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INGERSOLL-RAND COMPANY
TEST REPORT

SCOPE OF WORK
Emissions Testing on Model(s) QXXD2PT024ES06, QXXD2AT027ES06, QXXD5AT080ES08

REPORT NUMBER
104363035BOX-003

ISSUE DATE
February 17, 2021

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Original issue

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EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 104363035BOX-003
Project Number: G104363035

Report Issue Date: 02/17/2021

Model(s) Tested: QXXD2PT024ES06
Model(s) Partially Tested: QXXD2AT027ES06, QXXD5AT080ES08
Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C: 01/2021,
CFR47 FCC Part 15 Subpart B: 01/2021,
RSS-247 Issue 2 February 2017,
ICES-003 Issue 7 October 2020
RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019,

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Ingersoll-Rand Company
1467 Route 31 South
Annandale, NJ 08801
USA

Report prepared by

Vathana Ven / EMC Staff Engineer

Report reviewed by

Kouma Sinn / EMC Staff Engineer

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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	Maximum Peak Output Power CFR47 FCC Part 15 Subpart C:01/2021, Section 15.247 (b)(3) RSS-247 Issue 2 February 2017	Pass
7	6 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C: 01/2021, Section 15.247 (a)(2) RSS-247 Issue 2 February 2017	Pass
8	Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 01/2021, Section 15.247 (e) RSS-247 Issue 2 February 2017	Pass
9	Band Edge Compliance CFR47 FCC Part 15 Subpart C: 01/2021, Section 15.247 (d) RSS-247 Issue 2: 02/2017)	Pass
10	Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 01/2021, Section 15.247 (d) RSS-247 Issue 2 February 2017	Pass
11	Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 01/2021, ICES-003 Issue 7 October 2020	Pass
---	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 01/2021 ICES-003 Issue 7 October 2020	N/A*
12	Revision History	--

Note: *The device was battery powered.

3 Client Information

This EUT was tested at the request of:

Client: Ingersoll-Rand Company
1467 Route 31 South
Annandale, NJ 08801
USA

Contact: Bill Ball
Telephone: 908-238-7131
Email: william_ball@irco.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Ingersoll-Rand Company
1467 Route 31 South
Annandale, NJ 08801
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Pistol Driver	Ingersoll-Rand Company	QXXD2PT024ES06	IR20J30013 IR20J30022
Low Torque Driver	Ingersoll-Rand Company	QXXD2AT027ES06	IR20K09010 IR20K07027
High Torque Driver	Ingersoll-Rand Company nics	QXXD5AT080ES08	IR20K07018 IR20K07007

Receive Date:	11/17/2020
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The EUTs are angle wrenches

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
20VDC	2.5Ah	N/A	N/A
40VDC	2.5Ah	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	The EUT was set to transmit at Low, Mid, and High channel continuous with modulation at 100 % duty cycle.
2	The EUT was set to receive mode.

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Clear Terminal version 2.0.0.4
2	STM32CubeMonitor_RF version 2.5.0

Radio/Receiver Characteristics BLE Pistol Driver (worst-case)	
Frequency Band(s)	2402-2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	14.17 dBm EIRP (Pistol Angle Wrench) 10.79 dBm EIRP (Low Torque Angle Wrench) 12.00 dBm EIRP (High Torque Angle Wrench)
Test Channels	Low Channel (2402 MHz) Mid Channel (2442 MHz) High Channel (2480 MHz)
Occupied Bandwidth	Low Channel (2402 MHz):993.80 kHz Mid Channel (2442 MHz): 995.63 kHz High Channel (2480 MHz): 989.39 kHz
6 dB Bandwidth	Low Channel (2402 MHz): 657.80kHz Mid Channel (2442 MHz): 657.80 kHz High Channel (2480 MHz): 649.80 kHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
Antenna Type and Gain	Integrated, 2 dBi

Radio/Receiver Characteristics 802.15.4 Pistol Driver (worst-case)	
Frequency Band(s)	2405-2480 MHz
Modulation Type(s)	QPSK
Maximum Output Power	10.98 dBm EIRP (Pistol Angle Wrench) 10.79 dBm EIRP (Low Torque Angle Wrench) 7.70 dBm EIRP (High Torque Angle Wrench)
Test Channels	Low Channel (2405 MHz) Mid Channel (2440 MHz) High Channel (2480 MHz)
Occupied Bandwidth	Low Channel (2405 MHz): 2.372 MHz Mid Channel (2440 MHz): 2.383 MHz High Channel (2480 MHz): 2.334 MHz
6 dB Bandwidth	Low Channel (2405 MHz): 1.48 MHz Mid Channel (2440 MHz): 1.42 MHz High Channel (2480 MHz): 1.37 MHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
Antenna Type and Gain	Integrated, 2 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

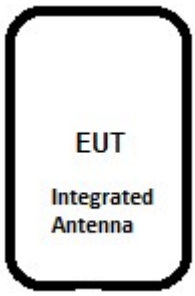
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	None	--	--	--	--

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
20V Lithium Ion battery Pack	INGERSOLL RAND	BL2012	Not Labelled
40V Lithium Ion battery Pack	INGERSOLL RAND	BL4011	Not Labelled
Li-ion charger	INGERSOLL RAND	BL1121	P120G0208
Li-ion charger	INGERSOLL RAND	BL1161	PI19F0280
Laptop	HP	EliteBook 8470p	Not Labelled

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 01/2021, FCC Part 15 Subpart B: 01/2021, RSS 247 Issue 2: 02/2017, ICES-003 Issue 7 October 2020, RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019, ANSI C 63.10: 2013, ANSI C 63.4: 2014, and 558074 D0115.247Meas Guidancev05r02.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, ANSI C63.10, and KDB 558074 D0115.247Meas Guidancev05r02.

TEST SITE: 10m ALSE

The 10m Absorber-lined Shielded Enclosures (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	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	01/21/2020	01/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	DC-18GHz cable 1.5M long	Huber & Suhner	SucoFlex 106A	HS002	11/19/2020	11/19/2021
145-423'	Pre-amp to under floor	Huber and Suhner	SF106A/11N/11N/1.5m	145-423	03/27/2020	03/27/2021
145-424'	9kHz to 40GHz Cable	Huber and Suhner	Sucoflex	145-424	03/27/2020	03/27/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

Name	Manufacturer	Version
None	---	---

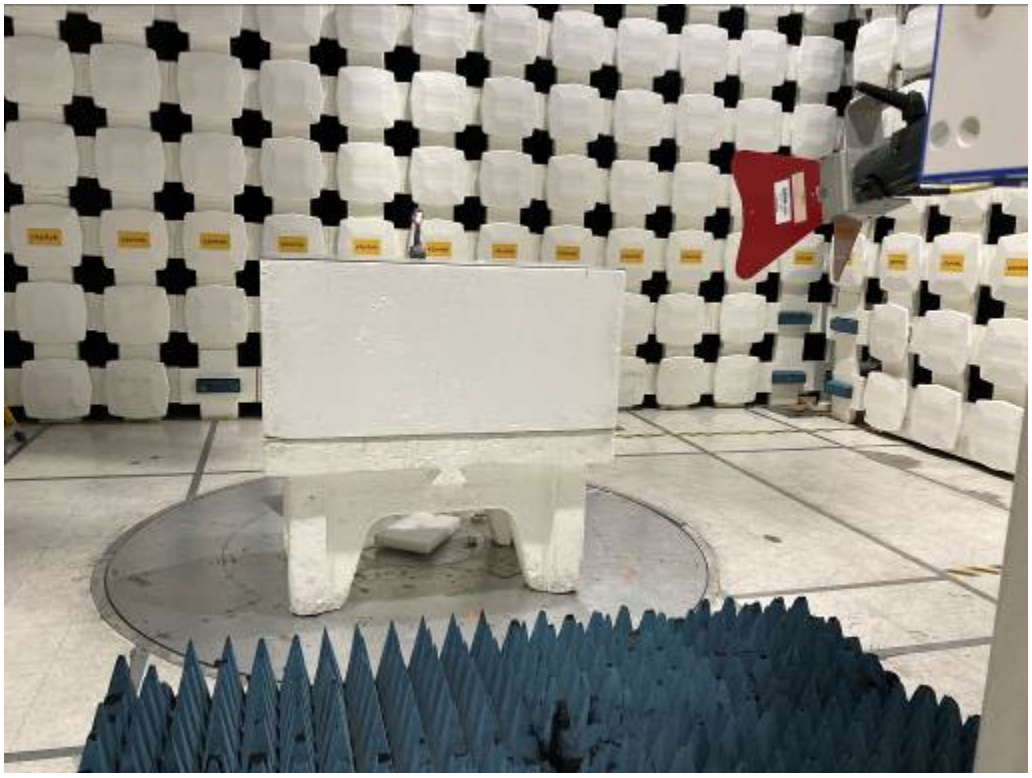
6.3 Results:

The sample tested was found to Comply.

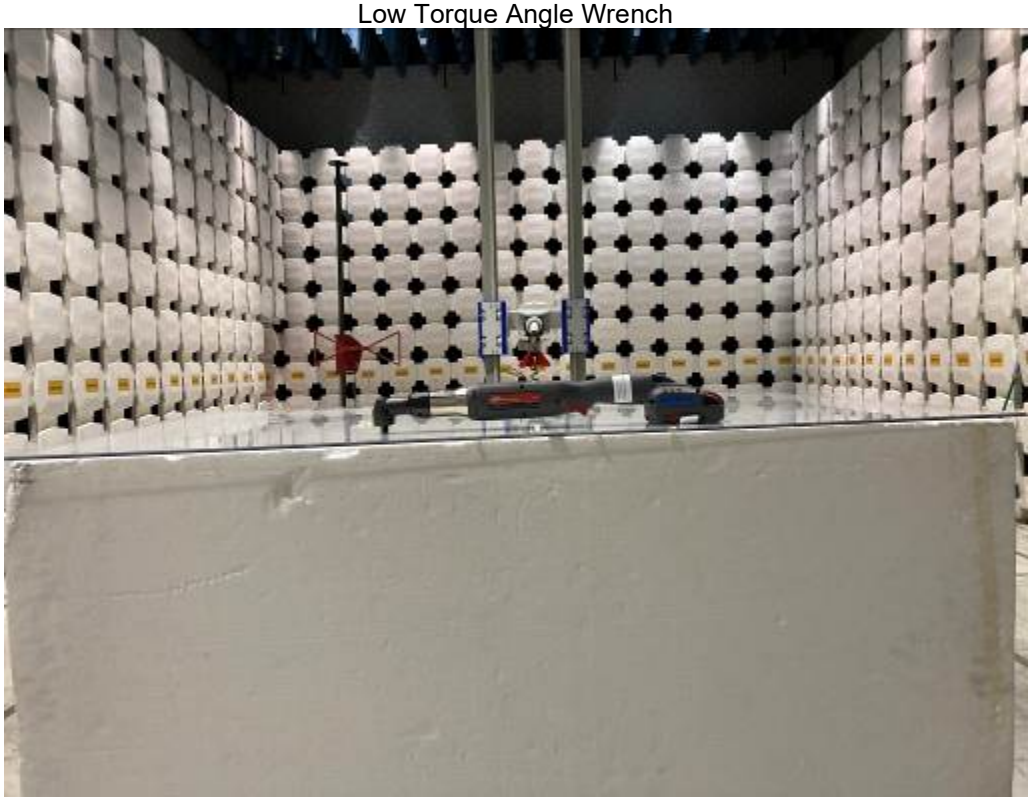
§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm or 36 dBm EIRP.

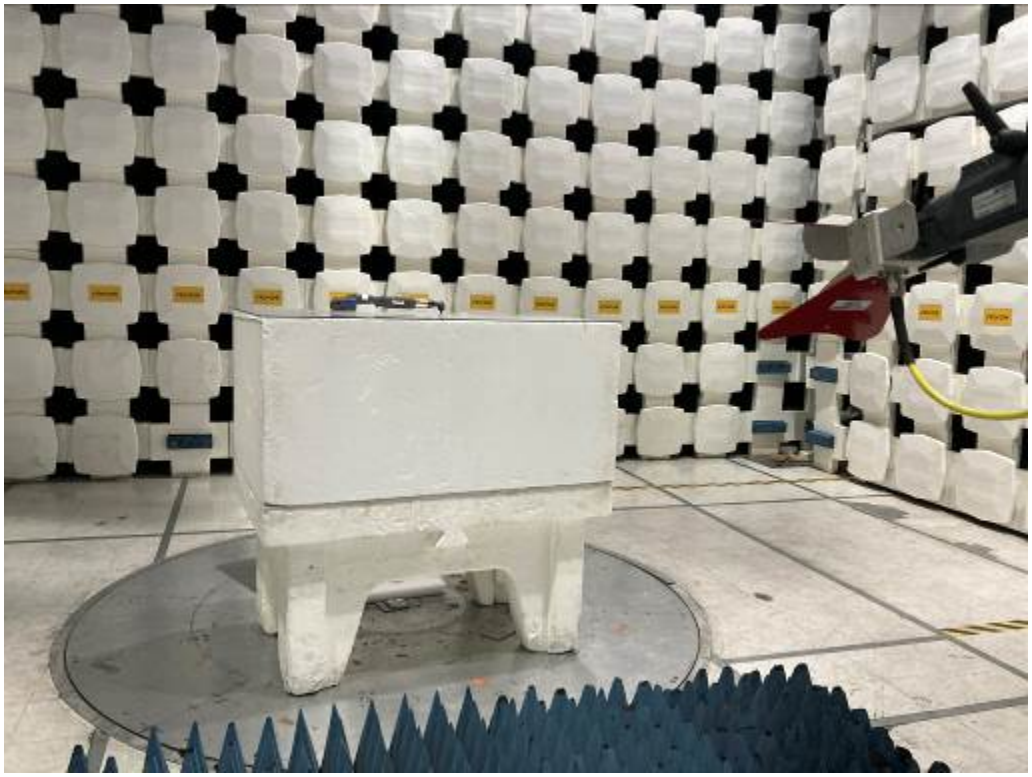
6.4 Setup Photograph:

Pistol Angle Wrench

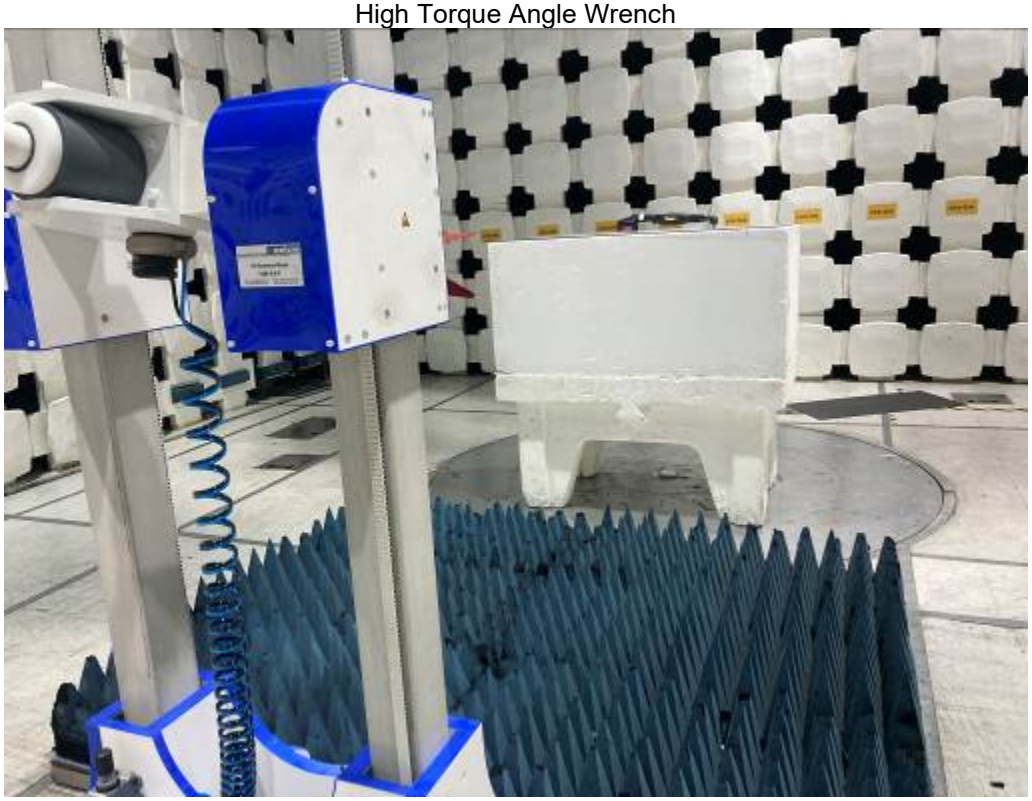


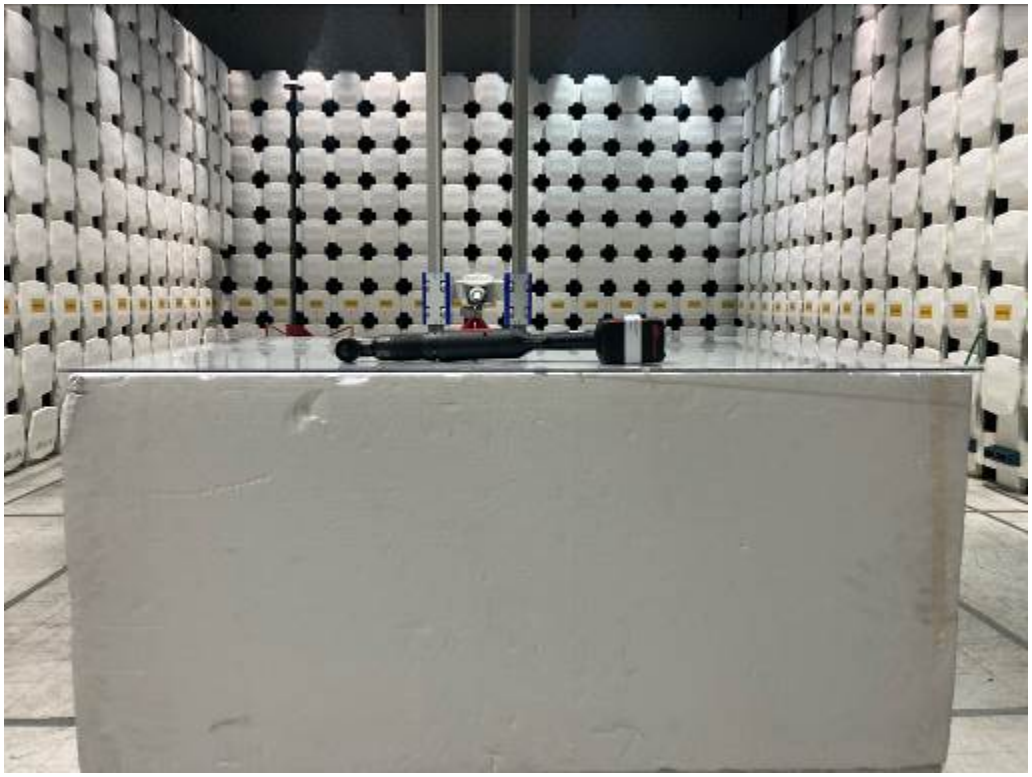
Low Torque Angle Wrench





High Torque Angle Wrench





6.5 Test Data:

BLE- Output power, Pistol Angle Wrench

Radiated Emissions, Output power, EIRP

Company: Ingersoll Rand
Model #: QXXD2PT024ES06 (BLE Pistol Angle Wrench)
Serial #: IR20J30012
Engineers: Vathana Ven
Project #: G104363035 Date(s): 12/04/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: NONE Test Distance (m): 3
PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 24 deg C 28% 1003mB

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (BLE) - X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	67.15	31.94	6.58	0.00	0.00	10.45	36.00	-25.55	5/10 MHz
PK	H	2402.000	65.46	31.94	6.58	0.00	0.00	8.76	36.00	-27.24	5/10 MHz
PK	V	2402.000	66.90	31.94	6.58	0.00	0.00	10.20	36.00	-25.80	1/3 MHz
PK	H	2402.000	64.80	31.94	6.58	0.00	0.00	8.10	36.00	-27.90	1/3 MHz
PK	V	2442.000	67.29	32.23	6.58	0.00	0.00	10.88	36.00	-25.12	5/10 MHz
PK	H	2442.000	68.77	32.23	6.58	0.00	0.00	12.36	36.00	-23.64	5/10 MHz
PK	V	2442.000	66.90	32.23	6.58	0.00	0.00	10.49	36.00	-25.51	1/3 MHz
PK	H	2442.000	68.54	32.23	6.58	0.00	0.00	12.13	36.00	-23.87	1/3 MHz
PK	V	2480.000	68.71	32.41	6.58	0.00	0.00	12.48	36.00	-23.52	5/10 MHz
PK	H	2480.000	65.98	32.41	6.58	0.00	0.00	9.75	36.00	-26.25	5/10 MHz
PK	V	2480.000	68.33	32.41	6.58	0.00	0.00	12.10	36.00	-23.90	1/3 MHz
PK	H	2480.000	65.29	32.41	6.58	0.00	0.00	9.06	36.00	-26.94	1/3 MHz
Note: RF Output Power (BLE) - Y-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	62.82	31.94	6.58	0.00	0.00	6.12	36.00	-29.88	5/10 MHz
PK	H	2402.000	66.47	31.94	6.58	0.00	0.00	9.77	36.00	-26.23	5/10 MHz
PK	V	2402.000	62.09	31.94	6.58	0.00	0.00	5.39	36.00	-30.61	1/3 MHz
PK	H	2402.000	66.16	31.94	6.58	0.00	0.00	9.46	36.00	-26.54	1/3 MHz
PK	V	2442.000	66.55	32.23	6.58	0.00	0.00	10.14	36.00	-25.86	5/10 MHz
PK	H	2442.000	70.58	32.23	6.58	0.00	0.00	14.17	36.00	-21.83	5/10 MHz
PK	V	2442.000	66.25	32.23	6.58	0.00	0.00	9.84	36.00	-26.16	1/3 MHz
PK	H	2442.000	69.90	32.23	6.58	0.00	0.00	13.49	36.00	-22.51	1/3 MHz
PK	V	2480.000	61.95	32.41	6.58	0.00	0.00	5.72	36.00	-30.28	5/10 MHz
PK	H	2480.000	67.43	32.41	6.58	0.00	0.00	11.20	36.00	-24.80	5/10 MHz
PK	V	2480.000	61.24	32.41	6.58	0.00	0.00	5.01	36.00	-30.99	1/3 MHz
PK	H	2480.000	67.02	32.41	6.58	0.00	0.00	10.79	36.00	-25.21	1/3 MHz
Note: RF Output Power (BLE) - Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	64.67	31.94	6.58	0.00	0.00	7.97	36.00	-28.03	5/10 MHz
PK	H	2402.000	67.02	31.94	6.58	0.00	0.00	10.32	36.00	-25.68	5/10 MHz
PK	V	2402.000	64.40	31.94	6.58	0.00	0.00	7.70	36.00	-28.30	1/3 MHz
PK	H	2402.000	66.64	31.94	6.58	0.00	0.00	9.94	36.00	-26.06	1/3 MHz
PK	V	2442.000	66.27	32.23	6.58	0.00	0.00	9.86	36.00	-26.14	5/10 MHz
PK	H	2442.000	69.01	32.23	6.58	0.00	0.00	12.60	36.00	-23.40	5/10 MHz
PK	V	2442.000	65.84	32.23	6.58	0.00	0.00	9.43	36.00	-26.57	1/3 MHz
PK	H	2442.000	68.77	32.23	6.58	0.00	0.00	12.36	36.00	-23.64	1/3 MHz
PK	V	2480.000	66.55	32.41	6.58	0.00	0.00	10.32	36.00	-25.68	5/10 MHz
PK	H	2480.000	70.17	32.41	6.58	0.00	0.00	13.94	36.00	-22.06	5/10 MHz
PK	V	2480.000	66.45	32.41	6.58	0.00	0.00	10.22	36.00	-25.78	1/3 MHz
PK	H	2480.000	69.90	32.41	6.58	0.00	0.00	13.67	36.00	-22.33	1/3 MHz

BLE- Output power, Low Torque Angle Wrench

Radiated Emissions, Output power, EIRP

Company: Ingersoll Rand
Model #: QXXD2AT027ES06 (BLE Low Torque Driver)
Serial #: IR20K09010
Engineers: Vathana Ven
Project #: G104363035 Date(s): 12/04/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: NONE Test Distance (m): 3

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 24 deg C 28% 1003mB

PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (BLE) - X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	65.46	31.94	6.58	0.00	0.00	8.76	36.00	-27.24	5/10 MHz
PK	H	2402.000	64.27	31.94	6.58	0.00	0.00	7.57	36.00	-28.43	5/10 MHz
PK	V	2402.000	64.92	31.94	6.58	0.00	0.00	8.22	36.00	-27.78	1/3 MHz
PK	H	2402.000	63.61	31.94	6.58	0.00	0.00	6.91	36.00	-29.09	1/3 MHz
PK	V	2442.000	63.10	32.23	6.58	0.00	0.00	6.69	36.00	-29.31	5/10 MHz
PK	H	2442.000	66.68	32.23	6.58	0.00	0.00	10.27	36.00	-25.73	5/10 MHz
PK	V	2442.000	62.46	32.23	6.58	0.00	0.00	6.05	36.00	-29.95	1/3 MHz
PK	H	2442.000	66.44	32.23	6.58	0.00	0.00	10.03	36.00	-25.97	1/3 MHz
PK	V	2480.000	65.20	32.41	6.58	0.00	0.00	8.97	36.00	-27.03	5/10 MHz
PK	H	2480.000	67.02	32.41	6.58	0.00	0.00	10.79	36.00	-25.21	5/10 MHz
PK	V	2480.000	64.60	32.41	6.58	0.00	0.00	8.37	36.00	-27.63	1/3 MHz
PK	H	2480.000	67.02	32.41	6.58	0.00	0.00	10.79	36.00	-25.21	1/3 MHz
Note: RF Output Power (BLE) - Y-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	64.27	31.94	6.58	0.00	0.00	7.57	36.00	-28.43	5/10 MHz
PK	H	2402.000	67.15	31.94	6.58	0.00	0.00	10.45	36.00	-25.55	5/10 MHz
PK	V	2402.000	63.67	31.94	6.58	0.00	0.00	6.97	36.00	-29.03	1/3 MHz
PK	H	2402.000	66.82	31.94	6.58	0.00	0.00	10.12	36.00	-25.88	1/3 MHz
PK	V	2442.000	65.07	32.23	6.58	0.00	0.00	8.66	36.00	-27.34	5/10 MHz
PK	H	2442.000	66.64	32.23	6.58	0.00	0.00	10.23	36.00	-25.77	5/10 MHz
PK	V	2442.000	64.26	32.23	6.58	0.00	0.00	7.85	36.00	-28.15	1/3 MHz
PK	H	2442.000	66.40	32.23	6.58	0.00	0.00	9.99	36.00	-26.01	1/3 MHz
PK	V	2480.000	65.85	32.41	6.58	0.00	0.00	9.62	36.00	-26.38	5/10 MHz
PK	H	2480.000	64.14	32.41	6.58	0.00	0.00	7.91	36.00	-28.09	5/10 MHz
PK	V	2480.000	65.39	32.41	6.58	0.00	0.00	9.16	36.00	-26.84	1/3 MHz
PK	H	2480.000	63.61	32.41	6.58	0.00	0.00	7.38	36.00	-28.62	1/3 MHz
Note: RF Output Power (BLE) - Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	65.07	31.94	6.58	0.00	0.00	8.37	36.00	-27.63	5/10 MHz
PK	H	2402.000	60.09	31.94	6.58	0.00	0.00	3.39	36.00	-32.61	5/10 MHz
PK	V	2402.000	64.65	31.94	6.58	0.00	0.00	7.95	36.00	-28.05	1/3 MHz
PK	H	2402.000	59.29	31.94	6.58	0.00	0.00	2.59	36.00	-33.41	1/3 MHz
PK	V	2442.000	65.59	32.23	6.58	0.00	0.00	9.18	36.00	-26.82	5/10 MHz
PK	H	2442.000	61.81	32.23	6.58	0.00	0.00	5.40	36.00	-30.60	5/10 MHz
PK	V	2442.000	65.05	32.23	6.58	0.00	0.00	8.64	36.00	-27.36	1/3 MHz
PK	H	2442.000	61.09	32.23	6.58	0.00	0.00	4.68	36.00	-31.32	1/3 MHz
PK	V	2480.000	66.45	32.41	6.58	0.00	0.00	10.22	36.00	-25.78	5/10 MHz
PK	H	2480.000	61.39	32.41	6.58	0.00	0.00	5.16	36.00	-30.84	5/10 MHz
PK	V	2480.000	66.08	32.41	6.58	0.00	0.00	9.85	36.00	-26.15	1/3 MHz
PK	H	2480.000	60.94	32.41	6.58	0.00	0.00	4.71	36.00	-31.29	1/3 MHz

BLE- Output power, High Torque Angle Wrench

Radiated Emissions, Output power, EIRP

Company: Ingersoll Rand
Model #: QXXD5AT080ES08 (BLE High Torque Driver)
Serial #: IR20K07007
Engineers: Vathana Ven
Project #: G104363035 Date(s): 11/29/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: NONE Test Distance (m): 3
PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 24 deg C 24% 1009mB

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (BLE) - X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	65.07	31.94	6.58	0.00	0.00	8.37	36.00	-27.63	5/10 MHz
PK	H	2402.000	64.51	31.94	6.58	0.00	0.00	7.81	36.00	-28.19	5/10 MHz
PK	V	2402.000	64.60	31.94	6.58	0.00	0.00	7.90	36.00	-28.10	1/3 MHz
PK	H	2402.000	65.07	31.94	6.58	0.00	0.00	8.37	36.00	-27.63	1/3 MHz
PK	V	2442.000	64.22	32.23	6.58	0.00	0.00	7.81	36.00	-28.19	5/10 MHz
PK	H	2442.000	68.41	32.23	6.58	0.00	0.00	12.00	36.00	-24.00	5/10 MHz
PK	V	2442.000	64.25	32.23	6.58	0.00	0.00	7.84	36.00	-28.16	1/3 MHz
PK	H	2442.000	67.96	32.23	6.58	0.00	0.00	11.55	36.00	-24.45	1/3 MHz
PK	V	2480.000	65.98	32.41	6.58	0.00	0.00	9.75	36.00	-26.25	5/10 MHz
PK	H	2480.000	64.54	32.41	6.58	0.00	0.00	8.31	36.00	-27.69	5/10 MHz
PK	V	2480.000	65.64	32.41	6.58	0.00	0.00	9.41	36.00	-26.59	1/3 MHz
PK	H	2480.000	64.20	32.41	6.58	0.00	0.00	7.97	36.00	-28.03	1/3 MHz
Note: RF Output Power (BLE) - Y-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	63.88	31.94	6.58	0.00	0.00	7.18	36.00	-28.82	5/10 MHz
PK	H	2402.000	66.83	31.94	6.58	0.00	0.00	10.13	36.00	-25.87	5/10 MHz
PK	V	2402.000	63.36	31.94	6.58	0.00	0.00	6.66	36.00	-29.34	1/3 MHz
PK	H	2402.000	66.77	31.94	6.58	0.00	0.00	10.07	36.00	-25.93	1/3 MHz
PK	V	2442.000	65.46	32.23	6.58	0.00	0.00	9.05	36.00	-26.95	5/10 MHz
PK	H	2442.000	63.36	32.23	6.58	0.00	0.00	6.95	36.00	-29.05	5/10 MHz
PK	V	2442.000	64.67	32.23	6.58	0.00	0.00	8.26	36.00	-27.74	1/3 MHz
PK	H	2442.000	62.89	32.23	6.58	0.00	0.00	6.48	36.00	-29.52	1/3 MHz
PK	V	2480.000	65.72	32.41	6.58	0.00	0.00	9.49	36.00	-26.51	5/10 MHz
PK	H	2480.000	64.00	32.41	6.58	0.00	0.00	7.77	36.00	-28.23	5/10 MHz
PK	V	2480.000	65.23	32.41	6.58	0.00	0.00	9.00	36.00	-27.00	1/3 MHz
PK	H	2480.000	63.33	32.41	6.58	0.00	0.00	7.10	36.00	-28.90	1/3 MHz
Note: RF Output Power (BLE) - Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	64.01	31.94	6.58	0.00	0.00	7.31	36.00	-28.69	5/10 MHz
PK	H	2402.000	60.09	31.94	6.58	0.00	0.00	3.39	36.00	-32.61	5/10 MHz
PK	V	2402.000	63.41	31.94	6.58	0.00	0.00	6.71	36.00	-29.29	1/3 MHz
PK	H	2402.000	59.29	31.94	6.58	0.00	0.00	2.59	36.00	-33.41	1/3 MHz
PK	V	2442.000	65.59	32.23	6.58	0.00	0.00	9.18	36.00	-26.82	5/10 MHz
PK	H	2442.000	64.81	32.23	6.58	0.00	0.00	8.40	36.00	-27.60	5/10 MHz
PK	V	2442.000	65.18	32.23	6.58	0.00	0.00	8.77	36.00	-27.23	1/3 MHz
PK	H	2442.000	64.26	32.23	6.58	0.00	0.00	7.85	36.00	-28.15	1/3 MHz
PK	V	2480.000	63.10	32.41	6.58	0.00	0.00	6.87	36.00	-29.13	5/10 MHz
PK	H	2480.000	60.23	32.41	6.58	0.00	0.00	4.00	36.00	-32.00	5/10 MHz
PK	V	2480.000	62.53	32.41	6.58	0.00	0.00	6.30	36.00	-29.70	1/3 MHz
PK	H	2480.000	59.72	32.41	6.58	0.00	0.00	3.49	36.00	-32.51	1/3 MHz

802.15.4 - Output power, Pistol Angle Wrench

Radiated Emissions, Output power, EIRP

Company: Ingersoll Rand
Model #: QXXD2PT024ES06 (802.15.4 Pistol Angle Wrench)
Serial #: IR20J30022
Engineers: Vathana Ven
Project #: G104363035 Date(s): 12/06/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: None Test Distance (m): 3

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 23 deg C 29% 993mB

PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2405.000	63.15	31.94	6.58	0.00	0.00	6.45	36.00	-29.55	5/10 MHz
PK	H	2405.000	60.00	31.94	6.58	0.00	0.00	3.30	36.00	-32.70	5/10 MHz
PK	V	2405.000	62.55	31.94	6.58	0.00	0.00	5.85	36.00	-30.15	1/3 MHz
PK	H	2405.000	59.09	31.94	6.58	0.00	0.00	2.39	36.00	-33.61	1/3 MHz
PK	V	2440.000	63.45	32.23	6.58	0.00	0.00	7.04	36.00	-28.96	5/10 MHz
PK	H	2440.000	59.74	32.23	6.58	0.00	0.00	3.33	36.00	-32.67	5/10 MHz
PK	V	2440.000	62.92	32.23	6.58	0.00	0.00	6.51	36.00	-29.49	1/3 MHz
PK	H	2440.000	58.95	32.23	6.58	0.00	0.00	2.54	36.00	-33.46	1/3 MHz
PK	V	2480.000	61.84	32.41	6.58	0.00	0.00	5.61	36.00	-30.39	5/10 MHz
PK	H	2480.000	60.46	32.41	6.58	0.00	0.00	4.23	36.00	-31.77	5/10 MHz
PK	V	2480.000	61.19	32.41	6.58	0.00	0.00	4.96	36.00	-31.04	1/3 MHz
PK	H	2480.000	59.93	32.41	6.58	0.00	0.00	3.70	36.00	-32.30	1/3 MHz
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, Y-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2405.000	56.67	31.94	6.58	0.00	0.00	-0.03	36.00	-36.03	5/10 MHz
PK	H	2405.000	60.26	31.94	6.58	0.00	0.00	3.56	36.00	-32.44	5/10 MHz
PK	V	2405.000	55.53	31.94	6.58	0.00	0.00	-1.17	36.00	-37.17	1/3 MHz
PK	H	2405.000	59.35	31.94	6.58	0.00	0.00	2.65	36.00	-33.35	1/3 MHz
PK	V	2440.000	60.13	32.23	6.58	0.00	0.00	3.72	36.00	-32.28	5/10 MHz
PK	H	2440.000	67.39	32.23	6.58	0.00	0.00	10.98	36.00	-25.02	5/10 MHz
PK	V	2440.000	59.50	32.23	6.58	0.00	0.00	3.09	36.00	-32.91	1/3 MHz
PK	H	2440.000	66.86	32.23	6.58	0.00	0.00	10.45	36.00	-25.55	1/3 MHz
PK	V	2480.000	59.35	32.41	6.58	0.00	0.00	3.12	36.00	-32.88	5/10 MHz
PK	H	2480.000	62.40	32.41	6.58	0.00	0.00	6.17	36.00	-29.83	5/10 MHz
PK	V	2480.000	58.40	32.41	6.58	0.00	0.00	2.17	36.00	-33.83	1/3 MHz
PK	H	2480.000	61.57	32.41	6.58	0.00	0.00	5.34	36.00	-30.66	1/3 MHz
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2405.000	57.90	31.94	6.58	0.00	0.00	1.20	36.00	-34.80	5/10 MHz
PK	H	2405.000	65.68	31.94	6.58	0.00	0.00	8.98	36.00	-27.02	5/10 MHz
PK	V	2405.000	56.81	31.94	6.58	0.00	0.00	0.11	36.00	-35.89	1/3 MHz
PK	H	2405.000	65.16	31.94	6.58	0.00	0.00	8.46	36.00	-27.54	1/3 MHz
PK	V	2440.000	61.98	32.23	6.58	0.00	0.00	5.57	36.00	-30.43	5/10 MHz
PK	H	2440.000	67.26	32.23	6.58	0.00	0.00	10.85	36.00	-25.15	5/10 MHz
PK	V	2440.000	61.44	32.23	6.58	0.00	0.00	5.03	36.00	-30.97	1/3 MHz
PK	H	2440.000	66.78	32.23	6.58	0.00	0.00	10.37	36.00	-25.63	1/3 MHz
PK	V	2480.000	60.26	32.41	6.58	0.00	0.00	4.03	36.00	-31.97	5/10 MHz
PK	H	2480.000	61.84	32.41	6.58	0.00	0.00	5.61	36.00	-30.39	5/10 MHz
PK	V	2480.000	59.22	32.41	6.58	0.00	0.00	2.99	36.00	-33.01	1/3 MHz
PK	H	2480.000	61.15	32.41	6.58	0.00	0.00	4.92	36.00	-31.08	1/3 MHz

