Technical Information

Applic	ant	Manufacturer
Name: Smart S	structures, Inc. Name:	Smart Structures, Inc.
Address: 324 Second	Street Pike, Unit #13 Addres	ss: 324 Second Street Pike, Unit #13
City, State, Zip: South	nampton, PA 18966 City, S	tate, Zip: Southampton, PA 18966

Test Specification: FCC Rules and Regulations Part 15, Subpart C, Para. 15.247

Test Procedure: ANSI C63.4:2003

Test Sample Description

Test Sample: 2.4 GHz Frequency Hopping Spread Spectrum Transmitter

Brandname: Smart Structures

Model Number: SP_401

FCC ID: V9CSP-X01D2

Type: 2.4 GHz Frequency Hopping Spread Spectrum Transmitter

Power Requirements: 3 VDC derived from an Internal Battery

Frequency of Operation: 2.4 to 2.4835 GHz

Tests Performed

Para. 15.247(a)(1) Channel Separation
Para. 15.247(a)(1) 20 dB Bandwidth

Para. 15.247(a)(1)(ii) Number of Channels and Occupancy Time

Para. 15.247(b)(1) and (4) Peak Conducted Output Power

Para. 15.247(d) Spurious Emissions, 30 MHz to 25 GHz

Para. 15.247(a)/15.209(a) Field Strength of Spurious Emissions (Digital Device)

Report of Measurements

Applicant: Smart Structures, Inc.

Device: 2.4 GHz Frequency Hopping Spread Spectrum Transmitter

FCC ID: FCC ID: V9CSP-X01D2

Power Requirements: 3 VDC derived from an Internal Battery

Applicable Rule Section: Part 15, Subpart C, Section 15.247

Test Results

15.247 (a)(1) - Channel Separation and 20 dB Bandwidth

The frequency hopping system utilizes channel carrier frequencies separated by 1 MHz. This complies with the requirement that the carrier frequencies be separated by 25 kHz or the 20 dB bandwidth of 35 kHz, whichever is greater.

15.247 (a)(1)(ii) - Number of Channels and Occupancy Time

The frequency hopping system utilizes 79 channels, which complies with the requirement that a minimum of 15 channels be used in the 2400 to 2483.5 MHz band. The average time of occupancy on any channel is 0.312 seconds within a period of 31.6 seconds. This complies with the requirement that the average occupancy time shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

15.247 (b)(1) and (4) - Peak Conducted Output Power

The frequency hopping system utilizes a transmitting antenna with a directional gain of 9 dBi. The peak output power limit of 1 watt was therefore reduced by 3 dB, the amount in dB that the directional gain of the antenna exceeds 6 dBi, resulting in a peak power output limit of 500 milliwatts. The maximum peak conducted output power was measured to be 14.58 milliwatts.

The measured output power complies with the reduced power output limit of 500 milliwatts.

15.247 (d) – Spurious Emissions

In any 100 kHz bandwidth outside of the 2400 to 2483.5 MHz operating frequency band, the radio frequency power that was produced by the intentional radiator, when measured by means of an RF conducted method, was at least 50 dB below that in the 100 kHz bandwidth within the band that contained the highest level of desired power.

The antenna conducted spurious emissions comply with the requirement that the radio frequency power be at least 20 dB below the highest in band level.

In addition, Harmonic and Spurious Emissions which were found to be within the restricted bands of operation, as defined in section 15.205 (a) were found to be in compliance with the general limits specified in section 15.209 (a).

15.247 (i) – Exposure to Radio Frequency Energy

The frequency hopping system is operated in such a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. The system utilizes a high gain (9 dBi) antenna which is for outdoor operations. The maximum output power was measured to be 14.58 milliwatts of the antenna terminals. The directional gain of the antenna is 9 dBi, yielding a maximum power density of 0.023 mW/cm², which is well below the MPE guideline specified in OET Bulletin 65, Supplement C for transmitting using high gain antennas for outdoor operations.

15.107 (a) / 15.209 (a) – Field Strength of Spurious Radiation

The radiated emissions produced by the digital portions of the frequency hopping system did not exceed the limits specified in sections 15.109 (a) and 15.209 (a) over the frequency range of 30 MHz to 1 GHz.

Spectrum Analyzer Desensitization Considerations

Due to the nature of the emissions being measured, care was taken to ensure that the resolution bandwidth of the spectrum analyzer was adequate to provide accurate measurements. FCC specified bandwidths of 100 kHz and 1 MHz were utilized below and above 1 GHz, respectively.

