RF Exposure

This Class II Permissive Change application is to authorize the co-location of the WLAN radio FCC ID: KBCIX-512AN with the Bluetooth radio FCC ID: KBCIX-WT11, and cellular WAN radio FCC ID: KBCIX-GOBI2, in the General Dynamics Itronix Corporation, rugged laptop PC, Model: GD8000.

The WLAN and WWAN antennas are located more than 20cm from the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091 (b). Also, all antennas are greater then 5 cm from all other simultaneous transmitting antennas. The attached photograph diagrams the location of the transmitter antennas.

"KDB 447498 D01 Mobile Portable RF Exposure v04" provides the procedures, requirements, and authorization polices for mobile and portable devices. Item #8 best fits the exposure condition described in this C2PC application. Since this mobile device is categorically excluded from routine evaluation, and per footnotes 1 and 32 of KDB 447498, simple calculations may be used to estimate the power density to demonstrate compliance with 47 CFR 1.1310 requirements. The attached estimates show MPE limits are met for simultaneous transmission at a 20 cm compliance boundary.


WWAN Main
WLAN Main
WWAN Diversity
GPS
WLAN Aux
GPS, WWAN Main, WWAN Diversity mounted on back of LCD enclosure
WLAN antennas mounted on edge of LCD enclosure
Bluetooth antenna is located just under the plastic palmrest cover
Bluetooth

Compliance with 47 CFR 15.247(i)

> "*Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter*."

The EUT will only be used with a separation distance of 20 centimeters or greater between the antenna and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091 (b). Calculations are provided for each radio transmitting through its own internal antenna and optional external antenna.

The total transmit power is less than 1.5 W (ERP), therefore the EUT is categorically excluded from routine environmental evaluation per 47 CFR 2.1091(c).

The MPE estimates are as follows:

Table 1 in 47 CFR 1.1310 defines the maximum permissible exposure (MPE) for the general population. The exposure level at a 20 cm distance from the EUT's transmitting antenna is calculated using the general equation:

$S = (PG)/4\pi R^2$
Where: S = power density (mW/cm^2)
P = power input to the antenna (mW)
G = numeric power gain relative to an isotropic radiator
R = distance to the center of the radiation of the antenna (20 cm = limit for MPE estimates)
PG = EIRP

Solving for S, the maximum power densities 20 cm from the transmitting antennas are summarized in the tables on the following pages:

MPE Estimates for Self-Located WAN Device

FCC ID: KBCIX-GOBI2								
In the GD8000, Host PC								
GSM, GPRS, EDGE, UMTS, WCDMA, HSDPA, CDMA 2000 1xRTT, EVDO Rev 0, Rev A								
Modulation Type	**GD8000 WAN Antenna Type Antenna Part No.**	**Transmit Frequency**	**Max Peak Conducted Output Power**	**Antenna Gain**	**Min. Ant. cable loss**	**Power Density @ 20 cm Duty cycle correction in blue ( )**	**General Population Exposure Limit from 1.1310**	**Ratio of Power Density to the Exposure Limit**
	Internal Meander Line	**(MHz)**	**(mW)**	**(dBi)**	**(dB)**	**(mW/cm^2)**	**(mW/cm^2)**	
GPRS 850 (2 UL Slots)	47-0384-001R	824	1919	2.3	0.89	0.5263 (.1316) *	0.55	**0.239 ***
WCDMA 850	47-0384-001R	824	262	2.3	0.89	.0718	0.55	.131
CDMA 850	47-0384-001R	824	290	2.3	0.89	.0795	0.55	.145
GPRS 1900 (2UL Slots)	47-0384-001R	1850	874	3.1	1.5	.2513	1	.251
WCDMA 1900	47-0384-001R	1850	256	3.1	1.5	.0735	1	.074
CDMA 1900	47-0384-001R	1850	291	3.1	1.5	.0836	1	.084
	External MaxRad							
GPRS 1900 (2UL Slots)	BMLPVDB800/1900	824	1919	3	2.2	0.458 (. 1145) *	0.55	.208
WCDMA 1900	BMLPVDB800/1900	824	262	3	2.2	0.063	0.55	.115
CDMA 1900	BMLPVDB800/1900	824	290	3	2.2	0.069	0.55	.125
GPRS 1900 (2UL Slots)	BMLPVDB800/1900	1850	874	3	3.7	0.148	1	.148
WCDMA 1900	BMLPVDB800/1900	1850	256	3	3.7	0.043	1	.043
CDMA 1900	BMLPVDB800/1900	1850	291	3	3.7	0.049	1	.049

Worst Case Ratio of Power Density to the Exposure Limit **= 0.239**

* Source-based time averaging corrected power density for the GPRS 2 Slot UL Duty Cycle of 25% "worst case". (0.5263 x 25% = 0.1316 mW/cm^2 /0.55 = 0.239)

Excerpts from TCB Training, April 3, 2002, "Mobile Transmitters", Slide 6:

"Devices operating in multiple frequency bands

- *When RF exposure evaluation is required for TCB approval*
  - *Separate antennas – estimated minimum separation distances may be considered for the frequency bands that do not require evaluation or TCB approval, however, the estimated distance should take into account the effect of co-located transmitters. (Note 24)*

Note 24 According to multiple frequency exposure criteria, the ratio of field strength or power density to the applicable exposure limit at the exposure location should be determined for each transmitter and the sum of these ratios must not exceed 1.0 for the location to be compliant."

