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DATE: 30 January 2020

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Aquatron Robotic Technology Ltd.

Equipment under test:

Power Supply with BT

AQ11091W1

Tested by: _____
M. Zohar

Approved by: _____
D. Shidlowsky

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Measurement/Technical Report for

Aquatron Robotic Technology Ltd.

Power Supply with BT

AQ11091W1

FCC ID: VQBAQ11091W1

This report concerns:	Original Grant: X Class I Change: Class II Change:
Equipment type:	FCC: (DTS) Digital Transmission System
Limits used:	47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 v03r05 and ANSI C63.10:2013

Application for Certification
Prepared by:
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Applicant for this device:
(different from "prepared by")
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1. General Information

1.1 *Administrative Information*

Manufacturer:	Aquatron Robotic Technology Ltd.
Manufacturer's Address:	P.O.Box 1088, Alon Tavor Industrial Zone, Afula Elite, 1811002, Israel Tel: +972-4-6580034. Fax: +972-4-6523520. E-mail: agoodz@aquatron.co.il
Manufacturer's Representative:	Arnold Goodz
Equipment Under Test (E.U.T):	Power Supply with BT
Equipment PMN:	AQ11091W1
Equipment Serial No.:	TBJ20190142
Date of Receipt of E.U.T:	November 13, 2019
Start of Test:	November 14, 2019
End of Test:	December 12, 2019
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod, 7120101, Israel.
Test Specifications:	FCC Part 15, Subpart C, Part 15.247

1.2 *List of Accreditations*

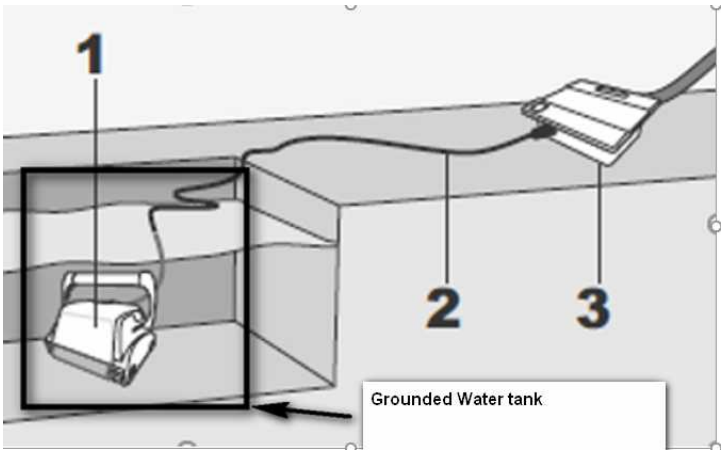
The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 *Product Description*

The E.U.T is AC-DC power supply connected to automatic pool cleaner which is operating while submerged and powering 1 pump motor and 2 drive wheel motors incorporated in the cleaner



Automatic swimming pool cleaner system:
1. Robotic cleaner.
2. Float cable.
3. **Power supply**.

Working voltage(nominal)	115VAC
Mode of operation	Transceiver
Modulations	GFSK
Assigned Frequency Range	2400.0-2483.5MHz
Operating Frequency Range	2402.0-2480.0MHz
Transmit power(conducted)	~ -4.5dBm
Antenna Gain	+5.3 dBi PCB antenna.
Modulation BW	1MHz
Bit rate (Mbit/s)	1, 2, 3

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r05 and ANSI C63.10: 2013, Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 Measurement Uncertainty

Conducted Emission
Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 – 30 MHz:
Expanded Uncertainty (95% Confidence, K=2):
± 3.44 dB

Radiated Emission
Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site:

30-1000MHz:
Expanded Uncertainty (95% Confidence, K=2):
± 4.96 dB

1 GHz to 6 GHz
Expanded Uncertainty (95% Confidence, K=2):
±5.19 dB

>6 GHz
Expanded Uncertainty (95% Confidence, K=2):
±5.51 dB

2. System Test Configuration

2.1 *Justification*

1. The E.U.T contains transceiver : IEEE 802.15.1 standard (BLE)
2. The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz).
3. Conducted emission tests were performed with the E.U.T. antenna terminal connected by a RF cable to the Spectrum Analyzer through a 30dB external attenuator.
4. Final radiated emission test was performed in typical operation installation position.
5. The evaluation was done with dummy load termination for simulation of the robotic swimming pool device (which only works in water).

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

2.4 *Equipment Modifications*

No modifications were necessary in order to achieve compliance.

