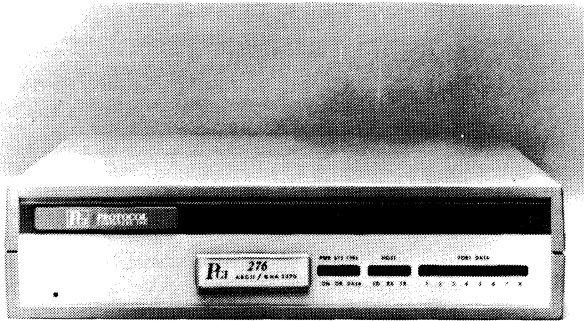# Protocol Computers, Inc.
Protocol Converters

PCI's Series 200 products are offered as program packs that slide into a space on an enclosure. The piece marked 276 in the above photograph pulls out of the unit and may be replaced with another Series 200 converter pack. All of the converters offer network management capabilities and security features.

MANAGEMENT SUMMARY

UPDATE: *This report has been updated to include additions to Protocol Computers' product line. The company has revamped the X.25 Series product line by repackaging the 1076X, 73SX, and R73SX units into the SmartNet 1000 Series 1100, 1200, and 1300 units, respectively. A new SmartNet Series 2000 line includes the 2500 asynchronous PAD, the 2600 switching PAD, and the 2700 packet switch. (The packet switch is not given detailed coverage in this report.)*

Protocol Computers, Inc. (PCI), one of the original companies to specialize in protocol conversion technology, offers one of the broadest ranges of conversion products available from one vendor. PCI offers a number of different approaches to conversion. Some of its products are traditional "black box" units, while others, the new Series 200 units for example, are program packs that slide into a slot on a basic enclosure. The new SmartNet Series 2000 X.25 PADs operate via a network management and control package.

The company offered its first converter, the PCI 1067, in 1980—well before most other vendors introduced conversion products. The converter allowed inexpensive ASCII terminals to emulate IBM 3767s in an SNA/SDLC environment. The company's second offering, the PCI 1076, put PCI in a leading market position because the device gave customers the type of conversion they most desired—ASCII to 3270. As the data communications market grew, and protocol conversion became more accepted as a viable means to use inexpensive asynchronous devices in an IBM environment, PCI continued to expand its product line to include not only ASCII-to-SDLC converters, but also units that allow ASCII-to-BSC conversion, BSC-to-SDLC conversion, and access to X.25 public networks. In 1984, PCI introduced the Series 100 versions of its converters. These units, which in effect replace the Series 1000 units, offer the same conversion capabilities that were available on the older devices, but at a lower price. PCI's newer converters, the Series 200, offer a number of extra features, such as ▷

Protocol Computers, Inc. offers a broad line of protocol converters, including devices that handle asynchronous ASCII-to-SDLC, asynchronous ASCII-to-BSC, BSC-to-SDLC, and X.25 conversions.

MODELS: Series 100, which includes 151, 167, 176, 171; Series 200, which includes 276, 271, 251; 71B/SNA, 75B/SNA, 3780/SNA; SmartNet Series 1000, which includes the 1100 (formerly 1076X), 1200 (formerly 73SX), 1300 (formerly R73SX); and the SmartNet Series 2000, which includes the 2500 asynchronous PAD, 2600 switching PAD, and the 2700 packet switch.
CONVERSION: 151, 167, 176, 251, 276—ASCII-to-SDLC; 171, 271—ASCII-to-BSC; 71B/SNA, 75B/SNA, and 3780/SNA—BSC-to-SDLC; SmartNet Series 1000—ASCII-to-SDLC through X.25; SmartNet Series 2000—asynchronous to X.25.
TRANSMISSION RATES: Up to 9600 bps, on both the terminal side and the host side for all models except those in Series 200, which transmit up to 19.2K bps on both host and terminal sides, and the SmartNet 1000 Series, which transmit up to 9600 bps on the X.25 side and up to 1200 bps on each terminal line. The 2500 and 2600 PADs each support one 64K bps X.25 link.
COMPETITION: In the protocol converter market: Micom Systems, Icot, Datastream, Local Data, IBM. In the PAD market: Memotec, General DataComm, Dynapac, and Datagram.
PRICE: Ranges from $1,650 for a basic Series 1000 unit to $9,950 for a 32-port 271.

CHARACTERISTICS

▷ network management capabilities and security, that are generally not available on protocol converters. During 1986, PCI has concentrated its major efforts on X.25 networking products. It has repackaged the 1076X, 73SX, and R73SX X.25 Series units and given them a new name, the SmartNet Series 1000, and new model numbers. The 1076X is now the Model 1100; the 73SX is the Model 1200; and the R73SX is the Model 1300. The SmartNet Series 2000 units represented PCI's new-product introduction. The line includes the 2500 asynchronous PAD, the 2600 switching PAD, and the 2700 packet switch.

