User Manual - ICC Multiport Card

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330 Warren Avenue
Fremont, California 94539
415-659-9097

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Acknowledgements

Special thanks to our customers for requesting this product and for cooperation as alpha and beta test sites during its creation.

Card architecture and design implementation by Jim Wall.

System software by Bob Glossman.

About The Authors

Jim Wall has been a digital design engineer specializing in UNIX systems for over 8 years. Prior to Bell Technologies, Jim was a senior design engineer with Fortune Systems, where his designs included work on intelligent UNIX serial port controllers and extremely high speed UNIX supermicro systems design. Prior to Fortune, Jim was a senior design engineer with AMD. He started his digital design career while still in high school by working on microprocessor controlled experiment packages for the Pioneer/Venus spacecraft at NASA Ames Research Center. The ICC is his fourth intelligent serial port card design.

Bob Glossman received a Master's degree in Computer Science from Stanford University and has held senior software engineering positions at Intel, Cromemco, Fortune Systems, and Convergent Technologies. At Fortune, Bob coded a Wang look-alike word processor for UNIX which has set the standard for a generation of word processors. At Convergent, Bob ported UNIX System V to the AT&T UNIX PC 7300, and wrote the 7300's windowing system.

1. Introduction

This manual will teach you how to install and use the Bell Technologies Intelligent Channel Controller Multi-Port Serial Card in UNIX or Xenix environments. Throughout this manual we will refer to the Intelligent Channel Controller as the "ICC," as it is commonly known at Bell.

Bell's ICC provides six additional serial ports for IBM PC AT computers and compatibles which are running standard UNIX System V (System V/286 and System V/386 Releases 2 and 3, Microport, Interactive 386/ix, Intel, or similar), IBM's Xenix operating system, Unisys (Sperry) Xenix System V, Tandy Xenix, or the System V based Xenix release from Santa Cruz Operation.

You may install up to four ICCs in your PC AT for a total of 24 ICC serial ports. These additional serial ports may be used with terminals, modems, printers, system-to-system connections, or for any other RS232 compatible serial device. The ICC can drive serial ports at up to 38400 baud.

The ICC has been specifically designed for use in UNIX and Xenix operating systems. It offers several advantages over cards originally designed for DOS and is unique in the market for providing all of these benefits at once:

* **On-Board "Minicomputer" Subsystem**: The ICC uses an 8 or 10MHZ 16 bit integrated microprocessor, the 80186, together with one-half megabyte of RAM to create a complete computer subsystem that is dedicated to managing the serial ports. The ICC subsystem is so fast it exceeds the power of some 16 bit "minicomputers" still being sold today.

* **Efficient I/O Map Utilization**: Most other serial cards require at least eight bytes per serial port. Installing 8 ports using such cards requires 64 free bytes of I/O space while installing 24 ports usually requires 192 bytes. This means that most serial cards "step on" other cards when significant numbers of ports are used. In contrast, Bell's ICC requires only four bytes of I/O space, even if four cards are installed for a total of 24 ports. This means you will always be able to avoid I/O map conflicts.

* **Relocatable I/O Base Address**: The ICC allows you to relocate the base address of the card. This allows you to put the two bytes of ICC base address anywhere you desire. Doing so allows you to mix and match cards and peripherals from different vendors to obtain the system configuration which suits you best.

* **Shared Interrupts**: Bell's proprietary hardware and software design can share interrupt vectors on the PC bus across multiple cards. Four ICCs and a tape mechanism, for example, can all share a single interrupt line. This allows you to attach more high performance peripherals to your PC AT without running out of interrupt vectors.

* **Relocatable Interrupt Vector**: The ICC device drivers are supplied in user-configurable form, and the ICC hardware provides a simple means of selecting interrupt lines in hardware, including the rarely utilized "higher" PC AT interrupt lines. If you ever need to relocate the ICC interrupt vector, you can do so easily.

* **Space Saving Modular Cables:** No need to disfigure the outside of your PC AT. Bell's ICC uses eight line modular telephone jacks to bring six serial lines out the back of a single PC AT card slot opening. Other cards use bulky mechanical gadgets which must be affixed to the rear of the PC and block access to the other card slots. By using modular cables, Bell frees up access to the back of your PC AT. An additional benefit is that the

modular cables and adaptors free you from the need to constantly screw on and unscrew old-fashioned DB25 connectors. Finally, by using standard modular cables you will never need to stock or keep track of a variety of null modem, terminal, printer, gender bender, or other custom cables. Simply affix the appropriate adaptor to the target piece of equipment and then use standard modular cables without need to keep track of which item requires a null modem and which does not.

* **OEM Options**: The ICC provides for RS232 or other interface protocols in OEM applications. Two ports, for example, can be converted in the field to RS422 operation. A 50 Pin header socket adjacent to the RJ45 modular jacks enables OEM use of any cableing system desired: DB9, DB25, or even coax or twin-ax!.

* **IBM Compatible Communications Chip**: The ICC uses the same 8531 communications and modem control chip used by IBM in IBM's own "smart card." By utilizing a similar architecture, the ICC retains perfect hardware and systems compatibility across a wide range of IBM architecture systems. The 8530/31 series chips also make it far easier to convert existing OEM 327x, HDLC, SDLC, X.25 and other advanced protocols to utilize the ICC's advanced hardware.

* **Expanded Functionality over our "HUB6" Card**: Because of its on-board computing engine, the ICC can deliver expanded functionality when compared to Bell's simpler multiport card offering. Additional features include CTS/RTS handshaking, and enhanced speed operation, up to 38,400 baud in aysynchronous tty mode. In addition, the ICC supports simultaneous modem auto-answer and dial-out on the same line. Further, the ICC off-loads tty handling from the main CPU to dramatically enhance system performance in many applications.

2. Installation

This manual is designed to help you install your ICC and get it operational as rapidly as possible. The installation section covers use of *one* ICC in Xenix and UNIX System V with standard terminal-type devices.

If you wish to use more than one ICC or have specialized questions, set the dip switches on the second, third, and fourth cards (if installed) as directed and consult the rest of this manual for additional information.

2.1 Hardware Installation

This section will teach you how to install the ICC in your PC AT or PC AT compatible. Before we proceed, some general notes:

* **Beware of Lightning!**: Like all modern PC cards, the ICC includes static sensitive components. That's why it is packed in a silvery plastic static protection bag. Small amounts of static electricity can damage the ICC. If you have ever felt a spark on touching a grounded metal item you know how easy it is to accumulate a light static charge. Always "ground" yourself by touching a grounded metal object (such as the chassis of your PC AT when it is plugged in) before removing the ICC from its protective bag or otherwise handling it. When not in use, store or ship the ICC in its static bag.

* **Don't Get Stuck!**: If you've ever handled printed circuit boards before, you know they have the capability of drawing blood. The component pins on the "solder side" of the board are quite sharp and will literally draw blood from pinpricks, scratches, etc. Handle with care.

2.1.1 Unpacking

Carefully remove all components from the package and inspect each for possible shipping damage. If the container or any of the components appears to have received damage during shipping, immediately contact the shipper who delivered your package and request they come out and inspect the damage. The Bell Technologies warranty does not include damage due to shipping. Therefore, it is very important that any such damage claims be made against the shipper to prevent any further expense on your part. Even if the outside of the container has sustained some minor shipping damage, it is unlikely that the ICC has been harmed.

If you see any shipping damage, make sure to retain all packing materials in case you need to file a claim against the shipper. **You will also need the original packing material should you ever need to return your ICC to Bell Technologies for warranty service.**[1]

1. Early ICC releases may not include Xenix/386 or Microport '286 or '386 diskettes. Contact your Bell Technologies marketing representative for more information.

Check for the following items:

____ ICC packed in silvery static bag

____ 25' modular cable

____ Standard terminal adaptor

____ IBM Xenix ICC Installation diskette

____ SCO Xenix ICC Installation diskette

____ UNIX System V/386, Release 3.0 ICC Installation diskette

____ Microport '286 and '386 ICC Installation diskettes

____ ICC User Manual

____ Warranty & User Registration Card

____ Miscellaneous sales literature

2.1.2 Hardware Preliminaries

Unpack your ICC and inspect it. Slight warpage in the card is perfectly normal.

2.1.3 Write Down The Serial Number

We track all products by serial number individually in order to provide support. Since software releases are updated from time to time it is essential we know exactly what revision level and serial number you are using in both hardware and software. Without this information we are not able to provide intelligent support.

Write down the serial number of the card and revision number in this manual for future reference should you ever require support or service:

Serial Numbers and Revision Information:

SN: _____

REV: _____

Diskette Serial Numbers:

_____

_____

2.1.4 Verify System is Functional

Prior to installing your ICC, please verify that your system hardware and software is functional. Doing so will eliminate potential uncertainties should you encounter any difficulties during your ICC installation. Many calls to our Technical Support line that are initially reported as ICC problems are eventually resolved by determining that the original system hardware was not functional or that the operating system was not correctly installed. The following checklist will help:

____ Configure the system as you propose to use it, without installing the ICC or any other third party UNIX or Xenix peripherals. (We suggest you install the ICC software before any non-Bell Technologies peripheral software).

____ Turn the system on, and verify the following:

- ____ System display monitor is operational and displaying characters.
- ____ Power-on self test functions; memory count up sequence is displayed.
- ____ The AT attempts to boot operating system.

____ Load your operating system if it has not yet been loaded.

____ Verify that the UNIX or Xenix operating system has been installed correctly and is functioning.

____ [Optional] If you are planning to reconfigure your kernel (an advanced, optional use), try reconfiguring your kernel *without* any changes to verify that you have all of the software necessary to do so correctly installed.

