# RETLIF TESTING LABORATORIES TEST REPORT R-4249N1 April 19, 2004

FCC PART 15.231 COMPLIANCE TEST REPORT ON

MADGETECH, INC. WIRELESS DATA LOGGER FCC ID: RUYRFPHTEMP

APPLICANT	MANUFACTURER
Madgetech, Inc. 201 Route 103 West Warner, NH 03278	SAME

TEST SPECIFICATION: FCC Rules and Regulations Part 15, Subpart C, Para. 15.231

TEST PROCEDURE: ANSI C63.4:1992

#### TEST SAMPLE DESCRIPTION

BRANDNAME: Madgetech	MODEL: <u>RFPHTEMP101</u>
TYPE: Wireless Data Logger	
POWER REQUIREMENTS: 3.5VDC via internal batte	ry
FREQUENCY OF OPERATION: 418.0MHz	
TYPE OF TRANSMISSION: Pulsed emission containing	g manchester encoded data bits
FCC ID: RUYRFPHTEMP	
APPLICABLE RULE SECTION: Part 15. Subpart C.	Section 15.231

#### **TESTS PERFORMED**

15.231 (e) Spurious Emissions (30MHz to 4.2GHz)

15.231 (e) Field Strength of Fundamental

15.231 (c) Occupied Bandwidth, 0.25% of Fundamental Frequency

**Duty Cycle Determination** 

#### TEST SAMPLE OPERATION

The EUT is powered by 3.5VDC, internal battery. The device is automatically operated and is intended to transmit variable environmental test data such as temperature, humidity or PH at a user defined interval (30 seconds to 12 hours). Operation of the EUT complies with the parameters required in Part 15, Subpart C, Section 15.231 (e) for devices which will transmit data and with the general requirements of 15.231 for automatically operated devices. For testing purposes the EUT was configured to continuously transmit at maximum duty cycle with new battery installed.

#### TEST SAMPLE / TEST PROGRAM

- The transmitter ceases transmission within 5 seconds after activation per the requirements of 15.231 a (2).
- Operation is limited so that the duration of each transmission is less than one second (.937sec) and the minimum silent period between transmissions 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).
- The device is not employed for RC purposes involving fire, security and safety of life.
- The fundamental field strength at 418.0MHz did not exceed 4133 $\mu$ V/M (Average) at a test distance of 3 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  $413\mu\text{V/M}$  as specified in 15.231 (e) for a fundamental frequency of 418.0MHz.
- The device operates at a single frequency of 418.0MHz The bandwidth of emission did not exceed 0.25% of the operating frequency as specified in 15.231 (c) and was 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 - 0.5225MHz

418.0 MHz - 0.5225 MHz = 417.4775 MHz418.0 MHz + 0.5225 MHz = 418.5225 MHz

Bandwidth Range = 417.4775MHz - 418.5225MHz

- The device uses an external 1/4 wave whip antenna with a reverse SMA antenna connector which meets the unique antenna connector requirement of 15.203
- Radiated Emissions from the EUT were measured in all three axis. The attached Radiated Emissions test data is representative of the worst case orientation.

#### DETERMINATION OF FIELD STRENGTH LIMITS

The field strength limits shown below were calculated as specified 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:

16.6667(F) - 2833.3333 = Field Strength Limit ( $\mu$ V/m)

 $16.6667 \times 418.0 = 6966.6806$ 6966.6806 - 2833.3333 = 4133.35

Field Strength Limit =  $4133.35 \mu V/m = 72.33 dBuV/M$ 

The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level which equals  $413.33 \mu V/m = 52.33 dBuV/M$ .

#### 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. As the pulse train exceeded 100msec in duration the worst case duty cycle was determined by analyzing the 100msec period with the greatest on time. The "on time" within the pulse train was determined as follows:

The individual pulse widths within the pulse train were measured and summed in order to obtain the total "on time" within the train.

#### **Fundamental Frequency: 418.0MHz**

Transmitter On Time = 8.421 milliseconds
Transmitter Cycle Time = 100 milliseconds

Transmitter Duty Cycle = 8.421%

On Time divided by Cycle Time = Duty Cycle Factor

8.421 divided by 100 = 0.084210.08421 converted to dB (LOG<sub>10</sub> .08421)20 = -21.49dB **Duty Cycle Factor** = -21.49dB

Duty Cycle Factor Determination Plots are included with this application as a separate attachment.. The duty cycle factor was applied to the peak readings in order to determine the average value of the emissions.

