

## Technical Information

Applicant	Manufacturer
Name: Smart Structures, Inc.	Name: Smart Structures, Inc.
Address: 324 Second Street Pike, Unit #13	Address: 324 Second Street Pike, Unit #13
City, State, Zip: Southampton, PA 18966	City, State, 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/cm<sup>2</sup>, 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.

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Joseph Maiello  
Branch Manager

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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	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(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

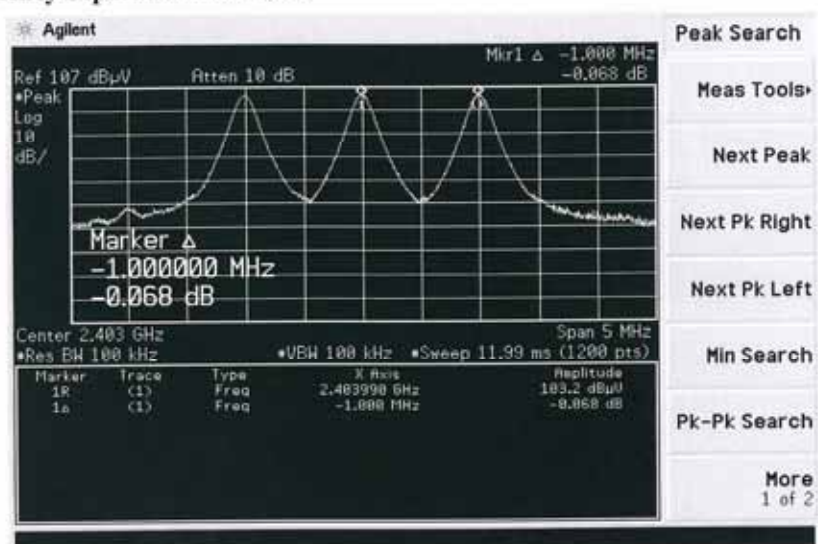
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESIB26	8/12/2007	8/12/2008
8017	Double Ridge Guide	EMCO	1 - 18 GHz	3115	8/6/2007	8/6/2008
8060A	Cable	Retlif	10 kHz - 18 GHz	25' Type N	7/31/2007	7/31/2008