15.203 Antenna Requirement

This device is intended to be professionally installed, therefore the unique antenna connector requirement does not apply.

General Notes

- 1. All radiated emissions measurements were taken utilizing both peak and average detector functions at a test distance of 3 meters.
- 2. All measurements were made with 3 VDC derived from an Internal Battery.
- 3. The frequency range was scanned from 30 MHz to 25 GHz. All emissions not reported were more than 20 dB below the specified limit.

Certification and Signatures

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.
Joseph Maiello Branch Manager
Richard J. Reitz Corporate Laboratory Manager NARTE Certified Engineer: ALT-0036-E

Non-Warranty Provision

The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

Non-Endorsement

This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested. This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

Equipment List

Para. 15.247(b)(1) - Output Power

EN 713	Type EMI Test Receiver	Manufacturer Rohde & Schwarz	Description 20 Hz - 26.5 GHz	Model No. ESIB26	Cal Date 8/12/2007	Due Date 8/12/2008
	Р	ara. 15.247(a)(1)(ii) - Occupied	Bandwidth		
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008
8109	10db attenuator	Aeroflex/Weinschel	DC-18 GHz	46-20-34	5/2/2007	5/2/2008

Para. 15.247(c) - Antenna Conducted Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008

Para. 15.247(c) – Spurious Radiated Emissions, 30 MHz to 1.0 GHz

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008
8365	Biconilog	EMCO	26MHz-3000MHz	3142C	9/12/2007	9/12/2008
8060A	Cable	Retlif	10 kHz - 18 GHz	25' Type N	7/31/2007	7/31/2008
8060D	Cable	Retlif	10 kHz - 18 GHz	6' Type N	7/31/2007	7/31/2008
8061D	Cable	Retlif	10 kHz - 18 GHz	6' Type N	7/31/2007	7/31/2008
8300	Open Area Test Site	RSI	3/10 Meter Site		5/4/2007	5/4/2008
8317	Preamplifier	Agilent	1-26.5 GHz, 30 dB	8449B	4/6/2007	4/6/2009

Para. 15.247(c) - Spurious Radiated Emissions, Band Edge

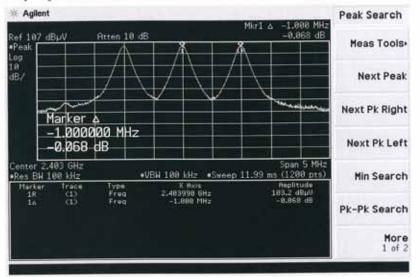
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008
8017	Double Ridge Guide	EMCO	1 - 18 GHz	3115	8/6/2007	8/6/2008
8060A	Cable	Retlif	10 kHz - 18 GHz	25' Type N	7/31/2007	7/31/2008

Para. 15.247(c) – Spurious Radiated Emissions, 1.0 GHz to 25 GHz

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008
8365	Biconilog	EMCO	26MHz-3000MHz	3142C	9/12/2007	9/12/2008
8060A	Cable	Retlif	10 kHz - 18 GHz	25' Type N	7/31/2007	7/31/2008
8060D	Cable	Retlif	10 kHz - 18 GHz	6' Type N	7/31/2007	7/31/2008
8061D	Cable	Retlif	10 kHz - 18 GHz	6' Type N	7/31/2007	7/31/2008
8300	Open Area Test Site	RSI	3/10 Meter Site		5/4/2007	5/4/2008
8317	Preamplifier	Agilent	1-26.5 GHz, 30 dB	8449B	4/6/2007	4/6/2009

