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V.F 28.8/33.6 Modem, DeskTop Platform

Installation and Operation

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Documentation

Revision History

Issue Number	Date	Description of Change
1		Initial Release
2		Update
3		Update
4		Update
5		Update
6		Update
7		Update
8		Update
9	Nov 1999	New format and incorporation of erratas
10	April 2002	Update

Related Publications

A listing of related user manuals is provided below. In addition to the hardware and software manuals, always read the software System Release Notes supplied with your product.

Publication Name	Publication Number*

* For publications numbers, **REV** is the hardware manual revision (for example, -000, -001, etc.) **VREF** (if listed) is the software revision (for example, -V120 would read, Version 1.2) and corresponds to the most current revision.

Scope

This manual describes how to install and operate the DeskTop V.F 28.8/33.6 Modem. The information contained in this manual has been carefully checked and is believed to be entirely reliable. However, as General DataComm improves the reliability, function, and design of their products, it is possible that information may not be current. Contact General DataComm if you require updated information for this or any other General DataComm product.

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Manual Organization

This manual is divided into the following chapters:

Chapter 1, Introduction

Chapter 2, Installation

Chapter 3, Basic Operation

Chapter 4, AT Command Set Operation

Chapter 5, V.25 bis Command Set Operation

Chapter 6, Tests

Appendix A, Technical Characteristics

Appendix B, Business Equipment Interface (EIA/TIA-232-E, ITU-T V.24/V.28/ISO 2110)

Appendix C, Business Equipment Interface (EIA/TIA-530-A, ITU-T V.10/V.11/V.24/ISO 2110)

Appendix D, Business Equipment Interface (ITU-T V.35/V.24/V.28/ISO 2593)

Appendix E, ASCII/EBCDIC Character Sets And Hexadecimal/Binary Conversions

Safety Information

This manual should be read in its entirety and all procedures completely understood before installing or operating the unit. The notes that appear throughout this manual must be read prior to any installation or operating procedure. Examples of notes used in this manual are shown below.

Note *Indicates a note. It is something you should be particularly aware of; something not readily apparent. A note is typically used as a suggestion.*

Important *Indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent. Important is typically used to prevent equipment damage.*

The CAUTION, WARNING, and DANGER statements that appear throughout this manual are intended to provide critical information for the safety of both the service engineer and operator. These statements also enhance equipment reliability. The following definitions and symbols for CAUTION, WARNING, and DANGER as they are used comply with ANSI Z535.2, American National Standard for Environmental and Facility Safety Signs, and ANSI Z535.4, Product Safety Signs and Labels, issued by the American National Standards Institute.



CAUTION *Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury. It may also be used to alert against unsafe practices.*



WARNING *indicates an imminently hazardous situation which, if not avoided, could result in death or serious injury.*



DANGER *indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

Safety Guidelines

Always use the following guidelines when unsafe conditions exist or when potentially hazardous voltages are present:

- Always use caution and common sense.
- Repairs must be performed by qualified service personnel only.
- To reduce the risk of electrical shock, do not operate equipment with the cover removed.
- Never install telephone jacks in a wet location unless the jack is designed for that location.
- Never touch uninsulated telephone wires or terminals unless the telephone line is disconnected at the network interface.
- Never install telephone wiring during an electrical storm.

Antistatic Precautions

Electrostatic discharge (ESD) results from the buildup of static electricity and can cause computer components to fail. Electrostatic discharge occurs when a person whose body contains a static buildup touches a computer component. This product may contain static-sensitive devices that are easily damaged. Proper handling, grounding and precautionary ESD measures are essential when installing parts or cards. Keep parts and cards in antistatic packaging when not in use or during transport. If possible, use antistatic floorpads and workbench pads.

When handling components, always use an antistatic wrist strap connected to a grounded equipment frame or chassis. *If a wrist strap is not available, periodically touch an unpainted metal surface on the equipment.* Never use a conductive tool, like a screwdriver or a paper clip, to set switches.

FCC Part 68 Compliance

Connection of data communications equipment to the public telephone network is regulated by FCC Rules and Regulations. This equipment complies with Part 68 of these regulations which require all of the following:

All connections to the telephone network must be made using standard plugs and telephone company provided jacks or equivalent.

Connection of this equipment to party lines and coin telephones is prohibited. A label on the component side of the unit's printed circuit board provides the FCC Registration number for the unit. If requested, give this information to the telephone company. To connect the product to the Public Telephone Network, you are required to give the following information to the telephone company:

- FCC Registration Number: TBD
- Facility Interface Codes: 04DU9-BN, 04DU9-DN, 04DU9-1KN, 04DU9-1SN

- Service Order Code: 6.0Y
- Telephone Company jack type: RJ48C

The telephone company may discontinue your service if the unit causes harm to the telephone network. If possible, you will be notified of such an action in advance. If advance notice is not practical, you will be notified as soon as possible and will be advised of your right to file a complaint with the FCC. The telephone company may change its communication facilities, equipment, operations and procedures where reasonably required for operation. If so, the telephone company will notify you in writing. All repairs or modifications to the equipment must be performed by General DataComm. Any other repair or modification by a user voids the FCC registration and the warranty.

Part 15 Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference and
2. This device must accept any interference received, including interference that may cause undesired operation.

Industry Canada Notification

The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operation and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Notice: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

Electromagnetic Compatibility

This Class A digital apparatus complies with Canadian ICES-003.

Avis D'industrie Canada

L'étiquette d'Industrie Canada identifie le matériel homologué. Cette étiquette certifie que le matériel est conforme aux normes de protection, d'exploitation et de sécurité des réseaux de télécommunications, comme le prescrivent les documents concernant les exigences techniques relatives au matériel terminal. Le Ministère n'assure toutefois pas que le matériel fonctionnera à la satisfaction de l'utilisateur.

Avant d'installer ce matériel, l'utilisateur doit s'assurer qu'il est permis de le raccorder aux installations de l'entreprise locale de télécommunication. Le matériel doit également être installé en suivant une méthode acceptée de raccordement. L'abonné ne doit pas oublier qu'il est possible que la conformité aux conditions énoncées ci-dessus n'empêche pas la dégradation du service dans certaines situations.

Les réparations de matériel homologué doivent être coordonnées par un représentant désigné par le fournisseur. L'entreprise de télécommunications peut demander à l'utilisateur de débrancher un appareil à la suite de réparations ou de modifications effectuées par l'utilisateur ou à cause de mauvais fonctionnement.

Pour sa propre protection, l'utilisateur doit s'assurer que tous les fils de mise à la terre de la source d'énergie électrique, des lignes téléphoniques et des canalisations d'eau métalliques, s'il y en a, sont raccordés ensemble. Cette précaution est particulièrement importante dans les régions rurales.

Avertissement: L'utilisateur ne doit pas tenter de faire ces raccordements lui-même; il doit avoir recours à un service d'inspection des installations électriques, ou à un électricien, selon le cas.

Avis: L'indice d'équivalence de la sonnerie (IES) assigné à chaque dispositif terminal indique le nombre maximal de terminaux qui peuvent être raccordés à une interface. La terminaison d'une interface téléphonique peut consister en une combinaison de quelques dispositifs, à la seule condition que la somme d'indices d'équivalence de la sonnerie de tous les dispositifs n'excède pas 5.

La Compatibilité d'Électro-magnétique

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Deutschland

Installations Anweisungen: Installieren Sie die Telefonleitungen nicht während eines Gewitters. Installieren Sie die Telefonleitungen nicht in einem feuchten Raum, außer die Dose entspricht den Vorschriften für Feuchträume. Berühren Sie unisolierte Telefonleitungen oder Einrichtungen nicht, außer diese sind vom Telefonnetz getrennt. Vorsicht bei der Installation oder Änderung von Telefonleitungen. *Achtung:* Es gibt keine durch den Benutzer zu wartende Teile im Gerät. Wartung darf nur durch qualifiziertes Personal erfolgen.

EC Declaration of Conformity

We: General DataComm Inc.
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The products to which this declaration relates are in conformity with the following relevant harmonized standards, the reference numbers of which have been published in the Official Journal of the European Communities.

Electromagnetic Compatibility

EN 55022: 1994

Specification for limits and methods of measurement of radio interference characteristics of information technology equipment.

EN 50082-1: 1992

Generic immunity standard Part 1 Residential, Commercial, and Light Industry.

Safety

EN 60950: 1995 A1 through A3

Low Voltage Directive relating to electrical equipment designed for use within certain voltage limits.

Service Support and Training

VITAL Network Services is a leading single-source, data communications organization which provides network service and support for General dataComm customers throughout the world. VITAL network Services provides the support and training required to install, manage and maintain your GDC equipment. Training courses are available at centers in the US, UK, France, Singapore and Mexico, as well as at a customer's site.

For more information VITAL Network Services or for technical support assistance, contact VITAL Network Services at:

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[Appendix A: Technical Characteristics](#)

[Appendix B: Business Equipment Interface \(EIA/TIA-232-E,
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[Appendix C: Business Equipment Interface \(EIA/TIA-530-A,
ITU-T V.10/V.11/V.24/ISO 2110\)](#)

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[Appendix E: ASCII/EBCDIC Character Sets And
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Chapter 1: Introduction

V.F 28.8/33.6 Features

- Integral synchronous/asynchronous operation.
- Synchronous DTE rates to 28.8/33.6K.
- Asynchronous DTE rates to 128K.
- Supports DCE rates from 2.4 to 33.6 Kbps.
- 2-wire, full-duplex, switched network operation with programmable or permissive transmit levels.
- 2- or 4-wire private line operation, with selectable transmit level.
- Automatic VF line rate determination in V.34 and V.32 *bis* modes, with fallforward/fallback.
- Auto Dial Restoral to restore a failed private line link over the switched network.
- Synchronous data compression (supports rates up to 128 Kbps).
- EIA/TIA-602 "AT" Command Set support.
- V.25 *bis* compatible command protocol support.
- Remote Configuration to change a remote modem's user configuration profile.
- Front panel keypad and LCD screen for configuration and testing.
- Flash memory for downloading modem firmware.
- Permanent storage of modem configuration profiles in non-volatile memory.
- External, Internal or Receiver Recovered transmit timing.
- Maximum line rate selection.
- Asynchronous character lengths of 8, 9, 10 and 11 bits.
- Password security.
- Security Callback to prevent unauthorized access to a remote modem.
- Intelligent Serial Terminal Dialer via the DTE interface, using the AT Command Set.
- Stores up to ten telephone numbers for easy dialing.
- Pulse or tone dialing.
- Manual or automatic answer.
- Audible Call Progress Monitor.
- Analog Loopback with and without Self-Test features.
- Digital Loopback and Remote Digital Loopback.
- End-to-End Self-Test (511 or in FSK ALT pattern).

- Front panel lockout.
- Optional ITU-T V.35 and EIA RS-530A DTE interfaces.
- Supports FAX Class 1 operation using V.27 or V.29 modulation.
- On-line compatible with all other modems that comply with V.34.

Description

The GDC V.F 28.8/33.6 modem is a universal, full-duplex, multi-speed modem that provides 28.8 kbps to 300 bps operation over the telephone (VF) line. It can be connected to a 2-wire switched line, a 2-wire private line, or a 4-wire private line.

The modem can support asynchronous or synchronous DTE data rates up to 128 Kbps. Operation can be synchronous or character asynchronous at all speeds down to 1200 bps. Operation is asynchronous at 0 to 300 bps. Synchronous rates above 28.8 Kbps require use of the modem's synchronous data compression feature.

The modem supports the following protocols:

- V.34 for negotiated high-data-rate connections
- V.42 (LAPM) error correction
- V.42 *bis* data compression
- ITU-T (formerly CCITT) V.32 *bis*, V.32, V.22 *bis*, V.22, V.21
- Bell 212A and Bell 103 specifications

The V.F 28.8/33.6 provides automatic dial (AT Command) and automatic answer for switched network operation. It also supports 2- and 4-wire private line operation.

The V.F 28.8/33.6 can be controlled in a number of ways. It can accept commands from its local DTE using either the AT command set or the ITU-T V.25 *bis* command set. The AT commands can also be used for remote configuration performed through an off-site V.F 28.8/33.6 modem and DTE. The modem includes front panel controls for configuration and testing.

Modem Equipment

The V.F 28.8/33.6 modem is available in a variety of models. When unpacking the modem, check that all components are included. (Each modem includes this manual, the Operation and Installation Manual, GDC P/N 054R207-000.)

[Table 1-1](#) lists the 117 V ac, 60 Hz models, each of which includes GDC power supply P/N 750-015-001.

[Table 1-2](#) lists the 220 V ac, 50/60 Hz models, each of which includes GDC power supply P/N 750-015-101.

Appendix A, Technical Characteristics describes the V.F 28.8/33.6's technical characteristics.

DTE Cables

With the EIA/TIA-232-E (ITU-T V.24/V.28/ISO 2110) DTE interface, use standard EIA/TIA-232-E cables (except as noted in *Chapter 2, Installation* under Special Considerations for High Data Rates).

With the ITU-T V.35 (ITU-T V.24/V.28/V.35/ISO 2593) DTE interface, use GDC adapter cable P/N 027H572-001.

With the EIA/TIA-530-A (ITU-T V.10/V.11/V.24/ISO 2110 Amendment 1) DTE interface, use GDC cable P/N 027H525-XXX.

Software Selection

There are two types of computer software for use with a modem: terminal emulation software and data communications software.

Terminal emulation software essentially "downgrades" your computer to a dumb terminal. It allows you to type at the keyboard and see responses on the video display or printer. Emulation programs are often used to communicate with main-frame or mini-computers, and usually do not support disk management or file transfers.

A full-featured data communications software package does allow file transfers, as well as providing a dial directory, a script language for automated sessions, and a host of other features. Of course, the more powerful and flexible a software package is, the more difficult it may be to master.

To take full advantage of the features of the V.F 28.8/33.6 modem, your selected program should allow turning off the autobaud feature. You should also be able to toggle both XON/XOFF and hardware flow control. In addition, it should support several file transfer protocols designed to be used with an error-correcting modem.

Although your modem will work with most standard communications programs and file protocols such as XMODEM, there may be a throughput penalty when using a software error-detecting protocol due to the redundant error-checking overhead. File transfer protocols that are tailored for use with error-correcting modems are YMODEM-G and IMODEM.

Fax

The modem (Revision G software and later) can support FAX Class 1 transmission and reception. The function requires use of ITU-T V.27 or V.29 modulation.

QuickLink FAX software is available separately from GDC to support the modem's FAX Class 1 transmission and reception capabilities. The GDC part number for that software is 759-052S001.

Note *Before you load and activate the fax software, make sure that the modem is connected to the PC and switched On.*

Table 1-1 117 V AC Models

P/N	Network Type		DTE Interface			Cables
	SN	PL	232	530	V.35	
-001	✓	✓	✓			See note 1
-011	✓		✓			See note 2
-101 *	✓	✓	✓			See note 1
-111 *	✓		✓			See note 2
-201	✓	✓			✓	See note 1
-211	✓				✓	See note 2
-301	✓	✓		✓		See note 1
-311	✓			✓		See note 2

* For sale only in USA and countries with USA-like requirements.

-
- Notes**
1. Includes one 830-027-407 (for switched network permissive connection) and two 830-028-807 (for switched network programmable connection or four-wire private line).
 2. Includes one 830-027-407 (for switched network permissive connection) and one 830-028-807 (for switched network programmable connection).
-

Table 1-2 220 V AC Models

P/N	Network Type		DTE Interface			Cables
	SN	PL	232	530	V.35	
-002	✓	✓	✓			<i>See note 1</i>
-012	✓		✓			<i>See note 2</i>
-102 *	✓	✓	✓			<i>See note 1</i>
-112 *	✓		✓			<i>See note 2</i>
-202	✓	✓			✓	<i>See note 1</i>
-212	✓				✓	<i>See note 2</i>
-302	✓	✓		✓		<i>See note 1</i>
-312	✓			✓		<i>See note 2</i>

* For sale only in USA and countries with USA-like requirements.

- Notes**
1. Includes one 830-027-407 (for switched network permissive connection) and two 830-028-807 (for switched network programmable connection or four-wire private line).
 2. Includes one 830-027-407 (for switched network permissive connection) and one 830-028-807 (for switched network programmable connection).

Additional Manual Updates

Additional V.F 28.8/33.6 Modem updates and product release notes are listed on the GDC web site at: <http://www.gdc.com/>

The modem information is located in the Service & Support section under Modem/DSU support.

Chapter 2: Installation

Note *The installation of this unit is to be done by qualified service personnel only.*

This section describes installation of the V.F 28.8/33.6 modem.

Unpacking Your Modem

When you remove the modem from its box, make sure that it is undamaged and that the proper cables and an ac power supply are included. If any of the components are missing, call your local representative.

Keep the carton and protective packing material so you can repack the equipment for storage or shipment. If there is any visible damage to the modem, record it on the freight bill, have the freight carrier acknowledge it and submit your claim to the carrier



CAUTION

Do not install or operate damaged equipment as safety and performance may be affected.

Modem Installation

The rear panel of the V.F 28.8/33.6 has several external interface connectors: an ac power supply receptacle and a power On/Off switch.

Refer to [Table 2-3](#), [Table 2-2](#), and [Figure 2-2](#) for additional details.

Installation procedure:

1. Turn Off the modem and the equipment connected to it.
2. For switched network operation, connect the telephone line to the modem using the modular jack marked SN. For private line operation, connect the telephone line to the modular jack marked PL. Refer to [Table 2-2](#) for the pinouts of the modular jacks.
3. If a telephone is required, connect it to the modem using the modular jack marked PHONE. (In private line operation, no telephone is used.)

4. Connect the DTE interface cable to the modem using the female DB25 connector labeled Business Equipment.

Note *A shielded cable is required to comply with FCC Class B and EN 55022 Class B EMI requirements.*

5. Plug the other end of the DTE interface cable into the serial port on your asynchronous DTE. For most computers, this port is usually located on the back and is often referred to as an RS-232-C (the recent terminology is EIA/TIA-232-E), serial, or asynchronous port. (Check with your computer dealer or computer manual for the correct connector. Some computers, such as Macintosh, use different plugs, pin assignments, and numbers of pins.)
6. Use a small screwdriver to tighten the screws on the DTE interface cable. This will ensure that this cable cannot be accidentally disconnected.
7. Check that the label on the ac power supply displays the proper voltage rating for use with the local national requirements.
8. Connect the ac power supply to the modem by inserting the plug into the DIN connector labeled POWER.
9. Plug the ac power supply into a standard ac outlet.

Note *In order to comply with EMI requirements the power supply box must be located on the floor.*

10. Turn On the modem and the equipment.

Note *When installing the high speed modem on an asynchronous port, it is important to confirm the highest speed supported by the DTE. Some asynchronous PC ports are restricted to 9600 bps or 19,200 bps operations. Special boards that support up to 115,200 bps are available for PCs, but the communication software that you use must be able to support it. The Technical Reference Section of your computer hardware manual provides this information. Further restrictions may be placed on the asynchronous port performance by the computer's operating system if "multitasking" or "Windows" are used. Review your operating systems limitations before selecting high speed operations.*

Special Considerations for High Data Rates

Because of the high data rates possible with the V.F 28.8/33.6, the type and length of the DTE cable are important factors in ensuring data integrity. The modem's higher data rates require the use of shielded DTE cables. Further, the cable's capacitance and resistance, which vary with its length, must be evaluated to ensure that it can support the chosen data rate over the required distance.

Cable capacitance is specified in two categories: conductor-to-conductor (C-C) and conductor-to-shield (C-S). Each of those capacitance values is expressed in PicoFarads per foot (pF/ft). A cable's total capacitance is arrived at by adding C-C to C-S and multiplying by its length in feet. The following example illustrates calculations for the total capacitance of a 10-foot cable with a C-C capacitance of 12.5 pF/ft and a C-S capacitance of 22.0 pF/ft:

$$\text{Total capacitance} = [(C-C) + (C-S)] * 10$$

$$\text{Total capacitance} = (12.5 + 22.0) * 10$$

$$\text{Total capacitance} = 34.5 * 10$$

$$\text{Total capacitance} = 345 \text{ pF}$$

The following table shows the greatest total capacitance tolerated for each range of data rates.

Data Rate (Kbps)	Total Capacitance (pF)
0.0 - 20.0	2400
20.0 - 30.0	1200
30.0 - 60.0	900
60.0 - 100.0	450
100.0 - 128.0	200

A DTE cable for use with the V.F 28.8/33.6 modem must have total resistance of 20 ohms or less. To calculate a cable's resistance, multiply its specified resistance value (in ohms per 1000 feet) by its length (in feet). The following example illustrates the calculation for a 10-foot cable with a resistance of 24 ohms/1000 ft:

$$\text{Total Resistance} = (24/1000) * 10$$

$$\text{Total Resistance} = 0.024 * 10$$

$$\text{Total Resistance} = 0.24 \text{ ohms}$$

The following table shows for two GDC DTE cables the greatest lengths that can be used at differing data rates. The two cables shown are 028H511-XXX (DB25 male-to-female) and 028H502-XXX (DB25 male-to-male). When ordering these cables, replace the -XXX with the three-digit dash number that indicates the desired length (50, 25, 10, or 5 feet).

Data Rate (Kbps)	028H511-				028H502-			
	-050	-025	-010	-005	-050	-025	-010	-005
0.0 - 20.0	✓				✓			
20.0 - 30.0		✓				✓		
30.0 - 60.0		✓				✓		
60.0 - 100.0			✓				✓	
100.0 - 128.0				✓				✓

Verifying Your Connections

Your modem should now be connected. You can verify the connections by following these steps:

1. To verify that the ac power supply is connected properly, see if the LCD display on the front panel is displaying the Home Screen (the Home Screen is displayed a few seconds after the GDC logo). If not, turn Off the modem, then turn it On again. If the Home Screen still does not appear, then either the ac power supply is not connected properly, or the modem is not functioning.
2. To verify that the switched network telephone line is connected properly, place a voice call using a telephone plugged into the modem.
3. If using a terminal as the DTE, proceed to the next step. If using a computer as the DTE, then run your communications software and configure it for terminal emulation. If using an intelligent communications software package, it may be necessary to configure it for "dumb" mode. See Chapter 3 for further details.
4. Type the command AT followed by a carriage return on the DTE. The modem should respond with an OK message. If the modem does not respond with an OK message, then either the DTE interface cable is not connected properly or the DTE is not

configured properly. See Appendix A for a complete list of compatible DTE configurations such as speed and parity.

Note *If several telephone sets share the same extension as the modem, lifting one of the telephone hand-sets while data is being received may introduce errors.*

Cover Removal And Replacement

If it is necessary to inspect or change the option jumpers, or to inspect the option plug-in cards, first remove the modem's cover. To remove the cover:

1. Turn Off the modem and the equipment connected to it.
2. Remove all screws from the bottom of the case.
3. Insert a thin-blade slotted screwdriver into one of the slots along the bottom rear edge. Tilt the handle slightly away from the unit to release the internal tab.
4. With one tab loose, use your fingers to snap open the cover at the other rear corner. The front panel assembly is connected to the base card by cables: it is not necessary to un-plug them.

To reinstall the cover:

1. Hook its front lip onto the two hooks at the front of the base, then snap the cover shut at the rear.
2. Replace the screws removed from the bottom of the case.

Option Jumpers

The V.F 28.8/33.6 has only one user-configurable option, jumper (X3). It sets the line termination impedance in switched network mode (the impedance in private line mode is fixed at 600 ohms). The factory default is 600 ohms. Refer to [Table 2-1](#) and [Figure 2-1](#) for details.

There are three other factory-set jumpers. Verify that they are set as described in [Table 2-1](#) and shown in [Figure 2-1](#).

Option Plug-in Cards

The V.F 28.8/33.6 is available in several models, and some require option plug-in cards. There are two types of plug-in cards: the VF card and the DTE interface card.

Note *These option plug-in cards are not ordered separately nor are they field-upgradeable: They are included in the modem top assembly part number (refer to [Table 1-1](#) and [Table 1-2](#)).*

VF Card

The VF card allows the factory to configure the modem for individual national requirements, so a country-specific VF card is installed on each international model. The VF card also provides private line circuitry, so it is installed on each domestic model used in a private line application. The VF card attaches to the modem base card via connectors XA1J1, XA1J2, XA1J3 and XA1J4, as illustrated in [Figure 2-1](#). It has no option jumpers.

A domestic model used only in a switched network application does not require a VF card.

DTE Interface Card

The V.F 28.8/33.6 has a built-in EIA/TIA-232-E (ITU-T V.24/V.28/ISO 2110) DTE interface. There are two other interfaces available that each require a unique option plug-in card:

- ITU-T V.35 (ITU-T V.24/V.28/V.35/ISO 2593)
- EIA/TIA-530-A (ITU-T V.10/V.11/V.24/ISO 2110 Amendment 1)

A DTE interface card attaches to the modem base card via connectors XA2J1, XA2J2, XA2J3, and XA2J4, as illustrated in [Figure 2-1](#). DTE interface cards have no option jumpers.

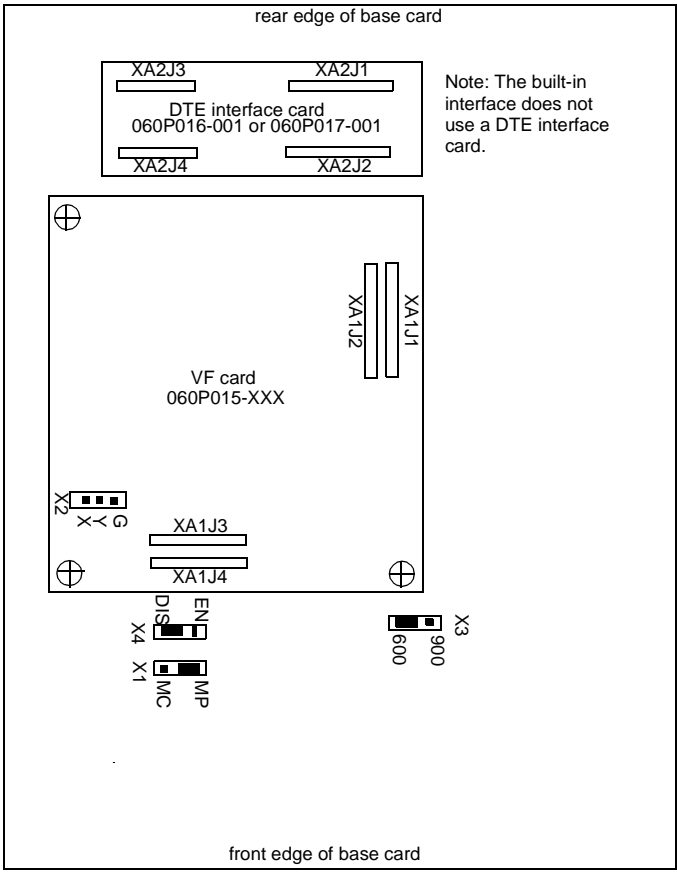


Figure 2-1 PC Card Layout

Table 2-1 Option Jumpers

Option	Selection	Jumper	Position	Description
Line impedance	600 ohms	X3	600 *	Matches a 600 ohm line, common domestically. For switched network only.
	900 ohms	X3	900	Matches a 900 ohm line. For switched network only.
n/a	MP	X1	MP *	MUST be in the MP position.
n/a	no jumper	X2	no jumper *	MUST have no jumper installed.
n/a	DIS	X4	DIS *	MUST be in the DIS position.
* Factory default position.				

Table 2-2 Modular Jack Pinouts

Pin Number	Switched Network (SN)	Private Line (PL)	
		Four-wire	Two-wire
1	nc	Tx-A	Tx/Rx-R
2	nc	Tx-B	Tx/Rx-T
3	nc	nc	nc
4	R	nc	nc
5	T	nc	nc
6	nc	nc	nc
7	PR	Rx-B	nc
8	PC	Rx-A	nc
nc = no connection			

Table 2-3 Rear Panel

Name	Function
PL	8-position modular jack (US RJ45) for connection to a private line.
SN	8-position modular jack (US RJ45) for connection to a switched network line.
PHONE	6-position modular jack (US RJ11) for connection to an optional 500- or 2500-type telephone.
Business Equipment	A female DB25 connector for connection to a DTE (terminal or computer).
POWER	A DIN connector for the included ac power supply.
ON/OFF	A switch to turn the modem on or off.

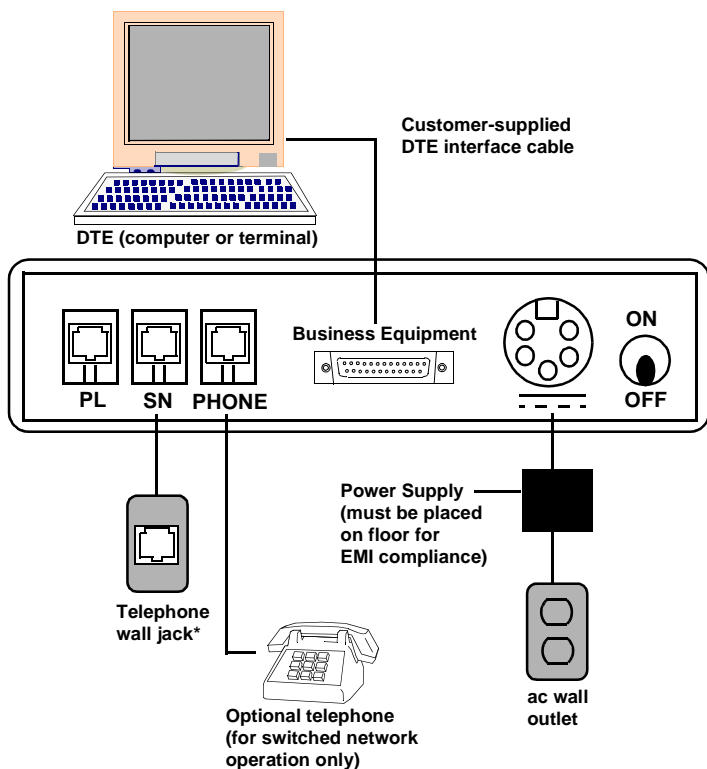


Figure 2-2 Rear Panel

Chapter 3: Basic Operation

Overview

This chapter describes how to operate and configure the V.F 28.8/33.6 modem. Modem control functions can be performed in three ways:

- using the modem's front panel switches and display;
- using AT commands sent to the modem from a terminal, PC, or other asynchronous DTE;
- using ITU-T V.25 *bis* commands sent to the modem from a terminal, PC, or other DTE;

This chapter begins by describing the use of the front panel. That is followed by the modem's call control functions, which are carried out principally by means of AT commands. The broader uses of the AT command set for configuration and control are then described. The AT command set provides a broader range of capabilities than does the front panel.

Chapter 4, AT Command Set Operation describes each AT command in detail, which involves also describing the modem's configurable characteristics and functions that are controlled by the commands.

Chapter 5, V.25 bis Command Set Operation describes the V.25 *bis* command set.

Using The Front Panel

The V.F 28.8/33.6 front panel includes a 12-button keypad for controlling the modem, 10 status LEDs and a 2-line by 16-character LCD screen. [Table 3-1](#) describes the front panel indicators (the LEDs) [Table 3-2](#) describes the front panel controls (the keypad). The LCD screen displays the status of the modem and, with the keypad, allows you to configure and test the modem without connecting a terminal. [Table 3-3](#) through [Table 3-12](#) list the messages you see when using the front panel, and include the related AT command for each option or function.

