
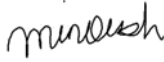



RF Test Report

Test Report Number	HME-23111361-LC-FCC-IC-RF-2.4G		
FCC ID	BYM1409		
IC	1860A-1409		
Applicant	HM Electronics, Inc.		
Applicant Address	2848 Whiptail Loop, Carlsbad, CA 92010 USA		
Product Name	Wireless Beltpack		
Model (s)	1409		
Date of Receipt	11/13/2023		
Date of Test	11/16/2023 – 11/20/2023		
Report Issue Date	12/05/2023		
Test Standards	47CFR Part 15.407 RSS-247 Issue 3, Aug 2023		
Test Result	PASS		
		Issued by: Vista Compliance Laboratories 1261 Puerta Del Sol, San Clemente, CA 92673 USA www.vista-compliance.com	
 <hr/> Minoush Niknam (Test Engineer)		 <hr/> David Zhang (Technical Manager)	
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REVISION HISTORY

Report Number	Version	Description	Issued Date
HME-23111361-LC-FCC-IC-RF-2.4G	01	Initial report	12/05/2023

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1 Test Summary

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A
DTS (6 dB) Channel Bandwidth	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A
Occupied Bandwidth	RSS-Gen Issue 5, Mar 2019	RSS-Gen Issue 5, Feb 2021	N/A
Conducted Maximum Output Power	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A
Power Spectral Density	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A
Conducted Band-Edge & Unwanted Emissions	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A
Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	Pass
AC Power Line Conducted Emissions	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2013)	N/A

Note: This product was certified for FCC/ISED. Testing in this report is for class II permissive change due to the change of 5GHz antennas (new UNII antennas, part number: W3713-2904237, W3714-2904383). Only Radiated emission were tested in this report, for the other test item, please see the original test report under FCC ID: BYM1409 and ISED ID: 1860A-1409.

2 General Information

2.1 Applicant

Applicant	HM Electronics, Inc.
Applicant Address	2848 Whiptail Loop, Carlsbad, CA 92010 USA
Manufacturer	HM Electronics, Inc.
Manufacturer Address	2848 Whiptail Loop, Carlsbad, CA 92010 USA

2.2 Product information

Product Name	Wireless Beltpack
Model Number	1409
Family Models	N/A
Serial Number	085DC44F 2023-11
Frequency Band	BLE: 2402-2480MHz 5Ghz-20MHz: 5180-5240MHz, 5260-5320MHz, 5500-5720MHz, 5745-5825MHz
Type of modulation	BLE: GFSK 5GHz: OFDM
Equipment Class	DTS
Antenna Information	BLE: Internal PCB antenna, 2.5 dBi gain 5GHz: 2 x Embedded omni-directional antenna, 2.8 dBi gain
Clock Frequencies	N/A
Input Power	3.6VDC (battery), 5V/3A (USB-C adapter)
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BLE and 5GHz can transmit simultaneously
Additional Info	EUT has two 5GHz antennas, but these two antennas do not transmit simultaneously. EUT is re-evaluated due to 5GHz antenna change.

2.3 Test standard and method

Test standard	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023
Test method	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	58.2%	996 mbar
Radiated Emission Testing	23.5°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

N/A

5 Test Configuration and Operation

5.1 EUT Test Configuration

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing
Putty.exe 0.63	Set Wi-Fi radio to different test mode

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #	Remark
USB-C adapter	CHOETECH	TC0003	N/A	Provide by client
Laptop	ASUS	P29G	34917771602	Remote access

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Radiated Spurious Emissions into Restricted Frequency Bands

7.1.1 Requirement

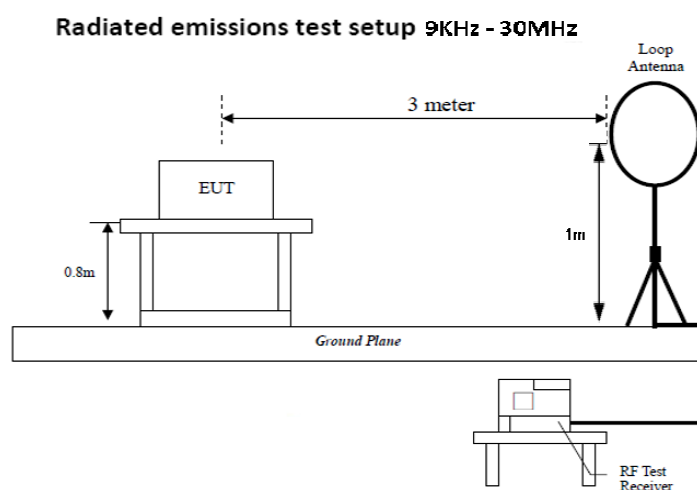
§ 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