2.5 *Configuration of Tested System*

Figure 1. Configuration of Tested System Conducted

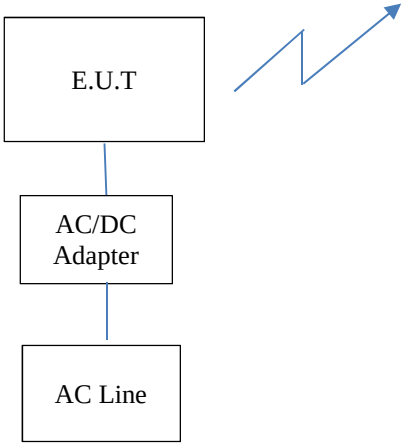


Figure 2. Configuration of Tested System Radiated

3. Conducted & Radiated Measurement Test Set-Up Photos

Figure 3. Conducted Emission from AC Line Test

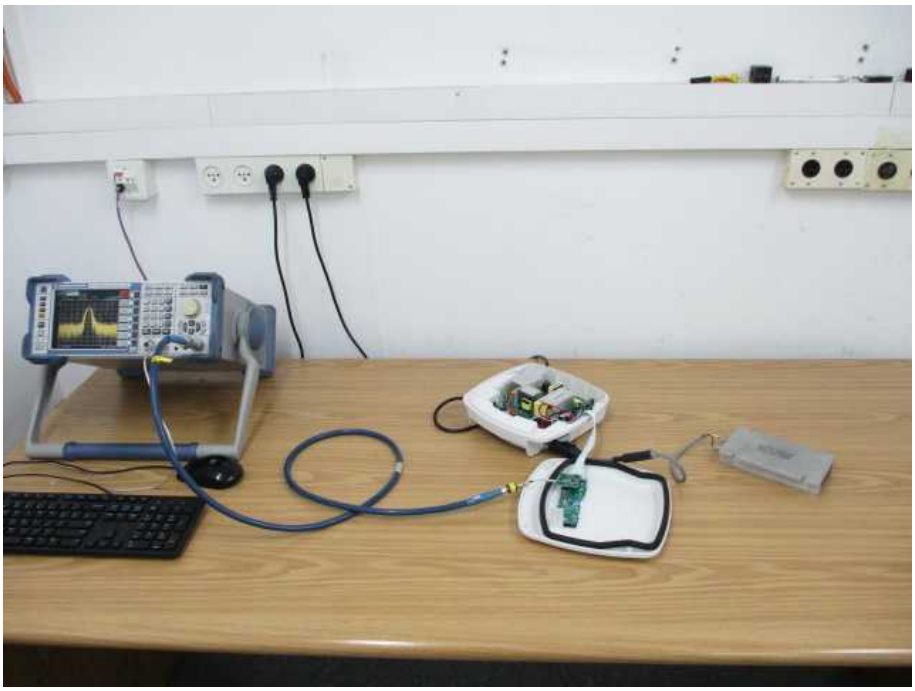


Figure 4. Conducted Emission Test

Figure 5. Radiated Emission Test, 0.009-30MHz

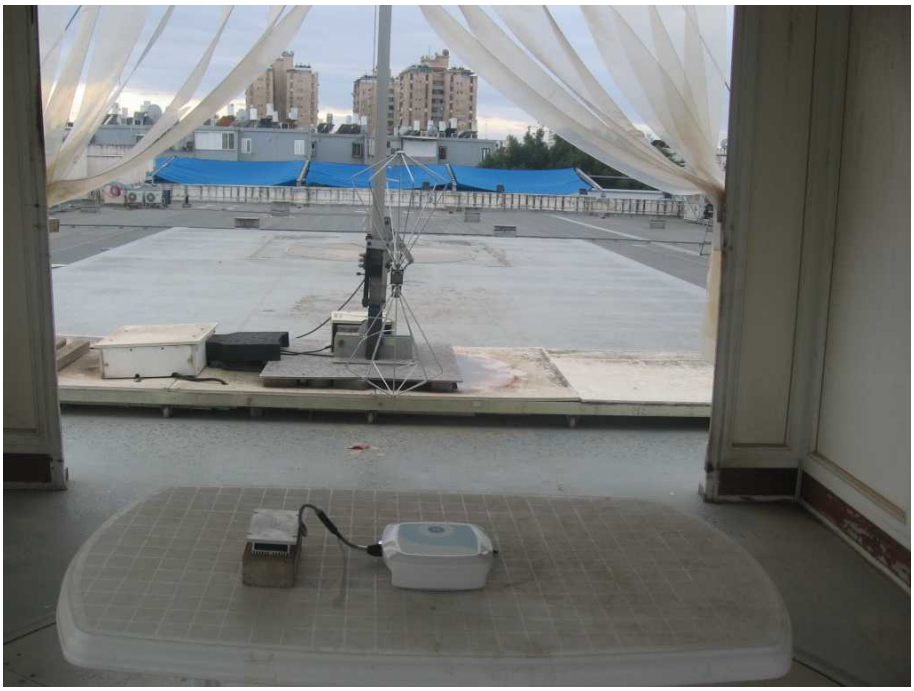


Figure 6. Radiated Emission Test, 30-200MHz

Figure 7. Radiated Emission Test, 200-1000MHz

Figure 8. Radiated Emission Test, 1-18GHz

Figure 9. Radiated Emission Test, 18-26.5GHz

4. Conducted Emission from AC Mains

4.1 *Test Specification*

FCC Part 15, Subpart C, Section 15.207

4.2 *Test Procedure*

(Temperature (21°C)/ Humidity (57%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 µHn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T.

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

4.3 *Test Limit*

Frequency of Emission (MHz)	**Conducted Limit (dBµV)**	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

4.4 *Test Results*

JUDGEMENT: Passed by 4.95 dB

The margin between the emission levels and the specification limit is, in the worst case, -6.82 dB for the phase line at 0.31 MHz and -4.95 dB at 0.31 MHz for the neutral line.

The EUT met the F.C.C. Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 10* to *Figure 13*.

Conducted Emission

E.U.T Description	Power Supply with BT
Type	AQ11091W1
Serial Number:	TBJ20190142

Specification:	FCC Part 15, Subpart C;
Lead:	Phase
Detectors: :	Peak, Quasi-peak, Average
Power Operation	AC line

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	48.47	-17.52
2	Average	206 kHz	35.68	-17.68
2	Average	310 kHz	43.14	-6.82
1	Quasi Peak	314 kHz	49.84	-10.01
2	Average	502 kHz	37.43	-8.56
1	Quasi Peak	506 kHz	45.78	-10.21
1	Quasi Peak	946 kHz	41.57	-14.42
2	Average	946 kHz	31.66	-14.33
1	Quasi Peak	1.366 MHz	38.26	-17.73
2	Average	1.366 MHz	26.14	-19.85
1	Quasi Peak	2.206 MHz	36.94	-19.06
2	Average	2.206 MHz	25.16	-20.83
2	Average	3.89 MHz	22.31	-23.68
1	Quasi Peak	4.73 MHz	34.72	-21.27
2	Average	8.726 MHz	26.37	-23.62
1	Quasi Peak	8.93 MHz	38.92	-21.07
1	Quasi Peak	14.21 MHz	30.17	-29.82
2	Average	17.57 MHz	25.02	-24.97
2	Average	20.806 MHz	33.42	-16.57
1	Quasi Peak	21.006 MHz	41.68	-18.32

Date: 5.DEC.2019 11:19:21

Figure 10. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description	Power Supply with BT
Type	AQ11091W1
Serial Number:	TBJ20190142

Specification:	FCC Part 15, Subpart C;
Lead:	Phase
Detectors:	Peak, Quasi-peak, Average
Power Operation	AC line

