

June 20, 2000

**Cellular Data Modem CM 900 (OEM)  
Point-to-Point Wireless Access Solution.**

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**Introduction**

## Product Overview

The **Cellular Modem 900, CM 900**, is a self-contained module that uses the **Advanced Mobile Phone System (AMPS)** cellular network for data transmission. AMPS is the cellular system used in North America, Latin America, Australia, New Zealand and parts of Africa. AMPS system is not compatible with the GSM system that is used in Europe and Asia.

The **CM 900** has the choice of RS232 or TTL (V24) interface and supports the popular AT command set normally associated with modems.

## CM 900 Features

The **CM 900** provides the following features:

- ◆ **OEM Module designed for embedded applications.**
- ◆ **Overall dimensions (excluding antenna) only 4.5 x 2 x 1.1 inches**
- ◆ Uses AMPS Switched Circuit Cellular network for data transmission
- ◆ User friendly modem AT command set
- ◆ Choice of RS 232 or TTL (V24) serial interface
- ◆ Choice of Hardware or Software Flow Control
- ◆ Incorporates "Quiet Mode" (explained later) thereby enabling communication with "non-intelligent" systems

## Sample Application Areas

Although any application requiring Data Communications can use the **CM 900**, the following are the areas where our OEM customers are using the **CM 900**.

- ◆ Packet Data Radio
- ◆ SCADA and Telemetry Systems
- ◆ Remote gas/water/electric meter readings.
- ◆ Factory Automation systems
- ◆ Vending Machines

## Specifications

- |  |   |
|--|---|
| ◆ Air Speed                                | upto 9600 bps   |
| ◆ DTE Rate                                 | 300, 1200, 2400, 9600, 19200<br>57600 bps (DIP switch selectable) |
| ◆ Data Compression & Error Detection       | MNP2-5, V42, V42bis, MNP 10                                       |
| ◆ Transmit Power                           | 0.6 watts   |
| ◆ Power Supply                             | 5 Volts DC @ 1000 ma  |
| ◆ Interface                                | RS 232 / TTL (V24) Asynchronous                                   |
| ◆ Signals supported                        | TXD, RXD, CD, DSR, RTS, CTS, RI, DTR                              |
| ◆ Operating Temperature Range              | 0 to 70 deg C ( -10 to + 85 optional )                            |
| ◆ <b>Custom Configurations and Options</b> | <b>Yes</b>  |

## Your package includes:

- ◆ **CM 900** unit (Radio included)
- ◆ Antenna
- ◆ Flat Cable (for RS 232 units only)
- ◆ This manual

### What you need to provide:

- ◆ 5 Volts, 1.5 Amp DC Regulated DC Power Supply
- ◆ Host PC with terminal program like Hyper terminal, Procomm etc
- ◆ MIN information (from your cellular service provider)
- ◆ SID Information (from your cellular service provider).
- ◆ A host PC with terminal program like Hyper terminal, Procomm etc
- ◆ **Mobile Identification Number (MIN)** provided by your Cellular service provider. MIN is your cellular phone number.
- ◆ **System ID (SID)** information (from your cellular service provider) SID uniquely identifies your cellular service provider.

### Registering the CM 900 Unit

To register your **CM 900** unit, do the following:

1. Contact your cellular service provider
2. Provide the cellular operator with the ESN (**E**lectronic **S**erial **N**umber) number located on the label at the top of your unit.
3. Inform the cellular operator that the unit is an **ONLY AMPS ANALOG** unit with a power rating of class 3 (power 600 mw).

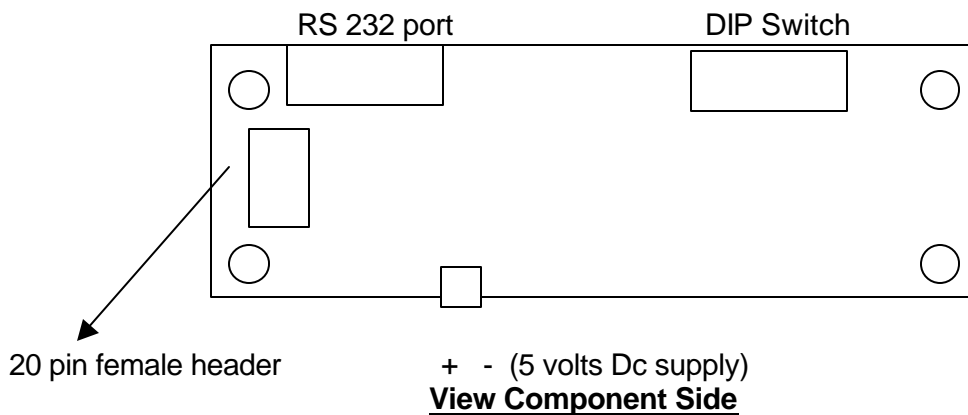
The cellular operator will register your unit and provide you the following information:

- a) MIN (Mobile Number) Number:
- b) System preference: A or B
- c) SID (System ID)

It is recommended that the MIN and SID information be stored in an easy to access location.