If you have trouble with any of the above steps, you obviously will need to resolve the problem prior to proceeding with the ICC installation. Consult the manuals provided by your computer hardware vendor and/or by your operating systems vendor.

2.1.5 Plugging the ICC into your Computer

The ICC may be inserted into any slot in your PC AT bus compatible computer. Proceed as follows:

____ Unplug your PC AT. **REMOVE THE POWER CORD.**

____ Unscrew the five cover retaining screws at the rear of your PC AT. Slide the cover off towards the front and set it aside.

____ Locate an empty card slot. The ICC may be installed into any AT (two connector) card slot in the PC AT.

____ Some PC AT's or compatibles may have large capacitors protruding up from the motherboard in the space between the card edge connectors and the rear panel of the AT's chassis. The standard PC AT does not have any such protruding components. If your AT or compatible has a capacitor or other component protruding up beyond the level of the rest of the chips on the motherboard, you will need to either push it down out of the way or use a different slot for your ICC.

____ Remove the metal plate covering the expansion card slot opening in the rear of the PC AT chassis corresponding to the card edge connector into which you will insert the ICC.

____ Take a moment to verify that the three DIP switches on the ICC are correctly set. The leftmost and rightmost DIP switches are set the same way for all ICC's in your system, while the setting of the center DIP switch varies depending on whether your ICC is the first, second, third or fourth ICC installed.

Switch 1 (Leftmost)								
ON		X	X					X
OFF	X			X	X	X	X	
No.:	1	2	3	4	5	6	7	8

TABLE 1. Switch 1 Settings for ICC

Switch 2 (Center)								
ON			X	X	X	X		X
OFF	X	X					X	
No.:	1	2	3	4	5	6	7	8

TABLE 2. Switch 2 Settings for First ICC

Switch 2 (Center)								
ON			X	X	X	X		
OFF	X	X					X	X
No.:	1	2	3	4	5	6	7	8

TABLE 3. Switch 2 Settings for Second ICC

Switch 2 (Center)								
ON			X	X	X		X	X
OFF	X	X				X		
No.:	1	2	3	4	5	6	7	8

TABLE 4. Switch 2 Settings for Third ICC

Switch 2 (Center)									
ON			X	X	X		X		
OFF	X	X				X		X	
No.:	1	2	3	4	5	6	7	8	

TABLE 5. Switch 2 Settings for Fourth ICC

Switch 3 (Rightmost)										
ON							X			
OFF	X	X	X	X	X	X		X	X	X
No.:	1	2	3	4	5	6	7	8	9	10

TABLE 6. Switch 3 Settings for ICC

____ Insert the ICC into the desired slot. Verify that all of the modular jacks are accessible from the outside of the AT.

____ Make sure the card is firmly seated, and is not kept from being completely inserted into the PC AT bus connector by any loose cables or components sticking up from the PC AT's motherboard.

____ Screw down the ICC's metal flange to the PC AT's back panel.

____ Replace the lid and replace the five back panel screws which hold it in place.

2.2 Getting Going with UNIX System V/386, Release 3.0

This section tells you how to install the ICC software on the standard UNIX System V/386 Release 3 software created by Interactive Systems for Intel Corporation and AT&T for use on PC AT compatible 80386 machines. The standard 386 release should not be confused with Xenix/386 or Microport System V/386. This section refers only to the officially certified, complete AT&T sanctioned and licensed product available through Intel, Bell Technologies, Interactive Systems, and a host of OEMs.

2.2.1 Software Installation - UNIX '386 5.3

The ICC is shipped with an installation diskette for use with UNIX System V/386 Release 3.0. This installation software should be used with true UNIX System V/386 Release 3.0 systems supplied by Intel Corporation or compiled from the official AT&T certified tape and installed with Bell Technologies or Interactive Systems Corporation device drivers. Use this diskette with your Bell Technologies System V/386 Release 3.0 operating system.

Note: The ICC software simply installs a new kernel into which the ICC software has been linked. It also installs the uploaded ICC software system which is loaded into the ICC card during boot up.

_____ Install UNIX System V/386.

_____ Bring up the system "multiuser." Other users should not be logged in on your system while the ICC software is being installed.

_____ Login as "**root**" or other super user.

_____ Make sure you are at the root of the file system with the following command:

cd /

_____ Insert the ICC Installation Diskette for UNIX System V/386 Release 3.0.

_____ Enter the following command:

cpio -icduvmB < /dev/rdsk/f0q15dt

_____ Remove the ICC installation diskette and store it in a safe place.

_____ Shutdown the system and reboot.

On bootup, the ICC systems software announces its presence with a message similar to

ICC (SysV) v1.0 (c) 1986 Bell Technologies

and then a report on how many cards it finds. If it recognizes no ICCs present, it announces "no cards installed." For each card it finds it announces "card 0 installed," "card 1 installed," and so on.

If you *do not* see the ICC announcement during boot-up, you are working with a downrev kernel or

5.3 release that has been modified from the standard release. Please contact your Bell Technologies dealer or marketing representative.

As the system is coming up, you will see a message reporting the activity of the "DLOAD" command while it is loading the ICC with its on-board operational software. This is a normal message and indicates correct functioning of the ICC software and hardware.

2.2.2 Attaching a 9600 Baud Terminal - UNIX System V/386

The simplest task is to attach a modern 9600 baud terminal to the ICC using the modular cable and adaptor provided. Most installations require little or no additional work to be functional.

____ Attach the Bell Technologies modular adaptor to your terminal. Screw it in place.

____ Plug one end of the modular cable into the *lowest* port on the ICC. Plug the other end into the Bell Technologies modular adaptor affixed to your terminal.

____ Set your terminal to run at 9600 baud. Instructions to do so will be in an obscure section of your terminal's user manual.

If you are working with modems and wish to feed a login to a modem, you will need to use a Bell Technologies modem adaptor or to insert a "null modem" adaptor between your Bell Technologies terminal adaptor and the modem. See the other sections of this manual for more information on working with modems.

2.2.3 Turning On a Terminal in UNIX System V/386

UNIX System V/386 products are distributed with licenses allowing either 1 to 2 users to run on the system, or with unlimited users to run on the system. Note that if you wish to run with more than two users, you will need to have installed the UNIX System V/386 operating system product allowing operation with unlimited number of users.

Please note that systems limited to only two users is a function of your UNIX license and is not an aspect of ICC operation. The ICC hardware and software will allow you to operate with as many users as allowed by the UNIX you have installed.

Unless you have installed an unlimited UNIX license, you will not be able to set up a login for more than one terminal in addition to your PC AT console.

____ Turn on the PC AT. Login as root. Using your favorite editor, add this line at the end of the file **/etc/inittab**

```
ia:23:respawn:/etc/getty ttyia 9600
```

____ Save the file and exit the editor. Then enter the following command:

init q

____ This should produce a "Login" message on your terminal. If it does not, turn to the troubleshooting section of this manual after trying all of the obvious stuff (ie, cables fully plugged in, terminal turned on, baud rate set right, etc, etc.)

Note: The lowest port on the ICC is called **ttyia**. The next port up from the bottom is called **ttyib** and so on to the top port which is **ttyif**. If you want to run your terminal off of the top port, you should plug the cable into the top port and enable it using the above procedure but substituting **if** for "ia" and **/dev/ttyif** for "/dev/ttyia".

2.2.4 Some Notes for the Experienced User

If you are familiar with serial devices and UNIX, this section should get your most important questions answered right away. You will still probably want to read the rest of this manual.

ICC software utilizes a set of 72 tty devices in **/dev**. 48 of these devices are labeled **ttyia** through **ttyix** and **ttyiA** through **ttyiX**. These 48 devices represent two tty device special files (one with modem controls, one without) for each of the 24 possible ICC serial ports.

The lower case devices do not have modem controls, while the upper case devices have modem controls. The devices correspond to the ports on the ICC with **ttyia** and **ttyiA** referring to the **bottom** port of the first card and **ttyif** and **ttyiF** referring to the top port of the first card.

The bottom port of the second card is called **ttyig** and so on, with the top port of the fourth ICC installed called **ttyix**.

24 additional devices are called **ttyoa** through **ttyox**. The "o" in the "ttyoa" is for "output." **These devices should not be enabled for input.** These devices are used to **cu** outbound through a given port at the same time that one of the corresponding **"ttyiA"** (modem control) style devices is enabled for input. The intent is to enable people to **cu** outbound through a line connected to a modem which is waiting to receive an inbound call. Thus, one may establish a login on one of the inbound, modem-control devices. The login waits for the modem to answer a call before it is actually established. The login goes away after the modem hangs up. At all other times, when the modem is not actually servicing an inbound call, one may dial outbound through the same port using the corresponding "o" device.

System V UNIX controls the activity of serial ports via a collection of files located in the **/etc** directory. **/etc/inittab** is the primary file which needs to be edited to get terminals going. This file tells the **init** process what to do for various states of the system.\[2] **/etc/inittab** should contain instructions for **init** to start off copies of the **getty** program aimed at special files in the **/dev** directory which are associated with terminals.

Getty gets its marching orders from the **/etc/gettydefs** file. This file contains the definitions for the getty state codes which are used in **/etc/inittab**. By editing **/etc/gettydefs** you do all kinds of wonderful things, such as changing login prompts on a per-port basis, setting up variable port

2. Note that the format of the lines in **/etc/inittab** changed slightly from UNIX System V Release 2 to UNIX System V Release 3.0; for example, one now says "ttyia" in the inittab line instead of "/dev/ttyia".

speeds and other fun activities.

