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RF EXPOSURE INFORMATION

REFLEX TELEMETRY DEVICE, OMNIDATA, MODEL PT1005-A

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The OMNIDATA device contains a transmitter and a receiver. When it is turned on it receives and it may transmit radio frequency energy in the 900MHz band. During transmissions the output power level at the antenna port varies over a range from 0.125 to 1 watt. The paging carrier service provider controls the output power level.

The antenna used for this transmitter must be fixed mounted in a permanent structure providing a separation distance of at least 20 cm from all persons during normal operation. The OMNIDATA is provided without an external antenna. During measurements for FCC certification PerComm used the Larsen quarter-wave dipole antenna model SPWH20918 with a 4"x4" metallic ground plane. If another antenna is used its maximum gain should not exceed the theoretical dipole gain of 2.15dBi.

During the measurements for FCC certification the maximum effective radiated output power was less than the 1.5 watts FCC limit for mobile devices, hence OMNIDATA should be excluded from routine environmental evaluation for RF exposure as per §2.1091(c) of FCC rules.

OMNIDATA transmits with a source-based time averaging duty factor not exceeding 21.74%. The maximum radiated output power of the recommended antenna, including the applicable source based time averaging duty factor satisfies the maximum permissible exposure (MPE) limits as specified in §1.1310 of FCC regulations for general population/uncontrolled exposure as long as the minimum separation distance of 20cm between the radiating element and the person is respected.

The calculation of the maximum permissible exposure

The MPE evaluation is done making the following assumptions: OMNIDATA transmits at the maximum rated power of Pout =1 Watt, the antenna is a half dipole having the maximum gain of 2.2dBi, the transmitter duty cycle is the worst-case allowed under the ReFLEX protocol, the power density limits are for general population/ uncontrolled exposure.

The worst-case duty cycle for the OMNIDATA device transmitter occurs on a collapse rate of 1 when the device is sending messages to the infrastructure. For this calculation, we assume infinite messages are queued in the device; each message is the maximum length allowed (700 bytes) and the back channel is running at its slowest speed (800 bps).

The ReFLEX protocol is timed on frames, each being 1.875 seconds long. The sequence for transmitting a message from the device is shown in the following table. Also shown is transmitter on time and elapsed time in seconds.

Frame	Event	Transmitter on-time	Elapsed time
1	Device sends Request to Transmit to system	0.162	1.875
2	Request goes to system controller and is scheduled	0	1.875
3	Unusable Frame	0	1.875
4	Grant for data unit is sent to Device	0	1.875
5	Device sends first data unit (100 Bytes) to system	1.875	1.875
6	Data unit goes to system controller and next data unit is scheduled	0	1.875
7	Unused frame	0	1.875
8	Grant for next data unit is sent to Device	0	1.875
9	Device sends data unit to system	1.875	1.875
10 – 29	Repeat steps 6-9 until entire message is transmitted (5 more data units for a total of 7)	5 x 1.875	20 x 1.875
30	Last data unit goes to system controller, and End of Transmission is scheduled	0	1.875
31	Unusable frame	0	1.875
32	End of Transmission is send to Device	0	1.875
33	Device sends ACK to End of Transmission to system	0.162	1.875
	Totals	**13.449s**	**61.875s**

Thus, the maximum duty cycle for the Location Tag device transmitter is:

$$D = \frac{13.449}{61.875} = 21.74\%$$

Note: This is the theoretical maximum based on the protocol, but is not achievable in a real system due to computing delays and traffic delays.

According to FCC recommendations the RF power density is averaged over 30 minutes and this duration being much longer than 65.875 seconds it is correct to use the calculated duty cycle as the averaged maximum duty cycle.

The maximum gain of the half-wave dipole antenna on a linear scale is:

$$G = 10^{\frac{2.2}{10}} = 1.66$$

The minimum allowed distance between persons and the antenna (see OMNIDATA User guide, page 10) is:

$$R_{\min} = 20\ cm$$

The theoretical power flux density at this distant is:

$$S = \frac{P_{out} \cdot G \cdot D}{4 \cdot \pi \cdot R_{\min}^2} = \frac{1\,W \cdot 1.66 \cdot \frac{21.74}{100}}{4 \cdot \pi \cdot (20\ cm)^2} = 0.0702 \quad \frac{mW}{cm^2}$$

The MPE limit for general/uncontrolled exposures at the minimum transmit frequency of 901MHz is:

$$S_{MPE} = \frac{f(MHz)}{1500}\ \frac{mW}{cm^2} = \frac{901}{1500}\ \frac{mW}{cm^2} = 0.601\ \frac{mW}{cm^2}$$

As can be seen from these calculations the OMNIDATA device equipped with a half-wave dipole antenna is well below the FCC limits for MPE. The distance from the antenna for which the MPE limit is reached is:

$$R_{MPE} = \sqrt{\frac{P_{out} \cdot G \cdot D}{4 \cdot \pi \cdot S_{MPE}}} = \sqrt{\frac{1\,W \cdot 1.66 \cdot 0.2174}{4 \cdot \pi \cdot 0.601\ \frac{mW}{cm^2}}} = 6.9\ cm$$