USRobotics
A Division of UNICOM Global

USRobotics® Courier® Modemulator™

User Guide & Technical Documentation

For the following products:

Modemulator & 3G M2M Cellular Gateway

USR3520, USR803520

Modemulator Upgrade Kit

USR3516-EMU

R24.0800.02
Rev 1.1 7/1/2016
For firmware version 1.0.03

Contents

About This Guide

This Modemulator User Guide contains operating instructions for the USRobotics Courier Modemulator. It describes the characteristics of the Modemulator when operating in Modemulator mode. For guidance on the Modemulator operating in Gateway mode, refer to the USR3520/USR803520 Gateway User Guide.

Chapter 1 summarizes some of the key features of the Modemulator, and presents its external interfaces.

Chapter 2 explains how to verify that the Modemulator is operational and how to test the cellular connectivity before installing the Modemulator into specific deployments.

Chapter 3 shows the intended applications of the Modemulator, and describes its operation in those applications.

Chapter 4 is a detailed listing of the Modemulator command set with examples of command usage.

Chapter 5 lists Modemulator technical specifications.

Symbols Used In This User Guide

This symbol invites the User to read more technical details.

This symbol identifies helpful User information.

This symbol warns the User to stop, read, and understand critical information.

This symbol denotes supplemental information.

Important Safety Instructions

Please read the following guidelines carefully. Not following these guidelines can cause harm to the gateway, yourself or other persons.

RF EXPOSURE WARNING

A minimum distance of 20cm must be maintained between the user's body and the device antennas.

General Recommendations For Use

- do not open your product when powered.
- do not expose to liquid, moisture or humidity.
- do not drop, throw or try to bend your product.
- do not paint your product.
- do not touch the antenna unnecessarily.

Ambient Temperatures

Do not operate your product at ambient temperatures beyond the range of -30 and +70 degrees Celsius (exception: PoE functionality is limited to 45°C when using more than 30W). When using an AC adapter make sure that the ambient temperature doesn't exceed the specified temperature limits of the AC adapter.

In restricted areas, such as dedicated equipment rooms or electrical closets, where the temperature can exceed 65°C, the temperature of the surface might reach high values and therefore under these conditions the products need to be protected against accidental contact. We recommend that operators who plan to use this product at these high temperatures stick a warning sticker, in accordance with IEC 60417-5041 (DB:2002-10), on a visible part of the device, or attach a sticker with the following text:

WARNING

HOT SURFACE
DO NOT TOUCH

Explosive Atmosphere

Turn off your device in any area with a potentially explosive atmosphere. It is rare, but your device could generate sparks, which could cause an explosion or fire. Areas with a potentially explosive atmosphere are

not always clearly marked. They include fueling areas (petrol filling stations), below deck on boats, fuel or chemical transfer or storage facilities and areas where the air contains chemicals or particles, such as grain, dust, or metal powders. Do not transport or store your product in the compartment of a vehicle which contains flammable gas, liquid or explosives.

Blasting Areas – Construction Sites

Turn off your product when in a blasting area in order to avoid interfering with two-way radios used in blasting operations.

Do Not Use On Aircraft

Using wireless devices on aircraft can cause interference. Do not use it when the plane is on the ground without permission from the aircraft crew.

Driving

Do not operate your device while driving. Park the vehicle first.

Medical Equipment

Do not use near medical equipment, especially life support equipment that might be susceptible to radio interference.

ESD Notice

Electrostatic Discharge (ESD) is caused by a buildup of static electricity and can happen when making contact with a product. To limit the likelihood of Electrostatic Discharge, it is recommended to:

- avoid conditions that result in high static electricity (carpet, cool and dry air,…);
- avoid touching any connectors when handling the unit; only touch the casing if possible;
- ground yourself prior to handling by touching a large metal object.

In case the product encounters loss of performance after an Electrostatic Discharge, please reset the device in order to restore it to normal functionality.

Class A Device

This is a Class A product. In a domestic environment this product may cause radio interference in which case the User may be required to take adequate measures. The operation of the gateway is restricted for use in a commercial, industrial or business environment.

Chapter 1: Features

Introduction

The USRobotics Courier Modemulator allows a legacy M2M system to be conveniently converted to cellular without upgrading or replacing application software. The Modemulator accepts and responds to analog modem commands and sends result codes that mimic a PSTN connection, which allows drop-in compatibility with legacy application software.

Overview of Main Features

The following features and capabilities assure an easy transition from dial-up to cellular M2M.

Cellular Gateway Engine

The Modemulator is embedded into a full-featured cellular gateway, and connects to cellular networks using the gateway resources.

Operating Modes

The Modemulator operates in two distinct modes, which are selected by a MODE switch on the front of the device.

- Modemulator mode
- Gateway mode

Modemulator Mode

In Modemulator mode, the Modemulator's command line user interface emulates the behavior of a serial dial-up modem connecting over the PSTN.

- Modem AT command set
- Originate or answer calls
- PSTN response codes
- Translate up to 7200 phone numbers into IP addresses

Cellular Gateway Mode

When in cellular gateway mode, the Modemulator configures the base unit to operate as a full-featured cellular gateway. Some of the key gateway features are:

- Interoperability with most cellular networks
- GPS receiver
- One 10/100 Mbps RJ45 Ethernet port
- One DB9 RS-232 DCE serial port
- IPsec VPN
- Firewall
- Graphical User Interface

Automatic Switchover to Dial-up

To facilitate the gradual conversion of legacy systems to cellular or a permanently mixed system, the Modemulator can initiate and answer connections over the PSTN to sites with a dial-up modem by automatically diverting commands to a dial-up modem attached to its Modem serial port. This provides the User a single interface and protocol for connecting with both cellular and dial-up sites.

Dial Security

The Modemulator provides three forms of dial security for your connections, similar to those of a dial-up modem.

Programmable Login & Security Banners

The Modemulator can display a programmable login banner if Password Prompting is enabled, and display a programmable warning banner to alert unauthorized Users, similar to those of a dial-up modem.

HELP Screens

The Modemulator displays screens that summarize the AT command set, Dial command options, and S-register functions, similar to those of a dial-up modem.

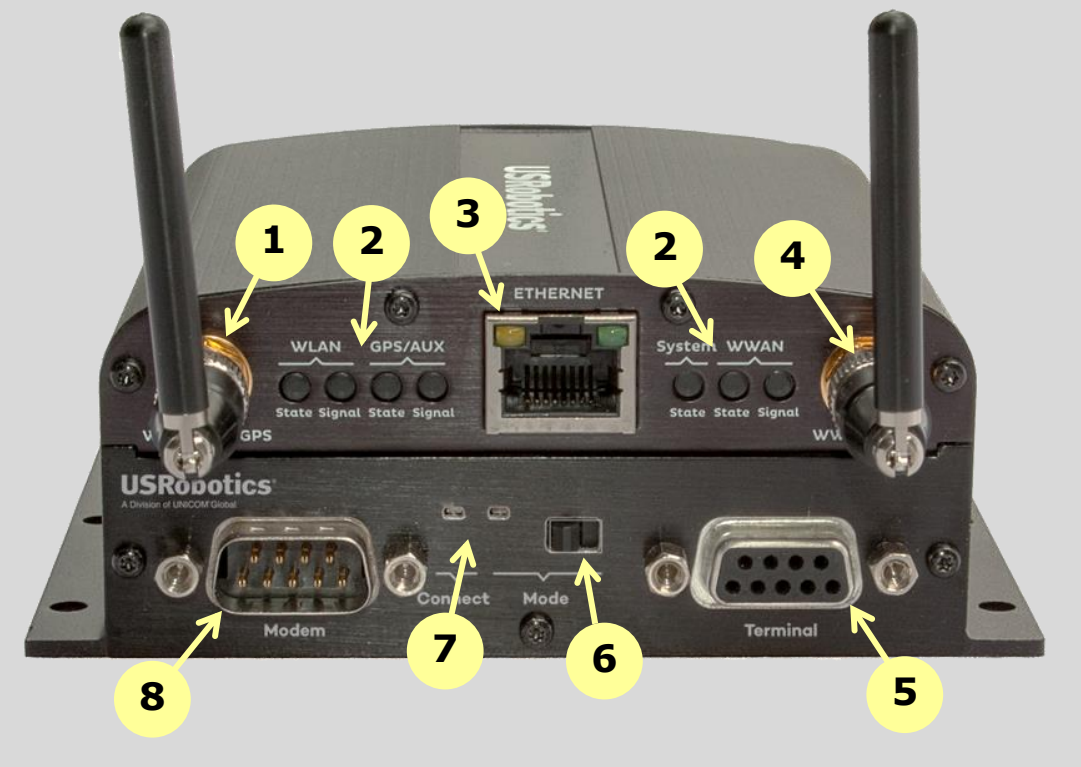
Remote Access

The Modemulator settings can be configured remotely as well as locally, similarly to a dial-up modem.

Firmware Upgrades

The Modemulator firmware is upgradable locally or remotely, allowing easy access to the latest Modemulator features and functions.

Physical Features



1. **WWAN Diversity Antenna Connector** - SMA-female antenna port for connection to a diversity antenna or a GPS antenna. See the USR3520/USR803520 Gateway User Guide for details.

2. **Gateway LEDs** – The seven Gateway LEDs indicate the operating status of the Gateway base unit. See the USR3520/USR803520 Gateway User Guide for details.

3. **Ethernet Port** – 10/100 Mbps RJ-45. See the USR3520/USR803520 Gateway User Guide for details.

4. **WWAN Main Antenna Connector -** SMA-female antenna port for connection to a cellular antenna. See the USR3520/USR803520 Gateway User Guide for details.

5. **Terminal Serial Port -** The terminal serial port provides an RS-232 asynchronous serial DCE connection via a DB9-F connector. See Appendix J for pinout details. Use an appropriate serial cable to connect this port to the DTE serial port of a terminal that will send modem AT commands to the Modemulator. In gateway mode, this port is configured and activated by the Plugin tab of the gateway's graphical user interface.

6. **Mode Switch –** This switch selects the operating mode. See Table 1 below for details.

7. **Modemulator LEDs -** These LEDs indicate the Modemulator operating mode and connection status. See Table 1 for details.

		CONNECT LED	MODE LED	Switch Position
Modemulator mode	**Connected**	Green	Green	←
	Connection pending (Originate or Answer)	Blinking	Green	←
	Ready	Off	Green	←
	Busy	Red	Green	←
Gateway mode		Off	Red	→
Power OFF		Off	Off	N/A

Table 1

8. **Modem Serial Port -** The modem serial port provides an RS-232 asynchronous serial DTE connection via a DB9-M connector. See Appendix J for pinout details. Use an appropriate serial cable to connect this port to the DCE serial port of a dial-up modem to enable the Modemulator to manage PSTN connections to or from remote dial-up modems. In gateway mode, this port is inactive.

9. **External Power Supply Input –** This input receives operating power from the external low voltage power supply that is included with the base unit. Connect the included power supply to this connector. See the USR3520/USR803520 Gateway User Guide for details.

10. **Reset Button -** Press and hold for less than five seconds to reset the unit to the last working settings. Press and hold for five seconds or more to reset the unit to factory settings. See the USR3520/USR803520 Gateway User Guide for details.

Mounting Instructions

The gateway can be mounted on a wall or DIN rail. See the USR3520/USR803520 Gateway User Guide for details.

Chapter 2: Getting Started

This chapter describes:

- Verifying Modemulator Operation
- Testing Modemulator Connectivity

For detailed configuration and advanced operating features see the Modemulator Command Reference section in this guide, and see the USR3520/USR803520 Gateway User Guide.

Verifying Modemulator Operation

Because Modemulators make a peer-to-peer connection to another Modemulator, it is required to perform this set-up procedure on two Modemulators.

For the USR3520/USR803520, please proceed directly to step 1.

For the USR3516-EMU upgrade kit, first follow the instructions in the USR3516-EMU Installation Guide to upgrade a USR3510/USR803510 Gateway to a USR3520/USR803520.

1. Check system requirements:
   - Computer with an DB9 RS-232 serial port
   - Terminal emulation application that communicates with a COM port

If the computer does not have a serial port, use a USB-to-serial cable that is compatible with the computer's operating system.

2. Connect a computer to the Modemulator.

   Use a DB9-to-DB9 serial cable to connect the computer's serial port to the Modemulator Terminal port.

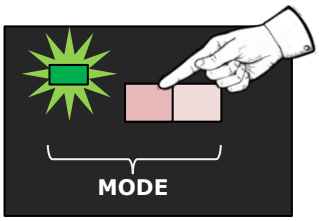
Serial cables are widely available from electronics distributors and retailers.

3. Connect the included power supply unit (PSU) to the base unit.

   Use the included PSU to power the base unit. Connect the PSU output jack to the power supply input, and then plug the PSU into a mains power outlet.

The Modemulator will take about two minutes to become operational.

4. Put the Modemulator into Modemulator mode by moving the MODE switch to the *left* if not already there.



   The MODE LED will be green when the Modemulator is switched into Modemulator mode.

5. Open a Terminal Emulation Application.

   Open a terminal emulation window on the computer and select the COM port corresponding to the computer's serial port (usually COM1). Set the port parameters for 9600bps, 8 data bits, no parity, 1 stop bit.

Refer to the terminal emulation application documentation for details on setting parameters. It is recommended to set the application's font for Courier, Courier New, or another fixed character width font to properly display the Modemulator screens.

6. Confirm communication with the Modemulator.

   In the terminal emulation window, type **AT<Enter>**. The Modemulator should respond *OK*.

Type **ATI7<Enter>**. The Modemulator should display the I7 information screen, as shown in Figure 1. Actual parameter values may vary from Figure 1.

```
ati7
USRobotics Courier EMU Configuration Profile...

Product type      Modemulator
Product ID        USR3516-EMU
Code Date         07/14/16
Code Rev          1.0.03
Modemulator S/N   1MENB2AP0001
Cellular S/N      MB19D8K0LH
IMEI/MEID         356144040623593
IMSI              310410564600725
F/W Version       m2m-1.46.0.2
S/W Version       "USRobotics_V1.0.38"
Date/Time         2016-05-26/16:38:10
Internet State    connected
WWAN Reg State    registered
Operator          AT&T
Carrier IP Addr   10.17.93.73
Signal Strength   -74
ECIO              -12
APN               a105.2way.net

OK
```

Figure 1

The Modemulator is now operational and ready to connect to the cellular network.

If the Modemulator does not respond to AT commands, remove power from the base unit and check the Troubleshooting section.

Testing Modemulator Connectivity

Because Modemulators make a peer-to-peer connection to another Modemulator, it is required to perform this set-up procedure on two Modemulators.

System requirements

- A computer with
  - *two* DB9 RS-232 serial ports
  - An Ethernet port
- Terminal emulation application that communicates with COM ports
- Web browser application

Or

- Two computers, each with
  - *one* DB9 RS-232 serial port
  - An Ethernet port
- Terminal emulation application that communicates with COM ports
- Web browser application

If the computer does not have a serial port, use a USB-to-serial cable that is compatible with the computer's operating system.

Set Up Cellular Connectivity

1. Attach both of the included antennas to the antenna connectors on the front of the Modemulator.
2. Make sure that a cellular service plan is associated with the device (for CDMA networks) or with a SIM card (for GSM networks).

Modemulator functionality requires a cellular service plan that has device-to-device IP routing. This type is service is generally not available directly from Mobile Network Operators, so contact a Mobile Virtual Network Operator (MVNO) to obtain a suitable service plan. See Appendix K for details. Contact a USRobotics Sales representative for advice on finding a suitable service plan.

Preparing for GSM Networks

1. Remove power from the Modemulator.
2. Install the SIM (for GSM networks):
   a. Remove the four Torx T6 screws from the top cover plate on the back of the unit and remove the plate.

The MVNO will provide a document listing the peer-to-peer static IP address assigned to this SIM. Make note of this IP address for later use.

b. Insert the SIM into the SIM slot as shown in Figure 2.

Figure 2

c. Replace the top cover plate and its four TorxT6 screws.

Preparing for CDMA Networks

Devices connecting to a CDMA network do not require a SIM. After the MVNO has provisioned the data service, the Modemulator will automatically activate itself onto the CDMA network.

The MVNO will provide a document listing the peer-to-peer static IP address assigned to this device. Make note of this IP address for later use.

Connecting to the Cellular Network

1. Power up the Modemulator by plugging the provided power supply into the connector on the back of the device.

Helpful Information

The Modemulator will take about two minutes to become operational.

The Modemulator card uses the gateway resources for cellular connectivity. So the gateway must be setup for cellular connectivity before using Modemulator functionality.

2. Use an Ethernet cable to connect the gateway's Ethernet port to and a computer Ethernet port.
3. Open a web browser on the computer and enter the address **192.168.1.1** into the address bar. Enter the default username (**admin**) and password (**admin**). After a successful login, the Home screen will appear.

WARNING!

LAN to WAN routing is enabled by default. Once connected, any Internet activity on your system will consume Cellular Data. For configuration and more information go to Appendix B

4. Click on the "Interfaces" tab on the top menu bar and select 3G connection.
5. In the "General" section, select the radio firmware for the wireless service provider that you are using. Click "Save changes".
6. Verify/Update the gateway APN to match the network APN provided by the MVNO.

   For GSM wireless service:

   - The network settings will populate automatically for many SIM cards. Check the settings of the APN, Username, Password, and International Roaming. Update if necessary.
   - Click "Save changes".

   For CDMA service:

   - For both Verizon Wireless and Sprint services the activation will occur automatically.
   - Click on the "Home" tab on the top menu bar.
   - Connection to the network will be setup automatically.
7. Disconnect the Ethernet cable.

Configure Modemulator Dialing Directory

The Modemulator makes a peer-to-peer connection to another Modemulator, which emulates a dial-up modem connecting to another dial-up modem. In both cases, the calling device has to know the "number" of the answering device.

For an M2M system based on dial-up modems and PSTN networks, the telephone service provider assigns a phone number to the destination, and the User (or software application) commands the calling modem to dial the phone number of the destination modem.

For an M2M system based on Modemulators and cellular networks, the MVNO that provides the cellular data service will assign a static IP address to each device (CDMA) or SIM (GSM) on the account. That IP address is the "number" that the calling device must know.

In order for the Modemulator to be a drop-in replacement for dial-up modems, it has to accept a command to dial a PSTN phone number, but translate that number into the IP address of the destination Modemulator. That translation is done by the Modemulator dialing directory.

For this example, one Modemulator will be referred to as the "**local**" Modemulator, and the other will be referred to as the "**remote**" Modemulator.

In this example, the **local** Modemulator's dialing directory will be programmed to recognize the example phone number 555-1234 and translate it into the IP address of the **remote** Modemulator.

Conversely, the **remote** Modemulator's dialing directory will be programmed to recognize the example phone number 555-5678 and translate it into the IP address of the **local** Modemulator.

Set-Up the Local Modemulator Dialing Directory

1. Power up the **local** Modemulator by plugging the provided power supply into the connector on the back of the device, and then plug the PSU into a mains power outlet.

The Modemulator will take about two minutes to become operational.

2. Connect the **local** Modemulator Terminal port to a computer serial port. In the terminal application, set this COM port for 9600bps, 8N1.

3. Consult the MVNO documentation for the static IP address assigned to the **remote** Modemulator for CDMA networks or assigned to the SIM installed in **remote** Modemulator for GSM networks.

4. Enter the example phone number, port number (Modemulator listens to port 8888 by default), and IP address (assigned by the MVNO) of the **remote** Modemulator into the **local** Modemulator's dialing directory by typing the following command into the **local** Modemulator, *substituting the static IP address* assigned by the MVNO for the **remote** Modemulator:

   AT{Y=5551234:8888:xxx.xxx.xxx.xxx <Enter>

   phone number — port number — IP address

   Modemulator should respond *OK.*

5. Type the following command to set the **local** Modemulator to auto-answer on one ring:

   ATS0=1 <Enter>

   Modemulator should respond *OK.*

6. Keep the **local** Modemulator powered-up and connected to the computer serial port.

Set-Up the Remote Modemulator Dialing Directory

1. Power up the **remote** Modemulator by plugging the provided power supply into the connector on the back of the device, and then plug the PSU into a mains power outlet.

The Modemulator will take about two minutes to become operational.

2. Connect the **remote** Modemulator Terminal port to another computer serial port. In the terminal application, set this COM port for 9600bps, 8N1.