To turn on a login to a given port, you must edit the **/etc/inittab** file to add a line containing the ICC device of your choice. For example, to enable the ICC port 4c to operate at 9600 baud, add the following line to **/etc/inittab**:

```
ic:23:respawn:/etc/getty ttyic 9600
```

Then enter the command **init q**.\[3]

When editing **/etc/inittab** to enable ports, note that if you do not specify baud rate (9600 baud in the above example), the default is 300 baud. In addition, please note that there are no entries in the existing **/etc/inittab** in UNIX System V/386 as it is shipped, so you **must** add the above command line or similar to the file to enable operation of the ICC ports.

The modem control devices assert DTR and RTS (that is, they go high) on open and wait for DCD. The "open" will be blocked until the attached serial device asserts DCD.

On close, the modem control devices drop DTR and RTS. Should DCD be dropped by the serial device attached to the port while it is open, an interrupt will be generated and a signal sent as per standard UNIX conventions. Neither this interrupt nor its associated signal exist in the non-modem control devices.

3. In general, typing "init q" as the super-user tells the system to read /etc/inittab and to turn ports on or off as necessary to reflect the current contents of /etc/inittab.

2.3 Getting Going with IBM or SCO Xenix

This section tells you how to install the ICC software on your Xenix system and how to get serial ports working with simple 9600 baud terminals. This covers 95% of the usage of the ICC. If you need to accomplish a more complex installation, you will need to consult other sections of this manual *after* reading this section through.

2.3.1 Software Installation - Xenix

The ICC is shipped with two Xenix diskettes: an IBM Xenix Installation Diskette,[4] and an SCO Xenix Installation Diskette. Use the appropriate diskette for the Xenix system you are using.

____ Install the Xenix of your choice. You **do not** need to install development utilities for either IBM Xenix or SCO Xenix.

____ Bring the system up "multiuser." You should not allow other users on the machine while installing the ICC software.

____ Login as "**root**" or other super user.

____ If you are using IBM Xenix, insert the ICC IBM Xenix Installation Diskette. If you are using SCO Xenix, insert the ICC SCO Xenix installation diskette.

____ If you are using IBM Xenix, enter the following command lines:

```
/etc/mount /dev/fd0 /mnt
/mnt/install
```

____ If you are using SCO Xenix, enter the following command:

```
install /dev/fd096ds15
```

____ The screen will clear and a message will appear advising you of what the installation procedure will do. Hit the <Enter> key to initiate the installation procedure. Once installation commences, do not attempt to interrupt it.

____ Although it is tempting to let the installation script run unattended while you get a cup of coffee, take a few minutes to observe the installation procedure through to completion, just in case an error occurs. Should an error occur, immediately write down the error message for future reference.

____ When the installation process has completed, you will see an "Installation completed" message. You may see an "Installation completed" message even if an error occured during installation which might require re-installation or correction of a non-standard

4. All references to "IBM Xenix" mean IBM Xenix 2.0. Bell Technologies no longer supports IBM Xenix 1.0.

condition prior to your ICC being usable.

____ If you are running IBM Xenix, enter the following command to unmount the floppy:

/etc/umount /dev/fd0

____ Remove the installation diskette and put it in a safe place.

____ Shutdown the system with a **haltsys** command.

____ Reboot the system by pressing the <Enter> key.

On bootup, the ICC systems software announces its presence with the message similar to :

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and then a report on how many cards it finds. If it recognizes no ICCs present, it announces "no cards installed." For each card it finds it announces "card 0 installed," "card 1 installed," and so on.

As the system is coming up, you will see a message reporting the activity of the "DLOAD" command while it is loading the ICC with its on-board operational software. This is a normal message and indicates correct functioning of the ICC software and hardware.

If you *do not* see the ICC announcement during boot-up, the software installation has not proceeded correctly. Please try the installation again, taking special note of any error messages displayed. Be extra careful to follow each step, in order, described in this manual. If a repeat installation is still unsuccessful, turn to the Troubleshooting section of this manual.

2.3.2 Attaching a 9600 Baud Terminal - Xenix

The simplest task is to attach a modern 9600 baud terminal to the ICC using the modular cable and adaptor provided. Most installations require little or no additional work to be functional.

____ Attach the Bell Technologies modular adaptor to your terminal. Screw it in place.

____ Plug one end of the modular cable into the *lowest* port on the ICC. Plug the other end into the Bell Technologies modular adaptor affixed to your terminal.

____ Set your terminal to run at 9600 baud. Instructions to do so will be in an obscure section of your terminal's user manual.

____ Turn on the PC AT. Type <CTRL-D> to go multiuser. Login as root. Enter the following command:

enable ttyia

____ This should produce a "Login" message on your terminal. If it does not, turn to the troubleshooting section of this manual after trying all of the obvious stuff (ie, cables fully plugged in, terminal turned on, baud rate set right, etc, etc.)

Note: The lowest port on the ICC is called **ttyia**. The next port up from the bottom is called **ttyib** and so on to the top port which is **ttyif**. If you want to run your terminal off of the topmost port, you should plug the cable into the top port and enable it with a **enable ttyif** command.

To turn off logins to a port, use the Xenix **disable** command. For example, to turn off the bottom port on your ICC, say the following:

disable ttyia

If you are working with modems and wish to feed a login to a modem, you will need to use a Bell Technologies modem adaptor or to insert a "null modem" adaptor between your Bell Technologies terminal adaptor and the modem.

2.3.3 Some Notes for the Experienced User

If you are familiar with serial devices and Xenix, this section should get your most important questions answered right away. You will still probably want to read the rest of this manual.

ICC software utilizes a set of 72 tty devices in **/dev**. 48 of these devices are labeled **ttyia** through **ttyix** and **ttyiA** through **ttyiX**. These 48 devices represent two tty device special files (one with modem controls, one without) for each of the 24 possible ICC serial ports.

The lower case devices do not have modem controls, while the upper case devices have modem controls. The devices correspond to the ports on the ICC with **ttyia** and **ttyiA** referring to the **bottom** port of the first card and **ttyif** and **ttyiF** referring to the top port of the first card.

The bottom port of the second card is called **ttyig** and so on, with the top port of the fourth ICC installed called **ttyix**.

24 additional devices are called **ttyoa** through **ttyox**. The "o" in the "ttyoa" is for "output." **These devices should not be enabled for input.** These devices are used to **cu** outbound through a given port at the same time that one of the corresponding **"ttyiA"** (modem control) style devices is enabled for input. The intent is to enable people to **cu** outbound through a line connected to a modem which is waiting to receive an inbound call. Thus, one may establish a login on one of the inbound, modem-control devices. The login waits for the modem to answer a call before it is actually established. The login goes away after the modem hangs up. At all other times, when the modem is not actually servicing an inbound call, one may dial outbound through the same port using the corresponding "o" device.

To turn on a login to a given port, edit the **/etc/ttys** file for the baud rate desired, then turn the port on with an **enable** command just as you would the stock **tty01** or **tty02** ports.

The modem control devices assert DTR and RTS (that is, they go high) on open and wait for

DCD. The "open" will be blocked until the attached serial device asserts DCD.

On close, the modem control devices drop DTR and RTS. Should DCD be dropped by the serial device attached to the port while it is open, an interrupt will be generated and a signal sent as per standard Xenix conventions. Neither this interrupt nor its associated signal exist in the non-modem control devices.

2.4 Getting Going with Microport System V/AT

This section tells you how to install the ICC software on your Microport System V/AT system and how to get serial ports working with simple 9600 baud terminals. This covers 95% of the usage of the ICC. If you need to accomplish a more complex installation, you will need to consult other sections of this manual *after* reading this section through. This section applies only to Microport System V/AT for **80286** based machines, and does not apply to Microport System V/386.

2.4.1 Software Installation - Microport

Follow this procedure to install the ICC software when using Microport System V/AT:

____ Install Microport. You **do not** need to install development utilities.

____ Login as "**root**" or other super user.

____ Insert the Microport Drivers Installation diskette.\[5]

____ Enter the following command line:

installit

____ The screen will clear and a message will appear advising you of what the installation procedure will do. Hit the <Enter> key to initiate the installation procedure. Once installation commences, do not attempt to interrupt it.

____ Although it is tempting to let the installation script run unattended while you get a cup of coffee, take a few minutes to observe the installation procedure through to completion, just in case an error occurs. Should an error occur, immediately write down the error message for future reference.

____ When the installation process has completed, you will see an "Installation completed" message. You may see an "Installation completed" message even if an error occured during installation which might require re-installation or correction of a non-standard

5. Note: Bell Technologies distributes ICC, HUB6 and tape backup device drivers and software on the same Microport Installation diskette.

condition prior to your ICC being usable. Take care to note any error messages printed during the installation procedure.

____ Remove the installation diskette and put it in a safe place.

____ Shutdown the system with the following commands.

```
sync
init 0
```

____ Reboot the system by pressing the <CTRL>, <ALT> and <DEL> keys simultaneously.

On bootup, the ICC systems software announces its presence with the message similar to

ICC (SysV) v1.0 (c) 1987 Bell Technologies

and then a report on how many cards it finds. If it recognizes no ICCs present, it announces "no cards installed." For each card it finds it announces "card 0 installed," "card 1 installed," and so on.

As the system is coming up, you will see a message reporting the activity of the "DLOAD" command while it is loading the ICC with its on-board operational software. This is a normal message and indicates correct functioning of the ICC software and hardware.

