SMC-CDMA-XXX
LandCell SMC Embedded Wireless Modem
CDMA 1XRTT Universal Socket

User Manual
001-0004-819
Rev01; November 2011

Rev00	Released	01/2010
Rev01	Minor corrections Added Appendix for DUN connection	11/2011

SECTION 1 -   PREFACE

Copyright Notice

©2010 CalAmp. All Rights Reserved.

This manual covers the operation of the CalAmp SMC-CDMA Embedded Wireless Modem. Specifications described are typical only and are subject to normal manufacturing and service tolerances.

CalAmp reserves the right to modify the equipment, its specification or this manual without prior notice, in the interest of improving performance, reliability or servicing. At the time of publication all data is correct for the operation of the equipment at the voltage and/or temperature referred to. Performance data indicates typical values related to the particular product.

No part of this documentation or information supplied may be divulged to any third party without the express written consent of CalAmp.

Products offered may contain software which is proprietary to CalAmp. The offer or supply of these products and services does not include or infer any transfer of ownership.

Modem Design Considerations

The suppression of noise, both coupled and radiated, by the OEM board design is essential to ensure proper operation of the SMC-CDMA modem on any provider's cellular network. Proper PC board layout and design guidelines should be considered to ensure the end device passes required electromagnetic interference (EMI) specifications and does not impede the performance of the SMC-CDMA modem when operating on the cellular network. The following guidelines can be used to help minimize generated EMI from the OEM main board containing the SMC-CDMA modem.

- Provide a good ground plane. If a multilayer board can be used, use one full layer each for ground and power distribution.

- Any high frequency signals should be kept as short as possible, these circuits should be located in a separate area of the board and isolated, with shielding and ground plane, from connectors, cables, and the SMC-CDMA modem to minimize coupling.

- Keep DC power decoupling capacitors as close to the SMC-CDMA modem as possible.

Other layout techniques may be required to properly isolate unwanted interference for a specific application. Please consult other engineering publications or contact our technical service department.

NOTE: For OEM customers using the Sprint network; the SMC-CDMA modem has been certified with a specific modem and antenna configuration. If this configuration is changed in any way, the final device would have to go through the Sprint certification process. To enter the Sprint certification process please send an email to embeddedsolutions@sprint.com.

Modem Use

The SMC-CDMA modem is designed and intended for use in fixed and mobile applications. "Fixed" assumes the device is physically secured at one location and not easily moved to another location. Please keep the cellular antenna of the SMC-CDMA at a safe distance from your head and body while the modem is in use (see below).

Important

Maintain a distance of at least 20 cm (8 inches) between the transmitter's antenna and any person while in use. This modem is designed for use in applications that observe the 20 cm separation distance.

Interference Issues

Avoid possible radio frequency (RF) interference by following these guidelines:

- The use of cellular telephones or devices in aircraft is illegal. Use in aircraft may endanger operation and disrupt the cellular network. Failure to observe this restriction may result in suspension or denial of cellular services to the offender, legal action or both.

- Do not operate in the vicinity of gasoline or diesel-fuel pumps unless use has been approved and authorized.

- Do not operate in locations where medical equipment that the device could interfere with may be in use.

- Do not operate in fuel depots, chemical plants, or blasting areas unless use has been approved and authorized.

- Use care if operating in the vicinity of protected personal medical devices, i.e., hearing aids and pacemakers.

- Operation in the presence of other electronic equipment may cause interference if equipment is incorrectly protected. Follow recommendations for installation from equipment manufacturers.

Mobile Application Safety

- Do not change parameters or perform other maintenance of the SMC-CDMA while driving.

- Road safety is crucial. Observe National Regulations for cellular telephones and devices in vehicles.

- Avoid potential interference with vehicle electronics by correctly installing the SMC-CDMA. CalAmp recommends installation by a professional.

Related Documents

[1] MOT by Telit, C24 Developer's Guide, AT Commands Reference Manual

SECTION 2 - ABBREVIATIONS

Abbreviation	Description
APN	Access Point Name
CDMA	Code Division Multiple Access
CSD	Circuit Switched Data
CTS	Clear to Send
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
DUN	Dial-Up Network
EDGE	Enhanced Data rates for Global Evolution
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
IMEI	International Mobile Electronic Identity
LED	Light Emitting Diode
ME	Mobile Equipment
MS	Mobile Station
OTA	Over the Air
PDP	Packet Data Protocol
PPP	Point to Point Protocol
PRL	Preferred Roaming List
RSSI	Receive Signal Strength Indication
RX	Receive
TA	Terminal Adapter
TE	Terminal Equipment
TX	Transmit

SECTION 3 -   PRODUCT OVERVIEW

Module Identification

Label Information
The label contains the CalAmp part number, serial number, FCC ID, and the MEID number.

MEID: The Mobile Equipment Identifier of the cellular module (hexadecimal format).

General Description

The LandCell SMC-CDMA embedded wireless modem from CalAmp is a versatile, cost-effective wireless communications device designed for the industry-standard universal socket. Dual-band 800/1900 1x CDMA offers compatibility with many cellular networks.

The SMC-CDMA embedded modem is ideal for OEM customers looking to add cellular wireless communications to their products. Applications include: monitoring, metering, diagnostics, security, data collection, and other applications requiring wireless connectivity.

Features and Benefits

- Industry-standard Universal Socket open interface
- Dual Band 800/1900 1x CDMA Operation
- Embedded GPS Receiver
- TCP/IP stack access via AT commands
- Circuit Switch Data
- Short Message Service (SMS)
- Packet Data
- MMCX Antenna Connector
- Optimized for OEM applications

Catalog Part Number Breakdown

SMC-CDMA-XXX   (XXX = Carrier Identifier)

SPN = Sprint
ARS = Aeris

SMC-CDMA Module Description

Top side reference
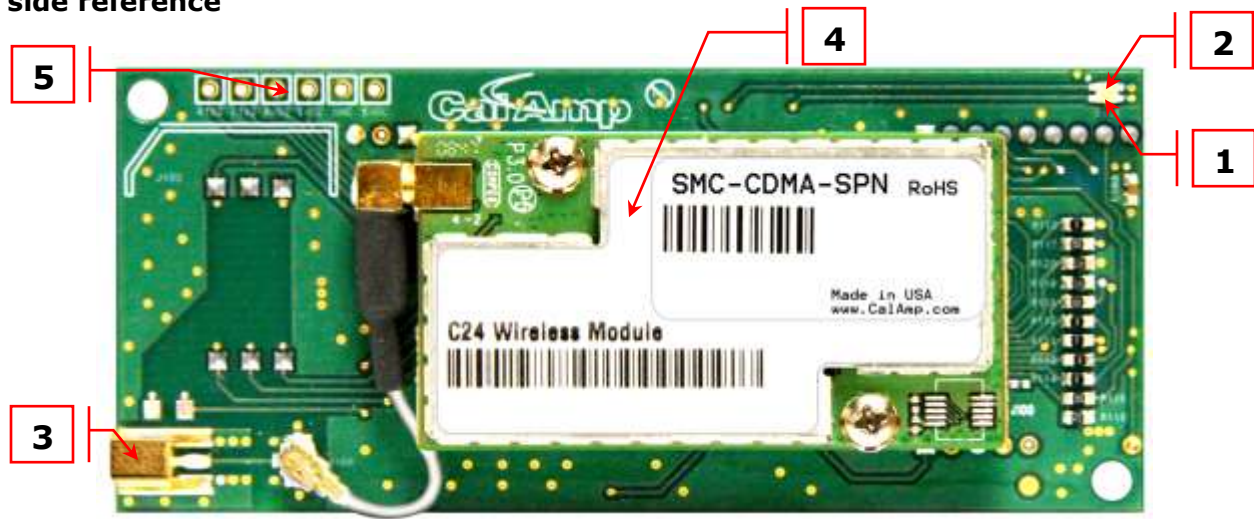
Fig. 2.1 SMC-CDMA Top Side

SMC-CDMA top side components:

1. Power: Green LED indicating cell module power on.

2. CDMA: Red LED indicating CDMA connection status.

3. RF (antenna): MMCX socket, primary antenna connection.

4. CDMA Cell Module

5. Secondary Serial UART test points

Bottom side reference

Fig. 2.2 SMC-CDMA Bottom Side

SMC-CDMA bottom side socket pins:

1. VCC/GND pins

2. –RESET/GND pins

3. Primary Serial UART pins

Figure 2.3 SMC Pins, Top View

Pin Descriptions

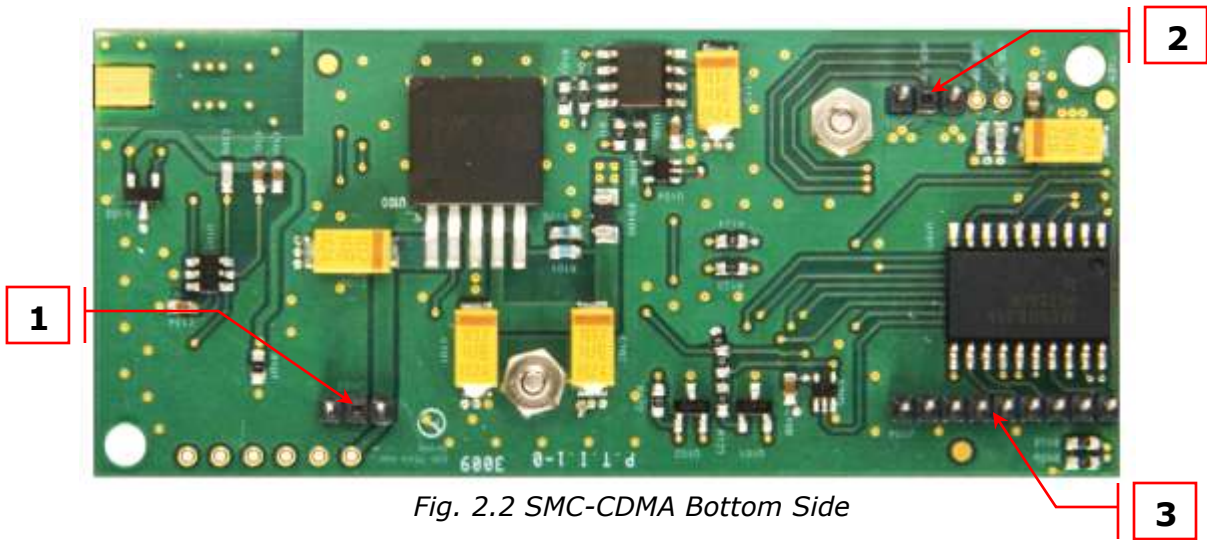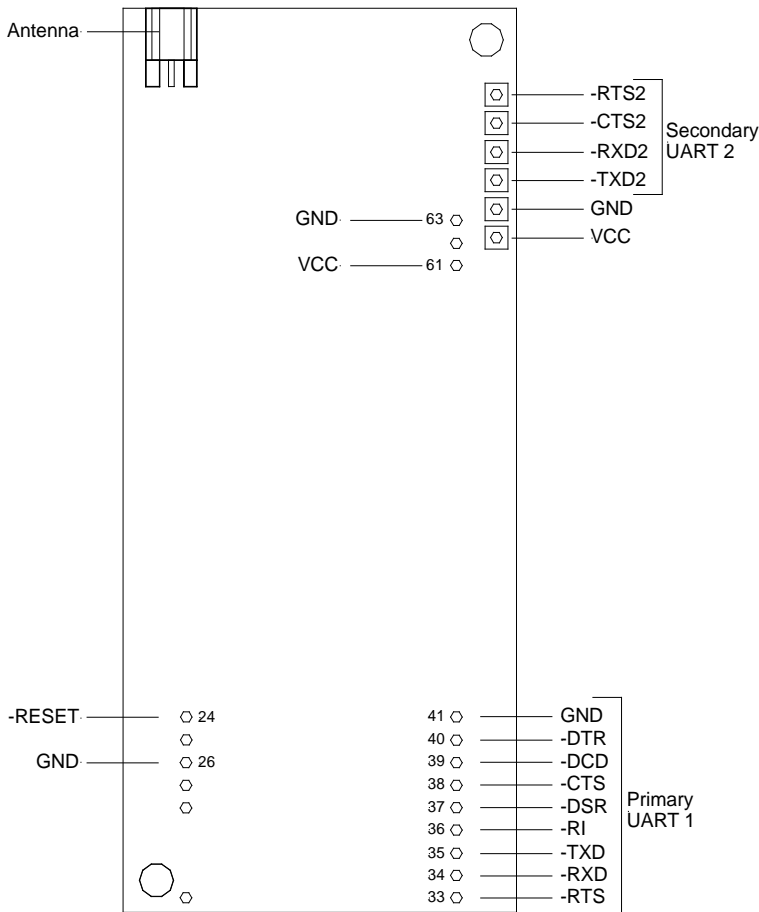| Pin #	Pin Name	I/O Type	Description
24	-RESET	Input	This signal can be used to turn the C24 module on or off. If the unit is on, asserting a low for a minimum of 2 seconds will shut the C24 module off. Asserting a low for not more than 0.5 seconds will power the C24 back on. Data stored in volatile memory will be lost. This line must be driven by an open drain or open collector. If unused, keep line open.
26, 41, 63	GND		Ground
33	-RTS	Input	Request to Send. Signal used for hardware flow control
34	-RXD	Output	Received Data. Line used to send received data and modem responses to the DTE (Data Terminal Equipment)
35	-TXD	Input	Transmitted Data. Line used to send data and transmit commands from the DTE.
36	-RI	Output	Ring Indicator. Output low (ON) indicates the presence of a ring signal.
37	-DSR	Output	Data Set Ready. Line used to indicate modem status to the DTE.
38	-CTS	Output	Clear to Send. Line controlled by the modem to indicate whether or not the modem is ready to transmit data.
39	-DCD	Output	Data Carrier Detect. Line asserted by the DTE to indicate connection status.
40	-DTR	Input	Data Terminal Ready. Line asserted by the DTE to indicate that it is ready to transmit or receive data.
61	VCC	Power	+5 VDC ±0.25 VDC

Serial UART1 Input lines: Input High, Min 3.5 V
                             Input Low, Max 1.5 V

Serial UART 1 Output Lines: Output High, Min 4.2 V
                            Output Low, Max 0.4 V

Serial UART 1 Line Current: Drive: $I_{OUT} = 6.0$ mA

NOTE: VCC is the maximum voltage rating on Primary Serial UART 1 input pins.

Serial UART 2 Input lines: Input High, Min 2.0V
                              Input Low, Max 0.3 V

Serial UART 2 Output Lines: Output High, Min 2.6 V
                            Output Low, Max 0.3 V

Serial UART 2 Line Current: Drive: $I_{OUT} \leq 4.0$ mA

NOTE: 3.0 VDC is the maximum voltage rating on Secondary Serial UART 2 input pins.

