USWD500

CDPD Modem

User's Manual

For CDPD Version 1.1 with UDP/TCP Protocol

Version 3.01
February 5, 1999

FCC Information

The Federal Communication Commission Radio Frequency Interference Statement includes the following paragraph:

> This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and radiates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

The user should not modify or change this equipment without written approval from U.S. Wireless Data. Modification could void authority to use this equipment.

WARNING LABEL

This label will be placed on the final product, clearly visible to all persons exposed to the transmitter. The specific location on the final product will be consistent with each same final product, but will vary in location across various final products, and in any case will always be clearly visible to all persons exposed to the transmitter. The physical size of the label and font size of the lettering will be dependent on the size of the final product, but in any case will always be clearly visible to all persons exposed to the transmitter.

WARNING LABEL EXAMPLE

While this device is in operation, a separation distance of at least 20 centimeters must be maintained between radiating antennas and the body of the user or nearby persons in order to meet the FCC RF exposure guidelines.

Copyright

Trademarks

USWD500 is a trademark of U.S. Wireless Data, Inc.

Limited Warranty

In no event will U.S. Wireless Data, Inc. be liable for any damage, including loss of data or profits, cost of cover, or other incidental, consequential or indirect damages arising from the installation, maintenance, use, performance, failure, or interruption of USWD's products, for whatever cause and on any theory of liability. This limitation will apply even if U.S. Wireless Data has been advised of the possibility of such damage.

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About This Manual

The USWD500 User's Manual was first published by U.S. Wireless Data, Inc., in 1997. This revision is for the USWD500 for CDPD Version 1.1 with UDP/TCP Protocol, issued in July 1998. This manual provides information for setting up, maintaining, and troubleshooting the USWD500 CDPD Modem.

CONTENTS

Chapter 1 Introduction

Who Should Read this Manual

This manual is designed to assist the application software developer with installation, testing, and preparing software interfaces for the USWD500 CDPD Modem. It assumes that the reader has a basic working knowledge of UDP/IP and the use of the AT Command set.

Purpose of this Manual

The purpose of this manual is to help OEM integrators to successfully reach the goal of producing a wireless product integrating the USWD500 CDPD Modem. In this manual, we offer specific technical details, relevant examples, general principles, and guidelines in an effort to bridge the gap between the various engineering and business disciplines. Our guiding philosophy is that providing a top-down, progressive disclosure of information is the best approach to forming a common understanding of any problems and their appropriate solutions.

General Description and Features

The USWD500 CDPD Modem is the network component by which CDPD network subscribers gain access to the CDPD network. Support services provided by the USWD500 include transmission and reception of data across the airlink on a full-duplex basis, medium access control to the airlink, mobile data link procedures, subnetwork convergence features, and end-to-end delivery of network-level packets that are either based on UDP/IP or TCP/IP.

General Features:

- Compact and lightweight (78.9X48.8X9.8mm and 1.6oz.)
- Antenna connector (MMCX Type) supports straight or right angle cable plug
- 0.6 WATT transmit power
- RF protocol: CDPD Specification V1.1
- 30 pin FFC connector interface (.5mm between pins)
- TX: 824.01MHz~848.97MHz
- RX: 869.01MHz~893.97MHz
- 30KHz channel spacing

USWD500 Product Package and Services

Product Package

Your USWD500 package contains the following items. Check to make certain all items are included:

- One USWD500 CDPD Modem
- One USWD500 CDPD Modem User's Manual

Services

- USWD500 CDPD Modem technical training
- On-site consulting

How to Use this Manual

This manual provides information and assistance for both physical installation and programming of the USWD500 CDPD Modem.

Chapter 1: Introduction	Describes the basic concept of the USWD500 CDPD Modem, the general audience for this manual, and how this manual should be used.
Chapter 2: Product Specifications	Provides the hardware specifications, I/O pin assignments, and mechanical specifications of the USWD500 CDPD Modem.
Chapter 3: Installation and Setup	Illustrates the basic information needed to install, set up, and test the USWD500 CDPD Modem on the CDPD network.
Chapter 4: Integrating Considerations	Discusses important issues integrators need for integration of the USWD500 Modem with their device.
Chapter 5: Application Development	Provides additional information for planning and designing CDPD applications in either the UDP or SLIP environments.

Chapter 2 Product Specifications

This chapter provides hardware specifications, I/O pin assignments, and mechanical specifications for the USWD500 CDPD Modem.

Hardware Specifications

This section includes general product specifications for the USWD500 CDPD Modem, as well as specifications for the receiver and transmitter.

General Specifications

The following table summarizes the general specifications of the USWD500 CDPD Modem.

Current dissipation	RF Part 750mA(Max.) Digital Part 160mA(Max.)
Power supply	DC 5.5V±0.5V
Antenna connector	MMCX 50ohm socket
Power/Serial interface connector	FFC
Temperature	0 to +45 degrees centigrade

Receiver Specifications

The following table summarizes the receiver specifications of small form factor as per the FCC Part 409 “Minimum Performance Standards for CDPD Mobile End Systems” for the United States. All performance standards for CDPD Mobile End Systems outside the United States also apply.

RF sensitivity	-111 dBm@BLER<0.05
RF sensitivity w/ Rayleigh fading	-98 dBm, 8km/hr -100 dBm, 50km/hr -100 dBm, 100km/hr
Co-channel interference in Rayleigh fading & delay	17dB, 8□s
RX adjacent/alternate channel selectivity	16dB @ 30 kHz 60dB @ 60 kHz
RX intermodulation	57 dB
RSSI	±6 dB absolute ±3 dB relative
Radiated & conducted spurious	FCC Part15 Specification for the United States
Forward channel busy/idle flag & decode status flag decode	Failure< .001

Transmitter Specifications

The following table summarizes the small form factor transmitter specifications as per the FCC Part 409 “Minimum Performance Standards for CDPD Mobile End Systems” for the United States. All performance standards for CDPD Mobile End Systems outside the United States also apply.

TX frequency stability	±2.5 ppm
TX phase noise	-55 dBc @ 1 kHz -75 dBc @ 10 kHz
Emissions spectrum	±30 kHz, -26 dBc ±60 kHz, -45 dBc ±90 kHz, -60 dBc
TX channel switching time	<40 ms within 2 kHz
TX power control/stability	6 different levels +2/-4 dB +28 dBm, +24 dBm +20 dBm, +16 dBm +12 dBm, +8 dBm
TX on/off & off/on	2ms
Modulation requirements	Mod. Index=.5±5% 19.2 kbps±50 ppm
Radiated and conducted emissions	FCC Part 22 Specification compliant

I/O Pin Assignments (FFC Connector)

The following table provides a list of the pin assignments and descriptions for the USWD500 CDPD Modem. (NC = no connection)

Pin	Signal name	Type	Description
1	DCD	Output	Network Connected (active low)
2	TXD	Output	Output Data From The Modem
3	RXD	Input	Input Data To The Modem
4	DTR	Input	Host Ready Signal (active low)
5	GND	Ground	Signal Ground
6	DSR	Output	Modem Ready Signal (active low)
7	RTS	Input	Host Output Signal (active low)
8	CTS	Output	Modem Output Signal (active low)
9	RI	Output	Pulses For A Modem event (active low)
10	RESET	Input	Modem Reset (active low)
11	NC		
12	NC		
13	VCC	Power	DC 5.5V±.5V, 800mA
14	VCC	Power	DC 5.5V±.5V, 800mA
15	VCC	Power	DC 5.5V±.5V, 800mA
16	VCC	Power	DC 5.5V±.5V, 800mA
17	NC		
18	NC		
19	NC		
20	NC		
21	NC		
22	PWR	Power	DC 5.5V±.5V, 800mA
23	PWR	Power	DC 5.5V±.5V, 800mA
24	PWR	Power	DC 5.5V±.5V, 800mA
25	PWR	Power	DC 5.5V±.5V, 800mA
26	NC		

Pin	Signal name	Type	Description
27	GND	Power	Power Ground
28	GND	Power	Power Ground
29	GND	Power	Power Ground
30	GND	Power	Power Ground

Mechanical Specifications

This section contains the size specifications for the USWD500 CDPD Modem and the specifications for the MMCX RF connector and the FFC 30-pin connector.

Mechanical Size

The mechanical size of the USWD500 CDPD Modem is shown in Figure 2-1.

