U.S. WIRELESS DATA® INC.

Delivering The New Standard In Transaction Processing

USWD500

CDPD Data Module

User's Installation Manual

For CDPD Version 1.1 with UDP/TCP Protocol

Version 2.0.6

August 27, 1998

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.

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

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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

USWD500 User's and Installation Manual was first published by U.S. Wireless Data, Inc., in 1997. This revision is for USWD500 for CDPD Version 1.1 with UDP/TCP Protocol, issued in July 1998. The purpose of this manual is for the setup of the product USWD500. It includes procedures that shall assist you to avoid unforeseen problems.

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CONTENTS (CONTINUATION)

Chapter 1 Introduction

1-1 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 Data Module. It assumes that the reader has a basic working knowledge of UDP/IP and the use of the AT Command set.

1-2 Purpose of this Manual

This manual is to help the OEM integrators to successfully reach the goal of producing a wireless product that integrates the USWD500 CDPD data module. Wherever possible, in this manual we strive to offer specific technical details, relevant examples, general principles and guidelines 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 problems and solutions to reach success.

1-3 General Description & Features

USWD500 Data Module 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 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.

General Features:

- Compact, Light weight, with four Mounting Locations
- 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
- TX: 824.01MHz~848.97MHz
- RX: 869.01MHz~893.97MHz
- 30KHz Channel Spacing

1-4 USWD500 Product Package and Services

1-4-1 Product Package

Please go through each item listed below. Your USWD500 package contains the following items:

- One USWD500 CDPD Data Module
- One USWD500 User's and Installation Manual

1-4-2 Services

- USWD500 Data Module technical training
- On-Site consulting

1-5 How to Use this Manual

This manual provides information and assistance for both physical installation and programming of the USWD500 Data Module.

Chapter 1: Introduction	Offers a general idea of USWD500 CDPD data module, and how to utilize this manual.
Chapter 2: Product Specifications	Describes the hardware specifications, I/O pins assignment, and mechanical specifications of the USWD500 Data Module.
Chapter 3: Installation, Setup & Test	Illustrates the basic information needed to install, setup, and test the USWD500 on the CDPD network.
Chapter 4: Integrating Considerations	Discusses important issues integrators need to consider before initializing such a project.
Chapter 5: Application Development	Provides additional information for use in planning and designing CDPD applications in either the UDP or SLIP environments.

Chapter 2 *Product Specifications*

2-1 Hardware Specifications

General Specifications

Current Dissipation	RF Part Digital Part	750mA(Max.) 160mA(Max.)
Power Supply	DC 5V±0.5V	
Antenna connector	MMCX	
Baseband connector	FFC	
Temperature	0: to + 45:	

Receiver Specifications

The following 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 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

2-2 I/O Pins Assignment (FFC Connector)

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	NC		
23	NC		
24	NC		
25	NC		
26	NC		
27	GND	Power	Power Grounding
28	GND	Power	Power Grounding
29	GND	Power	Power Grounding
30	GND	Power	Power Grounding

2-3 Mechanical Specifications

Mechanical Size

The mechanical size of the USWD500 modem is shown in Fig.1.

