



CDS-1900 GPRS/GPS Modem

User Manual

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1. Introduction

1.1. Scope

This document provides the necessary product description and configuration information for user operation of the CDS-1900 modem product. This includes product feature descriptions, operation overview, detail programming and reporting formats and modem specifications summary.

1.2. Modem Description

CDS-1900 is an all digital quad-band GPRS cellular modem utilizing the latest digital GSM cellular networks for highest wireless connectivity reliability. This rugged modem is designed to meet extreme environmental conditions and is uniquely optimized for compact size, configuration versatility, ease of use and low cost. The modem asynchronous serial port supports configurable RS-232 and optional RS-485 interfaces with rates up to 460,800 baud and can connect to virtually any device with RS-232, RS-485 or USB interface in any country with GSM/GPRS network. With multiple user defined I/O ports and user programmable event generator, CDS-1900 can be configured for reliable remote control and monitoring of functions. An embedded GPS receiver (optional ordering configuration) provides position and velocity tracking as well as Geofencing capability which further augments the broad feature set of this product family.

1.2.1. Features

- Quad band GPRS: 2W @850/900 MHz and 1W@1800/1900 MHz
- GPRS class B multi-slot class 10
- AT command functionality control with remote access via SMS or Telnet
- Serial data rate programmability up to 460,800 baud
- Supports TCP, UDP, FTP and Telnet
- Auto report of new dynamic IP address
- Over-the-air firmware upgrade
- SMS event triggered messages with to up to 4 user stored numbers
- Auto setting real-time clock: GPS time or NITZ network time (if no GPS)
- GPS position location and velocity estimation with “indoor” acquisition sensitivity
- Geofence definition, monitoring and reporting
- Battery recharging circuit (with use of optional external battery specified by manufacturer)
- Serial Communication Connections: RS-232, RS-485, USB (configuration options)
- IO Connections: 1- ignition sense input, 4 – digital input, 2- analog input, 2- digital output
- LEDs:
 - Tri-color LED showing network registration / SIM / GPRS connection status
 - Green LED showing GPS position acquisition status
 - Battery charging indicator LED

1.2.2. Configurations and Applications

The CDS-1900 product series is available in several ordering configurations which have been optimized to address a variety of applications as listed in Table 1.2.2 below.

Table 1.2.2: CDS-1900 Modem Configurations and Applications

Part Number	Application	Functions/Interface
CDS-1900-V	Automated Vehicle Location	GPRS, SIM card tray and Antenna GPS and Antenna RS-232 and USB I/O terminal block Battery Charger
CDS-1900-M	Remote Equipment Monitoring/ Automated Meter Reading	GPRS, SIM card tray and Antenna RS-232, RS-485 and USB I/O terminal block Battery Charger
CDS-1900-E	Embedded module applications	GPRS, SIM card tray and Antenna GPS and Antenna High density GPIO

1.2.3. Physical Layout and Connections

1.2.3.1. Front Panel Interface

The modem front panel and interface descriptions are shown in the figure and table below. Connector pin-out information is provided in the Connector Definition section of this document.

Figure 1.2.3.1: Modem Front Panel Interface
(All possible connections shown for reference)



Table 1.2.3.1: Front Panel Interface Descriptions

Label	CDS-1900 Models	Description	Interface Detail
Connectors			
GPS ANT	-V, -E	Connector for GPS antenna	50 ohm, female SMA connector +3.3V DC bias for active antenna
GSM ANT	-V,-M,-E	Connector for GSM antenna	50 ohm, female SMA connector.
RS-232	-V, -M	Connector for RS-232 port interface	8 pin, mini-DIN female receptacle configured for RS-232 DCE signaling. (Reference section 6.2 for connector detail)
USB	-V, -M	Connector for USB interface	Mini-USB, universal type A/B receptacle configured as type B USB device. (Reference section 6.3 for connector detail)
LEDs			
CHRG	-V,-M	LED for battery charging	Green LED Solid Green when charging Off when fully charged or not connected
GSM/GPRS	-V,-M,-E	LED for GSM/GPRS status	Tricolor LED Solid Red - GSM unregistered Solid Green - GSM registered Solid Blue - GPRS Attached
GPS	-V, -E	LED for GPS status	Green LED for GPS status Blinking – Acquiring Satellites Solid - Satellite lock
Other			
SIM	-V,-M,-E	Tray holder for SIM card	Ejector pin external access.
RESET	-V,-M,-E	Switch for modem reset	Tact switch access, press to reboot modem

1.2.3.2. Rear Panel Interface

The modem rear panel and interface descriptions are shown in the figure and table below. Connector pin-out information is provided in the Connector Definition section of this document.

Figure 1.2.3.2: Modem Rear Panel Interface
(All possible connections shown for reference)



Table 1.2.3.2: Rear Panel Interface Descriptions

Label	CDS-1900 Models	Description	Interface Detail
Connectors			
RS-485	-M	Connector for RS-485 interface	6 pin, single row, 3mm, locking, male receptacle. RS-485 half/full duplex configurable. (Reference section 6.4 for connector detail)
PWR/CHG	-V, -M	Connector for DC Power (+6V to +32V) and external Battery Backup/Charging	4 pin, single row, 3mm, locking, male receptacle. (Reference section 6.1 for connector detail)
I/O	-V, -M	Connector for Modem IO signals	10 pin, dual row, 3mm, locking, male receptacle. (Reference section 6.5 for connector detail)
GPIO	-E	Connector for embedded modem applications	70 pin, dual row, 50 mil, female receptacle. High density I/O access to modem internal signal and control. (Reference section 6.6 for connector detail)

1.3. Safety Precautions

The following notes refer to OEM modules for the CDS-1900 Series Modem and to applications based on CDS-1900 Modem. These safety precautions must be incorporated into the instruction manual of the end user of any application based on the CDS-1900 Modem Series.

Electrical Safety:

The lowest input voltage that can be applied to the CDS-1900 is 6 VDC; the highest voltage that can be used is 32 VDC.

Aircraft Safety:

Cellular communications can interfere with an aircraft's navigation system and communication systems. The use of CDS-1900 Modem on board aircraft is forbidden by federal law.

Electronics in Medical Equipment:

Radio transmitters, including cellular engines, can interfere with the operation of inadequately protected medical devices. Address all questions to a physician or to the manufacturer of the medical device.

Precautions in the Event of Loss/Theft of the CDS-1900:

If the CDS-1900 GPRS Modem is missing or stolen, notify the cellular network operator immediately in order to prevent unauthorized use.

RF Exposure Safety:

The antenna(s) used for this transmitter must be installed at a distance of at least 20cm from all persons and must not be co-located or used in conjunction with any other antenna or transmitter. The antenna(s) used for this transmitter must not exceed a gain of 3 dBi at 1900 MHz / 1.4 dBi at 850 MHz for mobile operating configurations and 7 dBi at 1900 MHz / 1.4 dBi at 850 MHz for fixed mounted operations

2. Getting Started

2.1. Contents Inspection

The contents of the modem package will vary based on modem HW configuration and accessory ordering. Below is a comprehensive list of the items:

Base items (included with modem order):

- CDS-1900 modem
- GSM Antenna
- Power connector plug and wire harness (-V and -M models)
- IO connector plug and wire harness (-V and -M models)
- RS-485 connector plug and wire harness (-M model)
- RS-232 Mini-DIN to DB9 cable/adaptor (-V and -M models)
- SIM card tray
- CD: CDS-1900 user manual and PC USB driver

Accessory items (ordered separately):

- GPS Antenna (-V and -E models)
- AC to DC power supply
- Mounting hardware

Please make sure that the contents match the particular configuration that was ordered.

2.2. SIM card and Service Plan Confirmation

It is the sole responsibility of the user to obtain a SIM card from their selected GSM service provider with the appropriate service plan for their applications.

Note: The type of service obtained may limit some of the modem features, based on static vs dynamic IP addresses, routable vs non-routable IP addresses and NAT vs non- NAT. Specifically, the latter two items (non-routable and NAT) would prevent modem server based functions such as inbound data calls and remote Telnet access.

2.3. GPRS Connection Example

The following sections provide the basic set-up and configuration steps for initiating a TCP data connection over the GPRS network.

2.3.1. Modem Connections

Antenna

- Connect and tighten the GSM and GPS (-V) antennas to their respective SMA bulkhead connectors on the modem.
- The antennas should be oriented such that there are no metal obstructions which can inhibit signal reception.

Serial Port

- Several options are available for serial connection to the modem: RS-232, RS-485, and USB, depending on your hardware configuration. For this example, an RS-232 interface will be used.

- Attach the RS-232 cable adaptor, provided with the unit, to the modem and to a local PC for device configuration. The cable adaptor connects the modem circular mini-DIN to the PC DB9 serial port.
- The local PC should have terminal emulation software (HyperTerminal or other) installed and configured for the port being connected to the modem (default settings of 115200 baud and 8-N-1 framing).

SIM card

- Carefully insert the SIM card onto the SIM tray provided and slide into the modem SIM slot on the front panel.
- Make sure that the tray is inserted completely into the modem receptacle.

