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Reference Documents

PCI Express Mini Card References

PCI Express Mini Card Electromechanical Specification Revision 1.0 June 2, 2003

PCI Express Card Electromechanical Specification revision 1.1 March 28th 2005

SMBus Specification, Revision 2.0

The I2C-BUS SPECIFICATION Version 2.1 January 2000

3GPP References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

For a specific reference, subsequent revisions do not apply.

For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] Void.
- [2] 3GPP TS 23.038: "Alphabets and language-specific information".
- [3] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".
- [4] 3GPP TS 23.041: "Technical realization of the Cell Broadcast Service (CBS)".
- [5] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".
- [6] 3GPP TS 24.011: "Short Message Service (SMS) support on mobile radio interface".
- [7] 3GPP TS 24.012: "Cell Broadcast Service (CBS) support on the mobile radio interface".
- [8] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".
- [9] 3GPP TS 27.007: "AT command set for User Equipment (UE)".
- [10] 3GPP TS 51.011: "Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".
- [11] ITU-T Recommendation V.25ter: "Serial asynchronous automatic dialing and control".
- [12] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".
- [13] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".



- [14] ITU-T Recommendation E.163: "Numbering plan for the international telephone service".
- [15] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [16] 3GPP TS 31.102: "Characteristics of the USIM application".

Notices

Safety Warning

Neither the E725 nor EU860D / EU870D products may be used in an environment where radio frequency equipment is prohibited or restricted in its use. This includes aircraft/airports, hospitals, and other sensitive electronic areas.

Do not operate RF devices in an environment that may be susceptible to radio interference resulting in danger, specifically:

- **Areas where prohibited by the law**
Follow any special rules and regulations and obey all signs and notices. Always turn off the host device when instructed to do so, or when you suspect that it may cause interference or danger.
- **Where explosive atmospheres may be present**
Do not operate your modem in any area where a potentially explosive atmosphere may exist. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death. Be aware and comply with all signs and instructions.
- **Users are advised not to operate the modem while at a refueling point or service station.**
Users are reminded to observe restrictions on the use of radio equipment in fuel depots (fuel storage and distribution areas), chemical plants or where blasting operations are in progress.
- **Areas with a potentially explosive atmosphere are often but not always clearly marked.**
Potential locations can include gas stations, below deck on boats, chemical transfer or storage facilities, vehicles using liquefied petroleum gas (such as propane or butane), areas where the air contains chemicals or particles, such as grain, dust or metal powders, and any other area where you would normally be advised to turn off your vehicle engine.
- **Near Medical and life support equipment**
Do not operate your modem in any area where medical equipment, or life support equipment may be located, or near any equipment that may be susceptible to any form of radio interference. In such areas, the host communications device must be turned off. The modem may transmit signals that could interfere with this equipment.
- **On an aircraft, either on the ground or airborne**
In addition to FAA requirements, many airline regulations state that you must suspend wireless operations before boarding an airplane. Please ensure that the host device is turned off and your modem is removed from the card slot prior to boarding aircraft in order to comply with these regulations. The modem can transmit signals that could interfere with various onboard systems and controls.
- **While operating a vehicle**
The driver or operator of any vehicle should not operate a wireless data device. Doing so will detract from the driver or operator's control and operation of that

vehicle. In some countries, operating such communication devices while in control of a vehicle is an offence.

Under extended operation the EU870D and EU860D modem will generate a noticeable amount of heat. Like all PC Cards, the modem generates heat during normal operation and will be heated by the host computer. For this reason it is recommended that after extended periods of operation, prior to removal and handling, you allow the modem to cool down.

Federal Communications Commission Notice (FCC—United States)

FCC applies to E725 and EU860D/870D. Refer to sections on Regulatory Compliance for more details.

Electronic devices, including computers and wireless modems, generate RF energy incidental to their intended function and are therefore subject to FCC rules and regulations. This equipment will be tested, and found to be within the acceptable 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 when the equipment is operated in a residential environment. This equipment generates radio frequency energy and is designed for use in accordance with the manufacturer's user manual. However, there is no guarantee that interference will not occur in any particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are 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 the 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/television technician for help

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Radio Frequency Exposure Evaluation Requirements

This wireless module is a radio transmitter and receiver. It is designed and manufactured not to exceed the exposure limits for radio frequency (RF) energy set by the Federal Communications Commission (FCC) of the U.S. Government. These limits are part of comprehensive guidelines and establish permitted levels of RF energy for the general population. The guidelines are based on standards that were developed by independent scientific organizations through periodic and thorough evaluation of scientific studies. The standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health.

The exposure standard for wireless devices including mobile phones and wireless modems uses a unit of measurement known as the Specific Absorption Rate, or SAR. Tests for SAR are conducted using standard operating positions reviewed by the FCC with the device under test

transmitting at its highest certified power level in all frequency bands. Although the SAR is determined at the highest certified power level, the actual SAR level of the phone or modem while operating can be well below the maximum value. This is because the phone or modem is designed to operate at multiple power levels so as to use only the power required to reach the network. In general, the closer you are to a wireless base station antenna, the lower the power output.

Before this device is made available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government-adopted requirement for safe exposure. The tests are performed in positions and locations (for example, at the ear or worn on the body) as required by the FCC for each model.

In general, for the United States market, the embedded modules are treated as “mobile devices” as per FCC CFR47 paragraph 2.1091. A mobile device is defined as “a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s radiating structure(s) and the body of the user or nearby persons.” Manufactures of mobile devices may be able to submit a Maximum Exposure Rate (MPE) calculation in order to demonstrate SAR compliance.

CE (Conformité Européenne or European Conformity)

This module will be tested to and conforms to the regulatory requirements of the European Union and has attained CE Marking. The CE Mark is a conformity marking consisting of the letters “CE”. The CE Mark applies to products regulated by certain European health, safety and environmental protection legislation. The CE Mark is obligatory for products it applies to: the manufacturer affixes the marking in order to be allowed to sell his product in the European market.

Radiocommunications and Telecommunications Terminal Equipment Industries (R&TTE)

This is mandatory for European operation and the directive applies to products using the radio frequency spectrum and all equipment attached to public telecommunications networks.

This product conforms to the essential requirements of the Radiocommunications and Telecommunications Terminal Equipment Directive (R&TTE) 1999/5/EC with respect to the following articles:

- 3.1a Safety
- 3.1b EMC
- 3.2 Spectrum

A notified body will determine that this device has properly demonstrated that the requirements of the directive have been met and has issued a favorable certificate of expert opinion. As such the device will bear the notified body number (TBD) after the CE Mark.

Compliance & Certification Requirements

PCS Type Certification Review Board (PTCRB)

PTCRB Certification is mandated and the product is technically evaluated to meet the minimum requirements for registration on the PTCRB Operators' networks. The purpose of the PTCRB is to provide the framework within which GSM Mobile Equipment (ME) Type Certification can take place for members of the PTCRB. The PTCRB process is recommended for all Manufacturers who wish to have their products operating within the areas served by the PTCRB Operators. This includes but is not limited to determination of the test specifications and methods to implement the Type Certification process for GSM Mobile Equipment.

PTCRB type certification will be based on GSM and OMA (Open Mobile Alliance) Specifications with modifications per North American Standards and additional requirements from FCC rules, and any other government agency that may have jurisdiction and or competence in the matter. Additions to the PTCRB Specifications will be developed by the GSM operators. The additions will be limited to MS-related features. The PTCRB document NAPRD 03 (Permanent Reference Document) will be modified to include references to the above specifications once they are written and accepted by majority of the review board.

To learn more about device certifications, please visit the [PTCRB Website](#). You must sign up as a member to gain access

Global Certification Forum (GCF),

The Global Certification Forum (GCF) is an independent organization with a wide-ranging membership of operators, equipment manufacturers and other interested parties. The actions of the Forum are actively supported by key staff from the Association Technical Projects operation and by the Association Executive Management Committee.

GCF is recommended but not mandatory for attachment to the European network. It is a partnership between network operators and terminal manufacturers and allows independent interoperability validation of the 2G and 3G mobile wireless terminal. GCF is typically required for formal carrier technical acceptance of the mobile wireless terminal.

Membership of GCF is entirely voluntary. Full GCF membership is open to mobile terminal manufacturers and network operators. Other interested members of the mobile wireless community, including test laboratories and test equipment manufacturers, may participate in GCF as observers.

The current membership includes almost 150 network operators worldwide, more than 35 leading terminal manufacturers and over 50 test equipment manufactures. Members decide the organization and administration of the forum at regular Steering Group meetings. Technical issues associated with testing new terminals and features are reviewed at regular Agreement Group meetings by manufacturers, test laboratories and other observers.

To learn more about device certifications, please visit the [GCF Website](#). The website identifies manufacture, terminal names and the date which the terminal was certified. You must sign up as a member to gain full access.

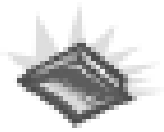


Windows Platforms

The Phoenix API will interface with your top level applications and provide the abstraction of the module specifics to the upper applications. Please refer to the Phoenix API Interface Appendix for details.

Please refer to the MobiLink Phoenix SDK chapter for details on developing applications and communicating with the modem on Windows platforms.

Technical Support Contacts



WWW: <http://www.nvtl.com/support/index.html>

Email: support@novatelwireless.com

Getting Started

General

The purpose of this document is to provide advance design and integration information to assist in the integration planning and evaluation of Novatel Wireless PCI Express Mini-cards. This document is intended to specify key components of the integration tools available for the Novatel Wireless line of PCI Express Mini-cards.

The E725, EU860D & EU870D are Novatel Wireless' versatile modules that add WWAN capability to other devices. They were developed to be integrated into other devices based on the PCI Express Mini-card specification 1.0.

The E725, EU860D and EU870D will work with all Windows driven laptops given the drivers are properly installed. When MobiLink™ is installed on a Windows OS system it will automatically include the drivers necessary to communicate with the PCI Express Mini-card. MobiLink™ is Novatel's Windows application manager for the PCI Express Mini Card. MobiLink provides an easy interface to make a data connection, change operating parameters, and view alerts such as SMS or signal strength indicator. However, anyone can still install the drivers manually. In addition, once the drivers are installed, following the Phoenix Client API functions, anyone could develop their Client side software manager to interact with the PCI Express Mini-card.

When using any of these devices, EU860D, EU870D or the E725, activation is required for the device to be allowed on the operator's network. For example, Sprint requires the customer to run IOTA (Internet Over-The-Air) provisioning to prepare the device to work on the wireless network. Please refer to the Customer Configuration section on provisioning with IOTA for assistance.

The EU860D and EU870D require a valid SIM card before it can be used on the operator's wireless network. Please refer to the Customer Configuration section on PRI for further information.

Setting Up

The purpose of this section is to assist in the initial connection and provide the reader with instructions for how to setup and establish communication with the Novatel Wireless line of PCI Express Mini-card. The following setup guide refers to an HSDPA Mini-card for convenience of the set up discussion. The same setup is valid for both the HSDPA and EVDO Mini-cards.

Setting up and establishing communication with the Novatel Wireless PCI Express Mini-card involves:

- Connecting the PCI Express Mini-card to the computer and the Development Board.
- Establishing communication with the PCI Express Mini-card and determining the computer COM Port being used.
- Setting up and using the HyperTerminal program to communicate with the Mini-card

CONNECTING THE PCI EXPRESS MINI-CARD TO THE COMPUTER AND THE DEVELOPMENT BOARD

Insert the PCI Express Mini-card into the Development Board (Novatel Wireless Part # 01017568) by sliding the connector end of the Mini-card into the Molex connector. Push down on the opposite end of the Mini-card until the 2 black locking tabs snap into place.

Connect an A to B USB cable from the Development Board to the computer USB port. When ready to power up the modem, plug the AC wall adaptor that came with the Development board into the wall.

If desired, the Development Board can be powered by a bench top power supply. See the Hardware Development Kit section for more details.

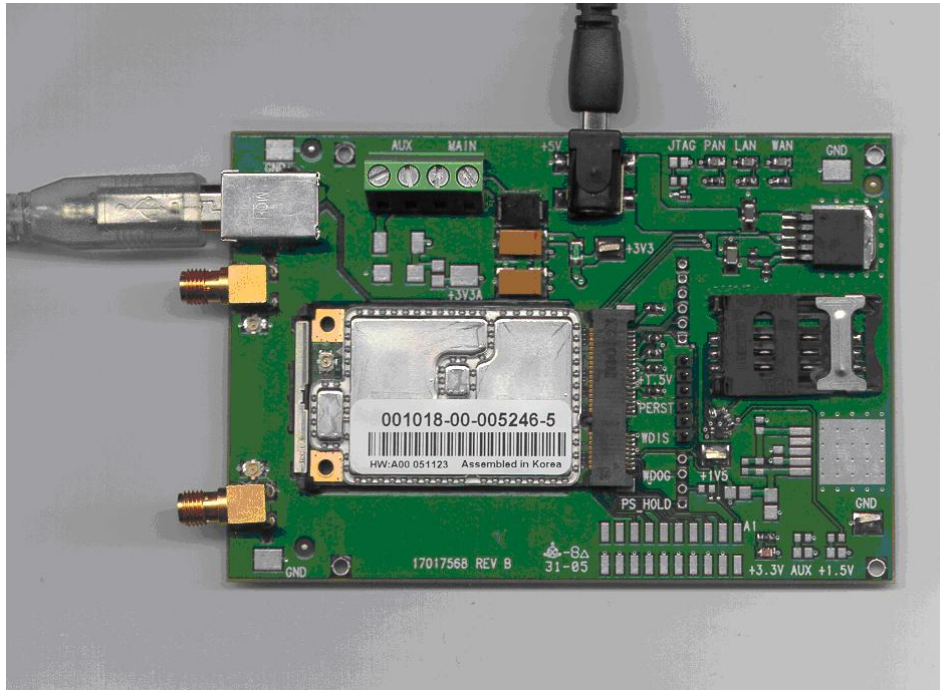


Figure 1 – Modem Interface Board and Cables

ESTABLISHING COMMUNICATION WITH THE PCI EXPRESS MINI-CARD AND DETERMINING THE COMPUTER COM PORT BEING USED

Once the modem is powered up and connected, you should hear a sound indicating the computer has recognized the modem.

Determining the Computer's Active Primary COM Port

To verify the computer's recognition of the modem and to verify which Primary COM Port it is connected to, navigate to Start\Control Panel\Phone and Modem Options and then click on the Modems tab within the Phone and Modem Options window. Refer to Figure 2 below.

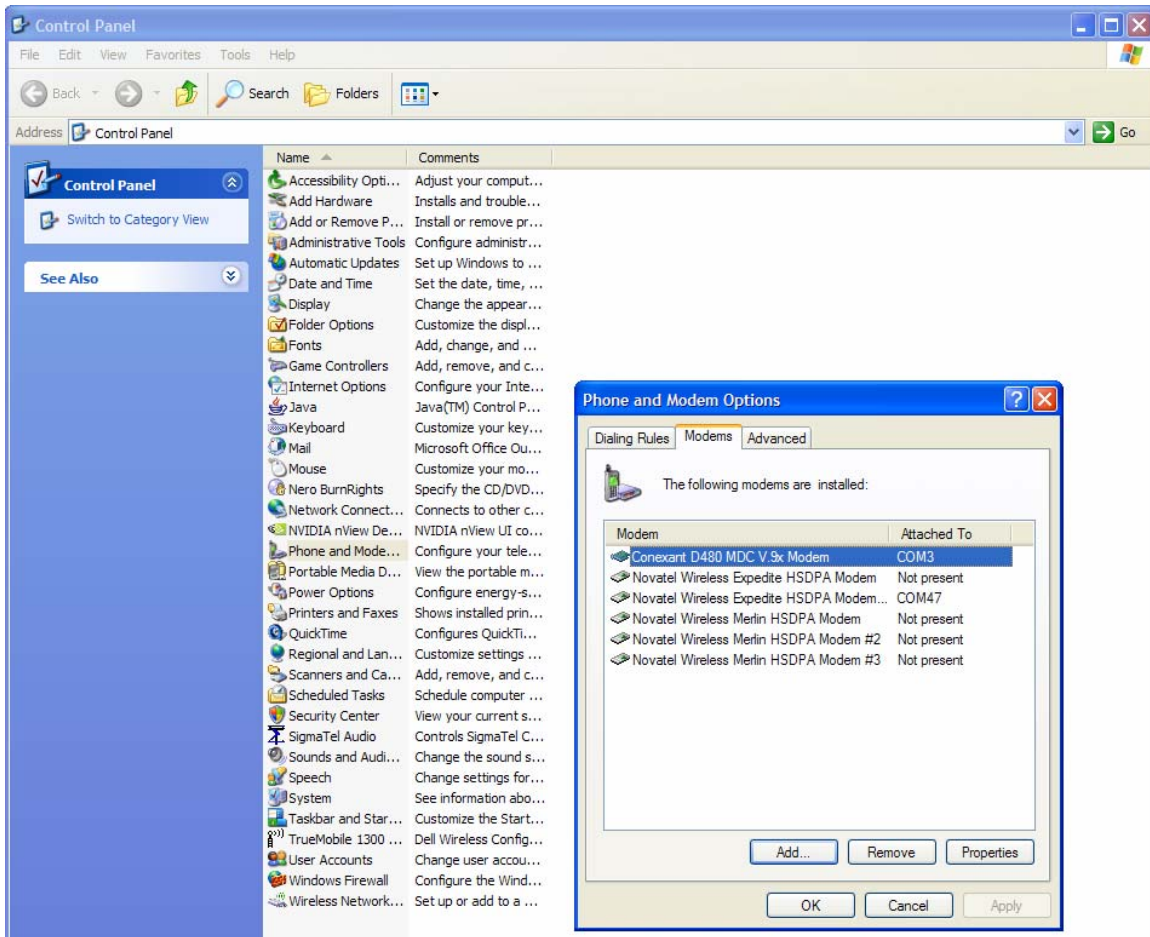


Figure 2 – Phone and Modems Options Window

Look for the Novatel Wireless Merlin HSDPA Modem item on the list. To the right of this item in the 'Attached To' column, you will see a COM port number - make a note of this Primary COM Port Number. If you do not see any COM No. for this item and you only see "Not Present", then this indicates that the modem is not being recognized and is not attached to a COM Port on the computer. In this case, make sure the USB and power cable are properly connected at both ends. If the modem has properly booted up, with no SIM in the SIM holder, the WAN LED on the Development Board should be blinking at a steady rate. If there is a SIM in the SIM Holder, the LED will be solid green.

Determining the Computer's Active Secondary or Status COM Port

To verify which Secondary, or Status COM Port the modem is connected to, navigate to Start\Control Panel\System. After you have double-clicked on the System Icon, click on the Hardware Tab within the System Properties window. Now click on the Device Manager tab. In the Device Manager window, click on the "+" beside Modems to expand this item. You should now see the Novatel Wireless Expedite HSDPA Modem, or something similar listed here. Refer to Figure 3 below. Now click on the "+" beside Ports (COM & LPT) to expand this item. You should now see the Novatel Wireless Expedite HSDPA Status Port (COM XX) listed here. This is the Secondary or Status COM port Number. Again, refer to Figure 3 below. Make a note of this Port Number.

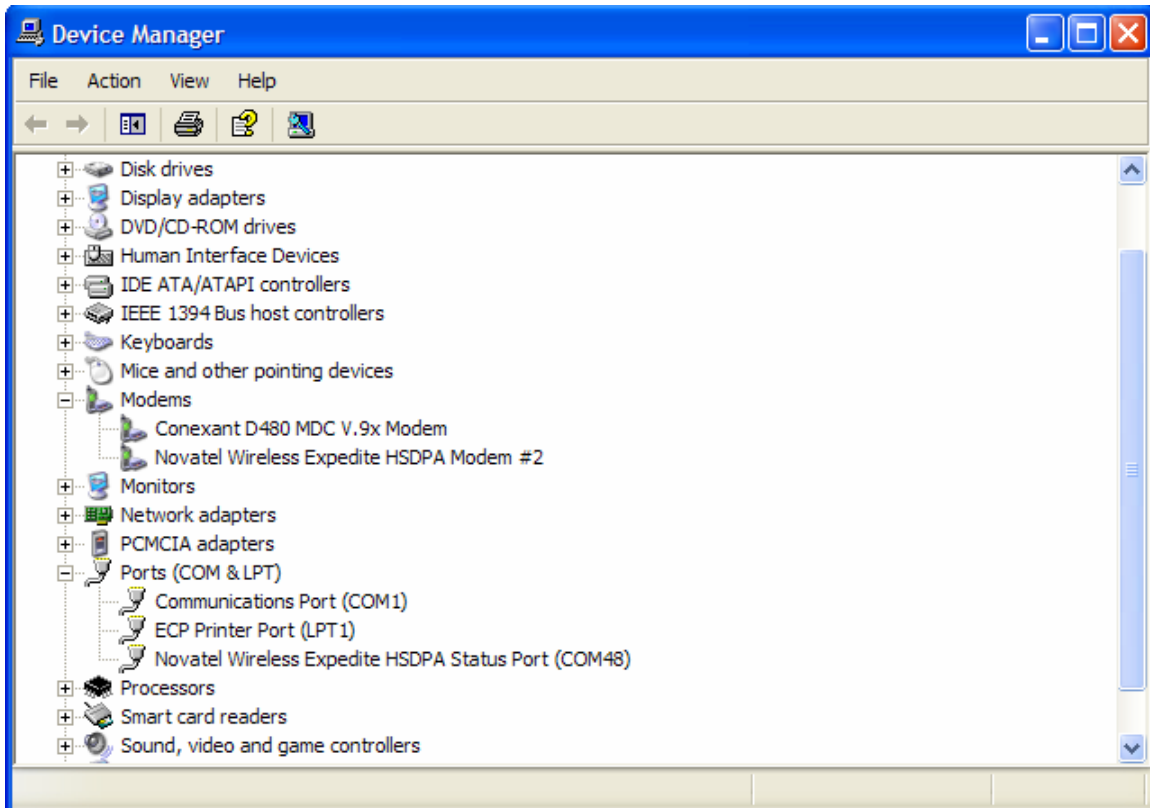


Figure 3 – Device Manager Window Showing the Computer's Active Status COM Port

SETTING UP HYPERTERMINAL TO COMMUNICATE WITH THE MODEM

Ensure that the Mini-card is still powered on with a USB connection to the computer, and that it is recognized by the computer as per the previous step.

Open up a HyperTerminal session by navigating to Start\All Programs\Accessories\Communications\HyperTerminal.

Type in a Connection Description title, such as the Active Primary COM Port number that was identified earlier - click 'OK'. See Figure 4 below as an example:

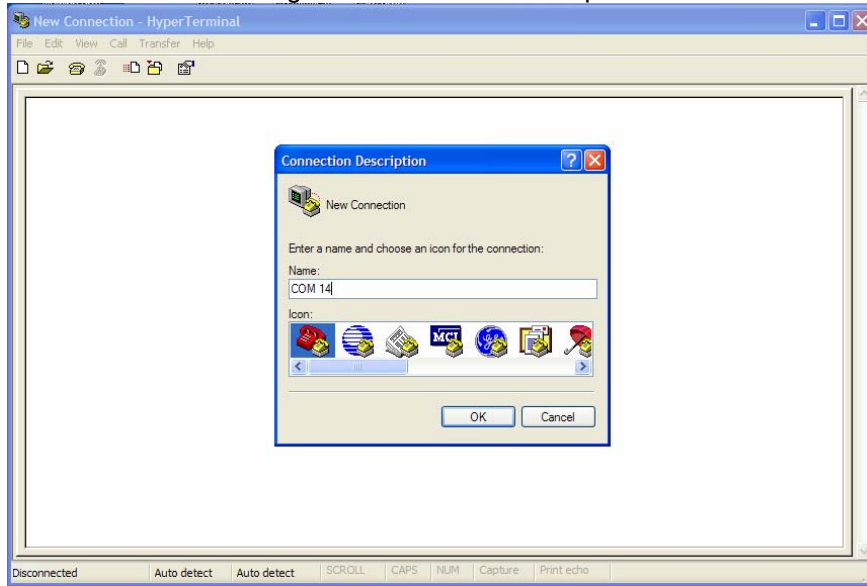


Figure 4 – HyperTerminal Connection Description Window

In the “Connect Using” pull down menu, select the proper COM port (Primary COM port number), that the computer is using to communicate with the modem, then click 'OK'. See the example in Figure 5 below:

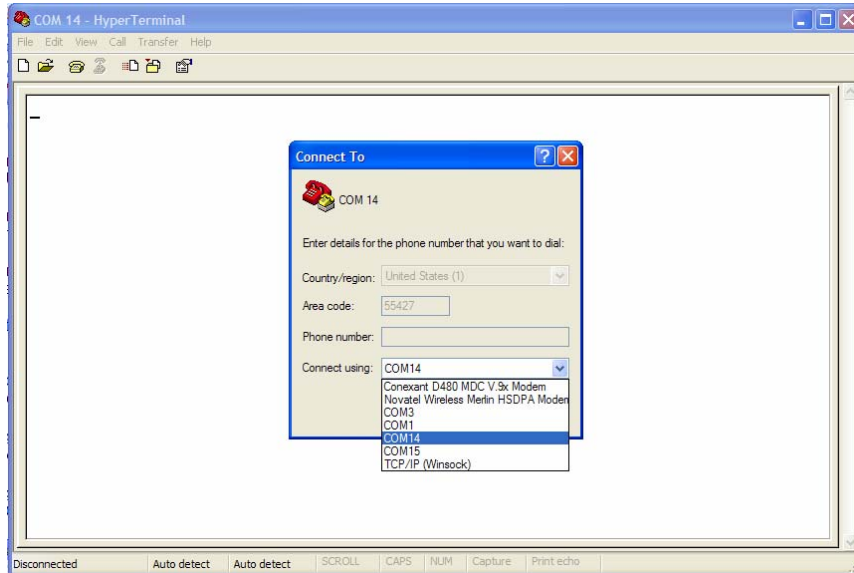


Figure 5 – HyperTerminal COM Port Selection Window

When the 'COM XX Properties' window comes up, just click on OK as there is no need to select or modify any of these settings. Refer to Figure 6 below:

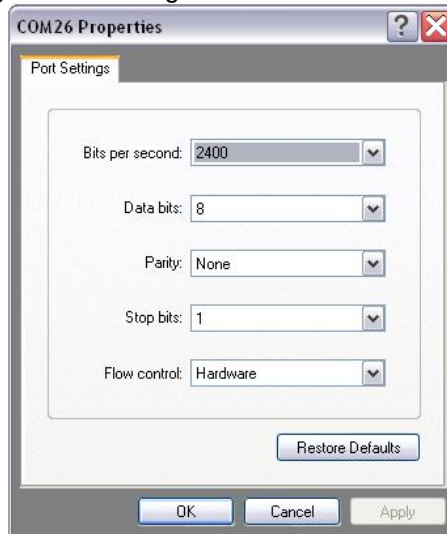


Figure 6 – HyperTerminal Properties Window

Now the modem should be automatically connected, as will be indicated in the bottom left corner of the HyperTerminal window. To further ensure there is communication to the modem, type "ATI" and press ENTER. The modem manufacturer, model number, FW revision and IMEI information will then be returned as is shown in Figure 7 below.