Using the Keypad

- There are three groups of options or functions - Configuration, Diagnostics, and Dial. The Configuration group is further divided into subgroups. Press the CONFIG, DIAG or DIAL key to access a group. Use the left and right arrow keys to move between options or functions. Use the up and down arrow keys to scroll through the list of choices for an option, or to move between subgroups.

- The modem does not accept configuration from the front panel while it is in data mode. A switched network modem is in the idle mode whenever it does not have an active connection, but a private line modem has to be placed in idle mode manually by means of the Talk/Data switch.
- An asterisk (*) on the right side of the LCD screen indicates the displayed option's current configuration. The asterisk is not shown in [Table 3-3](#) through [Table 3-12](#).
- Every option or function accessible from the front panel has a related AT command, but not all AT commands are accessible from the front panel. A terminal is required to access the entire complement of AT commands.
- In [Table 3-3](#) through [Table 3-12](#) the related AT command appears to the right of each option or function. The AT commands are not displayed on the LCD screen.
- The options related to S-Registers (e.g., WAIT DIALTONE) list only a few commonly used values. To select other values, use the AT command.

To dial, view, or store a phone number:

1. Press DIAL to access the dial group.
2. Scroll right or left to display the desired dial function.
3. Scroll down to enter the displayed function.
4. Enter the cell number or phone number, as prompted.
5. To insert a dial command modifier (e.g., T for tone dialing):
 - Press DIALMOD.
 - Scroll up or down the list to display the desired modifier.
 - Press ENTER to complete the action.
6. When dialing or storing, press ENTER to complete the action. If prompted, press ENTER again to confirm or ESC to escape.

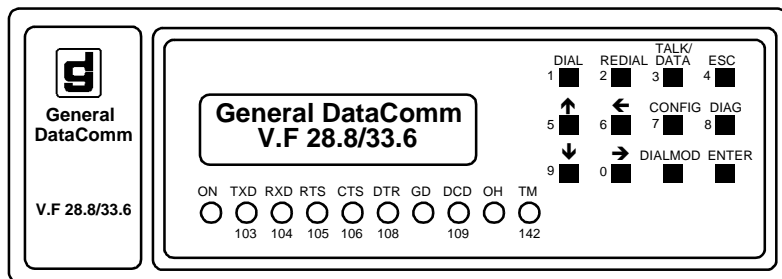


Table 3-1 Front Panel Indicators

LED	Definition	LED State	Description
ON	Power On	On	The internal +5 V dc power supply is okay.
		Off	No +5 V dc.
TXD 103	Transmit Data	On	Indicates a SPACE condition in the transmitted data.
		Off	Indicates a MARK condition.
RXD 104	Receive Data	On	Indicates a SPACE condition in the received data.
		Off	Indicates a MARK condition.
RTS 105	Request to Send	On	The DTE has turned On DTE interface pin 4 (or RTS is On), indicating that the DTE is requesting the modem for data transmission.
		Off	Pin 4 is Off.
CTS 106	Clear to Send	On	The modem has turned On DTE interface pin 5 (or CTS is On), indicating it is ready to transmit data.
		Off	The modem has turned Off pin 5, indicating it is not ready to transmit data.
DTR 108	Data Terminal Ready	On	The DTE has turned On DTE interface pin 20 (or DTR is forced On), indicating it is ready for data communications.
		Off	The DTE has turned Off pin 20, indicating it is not ready for data communications.
GD	Good Data	On	The modem is receiving an acceptable carrier level and is equalized.
		Off	The modem is not receiving an acceptable carrier level or is not equalized.

(Sheet 1 of 2)

Table 3-1 Front Panel Indicators (Continued)

LED	Definition	LED State	Description
DCD 109	Data Carrier Detect	On	The modem has turned On DTE interface pin 8 (or DCD is On), indicating it is receiving data.
		Off	The modem has turned Off pin 8, indicating it is not receiving data.
OH	Off-Hook	On	The modem is in the off-hook state.
		Off	The modem is in the on-hook state.
		Flashing	The modems are handshaking.
TM 142	Test Mode	On	The modem is in a test mode.
		Off	The modem is not in a test mode.

(Sheet 2 of 2)

Table 3-2 Front Panel Controls

Key	Function
DIAL	Dial and store phone numbers. The Dial group includes functions to: <ul style="list-style-type: none">• Manually dial a phone number from the keypad.• View a stored phone number.• Store a phone number.• Dial a stored phone number (a cell).
REDIAL	Redial the last dialed phone number.
TALK/DATA	Switch between talk mode and data mode. Modem must be in talk mode to accept configuration from the front panel. Private line modem will only enter Talk mode in response to this switch.
ESC	Return to the home screen, without saving your changes.
.	Move to the screen above, or scroll up through a list of choices.
?	Move to the screen to the left.
CONFIG	Configure modem options. The Configuration group includes the following subgroups, and each sub-group typically includes a number of functions, each with a menu of related options for which you can select a parameter: <ul style="list-style-type: none">• Quick Start• Network Options• Terminal Options• Modem Options• Dialer Options• Protocol Options• Modem Information• Save Configuration
DIAG	Perform diagnostic tests. The Diagnostics group includes the following functions for controlling tests: <ul style="list-style-type: none">• ITU-T V.54 Loop 3 with self-test (ANALOOOP Self-Test)• ITU-T V.54 Loop 3 (ANALOOOP)• ITU-T V.54 Loop 2 with self-test (Remote Digital Loopback Self-Test)• ITU-T V.54 Loop 2 (Remote Digital Loopback)• End-to-End Self-Test• ITU-T V.54 Loop 2 (Digital Loopback)• Cancel Test
,	Move to the screen below, or scroll down through a list of choices.
‡	Move to the screen to the right.
DIALMOD	Display dial command modifiers to insert in a phone number. Refer to the D command in Section 4 for a list of dial command modifiers.
ENTER	Select the choice displayed in line 2. When line 2 is blank, ENTER functions like the →key.
0 to 9	Numeric keys, used to enter a phone number or select an item.

Table 3-3 The Config - Quick Start Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
QUICK START	SELECT CONFIG	FACTORY DEF 0 FACTORY DEF 1 FACTORY DEF 2 FACTORY DEF 3 USER PROFILE 0 USER PROFILE 1 USER PROFILE 2 USER PROFILE 3	&F0 &F1 &F2 &F3 Z0 Z1 Z2 Z3
	ANSWER ORG MODE	ORG IF NO RING FORCED ANSWER AUTO ANS IN ORG	%O0 %O1 %O2
	PL HDSK MODE	V.34 ONLY V32 <i>B/S</i> ONLY V32 ONLY	&P0 &P1 &P2
	SN HDSK MODE	V.34 AUTO V.34 ONLY V32 <i>B/S</i> AUTO V32 <i>B/S</i> ONLY V32 AUTO V32 ONLY V22 <i>B/S</i> ONLY V22 ONLY 212 ONLY 103 ONLY V21 ONLY	&H0 &H1 &H2 &H3 &H4 &H5 &H6 &H7 &H8 &H9 &H10
	MAX DC RATE	4.8 KBPS, MAX 7.2 KBPS, MAX 9.6 KBPS, MAX 12 KBPS, MAX 14.4 KBPS, MAX 16.8 KBPS, MAX 19.2 KBPS, MAX 21.6 KBPS, MAX 24 KBPS, MAX 26.4 KBPS, MAX 28.8 KBPS, MAX 31.2 KBPS, MAX 33.6 KBPS, MAX	&G5 &G6 &G7 &G8 &G9 &G10 &G11 &G12 &G13 &G14 &G15 &G16 &G17
	OPERATING MODE	ASYNC DATA SYNC DATA	&M0 &M1
	SAVE CONFIG	USER PROFILE 0 USER PROFILE 1 USER PROFILE 2 USER PROFILE 3	&W0 &W1 &W2 &W3

Table 3-4 The Config - Network Options Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
NETWORK OPTIONS	NETWORK SELECT	SWITCH NETWORK PL 2W PL 4W	&L0 &L1 &L2
	SN TX LEVEL	PERMISSIVE PROGRAMMABLE	:P0 :P1
	PL TX LEVEL	0 dBm -1 dBm -2 dBm -3 dBm -4 dBm -5 dBm -6 dBm -7 dBm -8 dBm -9 dBm -10 dBm -11 dBm -12 dBm -13 dBm -14 dBm -15 dBm	:T0 :T1 :T2 :T3 :T4 :T5 :T6 :T7 :T8 :T9 :T10 :T11 :T12 :T13 :T14 :T15
	AUTODIAL REST	DISABLE END SESSION NO END SESSION	&B0 &B1 &B2
	PL LOOK BACK	DISABLE 10 MINUTES 20 MINUTES 30 MINUTES 40 MINUTES	S41=0 S41=1 S41=2 S41=3 S41=4
	PL DOWN TIME	DISABLE 1 MINUTE 2 MINUTES 3 MINUTES 4 MINUTES	S40=0 S40=1 S40=2 S40=3 S40=4

Table 3-5 The Config - Terminal Options Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
TERMINAL OPTIONS	DTE SPEED	AUTOBAUD SPEED LAST AT SPEED 300 1200 2400 4800 7200 9600 12000 14400 16800 19200 21600 24000 26400 28800 31200 33600 38400 57600 76800 115200 128000 32000 48000 56000 64000 72000 96000 112000	\T0 \T1 \T2 \T3 \T4 \T5 \T6 \T7 \T8 \T9 \T10 \T11 \T12 \T13 \T14 \T15 \T16 \T17 \T18 \T19 \T20 \T21 \T22 \T23 \T24 \T25 \T26 \T27 \T28 \T29
	CPM RESP SPEED	AUTOBAUD SPEED LAST CON SPEED 300 1200 2400 4800 7200 9600 12000 14400 16800 19200 21600	%R0 %R1 %R2 %R3 %R4 %R5 %R6 %R7 %R8 %R9 %R10 %R11 %R12

(Sheet 1 of 3)

Table 3-5 The Config - Terminal Options Subgroup (Continued)

Subgroup	Option (Line 1)	Choice (Line 2)	Command
TERMINAL OPTIONS (Cont.)	CPM RESP SPEED	24000	%R13
		26400	%R14
		28800	%R15
		31200	%R16
		33600	%R17
		38400	%R18
		57600	%R19
		76800	%R20
		115200	%R21
		128000	%R22
		32000	%R23
		48000	%R24
		56000	%R25
		64000	%R26
		72000	%R27
		96000	%R28
		112000	%R29
	CHAR LENGTH	8 6D	\B0
		9 7D	\B1
		10 7D PAR	\B2
		10 8D	\B3
		11 7D PAR 2 STP	\B4
		11 8D PAR	\B5
	PARITY	EVEN	\P0
		SPACE	\P1
		ODD	\P2
		MARK	\P3
		AUTO	\P4
	OVERSPEED	NOMINAL	\A0
		EXTENDED	\A1
	DTE FLOW CTL	DISABLE	\Q0
		XON/XOFF	\Q1
		CTS	\Q2
		RTS/CTS	\Q3
		UNIDIR XON/XOFF	\Q4
		CLK STOPPING	
		CLK THROTTLING	
	TERMINAL ECHO	DISABLE	E0
		ENABLE	E1
	DCD CONTROL	ON	&C0
		REAL	&C1
		ON WINK DISC	&C2

(Sheet 2 of 3)

Table 3-5 The Config - Terminal Options Subgroup (Continued)

Subgroup	Option (Line 1)	Choice (Line 2)	Command
TERMINAL OPTIONS (Cont.)	CTS CONTROL	CMD ON/RTS CMD ON/REAL REAL FORCED ON	&R0 &R1 &R2 &R3
	DTR TRANS CTL	IGNORED ON/OFF CMD MD ON/OFF IDLE ON/OFF RESET	&D0 &D1 &D2 &D3
	DSR CONTROL	ON WINK DISC NORMAL FOLLOWS DCD FORCED ON	&S0 &S1 &S2 &S3
	DSR IN ANALOOOP	ON OFF	%D0 %D1
	TRANSMIT CLOCK	INTERNAL EXTERNAL WRAP	&X0 &X1 &X2
	RTS/CTS DELAY	0 MSEC 15 MSEC 60 MSEC 100 MSEC	S26=0 S26=15 S26=60 S26=100

(Sheet 3 of 3)

Table 3-6 The Config - Modem Options Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
MODEM OPTIONS	RINGS TO ANSWER	DISABLE 1 2 4 8	S0=0 S0=1 S0=2 S0=4 S0=8
	FALL FWD BCKWD	DISABLE ENABLE	&A0 &A1
	TRELLIS	ENABLE DISABLE	&U0 &U1
	RETRAIN OPTIONS	DISABLE ENABLE 3 TIMES FOREVER	%Q0 %Q1 %Q2

(Sheet 1 of 2)

Table 3-6 The Config - Modem Options Subgroup (Continued)

Subgroup	Option (Line 1)	Choice (Line 2)	Command
	LONG SPACE DISC	DISABLE ENABLE	Y0 Y1
	SPEAKER CONTROL	OFF OFF IN DATA ON ON DURING CPM	M0 M1 M2 M3
	SPEAKER VOLUME	LOW MEDIUM HIGH	L0 or L1 L2 L3
	MAKE BUSY	DISABLE ON LOSS OF DTR IN ANALOOP IN AL NO RS TR ON LOSS OF RTS	%B0 %B1 %B2 %B3 %B4
	POWER UP AS	USER PROFILE 0 USER PROFILE 1 USER PROFILE 2 USER PROFILE 3	&Y0 &Y1 &Y2 &Y3
	RDL OPTIONS	ENABLE DISABLE	&T4 &T5
	TEST TIMER	DISABLE 1 MINUTE 5 MINUTES 10 MINUTES	S18=0 S18=6 S18=30 S18=60
	DTE TEST CTL	DISABLE ENABLE	%E0 %E1
MODEM OPTIONS (Cont.)	DCD LOSS TO DISC	2 SEC 4 SEC 8 SEC DISABLE	S10=20 S10=40 S10=80 S10=255
	DELAY DTR	10 SEC 20 SEC 30 SEC	S25=10 S25=20 S25=30
	CD RESP TIME	500 MSEC 1 SEC 2 SEC	S9=5 S9=10 S9=20
	REMOTE CONFIG	ENABLE DISABLE	*R0 *R1

(Sheet 2 of 2)

Table 3-7 The Config - Dialer Options Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
DIALER OPTIONS	COMMAND FORMAT	AT V25 <i>bis</i> ASYNC V25 <i>bis</i> HDLC V25 <i>bis</i> BISYNC NONE	%V0 %V1 %V2 %V3 %V4
	ALPHA NUMERIC	NUMERIC ALPHA	V0 V1
	CALL PROGRESS	BASIC NO CPM EXTD RES NO CPM EXTD DIALTONE EXTD BUSY EXTD FULL CPM	X0 X1 X2 X3 X4
	RESPONSE MODE	ENABLE DISABLE ENABLE IN ORG	Q0 Q1 Q2
	DTR DIAL	DISABLE CELL 0 CELL 1 CELL 2 CELL 3 CELL 4 CELL 5 CELL 6 CELL 7 CELL 8 CELL 9 DTR TALK/DATA	%Z0 %Z1=0 %Z1=1 %Z1=2 %Z1=3 %Z1=4 %Z1=5 %Z1=6 %Z1=7 %Z1=8 %Z1=9 %Z2
	DIAL TYPE	PULSE DTMF	P T
	PAUSE TIME , <	2 SEC 4 SEC 6 SEC 8 SEC	S8=2 S8=4 S8=6 S8=8
	WAIT DIALTONE	2 SEC 4 SEC 8 SEC	S6=2 S6=4 S6=8

Table 3-8 The Config - Protocol Options Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
PROTOCOL OPTIONS	ASYNC PROTOCOL	WIRE MODE DIRECT MODE MNP REL MODE AUTO REL MODE V42 REL MODE REL LAPM OR MNP V13 MODE	\N0 \N1 \N2 \N3 \N4 \N5 \N6
	COMPRESSION	DISABLE ENABLE TX PATH ONLY RX PATH ONLY	%C0 %C1 %C2 %C3
	BREAK HANDLING	EXP DST EXP NON DST NON EXP-DST IGNORED TMD NON EXP-DST	\K0 \K1 \K2 \K3 \K4
	MODEM FLOW CTL	DISABLE ENABLE UNIDIRECTIONAL BIDIR PASSTHRU	\G0 \G1 \G2 \G3
	EC DATA IN HSK	NO BUFFER BUFFER RX DATA FB w/FB CHR FB V14 NO BUFR FB w/FB CHR V14	\C0 \C1 \C2 \C3 \C4
	SYNC PROTOCOL	NORMAL SYNC SYNC V13 SYNC COMPRESSION	\M0 \M1 \M2
	V13 MODE	BIDIRECTIONAL TX ENABLE RX ENABLE	&E0 &E1 &E2
	CONN & LINK MSGs	SEPARATE MSGS BOTH AFTER LINK MICROCOM COMPAT CONN AFTER LINK	\V0 \V1 \V2 \V3

Table 3-9 The Config - Modem Info Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
MODEM INFO	PROTOCOL SELECT	Displays current protocol	n/a
	PL CARD	Displays installed VF card	n/a
	DTE CARD	Displays installed DTE card	n/a
	MODEM FIRMWARE	Displays letter identifying firmware revision	n/a
	SYMBOL RATE	Displays symbol rate.	n/a
	RECEIVE LEVEL	Displays current receive signal level	n/a
	EQLR QUALITY	Displays current signal quality	n/a

Table 3-10 The Config - Save Config Subgroup

Subgroup	Option (Line 1)	Choice (Line 2)	Command
SAVE CONFIG	SAVE CONFIG	USER PROFILE 0 USER PROFILE 1 USER PROFILE 2 USER PROFILE 3	&W0 &W1 &W2 &W3

Table 3-11 The Diag Group

Group	Function (Line 1)	(Line 2)	Command
TESTS	ANALOOP SELFTEST	n/a	&T8
	ANALOOP	n/a	&T1
	RDL SELFTEST	n/a	&T7
	RDL	n/a	&T6
	SELFTEST	n/a	&T9
	DIGITAL LOOPBACK	n/a	&T3
	CANCEL TEST	n/a	&T0

Table 3-12 The Dial Group

Function (Line 1)	(Line 2)	Command
DIAL CELL NUMBER	n/a	DSx
MANUAL DIAL	n/a	Dn
VIEW CELL	n/a	&V
STORE CELL NUM	n/a	&Zn=nnn

Call Control

Call control involves call initiation, completing a connection, call answering, and disconnecting a call.

The V.F 28.8/33.6 modem can be made to initiate a call in any of three ways:

- Manually, using a telephone number supplied at the time the call is initiated
- Manually, using a telephone number stored previously in one of the 10 memory cells provided for that purpose
- Automatically in response to an Off-to-On transition of the DTR interface circuit, using a telephone number stored previously in memory cell 0

The following three headings describe the procedures required for each type of call initiation. [Table 3-4](#) describes common commands used for call initiation, answering, and disconnection. Call completion, answering, and disconnection are discussed under their own headings following the table.

Manual Call Initiation

The following example illustrates manual call initiation with a telephone number supplied at the time of the call. At the terminal or computer keyboard, type

```
AT DP 9W (809) 555-1234 (enter)
```

where:

AT	AT command prefix, instructs modem to pay attention to the characters that follow
D	dial command, instructs modem to dial
9	instructs modem to dial 9 (to reach an outside line)
W	dial modifier, instructs modem to wait for a dial tone before continuing
(809) 555-1234	number modem is to dial - it will ignore parentheses, spaces, and hyphens
(enter)	pressing Enter or Return key sends command line to the modem
P	dial modifier, instructs modem to use pulse dialing

The description of the Dial (*Dn*) command that appears in *Chapter 4, AT Command Set Operation* includes the functions of all dial modifier characters (such as P and W in this example).

Manual Call Initiation with a Stored Number

The following examples illustrate how to store a telephone number in one of the modem's memory cells and how to initiate a manual call using a stored number.

To store a telephone number type

```
AT &Z3=(809) 555-1234 (enter)
```

where:

AT	AT command prefix, instructs modem to pay attention to the characters that follow
&Z3=(809) 555-1234	instructs modem to store the telephone number in non-volatile memory cell 3
(enter)	pressing Enter or Return key sends command line to the modem

When you require a modem connection to that stored telephone number at any later time, type

```
AT DT S3 (enter)
```

where:

AT	AT command prefix, instructs modem to pay attention to the characters that follow
D	dial command, instructs modem to dial
T	dial modifier, instructs modem to use tone dialing
S3	dial modifier, instructs modem to dial the number stored in memory cell 3
(enter)	pressing Enter or Return key sends command line to the modem

The description of the Dial (*Dn*) command that appears in *Chapter 4, AT Command Set Operation* includes the functions of all dial modifier characters (such as T and S in this example).

Automatic Call Initiation in Response to DTR

The AT commands %Z1 and %Z3 both instruct the modem to observe the state of the Data Terminal Ready (DTR) interface lead, and to perform automatic call initiation when an Off-to-On transition occurs on that lead. This function always uses the telephone number stored in memory cell 0.

When %Z1 is used, the modem will dial automatically only when it detects a transition on the DTR lead.

When %Z3 is used, the modem will dial automatically whenever it is not connected to a remote modem and the DTR lead is On. The significance of this is that the %Z3 command will cause the modem to perform automatic re-dial for recovery of a broken connection without requiring intervention by the DTE.

Table 3-13 Common Call Control Commands

Command	This will...	Remember...
AT	get the modem's attention, telling it that a command is to follow.	this command must always precede any command line, except A/.
AT D	get the modem to dial the specified telephone number that follows.	your number can contain up to 30 digits.
P (following D command)	tell the modem to pulse dial.	you can use dial digits 0 through 9 for pulse dialing.
T (following D command)	tell the modem to tone dial.	you can use dial digits 0-9 and symbols A, B, C, D, #, * for tone dialing.
W (as part of dial command)	indicate to the modem that it must wait for a dial tone before dialing the number that follows.	you will use this command when you have to dial 9 to obtain an outside line.
; (as part of dial command)	cause the modem to return to the command mode after it has dialed the number, rather than immediately entering data mode.	this will serve to separate a command string containing more than 30 characters (so as not to overflow the buffer).
Sn (following D command)	instructs the modem to dial a previously stored number.	you can store 10 telephone numbers ($n = 0 - 9$) up to 30 digits each.
R (as last character in dial command)	cause the modem to establish a call in answer mode when calling an originate-only modem.	the R command must be the last character in the dial string before you enter a carriage return.
AT A	force the modem to answer incoming call.	the modem will not wait for a ring; no matter what is specified in the S0 register (see S-Registers in Chapter 4). This command is used for manually answering a call.
AT H	force the modem to hang up.	if you are in data mode, you must first enter command mode before using this command.

Completing a Connection

Once you have issued a dial command, the front panel should display DIALING. If the connection is successful, a CONNECT result code will appear. This means you are connected to the remote end. See *Chapter 4, AT Command Set Operation* for a list of standard and extended result codes. The result codes appear on your DTE screen when you issue a command.

Usually you will need to press Enter or Return on the keyboard in order to receive a prompt from the answering equipment. If you do not do so, you may be disconnected.

The CTS and DCD indicators will remain on while the V.F 28.8/33.6 modem is connected to the remote end. The TXD indicator will flash while the modem is sending data and the RXD indicator will flash while it is receiving data from the remote end.

Call Answering - Automatic

The V.F 28.8/33.6 modem automatically answers and switches to the data mode if the automatic answering function is enabled. The modem has built-in "ring-detection" circuitry that can be enabled to provide automatic response to incoming calls. The value stored in S-Register 0 determines whether auto-answer is enabled. If the value is greater than 0, the modem will count ring signals on the line and display a RING message for each ring it counts. Once the ring count equals or exceeds the value of S0, the modem will go off hook and begin the handshaking procedure.

Note *For more information on the S-Registers, see Chapter 4, AT Command Set Operation .*

The default value of the S0 register $n = 1$ (auto-answer enabled on the first ring). The value of n is programmable in AT modes of operation. For AT operation, refer to S-Register 0 in *Chapter 4, AT Command Set Operation* .

Call Answering - Manual

You may prefer that the modem not answer incoming calls automatically; for example, if both voice and data calls will be received on the same line. Storing the value 0 in S-Register 0 disables auto-answer so the modem will not answer calls by itself under any circumstances.

You can manually answer a data call from either the keyboard or the modem's front panel. To answer from the keyboard, enter the command AT A (enter) upon receiving ring. To answer from the front panel, press the SEL key three times (this acts as the talk/data switch). Either action will cause the modem to go off-hook and begin the handshaking sequence.

Disconnecting a Call

There are several ways to disconnect a call:

- **H command** - disconnects the modem from the VF line. When using the modem in the asynchronous mode, first type the ESCAPE sequence (ESCAPE is a programmable character string, default +++). When the modem returns an OK to the DTE, type AT H (enter) to terminate the connection.
- **Loss of DTR** - an irreversible data mode disconnect sequence occurs if circuit 108.2 (DTR) turns Off for more than 50 milliseconds when the modem is in data mode. The modem can be optioned for circuit 108.2 forced On (terminal dial mode) so that a DTE cannot cause a disconnect to occur using circuit 108.2.
- **Character abort** - when this feature is enabled, any character sent from the DTE to the modem at the originate end during dialing or the handshake sequence will abort the call. %Kn controls this function in all command modes.
- **Loss of carrier** - the modem will go on-hook if the handshake sequence is not completed successfully within the time specified in S-Register 7. This abort timer is programmable for 1 to 30 seconds via the S7=x command. The originating and answering modem both have the abort timer active during the handshake sequence.
- **No answer or busy** - when an originating call is not answered within the time specified by S-Register 7, the modem will disconnect. If it detects a busy tone, the modem will disconnect immediately and display the BUSY message.
- **Long space disconnect** - if optioned to do so via the Yn command, the V.F 28.8/33.6 will initiate and respond to the long space disconnect procedure. When initiating disconnect (for any reason except loss of carrier) the modem will transmit 4 seconds of continuous spacing (receive data clamped to a mark), and then go on-hook. A modem receiving 1.6 seconds of continuous space on the VF line will go on-hook. This feature is only functional at speeds of 2400 bps and lower.

Passwords

The V.F 28.8/33.6 modem provides a variety of configurable password security arrangements. The two principle categories are the general security (or "handshake") password, and the on-line password. An answering modem will terminate the call if it does not receive a required password.

You can enable either type of password function, or both, by means of the %Sn command. A general security password, when used, is transmitted and checked as part of the handshake sequence between a calling modem and an answering modem. When an on-line password is enabled, the operator placing a call is prompted to supply further information manually after the modems make their initial connection.

Note *In order to use a general security password the modems' handshake modes must be V.34 (&H0, &H1, or &P0 command), V.32 bis (&H2, &H3, or &P1 command) or V.32 (&H4, &H5, or &P2 command).*

The modem has ten memory cells for password storage. The command for storing a password is %Pn=xxx, where *n* is the password memory cell number and *xxx* is the password. The memory cell number can be any digit, 0 - 9. The password can be any string of up to ten alphanumeric and punctuation characters (one exception: comma ", " may not be used). The handshake password function always uses the contents of memory cell 0. The modem compares received on-line passwords to the contents of all ten memory cells in search of a match.

When an on-line password is required by an answering modem that is connected to an MMS controller, the remote operator who placed the call is prompted for three successive items:

ENTER SYSTEM

ENTER USER NAME

ENTER PASSWORD

As each prompt is received, the operator has 15 seconds to respond. The MMS controller performs the actual verification of the operator's responses.

A non-MMS answering modem sends only the ENTER PASSWORD prompt when an on-line password is required.

Security Callback

The Security Callback procedure is invoked by the AT dial command modifier \n (*n* = 0 - 9). A call placed using the modifier causes the answering modem to disconnect after handshaking, then dial a call back to the modem that made the original call. In the command modifier, *n* represents a phone number memory cell in the answering modem. For example, to call the remote modem at 555-1212 and have it call the phone number in cell 1, enter:

ATD5551212\1

After handshaking and a short delay, the remote modem terminates the call, then places a new call to the local modem, using the phone number that it has stored in cell 1.

Use of Security Callback requires the following:

- General security password must be enabled in both modems.
- The same general security password must be used by both modems (%Pn command).
- The originating modem's phone number must be stored in one of the answering modem's phone cells.

Note *A telephone number stored for Security Callback use should always include the :n (retry) modifier. Specify that the modem will make at least three attempts to dial the number. Retries compensate for any delay in receiving dialtone from the Central Office after termination of the initial connection.*

On-line Password Callback Extensions

An operator sending an on-line password may be permitted to include one of several optional callback extensions. A callback extension causes the answering modem to disconnect and then call back to the modem that placed the original call. When you configure a password memory cell you must enable or disable its callback extension capability by means of the %Fn=x command. In this command *n* is the cell number and *x* defines whether and how the cell's password can be used for callback (see *Chapter 4, AT Command Set Operation* for further details).

The comma, which cannot be used as a character in a password, functions as a special character to identify the callback request extensions described in the following paragraphs.

There are three callback request extensions that a remote operator may be permitted to add to an on-line password: R, C, or F. A password stored with password cell qualifier Fn=0 will not accept any callback extension. An answering modem will terminate the call if it receives an Fn=0 password with a callback extension attached.

The roving callback extension (,R) causes the answering modem to prompt the caller for a telephone number to use for the callback. Once the number is supplied, the answering modem disconnects the original call and places a return call using the number it has just been given. The password to which the roving callback extension is attached must have been stored in the answering modem with the appropriate password cell qualifier, Fn=1 or Fn=3.

The memory cell callback extension (,C) causes the answering modem to prompt the caller for the number (0 - 9) of a phone number memory cell in the answering modem. Once the cell number is supplied, the answering modem disconnects the original call and places a return call using the telephone number stored in the specified memory cell. There are two conditions on the use of the memory cell callback extension:

- It is valid only when the answering modem is not connected to an MMS controller.
- The password to which the memory cell callback extension is attached must have been stored in the answering modem with the appropriate password cell qualifier, Fn=2 or Fn=3.

Note A telephone number stored for callback use should always include the :n (retry) modifier. Specify that the modem will make at least three attempts to dial the number. Retries compensate for any delay in receiving dialtone from the Central Office after termination of the initial connection.

The fixed callback extension (,F) is only valid when the answering modem is connected to an MMS controller. It causes the answering modem to disconnect the original call and place a return call using a number stored in the controller. Callback numbers are stored in the controller associated with user names. A user name has to be supplied as part of the on-line password procedure when the answering modem is connected to an MMS controller. This extension is not enabled by an Fn qualifier since it is administered by the controller, not the modem.

Communication Operation and AT Commands

This part of the section describes both communication operating procedures for the V.F 28.8/33.6 modem and the AT commands by which you can implement those procedures. To operate a V.F 28.8/33.6 modem using AT commands, you need to have a computer or terminal (the DTE) with an EIA/TIA-232-A, EIA/TIA-530-A, or V.35 serial port. The port enables communication between the DTE and the modem. If a computer is being used as the DTE, it will also require a communications software package. If you plan on using error correction or data compression, the software package must support flow control.

Command Mode and Data Mode

There are two categories of communication between the V.F 28.8/33.6 modem and its DTE: command mode and data mode. In command mode the DTE communicates with the modem itself to establish configuration and to initiate functions. In data mode the DTE communicates through the modem over a telephone line to a modem and DTE at another site.