Power

- Attach the cable harness provided with the unit to an external DC power supply (+6 to +32 V DC) making sure that the proper pin-out and polarity match the modem connector definition in section 6 of this document. The battery backup function is not used for this example and therefore the BATT terminal should not be connected.
- The power supply should remain turned off during the connection process.

2.3.2. Initial Power-up and Configuration

- Apply DC power to the unit.
- The modem GSM/GPRS LED will blink during initialization and will settle to a solid color in approximately 45 seconds. The final color (green or blue) will depend on whether valid GPRS login settings are stored in the unit. This will be set-up in the next section.
- Using the RS-232 port terminal, enter “AT” and carriage return (<CR>). An “OK” response indicates proper communication set-up. If no response is observed or if “garbage” characters are seen, check the com port set-up for proper baud and framing. The default modem settings are 115200 baud and 8-N-1 framing).
- Enter “AT+XCNFG?” <CR> on the RS-232 terminal. A list of parameters for the configuration command will be reported.
- Check the parameters against the specific service and application information for your modem and update items using the AT+XCNFG command (reference AT command section of this document). For example:

Phone number, enter:	AT+XCNFG=1,1, “ <i>Modem Phone number</i> ”<CR>
APN, enter:	AT+XCNFG=2,1, “ <i>Service APN</i> ”<CR>
GPRS login, enter:	AT+XCNFG=3,1, “ <i>Service Login</i> ”<CR>
GPRS password, enter:	AT+XCNFG=4,1, “ <i>Service Password</i> ”<CR>

- Check parameters that have been entered by issuing another “AT+XCNFG?” and correct items as necessary.
- A user defined password may be set for remote access to the AT command processor via SMS or Telnet. Enter a user password using the AT+XPASS command (reference AT command section of this document). For example:
Remote access PW, enter: AT+XPASS=1,“*User Password*”<CR>
- Check the password entry by entering “AT+XPASS?”<CR> and correct as necessary.
- The unit must be reset for the GPRS changes to take effect. This may be done by re-cycling modem power or by issuing “AT+CFUN=1”<CR> .

2.3.3. Network Connection and Verification

- Apply DC power to the modem if it is OFF or issue “AT+CFUN=1”<CR> to reset the modem if it is already ON.

- The GSM/GPRS LED will blink during initialization and will settle to solid blue color (after period of solid yellow: SIM initialization and solid green: GSM registration). The final solid blue color indicates attachment to the GPRS network.
- The ATDT, ATD or AT+XTCPC commands may be used to initiate an outbound packet data call command (reference AT command section of this document). Any valid remote TCP server IP address and port may be specified. Verify that the designated TCP server is available and that the port is opened (listening). Enter the command example below:
TCP call to remote IP, enter: AT+XTCPC="IP address",Port#,0<CR>
- A "CONNECT 0" response indicates that the TCP connection has been made and data may now be passed from the RS-232 port to the destination server. *Note: If hardware is configured with an RS-485 port, the data connection will be made to RS-485 port instead of the RS-232 port.*
- The data connection may be verified by sending data (keyboard entry or file transfer) between the modem terminal and the remote TCP server.
- The connection may be terminated by typing "+++" at the modem terminal. This switches the port back to command mode and disconnects the TCP connection.
- Remote AT Command access via Telnet may also be verified by remotely connecting to port 23 of the modem. If the IP address of the modem is not know (dynamic IP), enter the "AT+XSTAT"<CR> command and note the IP address. Using any remote TCP client terminal, connect to the modem IP address and port 23 (Telnet). *Note: As previously indicated, remote access via Telnet will not be possible if the GPRS service is NAT'd IP or non-routable IP addresses.*
- The remote client terminal will respond with a "Password:" prompt when connection is made to the modem. Enter the previously defined "User Password" followed by a <CR>. An "OK" response will indicate that you are now connected to the modem AT command processor.
- As simple verification of AT command mode, enter "AT+XSTAT" <CR> in the remote client terminal and verify that the modem information is reported. Other AT commands may also be entered and verified (reference AT command section of this document).
- The Telnet connection may be disconnected using the appropriate client terminal call disconnect function. Issuing an AT command such as ATH in the remote Telnet window will not close the connection. Appendix A lists the AT commands restrictions via remote access.
- Remove DC power from the unit when finished.

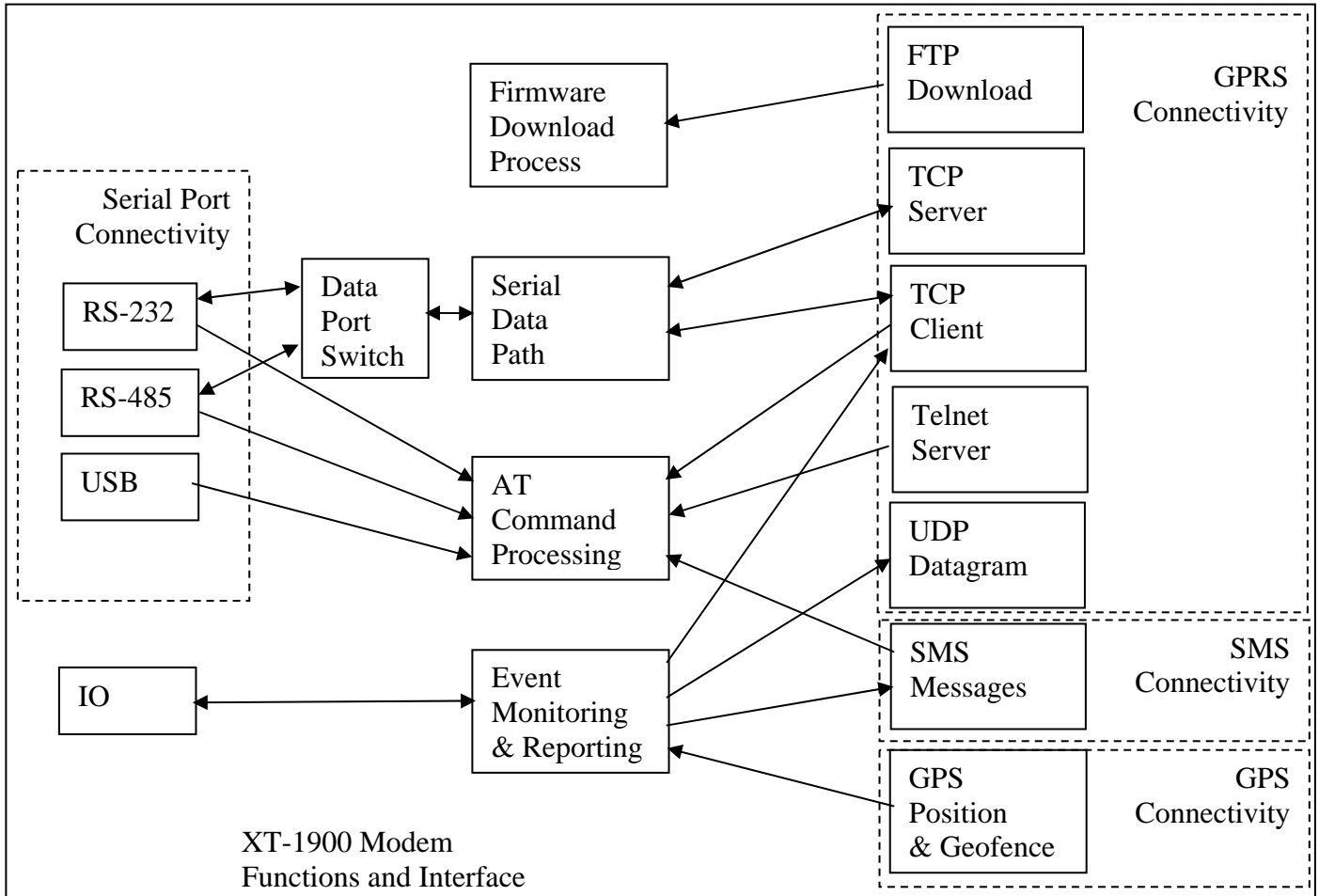
Note: Once the basic modem power-up, configuration and network connections examples have been successfully executed as described above, application specific modem functions and features can be implemented using the information presented in the remainder of this document.

3. Modem Operation

3.1. Block Diagram

The following block diagram shows the fundamental modem connections and functions. This diagram provides a visual reference for specific modem operations described in the subsequent sections of this document.

Figure 3.1 Modem Block Diagram



3.2. GPRS Connectivity

GPRS is the primary communication mode of the CDS-1900 modem. The modem automatically attaches to the GPRS network on power-up provided that the network is available and valid login information is configured in the modem. The login information is configured using the AT+XCNFG command. Detail information regarding this command can be found in the AT Command section of this document.

Upon successful attachment to the network, the modem automatically reports the assignment of the new dynamic IP address. The reporting of the IP address can be provided by UDP datagram format. The UDP datagram reporting will work directly with the IP Manager 5.0 DNS server from the manufacturer. The IP address reporting is configured using the AT+XCNFG command.