If no information is returned in the HyperTerminal window after typing ATI, then click on the Disconnect tab at the top of the HyperTerminal window (or click on Call\Disconnect). Reconnect by clicking on the Connect tab at the top of the HyperTerminal window (or click on Call\Connect). Now type ATE which will enable the "echo" function of the modem and therefore will allow the characters typed in the HyperTerminal window to be displayed. Once this has been done, retype the ATI command and all the modem information should now be displayed in the HyperTerminal window.

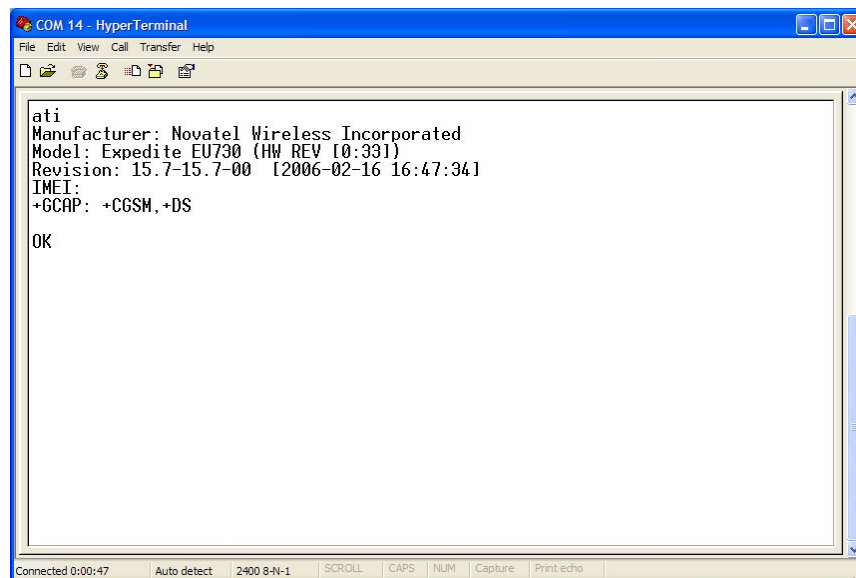


Figure 7 – HyperTerminal Communication Window

Hardware Development Kit (HDK)

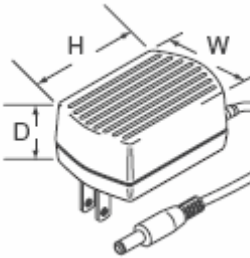
HDK

The Hardware Development Kit (HDK) consists of a development board, power supply and USB connection. The interface board communicates to the host PC via a USB cable. It is powered via an external wall mount power pack or direct contacts to a lab power supply may be used. The development board provides a SIM holder and indicator LED's. The indicator LED's align to the WPAN, WLAN and WWAN LED as specified in the PCI Express Mini Card Electromechanically Specification.

Use

The board is intended to be used in a lab or office environment. It supports the HSDPA and EVDO minicard development.

Power Supply



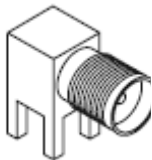
For lab use, an AC adaptor is used. This is a wall mount power adaptor with a rated output of 5VDC. The 5VDC \pm 5% at 3.0 A max power supply is connected to an LDO regulator on the HDK which outputs +3.3V to the +3.3V rail. Since neither the HSDPA nor EVDO modules use the +3.3VAUX supply, this rail is not powered.

The DC plug on the wall mount adaptor will fit into the DC input jack on the development board.



For lab use, the development board can be directly wired to external programmable power supplies giving individual control of the +3.3V and +3.3VAUX rails. The power connections are made via screw terminal blocks, as shown at left. Polarity protection is provided by series diodes. To account for the diode voltage drop, the input voltage must be around 4.0VDC to get 3.3VDC to the power rails.

Antenna Connections



To provide a more robust means of connecting antennas to the minicards, the development board has 2 SMA jacks mounted on the rear edge of the board. A short length of coax cable runs from each SMA connector to the UFL connectors on the minicard.

Audio

The development board has a provision for testing the audio functions of the minicard. The pin header will consist of 6 signals, comprised of the 4 PCM signals, power and ground. Access is provided via non-populated connector (P3 on the Assembly drawing) and is indicated on the schematic as PCM.

Signal	Reference
PCM_CLK	P3-Pin 1
PCM_SYNC	P3-Pin 2
PCM_DOUT	P3-Pin 3
PCM_DIN	P3-Pin 4
GND	P3-Pin 5
+3.3V	P3-Pin 6



Note that not all minicards will have PCM connections brought out to the minicard header as it is a population option. This is not presently populated for all commercial minicards.

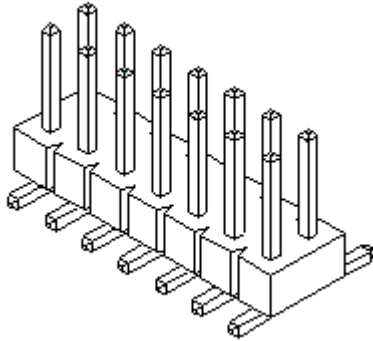
LEDs

There is a total of 7 surface mount LEDs available of which 4 are populated. Their functions are as follows:

Reference	Function	Colour	Comment
D1	PAN	Green	Populated
D2	LAN	Green	Populated
D3	WAN	Green	Populated
D5	+3.3V	Red	Populated
D6	+3.3VAUX	Red	Not Populated
D7	+1.5V	Red	Not Populated
D9	JTAG	Green	Not Populated

The indicator LED's align to the WPAN, WLAN and WWAN LED as specified in the PCI Express Mini Card Electromechanically Specification.

JTAG Connector



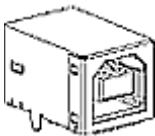
Development (non-commercial) Minicards may be internally configured to support JTAG programming through the mPCI-E interface connector. These specially configured cards can be programmed through a 2x10 pin header. The pinout of this header conforms to industry standard JTAG pinouts. If the JTAG LED is illuminated, it indicates that the minicard is likely configured for JTAG operation. **The JTAG header is normally not populated with the HDK.**

SIM Card Holder



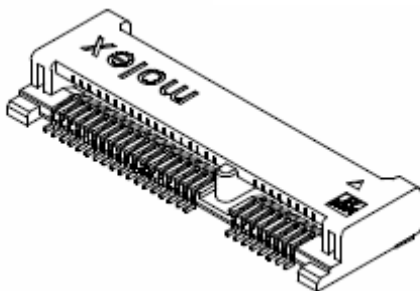
A SIM card holder is provided to allow minicard software to test the SIM interface. An ESD protection diode array is placed near the SIM card holder. The holder used has a hinged cover. It does not have a card detect switch as this signal is not supported in the mPCI-E interface standard.

USB Connector



The minicard's USB interface signals are routed to a Type B USB connector for connection to an external host. No additional signal conditioning or protection is provided.

Minicard Holder



The minicard is installed onto the development board by inserting the edge fingers into the 52 pin mPCI-E host connector and then pushing the opposite end down until it snaps into the hold down mechanism. The PCB of the development board is removed from the area below the minicard to allow access to the bottom side of the minicard.

Pin Headers

A number of signals from the minicard can be manipulated manually by installing or removing shorting plugs from pin headers. They are described below:

<i>Signal</i>	<i>Reference</i>	<i>Shunt On</i>	<i>Shunt Off</i>
PS_HOLD	P2-1 P2-2	Force high	Normal mode
WDOG	P2-3 P2-4	Watchdog disabled	Watchdog enabled
WDIS	P5-1 P5-2	Force low	Normal mode
PERST	P5-3 P5-4	Force low	Normal mode
+1.5V	P5-5 P5-6	Enable 1.5V regulator	Disable 1.5V regulator

Mounting Holes

The board has 4 mounting holes, one at each corner, with rectangular geometry. The plated through holes accommodate #6-32 screws and are connected to the ground plane. If it is desired to keep the board electrically insulated from the mounting platform, then non-metallic screws and standoffs should be used.

Development Board

Fixture Diagram/Assembly Diagram

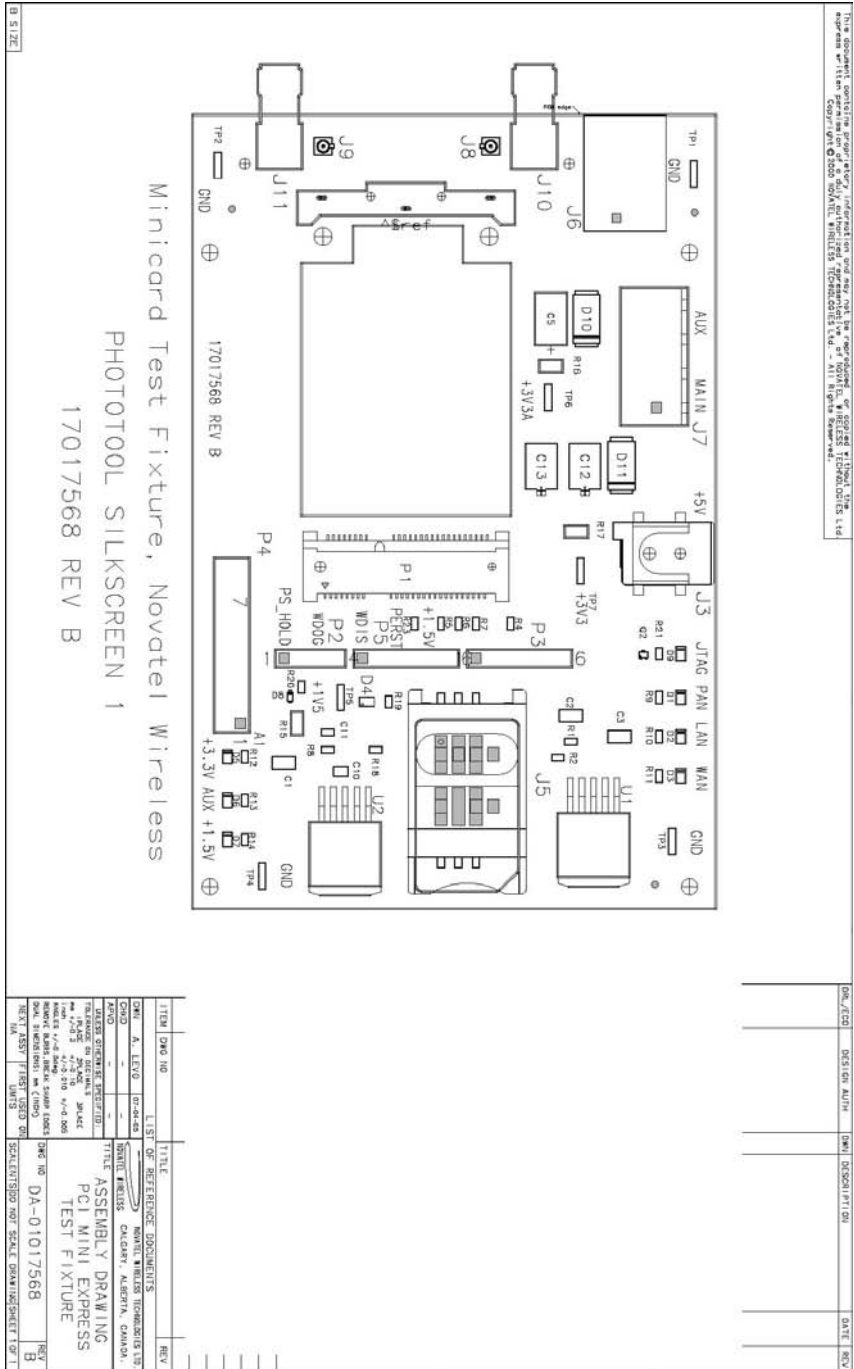
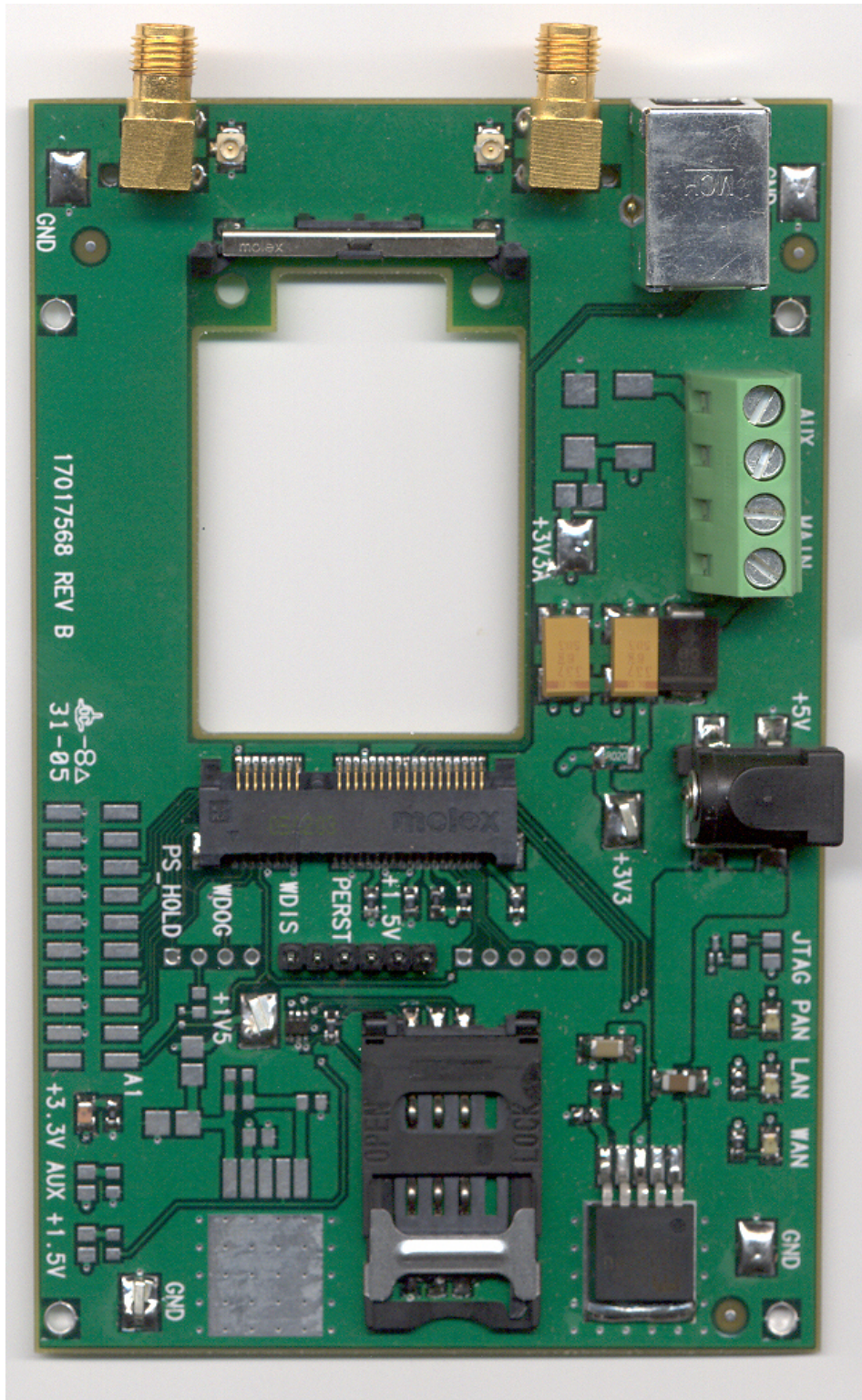
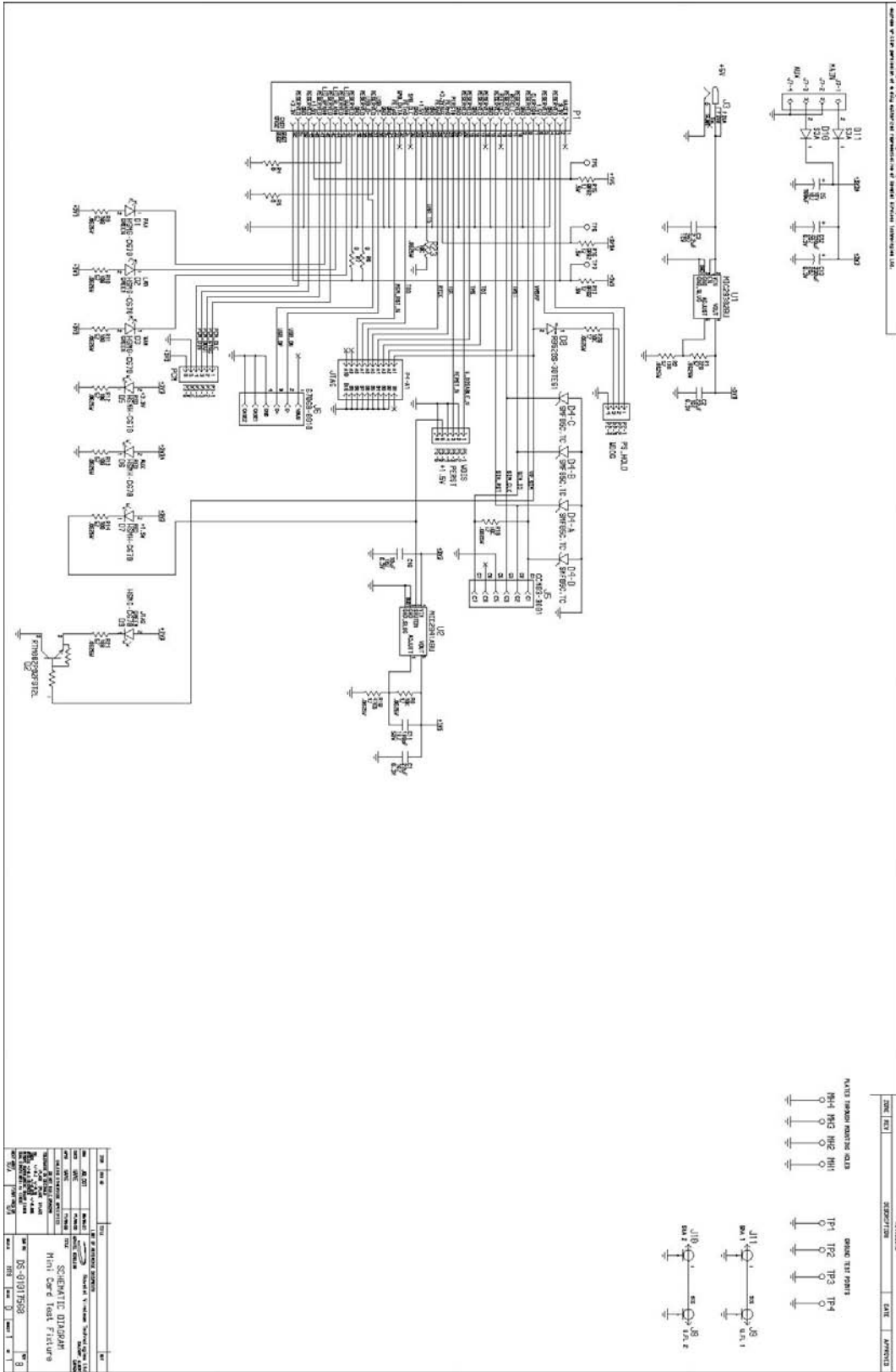


Photo of Top View



Schematic



MobiLink Phoenix SDK

SDK

Introduction

This document describes the high-level architecture and design of the Phoenix SDK. This SDK is meant for Novatel Wireless data products.

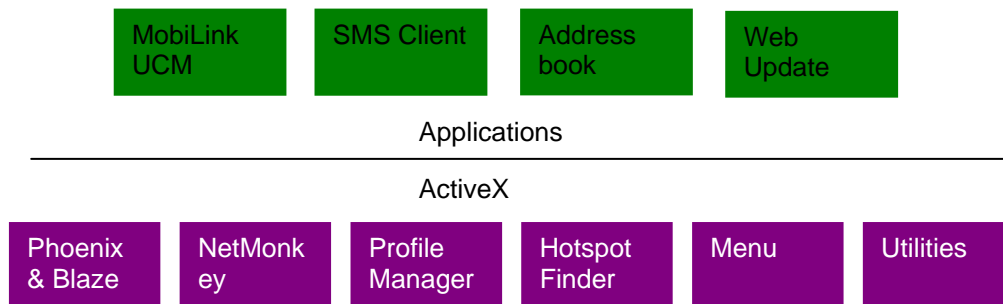
Requirements

- Single Server
- Multiple Clients
- Support Novatel Wireless product line
- Single, Internal State Machine
- Event Driven support for 2-way communication

SDK MODULES

Any number of Client applications can take full advantage of the Phoenix SDK.

Figure 1: Applications



Phoenix & Blaze

Phoenix is the brains of the SDK. Phoenix maintains a single state machine which all Clients communicate with. Anything and everything involving communication to the device takes place through the Phoenix server. Implemented as a Document/View executable supporting automation, the Phoenix server automatically keeps a count of how many Clients are attached to it via COM interfacing. The server is initialized automatically once the first Client is instantiated and shut down once the last Client instance is terminated. With the beauty of OLE Automation, the Phoenix server can be utilized using many different programming languages, including C++, MFC, JavaScript, VBScript, etc. Refer to *Phoenix.chm* for API documentation. If wanting to use Phoenix in Visual Studio, import the type library *Phoenix.tlb* and create a wrapper class for it.

Blaze ActiveX control helps Client applications to receive events fired by the Phoenix server. This allows for simple 2-way communication, replacing redundant loop checking used in the past. Refer to *Blaze.chm* for API documentation. If wanting to use Blaze ActiveX control in Visual Studio, add the NVTL Blaze control from the registered Components and Controls Gallery and create a wrapper class for it.

Sample Code: Refer to PhoenixClient VC++/MFC Project

NetMonkey

NetMonkey ActiveX control provides interfaces to some very useful networking components for managing WLAN, LAN, & WWAN. The WLAN component utilizes Windows XP's Wireless Zero Config when managing and configuring Wi-Fi access points for seamless and easy-to-use access. Currently, the WWAN component supports only Novatel Wireless products, given the proper NDIS drivers. Refer to *NetMonkey.chm* for API documentation.

Profile Manager

Profile Manager ActiveX control helps to manage many types of WWAN network configurations needed in order to make successful connections to a network. Mostly utilized by UMTS/HSDPA networks, it provides a means to store settings like PDP type, PDP Address, APN, Quality of Services settings, IP addresses, proxy settings and more. Each profile is maintained in a local database in a proprietary XML format. Profile properties allow for seamless use via the Phoenix server API. Refer to *ProfileManager.chm* for API documentation.

Hotspot Finder

Hotspot Finder ActiveX control, given a database directory of Wi-Fi hotspots, provides a simple GUI which allows the end-user to easily refine searches in order to find the closest Wi-Fi hotspot. Refer to *Hotspots.chm* for API documentation.

Menu

Menu ActiveX control, currently used in MobiLink, provides a set of GUI's for the end-user. The Properties dialog displays details relating to the currently selected device. The Configuration dialog provides a means to change certain UI settings, as well as change a limited amount of WWAN, WLAN, and LAN settings. The Report dialog shows connection logs and statistics, while the Unlock dialog provides a UI for unlocking the current device. Lastly, the Activation dialog provides a step-by-step Wizard for the user to activate his or her device, while the Debug dialog provides immediate network debugging information for technical support. Refer to *Menu.chm* for API documentation. (*Debug Info and Activation work in progress*)

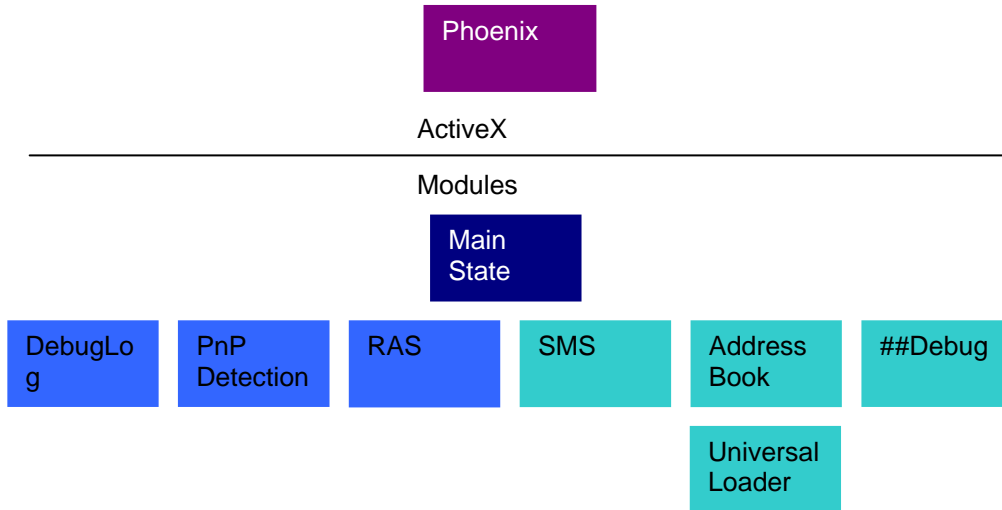
Utilities

Utilities ActiveX control mainly provides a set of Novatel Wireless proprietary utility components. Currently available is the Language component, which provides a set of translations for a number of languages. Components involving any kind of UI take advantage of the Language component in order to support localization. Refer to *Utilities.chm* for API documentation.