# **EQUIPMENT LISTS**

# Spurious Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	7/30/2003	7/30/2004
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	8/29/2003	8/29/2004
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	3/22/2004	3/22/2005
4984A	High Gain Horn	Microlab/FXR	1.0 - 1.7 GHz	L638A	1/22/2004	1/22/2005
4984B	High Gain Horn	Microlab/FXR	1.7 - 2.6 GHz	R638A	1/22/2004	1/22/2005
4984C	High Gain Horn	Microlab/FXR	2.6 - 3.95 GHz	S638A	1/22/2004	1/22/2005
4984D	High Gain Horn	Microlab/FXR	3.95 - 5.85 GHz	H638A	1/22/2004	1/22/2005

# Fundamental Field Strength

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	7/30/2003	7/30/2004
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	8/29/2003	8/29/2004
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	3/22/2004	3/22/2005

# Occupied Bandwidth/Duty Cycle

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	9/5/2003	9/5/2004

2000 (38)	Duty Cycle							eno magno ij - manim				
er:	Madgetech, Inc.			Test	t Sample: Da	ata Logger			· · · · · · · · · · · · · · · · · · ·		Job No:	
Vo:	RFPHTEMP101			Seri	al No:	a					Technic	ian: T. Fir
ecification:	FCC Part 15, Subp	art C		Para	agraph: 15.231	(e)					Date:	April
ng Mode:	Transmitting Modul	ated Signal								,		
> _	_					RBW	100	kHz -	RI	Att	О	) dB
Ref						VBW	300	kHz	т т.	nit		dBµV
7	dΒμV					SWT	100	ms				шμν
Ì												
				_								
0												
0												
	<u> </u>					****			van.	•	<b>.</b>	
OUTE	w			<b></b>								
									TII -			
					<b>         </b>							
									-1-11			
		<b>]</b>										
o <del>rr</del> g	<del>- 19:8 dB</del>	, p. 1	<del>-                                    </del>	<b>H</b>								
	اساس بها الماسس	W Murry	March 1922 H	سرامر الا	A Maria	n 14 1	Mund		8/ III ~-	m Ma	hours	
Like		P -	9-3-3-	-U (J.m.		W .	, 000m - h	0.00.0		<b>.</b>		, ,

thod:	Duty Cy	/cle										y					
er:	Madget	0.0000.000.00		27 - 1:200	2020		Test Sampl		ogger							Job No:	R-4249N
lo:	RFPHT						Serial No:	n/a			to the keep comment					Technician:	
ecification:	FCC Pa	ırt 15, S	ubpart C				Paragraph:	15.231 (e)			*					Date:	April 6, 2
ng Mode:	Transm	itting M	odulated S	Signal										<u> </u>			
						,		×			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						-
>	<b>-</b> -			Delta	1	[T1]	0.0 1		BW	100		Hz -	3	RF At	t	0 <	B.
	Lvl dBµV	τ					.33 dB L14 ms		BW WT	300	Jк. 5 m	Hz s	т	Jnit		dī	3μV
7	αвμι					9.007.	LI4 IUS		~~ <u>~</u>		J 111	<u>.</u>				· · · · · · · · · · · · · · · · · · ·	<del></del>
					-												
																	ם   י
											_	_					1
1V/E	* <b>†</b>								. 1.2.	* * *						·	1
																	1
	ΙΙΙ				ŀ												ł
	<del>       </del>										<del>†</del> ††	11 1	╅╫				
	111									4	<b>1</b>	<b>/I</b> [	1 (1				
<b>□</b>	+ + +	┞╌┦╂			_						$\ \cdot\ $	+H-	1 11				
	1	<u> </u>										11					
												41	Ш				
												11 /					
	] ] [	] ] [									1	1					
	<del>/      </del>	111		•				1				111	111		_		
المناا		ا لا ا	الماليا	<b>Ի</b> ԵՎ	المارين	بأسر اللهديان	المربعة المرابعة	Alia AL	الأن العبر	Na Alband		1   1	U/ U	ورطامنارات	السلال		ونداي
	VI I	Ŋ	All N	այթ-ս այլսպ	<b>1</b> 33	AND AND	hman (h		L MAN II	hrm	<b>\</b>		V# `	A residence	<b>40 4</b> (	AMD. A.	<u> </u>
							* 1										l
TR											.						
3																<u> </u>	