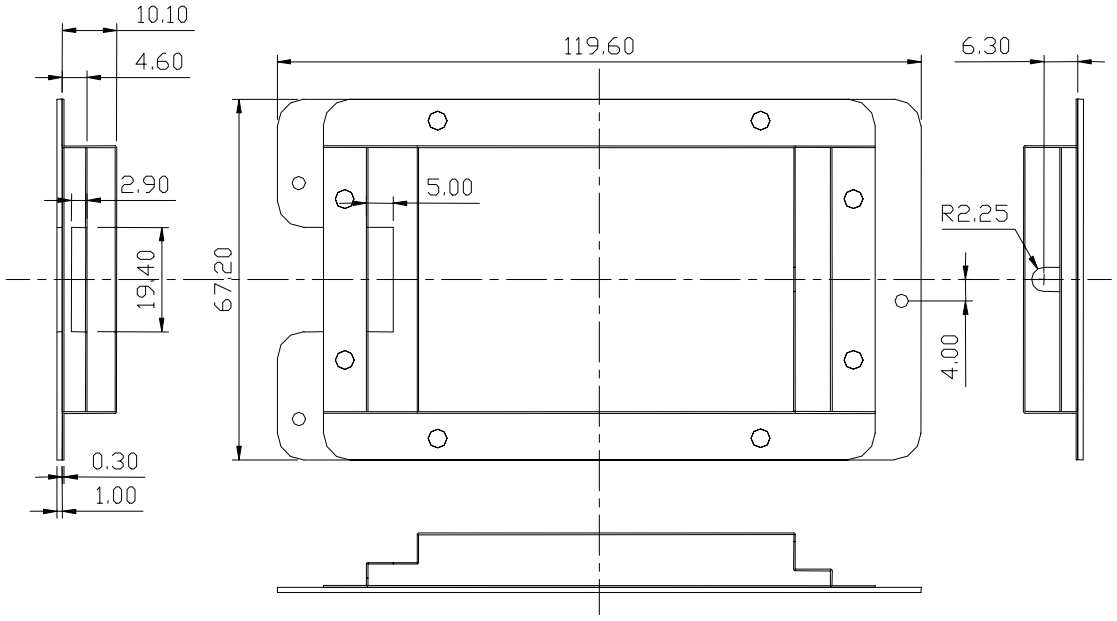


Fig.1 Mechanical size of USWD500

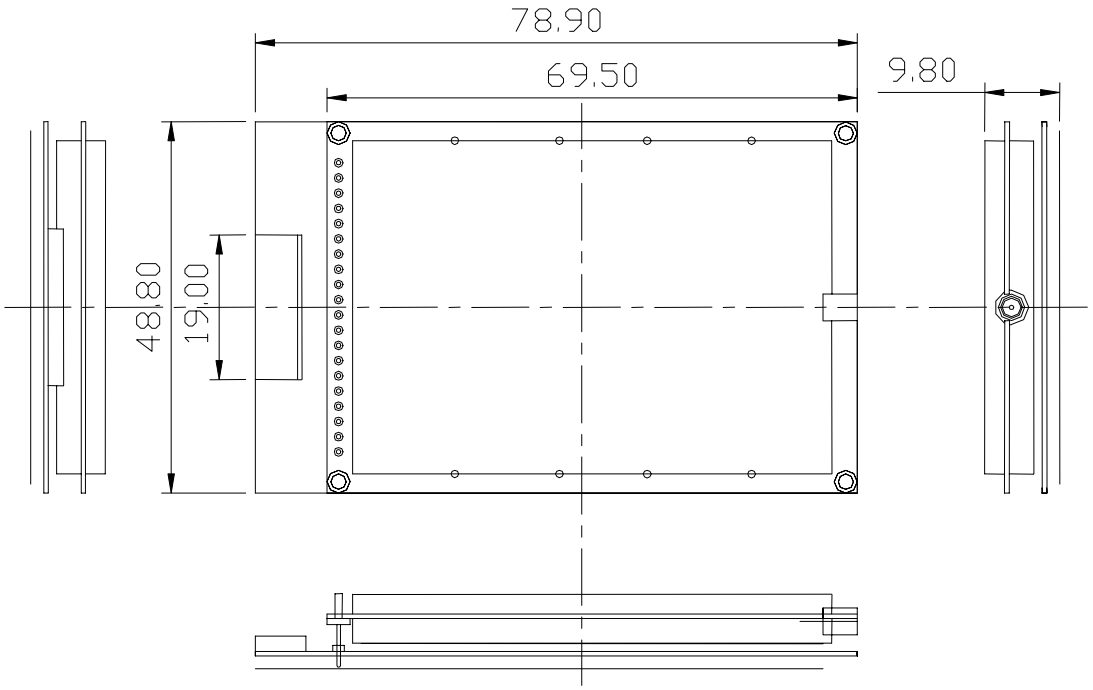
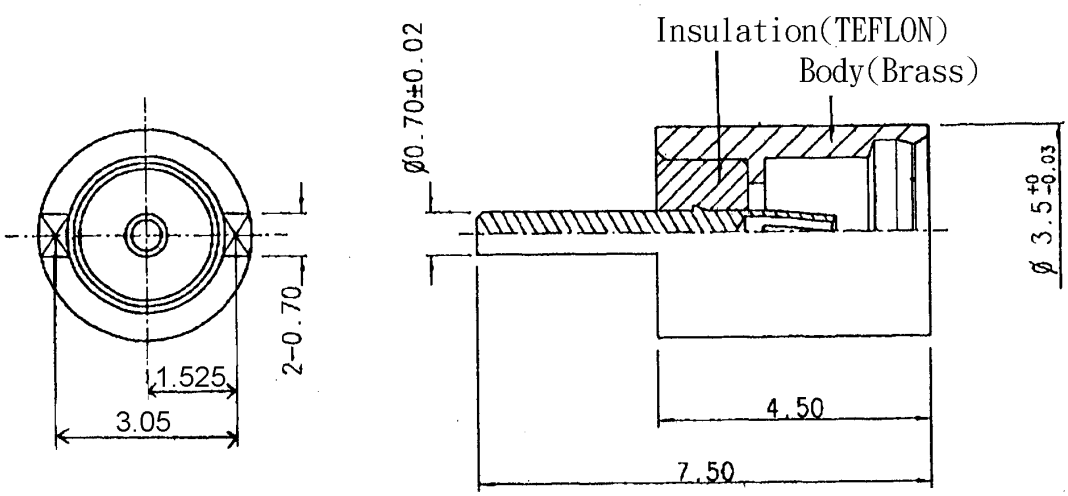


Fig.2 PCB size of USWD500

MMCX RF Connector

The RF connector has to be Huber-Suhner P/N: 82 MMCX-S50-0-2, or exact replacement approved by U.S. Wireless Data no later than June 1, 1998.



