Engineering Test Report No. 2201231-02		
Report Date	August 1, 2022	
Manufacturer Name	Spring Window Fashions LLC	
Manufacturer Address	7549 Graber Road Middleton, WI 53562-1096	
Model No.	CRZB	
Date Received	April 18, 2022	
Test Dates	April 18, 2022 – April 21, 2022	
Specifications	FCC “Code of Federal Regulations” Title 47 Part 15, Subpart C, Section 15.247 FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249 FCC “Code of Federal Regulations” Title 47 Part 15, Subpart B Innovation, Science, and Economic Development Canada, RSS-210 Innovation, Science, and Economic Development Canada, RSS-247 Innovation, Science, and Economic Development Canada, RSS-GEN	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature	Nathaniel Bouchie	
Tested by	Nathaniel Bouchie	
Signature	Raymond J Klouda	
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	D01-005843	

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C, Section 247; FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations”, Title 47, Part 15, Subpart B; Innovation, Science, and Economic Development Canada, RSS-210; and Innovation, Science, and Economic Development Canada, RSS-2477. The data presented in this test report pertains to the EUT on the test dates specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification. This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Table of Contents

1. Report Revision History

Revision	Date	Description
–	16 AUG 2022	Initial Release of Engineering Test Report No. 2201231-02

2. Introduction

2.1. Scope of Tests

This document presents the results of a series of RF emissions tests that were performed on the Spring Window Fashions LLC Cellular Window Shade (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured and submitted for testing by Spring Window Fashions LLC located in Middleton, WI.

2.2. Purpose

The test series was performed to determine if the EUT meets the RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations” Title 47 Part 15, Subpart C, Section 15.247; and FCC “Code of Federal Regulations” Title 47 Part 15, Subpart B.

The test series was also performed to determine if the EUT meets the RF emission requirements of the Industry Canada Radio Standards Specification RSS-Gen, Industry Canada Radio Standards Specification RSS-210, and Industry Canada Radio Standards Specification RSS-247 for Transmitters.

Testing was performed in accordance with ANSI C63.10-2013 and ANSI C63.4-2014.

2.3. Identification of the EUT

The EUT was identified as follows:

EUT Identification	
Product Description	Cellular Window Shade
Model/Part No.	CRZB
S/N	Unit 1
Band of Operation	902-928 MHz and 2400-2483.5 MHz
Modulation Type	FSK
Software/Firmware Version	V1.0
Rated Output Power	0dBm
Antenna Type	None
99% Bandwidth	141.835kHz
Size of EUT	27.5 in x 1.5 in x 1.5 in

The EUT listed above was used throughout the test series.

3. Power Input

The EUT obtained 15VDC power through an AC power adapter. The primary of this adapter received 120V 60Hz power through lowpass powerline filters on the wall of the shielded enclosure.

4. Grounding

The EUT was not connected to ground.

5. Support Equipment

The EUT was submitted for testing along with the following support equipment:

Description	Model #	S/N
AC Adapter	GT-41130-2016-1.0-W2	n/a

6. Interconnect Leads

No interconnect leads were used during the tests.

7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

8. Modes of Operation

Mode	Description
Tx Standby	This mode was set by applying power to the device
ZWave Tx @ 908.4MHz	This mode was set by applying power to the device and pressing the only accessible button 3 times
ZWave Tx @ 916MHz	This mode was set by applying power to the device and pressing the only accessible button 2 times
BLE Tx Ch0 @ 2402MHz	This mode was set by applying power to the device and connecting a Bluetooth device via the Silicon Laboratories mobile app. Commands were input have the transmitter transmit at 2402MHz
BLE Tx Ch19 @ 2440MHz	This mode was set by applying power to the device and connecting a Bluetooth device via the Silicon Laboratories mobile app. Commands were input have the transmitter transmit at 2440MHz
BLE Tx Ch39 @ 2480MHz	This mode was set by applying power to the device and connecting a Bluetooth device via the Silicon Laboratories mobile app. Commands were input have the transmitter transmit at 2480MHz
MultiTx	This mode included the Zwave Tx set to transmit at 908.4MHZ and the BLE Tx set at 2440MHz
ZWave Rx @ 908MHz	This mode was set by applying power to the device and pressing the only accessible button once. The Rx operated at 908MHz.

9. Test Specifications

The tests were performed to selected portions of, and in accordance with the Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C, Section 247; FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations”, Title 47, Part 15, Subpart B; Innovation, Science, and Economic Development Canada, RSS-210; and Innovation, Science, and Economic Development Canada, RSS-247 test specifications.

- Federal Communications Commission “Code of Federal Regulations” Title 47 Part 15, Subpart B
- Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C
- ANSI C63.4-2014, “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz”
- ANSI C63.10-2013, “American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”
- RSS-210 Issue 10, December 2019, “License-Exempt Radio Apparatus: Category I Equipment”

- RSS-247 Issue 2, February 2017, “Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices”

- RSS-Gen Issue 5, March 2019, Amendment 1, Innovation, Science, and Economic Development Canada, “Spectrum Management and Telecommunications, Radio Standards Specification, General Requirements for Compliance of Radio Apparatus”

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Spring Window Fashions LLC and used in conjunction with the Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C, Section 247; FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations”, Title 47, Part 15, Subpart B; Innovation, Science, and Economic Development Canada, RSS-210; and Innovation, Science, and Economic Development Canada, RSS-247; ANSI C63.4-2014; and ANSI C63.10-2013 specifications.

11. Deviation, Additions to, or Exclusions from Test Specifications

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

Ambient Parameters	Value
Temperature	22.1°C
Relative Humidity	18%
Atmospheric Pressure	1018.4mb

13. Summary

The following EMC tests were performed, and the results are shown below:

Test Description	Requirements	Test Methods	S/N	Results
Powerline Conducted Emissions Test (AC Mains)	FCC 15C RSS-GEN	ANSI C63.10: 2013	Unit 1	Conforms
Occupied Bandwidth Measurements	FCC 15C ISED RSS-210	ANSI C63.10: 2013	Unit 1	Conforms
Duty Cycle Factor Measurements	FCC 15C ISED RSS-210	ANSI C63.10: 2013	Unit 1	Conforms
Band-Edge Compliance	FCC 15C ISED RSS-210	ANSI C63.10: 2013	Unit 1	Conforms
Module Integration	FCC 15C ISED RSS-247	ANSI C63.10: 2013	Unit 1	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB).

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

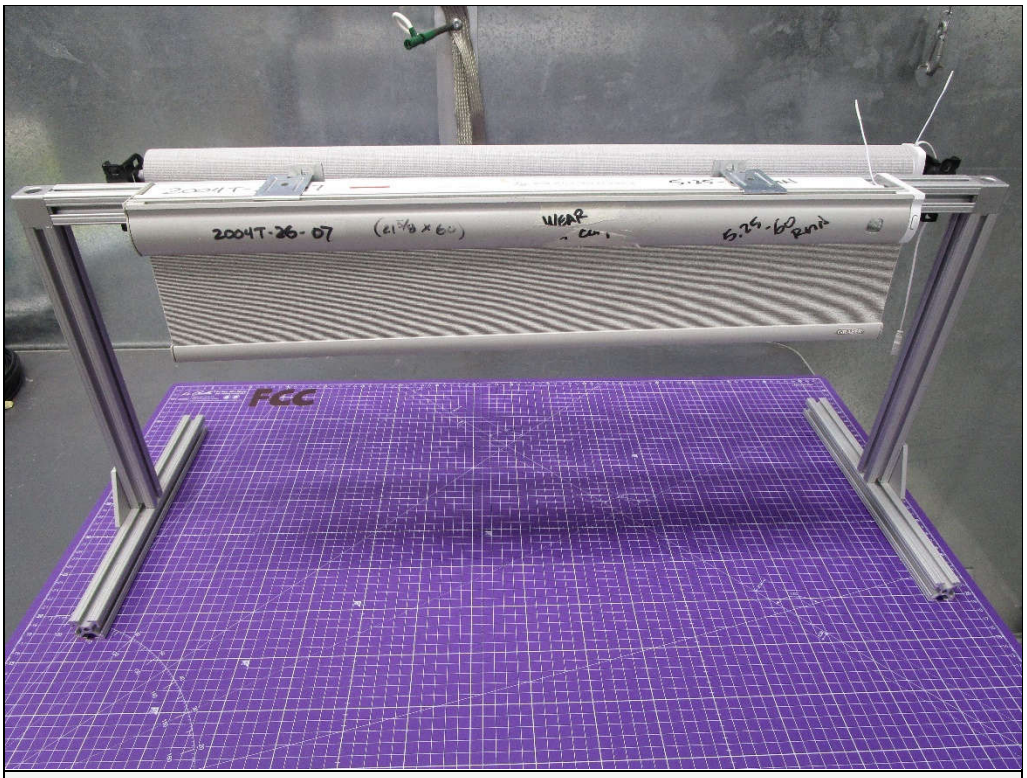
15. Statement of Conformity

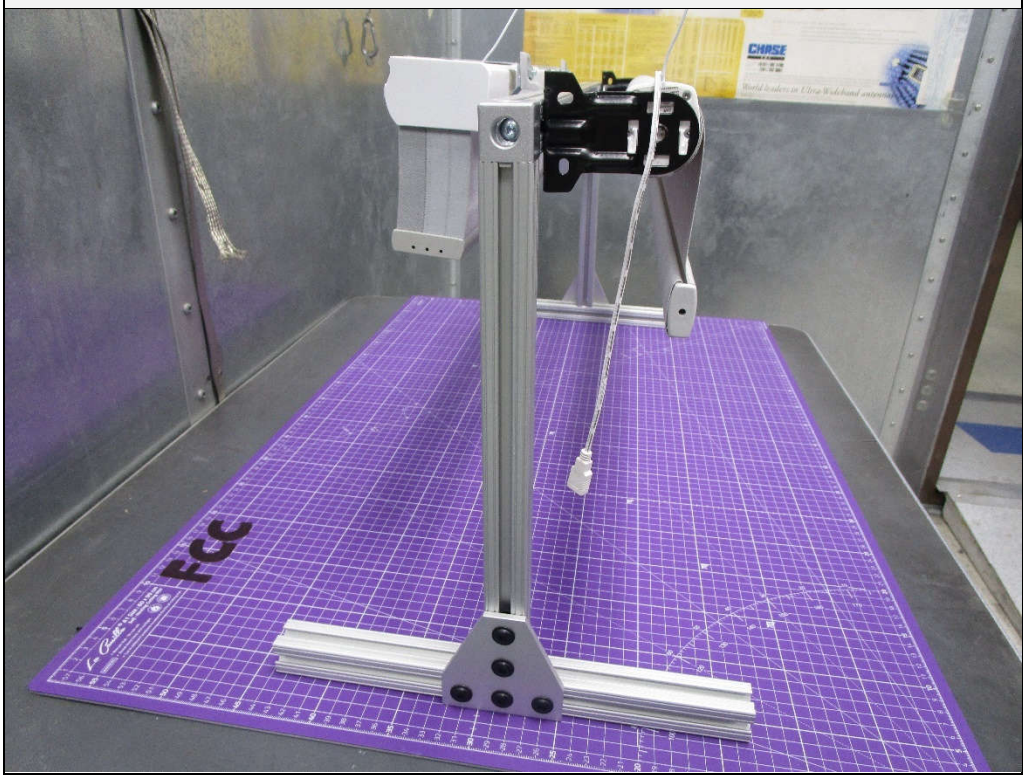
The Spring Window Fashions LLC Cellular Window Shade, Model No. CRZB, Serial No. Unit 1, did fully conform to the selected requirements of Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C, Section 247; FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations”, Title 47, Part 15, Subpart B; Innovation, Science, and Economic Development Canada, RSS-210; and Innovation, Science, and Economic Development Canada, RSS-247.

16. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C, Section 247; FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.249; FCC “Code of Federal Regulations”, Title 47, Part 15, Subpart B; Innovation, Science, and Economic Development Canada, RSS-210; and Innovation, Science, and Economic Development Canada, RSS-247 test specifications. The data presented in this test report pertains to the EUT on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

17. Photographs of EUT



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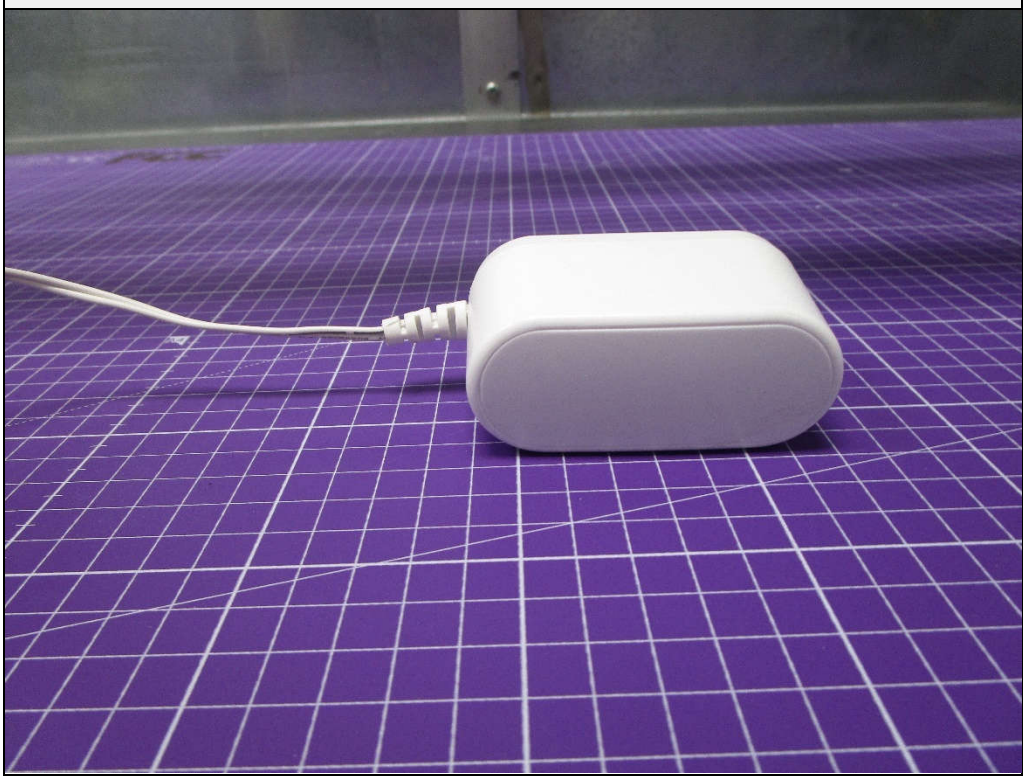


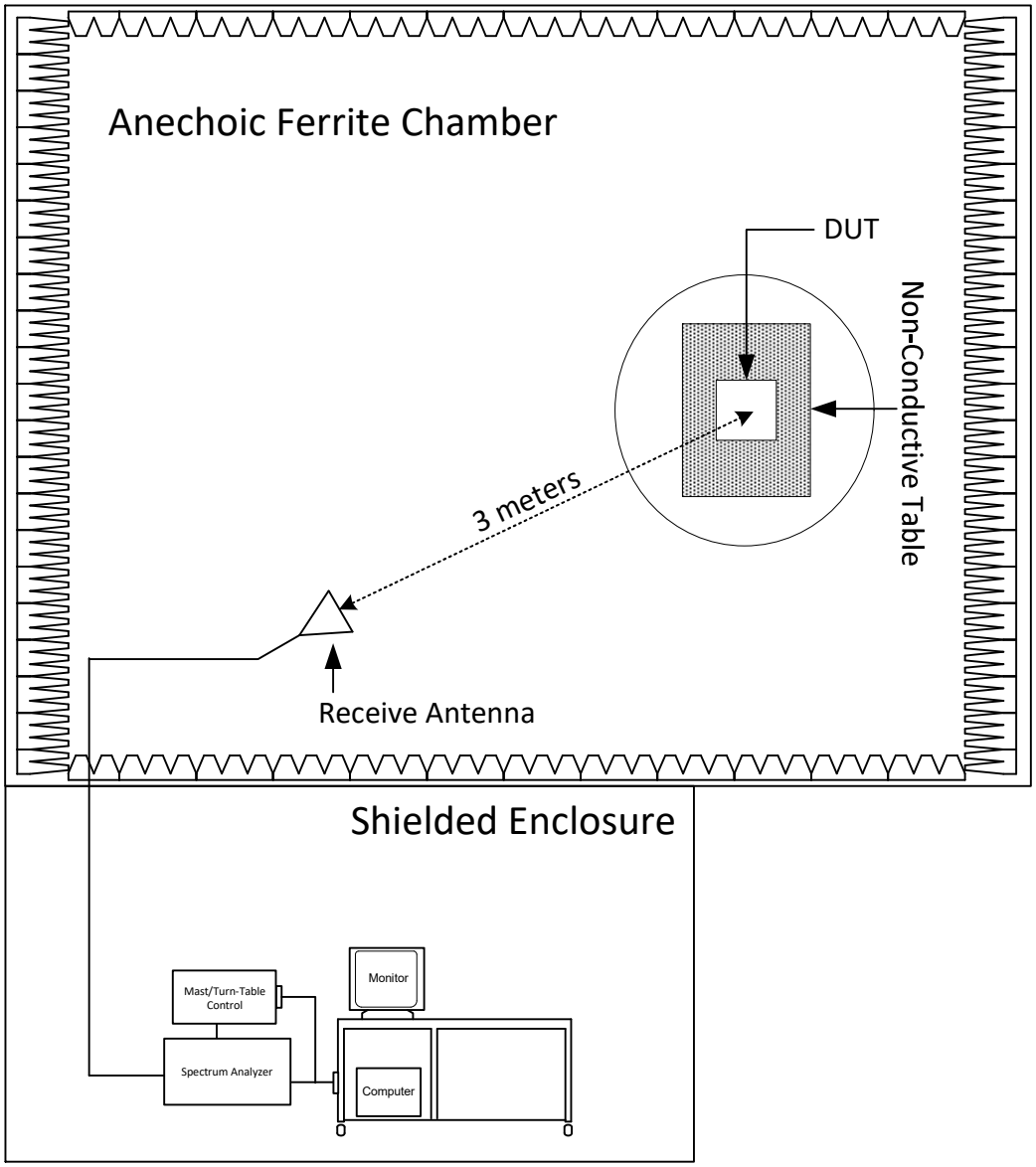
18. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	3/9/2022	3/9/2023
CDZ4	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
GRB0	1MHZ, LISN SIGNAL CHECKER	ELITE	LISNCHKR1M	1	1MHZ	6/17/2021	6/17/2023
MEA3	MICRO-OHM METER	KEITHLEY	580	772667	10UOHM-200KOHM	6/6/2022	6/6/2023
NSDS1	UNIVERSAL SPHERICAL DIPOLE SOURCE	AET	USDS-H	AET-1116		NOTE 1	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	10/5/2020	10/5/2022
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	5/26/2022	5/26/2024
PLF2	CISPR16 50UH LISN	ELITE	CISPR16/70A	002	.15-30MHz	4/5/2022	4/5/2023
PLF4	CISPR16 50UH LISN	ELITE	CISPR16/70A	003	.15-30MHz	4/5/2022	4/5/2023
R21F	3M ANECHOIC CHAMBER NSA	EMC TEST SYSTEMS	3M ANECHOIC		30MHZ-18GHZ	3/30/2022	3/30/2023
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	4/7/2022	4/7/2023
T1ED	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BN2320	DC-18GHZ	1/6/2022	1/6/2024
VBR8	CISPR EN FCC CE VOLTAGE.exe					N/A	
VBV2	CISPR EN FCC ICES RE.EXE	ELITE	CISPR EN FCC ICES RE.EXE	---	---	N/A	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ7	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	5	1.8-10GHZ	2/3/2021	2/3/2023

