BOCA PRO16

Installation Guide

Product Code:
PRO16SA

Before You Begin your Installation

This installation manual contains detailed
instructions for the installation of your product.
We recommend reading and following these
instructions thoroughly first. If you require
technical assistance, Boca Research has a number
of available options as described below.

How to get Technical Assistance

The dealer that you purchased this product or your computer from is
the first place you should go for technical assistance. The dealer is
usually the most qualified source of help, and is most familiar with
your system and how this product should be installed. Many dealers
have customer service and technical support programs, with varying
levels of support offered, depending on your needs and computer
knowledge. ***Please contact the dealer first whenever a problem
occurs.*** International customers will find that contacting the place of
purchase for assistance will be much more efficient than contacting
Boca Research directly.

If your Dealer Can't Assist you

If you can't get assistance from your dealer, the manufacturer
provides varying levels of technical assistance as summarized below.
All phone numbers are based in the United States.

Boca BBS
561-241-1601

*Standard Free
Technical Support*
561-241-8088

**Technical
Support Fax
561-997-2163**

Priority Service
**900-555-4900
($2 per minute)**

**Automated *Fax
Retrieval System*
561-995-9456**

The Standard Free Technical Support number is for quick answers to specific inquiries on product features and technical questions (call **561-241-8088**; M-F, 8 am to 6:30 pm EST). Direct access to technical support representatives is provided on a limited basis. If you require immediate attention or in-depth help with the installation of the product, please call our 900-priority support number for service. This number gives you immediate access to senior-level technicians. The number is **900-555-4900**. You will be charged $2.00 per minute. The charges will appear on your next phone bill.

Damaged or Missing Items

We use many world-class quality assurance programs to ensure the product you purchased is of the highest caliber. Sometimes, however, a component may be missing from the box, or is damaged or corrupt in some way. If this happens, immediately return the entire package to your place of purchase so you may exchange it for a new one. Your dealer should be able to provide you with an exchange far more quickly than by contacting us directly. If for some reason you are unable to return the product directly to its place of purchase, refer to the "Servicing Your Product" and "Warranty" sections in this manual for instructions.

On-Line Support!
CompuServe: **GO BOCA**
Internet:
  email: **support@bocaresearch.com**
  World-wide on the WEB:
  http://www.bocaresearch.com

Contents

1. Introduction

Welcome to the *Easy Installation Guide*, a basic guide to installing and using your modem.

• The *Easy Installation Guide,* explains how to easily install your modem, with sections on unpacking, connecting, testing, setting up and configuring your new modem.

• The guide also explains how your modem operates, documents how to use your modem with communications software. Refer to the Command Reference sheet for using the AT Commands.

• A Troubleshooting section is included along with a section on how to service your product for any problems you may have.

2. What is a Modem?

A modem is a device that allows computers to communicate with each other over normal telephone lines.

You may know that computers process information in the form of digital electronic signals. Because telephone lines are designed to carry voice or sound, a modem is required to convert the digital signals of the computer to sound signals. Another modem is required to convert the sound signals back to digital signals at the other end.
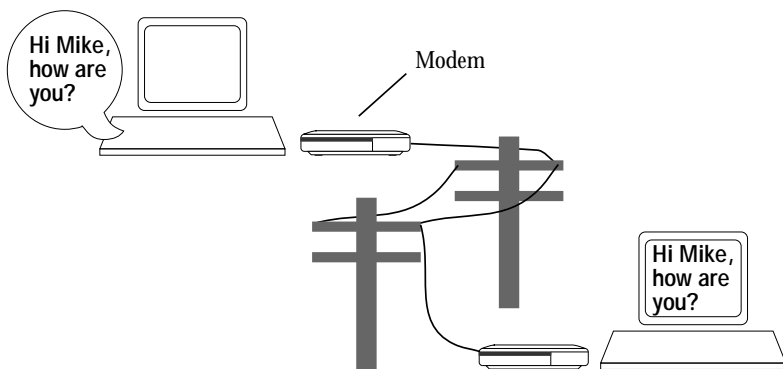
The word "modem" is an abbreviation of the words "Modulator/Demodulator". Modulation describes the process of converting the digital signal to a sound signal; demodulation is the reverse process.

Boca Research, Inc. is an award winning developer of communications products and markets a range of modems that span low-cost, general purpose modems for home and education use, competitively priced models for small and medium sized businesses as well as advanced, high-speed, high-featured modems for major corporate and government users.

3. Unpacking Your PRO16SA

Your modem packaging will include *some*, or *all* of the
following :

- Modem Unit

- Power Adapter

- RS-232 Serial Cable

- Telephone Line Cord

- Easy Installation Guide

- Fax/Data Software

It is recommended that you save the modem packaging for
protection when transporting or storing.

Modem Unit

This package will contain one the following:

• An External Desktop Modem
This unit connects to your computer's serial port.

Power Adapter

• A power adapter is supplied which plugs into a
standard 240V AC outlet

RS-232 Serial Cable

• This is the cable that connects between the external
modem and the computer.

Telephone Line Cord

• Your modem is provided with a telephone cable which
plugs into any standard telephone socket

• Either end comes with an RJ-11 connector; one end
plugs into the back of the modem and the other end
into a wall phone jack.

• If you are going to use the modem with a digital PBX,
confirm that it will output analog signals, if not it will
cause damage to your modem and void your
PRO16SA's warranty

Easy Installation Guide

• This *Easy Installation Guide* is a "first-step" guide to installing and using your PRO16SA.
• Technical help and troubleshooting is also provided for any difficulties
• AT Command and S-Register Reference

Fax/Data Software

• Fax/Data software for Windows 95 and Windows 3.x allows you to send and receive faxes from your desktop as well as be able to upload files from your computer and download files from a remote BBS.

4. Before Connecting Your PRO16SA

Communications (COM) Ports

• Your PRO16SA must communicate with your computer through a serial port, also known as a COM port

• You must know the number of COM ports that already exist so that you can configure your modem correctly

The COM ports in your machine are controlled by two settings:

1. *Address* which tells your computer at what hexadecimal location your COM port exists.

2. *IRQ* (known as the interrupt) which is a signal the computer uses to communicate with the installed hardware.

Following are the typical configurations for COM ports:

COM PORTS	ADDRESS	IRQ (interrupt)
COM 1	3F8H	4
COM 2	2F8H	3
COM 3	3E8H	4
COM 3	3E8H	5
COM 4	2E8H	3
COM 4	2E8H	5

• You will notice that both COM3 and COM4 can be set to an IRQ (interrupt) of 5

• Your computer can share an IRQ (interrupt) between two COM ports, as long as both COM ports are not accessed at the same time

• Unlike an IRQ (interrupt), an address cannot be shared between two hardware devices

For example:
• If you are sharing an IRQ with the mouse on COM3 and your modem on COM4, when you run software to use the modem, the mouse will freeze or become erratic and the machine will halt and lock up.

• This is because there are two hardware devices which are both trying to use the same IRQ (interrupt) at the same time.

• It is not recommended to share an IRQ (interrupt) in your computer, and if you are experiencing problems similar to this then contact your dealer.

5. Connecting Your PRO16SA

Follow these simple steps to connect the modem to your computer:

1. Turn off your computer and all peripheral devices.

2. Examine the back of the modem and review the attached interfaces as shown below.
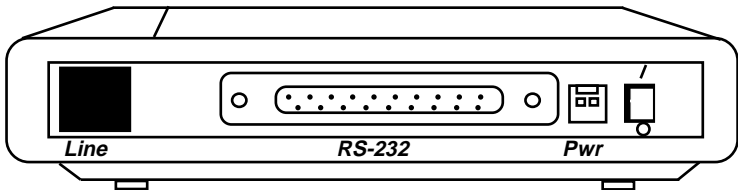
3. Check to make sure that the power switch is OFF (DOWN). Then plug the small end of the power adapter into the power jack on the back of the modem and plug the power adapter into a standard 115V AC wall socket.

4. Disconnect your present phone cord from the wall jack. Plug the end of the phone cord that came with the modem into the wall jack, and the other end into the RJ-11 jack at the rear of the modem marked **LINE**. NOTE: Phone cable configuration will vary for international settings.

5. Lastly, connect the modem to the computer's serial port with the serial cable. The modem is now ready to be tested and operated. Turn your computer on now, then switch ON the modem (switch in the UP position).
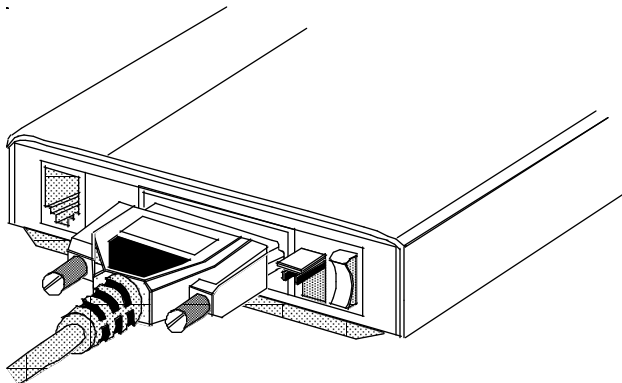
6. Run COMCHECK to ensure that your system sees the modem. Insert the diskette containing the COMCHECK program and type: **A:\COMCHECK** or **B:\COMCHECK**.

COMCHECK will automatically start Windows. If you have another application that starts when you run Windows, you will have to close it now in order to view COMCHECK. Follow the on-screen instructions.

NOTE: You must have the Modem switch turned on (up position) for COMCHECK to detect the modem. DO NOT RUN COMCHECK IF YOU ARE RUNNING WINDOWS 95. Continue with page 18.

6. Testing Your Modem

You are now ready to test your modem and make sure that it is configured correctly.

If you have any difficulties with the below points then see *Appendix A: Troubleshooting*

Testing Your Modem with Windows 3.1/3.11

1. Turn the computer on and load Windows.

2. Choose the Window Menu from the top of the Program Manager.

3. Choose the Accessories Group (from the pull down menu).

4. Double-click on the icon called Terminal located in the Accessories Group.

• If you cannot find the icon then go to the File Menu in the Program Manager and choose Run
• Type in *terminal* at the command line and this will load Terminal for you

5. You will now be presented with a screen called Terminal-Untitled with a flashing cursor in the top left of the screen.