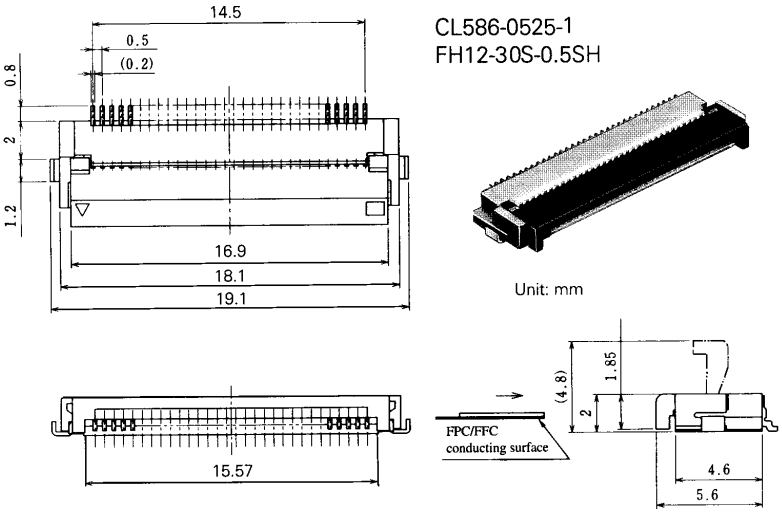
ım

a

b. Insulator: Teflon

c. Female Contact: Beryllium Copper, Gold Plated Finish

FFC 30 pin connector



Chapter 3 *Installation, Setup & Test*

3-1 Installation & Setup

3-1-1 Basic Testing: Verify the USWD500 Working Status

USWD500 provides two-way wireless packet communications on the CDPD network for OEM integration into a host device. Before physical integration, a stable communicating status between the host and the USWD500 has to be verified. Also, you might need to change some existing default values of the USWD500. Therefore, we offer a PC-emulation mode for you to change the existing default value, and to test the working status of the USWD500. You can use a PC or notebook to emulate the host, and send AT Command to the module via a appropriate interface cable.

Before using the USWD500 to develop your applications under wireless data communication environment, you have to test this data module by using your host PCs. Please verify the following items for basic testing:

- USWD500 Data Module
- DC Power Supply 5V±10% 1A
- Cellular Antenna for the USWD500
- Interface Cable between the USWD500 and your Host. This cable converts the USWD500 FFC interface into RS-232 or UART for your host.
- User's and Installation Manual
- The AT-Command set list and installation procedures will be shown in this manual.

As you collect the above items, take the following steps for basic testing:

Step 1 Establish Hardware Connection

a. Attach the cellular antenna to the USWD500.
b. Connect the power adapter to the USWD500.
c. Attach the interface cable to the USWD500.
d. Attach the interface cable to your host.

Step 2 Establish Software Test Environment

To send AT Command to the module, you must find a communications program to be operated in ASCII terminal emulation mode under your PCs (host). This will enable the PC to function as a terminal attached to the modem and will permit you to enter the AT Command required for modem setup and diagnostics. The following are sample programs:

a. **WINDOWS TERMINAL** in WINDOWS 3.1

b. **HYPER TERMINAL** in WINDOWS 95

c. **TELIX** or similar alternatives

In the Terminal Program you choose, set the parameters of interface cable as follows:

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

***Caution**: The above parameters are set up for the communication between USWD500 and the host. They are default values for USWD500 Data Module. You must set the same parameters with your Terminal Programs so that the host can obtain initial connection to the module.*

Step 3 Power on the USWD500

This step is to ensure the link between the USWD500 and the host functions well. Take the following procedures for Basic Testing.

a. When the software test environment is set up, turn on the power supply.

b. Use your ASCII terminal emulation program, and make sure your PC is connected to the USWD500 via the appropriate interface cable.

   If ASCII terminal emulation program is running, you can turn on the power supply again. And you should receive initial OK messages on the terminal program.

c. The other way to verify the setup procedure is to enter AT in the terminal program and then press ENTER. If you get an “OK” response, you have set up the connection correctly.

   If not, you need to check if your communications program and cables are working correctly. If the AT command still doesn’t get any response, you should contact your USWD500 supplier for technical support.

When you can get initial **OK** messages after powering on or get an **OK** response after entering **AT**, the basic function of USWD500 Data Module works correctly as well as the link between the USWD500 and the host.

3-1-2 Connect to the CDPD Network

3-1-2-1 Installation Procedures

This section offers a quick installation guide for you to clarify all the critical steps required for installing the USWD500. Once you get the **OK** message in the basic testing, you can proceed with the following steps. Make sure you have passed the basic test in 3-1-1, then take the following instruction for installation.

Step 1 Set IP Address and Side Preference

Before the USWD500 can be worked on the CDPD network, it requires an Internet Protocol Address (IP Address), and the side preference (A or B) for your network carrier to be specified. These are general parameters illustrated in **3-1-2-2 General Parameters Setup**, with the setup procedures described in detail.

These parameters must be setup before connecting to the CDPD network. You should get these values from the CDPD network carrier or service provider. Refer to **3-1-2-2 General Parameters Setup** for setting up these parameters.

Step 2 Verify the status of other parameters

Make sure that all the parameters are set correctly as you want. AT commands for setting up other parameters are described in more detail in **3-1-2-3 Advance Parameter Setup**. The section **3-1-2-3 Advance Parameters Setup** includes setup procedures for Communication Port parameters, UDP parameters, SPI/SPNI/WASI parameters, S-Registers, and Sleep Mode parameters. You can either change these parameters via AT commands or use the default that has been set.

The following table shows the default value of USWD500. You can refer to this table on modifying the parameters.

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 all 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** will scan all channels and select a channel for connection. The **Manual Set Mode** dedicates a channel number to connect to the CDPD network. Choose either Auto Scan Mode or Manual Set Mode by the **AT!A1** or **AT!A0** command.

Find the instructions for determining Scan Mode in **3-1-2-2 General Parameters Setup, C. Select the Scan Mode**. If **Auto Scan Mode** is selected, you can skip Step 4.

Step 4 Set the channel number

If you chose **Manual Set Mode**, set the channel number via the **Ats60=xxx** command. You can find more information about this step in **3-1-2-2 General Parameters Setup, C. Select the Channel Scan Mode**.