If you *do not* see the ICC announcement during boot-up, the software installation has not proceeded correctly. Please try the installation again, taking special note of any error messages displayed. Be extra careful to follow each step, in order, described in this manual. If a repeat installation is still unsuccessful, turn to the Troubleshooting section of this manual.

NOTE: Since Bell Technologies distributes all of our software for Microport on the same installation diskette, as a by-product of installing ICC software on your PC AT you will also install our HUB6 and tape system software. The tape software and HUB6 will announce its presence with a boot-up banner similar to the ICC software. If you do not have a Bell Technologies tape or HUB6 installed, the tape and HUB6 software will not be functional and will not interfere with your use of the system in any way.\[6]

2.4.2 Attaching a 9600 Baud Terminal - Microport

The simplest task is to attach a modern 9600 baud terminal to the ICC using the modular cable and adaptor provided. Most installations require little or no additional work to be functional.

____

6. If you do not have a Bell Technologies tape system installed please immediately contact your Bell Technologies marketing representative at 800-FOR-UNIX or 415-659-9097 (in California) for ordering and shipping information. Your system deserves the best!

Attach the Bell Technologies modular adaptor to your terminal. Screw it in place.

____ Plug one end of the modular cable into the *lowest* port on the ICC. Plug the other end into the Bell Technologies modular adaptor affixed to your terminal.

____ Set your terminal to run at 9600 baud. Instructions to do so will be in an obscure section of your terminal's user manual.

If you are working with modems and wish to feed a login to a modem, you will need to use a Bell Technologies modem adaptor or to insert a "null modem" adaptor between your Bell Technologies terminal adaptor and the modem. See the other sections of this manual for more information on working with modems.

2.4.3 Turning On a Terminal in Microport System V/AT

The Microport product is distributed with a license allowing only two users to run on the system. If you wish to run with more than two users, you will need to procure the Microport upgrade product allowing operation with more than two users. Please note that this limitation to two users if the upgrade has not been purchased is built into Microport and is not a function of the ICC. The ICC hardware and software will allow you to operate with as many users as allowed by the Microport product you have purchased.

Unless you have purchased the upgrade to run more than 2 users at a time you will not be able to set up a login for more than one terminal in addition to your PC AT console.

____ Turn on the PC AT. Login as root. Using your favorite editor, add this line at the end of the file **/etc/inittab**

4a:1234:respawn:/etc/getty /dev/ttyia 9600

____ Save the file and exit the editor. Then enter the following command:

init q

____ This should produce a "Login" message on your terminal. If it does not, turn to the troubleshooting section of this manual after trying all of the obvious stuff (ie, cables fully plugged in, terminal turned on, baud rate set right, etc, etc.)

Note: The lowest port on the ICC is called **ttyia**. The next port up from the bottom is called **ttyib** and so on to the top port which is **ttyif**. If you want to run your terminal off of the top port, you should plug the cable into the top port and enable it using the above procedure but substituting **4f** for "4a" and **/dev/ttyif** for "/dev/ttyia".

2.4.4 Some Notes for the Experienced User

If you are familiar with serial devices and UNIX, this section should get your most important questions answered right away. You will still probably want to read the rest of this manual.

ICC software utilizes a set of 72 tty devices in **/dev**. 48 of these devices are labeled **ttyia** through **ttyix** and **ttyiA** through **ttyiX**. These 48 devices represent two tty device special files (one with modem controls, one without) for each of the 24 possible ICC serial ports.

The lower case devices do not have modem controls, while the upper case devices have modem controls. The devices correspond to the ports on the ICC with **ttyia** and **ttyiA** referring to the **bottom** port of the first card and **ttyif** and **ttyiF** referring to the top port of the first card.

The bottom port of the second card is called **ttyig** and so on, with the top port of the fourth ICC installed called **ttyix.**

24 additional devices are called **ttyoa** through **ttyox**. The "o" in the "ttyoa" is for "output." **These devices should not be enabled for input.** These devices are used to **cu** outbound through a given port at the same time that one of the corresponding **"ttyiA"** (modem control) style devices is enabled for input. The intent is to enable people to **cu** outbound through a line connected to a modem which is waiting to receive an inbound call. Thus, one may establish a login on one of the inbound, modem-control devices. The login waits for the modem to answer a call before it is actually established. The login goes away after the modem hangs up. At all other times, when the modem is not actually servicing an inbound call, one may dial outbound through the same port using the corresponding "o" device.

System V UNIX controls the activity of serial ports via a collection of files located in the **/etc** directory. **/etc/inittab** is the primary file which needs to be edited to get terminals going. This file tells the **init** process\[7] what to do for various states of the system. **/etc/inittab** should contain instructions for **init** to start off copies of the **getty** program\[8] aimed at special files in the **/dev** directory which are associated with terminals.

Getty gets its marching orders from the **/etc/gettydefs** file. This file contains the definitions for the getty state codes which are used in **/etc/inittab**. By editing **/etc/gettydefs** you do all kinds of wonderful things, such as changing login prompts on a per-port basis, setting up variable port speeds and other fun activities.

To turn on a login to a given port, you must edit the **/etc/inittab** file to add a line containing the ICC device of your choice. For example, to enable the ICC port 4a to operate at 9600 baud, add the following line to **/etc/inittab**:

```
4a:1234:respawn:/etc/getty /dev/ttyia 9600
```

Then enter the command **init q**.\[9]

The modem control devices assert DTR and RTS (that is, they go high) on open and wait for DCD. The "open" will be blocked until the attached serial device asserts DCD.

---

7. *init: The central process dispatcher in UNIX. Init runs first and gets everything going. /etc/inittab is so complex because it specifies optional usages of init in several different possible states of the system.*
8. *getty: A contraction of "get tty". UNIX quaintly refers to terminals as "tty"s (short for teletype). Getty has a lot of options allowing you to tell it precisely how it is to manage a terminal attached to a particular port.*
9. *In general, typing "init q" as the super-user tells the system to read /etc/inittab and to turn ports on or off as necessary to reflect the current contents of /etc/inittab.*

On close, the modem control devices drop DTR and RTS. Should DCD be dropped by the serial device attached to the port while it is open, an interrupt will be generated and a signal sent as per standard UNIX conventions. Neither this interrupt nor its associated signal exist in the non-modem control devices.

3. Serial Devices and UNIX

One of the strengths of the UNIX operating system is that everything within the system looks like a regular file. Interfaces to physical devices are implemented via operating systems constructs which appear to be regular files. These **device special files** are traditionally kept in the **/dev** directory. An example is **/dev/tty00**. For simplicity's sake, we will henceforth dispose of the absolute pathname prefix **/dev/** when referring to device files. So whenever we say **tty00**, for example, we mean **/dev/tty00**.

For virtually all purposes, device files may be treated just like regular files. They may be opened or closed. Programs may open them, write bytes to them, read bytes from them, and then close them just like regular files. Commands which redirect output into device files are usually perfectly legal (although sometimes it is not sensible to scribble at random onto certain devices, such as one's hard disk).

By tradition, the device special files associated with serial ports are called **tty** something or other. This is short for "teletype," and a throwback to the quaint old days when terminals were electro-mechanical teletype printers. This brings us to the principal difference between device special files and regular UNIX files.

Since device files are associated with a very wide array of electromechanical gadgets, to get the desired effect on the subject electromechanical gadget we usually need to do more then simply feed characters to the gadget. We usually will need to specify baud rates and many other factors such as word size, parity, and other control parameters. When UNIX or Xenix light up, they set control factors for each port based on the information in controlling files like **/etc/inittab** and **/etc/gettydefs**. The **stty** (for "set tty") command may be used to interactively set control parameters.

UNIX System V/386 and Microport refer to the PC AT console as **/dev/console**, and refer to the first and second IBM serial port as **tty0** and **tty1**. These devices only function if you have installed IBM's Parallel / Serial Adaptor card, which delivers serial ports for your use at the inefficient ratio of one per card.

Xenix by default is delivered with three device files which are used with terminals or serial ports. They are **tty00**, **tty01**, and **tty02**. **tty00** refers to the console and is not really a serial port. **tty01** refers to the serial port implemented as IBM's Primary Serial Port using IBM's Parallel / Serial Adaptor for the PC AT. **tty02** refers to the serial port implemented as IBM's Secondary Serial Port using IBM's Parallel / Serial Adaptor.

The 48 serial port devices (2 devices for each of the 24 possible ICC ports) created by the ICC installation software are called alphabetically **ttyia** through **ttyix** and **ttyiA** through **ttyiX**.

Most RS232 devices (modems, terminals, printers, bar code readers, etc, etc) can operate over a wide range of data transfer rate speeds. The different speeds are called "baud" rates. "Baud" may be very loosely defined as "bits per second." Baud rates are by convention set to be one of a standard set of rates. The most popular rates are 110 baud, 300 baud, 1200 baud, 2400 baud, 4800 baud, 9600 baud, and 19200 baud. The ICC can operate at 38400 baud asynchronous as well.

Baud rates on serial devices like terminals, modems, and printers are usually set with DIP switches or some other obscure means. By convention, the information on how to set baud rate is never clearly presented in the user manual for the terminal, modem, or whatever. Once you figure out

how to set the baud rate for your particular terminal or whatever, make sure to write down the information in a safe place.

The first hurdle in working with a device special file which talks to a serial port which talks to a mechanical gadget such as a terminal is to make sure they are all set to the same baud rate.

The second hurdle in attaching RS232 serial devices to one's computer is to make sure that the wires running from serial port to the device are correctly connected. This is never as simple as it should be.