SECTION 4 - DEVELOPMENT/TEST BOARD INTERFACE

Development/Test board

The Development/Test board can be used to interface the SCM-CDMA modem to a standard RS232 serial connection. The SMC test board also supplies the SMC-CDMA modem with the required +5VDC supply voltage from an externally supplied 10 to 28 VDC power source, +12VDC typical.
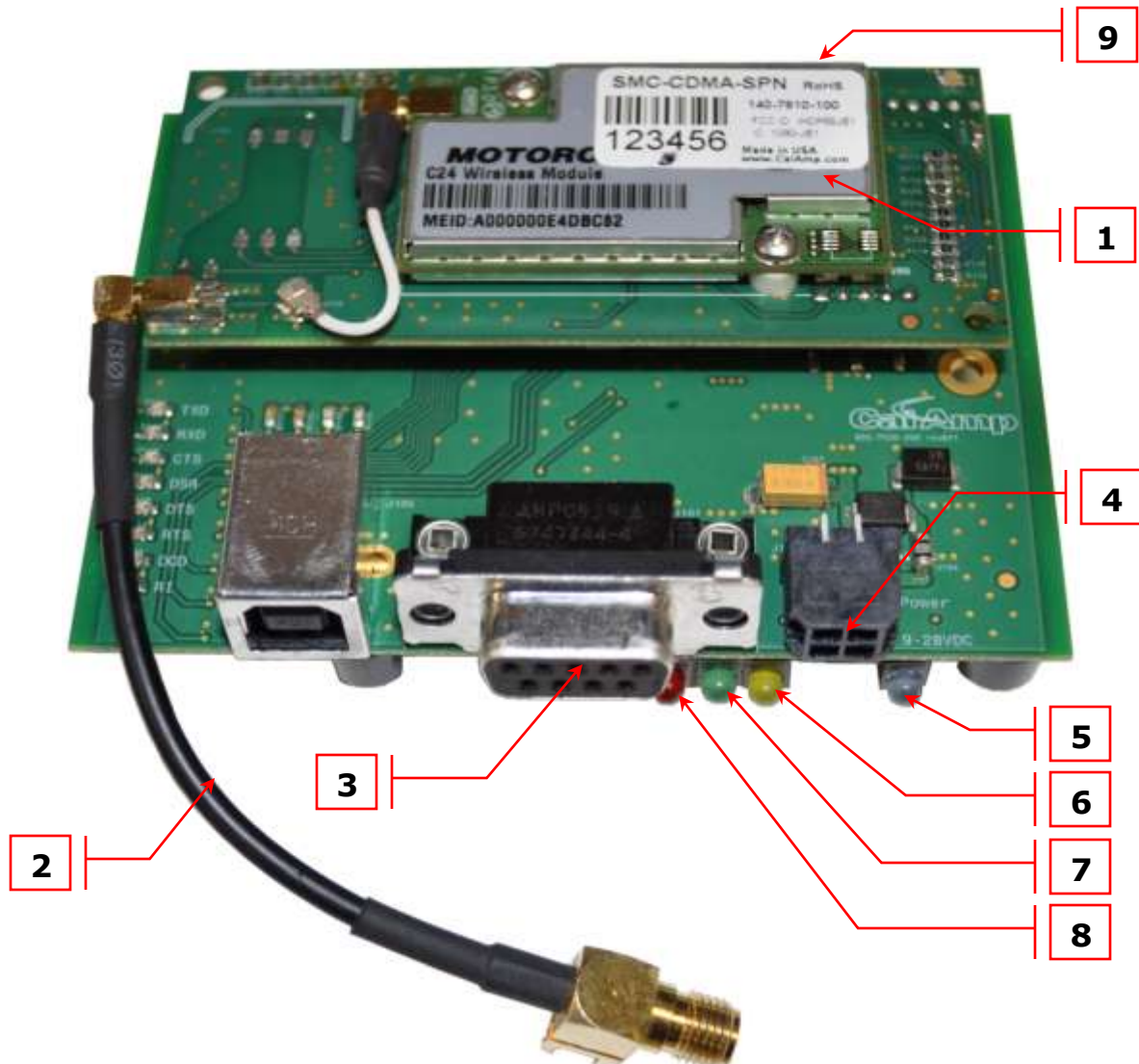

Figure 4.1 SMC modem with DK test board

SMC-CDMA test board components:

1. **SMC-CDMA modem**
2. **MMCX to SMA RF cable:** Provides connection to external antenna.
3. **RS-232 Port:** Standard D-Sub, 9 pin, female connector.
4. **Power Connector:** Molex 4-pos 3MM receptacle (lower left: GND, lower right: +VDC).
5. **Blue LED:** Power Indicator
6. **Yellow LED:** DCD Indicator
7. **Green LED:** RXD Indicator
8. **Red LED:** TXD Indicator
9. **RESET Switch**: Bottom side of DK test board (under UART port connections)

Note: USB connector reserved for future use.

RS-232 Serial Port Integration Parameters

Table 4.2 provides the serial cable design information for the SMC-CDMA using the DK test board.

Table 4.2 Standard RS-232 DE-9 Pin out

Pin	Name	Direction	Description
1	CD	«—	Carrier Detect
2	RX	«—	Receive Data
3	TX	—»	Transmit Data
4	DTR	—»	Data Terminal Ready
5	GND		System Ground
6	DSR	«—	Data Set Ready
7	RTS	—»	Request to Send
8	CTS	«—	Clear to Send
9	RI	«—	Ring Indicator

Note: Direction is DTE relative DCE.
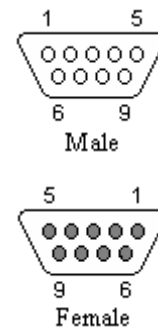
Table 4.3 Default RS-232 Communication Parameters

Bits Per Second	115,200
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	Hardware

Accessories

Antenna	3" Mag Mount Antenna	L2-ANT0003
Antenna Adapter Cable	MMCX to SMA cable	497-7500-003 or 697-7500-003
Power Supply	110 VAC input DC Power Cable	150-7001-001 150-7500-002
Interface Cable	Serial Cable	L2-CAB0002

Primary Antenna

The primary antenna connection on the SMC-CDMA is a MMCX connector. Mounting options and cable lengths are user's choice and application specific.

SECTION 5 -   GETTING STARTED USING THE SMC TEST BOARD

This section describes the use of the SMC test board to communicate with the SMC modem for provisioning and testing using HyperTerminal. Please refer to **Appendix A** for details on setting up a modem driver for a DUN connection.

Connecting Up the SMC Test Board

Connect the Power cable, RS232 cable, Antenna cable to the SMC test board as shown in Figure 5.1.

Figure 5.1 SMC test board connections

HyperTerminal Settings

Open a HyperTerminal session and configure the properties for the COM port used to connect the SMC test board.

Set HyperTerminal properties for:

Bits per second: **115200**

Data bits: **8**
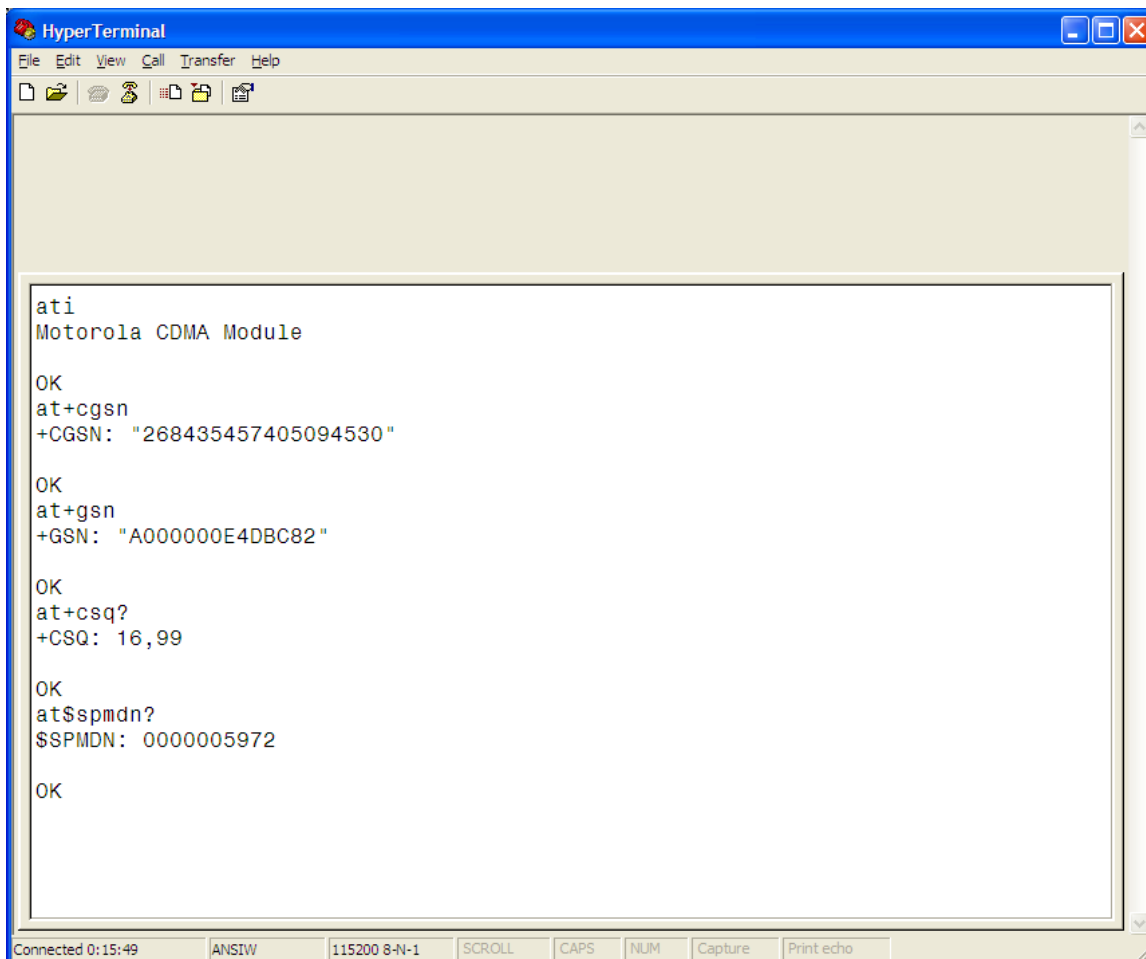
Parity: **None**

Stop bits: **1**

Flow control: **Hardware**
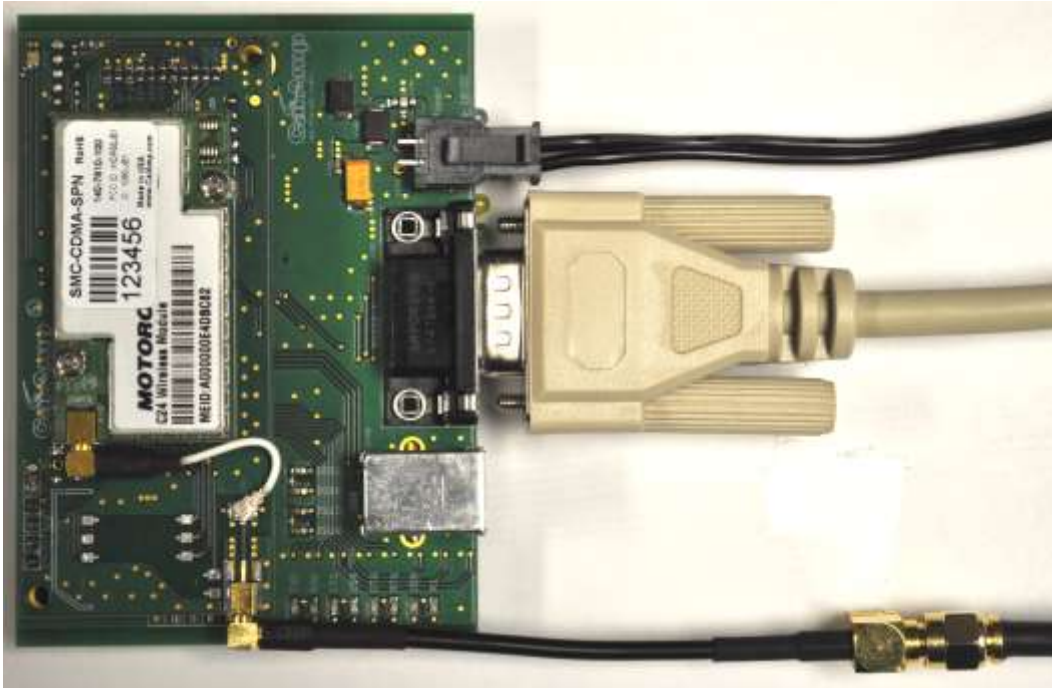
Verify SMC Modem Connectivity

Power on the SMC test board (+12VDC typical), then start HyperTerminal.

```
ati
Motorola CDMA Module

OK
at+cgsn
+CGSN: "268435457405094530"

OK
at+gsn
+GSN: "A000000E4DBC82"

OK
at+csq?
+CSQ: 16,99

OK
at$spmdn?
$SPMDN: 0000005972

OK
```

Figure 5.2 HyperTerminal screen responses

The **ATI** command prints the cell module product information. If you get an Error or no communication, verify the modem is connected to the proper COM port and powered on. Refer to Figure 5.2 for all the AT commands listed below.

Verify the modems Mobile Equipment Identity (MEID) number with the **AT+CGSN** (for Decimal number) or **AT+GSN** (for Hexadecimal number) command. The MEID number replaces the ESN (Electronic Serial number).

Verify good signal strength with the **AT+CSQ?** command. A typical reply is +CSQ: 16, 99, using the mag-mount antenna indoors. The first number is signal strength and ranges from 0 to 31 (the higher the number, the stronger the signal).

Confirm the phone number currently in the modem with the **AT$SPMDN?** command. If the unit is not provisioned, the number should be 10 digits beginning with several zeros, i.e. 0000005972.

Exit HyperTerminal before attempting to connect using a Dial-Up-Networking connection.

SECTION 6 -   SMC-CDMA PROVISIONING

OMA-DM SPRINT

Sprint provides customer functionality and miscellaneous services that will utilize "server-initiated" OMA DM sessions. These services include, but are not limited to, firmware updates, PRL updates, and application downloads, etc.

The OMA-DM sessions can be initiated by the network (NI) or by the Client (CI).

Sprint requires that OMA-DM runs in profile 0, and other data sessions run in profile 1. Other data sessions are restricted when OMA is in progress such as DUN, TCPIP etc.

HFA (Hands-Free Activation) – is basically a CIDC session that is automatically triggered by the device. A Hands-Free Activation session is only triggered for initial activation on the first power-up, or on the first power-up after being refurbished (Master Reset: +MMR).

HFA retries - If the device connects to the OMA-DM server and no profile information is available, the device will pause for 60 seconds and retry up to 5 times. The device will retry only when successfully connecting to the server and no profile information is available. The device will not retry when an error occurs during the connection or the session with the server.

NIDC/NIPRL/NIFUMO – Only in the case of network initiated OMA-DM, if the session establishment fails due to a network problem, the OMA-DM Client will attempt to re-establish the session every 1 minute until the DM session is successful or until it retries 5 times.

Verifying a Hands Free Activation

Once an account has been established for the SMC-CDMA-SPN modem, the OMA-DM provisioning can occur. To start a Hands-Free activation using the SMC Test Board, follow these steps.

1. Establish a HyperTerminal session with the SMC-CDMA-SPN modem.

2. Type **AT+MMR** to re-set the modem to factory defaults and allow the automatic CIDC session to start when the modem is powered up again.

3. Power up the SMA-CDMA-SPN modem and type **AT+MODIND=1** to enable the OMA-DM unsolicited informational report lines to be displayed on the HyperTerminal screen.

   - +MODIND: 5, indicates the HFA has started.

   - +MODIND: 7, indicates the Device Configuration (DC) is updating.

   - +MODIND 14, indicates the HFA update is complete. At this point the SMC-CDMA-SPN modem should be provisioned on the network.

   - +MODIND 18, indicates the Network Initiated OMA-DM session is complete.

Type the **AT$SPMDN?** command to verify the correct phone number was programmed in the unit.