### Starting and configuring the CM 900 unit

The CM900 is configured as a DCE (e.g. modem). It communicates with a PC through the serial (RS 232) port.



### Starting the CM 900 Unit

To start the **CM 900** unit, perform the following steps:

- 1) Connect the 5 Volts DC power supply. Please take precaution that the polarity of the applied voltage is correct. Connect the **CM 900** to the PC with the RS 232 cable provided.
- 2) Connect the Antenna to connector at the top left of the CM 900.

- 3) Click the Hyper Terminal icon on the PC. Or select **Start>Programs>Accessories>Hyper Terminal>Hyperterm.exe**  
The Connection Description Dialog Box opens.
- 4) In the name field, enter **CM 900** and click OK.  
The **Connect To** dialog box is now active.
- 5) Select **Connect Using** and then select the COM Port the CM 900 is connected to. For example, if the **CM 900** is on COM 2, choose "Direct to Com2" and click OK.
- 6) The **COM2 Properties** dialog box now opens. Select the following:
  - a) Bits per second to match the DIP switch settings on the CM 900
  - b) Data Bits: 8
  - c) Parity: None
  - d) Stop Bits: 1
  - e) Flow Control based on the CM 900 switch settings.
  - f) Click OK.
- 7) Select **Call>Disconnect**
- 8) Select **Call>Connect**
- 9) Select **File>Properties>Settings>ASCII setup**
- 10) Check the following:
  - a) In the ASCII Sending field, check **Echo typed characters locally**
  - b) In the ASCII receiving field, check **Append line feeds to incoming line ends** and **Wrap lines that exceed terminal width**.
- 11) Click OK twice.
- 12) Select **Call>disconnect**
- 13) Select **Call>connect**
- 14) Select **File>Save**
- 15) Hit **<CR>** on the keyboard. The **CM 900** will return OK. This is the indication that the entire hardware setup and configuration is fine.

### **Configuring the CM 900**

To configure the **CM 900**, perform the following steps:

- 16) Enter **AT+TEST<CR>**. The unit responds OK.
  - a) Enter **AT+MIN=< allocated\_MIN ><CR>** The unit responds OK.
  - b) Enter **AT+SID=< allocated\_SID ><CR>** The unit responds OK
  - c) Enter **AT+SYS=02 <CR>** (SID will determine preferred system, also called normal mode)
    - =00 <CR> (will select system B only)
    - =01 <CR> (will select system A only)

Check with your provider as to which is the recommended system.

**The CM 900 does NOT have to configured every-time. The above information is stored in the unit's non-volatile memory.**

- 17) Enter **AT+MODE=02<CR>** The unit is now set for data mode.
- 18) Enter **AT+SER <CR>** The unit responds with SERVICE AVAILABLE.

### **Using the CM 900 to communicate**

To use the **CM 900** to communicate with a modem, perform the following steps:

- 1) Enter **ATDT XXXX <CR>**  
XXXX is the phone number of the modem you are calling. After approximately 30 seconds, the **CM 900** responds with CONNECT message.

- 2) Type " Hello how are you"  
The party you called should see the message on their terminal screen.
- 3) Ask the called party to type a message and you should see that on your terminal screen.
- 4) Enter the Escape sequence +++  
The modem responds OK.
- 5) Enter ATH0<CR>  
The **CM 900** responds "No Carrier " indicating that the connection is terminated.
- 6) Ask the remote party to dial you MIN number.  
**CM 900** responds with CONNECT message after approximately 30 seconds.
- 7) Repeat steps 2 to 5.

### Theory of Operation

The CM-900 (hereafter also referred to as "modem") is always in one of the two states:

- Command state
- Online state

This section describes the two states.

#### **Command State**

The **CM 900** assumes the Command state when it is turned ON. In this state, you can configure the unit for a particular application. In the Command State, all inputs from the PC are treated as commands.