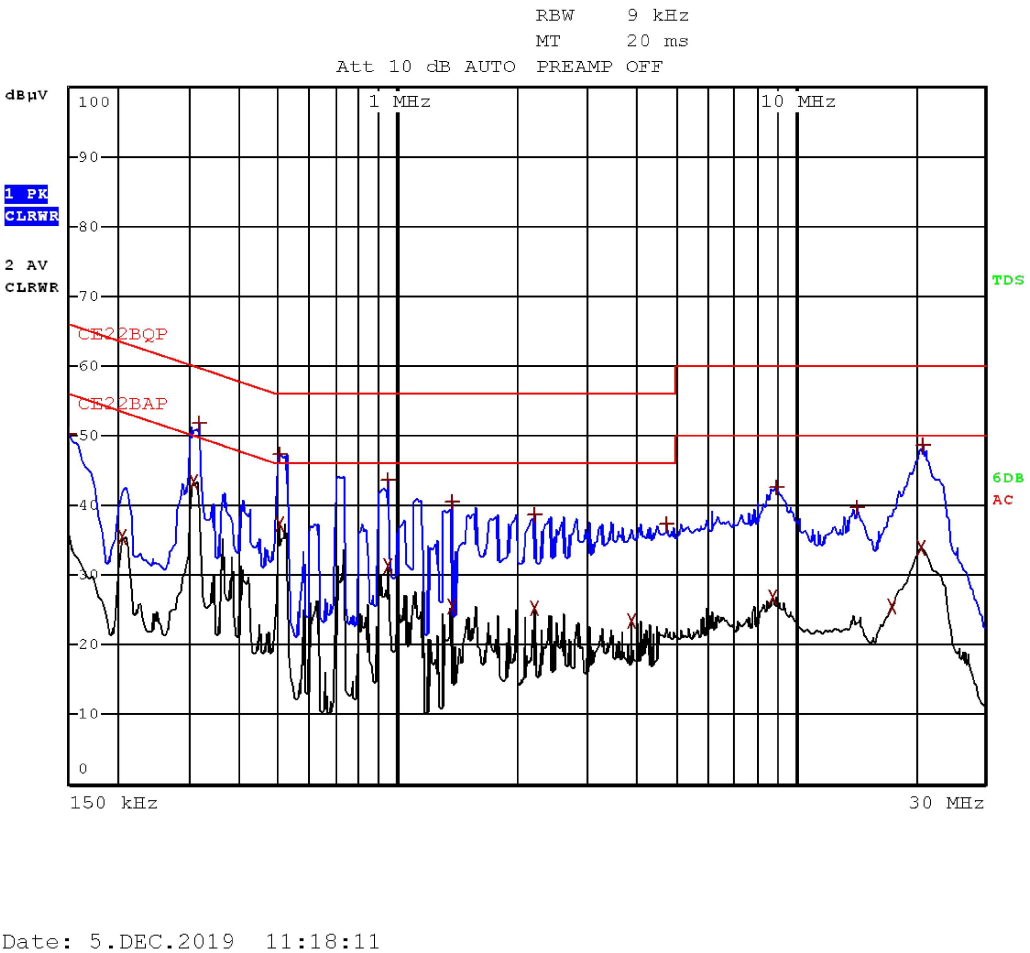


Figure 11. Detectors: Peak, Quasi-peak, Average

Conducted Emission

E.U.T Description	Power Supply with BT
Type	AQ11091W1
Serial Number:	TBJ20190142

Specification:	FCC Part 15, Subpart C;
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average
Power Operation	AC line

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	48.45	-17.54
2	Average	206 kHz	34.31	-19.04
1	Quasi Peak	314 kHz	51.22	-8.63
2	Average	314 kHz	44.90	-4.95
1	Quasi Peak	510 kHz	40.78	-15.21
2	Average	526 kHz	32.53	-13.46
1	Quasi Peak	946 kHz	39.97	-16.02
2	Average	946 kHz	30.49	-15.50
1	Quasi Peak	1.37 MHz	39.43	-16.56
2	Average	1.578 MHz	27.27	-18.72
2	Average	2.21 MHz	26.52	-19.47
1	Quasi Peak	2.214 MHz	40.00	-15.99
1	Quasi Peak	3.666 MHz	36.28	-19.71
2	Average	4.106 MHz	25.27	-20.72
2	Average	8.85 MHz	25.79	-24.20
1	Quasi Peak	9.05 MHz	38.85	-21.15
1	Quasi Peak	17.498 MHz	36.80	-23.19
2	Average	17.602 MHz	24.32	-25.67
2	Average	23.094 MHz	36.56	-13.44
1	Quasi Peak	23.226 MHz	43.99	-16.00

Date: 5.DEC.2019 11:27:13

Figure 12. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description	Power Supply with BT
Type	AQ11091W1
Serial Number:	TBJ20190142

Specification:	FCC Part 15, Subpart C; RSS Gen, Issue 5, Clause 8.8
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average
Power Operation	AC line