Step 5 Check the status of UDP and SLIP mode

You can use "**ATS14**" command to check your card in UDP or SLIP mode. For example:

ATS14	**Read register S14**
152	**UDP mode is disable and SLIP mode is enable**

Or

168	**UDP mode is enable and SLIP mode is disable**

***Note**: By **AT!S0** command, **SLIP mode** is disable.*
*By **AT!S1** command, **SLIP mode** is enable.*
*By **AT!U0** command, **UDP mode** is disable.*
*By **AT!U1** command, **UDP mode** is enable.*

Step 6 The connected message

When UDP mode is *disable*, you can use **ATD** command to do connection setup. For example:

ATD	**Dial when UDP is disable.**
CONNECT	**The connected message. And enter into on-line mode.**

When the "**CONNECT**" message appears, the USWD500 is successfully connected to the remote terminal. Then you are already in **ON-LINE mode** and start transmitting and receiving data. Or, for example:

ATD;	**Dial when UDP is disable.**
CONNECT	**The connected message. And back to command mode.**

The "**;**" **Dial Modifier** is used to return to **command mode** when connection setup is complete. You can also use the **ATS57** command to check the connecting status. For more information about ATS57 command and On-Line mode, please refer to **3-1-3 Useful Commands**.

When UDP mode is *enable*, you can use **ATD(remote address)/(remote port)** command to do connection setup. For example:

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

Or

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

Step 7 Trouble Shooting

If you have waited for a long time and cannot connect to the CDPD network, you have to use some AT-Commands to check the network status. For instance, parameters related to RSSI value, IP address, Side preference, UDP, etc. are critical to the CDPD network connection. Please read Chapter 3 thoroughly to verify important parameters. To obtain further support, contact USWD's technical support team at **(510) 596-2025**.

Step 8 USWD500 Disconnection

If you want to disconnect to the CDPD network, you can use the **ATH** command.

3-1-2-2 General Parameters Setup

A. IP Address Setup

Before using the USWD500 on the CDPD network, you need to setup an IP address, which is supposed to be furnished by the CDPD network carrier. You can use the **AT!I?** command to check whether the IP address has been set. For example:

AT!I?

203.67.40.245

After typing AT!I?, the module responses **203.67.40.245**, which means this module has the IP address entered as 203.67.40.245.

If the IP address has not been set yet, you have to set it up by taking as following: Enter the IP address via the **AT!I**xxx.xxx.xxx.xxx command.

You can use "AT!I?" to verify setup. For example:

AT!I203.67.40.244	**Setup the IP address**
ok	
AT!I?	**Test: inquire the IP address**
203.67.40.244	**IP address entered as 203.67.40.244**

***Note**: Please reset the module by typing "**ATZ**" after setting IP address.*

B. Side Preference Setup

You have to specify which service provider side (A or B) to search 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 set up this value or provided you with their preference. The default of USWD500 is "A side prefer", which is not exactly appropriate for you.

The command to configure the appropriate side setting is **AT\Nn**. Use this command to specify the service provider side (A or B).

For example:

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

***Note**: "1" means Side A only*
"2" means Side B only
"3" means Side A prefer
"4" means Side B prefer

C. Select the Channel Scan Mode

The theory of CDPD technology is to use any available channel when it's not in use for a voice call. Theoretically, the voice users have higher priority for channels than CDPD users. If a voice call wants a channel already in use for CDPD, the MDBS notes that occurrence and moves CDPD to another available channel. The USWD500 detects the fact that the current channel no longer supports CDPD, and begins channel searching to find a new CDPD channel.

The USWD500 provides two modes for channel scanning. The **Auto Scan Mode** is to search all the CDPD channels, then find a channel of best condition in the serving area. The **Manual Set Mode** is designed for saving scanning time. If you know exactly the channel of best condition in the area, you can directly assign the channel manually in order to avoid wasting time on scanning all the channels. Examples for both modes are presented as below:

Auto Scan Mode	
AT!A1	**Get into the auto scan mode**
ok	

Or

Manual Set Mode	
AT!A0	**Get into the manual set mode**
ok	

You can get the details of these commands in **Appendix A**. If you select Manual Set Mode, take the following procedures to set up the channel number.

Manual Set Mode: Channel Number Setup

When you select **Manual Set Mode** to connect to the CDPD network, the command **ATS60=n** can be used to set the channel number you want. For example:

ATS60=799	**Set the channel number as 799**
ok	
ATS60	**To get the channel number assigned**
799	
ok	

***Note**: S60 is ineffective under the auto scan mode.*

3-1-2-3 Advance Parameters Setup

The advance parameters in this section include **Serial Port parameters**, **UDP parameters**, **SPI/SPNI/WASI parameters**, **S-Registers** and **Sleep Mode parameters**. Please read the instruction of each section to complete the setup.

A. Serial Port Parameter Setup (Optional)

You have to configure the appropriate communication port setting between the host (emulated by PCs) and the USWD500. The RS-232 parameters setting include baud rate, data bits length, and stop bits length and parity check. These parameters have default values set as follows:

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

By using "**AT&L**" command, the baud rate can be changed. For example:

AT&L9600	**Change the baud rate to be 9600 bps**
ok	

***Note**: After change the baud rate, you must change the baud rate setting of **Terminal** program with same value. Otherwise, the host can not communicate with USWD anymore.*

Hardware Flow Control Setup

RTS/CTS flow control is part of the 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 USWD500 Data Module. And the USWD500 uses CTS to start and stop the flow of data from the host.