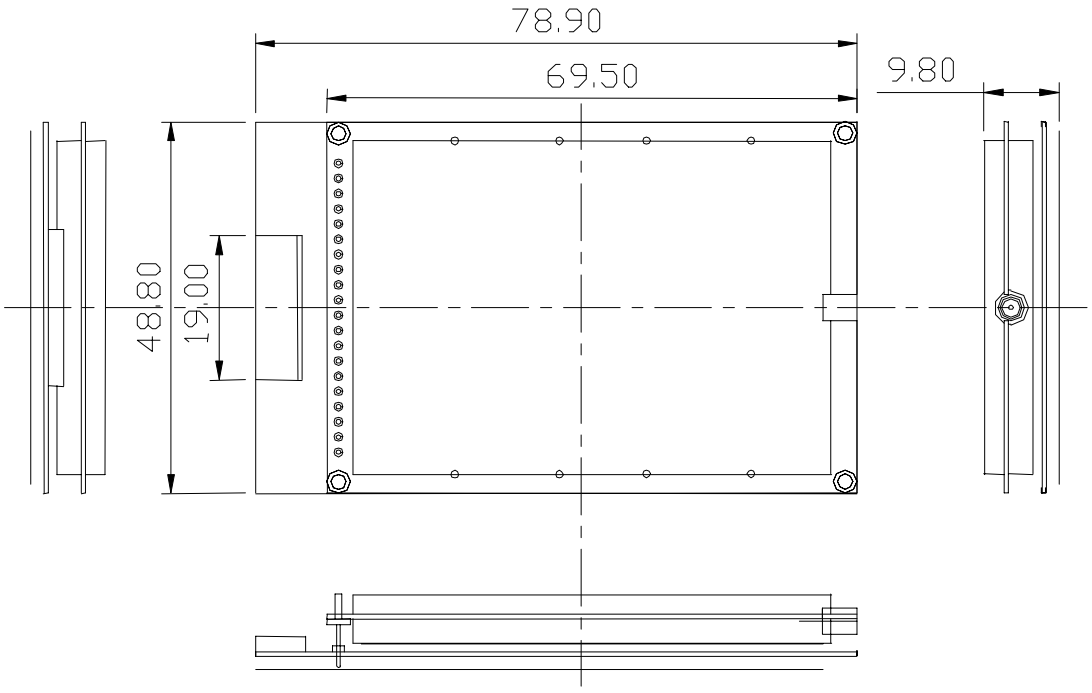
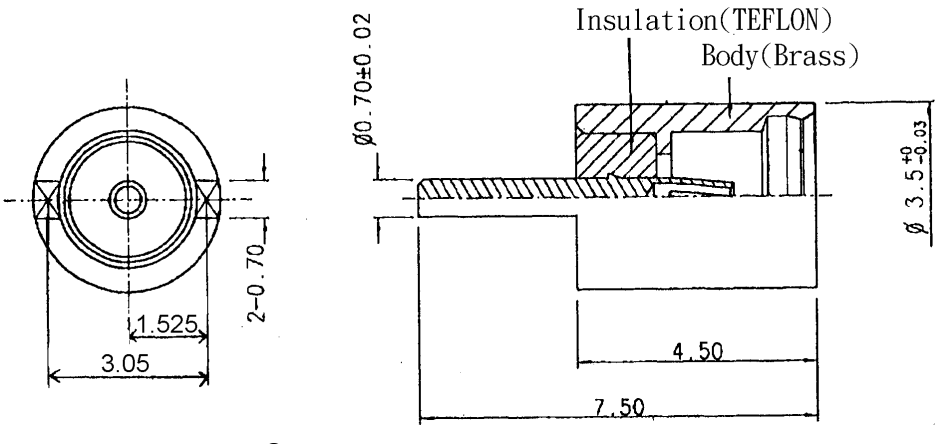


Figure 2-1 Mechanical size of the USWD500 (unit = mm)

MMCX RF Connector

The dimensions of the RF connector, a Huber-Suhner (**P/N: 82 MMCX-S50-0-2**), are provided in Figure 2-2 (unit = mm).

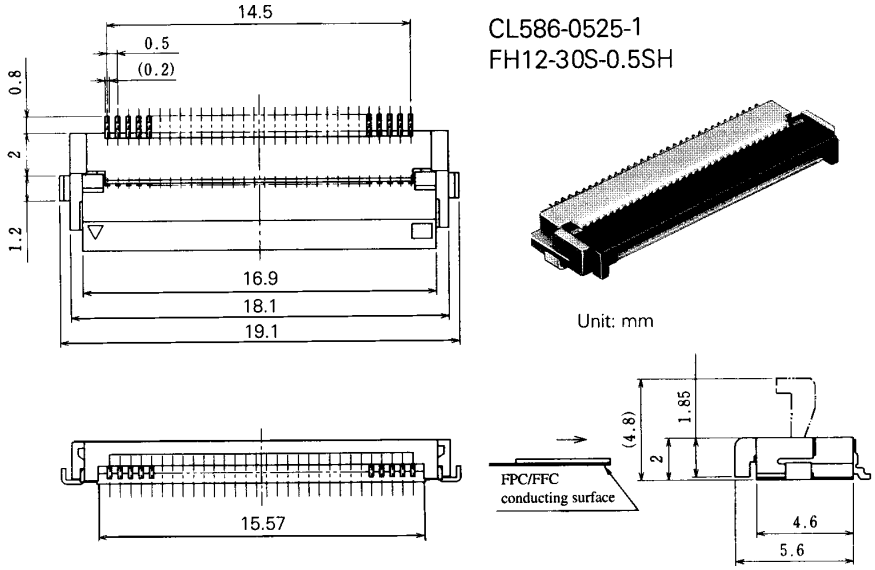


Component materials for the MMCX RF connector are as follows:

- Body: Brass, Gold-plated finish
- Insulator: Teflon
- Female contact: Beryllium copper, Gold-plated finish

FFC 30-pin connector (ZIF)

The FFC 30-pin connector is illustrated in Figure 2-3.



Chapter 3 Installation and Setup

This chapter provides the basic information needed to install, set up, and test the USWD500 CDPD Modem on the CDPD network.

Initial Setup

Initial setup for the USWD500 Modem involves checking that your hardware is connected properly, configuring a software test environment, and testing the link between the USWD500 Modem and your host PC. The following sections describe these processes.

Verifying the USWD500 Working Status

The USWD500 CDPD Modem provides two-way wireless packet communications on the CDPD network for Original Equipment Manufacturers to integrate into a host device. Before physical integration, a stable communicating status between the host and the USWD500 Modem must be verified. Also, you might need to change some of the existing default values of the USWD500 Modem. To this end, a PC-emulation mode is provided for you to change the existing default values and test the working status of the USWD500 Modem. With the appropriate interface cable, you can use a PC or laptop to emulate the host and send AT commands to the USWD500 Modem.

Before using the USWD500 CDPD Modem to develop applications for a wireless data communication environment, you need to test the modem using your host PC. Verify that you have the following items for basic testing:

- ✓ USWD500 CDPD Modem
- ✓ DC power supply 5.5V±.5V 1Amp
- ✓ Cellular antenna for the USWD500 Modem
- ✓ Interface cable between the USWD500 Modem and your host. This cable converts the USWD500 FFC interface into RS-232 or UART for your host.
- ✓ USWD500 CDPD Modem User's Manual (for the AT Command set list and installation procedures)

After you have gathered these items, use the following procedures for basic testing:

Step 1 Establish a Hardware Connection

a. Attach the cellular antenna to the USWD500 Modem.

b. Connect the power adapter to the USWD500 Modem.

c. Attach the one end of the interface cable to the USWD500 Modem and attach the other end of the interface cable to your host.

Step 2 Establish a Software Test Environment

To send AT commands to the USWD500 Modem, find a communications program which will operate in ASCII terminal emulation mode on your PC. This enables your PC to function as a terminal attached to the USWD500 Modem and allows you to enter the AT commands required for modem setup and diagnostics. The following are sample programs:

a. PROCOMM PLUS Terminal Emulation

b. HYPER WINDOWS TERMINAL in WINDOWS 3.1

c. TERMINAL in WINDOWS 95

d. TELIX or similar alternatives

In the communications program you choose, set the parameters for the interface cable as follows:

19200 bps, 8 data bits, No parity check and 1 stop bit.

***Caution**: The above parameters are set for communication between the USWD500 Modem and the host PC. These are the default values for the USWD500 Modem. You must set the same parameters with your communications program so the host PC can obtain its initial connection to the USWD500 Modem. Setting your host PC's communications program to half-duplex allows you to view what you're typing.*

Step 3 Power Up the USWD500 Modem

This procedure ensures the link is functioning properly between the USWD500 Modem and the host PC. Use the following procedure to verify.

a. Run your ASCII terminal emulation program and make sure your PC is connected to the USWD500 Modem with the appropriate interface cable.

b. Once the software test environment is running, turn on the power supply.

c. If your ASCII terminal emulation program is already running, turn the power supply off and on again. At this point, you should receive "**OK**" or "**0**" from the USWD500 Modem.

An alternative method for verifying the connection is to enter **AT** in your communications program and then press ENTER. If you get an **OK** response, you have set up the connection correctly.

The following table shows the various types of responses you can receive:

OK	Verbose response
0	Terse response
OK	Verbose response with STX ETX LRC framing
0 3	Terse response with STX ETX LRC framing

Note that the USWD500 Modem has been optimized for performing electronic credit card authorizations. Because of this, its modem characteristics may differ somewhat from a typical Hayes-compatible modem. It can, however, perform just like a Hayes-compatible modem.

In general, most Hayes-compatible modems use command responses framed in Carriage Return and Line Feed characters. However, since the USWD500 Modem is used extensively in the credit card authorization environment, its default response messages are framed in the STX (start of text), ETX (end of text), LRC (longitudinal redundancy check) fashion. Its default response is also displayed in terse, non-verbose, or numeric format. This type of framing and non-verbose responses are much more compatible with credit card authorization equipment.