PHOENIX SERVER Software design

Overall module design is shown below.

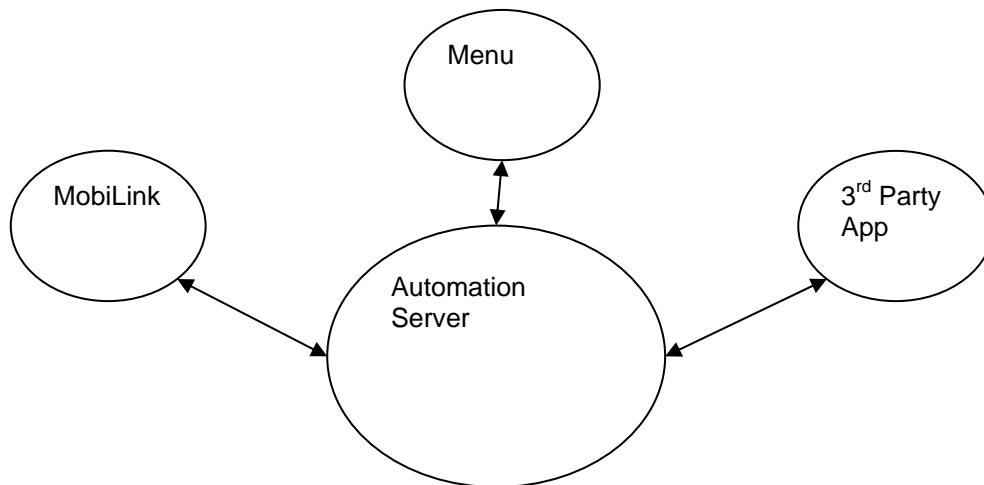
Figure 2: Module Design



Single Server and Multiple Clients

Server-Client design has been implemented using COM and OLE Automation.

Figure 3: Automation Server

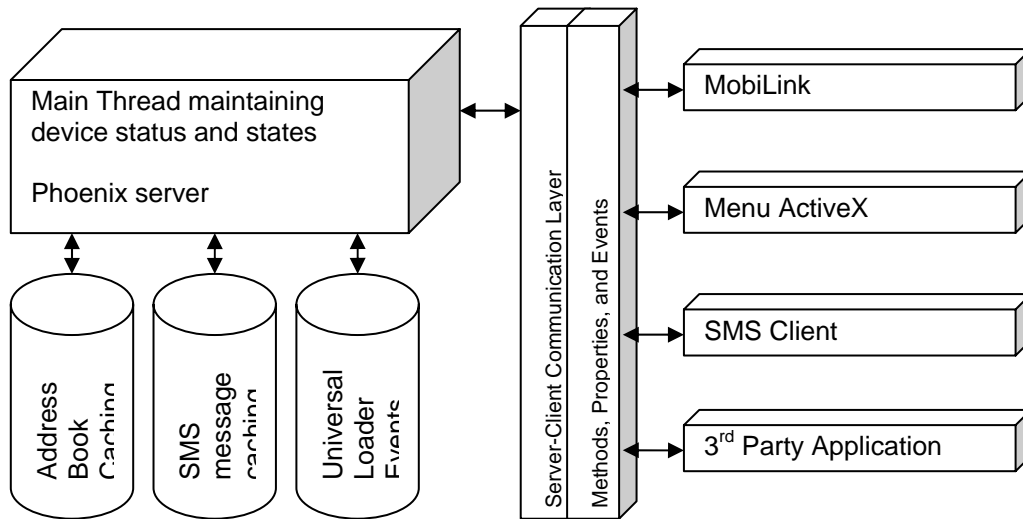


Novatel Wireless Product Line Support

Customer driven product line will be support via the Universal Loader which will allow Phoenix a generic means of communication to all products.

State Machine with 2-Way Communication

Figure 4: State Machine



Product Overview

The purpose of this section is to provide a high level overview of the EU860D & EU870D HSDPA and E725 EVDO module.



HSDPA Module Overview

The EU860D is primarily targeted for the North American market while the EU870D is primarily targeted for the European market. They are both wireless modem modules designed to be embedded into laptop computers and other host devices.

The **EU870D** will operate in the **850/900/1800/1900 GPRS/EDGE** bands and in the **850/1900/2100D UMTS/HSDPA** band. The 2100 band supports receive diversity as indicated by the "D" appended to the bands frequency. The EU870D is built on the MSM6280/RF Platform D chipset from Qualcomm™ with Equalizer and receive Diversity supported. This product will be commercially launched operating up to 3.6 Mbps and will be capable of future upgrade to 7.2Mbps.

The **EU860D** will operate in the **850/900/1800/1900 GPRS/EDGE** bands, and **850D/1900D/21200 UMTS/HSDPA** band. The 850D/1900D bands supports receive diversity as indicated by the "D" appended to the bands frequency. The EU860D is built on the MSM6280/RF Platform D chipset from Qualcomm™ with Equalizer and receive Diversity supported. This product will be commercially launched operating up to **3.6 Mbps** and will be capable of future upgrade to **7.2Mbps**.

The modules will be compatible with Windows™ compliant applications including VPN, e-mail, and web browsing.

The core protocol stack will be supplied by Qualcomm™ and contains UMTS, HSDPA, GPRS and EDGE technologies. Around this core, Novatel Wireless has created the firmware drivers that provide access to the hardware on the embedded modem. The feature set is comprised of the data device features supported in the Qualcomm™ protocol stack.

The hardware consists of a PCI Express Mini Card compliant interface (except as detailed herein), a baseband chipset from Qualcomm™, an RF radio chipset from Qualcomm™, and the various other components used to support these major components.



HSDPA Module Key Feature List

- Release 5 HSDPA Category 6
 - Triband- UMTS/HSDPA 850/1900/2100
 - Up to 3.6 Mbps DL
 - Up to 384Kbps UL
- EDGE/GPRS class 12
- Quadband- GPRS/EDGE 850/900/1800/1900
- GPS
- SIM/USIM
- MobiLink and SDK available for third party dashboards
- Advanced HSDPA equalizer support
- HSDPA Category 8 (7.2 Mbps DL) Upgrade based on Qualcomm (Rel. 4.x Dec. 2006)



EVDO Module Overview

The E725 will operate in the 800/1900 CDMA bands. The E725 is primarily targeted for the North American market.

The modules will be compatible with Windows™ compliant applications including VPN, e-mail, and web browsing.

The hardware will consist of a Mini PCI express interface, a baseband chipset from Qualcomm™, an RF radio chipset from Qualcomm™, and the various other components used to support these major components. The baseband and firmware will be based on the MSM6800 series chipset.

The core protocol stack will be supplied by Qualcomm and will contain CDMA, CDMA 1XRTT, and CDMA 1XEV-DO, and 1XEVDO Rev A technologies. Around this core, Novatel Wireless will create the firmware drivers that provide access to the hardware. The feature set supported in the E725 will be data device features supported in the Qualcomm protocol stack.

Network Overview

HSDPA (High Speed Downlink Packet Access)

HSDPA is based on WCDMA and is standardized as part of 3GPP Release 5 WCDMA specifications. The new modulation method improves system capacity and increases user data rates in the downlink direction. Key performance improvements are:

- Adaptive modulation and coding
- Fast packet scheduling function as controlled by the Node B (base station or BTS), rather than by the radio network controller (RNC).
- Fast retransmissions (HARQ-Hybrid Automatic Repeat Request) with incremental redundancy

The WCDMA system normally carries user data over dedicated transport channels, or DCHs. HSDPA introduces a new transport channel type, High Speed Downlink Shared Channel (HS-DSCH) that makes efficient use of radio frequency resources and accounts for bursty packet data. The High Speed Downlink Shared Channel (HS-DSCH) shares multiple access codes, transmission power and also shares infrastructure hardware between several users. The radio network resources can efficiently serve a large number of users who are accessing bursty data.

EVDO Rev A (Evolution Data Optimized)

1xEV-DO is a "3G" CDMA standard. EVDO stands for **EV**olution, **D**ata-**O**nly. 1xEV-DO is based on a technology initially developed by Qualcomm. The international standard is IS-856. There are currently two main versions of 1xEV-DO: "Release 0" and "Revision A".

1xEV-DO allows mobile terminals with data rates of up to 2.4576 Mb/s with Rev. 0. EVDO provides data rates over 10 times faster than 1xRTT, the previous data technology for CDMA networks. It is available where CDMA voice service is available.

EVDO Rev. A:

- Maximum downlink (forward link) data rate of 3.1 Mb/s
- Uplink rate of from 0.15 Mb/s to 1.8 Mb/s.
- Fast packet establishment on the forward and reverse links
- Air interface enhancements with
 - Reduce latency
 - Improved data rates.

EV-DO Rev. A supports low latency services including VoIP and Video Telephony.

Application Software Overview

MobiLink™ connection manager

Novatel Wireless provides Mobilink™ application software. The software is defined in later Chapters.

MobiLink™ connection manager software to install and configure modem (for all supported platforms)

Key Features

- AT Command Set Support per IS-707
- Fully compatible and interoperable with current Microsoft™ OS platforms: PPC 2000/2002/HPC, Windows 98, Windows 2000, Windows ME, & Windows XP
- Integrated drivers for Windows OS, configurable as either a modem or network card
- PCI Express Mini-card
- Compatibility with all major brands of PC's and PPC computing platforms
- Sleep Mode capabilities
- Uses common base technology shared with OEM Module
- IS-683A compliant - Over-The-Air activation and parameter update capabilities.
- On-line help, getting started guide, documentation
- All software applications necessary to communicate with the PCI Express Mini Card will operate with the following platforms: PPC 200/2002/HPC, Windows 98, Windows 2000, Windows ME, & Windows XP
- All software shall support 640x480, 640x240, and 800x600 color and monochrome displays
- MobiLink allows the user to configure the modem easily
- MobiLink provides diagnostic capability
- MobiLink provides a Help menu that is Context Sensitive

Device Specifications

PCI Express Mini Card

Novatel Wireless has designed a line of embedded broadband access modules around the PCI Express Mini Card Specification 1.1¹. This product line provides platform developers and system integrators with the ability to enable global 3G broadband access. The governing body for PCI Express standardization is PCI SIG (Peripheral Component Interconnect Special Interest Group.) The website for PCI SIG can be found at the following URL:

www.pcisig.com/home

¹ Customizations that deviate from the *PCI Express Card Electromechanical Specification revision 1.1* are noted in this document

Hardware

Card Specifications

The E725, EU860D and EU870D are designed to meet the PCI Express Mini Card electro-mechanical card standard with some exceptions to accommodate the power requirements. These modules all support only the USB portion of the minicard standard.

Chipset

E725

The Qualcomm MSM6800 baseband processor, PM6650 power management IC, RFT6150, and the RFR6500 shall be the chipset used.

EU860D

The HSDPA PCI Express Mini-card baseband incorporates the Qualcomm MSM6280 baseband processor and the PM6650 power management IC. The EU860D North American RF deck consists of the Platform D (Rx Diversity) chipsets, RTR6275, and the RFR6500.

EU870D

The HSDPA PCI Express Mini-card baseband incorporates the Qualcomm MSM6280 baseband processor and the PM6650 power management IC. The EU870D Euro RF deck consists of the Platform D (Rx Diversity) chipsets, RTR6275, and the RFR6525.

Mechanical Specification

The drawing in Figure 5 to Figure 7 shows the dimensions of the E725 & EU860D/EU870D modules. The measurements given below are typical. Consider thickness to be 5.0 max in designing. Note that EU860D/870 antenna connection and final dimensions will be detailed in next release of this handbook. Figures 6 and 7 show detail associated with the shielding used on the EU730/EU740. The EU860D and EU870D will use metal shields.

RF (Antenna) connector

The two RF connectors used are Hirose U.FL-R-SMT or equivalent.

Host Interface connector

The host interface connector is a 1 mm wide card edge connector. This is compatible with the following host connectors:

Molex	67910-0002
-------	------------

The host connector should be compliant with the Mini PCI express Electromechanical specification.

Shielding / Mechanical enclosure

The EU860D and EU870D use metal shield technology. The shield dimensions are presently under revision and the high side/low side thickness dimensions and tolerances will be updated in next release of this guide.

The E725 will use a stamped sheet metal shield technology. The shields are held in place with solder.

Figure 5: E725 Module

All Dimensions in mm

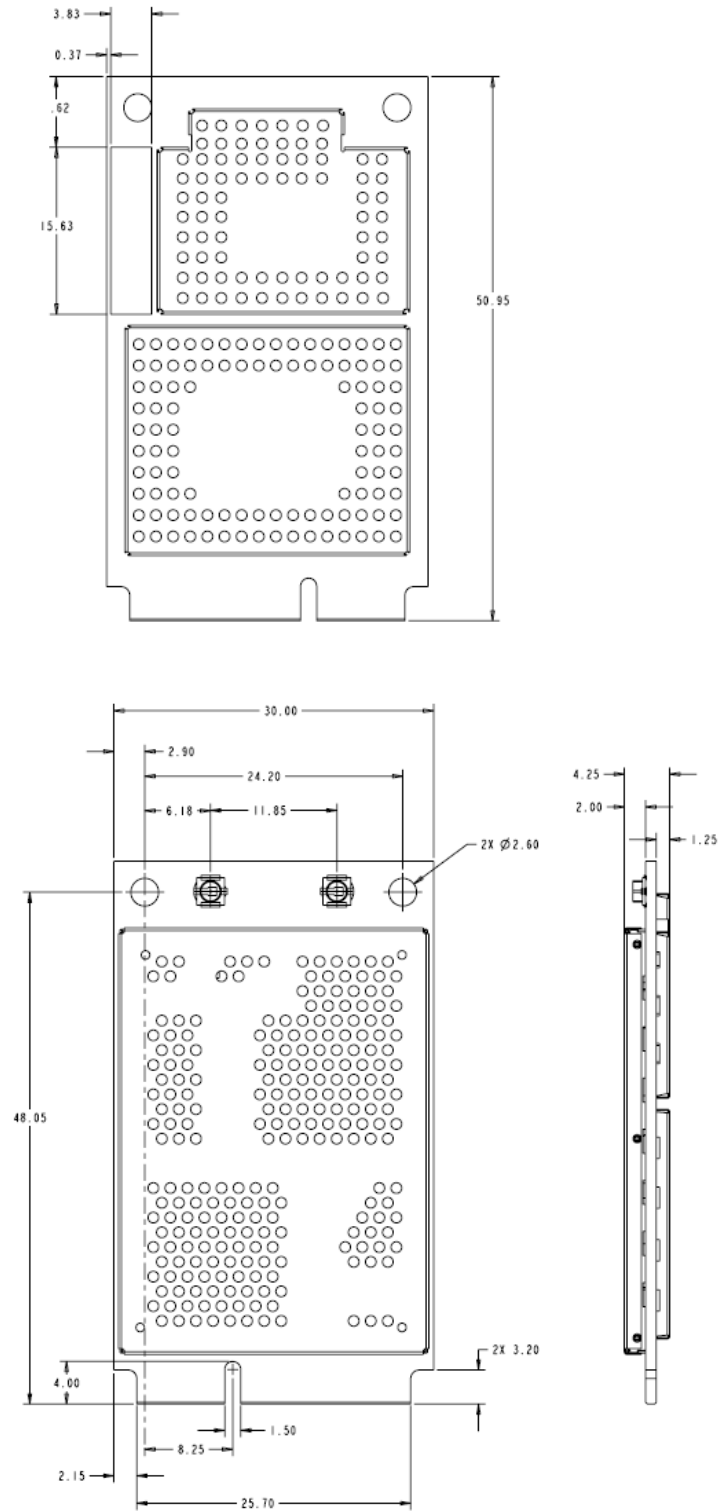


Figure 6: EU860D/EU870D Module

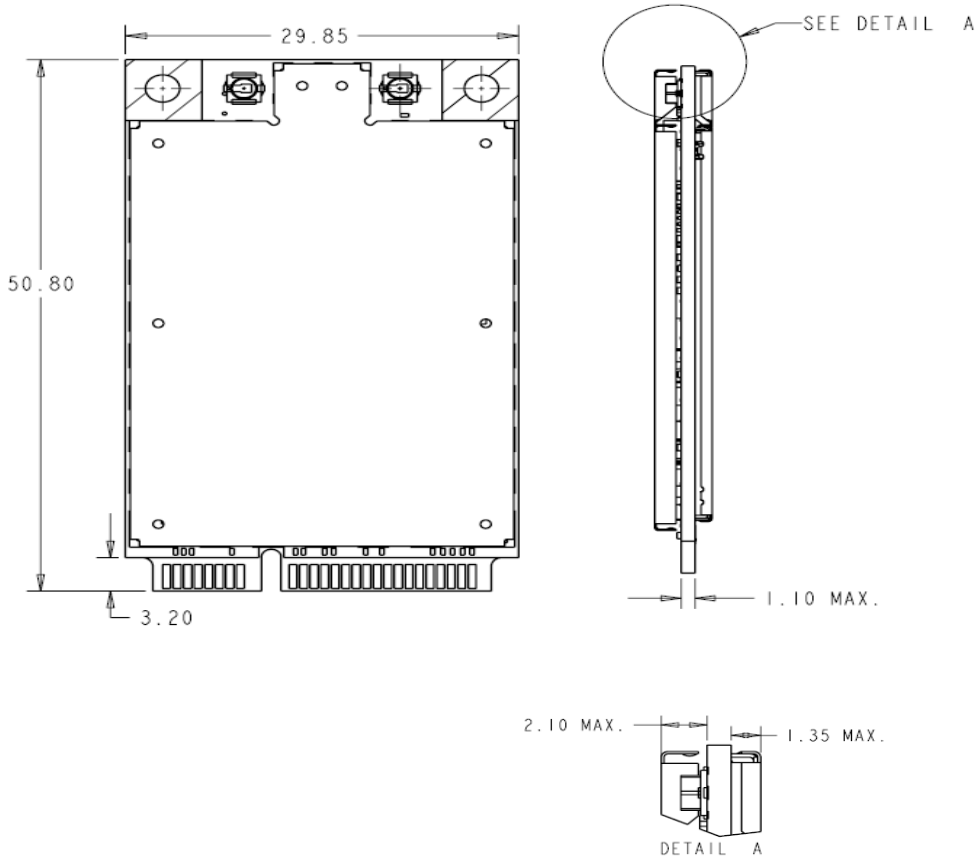


Figure 7: EU860D/EU870D Module

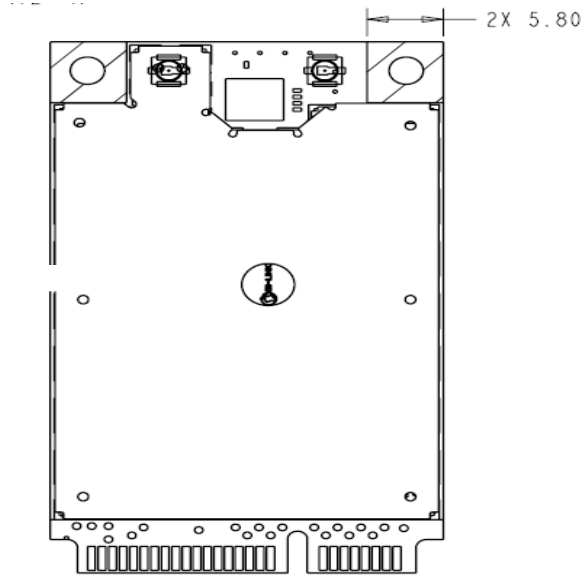
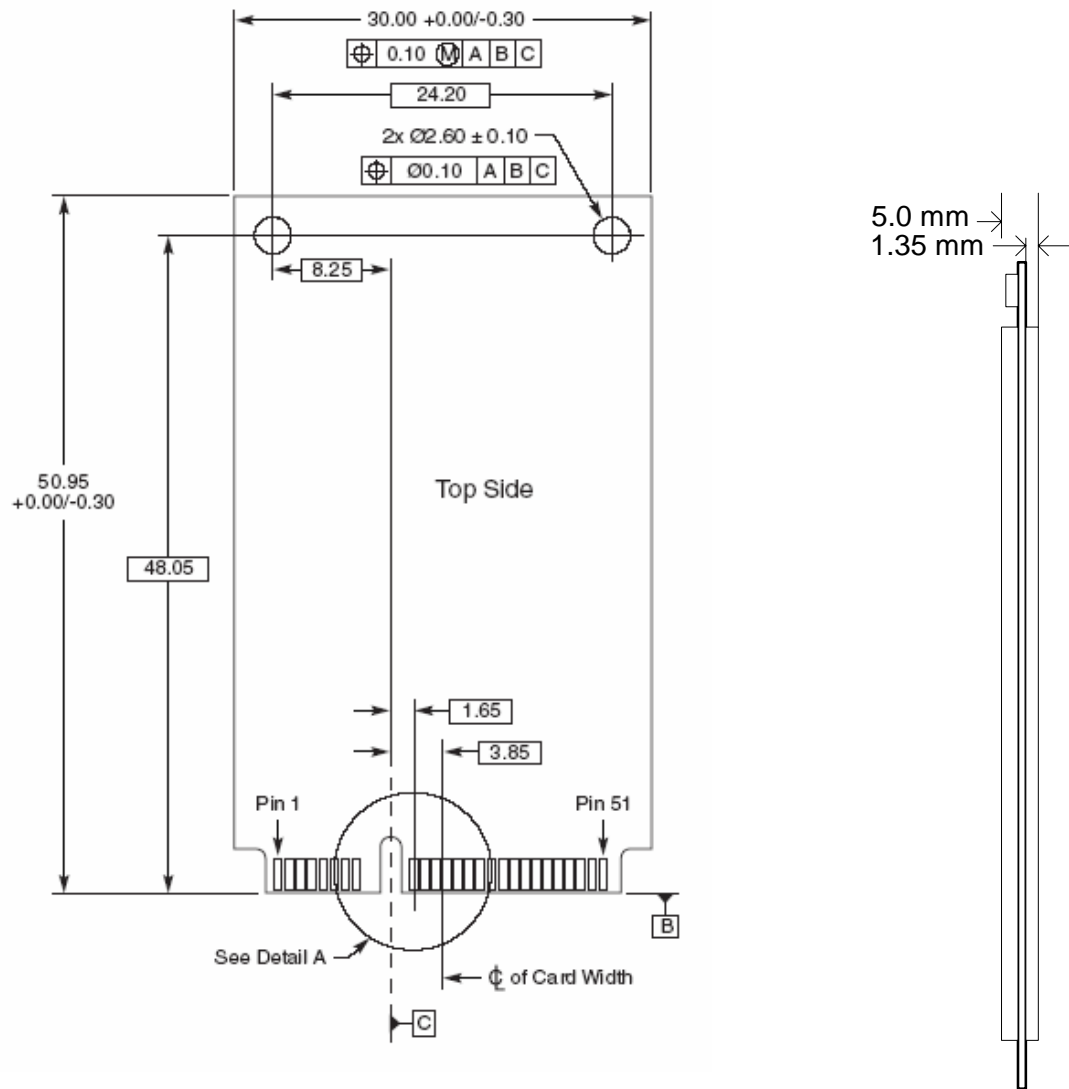


Figure 8: PCIe Minicard Module Envelope



Interface Specification

Host Interface

The E725 and EU860D/870D are designed to meet the PCI Express Mini-Card specification. The table below gives a description of the pin-out and usage. The USB option of the specification is supported. Deviations from the Mini PCI Express card specification 1.1 are noted.

Host Interface specification

Pin	PCIe Spec	EVDO	HSDPA	Pin	PCIe Spec	EVDO	HSDPA
1	WAKE#	NC	NC	2	3.3V	3.3V	3.3V
3	Reserved	NC	NC	4	GND	GND	GND
5	Reserved	NC	NC	6	1.5V	NC	NC
7	CLKREQ#	NC	NC	8	UIM_PWR	UIM_PWR	UIM_PWR
9	GND	GND	GND	10	UIM_DATA	UIM_DATA	UIM_DATA
11	REFCLK-	NC	NC	12	UIM_CLK	UIM_CLK	UIM_CLK
13	REFCLK+	NC	NC	14	UIM_RESET	UIM_RESET	UIM_RESET
15	GND	GND	GND	16	UIM_VPP	NC	NC
Mechanical Key							
17	Reserved	NC	NC	18	GND	GND	GND
19	Reserved	NC	NC	20	W_DISABLE#	W_DISABLE#	W_DISABLE#
21	GND	GND	GND	22	PERST#	PERST#	PERST#
23	PERn0	NC	NC	24	+3.3Vaux	NC	NC
25	PERp0	NC	NC	26	GND	GND	GND
27	GND	GND	GND	28	+1.5V	NC	NC
29	GND	GND	GND	30	SMB_CLK	SMB_CLK	SMB_CLK
31	PETn0	NC	NC	32	SMB_DATA	SMB_DATA	SMB_DATA
33	PETp0	NC	NC	34	GND	GND	GND
35	GND	GND	GND	36	USB_D-	USB_D-	USB_D-
37	Reserved	GND	NC/GND	38	USB_D+	USB_D+	USB_D+
39	Reserved	3.3V	3.3V	40	GND	GND	GND
41	Reserved	3.3V	3.3V	42	LED_VWAN#	LED_VWAN#	LED_VWAN#
43	Reserved	GND	GND	44	LED_WLAN#	NC	NC
45	Reserved	NC	NC/PCM_CLK	46	LED_WPAN#	NC	NC
47	Reserved	NC	NC/PCM_SYNC	48	+1.5V	NC	NC
49	Reserved	NC	NC/PCM_DOUT	50	GND	GND	GND
51	Reserved	NC	NC/PCM_IN	52	3.3V	3.3V	3.3V

Notes:

NC	No Connect
W_DISABLE	Radio Transmit Disable
NC/XXXX	Standard product will have No Connect, Population option,
PCM_XXXX	PCM Voice interface (Data in, Data out, Sync & clock)

USB Interface

The Mini card acts as a peripheral device and supports the USB 2.0 standard at low speed (1.5 Mbps) and full speed (12 Mbps). It does not support the high speed (480 Mbps) mode of operation.