The modem's essential functions are the transmission and reception of data that take place while it is in data mode. The commands given to the modem while it is in command mode determine how it accomplishes those functions.

Command mode is always asynchronous; data mode can be either asynchronous or synchronous. The modem can be configured (by the &M command) for asynchronous operation in both command and data modes or asynchronous operation in command mode and synchronous operation in data mode.

The modem is initially in command mode when it is powered On. It enters data mode when you command it to go on-line to another modem (by dialing a switched network connection or initiating handshake for a private line connection) or when it goes on-line in response to a connection initiated by a remote modem.

Depending on its option settings, you can cause the V.F 28.8/33.6 modem to enter command mode and wait for the next AT command by using &D1, dropping DTR, or typing the Escape sequence (+++).

AT Command Mode

In command mode the modem looks at everything you type on the DTE keyboard, checking constantly for a valid command (AT commands are described below, and *Chapter 4, AT Command Set Operation* contains a complete list of available AT commands). When the modem detects a valid command, it will execute that command for you. In AT Command Mode, you may ask the V.F 28.8/33.6 modem to answer a call, hang up or dial, change an S-Register value, or perform other command functions.

Some, but not all, AT commands can be issued from the modem's front panel. Front panel operation is described elsewhere in this section.

Configuration Profiles

A configuration profile consists of the set of AT commands the modem is given to establish its operating characteristics. The V.F 28.8/33.6 modem can store up to eight configuration profiles: four factory-provided fixed profiles and four user defined profiles. By recalling and loading a stored profile you can completely re-configure the modem without having to change individual options.

The individual profiles in each of the two sets are identified as 0 - 3. The command to recall and load a fixed profile is &Fn. The description of the &Fn command in *Chapter 4, AT Command Set Operation* lists the characteristics of the four fixed profiles.

The command to recall and load a user defined profile is Zn. The command to store a user defined profile is &Wn. When it receives the &Wn command, the modem stores the configuration options in effect at that time as user defined profile *n*.

Each time its power is turned On the modem recalls and loads a user defined profile. You specify which of the four user defined profiles it will use for that purpose by means of the Power Up User Configuration Profile command, &Yn. When the modem leaves the factory the initial default setting for &Yn is user defined profile 0. The factory default for user profile 0 is the same as fixed profile 0.

Command Syntax

An AT command takes the form of a single letter or a combination of a letter and a modifier character, often followed by one or more numeric characters. The modem interprets the AT command as a direction to set a configuration parameter or perform an action. The command (letter or letter and modifier) identifies the parameter or action, and the numeric value specifies (from a pre-established range of choices) how the parameter is to be set or how the action is to be performed. Some AT commands, such as those used to program telephone numbers, involve further modification through the use of an equal sign (=) followed by additional numeric characters.

Note *There is one exception to the rule that an AT command is a letter or a letter/modifier combination: the command for displaying basic AT command set help is \$. It can also be combined with any of the valid modifiers to display help for the extended AT command sets.*

You send AT commands to the modem in the form of a "command line." Each command line is preceded by the letters AT or at, contains one or more commands, and ends with a carriage return. The letters AT stand for "ATtention" and signal the modem that a command (or commands) will follow. The modem determines the asynchronous data rate and parity settings of the local DTE from the command line's AT prefix.

The A/ command is the one exception that does not require the AT command line prefix. It is discussed below under the Command Buffer heading.

It is possible to enter multiple commands on a single line, up to a maximum of 40 characters. The commands may be separated by space or line feed characters to improve readability. The modem will ignore space and line feed characters, so they do not count as part of the line's 40 characters. A carriage-return character must be entered at the end of a command line to signal the modem to process the commands.

While entering a command line you can correct mistakes by using the backspace, or Ctrl-H, character. It moves the cursor one character to the left and deletes the character. The AT prefix cannot be deleted.

Command Buffer

When the command line is sent to the modem, it is loaded into a command buffer with a capacity of 40 characters. The AT prefix, spaces, line feed characters, and carriage return are not loaded into the buffer, and so do not count as part of the 40-character limit. If a command line is more than 40 characters long, the modem will only act on commands that are contained in the first 40 characters.

The A/ command instructs the modem to re-execute the command line currently in the buffer. It is to be sent to the modem as a command line that consists of only the A/ command and a carriage return - no AT prefix. This is the only command line that does not need to be preceded by the AT prefix.

Automatic DTE Speed and Parity Detection

In command mode the modem automatically detects the DTE's operating speed and asynchronous character parity when it receives the AT prefix from the DTE.

The modem can automatically adapt to incoming data at any of the following asynchronous bit rates:

128,000 bps	115,200 bps	112,000 bps	96,000 bps
76,800 bps	72,000 bps	64,000 bps	57,600 bps
56,000 bps	48,000 bps	38,400 bps	32,000 bps
32,000 bps	31,200 bps	28,800 bps	26,400 bps
24,000 bps	21,600 bps	19,200 bps	16,800 bps
14,400 bps	12,000 bps	9600 bps	7200 bps
4800 bps	2400 bps	1200 bps	300 bps

Note *Configuration via the &H command determines what modulation the modem will operate with at a DTE speed of 1200 or 300 bps. At 1200 bps the modem can be configured to use either ITU-T V.22 or Bell 212A modulation. At 300 bps the modem can be configured to use either ITU-T V.21 or Bell 103 modulation.*

The modem can automatically adapt to the character length and parity of the characters coming from the DTE. It adapts to ODD, EVEN, SPACE, or MARK/NONE parity.

The automatic detection and adaptation function works for either lower case "at" or upper case "AT". Mixed cases ("At" or "aT") will not give predictable results.

Remote Configuration Using the AT Commands

Remote Configuration allows you to use a local V.F 28.8/33.6 modem to connect to a remote V.F 28.8/33.6 modem and view or change the remote modem's current user configuration profile.

Before you initiate a Remote Configuration session, you must ensure the following:

- Modems must either both be in switched network mode or both be in private line mode.
- The local modem must be in AT command mode (%V0 or PRS AT command). The remote modem will be forced into AT command mode when the connection is established.
- The local modem must be in an asynchronous error correcting mode. The remote modem will be forced into asynchronous mode when the connection is established.
- Both modems must have the same remote configuration security password (*Pn command). If the remote modem does not have a remote configuration security password, you may configure one during the Remote Configuration session.
- The remote modem's handshake mode must be V.34 (&H0, &H1, or &P0 command), V.32 *bis* (&H2, &H3, or &P1 command), or V.32 (&H4, &H5, or &P2 command).
- If you intend to save changes, you must enable remote configuration write access (*R0 command) at the remote modem before initiating the session.

-
- Note**
- a. The DTE interface on the remote modem is disabled during the Remote Configuration session to prevent the remote DTE from inadvertently terminating the session.*
 - b. Responses and echoes from the remote to the local modem are enabled regardless of the optioning of the remote modem. If quiet mode is selected on the remote modem, it will still send echo back to the local modem.*
-

To initiate a Remote Configuration session, enter *W1 at the local modem. In private line mode, the connection is made automatically. In switched network mode, you must place the call to the remote modem. Upon connection, the local modem displays

OK REMOTE CONFIG SESSION VIEW

if Remote Configuration write access is disabled, or

OK REMOTE CONFIG SESSION EDIT

if Remote Configuration write access is enabled.

After you establish a Remote Configuration session, you may view or edit (change) the remote modem's current user configuration profile in the same way you would the local modem's. The changes that you make do not affect the modem as you make them. Instead, they become part of a configuration profile. Once you have made all the changes you intend to, you have the following options:

- To terminate the session without saving or using the new configuration profile, enter *X0.
- To terminate the session and put the new configuration profile into use temporarily (i.e., modem will use the new configuration only until it is reset or power is cycled), enter *X1.
- To save the new configuration as a user defined profile that can be recalled and loaded in the future, use the &Wn command before entering *X1 to terminate the session and put the new configuration into use.

The following commands are invalid during a Remote Configuration session and will cause an error response:

- A (answer call)
- Dn (dial)
- Hn (hookswitch)
- On (on-line)
- &Tn (test mode), except &T4 and &T5

Data Mode

The V.F 28.8/33.6 modem is in data mode while it has a telephone line connection to another modem or is in the process of establishing a connection. In Data Mode the modem transmits all the data it receives from the DTE over the phone line.

In data mode the modem can operate either asynchronously or synchronously, as specified by the &M command. A variety of data protocols are available for each type of operation. Some protocols provide error correction to improve reliability and/or data compression to increase throughput. The two types of data mode operation, and their protocols, are described at length in the following pages.

Each telephone line connection (whether switched network or private line) between two modems in data mode begins with a handshaking sequence. During that sequence the modems determine the VF (telephone line) speed, data protocol, and related parameters for the data link. Configuration determines the range of choices available to the modem in the negotiation process. Most configuration options in the V.F 28.8/33.6 modem act to limit the range over which a parameter can be negotiated, rather than making specific assignments.

The modem's DTE can cause it to enter data mode and initiate dialing (switched network) or handshaking (private line) by asserting the Data Terminal Ready (DTR) signal at the interface or by issuing an AT command to dial. Configuration determines whether or not the modem

is controlled by DTR. The presence of a carrier from a remote modem will cause the V.F 28.8/33.6 modem to enter data mode and assert a Data Carrier Detect (DCD) signal to its DTE.

Asynchronous Operation

When you select Operating Mode 0 (&M0) the V.F 28.8/33.6 modem will operate asynchronously both while on-line (data mode - connected to the telephone line) and while off-line (Command Mode - disconnected from the telephone line).

The V.F 28.8/33.6 modem can employ error correction (reliable) protocols to ensure error-free delivery of asynchronous data sent between computers. The error control methods are based on grouping data into frames with checksums determined by the contents of each frame. The receiving modem checks the frames and sends acknowledgments to the transmitting modem. When it detects a faulty frame, the receiving modem requests a re-transmission. Frame length varies according to the amount of data transmitted or the number of re-transmissions requested from the DTE.

The modem can achieve DTE speeds greater than the maximum VF speed through the use of a data compression protocol. The asynchronous compression protocol available is the V.F 28.8/33.6: ITU-T V.42 *bis*. It attempts to increase throughput by compressing the information to be sent before actually sending it. The modem is thus able to transmit more data in a given period of time. Characteristics of the individual compression technique are discussed below.

The V.F 28.8/33.6 supports the following asynchronous DTE speeds:

128,000 bps	115,200 bps	112,000 bps	96,000 bps
76,800 bps	72,000 bps	64,000 bps	57,600 bps
56,000 bps	48,000 bps	38,400 bps	32,000 bps
28,800 bps	26,400 bps	24,000 bps	21,600 bps
19,200 bps	16,800 bps	14,400 bps	12,000 bps
9600 bps	7200 bps	4800 bps	2400 bps
1200 bps	300 bps		

The V.F 28.8/33.6 supports the following VF data speeds:

33,600 bps	31,200 bps	28,800 bps	26,400 bps
24,000 bps	21,600 bps	19,200 bps	16,800 bps
14,400 bps	12,000 bps	9600 bps	7200 bps
4800 bps	2400 bps	1200 bps	300 bps

Error Correcting Modes

The V.F 28.8/33.6 modem can employ the following error correcting mode:

- V.42 (LAPM) reliable

The \N command selects the modem's error correcting mode. The modem interprets \N in combination with the %C command to determine what data compression protocol (if any) is available. [Table 3-3](#) shows the combinations of those commands that achieve the various available modes. The full characteristics of each command are described in *Chapter 4, AT Command Set Operation*.

Each mode has specific features that impact how the modem will function. One major distinction between the standard modem state and the error correction modem state is that bi-directional data buffering and flow control are required for error correction. Buffering and flow control allow the modem to operate with the computer serial port and the modem port set for different data rates. Flow control is discussed following the descriptions of the error correcting and compression protocols.

V.42 (LAPM) Reliable Mode Error Correction

The V.42 (LAPM) reliable error correction mode first looks for the LAPM character during the handshake. The modem transmits a Link Access Protocol (LAPM) character as part of the handshake when it attempts to negotiate a V.42 link. The V.42 protocol provides error correction compliant with the ITU-T V.42 error correction scheme and supports the ITU-T V.42 *bis* data compression algorithm.

Due to increased complexities during the handshaking procedures, the V.42 (LAPM) reliable mode is recommended for use only with other V.42 modems when data integrity is critical.

Non-Error Correcting Modes

The V.F 28.8/33.6 modem also employs the following non-error correcting modes:

- wire mode
- direct V.14 asynchronous mode
- V.13 mode

These modes are configured using the \N command. *Chapter 4, AT Command Set Operation* contains full description of the options for that command.

Wire Mode

Wire mode (\N0) is used to communicate with standard, non-error correcting modems. The V.F 28.8/33.6 will fall back to wire mode if it fails in an attempt to negotiate an auto-reliable link with the remote modem. Error correction is not active in wire mode.

Wire mode provides data buffering so that the modem's DTE and VF interfaces can operate at different speeds. For example, the local DTE can exchange data with the local modem at 19,200 bps while the modem communicates at 2400 bps with the remote modem. To do this, however, the local terminal emulation software must allow its autobaud feature to be turned off and allow flow control.

Direct V.14 Asynchronous Mode

In direct V.14 mode (\N1) there is no error correction, data compression, or data buffering. The modem's DTE data rate and VF line speed must be set to the same value. If, for example, the link between the V.F 28.8/33.6 and the remote modem operates at 9600 bps, then the local DTE must exchange data with the V.F 28.8/33.6 at 9600 bps.

V.13 Mode

V.13 mode (\N1) is a simulated controlled carrier mode designed for polling applications. It uses the ITU-T V.13 RTS/DCD signaling method to control the remote modem's DCD lead via the local modem's RTS lead. It can be used for both synchronous and asynchronous data.

The RTS/DCD signaling can be configured for either bi-directional or unidirectional control by the &E command.

Flow Control

The V.F 28.8/33.6 modem supports flow control. In combination with internal data buffering flow control permits portions of a data link to operate at different speeds. For example, the rate of transfer between the local DTE and modem can be greater than the VF line speed negotiated between the local and remote modems, while the modem-to-DTE transfer rate at the remote site can differ from both. The modems' buffers compensate for such differences to a large degree, but flow control comes into play when data traffic approaches the limits of buffer capacity. Flow control meters incoming data and can stop it from coming in when there is not enough room available in the modem's internal buffer. Without flow control, data will be lost if the modem port and the VF line interface don't operate at the same bps rate.

Error correction and data compression are both sources of the rate differences that flow control and buffering compensate for.

Flow control can be achieved either by software or by hardware. Software flow control involves control characters inserted within the transmitted data. Hardware flow control is achieved by altering the voltage level of various signal lines at the interface between the computer's serial port and the modem. The V.F 28.8/33.6 supports three forms of hardware flow control: one (described below) that is compatible with asynchronous operation, and two that are only for use with synchronous data compression.

Software Flow Control

Software flow control uses the XON and XOFF characters, which are also known as Control-Q and Control-S, respectively. The characters are inserted in the transferred data.

Use of XON/XOFF software flow control requires care to make sure that only the desired element in the system responds to the flow control characters. If you are using XON/XOFF to control the local serial port, you may not want the flow control characters to be passed along to the remote modem with the data.

The \G command is used to determine whether the V.F 28.8/33.6 processes the flow control characters and passes them to the remote modem along with the data, or simply processes them and deletes them from the data stream.

Hardware Flow Control

Hardware flow control can be either unidirectional or bi-directional. Exactly how you set the flow control commands depends on your application. Bi-directional hardware flow control is recommended if your application demands both file uploads and downloads and the transfer protocol does not support any form of XON/XOFF.

Hardware flow control for asynchronous operation usually uses the signals RTS (request to send) and CTS (clear to send). Study the commands \G and \Q in the Extended AT Command Set in *Chapter 4, AT Command Set Operation* for further information on this topic. In MNP Reliable Mode or V.42 Mode the protocol itself controls data flow on the modem port. Retransmissions due to a very noisy phone line may cause the buffer to fill, however, so the use of flow control on the serial port is still important.

[Table 3-14](#) lists the AT commands used to enable the different types of data compression and error correction.

Table 3-14 Enabling Error Correction/Data Compression

To Enable	Use AT Commands
V.42 Auto Reliable V.42 <i>bis</i> Wire	\N3 and %C1
V.42 (LAPM) and V.42 <i>bis</i> only	\N4 and %C1
V.42 only	\N4 and %C0
V.42, V.42 <i>bis</i> or MNP 2-5 only	\N5 and %C1
No data compression and no error correction	\N0 or \N1, and %C0

Synchronous Operation

Synchronous Operating Modes

The **&Mn** (Operating Mode) command selects between asynchronous and synchronous Data Mode operation. Its synchronous mode setting, **&M1**, supports asynchronous dialing with synchronous transmission.

Each synchronous operating mode is detailed on the following pages.

Following the descriptions of the dialing/data transmission modes the manual describes the three available synchronous protocols. The **\Mn** command selects the protocol that the modem will follow while it is in synchronous Data Mode.

In addition, the V.F 28.8/33.6 modem can be configured for synchronous operation by selecting one of the above synchronous operating modes from the front panel.

Asynchronous Dialing with Synchronous Transmission

The **&M1** mode, Asynchronous Dialing with Synchronous Transmission, supports DTE that are capable of communicating synchronously or asynchronously over the same RS-232 port.

Your call is placed using the asynchronous command set. Once the call connection is established, the V.F 28.8/33.6 modem will automatically switch to synchronous operation.

The **&M1** mode also permits you to use an asynchronous DTE to dial and then switch to a synchronous-only DTE once the call is connected. If the **&D** setting is other than **&D0**, the **S25** register will determine the length of time permitted to switch DTE before the call is disconnected.

Direct Dialing in Synchronous Mode

Direct dialing in synchronous data mode can be accomplished in either of two ways:

- DTR dialing, selected by %Zn
- V.25 bis commands

When DTR dialing is enabled (%Z1), the V.F 28.8/33.6 modem will automatically dial the previously stored number (stored using the &Zn=nnn command) when it detects an OFF to ON transition on DTR.

If you wish to save this profile, issue the &W command. The modem will then come up in this mode any time power is applied.

Note *Once DTR dialing has been selected, you may find that the modem goes off-hook and begins dialing the stored number the moment you connect your DTE. To prevent this, turn off your modem before you connect the DTE to the modem. When the connection is complete, turn the modem back on.*

The V.25 bis command set is described in detail in *Chapter 5, V.25 bis Command Set Operation*.

Normal Synchronous Mode

The \M0 command selects the Synchronous Protocol for normal synchronous operation. The modem employs a constant carrier on the VF line. The DTE-to-VF speed relationship is direct, that is the two speeds must match.

The following DTE data rates are available (\Tn command) when the modem operates in normal synchronous mode:

28,800 bps	26,400 bps	24,000 bps	21,600 bps
19,200 bps	16,800 bps	14,400 bps	12,000 bps
9600 bps	7200 bps	4800 bps	2400 bps
1200 bps	300 bps		

V.13 Synchronous Mode

The \M1 command selects the Synchronous V.13 Protocol. V.13 mode is a simulated controlled carrier mode designed for polling applications. It uses the ITU-T V.13 RTS/DCD signaling method to control the remote modem's DCD lead via the local modem's RTS lead.

The RTS/DCD signaling can be configured for either bi-directional or unidirectional control by the &E command.

The following DTE data rates are available ($\backslash Tn$ command) when the modem operates in V.13 synchronous mode:

28,800 bps	26,400 bps	24,000 bps	21,600 bps
19,200 bps	16,800 bps	14,400 bps	12,000 bps
9600 bps	7200 bps	4800 bps	2400 bps
1200 bps	300 bps		

Synchronous Compression Mode

The $\backslash M2$ command selects the Synchronous Compression Protocol. The modem can compress synchronous DTE data framed in HDLC/SDLC format, with a maximum frame length of 2048 bytes.

Note *Synchronous Compression is an optional feature that is not included in all V.F 28.8/33.6 modems. To check the presence of the feature in your modem, use AT command I5 to display a list of information concerning the modem. Sync Compression On/Off is included in that list.*

Synchronous compression supports the following DTE data rates ($\backslash Tn$ command):

128,000 bps	115,200 bps	112,000 bps	96,000 bps
76,800 bps	72,000 bps	64,000 bps	57,600 bps
56,000 bps	48,000 bps	38,400 bps	32,000 bps
28,800 bps	26,400 bps	24,000 bps	21,600 bps
19,200 bps			

Two techniques for modem-to-DTE hardware flow control are available for use with synchronous compression. Both require that the modem be configured for internal timing (see below). Flow control for synchronous compression can be accomplished by:

- Clock Stopping (\Q5) in which the modem prevents buffer overflow by sharply reducing the frequency of the transmit clock signal it outputs to the DTE.
- Clock Throttling (\Q6) in which the modem prevents buffer overflow by varying the rate at which it outputs the transmit clock signal to the DTE.

Clock Selection

The synchronous format relies on transmit and receive clocks to maintain character timing. It therefore does not need start and stop bits for each character as does the asynchronous format. The V.F 28.8/33.6 modem can be configured to use one of the following three clock sources to transmit synchronous data:

- Internal (&X0) - transmit clock generated by the V.F 28.8/33.6 modem.
- External (&X1) - transmit clock signal generated by the DTE is passed to the modem along with data.
- Receiver (&X2) - transmit clock derived by the local modem from the data it is receiving from the remote modem (also called wrap timing).

The preferred clock source varies for different computer systems. Consult your computer's manual for its particular specifications.

Regardless of which transmit clock source it is using, the V.F 28.8/33.6 modem always outputs its transmit clock signal to the DTE on pin 15 of the EIA interface. Pin 17 always provides the receive clock signal derived from the incoming data. When the DTE provides external transmit clock it does so on Pin 24.

Note *The receive clock is always controlled by the remote modem that sends the data being received. It is not recommended to have the local and remote modems both configured to derive transmit clock from received data.*

Switched Network Operation

To establish a connection with another modem, you use the auto-dial facility of the V.F 28.8/33.6 modem.

Telephone Lines

To achieve optimum throughput with the V.F 28.8/33.6 modem it is advisable to connect it to a single switched line, that only it uses. If it is connected to a business telephone system, such as a multi-line key system or PBX, there can be noise generated by the system that can affect telephone quality.

Many telephone companies offer "call waiting" service that alerts you to another call coming in while you are on the line. Call waiting service can interfere with modem data calls or even disconnect the modem. In error correction mode the modem will correct data interference caused by call-waiting, but doing so degrades throughput. If you have call-waiting, you should disable it while you are on the line to prevent loss of through-put. In some areas, for example, you can disable call waiting by dialing 70# or *70 on your pushbutton telephone. Verify the call-waiting numbers with your local telephone company.

The following are examples of commands to send to the modem to disable call waiting for the duration of a call (the telephone number 555-1234 is provided for example only):

ATDT*70W5551234
(For Touch-Tone Dialing)

ATD1170W5551234
(For Both Pulse and Touch-Tone Dialing)

Note After the *70 or 1170 number is dialed, your PSTN should respond with dial tone. The call you then dial will have the call-waiting feature disabled for its duration. Once the call is disconnected, the call-waiting feature will re-enable itself. Verify the numbers and their effects with your local telephone company.

Another method is to set your modem to S10=150. This setting lets your modem ignore a brief cut-off caused by call-waiting, and prevents it from hanging up while on-line.

Private Line Operation

Besides being able to operate over the public switched telephone network, the V.F 28.8/33.6 modem can be configured to operate over a point-to-point, unconditioned, voice grade private line (speech band leased line).

Point-to-point private lines rented from the telephone company are dedicated, direct, semi-permanent phone line connections between two locations. In applications that require a continuous data transfer between fixed points, it may be more economical to rent a private line at a fixed rate, than to pay monthly long distance charges for dial up calls. The communication link between two multiplexers will generally involve a modem operating over private lines.

Note *Speeds below V.32 4800 bps are not supported in private line operation.*

Two-wire or Four-wire Selection

The V.F 28.8/33.6 modem is capable of operation on private line networks, using either 4-wire or 2-wire circuits. Use &L1 to select 2-wire operation or &L2 to select 4-wire operation.

-
- Note**
- a. *For proper private line connection, the 8-pin cable should be used to connect the modem's jack marked PL to the JM8 wall outlet supplied by your service provider.*
 - b. *It is recommended that the front panel be used to set and store the transmit levels. Before using the AT command to set/store the transmit levels, verify that the correct value is entered using the front panel display.*
 - c. *When using Factory Default 0 (&F0) to set up a private line connection, make all other option settings before issuing the &L1 or &L2 command. The modem will begin its training sequence at once when it is given the &L command. (To abort training sequence and return to Command mode you can either press the SEL button three times or press the AL button.*
-

Other Configuration

Configuring the V.F 28.8/33.6 for private line operation is very simple. In any private line connection, first designate one modem as the originate modem (%O0) and the other as the answer modem (%O1). Next, configure both modems for the type of communication they are intended to perform: these include normal or reliable modes (\N command), synchronous or asynchronous modes (&M command), DTE and VF speeds (\T and &P commands), etc. Select &P0 (V.34 only), &P1 (V.32 bis only) or &P2 (V.32 only) to establish the desired modulation in private line.

It is also possible to configure the modem for private line operation as above from the front panel.

Transmit Level

It is possible in private line operation for the transmit levels of the modems to be either too low or too high. When that is the case the connection usually will not be dependable and will be filled with errors. To correct such situations, the transmit level of the V.F 28.8/33.6 for private line operation can be configured in 1 dBm increments between 0 dBm and -15 dBm. This selection can be done either from the front panel or with the :T command. See *Chapter 4, AT Command Set Operation* for details.

Note *It is recommended that you permanently store the above settings either by entering the &W command, or by using the front panel and saving the entry. The modems are now ready for private line communications.*

Automatic and Manual Handshaking

The V.F 28.8/33.6 modems utilize a private line "idle" mode to facilitate the use of the AT command set for private line set up. The modems can be put into private line idle via the front panel talk/data switch (SEL key), AT command H, or the MMS command Private Line Talk/Data. If the modems are already trained and option changes are desired, a "+++" sequence can be used to enter command mode. After the changes are complete, an O command can be used to go back on line or an H command can be issued to go to idle. From idle, either the talk/data switch or O can be used to initiate a new connection. Once told to handshake, the modems will continuously try to complete a handshake. When this process is complete, the modem will display a CONNECT message on the DTE.

When communicating with a different modem in private line operations, the following steps outline how to configure the modems:

1. Configure both modems for the type of communications they are intended to perform.
2. Configure the V.F 28.8/33.6 modem as the ORIGINATE modem, using the %O0 command.
3. Again, use the &W command to permanently store the current configurations for both modems.

Auto Dial Restoral

Auto Dial Restoral (ADR) allows the V.F 28.8/33.6 modem to attempt automatic restoration of the data link over a switched network line if the private line fails.

When the originate modem goes into a retrain (because of poor signal quality or a line interruption), the private line down timer (S-Register 40) is activated. The modem will continue retrains until successful or until the timer expires. When a retrain is successful, the timer is reset. If the timer expires before there is a successful retrain, the modem will attempt a switched network connection by dialing the number stored in cell 0. (This number may have dial modifiers to link to another cell or redial as many times as desired.) The modem stays in switched network mode until the lookback function returns it to private line mode or until you manually disconnect the call. If the modem cannot establish the switched network connection, it reverts to private line mode and starts the process over.

The originate modem's private line lookback timer (S-Register 41) determines how long the modem will operate on the switched network connection before it tries to return to private line mode. When the private line lookback timer expires, the modem will attempt a private line handshake. When the private line connection is made, the modem will drop the switched network call. If the private line connection cannot be made, the modem will reset the timer and try again when the timer expires. (If the timer is disabled, the modem makes no attempts to return to the private line.)

There are two configurations for Auto Dial Restoral: restore the data link with a switched network connection to the same modem used in private line mode, or restore the data link with a switched network connection to a different modem (usually one in a modem pool).

Note *Character Abort should be disabled (Command %K1) in modems that will perform Auto Dial Restoral. If this is not done, data on the modem's interface leads can cause dialing to abort.*

To restore the data link with a switched network connection to the same modem, you must ensure the following:

- Both modems (originate and answer) must have Auto Dial Restoral enabled (&Bn command). Use &B2 when dial restoral is expected to appear as a retrain. This is typical when the modem being dialed is the one on the answer end of the failed private line.
- Cell 0 of the originate modem must contain the phone number of the answer modem.

- The private line down timer for the originate modem must be enabled (S-Register 40 must be non-zero).
- Automatic answer for the answer modem must be enabled (S-Register 0 must be non-zero).
- The private line answer modem must be in a retrain or be idle to be able to answer a call.

To restore the data link with a switched network connection to a different modem, you must ensure the following:

- The originate modem must have Auto Dial Restoral enabled (&Bn command). Use &B1 when a line failure indication is required at the DTE (the DSR, CD and CTS signals operate according to their options between dial restoral and successful lookback operations). This is typical when the dial-back answer modem is in a modem pool.
- Cell 0 of the originate modem must contain the phone number of the answer modem.
- The private line down timer for the originate modem must be enabled (S-Register 40 must be non-zero).
- The answer modem can be any compatible switched network modem.

Testing The Modem

Chapter 6, Tests describes basic diagnostics. Tests performed with the modem in asynchronous mode do not use error control. Consequently, by making the remote loop test during an error control connection, the error control mode is terminated and transmission errors caused by the transmission link can be detected.

Chapter 4: AT Command Set Operation

Overview

This section describes the V.F 28.8/33.6 modem's AT (attention) command set. The complete AT command set includes the basic AT and extended AT&, AT%, AT\, AT: and AT* command sets.

This section includes several tables listing the AT commands. They group the commands as follows:

- By option name ([Table 4-1](#)) - Use this table if you know the name of an option and need to find out what its AT command is and on which page it is described.
- By the type of function ([Table 4-2](#)) - Use this table to find out which options apply to terminal configuration or diagnostics, for example. It closely follows the structure seen when using the front panel.
- By command set ([Table 4-3](#)) - Use this table when you know that what you're looking for is an AT& command, for example, but you can't remember if it's &C*n* or &D*n*.

The above tables list only the name and command. To quickly see the choices available for each command, use [Table 4-4](#) through [Table 4-9](#). They provide a brief description of all of the choices for each command. Each table groups one command set. A detailed command reference follows these tables.

Commanding The Modem

The V.F 28.8/33.6 supports the AT command protocol that permits you to:

- Obtain information from the modem
- Configure the modem
- Establish data communications
- Test the modem and data communications system

After the modem is installed and/or powered up, it is in the command mode and will accept commands from the terminal. Each command (except A/) must be preceded by the letters AT and followed by a carriage return or enter (enter). A/ is used to repeat the last command without entering the AT-prefix. When AT is entered, the modem detects the data rate and parity used by the terminal and begins operating at that same data rate and parity until it gets changed.

Note***Special Considerations in Asynchronous Operation***

The V.F 28.8/33.6 modem is shipped from the factory with the data terminal (DTE) interface set for 7 bits with parity, at the last AT speed. This determines the modem's DTE speed when auto answering. If no commands are entered, to change and store a new default, set your terminal/communication program to the desired speed, data length and parity. Then type "AT&W." This stores the DTE interface parameters. These parameters remain until an AT command is entered which will change the modem's DTE speed from the stored values.

