Excellence in Compliance Testing

Certification Test Report

FCC ID: 2AHPO-HZM1

FCC Rule Part: 15.249

ACS Report Number: 16-2015.W06.1B

Manufacturer: ENCO Electronic Systems LLC
Model(s): HZM1

Test Begin Date: **March 7, 2016**
Test End Date: **March 29, 2016**

Report Issue Date: May 20, 2016

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

Reviewed by:

Thierry Jean-Charles
EMC Engineer
Advanced Compliance Solutions, Inc. .

This report contains 21 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations for a limited modular approval.

1.2 Product description

The ENCO Electronic Systems LLC model HZM1 is a Zwave radio module based around the Sigma Designs ZM5202 self-contained RF module. The module is used within the ENCO Electronic Systems LLC products for building management services. This test report covers the evaluation of the module when integrated within the Halo Pro A and Halo Pro B host devices.

Technical Details
Frequency of Operation: 908.4 MHz
Number of Channels: 1
Modulation: FSK
Data Rate: 40 kbps
Antenna / Gain: Printed Dipole Antenna/ 1 dBd
Input Voltage: 3.3 VDC

Manufacturer Information:
ENCO Electronic Systems LLC
PO Box 8683
Dothan, AL 36303

Test Sample Serial Number(s): N/A

Test Sample Condition: Good

1.3 Test Methodology and Considerations

The EUT was evaluated for radiated and power line conducted emissions while integrated within the Halo Pro A and the Halo Pro B host devices. The module was set to power setting 15. The host devices were configured with ferrites to meet the unintentional emissions' requirements. The details are documented in the unintentional emissions verification test report.

The Halo Pro A and Halo Pro B include a plug-in Wi-Fi transceiver (FCC ID: 2AAD8-WU112K). Both host devices were evaluated for intermodulation products generated during co-transmission between the Wi-Fi and Zwave (HZM1) transceivers. All intermodulation products were found to be incompliance to the test requirements.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

