
# User Manual
# and
# Integrator's Guide

# Boomer-III Mobitex
# OEM Modem Module:

# BM3-900M

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Published by Wavenet Technology Pty Ltd.

This product is a modular transmitter approved under FCC Part 2 and Part 90 rules.

900MHz Modem Module - FCC ID: PQS-BM3900M

This device complies with Part 15 Class B of the FCC rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received including interference that may cause undesired operation.

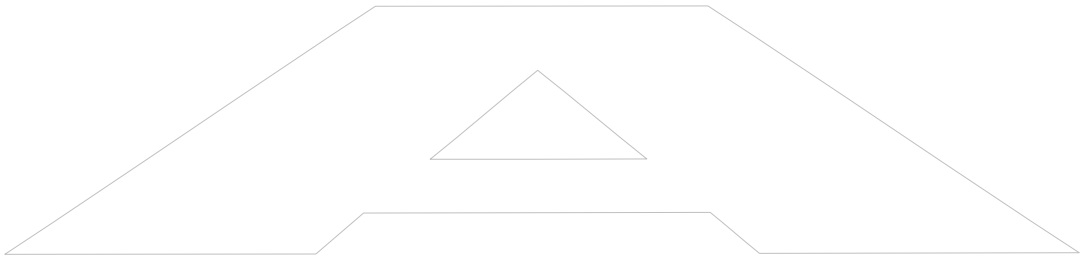
This product is approved under Industry Canada (IC) RSS119 rules.

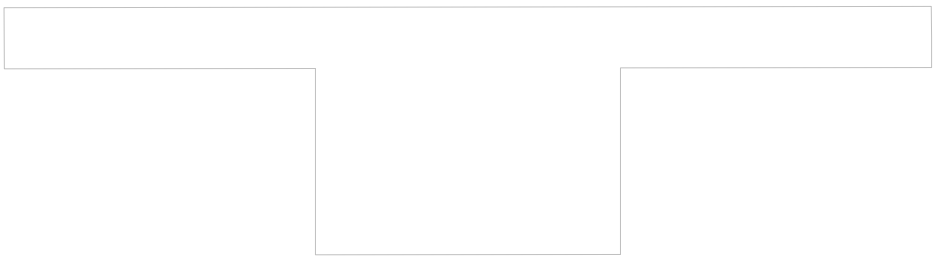
900MHz Modem Module - IC: 4062A-BM3900M

# Contents







# Introduction

The Boomer-III OEM Modem Module is a radio packet modem, intended for use on Mobitex 900MHz data communication networks.

It is primarily designed to be integrated into customer equipment as an OEM module, for use with an Enterprise Application Server running wireless applications or as the RF communications enabler device for telemetry products

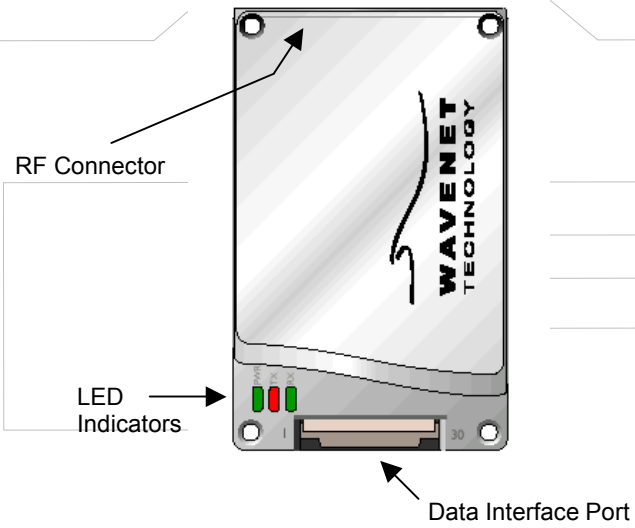
Messages from the end user are sent from the host/terminal through the serial interface, and are transmitted by the modem when it is in network coverage. Messages to the end user are received and acknowledged by the modem, then passed to the host/terminal.

Within an area of coverage, the modem performs auto-roaming (auto-scanning, channel selection, and registration on a new channel). The modem operates in either battery save or non-battery save modes, as instructed by the network and overridden by the host/terminal.

The modem interfaces to the host/terminal by using the data interface port. The protocol supported over this link is Mobitex Asynchronous Serial Communications (MASC).

The Boomer-III modem has the ability to contain on-board third party applications software for embedded solutions. A Software Development Kit (SDK) is available and described later in this manual to assist this process.

A picture of the Boomer-III OEM Modem Module is shown below.



This manual contains the following major sections:

Section 1: Introduction

Section 2: The Integrator's Task

Section 3: Installing the Modem

Section 4: Modem Test Jig

Section 5: Wavenet Software Tools

Section 6: Integration Testing

In addition useful reference information has been included in the appendices.

## Modem Features

The Boomer-III OEM Modem is smaller than the average size of a credit card. The modem is easily connected to many other devices and can be incorporated into a variety of package formats.

The Boomer-III OEM Modem has the following features:

- Up to three UART Serial communications interface ports and one SPI port
- On-Board Real Time Clock with battery back input option
- Indicator lights showing power supply and data status
- Five configurable multiple function digital/analogue inputs or five digital output lines for external control/monitoring
- Software configurable RF calibration adjustments to suit specific networks
- High sensitivity reception
- Small footprint and low profile design
- Low-voltage and low standby current consumption for battery based products
- Auto-wake up of host/terminal on incoming messages
- Roaming capabilities as defined by the network
- Easy to install, service and update

## Wireless Applications

Wireless applications in which the Boomer-III OEM Modem may be used include the following:

**Meter Reading**

The modem can be used to read billing information from intelligent electrical meters and basic disc meters. Data is transmitted wirelessly through a radio network to billing computers.

**Point of Sale**

The modem can perform handshaking and complete verification of all data transmitted through the wireless network whilst providing convenient operator mobility such as open air events or conferences.

**Vending Machines**

Vending machines can also utilise radio data technology. Many machines already transmit usage and refill requirements to company head offices via standard telephone lines. Radio modems allow vending machines to be placed in areas with poor access to telecommunications infrastructure, providing a cost-effective alternative to installing new telephone lines. On refilling, only the required refills will be despatched to the required sites maximising truck carrying capacity and consequently efficiency.

**Alarm Detection**

Conventional telephone wire connections are slow to dial out and can burn before the emergency call can be placed. Laws in many states and countries require businesses to have an on-line dial out fire alarm system. The Boomer-III OEM Modem offers a real solution to this problem.

**Parking, Buses and Ticketing**

Ticketing machines are being be converted to cashless operation. The Boomer-III OEM Modem is the best alternative to facilitate the introduction of this cashless technology.

## Developer Support

A complete developers program is offered by Wavenet to assist integrators in the design, testing and implementation phases of their wireless applications. This includes a developer's kit, modem software tools, sample source code and prototyping components. Wavenet's experienced team of RF and software engineers are available to give technical support as required.

## Integrator Developers Kit

To facilitate the rapid development and deployment of wireless applications, Wavenet has available an Integrator Developers Kit which contains all the components necessary to get an evaluation and development platform up and running in the shortest possible time. The kit contains the following components:

- Evaluation Board for interface to a PC for testing (Boomer-III Modem Test Jig)
- Power cable for connection to a variable power supply
- 800 MHz (blue tip) or 900 MHz (red tip) ¼ wave whip antenna
- Antenna cable
- PC Serial interface cable
- 5 sample FPC strips for prototyping purposes
- 5 sample FPC connectors for prototyping purposes
- Software Developers Kit on CDROM containing Integrators Guide and User Manual, Modem communications software, device drivers and sample source code

### System Requirements

The minimum system requirements of a host/terminal emulation PC in order to utilise the Integrator Developers Kit are:

- Intel compatible Pentium computer or higher
- Windows 2000 or later
- 16MB RAM (memory) minimum, 32MB recommended
- 1MB available hard disk space
- 9-pin serial Port using a 16550 UART
- 3.5-inch Disk Drive
- CD-ROM drive

## Compliance Statement

The Wavenet Boomer-III OEM Modem Module has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

Output is specified at the antenna terminal of this module. This modular transmitter is only approved for OEM integration into final products that satisfy mobile operating requirements of 2.1091 of the FCC rules. The final product and its antenna must operate with a minimum separation distance of 20 cm or more from all persons using the antenna with maximum average gain not exceeding 5dBi to satisfy MPE compliance. Separate approval is required for this module to operate in portable products with respect to 2.1093 of FCC rules.

Wavenet has obtained certificates of Technical Acceptability for use in Canada in accordance with the Radio Standards Procedure RSP-100 and Radio Standards Specification RSS119, Issue 3.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the manufacturer's instructions, may cause interference harmful to radio communications.

There is no guarantee however, that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult your supplier or an experienced radio/TV technician for assistance.

**Warning**: *Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.*

## Information for Your Safety

Please read these safety instructions and the operation instructions provided in this manual before operating the Boomer-III OEM Modem.

### Safe Use

Switch the modem off in areas where radio devices are forbidden, or when it may cause interference or danger. For example, fuel depots (fuel storage and distribution areas), chemical plants, and locations in which hazardous or combustible gases may be present and where blasting operations are in progress.

Do not use the modem in an aircraft. Such use may affect aircraft instrumentation, communication and performance and may be illegal.

Be aware that the modem may interfere with the functionality of inadequately protected medical devices, including pacemakers. Additionally, the effect of the radio signals from the modem on other electronic systems, including those in your car (such as electronic fuel-injection systems, electronic anti-skid braking systems, and electronic cruise-control systems) may affect the operation of these systems, which should be verified before use in the applications

Do not place the modem on an unstable surface. It may fall and damage the equipment.

Never push objects of any kind into the modem through openings as they may short out parts that could result in a fire or electrical shock. Never spill liquid of any kind on the modem. Do not use the modem near water (for example near a bathtub or sink, in a wet basement, near a swimming pool etc.). The modem should be situated away from heat sources.

Disconnect the modem from the power source before cleaning. Do not use liquid or aerosol cleaners. Use a damp cloth to clean the unit.

Disconnect the modem from the power source and contact your supplier if:

- Liquid has been spilled or objects have fallen onto the modem.
- It has been exposed to rain or water.
- It has been dropped or damaged in any way.
- It does not operate normally by following the instructions contained in this manual.
- It exhibits a distinct change in performance.

Failure to observe all these instructions will void the limited warranty.

# The Integrator's Task

This section provides background information and points out the objectives and tasks of reaching the goal of a successful implementation.

| Areas of Focus | Benefits |
|---|---|
| Serial Port Pass-Through Capability | ❑ Enables modem diagnostics and software upgrades without the need to disassemble the host/terminal |
| Understanding RF Design | ❑ Provides the required network coverage.<br>❑ Sets end-user performance criteria.<br>❑ Reduces risk of costly redesigns. |
| Software & Hardware | ❑ Provides reliable operation through a state-of-the-art functional interface.<br>❑ Helps ensure longer service life and fewer field returns. |

Because wireless data communication technologies are usually described using a unique variety of jargon, buzzwords, and technical details, it is sometimes hard to know where to start. You may also have difficulty evaluating this technical information when you find it.

As an OEM integrator, you must accurately choose where and how a wireless technology will facilitate communication for your application. You will also have to evaluate which technical considerations will give your product an edge over the competition.

To successfully integrate the Boomer-III OEM wireless modem into the host/terminal, you must perform the following tasks:

- Plan the product and create the design
- Develop and validate the hardware
- Develop supporting applications software
- Test and approve the product

As you review these tasks, allow sufficient time for such required activities as the regulatory approval process. Identify critical path activities up front.

## Plan the Product and Create the Design

To plan the product and create the design, perform the following steps:

- Develop a usage model.
- Develop a message model.
- Define a service strategy.
- Investigate and obtain regulatory approval.

### Develop a Usage Model

The usage model answers the question, "How will the end product be used (portable or mobile; 8 hours, 7 days a week; and so on)?"

Perhaps the most important enabler of success is a clear determination of how the final product is to be used. This steers the development process, because all design considerations drive toward meeting the needs of the final user. For example, design issues related to a mobile device, such as alternator noise and vibration, are completely different from considerations required for a fixed-point telemetry application powered by a solar panel. Defining what is and what is not important to the end user helps to make the critical engineering trade-off decisions that are inevitable in every product design.

### Develop a Message Model

The message model defines how many messages are sent/received and how often. To create the message model, determine how much and how often data will be sent in each of the uplink (terminal to network) and downlink (network to terminal) directions.

Answer the question, "Is there a requirement for the terminal to be on and able to receive 8 hours a day, or does the user turn the unit on only when making a query to the Enterprise Server Application?" The answer has a direct bearing on the battery size and capacity requirement for powering the device. The amount of data sent and received is relevant in calculating the cost of airtime and deciding on which type of network connection to use. In short, the message model is required source data for making many engineering design decisions, especially in calculating such values as sleep time versus wake time and in determining battery capacity requirements.

For additional information, refer to section "Message Traffic Model" on page 44. The typical approach to creating the model is to define the peak and average network throughput requirements based on input from the user. Wavenet Technology is able to provide current consumption figures for each of the various modes of operation (receive and transmit, for example) and explain the functionality of the network Power Save protocol.

The network throughput of the host/terminal depends on many factors in addition to the raw throughput of the radio channel. For example, in addition to the overhead involved in forward error correction and

support for packet headers, the number of active users on a shared RF channel can directly affect network throughput.

### Define a Service Strategy

The service strategy determines whether the integrated modem is the cause of a user's problem and sets a policy for keeping the end user operational during repair. The service strategy must consider all potential service situations and evaluate them in light of the usage model.

To ensure that a final product can be efficiently serviced, you must design for service-ability early in the development process. At a minimum, you must develop a functional service strategy that contains a well-considered procedure for performing unit-level screening. The test must primarily determine whether a fault lies with the modem or with the product. The test must also screen for network problems and human error.

Wavenet provides an evaluation board (a standalone test jig) and various software test utilities. The evaluation board provides a mounting platform and electrical interface to the modem. Testing is performed much more efficiently while the modem is still integrated within the host/terminal, whether for a factory end-of-line test or while at the user's site.

For your product to allow integrated testing of the modem, you are required to provide modem pass-through mode and utilise Wavenet Commander software. See "End User Problem Resolution" on page 72. Without pass-through, the modem must be mounted on the evaluation board for diagnostics and troubleshooting. Pass-through mode also allows for modem software upgrades.

A thoroughly developed OEM serviceability plan typically includes a needs assessment for developing software utilities that can assist in identifying communication problems between the host/terminal and the modem and between the modem and the RF network.

These utilities must be able to send commands to the modem, evaluate the modem responses, perform network connectivity testing, and verify data communication with the network.

Such a software utility is essential for field service engineers and shop technicians to diagnose problems with the product and to troubleshoot a problem to a failed assembly or mismanaged communication link.

### Diagnostic Capabilities

To provide modem diagnostics, there are three LED's on the modem itself. When the unit is first powered up it goes through its own self test and the status is reflected in the visual status of the LED's.

### Customer Problem Isolation

When application-visible problems are discovered in the field, you must isolate the source of the problem. Is it the network, wireless

modem, or the host/terminal that is not working as expected? Often it can be a user's misunderstanding of how to use the product. Regardless, remote troubleshooting is essential to reducing the number of returned products and lowering service costs, particularly if the host/terminal must be disassembled for removal of the modem.

Wavenet recommends that your product application (both at the terminal and Enterprise Server Application ends) incorporate sufficient problem diagnostic software to determine the cause of the problem remotely. Often, the best approach is to incorporate progressively deeper loop back tests to determine the point at which the communication link fails.

As stated elsewhere, you need to make this remote diagnostic functionality be part of your standard software load.

### End User Support

You have two choices in dealing with an integrated modem that needs to be swapped out and returned for service:

- Decommission the modem and re-use its unique ID
- Replace the modem

If you decommission the modem ID from the defective unit and transfer it to a replacement unit, the user and the network operator are unaffected. This can only be done by an authorized Wavenet service centre with the appropriate permissions and authority. If you simply swap the defective unit with a replacement, the user must notify the network operator.

### Investigate and Obtain Regulatory Approval

Most countries where the final product will be sold currently require approval from the local government regulatory body. It is your responsibility to investigate and obtain the proper regulatory approval and certification for each country in which the product is sold.

Regulatory issues are discussed in more detail in "Regulatory Requirements" on page 19. In addition, see "Regulatory Compliance" on page 71.

## Develop and Validate the Hardware

To develop and validate the hardware, perform the following steps:

- Design the hardware platform
- Consider power supply options
- Select the source antenna
- Set up a development test environment

### Design the Hardware Platform

Integrating a wireless modem into a hardware design requires many steps. Here again, the usage and message models are necessary to calculate issues such as battery size, heat dissipation, isolation from EMI, and physical mounting of the unit to ensure proper grounding.

Hardware design is your responsibility. Wavenet can provide recommendations where applicable and may also assist with verification of EMI-caused desense once the modem is integrated into the host/terminal.

### Consider Power Supply Options

Power supply requirements vary according to the usage and message models. Beyond accounting for the current drain of the modem in its various operating modes, consider ripple and noise on the power lines, and the ability to supply sufficient instantaneous current to allow proper operation of the transmitter. Also, ensure that the power supply can accommodate the highest power consumption under transmit conditions and that the voltage does not fall below the minimum levels at the modem terminals. (Remember voltage drops can occur in the interconnectivity wiring and this must be kept as short as possible.)

Together, these requirements define the type and size of power supply to use with the modem. These issues are discussed in more detail in the sections "Supplying Power" on page 42 and "Batteries" on page 48.

**Important**: *Avoid use of switching power supplies. They can easily cause RF noise that desenses the modem.*

### Select the Source Antenna

The ERP (Effective Radiated Power) generated by the antenna must meet the requirements of the various network operators. Consider these network requirements when you select an antenna system. See "Connecting & Positioning the Antenna" on page 37.

### Set Up a Development Test Environment

A number of development test aids are available to assist in hardware and applications development. Wavenet can provide both the modem hardware and an evaluation board. The evaluation board is a specially developed circuit board with test points and jumper switches. The

evaluation board allows for maximum flexibility in accessing and controlling connections into and out of the modem. Wavenet also provides various software utilities that can help in performing development tests. See "Testing" on page 69.

Supplementing the test environment, the network operator sometimes provides a live development network, one separate from the production network on which you can develop and test your application.

## Develop Supporting Applications Software

To develop supporting applications software, perform the following steps:

- Select a communications model
- Develop end-to-end applications software

### Select a Communications Model

Select a communications model. Vertical market applications may use a native connection to a single Enterprise Server Application, whereas horizontal applications typically use a gateway to allow connection to the Internet or other external networks.

### Develop End-to-End Applications Software

In addition to coding the product-specific features for your application, you are urged to incorporate RF-specific reporting and monitoring features, such as received signal strength (RSSI), channel quality, and in-range/out-of-range conditions. Many applications track the number of packets sent and received and the various events and status indicators available from the modem. The Boomer-III modem uses a packetised serial interface (MASC) to allow the application to simultaneously monitor RF-related information and application-specific data.

## Test and Approve the Product

To test and approve the product, perform the following steps:

- Perform EMI and desense testing
- Set up a final test environment
- Install and field test the product

### Perform EMI and Desense Testing

Proper modem operation requires that you minimize EMI (electromagnetic interference) radiated from your product's platform. Excess noise significantly reduces the wireless modem's ability to receive, making the network less likely to be heard.

Wavenet provides a test facility for measuring host/terminal emissions and subsequent modem desense of integrated host/terminals. See

"Desense and EMI" on page 70. In addition, see "Guide to Desense" on page 75.

### Set Up a Final Test Environment

To ensure proper assembly of the final product (antenna properly connected, serial port operational, and so on), perform an end-to-end test that proves the final product can receive and transmit at the required signal levels.

In locations where the final assembly test is performed within network coverage area, this test is relatively simple. In some countries the network operator may provide a dedicated test network for this purpose. You should consult with the relevant network operator for assistance prior to any testing commencing on a live or test network. In locations where network coverage is not available, or for products to be shipped to another country, it is necessary to test by secondary means.

The final assembly test must verify that all connections to the modem are made correctly. Testing on a network is not required. See "Final Assembly" on page 72, and "End User Problem Resolution" on page 72.

### Install and Field Test the Product

When the product is shipped to a site, it is installed or mounted in a particular location, one that might restrict RF communications. The service question is whether the behaviour of a dysfunctional product is caused by poor coverage or a network service provider is down. To guarantee that the modem is located in an area of good coverage and that an end-to-end loop back message is possible, your product needs a software application to perform the test.

Your most effective approach to field testing is to include an installation test procedure as part of your standard software load. See "Final Assembly" on page 72 and see "End User Problem Resolution" on page 72.

## Environmental Issues

The Boomer-III OEM modem is designed for a combination of easy serviceability and general ruggedness but are designed to be housed in a host/terminal. The modem is tested to conform to the environmental levels (for example, industrial use specifications and PC card standards) that meet the intended applications of most integrators. If you need additional ruggedness and safety in your products, you must engineer the environmental characteristics of your host/terminal to achieve a special safety rating.

### General Precautions

- Minimise handling of static sensitive modules and components.
- Wear a grounded anti static wrist strap while handling static sensitive components.
- Do not bend or stress the modem in any way.
- Reinsert connectors straight and evenly to avoid causing short and open circuits.

## ESD Handling Precautions

The Boomer-III OEM modem contains components sensitive to ESD (electrostatic discharge). For example, people experience up to 35kV ESD, typically while walking on a carpet in low humidity environments. In the same manner, many electronic components can be damaged by less than 1000 volts of ESD. Although the Boomer-III modem has been designed with a high level of ESD protection you should observe the following handling precautions when servicing host/terminal devices:

- Always wear a conductive wrist strap.
- Eliminate static generators (plastics, Styrofoam, and so on) in the work area.
- Remove nylon or polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties.
- Store and transport all static sensitive components in ESD protective containers.
- Disconnect all power from the unit before ESD sensitive components are removed or inserted, unless noted.
- Use a static safeguarded workstation, which can be set up by using an anti static kit. This kit typically includes a wrist strap, two ground cords, a static control table mat, and a static control floor mat.