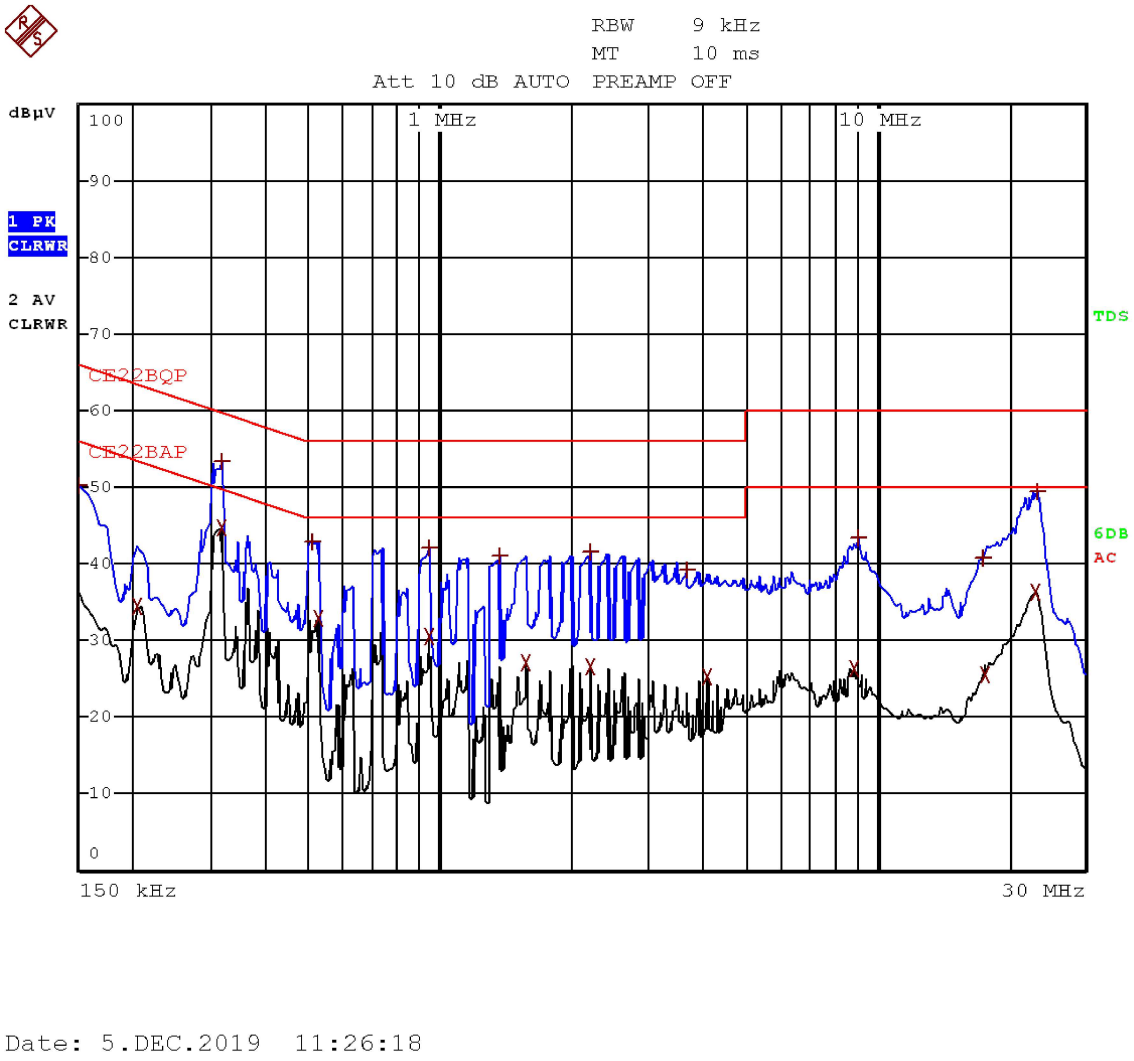


Figure 13 Detectors: Peak, Quasi-peak, Average

4.5 *Test Equipment Used; Conducted Emission*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
LISN	Fischer	FCC-LISN-25A	127	08/09/2019	30/09/2020
Transient Limiter	HP	11947A	3107A01308	16/09/2019	30/09/2020
EMI Receiver	Rohde & Schwarz	ESCI7	100724	27/02/2019	29/02/2020
Cable CE Chamber 3M + 3M	Testline 18 + RJ214	11556	--	31/03/2019	31/03/2020

Figure 14 Test Equipment Used

5. 6 dB Minimum Bandwidth

5.1 *Test Specification*

FCC Part 15, Subpart C, Section 247(a) (2),

5.2 *Test Procedure*

(Temperature (20°C)/ Humidity (61%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss=31.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.
The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

5.3 *Test Limit*

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.

5.4 *Test Results*

Protocol Type	Operation Frequency	Reading	Limit
	(MHz)	(kHz)	(kHz)
BLE	2402.0	709.0	>500.0
	2440.0	709.0	>500.0
	2480.0	709.0	>500.0

Figure 15 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see Figure 16to Figure 18

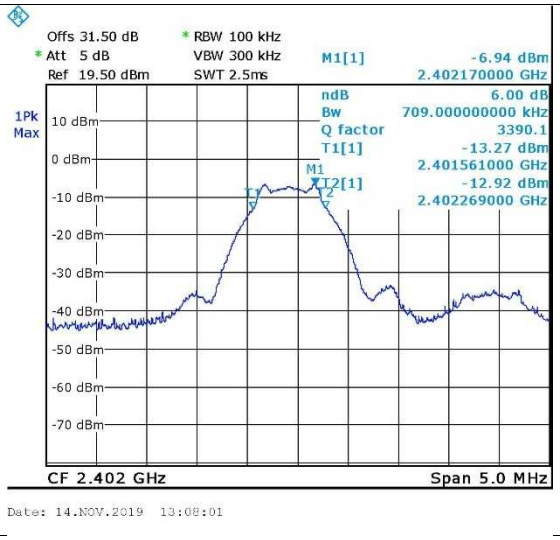


Figure 16. 2402.0 MHz, BLE

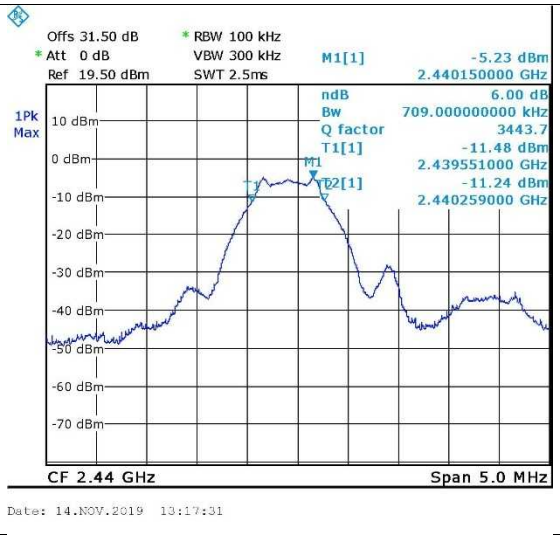


Figure 17. 2440.0 MHz, BLE

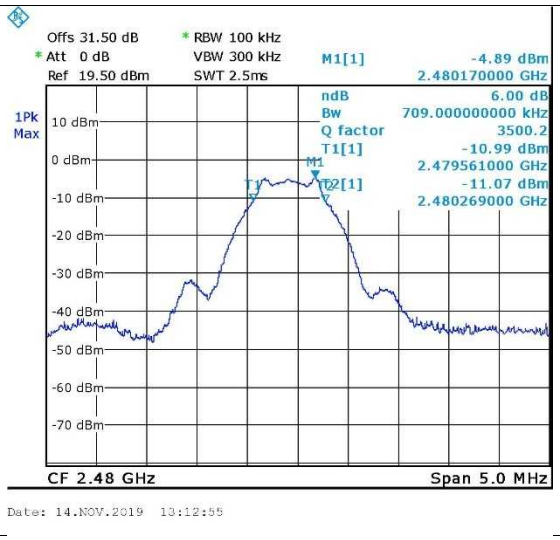


Figure 18. 2480.0 MHz, BLE

5.5 *Test Equipment Used; 6dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	24/03/2019	31/03/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM		705A009301 EIM	24/12/2018	31/12/2019

Figure 19 Test Equipment Used

6. Maximum Conducted Output Power

6.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(b)(3)

6.2 *Test Procedure*

(Temperature (20°C)/ Humidity (61%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss=31.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

6.3 *Test Limit*

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

6.4 *Test Results*

Protocol Type	Operation Frequency (MHz)	Power (dBm)	Power (mW)	Limit (mW)	Margin (mW)
BLE	2402.0	-6.0	0.3	1000.0	-999.7
	2440.0	-4.6	0.3	1000.0	-999.7
	2480.0	-4.4	0.4	1000.0	-999.6

Figure 20 Maximum Peak Power Output

JUDGEMENT: Passed by -999.6 mW

For additional information see Figure 21 to Figure 23.

