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GPS INDUSTRIES, LLC MPE REPORT

SCOPE OF WORK

MPE CALCULATION
ON THE V3-1005AQ AND V3-1004Q

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MPE TEST REPORT

Report Number: 104702325LEX-004
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Product Name: V3-1005AQ and V3-1004Q

Standards: FCC Part 1.1310 Limits for Maximum
Permissible Exposure (MPE)

RSS-102 Issue 5 RF Field Strength Limits for
Devices Used by the General Public

Tested by:
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Client:
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1074 N. Orange Ave.
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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
8	FCC Part 1.1310 Limits for Maximum Permissible Exposure (MPE) (Limits for General Population / Uncontrolled Exposure)	Pass
	RSS-102 Issue 5 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:	GPS INDUSTRIES, LLC
Address:	1074 N. Orange Ave. Sarasota, FL 34236 USA
Contact:	Josh Hubert
Telephone:	1+706.619.3122
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Manufacturer Information	
Manufacturer Name:	GPS INDUSTRIES, LLC
Manufacturer Address:	1074 N. Orange Ave. Sarasota, FL 34236 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	V3-1005AQ and V3-1004Q
Model Number	V3-1005AQ and V3-1004Q
Serial Number	861364040286344
Embedded Modules	Texas Instruments Model WL18MODGB (FCCID: Z64-WL18SBMOD) Quectel Model EM06-A (FCCID: XMR201906EM06A)
Receive Date	9/9/2021
Test Start Date	9/9/2021
Test End Date	10/16/2021
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	12VDC
Description of Equipment Under Test (provided by client)	
The V3-1005AQ and V3-1004Q is a tracking device that installs on golf carts. It provides distances to holes, tracking capabilities for the golf carts.	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 FCC Limits

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 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)
(A) Limits for Occupational/Controlled Exposures				
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
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) 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
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.



6 RSS-102 Issue 5 Exposure Limits:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
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 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. * Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				



7 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with the general population exposure limits from FCC §2.1091 and RSS-102 Issue 5. The maximum power density was calculated for each transmitter band at a separation distance of 20cm using the maximum declared output power including tune up tolerance.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

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



8 Results:

The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 1.1310 and RSS-102 Issue 5.

Additionally, to demonstrate compliance for simultaneous transmission between any cellular band and WiFi the worst-case limit to MPE ratios for each radio were summed. Since that sum was less than 1 that combination of radios is deemed to comply with the simultaneous transmission RF exposure criteria.

FCC MPE Data

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm ²)	MPE Limit (mW/cm ²)	Margin to Limit (mW/cm ²)	MPE / Limit Ratio (for Co-Location)
WiFi	2412	17.3	17.30	2.2	0.0177	1.0000	0.9823	0.0177
WCDMA Band 2	1850	27	27.00	3.46	0.2212	1.0000	0.7788	0.2212
WCDMA Band 4	1710	27	27.00	3.46	0.2212	1.0000	0.7788	0.2212
WCDMA Band 5	824	27	27.00	1.45	0.1392	0.5493	0.4101	0.2535
LTE Band 2	1850	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396
LTE Band 4	1710	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396
LTE Band 5	824	25	25.00	1.45	0.0878	0.5493	0.4615	0.1599
LTE Band 7	2500	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396
LTE Band 12	699	25	25.00	1.45	0.0878	0.4660	0.3782	0.1885
LTE Band 13	777	25	25.00	1.45	0.0878	0.5180	0.4302	0.1696
LTE Band 25	1850	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396
LTE Band 26	814	25	25.00	1.45	0.0878	0.5427	0.4548	0.1619
LTE Band 29	717	25	25.00	1.45	0.0878	0.4780	0.3902	0.1838
LTE Band 30	2305	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396
LTE Band 66	1710	25	25.00	3.46	0.1396	1.0000	0.8604	0.1396

The antenna gains used above were provided by the client and could affect compliance. The maximum power values used above were obtained from the module manufacturers datasheets and could affect compliance.

The calculation for the worst case simultaneous transmission combination is shown below. Since the sum of the MPE / limit ratios is less than 1 the V3-1005AQ and V3-1004Q is deemed to comply with the simultaneous transmission requirements for MPE.

$$0.0177 + 0.2535 = 0.2712$$



RSS-102 Issue 5 MPE Data

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (W/m ²)	MPE Limit (W/m ²)	Margin to Limit (W/m ²)	MPE / Limit Ratio (for Co-Location)
WiFi	2412	17.3	17.30	2.2	0.1773	5.3660	5.1887	0.0330
WCDMA Band 2	1850	27	27.00	3.46	2.2117	4.4763	2.2646	0.4941
WCDMA Band 4	1710	27	27.00	3.46	2.2117	4.2419	2.0302	0.5214
WCDMA Band 5	824	27	27.00	1.45	1.3923	2.5756	1.1833	0.5406
LTE Band 2	1850	25	25.00	3.46	1.3955	4.4763	3.0808	0.3118
LTE Band 4	1710	25	25.00	3.46	1.3955	4.2419	2.8464	0.3290
LTE Band 5	824	25	25.00	1.45	0.8785	2.5756	1.6971	0.3411
LTE Band 7	2500	25	25.00	3.46	1.3955	5.4991	4.1035	0.2538
LTE Band 12	699	25	25.00	1.45	0.8785	2.3017	1.4232	0.3817
LTE Band 13	777	25	25.00	1.45	0.8785	2.4743	1.5958	0.3550
LTE Band 25	1850	25	25.00	3.46	1.3955	4.4763	3.0808	0.3118
LTE Band 26	814	25	25.00	1.45	0.8785	2.5542	1.6757	0.3439
LTE Band 29	717	25	25.00	1.45	0.8785	2.3421	1.4636	0.3751
LTE Band 30	2305	25	25.00	3.46	1.3955	5.2022	3.8067	0.2683
LTE Band 66	1710	25	25.00	3.46	1.3955	4.2419	2.8464	0.3290

The antenna gains used above were provided by the client and could affect compliance. The maximum power values used above were obtained from the module manufacturers datasheets and could affect compliance.

The calculation for the worst case simultaneous transmission combination is shown below. Since the sum of the MPE / limit ratios is less than 1 the V3-1005AQ and V3-1004Q is deemed to comply with the simultaneous transmission requirements for MPE.

$$0.0330 + 0.5406 = 0.5736$$



9 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	11/30/2021	104702325LEX-004	<i>JB</i>	<i>BCT</i>	Original Issue