### 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

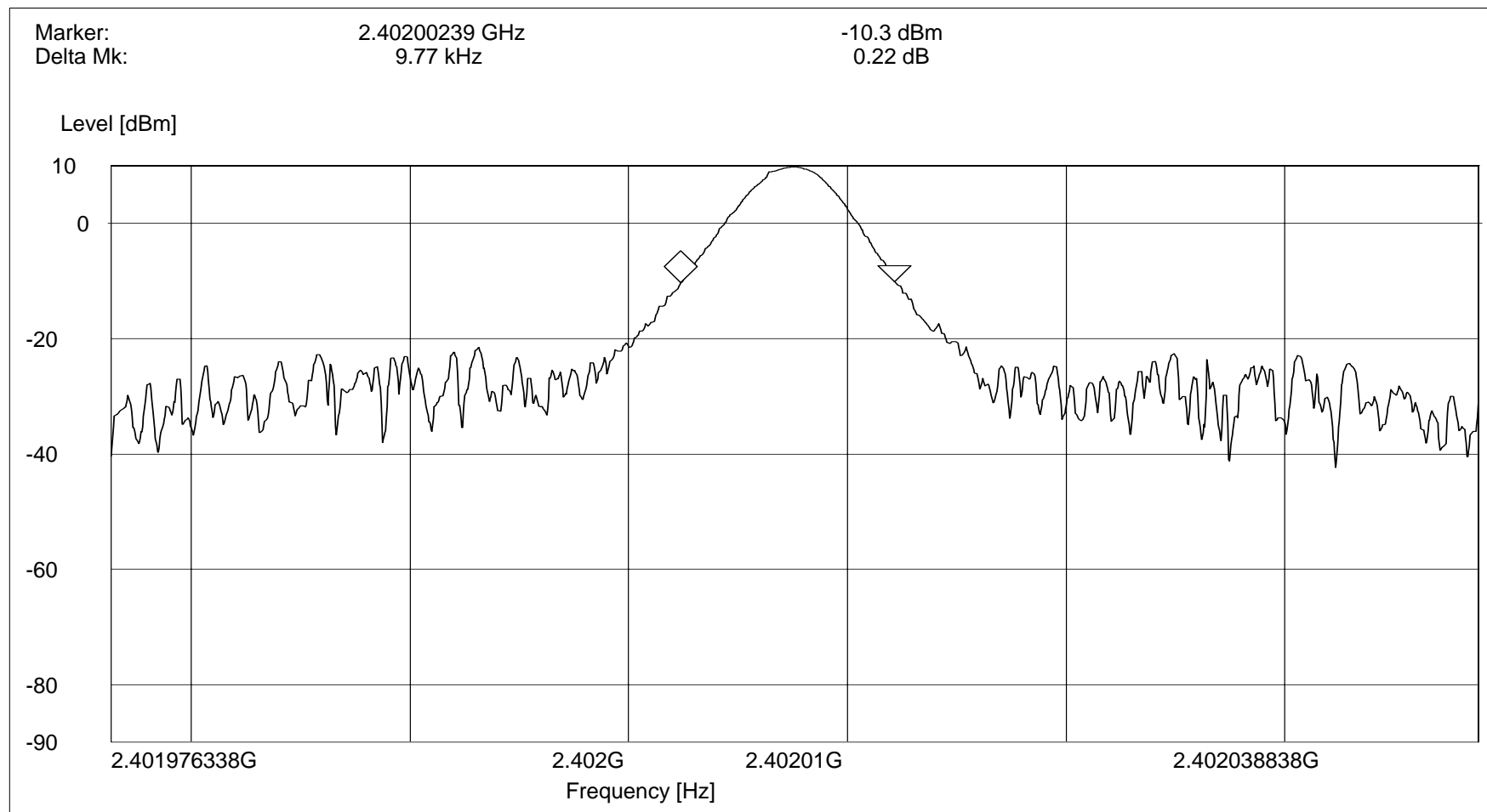


**FCC Part 15, Subpart C, 15.247 (a)(1)**  
**20 dB Bandwidth**  
**Test Data**



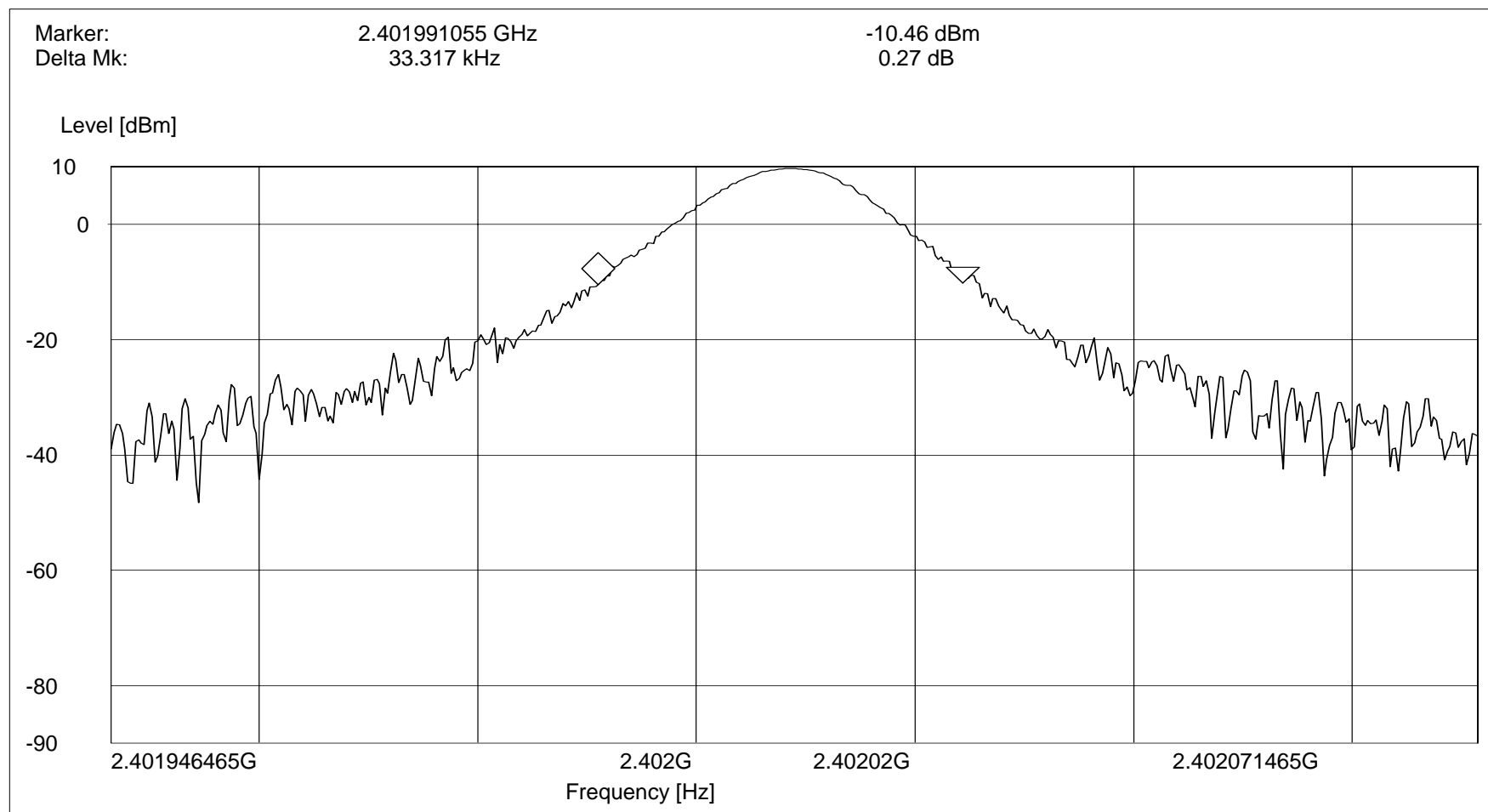
Test Method FCC Part 15 Occupied Bandwidth