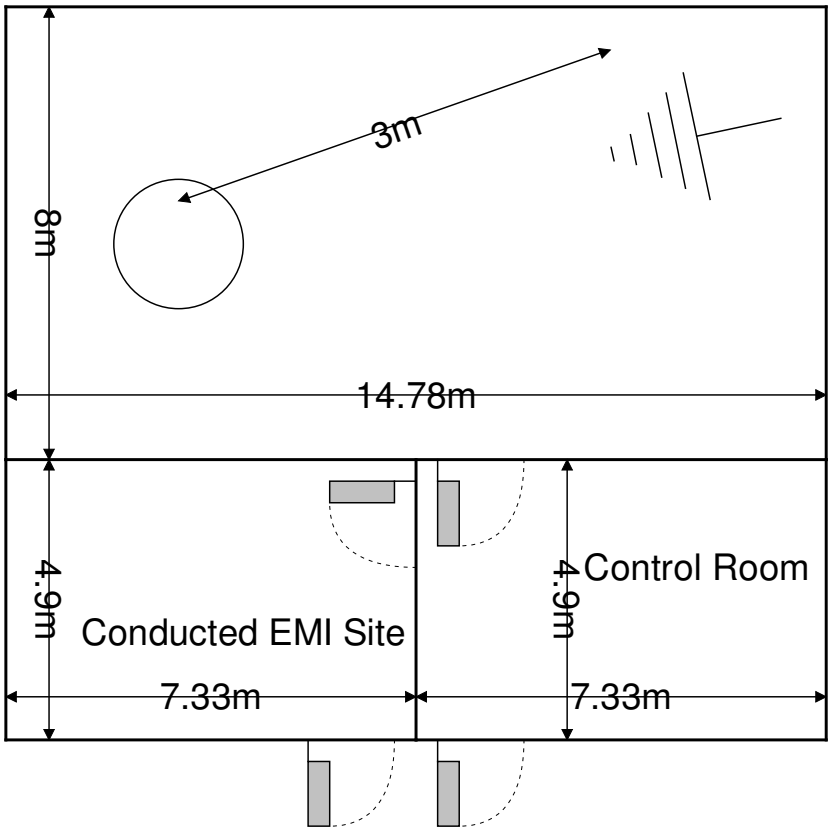


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

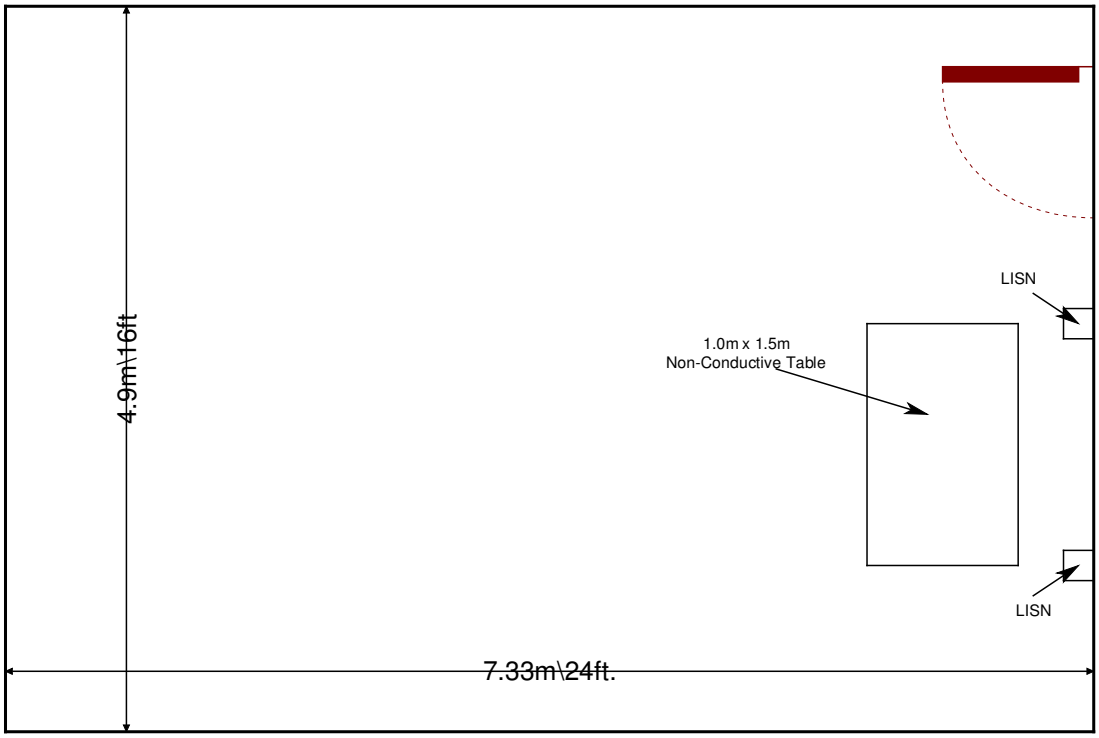


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8 December 2010.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
479	Electro-Metrics	ALP-70	Antennas	158	12/3/2015	12/3/2017
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
2002	EMCO	3108	Antennas	2147	11/19/2015	11/19/2017
2004	EMCO	3146	Antennas	1385	11/19/2015	11/19/2017
2006	EMCO	3115	Antennas	2573	4/14/2015	4/14/2017
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/18/2015	11/18/2016
2022	EMCO	LISN3825/2R	LISN	1095	9/14/2015	9/14/2017
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	11/11/2015	11/11/2016
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	11/17/2015	11/17/2016
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/16/2015	11/16/2016
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/9/2015	12/9/2016
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/22/2015	8/22/2016
3004	Teseq	CFL 9206A	Attenuators	34720	10/7/2015	10/7/2016
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR

NCR=No Calibration Required

5 SUPPORT EQUIPMENT

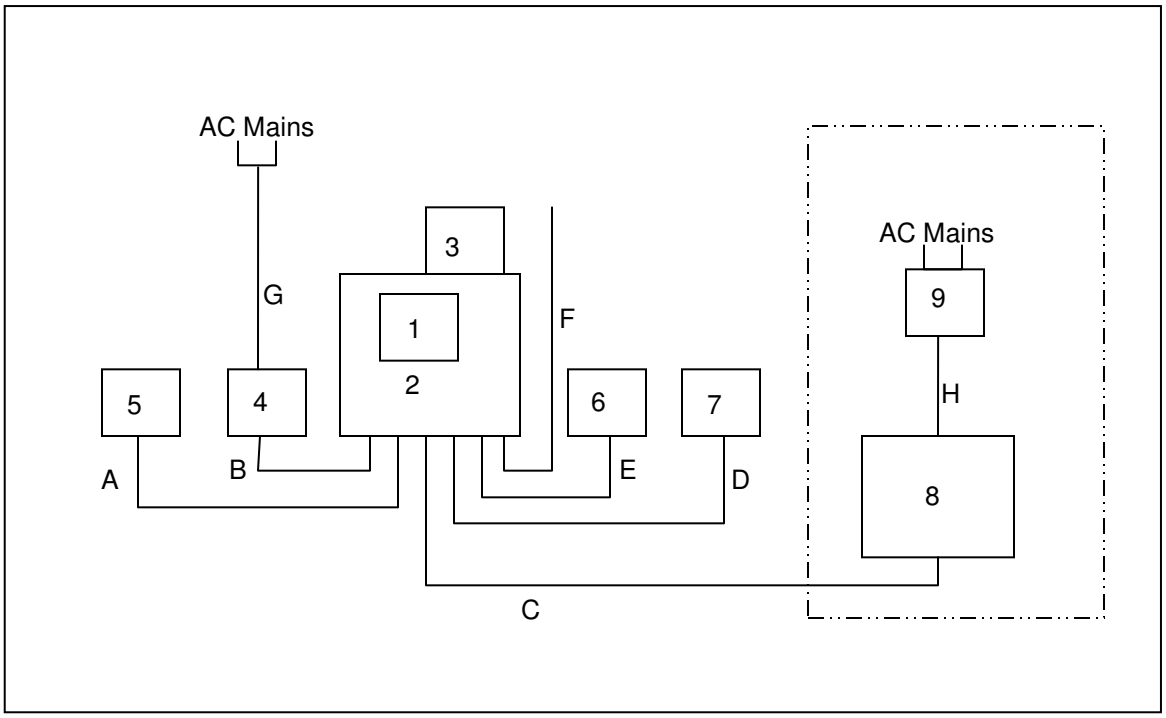
Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	ENCO Electronic Systems LLC	HZM1	N/A
2	Host	ENCO Electronic Systems LLC	Halo Pro A	ACS#16
			Halo Pro B	ACS#18
3	Wi-Fi Dongle	Haoliyuan (Shenzhen) Electronic Co., Ltd.	WU112K	ACS#2
4	5 VDC Power Supply	Phihong	PSA10F-050Q	N/A
5	Expansion Module	ENCO Electronic Systems LLC	Halo Module	ACS#19
6	Expansion Module	ENCO Electronic Systems LLC	Halo Module	ACS#20
7	Expansion Module	ENCO Electronic Systems LLC	Halo Module	ACS#21
8	Ethernet Switch	Linksys	BEFSSR41	C2171G508151
9	9 VDC Power Supply	Linksys	AM-91000A	2102-10091000R