N/A: Not Applicable I/O: Initial Only CNR: Calibration Not Required

NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

19. Block Diagram of Test Setup



Radiated Measurements Test Setup

20. Powerline Conducted Emissions Test (AC Mains)

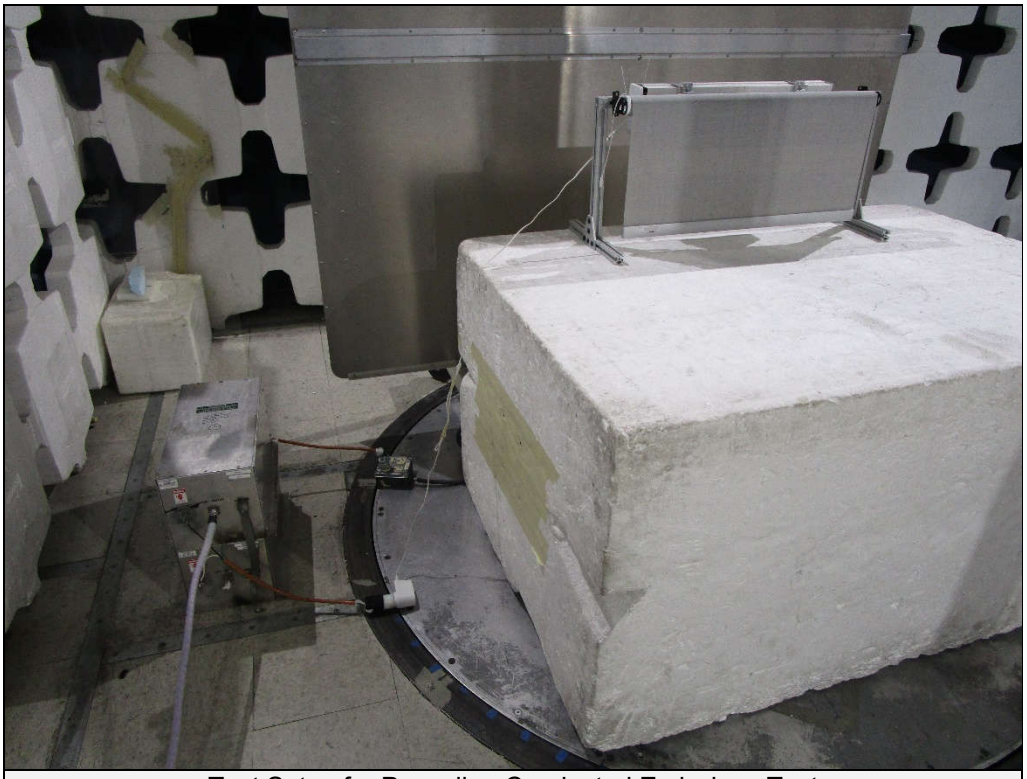
Test Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model	CRZB
Serial No	Unit 1
Modes	Tx Standby ZWave Tx @ 908.4MHz BLE Tx Ch0 @ 2402MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic
Test site used	Room 21
Note	None

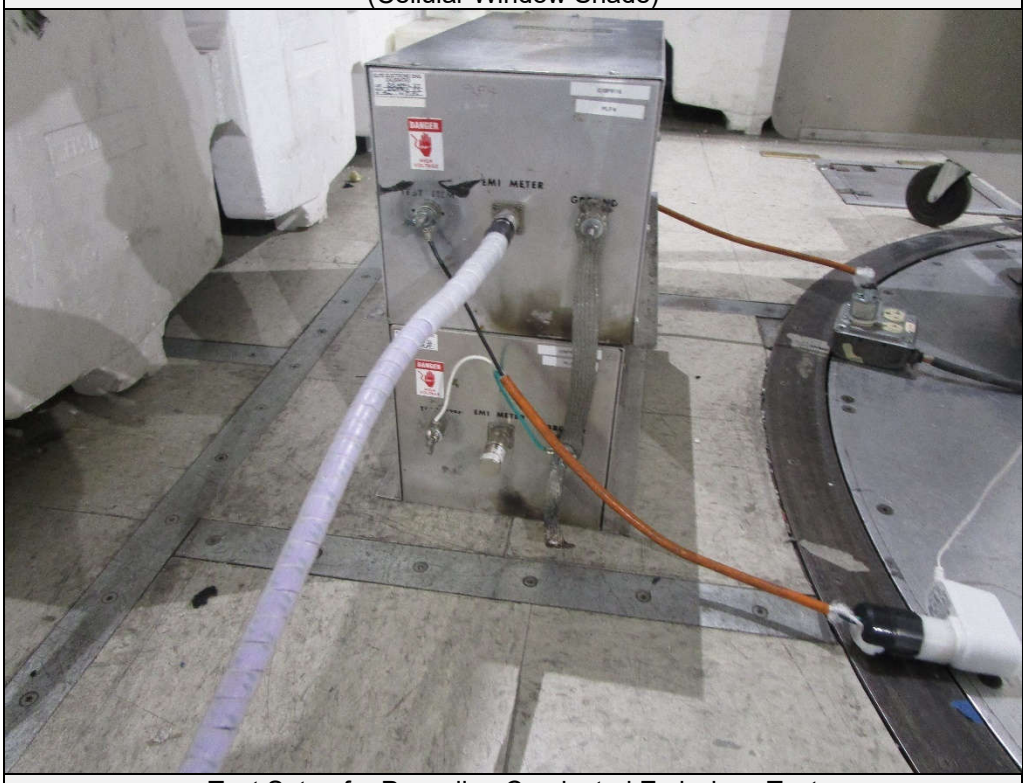
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Conducted disturbance (mains port) (150 kHz – 30 MHz)	2.7

Requirements		
All radio frequency voltages on the power lines for any frequency or frequencies of an intentional radiator shall not exceed the limits in the following table:		
Frequency of Emission (MHz)	Conducted Limits (dBµV)	
	Quasi-peak	Average
0.15-05 0.5-5 5-30	66 to 56* 56 60	56-46* 46 50

Procedures
The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms. 1) The EUT was operated in the Tx Standby mode. 2) Measurements were first made on the Voltage high line. 3) The frequency range from 150 kHz to 30 MHz was broken up into smaller frequency sub-bands. 4) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector. 5) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 0dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.) 6) Steps (4) and (5) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits. 7) Steps (3) through (6) were repeated on the Voltage return line. 8) Steps (2) through (7) were repeated with the EUT operated in the ZWave Tx @ 908.4MHz mode. 9) Steps (2) through (7) were repeated with the EUT operated in the BLE Tx Ch0 @ 2402MHz mode.



Test Setup for Powerline Conducted Emissions Test
(Cellular Window Shade)



Test Setup for Powerline Conducted Emissions Test
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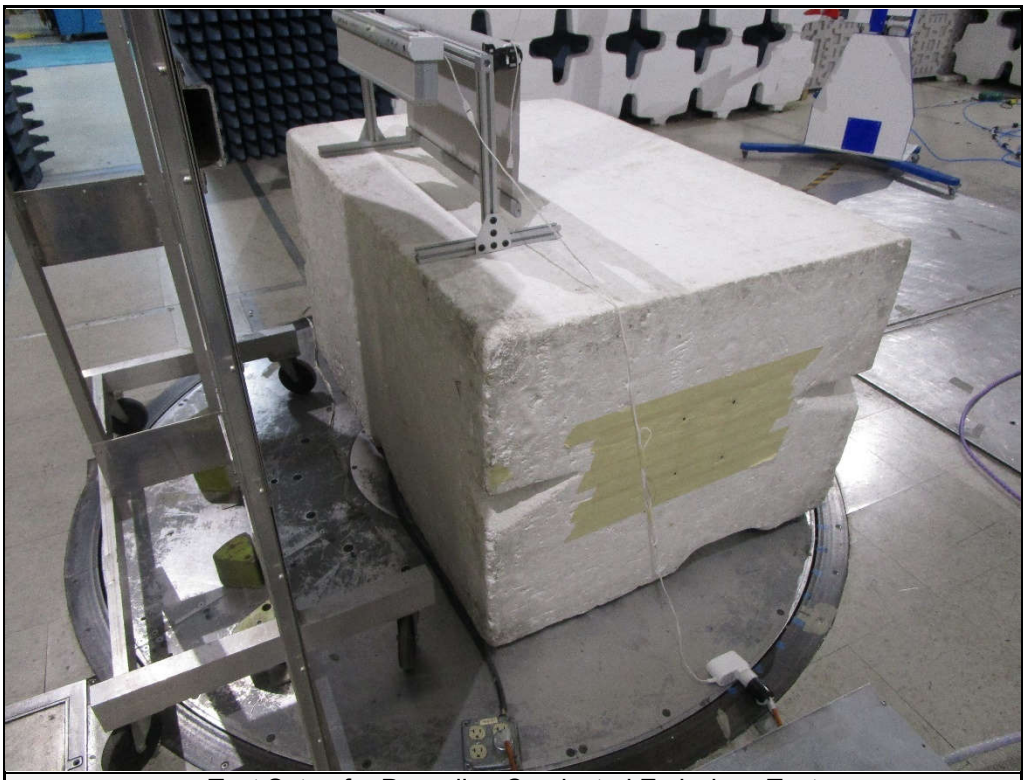
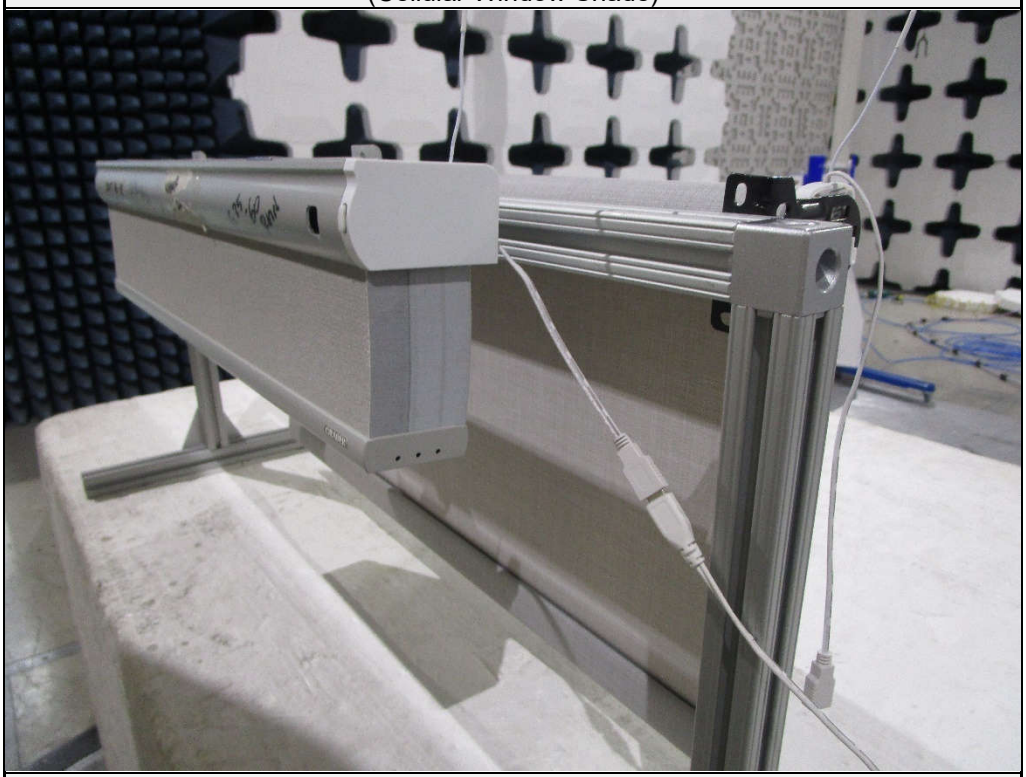


Test Setup for Powerline Conducted Emissions Test
(Cellular Window Shade)



Test Setup for Powerline Conducted Emissions Test
(Cellular Window Shade)

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:27:57 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

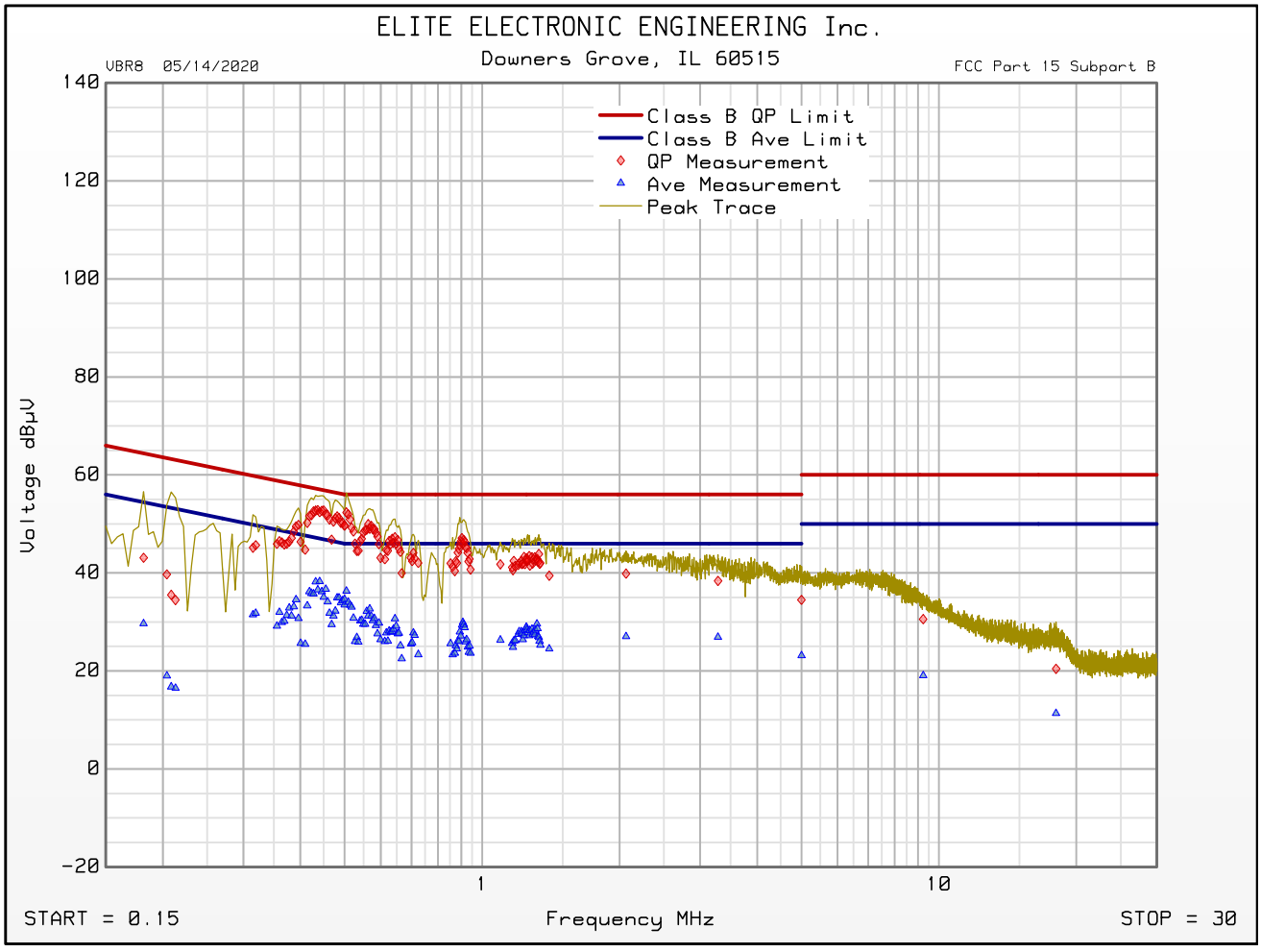
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.182	43.1	64.4		29.7	54.4	
0.450	52.7	56.9		35.1	46.9	
0.505	52.3	56.0		36.3	46.0	
0.903	47.1	56.0		29.3	46.0	
1.331	43.9	56.0		26.9	46.0	
2.066	39.8	56.0		27.0	46.0	
3.284	38.4	56.0		26.9	46.0	
5.000	34.5	56.0		23.1	46.0	
9.234	30.6	60.0		19.0	50.0	
18.050	20.4	60.0		11.3	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:27:57 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:16:49 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

