

Eaton's Cooper Controls TEST REPORT

SCOPE OF WORK

EMC TESTING – HIWAC1BLE40AWH & HIWMA1BLE40AWH

REPORT NUMBER

103427082ATL-001d

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EMC TEST REPORT
(FULL COMPLIANCE)

Report Number: 103427082ATL-001d

Project Number: G103427082

Report Issue Date: March 27, 2018

Report Update: June 5, 2018

Model(s) Tested: HIWAC1BLE40AWH &
HIWMA1BLE40AWH

Standards: FCC CFR47 Part 15 Subpart B: 2018 (15.109 & 15.107)
FCC CFR47 Part 15 Subpart C: 2018 (15.209 & 15.207)
FCC CFR47 Part 15.247 Subpart C:2018
ICES-005:2015 Ed. 5
RSS-247:2017 Issue 2
RSS-102:2015 Issue 5
RSS-GEN:2018 Issue 5

Tested by:
Intertek Testing Services NA, Inc.
1950 Evergreen Blvd, Suite 100
Duluth, GA 30096 USA

Client:
Eaton's Cooper Controls
203 Cooper Cir
Peachtree City, GA 30269-3075
USA

Report prepared by



Dan Alvarez / EMC Engineer

Report reviewed by



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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	
4	Description of Equipment Under Test and Variant Models	
5	System Setup and Method	
6	Radiated Emissions: FCC CFR47 Part 15 Subpart B:2018 (15.109); Subpart C: 2018 (15.209); ICES-005:2015 Ed. 5	Compliant
7	AC Conducted Emissions: FCC CFR47 Part 15 Subpart B:2018 (15.107); Subpart C: 2018 (15.207); ICES-005:2015 Ed. 5	Compliant
8	Band Edge: FCC 47CFR Part 15 Subpart C:2018 Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
9	Spurious Emissions: FCC 47CFR Part 15 Subpart C:2018 Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
10	Duty Cycle: FCC 47CFR Part 15 Subpart C - Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
11	Power Spectral Density: FCC 47CFR Part 15 Subpart C - Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
12	Maximum Conducted Output Power: FCC 47CFR Part 15 Subpart C - Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
13	Occupied Bandwidth: FCC 47CFR Part 15 Subpart C - Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
14	RF Exposure: FCC 47CFR Part 15 Subpart C - Intentional Radiators; 15.247; RSS-247:2017 Issue 2	Compliant
15	Revision History	

3 Client Information

This EUT was tested at the request of:

Client: Eaton's Cooper Controls
 203 Cooper Cir
 Peachtree City, GA 30269-3075
 USA
Contact: Danny Wilson
Telephone: (770) 486-4048
Email: DannyDWilson@Eaton.com

4 Description of Equipment Under Test

Manufacturer: Leedarson Lighting Co LTD
 Xingda Rd
 Xingtai Industrial Zone, Changtai County, Zhangzhou, Fujian
 China

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
In-Wall Smart Dimmer	Leedarson	HIWMA1BLE40AWH	ATL1803060830-001
In-Wall Accessory Dimmer	Leedarson	HIWAC1BLE40AWH	ATL1803060830-004

Receive Date:	03/06/2018
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)

Bluetooth Low Energy Dimmers

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
120 VAC	5A	60Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	BLE transmissions – use CSR/Qualcomm test app to transmit as much as possible. (Duty Cycle was measured at 66%.

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	CSR/Qualcomm uEnergyTestApp

Radio/Receiver Characteristics	
Frequency Band(s)	2400 – 2483.5 MHz
Modulation Type(s)	GFSK
Maximum Output Power	-1.14 dBm
Test Channels	0 (2402MHz), 19 (2440 MHz), 39 (2480MHz)
Occupied Bandwidth	666 kHz (6 dB), 1195 kHz (99%)
Frequency Hopper: Number of Hopping Channels	-
Frequency Hopper: Channel Dwell Time	-
Frequency Hopper: Max interval between two instances of use of the same channel	-
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Module
Antenna Type and Gain	¼ wave monopole, 4 dBi
Power Level Setting	-5

5 System Setup and Method

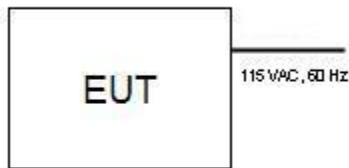
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	AC Mains Cable	1.5 m	N/A	N/A	Mains

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

5.1 Method:

Configuration as required by ANSI C63.4:2014 and ANSI C63.10:2013.

5.2 EUT Block Diagram:



6 Radiated Emissions (15.109 & 15.209)

6.1 Method

Tests are performed in accordance with ANSI C63.4, FCC 47CFR: (Part 15 Subpart B), ICES-005. Measurements from 30MHz to 1 GHz were performed at a 10m test distance.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.1 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.8 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.1 dB	5.2 dB
Radiated Emissions, 3m	6-18 GHz	3.9 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.5 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212054'	Barometric Pressure/Humidity/Temperature Datalogger	Extech	SD700	A.032434	10/17/2017	10/17/2018
232944'	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
200069	Preamplifier, 10 MHz to 2000 MHz, 40 dB gain	Mini-Circuits	ZKL-2	D011105	04/19/2017	04/19/2018
ST-7	RF Coax Cable - Rated 9 kHz to 18 GHz.	Teledyne Storm Micro	A81-0303-275	16-01-802	02/14/2018	02/14/2019
MM1	RF Coax Cable 10KHz-18GHz	Maury Microwave	UC-N-MM36	161471	05/03/2017	05/03/2018
E211	RF Coax Cable	Megaphase	TM18-N1N1-120	15055601001	06/22/2017	06/22/2018
TW2	RF Coax Cable 9KHz-18GHz	Fairview Microwave	FMCA1282-472	TW2	08/22/2017	08/22/2018
211411	RF Coax Cable 9KHz-18GHz	Fairview Microwave	FMCA1282-472	TW2	08/22/2017	08/22/2018
25401;	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified
213312	Bilog antenna	Teseq	CBL 6112D	40527	05/25/2017	05/25/2018

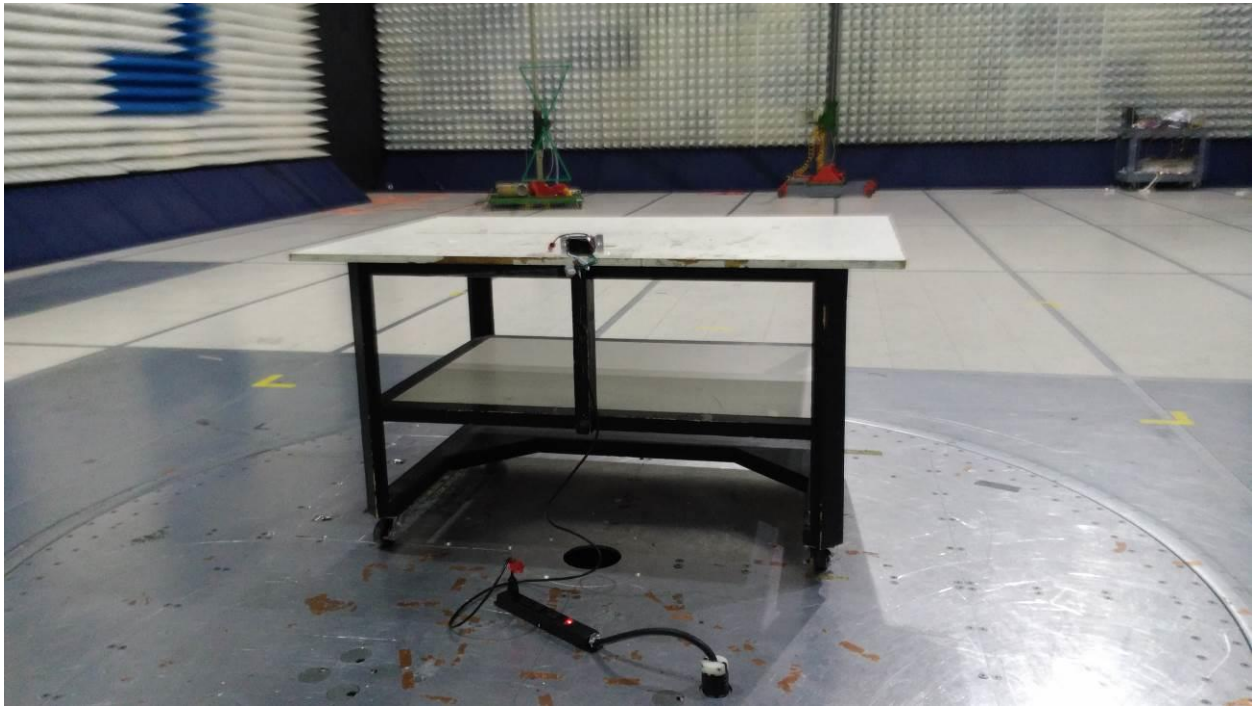
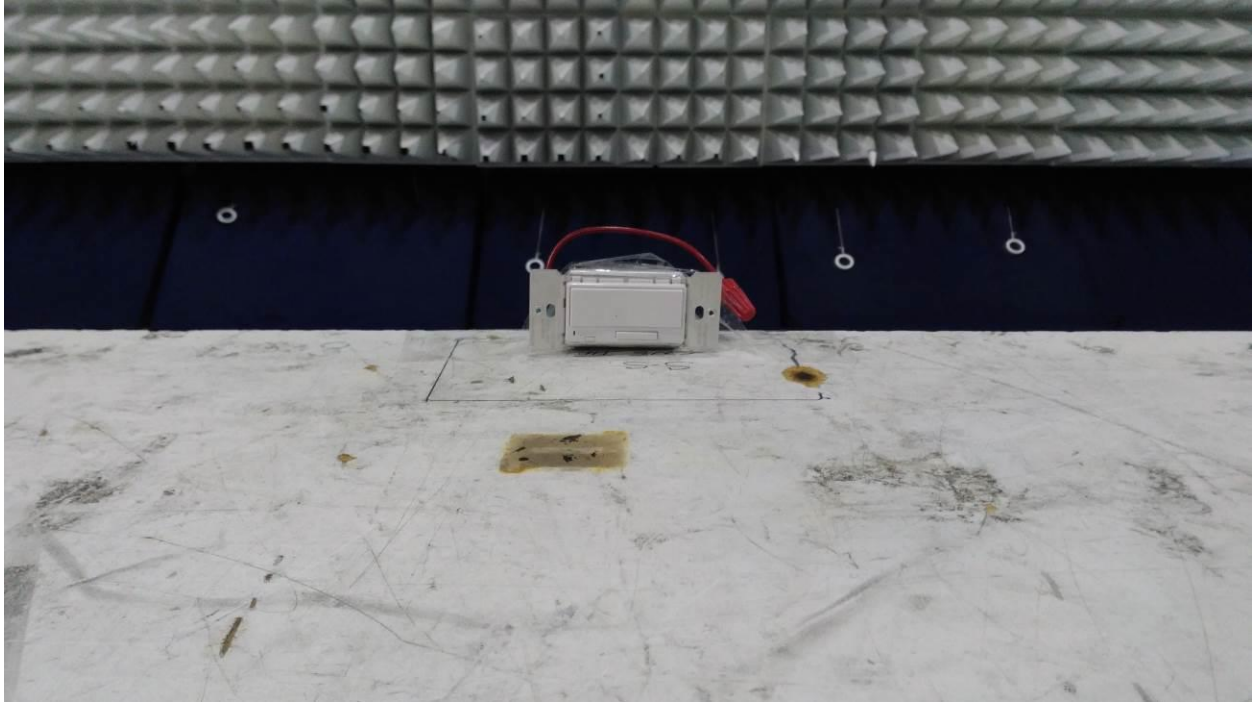
Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

6.3 Results:

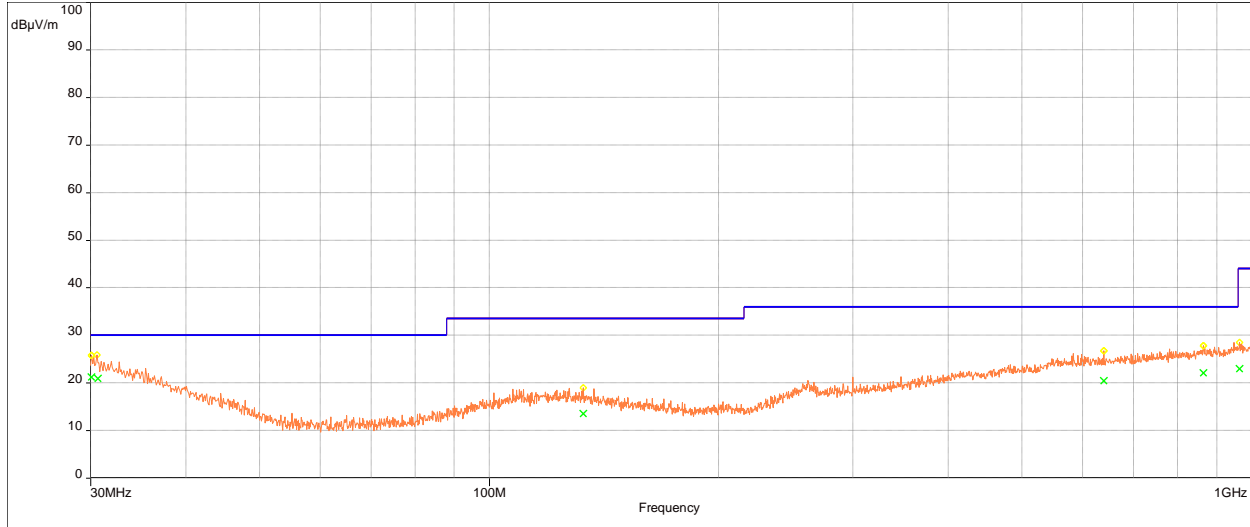
The sample tested was found to Comply.

6.4 Setup Photographs:



6.5 Plots/Data:

Model: HIWMA1BLE40AWH, FCC Part 15 Class B, 30M-1GHz Scan
 Emissions Graph: HIWMA1BLE40AWH - RE 30MHz-1GHz_120VAC,60Hz



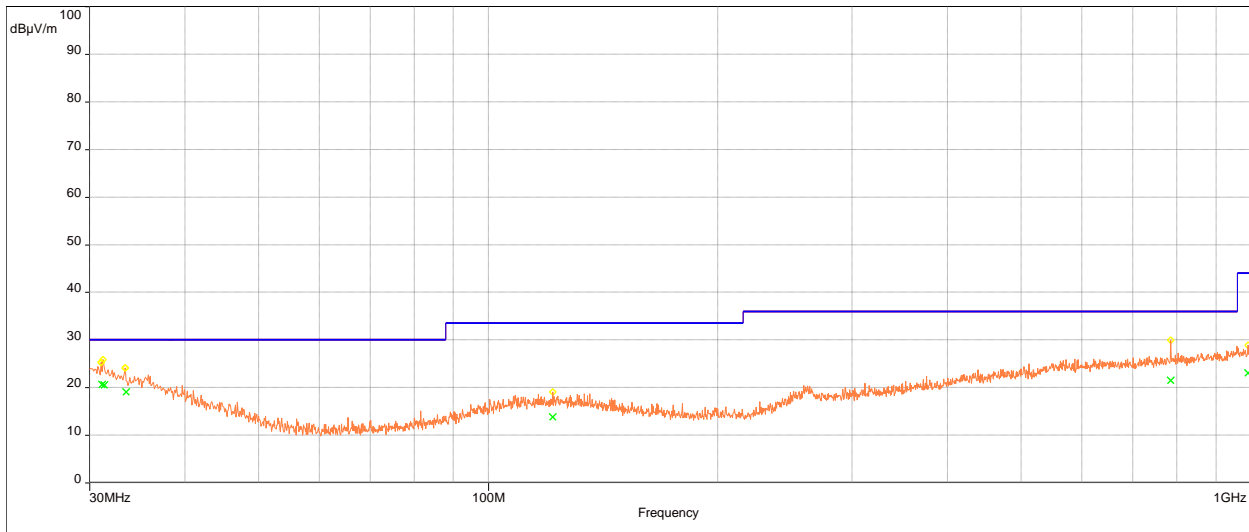
FCC Part 15/FCC Part 15 30M-1GHzB

Data Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
30.09196	1	21.24	30.00	-8.76	162.00	2.29	Vertical	0.10	-11.16
30.654984	1	20.93	30.00	-9.07	156.00	2.00	Vertical	0.10	-11.44
132.836416	1	13.56	33.50	-19.94	107.00	3.58	Horizontal	0.10	-17.40
639.74516	1	20.42	36.00	-15.58	200.00	2.02	Horizontal	0.10	-8.17
864.881776	1	22.07	36.00	-13.93	110.00	3.48	Vertical	0.10	-6.52
963.98164	1	22.98	44.00	-21.02	193.00	2.18	Horizontal	0.10	-5.61

Model: HIWAC1BLE40AWH, FCC Part 15 Class B, 30M-1GHz Scan
Emissions Graph: RE_HIWAC1BLE40AWH_30MHz-1GHz_120VAC,60Hz



FCC Part 15/FCC Part 15 30M-1GHzB

Data Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
31.159616	1	20.63	30.00	-9.37	134.00	2.27	Vertical	0.10	-11.72
31.374112	1	20.49	30.00	-9.51	241.00	2.18	Horizontal	0.10	-11.87
33.446024	1	19.09	30.00	-10.91	70.00	3.52	Vertical	0.10	-13.19
121.61	1	13.79	33.50	-19.71	8.00	2.13	Vertical	0.10	-17.11
785.136968	1	21.52	36.00	-14.48	320.00	3.48	Vertical	0.10	-7.02
991.584176	1	23.08	44.00	-20.92	283.00	3.48	Horizontal	0.10	-5.46

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable)
 Product Standard: FCC; ICES-005
 Input Voltage: 120VAC,60Hz
 Pretest Verification w/ Ambient Signals or BB Source: Y

Test Date: 03/06/2018
 Limit Applied: Class B
 Ambient Temperature: 23 °C
 Relative Humidity: 32 %
 Atmospheric Pressure: 984 mbars

Deviations, Additions, or Exclusions: None

7 AC Mains Conducted Emissions (15.107 & 15.207)

7.1 Method

Tests are performed in accordance with ANSI C63.4 and FCC 47CFR: (Part 15 Subpart B), ICES-005.

TEST SITE: 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.8 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where UF = Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212054	Barometric Pressure/Humidity Datalogger	Extech	SD700	none	10/17/2017	10/17/2018
MP4	RF Coax Cable 9KHz-18GHz	Fairview Microwave	FMCA1282-394	MP4	08/22/2017	08/22/2018
MM9	RF Coax Cable 9KHz-18GHz	Maury Microwave	UC-N-MM267	1635290	10/17/2017	10/17/2018
E212	RF Coax Cable	Megaphase	TM18-N1N1-120	15055601002	06/22/2017	06/22/2018
213051	Line Impedance Stabilization Network (LISN) - Rated 9kHz to 30 Mhz, 15 Amps.	Com-Power	LI-215A	191959	02/21/2018	02/21/2019
213100	Transient Limiter	Hewlett Packard	11947A	3107A01550	11/20/2017	11/20/2018
200076;	Conducted Emissions Site Source	Com-Power	CGC-255	311024	VBU	Verified
232944	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018

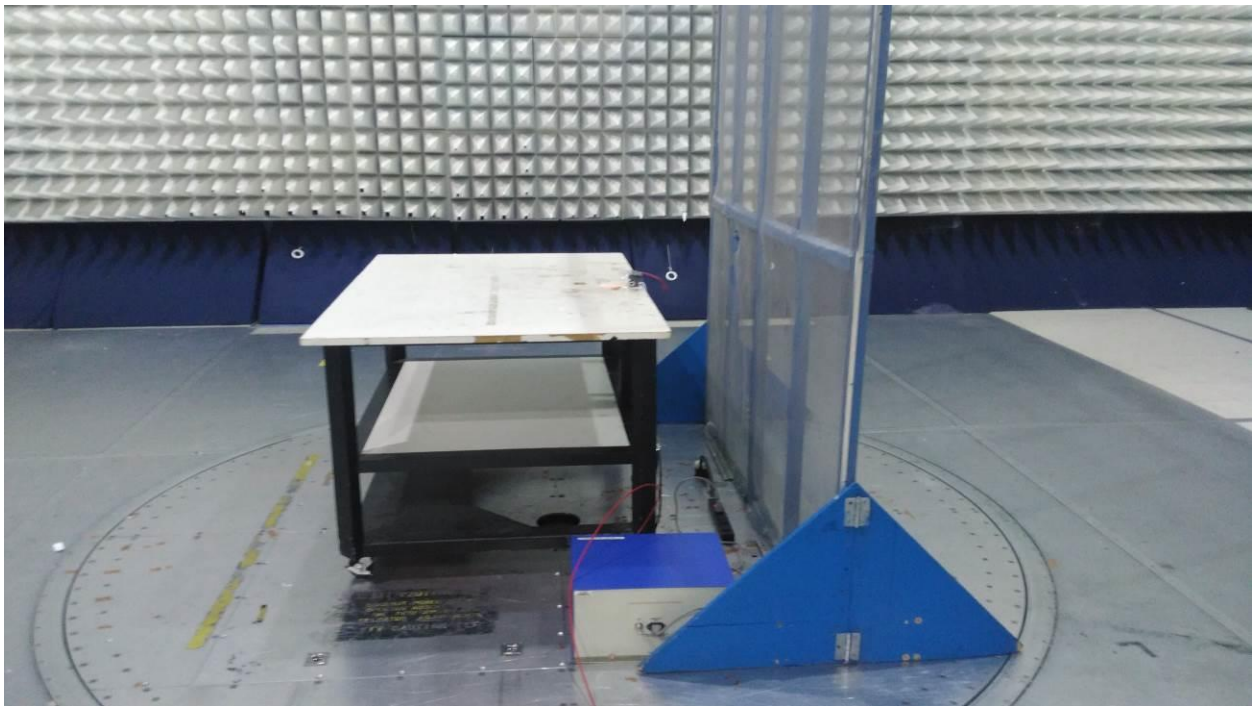
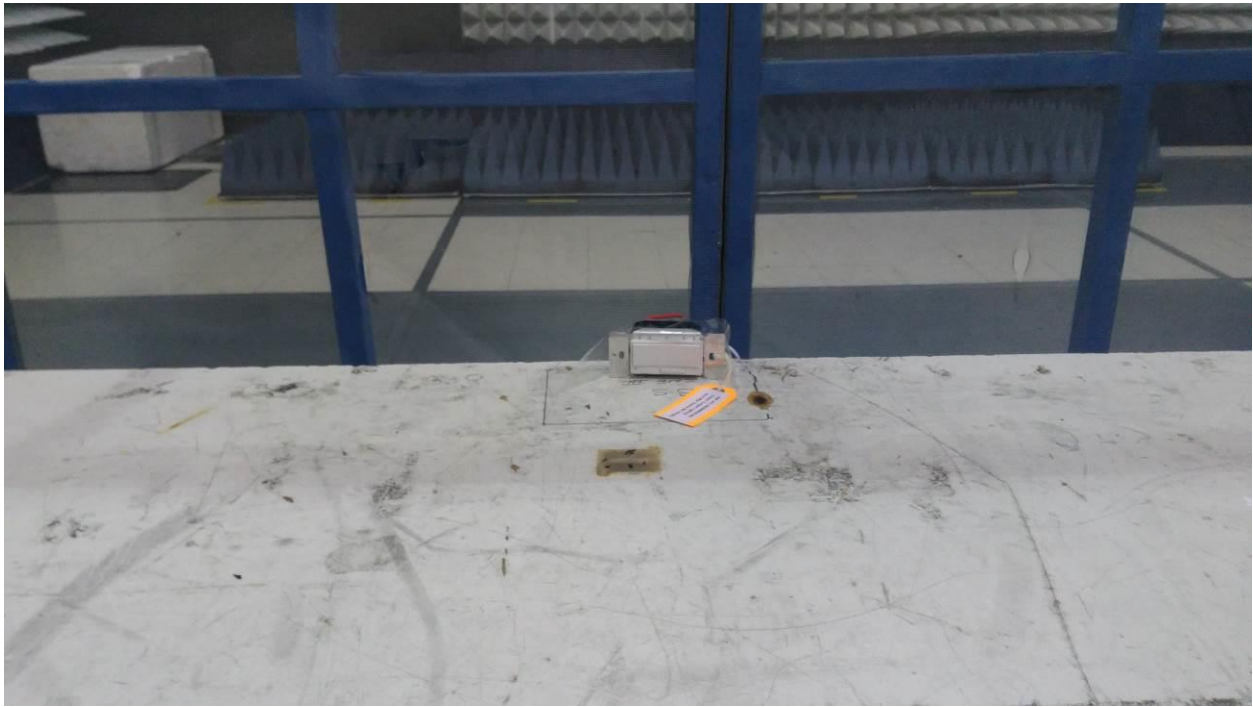
Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

7.3 Results:

The sample tested was found to Comply.