Verify Activation using HyperTerminal
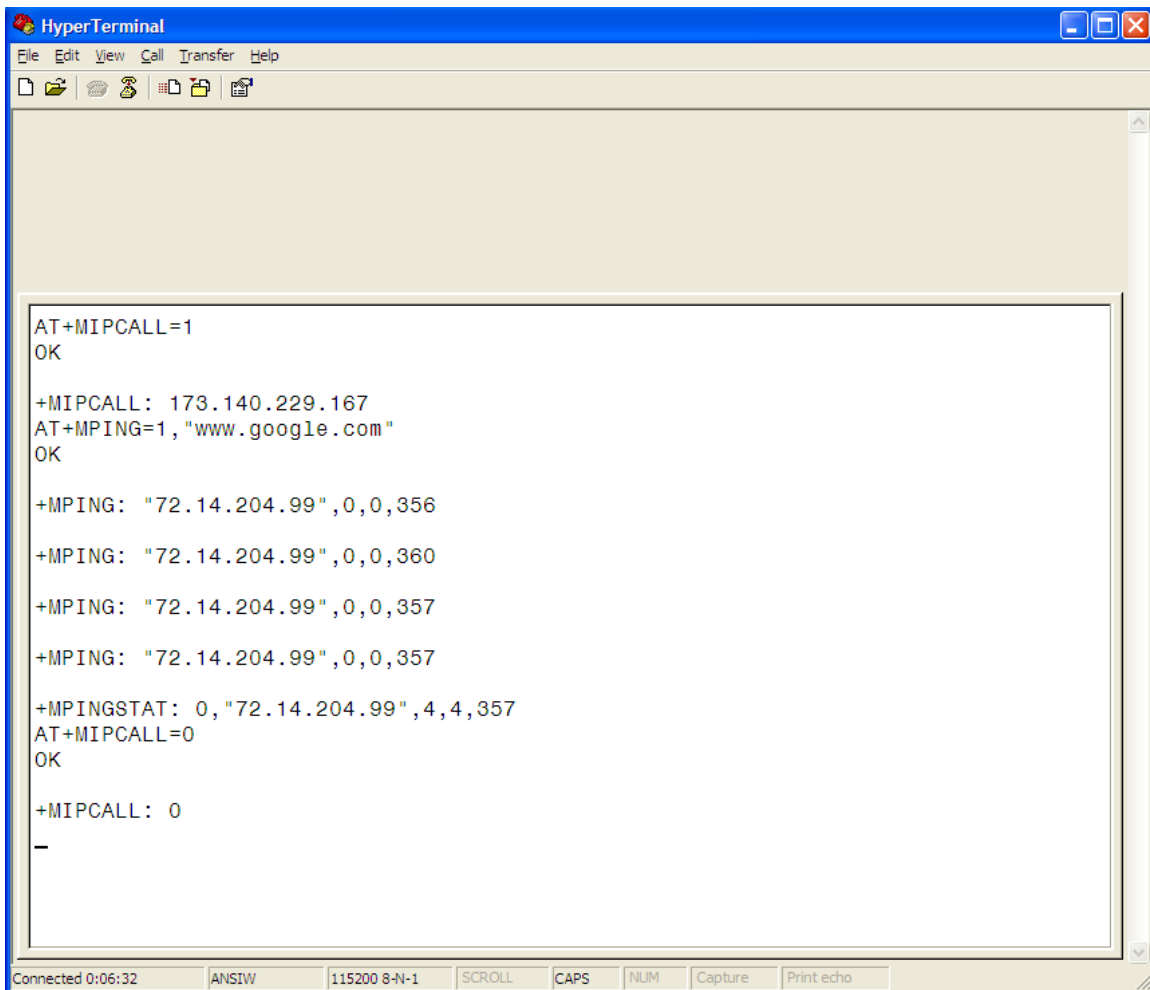
With the provisioned SMC-CDMA modem installed, power on the SMC test board (+12VDC typical) and start HyperTerminal as described in Section 5.

Type the **AT+MIPCALL=1** command to start a PPP connection with the carrier network.

If the module is provisioned properly, an IP address will be assigned.

Type **AT+MPING=1,"www.google.com".** This will ping the Google server and send back the ping statistics.

Typing **AT+MPCALL=0** will terminate the PPP connection. Refer to Figure 6.1 below.

Figure 6.1: HyperTerminal MIPCALL example

Verify Activation using a Dial-Up-Network Connection

A Windows Dial-up network connection can be used to verify carrier activation on the network. Create a dial-up network connection using a standard modem set to 115200 bps. Go to the Network Connections screen and double click on the Dial-Up connection (example: SMC-CDMA).
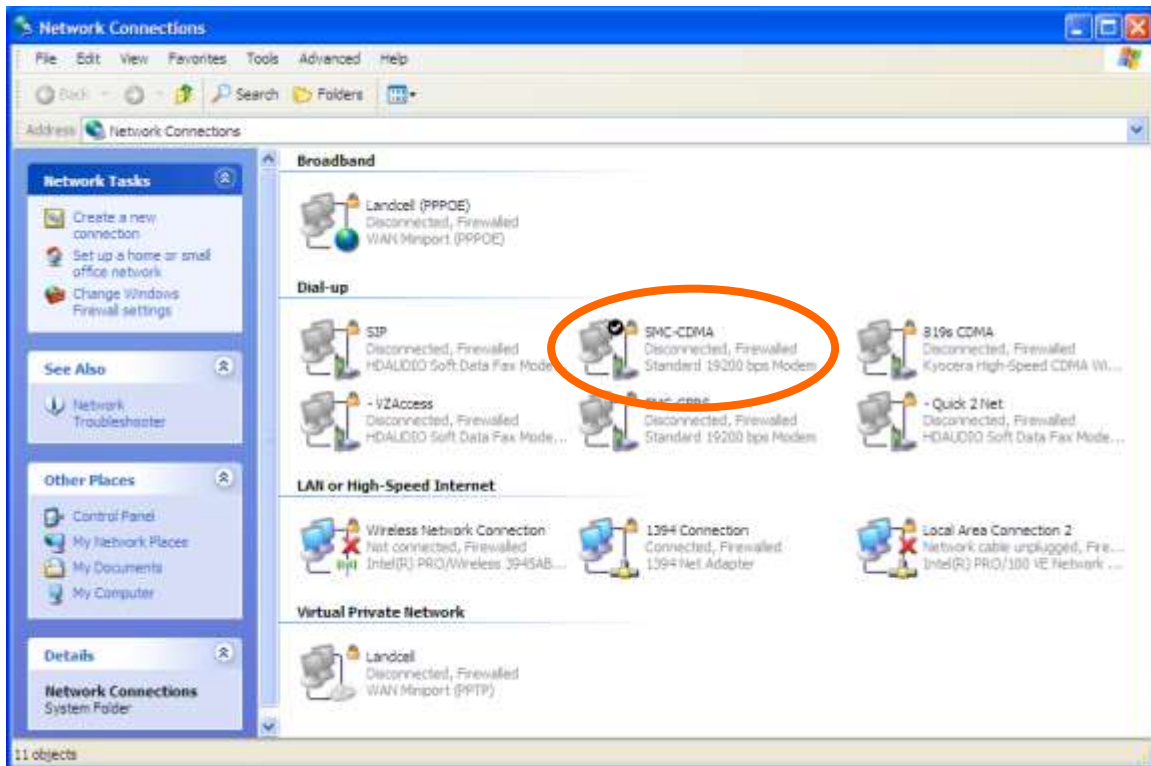
When the connect window appears, set the username and password as defined for your carrier (usually blank). Enter the phone number as **#777** and click the **Dial** button.

The modem will attempt to connect to the provider network. If the configured baud rate for the COM port, the modem, and the DUN do not match, the DUN will not be able to talk to the modem properly and you will get a hardware error message. Otherwise the DUN will contact the cellular network and authenticate the user on the network.
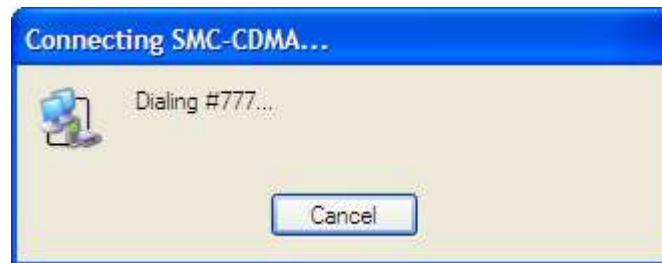
Once connected you should be able to browse the internet thorough the DUN session. To confirm this, disable any other network connections you may have running.
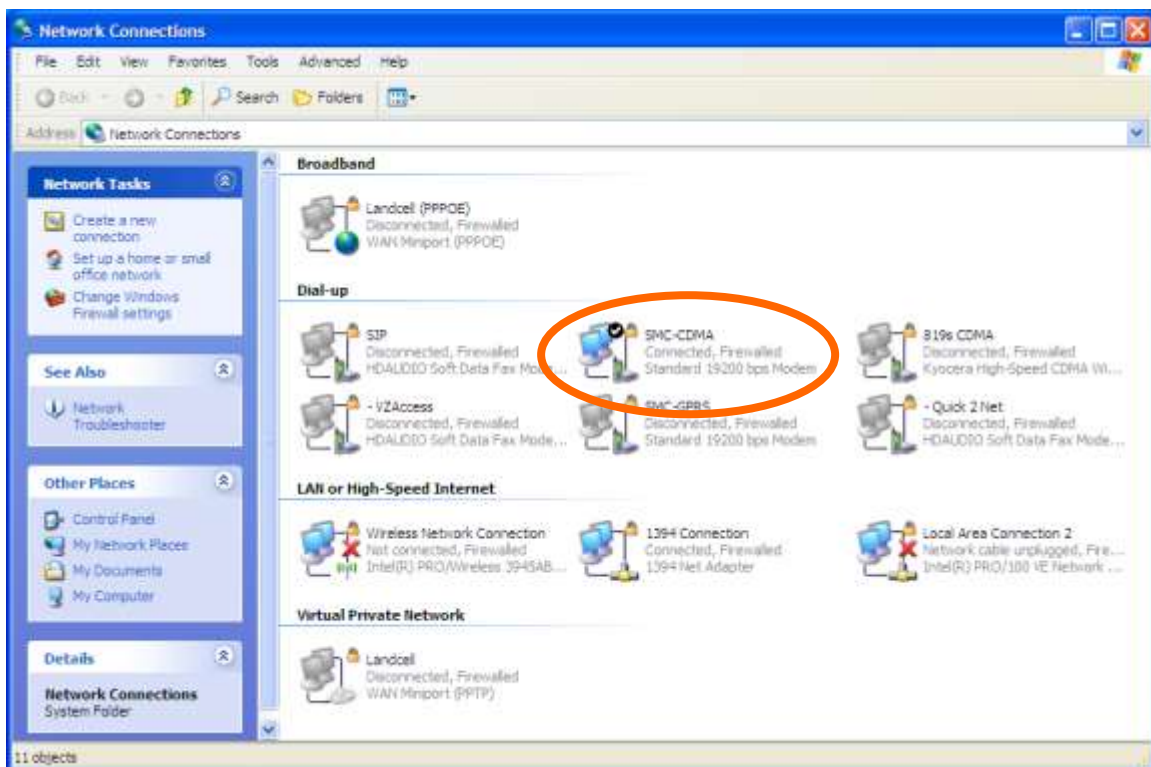
Right click on the connected Dial-Up connection icon and select the Details tab. The status of the connection will be displayed, including the IP address assigned by the carrier network.
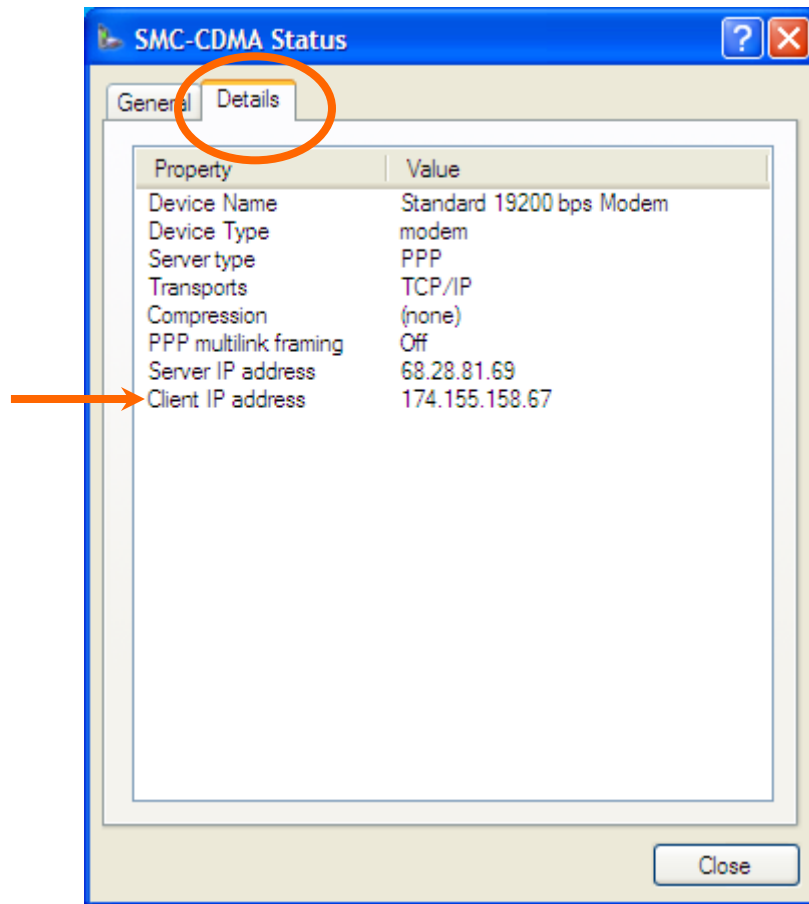
SECTION 7 -   SMC-CDMA OPERATIONAL FEATURES

This section provides information on various features and call scienerios using the SMC-CDMA modem with the SMC Development/Test board and HyperTerminal. The SMC-CDMA modem integrates Telit's MOT-C24 cell module and uses it's serial UART interface.

See related document, MOT by Telit C24 Developer's Guide, AT Commands Reference Manual **[1]** for more detailed descriptions and examples for all features and call types.

Types of calls and features:

- 1x Packet Data
- Circuit Switched Data (CSD)
- Short Message Service (SMS)
- FAX
- Internet Services
    - TCP/UDP IP Connection
    - FTP Connection
- MUX Integration

1x Packet Data

The 1x data call allows the service subscriber to send and receive data in an end-to-end packet-transfer mode, without utilizing network resources in circuit-switched mode.

The SMC modem is able to both 1x data call and other CDMA services, but can only operate one set of services at a time (1x data call or CSD).

The SMC modem can activate a 1x data call and at the same time be alerted for an incoming call.

This functionality is available on the SMC modem single serial line by either of two procedure options:

Option 1:
1. While in 1x data call, listen to the RI signal (RS232) for an incoming call ring.
2. Upon being interrupted by the RI signal, drop the DTR line to switch to command mode (depending on the previous DTR configuration: AT&D).
3. Answer the call (suspending the data call session).
4. At the end of the call, pull the DTR to resume the data call session.

Option 2:
Use the MUX protocol for virtual channels support, with a unique channel for the 1x data call session (Data) and a unique channel for answering the voice call (command)

Circuit Switched Data (CSD)

Data transfer over Circuit Switched Data (CSD) is possible. Once the connection is established, data can be transferred to and from the remote side.

CSD operation enables the terminal to perform a data transfer over a circuit switched link. It enables the user to:

- Connect to a remote modem without any Internet network involvement.
- Own a real IP address and enable its access by connecting to an external ISP.

The following are examples of standard CSD call uses:

- Connecting an Internet Service Provider (ISP).
- Remotely accessing corporate Intranet via Remote Access Server (RAS).
- User specific protocol, where the user defines both the remote and local sides.

The SMC-CDMA working modes can be divided into two modes of operation.

Data Mode: In this mode, once the SMC-CDMA has established a link with the remote modem, it does not respond to any data passing through it (except for the Escape Sequence search). The SMC-CDMA becomes a transparent link, connecting the terminal with the remote side.

Command Mode: In this mode, the SMC-CDMA responds to the AT commands issued by the terminal. This is the default working mode.

Note: It is possible to switch between the operating modes.

The Terminal mode allows you to instruct the modem to dial a remote modem by issuing the Dial command followed by the phone number. You can also include dial string modifiers, such as ",", for pause, in your command line to give the modem additional instructions.

Short Message Service (SMS)

The SMS feature provides means for SMS messages handling and the reporting of SMS reception events. The SMC modem SMS implementation is based on the 3GPP 23.040 specification.