Up to 40 command characters may be entered. AT commands that exceed 40 characters will not be executed. The AT prefix, space, carriage return and line feed characters are ignored by the modem, and therefore do not count as part of the command line. A carriage-return character must be entered at the end of the command line, otherwise the command will not be processed. Mistakes may be corrected by typing the backspace character. This will move the cursor over the character to be corrected. The AT prefix cannot be deleted.

After each command is entered, the modem responds by sending a result code back to the terminal. Unless the result code function is disabled or the communications software being run on a computer emulating a terminal ignores result codes, the code is displayed by the terminal to indicate the result of the entered command. Valid commands return OK; invalid commands return ERROR.

New commands can not be issued until a response to the previous command is received. If there is no response, a wait of three character times is required before the next command. If the DTE rate is changed then 1 second must elapse.

Setup Procedures

1. Install the V.F 28.8/33.6 modem as described in *Chapter 2, Installation* .
2. Select the proper communications port on the terminal or terminal emulator program and ensure 10 bit ASCII is selected.
3. If a communications software package is being used, it will interface with the modem and no further setup is required. Refer to the documentation for the communication software package.

4. If the modem is being used interactively on a terminal or with a terminal emulation package, issue AT\$ (enter). If the V.F 28.8/33.6 is connected properly, it will respond to the command by displaying the basic AT command set help menu.
5. Use the commands in this section to configure and operate the V.F 28.8/33.6 as required.

Table 4-1 AT Commands Listed by Name

Name	Cmd.	Page
Adjustable transmit level display	S100?	4-48
Answer call	A	4-25
Answer mode	%On	4-39
Asynchronous protocol	\Nn	4-38
AT command set help	\$	4-24
AT% command set help	%%\$	4-24
AT& command set help	&\$	4-24
AT: command set help	: \$	4-24
AT\ command set help	\\$	4-24
AT* command set help	*\$	4-24
Auto Dial Restoral	&Bn	4-26
Auto-reliable fallback character	%An	4-25
Automatic answer	S0=x	4-45
Automatic fallforward/fallback	&An	4-25
Backspace character	S5=x	4-45
Break character handling	\Kn	4-37
Call Progress Monitor	Xn	4-56
Call Progress Monitor message response speed	%Rn	4-42
Carriage return character	S3=x	4-45
Carrier loss timer	S10=x	4-46
Carrier presence timer	S9=x	4-46
Carrier, dial and ringback wait timer	S7=x	4-45
Character abort	%Kn	4-36
Character length	\Bn	4-26
Command format	%Vn	4-52
Connect message type	\Vn	4-52

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Table 4-1 AT Commands Listed by Name (Continued)

Name	Cmd.	Page
Country code	N?	4-38
CTS operation	&R <i>n</i>	4-41
Data compression	%C <i>n</i>	4-27
DCD operation	&C <i>n</i>	4-26
DCE rate limit	&G <i>n</i>	4-34
Dial	D <i>n</i>	4-28
Dial pause timer	S8= <i>x</i>	4-46
Dial tone wait timer	S6= <i>x</i>	4-45
Dialing type	P, T	4-39 , 4-49
DSR operation	&S <i>n</i>	4-48
DSR operation in test mode	%D <i>n</i>	4-29
DTE interface-controlled tests	%E <i>n</i>	4-29
DTE speed	\T <i>n</i>	4-50
DTR delay timer	S25= <i>x</i>	4-47
DTR dialing	%Z <i>n</i>	4-58
DTR On-to-Off transition	&D <i>n</i>	4-29
Escape code character	S2= <i>x</i>	4-45
Escape code guard timer	S12= <i>x</i>	4-46
Fallback selection and pre-link data buffer	\C <i>n</i>	4-27
Front panel lockout	&I <i>n</i>	4-36
General security password	%P <i>n</i>	4-40
Hang-up delay timer	S38= <i>x</i>	4-47
Hookswitch	H <i>n</i>	4-35
Identification and checksum	I <i>n</i>	4-36
Line feed character	S4= <i>x</i>	4-45
Load fixed configuration profile	&F <i>n</i>	4-30
Load user configuration profile	Z <i>n</i>	4-57
Local DTE echo	E <i>n</i>	4-29
Long space disconnect	Y <i>n</i>	4-57
Make busy	%B <i>n</i>	4-26
Modem-to-DTE flow control	\Q <i>n</i>	4-41
Modem-to-modem flow control	\G <i>n</i>	4-34

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Table 4-1 AT Commands Listed by Name (Continued)

Name	Cmd.	Page
Network type	&Ln	4-37
On-line	On	4-39
Operating mode	&Mn	4-38
Overspeed correction	\An	4-25
Parity type	\Pn	4-40
Password cell qualifier	%Fn	4-33
Password operation	%Sn	4-49
Power-up user configuration profile	&Yn	4-57
Private line down timer	S40=x	4-47
Private line handshake mode	&Pn	4-39
Private line lookback timer	S41=x	4-48
Private line transmit level	:Tn	4-51
Remote configuration control	*Wn	4-56
Remote configuration exit	*Xn	4-57
Remote configuration security password	*Pn	4-40
Remote configuration write access	*Rn	4-43
Repeat command	A/	4-26
Response mode	Qn	4-40
Result code type	Vn	4-52
Retrain on poor signal quality	%Qn	4-40
Retransmission counter	S70=x	4-48
Ring counter	S1=x	4-45
RTS-to-CTS delay timer	S26=x	4-47
S-Register help	S\$	4-25, 4-43
S-Registers	Sn	4-43
Save settings as a user configuration profile	&Wn	4-56
Simulated controlled carrier	&En	4-29
Speaker operation	Mn	4-37
Speaker volume	Ln	4-37
Store a phone number	&Zn=nnn	4-58
Store password	%Pn=nnn	4-40
Switched network handshake mode	&Hn	4-35

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Table 4-1 AT Commands Listed by Name (Continued)

Name	Cmd.	Page
Switched network transmit type	:P <i>n</i>	4-40
Synchronous protocol	\M <i>n</i>	4-38
Test mode	&T <i>n</i>	4-49
Test mode timer	S18= <i>x</i>	4-46
Transmit clock source	&X <i>n</i>	4-56
Trellis coding	&U <i>n</i>	4-51
View stored phone numbers	&V	4-52

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Table 4-2 AT Commands Listed by Function

Name	Cmd.
AT Command Set Options	
AT command set help	\$
AT& command set help	&\$
AT% command set help	'%\$
AT\ command set help	\\$
AT: command set help	:\$
AT* command set help	*\$
Repeat command	A/
S-Register help	S\$
S-Registers	S <i>n</i>
Configuration Profile Options	
Load fixed configuration profile	&F <i>n</i>
Load user configuration profile	Z <i>n</i>
Power-up user configuration profile	&Y <i>n</i>
Save settings as a user configuration profile	&W <i>n</i>
Diagnostics Options	
DSR operation in test mode	%D <i>n</i>
DTE interface-controlled tests	%E <i>n</i>
Test mode	&T <i>n</i>
Test mode timer	S18= <i>x</i>

(Sheet 1 of 4)

Table 4-2 AT Commands Listed by Function (Continued)

Name	Cmd.
Dialer Options	
Command format	%Vn
Dial	Dn
Dial pause timer	S8=x
Dial tone wait timer	S6=x
Dial wait timer	S7=x
Dialing type	P, T
DTR dialing	%Zn
Ringback wait timer	S7=x
Store a phone number	&Zn=nnn
View stored phone numbers	&V
Modem Options	
Answer call	A
Automatic answer	S0=x
Carrier loss timer	S10=x
Carrier presence timer	S9=x
Carrier wait timer	S7=x
Country code	N?
Front panel lockout	&ln
General security password	%Pn
Hang-up delay timer	S38=x
Hookswitch	Hn
Identification and checksum	ln
Long space disconnect	Yn
Make busy	%Bn
On-line	On
Remote configuration control	*Wn
Remote configuration exit	*Xn
Remote configuration security password	*Pn
Remote configuration write access	*Rn
Retransmission counter	S70=x
Ring counter	S1=x

(Sheet 2 of 4)

Table 4-2 AT Commands Listed by Function (Continued)

Name	Cmd.
Speaker operation	<i>Mn</i>
Speaker volume	<i>Ln</i>
Transmit clock source	<i>&Xn</i>
Network Options	
Auto Dial Restoral	<i>&Bn</i>
Network type	<i>&Ln</i>
Private line down timer	<i>S40=x</i>
Private line lookback timer	<i>S41=x</i>
Private line transmit level	<i>:Tn</i>
Switched network transmit type	<i>:Pn</i>
Protocol Options	
Answer mode	<i>%On</i>
Asynchronous protocol	<i>\Nn</i>
Auto-reliable fallback character	<i>%An</i>
Automatic fallforward/fallback	<i>&An</i>
Data compression	<i>%Cn</i>
Modem-to-modem flow control	<i>\Gn</i>
Private line handshake mode	<i>&Pn</i>
Retrain on poor signal quality	<i>%Qn</i>
Simulated controlled carrier	<i>&En</i>
Switched network handshake mode	<i>&Hn</i>
Synchronous protocol	<i>\Mn</i>
Trellis coding	<i>&Un</i>
Terminal (DTE) Options	
Backspace character	<i>S5=x</i>
Break character handling	<i>\Kn</i>
Call Progress Monitor	<i>Xn</i>
Call Progress Monitor message response speed	<i>%Rn</i>
Carriage return character	<i>S3=x</i>
Character abort	<i>%Kn</i>
Character length	<i>\Bn</i>
Connect message type	<i>\Vn</i>

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Table 4-2 AT Commands Listed by Function (Continued)

Name	Cmd.
CTS operation	&R <i>n</i>
DCD operation	&C <i>n</i>
DSR operation	&S <i>n</i>
DTE speed	\T <i>n</i>
DTR delay timer	S25= <i>x</i>
DTR On-to-Off transition	&D <i>n</i>
Escape code character	S2= <i>x</i>
Escape code guard timer	S12= <i>x</i>
Line feed character	S4= <i>x</i>
Local DTE echo	E <i>n</i>
Modem-to-DTE flow control	\Q <i>n</i>
Operating mode	&M <i>n</i>
Overspeed correction	\A <i>n</i>
Parity type	\P <i>n</i>
Fallback selection and pre-link data buffer	\C <i>n</i>
Response mode	Q <i>n</i>
Result code type	V <i>n</i>
RTS-to-CTS delay timer	S26= <i>x</i>

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Table 4-3 AT Commands Listed by Command Set

Name	Cmd.
Basic AT Command Set	
Answer call	A
AT command set help	\$
Automatic answer	S0= <i>x</i>
Backspace character	S5= <i>x</i>
Call Progress Monitor	X <i>n</i>
Carriage return character	S3= <i>x</i>
Carrier loss timer	S10= <i>x</i>

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Table 4-3 AT Commands Listed by Command Set (Continued)

Name	Cmd.
Carrier presence timer	S9=x
Carrier wait timer	S7=x
Country code	N?
Dial	Dn
Dial pause timer	S8=x
Dial tone wait timer	S6=x
Dial wait timer	S7=x
Dialing type	P
Dialing type	T
DTR delay timer	S25=x
Escape code character	S2=x
Escape code guard timer	S12=x
Hang-up delay timer	S38=x
Hookswitch	Hn
Identification and checksum	In
Line feed character	S4=x
Load user configuration profile	Zn
Local DTE echo	En
Long space disconnect	Yn
On-line	On
Private line down timer	S40=x
Private line lookback timer	S41=x
Repeat command	A/
Response mode	Qn
Result code type	Vn
Retransmission counter	S70=x
Ring counter	S1=x
Ringback wait timer	S7=x
RTS-to-CTS delay timer	S26=x
S-Register help	S\$
S-Registers	Sn
Speaker operation	Mn

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Table 4-3 AT Commands Listed by Command Set (Continued)

Name	Cmd.
Speaker volume	<i>Ln</i>
Test mode timer	S18= <i>x</i>
Extended AT& Command Set	
AT& command set help	&\$
Auto Dial Restoral	&B <i>n</i>
Automatic fallforward/fallback	&A <i>n</i>
CTS operation	&R <i>n</i>
DCD operation	&C <i>n</i>
DSR operation	&S <i>n</i>
DTR On-to-Off transition	&D <i>n</i>
Front panel lockout	&I <i>n</i>
Load fixed configuration profile	&F <i>n</i>
Maximum DCE speed	&G <i>n</i>
Network type	&L <i>n</i>
Operating mode	&M <i>n</i>
Power-up user configuration profile	&Y <i>n</i>
Private line handshake mode	&P <i>n</i>
Save settings as a user configuration profile	&W <i>n</i>
Simulated controlled carrier	&E <i>n</i>
Store a phone number	&Z <i>n=nnn</i>
Switched network handshake mode	&H <i>n</i>
Test mode	&T <i>n</i>
Transmit clock source	&X <i>n</i>
Trellis coding	&U <i>n</i>
View stored phone numbers	&V
Extended AT% Command Set	
Answer mode	%O <i>n</i>
AT% command set help	%%\$
Auto-reliable fallback character	%A <i>n</i>
Call Progress Monitor message response speed	%R <i>n</i>
Character abort	%K <i>n</i>
Command format	%V <i>n</i>

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Table 4-3 AT Commands Listed by Command Set (Continued)

Name	Cmd.
Data compression	%C <i>n</i>
DSR operation in test mode	%D <i>n</i>
DTE interface-controlled tests	%E <i>n</i>
DTR dialing	%Z <i>n</i>
General security password	%P <i>n</i>
Inactivity Timer	%T <i>n</i>
Make busy	%B <i>n</i>
Private Line Heartbeat	%H <i>n</i>
Retrain on poor signal quality	%Q <i>n</i>
Extended AT\ Command Set	
Asynchronous protocol	\N <i>n</i>
AT\ command set help	\\$
Break character handling	\K <i>n</i>
Character length	\B <i>n</i>
Connect message type	\V <i>n</i>
DTE speed	\T <i>n</i>
Modem-to-DTE flow control	\Q <i>n</i>
Modem-to-modem flow control	\G <i>n</i>
Overspeed correction	\A <i>n</i>
Parity type	\P <i>n</i>
Fallback selection and pre-link data buffer	\C <i>n</i>
Synchronous protocol	\M <i>n</i>
Extended AT: Command Set	
AT: command set help	:\$
Private line transmit level	:T <i>n</i>
Switched network transmit type	:P <i>n</i>
Extended AT* Command Set	
Remote configuration security password	*P <i>n</i>
Remote configuration write access	*R <i>n</i>
Remote configuration control	*W <i>n</i>
Remote configuration exit	*X <i>n</i>

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Table 4-4 Basic AT Command Set Summary

Command	Action
\$	AT command set help
\$	Display help menu for the basic AT command set
A/	Repeat command
A/	Repeat last command
A	Answer call
A	Answer incoming call
Dn	Dial
Dn	The dial command, followed by one or more dial command modifiers, manually dials a phone number: ! or & Flash hookswitch for 1/2 second , or < Pause before continuing. Time is in S-Register 8 (default: 2 seconds). :n Redial up to <i>n</i> times to achieve data mode ; Return to AT command mode @ Wait for quiet answer before continuing. Time is in S-Register 7 (default: 60 seconds). Ln Link to cell <i>n</i> if modem can't achieve data mode \i Remote modem uses cell <i>n</i> for Security Callback P Pulse (rotary) dialing R Reverse to answer mode. Must be the last character entered. S Stored number T Tone (DTMF) dialing W Wait for dial tone before continuing. Time is in S-Register 6 (default: 2 seconds). *,#,A,B,C,D,0,1,2,3,4,5,6,7,8,9 (DTMF digits) 0,1,2,3,4,5,6,7,8,9 (pulse digits)
En	Local DTE echo
E0	Disable
E1	Enable
Hn	Hookswitch
H0	Go on-hook (hang up modem)
H1	Go off-hook
In	Identification and checksum
I0	Display product code
I1	Display calculated checksum
I2	Compare stored checksum with calculated checksum
I3	Display firmware revision level (A-)
I4	Display a summary of all S-Registers

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Table 4-4 Basic AT Command Set Summary (Continued)

Command	Action
<i>Ln</i> L0 L1 L2 L3	Speaker volume Low volume (per Hayes technical reference manual) Low volume Medium volume High volume
<i>Mn</i> M0 M1 M2 M3	Speaker operation Speaker is always Off Speaker is On while dialing and handshaking, Off in data mode Speaker is always On Speaker is Off while dialing, On during handshaking and re-training
<i>N?</i> <i>N?</i>	Country code Display modem's current country code configuration
<i>On</i> O0 O1	On-line Go on-line (enter data mode) Go on-line and retrain (at any speed except 300 bps)
<i>P</i> <i>P</i>	Dialing type Pulse (rotary) dial
<i>Qn</i> Q0 Q1 Q2	Response mode Enable Disable (enable quiet mode) Disable in answer mode only
<i>Sn</i> S\$ Sn? Sn=x	S-Registers Display help menu for S-Registers Display contents of S-Register <i>n</i> Set S-Register <i>n</i> to value <i>x</i>
<i>T</i> <i>T</i>	Dialing type Tone (DTMF) dial
<i>Vn</i> V0 V1	Result code type Numeric result codes; connect message = VF line speed Alphanumeric (verbal) result codes; connect and protocol messages after link; connect message = DTE speed, except for ITU-T V.14 mode
<i>Xn</i> X0 X1 X2 X3 X4	Call Progress Monitor (CPM) Basic results; disable CPM Extended results; disable CPM Extended results and detect dial tone only Extended results and detect busy only Extended results, full CPM and detect ringback

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Table 4-4 Basic AT Command Set Summary (Continued)

Command	Action
<i>Yn</i> Y0 Y1	Long space disconnect Disable Enable
<i>Zn</i> <i>Zn</i>	Load user configuration profile Recall (load) user-defined configuration profile <i>n</i> (<i>n</i> = 0 to 3). Storable S-Registers are stored with user-defined settings.

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Table 4-5 Extended AT& Command Set Summary

Command	Action
&\$ &\$	AT& command set help Display help menu for the extended AT& command set
&An &A0 &A1	Automatic fallforward/fallback Disable Enable
&Bn &B0 &B1 &B2	Auto Dial Restoral Disable ADR Enable ADR, with line failure indication Enable ADR, without line failure indication
&Cn &C0 &C1 &C2 &C3	Controls the EIA Data Carrier Detect signal. Selects DCD to be forced On. Selects DCD to be On after link established. Selects DCD to be forced On; Toggle Carrier On disconnect. Selects Real mode (follows modem energy detection).
&Dn &D0 &D1 &D2 &D3	DTR On-to-Off transition Ignore (force DTR On) Enter AT command mode Go on-hook (hang up) Same as &D2, but perform the <i>Zn</i> command on a loss of DTR greater than S-25 timer
&En &E0 &E1 &E2	Simulated controlled carrier (ITU-T V.13) Enable in transmit and receive paths Enable in transmit path only Enable in receive path only

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Table 4-5 Extended AT& Command Set Summary (Continued)

Command	Action
&F <i>n</i> &F0	Load fixed configuration profile Switched network, asynchronous, ITU-T V.42 error correction, V.42 <i>bis</i> data compression
&F1	Switched network, synchronous
&F2	Two-wire private (leased) line, asynchronous
&F3	Two-wire private (leased) line, synchronous
&G <i>n</i> &G5 &G6 &G7 &G8 &G9 &G10 &G11 &G12 &G13 &G14 &G15 &G16 &G17	Maximum DCE speed 4.8 Kbps 7.2 Kbps 9.6 Kbps 12 Kbps 14.4 Kbps 16.8 Kbps 19.2 Kbps 21.6 Kbps 24 Kbps 26.4 Kbps 28.8 Kbps 31.2 Kbps 33.6 Kbps
&H <i>n</i> &H0 &H1 &H2 &H3 &H4 &H5 &H6 &H7 &H8 &H9 &H10	Switched network handshake mode V.34 auto (28.8 kbps to 300 bps) V.34 only (28.8 kbps to 9600 bps) ITU-T V.32 <i>bis</i> automatic (14.4 kbps to 300 bps) ITU-T V.32 <i>bis</i> only (14.4 kbps to 4800 bps) ITU-T V.32 automatic (9600 bps to 300 bps) ITU-T V.32 only (9600 bps to 4800 bps) ITU-T V.22 <i>bis</i> only (2400 bps to 1200 bps) ITU-T V.22 only (1200 bps) Bell 212 only (1200 bps) Bell 103 only (300 bps) ITU-T V.21 only (300 bps)
&I <i>n</i> &I0 &I1	Front panel control Disable Enable
&L <i>n</i> &L0 &L1 &L2	Network type Switched network Two-wire private (leased) line Four-wire private (leased) line

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Table 4-5 Extended AT& Command Set Summary (Continued)

Command	Action
&Mn &M0 &M1 &M2	Operating mode Asynchronous data mode Asynchronous command mode/synchronous data mode, with DTR-to-data delay (S-Register 25) Synchronous data mode
&Pn &P0 &P1 &P2	Private (leased) line handshake mode V.34 only (28.8 kbps to 9600 bps) ITU-T V.32 <i>bis</i> only (14.4 kbps to 4800 bps) ITU-T V.32 only (9600 bps to 4800 bps)
&Rn &R0 &R1 &R2 &R3	CTS operation Synchronous mode: RTS-CTS delay Asynchronous mode: On in command mode AT command mode: Force CTS On Synchronous mode: Real Asynchronous mode: On in command mode AT command mode: Force CTS On Synchronous mode: Real Asynchronous mode: Real AT command mode: Real Synchronous mode: Force CTS On Asynchronous mode: Force CTS On AT command mode: Force CTS On
	<i>Note: ITU-T V.13 simulated carrier (&En) and flow control (\Qn) options override the &Rn settings for CTS in data mode.</i>
&Sn &S0 &S1 &S2 &S3	DSR operation Force DSR On; toggle Off on disconnect Normal DSR operation DSR follows carrier detect Force DSR On
&Tn &T0 &T1 &T3 &T4 &T5 &T6 &T7 &T8 &T9	Test mode Cancel (terminate) test mode Initiate ITU-T V.54 Loop 3 test (ANALOOP) Initiate ITU-T V.54 Loop 2 test (Digital Loopback) Enable ITU-T V.54 Loop 2 test (Remote Digital Loopback) Disable ITU-T V.54 Loop 2 test (Remote Digital Loopback) Initiate ITU-T V.54 Loop 2 test (Remote Digital Loopback) Initiate ITU-T V.54 Loop 2 with self-test (Remote Digital Loopback Self-Test) Initiate ITU-T V.54 Loop 3 with self-test (ANALOOP Self-Test) End-to-End Self-Test

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Table 4-5 Extended AT& Command Set Summary (Continued)

Command	Action
&Un &U0 &U1	Trellis coding Enable Disable
&V &V	View stored phone numbers Display all 10 stored phone numbers, in sequence
&Wn &Wn	Save settings as a user configuration profile Save option settings as user configuration profile <i>n</i> in non-volatile RAM (<i>n</i> = 0 to 3)
&Xn &X0 &X1 &X2	Transmit clock source Internal clock (modem) External clock (DTE) Receiver wrap clock (network)
&Yn &Yn	Power-up user configuration profile Load user configuration profile <i>n</i> at power up (<i>n</i> = 0 to 3)
&Zn=nnn &Zn=nnn	Store a phone number Store phone number <i>nnn</i> (including dial command modifiers) in cell <i>n</i> (<i>n</i> = 0 to 9)

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Table 4-6 Extended AT% Command Set Summary

Command	Action
%%\$ %%\$	AT% command set help Display help menu for the extended AT% command set
%An %An	Auto-reliable fallback character Set auto-reliable fallback character to <i>n</i> (<i>n</i> = ASCII 0 to 127)
%Bn %B0 %B1 %B2 %B3 %B4	Make busy Disable Enable on loss of DTR Enable in ITU-T V.54 Loop 3 test (ANALOOP) Enable in ITU-T V.54 Loop 3 test (ANALOOP), or on loss of RTS or DTR Enable on loss of RTS

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Table 4-6 Extended AT% Command Set Summary (Continued)

Command	Action
%C <i>n</i> %C0 %C1 %C2 %C3	Data compression Disable Enable in transmit and receive paths Enable in transmit path only in V.42 <i>bis</i> Enable in receive path only in V.42 <i>bis</i>
%D <i>n</i> %D0 %D1	DSR operation in test mode Force DSR On during ITU-T V.54 Loop 3 test (ANALOOP) Force DSR Off during this test
%E <i>n</i> %E0 %E1	DTE interface-controlled tests Disable tests controlled by DTE interface pins Enable tests (ITU-T V.24 Circuit 140 and 141)
%H <i>n</i>	Private line heartbeat
%K <i>n</i> %K0 %K1	Character abort 2-second delay to character abort Disable
%O <i>n</i> %O0 %O1 %O2	Answer mode Answer mode if ringing Force to answer mode Automatic answer in originate mode
%P <i>n</i> %P <i>n</i> %P	General security password Define general security password (<i>n</i> = 1 to 10 characters) Disable or clear the password
%Q <i>n</i> %Q0 %Q1 %Q2	Retrain on poor signal quality Disable Attempt up to 3 consecutive retrains; disconnect if not successful Retrain until signal quality is good

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Table 4-6 Extended AT% Command Set Summary (Continued)

Command	Action
%R <i>n</i>	Call Progress Monitor (CPM) message response speed
%R0	Autobaud
%R1	Send at last connect speed
%R2	300 bps
%R3	1200 bps
%R4	2400 bps
%R5	4800 bps
%R6	7200 bps
%R7	9600 bps
%R8	12.0 kbps
%R9	14.4 kbps
%R10	16.8 kbps
%R11	19.2 kbps
%R12	21.6 kbps
%R13	24.0 kbps
%R14	26.4 kbps
%R15	28.8 kbps
%R16	31.2 kbps
%R17	33.6 kbps
%R18	38.4 kbps
%R19	57.6 kbps
%R20	76.8 kbps
%R21	115.2 kbps
%R22	128.0 kbps
%R23	32.0 kbps
%R24	48.0 kbps
%R25	56.0 kbps
%R26	64.0 kbps
%R27	72.0 kbps
%R28	96.0 kbps
%R29	112.0 kbps
%T <i>n</i>	Inactivity timer
%V <i>n</i>	Command format
%V0	AT command set
%V1	V.25 <i>bis</i> asynchronous command set
%V2	V.25 <i>bis</i> HDLC command set
%V3	V.25 <i>bis</i> BSC command set
%V4	None
%Z <i>n</i>	DTR dialing
%Z0	Ignore
%Z1= <i>x</i>	Dial cell <i>x</i>
%Z2	Go off-hook and attempt to handshake

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Table 4-7 Extended AT\ Command Set Summary

Command	Action
\\$	AT\ command set help
\\\$	Display help menu for the extended AT\ command set
\An	Overspeed correction
\A0	1.25% (nominal) asynchronous overspeed correction
\A1	2.5% (extended) overspeed correction
\Bn	Character length (data bits/parity/stop bits)
\B0	6N1
\B1	7N1
\B2	7P1 (\Pn command sets parity type)
\B3	8N1
\B4	7P2 (\Pn command sets parity type)
\B5	8P1 (\Pn command sets parity type)
\Cn	Fallback selection and pre-link data buffer
\C0	Timeout and fallback; speed buffer; no data buffer
\C1	Timeout and fallback; speed buffer; buffer receive data
\C2	Auto-reliable; fallback with fallback character speed buffer; no receive data buffer
\C3	Timeout and fallback; ITU-T V.14; buffer receive data
\C4	Timeout or fallback with fallback character; ITU-T V.14; no data buffer
\Gn	Modem-to-modem flow control
\G0	Disable
\G1	Enable XON/XOFF in transmit and receive paths
\G2	Enable in transmit path only
\G3	Enable in transmit and receive paths, with pass-through
\Kn	Break character handling
\K0	Expedite break; destroy buffers
\K1	Expedite break; save buffers
\K2	Timed break; save buffers
\K3	Ignore break
\K4	Timed break until no break character; save buffers
\K5	Timed break until no break character; save buffers
\Mn	Synchronous protocol
\M0	Normal synchronous mode
\M1	ITU-T V.13 synchronous mode (simulated controlled carrier)
\Nn	Asynchronous protocol
\N0	Wire mode
\N1	Direct ITU-T V.14 asynchronous mode
\N4	V.42 (LAPM) reliable mode (or drop call)
\N6	Simulated controlled carrier (ITU-T V.13)

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Table 4-7 Extended AT Command Set Summary (Continued)

Command	Action
\Pn	Parity type
\P0	Even
\P1	Space
\P2	Odd
\P3	Mark
\P4	Automatic (from last AT command)
\Qn	Modem-to-DTE flow control
\Q0	Disable in both directions
\Q1	Use XON/XOFF in both directions
\Q2	Use CTS
\Q3	Use RTS/CTS
\Q4	Use XON/XOFF from modem to DTE only
\Tn	DTE speed
\T0	Autobaud; %R sets CPM message response speed
\T1	Last AT speed
\T2	300 bps
\T3	1200 bps
\T4	2400 bps
\T5	4800 bps
\T6	7200 bps
\T7	9600 bps
\T8	12.0 kbps
\T9	14.4 kbps
\T10	16.8 kbps
\T11	19.2 kbps
\T12	21.6 kbps
\T13	24.0 kbps
\T14	26.4 kbps
\T15	28.8 kbps
\T16	31.2 kbps
\T17	33.6 kbps
\T18	38.4 kbps
\T19	57.6 kbps
\T20	76.8 kbps
\T21	115.2 kbps
\T22	128.0 kbps
\T23	32.0 kbps
\T24	48.0 kbps
\T25	56.0 kbps
\T26	64.0 kbps
\T27	72.0 kbps
\T28	96.0 kbps
\T29	112.0 kbps

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Table 4-7 Extended AT\ Command Set Summary (Continued)

Command	Action
\Vn	Connect message type
\V0	Connect message reports VF rate upon data mode, link message after link negotiation (GDC format)
\V1	Connect and protocol message sent after link negotiation, connect reported as DTE rate
\V2	Connect and protocol message after link negotiation and Microcom compatible, connect reported as VF rate
\V3	Connect message only after protocol negotiation, connect reported as DTE rate
\V4	Displays the transmit and receive DCE rate as CONNECT rrrrr ttttt, where rrrrr is receive speed, and ttttt is transmit speed. (Numeric result codes in asymmetrical mode indicate the receive speed.)

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Table 4-8 Extended AT: Command Set Summary

Command	Action
:\$	AT: command set help
:\$	Display help menu for the extended AT: command set
:Pn	Switched network transmit type
:P0	Permissive
:P1	Programmable
:Tn	Private (leased) line transmit level
:Tn	Set transmit level for private (leased) line to n dBm (n = 0 to 15, for 0 to -15 dBm; range depends on country code configuration)

Table 4-9 Extended AT* Command Set Summary

Command	Action
\$	AT command set help
\$	Display help menu for the extended AT command set
*Pn	Remote configuration security password
*Pn	Remote configuration security password (n = 1 to 11 characters)
*P	Disable or clear the password
*Rn	Remote configuration write access
*R0	Enable write access (read/write)
*R1	Disable write access (read only)
*Wn	Remote configuration control

Table 4-9 Extended AT* Command Set Summary (Continued)

Command	Action
*W0	Disable remote configuration
*W1	Enable remote configuration
*Xn	Remote configuration exit
*X0	Terminate session without saving changes
*X1	Terminate session and save changes

AT Command Reference

All commands are assumed preceded by an AT and followed by a carriage return. The only exception is the A/ command, which is used to repeat the last AT command. A description of each command follows. They are organized alphabetically, with all variations of the letter grouped together as follows:

- The basic AT command.
- The extended AT& command.
- The extended AT% command.
- The extended AT\ command.
- The extended AT: command.
- The extended AT* command.