Subscriber Identification Module (SIM) Interface (*EU860D/EU870D only*)

A 4 line SIM interface is provided on the mini-card edge connector for the EU860D/860. The signal levels comply with the ETSI standard Specification of the 3 Volt Subscriber Identity Module - Mobile Equipment (SIM-ME) interface (GSM 11.12 version 4.3.1). Note that no ESD protection will be provided on the mini-card. The host device is expected to provide the ESD protection at the SIM connector.

The OEM Module supports a 3.0V SIM as described in ETSI 11.12. The relevant signals are brought out on the 70 pin connector.

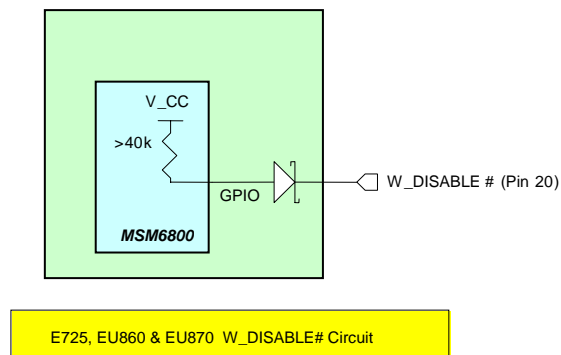
- The SIM interface shall support 1.8 V USIMs
- The SIM interface shall support 3.0V USIMs
- The SIM interface shall support 3.0V SIMs

The USIM will be provided by the host. A SIM connector is not included on the mini-card. The interface to the USIM is provided on the host interface connector. A recommended interface card design criteria is available from Novatel. Please refer to the **Integrator Design Elements: Antenna, Power & SIM** section for further details.

WDISABLE

The modem is made incapable of transmitting when the WDISABLE pin is pulled low. The following diagram illustrates the Pull-Up resistor configuration:

Figure 9: W_Disable Pull-up Configuration



The W_DISABLE# signal from the host interface connector is used to control the operational status of the radio transmitter. When it is high, the radio is made capable of transmitting. When it is low, the radio is made incapable of transmitting by removing the various power supplies.

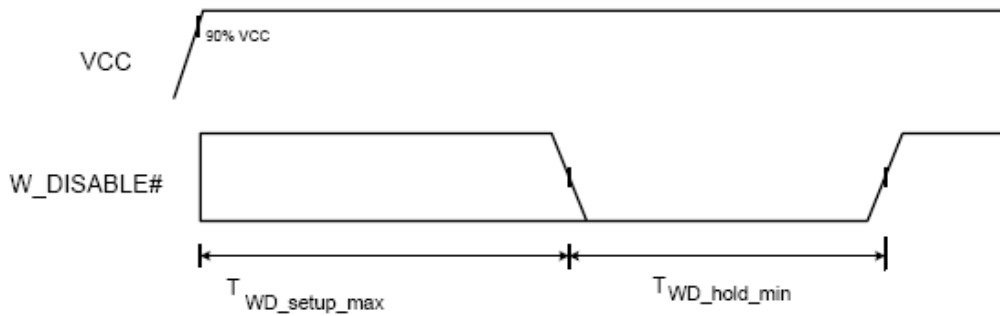
HSDPA Module Operation

During normal operation, the W_DISABLE# signal is high. When the host asserts the W_DISABLE# signal low, an interrupt is generated which executes power down routines such as saving any required data. The software programs the power management device (PM6650) to selectively disable voltage regulators in order to render the Mini Card incapable of transmitting.

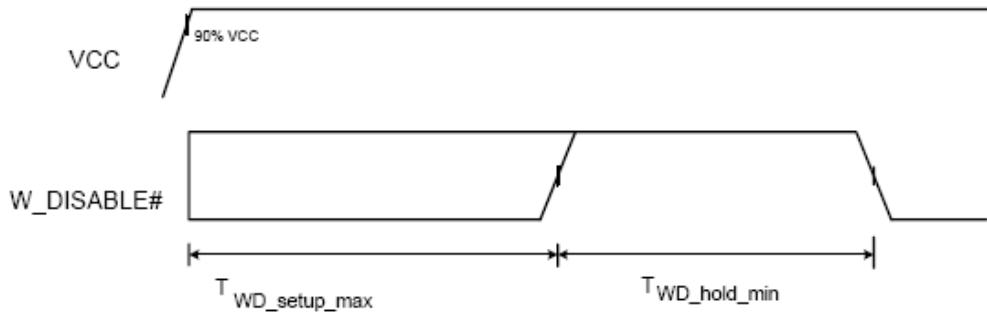
W_DISABLE# signal from the host may be asynchronously applied to the E725, EU860 & EU870.

W_DISABLE Power Up Timing

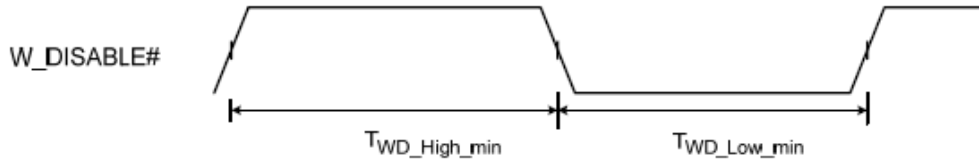
Transmit Disable Mode



Normal Power Mode



Symbol	Description	Min	Max	Units
$T_{WD_setup_max}$	W_Disable# Power up Set up time		6	Sec
$T_{WD_hold_min}$	W_Disable# Power up Hold time	4		Sec



Symbol	Description	Min	Max	Units
$T_{WD_High_min}$	W_Disable# Power up Set up time	4		Sec
$T_{WD_Low_min}$	W_Disable# Power up Hold time	4		Sec

W_Disable # Interface

Pin Number	Main Function	Pad Voltage	Pad Type	Drive
20	W_DISABLE#	2.6V	Schmitt w/PULL UP	3 mA

Pad Voltage = 2.6V (typ) 2.5Vmin. 2.7Vmax.

Pad Type = Default Pull down (PD) , configured at Initialization with Pull up (PU)

E725 W_Disable # Pin Characteristics

W_DISABLE#

Parameter	Min	Typ	Max	Units
High-level Input voltage	1.69		2.8	V
Low-level Input voltage	-.3V		0.91	V
Schmitt hysteresis voltage	150			mV
Input high leakage current	-		1	uA
Input low leakage current with pull-up	-60		-10	uA
Input capacitance	-		7	pF

LED Interface

A signal for the WWAN LED shall be available on the host connector. The LED cadence shall support one of 3 schemes which shall be selectable using an NV item:

Scheme 1:

State	LED function
On	The WWAN radio is on, and <u>capable</u> of transmitting
Off	The WWAN radio is not capable of transmitting.

Scheme 2:

State	LED function
Off	Not powered
On	Powered, associated and authenticated but not transmitting or receiving
Slow Blink	Powered but not associated or authenticated; searching
Intermittent blink	Activity proportional to transmitting/ receiving speed

Scheme 3:

State	LED function
Off	Not powered
On	Connected
Slow Blink	No SIM Card, Out of range
Intermittent blink	Activity proportional to transmitting/ receiving speed

SM Bus Interface

A 2 line SM Bus shall be supported using the designated pins on the host interface. The card shall support SM Bus as a master only. Please refer to the **SM Bus Design Guidelines** section for further details.

PCM Voice Interface

A 4 line PCM voice interface shall be provided as a population option. Please contact Novatel Wireless for details on the support of this feature.

JTAG Interface

A JTAG interface is available to support development activities. The JTAG interface shall not be available for customer use.

Power Supply

The card shall operate within specification for the voltage range of 3.00 to 3.56 V with the nominal voltage being 3.3 V. Current is drawn from the 3.3V pins on the Mini Card connector as shown in tables following.

Idle/Low Power Mode Current

Symbol	Parameter	Min	Typ	Max	Units
Icc Idle/Standby HSDPA/UMTS/EDGE/GPRS	No connection to host, Driver not active. (Note 1)		50		mA
Icc Low Power Mode HSDPA/UMTS/EDGE/GPRS	USB Selective Suspend With SIM Without SIM Connection to host, Driver active, (Note 1)		20 10		mA mA
Icc Idle/Standby EVDO	USB Suspend		TBD		mA
Icc Low Power Mode EVDO	USB Selective Suspend		TBD		mA

Note1: Test conditions: Temperature: 25 degree Celsius
 Supply voltage: 3.3V

Note 2: Forward looking estimates based on existing platforms. Actual values to be provided once available.

Peak Current

Symbol	Parameter	Min	Typ	Max	Units
icc peak_GPRS	Peak current			2750 (Note 2)	A
icc peak_HSDPA_UMTS	Peak current			1000	mA
icc peak_EDGE	Peak Current			1000	mA
icc peak_EVDO	Peak Current			1000	mA

Note 1: Test conditions:
 1. VSWR 4:1
 2. Temperature: 25 degree Celsius
 3. Supply voltage 3.3V

Note 2: Forward looking estimates based on existing platforms. Actual values to be provided once available.

Blocked antenna condition creating a VSWR greater than 4:1 may create a condition where the transmitted power increases and currents peak drawn in GPRS/EDGE mode exceed 2.750 Amps

Estimated current consumption during transmit periods is shown in the following table.

Transmit Power Consumption

Band	Technology	Power Class	Spec		Set Point dBm	3.3V rail	
				dBm		Avg mA	Peak (Note 1)
Band I	WCDMA/HSDPA	3	24	+1/-3	23	<1000	
Band II	WCDMA/HSDPA	3	24	+1/-3	23	<1000	
Band IV	WCDMA/HSDPA	3	24	+1/-3	24	<1000	
GSM850	GPRS	4	33	+/- 2	33	<500	< 1800
	EDGE	E2	27	+/- 3	27	<500	< 1800
GSM900	GPRS	4	33	+/- 2	33	<500	< 1800
	EDGE	E2	27	+/- 3	27	<500	< 1800
GSM1800	GPRS	1	29	+/- 2	30	<500	< 1800
	EDGE	E2	26	+/- 3	26	<500	< 1800
GSM1900	GPRS	1	29	+/- 2	30	<500	< 1800
	EDGE	E2	26	+/- 3	26	<500	< 1800
Cellular	EVDO				24	<700	
PCS	EVDO				24	<800	

Note 1 GPRS: 2750mA Max into 4:1 VSWR

Note 2 Forward looking estimates based on existing platforms. Actual values to be provided once available.

Power Class

The power class of the PCI Express Mini cards are detailed in the following table.

Band	Technology	Power Class		Spec	Set Point	Delta¹	
				dBm	dBm	EU730/ EU740	
Band I 2100	WCDMA/HSDPA	3	TS 25.101	24	+1/-3	23	
Band II 1900	WCDMA/HSDPA	3	TS 25.101	24	+1/-3	24 ²	+3
Band IV 850	WCDMA/HSDPA	3	TS 25.101	24	+1/-3	24 ²	+3
GSM850	GPRS	4	TS 51.010	33	+/- 2	33 ²	+1
	EDGE	E2	TS 51.010	27	+/- 3	27	
GSM900	GPRS	4	TS 51.010	33	+/- 2	33 ²	+1
	EDGE	E2	TS 51.010	27	+/- 3	27	
GSM1800	GPRS	1	TS 51.010	30	+/- 2	30 ²	+1
	EDGE	E2	TS 51.010	26	+/- 3	26	
GSM1900	GPRS	1	TS 51.010	30	+/- 2	30 ²	+1
	EDGE	E2	TS 51.010	26	+/- 3	26	
Cellular 824-849 (Tx) 869-894 (Rx)	CDMA	Class III	Per IS-98D	23-30		24	
	CDMA 1XRTT	Class III	Per IS-98D	23-30		24	
	CDMA 1XEV-DO	Class III	Per IS-98D	23-30		24	
PCS 1850-1910 (Tx) 1930-1990 (Rx)	CDMA	Class II	Per IS-98D	23-30		24	
	CDMA 1XRTT	Class II	Per IS-98D	23-30		24	
	CDMA 1XEV-DO	Class II	Per IS-98D	23-30		24	

Note 0: The maximum power factory calibration tolerance is ± 0.7 dB for both technologies

Note 1: Delta on transmit power from EU730/EU740 in dBm.

Note 2: Novatel Wireless reserves the right to change the set point for transmit power in order to resolve integration issues in order to meet system requirements as input power, thermal dissipation and SAR requirements. The transmit power set point was selected in order to meet expected system TRP requirements from the carriers.

Conducted Sensitivity

The estimated conducted Sensitivity is detailed in the following table.

Conducted Sensitivity

	GPRS		EDGE		WCDMA		EVDO	
	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm
Band	Spec #1	Typ	Spec #2	Typ	Spec	Typ	Spec	Typ
850	-99		-86		-104.7		-104	
900	-99		-86					
1800	-97		-86					
1900	-99		-86		-104.7		-104	
2100					-106.7			

Note 1: 51.010 14.18 PDTCH MCS-4

Note 2: 51.010 14.18 PDTCH MCS-9

Note 3: Contact Novatel Wireless for typical values to enable prediction of integrated TIS values.

Note 4: Factory test limits typically 2-3 dB beyond Specified Limits. Typical sensitivity will have additional margin above Factory Test Limits.

Antenna

The enhanced antenna feature supports:

- SAIC (Single Antenna Receiver Interference Cancellation) – R2.x, R4.x
- Rx Diversity, Equalizer – R4.

Antenna Connectivity Comparison

HSDPA

EVDO

Primary Antenna

Primary Antenna

HSDPA Band I
HSDPA Band II
HSDPA Band IV
QB GPRS/EDGE

Cellular Band 0
PCS Band 1

Diversity Antenna

Diversity Antenna

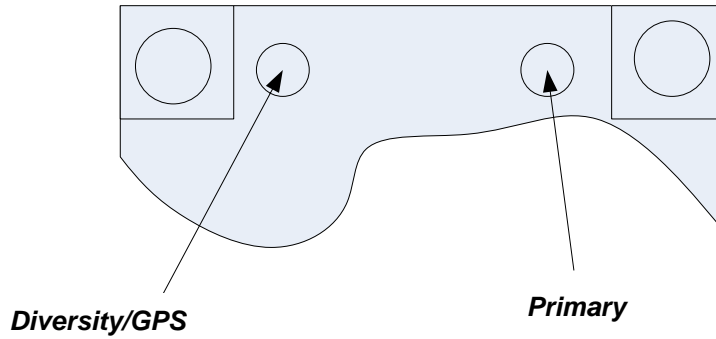
HSDPA Band I or Band II Diversity
HSDPA Band IV Diversity
GPS

Cellular Band 0
PCS Band 1
GPS

The RF connectors shall be Hirose U.FL-R-SMT or equivalent. This connector is designed for a limited number of insertions. For an embedded application this is expected to be acceptable. The antenna interface shall be as defined below:

	<i>EU870D</i>	<i>EU860D</i>	<i>E725</i>
RF Connector (main)	UMTS Tx_Rx	UMTS Tx_Rx	Cellular Band 0
	GPRS/EDGE	GPRS/EDGE	PCS Band 1
RF Connector (Diversity)	UMTS 850/2100 Rx	UMTS 850/1900 Rx	Cellular Band 0
	GPS	GPS	PCS Band 1
			GPS

The connector location shall be as shown below:



The E725 and EU860/870 are designed to be connected to an external antenna integrated into the host system. The antenna port presents a nominal 50 Ω impedance.

Diversity

The EU860D shall support diversity on the UMTS/HSDPA 850 and 1900 bands. Roaming onto the 2100 band is supported.

The EU870D shall support diversity on the UMTS/HSDPA 2100 bands. Roaming onto the 850 and 1900 bands is supported.

The EU870D/EU860D shall operate in the 850/900/1800/1900 GPRS/EDGE bands. Diversity is not supported in the GPRS/EDGE bands.

The E725 supports receive diversity in the 800/1900 bands.

GPS

E725

GPS is supported.

EU860D/EU870D

GPS is supported.

The EVDO Rev. A and HSDPA module receives GPS signals on the diversity antenna.

The EVDO Rev A and HSDPA module will support the following GPS features to the extent the associated application and network also supports the operation of the features identified below. Thus some of the features will not be operational until the application and/or network support is available.

GPS Features

- **GPS Standalone** runs well without network
- **GPS MS-Based** gives fast fix and better sensitivity - requires periodic PDE support
- **GPS MS-Assisted** best coverage and best accuracy - requires constant PDE support
- **GPS Control Plane** network service completion
- **GPS SMS** Remote initiation with service payload for GPS tracking (planned)

GPS Application Services

- Simultaneous GPS fix and data session
- Autonomous GPS with caching of ephemeris and last fix
- Interfaces
 - Serial NMEA interface pass-through
 - MobiLink API for location request, tracking
 - SMS Activated Location Responder
 - GPS Timer and Fencepost trigger
- Application
 - Common GPS client on host device
 - Popular Adapters to Browser, Map, Traffic & POI client apps
 - Vertical Market Subsystem enabler – client tracking & fixing
 - Possible Location Server / Dispatch Assist

Firmware

Overview

The firmware for the EU860D/870 is comprised of the Qualcomm™ supplied UMTS/GPRS protocol stack (Advanced Mobile Subscriber Station (AMSS) 6275 Software) with additional Novatel Wireless firmware specific to the Mini Card implementation. The firmware runs on ARM9 core in the MSM6280 ASIC.

The firmware for the E725 is comprised of the Qualcomm™ supplied protocol stack (Advanced Mobile Subscriber Station (AMSS) 6800 Software) with additional Novatel Wireless firmware specific to the Mini card implementation. The firmware runs on ARM9 core in the MSM6800 ASIC.

Memory

In order to reduce the MSM6275 and the MSM6500 firmware memory footprint, unused application features, drivers and services are removed. The network protocol layers (Mobility Management, Data services, Radio Resource Control, Radio Link Control, Media Access Control, Physical Layer control and Drivers to Qualcomm™'s RF chipsets) remain unaltered.

EU860D/870 Firmware Features

HSDPA & UMTS Protocol and Features

General

- Triband- UMTS/HSDPA 850/1900/2100

HSDPA

- Release 5 HSDPA Category 6
 - Up to 3.6 Mbps DL
 - Up to 384Kbps UL
- Advanced HSDPA Equalizer support
- HSDPA Category 8 (7.2 Mbps DL) Upgrade based on Qualcomm (Rel. 4.x Dec. 2006)
- 3.6 Mbps HSDPA data cards with (Release 4.0E)
- DCCH 3.4 Kbps
- Establish/ Release/ Reconfigure of HSDPA channel
- HSDPA channel re-pointing (Synchronized and non- synchronized cell change) for mobility.
- Up switching and Down switching of PS RAB between DPCH and HS- DSCH
- Switching between HSDPA channel and common channel
- Integrity protection and ciphering
- Primary PDP context.
- HSDPA Protocol
- Uplink Channels
 - HS-DPCCH (HS Dedicated Physical Control Channel)
 - CQI (Channel Quality Indicator)
 - Scheduling downlink Packet
- Downlink Channels

- HS-SCCH (HS Shared Control Channel)
- Channelization code set
- Modulation scheme
- Transport block size
- HARQ process information
- Redundancy & constellation version
- New data indicator
- HS-PDSCH (HS Physical Downlink Shared Channel)
- Category 12 (QPSK)
- **Code Rates**
 - Rate $\frac{1}{4}$
 - Rate $\frac{1}{2}$
 - Rate $\frac{1}{3}$
- **HSDPA Logical Channels**
 - HS-SCCH
 - HS-DPCCH
 - HS-PDSCH
 - Up to 5 HS-PDSCH channels support
- **HSDPA Transport Channels**
 - HS-DSCH
 - . 120 kbps
 - . 240 kbps
 - . 360 kbps
- Fast L1 HARQ
- Incremental redundancy
- Chase combining retransmission scheme
- Multi-Code Operation 1 code
 - 5 codes
 - 480 kbps
 - 600 kbps
 - 720 kbps
 - 1.2 Mbps
 - 1.8 Mbps
- Fast link adaptation
- Vary the effective code rate
- HARQ, MAC-HS disassembly
- MAC-HS reordering queue distribution and processing support
- Synchronous and non-synchronous cell change support
- Intra-NodeB (softer re-pointing) cell change support
- Inter-NodeB (soft re-pointing) cell change support
- Ciphering on the HS channel
- Support to not resume the HS channel if inter-RAT handover fails, but save the RB mapping information
- Support to not resume the HS channel if a radio link failure occurs, but save the RB mapping information
- **QoS**
 - Background QoS class supported
 - Interactive QoS class supported
 - Streaming QoS class supported

UMTS

- UMTS: 3GPP Release 5, June 2004

- Cell_PCH and URA_PCH
- WCDMA-to-GPRS reselection in CELL_FACH
- 64K Sync CSD
- Radio link failure (RRC)
- Inter-frequency reselection in Cell_FACH
- SIB scheduling
- Path loss measurements
- 6F/6G (UE internal)
- Re-establishment procedure
- SIB modification
- SIB 7
- Inter-frequency redirection
- Inter-RAT redirection (RRC connection reject to GSM)
- HCS

GPRS/EGPRS Protocol and Features

General

- Quadband- GPRS/EDGE 850/900/1800/1900

GPRS

- channel coding schemes CS1-4
- link adaptation
- multislot class 12
- One-phase packet access
- Two-phase packet access
- GPRS test modes (ETSI test mode A and B)
- Attach / Detach
 - GPRS detach only
 - Combined GPRS/IMSI detach
 - MS-initiated detach
 - NW-initiated detach
 - Automatic GPRS attach at power-up
 - GPRS attach status indication

EGPRS

- Uplink modulation and coding schemes MCS 1-4
- downlink modulation and coding schemes MCS 1-9
- 8PSK modulation on both uplink and downlink for MCS 5-9
- One-phase packet access
- Two-phase packet access
- EGPRS test modes (ETSI test mode A and B)
- EGPRS link adaptation
- EGPRS incremental redundancy
- EGPRS multislot class 12

NC0

Medium access modes – dynamic allocation

RLC-acknowledged operation mode

RLC unacknowledged operation mode

LLC-acknowledged transmission mode

LLC-unacknowledged transmission mode
 GSM network operation mode I
 GSM network operation mode II
 PBCCH/PCCCH support in NOM I

PDP Context

- Mobile-originated PDP context activation
- Mobile-originated PDP context deactivation
- Network-originated PDP context deactivation
- Network-originated PDP context activation
- PDP context modification (NW initiated)
- Active PDP context indication
- PDP address (IPv4)
- PDP address (IPv6)
- PDP context type – IP
 - Static IP
 - Dynamic IP
 - RFC1144 TCP/IP header compression
 - WINS address support-primary and secondary
- **QoS**
 - Support QoS profile (release 97)
 - Enhanced QoS (refer to 3GPP TS 22.060, Section 5.6.2; TS 24.008, Section 10.5.6.5)
 - Support QoS profile (release 99, EGPRS-capable terminals)
 - Background QoS class supported
 - Interactive QoS class supported
 - Streaming QoS class supported

V.42bis data compression

Carrier will be able to program GPRS service parameters (PDP context) (via Application Profile)
 Data counter (time and transferred bytes per session and cumulative sessions)
 Packet enhanced measurement report (PEMR)
 Network-assisted cell change (R4 GERAN Feature Set 1)
 Extended UL TBF mode (R4 GERAN Feature Set 1)

Security

- Support of encryption A5/1
- Support of encryption A5/2
- GPRS ciphering algorithm GEA1
- GPRS ciphering algorithm GEA2
- PAP for RADIUS authentication - GPRS/EGPRS
- CHAP for RADIUS authentication - GPRS/EGPRS
- Support for encryption algorithm UEA1 (Kasumi)
- Support for integrity algorithm UIA1 (Kasumi)
- SIM lock

SMS

- **Mobile-originated SMS (MO-SMS) over CS channel**
- Mobile-originated SMS (MO-SMS) over PS channel
- Mobile-originated SMS over PS shall fall back to CS if: a) PS service is not available, or b) there is a PS network failure
- Mobile-originated SMS (MO-SMS) concatenation (minimum of 5 segments)
- Mobile-terminated SMS (MT-SMS) over CS channel

- Mobile-terminated SMS (MT-SMS) over PS channel
- Mobile-terminated SMS (MT-SMS) concatenation (minimum of 5 segments)

USSD

- Unstructured supplementary service data – mobile-originated (MO-USSD)
- Unstructured supplementary service data – mobile-terminated (MT-USSD)

Network Selection

- Support for the network selection procedures described in 3G 22.011, R4 minimum
- Support for the network selection procedures described in 3G 23.122, R4 minimum
- Support for the RRC connection reject message to redirect from a 3G system to a 2G system, according to 25.331, R4 minimum
- Support for the network selection procedures described in 3G 43.022, R4 minimum
- Support for an initial HPLMN scan at a 2mins after power on
- Support for a HPLMN rescan irrespective of the serving MCC
- Support of equivalent PLMN
- Network selection within 30 seconds upon power up

Inter-RAT and Inter-Frequency

- GSM900 ↔ WCDMA2100 handover – blind mode
- GSM1800 ↔ WCDMA2100 handover – blind mode
- GSM900 → WCDMA2100 handover – idle frame measurements
- GSM1800 → WCDMA2100 handover – idle frame measurements
- GSM900 ↔ WCDMA2100 cell reselection
- GSM1800 ↔ WCDMA2100 cell reselection
- GSM900 ↔ WCDMA2100 CCO
- GSM900 ↔ WCDMA 2100 CCO
- GSM900 (w/BCCH/ PBCCH) → WCDMA2100 reselection in packet transfer
- GSM1800 (w/BCCH/ PBCCH) → WCDMA2100 reselection in packet transfer
- PS data continuity during OOS and RAT change
- PS data continuity with MPDP (primary and secondary contexts) and RAT change
- EDGE ↔ WCDMA cell reselection in packet transfer
- Inter-RAT NACC 2G 1 3G
- 3G background PLMN search while in 2G
- 3G background PLMN search while in 3G