When anti static facilities are unavailable use the following techniques to minimize the chance of damaging the equipment:

- Let the static sensitive component rest on a conductive surface when you are not holding it.
- When setting down or picking up the static sensitive component, make skin contact with a conductive work surface first and maintain this contact while handling the component.
- If possible, maintain relative humidity of 70-75% in development labs and service shops.

# Regulatory Requirements

You are required to obtain regulatory approval of products that integrate the Boomer-III OEM wireless modem into a host/terminal. The specific details for achieving regulatory approval vary from country to country.

Worldwide, government regulatory agencies for communications have established standards and requirements for products that incorporate fixed, mobile, and portable radio transmitters. The Boomer-III OEM modem is certified in specific regional markets to levels of compliance appropriate for an integrated device.

## Modem Only Certification

The non-integrated modem meets the regulatory requirements for the countries listed below (but related certification does not necessarily exist):

| Country | Regulation Agency | Related Requirements | Modem Model | Approval Number |
|---|---|---|---|---|
| Canada | Industry Canada (IC) | RSS119 – Radio Performance | BM3-900M | 4062A-BM3900M |
| United States of America | Federal Communications Commission (FCC) | FCC CFR Title 47, Part 15 Conducted and Emitted Radiation Class B<br>FCC Part 90 – Radio Performance | BM3-900M | PQS-BM3900M |

## Full Product Certification

As the integrator, you must determine what additional specific regulatory requirements are required for the country in which your product is sold. This means, your product must be individually certified, even though the Boomer-III OEM Modem Module may already be approved. The certification process includes submittal of prototype products and acceptable test results.

Integrators can use Boomer-III OEM Modem Module certifications to facilitate this integrated-product approval process. Upon request, Wavenet can send copies of the certifications and related information.

Be prepared for the certification process for your product to take from a few weeks to several months. Its duration can be affected by safety requirements, the type of product, and the country in which you are seeking approval.

## Country Requirements

The country requirements given below are provided as a general guide to the certification processes in the regions and countries given. You are strongly encouraged to use the services of a consultant or a full-service test house if you have limited expertise in meeting the regulatory requirements of a specific country.

All certification tests must be made by a qualified laboratory to ensure that the equipment complies with the applicable technical standards.

### United States of America

The Federal Communications Commission (FCC) requires application for certification of digital devices in accordance with CFR Title 47, Part 2 and Part 15. A Wavenet Boomer-III OEM Modem Module is part of a complete system and certain testing is necessary for the integrated product.

**FCC Part 15, Class A or B certification** (dependant upon final integrated product type) must be performed with the maximum configuration use and include all peripherals of the integrated product. The application for certification must refer to the approval data on file for the particular Boomer-III Modem Module, as shown in the following example. Include the following language in the documentation inserting the name of the integrated product in place of xxx below:

> "The Wavenet Boomer-III OEM modem module is a subassembly of xxx and has FCC Identifier PQS-BM3900M"

**FCC Part 2 certification** requires all integrated products to have routine environmental evaluation for radio-frequency (RF) exposure prior to equipment authorization or use in accordance with FCC rules 2.1091 and 2.1093 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin 65 and its Supplement C.

For "**portable devices"**, defined in accordance with FCC rules as transmitting devices designed to be used within 20 cm of the user body under normal operating conditions, Specific Absorption Rate (SAR) testing must be performed and the unit re-submitted for separate FCC certification approval. An exposure limit of 1.6 W/kg will apply to most OEM integrated applications.

For "**mobile or fixed devices"**, defined as transmitting devices designed to be generally used such that a separation distance of at least 20 cm is maintained between the body of the user and the transmitting radiated structure, Maximum Permissible Exposure (MPE) limits may be used with field strength or power density limit of 0.597 mW/cm2 (at 896 MHz).

Wavenet submitted module specific information and test reports for generic MPE compliance. If the Boomer-III OEM Modem Module is used in a mobile or fixed application with an antenna system gain less than 5dBi, the MPE limits will not be exceeded. In this case, the following clause should be included in the installation and user documentation:

> "To satisfy FCC RF exposure requirements a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To

ensure compliance, operations at closer than this distance is not recommended."

If an antenna system is used which has an average gain greater than 5dBi then the integrated product must be re-tested as a complete unit and submitted with its own FCC ID.

It is mandatory for portable integrated products such as handheld and body-worn devices to comply with FCC guidelines for Specific Absorption Rate (SAR) requirements. Refer to OET Bulletin 65 and Supplement C (June 2002). The submission should include end product information, end product SAR/MPE test report, and a reference to the Wavenet Boomer-III OEM Modem Module FCC ID for all other Part 90 requirements.

It is a requirement for integrated product certification that you provide the following statement in user documentation:

**"Regulatory Notice of Compliance**

This equipment has been tested and found to comply within the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help."

**Labelling**

The FCC requires the integrated product to be labelled as shown here:

"This product contains a type-accepted transmitter approved under FCC ID: PQS-BM3900M."

Refer to FCC CFR 47, Part 2, Subpart J for information on obtaining an FCC grantee code, FCC identifier requirements, label requirements, and other equipment authorisation procedures.

The FCC does not permit use of an FCC identifier until a Grant of Equipment Authorisation is issued. If you display a device at a trade show before the FCC has issued a grant, the following statement must be prominently displayed:

> "This device has not been approved by the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, sold or leased until the approval of the FCC has been obtained."

## Canada

Industry Canada (IC), formerly the Department of Communications, requires certification for all radio transceivers as either type-approved or technically accepted.

If you do not make any physical or electrical changes to the Boomer-III OEM modem and you add an antenna externally to your host/terminal, you are not required to make a formal application to Industry Canada, because Boomer-III OEM modems continue to be covered under the original Radio Equipment Certificate of Type Approval.

Most of the tests required for FCC applications can be used for Industry Canada applications. IC requires additional tests, which distinguishes their certification process as unique.

The Radio Standards Procedure RSP-100 describes the procedure for obtaining certification of radio equipment and labelling requirements. These documents are available upon request from Industry Canada in Ottawa or from their website at http://spectrum.ic.gc.ca/~cert/certprocedures_radio_e.html .

### Labelling

Industry Canada requires OEM products to be labelled as follows:

> IC: XXXX-BM3900M

Where XXXX represents the number supplied to the OEM by Industry Canada.

# Installing the Modem

This section will help you to successfully integrate the Boomer-III OEM Modem into your custom application.

When integrating a wireless modem, internal connections and placements are critical to a successful implementation. Specific attention must be paid to the following support mechanisms:

- Mechanical mounting
- Serial interface and control
- Antenna connection
- Regulated power supply
- Application software
- Desense control

The OEM wireless modem is well suited for mobile or fixed applications. Ruggedised and capable of operating in extreme environments, the modem can provide communications for a wide variety of products.

**Handheld Portable Terminal Use**

Without question, handheld designs produce the most hostile environment for an integrated modem. A handheld device, such as a portable terminal, is typically battery powered, subjected to temperature extremes, and designed to be physically robust.

When designing portable devices, you must consider the following issues:

- DC power noise levels on the host/terminal interface
- Minimum operating voltage levels
- Shutdown procedures
- Device internal ambient temperature
- Antenna gain and proximity to user
- Repair and reprogramming facilities (pass-through mode of operation)
- Mechanical design for drop, vibration, dust, salt, and liquid spill

**Note**: *Regarding the mechanical design, the Boomer-III OEM modem is designed assuming that the host/terminal controls these conditions.*

**Fixed Mount Usage**

Fixed-mount usage eliminates most of the mechanical constraints of handheld designs, although the requirements still apply. Fixed-mount units are sometimes AC-line powered and require filtering to eliminate

the 50Hz or 60Hz noise that can impair modem operation, depending upon country of use.

Other considerations include mobile usage, which typically implies vehicular applications. Some of the design implications of mobile usage include:

**Resets**

The design must attempt to eliminate modem resets caused by supply voltage drops while the vehicle is starting. This is very disruptive to the network link.

**Supply and Noise Levels**

Special care is required to ensure the modem is not subjected to DC voltages exceeding specifications. This could create costly damage to the RF section of the modem. Adhere to the power supply noise specifications in your design.

**Antenna**

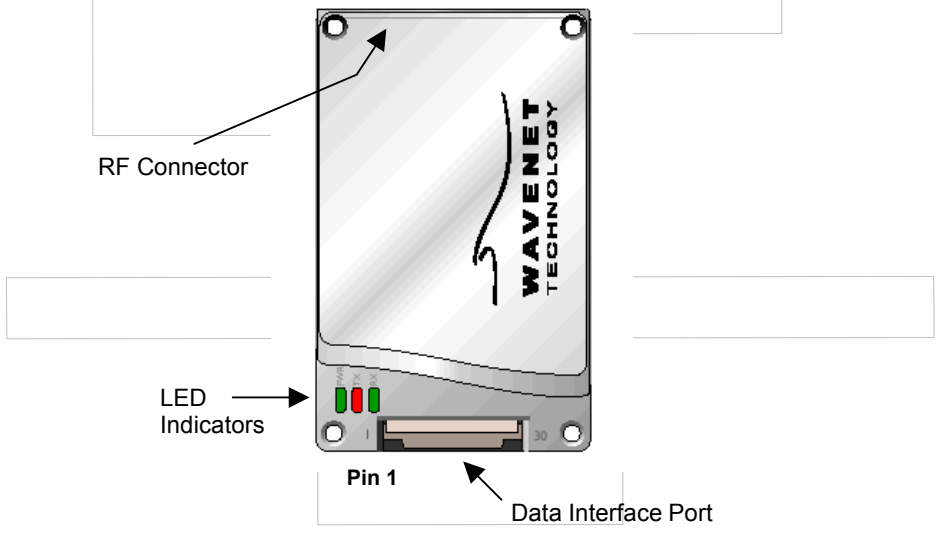
The antenna must be mounted like any other cellular or land mobile radio antenna. Usually the vehicle roof provides a good ground plane unless it is fabricated of non-metallic material such as fibreglass.

## Mounting the Boomer-III OEM Modem to Your Device

Before using your modem you must:

- Mount the Boomer-III OEM Modem to your device
- Connect the Data Interface Port
- Connect and position the antenna
- Supply power

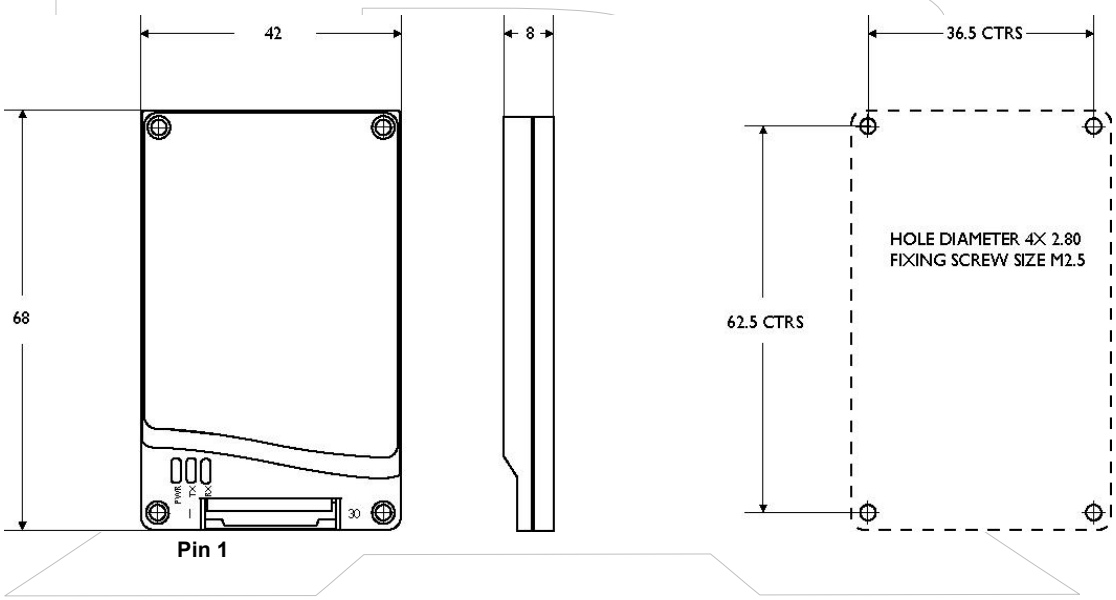
A picture of the Boomer-III OEM Modem is shown below.



Proper mounting of the modem requires securely fastening it within the product housing. The mating surface should be flat and ensure a rigid mounting for the modem to minimise vibration to the unit. There should be an adequate supply of airflow to ensure the modem's temperature limits are not exceeded.

To ensure ease of access for installation and troubleshooting, locate the modem within the product in such a way that host and antenna connections are readily accessible. Quick access to the modem allows it to be efficiently removed, probed, and functionally tested.

The modem has M2.5 mounting holes in each corner. The mounting hole pattern is shown below;




## Connecting the Data Interface Port

There are two connectors to interface the Boomer-III OEM Modem with your device.

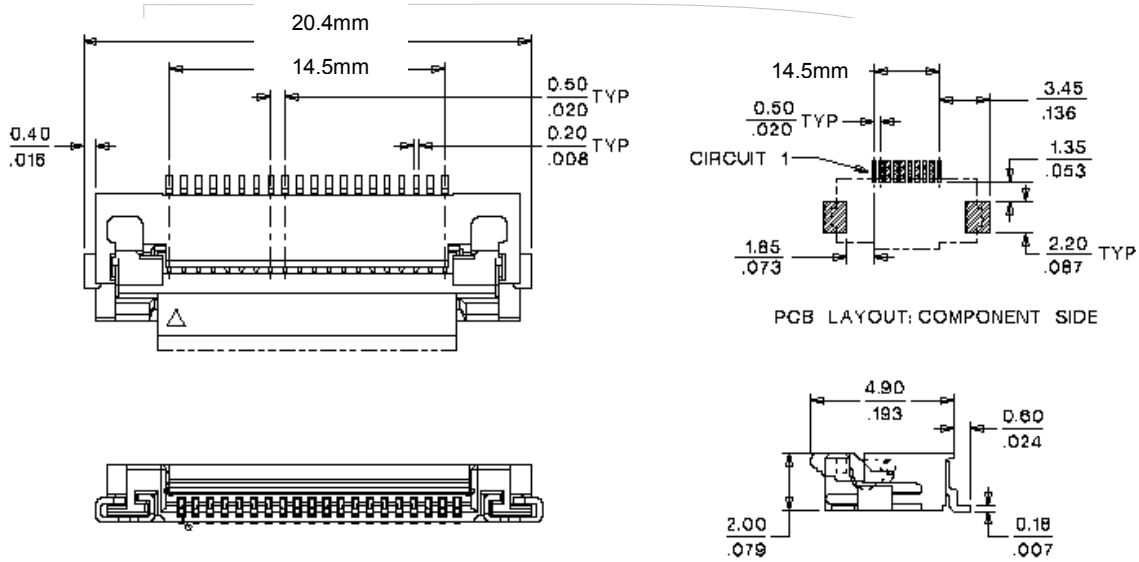
- RF Connector (described in the next section), and
- Data Interface Port

The data interface port is used to interface the modem to a serial computing device and a power supply. The power supply requirements are described in the next section.

A flat 30-way Flexible Printed Circuit (FPC) cable (approx 0.3 mm thick with 0.5 mm centreline spacing) is used between the Boomer-III OEM Modem's Data Interface Port and the host/terminal. The connector specification is given below.

The modem utilises connector part number 803-30-T-U from A-Point however, connector equivalents such as F006-52893 from Molex as shown below, may also be used in the host/terminal.




**Molex FPC Connector F006-52893**

Pin 1 of the connector is adjacent to the LED window; it is also marked on the housing.

The pin assignment of the Data Interface Connectors is shown in the following table.

## Data Interface Pin Descriptions

| Pin | Signal | Description | Signal | Reset State |
|---|---|---|---|---|
| 1 | DCD | Data Carrier Detect | Output | High Impedance |
| 2 | RXD | Receive Data | Output | High Impedance |
| 3 | TXD | Transmit Data | Input | 100k pull up to 3V |
| 4 | DTR | Data Terminal ready | Input | 100k pull up to 3V |
| 5 | GND | Ground | Ground | 0V |
| 6 | DSR | Data Set Ready | Output | High Impedance |
| 7 | RTS | Request to Send | Input | 100k pull up to 3V |
| 8 | CTS | Clear to Send | Output | High Impedance |
| 9 | RI | Ring Indicator | Output | High Impedance |
| 10 | HCRESET | Modem Reset | Input | 40-80k pull up to 3V |
| 11 | RTC_BB | RTC battery backup | Input | High Impedance |
| 12 | HOSTPWR_ON | Modem Power on/off | Input | 80k pull down to 0V |
| 13 | LED0_MSGWTG | Message Waiting | Output | High Impedance |
| 14 | LED1_INRANGE | In Range | Output | High Impedance |
| 15 | LED2_LOWBAT | Low Battery | Output | High Impedance |
| 16 | SS0/RXD2 | Status Signal 0 | Bi-directional | 100k pull up to 3V |
| 17 | SS1/TXD2/AD1 | Status Signal 1 | Bi-directional | 100k pull up to 3V |
| 18 | SS2/RXD3/AD2 | Status Signal 2 | Bi-directional | 100k pull up to 3V |
| 19 | SS3/TXD3/AD3 | Status Signal 3 | Bi-directional | 100k pull up to 3V |
| 20 | HOST 3.8V | Supply Voltage | Supply | 3.4 – 4.2V |
| 21 | HOST 3.8V | Supply Voltage | Supply | 3.4 – 4.2V |
| 22 | HOST 3.8V | Supply Voltage | Supply | 3.4 – 4.2V |
| 23 | HOST 3.8V | Supply Voltage | Supply | 3.4 – 4.2V |
| 24 | TEST-PIN | Do not connect | | |
| 25 | HOST GND | Ground | Ground | 0V |
| 26 | HOST GND | Ground | Ground | 0V |
| 27 | HOST GND | Ground | Ground | 0V |
| 28 | HOST GND | Ground | Ground | 0V |
| 29 | TEST-PIN | Do not connect | | |
| 30 | SS4 | Status Signal 5 | Bi-directional | 100k pull up to 3V |

*Warning: Do not connect the TEST-PIN terminals (pins 24 and 29) or the modem may malfunction. Leave disconnected.*

*Warning: The input voltage on RTC-BB (pin 11) must never exceed 3V under any circumstances or the modem may be damaged.*

Note: The voltage range of most of the modem input pins is typically 0-3V, however, 0-5V may be used for compatibility with conventional digital logic, unless otherwise stated.

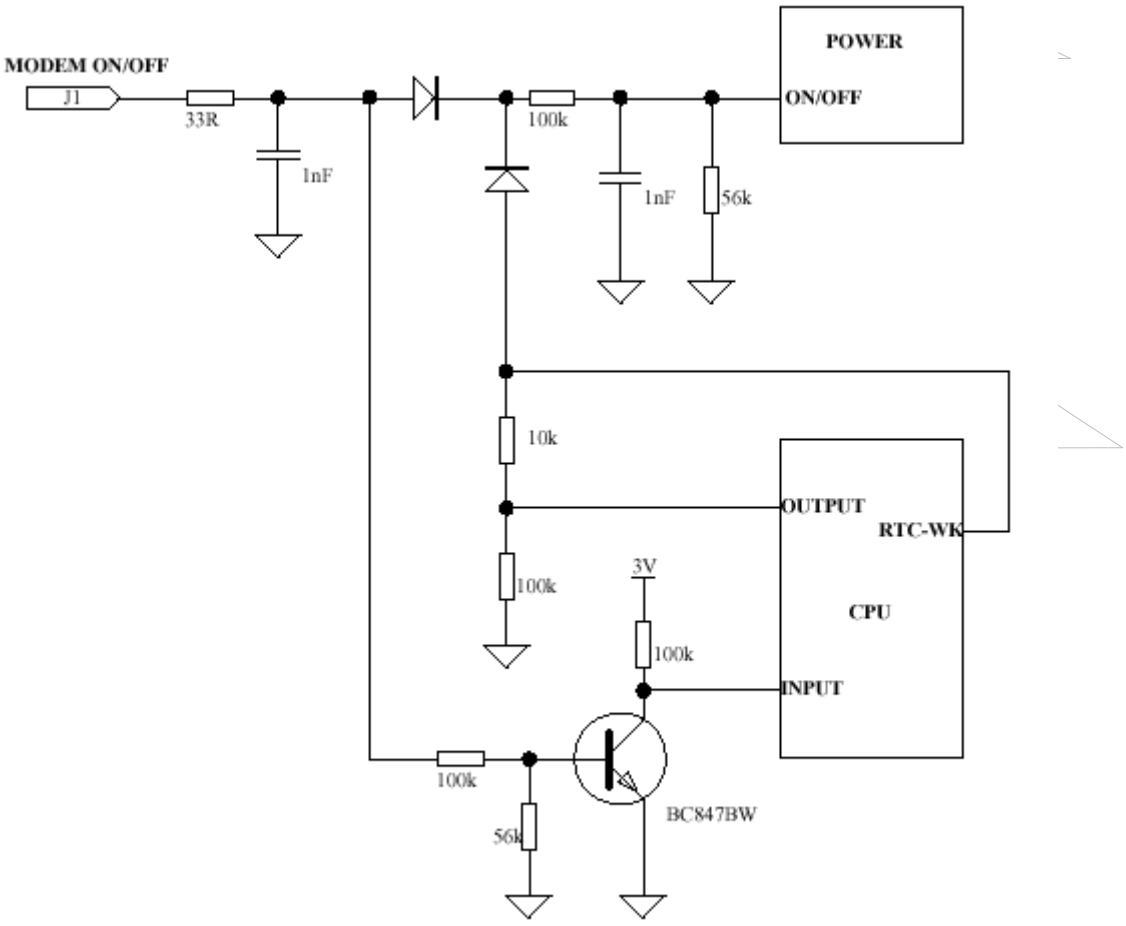
## Modem On/Off Control

The modem on/off input line (HOSTPWR_ON) is an active high input signal and is fitted with a 33Ω series resistor for input protection. Internally it is passively pulled low (after the series resistor) to ground and is asserted with a high input signal.