Not every letter of the alphabet has a command for each of these groups.

\$ AT command set help

This command causes the modem to display the basic AT command set help menu.

&\$ AT& command set help

This command causes the modem to display the extended AT& command set help menu.

%% AT% command set help

This command causes the modem to display the extended AT% command set help menu.

\\$ AT\ command set help

This command causes the modem to display the extended AT\ command set help menu.

:\$ AT: command set help

This command causes the modem to display the extended AT: command set help menu.

***\$ AT* command set help**

This command causes the modem to display the extended AT* command set help menu.

S\$ S-Register help

This command causes the modem to display the S-Register help menu. Only S-Registers not containing bit mapped options will be displayed.

A Answer call

The A command directs the modem to answer an incoming call. It is used to go off-hook and generate the proper answer sequence.

&An Automatic fallforward/fallback

This command controls the automatic fallback and fall forward capabilities.

&A0 disables the fallforward/fallback feature.

&A1 enables the fallforward/fallback feature.

Note: The &A1 command functions only when the modem is optioned for synchronous data mode or for asynchronous with speed buffering, and only for V.32, V.32 bis, and V.34 modes.

%An Auto-reliable fallback character

This command selects the modem's auto-reliable fallback character, specified by a number between 0 and 127. The fallback character is an ASCII character (alphanumeric, punctuation, or control) that the modem will check for when it performs auto-answer and attempts to negotiate an auto-reliable (\N3) error correcting link on the VF line. If the modem detects two successive fallback characters, it will terminate the negotiation process and go directly to a non-error correcting mode.

The \C command determines which non-error correcting mode (wire or direct) the modem will fall back to, and what will become of data transferred to the modem during the negotiation process.

Appendix E contains a table that lists the ASCII characters and their corresponding numeric values. Note that fallback character detection is case-sensitive, since upper and lower case letters are separate ASCII characters.

\An Overspeed correction

This option selects overspeed correction for V.14 asynchronous data modes.

\A0 selects 1.25% (nominal) overspeed correction.

\A1 selects 2.5% (extended) overspeed correction.

A/ Repeat command

The A/ command, the only command not preceded by an AT, is used to re-execute the most recent AT command line sent to the modem. This command can be used to cause redial of a previous number when a handshake attempt fails.

&Bn Auto Dial Restoral

This command controls Auto Dial Restoral. Refer also to the Auto Dial Restoral feature description.

- &B0** disable Auto Dial Restoral.
- &B1** enable Auto Dial Restoral, with line failure indicator.
- &B2** enable Auto Dial Restoral, without line failure indicator.

%Bn Make busy

This command controls the make busy option as follows:

- %B0** make busy disabled.
- %B1** make busy on loss of DTR.
- %B2** make busy in ANALOOP.
- %B3** make busy on loss of RTS, loss of DTR, or in AL.
- %B4** make Busy on loss of RTS.

\Bn Character length

This command sets up the character length and format the modem uses in data mode for front ends that do not send AT commands. The character length includes start, data, parity, and stop bits. Default is \B2.

- \B0** character length = 8 bits (6 data)
- \B1** character length = 9 bits (7 data)
- \B2** character length = 10 bits (7 data, 1 parity). With automatic parity enabled (\P4), this also accommodates 8 data bits with no parity.
- \B3** character length = 10 bits (8 data)
- \B4** character length = 11 bits (7 data, parity, 2 stop)
- \B5** character length = 11 bits (8 data, parity)

Note: The V.42 and MNP protocols (\N2 through \N5) do not support 11-bit character lengths (\B4 and \B5).

&Cn DCD operation

The &Cn command controls the EIA Data Carrier Detect signal.

- &C0** selects DCD to be forced On.
- &C1** selects DCD to be real (follow modem energy detect).
- &C2** selects DCD to be forced On in Command mode, and real in Data mode.

%Cn**Data compression**

This option controls the selection of data compression for MNP-5 reliable, V.42 *bis* reliable, and synchronous data links.

- %C0** disables data compression.
- %C1** enables data compression in both directions.
- %C2** in V.42 *bis* or synchronous, enables data compression in the transmitter path. In MNP 5, enables data compression in both directions.
- %C3** in V.42 *bis* or synchronous, enables data compression in the receiver path. In MNP 5, enables data compression in both directions.

\Cn**Fallback selection and pre-link data buffer**

This command determines fallback selection. If an error correcting protocol is enabled, this command determines whether incoming data from the remote modem will be buffered while the receiver modem waits for establishment of the error correction link.

- \C0** receiver modem discards all incoming VF data from the remote modem until it has sent a PROTOCOL: NONE message to its DTE. Receiver modem then passes data through.
- \C1** receiver modem buffers incoming VF data (up to 200 characters) until it has sent a PROTOCOL: NONE message to its DTE. It then passes the buffered data through to the DTE. The modem will fall back to wire mode if more than 200 characters are received before an error correction link is established.
- \C2** receiver modem discards all incoming VF data until it detects two consecutive fallback characters (%An). At that point it falls back to wire mode. The receiver modem passes one fallback character through to its DTE as data.
- \C3** same as \C1, except that with no link the modem will fall back to V.14 (direct) mode.
- \C4** same as \C2, except that with no link the modem will fall back to V.14 (direct) mode.

Dn

Dial

The *Dn* command is used to initiate a phone number dial. This command, followed by the number to be dialed, directs the modem to go off-hook and dial the number (*n...*). Commands other than dial modifiers must not be placed after the *D* command. Any command that is placed after the *D* is either ignored or interpreted as a dial command modifier.

Dial Command Modifiers

T	selects the numbers to be tone dialed.
P	selects the numbers to be pulse dialed (if permitted by country code).
Sn	selects a stored phone number to be recalled and dialed. The modem's default when the AT command DS is issued is to dial the phone number stored in cell 0. (<i>n</i> = 0 to 9)
R	switches modem operation to handshake in the answer mode when this command appears as the last character in the dial string.
, or <	pauses dialing for a programmable length of time determined by S-Register 8. Default is 2 seconds.
W	directs the dialer to wait for a dial tone before continuing the dial string.
@	directs the dialer to wait for a quiet answer before continuing the dial string.
!	directs the dialer to place a 1/2 second hook-switch flash in the dial string.
;	directs the dialer to return the modem to the command mode.
:n	directs the dialer to redial the attempted dial string up to <i>n</i> times if the modem does not achieve data mode.
Ln	directs the dialer to dial phone cell <i>n</i> if the modem fails to achieve data mode with the current dial string.
\n	remote modem uses cell <i>n</i> for Security Callback.
A	causes the DTMF A tone to be generated.
B	causes the DTMF B tone to be generated.
C	causes the DTMF C tone to be generated.
D	causes the DTMF D tone to be generated.
0-9	tone or pulse dial the appropriate number.

Note:

- a.* A, B, C and D are ignored in Pulse mode.
 - b.* A, B, C and D cannot be dialed from the front panel.
-

&Dn**DTR On-to-Off transition**

The **&Dn** command controls the result of On-to-Off transitions of Data Terminal Ready.

&D0 causes the modem to ignore Off transitions and forces internal DTR On.

&D1 causes the modem to change to command mode when it senses an Off transition during an established data link.

&D2 causes the modem to recognize Off transitions of DTR and respond by hanging up.

&D3 functions the same as **&D2**, and additionally causes the modem to perform AT command Z.

%Dn**DSR operation in test mode**

This command specifies whether Data Set Ready (DSR) will be On or Off during an ANALOOP test.

%D0 DSR will turn On whenever the modem is operating an ANALOOP test.

%D1 DSR forced Off when in an ANALOOP test.

En**Local DTE echo**

The **En** command controls the status of local echo.

E0 turns the local echo Off.

E1 turns the local echo On.

&En**Simulated controlled carrier**

The **&En** command controls the selection of V.13 modes.

&E0 selects Bi-directional V.13.

&E1 selects V.13 TX side enabled.

&E2 selects V.13 RX side enabled.

%En**DTE interface-controlled tests**

This option determines whether or not tests can be controlled by DTE interface leads.

%E0 tests cannot be commanded by signals on the DTE interface.

%E1 the modem will perform the ANALOOP (AL) test under command of Pin 18 of the DTE interface, and will perform the remote digital loop (RDL) test under command of Pin 21.

&Fn **Load fixed configuration profile**

The **&Fn** command loads the modem with factory-defined settings for a fixed configuration profile. [Table 4-10](#) lists the settings for the four fixed configuration profiles.

- &F0** selects asynchronous switched network operation, with V.42 error correction and V.42 *bis* data compression.
- &F1** selects synchronous switched network operation.
- &F2** selects asynchronous two-wire private line operation.
- &F3** selects synchronous two-wire private line operation.

Table 4-10 Fixed Configuration Profile Settings

Option (AT Command)	Fixed Profile 0	Fixed Profile 1	Fixed Profile 2	Fixed Profile 3
Answer mode (%O)	Ans. mode if ringing	Ans. mode if ringing	Ans. mode if ringing	Ans. mode if ringing
Asynchronous protocol (N)	Auto-reliable	Auto-reliable	Auto-reliable	Auto-reliable
Auto Dial Restoral (&B)	Disable	Disable	Disable	Disable
Auto-reliable fallback char. (%A)	"CR"	"CR"	"CR"	"CR"
Automatic fallforward/fallback (&A)	Disable	Disable	Disable	Disable
Break character handling (\K)	See \K5	See \K5	See \K5	See \K5
Call Progress Monitor (X)	Ext. results/full CPM	Ext. results/full CPM	Ext. results/full CPM	Ext. results/full CPM
Character abort (%K)	2-sec. delay	Disable	2-sec. delay	Disable
Character length (\B)	See \B2	See \B2	See \B2	See \B2
Connect message type (\V)	See \V3	See \V3	See \V3	See \V3
Country code (N)	USA	USA	USA	USA
CPM message response speed (%R)	Autobaud speed	Autobaud speed	Autobaud speed	Autobaud speed
CTS operation (&R)	See &R1	See &R2	See &R2	See &R2
Data compression (%C)	Enable both ways	Enable both ways	Enable both ways	Enable both ways
DCD operation (&C)	Real mode	Real mode	Real mode	Real mode

(Sheet 1 of 4)

Table 4-10 Fixed Configuration Profile Settings (Continued)

Option (AT Command)	Fixed Profile 0	Fixed Profile 1	Fixed Profile 2	Fixed Profile 3
DCE rate limit (&G)	33.6 Kbps max	33.6 Kbps max	33.6 Kbps max	33.6 Kbps max
Dialing type (P, T)	Tone (T)	Tone (T)	Tone (T)	Tone (T)
DSR operation (&S)	Normal	Normal	Normal	Normal
DSR operation in test mode (%D)	Forced Off	Forced Off	Forced Off	Forced Off
DTE interface-controlled tests (%E)	Disable	Disable	Disable	Disable
DTE speed (\T)	Last AT speed	Auto Baud	Last AT speed	Auto Baud
DTR dialing (%Z)	Disable	Disable	Disable	Disable
DTR On-to-Off transition (&D)	Ignore	Go on-hook	Go on-hook	Go on-hook
Front Panel Lockout (&I)	Enable	Enable	Enable	Enable
Local DTE echo (E)	Enable	Enable	Disable	Disable
Long space disconnect (Y)	On	On	On	On
Make busy (%B)	Disable	Disable	Disable	Disable
Modem-to-DTE flow control (\Q)	Use CTS	Use CTS	Use CTS	Use CTS
Modem-to-modem flow control (\G)	Disable	Disable	Disable	Disable
Network type (&L)	Switched network	Switched network	Two-wire private line	Two-wire private line
Operating mode (&M)	Async data	Sync data	Async data	Sync data
Overspeed correction (\A)	Nominal	Nominal	Nominal	Nominal
Parity type (\P)	Auto	Auto	Auto	Auto
Pre-link data buffer (\C)	See \C2	See \C2	See \C2	See \C2
Private line handshake mode (&P)	V.34 only	V.34 only	V.34 only	V.34 only
Private line transmit level (:T)	-9 dBm	-9 dBm	-9 dBm	-9 dBm
RDL options (&T4, &T5)	Disable RDL	Disable RDL	Disable RDL	Disable RDL
Response mode (Q)	Result codes	Quiet	Quiet	Quiet
Result code type (V)	Verbal	Verbal	Verbal	Verbal

(Sheet 2 of 4)

Table 4-10 Fixed Configuration Profile Settings (Continued)

Option (AT Command)	Fixed Profile 0	Fixed Profile 1	Fixed Profile 2	Fixed Profile 3
Retrain on poor signal quality (%Q)	Until SQ is good	Until SQ is good	Until SQ is good	Until SQ is good
DSR Operation (&S)	Normal	Normal	Normal	Normal
S-Registers (S)	Decimal (ASCII)	Decimal (ASCII)	Decimal (ASCII)	Decimal (ASCII)
0 Rings to answer on	1	1	1	1
2 Escape code character	43 (+)	43 (+)	43 (+)	43 (+)
3 Carriage return character	13 (CR)	13 (CR)	13 (CR)	13 (CR)
4 Line feed character	10 (LF)	10 (LF)	10 (LF)	10 (LF)
5 Back space character	08 (BS)	08 (BS)	08 (BS)	08 (BS)
6 Wait for dial tone	2 sec.	2 sec.	2 sec.	2 sec.
7 Wait for carrier for W and @	60 sec.	60 sec.	60 sec.	60 sec.
8 Pause time for , or <	2 sec.	2 sec.	2 sec.	2 sec.
9 Carrier detect response time	0.6 sec.	0.6 sec.	0.6 sec.	0.6 sec.
10 Loss of carrier to hang up delay	1.4 sec.	1.4 sec.	1.4 sec.	1.4 sec.
12 Escape sequence guard time	1 sec.	1 sec.	1 sec.	1 sec.
18 Modem test timer	0 sec.	0 sec.	0 sec.	0 sec.
25 Delay to DTR - all modes	0.05 sec.	0.05 sec.	0.05 sec.	0.05 sec.
&V0 or %V1 with sync data modes	5 sec.	5 sec.	5 sec.	5 sec.
26 RTS/CTS delay	0 sec.	0 sec.	0 sec.	0 sec.
38 Hang-up delay timer	20 sec.	20 sec.	20 sec.	20 sec.
40 Private line down timer	1 min	1 min	1 min	1 min
41 Private line lookback timer	10 min	10 min	10 min	10 min
42 Call failures before modem make busy (special feature, implemented only on a point-of-sale basis)	N/A	N/A	N/A	N/A
70 Max. no. of re-transmissions	100	100	100	100
Simulated controlled carrier (&E)	Enable both ways	Enable both ways	Enable both ways	Enable both ways
Speaker operation (M)	Off while rec. DCD	Off while rec. DCD	Off while rec. DCD	Off while rec. DCD
Speaker volume (L)	Medium	Medium	Medium	Medium
Store password (%P)	None	None	None	None
Switched network handshake mode (&H)	V.34 auto	V.34 auto	V.34 auto	V.34 auto
Switched network transmit type (:P)	Permissive	Permissive	Permissive	Permissive

(Sheet 3 of 4)

Table 4-10 Fixed Configuration Profile Settings (Continued)

Option (AT Command)	Fixed Profile 0	Fixed Profile 1	Fixed Profile 2	Fixed Profile 3
Synchronous protocol (M)	Normal	Normal	Normal	Normal
Transmit clock source (&X)	Internal	Internal	Internal	Internal
Trellis coding (&U)	Enable	Enable	Enable	Enable
Power-up user configuration profile (&Y)	Fixed Profile 0	Fixed Profile 0	Fixed Profile 0	Fixed Profile 0

(Sheet 4 of 4)

%Fn=x**Password cell qualifier**

This command determines which callback extension(s), if any, can be used with the password stored in a specified password memory cell. In the command, *n* represents the number (0 - 9) of a password memory cell.

This command does not affect use of the fixed callback extension (,F), which is administered by an MMS controller.

- %Fn=0** disables the use of callback extensions with the password stored in cell *n*. The modem will terminate any call in which it receives that password with a callback extension attached.
- %Fn=1** permits the roving callback extension (,R) to be used with the password stored in cell *n*. When the modem receives the ,R extension attached to the password it will prompt the remote user for a callback phone number and then perform the callback procedure. The password can be used without an extension, but the use of any extension other than ,R will cause the modem to terminate the connection.
- %Fn=2** permits the phone cell callback extension (,C) to be used with the password stored in cell *n*. When the modem receives the ,C extension attached to the password it will prompt the remote user for the number of a phone number memory cell in the answering modem. The answering modem will then use the phone number stored in that memory cell to perform the callback procedure. The password can be used without an extension, but the use of any extension other than ,C will cause the modem to terminate the connection.

%Fn=3 permits the use of either the roving (,R) or phone cell (,C) callback extension with the password stored in cell *n*. When the modem receives an extension attached to the password it will issue the appropriate prompt to the remote user and perform the specified callback procedure. The password can be used without an extension.

&Gn

DCE rate limit

This command sets the maximum rate at which the modem can make a VF connection to a remote modem when using the V.32, V.32 *bis*, and V.34 modulation schemes. The allowable rates for each scheme are:

V.32 only - 4.8 or 9.6 Kbps

V.32 *bis* only - 4.8 to 14.4 Kbps

V.34 only - 2.4 to 28.8 Kbps

If the rate specified with this command is greater than the highest rate available with the type of modulation being used, the modem will use the highest available rate. If the rate specified with this command is less than the lowest rate available with the type of modulation being used, the modem will use the lowest available rate.

- &G5** 4.8 Kbps, maximum rate
- &G6** 7.2 Kbps, maximum rate
- &G7** 9.6 Kbps, maximum rate
- &G8** 12 Kbps, maximum rate
- &G9** 14.4 Kbps, maximum rate
- &G10** 16.8 Kbps, maximum rate
- &G11** 19.2 Kbps, maximum rate
- &G12** 21.6 Kbps, maximum rate
- &G13** 24 Kbps, maximum rate
- &G14** 26.4 Kbps, maximum rate
- &G15** 28.8 Kbps, maximum rate
- &G16** 31.2 Kbps, maximum rate
- &G17** 33.6 Kbps, maximum rate (default)

\Gn

Modem-to-modem flow control

This command is used to provide modem-to-modem flow control for non-error corrected data links that require a constant speed DTE interface (Wire Mode).

- \G0** disables flow control between the two modems.
- \G1** enables bi-directional modem flow control based on XON/XOFF signaling. The XON/XOFF signals are detected, acted on, and deleted from the data stream.

- IG2** provides unidirectional flow control: the modem may send XON/XOFF signals to the remote modem, yet ignore and pass through to its DTE any that it receives as VF signals.
- IG3** same as IG1, except that, after they are acted upon, XON/XOFF signals are passed through to the DTE instead of being deleted.

Hn

Hookswitch

The Hn command controls the off-hook relay.

- H0** opens the relay for on-hook condition (modem hang-up).
- H1** closes the relay for off-hook condition. Modem remains off-hook until termination of on-line status, or until the H0 command is issued.

&Hn

Switched network handshake mode

&Hn controls the selection of the switched network hand-shake mode.

Note

- a. When the modem is optioned for an external transmit clock source (&X1), the modem should be optioned for a fixed handshake mode, not an automatic hand-shake mode (e.g., select V.32 bis only [&H3] instead of V.32 bis automatic [&H2]). The modem will then handshake only at the speed given to it by the DTE.
- b. For 1200 bps V.22 operation, select &H7. &H6 is an auto mode, so setting the DTE to 1200 bps (\T3) will not force the connection to 1200 bps.

-
- &H0** selects V.34 auto (28.8 - 300)
 - &H1** selects V.34 only (28.8 - 9600)
 - &H2** selects V.32 bis automatic (14.4 - 300)
 - &H3** selects V.32 bis only (14.4 - 4800)
 - &H4** selects V.32 automatic (9600 - 300)
 - &H5** selects V.32 only (9600 - 4800)
 - &H6** selects V.22 bis only (2400 - 1200)
 - &H7** selects V.22 only (1200)
 - &H8** selects 212 only (1200)
 - &H9** selects 103 only (300)
 - &H10** selects V.21 only (300)

%Hn

Private Line Heartbeat (All private Line Products)

EIA TX or RX Data, in half minute intervals, for transmission of the H<CR> heartbeat on an idle line.

n = 0 to 255

The value disables heartbeat transmission (default).

In

Identification and checksum

The *In* command requests modem identification and checksum codes to be transmitted to the DTE.

- I0** displays the modem product code. The V.F 28.8/33.6 product code is 288.
- I1** displays the stored checksum.
- I2** (reserved for future use, displays the OK message)
- I3** displays the revision level of the modem's firmware (an alphabetical character) followed by the OK message.
- I4** displays a listing of the following modem information:
 - Firmware Level - revision level as displayed by I3
 - Product Type - product code as displayed by I0
 - Management System - On/Off status of MMS control
 - Sync Compression - On/Off status
 - Leased Line - On/Off status; Off = modem configured for switched network only operation
 - VF Card - DOM (domestic switched network modem - no card), or card's letter identifier (A, B, C, etc.; for domestic leased line or international modem)
 - DTE Card - 232, 530, or V35
 - Country Code - as displayed by the N? command
- I5** displays the modem's serial number.

&In

Front panel lockout

This option permits you to disable the modem's front panel switches.

- &I0** enables front panel.
- &I1** disables front panel.

%Kn

Character abort

This option controls the character abort option. It is only available when the modem is in AT operation and asynchronous mode.

- %K0** enables character abort: any character typed at the DTE within 2 seconds after the modem goes off-hook will abort the dialing process.
- %K1** disables character abort.

\Kn**Break character handling**

This command determines how the modem will react to break characters received from the DTE during an error corrected data link.

- \K0** modem will immediately transmit a break character for a fixed time (300 ms) and destroy any currently buffered data.
- \K1** same as the \K0 option, except all buffered data will be saved.
- \K2** modem will transmit a fixed time break character in sequence with the rest of the data (default).
- \K3** modem will ignore all breaks received from the DTE.
- \K4** modem will transmit break characters in sequence with the rest of the data as long as the DTE is transmitting this character.
- \K5** same as \K4 - required for compatibility with some communication software.

Ln**Speaker volume**

This command controls the volume of the modem's speaker when it is enabled by the Mn command.

- L0, L1** both select low volume as per the Hayes Technical Reference guide.
- L2** selects medium volume.
- L3** selects high volume.

&Ln**Network type**

This option sets the modem for private line or switched network lines.

- &L0** switched network mode.
- &L1** 2-wire private line mode.
- &L2** 4-wire private line mode.

Mn**Speaker operation**

This command controls when the speaker will be On (audible).

- M0** speaker Off at all times.
- M1** speaker On during dialing and handshaking, and Off in data mode.
- M2** speaker On at all times.
- M3** speaker Off during dialing, and On during handshaking and retraining.

&Mn**Operating mode**

The &Mn command selects between asynchronous and synchronous operation in data mode. See the %Vn command to select command mode format.

&M0 selects asynchronous operation in data mode. See the \Nn command to select an asynchronous protocol.

&M1 selects synchronous operation in data mode. See the \Mn command to select a synchronous protocol.

\Mn**Synchronous protocol**

This command selects the synchronous protocols that are available to the modem.

\M0 selects normal synchronous mode.

\M1 selects synchronous V.13, simulated controlled carrier, mode. Select transmit, receive, or bidirectional with &En command.

\M2 selects synchronous data compression mode. Modem must be configured for internal transmit timing, and either Clock Stopping (\Q5) or Clock Throttling (\Q6) flow control.

N?**Country code**

N? will display the current country the modem is configured for. In general, the country code displayed is the country's international calling code.

\Nn**Asynchronous protocol**

This command is used to select the various possible asynchronous protocols the modem is allowed to negotiate upon establishing a data link.

\N0 options the modem to run in wire mode, performing speed buffering by copying characters from the VF port to the DTE port and vice versa.

\N1 options the modem to run in direct mode: the DTE and VF speeds must match, and there is no speed buffering. Direct mode is V.14 asynchronous mode.

\N3 options the modem to run in auto reliable mode, and to negotiate V.42 or alternate links. With no link, the modem enters wire mode (speed buffering).

\N4 limits error correction to a V.42 (LAPM) link only, or hang up.

\N6 selects the use of V.13 simulated controlled carrier operation.

On

On-line

The *On* command directs the modem to go on-line (enter data mode) after an escape to local command mode is issued. This command transfers the modem from the command to the data mode.

OO tells the modem to go on-line.

O1 tells the modem to go on-line and issue a retrain sequence if operating on *V.22 bis*, *V.32*, *V.32 bis*, or *V.34* modes.

%On

Answer mode

For a modem being used on a switched network this option selects the band the modem will use for answering calls. The selection applies to both automatically and manually answered calls. For a modem being used on a private line, this option selects the band the modem will use for connections.

%O0 commands the modem, in switched network mode, to use the presence of a ring to determine the band, regardless of whether the talk/data switch (the SEL key) on the front panel is used or automatic answer is selected. In private line mode, the modem will be in the originate band.

%O1 commands the modem to answer calls in the answer band in either switched network or private line mode.

%O2 commands the modem to answer calls in the originate band in either switched network or private line mode.

P

Dialing type

This command directs the modem to use pulse dialing as its selected dialing method. The command may be used alone or as part of a dial string.

When *P* is used alone as a command it makes pulse dialing the modem's default - to be used unless a dial string includes a tone modifier. When *P* is used in a dial string, it acts as a modifier and affects only the dialing of that string.

Pulse dialing is blocked by some country code configurations.

&Pn

Private line handshake mode

&Pn controls the selection of the private line handshake mode.

&P0 selects *V.34* only (28.8 - 9600)

&P1 selects *V.32 bis* only (14.4 - 4800)

&P2 selects *V.32* only (9600 and 4800)

%Pn=nnn**Store password**

This command stores a password in one of the 10 memory cells ($n = 0 - 9$) the modem provides for that purpose. Each password (nnn) can consist of up to 10 characters.

Refer also to the Passwords feature description.

nnn = password, 1 to 10 characters (to disable or clear the password, enter %P).

\Pn**Parity type**

This command sets up what parity to use in data mode for front ends that do not send AT commands.

- \P0** even parity
- \P1** space parity
- \P2** odd parity
- \P3** mark parity
- \P4** automatic parity; last AT (default)

:Pn**Switched network transmit type**

This command allows you to select permissive or programmable mode for switched network operation.

- :P0** selects permissive mode.
- :P1** selects programmable mode.

Pn*Remote configuration security password**

This command defines the remote configuration security password. Refer also to the Remote Configuration feature description.

n = password, 1 to 11 characters (to disable or clear the password, enter *P).

Qn**Response mode**

The Qn command controls the transmission of result codes.

- Q0** requests non-quiet mode: result codes are transmitted to the DTE as appropriate.
- Q1** requests quiet mode: modem does not send any result codes to the DTE.
- Q2** disables Call Progress Monitor responses in answer mode only. Modem enters this mode on detection of ring signal.

%Qn**Retrain on poor signal quality**

This option controls retrain initiation.

- %Q0** disables retrain initiation.
- %Q1** modem will try up to 3 consecutive retrains upon detection of poor signal quality. If not successful, the modem will disconnect the line.

%Q2 modem will retrain on poor signal quality until signal quality is OK.

\Qn

Modem-to-DTE flow control

This command selects the type of data mode flow control used on the DTE port.

\Q0 disables all flow control.

\Q1 enables XON/XOFF signaling between modem and DTE.

\Q2 enables the modem to flow control the DTE via CTS.

\Q3 operates the same as the \Q2 option, and also allows the DTE to flow control the modem via RTS as a ready to receive signal.

\Q4 allows the modem to XON/XOFF the DTE yet ignore these signals when sent by the DTE (unidirectional flow control).

\Q5 allows the modem to flow control the DTE by almost stopping the transmit clock (internal transmit timing must be selected). Used with synchronous data compression.

\Q6 allows the modem to flow control the DTE by varying the rate of the transmit clock (internal transmit timing must be selected). Used with synchronous data compression.

&Rn

CTS operation

The &Rn command defines the functionality of the Request to Send and Clear to Send EIA interchange circuits.

&R0 causes CTS to follow RTS with an interjected delay specified in S-Register 26 when in synchronous mode. In asynchronous command mode, CTS will be On. Upon reaching asynchronous data mode, CTS will follow the applicable ITU-T specification for the modulation chosen during handshake.

&R1 causes CTS to follow the applicable ITU-T specification in data mode (in synchronous modes, CTS will not follow RTS) and in command mode CTS will be On.

&R2 causes CTS to follow the applicable ITU-T specification. During test modes, CTS will follow V.54 conventions. CTS does not follow RTS in data modes. CTS will go Off after the call is dropped.

&R3 forces CTS On in all modes of operation (RTS is ignored).

Note: *V.13 and flow control options override &R settings for CTS.*

%Rn**Call Progress Monitor message response speed**

%Rn options control the rate at which Call Progress Monitor (CPM) responses are sent to the DTE when the modem is optioned for \T0.

%R0	Auto speed	%R1	last AT speed
%R2	300 bps	%R3	1200 bps
%R4	2400 bps	%R5	4800 bps
%R6	7200 bps	%R7	9600 bps
%R8	12.0 kbps	%R9	14.4 kbps
%R10	16.8 kbps	%R11	19.2 kbps
%R12	21.6 kbps	%R13	24.0 kbps
%R14	26.4 kbps	%R15	28.8 kbps
%R16	31.2 kbps	%R17	33.6 kbps
%R18	38.4 kbps	%R19	57.6 kbps
%R20	76.8 kbps	%R21	115.2 kbps
%R22	128.0 kbps	%R23	32.0 kbps
%R24	48.0 kbps	%R25	56.0 kbps
%R26	64.0 kbps	%R27	72.0 kbps
%R28	96.0 kbps	%R29	112.0 kbps

\Rn**Enable and Disable asymmetrical rates**

\R0 disable asymmetrical rates - when this command is active the transmit and receive DCE rate will be the same.

\R1 enable asymmetrical rates - when this command is active (BUFFERED ASYNCHRONOUS MODES ONLY) the transmit and receive DCE rates may be negotiated for different rates based on the line conditions. The modems receiver will select the remote modems transmit rate.

Special Considerations:

1. *The following commands disable asymmetrical rates: \N1, \N6 and &M1.*
2. *The &Gn command limits only the rate of the receiver in \R1 mode.*
3. *The \V0 and \V2 command formats remain the same reporting the receivers rate.*
4. *The \V4 command reports the asymmetrical rates.*
5. *Front panels report the Receive Rate.*

Rn*Remote configuration write access**

This command controls remote configuration write access. Refer also to the Remote Configuration feature description.

***R0** enables write access (read/write).

***R1** disables write access (read only).

Sn**S-Registers**

The S command allows you to view (Sn?) or change (Sn=x) the S-Registers. The S-Registers store values for functions that are not often changed, such as timers or counters, and the ASCII values of control characters, such as Carriage Return. [Table 4-11](#) summarizes the S-Register set. It is followed by a detailed command reference.

Examples:

To view the value of S-Register 2, type:

```
ATS2?<cr>
```

The response might be:

```
005<cr><lf>
```

```
OK<cr><lf>
```

To set the value of S-Register 2 to equal 5, type:

```
ATS2=5<cr>
```

To view the value of the last S-Register that was queried, type:

```
AT?<cr>
```

S\$**S-Register help**

This command causes the modem to display the S-Register Help Menu.

