

COMPLIANCE WORLDWIDE INC. TEST REPORT 197-20

In Accordance with the Requirements of
FCC PART 15.209, SUBPART C
INDUSTRY CANADA RSS-210, ISSUE 10

Low Power License-Exempt Radio Communication Devices
Intentional Radiators

Issued to
Rockwell Automation
2 Executive Drive
Chelmsford, MA 01824

for the
Guardmaster Safety Switch
440G-MZ

FCC ID: USM-440G-MZ
IC: 26075-440GMZ

Report Issued on April 30, 2020

Tested by



Brian F. Breault

Reviewed by



Larry K. Stillings

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1. Scope

This test report certifies that the Guardmaster Safety Switch 440G-MZ, as tested, meets the FCC Part 15.209, and ISED Canada RSS-210 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required.

2. Product Details

2.1. Manufacturer:	Rockwell Automation
2.2. Model Number:	440G-MZS20SNRJ, 440G-MZS20UNRJ, 440G-MZS20SNLJ, 440G-MZS20UNLJ
2.3. Serial Numbers:	77051867
2.4. Description:	This 440G-MZ Guardmaster® Guard Locking Switch locks a guard door in the closed position and does not release it until the hazardous machine functions that are covered by the guard are in a safe condition.
2.5. Power Source:	24 VDC
2.6. Hardware Revision:	N/A
2.7. Software Revision:	v1.001.003
2.8. Modulation Type:	Pulse Modulation
2.9. Operating Frequencies:	125 kHz
2.10. EMC Modifications:	None

3. Product Configuration

3.1. Operational Characteristics & Software

Once powered is applied to the product via the support equipment the EUT is configured to transmit continuously.

3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Volts	Freq (Hz)	Description/Function
Rockwell Automation	440G-MZ	77051867	24	VDC	125 kHz Prox Card Reader

3.3. EUT Cables/Transducers

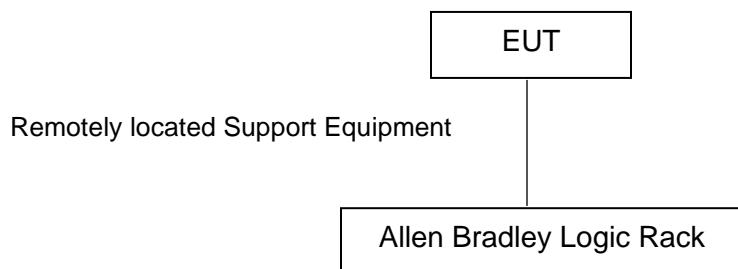
Cable Type	Length	Shield	From	To
DC Power I/O	Yes	10M	EUT	Support Equipment

3. Product Configuration (continued)

3.4. Support Equipment

Device	Manufacturer	Model	Serial #
Logic Rack	Allen Bradley		
1606-XLP Power Supply			
GSR-EIP			
GSR-DG			
TLSZR-GD2			
440S-SF8D			

3.5. Block Diagram



4. Measurements Parameters

4.1. Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Test Receiver, 9kHz - 7GHz ¹	Rohde & Schwarz	ESR7	101156	9/10/2020	2 Years
EMI Test Receiver, 10 Hz - 7GHz ¹	Rohde & Schwarz	ESR7	101770	10/3/2020	2 Years
Loop Antenna 9 kHz - 30 MHz	EMCO	6512	9309-1139	1/28/2022	3 Years
Loop Antenna 20 Hz - 5 MHz	ETS-Lindgren	6511	00108119	1/28/2022	3 Years
Biconilog Antenna, 30 MHz - 2 GHz	Sunol Sciences	JB1	A050913	6/5/2022	2 Years
Digital Barometer	Control Company	4195	ID236	4/3/2021	3 Years

¹ ESR7 Firmware revision: V3.48, Date installed: 10/17/2019

Previous V3.46, installed 12/5/2018.

Manufacturer	Software Description	Title or Model #	Rev.	Report Sections
Compliance Worldwide	Test Report Generation Software	Test Report Generator	1.0	Used to process conducted emissions data

4.2. Measurement & Equipment Setup

Test Dates:	April 17 th – April 21 st , 2020
Test Engineer:	Sean Defilice
Normal Site Temperature (15 - 35°C):	24.0
Relative Humidity (20 -75%RH):	33%
Frequency Range:	9 kHz to 1 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 10 to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	>= 3 * RBW
Detector Function:	Peak, QP - 30 MHz to 1 GHz Peak, Avg - Above 1 GHz Unless otherwise specified.

4.3 Measurement Procedure

The test measurements contained in this report are based on the requirements detailed in FCC Part 15, Subpart C - Intentional Radiators, notably Section 15.209, Radiated emission limits; general requirements, ISED Canada RSS-210, Issue 10 and ANSI C63.10:2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

5. Choice of Equipment for Test Suites

5.1. Choice of Model

This test report is based on the test samples supplied by the manufacturer and are reported by the manufacturer to be equivalent to the production units.

5.2. Presentation

The test sample was tested complete with all required ancillary equipment. Refer to Section 3 of this report for the product equipment configuration.

5.3. Choice of Operating Frequencies

The transmitter in the unit under test utilizes a single operating frequency at approximately 125 kHz.