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	2 Wire Cable	6.2 m	No	Halo Module to Halo Pro
B	USB	6.0 m	No	Power Supply to Halo Pro
C	Ethernet	10 m	No	Halo Pro to Ethernet Switch
D	2 Wire Cable	6.2 m	No	Halo Module to Halo Pro
E	2 Wire Cable	6.2 m	No	Halo Module to Halo Pro
F	2 Wire Cable	5.3 m	No	Not Terminated
G	Extension Cord	2.7 m	No	Power Supply to AC Mains
H	Power	1.85 m	No	Power Supply to Router

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



Note: The equipment within the dotted box was set outside of the test environment during the radiated emissions tests.

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses a 1 dBd (3.15 dBi) PCB Dipole Antenna. The unit uses an SMA connector at the antenna port. The module is professionally installed by ENCO Electronic Systems, LLC. A justification for professional installation is provided in the installation manual of the equipment.

7.2 20dB / 99% Bandwidth: IC RSS-Gen 6.6

7.2.1 Measurement Procedure

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected.

The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was to ≥ 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission, including the emissions skirts. The RBW was greater or equal to 1% to 5% of the occupied bandwidth. The occupied 99% bandwidth was measured by using a delta marker at the lower and upper frequencies leading to 0.5% of the total power.

7.2.2 Measurement Results

Results are shown below:

Table 7.2.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
908.4	93.0	90.0

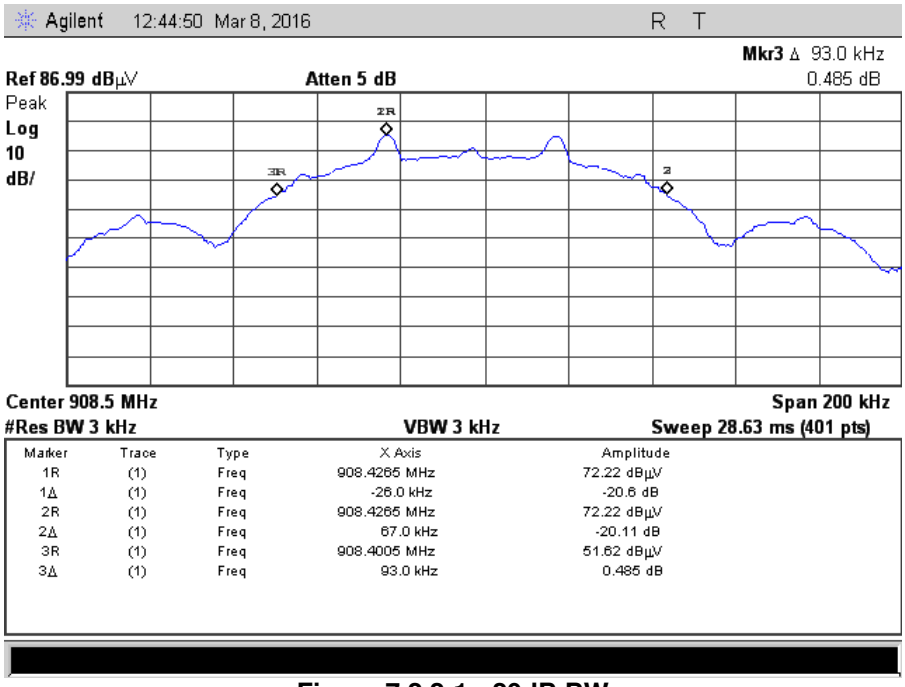


Figure 7.2.2-1: 20dB BW

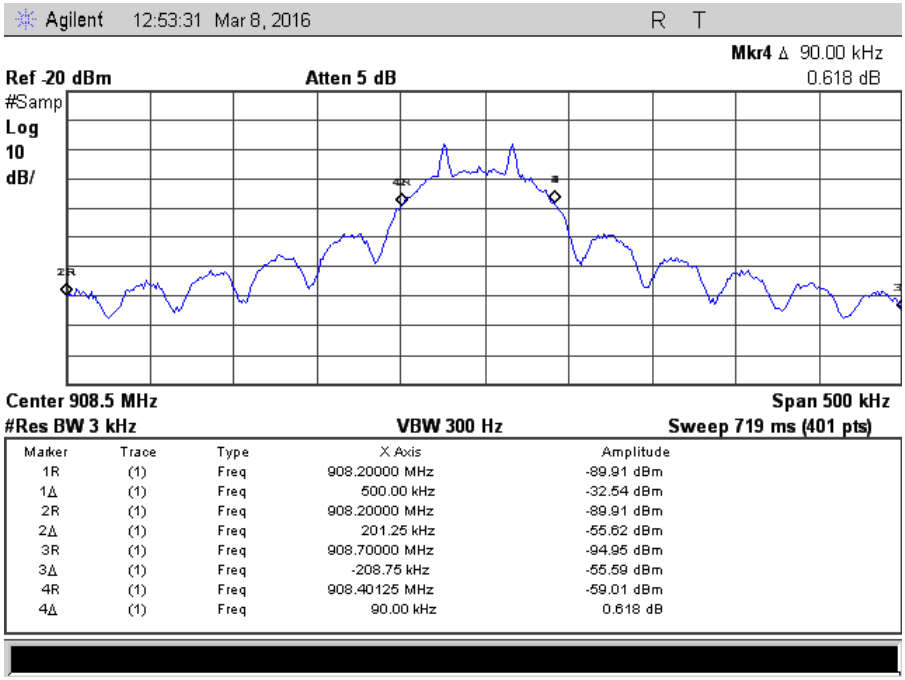


Figure 7.2.2-2: 99% OBW

7.3 Radiated Spurious Emissions - FCC Section 15.249 (a); IC: RSS-210 A2.9

7.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements made with RBW and VBW of 1 MHz and 3MHz respectively.

7.3.2 Measurement Results

Radiated spurious emissions found in the band of 9 kHz to 10 GHz are reported below.

ENCO Pro A

Table 7.3.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qp/avg	(H/V)	(dB)	pk	Qp/avg	pk	Qp/avg	pk	Qp/avg
Fundamental Frequency										
908.45	93.81	93.69	H	-1.88	---------	91.81	--------	94	--------	2.2
908.45	88.62	87.90	V	-1.88	---------	86.02	--------	94	--------	8.0
Emissions below 1 GHz										
250	---------	56.77	H	-14.47	---------	42.305	--------	46	---------	3.7
250	---------	52.83	V	-14.47	---------	38.365	--------	46	---------	7.6
480	---------	47.95	H	-7.91	---------	40.041	--------	46	---------	6.0
480	---------	49.51	V	-7.91	---------	41.601	--------	46	---------	4.4
478	---------	47.26	V	-7.94	---------	39.3196	--------	46	---------	6.7
Spurious Emissions										
2725.35	57.92	55.73	H	-3.35	54.57	52.38	74	54	19.4	1.6
2725.35	53.43	48.49	V	-3.35	50.08	45.14	74	54	23.9	8.9
3633.8	47.09	38.18	H	1.23	48.32	39.41	74	54	25.7	14.6
3633.8	47.45	39.86	V	1.23	48.68	41.09	74	54	25.3	12.9
4542.25	48.01	40.81	H	1.70	49.71	42.51	74	54	24.3	11.5
4542.25	46.88	38.67	V	1.70	48.58	40.37	74	54	25.4	13.6
6359.15	44.35	33.06	H	5.34	49.69	38.40	74	54	24.3	15.6
6359.15	44.32	34.42	V	5.34	49.66	39.76	74	54	24.3	14.2
7267.6	42.67	30.16	H	8.32	50.99	38.48	74	54	23.0	15.5
7267.6	43.18	31.17	V	8.32	51.50	39.49	74	54	22.5	14.5
8176.05	44.93	34.26	H	9.61	54.54	43.87	74	54	19.5	10.1
8176.05	45.03	34.75	V	9.61	54.64	44.36	74	54	19.4	9.6
9084.5	42.41	29.41	H	11.51	53.92	40.92	74	54	20.1	13.1
9084.5	42.34	29.36	V	11.51	53.85	40.87	74	54	20.2	13.1