FCC Part 15, Subpart C, 15.247 (a)(1)
Channel Separation
Test Data

Frequency Separation Test Data



FCC Part 15, Subpart C, 15.247 (a)(1)
20 dB Bandwidth
Test Data

Test Method FCC Part 15 Occupied Bandwidth

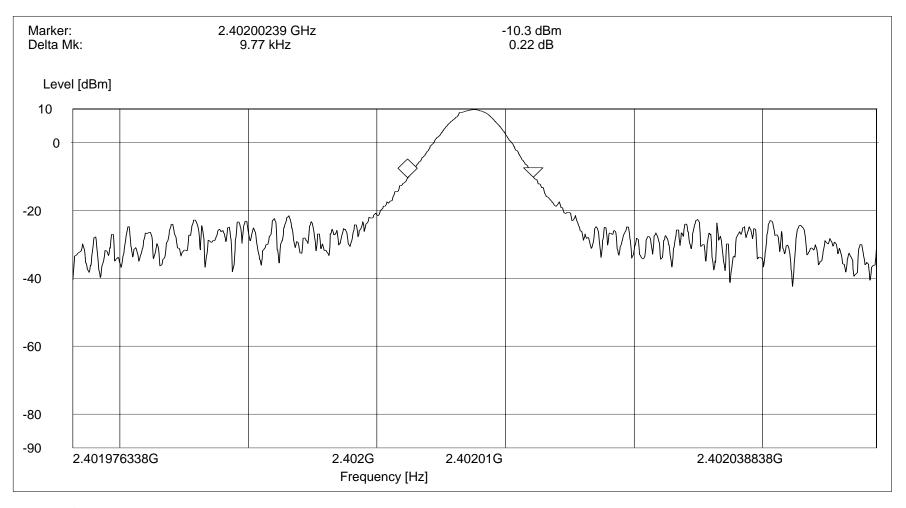
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 3KHz.CH 1



Page 1 of 6

Test Method FCC Part 15 Occupied Bandwidth

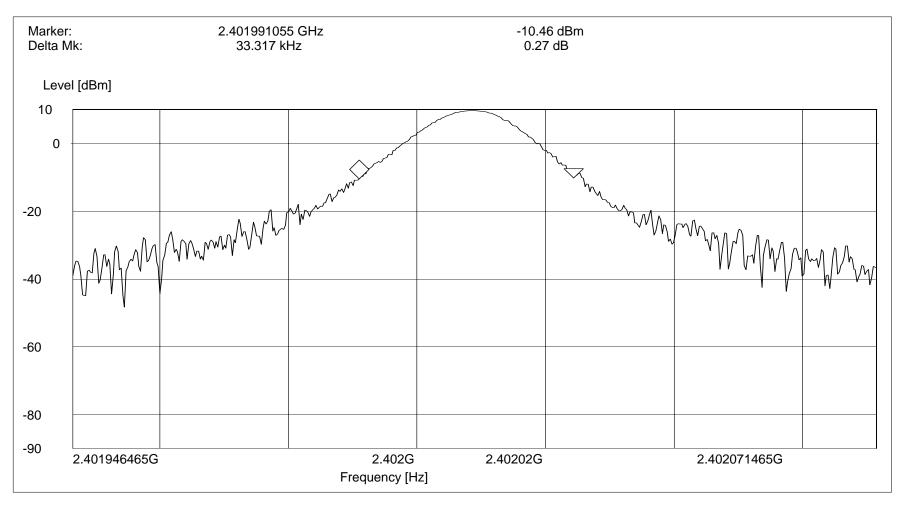
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 10k CH 1



Page 2 of 6

Test Method FCC Part 15 Occupied Bandwidth

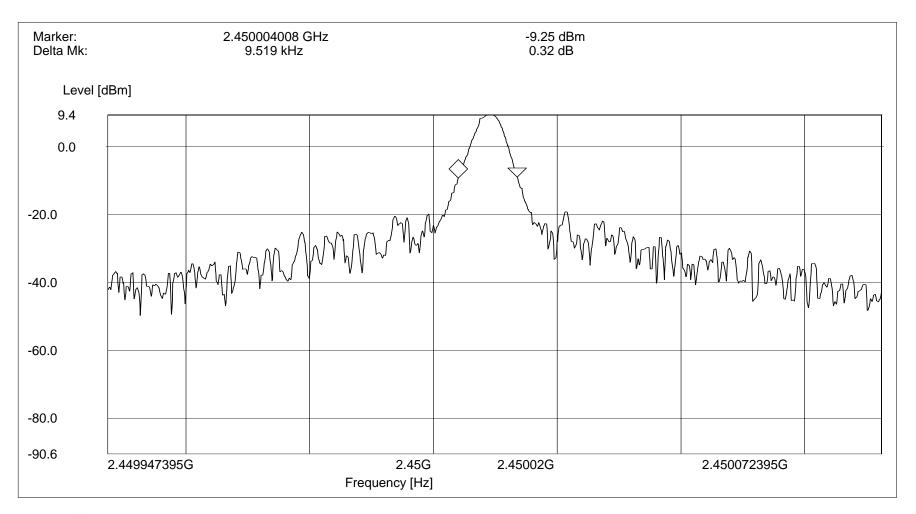
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 3k CH 2



