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RADIOFREQUENCY RADIATION EXPOSURE EVALUATION: MOBILE DEVICES

REPORT NUMBER: M2001003-4

TEST STANDARD: 47 CFR PART 2.1091

**CLIENT: DIGITAL MINING
TECHNOLOGY**

DEVICE: CAS-GPS NODE

**MODEL: PROD1116-E2, PROD1116-E2X,
PROD1116-L2, PROD1116-L2X,
PROD1116-S2, PROD1116-S2X,
PROD1116-P2, PROD1116-P2X**

DATE OF ISSUE: 24 FEBRUARY 2020

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REVISION TABLE

Version	Sec/Para Changed	Change Made	Date
1		Initial issue of document	24/02/2020

CONTENTS

1	Introduction.....	5
1.1	Laboratory Overview.....	5
1.2	Test Laboratory/Accreditations.....	5
2	Device Details.....	5
2.1	Description of Sample.....	5
2.2	Transmitter and Antenna Details.....	6
3	Limits for Maximum Permissible Exposure (MPE), §1.1310.....	7
4	Uncertainty.....	7
5	Assumptions in this Assessment.....	7
6	MPE Calculations.....	8
7	Co-Location Consideration.....	8
8	Conclusion.....	9



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RADIOFREQUENCY RADIATION EXPOSURE EVALUATION

Device: CAS-GPS Node
Model Number: PROD1116-E2, PROD1116-E2X, PROD1116-L2, PROD1116-L2X,
PROD1116-S2, PROD1116-S2X, PROD1116-P2, PROD1116-P2X
Serial Number: -
Part Number: -
Manufacturer: Digital Mining Technology

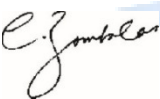
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Standards: **47 CFR Part 2.1091**
"Radiofrequency radiation exposure evaluation: mobile devices"
47 CFR 1.1310
"Radiofrequency radiation exposure limits"
KDB 447498 D01 General RF Exposure Guidance v06
"RF exposure procedures and equipment authorization policies for
mobile and portable devices".

Result: Based on an assessment of the documentation provided the CAS-GPS Node, model PROD1116-E2, PROD1116-E2X, PROD1116-L2, PROD1116-L2X, PROD1116-S2, PROD1116-S2X, PROD1116-P2, PROD1116-P2X complies with the RF exposure requirements of 47 CFR Part 2.1091, however an exclusion zone of 20 cm in front of the radiating elements applies, elsewhere the exposure level was below the MPE limits. Refer to Report M2001003-4 for full details.

Assessment Date: 20 February 2020
Issue Date: 24 February 2020


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1 INTRODUCTION

This report is intended to demonstrate compliance of the CAS-GPS Node, model PROD1116-E2, PROD1116-E2X, PROD1116-L2, PROD1116-L2X, PROD1116-S2, PROD1116-S2X, PROD1116-P2, PROD1116-P2X with the RF exposure requirements of 47 CFR Part 2.1091. Evaluation was performed in accordance with FCC KDB 447498 D01.

The product sample was provided by the Client and confirmed that the product models listed in this report have the same transmitters and antenna components/configuration. The conclusion herein is based on the information provided by the client.

1.1 Laboratory Overview

EMC Technologies Pty. Ltd. is an independently owned Australian company that is NATA accredited to ISO 17025 for both testing and calibration and ISO 17020 for Inspection. – **Accreditation Number 5292.**

The laboratory is FCC accredited.

1.2 Test Laboratory/Accreditations

Table 1-1: Accreditations for Conformity Assessment

Country/Region	Body	
Australia/New Zealand	NATA	Accreditation Number: 5292
Europe	European Union	Notified Body Number: 0819
USA	FCC	Designation Number: AU0001
Canada	ISED Canada	Company Number: 3569B
Japan	VCCI	Company Number: 785
Taiwan	BSMI	Lab Code SL2-IN-E-5001R

2 DEVICE DETAILS

(Information supplied by the Client)

2.1 Description of Sample

The CAS-GPS intelligent multi-purpose node comprises of a high-performance GPS receiver, Vehicle to Vehicle (V2V) radio transceiver, high accuracy Ranging RF transceiver (ToF), RS-232/485 communications, Digital Input (2) / Output (1), Personal Area Network (PAN) and internal battery.