3. Consult the MVNO documentation for the static IP address assigned to the **local** Modemulator for CDMA networks or assigned to the SIM installed in **local** Modemulator for GSM networks.

4. Enter the example phone number, port number (Modemulator listens to port 8888 by default), and IP address (assigned by the MVNO) of the **local** Modemulator into the **remote** Modemulator's dialing directory by typing the following command into the **remote** Modemulator, *substituting the static IP address* assigned by the MVNO for the **local** Modemulator:

   AT{Y=5555678:8888:xxx.xxx.xxx.xxx <Enter>

   phone number — port number — IP address

   Modemulator should respond *OK.*

5. Type the following command to set the **remote** Modemulator to auto-answer on one ring:

   ATS0=1 <Enter>

   Modemulator should respond *OK.*

6. Keep the **remote** Modemulator powered-up and connected to the computer serial port.

Making a Connection

With connectivity and dialing directories now set-up, follow the steps below to make a Modemulator test connection.

1. Type the following command to the **local** Modemulator to initiate a connection to the **remote** Modemulator:

   ATD5551234 <Enter>

   The **local** Modemulator will take a few moments to make a connection to the **remote** Modemulator.

   - The **local** Modemulator should first report *RINGING*, then *CONNECT 9600.*
   - The **remote** Modemulator should first report *RING*, then *CONNECT 9600.*

2. Test the data transfer:

   - Type characters into the **local** terminal. A few moments later the characters should appear on the **remote** terminal.

- Type characters into the **remote** terminal. A few moments later the characters should appear on the **local** terminal.

3. Drop the connection by using one of these two methods:

   - Type the escape sequence **+++** into the **local** terminal to drop the connection. The **local** Modemulator should then respond *NO CARRIER*.
   - Using the **local** terminal capabilities, de-assert the RS-232 DTR signal to drop the connection. The **local** Modemulator should respond *NO CARRIER*. Then re-assert DTR to allow further communication.

The Modemulators are now operational and ready to install.

Chapter 3: Applications

This chapter summarizes how to:

- Convert a legacy dial-up M2M system to cellular
- Maintain compatibility with dial-up modems

For detailed configuration and advanced operating features see the Modemulator Command Reference section in this guide, and see the USR3520/USR803520 Gateway User Guide.

Convert A Legacy Dial-up M2M System To Cellular

Properly configured Modemulators are drop-in cellular replacements for dial-up PSTN modems, which extends the useful life of legacy M2M software and hardware, while providing the benefits of a transition from the PSTN to the cellular network.

Modemulators normally operate in a peer-to-peer fashion, with a Modemulator on both ends of a connection. Alternatively, the Modemulator can operate in single-ended mode for a system that has **remote** Modemulators connecting directly with a TCP/IP server. Both types of systems are described below.

Peer-to-Peer Operation

First, follow the Getting Started chapter in this guide to verify that two Modemulators are operating properly.

System Architecture

A legacy M2M **host** site (Headquarters, Operations Center, etc.) is the source of data being transferred to all of the **remote** sites, or is the destination of data being transferred from all of the **remote** sites. This **host** site has application hardware and software that normally interfaces with a serial dial-up modem used to transfer the data.

The legacy M2M **remote** sites are the sources of data being transferred to a **host** site, or are the destinations of data being transferred from a **host** site. Each **remote** site has application hardware and software that normally interfaces with a serial dial-up modem used to transfer the data.

The Terminal port of the Modemulator at the **host** site connects to a serial port of the **host** application hardware that would normally connect to a serial dial-up modem, and the Terminal port of the Modemulator at each **remote** site connects to a serial port of the **remote** application hardware that would normally connect to a serial dial-up modem.

An RF survey of the host and remote sites may be necessary to determine if the installations are in range of cellular reception from the operator chosen to provide service. Consult a professional cellular installer for assistance.

Set-Up the Host Modemulator

The Modemulator defaults to peer-to-peer mode, which allows the **host** Modemulator to initiate a connection to any **remote** Modemulator or any **remote** Modemulator to initiate a connection to the **host** Modemulator.

The Modemulator that interfaces to the **host** application software must be configured as required by the software with the same settings as a dial-up modem. The application software may automatically send initialization commands to the modem, or may require the modem to be pre-configured. Consult the application software User Guide for any requirements for pre-configuring the attached modem.

If the application software User Guide is not available, modem configuration settings can normally be read directly from the dial-up modem. See the modem User Guide for details. Those settings can then be referenced when pre-configuring the Modemulator.

Choose an arbitrary phone number for each **remote** Modemulator. For drop-in compatibility with the **host** software, use the phone numbers that the **host** software is already programmed to dial. Program the **host** Modemulator's dialing directory with the static IP address of each **remote** Modemulator and the corresponding phone number.

Disconnect the dial-up modem from the application hardware serial port, and connect the Modemulator to the application hardware serial port. The application hardware will now use the Modemulator for all communications.

Set-Up Each Remote Modemulator

The Modemulator defaults to peer-to-peer mode, which allows the **host** Modemulator to initiate a connection to any **remote** Modemulator or any **remote** Modemulator to initiate a connection to the **host** Modemulator.

The Modemulator that interfaces to the **remote** application software must be configured as required by the software with the same settings as a dial-up modem. The application software may automatically send initialization commands to the modem, or may require the modem to be pre-configured. Consult the application software User Guide for any requirements for configuring the attached modem.

If the application software User Guide is not available, modem configuration settings can be read directly from the dial-up modem. See the modem User Guide for details. Those settings can then be referenced when pre-configuring the Modemulator.

Choose an arbitrary phone number for the **host** Modemulator. For drop-in compatibility with the **remote** software, use the phone number that the **remote** software is already programmed to dial. Program each **remote** Modemulator's dialing directory with the static IP address of the **host** Modemulator and the corresponding phone number.

Disconnect the dial-up modem from the application hardware serial port, and connect the Modemulator to the application hardware serial port. The application hardware will now use the Modemulator for all communications.

Outgoing Calls

In a peer-to-peer system the **host** Modemulator or any **remote** Modemulator may initiate a connection.

To initiate a connection from an **originating** Modemulator to an **answering** Modemulator, a dial command is sent by the legacy software to the **originating** Modemulator. The **originating** Modemulator will search its dialing directory for an entry containing the phone number from that dial command.

- If an entry for that phone number is found in the dialing directory, the **originating** Modemulator will open an IP connection to the IP address of the **answering** Modemulator. The **originating** Modemulator and the **answering** Modemulator will then send call-progress messages to the legacy application software that mimic those of a dial-up modem. If the **answering** Modemulator is configured to auto-answer or if the application software issues an answer command, the connection will complete, which emulates the behavior of dial-up modems.
- If the **answering** Modemulator does not auto-answer or manually answer, the connection will time-out, which emulates the behavior of dial-up modems.
- The **originating** Modemulator will report *NO DIALTONE* or *BUSY* or *NO CARRIER* if the **answering** Modemulator already has a connection in-progress with another Modemulator.
- The **originating** Modemulator will report *NOT FOUND* if an entry for that phone number is not found in the dialing directory, and a dial-up modem is not attached or not available. See Maintain Compatibility With Dial-up Modems for information about attaching a dial-up modem to a Modemulator.
- If an entry for that phone number is not found in the dialing directory, and a dial-up modem is attached and available, the **originating** Modemulator will forward the dial command to the attached dial-up modem which will dial the number via the PSTN. See Maintain Compatibility With Dial-up Modems for information about attaching a dial-up modem to a Modemulator.

The legacy software sends the same type of command to initiate both cellular and analog connections, and receives the same type of responses. This makes the type of connection indistinguishable and transparent to the legacy software.

Incoming Calls

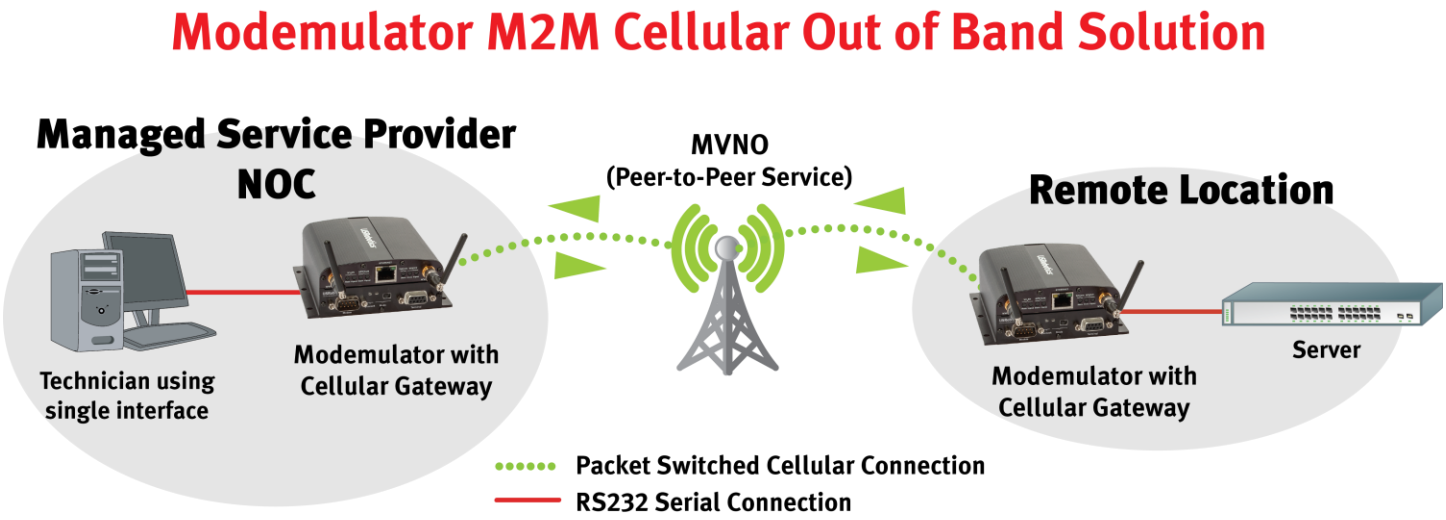
In a peer-to-peer system the **host** Modemulator or any **remote** Modemulator may answer a connection. Incoming cellular calls will route through the **answering** Modemulator's Terminal port to the legacy application software when a connection completes.

- If the **answering** Modemulator does not have a cellular connection already in-progress with another Modemulator, the **answering** Modemulator will accept the IP connection from the **originating** Modemulator. The **originating** Modemulator and the **answering** Modemulator will

then send call-progress messages to the legacy application software that mimic those of a dial-up modem. If the **answering** Modemulator is configured to auto-answer or if the application software issues an answer command, the connection will complete, which emulates the behavior of dial-up modems.

- If the **answering** Modemulator does not auto-answer or manually answer, the connection will time-out, which emulates the behavior of dial-up modems.
- If the **answering** Modemulator has a cellular connection already in-progress with another Modemulator, the current connection will not be interrupted and the **originating** Modemulator will report *NO DIALTONE* or *BUSY* or *NO CARRIER*.

The following diagram illustrates a simplified peer-to-peer legacy system using two Modemulators and peer-to-peer cellular service.



Single-Ended Operation

First, follow the Getting Started chapter in this guide to verify that one Modemulator is operating properly.

System Architecture

A legacy M2M **host** site (Headquarters, Operations Center, Transaction Processor) is the destination of data being transferred from all of the **remote** sites. This **host** site has application hardware and software that interfaces with the Internet to accept an IP connection and transfer the data.

The legacy M2M **remote** sites are the sources of data being transferred to the **host** site. Each **remote** site has application hardware and software that normally interfaces with a serial dial-up modem used to transfer the data.

Modemulators can replace the dial-up modems at all or some of the **remote** sites. The Terminal port of the Modemulator at each **remote** site connects to a serial port of the **remote** application hardware that would normally connect to a serial dial-up modem.

An RF survey of the remote sites may be necessary to determine if the installations are in range of cellular reception from the operator chosen to provide service. Consult a professional cellular installer for assistance.

Set-Up Each Remote Modemulator

The Modemulator defaults to peer-to-peer mode, but for a single-ended system it must be configured for single-ended operation. Single-ended operation is enabled by issuing the {M1 command. See the Command Reference chapter of this document for details.

The Modemulator that interfaces to the **remote** application software must be configured as required by the software with the same settings as a dial-up modem. The application software may automatically send initialization commands to the modem, or may require the modem to be pre-configured. Consult the application software User Guide for any requirements for configuring the attached modem.

If the application software User Guide is not available, modem configuration settings can be read directly from the dial-up modem. See the modem User Guide for details. Those settings can then be referenced when pre-configuring the Modemulator.

Choose an arbitrary phone number for the **host** server. For drop-in compatibility with the **remote** software, use the phone number that the **remote** software is already programmed to dial. Program each **remote** Modemulator's dialing directory with the IP address of the **host** server and the corresponding phone number.

Disconnect the dial-up modem from the application hardware serial port, and connect the Modemulator to the application hardware serial port. The application hardware will now use the Modemulator for all communications.

Modemulator Outgoing Calls

In a single-ended system the **host** is a TCP/IP server, and any **remote** Modemulator may initiate a connection.

To initiate a connection from a **remote** Modemulator to the **host**, a dial command is sent by the legacy software to the **remote** Modemulator. The **remote** Modemulator will search its dialing directory for an entry containing the phone number from that dial command.

- If an entry for that phone number is found in the dialing directory, the **remote** Modemulator will open an IP connection to the IP address of the **host**. The **remote** Modemulator will then send call-progress messages to the legacy application software that mimic those of a dial-up modem. If the **host** accepts the IP session, the connection will complete, which emulates the behavior of dial-up modems.
- If the **host** does not accept the IP session, the connection will time-out, which emulates the behavior of dial-up modems.

- The **remote** Modemulator will report *NOT FOUND* if an entry for that phone number is not found in the dialing directory, and a dial-up modem is not attached or not available. See Maintain Compatibility With Dial-up Modems for information about attaching a dial-up modem to a Modemulator.

- If an entry for that phone number is not found in the dialing directory, and a dial-up modem is attached and available, the **remote** Modemulator will forward the dial command to the attached dial-up modem which will dial the number via the PSTN. See Maintain Compatibility With Dial-up Modems for information about attaching a dial-up modem to a Modemulator.

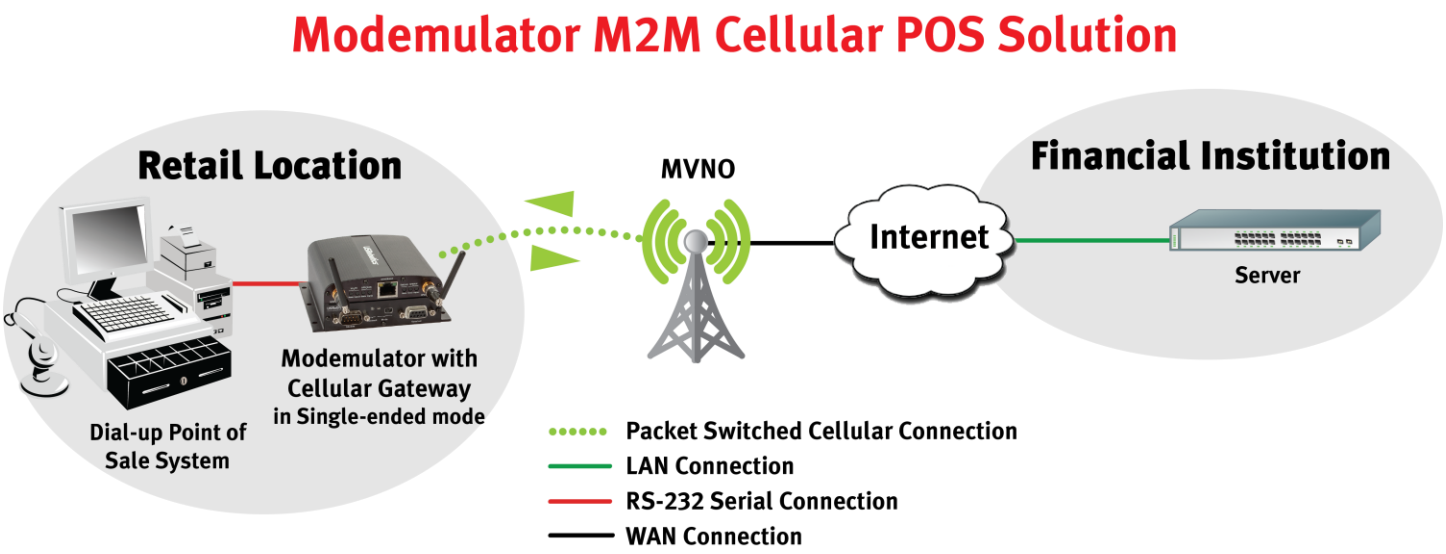
The legacy software sends the same type of command to initiate the cellular connection as it does for an analog connection, and receives the same type of responses. This makes the cellular connection indistinguishable from an analog connection to the legacy software.

Modemulator Incoming Calls

In a single-ended system that uses conventional cellular service, the **host** will be unable to initiate a connection to the **remote** Modemulators because of constraints in the cellular network, unless a VPN tunnel or public static IP address is used.

- The cellular service provider normally assigns dynamic IP addresses to the cellular devices, which prevents the **host** from knowing the current IP address of the **remote** Modemulators.
- The cellular service provider may have a firewall preventing any **host** from contacting the IP address of any cellular devices.

The following diagram illustrates a simplified single-ended legacy system using one Modemulator and conventional client/server cellular service.



Maintain Compatibility with Dial-up Modems

The **host** Modemulator of a peer-to-peer system can utilize an attached serial dial-up modem for connections with **remote** dial-up modems via the PSTN. This section describes a system that has a mixture of **remote** Modemulators and **remote** dial-up modems.

A mixed cellular / dial-up system requires:

- Cellular peer-to-peer service for the **host** Modemulator and **remote** Modemulators
- PSTN service at the **host** site and at all **remote dial-up** sites
- A serial dial-up modem attached to the **host** Modemulator at the **host** site
- A dial-up modem attached to the **remote** application hardware at each **remote dial-up** site

Follow the set-up for peer-to-peer operation to program the **host** Modemulators dialing directory with IP addresses for the **remote** Modemulators.

Do not enter the PSTN phone number of any **remote dial-up** site into the **host** Modemulators dialing directory.

The **host** Modemulator can initiate or answer PSTN connections by using an attached serial dial-up modem. Also, any configuration commands sent to the Modemulator are processed by both the Modemulator and by the attached modem. In that way, modem initialization strings sent by legacy software will apply to both the Modemulator and the dial-up modem.

Outgoing PSTN Calls

For a PSTN connection to be initiated, a dial command is sent to the **host** Modemulator by the legacy software. The **host** Modemulator will search its dialing directory for an entry containing the phone number in the dial command.

- If no entry is found for that phone number, the dial command will be forwarded to the attached dial-up modem which will dial that phone number via the PSTN, allowing the legacy software to contact any **remote** dial-up site.
- The **host** Modemulator will report *NOT FOUND* if a PSTN phone number is dialed and a dial-up modem is not attached or not available based on the RS232 CTS signal.