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



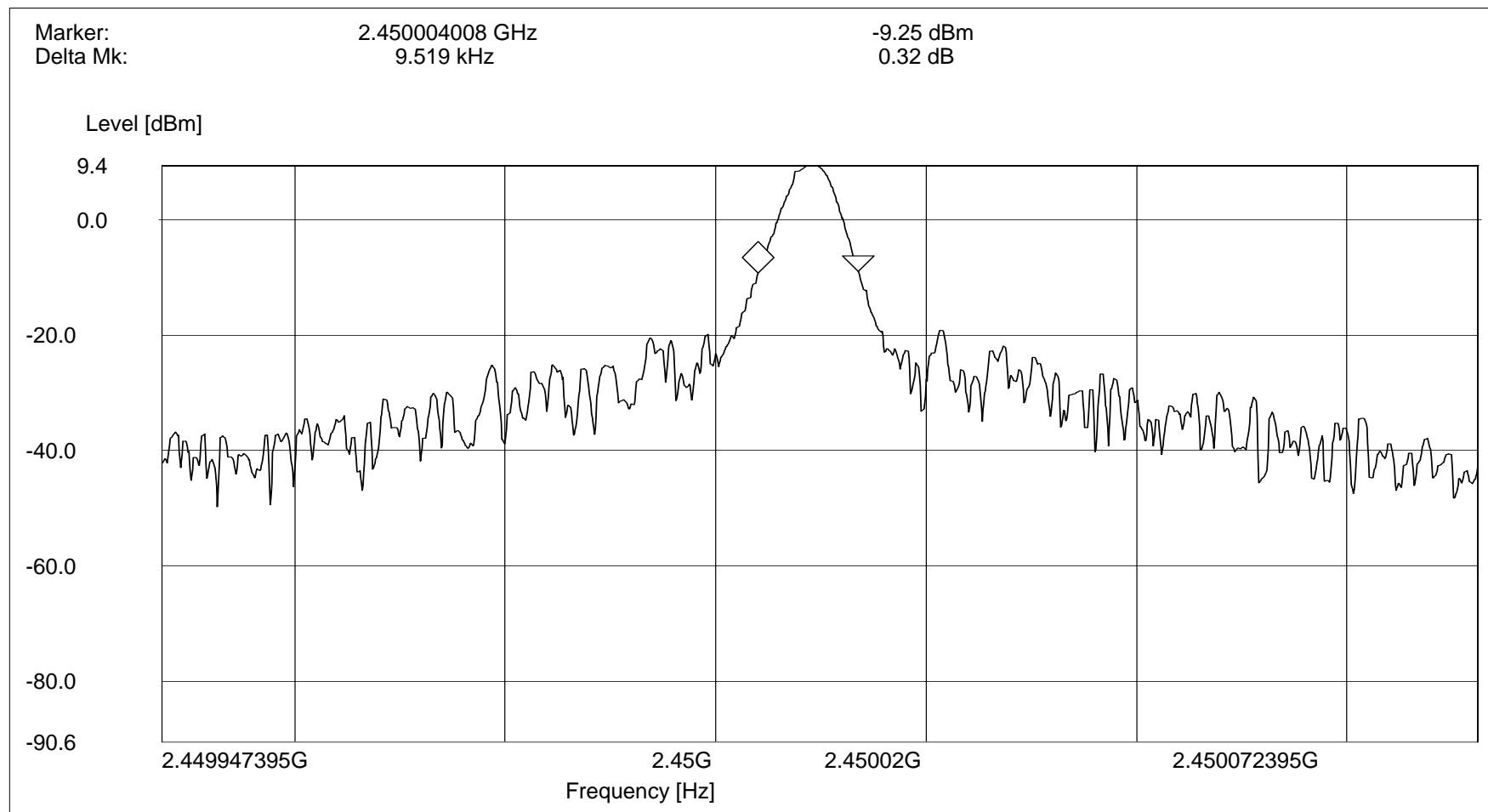
Test Method FCC Part 15 Occupied Bandwidth