ENCO Pro B

Table 7.3.2-2: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qp/avg	(H/V)	(dB)	pk	Qp/avg	pk	Qp/avg	pk	Qp/avg
Fundamental Frequency										
908.45	93.26	93.08	H	-1.88	---------	91.20	--------	94	--------	2.8
908.45	88.95	88.42	V	-1.88	---------	86.54	--------	94	--------	7.5
Emissions below 1 GHz										
175	---------	55.38	H	-13.38	---------	42.004	--------	43.5	---------	1.5
175	---------	52.86	V	-13.38	---------	39.481	--------	43.5	---------	4.0
200	---------	50.20	V	-12.77	---------	37.428	--------	43.5	---------	6.1
250	---------	59.58	V	-14.47	---------	45.115	--------	46	---------	0.9
250	---------	58.67	H	-14.47	---------	44.205	--------	46	---------	1.8
275	---------	52.70	V	-13.16	---------	39.5425	--------	46	---------	6.5
275	---------	53.89	H	-13.16	---------	40.7325	--------	46	---------	5.3
300	---------	52.88	V	-11.38	---------	41.496	--------	46	---------	4.5
300	---------	51.85	H	-11.38	---------	40.466	--------	46	---------	5.5
Spurious Emissions										
2725.35	54.87	51.30	H	-3.35	51.52	47.95	74	54	22.5	6.1
2725.35	54.83	50.24	V	-3.35	51.48	46.89	74	54	22.5	7.1
3633.8	46.53	36.56	H	1.23	47.76	37.79	74	54	26.2	16.2
3633.8	47.12	37.36	V	1.23	48.35	38.59	74	54	25.6	15.4
4542.25	47.39	39.01	H	1.70	49.09	40.71	74	54	24.9	13.3
4542.25	46.59	38.13	V	1.70	48.29	39.83	74	54	25.7	14.2
6359.15	44.32	33.02	H	5.34	49.66	38.36	74	54	24.3	15.6
6359.15	44.16	33.64	V	5.34	49.50	38.98	74	54	24.5	15.0
7267.6	42.52	29.85	H	8.32	50.84	38.17	74	54	23.2	15.8
7267.6	43.20	31.54	V	8.32	51.52	39.86	74	54	22.5	14.1
8176.05	45.29	35.60	H	9.61	54.90	45.21	74	54	19.1	8.8
8176.05	45.78	36.35	V	9.61	55.39	45.96	74	54	18.6	8.0
9084.5	42.51	29.31	H	11.51	54.02	40.82	74	54	20.0	13.2
9084.5	42.64	29.64	V	11.51	54.15	41.15	74	54	19.9	12.9

7.3.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak
Corrected Level: 57.92 + (-3.35) = 54.57 dBµV/m
Margin: 74 dBµV/m – 54.57 dBµV/m = 19.4 dB

Example Calculation: Average
Corrected Level: 55.73 + (-3.35) = 52.38 dBµV/m
Margin: 54 dBµV/m – 52.38 dBµV/m = 1.6 dB

7.4 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 8.8

7.4.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.4.2 Measurement Results

Results are shown below.