6. Go to the Settings Menu in Terminal and choose Communications from the pull down menu.

• The Communications setup screen now loads

7. Choose the COM port that the modem is plugged into from Connector.

8. Select a Baud Rate of 2400 and then click on the OK button.

• Now you will be at a blank screen with a flashing cursor
• This is called "Terminal Mode" or "Local Mode" and allows you to send AT Commands to your modem

9. Type the letters AT in lower or caps and press Enter.

• If your modem is configured properly, it should echo back the word "OK".

10. Type ATD and press ENTER.

• The modem should make a noise and you should hear the dial tone from the telephone also, as if you had picked a telephone handset up

11. Press the Enter key. NO CARRIER will appear.

• This means that your modem is responding to your computer and the phone line is working.
• If no dial tone is heard, check the telephone connections and try again

12. Go to the File Menu in Terminal and choose Exit.

13. Choose No when Terminal prompts you to save changes.

Installing and Testing Your Modem with Windows 95

1. Select the Start button.

2. Choose Settings and then Select Control Panel.

3. Select to Add New Hardware in the Control Panel.

4. Click on the Next button.

5. Select Yes for Windows 95 to automatically detect new
   hardware.

• This will take approximately 10 minutes depending on the
  speed of your machine
• If the modem is configured correctly, Windows 95 will detect
  a standard modem attached
• If Windows 95 does not detect your modem, check all the
  cables or contact your dealer

6. Click on the Finish button. You will now be asked to:

• Select your modem type
• Click on the Change button

7. Select the manufacturer of your modem and then select the
   model of modem that you have.
• Click on the OK button
• Click on the Next button

Your modem is now configured for Windows 95.

7. The Option Switches

The Option Switches

The Option switches allow you to control the operation of your modem in Dumb mode, as well as providing additional features in Smart mode.
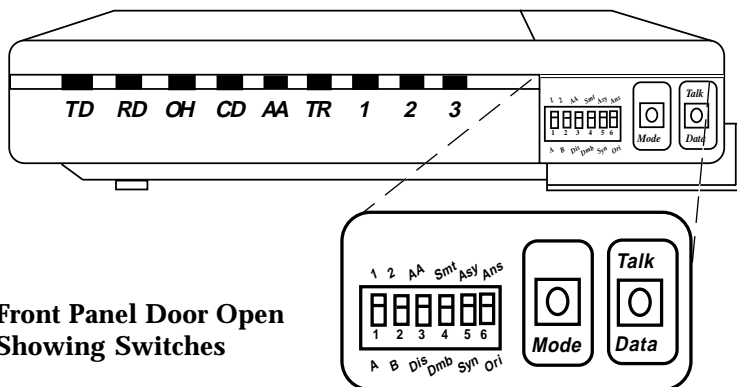
Front Panel Door Open Showing Switches

Switches 1 and 2 are used to select AT command mode or V.25bis command mode, or control the state of the DTR and DSR signals.

Description	*AT%F*	*Switch 1*	*Switch 2*
AT command mode	%F0	Up	Up
V.25bis asynchronous	%F0	Up	Down
V.25bis synchronous (HDLC framing)	%F0	Down	Up
V.25bis sync (BSC character framing)	%F0	Down	Down
DTR controlled by computer	%F1	Up	n/a
DTR assumed to be asserted (raised)	%F1	Down	n/a
DSR acts normally	%F1	n/a	Up
DSR mimics DTR%F1	n/a	Down	

Switches 3 - **6** allow you to set up Dumb mode operation, as well as manually selecting loopback tests in Smart mode.

Description	*AT#F*	*Switch*	*Switch*
Smart mode	n/a	4 - Up	n/a
Dumb mode	n/a	4 -Down	n/a
Loopback Test Pattern Off	#F1	3 - Up	4 - Up
Loopback Test Pattern On	#F1	3 -Down	4 - Up
Analog Loopback Off	#F1	5 - Up	4 - Up
Analog Loopback On	#F1	5 -Down	4 - Up
Remote Digital Loopback Off	#F1	6 - Up	4 - Up
Remote Digital Loopback On	#F1	6 -Down	4 - Up
Auto-answer enabled	n/a	3 - Up	4 - Down
Auto-answer disabled	n/a	3 -Down	4 - Down
Asynchronous operation	n/a	5 - Up	4 - Down
Synchronous operation	n/a	5 -Down	4 - Down
Answer mode	n/a	6 - Up	4 - Down
Originate mode	n/a	6 -Down	4 - Down

The **MODE button** is used to change the modem's baud rate while in dumb mode. Use the Mode LED chart (see page 57) to determine the correct baud rate for the modem.

The **TALK/DATA button** is not used with the PRO16SA modem.

For details on the various modes of operation controlled by these switches and buttons (i.e., Leased Line, Dumb Mode, Synchronous Operation, consult the Appendix.)

8. Software Setup Tips

If you are not going to use the supplied software then following are some tips for setting up the software of your choice. Every form of Communications software usually requires a few setup options as outlined below.

Set the software for the correct COM port.
• If your modem is on COM2 then make sure that you set it for COM2 in the software

Set the speed at which the computer is going to talk to the modem.
• This is called Terminal Speed, Port Speed or Baud Rate
• If you have a 14400bps (14.4k) modem then set the Terminal Speed at 19200
• If you have a 28800bps (28.8k) modem and a 16550 UART card, choose 57600 or 115200 as the Terminal Speed in the software

Set the form of Flow Control that you will be using.
• Flow Control should be set for Hardware, also known as RTS/CTS Flow Control

If you are going to be calling Bulletin Board Systems (BBS) then set the Terminal Emulation to ANSI.

• Also set Data Bits to 8, Parity to None and Stop Bits to 1

Appendix A: Troubleshooting

This section is provided to help solve problems you may encounter with your modem. Before you call Customer Support, check to see whether your problem is answered in this section.

Having Problems?

This flow chart is designed to help you work through installation problems. The most common problems encountered by new users relate to the way the modem is installed. If you are having problems with your modem, work through this chart. It will help you solve any simple installation problems.

START HERE

Is the modem installed as shown in the installation section?

NO → **Install your PRO16SA as described in the installation section.**

YES

Is the modem switched on at both the wall socket and its OFF/ON switch?

NO → **Switch on the modem.**

YES

Are the option switches in the up position?

NO → **Place the option switches in the up position.**

YES

Run a PC communications program that has "terminal mode".

YES

Enter the "Terminal Mode" or "Local Mode" of your communications software

GO TO NEXT PAGE

FROM PREVIOUS PAGE

Make sure the modem is connected to the COM port being used by your communications software.

NO → Change your software to use the correct COM port.

YES

Type AT&F and press ENTER. Does the modem display an OK message on your computer screen?

NO

YES

Type ATI3 and press ENTER. The modem displays an OK message on your computer screen.

Contact Boca Research Technical Support. See Appendix I.

Your modem is operating correctly.

Using Other Communications or Fax Programs

The communications programs supplied with your modem have been tested to ensure they work with your modem. Other, special-use, communications programs are available and you may find one of these programs suits your communications needs. In most cases, these "third-party" communications programs will work with your modem.

• In a small number of cases, a special command or Option switch setting may be required to make your communications program work correctly with your modem. If you encounter difficulties with your communications program and modem:

• Confirm your modem is installed correctly by working through the *Having Problems?* check list

• Using your communications software, dial the Boca Research bulletin board to make sure the modem is working correctly. While connected to the bulletin board, look in the File areas for any modem drivers or modem scripts that are available for your communications program

• If you encounter problems, see *Common Questions and Answers* for a solution. If you have no luck, contact Boca Research Technical Support.

• Try your communications program again. If the problem still exists, contact the supplier of your communications program

• If you are having difficulties with a fax program, contact the supplier of the fax program and check that it has been tested with your modem

Tips for WinFax and DosFax Users.

If you are using your modem with WinFax Pro v4, WinFax Pro v3 or DosFax, the following changes must be added to your WinFax or DosFax programs.

For WinFax Pro v4:
• From Windows, double-click the WinFax Pro icon
• Choose Fax/Modem from the Setup menu
• For Class 1 Fax/Modems choose from the Model drop down
  list, Generic Class 1 (Hardware Flow Control)
• For Class 2 Fax/Modems choose from the Model drop down
  list, Generic Class 2 Send/Receive Fax/Modem
• In the Reset box type: ATZ\
• Click OK
• Restart WinFax

Your Boca PRO16SA supports Fax Class 1 and 2.

The Boca Research Bulletin Board

Boca Research provides a bulletin board service that you may
dial. This bulletin board gives you free access to useful
information about your modem and provides a range of
modem drivers which may allow you to use your modem with
other communications programs.

Using a data communications program, call the Boca Research
BBS.

Restoring the Factory Settings

If you are experiencing problems with your modem, it is best to restore your modems factory settings (or "factory defaults" as they are sometimes known). This will ensure your modem is reliably set up. To do this:

• Run a communications program and enter "local mode" or "terminal mode"
• Type: AT&F and press ENTER
• Type: AT&W and press ENTER
• Exit the communications program

This will restore and save the original settings of your modem.

Common Questions & Answers

My modem is not responding.
• If your modem is not responding then make sure that all the cables are firmly plugged into the appropriate ports and sockets
• If in doubt then remove all the cables and connect them again ensuring they are all socketed firmly
• Try using another COM Port or try it on another computer
• If you still cannot get a response then contact your dealer for help

My modem is not dialing out correctly.
• If you are using your modem on a PBX and it is not dialing out correctly, then check to see whether you are placing the necessary digit at the beginning of the telephone number. e.g., 9,028783755 where 9 is requesting an outside line
• Also make sure that the PBX is not digital

My mouse freezes when I load Communications Software.
• The COM ports that the modem and the mouse are on must be using the same IRQ (interrupt)
• See *Before Connecting Your PRO16SA* and make sure that your ports are setup correctly
• If you are unsure of how to configure your ports then check with your dealer

***My modem is not sending faxes properly with 'XYZ' fax
software.***
• If you are using other fax software and you cannot send faxes
  properly then install the bundled communications software to
  test the modem
• If you can send a fax successfully with bundled software then
  the problem is with the other fax software that you are using
• Contact your dealer or distributor of the software for more
  information on setup

My modem is not answering calls and connecting properly.
• If your modem is not connecting or answering calls properly,
  then try removing 'all' devices that are sharing the phone line
  with the modem and test your connections again
• Devices such as fax machines, telephone handsets and
  answering machines can sometimes cause interference with
  your modems performance
• More often than not it may come down to a device sharing
  the phone line with the modem that is causing the problem;
  such as another fax or phone

My software does not have a modem driver to choose.
• If you have purchased software to use with your modem and
there is no script provided for your modem, then call the Boca
Research BBS. Scripts, Modem Drivers and general Help Files
are available free for download
• If you have Internet access you can FTP the same drivers
from bocaresearch.com using an anonymous login.