When RTS is inactive, the USWD500 cannot send any data from the host. For the same reason, when the USWD500 is busy transmitting data to the CDPD network, it asserts CTS to stop the flow of data. The command for hardware flow control is presented below:

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

DTR/DSR Operation Mode Setup

DTR means **Data Terminal Ready**, it is sent out from DTE (host). When DTR is inactive, the "host" is not ready. There are three DTR operation modes in the USWD500. The commands are illuminated as below:

AT&D0	**DTR is ignored**
AT&D1	**Enter command state upon detecting active-to-**

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

DSR means **Data Set Ready**, it is sent out from the USWD500 under the following conditions:

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

B. UDP Parameters Setup

Local socket port register **S80** is an important parameter for UDP mode. By **S80**, you can define your own port number for USWD. Then the other users can use this port number to communicate with your USWD in UDP mode. Please remember to restore (**AT&W**) and reset (**ATZ**) your USWD after change the port number of **S80**.

C. SPI/SPNI/WASI Parameters

SPI (**Service Provider Identity**) defined by register **S61** is used by service provider to recognize the USWD500 is legal or not. **SPNI** (**Service Provider Network Identity**) defined by register **S62** is also used by service provider to recognize what service network can be issued to the users. **WASI** (**Wide Area Service Provider Identity**) defined by register **S63** is used for service provider to recognize users from other service system. By **WASI**, the using records of users from other service provider can be made for billing issue. The value of those three parameters should be given from service provider. The default value is 65535 that means USWD500 communicate with service network without checking those identities.

D. S-Registers

S-Registers are used to save the necessary parameters. You can use "**ATSn**" command to read and write the value. Please refer to **Appendix AT-Command List** for detail description of S-Registers.

E. Sleep Mode Parameters

While USWD500 stopping to communicate with system network, the timer **T203** starts to count down. When T203 time out, the USWD500 will go to sleep for a **T204** period, then wake up. The time period T204 is given from MDBS of system while USWD500 register on system network. The timer T203 can be set by register **S59**. For example:

ATS59=5	**Set the timer T203 to be 5 sec.**
ok	

Note: *By the bit 1 of* ***S57****, USWD500 is sleeping or not can be monitored.*

3-1-3 Useful Commands

A. Quick Connection to the CDPD Network

Once the USWD500 is successfully installed, you don't have to repeat every step in **3-1 Installation & Setup** to connect to the CDPD network. For the second access and afterward, you can simply operate the following procedures for quick connection. Before quickly connecting, you need to save destination addresses by "**AT&Z**" command.

For example:

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

After saving addresses, you can quickly connect by using **"ATDSn**" command. For example:

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

B. Get Status Command

<u>Read RSSI Value</u>

RSSI means **Received Signal Strength Indication**. The command **AT!R** can be used to monitor the signal strength received by the USWD500. For example:

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

Note*: The unit of this value is dBm.*

To Get Connection Status

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

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

Note*: You should check S57 bit 0 to verify the connection status. Such, If the response value is even, ex. 0, 2, 4, 128…, it means USWD500 is not connected to the CDPD network. USWD500 is connected to the CDPD network if an odd value appears.*

C. ON-LINE/OFF-LINE Mode

When the USWD500 is connected to the CDPD network, the command **ATO** can be used to get into the ON-LINE mode. Only under the ON-LINE mode can you transmit and receive data between remote host and local host. Otherwise all characters will be command strings for the USWD500. For example:

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*: Only when you see the "**CONNECT**" message you can use the AT Command, or an error message will appear after you enter any AT command.*

While in the ON-LINE mode, if you want to send AT-Command to the USWD500, you need to leave the ON-LINE mode by using the "**+++**" **escape command**. For example:

+++	**Leave ON-LINE mode**
AT	**OFF-LINE (command) mode**
ok	

While finishing the sending of data string, before typing "**+++**", you need to wait for a guard time that is defined by register **S12**. And after typing "**+++**", waiting for the same guard time, the command mode will come back.

3-2 Using USWD500 with Terminal Program

3-2-1 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 communication endpoint. A port is a number that identifies a socket from the outside. The port number is part of the network address. Please use **ATS80** to set your socket port.

3-2-2 Data Transmitting and Receiving under UDP Protocol

The USWD500 provides UDP protocol in its protocol stack. You can send and receive UDP packet from the Internet. Before using UDP, you should ensure that the network status is **CONNECT**.

After connecting the USWD500 to the CDPD network, you must get into 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	**into the ON-LINE mode**
test-test-test-test-test	**send out UDP in packets**
test-test-test-test-test host, if the	**receive message echoed from the remote UDP echo service is running.**
+++	**leave the ON-LINE mode**

3-2-3 When will USWD500 send out the queued data

A. Buffer full

When the transmitting buffer of USWD500 is full, the modem will send out the data queuing in the buffer automatically. At the same time, USWD500 will send a **CTS high** signal to host indicating that the modem is not ready. After the data was sent, the modem will return a **CTS low** signal to host indicating that “I am ready, you can send data to me again.” (That is hardware flow control.)

B. S50 Time Out (data forwarding idle time out)

Automatic transmit control function can be enabled or disabled by user. If you enable the function by using **AT\T1** command, you need to set **S50** by using **ATS50=t** (t= 0 ~ 255), then save the register value (**AT&W**) and reset (**ATZ**) the modem to restart the connection. Therefore, if the modem waits for more than **S50** time period and does not receive any more data or data forwarding character, it will send out the data queuing in the transmit buffer automatically. Or you can disable the function by using **AT\T0** command, the modem will wait until it received a data forwarding character or its buffer is full.