If you want to receive normal Hayes-compatible responses from your USWD500 Modem, use the **AT!T0** command to shut off framing and the **ATV1** command to enable verbose responses.

If you continue to receive intermittent responses from the modem's AT command, check your power supply regulation. Note that 5.0V DC is the *absolute minimum* voltage requirement. If the AT command still doesn't return a response, you should contact your USWD500 Modem supplier for technical support.

When initial **OK** messages are displayed after powering up, or you receive an **OK** response after issuing the **AT** command in your communications program, the basic functionality of the USWD500 CDPD Modem's digital circuitry is working correctly.

Connecting to the CDPD Network

This section provides a quick installation guide to familiarize you with the critical steps required for successful communication with the CDPD network using a USWD500 Modem. After you have received the **OK** message in the previous section "**Verifying the USWD500 Working Status**", proceed with the following steps.

Step 1 Set the IP Address and Side Preference

Before the USWD500 Modem will operate on the CDPD network, you must specify an Internet Protocol Address (IP Address) and a side preference (A or B) for your network carrier. Specific details are provided in **"General Parameters Setup"** on Page 20, with the setup procedures described in detail.

These parameters must be set before connecting to the CDPD network. Obtain these values from your CDPD network carrier or service provider. After you have determined the appropriate values, refer to **"General Parameters Setup"** on Page 20**,** for setting the parameters.

Step 2 Verify the status of other parameters

AT commands for setting up other parameters are described in more detail in **"Advanced Parameters Setup"** on Page 23, which includes setup procedures for communications port parameters, UDP parameters, SPI/SPNI/WASI parameters, S-Registers, and Sleep Mode parameters. You can either change these parameters using AT commands or simply use the factory default settings.

The following table shows the factory default settings for the USWD500 Modem.

Parameter name	Command
Side Preference setup	AT\N3
Baud Rate	19200 bps
Data Bits Length	Fixed (8 bits)
Auto scan enable	AT!A1
SLIP disable	AT!S0
UDP enable	AT!U1
H/W Flow Control	AT\Q2
Automatic TX time out enable	AT\T1
Local socket port	S80=1025
Command mode echo off	ATE0
On-line Mode echo off	ATF0
Disable Quiet mode	ATQ0
Use verbose result code	ATV1
DCD follows the state of the "RF In-Range" condition.	AT&C0

DTR is ignored	AT&D0
DSR is always active	AT&S0
Data forwarding characters are included in packets to the remote data service	AT\F3
Enable data forwarding character recognition	AT\M1

Step 3 Determine the scan mode

The **Auto Scan Mode** scans all channels and selects a channel for connection. The **Manual Set Mode** dedicates a specific channel number for connection to the CDPD network. Choose either Auto Scan Mode or Manual Set Mode using the **AT!A1** or **AT!A0** commands respectively.

Find the instructions for determining the scan mode in "

Selecting the Channel Scan Mode" on Page 22. If **Auto Scan Mode** is selected, skip to Step 5.

Step 4 Set the channel number

If you chose **Manual Set Mode**, set the channel number with the **ATS60=*xxxx*** command, where *xxxx* is the channel number (in decimal). You can find more information about this step in "

Selecting the Channel Scan Mode" on Page 22.

Step 5 Check the status of UDP and SLIP mode

Use the **ATS14** command to check for UDP or SLIP mode. For example:

ATS14	**Read register S14**
152	**UDP mode is disabled and SLIP mode is enabled**

...or

168	**UDP mode is enabled and SLIP mode is disabled**

The following table describes each command for changing UDP or SLIP mode.

Command	***Result***
AT!S0	SLIP mode is disabled.
AT!S1	SLIP mode is enabled.
AT!U0	UDP mode is disabled.
AT!U1	UDP mode is enabled.

Step 6 The "CONNECT" message

When UDP mode is *disabled*, use the **ATD** command for connection setup as follows:

ATD	**Dial when UDP is disabled.**
CONNECT	**The connected message (and enter on-line mode).**

When the "**CONNECT**" message is displayed, it means the USWD500 Modem is successfully connected to the remote terminal. You are already in **ON-LINE** mode and ready to start transmitting and receiving data. For example:

ATD;	**Dial when UDP is disabled.**
CONNECT	**The connected message (and back to command mode).**

The "**;**" *dial modifier* is used to return to **Command** mode after your connection setup is complete. You can also use the **ATS57** command to check the connection status. For more information about the **ATS57** command and **ON-LINE** mode, refer to **"Useful Commands"** on Page 26.

When UDP mode is *enable*d, use the **ATD(*remote address*)/(*remote port*)** command for connection setup as follows:

ATD203.67.40.254/7	**Dial and enter on-line mode when UDP is enabled.**
CONNECT	

...or

ATD203.67.40.254/7;	**Dial and back to command mode when UDP is enabled.**
CONNECT	

Step 7 USWD500 Disconnection

To disconnect from the CDPD network, use the **ATH** command that best applies to your situation, as described in **Appendix A "AT Command List"** on Page 43.

Problem Solving Table

If you are still unable to connect to the CDPD network, use the AT commands provided in this table to help you resolve the following issues:

Issue	Determine with these AT commands
Is RSSI unstable?	Repeat the **AT!R** command to determine the current RSSI value.
Is the modem channel scanning?	Repeat the **AT!D** command to determine the current channel value.
Is the IP address correct?	Issue the **AT!I?** command to check the current IP address.
Is the side preference setting correct?	Issue the **ATS57?** command and check bits 6 and 7. These indicate the current side preference setting. Refer to the table on Page 50 for bits 6 and 7 definitions.

Parameters relating to RSSI value, the IP address, the side preference, UDP, etc. are critical to your CDPD network connection. Read Chapter 3 of this manual thoroughly to verify you have set important parameters appropriately. To obtain further support, contact US Wireless Data's technical support team at **(510) 596-2025**.

General Parameters Setup

This section describes how to set up the USWD500 Modem's general parameters. This involves setting the IP address, the side preference, and the channel scan mode.

IP Address Setup

Before using the USWD500 Modem on the CDPD network, you need to set an IP address for the modem. This address should be furnished by the CDPD network carrier. Use the **AT!I?** command as shown to check whether the IP address has been set. For example:

```
AT!I?

203.67.40.245
```

After .entering the **AT!I?** command, the USWD500 Modem responds with

"**203.67.40.245**," which means this modem has the IP address 203.67.40.245 currently assigned to it.

If the IP address has not yet been set, enter the IP address using the **AT!I**xxx.xxx.xxx.xxx/***password*** command as follows.

AT!I203.67.40.244/*password*	**Set the IP address**
Ok	

Use the **AT!I?** command to verify that the IP address has been set:

AT!I?	**Test: inquire the IP address**
203.67.40.244	**IP address entered as 203.67.40.244**

Note*: You must reset the USWD500 Modem by typing the* ***ATZ*** *command after setting the IP address.*

Side Preference Setup

You have to specify which service provider side (A or B) should be searched for a usable CDPD channel. There are usually 2 service providers, an **A side carrier** and a **B side carrier**. Your carrier should have either already set this value, or provided you with their preference. The default for the USWD500 Modem is "**A side prefer**", which may not be appropriate for your application.

The command to configure the appropriate side setting is **AT\N*n***, where *n* is a value representing one of the following:

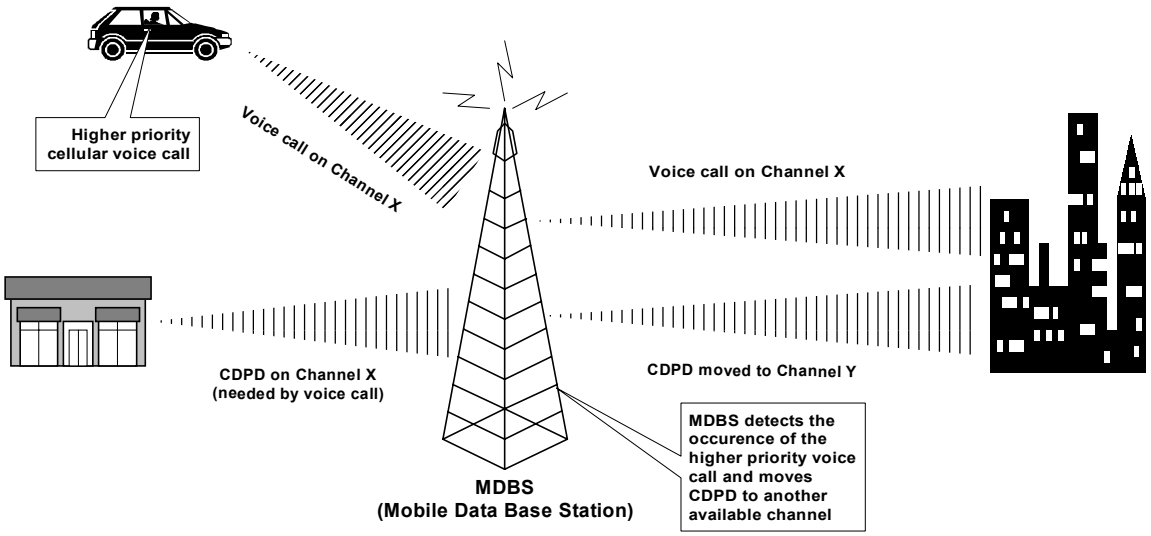
n =	***RESULT***	***OTHER***
1	***"*Side A only"**	If no A channel found, look on B side
2	***"*Side B only"**	If no B channel found, look on A side
3	***"*Side A prefer*"***	
4	***"*Side B prefer*"***	

As an example, you can use the **AT\N*n*** command to specify the service provider side as follows:

AT\N4	**Set side preference as "B prefer"**
ok	

Selecting the Channel Scan Mode

In CDPD technology, the theory is to use any available channel when it's not in use for a voice call. Some areas, however, have dedicated CDPD channels (ie. no voice traffic). In areas where this is not the case, voice users theoretically have a higher priority for channels than CDPD users. If a voice call needs a channel already in use for CDPD, the mobile data base station (MDBS) notes the occurrence and moves CDPD to another available channel. The USWD500 Modem detects the fact that the current channel no longer supports CDPD and begins channel searching to find a new CDPD channel.