My modem hangs up after about 5 to 10 minutes for no reason?
• No doubt you have a phone plugged in line with your
  modem
• Unplug the phone while using the modem (disconnect all
  other phones)

What is Flow Control?
• Flow Control is a means of controlling the data movement
  between a PC and a modem to allow the data to be handled
  and processed at the speed that the device is capable of.

For example; using a PRO16SA at 28800 bps line speed, but at a
terminal speed (between modem and computer) of 38400. The
data will be sent to the modem too fast for it to process. Flow
Control is used to prevent the data in its buffer from being lost.

My modem returns 'NO Dial tone' when I try to dial?
• It is because your modem is not detecting the dial tone from
  your exchange, or the phone line is not correctly installed
• Try turning off dial tone detection by typing 'ATX3&W' in
  local mode or check the phone line

My Modem will not work properly with Windows 95.
• You may need an updated INF modem file
• Call the Boca Research BBS for the latest version of the INF
  modem files that Windows 95 uses
• These INF files are also available from the Boca Research Web
  site

My modem does not connect when I dial an information service or bulletin board.
- Your modem may be incorrectly set up.
- Restore the factory settings of your modem.
- Run a communications program and enter "local mode" or "terminal mode"
- Type: AT&F and press ENTER
- Run a communications program and enter "local mode" or "terminal mode"
- Type: AT\N0%C0 and press ENTER
- Exit the communications program.
- Enter the program and try to connect.

I see garbage characters on the screen after connecting.
The telephone line quality may be causing this problem.
- By using the error correction features of your modem you should never see "garbage" or "rubbish" characters on your computer screen
- If the other modem does not support error correction, you may see a few unreadable characters. This occurs because of changes in the quality of the telephone line, and can often be corrected by hanging up and redialing
- If normally when you pick up the telephone handset you can hear a lot of background noise, it is likely you will have trouble with your modem. Contact the supplier of your telephone line for assistance

If your telephone line is generally noise-free, check the following:
• Are you are using the correct parity for the service you are dialing? Most information services and bulletin boards use either 8 Data/No Parity/1 Stop bit or 7 Data/Even Parity/1 Stop bit. Your communications software user's guide will explain how to set parity
• Check your communications software for correct flow control. Your modem has flow control switched on when it leaves the factory
• Make sure error correction is switched on (unless the information service does not support it)
• Hang up and dial again. You may get a better connection
• Lower the connection speed and try again
• Consult your dealer. You may need to have your modem tested

When I type commands to my modem each character appears twice.
This may be because of an incorrect communications software setting.
• If what you type appears double (tthhiiss iiss wwhhaatt hhaappppeennss), the most probable cause is that your communications program has "character echo" selected. Refer to your communications software Users Guide for details of switching "character echo" or "local echo" off

Why am I losing characters when sending large files?
You probably need to select flow control.

My communications program does not have a terminal mode. How do I configure the modem?
• If your communications software does not have a terminal mode, it probably requires a special modem script or modem driver. If your modem is not supported by the software, contact your software supplier for help. The Boca Research bulletin board provides a variety of modem scripts for various communications programs, that you may obtain using the communications programs supplied with your modem.

My modem hangs up while it is trying to connect to another modem.
Check that no characters are sent by the computer while the modem is connecting; this will cause the modem to hang up. Mainframe computers and multiplexers sometimes do this.

If your modem supports the &N command (the Abort Connection command — check *Appendix J: Command Reference*):
• Run a communications program and enter "local mode" or "terminal mode"
• Type: AT&N0&W and press ENTER.
• Exit the communications program

I am having problems using my modem with a Unix computer.
The Unix computer rejects the CONNECT messages (and other messages) sent to it by your modem.

Some mainframe or Unix/Xenix computers cannot operate with modems which send messages to the computer. If this is the case, switch off character echo response codes:

- Run a communications program and enter "local mode" or "terminal mode"
- Type: ATE0Q1&W and press ENTER
- Exit the communications program

My modem does not dial a stored phone number when used for synchronous communication.
Your computer may not be raising the DTR signal.

- You usually use stored number dialing if you have the modem connected to a synchronous computer
- In synchronous mode your communications software must be able to assert (or raise) the DTR signal in order to make the modem dial
- Check your communications software User Guide or contact your computer dealer to be sure your computer can control the DTR signal
- If your modem has Option switches, check the DTR option switch is in the Up position

My modem is STILL not working.
• First of all make sure you have followed the Installation
  section correctly
• If you are still encountering difficulties then it is suggested to
  contact your dealer or place of purchase
• They will be able to test your modem for you to arrange
  replacement if the unit proves faulty

I Want More Information
If you want more information about the AT commands
supported by your modem, you may contact Boca Research for
the *BOCA PRO16 Modem Reference Guide.*

This manual provides detailed information about the AT
commands and S Registers supported by your modem, as well
as information about how to use features such as synchronous
mode, security, and DES encryption.

To assist in the ordering of the correct manual, please have the
model name and number of your modem ready (these are
found on the serial plate of your modem).

Before You Call Technical Support

Boca Research is committed to continually improving the reliability of its products. We use sophisticated manufacturing techniques to achieve this goal and are confident that each time you use your modem, it will perform reliably and to your satisfaction.

If you do encounter problems, Boca Research provides a team of trained technicians. It is their goal to help solve your modem problem as quickly as possible.

Many problems reported to Technical Support are simple installation mistakes — such as not switching on the power at the wall socket — rather than an actual product fault. Before calling Technical Support, please recheck the installation of your modem.

Please have the following information ready when you call Technical Support:

• The model name and number of your modem
• The identity message of your modem. Use the ATI9 command to obtain the identity message
• The name and version number of the communications program or fax program you are using
• For what application are you using the modem? (For example, "Dial CompuServe", or "Set up a bulletin board", or "Attach the modem to a mainframe computer")
• The speed at which you are trying to use the modem
• Are you using a dial-up connection (normal telephone line) or a leased line connection?
• The brand and model name of modem or fax machine you are dialing (if known)

If it is necessary to return your modem to Boca Research, see Appendix I for procedures.

Appendix B: Leased Line Configuration

If you wish to use your PRO16SA over leased lines, you will require a special phone cable to connect it to a leased line socket. The phone cable supplied with your modem is suitable for use with normal, dial-up lines only.

You will also need to change a jumper on the modem card inside the PRO16SA case as shown following. First, you will have to remove the case cover which is best accomplished using a narrow, thin-bladed instrument like a very small flat-blade screwdriver with a fine edge (such as the type used to repair eyeglasses), or a small pocket-knife.

With the front of the unit facing you, open the latch cover which conceals the option and mode switches. Insert the blade into the seam just above the exposed notch and gently pry up one corner of the case.
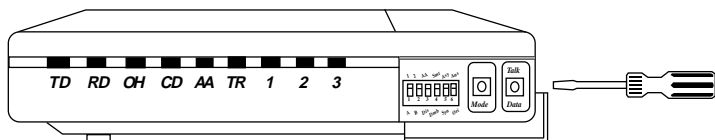
Now, turn the modem case over, with the front portion facing up. Insert the blade into the last ventilation slot on your left and gently press the plastic tab to release the other corner of the case. The top cover of the case should then become disengaged.
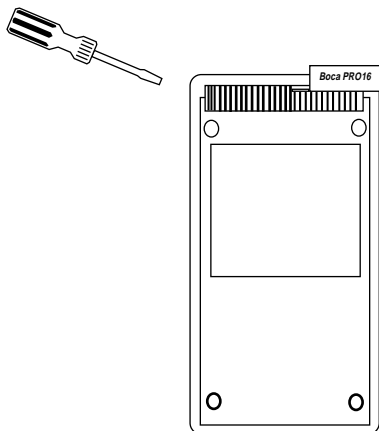
The jumper is located in the lower right-hand corner of the modem card (component side up with the rear connectors on your right). The default setting is for PSTN (standard phone line), or the two leftmost pins on the three-pin jumper block. Move the jumper to 'LL' (two rightmost pins) for leased line operation. Then simply snap the case cover back on.
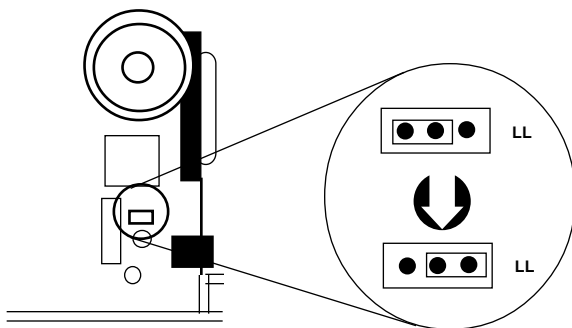
Appendix C: Synchronous Modes

This section explains the use of your modem in synchronous modes. A *dumb* mode or *manual* mode allows some of the functions of your modem to be accessed via the front panel switches.

Your modem offers two synchronous modes, conforming to the Hayes modem synchronous modes 1 and 2. These modes allow synchronous communication over two-wire PSTN or leased lines when connected to asynchronous/synchronous computers or dedicated synchronous terminals.

Synchronous Operation

Your modem supports two synchronous modes. Mode 1 allows operation with computers which support asynchronous and synchronous communication on a single RS-232 port. Mode 2 allows your modem to be operated with dedicated synchronous terminals.

Although your modem can only operate over a single two-wire connection, it will still perform full-duplex synchronous communication. Half-duplex operation could be simulated by controlling the state of the RTS and CTS signals.

Terminal Speeds

Your synchronous terminal or host should use the clock signals provided by the modem to synchronize transmit and receive data. The clock speed will represent the actual connection speed of the modem.