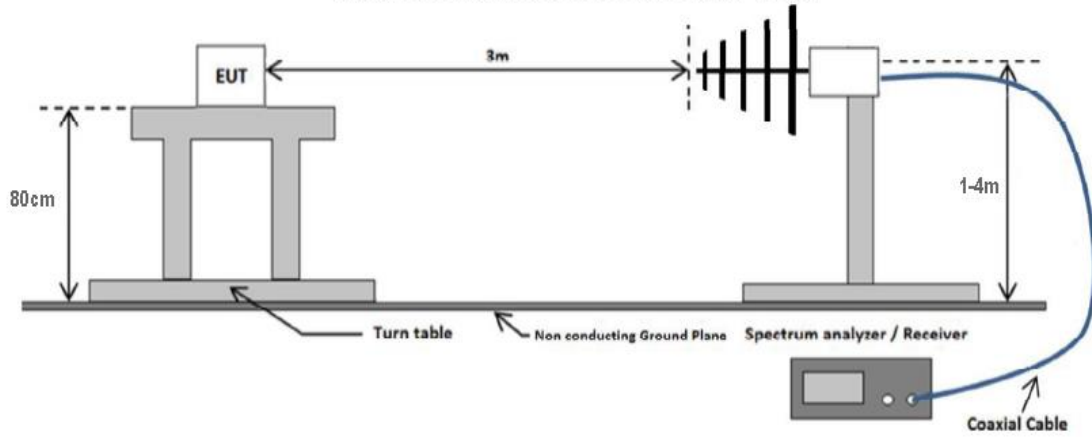
Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency Range (MHZ)	Field Strength ($\mu\text{V/m}$)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

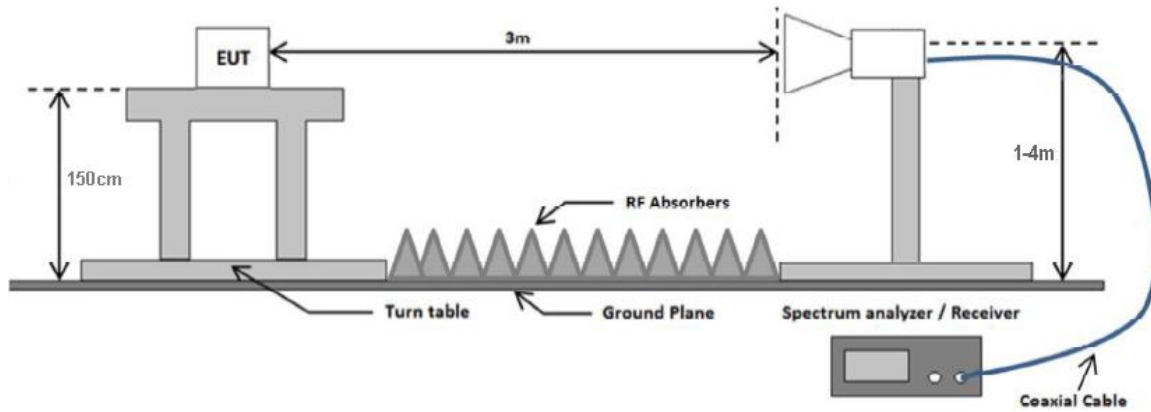
7.1.2 Test Setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.1.3 Test Procedure

According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C63.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

