W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

RF Evaluation Exclusion Exhibit For:

OPTICOMGPS4 Radio Transceiver Module

Prepared by:

Kimberly Bay, EMC Engineering

5-25-2016

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

Contents

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

Product Description:

This module is a complete RF module with an integral reference oscillator. It is part of a GPS based priority control system and uses a proprietary 2.4 GHz FHSS/TDMA transceiver to transfer data between emergency vehicles and any traffic intersection controllers within radio range.

The following information has been supplied by the applicant.

Product Name:	OPTICOMGPS4 Radio Transceiver Module
Model Number:	OPTICOMGPS4
Serial Number:	RK15450001, RK15450003, RK15450005, RK15450006, RK15450009
FCC ID:	VJB-OPTICOMGPS4
IC:	7275A-OPTICOM4

Associated Antenna(s):

The antennas associated with the EUT are:

A.) HOW TSEN # S-00101 Dipole: 2.0 dBi.
B.) Mobile Mark #DM2-2400/1575: 2.5 dBi.
C.) Panorama #TRNBG-7-24: 7.0 dBi.
D.) Laird #MAF94192: 3.5 dBi.

Statement of compliance:

The EUT was evaluated against the mobile requirements and limits of OET Bulletin 65, KDB 447498 as well as RSS-102 Issue 5 and was found to be compliant.

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

Limits:

A. Mobile (MPE)

OET Bulletin 65 limits for General population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
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

RSS 102 limits for General population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
$0.003\text{-}10^{21}$	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	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

Per RSS 102 issue 5 section 2.5.2, RF exposure evaluation is required is separation distance between the user and/or bystander and the device's radiating element is greater than 20cm, 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 $22.48/f^{0.5}$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 $1.31 \times 10^{-2}\ f^{0.6834}$ 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).

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

B. Portable (SAR Test Exclusion Threshold).

FCC:

SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 20 cm

1-g SAR test exclusion threshold equation:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)] ≤ 3.0

10-g SAR test exclusion threshold equation:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)] ≤ 7.5

RSS 102:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Note:

1. Table above if for 1-gram tissue, head and body, evaluation (uncontrolled). Limb-worn devices where 10-gram tissue applies, multiply limit by a factor of 2.5

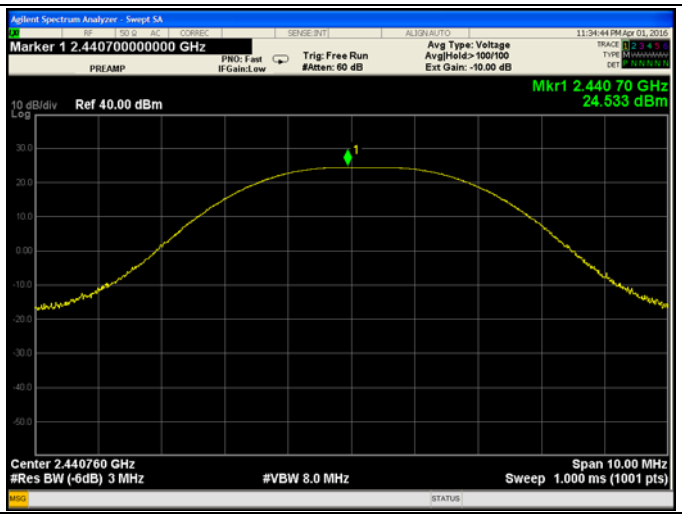
W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

Data and calculations:

Data Table

Frequency (MHz)	Peak Conducted Output Power (dBm)
2401.02	23.7
2440.96	24.5
2476.80	24.3

Plot –Maximum Peak Conducted Output Power



2440.96 MHz

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

A. MPE Calculation

The following MPE calculations are based on a measured conducted RF power of +24.5 dBm with 1dB tune-up tolerance. The maximum antenna gain used in the calculation, based on the data sheet, is 7.0 dBi.

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	25.50	(dBm)
Maximum peak output power at antenna input terminal:	354.813	(mW)
Antenna gain(typical):	7	(dBi)
Maximum antenna gain:	5.012	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2441	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.353777	(mW/cm^2)
Maximum allowable antenna gain:	11.5	(dBi)
Margin of Compliance at 20 cm =	4.5	dB

Power Density = **0.35377 mW/cm^2** = **3.5377 W/m^2**

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

RF Exposure Evaluation:

Evaluated against exposure limits: General Public Use ☒ Controlled Use ☐
Duty cycle used in evaluation: 100 %
Standard(s)/Procedure(s) used for evaluation (e.g. IEEE C95.3):OET Bulettin 65 and RSS 102
Measurement distance: 20 cm
RF field strength value: **3.54** V/m ☐ A/m ☐ W/m² ☒
Measured ☐ Computed ☐ Calculated ☒

Summary:

The calculated power density of the EUT was found to be below the OET Bulletin 65 MPE limit.

Per RSS 102 issue 5 section 2.5.2, the limit:

$1.31 \times 10^{-2} * (2441)^{0.6834}$ W = **2.71W**

EUT EIRP = 24.5dBm + 1.0dB + 7.0dBi = 32.5dBm = **1.78 W**

The EUT is excluded from Routine evaluation.

W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

B. SAR Test Exclusion

This section is not applicable