HSPDA

System

- Network Selection
- Enhanced Network Selection (ENS)
- Supplementary Services

SIM

- Dual IMSI

Fixes to Feature and Protocol deficiencies identified through testing of Beta Release
HSDPA Compressed mode with active HS channel
MAC-d de-multiplexing

E725 Firmware Features

The EVD0 Rev A Firmware Features are listed below:

Standards Support

- IS-707: 14.4 kbps Data Services
- TSB-74: 14.4 kbps Radio Link Protocol and Interband Operations
- TIA/EIA/IS-2000 PN-4756 (Ballot Version): Addendum 1 (to the IS-2000 standard)
- IS-707A: CDMA Data Services Revision for IS-95B
- IS-707A-1: CDMA Data Services Revision for cdma2000 Rel. 0
- IS-95A, IS-95B: CDMA Dual-Mode Air Interface Standard
- PN-4430 (Ballot Resolution Version 0.14, to be published as TIA/EIA-IS-2000.4): cdma2000: Signaling Layer 2 Standard for Spread Spectrum Systems
- J-STD-008: IS-95 adapted for 1900 MHz frequency band
- PN-4429 (Ballot Resolution Version, to be published as TIA/ EIA-IS-2000.3): Medium Access Control (MAC) for cdma2000 Spread Spectrum Systems
- TIA/EIA-95-B: Mobile Station-Base Station Compatibility Standard for Dual-Mode Spread Spectrum Systems
- IS-683A: OTA Update: Roaming System Selection and Programming Block
- PN-4428 (Ballot Resolution Version, to be published as TIA/ EIA-IS-2000.2): Physical Layer Standard for cdma2000 Spread Spectrum Systems
- IS-637A: Short Message Service including mobile-origination
- PN-4431 (Ballot Resolution Version 1.06, to be published as TIA/EIA-IS-2000.5): Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems
- IS-856-2 (3GPP2 C.S0024): cdma2000® High Rate Packet Data Air Interface Specification
- IS-856-A (3GPP2 C.S0024): cdma2000® High Rate Packet Data Air Interface Specification Rev A

Frequency Band Support

- Band Class 0 – Cellular 800 MHz
- Band Class 1 – PCS 1.9 GHz

CDMA Air Interface

- TIA/EIA/IS-95-A Air Interface
- TIA/EIA-95-B Air Interface
- J-STD-008 + TSB74 Air Interface
- TIA/EIA/IS-2000-0 Air Interface
- TIA/EIA/IS-2000-A Air Interface
- TIA/EIA/IS-2000-B air interface
- TIA/EIA/IS-2000-C air interface
- TIA/EIA/IS-2001 Data Session Handoff
- TIA/EIA-126 Loop back Services
- TIA/EIA/IS-870 Test Data Services
- TIA/EIA/IS-871 Markov Services
- TIA/EIA/IS-707-A Data Services
- TIA/EIA-637-A Short Message Services
- TIA/EIA/IS-683-A OTASP Services
- Traffic State Receiver Diversity Combining
- Dynamic QPCH thresholds

- MEID
- Idle State Low-Power Slotted Mode
- Dynamic P_REV Specification
- Dynamic Feature Selection

1xEV-DO Air Interface

- TIA/EIA/IS-856-2 air interface
- TIA/EIA-878 authentication and session handoff
- TIA/EIA/IS-890-1 test application
- Connected state receiver diversity combining
- 1xEV-DO AN authentication with CAVE algorithm
- 1xEV-DO BCMCS air interface
- Simultaneous HDR (S-HDR) feature with dual Rx
- 1xEV-DO BCMCS multi-frequency support
- 1xEV-DO off-frequency searching optimizations
- 1xEV-DO out-of-coverage Hybrid mode optimizations
- 1xEV-DO Revision A reverse traffic channel MAC subtype-3
- 1xEV-DO Revision A enhanced forward traffic channel MAC
- 1xEV-DO Revision A physical layer subtype-2
- 1xEV-DO Revision A overhead protocols support

Multimode Services

- System Determination 2.0
- Multimode Call Manager
- TIA/EIA/IS-683C Preferred Roaming List
- CDMA-Only Mode
- HDR-Only Mode
- CDMA+HDR Mode
- CDMA+HDR Hybrid Mode
- CDMA QPCH in Hybrid Idle State
- Hybrid in CDMA Power-Save

Data Services

- TIA/EIA/IS-707 AT Command Processing
- TIA/EIA/IS-835 Wireless IP Networking
- Internet Protocol Stack (TCP/UDP/IP/PPP)
- Simple IP Address Management
- Mobile IP Address Management
- RFC1750 Dynamic Mobile IP Key Update (DMU)
- Embedded internet over the air (eIOTA) activation client
- Relay Mode Operation
- Network Mode Operation
- Sockets Mode Operation
- Socket Layer API

UIM Card Services

- No R-UIM Support will be provided.

Universal Serial Bus Interface

- USB Specification 2.0, Full Speed
- Full Speed Device Operation
- USB OTG host stack
- Communications Device Class Profile
- Composite Device Profile
- Data Service Interface
- Diagnostics Service Interface
- Download Service Interface

Environmental

The EU860D/870D and E725 will be compliant with the Mini PCI Express Electromechanical specification as detailed in the table below.

It should be noted that Novatel Wireless cannot guarantee that the host device (laptop; PDA; notebook etc.) will be able to endure these same environmental conditions. Users are advised to consult the host device documentation for specifications and observe any restrictions of use.

EU860D/870D & E725 Environmental Specification

Parameter	E725	EU860D/860
Low Temperature Storage	-30 °C	-30 °C
High Temperature Storage	85 °C	85 °C
Low Temperature Operating	-20 °C	0 °C ^{Note 1}
High Temperature Operating	65 °C ²	65 °C
Relative Humidity	95% maximum (non condensing)	95% maximum (non condensing)
ESD EVDO Rev A	8kV Air / 4kV Contact	
ESD HSDPA USB & SIM Pins only		8kV Air / 4kV Contact Performance Criterion 3
Vibration and High Frequency	147m/s ² (15G) peak; 10 to 2000 Hz	147m/s ² (15G) peak; 10 to 2000 Hz
Drop	75 cm	75 cm

Note 1: Low Temp Operation limit under review pending component review. Design target -20 °C

Note 2: Limit under review, design target for USB & SIM pins IEC 61000-4-2; Level 4 (ESD) 15kV air, 8kV contact.

The E725 product operates in a reliable fashion consistent with CDMA (IS-98C) and PCMCIA V2.1 standards. It will withstand three-foot drop and still remain functional.

Electrostatic Discharge and Electro-Magnetic Interference

The modem does not protect itself from ESD. It is the responsibility of the host to ensure that there will not be any harmful discharges to the modem.

With regard to EMI, the modem will meet FCC part 15 for North American markets, and ETSI EN 301 489-1 for European markets. This device when incorporated in any other product may require FCC and/or other approvals. It is the user's responsibility to do this.

² It is required that the shield temperature not exceed 80°C at anytime. It may be necessary for the system integrator to provide some method to insure this surface temperature is not exceeded.

Reliability

The E725 & EU860D/EU870D **Reliability Test Reports** can be provided upon request.

Packaging

The modules will be shipped using bulk method. This means that each individual module will be placed in an electro-static safe bag. One Hundred (100) modules will then be placed in a cell and 5 cells will comprise one box (500). Partition documentation is shown below:



Novatel partition
spec sheet- 4x25x5.r

Labeling

Example generic HSDPA label and generic bag label drawings are provided below. EU7X0 are shown for reference purposes. These will be upgraded to EU8X0 & E725 in future releases of this document.



DA-01017753_GEN_I
MEI_LABL_EU7X0_rev



DA-01017752_GEN_
BAG_LABL_MEI__2D

RoHS

The E725 & EU860D/EU870D shall be RoHS Directive 2002/95/EC compliant

WEEE

The EU860D/EU870D shall be WEEE Directive 2002/96/EC compliant

Integrator Design Elements: Antenna, SIM & SMBus

Antenna

HSDPA and EVDO Rev A Antenna Requirements

Design specifications for the Diversity EVDO antenna

Description	Minimum	Maximum	Unit
Primary Antenna (Transmit & Receive)			
Peak Antenna Gain	1.0		dBi
Average Gain	-3.0		dBi
Efficiency	-4.0 (40)		dB (%)
Polarization (Ratio Gv:Gh)	0.0		dB
Input VSWR		2.5:1	
Average Power Handling	2.0		Watt
Secondary Antenna (Receive Only Diversity)			
Average Gain	-9.0		dBi
Efficiency	-10.0 (10)		dB (%)
Polarization (Ratio Gv:Gh)	0.0		dB
Input VSWR		2.5:1	
Antenna to Antenna Requirements			
Isolation		-8.0	dB
Fading Correlation Coefficient		0.5	dB (%)

Total Radiated Power (TRP)

TRP measures the effective level of radiated power that is emitted while in transmit mode. To quantify the performance of the transmitter, the output power is measured on a spherical surface surrounding the laptop/handheld. The result of the measurement is a spherical radiation pattern of the radiated power or EIRP (Effective Isotropic Radiated Power). To obtain a single figure of merit the EIRP pattern is integrated over the spherical surface to obtain the TRP (Total Radiated Power). Carriers provide antenna performance specifications which identify the necessary TRP performance in order to be compliant with the carrier limits and attain Technical Acceptance.

Total Radiated Power Estimator

TRP can be estimated by summing the transmitted power of the Novatel Mini PCI Express cards with the expected losses and antenna efficiency. A basic spreadsheet estimator³ is available from Novatel Wireless and a sample is shown below. The EU860D/870D and E725 set points are typical of factory production. The Cable & Connector Loss and the Antenna efficiency are estimated by the host integrator to be representative of the laptop or handheld under

³ **Disclaimer:** This spread sheet is provided with no warranties whatsoever. Novatel Wireless disclaims all liability relating to the use of information in this specification. Note that this table is provided for rough estimation purposes only and is intended to provide a first pass guideline for antenna loss planning. It is not to be a substitute for detailed design activity. Additional losses, efficiency considerations and other system affects will modify the actual resulting TRP and as such results will deviate from the TRP calculator shown above. Updates to TRP limits are not controlled in this document.

consideration. The results are typically compared against carrier requirements to estimate compliance margin.

TRP Calculator for Embedded Module Antenna					
Band		Conducted Max Power (dBm)	Cable + Connector Loss (dB)	Antenna Efficiency without cable (%)	Estimated TRP (dBm)
Cellular 824-849 (Tx) 869-894 (Rx)	EVDO	24	0	100	24
PCS 1850-1910 (Tx) 1930-1990 (Rx)	EVDO	24	0	100	24
Band I 2100	WCDMA	23	0	100	23.0
Band II 1900	WCDMA	24	0	100	24.0
Band IV 850	WCDMA	24	0	100	24.0
GSM850	GPRS	33	0	100	33.0
	EDGE	27	0	100	27.0
GSM900	GPRS	33	0	100	33.0
	EDGE	27	0	100	27.0
GSM1800	GPRS	30	0	100	30.0
	EDGE	26	0	100	26.0
GSM1900	GPRS	30	0	100	30.0
	EDGE	26	0	100	26.0

Total Isotropic Sensitivity (TIS)

TIS measures the effective sensitivity for a designated error rate. To quantify the performance of the receiver, the receiver sensitivity is measured on a spherical surface surrounding the Laptop/Handset. The sensitivity is defined as the minimum power level at which the digital error rate of the receiver is better than a specific limit. Depending on the system this limit is a Bit Error Rate (BER) limit, Block Error Rate (BLER) limit or a Frame Erasure Rate (FER) limit. Sensitivity is measured by lowering the transmit power level of the base station simulator until the specified digital error limit is reached. The power that was required to obtain the error limit is the sensitivity value.

TIS (Total Isotropic Sensitivity) Estimator

TIS can be estimated by reducing the Conducted Sensitivity of the module by losses and desense noise. The Conducted Sensitivity is reduced by Cable loss, Cable loss, Antenna Efficiency and reduced by an estimation of the Laptop/Handheld noise. A basic spreadsheet estimator⁴ is available from Novatel wireless and a sample is shown below.

⁴ **Disclaimer:** This spread sheet is provided with no warranties whatsoever. Novatel disclaims all liability relating to the use of information in this specification. Note that this table is provided for rough estimation purposes only and is intended

TIS Calculator for Embedded Modules in Jammer Free Environment							
Band	Technology	Conducted Sensitivity Spec	CS Mode ¹ Conducted Sensitivity (dBm)	Cable + Connector Loss (dB)	PC Noise Rise over Thermal (dB)	Antenna Efficiency without Cable%	Estimated TIS - Noise Free (dBm)
Cellular 824-849 (Tx) 869-894 (Rx)	EVDO	-104	-108	0	0	100	-108.0
PCS 1850-1910 (Tx) 1930-1990 (Rx)	EVDO	-104	-108	0	0	100	-108
Band I 2100	WCDMA	-106.7	-108	0	0	100	-108
Band II 1900	WCDMA	-104.7	-108	0	0	100	-108
Band IV 850	WCDMA	-104.7	-108	0	0	100	-108
GSM850	GPRS	-99	-108	0	0	100	-108
GSM900	GPRS	-99	-108	0 <td 0	100	-108	
GSM1800	GPRS	-97	-108	0	0	100	-108
GSM1900	GPRS	-99	-108	0	0	100	-108

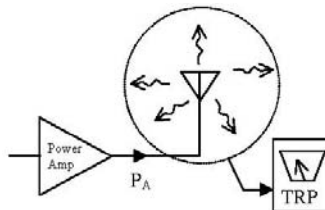
Note 1: TIS is measured in Circuit Switched Mode, do not use Packet Switched values in spreadsheet. Values shown are not actual Sensitivity values but provided for illustration purposes only.

The EU860D/870D and E725 conducted Sensitivity typical of factory production units will be made available from Novatel Wireless. Although the data cards operate in Packet switched mode the values used for estimation are from Circuit Switched mode of operation as this is the mode the TIS is measured. The results are typically compared against carrier requirements to estimate compliance margin.

TRP (Total Radiated Power) Requirements

Good radiated performance is critical to the effective operation of a mobile in networks. A comprehensive characterizing of radiated performance enables carriers to know how well mobiles work within the specific network design constraints.

Figure 10: Total Radiated Power



to provide a first pass guideline for antenna loss planning. It is not to be a substitute for detailed design activity. Additional losses, efficiency considerations and other system affects will modify the actual resulting TIS and as such results will deviate from the TIS calculator shown above. Updates to TIS limits are not controlled in this document.

Tests shall be carried out for three different frequency pairs across the bands supported by the device, as defined for CDMA TIA/EIA-98-D and for GSM 1900 3GPP TS 51.010 in the tables below.

CDMA Test Frequencies

Band	Channel Pair	Designation	Frequency (MHz)
Cellular A	1013	CH ₁ -TX	824.7
Cellular A	1013	CH ₁ -RX	869.7
Cellular B	384	CH ₂ -TX	836.52
Cellular B	384	CH ₂ -RX	881.52
Cellular B	777	CH ₃ -TX	848.31
Cellular B	777	CH ₃ -RX	893.31
PCS A	25	CH ₄ -TX	1851.25
PCS A	25	CH ₄ -RX	1931.25
PCS B	600	CH ₅ -TX	1880.00
PCS B	600	CH ₅ -RX	1960.00
PCS C	1175	CH ₆ -TX	1908.75
PCS C	1175	CH ₆ -RX	1988.75

GSM-1900 Test Frequencies

Band	Channel Pair	Designation	Frequency (MHz)
PCS A	512	CH ₁ -TX	1850.20
PCS A	512	CH ₁ -RX	1930.20
PCS B	661	CH ₂ -TX	1880.00
PCS B	661	CH ₂ -RX	1960.00
PCS C	810	CH ₃ -TX	1909.80
PCS C	810	CH ₃ -RX	1989.80

Radiated power measurements will be recorded in the “free-space” configuration on all applicable frequencies. For portable units, TPR measurements are repeated on all applicable frequencies. TPR will be reported using the Figure of Merit for industry analysis. Device power shall comply with the power levels specified in the relevant industry standards

SIM Design Guidelines

Description

The SIM contains subscriber identification, specification and authentication information; and is required to obtain service. 3.0V and 1.8V SIMs are supported. The physical size and contact location for the "Plug-in SIM" format is defined in reference [2]. Contact identification is defined in reference [7]. Electrical characteristics for a 3V SIM are defined in reference [3], and for a 1.8V SIM in reference [4]. Power sequencing and general protocol operation is defined in reference [8]. The figure below shows a "Plug-in SIM".

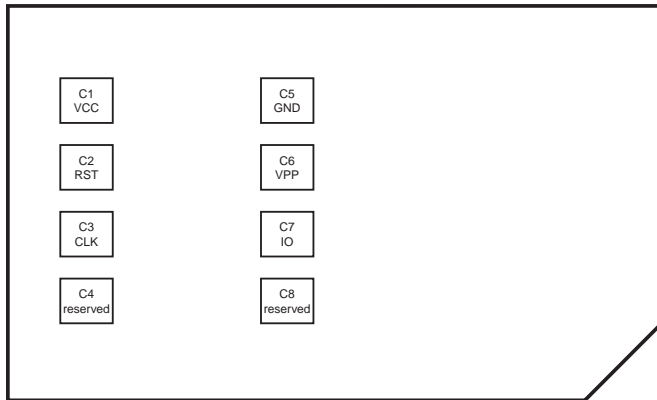


Figure 11: Plug-in SIM (shown from contact side)

References

1. 3GPP TS 01.04: "Abbreviations and acronyms"
2. 3GPP TS 11.11: "Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface"
3. 3GPP TS 11.12: "Specification of the 3 Volt Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".
4. 3GPP TS 11.18: "Specification of the 1.8 Volt Subscriber Identity Module - Mobile Equipment (SIM - ME) interface"
5. 3GPP TS 51.010-1 "Mobile Station (MS) conformance specification; Part 1: Conformance specification"
6. ISO/IEC 7816-1: "Identification cards – Integrated circuit cards with contacts – Part 1: Physical characteristics"
7. ISO/IEC 7816-2: "Identification cards – Integrated circuit cards with contacts – Part 2: Dimensions and locations of the contacts"
8. ISO/IEC 7816-3 "Identification cards – Integrated circuit cards with contacts – Part 3: Electronic signals and transmission protocols"

Operation of SIM interface

For the purposes of this document, the SIM interface is the interface between the SIM and the laptop at the SIM connector. The ME includes the HSDPA module and laptop SIM circuit. The SIM interface provides power, clock, reset and data to the SIM. The data is half-duplex (bi-directional but only able to transfer data in one direction at any time) circuit implemented as an open-collector signal. When data is transmitted, the ME or the SIM will pull the line to a low voltage, otherwise the line is pulled up through a resistor. The SIM operates in a command/response mode where it will only transmit data in response to a received command. One exception to this is the Answer-To-Reset (ATR) when the SIM transmits data in response to a reset.

The SIM is interrogated during the boot sequence. First the SIM interface is power sequenced for 1.8 volt operation. If 1.8 volt operation is unsuccessful then the SIM interface is power sequenced for 3.0 volt operation. Initially a large amount of data is transferred. After this the SIM is periodically polled to insure it has not been removed.

The following is a high level summary of SIM operation:

1. power cycle at 1.8 volts
2. power cycle at 3.0 volts (if required)
3. SIM transmits ATR
4. ME and SIM exchange data continuously over several seconds
5. ME polls SIM every 25 to 30 seconds

Description of signals

The SIM interface consists of the signals listed in Table 1.

Table 1: SIM interface signals

Name	MiniCard pin	SIM pin
VCC	8	C1
RST	14	C2
CLK	12	C3
Reserved	not connected	C4
GND	4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 40, 50	C5
VPP	16	C6
IO	10	C7
Reserved	not connected	C8

GND

The GND signal is the ground for the ME. All voltages are referenced to this.

VCC

VCC is supplied from the ME by a dedicated regulator. Operation is at 3V and 1.8V. See Table 2 for a summary of the 3GPP electrical requirements.

Table 2: VCC electrical requirements

Symbol	Conditions	Minimum	Maximum	Unit
Vcc	3V operation	2.7	3.3	V
Vcc	1.8V operation	1.62	1.98	V

RST

RST is driven by the ME. A low signal indicates a reset condition. See Table 3 for a summary of the 3GPP electrical requirements.

Table 3: RST electrical requirements

Symbol	Conditions	Minimum	Maximum	Unit
V _{OH}	I _{OHmax} = + 200 μ A	0.8 x Vcc	Vcc	V
V _{OL}	I _{OLmax} = 200 μ A	0	0.2 x Vcc	V
t _R t _F			400	μ s

CLK

CLK is driven by the ME. It is the system clock for the SIM. It may be used by the SIM as a processor clock. The frequency of this signal is from 1 to 4 MHz. The clock is not continuously running and is stopped in between data transfers. See Table 4 for a summary of the 3GPP electrical requirements.

Table 4: CLK electrical requirements

Symbol	Conditions	Minimum	Maximum	Unit
V_{OH}	$I_{OHmax} = + 20 \mu A$	$0.7 \times V_{CC}$	V_{CC}	V
V_{OL}	$I_{OLmax} = - 20 \mu A$	0	$0.2 \times V_{CC}$	V
t_R t_F			50	ns

IO

IO is the bi-directional data signal. The ME may drive this signal low, or may pull it up to VCC. The SIM may drive this signal low, or it may pull it up to VCC. The pull-up on the HSDPA module is described in the following figure.

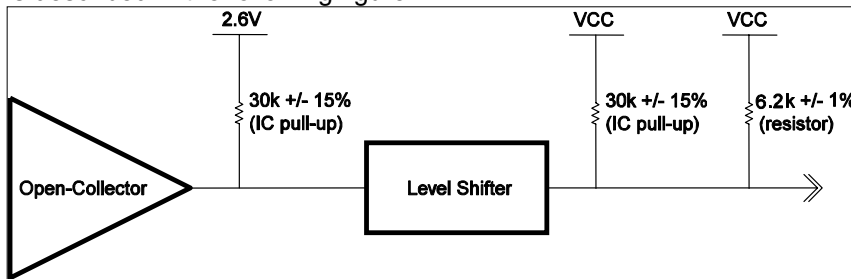


Figure 12: IO driver and pull-ups

The IO signal is much slower than the CLK signal. The default bit time is 372 clock periods. Each data word is 10 bit times; a start bit, eight (8) data bits, and a parity bit. The data signal may be direct convention (high voltage is a binary 1, LSB sent first) or inverse convention (low voltage is a binary 1, MSB sent first) depending on the ATR. See Table 5 for a summary of the 3GPP electrical requirements.

Table 5: IO electrical requirements

Symbol	Conditions	Minimum	Maximum	Unit
V_{IH}	$I_{IHmax} = \pm 20 \mu A$	$0.7 \times V_{CC}$	$V_{CC} + 0.3$	V
V_{IL}	$I_{ILmax} = + 1 mA$	- 0.3	$0.2 \times V_{CC}$	V
V_{OH}	$I_{OHmax} = + 20 \mu A$	$0.7 \times V_{CC}$	V_{CC}	V
V_{OL}	$V_{CC} = 3V, I_{OLmax} = - 1mA$	0	0.4	V
V_{OL}	$V_{CC} = 1.8V, I_{OLmax} = - 1mA$	0	0.3	V
t_R t_F			1	μs

VPP

VPP is the programming voltage. It is not used and the SIM connector pin should not be connected. The module pin is not connected.

Reserved

The reserved pins should not be connected on the SIM connector. The SIM connector need not have contacts at these locations.

Implementation

Refer to the figure below for the recommended circuit.

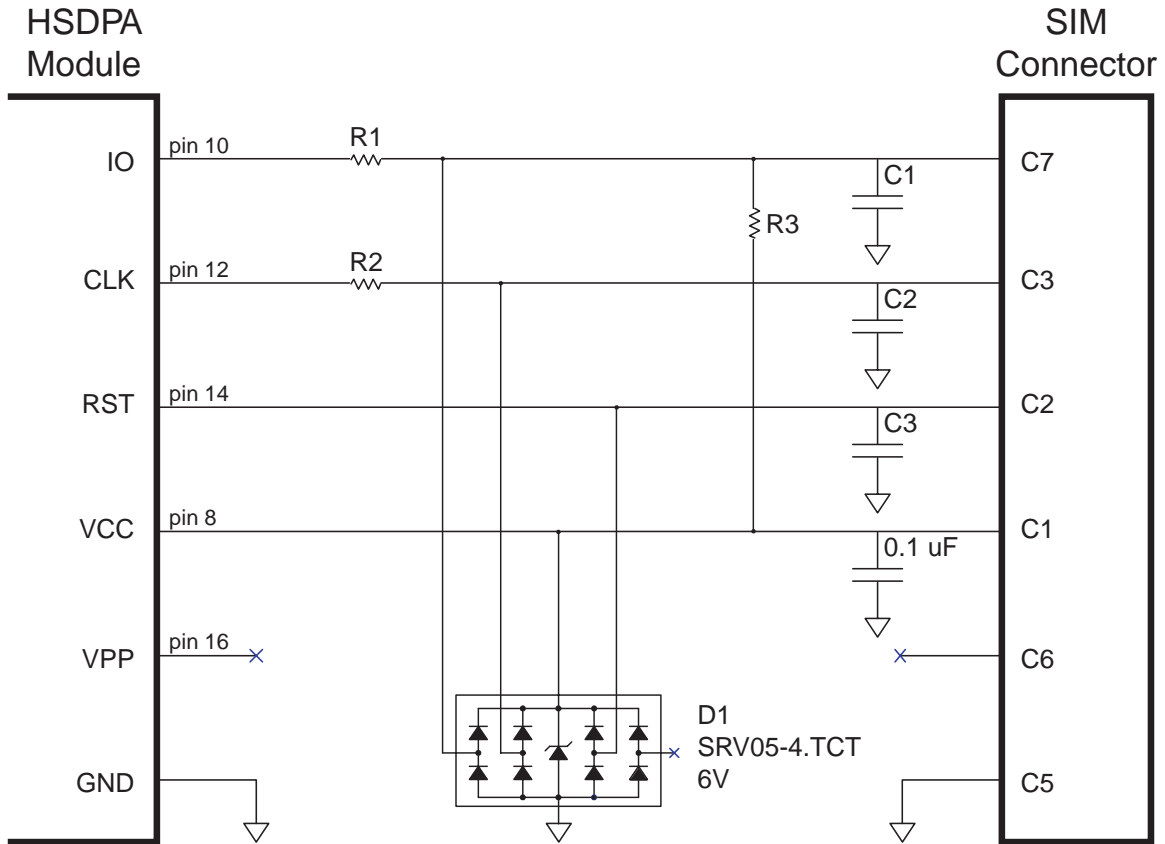


Figure 13: Reference circuit

C1, C2, C3

C1, C2 and C3 are not to be populated. They exist if additional filtering is required. These components should be placed close to the SIM connector.