The integrated TCP stack of the CDS-1900 modem supports TCP, FTP, Telnet and UDP protocols. The TCP stack is utilized to support the following modem functions:

- Remote command line interface via Telnet
- Transfer of data from Internet to serial port via TCP
- Over-the-air firmware upgrade using FTP
- Reporting of event information using UDP or TCP

3.2.1. Mobile Terminated Packet Commands

The CDS-1900 modem supports remote entry of AT commands (mobile terminated) via the embedded Telnet server. The remote Telnet client connects to port 23 of the modem which is dedicated for Telnet Server access. The command line interface allows the AT commands to be entered through the remote Telnet client. The Telnet server may be password protected via the AT+XPASS command. This same password is used for both SMS and Telnet access authorization. If no entry is provided, the password feature is disabled.

Note: Some of the modem AT commands are restricted from use when accessing modem command processor remotely. This ensures that a command entry will not inadvertently disable the communication capability of the modem. The AT Command list in Appendix A identifies which commands are available via remote access.

3.2.2. Mobile Terminated Packet Call

When the modem receives an inbound packet call (mobile terminated), a TCP connection is made and a pass through data path to the serial port of the modem is established. In this mode, the modem effectively functions as a TCP server and listens on the predefined port of the modem for inbound connection requests. Two TCP connection modes are supported by the modem and are described in the subsequent paragraphs. The specific port number and connection mode information for the modem are controlled via the AT+XCNFG command (reference AT command section of this document).

Call Connection

Connection Mode 0 is the default connection mode. When the TCP connection is requested by remote client, the modem automatically sets up the TCP connection. A carrier detect is activated when the TCP connection is completed and a “CONNECT” response issued to the serial port.

Connection Mode 1 is used to interface with Hayes compatible devices. When the TCP connection is requested by a remote client in this mode, a “RING” message is sent over serial port. The modem
DataRemote Inc.

awaits an “ATA” answer command from the DTE before completing TCP connection. Once the connection is completed, the carrier detect is activated and the “CONNECT” response is sent to the serial port.

When a TCP connection is established, the serial port is automatically switched to Data Mode. In Data Mode, all inbound TCP data is sent through the serial port and all serial outbound data is sent to the TCP socket.

Call Termination

The TCP session may be terminated by either side of the connection (modem or remote client). When terminated by the remote client, using normal TCP socket teardown mechanisms, a “NO CARRIER” is sent over the serial port and the serial port is switched back to AT command mode (default).

The TCP session may be terminated locally (modem side) when in Connection Mode 1 by first switching the serial port from data mode to AT Command Mode. The serial is switched to AT Command Mode by issuing a “+++” character string with 1 second pauses on either side of the string. Note that the serial port may be switched back to Data Mode by issuing an “ATO” command. While in the AT Command Mode the TCP session is terminated by issuing an “ATH” hang-up command.

The TCP session may also be terminated locally when operating in Connection Mode 0. In this connection mode, issuing the “+++” sequence as described previously will automatically close the TCP connection socket and switch the serial port to AT command mode. Since the TCP connection is closed automatically, the “ATH” command is not required as in Connection Mode 1.

When the TCP session socket is closed (modem or remote client), the modem TCP server still remains open to allow subsequent connections to be established.

3.2.3. Mobile Originated Packet Call

When the modem initiates outbound packet calls (mobile originating), a local AT command forces a TCP connection to be made and a pass through data path is established to the serial port of the modem. In this mode, the modem effectively functions as a TCP client by providing a connection request to a predefined IP address and port location of the destination device. The TCP connection is initiated via the AT+XTCPC, ATDT or ATD commands and, as discussed the previous section, the TCP connection mode is defined using the AT+XCNFG command (reference AT command section of this document).

Note: In addition to local AT command initiated calls, user defined event reporting actions automatically initiate TCP or UDP connections to send predefined messages before disconnecting. The event triggering and reporting operation are described in later sections of this document. Also a Mode parameter in the AT+XTCPC command has been created to permit remote SMS initialization of an outbound TCP connection in AT command mode. More information on this connection is provided in the SMS Connectivity section of this document.

Call Connection

There are two fundamental methods of initiating a TCP packet call via AT commands: Initiation Mode A and Initiation Mode B.

Initiation Mode A establishes a TCP connection by issuing the standard “ATD” or “ATDT” command sets when serial port is in AT command mode. This command is followed by numeric IP address

(with leading 0 fill to provide 3 digits per field) followed by port number, separated by comma. After sending the AT command a “CONNECT” response will be returned when the TCP connection is successfully established. If an “ERROR” response is returned, an incorrect syntax was received. A “NO ANSWER” response is returned if the connection time out was exceeded (user programmable timeout). A “NO CARRIER” response indicates that the TCP client socket is already in use or there is no GPRS connectivity. When connected, the serial port is switched to Data Mode and all data received at the serial port is sent to remote TCP client and all data received through TCP connection is output through serial port.

Initiation Mode B establishes a TCP connection by issuing the “AT+XTCPC” command when serial port is in AT command mode. This command is followed by an IP address or DNS lookup followed by port number, separated by comma. The IP Address must be surrounded by quotes and will accept numeric entry without leading zeros (e.g. a.b.c.d) or a name lookup through DNS. After sending the AT command, a “CONNECT” response will be returned when the TCP connection is successfully established. If an “ERROR” response is returned, an incorrect syntax was received. A “NO ANSWER” response is returned if the connection time out was exceeded (user programmable value). A “NO CARRIER” response indicates that the TCP client socket is already in use or there is no GPRS connectivity.

Call Termination

The TCP session may be terminated by either side of the connection (modem or remote server) as previously described with Mobile terminated calls. When terminated by the remote server, using normal TCP socket teardown mechanisms, a “NO CARRIER” is sent over the serial port and the serial port is switched back to AT command mode (default).

The TCP session may also be terminated locally (modem side) when in Connection Mode 1 by first switching the serial port from data mode to AT command mode. The serial port is switched to AT command mode by issuing a “+++” command with 1 second pauses on either side of the string. The serial port may be switched back to Data Mode by issuing an “ATO” command. While in the AT command mode the TCP session is terminated by issuing an “ATH” hang-up command.

The TCP session may also be terminated locally when operating in Connection Mode 0. In this connection mode, issuing the “+++” sequence (as described previously) will automatically close the TCP connection socket and switch the serial port to AT command mode. Since the TCP connection is closed automatically, the “ATH” command is not required as in Connection Mode 1.

When the TCP session socket is closed (modem or remote client), the modem TCP server still remains open to allow subsequent connections to be established.

3.2.4. Download Over the Air (DOTA)

Firmware downloads over the air are performed via FTP and are initiated at the modem side using an AT command. The modem logs on to a manufacturer specified remote FTP server using appropriate login credentials and initiates a download of a firmware update over the air. The download file is an encrypted software update which is decrypted and error checked after download. The specific IP address, port #, filename, password and subdirectory location are identified using the AT+XFTPD command (reference AT command section of this document). Should your modem need a firmware update, your supplier will provide you with an exact command string that includes all of these fields, in order to enable the download.

Upon successful download the modem automatically reboots with new software running and a “Firmware Updated” message is returned at the serial port upon reboot. If connection problems are encountered a “NO ANSWER” message is returned. If the modem identifies an invalid file or hexadecimal password, an “ERROR” message is returned. An “ERROR” message will also be returned if errors are detected in the download process.

3.3. SMS Connectivity

The CDS-1900 modem supports inbound and outbound SMS messaging anytime after network registration and SIM initialization. The inbound SMS messaging provides remote AT command line access and the outbound SMS messaging provides event triggered reporting. Up to 4 independent SMS phone #s are stored in the modem and are configured using the AT+XCNFG command (reference AT command section of this document).

3.3.1. Mobile Terminated SMS Commands

AT commands may be remotely sent to the modem through SMS messaging (Mobile Terminated). The modem responses to the AT commands which are normally sent to the originating serial port, are now automatically returned back to the calling number via SMS messaging with a new SMS message being generated for each line of response. A user defined password protects unauthorized access to this remote command line capability. The password is set using the AT+XPASS command (ref AT command section of this document). This same password is used for both SMS and Telnet access authorization. If no entry is provided, the password feature is disabled.

The SMS text format is shown below:

SMS text when Password enabled: <password>,<AT command>

SMS text when Password disabled: <AT command>

Note: Care should be taken when issuing certain remote AT commands as some command responses can be quite large and therefore generate a large number of response SMS messages.

A custom AT command option has been created to permit SMS initiation of a modem outbound TCP connection in AT command mode. This special SMS AT command remotely triggers the modem to initiate a TCP connection to a specified IP address/port and directly communicate with the AT command processor in the modem. A single AT+XTCPC command is sent via SMS which defines the IP address and port of the remote terminal and, with the Mode parameter set to "1", provides direct AT command processor access (reference AT command section of this document). The destination PC will then have remote TCP access to AT command entry. Termination of this connection is the same as any other TCP call. There is no password protection applied to this method of communication, as it should only be initiated from an SMS message that was already authenticated using the password (assuming a password was configured by the user).