hod:	Duty Cycl	W		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		ГБ.4. I	11.11.11.00 makes		······································			Job No: R-42
er;	Madgetech				Test Sample			···				
0:	RFPHTEM				Serial No:	n/a			<u></u>			Technician: T. Fi
ecification:		15, Subpart C			Paragraph: 1	15.231 ( e )			·			Date: April
ng Mode:	Fransmittir	ng Modulated	Signal						drin			
		,	Delta	1 [T1]		RBW	100	kH:	<del></del>	RF	Att	0 dB
, Ref	Lvl		Derta		.06 dB	VBW	300	kH:		TAT	ALL	0 32
	dΒμV			1.6212		SWT		ms		Un.	it.	dВµV
7			T		<u> </u>			<del></del>		1		
⊃ <b> </b>												
1 vae		a						-a∐a	n	n		,
								$-\mathbf{I} + \mathbf{I}$				
		11										]
		1										
	] ] ]]						1	1				}
		Н										
	1											
	}											
		<u> </u>				-						
									[]]			
	}	╀						$+\!\!+\!\!\!+\!\!\!+$	<del>-   ¶  </del>			
	1 1.11	المال	. النامين	ال المحادية	1 2 2 4 4 4	<b>.</b>	ل منامات		.117	l I.		سد والمرابا
	U W		Mary Mary	withhalphank				\h	الا الل	/ <b>/</b> W		Lygh Miller
	•	W					•					
TR												

hod:	Duty C												
er:	Madget		www.communication	Jan 1932 co- 6	. An idealise	Test Sam		ta Logger				TO SERVICE THE PROPERTY OF A SERVICE TO SERVICE THE SERVICE	R-4249
o:	RFPHT					Serial No	Y. A					Technician:	T. Firk
cificatio	n: FCC Pa	rt 15, Subpart	С			Paragraph	: 15.231 (	e)				Date:	April 6
g Mode:	Transm	itting Modulate	d Signal										
			Delt	a 1		06 17		RBW			F Att	0 0	æ
Ref	Lvl dBul	r		1 /1		.26 dB 561 µs		VBW SWT	300 2 :		nit	ДŦ	3μV
<i>ر د</i> —7	ч ч				0.280			> N T			,		- μ υ
													1
									*				_
<b></b>											-		_
171		_			_						·		
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	- E-W			$-/\!\!\!\perp$								+/ $+$	
					-		V						
							<b>.</b>		<u> </u>				
		1					1						- 1
		ļ		$I \perp$	Ì		/	ĺ					
	<b>†</b>			1			II						
	$\parallel \parallel \parallel \parallel$	<u> </u>		1			<i>[</i> ]					I	
)		<del>-                                    </del>					<i>!</i>						
		1			1				ł			/	<u> </u>
	1				}	}			$\overline{}$		<del>                                     </del>		
	ا ا		أمرا					-	1	Ank I	. 1		l. I
· krt/	שע		What I						<u>\_</u>		h		
AAA		V V	The work		4/4	rally of	•		ijV	in manage	d as with the		
,	TR					,							
á 🗀													

ethod:	Duty Cycle	V (300				Military Control					_		
ner:	Madgetech, I						le: Data Logger				Job No:		249 <b>N</b> 1
No:	RFPHTEMP1				<u> </u>	Serial No:	n/a				Technician:		
ecification:	FCC Part 15,					Paragraph:	15.231 ( e )	y			Date:	April	6, 20
ng Mode:	Transmitting	Modulated S	Signal	,									3000
	<u> </u>		<u> </u>				T) T F. T	100	1	T 3++		-170	
> Ref	Lvl		Delta	a 1		_91 dB	RBW VBW	100 300	кнz к kHz	F Att	0 6	dB	
	dBµV			14		-93 μs	SWT	2 :		Jnit	d)	вµ∨	T
7	' 		<u> </u>										1
							5						
0													1
													l
													T
											+		
1VIE	w —				٦								1 P
	<del>         </del>			+			<del>   </del>				+/		
				I			V				-1/		
0							<b> </b>				$\parallel$		
				}			<u>, </u>	}				Ī	ĺ
0							<b>/</b>						TI
			<b>-</b>	<b>;</b>	\ 						/	\ <b>\</b>	
0					<u></u>	<b></b>	:						
	[ ]				\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			Į				l I	
		<b>\</b>	- {		1	1 /		İ		1 1	[ ]	) [	1
					1			1					ł
Ja Al		\ <b>a</b> .	. 181		h., d	4			NH MAN	1 11		},	l
° <del>∖(∤∜∖∫</del>		The Day						4	<del>Ŋ</del> Ĭ <del>ϤͺͿͶ</del> ʹͿϭϤϧϳϹͺ϶			W	İ
			•					·		9 30 8			
o T	R									+			