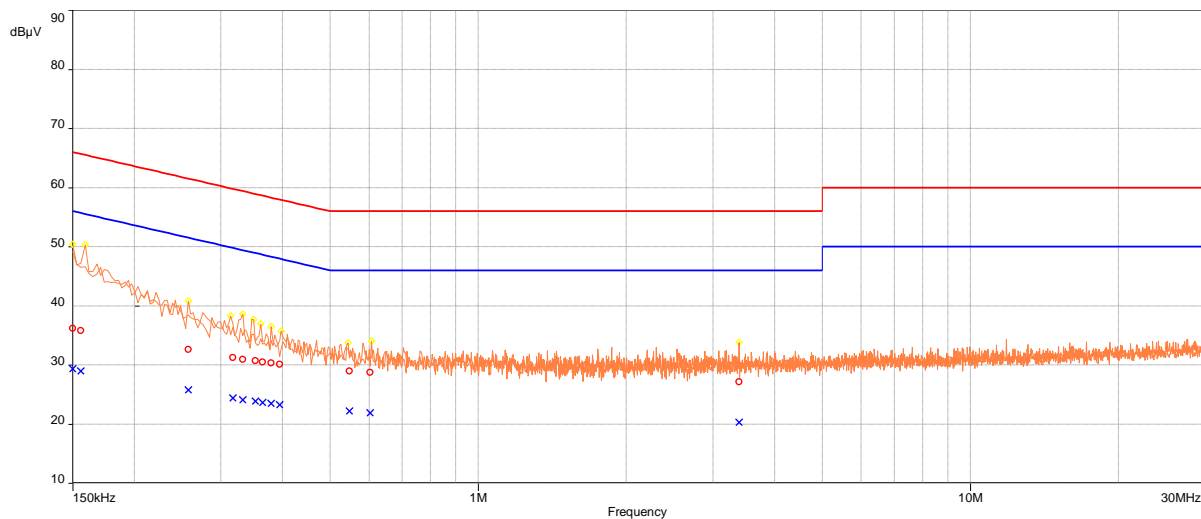
7.4 Setup Photographs:



7.5 Plots/Data:

Model: HIWAC1BLE40AWH, FCC Part 15.107 – Class B

Emissions Graph: HIWAC1BLE40AWH_CE_120VAC,60Hz



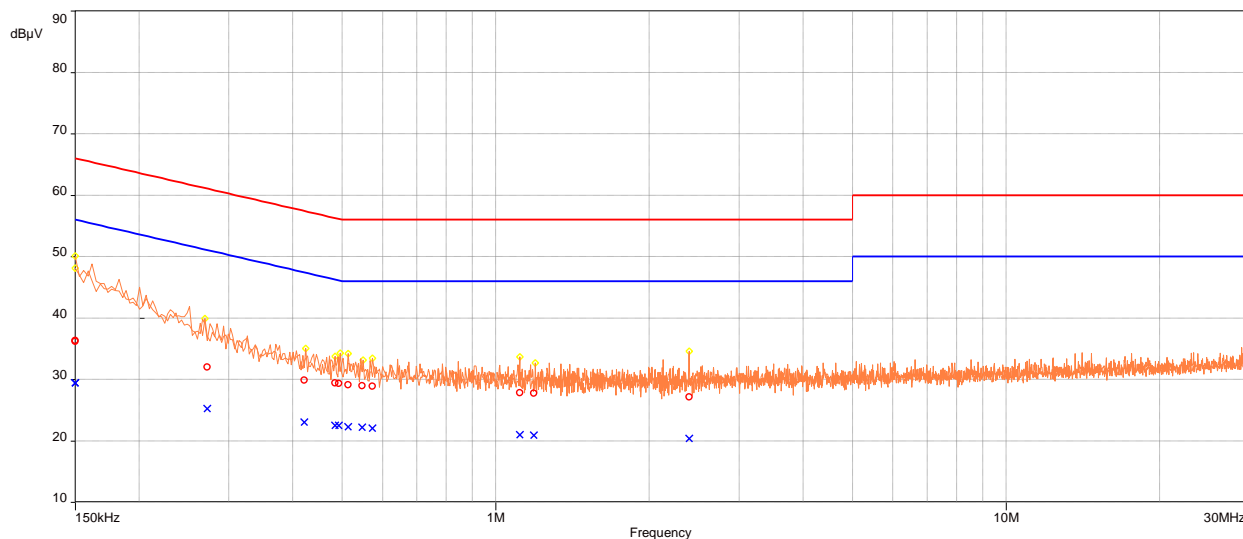
Data Results:

Final QP and AVG (12)

Frequency (MHz)	SR	AVG Level (dBuV) (dBµV)	QP Level (dBuV) (dBµV)	AVG Limit (dBuV)	QP Limit (dBuV)	AVG Margin (dB)	QPeak Margin (dB)	Position	Correction (dB)
0.149357	1	29.32	36.19	56.00	66.00	-26.68	-29.81	Phase 1	9.96
0.352876	1	23.85	30.70	48.89	58.89	-25.04	-28.19	Phase 1	10.00
0.380083	1	23.48	30.32	48.28	58.28	-24.80	-27.96	Phase 1	10.00
0.546035	1	22.14	28.96	46.00	56.00	-23.86	-27.04	Phase 1	10.05
0.604533	1	21.88	28.68	46.00	56.00	-24.12	-27.32	Phase 1	10.07
3.390536	1	20.26	27.09	46.00	56.00	-25.74	-28.91	Phase 1	10.32
0.154782	2	28.96	35.81	55.68	65.68	-26.71	-29.86	Neutral	9.89
0.256039	2	25.71	32.57	51.51	61.51	-25.80	-28.94	Neutral	9.92
0.316724	2	24.39	31.22	49.78	59.78	-25.39	-28.56	Neutral	9.94
0.333371	2	24.11	30.90	49.40	59.40	-25.29	-28.50	Neutral	9.95
0.363478	2	23.65	30.48	48.62	58.62	-24.96	-28.13	Neutral	9.96
0.394565	2	23.26	30.07	47.96	57.96	-24.71	-27.90	Neutral	9.98

Model: HIWMA1BLE40AWH, FCC Part 15.107 – Class B

Emissions Graph: HIWMA1BLE40AWH – CE_120VAC,60Hz



Data Results:

Final QP and AVG (12)

Frequency (MHz)	SR	AVG Level (dBuV) (dBµV)	QP Level (dBuV) (dBµV)	AVG Limit (dBuV)	QP Limit (dBuV)	AVG Margin (dB)	QPeak Margin (dB)	Position	Correction (dB)
0.147283	1	29.43	36.17	56.00	66.00	-26.57	-29.83	Phase 1	9.96
0.421484	1	23.01	29.86	47.42	57.42	-24.40	-27.55	Phase 1	10.01
0.494101	1	22.49	29.35	46.11	56.11	-23.62	-26.76	Phase 1	10.03
0.547594	1	22.15	28.96	46.00	56.00	-23.85	-27.04	Phase 1	10.05
0.573979	1	21.99	28.84	46.00	56.00	-24.01	-27.16	Phase 1	10.06
1.190062	1	20.88	27.71	46.00	56.00	-25.12	-28.29	Phase 1	10.20
0.146604	2	29.41	36.28	56.00	66.00	-26.59	-29.72	Neutral	9.89
0.273607	2	25.20	31.96	51.04	61.04	-25.85	-29.09	Neutral	9.93
0.483999	2	22.45	29.43	46.26	56.26	-23.82	-26.84	Neutral	10.00
0.513378	2	22.29	29.11	46.00	56.00	-23.71	-26.89	Neutral	10.01
1.115582	2	20.94	27.78	46.00	56.00	-25.06	-28.22	Neutral	10.17
2.395171	2	20.35	27.08	46.00	56.00	-25.65	-28.92	Neutral	10.24

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable)
 Product Standard: FCC: ICES-005
 Input Voltage: 120VAC,60Hz
 Pretest Verification w/ Ambient Signals or BB Source: Y

Test Date: 03/06/2018

Limit Applied: Class B
 Ambient Temperature: 23 °C
 Relative Humidity: 32 %
 Atmospheric Pressure: 984 mbars

Deviations, Additions, or Exclusions: None

8 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Band Edge

8.1 Method

Tests are performed in accordance with FCC CFR47 Part 15 Subpart C, ANSI C63.10, RSS-247. All measurements were performed at 3m distance.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.1 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.8 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.1 dB	5.2 dB
Radiated Emissions, 3m	6-18 GHz	3.9 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.5 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212054'	Barometric Pressure/Humidity/Temperature Datalogger	Extech	SD700	A.032434	10/17/2017	10/17/2018
232944'	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401;	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified

Above 1 GHz

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKKN-394	MP3	05/03/2017	05/03/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

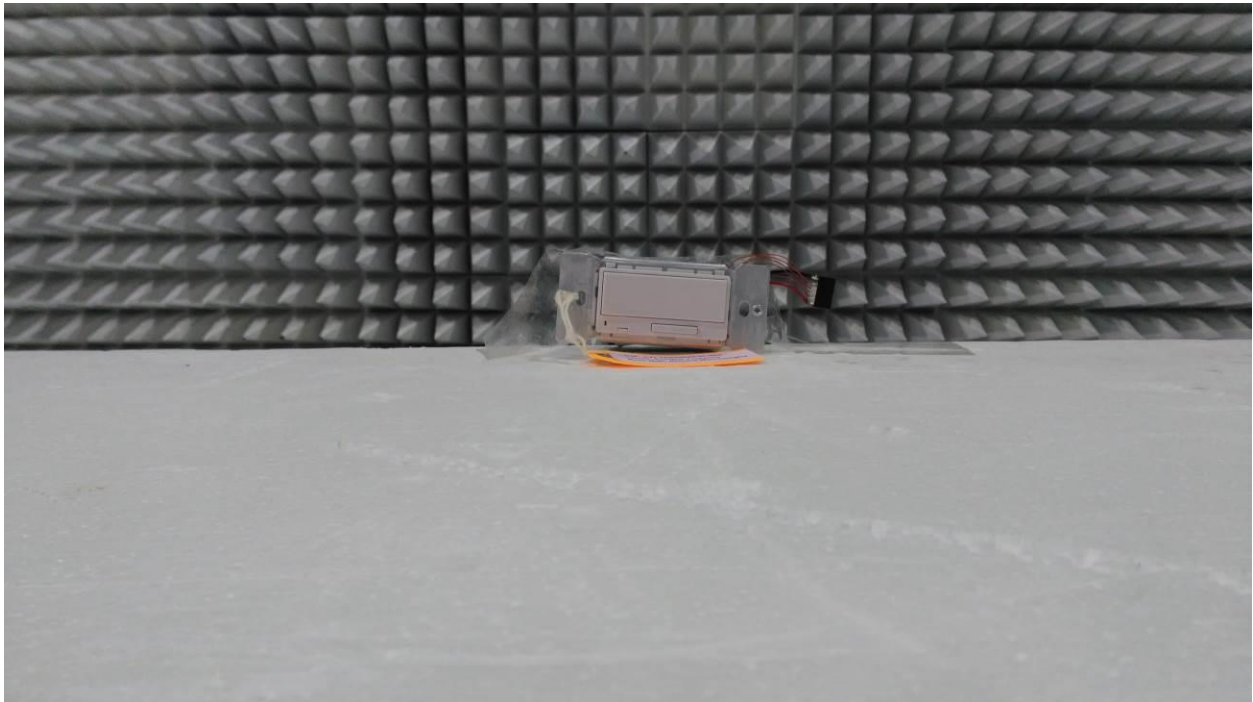
8.3 Results:

The sample tested was found to Comply.

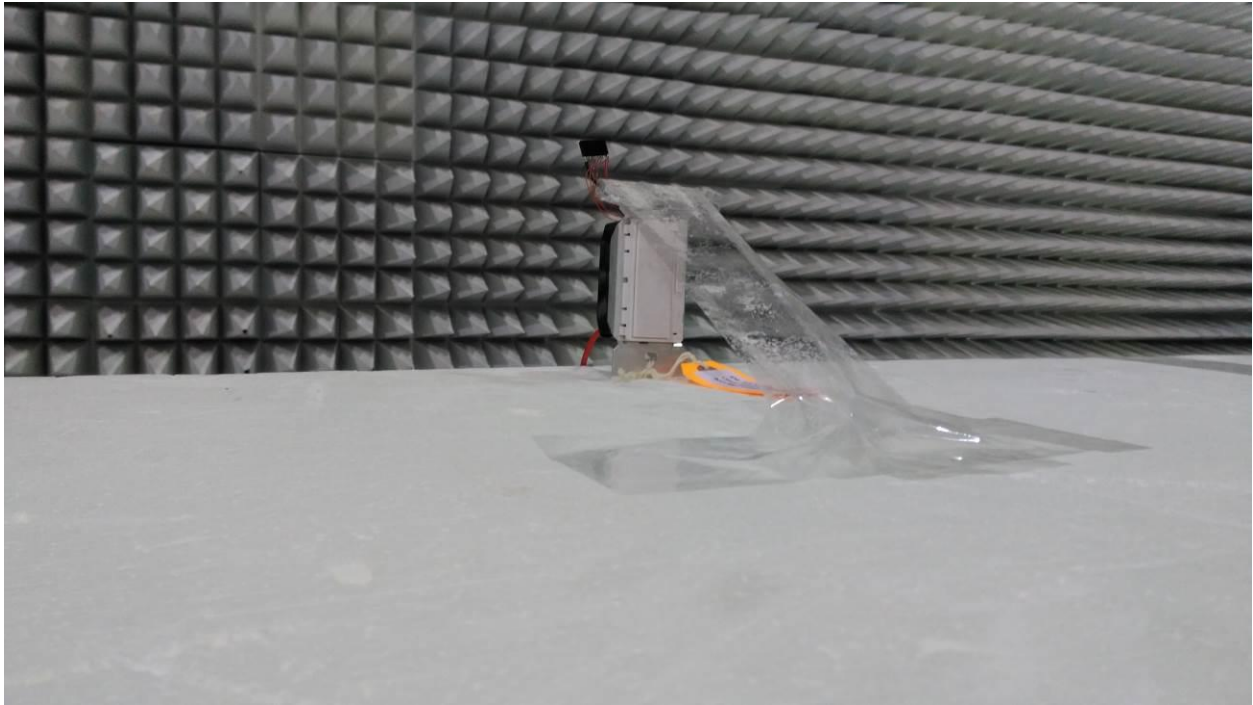
8.4 Setup Photographs:



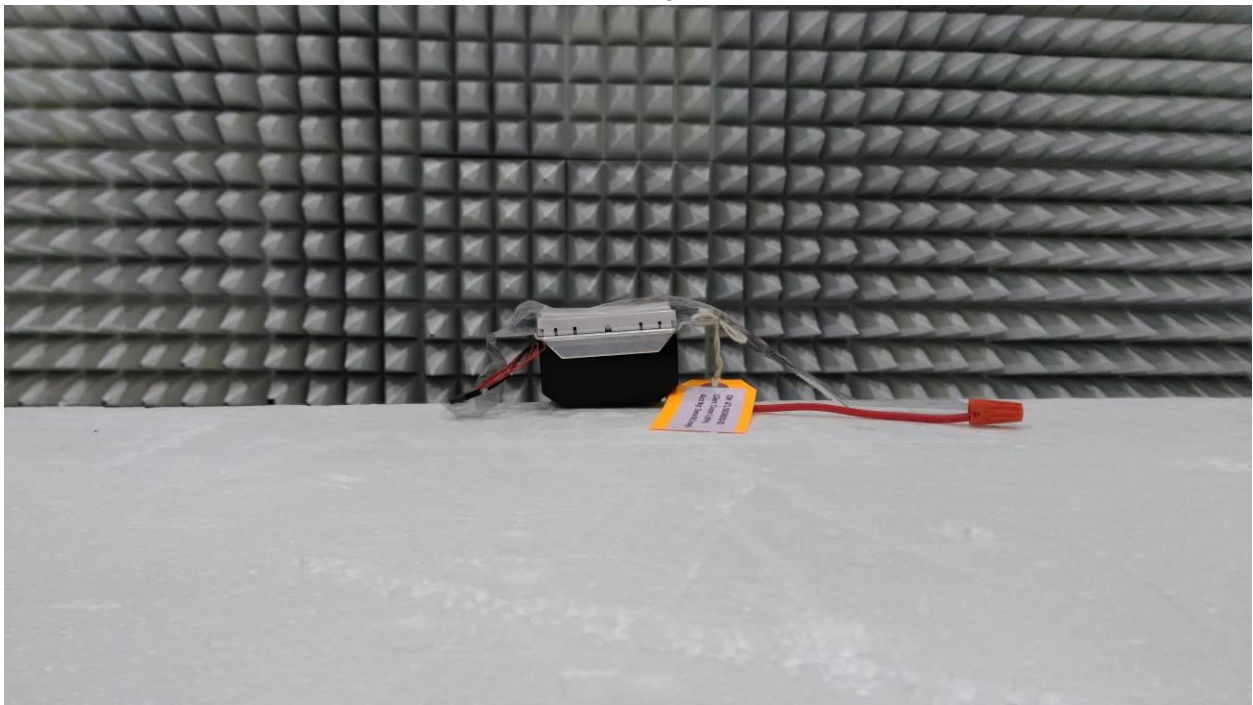
X - Axis



Y - Axis

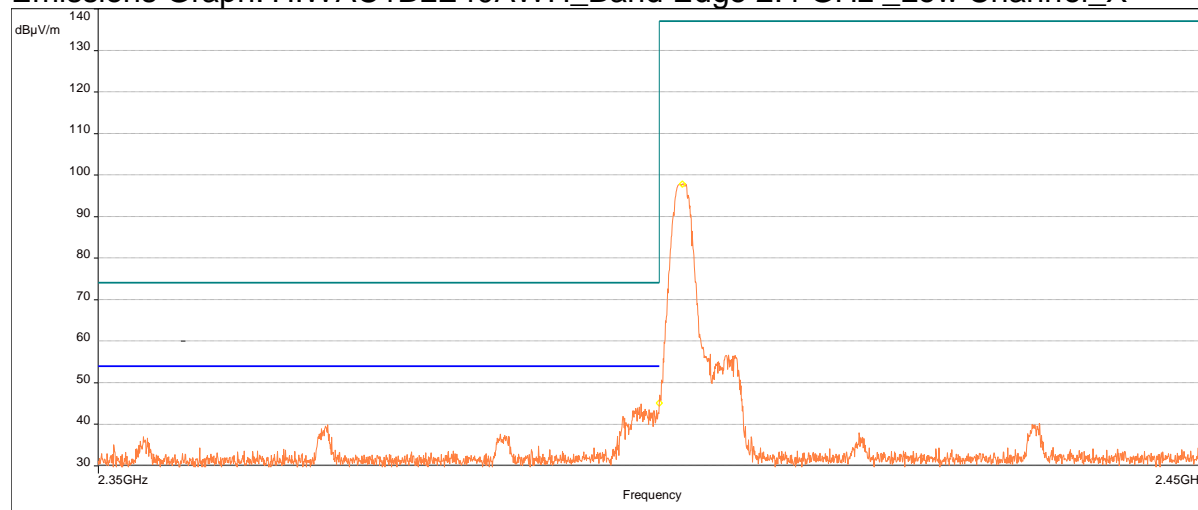


Z - Axis



8.5 Plots/Data:

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Lower Band Edge (X-axis)
Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz_Low Channel_X



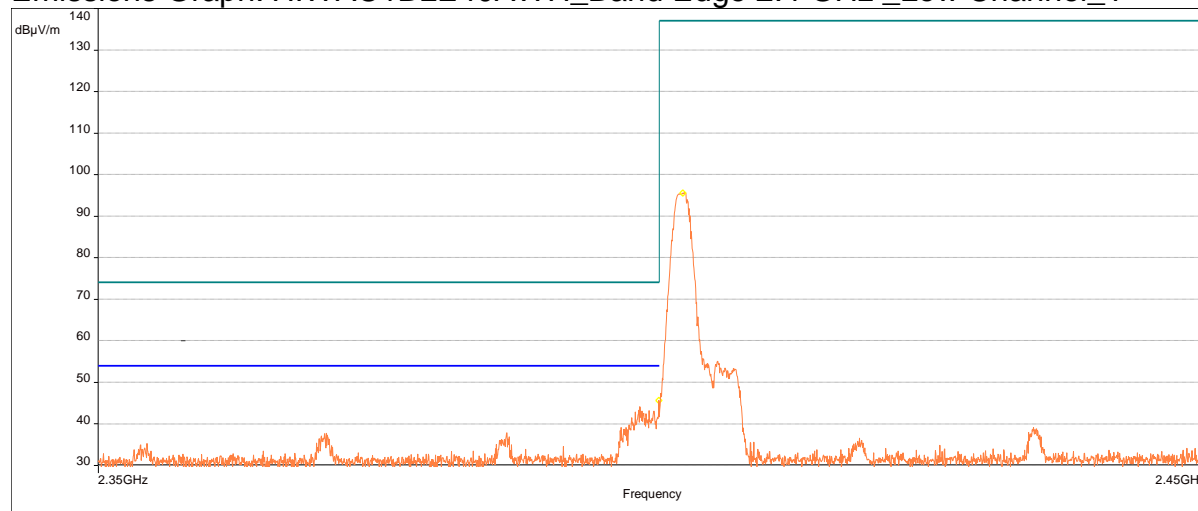
FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance
 Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2399.9733 33	1	45.07	54.00	-8.93	3.98	0.00	Vertical polarization	-1.83

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Lower Band Edge (Y-axis).
Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz_Low Channel_Y



FCC Part 15 Transmitters/15.247 Band Edge

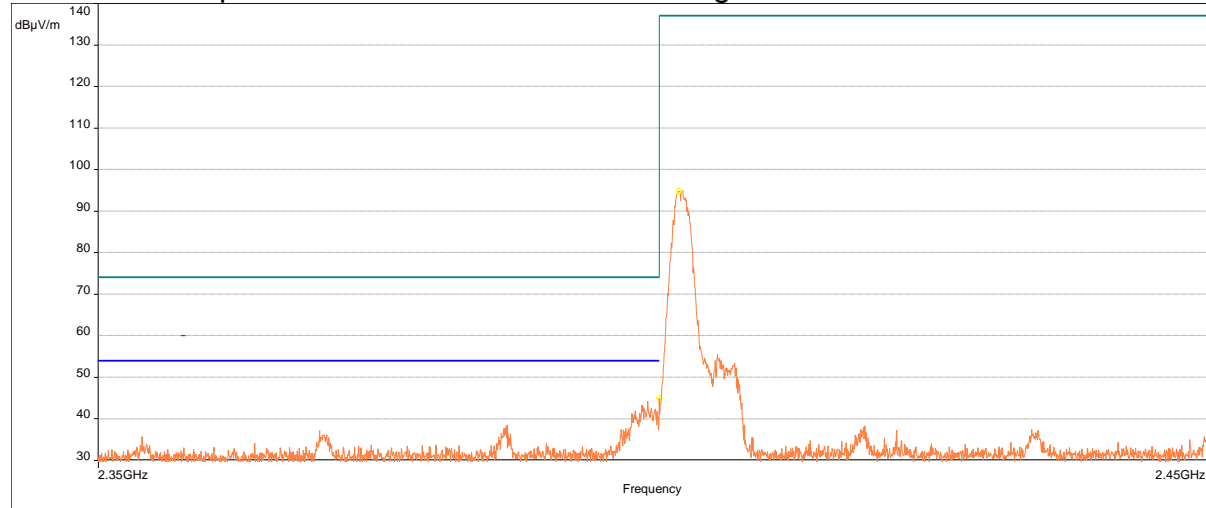
Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance
 Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2399.93	1	45.65	54.00	-8.35	3.98	0.00	Vertical polarization	-1.83

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section15.247, Lower Band Edge (Z-axis)

Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz _Low Channel_Z



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

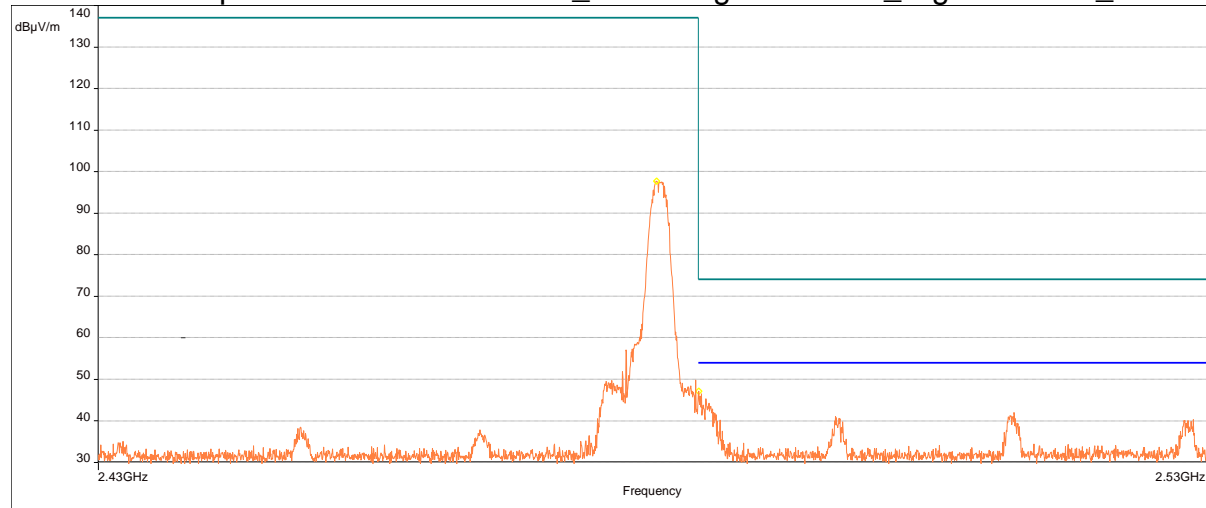
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2399.976667	1	44.94	54.00	-9.06	3.98	0.00	Vertical polarization	-1.83

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section15.247, Upper Band Edge (X-axis)

Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz _High Channel_X



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

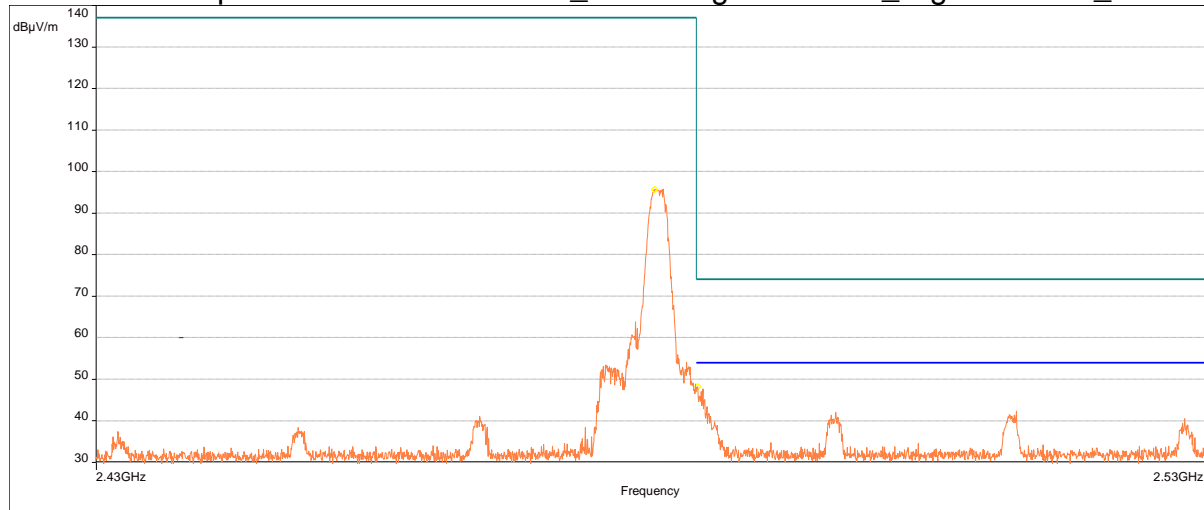
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2483.566667	1	47.13	54.00	-6.87	1.00	0.00	Vertical polarization	-1.70

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section15.247, Upper Band Edge (Y-axis)

Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz _High Channel_Y



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

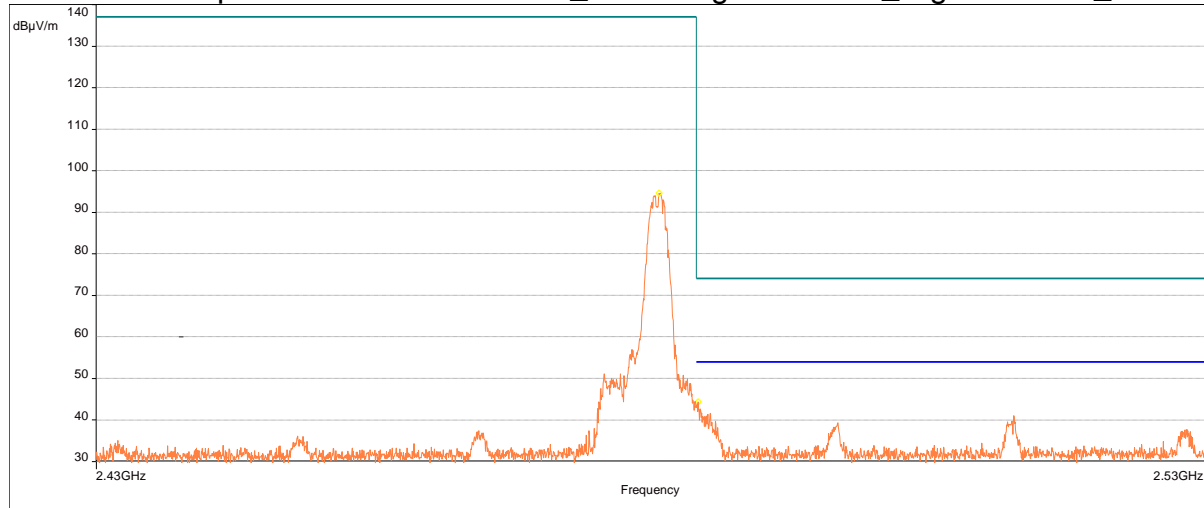
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2483.636667	1	48.18	54.00	-5.82	1.01	47.00	Horizontal polarization	-1.70

