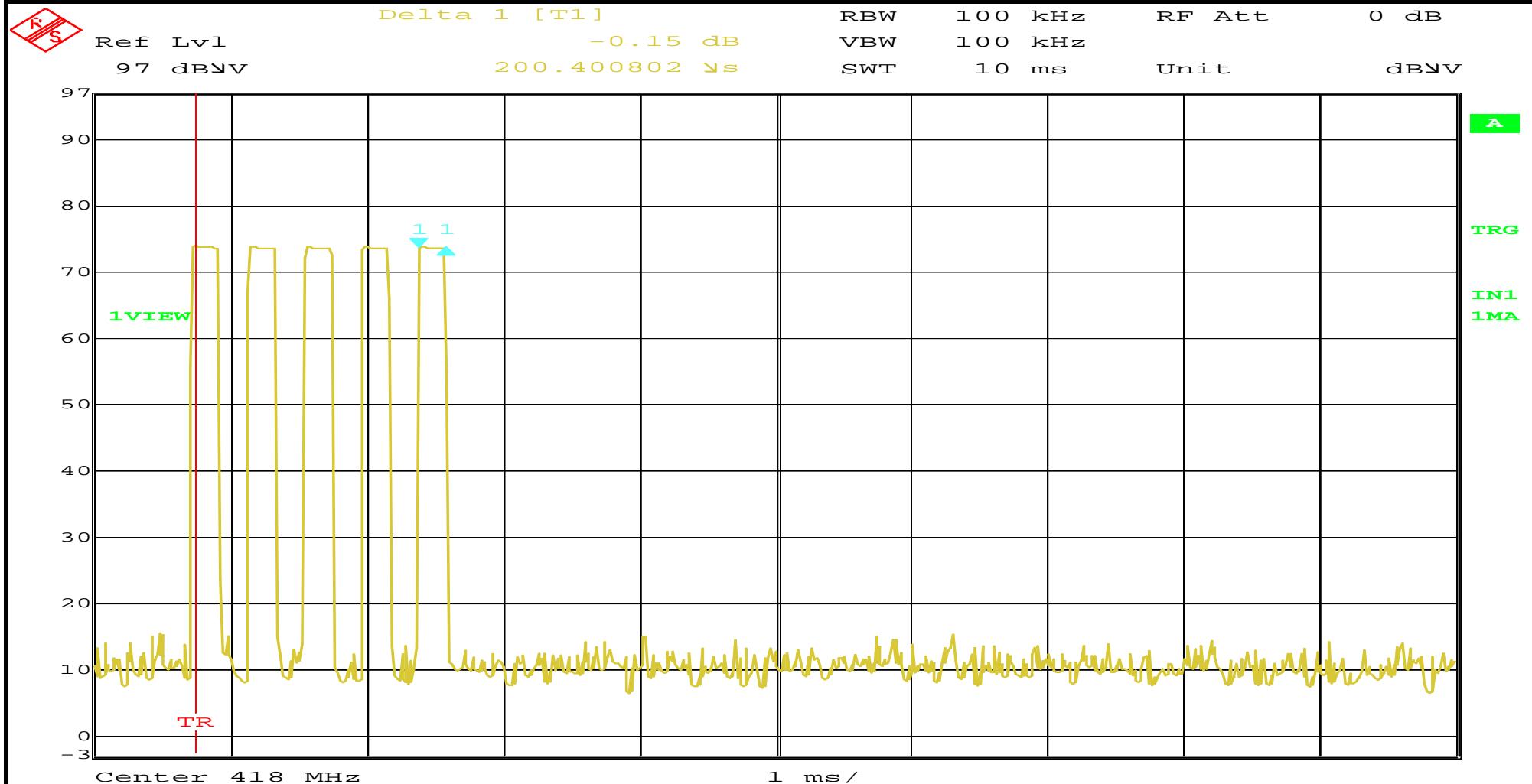
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# RETLIF TESTING LABORATORIES

## EMISSIONS DATA SHEET

Test Method:	Duty Cycle Plots		
Customer:	MadgeTech	Test Sample:	Temperature Recorder and Wireless Transmitter Data Logger
Model No:	RFOT	Serial No:	Eng. Prototype
Test Specification:	FCC Part 15, Subpart C	15.231( e )	Job No: R-5138N
Operating Mode:	Continuously Transmitting	Technician:	M. Seamans
Notes:	Fundamental Frequency: 347MHz		



Date: 6. FEB. 2009 09:52:44

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