NOTE: When synchronous mode is selected, your modem cannot operate in constant speed mode or use the error correction or data compression facilities of the modem. Only variable speed mode is available in synchronous connections (this refers to the modem's terminal speed).

Line Speeds

Your modem supports a number of synchronous line speeds. Your Command Card lists the line speeds available for your modem.

Command	*Speed*
B8	V.22bis/2400bps
B10	V.32/4800bps
B11	V.32bis/7200bps
B13	V.32/9600bps
B15	V.32bis/14,400bps
B16	V.Fast Class/14,400bps
B17	V.Fast Class/16,800bps
B18	V.Fast Class/19,200bps
B19	V.Fast Class/21,600bps
B20	V.Fast Class/24,000bps
B21	V.Fast Class/26,400bps
B22	V.Fast Class/28,800bps

When operating in synchronous mode, your modem should always be configured with a locked, non-auto-ranging **B** setting (this refers to modem line speed).

For V.34 or V.FC, the B setting only sets the maximum speed. The modem will automatically determine the highest usable speed for the line.

Synchronous Mode 1

Your modem is capable of dialing remote systems in asynchronous mode and then automatically switching to synchronous mode once connection has been made. If the connection is lost, your modem will hang up and return to asynchronous local command state.

The computer required to support synchronous communication with your modem must be capable of switching between synchronous and asynchronous modes with the same RS-232 port, as well as controlling the state of the DTR signal under software supervision.
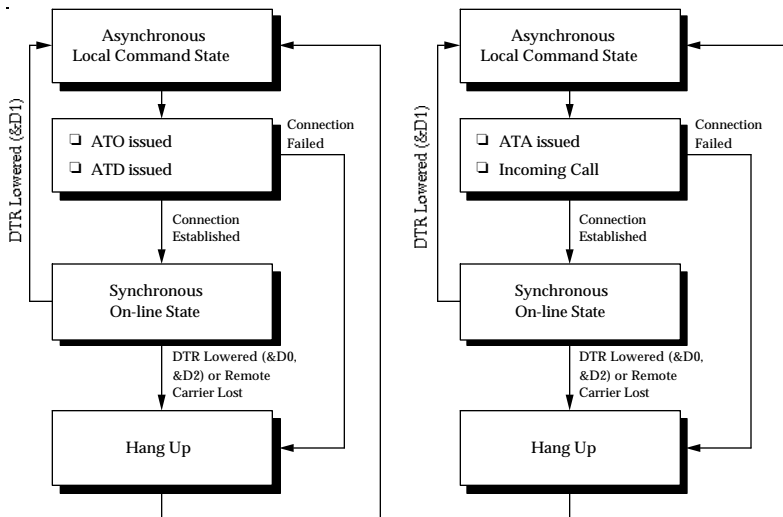
Synchronous Mode 1 Originate and Answer Mode

Selecting Synchronous Mode 1

Synchronous mode 1 is selected with the **&M1** command.
• Type: AT&M1 and press ENTER
Your modem will enter synchronous mode whenever it successfully connects to a remote modem.

You should also:
• Type: AT&D2 and press ENTER
This allows hang up via your computer's DTR signal.

NOTE: Your computer will not be able to hang up the modem if the DTR Option Switch is in the DOWN position (DTR will always be asserted). DTR must be lowered to make the modem hang up.

To return to asynchronous operation:
• Type: AT&M0 and press ENTER

Dialing

Your computer must be in asynchronous mode before dialing
commences. To begin dialing use the **D** command. Response
codes sent to the computer depend upon the settings of the **X**,
V and **Q** commands. As soon as a connection can be
established, your modem will assert CTS and enter
synchronous on-line state. If connection cannot be made, your
modem will hang up and return to asynchronous local
command state. Character echo and response codes should not
be selected when synchronous communications are used. Use
the **E0** and **Q1** commands to disable character echo and
response codes.

As soon as your modem has completed dialing it will examine
the state of the DTR signal. If DTR is asserted your modem
will go on line in synchronous mode, otherwise the modem will
hang up and return to asynchronous local command state.

Data should only be transmitted once DCD, DTR and CTS have
been asserted. Your computer should not assume that if CTS is
asserted then it is safe to begin transmitting data — your
modem will keep CTS asserted whenever it is in local
command state.

Hanging Up
Your modem will hang up and return to asynchronous mode if
carrier is lost for longer than the period defined by S Register
10 or if DTR is lowered after the **&D2** command has been
issued.

Answering Calls

To automatically answer incoming calls, S Register 0 must be set to a non-zero value (as with asynchronous auto-answering). Once a call has been answered there is no means of returning to asynchronous mode apart from hanging up the modem. This will occur if the carrier is lost for a period in excess of the time defined by S Register 0 or if DTR is lowered after the **&D2** command has been issued.

Synchronous Mode 2

Synchronous mode 2 is specifically designed for use with dedicated synchronous terminals. The phone number to be dialed is stored in the modem, the synchronous terminal causing the modem to dial by asserting the DTR signal.

When the terminal asserts the DTR signal (DTR makes an OFF-ON transition), your modem will dial stored phone number zero. The phone number may contain dial modifiers. See the Command Descriptions chapter of this guide for details on the **&Z** command.

Before connecting your modem to your synchronous terminal, the modem must first be configured using an asynchronous terminal or computer.

The Sample Setups section of this manual details a common configuration for synchronous mode 2.
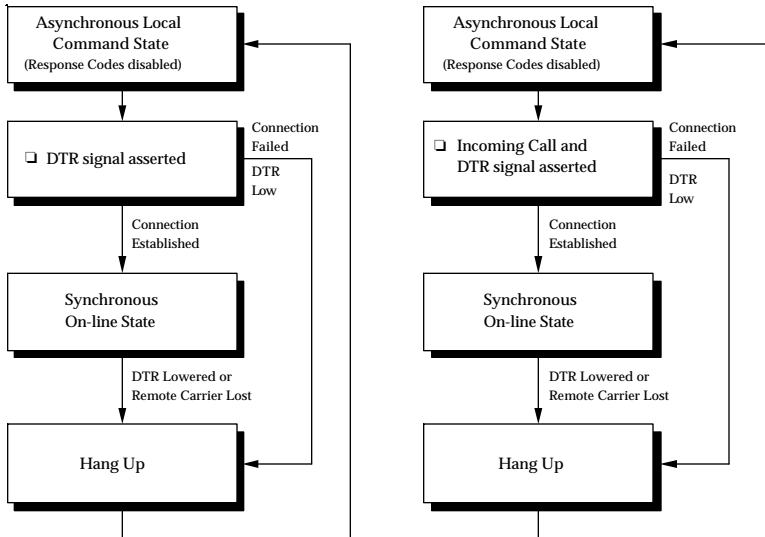
Synchronous Mode 2 Originate and Answer Mode

Selecting Synchronous Mode 2

Synchronous mode 2 is selected with the **&M2** command.
• Type: AT&M2 and press ENTER
Your modem will enter synchronous mode whenever it successfully connects to a remote modem.

You should also:
• Type: AT&D2 and press ENTER
This allows you to dial and hang up.

To return to asynchronous mode:
• Type: AT&M0 and press ENTER
Your modem will remain in asynchronous mode.

Dialing

Dialing will commence as soon as the DTR signal is asserted (an OFF-ON transition occurs). Your modem will not generate response codes when synchronous mode 2 is selected. All call progress is indicated by your modem's speaker (the **M** command controls the operation of your modem's speaker).

As soon as your modem connects to a remote modem it will assert the DSR and DCD signals.

Hanging Up

Your modem will hang up and return to quiet asynchronous mode if the carrier is lost for longer than the period defined by S Register 10 or if DTR is lowered.

Answering Calls

Whenever your modem receives an incoming call it will assert the **RI** signal. The terminal may accept the call by asserting the DTR signal as soon as the number of rings defined by S Register 0 is reached. The terminal may refuse the call by keeping DTR low eight seconds after the number of rings in S Register 0 is reached.

Your modem will not dial the stored number in response to DTR being asserted between the time an incoming call is initially detected and the call being cleared.

Leased Line Operations

A leased line, or private line, is a telephone line that permanently connects two or more locations. The leased line does not have any switching equipment associated with it. Leased-line operation with the modem is selected with the **&L** command.

The **&L** command informs your modem that communications will occur over leased lines, with no answer tones being generated by the modem. If the modem detects a loss of the remote carrier signal while leased-line operation is selected, it will attempt to re-establish the connection rather than hang up.

If you select leased line operation with the **&L1** command, you must issue the **ATA** command to answer a call, and the **ATD** command to initiate a call.

If you use **&L2** or **&L3** to select Auto leased line operation, you do not need to issue the **ATA** or **ATD** commands; **&L2** selects Originate mode automatically and **&L3** selects Answer mode automatically. To dial or answer, raise DTR; to return to local command state, lower DTR.

NOTE: You will require a special phone cable (available from your dealer) to connect your modem to a leased-line socket. The phone cable supplied with your modem is suitable for use with normal, dial-up, voice (PBX) lines.

Before commencing leased-line communications, it is recommended that a non-auto-ranging **B** setting be specified.

NOTE: If error correction is required, select a Reliable mode, not an Auto-Reliable mode. (See the **\N** command.)

Auto-ranging and fallback are disabled in leased-line mode. Your modem will only attempt to connect using the communications standard specified by the **B** command and the terminal speed. Once a connection has been established, if your modem detects a loss of carrier it will continuously attempt to re-establish the connection.

Smart Leased-Line Mode

Leased-line operation is available in both asynchronous and synchronous mode 1.