ENCO Pro A

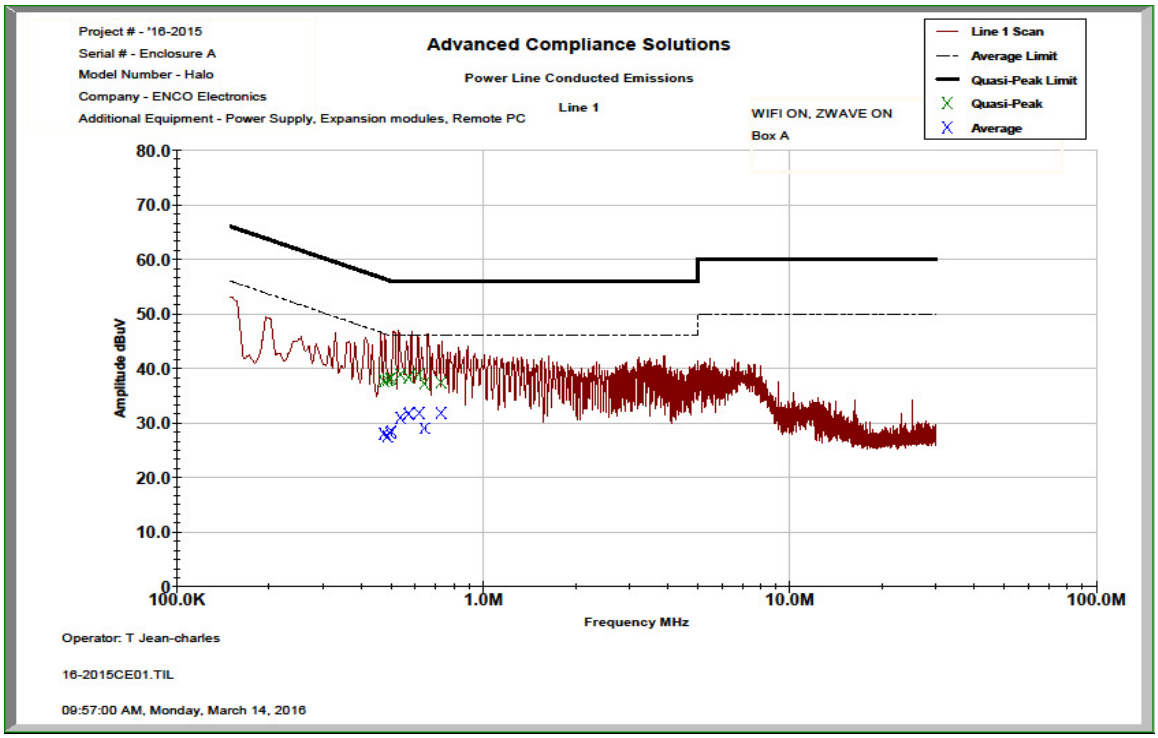


Figure 7.4.2-1: Conducted Emissions Results – Line 1

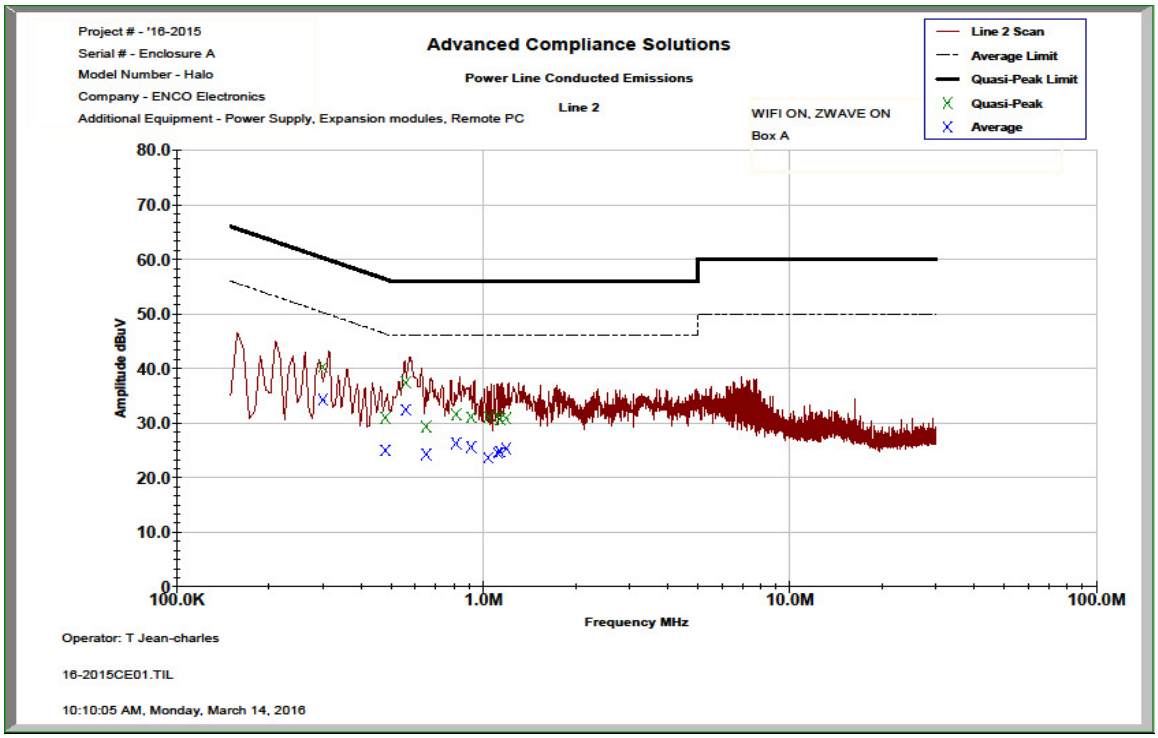


Figure 7.4.2-2: Conducted Emissions Results – Line 2

Table 7.4.2-1: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 16-2015CE01
Power Supply Description: 5 VDC