4. The EIA RS-232-C Standard

The theoretical standard which most serial device manufacturers allege to support is the EIA RS-232-C Type D or Type E interface. This interface is a standard developed jointly by the Electronic Industry Association (EIA), the Bell System, and various manufacturers. The standard specifies how two types of serial gadgets, known as Data Terminal Equipment (DTE) and Data Communications Equipment (DCE), can speak to each other using connections of 25 wires.

Most serial devices use male or female 25 pin connectors in the so-called "DB25" configuration. The DB25 connector is the wide, squat connector with two rows of pins in it which one sees on virtually every serial device (modems, terminals, etc) in existence.

Each of the 21 signals specified in the official EIA standard is assigned a pin in the DB25 connector. DTE gadgets use male connectors, and DCE gadgets are supposed to use female connectors. This convention allegedly makes it easy to plug one gadget into another without resorting to adaptors which convert male plugs to female.

No manufacturer actually supports the full and complete EIA RS232 standard. Most vendors support a "three wire" subset for simple serial devices. Vendors selling more complex devices often support a subset using eight or nine wires. As a practical matter, only eight wires are actually used even in very complex systems. Thus in modern UNIX systems, fewer and fewer vendors are using DB25 connectors. IBM itself has just switched to DB9 (9 wire) connectors on the PC AT. The new standard in UNIX, especially on PC AT's, is the use of 8 line modular telephone jacks.

What are the RS232 signals that people actually use? To understand what they are, we need to learn a bit more about the original RS232 standard.

The standard originally evolved from the simple usage of terminals with modems to call remote computers. In this scenario, the terminal is a "Data Terminal Equipment" item, and the modem is a "Data Communications Equipment" item.

Communications between these two items occurs simultaneously over two wires: the **transmit data** wire (abbreviated **TXD**) and the **receive data** wire (**RXD**). These names are reckoned from the terminal's point of view, in that the terminal sends information to the modem over the **TXD** wire and receives information from the modem over the **RXD** wire. From the modem's point of view, it is transmitting data to the terminal over the **RXD** wire and receiving data over the **TXD** wire.

The official standard's view of the world is that modems talk to modems over telephone lines and that terminals talk to modems over the TXD and RXD wires. So that if terminal A wants to talk to terminal B (as is the case using telex or other teletype to teletype connections), the terminals communicate over phone lines with a pair of modems between them.

One often desires to plug two serial devices which look like terminals directly into each other without modems in between. For example, one often wishes to connect a serial printer to the "Auxilary" port of a serial terminal. The usual implementation of the RS232 standard allows us to do so.

To connect a terminal to another terminal, one plugs the **TXD** line of one terminal into the **RXD** input of the other terminal and vice versa:

This connection is usually made using a special cable or adaptor plug which has the TXD and RXD pins switched around at one end of the cable. Because such a cable or cable adaptor has the effect of replacing two modems in between two terminals, it is usually referred to as a "Null Modem" cable or adaptor.

While this was a simple enough concept when the only serial gadgets that played together were terminals and modems, it has been the source of endless confusion in modern times. Now that terminals talk to terminals and computers talk to computers and modems talk to modems, it is no longer possible to simply say "this item is Data Terminal Equipment and this item is Data Communications Equipment." Many manufacturers seeking to simplify the connections to their terminals are actually wiring terminals to look like modems and computers to look like terminals.

In addition to the TXD and RXD signals there is usually one more wire utilized: the **signal ground** wire, abbreviated **GND**. The utilization of TXD, RXD, and GND comprises the basic three wire subset of the RS232 standard. Most modern serial devices will work with just these three wires connected. Why then, is the EIA standard so complicated with 25 wires?

The answer is a desire for increased functionality. When using modems for telecommunications one often requires additional information. For example, a modem connected to a computer should have some means of signalling the computer when it loses the telephone line carrier (that is, when the party calling the computer hangs up). In most UNIX installations, the loss of telephone line carrier on a remote login line causes the system to kill the process. The objective is to automatically log users out of the system when they hang up without manually logging out.

The EIA standard provides a wide array of such supplemental signals. Only nine have ever really been used, and with the evolution of modems in the last few years the number of useful signals has dropped to eight. These signals and their official ICC abbreviations are:

Transmitted Data: TXD - "Outbound" data path.

Received Data: RXD - "Inbound" data path.

Signal Ground: GND - Reference ground for data.

Data Terminal Ready: DTR - "Terminal" gadget is ready to go to work.

Request To Send: RTS - "Terminal" is asking permission to begin sending data.

Data Carrier Detect: DCD - "Modem" says the "phone line" is alive with a carrier.

Clear to Send: CTS - "Modem" says it is ok to begin sending data.

Shield Ground: SHIELD - A "chassis ground" line to keep circuits and people from being electrocuted. Used to prevent signal noise as well.

The pure version of the standard specifies how these signals are used. As a practical matter, one wires the transmit and receive lines appropriately for the equipment being used. One then fools around for hours with the manuals to one's serial equipment to hot-wire the DTR, RTS, DCD lines so that the two items can talk. Luckily, standard adaptors are available for wiring almost any standard serial item to another.

There are two additional lines which have fallen from common usage in modern times, but you

should know about them anyway since terminal and printer manufacturers seem to be stuck in the 1960's. These lines are **Data Set Ready** and **Ring Indicator**. DSR is the modem equivalent of DTR. In common usage, it is redundant since modern modems are assumed to be functional when they are turned on.

Ring tells the terminal that the telephone bell is ringing. Again, modern modems are presumed to be intelligent enough to answer the telephone when it rings without requiring special software programming from their host system or terminal every time the phone rings. If you are working with a Hayes or similar post-1980 modem this line is completely unnecessary.

Almost all UNIX systems now assert DTR and RTS when turned on and then wait for DCD. The DCD line is used as a generic "I'm alive and ready" line to signal to the serial port that whatever is plugged into it is functioning and ready to go. When the DCD line is dropped (phone hung up, printer runs out of paper, terminal is turned off) the serial port assumes that the device plugged into it is no longer alive. The usual UNIX systems interpretation of such an event is to logout the user on that port or to make the special device file associated with that port un-openable. Bell Technologies supports this standard way of working with serial ports.

In addition, we have provided a subset of the above protocol to make life easier for our users. Since directly connected terminals commonly are attached to systems using the three wire substandard, we provide a collection of ICC **tty** devices which will run with just the three basic wires. Logins attached to such tty devices or reads and writes from such devices will not be dependent upon the status of the DCD line.

Unlike the driver for our simpler card, the HUB6 multiport adaptor, the ICC UNIX driver **does** provide CTS-RTS handshaking.

UNIX has a robust set of programming constructs for dealing with the varied nature of serial devices commonly attached to **tty** devices. One example is the idea of **terminal modes** to cover functions such as baud rate and modem control requirements. Much of the complexity of getting a particular terminal or printer to function with your system involves simply telling UNIX the correct modes for that serial device. There is no substitute for learning how to use the **stty** command.

There are many ways in UNIX of controlling the function and interface to serial devices. While we will cover many of them in this manual the only way to get the most out of your PC AT UNIX system is to get your hands on a good book describing data communications over the RS232 standard and to read and reread your UNIX manuals. Bell Technologies Press sells excellent books that cover many important topics in RS-232 communications: "The RS-232 Solution" is highly recommended. In addition, our Kermit communications products include a text on Kermit that covers RS-232 topics in detail.

5. Attaching a Login to a Serial Port - In Xenix

This section focuses on Xenix serial port administration. UNIX System V serial port administration is covered in a number of standard books on UNIX System V available through Bell Technologies Press. Xenix follows UNIX Version 7 traditions in the administration of serial ports. Since the recent crop of UNIX books tends to be aimed more at System V, we have included this section to make life easier for our users.

When the Xenix kernel goes multiuser, "login" processes are fired off to serial ports depending on the information in the **/etc/ttys** file. This file contains a list of all valid tty devices and what is to be done with them. The first few lines look like:

```
16tty00
06tty01
06tty02
16ttyia
06ttyib
.
.
.
```

The first digit is either a **1** or a **0**. A **1** indicates that the tty device is to be opened for logging in. The second digit refers to what speed and type of device should be assumed if the line is to be opened for logging in. A **6** corresponds to some initialization parameters in /etc/gettydefs one of which is 9600 baud. The function of this numerical code can be discovered by looking at the contents of the **/etc/gettydefs** file. Type out the contents of this file with the following command:

```
cat /etc/gettydefs
```

The second digit codes used in **/etc/ttys** and defined in **/etc/gettydefs** are historically derived. In a rather facinating twist, IBM actually includes hardware/software support for horribly obsolete AT&T and DEC equipment.

For quick reference, the second digit codes are:

- *110 baud. Intended for an ASR-33 console; for example, an operator's console.*

0 *150 baud for an ASR-37 console.*

1 *Cycles through 300-150-110-1200 baud. Useful for dialup lines using obsolete equipment.*

2 *300 baud console DECwriter.*

3 *Cycles through 1200-300-150-110 baud. Recommended for dialup lines.*

4 *2400 baud.*

5 *4800 baud.*

6 *9600 baud.*

7 *9600 baud for IBM 3101 terminal.*

Simply poking a **1** in front of the desired tty entry is usually adequate when working with most terminals. It also usually works when working with modems. For security reasons we strongly recommend you take a moment to learn how to use the "modem control" devices provided in the ICC driver.

Should you wish to operate at speeds higher than 9600 baud, simply edit the **gettydefs** file to define a getty code number (8, 9, etc) for faster speeds, such as 19200 and 38400 baud.