C. Receive a data forwarding character

User via **AT\F** command can select the data forwarding operation rule. (Detail usage please refer the extended AT command set.) You can setup **S51** (primary data forwarding character) and **S52** (secondary data forwarding character) before selecting the data forwarding operation rule. Please remember to save the register value and reset the modem after you change any register values. The USWD500 will send out the data after receiving a data forwarding character if you enable the data forwarding operation function.

3-3 Using USWD500 with WIN95

If you disable the UDP protocol stack function, in this case you should turn off the UDP function by using command **AT!U** in terminal window. Normally, in the case of UDP disable, you need turn on SLIP function (**AT!S1**).

By using the "**inf**" file, you can set up USWD500 in WIN95 environment. These procedures are described as follow.

Step 1: Click the WIN95 **Start** function and select **Control Panel** to open it. Then double click to open **Modem** icon.

Step 2: Choose **Add New Modem** and put the utility disk with "**inf**" file in driver A.

Step 3: Choose **Other** and then select "**don't check my modem, I will pick up from the list**". Go to next step.

Step 4: Select install from the disk, then click browse and make sure you select the **mdzcare.inf** in the disk of driver A. Click **OK** twice. Then the window will show the "**USWD500 CDPD modem**" item, choose it and click next step.

Step 5: Choose the **com** port you want to use (COM1 or COM2 depends on which one is available) then click next step.

Step 6: The window will give you a message to indicate the modem is installed. Then click finish icon and close the window of installing new modem.

After you finish the installation of USWD500 CDPD modem, the next procedure is to setup the **Dial-Up Network** to establish new connection. The following steps will show you how to establish a CDPD USWD500 connection correctly.

Step 1: Double click "**My Computer**" icon on the desktop, then open "**Dial-Up Network**".

Step 2: Choose "**Setup New Connection**" icon and get in.

Step 3: In "**Setup New Connection"** window, input the name of the connection and select USWD500 CDPD modem (in the type of the modem). Then select next step to see the next window.

Step 4: In this window you should input the area code with 002 and the phone call # is default to PPP, the country code is USA (1). Then select next step to get into next window.

Step 5: In this window click finish and win95 will create an icon for your new connection.

Step 6: Select the icon of your new connection and choose the property item from the File Function menu to open the next window.

Step 7: Select server type in this window. Then get into the "**Server Type**" window, select the type of dial-up Server with "**SLIP Unix connection**" and disable the login network, finally click ok twice to finish your setting

Now you can double click your new connection icon, then click continue and input the IP Address you want to use (make sure the IP Address you input here is the same with your M-ES setting). Then WIN95 will show you the connection is established and start count on the connection time. After you finish all above steps, you can use all of the applications (e.q. FTP, telnet, ping, etc) in WIN95 environment.

3-4 Broadcast and Multicast

3-4-1 Broadcast

Because the **Broadcast IP** address is network-dependent, the service provider should issue the **Broadcast IP address** to users. The broadcast IP address can be set into register S82 by using ATSn. For example:

```
ATS82=203.67.40.244

OK
```

By register S84, the unicast, broadcast and multicast can be chosen independently. The default value of register S84 is 1 (decimal). That means the bit 0 (for unicast) is unmasked. To enable USWD500 receiving broadcast packets, bit 1 of register S84 should be unmasked also.

3-4-2 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 AT!M. 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
```

And the multicast IP addresses can be set by using AT!Mn=. For example:

```
AT!M0=203.67.40.248/1
```

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

```
AT!M?