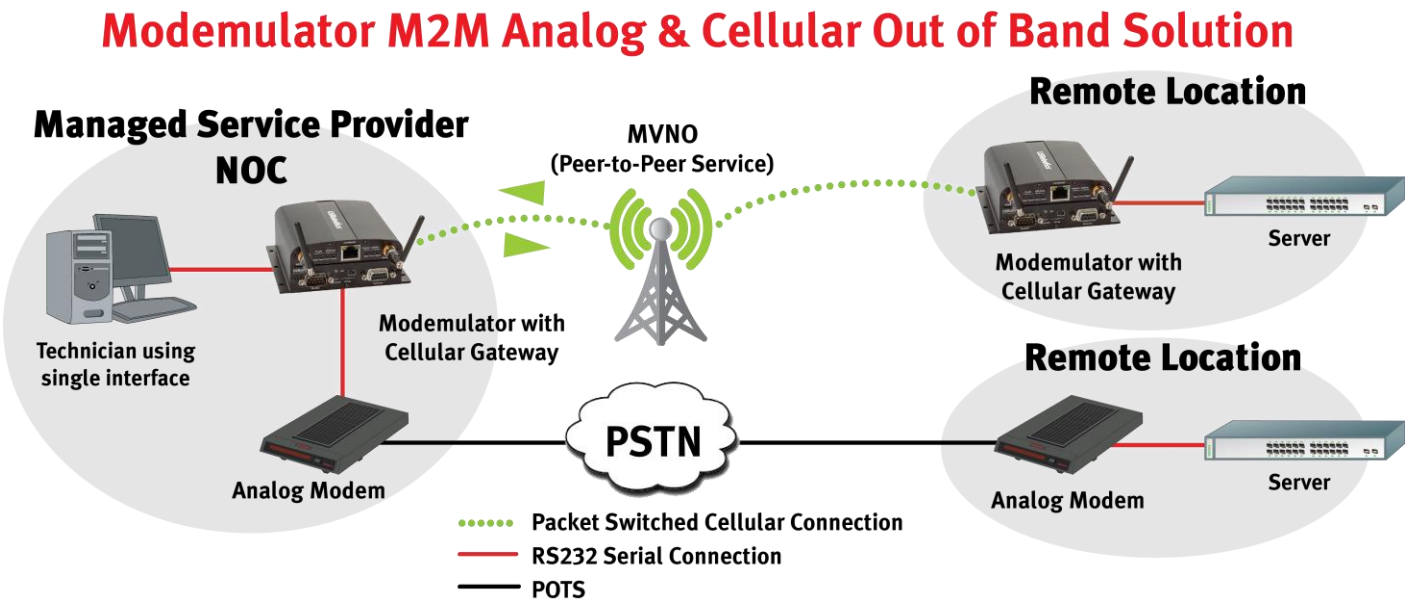
The legacy software sends the same type of dial command to initiate either cellular or PSTN connections, and receives the same type of responses. This makes the type of connection indistinguishable and transparent to the legacy software.

Incoming Calls

Incoming PSTN calls or incoming cellular calls will route through the **host** Modemulator's Terminal port to the legacy application software when a connection completes.

- If the **host** Modemulator has a cellular connection already in-progress with a **remote** Modemulator, the **host** Modemulator will de-assert the RS-232 DTR signal to the attached dial-up modem to prevent the attached dial-up modem from answering an incoming PSTN call.
- If the **host** Modemulator has a PSTN connection already in-progress with a **remote** dial-up modem and a **remote** Modemulator attempts to contact the **host** Modemulator, the **remote** Modemulator will report *NO DIALTONE*.
- If the **host** Modemulator has a cellular connection already in-progress with a **remote** Modemulator, and another **remote** Modemulator attempts to contact the **host** Modemulator, the **remote** Modemulator will report *NO DIALTONE* or *BUSY* or *NO CARRIER*.

The following diagram illustrates a simplified peer-to-peer legacy system using two Modemulators, cellular peer-to-peer service, two dial-up modems, and PSTN service.



Chapter 4: Command Reference

This section includes information about:

- Using the AT Command Set
- Modemulator Memory
- AT Command Reference Guide

Using the AT Command Set

Overview

If Modemulator mode is enabled by the Mode switch on the front panel, and if no connection is in-progress, AT commands can be sent to the Modemulator Terminal port to change Modemulator settings.

To send AT commands to the Modemulator, run a terminal emulation application on a computer, configured so the selected COM port sends whatever is typed to the computer RS-232 serial port that is attached to the Modemulator. By default, the Modemulator will echo commands back to the terminal.

General rules for using AT commands

Here are some general guidelines for sending AT commands to the Modemulator:

Type **AT** before each command and press **ENTER** after each command.

The exceptions are **A/** and **+++**, which require neither **AT** nor **ENTER**.

Leave zeroes off the end of AT commands. A missing numeric parameter is assumed to be a zero. For example, **ATE** is equivalent to **ATE0**.

Either use **AT** (all caps) or **at** (all lower case). Mixed case, as in **At** for example, is unacceptable.

Create compound commands of up to 58 characters between **AT** and **ENTER**.

Example: **AT&H1 D(847)555-1234**

AT Attention; a command follows.
&**H1** Enable hardware flow control.
D Dial the following number.

Optional hyphens, spaces, and parentheses add to the count of 58 characters.

Commands not recognized will be accepted and ignored.

Modemulator Memory

This section describes the types of memory that are included in the Courier Modemulator & M2M Gateway, what the memory is used for, and where the memory is located.

The Modemulator Base Unit

The Courier Modemulator & M2M Gateway base unit contains Random Access Memory (RAM) and Flash memory. These memories hold the operating system, radio firmware, system firmware, and application software that control the operation of the base unit. The system firmware and the application software are user-upgradable. See the USR3520/USR803520 Gateway User Guide or the USR3516-EMU Installation Guide for details on loading new system firmware and application software into the base unit.

The Modemulator Expansion Card

The USR3516-EMU expansion card that is installed into the Courier Modemulator & M2M Gateway contains three types of memory that users can interact with: Random Access Memory (RAM), NonVolatile Random Access Memory (NVRAM), and Flash memory.

Random Access Memory

The RAM holds the current settings that control the Modemulator card operation. These settings are recalled from NVRAM and loaded into the RAM on power-up or when the Modemulator receives an **ATZ** command. Commands sent to the Modemulator to change settings will modify the RAM parameters only. The settings must be saved into NVRAM to make the new settings nonvolatile. The commands to display and manage the Modemulator card settings are detailed in the AT Command Reference Guide section in this guide.

Nonvolatile Random Access Memory

The Modemulator card uses Electrically Erasable Programmable Read Only Memory (EEPROM) for nonvolatile storage. This NVRAM is used to hold Modemulator card settings that are recalled to RAM on power-up or when the Modemulator receives an **ATZ** command, and also holds the Modemulator card dialing directory, security accounts, and security banners. The commands to display and manage the Modemulator card NVRAM are detailed in the AT Command Reference Guide section in this guide.

Flash Memory

The Modemulator card firmware is stored in the Modemulator card Flash memory, which is another type of nonvolatile storage. This firmware includes factory defaults that can be recalled by sending **AT&F0**, **AT&F1**, or **AT&F2** commands. See the AT Command Reference Guide section in this guide for details. The firmware stored in the Modemulator card Flash memory is user-upgradable. See Appendix I in this guide for details on loading new Modemulator card firmware into Flash memory.

AT Command Reference Guide

'*' denotes command available in Remote Command Mode. (See the {R1 command)

Basic Commands

AT$ * Display Basic Command Help Screen:

```
at$
  Basic Command Help (unrecognized commands accepted & ignored)

 D$   Dial         Command Help    I1   Main Checksum
 &$   Ampersand    Command Help    I3   Product Type & Version
 {$   Modemulator  Command Help    I4   RAM    Variables
 S$   S-Register   Command Help    I5   EEPROM Variables
                                  I6   Link Diagnostics
 !!   Flash New Code              I7   Product Profile

 A/   Repeat Last Command         O    Return Online

 A    Manual Answer               Q0   Display Result Codes
                                  Q1   Quiet Mode
 E0   Command Echo Off
 E1   Command Echo On             V0   Numeric Result Codes
                                  V1   Verbal  Result Codes
 F0   Local Online Echo On
 F1   Local Online Echo Off       X0-7 Result Code Options

 H    Hang Up                     Z    Recall EEPROM Variables

OK
```

This command will not be forwarded to the analog modem.

A/ * Repeat Last Command

This command will repeat the last AT command string attempted. If the last AT command ended in DL, then "ERROR" will be displayed.

This command will not be forwarded to the analog modem.

A Manual Answer

This must be the last command in the AT command string.

This command would be used to answer an incoming call when autoanswer is disabled. The command would be issued by the User, or by an application when the *RING* message is received, or when the Ring Indicate (RI) signal goes active on the RS-232 interface.

D$ Dial Command Help Screen:

```
atd$
  Dial Command Help (unrecognized commands accepted & ignored)

 D:IP:Port Direct IP Dialing

 D:IP      Direct IP Dialing if Port=8888

 DL        Dial Last Number

 Dn        Dial Phone Number n

 ,         Dial Modifier for Pause (S8 seconds)

OK
```

This command will not be forwarded to the analog modem.

Dn Dial (n=phone number)

This must be the last command in the AT command string.

Dial modifier characters (except comma, colon, and L) in dial commands that initiate cellular connections are ignored. Dial modifier characters in dial commands that are forwarded to an attached dial-up modem are processed by the modem.

Use this command as you would for an ordinary analog modem. There are two cases:

1. The dialing directory is searched for an entry containing the phone number **n** and a match is found. (see the {Y command). In this case, the legacy analog phone number (or any number of your choosing) is translated into the Port number and IP address in the directory entry, and used to create a TCP client connection to the remote TCP server (Listener).

   Example: **ATD3456789**

   (The remote analog modem with this phone number was replaced by a Modemulator, and {Y was used to translate the number to a Port/IPaddress)

   Example: **ATDT4**

   (The {Y command was used to create an entry having the phone number 4, with the associated Port/IPaddress of the new remote Modemulator)

This is equivalent to **ATD4** since the 'T' dial modifier is ignored.

2. The dialing directory is searched for an entry containing the phone number **n** and a match is not found. In this case, the entire AT command string is forwarded to the connected analog modem (if present), and an ordinary analog modem connection is attempted. If no analog modem is attached, the *NOT FOUND* message is displayed.

   To forward only the dial string portion, but not the configuration commands, issue the {F1 command.

   Example: **ATDT18005551234**

   (a remote analog modem's phone number)

The following commands are not forwarded to the analog modem:

$	(Help) commands
I	(Info) commands
{	(Modemulator-only) commands
&C0	(force DCD) command
A/	(repeat last command)

If a command string is to be forwarded to the analog modem, any of the above commands should be grouped at the end of the configuration commands, and before the Dial command, if present.

DL Dial Last Number

This must be the last command in the AT command string.

Redial the last phone number attempted. It proceeds as in the cases described in the Dn or D: commands.

DSn Dial Stored Number

Since the 'S' in ATDSn is ignored as a non-implemented dial modifier, Dial Stored Number commands can be emulated. The USRobotics Courier analog modem allows stored numbers in locations 0 through 79, so to emulate a stored phone number with the Modemulator, simply assign a phone number in the Modemulator dialing directory equal to the legacy storage location index.

Example: **AT{Y=2::172.17.2.1**

(Stores the phone number 2, the default port number, and the IP address into the Modemulator dialing directory)

ATDS2

(Dials the stored number 2, where 2 was formerly the location of the stored number in the analog modem)

D:i:p Direct IP Dialing (i=destination IP address, p=destination port number)

This must be the last command in the AT command string.

Bypass the directory lookup, and attempt to create the TCP client connection directly, using the IP address and port number supplied in the command.

Separate the ATD, IP address, and Port number with ':' (colon) characters.

Example: **ATD:172.17.2.1:2025**

If using the default Listener port number (8888) on the answering Modemulator, you may optionally omit the port number.

Example: **ATD:172.17.2.1**

One advantage of using direct IP dialing is that it doesn't use the dialing directory, so the number of remotes is unlimited. The dialing directory is limited to 7200 entries.

E0 * Command Echo OFF

Disable local echo of typed characters.

E1 * Command Echo ON (default)

Enable local echo of typed characters.

F0 * Local Online Echo ON

Enable local echo of typed characters in a data connection.

This is sometimes known as half-duplex mode.

F1 * Local Online Echo OFF (default)

Disable local echo of typed characters in a data connection.

This is sometimes known as full-duplex mode.

H * Hang Up

This must be the last command in the AT command string.

Disconnect the local TCP client from Remote Command Mode (see the {R1 command) and cause both Modemulators to report *NO CARRIER*.

I1 * Display Checksum

Display the Modemulator firmware's 4 digit hex checksum (used mainly by tech support).

Example:

```
ati1
9225

OK
```

This command will not be forwarded to the analog modem.

I3 * Display Product Type and Version

Display the product description and the firmware version number.

Example:

```
ati3
USRobotics Courier EMU V1.0.03

OK
```

This command will not be forwarded to the analog modem.

I4 * Display RAM Variables

Display the current settings of RAM variables. This screen is formatted to be similar to a USRobotics Courier Dial-up Business Modem.

Example:

```
ati4
USRobotics Courier EMU Settings...

   BAUD=9600   PARITY=N  WORDLEN=8

   E1  F1  Q0  V1  X7

   &A3  &C1  &D2  &H1  &I0  &L0  &R2  &S0

   {C0  {D0  {F0  {H0  {J0  {M0  {O0  {R0

   S00=000  S01=000  S02=043  S07=060  S08=002  S19=000  S21=010
   S22=017  S23=019  S25=002  S44=015  S59=000  S60=020  S61=120
   S64=060  S65=015

   LAST DIALED #: 18478742000

OK
```

This command will not be forwarded to the analog modem.

I5 * Display NVRAM Variables

Display the current settings of variables stored in EEPROM. This screen is formatted to be similar to a USRobotics Courier Dial-up Business Modem.

Example:

```
ati5
USRobotics Courier EMU NVRAM Settings...

   BAUD=115200 PARITY=N  WORDLEN=8

   E1   F1   Q0   V1   X7

   &A3  &C1  &D2  &H1  &I0  &L0  &R2  &S0

   {C0  {D0  {F0  {H0  {J0  {M0  {O0  {R0

   S00=000  S02=043  S07=060  S08=002  S19=000  S21=010  S22=017
   S23=019  S25=002  S44=015  S59=000  S60=020  S61=120  S64=060
   S65=015

OK
```

This command will not be forwarded to the analog modem.

I6 * Display Link Diagnostics

Display the link diagnostic information for the last connection (or current connection if in Remote Command Mode - see the {R1 command).

Example:

```
ati6
USRobotics Courier EMU Link Diagnostics...

Chars Sent                0
Chars Rcvd                0

Max Latency (sec)       000

Last Call      000:00:00:00

Disconnect Reason is DTR dropped

OK
```

Chars Sent	TXD characters sent to remote Modemulator.
Chars Rcvd	RXD characters received from remote Modemulator.
Max Latency	(See S61 for description)
	(Blank in Single-Ended mode)
	(Blank if remote heartbeat period is zero)
Last Call	Duration of call in days:hrs:min:sec.
	(Labeled "Current Call" if in Remote Command Mode)
Disconnect Reason	(See Appendix E for a list)

This command will not be forwarded to the analog modem.

I7 * Display Configuration Profile

Display information about the product.

Example:

```
ati7
USRobotics Courier EMU Configuration Profile...

Product type      Modemulator
Product ID        USR3516-EMU
Code Date         07/14/16
Code Rev          1.0.03
Modemulator S/N   1MENB2AP0001
Cellular S/N      MB19D8K0LH
IMEI/MEID         356144040623593
IMSI              310410564600725
F/W Version       m2m-1.46.0.2
S/W Version       "USRobotics_V1.0.38"
Date/Time         2016-05-26/16:38:10
Internet State    connected
WWAN Reg State    registered
Operator          AT&T
Carrier IP Addr   10.17.93.73
Signal Strength   -74
ECIO              -12
APN               a105.2way.net

OK
```

Not shown while in Remote Command mode

This command will not be forwarded to the analog modem.

O * Return Online

This must be the last command in the AT command string.

Exit Remote Command Mode (see the {R1 command) and return to ordinary data connection.

The CONNECT message will report the DTE speed of the answer side.

Q0 * Display Result Codes (default)

Enable the display of result codes (verbal or numeric).

(See Appendix D for a description of result codes)

Q1 * Quiet Mode

Disable the display of result codes (verbal and numeric).

V0 * Numeric Result Codes

Replace verbal result codes with numeric codes.

(See Appendix D for a description of result codes)

V1 * Verbal Result Codes (default)

Use verbal result codes.

(See Appendix D for a description of result codes)

Xn * Result Code Options (default=X7)

Result Code Options:	X0	X1	X2	X3	X4	X5	X6	X7
0/OK	*	*	*	*	*	*	*	*
1/CONNECT	*	*	*	*	*	*	*	*
2/RING	*	*	*	*	*	*	*	*
3/NO CARRIER	*	*	*	*	*	*	*	*
4/ERROR	*	*	*	*	*	*	*	*
6/NO DIAL TONE			*		*		*	*
7/BUSY				*	*	*	*	*
8/NO ANSWER				*	*	*	*	*
10/REFUSED	*	*	*	*	*	*	*	*
11/RINGING						*	*	*

The local DTE speed is appended to the *CONNECT* message.

(See Appendix D for a description of result codes)

Z * Recall NVRAM Variables

This must be the last command in the AT command string.

Recall all stored variables from EEPROM and copy to RAM.

Settings for the following RAM variables are stored in EEPROM:

E F Q V X

&A &C &D &H &I &L &R &S

{C {D {F {H {J {M {O {R

S0 S2 S7 S8 S19 S21 S22 S23 S25 S44 S59 S60 S61 S64 S65

(See &W command for storing variables in EEPROM)

!! * Flash New Modemulator Code

This must be the last command in the AT command string.

(See Appendix I Procedure for Flashing New Firmware into Modemulator)

Ampersand Commands

&$ * Display Ampersand Command Help Screen:

```
at&$
  Ampersand Command Help (unrecognized commands accepted & ignored)

 &A0  CONNECT n                        &I0  S/W Recv Flow Ctrl Disabled
 &A1  CONNECT n/ARQ                    &I1  Xon/Xoff Signals Local & Remote
 &A2  CONNECT n/ARQ/V34                &I2  Xon/Xoff Signals Local Only
 &A3  CONNECT n/ARQ/V34/LAPM/V42BIS
                                       &L0  Normal Line
 &C0  CD Override                      &L1  Leased Line
 &C1  CD Normal
                                       &R1  Modem Ignores RTS
 &D0  DTR Override                     &R2  RTS Controls RXD Out
 &D2  DTR Normal
                                       &S0  DSR Override
 &F0  Factory (no  flow)               &S1  DSR Follows CD
 &F1  Factory (H/W flow)
 &F2  Factory (S/W flow)               &W   Save Settings to EEPROM

 &H0  Flow Ctrl Disabled
 &H1  Flow Ctrl H/W
 &H2  Flow Ctrl S/W

OK
```

This command will not be forwarded to the analog modem.

&A0 * Basic CONNECT Message

If the programmable CONNECT message is empty, then upon connection, emulate the basic CONNECT message.

Example:

CONNECT 33600

&A1 * ARQ CONNECT Message

If the programmable CONNECT message is empty, then upon connection, emulate the ARQ CONNECT message.

Example:

CONNECT 33600/ARQ

&A2 * Modulation CONNECT Message

If the programmable CONNECT message is empty, then upon connection, emulate the ARQ and modulation CONNECT message.

Example:

CONNECT 33600/ARQ/V34

&A3 * Compression CONNECT Message (default)

If the programmable CONNECT message is empty, then upon connection, emulate the ARQ, modulation and compression CONNECT message.

Example:

CONNECT 33600/ARQ/V34/LAPM/V42BIS

&C0 * CD Override

Assert the DCD signal on the RS-232 interface for DTE applications that require it.

This command will not be forwarded to the analog modem.

&C1 * CD Normal Operation (default)

The DCD signal on the RS-232 interface behaves normally. If the Modemulator is currently in a cellular or analog connection, the DCD signal will be asserted.

&D0 * DTR Override

If the local DTE does not provide the DTR signal on the RS-232 interface, the Modemulator firmware can behave as if DTR is asserted with this command.

&D2 * DTR Normal Operation (default)

The DTR signal on the RS-232 interface behaves normally. If the Modemulator is currently in a cellular or analog connection, and the DTR signal is de-asserted, the connection will be terminated. Be sure to re-assert DTR before the next connection attempt.

&F0 * Set Factory Defaults - no flow ctrl

Equivalent to sending **AT&F1 X1 &H0 &R1**

(See Factory Defaults Table below)

&F1 * Set Factory Defaults - H/W flow ctrl (as shipped from factory)

(See Factory Defaults Table below)

&F2 * Set Factory Defaults - S/W flow ctrl

Equivalent to sending **AT&F1 &H2 &I2 &R1**

(See Factory Defaults Table below)

Factory Defaults Table:

Parameter	&F0	&F1	&F2
E	1	1	1
F	1	1	1
Q	0	0	0
V	1	1	1
X	1	7	7
&A	3	3	3
&C	1	1	1
&D	2	2	2
&H	0	1	2
&I	0	0	2
&L	0	0	0
&R	1	2	1
&S	0	0	0
{C	0	0	0
{D	0	0	0
{F	0	0	0
{H	0	0	0
{J	0	0	0
{M	0	0	0

Parameter	&F0	&F1	&F2
{O	0	0	0
{R	0	0	0
S0	000	000	000
S2	043	043	043
S7	060	060	060
S8	002	002	002
S19	000	000	000
S21	010	010	010
S22	017	017	017
S23	019	019	019
S25	002	002	002
S44	015	015	015
S59	000	000	000
S60	020	020	020
S61	120	120	120
S64	060	060	060
S65	015	015	015

&H0 * Flow Control Disabled

No Hardware or Software flow control will be used.