Page 3 of 6

Test Method FCC Part 15 Occupied Bandwidth

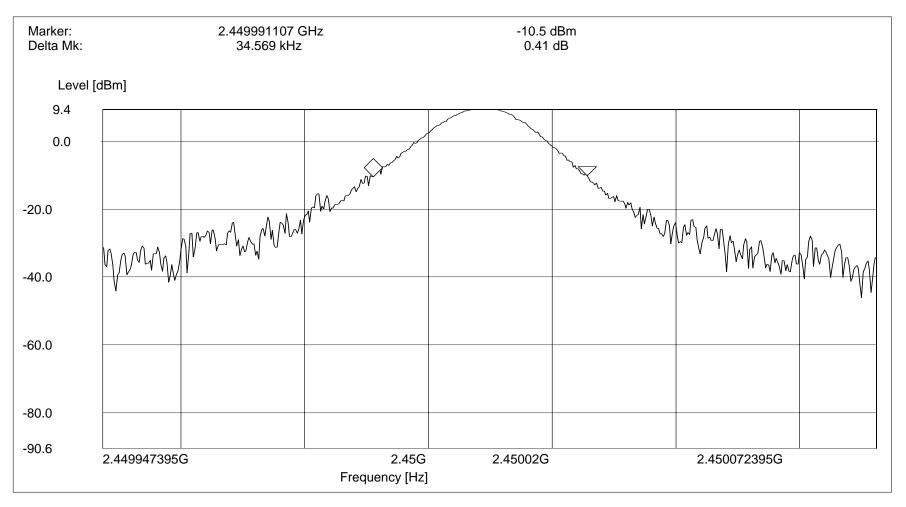
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 10k CH 2



Page 4 of 6

Test Method FCC Part 15 Occupied Bandwidth

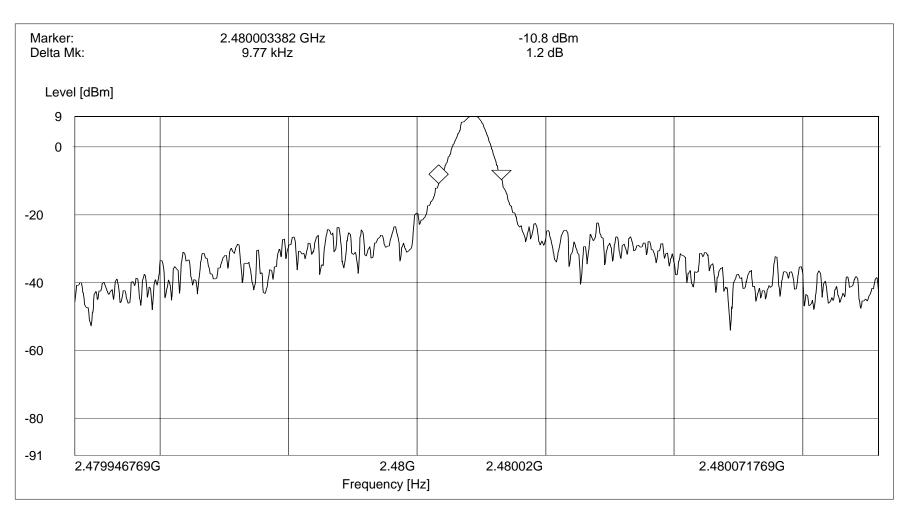
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 3k CH 3



Page 5 of 6

Test Method FCC Part 15 Occupied Bandwidth

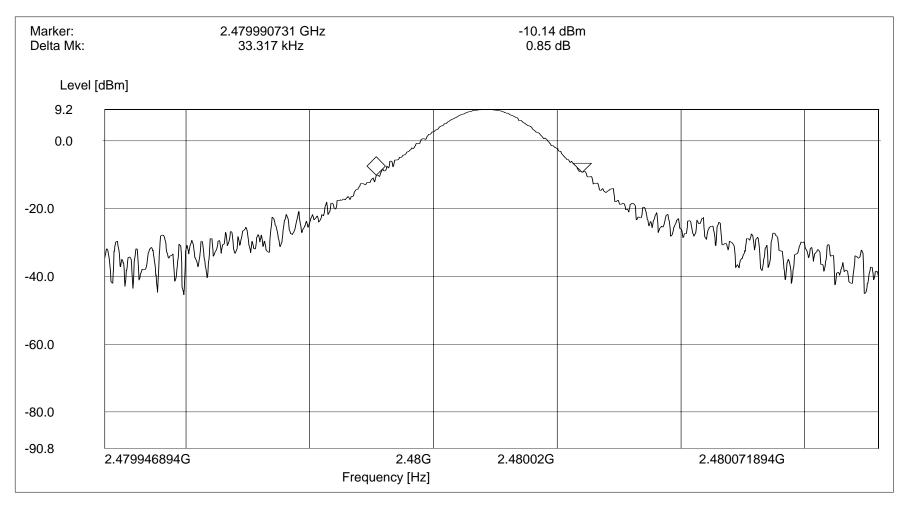
Customer: Smart Structures Inc.
Test Sample: Spread Spectrum Transmitter

