



RF Exposure Evaluation Report

FOR:

Geoforce Inc.

Brand:

Geoforce

Marketing Name:

Geoforce GT1/GT1s and Geoforce GT0/GT0s

Model Number:

OWA1S52

Product Description:

Battery Powered Asset Logistics Device

FCC ID: OWA00GT1X

IC: 10540A-00GT1X

Per:

CFR Part 1 (1.1307), Part 2 (2.1091)
FCC KDB 447498 D01 General RF Exposure Guidance v06
ISED RSS-102 Issue 6

Report number: EMC_GEOFO_038_23001_FCC_ISED_RF_Exposure

DATE: 2024-05-21



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3462B

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1 Assessment

This RF Exposure evaluation report provides evidence for compliance of the equipment (as identified in section 3 of this test report) with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1.1307, Part 2 (2.1091) and ISED standard RSS-102 issue 6 under worst case conditions (measured or rated RF output power including tune-up tolerance, antenna gain, the distance towards the human body, multiple transmitter information as presented by the applicant).

In addition, maximum antenna gain or minimum distance towards the human body is calculated respectively, where relevant.

The device meets the limits stipulated by the above given FCC and ISED rule parts based on available specifications for worst-case conditions at a separation distance greater than 20cm to the body.

Company	Description	Model #
Geoforce	Battery Powered Asset Logistics Device	OWA1S52

Responsible for the Report:

2024-05-21 Compliance Lui, Chin Ming
(EMC Test Engineer)

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2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
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EMC Lab Manager:	Ghanma, Issa
Responsible Project Leader:	Sivaraman, Sangeetha

2.2 Identification of the Client

Applicant's Name:	Geoforce
Street Address:	5830 Granite Parkway, Suite 1200
City/Zip Code	Plano, TX, 75024
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client /-----
Manufacturers Address:	-----
City/Zip Code	-----
Country	-----

3 Equipment under Assessment

Brand:	Geoforce
Model No:	OWA1S52
Marketing name:	Geoforce GT1/GT1s and Geoforce GT0/GT0s
FCC-ID :	OWA00GT1X
IC:	10540A-00GT1X
HW Version :	R3
SW Version :	11.X
HVIN:	OWA1S52
PMN:	Geoforce GT1/GT1s and Geoforce GT0/GT0s
Product Description:	Battery Powered Asset Logistics Device
Radio information:	❖ Bluetooth LE: Nordic NRF5280 (DTS) - o Modulation: GFSK - o 2402 – 2480 MHz (39 Channels, 2 MHz spacing) - o Highest conducted output power (Measured Peak): 2.23 dBm @ 2480 MHz - o Max declared EIRP: 6.0 dBm ± 1.0 dBm ❖ Satcom: Discrete Licensed Geoforce Transmitter (TNB) - o Mode of Operation: DSSS - o Modulation: BPSK - o 1611.25 – 1618.75 (4 Channels, 2.5 MHz spacing) - o Highest conducted output power (Measured RMS): 19.05 dBm @ 1611.25 MHz - o Max declared EIRP: 23.0 dBm ± 1.0 dBm ❖ GNSS: U-Blox MAX-M10S (RCV Only) - o 1575.42, 1602, 1561 MHz
Power Supply/ Rated Operating Voltage Range:	Nominal 3.6 V DC; High 3.9 V DC
Operating Temperature Range:	T min: -40 °C / T Nom: 20 °C / T max: +85 °C
Antenna Information as declared:	❖ Bluetooth LE: Molex - o Type: 2.4GHz SMT MID Chip Antenna - o Peak Gain: 3.3 dBi ❖ Satcom: Tallysman Wireless - o Type: TW11-0006-1 Dual Feed Patch Antenna - o Gain: 5 dBi
Sample Revision:	☐ Production Unit; ☒ Pre-Production
Product dimensions [mm]:	7.1 cm x 7.1 cm x 3.2 cm
Note: The information of the EUT specifications in the table above is provided by the client except the specified measured output power. Refer to following documents: • Operational Description: GT0-GT1 Theory of Operation Description Document # HW-SP-0-0160 • EUT Model Declaration of Similarities: Declaration of Product Model Code • Antenna Datasheet – BLE: Molex 0479480001, 2.4 GHz SMT MID Chip Antenna • Antenna Datasheet – GPS-SAT: Tallysman Wireless TW11-0006-1, Dual Feed Patch Antenna	

4 RF Exposure Limits and FCC and ISSED Basic Rules

4.1 FCC Rules

4.1.1 § 2.1091(c)(1)

Evaluation of compliance with the exposure limits in § 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for mobile devices with single RF sources having either more than an available maximum time-averaged power of 1 mW or more than the ERP listed in Table 1 to § 1.1307(b)(3)(i)(C), whichever is greater. For mobile devices not exempt by § 1.1307(b)(3)(i)(C) at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP) in comparison with the following formula only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

$$P_{th}(\text{mW}) = ERP_{20\text{ cm}}(\text{mW}) = \begin{cases} 2040f & 0.3\text{ GHz} \leq f < 1.5\text{ GHz} \\ 3060 & 1.5\text{ GHz} \leq f \leq 6\text{ GHz} \end{cases}$$

4.1.2 § 2.1091(c)(2)

For multiple mobile or portable RF sources within a device operating in the same time averaging period, routine environmental evaluation is required if the formula in § 1.1307(b)(3)(ii)(B) of this chapter is applied to determine the exemption ratio and the result is greater than 1.