802.15.4 - Output power, Low Torque Angle Wrench

Radiated Emissions, Output power, EIRP

Company: Ingersoll Rand
Model #: QXXD2AT027ES06 (802.15.4 Low Torque Angle Wrench)
Serial #: IR20K07027
Engineers: Vathana Ven
Project #: G104363035 Date(s): 12/06/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: NONE Test Distance (m): 3
PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 23 deg C 29% 993mB

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (802.15.4) - X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	58.29	31.94	6.58	0.00	0.00	1.59	36.00	-34.41	5/10 MHz
PK	H	2402.000	58.03	31.94	6.58	0.00	0.00	1.33	36.00	-34.67	5/10 MHz
PK	V	2402.000	57.36	31.94	6.58	0.00	0.00	0.66	36.00	-35.34	1/3 MHz
PK	H	2402.000	57.08	31.94	6.58	0.00	0.00	0.38	36.00	-35.62	1/3 MHz
PK	V	2440.000	59.09	32.23	6.58	0.00	0.00	2.68	36.00	-33.32	5/10 MHz
PK	H	2440.000	63.68	32.23	6.58	0.00	0.00	7.27	36.00	-28.73	5/10 MHz
PK	V	2440.000	58.14	32.23	6.58	0.00	0.00	1.73	36.00	-34.27	1/3 MHz
PK	H	2440.000	63.14	32.23	6.58	0.00	0.00	6.73	36.00	-29.27	1/3 MHz
PK	V	2480.000	61.30	32.41	6.58	0.00	0.00	5.07	36.00	-30.93	5/10 MHz
PK	H	2480.000	61.57	32.41	6.58	0.00	0.00	5.34	36.00	-30.66	5/10 MHz
PK	V	2480.000	60.81	32.41	6.58	0.00	0.00	4.58	36.00	-31.42	1/3 MHz
PK	H	2480.000	60.91	32.41	6.58	0.00	0.00	4.68	36.00	-31.32	1/3 MHz
Note: RF Output Power (802.15.4) - Y-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	58.95	31.94	6.58	0.00	0.00	2.25	36.00	-33.75	5/10 MHz
PK	H	2402.000	59.61	31.94	6.58	0.00	0.00	2.91	36.00	-33.09	5/10 MHz
PK	V	2402.000	58.02	31.94	6.58	0.00	0.00	1.32	36.00	-34.68	1/3 MHz
PK	H	2402.000	58.74	31.94	6.58	0.00	0.00	2.04	36.00	-33.96	1/3 MHz
PK	V	2440.000	60.64	32.23	6.58	0.00	0.00	4.23	36.00	-31.77	5/10 MHz
PK	H	2440.000	62.40	32.23	6.58	0.00	0.00	5.99	36.00	-30.01	5/10 MHz
PK	V	2440.000	60.11	32.23	6.58	0.00	0.00	3.70	36.00	-32.30	1/3 MHz
PK	H	2440.000	61.75	32.23	6.58	0.00	0.00	5.34	36.00	-30.66	1/3 MHz
PK	V	2480.000	61.88	32.41	6.58	0.00	0.00	5.65	36.00	-30.35	5/10 MHz
PK	H	2480.000	58.69	32.41	6.58	0.00	0.00	2.46	36.00	-33.54	5/10 MHz
PK	V	2480.000	61.23	32.41	6.58	0.00	0.00	5.00	36.00	-31.00	1/3 MHz
PK	H	2480.000	57.61	32.41	6.58	0.00	0.00	1.38	36.00	-34.62	1/3 MHz
Note: RF Output Power (802.15.4) - Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2402.000	58.03	31.94	6.58	0.00	0.00	1.33	36.00	-34.67	5/10 MHz
PK	H	2402.000	54.23	31.94	6.58	0.00	0.00	-2.47	36.00	-38.47	5/10 MHz
PK	V	2402.000	56.96	31.94	6.58	0.00	0.00	0.26	36.00	-35.74	1/3 MHz
PK	H	2402.000	52.89	31.94	6.58	0.00	0.00	-3.81	36.00	-39.81	1/3 MHz
PK	V	2440.000	60.26	32.23	6.58	0.00	0.00	3.85	36.00	-32.15	5/10 MHz
PK	H	2440.000	57.25	32.23	6.58	0.00	0.00	0.84	36.00	-35.16	5/10 MHz
PK	V	2440.000	59.35	32.23	6.58	0.00	0.00	2.94	36.00	-33.06	1/3 MHz
PK	H	2440.000	56.09	32.23	6.58	0.00	0.00	-0.32	36.00	-36.32	1/3 MHz
PK	V	2480.000	60.46	32.41	6.58	0.00	0.00	4.23	36.00	-31.77	5/10 MHz
PK	H	2480.000	58.03	32.41	6.58	0.00	0.00	1.80	36.00	-34.20	5/10 MHz
PK	V	2480.000	59.57	32.41	6.58	0.00	0.00	3.34	36.00	-32.66	1/3 MHz
PK	H	2480.000	56.95	32.41	6.58	0.00	0.00	0.72	36.00	-35.28	1/3 MHz

802.15.4 - Output power, High Torque Angle Wrench

Radiated Emissions, Output power EIRP

Company: Ingersoll Rand
Model #: QXXD5AT080ES08 (802.15.4 High Torque Angle Wrench)
Serial #: IR20K07018
Engineers: Vathana Ven
Project #: G104363035 Date(s): 12/06/20
Standard: FCC Part 15 Subpart C 15.247
Receiver: R&S ESIB40 (145-108) 06-08-2021 Limit Distance (m): 3
PreAmp: NONE Test Distance (m): 3

Antenna & Cables: HF Bands: N, LF, HF, SHF
Antenna: TES002_3Mhoriz__8-3-2021.txt TES002_3Mhoriz__8-3-2021.txt
Cable(s): HS002__11-19-2021.txt IW006__11-19-2021.txt
Location: 10m Chamber Barometer: DAV007 Filter: NONE
Temp/Humidity/Pressure: 23 deg C 29% 993mB

PreAmp Used? (Y or N): N Voltage/Frequency: Battery power Frequency Range: Frequencies Shown

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	EIRP Net dBm	EIRP Limit dBm	Margin dB	Bandwidth
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, X-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2405.000	58.69	31.94	6.58	0.00	0.00	1.99	36.00	-34.01	5/10 MHz
PK	H	2405.000	62.70	31.94	6.58	0.00	0.00	6.00	36.00	-30.00	5/10 MHz
PK	V	2405.000	57.77	31.94	6.58	0.00	0.00	1.07	36.00	-34.93	1/3 MHz
PK	H	2405.000	62.04	31.94	6.58	0.00	0.00	5.34	36.00	-30.66	1/3 MHz
PK	V	2440.000	60.36	32.23	6.58	0.00	0.00	3.95	36.00	-32.05	5/10 MHz
PK	H	2440.000	64.19	32.23	6.58	0.00	0.00	7.78	36.00	-28.22	5/10 MHz
PK	V	2440.000	59.53	32.23	6.58	0.00	0.00	3.12	36.00	-32.88	1/3 MHz
PK	H	2440.000	63.74	32.23	6.58	0.00	0.00	7.33	36.00	-28.67	1/3 MHz
PK	V	2480.000	60.83	32.41	6.58	0.00	0.00	4.60	36.00	-31.40	5/10 MHz
PK	H	2480.000	63.81	32.41	6.58	0.00	0.00	7.58	36.00	-28.42	5/10 MHz
PK	V	2480.000	60.24	32.41	6.58	0.00	0.00	4.01	36.00	-31.99	1/3 MHz
PK	H	2480.000	63.14	32.41	6.58	0.00	0.00	6.91	36.00	-29.09	1/3 MHz
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, Y-Axis											
PK	V	2405.000	56.96	31.94	6.58	0.00	0.00	0.26	36.00	-35.74	5/10 MHz
PK	H	2405.000	58.82	31.94	6.58	0.00	0.00	2.12	36.00	-33.88	5/10 MHz
PK	V	2405.000	55.74	31.94	6.58	0.00	0.00	-0.96	36.00	-36.96	1/3 MHz
PK	H	2405.000	57.88	31.94	6.58	0.00	0.00	1.18	36.00	-34.82	1/3 MHz
PK	V	2440.000	60.13	32.23	6.58	0.00	0.00	3.72	36.00	-32.28	5/10 MHz
PK	H	2440.000	62.40	32.23	6.58	0.00	0.00	5.99	36.00	-30.01	5/10 MHz
PK	V	2440.000	59.33	32.23	6.58	0.00	0.00	2.92	36.00	-33.08	1/3 MHz
PK	H	2440.000	61.84	32.23	6.58	0.00	0.00	5.43	36.00	-30.57	1/3 MHz
PK	V	2480.000	58.82	32.41	6.58	0.00	0.00	2.59	36.00	-33.41	5/10 MHz
PK	H	2480.000	63.93	32.41	6.58	0.00	0.00	7.70	36.00	-28.30	5/10 MHz
PK	V	2480.000	58.00	32.41	6.58	0.00	0.00	1.77	36.00	-34.23	1/3 MHz
PK	H	2480.000	63.29	32.41	6.58	0.00	0.00	7.06	36.00	-28.94	1/3 MHz
Note: RF Output Power (802.15.4), PA Level setting = 1, Power Level setting = -3, Z-Axis											
Note: EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	V	2405.000	60.36	31.94	6.58	0.00	0.00	3.66	36.00	-32.34	5/10 MHz
PK	H	2405.000	55.67	31.94	6.58	0.00	0.00	-1.03	36.00	-37.03	5/10 MHz
PK	V	2405.000	59.46	31.94	6.58	0.00	0.00	2.76	36.00	-33.24	1/3 MHz
PK	H	2405.000	54.52	31.94	6.58	0.00	0.00	-2.18	36.00	-38.18	1/3 MHz
PK	V	2440.000	61.98	32.23	6.58	0.00	0.00	5.57	36.00	-30.43	5/10 MHz
PK	H	2440.000	56.96	32.23	6.58	0.00	0.00	0.55	36.00	-35.45	5/10 MHz
PK	V	2440.000	61.36	32.23	6.58	0.00	0.00	4.95	36.00	-31.05	1/3 MHz
PK	H	2440.000	55.93	32.23	6.58	0.00	0.00	-0.48	36.00	-36.48	1/3 MHz
PK	V	2480.000	61.60	32.41	6.58	0.00	0.00	5.37	36.00	-30.63	5/10 MHz
PK	H	2480.000	61.20	32.41	6.58	0.00	0.00	4.97	36.00	-31.03	5/10 MHz
PK	V	2480.000	61.06	32.41	6.58	0.00	0.00	4.83	36.00	-31.17	1/3 MHz
PK	H	2480.000	60.64	32.41	6.58	0.00	0.00	4.41	36.00	-31.59	1/3 MHz

		Test Date:	11/29/2020 12/04/2020 12/06/2020
Test Personnel:	Vathana Ven VJV		
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247, RSS-102	Limit Applied:	See report section 6.3
Input Voltage:	Battery power		
		Ambient Temperature:	24, 24, 23 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	24, 28, 29 %
		Atmospheric Pressure:	1009, 1003, 993 mbars

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10 and KDB 558074 D0115.247Meas Guidancev05r02.

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.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	01/21/2020	01/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	DC-18GHz cable 1.5M long	Huber & Suhner	SucoFlex 106A	HS002	11/19/2020	11/19/2021
145-423'	Pre-amp to under floor	Huber and Suhner	SF106A/11N/11N/1.5m	145-423	03/27/2020	03/27/2021
145-424'	9kHz to 40GHz Cable	Huber and Suhner	Sucoflex	145-424	03/27/2020	03/27/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

Name	Manufacturer	Version
None	---	---

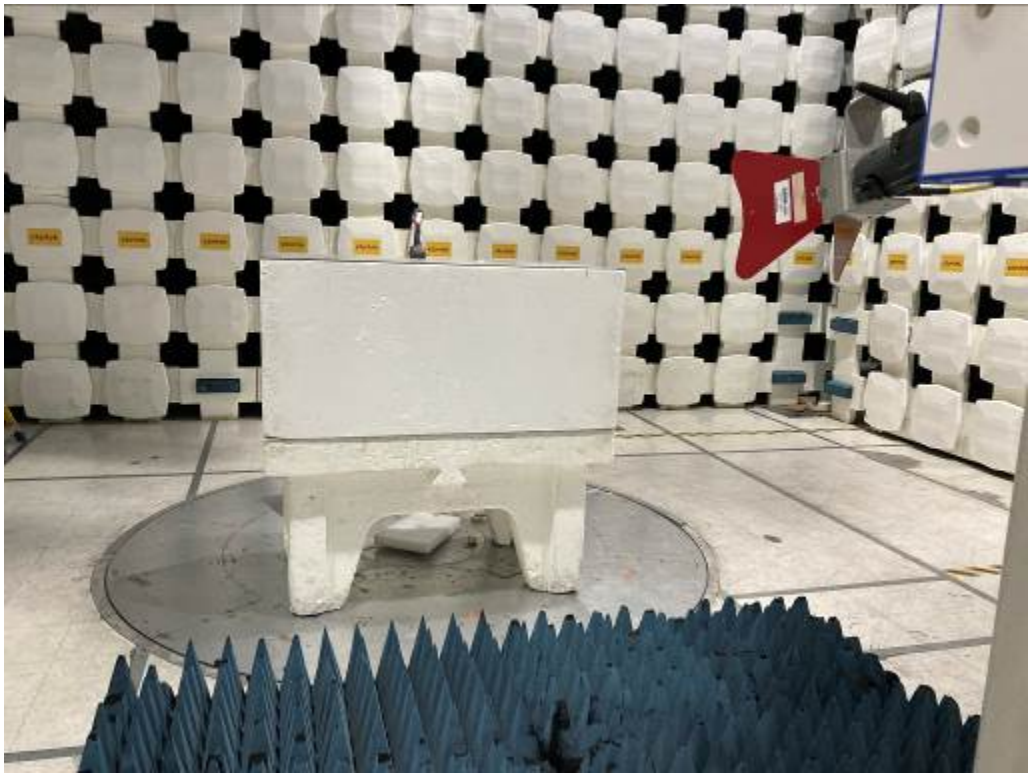
7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.4 Setup Photographs:

Pistol Angle Wrench (Tool with worst-case output power was used for a full testing)

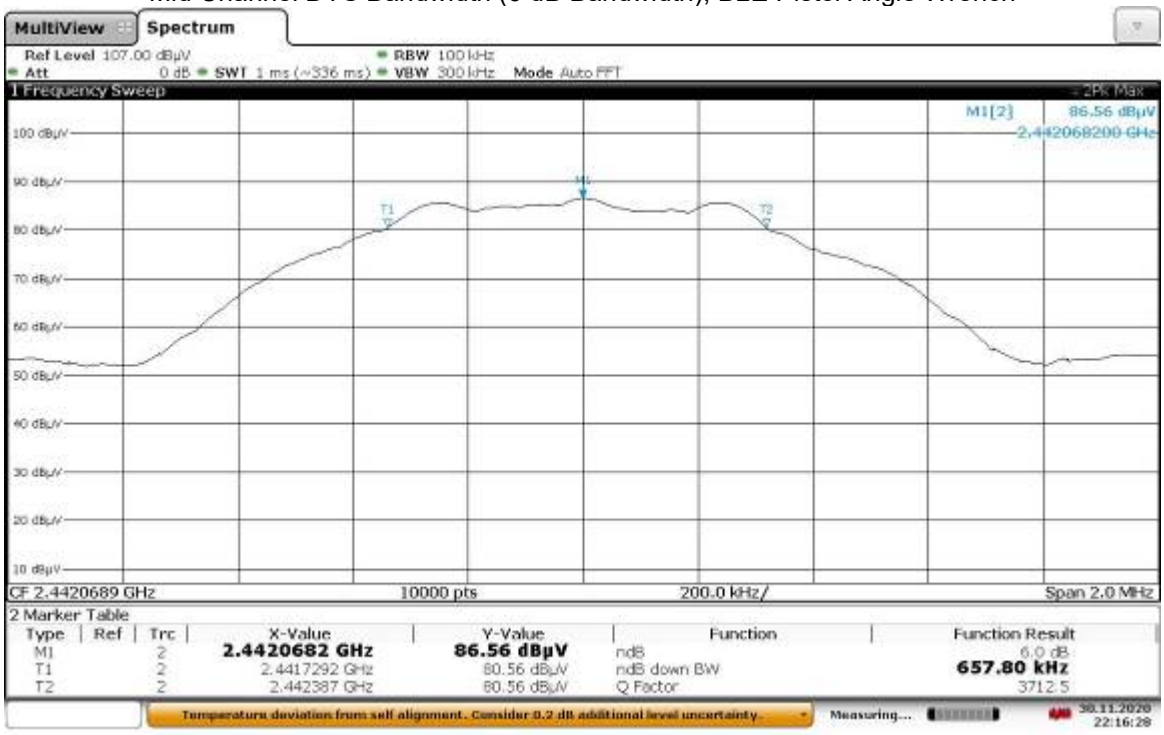


7.5 Plots/Data:

Low Channel DTS Bandwidth (6 dB Bandwidth), BLE Pistol Angle Wrench

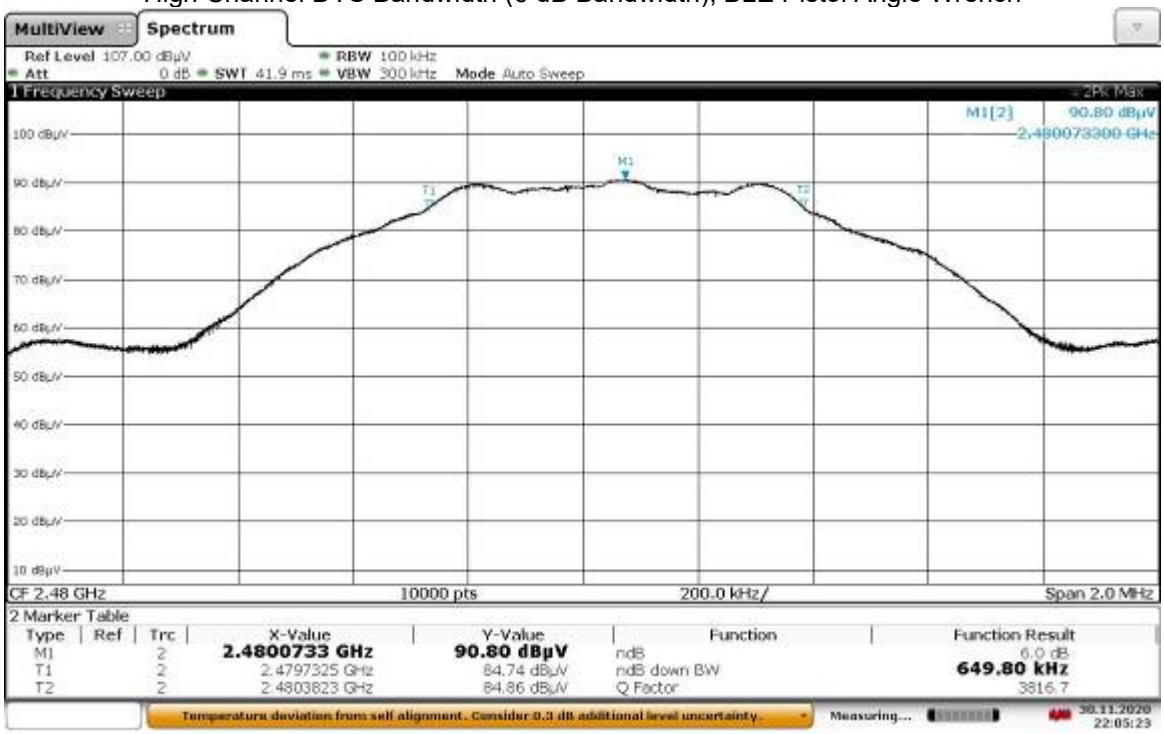
22:08:56 30.11.2020

Mid Channel DTS Bandwidth (6 dB Bandwidth), BLE Pistol Angle Wrench

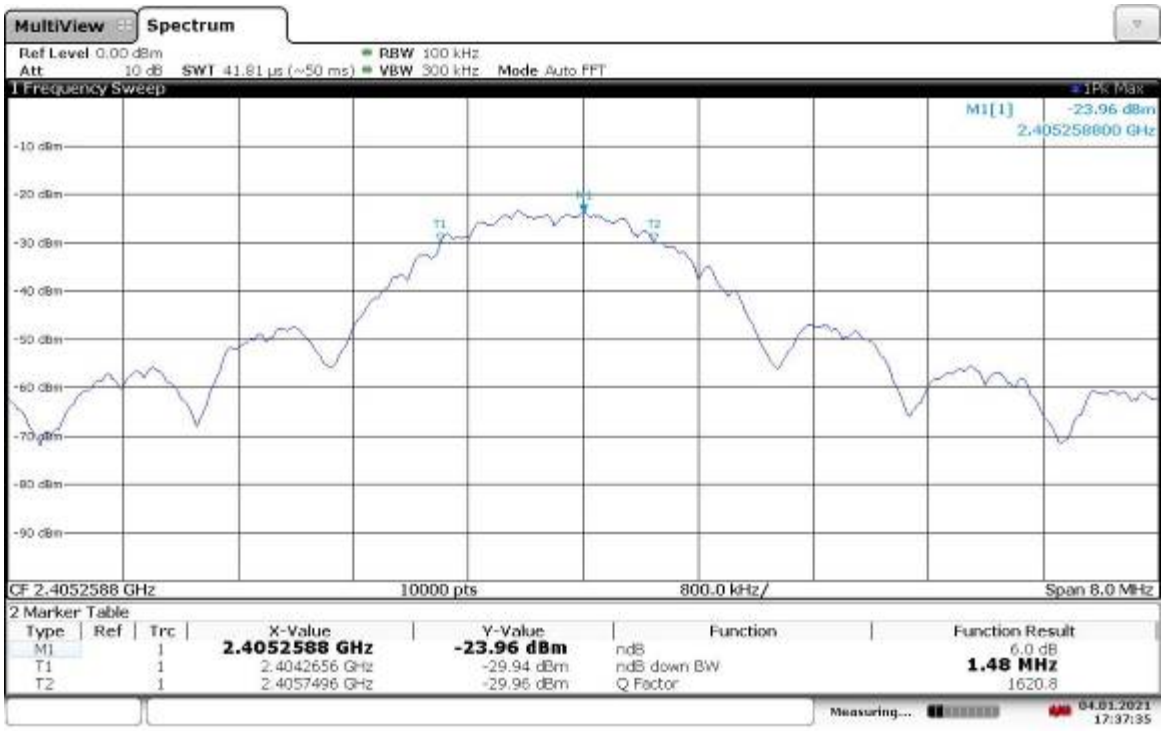


22:16:29 30.11.2020

High Channel DTS Bandwidth (6 dB Bandwidth), BLE Pistol Angle Wrench



Low Channel DTS Bandwidth (6 dB Bandwidth), 802.15.4 Pistol Angle Wrench



17:37:36 04.01.2021

Mid Channel DTS Bandwidth (6 dB Bandwidth), 802.15.4 Pistol Angle Wrench

17:51:28 04.01.2021

High Channel DTS Bandwidth (6 dB Bandwidth), 802.15.4 Pistol Angle Wrench

17:54:59 04.01.2021

Low Channel Occupied Bandwidth, BLE Pistol Angle Wrench

22:08:09 30.11.2020

Mid Channel Occupied Bandwidth, BLE Pistol Angle Wrench

22:07:22 30.11.2020

High Channel Occupied Bandwidth, BLE Pistol Angle Wrench

Low Channel Occupied Bandwidth, 802.15.4 Pistol Angle Wrench

17:43:56 04.01.2021

Mid Channel Occupied Bandwidth, 802.15.4 Pistol Angle Wrench

17:46:47 04.01.2021

High Channel Occupied Bandwidth, 802.15.4 Pistol Angle Wrench

17:55:53 04.01.2021

DTS Bandwidth (6 dB Bandwidth) and Occupied Bandwidth, BLE Pistol Angle Wrench

Frequency	DTS Bandwidth (6 dB Bandwidth)	Occupied Bandwidth
(MHz)	(kHz)	(kHz)
2402	657.80	993.80
2442	657.80	995.63
2480	649.80	989.39

DTS Bandwidth (6 dB Bandwidth) and Occupied Bandwidth, 802.15.4 Pistol Angle Wrench

Frequency	DTS Bandwidth (6 dB Bandwidth)	Occupied Bandwidth
(MHz)	(MHz)	(MHz)
2405	1.48	2.37
2440	1.42	2.38
2480	1.37	2.33

Test Personnel:	Vathana Ven VJV	Test Date:	11/30/2020 01/04/2020
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 7.3
Input Voltage:	Battery power	Ambient Temperature:	22, 24 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	12, 20 %
		Atmospheric Pressure:	1017, 1003 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10, and KDB 558074 D0115.247Meas Guidancev05r02.

TEST SITE: EMC Lab

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.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	01/21/2020	01/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	DC-18GHz cable 1.5M long	Huber & Suhner	SucoFlex 106A	HS002	11/19/2020	11/19/2021
145-423'	Pre-amp to under floor	Huber and Suhner	SF106A/11N/11N/1.5m	145-423	03/27/2020	03/27/2021
145-424'	9kHz to 40GHz Cable	Huber and Suhner	Sucoflex	145-424	03/27/2020	03/27/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

Name	Manufacturer	Version
None	--	--

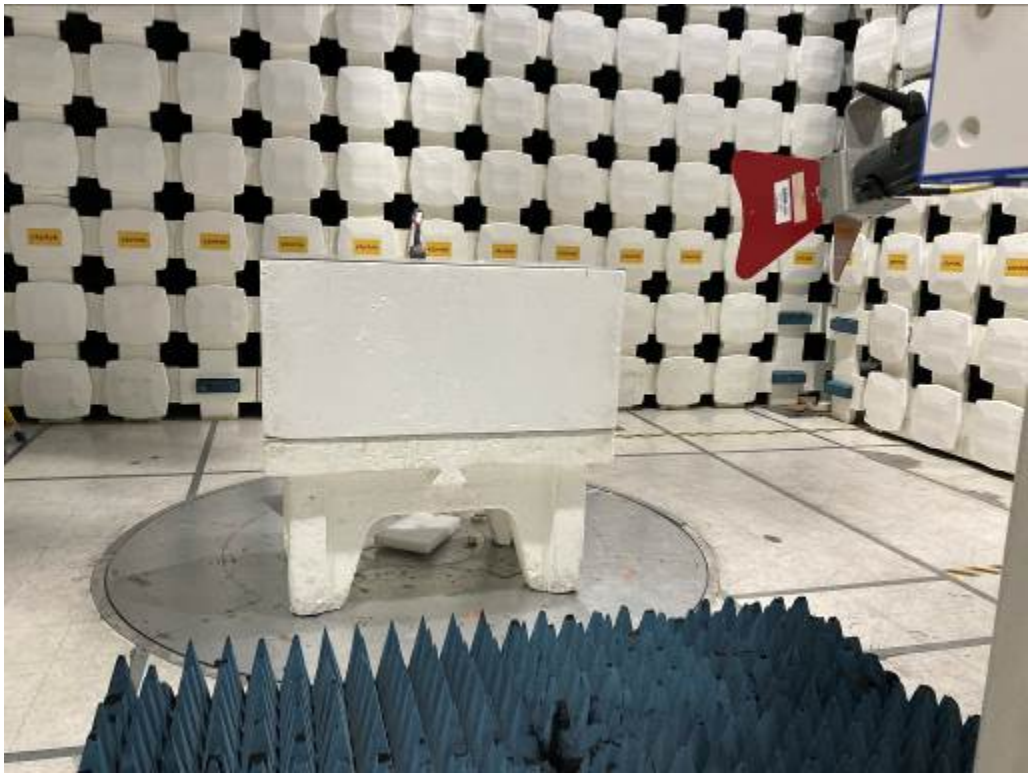
8.3 Results:

The sample tested was found to Comply.

§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.

8.4 Setup Photographs:

Pistol Angle Wrench (Tool with worst-case output power was used for a full testing)



8.5 Test Data:

Radiated Emissions, Substitution

Company: Ingersoll Rand
Model #: QXXD2PT024ES06
Serial #: IR20J30012 (BLE), IR20J30022 (802.15.4)
Engineer(s): Vathana Ven
Location: 10m Chamber
Project #: G104363035
Date(s): 12/04/20 12/23/2020
Standard: ETSI EN 300 328
Barometer: DAV007 Temp/Humidity/Pressure: 24, 24 deg C 24, 16% 1009/1018mB

Rx Antenna: ETS002
Rx Cable(s): 145-420 145-414 HS002
Rx Preamp: None Receiver: 145108
Tx Antenna: EMC02
Tx Cable(s): CBLHF2012-2M-2
Tx Signal Generator: HEW62
ERP or EIRP?: EIRP

Test Distance (m): 3 Voltage/Frequency: Battery power Frequency Range: Fundamental

Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain (dBi or dBd)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Note: Peak Power Spectral Density, BLE - Y-Axis (worst-case orientation)											
RMS	H	2402.000	53.02	43.92	1.18	9.47	-20.00	-2.61	10.00	-12.61	10/30 KHz
RMS	H	2442.000	55.65	44.11	1.18	9.47	-20.00	-0.17	10.00	-10.17	10/30 KHz
RMS	H	2480.000	54.06	44.62	1.44	9.82	-20.00	-2.18	10.00	-12.18	10/30 KHz
Note: Peak Power Spectral Density, 802.15.4 - Y-Axis (worst-case orientation)											
RMS	H	2405.000	53.02	45.31	1.18	9.47	-20.00	-4.00	10.00	-14.00	10/30 KHz
RMS	H	2440.000	55.65	44.24	1.18	9.47	-20.00	-0.30	10.00	-10.30	10/30 KHz
RMS	H	2480.000	54.06	44.62	1.44	9.82	-20.00	-2.18	10.00	-12.18	10/30 KHz

Test Personnel: Vathana Ven VJV
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: CFR47 FCC Part 15.247 RSS-247
Input Voltage: Battery power
Pretest Verification w/ Ambient Signals or BB Source: **N/A**

Test Date: 12/04/2020 12/23/2020
Limit Applied: See report section 8.3
Ambient Temperature: 24, 24 ºC
Relative Humidity: 24, 16 %
Atmospheric Pressure: 1009, 1018 mbars

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247 RSS 247, ANSI C 63.10.

TEST SITE: EMC Lab

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.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	01/21/2020	01/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	DC-18GHz cable 1.5M long	Huber & Suhner	SucoFlex 106A	HS002	11/19/2020	11/19/2021
145-423'	Pre-amp to under floor	Huber and Suhner	SF106A/11N/11N/1.5m	145-423	03/27/2020	03/27/2021
145-424'	9kHz to 40GHz Cable	Huber and Suhner	Sucoflex	145-424	03/27/2020	03/27/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

Name	Manufacturer	Version
None	--	--

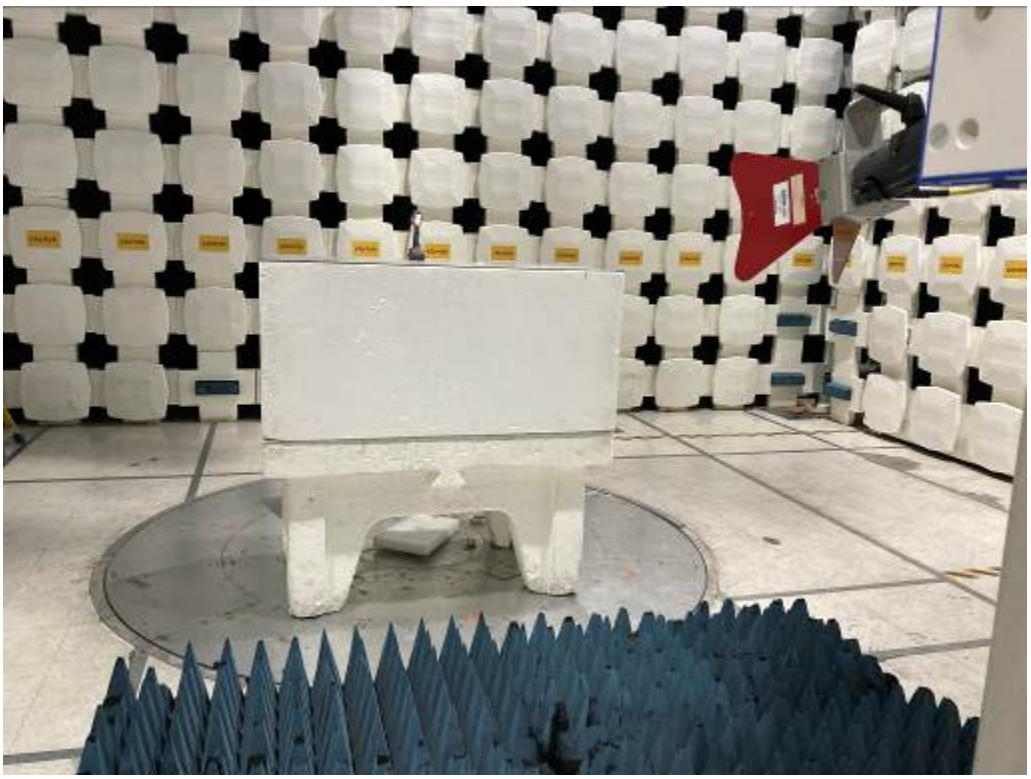
9.3 Results:

The sample tested was found to Comply.