Model: HIWAC1BLE40AWH, FCC Part 15 Subpart C Section15.247, Upper Band Edge (Z-axis)

Emissions Graph: HIWAC1BLE40AWH_Band Edge 2.4 GHz _High Channel_Z



FCC Part 15 Transmitters/15.247 Band Edge

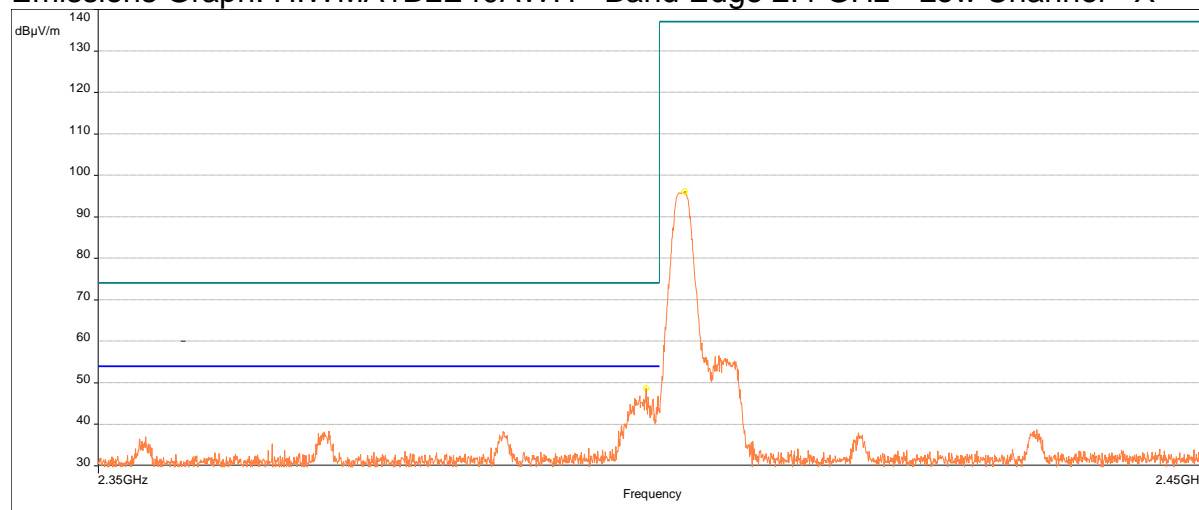
Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2483.68	1	44.37	54.00	-9.63	1.00	0.00	Vertical polarization	-1.70

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Lower Band Edge (X-axis)
Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - Low Channel - X



FCC Part 15 Transmitters/15.247 Band Edge

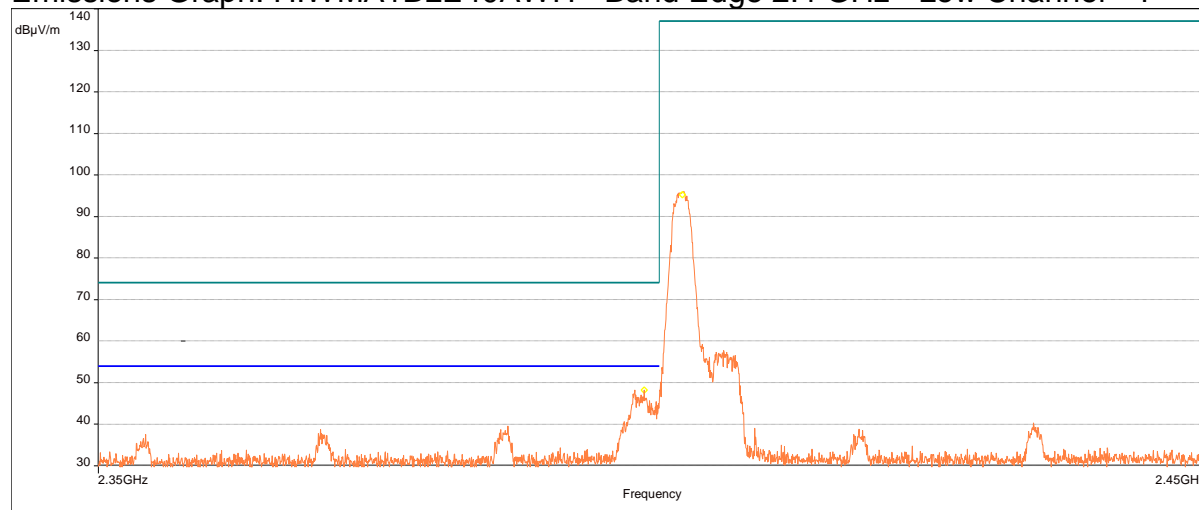
Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2398.78333	1	48.64	54.00	-5.36	1.00	43.00	Vertical polarization	-1.83

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Lower Band Edge (Y-axis)
Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - Low Channel - Y



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

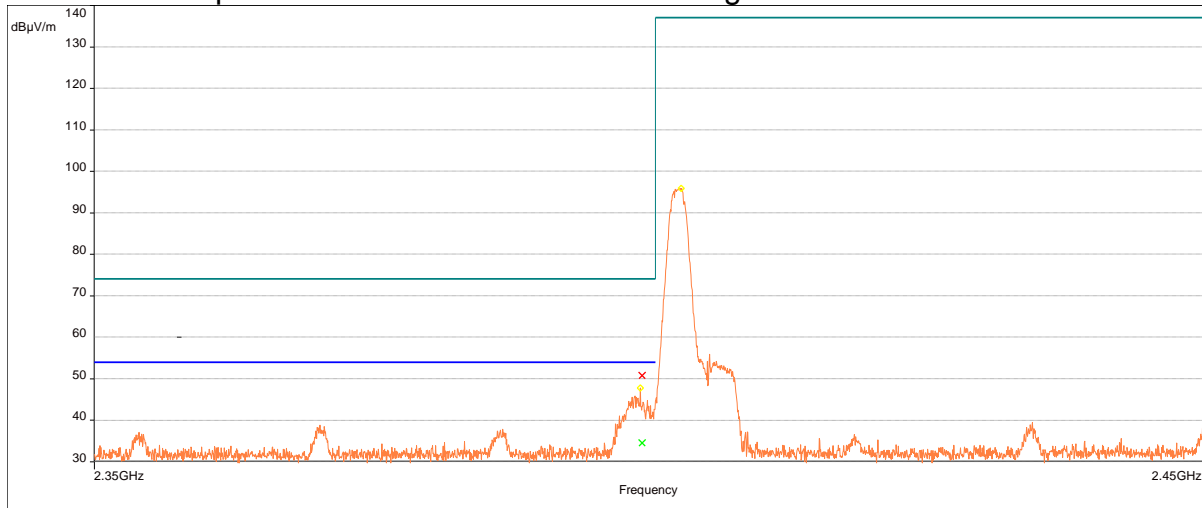
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2398.63	1	48.22	54.00	-5.78	3.99	314.00	Horizontal polarization	-1.83

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Lower Band Edge (Z-axis)

Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - Low Channel - Z



Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Manual suspects (2)

Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
2398.616667	1	47.73	3.98	0.00	Vertical
2402.293333	1	95.90	3.98	0.00	Vertical

Avg (PASS) (1)

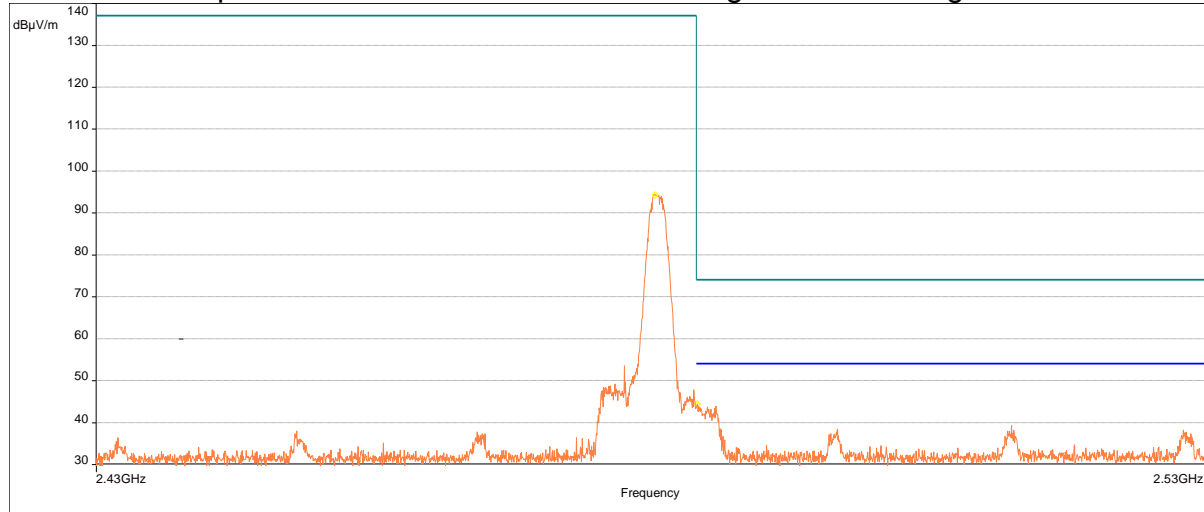
Frequency (MHz)	SR	Level (dBµV/m)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2398.7969	1	34.46	8.00	3.95	Vertical	0.10	-1.83

Peak (Pass) (1)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2398.7969	1	50.78	74.00	23.22	8.00	3.95	Vertical	0.10	-1.83

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section15.247, Upper Band Edge (X-axis)

Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - High Channel - X



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

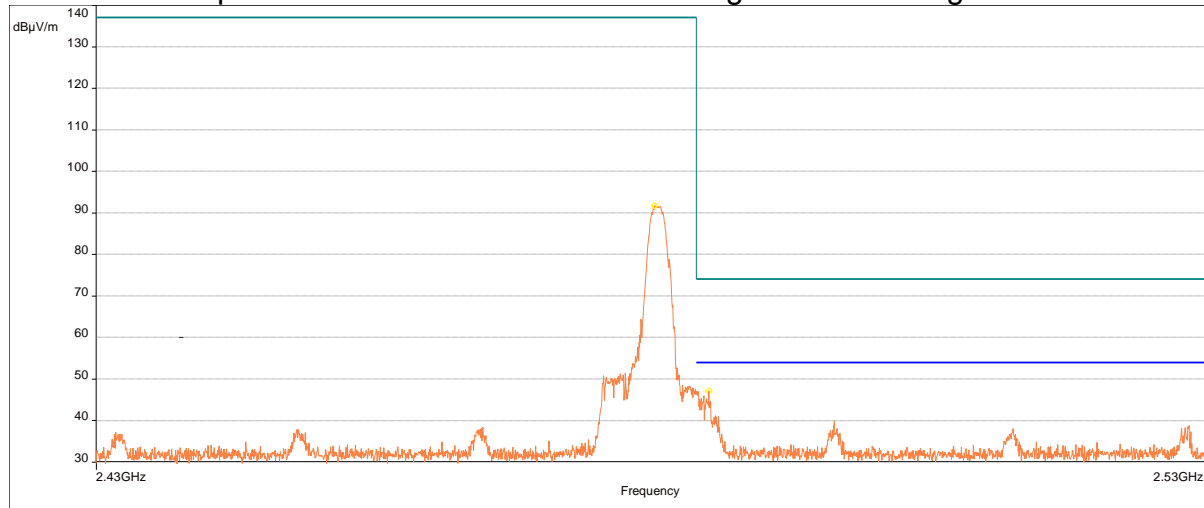
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2483.6066 67	1	44.46	54.00	-9.54	2.51	223.00	Horizontal polarization	-1.70

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section15.247, Upper Band Edge (Y-axis)

Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - High Channel - Y



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

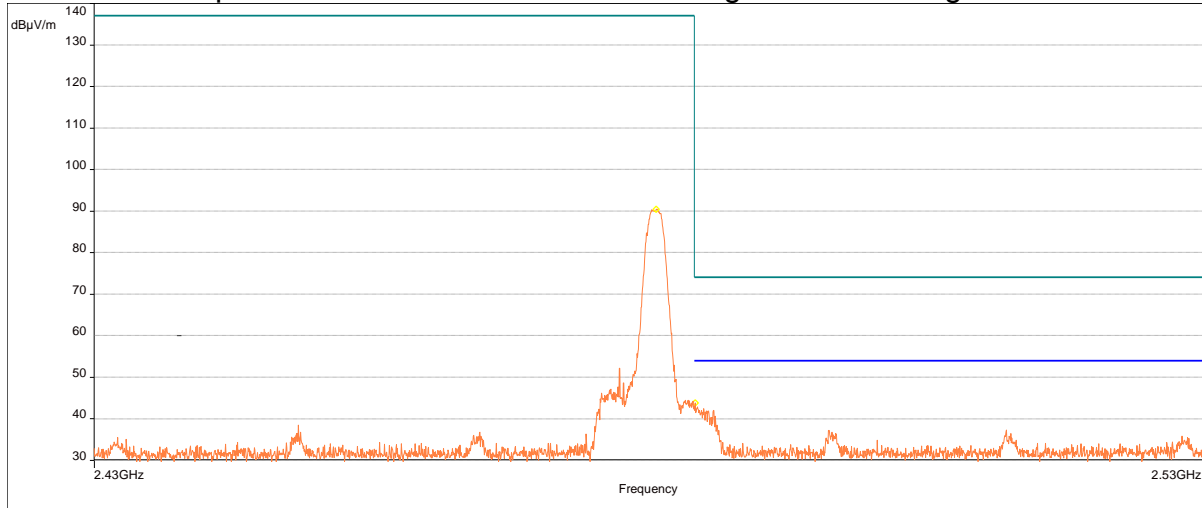
1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2484.6366 67	1	47.07	54.00	-6.93	1.02	313.00	Horizontal polarization	-1.70

Model: HIWMA1BLE40AWH, FCC Part 15 Subpart C Section 15.247, Upper Band Edge (Z-axis)

Emissions Graph: HIWMA1BLE40AWH - Band Edge 2.4 GHz - High Channel - Z



FCC Part 15 Transmitters/15.247 Band Edge

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak /Lim. Average (1)

Frequency (MHz)	SR	Peak (dBµV/m)	Lim. Average (dBµV/m)	Peak-Lim (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2483.606667	1	43.78	54.00	-10.22	3.98	0.00	Vertical polarization	-1.70

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable)
 Product Standard: FCC; RSS-247
 Input Voltage: 120VAC,60Hz

Pretest Verification: Y

Test Date: 03/06/2018

Limit Applied: 15.205

Ambient Temperature: 23 °C
 Relative Humidity: 32 %
 Atmospheric Pressure: 984 mbars

Deviations, Additions, or Exclusions: None

9 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Spurious Emissions

9.1 Method

Tests are performed in accordance with FCC CFR47 Part 15 Subpart C and ANSI C63.10, RSS-247. All measurements were performed at 3m distance.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	4.1 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.8 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.1 dB	5.2 dB
Radiated Emissions, 3m	6-18 GHz	3.9 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.5 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212054'	Barometric Pressure/Humidity/Temperature Datalogger	Extech	SD700	A.032434	10/17/2017	10/17/2018
232944'	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401;	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified

Above 1 GHz

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/03/2017	05/03/2018
213023	Antenna, Horn, 18-40 GHz	EMCO	3116	9310-2222	09/21/2017	09/21/2018
E402	Cable E402, 40 GHz, 2.9, 9"	Megaphase	TM40 K1K1 9	E402	09/22/2017	09/22/2018
E404	Cable E404, 40 GHz, 2.9, 2m	Megaphase	TM40 K1K1 80	E404	09/22/2017	09/22/2018
200080	Preamplifier, 18-40GHz, 29 dB Gain	Miteq	JS41800400-30-5P-S	818197	09/28/2017	09/28/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

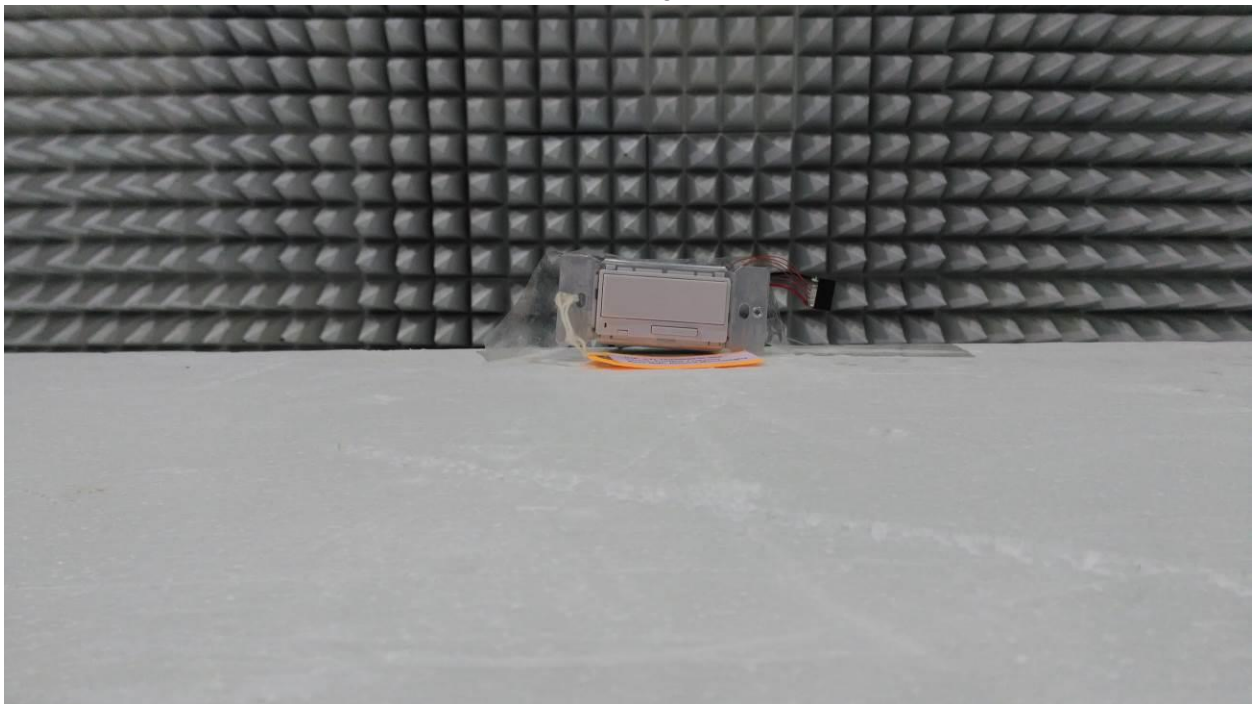
9.3 Results:

The sample tested was found to Comply.

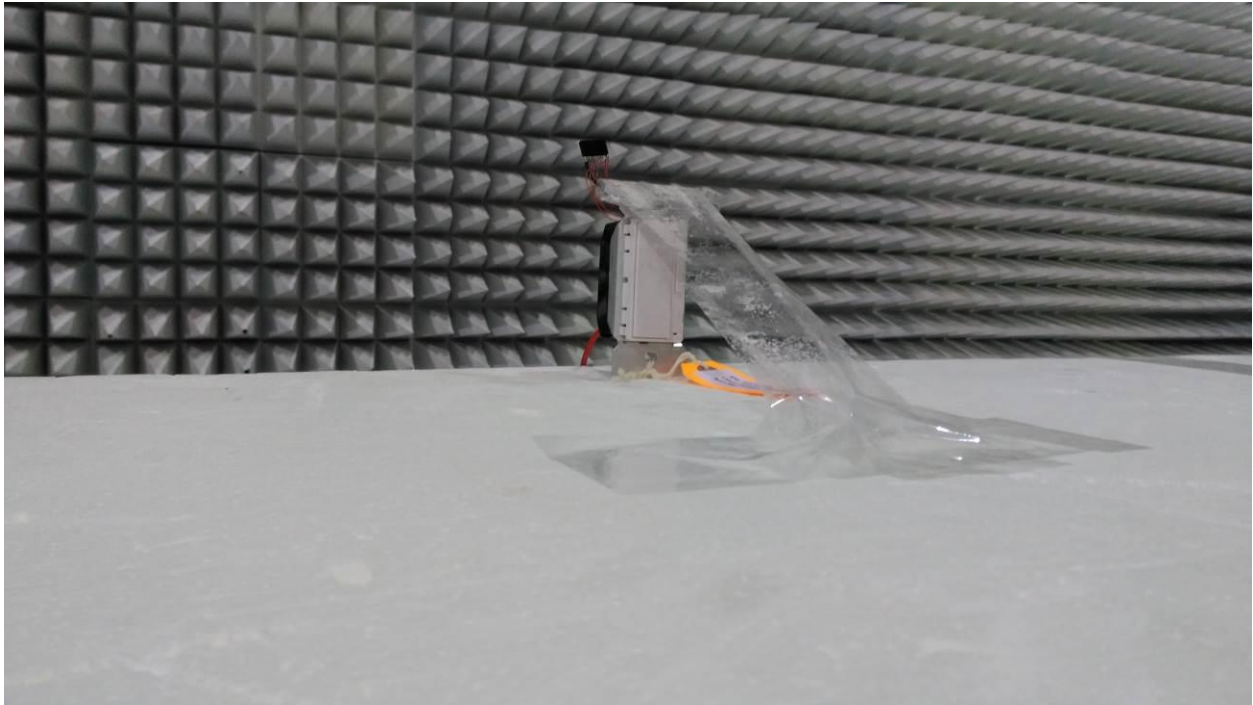
9.4 Setup Photographs:



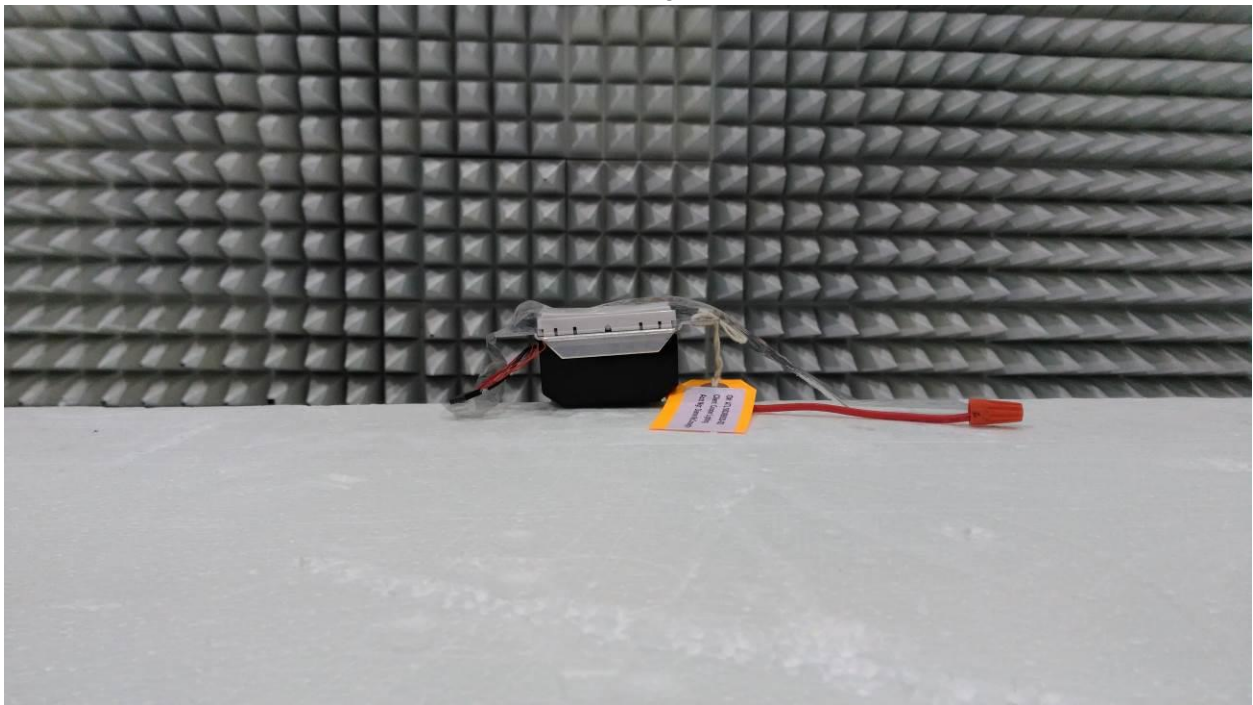
X - Axis



Y - Axis



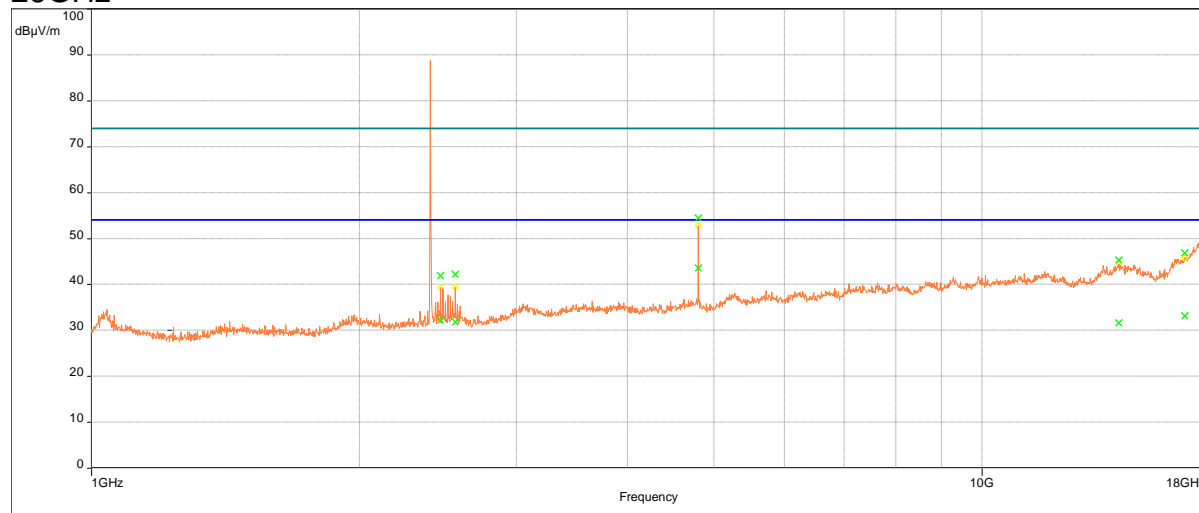
Z - Axis



9.5 Plots/Data:

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, Low Channel, 1-26 GHz

Emissions Graph: HIWAC1BLE40AWH_Spurious_X_Low Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2466.0647	1	32.22	54.00	-21.78	48.00	1.02	Vertical	0.10	-1.72
2562.2583	1	31.81	54.00	-22.19	1.00	1.29	Vertical	0.10	-1.43
4804.4928	1	43.55	54.00	-10.45	7.00	1.40	Vertical	0.10	3.91
14238.7158	1	31.56	54.00	-22.44	298.00	3.65	Vertical	0.10	12.60
16887.5798	1	33.11	54.00	-20.89	321.00	3.49	Vertical	0.10	13.61
17910.0558	1	39.50	54.00	-14.50	44.00	3.49	Vertical	0.10	21.14

(Det. Used: Peak) Peak (PASS) (6)

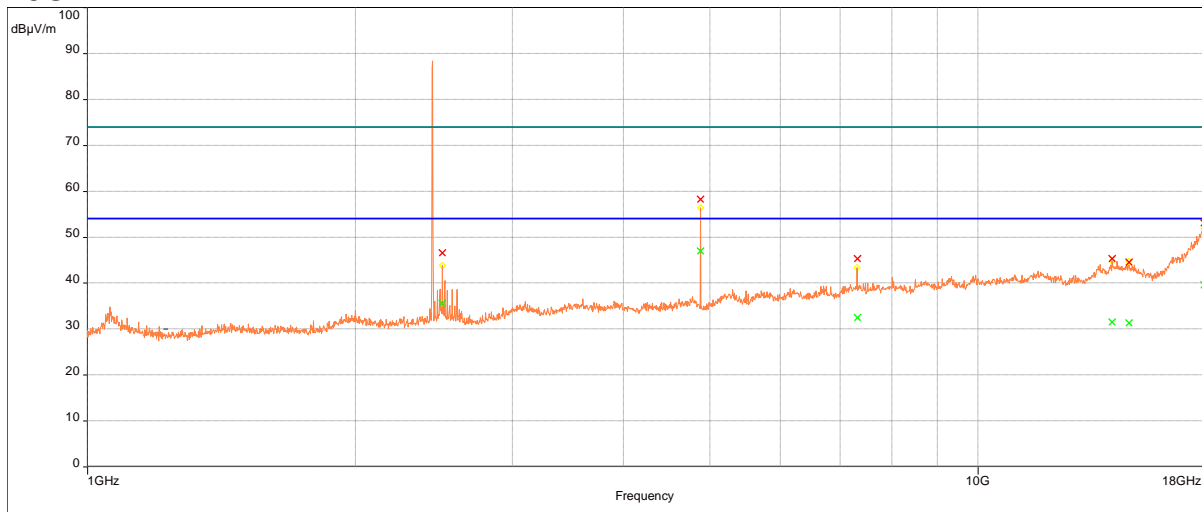
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2466.0647	1	41.93	74.00	-32.07	48.00	1.02	Vertical	0.10	-1.72
2562.2583	1	42.20	74.00	-31.80	1.00	1.29	Vertical	0.10	-1.43
4804.4928	1	54.39	74.00	-19.61	7.00	1.40	Vertical	0.10	3.91
14238.7158	1	45.29	74.00	-28.71	298.00	3.65	Vertical	0.10	12.60
16887.5798	1	46.80	74.00	-27.20	321.00	3.49	Vertical	0.10	13.61
17910.0558	1	52.65	74.00	-21.35	44.00	3.49	Vertical	0.10	21.14

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19224.000	1	70	84.00	-14	48.00	1.02	Vertical	0.10	-1.72

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, Mid Channel, 1-26 GHz.