Note: Some geographic areas provide dedicated CDPD-only channels.

The USWD500 Modem provides two modes for channel scanning. The **Auto Scan Mode** is used to search all CDPD channels and find the most appropriate channel in the service area. The **Manual Set Mode** is designed to save scanning time. If you know the most appropriate channel in your service area, you can directly assign the channel manually to avoid taking the time necessary to scan all channels. Examples for setting either mode are as follows:

Auto Scan Mode

AT!A1 **Change to auto scan mode**

ok

...or

Manual Set Mode

AT!A0	**Change to manual set mode**
ok	

Further details on these commands are provided in **Appendix A**, **"AT Command List"** on Page 43.

If you select **Manual Set Mode**, use the following procedure to set up the channel number.

Manual Set Mode: Setting the Channel Number

When you select **Manual Set Mode** to connect to the CDPD network, use the **ATS60=*n*** command (where *n* is the channel number) to set the desired channel number. For example:

ATS60=799	**Set the channel number as 799**
ok	
ATS60	**To query the channel number**
799	
ok	

Note**: The* **ATS60=*n *command is ineffective if your USWD500 Modem is set to auto scan mode.*

Advanced Parameters Setup

The advanced parameters in this section include Serial Port parameters, UDP parameters, SPI/SPNI/WASI parameters, S-Registers and Sleep Mode parameters.

Serial Port Parameter Setup (Optional)

Use the Serial Port parameters to configure the communications port setting between the host PC or device and the USWD500 Modem. The Serial Port parameters include baud rate, data bits length, parity check, and stop bits length. These parameters have default values set as follows:

19200 bps, 8 data bits, No parity check and 1 stop bit.

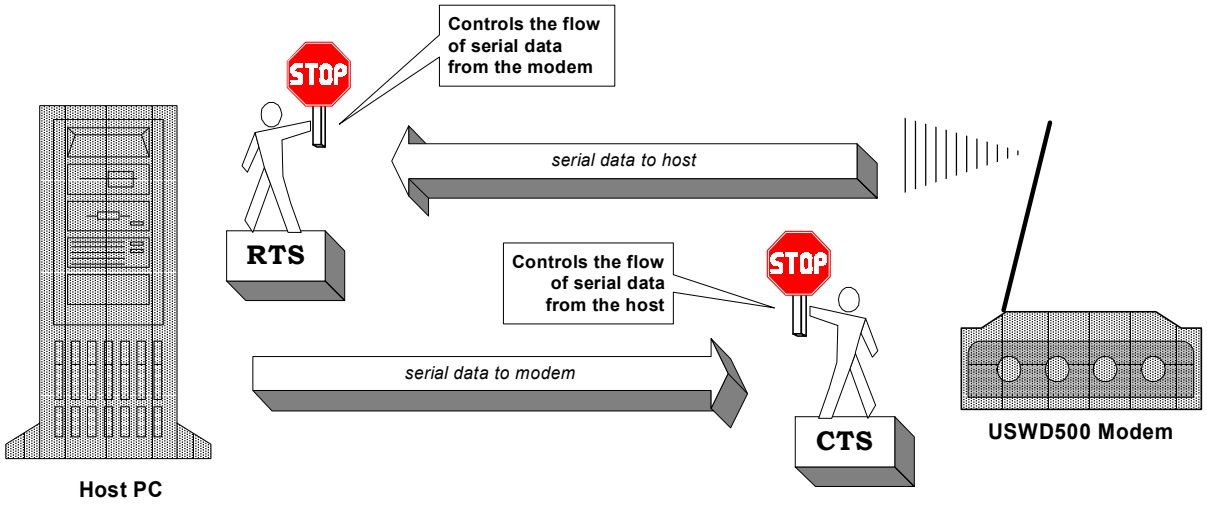
Adjust the baud rate using the **AT&L*n*** command (where *n* is the desired baud rate). For example:

AT&L9600	**Changes the baud rate to 9600 bps**
ok	

***Note**: After changing the baud rate setting, you must also change the baud rate setting in your communications program on your host device to the same value. Otherwise, the host device will no longer communicate with the USWD500 Modem.*

Hardware Flow Control Setup

RTS/CTS flow control is part of a family of flow-control methods collectively referred to as "hardware flow control." Hardware flow control methods use RS-232 control lines to start and stop the flow of serial data. With RTS/CTS, the host uses RTS to start and stop the flow of data from the USWD500 Modem. The USWD500 Modem uses CTS to start and stop the flow of data from the host. This process is described in the following illustration:



RTS/CTS Hardware Flow Control

When RTS is inactive, the USWD500 Modem cannot send data to the host. For the same reason, when the USWD500 Modem is busy transmitting data to the CDPD network, it asserts CTS to stop the flow of data. An example of the command for controlling hardware flow is provided below:

AT\Q2	**Enable hardware flow control**
ok	

DTR/DSR Operation Mode Setup

DTR, (which means **Data Terminal Ready)**, is controlled from the host PC or device. Pulsing DTR will disconnect your connection and return you to AT command mode. There are three DTR operation modes for the USWD500 Modem. The commands for each mode are shown below:

AT&D0	**DTR is ignored**
AT&D1	**Enter command state upon detecting active-to-inactive transition of DTR.**
AT&D2	**Closes the connection upon detecting active-to-inactive transition of DTR. Equivalent to executing ATH2 command. Auto-answer is disabled while DTR is inactive.**

DSR (which means **Data Set Ready)**, is sent out from the USWD500 Modem under the following conditions:

AT&S0	**DSR is always active**
AT&S1	**DSR following the state of the "Connection Established" condition.**

Pulsing DTR is the preferred hardware method for hanging up or breaking your (UDP) connection.

UDP Parameters Setup

The local socket port register **S80** is an important parameter for UDP mode. By adjusting the **S80** register, you can define your own port number for the USWD500 Modem. Other users can then use this port number to communicate with your USWD500 Modem in UDP mode. Don't forget to store your modem's register configuration (**AT&W**) and reset your USWD500 Modem (**ATZ**) after changing the port number of the **S80** register.

SPI/SPNI/WASI Parameters

SPI (**Service Provider Identity**) is defined by socket port register **S61**. This parameter is used by your service provider to determine whether your USWD500 Modem is legal.

SPNI (**Service Provider Network Identity**) is defined by socket port register **S62**. This parameter is used by your service provider to recognize what service network can be issued to the users.

WASI (**Wide Area Service Provider Identity**) is defined by socket port register **S63**. This parameter is used by your service provider to recognize users from

other service providers. Using this parameter, your service provider can monitor the records of users from other service providers to address billing issues.

The values for these three parameters should be provided by your service provider. The default value is 65535, which instructs the USWD500 Modem to communicate with the service network without verifying identities.

S-Registers

S-Registers are used to save the necessary parameters. Use the **ATS*n*=** command to write the value. Use the **ATS*n*?** command to read the value. Refer to **Appendix B, "S-Registers"** on Page 48 for a more detailed description of S-Registers.

Sleep Mode Parameters

When the USWD500 Modem ends its communications with the system network, the timer (**T203**) begins counting down. When this timer times out, the USWD500 Modem goes to sleep for a period specified by **T204** and then wakes up. The **T204** time period is provided by the MDBS of the CDPD cellular system while the USWD500 Modem is registered on the system. A typical **T204** time period is about 90 seconds.

Set the timer **T203** by adjusting register **S59**. For example:

```
ATS59=5                    Set the T203 timer to 5 sec.

ok
```

Note: *By monitoring bit 1 of the **S57** register, you can determine whether or not the USWD500 Modem is sleeping. (**S57** bit **1** – sleep state: **0** = not sleeping, **1** = sleeping)*

Useful Commands

Quick Connection to the CDPD Network

After the USWD500 Modem is successfully installed, you don't have to repeat every step in Chapter 3, **"Installation and Setup"** on Page 12 to connect to the CDPD network. For the second and all subsequent connections, use the following procedures for quick connection.

Before using the quick connection procedure, save the destination addresses using the "**AT&Z**" command.