#### **Command guidelines**

Command line is a string of characters sent from the DTE (example PC) when the unit is in the Command state. All commands must adhere to the following guidelines

- Command lines must have a prefix , a body and a terminator.
- Command lines must begin with a character sequence AT.
- Command Lines must end with Carriage return (CR).
- Either all upper case or all lower case characters must be used.
- Each command must be entered separately.
- Command buffer is 40 characters.

**Note:** Commands entered incorrectly or with out-of-range parameters will result in ERROR message. Commands entered correctly will result in OK message.

#### **Result Codes**

Result Codes refer to the responses of the **CM 900** unit to a command.

Unless the **CM 900** has been programmed to be in the Quiet mode (explained later in the AT command section), the unit will respond each time a command is issued. The default mode of the **CM 900** is the Verbose mode. The responses in verbose mode are characters.

Using AT commands, the modem can be put into terse (non-verbose) mode. The responses in non-verbose mode are numerical digits.

Various modem responses are shown below:

#### **Examples of CM 900 responses:**

Response in Terse Mode	Response in Verbose Mode	Meaning
0	OK	Command executed without errors.

1	CONNECT	Connection at 300 bps
2	RING	Ringing signal detected
3	NO CARRIER	Carrier lost or never present
4	ERROR	Invalid command
5	CONNECT 1200	Connection at 1200 bps
6	NO DIALTONE	Cellular service not available
7	Busy	Called party on-line
8	No Answer	
9	Connect 0600	
10	Connect 2400	
11	Connect 4800	
12	Connect 9600	
13	Connect 7200	
66	Compression class 5	Connection established MNP- 5
67	Compression V42bis	
68	Not used	
69	Compression none	
76	Protocol: none	
77	Protocol: LAPM	
99	SERVICE UNAVAILABLE	Cellular service not available
100	SERVICE AVAILABLE	Unit ready for communication

### **On-line state**

In online state, input(s) from the PC is treated as data to be shipped over the airwaves, and input(s) from the airwaves is treated as received data from the remote end.

The **CM 900** is in online state in one of the two conditions:

- a) **CM 900** dials out and a successful connection is established.
- b) **CM 900** answers an incoming call and a successful connection is established.

When the **CM 900** is in online state, all serial data presented to the radio is transmitted over the air.

You should NOT change communication parameters (e.g. baud rate) in this mode.

To go back to Command State, Escape Sequence (described in this section) is required.

### **Transitioning from Online state to Command state (Escape sequence)**

The sequence of characters to transition from Online State to the Command State is called the escape sequence.

For **CM 900**, the escape sequence is +++

The timing interval between the + signs must be between 250 msec and 750 msec.

When the **CM 900** receives a valid escape sequence, the modem will enter Command State and respond with OK.

### **Supported AT commands**

This section describes the basic Attention (AT) commands used to configure the **CM 900**. These commands are a subset of the commands used in typical high-speed modems.

A command line is a string of characters sent from the DTE (e.g. a PC) while the modem is in Command State. A command line has a prefix, a body and a terminator. Each

command line must begin with a character sequence AT and must terminate with a carriage return.

The Radio starts the processing of commands only after AT string sequence is received. Commands entered with out of range parameters will result in ERROR message. Correct commands will result in OK message in verbose mode, and 0 in terse mode.

**Supported AT commands:**

Command	Action	Note
1) ATZ<CR>	Resets the modem.	
2) ATO<CR>	The unit responds with OK messages Go on line. This is done after the state of the unit is changed from on-line to command state. ATO then puts the unit back into online state.	
3) ATDT XXXX <CR>	Cell modem dials out. XXXX is the phone number	
4) AT+TEST <CR>	Puts the unit in test mode	
<b>The commands AT+SYS, AT+MIN, AT+SID and AT+ID can be entered only when the unit is in Test Mode.</b>		
5) AT+SYS=xx<CR>	Sets system preference. SYS =00 sets the unit for system B only SYS =01 sets the unit for system A only SYS =02 is for normal mode. SID determines preferred system SYS =03 is for home use only	
6) AT+RSSI<CR>	Indicates the Received Signal Strength. Should be > -100 dbm for reliable communication.	
7) AT+SER <CR>	Indicates if service is available or not	
8) AT+MIN=XXXXX<CR>	Sets the MIN number. The modem responds OK	
9) AT+SID=XXXX<CR>	Sets SID. Modem responds OK	
10) AT+ID?<CR>	Displays ESN, MIN, SID, System Preference information.	
Note: MIN, ESN, SID information are stored in the non-volatile memory of the cell-modem. These do not have to be entered every-time on power-up. To exit test mode, enter AT+MODE=02<CR>		
11) ATQ1<CR>	Unit does not respond with OK or non-verbose messages. This is ideal for in situations where the Data Link is connected to "non-intelligent" host. This mode is also called Quiet Mode.	
12) ATQ1&W&W1	Q1 instruction stored in non-volatile memory.	
13) AT&V<CR>	Displays settings of the cell modem	
14) ATI3<CR>	Displays Software Revision #	
15) ATH0	Modem disconnects and initializes	
16) ATV0	Unit responds in terse mode. Results code	