Emissions Graph: HIWAC1BLE40AWH_Spurious_X_Mid Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2504.2627	1	35.58	54.00	-18.42	1.00	1.10	Vertical	0.10	-1.66
4880.5347	1	46.98	54.00	-7.02	0.00	1.08	Vertical	0.10	4.10
7319.8816	1	32.48	54.00	-21.52	1.00	1.11	Vertical	0.10	8.63
14146.9434	1	31.52	54.00	-22.48	190.00	2.40	Vertical	0.10	12.48
14784.1556	1	31.29	54.00	-22.71	317.00	2.69	Horizontal	0.10	12.89
17936.2118	1	39.53	54.00	-14.47	72.00	2.38	Horizontal	0.10	21.27

(Det. Used: Peak) - Peak (PASS) (6)

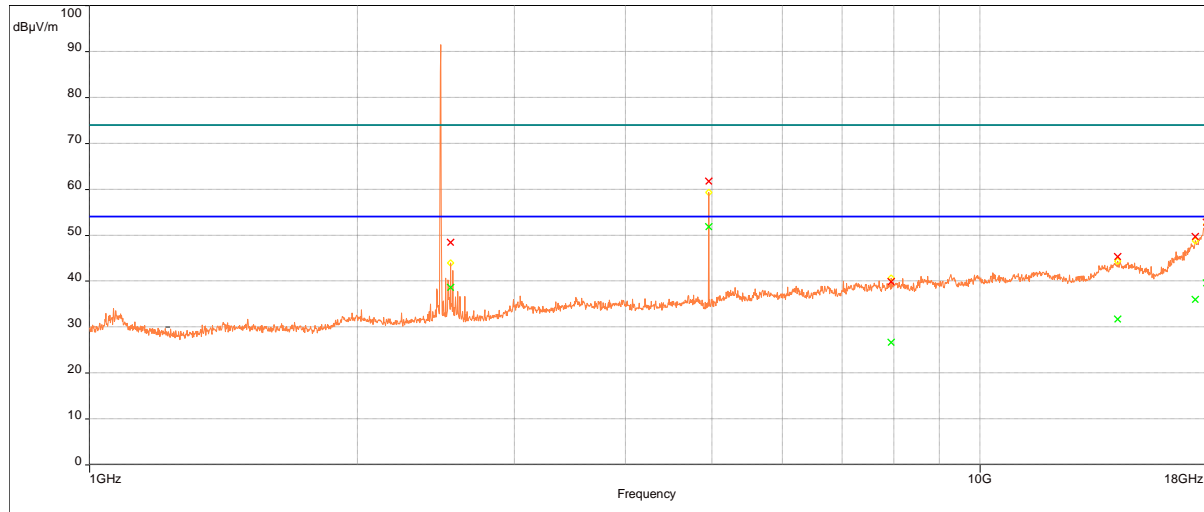
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2504.2627	1	46.54	74.00	-27.46	1.00	1.10	Vertical	0.10	-1.66
4880.5347	1	58.25	74.00	-15.75	0.00	1.08	Vertical	0.10	4.10
7319.8816	1	45.31	74.00	-28.69	1.00	1.11	Vertical	0.10	8.63
14146.9434	1	45.30	74.00	-28.70	190.00	2.40	Vertical	0.10	12.48
14784.1556	1	44.57	74.00	-29.43	317.00	2.69	Horizontal	0.10	12.89
17936.2118	1	53.07	74.00	-20.93	72.00	2.38	Horizontal	0.10	21.27

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19520.000	1	67.00	84.00	-17	48.00	1.02	Vertical	0.10	-1.72

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, High Channel, 1-26 GHz

Emissions Graph: HIWAC1BLE40AWH_Spurious_X_High Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.8817	1	38.63	54.00	-15.37	3.00	1.40	Vertical	0.10	-1.51
4959.4876	1	51.82	54.00	-2.18	1.00	1.08	Vertical	0.10	4.13
7949.9219	1	26.59	54.00	-27.41	30.00	1.19	Vertical	0.10	9.29
14274.8924	1	31.70	54.00	-22.30	6.00	2.86	Vertical	0.10	12.68
17444.4916	1	35.92	54.00	-18.08	132.00	1.21	Vertical	0.10	17.60
17961.883	1	39.52	54.00	-14.48	306.00	1.40	Vertical	0.10	21.42

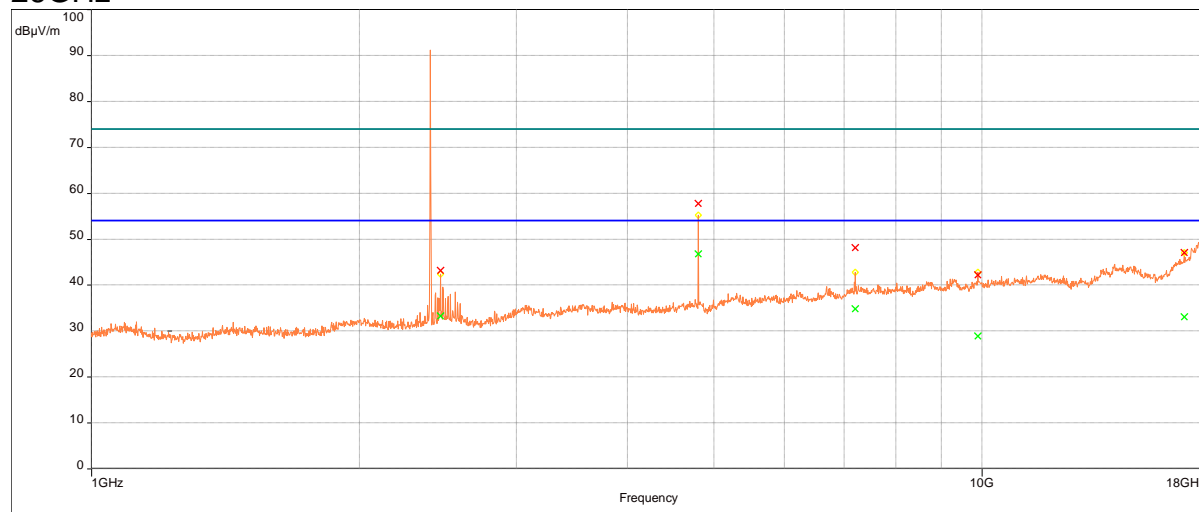
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.8817	1	48.39	74.00	-25.61	3.00	1.40	Vertical	0.10	-1.51
4959.4876	1	61.68	74.00	-12.32	1.00	1.08	Vertical	0.10	4.13
7949.9219	1	39.83	74.00	-34.17	30.00	1.19	Vertical	0.10	9.29
14274.8924	1	45.29	74.00	-28.71	6.00	2.86	Vertical	0.10	12.68
17444.4916	1	49.71	74.00	-24.29	132.00	1.21	Vertical	0.10	17.60
17961.883	1	52.78	74.00	-21.22	306.00	1.40	Vertical	0.10	21.42

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19832.000	1	68.20	84.00	-15.8	48.00	1.02	Vertical	0.10	-1.72

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, Low Channel, 1-26 GHz
Emissions Graph: HIWAC1BLE40AWH_Spurious_Y_Low Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

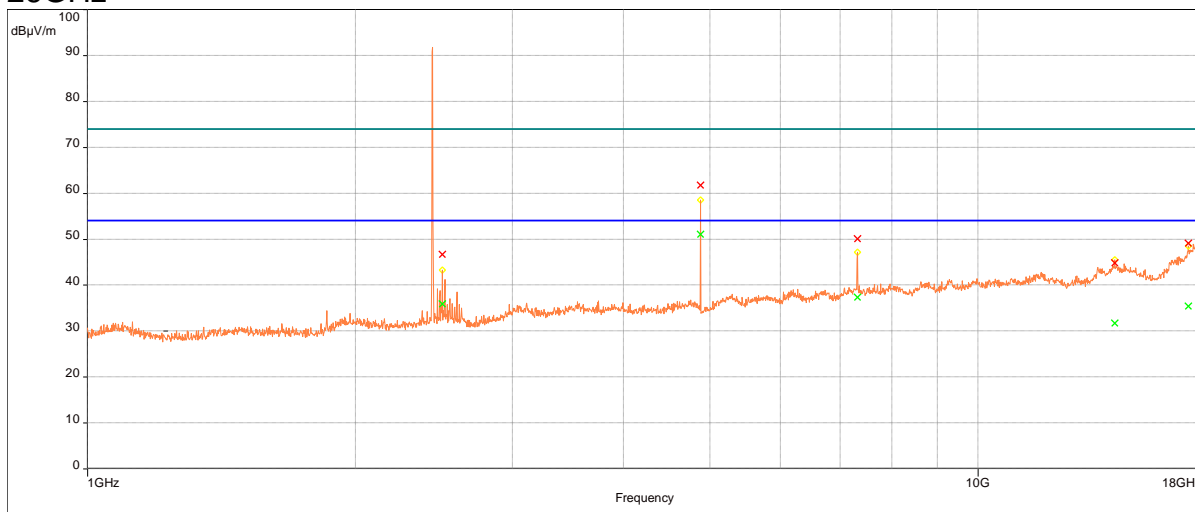
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2465.8549	1	33.27	54.00	-20.73	296.00	1.01	Horizontal	0.10	-1.72
4804.5054	1	46.71	54.00	-7.29	318.00	4.00	Horizontal	0.10	3.91
7206.8848	1	34.76	54.00	-19.24	308.00	1.08	Horizontal	0.10	8.15
9899.5558	1	28.91	54.00	-25.09	34.00	2.21	Vertical	0.10	11.24
16873.2244	1	33.03	54.00	-20.97	95.00	3.52	Vertical	0.10	13.56
17887.0868	1	39.46	54.00	-14.54	147.00	3.90	Horizontal	0.10	21.02

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2465.8549	1	43.15	74.00	-30.85	296.00	1.01	Horizontal	0.10	-1.72
4804.5054	1	57.69	74.00	-16.31	318.00	4.00	Horizontal	0.10	3.91
7206.8848	1	48.15	74.00	-25.85	308.00	1.08	Horizontal	0.10	8.15
9899.5558	1	42.16	74.00	-31.84	34.00	2.21	Vertical	0.10	11.24
16873.2244	1	47.08	74.00	-26.92	95.00	3.52	Vertical	0.10	13.56
17887.0868	1	52.71	74.00	-21.29	147.00	3.90	Horizontal	0.10	21.02

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, Mid Channel, 1-26 GHz.
Emissions Graph: HIWAC1BLE40AWH_Spurious_Y_Mid Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2504.2619	1	35.86	54.00	-18.14	3.00	1.26	Horizontal	0.10	-1.66
4880.4821	1	51.08	54.00	-2.92	316.00	3.95	Horizontal	0.10	4.10
7320.7704	1	37.37	54.00	-16.63	316.00	3.97	Horizontal	0.10	8.63
14244.1184	1	31.73	54.00	-22.27	12.00	3.62	Horizontal	0.10	12.59
17231.029	1	35.38	54.00	-18.62	216.00	2.93	Vertical	0.10	16.49
17900.8926	1	39.53	54.00	-14.47	271.00	2.38	Horizontal	0.10	21.10

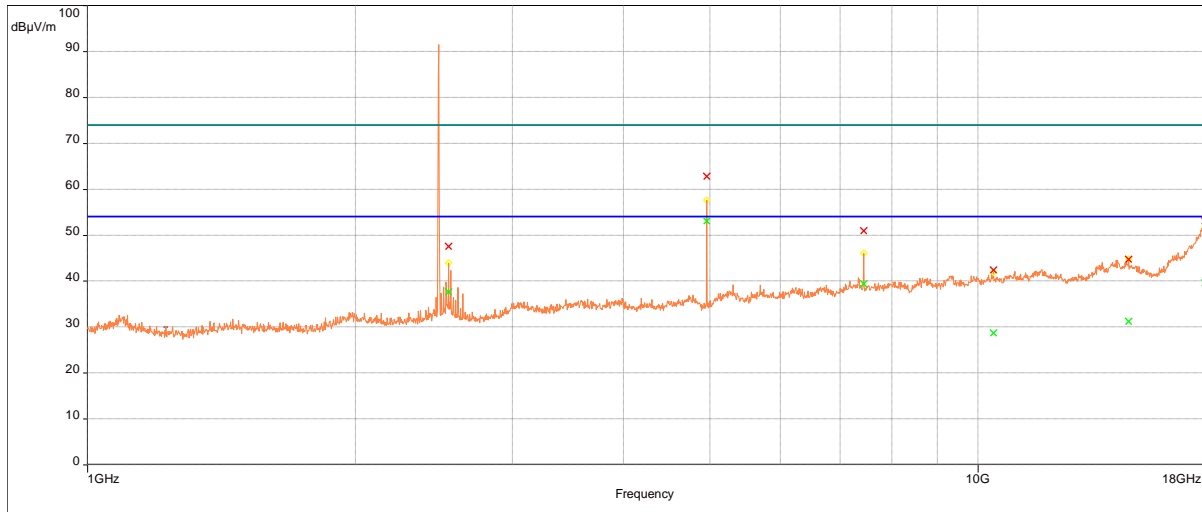
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2504.2619	1	46.61	74.00	-27.39	3.00	1.26	Horizontal	0.10	-1.66
4880.4821	1	61.73	74.00	-12.27	316.00	3.95	Horizontal	0.10	4.10
7320.7704	1	50.01	74.00	-23.99	316.00	3.97	Horizontal	0.10	8.63
14244.1184	1	44.83	74.00	-29.17	12.00	3.62	Horizontal	0.10	12.59
17231.029	1	49.05	74.00	-24.95	216.00	2.93	Vertical	0.10	16.49
17900.8926	1	53.17	74.00	-20.83	271.00	2.38	Horizontal	0.10	21.10

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, High Channel, 1-26 GHz.

Emissions Graph: HIWAC1BLE40AWH_Spurious_Y_High Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.7535	1	37.66	54.00	-16.34	1.00	1.32	Horizontal	0.10	-1.51
4959.5143	1	53.08	54.00	-0.92	14.00	1.00	Horizontal	0.10	4.13
7439.2231	1	39.33	54.00	-14.67	6.00	2.15	Horizontal	0.10	8.75
10411.5848	1	28.67	54.00	-25.33	138.00	2.88	Vertical	0.10	11.69
14765.1778	1	31.16	54.00	-22.84	45.00	1.30	Vertical	0.10	12.92
17975.5296	1	39.56	54.00	-14.44	56.00	2.40	Vertical	0.10	21.50

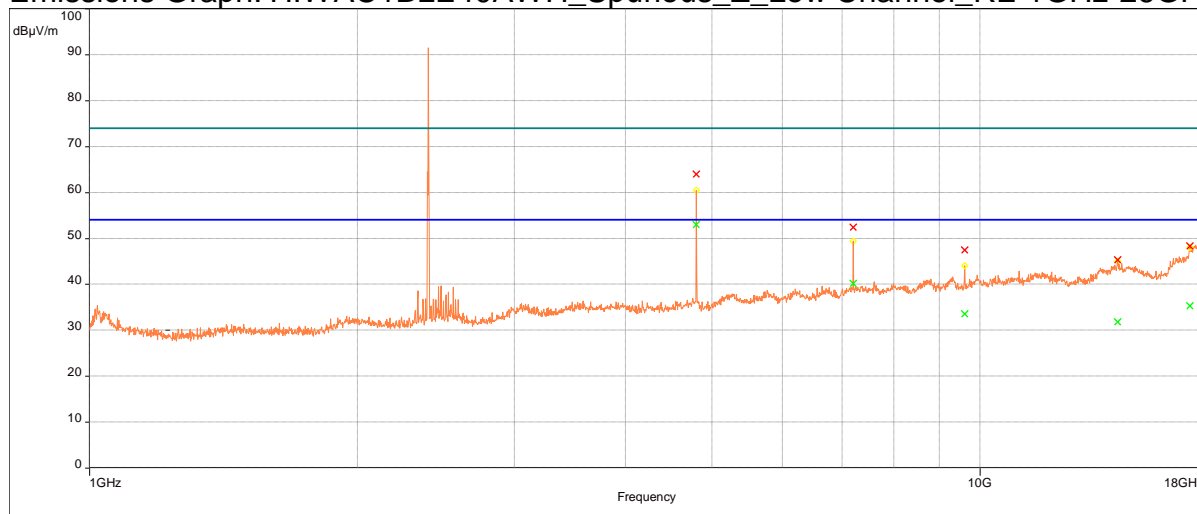
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.7535	1	47.51	74.00	-26.49	1.00	1.32	Horizontal	0.10	-1.51
4959.5143	1	62.76	74.00	-11.24	14.00	1.00	Horizontal	0.10	4.13
7439.2231	1	50.95	74.00	-23.05	6.00	2.15	Horizontal	0.10	8.75
10411.5848	1	42.42	74.00	-31.58	138.00	2.88	Vertical	0.10	11.69
14765.1778	1	44.71	74.00	-29.29	45.00	1.30	Vertical	0.10	12.92
17975.5296	1	53.10	74.00	-20.90	56.00	2.40	Vertical	0.10	21.50

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, Low Channel, 1-26 GHz

Emissions Graph: HIWAC1BLE40AWH_Spurious_Z_Low Channel_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

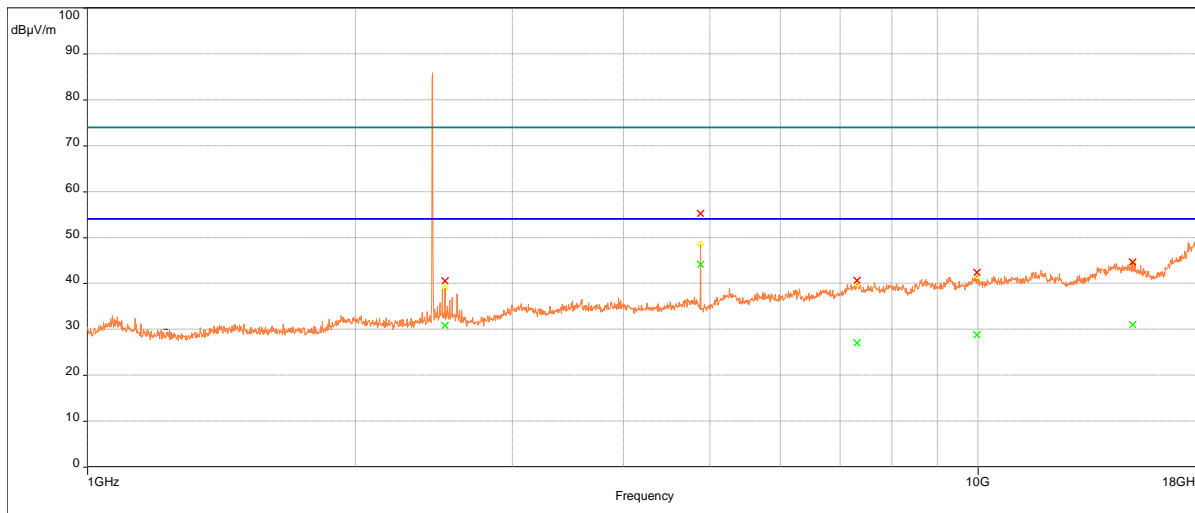
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
4804.5258	1	52.96	54.00	-1.04	1.00	2.73	Vertical	0.10	3.91
7206.7422	1	40.18	54.00	-13.82	8.00	2.73	Vertical	0.10	8.15
9609.0462	1	33.53	54.00	-20.47	10.00	3.96	Vertical	0.10	10.80
14276.4542	1	31.82	54.00	-22.18	142.00	2.40	Horizontal	0.10	12.69
17217.8354	1	35.25	54.00	-18.75	309.00	3.62	Horizontal	0.10	16.39
17996.4672	1	39.62	54.00	-14.38	0.00	2.53	Horizontal	0.10	21.53

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
4804.5258	1	63.99	74.00	-10.01	1.00	2.73	Vertical	0.10	3.91
7206.7422	1	52.37	74.00	-21.63	8.00	2.73	Vertical	0.10	8.15
9609.0462	1	47.41	74.00	-26.59	10.00	3.96	Vertical	0.10	10.80
14276.4542	1	45.32	74.00	-28.68	142.00	2.40	Horizontal	0.10	12.69
17217.8354	1	48.29	74.00	-25.71	309.00	3.62	Horizontal	0.10	16.39
17996.4672	1	53.23	74.00	-20.77	0.00	2.53	Horizontal	0.10	21.53

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, Mid Channel, 1-26 GHz
Emissions Graph: HIWAC1BLE40AWH_Spurious_Z_Mid Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2520.1089	1	30.77	54.00	-23.23	2.00	1.04	Vertical	0.10	-1.60
4880.4851	1	44.13	54.00	-9.87	6.00	3.88	Vertical	0.10	4.10
7311.8081	1	27.01	54.00	-26.99	150.00	3.65	Horizontal	0.10	8.62
9979.1593	1	28.82	54.00	-25.18	33.00	2.66	Vertical	0.10	11.44
14914.2622	1	31.04	54.00	-22.96	326.00	3.76	Vertical	0.10	12.50
17917.1908	1	39.49	54.00	-14.51	91.00	2.53	Vertical	0.10	21.18

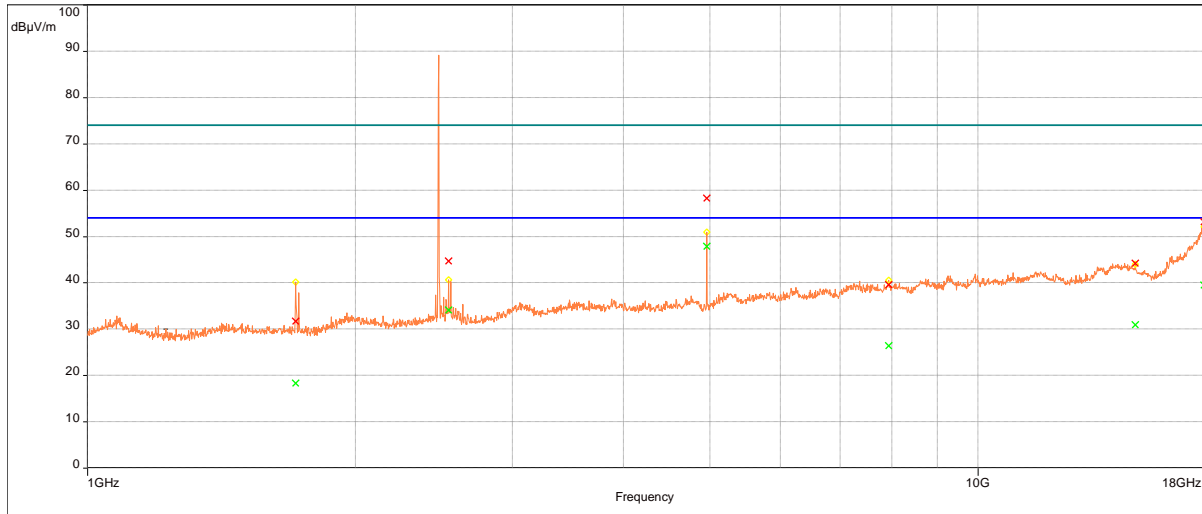
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2520.1089	1	40.56	74.00	-33.44	2.00	1.04	Vertical	0.10	-1.60
4880.4851	1	55.24	74.00	-18.76	6.00	3.88	Vertical	0.10	4.10
7311.8081	1	40.61	74.00	-33.39	150.00	3.65	Horizontal	0.10	8.62
9979.1593	1	42.38	74.00	-31.62	33.00	2.66	Vertical	0.10	11.44
14914.2622	1	44.65	74.00	-29.35	326.00	3.76	Vertical	0.10	12.50
17917.1908	1	52.80	74.00	-21.20	91.00	2.53	Vertical	0.10	21.18

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWAC1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, High Channel, 1-26 GHz.