4.1.3 § 1.1307(b)(3)(i)

For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}(\text{mW}) = \begin{cases} ERP_{20\text{ cm}}(d/20\text{ cm})^x & d \leq 20\text{ cm} \\ ERP_{20\text{ cm}} & 20\text{ cm} < d \leq 40\text{ cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\text{ cm}}\sqrt{f}}\right) \text{ and } f \text{ is in GHz};$$

and

$$ERP_{20\text{ cm}}(\text{mW}) = \begin{cases} 2040f & 0.3\text{ GHz} \leq f < 1.5\text{ GHz} \\ 3060 & 1.5\text{ GHz} \leq f \leq 6\text{ GHz} \end{cases}$$

d = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C)—Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3–1.34	$1,920 R^2$.
1.34–30	$3,450 R^2/f^2$.
30–300	$3.83 R^2$.
300–1,500	$0.0128 R^{2f}$.
1,500–100,000	$19.2R^2$.

4.1.4 § 1.1307(b)(3)(ii)

For multiple RF sources: Multiple RF sources are exempt if:

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

4.2 ISSED Rules

4.2.1 RSS-102 – Clause 6.3 SAR exemption limits

Devices operating at or below the applicable output power levels (adjusted for tune-up tolerance) specified in table 11, based on the separation distance, are exempt from SAR evaluation. The separation distance, defined as the distance between the user and/or bystander and the antenna and/or radiating element of the device or the outer surface of the device, shall be less than or equal to 20 cm for these exemption limits to apply.

Table 11: Power limits for exemption from routine SAR evaluation based on the separation distance

Frequency (MHz)	≤ 5 mm (mW)	10 mm (mW)	15 mm (mW)	20 mm (mW)	25 mm (mW)	30 mm (mW)	35 mm (mW)	40 mm (mW)	45 mm (mW)	> 50 mm (mW)
≤ 300	45	116	139	163	189	216	246	280	319	362
450	32	71	87	104	124	147	175	208	248	296
835	21	32	41	54	72	96	129	172	228	298
1900	6	10	18	33	57	92	138	194	257	323
2450	3	7	16	32	56	89	128	170	209	245
3500	2	6	15	29	50	72	94	114	134	158
5800	1	5	13	23	32	41	54	74	102	128

The exemption limits in table 11 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 50 mm from a flat phantom, which provides a SAR value of approximately 0.4 W/kg for 1 g of tissue.

For limb-worn devices where the 10 gram of tissue applies, the exemption limits for routine evaluation in table 11 are multiplied by a factor of 2.5.

For controlled-use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in table 11 are multiplied by a factor of 5.

When the operating frequency of the device is between two frequencies located in table 11, linear interpolation shall be applied for the applicable separation distance. If the separation distance of the device is between two distances located in table 11, linear interpolation may be applied for the applicable frequency. Alternatively, the limit corresponding to the smaller distance may be employed. For example, in case of a 7 mm separation distance, either use the exception value for a 5 mm separation distance or interpolate between the limits corresponding to 5 mm and 10 mm separation distances.

4.2.2 RSS-102 – Clause 6.6 Field reference level exposure exemption limits

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:

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 $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz

8 Evaluations

8.1 FCC RF Exposure (Standalone)

Radio	Technology / Band	Frequency [GHz]	Power [dBm]	Gain [dBi]	EIRP [dBm]	EIRP [W]	ERP [W]	FCC 1.1307(b)(3)(i)(c) Threshold ERP [W]	ERP < Threshold
BT	LE	2.402	-	3.3	7.0	0.005	0.003	0.77	Exempt
Satcom	DSSS	1.61125	19.05	5	24.05	0.254	0.155	0.77	Exempt

Note 1: The worst case BLE and Satcom output power are used for evaluation as listed in Radio Information under Section 3 of this test report. For BLE, the max declared transmit EIRP of 6.0 dBm $\pm$ 1.0 dB from GT0-GT1 Theory of Operation Description Document # HW-SP-0-0160 is used. For Satcom, the measured RMS output power of 19.05 dBm is used.

Note 2: Evaluation of lowest frequency of each radio

8.2 ISSED RF Exposure (Standalone)

Radio	Technology / Band	Frequency [GHz]	Power [dBm]	Gain [dBi]	EIRP [dBm]	EIRP [W]	Exemption limit for Routine Evaluation [W]	EIRP < Threshold
BT	LE	2.402	-	3.3	7.0	0.005	2.68	Exempt
Satcom	DSSS	1.61125	19.05	5	24.05	0.254	2.04	Exempt

Note 1: The worst case BLE and Satcom output power are used for evaluation as listed in Radio Information under Section 3 of this test report. For BLE, the max declared transmit EIRP of 6.0 dBm $\pm$ 1.0 dB from GT0-GT1 Theory of Operation Description Document # HW-SP-0-0160 is used. For Satcom, the measured RMS output power of 19.05 dBm is used.

Note 2: Evaluation of lowest frequency of each radio

8.3 Multiple RF sources

According to GT0-GT1 Theory of Operation Description Document # HW-SP-0-0160, no simultaneous transmission is allowed between the radios.

9 Revision History

Date	Report Name	Changes to report	Prepared by
2024-05-21	EMC_GEOFO_038_23001_FCC_ISED_RF_Exposure	Initial Version	Lui, Chin Ming

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