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, as permitted under paragraph (b)(3) of this section, 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))

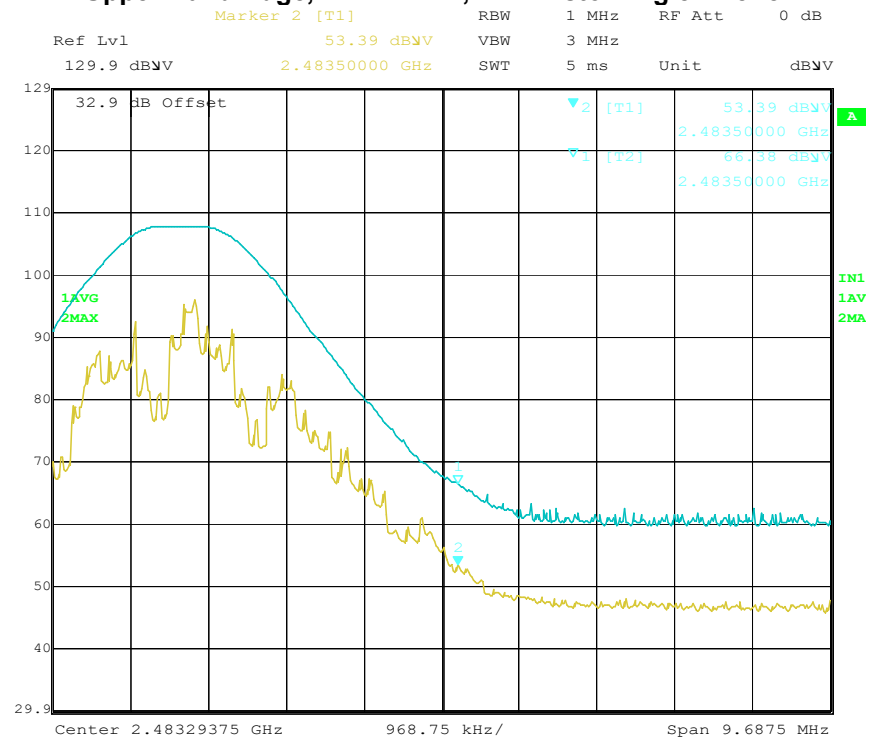
9.4 Setup Photographs:

Pistol Angle Wrench (Tool with worst-case output power was used for a full testing)



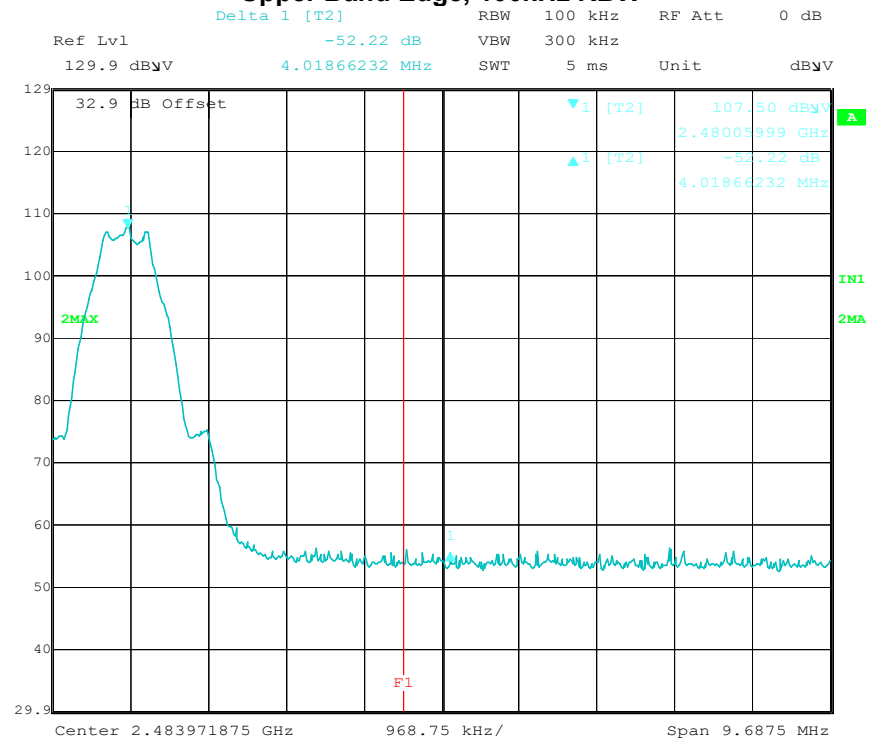
9.5 Test Data:

Upper Band Edge, 1MHz RBW, BLE Pistol Angle Wrench



Date: 10.JAN.1997 20:52:54

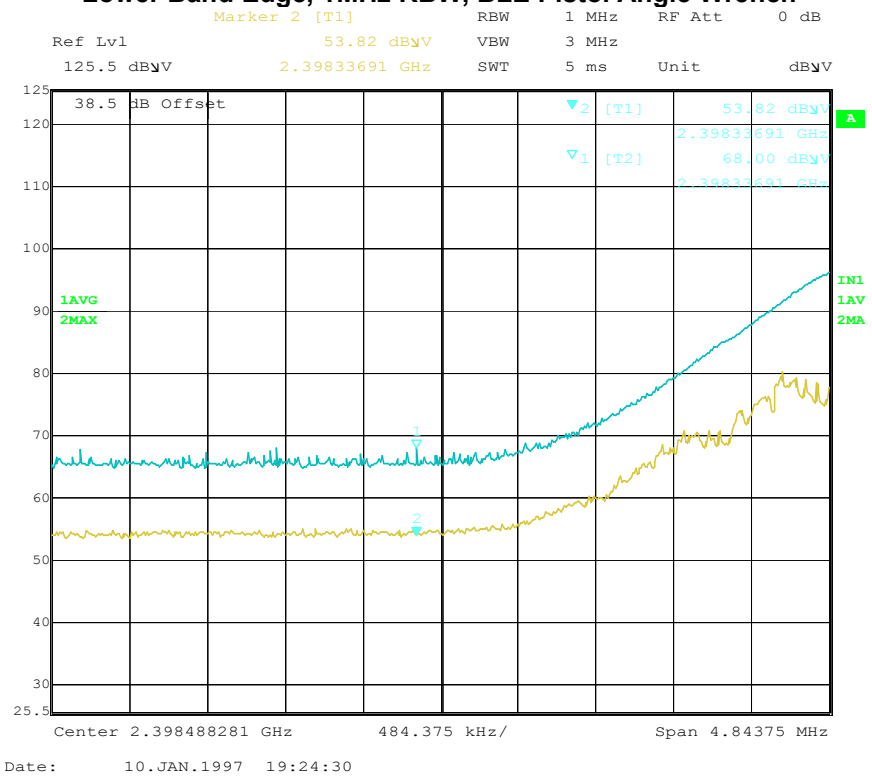
Upper Band Edge, 100kHz RBW



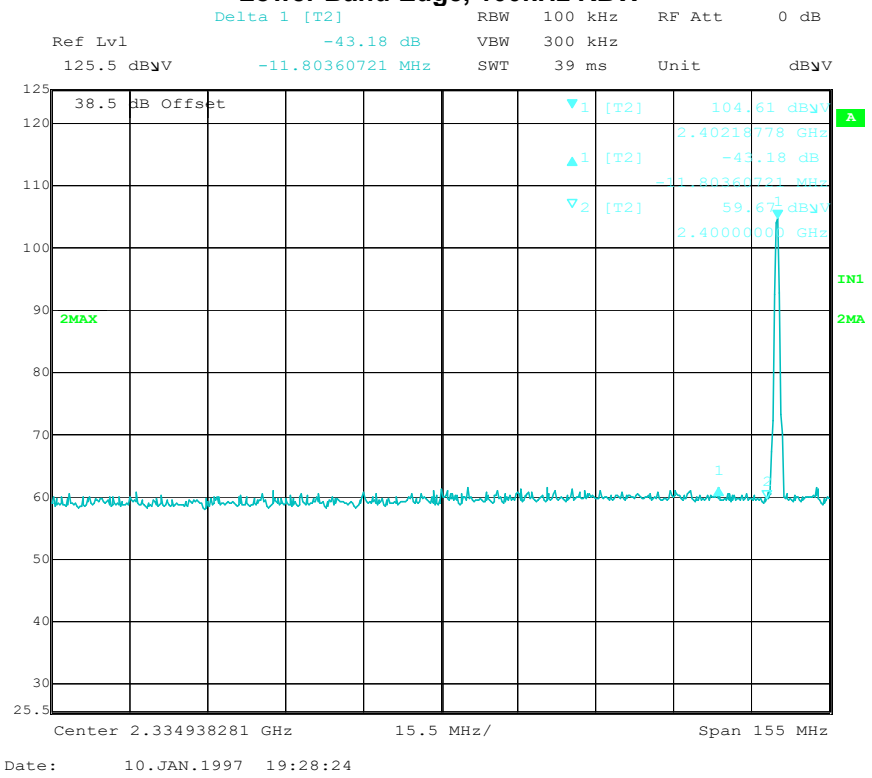
Date: 10.JAN.1997 20:55:05

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF). Date on the plots was manufacturer's default date.

Lower Band Edge, 1MHz RBW, BLE Pistol Angle Wrench

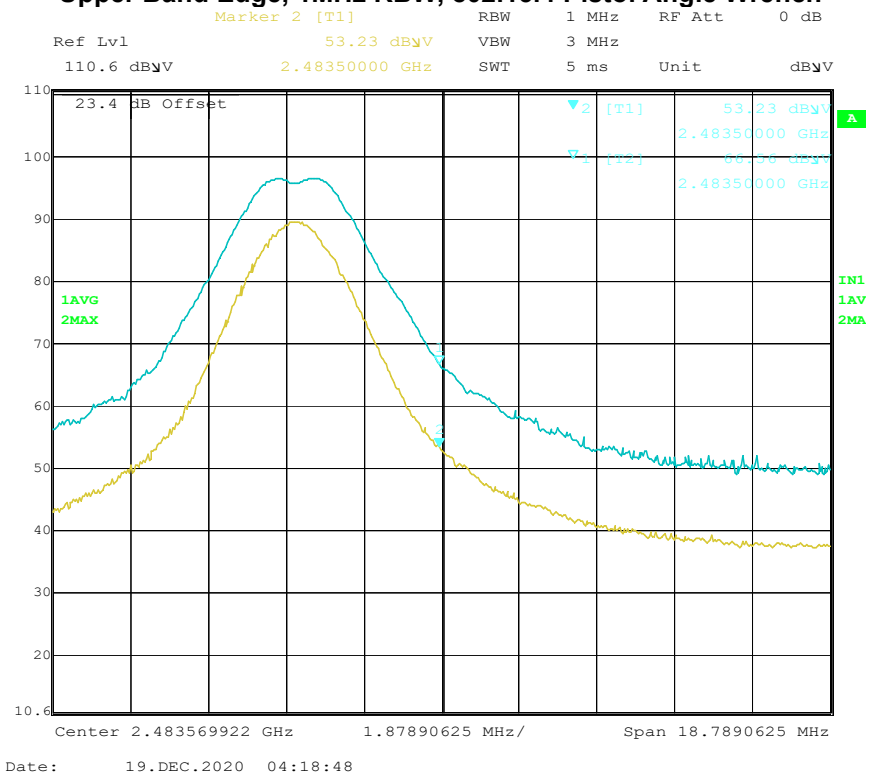


Lower Band Edge, 100kHz RBW

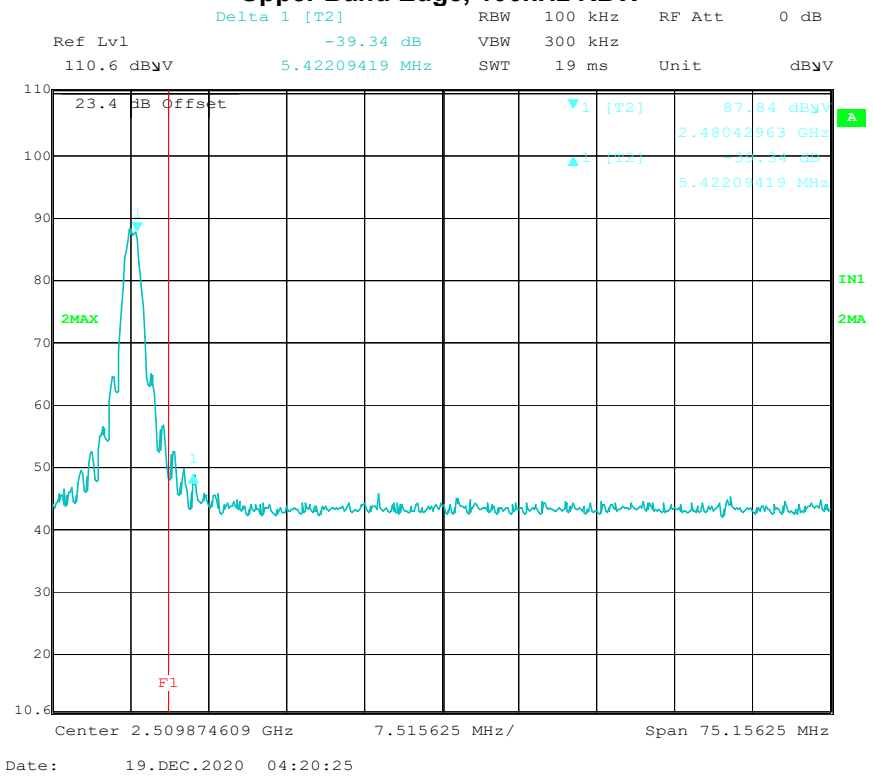


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF). Date on the plots was manufacturer's default date.

Upper Band Edge, 1MHz RBW, 802.15.4 Pistol Angle Wrench

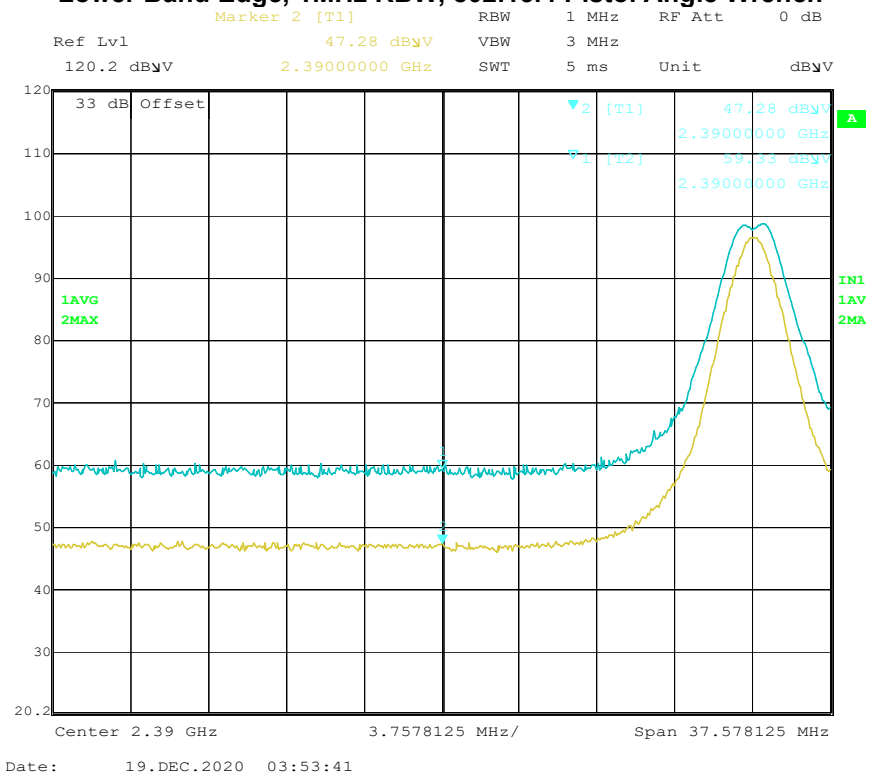


Upper Band Edge, 100kHz RBW

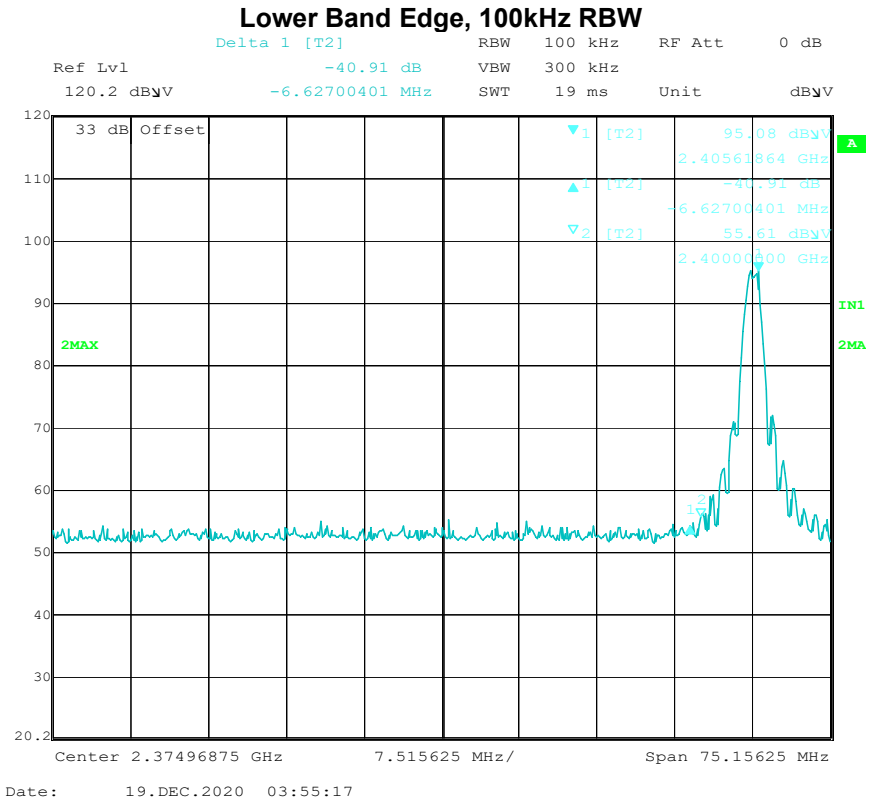


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Lower Band Edge, 1MHz RBW, 802.15.4 Pistol Angle Wrench



Lower Band Edge, 100kHz RBW



Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Test Personnel:	Vathana Ven VSV	Test Date:	12/19/2020
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 9.3
Input Voltage:	Battery power	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	12 %
		Atmospheric Pressure:	1017 mbars

Notes: The antenna factor and cable loss were compensated in the EMI receiver as transducer factor.

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, RSS 247 ICES 003, ANSI C 63.10, and ANSI C 63.4.

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	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

TEST SITE: EMC Lab

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.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/11/2020	09/11/2021
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/08/2020	05/08/2021
IW001'	2 meter cable	Insulated Wire	2801-NPS	001	10/08/2020	10/08/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	09/21/2020	09/21/2021
HS001'	DC-18GHz cable 1.5m long	Huber & Suhner	SucoFlex 106A	HS001	10/07/2020	10/07/2021
IW003'	8.4 meter cable	Insulated Wire	2800-NPS	003	06/10/2020	06/10/2021
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/17/2020	02/17/2021
HS003'	10m under floor cable	Huber-Schuner	10m-1	HS003	04/29/2020	04/29/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/17/2020	02/17/2021
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/25/2020	02/25/2021
REA006'	18GHz High Pass Filter	Reactel, Inc	7HS-18G/40G K11	(06)1	04/20/2020	04/20/2021
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMC84	3115	2784	09/28/2020	09/28/2021
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2020	07/11/2021

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010
BAT-EMC	Nexio	3.18.0.16

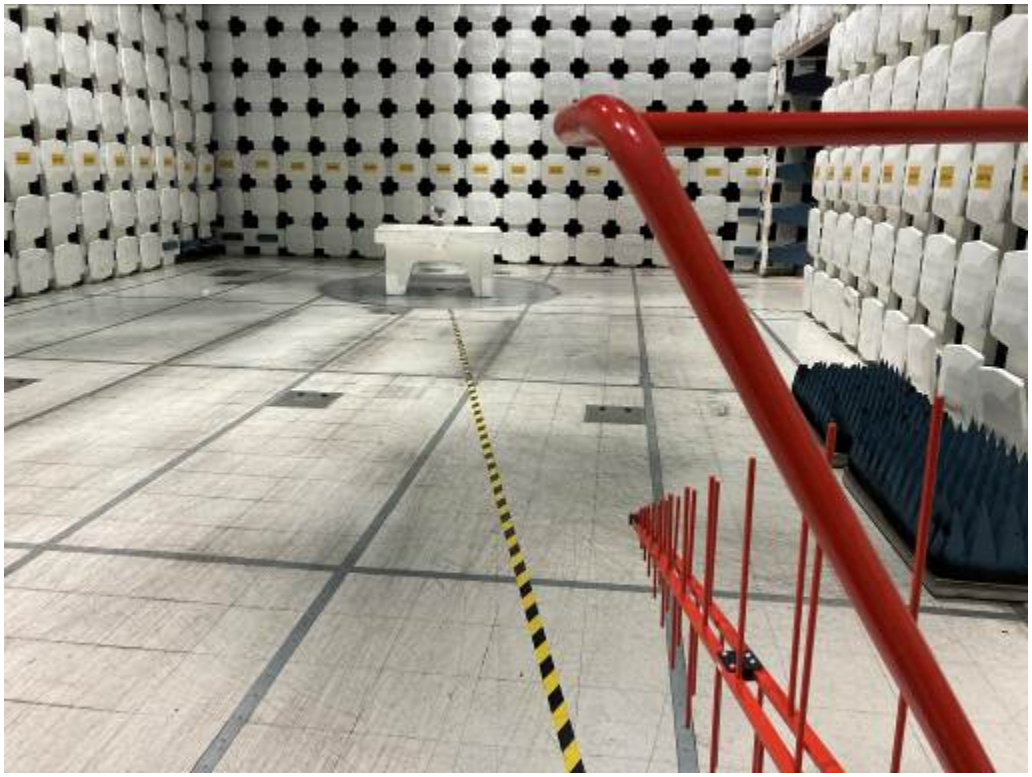
10.3 Results:

The sample tested was found to Comply.

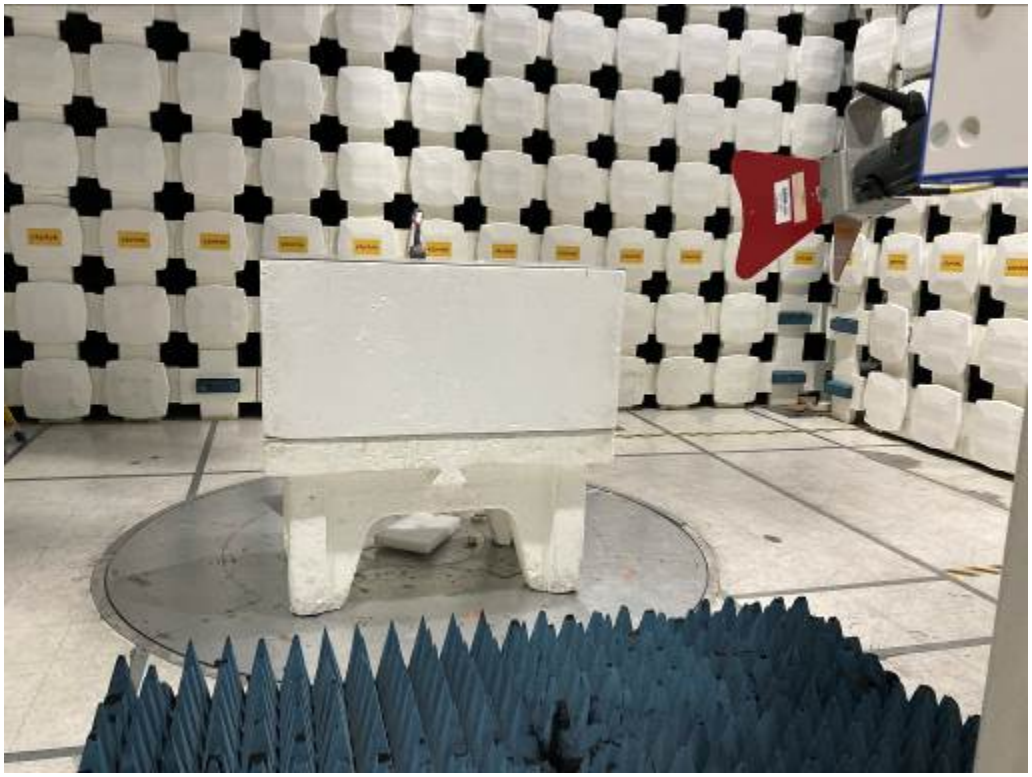
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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, as permitted under paragraph (b)(3) of this section, 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))

10.4 Setup Photographs:

Test Setup, 30-1000 MHz, Pistol Angle Wrench

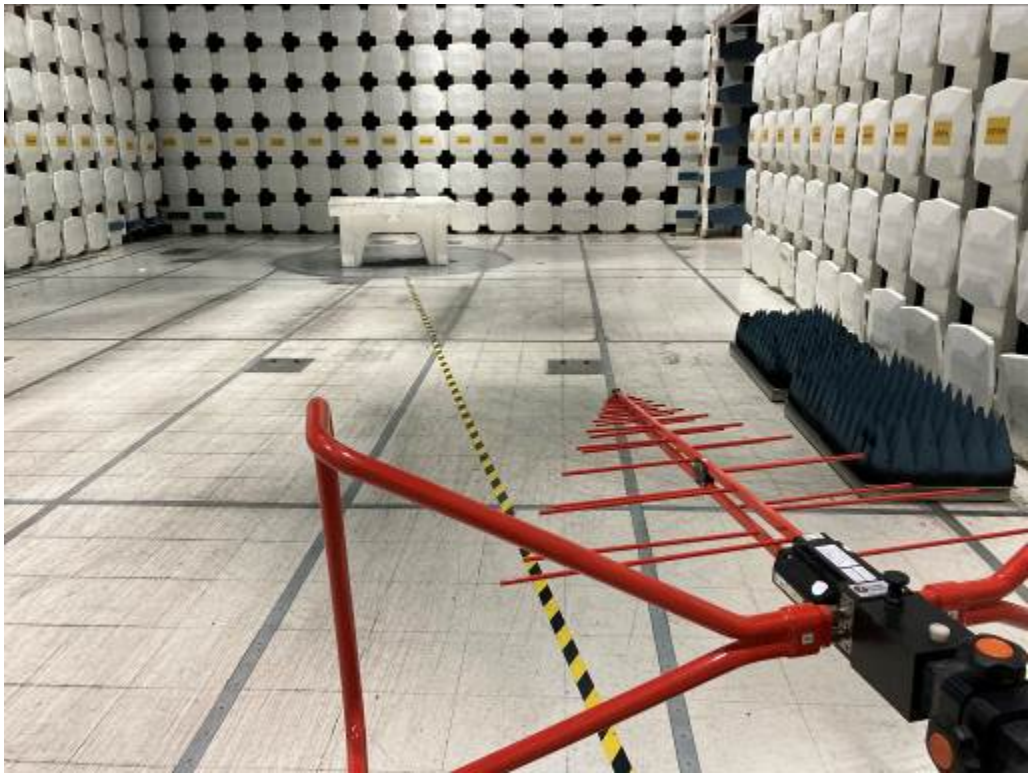


Test Setup, 1-18 GHz, Pistol Angle Wrench

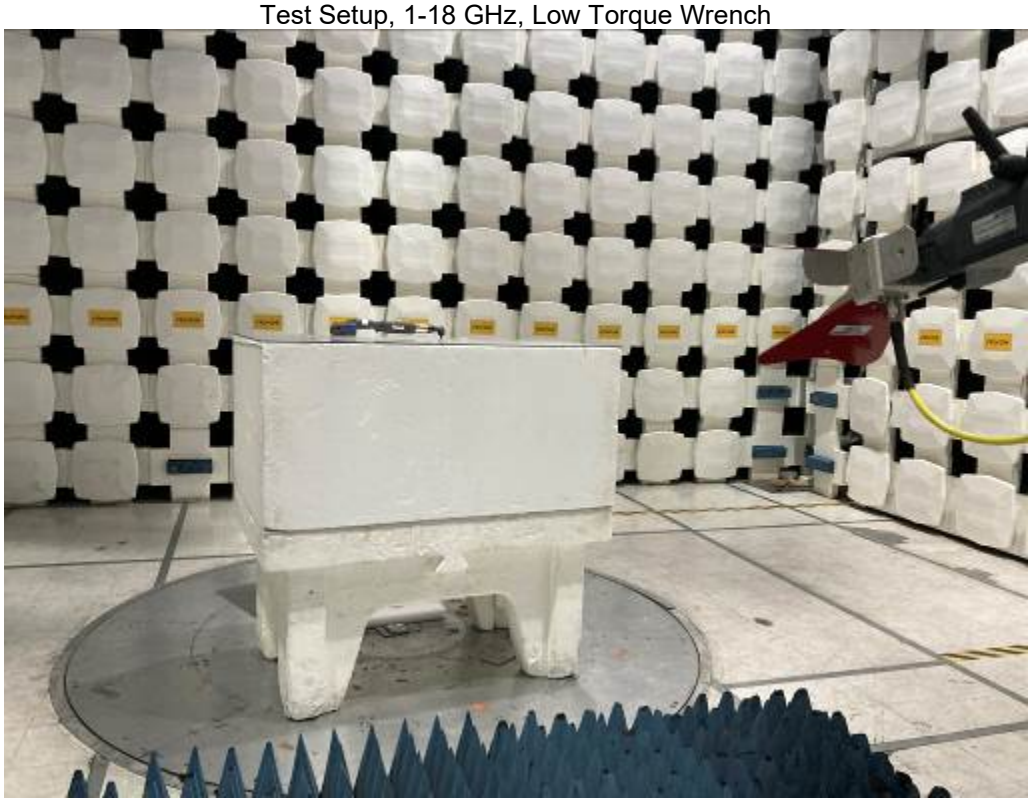


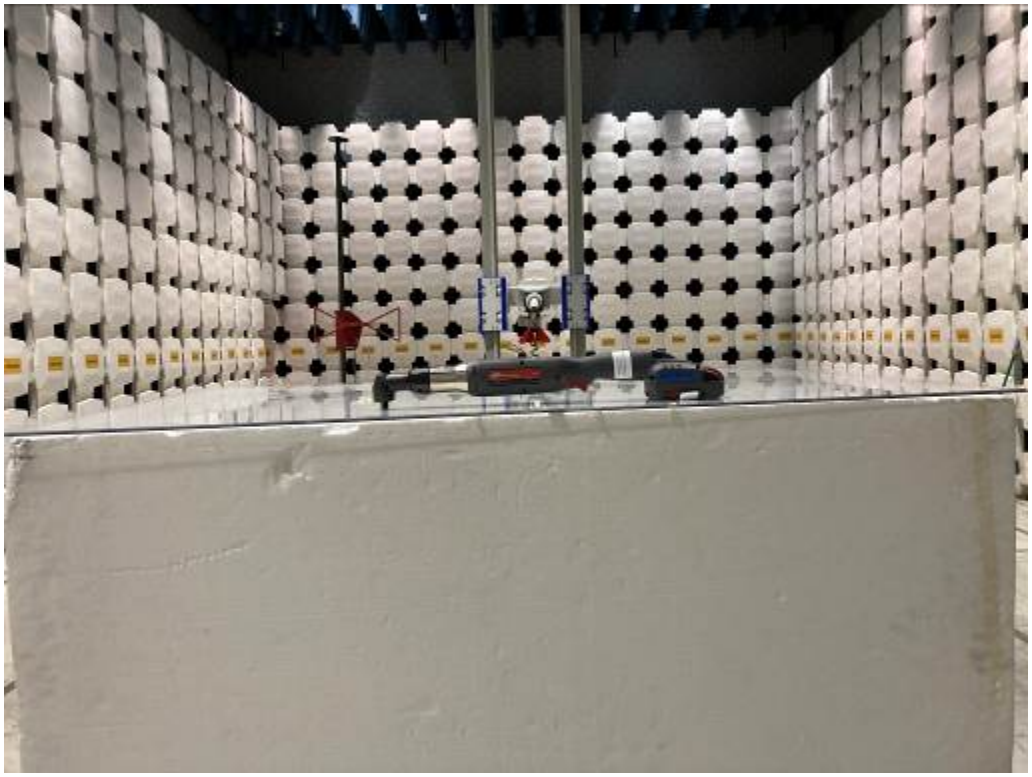
Manual scan at a distance of 10 cm, 18-25 GHz, Pistol Angle Wrench

Test Setup, 30-1000 MHz, Low Torque Wrench

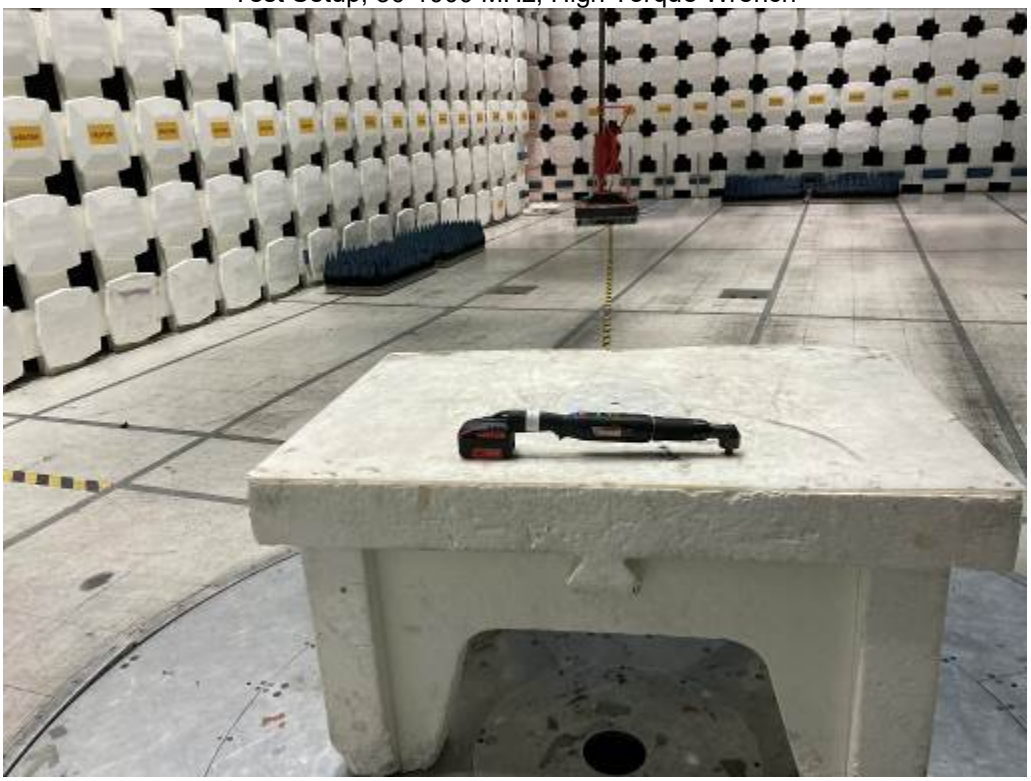


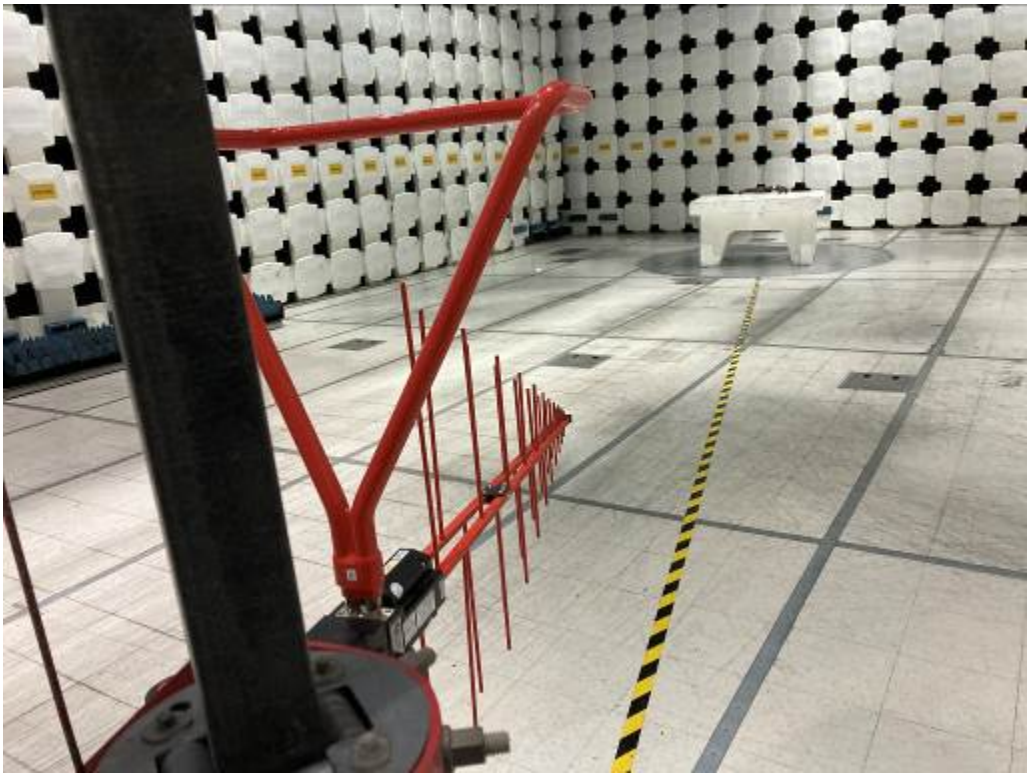
Test Setup, 1-18 GHz, Low Torque Wrench



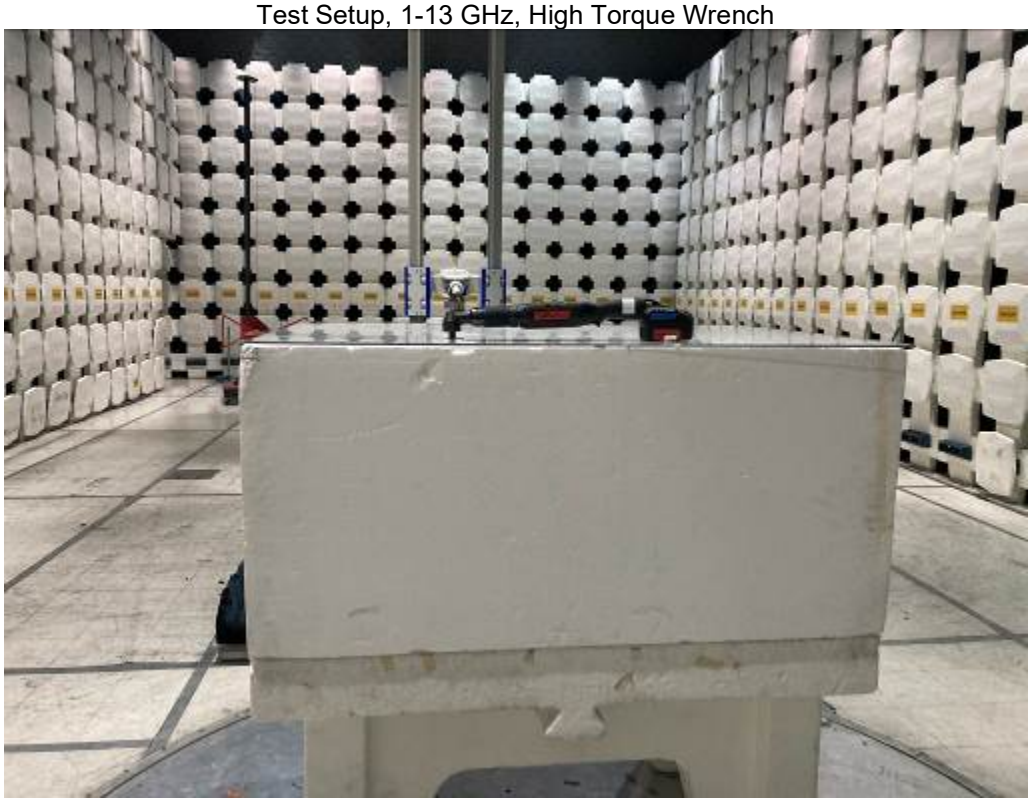


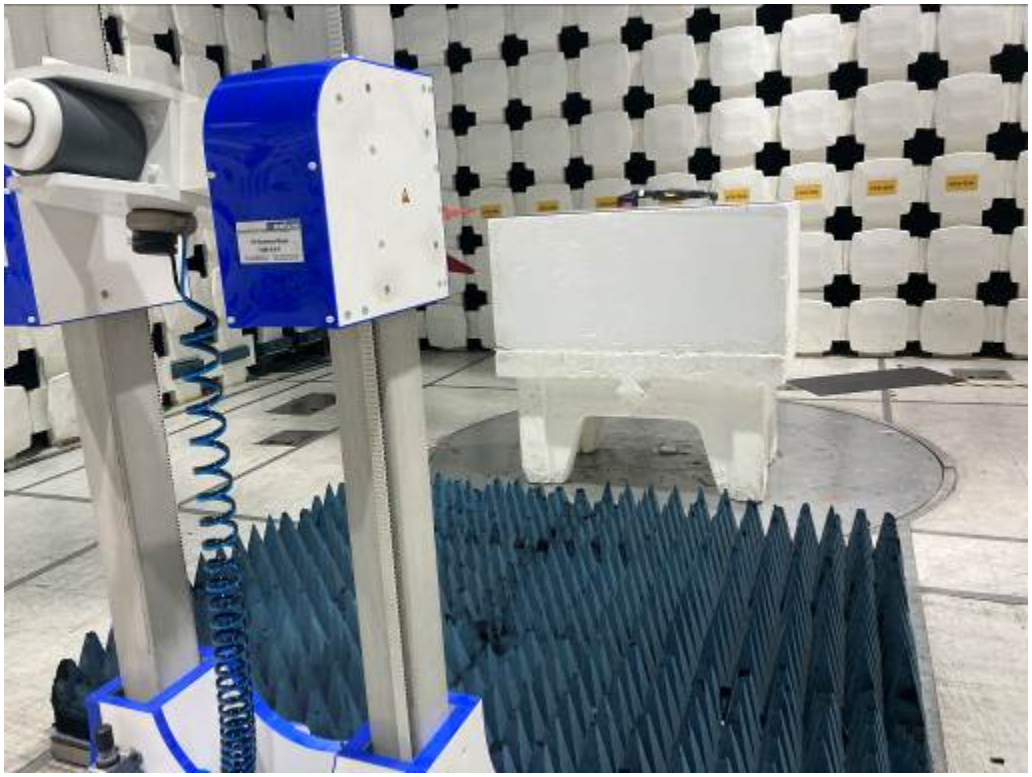
Test Setup, 30-1000 MHz, High Torque Wrench