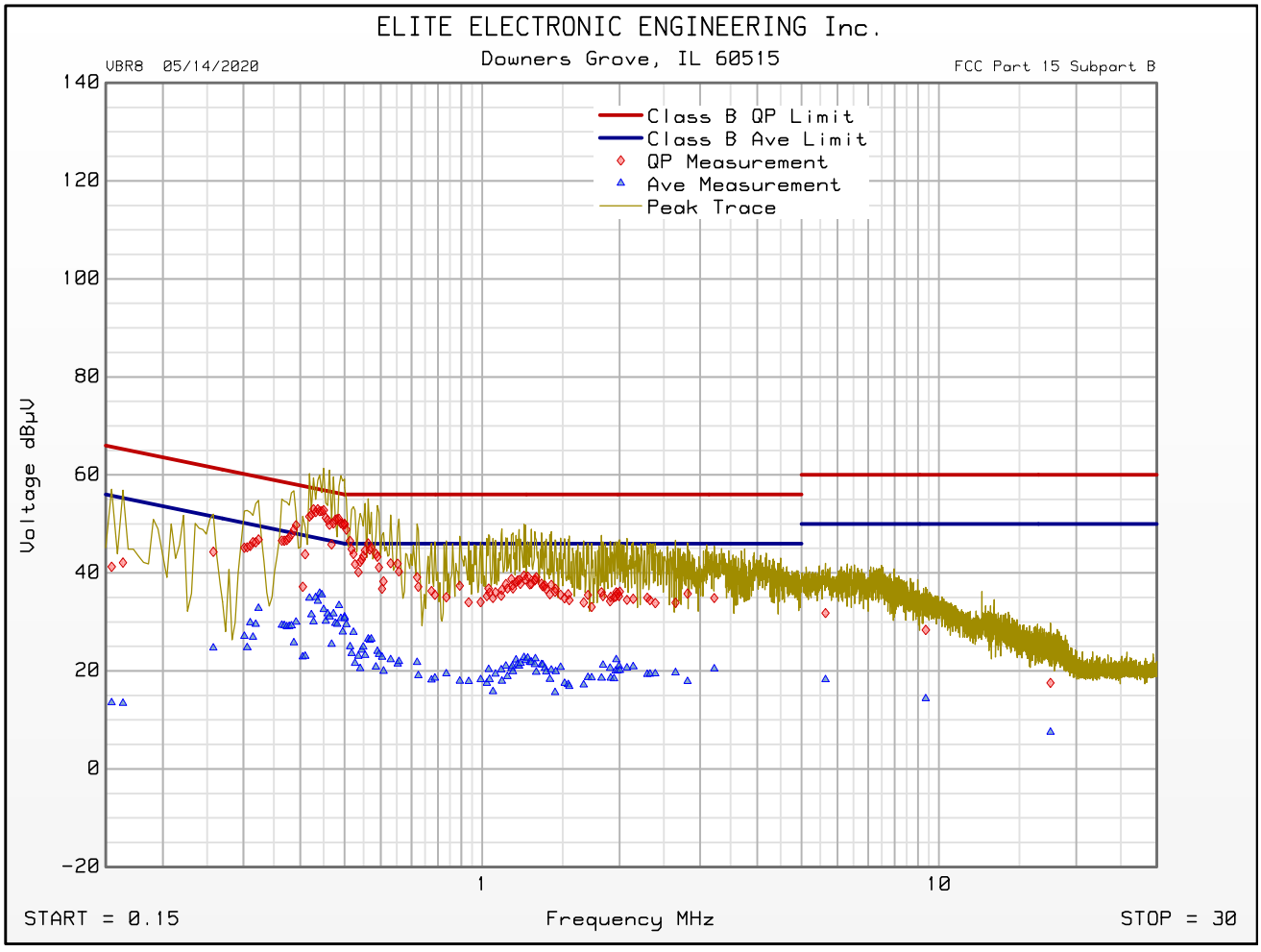
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.258	44.3	61.5		24.7	51.5	
0.450	52.8	56.9		32.5	46.9	
0.500	49.9	56.0		30.7	46.0	
1.236	39.5	56.0		22.7	46.0	
1.259	39.2	56.0		22.6	46.0	
2.003	36.2	56.0		20.1	46.0	
3.221	34.9	56.0		20.4	46.0	
5.644	31.8	60.0		18.2	50.0	
9.360	28.4	60.0		14.3	50.0	
17.546	17.6	60.0		7.5	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:16:49 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart C Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	ZWave Tx @ 908.4MHz
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:35:35 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

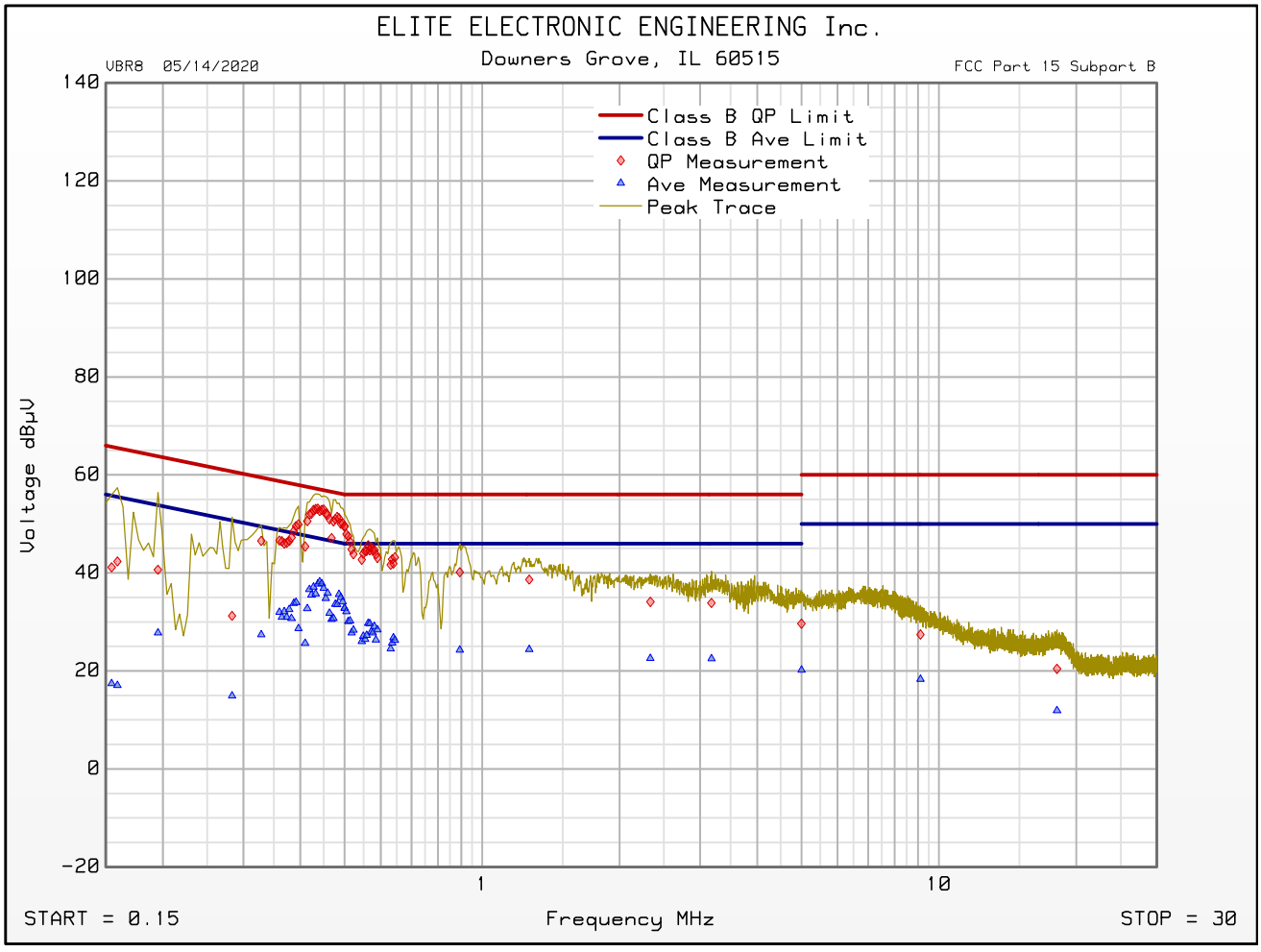
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.195	40.6	63.8		27.8	53.8	
0.450	52.9	56.9		36.9	46.9	
0.500	49.5	56.0		32.8	46.0	
0.894	40.1	56.0		24.2	46.0	
1.268	38.6	56.0		24.4	46.0	
2.336	34.1	56.0		22.6	46.0	
3.176	33.9	56.0		22.5	46.0	
5.000	29.6	56.0		20.2	46.0	
9.113	27.4	60.0		18.3	50.0	
18.140	20.4	60.0		11.9	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	ZWave Tx @ 908.4MHz
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:35:35 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart C Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	ZWave Tx @ 908.4MHz
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:41:39 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

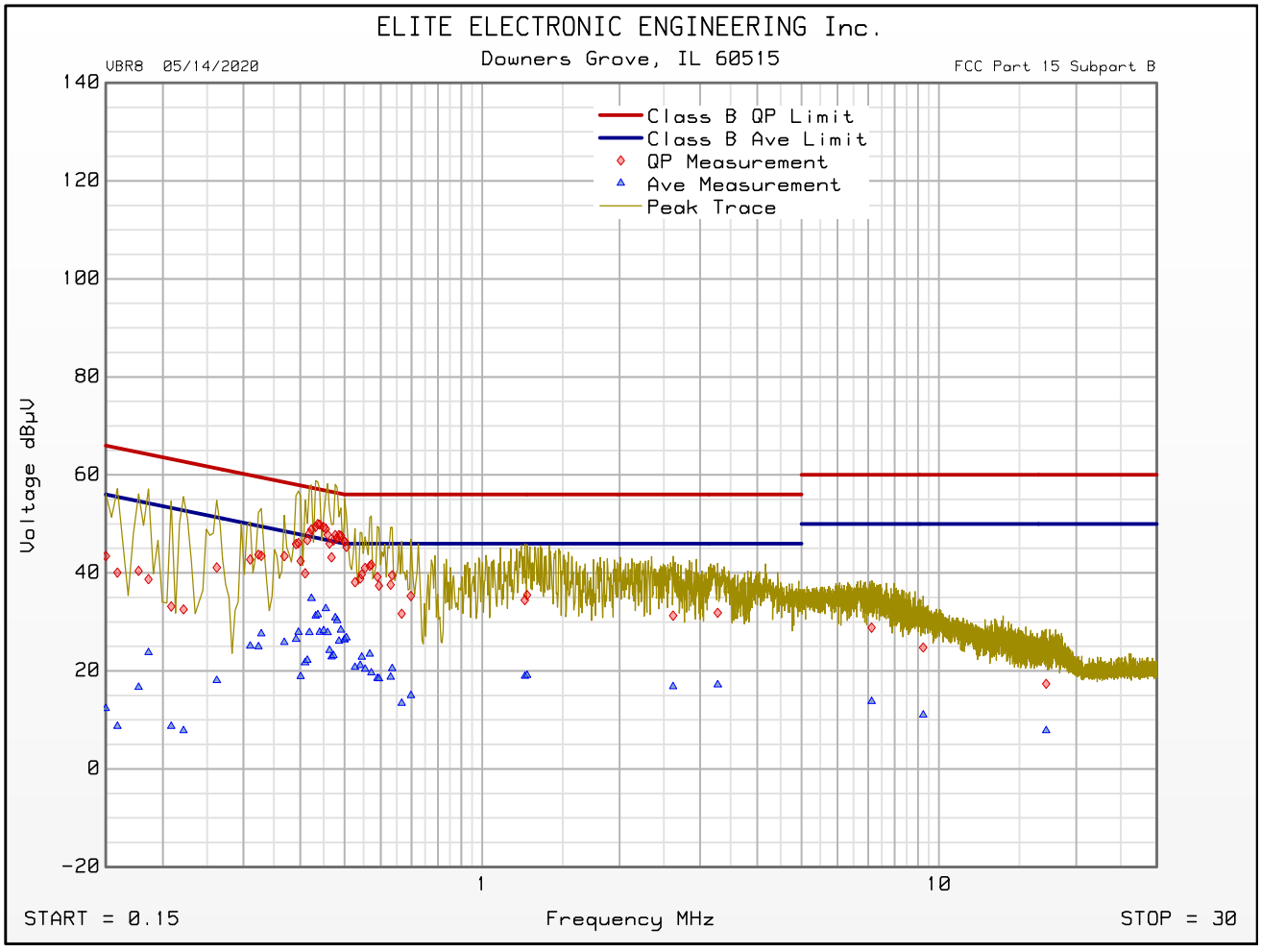
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.263	41.1	61.4		18.0	51.4	
0.441	49.9	57.0		27.9	47.0	
0.500	46.4	56.0		26.4	46.0	
1.240	34.4	56.0		19.0	46.0	
1.255	35.5	56.0		19.1	46.0	
2.619	31.3	56.0		16.8	46.0	
3.280	31.9	56.0		17.1	46.0	
7.120	28.8	60.0		13.8	50.0	
9.234	24.8	60.0		11.0	50.0	
17.168	17.4	60.0		7.8	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	ZWave Tx @ 908.4MHz
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:41:39 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart C Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	BLE Tx Ch0 @ 2402MHz
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:01:36 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

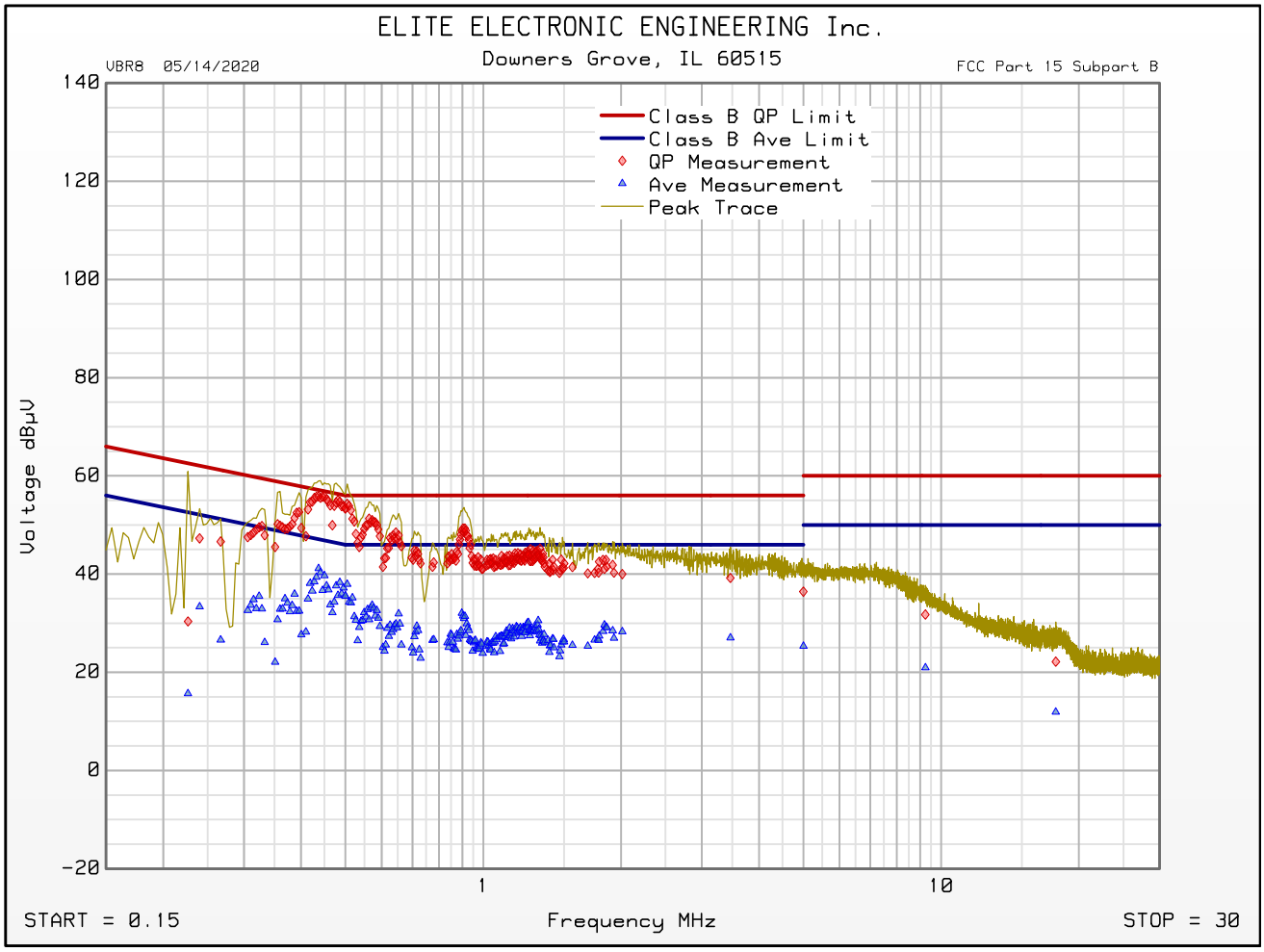
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.267	46.6	61.2		26.6	51.2	
0.450	55.8	56.9		39.7	46.9	
0.505	54.3	56.0		38.0	46.0	
0.912	49.3	56.0		31.4	46.0	
1.331	45.2	56.0		26.4	46.0	
2.012	40.0	56.0		28.3	46.0	
3.464	39.2	56.0		27.0	46.0	
5.000	36.4	56.0		25.3	46.0	
9.234	31.8	60.0		21.0	50.0	
17.803	22.2	60.0		11.9	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	BLE Tx Ch0 @ 2402MHz
Line Tested	:	High PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:01:36 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart C Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	BLE Tx Ch0 @ 2402MHz
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:09:50 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold

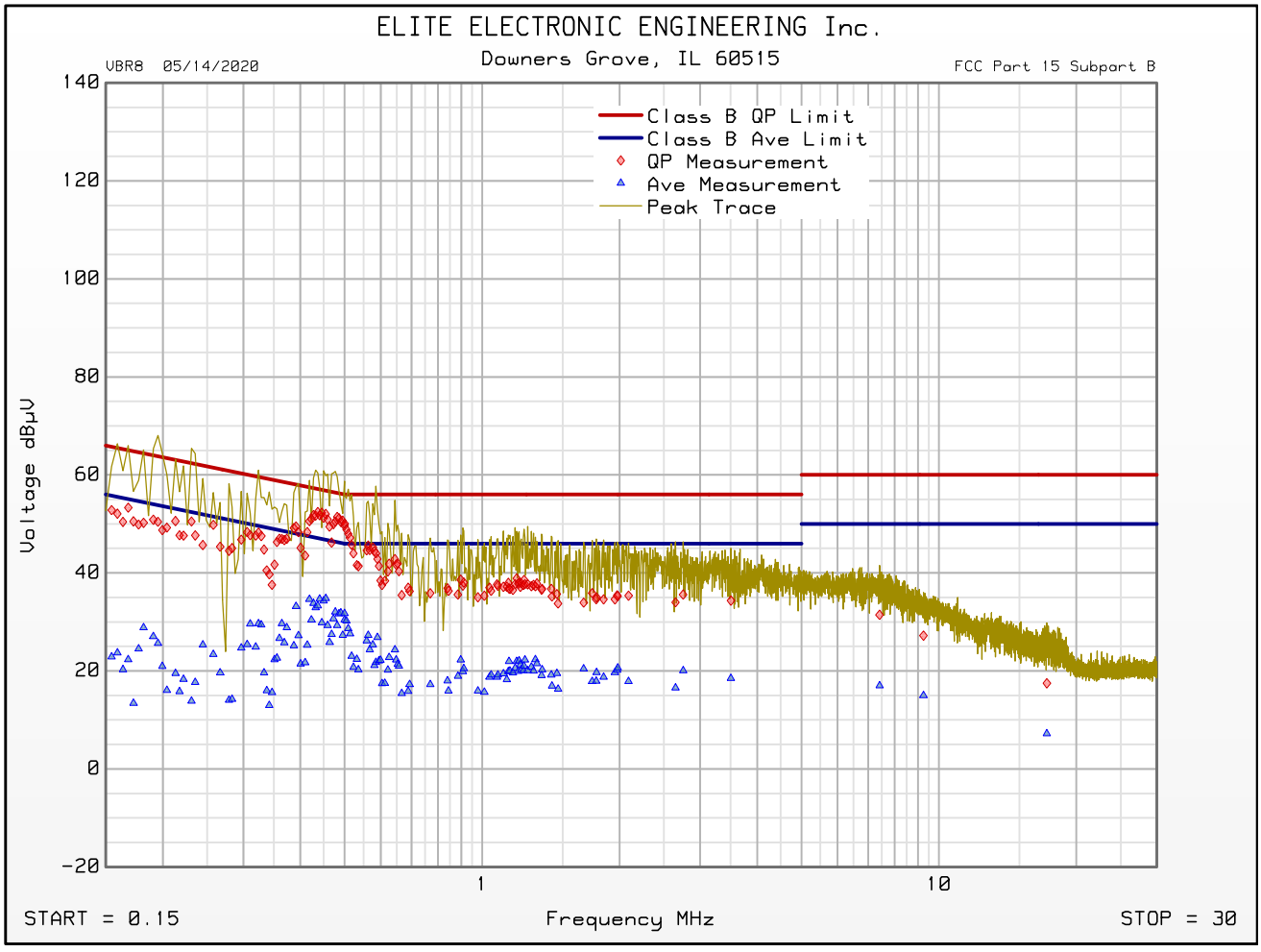
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.258	49.8	61.5		23.4	51.5	
0.446	52.3	57.0		29.9	47.0	
0.500	50.1	56.0		30.4	46.0	
1.191	38.9	56.0		21.9	46.0	
1.318	37.8	56.0		21.5	46.0	
2.754	35.6	56.0		20.1	46.0	
3.505	34.3	56.0		18.5	46.0	
7.412	31.4	60.0		17.0	50.0	
9.248	27.2	60.0		15.0	50.0	
17.231	17.5	60.0		7.2	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Spring Window Fashions LLC
Model	:	CRZB
DUT Revision	:	
Serial Number	:	Unit 1
DUT Mode	:	BLE Tx Ch0 @ 2402MHz
Line Tested	:	Neutral PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	0
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 20, 2022 04:09:50 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

21. RF Radiated Emissions

EUT Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model No.	CRZB
Serial No.	Unit 1
Modes	Tx Standby ZWave Rx @ 908MHz

Test Site Information	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	Room 21
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Highest Internal Frequency	916MHz
Highest Measurement Frequency	13GHz
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the values in the following tables.

FCC Part 15 Class B Radiated Emissions Limits (30MHz to 1GHz)		
Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	54
FCC Part 15 Class B Radiated Emissions Limits (Above 1GHz)		
Frequency of Emission (MHz)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)
Above 1000	74	54

Procedure

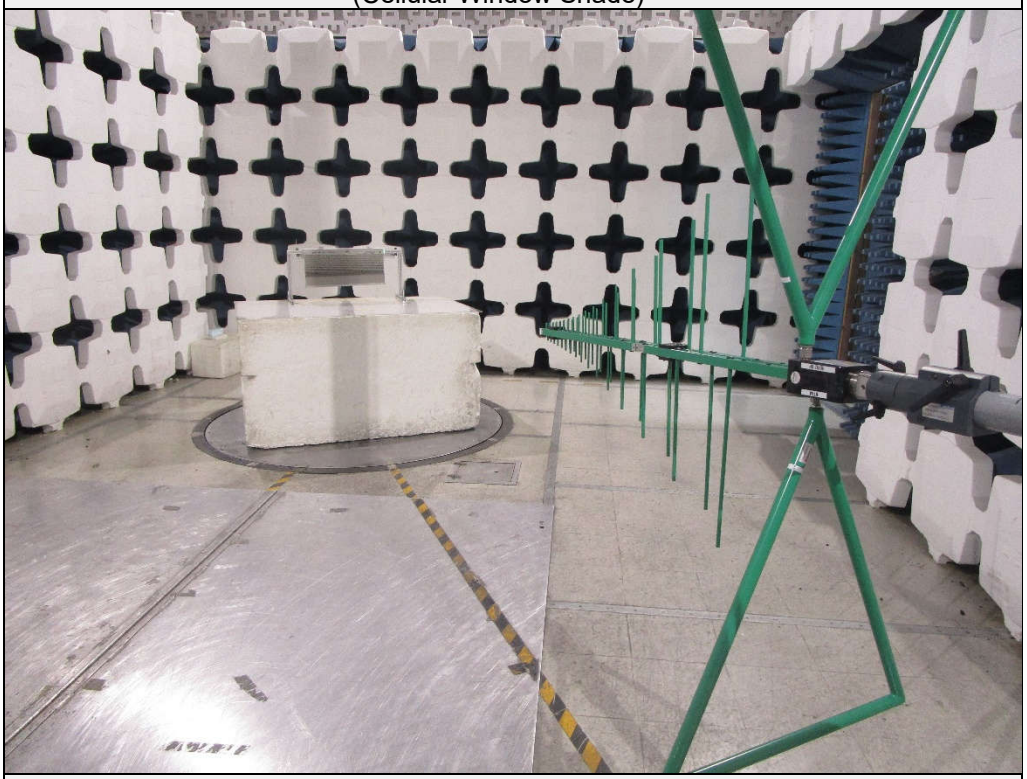
Since a quasi-peak detector and an average detector require long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector.

The EUT and all peripheral equipment were placed on an 80cm high non-conductive stand. The broadband measuring antenna was positioned at a 3-meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 13GHz was investigated using a peak detector function with the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted.

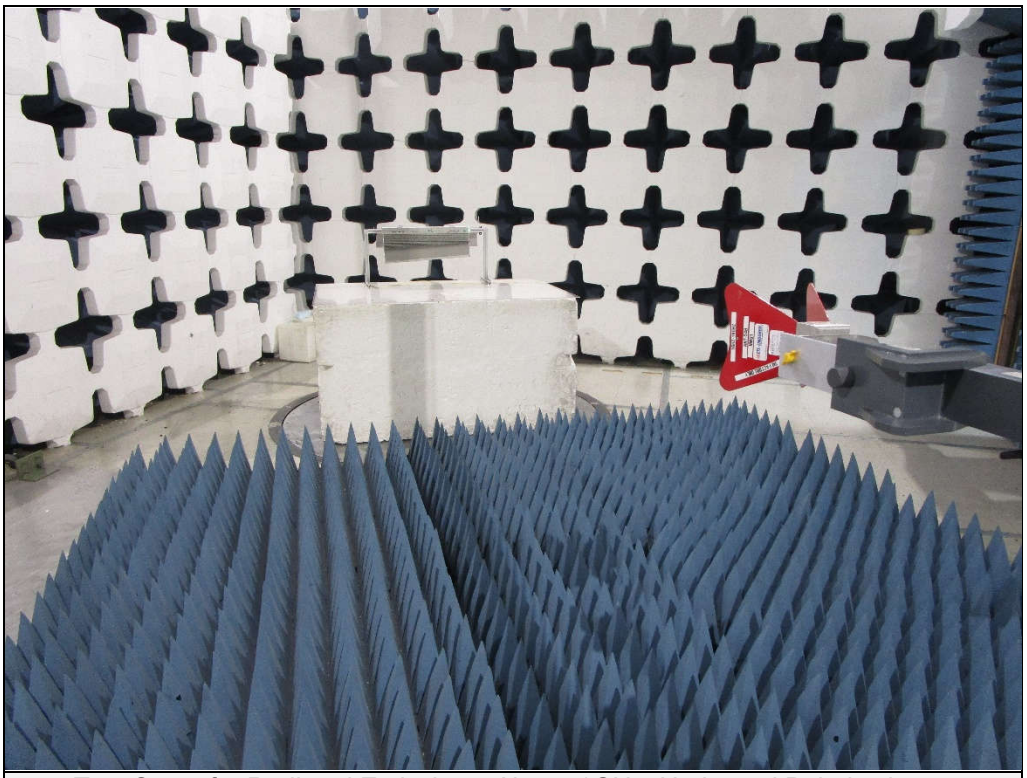
Final radiated emissions were performed on all significant broadband and narrowband emissions found in the exploratory sweeps using the following methods:

1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.
2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:
    a) The EUT was rotated so that all sides were exposed to the receiving antenna.
    b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
    c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
    d) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.
3) Steps (b) through (d) were repeated with the EUT operated in the ZWave Rx @ 908MHz mode.

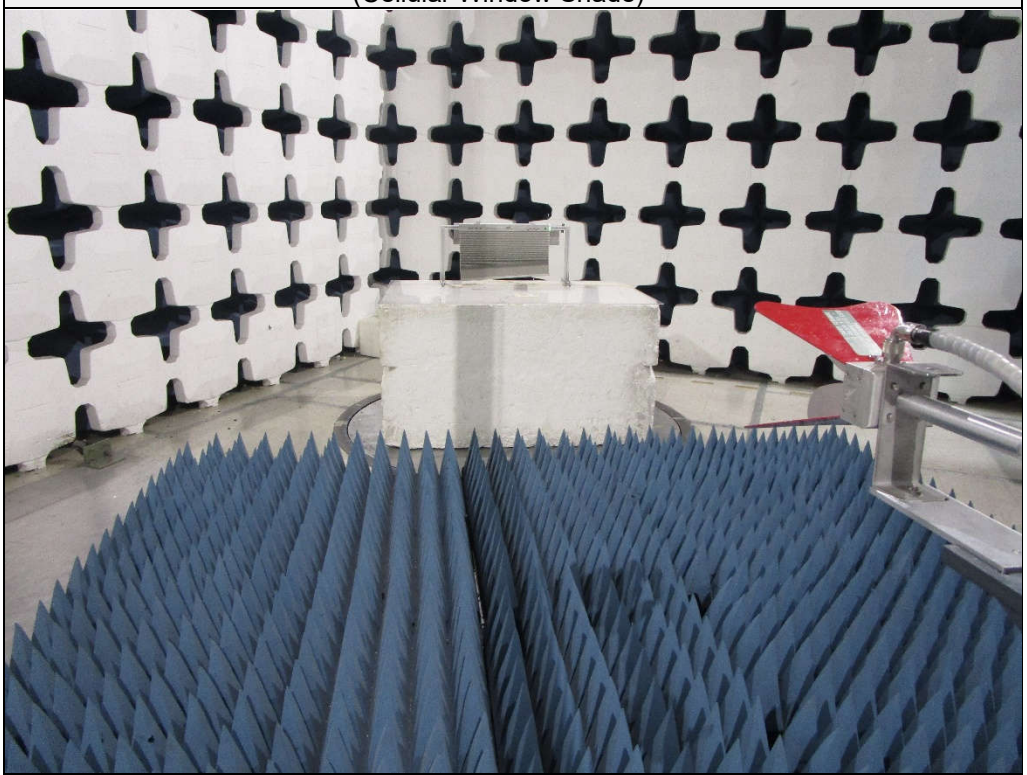
Test Setup for Radiated Emissions: 30MHz to 1GHz, Horizontal Polarization
(Cellular Window Shade)



Test Setup for Radiated Emissions: 30MHz to 1GHz, Vertical Polarization
(Cellular Window Shade)



Test Setup for Radiated Emissions: Above 1GHz, Horizontal Polarization
(Cellular Window Shade)



Test Setup for Radiated Emissions: Above 1GHz, Vertical Polarization
(Cellular Window Shade)

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

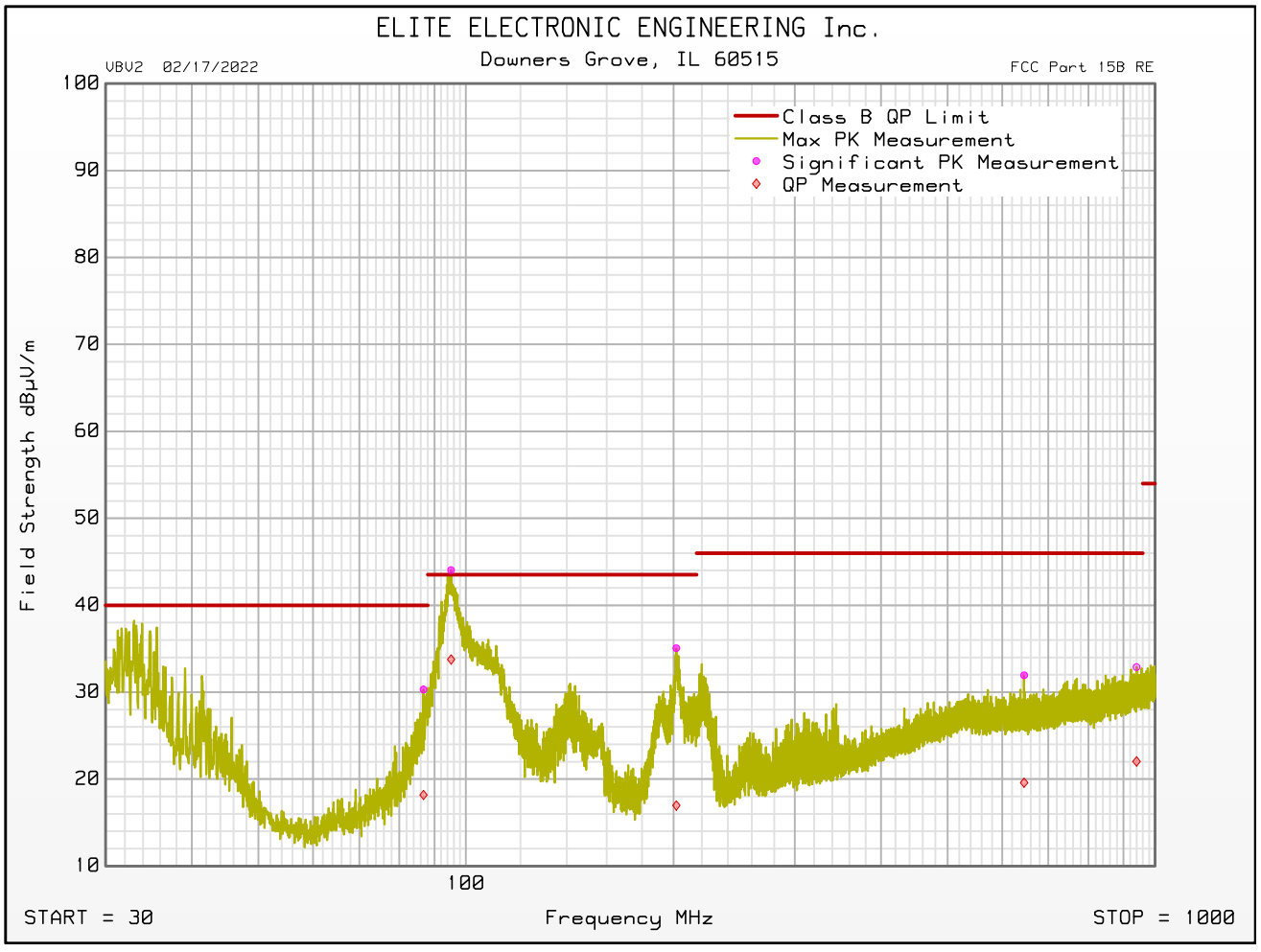
Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby, Motor Cycling
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:06:20 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive QP Level
34.440	19.5	12.7	22.3	0.0	0.5	0.0	42.3	35.6	40.0	-4.4	Vertical	120	0	
42.000	18.7	12.0	18.4	0.0	0.5	0.0	37.6	30.9	40.0	-9.1	Vertical	120	0	
51.360	18.6	11.9	14.5	0.0	0.5	0.0	33.6	26.9	40.0	-13.1	Vertical	120	0	
65.640	16.4	9.2	12.4	0.0	0.5	0.0	29.3	22.1	40.0	-17.9	Vertical	200	0	
86.760	15.5	3.4	14.3	0.0	0.5	0.0	30.3	18.2	40.0	-21.8	Horizontal	200	135	
95.140	27.5	17.2	16.1	0.0	0.5	0.0	44.0	33.8	43.5	-9.8	Horizontal	200	135	
128.620	19.0	12.2	17.9	0.0	0.7	0.0	37.6	30.8	43.5	-12.7	Vertical	120	45	
130.240	17.3	9.5	17.8	0.0	0.7	0.0	35.8	28.1	43.5	-15.5	Vertical	200	0	
131.080	17.9	9.7	17.8	0.0	0.7	0.0	36.4	28.1	43.5	-15.4	Vertical	120	45	
193.420	17.1	17.4	15.3	0.0	1.0	0.0	33.4	33.7	43.5	-9.8	Vertical	120	45	
201.940	18.6	0.5	15.4	0.0	1.0	0.0	35.1	17.0	43.5	-26.6	Horizontal	200	135	
213.880	15.0	1.4	15.0	0.0	1.0	0.0	31.0	17.4	43.5	-26.1	Vertical	120	45	
327.240	11.4	2.1	19.7	0.0	1.2	0.0	32.3	22.9	46.0	-23.1	Vertical	200	135	
338.880	11.0	1.7	19.8	0.0	1.2	0.0	32.0	22.7	46.0	-23.3	Vertical	200	135	
343.500	10.8	2.3	20.0	0.0	1.2	0.0	32.0	23.5	46.0	-22.5	Vertical	200	135	
645.540	5.4	-6.9	24.9	0.0	1.6	0.0	31.9	19.6	46.0	-26.4	Horizontal	120	225	
939.720	3.9	-6.9	26.9	0.0	2.0	0.0	32.9	22.0	46.0	-24.0	Horizontal	200	45	