For example:

AT&Z?	**List all saved addresses.**
0: xxx.xxx.xxx.xxx/x **1: xxx.xxx.xxx.xxx/x** **2: xxx.xxx.xxx.xxx/x** **3: xxx.xxx.xxx.xxx/x** **4: xxx.xxx.xxx.xxx/x**	**Saved addresses in address 0 ~ 4** **xxx = 0 ~ 255**
AT&Z*n*=adds	**Save "adds" as dial address <*n*>,** **adds = xxx.xxx.xxx.xxx/x, and *n* = 0 ~ 4**
ok	

After saving the destination addresses, use the **"ATDSn**" command for quick connection to the CDPD network. For example:

ATDS*n*	**Speed dial with saved address <*n*>, *n* = 0 ~ 4.**
CONNECT	**message for successful connection**

Get Status Command

Reading the RSSI Value

RSSI means **Received Signal Strength Indication**. Use the **AT!R** command to monitor the signal strength received by the USWD500 Modem as follows:

AT!R	**Request for the RSSI value**
-87	**The signal strength received is -87dBm**

***Note**: The unit of the returned value is dBm. (At -87dBm, -85dBm would be greater signal strength, while -89dBm would be less signal strength.)*

To Get Connection Status

The **ATS57** command can be used to monitor the status of your connection while trying to connect to the CDPD network. For example:

ATS57	**To get connection status**
0	**Disconnected from the CDPD network**

***Note**: Check S57 bit 0 to verify the connection status. If the response value is even (ie. 0, 2, 4, 6, 128), it means that the USWD500 Modem is not currently connected to the CDPD network. If an odd value (ie. 1, 3, 5, 139) is returned, the USWD500 Modem is connected to the CDPD network.*

ON-LINE/OFF-LINE Mode

When the USWD500 Modem is connected to the CDPD network, you can use the **ATO** command to enter the ON-LINE mode. Only in the ON-LINE mode can you transmit and receive data between a remote host and the local host. Otherwise, all characters will be command strings directed to the USWD500 Modem. The following illustrates the procedure for entering ON-LINE mode:

CONNECT	**Message for successful connection**
ATO	**Get into ON-LINE mode**
this is a test string	**Send test data string to the remote host**

***Note**: You can only use AT commands if the "**CONNECT"** message is displayed. Otherwise, an error message appears.*

If you want to send an AT command to the USWD500 Modem and you are currently in ON-LINE mode, you must leave the ON-LINE mode using the "**+++**" **escape command** as follows:

+++	**Leave ON-LINE data mode/Return to AT command mode**
AT	**OFF-LINE (command) mode**
ok	

If you are in data mode after the last data character you sent, you must wait for a guard time (register **S12**) before typing **+++**. The guard time is defined using register **S12**. After sending **+++**, wait for the same guard time before entering AT command mode.

Using the USWD500 Modem with a Terminal Emulation Program

UDP Concept

UDP (User Datagram Protocol) is defined in RFC768. This protocol provides a procedure for the application program to send messages to other programs with a minimum of protocol mechanism.

A *socket* is an internal communications endpoint. A *socket port* is a number that identifies a socket from the outside. The *port number* is part of the network address. Use the **ATS80** command to set your USWD500 Modem's socket port.

Data Transmitting and Receiving Under UDP Protocol

The USWD500 Modem provides UDP protocol in its protocol stack. You can send and receive UDP packets from the Internet. Before using UDP, make sure that the modem's network status is **CONNECT**. Re-issue the **AT!D** command. The first three characters of the returned string should be **RCI**.

After connecting the USWD500 Modem to the CDPD network, you must enter the ON-LINE Mode for data transmitting and receiving. Use the following command to set the remote IP address and the port number for UDP.

For example:

ATD203.67.40.248/7;	**set remote IP address and port number for UDP**
CONNECT	**the network status**
ATO	**enter the ON-LINE mode**
test-test-test-test-test	**send out UDP in packets**
test-test-test-test-test	**receive message echoed from the remote host, if the UDP echo service is running.**
+++	**leave the ON-LINE mode**

When Will the USWD500 Modem Send Out Queued Data?

Buffer full

When the transmitting buffer of the USWD500 Modem is full, the modem automatically sends out the data queued in the buffer. Simultaneously, the USWD500 Modem sends a **CTS high** signal to the host indicating that the modem is *not* ready. After the data is sent, the modem returns a **CTS low** signal to the host indicating that it's now ready and the data can again be sent.

S50 Time Out (Data Forwarding Idle Time Out)

The automatic transmit control function can be enabled or disabled by the user. If you enable this function using the **AT\T1** command, you also need to set **S50** with the **ATS50=*t*** command (where *t*= 0 ~ 255). Then save the register value (**AT&W**) and reset (**ATZ**) the modem to restart the connection. Therefore, if the USWD500 Modem waits for more than the **S50** time period and does not receive any more data or data forwarding characters, it will automatically send out the data queued in the transmit buffer.

You can disable the automatic transmit control function using the **AT\T0** command. The modem waits until it receives a data forwarding character, or its buffer becomes full.

Receive a data forwarding character

Using the **AT\F** command, users can select the data forwarding operation rule. For details on this command, refer to the extended AT command set. You can set up **S51** (primary data forwarding character) and **S52** (secondary data forwarding character) before selecting the data forwarding operation rule. Remember to save the register value and reset the modem after you change any register values. If you enable the data forwarding operation function, the USWD500 Modem sends out the data after receiving a data forwarding character.

Broadcast and Multicast

Broadcast

Because the **Broadcast IP** address is network-dependent, the service provider should issue the **Broadcast IP address** to CDPD users. The broadcast IP address can be set in register **S82** using the **ATS*n*** command (where *n* is the IP address). For example:

```
ATS82=203.67.40.244

OK
```

By setting register **S84**, you can choose the unicast, broadcast, and multicast independently. The default value of register S84 is 1 (decimal), which means bit 0 (for unicast) is unmasked. To enable the USWD500 Modem to receive broadcast packets, bit 1 of register S84 should be unmasked also.

Multicast

Because the **Multicast IP addresses** is also network-dependent, the service provider should issue the **Multicast IP addresses** to users. The multicast IP addresses can be read using the **AT!M** command. For example:

```
AT!M?

0  0.0.0.0/0    offline     The default value of IP/gmid is
1  0.0.0.0/0    offline     0.0.0.0/0  offline
2  0.0.0.0/0    offline
3  0.0.0.0/0    offline
4  0.0.0.0/0    offline
```

The multicast IP addresses can be set by using the **AT!M*n*** command (where *n* is the IP address). For example:

AT!M0=203.67.40.248/1

To use the USWD500 Modem in the multicast mode, bit 2 of register S84 should be unmasked. After setting the S84 register, the USWD500 Modem needs to be registered with the system again. Then, for example:

AT!M?

0 203.67.40.248/1 online

1 0.0.0.0/0 offline

….

Chapter 4 Integration Considerations

This chapter provides OEMs (Original Equipment Manufacturers) with discussions of critical research and development (R&D) issues that must be considered to ensure successful integration of the USWD500 CDPD Modem into their host platforms. This overview identifies your areas of responsibility and U.S. Wireless Data's level of support required to resolve each issue. The following list summarizes the R&D procedures, including many tasks that you need to perform when integrating the USWD500 Modem.

Determining End Product Use

Because all design considerations are driven by an effort to meet the needs of the final user, it is important to have a clear understanding of how the end product will be used. For example, design issues related to a mobile device (e.g. POS terminal), such as the EMI (electromagnetic interference) generated by a vehicle's engine and vibration, are completely different from considerations required for a fixed telemetry application device. Knowing what is and what is not important to the end user helps make engineering decisions in every product design.

It is your responsibility to develop the usage model. U.S. Wireless Data is available to provide assistance and answer questions related to the USWD500 CDPD Modem, but is not directly involved in this phase.

Amount and Frequency of Messages Sent/Received

It is important to determine how much and how often data will be sent in each of the uplink (terminal to network) and downlink (network to terminal) directions. Does the end user turn the terminal on and run for a long time (e.g. 8 hours a day)? Does the user turn on the unit only when making a query to the host system? This information has a critical influence on the requirement for battery capacity and the values of sleep mode.

You are responsible for developing the message model. A helpful approach for creating this model is to define the peak and average throughput requirements based on input from the user.

Hardware Design Considerations

The process of integrating the USWD500 CDPD Modem into a hardware design requires many considerations, such as power requirements, heat dissipation, and physical mounting of the unit to ensure proper grounding.

Hardware design is your responsibility, though U.S. Wireless Data can provide recommendations where applicable.

Power Supply Considerations

The type of power supply and other specifications are determined according to the needs you defined in Chapter 3, “Installation and Setup.” As with hardware design in general, designing an appropriate power supply is your responsibility.

Identifying the Source Antenna

A typical interface to the USWD500 Modem’s antenna connector (MMCX) would consist of RG-178 coax cable attached to a TNC, SMA, multi-UHF type antenna connector. The USWD500 Modem operates using standard mobile cellular radio signals (825 – 900mhz) and any standard cellular antenna of good quality, and compliant with FCC requirements.