6. Modem Control Devices

These devices are invoked by referring to the desired ICC using an upper case letter in the tty name. The bottom port on the first ICC installed, for example, would be referred to as **ttyiA** if modem controls were desired. The modem control devices are listed in the **/etc/ttys** file after the 24 entries for the non-modem control devices. It is a mistake to simultaneously turn on both a modem control and a non-modem control device for login.

To turn on a login to one of the ICC ports in modem control mode, use the same procedure you would use in Xenix or UNIX to turn on a login but refer to the ICC tty device using an uppercase letter. For example, in Xenix we turn on the bottom port of the first ICC *without* modem controls with this command:

enable ttyia

With modem controls the command would be:

enable ttyiA

(In UNIX, to get the modem control device instead of the non-modem control device, likewise substitute "ttyiA" for "ttyia" in the examples in the "Getting Going" sections for UNIX.)

Connect the modem to the ICC using either Bell's modem modular adaptor, or using Bell's terminal adaptor with an eight wire null modem between the terminal adaptor and the modem. Note that for most modems you will have to change the default port speed of 9600 baud to 2400 or 1200 baud.

We strongly urge you to get the appropriate Bell modular adaptor for each piece of serial equipment you use. You can then permanently affix the adaptor to the serial item and be free forever from having to worry which item needs male plugs, which uses female, which gadget wants a null modem cable, and which uses a straight through cable.

By using the modem control device when running a login out to a dialup modem, you protect your system from unauthorized logins. If a user is accidentally or deliberately disconnected prior to logging out, the session will automatically be terminated by UNIX. In contrast, if you connect a modem up to a non-modem control device, accidental disconnects can leave a live user login (maybe even with superuser status!) outbound on the modem. The next person to dial in will find himself logged in exactly as the last user was logged in.

7. Some Guidelines for Attaching Common Devices

The following sections provide some notes on attaching commonly occuring devices to the ICC.

7.1 Attaching the Bell Technologies Intelligent Power Supply

By default, the Bell IPS systems software utilizes a serial tty device associated with our HUB6 multiport product. To adapt the IPS software for use with ICC two files need to be edited, the **/etc/default/pwrdemon** file and the **/etc/rc** file.

Edit the **/etc/default/pwrdemon** file so that the line which says "DEVICE=/dev/tty4F" says "DEVICE=/dev/ttyiF".

The ICC software modifies the **/etc/rc** file to add a command to upload runtime software into the ICC card via the DLOAD command. If your IPS software was installed first, you must move the IPS initializing command line to a position in the **/etc/rc** file after the ICC DLOAD command line. In addition, since the DLOAD process takes a few seconds, you must insert a "sleep 30" command between the ICC initialization command line and the IPS initialization command. This is easy to do.

____ Edit the **/etc/rc** file to move the IPS initialization command to the last line in the **/etc/rc** file.

____ Insert the following line just before the IPS initialization command line:

sleep 30

When you are done, the last two lines in your **/etc/rc** file will be the following (in IBM Xenix, for example):

```
sleep 30
/etc/pwrdemon < /dev/console > /dev/console 2>&1
```

This procedure utilizes ICC port **ttyiF**, the uppermost port in the first card, for interfacing with the Intelligent power supply. Installation is simple: plug in the IPS adaptor to the power supply unit, and then install the supplied modular cable between the IPS and the **F** port of the ICC. **When the ICC is used for an IPS connection, ttyif MUST NOT be enabled for login.**

7.2 Attaching a Hayes Modem

Use the Bell Technologies modem adaptor part or utilize the standard terminal adaptor plus a null modem.

7.3 Attaching an NEC 3515 Printer

UNIX is not especially well set up for running serial printers. Beware of the special **stty** modes which must be used for any given printers. The pinout for the Bell Technologies NEC3500 series adaptor is given in the section of this manual on Connector Pinouts.

7.4 Connecting One System To Another via the ICC

The simplest way is to use a standard terminal adaptor plugged through a gender bender into a standard modem adaptor.

8. Connector Pinouts

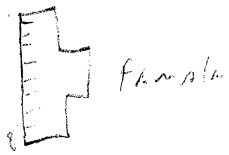
The following tables show the pinouts from the ICC modular jacks as well as the internal wiring inside the standard range of Bell Technologies adaptors. You may wire your own adaptors by ordering the "kit" series of Bell Technologies Modular to DB25 adaptors. The adaptor kits are shipped unassembled so that the connections from the Modular jack may be made to any DB25 pins desired. Adaptor kits are available in Male or Female DB25 connectors.

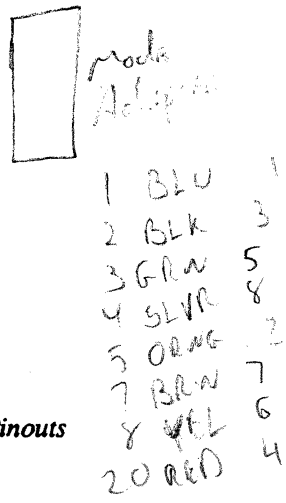
In the following diagrams, the "<----->" symbol indicates a connection between the two pins. For example, in the Standard Terminal Adaptor, ICC Modular Jack Pin number 3 is connected to pin number 3 in the DB25 connector. The labels on each of the pins ("TXD", "RXD") are provided for your convenience and represent the standard RS-232 nomenclature usually used.

ICC Modular Jack	
1	SHIELD
2	CTS
3	TXD
4	DTR
5	RXD
6	DCD
7	GND
8	RTS

TABLE 7. Connector Pinout: ICC Modular Jack

Note: Pin 1 is uppermost when viewing connector from outside of the PC AT.





Standard Terminal Adaptor				
ICC Pins			DB-25 Pins	
SHIELD	1	<----->	1	SHIELD
CTS	2	<----->	4	RTS
TXD	3	<----->	3	RXD
DTR	4	<----->	8	DCD
RXD	5	<----->	2	TXD
DCD	6	<----->	20	DTR
GND	7	<----->	7	GND
RTS	8	<----->	5	CTS

TABLE 8. Internal Connections, Standard Terminal Adaptor

Standard Modem Adaptor				
ICC Pins			DB-25 Pins	
SHIELD	1	<----->	1	SHIELD
CTS	2	<----->	5	CTS
TXD	3	<----->	2	TXD
DTR	4	<----->	20	DTR
RXD	5	<----->	3	RXD
DCD	6	<----->	8	DCD
GND	7	<----->	7	GND
RTS	8	<----->	4	RTS

TABLE 9. Internal Connections, Standard Modem Adaptor

8-Wire NEC 3500R Adaptor					
ICC Pins			DB-25 Pins		
SHIELD	1	<----->	1	SHIELD	
CTS	2				
TXD	3	<----->	3	RXD	
DTR	4	<----->	8	DCD	
RXD	5	<----->	2	TXD	
DCD	6	<----->	20	DTR	
GND	7	<----->	7	GND	
RTS	8	<----->	6	DSR	
			4	RTS wired to 5	CTS

TABLE 10. Internal Connections, 8-Wire NEC 3500R Adaptor

9. Advanced Use of the ICC

[Editor's Note: This preliminary version of the ICC manual does not include the full text planned for this section. The preliminary version only includes information on DIP Switch position settings. An extensive OEM manual is underway. Please contact your Bell Technologies marketing representative for availability of advance OEM information.]

9.1 DIP Switch Functions - Preliminary Information

The following, brief, sections identify the function of each of the DIP switches on board. **Note:** In the sections that follow, turning a switch in the DIP switch array to the "ON" position means you are setting a logical value to that bit of "0". While this is exactly opposite of how most people reckon, it is the standard view of the universe among hardware engineers.

9.1.1 DIP Switch 1 (Leftmost): DMA Select and Base RAM Address

The leftmost DIP switch array is used to set DMA level and base address for the on-board ICC RAM. Bit definitions are as follows ("ON" = "0"):

Switch 1 (Leftmost) DMA and Base Address (ON = Logical 0)								
Switch:	S1	S2	S3	S4	S5	S6	S7	S8
Meaning:	DMA 02	DMA 01	DMA 00	A23	A22	A21	A20	A19

TABLE 11. Selecting DMA and Base Address: Switch 1 Bit Assignments

The first three switches (DMA 02-00) form a binary number that identifies which DMA level used by the ICC board to access AT main memory under ICC control. The three bits allow selection of the binary numbers 001, 010, 011, and 100 and above for DMA channel values of 1, 2, 3, 4 and above. Numbers at 4 and above mean DMA under ICC control is not selected. The default setting is "100" which is binary for "4". Selecting a value of 4 means DMA from the ICC into the AT under ICC control is unused. Currently, DMA is used only from the AT into the ICC and not from the ICC into the AT, so this feature is unused in the standard asynchronous driver.

The remaining bits in Switch 1 set the base address used for the ICC dual-ported memory in the 16MB AT memory map. Any AT bus memory access that falls within the 1/2 MB range commencing at the base address defined by these switches will result in a memory access to the appropriate position in the ICC memory. The default setting is 11110 which positions the ICC memory to occupy the range F0,0000 through F7,FFFF hexadecimal.

9.1.2 DIP Switch 2 (Center): I/O Address Location

The ICC requires 4 I/O addresses for control. This switch sets the base address occupied by the 4 I/O bytes. Each ICC board in a multi-board system should be set to occupy a different I/O address range to prevent collisions. Bit values are as follows ("ON" = "0"):

Switch 2 (Center) I/O Address (ON = Logical 0)								
Switch:	S1	S2	S3	S4	S5	S6	S7	S8
Bit:	A9	A8	A7	A6	A5	A4	A3	A2

TABLE 12. Selecting I/O Address: Switch 2 Bit Assignments

Any I/O access made on the AT bus that falls within the four bytes defined by this switch will result in an I/O access to the ICC board, with which of the four bytes accessed depending on your values of A1 and A0 used in the memory reference. The default setting is 11000010 which sets the ICC I/O address to 308 through 30B. The second card setting is 11000011 to select 30C through 30F. The third card setting is 11000100 for a range of 310 through 313, and the fourth card setting is 11000101 for a selection of 314 through 317. [ICC locations given in hexadecimal].