Test Setup, 1-13 GHz, High Torque Wrench





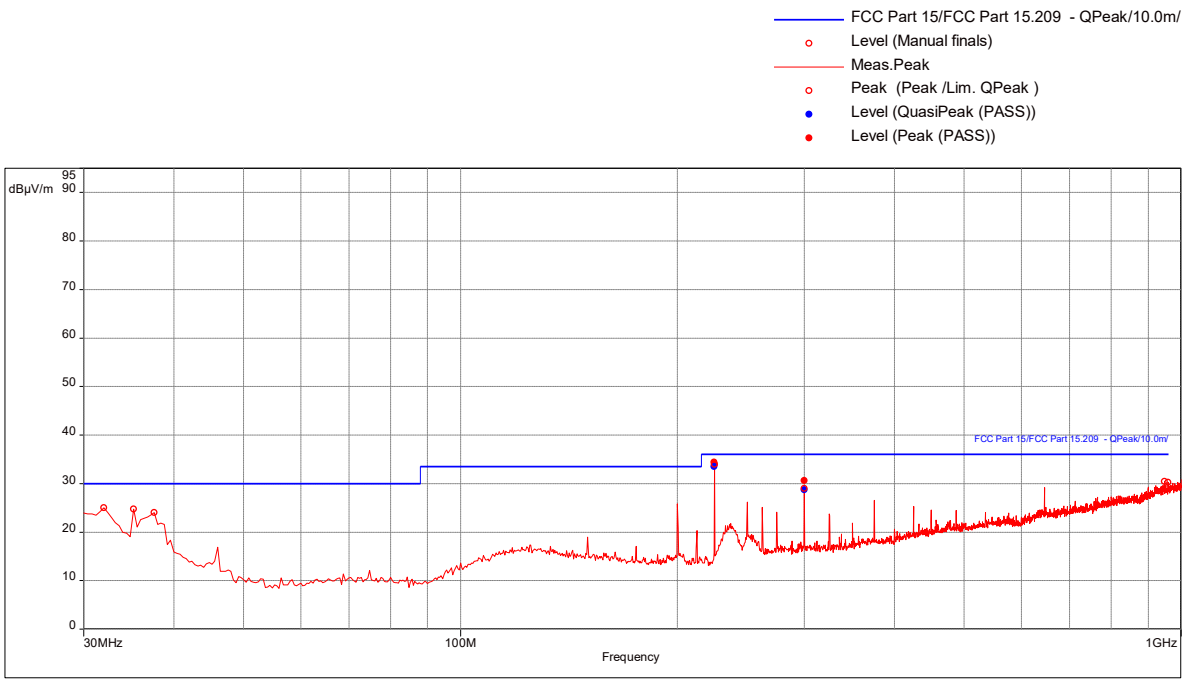
10.5 Plots/Data:

BLE Pistol, Transmit at Low Channel (X-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/13/2020 1:28:54 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_Pistol Driver_BLE_Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (2)

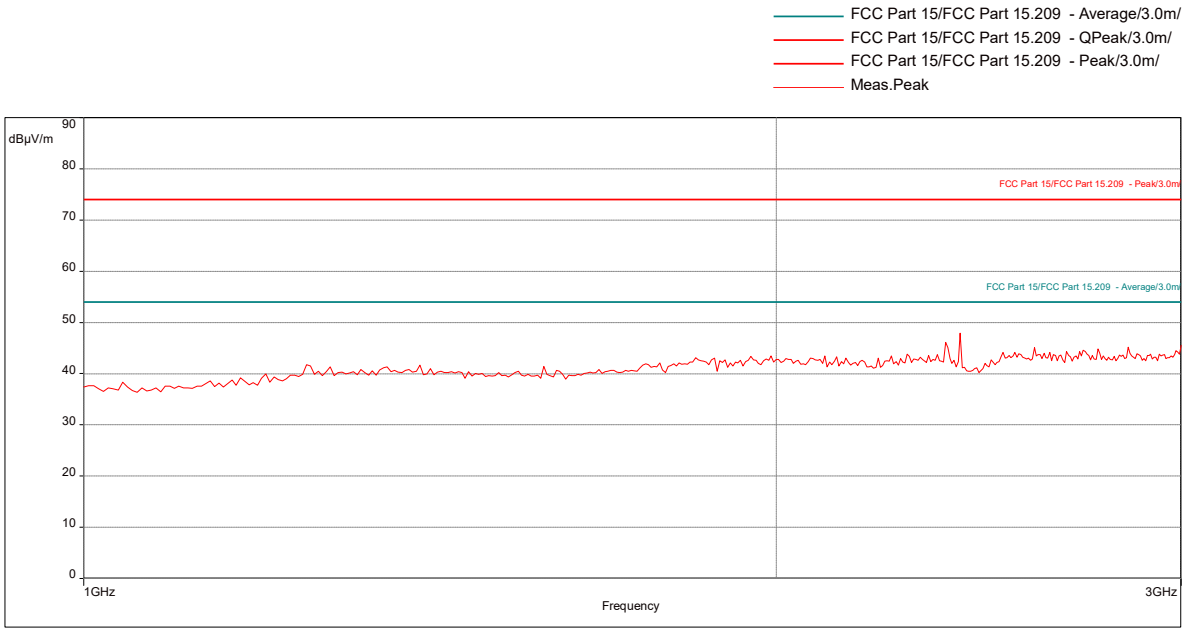
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
224.9789474	33.51	36.00	-2.49	0.00	3.31	Horizontal	120000.00	-20.76
300	28.74	36.00	-7.26	4.00	2.65	Horizontal	120000.00	-17.87

BLE Pistol, Transmit at Low Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 11:14:56 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



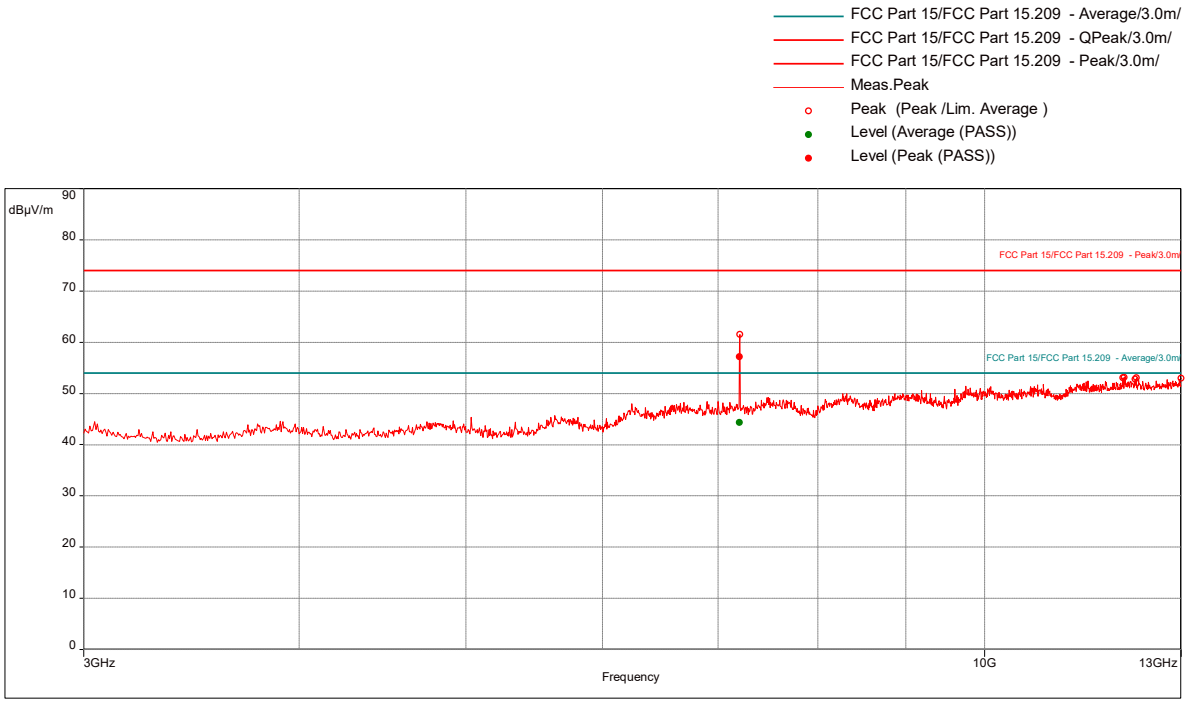
Results:

BLE Pistol, Transmit at Low Channel (X-axis, worst-case), 3-18 GHz

Test Information:

Date and Time	12/18/2020 10:50:40 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	57.20	74.00	-16.80	69.00	2.15	Horizontal	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	44.36	54.00	-9.64	69.00	2.15	Horizontal	1000000.00	-6.16

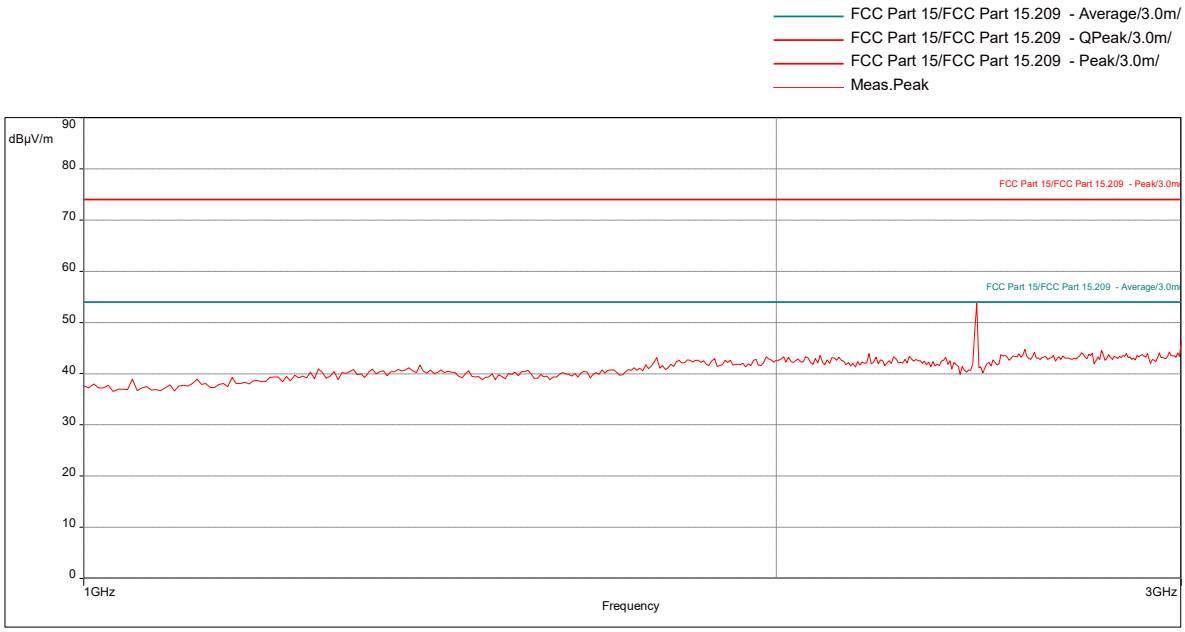
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE Pistol, Transmit at Mid Channel (Y-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 11:03:18 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_BLE_Tx mode_Mid CH_Y-Axis (worst-case)

Graph:



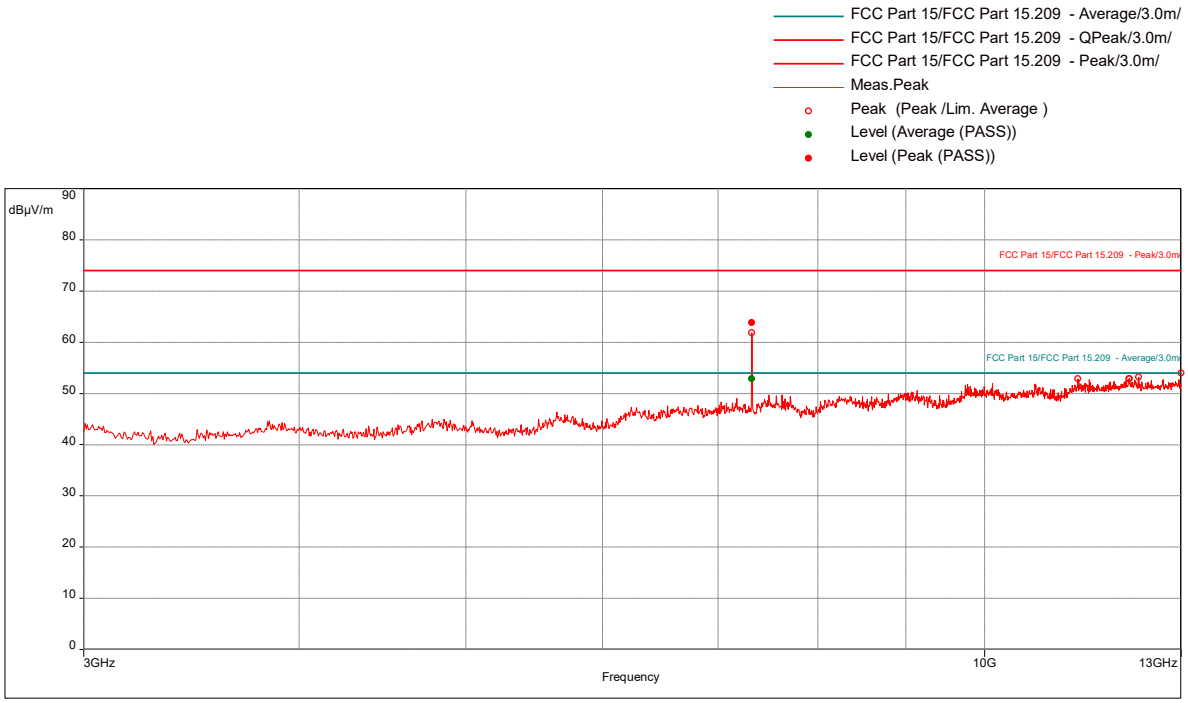
Results: No emissions were detected above the measuring equipment noise floor.

BLE Pistol, Transmit at Mid Channel (Y-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/18/2020 11:18:49 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_BLE_Tx mode_Mid CH_Y-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7325.526316	63.87	74.00	-10.13	114.00	1.00	Horizontal	1000000.00	-6.11

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7325.526316	52.92	54.00	-1.08	114.00	1.00	Horizontal	1000000.00	-6.11

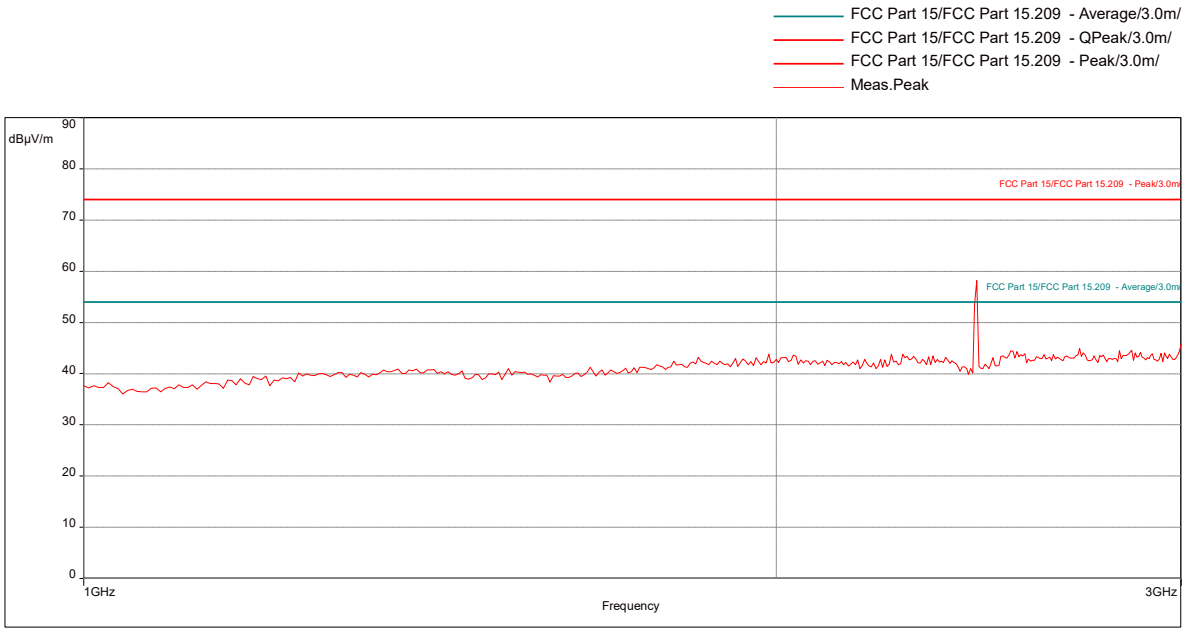
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE Pistol, Transmit at High Channel (Y-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 11:19:50 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_BLE_Tx mode_High CH_Y-Axis (worst-case)

Graph:



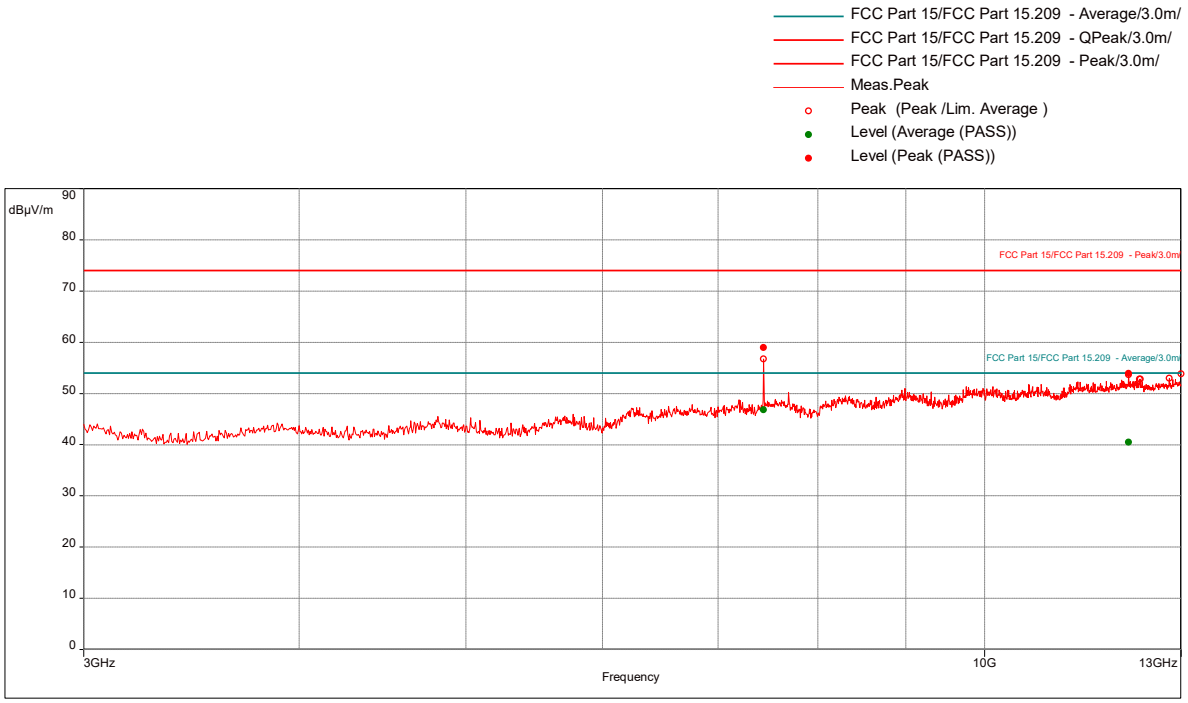
Results: Big peak is a fundamental frequency.

BLE Pistol, Transmit at Mid Channel (Y-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/18/2020 11:32:13 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_BLE_Tx mode_High CH_Y-Axis (worst-case)

Graph:



Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	58.92	74.00	-15.08	283.00	2.40	Horizontal	1000000.00	-5.93
12121.57895	53.92	74.00	-20.08	226.00	1.65	Vertical	1000000.00	1.19

Average (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	46.81	54.00	-7.19	283.00	2.40	Horizontal	1000000.00	-5.93
12121.57895	40.43	54.00	-13.57	226.00	1.65	Vertical	1000000.00	1.19

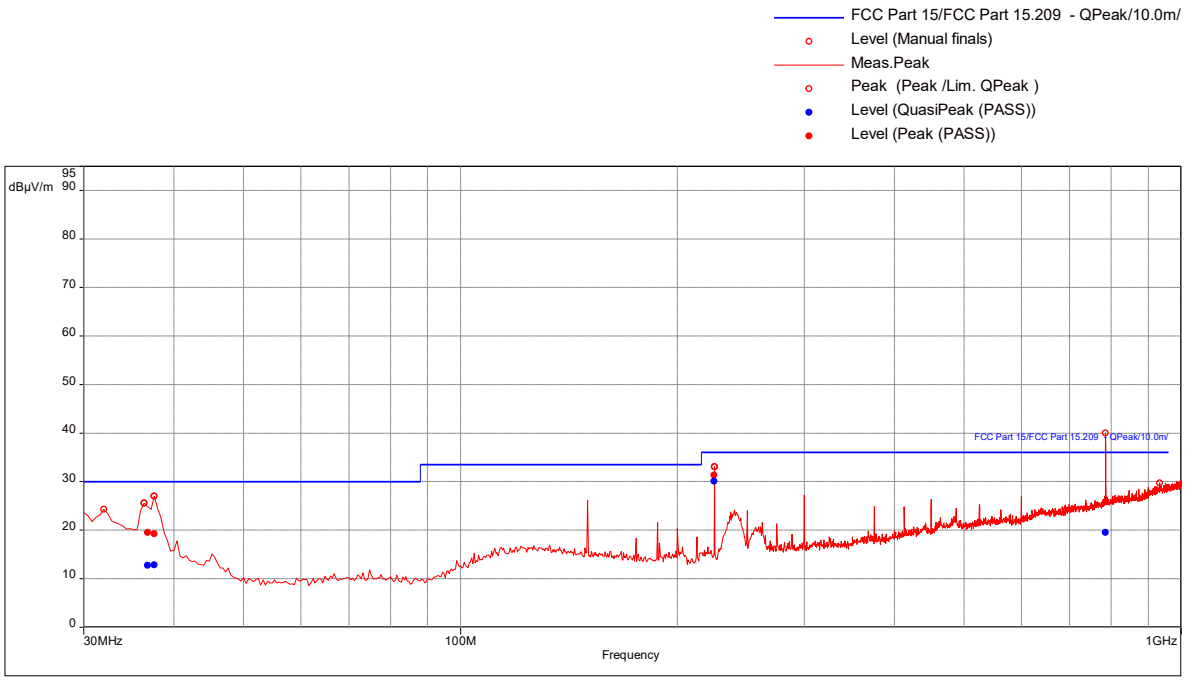
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE Low Torque, Transmit at Low Channel (X-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/17/2020 4:56:04 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 30-1000MHz_Battery power_Low Torque Driver_BLE_Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (4)

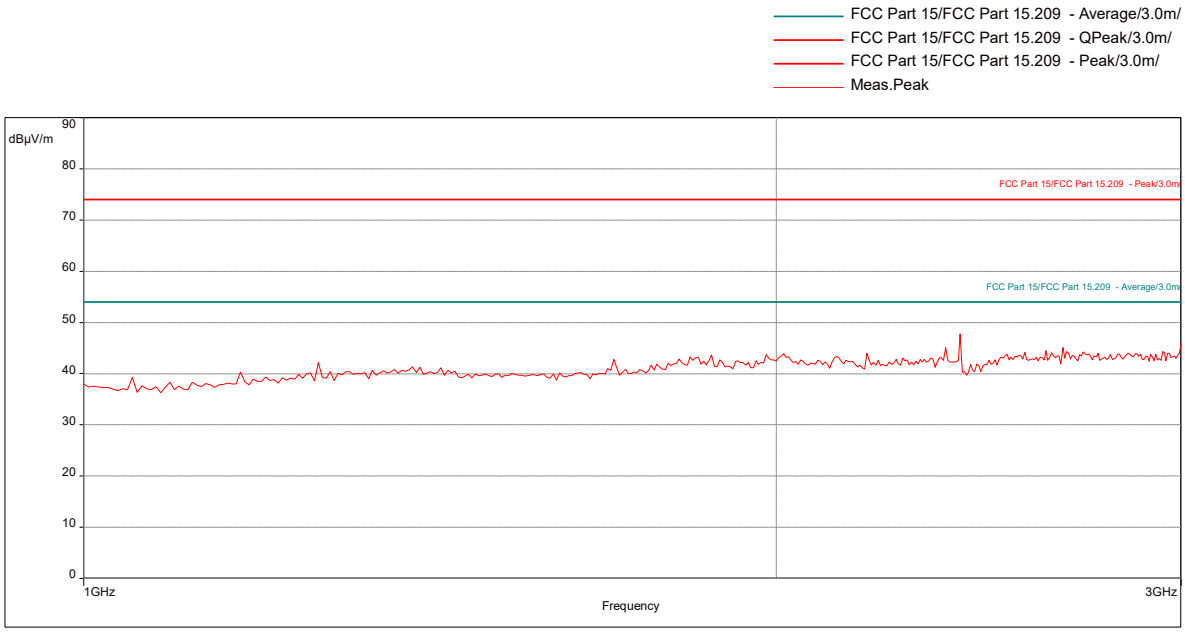
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
36.65263158	12.77	30.00	-17.23	297.00	2.88	Vertical	120000.00	-16.77
37.47368421	12.82	30.00	-17.18	313.00	3.48	Vertical	120000.00	-17.42
224.9789474	30.05	36.00	-5.95	0.00	1.97	Horizontal	120000.00	-20.76
785.6315789	19.54	36.00	-16.46	151.00	1.52	Vertical	120000.00	-7.50

BLE Low Torque, Transmit at Low Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:58:35 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Low Torque Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



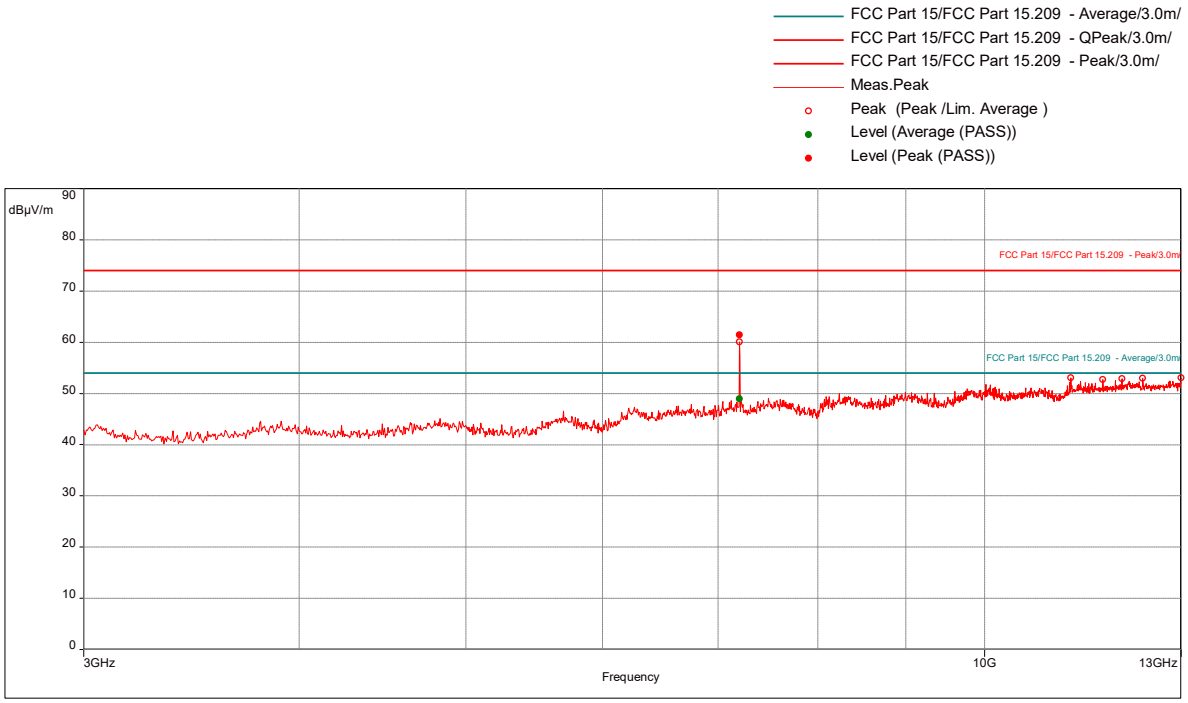
Results:

BLE Low Torque, Transmit at Low Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 12:29:46 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	61.41	74.00	-12.59	180.00	1.95	Vertical	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	48.95	54.00	-5.05	180.00	1.95	Vertical	1000000.00	-6.16

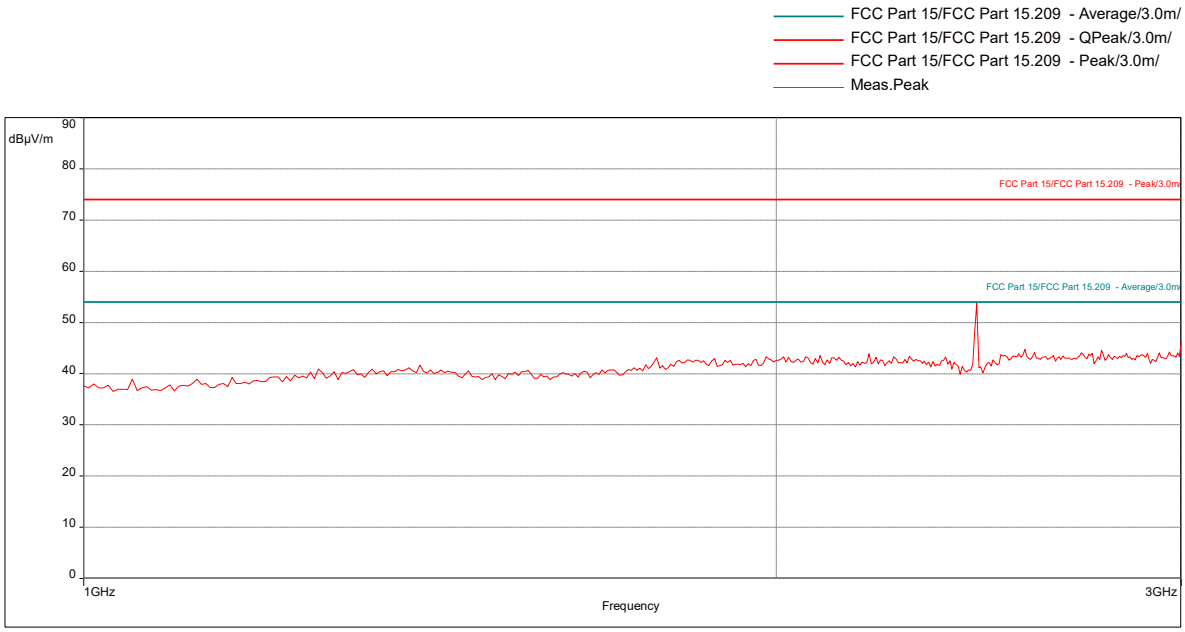
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE Low Torque, Transmit at Mid Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 11:03:18 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_BLE_Tx mode_Mid CH_Y-Axis (worst-case)

Graph:



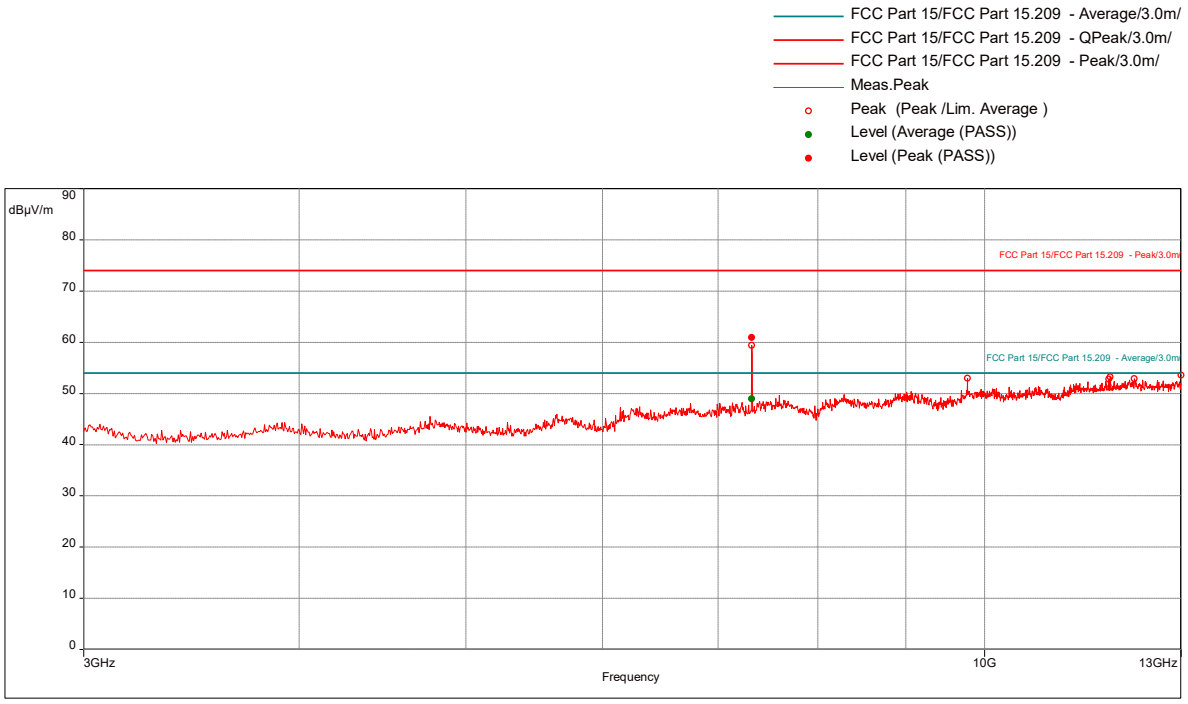
Results: Big peak is from the fundamental frequency.