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.475025	27.471	17.834	10.21	37.68	28.04	56.43	46.43	18.7	18.4
0.4878	27.698	17.349	10.21	37.91	27.56	56.21	46.21	18.3	18.6
0.497	27.855	17.934	10.21	38.06	28.14	56.05	46.05	18.0	17.9
0.50185	28.014	18.376	10.20	38.22	28.58	56.00	46.00	17.8	17.4
0.537188	28.692	20.824	10.20	38.90	31.03	56.00	46.00	17.1	15.0
0.571288	28.199	21.482	10.20	38.40	31.69	56.00	46.00	17.6	14.3
0.572674	28.132	21.525	10.20	38.34	31.73	56.00	46.00	17.7	14.3
0.618174	28.709	21.621	10.20	38.91	31.82	56.00	46.00	17.1	14.2
0.64265	27.007	18.838	10.20	37.21	29.04	56.00	46.00	18.8	17.0
0.728774	27.266	21.639	10.22	37.49	31.86	56.00	46.00	18.5	14.1
Line 2									
0.300125	30.03	24.067	10.21	40.24	34.28	60.24	50.24	20.0	16.0
0.479999	20.787	14.778	10.21	31.00	24.99	56.34	46.34	25.3	21.4
0.560013	27.217	22.258	10.21	37.43	32.47	56.00	46.00	18.6	13.5
0.652375	19.126	14.061	10.21	29.34	24.27	56.00	46.00	26.7	21.7
0.816549	21.404	16.073	10.21	31.61	26.28	56.00	46.00	24.4	19.7
0.913563	20.854	15.402	10.20	31.06	25.61	56.00	46.00	24.9	20.4
1.04042	20.843	13.392	10.25	31.09	23.64	56.00	46.00	24.9	22.4
1.11505	20.998	14.35	10.25	31.25	24.60	56.00	46.00	24.8	21.4
1.13744	20.509	14.45	10.25	30.76	24.70	56.00	46.00	25.2	21.3
1.18968	20.595	15.088	10.25	30.85	25.34	56.00	46.00	25.2	20.7