The Boomer-III modem is fitted with a Real Time Clock that third party applications may utilise to wake-up the modem at a pre-programmed alarm time. This facility may be utilised to further reduce current consumption in battery powered applications, but note that the modem may need to re-register on the network after wake-up

The electrical interface specification and equivalent circuit is as follows:

## Modem On/Off Control Equivalent Circuit




## Modem On/Off Control Electrical Characteristics

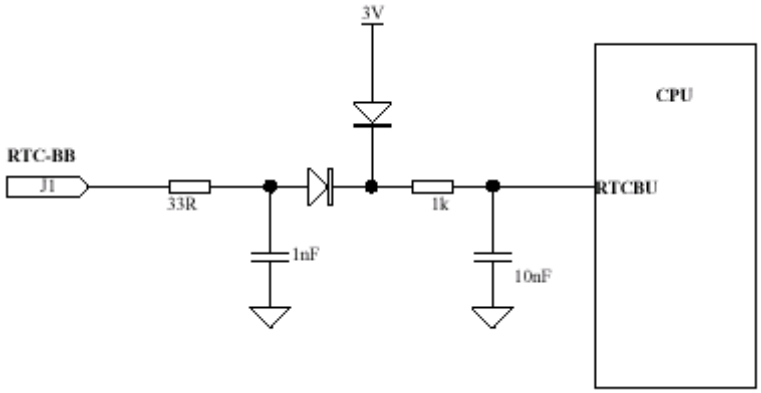
| Parameter | Range | Low | High |
|---|---|---|---|
| Input Voltage | 0-3V OR 0-5V | 1.0 V (max) | 2.5 V (min) |
| Input Current | | 20 µA (max) | 100 µA (max) |

*Warning: When the modem is turned off using the HOSTPWR_ON signal and HOST_3.8V power is removed, all other signals connected to the Data Interface Connector should also be turned off or set to 0V otherwise the modem may remain powered on via these signals.*

### Real Time Clock Battery Backup

The Boomer-III contains an on-board Real Time Clock (RTC) and the RTC Battery Backup (RTC_BB) pin is an optional input to maintain the clock settings (time and date) in the event the main power to the modem is removed. If used this input must be connected to a stable voltage supply (such as a suitable alkaline cell) that does not exceed the maximum input voltage specifications. If not required this input can be left disconnected and the RTC will be powered internally. The electrical interface specification and equivalent circuit is as follows:

### Real Time Clock Equivalent Circuit




### Real Time Clock Electrical Characteristics

| Parameter | Range | Min | Max |
|---|---|---|---|
| Input Voltage | | 2.1 V | 3V (max) |
| Input Current | | 1 µA | 10 µA |

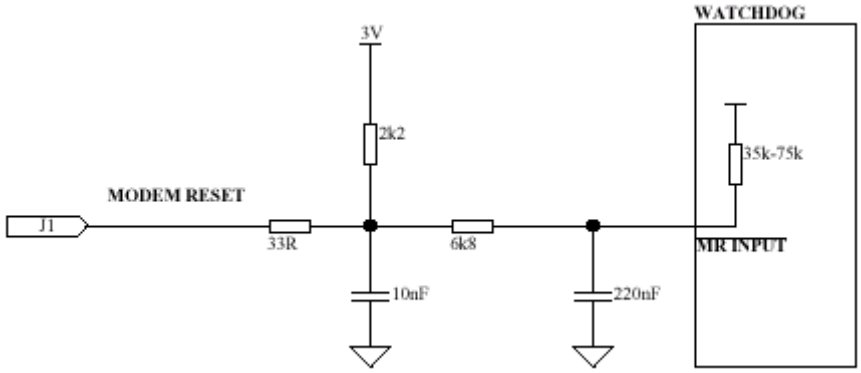
*Warning: The input voltage on RTC-BB (pin 11) must never exceed 3V under any circumstances or the modem may be damaged.*

## Modem Reset Input

The reset input line (HCRESET) is an active low input signal (TTL compatible) and is fitted with a 6.8kΩ series resistor for input protection. Internally it is passively pulled high (after the series resistor) to the supply rail (3V) and is asserted with an actively driven low signal to ground. The electrical interface specification and equivalent circuit is as follows:

## Reset Input Equivalent Circuit




## Reset Electrical Characteristics

| Parameter | Range | Reset Active | Reset Inactive |
|---|---|---|---|
| Input Voltage | 0-3V OR 0-5V | 0 V | 1.8 V (min) |
| Input Current | | 200 µA (max) | 200 µA (max) |
| Pulse width | 5mS (min) | | |

## Serial Communications Interface

The modem communicates with the controller using the Data Interface Port connection interface. The host asynchronous serial interface on the Boomer-III OEM Modem operates at 3V and can be controlled by a wide variety of micro controllers and microprocessors.

If the modem is to be connected directly to a PC or other RS232 device, an interface must be provided to convert the signal voltage to the higher values required by an RS232 device.

The protocol supported over this link is network dependant. The data format is generally: 8 data bits, no parity, 1 stop bit, unless otherwise specified.

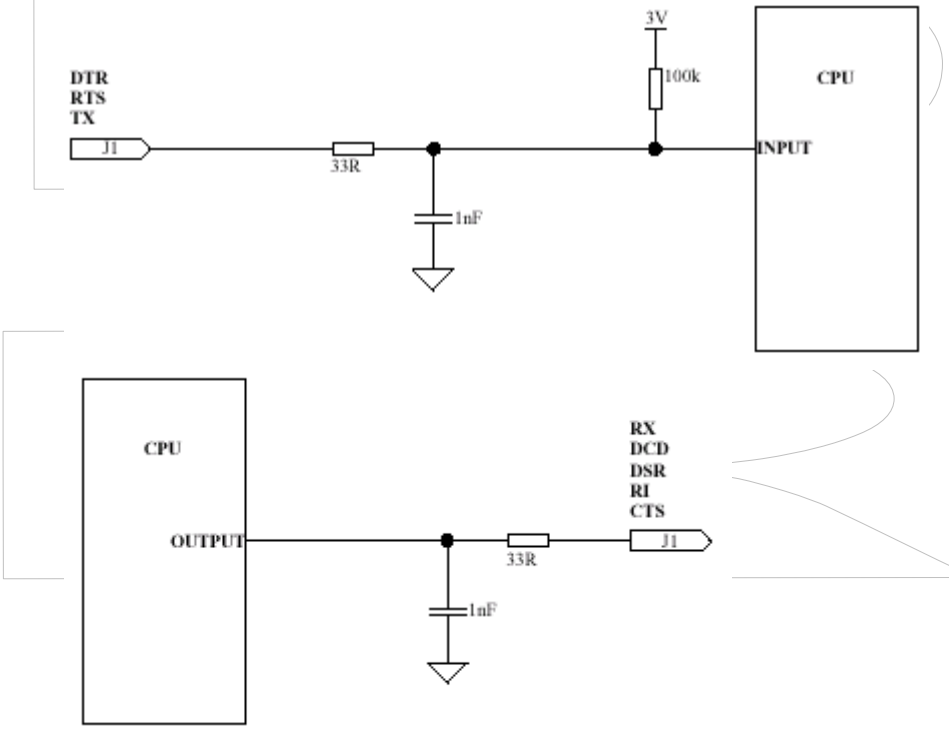
The serial interface lines (RXD, TXD, DCD, DTR, DSR, RTS, CTS, RI) are 3V logic compatible. They are fitted with a 33Ω series resistor for protection. The electrical interface capability, equivalent circuit and operation of these lines is summarized below:

## Serial Communications Interface Definitions

| J1 Pin # | Signal | Description | Signal | Active State |
|---|---|---|---|---|
| 1 | DCD | Data Carrier Detect | Output | Low when modem in-range |
| 2 | RXD | Receive Data | Output | Low when active |
| 3 | TXD | Transmit Data | Input | Low when active |
| 4 | DTR | Data Terminal Ready | Input | Low when ready |
| 6 | DSR | Data set ready | Output | Low when ready |
| 7 | RTS | Request to send | Input | High when host/terminal requires data throttling |
| 8 | CTS | Clear to send | Output | High when modem requires data throttling |
| 9 | RI | Ring indicator | Output | Pulses Low when messages are waiting |

## Serial Communications Equivalent Circuits




## Serial Communications Electrical Characteristics

| Parameter | Range | Low | High |
|---|---|---|---|
| Input Voltage | 0-3V OR 0-5V | 0.8 V (max) | 2.0 V (min) |
| Output Voltage | 0 – 3V | 0.4 V (max) | 2.5 V (min) |
| Input Current | | 100 µA (max) | 100 µA (max) |
| Output Current | | 4 mA (max) | 4 mA (min) |

## Status Signal Multi-Function Lines

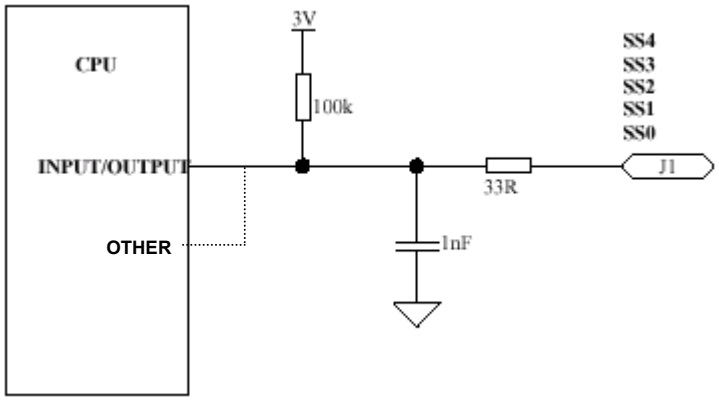
The status lines (SS0 to SS4) have multi-functional capability and may be software configured for specific operation. All the lines may be used as digital input/outputs. SS0/SS1 and SS2/SS3 may be used as a second and third serial communications port respectively. SS2-SS3 may be used to measure analogue input voltages with 10-bit resolution. SS4 may be used as a Synchronous Peripheral Interface (SPI) port chip select signal (refer to LED Output section later).

Each Status line has a 100kΩ resistor to define default input status and a 33Ω series resistor for protection. The electrical interface capability, equivalent circuit and operation of these lines is summarized in the tables below:

## Status Signal Interface Definitions

| J1 Pin # | Signal | Description | Digital Capability | Alternate Function | Other |
|---|---|---|---|---|---|
| 16 | SS0 | Status Signal 0 | Input/ Output | - | RXD2 |
| 17 | SS1 | Status Signal 1 | Input/ Output | AD1 | TXD2 |
| 18 | SS2 | Status Signal 2 | Input/ Output | AD2 | RXD3 |
| 19 | SS3 | Status Signal 3 | Input/ Output | AD3 | TXD3 |
| 30 | SS4 | Status Signal 3 | Input/ Output | SPI_CS | - |

## Status Signal Equivalent Circuits




## Status Signal Electrical Characteristics

| Parameter | Range | Low | High |
|---|---|---|---|
| Input Voltage | 0-3V OR 0-5V | Digital: 0.8 V (max)<br>Analogue: 0V (min) | Digital: 2.0 V (min)<br>Analogue: 3V (max) |
| Output Voltage | 0 – 3V | 0.4 V (max) | 2.5 V (min) |
| Input Current | | 100 µA (max) | 100 µA (max) |
| Output Current | | 4 mA (max) | 4 mA (min) |

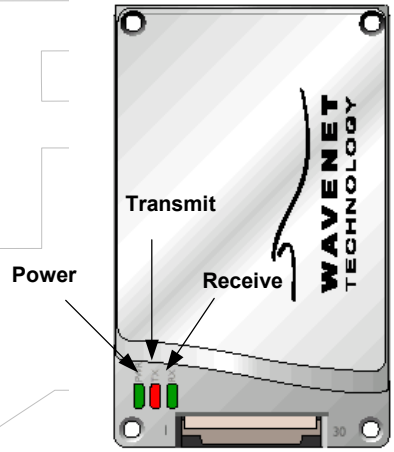
 

## LED Indicators

The modem provides three on-board indicators (LED's), for diagnostic monitoring purposes as well as three modem controllable LED outputs through the Data Interface Connector.

## On-Board LED Indicators

The on-board LED's are visible through windows in the case of the modem and are defined as below.




**Position of On-Board LED Indicators**

## On-Board LED Indicator Definitions

| LED Indicator | Colour | Operating Mode | | |
|---|---|---|---|---|
| | | Off | On | Flashing |
| POWER | Green | Power off | Power normal and locked on channel | Power normal and scanning channels |
| TRANSMIT DATA | Red | No activity | N/a | Data Transmitted |
| RECEIVE DATA | Green | No activity | N/a | Data Received |

*Note: The LED's may be disabled to minimise power consumption. All LED's will flash on start-up and the Receive and Transmit LED's will flash on power down regardless of the state of the LED disable control.*

## LED Output Lines

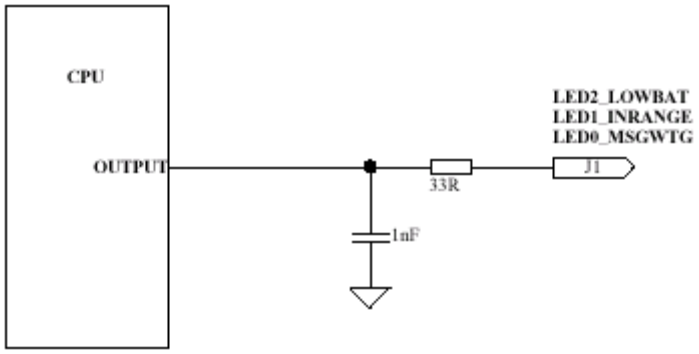
In addition to the on-board LED's there are three signal lines (Low Battery, Message Waiting, In-range), which are controllable by the modem for connection to an external LED. These lines also have multi-function capability through software configuration as digital input/outputs or as a Synchronous Peripheral Interface (SPI) port. SS4 may be used as a SPI chip select signal (refer to Status Signals section previously).

Each LED output line has a 33Ω series resistor for protection. It is recommended a series resistor be used with the external LED to limit current accordingly. The electrical interface capability, equivalent circuit and operation of these lines is summarized in the tables below:

## LED Output Interface Definitions

| J1 Pin # | Signal | Description | Digital Capability | Alternate Function |
|---|---|---|---|---|
| 13 | LED0_MSGWTG | LED Signal 0 | Input/ Output | SPI_CLK |
| 14 | LED1_INRANGE | LED Signal 1 | Input/ Output | SPI_MOSI |
| 15 | LED2_LOWBAT | LED Signal 2 | Input/ Output | SPI_MISO |

## LED Output Lines Equivalent Circuit




## LED Interface Electrical Characteristics

| Parameter | Range | Low | High |
|---|---|---|---|
| Output Voltage | 0 – 3V | 0.4 V (max) | 2.5 V (min) |
| Output Current | | 4 mA (max) | 4 mA (min) |

## LED Interface Definitions

| J1 Pin # | Signal | Description | Signal | Active State |
|---|---|---|---|---|
| 13 | LED0_MSGWTG | Message waiting | Output | Low when message waiting |
| 14 | LED1_INRANGE | In range | Output | Low when modem in-range |
| 15 | LED2_LOWBAT | Low battery | Output | Low when battery is <3.5V, High when battery is >3.6V |

### Low Battery

The Low Battery signal is held active low whenever the supply voltage drops below an acceptable level and deactivated when the voltage level becomes acceptable again. The 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 RF reception range.

# 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. Also always consult the appropriate technical representative of the target network operator prior to selecting and / or designing the antenna, so that it will pass network certification requirements.

## 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/terminal is to be used.

The integrator should refer to the statement of Compliance on page 8 of this manual and Regulatory Requirements section on pages 19-xx 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-III OEM Modem are:

| | |
|---|---|
| Antenna Gain: | 5dBi (isotropic) maximum average gain if modular FCC approvals are to be used without separate equipment approval for the host/terminal. |
| Impedance: | 50Ω |
| Centre Frequency: | 921MHz ± 3MHz |
| Frequencies of operation: | 896 to 902MHz (for transmit)<br>935 to 941MHz (for 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-III OEM Modem is nominally 2W at the antenna port. The antenna gain or loss will affect the radiated value.

### Connecting the Antenna

The Boomer-III 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. It is recommended that a Huber+Suhner connector be used to connect to the modem as below:

- 11 MMCX series Straight Connector
- 16 MMCX series 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 radio 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-III 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 8 of this manual and Regulatory Requirements section from pages 19 onwards, for country requirements.

### Source Based Time Averaging Function

For portable or handheld applications the integrated host/terminal must comply with OET Bulletin 65 and Supplement C (June 2002) with respect to Specific Absorption Rate (SAR) requirements.

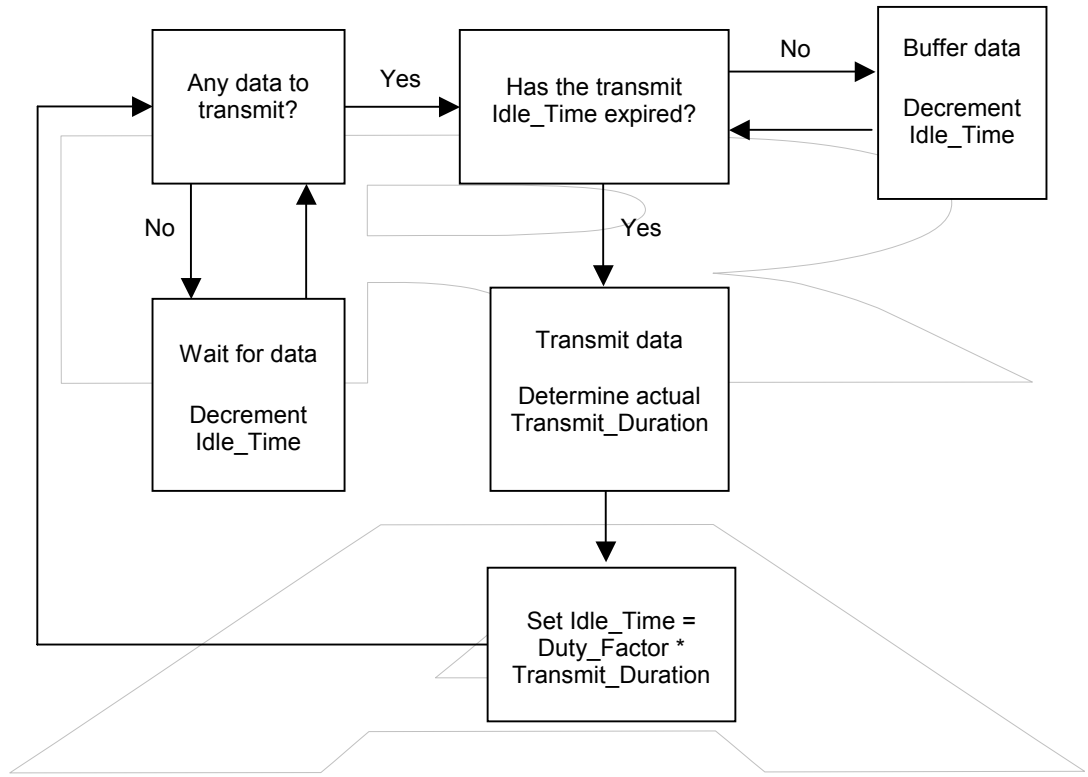
The Boomer-III modem module operates on a packet data network which sets the timing of most aspects of the RF signalling protocol. The shortest transmit event over which the Boomer-III modem has control is a transmit transaction which is comprised of a series of transmit pulses.

For portable or handheld applications a source based time averaging function has been incorporated in the Boomer-III modem firmware. This function limits the transmit duty cycle by controlling the timing of when transmit transactions are initiated and the delay period between them.

When a data transmission occurs, the actual transmit time is recorded. Subsequent data transmissions are inhibited until a delay period (idle time) has elapsed to ensure the average duty cycle of transmissions is less than the preset "Duty Cycle" limit. Any delayed user data that is to be transmitted will be buffered until it is permitted to be sent.

The algorithm for the Source Based Time Averaging transmit control and the relevant parameters are given below:

- Idle_Time = Duty_Factor * Transmit_Duration
- Duty Factor = (100 – Duty_Cycle%) / Duty_Cycle%
- Duty_Cycle% = Preset limit for SAR compliance




**Source Based Time Averaging Transmit Algorithm**

The Boomer-III modem module has an overall transmit Duty Cycle limitation of 30% (maximum) to physically protect the modem hardware.

The default Duty Cycle preset in the factory at the time of manufacture is 10%. Other duty factors and SAR evaluation must be addressed at the time of OEM integration into any final host/terminal product and is the responsibility of the OEM Integrator.

The algorithm and preset Duty Cycle is recorded in the module firmware at the time of manufacture and cannot be altered by the end user.

## Supplying Power

The Boomer-III OEM Modem must be provided with a clean power source capable of delivering bursts of high current.

The modem draws its power in bursts. The power required changes rapidly depending on whether the modem is transmitting, receiving or on standby.