Test Specification: FCC Part 15.247

Model Number/S/N: SP401 S/N 00.A0.96.1A.CB.A7

Operating Mode: Continuously transmitting on a single channel

Operator/Date: RW 4-25-08 Notes: RBW 10k CH 3



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FCC 15.247 (a)(1)(ii)
Number of Channels and Occupancy Time
Test Data

FCC Part 15, Subpart C, Paragraph 15.247(b) (1) and (4)
Peak Conducted Output Power
Test Data

Test Metho	od:	FCC Part 15, Sub	part C. Section 1	5 247 (b) (1) and	(4) Power Out	rout	
Customer:		Smart Structures		0.217 (8) (i) and		R-1032P	
Test Samp		Spread Spectrum				0 0 10 11 10 1		
Model No.:		SP_401	Transmitter			FCC ID:	V9CSP-X01D2	
Operating		Continuous Trans	mission					
Techniciar		F. Civitello/R. Rei				Date:	3-4-2008	
Notes:	Refere	nce Level:	100mW		Resol	lution BW: 10MHz		
	Video	Bandwidth:	10MHz		Swee	p Time:	10sec	
	RF Att	enuation:	40db		Span	•	80MHz	
	Extern	al Attenuation:	10db					
Channel		Freque	ncy		wer tput		Limit	
#		MHz	7	n	ιW		mW	
			_					
1		2402	2	12	2.59		500	
2		2450)	14	.58		500	
3		2480)	14	.16		500	
							+	
							+	
	_							
	Note:	Power Output limit	of 1 watt reduced	d 3 dB to 5	00 mw	due to antenna	a gain of 9 dBi.	

FCC Part 15, Subpart C, Section 15.247(d)
Antenna Port, Spurious Emissions
Test Data

Test Method FCC Part 15 Conducted Emissions, Antenna

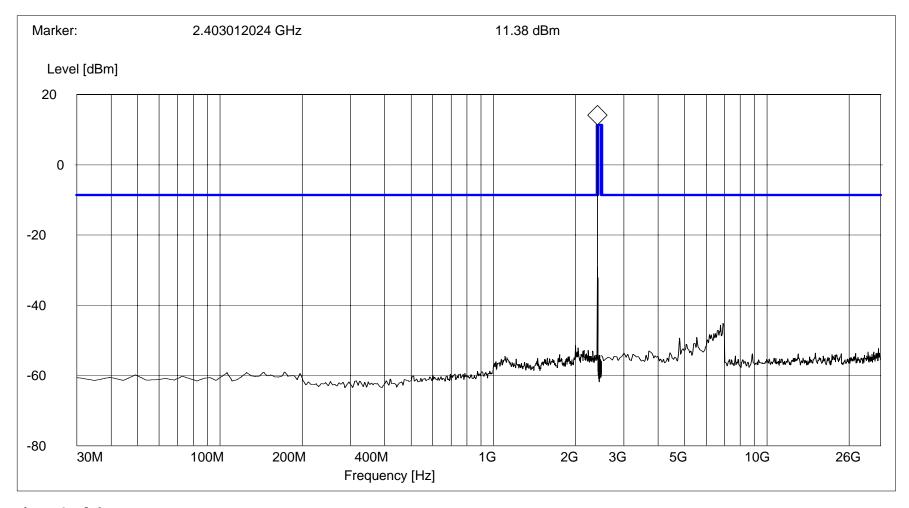
Customer: Smart Structures Inc.

