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Geospace Technologies Corporation RF EXPOSURE REPORT

SCOPE OF WORK

RF EXPOSURE CALCULATION
ON THE AQUALINK

REPORT NUMBER

106145616LEX-004

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RF EXPOSURE TEST REPORT

Report Number: 106145616LEX-004

Project Number: G106145616

Report Issue Date: 7/16/2025

Product Name: Aqualink

Product Model: Aqualink

Standards: FCC Title 47 CFR Part 1.1310(e)(1) Limits for
Maximum Permissible Exposure (MPE)

RSS-102 Issue 6 RF Field Strength Limits for
Devices Used by the General Public

Tested by:
Intertek Testing Services NA, Inc.
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USA

Client:
Geospace Technologies Corporation
7007 Pinemont Dr
Houston, TX 77040-6601
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Table of Contents

1	<i>Introduction and Conclusion.....</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models.....</i>	6
5	<i>Output Power.....</i>	7
6	<i>Antenna Gain</i>	8
7	<i>RSS-102 Issue 6 RF Exposure Limits.....</i>	10
9	<i>Test Procedure</i>	11
10	<i>Results:.....</i>	12
11	<i>Revision History.....</i>	15



1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 4. 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
10	FCC Title 47 CFR Part 1.1310(e)(1) Limits for Maximum Permissible Exposure (MPE) (Limits for General Population / Uncontrolled Exposure)	Pass
	RSS-102 Issue 6 RF Field Strength Limits (For Devices Used by the General Public)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Geospace Technologies Corporation
Address:	7007 Pinemont Dr Houston, TX 77040-6601 USA
Contact:	Mark McAllister
Telephone:	2816301341
Email:	mmcallister@geospace.com
Manufacturer Information	
Manufacturer Name:	Geospace Technologies Corporation
Manufacturer Address:	7007 Pinemont Dr Houston, TX 77040-6601 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Aqualink
Model Number	Aqualink
Hardware Version	N/A
Software Version	N/A
Embedded Module(s)	BLE: Texas Instruments, CC2652R7 LoRa: Murata, 1SJ
FCC ID	BLE: N/A LoRa: VPYLBAA0QB1SJ
Supported Transmit Bands	BLE: 2402MHz – 2480MHz LoRa: 902.3MHz – 914.9MHz
Antenna Gain ¹	BLE: -0.48dBi LoRa: -1.11dBi
Maximum Output Power	BLE: 1.74dBm LoRa: 20.44dBm ¹
Ratings	3.6VDC
Description of Equipment Under Test (provided by client)	
The Geospace Technologies Corporation Aqualink is a LoRa endpoint.	

4.1 Variant Models:

There were no variant models covered by this evaluation.

¹ Values were provided by the client and may affect compliance. Intertek does not make any claims of compliance for values other than those shown.



5 Output Power

5.1 BLE Radio

Output power was taken from Intertek Report 106145616LEX-001, Intertek makes no claims of compliance for values other than those shown below.

7.7 Test Data:

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (W)	Output Power Limit (W)	EIRP Limit (W)
2402	1.74	0.001	-0.48	1.26	0.001	1	4
2440	1.27	0.001	-0.48	0.79	0.001	1	4
2480	0.87	0.001	-0.48	0.39	0.001	1	4

5.2 LoRa Radio

Output power was taken from FCC Report 2430061R-RF-US-P06V01, Intertek makes no claims of compliance for values other than those shown below.

DEKRA Testing and Certification (Suzhou) Co., Ltd.
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu, China
TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098



4.2.4 Test Data							
Mode	Channel	Test Frequency (MHz)	Output Power (dBm)	E.I.R.P (dBm)	Conducted Limit (dBm)	E.I.R.P Limit (dBm)	Result
1	00	902.3	20.44	22.74	30.00	36.00	Pass
	31	908.5	20.36	22.66	30.00	36.00	Pass
	63	914.9	20.31	22.61	30.00	36.00	Pass
2	64	903.0	20.42	22.72	30.00	36.00	Pass
	67	907.8	20.37	22.67	30.00	36.00	Pass
	71	914.2	20.30	22.60	30.00	36.00	Pass
Note: 1. E.I.R.P.= Output Power + Antenna Gain 2. Please refer to clause 1.2 for antenna gain.							



6 Antenna Gain

6.1 BLE Radio

Antenna gain was taken from Antenna Test Report 593-02250-01, a document provided by the client, Intertek makes no claims of compliance for values other than those shown below.

2.4GHz Antenna Test Report

04/22/2025

Antenna Information

- 1- Operating Frequency: 2.4GHz
- 2- Antenna Material: FR-4 PCB
- 3- Antenna Type: Printed PIFA antenna
- 4- Antenna Dimension 45 x 35 mm
- 5- Input Impedance 50 Ω
- 6- Return Loss (S11): $>-30\text{dB}$
- 7- Standing Wave Ratio (SWR): 1.05:1
- 8- Peak gain: -0.48 dBi on XZ-plane and -1.25dBi on XY-plane
- 9- Polarization: Linear

6.2 LoRa Radio

Antenna gain was taken from Antenna Test Report 593-02260-01, a document provided by the client, Intertek makes no claims of compliance for values other than those shown below.