Note: As with Telnet remote command access, some of the SMS modem AT commands are restricted from use when accessing modem command processor remotely. This ensures that a command entry will not inadvertently disable the communication capability of the modem. The AT Command list in Appendix A identifies which commands are available via remote access.

3.3.2. Mobile Originated SMS Call

Outbound SMS calls (Mobile Originated) are initiated automatically via event reporting messages. The standard messages are sent to SMS numbers stored in the modem upon event triggering. Up to four unique numbers are stored in the modem and are entered via the AT+XCNFG command. Details of the event reporting format are covered in later sections of this document.

3.4. Serial Port Connectivity

The CDS-1900 modem provides local serial communication connectivity via RS-232 port, RS-485 port and/or USB ports depending on the modem hardware configuration. These serial connections are described in the subsequent sub-sections.

There are two fundamental modes of serial communication provided by the modem: AT Command Mode and Data Mode.

AT Command Mode

The AT Command Mode is the default serial communication mode in which the modem is available to accept and respond to AT commands from the DTE device. Since the modem is only looking for AT commands in this mode, only modem recognizable AT command syntaxes will be accepted by the modem.

User defined “Null Commands” are available to provide compatibility with legacy equipment by defining, recognizing and responding “OK” to AT commands which are not normally supported. The Null Commands are defined and stored using the AT+XNULL command (reference AT command section of this document).

Data Mode

The serial port Data Mode is established whenever a TCP connection is made. In this mode, all serial port data is directly passed through to the TCP socket for wireless transmission and all wireless data received by the TCP socket is passed directly to the serial port. AT commands entered during this mode will be treated as transmit data characters instead of being recognized as valid AT commands.

As described in previous sections, the serial port can be switched back to AT Command mode by entering “+++” string when in TCP Connection Mode 1 without losing the TCP connection. Subsequently entering an ATO command when in the AT Command mode will toggle back to Data Mode as long as the TCP connection is still active.

When a TCP connection is closed, the serial port switches back to the default AT Command Mode until another connection is established.

3.4.1. RS-232 port

The RS-232 port connector is an 8 pin, female Mini-DIN connector with full hardware flow control capability and programmable rate capability up to 460,800 baud. A manufacturer supplied interface/adaptor cable provides connection between the DCE configured modem port and an external standard DB9 connector on the DTE device. The modem baud rate is programmed via the standard AT+IPR command (reference AT command section of this document). Detail connector interface information is provided in Section 6 of this document.

The RS-232 port is always available for AT Command mode operation but the Data Mode capability is only available when the RS-485 port is not configured in the Hardware (-V model). When a RS-485 port is also present (-M model), the RS-232 port will only provide an alternative AT command interface through its dedicated port connection.

3.4.2. RS-485 port

The RS-485 port connector is a 10 pin, male terminal connector with external pin selectivity for half and full duplex mode operation. As with the RS-232 port, the modem baud rate is programmed via standard AT+IPR command (reference AT command section of this document). Detail connector interface information is provided in Section 6 of this document.

The RS-485 port is always available for AT Command and Data Mode operation (-M model). As previously described, the Data Mode operation is switched to this RS-485 port instead of the RS-232 port.

3.4.3. USB port

The USB port connector is a universal mini-USB connector configured for type B USB device operation. This port is intended for direct connection to a local host PC which has a manufacturer provided driver installed. The custom driver essentially emulates a serial communication port on the PC. Terminal emulation software will permit communication to the modem over this connection. Detail connector interface information is provided in Section 6 of this document.

The USB port interface is only available for AT Command mode operation. All Data Mode connectivity is passed to either the RS-232 or RS-485 port depending on HW configurations as described previously.

3.5. GPS Connectivity

The CDS-1900 provides automatic connection to the GPS satellite system via an embedded GPS receiver when the modem is appropriately configured for location measurement. Once enabled, the GPS receiver acquires available satellites via the dedicated antenna port and upon successful acquisition of a minimum number of satellites, the receiver provides the modem with accurate position information. Depending on the modem configuration settings, the position information can be reported periodically as defined by the user or may also be utilized for Geofencing capability. The periodic reporting parameters are set via the AT+XCNFG command and the Geofencing features are configured using the AT+XGEOF and AT+XEVGE commands (reference AT command section of this document).

Periodic Location Reporting

When the periodic location feature is enabled, the modem will measure and report location information via TCP or UDP. The reporting destination (TCP or UDP, address and port) and period parameters are defined by the AT+XCNFG command. Independent reporting periods may be set for three different states: vehicle turned off, vehicle running and vehicle moving (reference AT command section of this document). Detail information on the reporting message formats can be found in Report Message section of this document.

Geofencing

The Geofencing feature provides the capability to define a geographic boundary area or areas (location and radius) such that an event trigger will occur if the device moves outside the defined area. When an event trigger occurs a report message will be sent to a predefined remote site via TCP, UDP or SMS. The event may include multiple Geofence areas and may also be reversed such that a trigger occurs when the device enters the Geofence area. The AT+XGEOF command defines and saves the set of Geofence boundaries (up to 16 unique areas) and the AT+XEVGE command configures the event reporting parameters.

3.6. Event Triggering and Reporting

The CDS-1900 modem can be configured to monitor a variety of local events, compare them against predefined trigger thresholds and provide a selected action(s) when the event trigger occurs. The events which can be programmed include the following:

- Any one of the general purpose inputs going high or low
- Either of the analog inputs crossing a specific voltage level
- Entering or leaving a Geofence or group of Geofences
- Command received to set / reset a general purpose output

All the event programming is accomplished via AT commands. These events can be generically categorized as IO based, and location based events. The IO based events are programmed using the AT+XEVIO command, the location based events are programmed by the AT+XEVGE command in conjunction with the AT+XGEOF command (reference AT command section of this document).

When an event trigger occurs, the modem will take action according to the AT command action parameters. Any combination of the actions listed below may be taken when an event trigger occurs:

- Send an SMS report message to any of four pre-programmed numbers
- Initiate a TCP session to a pre-defined reporting IP address and port and send an event report message
- Send a UDP datagram to a pre-defined reporting IP address and port containing event indication
- Set or reset one of the user defined general purpose outputs

All event message reporting is done via SMS, TCP or UDP connections. These report messages provide the unit ID (phone number of IMEI, as defined by user), type of event, and event-relevant information (e.g. GPS coordinates, speed for location based event, IO status for IO based event). The reporting ID information, GPS update interval and Report format selections are entered using the AT+XCNFG command. The detail characteristics of the event message format can be found in the Report Message section of this document.

4. Modem Programming

4.1. AT Commands

4.1.1. Command Structure

All commands are in ASCII format and always start with “AT” characters (ATtention, start of message) and finish with a <CR> character (end of message). The fields in the command are delimited by the comma (,) character.

Each command is defined in the following format:

<u>Description:</u>	Brief description of the command function
<u>Syntax:</u>	Format of the command line structure (start with “AT” and end with <CR>)
<u>Field Definition:</u>	Definition of field parameters identified in syntax (if applicable)
<u>Response:</u>	List of possible ASCII responses received after execution of the command
<u>Query Syntax and Response:</u>	Additional syntax/response variants for query operation (if applicable)

4.1.2. Configuration Commands

4.1.2.1. AT+XCNFG

Description:

This command provides the capability to set all modem configuration parameters in RAM and FLASH as well as query and display all parameters which have been previously set.

Syntax:

AT+XCNFG=<Parameter>, <Save Mode>, “<Value>”<CR>

Field Definition:

- <Parameter>:
- 1: Phone Number
 - 2: GPRS Access Point Name
 - 3: GPRS Username
 - 4: GPRS Password
 - 5: TCP Server Port
 - 6: UDP Refresh IP Address
 - 7: UDP Refresh Port
 - 8: TCP Reporting IP Address
 - 9: TCP Reporting Port
 - 10: UDP Reporting IP Address
 - 11: UDP Reporting Port
 - 12: SMS#1 Phone Number
 - 13: SMS#2 Phone Number
 - 14: SMS#3 Phone Number
 - 15: SMS#4 Phone Number
 - 16: Connection Mode for mobile originated TCP connections (0 or 1)
 - 17: Number of times mobile terminated packet call should issue “RING” indication before terminated (applies only for Connection Mode 1)
 - 18: Time between rings (expressed as 100 msec increments; only applies for Connection Mode 1)
 - 19: TCP Timeout (expressed as 100 msec increments) – defines how long a mobile originated TCP packet call will wait for connection before timing out

20: GPS Reporting Time High (expressed as 100 msec increments) – defines the time between periodic location reports when Ignition Sense input is high – Note: changing this variable will cause an initial periodic report to be generated

21: GPS Reporting Time Low (expressed as 100 msec increments) – defines the time between periodic location reports when Ignition Sense input is low – Note: changing this variable will cause an initial periodic report to be generated

22: Reporting Mode (0 = Short reporting mode, 1 = Extended reporting mode) – defines whether input and output values are transmitted in periodic location reports

23: Reporting Unit ID (0 = Phone number, 1 = IMEI (default)) – defines what parameter is used for Unit ID in all event and periodic reports

24: Virtual Ignition Sense through Movement (No motion threshold expressed as 100 msec increments) – uses movement instead of ignition sense to change reporting times (between #20 and #21 described above). Defines the time the vehicle is not in motion before it is determined that the vehicle has been turned off. This value must be either 0 to disable or must equal the value entered in #20 above.