6. Measurements Summary

Test Requirement	FCC Rule Requirement	ISED Rule Requirement	Report Section	Result
Antenna requirement	15.203	RSS-GEN 6.8	7.1	Compliant
Radiated Field Strength of Fundamental	15.209(a)	RSS-GEN Table 5	7.2	Compliant
Emission Bandwidth	15.209 Not Specified	Not Specified	7.3	Compliant
99% (Occupied) Bandwidth	Not Specified	RSS-GEN 6.7	7.4	Compliant
Combined Spurious Harmonic Emissions	15.209	RSS-210 A8.9	7.5	Compliant
Spurious Radiated Emissions	15.209	RSS-210 A8.9	7.6	Compliant
Power Line Conducted Emissions	15.207	RSS-GEN 8.8	7.7	Not Applicable
Public Exposure to Radio Frequency Energy Levels.	1.1307 (b)(1)	RSS 102, Issue 5	7.8	Compliant

7. Measurement Data

7.1. Antenna Requirement (15.203, RSS-GEN, ISSUE 5 Section 6.8)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

Status: For the 125 kHz transmitter, the device under test utilizes an internal, PCB mounted coil antenna. There is no user access to this antenna.

7.2. Radiated Field Strength of Fundamental (15.209, Section (a), RSS-GEN Table 6)

Requirement: Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

For 125 kHz: Field Strength (μ V/m) = $2400/F(\text{kHz})$ at 300 meters.

Field Strength (μ V/m) = $2400/125.000$

Field Strength (μ V/m) = 19.20

Field Strength ($\text{dB}\mu\text{V}/\text{m}$) = $20 \log_{10}(19.20)$

Field Strength ($\text{dB}\mu\text{V}/\text{m}$) = 25.67 at 300 meters.

For 125 kHz: Field Strength (μ A/m) = $6.37/F(\text{kHz})$ at 300 meters.

Field Strength (μ A/m) = $6.37/125.000$

Field Strength (μ A/m) = 0.0510

Field Strength ($\text{dB}\mu\text{A}/\text{m}$) = $20 \log_{10}(0.0510)$

Field Strength ($\text{dB}\mu\text{A}/\text{m}$) = -25.86 at 300 meters.

Test Notes: From 110 kHz to 490 kHz, the field strength limit employs an average detector (FCC Part 15.209(d), RSS-GEN Table 6).

Reference ANSI C63.10-2013 sections 5.3.2 and 6.4.4.2. The following formula was used to extrapolate the measurement distance to the limit distance:

$$FS_{\text{limit}} = FS_{\text{max}} - 40 \log\left(\frac{d_{\text{near field}}}{d_{\text{measure}}}\right) - 20 \log\left(\frac{d_{\text{limit}}}{d_{\text{near field}}}\right) \quad \text{Equation 1}$$

FS_{limit} is the calculation of field strength at the limit distance ($\text{dB}\mu\text{V}/\text{m}$) -42.84

FS_{max} is the measured field strength, expressed in ($\text{dB}\mu\text{V}/\text{m}$) (average) 37.16

$d_{\text{near field}}$ is the $\lambda/2\pi$ distance (Meters) 381.97

d_{measure} is the distance of the measurement point from the EUT (Meters) 3.00

d_{limit} is the reference limit distance (Meters) 300.00

Since $d_{\text{near field}}$ is greater than d_{limit} , the measurement formula was simplified to:

$$FS_{\text{limit}} = FS_{\text{max}} - 40 \log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right).$$

Results: Compliant

7. Measurement Data (continued)

7.2. Radiated Field Strength of Fundamental (15.209, Section (a), RSS-GEN Table 6)

7.2.1. Worst Case Radiated Field Strength of Fundamental

Freq. (MHz)	Amplitude ¹ (dB μ V/m)	Duty Cycle Correction ²	Corr. Ampl. ² (dB μ V/m)	FCC 15.209 Limit (dB μ V/m) (Average)	Margin (dB)	Ant Position	Ant Height	Turntable Azimuth	Result
	Average	dB	Average			Par/Per	cm	Deg	
0.125000	-42.84	0.00	-42.84	25.67	-68.51	Par	100	350	Compliant

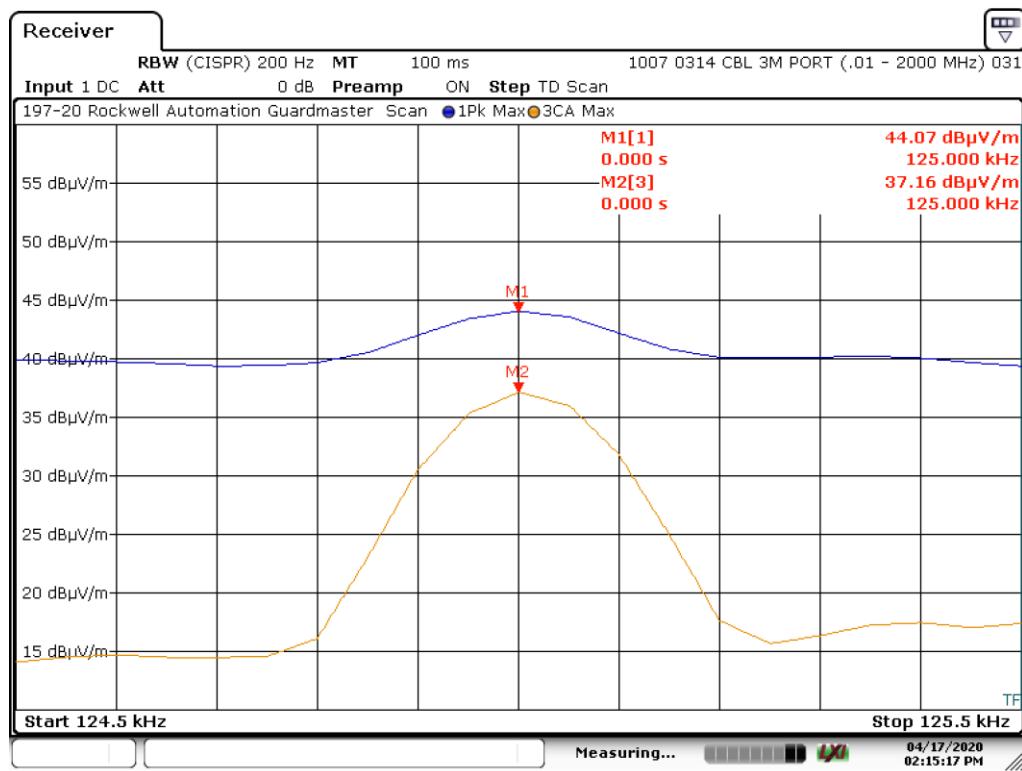
¹ Measurement has been extrapolated from 3 meters to 300 meters using Equation 1 on the previous page.