9.1.3 DIP Switch 3 (Rightmost): Interrupt Select

This switch array selects 1 of 10 possible interrupt levels for the ICC to use. **Only one** of these switches may be "ON" (that is, selected). Turning a switch "ON" selects the corresponding interrupt. The following bit definitions apply:

Switch 3 (Rightmost) Interrupt Selects (ON = Selected)										
Switch:	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Interrupt:	3	4	5	6	7	9	10	11	14	15

TABLE 13. Selecting Interrupt: Switch 3 Bit Assignments

The default setting is for switch position 7 to be on (Interrupt level 10) and all others to be off. Only one of these switches may be "ON"; all of the others **must** be "OFF."

10. Troubleshooting

Please read through this entire section before attempting any troubleshooting.

This section will help you eliminate common errors encountered in using the ICC. The vast majority of technical support calls involve simple mistakes in installation, cabeling, or administering your operating system. Keep in mind that it is very easy in UNIX or Xenix for even very experienced users to make simple errors. Other points of confusion arise when more than one person has worked on an installation and there is no clear, complete statement of what was installed, when, where and how.

Certain classes of uses (uucp, and other communications protocols, for example) are notoriously difficult to use. There is no substitute for acquiring the basic UNIX skills needed to manage these very complex packages.

10.1 Some Safety Measures

Many users and computer dealers have adopted a very casual attitude towards working with computer systems hardware because of the low voltages that are used in modern desktop systems. Nonetheless, we reccommend you observe a few elementary precautions to protect yourself and your equipment. Our service personnel observe the following:

1) **Always** turn off power to your system before removing or installing any components or expansion boards.

2) **Do NOT** attempt to reset dip switches, plug or unplug cables, or otherwise adjust the configuration of your system while it is turned on.

3) Nearly all computer systems components are static sensitive. **Ground** yourself by touching a grounded part of your system (such as the metal case on the power supply when the system's cover is removed) before handling any component. Better still, work at a grounded lab table with a ground strap attached to your wrist.

4) For further safety, **REMOVE THE POWER CORD** before opening up your system.

Note: working with the ICC is very simple: the above are guidelines we find useful in working with most desktop systems.

10.2 Before You Call Technical Support

While we encourage you to call us with your problems, it is often far quicker and easier to resolve the problem on the spot. Make sure you check on the relevant sections in this manual and in your UNIX or Xenix manual. Consult the index for possibly helpful sections. Run down the individual checklists in this Troubleshooting section.

If you decide to call Technical Support, make sure you have the information at hand they will need to help you. Very often simply stating the problem in a comprehensive way reveals a simple mistake. The information needed to state the problem in a comprehensive way will also be needed by our Technical Support staff. Try to assemble as much as possible of the following information, writing down as much as you can:

____ What computer hardware are you using? Include **every** hardware component utilized with your system, including every card plugged in, all disk drives, monitors, terminals, and so on. Include all Revision levels and model numbers.

____ What, exactly, are the cables and connections being used between the serial devices in your installation? Write down the pin-outs and the signal names from the user manuals for each of the serial devices you are using. Draw a diagram that shows how the pins from your PC AT serial ports (IBM or ICC) are connected to your other serial devices. All "serial ports" are not alike.

____ What software are you using? Write down the name of the operating system and the release level. If you are using a base ("Runtime") operating system plus a Development Tools option, you will need to know the revision level of each. Some operating systems have issued Runtime release and Development Systems which are incompatible. You will need to make a note of **any** systems software that has been installed, whether or not the component involved is still in the system. The most accurate information is usually found in the boot up banners displayed by your software when your system boots up.

While the above information may seem like a lot, our customers tell us that just getting it together frequently solves the problem.

10.3 Basic ICC Troubleshooting

There are four basic checkpoints to determine what level of problem you are confronting. We discuss these four checkpoints in detail in the following troubleshooting sections. Following is a summary of the checkpoints

1) The display is completely blank when the machine is turned on.

2) The AT completes self-test (memory count-up, etc), but attempting to boot the operating system causes the system to hang indefinitely.

3) The AT boots UNIX, but no ICC boot-up sequence announcement banner is visible, and the ICC does not work.

4)

The AT boots UNIX, a ICC announcement banner *is* visible, but the ICC or some ICC ports do not function correctly.

10.3.1 Blank Display When AT is Turned On

Use the following troubleshooting procedure:

____ Check that the video monitor is fully plugged in and turned on.

____ Turn the AT off.

____ Remove the ICC.

____ Turn the AT on: If the display remains blank with the ICC removed, then you have non-ICC problems with your AT. Check the following:

- ____ Video display adaptor is firmly seated.
- ____ Monitor cable is connected to correct display adaptor
- ____ Correct DIP switches and adaptor type are selected on adaptor and on (some) motherboard.
- ____ Monitor power is on. Intensity and contrast are turned up.
- ____ Fan on AT is running. If the fan is not running, immediately turn power OFF and procede to your system vendor's troubleshooting procedure.

____ If the monitor displays the normal self-test (memory count up, etc) **only** when the ICC is **not** installed, try the following:

- ____ Install the ICC in a different expansion slot. If the system now works correctly, assume that the expansion slot connector first used is defective or that the ICC was not seated properly.
- ____ If the monitor display is still blank, do the following:
  - ____ Remove all boards except the video adaptor, ICC, and disk controller.
  - ____ If the system now comes up OK, there is probably a conflict between the ICC and some other expansion card. Install the boards that were working one at a time to determine the culprit.

10.3.2 System Self-Tests, But Hangs When Attempting Boot

NOTE: This section assumes that the ICC software was installed using the STANDARD

INSTALL PROCEDURE and thereafter the operating system has not successfully booted. This section does not pertain to UNIX V.3.

If the AT self-tests correctly (memory count, etc), but hangs when attempting to boot the UNIX or Xenix operating system from the "boot" prompt, the most likely problem is that a "bad" UNIX or Xenix image was created during installation. There are many reasons why a "bad" image might be created, the most likely being a corrupt filesystem or files existing on the system prior to beginning installation. If this is the problem, it is easy to verify. Before we proceed, a note on how UNIX and Xenix boot.

When the boot prompt comes up, if you hit <ENTER> to proceed in the default way, the boot program reaches out into the root partition of your hard disk and tries to find a program called **unix** (in the case of UNIX) or **xenix** (in the case of Xenix) located at the root of the file system. ICC installation software automatically makes a copy of your original **unix** or **xenix** program under the name **unix-** or **xenix-**. If for any reason the new kernel program has come out "bad" you can reboot your system by using the backup copy of the old kernel. You can then copy the old kernel back to its original name of **unix** or **xenix** and retry the installation. Do this as follows:

To copy the old kernel back to its original name do the following:

____ **IBM Xenix Users:** Reboot the AT by turning it off and then on. At the boot prompt, do **not** hit <ENTER>. Instead type in **hd xenix- <ENTER>**. This will boot the backup copy of the old kernel.

____ **SCO Xenix Users:** Reboot the AT by turning it off and then on. At the boot prompt, do **not** hit <ENTER>. Instead type in **hd(40,0)xenix- <ENTER>**. This will boot the backup copy of the old kernel.

____ **Microport Users:** Insert the Microport installation floppy diskette into the floppy drive. Turn the AT off and then on to boot the floppy. Type the following commands:

```
mount /dev/dsk/0s0 /mnt
ln /mnt/unix /mnt/unix.bad
ln /mnt/unix- /mnt/unix
ln /mnt/unix- /mnt/system5
umount /dev/dsk/0s0
```

____ Reboot the system by typing the command **uadmin 2 0** (Remove the floppy disk so you can boot up off of the hard disk). This enables you to boot off the backup copy of the old unix.

____ If your system still does not boot all the way, you may have damaged system files or even a hardware problem. If this is the case you may want to reinstall the operating system or try to boot the hard disk on another AT.

____ Once you are up on the old kernel, here are some things to check:

____ **Xenix Users:** The file size of **/xenix** or of should be greater than that of **/xenix-**. You can get the file size by typing **ls -l /xenix**, for example.

____

Likewise, the creation date (as given by a **ls -l** command) of **/xenix** should be later than that of **/xenix-**.

____ If everything in the file system appears to be correct, you may want to try reinstalling your UNIX or Xenix system from floppy diskette. Some of your system files may have been damaged during the original installation of your operating system, or may have been damaged during the operation of your system. Defective distribution media for the operating system is also a possibility, albeit not a likely one.

10.3.3 System Boots Up, but No ICC Startup Banner

If the operating system starts up after the boot phase *without* displaying a ICC boot up sequence announcement (ie, when UNIX or Xenix boots, does a message like "ICC (Sys V) v1.0 (c) 1987 Bell Technologies" appear?), the ICC software has not correctly been installed in the active kernel.

There may have been error messages during installation that were not noted. You may have copied out the UNIX or Xenix kernel that included ICC software. You may have restored the UNIX or Xenix kernel from a backup that was made before the ICC software was installed. You may have installed some alien systems software after installing your ICC, only to have the alien software wipe out previously installed device drivers. Repeat the ICC software installation.