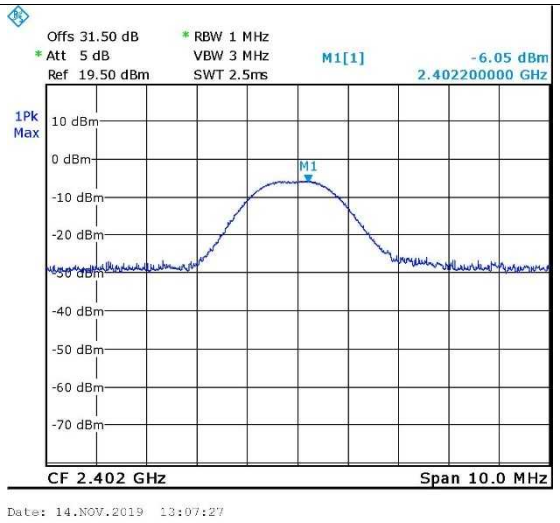


Figure 21. 2402.0 MHz, BLE

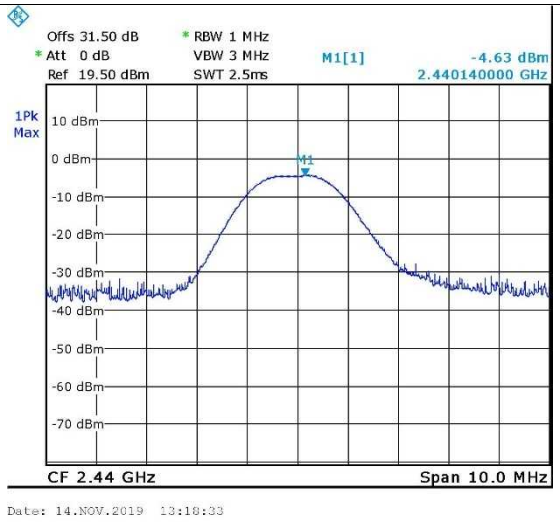


Figure 22. 2440.0 MHz, BLE

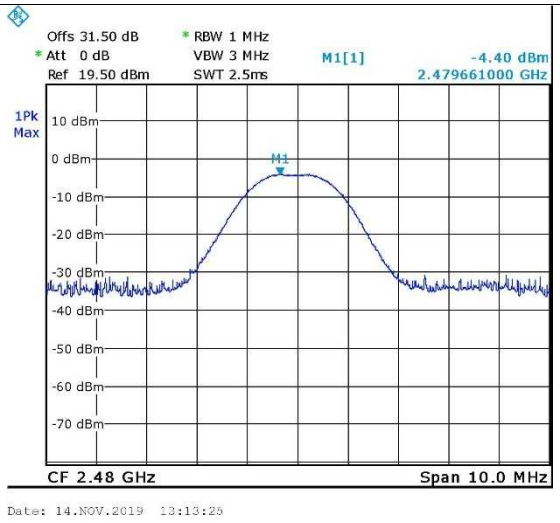


Figure 23. 2480.0 MHz, BLE

6.5 *Test Equipment Used; Maximum Peak Power Output*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	24/03/2019	31/03/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM	--	705A009301 EIM	24/12/2018	31/12/2019

Figure 24 Test Equipment Used

7. Band Edge Spectrum

7.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(d)

7.2 *Test Procedure*

(Temperature (20°C)/ Humidity (61%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=31.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW was set to 100 kHz.

7.3 *Test Limit*

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.

7.4 *Test Results*

Protocol Type	Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBm)	Limit (dBm)	Margin (dB)
BLE	2402.0	2400.0	-48.2	-27.5	-20.7
	2480.0	2483.5	-46.1	-25.0	-21.1

Figure 25 Band Edge Spectrum

JUDGEMENT: Passed by -20.7 dB

For additional information see Figure 26 and Figure 27.

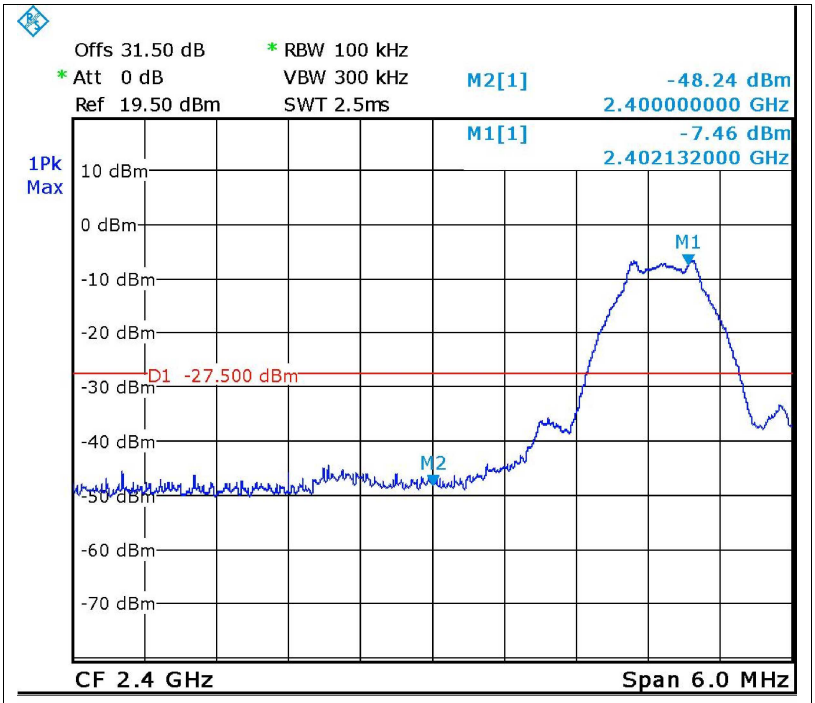


Figure 26. 2402.0 MHz, BLE

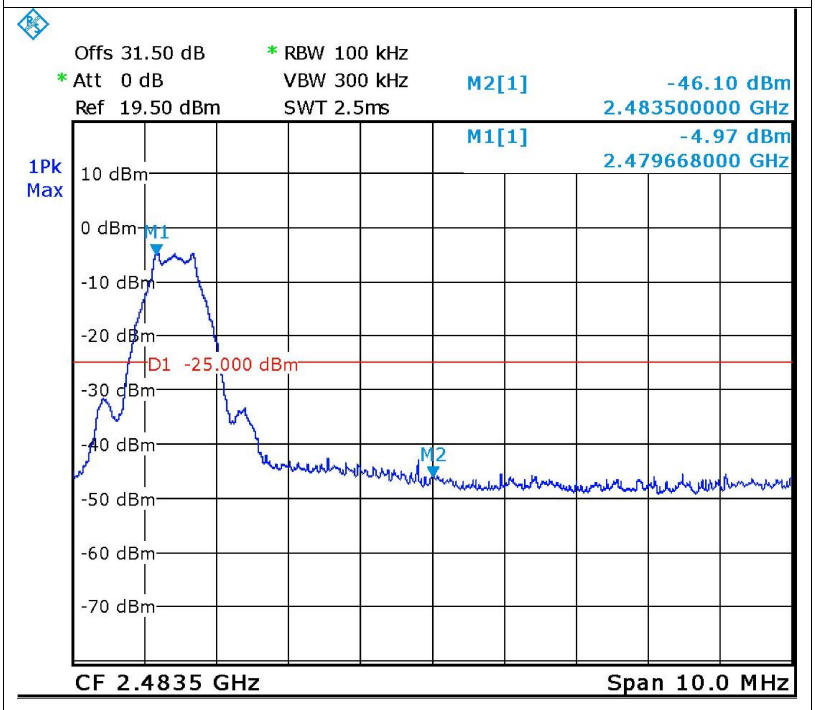


Figure 27. 2480.0 MHz, BLE

7.5 *Test Equipment Used; Band Edge*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	24/03/2019	31/03/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM	--	705A009301 EIM	24/12/2018	31/12/2019

Figure 28 Test Equipment Used

8. Transmitted Power Density

8.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(e)

8.2 *Test Procedure*

(Temperature (20°C)/ Humidity (61%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.5dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum analyzer was set to 3 kHz RBW.