² The test signal was transmitting at close to a 100% duty cycle. Therefore, a correction factor to the peak field strength as not necessary.

$$\text{dB μ A/m} = \text{dB μ V/m} - 51.5$$

Freq. (MHz)	Amplitude ¹ (dB μ A/m)	Duty Cycle Correction ²	Corr. Ampl. ² (dB μ A/m)	ISED RSS- GEN Limit (dB μ A/m) (Average)	Margin (dB)	Ant Position	Ant Height	Turntable Azimuth	Result
	Average	dB	Average			Par/Per	cm	Deg	
0.125000	-60.03	0.00	-60.03	-25.86	-34.17	Par	100	350	Compliant

7.2.2. Worst Case Radiated Field Strength of Fundamental



Date: 17.APR.2020 14:15:18

Test Number: 197-20
Issue Date: 4/30/2020

7. Measurement Data (continued)

7.3. Emission Bandwidth (FCC Sections 15.209, RSS-210 Section A2.3)

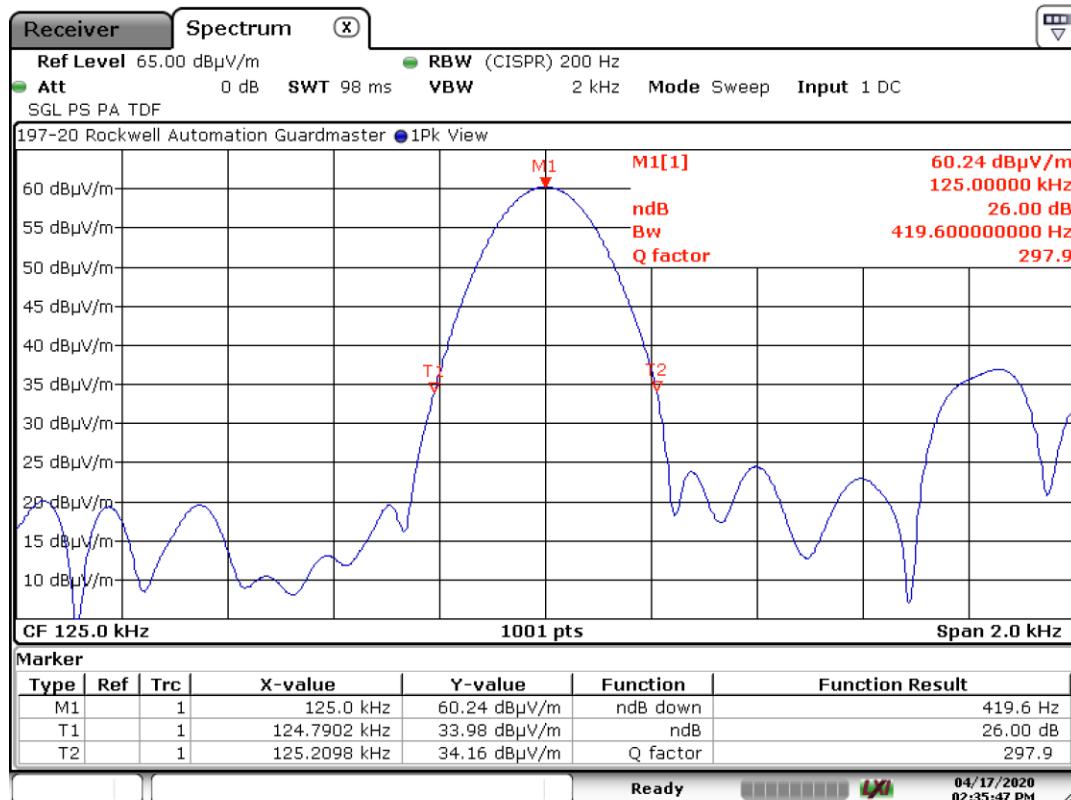
Requirement: For FCC Part 15.209, the bandwidth requirement is not specified. The 26 dB bandwidth has been included as part of this test report.

Test Note: Reference ANSI C63.10-2013, Section 6.9.1. for the bandwidth measurement method.