10.3.4 ICC Announcement Banner OK, but ICC Doesn't Work

If you have a ICC correctly installed, the ICC boot up sequence announcment banner should report something like "Card 0 Installed" after displaying the revision number of ICC software and copyright information.

____ Does the announcement banner report finding a ICC in the form "Card 0 Installed?" (In multi-card installations, each card should be found).

If it does not find a card you have installed, check the DIP switches on the card. Base address or card id switches may be set wrong.

____ If the problem persists, try moving the card to a different slot.

____ If the problem still persists, simplify your system to just the display adaptor, disk controller and ICC. If the problem goes away, plug in any cards removed one by one to find out which one is causing trouble.

If the ICC announcement banner comes up during boot time and the card is found, the systems software and major ICC hardware systems are almost certainly functional. It is easy to see if the port hardware is operating correctly, since it is almost inconceivably unlikely that the hardware paths beyond the major ICC CPU/RAM systems through all six ports are malfunctioning simultaneously.

____

If none of the ports work, it is most likely you are making a systemic mistake of some sorts, such as setting up logins incorrectly or some other very general error:

____ Check the contents of the **/etc/ttys** file (in Xenix) and **/etc/inittab** in Microport and System V. Failing to "turn on" a port is an extremely common error. Reboot the system to make sure any changes in port information are known to all system programs. Check the baud rates assigned to the ports in the ttys or innittab file. Make sure you are using the right **ttyi?** device and that you are correctly counting or naming the ICC ports (ttyia is the *bottom* port, for example).

____ Use the **ps** command as super-user to see if there is a **getty** process tending the port. Read the documentation for **ps** in your manual. If there is no **getty** tending the ICC port, you have not set up your UNIX system administration files correctly. Microport users should check their System Vision settings and Xenix users should make sure that they have **enabled** the right port.

____ If you are using Microport and are trying to run with more than two logins, have you made sure to install your unlimited user license upgrade?

____ Check the obvious things: try a different interface cable. Try a different adaptor. Use a different terminal, modem, or printer if one is available.

____ Check the baud rate settings of the serial device you are trying to employ. Inversions (ie, reading stuff or pressing down switches backwards) of DIP style switch settings is an extremely common error. Check settings of parity bits and other options.

____ Try a 3 wire connection with and without a null modem in between the ICC and the target device. Remember that if you are connecting an AT to another AT by connecting a ICC directly to another ICC, you need a null modem in between.

____ If you are having trouble with one port, try the same procedure on **all of the other** five ports. (Make sure to try a different cable or adaptor).

____ If the problem is restricted to a single port, please call Technical Support.

10.4 Common Serial Hardware Interface Problems

There is an extremely wide range of common problems associated with getting RS-232 devices to talk to each other. A good book like "The RS-232 Solution" together with a simple LED break-out box for tracing signals is a tremendous benefit. It is also very handy to have a set of male-male, female-female, male-female ("gender benders") and null modem adaptors when troubleshooting RS-232 connections. The following comments will help you in getting modems to run as well.

____ If you cannot get a terminal to function with the ICC, but you know the ICC is functioning OK:

_____ en your terminal's user manual and locate the pin-out information for serial connector. Make sure you are using the main serial port nnector on the terminal and not some "Auxiliary" or "Printer" port which might also be provided on the terminal.

_____ Double check the baud rate setting for your terminal. Check to see what "modes" your terminal is in. Check to see if your terminal is locked up in some funny setup or block transfer mode.

_____ Try a simple three wire connection from the ICC to the terminal.

_____ Do not use a "modem control" tty device. If the problem goes away when you do not use a modem control device, suspect a problem in cables, wiring, or RS-232 protocol handling. If you *must* use the modem control device in these circumstances, buy "The RS-232 Solution" and commence tracking down the wiring needed for your device.

_____ Double check the baud rates set up by your operating system for the port.

_____ Has your port been turned on? Use the **enable** command in Xenix, and double check the System Vision settings in Microport. Try rebooting the system to make sure any changes made can take effect.

_____ Use the **ps** command as super-user to see if there is a **getty** process tending the port. Read the documentation for **ps** in your manual. If there is no **getty** tending the ICC port, you have not set up your UNIX system administration files correctly.

_____ Try using a null modem adaptor, or a null modem. It is amazing how many problems go away when a null modem is inserted. If you do not know what a null modem is, read the section of this manual on serial devices and UNIX.

11. Customer Service Procedures

If you have any problems following the directions in this manual, our customer service staff is available to you. Please be prepared to describe the problem in detail to our staff. Our customer services exist to help you resolve problems with the equipment we sell.

As much as we would like to help you with other problems, we cannot teach you to use your computer or its operating system. To avoid the need to spend time discussing procedures that are outlined in this manual, please review the entire manual before calling us.

If you have a question or are unclear about the installation or operation of your ICC, please call us at:

1 (415) 659-9097 and ask for Customer Service.

Service hours are between the hours of 9 a.m. and 5 p.m. Pacific Standard Time. If our lines are busy, please keep trying. It is possible that when you call, all of our customer service representatives may be unavailable. If you leave your name and number your call will be returned in sequence within a short period of time.

11.1 Missing or Damaged Components

If you have determined that you are missing some of the components from your ICC or that some of your components have been damaged, please call our customer service number. Tell our representative about the missing or damaged components. We will do what we can to quickly replace the missing component or to help you resolve the damage problem.

11.2 Warranty Service

Our warranty repair procedures are available for units which have been registered using the warranty registration card enclosed with your ICC and which have malfunctioned during the warranty period. If you have determined that your unit is not functioning correctly and must be returned for repair, please follow these procedures:

____ Have the serial number of the unit and the date of purchase available. The serial number is on the top edge of ICC.

____ Call our customer service representatives at:

1 (415) 659-9097

____ Tell them your unit is not functioning and you wish to return it for warranty repair. Please be ready to discuss the problem.

____ You will be given an RMA number (Returned Material Authorization). UNITS WILL NOT BE ACCEPTED FOR REPAIR WITHOUT THIS NUMBER.

____ After receiving your RMA number, package the unit in its original container. Please include all components which may be malfunctioning (you should not include manuals or diskettes). If your customer service staff has instructed you to include just a specific component, you need only include that component.

____ Include your name, complete SHIPPING address and your phone number in the package. Also include a written description of the problem with any printouts or other items that might help us find the problem. If we do not have your warranty registration card on file you must enclose a copy of your invoice.

____ Ship the unit to the Bell Technologies service location provided to you along with the RMA number by your customer service representative. Include "Attention Warranty Repair" and your RMA number in the lower left corner of the package. Your RMA number MUST be visible or our receiving group will refuse the package.

____ We suggest you ship the unit UPS Blue Label or, if time is of the essence, Federal Express. Please make sure you insure your package.

Your unit will be repaired or replaced at the discretion of Bell Technologies and returned to you promptly. We will ship the unit pre-paid via UPS or similar service to anywhere within the continental USA. If for some reason you need the unit more rapidly, we will ship Federal Express or similar service if you provide us with your account number. We will not prepay Federal Express or any other accelerated shipping charges.

12. One Year Warranty Policy

Bell Technologies Incorporated ("Bell") warrants to the original purchaser that each of its hardware products, and all components thereof, will be free from defects in materials and/or workmanship for one year from the date of purchase. Any warranty hereunder is extended only to the original consumer purchaser and is not assignable.

In the event of a malfunction or other indication of failure attributable directly to faulty workmanship and/or materials, Bell will, at its option, repair or replace the defective products or components, to whatever extent it shall deem necessary to restore the product or component to proper operating condition, provided the consumer purchaser sends with the defective product proof of the date of purchase of the product. Please note that Bell may replace the defective product with a new or remanufactured functionally equivalent product of equal value, at the option of Bell. Before returning a product for repair, the customer must call Bell Technologies customer service at 1-(415)-659-9097 for a Returned Material Authorization (RMA) number. This number should be included with the customer's mailing address and telephone number when the product is returned.

During the first year after the date of purchase, all labor and materials will be provided without charge. There shall be no warranty for either parts or labor after the expiration of one year from the date of purchase. This warranty does not apply to damage which occurs while the product is in transit between Bell and the customer site. This warranty does not apply to units which have been mishandled, dropped, or used in any way not in accordance with the purposes outlined in this manual. This warranty does not apply to intentional or unintentional damage occurring to the product or to the equipment in which it is installed by any outside cause. This warranty does not apply to damage resulting from faulty operation of other components installed in the same chassis as the product.

Units must be returned to Bell in the original shipping carton with all protective shipping materials properly installed. If the original shipping container is not available, Bell will provide a replacement for a nominal charge. This warranty will be voided for units received in unauthorized containers. Units must be returned postage or shipping prepaid. It is recommended that the unit be insured when shipped. Units returned without proof of date of purchase or out-of-warranty units will be repaired or replaced at the option of Bell Technologies and the customer will be charged for parts and labor. By returning any unit to Bell for repair, customer grants Bell a security interest in the unit for unpaid parts, labor, and shipping charges.

Products will be returned to the customer after repair or replacement has been completed by carrier and method chosen by Bell to any destination within the continental U.S.A. If the customer desires other conveyance or is located beyond the borders of the continental U.S.A., the customer must bear the cost of return shipment. This warranty is contingent upon proper use of the product. This warranty will not apply if adjustment, repair or parts replacement is required because of alteration, accident, unusual physical, electrical or electro-mechanical stress, neglect, misuse, failure of electric power, air conditioning, humidity control, transportation, or operation with media not meeting or not maintained in accordance with Bell specifications.

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