R1

R1 should be zero ohms. It exists if additional filtering is required.

R2

R2 should be zero ohms. It exists if additional filtering is required.

R3

R3 should be not be populated. It exists if pull-up adjustments are required.

D1

D1 should be a low capacitance ESD diode array (5 pF or less). It is important to minimize the capacitance on the IO line. D1 should be placed close to the SIM connector. There is no ESD protection on the HSDPA module. It is recommended that the ESD protection meet IEC61000-4-2, level 4 ($\pm 15\text{kV}$ air, $\pm 8\text{kV}$ contact).

Signal routing

The CLK line is a high speed digital signal and care must be taken to insure it is isolated from the other signals. A guard trace between it and the other signals should be used if they are to be adjacent for any length. A multi-layer PCB with a ground plane should be used. Traces should be as short as possible. All the SIM interface signals should be routed carefully to avoid being corrupted by each other or external signals.

IO signal capacitance

The rise time of the IO signal is determined by the total capacitance on the line and the pull-up resistance. The module has a maximum capacitance of 50 pF and the SIM is considered to have a maximum capacitance of 30 pF. The laptop capacitance on the IO signal (including connectors) should be as targeted to be lower than 30 pF. Additional capacitance may be required to reduce noise, however the IO circuit rise time limit of 1 μs must be considered.

IO signal resistance

The SIM may also have a pull-up on the IO signal, which would have the effect of injecting up to 1 mA into the ME when the ME is transmitting a low level. Series resistance of the IO signal must be kept very low as the voltage drop across it due to the injected current may cause the output voltage to rise above the voltage output low specification.

Certification

As the SIM interface is unique to each laptop, each laptop must pass several test cases to obtain certification. The SIM electrical test cases are specified in section 27.17.2 in reference [5]. The following is a summary of these tests:

- **27.17.2.1.1 Electrical tests on contact C1 (VCC) – Test 1**
 - e.1) The voltage on contact C1 of the SIM/ME interface shall be $3\text{V} \pm 10\%$ for I_{cc} up to 6 mA when the interface is in 3V operation mode.
 - e.2) The voltage on contact C1 of the SIM/ME interface shall be $1.8\text{V} \pm 10\%$ for I_{cc} up to 4 mA when the interface is in 1.8V operation mode.
- **27.17.2.1.2 Electrical tests on contact C1 (VCC) – Test 2**
 - e.1) The voltage on contact C1 of the SIM/ME interface shall be $3\text{V} \pm 10\%$ for spikes in the current consumption with a maximum charge of 12 nAs with no more than 400 ns duration and an amplitude of at most 60 mA when the interface is in 3V operation mode.
 - e.2) The voltage on contact C1 of the SIM/ME interface shall be $1.8\text{V} \pm 10\%$ for spikes in the current consumption with a maximum charge of 12 nAs with no more than 400 ns duration and an amplitude of at most 60 mA when the interface is in 1.8V operation mode.

The following current spikes are applied (The specified spike durations are measured at 50 % of the spike amplitude):

- 1) continuous spikes:
current amplitude 12 mA
current offset 0 mA
Duration 100 ns
Pause 100 ns
 - 2) continuous spikes:
current 12 mA
current offset 0 mA
Duration 400 ns
Pause 400 ns
 - 3) continuous spikes:
current amplitude 9 mA
current offset 3 mA
(i.e. maximum amplitude = 3 mA + 9 mA = 12 mA)
Duration 150 ns
Pause 300 ns
 - 4) random spikes:
current amplitude 60 mA
current offset 0 mA
Duration 200 ns
Pause between 0.1 ms and 500 ms, randomly varied
 - 5) random spikes:
current amplitude 30 mA
current offset 0 mA
Duration 400 ns
Pause between 0.1 ms and 500 ms, randomly varied
 - 6) random spikes
current amplitude 57 mA
current offset 3 mA
(i.e. maximum amplitude = 3 mA + 57 mA = 60 mA)
Duration 200 ns
Pause between 0.1 ms and 500 ms, randomly varied
- **27.17.2.2 Electrical tests on contact C2 (RST)**
 - e.1) The voltage on contact C2 (RST) of the SIM/ME interface shall be between 0.3V and +0.7V for a current of 200 μ A in low state and between 2.15 V and $V_{cc} + 0.3V$ for a current of +200 μ A in high state when the interface is in 3V operation mode.
 - e.2) The voltage on contact C2 (RST) of the SIM/ME interface shall be between 0.3V and +0.47V for a current of 200 μ A in low state and between 1.3 V and $V_{cc} + 0.3V$ for a current of +200 μ A in high state when the interface is in 1.8V operation mode.
 - **27.17.2.3 Electrical tests on contact C3 (CLK)**

- e.1) The voltage on contact C3 (CLK) of the SIM/ME interface shall be between 0.3V and +0.47V for a current of 20 μ A in low state and between 1.21V and $V_{cc} + 0.3V$ for a current of +20 μ A in high state when the interface is in 1.8V operation mode.
 - e.2) The rise and the fall time of the clock signal shall not exceed 50 ns when the interface is in 1.8V operation mode.
 - e.3) The cycle ratio of the clock signal shall be between 40 % and 60 % of the period, in steady state when the interface is in 1.8V operation mode.
 - e.4) The frequency of the clock signal shall be between 1 MHz and 4 MHz when the interface is in 1.8V operation mode.
 - e.5) The voltage on contact C3 (CLK) of the SIM/ME interface shall be between 0.3V and +0.6V for a current of 20 μ A in low state and between 1.9V and $V_{cc} + 0.3V$ for a current of +20 μ A in high state when the interface is in 3V operation mode.
 - e.6) The rise and the fall time of the clock signal shall not exceed 50 ns when the interface is in 3V operation mode.
 - e.7) The cycle ratio of the clock signal shall be between 40 % and 60 % of the period, in steady state when the interface is in 3V operation mode.
 - e.8) The frequency of the clock signal shall be between 1 MHz and 4 MHz when the interface is in 3V operation mode.
- **27.17.2.5 Electrical tests on contact C7 (IO)**
 - e.1) ME receiving state A (low state):
With an imposed voltage of 0V the current flowing out of the ME shall not exceed 1 mA when the ME is in 3V operation mode.
 - e.2) ME transmitting state A (low state):
The voltage shall be between 0.3V and 0.4V when a current of 1 mA flowing into the ME is applied when the ME is in 3V operation mode.
 - e.3) ME transmitting or receiving state Z (high state):
The voltage shall be between $0.7 \cdot V_{cc}$ and $V_{cc} + 0.3V$ when a current of 20 μ A flowing out of the ME is applied when the ME is in 3V operation mode.
 - e.4) The rise time and the fall time of the I/O signal shall not exceed 1 μ s when the ME is in 3V operation mode.
 - e.5) ME receiving state A (low state):
With an imposed voltage of 0V the current flowing out of the ME shall not exceed 1 mA when the ME is in 1.8V operation mode.
 - e.6) ME transmitting state A (low state):
The voltage shall be between 0.3V and 0.3V when a current of 1 mA flowing into the ME is applied when the ME is in 1.8V operation mode.
 - e.7) ME transmitting or receiving state Z (high state):
The voltage shall be between $0.7 \cdot V_{cc}$ and $V_{cc} + 0.3V$ when a current of 20 μ A flowing out of the ME is applied when the ME is in 1.8V operation mode.
 - e.8) The rise time and the fall time of the I/O signal shall not exceed 1 μ s when the ME is in 1.8V operation mode.

SM Bus Design Guidelines

Introduction

This section will describe the SMBus interface parameters ensuring interoperability with Novatel's PCI Express Mini Cards the SM Bus interface.

The SMBus is a two-wire interface through which various system components can communicate with each other and the rest of the system. It is based on the principles of operation of I²C. See the PCI Express Card Electromechanical Specification for more details on the functional requirements for the SMBus.

The SMB_CLK signal and the SMB_DAT signal are available on pins 30 and 32 of the PCI Express Mini connector.

This interface will support a subset of the specification as detailed in this section.

SMBus is an i2c based protocol that will drive a slave device and report various data regarding mobile status or real-time e-mail to it, in accordance to the SMBus protocol specification. It is important to note that the ***EU860D/EU870D & E725 PCI Express Mini-card acts as a bus master and not as a slave.***

I2C Controller

The controller is an I2C-compliant, master-only device. The controller can access all available I2C slaves on the bus, but cannot be accessed by any other masters on the bus.

Both SDA and SCL are bi-directional lines, connected to a positive supply voltage via a current-source or pull-up resistor. When the bus is free, both lines are HIGH. The output stages of devices connected to the bus must have an open-drain or open-collector to perform the wired-AND function.

A simplified version of the I2C bus operation is as follows:

- The master generates a START condition, signaling all ICs on the bus to listen for data.
- The master writes a 7-bit address, followed by a read/write bit to select the device as a transmitter or receiver.
- The receiver sends an acknowledge bit over the bus. The transmitter must read this bit to determine whether or not the addressed device is on the bus.
- Depending on the value of the read/write bit, any number of 8-bit messages can be transmitted or received by the master. These messages are specific to the I2C device used. After 8 message bits are written to the bus, the transmitter will receive an acknowledge bit. This message and acknowledge transfer continues until the entire message is transmitted.
- The message is terminated by the master with a STOP condition. This frees the bus for the next master to begin communications.
- Data on the I2C-bus can be transferred at rates of up to 100 kbps in the Standard-mode,
- The number of interfaces connected to the bus is solely dependent on the bus capacitance limit of 400 pF.

HW Parameters

The System Management Bus (SMBus) is a two-wire interface through which various system component chips can communicate with each other and with the rest of the system. It is based on the principles of operation of I²C.

The reader is referred to SMBus reference as described in the *System Management Bus (SMBus) Specification, Version 2.0* for further details on its operation.

The peripheral board communicating to the SMBus must provide pull-ups to 2.6V. It is recommended that a 2.7 K ohm pull connected to 2.6 Volt rail.

DC parameters

Symbol	Parameter	Limits		Units
		Min	Max	
VIL	Data, Clock Input Low Voltage	- 0.3	0.86	V
VIH	Data, Clock Input High Voltage	1.78	2.77	V
VOL	Data, Clock Output Low Voltage	0	0.45	V
ILEAK	Input Leakage	- -	±5	µA
VDD	Nominal bus voltage	2.47	2.73	V

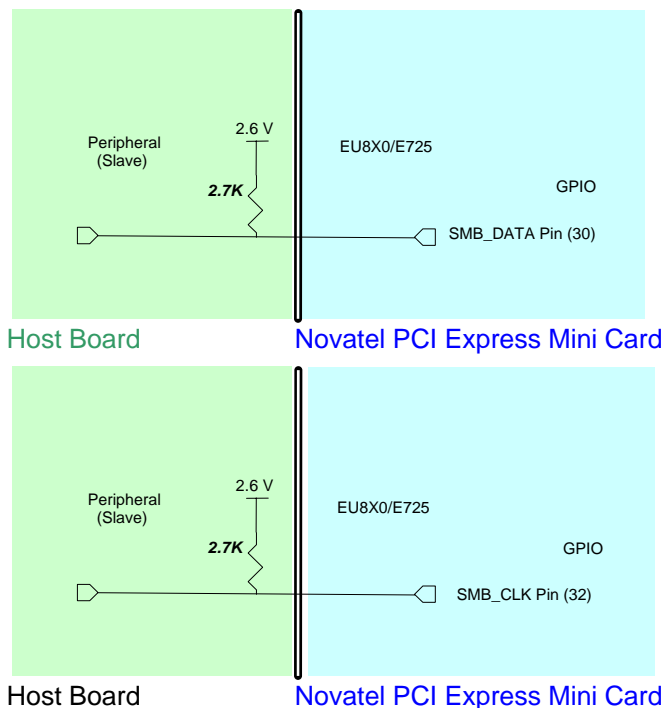
Table 2: SMBus DC specification

SM Bus interface Board

Pull up resistors on both lines (SMB_CLK and SMB_DATA) and solid ground connections are necessary. Without proper pull up values and good ground and instability in communication will be experienced.

As illustrated below it is recommended that a 2.7 K ohm pull connected to 2.6 Volt rail.

Figure 14: SM Pull-up Configuration



MobiLink Connection Manager

Overview

The Novatel Wireless MobiLink™ Communications Software Suite is a family of wireless connectivity applications that connect mobile devices using wireless wide area networks (WWAN) as well as WiFi and Ethernet in a single application to allow quick and easy access to email, the Internet and corporate networks anytime, anywhere. With MobiLink and a wide area wireless device, mobile users can stay productive and connected to customers and colleagues while out of the office. MobiLink is optimally engineered to work with all of Novatel Wireless' Wireless Modems for best in class 3G wireless broadband access solutions.

The MobiLink Communications Software Suite of applications contains a messaging Client that manages 2 way SMS operations, an address book Client that manages contacts and phone number, connection manager that manages the connectivity, and a customization utility to manage and generate install customization settings. The following section will detail the features of each application.

Purpose

This section provides high level user interface information regarding the appearance and operation of the **MobiLink™** Connection Manager application developed for Windows 2000, XP Pro, and XP Home.

Applicable Documents

All software names and version numbers displayed should meet the requirements outlined in the **Consistency & Naming Conventions Requirements Document**. This document also covers the requirements for the desktop, including the necessary icons and the use of the Start menu.

For more details on meeting the requirements for Microsoft™ Windows certification, refer to the document entitled, **Application Specification for Microsoft™ Windows 2000 and Windows XP for Desktop Applications**, which can be found on Microsoft™'s web site.

GENERAL FEATURES

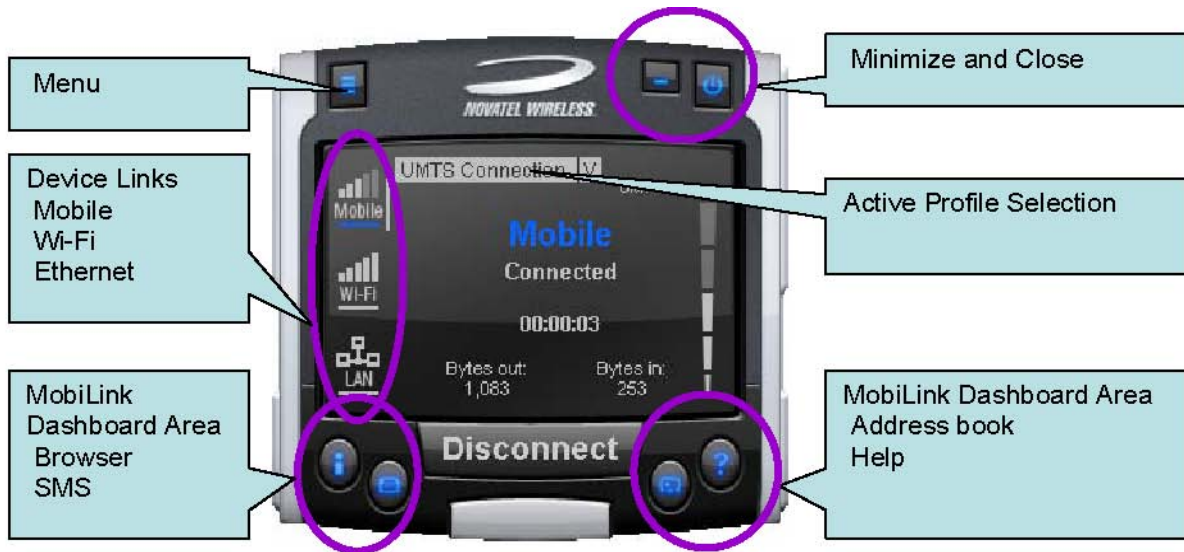
User Interface Functionality

The first design principle for MobiLink applications is that the basic information and controls needed for day-to-day operations are quickly and easily accessible while less frequently used functions are located deeper in the menu system. The user interface is designed to be intuitive to use and will not require a large learning curve for the average user. The second design principle for MobiLink is to be easily customizable in order to be able to meet the various requirements of a global market.

Layout

The general layout of the main windows is designed to display important information for connectivity while making it easy to navigate to other functions. The main function such as mobile status and signal strength display is shown in the main window. The connection button is prominently displayed and easily accessible. The main MobiLink display is shown below.

Figure 15: Main MobiLink Display



The menu button is located on the left upper corner and contains additional functionality such as settings and configurations. The menu system is designed as a button that when clicked, shows a drop down list of other options. Because it's a drop down list, it allows for expansion of functions as well as reduces the clutter on the main display.

The Device Links area is an active navigation bar that shows status for all the three types of connections as well as a clickable area to shift the main display information to the specific type of connection

The Dashboard Area in the layout is designed as a launching area for other applications. The default applications in the current design are internet browser, SMS Client, Addressbook, and Help file. Other applications can be launched.

The Active Profile Selection is a list that allows for easy access to choose the active profile to use for connection. For 3G, this list is a list of connection profiles while for WiFi, this is a list of access points found. For WiFi, this list also shows the signal quality and whether the access point is encrypted.

Lastly, there are the standard minimize and close buttons that are the main stay of any application. The minimize button hides the application as a tray icon and the close button gracefully closes the application.

Mouse Over

Mouse over is a feature of the application that displays helpful hint about the function of the application as the mouse is moved over an active area of the application such as the menu button.

Snap to Edge

Snap to edge is a feature that makes the MobiLink application window snap to the sides of the Windows desktop as the user drags the application close to the edge.

Hot Swapping

The design of MobiLink allows for hot swapping of the 3G device. Users can plug and unplug a 3G wireless device and MobiLink will automatically recognize the technology and dynamically change the display to show the relevant information.

Skinning Customization

Due to the software design and the underlying graphics engine used, the main “skin” of MobiLink is completely customizable. The skin is contained in separate resource files that can be easily changed for branding or function. One design is shown below and more can be developed.

Figure 16: Skin Design



Localization

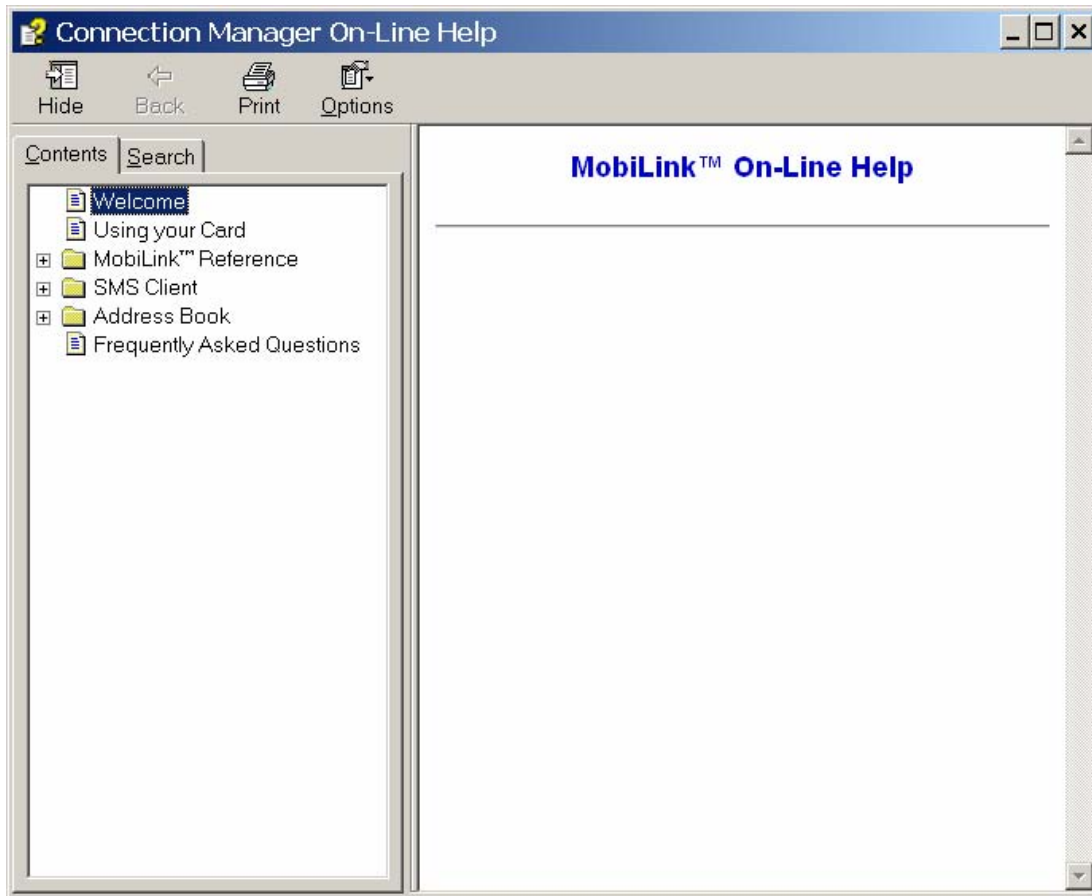
It is the intent of the MobiLink™ connection manager design to be able to support localization. Double byte Unicode is used and all the text used by MobiLink is kept in resource files that can easily be translated and added. Currently MobiLink supports the following languages:

- Chinese Simplified
- Chinese Traditional
- Danish
- English
- French
- German
- Italian
- Spanish
- Swedish
- Polish

File

The MobiLink™ connection manager shall contain a help file that can be accessed through a help button or via F1 key. The help file is also localizable and is in HTML format as shown below:

Figure 17: On-Line Help



MOBILINK™ FEATURES

The following sections describe the various features of MobiLink.

Main Display Window

The main display area of MobiLink is used for status indication of the different types of connections. The following information is displayed.

Figure 18: Status Indication



Status Indication

Number Reference	Status Information	Description
1	Signal Strength Bar	This is the quality of the signal for the selected
2	Connection Status	This is a text indicating the connection status
3	Connect Duration	This indicates the number of hours, minutes, and seconds the current connection has been up
4	Bytes Out/Packets Out	This indicates the number of bytes sent for the current connection
5	Connect Duration	This indicates the number of hours, minutes, and seconds the current connection has been up
6	Mobile Connected	This is a text indicating the connection status
7	UMTS Connection V	This is a text indicating the connection status
8	UMTS	This is a text indicating the connection status
9	Mobile	This is a text indicating the connection status
Number Reference	Status Information	Description

5	Bytes In/Packet In	This indicates the number of bytes received for the current connection
6	Network Name	For UMTS/HSDPA, this would show the network name received from the AT+COPS command
7	Profile List	This is the list of supported profiles that contains the connection settings such as username and password and QoS for 3G. This is a list of the 3G profiles for the 3G networks and a list of WiFi profiles for the WiFi network. The displayed profile is the active profile.
8	Indicators	The indicators are icons that show additional status of the 3G wireless. Each indicator will be described below.
9	Connection Type Selection Bar	This is a navigation bar that selects which connection information is displayed in the main window. As the connection is selected, the main window will slide to show the right information. Each of the connection icons for this navigation bar also shows the signal strength of the respective connection.

The connection navigation bar was added to support the universal connection management functionality. By having a navigation bar, the user is presented with just the information that is required for the connection of interest. The pictures below show the three views for each connection type.

Figure 19: 3G Wireless View



With the 3G Wireless view, connection button can be used to connect to the chosen profile displayed. The status icons for 3G will be displayed on the top right corner and when connected, byte count and time displayed will be shown. The vertical bar next to the navigation bar indicates which view is currently active. When the user clicks on the WiFi navigation button, the WiFi view will be shown.

Figure 20: WiFi View



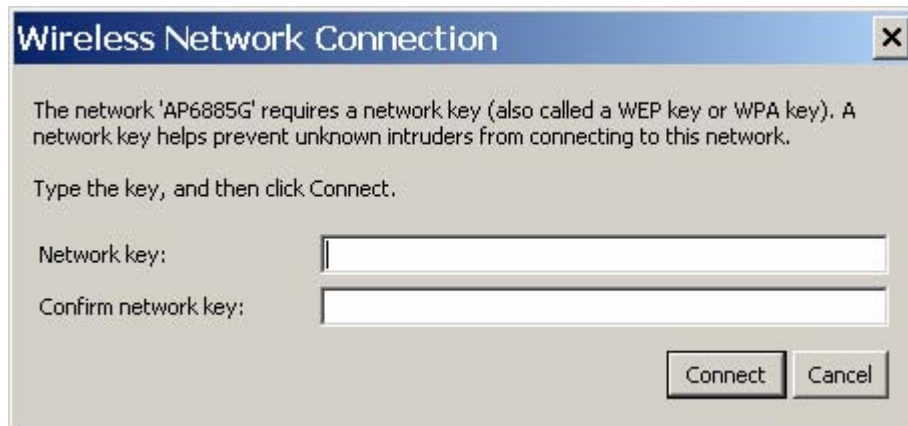
The WiFi view does not have a connection button since WiFi is a connectionless adaptor. The view does show signal strength, packet count, and connection time as well as connection status. Since MobiLink's WiFi is developed using Windows zero configuration, MobiLink WiFi control can coexist with Windows wireless network connection. The default hotspot is shown in the selection list in the same place as the 3G profile list. The list of hotspots is dynamically generated based on a WiFi network scan of the area. Users can choose to make another hotspot active by clicking on the selection list shown below.