Smart Leased-Line Mode (&L1)
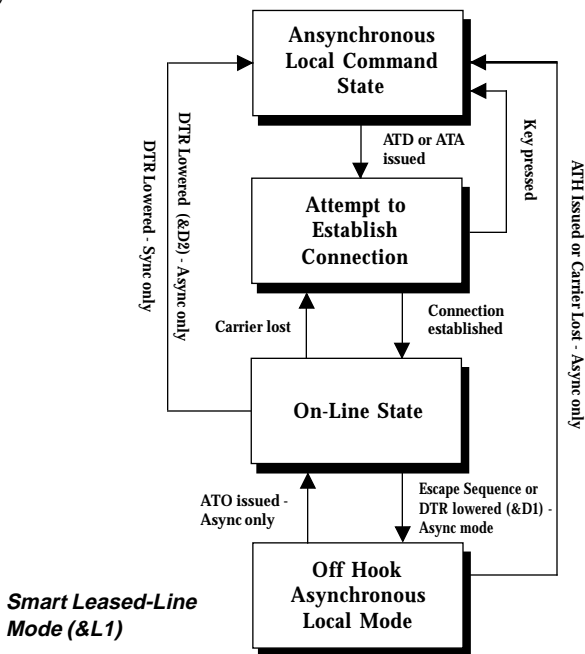
Calling and Answering Using &L1

When operating in smart mode (**&L1** set), the **ATD** and **ATA** commands are used to initiate and answer calls respectively.

NOTE: Your modem will hang up and return to local command state if your computer transmits characters while the modem is attempting to establish or re-establish a connection (unless **&N0** has been issued).

Auto Leased Line Operation (&L2 or &L3)

You can select Auto leased line operation with the **&L2** or **&L3** command. In Auto leased line operation you do not need to issue the **ATA** command to answer a call, or the **ATD** command to initiate a call. Issue the **&L2** command to automatically select Originate mode, or the **&L3** command to automatically select Answer mode.

In Auto leased line operation **AT** commands can only be entered while DTR is low. Irrespective of the **&D** setting, your modem will remain in idle mode when DTR is low, and will go on-line when DTR is high and the modem's TALK/DATA switch is set to DATA. If DTR is lowered (or the TALK/DATA switch is set to TALK) when your modem is on-line, it will hang up and return to idle mode. If power is lost, your modem will enter on-line state when DTR is restored.

NOTE: Your communications software must be capable of altering the state of the DTR signal to work successfully with the **&L2** and **&L3** commands. If your modem has a TALK/DATA switch, it must be set to DATA.

Hanging Up

There are five ways of hanging up your modem when leased-line mode is selected.

❑ If your modem is attempting to establish or re-establish a connection, sending characters to it will cause it to hang up (unless **&N0** has been issued).
❑ If synchronous mode is selected, lowering the DTR signal will cause your modem to immediately hang up.
❑ If asynchronous mode is selected, issuing the **ATH** command will cause the modem to hang up.
❑ If asynchronous mode is selected (**&L2** or **&L3**), lowering DTR will cause the modem to hang up.
❑ Switch the TALK/DATA switch to TALK.

NOTE: XON/XOFF flow control should not be selected for leased-line connections. Your modem will prematurely hang up if your computer sends an XON/XOFF character while the modem is attempting to re-establish a connection.

Improving the Reliability of Leased-Line Connections

If you are experiencing data errors over leased lines, issue the **%L** command to lower the transmit level of your modem.

You may need to experiment with the levels, but start between **%L15** and **%L19**.

The transmit level should be changed on both modems.

Appendix D: Dumb Mode Operation

Your modem has two methods of operating with your computer. The commonly used method is "smart mode", where the computer issues "AT" commands to the modem to make it dial and hang up. For computers which do not offer an asynchronous port or cannot communicate synchronously using V.25bis commands, dumb mode permits manual control of your modem.

Setting Up your Modem

In most instances, your modem will need to be configured prior to entering Dumb mode. All configuration of your modem is performed using the AT commands.

For example, if you wish to have your modem dial a stored telephone number when the computer asserts (or "raises") the DTR signal, you must first store the telephone number in the modem and select stored number dialing operation, using the AT commands.

Hints for Unix Computers and Multiplexers

Many Unix computers and multiplexers which offer synchronous communications ports cannot cope with the response messages generated by the modem. For this reason, you may wish to switch off response messages before you connect your modem to the Unix computer or multiplexer.

- Place front panel Option switch 4 in the Up position to select Smart mode.
- Connect your modem to a personal computer, a Unix computer or a serial server.
- Run a communications program (for Windows, or TIP or CU for Unix) and enter "local mode" or "terminal mode"
- Type: ATE0Q1&N0&W and press ENTER
- Exit the communications program

This command switches off response messages and character echo, causes the modem to ignore characters sent to it from the host while dialing or answering, and saves the changes in the modem.

Dialing in Dumb Mode

There are three ways of dialing in dumb mode:

❑ Use a telephone handset connected to the modem.
❑ Store a telephone number in the modem and then have the computer raise the DTR signal.
❑ Store a telephone number in the modem and then press the Talk/Data switch.

Dialing with a Telephone Handset

Manual dialing requires a telephone handset to be connected to the same phone line as your modem. Use a telephone cable with a double adaptor socket to connect your modem and telephone to the same phone line.

Using DTR to Dial

You may commence dialing by having your computer raise its DTR signal.

• Connect your modem to a personal computer.
• Run a communications program and enter "local mode" or "terminal mode"
• Type: AT&Z0=phoneno and press ENTER
Where "phoneno" is the telephone number you want your modem to dial. This stores the number as stored telephone number zero.

NOTE: If you are using your modem over leased lines, do not store a phone number.

• Type: AT&D2&M4 and press ENTER
or:
Type: AT&D2&M2 and press ENTER
Issue the **&M4** command if you wish to use asynchronous communications; issue **&M2** if you wish to use synchronous communications.

• Type: AT&Wn and press ENTER
The modem set up is saved to profile n=0-3
• Place front panel Option switch 4 in the Down position (select Dumb mode)
• If necessary, use the Mode button to select the required communication speed

The connection speed of the modem is indicated by the Mode LEDs. Refer to the table at the end of this section (page 57) which shows the meaning of each combination of Mode LEDs.

• Raise the DTR signal on your computer

DTR must change from "low" to "high" to commence dialing. Your modem dials the stored telephone number zero. The OH and CD LEDs glow when the modem connects.

To hang up:
• Have your computer lower the DTR signal, or press the Talk/Data button to Talk

Answering Calls in Dumb Mode

Your modem is able to answer incoming calls, automatically or by manual intervention.

Automatic Answering

Your modem is able to auto-answer incoming calls in Dumb mode. You do not need a telephone handset to have your modem answer incoming calls.

• Connect your modem to a personal computer .
• Run a communications program and enter "local mode" or "terminal mode"
• Type: ATBx and press ENTER
where "x" is a valid setting of the B command. The B command is used to set the communications standard used by your modem.

• Type: AT&D2&M0 and press ENTER
or:
Type: AT&D2E0Q1&M1 and press ENTER

Issue the &M0 command if you wish to use asynchronous communications; issue &M1 if you wish to use synchronous communications.

• Type: AT&W and press ENTER
The modem set up is saved.
• Place front panel Option switch 4 in the Down position (select Dumb mode)

If the &D2 command has been issued to the modem, DTR must be raised by your computer.

Your modem answers incoming calls after the number of rings specified in S Register 0.

Manual Answering

For reasons of data security, it may be desirable to verbally identify a caller before allowing connection to your computer. A telephone handset must be connected to the same telephone line as your modem to permit manual answering.

Front Panel Mode LEDs

Front Panel Mode LEDs			
Line Modulation	Mode 1	Mode 2	Mode 3
28800 bps	✳ F	O	O
26400 bps	✳ F	O	●
24000 bps	✳ F	●	●
21600 bps	✳ M	O	O
19200 bps	✳ M	●	O
16800 bps	✳ M	O	●
14400 bps	O	O	O
12000 bps	O	O	●
9600 bps	O	●	O
7200 bps	O	●	●
4800 bps	●	O	O
2400 bps	✳ S	O	O
1200 bps	✳ S	O	●
V23	✳ S	●	O
V21	✳ S	●	●
Fax 14400 bps	O	✳ S	✳ S
Fax 9600 bps	O	O	✳ S
Fax 7200 bps	O	●	✳ S
Fax 4800 bps	●	O	✳ S
Fax 2400 bps	●	●	✳ S

LED: On = O , Off = ● ,
Flashing: ✳S = Slow, ✳M = Med, ✳F = Fast

Appendix E: Upgrading Firmware

The Load program is not shipped with the PRO16SA. This program as well as the latest firmware can be found on the Boca Research BBS at (561-241-1601) or Web site: http://www.bocaresearch.com

The modems' firmware is the latest from Boca Research. However, if you are experiencing problems, or if Boca Research has a newer version of code, you will have to use our flash update programs to update your firmware.

Load Program

The loader program is designed to be used only for downloading firmware file from DOS based systems to Boca Research's family of PRO16 modems. It is used for upgrading firmware to a newer version. It is used to upgrade a single modem at a time.

❑ How to use the Loader
• Have your modem connected to PC with your standard modem cable.
• Make sure the modem is turned on.
• Run loader with the specified parameters.

❑ To get help on parameters required by the Loader
• Type 'LOAD' without any parameters followed by CR.

The Loader will display the following information:
• Boca Research Loader and EEPROM Programmer v (current version number)
• Format -   load /f=FullFileName [/p=CommPort /
                  c=CommPortParams]
• To run downloader the following must be specified:
                  File name with /f=.... (no default)

Optionally you can specify:
        comm port with /p=x
        where   x=COM1
                x=COM2
                x=COM3
                x=COM4
                (default x=COM1)

        comm port parameters with /c=x
        where   x=9600
                x=19200
                x=38400
                x=57600
                (default x=38400)

❖ Port is set to no parity, 8 data bits, 1 stop bit

WARNING: Loader does not perform any checking on the file specified. Make sure before running the Loader that the file is the right one.

WARNING: During downloading and reprogramming DO NOT switch off the modem. The modem may not work at all due to corrupted firmware.

During downloading and reprogramming operation, Loader displays progress status. It can be interrupted at any stage, but once the erasing has started it cannot be interrupted or the firmware will NOT be properly loaded.

Possible problems:

If the Loader cannot communicate with the modem make sure that:

- The modem is capable of reprogramming the firmware in its original position.
- All modems manufactured after December 1994 should have reprogramming capabilities.
- Some models before that date may have this facility.
- No modems were reprogrammable before January 1994.
- The modem is "ON" .
- Is properly connected to the PC.
- Right communication port is specified.
- Modem is in Autobauding state (issue ATR0).