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



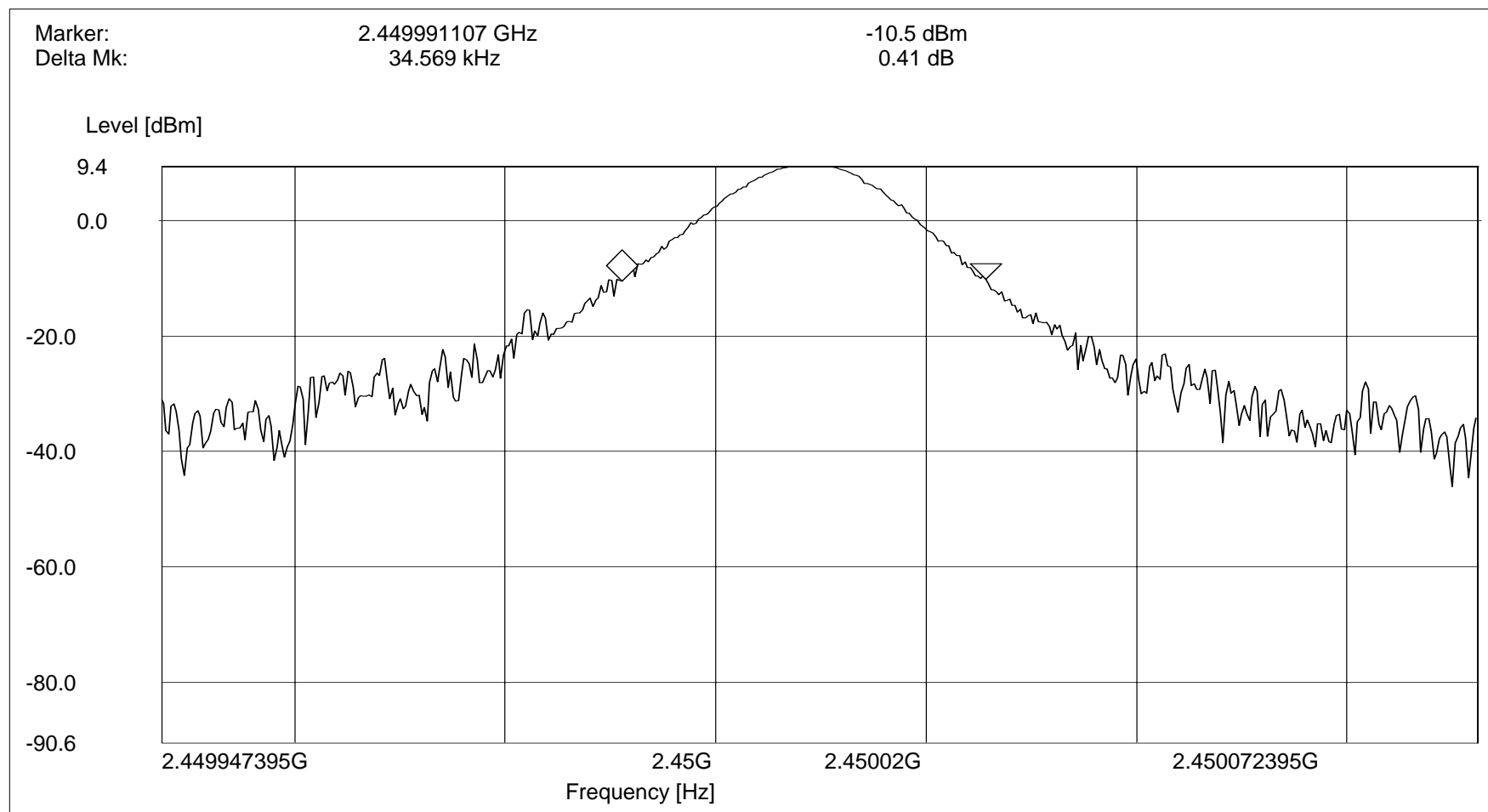
Test Method FCC Part 15 Occupied Bandwidth