- |     |           |   |
|-----|-----------|---|
| 17) | ATV0&W&W1 | Displayed as digits<br>Above command stored in non-volatile memory.<br>On power-up, the modem will be in terse mode.            |
| 18) | ATV1      | Unit responds in verbose mode. Results codes are displayed as messages.   |
| 19) | ATV1&W&W1 | Above command stored in non-volatile memory.<br>On power-up, the modem will be in verbose mode.                                 |
| 20) | ATS0      | Default is 0. If 0, then the unit will not answer incoming call. Please use ATS0=1&w&w1 to have the unit answer incoming calls. |

**Escape Sequence:**

When the modem is on-line state, it is possible to break the data transmission/reception. This is achieved by sending a sequence of three ASCII characters. For ease of use, the default character is +.

The Radio will respond with OK on detection of valid escape sequence.

- |     |     |                 |    |
|-----|-----|-----------------|----|
| 21) | +++ | Escape sequence | OK |
|-----|-----|-----------------|----|

**Basic Troubleshooting :**

- 1) If the unit draws too much power. Please ensure that the correct power supply is used and correctly wired.
- 2) If dialing out is repeatedly unsuccessful and modem gives the message "NO DIALTONE ", please check if service is available.
- 3) If the unit never connects on dialing out, please ensure that the ESN (Electronic Serial Number) and the MIN numbers are right.
- 4) Please check RSSI level. If low (lower than -95 dbm), placing the antenna vertical will help.
- 5) If remote landline modem connection drops frequently, please have the calling party set S7=60 & S10 register to 200. This will make the modem more tolerant of noise hits. This can be done as follows:  
ATS0=1S7=60S10=200&W&W1<CR>
- 6) If for some reason, the CM 900 unit is not responding, please try the command AT&F&W&W1 <CR>  
Whenever the command AT&F&W&W1 is issued, then you must do the following  
ATS0=1N2+MS=11,1,1200,2400&W&W1 <CR>  
AT-SEC=1,15&W&W1 <CR>
- 7) If that also fails, power down the unit and power it up again.
- 8) Please read next section on FAQs.

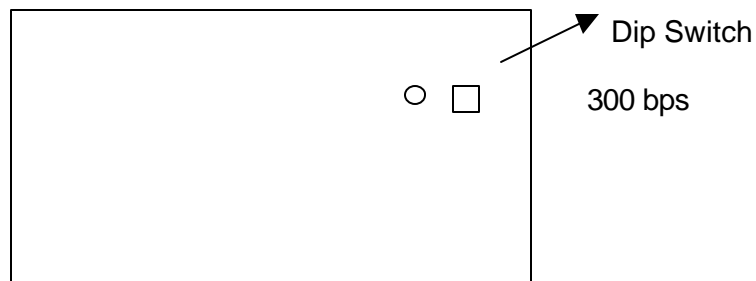
**Frequently Asked Questions (FAQs)**

- 1) Question: What is the flow control method recommended?  
Answer: If the host is a PC, Hardware flow control is recommended. However, in most control instrumentation, either software or no flow control is called for.
- 2) Question: How do I disable any flow control?  
Answer: Simply disable both the Hardware and software control switch settings. This is not recommended for large file transfers.
- 3) Question: I need to connect the Cellular Data Link to a machine which does not understand your messages. All it needs is data. Which