Table 4-11 S-Register Summary

S-Reg.	Function	Decimal	ASCII	Units	Storable
0	Automatic answer	0			Yes
1	Ring counter	0			No
2	Escape code character	43	+		No
3	Carriage return character	13	CR		No
4	Line feed character	10	LF		No
5	Backspace character	08	BS		No
6	Dial tone wait timer	02		seconds	Yes
7	Carrier wait timer; W and @ dial command modifier wait timer; ringback wait timer	60		seconds	Yes
8	Dial pause timer for , and < dial command modifiers	02		seconds	Yes
9	Carrier presence timer	06		0.1 second	Yes
10	Carrier loss timer	14		0.1 second	Yes
12	Escape code guard timer	50		0.02 second	No
18	Test mode timer	00		10 seconds	Yes
25	DTR delay timer	0.05		seconds (&M0)	Yes
		005		seconds (&M1)	
26	RTS-to-CTS delay timer	00		milliseconds	Yes
38	Hang-up delay timer	20		seconds	Yes
40	Private line down timer	01		minutes	Yes
41	Private line lookback timer	01		10 minutes	Yes
70	Retransmission counter	100			Yes
100	Adjustable transmitter level display			dBm	

- S-Register 0 Automatic answer**
- This register determines the number of rings the modem must detect before answering a telephone call. It is programmable from 0 to 255. If the register value is 0, automatic answer is disabled. There is a default value of 2 rings if automatic answer is turned On.
- S-Register 1 Ring counter**
- This register counts incoming rings detected. It increments upon each detected ring, and is cleared after 8 seconds of ring silence and Idle mode. It cannot be cleared in data mode.
- S-Register 2 Escape code character**
- This register holds the ASCII equivalent of the Escape Code character. Its range is from 0 to 127, and the default is 43 (+). Any value above 127 effectively disables the Escape code function.
- S-Register 3 Carriage return character**
- This register holds the ASCII equivalent of the Carriage Return character. Its range is from 0 to 127, and the default is 13 (<cr>).
- S-Register 4 Line feed character**
- This register holds the ASCII equivalent of the Line Feed character. Its range is from 0 to 127, and the default is 10 (<lf>).
- S-Register 5 Backspace character**
- This register holds the ASCII equivalent of the Backspace character. Its range is from 0 to 127, and the default is 08 (H).
- S-Register 6 Dial tone wait timer**
- This register is the programmable dial tone wait timer that determines how many seconds the modem will wait for a dial tone before it starts dialing. This register applies only when blind dialing is selected (X0, X1, or X3). This register can be set from 0 to 255. The default is 2 seconds.
- S-Register 7 Carrier, dial and ringback wait timer**
- This register stores the carrier wait time, how many seconds the modem will wait for carrier detection after dialing has been completed.
- The wait time set in this register is also used for the dial command modifiers W (wait for dial tone before dialing) and @ (wait for quiet answer before dialing).
- This register also sets the number of seconds the modem will wait for ringback when originating a call. This condition only occurs when using extended result code options X3 or X4.
- This register can be programmed for from 1 to 60 seconds. The default is 60 seconds.

S-Register 8 Dial pause timer

This register stores the duration, in seconds, of the pause that will occur when either of the pause dialing modifiers (, or <) is used. It can be programmed from 0 to 255. The default is 2 seconds.

S-Register 9 Carrier presence timer

The value in this register determines how many tenths of a second the carrier signal must be present following a carrier loss before the modem will turn on the EIA DCD signal to the DTE. This is called loss of carrier reacquire debounce time. The register's range is from 1 to 255. The default is 6 (0.6 second).

S-Register 10 Carrier loss timer

The value in this register determines how many tenths of a second the remote carrier signal must be lost before the local modem disconnects. The delay permits the carrier to disappear momentarily without causing the modem to hang up. The register's timer range is from 1 to 254. Selecting 255 disables disconnect.

The modem recognizes a carrier after a period of time specified in S9. Therefore, if the value of S10 is less than that set for S9, even a momentary loss of carrier will cause the modem to disconnect.

When the modem is operating in half-duplex asynchronous mode, it ignores the value of this register.

S-Register 12 Escape code guard timer

The value in this register determines (in 50ths of a second) the Escape code guard time the modem will use to recognize a valid escape sequence. The modem constantly monitors the data stream for the occurrence of three consecutive +++ (escape code characters) within the time specified in this register. The modem will transfer from the data mode to the command mode when it detects such an occurrence. This register may be set from 1 to 255. The default is 50 (1 second).

S-Register 18 Test mode timer

The value in this register determines (in 10-second increments) how long automatically timed tests will run. It may be set from 0 (no time out, tests run until ended manually) to 60 (10 minutes). The default is 0.

S-Register 25 DTR delay timer

This register sets the delay for DTR, but its precise function depends on the modem's Operating Mode (&Mn command) and Command Format (%Vn command).

When the modem is configured for asynchronous Operating Mode (&M0), the value in this register is always the time used to debounce the DTR signal. It is set in hundredths of a second (0 to 255). The default is 5 (0.05 second).

When the modem is configured for synchronous Operating Mode (&M1) and an asynchronous Command Format (%V0 or %V1), this register initially sets the time available to the operator for switching the EIA cable from asynchronous equipment to synchronous equipment. It can be set from 0 to 255 seconds. The default is 5 seconds. After the whole-second timer expires, the register is then used to debounce the DTR signal, as above. The same number, stored in the register, is applied to both the whole-second and hundredth-of-a-second counts.

S-Register 26 RTS-to-CTS delay timer

The value in this register determines (in milliseconds) the amount of delay between RTS and CTS. It can be set from 0 to 255. The default value is 0.

S-Register 38 Hang-up delay timer

The value in this register determines the maximum delay (in seconds) between the modem's receipt of the command to hang up and the disconnect operation. (If the modem is configured to follow the DTR signal, an On-to-Off transition acts as a command to hang up.) This register is useful for error-control and speed-buffering communications to ensure that data in the modem buffers is sent before the connection is terminated.

If this register is set between 0 and 254, the modem will wait up to that number of seconds for the remote modem to acknowledge receipt of all data buffers before hanging up. The default is 20. If all data is transmitted prior to the timeout, the response to the H0 command will be OK. If the timeout occurs before all data can be sent, the NO CARRIER (3) result code will be sent to indicate that data has been lost.

If this register is set to 255, the modem does not time-out, and continues to attempt to deliver data in the buffers until the connection is lost, or the data is delivered.

S-Register 40 Private line down timer

The value in this register determines (in minutes) how long the modem will continue private line retrains before it attempts a switched network connection. It can be set from 0 (timer disabled) to 255.

Refer also to the Auto Dial Restoral feature description.

S-Register 41 Private line lookback timer

The value in this register determines (in 10 minute increments) how long the modem will operate in switched network mode before it automatically attempts to return to private line mode. It can be set from 0 (timer disabled) to 255. When the timer is disabled, the modem does not automatically attempt to return to the private line.

Refer also to the Auto Dial Restoral feature description.

S-Register 42 Call failures before modem make busy

This feature is only enabled in the modem by special arrangement between the customer and GDC. When it is enabled the modem will take itself out of service by presenting a busy signal on the telephone line when the number of consecutive failed calls equals the number configured here. It can be set from 3 to 15.

S-Register 70 Retransmission counter

The value in this register determines how many times the modem will retransmit any one frame while in an error correcting connection. The modem hangs up when it reaches the limit set by this register. It can be set from 0 to 255. The default is 100. Retransmissions become necessary when data errors introduced by noise disrupt the reception of a frame. Raising this limit may be necessary if, for example, telephone lines are extremely noisy. The retransmission delays may be undesirable, but the modem will not hang up.

S-Register 100 Adjustable transmit level display

When you issue the command S100? the value in this register displays the transmit level configured in the modem. This register is not a valid display in any country, such as the United States, that limits transmit level selections to Programmable or Permissive.

&Sn DSR operation

This command controls how the Data Set Ready EIA interchange circuit will operate.

- &S0** selects DSR to remain On and glitch Off for disconnect.
- &S1** causes DSR to be real (per ITU-T).
- &S2** selects DSR to follow carrier detect.
- &S3** selects DSR forced On in all modes.

Note: The %Dn command overrides the functionality of this command during any ANALOOP test.

%Sn

Password operation

This command selects what type of password security the modem will enforce.

- %S0** password security disabled.
- %S1** general security password enforcement enabled. This is the GDC proprietary handshake password. Originating modem transmits contents of password cell 0. Answering modem compares received password to contents of password cell 0.
- %S2** on-line password enforcement enabled. Answering modem prompts remote for manually input password; checks for match in any password cell, 0 - 9.
- %S3** both handshake and on-line password enforcement enabled.
- %S4** enable mandatory Callback Security - when this command is active pass-through security is disabled.
- %S6** Enables Online Security with mandatory call-back.
- %S7** Enables SteadFast Security and Online Security with mandatory call-back.

T

Dialing type

This command directs the modem to use tone dialing as its selected dialing method. The command may be used alone or as part of a dial string.

When T is used alone as a command it makes tone dialing the modem's default - to be used unless a dial string includes a pulse modifier. When T is used in a dial string, it acts as a modifier and affects only the dialing of that string.

&Tn

Test mode

The &Tn command controls the soft operation of test modes.

- &T0** clears any active test and resumes normal data set operation.
- &T1** initiates a soft ANALOOP test mode that directs all local data through the transmitter and receiver of the modem. To terminate this test, type +++ (escape sequence) followed by &T0.
- &T3** initiates a soft Digital Loop test mode that directs all received data from the remote modem to be looped back to the transmit data. This has the effect of echo on the remote DTE. Any data the remote DTE sends is returned.
- &T4** directs the modem to accept the in-band request to initiate a remote digital loopback.

- &T5** directs the modem to ignore the in-band request to initiate a remote digital loopback.
- &T6** directs the modem to transmit the in-band request to establish a remote digital loopback with the far modem.
- &T7** directs the modem to transmit the in-band request to establish a remote digital loopback with the far modem, and to run the self-test pattern generator.
- &T8** directs the modem to enter the ANALOOP test mode, and to run the self-test pattern generator.
- &T9** directs the modem to send a self-test pattern to the remote modem while checking the receive data for the same test pattern and checking for errors.

All tests operate for the amount of time specified in S-Register 18. Pending tests such as DL are not allowed. The self-test pattern for speeds of 1200 and 2400 bps is made up of alternate ones and zeros; the 511 pattern is generated for all other speeds. Remote digital loopback and self-tests are not operational when the modems are passing data at 300 bps.

%Tn

Inactivity Timer (Switched Network)

Sets the inactivity Time-out Timer on idle TX or TX Data, in minute intervals, for disconnecting the line when this idle period is reached.
n = 0 to 255
 The 0 value disables the Inactivity Timer (default).

\Tn

DTE speed

This command, in conjunction with the switched network handshake mode command (&H*n*), controls the DTE speed. There are several configurations to consider:

- a. An automatic handshake mode (e.g., V.32 *bis* auto [&H1], V.32 auto [&H4], V.22 *bis* only [&H6]) takes precedence over the \T*n* selection, and the modem tries for the highest VF speed common to the two commands.
- b. For 1200 bps V.22 operation, select &H7. &H6 is an auto mode, so setting the DTE to 1200 bps (\T3) will not force the connection to 1200 bps.
- c. When the modem is optioned for an automatic hand-shake mode and direct V.14 asynchronous mode (\N1), it sends a connect message to the DTE at the selected \T*n* speed. In order to pass data, the user must change the DTE's speed to match the displayed connect speed.
- d. When the modem is optioned for speed buffering (\N0), the \T*n* command alone selects the DTE speed, and the &H*n* command selects the hand-shake mode.

- e. When the modem is optioned for a fixed handshake mode and direct mode (N1), the \Tn command selects not only the DTE speed, but also forces the VF speed to match it. If this speed is not available, the modem drops the call. (This does not apply to V.22 *bis* only, which handshakes at the highest VF speed.)
- f. When using the modem in direct mode (N1), if the desired connect speed is known, set the speed to match using the \Tn command. Set the DTE to the same speed and "AT" the modem so that it will know at what speed to send messages.

\T0	Auto Baud speed	\T1	last AT speed
\T2	300 bps	\T3	1200 bps
\T4	2400 bps	\T5	4800 bps
\T6	7200 bps	\T7	9600 bps
\T8	12.0 kbps	\T9	14.4 kbps
\T10	16.8 kbps	\T11	19.2 kbps
\T12	21.6 kbps	\T13	24.0 kbps
\T14	26.4 kbps	\T15	28.8 kbps
\T16	31.2 kbps	\T17	33.6 kbps
\T18	38.4 kbps	\T19	57.6 kbps
\T20	76.8 kbps	\T21	115.2 kbps
\T22	128.0 kbps	\T23	32.0 kbps
\T24	48.0 kbps	\T25	56.0 kbps
\T26	64.0 kbps	\T27	72.0 kbps
\T28	96.0 kbps	\T29	112.0 kbps

:Tn

Private line transmit

This command enables you to select the transmit level for private line data links. The range may be limited on a per country code basis. The range is *n* = 0 to -15 dBm. The default value is -9 dBm.

&Un

Trellis coding

When the modem is operating in V.32 mode at 9600 bps this option allows you to select Trellis coded data (&U0), or uncoded data (&U1).

&U0 enables Trellis coding.

&U1 disables Trellis coding.

Vn**Result code type**

This command controls the transmission of result codes. Refer to the \Vn command for a list of all possible result codes.

V0 selects the non-verbal (numeric equivalent) result codes to be transmitted. The connect message is the VF line speed.

V1 selects verbal result codes. The connect message is the DTE speed, except for V.14 mode.

&V**View stored phone numbers**

This option displays the 10 stored telephone number cells. When this command is selected from the LCD it will display one cell at a time, and can be scrolled from cell 0 to 9.

%Vn**Command format**

This command determines the command format.

Note: When either of the two asynchronous command formats (%V0 or %V1) is used with synchronous data mode (&M1) a special function of S-register 25 comes into effect. Consult the description of S-register 25 for further information.

%V0 AT command set

%V1 V.25 *bis* asynchronous command set

%V2 V.25 *bis* HDLC (High-level Data Link Control) command set

%V3 V.25 *bis* BSC (IBM Binary Synchronous Communications) command set

%V4 None

\Vn**Connect message type**

This command determines the type of connect message sent to the DTE upon establishing a data link.

V0 options the modem to send the standard GDC Connect message upon reaching data mode plus V.42 messages after the link negotiation. The connect message displays the VF line speed.

MEANING	VERBAL RESPONSE	NUMERIC
COMMAND WAS SUCCESSFUL	OK	0
COMMAND FAILED	ERROR	4
LINK ESTABLISHED	CONNECT	1
INCOMING RING DETECTED	RING	2
RINGBACK DETECTED	RINGING	23
EXCHANGE CANNOT DIAL NUMBER	UNOBTAINABLE NUMBER	24
LINK DROPPED	NO CARRIER	3
DIAL TONE NOT PRESENT	NO DIALTONE	6
REMOTE NOT ANSWERING	NO ANSWER	8
LINE BUSY	BUSY	7
LINK ESTABLISH AT 300	CONNECT	1
LINK ESTABLISH AT 1200	CONNECT 1200	5
LINK ESTABLISH AT 2400	CONNECT 2400	10
LINK ESTABLISH AT 4800	CONNECT 4800	11
LINK ESTABLISH AT 7200	CONNECT 7200	15
LINK ESTABLISH AT 9600	CONNECT 9600	12
LINK ESTABLISH AT 12000	CONNECT 12000	16
LINK ESTABLISH AT 14400	CONNECT 14400	17
LINK ESTABLISH AT 16800	CONNECT 16800	18
LINK ESTABLISH AT 19200	CONNECT 19200	14
LINK ESTABLISH AT 21600	CONNECT 21600	19
LINK ESTABLISH AT 24000	CONNECT 24000	20
LINK ESTABLISH AT 26400	CONNECT 26400	21
LINK ESTABLISH AT 28800	CONNECT 28800	22
LINK ESTABLISH AT 31200	CONNECT 31200	23
LINK ESTABLISH AT 33600	CONNECT 33600	24

With \V0 and \V1, the following connect messages are sent when link negotiation is complete:

MEANING	VERBAL RESPONSE	NUMERIC
NO PROTOCOL	PROTOCOL:NONE	70
V.42 PROTOCOL	PROTOCOL:V.42	77
V.42 BIS PROTOCOL	PROTOCOL:V.42BIS	79

\V1 options the modem to delay sending the Connect message until an error corrected link has been established. The Connect message indicates DTE speed unless a V.14 connection was established, in which case it will indicate the VF speed.

MEANING	VERBAL RESPONSE	NUMERIC
DTE LINK AT 300	CONNECT	1
DTE LINK AT 1200	CONNECT 1200	5
DTE LINK AT 2400	CONNECT 2400	10
DTE LINK AT 4800	CONNECT 4800	11
DTE LINK AT 7200	CONNECT 7200	15
DTE LINK AT 9600	CONNECT 9600	12
DTE LINK AT 12000	CONNECT 12000	16
DTE LINK AT 14400	CONNECT 14400	17
DTE LINK AT 16800	CONNECT 16800	18
DTE LINK AT 19200	CONNECT 19200	14
DTE LINK AT 21600	CONNECT 21600	19
DTE LINK AT 24000	CONNECT 24000	20
DTE LINK AT 26400	CONNECT 26400	21
DTE LINK AT 28800	CONNECT 28800	22
DTE LINK AT 38400	CONNECT 38400	25
DTE LINK AT 57600	CONNECT 57600	26
DTE LINK AT 76800	CONNECT 76800	27
DTE LINK AT 115200	CONNECT 115200	28
DTE LINK AT 128000	CONNECT 128000	29

W2

is similar to the W1 function except that /REL will be included at the end of the message when a V.42 error corrected link has been established. Message Numbers 0 - 10 are the same as for W0.

MEANING	VERBAL RESPONSE	NUMERIC
RELIABLE DTE LINK AT 300	CONNECT REL	30
RELIABLE DTE LINK AT 1200	CONNECT 1200/REL	31
RELIABLE DTE LINK AT 2400	CONNECT 2400/REL	32
RELIABLE DTE LINK AT 4800	CONNECT 4800/REL	33
RELIABLE DTE LINK AT 7200	CONNECT 7200/REL	34
RELIABLE DTE LINK AT 9600	CONNECT 9600/REL	35
RELIABLE DTE LINK AT 12000	CONNECT 12000/REL	36
RELIABLE DTE LINK AT 14400	CONNECT 14400/REL	37
RELIABLE DTE LINK AT 16800	CONNECT 16800/REL	38
RELIABLE DTE LINK AT 19200	CONNECT 19200/REL	39
RELIABLE DTE LINK AT 21600	CONNECT 21600/REL	40
RELIABLE DTE LINK AT 24000	CONNECT 24000/REL	41
RELIABLE DTE LINK AT 26400	CONNECT 26400/REL	42
RELIABLE DTE LINK AT 28800	CONNECT 28800/REL	43
RELIABLE DTE LINK AT 31200	CONNECT 31200/REL	44
RELIABLE DTE LINK AT 33600	CONNECT 33600/REL	45
RELIABLE DTE LINK AT 38400	CONNECT 38400/REL	46
RELIABLE DTE LINK AT 57600	CONNECT 57600/REL	47
RELIABLE DTE LINK AT 76800	CONNECT 76800/REL	48
RELIABLE DTE LINK AT 115200	CONNECT 115200/REL	49
RELIABLE DTE LINK AT 128000	CONNECT 128000/REL	50

W3

sends only the connect message after the link negotiation. The message will indicate the VF rate for V.13 and V.14 connections, and the DTE rate for all other connections (default).

Note

*Verbal text responses are terminated by <cr><lf>.
Numeric code responses are terminated by <cr>.*

&Wn

Save settings as a user configuration profile

This command directs the modem to write the current settings for user defined and storable options into memory. You can save up to four user configuration profiles

(*n* = 0 - 3)

Zn is the command for loading a user configuration profile that has been stored by means of this command.

***Wn**

Remote configuration control

This command controls remote configuration. Refer also to the Remote Configuration feature description.

***W0** disables remote configuration.

***W1** enables remote configuration.

Xn

Call Progress Monitor

This command controls which Call Progress Monitor (CPM) signals are monitored and reported to the local DTE. This option is user storable unless it is defined by country configuration parameters.

X0 forces the modem to blind dial, and will only send a CONNECT message for all established links. All CPM is disabled.

X1 blind dial, CPM disabled, CONNECT message includes connected speed.

X2 CPM enabled for pre-dial signals (dialtone) only, CONNECT message includes connected speed.

X3 blind dial, CPM enabled for post-dial signals (busy, unobtainable number, etc.) only, CONNECT message includes connected speed.

X4 enables CPM response codes and monitoring, CONNECT message includes connected speed.

X5 enables all CPM response codes and monitoring, including ringback detection, CONNECT message includes connected speed.

&Xn

Transmit clock source

This command selects the clock source when the modem operates in synchronous Data Mode.

&X0 directs the modem to use the internally generated clock source.

&X1 selects the DTE clock as a source for the modem.

&X2 selects the modem's RECEIVER derived timing clock to be used in the transmitter.

***Xn**

Remote configuration exit

This command controls remote configuration exit. Refer also to the Remote Configuration feature description.

***X0** terminates the session without saving changes.

***X1** terminates the session and saves changes.

Yn

Long space disconnect

This command enables or disables the long space disconnect option. When the option is enabled a disconnect request (ATH0, loss of DTR or DCD, etc.) will cause the modem to transmit 4 seconds of continuous space (BREAK). A modem with long space disconnect enabled will hang up when it receives more than 1.5 seconds of continuous space (BREAK) while on-line.

Y0 disables long space disconnect.

Y1 enables long space disconnect.

&Yn

Power-up user configuration profile

This command is used to determine which user configuration profile, stored by means of the &Wn command, is activated at modem power-up. You can select from up to four user configuration profiles ($n = 0 - 3$).

Zn

Load user configuration profile

This command re-initializes the modem options with a user-defined configuration profile that has been stored by means of the &Wn command. You can select from up to four user configuration profiles ($n = 0 - 3$).

&Zn=nnn

Store a phone number

This command stores a telephone number (nnn) in a memory cell (n). The equal sign can be followed by up to thirty-six characters, including any of the commands that can be used in a dial string. There are 10 cells ($n = 0$ to 9) available in which to store telephone numbers.

%Zn**DTR dialing**

This command controls the Off-to-On DTR transition options for DTR dialing.

- %Z0** sets the modem to ignore the Off-to-On transition of DTR.
- %Z1** sets the modem to dial when a DTR Off-to-On transition occurs and DTR remains On. The format for this command is %Z1=x, where x is the memory cell that contains the number to be dialed. The specified phone cell must be programmed with a valid phone number prior to this operation. When no cell number is provided, Cell 0 is the default.
- %Z2** sets the modem to go off-hook and try to handshake on an Off-to-On transition of DTR.
- %Z3** performs the same function as %Z1 with one additional feature: modem will redial if the connection is broken while DTR remains On. %Z1 dials only on transition. The format for this command is %Z3=x.

Note

The &D0 command overrides this option.

Chapter 5: V.25 *bis* Command Set Operation

Overview

This section describes the operating procedures for the V.F 28.8/33.6 modem when using the ITU-T (formerly CCITT) V.25 *bis* compatible command protocol (command set).

108 Modes

The ITU-T V.25 *bis* protocol operates in one of two modes: 108.2 or 108.1. The modes are named for the two ITU-T designations for circuit 108 of the terminal interface:

- In 108.2 mode, the circuit is the "Data Terminal Ready" signal.
- In 108.1 mode, the circuit is the "Connect Data Set to Line" signal.

Circuit 108 is pin 20 in a DB25 connector; in a 34-pin V.35 connector it is pin H.

108.2 Mode

The 108.2 operating mode supports convenient outbound calling to multiple locations. When the DTE instructs the modem to originate a call in 108.2 mode, it also specifies the number to be dialed. The DTE can either supply the number itself along with the command to dial, or identify which of the modem's memory cells contains the number to be dialed.

In 108.2 mode the modem supports an ITU-T V.25 *bis* compatible command set you can use from the DTE to interrogate and configure the modem, and to control communication and test functions. Configuration by means of the command set can include operating parameters such as data rate, handshake mode, and synchronous timing source; as well as storage of phone numbers in the modem's memory cells.

In order for the V.25 *bis* command set to function, the modem must be operating in 108.2 mode and terminal interface circuit 108.2 (Data Terminal Ready) must be On. When circuit 108.2 is Off, the modem ignores the commands. Circuit 108.2 can be forced On with the &D0 AT command (this can only be done in asynchronous operations).

108.1 Mode

The 108.1 operating mode supports automatic outbound calling directed primarily to a single location. The DTE instructs the modem to originate a call by turning On circuit 108.1, Connect Data Set to Line. The modem then goes off-hook, dials the number stored in its memory cell 0, and attempts to establish communication.

The modem will disconnect from the line if it does not successfully handshake in the time specified in the abort timer selected by the $S7=x$ AT command (default is 30 seconds). If you turn Off 108.1 while the modem is in the data mode, the modem will hang up and disconnect.

The ITU-T V.25 *bis* compatible command set is not available when the modem is operating in 108.1 mode. Storage of a telephone number in memory cell 0 must be performed either in 108.2 mode (using the PRN command), or by means of AT commands.

Any number can be called in 108.1 mode by dialing manually and then turning On circuit 108.1 when answer tone is heard from the remote modem.

Operating Procedures

Refer to the ITU-T V.25 *bis* Command Set Communication Operating Procedures below for a full description of the communication procedures for the 108.2 and 108.1 modes.

Refer to Synchronous V.25 *bis* Interface Specifications below for synchronous dialing protocol formats.

Commanding The Modem

Although the AT command set is the primary command set for configuring the modem, the modem provides an enhanced ITU-T V.25 *bis* command protocol that permits you to configure modem dial parameters and establish data communications. After configuring the modem using the AT command set, use the %Vn command to switch to the V.25 *bis* command set.

[Table 5-1](#) summarizes the V.25 *bis* compatible command set. When entering commands, terminate each one with a line feed <LF> control character. The modem sends a response back to the terminal for each command. [Table 5-2](#) explains responses to valid commands. [Table 5-3](#) explains responses to invalid commands. Most terminals display the responses to indicate each entered command's result, but responses are ignored by some communications software that enables a computer to emulate a terminal.

Descriptions of each V.25 *bis* 108.2 mode command appear on the following pages.

Operating procedures for establishing and terminating data communications are explained following the command descriptions.

Table 5-1 V.25 *bis* Command Set Summary

Configuration Commands		
Name	Cmd.	Page
Write Option Settings to User Configuration Profile	NVW	5-5
Store Phone Number to Cell	PRN	5-5
Automatic Answering	PRS AA	5-5
AT Command Set	PRS AT	5-6
Connect Message Inhibit	PRS CM	5-6
DTE Data Rate	PRS DR	5-6
Handshake Mode	PRS HM	5-8
Termination Character	PRS TR	5-8
Synchronous Timing	PTM	5-9
Communication Commands		
Name	Cmd.	Page
Connect Incoming Call	CIC	5-9
Call Requested Number	CRN	5-9
Call Requested Stored Telephone Number	CRS	5-11
Disconnect Incoming Call	DIC	5-11

Table 5-2 Explanation of Valid Responses

Response	Description
CFI AB	Call failure indication: no carrier, call was aborted (time-out occurred or character was entered at keyboard).
CFI BF	Call failure indication: telephone number black list (which uses the 10 memory cells) is full. You cannot place any more calls until: a) after a timeout; b) the memory cell is modified; or c) the modem is reset.
CFI ET	Call failure indication: remote modem is busy.
CFI DT	Call failure indication: dial tone was not detected (dial tone time-out occurred).
CFI DF	Call failure indication: telephone number delayed list (which uses the 10 memory cells) is full. Numbers which are redialed continuously without making a connection are added to the delayed list. They are removed from the list: a) after a timeout; b) when a connection is made; c) when the memory cell is modified; or d) when the modem is reset.
CFI UT	Call failure indication: unobtainable number tone was detected.
CNX	300 bps connection is established.
CNX 1200	1200 bps connection is established.
CNX 2400	2400 bps connection is established.
CNX 4800	4800 bps connection is established.
CNX 7200	7200 bps connection is established.
CNX 9600	9600 bps connection is established.
CNX 12000	12,000 bps connection is established.
CNX 14400	14,400 bps connection is established.
CNX 16800	16,800 bps connection is established.
CNX 19200	19,200 bps connection is established.
CNX 21600	21,600 bps connection is established.
CNX 24000	24,000 bps connection is established.
CNX 26400	26,400 bps connection is established.
CNX 28800	28,800 bps connection is established.
INC	Incoming call was detected. This response is generated only once for each incoming call.
INV	See Table 5-3 for responses to commands that the modem does not recognize.
RNGBK	Ringback was detected by the originating modem.
VAL	Valid command was invoked.

Table 5-3 Explanation of Invalid Responses

Command Invoked	Description of INV Response
DIC	INC not received.
PRS	Non-selectable option in user's country.

V.25 *bis* Configuration Commands

Configuration commands allow you to configure the modem.

NVW Write Option Settings to User Configuration Profile

NVW saves the current settings to a user configuration profile in the modem's non-volatile memory, with the exception of the Terminator Character option (which is set to its factory default, the line feed control-character). This command saves a set of option values that is activated when the modem is powered up. To invoke this command, type:

```
NVW ; n <LF>
```

where *n* is the user configuration profile (0 to 3).

PRN Store Phone Number to Cell

PRN stores a telephone number in one of the modem's ten memory cells. Use it to store the number that is automatically dialed when you either invoke the CRS command in 108.2 mode or turn On circuit 108.1 in 108.1 mode (108.1 dialing uses the number stored in memory cell 0).

To store a number, type:

```
PRN n1 ; n2 <LF>
```

where *n1* is the memory cell (from 0 to 9) in which the number is to be stored, and *n2* is the phone number to be stored. *n2* may contain any legal dialing character (0-9 A-D P T # * , < ! & @).

PRS AA Automatic Answering

PRS AA controls the automatic answering function. When you enable automatic answering, you can specify the number of rings the modem is to wait before automatic answering occurs. Default is 4 rings.

To enable automatic answering, type:

```
PRS AA ; n <LF>
```

where *n* is the number of rings (from 1 to 255) that the modem waits before automatically answering an incoming call.

To disable automatic answering, type

```
PRS AA ; 0 <LF>
```

PRS AT

AT Command Set

PRS AT switches the modem from V.25 *bis* command set mode to AT command set mode.

To return to V.25 *bis* command set mode, use the %Vn AT command.

To invoke this command, type:

```
PRS AT <LF>
```

PRS CM

Connect Message Inhibit

PRS CM controls the CNX yy connect message responses. The V.F 28.8/33.6 supports both the 1989 and the 1984 recommendations for V.25 *bis* connection procedures. The 1989 CCITT Blue Book recommends that when the modem transfers from command mode to data mode it should send a connect message of the form CNX yy, where yy identifies the connect speed (96 = 9600 bps, 48 = 4800 bps, 24 = 2400 bps, and 12 = 1200 bps; omitted for 300 bps). The 1984 CCITT Red Book does not include these connect messages. Default is 0 (connect message disabled).