Figure 21: HotSpot Activation



The connection list displays all the available hotspots seen by the WiFi adaptor. The list is arranged in alphabetical order and the signal level for each is shown on the side. Also, if the hotspot is WEP protected, a lock icon will be shown. To change hotspot, users can select one from the list. If the hotspot is WEP protected the following dialog will be displayed to query for the network key.

Figure 22: Network Connection



Lastly, the user can view the Ethernet connection by clicking on the Ethernet navigation bar icon.

Figure 23: Ethernet View







The Ethernet view shows the connection status, the packet count, and the connection duration.

Indicators

3G indicators are shown on the right upper corner of the main status display. The design of these indicators is based on standard 3G indicators used on mobile devices. The following table describes all the indicators.

3G Indicators

Indicator	Status/Description
	3G radio is roaming
	3G in dormant mode (May not be applicable for all MAs)
	New SMS is available
	3G device is locked
WWAN Network	This is the type of WWAN protocol that is acquired. The types are: <ul style="list-style-type: none"> • HSDPA • GPRS • IS95a • UMTS • GSM • 1XRTT • EVDO

Connect/Disconnect Button

Since the main purpose of MobiLink’s connection manager is for connecting the user to the internet, the connection button is prominently placed. The Connection button is used to initiate a 3G data connection. The connection button is not used for WiFi or Ethernet since the network adaptors are connectionless and will automatically connect as long as there is a valid connection.

Figure 24: Connection Button



Menu

When the Menu button is clicked, the following menu subjects are displayed:

Menu Subjects

Menu Item	Description
Profile Manager	This menu item opens up the dialog for creating, editing, and deleting profiles
Configuration	This menu item opens up a dialog for changing MobiLink settings
Properties	This menu item opens up a dialog that displays the properties of the 3G modem
Report	This menu item opens up a dialog that displays the connections statistics and connection history
Transparency	This menu item is to set the application display transparency. This feature allows the desktop items below the application to be shown

	through the transparency
About	This menu item brings up information about the MobiLink application
Exit	This menu item will quit the MobiLink application

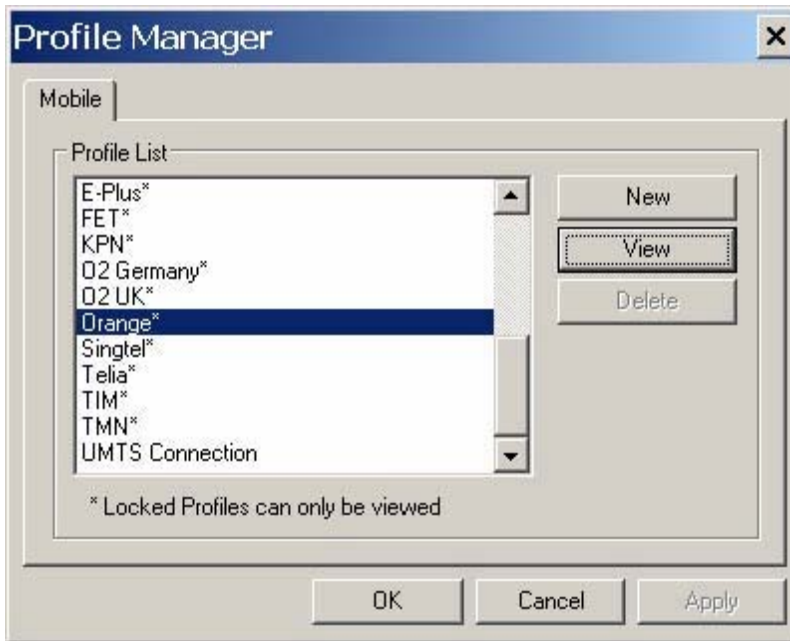
Profile Manager

The profile manager allows the user to manage the connection profiles for both the 3G connection and WiFi connection. The user can create a profile using the New, edit or view the profile, and delete a profile.

3G Wireless Profiles

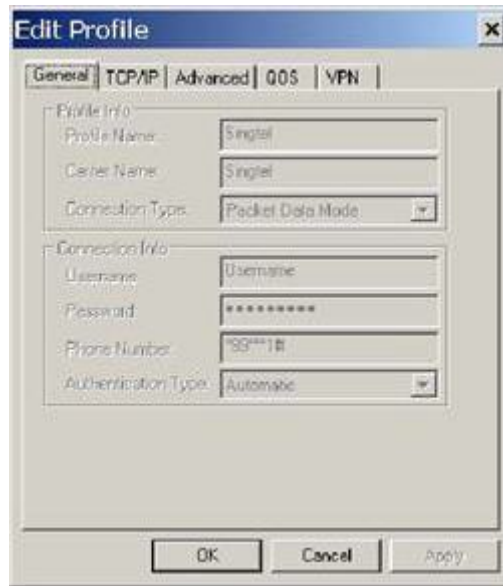
The first tab shows the 3G wireless profiles as shown below.

Figure 25: 3G Profiles



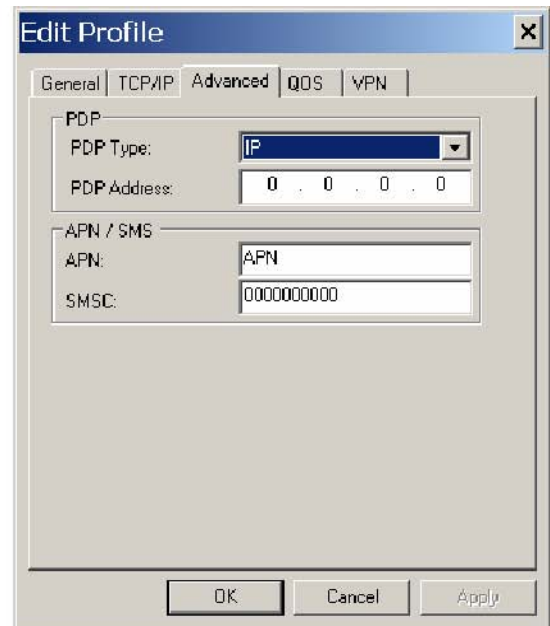
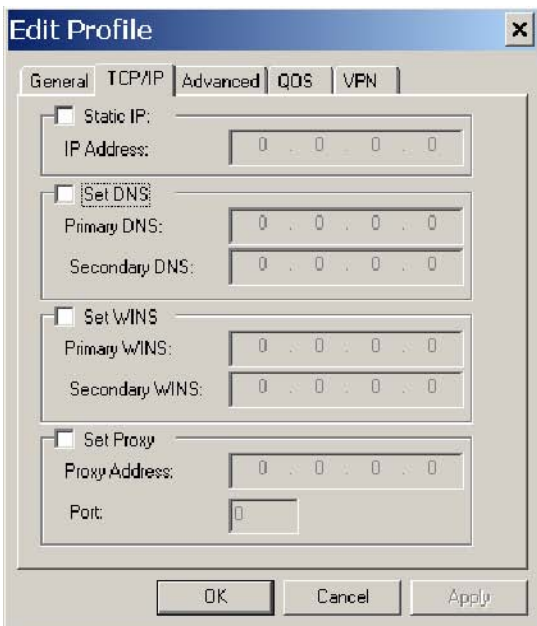
The wireless profiles can be selected for viewing in the case of a locked profile and for editing in the case of an unlocked profile. Locked profiles are preset and can not be deleted or altered. This is to reduce the incidence of connection problems related to incorrect settings due to user error. The dialog below shows the actual profile settings. For locked profiles, the settings are grayed out and cannot be modified.

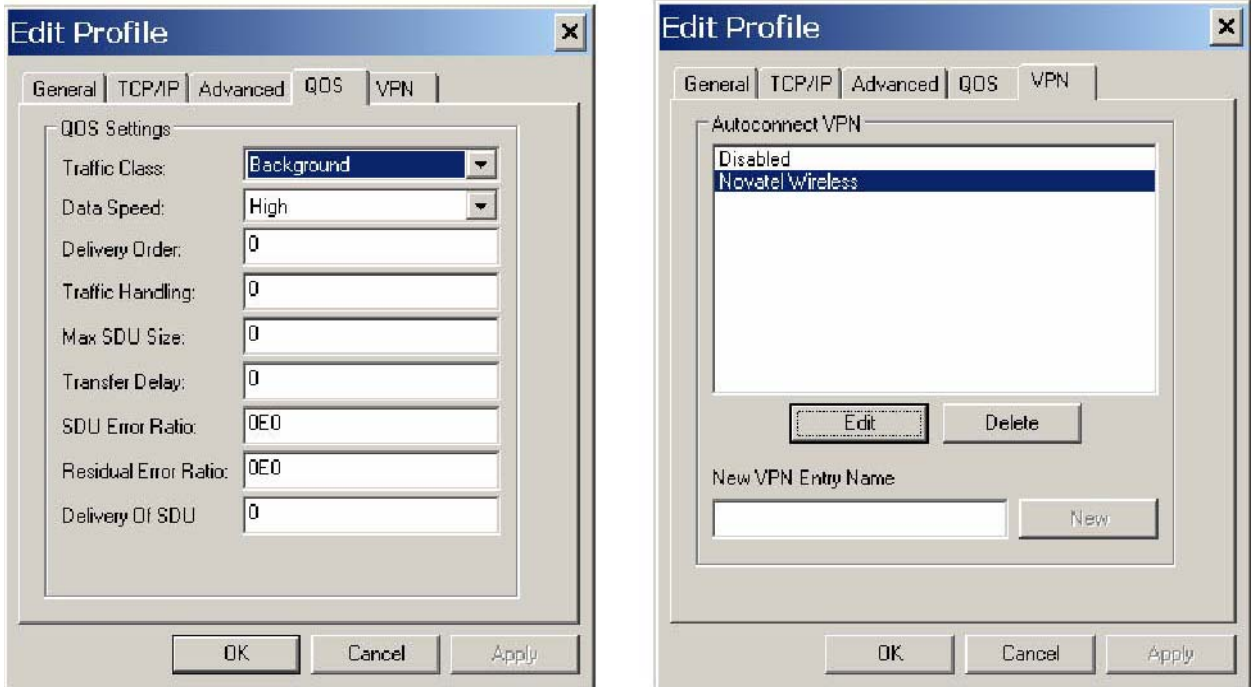
Figure 26: Profile Settings



The profile settings are categorized under different tabs and can be different for UMTS and CDMA. In the case of CDMA, the QoS tab does not apply. The following screens show the various settings under each tab.

Figure 27: Different Tab Settings





When changes are made to any of the tabs, the user must click the Apply button to effect the changes. Cancel can be clicked to cancel the settings. The exception is the on the last VPN tab. When creating a new VPN, the VPN entry is created when the user clicks the New button with an entry name. The apply button is used to change the associated VPN for the profile. VPN association is used to automatically establish a VPN session after a successful 3G connection.

When creating a profile by clicking on the New button, the profile wizard is used to guide the user through some simple steps for creating a new profile. The advanced settings are preset based on a template profile for the carrier network and hidden from the user. In the rare case where advanced parameters need to be changed, the user can then select the newly created profile and click on Edit to edit the parameters.

Figure 28: Profile Wizard Step 1



Figure 29: Profile Wizard Step #2



Figure 30: Profile Wizard Step #3



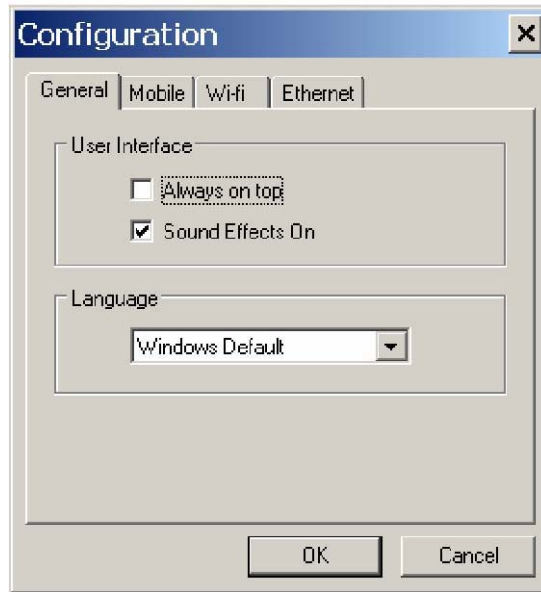
WiFi Profiles

TBD

Configuration

The configuration menu has all the available settings for MobiLink. The configuration window is broken down in to four functional tabs. The General tab is for the user interface settings and language selection. The Mobile tab is used to set parameters for the 3G device. The WiFi tab has settings for WiFi adaptor, and the Ethernet tab is used to set the Ethernet adaptor. Each of the tabs is shown below.

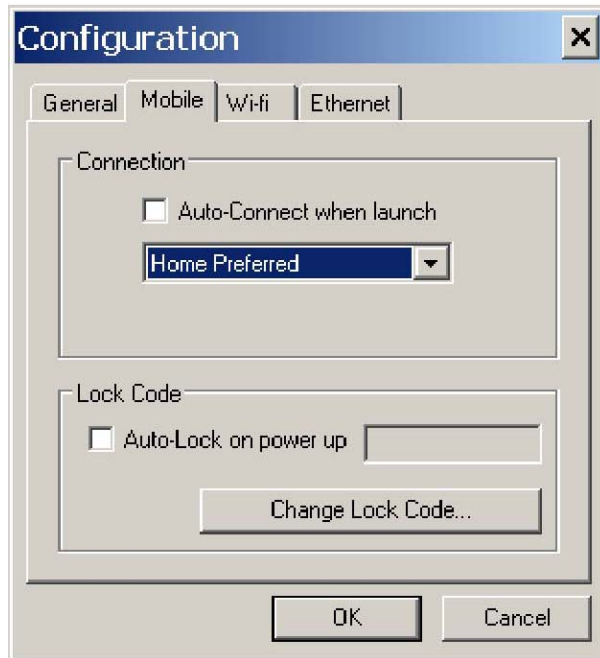
Figure 31: General Tab



General Tab Features

General Tab Feature	Description
Always on top	When checked, the application is always the top most application on the desktop
Sound Effects On	When checked, sounds will be played on user actions
Language	This is a selection list for choosing the language to be used for MobiLink. Windows Default will base the language on what Windows uses as the native language

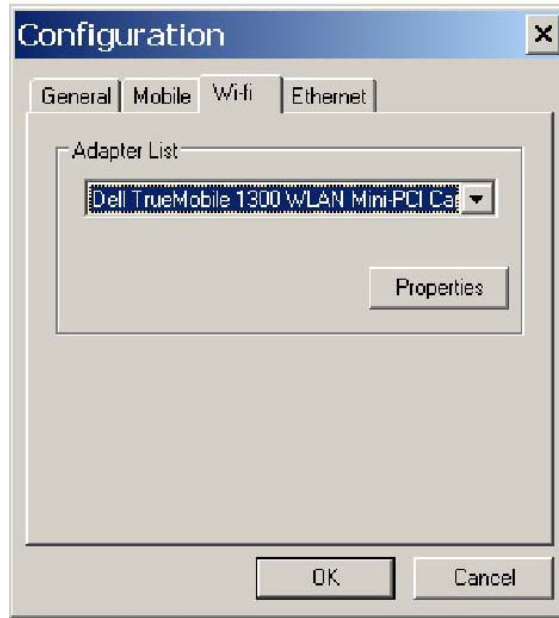
Figure 32: Mobile Tab



Mobile Tab Features

Feature	Description
Auto-Connect when launch	This feature is for MobiLink to automatically connect to the network when launched
Network Selection	This selection is used to select the network preference. For CDMA, this is to select the operating network and for UMTS/HSDPA, it's for selecting the radio access technology
Auto-Lock on power up	Check to lock the SIM upon power up. A 4 to 8 digits code must be supplied to turn on and off the auto lock feature.
Change Lock Code	Click this button to change the lock code. This button is only active if the auto-lock SIM feature is turned on.

Figure 33: WiFi Tab



The WiFi tab allows user to choose the WiFi adaptor from a list of detected adaptors. Also, the adaptor properties can be modified by clicking on the properties button. The wireless adaptor properties window is shown below.

Figure 34: WAP Window

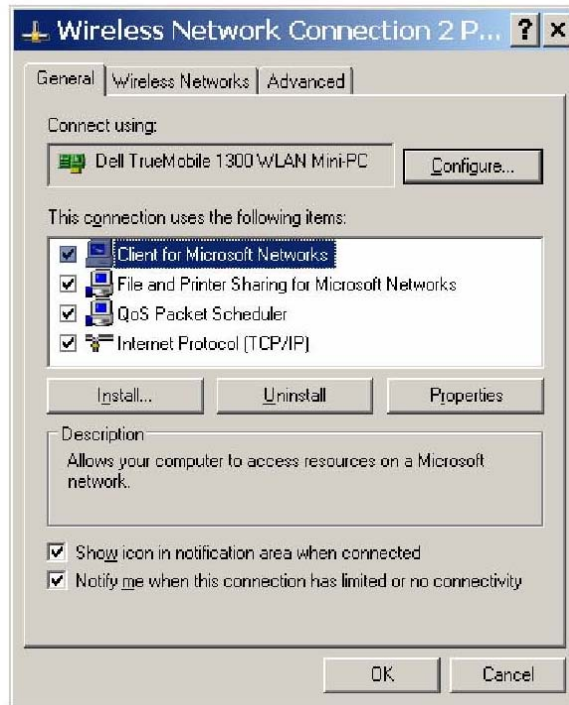
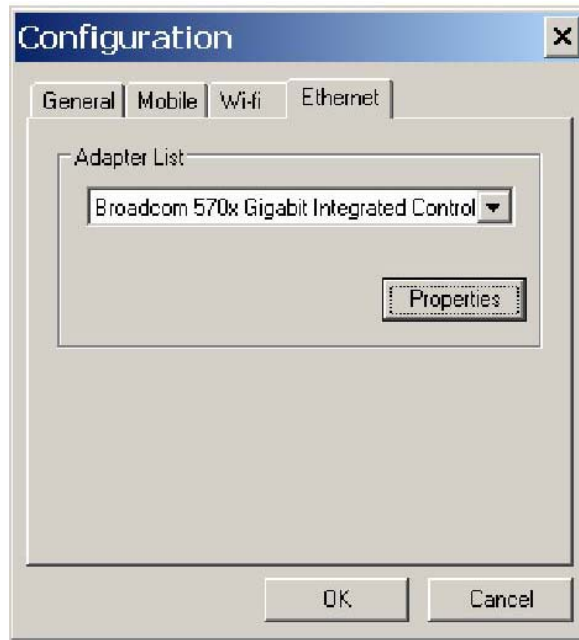
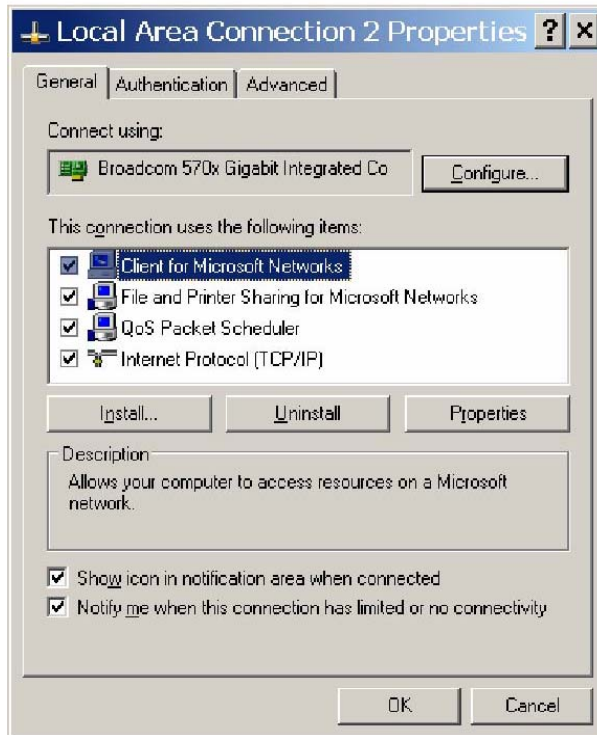


Figure 35: Ethernet Tab



The Ethernet tab allows user to choose the Ethernet adaptor from a list of detected adaptors. Also, the adaptor properties can be modified by clicking on the properties button. The adaptor properties window is shown below.

Figure 36: AP Window



Properties Menu

The properties menu displays some of the key properties of the UMTS and EVDO devices.

Figure 37: CDMA

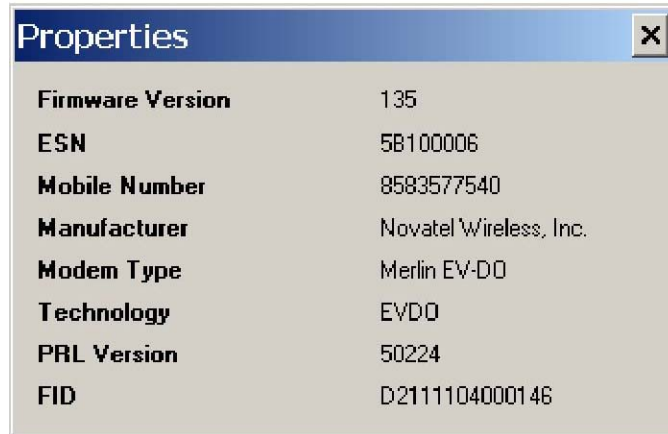
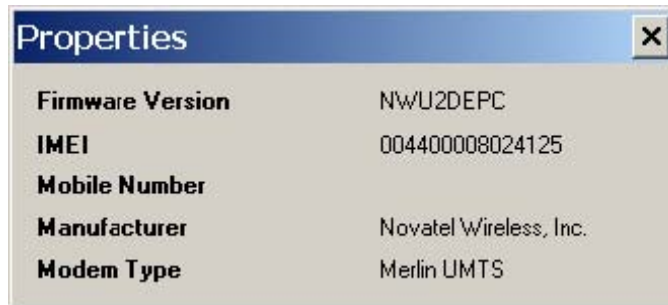


Figure 38: UMTS/HSDPA



Identity Properties

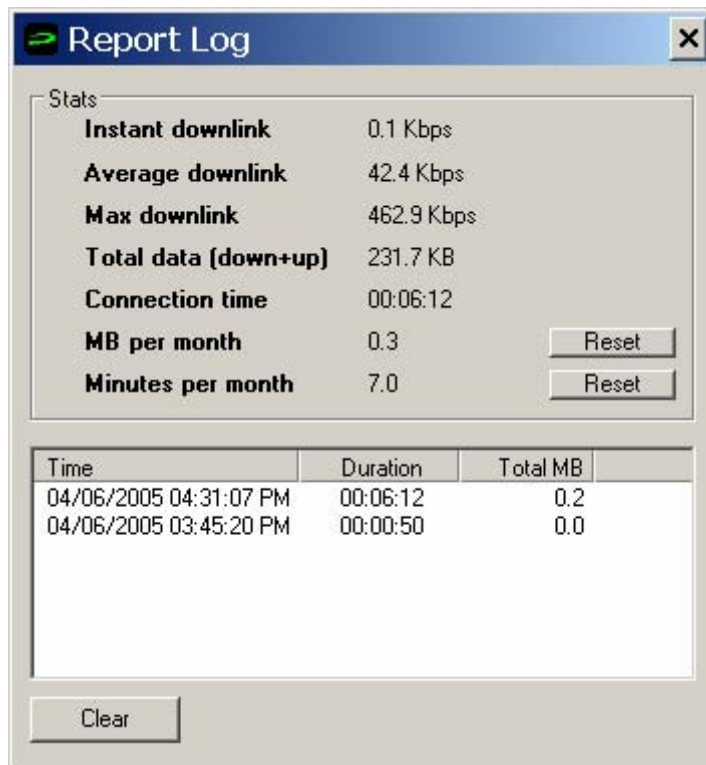
Property	Description
Firmware Version	Firmware version of the 3G device
IMEI/ESN	International Mobile Equipment Identity (UMTS)/ Electronic Serial Number (CDMA)
Mobil Number	Number for the mobile
Manufacturer	Who produced the modem
Modem Type	Modem technology
Technology	3G technology

PRL version	Preferred Roaming List version number(CDMA)
FID	Factory ID. This is a unique tracking number for factory builds

Report Log

The report log has statistic information about the current connection as well as a history list of past connections.

Figure 39: Report Log



Report Values

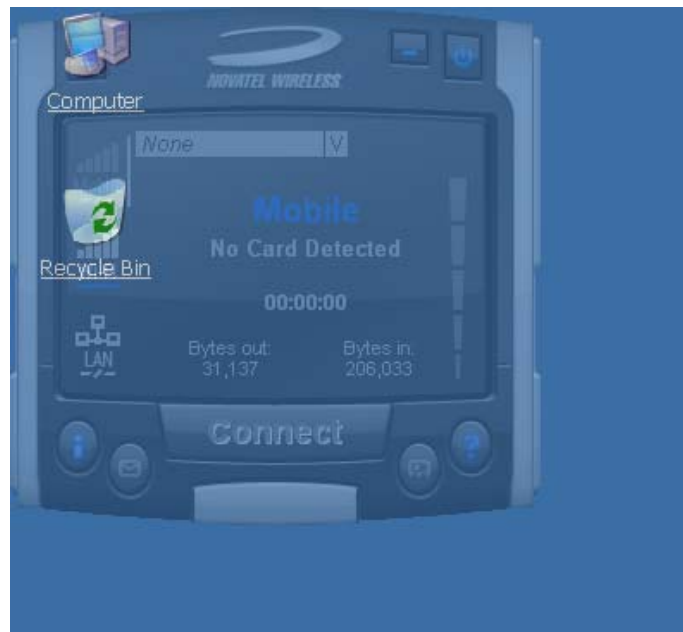
Value	Description
Instant downlink	This is most recent measured downlink throughput
Average downlink	This is the average of all the measured downlink throughput
Max downlink	This is the maximum achieved downlink throughput
Total data	This is the total data that has been ever sent since MobiLink has been installed on the machine

Connection time	The is the amount of time the connection has lasted
MB per month	This is a resettable counter of how many bytes since the last reset
Minutes per month	This is a resettable counter of how many minutes since the last reset

Transparency

This menu feature allows the user to select the percent transparency for MobiLink. The choices range from 0% to 90% with 0% being solid and 90% being very transparent. Transparency allows desktop items below MobiLink to be displayed for better multitasking. Below is an example of MobiLink transparency on a desktop.