25: Used to load all FLASH parameters to RAM

<Save Mode>: 0: set RAM value

1: set RAM and FLASH value

2: display parameter value in RAM

4: display parameter value in FLASH and load it into RAM

<Value>: String value for each of the parameters when setting them to RAM or FLASH (must be surrounded by quotes)

Response:

“ERROR” Syntax error

“OK” Successful command completion

Query Syntax and Response:

AT+XCNFG? Returns all parameters

AT+XCNFG=? Returns Command Syntax

4.1.2.2. AT+IPR

Description:

This command sets the serial port baud rate.

Syntax:

AT+IPR=<rate> <CR>

Field Definition:

<rate>: Baud rate values:
 0: Auto baud rate detection
 300
 600
 1200
 2400
 4800
 9600
 19200
 38400
 57600
 115200

230400
460800

Response:

“ERROR” Syntax error
“OK” Successful command completion

Query Syntax and Response:

AT+IPR? Returns current IPR value
AT+IPR=? Returns list of auto detectable and supported rates

Note: this configuration merely changes the value in RAM. The unit will revert back to the value stored in FLASH upon reboot or reset. In order to change the value stored in RAM and in FLASH, the command must be followed by “;&W”.

4.1.2.3. AT+XPASS**Description:**

This command sets the password for remote SMS and Telnet access.

Syntax:

AT+XPASS= <Save Mode>,”<password>”<CR>

Field Definition:

<password>: ASCII string representing password, 10 characters max (must be surrounded by quotes)
Null string entry disables the password feature.
<Save Mode>:0: set RAM value
1: set RAM and FLASH value
2: display parameter value in RAM
4: display parameter value in FLASH and load it into RAM

Response:

“ERROR” Syntax error
“OK” Successful command completion

Query Syntax and Response:

AT+XPASS? Returns all parameters values
AT+XPASS=? Returns Command Syntax

4.1.3. Status Query Commands

4.1.3.1. AT+XSTAT

Description:

This command returns status of the state machine corresponding to each parameter.

Syntax:

AT+XSTAT<CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after state response to Parameter.

SIM State Response:

“1” SIM removed,
 “2” SIM inserted,
 “3” SIM initialized,
 “4” PIN error,
 “5” PIN OK,
 “6” PIN Wait,
 “7” No PIN

GSM State response:

“0” Unregistered
 “1” Registered

GPRS State Response:

“1” Failed
 “2” Connected
 “3” Disconnected
 “4” Stopped

TCP/Telnet Server Response:

“0” TCP/Telnet server not up,
 “1” TCP/Telnet server ready

GPS State Response:

“Achieved First Fix, but no valid Location” At least one GPS position fix obtained since last pwr-up
 “Fixed never achieved” No GPS position fix obtained since last pwr-up
 “Current Lat: xxx Lon: yyy” The GPS position fix obtained is accurate

4.1.3.2. AT+CREG?

Description:

This command displays the GSM registration state.

Syntax:

AT+CREG? <CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after displaying GSM registration state

4.1.3.3. AT+CGATT?

Description:

This command identifies the attachment state of GPRS.

Syntax:

AT+CGATT? <CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after displaying GPRS attachment state

4.1.3.4. AT+CGREG?**Description:**

This command identifies the GPRS registration state.

Syntax:

AT+CREG? <CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after displaying the GPRS registration state.

4.1.3.5. AT+XVRSN**Description:**

This command provides the application firmware revision number.

Syntax:

AT+XVRSN<CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after display of application firmware revision number.

4.1.3.6. ATi3**Description:**

This command provides the operating system firmware revision number.

Syntax:

ATi3<CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after display of operating system firmware revision number.

4.1.3.7. AT+CSQ**Description:**

This command provides the RSSI and BER values for the modem.

Syntax:

AT+CSQ<CR>

Response:

“ERROR” Syntax error
 “OK” Successful command completion after displaying RSSI and BER values

4.1.4. Null Commands

4.1.4.1. AT+XNULL

Description:

This command creates a new user-defined command, which generates an “OK” response to facilitate interface compatibility with legacy devices that expect such responses.

Syntax:

AT+XNULL=<Number>, “<Command>” <CR>

Field Definition:

<Number>: 1-10: represents the reference ID of the command to be created and loaded into RAM and FLASH.

<Command>: Command string starting with “AT+”. Do not enter parameters in command string (i.e. enter “AT+Command” not “AT+Commmand=10”). Avoid commands that already exist, so as not to intercept valid commands. (must be surrounded by quotes) Null string disables the specific Null command number.

Response:

“ERROR” Syntax error

“OK” Successful command completion after displaying status of requested parameter

Query Syntax and Response:

AT+XNULL=? Returns Command Syntax

AT+XNULL? Returns List of all existing commands in FLASH

Warning: Care must be taken to not define standard commands as Null commands. Such definitions will disable features of the modem, which may only be retrievable through firmware update.

4.1.5. Connection Commands

4.1.5.1. AT+XTCPC

Description:

This command establishes a TCP connection with a server listening at IP address (may be DNS lookup) and port.

Syntax:

AT+XTCPC="<IP address>", <Port>,<Mode><CR>

Field Definition:

<IP address>: IP address string or DNS lookup string (must be surrounded by quotes)
 <Port>: Port number
 <Mode>: Selects connection mode:
 0: Data Mode (default). On TCP connection data path direct to serial port.
 1: AT command mode . This mode forces TCP connection with direct access to AT command processor instead of modem serial port. Primary function for remote SMS initiated command to provide modem AT command line interface connection to destination IP/port device.

Response:

"CONNECT 0"	Successful connection and serial port switched to data mode
"NO CARRIER"	No GPRS connection or socket unavailable
"NO ANSWER"	Cannot connect
"ERROR"	Syntax error

4.1.5.2. ATDT

Description:

This command is an alternate format to establish a TCP connection with server listening at <IP address> and port.

Syntax:

ATDT<IP address>, <Port><CR>

Field Definition:

<IP address>: IP address (must be leading 0 filled decimal formatted numeric IP address – e.g. an IP of 1.22.33.444 is entered as 001022033444)
 <Port>: Port number

Response:

"CONNECT 0"	Successful connection and serial port switched to data mode
"NO CARRIER"	No GPRS connection
"NO ANSWER"	Cannot connect
"ERROR"	Syntax error

4.1.5.3. ATD

Description:

This command is an alternate format for establishing a TCP connection with server listening at <IP address> and port.

Syntax:

ATD<IP address>, <Port><CR>

Field Definition:

<IP address>: IP address (must be leading 0 filled decimal formatted numeric IP address – e.g. an IP of 1.22.33.444 is entered as 001022033444)

<Port>: Port number

Response:

“CONNECT 0”	Successful connection and serial port switched to data mode
“NO CARRIER”	No GPRS connection
“NO ANSWER”	Cannot connect
“ERROR”	Syntax error

4.1.5.4. AT+XFTPD

Description:

This command provides download of specified firmware binary file from remote FTP server and reboots the modem with new firmware upon successful completion of download.

Syntax:

AT+XFTPD="<IP address>",<Port>,"<filename>","<password>","<subdirectory>",<CR>

Field Definition:

<IP address>: IP address string or DNS lookup string for FTP server (must be surrounded by quotes)

<Port>: Port number for FTP server

<filename>: Filename of encrypted downloadable binary file with extension .lwd (must be surrounded by quotes)

<password>: Sting of 10 hexadecimal digits (must be surrounded by quotes)

<subdirectory>: ASCII character string representing FTP server subdirectory target location (must be surrounded by quotes). Not required if target file is in root directory.

Response:

“Firmware Updated”	Successful download and modem reboot
“NO ANSWER”	FTP server connection error
“ERROR”	Syntax error, password/filename error or download error

4.1.5.5. ATA

Description:

This standard command accepts or “answers” an inbound TCP call to the modem. This is used when the modem is in Connection Mode 1 and the modem provides a “RING” character string to the serial port. The TCP connection is initiated upon execution of this command.

Syntax:

ATA<CR>

Response:

“OK”	Successful command completion
“ERROR”	Syntax error

4.1.5.6. ATH

Description:

This standard command disconnects the current TCP call connection.

Syntax:

ATH <CR>

Response:

“OK”	Successful command completion
“ERROR”	Syntax error

4.1.5.7. ATO

Description:

This standard command switches the serial port mode from AT command mode to Data Mode when a valid TCP connection session is active.

Syntax:

ATO <CR>

Response:

“OK”	Successful command completion
“ERROR”	Syntax error

4.1.6. Geofence Commands

4.1.6.1. AT+XGEOF

Description:

This command provides the necessary parameters to set-up the Geofence feature of the GPS modem.