Setting Up a Development Test Environment

To facilitate hardware and applications development, a field test should be run. Supplementing the test environment supported by U.S. Wireless Data, your network carrier sometimes provides a live development network (separate from the production network) on which you can develop and test your application. You are responsible for negotiating with the network carrier for air-time and for building and maintaining a development test environment at their facility.

Developing Software Applications

Development involves designing, coding, and testing end-to-end applications between the wireless terminal and host. In addition to your specific software application, U.S. Wireless Data suggests that you incorporate RF specific reporting and monitoring features, such as RSSI (Received Signal Strength Indicator), channel quality, and in-range/out-of-range conditions.

Performing EMI Testing

A proper design requires that you minimize EMI (electromagnetic interference) radiated from your product’s platform. Excess noise reduces the USWD500 Modem's ability to receive, making the network less likely to be heard. It is your responsibility to complete the testing.

Obtaining Regulatory Approval

All commercial RF devices must display a regulatory label on the host case of the product. You must obtain the regulatory certification for each country in which your product will be sold.

Final Assembly Testing

It is important to perform an end-to-end test to ensure proper assembly of the final product and to prove that the final product can receive and transmit at the required signal levels. Refer to **Chapter 3**, **"Installation and Setup"** on Page 12 to verify that all connections to the USWD500 Modem are made correctly.

Installation and Field Testing

To guarantee that your device is located in an area of good CDPD coverage and that end-to-end loop-back messaging is possible, you must perform an installation and field testing procedure. Refer to **Chapter 3**, **"Installation and Setup"** on Page 12 to determine testing procedures for both installation and connection to the CDPD network.

Chapter 5 Application Development

Scope of Application

The USWD500 CDPD Modem is well equipped for a wide variety of applications. It can be applied to the following categories:

Public Service (Police, Fire, Security)

The USWD500 Modem can provide real-time information access and improve resource management for police and fire departments, building inspectors, utility companies, and other public service agencies. For example, the USWD500 Modem can provide law enforcement agencies with instant access to criminal databases and motor vehicle administration records. It's the sort of product that will improve response time and increase productivity.

Telemetry

The USWD500 Modem can help you gather the latest information on weather conditions, current inventory in vending machines, or the status and location of a fire alarm. You are also able to correct errors or resolve problems without going to the remote host. Utility companies are able to remotely monitor and record gas, electric, and water meters.

Point of Sale

The USWD500 Modem can turn product into profits faster. The product has a reliable and secure encryption method for credit card verification and other point-of-sale applications. The USWD500 Modem provides tighter control on inventory, improves customer payment processing, and reduces billing and collecting problems. It can also provide real-time ordering.

Transportation

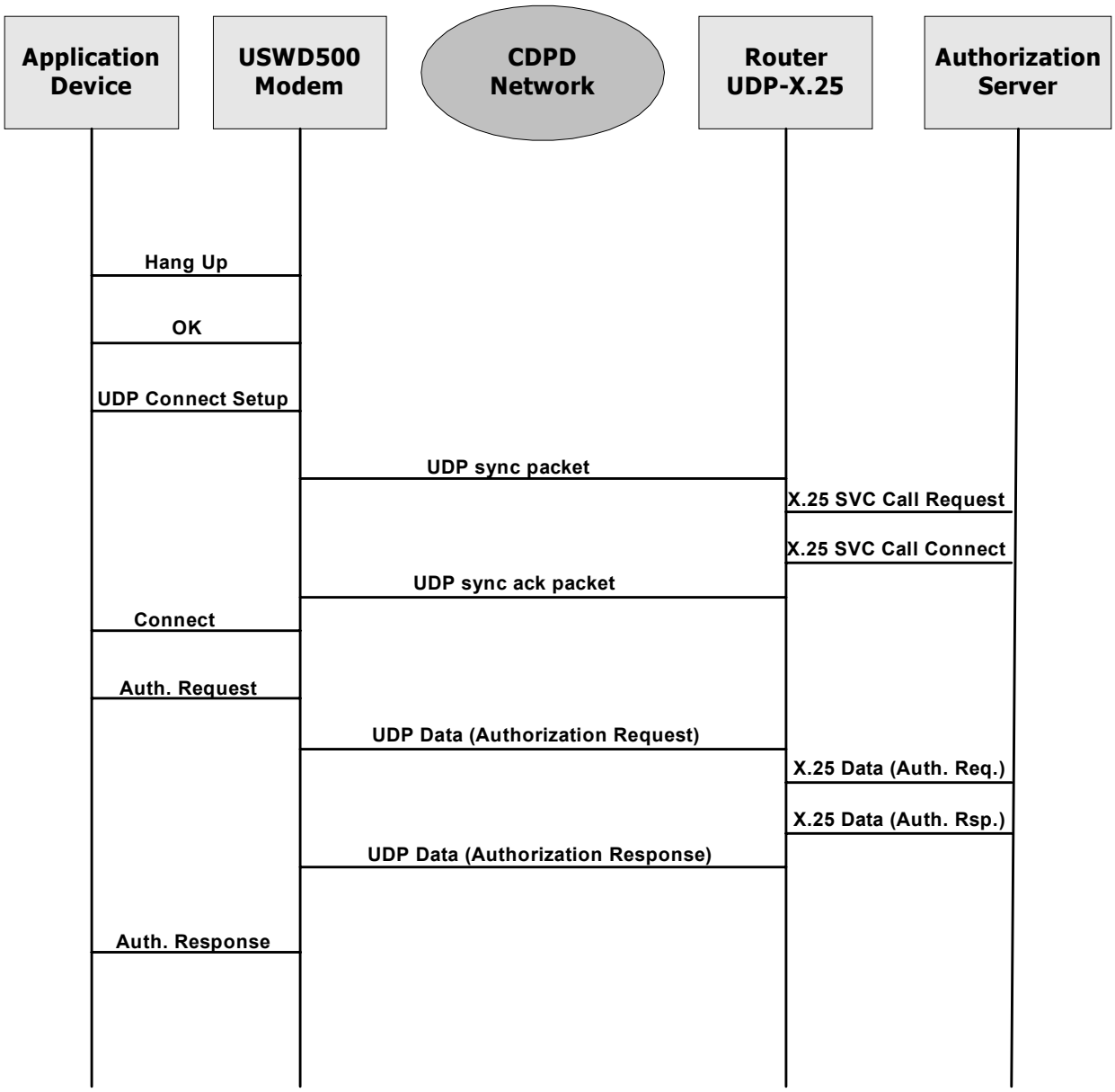
Messages can be transmitted to taxis or company trucks with pick-up and delivery instructions using the USWD500 Modem. Combining the USWD500 Modem with GPS makes it possible to locate and route vehicles in the field. Wireless data takes the shortest route between points and provides you with access to tracking and rerouting in real time. Information is available at hand whenever you need it.

On-Line, Point-to-Point Communications

The USWD500 Modem also provides point-to-point communications. For example, while monitoring the water-level of a reservoir, you can use the modem to send the water-level data from the remote site.

Example: Credit Card Verification with the USWD500 Modem

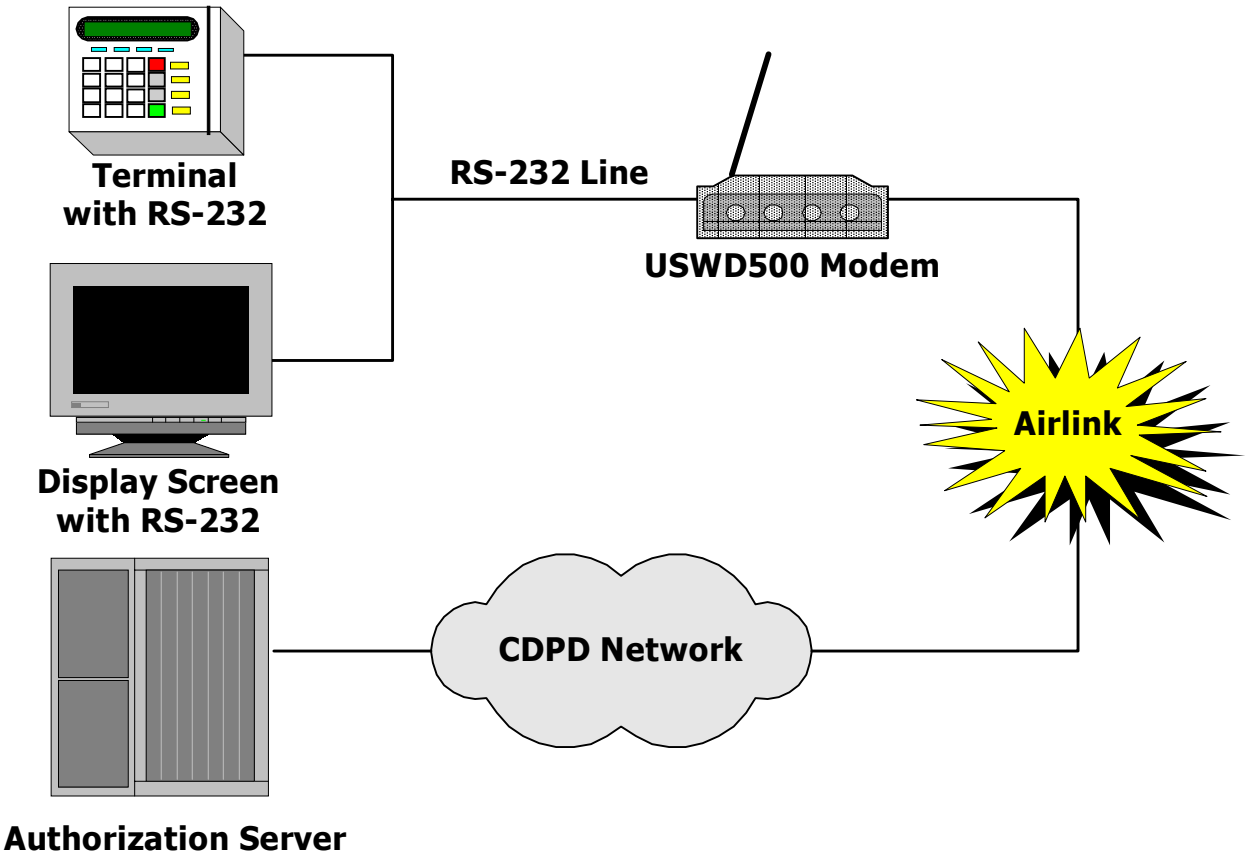
The following figure shows a sample of message exchanges in a typical credit card authorization application. Here we use UDP protocol to minimize billable byte count.