(See Appendix F Flow Control)

&H1 * H/W Flow Control (default)

Hardware flow control (CTS/RTS) will be used.

(See Appendix F Flow Control)

&H2 * S/W Flow Control

Software flow control (Xon/Xoff) will be used.

(See Appendix F Flow Control)

&I0 * S/W Receive Flow Control Disabled (default)

Xon and Xoff characters received from the local DTE are treated as ordinary data.

(See Appendix F Flow Control)

&I1 * Xon/Xoff Signals Local and Remote Modemulator

Xon and Xoff characters received from the local DTE control the flow of data to the DTE and Xon/Xoff characters are also passed along to the remote Modemulator as data.

(See Appendix F Flow Control)

&I2 * Xon/Xoff Signals Local Modemulator Only

Xon and Xoff characters received from the local DTE control the flow of data to the DTE, but are not passed along to the remote Modemulator as data.

(See Appendix F Flow Control)

&L0 * Normal Line (default)

Emulate normal PSTN dialup operation.

(See Appendix L Leased Line Operation)

&L1 * Leased Line

Emulate the operation of a private point-to-point leased circuit.

(See register S44 and Appendix L Leased Line Operation)

&R1 * Modemulator Ignores RTS

If &H is set to 1 (H/W flow control), then &R1 causes the Modemulator to ignore the incoming RTS receive flow control signal.

(See Appendix F Flow Control)

&R2 * RTS Controls RXD out (default)

If &H is set to 1 (H/W flow control), then &R2 causes the Modemulator to obey the incoming RTS receive flow control signal to enable/disable the flow of received data to the local DTE.

(See Appendix F Flow Control)

&S0 * DSR Override (default)

Assert the DSR signal on the RS-232 interface for DTE applications that require it.

This does not mean that DSR will be always ON. It will be ON when the Modemulator is ready for commands and when DCD is ON. It will be OFF while the cellular Gateway is booting or after a disconnect while the TCP/IP Listener is starting.

&S1 * DSR follows DCD

The DSR signal follows the DCD signal on the RS-232 interface.

&W * Store RAM Variables to EEPROM

This must be the last command in the AT command string.

Settings for the following RAM variables will be stored in EEPROM:

E F Q V X

&A &C &D &H &I &L &R &S

{C {D {F {H {J {M {O {R

S0 S2 S7 S8 S19 S21 S22 S23 S25 S44 S59 S60 S61 S64 S65

(See the Z command for recalling variables from EEPROM)

Also the current baud rate and parity format of the Terminal port will be saved to EEPROM which will then be applied to the Terminal port upon power-up.

Modemulator Commands

Modemulator commands will not be forwarded to the analog modem.

{$ * Display Modemulator Command Help Screen:

```
at{$
  Modemulator Command Help (unrecognized commands accepted & ignored)

 {B   Program Security Banner     {A  Switch to Analog Port until DTR off
 {B?  Display Security Banner     {I= Program  Caller ID
 {L   Program Login Banner
 {L?  Display Login Banner        {C1 Enable   Caller ID
 {K=  Program CONNECT Message     {D1 Enable   Dialback Security
 {K?  Display CONNECT Message     {F1 Disable  Command Forwd to Analog Port
                                  {H1 Enable   High Speed CONNECT Messages
 {S   Display Security Settings   {J1 Enable   Concatenate Banners
 {Sn= Set User n Password         {M1 Enable   Single-Ended Modemulation
 {Pn= Set User n Admin Privileges {O1 Enable   Originate Only
                                  {R1 Schedule Remote Command Mode Next Dial
 {W   Wipe    Phone:Port:IP Recs
 {X   Display Phone:Port:IP Recs  {Tn Force Remote Baud Rate
 {Y=  Program Phone:Port:IP Recs      n=5-9: 9600,19200,38400,57600,115200
 {Z=  Program Listener Port
                                  {Un Force Remote Parity
                                      n=0-2: None,Even,Odd
OK
```

{A Switch to Analog Modem Port until DTR Off

This must be the last command in the AT command string.

If an analog modem is attached to the analog modem port, you can communicate directly with it by using this command. When finished, toggle DTR off then back on to return to AT command mode in the Modemulator.

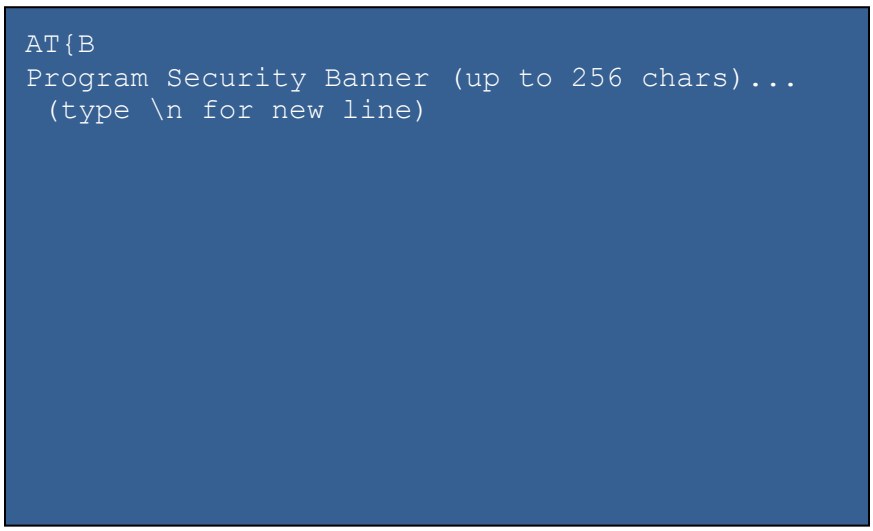
{B * Program Security Banner

This must be the last command in the AT command string.

When Password Prompting is enabled (see {Sn command), a Security Banner (up to 256 characters) can be displayed before the Login Banner and login prompt.

Factory default is no Security Banner.

After issuing this command, the following prompt will appear:



Type up to 256 displayable characters. Each occurrence of '\n' will be replaced with a carriage return/line feed pair (CRLF). When finished, press **Enter**.

To clear the Security Banner, enter **AT{B<Enter><Enter>**

{B? * Display Security Banner

Displays the programmed Security Banner.

{C0 * Disable Transmission of Caller ID String (default)

Prevents transmission of the Caller ID string during connection handshake.

{C1 * Enable Transmission of Caller ID String

If the calling Modemulator has {C1 set, and has programmed the Caller ID with the {I command, the Caller ID string will be sent to the answering Modemulator before acknowledging the first ringback.

If the answering Modemulator has {C1 set, then the Caller ID of the calling Modemulator must be found in the dialing directory (as the phone number) or else the connection is refused.

(See Appendix G Caller ID Screening)

{D0 * Disable Dialback Security (default)

Do not require a dialback number from the call originator.

{D1 * Enable Dialback Security

If Password Prompting is enabled in the answer Modemulator (see {Sn command) and this command is issued, then the Dialer must ask for a dialback.

A "Dialback:" instead of "Login:" prompt will be displayed. The Dialer should type the phone number containing the Dialer's IP address (shown in the answer Modemulator's dialing directory).

The dialing Modemulator will display "Dialback Security" and disconnect. Both Modemulators will restart their Listener port. The answering Modemulator will wait S44 (default=15) seconds, and then dial the requested phone number (translated to IP address).

Example: answer's directory contains: 5551234 8888 172.17.2.1

answer has issued the {D1 command

Dialer calls answer Modemulator

at "Dialback:", Dialer types 5551234

answering Modemulator disconnects and dials back to 172.17.2.1:8888

If the Dialer is requesting Remote Command Mode (see the {R1 command), then after the Dialback is connected, the "Login:" prompt will be displayed, requiring an Administrator's password.

(See Appendix G Setting Up Dialback Security for more details)

{F0 * Allow Forwarding of Configuration Commands to Analog Modem (default)

Normally, an AT command containing a dial string with a phone number not found in the dialing directory will be forwarded in its entirety to the analog modem attached to the modem port.

{F1 * Disable Forwarding of Configuration Commands to Analog Modem

This command will cause only the dial string portion of the AT command (not the configuration commands) to be sent to the attached analog modem.

{H0 * Normal CONNECT Messages (default)

At DTE speeds of 38400 and above, display 33600 in the CONNECT message.

{H1 * High Speed CONNECT Messages

At DTE speeds of 38400 and above, display the actual DTE speed in the CONNECT message.

Example:

CONNECT 115200/ARQ/V34/LAPM/V42BIS

{I= * Program Caller ID

This must be the last command in the AT command string.

Enter the Caller ID string to be sent to the Listener during Modemulator handshake protocol. The CID string may be up to 23 numeric (0-9) digits. Attempting to enter a non-numeric character or more than 23 digits will return *ERROR*.

Example:

AT{I=18005551234

See Appendix G Caller ID Screening

To clear the Caller ID string, enter **AT{I=<Enter>**

{J0 * Normal Security and Login Banners (default)

The Security and Login banners will remain separate.

{J1 * Concatenate (Join) Security and Login Banners

Issuing this command causes the space allocated for the 256 byte Security Banner to be contiguous with the 64 byte Login Banner, creating a 320 byte banner. This will remove the empty line between the banners.

\n will only be replaced with CRLF in the 256 byte Security Banner portion.

{K= * Program User-Defined CONNECT Message

This must be the last command in the AT command string.

If the standard CONNECT messages of &A0 through &A3 are not acceptable, the user may program a customized CONNECT message (up to 48 displayable characters) with this command.

Example:

AT{K=My Custom Programmable CONNECT Message

To clear the custom CONNECT message, enter **AT{K=<Enter>**

{K? * Display User-Defined CONNECT Message

Displays the programmed CONNECT message.

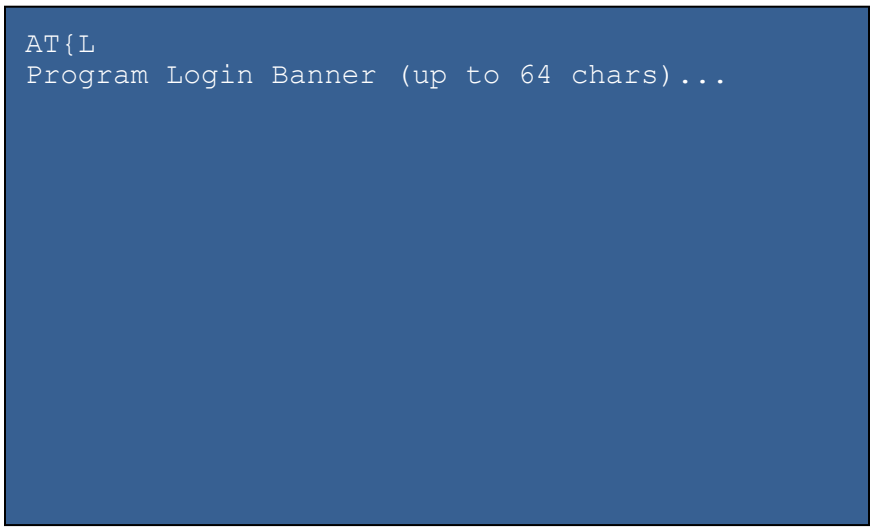
{L * Program Login Banner

This must be the last command in the AT command string.

When Password Prompting is enabled (see {Sn command), a Login Banner and login prompt will appear to the call originator. Use this command to program the desired Login Banner.

Factory default Login Banner: "USRobotics Courier M2M Modemulator Expansion Card"

After issuing this command, the following prompt will appear:



Type up to 64 displayable characters. When finished, press **Enter**.

(See the {J1 command to concatenate Security and Login Banners)

To clear the Login Banner, enter **AT{L<Enter><Enter>**

{L? * Display Login Banner

Displays the programmed Login Banner.

{M0 * Normal Modemulation (default)

Use normal Modemulation handshake protocol.

{M1 * Single-Ended Modemulation

When it is desired to connect to a TCP server or client that is not a Modemulator, the Modemulator handshake protocol must be disabled by issuing this command.

If S19 is zero, it will be set to 5 when Single-Ended is enabled. The User may change the inactivity timeout to any value from 1 to 255 minutes as desired, but attempting to set S19 to zero will result in a setting of 5 to allow for a secondary disconnect method, since there can be no heartbeats.

{O0 * Allow Answer Mode (default)

Whenever the Modemulator is in AT command mode, it will attempt to create a TCP server and be ready for a remote calling TCP client connection.

{O1 * Originate Only

Issuing this command will stop the TCP server (Listener) from being created, preventing answer mode.

{Pn=x * Grant or Deny Administrator Privileges for User n

When Password Prompting is enabled (see {Sn command), remote users must login in order to complete the connection. Use this command to grant (x=1) or deny (x=0) Administrator privileges to any User (n). User 0 is always an Administrator.

Administrator privileges are required in order for a User to gain access to the answer Modemulator's AT command set during a connection using Remote Command Mode (see the {R1 command).

Example to grant Administrator privileges to User 2:

AT{P2=1

{R0 * Normal Data Connections (default)

Normal data connections made without Remote Command Mode.

{R1 * Schedule Remote Command Mode on next Dial

If this command is issued, and the caller has Administrator privileges, then originating a call to a remote Modemulator will place the remote in “Remote Command Mode”, allowing the caller to issue most commands to the remote Modemulator. (See Appendix H)

When finished configuring the remote, you may either issue the O command to return to online data mode, or issue the H command or de-assert DTR to disconnect. Be sure to re-assert DTR before the next connection attempt. If the caller does not have Administrator privileges, "No Admin Privileges" will be displayed, and the caller will not be in Remote Command Mode.

{S * Display Security Settings

Example:

```
at{s
   Security Settings...

  Set Password Command       Admin
 ----------------------    -------
 AT{S0=Admin__Password                (Admin)
 AT{S1=User_1_Password     AT{P1=0
 AT{S2=User_2_Password     AT{P2=1    (Admin)
 AT{S3=User_3_Password     AT{P3=0
 AT{S4=User_4_Password     AT{P4=0
 AT{S5=User_5_Password     AT{P5=0
 AT{S6=User_6_Password     AT{P6=0
 AT{S7=User_7_Password     AT{P7=0
 AT{S8=
 AT{S9=User_9_Password     AT{P9=0

 AT{I=18005551234

OK
```

{Sn=p * Set Password for User n

In order to enable Password Prompting, an Administrator password must be programmed using the command '**AT{S0=p**' where p is replaced with the desired password. Each password may contain up to 15 displayable characters (case sensitive) with no spaces.

User 0 is always an Administrator. Users 1 through 9 may be granted Administrator privileges using the {Pn command. Each time a new User (1-9) is added, it will default with no Administrator privileges.

All passwords must be unique.

Example:

AT{S2=8]mYpasSwoRd[#!

To clear the password, enter **AT{Sn=<Enter>**

{Tn * Force Stored Remote Baud Rate

While a Modemulator is connected in Remote Command Mode (see the {R1 command), this command stores a new baud rate into the remote Modemulator's RAM and NVRAM to set the baud rate of the remote Modemulator's Terminal port for future connections.

n	Baud
1	300
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	115200

This command is available only in Remote Command mode, and is ignored if entered into the Modemulator's Terminal port.

{Un * Force Stored Remote Parity

While a Modemulator is connected in Remote Command Mode (see the {R1 command), this command stores a new parity into the remote Modemulator's RAM and NVRAM to set the parity of the remote Modemulator's Terminal port for future connections.

n	Parity
0	None (8 data bits, 1 stop bit)
1	Even (7 data bits, 1 stop bit)
2	Odd (7 data bits, 1 stop bit)

This command is available only in Remote Command mode, and is ignored if entered into the Modemulator's Terminal port.

{W * Wipe Phone:Port:IPaddr Records

This must be the last command in the AT command string.

This command will erase all existing records in the local phone number translation directory.

You will be prompted: *Are You Sure?*

The User must press **Y** in order to proceed with the erasure.

(See the {Y command for programming records)

{X * Display Phone:Port:IPaddr Records

Display the Listener Port number, and all entries in the local phone number translation directory stored in the EEPROM. Toggle DTR off to abort.

(See the {Y command for storing entries)

Example:

```
at{x

Listener Port: 8888

Phone Number            Port  IP Address
----------------------- ----- ---------------
18478742000             8888  172.18.3.2
18478742001             8888  172.18.3.3
2                       8888  172.18.3.9
3                       8888  172.18.4.163

OK
```

{Y=n * Program Phone:Port:IPaddr Records

This must be the last command in the AT command string.

Modemulators can be drop-in replacements for analog modems. On the originate side, the legacy dial string can be sent as-is to the Modemulator.

By using this command, the Modemulator can be told how to translate the old phone number to a TCP client port number and IP address.

Phone numbers may contain only numeric digits 0-9 and commas for delay. (See S8 register) All other dial modifier characters will be accepted and ignored.

There is EEPROM space available for 7200 records in the dialing directory.

Separate the phone number, port number, and IP address with ':' (colon) characters.

Example:

AT{Y=18478742000:2025:172.18.3.2

For new installations that are not replacing legacy analog modems, any phone number can be chosen (even a single digit). Just keep in mind that all phone numbers in the dialing directory must be unique.

Example:

AT{Y=4:2025:172.18.3.4

If using the default Listener port number (8888) on the remote Modemulator, you may optionally omit the port number.

Example:

AT{Y=4::172.18.3.4

(equivalent to **AT{Y=4:8888:172.18.3.4**)

Records may be deleted by specifying only the phone number. This will cause the last record in the dialing directory to be moved up to the empty slot.

Example:

AT{Y=4

(the above record would be deleted)

Records may be modified by simply reprogramming the same phone number with a new port number and/or IP address.

The Modemulator will prompt:

Replace Existing Record...

Are you sure [Y/N]?

Press **Y** to proceed, or **N** to abort.

Phone numbers may contain up to 23 digits, including commas.

Port numbers should generally be from 1000 to 65535.

Listener Port and TCP client port must match for a connection.

Phone numbers may be modified as long as the directory is not completely full (7200 entries).

{Z=n * Program Listener Port Number for Answer Mode

This must be the last command in the AT command string.

Each time the Modemulator is in AT command mode, the cellular Gateway will be instructed to create a TCP server to listen on this port number. The factory default Listener port is 8888.

Example:

AT{Z=2025

If the User wishes to disable Listener mode, select Originate-Only by issuing the {O1 command.

To clear the Listener port number, enter **AT{Z=<Enter>**

S Registers

Use ATSx=y to set S register x to value y.

Use ATSx? to display the current value of S register x.

S$ * Display S Register Command Help Screen:

```
ats$
  S-Register Command Help (unrecognized commands accepted & ignored)

 S0   Autoanswer Ring              S25  DTR Validation (100 ms)

 S2   Escape Char (ASCII)          S44  Leased Line Retry (sec)

 S7   NO ANSWER Timeout (sec)      S59  Reserved

 S8   Comma Dial Delay (sec)       S60  TX Heartbeat Period (sec)

 S19  Inactivity Timeout (mins)    S61  Maximum Latency (sec)

 S21  Break Time (10 ms)           S64  Login Timeout (sec)

 S22  Xon  Char (ASCII)            S65  Analog Answer Timeout (sec)

 S23  Xoff Char (ASCII)

OK
```

This command will not be forwarded to the analog modem.

S0 * Autoanswer Count (default=0)

S0=0 disables autoanswer (cellular and analog).

S0=1 causes the Modemulator to autoanswer and attempt a connection (cellular or analog) on the first RING.

S0 may range from 0 to 255, however the calling Modemulator would likely abort the connection attempt if S0 is set too high, because typically the NO ANSWER timeout is set to 60 seconds.

S1 Ring Count

S1 is read-only. The I4 command will display the number of RINGs received so far in the S1 register.

S2 * ASCII Code for Escape Character (default=43, 0x2B=+)

This is the programmable character used for the escape sequence. The default character for the escape sequence to terminate a data connection is '+' (ASCII code decimal 43).

Issuing **+++** during a data connection will cause the Modemulator to disconnect a cellular connection, and return to AT command mode.

If connected using the attached analog modem, it may enter local online command mode (depending on configuration). Issue ATH to disconnect.

S7 * NO ANSWER Timeout (default=60 seconds)

In analog calls, if the remote modem doesn't answer within this many seconds, the local Modemulator will report *NO CARRIER*.