### Ratings

The power supply requirements are:

| | |
|---|---|
| Voltage: | 3.8V (3.4 to 4.8V range) |
| Transmit Current: | 1.6A maximum |
| | (2.2A maximum if antenna mismatched) |
| Transmit Duration: | 32ms (minimum)<br>7s (maximum) |
| Duty Cycle | 30% (maximum) data dependant |
| Receive Current | TBD mA (typical) |
| Standby Current | TBD mA (typical) |
| | Add ~1.2mA if LED's enabled |
| Off current consumption: | < 20 µA |
| Power Supply Ripple: | < 15mV peak to peak |

### Design Considerations

The power supply is one of the key issues of design of wireless terminals.

Due to the burst nature of transmit periods the power supply must be able to deliver high current peaks for short periods of TBD ms to a maximum of TBD seconds. During this time the drop in the supply at the module itself must not exceed 200mV (total at the module), such that at no time module shall module supply drop below 3.4V and ripple must not exceed 15mVp-p during transmit.

The maximum transmit current into a matched antenna is 1.6A, however, this can increase if antenna mismatch occurs.

Wavenet recommends designing a robust power supply that can provide adequate power under non-ideal conditions such as an improperly matched antenna, where current can be up to 2.2A.

It is recommended that for ensuring power supply margin the following be done:

- A short FPC cable (e.g < 100mm) is used to minimise power supply voltage drop during transmission.
- The power supply should be set above nominal 3.8V to accommodate worst case power supply drop. i.e. 4.0V.

- The power supply should have good regulation with < 200mV drop at 2.2A.
- Adequate supply decoupling (10,000uF min.) is added at terminal connector to reduce ripple and smooth supply voltage steps.
- The power supply be capable of supplying non-ideal current consumption conditions of up to 2.2A for up to TBD seconds and with a duty cycle (set by data usage) ~ 30% maximum.
- Multiple pins are assigned to both power and ground connections for the modem. Connection of all designated pins to the appropriate supply or ground in the host/terminal is necessary to accommodate modem current requirements.
- The host/terminal must provide a continuous supply.

The modem is compliant with the Mobitex Power Save Protocol. The modem exists in the lowest power state possible (standby state) while still providing uninterrupted service. By de-asserting the HOSTPWR_ON signal, the modem disconnects from the network then enters a near-zero power state. The modem resets if the power source is cycled. This can cause network service issues, since the modem might not have had a chance to de-register. The modem spends the majority of time in sleep mode.

### Conservation

In installations requiring power conservation (such as, when the modem is powered from a battery or solar cell), you must monitor modem power consumption in various operating states. Even though the Boomer-III OEM modems are designed for minimal power consumption, by using the network Power Save protocol offered by Mobitex networks you can further reduce power consumption.

Note: The on-board LEDs may be disabled to minimise power consumption. All LEDs will flash on start-up and the Receive and Transmit LEDs will flash on power down regardless of the state of the LED disable control.

### Power Save Protocol

The modem typically uses current provided by the host/terminal battery. For the product to be usable for a reasonable period in portable applications, the host/terminal battery power must be conserved. To meet this requirement, the modem uses Mobitex Power Save protocol.

The Power Save Protocol defines the following four modem power consumption states:

**Off**

**Operating State**

**Standby State**

**Quick Channel Monitoring**

## Power Profile

The modem's power consumption profile depends on the usage and the network configuration of the Power Save protocol.

For example, the following numbers present a typical profile for the Boomer-III modem based on reasonably heavy usage and assuming a 3.8V supply current: (Power Save Mode = Maximum)

- ~~80 % Sleep @ 4.4 mA typical~~
- ~~19.9 % Receive @ 76 mA typical~~
- ~~0.1% Transmit @ 1.6A typical~~

The actual percentage of total time spent in each state (transmit, receive, sleep) is a function of the following variables.

**Network configuration**

On networks supporting Power Save operation, the network configuration impacts how long the modem must be in the sleep state.

**Note**: *Neither Wavenet nor any developer has any direct control over the network configuration. Networks supporting Power Save are typically configured to preserve the battery life of modems of their subscriber base.*

**Message traffic model**

The message traffic model defines how many messages are transmitted and received, and the average length of the messages sent and received in a given working day. For instance, a dispatch application could have a message traffic model as follows:

- Messages transmitted in 8 hour day: 25
- Average length of transmission: 120 bytes
- Messages received in 8 hour day: 10
- Average length of received message: 30 bytes

This analysis of message traffic allows the power consumption profile to be assessed in terms of percentage of time spent transmitting, receiving, and sleeping. (For more information, see *Develop a Message Model* on page 12.)

**Roaming Time**

The amount of time the modem spends scanning a channel or roaming to a new channel will affect the current consumption.

### Power Control

The host/terminal provides the supply rail (HOST 3.8V) to the modem through the Data Interface Connector.

The host/terminal turns the modem ON by asserting the HOSTPWR_ON signal.

The host/terminal may request the modem to turn OFF by de-asserting the HOSTPWR _ON or by sending a specific MASC command across the serial interface. For the modem to turn OFF after a MASC request the HOSTPWR_ON signal must be de-asserted.

### Power-Up Sequence

Reference should be made to the Power-UP Timing Diagram below when reading the following Power-UP Sequence description.

To turn the modem ON, power must be applied (HOST 3.8V) and the host/terminal asserts the HOSTPWR_ON signal.

The modem contains an internal voltage detector and reset delay circuit to generate a reset signal for the CPU to ensure orderly and reliable software initialisation.

An externally controllable reset signal (HCRESET) is optionally available if the host/terminal wants reset synchronisation or to force a modem reset while power is still applied.

If the HCRESET signal is used, once it is de-asserted the modem CPU will be able to initialise.

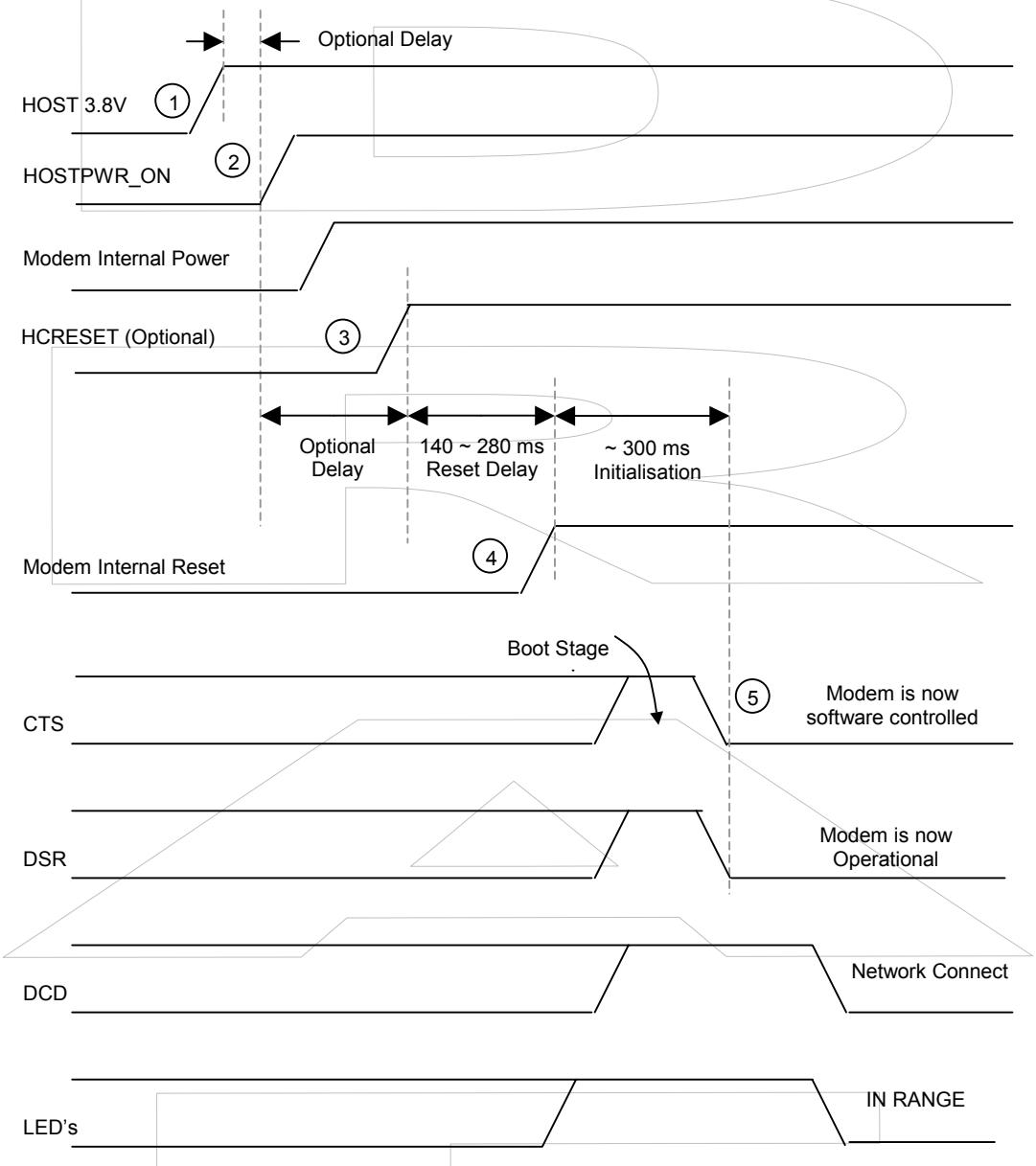
Once out of reset the first operation is the boot-up of the modem CPU. At this time CTS is momentarily asserted, then de-asserted. After a successful boot up, the CPU starts the modem initialisation sequence. After the initialisation sequence, the Native Mode interface and the serial interface are active.

Following successful initialisation, the modem asserts DSR and performs the initialisation protocols for both the DTE interface and the RF network. After successfully initialising the DTE interface, the modem asserts CTS. After the network ACK of the registration sequence, DCD is asserted.

The Boomer-III modem is fitted with a Real Time Clock that third party applications may utilise to wake-up the modem at a pre-programmed alarm time prior to turning the modem off. This facility may be utilised to further reduce current consumption in battery powered applications, but note that the modem will need to re-register on the network after wake-up

## Power-Up Timing Diagram




Note: HCRESET, CTS, DSR, DCD, the LED's and the internal modem reset are all active low signals.

**Power Up Diagram Callouts**

1 Power is supplied to the modem

2 The HOSTPWR_ON signal is asserted to turn on the modem.

3 The HCRESET signal is de-asserted.

4 The internal modem reset is released to allow the modem boot up sequence.

5 The modem exits the boot load state, is operational and is ready to communicate with the DTE.

## Power Down Sequence

The host/terminal may request the modem to turn OFF by de-asserting the HOSTPWR _ON or by sending a specific MASC command across the serial interface. For the modem to turn OFF after an MASC request the HOSTPWR_ON signal must be de-asserted.

*Warning: The power supply rail must be maintained during a power down sequence or else memory may be corrupted.*

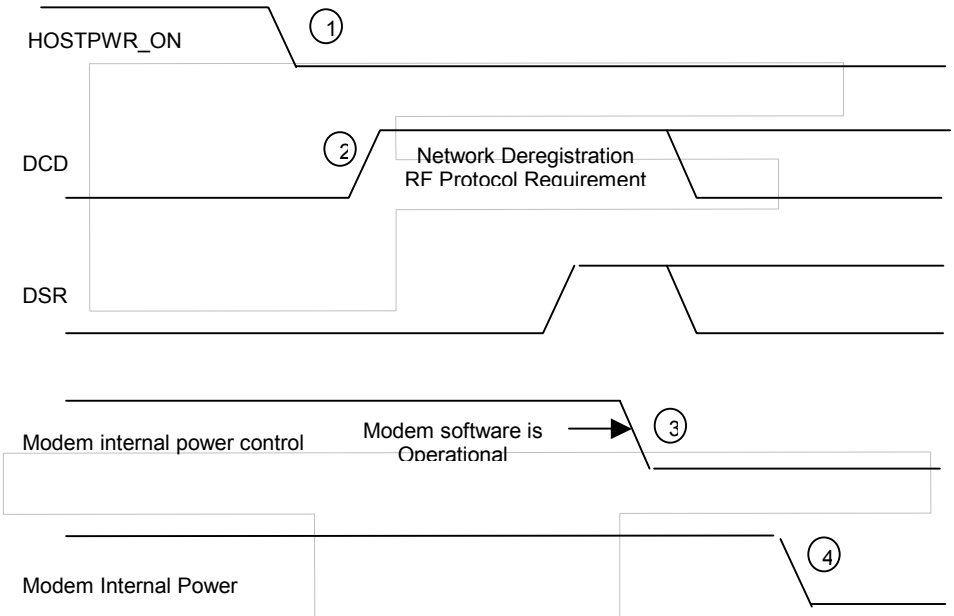
The soft shutdown process starts when the HOSTPWR_ON control line is de-asserted. The shutdown process consists of the modem first de-registering from the network and de-asserting the DCD line. Next, it saves the modem configuration and network channel information. The modem then de-asserts the DSR line, signalling the modem is no longer in a ready state. This process can take a few seconds to complete.

At this point, the host/terminal can remove the power from the modem and still maintain most of the modem settings and last registered network channel. The modem can be left with power applied and HOSTPWR_ON de-asserted.

The reset line HCRESET can be asserted at this time in preparation for the next power-up sequence. This is optional and is intended for rebooting the modem only. Resetting the modem causes a cold start and flushes the saved modem settings.

The following diagram shows the sequence for these actions.

## Power-Down Timing Diagram




Note: DSR and DCD are active low signals.

**Power Down Diagram Callouts**

1 HOSTPWR_ON is de-asserted from the host/terminal to the modem.

**Important**: *The power rail must be present for up to ten seconds (typically two seconds) after HOSTPWR_ON is de-asserted for the deregistration process to complete orderly*.

2 The modem starts the soft shutdown process. The battery status indicator pulses quickly until the shutdown steps are complete.

The modem initiates the deregistration process from the network and upon completion de-asserts DSR and DCD. DCD signifies network detachment, and DSR shows the modem's readiness state.

3 After deregistration, the internal modem CPU power-on signal is de-asserted. This deactivates the internal modem power rail to the radio.

4 At this point you can optionally de-asset HOSTPWR_ON signal to the modem and assert the HCRESET line to the modem.

## Batteries

The Boomer-III OEM Modem may be powered by batteries if used with a handheld device.

For battery operated devices, battery selection is a critical decision, requiring consideration of many factors. These include cell size, internal impedance, charging requirements, and susceptibility to common battery phenomena, such as memory effect or overcharging. Each of these factors is discussed in detail in this section.

The selected battery must be able to meet the Boomer-III power requirements as mentioned previously.

Three prevailing battery technologies exist today:

- Nickel cadmium (NiCad) batteries may be used for devices requiring wide temperature ranges.
- Nickel metal hydride (NiMH) and
- Lithium ion (Li+) batteries may also be used for devices utilised above 0ºC. Specifications for these batteries should be obtained from the manufacturer.

### NiCad

- Most mature technology
- Lower energy density (energy/volume) than NiMH or Li-ion
- Available in all cell sizes, including AA, 2/3A, 4/5A, A, 4/3A, and so on. This represents the greatest number of packaging options.
- Exhibits a memory effect when not occasionally discharged below the lower extent of its operating voltage. The memory effect reduces the usable capacity of each battery cell.

- Internal impedance of 25-30μΩ per 1.2V cell
- Typical cell voltages are 1.2V, with multiple cells used to obtain higher operating voltages
- Can withstand high current pulses, which are characteristic of packet data applications
- Typical charge method is −Δ V (known as negative delta voltage), which involves charging the battery while looking for the battery voltage to peak. Then enter a slight overcharge condition, where the voltage actually begins to decrease prior to terminating battery charging. NiCad is the most robust battery technology available today for non vehicular applications. NiCad can withstand over charging, over discharging, and harsh environments with reasonable resilience.
- Raw battery cells or battery packs can be purchased from suppliers

### NiMH

- Mature technology with potential for improvements in battery chemistry and energy density over the next five years
- Higher energy density than NiCad, but lower than Li-ion
- Available in standard sizes AA, 2/3A, 4/5A, A and 4/3A and some prismatic (rectangular) configurations
- Exhibits the memory effect in a manner similar to NiCad technology, but at a less pronounced level
- Internal impedance of 35-49μΩ per 1.2V cell
- Typical cell voltages are 1.2V, with multiple cells used to obtain higher operating voltages
- Earlier NiMH battery chemistry could be damaged by high current discharge pulses. Newer battery chemistry has eliminated this problem. When purchasing batteries of this type, determine if high current pulse discharging is an issue.
- Typical charge method is dT/dt, where T is temperature. As the battery reaches full charge, any further energy is dissipated as heat. A temperature threshold is used to terminate the charge cycle in conjunction with voltage monitoring. NiMH is more sensitive to overcharging then NiCad and exhibits decreased capacity if repetitively overcharged.
- Raw battery cells or battery packs can be purchased from suppliers.

### Li-ion

- Reasonably mature technology leaving lots of potential for increased capacity
- Higher energy density than either NiCad or NiMH

- Availability is an issue, as most suppliers do not sell cells, but force customers into particular solutions through their battery pack designs. Purchasing cells in an effort to design your own battery pack may be problematic due to cell lead times.
- Li-ion does not exhibit the memory effect and is unaffected by partial discharging-charging cycles
- Internal impedance of 100-150mΩ per 3.6V cell. Li-ion batteries are very susceptible to damage due to over discharge and high current pulses. As a result, manufacturers recommend that a protection circuit be added to battery pack designs. The resultant internal impedance of a battery pack with protection circuitry can reach the 500mΩ level.
- Typical cell voltages are 3.6V with multiple cells used to obtain higher operating voltages.
- Li-ion batteries are very sensitive to over-discharge and represent a hazard if not properly designed with protection circuitry.
- Typical charge method is constant-voltage, constant-current.

## Applying Battery Technologies

When reviewing different battery technologies, consider the following characteristics of OEM devices incorporating wireless data modems.

### Current drain is not constant

Typically, battery manufacturers specify the battery discharge profiles by assuming a constant-current drain model. In a wireless data system, the constant current drain model no longer applies. There are three levels of current drain contributions that can be expected: sleep, receive, and transmit. The modem cycles through these different states throughout the time it is powered on and in contact with the wireless network. To determine the realistic battery life or capacity for your product, you must contact the battery manufacturer or experiment by transmitting for various durations.

### Peak currents during transmissions

Since transmissions are typically short, the resultant current drain during transmissions can be viewed as current pulses. These pulses must be considered when selecting the proper battery technology, since not all technologies are equally tolerant of current pulses.

Additionally, the internal impedance of the battery must be taken into account at the peak currents during transmissions, since this is the time when the largest voltage drop occurs across the battery terminals. Adequate supply guard-band must be designed in to ensure that the modem and any other circuitry in the final product are not reset during transmissions.

**Messaging model**

To determine the required battery capacity for your product, you need to define the messaging model for your target market. In regard to battery selection, the messaging model details the following information:

- Optimal number of hours per day of use prior to recharging the battery
- Number of messages transmitted per hour
- Number of messages received per hour
- Average length of transmitted messages

Using this information and the typical current drains of the modem and other circuitry present in your product, you can define the requirements for battery supply voltage and capacity.

## Battery Recharging

### Plug-in Supplies

A mains plug-in supply must be designed to ensure that voltage spikes, lightening and other power fluctuations cannot damage the Boomer-III. Transient voltage protection zener diodes or other spike arrestor circuits may be added to keep the inputs within the power requirements mentioned previously. These should have a value of 20V and be placed on the supply side of the regulator circuit.

### Automotive Supplies

Extra protection is required from an automotive supply to protect the Boomer-III OEM Modem from power fluctuations when used in an automobile.

The electrical transient conditions (e.g. battery jump start), may damage the modem if not adequately clamped and filtered.