Appendix F: Specifications

Dimensions: Height: 31mm (1.24")
                      Length: 218mm (8.72")
                      Width: 122mm (4.88")

Power: Plug pack: 15VAC 10VA

ITU Standards:
V.34 (28,800bps)	V.32bis (14,400bps)
V.32 (9,600bps)	V.22bis (2,400bps)
V.22 (1,200bps)	V.23 (1,200/75bps)
V.21 (300bps)	V.17 (fax 14,400bps)
V.29 (fax 9,600bps)	V.27ter (fax 4,800bps)
Bell 212A (1,200bps)	Bell 103 (300bps)

Terminal Speeds: 300bps-230,400bps (with high-speed serial port capable of 230,400bps)

Command Sets: AT commands (async mode only); EIA Class 2 fax commands; V.25bis commands.

Data Formats: Synch; Async: 7/8 data bits

Flow Control: RTS/CTS, XON/XOFF and transparent XON/XOFF (async mode only)

Error Correction: V.42, MNP2-4, MNP10

Data Compression: V.42bis, MNP 5

Environmental: Operating 0° to +45° C
                    Non-operating: -10° to +50° C
Humidity: Operating: 10% to 90% non-condensing
                    Non-operating: 5% to 90% non-condensing

Appendix G: Regulatory Statements

FCC Statement:

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.
(2) This device must accept any interference received including interference that may cause undesired operation.

THIS UNIT COMPLIES WITH FCC PART 68 AS OF DATE OF MANUFACTURE.

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Re-orient or relocate the receiving antennae.
• Increase the separation between the equipment and the receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

Note: This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to insure compliance.

Note: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

Notification to the Telephone Company

Notification to the telephone company is no longer required prior to connecting the registered equipment but upon request from the telephone company the user shall tell the telephone company which line the equipment is connected to as well as the registration number and the ringer equivalence of the registered protective circuitry. In most, but not all areas, the sum of all RENs should be 5.0 or less. The FCC Registration number and Ringer Equivalence number are printed on the main chip in the center of the internal modem board, or on the underside of the modem.

Malfunction of the Equipment

In the event that the MODEM should fail to operate properly, the customer shall disconnect the equipment from the telephone line to determine if it is the customer's equipment which is not working properly, or if the problem is with the MODEM, the user shall discontinue use until it is repaired. In the event service is needed the user should contact the vendor from whom you purchased the MODEM.

Telephone Connection Requirements

Except for telephone company-provided ringers, all connections to the telephone network shall be made through standard plugs and standard telephone company-provided jacks, or equivalent, in such a manner as to allow for easy and immediate disconnection of the terminal equipment. Standard jacks shall also be arranged that, if the plug connected thereto is withdrawn, no interference to the operation of the equipment at the customer's premises which remains connected to the telephone network, shall occur by reason of such withdrawal.

Incidence of Harm

Should terminal equipment or protective circuitry cause harm to the telephone network, the telephone company shall, where practical, notify the customer that temporary discontinuance of service may be required; however, where prior notices are not practical, the telephone company may temporarily discontinue service if such action is deemed reasonable in the circumstances. In the case of such temporary discontinuance, the telephone company shall promptly

notify customers and will be given the right to bring a complaint to the FCC if they feel the disconnection is not warranted.

Changes in Telephone Company Equipment or Facilities

The telephone company may make changes in its communications facilities, equipment, operations, or procedures, where such action is reasonably required and proper in its business. Should any such changes render the customer's terminal equipment incompatible with the telephone company facilities, the customer shall be given adequate notice to make modifications to maintain uninterrupted service.

General

The FCC prohibits customer-provided terminal equipment be connected to party lines or to be used in conjunction with coin telephone service.

Installation

The MODEM is equipped with a USOC RJ-11 standard miniature modular jack and is designed to plug directly into a modular jack.

DOC Compliance Statement (Canada)

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective operational and safety requirements. 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. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). 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 made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunction, 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.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the load numbers of all the devices does not exceed 100. The Load number appears on the underside of the Boca Pro 16.

To be installed in UL-listed and CSA-certified computers with instructions on how to add/remove expansion cards.

Appendix H: Warranty Information

Limited Warranty

Boca Research, Inc. (BRI) warrants to the original buyer of this BRI product that the hardware is free of defects in materials and workmanship for a period of five (5) years from the date of purchase from BRI or its authorized dealer. Should the product fail to be in good working order at any time during the five-year period, BRI, will at its option, repair or replace this product as described below. This warranty does not cover defects resulting from misuse, abuse, negligence, accident, repairs, or alterations made by either the customer or another party. Boca Research reserves full rights to determine whether a defective product falls into this category.

The entire risk as to the quality and performance of the product rests with the customer. Any written or oral information or advice given by Boca Research dealers, distributors, agents, or employees will in no way increase the scope of this warranty. This warranty applies only to the product described in this manual and not to any other value-added software which may be included.

All products will be serviced and returned via UPS-ground at no charge to customers.

All customers are required to demonstrate proof of purchase when requesting a Return Merchandise Authorization (RMA). The period of service commences on the date of purchase. A copy of the sales slip must be included with the returned merchandise.

Products which require Limited Warranty service during the warranty period should be delivered to BRI at the address in the Appendix (Servicing Your Boca Product) with proof of purchase and the Return Merchandise Authorization (RMA) number provided by BRI Technical Support. Refer to the Appendix in your manual. Replacement parts or complete products will be furnished on an exchange basis only. Replaced parts and/or products become the property of BRI.

If the returned product is sent by mail, the purchaser agrees to prepay shipping charges, insure the product or assume the risk of loss or damage which may occur in transit, and to use a shipping container equivalent to the original packaging. ALL EXPRESS AND IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE FOR THE PRODUCT ARE LIMITED IN DURATION TO THE ABOVE FIVE- AND ONE-YEAR PERIODS, RESPECTIVELY.

UNDER NO CIRCUMSTANCES (WHETHER BASED IN CONTRACT OR TORT) SHALL BOCA RESEARCH BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL, OR PUNITIVE DAMAGES OF ANY KIND, OR FOR LOSS OF REVENUE, LOSS OF BUSINESS, OR OTHER FINANCIAL LOSS AS A RESULT OF THE SALE, INSTALLATION, MAINTENANCE, USE, PERFORMANCE, FAILURE, OR DISRUPTION OF ITS PRODUCTS.

Boca Research reserves the right to make periodic changes or enhancements to any Boca Research product without prior notification, but has no obligation to modify or update products once sold.

This warranty gives you specific legal rights, and you have other rights which may vary from state to state. This warranty is valid only in the United States.

Appendix I: Servicing Your Boca Product

If your Boca PRO16SA requires service, first contact the authorized dealer from whom you purchased the modem. If the dealer is unable to assist you, and you must contact Boca Research, Inc., please follow the instructions below.

Our electronic BBS is available 24 hours a day at (561) 241-1601 and will support data transmission speeds up to 28.8Kbps with settings of N, 8, 1. Once your modem is functional, the BBS may be helpful (especially during off hours) if you have a question about product settings, or if you wish to download special software or utilities.

If the Troubleshooting section (Appendix A) did not resolve your problem, you may call our technical support staff for assistance. If you haven't referred to the Troubleshooting section, do so now.

NOTE: CALLING TECHNICAL SUPPORT WITHOUT COMPLETE AND ACCURATE INFORMATION CONCERNING YOUR PROBLEM MAY BE BOTH TIME-CONSUMING AND FRUSTRATING FOR YOU.

1. When calling Boca Research Technical Support, have the following information available:

   - **Unit name and part number**
   - **Computer manufacturer**
   - **Computer Model**
   - **Peripherals in system**
   - **Operating system and version**

If you suspect a problem with a specific program or software package, make note of the name, version or release number, and manufacturer of the software.

2. Call our Technical Support Department between the hours of 8:00 a.m. and 6:30 p.m. EST Monday through Friday at (561) 241-8088. A technician will be available to discuss the problem(s) you are experiencing.

   If factory service is required, you will be given a Return Merchandise Authorization (RMA) number. Please place this number on the outside of the package when you return the item(s) for service and reference it on any correspondence included in the package. Boca Research, Inc. will return any product which is not accompanied by an RMA number.

3. Refer to the Warranty Statement if the product is covered under the five-year Boca Research, Inc. Limited Warranty.

4. Certain parts will not be covered under the Boca Research, Inc. Limited Warranty. Dealer installed parts are warranted by the dealer. Parts which you have installed yourself are covered only by the supplier's warranties. In these cases, Boca Research, Inc. can identify which parts are defective, but will not replace such parts until specific written authorization is received from you. The cost of parts and labor involved in making such repairs will be billed to you C.O.D.

5. When sending the Boca PRO16SA to Boca Research, Inc. for repairs, please be sure to include:

- **the Boca PRO16SA (unit only)**
- **a copy of the original invoice**
- **your return street address (for UPS purposes)**
- **phone number**
- **the RMA number mentioned above**

Package the product securely in a container equivalent to the original packaging, and insure the package to protect against loss or damage during transit. Shipping charges must be prepaid; C.O.D. shipments will not be accepted. Please use the address below for all correspondence:

Boca Research, Inc.
RMA Department - RMA # _____
1601 Clint Moore Road
Boca Raton, FL 33487-2841

6. If the repairs performed on your modem were covered by the warranty, Boca Research, Inc. will return it prepaid via UPS.

Appendix J: Command Reference

NOTE: AT command functionality may vary in international settings. Command definitions listed here and on subsequent pages reflect U.S. functionality.

Connection *Command*	**Commands** *Description*
A	Answer call
D	Dial number
H	Hang up modem
O	Enter On-line state

■ indicates factory defaults

❑ V.34/V.Fast default only

☞ If no value is entered in a command for 'n' or 'x', a value of 0 (zero) is selected.

