RF Exposure Assessment

Project Number: 4302247 / 6221
Report Number: 4302247EMC03 **Revision Level:** 0
Client: Trellis, Inc.

Equipment Under Test: Wireless Sensor Station and Central Base Station with Mercury Module
Models: Sensor Station rev 3.5
Base Station rev 5
Mercury Module rev B
FCC ID/ IC ID: 2AP6L-MERCURY

Applicable Standards: FCC Part 15 Subpart C, § 15.247 & 2.1091
RSS-102

Report issued on: 31 December 2018
Test Result: Compliant

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1 References

1) FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091 & 2.1093)
2) RSS-102: Issue5 clause 2.5.2
3) ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)
4) Council Recommendation 1999/519/EC of 12 July 1999 on the limitations of exposure of general public to electromagnetic fields
5) Council Recommendation 2004/40/EC of 29 April 2004 on the limitations of exposure of workers to electromagnetic fields
6) AS/NZS 2772.1 Radiofrequency fields, Part 1: Maximum exposure limits - 3 kHz to 300 GHz

1.1 *Modifications Required for Compliance*

None

2 General Information

2.1 *Client Information*

Name:	Trellis, Inc.
Address:	147 Technology Parkway, Suite 100,
City, State, Zip, Country:	Peachtree Corners, GA 30092 USA

2.2 *General Information of EUT*

Product:	Wireless Sensor and Gateway Base Station Sensor with Mercury Module
Model:	Sensor Station rev 3.5 Base Station rev 3.5 Mercury Module rev B
Frequency:	902.5 —927.5 MHz
Power to antenna:	16.28 dBm
Antenna gain:	2.0 dBi
Cable Inside:	-2.0dB

3 RF Exposure

3.1 *Introduction*

This generic standard applies to low power electronic and electrical apparatus for which no dedicated product – or product family standard regarding human exposure to electromagnetic fields applies. The frequency range covered is 10 MHz to 300 GHz.

The object of this standard is to demonstrate the compliance of such apparatus with the basic restrictions on exposure of the general public to electric, magnetic and electromagnetic fields and contact current.

All electromagnetic fields
If the average power emitted by the apparatus operating in the frequency range 10 MHz to 300 GHz is less than or equal top 20 mW the apparatus is deemed to comply with the basic restrictions without testing.

Averaging time is 6 minutes in the frequency range 10 MHz to 10 GHz. The average time is equal to 68/f1.05 minutes (where f is in GHz) in the frequency range 10 GHz to 300 GHz.

If the total supply power or the input power to the circuitry producing the greatest emissions in the device is less than or equal to 20 mW then it is assumed that the emitted power is less that 20 mW.

Pulse modulated electromagnetic fields with pulse duration less than 30 micro seconds For pulse of duration less than 30 microseconds at frequencies between 300 MHz and 10 GHz, there is also a basic restriction on SA. This is 2mJ kg^{-1} in any 10g of tissue in the head. For most pulses, the SAR restriction will be more stringent, but for pulses with a repetition frequency of less than 100 Hz, the SA restriction will predominate. For devices producing pulses with repetition rates below 100 Hz, the average power should be less that 20 x prf mW (prf in Hz).

Calculations are made using the following equation:

$$P_d = \frac{P_t G_t}{4\pi r^2}$$

Where

P_d = Power Density (W/m^2)
Pt = Power Transmitted (W)
Gt = Gain of Transmitting antenna
r = Distance from Antenna (meters)

3.2 *Reference Levels*

CFR 47 Part 1.1310

TABLE 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)
(A) 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
(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
300-1,500			f/1500	30
1,500-100,000			1.0	30

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

RSS-102:issue 5, 2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation

RF 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, except when the device operates as follows:

- Below 20 MHz and the source-based, time-averaged maximum e.i.r.p. 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 e.i.r.p. of the device is equal to or less than 22.48/f0.5 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 e.i.r.p. 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 e.i.r.p. of the device is equal to or less than 1.31 x 10-2 x f0.6834 W (adjusted for tune-up tolerance), where f is in MHz;

- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. 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 e.i.r.p. was derived.

3.3 *Exposure calculations*

As per the report 4302247EMC02, the power of the EUT are below,

Frequency (MHz)	Peak Output Power (dBm)	EIRP (mW)	ISED Power Limit (W)	Conclusion
902.5	16.28	42	1.371	Pass
915.0	16.04	40	1.384	Pass
927.5	15.88	39	1.397	Pass

Limit = $1.31 \times 10^{-2}\ f^{0.6834}$ W
Antenna with Cable Gain is 0.0 dBi, so the EIRP equals to conducted power.

The limit of the range as per table 1 and the calculated Power Density is:

Frequency (MHz)	Calculated Power Density (mW/cm^2)	FCC Power Limit (mW/cm^2)	Conclusion
902.5	0.008	0.602	Pass
915.0	0.008	0.610	Pass
927.5	0.008	0.618	Pass

Limit = f/1500 mW/cm^2, Antenna with Cable Gain is 0.0 dBi , 1.0.

4 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	31 August 2018
1	Revised/corrected EIRP	31 December 2018