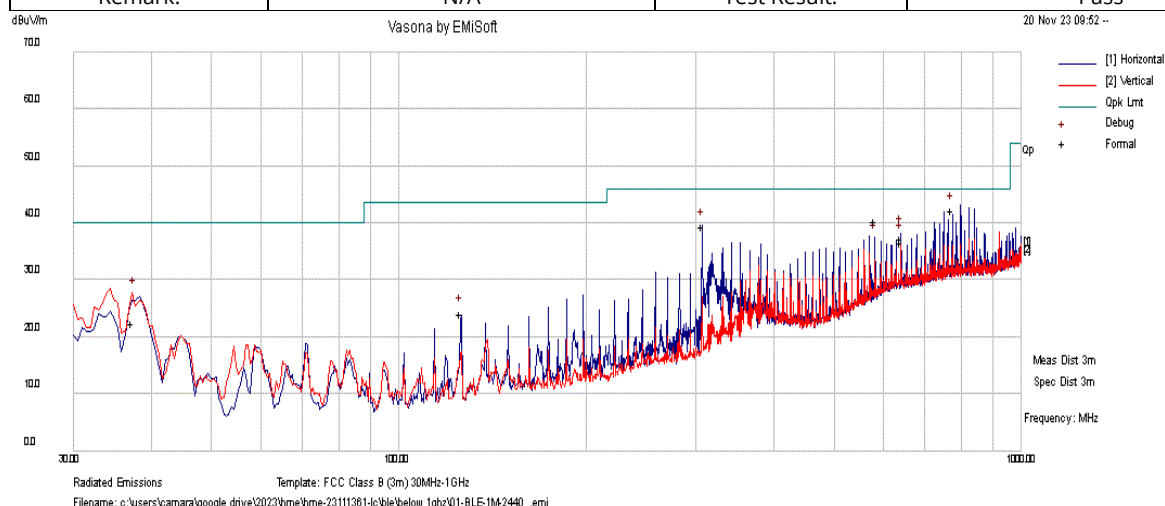
7.1.4 Test Result

Radiated Emission between 9KHz – 30MHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.209, 15.247, RSS-247	Mode:	BLE Mid- Channel-2440 MHz
Frequency Range:	30 MHz - 1 GHz	Test Date:	11/20/2023
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	N/A	Test Result:	Pass



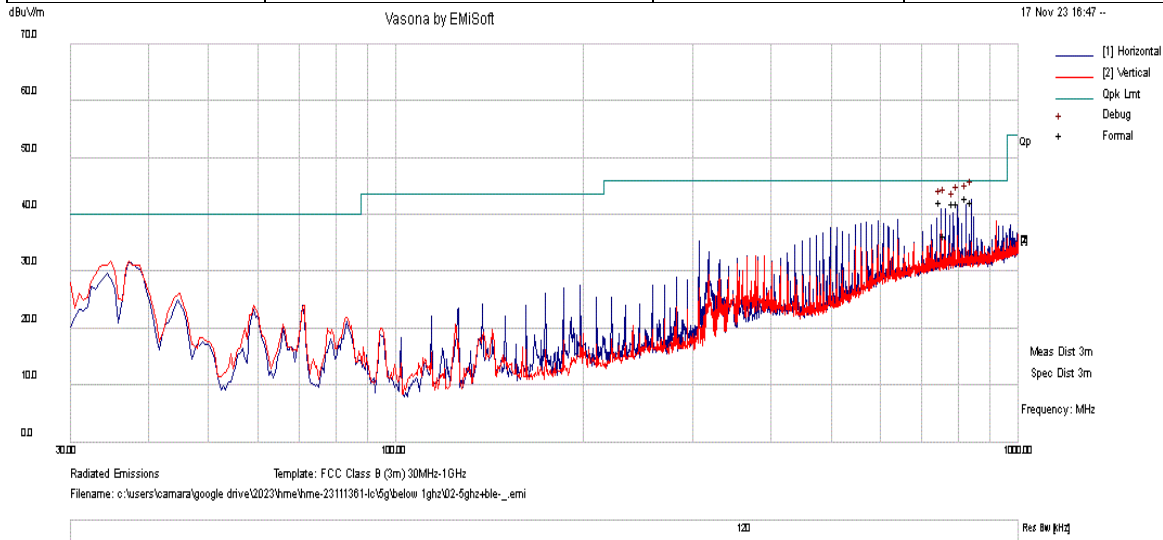
No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	774.19	34.79	7.26	0.25	42.30	Quasi Max	H	100	359	46.00	-3.70	Pass
2	307.21	46.38	5.74	-12.74	39.37	Quasi Max	H	100	29	46.00	-6.63	Pass
3	640.0	31.85	7.23	-1.72	37.36	Quasi Max	V	265	236	46.00	-8.64	Pass
4	581.97	36.65	6.98	-3.13	40.50	Quasi Max	H	131	268	46.00	-5.50	Pass
5	640.0	31.19	7.23	-1.72	36.70	Quasi Max	V	234	236	46.00	-9.30	Pass
6	37.34	35.78	2.47	-15.69	22.56	Quasi Max	V	156	208	40.00	-17.44	Pass
7	125.98	38.74	3.95	-18.58	24.11	Quasi Max	H	177	262	43.50	-19.39	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED SPURIOUS EMISSION BELOW 1GHZ

Test Standard:	15.209, 15.247	Mode:	5GHz+BLE Co-located
Frequency Range:	30 MHz - 1 GHz	Test Date:	11/17/2023
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	N/A	Test Result:	Pass