Dial Modifiers

Dial Digits	0-9, A, B, C, D, #, *
,	Pause while dialing
F or ^	Disable calling tones
J	Initiate MNP 10 at 1200 bps (V.22)
K	MNP 10 cellular power level adjustment for this call
L	Redial last number
M	Initiate MNP 10 at 4800 bps (V.32)
P	Pulse dial number (not supported in Holland, Norway, Sweden, and Denmark)
R	Switch to answer mode
S=n	Dial stored number 'n' (where n=0-9)
T	Tone dial number
W	Wait for dial tone
;	Return to Local command state
!	Hook flash
@	Wait for quiet answer

General Commands

Command	*Description*
+++	Escape Sequence
****	Universal Remote Access Sequence
?	Displays help. May be followed by the command(s) or a keyword for which help is needed
A/	Repeat Command
B0 ■	**Auto-Connect**
B1	Auto-Connect
B2	Auto-Connect

Command		Description
B3		V.21 - 300 bps
B4		Bell 103 - 300 bps
B5		V.23 - 1200/75 bps
B6		V.22 - 1200 bps
B7		Bell 212A - 1200 bps
B8		V.22bis - 2400 bps
B9		Auto-Connect
B10		V.32 - 4800 bps
B11		V.32bis - 7200 bps
B12		V.32 (Non-TCM) - 9600 bps
B13		V.32 - 9600 bps
B14		V.32bis - 12000 bps
B15		V.32bis - 14400 bps
B16	❑	V.34/V.Fast Class - 14400 bps
B17	❑	V.34/V.Fast Class - 16800 bps
B18	❑	V.34/V.Fast Class - 19200 bps
B19	❑	V.34/V.Fast Class - 21600 bps
B20	❑	V.34/V.Fast Class - 24000 bps
B21	❑	V.34/V.Fast Class - 26400 bps
B22	❑	V.34/V.Fast Class - 28800 bps
E0		Local command state echo off
E1	■	**Local command state echo on**
H1		Go off-hook
I0		Numeric firmware identity
I1		Checksum of firmware - return checksum
I2		Checksum of firmware - return OK/ERROR
I3		Modem Model
I4		Firmware Version and date
I5		Manufacturer ID
I9		Verbal firmware identity
L0		Lowest volume level
L1		Low volume level
L2	■	**Medium volume level**
L3		Highest volume level
M0		Speaker is always off
M1	■	**Speaker on when connecting, off when connected**
M2		Speaker always on
M3		Speaker off when dialing or after connection established
M4		Speaker on during dial, answer, retrain or rate change

Command Reference

Command		Description
O1		Enter On-line state and force communication retrain (V.22bis and V.32bis only)
O2		Retrain, don't go on-line (V.22bis & V.32bis)
O3		Change line speed to 4800 bps (V.32 & V.32bis)
O4		Change line speed to 7200 bps (V.32 & V.32bis)
O5		Change line speed to 9600 bps (V.32 & V.32bis)
O6		Change line speed to 12000 bps (V.32 & V.32bis)
O7		Change line speed to 14400 bps (V.32 & V.32bis)
P		Pulse dialing
Q0	■	**Modem returns response codes**
Q1		Modem does not return response codes
Q2		Modem does not return RINGING or response codes when answering
R9		9600 bps (locked terminal speed - no autobaud)
R14		14,400 bps (locked terminal speed - no autobaud)
R19		19,200 bps (locked terminal speed - no autobaud)
R28		28,800 bps (locked terminal speed - no autobaud)
R38		38,400 bps (locked terminal speed - no autobaud)
R57		57,600 bps (locked terminal speed - no autobaud)
R115		115,200 bps (locked terminal speed - no autobaud)
R230		230,400 bps (locked terminal speed - no autobaud)
Sn?		Display value in S Register 'n'
Sn=x		Place 'x' in S Register 'n'
T	■	**Tone dialing**
V0		Numeric response codes
V1	■	**Verbal response codes**
W0		CONNECT message reports the terminal speed
W1		CONNECT message reports the terminal speed
W2	■	**CONNECT message reports the line speed**
X0		Basic response codes (codes 0-4,8)
X1		Extended response codes (codes 0-5,8,10-12,30-40,60-62)
X2		Extended response codes (codes 0-6,8,10-12,30-40,60-62)
X3		Extended response codes (codes 0-5,7,8,10-12,30-40,60-62)
X4		Extended response codes (codes 0-7,10-12,30-40,60-62)
X5	■	Extended response codes (codes 0-7,10-13,30-40,60-62)
X6		Extended response codes (codes 0-5,7-8,10-13,30-40,60-62)
Zn		Restore configuration profile n (n=0,1,2,3)
&B0		8 bit character length
&B1		9 bit character length
&B2		10 bit character length
&B3		11 bit character length

Command		*Description*
&B4	∎	**10 or 11 bit character length determined by autobaud**
&C0		DCD signal always asserted
&C1	∎	**DCD signal responds to remote modem**
&C2		DCD signal always on, pulses low on disconnect
&C3		DCD asserted during voice session
&D0	∎	**Ignore DTR**
&D1		Return to Local command state if DTR goes low
&D2		Hang up and return to Local command state if DTR goes low, disable auto-answer until DTR asserted
&D3		Initialize with values in &Y profile if DTR goes low
&F0		Restore factory defaults
&F1		Restore non-error correction factory defaults
&F2		Restore synchronous mode factory defaults
&F.		Reset modem (clear security database/Telephone numbers)
&G0	∎	**No guard tone generated**
&G1		550 Hz guard tone generated
&G2		1800 Hz guard tone generated
&H0	∎	**Clocks always present in synchronous mode**
&H1		Clocks only appear after connection
&K0		Flow control disabled
&K3		RTS/CTS flow control
&K4		XON/XOFF flow control
&K5		Transparent XON/XOFF flow control
&K9	∎	**Failsafe flow control**
&L0	∎	**PSTN mode**
&L1		Leased-line mode
&L2		Auto leased-line originate mode
&L3		Auto leased-line answer mode
&M0	∎	**Asynchronous mode**
&M1		Synchronous mode with asynchronous dialing
&M2		Synchronous mode with stored number dialing
&M4		Asynchronous mode with stored number dialing
&N0		Abort dial character disabled
&N1	∎	**Abort dial character enabled**
&P0	∎	**39/61 make/break ratio (USA)**
&P1		33/67 make/break ratio (Aus/UK)
&R0	∎	**CTS follows RTS in Sync mode**
&R1		CTS is always on in Sync mode
&S0		DSR signal always asserted
&S1	∎	**DSR signal asserted at start of handshake**

Command		Description
&S2		DSR signal asserted at end of handshake (before CONNECT message)
&T0		Terminate test
&T1		Local Analog Loopback test
&T3		Local Digital Loopback test
&T4	■	**Grant Remote Digital Loopback test**
&T5		Deny Remote Digital Loopback test
&T6		Remote Digital Loopback test
&T7		Remote Digital Loopback & Self test
&T8		Local Analog Loopback & Self test
&V		View active configuration profile
&Vn		View stored profile (n=0-3)
&V8		View differences between active and default
&Wn		Save current configuration into stored profile n (n=0,1,2,3)
&X0	■	**Synchronous clocks generated by modem**
&X1		Clocks generated by computer - external clocking
&X2		Clocks generated by remote system - slave clocking
&Yn		Select stored profile n for Power on and &D3
&Zn=x		Store x as phone number n (x=0-9)
#A0		Prevent remote access
#A1		Allow remote access
#A2	■	**Allow remote access with security password**
#B0	■	**In 1200bps originate mode B0=V.23, B2=V.22**
#B1		In 1200bps originate mode B0=V.22, B2=V.23
#C0		V.25 calling tones disabled
#C1	■	**V.25 calling tones enabled**
#D0	■	**Disable direct calling procedures (V.25bis)**
#D1		Enable direct calling procedures (V.25bis)
#E0	■	**DES encryption disabled**
#E1		DES encryption enabled
#F0	■	**Disable front panel tests**
#F1		Enable front panel tests
#I0	■	**V.22bis leased line normal**
#I1		Use non-standard PSTN V.22bis over leased line
#J0		Assume V.42 compatibility
#J1	■	**Check V.42 compatibility**
#K0		Disable MNP 10
#K1	■	**Enable MNP 10**
#K2		Enable MNP 10 for Cellular links
#M0	■	**AT command operation**
#M1		Asynchronous V.25bis

Command		Description
#M2		Synchronous V.25bis (HDLC framing)
#M3		Synchronous V.25bis (Character framing - BSC mode)
#N0	■	**NRZ character encoding (V.25bis sync only)**
#N1		NRZI character encoding (V.25bis sync only)
#O0	■	**Characters ignored if modem buffers overflow**
#O1		Disconnects if terminal buffer overflows
#O2		Disconnects if line buffer overflows
#O3		Disconnects if either buffer overflows
#Q		**V.25bis Terminal Speed (see R command)**
#R		Remote control mode
#S		Enter security menu mode
#U0	■	**Use ASCII characters for V.25bis mode**
#U1		Use EBCDIC characters for V.25bis mode
#V0		Command and S Register verifier off
#V1	■	**Command and S Register verifier on**
%C0		Compression disabled
%C1		MNP 5 compression enabled
%C2		V.42bis data compression enabled
%C3	■	**V.42bis data compression enabled with fallback to MNP 5**
%Dn		Set disconnect delay to n seconds (default **%D0**)
%E0		Disable auto-retrain
%E1	■	**Enable auto-retrain**
%E2		Automatic Speed Stepping
%F0		Option switches 1 and 2 control V.25bis
%F1	■	**Option switch 1 and 2 control DTR and DSR**
%H0	■	**Use B setting for initial MNP 10 connection speed**
%H1		Initial connection is made at 1200 bps (MNP 10)
%H2		Initial connection is made at 4800 bps (MNP 10)
%H3		Initial connection is made at 9600 bps (MNP 10)
%H9		Use B setting for connection but do not upshift (MNP 10)
%K0	■	**CTS operates normally**
%K1		CTS off during dial and handshake
%L0		Report current received signal level (-dBm)
%Ln		Set transmit level (n=11 to 19; -11dBm to -19dBm)
%M0	■	**Mode LEDs indicate connection speed**
%M1		Mode LEDs indicate line quality, V.42/MNP errors & flow control
%N0	■	**Standard Baud Rates**
%N1		Standard to 14400 then 20800, 31200, 41600 and 62400
%N2		Standard to 38400 then 51200