The SMS, as defined within the GSM 800/1900 digital mobile phone standard:

- A single short message can be up to 160 characters of ASCII text in length (7-bit coded). Message text can comprise words, numbers or an alphanumeric combination.
- Short messages can be written and displayed in various coding schemes, including ASCII and UCS2.
- Reception of an incoming message can invoke an indication to the terminal. This feature is configurable using the command AT+CNMI.
- Cell broadcast messages can also be selected and received on the SMC modem. The SMc modem enables registration to specific broadcast channels.

A CDMA SMS message belongs to one of three message definitions:

- Point-to-point messages are for sending messages between phones. Such messages include addressing information and a structured data area, which can include fields that describe various message properties, as well as the user data (i.e. the message contents to display to the user).
- Acknowledge messages exist to pass status information. They simply contain a cause (error) code.
- Broadcast messages are sent from the network to all phones in a certain geographical area. They cannot be sent from a phone.

A point-to-point message can have a teleservice identifier to specify the application that should handle it. The standard defines the operation of six teleservices.

The Wireless Messaging Teleservice (WMT) is for short text messaging between users. The Wireless Enhanced Messaging Teleservice (WEMT) extends this to include EMS elements such as pictures. Outgoing messages of these two teleservices can be created. Incoming messages of these teleservices are stored in the message store.

Other teleservices defined are: IS-91 Extended Protocol Enhanced Services, Wireless Paging Teleservice (WPT), Voice Mail Notification (VMN), and Service Category Programming Teleservice (SCPT). Incoming WPT and VMN messages are stored in the message store.

A new incoming message is saved in the first free memory location, from index 251. The SMC modem cell module memory can contain up to 250 outgoing and broadcast (CB) messages. A new outgoing message is saved in the next free memory location, from index 1 up to index 200.

Incoming Message index: 251, 252, . . . 350 (max #)

Outgoing Message index: 1, 2, . . . 200 (max #)

CB Message index: 201, 202, . . . 250 (max #)

FAX

The SMC modem supports FAX Service Class 2.0. A Service Class 2.0 facsimile provides a level of services necessary to support Group 3 facsimile operation. This requires support from the facsimile terminal to implement the recommended T.30/T.32 procedures for document facsimile transmission and recommended T.4 for representing facsimile images.

A Service Class 2 Facsimile DCE includes the following services:
1. Connection;
2. Configuration:
    - T.30 Procedure Options,
    - T.30 Procedure Policy,
    - Optional Service Gateways,
    - Additional Parameters.
3. Session Status Reporting;
4. Transmit Phase C Data Transfer;
5. Bit reverse Phase C data;
6. Zero-Bit insertion for minimum transmit line time;
7. Copy Quality Checking on Received Data (if reception supported);
8. Other services mandatory in Recommendation T.30;
9. Packet Protocol for DCE-DTE data delivery.

A DTE working with a Service Class 2 facsimile DCE needs to do the following:
1. Preconfigure the DCE, if desired;
2. Initiate sessions: answer or dial;
3. Monitor session status;
4. Transfer Phase C image data, with page separation.

Please refer to the Motorola C24 Developer's Guide, AT Commands Reference Manual **[1]** for more detailed information regarding the implementation of the FAX feature.

Internet Services

The modem has an embedded TCP/IP stack that is driven by AT commands and enables the host application to easily access the Internet. The advantage of this solution is that it eliminates the need for the application manufacturer to implement their own TCP/IP and PPP stacks, thus minimizing cost and time to integrate Internet connectivity into a new or existing host application. Access is provided to the following Internet Services:

1. Socket Client (initiator) for TCP or Client/Server (initiator/listener) for UDP
2. FTP Client

The TCP/UDP IP feature provides the terminal with the following benefits:
- Up to four simultaneous protocol connections.
- Ability to pass data via the protocol stack using AT commands (command mode). This relieves the terminal from switching the RS232 to "binary mode" and back to "command mode".
- Ability to use UDP and TCP simultaneously.
- No need for protocol support from the terminal - only data sending and receiving.
- Reduced memory utilization. The C24 manages the protocol stack and therefore saves terminal memory.
- Ability to open TCP connections, secured with SSL/TLS.
- Ability to receive the incoming TCP connections.
- Ability to accept IP connections only if the IP belongs to a defined IP white list.

TCP/IP

When establishing the TCP/IP connection the SMC MODEM can only be the "initiator". The TCP/IP feature enables the SMC modem to be a wireless end point for a TCP/IP socket.

NOTE: The TCP protocol use the value TTL (Time to live) = 64.

Creating TCP/IP Connections

The following occurs when creating a TCP/IP connection from the SMC MODEM to the Web:

1. The SMC modem connects to the CDMA 1x network and receives an IP address (using the AT+MIPCALL command).

2. The SMC modem opens a TCP/IP stack as one of its "sockets" (it must know the target's IP address and port number).

3. Once the connection is established, data is transferred freely in both directions (upload and download).

The following occurs when creating a TCP/IP connection with another SMC modem using the "Windows Dialer":

1. The OEM on the target side (server) uses the "Windows Dialer" application. When using this application the TCP/IP is external to the OEM. (External TCP stack is used).

2. The target side activates the "server application" (The term "server application" means an application that has the ability to listen on a given IP address and port number).

3. After connecting to the CDMA 1x network, the "server" sends its IP address to the SMC modem using an alternative connection (for example, CSD, SMS and so on).

4. The server application listens on a known port, waiting for SMC modem to connect.

5. The SMC MODEM connects to the same CDMA 1x network as the server, and receives an IP address (using the +MIPCALL command).

6. The SMC MODEM initiates a TCP/IP connection with the listening "server". (It knows the IP address and port number of the server).

7. Once the server is connected, the TCP/IP connection is created and data can be transferred freely in both directions (upload and download).

UDP/IP

The set of AT commands created for the TCP/IP connection is used for the UDP/IP connection as well. Therefore, UDP/IP must open a UDP stack using the MIPOPEN AT command. The connection created does not change any concept regarding the UDP/IP known protocol (which is connectionless), this is just an easy way for the terminal to specify to the C24 which of the four possible stacks should be used.

When establishing the UDP/IP connection, the SMC modem is both the "initiator" and the "listener".

Creating UDP/IP Connections

The following occurs during a UDP/IP connection with another SMC modem:

1. Side A:

   – The SMC modem connects to the 1x network and receives an IP address (using the +MIPCALL command).

   – The SMC modem opens a UDP/IP stack as one of its "sockets" (using the +MIPOPEN and selecting the protocol UDP).

2. Side B:

   – The SMC modem connects to the 1x network and receives an IP address (using the +MIPCALL command).

   – The SMC modem opens a UDP/IP stack as one of its "sockets" (using the +MIPOPEN and selecting the protocol UDP).

3. Side A and B previously agree on a port number, and exchange their given IP addresses via other means of connection (SMS, CSD, Voice, DB and so on).

4. The SMC modem sends and receives data to and from the targeted site as it knows the IP address and port number of the target.

5. Sending (accumulating) data is done using the +MIPSEND command.

6. Actual send is done using the +MIPPUSH command, by specifying the IP address and port number of the destination.

NOTE: Every +MIPPUSH sets the destination IP address and destination port number for the current and future transactions. These values are used for the next push if not explicitly overwritten.

The following occurs when creating a UDP/IP connection from the SMC modem (client/server) to WEB (client/server):

1. Client side:

   – The SMC modem client connects to the 1x network and receives an IP address (using the +MIPCALL command).

   – The SMC modem opens a UDP/IP stack as one of its "sockets" (using the +MIPOPEN and selecting the protocol UDP).

2. The SMC modem sends data to the Website, as the Web site's IP address is known and is public, and the port number is previously agreed upon.

3. Sending (accumulating) data is done by the +MIPSEND command.

4. Actual send is done by the +MIPPUSH command by specifying the Website IP address and Website port number.

5. Server side:

   – After receiving the first packet from the client, the server knows the IP address and port number of the SMC modem.

   – The IP address and port number for the specific mobile SMC modem should be saved in the DB.

NOTE: Every +MIPPUSH sets the destination IP address and destination port number for the current and future transactions. These values are used for the next push if not explicitly overwritten. FTP

Online Data Mode

The Online Data Mode (ODM) feature, allows the user to transfer raw data (without using the AT+MIPSEND and AT+MIPPUSH commands) between SMC modem and Network. The data transfers via established network connection (socket), based on internal TCP or UDP protocol stack. RS232 connection between SMC modem and terminal with Hardware flow control is required for the feature execution.

A special AT Command AT+MIPODM (instead of AT+MIPOPEN) is used to open a socket in Online Data Mode. The command provides a set of parameters for the feature configuration and corrects performance. When a socket is successfully opened in Online Data Mode, all data, comes from terminal, "as is" is being sent to Network and vice versa: all data, comes from Network, "as is" is being sent to terminal.

Each socket, opened in Online Data Mode, allocates an accumulating buffer whose size is 1372 bytes. When the user sends amount of data, less then the buffer size, the data is being sent to Network after a spooling timeout (200 mS), otherwise the data is being sent to Network immediately.

When ODM feature is executed, pseudo-command mode is enabled in PREMUX state and disabled in MUX state by default (see RS232 Multiplexer Feature). ODM feature allows the user to disable pseudo-command mode, when SMC modem is in PREMUX state by setting "pseudo-command mode enable/disable" parameter to "1".Disabled pseudo-command mode provides better data transfer performance.

When SMC modem is in MUX state and ODM feature executed, a pseudo-command mode is not supported.

The user can suspend an opened in Online Data Mode socket by entering, for example, ESC sequence (by default "+++") from terminal, when pseudo-command mode is enabled. In this case SMC modem switches to pseudo-command mode, allowing the user to enter AT commands from terminal. The ATO command used to resume Online Data Mode from pseudo-command mode. When data comes from the Network and SMC modem is in pseudo-command mode, a special unsolicited event (+MIPDATA) is being sent to terminal.

When socket is in Online Data Mode (not in pseudo-command mode), RS232 communication DCD line is enabled.

There are two options to suspend a socket, opened in Online Data Mode, when SMC modem is in PREMUX state:

- Enter ESC sequence ("+++") from terminal.
- Disable DTR line on RS232 communication port in case of AT&D1 parameter configuration.

There are two options for valid closing of a socket, opened in Online Data Mode, when SMC modem is in PREMUX state:

- Switch SMC modem to pseudo-command mode and enter +MIPCLOSE command with opened in Online Data Mode Socket ID.
- Disable DTR line on RS232 communication port in case of A&D2 or AT&D3 parameter configuration.
-

When SMC modem is in MUX state, change of DTR or software DTR state on ODM MUX channel closes ODM session in case of A&D1, A&D2 or AT&D3.

When an error occurred with the socket, opened in Online Data Mode, the socket closes automatically and +MIPSTAT unsolicited response is being sent to terminal

FTP Connection

SMC modem implements FTP connection feature, based on RFC959 standard, and operates as a FTP client. When connected to a remote FTP server, SMC modem is able to receive information about remote file system, manage it and perform files transfer operations.

The AT+FTPOPEN command is used to open a FTP connection with a remote FTP server. When SMC modem performs FTP connection establish procedure, it allocates two TCP sockets. One of them is used for FTP control channel, the other for FTP data channel (listen mode). FTP control channel port has default identification number (ID) - 21 for source (client) and destination (server) sides, but the user is able to configure control channel port ID for client as well as for server by passing new source control port and/or new destination control port id as AT+FTPOPEN command optional parameters. This is applicable when a remote FTP server is able to accept FTP connection over non-standard (other then 21) ports. FTP data channel port has a default identification number (ID) - 20 for source (client) side, but the user is able to configure data channel port id by passing a new source data port id as AT+FTPOPEN command optional parameter. This is applicable when the remote FTP server is unable to establish data connection to some port IDs.

For example, to open a FTP connection with a remote FTP server, use the following settings:

destination URL	= <ftpsite>	(mandatory)
user	= <anonymous>	(mandatory)
password	= <*****>	(mandatory)
account	= ""	(optional, default value)
source control port id	= 1300	(optional, 21 default value)
destination control port id	= 21	(optional, 21 default value)
source data port id	= 1302	(optional, 20 default value)

AT+FTPOPEN = "<ftpsite>","<anonymous> ","<*****>",,1300,,1302

When FTP connection is establish, SMC modem remains in command mode. This mode is used for performing most of the FTP AT commands. Only AT+FTPLIST, AT+FTPSTOR and AT+FTPRETR commands switch SMC modem to online data mode. Generally, SMC modem returns to command mode after the data mode caused command execution is finished, but the user is able to interrupt online data mode (and closes the actual FTP connection) by changing the DTR line status from ON to OFF, when AT&D settings = 2 or 3.

Established FTP connection can be closed when SMC modem is in command mode by AT+FTPCLOSE command or by changing DTR line status from ON to OFF when data transfer operations are performed (SMC modem is in online data mode).

When FTP connection is established, the user is able to manage file system on the remote FTP server, like create, remove, change directory, rename or delete a file. The following FTP commands are used for remote file system management purpose.

AT+FTPCWD - changes the working directory on a remote server.

AT+FTPMKD - creates a new directory on a remote server.

AT+FTPRMD - removes existing directory on a remote server.

AT+FTPPWD - returns actual working directory name from a remote server.

AT+FTPCDUP - changes working directory on a remote server, up to parent directory.

AT+FTPDEL - deletes a file on a remote server.

AT+FTPREN - renames a file on a remote server.

The file transfer operation allows the user to transfer a file over an established FTP connection. To avoid end-of-file detection problem for user in download case and for SMC modem in upload case, SMC modem implements a special format of transferred files over FTP connection. The format proposed "escaping" one of the ASCII symbols of a file context and using the "escaped" symbol as end-of-file marker. An escaping algorithm is described below.

The algorithm defines two special characters: EOF (end-of-file character) and ESC (escape character). EOF symbol is a hexadecimal 0x03 (decimal 3) ASCII ETX symbol and ESC symbol is a hexadecimal 0x10 (decimal 16) ASCII DLE symbol - not to be confused with the ASCII ESCape character.

To encode a file to FTP File Transfer Format, the user or SMC modem will read each data byte from the source file and will perform the following operations:
- When a data byte has the same code as EOF character, a two byte sequence of ESC and EOF characters is sent instead.
- When a data byte has the same code as ESC character, a two byte sequence of ESC and ESC characters is sent instead.
- When end of file is reached, EOF character is sent.

To decode a file from FTP File Transfer Format, the user or SMC modem will read each data byte from the source file and will perform the following operations:
- When a data byte has the same code as ESC character and next data byte is ESC or EOF character, the first byte should be ignored.
- When a data byte has the same code as EOF character and previous data byte is not ESC character, end of file is reached.

Other FTP Operations and Interaction with MIP Commands

SMC modem provides AT+FTPINFO feature that allows the user to receive more information about FTP connection and FTP commands execution. When the feature is enabled, all FTP commands sent by SMC modem to the remote server and all FTP responses, received by the SMC modem from the remote server are printed to the user as AT+FTPINFO: <text> unsolicited response. Use the AT+FTPINFO=1 for the feature enabling, and the AT+FTPINFO=0 for the feature disabling in any SMC modem operation time, when SMC modem is in command mode.

The external ODM session is prohibited when the FTP feature is executed, because FTP feature data connection is based on socket, opened for ODM (internal ODM session), so, when SMC modem receives +MIPODM command within FTP connection, the error code: 302 (FTP session is active) is returned to the user.

The user cannot initiate FTP connection with AT+MIPOPEN command as well as close FTP connection with AT+MIPCLOSE command. However, AT+MIPOPEN and AT+MIPCLOSE commands in "read" state still indicate actually used / unused sockets include sockets, allocated for active FTP connection:
- AT+MIPOPEN? indicates inactive sockets (include allocated for active FTP connection)
- AT+MIPCLOSE? indicates active sockets (include allocated for active FTP connection)

When SMC modem receives AT+MIPCLOSE command for closing a socket, used within FTP connection, the error code: 302 (FTP session is active) is returned to the user.