Test Sample: Frequency Hopping Spread Spectrum Transmitter

Test Specification: FCC Part 15.247 (d)
Operating Mode: Continuously Transmitting

Operator and Date: FC/RW 3-4-08

Notes: Channel 1, 2.402GHz



Sheet 1 of 3

Test Method FCC Part 15 Conducted Emissions, Antenna

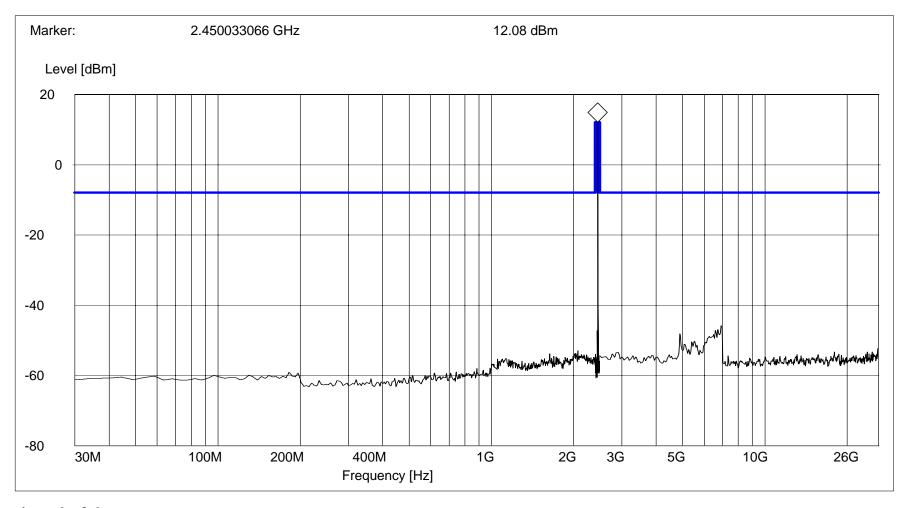
Customer: Smart Structures Inc.

Test Sample: Frequency Hopping Spread Spectrum Transmitter

Test Specification: FCC Part 15.247 (d)
Operating Mode: Continuously Transmitting

Operator and Date: FC/RW 3-4-08

Notes: Channel 2, 2.450GHz



Sheet 2 of 3

Test Method FCC Part 15 Conducted Emissions, Antenna

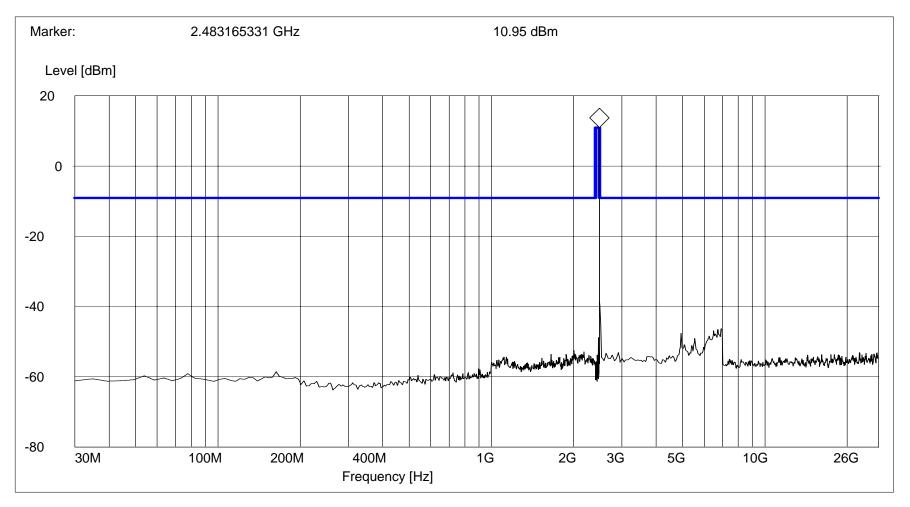
Customer: Smart Structures Inc.

Test Sample: Frequency Hopping Spread Spectrum Transmitter

Test Specification: FCC Part 15.247 (d)
Operating Mode: Continuously Transmitting

Operator and Date: FC/RW 3-4-08

Notes: Channel 3, 2.483GHz



Sheet 3 of 3

FCC Part 15, Subpart C, Paragraph 15.247(d)
Spurious Radiated Emissions
Band Edge and 1.0 GHz to 25 GHz
Test Data