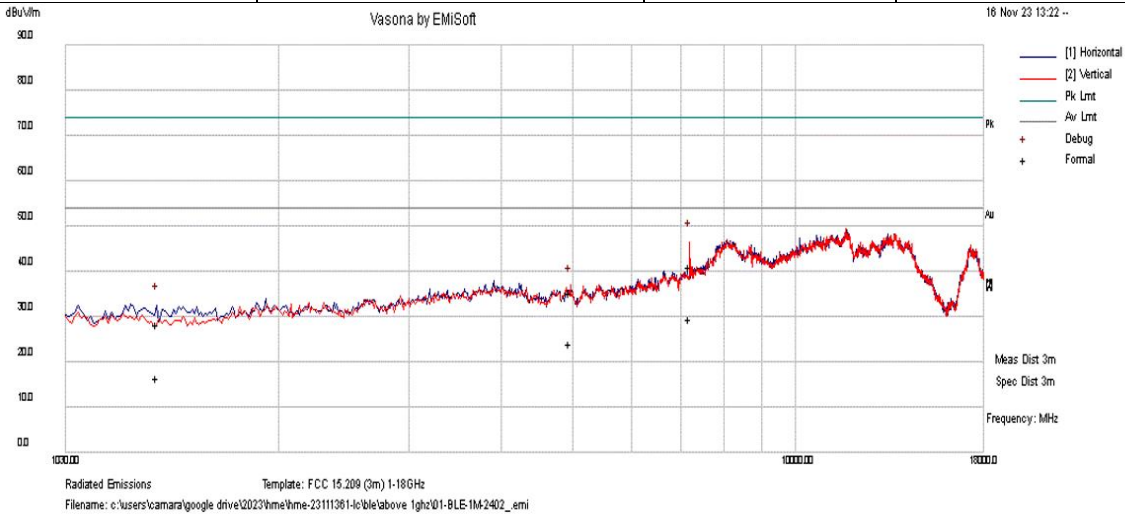
No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	840.0	34.17	7.40	0.62	42.18	Quasi Max	H	122	360	46.00	-3.82	Pass
2	823.33	35.04	7.33	0.58	42.96	Quasi Max	H	180	0	46.00	-3.04	Pass
3	798.74	34.24	7.24	0.52	42.00	Quasi Max	H	149	21	46.00	-4.00	Pass
4	762.24	29.10	7.27	0.11	36.48	Quasi Max	H	135	353	46.00	-9.52	Pass
5	750.01	34.98	7.28	-0.03	42.23	Quasi Max	H	210	34	46.00	-3.77	Pass
6	785.98	34.44	7.25	0.38	42.07	Quasi Max	H	100	41	46.00	-3.93	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED SPURIOUS EMISSION ABOVE 1GHZ

Test Standard:	15.209, 15.247	Mode:	BLE Low Channel-2402 MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	11/16/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Name
Remark:	N/A	Test Result:	Pass



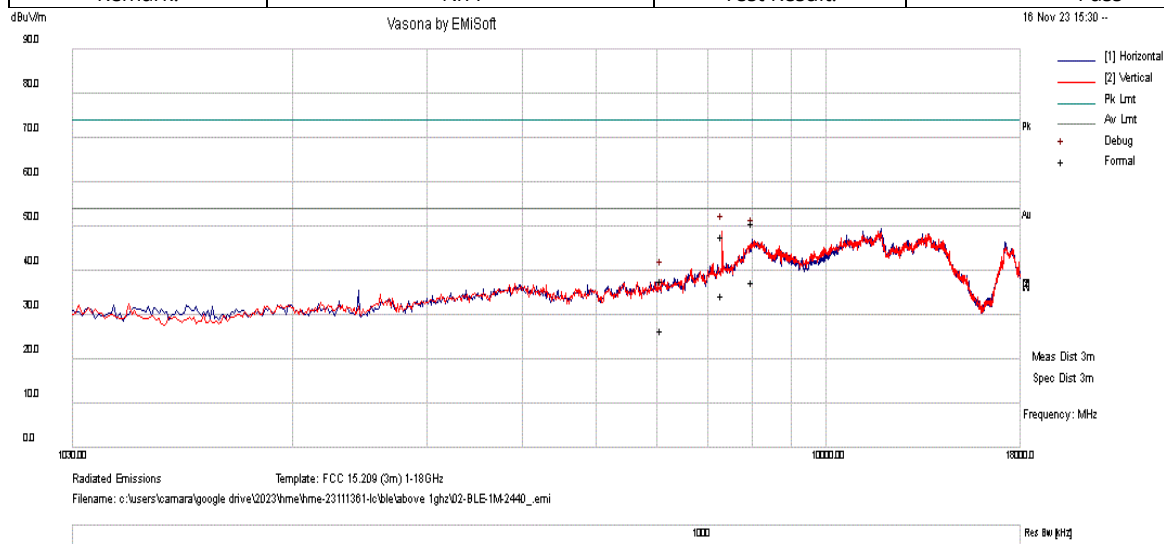
No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	7203.74	18.87	12.68	9.40	40.95	Peak Max	V	349	342	74.00	-33.05	Pass
2	4964.88	20.35	9.46	5.58	35.40	Peak Max	V	358	325	74.00	-38.60	Pass
3	1370.0	24.73	5.01	-1.29	28.45	Peak Max	H	224	288	74.00	-45.56	Pass
4	7203.74	7.58	12.68	9.40	29.66	Average Max	V	349	342	54.00	-24.34	Pass
5	4964.88	9.10	9.46	5.58	24.15	Average Max	V	358	325	54.00	-29.85	Pass
6	1370.0	12.77	5.01	-1.29	16.49	Average Max	H	224	288	54.00	-37.51	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED SPURIOUS EMISSION ABOVE 1GHZ

