transitions will occur at the same time as the low battery event occurs (or would occur if the event was activated). Note that in the case of a very fast transition between voltages, it may take up to 20 seconds for the modem to confirm a change in battery status.

### Message Waiting

The Message waiting signal is held active low whenever there is at least one complete message waiting in the outbound buffers (including the reread buffer).

### In-Range

The In Range signal is held active low whenever the modem is in range. It tracks the function of the Data Carrier Detect (DCD) signal.

## Selecting & Positioning the Antenna

Use this information to assist you in selecting the appropriate antenna to incorporate into your product package. For specific detailed information, Wavenet recommends that you use the expertise of an antenna design engineer to solve individual application concerns.

### Antenna Safety

The design of the integrated product must be such that the location used and other particulars of the antenna comply with the appropriate standards of the country in which the host device or terminal is to be used.

The integrator should refer to the statement of Compliance on page 12 of this manual and Regulatory Requirements section on pages 23-27 for country requirements.

### Mobile and Portable Devices

In the environment where portable devices are in use, many variables exist that can affect the transmission path. In this case, it would be preferable to use a vertically polarized, omni directional antenna. Antennas for portable devices include the following designs:

**Internal antenna (invisible or pull-up)**

An internal antenna must provide a gain sufficient to meet network specifications. Cable routing from the modem to the antenna needs to avoid RF sensitive circuits and high level, high-speed clock circuits. Consider:

- The location of the antenna to avoid RFI to a computing device.
- Good shielding to the display and other RF-sensitive components
- The most efficient method of cable routing

Otherwise, antenna gain can be offset by cable loss. A typical coaxial cable is very thin, such as RG178B used in portable devices, and cable loss can be 1dB or more per metre. Some coaxial cable manufacturers

market relatively thin double braid coaxial cables. These cables show much better isolation than single braid cables, typically by 30 to 40dB. These double braid cables reduce radiation and RF pick-up when routed inside a portable device.

**External antenna, removable and directly connected to the device**

You can design a portable device that can use an off-the-shelf, plug-in antenna, such as a ¼ wave monopole or ½ wave dipole antenna. Typical gain of these omni directional antennas is 0dBi and 2.14dBi, respectively.

Cabling demands the same consideration as an internal antenna application. In a typical laptop application, the antenna must be placed as far as possible from a display to avoid deflection. This usually causes a deep null in radiation patterns.

**External, remote antenna**

For remote antenna application use the same design approach as internal designs, including the RF cable routing of the external connector. You can choose an off-the-shelf mobile antenna of omni directional ½ wave length.

A double braid coaxial cable such as RG223 from the device to the antenna is recommended if the cable length is more than a metre. The difference in cable loss between low cost RG58 and the more expensive RG223 is approximately 4.5dB per 30 metres. If the cable must be routed through noisy EMI/RFI environments, a double braid cable such as RG223 can reduce radiation and pick-up by 30 to 40dB.

## Fixed Devices

Fixed data device applications use the same design recommendations as a portable device with a remote antenna.

As for the RF connector of an external antenna, whether it is a plug-in type or a remote type, the most economical and practical choice is a TNC threaded connector. TNC has a good frequency response to 7GHz, and leakage is low. A mini UHF threaded connector provides adequate performance and is an economical choice. If the size of the TNC and mini UHF connectors becomes critical, consider an SMA threaded connector or an SMB snap fit connector. (The SMB connector does not accept an RG58 or RG223 cable).

## Selecting an Antenna

The requirements for the antenna used with the Boomer II OEM Modem are:

| | |
|---|---|
| Antenna Gain: | 3 dBi (isotropic) maximum if module FCC approvals are to be used. |
| Impedance: | 50Ω |
| Centre Frequency: | 833MHz ± 5MHz |

| | |
|---|---|
| Frequencies of operation: | 806 to 825MHz (transmit)<br>851 to 870MHz (receive) |
| Acceptable return loss: | VSWR < 1.5 or RL < -14dB (recommended)<br>VSWR < 2.0 or RL < -10dB (minimum) |

The power output of the Boomer II OEM Modem is nominally 1.8W at the antenna port. The antenna gain or loss will affect this value.

### Connecting the Antenna

The Boomer II OEM Modem Module provides an MMCX RF connector located at the top of the unit, to attach to the antenna cable.

The antenna does not plug directly into the modem but uses an antenna cable to interface between the device and the modem.

The antenna cable should be a low loss, 50Ω impedance and have a MMCX plug that can mate with the modem's MMCX socket (82MMCX-S50-0-2). It is recommended that a Huber+Suhner connector be used to connect to the modem as below:

- 11 MMCX Straight Connector
- 16 MMCX Right Angle Connector

If an extension cable is required to the antenna, it should be low loss, as short as possible and an impedance of 50 ohms. Proper matching connectors should be used, as each connector introduces a return loss and reduces performance.

### Positioning the Antenna

Positioning the antenna will affect the gain provided by the antenna.

The antenna should be orientated so that it provides vertical polarisation as the DataTAC network is based on vertically polarised radio-frequency transmission.

The antenna should be located as far from the active electronics of the computing device as possible. Typically, a metal case of a computing device and its internal components may attenuate the signal in certain directions. This is undesirable as the sensitivity and transmit performance of the Boomer II would be reduced. However, careful use of metal used for the ground plane for an antenna can improve the antenna gain and the coverage area for the system.

If your device is designed to sit on a surface, the antenna should be positioned as far from the bottom of the device as possible. This is to reduce the radio frequency reflections if the device is placed on a metal surface.

If your device is hand held or is worn next to the body, the antenna should be positioned to radiate away from the body.

The integrator should refer to the statement of Compliance on page 12 of this manual and Regulatory Requirements section on pages 23-27 for specific country requirements.