MUX Operation

The SMC modem cell module is supplied with an internal 3GPP 27.10 protocol stack, also referred to as a multiplexer or MUX.

The SMC modem with multiplexer support utility provides the following capabilities:
- Provides the terminal with up to five virtual channels on one physical RS-232 connection.
- Provides simultaneous data (CSD/1x data call) and command (AT command set) services.

In this way, many applications can use a single RS232 line via virtual channels. This enables a user to make network and phone service inquiries and maintain data communication at the same time.

The SMC modem with the MUX feature ENABLES multiple channel operation and simultaneous data and control operation. For example, it allows a user to be connected to an Internet website (DATA session connected), receive a file via CSD Call, and query the Smc modem phone book all at the same time.

The following actions are enabled during a data session:
- Incoming call alert string RING (while SMC modem is in DATA session)
- Answering to incoming call via the ATA command (while SMC modem is in DATA session) SMC modem MUX Integration
- Receive Incoming SMS indication
- Inquiry NW coverage indication
- Setup a voice call (while SMC modem is in DATA session)
- Send & Receive SMS
- Read/write to/from Phone Book
- Local modem operation
- Network interrogation and settings

Please refer to the Motorola C24 Developer's Guide, AT Commands Reference Manual **[1]** for more detailed information regarding the implementation of the MUX feature.

SECTION 8 - SMC MODEM MODULE PROFILES

In addition to the default profile, you can store an individual one with AT&W. To alternate between the two profiles enter either ATZ (loads user profile) or AT&F (restores factory profile).

NOTE: Every ongoing or incoming call will be terminated.

Table 8.1: Profile Commands

AT&V	Returns the current parameter setting. The configuration varies depending on whether or not PIN authentication has been done.
AT&Wn	The Set command stores the current active configuration to user profile 0 or 1. Default is profile 0.
AT&F	Sets all current parameters to the manufacturer defined profile. Refer to Table 8.2.
ATZn	Sets all current parameters to the user profile n (0 or 1). If a connection is in progress, it will be terminated.

Table 8.2: Profile Parameters

Profile Parameter	Description	Parameter Range	Default Value
ATE	Echo	0-1	1
ATQ	Result code return mode	0-1	0
ATV	Display result code	0-1	1
ATX	Select result code	0-4	0
AT&C	Set circuit 109 (DCD) behavior	0-2	1
AT&D	Set circuit 109 (DTR) behavior	0-4	2
AT&K	Flow control	0, 3-6	3
AT&Y	Power-up profile	0-1	0
S00	Auto-answer	0-255	0
S02	Escape code character	0-255	43
S03	Carriage return character	0-127	13
S04	Line feed character	0-127	10
S05	Backspace character	0-32	8
S07	Waiting time in seconds before carrier detects the time to wait for a carrier from the remote modem before hanging up.	1-255	50
S08	Pause Time In seconds For Dial Delay -Controls how long the modem pauses when a comma "," is encountered in a dial string while executing a dial command.	0-255	2
S12	Sets/gets guard time (in units of 50 msec) for the escape character during CSD connections. Note: For a guard time specified by S-Register 12 no character should be entered before or after "+++". The duration between escape codes must be smaller than the guard time.	0-255	20

SECTION 9 - CORE AT COMMAND REFERENCE GUIDE

The SMC modem responds to limited commands set when the phone is locked. These commands are referred to as the "Core AT commands". Generally, when the SMC modem is in this state, the following commands available:

Table 9.1: Core AT Commands

Command	Description
AT$	This command displays a list of all the AT commands supported by the C24.
AT?	This command displays the most recently updated value stored in an S-register.
AT\S	This command displays the status of selected commands and ATS-registers.
AT&C	This parameter determines how the state of the DCD line relates to the detection of the received line signal from the distant end.
AT&D	This command determines how the SMC modem responds when the DTR (Data Terminal Ready) status is changed from ON to OFF during the online data state.
AT&F	This command restores the factory default configuration profile.
AT&K	This command configures the flow control.
AT&V	This command displays the current active configuration and stored user profiles.
AT&W	This command stores the current active configuration to user profile 0 or 1.
AT&Y	This command selects power-up configuration to user's profile.
AT+CBAUD	This command sets the baud rate.
AT+CBC	This command enables a user to query the battery power level.
AT+CEER	Extended Error Report.
AT+CFSN	This command displays the manufacturing serial number.
AT+CGMI	This command displays manufacturer identification.
T+CGMM	This command requests the model identification.
AT+CGMR	This command displays the revision identification.
AT+CGSN	This command displays the product serial number identification in decimal format.
AT+CIMI	This command displays the International Mobile Subscriber Identity number.
AT+CIND	This command is used to query the status of various ME indicators.
AT+CLAC	This command displays a list of all the AT commands supported by the C24.
AT+CLCC	This command displays a list of all current SMc modem calls and their statuses, and also enables/disables the unsolicited indication of the call list.
AT+CMEE	The Set command disables or enables the use of result code +CME ERROR: <err> as an indication of an error relating to the functionality of the SMC modem.
AT+CMER	Mobile Equipment Event Reporting.
AT+CPAS	This command displays the current activity status of the SMC modem, for example, call in progress, or ringing.
AT+CSCS	This command selects the Smc modem character set.
AT+CSQ	This command returns the Signal Quality Measure <SQM> and the Frame Error Rate <FER> from the SMC modem.
AT+FMI	This command displays manufacturer identification.
AT+FMM	This command displays the model identification.
AT+FMR	This command displays the revision identification.
AT+GCAP	This command indicates the major capability areas of the SMC modem.
AT+GMI	This command displays manufacturer identification.

Command	Description
AT+GMM	This command displays the model identification.
AT+GMR	This command displays the revision identification.
AT+GOI	Device Identification.
AT+GSN	This command requests the product serial number identification in Hex format.
AT+ICF	This command determines the Character Framing.
AT+IFC	This command controls the operation of Local Flow Control between the terminal and the SMC modem.
AT+ILRR	TE2-MT2 Local Rate Reporting.
AT+IPR	This command is responsible for setting and saving the request baud rate.
AT+MCST	This command displays the current state of the call processing, and also enables/disables the unsolicited indication of any change in the call processing state.
AT+MECALL	This unsolicited report sends indication of an emergency call to the terminal.
AT+MMUX	Enable MUX mode.
AT+MPESND	Requests Pseudo Electronic Serial Number Identification in Decimal.
AT+MPESNH	Requests Pseudo Electronic Serial Number Identification in Hex.
AT+MREFLASH	Enter to Re-Flash Mode.
AT+MRST	The +MRST command enables customer software to perform a hard reset to the SMC modem cell module unit.
AT+MSCTS	This command defines the behavior of the CTS line when the SMC modem is in normal mode (not Sleep mode).
AT+MSSI	This command enables/disables the unsolicited report for signal strength value.
AT+MTTY	This command is used to enable/disable the TTY (Tele Typewriter) support in the SMC modem.
AT$QCCLR	This command clears the mobile error log.
A/	This command repeats the last command entered on the terminal.
AT	This command checks the AT communication and only returns OK.
ATD	This command places a voice call on the current network, when issued from an accessory device. Note: Limited to Emergency call only.
ATE	This command defines whether input characters are echoed to output.
ATH	This command hangs up, or terminates a particular call.
ATI	This command displays various SMC modem information items.
ATQ	This command determines whether to output the result codes.
ATS[n]	These commands set/get/read the values of S-register parameters.
ATV	This command determines the response format of the data adapter and the contents of the header and trailer transmitted with the result codes and information responses.
ATX	This command defines the CONNECT result code format.
ATZ	This command drops the current call, and resets the values to default configuration.

NOTE: Products developed using the SMC-CDMA modem should allow access to the C24 cell module AT command set via external connection from a terminal program. This will provide the cellular carriers access to commands needed to better trouble shoot network connection issues.

SECTION 10 - AT COMMAND REFERENCE

All modem functions are controlled using the same industry-standard AT commands that are used to control landline modems. A knowledge of all these commands is not required by most users, but are provided here as a reference.

AT Command Types

There are several types of AT commands as defined in the following list;

- Modem ID Commands
- Hardware Information Commands
- Modem Configuration, Profile, & InterfaceCommands
- PRL and PRI Commands
- Enhanced AT Commands
- Call Control Commands
- Short Message Service (SMS) Commands
- Network Related & User Interface Commands
- TCP/UDP IP Commands
- FTP (File Transfer Protocol) Commands
- GPS – LBS Commands
- FOTA (Firmware update Over The Air) Commands

The parameters set by the various AT commands in this section are applied to all subsequent calls and will be used each time you place a call. As such, your custom settings (if not saved in a profile) will be available until you power down the modem. These settings are lost upon powerdown if not saved. For further information, refer to the Motorola C24 AT Command Set **[1]** document.

Command Line Syntax

The "AT" or "at" prefix must be set at the beginning of each command line. To terminate a command line enter <CR>. Commands are usually followed by a response or, result codes, that includes "<CR><LF><response><CR><LF>".

Table: 10.1 Command Syntax

AT command type	Syntax	Function
Test command	AT+XXX=?	The mobile equipment returns the list of parameters and value ranges set with the corresponding Write command or by internal processes.
Read command	AT+XXX?	This command returns the currently set value of the parameter or parameters.
Write command	AT+XXX=<...>	This command sets user-definable parameter values.
Exec(ution) command	AT+XXX	The execution command reads non-variable parameters determined by internal processes in the GSM engine.

Commands may be edited using the backspace key, but the backspace will not delete the AT attention command at the beginning of the command line.

Result Codes

After issuing a command, a result code will typically be displayed on the screen to inform you if the command was successful, unsuccessful, improperly formatted, etc. When in the command mode, thirteen possible result codes may be returned. The result codes can be set to display as either digits or words by accessing the Verbose command, **ATV**. The digit code is returned when the Verbose mode is OFF (ATV0); the word code is returned when Verbose is ON (ATV1). See table 10.2 for more information on Verbose format.

Table: 10.2 Result Codes

Numeric	Verbose	Description
0	OK	Command executed without errors.
1	CONNECT	Link established.
2	RING	Ring detected.
3	NO CARRIER	Link not established or disconnected.
4	ERROR	Invalid command or command line too long.
5	NO DIALTONE	No dial tone, dialling impossible, wrong mode.
6	BUSY	Remote station busy.
7	NO ANSWER	Remote station not answering.

Modem ID Commands

These commands allow the user to query the type of attached device, the technology used in the device, as well as basic operating information about the device.

Table 10.3: Modem ID Commands

Command	Description
AT+CGMI	This command displays manufacturer identification.
AT+GMI	This command displays manufacturer identification.
AT+FMI	This command displays manufacturer identification.
AT+CGMM	This command displays the model identification.
AT+GMM	This command displays the model identification.
AT+FMM	This command displays the model identification.
AT+CGMR	This command displays the revision identification.
AT+GMR	This command displays the revision identification.
AT+FMR	This command displays the revision identification.
AT+CGSN	This command displays the product serial number identification in decimal format.
AT+GSN	This command displays the product serial number identification in Hex format.
AT+CSCS	This command selects the cell module character set.
AT+CIMI	This command displays the International Mobile Subscriber Identity number.
AT+CFSN	This command displays the factory serial number.
ATI1	Reports Product Model C24.
ATI3	Reports Product Title Motorola CDMA Module
ATI5	Reports Software Architecture 3350
ATI6	Reports PRI Version <current PRI revision>
ATI7	Reports Product Description <current module type>
ATI8	Reports Software Version <current software revision>
AT$	This command displays a list of all the AT commands supported by the cell module.
AT+CLAC	This command displays a list of all the AT commands supported by the cell module.

Hardware Information Commands

The AT Commands described in this section allow the external application to obtain various hardware information from the modems cellular module.

Table 10.4: Hardware Information Commands

Command	Description
AT+GCAP	This command displays the overall capabilities of the cell module.
AT&C	This command determines how the state of the DCD line relates to the detection of the received line signal from the distant end.
AT&D	This command determines how the cell module responds when the DTR (Data Terminal Ready) status is changed from ON to OFF during the online data state.
AT+CBC	This command queries the battery charger connection.
AT+CBAUD	This command sets the baud rate on the current UART.
AT+IPR	This command is responsible for setting and saving the request baud rate per UART
AT&K	This command configures the flow control.
AT+CFUN	This command shuts down the phone functionality.
ATS97	This command indicates whether an antenna is physically connected to the cell modem RF connector.
AT+MRST	This command enables customer software to perform a hard reset to the cell module unit.

Modem Configuration, Profile, & Interface Commands

The AT Commands described in this section allow the external application to set and determine various settings related to the modems's configuration and profile settings.

The cell module holds certain data items in selected memory space, named Software Registers (S-registers) and Modem Registers. Some of these registers are used as bitmaps, where one register holds more than one data item.

Table 10.5: Modem Register Commands

Commands	Description
ATV	This command determines the response format of the data adapter and the contents of the header and trailer transmitted with the result codes and information responses.
ATQ	This command determines whether to output/suppress the result codes.
ATE	This command defines whether the C24 echoes the characters received from the user, (whether input characters are echoed to output).
ATX	This command defines the data adaptor response set, and the CONNECT result code format.
ATSn	This command reads/writes values of the S-registers.
ATS2	This command handles the selection of the escape characters.
AT\S	This command displays the status of selected commands and S-registers.
AT?	This command displays the most recently updated value stored in the S-register.
AT&F	This command restores the factory default configuration profile.
ATZ	This command resets the default configuration.
AT&V	This command displays the current active configuration and stored user profiles.
AT&W	This command stores the current active configuration to user profile 0 or 1.
AT&Y	This command selects power-up configuration to user's profile.

Table 10.6: NAM Programming Commands

Commands	Description
AT+MNAM	This command gets or sets the NAM parameters (parameters 1-12 out of 35).
AT+MNAM2	This command gets or sets the NAM parameters (parameters 13-22 out of 35).
AT+MNAM3	This command gets or sets the NAM parameters (parameters 23-35 out of 35).
AT+SNAM	This command Selects/reads the current active NAM to which the NAM data will be written/retrieved using AT+MNAM [x].

Table 10.7: Error Handling Commands

Commands	Description
AT+CMEE	This command enables/disables the use of result code +CME ERROR: <err> as an indication of an error relating to the functionality of the C24.
AT+CEER	This command returns an extended error report containing one or more lines of information text, determined by the manufacturer, providing the reasons for the call-clearing errors.

Table 10.8: Data Capabilities (truncated list)

Commands	Description
AT$QCMIPP	This command selects MIP user profile to be active.
AT$QCMIP	This command enables/disables Mobile IP functionality in the module.
AT+CAD	This command queries the analog or digital service.
AT+CDR	This command controls whether the extended-format +CDR: intermediate result code is transmitted by the MT2.
AT+CQD	This command sets the timer value that specifies the period of inactivity before a Data call is released.
AT+CMIP	This command is used to display the mobile station's temporary IP address. The value displayed is in standard IP address format.
AT+CBIP	This command is used to display the base station's temporary IP address. The value displayed is in standard IP address format.
AT+CMUX	This command Used to set the maximum number of multiplex options for the forward and reverse links for MDR (HSPD) calls.
AT+CFG	This command is used to set configuration string.
AT+GOI	This command transmits information text, determined by the manufacturer.

Table 10.9: Interface Commands

Commands	Description
AT$QCCLR	This command clears the mobile error log.
AT+ILRR	This extended-format numeric parameter controls whether the extended-format +ILRR:<rate> information text is transmitted from the MT2 to the TE2.
AT+ICF	This command determines the Character Framing.
AT+IFC	This command controls the operation of Local Flow Control between the terminal and the SMC module.
AT+MTTY	This AT command is used to enable or disable TTY (Tele Typewriter) support in the SMC modem.