8.3 *Test Limit*

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 *Test Results*

Protocol Type	Operation Frequency	PSD Reading	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
BLE	2402.0	-18.6	8.0	-26.6
	2440.0	-17.4	8.0	-25.4
	2480.0	-17.0	8.0	-25.0

Figure 29 Test Results

JUDGEMENT: Passed by 25 dB

For additional information see Figure 30 to Figure 32

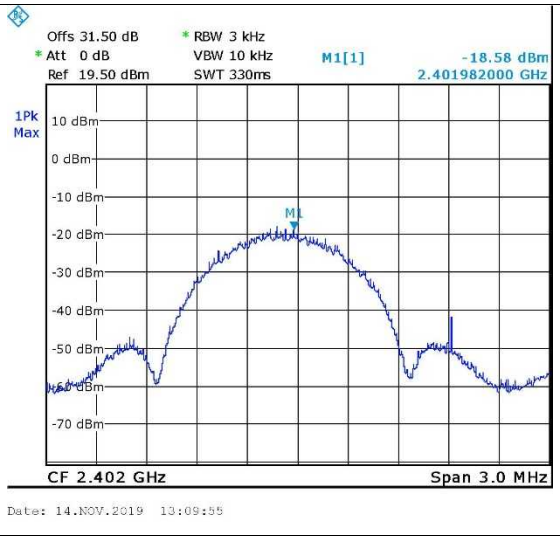


Figure 30. 2402.0 MHz, BLE

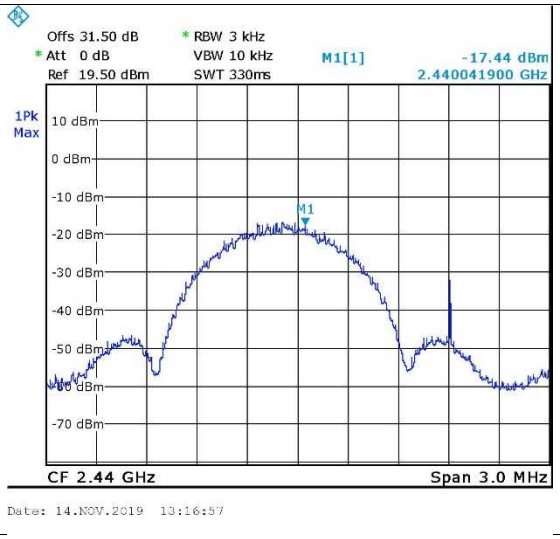


Figure 31. 2440.0 MHz, BLE

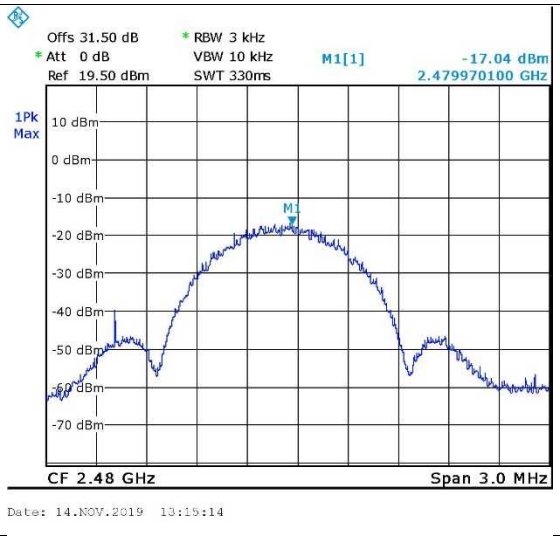


Figure 32. 2480.0 MHz, BLE

8.5 *Test Equipment Used; Transmitted Power Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	24/03/2019	31/03/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM	--	705A009301 EIM	24/12/2018	31/12/2019

Figure 33 Test Equipment Used

9. Occupied Bandwidth

9.1 *Test Specification*

FCC, Part 2, Sub part J, Section 2.1049

9.2 *Test Procedure*

(Temperature (20°C)/ Humidity (60%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report.
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.5dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW set to the range of 1% to 5% of the OBW. The span was set to ~ 3 times the OBW.
99% occupied bandwidth function was set on.

9.3 *Test Limit*

N/A

9.4 *Test Results*

Protocol Type	Operation Frequency (MHz)	Reading (MHz)
BLE	2402.0	1.06
	2440.0	1.05
	2480.0	1.06

Figure 34. Bandwidth Test Results

JUDGEMENT: Passed

See additional information in Figure 35 to Figure 37.