Emissions Graph: HIWAC1BLE40AWH_Spurious_Z_High Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

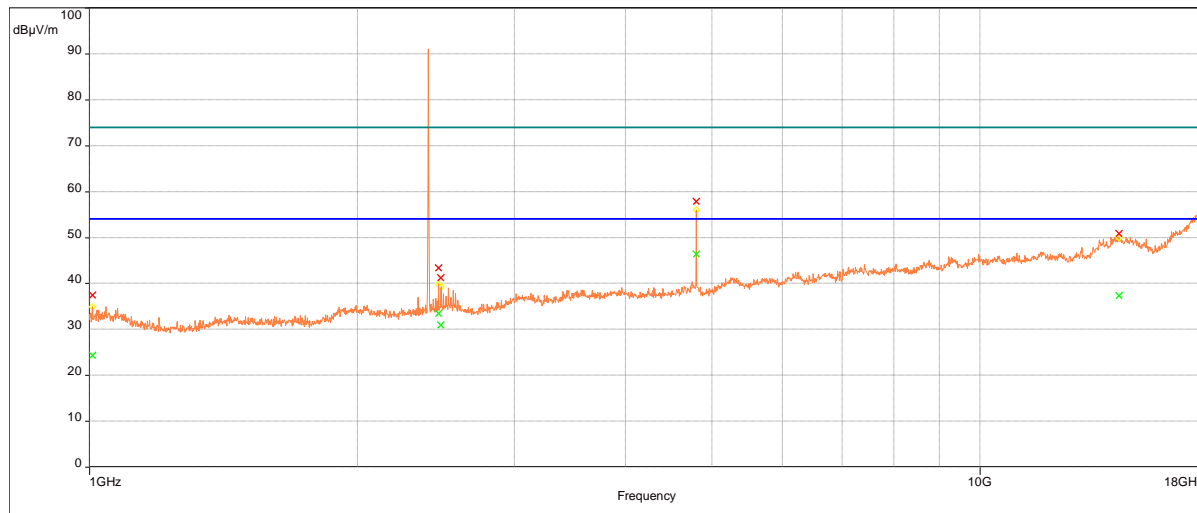
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1713.6654	1	18.32	54.00	-35.68	35.00	1.05	Vertical	0.10	-4.41
2543.7712	1	34.05	54.00	-19.95	224.00	1.03	Vertical	0.10	-1.51
4959.4435	1	47.84	54.00	-6.16	0.00	3.80	Vertical	0.10	4.13
7938.2269	1	26.40	54.00	-27.60	304.00	1.24	Vertical	0.10	9.27
15016.2452	1	30.91	54.00	-23.09	13.00	2.70	Horizontal	0.10	11.98
17945.1518	1	39.48	54.00	-14.52	75.00	1.48	Vertical	0.10	21.32

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1713.6654	1	31.70	74.00	-42.30	35.00	1.05	Vertical	0.10	-4.41
2543.7712	1	44.64	74.00	-29.36	224.00	1.03	Vertical	0.10	-1.51
4959.4435	1	58.22	74.00	-15.78	0.00	3.80	Vertical	0.10	4.13
7938.2269	1	39.60	74.00	-34.40	304.00	1.24	Vertical	0.10	9.27
15016.2452	1	44.21	74.00	-29.79	13.00	2.70	Horizontal	0.10	11.98
17945.1518	1	53.10	74.00	-20.90	75.00	1.48	Vertical	0.10	21.32

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, Low Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_X_Low Channel_Pwr5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1008.4947	1	24.31	54.00	-29.69	190.00	3.93	Horizontal	0.10	-5.67
2465.8593	1	33.43	54.00	-20.57	4.00	1.50	Vertical	0.10	0.15
2481.8428	1	30.93	54.00	-23.07	319.00	2.56	Vertical	0.10	0.18
4804.5536	1	46.38	54.00	-7.62	229.00	3.49	Horizontal	0.10	6.75
14329.3878	1	37.36	54.00	-16.64	218.00	2.88	Horizontal	0.10	18.23
17934.185	1	45.92	54.00	-8.08	126.00	3.83	Vertical	0.10	27.43

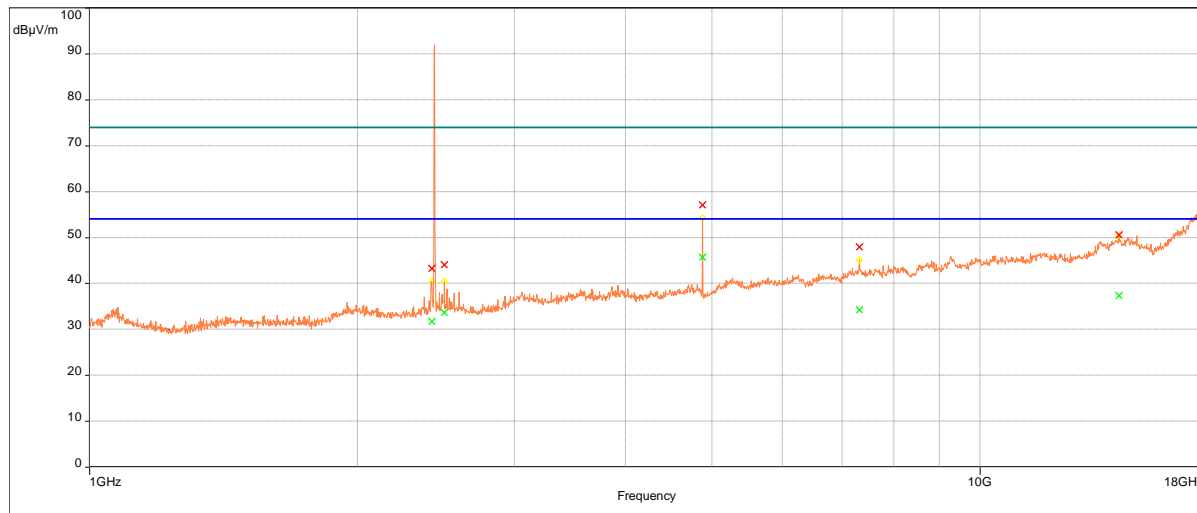
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1008.4947	1	37.39	74.00	-36.61	190.00	3.93	Horizontal	0.10	-5.67
2465.8593	1	43.38	74.00	-30.62	4.00	1.50	Vertical	0.10	0.15
2481.8428	1	41.19	74.00	-32.81	319.00	2.56	Vertical	0.10	0.18
4804.5536	1	57.81	74.00	-16.19	229.00	3.49	Horizontal	0.10	6.75
14329.3878	1	50.80	74.00	-23.20	218.00	2.88	Horizontal	0.10	18.23
17934.185	1	59.17	74.00	-14.83	126.00	3.83	Vertical	0.10	27.43

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19224.000	1	67.3	84.00	-16.7	48.00	1.02	Vertical	0.10	-1.72

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, Mid Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_X_Mid Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2423.8564	1	31.68	54.00	-22.32	299.00	3.93	Vertical	0.10	0.08
2504.0974	1	33.65	54.00	-20.35	0.00	2.61	Vertical	0.10	0.22
4880.5353	1	45.67	54.00	-8.33	225.00	2.96	Horizontal	0.10	6.96
7320.8999	1	34.20	54.00	-19.80	228.00	2.55	Horizontal	0.10	12.13
14334.092	1	37.31	54.00	-16.69	163.00	2.22	Horizontal	0.10	18.25
17930.5662	1	45.90	54.00	-8.10	215.00	3.81	Vertical	0.10	27.41

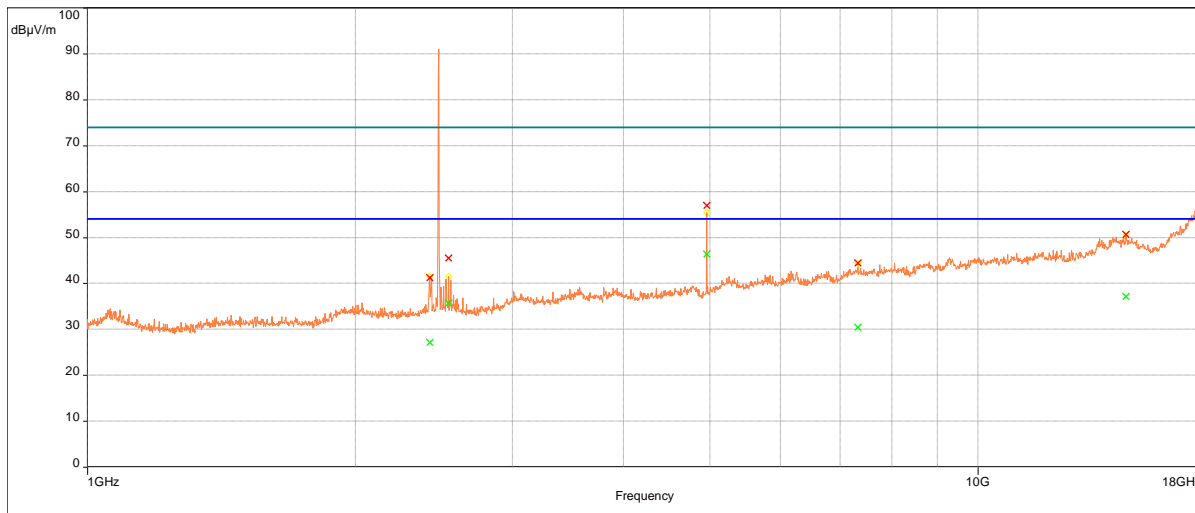
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2423.8564	1	43.23	74.00	-30.77	299.00	3.93	Vertical	0.10	0.08
2504.0974	1	43.98	74.00	-30.02	0.00	2.61	Vertical	0.10	0.22
4880.5353	1	57.06	74.00	-16.94	225.00	2.96	Horizontal	0.10	6.96
7320.8999	1	47.92	74.00	-26.08	228.00	2.55	Horizontal	0.10	12.13
14334.092	1	50.53	74.00	-23.47	163.00	2.22	Horizontal	0.10	18.25
17930.5662	1	59.77	74.00	-14.23	215.00	3.81	Vertical	0.10	27.41

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19520.000	1	67.7	84.00	-16.3	48.00	1.02	Vertical	0.10	-1.72

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, X-axis, High Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_X_High Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2423.8726	1	27.15	54.00	-26.85	165.00	2.56	Horizontal	0.10	0.08
2544.1309	1	35.66	54.00	-18.34	3.00	1.39	Vertical	0.10	0.39
4959.4468	1	46.34	54.00	-7.66	3.00	1.03	Vertical	0.10	7.03
7330.3677	1	30.43	54.00	-23.57	265.00	1.32	Vertical	0.10	12.14
14668.6248	1	37.13	54.00	-16.87	60.00	1.48	Horizontal	0.10	18.45
17962.7264	1	45.92	54.00	-8.08	94.00	1.27	Horizontal	0.10	27.60

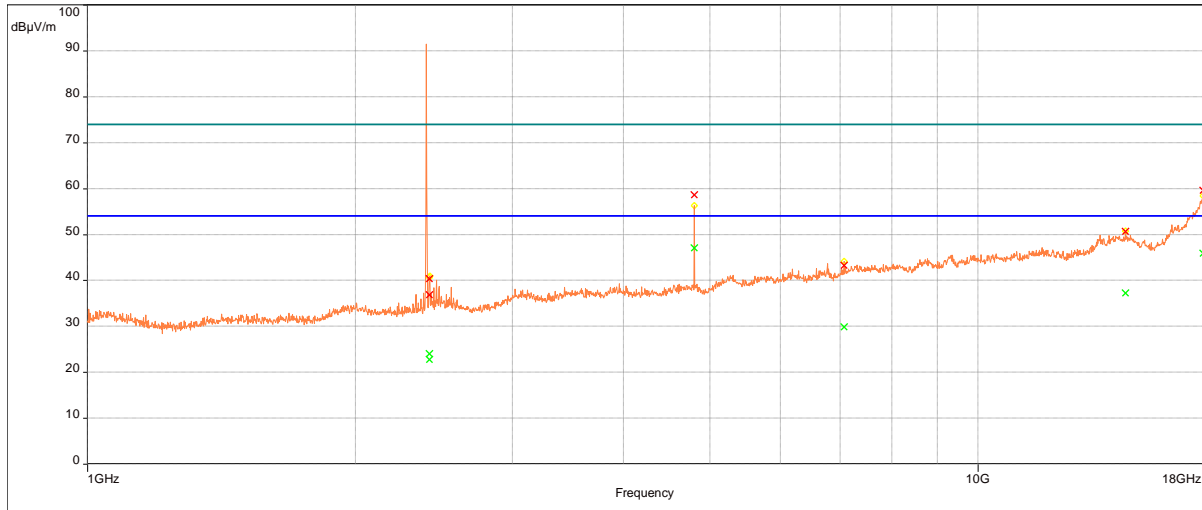
(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2423.8726	1	41.24	74.00	-32.76	165.00	2.56	Horizontal	0.10	0.08
2544.1309	1	45.49	74.00	-28.51	3.00	1.39	Vertical	0.10	0.39
4959.4468	1	56.95	74.00	-17.05	3.00	1.03	Vertical	0.10	7.03
7330.3677	1	44.44	74.00	-29.56	265.00	1.32	Vertical	0.10	12.14
14668.6248	1	50.64	74.00	-23.36	60.00	1.48	Horizontal	0.10	18.45
17962.7264	1	59.44	74.00	-14.56	94.00	1.27	Horizontal	0.10	27.60

(Det. Used: Ave) Hand Scan Measurement 18 to 26 GHz(Highest peak measurement recorded for X,Y,and Z Axis)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 10cm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
19831.000	1	69.7	84.00	-14.3	48.00	1.02	Vertical	0.10	-1.72

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, Low Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Y_Low Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

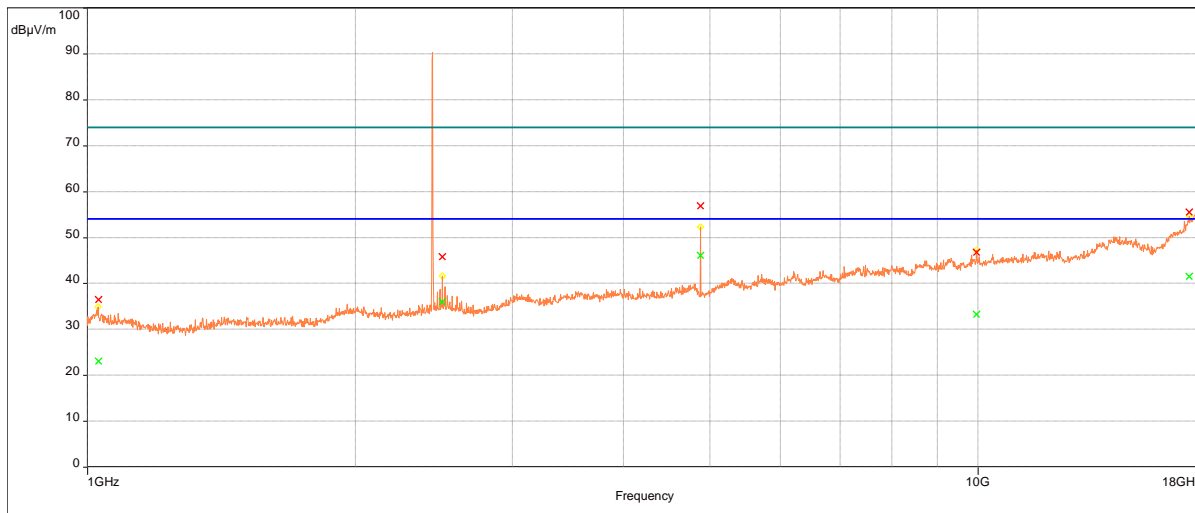
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2420.5642	1	23.99	54.00	-30.01	35.00	2.92	Vertical	0.10	0.08
2422.0808	1	22.79	54.00	-31.21	47.00	2.23	Vertical	0.10	0.08
4804.5376	1	47.06	54.00	-6.94	15.00	1.08	Horizontal	0.10	6.75
7072.8083	1	29.82	54.00	-24.18	191.00	2.91	Horizontal	0.10	10.99
14647.2734	1	37.19	54.00	-16.81	36.00	2.28	Vertical	0.10	18.43
17905.4536	1	45.90	54.00	-8.10	273.00	3.67	Horizontal	0.10	27.27

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2420.5642	1	40.39	74.00	-33.61	35.00	2.92	Vertical	0.10	0.08
2422.0808	1	36.88	74.00	-37.12	47.00	2.23	Vertical	0.10	0.08
4804.5376	1	58.61	74.00	-15.39	15.00	1.08	Horizontal	0.10	6.75
7072.8083	1	43.26	74.00	-30.74	191.00	2.91	Horizontal	0.10	10.99
14647.2734	1	50.67	74.00	-23.33	36.00	2.28	Vertical	0.10	18.43
17905.4536	1	59.57	74.00	-14.43	273.00	3.67	Horizontal	0.10	27.27

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, Mid Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Y_Mid Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

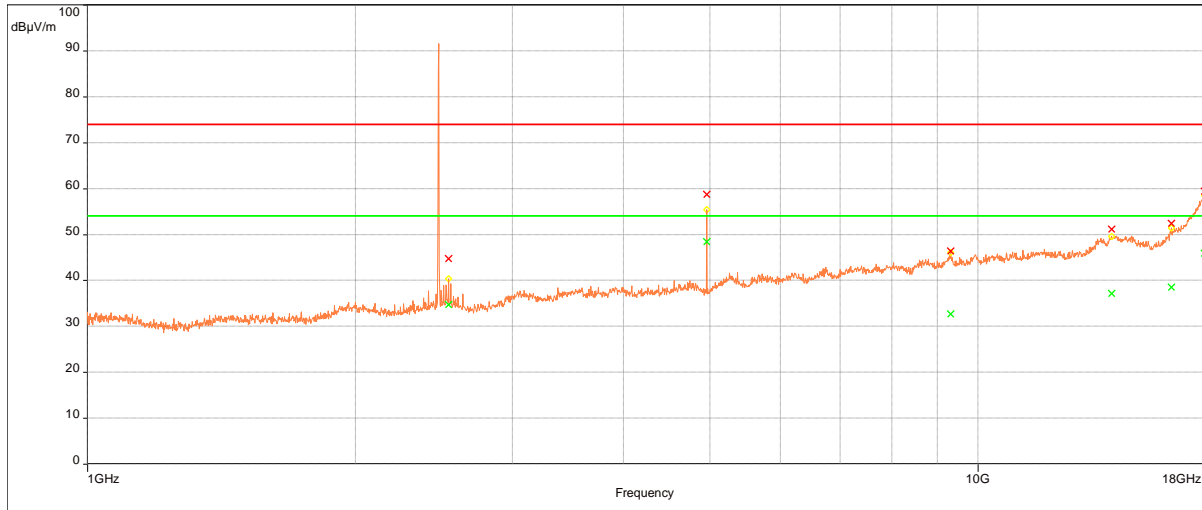
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1029.2787	1	23.05	54.00	-30.95	29.00	1.21	Vertical	0.10	-5.45
2504.0191	1	35.95	54.00	-18.05	11.00	1.37	Horizontal	0.10	0.22
4880.4719	1	46.05	54.00	-7.95	31.00	1.08	Horizontal	0.10	6.96
9966.1819	1	33.22	54.00	-20.78	263.00	2.85	Horizontal	0.10	15.62
17261.8182	1	41.51	54.00	-12.49	118.00	3.83	Vertical	0.10	22.64
17999.1876	1	46.00	54.00	-8.00	73.00	2.22	Horizontal	0.10	27.72

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
1029.2787	1	36.48	74.00	-37.52	29.00	1.21	Vertical	0.10	-5.45
2504.0191	1	45.82	74.00	-28.18	11.00	1.37	Horizontal	0.10	0.22
4880.4719	1	56.89	74.00	-17.11	31.00	1.08	Horizontal	0.10	6.96
9966.1819	1	46.79	74.00	-27.21	263.00	2.85	Horizontal	0.10	15.62
17261.8182	1	55.48	74.00	-18.52	118.00	3.83	Vertical	0.10	22.64
17999.1876	1	59.47	74.00	-14.53	73.00	2.22	Horizontal	0.10	27.72

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Y-axis, High Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Y_High Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

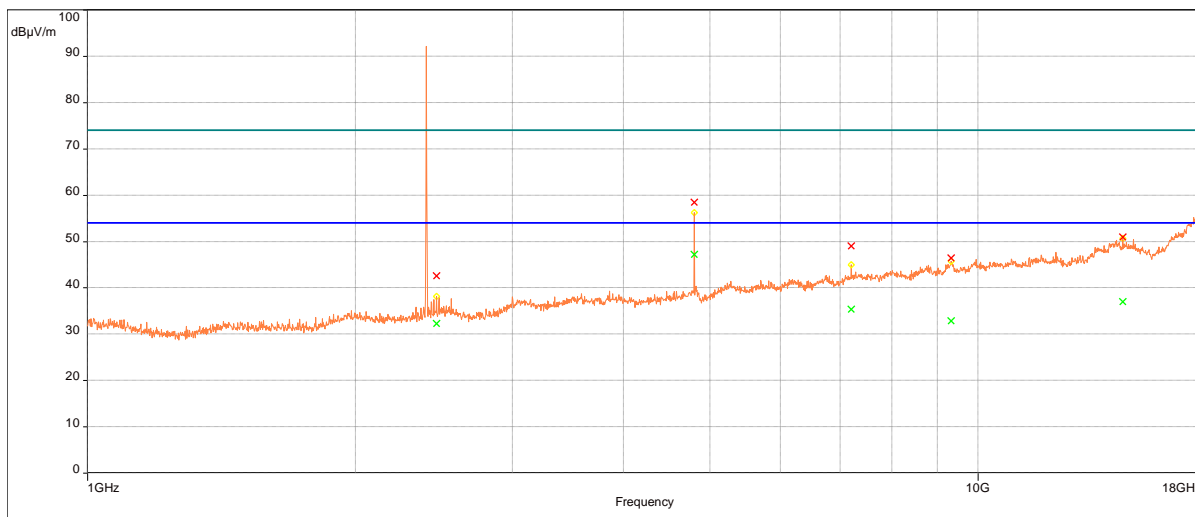
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.8695	1	34.66	54.00	-19.34	45.00	1.30	Horizontal	0.10	0.39
4959.4648	1	48.37	54.00	-5.63	55.00	1.08	Horizontal	0.10	7.03
9318.6328	1	32.70	54.00	-21.30	221.00	2.98	Horizontal	0.10	14.61
14130.7808	1	37.09	54.00	-16.91	100.00	1.24	Horizontal	0.10	17.87
16489.4566	1	38.45	54.00	-15.55	220.00	3.65	Horizontal	0.10	17.94
17953.4062	1	45.88	54.00	-8.12	325.00	1.24	Vertical	0.10	27.54

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.8695	1	44.73	74.00	-29.27	45.00	1.30	Horizontal	0.10	0.39
4959.4648	1	58.70	74.00	-15.30	55.00	1.08	Horizontal	0.10	7.03
9318.6328	1	46.33	74.00	-27.67	221.00	2.98	Horizontal	0.10	14.61
14130.7808	1	51.09	74.00	-22.91	100.00	1.24	Horizontal	0.10	17.87
16489.4566	1	52.41	74.00	-21.59	220.00	3.65	Horizontal	0.10	17.94
17953.4062	1	59.39	74.00	-14.61	325.00	1.24	Vertical	0.10	27.54

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, Low Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Z_Low Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

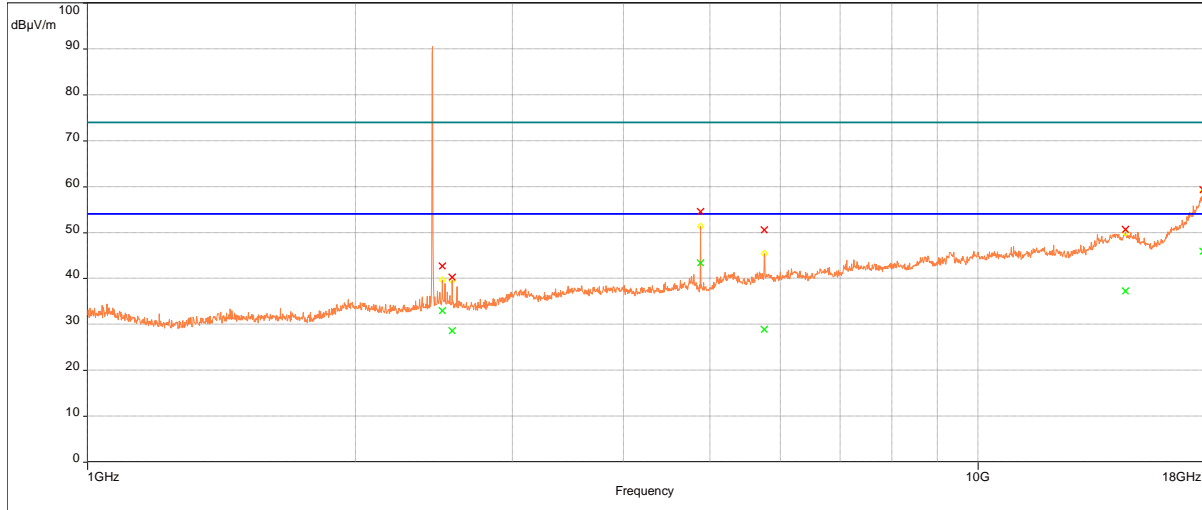
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2465.8873	1	32.23	54.00	-21.77	35.00	2.55	Vertical	0.10	0.15
4804.5276	1	47.19	54.00	-6.81	7.00	3.90	Vertical	0.10	6.75
7206.7436	1	35.36	54.00	-18.64	43.00	1.02	Vertical	0.10	11.62
9334.8253	1	32.78	54.00	-21.22	218.00	3.62	Vertical	0.10	14.67
14542.2714	1	37.01	54.00	-16.99	145.00	3.81	Horizontal	0.10	18.08
17969.8968	1	45.97	54.00	-8.03	323.00	3.60	Vertical	0.10	27.64

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2465.8873	1	42.54	74.00	-31.46	35.00	2.55	Vertical	0.10	0.15
4804.5276	1	58.46	74.00	-15.54	7.00	3.90	Vertical	0.10	6.75
7206.7436	1	48.96	74.00	-25.04	43.00	1.02	Vertical	0.10	11.62
9334.8253	1	46.39	74.00	-27.61	218.00	3.62	Vertical	0.10	14.67
14542.2714	1	50.89	74.00	-23.11	145.00	3.81	Horizontal	0.10	18.08
17969.8968	1	59.17	74.00	-14.83	323.00	3.60	Vertical	0.10	27.64

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, Mid Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Z_Mid Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

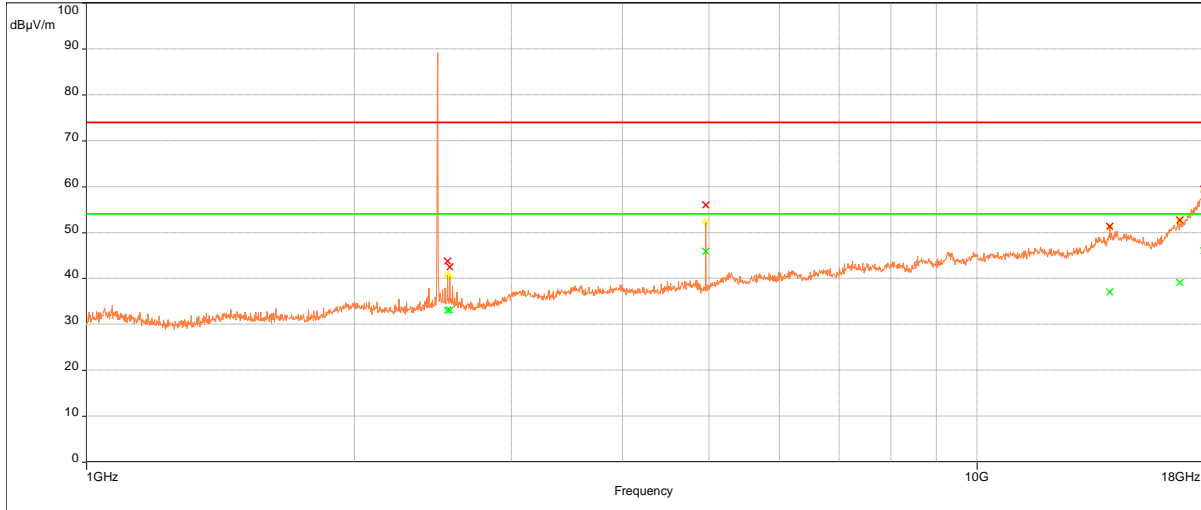
Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2503.9631	1	32.92	54.00	-21.08	303.00	1.50	Horizontal	0.10	0.22
2567.7125	1	28.57	54.00	-25.43	6.00	1.35	Vertical	0.10	0.49
4880.4833	1	43.33	54.00	-10.67	0.00	1.45	Vertical	0.10	6.96
5758.8847	1	28.84	54.00	-25.16	265.00	3.84	Vertical	0.10	8.26
14651.5174	1	37.23	54.00	-16.77	235.00	3.97	Vertical	0.10	18.43
17892.418	1	45.91	54.00	-8.09	122.00	3.75	Horizontal	0.10	27.20

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2503.9631	1	42.69	74.00	-31.31	303.00	1.50	Horizontal	0.10	0.22
2567.7125	1	40.28	74.00	-33.72	6.00	1.35	Vertical	0.10	0.49
4880.4833	1	54.52	74.00	-19.48	0.00	1.45	Vertical	0.10	6.96
5758.8847	1	50.57	74.00	-23.43	265.00	3.84	Vertical	0.10	8.26
14651.5174	1	50.68	74.00	-23.32	235.00	3.97	Vertical	0.10	18.43
17892.418	1	59.26	74.00	-14.74	122.00	3.75	Horizontal	0.10	27.20

Note: Hand Scanned Measurement from 18 to 26 GHz.