BLE Low Torque, Transmit at Mid Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 12:43:01 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_BLE_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7326.315789	60.94	74.00	-13.06	187.00	2.65	Vertical	1000000.00	-6.11

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7326.315789	48.98	54.00	-5.02	187.00	2.65	Vertical	1000000.00	-6.11

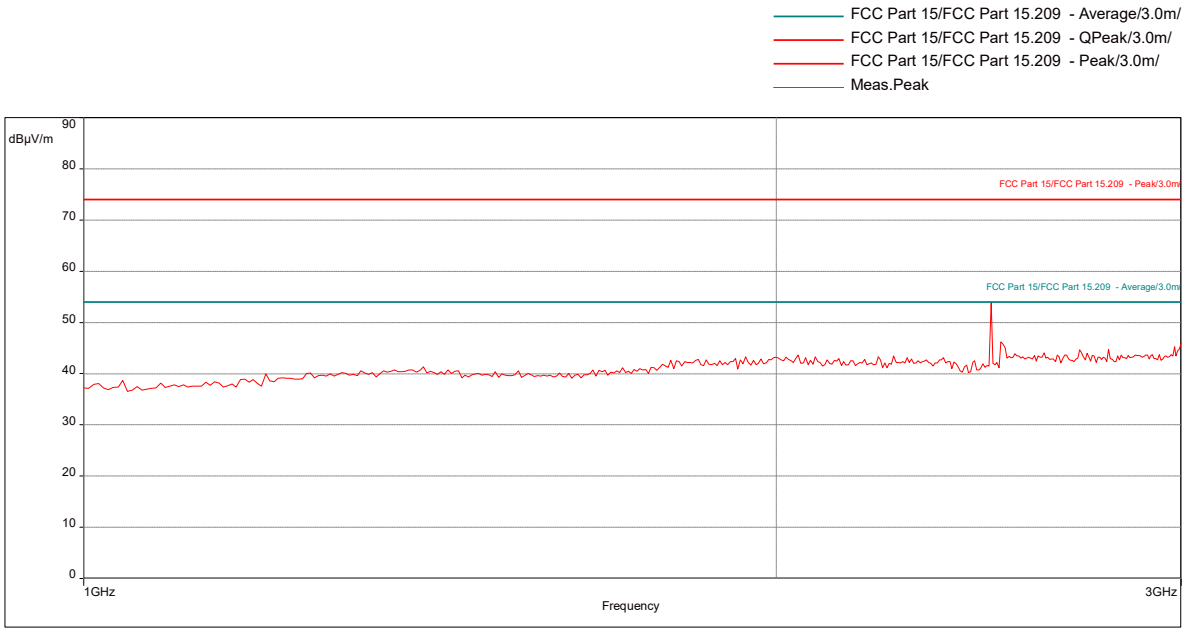
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE Low Torque, Transmit at High Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 11:25:16 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Low Torque Driver_BLE_Tx mode_High CH_Y-Axis (worst-case)

Graph:



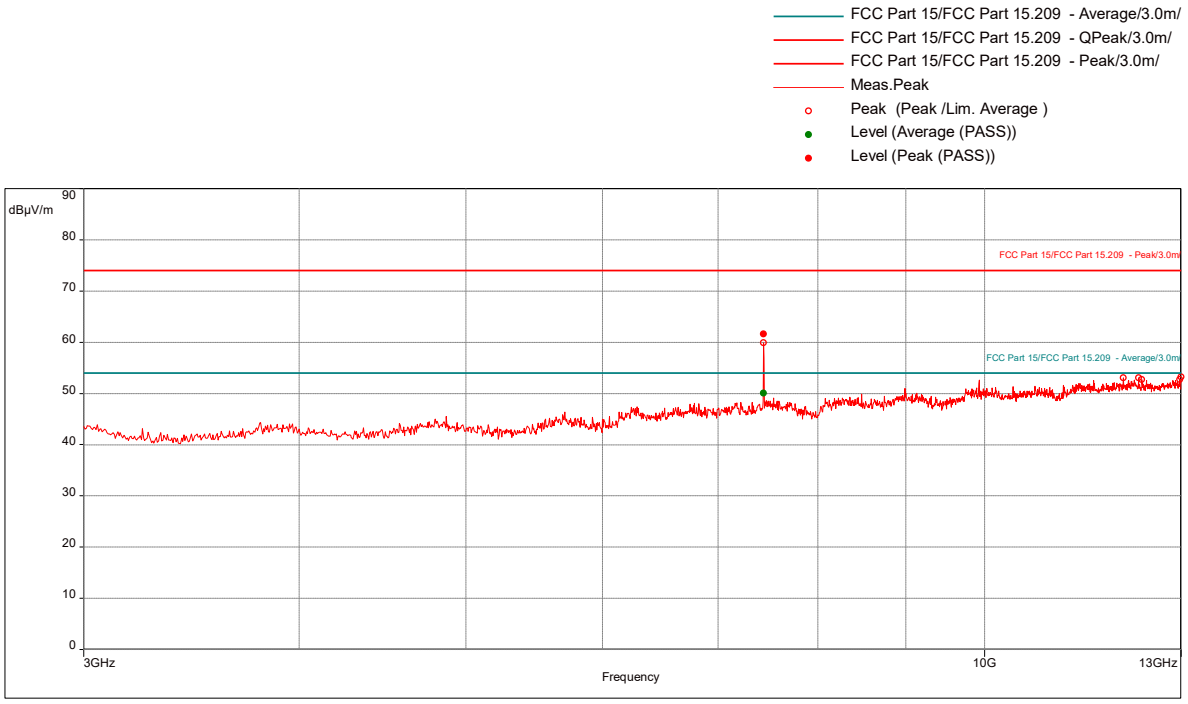
Results: Big peak is from the fundamental frequency

BLE Low Torque, Transmit at High Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 12:56:13 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_BLE_Tx mode_High CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	61.64	74.00	-12.36	187.00	2.80	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	50.02	54.00	-3.98	187.00	2.80	Vertical	1000000.00	-5.93

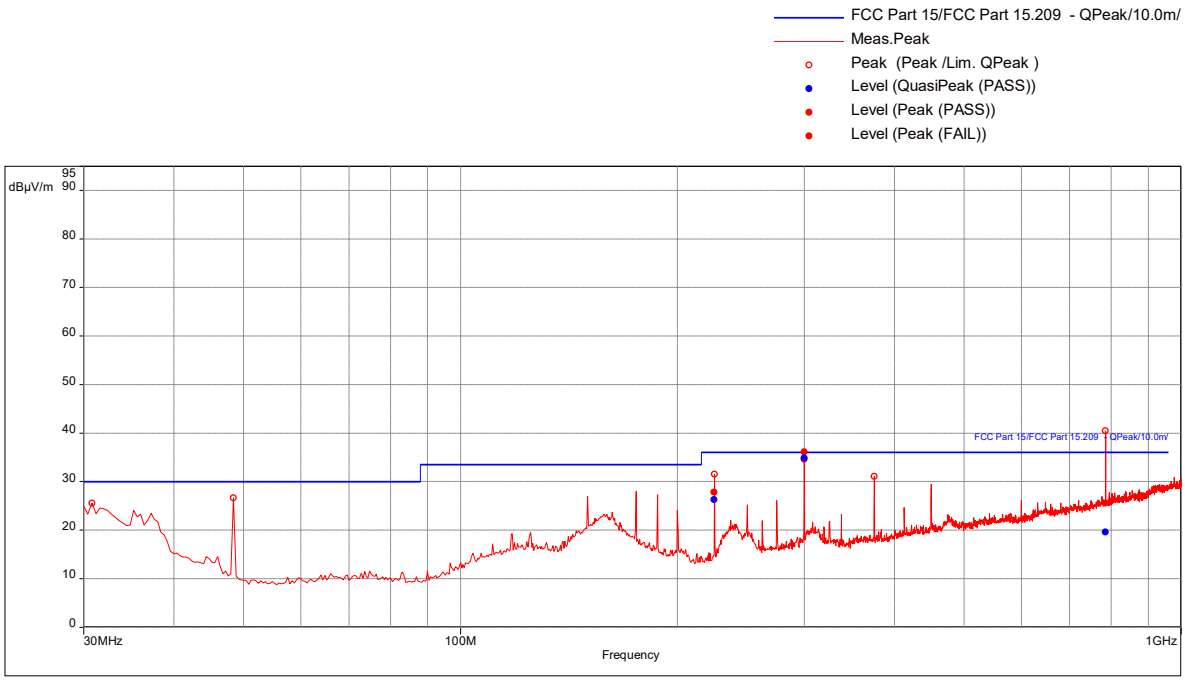
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE High Torque, Transmit at Low Channel (X-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/13/2020 11:31:49 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_High Torque Driver_BLE_Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (3)

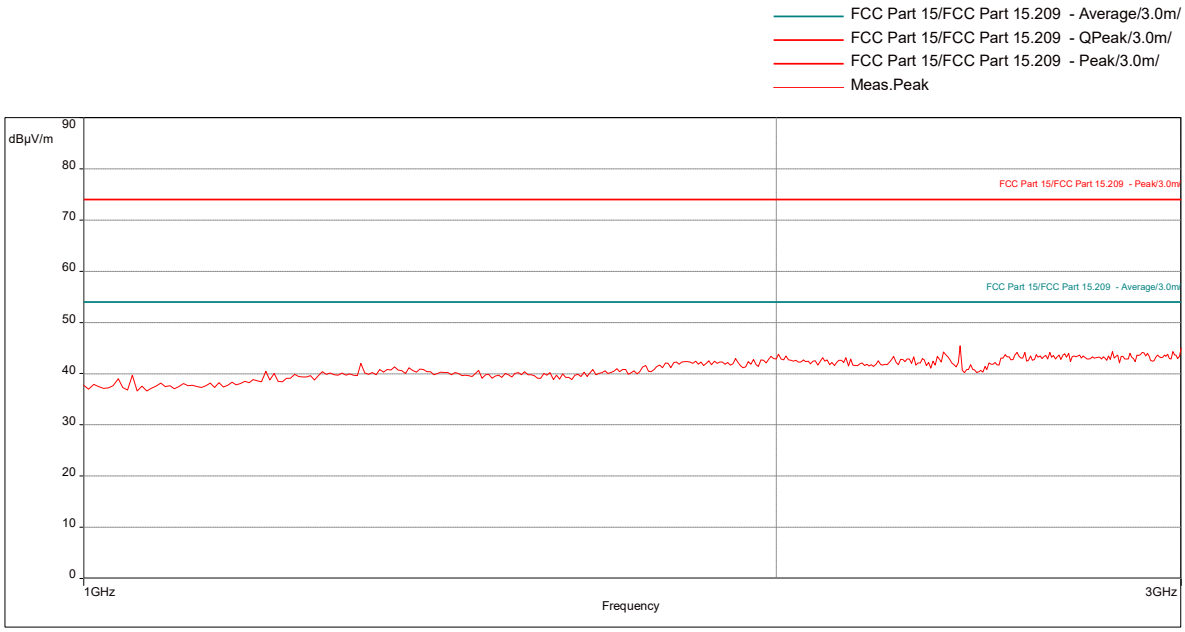
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
224.9789474	26.29	36.00	-9.71	0.00	1.54	Horizontal	120000.00	-20.76
300	34.88	36.00	-1.12	359.00	2.71	Horizontal	120000.00	-17.87
785.3789474	19.60	36.00	-16.40	283.00	2.54	Vertical	120000.00	-7.51

BLE High Torque, Transmit at Low Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:39:43 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



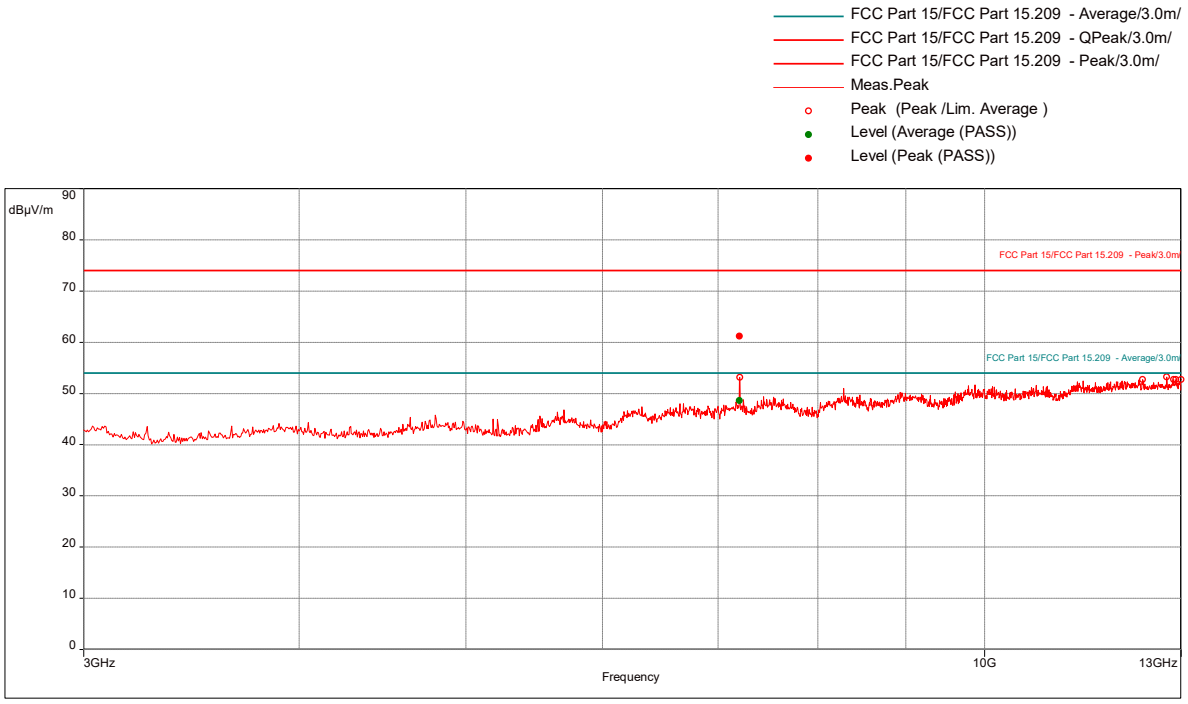
Results:

BLE High Torque, Transmit at Low Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 12:15:57 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_BLE_Tx mode_Low CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	61.16	74.00	-12.84	336.00	2.30	Vertical	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7206.842105	48.63	54.00	-5.37	336.00	2.30	Vertical	1000000.00	-6.16

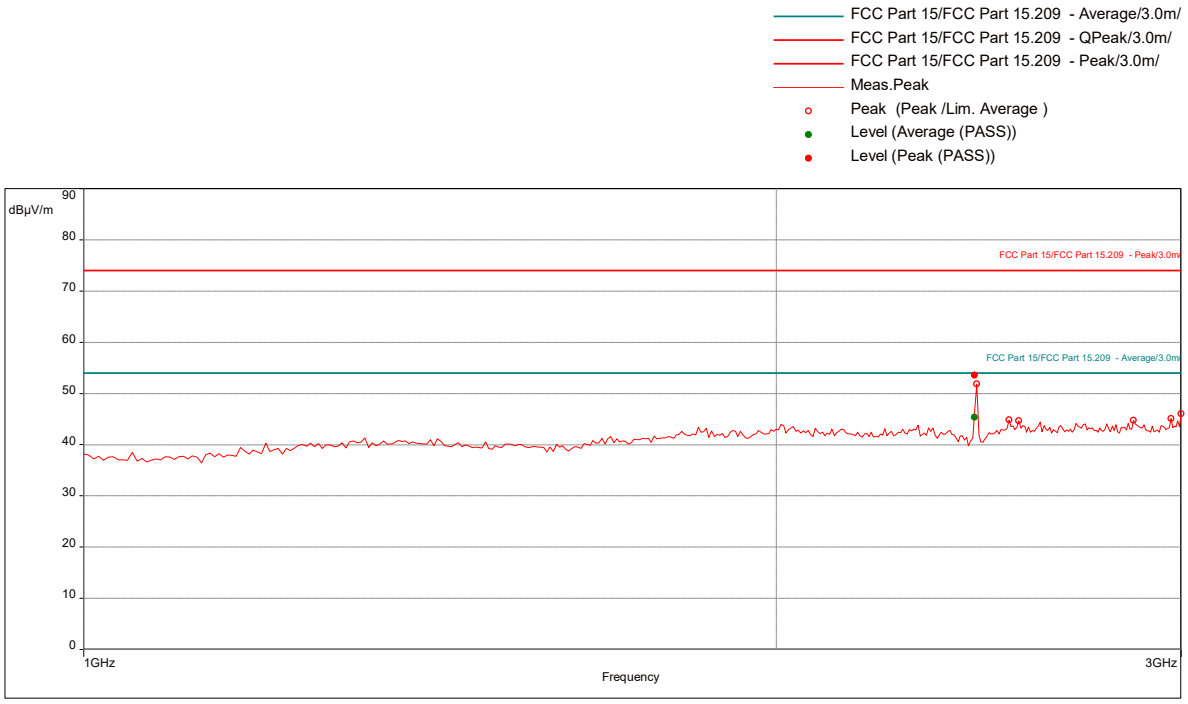
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE High Torque, Transmit at Mid Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:44:36 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_BLE_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2441.842105	53.60	74.00	-20.40	312.00	3.89	Vertical	1000000.00	-14.90

Average (PASS) (1)

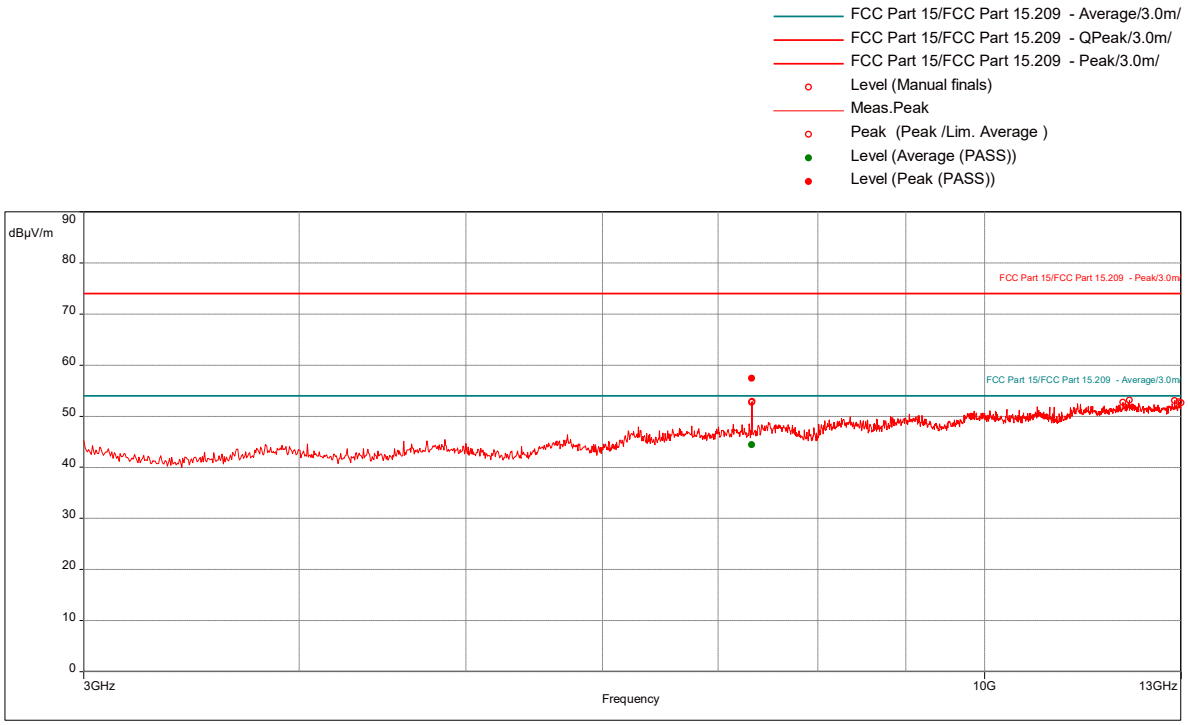
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2441.842105	45.32	54.00	-8.68	312.00	3.89	Vertical	1000000.00	-14.90

BLE High Torque, Transmit at Mid Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 12:02:45 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_BLE_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7326.842105	57.38	74.00	-16.62	210.00	1.85	Vertical	1000000.00	-6.11

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7326.842105	44.40	54.00	-9.60	210.00	1.85	Vertical	1000000.00	-6.11

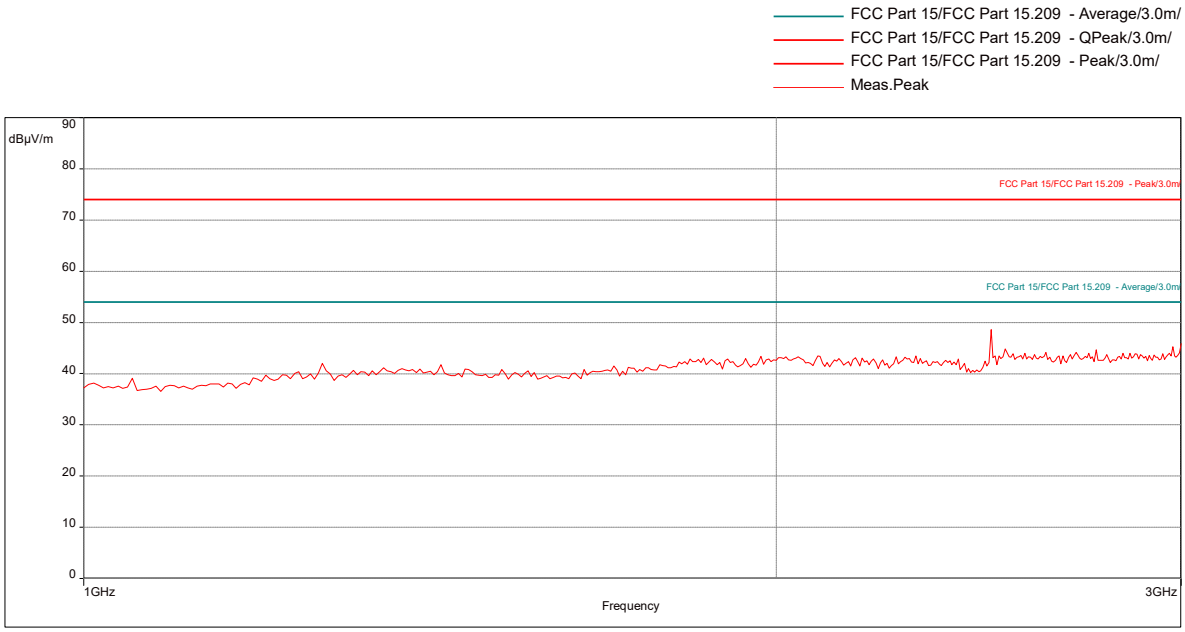
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

BLE High Torque, Transmit at High Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:53:23 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_BLE_Tx mode_High CH_X-Axis (worst-case)

Graph:



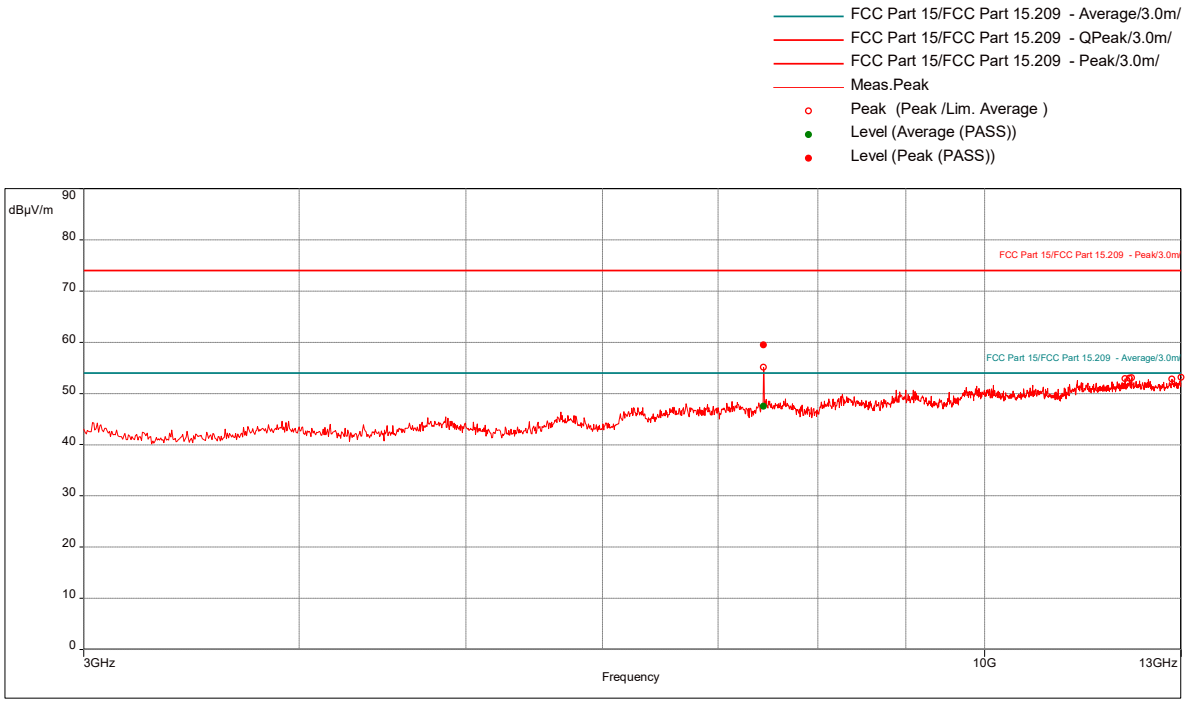
Results:

BLE High Torque, Transmit at High Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/18/2020 11:49:19 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_BLE_Tx mode_High CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	59.45	74.00	-14.55	202.00	2.20	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7439.473684	47.49	54.00	-6.51	202.00	2.20	Vertical	1000000.00	-5.93

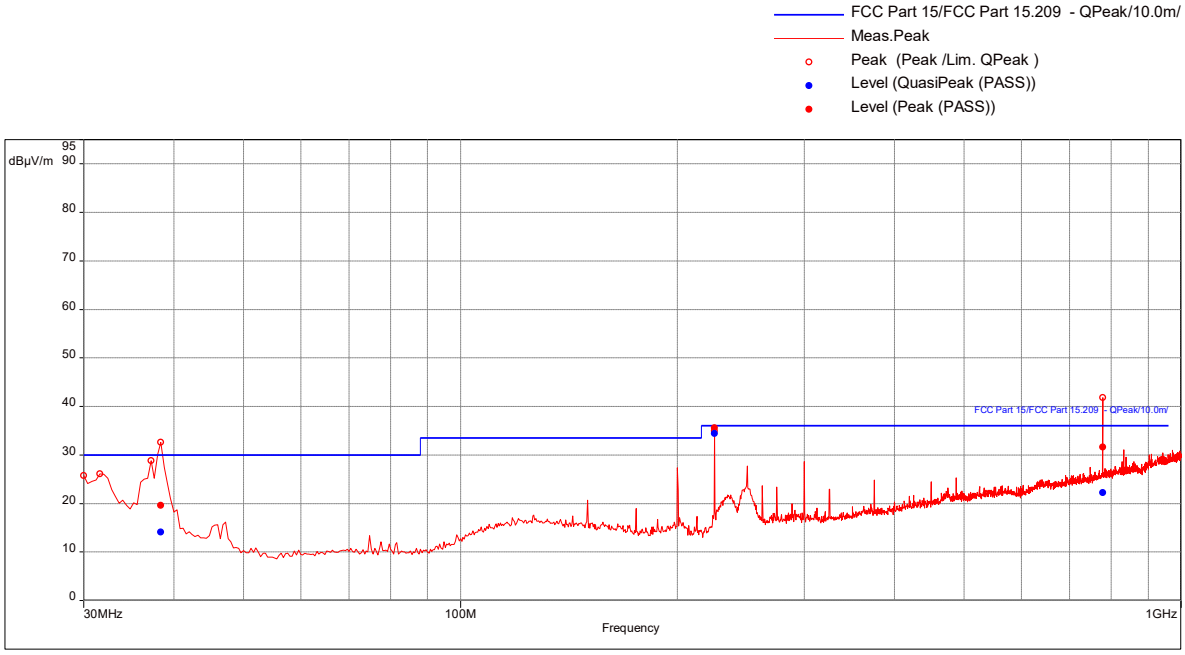
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Pistol, Transmit at Low Channel (Z-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/12/2020 12:58:11 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	24%
Atmospheric Pressure	1009 mB
Comments	RE 30-1000MHz_Battery power_Pistol driver_802.15.4_Tx mode_Low CH_Z-Axis

Graph:



Results:

QuasiPeak (PASS) (3)

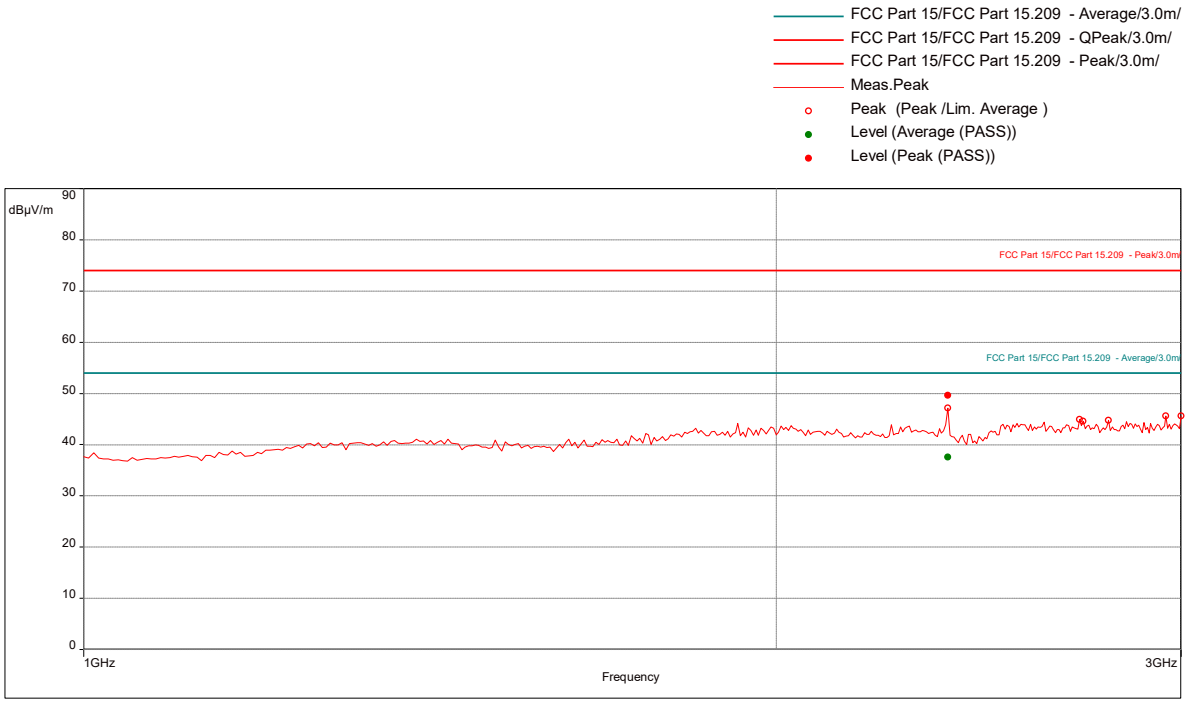
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
38.27368421	14.05	30.00	-15.95	313.00	1.01	Vertical	120000.00	-18.02
225.0105263	34.43	36.00	-1.57	11.00	1.00	Vertical	120000.00	-20.75
778	22.19	36.00	-13.81	84.00	2.67	Vertical	120000.00	-7.58

Zigbee Pistol, Transmit at Low Channel (Z-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 8:45:10 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_Low CH_Z-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2372.631579	49.65	74.00	-24.35	204.00	3.25	Horizontal	1000000.00	-15.34

Average (PASS) (1)

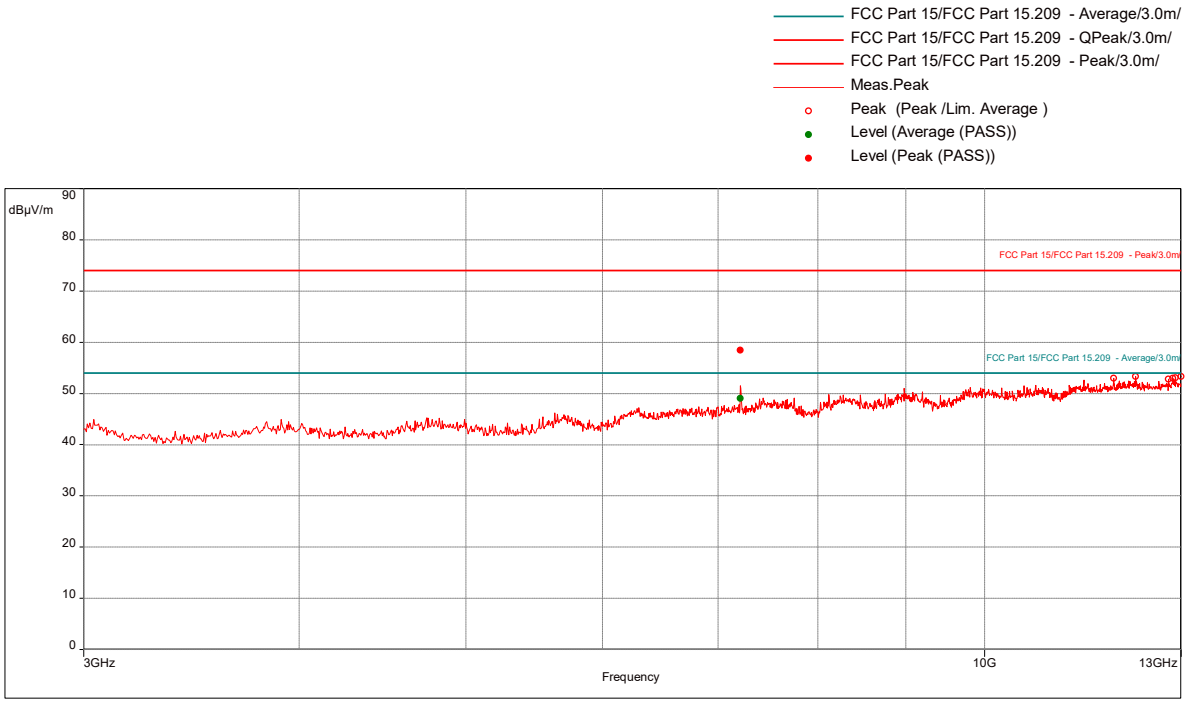
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2372.631579	37.55	54.00	-16.45	204.00	3.25	Horizontal	1000000.00	-15.34

Zigbee Pistol, Transmit at Low Channel (Z-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 2:00:36 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_Low CH_Z-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7216.315789	58.43	74.00	-15.57	276.00	3.15	Vertical	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7216.315789	49.06	54.00	-4.94	276.00	3.15	Vertical	1000000.00	-6.16

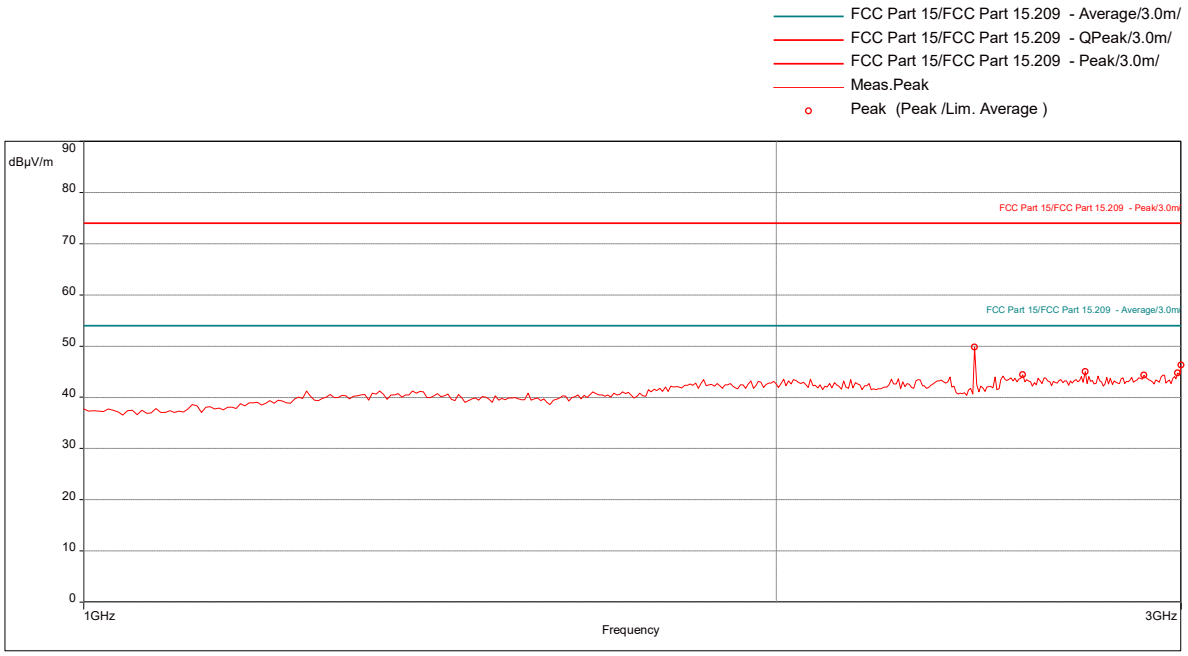
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Pistol, Transmit at Mid Channel (Z-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 9:38:59 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_Mid CH_Z-Axis (worst-case)

Graph:



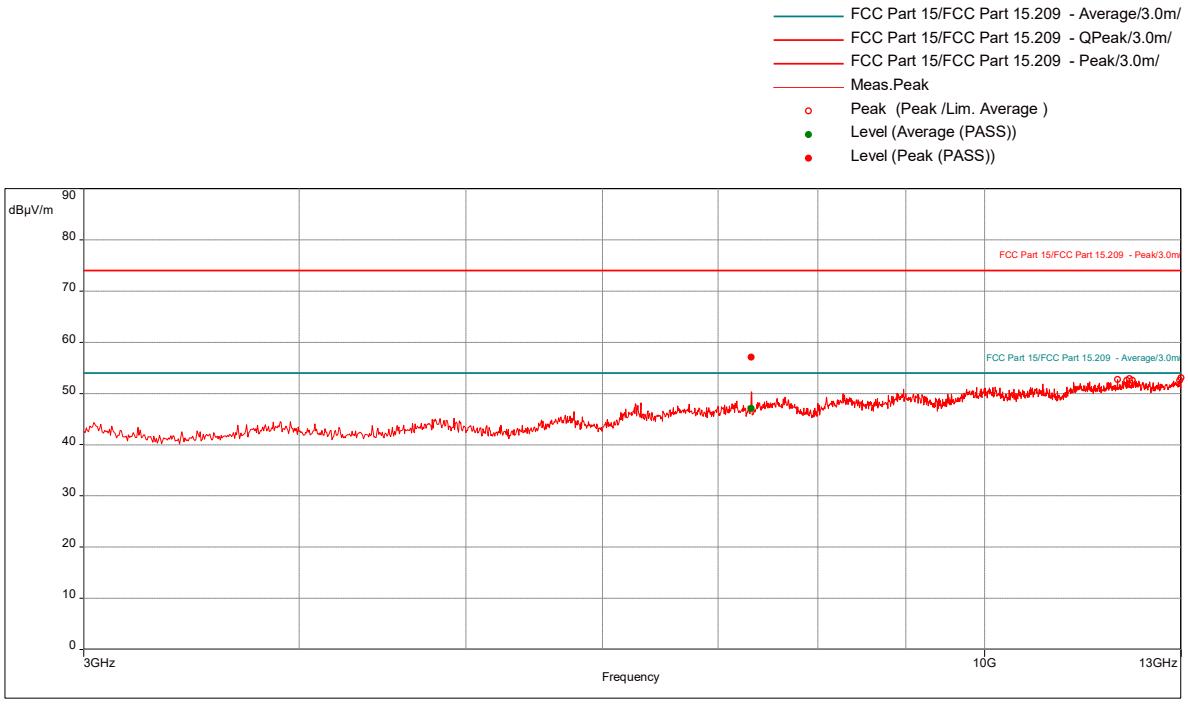
Results: Big peak is from the fundamental frequency.