7.3.1. -26 dB Bandwidth of the Fundamental Frequency

Fundamental Frequency (MHz)	-26 dB Bandwidth (kHz)	Required Bandwidth (kHz)	Result
0.125	0.4196	Not Specified	N/A

7.3.2. Emission Bandwidth Measurement Results



Date: 17.APR.2020 14:35:48

7. Measurement Data (continued)

7.4. 99% (Occupied) Bandwidth (RSS-GEN Section 6.7)

Requirement: The requirement for the occupied bandwidth is not specified for intentional radiators in this part of the frequency spectrum.

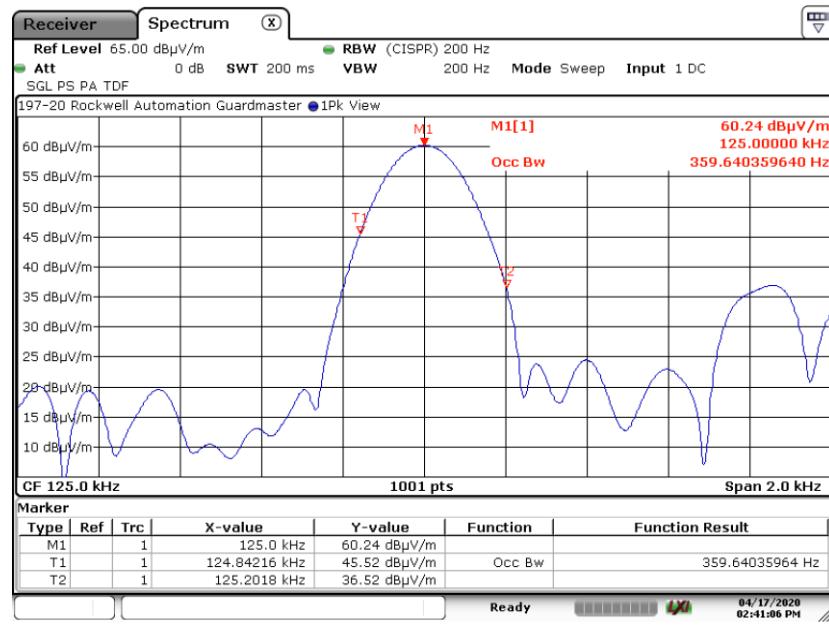
Test Note: RSS-Gen states that the transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. However the resolution and video bandwidths were not able to meet these criteria due to the low measurement frequency and limitations of the measurement receiver. To perform this measurement, the following settings were used:

Resolution Bandwidth : 200 Hz

7.4.1. 99% (Occupied) Bandwidth of the Fundamental Frequency

Frequency (MHz)	99% Power Bandwidth (kHz)
0.125	0.35964

7.4.2. 99% Power Bandwidth Measurement Results



Date: 17.APR.2020 14:41:06

7. Measurement Data (continued)

7.5. Combined Spurious Harmonic Emissions (FCC Part 15.209, RSS-210 A8.9)

Requirement: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (reference Section 15.205(c)).

Test Note: The following table represents the worst case measurement of each harmonic emission.

Resolution Bandwidth: 9 kHz
Video Bandwidth : 30 kHz

Results: Compliant

Freq. (MHz)	Measured Field Strength (dB μ V/m)		Limit (dB μ V/m)		Margin (dB μ V/m) ²		w/c Antenna Position (Par/Per G Par)	Turntable Position (Deg)	Result
	Peak	Quasi-Pk ¹	Peak	Quasi-Pk	Peak	Quasi-Pk			
0.250	46.55	33.12	119.64	99.64	-66.88	-57.32	Par	308	Compliant
0.375	44.03	31.98	116.12	96.12	-67.00	-58.76	Par	345	Compliant
0.500	55.45	53.03	93.63	73.63	-45.79	-33.12	Par	182	Compliant
0.625	43.70	32.29	91.69	71.69	-44.26	-32.37	Par	16	Compliant
0.750	43.17	32.33	90.11	70.11	-48.06	-30.74	Par	310	Compliant
0.875	42.89	31.88	88.78	68.78	-44.11	-29.44	Par	256	Compliant
1.000	43.66	33.59	87.62	67.62	-43.96	-28.27	Par	185	Compliant
1.125	43.11	32.07	86.60	66.60	-38.18	-24.23	Par	262	Compliant
1.250	43.78	31.94	85.69	65.69	-42.26	-26.76	Par	290	Compliant

¹ The measurements made at 250 kHz and 375 kHz utilized a CISPR average detector.

7. Measurement Data (continued)

7.6. Spurious Radiated Emissions (15.209), RSS-GEN 8.9

Requirement: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Regulatory Limits: FCC Part 15.209

Frequency Range (MHz)	Distance (Meters)	Limit (dB μ V/m) ¹
0.009 to 0.490	3	128.5 to 93.8
0.490 to 1.705	3	73.8 to 63.0
1.705 to 30	3	69.5
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
>960	3	54.0

¹ Measurements in the 9 to 90 kHz, 110 to 490 kHz and above 1000 MHz ranges employ an average detector. Otherwise a quasi-peak detector is used.

Regulatory Limits: ISED RSS-GEN 8.9

Frequency Range (MHz)	Distance (Meters)	Limit (μ A/m) ¹	Limit (dB μ A/m) ¹
0.009 to 0.490	300	6.37 / (F in kHz)	-3.00 to -37.72
0.490 to 1.705	30	63.7 / (F in kHz)	-17.72 to -28.55
1.705 to 30	30	0.08	-21.94

¹ Measurements in the 9 to 90 kHz, 110 to 490 kHz employ a linear average detector. Otherwise a quasi-peak detector is used.