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

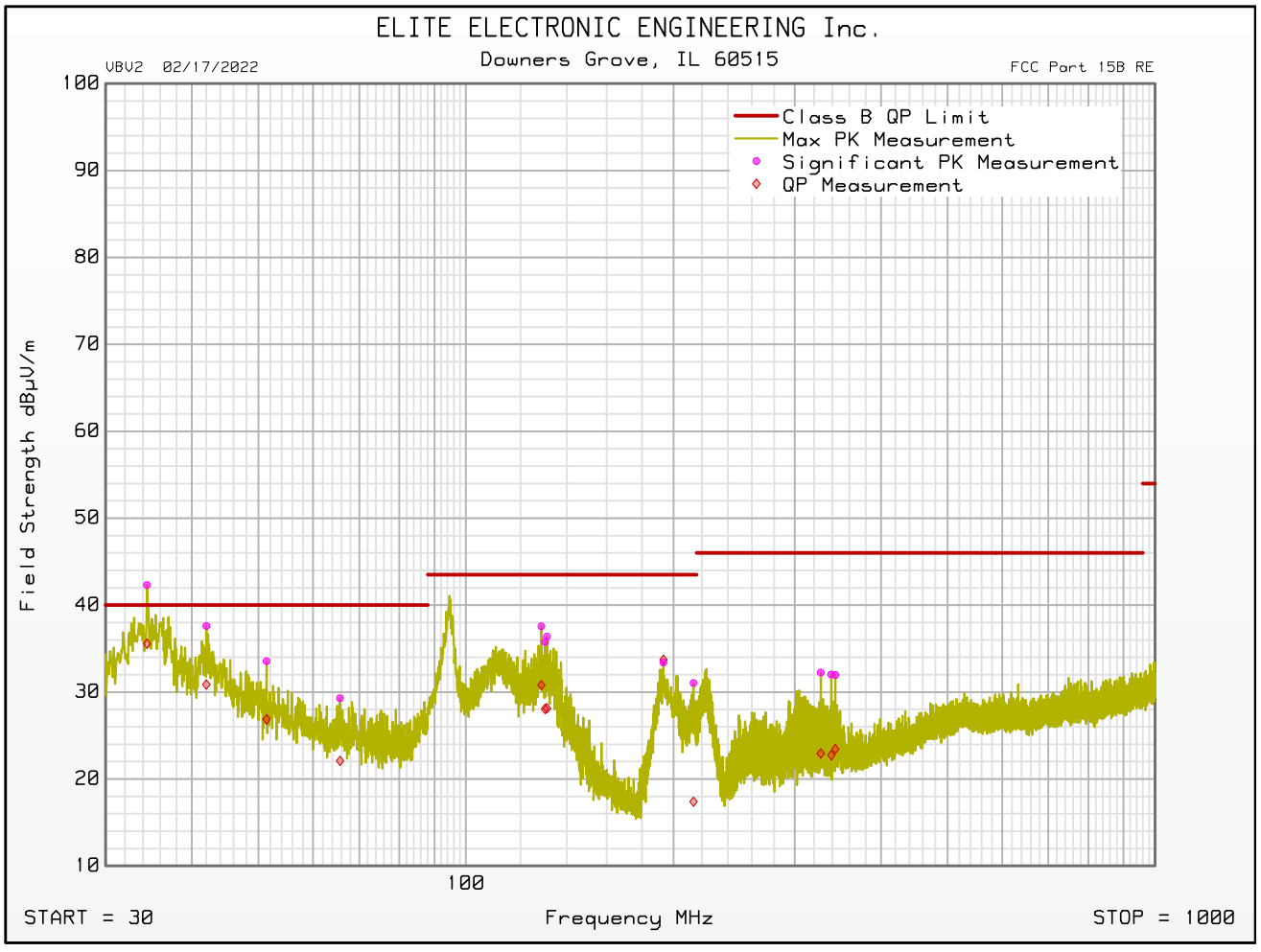
Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby, Motor Cycling
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:06:20 PM



FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby, Motor Cycling
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:06:20 PM



FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby, Motor Cycling
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 19, 2022 11:21:19 AM

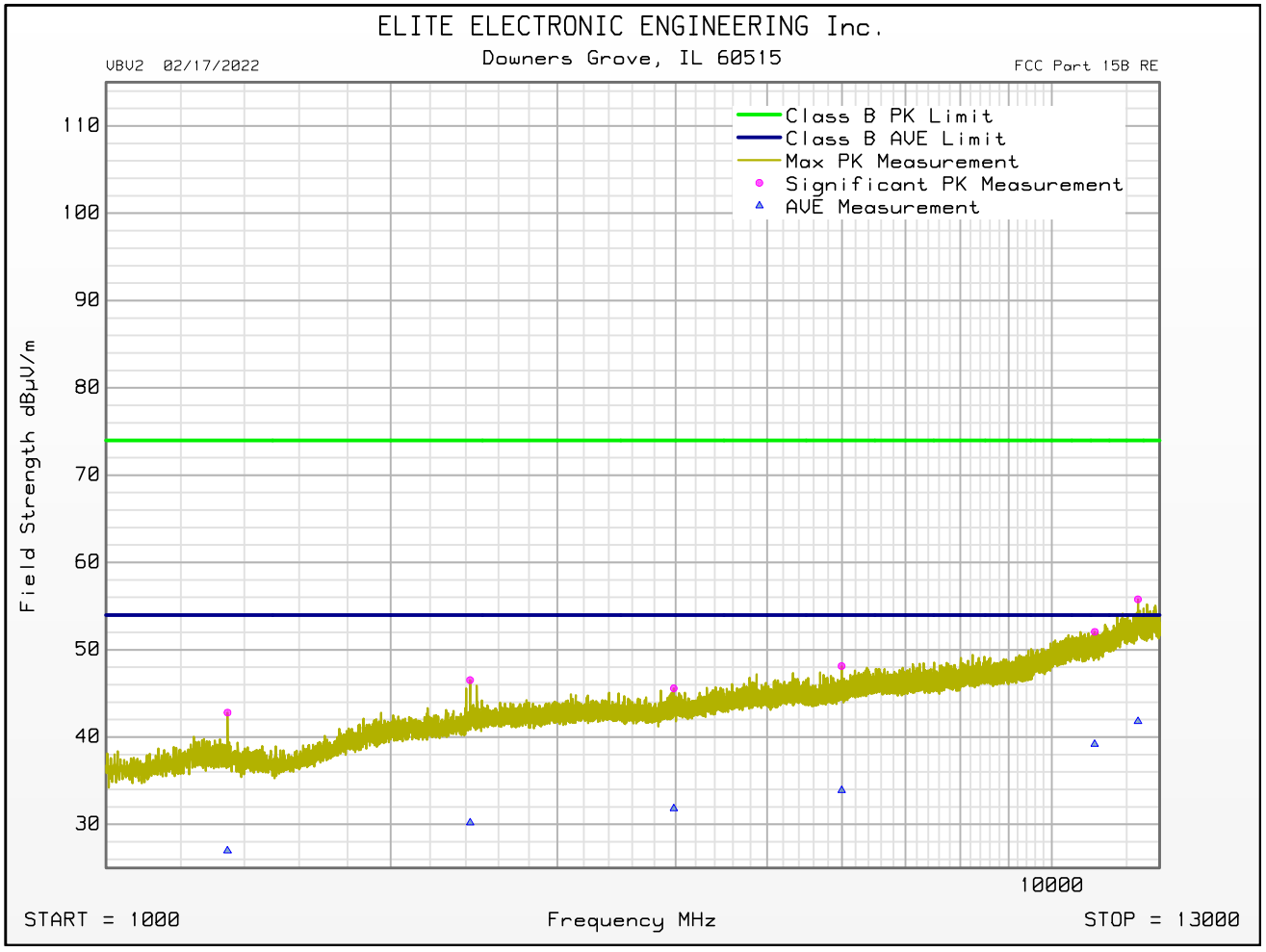
Freq MHz	Peak Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Peak Level
1344.000	52.9	29.0	-41.6	2.4	0.0	42.8	74.0	-31.2	Vertical	120	135	
2425.500	51.9	32.3	-41.1	3.4	0.0	46.5	74.0	-27.5	Horizontal	120	0	
3983.000	48.1	33.4	-40.4	4.5	0.0	45.6	74.0	-28.4	Vertical	340	0	
5993.000	48.1	35.1	-40.5	5.5	0.0	48.1	74.0	-25.9	Vertical	120	270	
11097.500	47.4	37.6	-40.5	7.6	0.0	52.1	74.0	-21.9	Horizontal	340	45	
12329.000	49.4	38.8	-40.4	8.0	0.0	55.8	74.0	-18.2	Horizontal	120	0	
13284.500	48.2	39.2	-40.5	8.1	0.0	55.1	74.0	-18.9	Horizontal	200	45	
13586.000	48.0	38.8	-40.4	8.3	0.0	54.7	74.0	-19.3	Horizontal	200	45	
14742.500	48.2	39.6	-40.4	8.9	0.0	56.3	74.0	-17.7	Horizontal	200	45	

Freq MHz	Average Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Average Level
1344.000	37.1	29.0	-41.6	2.4	0.0	27.0	54.0	-27.0	Vertical	120	135	
2425.500	35.6	32.3	-41.1	3.4	0.0	30.2	54.0	-23.8	Horizontal	120	0	
3983.000	34.3	33.4	-40.4	4.5	0.0	31.8	54.0	-22.2	Vertical	340	0	
5993.000	33.8	35.1	-40.5	5.5	0.0	33.9	54.0	-20.1	Vertical	120	270	
11097.500	34.6	37.6	-40.5	7.6	0.0	39.2	54.0	-14.8	Horizontal	340	45	
12329.000	35.4	38.8	-40.4	8.0	0.0	41.8	54.0	-12.2	Horizontal	120	0	
13284.500	35.0	39.2	-40.5	8.1	0.0	41.9	54.0	-12.1	Horizontal	200	45	
13586.000	34.8	38.8	-40.4	8.3	0.0	41.5	54.0	-12.5	Horizontal	200	45	
14742.500	34.8	39.6	-40.4	8.9	0.0	42.9	54.0	-11.1	Horizontal	200	45	

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	Tx Standby, Motor Cycling
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 19, 2022 11:21:19 AM



FCC Part 15.109
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

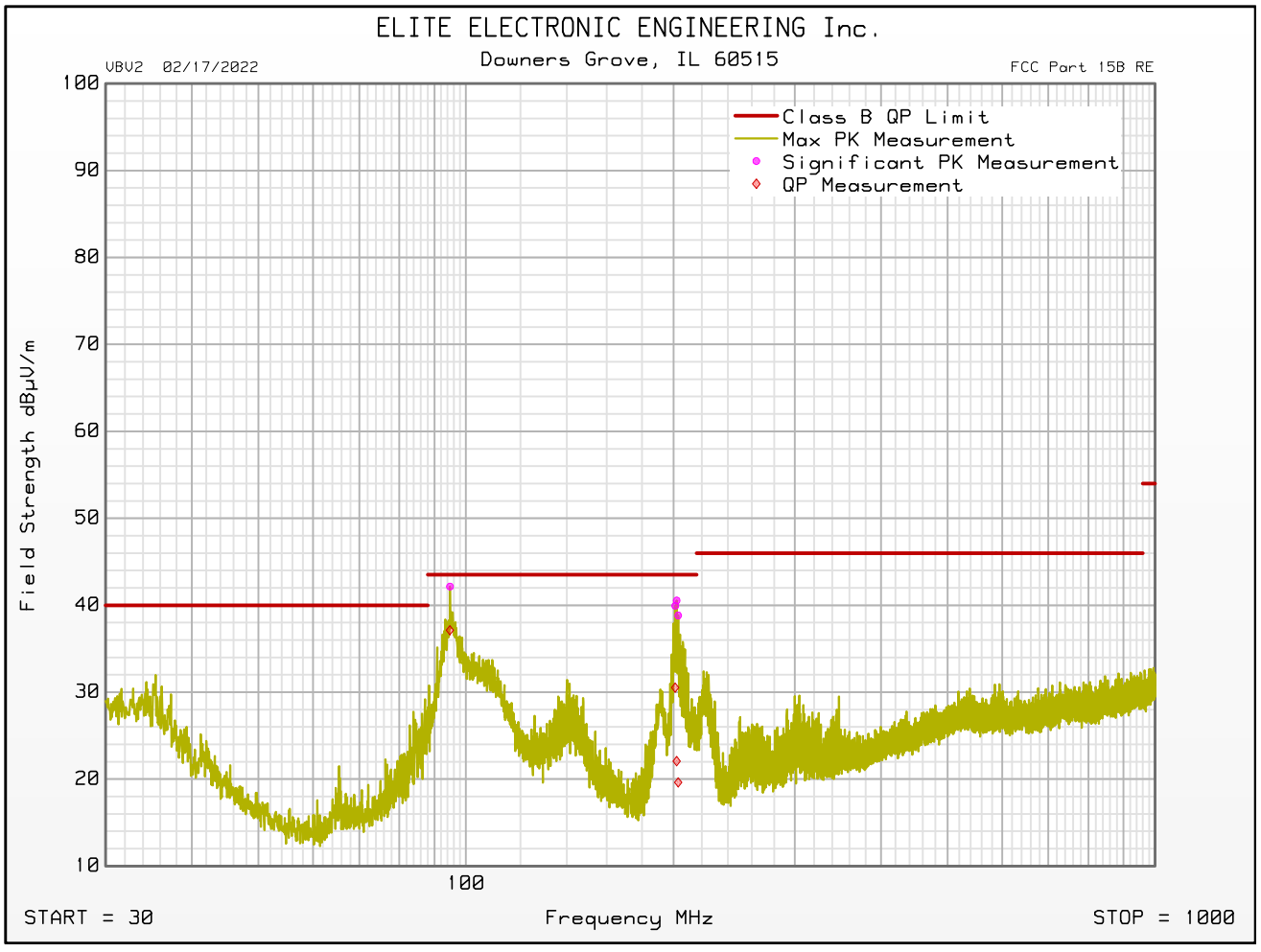
Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	ZWave Rx @ 908MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:37:40 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive QP Level
34.440	19.5	13.0	22.3	0.0	0.5	0.0	42.3	35.8	40.0	-4.2	Vertical	120	225	
39.300	18.0	10.9	19.7	0.0	0.5	0.0	38.2	31.1	40.0	-8.9	Vertical	120	180	
42.180	19.4	12.2	18.3	0.0	0.5	0.0	38.2	31.0	40.0	-9.0	Vertical	120	315	
70.440	17.3	11.2	12.6	0.0	0.5	0.0	30.4	24.3	40.0	-15.7	Vertical	200	315	
87.840	17.3	5.8	14.6	0.0	0.5	0.0	32.4	20.8	40.0	-19.2	Vertical	200	270	
94.780	25.6	20.6	16.0	0.0	0.5	0.0	42.1	37.1	43.5	-6.4	Horizontal	340	90	
130.300	19.4	12.6	17.8	0.0	0.7	0.0	37.9	31.1	43.5	-12.4	Vertical	120	45	
135.880	19.8	12.0	17.5	0.0	0.7	0.0	38.0	30.2	43.5	-13.3	Vertical	120	0	
141.460	15.5	7.9	17.2	0.0	0.8	0.0	33.4	25.9	43.5	-17.7	Vertical	120	0	
201.160	23.5	14.1	15.4	0.0	1.0	0.0	39.9	30.5	43.5	-13.0	Horizontal	200	0	
202.180	24.1	5.6	15.5	0.0	1.0	0.0	40.5	22.1	43.5	-21.4	Horizontal	200	0	
203.200	22.4	3.2	15.5	0.0	1.0	0.0	38.8	19.6	43.5	-23.9	Horizontal	200	0	
310.920	14.3	6.6	19.4	0.0	1.1	0.0	34.7	27.0	46.0	-19.0	Vertical	200	225	
315.600	14.7	6.2	19.4	0.0	1.1	0.0	35.3	26.7	46.0	-19.3	Vertical	200	225	
342.600	13.6	4.1	19.9	0.0	1.2	0.0	34.7	25.3	46.0	-20.7	Vertical	200	225	
936.900	4.0	-6.7	26.9	0.0	2.0	0.0	32.9	22.2	46.0	-23.8	Vertical	200	0	