The sum of the ratio(s) (power density to the exposure limit) does not exceed 1.0; therefore, the exposure condition is compliant with FCC rules.

MPE Estimates for Self-Located Device

FCC ID: KBCIX-512AN			**Host PC: GD8000 in GD8000 Vehicle Mount**					
Model: IX-512AN, WLAN, IEEE 802.11 (a) (b) (g) (n)								
Antenna Type	**Antenna Part No.**	**Transmit Frequency**	**Max. Peak Conducted Output Power**	**Ant. Gain**	**Min. Antenna Cable Loss**	**Power Density @ 20 cm**	**General Population Exposure Limit from 1.1310**	**Ratio of Power Density to the Exposure Limit**
		(MHz)	**(mW)**	**(dBi)**	**(dB)**	**(mW/cm^2)**	**(mW/cm^2)**	
GD8000 in GD8000 Vehicle Mount with the Magnetic Mount External 2.4 GHz MaxRad Antenna.								
External MaxRad	MAXC24505	2462	91.2	5	4.4	0.0208	1	0.0208
GD8000 Stand Alone								
GD8000 MAIN - R13M (Right Side of Display)	**TW13MWIPI02+C**	2412 - 2460	91.2	-2.31	*-Inc.-	0.0106	1	0.0106
GD8000 MAIN - R13M (Right Side of Display)	**TW13MWIPI02+C**	5745 –5825	20.9	2.40	*-Inc.-	0.0072	1	0.0072
GD8000 MAIN - R13M (Right Side of Display)	**TW13MWIPI02+C**	5180 –5320	27.5	1.22	*-Inc.-	0.0072	1	0.0072
GD8000 MAIN - R13M (Right Side of Display)	**TW13MWIPI02+C**	5500 - 5700	53.7	1.24	*-Inc.-	0.0142	1	0.0142
GD8000 AUX – R13M (Left side of Display)	**TW13MWIPI01+C**	2412 - 2460	91.2	-2.13	*-Inc.-	0.0111	1	0.0111
GD8000 AUX – R13M (Left side of Display)	**TW13MWIPI01+C**	5745 –5825	20.9	3.2	*Inc.	0.0087	1	0.0087
GD8000 AUX – R13M (Left side of Display)	**TW13MWIPI01+C**	5180 –5320	27.5	4.55	*Inc.	0.0156	1	0.0156
GD8000 AUX – R13M (Left side of Display)	**TW13MWIPI01+C**	5500 - 5700	53.7	2.66	*Inc.	0.0197	1	**0.0197**
* Included in antenna factor								

This transmitter complies with Part 15.407(f). The U-NII device is subject to and complies with the general population uncontrolled, radio frequency radiation exposure requirements of CFR 47 Parts 1.1307, 2.1091 for both the fundamental and unwanted emissions.

MPE Estimates for Self-Located Bluetooth Device

FCC ID: KBCIX-WT11								
Model: IX-WT11								
Bluetooth 2.0, EDR Radio								
Antenna Type	Antenna Part No.	Transmit Frequency	Max Peak Conducted Output Power	Antenna Gain	Minimum Antenna Cable Loss	Power Density @ 20 cm	General Population Exposure Limit from 1.1310	Ratio of Power Density to the Exposure Limit
Permanently attached		(MHz)	(mW)	(dBi)	(dB)	(mW/cm^2)	(mW/cm^2)	
IX-WT11, Internal PIFA	**TWR12BLPI01A**	2402	21.75	-2.86	*Inc.	0.0024	1	**0.0024**
Worst Case Ratio of Power Density to the Exposure Limit = **0.0024**								

Worst Case Co-Located Exposure Condition for Mobile Category

FCC ID: KBCIX-GOBI2 **FCC ID: KBCIX-512AH** **FCC ID: KBCIX-WT11**	
Per Note 24 shown below, the Sum of Worst Case Power Ratios cannot exceed 1.0	

GOBI2 Radio Worst Case Ratio of Power Density to the Exposure Limit	**802.11 WLAN** Worst Case Ratio of Power Density to the Exposure Limit	**Bluetooth** Worst Case Ratio of Power Density to the Exposure Limit	**Sum of Worst Case Ratios (Power Density to the Exposure Limit)**	**FCC Limit for Sum of Worst Case Ratios**	
0.239	0.0197	0.0024	**.2611**	1.0	***** PASS

The results shown in the above table are equivalent to the Sum of the EIRP of the three Co-located Transmitters (EIRP TX1 + EIRP TX2 + EIRP TX3) compared to the exposure limit. The benefit of this method is that accounts for transmitters operating at different frequencies against different exposure limits.