Syntax:

AT+ XGEOF=<Save Mode>, <Fence #>, “<Lat>”, “<Lon>”, <Radius><CR>

Field Definition:

<Save Mode>:0: Set RAM value
 1: Set RAM and FLASH value
 2: Load current value of FLASH into RAM
 <Fence #>: 1-16: Number assigned to identify each Fence parameter set
 <Lat>: Geofence latitude coordinates. A “0.0” value uses current Lat/Lon coordinates (values must be surrounded by quotation marks)
 <Lon>: Geofence longitude coordinates. A “0.0” value uses current Lat/Lon coordinates(values must be surrounded by quotation marks)
 <Radius>: Geofence radius size in km. (values must be surrounded by quotation marks)

Response:

“OK” Successful command completion
 “ERROR” Syntax error

Query Syntax and Response:

AT+XGEOF? Returns all parameters values
 AT+XGEOF=? Returns Command Syntax

4.1.7. Event Commands

4.1.7.1. AT+XEVGE

Description:

This command establishes the parameters for location based event programming.

Syntax:

AT+ XEVGE=<Save Mode>, <Event #>, <Apply>, “<Fences>”, <Action><CR>

Field Definition:

<Save Mode>:0: Set RAM value
 1: Set RAM and FLASH value
 2: Load current value of FLASH into RAM

<Event #>: 1-10: Number assigned to identify each Event parameter set

<Apply>: Sum of all desired trigger events defined below:
 0: Event is inactive
 1: Trigger when unit leaves all Geofences contained in parameters
 2: Trigger when unit leaves any Geofence contained in parameters
 4: Trigger when unit enters any Geofence contained in parameters
 Note: values 3 and 7 are not allowed

<Fences>: Hexadecimal number representing the bit pattern for the fences included in event (where 0 = do not include fence, 1 = include fence). (values must be surrounded by quotation marks)
 bit0 = Geofence 16
 bit1 = Geofence 15
 bit2 = Geofence 14
 bit3 = Geofence 13
 bit4 = Geofence 12
 bit5 = Geofence 11
 bit6 = Geofence 10
 bit7 = Geofence 9
 bit8 = Geofence 8
 bit9 = Geofence 7
 bit10 = Geofence 6
 bit11 = Geofence 5
 bit12 = Geofence 4
 bit13 = Geofence 3
 bit14 = Geofence 2
 bit15 = Geofence 1

<Action>: Sum of all the action to take if event is triggered as defined below:
 1, 2, 4, 8: Send SMS event message to pre-programmed SMS#1, SMS#2, SMS#3, SMS#4, respectively
 16: Send message as a UDP datagram to reporting IP address and port
 32: Send message in a TCP session to TCP reporting IP address and port
 64, 128: Set general purpose Output1 HIGH, LOW, respectively
 256, 512: Set general purpose Output2 HIGH, LOW, respectively

Response:

“OK” Successful command completion
 “ERROR” Syntax error

Query Syntax and Response:

AT+XEVGE? Returns all parameters values
 AT+XEVGE=? Returns Command Syntax

4.1.7.2. AT+XEVIO

Description:

This command establishes the parameters for IO based event programming.

Syntax:

AT+ XEVIO=<Save Mode>, <Input>, <Apply>, <Value>, <Action><CR>

Field Definition:

<Save Mode>:0: Set RAM value

1: Set RAM and FLASH value

2: Load current value of FLASH into RAM

<Input>: Input that the event should trigger on as defined below:

1: ADC1

2: ADC2

3: Not used

4: GPI 1

5: GPI 2

6: GPI 3

7: GPI 4

8: Ignition Sense Input

Note: GPIO is polled every 200 milliseconds and therefore a value must be achieved for at least this much time. Analog input is polled every 2 seconds and therefore the threshold value must be achieved for at least this much time.

<Apply>: Enables or disables a General Purpose IO event and configures how ADC threshold is treated as defined below:

0: Event is inactive (for GPI or ADC event)

1: Event is active (for GPI event)

1: Trigger when ADC is greater than threshold (for ADC event)

-1: Trigger when ADC is less than threshold (for ADC event)

<Value>: For ADC Events, Value = the threshold value

For GPI Events, Value is defined below:

0: Trigger event when selected input goes LOW

1: Trigger event when selected input goes HIGH

2: Trigger event when selected input TOGGLES from LOW to HIGH or from HIGH to LOW

<Action>: Sum of all the actions to take if event is triggered as defined below:

1, 2, 4, 8: Send SMS event message to pre-programmed SMS#1, SMS#2, SMS#3, SMS#4, respectively

16: Send event message as a UDP datagram to pre-programmed UDP reporting IP address and port

32: Send event message in a TCP session to pre-programmed TCP reporting IP address and port

64, 128: Set general purpose Output1 HIGH, LOW, respectively

256, 512: Set general purpose Output2 HIGH, LOW, respectively

Response:

“OK” Successful command completion

“ERROR” Syntax error

Query Syntax and Response:

AT+XEVIO?

Returns programmed values entered

AT+XEVIO=?

Returns the Command Syntax

4.2. Report Messages

4.2.1. Message Structure

The report messages for periodic location reporting, Geofencing event reporting and IO event reporting are in ASCII format and always start with “\$\$” characters (start of message) and finish with a “#” character (end of message). The fields in the response message are delimited by the comma (,) character. There are special extended formats for some messages.

Each response message is defined in the following format:

Description: Brief description of the response message
Syntax: Format of the response message structure (start with “\$\$” and end with “#”)
Field Parameter: Definition of field parameters identified in syntax

4.2.2. Periodic Location Reporting Message

The periodic location reporting messages support both standard and extended formats which are defined in the following sections. The initial periodic report is generated when a new value is entered for the reporting period through AT command or when the Ignition Sense input toggles or when motion is detected or when first GPS fix is achieved after power up. Subsequent reports are generated and stored based on programmed reporting time period settings in AT+XCNFG. The report messages are stored in the modem until they can be sent via the pre-defined connection method (TCP, UDP or SMS). Up to 16 messages can be stored in the modem at any one time.

4.2.2.1. Location Message Standard Format

Description: Standard message format for the periodic location reporting.

Syntax: \$\$<UID>,<EV#>,<D>,<T>,<LT>,<LN>,<SP>,<SV>,<MS>,#

Field Parameter:

- <UID>: Unit ID – selectable between the 15 digit IMEI number of the modem or user programmable 10 digit phone number (either a 15 character or 10 character string)
- <EV#>: Four digit event code that caused the trigger message as defined below:
4001: for all periodic location messages
- <D>: UTC Date of trigger (10 characters – YYYY/MM/DD)
- <T>: UTC Time of trigger (8 characters – HH:MM:SS)
- <LT>: Latitude (signed floating point number with 5 digits after decimal point)
- <LN>: Longitude (signed floating point number with 5 digits after decimal point)
- <SP>: Speed in kilometers per hour (unsigned integer)
- <SV>: Number of satellites used for position fix (unsigned 8 bit integer)
- <MS>: Message sequence (unsigned 8 bit number that wraps)

4.2.2.2. Location Message Extended Format

Description: Extended message format for the periodic location reporting.

Syntax: \$\$<UID>,<EV#>,<D>,<T>,<LT>,<LN>,<SP>,<SV>,<IN>:<OUT>:<ADC1>,<MS>,#

Field Parameter:

DataRemote Inc.

<UID>:	Unit ID – selectable between the 15 digit IMEI number of the modem or user programmable 10 digit phone number (either a 15 character or 10 character string)
<EV#>:	Four digit event code that caused the trigger message as defined below: 4001: for all periodic location messages
<D>:	UTC Date of trigger (10 characters – YYYY/MM/DD)
<T>:	UTC Time of trigger (8 characters – HH:MM:SS)
<LT>:	Latitude (signed floating point number with 5 digits after decimal point)
<LN>:	Longitude (signed floating point number with 5 digits after decimal point)
<SP>:	Speed in kilometers per hour (unsigned integer)
<SV>:	Number of satellites used for position fix (unsigned 8 bit integer)
<IN>:	Current state of inputs at time message was sent (unsigned decimal integer) Bit 0 (LSB): Ignition Sense Bit 5-Bit 1: GPI#1 – GPI#4
<OUT>:	Current state of outputs at the time message was sent (unsigned decimal integer) Bit 0 (LSB): GPO#1 Bit 1: GPO#2
<ADC1>:	Voltage measured at ADC # 1 value at the time message was sent floating point number with 2 digits after decimal
<MS>:	Message sequence (unsigned 8 bit number that wraps)

4.2.3. Geofence Event Reporting Message

The Geofence event reporting messages supports both standard and extended formats which are defined in the following sections. The Geofence report message is generated when the pre-defined geofence event trigger occurs as defined in AT+XGEOF and AT+XEVGE commands.

4.2.3.1. Geofence Message Standard Format

Description:

Standard message format for the Geofence reporting.

