

2/22/2024

Tractian Technologies Inc.
1389 Peachtree St NE
Atlanta, GA 30309
USA

Dear Jorge Sousa,

Enclosed is the EMC test report for testing of the Tractian Technologies Inc., Smart Receiver Ultra tested to the requirements of FCC Part 2.1091 and RSS-102 Issue 6

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if MET can be of further service to you, please do feel free to contact me.

Sincerely,



Nancy LaBrecque
Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: WIRA130598 – MPE_R1



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**RF Exposure Criteria
Test Report
Using Maximum Permissible Exposure (MPE) Calculations**

for the

Tractian Technologies Inc.
Smart Receiver Ultra

Tested under

FCC Part 2.1091 and RSS-102 Issue 6

Report: WIRA130598 – MPE_R1

2/22/2024



Bryan Taylor, Wireless Team Lead
Electromagnetic Compatibility Lab



Nancy LaBrecque
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.



Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
0	2/21/2024	Initial Issue.
1	2/22/2024	Corrected antenna gain for 915MHz ISM Transmitter

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
CISPR	Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference)
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kiloHertz
kPa	kiloPascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	MegaHertz
μH	microHenry
μF	microFarad
μs	microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
V/m	Volts per meter
VCP	Vertical Coupling Plane

1.0 Requirements Summary

Page Number	Test Name	Result
13	RSS-102 Issue 6 MPE Limits (For General Public Exposure)	Compliant
13	FCC Part 2.1091 MPE Limits (For General Public Exposure)	Compliant

Table 1. Summary of Test Results

2.0 Equipment Configuration

2.1 Overview

Eurofins MET Labs was contracted by Traction Technologies Inc. to perform testing on the Smart Receiver Ultra, under Traction Technologies Inc.'s purchase order number SRU-FCC-008.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Traction Technologies Inc. Smart Receiver Ultra.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Smart Receiver Ultra			
Model(s) Covered:	Smart Receiver Ultra			
Serial Number or Sample Number:	CER4F01 and CERF03			
EUT Specifications:	Primary Power: 100-250VAC, 50/60Hz			
	Antenna Gain ¹ :	915MHz ISM Transmitter: 1.1dBi		
		WiFi Transmitter: 2.4dBi		
		LTE Transmitter: 4.5dBi		
	EUT Frequency Ranges:	915MHz ISM Transmitter: 915MHz – 925MHz		
		WiFi Transmitter: 2412MHz – 2462MHz		
		LTE Transmitter: Band 2: 1850 – 1910MHz Band 4: 1710 – 1755MHz Band 5: 824 – 849MHz Band 12: 699 – 716MHz Band 13: 777 – 787MHz Band 25: 1850 – 1915MHz Band 26: 814 – 849MHz Band 41: 2496 – 2690MHz Band 66: 1710 – 1780MHz		
		Maximum Conducted Output Power:	915MHz ISM Transmitter: 19.89dBm	
			WiFi Transmitter: 27.00dBm (obtained from module RF Exposure report)	
	LTE Transmitter: 25.00dBm (obtained from module RF exposure report)			
	Preapproved Modules Onboard:	WiFi Transmitter: FCCID: 2AC7Z-ESP32WROVERE ICID: 21098-ESPWROVERE		
		LTE Transmitter: FCCID: 2AJYU-8PYA008 ICID: 23761-8PYA009		
Analysis:	The results obtained relate only to the item(s) tested.			
Environmental Test Conditions:	Temperature: 15-35° C			
	Relative Humidity: 30-60%			
	Barometric Pressure: 860-1060 mbar			
Type of Filing:	Original			
Evaluated by:	Bryan Taylor			
Report Date(s):	2/5/2024 through 2/19/2024			

Table 2. EUT Summary Table

¹ The antenna gain information was provided by Tractian Technologies Inc. at the time of testing.

2.2 Test Site

All testing was performed at Eurofins E&E North America, Austin, TX. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

2.3 References

RSS-102: Issue 6	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
FCC Part 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.

Table 3. References

2.4 Description of Test Sample

The Smart Receiver Ultra is a Gateway that collects data from Traction's IOT sensors and sent to the Traction platform using LTE networks or Wi-Fi. The LTE and WiFi radios are preapproved modules (FCCID: 2AJYU-8PYA007 and FCCID: 2AC7Z-ESP32WROVERE).

2.5 Modifications

2.5.1 Modifications to EUT

No modifications were made to the EUT.

2.5.2 Modifications to Test Standard

No modifications were made to the test standard.

2.6 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Traction Technologies Inc. upon completion of testing.

3.0 Maximum Permissible Exposure Results

3.1 RSS-102 RF 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).				

3.2 FCC Exposure Limits

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.				

Test Procedure:

An MPE evaluation for was performed in order to show that the device was compliant with the general population exposure limits. 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.

Test Results:

The Smart Receiver Ultra was **compliant** with FCC Part 2.1091 and RSS-102 Issue 6. The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 2.1091 and RSS-102 Issue 6.

Additionally, the sum of the worst case for each MPE to Limit ratio is less than 1 indicating that all radios may transmit simultaneously. Per information provided by Traction Technologies Inc. the 915MHz ISM radio may transmit simultaneously with either the LTE module or the WiFi module onboard. However, the LTE and WiFi modules will never transmit simultaneously with each other. Data is presented for both simultaneous transmission scenarios.

Test 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)
915MHz ISM	915.00	19.89	19.89	1.10	0.0250	0.6100	0.5850	0.0410
LTE Band 5	849.00	25.00	25.00	4.50	0.1773	0.5660	0.3887	0.3133
Sum:								0.3542

FCC MPE Data (915MHz ISM and Worst Case LTE)

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)
915MHz ISM	915.00	19.89	19.89	1.10	0.0250	0.6100	0.5850	0.0410
2.4GHz WiFi	2412.00	27.00	27.00	2.40	0.1733	1.0000	0.8267	0.1733
Sum:								0.2142

FCC MPE Data (915MHz ISM and Worst Case WiFi)

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)
915MHz ISM	915.00	19.89	19.89	1.10	0.2499	2.7668	2.5169	0.0903
LTE Band 5	849.00	25.00	25.00	4.50	1.7731	2.6288	0.8557	0.6745
Sum:								0.7648

ISED MPE Data (915MHz ISM and Worst Case LTE)

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)
915MHz ISM	915.00	19.89	19.89	1.10	0.2499	2.7668	2.5169	0.0903
2.4GHz WiFi	2412.00	27.00	27.00	2.40	1.7327	5.3660	3.6333	0.3229
Sum:								0.4132

ISED MPE Data (915MHz ISM and Worst Case WiFi)

Test Engineer(s): Bryan Taylor

Test Date(s): 2/19/2023