Procedure: Test measurements were made in accordance with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices.

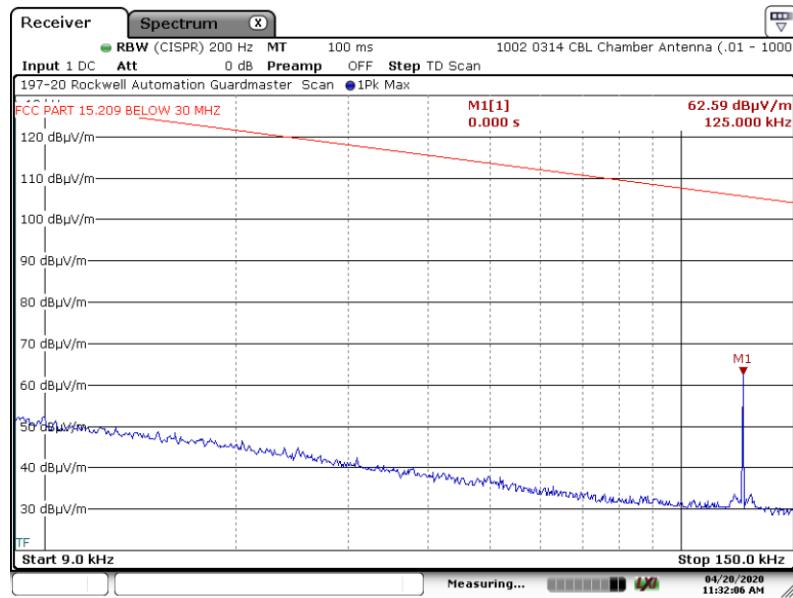
Results: Compliant. The device under test met the spurious radiated emissions requirements.

7. Measurement Data (continued)

7.6. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9 (continued)

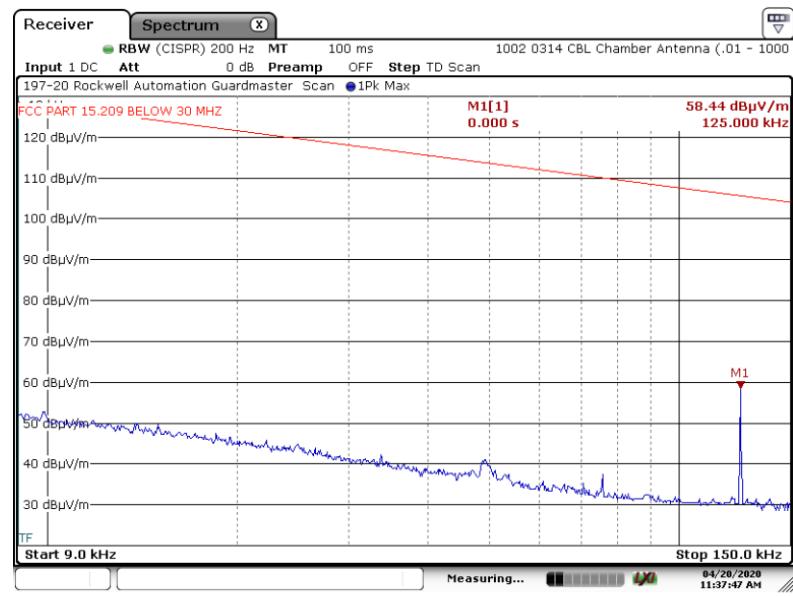
7.6.1. 9 kHz to 150 kHz

6.6.1.1. Parallel Receive Antenna Orientation



Date: 20.APR.2020 11:32:07

7.6.1.2. Perpendicular Receive Antenna Orientation



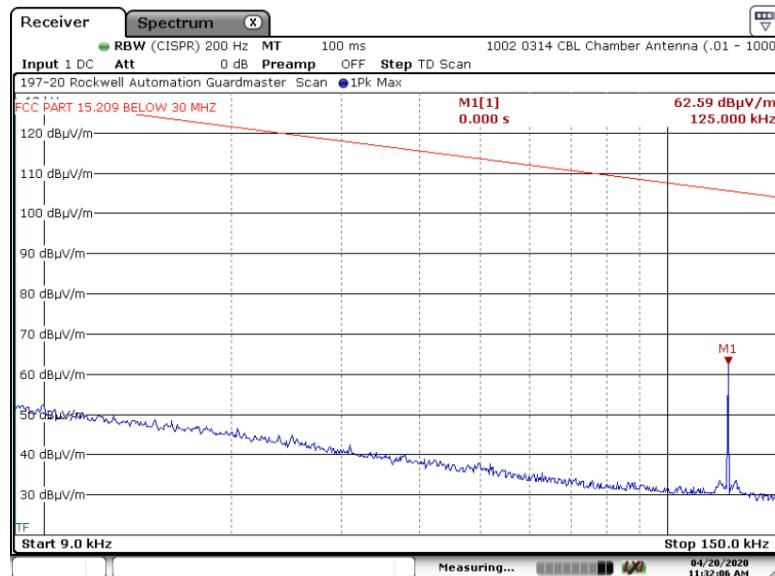
Date: 20.APR.2020 11:37:47

7. Measurement Data (continued)

7.6. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9 (continued)