In cellular calls:

If no RINGBACKs were received within half of this time, then the local Modemulator will report *BUSY*.

If at least one RINGBACK has been received, the local Modemulator will report *NO ANSWER* when S7 expires.

S7 will also control the connection attempt timeout in answer mode.

S8 * Comma Delay (default=2 seconds)

Each comma in the dial string will cause an extra delay before the *CONNECT* message is displayed (for applications that may require it).

S19 * Inactivity Timeout (minutes, default=0, disabled)

If no characters are sent or received for this many minutes, the local and remote Modemulator will disconnect and report *NO CARRIER*.

The Disconnect Reason will be *INACTIVITY TIMEOUT*.

S21 * Break Length (default=10, which is 100 ms)

Controls the length of the break signal (in 10 ms increments) generated and sent to the local DTE when a break token is received from the remote Modemulator. Set S21=0 to disable generation of break signals.

(See Appendix M Break Sequence Operation)

S22 * ASCII Code for Xon Character (default=17, 0x11=ctrl-Q)

This is the programmable character used to represent Xon in S/W Flow Control (&H2).

(See Appendix F Flow Control)

S23 * ASCII Code for Xoff Character (default=19, 0x13=ctrl-S)

This is the programmable character used to represent Xoff in S/W Flow Control (&H2).

(See Appendix F Flow Control)

S25 * DTR Validation Time (default=2 tenths second)

Sets the recognition time for changes in the DTR signal in tenths of seconds.

S44 * Leased Line Retry Timer (default=15 sec)

This register controls the number of seconds delay after a disconnect and restart of the Listener, that the Modemulator waits before attempting to reconnect to the remote Listener. This emulates the behavior of analog leased line modems.

(See &L1 command and Appendix L Leased Line Operation)

S44 is also used to delay the call for Dialback Security. See the {D1 command for a description of Dialback Security.

S59 * Bitmapped Register (default=0)

Reserved

S60 * Heartbeat Period (default=20 seconds)

Heartbeat tokens can be sent from each Modemulator when there are no data bytes sent for a period of seconds. This allows the remote's receiver to detect long latency in the system (including the cellular network, all processors & buffers, etc.)

(See S61 Maximum Latency)

S60 Setting	Result
0	heartbeat sent each 250 seconds if no data sent
1-19	heartbeat sent each 10 seconds if no data sent
20-29	heartbeat sent each 20 seconds if no data sent
30-39	heartbeat sent each 30 seconds if no data sent
40-49	heartbeat sent each 40 seconds if no data sent

S60 Setting	Result
50-59	heartbeat sent each 50 seconds if no data sent
60-69	heartbeat sent each 60 seconds if no data sent
70-79	heartbeat sent each 70 seconds if no data sent
80-89	heartbeat sent each 80 seconds if no data sent
90-99	heartbeat sent each 90 seconds if no data sent
100-109	heartbeat sent each 100 seconds if no data sent
110-119	heartbeat sent each 110 seconds if no data sent
120-129	heartbeat sent each 120 seconds if no data sent
130-139	heartbeat sent each 130 seconds if no data sent
140-149	heartbeat sent each 140 seconds if no data sent
150-159	heartbeat sent each 150 seconds if no data sent
160-169	heartbeat sent each 160 seconds if no data sent
170-179	heartbeat sent each 170 seconds if no data sent
180-189	heartbeat sent each 180 seconds if no data sent
190-199	heartbeat sent each 190 seconds if no data sent
200-209	heartbeat sent each 200 seconds if no data sent
210-219	heartbeat sent each 210 seconds if no data sent
220-229	heartbeat sent each 220 seconds if no data sent
230-239	heartbeat sent each 230 seconds if no data sent
240-249	heartbeat sent each 240 seconds if no data sent
250-255	heartbeat sent each 250 seconds if no data sent

If the remote Modemulator is firmware Rev 1.0.01, then the local Modemulator's heartbeat period will be limited to a maximum of 90 seconds.

S61 * Maximum Latency (default=120 seconds)

When the local Modemulator's receiver sees no received data bytes or heartbeats for this time plus the remote Modemulator's Heartbeat Period (S60), then disconnect will occur and *NO CARRIER* will be displayed.

Maximum Latency disconnect can be disabled by setting this register to zero. If you set S61 to zero, it is strongly recommended that you enable the inactivity timeout (S19) for an alternative means to disconnect.

Range for S61 is 60-255, or zero.

S64 * Login Timeout (default=60 seconds)

If Password Prompting is enabled (see {Sn command): upon making a TCP connection and completing Modemulator handshake, a Login screen will be presented to the caller. If the caller does not login before the Login Timeout expires, a disconnect will occur.

Range for S64 is 30-255.

S65 * Analog Answer Timeout (default=15 seconds)

If autoanswer is off (S0=0), and an analog call is detected, but not answered, S65 will determine the number of seconds after the last Ring Indicate (RI) signal before aborting analog handshaking and reverting to normal operation.

S65 should be stored to EEPROM with the &W command because S65 is restored to the last saved value after an Analog Answer Timeout.

Range for S65 is 5-45.

Alternative Commands

The Modemulator emulates these commands to improve interoperability with legacy software designed to interface with non-USRobotics modems.

&V * Display RAM Variables (alternative command set)

Display the current settings of RAM variables using the alternative commands where available.

(See Appendix N Alternative Command Set)

Example:

```
AT&V
 ----Option---------- -Setting- Cmd   ----Option---------- -Setting- --Cmd--
 Command Echo         Enabled    E1   Originate Only       Disabled  {O0
 Online  Echo         Disabled   F1   Remote Command Mode  Disabled  {R0
 Result Codes         Enabled    Q0   Break Time           100 ms    \B1
 Result Form          Verbal     V1   S/W Recv Flow Ctrl   Disabled
 Dialtn,Busy,Ringing  Enabled    X7
 /ARQ/V34/LAPM/V42BIS Enabled   &A3   Answer Ring Number    000       S00=000
 DCD Action           Std RS232 &C1   Escape Character     '+'       S02=043
 DTR Action           Std RS232 &D2   No Answer Timeout    060 sec   S07=060
 Flow Control         Hardware  &K3   Comma Pause          002 sec   S08=002
 Line Type            Normal    &L0   Xon  Character       ^Q        S22=017
 H/W Recv Flow Ctrl   RTS       &R2   Xoff Character       ^S        S23=019
 DSR Action           Override  &S0   DTR Validation Time  002 1/10  S25=002
 Caller ID            Disabled  {C0   Inactivity Timeout   000 min   S30=000
 Dialback Security    Disabled  {D0   Leased Retry Timer   015 sec   S44=015
 Command Fwd to Modem Enabled   {F0   Heartbeat Period     020 sec   S60=020
 High Speed CONN msg  Disabled  {H0   Max Latency          120 sec   S61=120
 Concatenate Banners  Disabled  {J0   Login Timeout        060 sec   S64=060
 Single-Ended         Disabled  {M0   Analog Answ Timeout  015 sec   S65=015

OK
```

&K0 * Flow Control Disabled

This is the same as &H0, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

&K3 * H/W Flow Control (default)

This is the same as &H1, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

&K4 * S/W Flow Control

This is the same as &H2, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

\Bn * Break Length (default=1, which is 100 ms)

This is the same as S21 but in tenths of a second, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

\X0 * Xon/Xoff Signals Local Modemulator Only

This is the same as &I2, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

\X1 * Xon/Xoff Signals Local and Remote Modemulator

This is the same as &I1, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

S30 * Inactivity Timeout (minutes, default=0, disabled)

This is the same as S19, for compatibility with alternative command set.

(See Appendix N Alternative Command Set)

Chapter 5: USR3520/USR803520 Technical Specifications

Physical

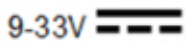
- 1 Main Antenna Connection: 50 Ohm SMA female (WWAN Main)
- 1 Diversity Antenna/GPS Connection: 50 Ohm SMA female (WWAN Div / GPS)
- 1 10/100 Mbps RJ45 Connector
- 1 Power connector: 4 pin Micro-Fit™ 3.0, dual row, 2 circuits
- 7 3-color LEDs showing system status and signal strength
- 1 reset switch
- 1 internal SIM slot (1.8V/3V) - USIM/SIM Class B and Class C
- DTE interface: 1 RS-232 DB9 Male connector
- DCE interface: 1 RS-232 DB9 Female connector
- 2 LEDs indicators: system connect status, operating mode
- 1 mode switch: Modemulator/Gateway

Serial Port Ratings

- Terminal Port RS-232C DCE: Auto-baud detection of 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200, and 300 bps
- Modem Port RS-232C DTE: 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200, and 300 bps

Power

The symbol on the label at the bottom side of the gateway shows the power requirements:



- Input voltage must be between 9V - 33V DC
- Internal electronic fuse limits the input current to 1.2A
- Attached to 3G network, no Ethernet, 3G call @ 2100MHz (band I): 361mA

  (All power measurements at 12V DC)

USRobotics recommends using a power cable between the external power supply unit and the gateway that has a wire thickness of 22 AWG!

SAFETY WARNING

This device operates on DC power provided via a DC power supply or AC power adapters. Only use power supplies in the range 9-33V DC and make sure the product is installed near a power outlet that is easily accessible. This product is regarded a class III equipment where protection against electric shock is provided by means of power supplied from a SELV (Safety Extra Voltage) circuit and does not generate hazardous voltages within itself.

SAFETY WARNING

When using an AC adapter make sure that the ambient temperature doesn't exceed the specified temperature limits of the AC adapter.

As a reference, the power supply available from USRobotics has the following parameters:

- Output voltage 12V DC
- Max output current 1A

If an industrial power supply is preferred USRobotics recommends:

http://www.us.tdk-lambda.com/ftp/Specs/dspa.pdf

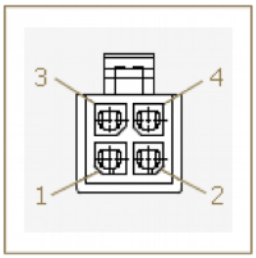
It can be sourced through Farnel, Mouser, Digikey, etc...

Power Connector

The power connector is a Micro-Fit connector from Molex (MX-43025-0400).

- Power Connector Drawing (PDF) --> http://support.usr.com/support/3510/files/molex_43025-400_drawing.pdf
- Power Connector Datasheet (PDF) --> http://support.usr.com/support/3510/files/molex_43025-400_datasheet.pdf

Pinout



Pin #	Function
Pin 1	Input voltage
Pin 2	GND
Pin 3	Not connected
Pin 4	Not connected

Radio Technology & Frequency Bands

- 3G UMTS/HSDPA/HSUPA/HSPA+: 800- 850/900/1900/2100 MHz and AWS band (1700/2100MHz) (B1, B2, B4, B5, B6, B8)
- 2G GSM/GPRS/EDGE: 850/900/1800/1900 MHz
- CDMA 1xRTT/EV-DO rev0/EV-DO revA (USR3520 only): 800/1900MHz (BC0, BC1)

Max. connectivity speeds

- HSPA+: 14.4Mbps (Cat 10) down, 5.76 (Cat 6) up
- EV-DO RevA mode: 3.1Mbps FL / 1.8Mbps RL
- HSPA+ Rel 7 SW features CPC (DTX/DRX), Enhanced L2, EF-DPCH

GPS

- Assisted/Standalone GPS
  - Standalone GPS, Assisted GPS, gps OneXTRA™
  - Wideband GPS processing (20MHz) for improved measurement accuracy
- Embedded Standalone GPS
  - Tracking sensitivity: -159 dBm
  - Cold start sensitivity: -145 dBm
  - Hot start sensitivity: -159 dBm
  - Open sky TTFF: cold start: 40 seconds
  - Open sky TTFF: super hot start: 1 second
  - Open sky accuracy: < 3M CEP -50
- NMEA sentences: GGA, GSA, GSV, RMC, VTG

Security

- Modemulator
  - Connects over a secure private network
  - Support for 1 Administrator account and 9 User accounts
  - Caller ID Screening
  - Password Prompting
  - Dialback Security
  - Configurable security warning banner (up to 256 characters)
  - Configurable login banner (up to 64 characters)
- IPsec VPN
  - Encryption: 3DES, AES128, AES 256
  - Authentication: MD5, SHA1, SHA256
  - Key Group: DH1, DH2, DH5, DH14
- Firewall
  - DMZ
  - Inbound Port Forwarding
  - Outbound Port Filtering
  - Outbound Trusted IPs

Minimum System Requirements

- Cellular device-to-device routing (for peer-to-peer operation)
- Computer hardware/software:
  - Ethernet port/web browser (for Gateway set-up)
  - RS-232 DTE port/terminal software (for Modemulator set-up)
- Optional peripheral hardware: RS-232 serial analog modem with access to PTSN

Command-line Interface

- Compatible with common Hayes modem AT commands

Graphical User Interface

- HTML configuration is supported by most web browsers

Environmental

- Operating temperature: -30°C to 70°C
- Storage temperature: -40°C to 85°C
- Humidity operational: 5% - 95% non-condensing
- Operating altitude: up to 2000m

Enclosure Type

- Industrial Grade Aluminum

Mounting

- 6 through holes for M4 bolts - 2 x 2 compatible with VESA Mount MIS-D 75 (optional standard DIN rail mounting interface)

Package Dimensions/Weight

- 8.5 x 5.55 x 2.5 in. (21.6 x 14.1 x 6.35 cm)
- 1.38 lb (.63 kg)

Product Dimensions/Weight

- 4.53 x 4.13 x 1.77 in. (11.5 x 10.5 x 4.5 cm)
- 0.77 lb (0.35 kg)

Troubleshooting and FAQs

General

If you have trouble with the USR3520/USR803520 first try the following:

- Try cycling the power off and on, then repeat the setup process.
- Make sure the correct COM port was selected.
- Consult the cellular service provider to verify that the Modemulator base unit is setup properly.
- Make sure the power supply is plugged in to an operational power outlet, and that the power supply is also securely plugged into the unit.
- Verify all cables and adaptors are correct for the type of ports.
- Verify that the Modemulator card is fully seated in the base unit.
- When power and interface cables are connected, type **AT<Enter>** to see if *OK* appears on the terminal.

What are displayable characters?

"Displayable characters" are all ASCII characters from 20h thru 7Eh.

What are programmable characters?

All 3 of the programmable characters (Escape, Xon, Xoff) can be any ASCII character 00h thru 7Fh (0 thru 255 decimal).

What are dial modifier characters?

Dial modifier characters are any non-numeric displayable character following a dial (D) command. Examples of common dial modifier characters used in dial-up modems are:

P T , ; " W @ / R ! L S $

Also punctuation characters like -) (and <space> are dial modifier characters.

Dial modifier characters (except comma, colon, and L) in Modemulator dial commands that initiate cellular connections are ignored. Dial modifier characters in Modemulator dial commands that are forwarded to an attached dial-up modem are processed by the dial-up modem.

Can I use the SIM from my phone for Modemulator?

Generally no. The SIM from your phone is not provisioned for peer-to-peer data connectivity, which Modemulators require in order to emulate the analog PSTN and dial-up modems.

However, depending on how your SIM is provisioned, it may allow connectivity to the Internet, and Modemulator can use this type of connectivity when operating in single-ended mode to originate a connection to the IP address of a TCP/IP server.

What type of screwdriver do I need for installing a SIM or an expansion card?

The gateway base unit panels are fastened by Torx T6 screws, so a Torx T6 screwdriver is required to remove a panel. Torx is the tip style, and is also called "star" or "6-point". T6 is the tip size.

What is peer-to-peer?

Peer-to-peer is a communications model in which each party has the same capabilities and either party can initiate a communication session. Peer-to-peer devices are capable of originating or answering a connection. Dial-up modems are an example of a peer-to-peer device.

What is point-to-point?

Point-to-point is a type of communications connection in which one device has an exclusive connection with one other device. The Public Switched Telephone Network (PSTN) is an example of a point-to-point network. An RS-232 serial link is another example.

Can I enable both Caller ID Screening and Password Prompting?

Yes. With Caller ID Screening and Password Prompting both enabled, a Modemulator connection will first validate the originating Modemulator with Caller ID Screening, then prompt for a password. If either authentication fails the connection will not complete.

Can I enable both Caller ID Screening and Dialback Security?

Yes. With Caller ID Screening and Dialback Security both enabled, a Modemulator connection will first validate the originating Modemulator with Caller ID Screening, then prompt for a dialback number. If either authentication fails the connection will not complete. When it does complete successfully, it will only connect to an IP address listed in the Answerer's phone directory.

Why does an originating Modemulator report *BUSY*?

Cellular data networks are packet-switched networks, and packets can be significantly delayed when travelling large distances from one Modemulator to another. One reason an originating Modemulator can report *BUSY* is when the total network delay exceeds the Modemulator busy timeout. Increasing the originating Modemulator's S7 setting may help by increasing the busy timeout.

Can I connect to the IP address reported by the USR3520/USR803520?

When the cellular service is provided by a Mobile Network Operator (MNO), the IP address reported by the USR3520/USR803520 GUI or I7 screen may be public and routable. Normally this IP address provided by

the MNO will be dynamic so it will change periodically, and the MNO may block access to this IP address with a firewall.

When the cellular service is provided by a Mobile Virtual Network Operator (MVNO), the IP address reported by the USR3520/USR803520 GUI or I7 screen is not public and routable. The reported IP address is used only by the MVNO to route traffic to the USR3520/USR803520 on the cellular operator's network. The MVNO will translate the IP address using Network Address Translation (NAT) and provide you with a different routable IP address, but the USR3520/USR803520 cannot report that IP address. The MVNO will control whether your IP address is private or public, and static or dynamic.

How do I configure a Modemulator for connection to the Vodafone UMTS network?

1. The Vodafone network requires any cellular device to report a Username and Password in order for the cellular connection to complete. The Username and Password are not assigned by Vodafone or by an MVNO, so an arbitrary Username and Password can be chosen by the User. Consult the USR3520/USR803520 Gateway User Guide for instructions on entering a Username and Password.

2. Follow the instructions in the USR3520/USR803520 Gateway User Guide for selecting the "Generic UMTS" network setting in the embedded GUI.

3. Enter the APN given by your cellular service provider. Consult the USR3520/USR803520 Gateway User Guide for instructions on entering an APN.

4. The embedded GUI of the USR3520/USR803520 has a "Connect while on international roaming" feature. Depending on how the Vodafone SIM is provisioned and on the geographical location of the gateway, you may need to enable this setting.

The SIM is programmed with a Mobile Network Code (MNC) and a Mobile Country Code (MCC). When a cellular device is connecting to a cellular network, the device receives the network's MNC and MCC which it compares to the MNC and MCC programmed in the SIM. If the SIM MNC doesn't match the network MNC, a roaming connection is established if the cellular service allows roaming to that local cellular network. If also the SIM MCC doesn't match the network MCC, the connection is international roaming. Contact your cellular service provider to determine your SIM's home country, and whether roaming to your local cellular network is allowed.

How do I restore the Modemulator expansion card to factory settings?

To restore the Modemulator operating parameters in the i4 screen to factory values and make the factory values non-volatile, enter this command string:

AT&F1&W <enter>

To restore all other Modemulator configurations to factory default, enter the commands below as needed. There is no need to restore configurations that are already at factory default.

Erase security banner:

AT{B <enter> <enter>

Restore factory login banner:

AT{L <enter> "USRobotics Courier M2M Modemulator Expansion Card" <enter>

Erase caller ID string:

AT{I= <enter>

Delete all passwords:

AT{S0= <enter>
AT{S1= <enter>
AT{S2= <enter>
AT{S3= <enter>
AT{S4= <enter>
AT{S5= <enter>
AT{S6= <enter>
AT{S7= <enter>
AT{S8= <enter>
AT{S9= <enter>

Disable all Administrator privileges:

AT{P1= <enter>
AT{P2= <enter>
AT{P3= <enter>
AT{P4= <enter>
AT{P5= <enter>
AT{P6= <enter>
AT{P7= <enter>
AT{P8= <enter>
AT{P9= <enter>

Erase all dialing directory entries:

AT{W <enter> y <enter>

Restore default Listener port:

AT{Z=8888 <enter>

Erase programmable CONNECT message:

AT{K= <enter>

Why do I need an M2M data plan with the Modemulator?

The Modemulator emulates the behavior of an analog modem, but actually connects over a cellular network instead of the legacy Public Switched Telephone Network (PSTN). Any device that connects to a cellular network must subscribe to a cellular service plan.