Test Standard:	15.209, 15.247	Mode:	BLE Mid-Channel-2440 MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	11/16/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Name
Remark:	N/A	Test Result:	Pass



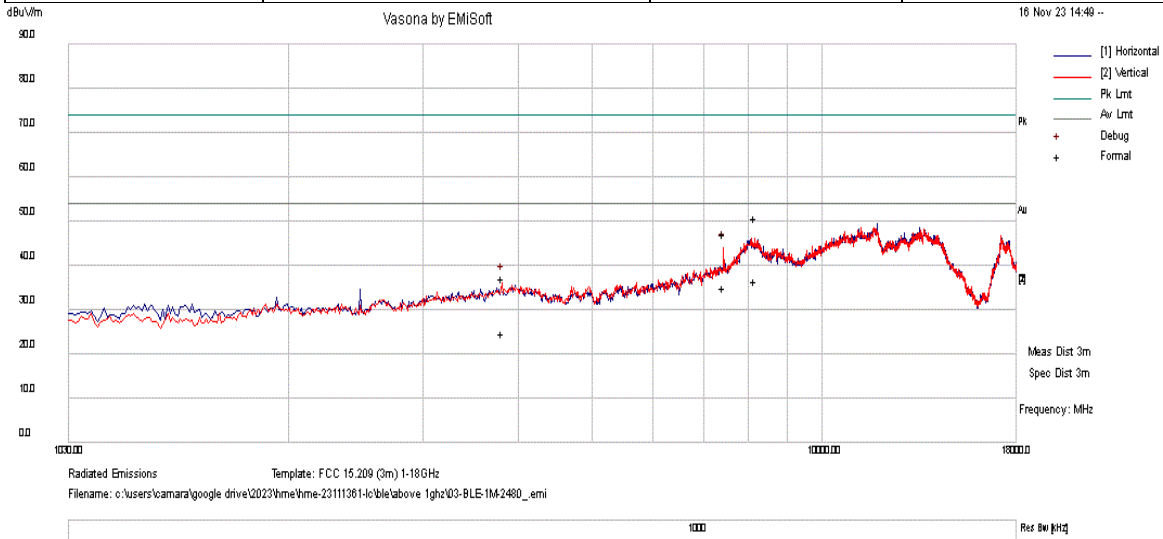
No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	7320.71	25.15	12.88	9.70	47.73	Peak Max	V	320	6	74.00	-26.27	Pass
2	8009.52	20.67	14.27	15.85	50.79	Peak Max	H	378	213	74.00	-23.21	Pass
3	6086.69	19.34	11.83	6.61	37.78	Peak Max	V	358	182	74.00	-36.22	Pass
4	7320.71	11.89	12.88	9.70	34.46	Average Max	V	320	6	54.00	-19.54	Pass
5	8009.52	7.39	14.27	15.85	37.51	Average Max	H	378	213	54.00	-16.49	Pass
6	6086.69	7.92	11.83	6.61	26.35	Average Max	V	358	182	54.00	-27.65	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED SPURIOUS EMISSION ABOVE 1GHZ

Test Standard:	15.209, 15.247	Mode:	BLE High Channel-2480 MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	11/16/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Name
Remark:	N/A	Test Result:	Pass