Model: HIWMA1BLE40AWH, FCC Part Subpart C Section 15.247, Spurious Emissions, Z-axis, High Channel, 1-26 GHz
Emissions Graph: HIWMA1BLE40AWH_Spurious_Z_High Channel_PWR5_RE 1GHz-26GHz



FCC Part 15/FCC Part 15 - Above 1GHzB

Data Results:

1 MHz RBW / 3 MHz VBW – 3m Test Distance

(Det. Used: Average) - Avg (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.7391	1	33.01	54.00	-20.99	1.00	1.38	Vertical	0.10	0.39
2559.8975	1	33.05	54.00	-20.95	2.00	1.00	Vertical	0.10	0.46
4959.4872	1	45.91	54.00	-8.09	325.00	1.24	Horizontal	0.10	7.03
14095.9298	1	37.06	54.00	-16.94	219.00	2.87	Horizontal	0.10	17.82
16895.132	1	39.11	54.00	-14.89	40.00	1.03	Horizontal	0.10	19.39
17972.5968	1	45.96	54.00	-8.04	118.00	3.01	Horizontal	0.10	27.66

(Det. Used: Peak) - Peak (PASS) (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m @ 3m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2543.7391	1	43.78	74.00	-30.22	1.00	1.38	Vertical	0.10	0.39
2559.8975	1	42.47	74.00	-31.53	2.00	1.00	Vertical	0.10	0.46
4959.4872	1	55.99	74.00	-18.01	325.00	1.24	Horizontal	0.10	7.03
14095.9298	1	51.27	74.00	-22.73	219.00	2.87	Horizontal	0.10	17.82
16895.132	1	52.65	74.00	-21.35	40.00	1.03	Horizontal	0.10	19.39
17972.5968	1	59.42	74.00	-14.58	118.00	3.01	Horizontal	0.10	27.66

Note: Hand Scanned Measurement from 18 to 26 GHz.

Test Personnel: Dan Alvarez
Supervising/Reviewing
Engineer:
(Where Applicable)
Product Standard: FCC; RSS-247
Input Voltage: 120VAC,60Hz

Pretest Verification: Y

Test Date: 03/06/2018; 03/20/2018

Limit Applied: 15.205

Ambient Temperature: 23 °C; 23 °C
Relative Humidity: 32 %; 19 %;
Atmospheric Pressure: 984 mbars; 985 mbars

Deviations, Additions, or Exclusions: None

10 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Duty Cycle

10.1 Method

Tests are performed in accordance with Tests are performed in accordance with 47 CFR Part 15 Subpart C and RSS-GEN. Radiated measurement methods were implemented.

10 Meter Semi-Anechoic Chamber The test site for radiated emissions is located at 1950 Evergreen Blvd, Suite 100, Duluth, Georgia 30096. It is a 10 meter semi-anechoic chamber manufactured by Panashield. Embedded in the floor is a 3 meter diameter turntable.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
232944	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified
212054	Barometric Pressure/Humidity Datalogger	Extech	SD700	none	10/17/2017	10/17/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/03/2017	05/03/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018

Software Utilized:

Name	Manufacturer	Version
None (Receiver Firmware used)		

10.3 Results:

The sample tested was found to Comply.

§15.35 Measurement detector functions and bandwidths.

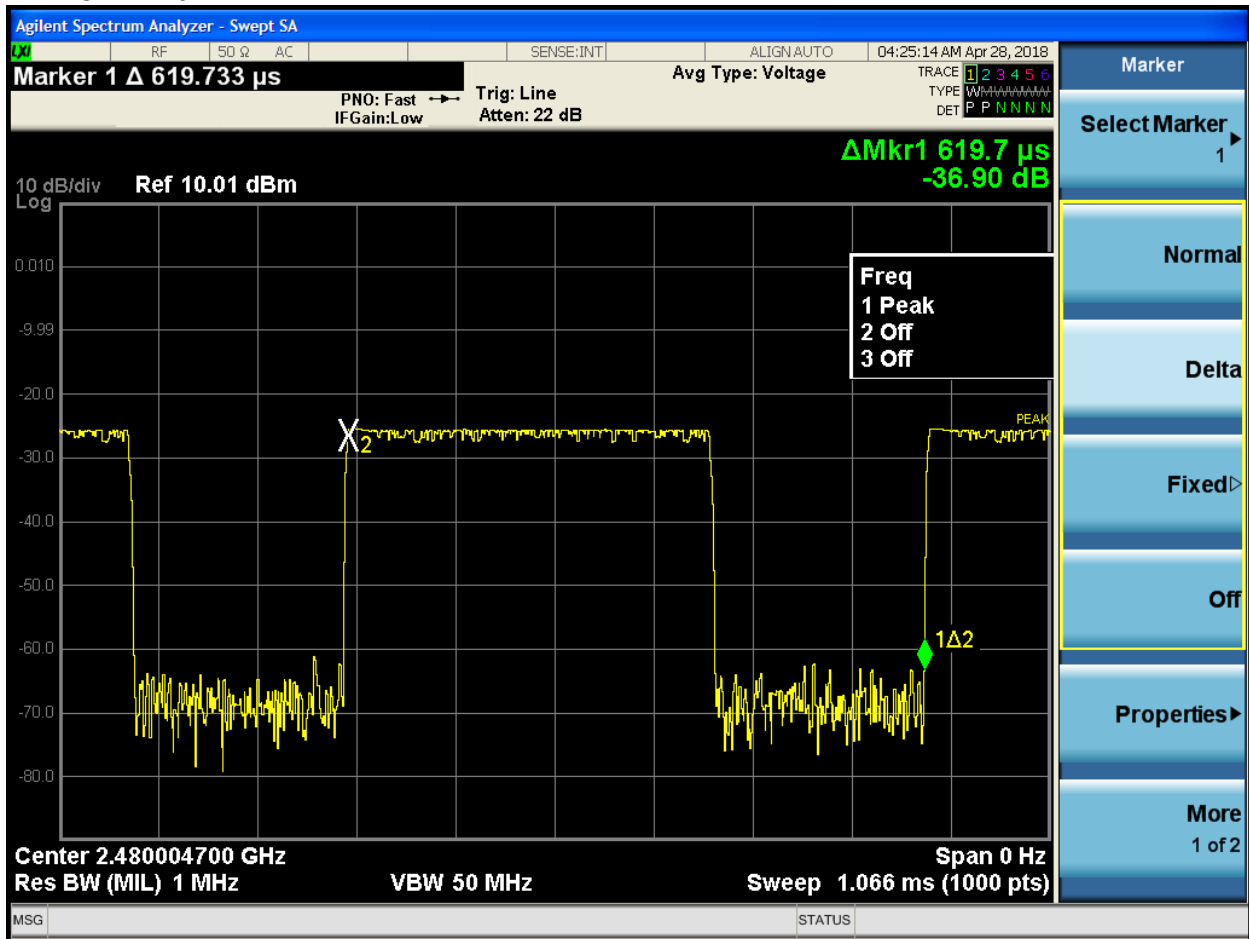
(c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

RSS-GEN Section 6.10

6.10 Pulsed Operation

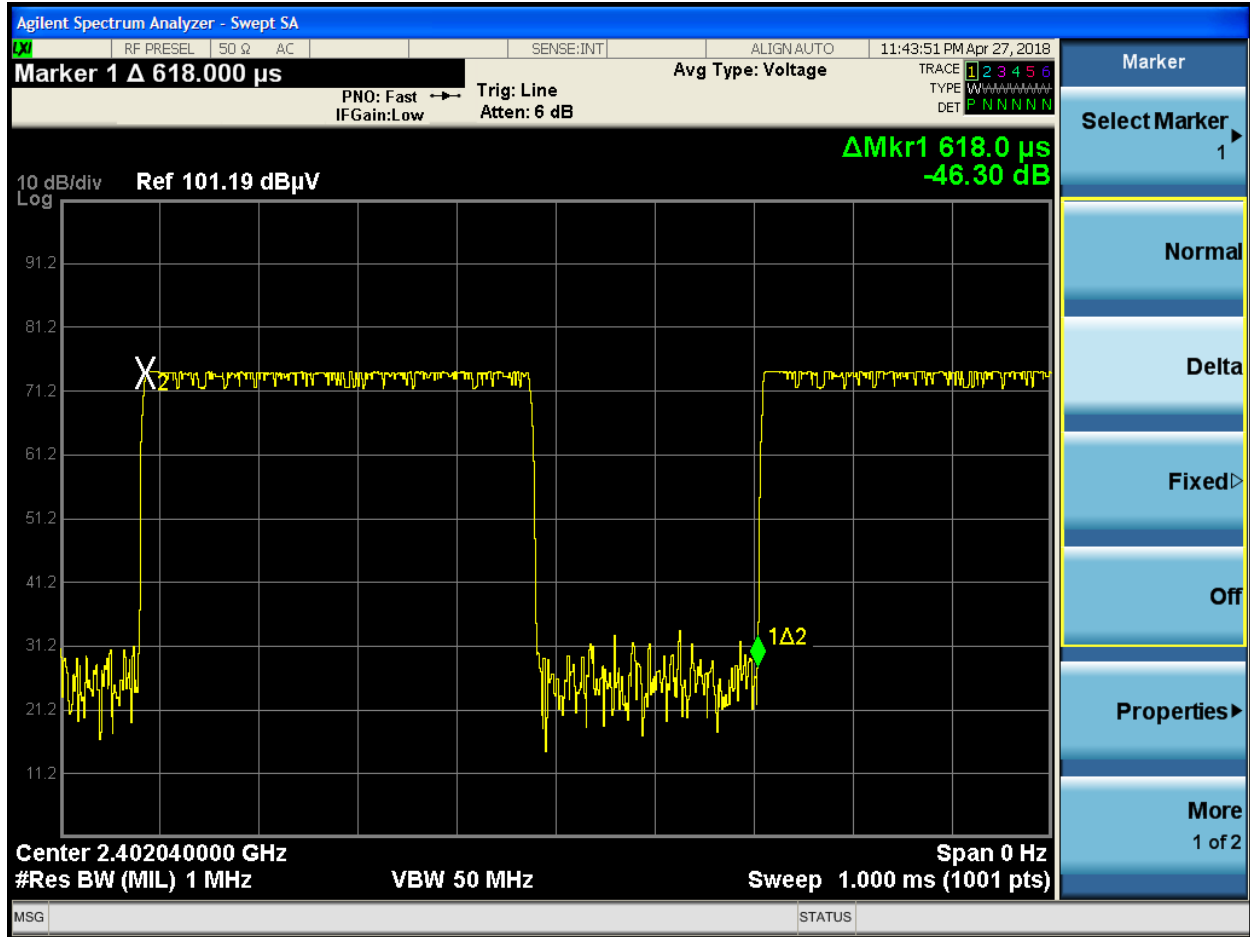
When the field strength (or envelope power) is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train, including blanking intervals within the pulse train, as long as the pulse train does not exceed 0.1 second. In cases where the pulse train exceeds 0.1 second, the average value of field strength or output power shall be determined during a 0.1 second interval during which the field strength or power is at its maximum value. The exact method of calculating the average field strength shall be submitted with the application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

10.4 Plots/Data:
HIWAC1BLE40AWH



The duty cycle = $388\mu s / 619.7\mu s = 0.626$
 Average factor = $20 * \text{LOG}(0.624) = -4.06 \text{ dB}$

HIWMA1BLE40AWH



The duty cycle = $386.1\mu s / 618\mu s = 0.624$
 Average factor = $20 * \text{LOG}(0.624) = -4.09 \text{ dB}$

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable) _____
 Product Standard: 47 CFR Part 15 Subpart C and RSS-GEN
 Input Voltage: 120Vac/60Hz
 Pretest Verification: N/A

Test Date: 04/26/2018
 Limit Applied: See Section 8.3
 Ambient Temperature: 23 °C
 Relative Humidity: 45.4 %
 Atmospheric Pressure: 979 mbars

Deviations, Additions, or Exclusions: None

11 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Power Spectral Density

11.1 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), RSS-247. Radiated measurement methods were implemented.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
232944	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified
212054	Barometric Pressure/Humidity Datalogger	Extech	SD700	none	10/17/2017	10/17/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/03/2017	05/03/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

11.3 Test Limits

§ 15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

11.4 Results:

The sample tested was found to Comply.

HIWAC1BLE40AWH

Mode	Channel Number	Frequency (MHz)	PSD in 100kHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
GFSK	0	2402	-6.55	8.0	-14.55	Compliant
GFSK	19	2440	-4.29	8.0	-12.29	Compliant
GFSK	39	2480	-1.75	8.0	-9.75	Compliant

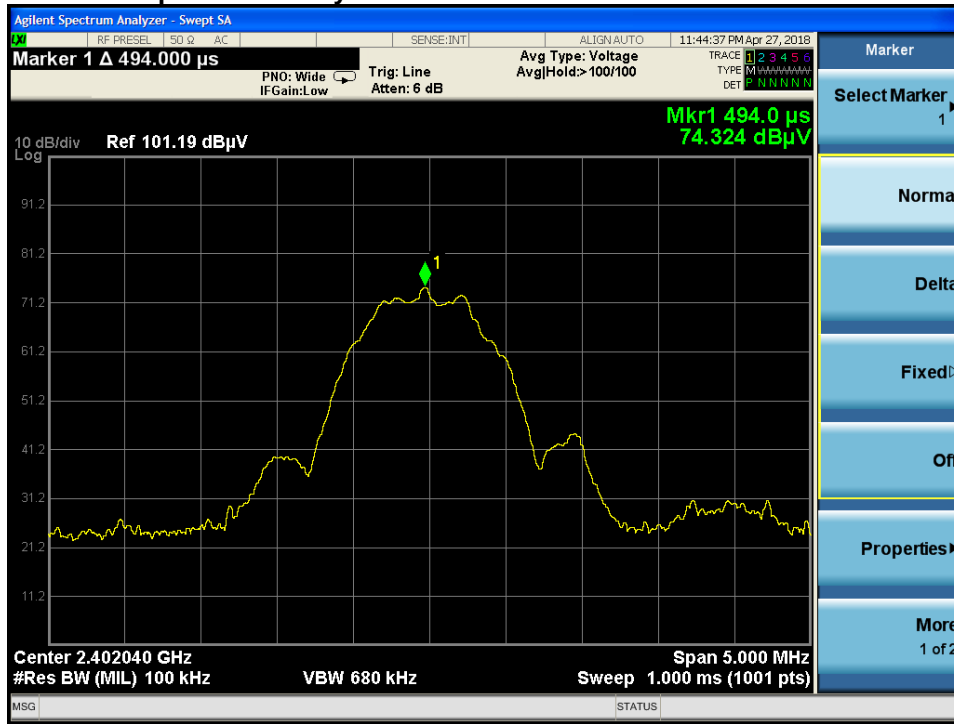
HIWMA1BLE40AWH

Mode	Channel Number	Frequency (MHz)	PSD in 100kHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
GFSK	0	2402	-6.93	8.0	-14.93	Compliant
GFSK	19	2440	-9.62	8.0	-17.62	Compliant
GFSK	39	2480	-5.36	8.0	-13.36	Compliant

11.5 Plots/Data:

PSD Settings: Unit met the requirements with a 100kHz RBW

Power Spectral Density – HIWAC1BLE40AWH Channel 0 GFSK mode



Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2402.00444	1	-23.896	8.00	-31.896	189.00	3.55	Vertical	0.10	-3.00

Calculations:

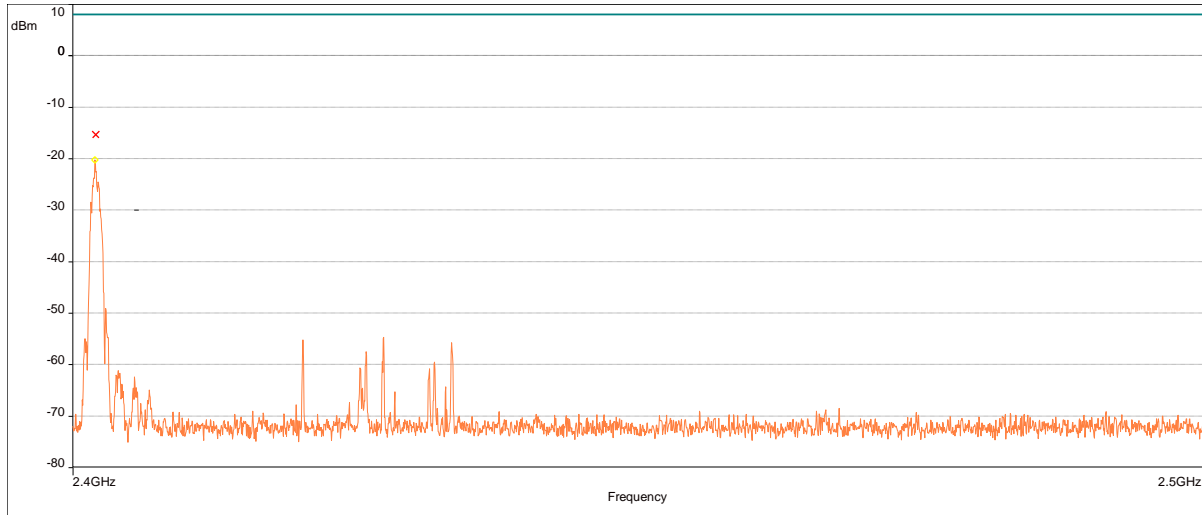
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 * \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$74.324\text{dBuV} - 95.22 = -20.896\text{dBm}$

- Level calculated by adding in the correction factor

$-20.896 + \text{Correction Factor} (-3.00 \text{ dB}) = -23.896\text{dBm}$

Power Spectral Density – HIWAC1BLE40AWH Channel 0 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2402.00444	1	-15.33	N/A	N/A	189.00	3.55	Vertical	0.10	-3.00
Calculated value									
2402.00444	1	-6.55	8	-14.55	189.00	3.55	Vertical	0.10	-3.00

Calculations:

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-15.33 + 107 = 91.67 \text{ dBuV}$$

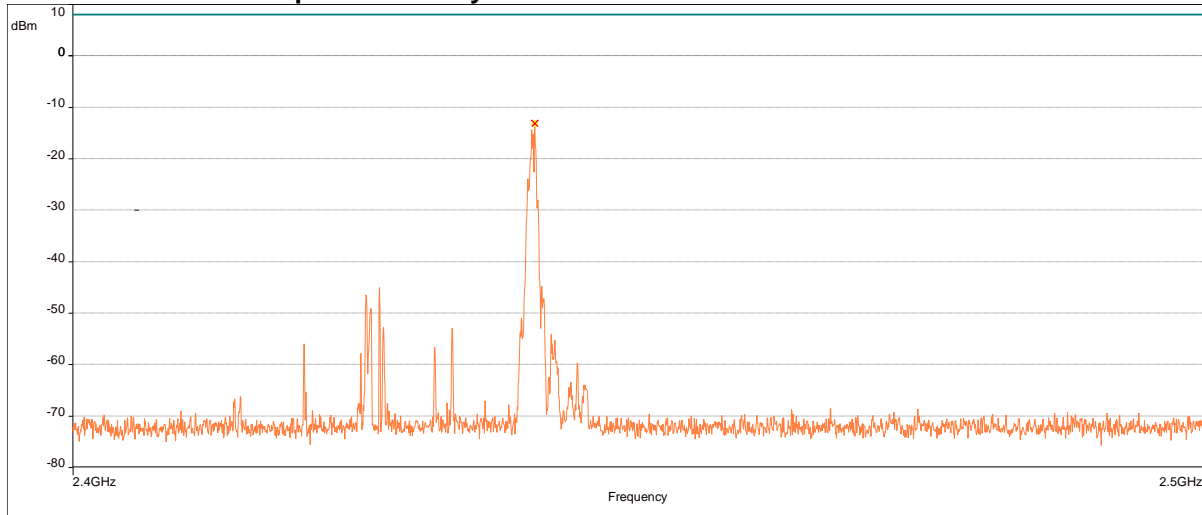
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 * \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$91.67 \text{ dBuV} - 95.22 = -3.55 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-3.55 + \text{Correction Factor} (-3.00 \text{ dB}) = -6.55 \text{ dBm}$$

Power Spectral Density – HIWAC1BLE40AWH Channel 19 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2440.2423	1	-13.17	N/A	N/A	316.00	3.98	Horizontal	0.10	-2.9
Calculated value									
2440.2423	1	-4.29	8	-12.29	316.00	3.98	Horizontal	0.10	-2.9

Calculations:

- Convert from dBm to dBuV

$\text{dBuVm} = \text{dBm} + 107$

$-13.17 + 107 = 93.83 \text{ dBuV}$

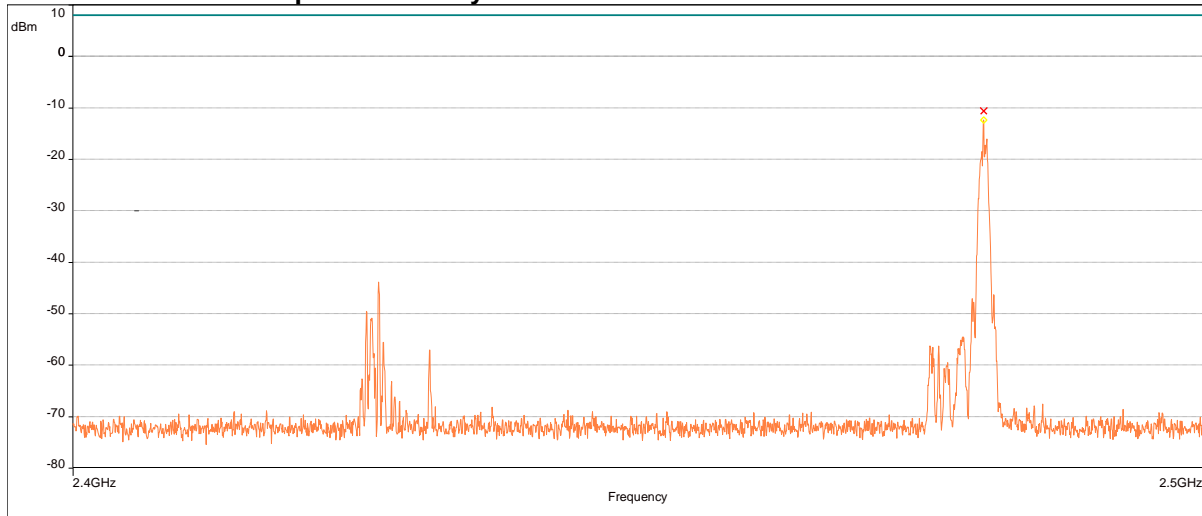
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$93.83 \text{ dBuV} - 95.22 = -1.39 \text{ dBm}$

- Level calculated by adding in the correction factor

$-1.39 + \text{Correction Factor} (-2.9 \text{ dB}) = -4.29 \text{ dBm}$

Power Spectral Density – HIWAC1BLE40AWH Channel 39 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2480.00474	1	-10.63	N/A	N/A	316.00	3.92	Horizontal	0.10	-2.9
Calculated value									
2480.00474	1	-1.75	8	-9.75	316.00	3.92	Horizontal	0.10	-2.9

Calculations:

- Convert from dBm to dBuV

$\text{dBuVm} = \text{dBm} + 107$

$-10.63 + 107 = 96.37 \text{ dBuV}$

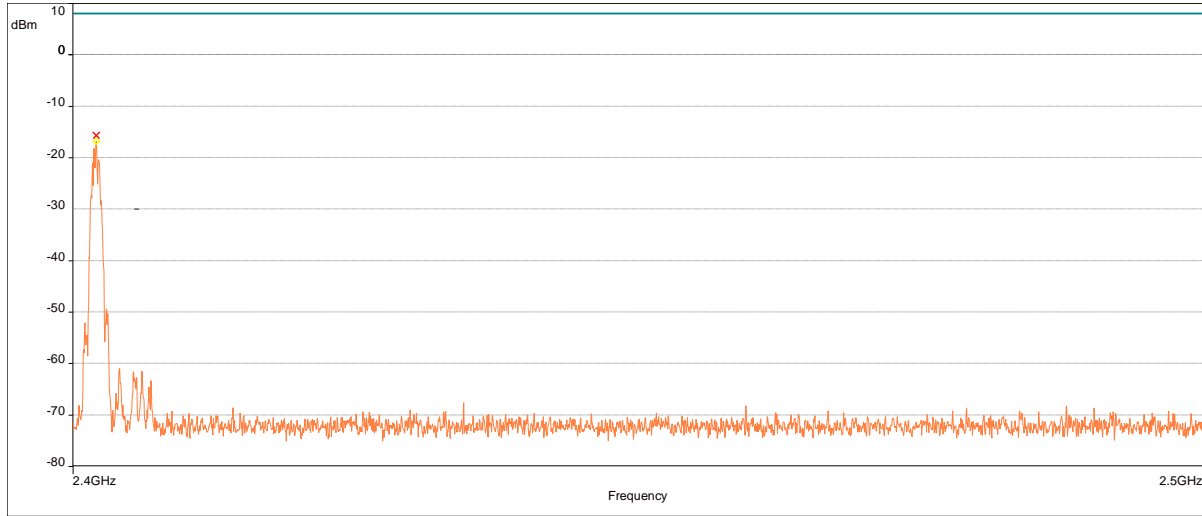
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$96.37 \text{ dBuV} - 95.22 = 1.15 \text{ dBm}$

- Level calculated by adding in the correction factor

$1.15 + \text{Correction Factor} (-2.9 \text{ dB}) = -1.75 \text{ dBm}$

Power Spectral Density – HIWMA1BLE40AWH Channel 0 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2402.00766	1	-15.71	N/A	N/A	14.00	1.10	Horizontal	0.10	-3.00
Calculated value									
2402.00766	1	-6.93	8	-14.93	14.00	1.10	Horizontal	0.10	-3.00

Calculations:

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-15.71 + 107 = 91.29 \text{ dBuV}$$

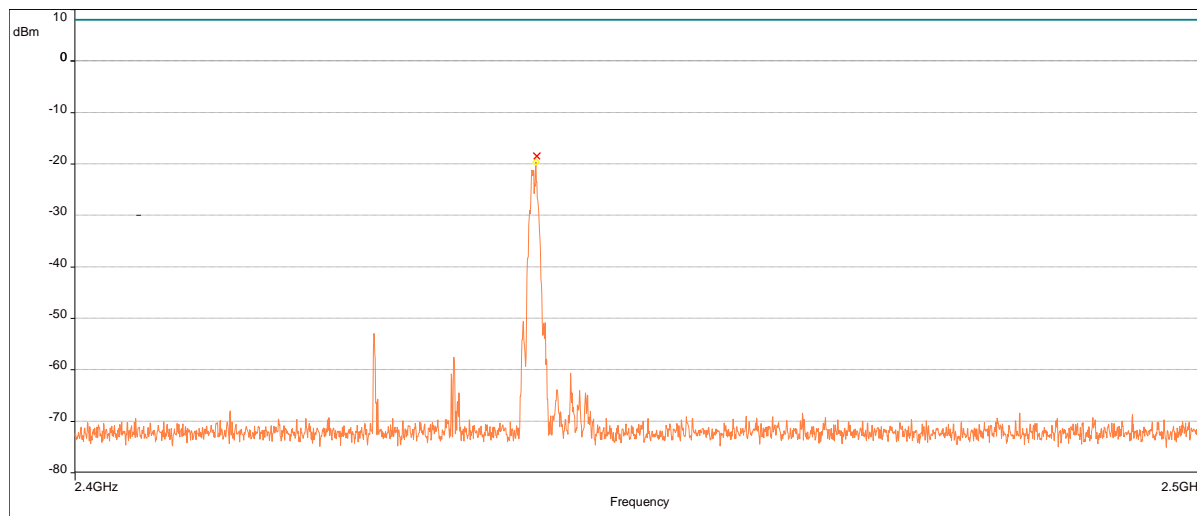
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 * \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$91.29 \text{ dBuV} - 95.22 = -3.93 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-3.93 + \text{Correction Factor} (-3.0 \text{ dB}) = -6.93 \text{ dBm}$$

Power Spectral Density – HIWMA1BLE40AWH Channel 19 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2440.24386	1	-18.50	N/A	N/A	0.00	3.98	Vertical	0.10	-2.9
Calculated value									
2440.24386	1	-9.62	8	-17.62	0.00	3.98	Vertical	0.10	-2.9

Calculations:

- Convert from dBm to dBuV

$dBuVm = dBm + 107$

$-18.50 + 107 = 88.5 dBuV$

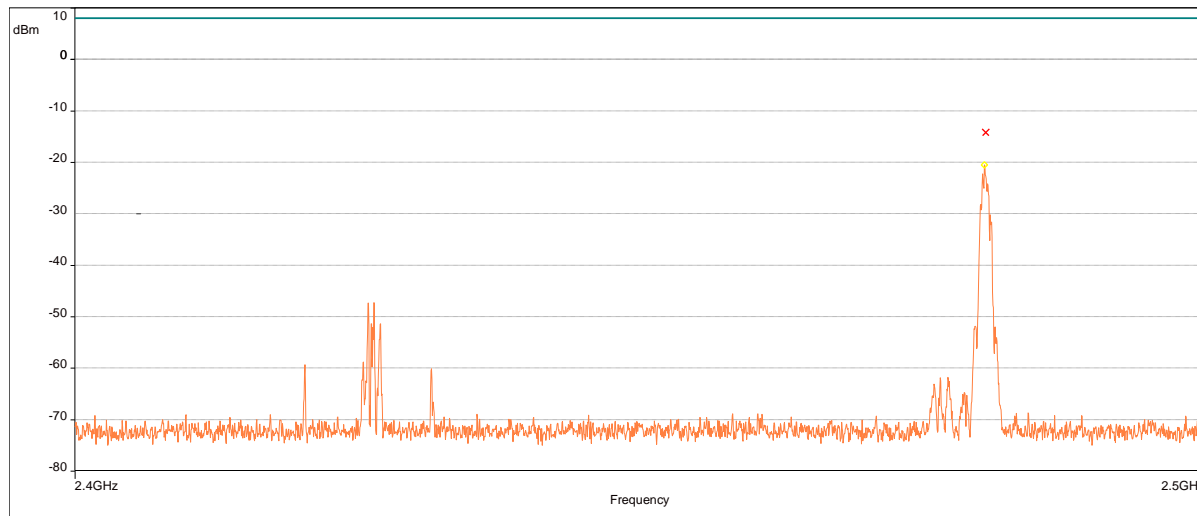
Path loss calculation $E(dBuV) = P(dBm) + 104.77 - 20 * LOG(3)$
 $E = P(dBm) + 95.22$

$88.5 dBuV - 95.22 = -6.72 dBm$

- Level calculated by adding in the correction factor

$-6.72 + \text{Correction Factor } (-2.9 \text{ dB}) = -9.62 dBm$

Power Spectral Density – HIWMA1BLE40AWH Channel 39 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2480.00946	1	-14.24	N/A	N/A	46.00	2.94	Horizontal	0.10	-2.9
Calculated value									
2480.00946	1	-5.36	8	-13.36	46.00	2.94	Horizontal	0.10	-2.9

Calculations:

- Convert from dBm to dBuV

$\text{dBuVm} = \text{dBm} + 107$

$-14.24 + 107 = 92.76 \text{ dBuV}$

Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$92.76 \text{ dBuV} - 95.22 = -2.46 \text{ dBm}$

- Level calculated by adding in the correction factor

$-2.46 + \text{Correction Factor} (-2.9 \text{ dB}) = -5.36 \text{ dBm}$

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable) _____
 Product Standard: 47 CFR Part 15 Subpart C and RSS-GEN
 Input Voltage: 120Vac/60Hz
 Pretest Verification: N/A

Test Date: 04/26/2018
 Limit Applied: See Section 8.3
 Ambient Temperature: 23 °C
 Relative Humidity: 45.4 %
 Atmospheric Pressure: 979 mbars

12 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Maximum Conducted Output Power

12.1 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), RSS-247:2017 Issue 2. Radiated measurement methods were implemented.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
232944	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified
212054	Barometric Pressure/Humidity Datalogger	Extech	SD700	none	10/17/2017	10/17/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKKNK-394	MP3	05/03/2017	05/03/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.10

12.3 Test Limits

§ 15.247(b)(3): For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

12.4 Results:

The sample tested was found to Comply.

HIWAC1BLE40AWH

Mode	Channel Number	Frequency (MHz)	MCOP in 1MHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
GFSK	0	2402	-5.62	30	-35.62	Compliant
GFSK	19	2440	-1.96	30	-31.96	Compliant
GFSK	39	2480	-1.14	30	-31.14	Compliant

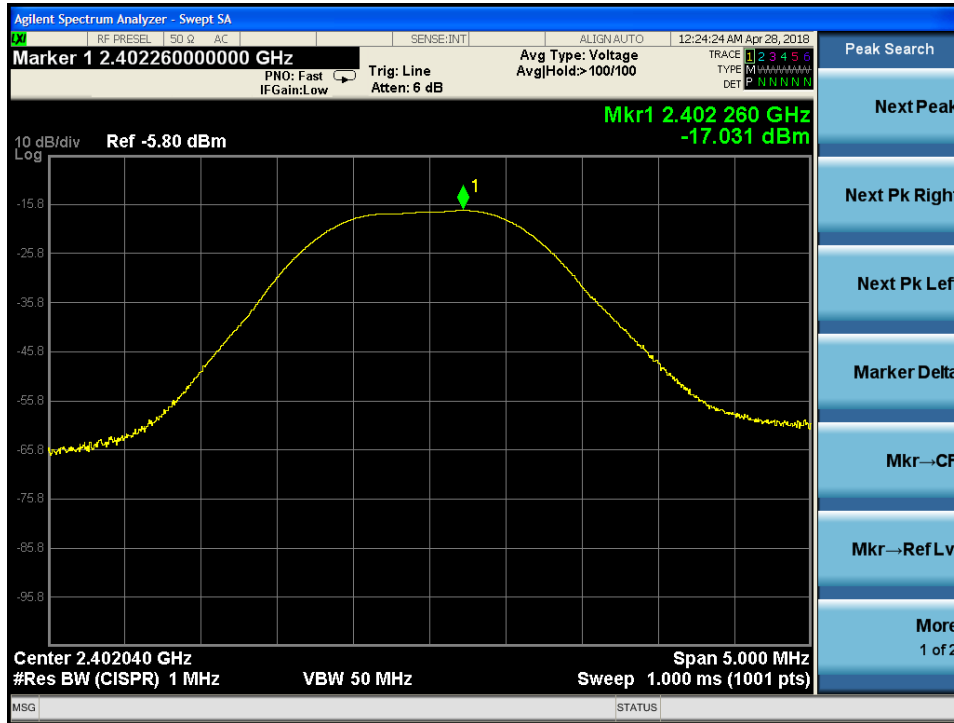
HIWMA1BLE40AWH

Mode	Channel Number	Frequency (MHz)	MCOP in 1MHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
GFSK	0	2402	-5.04	30	-35.04	Compliant
GFSK	19	2440	-6.68	30	-36.68	Compliant
GFSK	39	2480	-4.78	30	-34.78	Compliant

12.5 Plots/Data:

Settings: 1 MHz RBW / 50MHz VBW (Peak Detector) – 3m Test Distance

HIWAC1BLE40AWH Channel 0 GFSK mode



Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
2402.040	-8.251	30	-38.251	0.00	1.49	Horizontal	10	-3.00

Calculations:

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-17.031 + 107 = 89.969 \text{ dBuV}$$

$$\text{Path loss calculation } E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$$

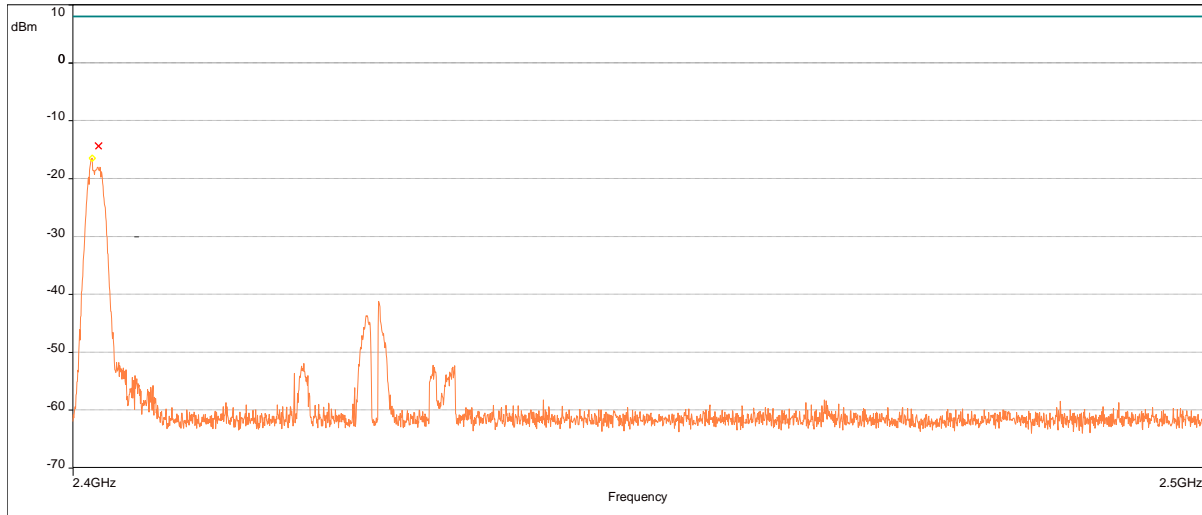
$$E = P(\text{dBm}) + 95.22$$

$$89.969 \text{ dBuV} - 95.22 = -5.251 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-2.46 + \text{Correction Factor} (-3.0 \text{ dB}) = -8.251 \text{ dBm}$$

Peak Conducted Power – HIWAC1BLE40AWH Channel 0 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2402.217	1	-14.40	N/A	N/A	0.00	1.49	Horizontal	0.10	-3.00
Calculated value									
2402.217	1	-5.62	30	-35.62	0.00	1.49	Horizontal	0.10	-3.00

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-14.40 + 107 = 92.6 \text{ dBuV}$$

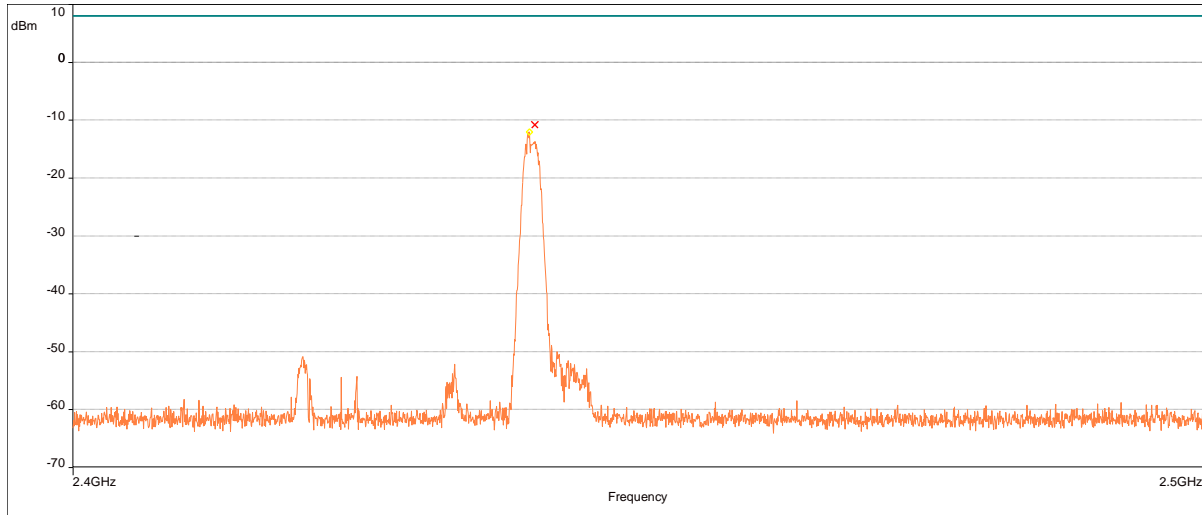
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$92.6 \text{ dBuV} - 95.22 = -2.62 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-2.62 + \text{Correction Factor} (-3.00 \text{ dB}) = -5.62 \text{ dBm}$$

Peak Conducted Power – HIWAC1BLE40AWH Channel 19 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2440.2581	1	-10.84	N/A	N/A	317.00	3.98	Horizontal	0.10	-2.9
Calculated value									
2440.2581	1	-1.96	30	-31.96	317.00	3.98	Horizontal	0.10	-2.9

- Convert from dBm to dBuV

$\text{dBuVm} = \text{dBm} + 107$

$-10.84 + 107 = 96.16 \text{ dBuV}$

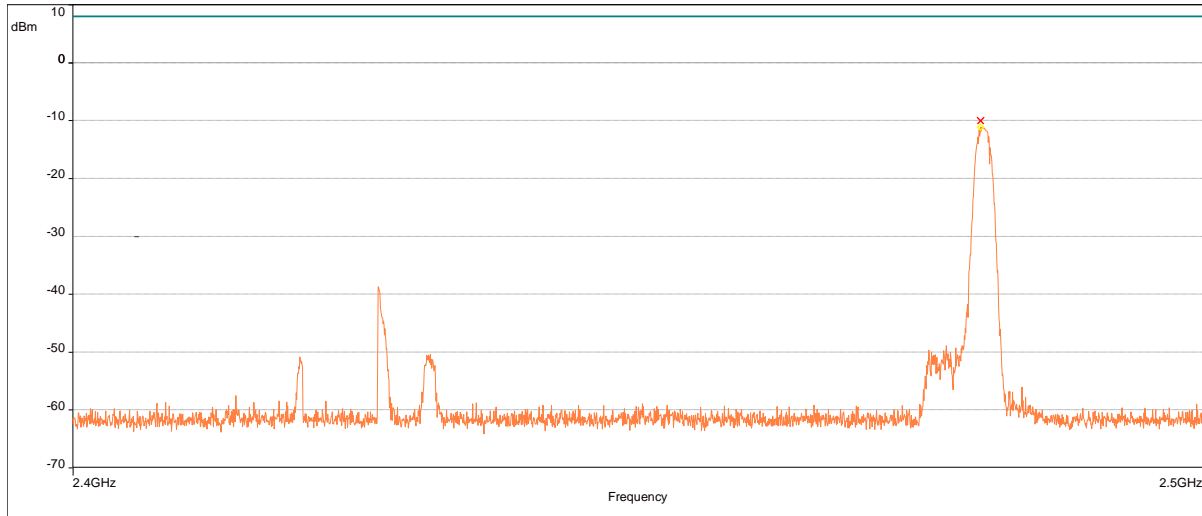
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$96.16 \text{ dBuV} - 95.22 = 0.94 \text{ dBm}$

- Level calculated by adding in the correction factor

$0.94 + \text{Correction Factor} (-2.9 \text{ dB}) = -1.96 \text{ dBm}$

Peak Conducted Power – HIWAC1BLE40AWH Channel 39 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2479.749	1	-10.02	N/A	N/A	317.00	3.93	Horizontal	0.10	-2.9
Calculated value									
2479.749	1	-1.14	30	-31.14	317.00	3.93	Horizontal	0.10	-2.9

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-10.02 + 107 = 96.98 \text{ dBuV}$$

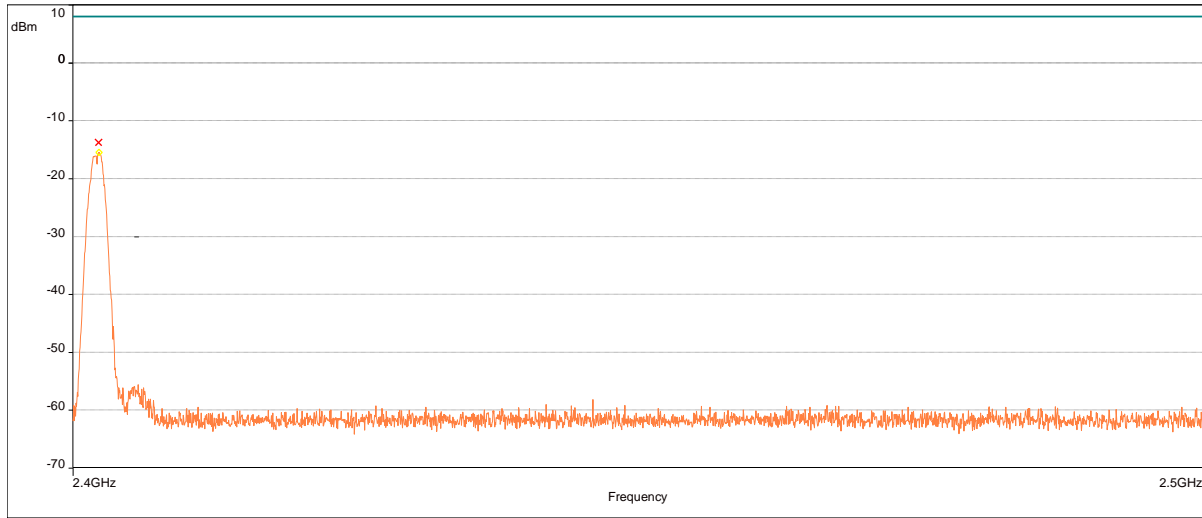
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$96.98 \text{ dBuV} - 95.22 = 1.76 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$1.76 + \text{Correction Factor} (-2.9 \text{ dB}) = -1.14 \text{ dBm}$$

Peak Conducted Power – HIWMA1BLE40AWH Channel 0 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2402.2368	1	-13.82	N/A	N/A	79.00	3.95	Horizontal	0.10	3.00
Calculated value									
2402.2368	1	-5.04	30	-35.04	79.00	3.95	Horizontal	0.10	3.00

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-13.82 + 107 = 93.18 \text{ dBuV}$$

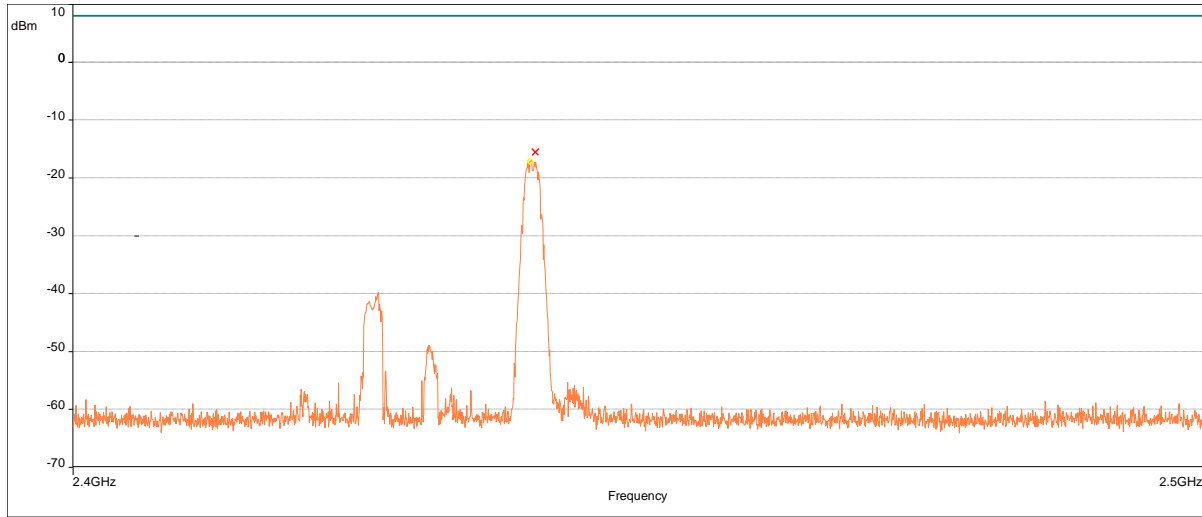
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$93.18 \text{ dBuV} - 95.22 = -2.04 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-2.04 + \text{Correction Factor } (-3.0 \text{ dB}) = -5.04 \text{ dBm}$$

Peak Conducted Power – HIWMA1BLE40AWH Channel 19 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2440.2833	1	-15.56	N/A	N/A	4.00	3.92	Vertical	0.10	-2.9
Calculated value									
2440.2833	1	-6.68	30	-36.68	4.00	3.92	Vertical	0.10	-2.9

- Convert from dBm to dBuV

$$\text{dBuVm} = \text{dBm} + 107$$

$$-15.56 + 107 = 91.44 \text{ dBuV}$$

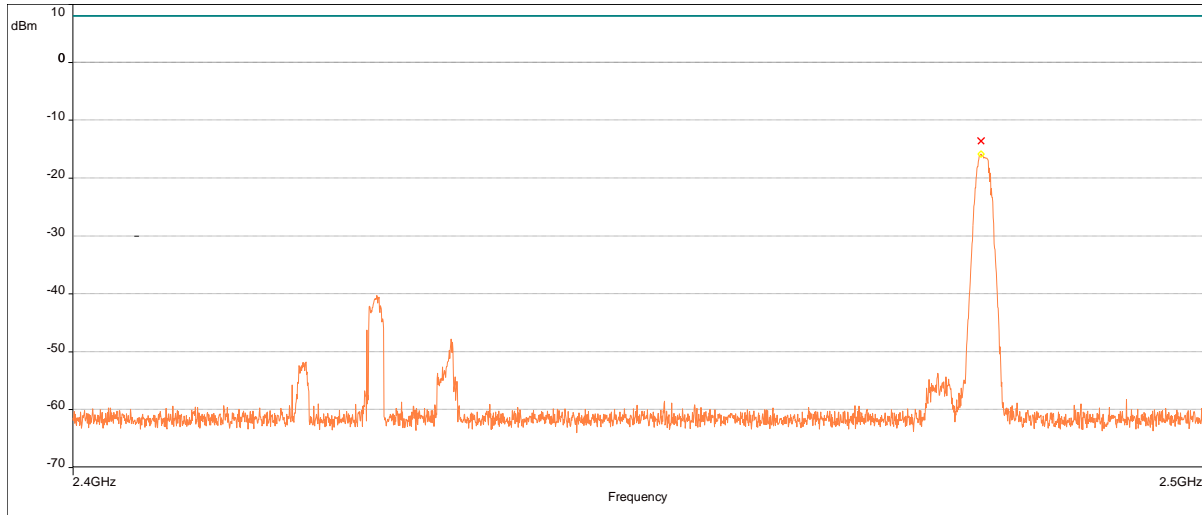
Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 * \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$$91.44 \text{ dBuV} - 95.22 = -3.78 \text{ dBm}$$

- Level calculated by adding in the correction factor

$$-3.78 + \text{Correction Factor} (-2.9 \text{ dB}) = -6.68 \text{ dBm}$$

Peak Conducted Power – HIWMA1BLE40AWH Channel 39 GFSK mode



FCC Part 15 Transmitters/Conducted Power and PSD

Data Results:

1 MHz RBW / 3 MHz VBW (Peak Detector) – 3m Test Distance

Peak (PASS) (1)

Frequency (MHz)	SR	Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Meas. time (s)	Correction (dB)
Measured value									
2479.7653	1	-13.66	N/A	N/A	15.00	1.10	Horizontal	0.10	-2.9
Calculated value									
2479.7653	1	-4.78	30	-34.78	15.00	1.10	Horizontal	0.10	-2.9

- Convert from dBm to dBuV

$\text{dBuVm} = \text{dBm} + 107$

$-13.66 + 107 = 93.34 \text{ dBuV}$

Path loss calculation $E(\text{dBuV}) = P(\text{dBm}) + 104.77 - 20 \cdot \text{LOG}(3)$
 $E = P(\text{dBm}) + 95.22$

$93.34 \text{ dBuV} - 95.22 = -1.88 \text{ dBm}$

- Level calculated by adding in the correction factor

$-1.88 + \text{Correction Factor} (-2.9 \text{ dB}) = -4.78 \text{ dBm}$

Test Personnel: Dan Alvarez
 Supervising/Reviewing Engineer: _____
 (Where Applicable) 47 CFR Part 15 Subpart C and RSS-GEN
 Product Standard: 120Vac/60Hz
 Input Voltage: _____
 Pretest Verification: N/A

Test Date: 04/26/2018
 Limit Applied: See Section 8.3
 Ambient Temperature: 23 °C
 Relative Humidity: 45.4 %
 Atmospheric Pressure: 979 mbars

13 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 Occupied Bandwidth

13.1 Test Procedure

ANSI C63.10 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247); RSS-247. Radiated measurement methods were implemented.

13.2 Test Equipment:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
232944	EMI Receiver 10Hz-26.5GHz	Agilent	MXE-9038A	MY51210135	08/01/2017	08/01/2018
25401	Comparison Noise Emitter, broadband noise source	York EMC	CNE III	679	10/27/2007	Verified
212054	Barometric Pressure/Humidity Datalogger	Extech	SD700	none	10/17/2017	10/17/2018
MP3	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/03/2017	05/03/2018
200108	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	06/22/2017	06/22/2018
213061	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	09/14/2017	09/14/2018

Software Utilized:

Name	Manufacturer	Version
Tile for Radiated Emissions	Quantum Change	3.4.k.29

13.3 Test Limits

§ 15.247(a)(2): For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz.