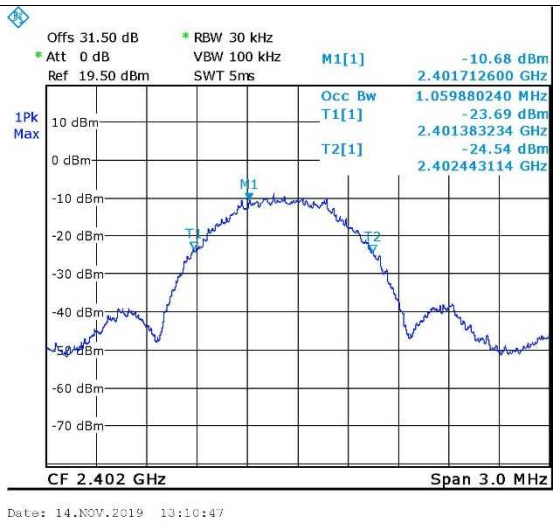


Figure 35. 2402.0 MHz, BLE

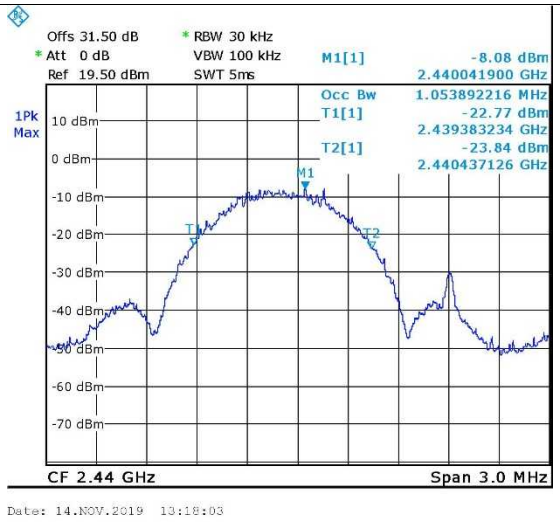


Figure 36. 2440.0 MHz, BLE

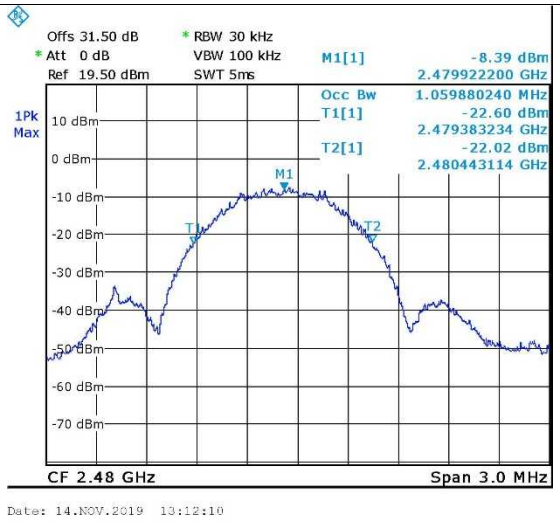


Figure 37. 2480.0 MHz, BLE

9.5 *Test Equipment Used; Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	24/03/2019	31/03/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM	--	705A009301 EIM	24/12/2018	31/12/2019

Figure 38 Test Equipment Used

10. Emissions in Non-Restricted Frequency Bands

10.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(d)

10.2 *Test Procedure*

(Temperature (20°C)/ Humidity (60%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report.
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (max total loss=34.0 dB).
Special attention was taken to prevent Spectrum Analyzer RF input overload.
RBW was set to 100 kHz, detector set to max peak and trace to "max hold".

10.3 *Test Limit*

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.

10.4 *Test Results*

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247(d) specification.

For additional information see Figure 39 to Figure 41.

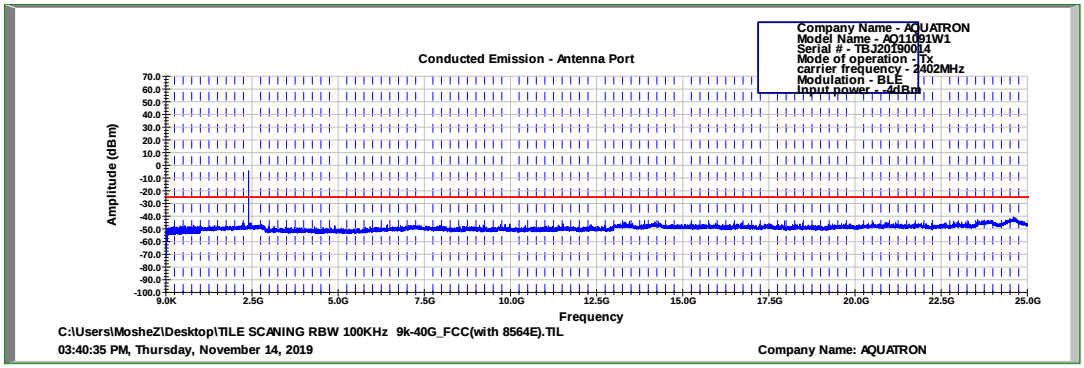


Figure 39 2402.0 MHz, BLE

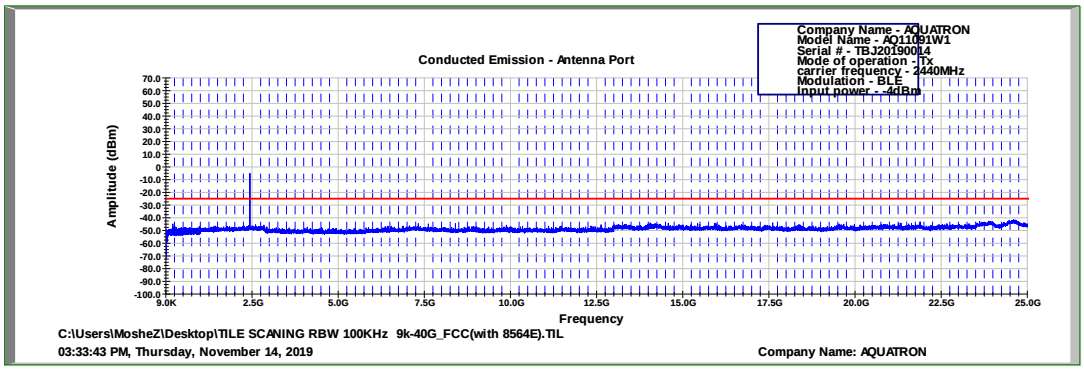


Figure 40 2440.0 MHz, BLE

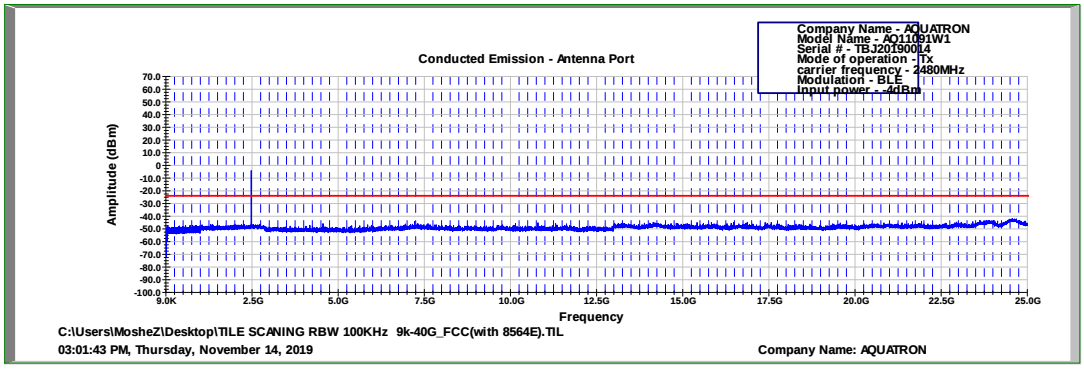


Figure 41 2480.0 MHz, BLE

Note: All peaks in plots are the fundamental transmission frequency.

10.1 *Test Instrumentation Used, Emission in Non Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	01/09/2019	30/09/2020
30dB Attenuator	MCL	BW-S30W5	533	24/12/2018	31/12/2019
RF Cable	EIM	--	705A009301 EIM	24/12/2018	31/12/2019

Figure 42 Test Equipment Used

11. Emissions in Restricted Frequency Bands

11.1 *Test Specification*

FCC Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

11.2 *Test Procedure*

(Temperature (20°C)/ Humidity (42%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30-1000MHz:
A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30MHz -1000MHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The frequency range 1GHz -25GHz was scanned.

Tests done for all “worst case”, each protocol type. The highest radiation describes in the tables below

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

11.3 *FCC Test Limit*

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

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)	Field Strength* (dBµV/m)	Field Strength* (dBµV/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

Figure 43 Table of Limits

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

11.4 *Test Results*

JUDGEMENT: Passed by -1.5 dB

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case -2.0 dB at the frequency of 2390.0 MHz, vertical polarization.