7.6.1. 9 kHz to 150 kHz

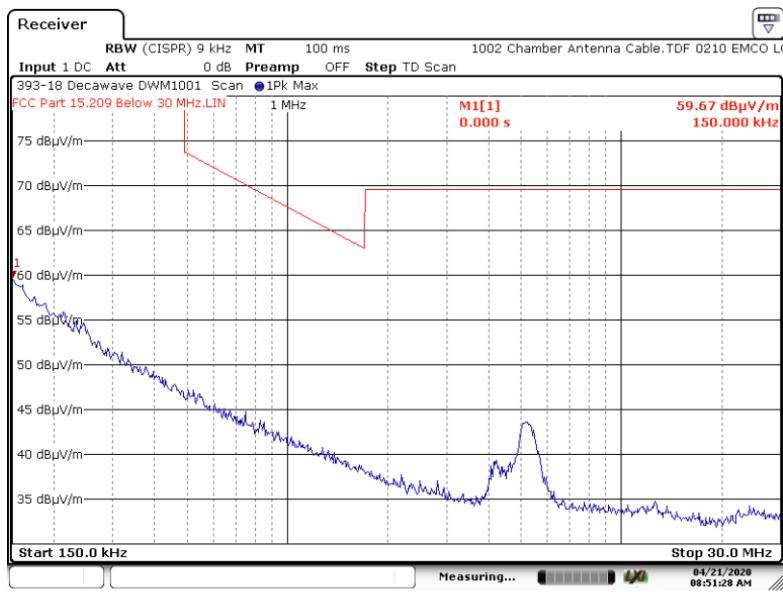
7.6.1.3. Ground Parallel Receive Antenna Orientation



Date: 20.APR.2020 11:32:07

7.6.2. 150 kHz to 30 MHz

6.6.2.1. Parallel Receive Antenna Orientation



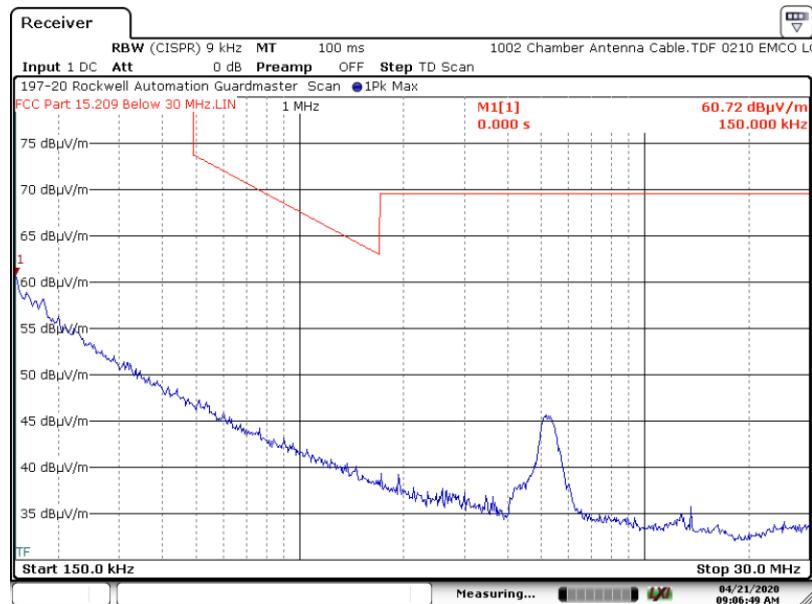
Date: 21.APR.2020 08:51:28

Test Number: 197-20
Issue Date: 4/30/2020

7. Measurement Data (continued)

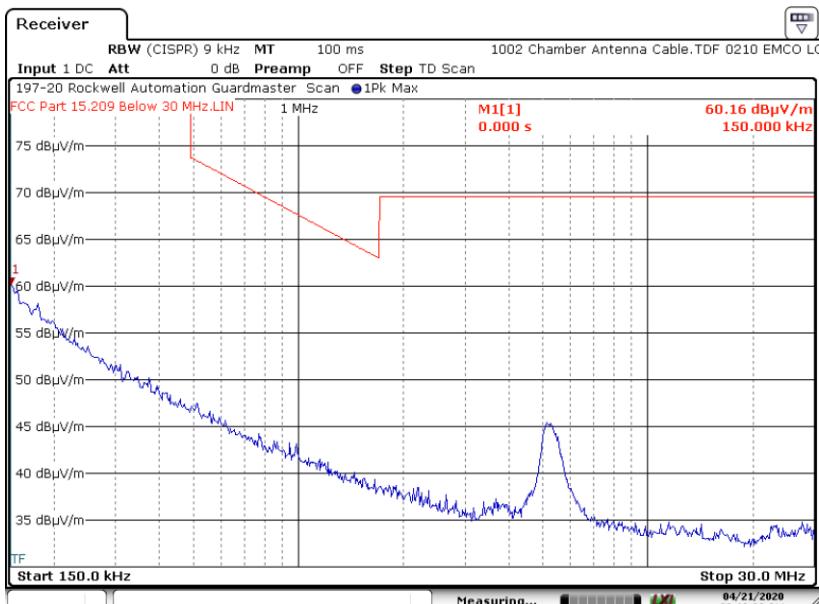
7.6. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9 (continued)