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



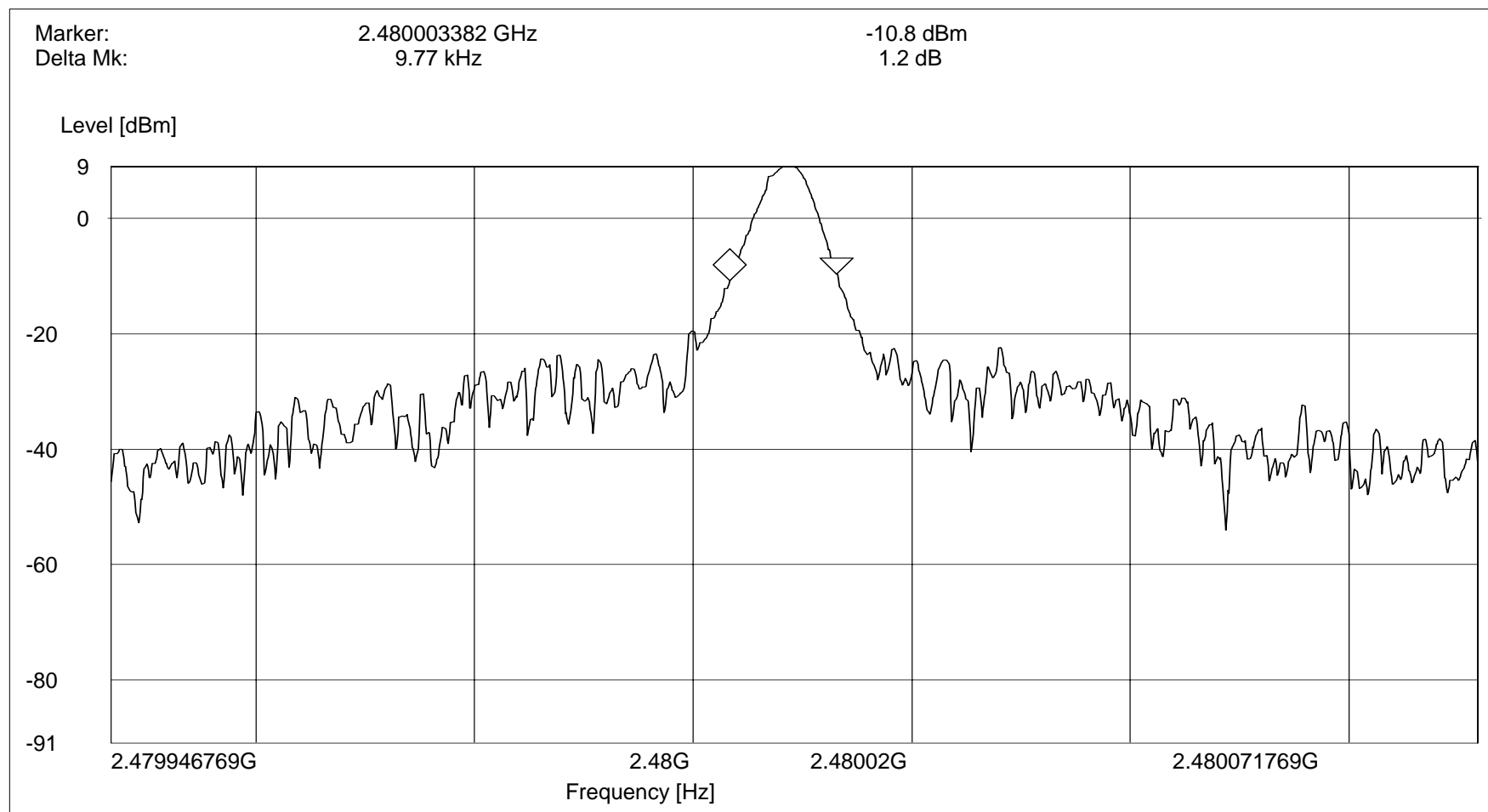
Test Method FCC Part 15 Occupied Bandwidth

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



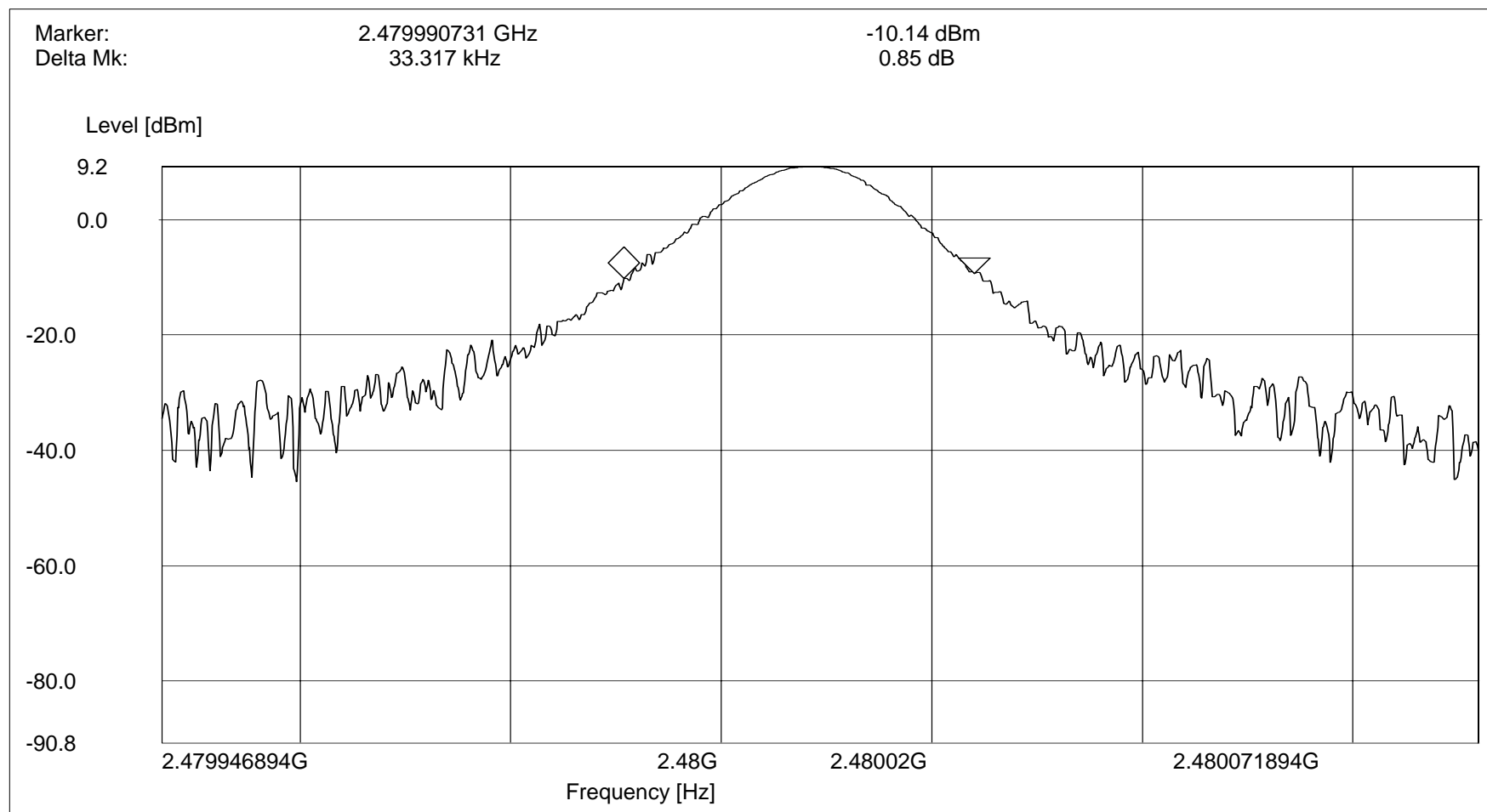
Test Method FCC Part 15 Occupied Bandwidth