Figure 40: Desktop Transparency



About

The About dialog displays MobiLink information such as version number, release date, and copyright.

Figure 41: About Dialogue



SIM/Lock Management

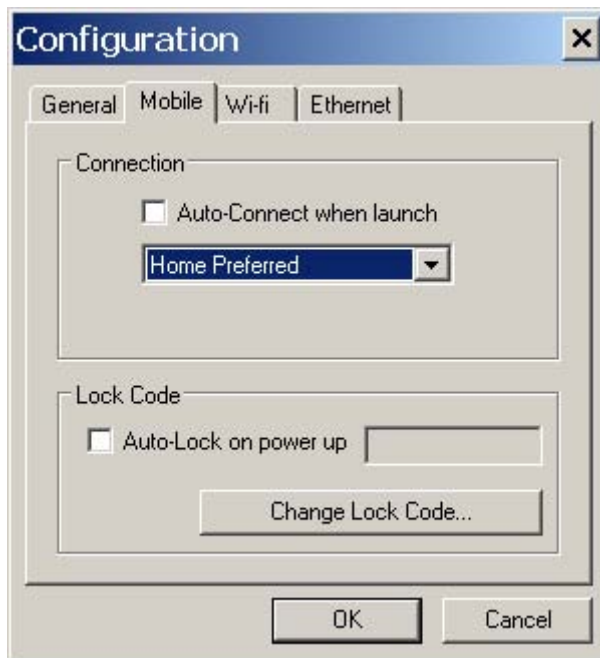
Upon MobiLink startup, if the device is locked on power up, a small dialog will be displayed such as below to ask the user to enter the unlock code prior to continuing with MobiLink.

Figure 42: Enter PUK



The lock setting and code can be managed in the Mobile tab of the configuration menu shown below.

Figure 43: Configuration Menu



Quick Access Buttons

The quick access buttons are designed to provide a launch pad for other applications. Four buttons are provided and can be remapped to other applications. The picture below shows the default functions assigned to the quick access buttons.

Figure 44: Quick Access Button Default Functions



Software Web Upgrade

TBD

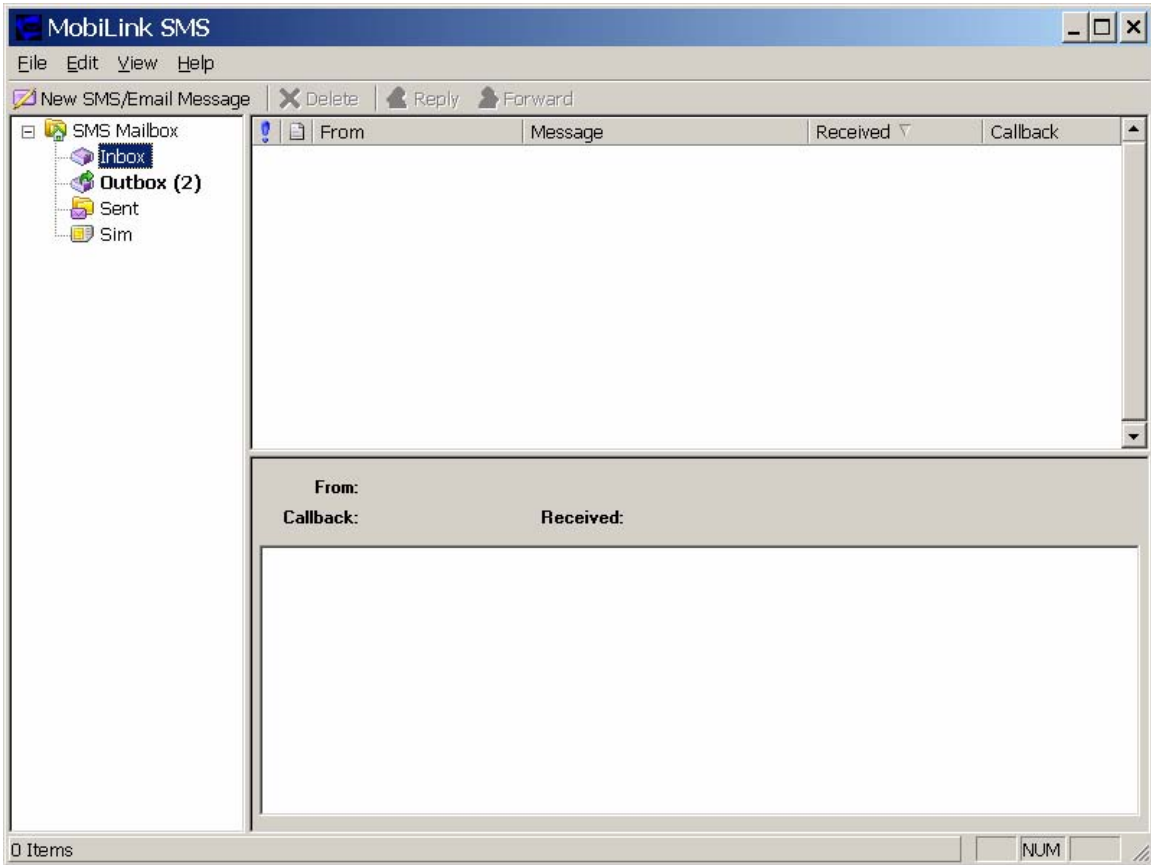
SMS Client

The MobiLink SMS Client is used to manage reading and sending SMS messages. The SMS Client is an application that is part of the MobiLink application suite. The design of this application is to emulate an email Client to reduce the amount of new learning that is required to start using this application. This application is launched from the main connection manager Quick Access button. The following features are supported.

- Send new messages
- Reply to message
- Forward message
- Email interworking
- Concatenated SMS
- Set priority of message
- Rich text editing functions
- Printing
- Support for embedded hyper links and email links in message
- Auto language selection

- Send to multiple recipients
- Status receipt of sent messages
- Status bar to indicate number of messages, character count, etc...

Figure 45: MobiLink SMS Client



SMS Mailboxes

Very much like an email Client, the SMS Client has multiple mail boxes to store different types of messages.

Mailbox List

Mailbox	Description
Inbox	All incoming SMS is delivered to this mail box and will be highlighted if unread.
Outbox	All outgoing SMS will be put into this mailbox. If the SMS has not been sent to the card, it will be held here until it can be sent.
Sent	All sent SMS messages are placed here.

SIM	All SMS messages that are still stored on the SIM.
-----	--

The message panel contains the key information for a list of messages. The messages can be reorded in the message panel by clicking on the fields located on the top strip. The fields are the following:

Fields List

Field	Description
!	Importance
From	Where the message is from. Only shown when Inbox is selected.
To	Where the message is sent. Only shown when Outbox or Sent box is selected.
Message	Displays the first few characters of the message
Received	Time when the message is received
Sent	Time when the message is sent
Callback	Callback number

Menu Bar

The menu bar contains the following items:

Menu	Item	Description
• File	o Exit	Exits the application
• Edit	o Undo	Undo last text editing
	o Cut	Cut the selected text
	o Copy	Copy the selected text
	o Paste	Paste text on clipboard
	o Select All	Select all text in message content panel
• View	o Toolbar	Display tool bar
	o Statusbar	Display Status bar
• Help	o About SMSClient	Display About dialog

Toolbar

The tool bar is accessible across the top and gives user quick access to common tasks. The tool bar contains the following buttons:

Tool Bar Button

Button	Description
New SMS Message	Opens up dialog to create a new SMS message
Delete	Deletes the highlighted message or group of messages.
Reply	Reply to the highlighted message.
Forward	Forward the contents of the highlighted message.

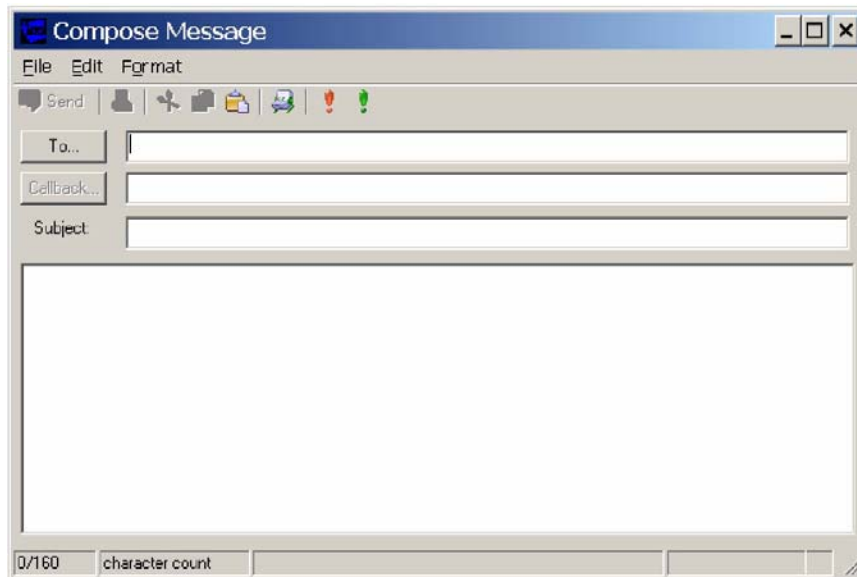
Status Bar

The status bar displays information about each of the mailboxes selected. It will give the number of messages and the number of unread messages. The status bar is located on the bottom strip.

Compose Message Window

Clicking on the New SMS Message button will bring up the following dialog: This window allows the user to enter the destination address, SMS message, a callback number for CDMA, and a subject text. Standard text editing such as cutting, copying, pasting is supported in the message box. In addition, the user can use the tool bar or the menu to set the priority and encoding of the message. Both Unicode and ASCII are supported. Unicode is used to send characters not in the standard ASCII character set.





Figure 46: Compose Message



For the destination address, users can chose to select from the address book by clicking on the To button. Also, multiple destinations can be entered separated by a comma or semicolon.

The toolbar supports the following functions: Clicking on the “To” button or the Addressbook button will bring up the following dialog to select the contact to insert into the destination field. Multiple destination addresses can be selected.

Destination Addresses

Button	Description
Send	Send the SMS message
	Print the SMS message
	Editing functions. Cut, copy, and paste text
	Open the addressbook to select from
!	Emergency priority
!	Urgent priority
	Set Unicode encoding for message

Email Interworking

A new feature added to this version of MobiLink is the ability for email interworking. What this feature does is to allow an email message to be sent over an SMS message. If the user types in an email address in the To field, the application will automatically format the SMS message so that the SMSC on the network side will forward it as an email.

The recipient of this email can simply reply to the message and the message will be forwarded back to the wireless device.

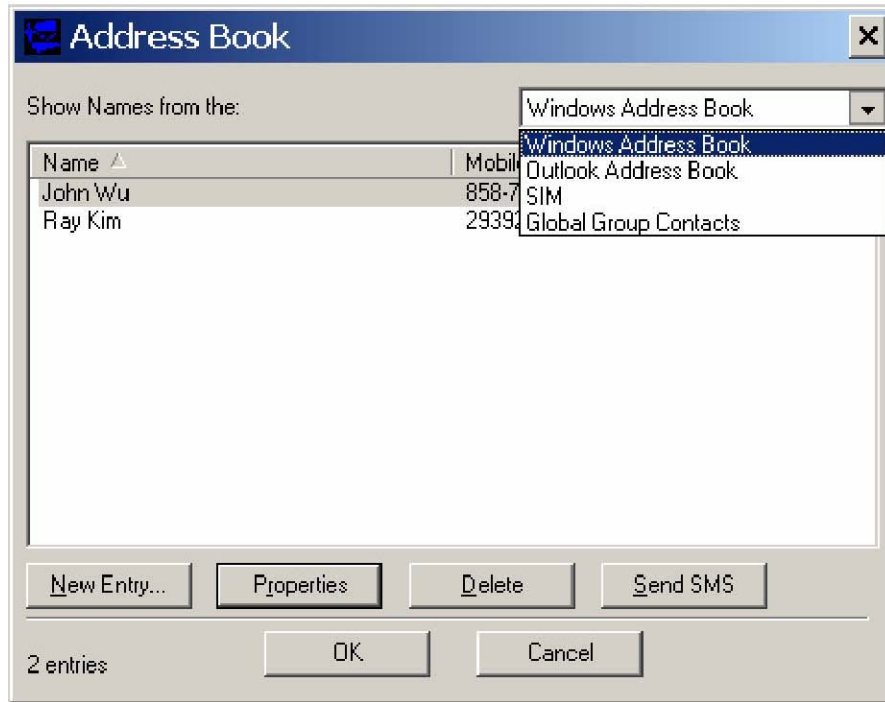
Concatenated SMS

With the addition of email interworking, the ability to send an SMS that is longer than the limited 160 characters is very important. To address that issue, the SMS Client will allow the user to enter a long message and automatically segment the message and send it as separate SMS with a special tag to indicate the messages are segments of a long message.

Addressbook Features

The MobiLink address book allows the management of phone numbers on the SIM, Windows Address Book and Outlook. The following screen shows the address book Client.

Figure 47: Address Book



The address book Client has a selection box that allows the user to chose which address book to view. The following addresses can be selected:

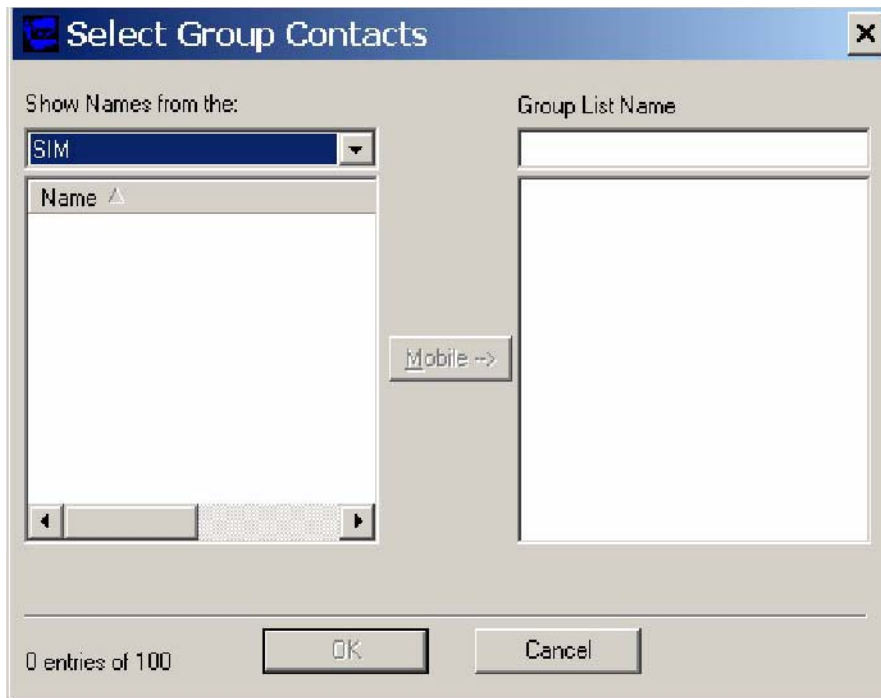
Address Books

Address book	Description
Windows Address Book	This is the native Windows Addressbook that is part of Windows Accessories folder
Outlook Address Book	This is the local Outlook Addressbook. This is only accessible if Outlook is installed on the computer
SIM	This is the address book located on the 3G device or the SIM of the device
Global Group Contact	This is the group contacts that contain distribution lists created by the user. This list can contain contacts from any of the above address books

User can create, delete, and view contact properties as well as send an SMS message using the selected contact by clicking on one of the buttons on the bottom of the Address Book Client.

Global Group Contact

Global Group Contact feature allows users to create distribution lists for sending SMS.

Figure 48: Select Group Contacts

When the user chooses to create a Global Group Contact, a new dialog will be opened up to allow the user to select from the different address books and move them to create a new distribution list. The total number in a distribution list is up to 100. The list can contain a mixture from different address books and can contain both mobile numbers as well as email addresses.



Appendix A - Customer Configuration & ID's

Introduction

This appendix contains introductory guidance on customer configuration of the Novatel Wireless PCI Express Mini-cards

USB ID

The USB ID sets the **USB Vendor ID** and **Product ID** fields (VID-PID) that are reported to the host computer during device enumeration. These ID are configured in the **Customer PRI document**.

HW ID

An AT commands can be used to identify the Hardware Revision of particular PCI Express Mini-cards. This can be useful tracking form, fit and function hardware changes to a mini card.

IMEI Numbers (HSDPA)

IMEI numbers are assigned on a block basis to be associated with specific laptop/handheld platforms. The logistics for the assignment are detailed in the **Customer PRI document** completed with Novatel Wireless.

HSDPA Product Release Instruction (PRI)

The purpose of this section is to provide information on customizable UMTS / HSDPA firmware features. The UMTS/HSDPA FIRMWARE FEATURES are detailed on the next page.

INTRODUCTION

The intended design of firmware for each UMTS/HSDPA product in the portfolio is to maintain a single code base. This means that to provide core features to customers the firmware must be configurable. This section details the configurable features of Novatel Wireless UMTS/HSDPA products including the U630, xU7x0 and xU860/U870.

Common Features

A common feature is a UMTS/HSDPA modem configuration which may be applicable to any customer. Although the feature operates in the same manner for any Novatel Wireless modem, it may not necessarily be implemented on all platforms. Further, the feature may have been introduced in a particular version of firmware

The following sections describe the common features defined for NVTL UMTS/HSDPA modems. The feature descriptions are formatted in the manner shown below.

Name	The engineering name for the feature of interest.
States	The possible configurations for the feature. Defaults, if they apply, are highlighted in BOLD font.
Devices	A list of devices that support the feature.
FW Version	A list of firmware BUILDs that support the feature.
AT Command	A reference to an applicable AT command which can control the feature. Provided for field support personnel.
NV Item	The NV Item that stores the data. Provided for engineering, field engineering and fulfillment personnel.

Network Lock (aka SIM/USIM Lock)

The Network Lock feature allows a service provider to prohibit a modem from connecting to their network unless the modem uses a SIM/USIM (herein referred to as SIM) that is provided by that carrier. Network Lock consists of two locking procedures, Network Code Lock (NCL) and Home Location Register Lock (HLRL). Both NCL and HLRL evaluate fields contained in the SIM to determine if the modem is in a locked or unlock state. The fields of interest are both contained in the International Mobile Subscriber Identity (IMSI). The IMSI is usually fifteen digits long starting with the Mobile Country Code (MCC), followed by the Mobile Network Code (MNC) and suffixed by the unique Mobile Subscriber Identity Number (MSIN) within the network's customer base. The NCL evaluates the MNC/MCC pair while the HLRL evaluates the MSIN and the MNC/MCC pair.

The Network Lock for both NCL and HLRL are performed at power-up. The modem determines if NCL and HLRL are enabled. If NCL is enabled the MNC/MCC pair is extracted from the IMSI then validated against the list of MNC/MCC pairs stored in the modem. If a match is found the modem is unlocked and is able to attach to the network. HLRL allows service providers to limit the roaming area of the user. If HLRL is enabled, the algorithm evaluates MNC/MCC pair, the first three leading digits of the MSIN which contains HLR-value (2 digits) and a National Destination Code (NDC) (1 digit). Similar to the NCL, the three fields are compared against the list programmed into the modem to determine the lock state. In the unlocked state the modem is able to attach to the network.

Network Lock Code

In the NCL mode of Network Lock the modems supports up to 30 MNC/MCC pairs that can be specified.

In the HLRL mode of Network Lock the modem, **ONLY** a single MNC/MCC pair may be specified.

Name	NetworkLockCode
States	Customer to provide MNC/MCC pairs
Devices	U630, xU7x0, xU860/870
FW Version	All
AT Command	AT\$NWNPC
NV Item	NW_NV_NETWORK_LOCK_CODES_I

HLR Range

In the HLRL mode of Network Lock the modem supports up to 4 sets of HLR ranges. For each HLR Range, there is a single digit NDC value, and 0..14 sets of min and max values specifying HLR. For all HLR min-max pairs, the max value must be greater than or equal to the min value.

Name	HLRLockHLRRange
States	Customer to provide HLR Lock Ranges
Devices	xU7x0, xU860/U870

FW Version	All
AT Command	AT\$NWHLR
NV Item	NW_NV_HLR_RANGE_I

Universal Serial Bus Identity (USBID)

The USB ID is the identifier which is presented by the modem to the host operating system during device enumeration. As part of the enumeration process the host associates this value to a device driver. It is possible to provide customer specific drivers with the use of the USB ID.

Name	UsbId
States	Customer to provide PID and VID pairs if customer drivers are utilized.
Devices	xU7x0, xU860/U870
FW Version	All
AT Command	N/A
NV Item	NW_NV_USB_ID_I



Four Com Port Support

The Four Com port feature enables the following ports: modem, status, QXDM and PC/SC port. If EAP-SIM support is required, this feature must be enabled.

Name	FourComPortsEnable
States	Customer to select - Enable, Disable
Devices	xU7x0, xU860/U870
FW Version	xU7x0 – Build 29 and above xU860/U870 – Build 7 and above
AT Command	AT\$NWFOURPORTENABLE
NV Item	NW_NV_FOUR_PORTS_ENABLED_I

HEDGE/WEDGE Selection

The firmware supports the selection of operation according to R99 (WEDGE) and R5 (HEDGE) using this configuration option.

Name	WedgeOnlyEnable
States	Customer to select - WEDGE, HEDGE
Devices	xU7x0, xU860/U870
FW Version	xU7x0 – Build 15.4 and above xU860/U870 - All
AT Command	N/A
NV Item	NV_WCDMA_RRC_VERSION_I

Mini-Card Feature Additions

The following sections detail the features which are **ONLY** applicable to mini-card

Wireless WAN Disable

This feature provides the following functionality: monitor an input which is under laptop control to set the state of the modem between Online Mode (OM) and Low Power Mode (LPM). In the OM state, if the input signals to disable the WAN, the modem will enter LPM and will cease transmitting until the signal is restored and the modem returns to OM. Upon entering LPM from OM, the modem will detach from the network with a “power down” reason code and disable the transmitter. In OM, the modem attaches to the network and can allow PDP context activation.

The functionality above can also be controlled via a software command (\$NWDIS). This allows applications to control the state of the modem so that users can disable the transmitter in situations such as boarding an aircraft.

Name	WwanDisableMonitor
States	Customer to select - Enable , Disable
Devices	xU7x0, xU860/U870
FW Version	All
AT Command	AT\$NWDIS
NV Item	NW_NV_W_DISABLE_MONITOR_I

Wireless WAN LED Function

This feature controls the preset functionality of the LED drivers as described below:

Function 0: the LED is driven HIGH when the unit is disabled from transmitting, and LOW when unit is allowed to transmit.

Function 1: the LED operates as defined by NVTL standard LED behavior.

Name	WwanLedFunction
States	Customer to select – Function 1, Function 2
Devices	xU7x0, xU860/U870
FW Version	All
AT Command	N/A
NV Item	NW_NV_LED_WWAN_FUNCTION_I



Thermal Limits

This feature provides a monitor of the temperature of the mini-card. Presently, the hot and smoking limits provide the same functionality. At temperatures below the high threshold, the modem will operate in its normal mode. If the modem temperature increases past the high temperature limit the modem will be forced to Low Power Mode (LPM) until the modem temperature is reduced below the warm temperature limit at which time, the modem will return to normal operation.

Name	ThermalLimits
States	Customer Defined Limits
Devices	xU7x0, xU860/U870
FW Version	All
AT Command	N/A
NV Item	NW_NV_THERMAL_LIMITS_I

Customer Requested Features

The following sections contain configurable features specified by a carrier and implemented by Novatel Wireless. These items should ONLY be available in a PRI document which is specific to that carrier or customer selling products on the specific carriers identified.

CarrierX

CarrierX has asked for 2 feature developments the first PWI was to support a product launch, namely the Home Zone product and second is a network feature needed to support the sharing of their network with CarrierY.

PWI Service

The PWI subscription allows PWI users to access the internet at home for a special tariff. Voice services are not allowed.

PWI subscribers can only access the CarrierX network. Access to TMD or other foreign networks is barred at the network. PWI subscribers will get a special PWI UICC and a PWI device.

The PWI device is a gateway between UMTS and a local data interface like W-LAN, LAN or Bluetooth, consisting of a Novatel Wireless PCMCIA card, one or more networking interfaces to a e.g. laptop, and a software (as firmware or linux or Windows based) to manage the different modules as well as to support the PWI zoning service.

The PWI UICC shall only be able to work with PWI Devices. The PWI device shall only be able to work with PWI UICCs.

The PWI device accesses only UMTS networks, not GSM. Thus, PWI subscribers can effectively only use the CarrierX UMTS network.

**PWI Zoning Enabled – SIM Applet**

Enabling this feature allows the PWI application to run from a SIM applet provided by CarrierX.

Name	NwPWIZoningAppEnabled
States	Enable, Disable
Devices	U630, xU7x0, xU860/U870
FW Version	All
AT Command	AT\$NWHLR
NV Item	NW_NV_PWI_SIM_APP_ENABLED_I

**PWI Zoning Enabled – Device Applet**

Enabling this feature allows the PWI application to run from the modem and override the SIM applet provided by CarrierX.

Name	NwPWIDeviceAppEnabled
States	Enable, Disable
Devices	U630, xU7x0, xU860/U870
FW Version	All
AT Command	N/A
NV Item	NW_NV_PWI_DEVICE_APP_ENABLED_I