The following steps provide a solution for designing credit card verification with the USWD500 Modem:

Step 1 ***Determine the system architecture of credit card verification.***

For example:



Step 2 ***Determine the control pins of the required RS-232.***

As in these examples:

DTR: Terminal is ready

DSR: USWD500 Modem is ready

DCD: CDPD network connected

These pins are used for card readers or display screens to notify users to start executing credit card verification.

Step 3 Define data formats for transaction.

The data formats include the output format of the card reader, authorization request format, and authorization response format. You can enable data encryption here by using the defined specific data format.

Step 4 Credit card verification process

When a customer pays with a credit card, the card reader reads the information from the credit card and sends this data to the authorization server on the CDPD network. If this transaction is confirmed by the credit card center, the USWD500 Modem receives a confirmation message at the local site and displays messages identifying the transaction as valid.

Step 5 The application layer with a point-of-sale device

The following is a typical sequence of commands you would perform to complete the initialization/power-up process and the authorization procedure.

Initialization is usually performed during power-up or is part of a function key procedure. To begin the initialization procedure, raise RTS prior to sending these commands in sequence. Remember to clear your device's receive buffer just prior to sending commands.

Pause for 1 second after sending the **&F** command. There is no need to interpret responses to this command.

AT&F	Factory reset

The response to each of these commands should be **<STX>0<ETX>{lrc}**. Any other response is an error condition. All responses will be framed in **<STX>response<ETX>{lrc}** format. A 5-second timeout for receiving the response is a good guideline.

AT\N3	Set side preference to **A preferred** (3) (See Note 2.)
AT&W	Save to non-volatile memory

Pause for 2 seconds after sending the **ATZ** command. There is no need to interpret the response to the **ATZ** command.

ATZ	Reset the device.

Before you begin the transaction procedure, you should continuously issue the **AT!D** command. When **AT!D** returns a status of **RNI**, you're ready to begin the transaction procedure.

Performing a Transaction

First, a disconnect/hang-up should be performed. Then check signal status to determine if signal quality is adequate for transmission. If the signal is okay, then connect to the cell site the same way a telephone-based modem would dial. After a successful connection, send the authorization request just as you would from your dial application, then wait for a response. After the response is received, an additional disconnect/hang-up should be performed.

Steps Required to Perform a Credit Card Transaction

FUNCTION	COMMAND	RESPONSE
Hang-up or Disconnect	Toggle RTS or transmit **+++ATH2**	**<stx>0<etx>{lrc}**
Check signal status	**AT!D**	**<stx>RNI0310729<etx>{lrc}**
Connect to IP and Port	**ATD111.222.333.444/8000**	**<stx>1<etx>{lrc}**
Transmit Request and Receive Response	N/A	N/A
Hang-up or Disconnect	Toggle RTS or transmit **+++** (wait for guard time, S12) then **ATH2**	**<stx>0<etx>{lrc}**

Signal Status Check Procedure

Transmit the status request command **AT!D** and receive **<STX>RxIxxxxxxxx<ETX>{lrc}**. If 'R' and 'I' are not present, the terminal should display **'NOT REGISTERED'** and not allow the transaction to proceed.

Connect Procedure

Transmit the connect command **ATD111.222.333.444/8004** and receive: **<STX>1<ETX>{lrc}**. The “1” indicates you have a connection. Any other response is an error. You don’t need to verify LRC.

Transmit Authorization Request

Transmit the authorization request**<STX>AUTH REQ<ETX>{lrc}** and receive response in **<STX>APPROVAL 123456<ETX>{lrc}** format.

Hang-up/Disconnect Procedure

Hardware hang-up (RTS toggle) is the default setting invoked after the **&F** command during initialization. Software hang-up (**+++ATH2**) requires that the **AT&D0** command be sent during the initialization. For hardware hang-up/disconnect, toggle the RTS line for no less that 10ms. For software hang-up/disconnect, send the **+++ATH2** command. When doing a software hang-up/disconnect, there should be a delay equal to, or greater than, the value in register **S12** between issuing the **+++** command and issuing the **ATH2** command.

Hardware or software hang-up or disconnect will respond with a **<stx>0<etx>{lrc}** packet. After receiving the disconnect response, the program should proceed just as it would during a dial-up transaction.

Note 1: **ATS80=***port number* sets the UDP port number used on the device. The port number in **S80** and the port number on the end of the **ATD** command must match in UDP mode.

Note 2: **AT\N**<*side preference*> specifies whether A side, B side, or some combination of both will be used. **1**=A side only, **2**=B side only, **3**=A side preference, **4**=B side preference.

Constant Monitoring of Signal Status

It is possible to perform a software signal status check from the POS terminal. You can accomplish this by issuing the **AT!D** command and receiving the **<stx>RNI0320432<stx>{lrc}** response packet. By monitoring the signal status with software, a signal status display can be created on the POS terminal's display. The **AT!D** command can also be implemented for diagnostic use because it shows registration status, in-out range status, signal strength, and channel number.

Suggested Terminal Configuration

Most POS terminal applications will have a configuration section which can be altered from the keypad. Here are some suggested settings:

#CreditCardIP =	111.222.333.444
#CreditCardPort =	8000
#DebitIP =	666.777.888.999
#DebitPort =	8006

#ChecksIP = 333.444.555.666

#ChecksPort = 2004

#SidePreference = 3

If your application doesn't have any free memory locations to store IP address/port number combinations, you can save several within the USWD500 Modem. Refer to "**Quick Connection to the CDPD Network**" on Page 26 for details.

Wireless Configuration Report

It is easier to print the wireless configuration information if a receipt printer is attached to the POS terminal. Using the receipt printer to display configuration information is easier than having a merchant read and scroll this information on the terminal's display. Here is a suggested format for a wireless configuration report.

```
Wireless Configuration

Credit Card IP :  000.111.222.333
Credit Card Port: 8000
Debit Card IP: 444.555.666.777
Debit Card Port:  2026
Check Auth IP: 888.999.000.111
Check Auth Port:  65000
Side Preference:  3
Termial's IP:  012.345.678.901
Model:     USWD 500
Manufacturer:  U.S. Wireless Data
EID:       00120A9E1800
Firm. Ver.:    2.00
```

The following commands retrieve the manufacturer, model number, firmware version, and EID from the USWD500 Modem. All responses will be in the **<stx>response<etx>{lrc}** format.

AT!I? TranzEnabler's IP address

ATI0 TranzEnabler's Electronic ID-EID

ATI1 TranzEnabler's Firmware Version

ATI2 TranzEnabler's Manufacturer

ATI3 TranzEnabler's Model Number

Appendix A AT Command List

AT Command	*Description*	*Result Code*	*Note*
AT	Answer Online	OK	
ATD **ATD*adds***	Dial (Connection setup) when UDP was disabled. Enter data mode when UDP was enabled. (***adds*=** destination address/port plus dial modifiers. Default dial address is the last destination address.) Dial modifiers: The "**;**" dial modifier is used to return to command mode when connection setup is complete.	(default) CONNECT NO CARRIER OK ERROR (Extend) BUSY NO ANSWER NO DIALTONE	
ATDS **ATDS*n***	Speed dial With saved address <*n*>	CONNECT NO CARRIER OK ERROR	 *n* = 0~4
ATO	Enter online mode	CONNECT ERROR	Return to online mode from command mode
ATE **ATE0*** **ATE1**	Command Mode Echo Echo off Echo on	OK ERROR	
ATF **ATF0*** **ATF1**	Online Mode Echo Disable full duplex (ie., Echo characters locally) Enable full duplex (ie., Do not echo characters locally)	OK ERROR	