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



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



**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**

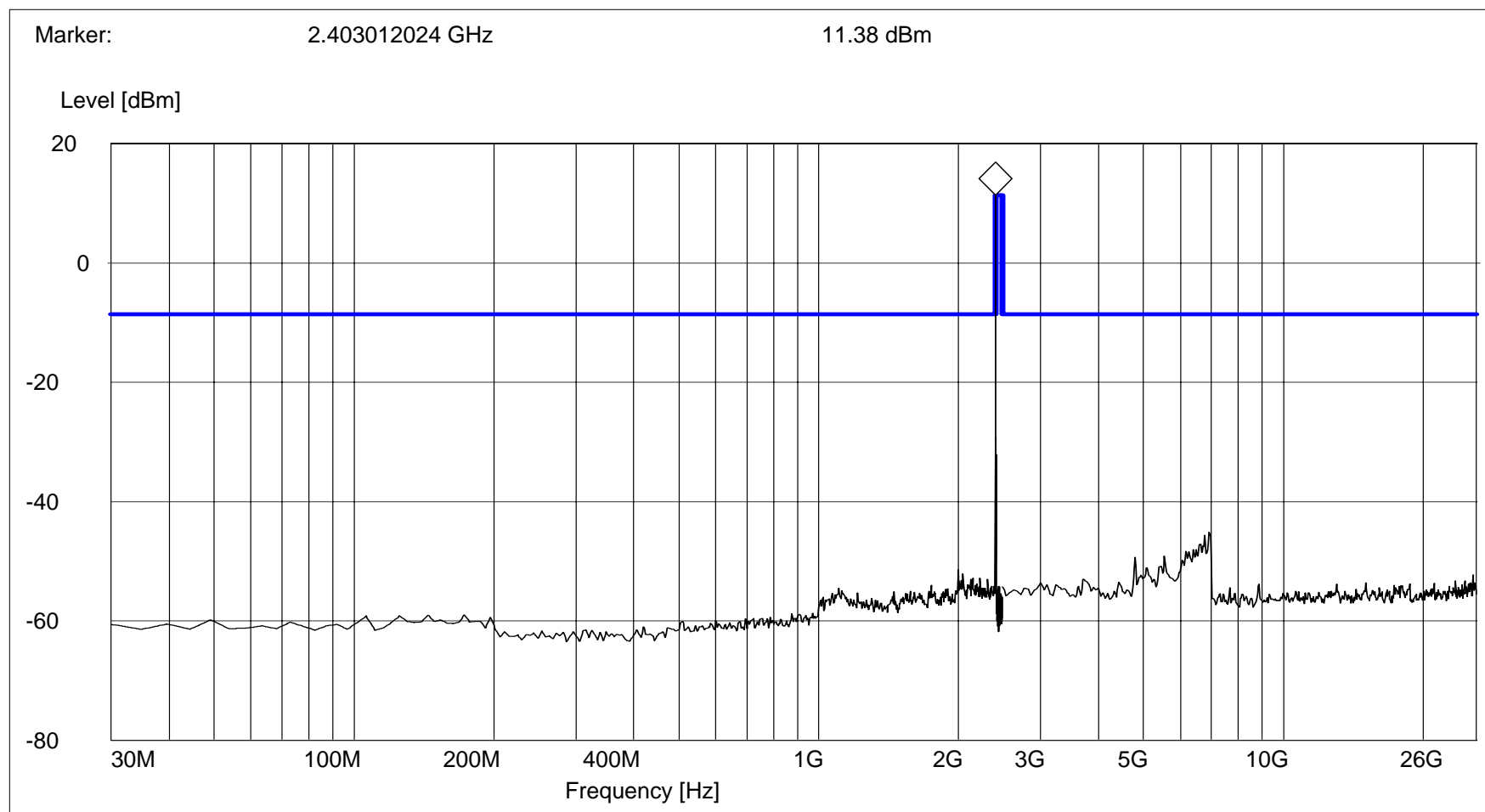
[illegible]