Also, since the Modemulator is sending and receiving digital data (not voice), the cellular service must be a data plan (not a voice plan).

And in order to emulate the operation of the legacy PSTN, the cellular data plan must be provisioned for peer-to-peer connectivity and static IP addressing. These provisioning features are available only from an M2M cellular data plan (not from consumer cellular data plans).

Can the Modemulator connect simultaneously to several remote sites?

No, the Modemulator emulates the behavior of dial-up modems and the PSTN, which allows only point-to-point connections from one endpoint to one other endpoint. A Modemulator must disconnect before a connection to another site can be made.

Can I use the Modemulator to connect to an analog site over the cellular network?

No. A dial-up modem sends and receives analog signals that can connect only to another analog modem. Modern cellular networks don't contain analog modems and don't offer analog services. The voice services that cell phones use are actually sending and receiving digital voice, not analog.

And also, cellular modem and gateways make data connections, not digital voice connections. The cellular network's digital voice service is too low-fidelity to carry a dial-up modem's analog signal.

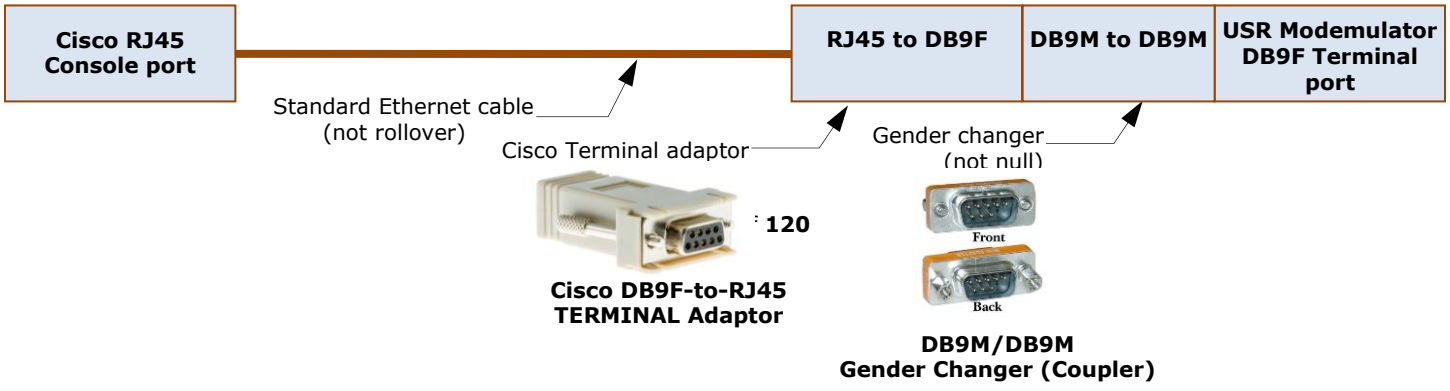
For an overview of cellular networking and the legacy PSTN, download the Cellular to Cellular Data Communications whitepaper.

Can the Modemulator be connected to the console port of a Cisco router?

Yes, with the proper cable and adaptors, and with the proper settings, the Modemulator can connect to a Cisco console port.

The Cisco console port is a serial port which can connect to the Modemulator's Terminal port. It may be useful to consult Cisco's online Cabling Guide for Console and AUX Ports.

For example, if the Cisco console port is presented on an RJ45 connector, one way to make the connection is as follows:



Also, the Cisco console port will require the Modemulator to be pre-configured with certain settings. For example, if the Cisco console port requires the Modemulator to be pre-configured for 9600bps 8-N-1 serial format:

1. Connect a computer's serial port to the Modemulator's Terminal port with a serial cable and set the computer's serial parameters for 9600bps 8-N-1.
2. Enter any AT command to establish the 9600bps 8-N-1 serial settings in the Modemulator.
3. Use the &W command to save those serial setting into the Modemulator's non-volatile memory.

The Cisco console port may work best with the Modemulator (or any modem) pre-configured for DTR override, flow control off, quiet mode, command echo off, and autoanswer on. It may be useful to consult Cisco's online guide for Attaching a USRobotics Modem to the Console Port of a Cisco Router to see their recommendations for configuring a USRobotics analog modem, and apply those recommendations to the Modemulator as needed.

Contact USRobotics technical support if these troubleshooting tips did not solve your issue.

Glossary of Terms

APN	Access Point Name
ASCII	American Standard Code for Information Interchange
CD	Same as DCD, Data Carrier Detect
CID	Caller ID
CRLF	Carriage Return/Line Feed control character pair
CTS	Clear To Send, used for H/W TXD flow control
DCD	Data Carrier Detect
DCE	Data Communication Equipment, such as a modem
DSR	Data Set Ready (sometimes known as Modem Ready)
DTE	Data Terminal Equipment, such as a computer
DTR	Data Terminal Ready
ECIO	Ratio (dB) of rcvd energy per code bit to interference level
EEPROM	Electrically Erasable Programmable Read Only Memory
F/W	Firmware
GUI	Graphical User Interface
H/W	Hardware
IMEI	International Mobile-station Equipment Identity
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
MEID	Mobile Equipment IDentifier
MVNO	Mobile Virtual Network Operator
NVRAM	Non-Volatile Random Access Memory
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
RI	Ring Indicate
RTS	Request To Send, used for H/W RXD flow control
RX	Receive
RXD	Receive Data
S/W	Software
TCP	Transmission Control Protocol
TX	Transmit
TXD	Transmit Data
UTC	Universal Time, Coordinated
WWAN	Wireless Wide Area Network

Support

1. Be prepared to provide model and serial numbers.

Product	**Model Number**
Courier Modemulator & 3G M2M Cellular Gateway	3520
Upgraded Product	**Model Number**
USRobotics Courier M2M 3G Cellular Gateway	3510
USRobotics Courier Modemulator Expansion Card	3516-EMU

   The USR3520 has two serial numbers, the base unit serial number and the Modemulator expansion card serial number. A USR3510 that was upgraded to a USR3520 also has two serial numbers, the base unit serial number and the Modemulator expansion card serial number.

   - The base unit serial number is on the side of the package, bottom of the unit, and is shown on the Modemulator I7 screen on the line labeled *Cellular S/N*.
   - The Modemulator expansion card serial number is shown on the Modemulator I7 screen on the line labeled *Modemulator S/N*. If the Modemulator is not responding to the I7 command, remove power from the unit and uninstall the Modemulator expansion card to find the Modemulator expansion card serial number on the expansion card label.

2. Visit the Support section of the USRobotics Web site at www.usr.com/support/3520

   Many of the most common issues that users experience have been addressed in the FAQ and Troubleshooting Web pages for the USR3520. The Support Web pages also contain information on the latest firmware, application software, and documentation updates.

3. Submit a technical support question to the USRobotics Technical Support Department using an online form:

Country	**Webmail**
United States & Canada	http://www.usr.com/emailsupport
Austria	www.usr.com/emailsupport/de
Belgium (Flemish)	www.usr.com/emailsupport/nl
Belgium (French)	www.usr.com/emailsupport/be
Czech Republic	www.usr.com/emailsupport/cz

Country	Webmail
Denmark	www.usr.com/emailsupport/ea
Finland	www.usr.com/emailsupport/ea
France	www.usr.com/emailsupport/fr
Germany	www.usr.com/emailsupport/de
Greece	www.usr.com/emailsupport/gr
Hungary	www.usr.com/emailsupport/hu
Ireland	www.usr.com/emailsupport/uk
Italy	www.usr.com/emailsupport/it
Luxembourg	www.usr.com/emailsupport/be
Netherlands	www.usr.com/emailsupport/nl
Norway	www.usr.com/emailsupport/ea
Poland	www.usr.com/emailsupport/pl
Portugal	www.usr.com/emailsupport/pt
Russia	www.usr.com/emailsupport/ru
Spain	www.usr.com/emailsupport/es
Sweden	www.usr.com/emailsupport/se
Switzerland	www.usr.com/emailsupport/de
Turkey	www.usr.com/emailsupport/tk
United Kingdom	www.usr.com/emailsupport/uk

For additional current support contact information, go to: http://www.usr.com/en/international/

Appendices

Appendix A: ASCII Chart

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
00	00	NUL	18	12	DC2	36	24	$	54	36	6
01	01	SOH	19	13	XOFF	37	25	%	55	37	7
02	02	STX	20	14	DC4	38	26	&	56	38	8
03	03	ETX	21	15	NAK	39	27	ë	57	39	9
04	04	EOT	22	16	SYN	40	28	(	58	3A	:
05	05	ENQ	23	17	ETB	41	29	)	59	3B	;
06	06	ACK	24	18	CAN	42	2A	*	60	3C	<
07	07	BEL	25	19	EM	43	2B	+	61	3D	=
08	08	BS	26	1A	SUB	44	2C	'	62	3E	>
09	09	HT	27	1B	ESC	45	2D	-	63	3F	?
10	0A	LF	28	1C	FS	46	2E	.	64	40	@
11	0B	VT	29	1D	GS	47	2F	/	65	41	A
12	0C	FF	30	1E	RS	48	30	0	66	42	B
13	0D	CR	31	1F	US	49	31	1	67	43	C
14	0E	SO	32	20	SP	50	32	2	68	44	D
15	0F	SI	33	21	!	51	33	3	69	45	E
16	10	DLE	34	22		52	34	4	70	46	F
17	11	XON	35	23	#	53	35	5	71	47	G

Dec	Hex	Char
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U

Dec	Hex	Char
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	à
95	5F	_
96	60	`
97	61	a
98	62	b
99	63	c

Dec	Hex	Char
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q

Dec	Hex	Char
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	DEL

Appendix B: Excessive Data Usage Warning

There are two default settings that can cause unintentional billable cellular data usage: LAN to WAN and Auto Provisioning.

1. By default LAN to WAN routing is turned on. Once the gateway is connected to a cellular data network it will route all of the attached computer's Internet traffic through the cellular data network. To prevent this cellular data usage, either turn off LAN to WAN or exit out of all programs that use the Internet while configuring the gateway for its intended use. Otherwise, computer Internet traffic will continue to use the LAN to WAN routing until the cellular gateway is disconnected.
2. By default auto provisioning is also turned on. This means that the gateway will connect to the USR Universe and check for updates each time it is powered on. If an update is available the gateway will automatically download and install the update. USR recommends auto provisioning only if the product is properly registered on the USR Universe. If the product is not registered, or if the gateway has a low cellular data rate plan, disable auto provisioning and check for updates manually to avoid the extra data usage.

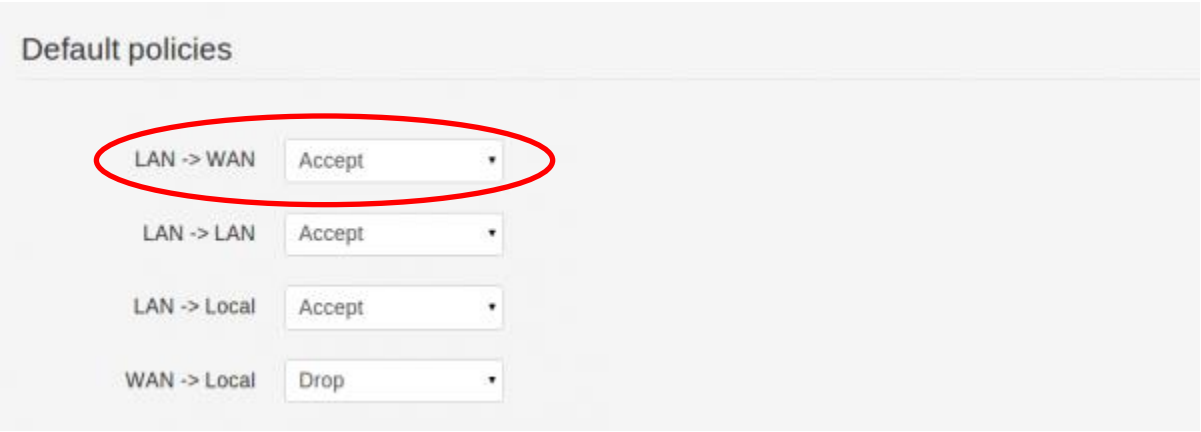
Do not manually or automatically update the gateway if a USR3510/USR803510 was upgraded to a USR3520/USR803520. The update will remove the Modemulator upgrade.

How to disable LAN to WAN

Before installing a SIM card or setting-up the carrier information, connect a computer's Ethernet port to the gateway's Ethernet port with a standard Ethernet cable, then open a web browser on the computer and enter the address ***192.168.1.1*** into the address bar. Enter the default username (**admin**) and password (**admin**). After a successful login, the Home screen will appear.

Click on the Firewall Tab.

Change the LAN -> WAN from Accept to Reject and click **Save changes**.



Now continue to configure the gateway as needed.

If the application requires LAN to WAN routing, close any programs running on the attached computer that might be using the Internet before returning to this page to re-enable LAN to WAN.

Closing Programs

If LAN to WAN routing is left enabled during the configuration process, USR strongly recommends closing any programs that might be using the Internet (web browsers, instant messengers, email programs, etc.) before connecting the gateway to a cellular network. Be sure to close any programs that are running in the background; e.g. auto updates or anti-virus. There are applications available that provide a list of current network activity like Windows' Resource Monitor that can be used as a guideline.

Auto Provisioning

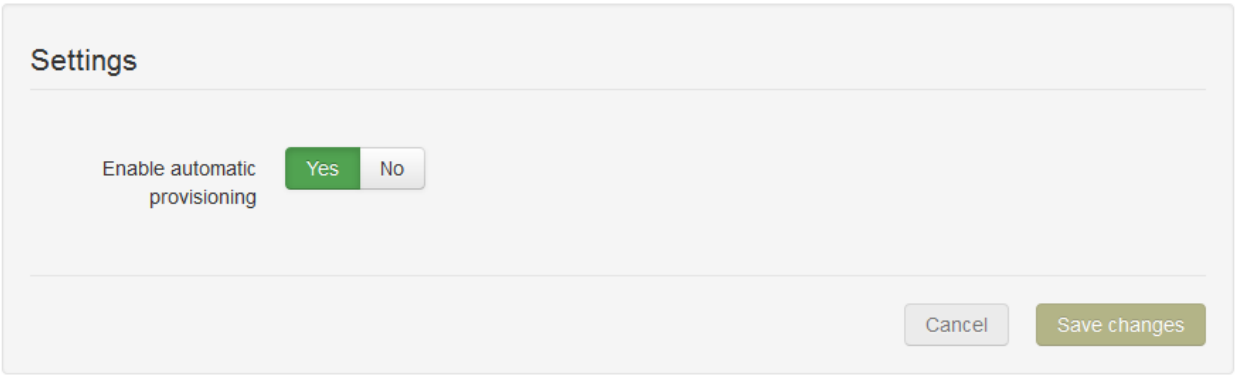
By default the gateway connects to the USR Universe each time the device is powered on, and checks for an updated image file. The gateway will automatically download and install updates from the USR Universe over the cellular connection. If the product is not properly registered on the USR Universe, or to reduce cellular data usage, disable auto provisioning and manually check for updates. If auto provisioning is turned off, USR strongly recommends checking for updates on a regular basis to manually update the gateway when updates are available.

How to Disable Auto Provisioning

Before installing a SIM card or setting-up the carrier information, connect a computer's Ethernet port to the gateway's Ethernet port with a standard Ethernet cable, then open a web browser on the computer and enter the address **192.168.1.1** into the address bar. Enter the default username (**admin**) and password (**admin**). After a successful login, the Home screen will appear.

Click on the Provisioning Tab.

To disable this feature go to Settings, then next to Enable automatic provisioning click No and click Save Changes.



Appendix C: DTE Interface Requirements

Baud rate and parity are automatically detected for each AT command.

Baud rate must be one of the following:

300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Parity must be one of the following:

8N1 - 8 data bits, no parity, 1 stop bit

7E1 - 7 data bits, even parity, 1 stop bit

7O1 - 7 data bits, odd parity, 1 stop bit

7M1 - 7 data bits, mark parity, 1 stop bit

7S1 - 7 data bits, space parity, 1 stop bit

7M1 is the same as 7 data bits, no parity, 2 stop bits

Appendix D: Result Codes

0/OK	Command has executed
1/CONNECT	Successfully connected with another Modemulator
2/RING	Incoming RING detected from remote Modemulator
3/NO CARRIER	Data connection has terminated
4/ERROR	Command is invalid or DSR not asserted
6/NO DIAL TONE	Network TCP connection attempt timed out
7/BUSY	Cellular: half of S7 expired with no ringbacks
8/NO ANSWER	Ringback(s) detected, but S7 expired
10/REFUSED	Caller ID failed authentication
11/RINGING	Remote Modemulator is displaying RING

Appendix E: ATI6 Disconnect Reasons

1. None

   No connection has been made since reset, or in Remote Command Mode while still connected.

2. DTR dropped

   DTR was de-asserted by the local DTE on the RS-232 interface.

3. Escape Code

   Escape Code (default='+++') was issued by the local DTE.

4. Loss of Carrier

   Gateway or analog modem de-asserted DCD.

5. Inactivity Timeout

   Local or remote Modemulator disconnected due to data inactivity.

6. DISC Received

   Remote Modemulator disconnected (unspecified reason).

7. Link Timeout

   Local Modemulator disconnected due to network latency.

8. Keypress Abort

   A key was pressed during connection handshake.

9. Refused

   Caller ID failed authentication at the Listener end.

Appendix F: Flow Control

1. Hardware Flow Control

    H/W Transmit Flow Control

    When the Modemulator's incoming transmit data buffer is getting full, it will de-assert the Clear to Send (CTS) signal on the RS-232 interface, which commands the local DTE to stop sending transmit data to the Modemulator. When sufficient space becomes available, CTS will be re-asserted, enabling data flow.

    H/W Receive Flow Control

    If set to &R2, the Modemulator will obey the incoming Request to Send (RTS) signal, sending or stopping receive data to the local DTE.

2. Software Flow Control

    S/W Transmit Flow Control

    When the Modemulator's incoming transmit data buffer is getting full, it will send the programmable Xoff character to the local DTE, which commands the DTE to stop sending transmit data to the Modemulator. When sufficient space becomes available, the programmable Xon character will be sent, enabling data flow.

    S/W Receive Flow Control

    If set to &I1 or &I2, the Modemulator will obey the incoming Xon/Xoff flow control characters, sending or stopping receive data to the local DTE. &I1 will pass Xon/Xoff through to the remote Modemulator, while &I2 will not.

S/W flow control should not be used for binary file transfers, since Xon and Xoff characters in the data could be falsely interpreted as flow control.

Appendix G: Dial Security

This appendix contains information about:

Overview

Dial Security is designed to protect networks and data centers from unauthorized access. There are three forms of Dial Security; each will be explained later in this appendix:

- Caller ID Screening
- Password Prompting
- Dialback Security

You should be familiar with these terms before you continue:

Remote site: One of multiple locations where a Modemulator is attached to equipment that transfers data to or from a host site.

Host site: The single location where a Modemulator is attached to a terminal or application server that transfers data to or from multiple remote sites.

Remote Modemulator: A Modemulator attached to equipment at a remote site. In a peer-to-peer system a remote Modemulator may originate or answer a connection.

Host Modemulator: A Modemulator attached to a terminal or application server at a host site. In a peer-to-peer system a host Modemulator may originate or answer a connection.

Administrator: With Password Prompting enabled in an answering Modemulator, an Administrator is a person or application that has privileges to contact the answering Modemulator to remotely configure it or to transfer data to/from the equipment attached to its Terminal port.

With Password Prompting disabled, any person or application has privileges to contact and remotely configure the answering Modemulator, and to transfer data to/from the equipment attached to its Terminal port.

User: With Password Prompting enabled in an answering Modemulator, a User is a person or application that has no privileges to remotely configure the answering Modemulator, but is allowed to contact the answering Modemulator and transfer data to/from the equipment attached to its Terminal port.

Any User can be granted Administrator privileges by the default Administrator or any other User that has Administrator privileges.

Setting Up Caller ID Screening

An originating Modemulator has the option of sending a Caller ID (CID) number during the connection handshake.

If the answering Modemulator has CID enabled, it will compare the received CID number with the phone numbers stored in its dialing directory. If the CID number is not found, the connection will fail and the originating Modemulator will display *REFUSED*.

Caller ID cannot be used when the answering Modemulator is operating in single-ended mode.