Zigbee Pistol, Transmit at Mid Channel (Z-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 2:16:44 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_Mid CH_Z-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7321.315789	57.10	74.00	-16.90	85.00	1.75	Vertical	1000000.00	-6.12

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7321.315789	47.03	54.00	-6.97	85.00	1.75	Vertical	1000000.00	-6.12

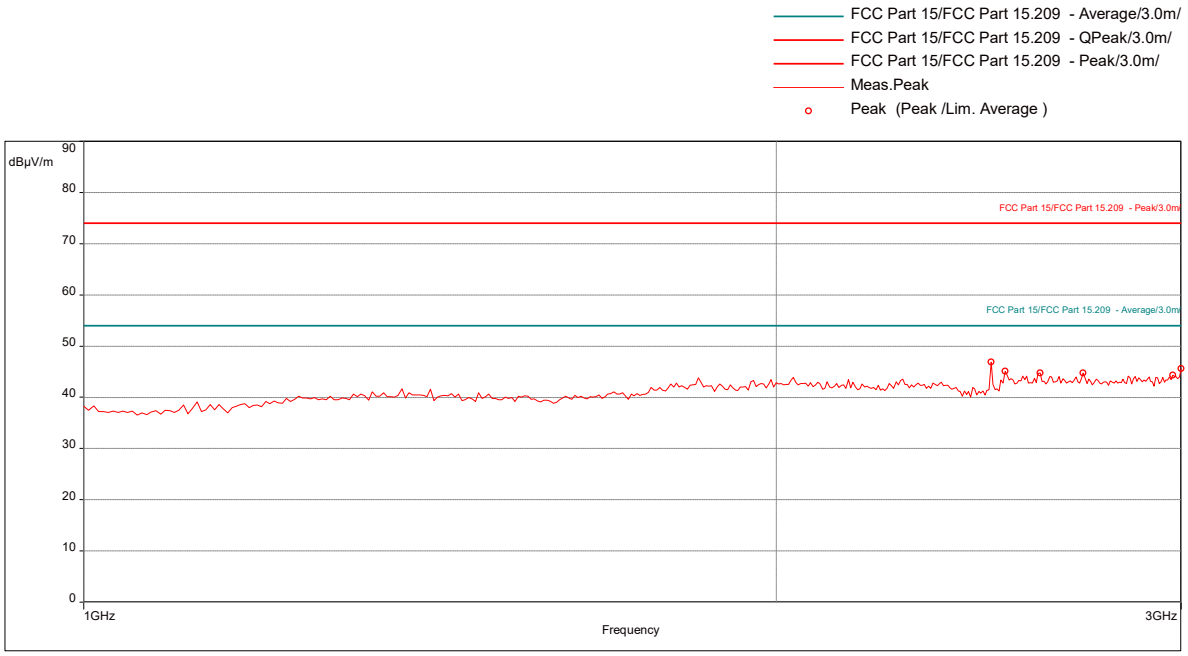
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Pistol, Transmit at High Channel (Z-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 9:43:55 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_High CH_Z-Axis (worst-case)

Graph:



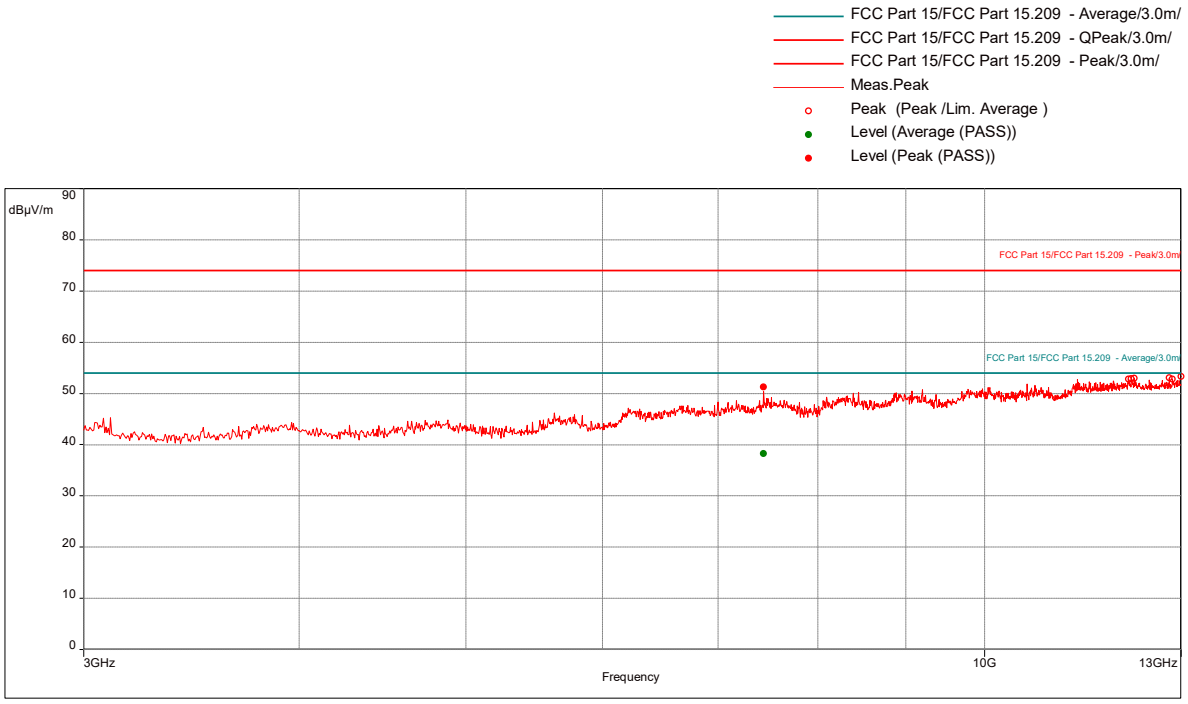
Results: No emissions were detected.

Zigbee Pistol, Transmit at High Channel (Z-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 2:31:16 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Pistol Driver_802.15.4_Tx mode_High CH_Z-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7441.315789	51.27	74.00	-22.73	128.00	3.20	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7441.315789	38.25	54.00	-15.75	128.00	3.20	Vertical	1000000.00	-5.93

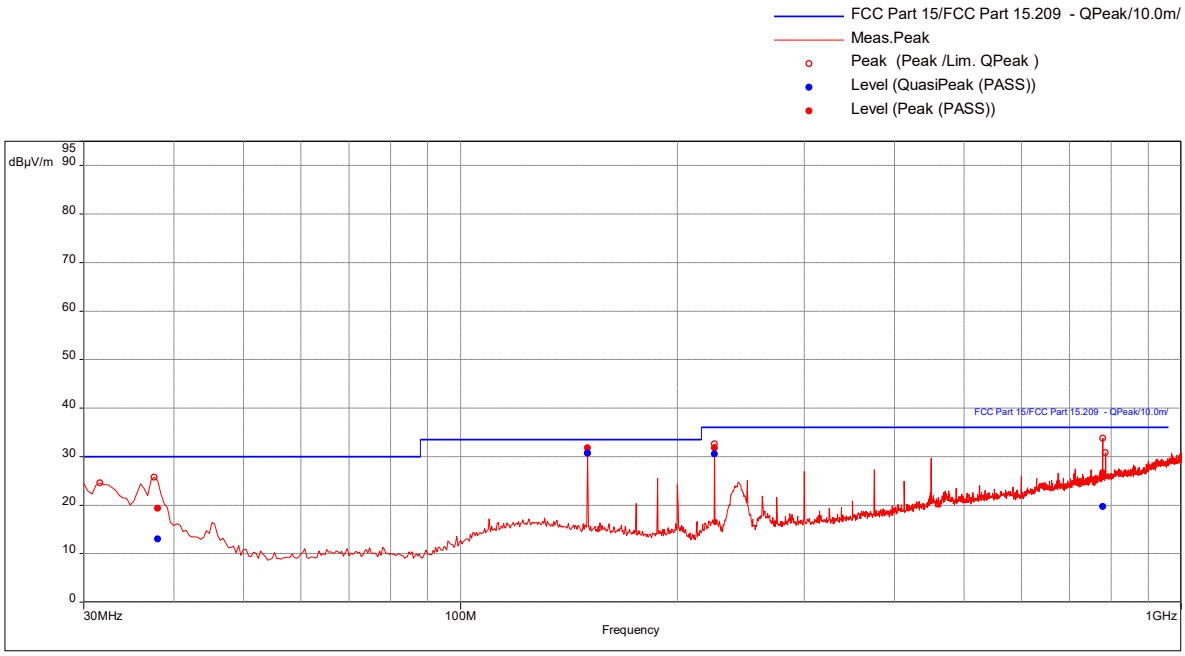
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Low Torque, Transmit at Low Channel (X-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/13/2020 8:11:56 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_Low Torque Driver_802.15.4_Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (4)

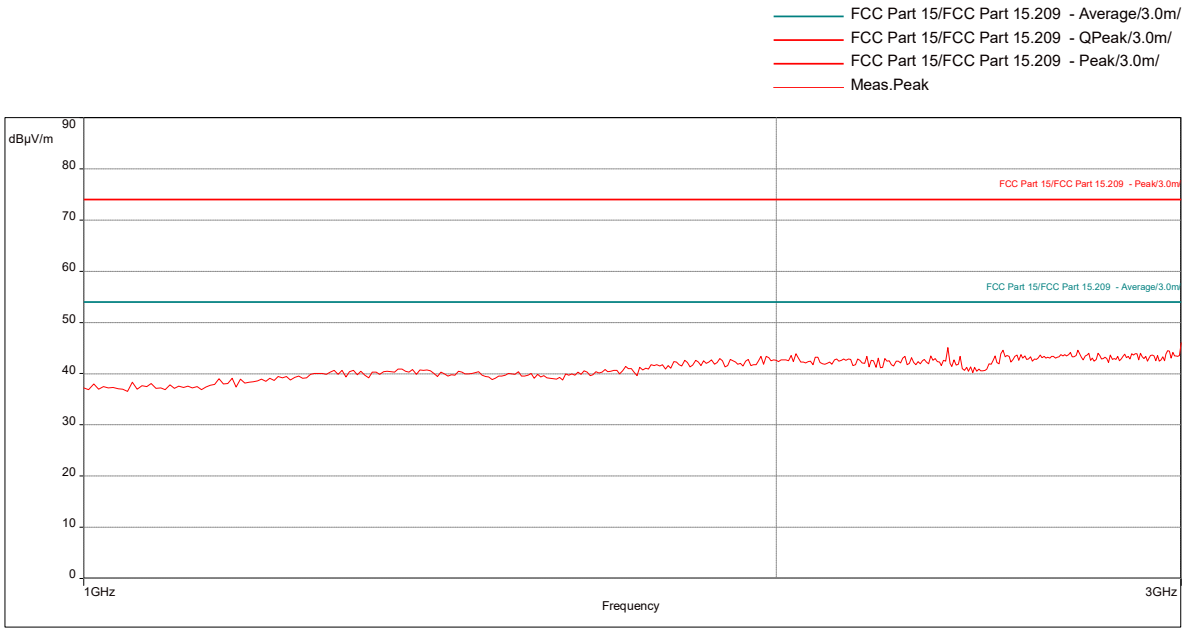
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
38.16842105	13.05	30.00	-16.95	269.00	2.43	Vertical	120000.00	-17.95
150	30.75	33.50	-2.75	174.00	4.00	Horizontal	120000.00	-19.61
225.0105263	30.51	36.00	-5.49	0.00	2.35	Horizontal	120000.00	-20.75
778.2210526	19.65	36.00	-16.35	239.00	2.52	Vertical	120000.00	-7.58

Zigbee Low Torque, Transmit at Low Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:15:37 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_Low CH_X-Axis (worst-case)

Graph:



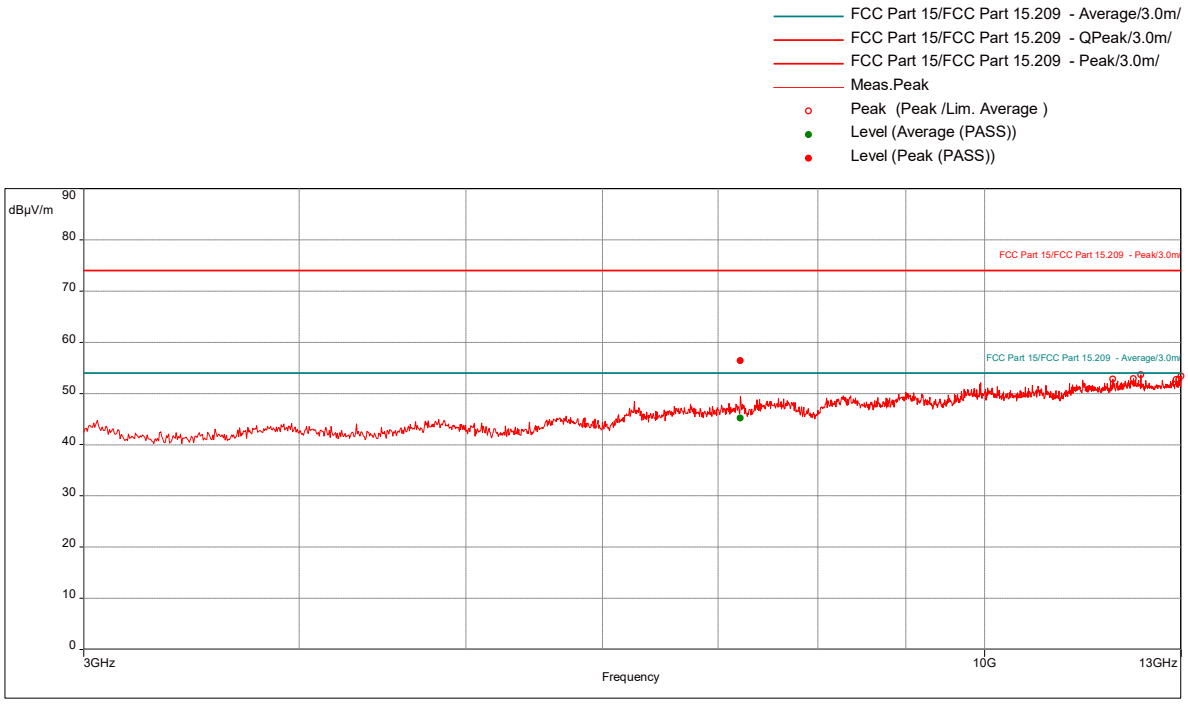
Results: No emissions were detected.

Zigbee Low Torque, Transmit at Low Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 2:47:36 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_Low CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7216.578947	56.42	74.00	-17.58	329.00	2.40	Vertical	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7216.578947	45.15	54.00	-8.85	329.00	2.40	Vertical	1000000.00	-6.16

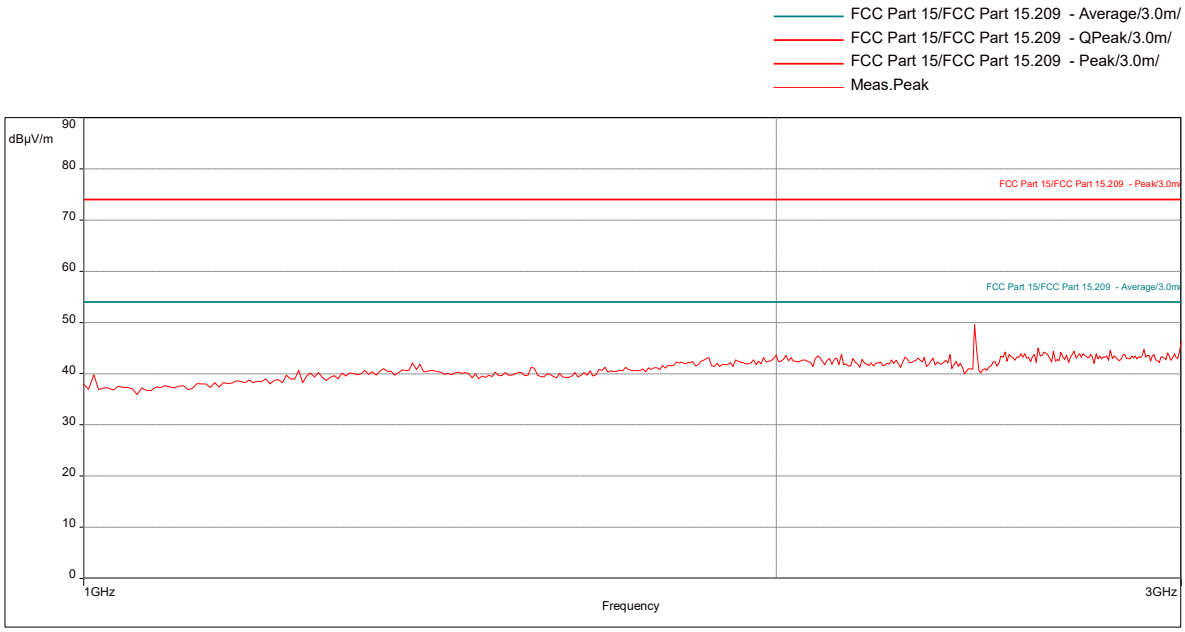
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Low Torque, Transmit at Mid Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:21:11 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



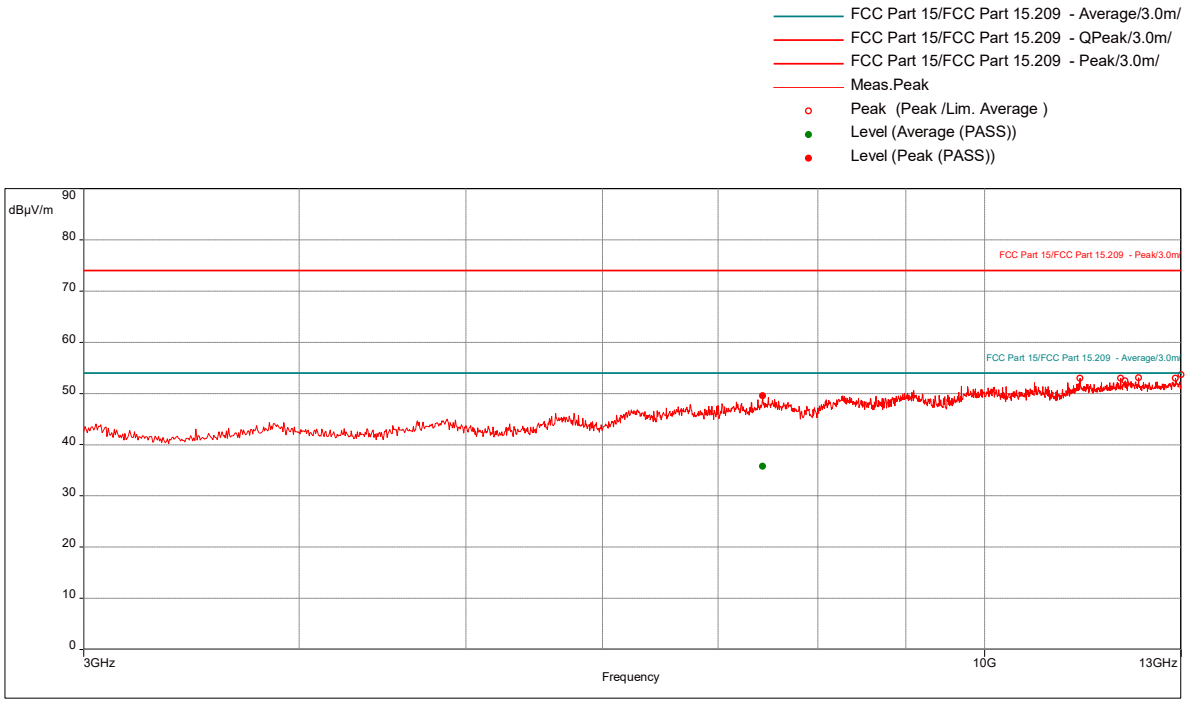
Results:

Zigbee Low Torque, Transmit at Mid Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 3:03:23 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7428.684211	49.52	74.00	-24.48	0.00	2.85	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7428.684211	35.74	54.00	-18.26	0.00	2.85	Vertical	1000000.00	-5.93

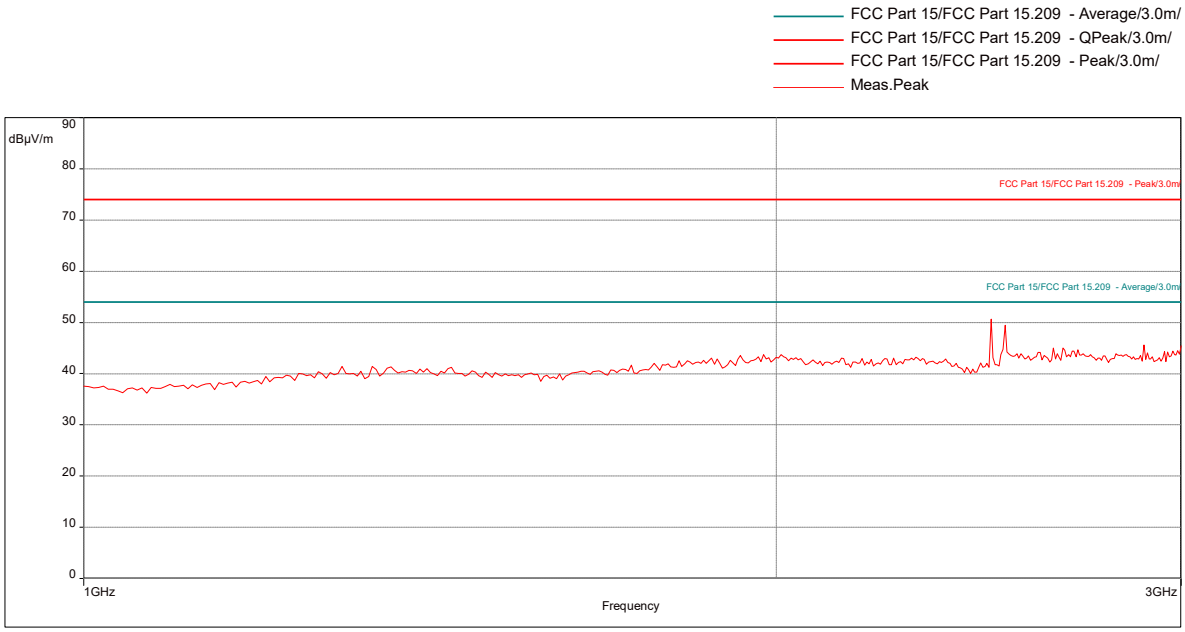
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee Low Torque, Transmit at High Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:27:36 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_High CH_X-Axis (worst-case)

Graph:



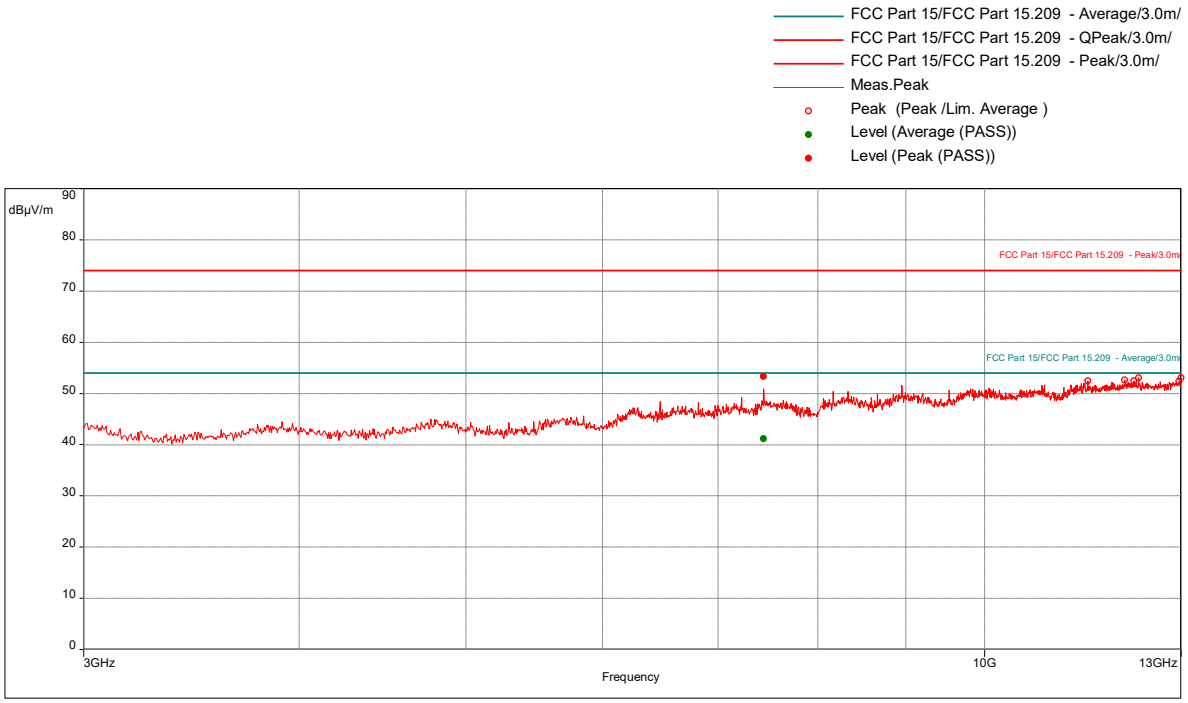
Results:

Zigbee Low Torque, Transmit at High Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 3:18:25 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_Low Torque Driver_802.15.4_Tx mode_High CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7441.578947	53.30	74.00	-20.70	194.00	1.30	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7441.578947	41.16	54.00	-12.84	194.00	1.30	Vertical	1000000.00	-5.93

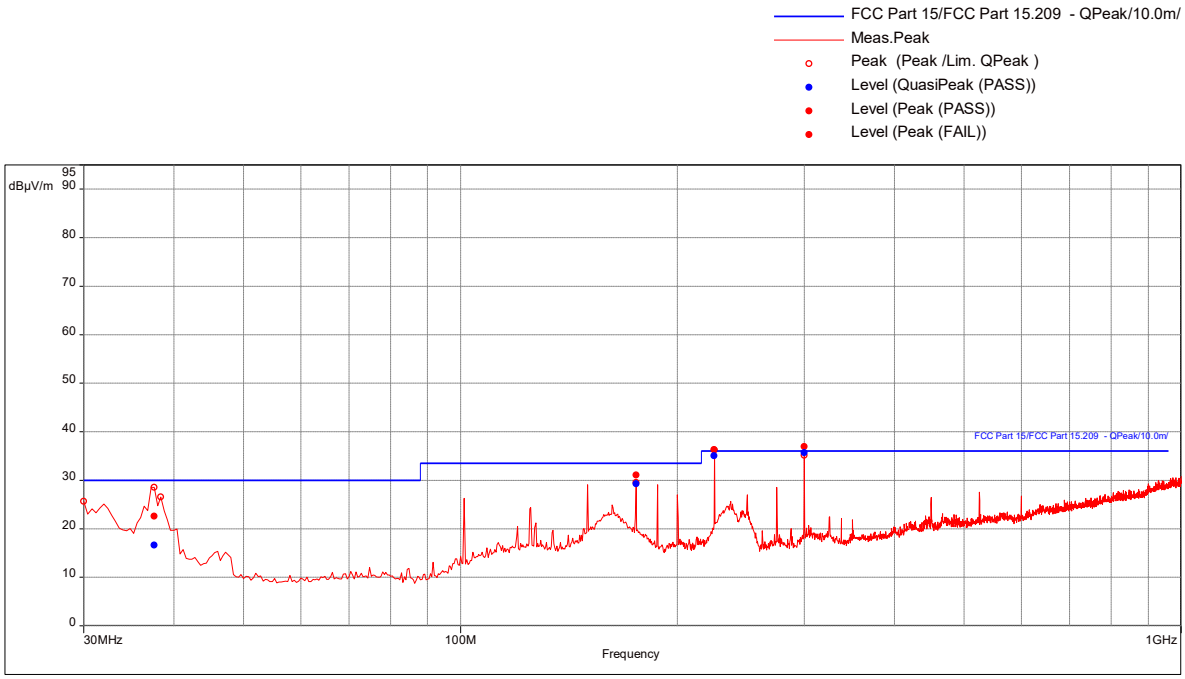
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee High Torque, Transmit at Low Channel (X-axis, worst-case), 30-1000 MHz

Test Information:

Date and Time	12/12/2020 2:20:46 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	24%
Atmospheric Pressure	1009 mB
Comments	RE 30-1000MHz_Battery power_High Torque Driver_802.15.4_Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (4)

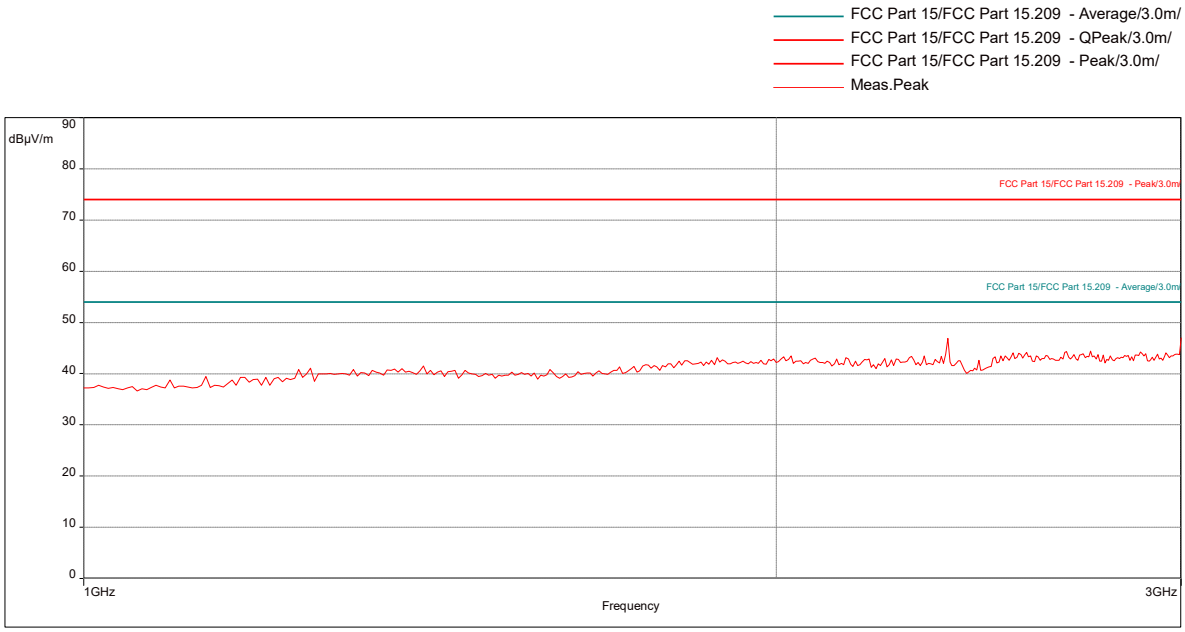
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
37.75789474	16.65	30.00	-13.35	269.00	3.66	Vertical	120000.00	-17.64
175.0105263	29.26	33.50	-4.24	359.00	4.00	Horizontal	120000.00	-20.46
224.9789474	35.01	36.00	-0.99	357.00	3.02	Horizontal	120000.00	-20.76
300	35.72	36.00	-0.28	356.00	2.63	Horizontal	120000.00	-17.87

Zigbee High Torque, Transmit at Low Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 9:56:06 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_Low CH_X-Axis (worst-case)

Graph:



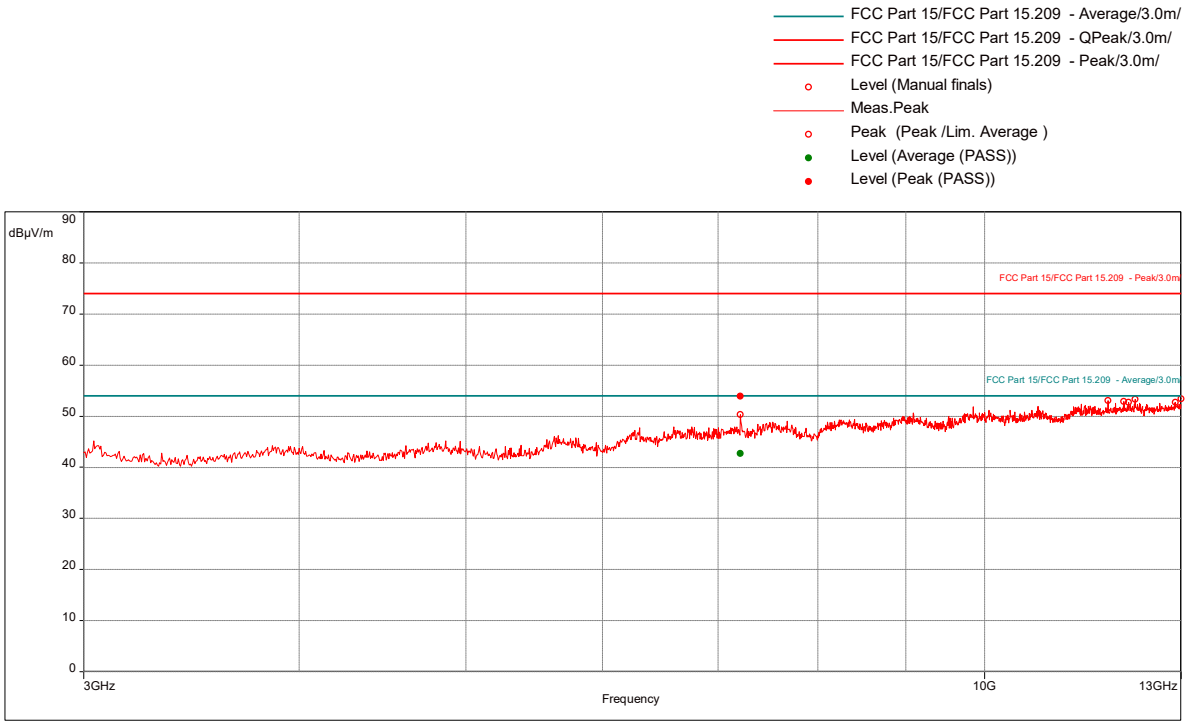
Results:

Zigbee High Torque, Transmit at Low Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 1:13:49 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_Low CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7213.947368	53.92	74.00	-20.08	150.00	1.45	Vertical	1000000.00	-6.16

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7213.947368	42.68	54.00	-11.32	150.00	1.45	Vertical	1000000.00	-6.16

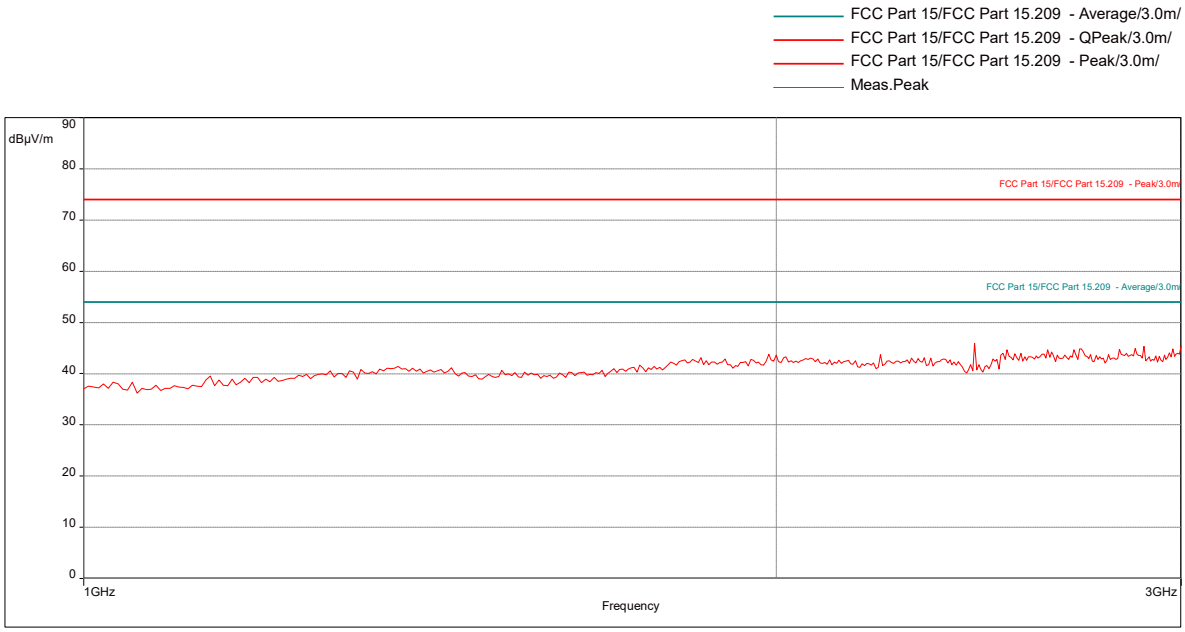
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee High Torque, Transmit at Mid Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:02:44 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



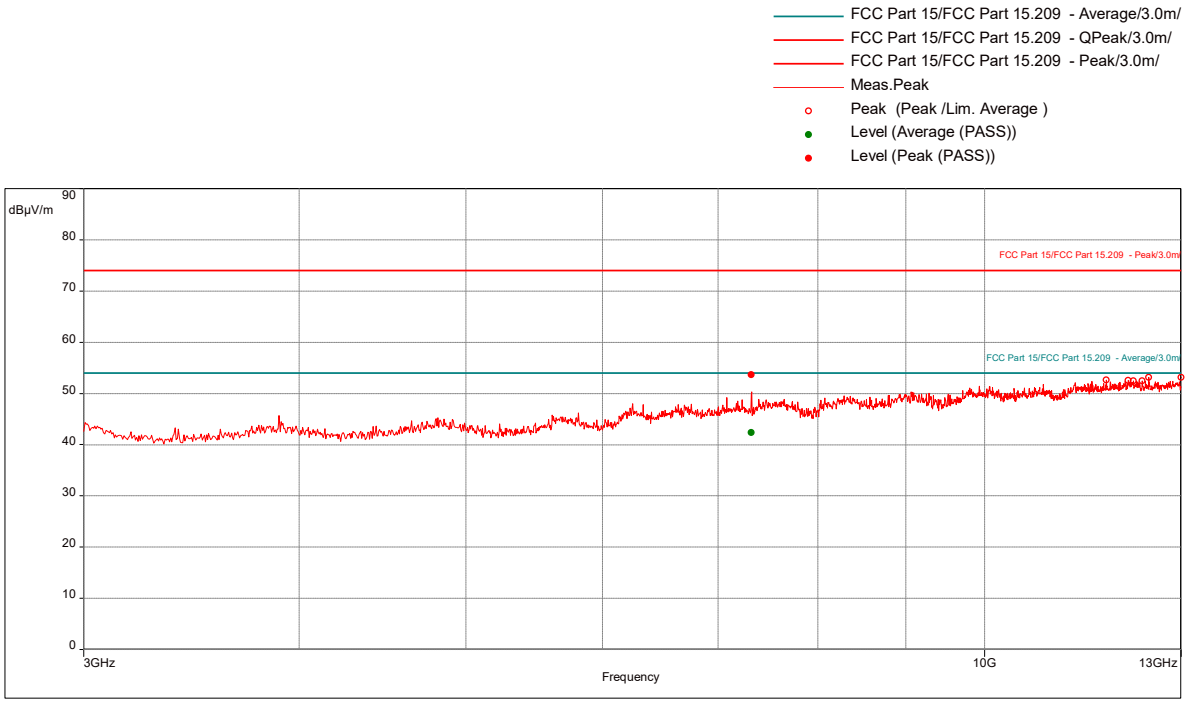
Results:

Zigbee High Torque, Transmit at Mid Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 1:30:29 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_Mid CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7321.315789	53.67	74.00	-20.33	137.00	2.40	Vertical	1000000.00	-6.12

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7321.315789	42.37	54.00	-11.63	137.00	2.40	Vertical	1000000.00	-6.12

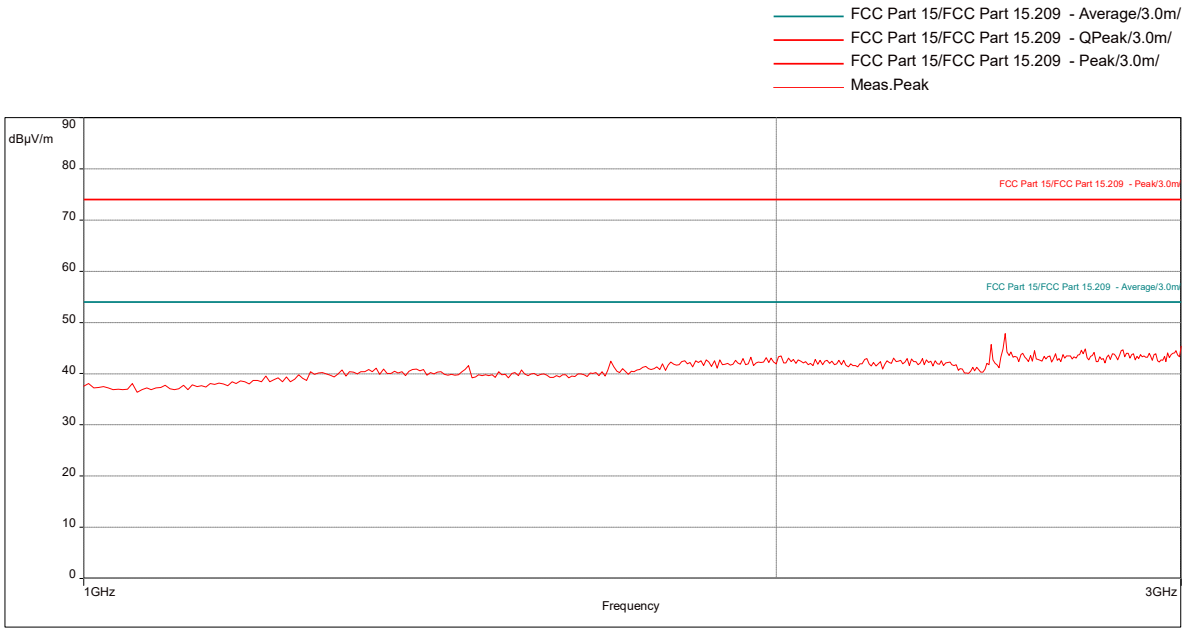
Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

Zigbee High Torque, Transmit at High Channel (X-axis, worst-case), 1-3 GHz

Test Information:

Date and Time	12/17/2020 10:08:51 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 3 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_High CH_X-Axis (worst-case)

Graph:



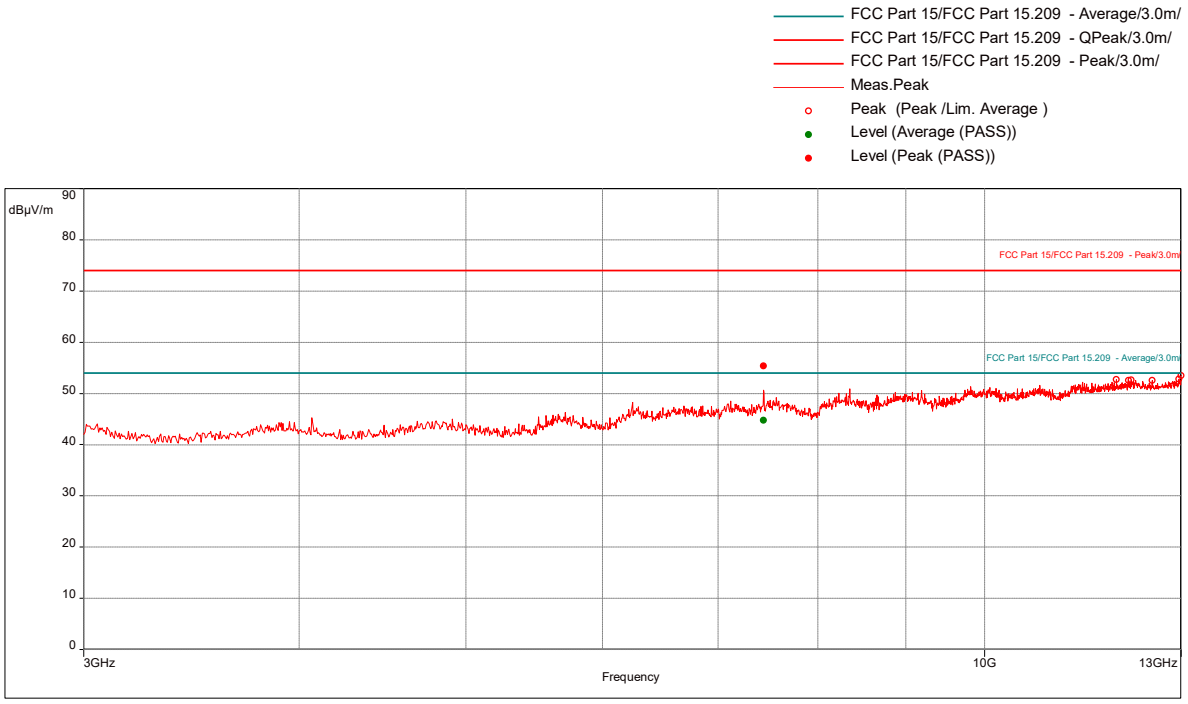
Results:

Zigbee High Torque, Transmit at High Channel (X-axis, worst-case), 3-25 GHz

Test Information:

Date and Time	12/19/2020 1:44:51 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	13 %
Atmospheric Pressure	1017 mB
Comments	RE 3 to 13 GHz_Battery power_High Torque Driver_802.15.4_Tx mode_High CH_X-Axis (worst-case)

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7438.684211	55.39	74.00	-18.61	201.00	2.00	Vertical	1000000.00	-5.93

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
7438.684211	44.71	54.00	-9.29	201.00	2.00	Vertical	1000000.00	-5.93

Note: Manual testing was performed from 13-25GHz, no emissions were detected above the measuring equipment noise floor.

		Test Date:	12/12/2020 12/13/2020 12/17/2020 12/18/2020 12/19/2020
Test Personnel:	Vathana Ven VSV		
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 10.3
Input Voltage:	Battery power		
		Ambient Temperature:	24, 24, 24, 24, 24 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	24, 27, 15, 13, 13 %
		Atmospheric Pressure:	1009, 1003, 1007, 1017, 1017 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ISED ICES-003, and ANSI C 63.4.

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	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/12/2020	03/12/2021
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/11/2020	09/11/2021
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/08/2020	05/08/2021
IW001'	2 meter cable	Insulated Wire	2801-NPS	001	10/08/2020	10/08/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	09/21/2020	09/21/2021
HS001'	DC-18GHz cable 1.5m long	Huber & Suhner	SucoFlex 106A	HS001	10/07/2020	10/07/2021
IW003'	8.4 meter cable	Insulated Wire	2800-NPS	003	06/10/2020	06/10/2021
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/17/2020	02/17/2021
HS003'	10m under floor cable	Huber-Schuner	10m-1	HS003	04/29/2020	04/29/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/17/2020	02/17/2021
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2020	07/11/2021

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

11.3 Results:

The sample tested was found to Comply.

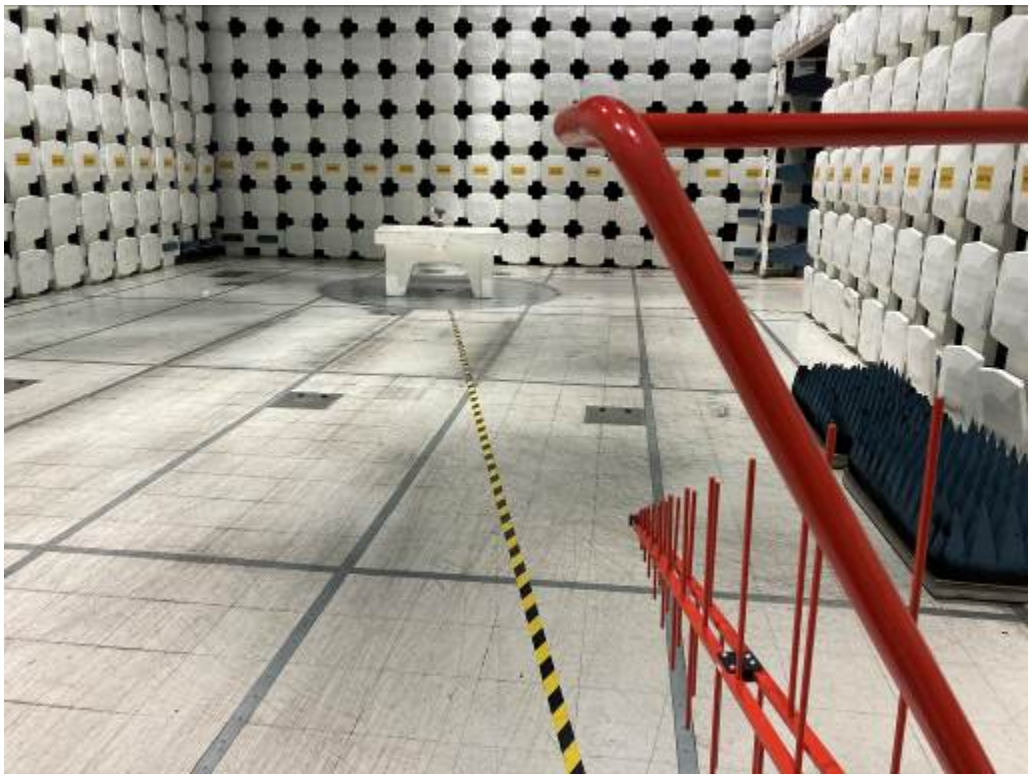
§15.109 Radiated emission limits.

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

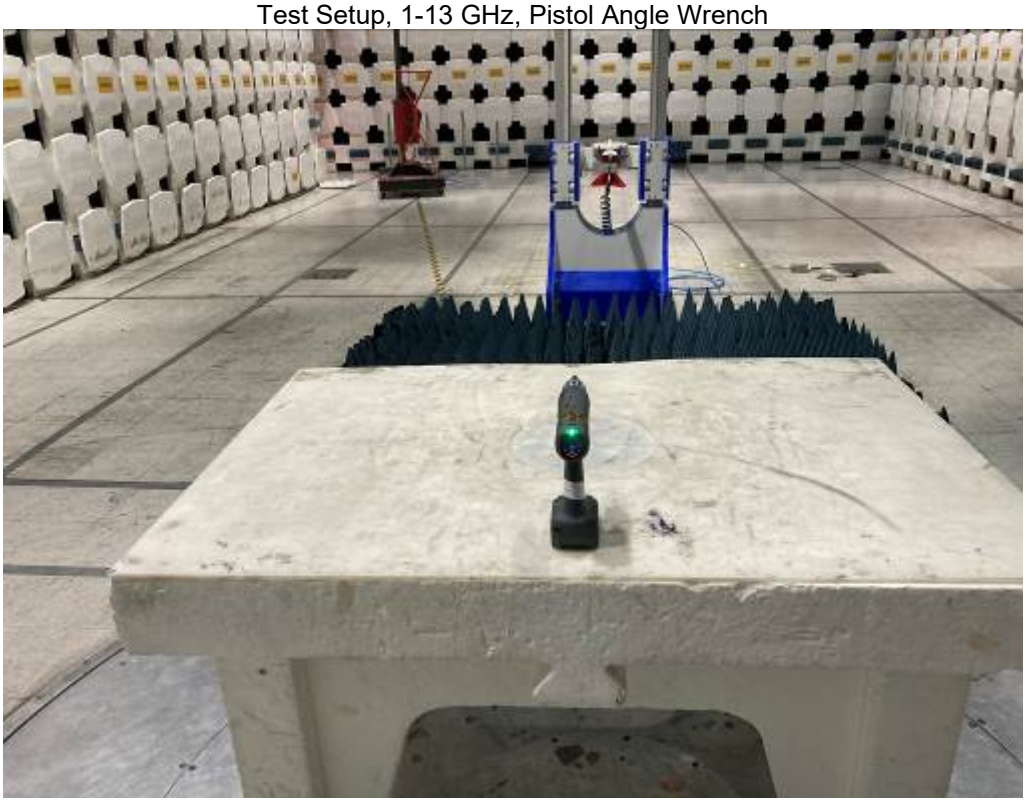
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

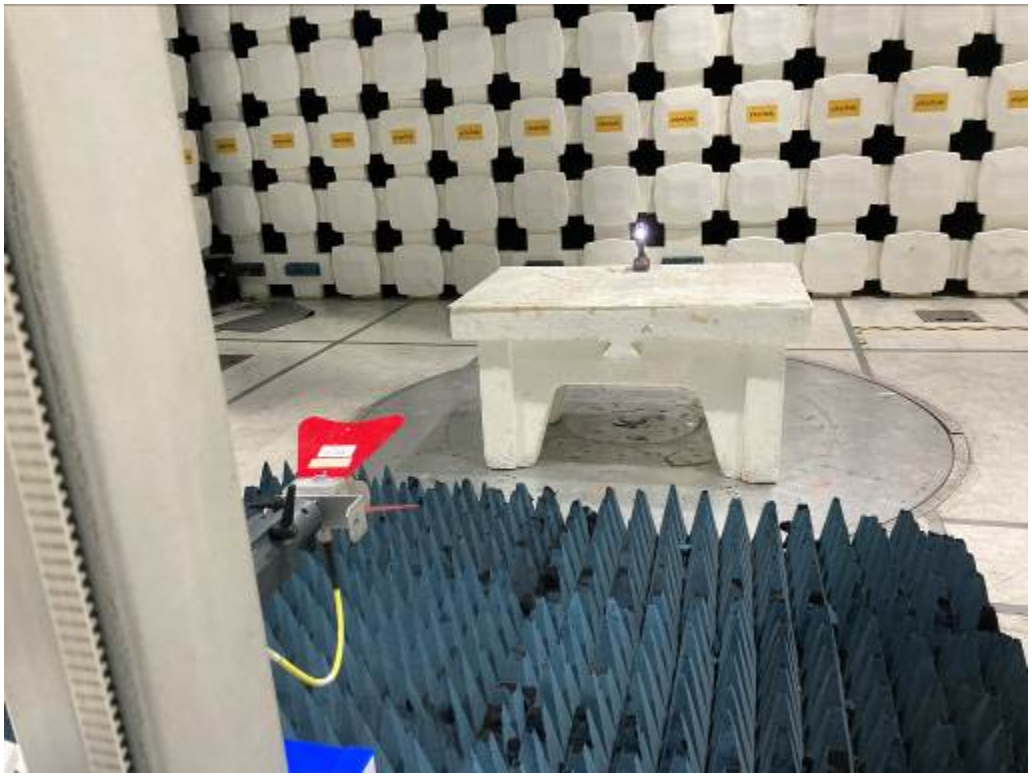
11.4 Setup Photographs:

Test Setup, 30-1000 MHz, Pistol Angle Wrench

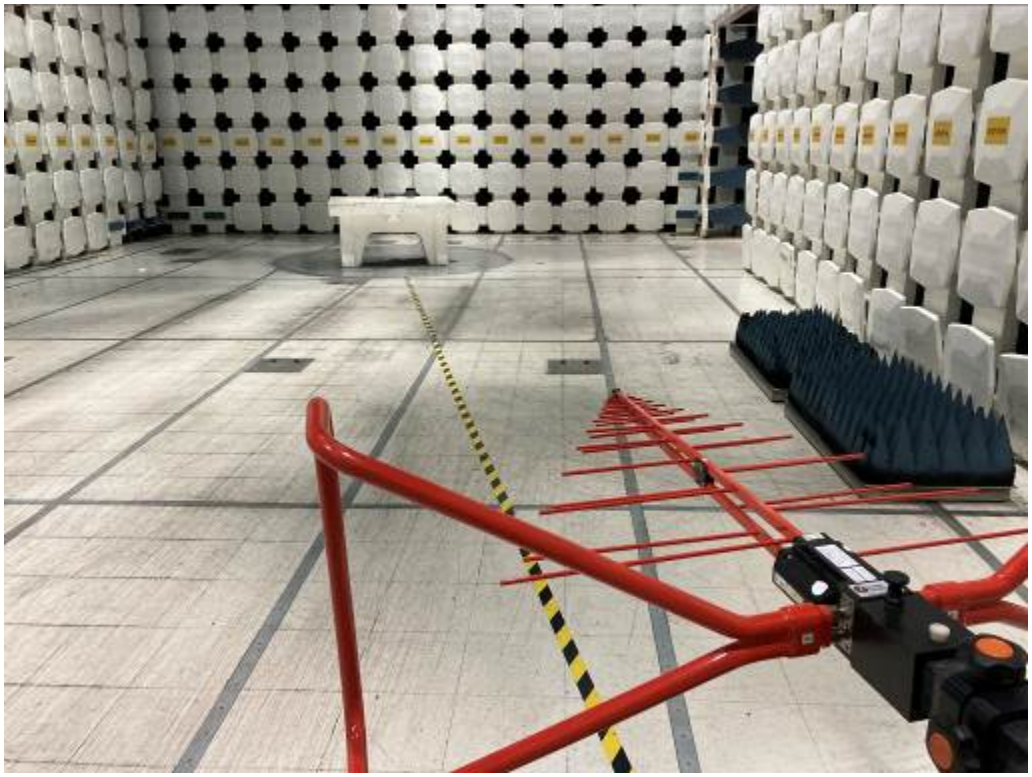


Test Setup, 1-13 GHz, Pistol Angle Wrench

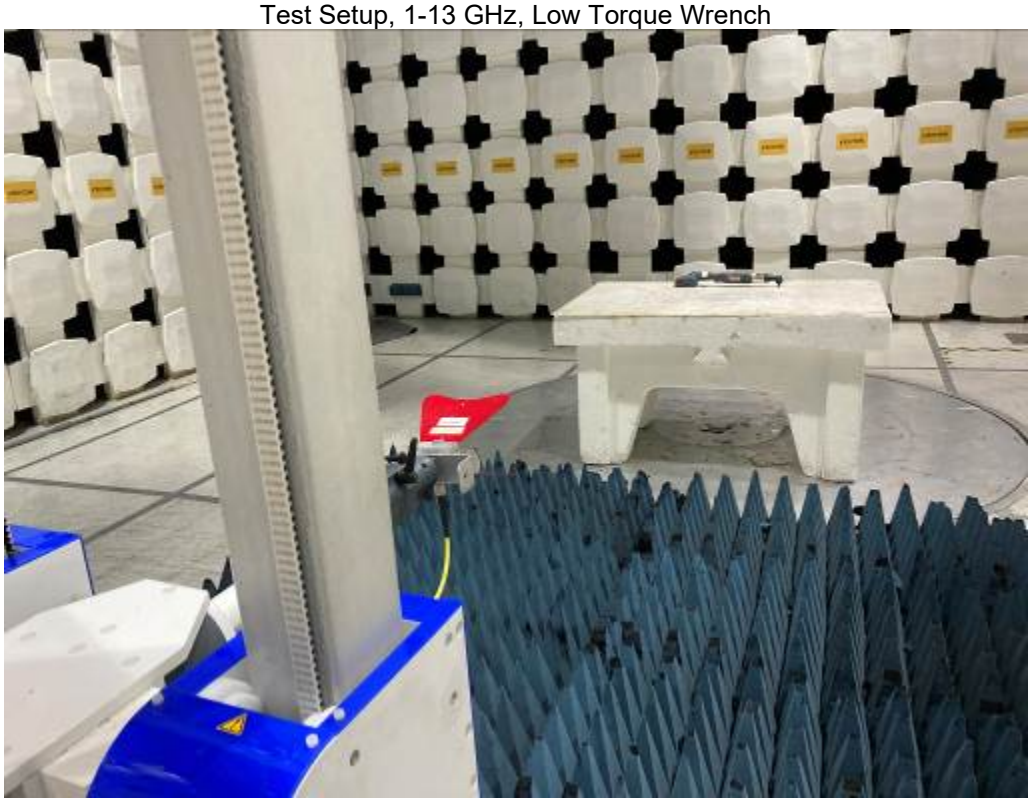


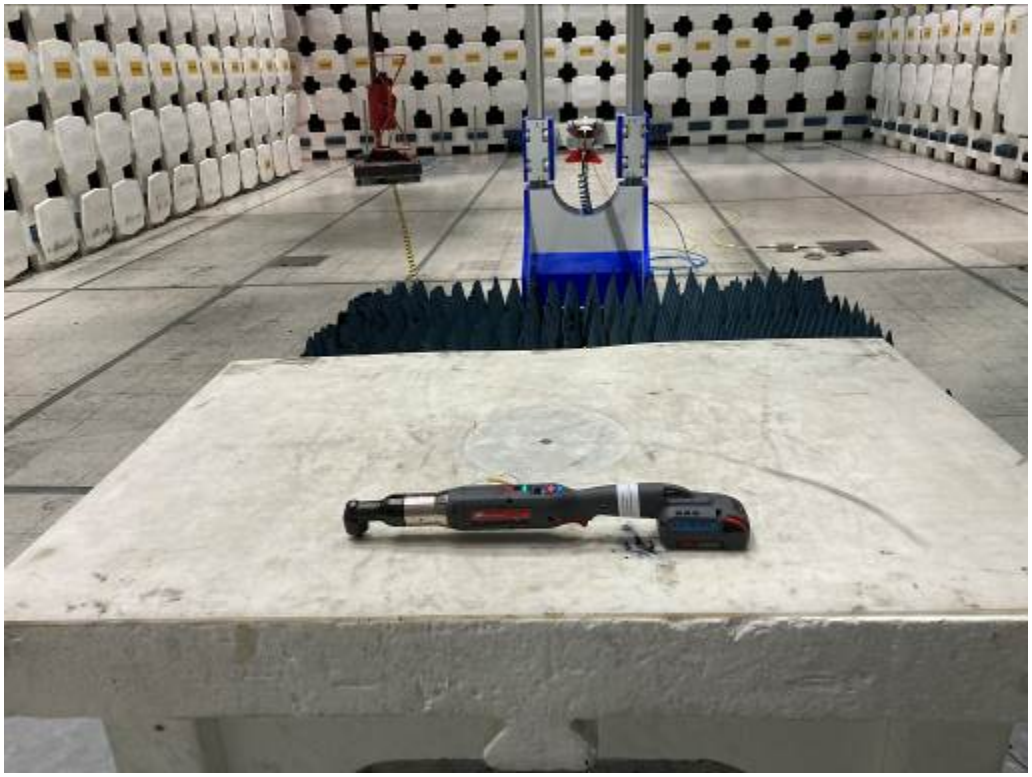


Test Setup, 30-1000 MHz, Low Torque Wrench

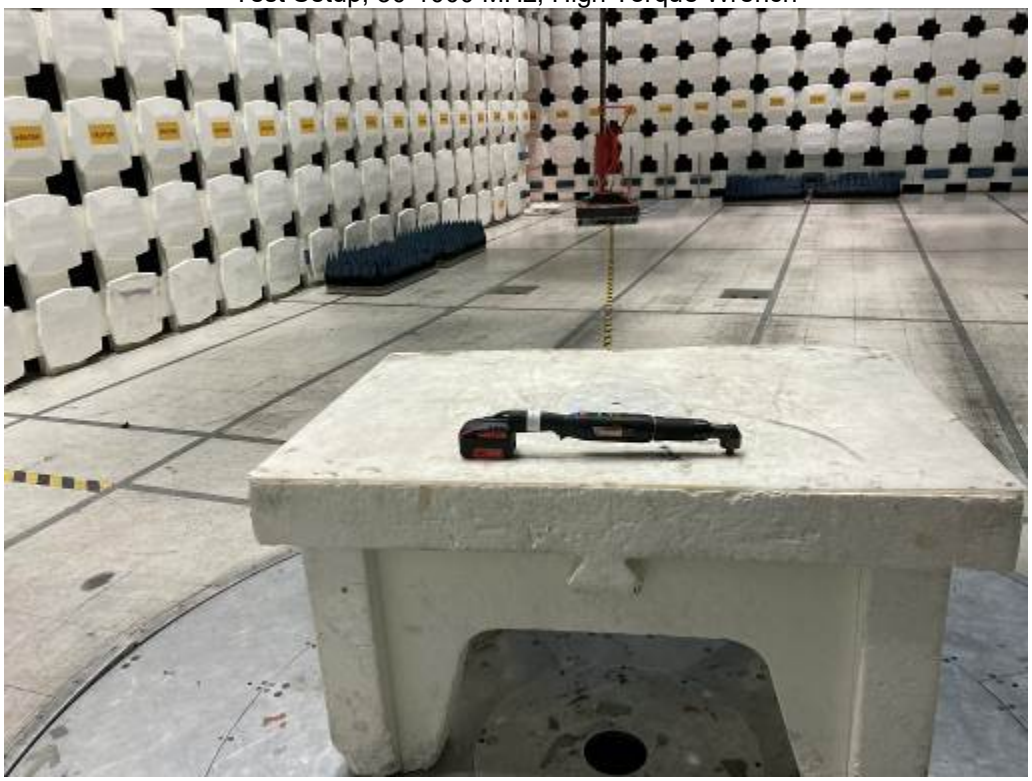


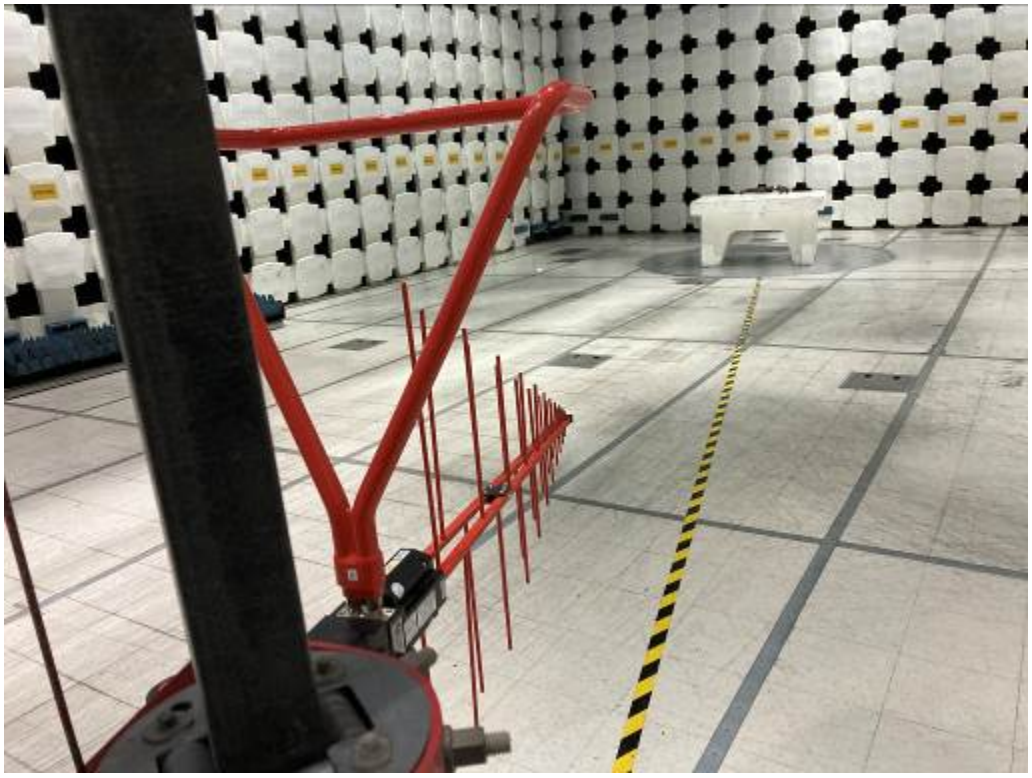
Test Setup, 1-13 GHz, Low Torque Wrench



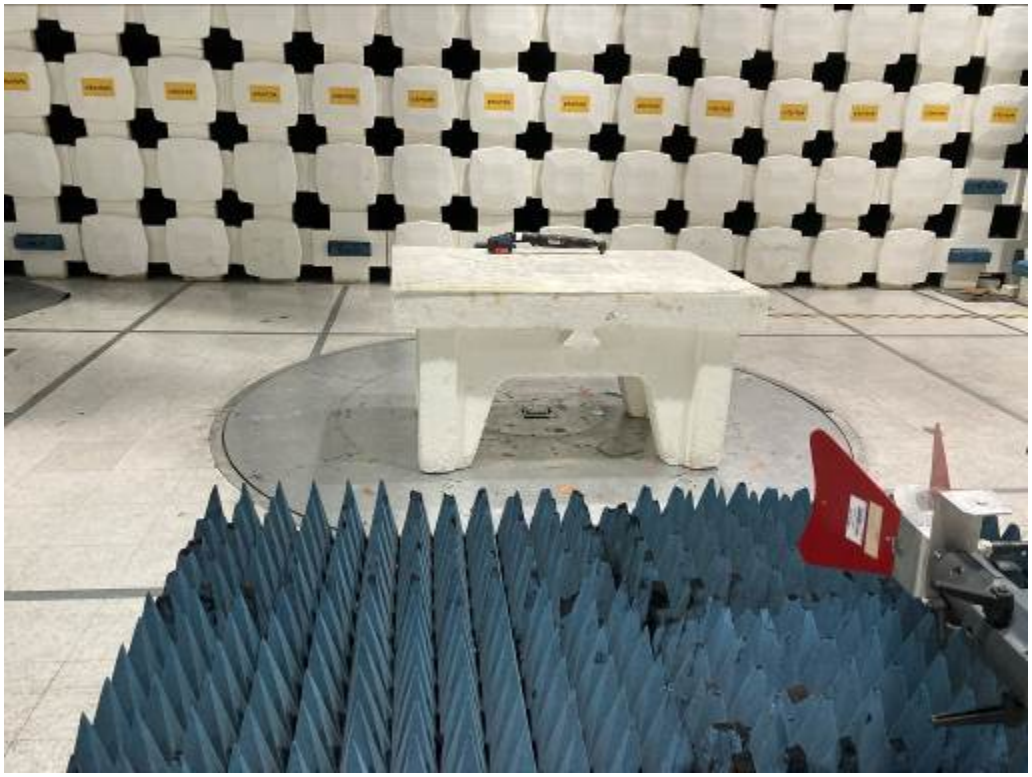


Test Setup, 30-1000 MHz, High Torque Wrench





Test Setup, 1-13 GHz, High Torque Wrench



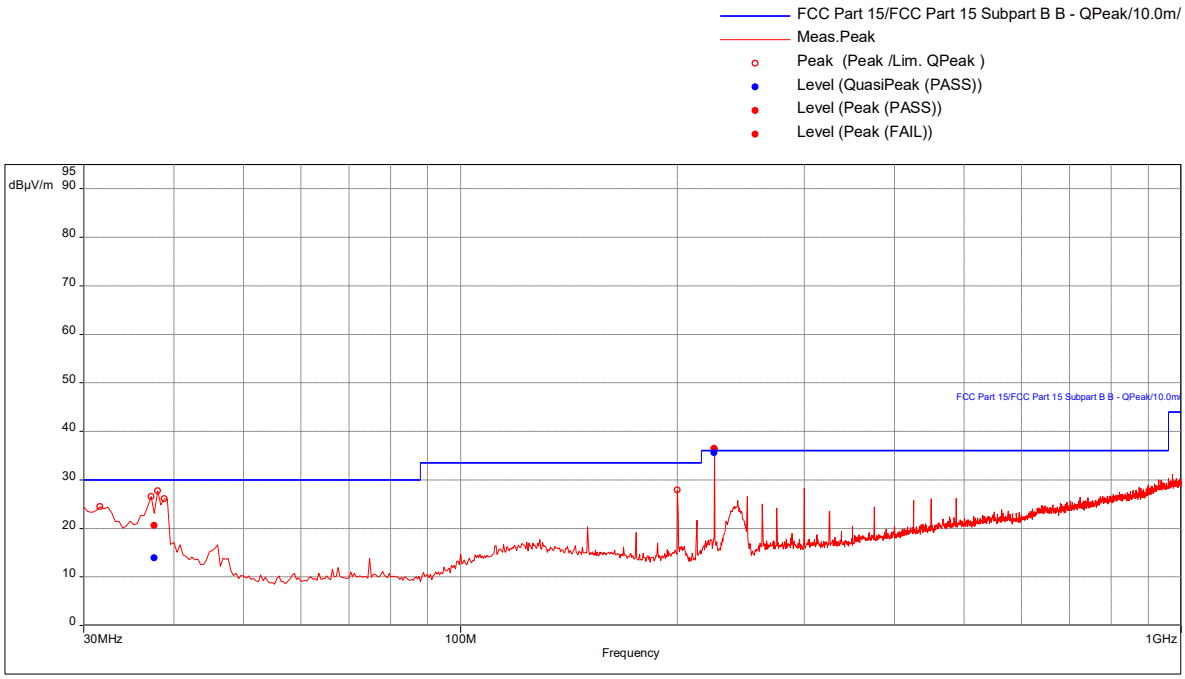
11.5 Plots/Data:

30-1000 MHz, BLE Pistol Angle Wrench

Test Information:

Date and Time	12/13/2020 12:50:55 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_Pistol Driver_BLE_Rx mode

Graph:



Results:

QuasiPeak (PASS) (2)

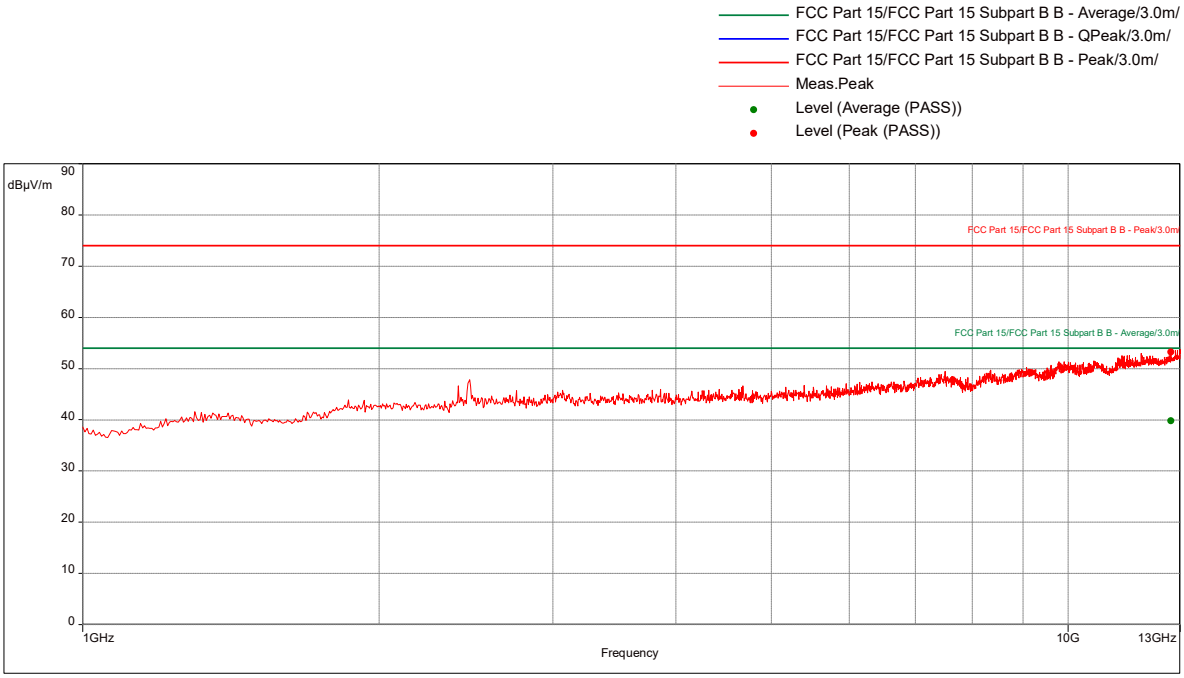
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
37.65263158	13.96	30.00	-16.04	314.00	2.71	Vertical	120000.00	-17.56
224.9789474	35.60	36.00	-0.40	25.00	1.00	Vertical	120000.00	-20.76

1-13 GHz, 30-1000 MHz, BLE Pistol Angle Wrench

Test Information:

Date and Time	12/17/2020 7:23:23 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_Pistol__Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12719.47368	53.26	74.00	-20.74	62.00	2.00	Horizontal	1000000.00	2.01

Average (PASS) (1)

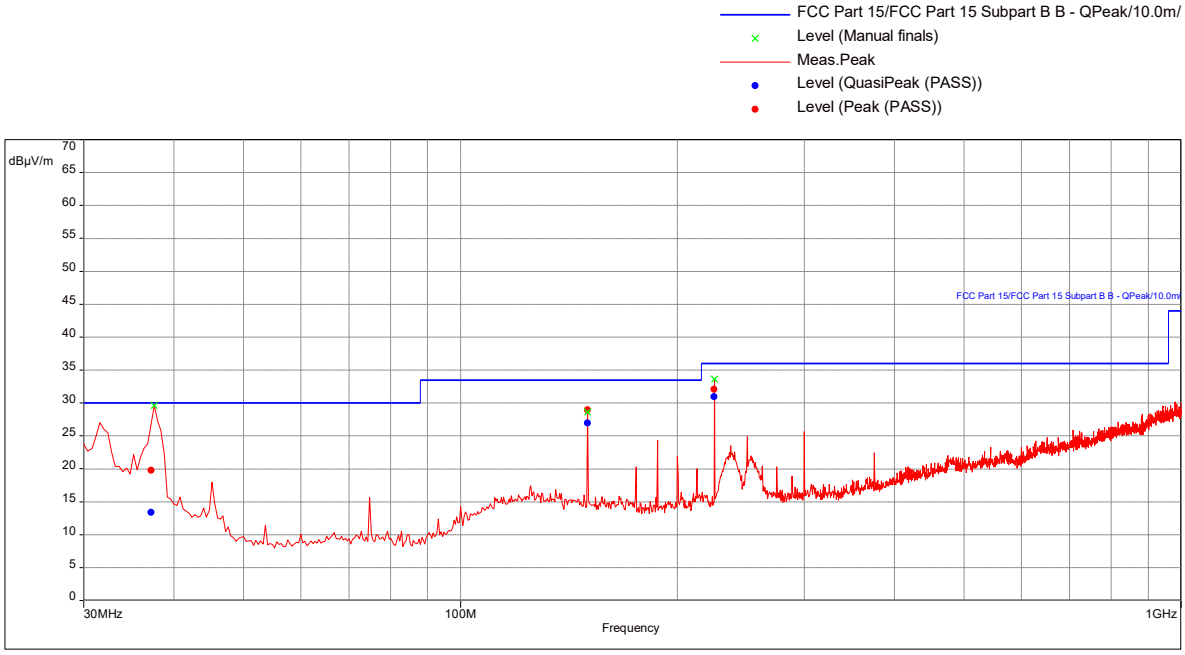
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12719.47368	39.78	54.00	-14.22	62.00	2.00	Horizontal	1000000.00	2.01

30-1000 MHz, BLE Low Torque Wrench

Test Information:

Date and Time	12/17/2020 6:14:41 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 30-1000MHz_Battery power_Low Torque Driver_BLE_Rx mode

Graph:



Results:

QuasiPeak (PASS) (3)

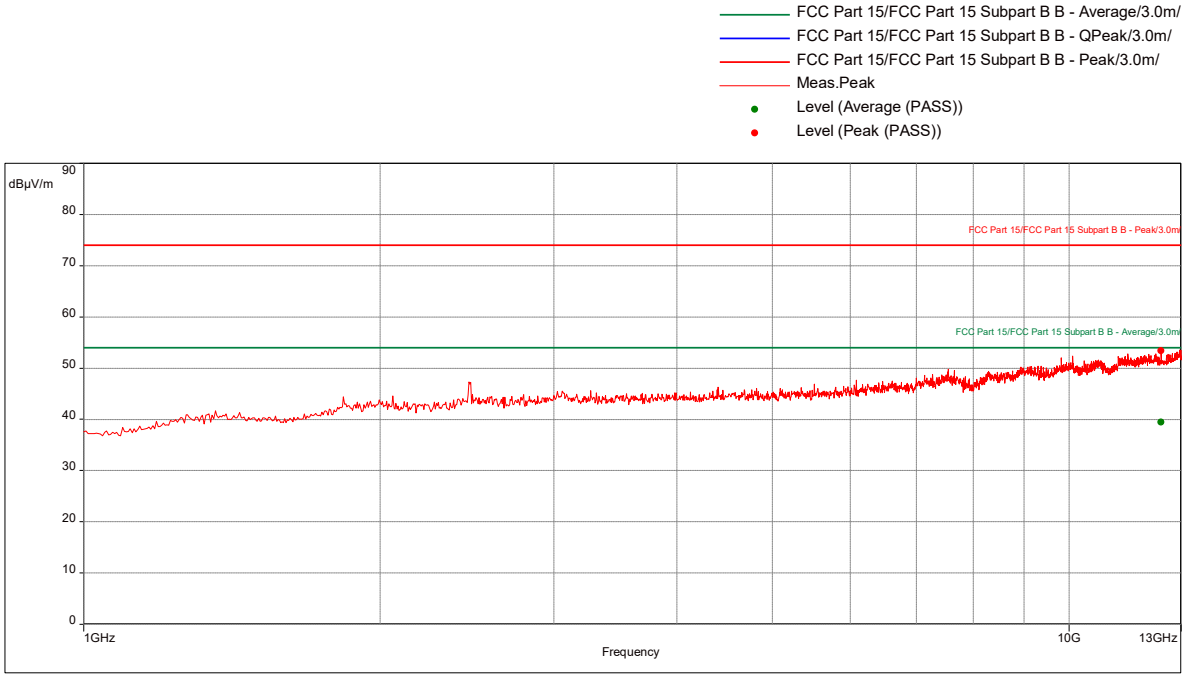
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
37.12631579	13.35	30.00	-16.65	313.00	2.77	Vertical	120000.00	-17.15
150	26.93	33.50	-6.57	24.00	2.32	Vertical	120000.00	-19.61
224.9789474	30.94	36.00	-5.06	62.00	1.52	Vertical	120000.00	-20.76

1-13 GHz, BLE Low Torque Wrench

Test Information:

Date and Time	12/17/2020 6:51:21 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_Low Torque Driver_BLE_Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12406.05263	53.40	74.00	-20.60	18.00	3.89	Horizontal	1000000.00	1.54

Average (PASS) (1)

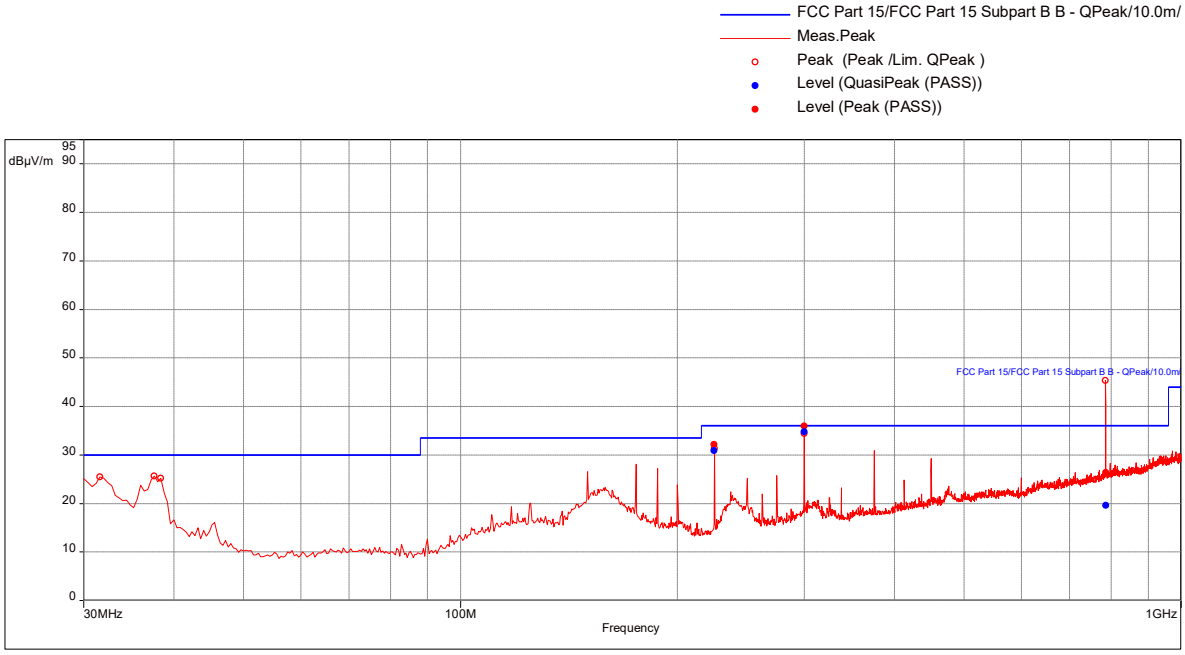
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12406.05263	39.47	54.00	-14.53	18.00	3.89	Horizontal	1000000.00	1.54

30-1000 MHz, BLE High Torque Wrench

Test Information:

Date and Time	12/13/2020 12:11:44 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_High Torque Driver_BLE_Rx mode

Graph:



Results:

QuasiPeak (PASS) (3)

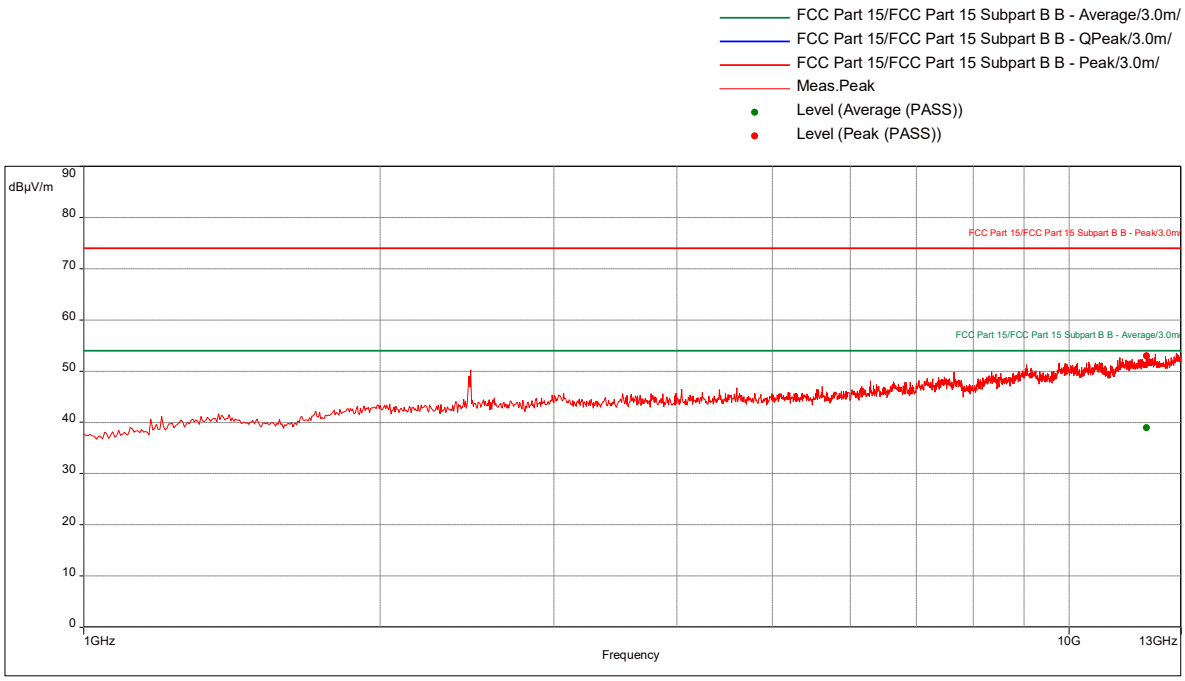
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
224.9789474	30.92	36.00	-5.08	0.00	3.32	Horizontal	120000.00	-20.76
300	34.78	36.00	-1.22	356.00	2.59	Horizontal	120000.00	-17.87
785.9789474	19.60	36.00	-16.40	299.00	3.26	Vertical	120000.00	-7.50

1-13 GHz, BLE High Torque Wrench

Test Information:

Date and Time	12/17/2020 7:10:06 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_High Torque Driver_BLE_Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
11991.31579	52.96	74.00	-21.04	357.00	3.44	Vertical	1000000.00	0.95

Average (PASS) (1)

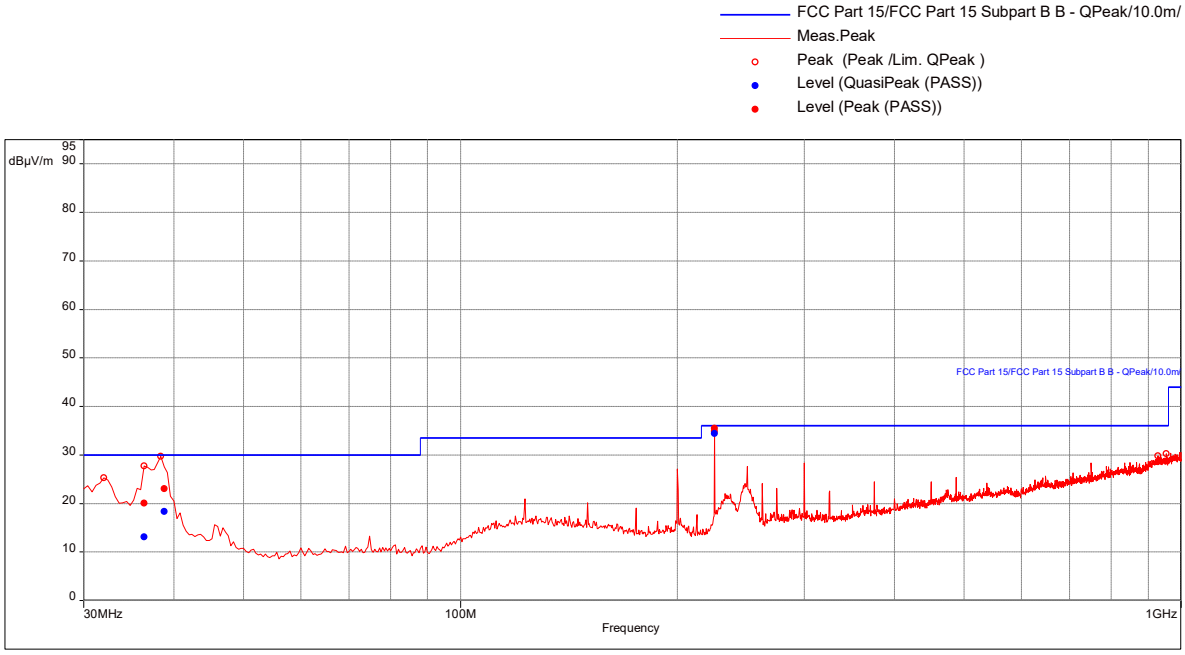
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
11991.31579	38.93	54.00	-15.07	357.00	3.44	Vertical	1000000.00	0.95

30-1000 MHz, Zigbee Pistol Angle Wrench

Test Information:

Date and Time	12/12/2020 1:40:14 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	24%
Atmospheric Pressure	1009 mB
Comments	RE 30-1000MHz_Battery power_Pistol Driver_802.15.4_Rx mode

Graph:



Results:

QuasiPeak (PASS) (3)

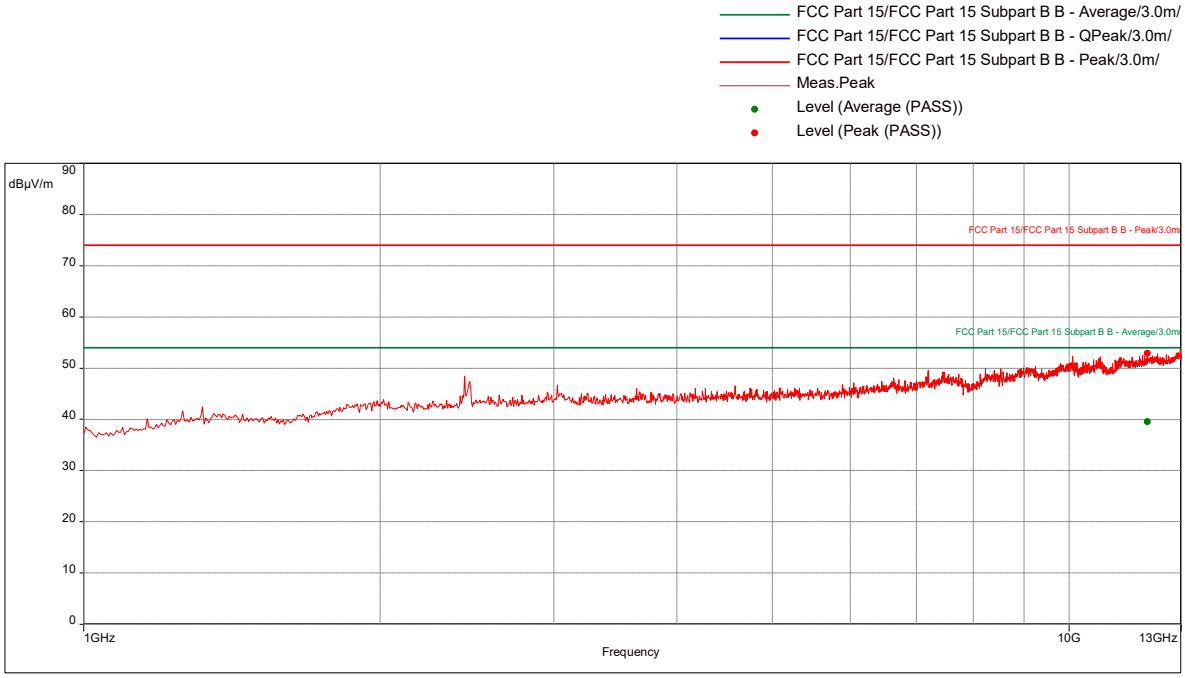
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
36.36842105	13.09	30.00	-16.91	306.00	2.76	Vertical	120000.00	-16.55
38.68421053	18.37	30.00	-11.63	269.00	3.65	Vertical	120000.00	-18.30
225.0105263	34.41	36.00	-1.59	356.00	1.00	Vertical	120000.00	-20.75

1-13 GHz, Zigbee Pistol Angle Wrench

Test Information:

Date and Time	12/17/2020 8:20:56 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_Pistol Driver_802.15.4_Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12016.84211	52.85	74.00	-21.15	54.00	1.25	Vertical	1000000.00	0.99

Average (PASS) (1)

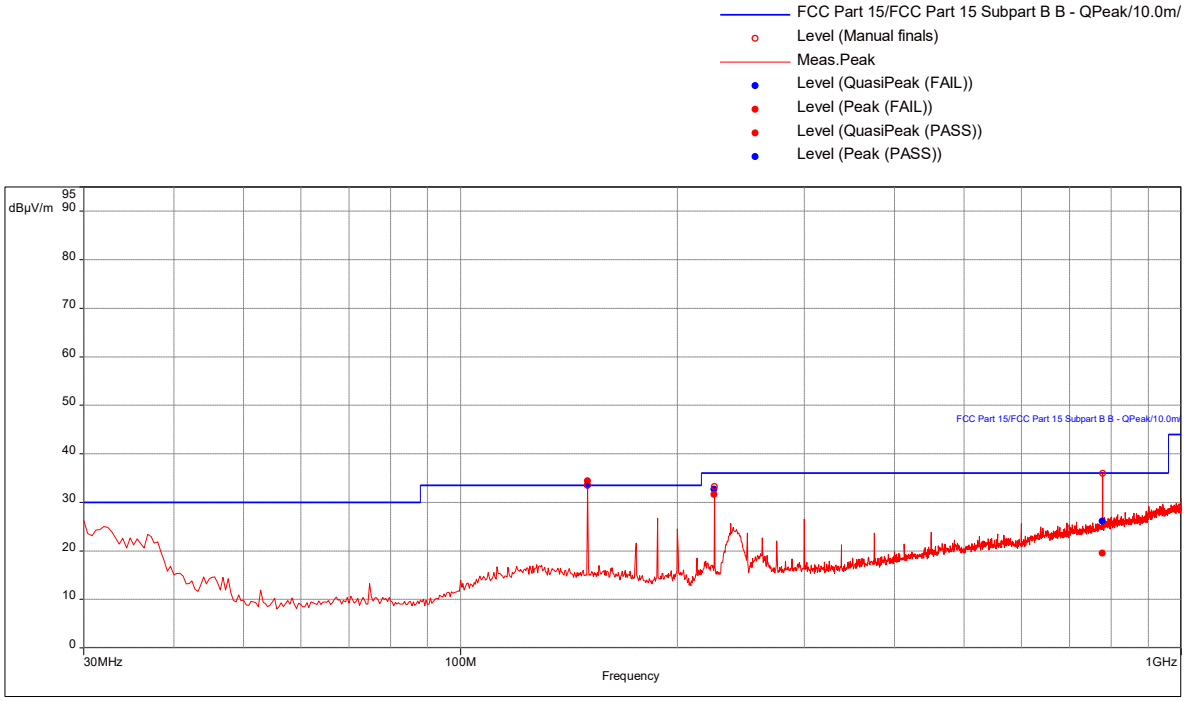
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
12016.84211	39.49	54.00	-14.51	54.00	1.25	Vertical	1000000.00	0.99

30-1000 MHz, Zigbee Low Torque Wrench

Test Information:

Date and Time	12/13/2020 10:06:31 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	27%
Atmospheric Pressure	1003 mB
Comments	RE 30-1000MHz_Battery power_Low Torque Driver_802.15.4_Rx mode

Graph:



Results:

QuasiPeak (PASS) (2)

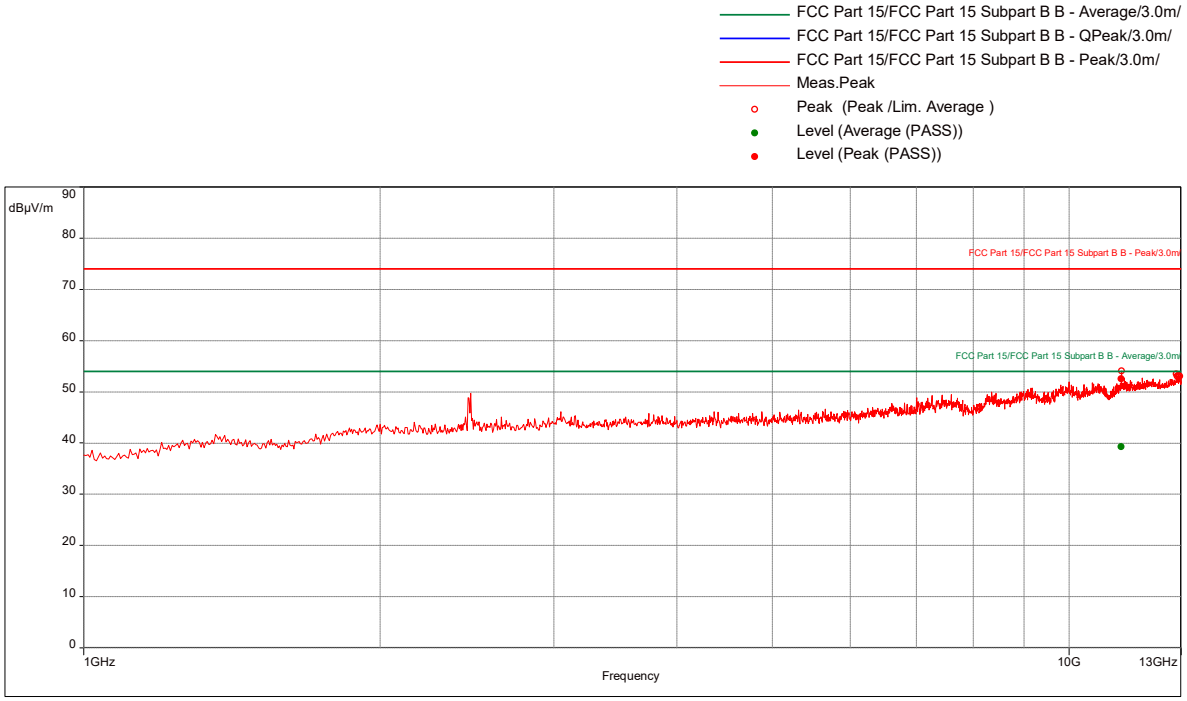
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
224.9789474	31.59	36.00	-4.41	17.00	1.36	Vertical	120000.00	-20.76
777.6842105	19.55	36.00	-16.45	334.00	1.44	Vertical	120000.00	-7.62
150	33.50	33.50	0.00	187.00	1.00	Vertical	120000.00	-19.61

1-13 GHz, Zigbee Low Torque Wrench

Test Information:

Date and Time	12/17/2020 8:05:47 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_Low Torque Driver_802.15.4_Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
11307.36842	52.51	74.00	-21.49	306.00	3.59	Horizontal	1000000.00	-0.21

Average (PASS) (1)

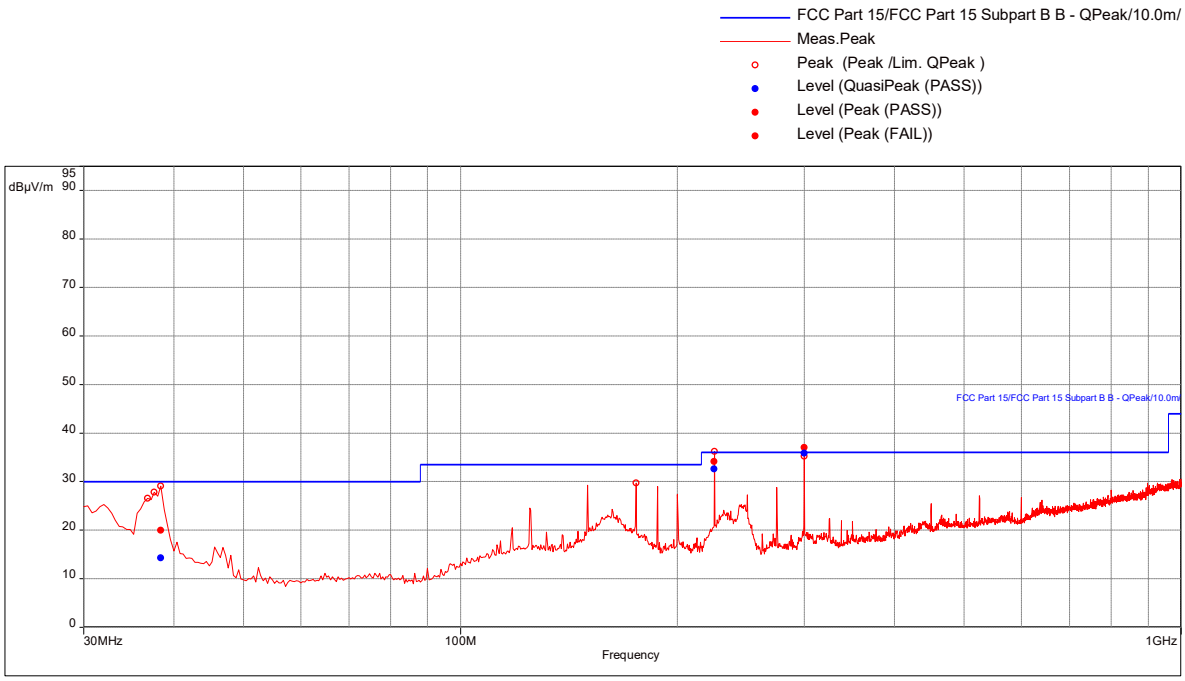
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
11307.36842	39.28	54.00	-14.72	306.00	3.59	Horizontal	1000000.00	-0.21

30-1000 MHz, Zigbee High Torque Wrench

Test Information:

Date and Time	12/12/2020 4:22:30 AM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	24%
Atmospheric Pressure	1009 mB
Comments	RE 30-1000MHz_Battery power_High Torque Driver_802.15.4_Rx mode

Graph:



Results:

QuasiPeak (PASS) (3)

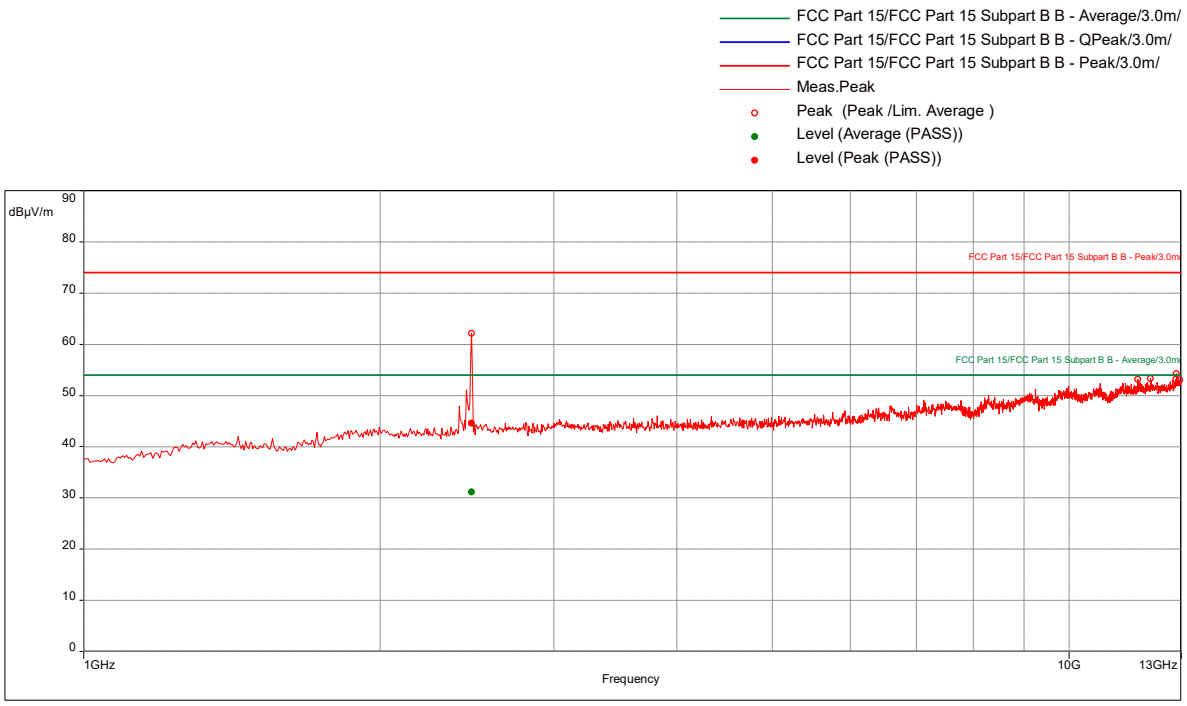
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
38.52631579	14.30	30.00	-15.70	314.00	3.65	Vertical	120000.00	-18.20
224.9789474	32.65	36.00	-3.35	357.00	1.90	Horizontal	120000.00	-20.76
300	35.82	36.00	-0.18	350.00	2.72	Horizontal	120000.00	-17.87

1-13 GHz, Zigbee High Torque Wrench

Test Information:

Date and Time	12/17/2020 7:43:10 PM
Client and Project Number	Ingersoll Rand_G104363035
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	15 %
Atmospheric Pressure	1007 mB
Comments	RE 1 to 13 GHz_Battery power_High Torque Driver_802.15.4_Rx mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2474.473684	44.57	74.00	-29.43	121.00	1.45	Vertical	1000000.00	-14.66

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2474.473684	31.13	54.00	-22.87	121.00	1.45	Vertical	1000000.00	-14.66

Test Personnel:	Vathana F. Ven VFV	Test Date:	12/12/2020 12/13/2020 12/17/2020
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B, ISED ICES-003	Limit Applied:	See report section 11.3
Input Voltage:	Battery power	Ambient Temperature:	24, 24, 24 ºC
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Relative Humidity:	24, 27, 15 %
		Atmospheric Pressure:	1009, 1003, 1007 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	02/17/2021	104363035BOX-003	VFV VFV	KPS KPS	Original Issue