FCC Part 15.109
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

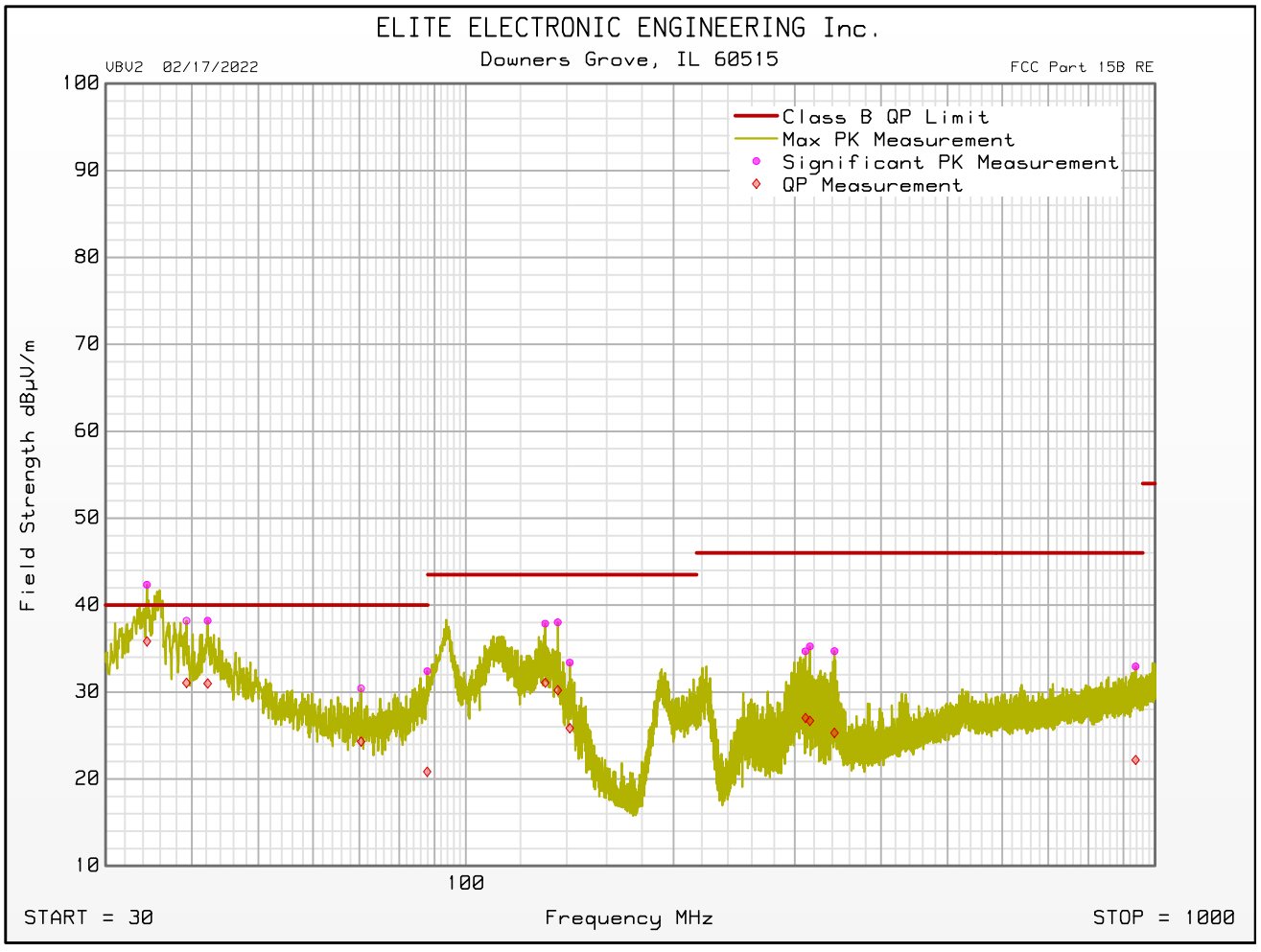
Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	ZWave Rx @ 908MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:37:40 PM



FCC Part 15.109
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	ZWave Rx @ 908MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 18, 2022 12:37:40 PM



FCC Part 15.109
Radiated RF Emissions Test

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	ZWave Rx @ 908MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 19, 2022 11:57:55 AM

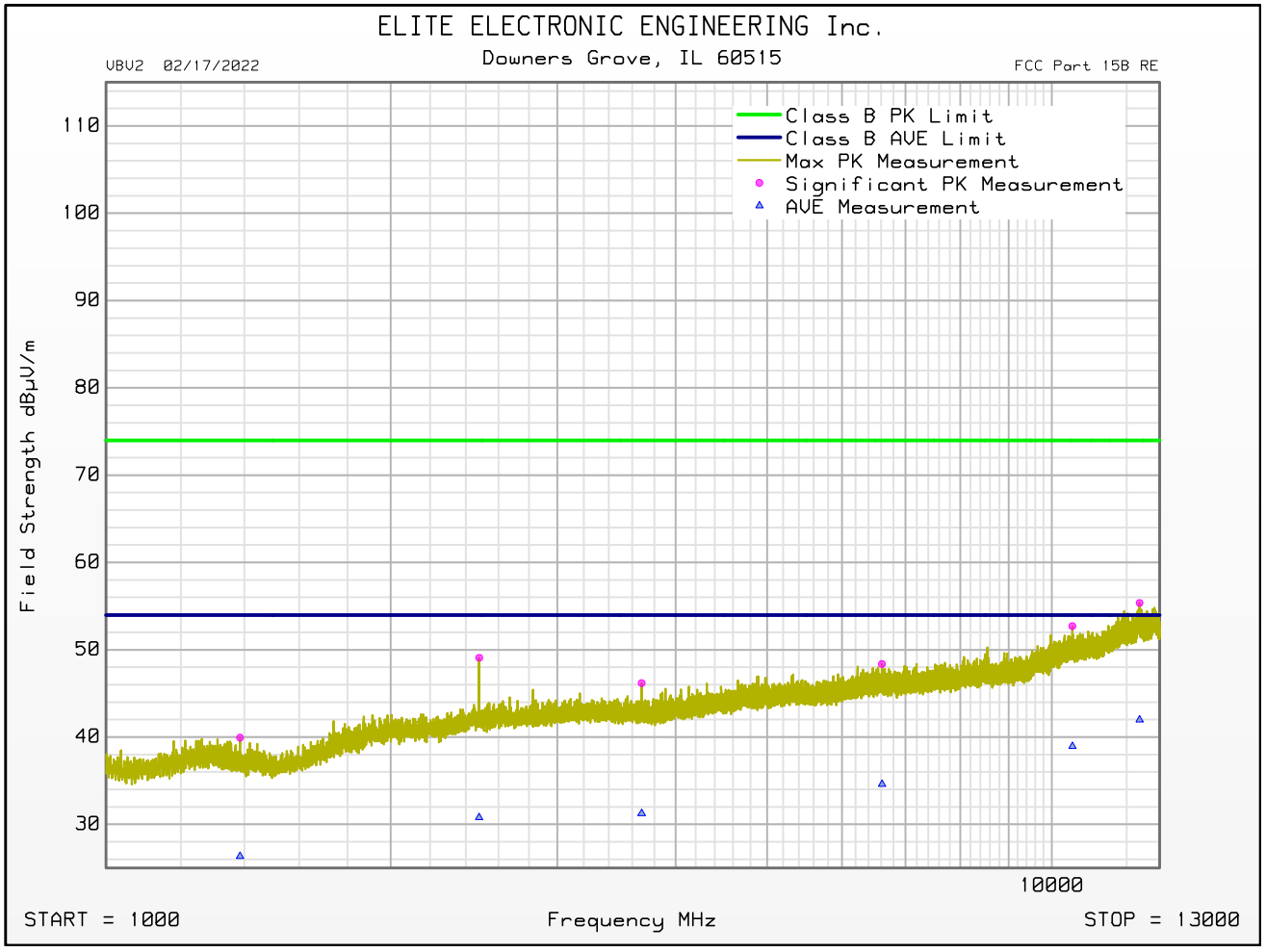
Freq MHz	Peak Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Peak Level
1385.500	50.3	28.5	-41.4	2.5	0.0	39.9	74.0	-34.1	Vertical	340	135	
2480.000	54.3	32.5	-41.2	3.5	0.0	49.1	74.0	-24.9	Vertical	340	45	
3683.000	49.3	33.0	-40.4	4.3	0.0	46.2	74.0	-27.8	Vertical	120	315	
6611.500	47.5	35.6	-40.6	5.8	0.0	48.4	74.0	-25.6	Horizontal	340	180	
10510.000	48.6	37.3	-40.5	7.3	0.0	52.7	74.0	-21.3	Vertical	120	315	
12379.500	48.9	38.8	-40.3	8.0	0.0	55.4	74.0	-18.6	Horizontal	200	135	

Freq MHz	Average Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Average Level
1385.500	36.7	28.5	-41.4	2.5	0.0	26.3	54.0	-27.6	Vertical	340	135	
2480.000	36.0	32.5	-41.2	3.5	0.0	30.8	54.0	-23.2	Vertical	340	45	
3683.000	34.3	33.0	-40.4	4.3	0.0	31.2	54.0	-22.7	Vertical	120	315	
6611.500	33.7	35.6	-40.6	5.8	0.0	34.6	54.0	-19.4	Horizontal	340	180	
10510.000	34.8	37.3	-40.5	7.3	0.0	38.9	54.0	-15.0	Vertical	120	315	
12379.500	35.5	38.8	-40.3	8.0	0.0	42.0	54.0	-12.0	Horizontal	200	135	

FCC Part 15.109
Radiated RF Emissions

SW ID/Rev: VBV2 02/17/2022

Manufacturer	:	Springs Windows
Model	:	CRZB
Serial Number	:	Unit 1
DUT Mode	:	ZWave Rx @ 908MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	Apr 19, 2022 11:57:55 AM



22. Occupied Bandwidth Measurements

Test Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model	CRZB
Serial No	Unit 1
Modes	ZWave Tx @ 908.4MHz ZWave Tx @ 916MHz
Test Date	April 18, 2022

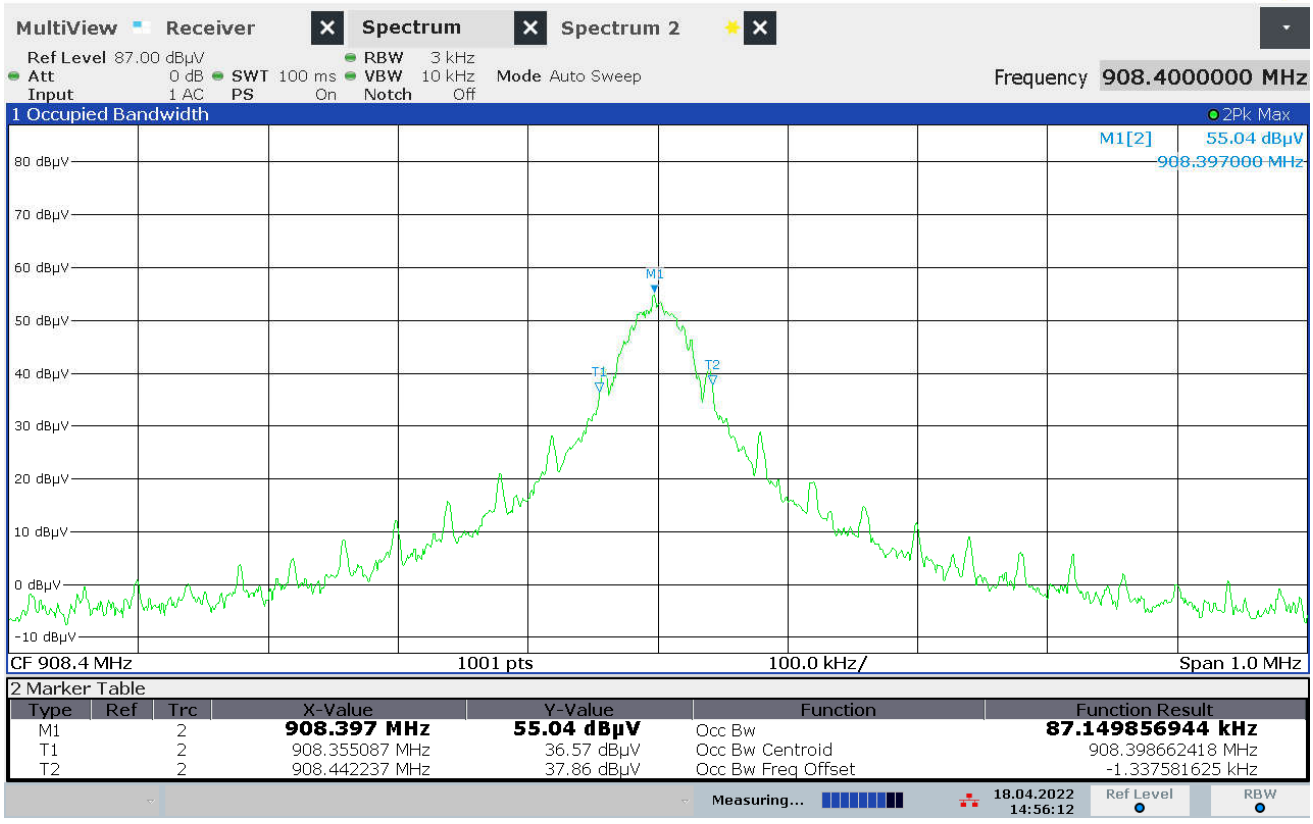
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic Chamber
Test site used	Room 21
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
The occupied bandwidth (99% Bandwidth) of momentarily operated devices shall be less than or equal to 0.25% of the center frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the center frequency.

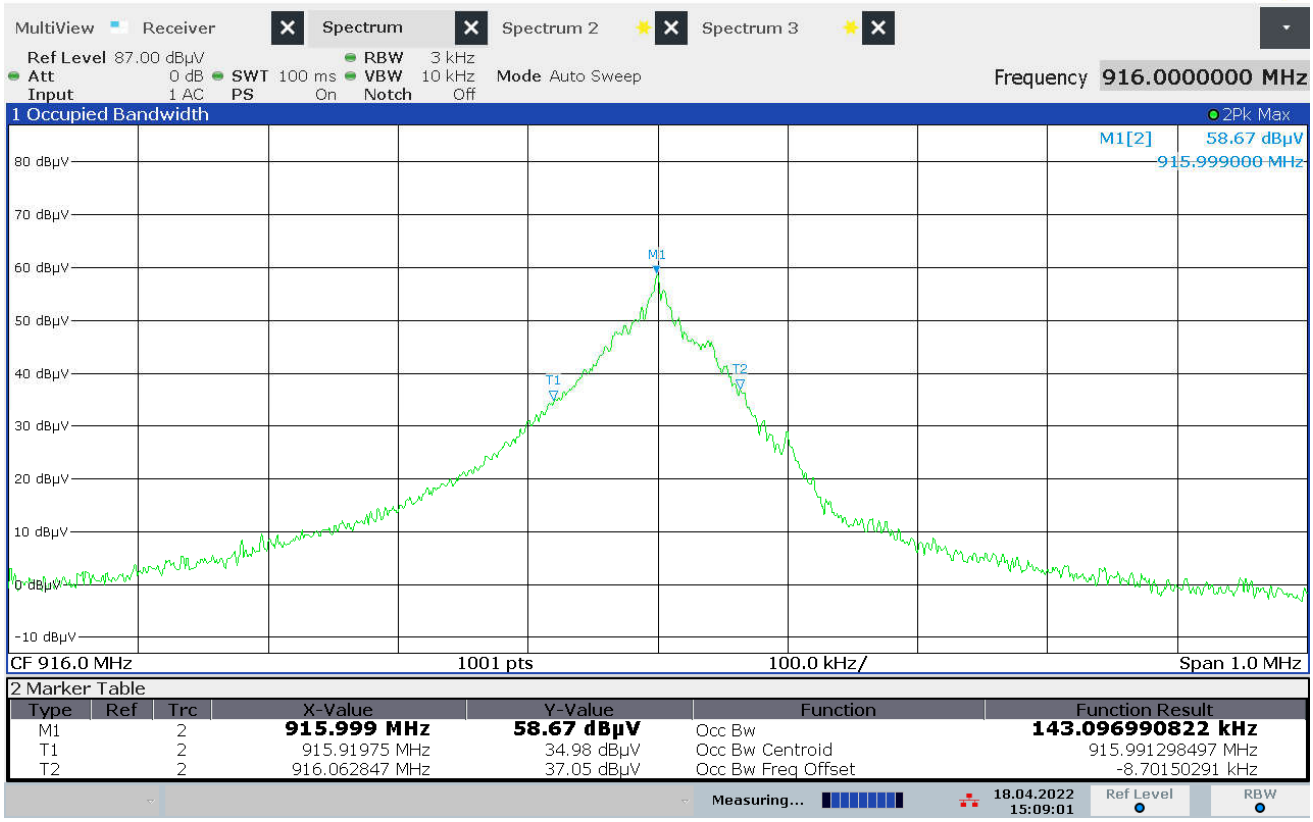
Procedures
The EUT was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 1% to 5% of the actual occupied bandwidth and span was set to 2MHz. The 99% Power Bandwidth function of the spectrum analyzer was enabled. A screen capture was taken of the frequency spectrum near the carrier using a screen dump function on the spectrum analyzer.