ENCO Pro B

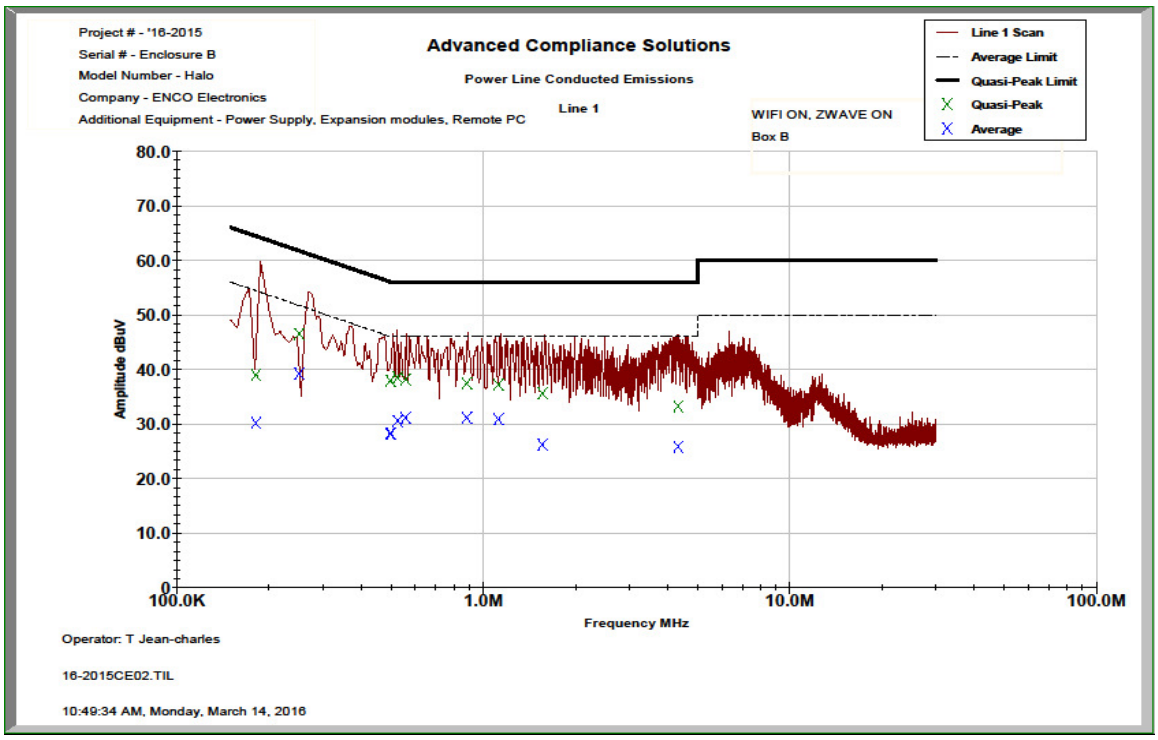


Figure 7.4.2-3: Conducted Emissions Results – Line 1

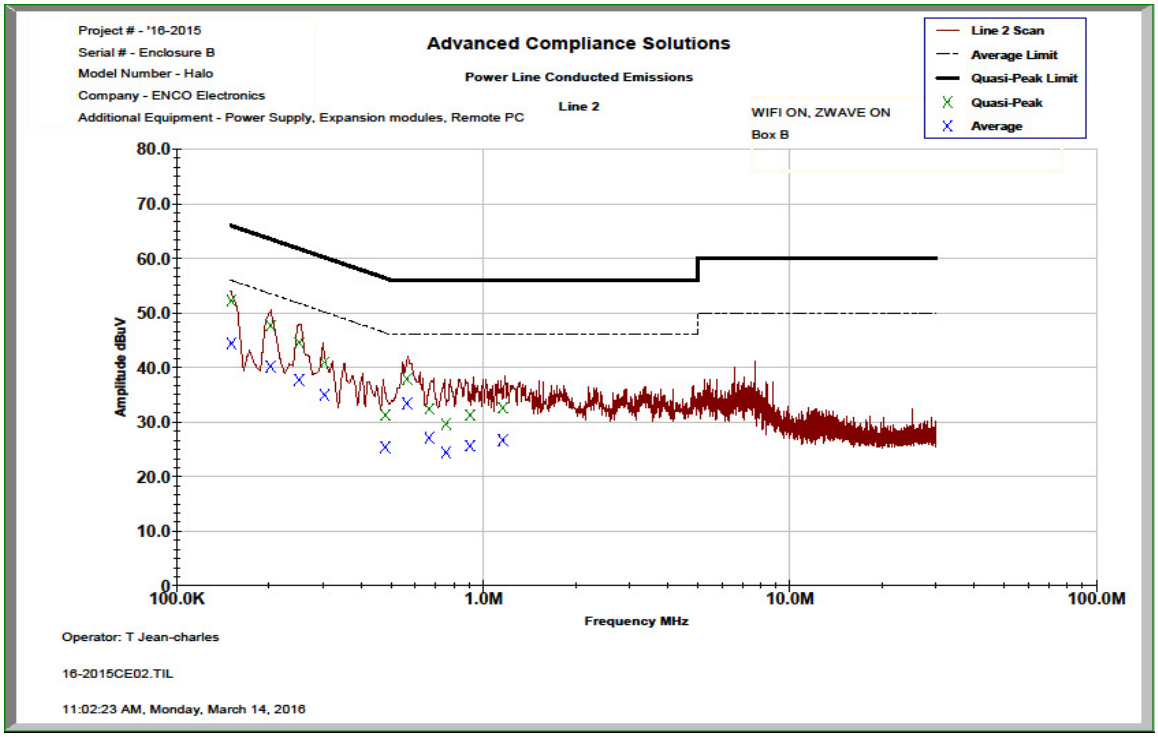


Figure 7.4.2-4: Conducted Emissions Results – Line 2

Table 7.4.2-2: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 16-2015CE02
Power Supply Description: 5 VDC

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.181663	28.769	19.972	10.20	38.97	30.18	64.41	54.41	25.4	24.2
0.251249	36.334	29.02	10.20	46.53	39.22	61.72	51.72	15.2	12.5
0.498449	27.708	17.94	10.21	37.92	28.15	56.03	46.03	18.1	17.9
0.498549	27.775	18.138	10.21	37.98	28.35	56.02	46.02	18.0	17.7
0.526775	28.39	20.407	10.20	38.59	30.61	56.00	46.00	17.4	15.4
0.559687	28.009	20.94	10.20	38.21	31.14	56.00	46.00	17.8	14.9
0.885087	27.269	20.951	10.19	37.46	31.14	56.00	46.00	18.5	14.9
1.12215	27.041	20.631	10.20	37.24	30.83	56.00	46.00	18.8	15.2
1.5628	25.385	15.979	10.20	35.59	26.18	56.00	46.00	20.4	19.8
4.33139	22.875	15.468	10.39	33.27	25.86	56.00	46.00	22.7	20.1
Line 2									
0.151007	41.995	34.176	10.23	52.23	44.41	65.94	55.94	13.7	11.5
0.202537	37.443	29.975	10.22	47.66	40.19	63.51	53.51	15.8	13.3
0.251025	34.352	27.534	10.21	44.56	37.74	61.72	51.72	17.2	14.0
0.303749	30.747	24.752	10.21	40.96	34.96	60.14	50.14	19.2	15.2
0.479999	21.04	15.202	10.21	31.25	25.41	56.34	46.34	25.1	20.9
0.565399	27.707	23.222	10.21	37.92	33.43	56.00	46.00	18.1	12.6
0.667299	22.209	16.859	10.21	32.42	27.07	56.00	46.00	23.6	18.9
0.756849	19.443	14.252	10.23	29.67	24.48	56.00	46.00	26.3	21.5
0.906099	21.064	15.431	10.20	31.27	25.63	56.00	46.00	24.7	20.4
1.15983	22.343	16.456	10.25	32.59	26.71	56.00	46.00	23.4	19.3

8 CONCLUSION

In the opinion of ACS, Inc. the HZM1, manufactured by ENCO Electronic Systems LLC meet the requirements of FCC Part 15 subpart C.

END REPORT