7.6.2.2. Perpendicular Receive Antenna Orientation

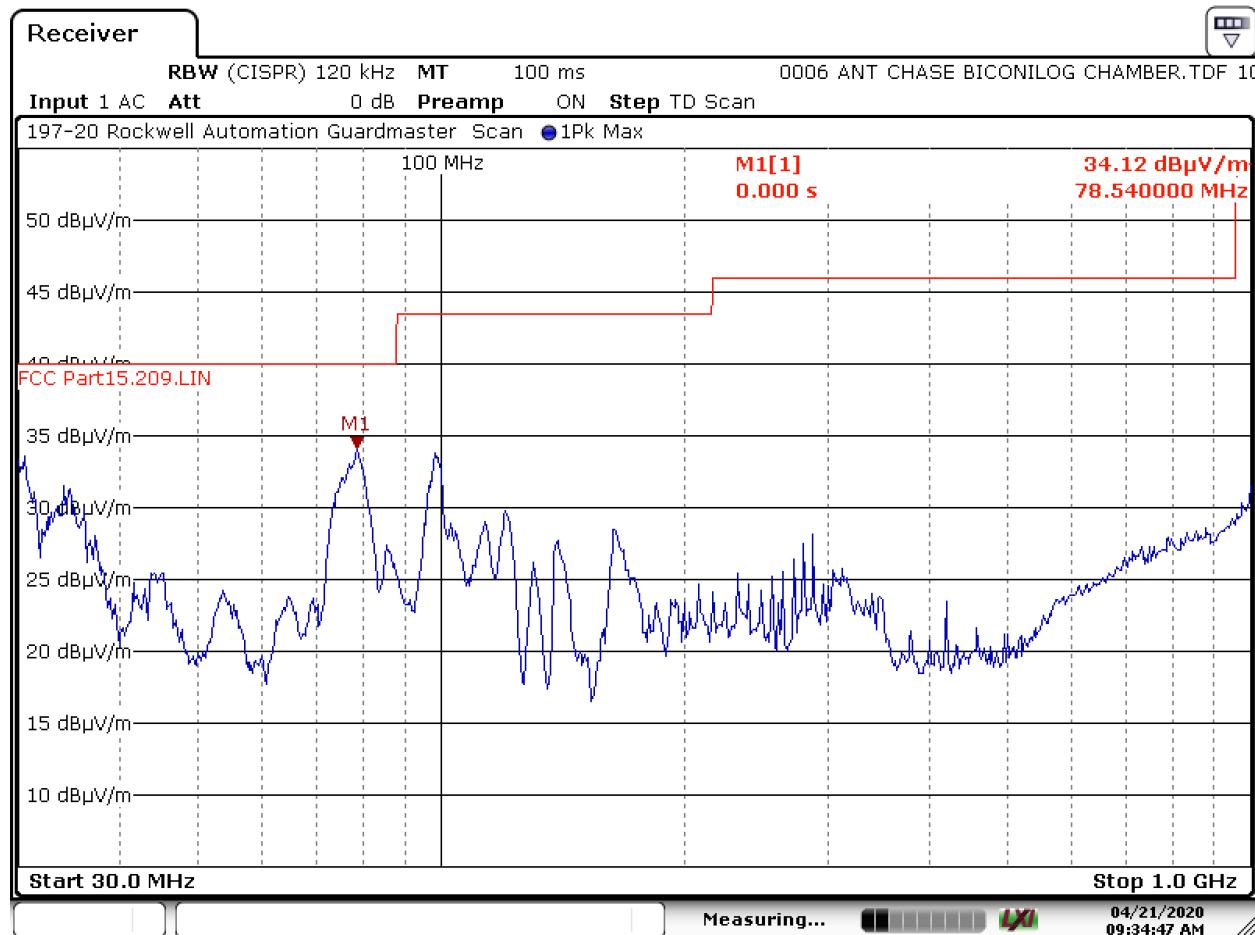


Date: 21.APR.2020 09:06:50

7.6.2.3. Ground Parallel Receive Antenna Orientation



Date: 21.APR.2020 09:13:00

7. Measurement Data (continued)
7.6. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9 (continued)
6.6.3. 30 MHz to 1 GHz
6.6.3.1. Horizontal Polarity