0 203.67.40.248/1     online

1 0.0.0.0/0           offline

….
```

Chapter 4 *Integrating Considerations*

This chapter provides Original Equipment Manufactures (OEMs) with discussions of critical research and development (R&D) issues that must be considered to ensure successful integration of USWD500 CDPD module into their host platforms. This overview identifies your areas of responsibility and U.S. Wireless Data's level 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.

4-1 How will the end product be used?

Because all design considerations drive toward meeting 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 alternator noise 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 in making 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 CDPD wireless module, but is not directly involved in this phase.

4-2 How many messages sent/received and how often?

This is an important issue for you 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? Or does the user turn on the unit only when making a query to the host system? These informations will influence the requirement for battery capacity and the values of sleep mode.

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

4-3 Hardware Design

The process of integrating USWD500 CDPD module into a hardware design requires many steps like calculating battery size, heat dissipation, physical mounting of the unit to ensure proper grounding.

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

4-4 Consider power supply options

It is according to the needs you defined in 2-1 and 2-2 that the type of power supply and other specifications are determined. As with hardware design in general, designing an appropriate power supply is your responsibility.

4-5 Identify the source antenna

You have the options of using the optional unit mounted flexible antenna, or providing your own antenna for attachment to the SMA connector. The USWD500 operates using standard mobile cellular radio signals and any standard cellular antenna of good quality compliant with the FCC requirement.

4-6 Set up a development test environment

Running a field test is to facilitate hardware and applications development. Supplementing the test environment supported by U.S. Wireless Data, your network carrier sometimes provides a live development network, which is separated 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.

4-7 Software Application Development

Design, code, and test an end-to-end application between the wireless terminal and host. In addition to the specific software application, U.S. Wireless Data suggests you to incorporate RF specific reporting and monitoring features, such as RSSI (Received Signal Strength), channel quality, and in-range/out-of-range conditions.

4-8 Perform EMI and dense testing

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

4-9 Regulatory Approval

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

4-10 Assembly Test

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. You may refer to **Chapter 3** to verify that all connections to the module are made correctly.

4-11 Installation and Field Test

To guarantee that the module is located in an area of good coverage and that end-to-end loop-back message is possible, you must operate an installation and field testing procedure. Please refer to **Chapter 3** to find testing procedures for both installation and connection to the CDPD network.

Chapter 5 Application Development

5-1 Scope of Application

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

Public Service (police, fire, security)

USWD500 Data Module can provide real-time information access and improve resource management for police department, building inspector, utility companies and other public service agencies. For example, the USWD500 can provide law enforcement agencies with instant access to criminal databases and motor vehicle administration records. It can improve response time and increase productivity.

Telemetry

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

Point of Sale

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

Transportation

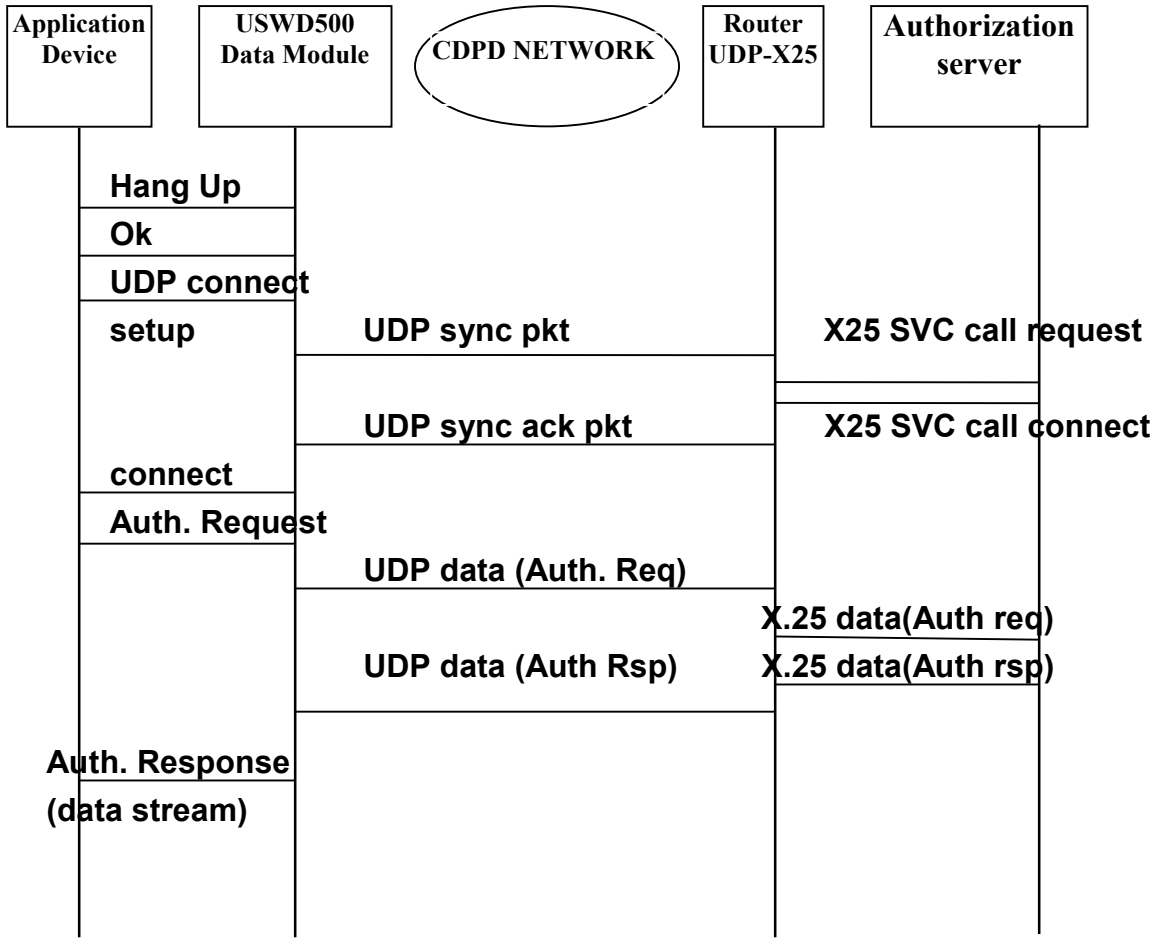
Messages can be transmitted to taxis or company trucks with pick-up and delivery instructions via USWD500 Data Module. With the USWD500 combined with GPS, you can also locate and route vehicles in the field. Wireless data takes the shortest routes between points and provides you with access to tracking and rerouting in real time. Information is available at hand whenever you need it.

On-Line, Point-to-Point Communications

USWD500 Data Module also provides point-to-point communications. For example, while monitoring the water-level of reservoir, you can use this Data Module to send the data of water-level from the remote site.