915 MHz Antenna Test Report

04/22/2025

Antenna Information

- 1- Operating Frequency: 915 MHz
- 2- Antenna Material: FR-4 PCB
- 3- Antenna Type: Printed monopole antenna
- 4- Antenna Dimension 30 x 23 mm
- 5- Input Impedance 50 Ω
- 6- Return Loss (S11): $>-30\text{dB}$
- 7- Standing Wave Ratio (SWR): 1.12:1
- 8- Peak gain: -1.11 dBi on XZ, and -3.5dBi on XY plane
- 9- Polarization: Linear



FCC RF Exposure Limits

Title 47 CFR Part 1.1310(d)(2):

For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b) of this part, except for portable devices as defined in § 2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in § 2.1093.

Table 1 to § 1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*(100)	≤6
3.0–30	1842/f	4.89/f	*(900/f ²)	<6
30–300	61.4	0.163	1.0	<6
300–1,500			f/300	<6
1,500–100,000			5	<6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	<30
1.34–30	824/f	2.19/f	*(180/f ²)	<30
30–300	27.5	0.073	0.2	<30
300–1,500			f/1500	<30
1,500–100,000			1.0	<30

f = frequency in MHz. * = Plane-wave equivalent power density.



7 RSS-102 Issue 6 RF Exposure Limits

RSS-102 Issue 6 § 6.6:

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 1 W (adjusted for tune-up tolerance)
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance)
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 5 W (adjusted for tune-up tolerance)

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

RSS-102 Issue 6 § 5.3.2:

The electric and magnetic field strength reference levels, power density reference levels, and associated reference period for devices employed by the general public (uncontrolled environment) and controlled-use devices (controlled environment) are specified in table 7 and table 8. Note that the power density limits specified in these tables apply to whole body exposure conditions.

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V _{RMS} /m)	Magnetic field (A _{RMS} /m)	Power density (W/m ²)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000 / f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

Note: f is frequency in MHz.



9 Test Procedure

An RF exposure calculation was performed to show that the device was compliant with the general population exposure limits from FCC Title 47 CFR Part 1.1310(e)(1), RSS-102 Issue 6, and ICNIRP Guidelines (2020). The maximum power density was calculated for each transmitter at a separation distance of 20cm using the maximum conducted output power (including tune up tolerance) plus antenna gain, or measured EIRP.

For each transmitter the maximum power density at a 20cm distance using the formula:

$$EIRP(dBm) = Conducted\ Power(dBm) + Antenna\ Gain(dBi)$$

$$EIRP(mW) = 10^{EIRP(dBm)/10}$$

$$Power\ Density\left(mW/cm^2\right) = \frac{EIRP(mW)}{4\pi \cdot (20cm)^2}$$

$$Power\ Density\left(W/m^2\right) = \left(\frac{100cm}{1m}\right)^2 \left(\frac{1W}{1000mW}\right) Power\ Density\left(mW/cm^2\right)$$

For transmitters that could operate simultaneously, the ratio of calculated power density to the corresponding limit for each transmitter was calculated and then summed. If the sum of the ratios was less than 1, that specific combination of transmitters was deemed to comply.



10 Results:

The calculated maximum power density at 20cm was less than or equal to the limits for general population exposure in FCC Title 47 CFR Part 1.1310(e)(1), RSS-102 Issue 6, and ICNIRP Guidelines (2020).

Additionally, to demonstrate compliance during simultaneous transmission, the worst-case power density to limit ratios for each transmitter were summed. Since the sum was less than 1 that combination of transmitters is deemed to comply with the simultaneous transmission RF exposure criteria.

**10.1 FCC RF Exposure Data**

Radio	Channel	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle (%)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value @ 20cm (mW/cm ²)	MPE Limit (mW/cm ²)	MPE / Limit Ratio (for Co-Location)
BLE	Low	2402	1.74	100.0%	1.74	-0.48	0.0003	1.0000	0.0003
	Mid	2440	1.27	100.0%	1.27	-0.48	0.0002	1.0000	0.0002
	High	2480	0.87	100.0%	0.87	-0.48	0.0002	1.0000	0.0002
LoRa	Low	902.3	20.44	100.0%	20.44	-1.11	0.0171	0.6015	0.0283
	Mid	908.5	20.36	100.0%	20.36	-1.11	0.0167	0.6057	0.0276
	High	914.9	20.31	100.0%	20.31	-1.11	0.0165	0.6099	0.0271
Sum:									0.0286

**10.2 RSS-102 Issue 6 RF Exposure Data**

Radio	Channel	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle (%)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value @ 20cm (W/m ²)	MPE Limit (W/m ²)	MPE / Limit Ratio (for Co-Location)
BLE	Low	2402	1.74	100.0%	1.74	-0.48	0.0027	5.3508	0.0005
	Mid	2440	1.27	100.0%	1.27	-0.48	0.0024	5.4085	0.0004
	High	2480	0.87	100.0%	0.87	-0.48	0.0022	5.4689	0.0004
LoRa	Low	902.3	20.44	100.0%	20.44	-1.11	0.1705	2.7405	0.0622
	Mid	908.5	20.36	100.0%	20.36	-1.11	0.1674	2.7533	0.0608
	High	914.9	20.31	100.0%	20.31	-1.11	0.1655	2.7665	0.0598
Sum:									0.0527

**11 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	7/16/2025	106145616LEX-004	JP	MC	Original Issue