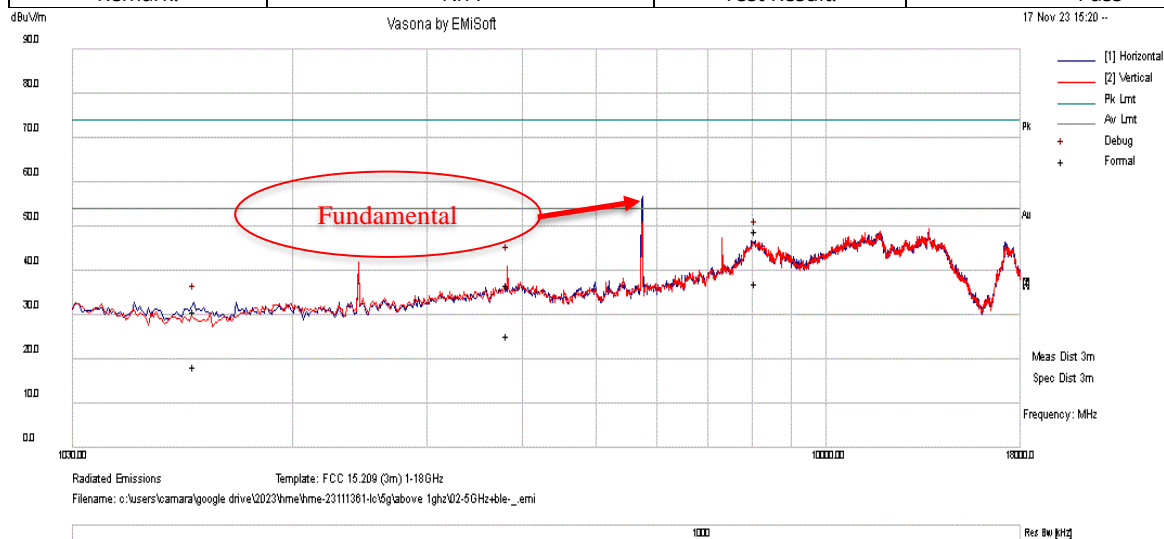
No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8167.37	21.00	14.19	15.62	50.82	Peak Max	V	395	50	74.00	-23.18	Pass
2	7440.57	23.98	13.19	10.00	47.16	Peak Max	V	112	81	74.00	-26.84	Pass
3	3812.79	22.59	9.11	5.37	37.07	Peak Max	V	380	104	74.00	-36.93	Pass
4	8167.37	6.76	14.19	15.62	36.57	Average Max	V	395	50	54.00	-17.43	Pass
5	7440.57	11.82	13.19	10.00	35.00	Average Max	V	112	81	54.00	-19.00	Pass
6	3812.79	10.24	9.11	5.37	24.72	Average Max	V	380	104	54.00	-29.29	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED SPURIOUS EMISSION ABOVE 1GHZ

Test Standard:	15.209, 15.247	Mode:	5GHz+ BLE Co-located
Frequency Range:	1 GHz - 18 GHz	Test Date:	11/17/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	N/A	Test Result:	Pass



No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8094.89	18.83	14.23	15.73	48.78	Peak Max	H	316	27	74.00	-25.22	Pass
2	3829.07	22.13	9.18	5.43	36.74	Peak Max	V	240	317	74.00	-37.26	Pass
3	1487.4	27.13	5.21	-1.77	30.57	Peak Max	H	358	146	74.00	-43.43	Pass
4	8094.89	7.15	14.23	15.73	37.11	Average Max	H	316	27	54.00	-16.89	Pass
5	3829.07	10.72	9.18	5.43	25.33	Average Max	V	240	317	54.00	-28.67	Pass
6	1487.4	14.84	5.21	-1.77	18.29	Average Max	H	358	146	54.00	-35.71	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission at 500 MHz is fundamental emission.