thod:	Duty Cycle		~~~~	· · · · · · · · · · · · · · · · · · ·			: 1406000000							
er:	Madgetech					Test Sam		Data Logger					Job No:	R-424
lo:	RFPHTEM	CO. 1100 (A. 110				Serial No:		n/a					Technician:	
ecification:	FCC Part 1	5, Subpart C				Paragraph	: 15.2	!31 (e)		v.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			Date:	April 6
ng Mode:	Transmittin	g Modulated S	Signal											
			***************************************								1			
>			Delta	1 1				RBW	100	kHz	RF	Att	0 c	B
	Lvl dBµV			20	.0 8.6573	.92 dB		VBW SWT	300 2	kHz ms	Т Т	ıit	d٦	3μV
7	авич	· · · · · · · · · · · · · · · · · · ·		3 Z	8.05/3	 ΣΙΟ με	11				- O1.			5μV
														1
0			-											
0														
o							$\parallel$							
i		7							<del></del>					
1VIE	M /			$/\!\!\perp$					-				+/-1	
ļ					-		/		1					l
		1		[ ]			1							
		1		1	}								1 1	
							∄		L					
			ļ				$I \ $		<u></u>				{	
0			1								1		]	
	1					1			l			ļ	<i>!</i>	١ ١
		1	<del>                                     </del>	-		1			<u> </u>				<u>'</u>	
ان بر		1.			\	l + 1 J				. at	,	∫		1. I
		11407/4	Hud W		<u>                                  </u>	Laght / Mills			<b>U</b> _	<del>₹∧∤₩∭₩</del> ₩	al a			
A A		עטי	CW-VOI IF		~\ <b>J</b>	տավ ու ուն։			υ	լայալը, <sub>Հ</sub> յ		o all had		
T	R					•								
3											i			

					E	MISSIONS	S DA	IA SHEE	1					
lethod:	Duty Cycle					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,								
mer:	Madgetech	, Inc.				Test Sam	ıple: [	Data Logger					Job No:	R-4249N
No:	RFPHTEMI	P101				Serial No	: [r	n/a					Technician:	T. Firkov
pecification:	FCC Part 1	5, Subpart C			40-1-11-11-11-1-1-1-1-1-1-1-1-1-1-1-1-1-	Paragrapi	า: 15.23	1 ( e )					Date:	April 6, 2
ting Mode:	Transmittin	g Modulated S	Signal											
_	<del>/ // // // // // // // // // // // // /</del>		Delta	1 [T	1]			RBW	10	0 1	EHZ F	RF Att	0 0	B.
	Lvl					63 dB		VBW	30		EHZ			
	dΒμV			148.	2965	93 µs		SWT		2 n	ns t	Jnit	dI	3μV
97														
9 0														-
							ŀ							
s o														
														T
7.0										*				
, 0														1
1VIE	G7 /	1						2 1 24 241	* = *					1
50			<del> </del>			11							17 1	
		ļ	]	1	İ		V		l				-	
50	+ -	<del> </del>	1	+ +			+							
			1				1		]				}	
40		<b>1</b>	<b></b>						1					T
	}	1		1			}					i	<b>†</b>	<b>^</b>
3 0	<u> </u>													
				1			1		[					
	1	1	1	1			/			}			[]	) [
20			<i></i>	1						<b>\</b>				
			.	}		<i></i>				ļ	A BELL			},
LO		They a	Hadill -							4,11	No. III No.	<del>。/∖₊/¶  ﻧﯩ∄  </del> /		
0 0		YU V	0>200			-44 A AR	•			ų <b>v</b>	ω ω · <b>υ μ</b> υ	d a section	İ	
O T	R					•								
- 3	<u> </u>	-		<u> </u>					20					
Cent	er 41	8 MHz				Ź	200	μs/						