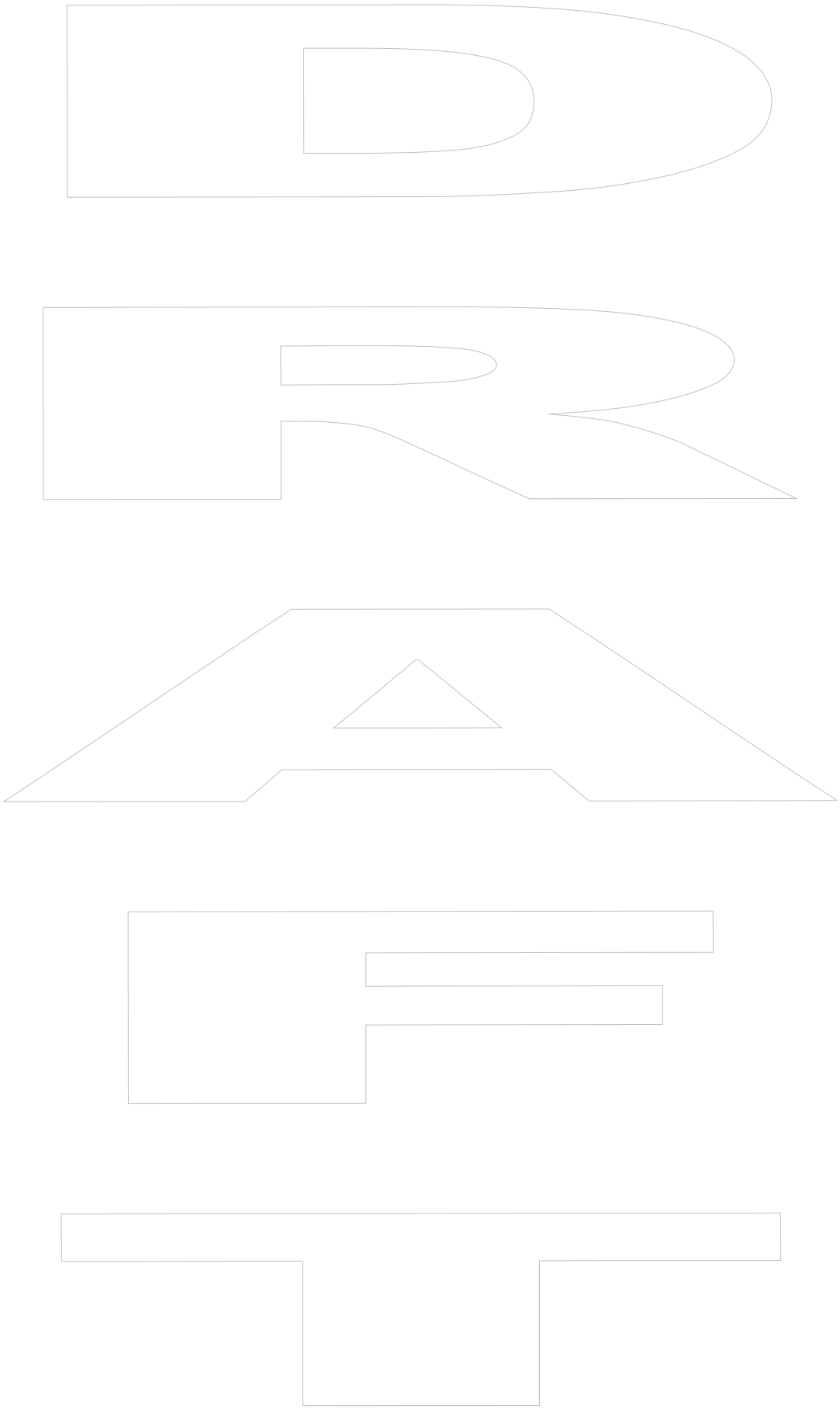
### Environmental Considerations

The environmental requirements of the Boomer-III OEM Modem are as follows:

| | |
|---|---|
| Operating Temperature: | -30° to +60°C |
| Storage Temperature: | -40° to +70°C |
| Relative Humidity | 0 to 95% non-condensing |

These limits should not be exceeded in the intended application.



# Using the Modem Test Jig

The Boomer-III modem may be used with the Boomer-II Test Jig which provides RS-232 serial interface ports between a PC and the modem. It is designed to enable you to quickly interface the Boomer-III to a standard PC (through a COM port) or a terminal device with an RS-232 serial port.

The test jig acts as a temporary host/terminal for the modem and provides access points to the radio's communication port, allowing you to monitor activity with a logic probe, multimeter or oscilloscope.

## Features

- All Input/Output Lines configurable by jumpers and/or accessible through parallel FPC connector.
- On-board dual RS232 Serial Communication interface ports with DB9 connectors
- Through the SPY MODEM connector, you can monitor the data transmitted from the modem (RX, DSR, and CTS).
- Through the PORT 2/SPY PC connector, you can monitor the data transmitted from the PC (TX, RTS and DTR), or talk to the second serial port of the modem. You can make this choice by putting all five jumper links on the right or left side of the RDW header connector near the port.
- Switches and LED indicators on SS0 - SS3 modem I/O lines.
- On-board voltage regulator for Boomer-III OEM supply rail.
- On-board LEDs for three external signals:
  - Low battery
  - Message waiting
  - In range
- On-board antenna matching network allowing conversion from MMCX to SMA connectors.

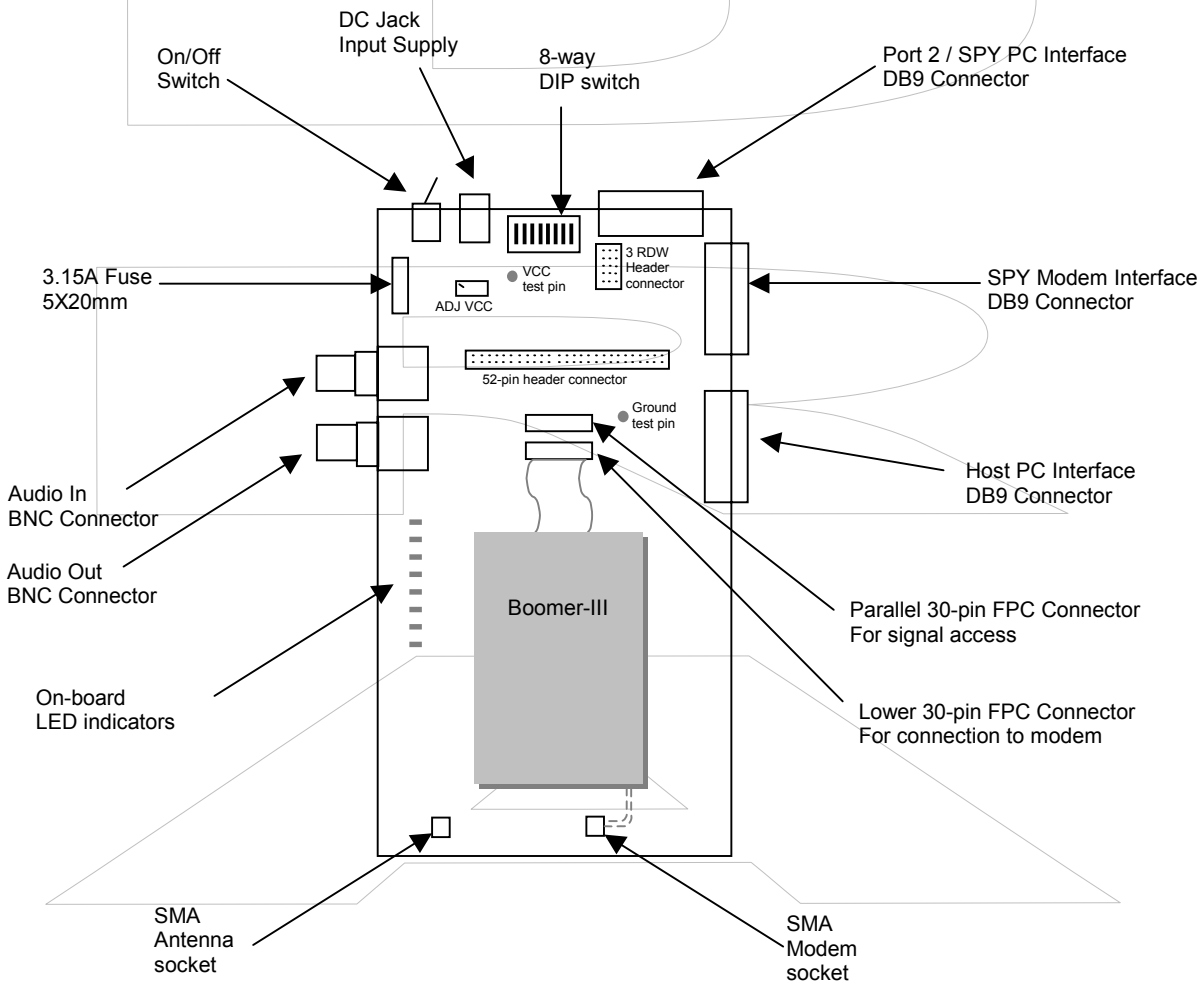
### Test Jig Updates

From time to time updates may be provided for the test jig and these should be implemented as per the Update Notice. If you are unsure if your test jig incorporates all the latest updates please contact Wavenet Technology.

## Exploring the Boomer-II Test Jig

The test jig comprises the following components:




On / Off switch — Switches the power to the test jig on or off.

DC Jack — Provides power to the test jig. (3.8V)

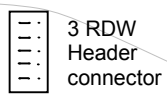
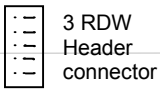
DIP Switch — 8-way DIP switch used to configure the test jig.

The following table shows the DIP switch configuration.

| Dip Switch # | Signal | On | Off | Default Position |
|---|---|---|---|---|
| 1 | Test | Always leave this switch in the OFF position | | OFF |
| 2 | Test | Always leave this switch in the ON position | | ON |
| 3 | SS3 | 3V | 10k Pull down to GND | OFF |
| 4 | SS2 | 3V | 10k Pull down to GND | OFF |
| 5 | SS1 | 3V | 10k Pull down to GND | OFF |
| 6 | SS0 | 3V | 10k Pull down to GND | OFF |
| 7 | H-P-ON | Turn the modem off | Turn the modem on | OFF |
| 8 | RESET | Keep modem reset | Keep modem in working status | OFF |

| | |
|---|---|
| Port 2 / SPY PC Connector | DB9 connector used for two purposes depending upon the settings of the jumper switches located just behind the connector on the PCB. If the jumpers are used to connect the centre column to the right hand outer column (TX, RTS etc), then the port acts as a spy connection for the data between the PC and the modem via the PC connector.<br>An analyser program such as "spy.exe" can be used to view the data. |
| SPY Modem Connector | DB9 connector, used to spy on the RS-232 data sent by the modem to the DTE (using DSR, RX, CTS and GND signals).<br>An analyser program such as "spy.exe" can be used to view the data. A communication program such as "HyperTerminal" can be of limited use if the data spied upon contains a lot of alpha-numeric ASCII characters. |
| Host PC Connector | DB9 connector, used to connect serial port 1 (of 2) of the modem to the DTE. The default values for this RS-232 connection is 9600bps, 8 bits, no parity, 1 stop bit.<br>This port can also be used to download new modem software to the Boomer-III. |
| Parallel FPC Connector | 30-way FPC (Flexible Printed Circuit) connector used for signal access. |
| Lower FPC Connector | 30-way FPC (Flexible Printed Circuit) connector used to connect the Boomer-III to the test jig. |
| Modem Connector | Used to connect the Boomer-III's antenna socket to the antenna connector. |
| Antenna Connector | Used to connect the external antenna. |
| LEDs | There are eight LEDs used to indicate the following:<br>Power<br>Low Battery<br>In Range<br>Message Waiting<br>SS0<br>SS1<br>SS2<br>SS3 |

| | |
|---|---|
| Audio Out | Connector for monitoring an audio output. Used to monitor base band signal, BIT Error Rate (requires a PER test jig), receiver and demodulation.<br>**Warning**: *Must use a high impedance monitor, 100kΩ.* |
| Audio In | Connector for monitoring an audio input. Used to monitor modulation and transmission.<br>**Warning**: *Must use a high impedance monitor, 100kΩ.* |
| 3 RDW Header Connector | Connectors used for jumpers (supplied).<br>For Port 2 use, all the jumpers are positioned from the centre column to the left hand column.<br>  <br>3 RDW Header connector<br>For Spy PC use, all the jumpers are positioned from the centre column to the right hand column.<br>  <br>3 RDW Header connector |
| 52-pin Header Connector | Connector used for jumpers (supplied).<br>All the jumpers are connected as default. |

| | |
|---|---|
| 1 | DCD |
| 2 | RX |
| 3 | TX |
| 4 | DTR |
| 5 | GND |
| 6 | DSR |
| 7 | RTS |
| 8 | CTS |
| 9 | RI |
| 10 | RESET |
| 11 | H-P-ON |
| 12 | MSGWTG |
| 13 | INRANGE |
| 14 | LOWBAT |
| 15 | SSO/RX2 |
| 16 | SS1/TX2 |
| 17 | SS2/CTS2 |
| 18 | SS3/RTS2 |
| 19 | 3.8V |
| 20 | 3.8V |
| 21 | 3.8V |
| 22 | 3.8V |
| 23 | GND |
| 24 | GND |
| 25 | GND |
| 26 | GND |

## Initial Calibration

Without connecting a Boomer-III OEM Modem to the Test Jig, initially check the calibration of the on-board voltage regulator. (This regulator supplies the RS232 converter and other on-board circuitry only. It does not supply power to the modem).

1. Connect the centre pin of the DC jack to the +3.8V power supply with 2A capability and the external pin to the ground.
2. Adjust the trim pot marked ADJ VCC to make sure the voltage on the test pin next to the ADJ VCC is 3V.
3. Keep all of the switches on the dipswitch in the off position (except DIP switch 2) for normal modem operation.

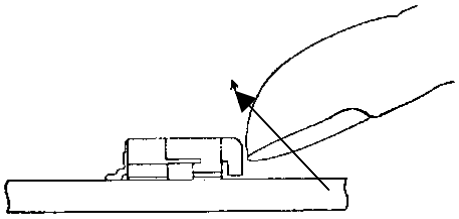
## Fitting the Boomer-III Modem

With the power off,

1. Connect the Boomer-III OEM modem to the lower FPC connector on the test jig using a 30-way FPC cable.

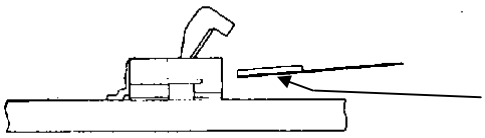
   Use the following procedure to insert the cable into the FPC connector.

   a. Lift up the lock lever of the FPC connector by flipping it up with the nail of your thumb or index finger.



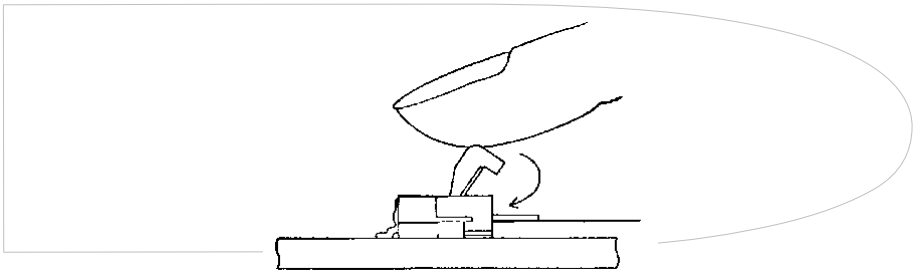
Lock Lever

   b. Ensure that the cable is inline with the connector and insert the FPC cable into the connector with the conducting surface of the cable facing downwards.



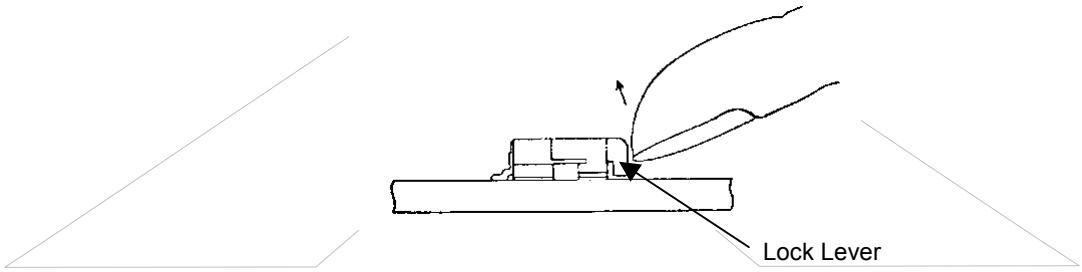
c. Press down the lock lever.



**Note**: *If the cable has been partially inserted, or out of alignment, the lock lever will not engage. Should this occur, remove the cable (see below) and repeat steps a-c.*

Use the following procedure to remove the cable from the FPC connector.

a. Lift up the lock lever of the FPC connector by flipping it up with the nail of your thumb or index finger.




b. Remove the cable after the lock is released.

2. Install an antenna to the modem. Use either the on-board SMA connection and an adapter cable between the modem MMCX connector and the test jig SMA connector, or connect directly to the modem itself.
3. Connect the PC serial cable to the DB9 connector marked "PC".
4. After making sure the power supply is set with the operating voltage range of the modem switch the power supply on.
5. Select the DIP switch labelled H-P-ON to the ON position. The green Power LED on the modem should illuminate.

   You are now ready to communicate with the modem using the PC as a host/terminal. The modem should be able to talk to the PC by using Wavenet Commander software, or other modem protocol software.

# Software Development Tools

## Wavenet SDK

Mobitex networks allow wireless communication and are installed in many different countries around the world.

The Wavenet Software Development Kit (SDK) has been developed to facilitate development of applications for these networks by providing a simple program interface for communicating with the network devices.

### SDK Contents

The SDK contains the following components:

- Integrators Guide and Users Manual for Boomer-III OEM modem (This manual)
- "Wavenet Commander" software

  Wavenet Commander is a modem application development and diagnostic communications tool that runs on a Windows PC and allows communication with the modem via the Boomer-III Test Jig. It provides a means for users to become familiar with the modem and uses MASC protocol to communicate with the modem.

### System Requirements

The minimum system requirements of a host/terminal emulation PC in order to utilise the Software Developers Kit are:

- Intel compatible Pentium computer or higher
- Windows 2000 or later
- Microsoft Message Queue (MSMQ)
- 16MB RAM (memory) minimum, 32MB recommended
- 1MB available hard disk space
- 9-pin serial Port using a 16550 UART
- 3.5-inch Disk Drive
- CD-ROM drive

## Wavenet Commander

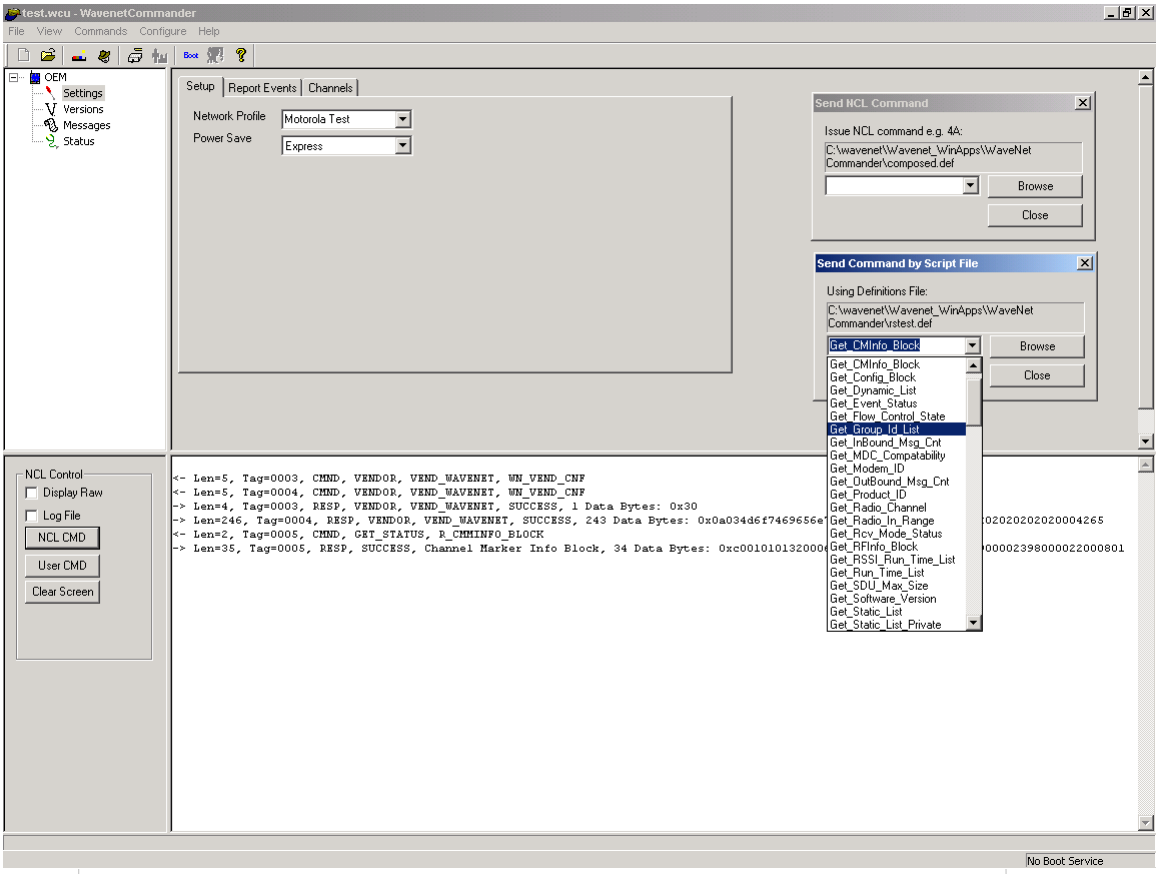
The radio service utility software "Wavenet Commander" enables a user to exercise and configure Wavenet Modems. This software runs under Windows 95, 98, NT, or 2000.

Wavenet Commander interfaces with the Boomer-III OEM Modem via a PC's communications port and the Test Jig's PC port using an RS-232 cable.

Wavenet Commander is issued as an install shield and will create the following files in the user designated installation directory:

- WC_End_User.wcu — The executable file
- user_defined.def — Definition file for User Scripts
- masc_generic.def — Default MASC Commands.

A typical screen shot from Wavenet Commander is shown below.



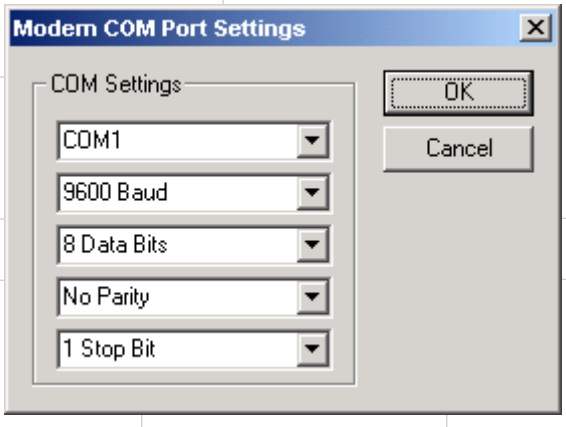
## Operations

Wavenet Commander display is broken up to four quadrants as follows:

| | |
|---|---|
| Upper-Left<br>**"Modem Info" Tree View**<br>The modem Type and display options are represented as Tree view. Use the mouse to select the following modem information views.<br>Settings: Basic Modem settings<br>Versions: Modems Versions<br>Messages: Send / Receive Messages.<br>Status: Modem Status.<br>For each view there are various associated property pages | Upper-Right<br>**"Modem Info" Property View**<br>Displays the associated property pages as selected by the quick link in the tree view. |
| Lower-Left<br>**TTY Control View**<br>TTY setting control allowing users to choose what kind of information they want to see in the Lower-Right hand quadrant. Allows the user clear the window, Issue User defined and standard modem commands. | Lower-Right<br>**Edit View**<br>Edit view displaying raw and/or interpreted data flowing between the modem and the PC. |

On start-up the user is presented with an icon in the tree view representing the type of modem Wavenet Commander was last connected to. To check /adjust the communication port settings, press the Hot Key **F6** or click on the connect icon in the toolbar. Choose the modem communications port when prompted and following view will be displayed.