PRL and PRI Commands

The Preferred Roaming List (PRL) is a database residing in a wireless (primarily CDMA) device, such as a cellphone, that contains information used during the system selection and acquisition process. In the case of RUIM-based CDMA devices, the PRL resides on the RUIM. The PRL indicates which bands, sub bands and service provider identifiers will be scanned and in what priority order. Without a PRL, the device may not be able to roam, i.e. obtain service outside of the home area. There may be cases where missing or corrupt PRL's can lead to a customer not having service at all.

On many networks, regularly updating the PRL is advised if the subscriber uses the device outside the home area frequently, particularly if they do so in multiple different areas. This allows the phone to choose the best roaming carriers, particularly "roaming partners" with whom the home carrier has a cost-saving roaming agreement, rather than using non-affiliated carriers. PRL files can also be used to identify home networks along with roaming partners, thus making the PRL an actual list that determines the total coverage of the subscriber, both home and roaming coverage.

The PRL is built by an operator and is normally not accessible to the user. Many operators provide the ability for the user to download the latest PRL to their device by dialing the Over-the-air (OTA) feature code *228.

Table 10.10: PRL & PRI Commands

Commands	Description
AT+CPRL1	This command set/get the PRL header parameters.
AT+CPRL2	This command enables the user to control the PRL acquisition table.
AT+CPRL3	This command enables the user to control the PRL System table.
AT+MPRISUM	This command returns the PRI checksum.

Enhanced AT Commands (Carrier Specific)

Table 10.11: Enhanced AT Commands

Commands	Description
AT$SPMDN	This command reads the 10 digits phone number.
AT$SPMSID	This command reads the 10 digits phone number.
AT$SPFWREV	This command reads the current Firmware version.
AT$SPMIPERR	This command retrieves the last MIP error from the device.
AT$SPSPC	This command unlocks the SPC code, to enable access to protected areas of the device.
AT$SPPRL	This command reads the current PRL number from the device.
AT$SPSERVICE	This command reads the service to which the modem will attempt to connect.
AT$SPSIGDBM	This command reads the current Receive Signal Strength Indicator.
AT$SPCURRENTLOCK	This command reads the current device lock code.
AT$SPROAM	This command selects the Roaming Preferences.
AT$SPERI	This command reports the current enhanced roaming indicator.
AT$SPRMGUARD	This command enables/disables the roam guard unsolicited report.
AT$SPLOCATION	This command enables/disables the GPS service.
AT$SPGETLOCATION	This command returns the device current location.
AT$SPNMEA	This command enables or disables the NMEA stream.
AT$SPRESET	This command reset the module (power off than power on).

Call Control Commands

The AT Commands described in this section are related to Mobile Originated (MOC, i.e. outgoing) Calls and Mobile Terminated (MTC, i.e. incoming) Calls.

Table 10.12: Call Control Commands

Command	Description
ATD	This command places a voice call on the current network when issued from an accessory device.
ATD>	This command places a voice/fax/data call on the current network by dialing directly from the cell module phone book.
ATDL	This command places a voice call to the last number dialed.
ATH	This command hangs up or terminates a data call.
ATA	This command answers an incoming call placing the C24 into the appropriate mode as indicated by the RING message
AT+MARS	This command enables the cell module to report when auto redial starts or ends when enabled.
AT+MARD	This command enables and disables the auto-redial capability of the cell module.
AT$QCCAV	This command answers an incoming voice call.
AT+CHV	This command hangs-up a voice call.
AT+CDV	This command dials voice calls.
AT+CRC	This command controls whether to present the extended format of the incoming call indication.
ATO	This command returns the cell module from the Command mode to the Online Data mode and issues a CONNECT or CONNECT <text> result code.
+++	Escape Sequence command, switches the connection from Data mode to Command mode.
AT+COLP	This command gets and changes the current setting of the Calling Line Presentation.
AT+CSO	This command specifies the preferred service to be requested for the next originated packet call.
AT+MDC	This AT command enables you to select the desired messages to be displayed upon connection of a voice call with a remote party.
AT+MFIC	This command instructs the cell module to query or set Filtering Incoming Calls parameters.
AT+MFOC	This command instructs the cell module to query or set Filtering Outgoing Calls parameters.

Short Message Service (SMS) Commands

The AT Commands described in this section allow an external application to use the Short Message Service with the modem.

Table 10.13: SMS Command Reference

Command	Description
AT+CSMS	This command handles the selection of the SMS message service type.
AT+CPMS	This command handles the selection of the preferred storage area for messages.
AT+CMGF	This command handles the selection of message formats.
AT+CSDH	This command shows the Text Mode parameters.
AT+CSMP	This command sets the Text Module parameters.
AT+CNMI	This command sends an unsolicited indication when a new SMS message is received by the cell module.
AT+CMTI	This unsolicited message including the SMS message index is sent upon the arrival of an SMS message.
AT+CMT	This unsolicited message forwards the SMS upon its arrival.
AT+CNMA	This command acknowledges the receipt of a +CMT response.
AT+CDS	This unsolicited response is sent to the TE upon receipt of a new SM.
AT+CMGL	This command displays a list of SMS messages stored in the cell module memory.
AT+MMGL	This command displays a list of SMS messages stored in the cell module memory.
AT+CMGR	This command reads selected SMS messages from the cell module memory.
AT+MMGR	This command reads selected SMS messages from the cell module memory.
AT+MMAR	This command changes the status of an SMS message in the cell module memory from "REC UNREAD" to "REC READ".
AT+CMGW	This command writes and saves messages in the cell module memory.
AT+CMSS	This command selects and sends pre-stored messages from the message storage.
AT+CMGD	This command deletes messages from the cell module memory.
AT+CMGS	This command sends an SM from the cell module to the network.

Network Related & User Interface Commands

The AT Commands in this section aply to various network and user interface functions and parameters. For futher information, refer to the Motorola C24 AT Command Set document available from Motorola **[1]**.

Table 10.14: Network Commands

Command	Description
AT+CREG	This command enables/disables the network status registration unsolicited result code.
AT+CSQ	This command displays the signal strength received by the C24.
AT+MSSI	This command enables/disables the unsolicited report for signal strength value.
AT+NETPAR	This command displays information regarding the active, candidate, and neighbor cell.
AT+MDISP	This command is used to display characters that the network sends to the module.
AT+MDORMANT	This command enable/disable the dormant indication unsolicited report.
AT+MPREFMODE	This command configures System Select setting.
AT+MBAND	This command selects Preferred Band.

Table 10.15: User Interface & Access Commands

Command	Description
AT+CLAN	This command handles the selection of language in the ME.
AT+CMER	Mobile Equipment Event Reporting.
AT+CIEV	An unsolicited indication regarding various phone indications that is sent to the DTE when the <ind> parameter of the +CMER command is set to 1.
AT+MMR	This command perform master reset.
AT+MMRR	This unsolicited message is sent to the DTE by the SMC modem if a master reset occurs, and master reset events reporting is enabled.
AT+CIND	This command is used to query the status of various ME indicators.
A/	This command repeats the last command entered on the terminal.
AT	This command checks the AT communication and only returns OK.
AT+MPIN	This command enables the accessory application to unlock the phone when the appropriate unlock code has been provided.
AT+CPWD	This command sets a new password for the facility lock.
AT+CLCK	This command locks, unlocks or interrogates a SMC Modem or a network facility <fac>.
AT+CCLK	This command reads/sets the SMC modem's current date and time settings.
AT+CPBS	This command handles the selection of the memory to be used for reading and writing entries that contain more than one phone book memory.
AT+CPBR	This command recalls phone book entries from a specific entry number, or from a range of entries.
AT+CPBF	This command searches the currently active phone book for a particular entry, by name.
AT+CPBW	This command stores a new entry in the phone book, or deletes an existing entry from the phone book.

TCP/UDP IP Commands

A brief description of the TCP/UDP IP commands. For futher information, refer to the Motorola C24 AT Command Set document available from Motorola **[1]**.

Table 10.16: TCP/UDP IP Commands

Command	Description
AT+MIPCALL	This command creates a wireless PPP connection with the GGSN or CSD service provider and returns a valid dynamic IP for the SMC modem.
AT+MIPOPEN	This command causes the SMC modem module to initialize a new socket and open a connection with a remote side.
AT+MIPCLOSE	This command causes the SMC modem module to free the socket accumulating buffer and disconnect the SMC modem from a remote side.
AT+MIPSETS	This command causes the SMC modem to set a watermark in the accumulating buffer. When the watermark is reached, data is pushed from the accumulating buffer into the protocol stack.
AT+MIPSEND	This command causes the SMC modem to transmit the data that the terminal provides, using an existing protocol stack.
AT+MIPPUSH	This command causes the SMC modem module to push the data accumulated in its accumulating buffers into the protocol stack.
AT+MIPFLUSH	This command causes the SMC modem module to flush (delete) data accumulated in its accumulating buffers.
AT+MIPRUDP	This unsolicited event is sent to the terminal when data is received from the UDP protocol stack.
AT+MIPRTCP	This unsolicited event is sent to the terminal when data is received from the TCP protocol stack.
AT+MIPSTAT	This unsolicited event is sent to the terminal indicating a change in link status.
AT+MIPXOFF	This unsolicited event is sent to the terminal to stop sending data.
AT+MIPXON	This unsolicited event is sent to the terminal when the SMC modem has free memory in the accumulating buffer.
AT+MIPCONF	This command allows configuring of TCP stack parameters.
AT+MPING	This command will allow verifying IP connectivity to another remote machine (computer) by sending one or more Internet Control Message Protocol (ICMP) Echo Request messages.
AT+MPINGSTAT	This is the unsolicited response that the SMC modem sends to the terminal to inform of ping execution status update and provides summary statistics of ping request when ping request execution is completed.
AT+MSDNS	This command set/read DNS IP address.
AT+MIPCFF	This command allows configuring the incoming TCP connection filtering feature parameters, such as list of allowed IP addresses or disabling/enabling the filtering.
AT+MIPSSL	This unsolicited event is sent to the terminal indicating an errors, warnings or alerts that occurred during SSL connection.
AT+MIPODM	This command causes the SMC modem module to initialize a new socket in Online Data Mode and open a connection with a remote side.
AT+MIPDATA	This unsolicited event is sent to the terminal indicating a data comes from Network when SMC modem is in pseudo-command mode.
AT+MIPCSC	This AT command is used to configure the SSL feature behavior in case of non - fatal alerts.
AT$QCPREV	This command returns the protocol revision in use.

FTP Commands

A brief description of the FTP (File Transfer Protocal) commands. For futher information, refer to the Motorola C24 AT Command Set document available from Motorola **[1]**.

Table 10.17: FTP Commands

Command	Description
AT+FTPOPEN	This command causes SMC modem to open a FTP connection with a remote FTP server, based on given parameters.
AT+FTPCLOSE	This command causes SMC modem to close FTP connection, when no data transfer occurred at that same time.
AT+FTPINFO	This command causes the SMC modem to enable or disable FTP unsolicited indication to the user.
AT+FTPSTAT	This command causes the SMC modem to request the remote FTP server to send status, in accordance to a given parameter.
AT+FTPSYST	This command causes the SMC modem to request the remote FTP server to send the operating system type.
AT+FTPNOOP	This command causes the SMC modem to request the remote FTP server to do nothing.
AT+FTPCWD	This command causes the SMC modem to request the remote FTP server to change the working directory in accordance to a given name.
AT+FTPMKD	This command causes the SMC modem to request the remote FTP server to create a new directory in accordance to a given name.
AT+FTPRMD	This command causes the SMC modem to request the remote FTP server to remove a directory in accordance to a given name.
AT+FTPPWD	This command causes SMC modem to request the remote FTP server to return the working directory name.
AT+FTPCDUP	This command causes the SMC modem to request the remote FTP server to change the working directory up.
AT+FTPDEL	This command causes the SMC modem to request the remote FTP server to delete a file, in accordance to a given name.
AT+FTPLIST	This command causes the SMC modem to request the remote FTP server to send a list, in accordance to a given parameter.
AT+FTPTYPE	This command represents the file supported by the SMC modem.
AT+FTPSTOR	This command causes the SMC modem to request the remote FTP server to store a file, sent by the SMC modem.
AT+FTPRETR	This command causes the SMC modem to request the remote FTP server to send a file to the SMC modem.
AT+FTPREN	This command causes the SMC modem to request the remote FTP server to rename a file, in accordance to given parameters.

GPS - LBS Commands

A brief description of the GPS commands. Commands in this section may require the use of the second serial UART test pins. For futher information, refer to the Motorola C24 AT Command Set document available from Motorola **[1]**.

Table 10.18: Motorola Binary AT Commands

Command	Description
AT+MGPSMODE	This command supports the GPS operation mode.
AT+MGPSLOC	This command displays solicited/unsolicited location message to the terminal.
AT+MGPSLUPD	This command set the interval of almanac/ephemeris data downloads.
AT+MGPSPPDEIP	This command set the IP address and port for the primary PDE server.
AT+MGPSSPDEIP	This command set the IP address and port for the secondary PDE server.
AT+MGPSMPCIP	This command set the IP address and port for the MPC server.
AT+MGPSPROT	This command sets the GPS protocol.
AT+MGPSRES	This command resets all location related parameters.
AT+MGPSQOS	This command sets the GPS QoS parameters.
AT+MNMEA	This commands routes the NMEA reports to UART2 or USB.

Table 10.19: Motorola NMEA AT Commands

Command	Description
ATGGA	This command displays the Global Positioning System Fixed Data.
ATGLL	This command displays the Geographic Position - Latitude/Longitude.
ATGSA	This command displays the GNSS DOP and Active Satellites.
ATGSV	This command displays the GNSS Satellites in View.
ATRMC	This command displays the Recommended Minimum Specific GNSS Data.
ATVTG	This command displays the Course Over Ground and Ground Speed.
ATZDA	This command displays the Time and Date.
AT$PMOTG	This command Executes NMEA output message commands.

FOTA Commands

A brief description of the FOTA (Firmware update Over The Air) commands. For futher information, refer to the Motorola C24 AT Command Set document available from Motorola **[1]**.

Table 10.20: FOTA Commands

Command	Description
AT+MFOTACNFG	This command enables setting the DM session as Automatic/Non-Automatic (i.e. Transparent/Non-Transparent).
AT+MFOTAREQ	This command sends FOTA requests toward DTE.
AT+MFOTARSP	This command is used to send response to +MFOTAREQ reports.
AT+MFOTAINSTL	Installs the updated package.
AT+MFOTAABORT	Aborts the DM session.
AT+MFOTAIND	This command sends Unsolicited FOTA indications toward DTE.
AT+MFOTARLBCK	This command causes the module to install the reverse firmware version.
AT+MFOTASTART	This command enable the DTE originates DM session and FOTA download & install.
AT+MODDC	This command Enable/Disable the OMA-DM DC update.
AT+MODPRL	This command Enable/Disable the OMA-DM PRL update.
AT+MODFUMO	This command Enable/Disable the OMA-DM FUMO update.
AT+MODCI	This command supports the client initiating of OMA-DM session.
AT+MODNI	This command supports the NW initiating of OMA-DM session.
AT+MODIND	This command displays the progress of the OMA-DM updates.
AT+MOTAIND	This command displays the progress of OTASP updates.

SECTION 11 - SPECIFICATIONS

Product specifications are subject to change without notice.

General Specifications

Interface Connectors:	Universal Socket Connectivity
LED Indicators:	Power & CDMA Connection
Antenna Interface:	Primary Antenna: MMCX, female, 50 ohms
Size:	3.150 x 1.375 x 0.570 in.
Weight:	0.8 oz.
Power Input:	5VDC ±0.25VDC; 170 mA (TX average) 600 mA (TX max)
Maximum TX Power:	CELL 800: +25dBm, PCS 1900: +25dBm

Frequencies:
Cellular: TX: 824-849 MHz   Rx: 869-894 MHz
PCS: TX: 1850-1910 MHz Rx: 1930-1990 MHz
GPS: 1575.42 MHz ±1.024MHz

Temperature:
Operating: -30°C to +70°C 100% Duty Cycle
Storage: -40°C to +85°C

Operating Humidity	0 – 85% non-condensing
Transport Protocols:	Serial UART data rates from 300 bps to 230.4 kbps
Command Protocol:	MOT by Telit, C24 AT Command set

Certifications:
FCC ID: RI7P56JE1
Industry Canada ID: 5131A-JE1
Carrier Approvals: Sprint, Aeris

NOTE: Power consumption while transmitting is dependant on the TX power level of the cellular module. The TX power level of the module is controlled by the cellular base station.