To disable the CNX yy connect message responses, type:

```
PRS CM ; 0 <LF>
```

To enable responses, type:

```
PRS CM ; 1 <LF>
```

Note

After modifying this option you should save the setting by using the NVW command.

PRS DR

DTE Data Rate

PRS DR, in conjunction with the hand-shake mode command (PRS HM), controls the DTE speed. There are several configurations to consider:

- a. An automatic handshake mode (e.g., V.32 *bis* auto [PRS HM ; 2], V.32 auto [PRS HM ; 4], V.22 *bis* only [PRS HM ; 6]) takes precedence over the PRS DR selection, and the modem tries for the highest VF speed common to the two commands.
- b. For 1200 bps V.22 operation, select PRS HM ; 7. PRS HM ; 6 is an auto mode, so setting the DTE to 1200 bps (PRS DR ; 3) will not force the connection to 1200 bps.
- c. When the modem is optioned for an automatic hand-shake mode and direct V.14 asynchronous mode (AT command \N1), it sends a connect message to the DTE at the selected PRS DR speed. In order to pass data, the user must change the DTE's speed to match the displayed connect speed.

- d. When the modem is optioned for speed buffering (AT command \N0) or an error correcting protocol (AT commands \N3 or \N4), the PRS DR command alone selects the DTE speed, and the PRS HM command selects the hand-shake mode.
- e. When the modem is optioned for a fixed handshake mode and direct mode (AT command \N1), the PRS DR command selects not only the DTE speed, but also forces the VF speed to match it. If this speed is not available, the modem drops the call. (This does not apply to V.22 *bis* only, which handshakes at the highest VF speed.)
- f. When using the modem in direct mode (AT command \N1), if the desired connect speed is known, set the speed to match using the PRS DR command. Set the DTE to the same speed and "AT" the modem so that it will know at what speed to send messages.

Note

The modem must be in the AT command set mode in order to configure the \Nn AT command.

To invoke this command, type:

PRS DR ; n <LF>

where n is the DTE rate, as follows:

<i>n</i>	rate	<i>n</i>	rate
0	Autobaud	11	19,200 bps
1	Last connect speed	12	21,600 bps
2	300 bps	13	24,000 bps
3	1200 bps	14	26,400 bps
4	2400 bps	15	28,800 bps
5	4800 bps	16	38,400 bps
6	7200 bps	17	57,600 bps
7	9600 bps	18	76,800 bps
8	12,000 bps	19	115,200 bps
9	14,400 bps	20	128,000 bps
10	16,800 bps		

PRS HM

Handshake Mode

PRS HM selects the handshake mode.

Note

- a. *When the modem is optioned for an external transmit clock source (PTM ; 1), the modem should be optioned for a fixed hand-shake mode, not an automatic hand-shake mode (e.g., select V.32 bis only [PRS HM ; 3] instead of V.32 bis automatic [PRS HM ; 2]). The modem will then handshake only at the speed given to it by the DTE.*
- b. *For 1200 bps V.22 operation, select PRS HM ; 7. PRS HM ; 6 is an auto mode, so setting the DTE to 1200 bps (PRS DR ; 3) will not force the connection to 1200 bps.*

To invoke this command, type:

```
PRS HM ; n <LF>
```

where *n* is the handshake mode, as follows:

- | | |
|----|---|
| n | mode |
| 0 | V.34 auto (28.8 kbps to 300 bps) |
| 1 | V.34 only (28.8 kbps to 9600 bps) |
| 2 | V.32 bis automatic (14.4 kbps to 300 bps) |
| 3 | V.32 bis only (14.4 kbps to 4800 bps) |
| 4 | V.32 automatic (9600 bps to 300 bps) |
| 5 | V.32 only (9600 bps to 4800 bps) |
| 6 | V.22 bis only (2400 bps to 1200 bps) |
| 7 | V.22 only (1200 bps) |
| 8 | Bell 212 only (1200 bps) |
| 9 | Bell 103 only (300 bps) |
| 10 | V.21 only (300 bps) |

PRS TR

Termination Character

PRS TR selects the ASCII character that represents the command termination character in the asynchronous mode. The command termination character is the character that is used to enter a command for interpretation by the modem. Select the command termination character that is compatible with your preference and your terminal. Default is 10 or <LF> (line feed).

To select the line feed control-character as the command termination character, type:

```
PRS TR ; 10 <LF>
```

To select the vertical tabulation control-character, type:

```
PRS TR ; 11 <LF>
```

To select the form feed control-character, type:

```
PRS TR ; 12 <LF>
```

PTM**Synchronous Timing**

PTM selects the clock source when operating in a synchronous data mode.

To select internal clock (supplied by the modem), type:

```
PTM ; 0 <LF>
```

To select external clock (supplied by the DTE), type:

```
PTM ; 1 <LF>
```

To select receiver wrap clock (derived from received data), type:

```
PTM ; 2 <LF>
```

V.25 bis Communication Commands

Communication commands allow you to establish and terminate data communications.

CIC**Connect Incoming Call**

CIC causes the modem to automatically answer the current incoming call. Use it to temporarily modify the automatic answering function (the modem answers the call after accepting CIC, ignoring the number of automatic answering rings selected with the PRS AA command). Ten seconds after one incoming call is completed, normal automatic answering is restored.

To invoke this command, type:

```
CIC <LF>
```

CRN**Call Requested Number**

CRN causes the modem to dial a telephone number, supplied with the command, to initiate data communication with another modem. If the handshake abort timer (AT command S7=x) times out before the modem detects answer tone, the modem will return on-hook.

To invoke this command, type:

```
CRN n <LF>
```

where *n* is the telephone number to be dialed. The modem recognizes only the characters contained in *n* that are listed in [Table 5-4](#). To dial 555-1234, for example, type:

```
CRN 5551234 <LF>
```

Table 5-4 Legal Dialing Characters

Character	Description
0 1 2 3 4 5 6 7 8 or 9	Pulse and tone dial digits
#	Tone dial character
*	Tone dial character
P	Causes dialed numerals following P to be dialed using pulses. Used to select pulse dialing for compatibility with your telephone system. Pulse dialing is blocked by some country code configurations.
T	Causes dialed alphanumeric characters following T to be dialed using tones. Used to select tone dialing for compatibility with the telephone system you intend to use.
, or <	Causes the modem to pause a specified length of time before dialing the next digit of a telephone number (the pause is 2 seconds in length by default and may be changed with the S8=x AT command). Used when the telephone system requires a pause before it can accept the next digit of the telephone number being dialed.
! or &	Causes the modem to go on-hook (flash) momentarily. Used to command certain internal telephone systems (PBXs).
@	Causes the modem to wait <i>n</i> seconds for one or more rings followed by five seconds of silence before dialing the next digit of a telephone number (if <i>n</i> seconds expire before a ring is detected, the modem will abort dialing and return to the command mode). Used to dial a telephone system that does not provide dial tone. Silence, rather than dial tone, indicates that the telephone system is ready to accept telephone number dialing. (<i>n</i> = the value selected in the abort timer.)
Ln	On dial failure, link to the telephone number stored in cell <i>n</i> (<i>n</i> = 0 to 9).
W or :	Causes the modem to wait a specified length of time for dial tone before dialing the next digit of the telephone number. The length of time is specified by the S7=x AT command. If this time expires before dial tone is detected, the modem will abort dialing and return to the command line.

CRS

Call Requested Stored Telephone Number

CRS causes the modem to dial the telephone number stored in a specified modem memory cell. The number to be dialed must have been stored in a memory cell previously by means of the PRN command.

To invoke this command, type:

```
CRS n <LF>
```

where *n* is the number (from 0 to 9) of the memory cell containing the telephone number to be dialed. To dial the number stored in memory cell 5, for example, type:

```
CRS 5 <LF>
```

DIC

Disconnect Incoming Call

DIC causes the modem to temporarily disable the automatic answering function and ignore an incoming call. Ten seconds after one incoming call is completed, normal automatic answering is restored.

To invoke this command, type:

```
DIC <LF>
```

ITU-T V.25 *bis* Command Set Operating Procedures

The following paragraphs describe communication operating procedures for the V.F 28.8/33.6 using the ITU-T V.25 *bis* command set. The descriptions include procedures for originating, answering, and terminating a call in the 108.2 and 108.1 modes.

108.2 Mode Operating Procedures

The following communication operating procedures are intended for the 108.2 mode.

Originating a Call

To establish communication by originating a call in the 108.2 mode:

1. From the DTE, use the CRN or CRS command to dial the desired telephone number.
2. When communication is established, your terminal displays the CNX response (if enabled with the PRS CM ; 1 command) and you may transfer data.

Automatic Call Answering

To have the modem automatically answer calls and establish communication:

1. Enable automatic answering by typing:

PRS AA ; n <LF>

where *n* is the number of rings (from 1 to 255) that the modem will wait before it performs automatic answering. The default is 4.

2. The modem will answer any incoming call automatically after the specified number of rings.
3. When communication is established, your terminal will display the CNX response and data transfer can take place. If communication is not established, your terminal will display the appropriate response and the modem will return to the command mode.

Manual Call Answering

The command **PRS AA ; 0 <LF>** disables automatic call answering. When automatic answering is disabled, use the following procedure to establish communication by manually answering calls:

1. When your terminal displays the INC result code to indicate an incoming call, type:
CIC <LF>
2. When communication is established, your terminal will display the CNX response and data transfer can take place. If communication is not established, your terminal will display the appropriate response and the modem will return to the command mode.

Automatic Call Termination

The modem will automatically terminate a call

- a. if terminal interface signal 108.2 (DTR) is turned Off while the modem is in data mode. This mode of automatic termination functions only when DTR is optioned for normal operation; it is disabled if 108.2 is optioned for forced On operation.
- b. if the handshaking sequence is not completed within the abort time period (selected by the **S7=x** AT command; default is 30 seconds) after originating or answering a call.
- c. if a long space is received and long space disconnect has been enabled by the **Yn** AT command. This mode of automatic termination functions only when the modem is operating at 300, 1200, or 2400 bps.

108.2 Call Establishment Procedure

The general principle for establishing a call between the DTE and DCE complies with the V.25 *bis* 108.2 mode of operation and is outlined below:

Originating a Call

DTE

Turn On DTR.

Send Command: CRN or CRS.

Wait for the connection (or abort the call by turning Off DTR).

Recognizes successful connection when DSR comes On.

Recognizes connected data rate from the CNX message.

Turn On RTS to send data.

Turn Off DTR to terminate call.

DCE

Turn On CTS.

Send VAL response.
Dial phone number.

Turn Off CTS when answer tone is detected or send CFI response in cases where the call has failed.
Turn On DSR and DCD when handshake is successful.

Send connect CNX message.
Enter data transfer mode.

CTS responds to RTS.

Disconnect from line.
Turn Off CTS, DSR, and DCD.
Send CFI call abort message.

Answering a Call

DTE

Turn On DTR.

Send CIC command to permit answering, or send DIC command to disregard the incoming ring.

Recognizes successful connection when DSR comes On.

Recognizes connected data rate from the CNX message.

Turn On RTS to send data.

Turn Off DTR to terminate call.

DCE

After detection of an incoming ring, send INC message.

When Auto Answer is enabled, modem will answer call after preset number of rings if DTR is On. The CIC command is not required.

Disregard incoming ring if DIC is received.

Answer call after the next ring if CIC is received.

At next ring, go off-hook.

Turn Off CTS.

Turn On DSR and DCD when going through handshake successfully.

Send connect CNX message.

Go into data transfer mode.

CTS responds to RTS.

Disconnect from line.

Turn Off CTS, DSR, and DCD.

Send CFI call abort message.

108.1 Mode Operating Procedures

The following communication operating procedures are intended for the 108.1 mode.

Originating a Call Automatically

To establish communication by automatically originating a call in the 108.1 mode:

1. Prior to the time of calling a telephone number must be stored in the modem's memory cell 0. That can be done with either the 108.2 mode PRN command or the AT command `&Zn=nmn`.
2. To initiate an automatically dialed call in 108.1 mode, turn On terminal interface circuit 108.1.
3. When communication is established with the remote modem, you may transfer data.

Originating a Call Manually

To establish communication by manually originating a call:

1. Lift the telephone handset, listen for a dial tone, and call the remote site.
2. When calling an automatically answered site, turn On terminal interface circuit 108.1 - or press the TALK/DATA switch on the front panel - when you hear answer tone.
3. When calling a manually answered site, ask the attendant who answers the call to transfer the remote modem to data mode. When you hear answer tone, turn On terminal interface circuit 108.1 - or press the TALK/DATA switch.
4. When communication is established, you may transfer data.

Automatic Call Answering

The modem can answer calls automatically in 108.1 mode if the function has not been disabled. The automatic answer enable/disable command (in 108.2 mode) is

```
PRS AA ; n <LF>
```

where n is the number of rings (from 1 to 255) that the modem will wait before it begins the automatic answering process.

PRS AA ; 0 <LF> disables automatic answering. The default is 4.

The following sequence of events takes place when the modem senses an incoming call:

1. After the specified number of rings, the modem turns On circuit 125 (Call Indicator) to alert the DTE that an incoming call is trying to make a connection.
2. If the DTE is prepared to accept the connection it responds by turning On circuit 108.1. While Call Indicator is On, circuit 108.1 acts as the command to perform automatic answering.
3. The modem then goes off-hook, performs handshaking, and, when that is successfully completed, begins data transfer with the remote modem.

Manual Call Answering

When automatic answering is disabled, use the following procedure to establish communication by manually answering calls:

1. When the telephone rings, lift the handset.

2. When the remote site attendant asks you to place the modem in data mode, turn On terminal interface 108.1 - or press the talk/data switch (D/TK key) on the front panel.
3. Hang up the handset. You may now commence data communications.

Terminating a Call

To terminate communication, turn Off terminal interface circuit 108.1 or press the TALK/DATA switch.

V.25 *bis* 108.2 Mode Interface Specifications

Physical connections between a DTE and a DCE may be either synchronous or asynchronous. The ITU-T V.25 *bis* 108.2 mode recommendations describe the exchange of commands and responses between the units using both types of operation. The V.F 28.8/33.6 supports command/response exchange in either mode.

The following paragraphs describe the functional characteristics of the V.25 *bis* synchronous and asynchronous interfaces, as used in the V.F 28.8/33.6 modem.

Interface Connections

From DCE to DTE:	104	RXD
	106	CTS
	107	DSR
	125	Call Indicator/Ring Detector
	114	TX Timing (synchronous only)
	115	RX Timing (synchronous only)
From DTE to DCE:	103	TXD
	105	RTS
	108.2	DTR
	113	TX Timing (synchronous only)

Synchronous Format Selection

The V.F 28.8/33.6 supports both the bit-oriented and the byte-oriented modes of synchronous operation.

Synchronous Bit-Oriented Operation

The modem uses the HDLC format in the bit-oriented synchronous mode (%V2 AT command). The structure of each message in this format is shown below:

← Time

F	FCS	Message	C	A	F
---	-----	---------	---	---	---

- F = Idle Flag (01111110)
- FCS = Frame Check Sequence (CRC-ITU-T, $x^{16}+x^{12}+x^5+1$)
- Message = Command/Response (7-bit ASCII data and 1 odd parity)
- C = Control (00010011*)
- A = Address (11111111*)

*The modem will not recognize the C or A fields unless verified as shown above.

Synchronous Byte-Oriented Operation

The modem uses the BISYNC (BSC) format in the byte-oriented synchronous mode (%V3 AT command). The structure of each message in this format is shown below:

← Time

BCC	ETX	Message	STX	SYN	SYN
-----	-----	---------	-----	-----	-----

- BCC = LRC Block Check Character for ASCII
- ETX = ASCII ETX Character (10000011)
- Message = Command/Response (7-bit ASCII data and 1 odd parity)
- STX = ASCII STX Character (00000010)
- SYN = ASCII SYN Character (00010110)

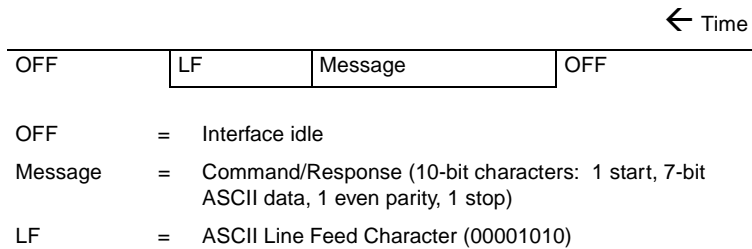
Note *BCC is always transmitted in the modem's responses, but optionally included in the DTE commands. In this way, the modem conforms to BSC conventions without deviating from the ITU-T V.25 bis Recommendations.*

Data Rate

The V.F 28.8/33.6 does not support 300 bps in the synchronous mode. Also, in the synchronous mode, the modem will not hand-shake with an incoming call at 300 bps FSK.

Asynchronous Format

The structure of each message in the asynchronous mode (%V1 AT command) format is shown below:



Modem Test Modes

When optioned to operate in the synchronous V.25 *bis* mode, the V.F 28.8/33.6 supports the following test modes that can be initiated from the front panel:

- Analog Loopback
- Analog Loopback with Self-Test
- Digital Loopback
- Remote Digital Loopback
- Remote Digital Loopback with Self-Test
- End-to-End Self-Test

All tests may be terminated from the front panel switches, and the modem returns to off-line idle command state when DTR goes from On to Off. Pending tests can be cleared only from the front panel.

Chapter 6: Tests

Overview

This section describes tests that can be invoked to isolate a trouble condition. The tests can isolate a problem to the data connection, data set operation, or the DTE interface level. Refer to [Table 6-1](#) for a sequence of tests for fault isolation.

-
- Note**
- a. *On-line tests, which involve data transmitted from one modem to another, can be performed with the modems operating in either synchronous mode or direct (NI) asynchronous mode. They cannot be initiated until the modem has been in data mode for approximately 30 seconds.*
 - b. *Once a modem is in Slave RDL, it will ignore all requests other than AL.*
 - c. *If an RDL request does not get a response from the Slave modem at 2400 bps, the Master will drop the line.*
-

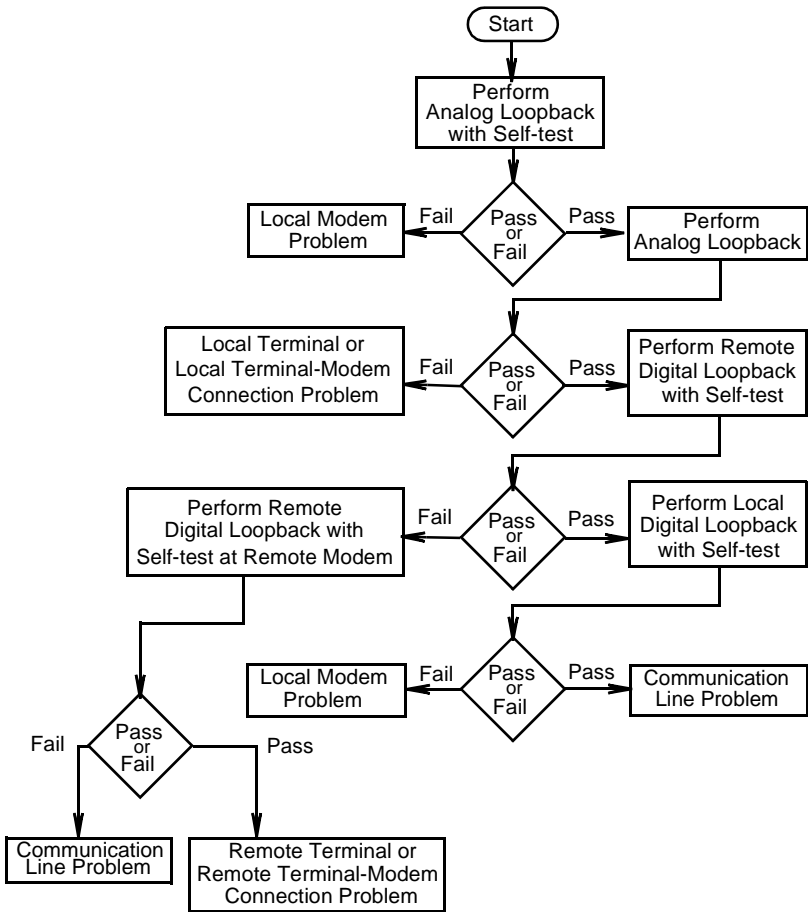


Figure 6-1 Fault Isolation Sequence

Analog Loopback

The analog loopback (ANALOOP) test mode is provided to isolate problems in the data set operation and the DTE interface. Specifically, ANALOOP tests modem modulator/demodulator operation, DTE receive/transmit operation, and DTE interface operation. The ANALOOP test can be controlled from the front panel or by AT commands.

Note *When the modem is used in \N0, \N3, \N4, or \N5 modes with a fixed DTE speed, it will not issue a CONNECT message. When the modem is used in \N1 mode, since the ANALOOP handshake speed may not match the DTE speed selected, the modem will issue a CONNECT _ _ _ _ message at the last known DTE rate. If the DTE rate and handshake rate differ, the user can change the DTE to match the rate reported by the CONNECT message.*

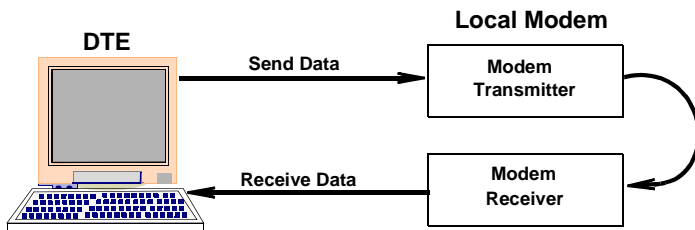


Table 6-1 Analog Loopback

Step	Front Panel	AT Command Mode
1.	Press DIAG, then scroll to ANALOOP and press ENTER.	Type: AT&T1 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.
2.	The modem flashes the TM LED and displays the test name (LL) while it is setting up the test, then lights the TM LED and decimal point three while the test is running.	The modem flashes the TM LED while it is setting up the test, then lights the TM LED and decimal point three while the test is running.
3.	Enter test data at DTE. Compare the data that was entered at the DTE with the data that is looped back and displayed by the DTE. If errors occur frequently, a problem may exist in the modem, DTE or DTE-to-modem connection. Refer to the fault-isolation diagram to isolate the problem.	
4.	To end test, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end test, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T (enter)

Analog Loopback With Self-Test

ANALOOOP may be combined with Self-Test. Upon initiation of Self-Test, a pattern is generated by the transmitter and sent to the receiver for analysis. The pattern is made up of alternate ones and zeros for speeds of 1200 and 2400 bps. For all other speeds the modem generates a 511 test pattern. The number of errors is displayed on the LCD screen. This test provides a means for the customer to determine whether the problem is in the local data set.

This test is not operational when the modems are passing data at 300 bps.

Table 6-2 Analog Loopback With Self-Test

Step	Front Panel	AT Command Mode
1.	Press DIAG, then scroll to ANALOOOP SELFTEST and press ENTER.	Type: AT&T9 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.
2.	The modem flashes the TM LED and displays the test names (LL and ST) while it is setting up the test, then lights the TM LED and displays four digits of the error count (0000 to 9999) while the test is running. It indicates larger numbers by lighting decimal point one and displaying the four least significant digits of the actual count (for example, the actual error count is 12345, but the modem displays 2.345).	The modem flashes the TM LED while it is setting up the test, then lights the TM LED while the test is running. When the test is terminated, the screen displays a four-digit number corresponding to the number of errors detected during the test, followed by the OK message. Any number greater than 0 indicates the modem has failed the test.
3.	If the timer, S-Register 18, is set to a value between 1 and 60, the test ends automatically after that value (in 10-second increments) is reached. The factory default for S-Register 18 is 000, meaning that the test will continue indefinitely.	
4.	To end test manually, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end test manually, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T (enter)

Digital Loopback

The modem can be commanded to enter digital loopback, illustrated in [Table 6-3](#), by means of the front panel or AT commands. This loopback is used while a call to the distant modem is established. In digital loopback the local received data is coupled to the transmitter input so that the remote unit can perform a loopback test without commanding remote loopback.

In asynchronous mode the clocks will be clamped at the EIA interface.

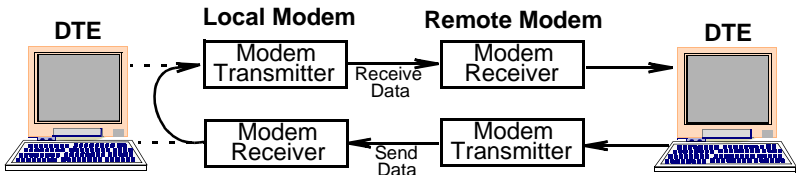


Table 6-3 Digital Loopback

Step	Front Panel	AT Command Mode
1.	Establish data communications with a remote modem.	
2.	To start the test, press DIAG, then scroll to DIGITAL LOOPBACK and press ENTER.	To start the test, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T3 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.
3.	The modem flashes the TM LED and displays the test name (DL) while it is setting up the test, then lights the TM LED and decimal point one while the test is running.	The modem flashes the TM LED while it is setting up the test, then lights the TM LED and decimal point one while the test is running.
4.	Direct the remote attendant to enter data at the remote DTE and then compare it with the data that is looped back and displayed by the DTE. If errors occur frequently, a problem may exist in the local or remote modems, the remote DTE, the remote DTE-to-modem connection, or the communication line. Refer to the fault isolation diagram to isolate the problem.	
5.	To end the test, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end the test, type: AT&T0 (enter) then type ATO (enter) to go back on line.

Remote Digital Loopback

Remote Digital Loopback, illustrated in [Table 6-4](#), is controlled at the local end. It can be commanded from the front panel, or with AT commands, or by the DTE's EIA pin 21. The loopback can be commanded only after a call is established and both ends are in data mode. In this loop, the demodulator's descrambled received data at the remote end is coupled to the remote transmitter input for transmission back to the local end.

This test is not operational when the modems are passing data at 300 bps.

Note *This test cannot be performed if the remote modem is commanded to ignore a remote digital loopback command. If the modems are operating at V.22 bis speeds and the local modem issues the RDL command to a remote unit configured to ignore the remote loop-back command, the resulting condition will cause the local modem to drop the connection.*

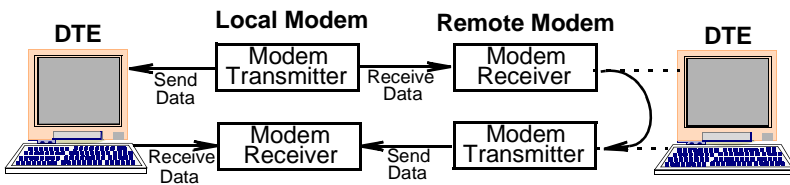


Table 6-4 Remote Digital Loopback

Step	Front Panel	AT Command Mode
1.	Establish data communications with a remote modem.	
2.	Check with the remote attendant that the remote modem will accept Remote Digital Loopback commands.	
3.	To start the test, press DIAG, then scroll to RDL and press ENTER.	To start the test, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T6 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.

(Sheet 1 of 2)

Table 6-4 Remote Digital Loopback (Continued)

Step	Front Panel	AT Command Mode
4.	The modem flashes the TM LED and displays the test name (RL) while setting up the test, then lights the TM LED and decimal point two while the test is running. (If the remote modem initiated the test, the local modem lights decimal points three and four while the test is running.)	The modem flashes the TM LED while it is setting up the test, then lights the TM LED and decimal point two while the test is running. (If the remote modem initiated the test, the local modem lights decimal points three and four while the test is running.)
5.	Enter data at the local DTE. Compare the data that was entered at the DTE with the data that is looped back and displayed by the DTE. If errors occur frequently, a problem may exist in the local or remote modems, the local DTE, the local DTE-to-modem connection, or the communication line. Refer to the fault-isolation diagram to isolate the problem.	
6.	To end the test, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end the test, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T0 (enter) then type ATO (enter) to go back on line.
Note:	<i>Any attempt to terminate the test at the remote modem by using the AT&T0 command will cause the modem to disconnect from the line.</i>	
Note:	<i>CTS at the remote modem will drop low during the test.</i>	

(Sheet 2 of 2)

Remote Digital Loopback With Self-Test

Remote Digital Loopback with Self-Test is controlled at the local end. It can be commanded from the front panel or with AT commands. This command can only be entered after the call is established and both ends are in the data mode. The test causes the local modem to generate a pattern that is transmitted across the telephone line to the remote modem's receiver, looped through to the remote modem's transmitter, and sent back across the telephone line to the local modem's receiver for analysis. The pattern is made up of alternate ones and zeros for speeds of 1200 and 2400 bps. For all other speeds the modem generates a 511 test pattern. The number of errors is displayed on the LCD screen. This test checks both modems and the telephone line.

This test is not operational when the modems are passing data at 300 bps.

Note *This test cannot be performed if the remote modem is commanded to ignore a remote digital loopback command.*

Table 6-5 Remote Digital Loopback With Self-Test

Step	Front Panel	AT Command Mode
1.	Establish data communications with a remote modem.	
2.	Check with the remote attendant that the remote modem will accept Remote Digital Loopback commands.	
3.	To start the test, press DIAG, then scroll to RDL SELFTEST and press ENTER.	To start the test, type the escape sequence (+++) and, after the modem is in command mode, type: AT&T7 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.
4.	The modem flashes the TM LED and displays the test names (RL and ST) while it is setting up the test, then lights the TM LED and displays four digits of the error count (0000 to 9999) while the test is running. It indicates larger numbers by lighting decimal point one and displaying the four least significant digits of the actual count (for example, the actual error count is 12345, but the modem displays 2.345).	The modem flashes the TM LED while it is setting up the test, then lights the TM LED while the test is running. When the test is terminated, the screen displays a four-digit number corresponding to the number of errors detected during the test, followed by the OK message.
5.	If the timer, S-Register 18, is set to a value between 1 and 60, the test ends automatically after that value (in 10-second increments) is reached. The factory default for S-Register 18 is 000, meaning that the test will continue indefinitely.	
6.	To end the test manually, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end the test manually, type the escape sequence (+++) and, after the modem is in the command mode, type: AT&T0 (enter) then type ATO (enter) to go back on line.

End-to-End Self-Test

End-to-End Self Test requires operators at both the local and remote modem. It can be commanded from the front panels or with AT commands. The commands can only be entered after the call is established and both ends are in the data mode. The test causes each modem to generate a pattern and to transmit it to the other modem. The modem receiving the pattern checks it for errors. The patterns are made up of alternate ones and zeros for speeds of 1200 and 2400 bps. For all other speeds the modems generate a 511 test pattern. The number of errors received is displayed on the screen. This test checks the operation of both modems and the communications line.

This test is not operational when the modems are passing data at 300 bps.

Table 6-6 End-To-End Self-Test

Step	Front Panel	AT Command Mode
1.	To start the test at each modem, press DIAG, then scroll to SELFTEST and press ENTER.	To start the test, at each modem type: AT&T9 (enter). If modem responds with an error message, type: AT%T0 (enter), which resets the test mode, then re-enter the command.
2.	The modem flashes the TM LED and displays the test name (ST) while it is setting up the test, then lights the TM LED and displays four digits of the error count (0000 to 9999) while the test is running. It indicates larger numbers by lighting decimal point one and displaying the four least significant digits of the actual count (for example, the actual error count is 12345, but the modem displays 2.345).	The modem flashes the TM LED while it is setting up the test, then lights the TM LED while the test is running. When the test is terminated, the screen displays a four-digit number corresponding to the number of errors detected during the test, followed by the OK message. Any number greater than 0 indicates the modem has failed the test.
3.	If the timer, S-Register 18, is set to a value between 1 and 60, the test ends automatically after that value (in 10-second increments) is reached. The factory default for S-Register 18 is 000, meaning that the test will continue indefinitely.	
4.	To end the test manually at each modem, press DIAG, then scroll to CANCEL TEST and press ENTER.	To end the test, type the escape sequence (+++) at each modem and, after the modem is in the command mode, type: AT&T0 (enter).