Note: The base station port is for Depot Test Mode, which is not available in the user version



Ensure the test jig with the modem is powered up and connected (Serial cable from PC port of the Test Jig to your PC's Communication port) and the above the communication settings are correct for your set-up.

### Modem Info Tree View

ModemInfo uses the MASC API to interface to the Mobitex network. Modem Info allows the user to view the modem's current status, to send and receive messages on the current channel the device is registered to. The options displayed in the tree include the following:

**Settings:** Allows the user to select an operational profile (i.e. Channel list, etc), and the modems power save mode (if required). The user can also set the notification events, and adjust the channel list.

**Versions:** Displays the devices ID number, serial number, software version, modem configuration version and the hardware platform.

**Messages:** Allows a user to send and receive messages from the channel the device is currently registered on.

**Status:** Displays the modem's current channel (if registered) and its RSSI level. If the device is not registered, it will be in scan mode, scanning the channels from the channel list in its current profile.

### Modem Info Property View

The property view is dependant on the tree view. The following property pages are displayed for each tree view.

**Settings:** The user can select, the network profile, and if required the modems power save mode.

- **Network Profile**: The current network profile is displayed. The user can select a profile via the profile display list when this field is selected. Note the device must be registered with the appropriate network provider for the device to log on.
- **Power Save**: The user can select the devices power save mode as required. Note in some networks power save mode is not supported.

**Versions:** Displays the devices ID number, serial number, hardware platform and software version.

**Messages:** Allows a user to send and receive messages from the channel the device is currently registered on. Type the required message in the send message window and then click on the <Send> button. Any received data messages will be displayed in both the received message window and the **Edit View** Window. Note your modem must be registered on a channel.

**Status:** Displays the modem's RF-Protocol, channel, RSSI, In Range Status, Base Station ID the modem is registered on, and the modems power source level.

### TTY Control View

The TTY control View allows the user to perform the following:

- Display detailed commands and responses. The commands to the modem and the responses from the modem are displayed in Hex format. A maximum of 200 bytes is displayed per command or response.
- Allows the user to enable / disable the wc.log file. The log file will contain the information displayed in the Edit View window for future reference.
- Allows the user to run standard MASC commands by selection of the <MASC CMD> button. The user can edit the masc_generic.def file with an external editor as required.
- Allows the user to run a user defined MASC commands by selection of the <User CMD> button. The user can modify the user_defined.def file using an external editor as required. Details on how to generate a user command are contained in the def file.
- Clear the Edit View screen by selection of the <Clear Screen> Button.

### Edit View

The Edit View displays the commands issued to the modem and the modems responses. Wavenet Commander will where possible interpret the modem's response, and display the response in detail; otherwise the response will be displayed as hex bytes. From this window the user can issue some basic commands that include the underscore '_' command which will get the modems status and the exclamation command "|" for the modem settings. Pressing '?' will display basic help.

### Hot Keys

Wavenet Commander has the following Hot Keys.

- **Fx** Standard MASC command Selection.
- **Fx** User MASC Command Selection
- **F6** Communication port configuration.

# Wavenet Application Loader

The Application Loader software is used to upgrade the resident software installed on your Wavenet OEM modem. For optimum performance ensure that you are using the latest application version.

This appendix explains the procedure for updating the Application Loader software and has a troubleshooting section to assist with any problems.

## Updating Application Loader Software on Your Modem

The Application Loader software may be used for all Wavenet modems. The procedure is the same for all modems but some of the screens may differ in appearance.

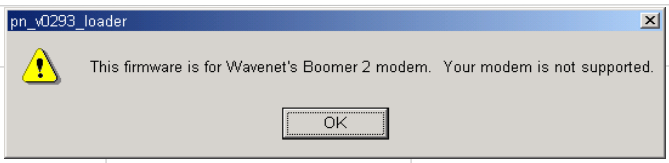
Follow the procedure below to check the software version currently loaded on your modem and if necessary, to upload the modem application.

1. Connect the Boomer-III to the Test Jig as described on page 22.
2. Connect the Data Communications Modem connector to the Boomer-III Test Jig's PC connector.
3. Connect the Data Communications PC connector to a COM (serial) port on your computer. Note that the Data Comms PC connector is a 9-pin plug. If your computer has a 25-pin serial port you will need a 9-pin to 25-pin adapter.
4. Switch the modem on.
5. Switch your PC on.
6. From the PC, open the appropriate Application Loader (Apploader) file for your modem.

   The letter(s) preceding the three numerical characters at the end of the Apploader file name denotes which modem the file is appropriate for, BM3 for the Boomer-III OEM modem.

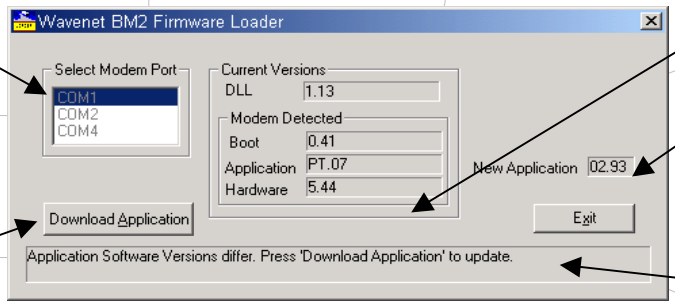
   The three numerical characters at the end of the file name show the version number of the application software, i.e.
   408 is software version 4.08 and
   233 is software version 2.33

   If you select the incorrect Apploader file for your modem the following typical message will be displayed.



**Note**: *The message shown above will appear if you are attempting to upgrade using ApploaderM408.exe with a BM3 modem.*

7. The following screen is typically displayed.




Select the appropriate com port on your PC that the modem is connected to.

Displays the current version of Application software on your modem.

Displays the new application available.

Click the Download Application button to download the latest version.

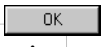
Status bar.

8. Select the appropriate PC communications port to which the modem is connected.
9. If the program recognises that the version of Application you are attempting to install is later than the version currently installed, the Download Application button will become enabled. A message is displayed in the status bar advising that the application software versions differ and requesting that you press the Download Application button to update.

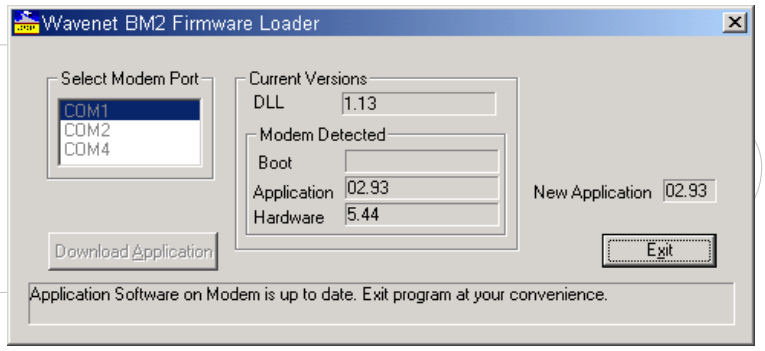
   If the program recognises that the version of Application you are attempting to install is earlier than the version currently installed, the Download Application button will remain disabled. A message is displayed in the status bar advising that the application software version on the modem is up to date and requesting that you exit the program.
10. Click 

to update the Application software.

    A progress bar is displayed informing you of the progress of the update, and the modems TX led will flash as the modem is being loaded.
11. After the application has been updated, the modem is automatically switched off. A message is displayed prompting you to switch the modem on again.


12. Click 

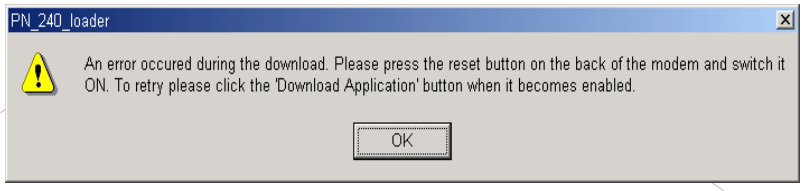
and the download window will read the modems application version and redisplay it.




13. A message is then displayed in the status bar, informing you that that the application software on the modem is up to date.
14. Click Exit to exit the program. This will automatically reset the modem.

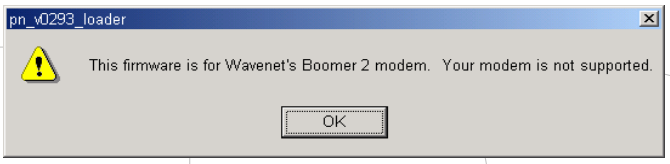
## Troubleshooting

You shouldn't encounter any problems updating the Application Loader software, however the following messages may appear.



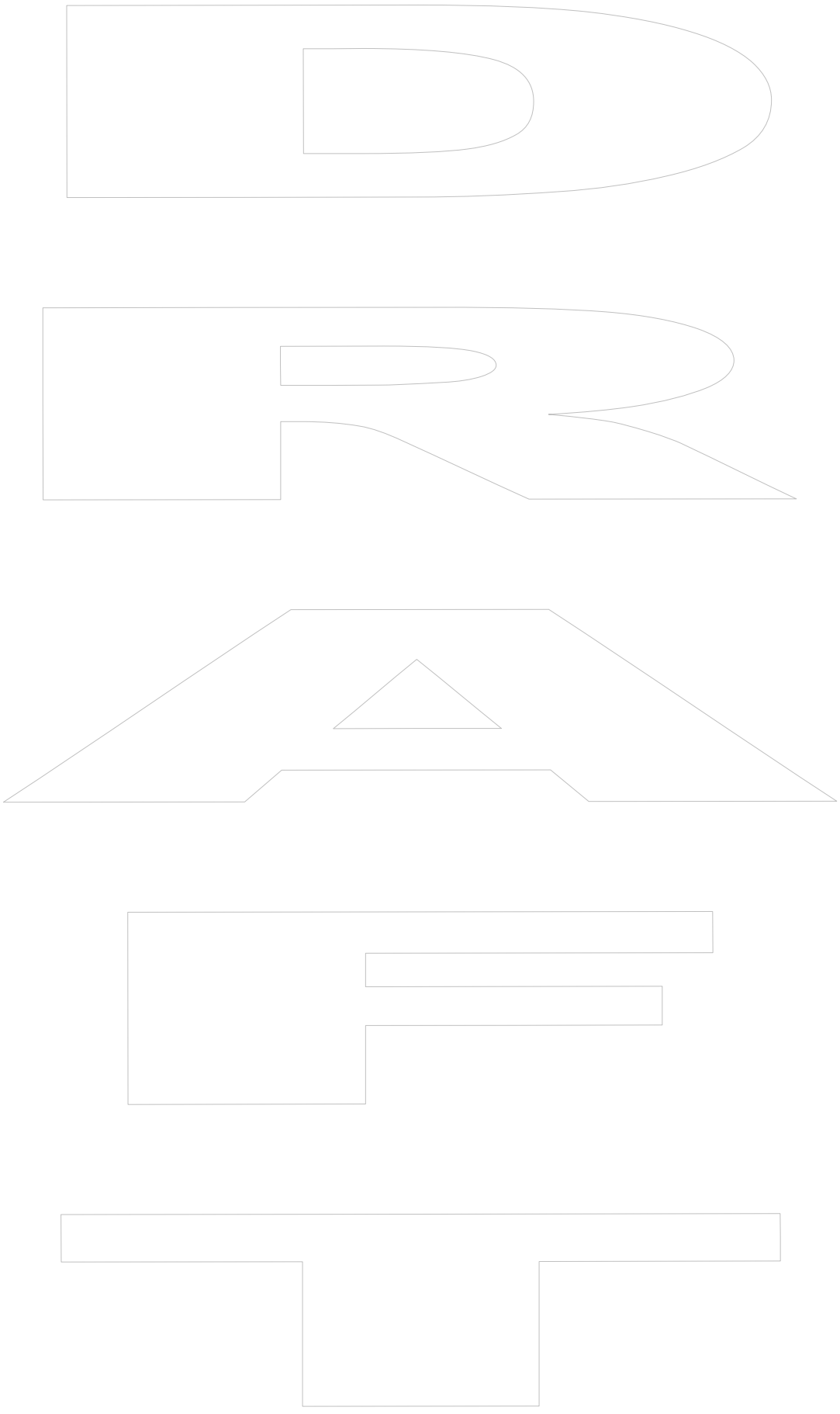

This message will appear if the modem is disconnected during the download. Ensure that all the connections between the PC and the modem are secure, check the battery connections, ensure the modem is switched on and follow the instructions in the message to try again.


This message will appear if the modem is disconnected whilst running the Application Loader. Ensure that all the connections between the PC and the modem are secure, check the battery connections and ensure the modem is switched on.




This message (or similar) will appear if you have attempted to upgrade your modem with the incorrect Application Loader file.

The letter preceding the three numerical characters at the end of the Application loader file name denotes which modem the file is appropriate for, i.e. BM3 for the Boomer-III OEM modem.



# Integration Testing

This section contains a product development checklist of parameters to check, requirements to meet, and standards of performance to evaluate. You can use these process checks and functional test procedures to fully qualify that the Boomer-III OEM Modem has been integrated properly into the host/terminal.

Proper testing throughout the development and integration cycle ensures that the final product works in both normal and exceptional situations. These tests are provided in several stages as follows:

1. Hardware integration
2. Desense and EMI
3. Regulatory compliance
4. Application software
5. Final assembly
6. End user problem resolution
7. OEM service depot repair

## Hardware Integration

To ensure that the integration effort is carried out properly, monitor all relevant engineering standards, requirements, and specifications. In addition, perform functional tests during product development to validate that the integrated package performs as designed.

### Enabler Functions

To test the interaction between the modem and host/terminal, your product must be able to perform the following:

- Turn the various hardware components on and off. This capability helps to isolate possible desense and other emissions problems. (See "Desense and EMI" on page 70.)
- Pass data through the host/terminal between the modem and the test platform. This allows external programming and configuration software to communicate with the modem while it is integrated within the host/terminal. For microprocessor-based products, pass-through mode uses software emulation involving the host/terminal processor, which passes full-duplex serial port data to and from the integrated modem. Otherwise, pass-through mode is implemented in hardware by level shifting between the 3V logic levels and the 12V RS-232 levels generally found on PCs.

### Specific Tests

In addition to the various tests that exercise your own circuitry, such as power-on self-test, design tests that ensure proper interaction between

the modem and host/terminal. Ensure that the following hardware integration issues are evaluated:

### RF Immunity

RF transmissions of the modem do not interfere with operation of the host/terminal.

### Electrical Signaling

Power sources and interface are functionally compatible between the host/terminal and the modem.

### Physical Parameters

Physical configuration of the modem inside the host/terminal provides adequate ventilation, mounting, shielding, and grounding.

### Antenna Performance

Integrated antenna system meets the required ERP specifications, VSWR specifications, antenna propagation patterns and any applicable network operator requirements.

### ESD Requirements

Host/terminal design protects the modem from ESD.

### RF Re-radiation

Host/terminal does not allow spurious emissions in excess of 60dBc, as caused by carrier re-radiation (for 3V/m fields).

## Desense and EMI

Any host/terminal in which the modem is integrated generates some EMI (electromagnetic interference), which tends to desensitise the modem's ability to receive at certain frequencies.

Wavenet can provide a facility for testing the amount of desense that your modem experiences while in a host/terminal. Specifically, modem receiver sensitivity is recorded while operating with the host/terminal under test. For this test, you provide an integrated product, including antenna, power supply and any peripherals. Wavenet Technology then produces a test graph that reports the amount of desense. All desense testing is generally performed at Wavenet Technology's facilities.

To prepare for the desense test, provide Wavenet with hardware to generate EMI that is representative of the final product, including the cables, power supplies, and other peripheral devices. The host/terminal must supply the modem the appropriate power requirements. The host/terminal hardware must be running its CPU, LEDs, and serial ports, etc (if so configured).

You must supply either the pass-through mode functionality ("Enabler Functions" on page 69) or provide physical access the serial port of the

modem . The ability to turn on and off the various circuits in the host/terminal allows for the identification and analysis of the host/terminal components that are responsible for desense. This approach to desense troubleshooting can greatly speed up the OEM integration effort.

For more detailed information about desense, refer to "Guide to Desense" on page 75.

## Regulatory Compliance

Most countries where the final product will be sold generally require approval from the local government regulatory body. In the US, the FCC requires that two individual requirements be met before the final product can be certified. The first test, the FCC Part 15 qualification, requires you to prove that the product electronics hardware does not yield local radiation capable of affecting other equipment, such as TVs, computer monitors, and so on.

The second test (FCC Part 90) requires you to prove when the modem transmits, it remains properly in its allocated channel spacing, and does not produce spikes or splatter in other frequencies. Wavenet undergoes FCC testing with the modem stand-alone to ensure compatibility with these requirements. But since the eventual transmit capability of the modem is highly integrated with the power supply and antenna system of the host/terminal, the fully integrated product must be submitted for final regulatory approval.

In addition, regulatory bodies can require the wireless modem to transmit random data patterns on specific frequencies while incorporated in the host/terminal. The Boomer-III OEM modem incorporates special debug modes to allow this kind of testing, provided the host/terminal application can issue the required commands to the modem.

The entire regulatory process can take many months to complete and should start early in the development cycle. The exact regulatory requirements of each country change from time to time. For efficient regulatory processing, it is recommend to use the services of specialized regulatory consultants to determine the specific requirements at the time of manufacture.

To prepare for regulatory testing, you need to integrate the pass-through mode into the product design (see "Enabler Functions" on page 69). Wavenet provides the ability to key and dekey the radio at the required frequencies and modulation levels from an external PC via the pass-through mode.

For further information about regulatory compliance, refer to "Regulatory Requirements" on page 19.

## Application Software

Tests need to verify the communications links between the host/terminal and the modem and between the modem and the network, as follows:

### Software Driver Configuration

Ensure that the host/terminal can enable the modem serial port to permit the host/terminal and modem to communicate. This test verifies that the driver software functions well and is configured properly.

### Network Configuration

Determine if the host/terminal can use the modem to communicate with the network. This test uses existing network software in an attempt to communicate with a specific network.

The final application must be able to respond correctly under all adverse network conditions, not just the ideal case. To achieve this, the application software has to be systematically tested against all possible failure and exception conditions. Situations such as low battery, out of range, host/terminal down, unexpected data, maximum message size, maximum peak/sustained throughput, and other conditions must not cause the host/terminal application to fail. Each condition must have a specific remedial action to alleviate it.

## Final Assembly

A final assembly test should be performed before shipment to ensure all components are working properly and issues such as crimped antenna cables, lose connections, and improper software load are resolved. During final assembly, the modem may send and receive a loopback message of maximum size. The successful return of the sent message proves the product can transmit and receive correctly.

Testing within areas lacking network coverage or for products shipped to another country requires a different approach. Wavenet can help you set up a closed loop final test system, using a base station and PC-based software to emulate a network.

## End User Problem Resolution

When the final product is in the hands of the end user, testing must quickly isolate the cause of the problem in the field. For example, is the problem caused by the host/terminal, the modem, the network, the configuration or a user error? Can the problem be fixed locally or does the unit need to be returned for service?

It is very time consuming and expensive to send products to service, especially if the problem is caused by a temporary network or Enterprise Server Application outage. For this reason, you should design the application to allow for end-user problem determination.

Effective tests provide a systematic, positive acknowledgment from each of the network components. For example:

Test 1 Is the OEM module able to pass its own self test?

Test 2 Is the OEM module able to communicate with peripherals?

Test 3 Is the OEM module able to communicate with the integrated modem?

Test 4 Is the modem able to hear the network?

Test 5 Is the modem registered and allowed to operate on the network?

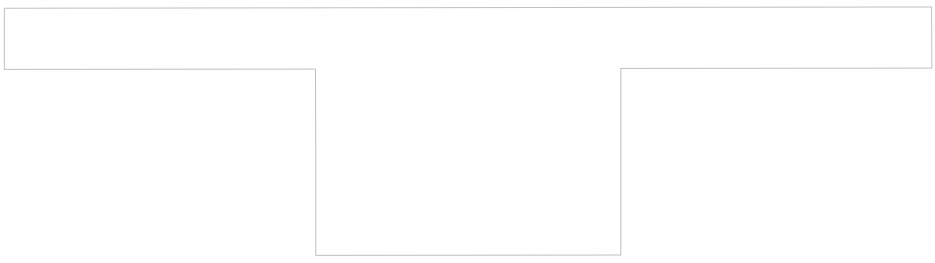
Test 6 Is the gateway (if present) up and running?

Test 7 Is the Enterprise Server Application up and running?