Syntax:

\$\$<UID>,<EV#>,<D>,<T>,<LT>,<LN>,<SP>,<SV>,<MS>,#

Field Parameter:

<UID>: Unit ID – selectable between the 15 digit IMEI number of the modem or user programmable 10 digit phone number (either a 15 character or 10 character string)

<EV#>: Four digit event code that caused the trigger message as defined below:
30XX: where XX = Event Number

<D>: UTC Date of trigger (10 characters – YYYY/MM/DD)

<T>: UTC Time of trigger (8 characters – HH:MM:SS)

<LT>: Latitude (signed floating point number with 5 digits after decimal point)

<LN>: Longitude (signed floating point number with 5 digits after decimal point)

<SP>: Speed in kilometers per hour (unsigned integer)

<SV>: Number of satellites used for position fix (unsigned 8 bit integer)

<MS>: Message sequence (unsigned 8 bit number that wraps)

4.2.3.2. Geofence Message Extended Format

Description:

Extended message format for the Geofence Event reporting.

Syntax:

\$\$<UID>,<EV#>,<D>,<T>,<LT>,<LN>,<SP>,<SV>,<IN>:<OUT>:<ADC1>,<MS>,#

Field Parameter:

<UID>: Unit ID – selectable between the 15 digit IMEI number of the modem or user programmable 10 digit phone number (either a 15 character or 10 character string)

<EV#>: Four digit event code that caused the trigger message:
30XX: where XX = Event Number

<D>: UTC Date of trigger (10 characters – YYYY/MM/DD)

<T>: UTC Time of trigger (8 characters – HH:MM:SS)

<LT>: Latitude (signed floating point number with 5 digits after decimal point)

<LN>: Longitude (signed floating point number with 5 digits after decimal point)

<SP>: Speed in kilometers per hour (unsigned integer)

<SV>: Number of satellites used for position fix (unsigned 8 bit integer)

<IN>: Current state of inputs at time message was sent (unsigned decimal integer)
Bit 0 (LSB): Ignition Sense
Bit 5-Bit 1: GPI#1 – GPI#4

<OUT>: Current state of outputs at the time message was sent (unsigned decimal integer)
Bit 0 (LSB): GPO#1
Bit 1: GPO#2

<ADC1>: Voltage measured at ADC # 1 value at the time message was sent floating point number with 2 digits after decimal
<MS>: Message sequence (unsigned 8 bit number that wraps)

4.2.4. IO Event Reporting Message

The IO event message reporting format is defined in the following section. The IO event reporting is generated when the pre-defined IO event trigger occurs as defined in AT+XEVI0 command.

4.2.4.1. IO Event Message Format

Description:

Message format for the IO Event reporting.

Syntax:

\$\$<UID>,<EV#>,<D>,<T>,<OLDIN>:<NEWIN>:<OUT>:<ADC1>:<ADC2>:<NU>,<MS>,#

Field Parameter:

<UID>: Unit ID – selectable between the 15 digit IMEI number of the modem or user programmable 10 digit phone number (either a 15 character or 10 character string)

<EV#>: Four digit event code that caused the trigger message as defined below:
 1001: ADC1 Triggered
 1002: ADC2 Triggered
 1004: GPI#1 Triggered
 1005: GPI#2 Triggered
 1006: GPI#3 Triggered
 1007: GPI#4 Triggered
 1008: Ignition Sense Triggered

<D>: UTC Date of trigger (10 characters – YYYY/MM/DD)

<T>: UTC Time of trigger (8 characters – HH:MM:SS)

<OLDIN>: State of inputs before event trigger (unsigned decimal integer)
 Bit 0 (LSB): Ignition Sense
 Bit 5-Bit 1: GPI#1 – GPI#4

<NEWIN>: Current state of inputs before event trigger (unsigned decimal integer)
 Bit 0 (LSB): Ignition Sense
 Bit 5-Bit 1: GPI#1 – GPI#4

<OUT>: Current state of outputs at the time message was sent (unsigned decimal integer)
 Bit 0 (LSB): GPO#1
 Bit 1: GPO#2

<ADC1>: Voltage measured at ADC # 1 value at the time message was sent floating point number with 2 digits after decimal

<ADC2>: Voltage measured at ADC # 2 value at the time message was sent floating point number with 2 digits after decimal

<NU>: Proprietary floating point value with 2 digits after decimal

<MS>: Message sequence (unsigned 8 bit number that wraps)

5. Modem Specification Summary

The following specifications apply to all CDS-1900 models unless noted otherwise.

Cellular Specification

- GPRS Class B, Multi-Slot 10
- Frequency Bands 850/900/1800/1900 MHz
- Transmit Power 2W @ 850/900 MHz
1W @ 1800/1900 MHz

GPS Specification (-V model only)

- Receiver 12 channels
- Receiver Sensitivity -154 dBm
- Accuracy 10 meter
- Cold Start 40 sec
- Hot Start 3 sec
- Interface SMA female connector, supports 3.3V for active antenna

Network Functionality

- Auto-Register to GPRS network
- Auto Reports Dynamic IP Assignment
- Remote command line interface via Telnet
- Configurable as TCP Server and Client
- Supports TCP, UDP, FTP, and Telnet
- OTA Firmware Upgrade Using FTP
- SMS connectivity- Stores up to 4 SMS numbers

Power Requirement

- D.C Power 6-32V
- GSM 850/900 80 mA average @12V (-V model)
25 mA average @12V (-M model)
- GSM 1800/1900 75 mA average @12V (-V model)
25 mA average @12V (-M model)
- External Battery backup Internal charging circuit (-V and -M models)
for external Ni-MH battery, 700-1800mAh capacity

Physical Interface

- Cellular Antenna Connector SMA female
- GPS Antenna Connector SMA female (-V and -E models)
- Data Connector (s) RS-232, 8 pin Mini DIN (-V and -M models)
RS-485 (-M model)
USB (-V and -M models)
- IO Connector 10 pin Terminal block (-V and -M models)
1 Ignition Sense, digital input
4 General purpose, digital Inputs
2 Analog inputs
2 Digital outputs
- GPIO Connector High density 70 pin Connector (-E model)
- LEDs Tricolor - Network registration / SIM / GPRS status
Green - GPS position acquisition status (-V model)
Green- Battery charging indicator

Note: Additional connector interface information is provided in sections 1.2.3 and 6.0 of this document.

6. Connector Definition

The connector pin-out definitions for the CDS-1900 modem are provided in the following sections.

6.1. PWR/CHG Connector

The PWR/CHG connector is a 4 pin, single row, 3mm, locking, male receptacle which provides external power and battery charging interface to the modem.

Table 6.1: PWR/CHG Connector Pin-out Definition (CDS-1900-V and -M models)

Pin Number	Signal Name	Input Output	Description/Usage
1	VIN	I	+6V to +32V DC, main modem external power
2	GND	-	Return for external modem power
3	BATT	I/O	External battery backup/charger connection: If pin1 (VIN) < 4V: BATT is an Input If pin1 (VIN)=6-32V: BATT is an Output (charging) External Battery requirement: Ni-MH, 700-1800mAh capacity
4	GND	-	Return for external battery

6.2. RS-232 Connector

The RS-232 connector is a circular, 8 pin-DIN, female receptacle which is configured for RS-232 DTE relative pin-out convention. The modem is configured as the DCE device.

Note: Manufacturer supplied cable/adaptor provides interconnect between modem (DCE) mini-DIN connector and external (DTE) device DB9 connector.

Table 6.2: RS-232 Connector Pin-out Definition (CDS-1900-V and -M models)

Pin Number	Signal Name	Input Output	Description/Usage
1	DCD	O	Carrier Detect signal to the DTE
2	RXD	O	Receive Data to the DTE
3	TXD	I	Transmit Data from the DTE
4	DTR	I	Data Terminal Ready signal from the DTE
5	GND	-	Common signal return line
6	DSR	O	Data Set Ready signal to the DTE
7	RTS	I	Request To Send signal from the DTE
8	CTS	O	Clear To Send signal to the DTE

6.3. USB Connector

The USB connector is a standard Mini-USB, universal type A/B receptacle which is internally configured as type B, USB device socket. A modem specific USB driver must be installed on the host PC for this connection to operate. This driver essentially emulates the USB port as a serial comm. port interface.

Note: The driver must be installed prior to physically connecting the modem USB port to the PC.

Table 6.3: USB Connector Pin-out Definition (CDS-1900-M model)

Pin Number	Signal Name	Input Output	Description/Usage
1	VBUS	I	+5V USB voltage from the Host PC
2	D-	I/O	“-“ differential data bus half duplex signaling
3	D+	I/O	“+” differential data bus half duplex signaling
4	NC	-	Not connected
5	GND	-	Ground return

6.4. RS-485 Connector

The RS-485 connector is a 6 pin, single row, 3mm, locking, male receptacle which is externally configurable for RS-485 half or full duplex operation.

Table 6.4: RS-485 Connector Pin-out Definition (CDS-1900-M model)

Pin Number	Signal Name	Input Output	Description/Usage
1	+RI	I -	Full duplex mode:“+” differential input signal Half duplex mode: No connection
2	-RI	I -	Full duplex mode:“-” differential input signal Half duplex mode: No connection
3	-DO	O I/O	Full duplex mode:“-” differential output signal Half duplex mode:“-“ differential input/output signal
4	+DO	O I/O	Full duplex mode:“+” differential output signal Half duplex mode:“+“ differential input/output signal
5	H/F	I	Duplex mode select Pin: Pin to Gnd: Full duplex mode Pin Open (NC): Half duplex mode
6	GND	-	Ground return

6.5. I/O Connector

The I/O connector is a 10 pin, dual row, 3mm, locking, male receptacle which provides the modem external input sensing and output control signal interface. These signals are configurable through AT commands (ref AT command section of this document).