Test Method:		FCC Par	t 15. Subpart C.	Band Edge, Pa	aragraph 15.247(d) Band Edge. F	Radiated Em	issions				
Customer:			ructures Inc.				•	ob No.:	R-1032P			
Test Sample:			cy Hopping Sprea	nd Spectrum Tra	ansmitter		3.	DD NO	K-1032F			
Model No.:		SP_401	cy Hopping Opice	ia opecitam me			Ser	ial No.:	00.AO.96	.1A.CB.7B		
Operating Mode):		ous Transmission							.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Technician:		F. Civitel	ivitello/R. Reitz Date: 3-5-2008									
Notes:	Test Di		ce: 3 Meters Temp: 21°C Humidity: 26%									
Frequency		enna sition	EUT Orientation	Meter Readings	1) Correction Factor	Marker Delta	Correcte d Reading		verted ading	Limit		
MHz	(V/H) /	Meters	Degrees	dBuV	dB	dBuV	dBuV/m	U	ıV/m	uV/m		
2402	V/	1.00	7.7	83.45	31.2	-66.52	48.13	25	54.9	500		
2480	V/	1.00	358.8	79.5	31.2	-68.79	41.91	12	24.6	500		
								·				
	1) Corr	ection fact	or includes anten	na factor and ca	able loss.							

Test Method:		FCC Par	t 15 Subpart C, S	Spurious Case	Radiated Emis	sions, Para	graph 15.247(d)		
Customer:		Smart St	tructures, Inc.				Job No.:	R-1032P	
Test Sample:		Battery F	Powered Instrume	ntation System	with Wireless In	terface			
Model No.:		SP-401		,			FCC ID:	V9CSP-X01D2	2
Operating Mod	de:	Continuo	ously Transmitting	a 2.402 GHz S	ignal CH.1				
Technician:		RW	-				Date:	4-17-08	
Notes:	Test Dis	stance: 3 l	Meters		Temp:	21°C	Humidity: 26%		
	Detecto	r: Peak a	nd average above	e 1 GHz			•		
Frequency		enna sition	EUT Orientation	Meter Readings	Correction Factor		ected ading	Converted Reading	Limit
MHz	(V/H) / I	Meters	Degrees	dBuV	dB	dB	uV/m	uV/m	uV/m
960.0									200
960.0									500
4804.0	\//	1.0	0.0	5.1 PK	38.6	A-	3.7	153.1	
4804.0		1.0	0.0	-6.5 AVG	38.6		2.1	40.2	
4804.0		1.0	0.0	3.0 PK	38.6		1.6	120.2	
4804.0	H/	1.0	0.0	-6.9 AVG	38.6	3	1.7	38.4	
*7206.0	V/	1.0	0.0	4.0 PK	44.2	4	8.2	257.0	
*7206.0		1.0	0.0	-4.9 AVG	44.2		9.3	92.2	
*9608.0		1.0 1.0	0.0	4.3 PK -4.5 AVG	47.4 47.4		1.7 2.9	384.5	
*9608.0	V/	1.0	0.0	-4.5 AVG	47.4	4.	2.9	139.6	
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Test Method:		FCC Par	rt 15 Subpart C, S	Spurious Case	Radiated Emiss	sions, Para	graph 15.247(d)		
Customer:		Smart S	tructures, Inc.				Job No.:	R-1032P	
Test Sample:			Powered Instrume	ntation System	with Wireless Int	erface			
Model No.:		SP-401		,			FCC ID:	V9CSP-X01D2	2
Operating Mo	de:	Continuo	ously Transmitting	a 2.450 GHz S	ignal CH.2			•	
Technician:		RW	<u> </u>		<u> </u>		Date:	4-17-08	
Notes:	Test Di	stance: 3 l	Meters		Temp:	21°C	Humidity: 26%	1	
	Detecto	or: Peak a	and average above	e 1 GHz	- '		, , , , , , , , , , , , , , , , , , , ,		
Frequency	Ant	enna sition	EUT Orientation	Meter Readings	Correction Factor		ected ading	Converted Reading	Limit
MHz	(V/H) /	Meters	Degrees	dBuV	dB	dB	uV/m	uV/m	uV/m
960.0									200
960.0									500
4900.0	1//	/1.0	0.0	5.0 PK	38.6	1	3.6	151.3	
4900.0		1.0	0.0	-1.0 AVG	38.6		7.6	75.8	
									i
4900.0		/1.0	0.0	5.3 PK	38.6		3.9	156.6	1 !
4900.0	H,	/1.0	0.0	-5.5 AVG	38.6	3	3.1	45.1	
*7350.0	V	/1.0	0.0	4.5 PK	44.2	4	8.7	272.2	1
*7350.0	V	1.0	0.0	-5.0 AVG	44.2	3	9.2	91.2	İ
******	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	/4.0	0.0	4.0 DIC	47.0		4.0	000.0	
*9800.0 *9800.0		/1.0 /1.0	0.0	4.0 PK -4.5 AVG	47.6 47.6		1.6 3.1	380.0 142.8	
	1	1.0	0.0	1.07110	17.0	•	0.1	1 12.0	
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	1								<u> </u>
1									
05.000.0									
25,000.0									500
	The em	nissions ob	I served from the E	UT do not exce	eed the specified	limits.	J		1
	Emissio	ons not red	corded were more	than 20dB und	er the specified I	imit.			
	* This r	neasurem	ent represents mir	nimum sensitivit	ty of the measure	ement syste	m.		
Dogo 2 of 1									