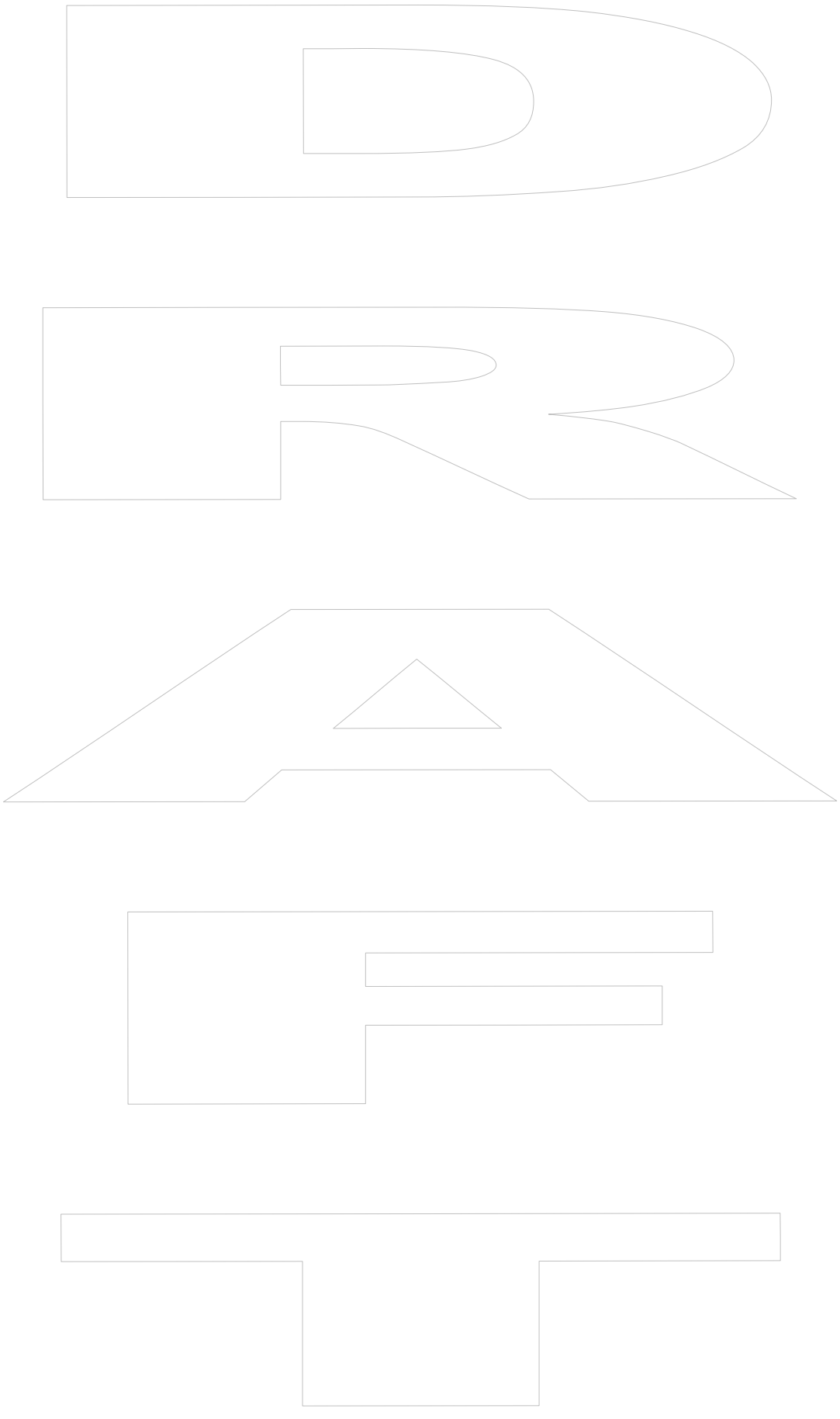
## OEM Service Depot Repair

When a host/terminal is returned for service, the first requirement is to determine whether the modem must be sent on to Wavenet for inspection and/or repair. To set up for this test, you need to have an evaluation board, a known-good Boomer-III OEM modem (for comparison), a power supply, Wavenet Commander software and an end-to-end test setup. The end-to-end test can employ either a live network or an over-the-air test involving a communications monitor that can transmit and receive at the appropriate frequencies. The objective is to test the suspect modem in a known-good environment, in which all other components are known to be operational.

If the modem has been determined to be faulty it should be returned to the place of purchase for inspection and repair.





# Appendix A – Guide to Desense

When you integrate wireless data radio technology into computing and telemetry devices, you must consider hardware issues related to RF emissions. For example, you must address the technical aspects of enabling a wireless RF device as an integrated peripheral in a host/terminal, such as RF performance and inter-operability with the host/terminal.

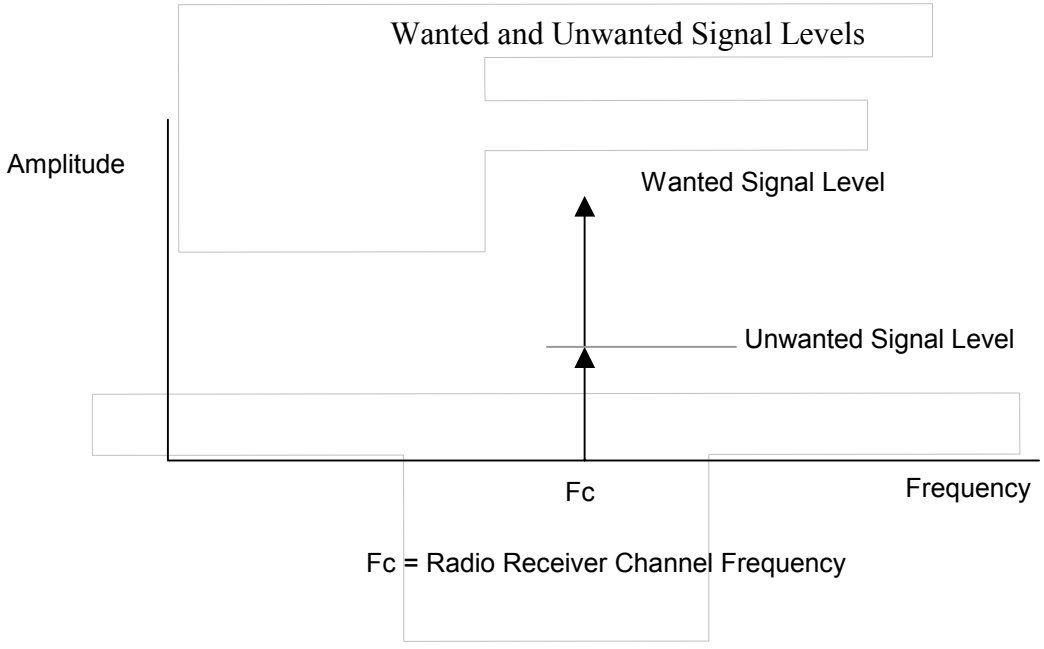
Specifically, this sections describes the following:

- The term "desense"
- Preferred test procedures
- Acceptable levels of electromagnetic interference (EMI)
- Approaches to solving desense problems
- Pertinent radio and antenna issues

**Note**: *This section considers, but does not attempt to resolve these technical issues for a particular platform. That is beyond the scope of this guide.*

Receiver desensitisation occurs when an unwanted signal is present at the radio receive frequency. The signal is usually the result of harmonic energy emanating from a high frequency, non-sinusoidal source. This noise desensitises or lowers the sensitivity threshold of the receiver.

The radio cannot differentiate between wanted and unwanted signals. In frequency-modulated systems, the radio receiver can capture the strongest signal present. If wanted and unwanted signals are present, and there is not a significant difference in level, the unwanted signal can overtake the receiver, effectively blocking the wanted signal see the following diagram.



Consistent and reliable reception occurs when a safety margin dictated by co-channel rejection is maintained. For example, if the co-channel rejection is 10dB, all unwanted signals must be 10dB below the receiver's sensitivity level. Some modems and networks have different rejection levels. Use the rejection level appropriate for your modem (typically –10dB). This means an interference signal that is more than 10dB below the wanted signal has little impact on the data receiver's data recovery. Any interfering source above this level creates desense, reducing the radio's sensitivity for data reception. For every one dB above the threshold level, one dB of desense is created.

## Noise Sources

CPU clocks, address and data buses, LCD refresh, switching power supplies, and peripheral drivers are the primary contributors of EMI. The frequencies of these emissions are often unstable. One reason for this instability is that high stability clock sources are not a requirement in host/terminal designs.

The frequency of sources drifts as a function of temperature, time, and aging. Other sources by nature move within the frequency spectrum as a function of time. The edges of clock signals create detectable harmonics well into the 1GHz band. This presents a challenge in measuring the effects of the emission, as one must first determine where the emission exists in the frequency spectrum.

Noise from the host/terminal can conduct through the electrical/mechanical interface or radiate electromagnetic fields that are received by the modem antenna and impact the modem. The Boomer-III OEM modem is specifically designed to minimize conducted noise.

Radiated electromagnetic fields emanating from the internal circuitry are incident on the modem antenna. These fields then are converted to noise power by the antenna and are incident on the receiver. The physical interface signalling connection has less impact on the receiver performance and can be electrically decoupled using passive components.

## Receiver Susceptibilities

The receiver is susceptible to being desensed within the channel bandwidth and at intermediate frequencies used for down conversion. Excessive noise on power supply pins can also create sensitivity problems.

## Measurement Techniques

Desense can be measured in one of the following ways:

- Indirectly by recording the emission level from the host/terminal and then calculating the effect on the modem.
- Directly by using packet error rate testing off air.

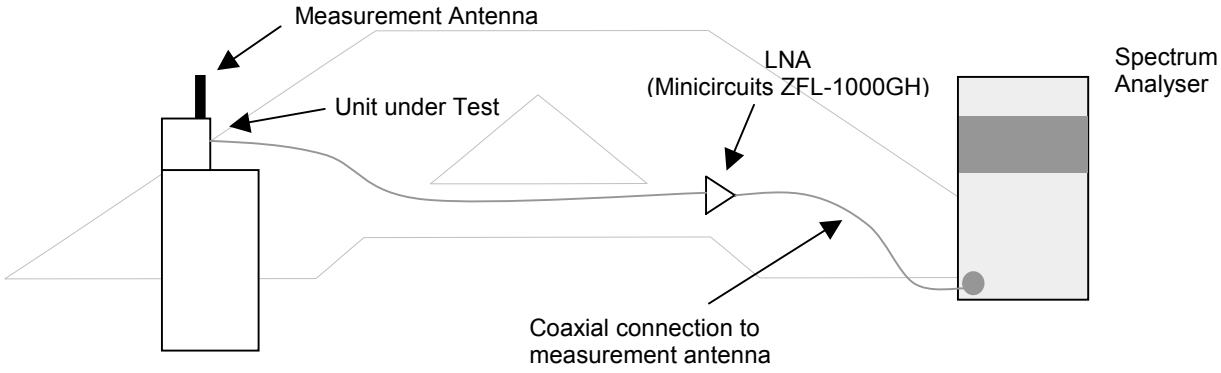
Testing directly is preferred method because it is more of a system test.

The test must be non-intrusive. Peripheral test cables or apparatus must not be connected to the unit under test, as they can have a significant effect on the receiver sensitivity results.

Indirect testing is essentially FCC Part 15 EMI testing that occurs today. Bear in mind that some assumptions have to be made to extrapolate the results and convert them to desense figures. Of course, these assumptions can create some error in the prediction.

## Alternate Measurement Method

Wavenet can performed desense testing on an integrated host/terminal using a special facility. The best alternate methods for determining the desense is to measure the signal the receiver port sees by using a spectrum analyser (see below).




**Spectrum Analyser Setup**

Using a spectrum analyser with an input impedance of 50 W, connect the antenna of the product under test to the analyser. If an antenna is currently not developed, use a portable dipole antenna as a measurement antenna.

The measurement apparatus is capable of measuring signals as low as -120dBm. A preamplifier is required to allow the spectrum analyser to achieve these levels. Use the analyser's smallest possible resolution bandwidth, typically 1kHz, to improve the dynamic range of the measurement.

If the input impedance of the analyser is the same as that of the radio receiver, and the antenna, you can measure the noise to which the receiver will be subjected. The gain on the LNA will make low-level noise more visible. Ensure that the spectrum analyser's input is not

over driven by other RF signals, such as FM radio stations. Any spikes that appear might cause desense problems.

The indirect method cannot account for characteristics of the data protocol and is less effective. Also, the bandwidth of the noise source is important. If the source is narrow-band, it has less effect than one occupying the entire channel bandwidth. The method is not effective in determining desensitisation at IF frequencies or from less obvious sources such as mixed products. The method provides information on how much effort, if any, needs to occur to resolve desense problems.

This method is useful when connection of the wireless card is not yet facilitated by the platform. This measurement could be performed without the wireless card present. This method determines the magnitude of the emissions, without extensive test facility requirements.

## Methods of Controlling Emissions

Preferred methods of controlling emissions observe that the emissions must be contained to a level 40dB less than the FCC Part 15 requirements. For WAN (Wide Area Network) products, the accepted method of achieving this is to shield.

Through past experience, it has become evident that standard techniques used to achieve FCC certification are not enough to satisfy wireless communications. Engineering teams logically attempt an array of decoupling, partial shielding, and PCB layout methods, which produce incremental improvements, but do not achieve the emission control requirements. Hybrid methods of shielding and source reduction are often a good approach.

**Important**: *Unless the host/terminal is already close to the goals set out in this document, source reduction efforts may only drive up the direct materials cost of the product and not increase return on that investment.*

If a compromise is chosen where the target levels are not the goal, standard EMI techniques can be of value. For narrowband emissions, some form of clock frequency "pulling" or control can be implemented.

### Shielding Approach

The mechanical design of the host/terminal must allow the EMC engineers to create a Faraday Box shield design. This is an electrically continuous shielded enclosure. If designed properly, such an enclosure easily attenuates radiated signals from the host/terminal.

The shield approach appears to be a big step at first. The advantage is that the shield will minimise the possible redesign required of the host/terminal PCB platform and circuitry.

For a thorough discussion of shielded enclosure design, an excellent reference is *Electromagnetic Compatibility: Principles and*

*Applications* by David A Weston. The publisher is Marcel Dekker, Inc. 270 Madison Avenue, New York, NY 10016. Any well written text on EMI control should cover the design of shielded enclosures.

### Components of the Shield Design

To be effective, the shield design must incorporate:

- A highly conductive shielded enclosure that encapsulates all of the active circuitry. This can be constructed of sheet metal or plated/sprayed plastic.
- Decoupling on all signals exiting the enclosure
- Control of aperture sizes in the shield to less than l/10 of the frequency of interest. This would apply to keyboard and display apertures in the enclosure. Testing of aperture radiation at the frequencies of interest may prove larger apertures are acceptable to the particular scenario.

### Benefits of the Shielding Approach

Emissions reduction can be achieved using shielding source reduction techniques, such as decoupling, or PCB layout and grounding, or a combination of the two. Once a shield is in place, any revisions to product circuitry have no effect on emissions levels. If a circuit level approach is used to control the emissions, a change in circuitry can bring a new unknown to the emissions performance.

### Alternate EMI Reduction Methods

Although shielding is the brute-force method of reducing emission levels, other methods are available, such as:

- PCB layout modification using ground layers adjacent to high speed layers
- Capacitive or filter decoupling
- Redistribution of module interconnects
- Clock Pulling

### Clock Pulling

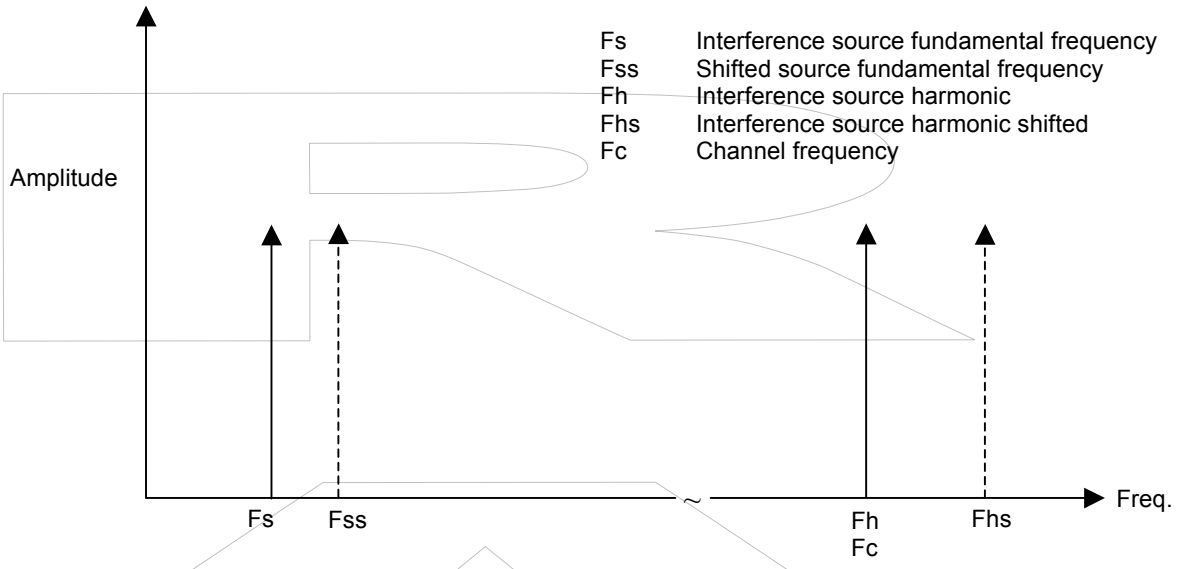
Clock pulling is effective when the emission sources are narrowband. To implement clock pulling, a method must be devised for the modem to tell the host/terminal it is having difficulty receiving. Devising such a method is admittedly very difficult. The host/terminal provides "pulling" of its internal emission source, which is identified as a potential problem.

If this source is the cause of the interference, the pulling or slight shift of the source frequency moves the harmonic energy out of the receive channel. This is an inexpensive way of solving the problem, as no special shielding or decoupling is required.

The limitations of the clock pulling method are:

- Computing devices have many more than one source
- Each source must be identified and controlled. This identification is at times difficult.
- The host/terminal and modem must communicate the problem at hand to attempt to correct it. This capability is not supported by the Boomer-III OEM modem.




**Pulling the Harmonic away from the Channel Frequency**

## RF Network Issues

Each RF network has its own requirements for the subscriber device. Most networks implement a coverage equalization scheme. This consists of configuring the infrastructure sites such that their RF power output is equal to that of the subscriber device.

Since most portable devices are battery operated, the transmitter power of the portable units is relatively low. To compensate for this, the base site transmitter power is decreased to a level equal to that of the portable. The base site has a much larger and reliable power source, and is capable of putting out more power. This would help overcome desense problems that the portable unit incurs. Most network managers prefer not to increase their site power because of ERP licence limitations and cell overlap issues.

Network operators must consider ambient noise levels when designing their coverage plans. Once the wireless modem and host/terminal are engineered not to "self-desense", other machines in the user's environment can still impact radio performance. These machines are not usually within close proximity of the wireless modem antenna, and have less effect. An FCC Class B radiator can impact the wireless

device if it is within 30 meters of the device, assuming that an emission exists at the channel frequency of the radio.

Networks can assist in the desense problem by offering more than one channel frequency at which to operate. If the radio encounters interference on a channel, it can then roam to another.

WAN protocols include retry mechanisms that resend messages not acknowledged from the subscriber device. These protocols can correct problems from intermittent noise sources by retrying during a time slot that does not coincide with noise source interference.

At a certain point, desensitising a wireless modem receiver creates unacceptable coverage in the network. This usually is in the 10dB range, though it can vary with networks.

The integrator should consult the technical staff at their target network for any minimum RF desense performance levels and related measurement methods that may be required for the device to be accepted for customer use on that network.

## Antenna

The Boomer-III OEM modem is not equipped with an on-board antenna and one must be provided externally in the host/terminal.

### Field Strengths from the Antenna

Field strengths from the wireless modem transmitter can reach as high as 100 V/M for WAN products. Harden the host/terminal to withstand these levels. LCD displays and switching power supplies are particularly susceptible to RF. Capacitive decoupling of sensitive areas is required. Decouple the reference voltage points on power supplies, reset lines on processors, and keyboard scanning circuitry.

### Antenna Interactions

There are two interactions that can impact the performance of the antenna. The user, by placing a hand near the antenna can detune the antenna and absorb energy. Accordingly, the antenna must be positioned such that interaction between the user and the card is minimized.

The host/terminal might also interact with the antenna. This is particularly true for WAN modems, which have higher output power. An imaginary sphere of real estate should be provided for the antenna to function. Cabling for other peripherals must not interfere with this region.

## Desense Summary

Desense considerations fall into two categories when using a wireless device and computer as a system:

- The impact of the host/terminal EMI on system performance

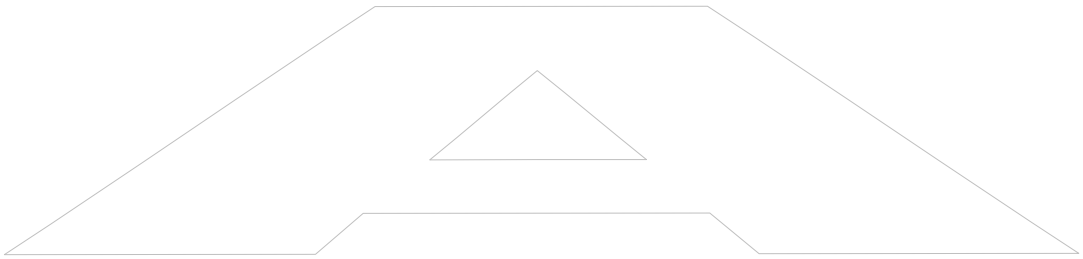
- The impact of the RF fields from the wireless device transmitter on host/terminal operation

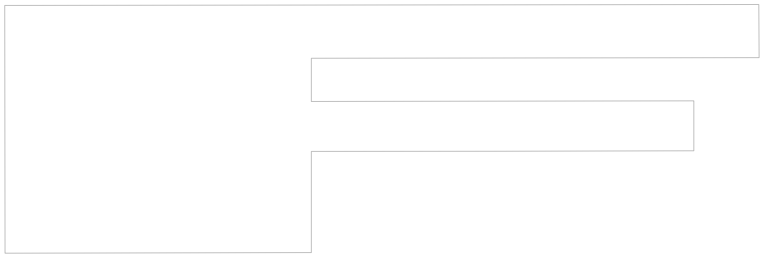
The latter consideration is not a significant problem. If RFI is assessed properly, it is usually corrected with little effort and cost.