Manufacturer: Digital Mining Technology
Sample: CAS-GPS Node
Model Number: PROD1116-E2
Serial Number: -

2.2 Transmitter and Antenna Details

Wireless Interface 1 (V2V):	SRD (Silicon Labs, Si4463)
Operating Frequency Range:	919.52 – 920.48 MHz
Max. RF Output Power level:	20 dBm (100mW)
Antenna Type:	Ceramic PCB mounted (Antenna 3)
Max. Antenna Gain:	3.2 dBi

Wireless Interface 2 (ToF):	IEEE 802.15.4a nanoPAN 5375 RF Module, Part Number: MN5375V2
Operating Frequency:	2.4375/2.442 GHz
Max. RF Output Power level:	10 dBm (10mW)
Antenna Type:	Ceramic PCB mounted (Antenna 1&2). No Simultaneous Tx. Configured for diversity through a SPDT RF switch.
Max. Antenna Gain:	2dBi

Wireless Interface 3 (PAN):	Bluetooth (u-blox, ODIN-W262)
Operating Frequency Range:	2.402 – 2.4835 GHz
Max. RF Output Power level:	11dBm (12.59mW)
Antenna Type:	Module's integral antenna.
Max. Antenna Gain:	3dbi

3 LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE), §1.1310

Table 3-1: Occupational and General Public MPE Limits

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

Where f = Frequency in MHz, * = Plane-wave power density

4 UNCERTAINTY

EMC Technologies has evaluated the tools and methods used to perform Radiated Electromagnetic Field predictions. The estimated measurement uncertainties for the calculation shown within this report are as follows:

Electromagnetic Modelling;

30 MHz to 100GHz ±2.8 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

5 ASSUMPTIONS IN THIS ASSESSMENT

This assessment does not include accumulated RF fields from nearby sites/antennas or possible radio signal reflections or attenuation due to buildings or the general environment.

Antenna Parameters and power settings were supplied by the customer.

A 100% duty cycle is assumed.

The aperture of the radiating element assumed to be a point source in free space and far field conditions.

6 MPE CALCULATIONS

The MPE was evaluated at 20 cm to show compliance with the power density listed in table 3-1
The following formula was used to calculate the power density at 20 cm

$$S = \frac{P * G}{4\pi R^2}$$

$$S = \frac{EIRP}{4\pi R^2}$$

Where

(S): Power density (mW/cm^2)

(P): Output power at antenna terminal (mW)

(G): Gain (ratio)

(R): Minimum test separation distance (20 cm)

Table 6-1: MPE Calculations

Technology	Frequency Band (MHz)	Power	Gain	Duty Cycle	EIRP	EIRP	Flux Density at 20 cm	Flux Density limit	Percentage of the limit
		<i>dBm</i>	<i>dBi</i>	%	<i>dBm</i>	<i>mW</i>	<i>mW/cm²</i>	<i>mW/cm²</i>	%
SRD (V2V)	919.52 – 920.48	20	3.2	100%	23.20	208.93	0.0416	0.61	6.78%
IEEE 802.15.4a (ToF)	2437.5/2442.0	10	2	100%	12.00	15.85	0.0032	1.00	0.32%
Bluetooth (PAN)	2402 – 2483.5	11	3	100%	14.00	25.12	0.0050	1.00	0.50%
Co-location total percentage of the limit at 20 cm (Worst Case)									7.60%

7 CO-LOCATION CONSIDERATION

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0 .

$$\sum_{1}^N \frac{S_{eqN}}{S_{limN}} = \frac{S_{eq1}}{S_{lim1}} + \frac{S_{eq2}}{S_{lim2}} + \dots + \frac{S_{eqN}}{S_{limN}} \leq 1$$

Where: S_{eq} = Power Spectral density (mW/cm^2) of a specific transmitter
 S_{lim} = MPE limit (mW/cm^2)

The following simultaneous transmissions are possible:

Table 7-1: MPE Ratio

V2V	ToF	PAN	MPE Ratio Sum	Result
SRD	IEEE 802.15.4a	Bluetooth	0.076	Pass



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8 CONCLUSION

Based on an assessment of the documentation provided the CAS-GPS Node, model PROD1116-E2, PROD1116-E2X, PROD1116-L2, PROD1116-L2X, PROD1116-S2, PROD1116-S2X, PROD1116-P2, PROD1116-P2X complies with the RF exposure requirements of 47 CFR Part 2.1091. An exclusion zone of 20 cm in front of the radiating elements applies, elsewhere the exposure level was below the MPE limits.



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