Table 6.5: I/O Connector Pin-out Definition (CDS-1900-Vand -M models)

Pin Number	Signal Name	Input Output	Description/Usage
1	IN 1	I	General purpose digital input Max Vin=32V
2	IN 2	I	General purpose digital input Max Vin=32V
3	IN 3	I	General purpose digital input Max Vin=32V
4	IN 4	I	General purpose digital input Max Vin=32V
5	IGNITION SENSE	I	Vehicle ignition sensing digital input Max Vin=32V
6	OUT 2	O	General purpose digital output Open drain, 250 mA max
7	OUT 1	O	General purpose digital output Open drain, 250 mA max
8	ADC 1	I	Analog A/D converter input 0V to +32V
9	ADC 2	I	Analog A/D converter input 0V to +32V
10	GND	-	Ground Return

6.6. GPIO Connector

The GPIO connector is a 70 pin, dual row, 50 mil, female receptacle which provides a high density interconnect to the internal cellular RF module. This connector is used exclusively for embedded applications (CDS-1900-E model only) which require direct access to internal RF module interfaces for custom configuration, control and programming.

Note: For detail information and operation requirements of the RF module pins listed below please refer to WAVECOM Wireless CPU Quick Q2687 Product Technical Specification (PTS, Rev 003 or later, www.wavecom.com).

Table 6.6: GPIO Connector Pin-out Definition (CDS-1900-E model)

Pin Number	Signal Name	Input Output	Description/Usage
1	GPIO1	O	SIM Reg. LED (used) , 1.8V CMOS
2	GPIO2	O	GPRS Reg. LED (used) , 1.8V CMOS
3	GPIO3	I	Interrupt Input 0, 1.8V CMOS
4	GPIO4	I/O	Keypad column 0, 1.8V CMOS
5	GPIO5	I/O	Keypad column 1, 1.8V CMOS
6	GPIO6	O	GSM Reg. LED (used) , 1.8V CMOS
7	GPIO7	I/O	Keypad column 3, 1.8V CMOS
8	GPIO8	I/O	Keypad column 4, 1.8V CMOS
9	GPIO9	I/O	Keypad Row 0, 1.8V CMOS
10	GPIO10	I/O	Keypad Row 1, 1.8V CMOS
11	GPIO11	I/O	Keypad Row 2, 1.8V CMOS
12	GPIO12	I/O	Keypad Row 3, 1.8V CMOS
13	GPIO13	I/O	Keypad Row 4, 1.8V CMOS
14	GPIO14	-	TXD2/GPS TX (internal signal Test Point, LEAVE OPEN)
15	GPIO15	-	RXD2/GPS RX (internal signal Test Point, LEAVE OPEN)
16	GPIO16	-	CTS2 (internal signal Test Point, LEAVE OPEN)
17	GPIO17	-	RTS2 (internal signal Test Point, LEAVE OPEN)
18	GPIO18	-	SIMPRES (internal signal Test Point, LEAVE OPEN)
19	GPIO19	-	GPS RESET (internal signal Test Point, LEAVE OPEN)
20	GPIO20	I/O	GPIO20, 2.8V CMOS
21	GPIO21	I/O	GPIO21, 2.8V CMOS
22	GPIO22	I/O	GPIO22, 2.8V CMOS
23	GPIO23	I/O	GPIO23, 2.8V CMOS
24	GPIO24	I/O	GPIO24, 2.8V CMOS
25	GPIO25	I	Interrupt 1 Input, 2.8V CMOS
26	GPIO26	O	I ² C Clock, Open Drain
27	GPIO27	I/O	I ² C Data, Open Drain
28	GPIO28	O	SPI1 Clock, 2.8V CMOS
29	GPIO29	I/O	SPI1 Data Input/Output, 2.8V CMOS
30	GPIO30	I	SPI1 Data Input, 2.8V CMOS
31	GPIO31	O	SPI1 Chip Select, 2.8V CMOS
32	GPIO32	O	SPI2 Clock, 2.8V CMOS
33	GPIO33	I/O	SPI2 Data Input/Output, 2.8V CMOS
34	GPIO34	I	SPI2 Data Input, 2.8V CMOS

Pin Number	Signal Name	Input Output	Description/Usage
35	GPIO35	O	SPI2 Chip Select, 2.8V CMOS
36	GPIO36	I	Main RS-232 Transmit, TXD1, 2.8V CMOS
37	GPIO37	O	Main RS-232 Receive, RXD1, 2.8V CMOS
38	GPIO38	I	Main RS-232 Request to Send, RTS1, 2.8V CMOS
39	GPIO39	O	Main RS-232 Clear to Send, CTS1, 2.8V CMOS
40	GPIO40	O	Main RS-232 Data Set Ready, DSR1, 2.8V CMOS
41	GPIO41	I	Main RS-232 Data Terminal Ready, DTR1, 2.8V CMOS
42	GPIO42	O	Main RS-232 Ring Indicator, RI1, 2.8V CMOS
43	GPIO43	O	Main RS-232 Data Carrier Detect, DCD1, 2.8V CMOS
44	GPIO44	I/O	GPIO44, 2.8V CMOS
45	ON/~OFF	I	CPU VBATT ON-OFF Control
46	BOOT	I	CPU BOOT, 1.8V CMOS
47	NC	-	Not connected
48	~RESET	I	RESET Input, 1.8V CMOS
49	SPK1P	O	Speaker 1 Output, Positive, analog
50	MIC1P	I	Microphone 1 Input, Positive, analog
51	SPK1N	O	Speaker 1 Output, Negative, analog
52	MIC1N	I	Microphone 1 Input, Negative, analog
53	NC	-	Not connected
54	NC	-	Not connected
55	FLASH_LED	O	FLASH LED Output, (Network Status), Open Drain
56	NC	-	Not connected
57	VIN	I	Input Supply Voltage, 6-32V
58	VIN	I	Input Supply Voltage, 6-32V
59	VCC_1V8	O	1.8V output supply (15 mA max)
60	VCC_2V8	O	2.8V output supply (15 mA max)
61	NC	-	Not connected
62	NC	-	Not connected
63	NC	-	Not connected
64	ADC2	I	Analog-to-Digital Converter, analog
65	NC	-	Not connected
66	ADC1	I	Analog-to-Digital Converter, analog
67	VOUT	O	5V, 500 mA
68	GND	-	GND
69	VOUT	O	5V (combined with pin 67)
70	GND	-	GND

Appendix A. AT Command List

The table below lists AT Commands necessary for general modem operation. The document paragraph reference is included for quick access to the detail command information. Also included is the access restriction for each command depending on the connection method to the AT command processor. The “Remote TCP Access” command line connection is established when an AT+XTCPC with Mode=1 is executed (typically via SMS).

Note: The AT-1900 modem supports a comprehensive list of Hayes compatible AT commands which are not all listed in this document. Additional commands may be found in the Wavecom “AT Commands Interface Guide for OS 6.61” (www.wavecom.com website). If any AT Commands definition conflicts are encountered between the two documents this document should take precedence.

Table A-1: AT Command List and Access Restrictions (S=set, Q=query)

AT Command	Paragraph Reference (hyperlink)	Local Serial Access	Remote Telnet Access	Remote SMS Access	Remote TCP Access
Configuration					
AT+XCNFG	4.1.2.1	SQ	SQ	SQ	SQ
AT+IPR	4.1.2.2	SQ	SQ	SQ	SQ
AT+XPASS	4.1.2.3	SQ	SQ	SQ	SQ
Status					
AT+XSTAT	4.1.3.1	Q	Q	Q	Q
AT+CREG?	4.1.3.2	Q	-	-	-
AT+CGATT?	4.1.3.3	Q	-	-	-
AT+CGREG?	4.1.3.4	Q	-	-	-
AT+XVRSN	4.1.3.5	Q	Q	Q	Q
ATI3	4.1.3.6	Q	Q	Q	Q
AT+CSQ	4.1.3.7	Q	Q	Q	Q
NULL					
AT+XNULL	4.1.4.1	SQ	SQ	SQ	SQ
Connection					
AT+XTCPC	4.1.5.1	S	S	S	-
ATDT	4.1.5.2	S	-	S	-
ATD	4.1.5.3	S	-	S	-
AT+XFTPD	4.1.5.4	S	S	S	S
ATA	4.1.5.5	S	-	-	-
ATH	4.1.5.6	S	-	-	-
ATO	4.1.5.7	S	-	-	-
Geofence					
AT+XGEOF	4.1.6.1	SQ	SQ	SQ	SQ
Event					
AT+XEVGE	4.1.7.1	SQ	SQ	SQ	SQ
AT+XEVI0	4.1.7.2	SQ	SQ	SQ	SQ