5-2 Example: Credit Card Verification with USWD500

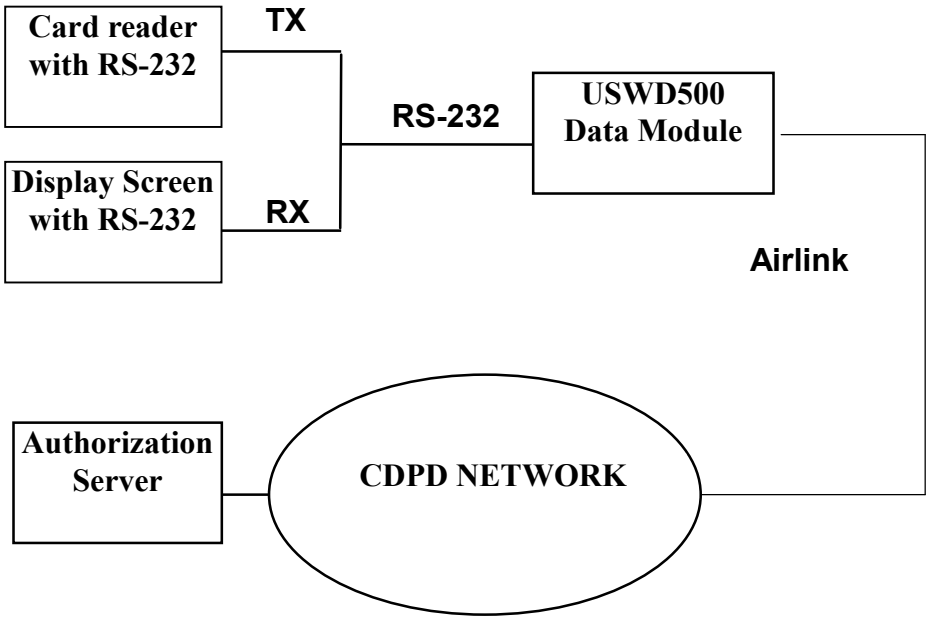
The following figure shows a sample of message exchanges in a typical credit card authorization application. Here we use UDP protocol to minimize billable byte count.



The following steps provide a solution to design credit card verification with USWD500 Data Module:

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

For example:



Step 2 ***Determine the control pins of RS-232 you need for this system.***

For examples:

DTR: Card reader is ready

DSR: USWD500 Data Module 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 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***

While customers pay by credit cards, the card reader reads the information from the credit card and sends these informations to the authorization server via CDPD network. If this transaction is confirmed by the credit card center, USWD500 Data Module will receive a confirm messages on the local site. And the messages will be shown on the display screen to identify this trade valid.

Step 5 ***What you have to do on the application layer***

If data transceiver is lost, you must check data valid on the application layer under UDP protocol architecture, because UDP doesn't guarantee data transfer.

Appendix A AT-Command List

I. General AT Command Set *"*" = Default*

AT Command	*Description*	*Result Code*	*Note*
AT	Answer Online	OK	
ATD ATDadds	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 ATDSn	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 character locally) Enable full duplex (ie., Do not echo characters locally)	OK ERROR	

ATH ATH0 ATH1 ATH2 ATH3	Hang-up (close connection) Transmit pending data, then close connection. Return result code OK Discard pending data, and close connection immediately. Discard pending data, close connection immediately and deregister from the network.	OK ERROR	
ATI ATI0 ATI1 ATI2 ATI3	Identify Identify SU equipment ID Identify firmware version number. Identify manufacturer Identify equipment model number		
ATQ ATQ0* ATQ1	Quite Mode Disable quiet mode (result code are sent to the MAS).(Default) Enable quiet mode (result code are not sent to the MAS)	<nothing> OK ERROR	
ATSn ATSn ATSn=	Select register Read selected register Write selected register	OK ERROR	See S register
ATV ATV0 ATV1*	Verbose result code Use terse result code Use verbose result code	OK ERROR	See Remark 1
ATZ	Soft Reset	OK	

AT Command	Description	Result Code	Note
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” condition		
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 AT&Lspd	M-ES Line Speed spd=1200, 2400, 4800, 9600, 19200		
AT&S AT&S0* AT&S1	Set DSR Operation DSR is always active DSR follows the state of the “Connection Established” condition.		
AT&V	View Active Profile		
AT&W	Save Active Profile	OK	
AT&Z AT&Z? AT&Z=adds AT&Zn=adds	Save Destination Address (Dial Directory) List all saved addresses. Save “adds” as dial address 0. Save “adds” as dial address <n>.		 n=0~4

AT Command	*Description*	*Result Code*	*Note*
AT!A AT!A0 AT!A1*	Autoscan Autoscan Disable Autoscan Enable	 OK	
AT!I AT!I n.n.n.n AT!I?	IP Address Set my IP Address Inquire my IP Address	 OK	“n” means 0~255
AT!M AT!Mn=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!U AT!U0 AT!U1*	 UDP Disable UDP Enable	OK	

Remark 1

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)

II. Extended AT Command Set

"" = Default*

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\Q	Set Flow Control Operation		
AT\Q0	No flow control		
AT\Q1	Bidirectional XON\OFF flow control.		
AT\Q2*	Hardware flow control		
AT\Q3	Both		
AT\T	Automatic Transmit Control		
AT\T0	Disable automatic timed transmission		
AT\T1*	Enable automatic timed transmission according to S50		

S Register

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

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 synchronized

S58 PAD Status

Bit 0	Auto transmit mode; see \T command
Bit 1	Manual transmit mode; see \M command
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 B Special AT-Command

There are two POS AT transaction-related commands:

AT!T command for STX/ETX mode

AT!T1	**Set USWD500 into STX/ETX mode**

Or

AT!T0	**Turn off the STX/ETX mode**

AT!D command for communication status monitoring

AT!D	**Get the communication status**
R/N C/N I/O XXX YYYY	**Status response**

Where R/N means successful register (R) or register failed (N).

And C/N means successful connection (C) or connection failed (N).

And I/O means in coverage range (I) or out of range (O).

And XXX is RSSI value in decimal notation.

For example, 000 means –113 dBm, 050 means –83 dBm.

And YYYY is current channel value in decimal notation.