13.4 Results:

HIWAC1BLE40AWH

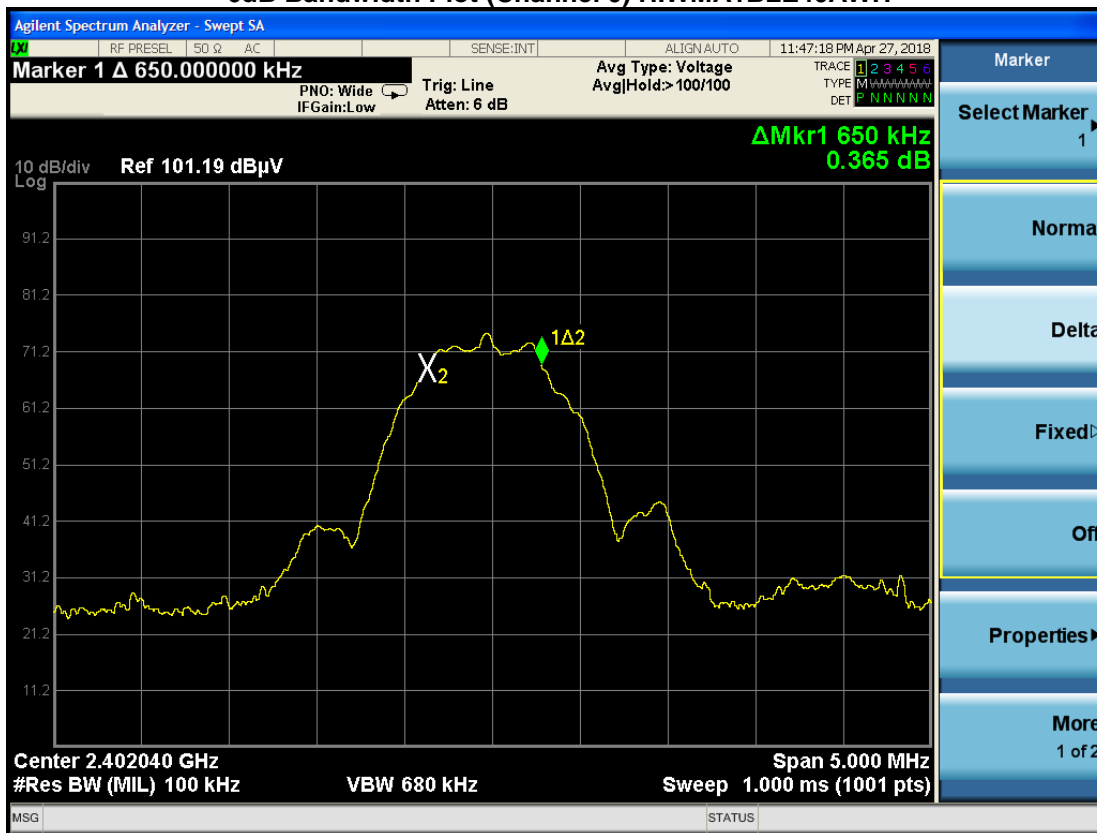
Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
GFSK	0	2402	650kHz	1.155 MHz	Compliant
GFSK	19	2440	660kHz	1.141 MHz	Compliant
GFSK	39	2480	650kHz	1.145 MHz	Compliant

HIWMA1BLE40AWH

Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
GFSK	0	2402	660kHz	1.195 MHz	Compliant
GFSK	19	2440	645kHz	1.135 MHz	Compliant
GFSK	39	2480	666kHz	1.145 MHz	Compliant

13.5 Plots/Data:

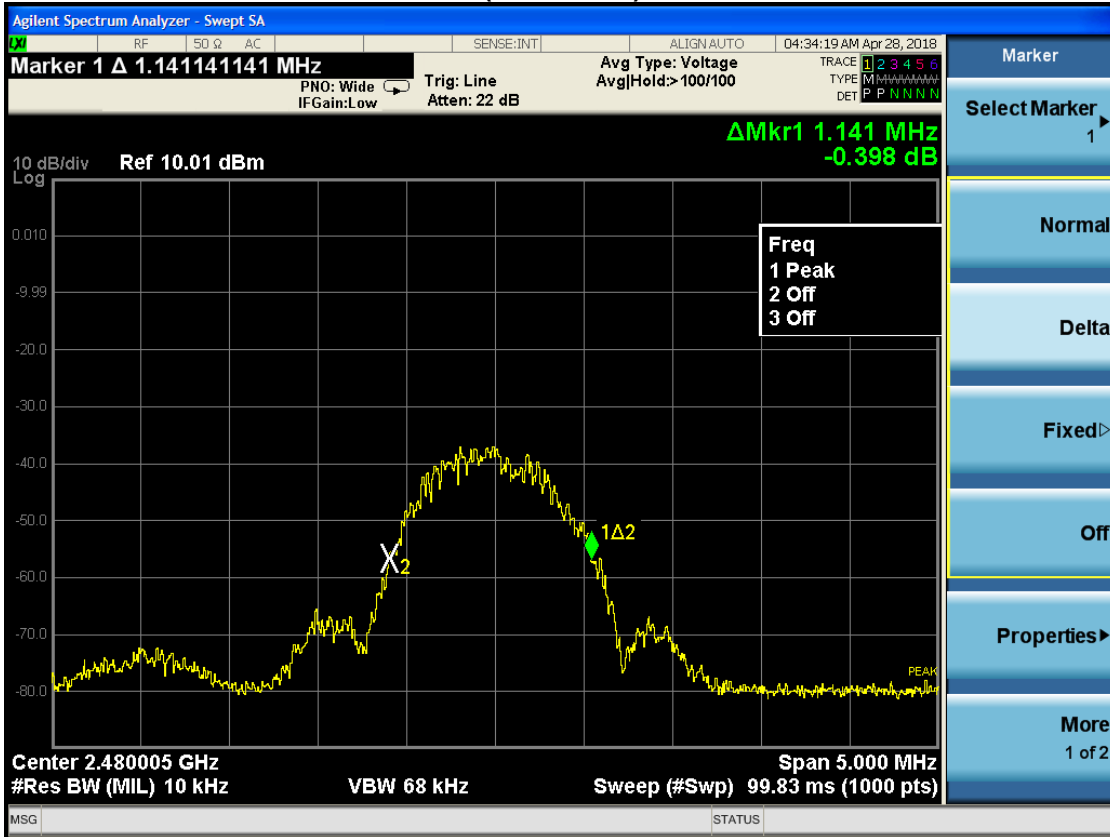
6dB Bandwidth Plot (Channel 0) HIWMA1BLE40AWH



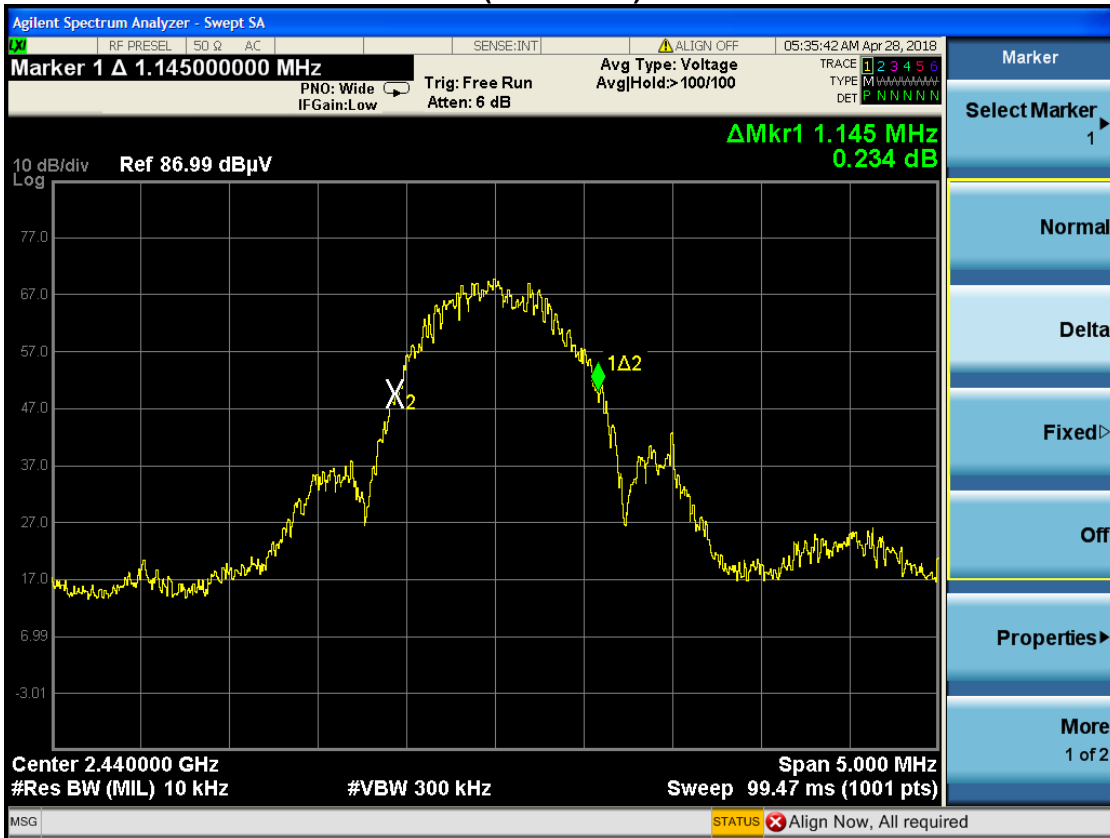
6dB Bandwidth Plot (Channel 19) HIWMA1BLE40AWH



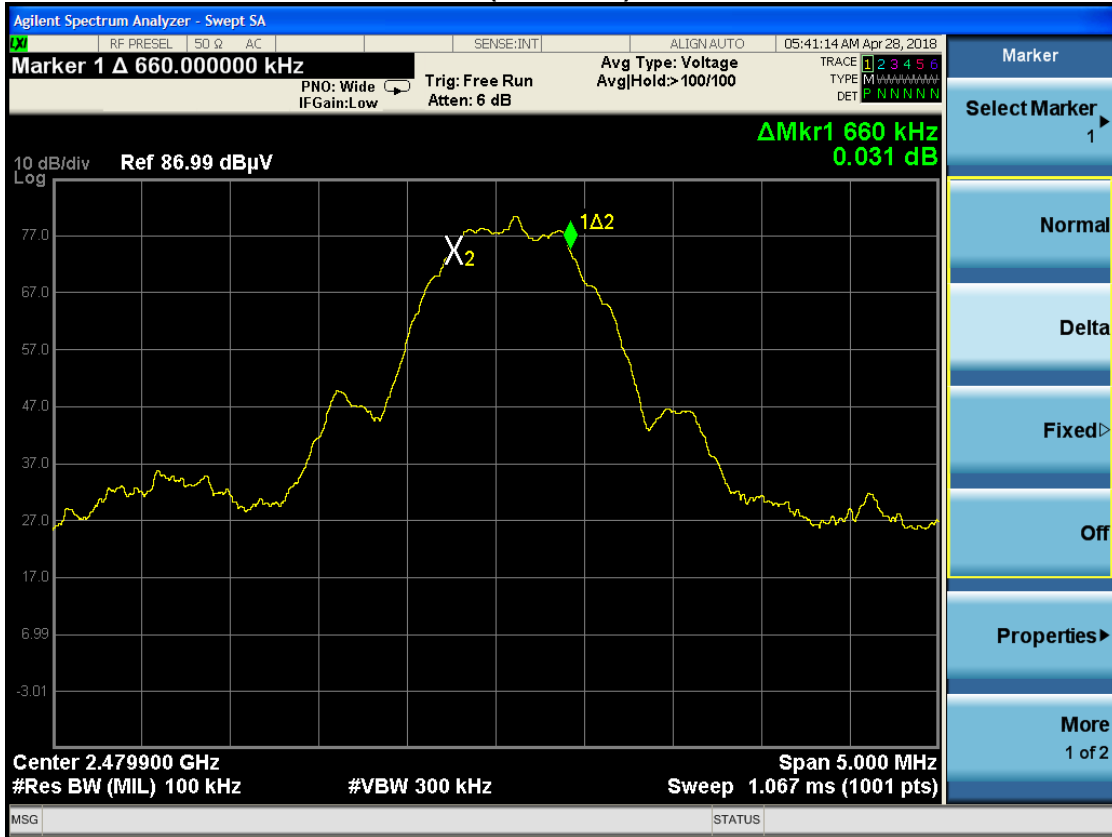
99% Bandwidth Plot (Channel 19) HIWMA1BLE40AWH



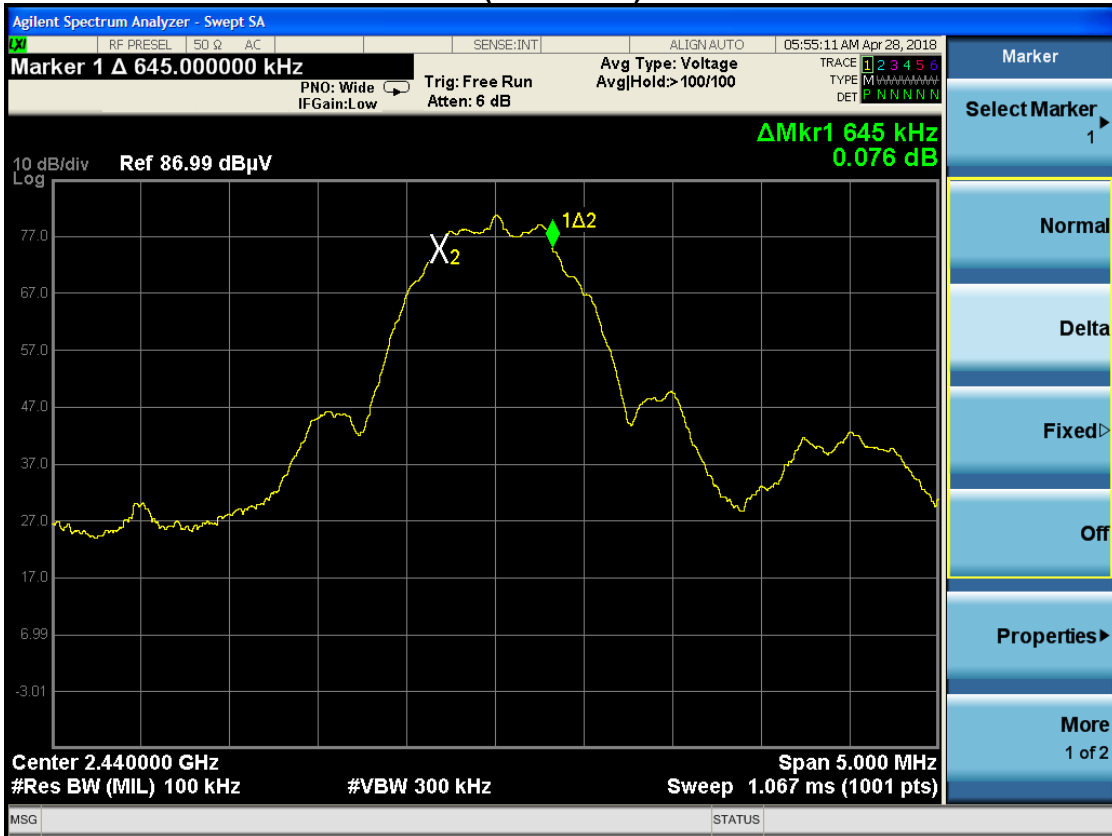
99% Bandwidth Plot (Channel 39) HIWMA1BLE40AWH



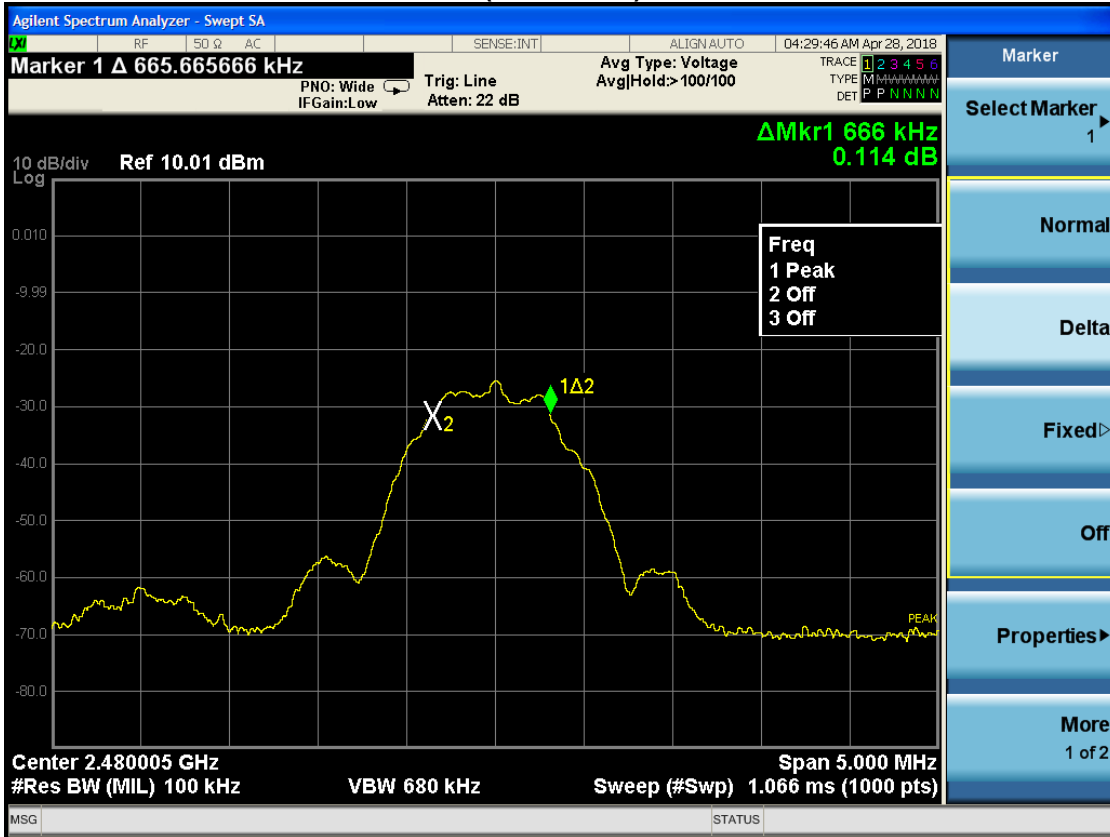
6dB Bandwidth Plot (Channel 0) HIWAC1BLE40AWH



6dB Bandwidth Plot (Channel 19) HIWAC1BLE40AWH



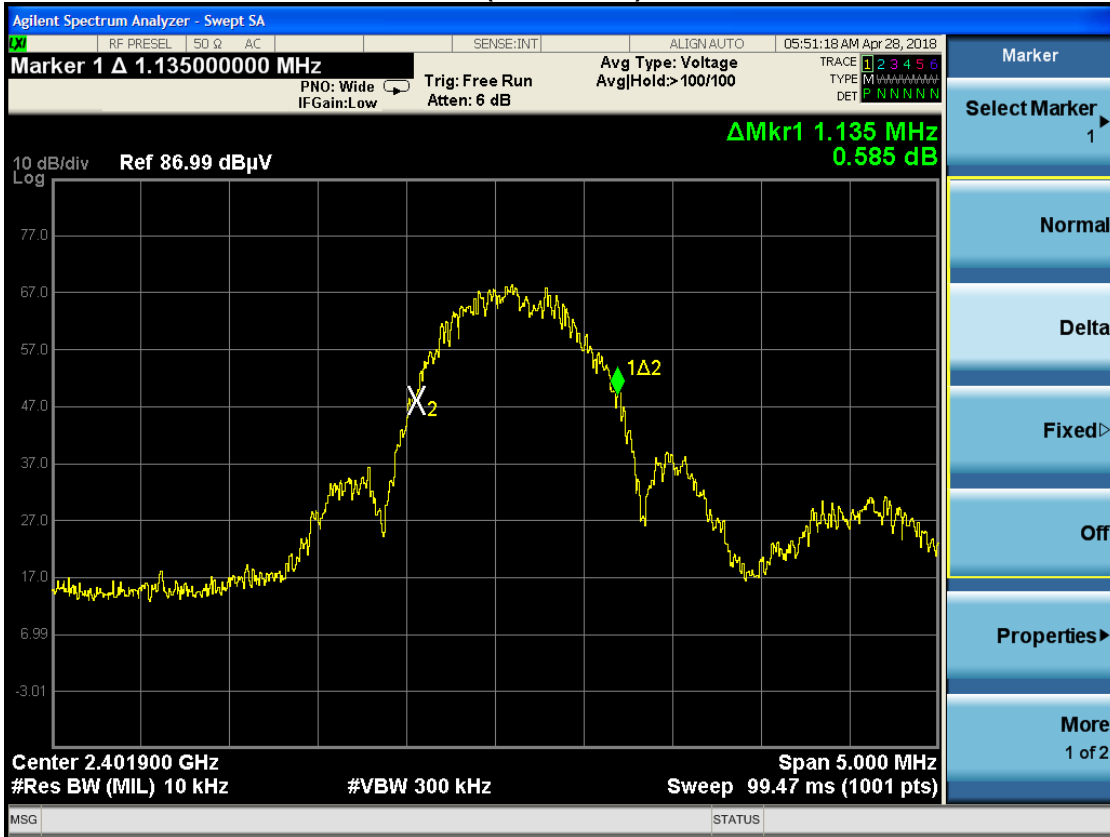
6dB Bandwidth Plot (Channel 39) HIWAC1BLE40AWH



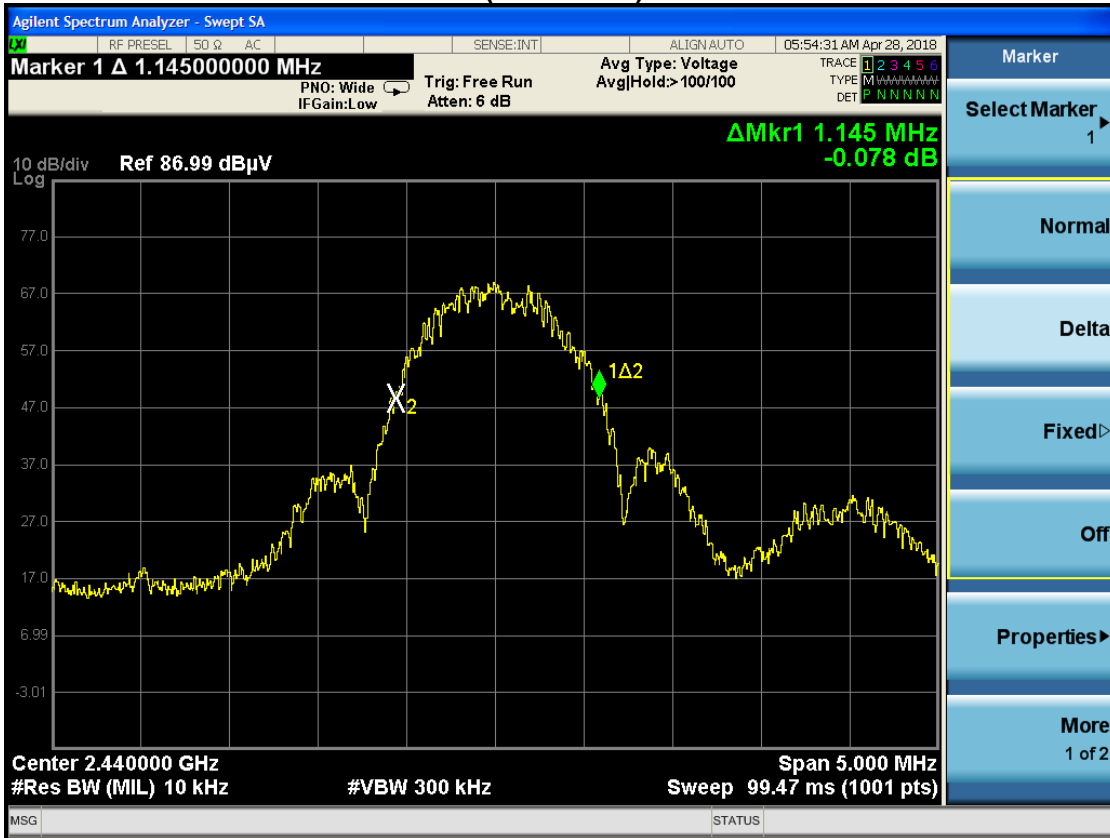
99% Bandwidth Plot (Channel 0) HIWAC1BLE40AWH



99% Bandwidth Plot (Channel 19) HIWAC1BLE40AWH



99% Bandwidth Plot (Channel 39) HIWAC1BLE40AWH



Test Personnel: Dan Alvarez
Supervising/Reviewing
Engineer:
(Where Applicable)
Product Standard: 47 CFR Part 15 Subpart C
and RSS-GEN
Input Voltage: 120Vac/60Hz
Pretest Verification: N/A

Test Date: 04/26/2018
Limit Applied: See Section 8.3
Ambient Temperature: 23 °C
Relative Humidity: 45.4 %
Atmospheric Pressure: 979 mbars

14 FCC 47CFR Part 15 Subpart C - Intentional Radiators - 15.247 RF Exposure

14.1 Test Procedure

SAR test exclusion threshold formula according to FCC KDB 447898 D01 v05r02 is

$$P \cdot \sqrt{f/d} < 3$$

where

P is max. power of channel, including tune-up tolerance, mW

f is operating frequency in GHz

d is min. test separation distance, mm

14.2 Results:

The sample tested was found to Comply.

HIWAC1BLE40AWH

The maximum measured radiated power is 0.0995 mW (-10.02 dBm). The worst case antenna gain, G is 0.0 dBi (0.0 numerical). Therefore, the conducted power (P) is 0.0000995 W.

At 5mm distance the condition for SAR exclusion threshold is

$$0.0995 \times 0.9084 \div 5 = 0.0180 \text{ which is less than 3.}$$

Therefore, SAR testing is not required as the SAR Test Exclusion Threshold condition is satisfied.

SAR Exemption limit according to ISED RSS-102 Issue 5, at 5 mm separation distance = 68.5 mW
Routine evaluation is not required since the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time averaged output power is below the exemption limit.

HIWMA1BLE40AWH

The maximum measured radiated power is 0.04305 mW (-13.66 dBm). The worst case antenna gain, G is 0.0 dBi (0.0 numerical). Therefore, the conducted power (P) is 0.00004305 W.

At 5mm distance the condition for SAR exclusion threshold is

$$0.04305 \times 0.9084 \div 5 = 0.0078 \text{ which is less than 3.}$$

Therefore, SAR testing is not required as the SAR Test Exclusion Threshold condition is satisfied.

SAR Exemption limit according to ISED RSS-102 Issue 5, at 5 mm separation distance = 68.5 mW
Routine evaluation is not required since the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time averaged output power is below the exemption limit.

15 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	03/27/2018	103427082ATL-001	DA	KPS/KPS	Original Issue
1	05/02/2018	103427082ATL-001a	DA	KPS/KPS	Sections for FCC 15.247 were added.
2	05/16/2018	103427082ATL-001b	DA	KPS/KPS	RF Exposure Section was added.
3	05/22/2018	103427082ATL-001c	DA	KPS/KPS	TCB corrections added.
4	06/05/2018	103427082ATL-001d	TJI	KPS/KPS	Added path loss calculation for Power Spectral Density and Maximum Conducted Output Power