Data Transmission Specifications

Internet Services	TCP, UDP, HTTP, FTP, SMTP, POP3
1x Data Transmission	Maximum 153.6 Kbps
CSD Data Transmission	Max BR 14.4 kbps
Specifications for SMS	MO/MT Text and PDU modes

Mechanical Specifications

The following section describes in detail the exterior dimensions of the SMC-CDMA. All of the drawings below are the approximate actual size. The drawings may be used as layout reference, but it is advised that a physical comparison be made to the modem before proceeding with the mounting process.
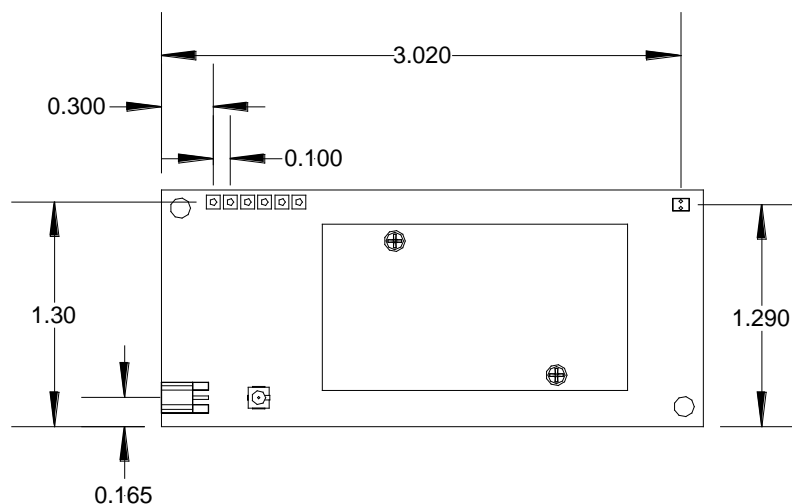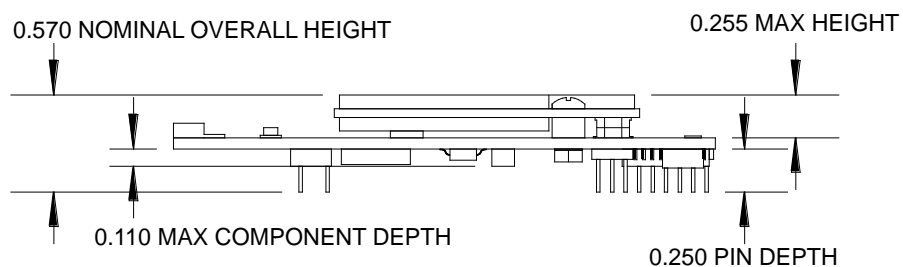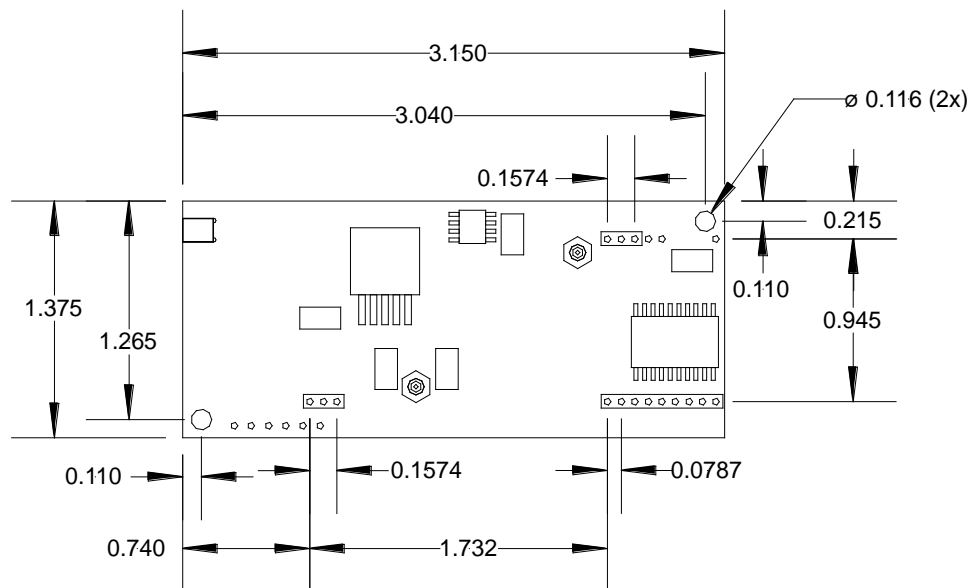
All dimensions in inches.

SECTION 12 - SERVICE AND SUPPORT

Product Warranty, RMA and Contact Information

CalAmp guarantees that every SMC-CDMA Cellular Modem will be free from physical defects in material and workmanship for one (1) year from the date of purchase when used within the limits set forth in the Specifications section of this manual.

The manufacturer's warranty statement is available in Appendix B. If the product proves defective during the warranty period, contact CalAmp Customer Service to obtain a Return Material Authorization (RMA).

RMA Request

Contact Customer Service:
CalAmp
299 Johnson Avenue, Suite.110
Waseca, MN 56093
Tel: 507-833-8819 ext. 6707
Fax: 507-833-6748

BE SURE TO HAVE THE EQUIPMENT MODEL AND SERIAL NUMBER, AND BILLING AND SHIPPING ADDRESSES ON HAND WHEN CALLING.

When returning a product, mark the RMA clearly on the outside of the package. Include a complete description of the problem and the name and telephone number of a contact person. RETURN REQUESTS WILL NOT BE PROCESSED WITHOUT THIS INFORMATION.

For units in warranty, customers are responsible for shipping charges to CalAmp Wireless DataCom. For units returned out of warranty, customers are responsible for all shipping charges. Return shipping instructions are the responsibility of the customer.

Product Documentation

CalAmp reserves the right to update its products, software, or documentation without obligation to notify any individual or entity. Product updates may result in differences between the information provided in this manual and the product shipped. For the most current product documentation, visit www.calamp.com for datasheets, programming software and user manuals.

Technical Support

M-F 7:30 AM to 4:30 PM CDT

CalAmp Wireless DataCom
299 Johnson Avenue, Ste.110
Waseca, MN 56093
Tel: 507-833-8819
E-mail: supportIMC@calamp.com

APPENDIX A – CREATING A DIAL-UP NETWORKING CONNECTION

Windows XP

Add Standard Windows Modem
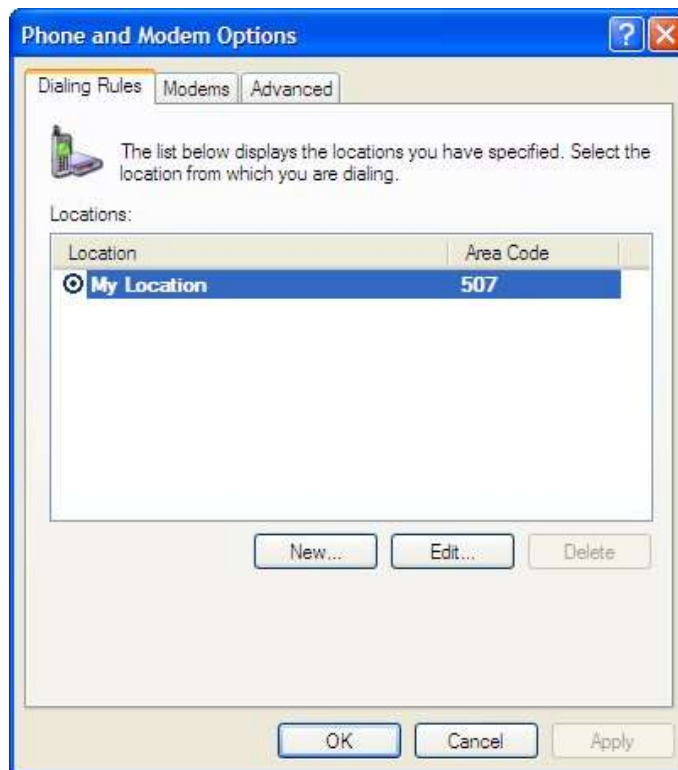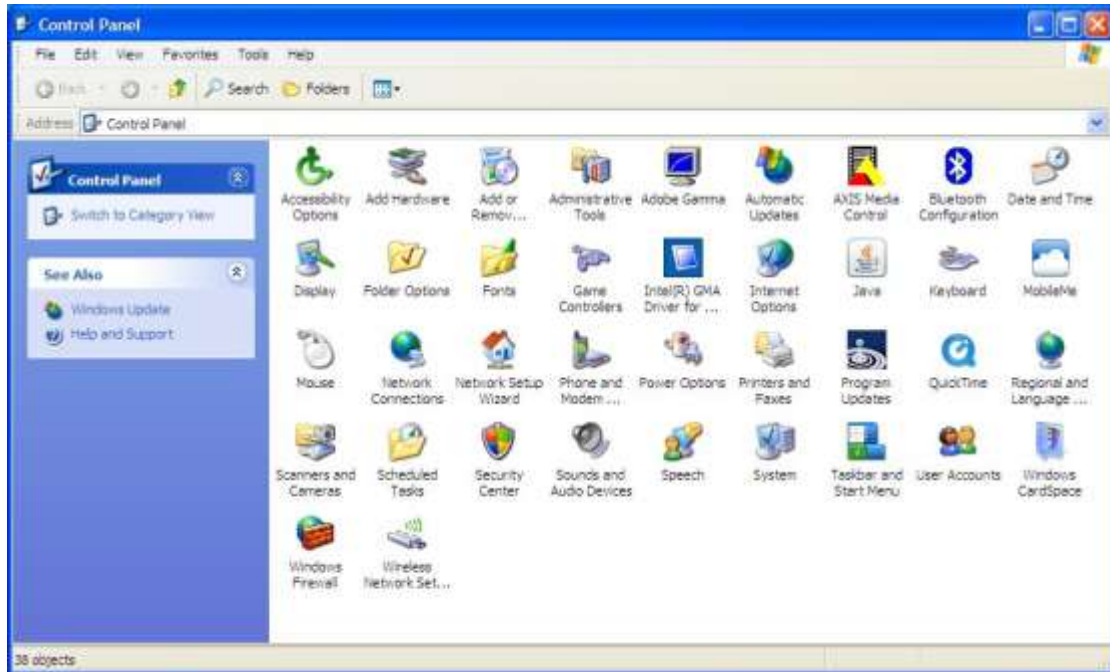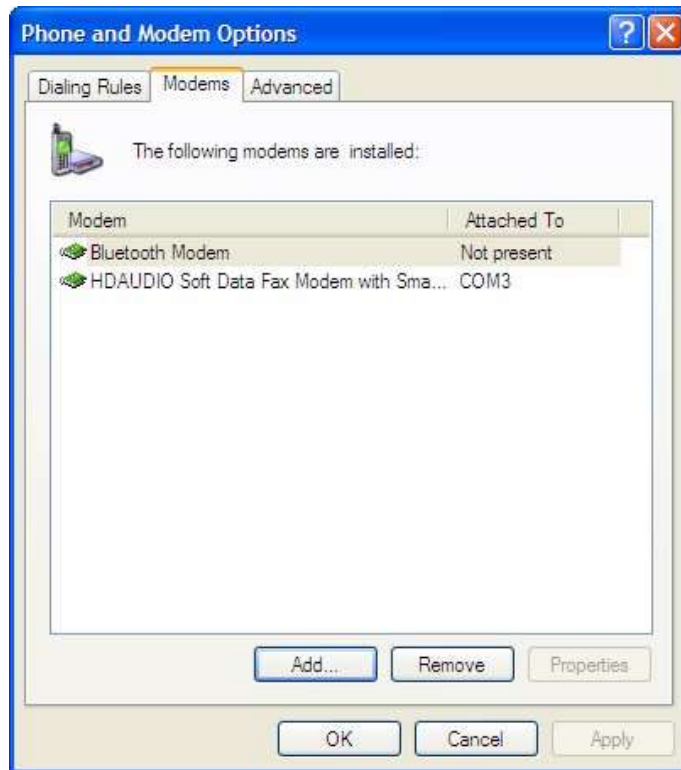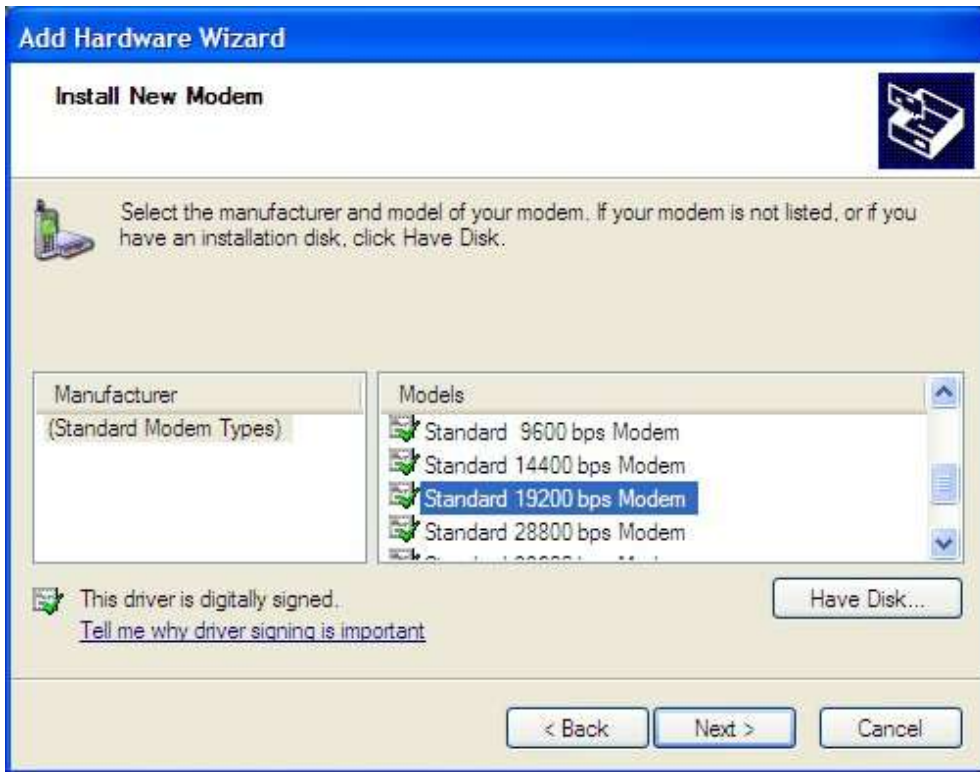
Configuring the Modem
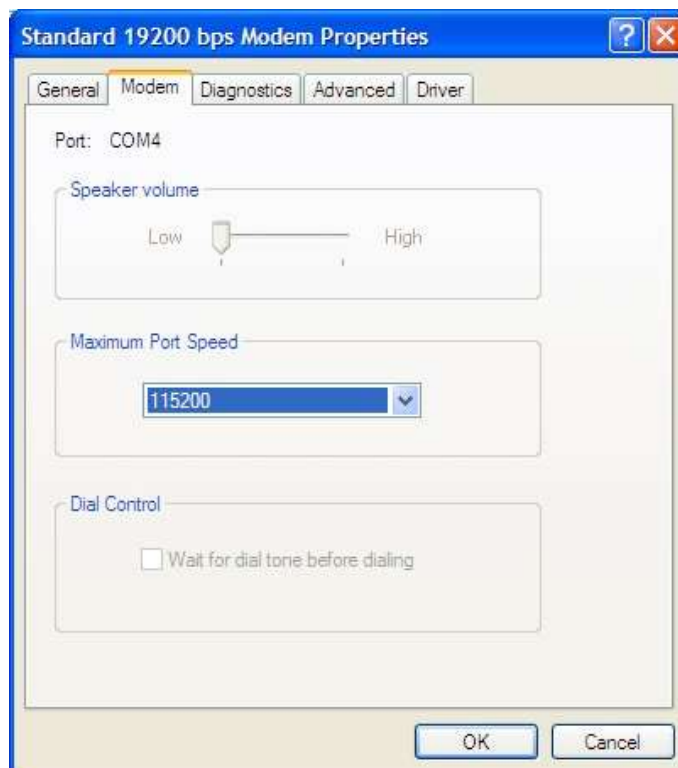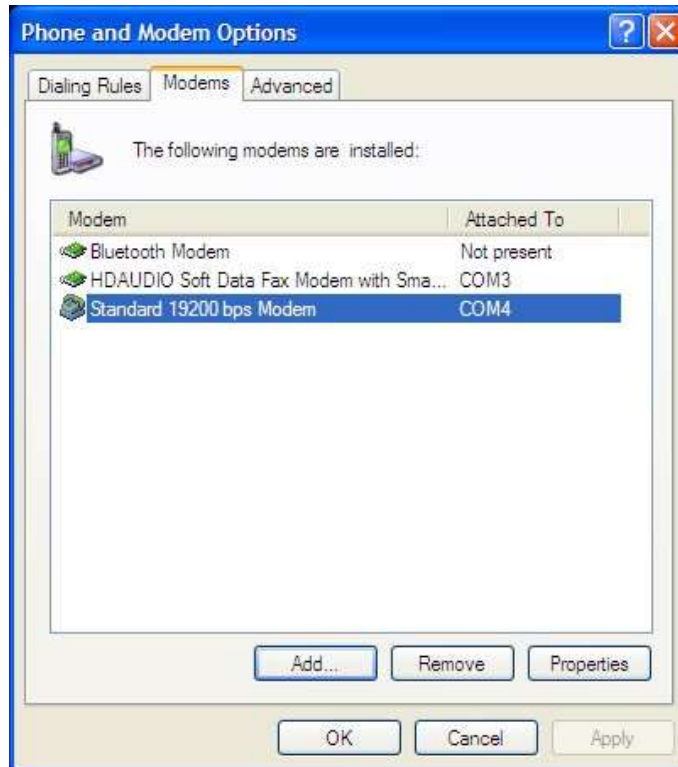
Create a Dial-Up Networking (DUN) Connection
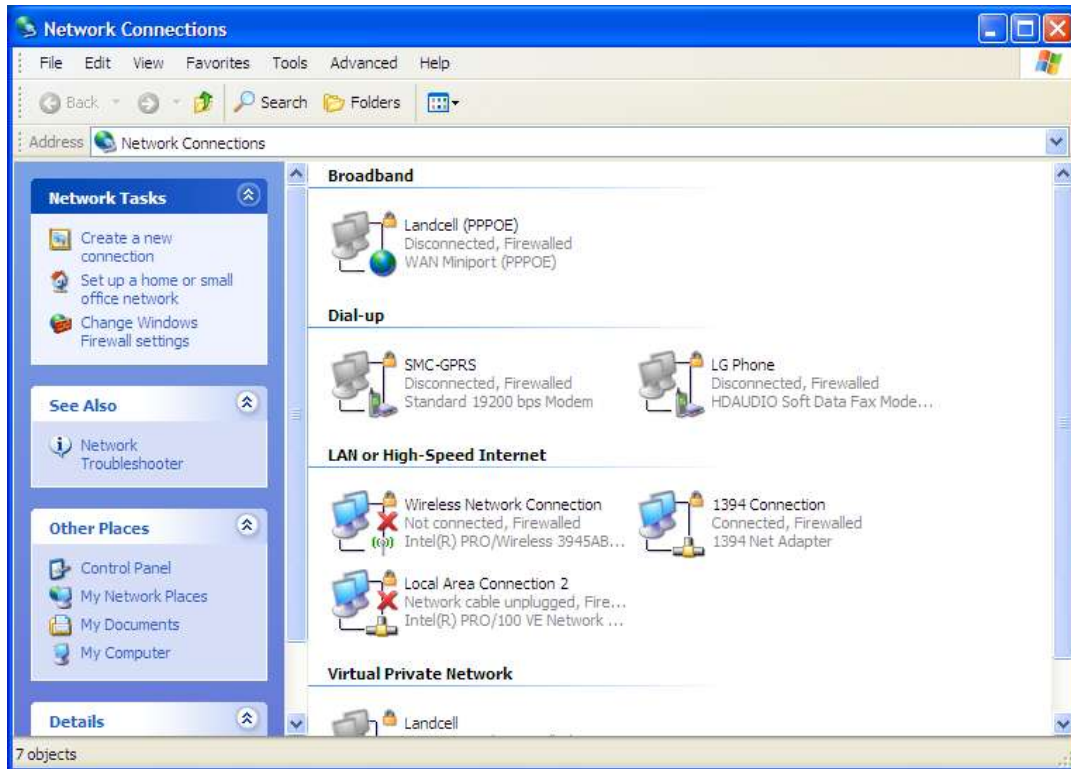
New Connection Wizard