RDLB Requests

Your modem is factory set to acknowledge a remote modem's request to participate in a remote digital loopback test initiated from the remote location. If you do not want to acknowledge such requests, enter **AT&T5&W**.

If you later decide to acknowledge such requests enter **AT&T4&W**.

Maintenance

The V.F 28.8/33.6 modem is designed to operate without maintenance. Certain steps should, however, be taken in order to assure that the modem will continue to operate without problem.

Connections

Periodically check to make sure that all of the modem connections are secure.

Cleaning

If the modem enclosure becomes dirty, it should be cleaned with a damp cloth. If necessary, add a drop of liquid soap to the cloth, but do not use cleansers, ammonia, or cleaning solvents as they can harm the enclosure.

Appendix A: Technical Characteristics

Item	Specification
VF Data Rate	
33.6 kbps (ITU-T V.34)	Synchronous/asynchronous
31.2 kbps (ITU-T V.34)	Synchronous/asynchronous
28.8 kbps (ITU-T V.34)	Synchronous/asynchronous
26.4 kbps (ITU-T V.34)	Synchronous/asynchronous
24.0 kbps (ITU-T V.34)	Synchronous/asynchronous
21.6 kbps (ITU-T V.34)	Synchronous/asynchronous
19.2 kbps (ITU-T V.34)	Synchronous/asynchronous
16.8 kbps (ITU-T V.34)	Synchronous/asynchronous
14.4 kbps (ITU-T V.34 or V.32 <i>bis</i>)	Synchronous/asynchronous
12.0 kbps (ITU-T V.34 or V.32 <i>bis</i>)	Synchronous/asynchronous
9600 bps (ITU-T V.34, V.32 <i>bis</i> , or V.32)	Synchronous/asynchronous
7200 bps (ITU-T V.34, V.32 <i>bis</i>)	Synchronous/asynchronous
4800 bps (ITU-T V.34, V.32 <i>bis</i> , or V.32)	Synchronous/asynchronous
2400 bps (ITU-T V.34 or V.22 <i>bis</i>)	Synchronous/asynchronous
1200 bps (ITU-T V.22 or Bell 212A)	Synchronous/asynchronous
300 bps (ITU-T V.21 or Bell 103))	Asynchronous only
Data Format	
Bit synchronous	
Bit asynchronous	Selectable 8, 9, 10, or 11 bits per character
Transmit Clock	Internal, External, or Receive Wrap
Compatibility	ITU-T V.34, V.32 <i>bis</i> , V.32, V.22 <i>bis</i> , V.22, V.21, Bell 212A, and Bell 103
Operating Mode	
Switched network	Two-wire full duplex
Private line	Two-wire or four-wire
Modulation	
Above 14.4 kbps	Proprietary
14.4 kbps	128-level TCM/2400 Baud $\pm 0.01\%$
12.0 kbps	64-level TCM/2400 Baud $\pm 0.01\%$

Item	Specification
Modulation (cont.)	
9600 bps 9600 bps 7200 bps 4800 bps 2400 bps 1200 bps 0-300 bps	32-level TCM/2400 Baud $\pm 0.01\%$ 16-level QAM/2400 Baud $\pm 0.01\%$ 16-level TCM/2400 Baud $\pm 0.01\%$ 4-level QAM/2400 Baud $\pm 0.01\%$ 16-level QAM/600 Baud $\pm 0.01\%$ 4-level PSK/600 Baud $\pm 0.01\%$ FSK 0-300 Baud $\pm 0.01\%$
Answer Tone ITU-T V.32 <i>bis</i> , V.32, V.22 <i>bis</i> , V.22 and V.21 modes ITU-T V.34 Bell 212A and 103 modes	2100 Hz ± 3 Hz As specified by ITU-T 2225 Hz ± 3 H
Transmit Carrier ITU-T V.34 ITU-T V.32 <i>bis</i> ITU-T V.32 ITU-T V.22, V.22 <i>bis</i> /Bell 212A Originate Mode Answer Mode ITU-T V.21 Originate Mode Answer Mode Bell 103 Originate Mode Answer Mode	As specified by ITU-T As specified by ITU-T As specified by ITU-T 1200 Hz ± 0.5 Hz 2400 Hz ± 1 Hz Mark Space 1180 Hz ± 12 Hz 980 Hz ± 12 Hz Mark Space 1850 ± 12 Hz 1650 ± 12 Hz Mark Space 1270 Hz ± 12 Hz 1070 Hz ± 12 Hz Mark Space 2225 Hz ± 12 Hz 2025 Hz ± 12 Hz
Output Level Permissive Programmable <i>Note: Receiver performance in ITU-T V.34, V.32 bis, and V.32 modes may be degraded when transmitting above -6 dBm.</i>	-9 dBm maximum or per country requirements. -6 to -12 dBm (U.S. Only)

Item	Specification
Receive Carrier ITU-T V.34 ITU-T V.32 bis ITU-T V.32	As specified by ITU-T As specified by ITU-T As specified by ITU-T
<p><i>Note: ITU-T V.34/V.32/V.32 bis, being echo canceling protocols, use signal quality as criteria for maintaining connection. They also provide for self-training detection to force disconnect.</i></p>	
ITU-T V.22 bis/Bell 212A Originate Mode Answer Mode ITU-T V.21 Originate Mode Answer Mode Bell 103 Originate Mode Answer Mode	2400 Hz \pm 7 Hz 1200 Hz \pm 7 Hz Mark Space 1850 \pm 12 Hz 1650 \pm 12 Hz Mark Space 1180 Hz \pm 12 Hz 1650 Hz \pm 12 Hz Mark Space 2225 Hz \pm 12 Hz 2025 Hz \pm 12 Hz Mark Space 1270 Hz \pm 12 Hz 1070 Hz \pm 12 Hz
Receive Level Switched Network Two-wire Private Line Four-wire Private Line	-6 to -43 dBm -6 to -33 dBm 0 to -26 dBm
Carrier Detect (Level for ITU-T V.22 bis, V.22, V.21, 212, 103) in Switched Network	Acquisition Release -43 dBm -48 dBm
Hysteresis	2 dBm minimum
<p><i>Note: ITU-T V.32/V.32 bis/V.34, being echo canceling protocols, use signal quality as criteria for maintaining connection. They also provide for self-training detection to force disconnect.</i></p>	

Item	Specification
DTE Interface Standard Optional	EIA/TIA-232-E (ITU-T V.24/V.28/ISO 2110) EIA/TIA-530-A (ITU-T V.10/V.11/V.24/ISO 2110 Amendment 1) ITU-T V.35 (ITU-T V.24/V.28/V.35/ISO 2593) ITU-T V.36 (requires a special optional cable)
Line Requirements Switched Network Private Line	Two-wire Two-wire or four-wire
Line Connection Switched Network Phone Private Line	8-position modular jack (US RJ45) 6-position modular jack (US RJ11) 8-position modular jack (US RJ45)
Line Impedance	600 ohms or 900 ohms
Line Equalization	Automatic Adaptive
Connection Options	One second Line Break Holdover in four-wire private line mode only. Loss of Carrier in ITU-T V.22 bis and lower. Loop Current Disconnect.
Phone Types	500 (rotary dial), 2500 (DTMF dial), and no phone
Dialing	Pulse and Tone
DTMF Output Level USA International	Per Part 68 per country requirements
Pulse Dial Ratio USA International	Make/Break: 39/61% per country requirements
Ring Cadence USA International	On 2 seconds; Off 4 seconds per country requirements

Item	Specification
DC Loop Current USA International	20-80 milliamps per country requirements
Call Progress Monitor	BUSY CONNECT (rate) (see ITU-T V.42 options for delay) CONNECT (see ITU-T V.42 options for delay) NO ANSWER NO CARRIER NO DIALTONE OK (character abort) RING RINGING UNOBTAINABLE NUMBER
Power Requirements Voltage Frequency Dissipation	99 to 129 V ac 50 to 60 Hz 13.5 W ac maximum (line cord)
DC Voltage (Typical) +5V +12V -12V	+5V $\pm 5\%$ at 1A +12V $\pm 5\%$ at 0.2A -12V $\pm 5\%$ at 0.2A
Dimensions (Printed circuit board with DeskTop Enclosure) Height Width Depth	36 mm (1.4 in) 188 mm (7.4 in) 279 mm (11 in)
Temperature Operating Non-operating	0 to 45°C (32° to 113°F) -40 to 70°C (-40° to 158°F)
Humidity, operating	Up to 95 % humidity (non-condensing)
Altitude, operating	0 m to 3,047 m (0 to 10,000 ft)

Appendix B: Business Equipment Interface (EIA/TIA-232-E, ITU-T V.24/V.28/ISO 2110)

Pin No.	Circuit		Name	Direction	Function
	232-E	V.24			
Description					
2	BA	103	SD	To DCE	Transmitted Data
	The data signals originated by the DTE to be transmitted via a data channel to remote data stations, or to be passed to the DCE for maintenance test purposes under control of the DTE, are transferred on this circuit to the DCE.				
3	BB	104	RD	From DCE	Received Data
	The data signals generated by the DCE in response to data channel line signals received from a remote data station, or in response to the DTE maintenance test signals, are transferred on this circuit to the DTE.				
4	CA	105	RTS	To DCE	Request to Send
	Signals on this circuit control the data transmit function of the DCE. The On condition causes the DCE to assume the data channel transmit mode. The Off condition causes the DCE to assume the data channel non-transmit mode when all data transferred on circuit 103 has been transmitted.				
5	CB	106	CTS	From DCE	Clear to Send
	Signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data. The Off condition indicates that the DCE is not ready to operate.				
6	CC	107	DSR	From DCE	Data Set Ready
	Signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data. The Off condition indicates that the DCE is not ready to operate.				
7	AB	102	SIG GND		Signal Ground
	This pin is the signal ground reference for the V.24 interface circuits.				

Pin No.	Circuit		Name	Direction	Function
	232-E	V.24			
Description					
8	CF	109	CO/DCD	From DCE	Data Channel Receive Line Signal Detect
Signals on this circuit indicate whether the receive data channel line signal is within appropriate limits, as specified in the relevant recommendation for DCE. The On condition indicates that the received signal is within appropriate limits. The Off condition indicates that the received signal is not within the appropriate limits.					
15	DB	114	SC	From DCE	Transmit Clock DCE Source
Signals on this circuit are used to provide the data terminal equipment with signal element timing information. The data terminal equipment shall provide a data signal on the Transmit Data line in which the transitions between signal elements nominally occur at the time of the Off-to-On transitions of the signal on the DB circuit.					
17	DD	115	RC	From DCE	Received Clock
Signals on this circuit are used to provide the data terminal equipment with received signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the BB (Received Data) circuit.					
18	LL	141	ALE	To DCE	Local Loopback
Signals on this circuit are used to provide test mode control of the local loop 3.					
20	CD	108/1		To DCE	Connect Data Set to Line
Signals on this circuit control switching of the signal-conversion or other similar equipment to or from the line. The On condition causes the DCE to dial a stored phone number and connect the signal-conversion or similar equipment to the line. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.					
20	CD	108/2	DTR	To DCE	Data Terminal Ready
Signals on this circuit control switching of the signal-conversion or similar equipment to or from the line. The On condition, indicating that the DTE is ready to operate, prepares the DCE to connect the signal conversion or similar equipment to the line and maintains this connection after it has been established by supplementary means. The DTE is permitted to present the On condition on circuit 108.2 whenever it is ready to transmit or receive data. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.					

Pin No.	Circuit		Name	Direction	Function
	232-E	V.24			
	Description				
21	2.5	140	RLE	To DCE	Remote Digital loopback
	The On condition in this circuit will initiate a Remote digital loopback test.				
22	CE	125	RI	From DCE	Ring Indicator
	The On condition of this circuit indicates that a ringing signal is being received on the communication channel. The On signal shall appear approximately coincident with the On segment of the ringing cycle (during rings) on the communication channel.				
23	CI	112	TC	From DCE	Speed Indicator
	The On condition indicates that the modem is operating at the highest speed within the selected handshake mode. The Off condition indicates that a speed lower than the maximum was selected.				
24	DA	113	TC	To DCE	Transmit Clock DTE Source
	Signals on this circuit are used to provide the transmitting signal converter with signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the BA (Transmit Data) line.				
25	TM	142	TME	From DCE	Test Mode Indicator
	The On condition in this circuit indicates that a maintenance condition in the DCE, precluding reception or transmission of data signals from or to a remote DTE. The Off condition indicates that the DCE is not in maintenance test condition.				

Appendix C: Business Equipment Interface (EIA/TIA-530-A, ITU-T V.10/V.11/V.24/ISO 2110)

Pin No.	Circuit		Name	Direction	Function
	530	V.11			
Description					
2	BA-A	103-A	SD	To DCE	Transmitted Data
	The data signals originated by the DTE to be transmitted via a data channel to remote data stations, or to be passed to the DCE for maintenance test purposes under control of the DTE, are transferred on this circuit to the DCE.				
3	BB-A	104-A	RD	From DCE	Received Data
	The data signals generated by the DCE in response to data channel line signals received from a remote data station, or in response to the DTE maintenance test signals, are transferred on this circuit to the DTE.				
4	CA-A	105-A	RTS	To DCE	Request to Send
	Signals on this circuit control the data transmit function of the DCE. The On condition causes the DCE to assume the data channel transmit mode. The Off condition causes the DCE to assume the data channel non-transmit mode when all data transferred on circuit 103 has been transmitted.				
5	CB-A	106-A	CTS	From DCE	Clear to Send
	Signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data. The Off condition indicates that the DCE is not ready to operate.				
6	CC	107	DSR	From DCE	Data Set Ready
	Signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data. The Off condition indicates that the DCE is not ready to operate.				
7	AB	102-A	SIG GND		Signal Ground
	This pin is the signal ground reference for the V.11 interface circuits.				

(Sheet 1 of 4)

Pin No.	Circuit		Name	Direction	Function
	530	V.11			
Description					
8	CF-A	109-A	CO/DCD	From DCE	Data Channel Receive Line Signal Detect
	Signals on this circuit indicate whether the receive data channel line signal is within appropriate limits, as specified in the relevant recommendation for DCE. The On condition indicates that the received signal is within appropriate limits. The Off condition indicates that the received signal is not within the appropriate limits.				
9	DD-B	115-B	RC	From DCE	Received Clock
	See pin 17, circuit DD-A.				
10	CF-B	109-B	CO/DCD	From DCE	Data Channel Receive Line Signal Detect
	See pin 8, circuit CF-A.				
11	DA-B	113-B	TC	To DCE	Transmit Clock DTE Source
	See pin 24, circuit DA-A.				
12	DB-B	114-B	SC	From DCE	Transmit Clock DCE Source
	See pin 15, circuit DB-A.				
13	CB-B	106-B	CTS	From DCE	Clear to Send
	See pin 5, circuit CB-A.				
14	BA-B	103-B	SD	To DCE	Transmitted Data
	See pin 2, circuit BA-A.				
15	DB-A	114-A	SC	From DCE	Transmit Clock DCE Source
	Signals on this circuit are used to provide the DTE with signal element timing information. The data terminal equipment shall provide a data signal on the Transmit Data line in which the transitions between signal elements nominally occur at the time of the Off-to-On transitions of the signal on the DB circuit.				
16	BB-B	104-B	RD	From DCE	Received Data
	See pin 3, circuit BB-A.				
17	DD-A	115-A	RC	From DCE	Received Clock
	Signals on this circuit are used to provide the DTE with received signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the BB (Received Data) circuit.				

(Sheet 2 of 4)

Pin No.	Circuit		Name	Direction	Function
	530	V.11			
Description					
18	LL	141	ALE	To DCE	Local Loopback
	Signals on this circuit are used to provide test mode control of the local loop 3.				
19	CA-B	105-B	RTS	To DCE	Request to Send
	See pin 4, circuit CA-A.				
20	CD	108.1		To DCE	Connect Data Set to Line
	Signals on this circuit control switching of the signal-conversion or other similar equipment to or from the line. The On condition causes the DCE to dial a stored phone number and connect the signal-conversion or similar equipment to the line. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.				
20	CD	108.2	DTR	To DCE	Data Terminal Ready
	Signals on this circuit control switching of the signal-conversion or similar equipment to or from the line. The On condition, indicating that the DTE is ready to operate, prepares the DCE to connect the signal conversion or similar equipment to the line and maintains this connection after it has been established by supplementary means. The DTE is permitted to present the On condition on circuit 108.2 whenever it is ready to transmit or receive data. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.				
21	RL	140	RLE	To DCE	Remote Digital loopback
	The On condition in this circuit will initiate a Remote digital loopback test.				
22	CE	125	RI	From DCE	Ring Indicator
	The On condition of this circuit indicates that a ringing signal is being received on the communication channel. The On signal shall appear approximately coincident with the On segment of the ringing cycle (during rings) on the communication channel.				
23	CI	112	TC	From DCE	Speed Indicator
	The On condition indicates that the modem is operating at the highest speed within the selected handshake mode. The Off condition indicates that a speed lower than the maximum was selected.				

(Sheet 3 of 4)

Pin No.	Circuit		Name	Direction	Function
	530	V.11			
Description					
24	DA-A	113-A	TC	To DCE	Transmit Clock DTE Source
	Signals on this circuit are used to provide the transmitting signal converter with signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the BA (Transmit Data) line.				
25	TM	142	TME	From DCE	Test Mode Indicator
	The On condition in this circuit indicates that a maintenance condition in the DCE, precluding reception or transmission of data signals from or to a remote DTE. The Off condition indicates that the DCE is not in maintenance test condition.				

(Sheet 4 of 4)

Appendix D: Business Equipment Interface

(ITU-T V.35/V.24/V.28/ISO 2593)

Pin No.		Circuit	Name	Direction	Function
V.35	DB25	Description			
B	7	102	SIG GND		Signal ground
		Establishes a common ground reference for all interface circuits except protective ground.			
C	4	105	RTS	To DCE	Request to send
		Signals on this circuit control the data transmit function of the DCE. The On condition causes the DCE to assume the data channel transmit mode. The Off condition causes the DCE to assume the data channel non-transmit mode when all data transferred on circuit 103 has been transmitted.			
D	5	106	CTS	From DCE	Clear to send
		Signals on this circuit indicate whether the DCE is ready to transfer data. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to initiate transfer of data. The Off condition indicates that the DCE is not ready to transfer data.			
E	6	107	DSR	From DCE	Data set ready
		Signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal converter or similar equipment is connected to the line and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data. The Off condition indicates that the DCE is not ready to operate.			
F	8	109	CO/DCD	From DCE	Receive line signal detect
		Signals on this circuit indicate whether the receive data channel line signal is within appropriate limits, as specified in the relevant recommendation for DCE. The On condition indicates that the received signal is within appropriate limits. The Off condition indicates that the received signal is not within the appropriate limits.			

Pin No.		Circuit	Name	Direction	Function
V.35	DB25	Description			
H	20	108.1		To DCE	Connect Data Set to Line
		Signals on this circuit control switching of the signal-conversion or other similar equipment to or from the line. The On condition causes the DCE to dial a stored phone number and connect the signal-conversion or similar equipment to the line. The On condition following Ring Indicator causes the DCE to perform automatic answer. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.			
H	20	108.2	DTR	To DCE	Data terminal ready
		Signals on this circuit control switching of the signal-conversion or similar equipment to or from the line. The On condition, indicating that the DTE is ready to operate, prepares the DCE to connect the signal conversion or similar equipment to the line and maintains this connection after it has been established by supplementary means. The DTE is permitted to present the On condition on circuit 108.2 whenever it is ready to transmit or receive data. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line.			
NN	25	142	TME	From DCE	Test mode
		The On condition in this circuit indicates a test mode in the DCE, precluding reception or transmission of data signals from or to a remote DTE. The Off condition indicates the DCE is not in test mode.			
L	18	141	ALE	To DCE	Analog Loopback enable
		Signals on this circuit are used to control Analog Loopback test.			
P	2	103	SD-A	To DCE	Transmitted data
		Data signals originated by the DTE - to be transmitted to a remote data station via a data channel, or to be passed to the DCE for maintenance test purposes under control of the DTE - are transferred to the DCE on this circuit.			
R	3	104	RD-A	From DCE	Received data
		Data signals generated by the DCE - in response to data channel line signals received from a remote modem, or in response to DTE maintenance test signals - are transferred to the DTE on this circuit.			
S	14	103	SD-B	To DCE	Transmitted data
		See pin P/2, SD-A.			
T	16	104	RD-B	From DCE	Received data
		See pin R/3, RD-A.			

Pin No.		Circuit	Name	Direction	Function
V.35	DB25	Description			
U	24	113	TT-A	To DCE	Terminal timing
		Signals on this circuit are used to provide the transmitting signal converter with signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the Transmit Data line.			
V	17	115	RT-A	From DCE	Receive timing
		Signals on this circuit are used to provide the data terminal equipment with received signal element timing information. The On-to-Off transition shall nominally indicate the center of each signal element on the Received Data circuit.			
W	11	113	TT-B	To DCE	Terminal timing
		See pin U/24, TT-A.			
X	9	115	RT-B	From DCE	Receive timing
		See pin V/17, RT-A.			
Y	15	114	ST-A	From DCE	Transmit timing
		Signals on this circuit are used to provide the data terminal equipment with signal element timing information. The data terminal equipment shall provide a data signal on the Transmit Data line in which the transitions between signal elements nominally occur at the time of the Off-to-On transitions of the signal on this circuit.			
AA/a	12	114	ST-B	From DCE	Transmit timing
		See pin Y/15, ST-A.			
N	21	140	RLE	To DCE	ReDigital Loopback enable
		Transfers signal from DTE to control RDL test mode.			
J	22	125	RI	From DCE	Ring Indicator
		The On condition of this circuit indicates that a ringing signal is being received on the communication channel. The On signal shall appear approximately coincident with the On segment of the ringing cycle (during rings) on the communication channel.			
-	23	112	CI	From DCE	Speed Indicator
		The On condition indicates that the modem is operating at the highest speed within the selected handshake mode. The Off condition indicates that a speed lower than the maximum was selected.			

Appendix E: ASCII/EBCDIC Character Sets And Hexadecimal/Binary Conversions

ASCII Character	EBCDIC Character	Decimal	Hexa- decimal	Binary
NUL	NUL	0	00	00000000
CTRL A (SOH)	SOH	1	01	00000001
CTRL B (STX)	STX	2	02	00000010
CTRL C (ETX)	ETX	3	03	00000011
CTRL D (EOT)	PF	4	04	00000100
CTRL E (ENO)	HT	5	05	00000101
CTRL F (ACK)	LC	6	06	00000110
CTRL G (BEL)	DEL	7	07	00000111
CTRL H (BS)		8	08	00001000
CTRL I (HT)	RLF	9	09	00001001
CTRL J (LF)	SMM	10	0A	00001010
CTRL K (VT)	VT	11	0B	00001011
CTRL L (FF)	FF	12	0C	00001100
CTRL M (CR)	CR	13	0D	00001101
CTRL N (SO)	SC	14	0E	00001110
CTRL O (SI)	SI	15	0F	00001111
CTRL P (DLE)	DLE	16	10	00010000
CTRL Q (XON)	DC1	17	11	00010001
CTRL R (DC2)	DC2	18	12	00010010
CTRL S (XOFF)	DC3	19	13	00010011
CTRL T (DC4)	RES	20	14	00010100
CTRL U (NAK)	NL	21	15	00010101
CTRL V (SYN)	BS	22	16	00010110
CTRL W (ETB)	IL	23	17	00010111
CTRL X (CAN)	CAN	24	18	00011000
CTRL Y (EM)	EM	25	19	00011001

(Sheet 1 of 5)

ASCII Character	EBCDIC Character	Decimal	Hexa-decimal	Binary
CTRL Z (SUB)	CC	26	1A	00011010
ESC		27	1B	00011011
FS	ITS	28	1C	00011100
GS	IGS	29	1D	00011101
RS	IRS	30	1E	00011110
US	IUS	31	1F	00011111
SP	DS	32	20	00100000
!	SOS	33	21	00100001
"	FS	34	22	00100010
#		35	23	00100011
\$	BYP	36	24	00100100
%	LF	37	25	00100101
&	EOB	38	26	00100110
'	ESC	39	27	00100111
(		40	28	00101000
)		41	29	00101001
*	3M	42	2A	00101010
+		43	2B	00101011
,		44	2C	00101100
-	ENR	45	2D	00101101
.	ACK	46	2E	00101110
/	BEL	47	2F	00101111
0		48	30	00110000
1		49	31	00110001
2	SYN	50	32	00110010
3		51	33	00110011
4	PN	52	34	00110100
5	RS	53	35	00110101
6	UC	54	36	00110110
7	EOT	55	37	00110111
8		56	38	00111000
9		57	39	00111001
:		58	3A	00111010

(Sheet 2 of 5)

ASCII Character	EBCDIC Character	Decimal	Hexa-decimal	Binary
;		59	3B	00111011
<	DC4	60	3C	00111100
=	NAK	61	3D	00111101
>		62	3E	00111110
?	SUB	63	3F	00111111
@	SP	64	40	01000000
A		65	41	01000001
B		66	42	01000010
C		67	43	01000011
D		68	44	01000100
E		69	45	01000101
F		70	46	01000110
G		71	47	01000111
H		72	48	01001000
I		73	49	01001001
J	¢	74	4A	01001010
K	.	75	4B	01001011
L	<	76	4C	01001100
M	(	77	4D	01001101
N	+	78	4E	01001110
O	|	79	4F	01001111
P	&	80	50	01010000
Q		81	51	01010001
R		82	52	01010010
S		83	53	01010011
T		84	54	01010100
U		85	55	01010101
V		86	56	01010110
W		87	57	01010111
X		88	58	01011000
Y		89	59	01011001
Z	!	90	5A	01011010
[	\$	91	5B	01011011

(Sheet 3 of 5)

ASCII Character	EBCDIC Character	Decimal	Hexa-decimal	Binary
\	#	92	5C	01011100
]	)	93	5D	01011101
^	;	94	5E	01011110
-		95	5F	01011111
`	-	96	60	01100000
a	/	97	61	01100001
b		98	62	01100010
c		99	63	01100011
d		100	64	01100100
e		101	65	01100101
f		102	66	01100110
g		103	67	01100111
h		104	68	01101000
i	/	105	69	01101001
j	|	106	6A	01101010
k	'	107	6B	01101011
l	%	108	6C	01101100
m		109	6D	01101101
n		110	6E	01101110
o	?	111	6F	01101111
p		112	70	01110000
q		113	71	01110001
r		114	72	01110010
s		115	73	01110011
t		116	74	01110100
u		117	75	01110101
v		118	76	01110110
w		119	77	01110111
x		120	78	01111000
y		121	79	01111001
z	:	122	7A	01111010
{	#	123	7B	01111011
|	@	124	7C	01111100

(Sheet 4 of 5)

ASCII Character	EBCDIC Character	Decimal	Hexa-decimal	Binary
}	'	125	7D	01111101
~	=	126	7E	01111110
DEL	"	127	7F	01111111

(Sheet 5 of 5)

EBC-DIC Char.	Decimal	Hex	Binary	EBC-DIC Char.	Decimal	Hex	Binary
	128	80	10000000		160	A0	10100000
a	129	81	10000001		161	A1	10100001
b	130	82	10000010	s	162	A2	10100010
c	131	83	10000011	t	163	A3	10100011
d	132	84	10000100	u	164	A4	10100100
e	133	85	10000101	v	165	A5	10100101
g	135	87	10000111	x	167	A7	10100111
h	136	88	10001000	y	168	A8	10101000
i	137	89	10001001	z	169	A9	10101001
	138	8A	10001010		170	AA	10101010
	139	8B	10001011		171	AB	10101011
	140	8C	10001100		172	AC	10101100
	141	8D	10001101		173	AD	10101101
	142	8E	10001110		174	AE	10101110
	143	8F	10001111		175	AF	10101111
	144	90	10010000		176	B0	10110000
j	145	91	10010001		177	B1	10110001
k	146	92	10010010		178	B2	10110010
l	147	93	10010011		179	B3	10110011
m	148	94	10010100		180	B4	10110100
n	149	95	10010101		181	B5	10110101
o	150	96	10010110		182	B6	10110110
p	151	97	10010111		183	B7	10110111
q	152	98	10011000		184	B8	10111000
r	153	99	10011001		185	B9	10111001
	154	9A	10011010		186	BA	10111010
	155	9B	10011011		187	BB	10111011
	156	9C	10011100		188	BC	10111100
	157	9D	10011101		189	BD	10111101
	158	9E	10011110		190	BE	10111110
	159	9F	10011111		191	BF	10111111

EBC-DIC Char.	Decimal	Hex	Binary	EBC-DIC Char.	Decimal	Hex	Binary
{	192	C0	11000000	'	224	E0	11100000
A	193	C1	11000001		225	E1	11100001
B	194	C2	11000010	S	226	E2	11100010
C	195	C3	11000011	T	227	E3	11100011
D	196	C4	11000100	U	228	E4	11100100
E	197	C5	11000101	V	229	E5	11100101
F	198	C6	11000110	W	230	E6	11100110
G	199	C7	11000111	X	231	E7	11100111
H	200	C8	11001000	Y	232	E8	11101000
I	201	C9	11001001	Z	233	E9	11101001
	202	CA	11001010		234	EA	11101010
	203	CB	11001011		235	EB	11101011
	204	CC	11001100		236	EC	11101100
	205	CD	11001101		237	ED	11101101
	206	CE	11001110		238	EE	11101110
	207	CF	11001111		239	EF	11101111
}	208	D0	11010000	0	240	F0	11110000
J	209	D1	11010001	1	241	F1	11110001
K	210	D2	11010010	2	242	F2	11110010
L	211	D3	11010011	3	243	F3	11110011
M	212	D4	11010100	4	244	F4	11110100
N	213	D5	11010101	5	245	F5	11110101
O	214	D6	11010110	6	246	F6	11110110
P	215	D7	11010111	7	247	F7	11110111
Q	216	D8	11011000	8	248	F8	11111000
R	217	D9	11011001	9	249	F9	11111001
	218	DA	11011010		250	FA	11111010
	219	DB	11011011		251	FB	11111011
	220	DC	11011100		252	FC	11111100
	221	DD	11011101		253	FD	11111101
	222	DE	11011110		254	FE	11111110
	223	DF	11011111		255	FF	11111111

ASCII CHARACTER PARITY SELECTION				
	START	DATA	PARITY	STOP
BITS	1	8	None	1
	1	7	Even	1
	1	7	Odd	1
	1	7	Mark	1
	1	7	Space	1

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*Pn 4-40
*Rn 4-43
*Wn 4-56
*Xn 4-57
:\$ 4-24
:Pn 4-40
\\$ 4-24
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\Bn 4-26
\Cn 4-27
\Kn 4-37
\Mn 4-38
\Pn 4-40
\Qn 4-41
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