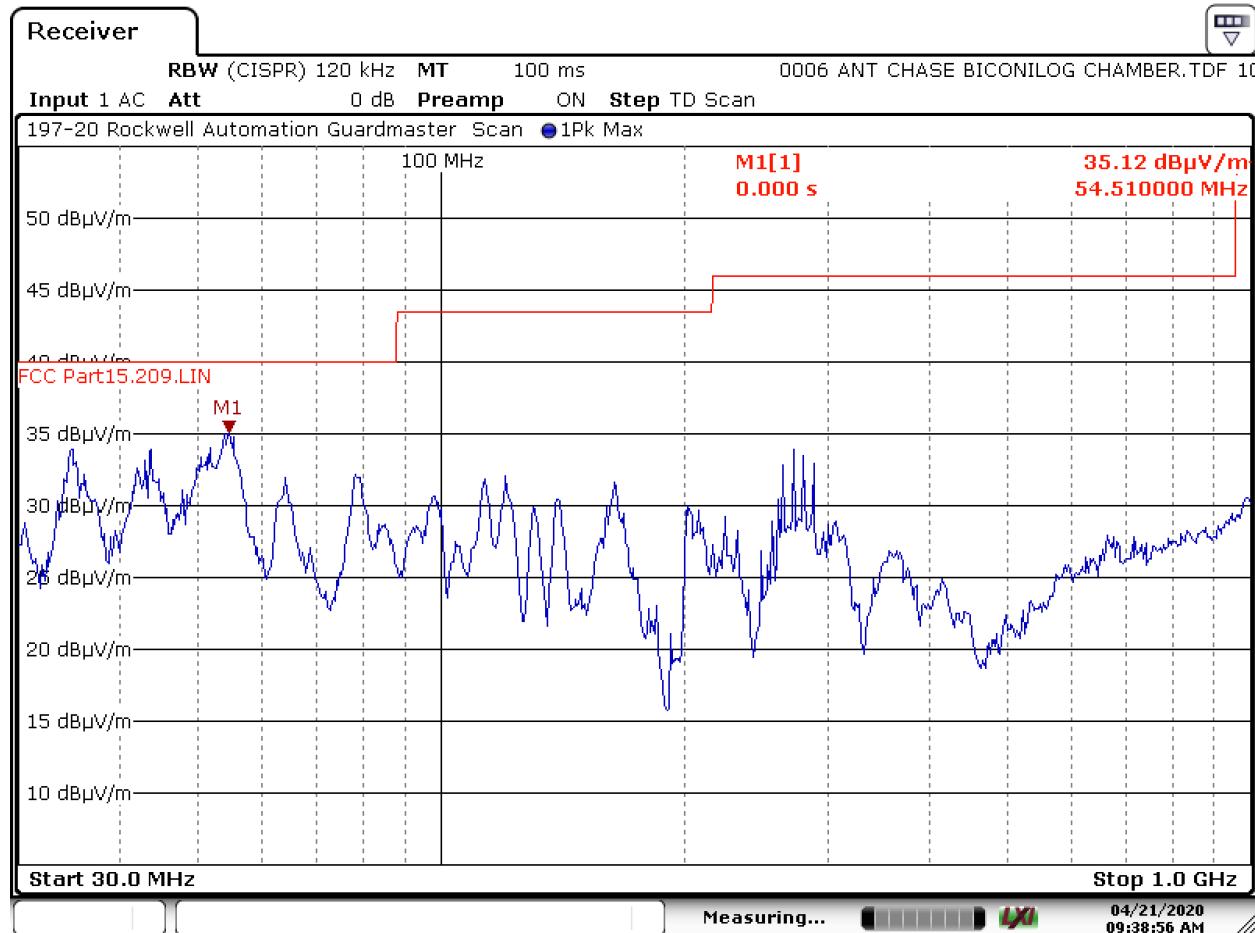
Date: 21.APR.2020 09:34:47

7. Measurement Data (continued)

7.6. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9 (continued)

7.6.3. 30 MHz to 1 GHz

7.6.3.2. Vertical Polarity



Date: 21.APR.2020 09:38:56

7. Measurement Data (continued)

7.7. Power Line Conducted Emissions (15.207), RSS-GEN

Requirement: An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges. (FCC Part 15.207(a).

Regulatory Limits: FCC Part 15.207

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

Procedure: Test measurements were made in accordance with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices.

Results: N/A, the device is 24 VDC Powered

7. Measurement Data (continued)

7.8. Public Exposure to Radio Frequency Energy Levels ((FCC KDB 447498 D01 v06, 1.1307 (b)(1), 2.1091(b)) RSS-GEN, RSS 102, Issue 5

7.8.1 SAR Test Exclusion (FCC KDB 447498 D01 v06, Clause 4.3.1.c)(2))

Frequency (MHz)	MPE Distance (mm)	DUT Output Power (mW)	SAR Test Exclusion (mW)	Result
	(1)	(2)	(3)	
0.125	≤50	0.00000157	925.699	Compliant

- (1) FCC KDB 447498 D01 v06, Clause 4.3.1.(c)(2)
- (2) Converted from 3M field strength measurement ($FS_{(dB\mu V/m)} - 95.2$)
Reference Section 7.2, Measured Field Strength
- (3) $\frac{1}{2}(1 + \log(100/f_{(MHz)}))$
Formula detailed in KDB 447498 D01 v06, Clause 4.3.1.(c)(2)

7.8.2 Exemption Limits for Routine Evaluation – SAR Evaluation (RSS-102 Clause 2.5.1)

Frequency (MHz)	MPE Distance (mm)	DUT Output Power (mW)	SAR Test Exclusion (mW)	Result
	(1)	(2)	(3)	
0.125	≤5 mm	0.00000157	71.0	Compliant

- (1) RSS-102, Clause 2.5.1
- (2) Converted from 3M field strength measurement ($FS_{(dB\mu V/m)} - 95.2$)
Reference Section 7.2, Measured Field Strength
- (3) RSS-102, Clause 2.5.1, Table 1 ≤ 300 MHz = 71 mW at ≤ 5 mm

8. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0274.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 32, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

The radiated emissions test site for measurements above 1GHz is a 3 Meter open area test site (OATS) with a 3.6 by 3.6 meter anechoic absorber floor patch to achieve a quasi-free space measurement environment per ANSI C63.4/C63.10 and CISPR 16-1-4 standards.

The sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.

9. Test Setup Images

9.1. Radiated Emissions – Front View



9. Test Setup Images

9.2. Radiated Emissions – Rear View Below 30 MHz



9. Test Setup Images

9.3. Radiated Emissions – Rear View 30 MHz to 1 GHz