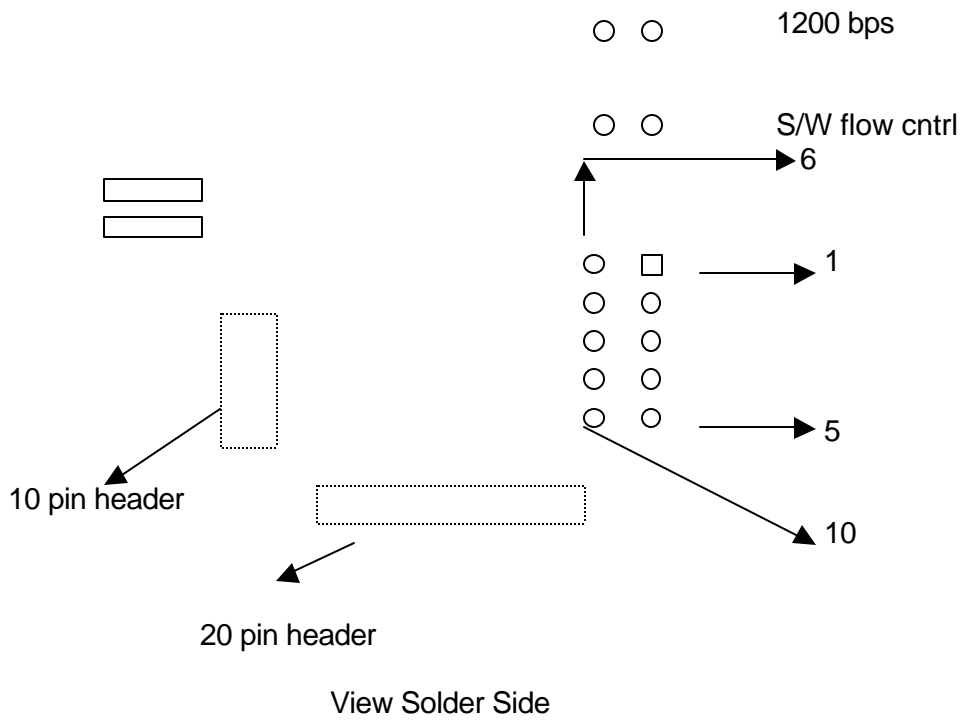


- configuration is recommended?
- Answer: Please use the ATQ1&w&w1<CR> command.
- 4) Question: Have you experienced that fact that communication with certain brands of modems is unreliable?
- Yes. And more so with generic brand which tend to throw hot signals (i.e strong signal levels) on the line. This causes the Cellular service to over-modulate which leads to distortions and results in unreliable connections.
- 5) Question: What is the solution then?
- Answer: We recommend that you use modems that support MNP-10 and also allow transmit level to be reduced to between -15 dbm. and -20 dbm. Rockwell based modem designs generally meet these requirements.
- For Rockwell based modems, please try the following commands on the land line modem:
- AT-SEC=1,18 <CR>. This will enable MNP 10 and set transmit level to -18 dbm.
- AT+MS=10,1,1200,4800&W&W1<CR>. Sets the modem to communicate between 1200 and 4800 bps.
- ATS91=15 <CR>.
- 6) Question: Is there any simple way to avoid frequent loss of connection?
- Answer: Please program the CM 900 as follows
- AT+MS=2,1,1200,1200&W&W1<CR>
- This will force the CM 900 to connect only at 1200 bps.
- 7) Question: Can IDC provide a landline modem I can use?
- Answer: Yes.
- 8) Question: What initialization string is recommended to communicate with non-MNP modem?
- 9) Answer: Connection with non-MNP landline modems is not recommended.
- 10) Question: My requirement(s) are totally unique. Can I count on IDC to help?
- Answer: Absolutely.
- 11) Question: Is there any recommended init string for various land line modems?
- Answer: the following have been tried with great success:
- For US Robotics / 3 Com modems:  
ATS10=200&A3&B1&N2&U2&W&W1 <CR>
  - For Rockwell chip set based land-line modems 33600 and lower  
AT%E2\N2S7=60S10=200+MS=11,1,1200,4800&w&w1 <CR>
  - For most other brands:  
ATN0S37=6S10=200&w&w1 <CR>
  - For Rockwell chip set based land-line modems 56K V90 models  
AT%E2\N2S10=200S7=60+MS=V34,1,1200,2400,1200,2400 <CR>

#### RS 232 pin-out diagram for the **CM 900**



Gnd  
Vcc



GND	6	1	Power / VCC (Square Pad)
DTR	7	2	RI
TXD	8	3	CTS
RXD	9	4	RTS
DCD	10	5	DSR