Radiated Emission between 18GHz – 40GHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

8 EUT and Test Setup Photos



EUT-External-Top



EUT-External-Bottom



EUT-External-Front



EUT-External-Back



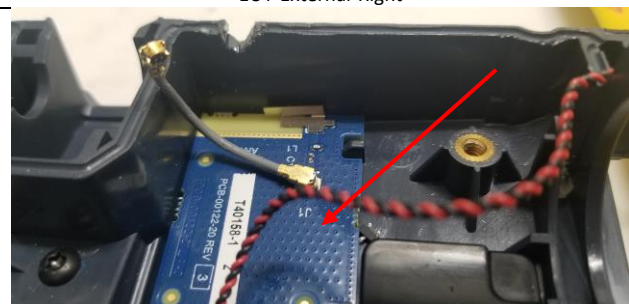
EUT-External-Left



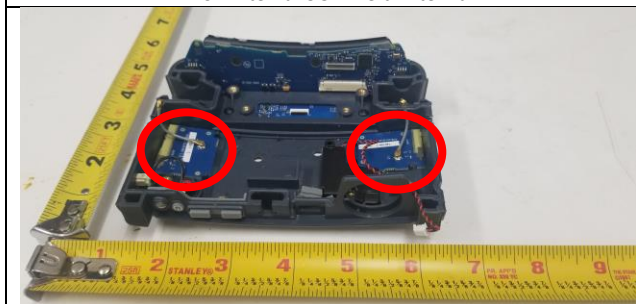
EUT-External-Right



EUT-Internal-5GHz Left Antenna



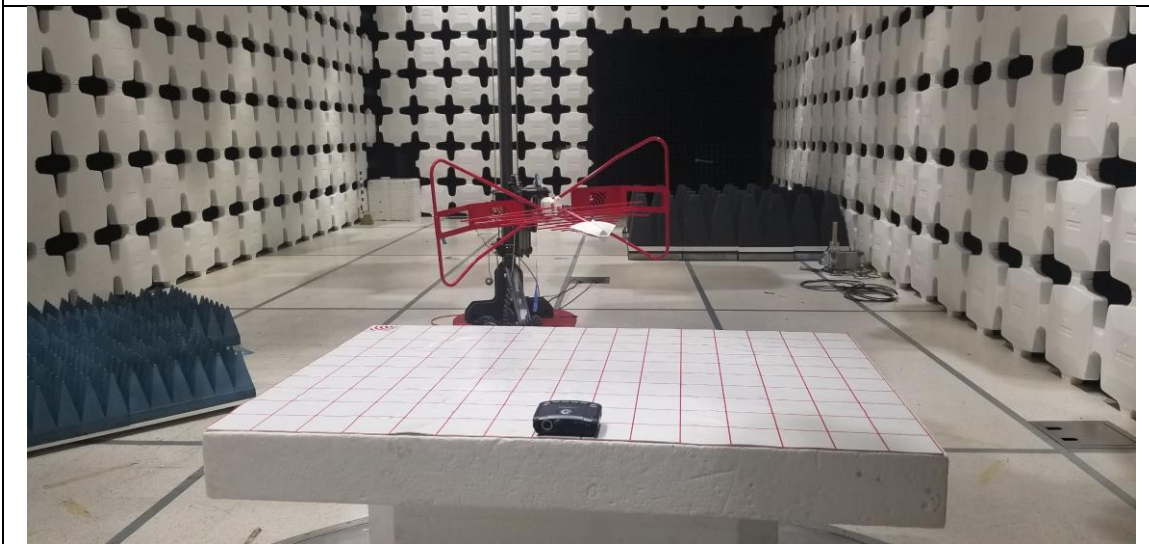
EUT-Internal-5GHz Right Antenna



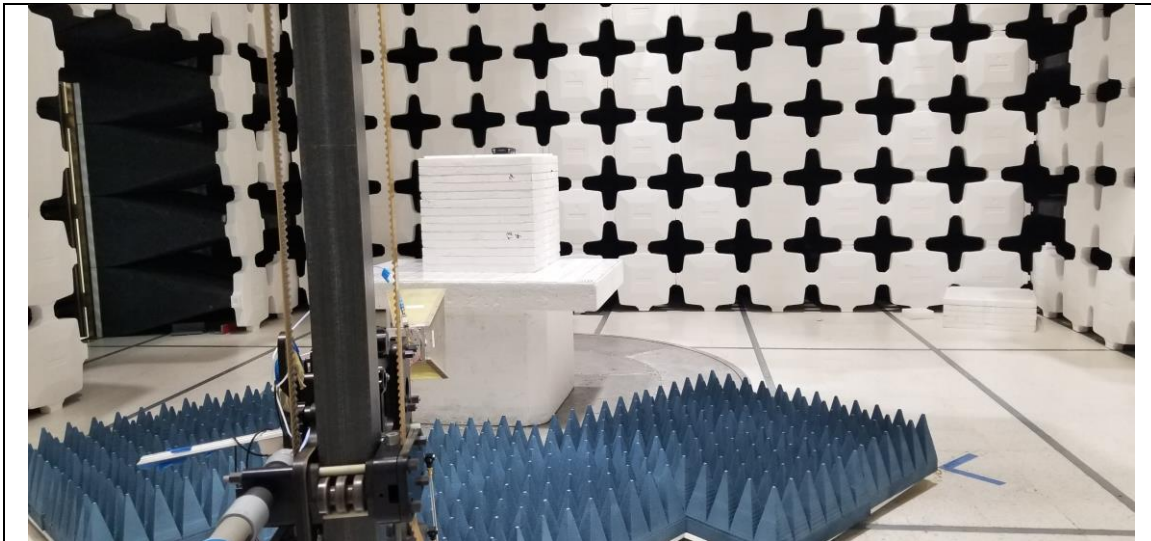
EUT-Internal-Top View



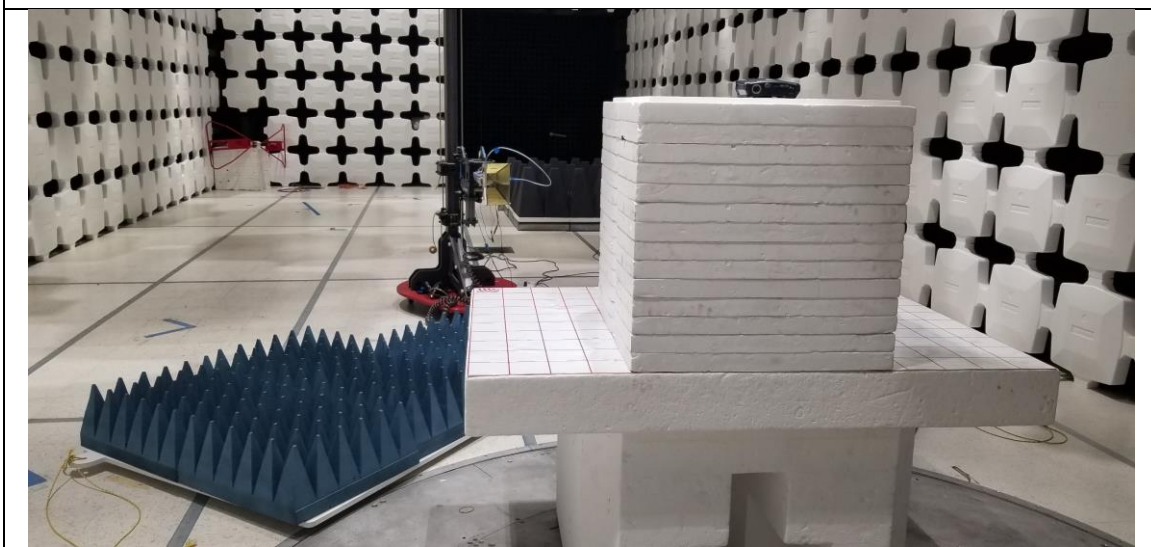
Radiated Emission Test below 1GHz Front View



Radiated Emission Test below 1GHz Rear View



Radiated Emission Test above 1GHz Front View



Radiated Emission Test above 1GHz Rear View

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2022	10/18/2024
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A1)	N/A1)
Spectrum Analyzer	Keysight	N9020A	MY50110074	06/09/2023	06/09/2024
EMC Test Receiver	R&S	ESL6	100230	06/07/2023	06/07/2024
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	07/12/2023	07/12/2024
Bi-Log Antenna	ETS-Lindgren	3142E	217921	07/19/2023	07/19/2024
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	07/21/2023	07/21/2024
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	07/21/2023	07/21/2024
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2023	07/16/2024
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	06/07/2023	06/07/2024
RF Attenuator	Pasternack	PE7005-3	VL061	07/16/2023	07/16/2024
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	07/16/2023	07/16/2024
EM Center Control	ETS-Lindgren	7006-001	160136	N/A1)	N/A1)
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A1)	N/A1)
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A1)	N/A1)
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	06/09/2023	06/09/2024
RE test cable (below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2023	07/16/2024
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2023	07/16/2024
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2023	07/16/2024
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2023	07/16/2024
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2023	07/16/2024
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2023	07/16/2024
USB RF Power Sensor	ETS-Lindgren	7002-006	SN 00151268	06/07/2023	06/07/2024
Agilent Signal Generator	MXG N5182A	N5182A	US47080548	06/07/2023	06/07/2024
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL052	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL053	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL054	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL055	N/A1)	N/A1)
Wideband Communication	R&S	CMW500	147508	05/10/2023	05/10/2024

Note:

- 1) This equipment is not for measurement purpose and only require functional verification. Calibration is not required.

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