. •

	RETLIF TESTING LABORATORIES													
	45.1 14.2 - 14.2			TABUL	AR DATA	SHEET	214							
Test Method: Customer: Test Sample:		Fundamental Field Strength												
		Madgetech, Inc	<b>.</b>			Job No:	R-4249N1							
		Data Logger	Data Logger											
Model No:		RFPHTEMP101 Serial No: n/a												
Test Specification: Operating Mode: Technician: Notes:		FCC Part 15, Subpart C												
		Transmitting M	Paragraph: 15.231 (e)  Transmitting Modulated Signal											
		T. Firkowski 4/2/2004  Test Distance: 3 Meters Detector: Peak												
														Transmit Frequency
MHz	MHz	Position Polarization/Axis	Reading	Factor dB	Peak Reading dBuV/m	Limit dBuV/m	Correction	Average Reading	Reading	at 3 Meters				
418.00	IVII IZ	1 Old (Zation/AXIS	uĐUV	UD	ubuv/m	ubuv/m	dB	dBuV/m	uV/m	uVm				
	418.0	V/Z	65.12	25.60	90.72	92.33	-21.49	69.23	2892.38	4133.35				
					,									
									•					
				-										
			·····											
								_						
			· <u> </u>											
		<del>                                     </del>					<b></b>							
						·								
		1		<u> </u>			<u></u>	<u> </u>						
Data Sheet	1 of 1				-	-				R-4249N1				
										11-4243IN1				

					NG LA			RIES =					
		TABULAR DATA SHEET											
Test Method: Customer:		Spurious Emissions 30MHz to 4.2GHz  Madgetech, Inc.  Job No: R-4249N1											
													Test Sample
							· · · · · · · · · · · · · · · · · · ·						
Model No: Test Specification:		RFPHTEMP101 Serial No: n/a											
		FCC Part 15, S	Subpart C			_			· · · · · · · · · · · · · · · · · · ·				
	14.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17.00 17					Paragraph: 1	5.231 (e)						
Operating Mode:		Transmitting Modulated Signal											
Technician:		T. Firkowski			1/	Date:	04/05/2004						
Notes:		Test Distance: 3 Meters											
· Line Sign Control Co		Detector: Peak											
Transmit	Test	Antenna/EUT	Meter	Correction	Corrected	Peak	Duty Cycle	Corrected	Converted	Limit			
Frequency	Frequency	Position	Reading	Factor	Peak Reading	Limit	Correction	Average Reading	Reading	at 3 Meters			
MHz	MHz	Polarization/Axis	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	uV/m	uVm			
418.00										413.33			
	836.0	-	<del>-</del>	-		-	-	-	-				
<del>!</del>	1254.0	-	-	-		-	-	-	-				
<u> </u>	1672.0		<u> </u>	-	- :	-	-	-	-	<u> </u>			
<u> </u>	2090.0 2508.0	-	-	-		-	-	-	-				
<u> </u>	2926.0	-	<del></del>	-	<u>-</u>	-	-	-	-				
i	3344.0	-		-	-	<del>-</del>	-			1			
<del>-                                    </del>	3762.0	_	-	-	<del>                                     </del>								
	4180.0	-	-	-		-		-	-	<u> </u>			
			W-10.						94	i			
418.00							<del>-</del> .,			413.33			
			<del></del>				<b>-</b>						
		<del>   </del>	<del></del>										
								1					
			<u>.</u>										
	No EUT emis	sions were obse	erved at the si	l pecified test di	I   istance, through	out the given	frequency spe	ectrum					
<del></del>				- 3004 1001 41	unougn	-actio giveii	oquency spe	Journal,					
										<u> </u>			
									·	<u> </u>			
Data Sheet	1 of 1					-,		· <del></del>		R-4249N1			

				EMISSIONS	DATA SHEE	Ι.			<u></u>	5761
lethod:	Occupied Bandwidth						<u> </u>		Job No:	R-4249I
Istomer: Madgetech, Inc.					Test Sample: Data Logger					
					Serial No: n/a					
pecification:	FCC Part 15, Subpart C Paragraph: 15.231 ( c )								Date:	April 6,
ing Mode:	Transmitting Modulated	d Signal								
>					RBW	100	kHz	RF Att	0 <	B
	Lvl				VBW	300	kHz		7	~ ~ ~
97	dΒμV				SWT	5	ms	Unit	at	μν
0										
0										
	69.62 dBµ	5. A								
	09.02 ασμ									] ,
1VIE	w				N 12 12 12 12 12 12 12 12 12 12 12 12 12				,	1
					1					
			كممي	γ	W NA					
0	D2 49.62	dBµV——			-	With an		Manny		
		V JANA JANA JANA				2000	Murry.	4 O		
O	4 - 1 0 -	9 9					4	2 Almar Action	William .	
	Ü								1.00	/ <b>/</b> ~
0										
			10.000 20.000 20.000	ļ.						
										ł
0				व्यं सू						
								F 2		
0	-	F 1.								
3	I .	<del></del>		1 .			Spa	1		