In the case of Modemulators replacing legacy dial-up modems, it is recommended that each originating Modemulator CID number be programmed with its former PSTN phone number. Each answering Modemulator should have an entry in its dialing directory containing the originator's phone number.

The User can, however, select any numeric string (up to 23 digits) as a Caller ID number, as long as the answering Modemulator has a corresponding entry in its dialing directory.

The originating and answering Modemulator must both be configured to enable Caller ID, which can be done locally (pre-deployment) or remotely (post-deployment). The following steps will describe how to do local configuration. To do remote configuration, see Appendix H for details about using Remote Access.

Here are the steps for locally setting up Caller ID Screening:

1. Enter a CID number in the originating Modemulator
   - Connect a computer serial port to the originating Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - Use the {I command to enter the Caller ID number that will be sent to the Listener during Modemulator handshake protocol. The CID number may be up to 23 numeric (0-9) digits. Attempting to enter a non-numeric character or more than 23 digits will return *ERROR*.

   Example:

   AT{I=18005551234

The number written by the {I command is automatically stored to EEPROM. It does not require you to send &W.

2. Enable CID in the originating Modemulator
   - Issue the {C1 command to enable CID in the originating Modemulator.

   Example:

   AT{C1&W

The {C setting is not automatically written to EEPROM. Send &W to maintain the S registers after a reset.

3. Enter the CID number of the originating Modemulator into the answering Modemulator's dialing directory
   - Connect a computer serial port to the answering Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - Use the {Y command to enter the same CID number that was programmed into the originating Modemulator in step 1, along with the port number and IP address of the originating Modemulator.

   Example:

   AT{Y=18005551234:8888:172.18.3.2

The number written by the {Y command is automatically stored to EEPROM. It does not require you to send &W.

4. Enable CID in the answering Modemulator
   - Issue the {C1 command to enable CID in the answering Modemulator.

   Example:

   AT{C1&W

The {C setting is not automatically written to EEPROM. Send &W to maintain the S registers after a reset.

5. Caller ID Screening is now operational

Steps 1 and 2 configure the originating Modemulator to always send its CID number when originating a connection. Steps 3 and 4 configure the answering Modemulator to always require a valid CID number when answering a connection. If a valid CID number is not received during a connection handshake, the connection will fail and the originating Modemulator will display *REFUSED*.

In a peer-to-peer system any Modemulator can originate or answer a connection. In that case, it is recommended to set up each Modemulator as both CID originator and CID answerer.

To disable CID, issue the {C0 command in the answering Modemulator.

Example:

AT{C0&W

Setting Up Password Prompting

With Password Prompting enabled in an answering Modemulator, an originating Modemulator will present a login banner and a login prompt before completing a connection. An optional security banner may precede the login banner. In order to complete the connection, a valid password must be entered at the login prompt.

If an invalid password is entered, the connection will fail and the originating Modemulator will display *Login Failed*. Or if no password is entered before S64 times-out, the connection will fail and the originating Modemulator will display *Login Failed*.

The Modemulator can store up to ten security accounts: one default Administrator account and nine User accounts. The account profiles are stored in the answering Modemulator's NVRAM.

The answering Modemulator must be configured to enable Password Prompting, which can be done locally (pre-deployment) or remotely (post-deployment). The following steps will describe how to do local configuration. To do remote configuration, see Appendix H for details about using Remote Access.

Here are the steps for locally setting up Password Prompting:

1. Enter an Administrator password in the answering Modemulator to enable Password Prompting
   - Connect a computer serial port to the answering Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - In order to enable Password Prompting, a password must be programmed for the default Administrator (User 0). Use the {S command to enter an Administrator password. The password may contain up to 15 displayable characters (case sensitive) with no spaces.

Do not forget the Administrator password! If the Administrator password is forgotten, the only way to reset the password is via a terminal connected locally to the Modemulator's Terminal port.

Example:

AT{S0=p

(where **p** is replaced with the desired password)

The passwords written by the {S command are automatically stored to EEPROM. It does not require you to send &W.

2. Enter a User password (optional)
   - Connect a computer serial port to the answering Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - Use the {S command to enter a User password.

Example:

AT{Sn=p

(where **n** is any User number from 1 through 9, and **p** is replaced with the desired password)

The passwords written by the {S command are automatically stored to EEPROM. It does not require you to send &W.

3. Enable Auto-answer in the answering Modemulator and save to NVRAM
   - Set register S0 greater than 0 to enable Auto-answer in the answering Modemulator.

   Example:

   ATS0=1&W

S register settings are not automatically written to EEPROM. Send &W to maintain the S registers after a reset.

4. Password Prompting is now operational

In order to disable Password Prompting, use the {S command to delete the Administrator (User 0) password.

Example:

AT{S0=

(Issuing the command with a blank password deletes the previous password)

Granting Administrator Privileges to a User

When Password Prompting is enabled, Users 1-9 have no Administrator privileges by default, but can be individually granted Administrator privileges.

A User can be granted or denied Administrator privileges locally (pre-deployment) or remotely (post-deployment). The following steps will describe how to do local configuration. To do remote configuration, see Appendix H for details about using Remote Access.

To grant Administrator privileges to a User:

- Connect a computer serial port to the originating Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
- Use the {Pn=x command to grant (x=1) or deny (x=0) Administrator privileges to any User (n).

Example:

AT{P2=1

(to grant Administrator privileges to User 2)

The Administrator privilege status written by the {P command is automatically stored to EEPROM. It does not require you to send &W.

Setting Up Dialback Security

With Password Prompting and Dialback Security both enabled in an answering Modemulator, an originating Modemulator will present a login banner and a dialback prompt before completing a connection. An optional security banner may precede the login banner. In order to complete the connection, the valid phone number of the originating Modemulator must be entered at the dialback prompt. The answering Modemulator can store up to 7200 phone numbers in its dialing directory, and any of the numbers in the dialing directory can be valid dialback phone numbers (a.k.a. whitelist).

- If the valid phone number of the originating Modemulator is entered before S64 times-out, the answering Modemulator will disconnect and after the duration set by the S44 register it will attempt to dialback the originating Modemulator.
- If an invalid phone number (not found in the answering Modemulator's dialing directory) is entered before S64 times-out, the connection will fail and the originating Modemulator will display *Login Failed*.
- If nothing is entered before S64 times-out, the connection will fail and the originating Modemulator will display *Login Failed*.
- If a valid phone number of another Modemulator is entered, the answering Modemulator will disconnect and after the duration set by the S44 register it will attempt to dial that Modemulator.

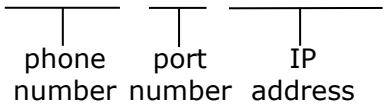
Dialback Security must be enabled in the answering Modemulator, which can be done locally (pre-deployment) or remotely (post-deployment). The following steps will describe how to do local configuration. To do remote configuration, see Appendix H for details about using Remote Access.

Here are the steps for locally setting up Dialback Security:

1. Password Prompting must be enabled in the answering Modemulator for Dialback Security to operate. Follow the instructions in Setting Up Password Prompting before proceeding to the next step.
2. Enter the dialback phone number of the originating Modemulator into the answering Modemulator's dialing directory.
   - Connect a computer serial port to the answering Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - Use the {Y command to enter the dialback phone number of the originating Modemulator into the answering Modemulator's dialing directory.

Example:

AT{Y=5556789:8888:172.18.3.3 <Enter>



In this example 5556789 is the phone number chosen for the originating Modemulator, 172.18.3.3 is the IP address of the originating Modemulator, and 8888 is the listening port of the originating Modemulator.

The number written by the {Y command is automatically stored to EEPROM. It does not require you to send &W.

3. Enable Auto-answer in the answering Modemulator and save to NVRAM
   - Set register S0 greater than 0 to enable Auto-answer in the answering Modemulator.

   Example:

   ATS0=1&W

4. Enable Dialback Security in the answering Modemulator and save to NVRAM
   - Issue the {D1 command to enable Dialback Security in the answering Modemulator.

   Example:

   AT{D1&W

Steps 3 and 4 can be performed with the single compound command **ATS0=1{D1&W**.

5. Enable Auto-answer in the originating Modemulator and save to NVRAM
   - Connect a computer serial port to the originating Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
   - Set register S0 greater than 0 to enable Auto-answer in the originating Modemulator.

   Example:

   ATS0=1&W

S register settings are not automatically written to EEPROM. Send &W to maintain the S registers after a reset.

6. Dialback Security is now operational

In order to disable Dialback Security, issue the {D0 command and save to NVRAM.

Example:

AT{D0&W

The {D setting is not automatically written to EEPROM. Send &W to maintain the S registers after a reset.

Appendix H: Remotely Accessing and Configuring the Modemulator

This appendix contains information about:

- Setting Up For Remote Access
- Starting A Remote Access Session
- Ending A Remote Access Session

Overview

Remote Modemulators can be accessed and configured over the cellular network via a host Modemulator. Privileges to do Remote Access depend on whether Password Prompting is enabled or disabled.

- With Password Prompting disabled, any User can do Remote Access
- With Password Prompting enabled, the Administrator or any User with Administrator privileges can do Remote Access

You should be familiar with these terms before you continue:

Remote site: One of multiple locations where a Modemulator is attached to equipment that transfers data to or from a host site.

Host site: The single location where a Modemulator is attached to a terminal or application server that transfers data to or from multiple remote sites.

Remote Modemulator: A Modemulator attached to equipment at a remote site. In a peer-to-peer system a remote Modemulator may originate or answer a connection.

Host Modemulator: A Modemulator attached to a terminal or application server at a host site. In a peer-to-peer system a host Modemulator may originate or answer a connection.

Administrator: With Password Prompting enabled in an answering Modemulator, an Administrator is a person or application that has privileges to contact the answering Modemulator to remotely configure it or to transfer data to/from the equipment attached to its Terminal port.

With Password Prompting disabled, any person or application has privileges to contact and remotely configure the answering Modemulator, and to transfer data to/from the equipment attached to its Terminal port.

User: With Password Prompting enabled in an answering Modemulator, a User is a person or application that has no privileges to remotely configure the answering Modemulator, but is allowed to contact the answering Modemulator and transfer data to/from the equipment attached to its Terminal port.

Any User can be granted Administrator privileges by the default Administrator or any other User that has Administrator privileges.

Setting Up for Remote Access

Remote Access allows authorized Users to remotely issue AT commands from a Modemulator to another Modemulator that is in Remote Command Mode. The AT commands that are supported by Remote Command Mode are identified with a '*' in the Command Reference chapter of this document.

Remote Command Mode is enabled on a per-connection basis at the originating Modemulator by issuing the {R1 command to schedule Remote Command Mode for the next connection with an answering Modemulator. The Remote Command Mode scheduling will automatically clear upon disconnect.

Here are the steps for locally setting up Remote Access:

1. Connect a computer serial port to the originating Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.
2. Issue the {R1 command to schedule Remote Command Mode in the originating Modemulator.

   Example:

   AT{R1

To prevent Remote Command Mode from being enabled following every reset, USR recommends *not* sending &W to the Modemulator while {R1 is set.

In Remote Command Mode, if S19=0, it will temporarily be set to 5 (5 minute Inactivity Timeout) to prevent falsely staying connected if the TCP connection has been lost.

Starting A Remote Access Session

1. Dial the remote Modemulator that you want to manage. Use any form of the D command (ATD, ATD: or ATDL) to initiate a connection to the remote Modemulator that you want to manage.

   Example:

   ATD18005551234

If the originating Modemulator detects that the phone number being dialed is a PSTN number and if a dial-up modem is connected to the Modemulator "Modem" port, Modemulator will attempt a dial-up connection. Regardless if that attempt succeeds or not, {R1 will automatically revert to {R0.

Password Prompting Is Disabled

If Password Prompting is disabled in the answering Modemulator, the originating Modemulator will display a CONNECT message and enter Remote Command mode. The answering Modemulator will then

accept and process any AT commands identified with a '*' in the Command Reference chapter of this document.

Password Prompting Is Enabled

If Password Prompting is enabled in the answering Modemulator, the originating Modemulator will display a *CONNECT* message, the login banner, and the login prompt.

2. Enter a password at the login prompt.

   - If the password is accepted and has Administrator privileges, a *Logged In* message is displayed and the answering Modemulator enters Remote Command Mode. The answering Modemulator will then accept and process any AT commands identified with a '*' in the Command Reference chapter of this document.
   - If the password is accepted but has no Administrator privileges, a *No Admin Privileges* message is displayed and the answering Modemulator then completes the connection to the equipment attached to its Terminal port.
   - If the password is not accepted, the answering Modemulator will disconnect, and the originating Modemulator will display a *Login Failed* message and return to command mode.
   - If no password is entered before S64 times-out, the answering Modemulator will disconnect, and the originating Modemulator will display a *Login Failed* message and return to command mode.

Ending A Remote Access Session

There are three ways to exit Remote Command Mode:

1. Use the O command to make the answering Modemulator exit Remote Command Mode and complete the connection to the equipment attached to its Terminal port.

   Example:

   ATO

2. Use the H command to make the answering Modemulator exit Remote Command Mode and disconnect.

   Example:

   ATH

3. De-assert DTR on the terminal application to make the originating Modemulator disconnect. Then re-assert DTR to allow further communication.

The Remote Command Mode scheduling bit will automatically clear upon disconnecting by any method, disabling Remote Command Mode in subsequent connections

Appendix I: Flashing New Firmware into Modemulator Card

Firmware can be flashed into a Modemulator expansion card locally (pre-deployment) or remotely (post-deployment). The following steps will describe how to do local flashing. To do remote flashing, see Appendix H for details about Remote Access.

To flash new firmware into a Modemulator card:

You will need a local computer with a serial port and terminal application, and access to the Internet.

1. Download the new Modemulator firmware hex file from the USR support website onto your computer.
2. Connect the computer serial port to the Modemulator Terminal port with a serial cable. Run a terminal application on the computer to facilitate sending commands into the Modemulator.

You will need to know how to send a hex file using ASCII protocol (text file) from your terminal application. Consult the terminal application documentation for help.

3. Use the !! command to begin the procedure of flashing new firmware into the Modemulator card's processor.

   Example:

   AT!!

   The following message will be displayed:

```
Flash New Code

 Are you sure [Y/N]?
```

4. Type **Y** to continue or **N** to abort the flash process.

   After typing **Y**, the *Boot*> prompt will be displayed:

```
(Press '!' to Reset)

Boot>
```

Press **!** to abort the flash process, exit the boot loader, and restart the current flash image.

Step 5 erases the current Modemulator firmware image. However the system will remain operational (with limited capability) until new firmware is loaded.

5. Within 40 seconds, type these three characters: **#$%**.

If the characters are not entered within 40 seconds, the flash process will abort and exit the boot loader, restarting the current flash image.

After typing the three characters, the following will be displayed:

6. Within 40 seconds after *LOAD HEX FILE* appears, start sending the hex file using ASCII protocol (text file or raw binary) from the terminal application. When the file transfer completes, a checksum will be performed. If it is successful, Modemulator will be in AT command mode, with *OK* responses.

   If the hex file is not sent within 40 seconds, or if the checksum fails, you will see *Boot*> instead of the normal *OK* response after AT commands. Repeat from step 3. If flashing cannot succeed, the hex file may be corrupt and should be replaced with a fresh file from USR's website or from customer service.

Appendix J: DB9 Pinouts

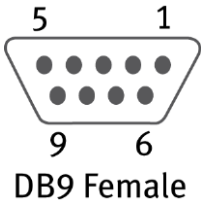
The USR3520/USR803520 has two DB9 serial ports.

Terminal Port

The USR3520/803520 Terminal port is an RS-232 DCE presented on a DB9 female connector using a standard pinout.

RS-232 output signal levels are nominally ±5v.

DB9F Pin	Symbol	Description	Direction
1	DCD	Carrier Detect	Output
2	TXD	Transmit Data	Output
3	RXD	Receive Data	Input
4	DTR	Data Terminal Ready	Input
5	GND	Ground	-
6	DSR	Data Set Ready	Output
7	CTS	Clear To Send	Input
8	RTS	Request To Send	Output
9	RI	Ring Indicator	Output



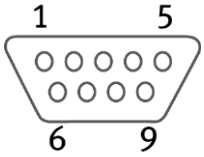
DB9 Female

Modem Port

The USR3520/803520 Modem port is an RS-232 DTE presented on a DB9 male connector using a standard pinout.

RS-232 output signal levels are nominally ±5v.

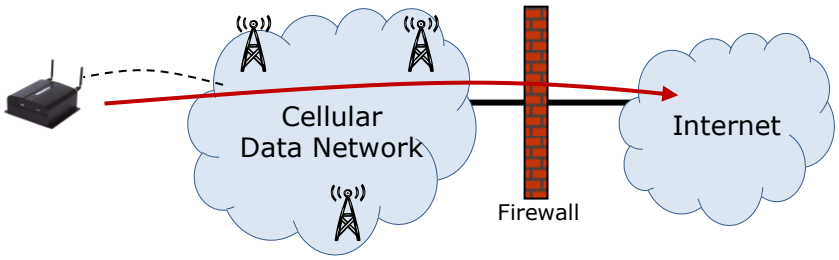
DB9M Pin	Symbol	Description	Direction
1	DCD	Carrier Detect	Input
2	RXD	Receive Data	Input
3	TXD	Transmit Data	Output
4	DTR	Data Terminal Ready	Output
5	GND	Ground	-
6	DSR	Data Set Ready	Input
7	RTS	Request To Send	Output
8	CTS	Clear To Send	Input
9	RI	Ring Indicator	Input



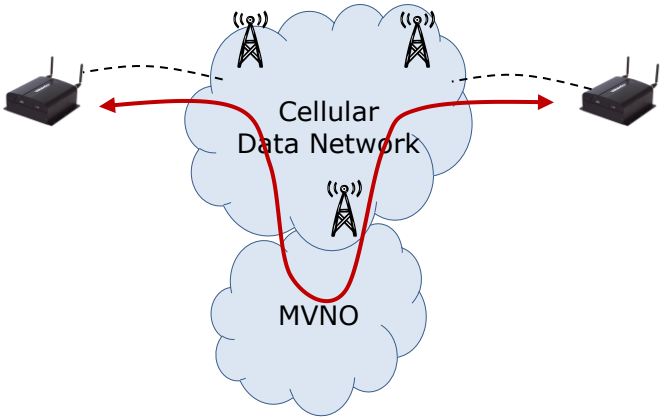
DB9 Male

Appendix K: Peer-To-Peer Cellular Data Service

Conventional cellular data service routes connections from a mobile device to the Internet, illustrated below. The Modemulator can use this type of data service only when operating in single-ended mode to make mobile-originated connections.



In order to emulate the PSTN, the Modemulator requires a special type of cellular data service when operating in the default peer-to-peer mode that doesn't route connections to or through the Internet. The Modemulator requires service that allows connection from one mobile device to another mobile device. This type of peer-to-peer data service is typically not available directly from mobile operators. However, Mobile Virtual Network Operators (MVNOs) can provide this type of service, illustrated below.



With this type of peer-to-peer data routing, each of the mobile devices are assigned a private, static IP address. An originating Modemulator can contact an answering Modemulator by addressing the IP address of the answering Modemulator. The IP addresses are routable only within the MVNO private network, and are not reachable by any outside networks.

When engaging with an MVNO to provide cellular data service for Modemulator, be sure to specify this type of peer-to-peer data routing. Also be sure to ask the MVNO about any restrictions in connectivity between devices or between different cellular networks.

Appendix L: Leased Line Operation

The &L1 command may be used to emulate the behavior of analog leased line modems. One Modemulator must be designated as originator, while the other Modemulator must be the answerer (Listener). The answerer must have autoanswer enabled (S0 greater than zero), and the originator must have S0 set to zero.

The User should decide whether response codes will be displayed, and set the Q command appropriately.

Register S44 determines how many seconds after a disconnect that the originating Modemulator waits before attempting to reconnect with the answering Modemulator.

When the &L1 command is issued to the originating Modemulator, it will attempt to connect with the answering Modemulator using the last dialed number, similar to issuing ATDL. It is, therefore, necessary to issue ATDn (where n is the desired phone number in the directory), or ATD:n (where n is the desired IP address) one time to populate the Last Dialed Number area. This means that the &L1 command also emulates the behavior of auto-redial.

If there is ever a disconnect, such as "DISC Received", "Loss of Carrier" or "Link Timeout", the originating Modemulator will wait S44 (default=15) seconds, and attempt to reconnect, repeating indefinitely.