For the operation frequency of 2440 MHz, the margin between the emission level and the specification limit is in the worst case -31.7 dB at the frequency of 4880.0 MHz, vertical polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case -1.5 dB at the frequency of 2483.5 MHz, Horizontal polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C Sections 15.209, 15.205, 15.247(d) specifications.

The details of the highest emissions are given in *Figure 44*

Radiated Emission

E.U.T Description Power Supply with BT
Type AQ11091W1
Serial Number: TBJ20190142

Specifications: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9kHz to 25.0 GHz
Protocol Type: BLE Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
2402.0	2390.0	V	64.5	74.0	-9.5	52.0	54.0	-2.0
	2390.0	H	60.8	74.0	-13.2	50.9	54.0	-3.1
	4804.0	V	39.3	74.0	-34.7	-	54.0	-
	4804.0	H	41.0	74.0	-33.0	-	54.0	-
2440.0	4880.0	V	42.3	74.0	-31.7	-	54.0	-
	4880.0	H	41.1	74.0	-32.9	-	54.0	-
2480.0	4960.0	V	43.2	74.0	-30.8	-	54.0	-
	4960.0	H	43.1	74.0	-30.9	-	54.0	-
	2483.5	V	57.3	74.0	-16.7	50.4	54.0	-3.6
	2483.5	H	65.2	74.0	-8.8	52.5	54.0	-1.5

Figure 44. Radiated Emission Results

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Peak Amp" includes correction factor.

* "Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

11.5 *Test Instrumentation Used; Emissions in Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	27/02/2019	29/02/2020
EMI Receiver	HP	8542E	3906A00276	28/02/2019	29/02/2020
RF Filter Section	HP	85420E	3705A00248	28/02/2019	29/02/2020
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	26/02/2019	29/02/2020
Active Loop Antenna	EMCO	6502	9506-2950	05/02/2019	29/02/2020
Biconical Antenna	EMCO	3110B	9912-3337	21/05/2019	31/05/2020
Log Periodic Antenna	EMCO	3146	9505-4081	31/05/2018	31/05/2020
Horn Antenna	ETS	3115	29845	31/05/2018	31/05/2021
Horn Antenna	ARA	SWH-28	1007	31/12/2017	31/12/2020
MicroWave System Amplifier	HP	83006A	3104A00589	24/12/2018	31/12/2019
Low Noise Amplifier 1GHz-18GHz	Miteq	AFSX4-02001800-50-8P	-	24/12/2018	31/12/2019
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132	24/12/2018	31/12/2019
RF Cable Oats	EIM	RG214-11N(X2)		26/05/2019	31/05/2020
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	24/12/2018	31/12/2019
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9908-1456	NCR	NCR

Figure 45 Test Equipment Used

12. Antenna Gain/Information

The antenna gain is +5.3 dBi, type: PCB antenna

13. R.F Exposure/Safety

1. Calculation of Maximum Permissible Exposure (MPE) Based on 47CFR1 Section 1.1307(b)(1) Requirements

2. The typical distance between the E.U.T. and the user is at least 20cm.

3. FCC Limit at 2400 MHz is: $1\frac{mW}{cm^2}$

4. Using Table 1 of 47CFR1 Section 1.1310 limit for general population/uncontrolled exposures, the above levels are an average over 30 minutes.

5. The power density produced by the E.U.T. is:

   $$S = \frac{P_t G_t}{4®R^2}$$

   P_t = Conducted Transmitted Power -4.4 dBm = 0.4 mW

   G_t = Antenna Gain +5.3dBi = 3.4 numeric

   R = Distance From Transmitter 20 cm

6. The peak power density produced by the E.U.T. is:

   $S = 0.4*3.4/4\pi(20)^2 = 1.36/5026.55 = 0.00027$ mW/cm^2

7. This is below the FCC limit.

14. APPENDIX A - CORRECTION FACTORS

14.1 *Correction factors for RF OATS Cable 35m ITL #1911*

Frequency (MHz)	Cable loss (dB)
1.00	0.5
10.00	1
20.00	1.34
30.00	1.5
50.00	1.83
100.00	2.67
150.00	3.17
200.00	3.83
250.00	4.17
300.00	4.5
350.00	5.17
400.00	5.5
450.00	5.83
500.00	6.33
550.00	6.67
600.00	6.83
650.00	7.17
700.00	7.66
750.00	7.83
800.00	8.16
850.00	8.5
900.00	8.83
950.00	8.84
1000.00	9

14.2 *Correction factor for RF cable for Anechoic Chamber ITL #1841*

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

14.3 *Correction factors for Active Loop Antenna ITL # 1075:*

f(MHz)	MAF(dBs/m)	AF(dB/m)
0.01	-33.1	18.4
0.02	-37.2	14.3
0.03	-38.2	13.3
0.05	-39.8	11.7
0.1	-40.1	11.4
0.2	-40.3	11.2
0.3	-40.3	11.2
0.5	-40.3	11.2
0.7	-40.3	11.2
1	-40.1	11.4
2	-40	11.5
3	-40	11.5
4	-40.1	11.4
5	-40.2	11.3
6	-40.4	11.1
7	-40.4	11.1
8	-40.4	11.1
9	-40.5	11
10	-40.5	11
20	-41.5	10
30	-43.5	8

14.4 *Correction factors for biconical antenna ITL #1356*

Frequency [MHz]	AF [dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17

14.5 *Correction factors for log periodic antenna ITL # 1349*

Frequency [MHz]	AF [dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22

14.6 *Correction factors for Double –Ridged Waveguide Horn ANTENNA ITL # 1352*

FREQUENCY (GHz)	AFE (dB/m)	FREQUENCY (GHz)	AFE (dB/m)
0.75	25	9.5	38
1.0	23.5	10.0	38.5
1.5	26.0	10.5	38.5
2.0	29.0	11.0	38.5
2.5	27.5	11.5	38.5
3.0	30.0	12.0	38.0
3.5	31.5	12.5	38.5
4.0	32.5	13.0	40.0
4.5	32.5	13.5	41.0
5.0	33.0	14.0	40.0
5.5	35.0	14.5	39.0
6.0	36.5	15.0	38.0
6.5	36.5	15.5	37.5
7.0	37.5	16.0	37.5
7.5	37.5	16.5	39.0
8.0	37.5	17.0	40.0
8.5	38.0	17.5	42.0
9.0	37.5	18.0	42.5

14.7 *Correction factors for Horn Antenna Model: SWH-28*

CALIBRATION DATA

3 m distance

Frequency, MHz	Measured antenna factor, dB/m [1]
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

[1] The antenna factor shall be added to receiver reading in dBµV to obtain field strength in dBµV/m.