Internet Connection
How do you want to connect to the Internet?

◉ **Connect using a dial-up modem**
This type of connection uses a modem and a regular or ISDN phone line.

○ **Connect using a broadband connection that requires a user name and password**
This is a high-speed connection using either a DSL or cable modem. Your ISP may refer to this type of connection as PPPoE.

○ **Connect using a broadband connection that is always on**
This is a high-speed connection using either a cable modem, DSL or LAN connection. It is always active, and doesn't require you to sign in.

[< Back] [Next >] [Cancel]

New Connection Wizard

Select a Device
This is the device that will be used to make the connection.

You have more than one dial-up device on your computer.

Select the devices to use in this connection:

☐ Modem - HDAUDIO Soft Data Fax Modem with SmartCP (COM3)
☑ Modem - Standard 19200 bps Modem (COM4)

[< Back] [Next >] [Cancel]

New Connection Wizard

Connection Name
What is the name of the service that provides your Internet connection?

Type the name of your ISP in the following box.

ISP Name

SMC-CDMA|

The name you type here will be the name of the connection you are creating.

[< Back] [Next >] [Cancel]

New Connection Wizard

Phone Number to Dial
What is your ISP's phone number?

Type the phone number below.

Phone number:

#777|

You might need to include a "1" or the area code, or both. If you are not sure you need the extra numbers, dial the phone number on your telephone. If you hear a modem sound, the number dialed is correct.

[< Back] [Next >] [Cancel]

Connect SMC-CDMA

User name:

Password:

☑ Save this user name and password for the following users:

◉ Me only

◯ Anyone who uses this computer

Dial: #777

[Dial] [Cancel] [Properties] [Help]

SMC-CDMA Properties

General | Options | Security | Networking | Advanced

Connect using:

☑ 🟢 Modem - Standard 19200 bps Modem (COM4)
☐ 🟢 Modem - HDAUDIO Soft Data Fax Modem with S⁞
☐ 🟢 Modem - Sierra Wireless AirCard HSDPA Modem ⁞
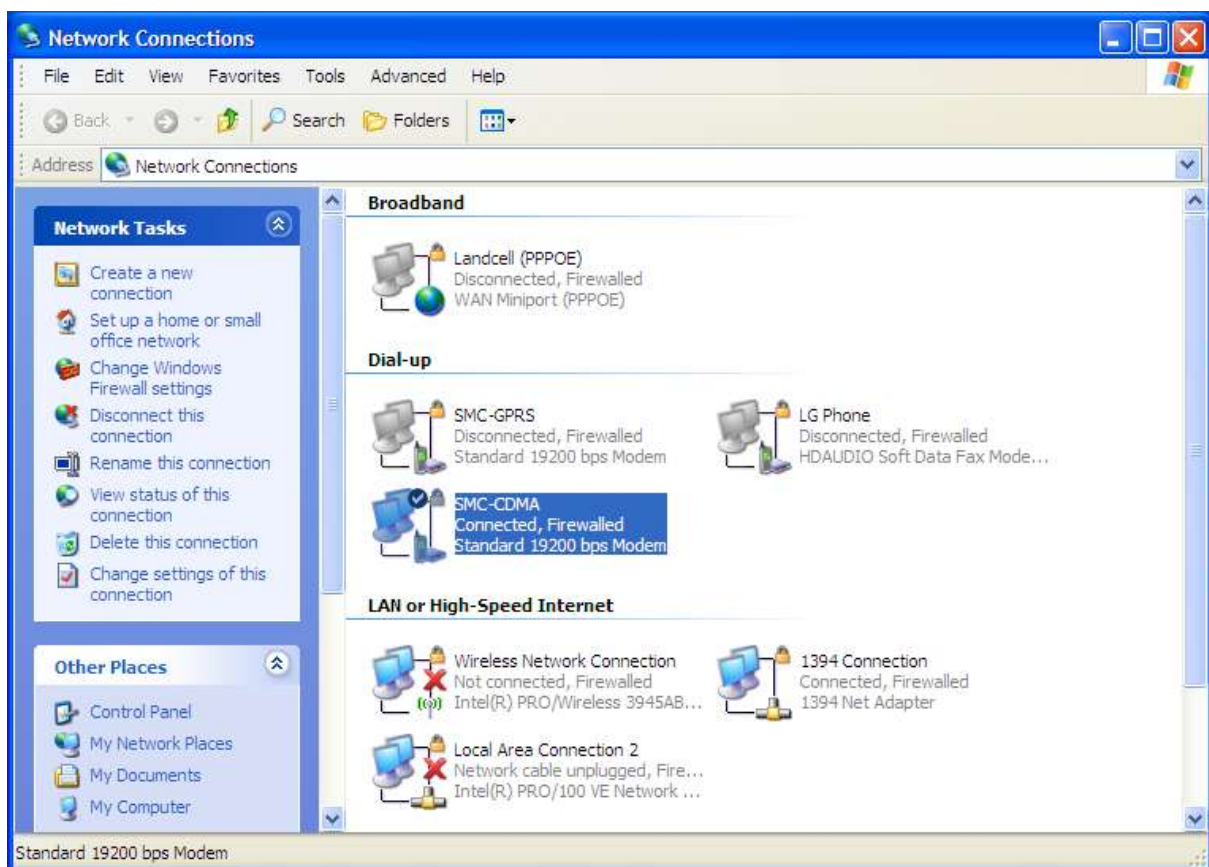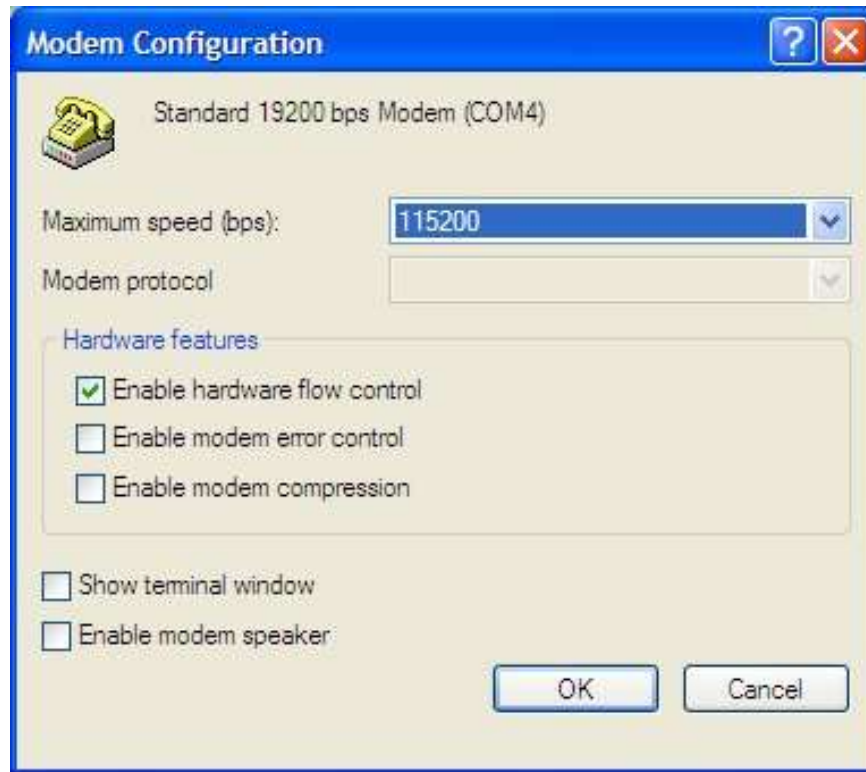
☑ All devices call the same numbers   [Configure...]

Phone number

Area code: Phone number:
[   ]   #777   [Alternates]

Country/region code:

☐ Use dialing rules   [Dialing Rules]

☑ Show icon in notification area when connected

[OK] [Cancel]

APPENDIX B – WARRANTY STATEMENT

CalAmp warrants to the original purchaser for use ("Buyer") that data telemetry products manufactured by DRL ("Products") are free from defects in material and workmanship and will conform to DRL's published technical specifications for a period of, except as noted below, one (1) year from the date of shipment to Buyer. DRL makes no warranty with respect to any equipment not manufactured by DRL, and any such equipment shall carry the original equipment manufacturer's warranty only. DRL further makes no warranty as to and specifically disclaims liability for, availability, range, coverage, grade of service or operation of the repeater system provided by the carrier or repeater operator. Any return shipping charges for third party equipment to their respective repair facilities are chargeable and will be passed on to the Buyer.

If any Product fails to meet the warranty set forth above during the applicable warranty period and is returned to a location designated by DRL. DRL, at its option, shall either repair or replace such defective Product, directly or through an authorized service agent, within thirty (30) days of receipt of same. No Products may be returned without prior authorization from DRL. Any repaired or replaced Products shall be warranted for the remainder of the original warranty period. Buyer shall pay all shipping charges, handling charges, fees and duties for returning defective Products to DRL or DRL's authorized service agent. DRL will pay the return shipping charges if the Product is repaired or replaced under warranty, exclusive of fees and duties. Repair or replacement of defective Products as set forth in this paragraph fulfills any and all warranty obligations on the part of DRL.

This warranty is void and DRL shall not be obligated to replace or repair any Products if (i) the Product has been used in other than its normal and customary manner; (ii) the Product has been subject to misuse, accident, neglect or damage or has been used other than with DRL approved accessories and equipment; (iii) unauthorized alteration or repairs have been made or unapproved parts have been used in or with the Product; or (iv) Buyer failed to notify DRL or DRL's authorized service agent of the defect during the applicable warranty period. DRL is the final arbiter of such claims.

THE AFORESAID WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED AND IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DRL AND BUYER AGREE THAT BUYER'S EXCLUSIVE REMEDY FOR ANY BREACH OF ANY OF SAID WARRANTIES IT AS SET FORTH ABOVE. BUYER AGREES THAT IN NO EVENT SHALL DRL BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES WHETHER ON THE BASIS OF NEGLIGENCE, STRICT LIABILITY OR OTHERWISE. The purpose of the exclusive remedies set forth above shall be to provide Buyer with repair or replacement of non-complying Products in the manner provided above. These exclusive remedies shall not be deemed to have failed of their essential purpose so long as DRL is willing and able to repair or replace non-complying Products in the manner set forth above.

This warranty applies to all Products sold worldwide. Some states do not allow limitations on implied warranties so the above limitations may not be applicable. You may also have other rights, which vary from state to state.

EXCEPTIONS

ONE YEAR: Labor to replace defective parts in repeaters or base stations
THIRTY DAY: Tuning and adjustment of telemetry radios
NO WARRANTY: Fuses, lamps and other expendable parts

Effective 1/2008