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Test Method:		FCC Par	rt 15 Subpart C, S	Spurious Case	Radiated Emiss	sions, Para	graph 15.247(d)		
Customer:		Smart St	tructures, Inc.				Job No.:	R-1032P	
Test Sample:			Powered Instrume	ntation System	with Wireless Int	erface			
Model No.:		SP-401		,			FCC ID:	V9CSP-X01D2	2
Operating Mo	de:	Continuo	ously Transmitting	a 2.480 GHz S	ignal CH.3				
Technician:		RW					Date:	4-17-08	
Notes:	Test Di	stance: 3 l	Meters		Temp:	21°C	Humidity: 26%	1	
	Detecto	or: Peak a	nd average above	e 1 GHz	·		•		
Frequency		enna sition	EUT Orientation	Meter Readings	Correction Factor		ected ading	Converted Reading	Limit
MHz	(V/H) /	Meters	Degrees	dBuV	dB	dB	uV/m	uV/m	uV/m
960.0									200
960.0									500
4960.0	\/.	/1.0	0.0	8.0 PK	38.6	1	6.6	213.7	
4960.0		/1.0	0.0	-5.0 AVG	38.6		3.6	47.8	
									j
4960.0	_	/1.0	0.0	5.2 PK	38.6		3.8	154.8	
4960.0	H,	/1.0	0.0	-4.8 AVG	38.6	3	3.8	48.9	
*7440.0	V	/1.0	0.0	4.0 PK	44.2	4	8.2	257.0	
*7440.0	V	1.0	0.0	-5.4 AVG	44.2	3	8.8	87.0	İ
******		/4.0	0.0	4.0 DK	47.0		1.0	000.4	
*9920.0 *9920.0		/1.0 /1.0	0.0	4.0 PK -5.1 AVG	47.6 47.6		1.6 2.5	380.1 133.3	
	,		0.0	3.1.7.1.0					
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25 000 0									F00
25,000.0									500
			served from the E				1		
			corded were more						
	* This r	neasurem	ent represents mir	nimum sensitivit	y of the measure	ement syste	m.		
Dogo 2 of 1									

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FCC Part 15, Subpart B and C Paragraph 15.247 (a) / 15.209 (a)
Field Strength of Spurious Emissions
Digital Device 30 to 1000 MHz
Test Data

Test Method: Customer: Test Sample: Model No.:		FCC Part 15, Subpart C, Radiated Emissions, 30 MHz to 1.0GHz, Paragraph 15.247(a)							
		Smart Structures, Inc. Battery Powered Instrumentation System SP_401					Job No.:	R-1032P	
							Serial No.:	00.A0.96.1A.CB.7B	
Operating Mo	de:		ously Transmitting	on a single ch	annel.				
Technician:		RW/RS					Date:	4-17-08	
Notes:		stance: 3 l	Meters i: Quasi-Peak bel	low 1 GHz, Pe		Temp:21 °C	Humidity	r:26 %	
Frequency	Antenr quency Position		EUT Orientation	Meter Reading	Correction Factor	Correcte Reading	-	Converted Reading	3 M Limi
MHz (V/H) / Me		Meters	Degrees	dBuV	dB	dBuV/m		uV/m	uV/r
30.0									100
*33.0	V	/1.0	0.0	6.7	18.75	25.45		18.7	
88.0									100
88.0									150
*110.0	V	/1.0	0.0	7.6	8.9	16.5		6.7	
*185.0	V	/1.0	0.0	3.4	10.3	13.7		4.8	
*205.0	V	/1.0	0.0	4.3	10.6	14.9		5.6	l e
216.0 216.0									150 200
210.0									200
*600.0	V	/1.0	0.0	2.7	20.7	23.4		14.8	
960.0									200
960.0									500
*995.0	V	/1.0	0.0	-3.8	25.6	21.8		12.3	
1000.0									500

The emissions observed from the EUT do not exceed the specified limits.

Emissions not recorded were more than 20dB under the specified limit.

*This measurement represents minimum sensitivity of the measurement system.