Command		Description
%P0	■	**CONNECT message appears before DCD asserted**
%P1		CONNECT message appears after DCD asserted
%Q		Report current line quality (EQM) (0=perfect)
%R0	■	**&R command determines state of CTS**
%R1		CTS always follows RTS (not reset by &F)
%R2		CTS follows DTR when offline (not reset by &F)
%S0	■	**DSR is not overridden**
%S1		DSR mimics the state of DTR (not reset by &F)
%T0	■	**DCD always follows state of carrier**
%T1		DCD is always high (not reset by &F)
%U0	■	**Standard error correction response codes**
%U1		V.42 response codes when V.42 connection established
%U2		V.42 response codes for V.42 connections, MNP 2,4,10 compression & DES messages displayed
%W0	■	**Disable welcome message**
%W1		Send message specified by *W to remote modem after connect
\A0		MNP block size = 64
\A1		MNP block size = 128
\A2		MNP block size = 192
\A3	■	**MNP block size = 256**
\Bn		Send Break sequence to remote modem (default **\B3**)
\J0	■	**Fallback to direct mode disabled**
\J1		Fallback to direct mode enabled
\Kn		Received Break control (default **\K5**)
\N0		Constant speed mode
\N1		Variable speed mode
\N2		MNP reliable mode
\N3	■	**V.42/MNP auto-reliable mode**
\N4		V.42 reliable mode
\N5		V.42 auto-reliable mode
\N6		V.42/MNP reliable mode, fallback to MNP reliable mode
\N7		MNP auto-reliable mode
\Q0		Flow control disabled
\Q1		XON/XOFF flow control from modem and computer
\Q2		CTS flow control
\Q3		CTS-RTS flow control (same as **&K3**)
\Q4		Modem-only XON/XOFF flow control
\Q5		CTS flow control (CTS low until connection)
\Q6		CTS-RTS flow control - CTS low until connect
\S		Display active configuration with detailed description

Command		*Description*
\Tn		Set inactivity timer to n seconds (Default **T0**)
\V0	■	**Disable reliable response codes**
\V1		Enable reliable response codes
\V8		Extended response codes
\V9		Extended response codes with diagnostic information
\X0	■	**XON/XOFF pass through disabled**
\X1		XON/XOFF pass through enabled
***C0**	■	**Enable V.34**
*C1		Disable V.34 use V.FC
*R		V13 Remote RTS signalling (on/off)
		*Wttt...tt Specify welcome message text used by %W1
		ttt...tt = text use | for new line

AutoModem Compatible Commands

:E0		Disable V.32 compromise equalizer
:E1	■	**Enable V.32 compromise equalizer**
Fn		If Fn>0 then B0=CCITT, B1=Bell (n=0,1,3-10,13-19)
N0		Disable automode
N1	■	**Enable automode**
-K0		Disable MNP 10
-K1		Enable V.42 to MNP 10 switching
-K2	■	**Enable V.42 to MNP switching & inhibit MNP Extended**

Services initiation during V.42 answer mode detection

-Q0		MNP 10 falls back to 4800 bps only
-Q1	■	**MNP 10 falls back to 4800 bps, 2400 bps or 1200 bps**
***H0**	■	**Initiate MNP 10 connections at highest available speed**
*H1		Initiate MNP 10 connections at 1200 bps
*H2		Initiate MNP 10 connections at 4800 bps
)M0	■	**Disable power level adjustment in MNP10 connections**
)M1		Enable power level adjustment in MNP 10 connections
&Qn		See &M commands (n=0,1,2,5,6)

S Registers

Reg	Range	Def	Unit	Function
0	0-255	02	rings	Rings Before Answer
1	0-255	00	rings	Ring Count
2	1-255	43(+)	ASCII	Escape Sequence Character
3	0-127	13	ASCII	Carriage Return Character
4	0-127	10	ASCII	Line Feed Character
5	0-127	08	ASCII	Backspace Character
6	4-7	04	secs	Wait for Dial Tone
7	1-60	30	secs	Wait for Carrier
8	1-7	04	secs	Delay for Pause Modifier
9	1-255	06	0.1 secs	Carrier Detect Response Time
10	1-255	18	0.1 secs	Lost Carrier/Hang Up Delay
11	70-254	95	msecs	Touch Tone Timing
12	3-255	50	0.02 secs	Escape Sequence Guard Time
16	0-8	00		Test in Progress (read only)
18	0-255	00	secs	Test Timer
25	0-255	05	0.01 secs	DTR Loss Detection Time
26	0-255	00	0.01 secs	RTS-CTS Delay
27	0-255	00	secs	Delay Before Security Dial-back
29	10-100	50	0.01 secs	Hook Flash Duration (also sets S100)
30	0-255	00	10 secs	Inactivity Timer (data mode)
	0-255	30	secs	Dead-man Timer (voice mode) (=S105)
33	0-255	03		EQM Threshold for V.32/V.32bis
38	0-255	00	secs	Disconnect Delay
42	0-255			Modem Disconnect Reason
43	Break Sequence	15	msecs	Break Sequence Length
45	0-255	98		EQM Threshold - V.22/V.22bis/212A
47	1-255	08	secs	Auto-Range Time
62	0-255	75	0.01 secs	V.42 detection timer
66	1-255	10	0.1 secs	Remote Access Guard Time
67	1-127	42(*)	ASCII	Remote Access Character
69	0-255	60	secs	Command line timeout
71	0-30	00	secs	V.25bis Ignore Incoming Call
74	0-255			Modem Disconnect Reason Previous Call

S Registers

Reg	Range	Def	Unit	Function
80	1-19	15	5%	Flow Control High Water Mark
81	1-19	03	5%	Flow Control Low Water Mark
82	1-255	60		Failsafe Flow Control Overrun
95	0-63	0	bitmap	Extended Result Codes
96	1-255	80		Help Page Width
97	1-255	24		Help Page Length
100	1-10	5	100 msecs	Hook Flash Duration (also sets S29)
105	0-255	30	secs	Voice-mode "Dead-man" timer

Use AT? to see the Command Set supported by your modem's version of code.

DECLARATION OF CONFORMITY
(In accordance with EN 45014)

We,

Boca Research, Inc.
1377 Clint Moore Road
Boca Raton, FL 33487

declare under our sole responsibility that the product,

Type of Equipment: Modems
Model Numbers: 'PRO16XXE'

***to which this declaration relates is in conformity with the following
standards or other normative documents:***

Safety: The Product complies with the requirements of the low voltage
directive 73/23/EEC, EN 60950 (1992), A1 & A2

EMC: EN 55022 (1993) Class B
           EN 50082-1 (1992)
                 IEC 801-2 (1991), 4kV CD; 8kV AD
                 IEC 801-3 (1984), 3 V/m
                 IEC 801-4 (1988), 0.5 kV Signal Lines,
                                   1 kV AC Power Lines

following the provision of EMC directive 89/336/EEC

Boca Raton, Florida USA

Signature and Date: available on request

Typed Name and Title: available on request

European Contact: **Boca Research Holland**

$C\epsilon$

**CAUTION: Telecommunications voltages and currents can exceed the limits
of safety extra low voltage (SELV), resulting in personal injury. Do not touch
any components on the modem's printed circuit board when power is
applied, or the telephone cable is plugged in.**

**Avoid installing, handling the telephone cable, or changing the jumper
settings on the modem during any weather activity where lightning strikes
may occur.**

**This unit is intended for installation in computing devices that are non-
operator accessible. Installation is to be performed by qualified service
personnel only**

WARNING/ATTENTION

#1"**CAUTION:** THIS MODEM CARD IS INTENDED TO BE INSTALLED IN CSA CERTIFIED EQUIPMENT IN THE FIELD BY THE USER IN THE MANUFACTURER'S DEFINED OPERATOR ACCESS AREA. CHECK THE EQUIPMENT OPERATING/INSTALLATION INSTRUCTIONS AND/OR EQUIPMENT MANUFACTURER TO VERIFY/CONFIRM IF YOUR EQUIPMENT IS SUITABLE FOR USER-INSTALLED APPLICATION CARDS."

"**ATTENTION**: CETTE CARTE MODEM EST DESTINEE A ETRE INSTALLEE PAR L'UTILISATEUR, SUR PLACE ET A L'INTERIEUR DE LA ZONE DEFINIE PAR LA FABRICANT, DANS UN APPAREIL CERIFIE CSA. CONSULTER LE MODE D'EMPLOI OU LE FABRICANT DE L'APPAREIL POUR VERIFIER OU CONFIRMER SI L'UTILISATEUR PEUT Y INSTALLER LUI-MEME DES CARTES PERIPHERIQUES."

#2"**CAUTION**: ALWAYS DISCONNECT MODEM BOARD (THE ONE WITH THE TELEPHONE/PLUG JACK) FROM THE TELEPHONE SYSTEM WHEN INSTALLING OR WHEN COVERS ARE REMOVED FROM THE HOST PRODUCT."

"**ATTENTION**: TOUJOURS DEBRANCHER LA LIGNE TELEPHONIQUE DE LA CARTE MODEM (MUNIE D'UNE PRISE OR D'UNE FICHE) AVANT DE PROCEDER A L'INSTALLATION DANS L'APPAREIL OU LORSQUE LE COUVERCLE DE CELUI-CI EST RETIRE."

#3"**CAUTION**: APPLY THE ENCLOSED ADHESIVE WARNING LABEL TO THE OUTSIDE OR INSIDE OF THE EQUIPMENT ENCLOSURE ADJACENT TO THE MODEM CARD."

"**ATTENTION**: APPOSER L'ETIQUETTE AUTOCOLLANTE DE MISE EN GARDE CI-INCLUSE SURE LE PAROI EXTERIEURE OU INTERIEURE DU BOITIER DE L'APPAREIL PRES DE LA CARTE MODEM.

CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER. DISCARD USED BATTERIES ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

ATTENTION: IL Y A DANGER D'EXPLOSION S'IL YA A REMPLACEMENT INCORRECT DE LA BATTERIE. REMPLACER UNIQUEMENT AVEC UNE BATTERIE DU MÊME TYPE OU D'UN TYPE RECOMMANDÉ PAR LE CONSTRUCTEUR. METTER AU RÉBUT LES BATTERIES USAGÉES CONFORMÉMENT AUX INSTRUCTIONS DU FABRICANT.

FOR USE WITH MODEL NO. PRO16.

POUR UTILISER AVÉC MODELE PRO16.

BOCA
RESEARCH INC

Part No. 9492
Rev. 1.0