**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

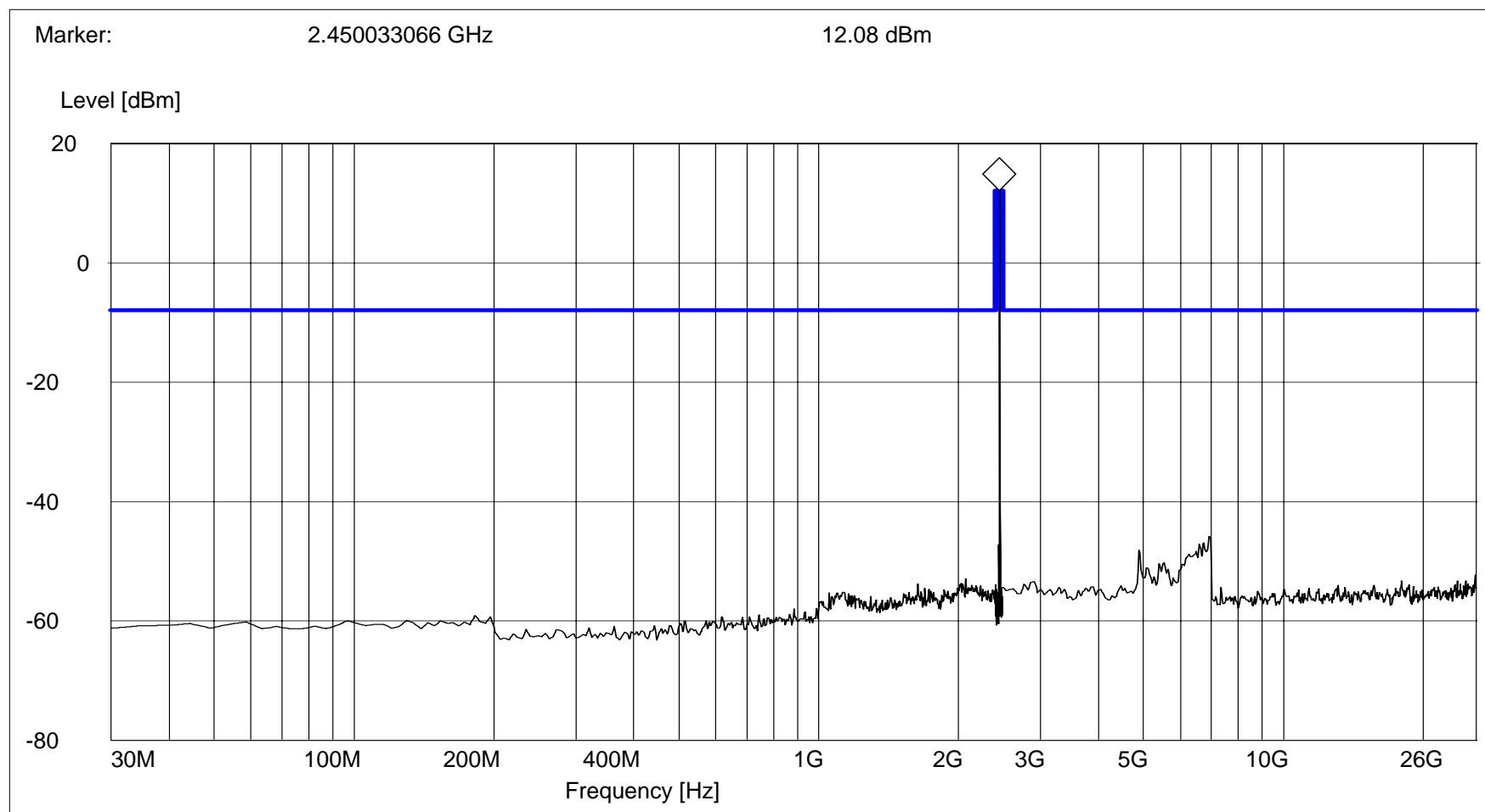
Notes: Channel 1, 2.402GHz



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

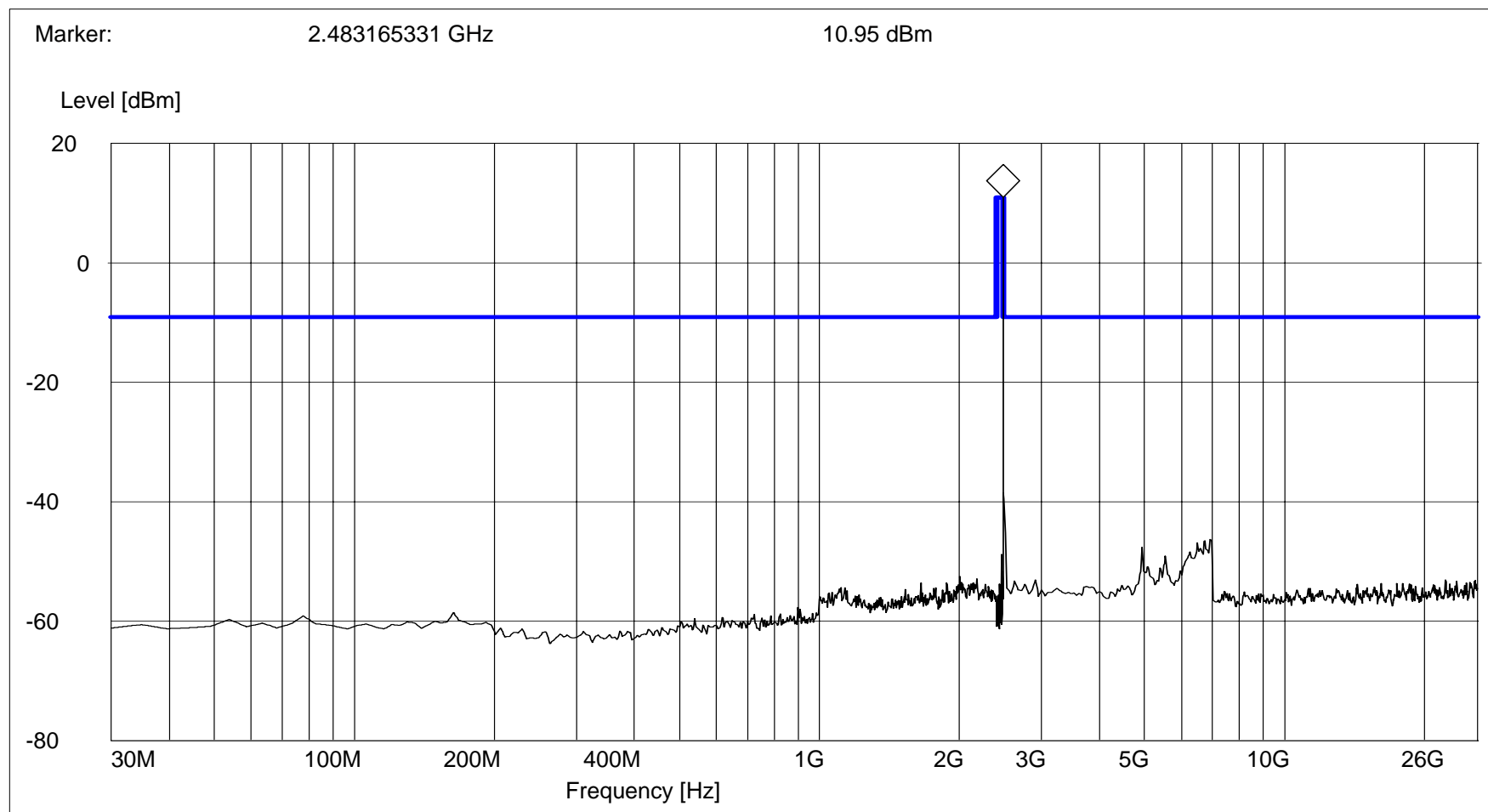
Notes: Channel 2, 2.450GHz



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



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











**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**

<b>Test Method:</b>	FCC Part 15, Subpart C, Radiated Emissions, 30 MHz to 1.0GHz, Paragraph 15.247(a)							
<b>Customer:</b>	Smart Structures, Inc.				<b>Job No.:</b>	R-1032P		
<b>Test Sample:</b>	Battery Powered Instrumentation System							
<b>Model No.:</b>	SP_401				<b>Serial No.:</b>	00.A0.96.1A.CB.7B		
<b>Operating Mode:</b>	Continuously Transmitting on a single channel.							
<b>Technician:</b>	RW/RS				<b>Date:</b>	4-17-08		
<b>Notes:</b> Test Distance: 3 Meters      Temp:21 °C      Humidity:26 % Detector Function: Quasi-Peak below 1 GHz, Peak above 1 GHz								
Frequency	Antenna Position	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading		Converted Reading	3 M Limit
MHz	(V/H) / Meters	Degrees	dBuV	dB	dBuV/m		uV/m	uV/m
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	
216.0								150
216.0								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 frequency range was scanned from 30 MHz to 1.0GHz.								
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.								