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 908.4MHz
Carrier Frequency	908.4MHz
Parameters	Occupied Bandwidth (99% Bandwidth) = 87.15kHz
Notes	None



14:56:13 18.04.2022

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 916MHz
Carrier Frequency	916MHz
Parameters	Occupied Bandwidth (99% Bandwidth) = 143.097kHz
Notes	None



15:09:01 18.04.2022

23. Duty Cycle Factor Measurements

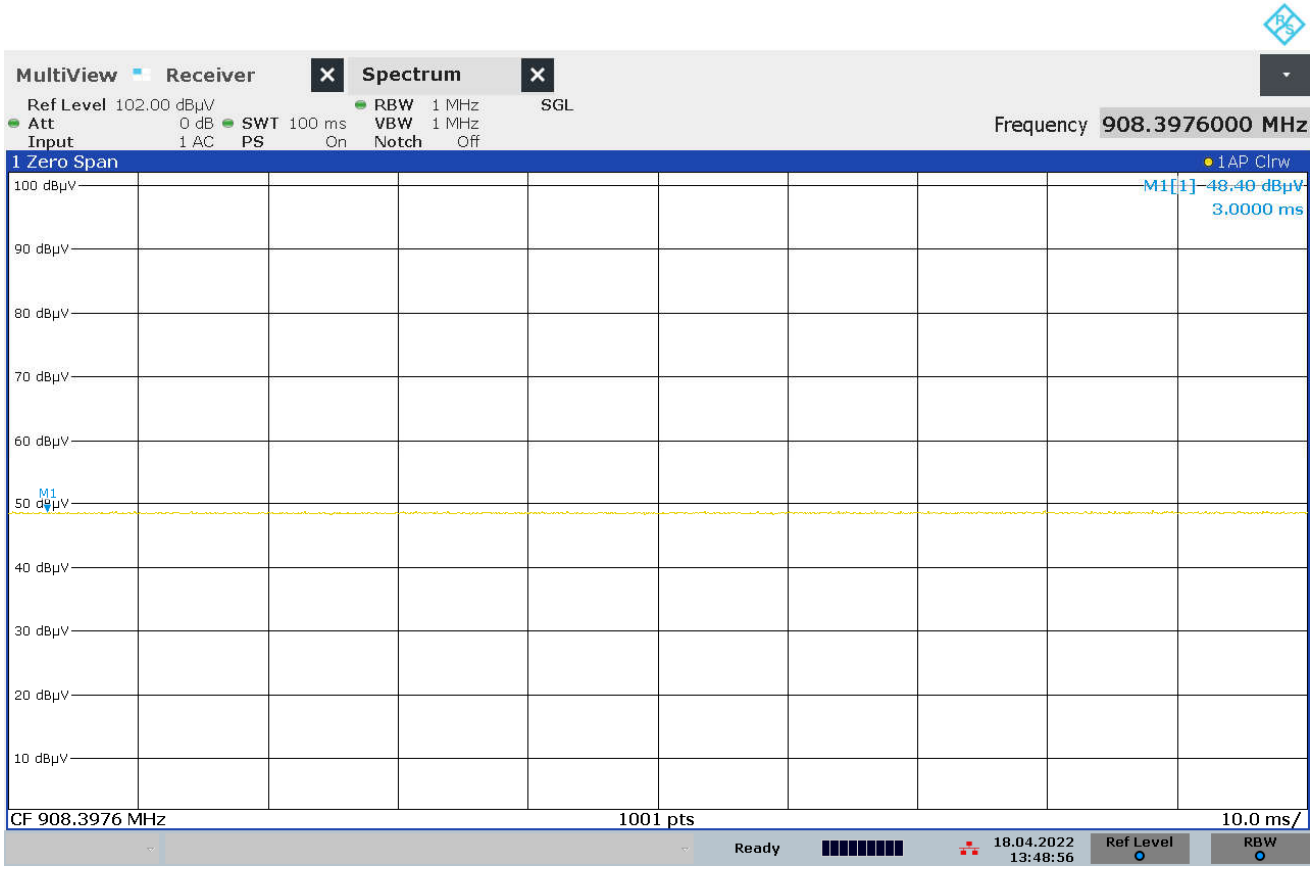
Test Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model	CRZB
Serial No	Unit 1
Modes	ZWave Tx @ 908.4MHz ZWave Tx @ 916MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/a
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test site used	Room 21
Notes	None

Procedures
The spectrum analyzer center frequency is set to the transmitter frequency with a zero-span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less than 100msec, the display is set to show at least one word. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

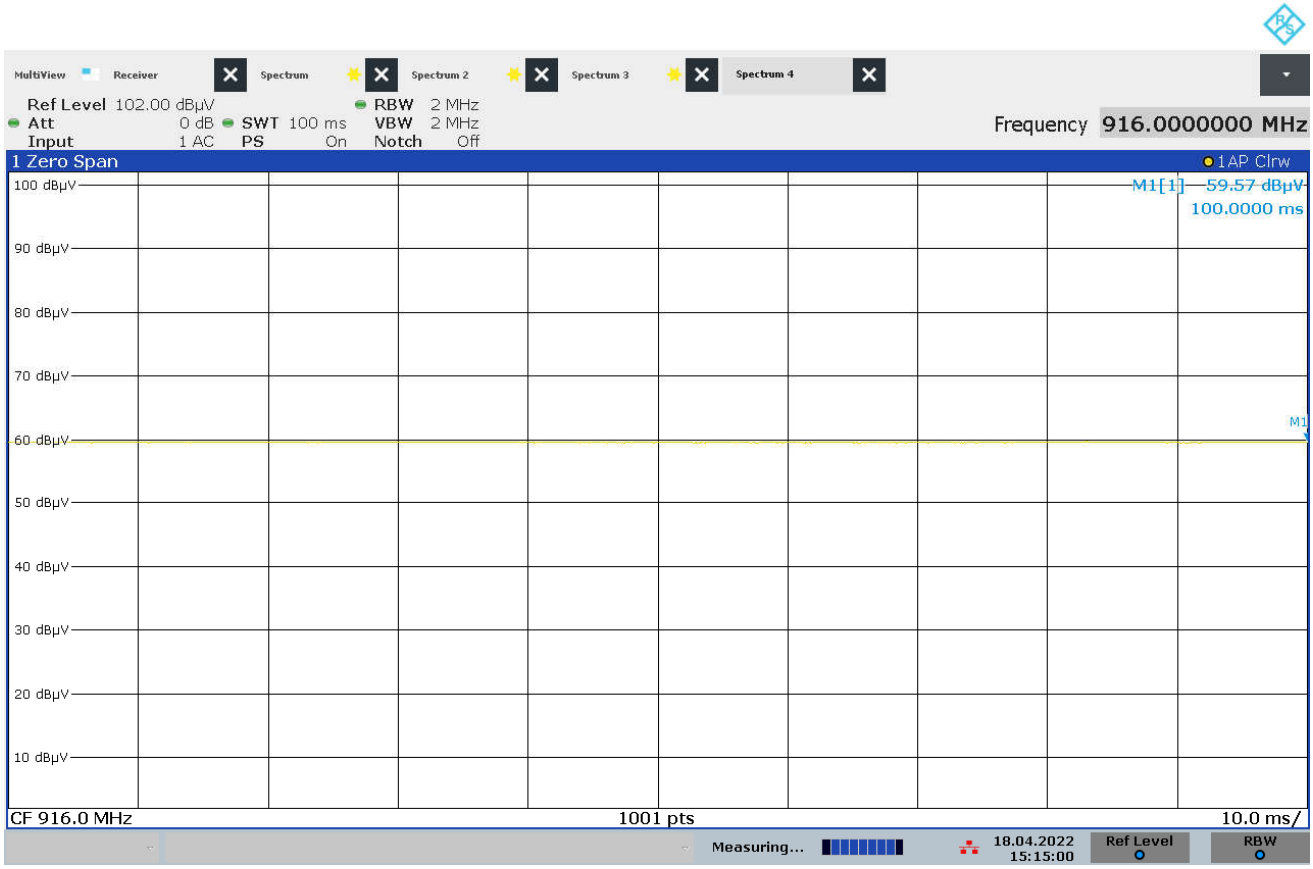
Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 908.4MHz
Carrier Frequency	908.4MHz
Parameters	On time = 100ms
Notes	Duty Cycle Factor = 0



13:48:57 18.04.2022

$$\text{Duty Cycle Factor} = 20\log\left(\frac{On - Time}{100\text{msec}}\right) = 20\log\left(\frac{100msec}{100\text{msec}}\right) = 0$$

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 916MHz
Carrier Frequency	916MHz
Parameters	On time = 100ms
Notes	Duty Cycle Factor = 0



15:15:01 18.04.2022

$$\text{Duty Cycle Factor} = 20\log\left(\frac{On - Time}{100\text{msec}}\right) = 20\log\left(\frac{100msec}{100\text{msec}}\right) = 0$$

24. Case Spurious Radiated Emissions

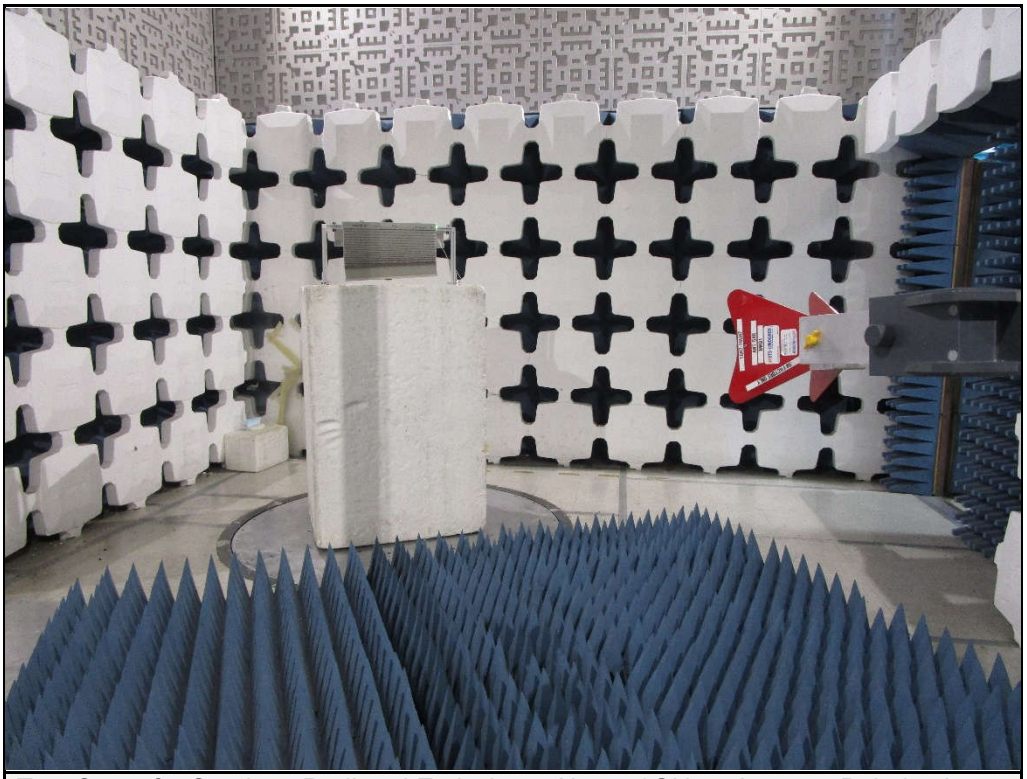
Test Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model	CRZB
Serial No	Unit 1
Modes	ZWave Tx @ 908.4MHz ZWave Tx @ 916MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/a
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test site used	Room 21
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Notes	None

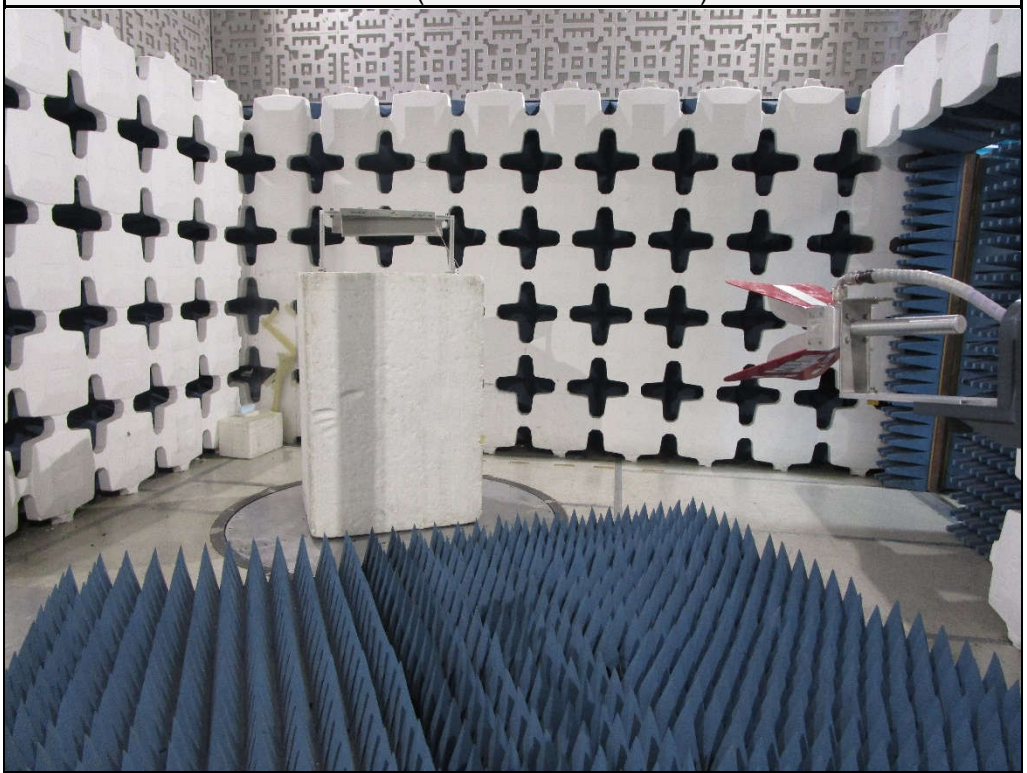
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements		
The field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:		
Fundamental Frequency	Field Strength of Fundamental (mV/m)	Field Strength (mV/m)
902-928 MHz 2400-2483.5 MHz 5725-5875 MHz 24.0-24.25 MHz	50 50 50 250	500 500 500 2500

Procedures
Radiated measurements were taken in a high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads. Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3-meter distance from the EUT. The entire frequency range from 30MHz to 13.0GHz was investigated using a peak detector function. The final open field emission tests were then manually performed over the frequency range of 30MHz to 13.0GHz. a) The field strength of the fundamental was measured using a bilog antenna. The bilog antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer. b) The field strengths of all of the harmonics were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer. c) To ensure that maximum or worst-case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions: i) The EUT was rotated so that all of its sides were exposed to the receiving antenna. ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured. iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings. iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.



Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Horizontal (Cellular Window Shade)



Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Vertical (Cellular Window Shade)

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 908.4MHz
Carrier Frequency	908.4MHz
Parameters	Peak Measurements
Notes	None

Frequency (MHz)	Ant Pol	Meter Reading (dBµV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total (dBµV/m) at 3m	Peak Total (µV/m) at 3 m	Peak Limit (µV/m) at 3 m	Margin (dB)
908.400	H	55.8		2.0	26.4	0.0	84.2	16271.8	50000.0	-9.8
908.400	V	57.7		2.0	26.4	0.0	86.2	20437.8	50000.0	-7.8
1816.800	H	51.9	*	2.9	30.9	-40.9	44.9	175.5	5000.0	-29.1
1816.800	V	51.4	*	2.9	30.9	-40.9	44.4	166.7	5000.0	-29.5
2725.200	H	53.2		3.7	32.6	-40.4	49.1	283.7	5000.0	-24.9
2725.200	V	53.4		3.7	32.6	-40.4	49.2	290.0	5000.0	-24.7
3633.600	H	49.6	*	4.3	33.2	-40.3	46.8	219.5	5000.0	-27.2
3633.600	V	49.0	*	4.3	33.2	-40.3	46.2	204.6	5000.0	-27.8
4542.000	H	50.2	*	4.7	34.2	-40.1	49.1	284.7	5000.0	-24.9
4542.000	V	50.3	*	4.7	34.2	-40.1	49.1	285.1	5000.0	-24.9
5450.400	H	50.0	*	5.2	35.0	-40.2	49.9	313.4	5000.0	-24.1
5450.400	V	49.2	*	5.2	35.0	-40.2	49.1	284.5	5000.0	-24.9
6358.800	H	49.5	*	5.6	35.5	-40.1	50.5	334.7	5000.0	-23.5
6358.800	V	49.7	*	5.6	35.5	-40.1	50.7	341.7	5000.0	-23.3
7267.200	H	49.4	*	6.1	35.7	-40.1	51.2	362.4	5000.0	-22.8
7267.200	V	49.4	*	6.1	35.7	-40.1	51.2	361.9	5000.0	-22.8
8175.600	H	49.7	*	6.5	35.8	-40.0	52.1	402.9	5000.0	-21.9
8175.600	V	51.4		6.5	35.8	-40.0	53.7	486.1	5000.0	-20.2
9084.000	H	49.4	*	6.5	36.3	-39.7	52.5	423.0	5000.0	-21.5
9084.000	V	49.9	*	6.5	36.3	-39.7	53.0	448.6	5000.0	-20.9

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 908.4MHz
Carrier Frequency	908.4MHz
Parameters	Average Measurements
Notes	None

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total (dBuV/m) at 3m	Average Total (uV/m) at 3 m	Average Limit (uV/m) at 3 m	Margin (dB)
1816.80	H	35.5	*	2.9	30.9	-40.9	0.0	28.5	26.6	500.0	-25.5
1816.80	V	35.5	*	2.9	30.9	-40.9	0.0	28.5	26.6	500.0	-25.5
2725.20	H	44.8		3.7	32.6	-40.4	0.0	40.7	108.0	500.0	-13.3
2725.20	V	44		3.7	32.6	-40.4	0.0	39.9	98.5	500.0	-14.1
3633.60	H	34.3	*	4.3	33.2	-40.3	0.0	31.5	37.5	500.0	-22.5
3633.60	V	34.5	*	4.3	33.2	-40.3	0.0	31.7	38.4	500.0	-22.3
4542.00	H	36	*	4.7	34.2	-40.1	0.0	34.8	55.3	500.0	-19.1
4542.00	V	36	*	4.7	34.2	-40.1	0.0	34.8	55.3	500.0	-19.1
5450.40	H	34.3	*	5.2	35.0	-40.2	0.0	34.2	51.4	500.0	-19.8
5450.40	V	34.3	*	5.2	35.0	-40.2	0.0	34.2	51.4	500.0	-19.8
6358.80	H	34.6	*	5.6	35.5	-40.1	0.0	35.6	60.3	500.0	-18.4
6358.80	V	35.1	*	5.6	35.5	-40.1	0.0	36.1	63.9	500.0	-17.9
7267.20	H	34	*	6.1	35.7	-40.1	0.0	35.8	61.5	500.0	-18.2
7267.20	V	34	*	6.1	35.7	-40.1	0.0	35.8	61.5	500.0	-18.2
8175.60	H	35.3	*	6.5	35.8	-40.0	0.0	37.7	76.6	500.0	-16.3
8175.60	V	39.6		6.5	35.8	-40.0	0.0	42.0	125.7	500.0	-12.0
9084.00	H	34.3	*	6.5	36.3	-39.7	0.0	37.4	74.4	500.0	-16.5
9084.00	V	34.4	*	6.5	36.3	-39.7	0.0	37.5	75.3	500.0	-16.4

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 916MHz
Carrier Frequency	916MHz
Parameters	Peak Measurements
Notes	None

Frequency (MHz)	Ant Pol	Meter Reading (dBµV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total (dBµV/m) at 3m	Peak Total (µV/m) at 3 m	Peak Limit (µV/m) at 3 m	Margin (dB)
916.000	H	57.7		2.1	26.4	0.0	86.2	20366.3	50000.0	-7.8
916.000	V	60.0		2.1	26.4	0.0	88.4	26418.7	50000.0	-5.5
1832.000	H	51.9	*	2.9	30.9	-40.8	44.9	176.2	5000.0	-29.1
1832.000	V	51.3	*	2.9	30.9	-40.8	44.3	164.0	5000.0	-29.7
2748.000	H	54.0		3.7	32.6	-40.4	49.9	313.4	5000.0	-24.1
2748.000	V	54.0		3.7	32.6	-40.4	49.9	313.4	5000.0	-24.1
3664.000	H	49.0	*	4.3	33.2	-40.3	46.3	205.4	5000.0	-27.7
3664.000	V	49.0	*	4.3	33.2	-40.3	46.2	203.5	5000.0	-27.8
4580.000	H	50.3	*	4.7	34.3	-40.1	49.3	291.3	5000.0	-24.7
4580.000	V	50.8		4.7	34.3	-40.1	49.7	307.1	5000.0	-24.2
5496.000	H	49.4	*	5.2	35.0	-40.2	49.4	294.1	5000.0	-24.6
5496.000	V	49.6	*	5.2	35.0	-40.2	49.5	299.5	5000.0	-24.5
6412.000	H	50.3	*	5.7	35.5	-40.1	51.4	370.0	5000.0	-22.6
6412.000	V	49.8	*	5.7	35.5	-40.1	50.9	351.0	5000.0	-23.1
7328.000	H	49.8	*	6.2	35.7	-40.1	51.6	378.3	5000.0	-22.4
7328.000	V	49.8	*	6.2	35.7	-40.1	51.6	378.3	5000.0	-22.4
8244.000	H	50.4	*	6.5	35.9	-39.9	52.9	440.7	5000.0	-21.1
8244.000	V	52.1		6.5	35.9	-39.9	54.5	531.0	5000.0	-19.5
9160.000	H	49.3	*	6.6	36.3	-39.7	52.5	421.7	5000.0	-21.5
9160.000	V	49.9	*	6.6	36.3	-39.7	53.1	454.5	5000.0	-20.8

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 916MHz
Carrier Frequency	916MHz
Parameters	Average Measurements
Notes	None

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total (dBuV/m) at 3m	Average Total (uV/m) at 3 m	Average Limit (uV/m) at 3 m	Margin (dB)
1832.00	H	35.8	*	2.9	30.9	-40.8	0.0	28.8	27.7	500.0	-25.1
1832.00	V	35.8	*	2.9	30.9	-40.8	0.0	28.8	27.7	500.0	-25.1
2748.00	H	45.3		3.7	32.6	-40.4	0.0	41.2	115.0	500.0	-12.8
2748.00	V	47.1		3.7	32.6	-40.4	0.0	43.0	141.4	500.0	-11.0
3664.00	H	34.3	*	4.3	33.2	-40.3	0.0	31.5	37.7	500.0	-22.5
3664.00	V	34.2	*	4.3	33.2	-40.3	0.0	31.4	37.2	500.0	-22.6
4580.00	H	35	*	4.7	34.3	-40.1	0.0	33.9	49.8	500.0	-20.0
4580.00	V	37.2		4.7	34.3	-40.1	0.0	36.1	64.2	500.0	-17.8
5496.00	H	34.1	*	5.2	35.0	-40.2	0.0	34.0	50.3	500.0	-19.9
5496.00	V	34.1	*	5.2	35.0	-40.2	0.0	34.0	50.3	500.0	-19.9
6412.00	H	34.8	*	5.7	35.5	-40.1	0.0	35.9	62.2	500.0	-18.1
6412.00	V	34.8	*	5.7	35.5	-40.1	0.0	35.9	62.2	500.0	-18.1
7328.00	H	34	*	6.2	35.7	-40.1	0.0	35.8	61.7	500.0	-18.2
7328.00	V	34	*	6.2	35.7	-40.1	0.0	35.8	61.7	500.0	-18.2
8244.00	H	35.6	*	6.5	35.9	-39.9	0.0	38.1	79.9	500.0	-15.9
8244.00	V	43.3		6.5	35.9	-39.9	0.0	45.8	193.9	500.0	-8.2
9160.00	H	34.6	*	6.6	36.3	-39.7	0.0	37.8	77.7	500.0	-16.2
9160.00	V	34.6	*	6.6	36.3	-39.7	0.0	37.8	77.7	500.0	-16.2

25. Band-Edge Compliance

Test Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model	CRZB
Serial No	Unit 1
Modes	ZWave Tx @ 908.4MHz ZWave Tx @ 916MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/a
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test site used	Room 21
Notes	None

Requirements
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209 and RSS-GEN, whichever is the lesser attenuation.

Procedures

Low Band Edge

1) The EUT was setup inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the low band-edge.
4) The EUT was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:
   a. Center frequency = low band-edge frequency.
   b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
   c. Resolution bandwidth (RBW) ≥ 1% of the span.
   d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
   e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)
   f. The analyzer's display was plotted using a 'screen dump' utility.

High Band Edge

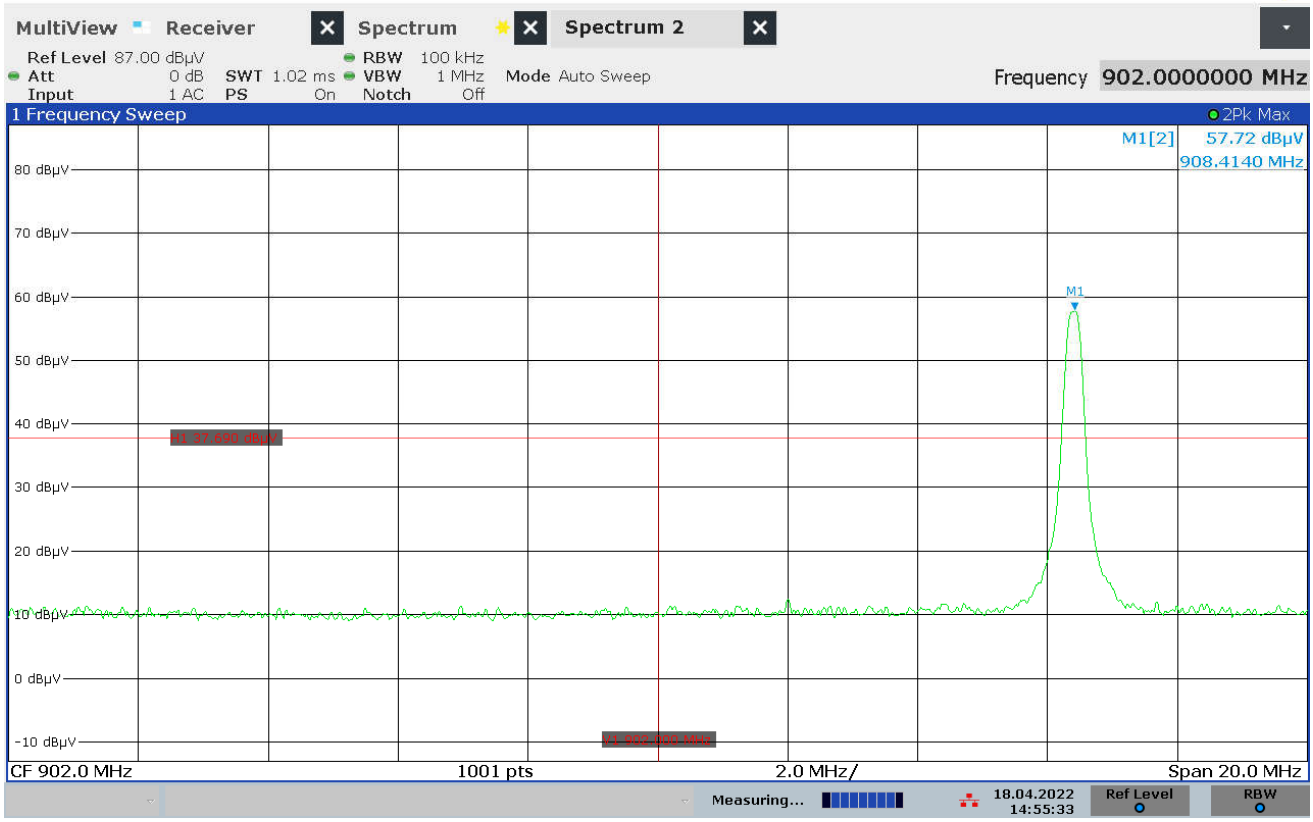
1) The EUT was setup inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the high band-edge.

4) The EUT was maximized for worst case emissions at the measuring antenna.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:

a. Center frequency = high band-edge frequency.
b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
c. Resolution bandwidth (RBW) ≥ 1% of the span.
d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the right of the center frequency (band-edge) must be below the display line.)
f. The analyzer's display was plotted using a 'screen dump' utility.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 908.4MHz
Carrier Frequency	908.4MHz
Parameters	Low Band-Edge
Notes	None



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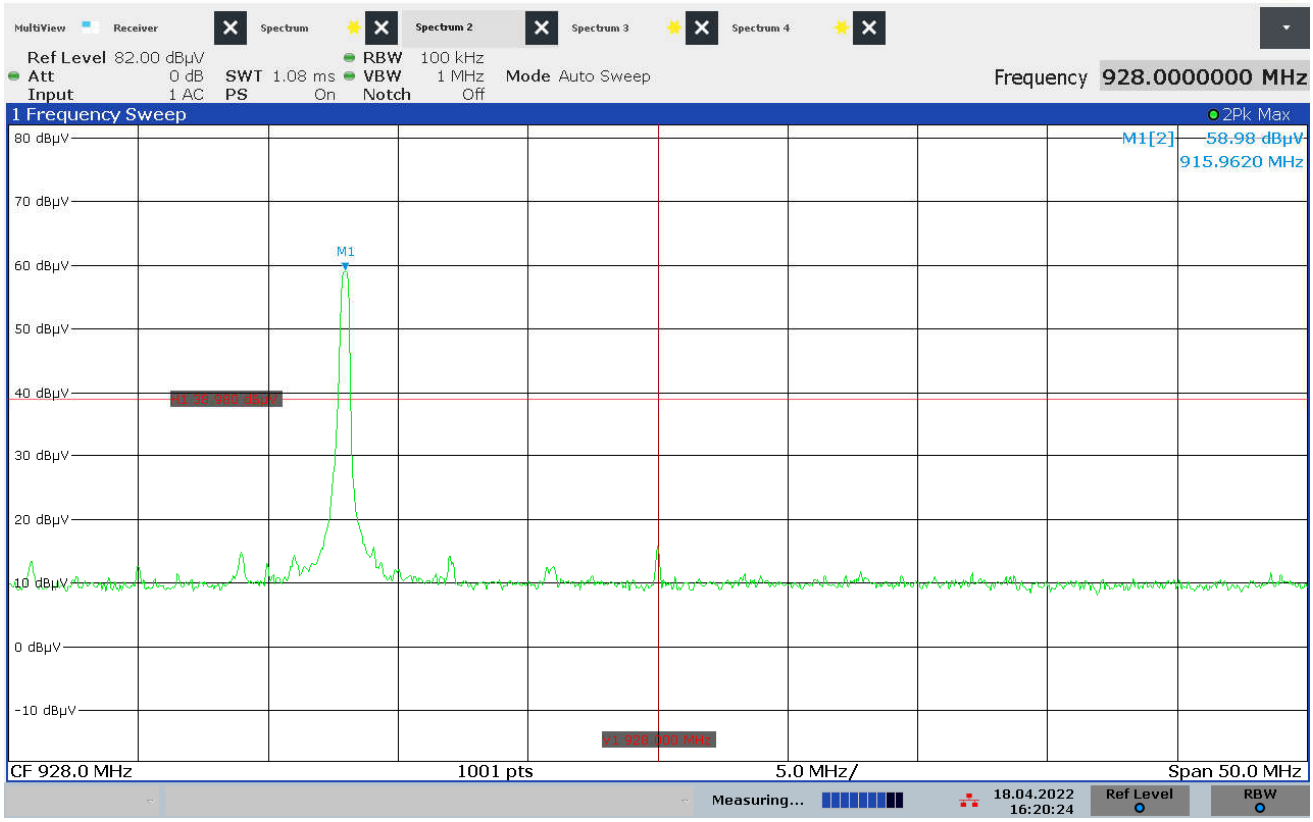
Test Details	
Manufacturer	Spring Window Fashions LLC
Model	CRZB
S/N	Unit 1
Mode	ZWave Tx @ 916MHz
Carrier Frequency	916MHz
Parameters	High Band-Edge
Notes	None



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26. Module Integration – Emissions Test

EUT Information	
Manufacturer	Spring Window Fashions LLC
Product	Cellular Window Shade
Model No.	CRZB
Serial No.	Unit 1
Modes	BLE Tx Ch0 @ 2402MHz BLE Tx Ch19 @ 2440MHz BLE Tx Ch39 @ 2480MHz MultiTx

Test Site Information	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	Room 21
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
Per 996369 D04 Module Integration Guide v01: Testing of the host product with all the transmitters installed is recommended, to verify that the host product meets all the applicable FCC rules. The radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). The testing shall also check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. No emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). FCC 15.247: In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles and anechoic absorber material is installed over the ferrite tiles. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3-meter distance from the EUT. The entire frequency range from 30MHz to 18.0GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 18.0GHz.

1) For all harmonics not in the restricted bands, the following procedure was used:

   a) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

   b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

   c) To ensure that maximum or worst-case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:

      i. The EUT was rotated so that all of its sides were exposed to the receiving antenna.

      ii. Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

      iii. The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

      iv. In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.

   d) All harmonics not in the restricted bands must be at least 20dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:

   a) The field strengths of all emissions below 1GHz were measured using a bi-log antenna. The bilog antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.

   b) The field strengths of all emissions above 1GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 1MHz was used on the spectrum analyzer.

c) To ensure that maximum (or worst case) emission levels were measured, the following steps were taken when taking all measurements:

   i. The EUT was rotated so that all of its sides were exposed to the receiving antenna.

   ii. Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

   iii. The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

   iv. In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded.

d) For all radiated emissions measurements below 1GHz, if the peak reading is below the limits listed in §15.209(a), no further measurements are required. If, however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

e) For all radiated emissions measurements above 1GHz, the peak readings must comply with the §15.35(b) limits. §15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1GHz must be no greater than 20dB above the limits specified in §15.209(a).

f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector and an average reading was taken.