* = factory default setting

AT Command	*Description*	*Result Code*	*Note*
ATH	Hang-up (close connection)	OK ERROR	
ATH0	Transmit pending data, then close connection.		
ATH1	Return result code OK		
ATH2	Discard pending data and close connection immediately.		
ATH3	Discard pending data, close connection immediately, and de-register from the network.		
ATI	Identify		
ATI0	Identify SU equipment ID		
ATI1	Identify firmware version number.		
ATI2	Identify manufacturer		
ATI3	Identify equipment model number		
ATQ	Quite Mode	<nothing> OK	
ATQ0*	Disable quiet mode (result codes are sent to the MAS).[Default]	ERROR	
ATQ1	Enable quiet mode (result codes are not sent to the MAS)		
ATS*n*	Select register	OK ERROR	See S register
ATS*n*	Read selected register		
ATS*n*=	Write selected register		

* = factory default setting

AT Command	*Description*	*Result Code*	*Note*
ATTS*n*=	Write to temporary text storage register 1-40 registers available…40 characters maximum per register	OK ERROR	**ATTS*n*=**”text” Quote characters must be included
ATTS*n*?	Read temporary text storage register 1-40 registers available…40 characters maximum per register		
ATV	Verbose result code	OK ERROR	See Remark 1
ATV0*	Use terse result code		
ATV1	Use verbose result code		
ATZ	Soft Reset	OK	
AT&C	Set DCD Operation		
AT&C0	DCD always active		
AT&C1	DCD follows the state of the “RF In Range” condition		
AT&C2	DCD follows the state of “Connection Established” condition		
AT&C3	DCD follows both the state of “RF In Range” and “Connection Established” conditions		
AT&C4*	DCD follows both the state of "RF In Range" And "Registered" conditions		

* = factory default setting

AT Command	*Description*	*Result Code*	*Note*
AT&D	Set DTR Operation		
AT&D0	DTR is ignored		
AT&D1	Enter command state upon detecting active-to-inactive transition of DTR		
AT&D2*	Closes the connection upon detecting active-to-inactive transition of DTR Equivalent to executing **ATH2** command Auto-answer is disabled while DTR inactive		
AT&F	Restore Factory Defaults	OK	After executing **AT&F**, use **AT&W** to burn in the S Registers
AT&L	M-ES Line Speed		
AT&L*spd*	*spd*=1200, 2400, 4800, 9600, 19200		
AT&S	Set DSR Operation		
AT&S0*	DSR is always active		
AT&S1	DSR follows the state of the “Connection Established” condition.		
AT&V	View Active Profile		
AT&W	Save Active Profile	OK	
AT&Z	Save Destination Address (Dial Directory)		
AT&Z?	List all saved addresses.		
AT&Z=*adds*	Save “*adds*” as dial address 0.		
AT&Z*n*=*adds*	Save “*adds*” as dial address <*n*>.		*n* = 0~4
AT!A	Autoscan		
AT!A0	Autoscan Disable	OK	
AT!A1*	Autoscan Enable		

* = factory default setting

AT Command	*Description*	*Result Code*	*Note*
AT!D	Get Communication Status R=Registered, N=Not Registered C=Connected, N=Not Connected I=In Range, N=Not In Range 032=Signal Strength(000=-113 dBm) (050=-83 dBm) 0746=Channel Number		RCI0320746
AT!I*xxx.xxx.xxx.xxx/ password* **AT!I?**	IP Address and password Inquire my IP Address	 IP Address	*x* = 0~255 111.222.333.444
AT!M **AT!M*n*=***adds***/gmid **AT!M?**	Multicast Save multicast IP address in address <*n*> List all multicast IP addresses	 OK	 *n* = 0~4
AT!R	Read RSSI		
AT!S **AT!S0*** **AT!S1**	 SLIP Disable SLIP Enable	OK	
AT!T **AT!T0** **AT!T1***	Response Framing CR/LF on end of response code <stx>Response<etx>{lrc} Format	 OK OK	 OK<cr><lf> <stx>OK<etx>{lrc}
AT!U **AT!U0** **AT!U1***	 UDP Disable UDP Enable	OK	

* = factory default setting

AT Command	*Description*	*Result Code*	*Note*
AT\F	Set Data Forwarding Operation		
AT\F0	Data forwarding characters are excluded from the packet (not transmitted)		
AT\F1	Data forwarding character specified by **S51** is included, but **S52** is excluded.		
AT\F2	Data forwarding character specified by **S52** is includes, but **S51** is excluded.		
AT\F3*	Both data forwarding characters **S51** and **S52** are included in packets to the remote data service.		
AT\M	Manual Transmit Control		
AT\M0*	Disable recognition of data forwarding characters		
AT\M1	Enable data forwarding character recognition		
AT\N	Set Side Preference		
AT\N1	A side only		
AT\N2	B side only		
AT\N3*	A side prefer		
AT\N4	B side prefer		
AT\T	Automatic Transmit Control		
AT\T0	Disable automatic timed transmission		
AT\T1*	Enable automatic timed transmission according to **S50**		

* = factory default setting

Appendix B S Registers

Register	Description	Value	Note
S2	Escape code character	0...255ASCII [43'+']	
S3	Carriage return character	0...127ASCII [13<CR>	
S4	Line feed character	0...127ASCII [10<LF>]	
S5	Backspace character	0...127ASCII [8<BS>]	
S12	Escape code guard time	.255 1/50sec [50]	
S14	Command status bitmap	bitmapped	Read Only
S21	Equipment status bitmap	bitmapped	Read Only
S22	Equipment status bitmap	bitmapped	Read Only
S23	Equipment status bitmap	bitmapped	Read Only
S50	Data forwarding idle timeout	.255 1/10sec [1]	
S51	Primary data forwarding character	0...255ASCII [13<CR>]	
S52	Secondary data forwarding character	0...255ASCII [26<ctl-Z>]	
S53	Remote party address/ Remote port No.	0.0.0.0/0	Read Only
S54	Pending reverse channel packet count	0..255	Read Only
S55	Pending forwarding channel packet count	0..255	Read Only
S56	Extended network error code	0..255	Read Only
S57	Network status bitmap	bitmapped	Read Only
S58	PAD status bitmap	bitmapped	Read Only
S59	T203. Number of seconds to sleep	0..255	
S60	Channel number for manual scan mode	[799]	
S61	SPI	[65535]	
S62	SPNI	[65535]	
S63	WASI	[65535]	
S64	Reserved	[0x0]	
S70	Tx Bytes	[0]	Read Only
S71	Rx Bytes	[0]	Read Only
S72	Tx Packets	[0]	Read Only
S73	Rx Packets	[0]	Read Only
S75	Current channel number	[0]	Read Only
S80	Local socket port	[1025]	
S82	Broadcast Address	[0,0,0,0]	
S83	Netmask	[255.255.255.0]	
S84	Filter Bit 0 -- Unicast Bit 1 – Broadcast Bit 2 – Multicast	[1]	 1 = Unmask 0 = Mask

S-Register Definitions

S14 Command status

Bit 0	Online mode echo; see F command		
Bit 1	Command mode echo; see E command		
Bit 2	Quiet mode; see Q command		
Bit 3	Verbose mode; see V command		
Bit 4	SLIP enable	1	AT!S1
	SLIP disable	0	AT!S0
Bit 5	UDP enable	1	AT!U1
	UDP disable	0	AT!U0
Bit 6,7	Unused		

S21 Equipment Signal Status (Read only)

Bit 0, 7	Unused
Bit 1, 2	DSR operation; see &S command
Bit 3, 4	DTR operation; see &D command
Bit 5, 6	DCD operation; see &C command

S22 Equipment Status (Read only)

Bit 0	Auto Scan	AT!A0	disable Auto Scan
		AT!A1	enable Auto Scan
Bit 1~7	Unused		

S57 Network Status

Bit 0	Registration state:	0=unregistered
		1=registered
Bit 1	Sleep state:	0=not sleep
		1=sleeping
Bit 2,3	Connection state:	0=no connection
		1=connected
		2=incoming connection pending
		3=outgoing connection pending
Bit 4,5,6	Unused	
Bit 7	RF in range:	0=out of range
		1=in range and synchronizedS58 PAD Status
Bit 0	Auto transmit mode; see \T command	
Bit 1	Manual transmit mode; see \M command	

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Bit 2,3 MAS flow control mode; see \Q command
Bit 4,5 Data forwarding character mode; see \F command
Bit 6,7 Side Preference Status: see \N command

Bit 7	Bit 6	Side Preference
0	0	Side A only
0	1	Side B only
1	0	Side A prefer
1	1	Side B prefer

Appendix C USWD500 Response Messages

Terse Code	*Verbose Response*	*Description*
0	OK	“;”dial modifier is used
1	CONNECT	Connection is established
2	RING	SU indicates MAS Receipt a remote connection request while S0=0
3	NO CARRIER	Connection is not established or command aborted (and extended result codes not selected)
4	ERROR	Connection already exists
6	NO DIALTONE	SU is not registered with the network and extended result codes are selected. (otherwise NO CARRIER)
7	BUSY	Connection is refused and extended result codes are selected. (otherwise NO CARRIER)
8	NO ANSWER	No response is received from the destination within S7 seconds and extended result codes are selected. (Otherwise NO CARRIER)

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