To disable leased line operation, enter the escape code (default is +++) or de-assert the RS-232 DTR signal to the originating Modemulator to cause a disconnect, then enter the &L0 command before the Modemulator attempts to reconnect.

Appendix M: Break Sequence Operation

If the Modemulator is in a cellular connection, it detects a break signal (spacing data bits longer than one character length) sent by the DTE into its Terminal port, and sends a token representing the break to the remote Modemulator. The remote Modemulator receives the token and generates a break signal on the DTE's RXD line. The length of the generated break signal is controlled by S21 (in 10 ms increments) on the receiving Modemulator. Set S21=0 on the receiving Modemulator to disable generation of break signals.

Since most of the data buffering takes place in the gateway's memory, the only version of break handling supported is unexpedited, non-destructive (&Y3 in USRobotics Courier analog modems).

Appendix N: Alternative Command Set

There are some dial-up modems that use an alternative command set. Most of the commands pertain to purely analog modem functions, such as modulation speeds, speaker commands, etc., so are not applicable.

A few of the alternative commands correspond to commands in the Modemulator's USR Courier-based command set, as shown below:

USR	Alt	Description
&H0	&K0	Flow Ctrl Disabled
&H1	&K3	Flow Ctrl H/W
&H2	&K4	Flow Ctrl S/W
&I1	\X1	Xon/Xoff Signals Local & Remote
&I2	\X0	Xon/Xoff Signals Local Only
S19	S30	Inactivity Timeout (minutes)
S21	\Bn	Break Time S21 in hundredths of seconds \B in tenths of seconds
I4	&V	Display RAM Variables

S21	Displayed in &V screen
000	Displayed as \B0 in &V
001-015	Displayed as \B1 in &V
016-025	Displayed as \B2 in &V
026-035	Displayed as \B3 in &V
036-045	Displayed as \B4 in &V
046-055	Displayed as \B5 in &V
056-065	Displayed as \B6 in &V
066-075	Displayed as \B7 in &V
076-085	Displayed as \B8 in &V
086-255	Displayed as \B9 in &V

If &I0 is issued, S/W Recv Flow Ctrl is displayed as Disabled in &V

Other examples:

Issuing &K3 results in a setting of &H1

Issuing \X0 results in a setting of &I2

Issuing S30=5 results in a setting of S19=5

Issuing \B3 results in a setting of S21=30

Issuing &V (with &F1 settings) displays the following:

```
AT&V
 ----Option---------- -Setting- Cmd   ----Option---------- -Setting- --Cmd--
 Command Echo         Enabled    E1   Originate Only       Disabled  {O0
 Online  Echo         Disabled   F1   Remote Command Mode  Disabled  {R0
 Result Codes         Enabled    Q0   Break Time           100 ms    \B1
 Result Form          Verbal     V1   S/W Recv Flow Ctrl   Disabled
 Dialtn,Busy,Ringing  Enabled    X7
 /ARQ/V34/LAPM/V42BIS Enabled   &A3   Answer Ring Number    000       S00=000
 DCD Action           Std RS232 &C1   Escape Character     '+'       S02=043
 DTR Action           Std RS232 &D2   No Answer Timeout    060 sec   S07=060
 Flow Control         Hardware  &K3   Comma Pause          002 sec   S08=002
 Line Type            Normal    &L0   Xon  Character       ^Q        S22=017
 H/W Recv Flow Ctrl   RTS       &R2   Xoff Character       ^S        S23=019
 DSR Action           Override  &S0   DTR Validation Time  002 1/10  S25=002
 Caller ID            Disabled  {C0   Inactivity Timeout   000 min   S30=000
 Dialback Security    Disabled  {D0   Leased Retry Timer   015 sec   S44=015
 Command Fwd to Modem Enabled   {F0   Heartbeat Period     020 sec   S60=020
 High Speed CONN msg  Disabled  {H0   Max Latency          120 sec   S61=120
 Concatenate Banners  Disabled  {J0   Login Timeout        060 sec   S64=060
 Single-Ended         Disabled  {M0   Analog Answ Timeout  015 sec   S65=015

OK
```

The settings in the &V screen correspond to the equivalent settings in the I4 screen:

```
ati4
USRobotics Courier EMU Settings...

   BAUD=9600   PARITY=N  WORDLEN=8

   E1  F1  Q0  V1  X7

   &A3  &C1  &D2  &H1  &I0  &L0  &R2  &S0

   {C0  {D0  {F0  {H0  {J0  {M0  {O0  {R0

   S00=000  S01=000  S02=043  S07=060  S08=002  S19=000  S21=010
   S22=017  S23=019  S25=002  S44=015  S59=000  S60=020  S61=120
   S64=060  S65=015

   LAST DIALED #: 18478742000

OK
```

Legal Notice

The information in this publication is subject to change without notice and is provided "AS IS" WITHOUT WARRANTY OF ANY KIND. THE ENTIRE RISK ARISING OUT OF THE USE OF THIS INFORMATION REMAINS WITH RECIPIENT. IN NO EVENT SHALL USROBOTICS BE LIABLE FOR ANY DIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER DAMAGES WHATSOEVER (INCLUDING WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION OR LOSS OF BUSINESS INFORMATION), EVEN IF USROBOTICS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

This publication does not constitute an endorsement of the product or products that were tested. The configuration or configurations tested or described may or may not be the only available solution. This test is not a determination or product quality or correctness, nor does it ensure compliance with any federal state or local requirements.

The safety precautions listed in this User Guide must be observed at all times. Failure to comply with these precautions may result in injury and property damage. **USRobotics assumes no liability for the customer's failure to comply with these requirements**.

WARNING!

YOU ARE EXPRESSLY PROHIBITED FROM USING THIS PRODUCT IN HIGH RISK APPLICATIONS AND SUCH USE SHALL BE AT YOUR SOLE RISK. AS USED IN THIS PARAGRAPH, "HIGH RISK APPLICATIONS" REFERS TO USAGE IN OR IN CONJUNCTION WITH EQUIPMENT FOR WHICH FAILURE OF THE USR PRODUCT MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, EMOTIONAL INJURY OR LOSS OF LIFE, INCLUDING BUT NOT LIMITED TO ATOMIC ENERGY CONTROL EQUIPMENT, AIRCRAFT OR SPACECRAFT EQUIPMENT, TRAFFIC CONTROL EQUIPMENT, TRANSPORTATION EQUIPMENT, COMBUSTIBLE CONTROL EQUIPMENT, MEDICAL OR DIAGNOSTIC EQUIPMENT, AND ALL TYPES OF MANUFACTURING AND SAFETY DEVICES.

For questions regarding your product or declaration, contact:

U.S. Robotics Corporation
1300 East Woodfield Road, Suite 506
Schaumburg, IL, 60173
U.S.A.
http://www.usr.com/

To identify this product we refer to the Part, Series, or Model number found on the product.

Warranty

U.S. Robotics Corporation Two (2) Year Limited Warranty

1.0 GENERAL TERMS:

1.1 This Limited Warranty is extended only to the original end-user purchaser (CUSTOMER) and is not transferable.

1.2 No agent, reseller, or business partner of U.S. Robotics Corporation (U.S. ROBOTICS) is authorized to modify the terms of this Limited Warranty on behalf of U.S. ROBOTICS.

1.3 This Limited Warranty expressly excludes any product that has not been purchased as new from U.S. ROBOTICS or its authorized reseller.

1.4 This Limited Warranty is only applicable in the country or territory where the product is intended for use (As indicated by the Product Model Number and any local approval stickers affixed to the product).

1.5 U.S. ROBOTICS warrants to the CUSTOMER that this product will be free from defects in workmanship and materials, under normal use and service, for TWO YEARS from the date of purchase from U.S. ROBOTICS or its authorized reseller.

1.6 U.S. ROBOTICS' sole obligation under this Limited Warranty shall be, at U.S. ROBOTICS' sole discretion, to repair the defective product or part with new or reconditioned parts; or to exchange the defective product or part with a new or reconditioned product or part that is the same or similar; or if neither of the two foregoing options is reasonably available, U.S. ROBOTICS may, at its sole discretion, provide a prorated refund to the CUSTOMER of the purchase price of the product, as evidenced by the proof of purchase, less any applicable service fees in accordance with the following schedule:

Months 0- 3:	100%
Months 4 – 12:	50%
Year 1 – 2:	25%

1.7 A product or part that is repaired or replaced under this Limited Warranty shall be covered for the remainder of the original warranty period applying to the product or part, or for NINETY (90) days, whichever is longer. All products or parts that are exchanged for replacement will become the property of U.S. ROBOTICS.

1.8 U.S. ROBOTICS makes no warranty or representation that this product will meet CUSTOMER requirements or work in combination with any hardware or software products provided by third parties.

1.9 U.S. ROBOTICS makes no warranty or representation that the operation of the software products provided with this product will be uninterrupted or error free, or that all defects in software products will be corrected.

1.10 U.S. ROBOTICS shall not be responsible for any software or other CUSTOMER data or information contained in or stored on this product.

1.11 U.S. ROBOTICS products are not designed for any "critical applications." "Critical applications" shall mean life support systems, medical applications, connections to implanted medical devices, commercial transportation, nuclear facilities or systems or any other applications where product failure could lead to injury to persons or loss of life or property damage.

2.0 CUSTOMER OBLIGATIONS:

2.1 CUSTOMER assumes full responsibility that this product meets CUSTOMER specifications and requirements.

2.2 CUSTOMER is specifically advised to make a backup copy of all software provided with this product.

2.3 CUSTOMER assumes full responsibility to properly install and configure this product and to ensure proper installation, configuration, operation and compatibility with the operating environment in which this product is to function.

2.4 CUSTOMER must furnish U.S. ROBOTICS or its authorized reseller a dated Proof of Purchase (copy of original, dated purchase receipt from U.S. ROBOTICS or its authorized reseller) for any warranty claims to be authorized.

3.0 OBTAINING WARRANTY SERVICE:

3.1 CUSTOMER must contact U.S. ROBOTICS Technical Support within the applicable warranty period to obtain warranty service authorization.

3.2 For information on how to contact U.S. ROBOTICS Technical Support please see the U.S. ROBOTICS corporate Web site at: www.usr.com

3.3 CUSTOMER should have the following information/items readily available when contacting U.S. ROBOTICS Technical Support:

Product Model Number

Product Serial Number

Dated Proof of Purchase

CUSTOMER contact name & telephone number

CUSTOMER Computer Operating System version

U.S. ROBOTICS Installation CD-ROM

U.S. ROBOTICS Installation Guide

4.0 WARRANTY REPLACEMENT:

4.1 In the event U.S. ROBOTICS Technical Support determines the product or part has a malfunction or failure attributable directly to faulty workmanship and/or materials; and the product is within the TWO (2) YEAR warranty term; the CUSTOMER will include a copy of the dated Proof of Purchase (original purchase receipt from U.S. ROBOTICS or its authorized reseller) with the returned product or part, then U.S. ROBOTICS will issue CUSTOMER a Return Material Authorization (RMA) and instructions for the return of the product to the authorized U.S. ROBOTICS Return Center.

4.2 Any product or part returned to U.S. ROBOTICS without an RMA issued by U.S. ROBOTICS prominently displayed on the exterior of the return packaging will be returned.

4.3 CUSTOMER agrees to pay shipping charges to return the product or part to the authorized U.S. ROBOTICS Return Center; to insure the product or assume the risk of loss or damage which may occur in transit; and to ship the product in the original packaging.

4.4 Responsibility for loss or damage does not transfer to U.S. ROBOTICS until the returned product or part is received as an authorized return at an authorized U.S. ROBOTICS Return Center.

4.5 Authorized CUSTOMER returns will be unpacked, visually inspected, and matched to the Product Model Number and Product Serial Number for which the RMA was authorized. The enclosed Proof of Purchase will be inspected for date of purchase and place of purchase. U.S. ROBOTICS may deny warranty service if visual inspection of the returned product or part does not match the CUSTOMER supplied information for which the RMA was issued.

4.6 U.S. ROBOTICS retains the final decision whether products are within warranty conditions. In the event U.S. ROBOTICS determines that the product is not within warranty conditions, or is without the original packaging and accessories, CUSTOMER will not be entitled to repair or a refund and the product will be returned to CUSTOMER**.**

4.7 Once a CUSTOMER return has been unpacked, visually inspected, and tested U.S. ROBOTICS will, at its sole discretion, repair or replace the product, using new or reconditioned product or parts, to whatever extent it deems necessary to restore the product or part to operating condition.

4.8 U.S. ROBOTICS will make reasonable efforts to ship the repaired or replaced product or part to CUSTOMER, at U.S. ROBOTICS expense, not later than TWENTY ONE (21) DAYS after U.S. ROBOTICS receives the authorized CUSTOMER return.

4.9 U.S. ROBOTICS shall not be liable for any damages caused by delay in delivering or furnishing repaired or replaced product or part.

5.0 LIMITATIONS:

5.1 THIRD-PARTY SOFTWARE: This U.S. ROBOTICS product may include or be bundled with third-party software, the use of which is governed by separate end-user license agreements provided by third-party software vendors. This U.S. ROBOTICS Limited Warranty does not apply to such third-party software. For the applicable warranty refer to the end-user license agreement governing the use of such software.

5.2 UNAUTHORIZED PRODUCTS: To the extent permitted by applicable law, this U.S. ROBOTICS Limited Warranty does not apply to distressed, "grey market" or liquidated inventory and all such products are sold "as is" without any warranty. Further, this U.S. ROBOTICS Limited Warranty does not apply and U.S. ROBOTICS assumes no responsibility or liability for counterfeit products or for products sold by auction or by parties who are not specifically authorized by U.S. ROBOTICS.

5.3 DAMAGE DUE TO MISUSE, NEGLECT, NON-COMPLIANCE, IMPROPER INSTALLATION, AND/OR ENVIRONMENTAL FACTORS: To the extent permitted by applicable law, this U.S. ROBOTICS Limited Warranty does not apply to normal wear and tear; damage or loss of data due to interoperability with current and/or future versions of operating system or other current and/or future software and hardware; alterations (by persons other than U.S. ROBOTICS); damage caused by operator error or non-compliance with instructions as set out in the user documentation or other accompanying documentation; damage caused by acts of nature such as lightning, storms, floods, fires, and earthquakes, etc. Products evidencing the product serial number has been tampered with or removed; misuse, neglect, and improper handling; damage caused by undue physical, temperature, or electrical stress; damage or loss of data caused by a computer virus, worm, Trojan horse, or memory content corruption; failures of the product which result from accident, abuse, misuse (including but not limited to improper installation, connection to incorrect voltages, and power points); electrical transients or disturbances in the line power (mains) connected to the device or in a telephone network connected to the device, including any transient phenomenon due to the cross connected nature of a device between these two networks, failures caused by products not supplied by U.S. ROBOTICS; damage cause by moisture, corrosive environments, high voltage surges, shipping, abnormal working conditions; or the use of the product outside the borders of the country or territory intended for use (As indicated by the Product Model Number and any local telecommunication approval stickers affixed to the product).

5.4 TO THE FULL EXTENT ALLOWED BY LAW, THE FOREGOING WARRANTIES AND REMEDIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES, TERMS, OR CONDITIONS, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES, TERMS, OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, SATISFACTORY QUALITY, CORRESPONDENCE WITH DESCRIPTION, AND NON-INFRINGEMENT, ALL OF WHICH ARE EXPRESSLY DISCLAIMED. U.S. ROBOTICS NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE, INSTALLATION, MAINTENANCE, WARRANTY, OR USE OF ITS PRODUCTS.

5.5 LIMITATION OF LIABILITY. TO THE FULL EXTENT ALLOWED BY LAW, U.S. ROBOTICS ALSO EXCLUDES FOR ITSELF AND ITS SUPPLIERS ANY LIABILITY, WHETHER BASED IN CONTRACT OR TORT (INCLUDING NEGLIGENCE), FOR INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL, OR PUNITIVE DAMAGES OF ANY KIND, OR FOR LOSS OF REVENUE OR PROFITS, LOSS OF BUSINESS, LOSS OF INFORMATION OR DATA, OR OTHER FINANCIAL LOSS ARISING OUT OF OR IN CONNECTION WITH THE SALE, INSTALLATION, MAINTENANCE, USE, PERFORMANCE, FAILURE, OR INTERRUPTION OF ITS PRODUCTS, EVEN IF U.S. ROBOTICS OR ITS AUTHORIZED RESELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND LIMITS ITS LIABILITY TO REPAIR, REPLACEMENT, OR REFUND OF THE PURCHASE PRICE PAID, AT U.S. ROBOTICS OPTION. THIS DISCLAIMER OF LIABILITY FOR DAMAGES WILL NOT BE AFFECTED IF ANY REMEDY PROVIDED HEREIN SHALL FAIL OF ITS ESSENTIAL PURPOSE.

6.0 STATUTORY RIGHTS OF CUSTOMER:

Some countries, states, territories or provinces do not allow the exclusion or limitation of implied warranties or the limitation of incidental or consequential damages for certain products supplied to consumers or the limitation of liability for personal injury, so the above limitations and exclusions may be limited in their application to CUSTOMER. When the implied warranties are not allowed by law to be excluded in their entirety, they will be limited in scope and duration to this written Limited Warranty. This Limited Warranty gives CUSTOMER specific legal rights. CUSTOMER may also have other rights that may vary from state to state or from country to

country. CUSTOMER is advised to consult applicable state or country laws for full determination of its rights. If any term is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired.

7.0 GOVERNING LAW:

This Limited Warranty shall be governed by the laws of the State of Illinois, U.S.A. excluding its conflicts of laws principles and excluding the United Nations Convention on Contracts for the International Sale of Goods.

U.S. Robotics Corporation
1300 East Woodfield Road, Suite 506
Schaumburg, IL, 60173
U.S.A.

Regulatory Information

FCC Compliance

Declaration of Conformity

U.S. Robotics Corporation
1300 E. Woodfield Rd. Suite 506
Schaumburg, IL 60173
U.S.A.

declares that this product conforms to the FCC's specifications:

Part 15, Class A

This equipment complies with Part 15, Class A for use in a commercial, industrial, or business environment.

Note: This equipment has been tested and found to comply with the limits for a Class A 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 commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the User will be required to correct the interference at one's own expense.

Modifications not expressly approved by the manufacturer could void the User's authority to operate the equipment under FCC rules.

UL Listing/CUL Listing

This information technology equipment is UL Listed and C-UL Listed for both the US and Canadian markets respectively for the uses described in this User Guide. Use this product only with UL Listed Information Technology Equipment (ITE).

Industry Canada (IC)

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the interference-causing equipment standard entitled Digital Apparatus, ICES-003 of Industry Canada.

Customer Information

Notice: This equipment meets the applicable Industry Canada Terminal Equipment Technical Specifications. This is confirmed by the registration number. The abbreviation, IC, before the registration number signifies that registration was performed based on a Declaration of Conformity indicating that Industry Canada technical specifications were met. It does not imply that Industry Canada approved the equipment.

CE Compliance

Declaration of Conformity

We, U.S. Robotics Corporation of 1300 E. Woodfield Rd. Suite 506, Schaumburg, Illinois, 60173-5446 USA, declare under our sole responsibility that the product, USRobotics model USR4204, to which this declaration relates, is in conformity with the following standards and/or other normative documents.

EN60950-1
EN55022
EN55024
EN61000-3-2
EN61000-3-3

We hereby declare that the above named product is in conformity with the essential requirements and other relevant provisions of **Directive 2011/65/EU.**

The conformity assessment procedure referred to in Article 10(3) and detailed in Annex IV of Directive 1999/5/EC has been followed.

An electronic copy of the original CE Declaration of Conformity is available at the U.S. Robotics website: **www.usr.com**

WEEE Compliance

CONSUMER NOTICE

For the following Countries:

Austria	Denmark	Greece	Latvia	Poland	Spain
Belgium	Estonia	Hungary	Luxemburg	Portugal	Sweden
Croatia	Finland	Iceland	Malta	Romania	Switzerland
Cyprus	France	Ireland	Netherlands	Slovakia	Turkey
Czech Republic	Germany	Italy	Norway	Slovenia	United Kingdom

This product is subject to Directive 2012/19/EU of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE) and, in jurisdictions adopting that Directive, is marked as being put on the market after July 4, 2012 and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements. For further information on the requirements regarding the disposition of this product and collection facilities that maybe available to you, please visit www.usr.com/weee.

Copyright Information

U.S. Robotics Corporation
1300 E. Woodfield Road, Suite 506
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USA