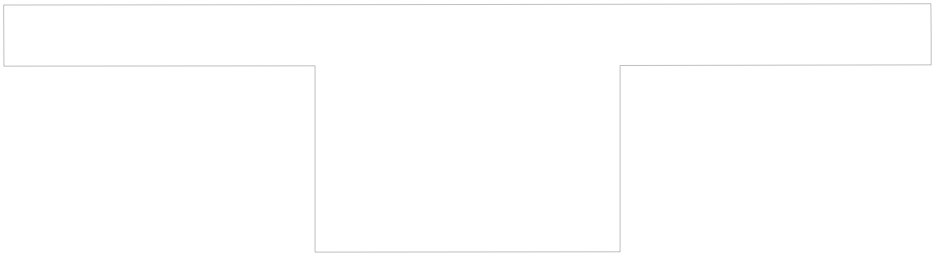
Because of the need for system coverage, the host/terminal EMI interaction with the radio receiver can be a significant and often elusive problem to characterize and correct. Most host/terminal devices are very fast and include numerous high frequency radiators. These can interfere with the radio reception of the wireless modem.

The theoretical levels at which the receiver might be impacted are derived from system coverage requirements and the sensitivity of the radio. These goals are not set arbitrarily to improve product performance, but to maintain the RF performance the networks demand and the radios are designed to deliver.

Since each product is unique. The level of noise is very difficult to predict, as is the amount of effort needed to control it. Measuring the product in an early engineering phase is key to managing the situation.





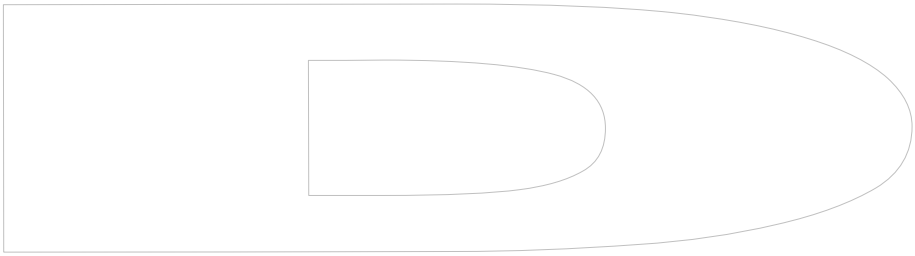


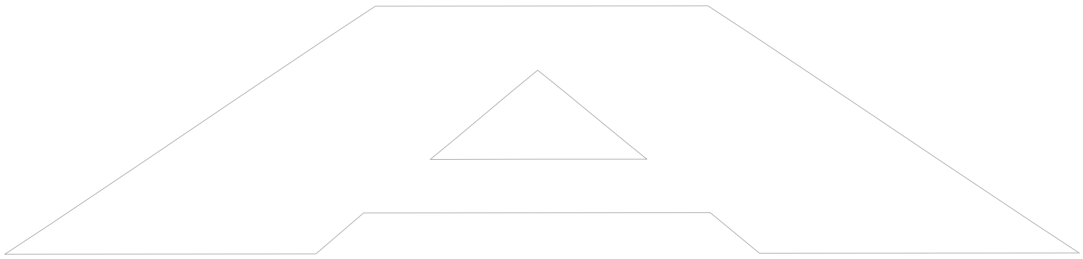
# Appendix B - Numeric Conversion Chart

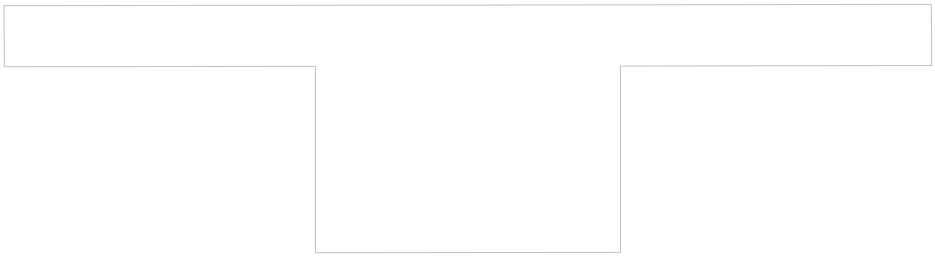
Binary/Octal/Decimal/Hex/C/ASCII Conversion Table

| Binary | Oct | Dec | Hex | C | ASCII | Definition | Binary | Oct | Dec | Hex | C | ASCII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00000000 | 000 | 0 | 00 | C | NUL | Null, or all zeros | 01000000 | 100 | 64 | 40 | P | @ |
| 00000001 | 001 | 1 | 01 | C | SOH | Start of Heading | 01000001 | 101 | 65 | 41 | UX | A |
| 00000010 | 002 | 2 | 02 | C | STX | Start of Text | 01000010 | 102 | 66 | 42 | UX | B |
| 00000011 | 003 | 3 | 03 | C | ETX | End of Text | 01000011 | 103 | 67 | 43 | UX | C |
| 00000100 | 004 | 4 | 04 | C | EOT | End of Transmission | 01000100 | 104 | 68 | 44 | UX | D |
| 00000101 | 005 | 5 | 05 | C | ENQ | Enquiry | 01000101 | 105 | 69 | 45 | UX | E |
| 00000110 | 006 | 6 | 06 | C | ACK | Acknowledge | 01000110 | 106 | 70 | 46 | UX | F |
| 00000111 | 007 | 7 | 07 | C | BEL | Bell | 01000111 | 107 | 71 | 47 | U | G |
| 00001000 | 010 | 8 | 08 | C | BS | Backspace | 01001000 | 110 | 72 | 48 | U | H |
| 00001001 | 011 | 9 | 09 | CS | HT | Horizontal Tab | 01001001 | 111 | 73 | 49 | U | I |
| 00001010 | 012 | 10 | 0A | CS | LF | Line Feed | 01001010 | 112 | 74 | 4A | U | J |
| 00001011 | 013 | 11 | 0B | CS | VT | Vertical Tab | 01001011 | 113 | 75 | 4B | U | K |
| 00001100 | 014 | 12 | 0C | CS | FF | Form Feed | 01001100 | 114 | 76 | 4C | U | L |
| 00001101 | 015 | 13 | 0D | CS | CR | Carriage Return | 01001101 | 115 | 77 | 4D | U | M |
| 00001110 | 016 | 14 | 0E | C | SO | Shift Out | 01001110 | 116 | 78 | 4E | U | N |
| 00001111 | 017 | 15 | 0F | C | SI | Shift In | 01001111 | 117 | 79 | 4F | U | O |
| 00010000 | 020 | 16 | 10 | C | DLE | Data Link Escape | 01010000 | 120 | 80 | 50 | U | P |
| 00010001 | 021 | 17 | 11 | C | DC1 | Device Control 1 (XON) | 01010001 | 121 | 81 | 51 | U | Q |
| 00010010 | 022 | 18 | 12 | C | DC2 | Device Control 2 | 01010010 | 122 | 82 | 52 | U | R |
| 00010011 | 023 | 19 | 13 | C | DC3 | Device Control 3 (XOFF) | 01010011 | 123 | 83 | 53 | U | S |
| 00010100 | 024 | 20 | 14 | C | DC4 | Device Control 4 | 01010100 | 124 | 84 | 54 | U | T |
| 00010101 | 025 | 21 | 15 | C | NAK | Negative Acknowledge | 01010101 | 125 | 85 | 55 | U | U |
| 00010110 | 026 | 22 | 16 | C | SYN | Synchronous Idle | 01010110 | 126 | 86 | 56 | U | V |
| 00010111 | 027 | 23 | 17 | C | ETB | End Transmission Block | 01010111 | 127 | 87 | 57 | U | W |
| 00011000 | 030 | 24 | 18 | C | CAN | Cancel | 01011000 | 130 | 88 | 58 | U | X |
| 00011001 | 031 | 25 | 19 | C | EM | End of Medium | 01011001 | 131 | 89 | 59 | U | Y |
| 00011010 | 032 | 26 | 1A | C | SUB | Substitute | 01011010 | 132 | 90 | 5A | U | Z |
| 00011011 | 033 | 27 | 1B | C | ESC | Escape | 01011011 | 133 | 91 | 5B | P | [ |
| 00011100 | 034 | 28 | 1C | C | FS | File Separator | 01011100 | 134 | 92 | 5C | P | \ |
| 00011101 | 035 | 29 | 1D | C | GS | Group Separator | 01011101 | 135 | 93 | 5D | P | ] |
| 00011110 | 036 | 30 | 1E | C | RS | Record Separator | 01011110 | 136 | 94 | 5E | P | ^ |
| 00011111 | 037 | 31 | 1F | C | US | Unit Separator | 01011111 | 137 | 95 | 5F | P | _ |
| 00100000 | 040 | 32 | 20 | S | SP | Space | 01100000 | 140 | 96 | 60 | P | ` |
| 00100001 | 041 | 33 | 21 | P | ! | | 01100001 | 141 | 97 | 61 | LX | a |
| 00100010 | 042 | 34 | 22 | P | " | | 01100010 | 142 | 98 | 62 | LX | b |
| 00100011 | 043 | 35 | 23 | P | # | | 01100011 | 143 | 99 | 63 | LX | c |
| 00100100 | 044 | 36 | 24 | P | $ | | 01100100 | 144 | 100 | 64 | LX | d |
| 00100101 | 045 | 37 | 25 | P | % | | 01100101 | 145 | 101 | 65 | LX | e |
| 00100110 | 046 | 38 | 26 | P | & | | 01100110 | 146 | 102 | 66 | LX | f |
| 00100111 | 047 | 39 | 27 | P | ' | | 01100111 | 147 | 103 | 67 | L | g |
| 00101000 | 050 | 40 | 28 | P | ( | | 01101000 | 150 | 104 | 68 | L | h |
| 00101001 | 051 | 41 | 29 | P | ) | | 01101001 | 151 | 105 | 69 | L | i |
| 00101010 | 052 | 42 | 2A | P | * | | 01101010 | 152 | 106 | 6A | L | j |
| 00101011 | 053 | 43 | 2B | P | + | | 01101011 | 153 | 107 | 6B | L | k |
| 00101100 | 054 | 44 | 2C | P | , | | 01101100 | 154 | 108 | 6C | L | l |
| 00101101 | 055 | 45 | 2D | P | - | | 01101101 | 155 | 109 | 6D | L | m |
| 00101110 | 056 | 46 | 2E | P | . | | 01101110 | 156 | 110 | 6E | L | n |
| 00101111 | 057 | 47 | 2F | P | / | | 01101111 | 157 | 111 | 6F | L | o |
| 00110000 | 060 | 48 | 30 | NX | 0 | | 01110000 | 160 | 112 | 70 | L | p |
| 00110001 | 061 | 49 | 31 | NX | 1 | | 01110001 | 161 | 113 | 71 | L | q |
| 00110010 | 062 | 50 | 32 | NX | 2 | | 01110010 | 162 | 114 | 72 | L | r |
| 00110011 | 063 | 51 | 33 | NX | 3 | | 01110011 | 163 | 115 | 73 | L | s |
| 00110100 | 064 | 52 | 34 | NX | 4 | | 01110100 | 164 | 116 | 74 | L | t |
| 00110101 | 065 | 53 | 35 | NX | 5 | | 01110101 | 165 | 117 | 75 | L | u |
| 00110110 | 066 | 54 | 36 | NX | 6 | | 01110110 | 166 | 118 | 76 | L | v |
| 00110111 | 067 | 55 | 37 | NX | 7 | | 01110111 | 167 | 119 | 77 | L | w |
| 00111000 | 070 | 56 | 38 | NX | 8 | | 01111000 | 170 | 120 | 78 | L | x |
| 00111001 | 071 | 57 | 39 | NX | 9 | | 01111001 | 171 | 121 | 79 | L | y |
| 00111010 | 072 | 58 | 3A | P | : | | 01111010 | 172 | 122 | 7A | L | z |
| 00111011 | 073 | 59 | 3B | P | ; | | 01111011 | 173 | 123 | 7B | P | { |
| 00111100 | 074 | 60 | 3C | P | < | | 01111100 | 174 | 124 | 7C | P | \| |
| 00111101 | 075 | 61 | 3D | P | = | | 01111101 | 175 | 125 | 7D | P | } |
| 00111110 | 076 | 62 | 3E | P | > | | 01111110 | 176 | 126 | 7E | P | ~ |
| 00111111 | 077 | 63 | 3F | P | ? | | 01111111 | 177 | 127 | 7F | C | DEL |







# Appendix C – Boomer-III Specifications

| Physical Properties | |
|---|---|
| Weight | < 75g |
| Size (L x W x H) | 68mm x 42mm x 8mm |

| Communication Protocols | |
|---|---|
| Modem to radio network protocol | Mobitex |
| Modem to host protocol | MASC<br>9600 bps<br>7 data bits, even parity, 1 stop bit |

| Environmental Conditions | |
|---|---|
| Operating temperature | -30°C to +60°C |
| Storage temperature | -40°C to 70°C |
| Relative Humidity | 0 to 95% |

| Ports | |
|---|---|
| Data Interface Port | 3V logic level serial port,<br>9600 baud |
| RF Connector | MMCX female socket, 50Ω.<br>Straight connection or right angle mating connector may be fitted |

| LED Indicators | | |
|---|---|---|
| Power | Green | flashes when scanning<br>On, when locked<br>Off, when the Boomer-III is off |
| Transmit | Red | flashes when transmitting |
| Receive | Green | flashes when receiving |

| Power | |
|---|---|
| Voltage | 3.8V nominal<br>(3.4 to 4.8V range) |
| Transmit | < 1.6 A (2.2 A if mismatched antenna) |
| Receive | < 80 mA |
| Standby | < TBD mA<br>(Add ~1.2 mA if LED's enabled) |
| Off current consumption | <20 µA |
| Power Supply Ripple | < 15 mV peak to peak |

| Synthesiser | |
|---|---|
| Frequency range | 890 – 902MHz |
| Channel spacing | 12.5kHz |
| Frequency Error | ±0.8ppm (750Hz) |

| Transmitter | |
|---|---|
| Frequency range | 896 – 902MHz |
| Channel spacing | 12.5kHz |
| Data rate | 8 kbps |
| Deviation | 2kHz |
| Modulation | GMSK |
| RF output power (at 50Ω antenna port) | 2.0 W nominal |
| Transmit Duty Cycle (over 5 min) | 10% default<br>30% (maximum) |
| Turn around time RX - TX | < 20ms |
| Spurious emission | < -20 dBm |
| Adjacent channel power | < -45 dBc at 12.5kHz channels |

| Receiver | |
|---|---|
| Frequency range | 935 – 941MHz |
| Channel spacing | 12.5kHz |
| Sensitivity | < -115dBm at 10% BLER |
| Spurious emission (receive mode) | < -57 dBm |
| Channel selectivity | > 47 dB (1.5kHz dev 1kHz tone) |
| Spurious rejection | > 55 dB |
| 90MHz Image rejection | > 45 dB |
| Blocking | > 84 dB (>±1MHz) |
| RSSI Reading | -120dBm ~ -45dBm |

# Appendix I - Glossary

| | |
|---|---|
| **ACK** | Acknowledgment |
| **ADC** | Analog-to-digital converter |
| **ALC** | Automatic level control |
| **ANSI** | American National Standards Institute |
| **AOC** | Automatic output control |
| **ASIC** | Application-specific integrated circuit |
| **ATE** | Automatic test equipment |
| **BGA** | Ball grid array |
| **BER** | Bit error rate |
| **BNC** | A type of connector used with coaxial cable |
| **Bps** | Bits per second |
| **BSC** | Base station controller (for a network) |
| **CCR** | Type of miniature RF connector |
| **CHRONOS** | Enhanced pendulum IC |
| **CLK** | Clock |
| **CMOS** | Complementary metal oxide silicon |
| **CNTL** | Control |
| **COM** | Communications (port) |
| **CPU** | Central processing unit |
| **CQA** | Customer quality assurance |
| **CNTL** | Control (key) |
| **CSA** | California Safety Authority |
| **DAC** | Digital-to-analog converter |
| **DB** | Decibel |
| **DBc** | Decibels relative to carrier |
| **DBm** | Decibels mean; levels relative to 1 mW |
| **DCD** | Detailed circuit description |
| **Debounce** | Protection against feedback voltage |
| **Desense** | Loss of sensitivity from high ambient noise |
| **DISC** | Discriminator |
| **DOS** | Disc operating system |
| **DTE** | Data terminal equipment, the user device |
| **DTR** | Data terminal ready |
| **DTU** | Device under test |
| **DVM** | Digital volt meter |
| **EEPROM** | Electrically erasable, programmable read-only memory |
| **EIA** | Electronic Industries Association (U.S.) |
| **EMA** | Embedded memory access (mode) |
| **EMI** | Electromagnetic interference |
| **EPC** | File name suffix for modem configuration files |
| **EPROM** | Erasable, programmable, read-only memory |
| **ERP** | Effective radiated power |
| **ESD** | Electrostatic discharge |
| **ESN** | Electronic serial number |
| **FCC** | Federal Communications Commission (U.S.) |
| **FET** | Field effect transistor |
| **FIFO** | First in, first out |
| **FNE** | Fixed network equipment |
| **FPC** | Flexible printed circuit |

| | |
|---|---|
| **FracN** | Fractional division synthesizer IC |
| **FRU** | Field-replaceable unit |
| **FSK** | Frequency shift keying |
| **GaAs** | Gallium arsenide, a semi-conducting material |
| **GND** | Ground |
| **GPIB** | A type of ATE interface |
| **GTEM** | Gigahertz transverse electromagnetic |
| **HCT** | High-speed CMOS technology |
| **Host** | The computer platform, or DTE directly connected to the modem |
| **HP** | Hewlett Packard |
| **I/O** | Input/Output |
| **IB** | Inbound |
| **IC** | Integrated circuit or Industry Canada |
| **Inbound** | Direction of wireless data originating from the host and/or modem to the fixed network equipment |
| **IP** | Internet protocol |
| **IR** | Infrared |
| **LC** | Inductor-capacitor |
| **LED** | Light-emitting diode |
| **Li-ion** | Lithium ion (battery technology) |
| **LNA** | Low noise amplifier |
| **MAN** | Mobitex Access Number |
| **MASC** | Mobitex Asynchronous Serial Communications |
| **MFR** | Multiple-frequency reuse |
| **MPS** | Maintenance Programming Software |
| **NAK** | Negative acknowledgment |
| **NatSim** | Native Mode Simulation (software utility) |
| **NiCad / NiCd** | Nickel-cadmium (battery technology) |
| **NiMH** | Nickel-Metal-Hydride (battery technology) |
| **NPN** | Type of bipolar transistor |
| **NSI** | Network systems integration |
| **OB** | Outbound |
| **OEM** | Original Equipment Manufacturer |
| **op-amp** | Operational amplifier |
| **OSMT** | Type of miniature RF connector |
| **Outbound** | Direction of wireless data originating from the fixed network destined for either the host application(s) or the modem itself |
| **PCA** | Printed circuit assembly (populated board) |
| **PCB** | Printed circuit board (bare board) |
| **PC Card** | A PCMCIA product |
| **PCMCIA** | Personal Computer Memory Card International Association |
| **PDA** | Personal data assistant |
| **PIC** | Personal information communicator |
| **PLL** | Phase-locked loop |
| **p/n** | Part number |
| **PMIT** | Packet modem integration test |
| **POST** | Power-on self test |
| **Ppm** | Parts per million |
| **QFP** | Quad flat pack |
| **R&D** | Research and development |
| **RAM** | Random-access memory |

| | |
|---|---|
| **Rayleigh** | A measure of multi-path fading depth of a signal |
| **RC** | Resistor-capacitor |
| **RD-LAP** | Radio Data-Link Access Procedure |
| **RF** | Radio frequency |
| **RFI** | Radio-frequency interference |
| **RGxxx** | Cabling designation number |
| **RMA** | Return material authorization |
| **RNC** | Radio network controller |
| **RPM** | Radio packet modem |
| **RS-232** | The EIA standard for a serial data interface |
| **RSSI** | Received signal strength indicator |
| **RTU** | Radio Training Utility |
| **Rx** | Receive or reception |
| **SAR** | Specific Absorption Rate |
| **Schottky diode** | A diode with low forward voltage drop and fast switching |
| **SDK** | Software developer's kit |
| **SINAD** | Ratio (measured in dB) of signal to noise-plus-distortion |
| **SMA** | Sub-miniature connector |
| **SMB** | Sub-miniature connector |
| **SNR** | Signal-to-noise ratio |
| **SPDT** | Single pole, double throw (switch) |
| **SPI** | Serial peripheral interface |
| **SRAM** | Static random-access memory (static RAM) |
| **TBD** | To be determined |
| **TNC** | Industry standard connector type |
| **Transorb** | Transient absorber |
| **TTO** | Transmitter turn-on time |
| **Tx** | Transmit or transmission |
| **UART** | Universal asynchronous receiver / transmitter |
| **UL** | Underwriters Laboratories |
| **VCC** | Voltage common collector |
| **VCO** | Voltage controlled oscillator |
| **VDD** | Voltage direct drain |
| **Vpp** | Voltage peak to peak |
| **VSWR** | Voltage standing-wave ratio |
| **Wireline** | Communications over a direct, physical link |
| **XIP** | Execute in place |
| **ZIF** | Zero insertion force |