PCI sells its products through direct sales and has strong commitments toward increasing revenues by selling more strongly to distributors and OEMs. According to PCI's *1984 Annual Report*, in 1983 the company derived 31 percent of its revenues from direct sales to end users. Realizing that a larger sales volume was needed to place PCI on sounder financial footing, the company sought and entered into OEM and private-label marketing agreements with several data communications companies. In fiscal 1984, 82 percent of total revenues came from sales to OEMs and distributors. During the same time period, PCI increased investment in research and development by 179 percent over the previous year. This was done to maintain PCI's leading market position, which has been threatened recently by price erosions and stiffer competition in the conversion marketplace.

PCI offers a wide number of units, which we have classified according to the type of conversion offered on each device. These conversions and corresponding products are as follows:

- Asynchronous ASCII to SDLC—PCI 151, 167, 176, 251, and 276.

- Asynchronous ASCII to BSC—171, 271.

- BSC to SDLC—PCI 71B/SNA, 75B/SNA, and 3780/SNA.

- X.25 conversion—SmartNet Series 1000 Models 1100 and 1200 (convert ASCII-to-SDLC and links SDLC host to X.25 node), and Model 1300 (ASCII-to-SDLC and SDLC- to-SDLC through X.25).

- Asynchronous to X.25—Smartnet Series 2000.

The PCI 151 is designed for use in a System 34 or 38 terminal network. The converter attaches either remotely or directly to a System 34 or 38 and replaces an IBM 5251-12 controller. Up to seven ASCII displays and printers can be attached through the PCI 151/1051 and appear to the System 34 or 38 as 5251-11 CRTs with Model 5256 printers attached.

The PCI 167 is an alternative to IBM's Network Terminal Operator (NTO) software. It emulates the 3767 controller and provides all NTO functions, eliminates the need to purchase and maintain software, and frees up processor memory space. With the 167, users can also link special ▷

▶ **SERVICED BY:** Protocol Computers, Inc.

MODELS

In this report, we cover PCI's Series 100, Series 200, SNA Series, Smartnet Series 1000, and Smartnet Series 2000 protocol converters. Each converter in a particular series handles one of five different conversions. The conversions and corresponding models are as follows.

ASCII-to-SDLC Conversion:

- **151**—used with IBM System 34/38; emulates the IBM 5251-12 workstation, allowing any combination of ASCII CRTs and printers to be attached to a System 34/38; one, three, or seven terminal ports are available.

- **167**—provides emulation of the IBM 3767 keyboard/printer terminal (Physical Unit Type 1); permits one, three, five, or seven ASCII devices to appear as 3767s in SNA network.

- **176**—emulates the IBM 3276 controller; one, three, five, or seven ports available; lets any combination of ASCII CRTs or printers appear as IBM 3278/3287 terminals with dial-up access to SNA/SDLC networks.

- **251**—emulates an IBM 5251-12 SNA/SDLC cluster controller for an IBM System 34/36/38; supports eight physical ports and one floating printer logical unit; allows virtually any type of ASCII device to communicate with the IBM System 34/36/38 host, including IBM PCs or compatible personal computers using PCI's "PCIterm" communications software. Available in standalone and rackmount versions.

- **276**—emulates an IBM 3274/76 Physical Unit Type 2 controller; supports up to 32 ports for host-terminal attachment of virtually any type of ASCII device. In addition to protocol conversion, the 276 provides line concentration, protocol enveloping (transparent mode), modem auto callback, automatic logon/logoff, a system password, ASCII graphic terminal support, and host control of DTR to external dial-up modems. Available in standalone and rackmount versions.

ASCII-to-BSC:

- **171**—emulates the IBM 3271; permits ASCII terminals to plug into BSC networks; available with one, three, five, or seven terminal ports.

- **271**—emulates an IBM 3271 controller, supports 8 physical devices and 32 Logical Units; allows virtually any ASCII device to access an IBM BSC network. In addition to protocol conversion, the 271 supports line concentration, modem auto callback, auto logon/logoff, a system password, and ASCII graphics terminals. Devices that otherwise would connect through the IBM Network Terminal Option (NTO) licensed program running on an IBM 3705 or 3725 can communicate through the 271.

BSC-to-SDLC Conversion:

- **71B/SNA**—converts 3271-type controllers to IBM 3274 emulation; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

- **75B/SNA**—converts 3275-type controllers to 3276 emulation; provides up to three terminal ports operating at up to 4800 bps or one terminal port at 9600 bps.

- **3780/SNA**—provides conversion of IBM 3780-type batch terminals to emulation of IBM 3776-2 single logic unit RJE workstations (PU Type 2); supports printers, card ▶

Protocol Computers, Inc.
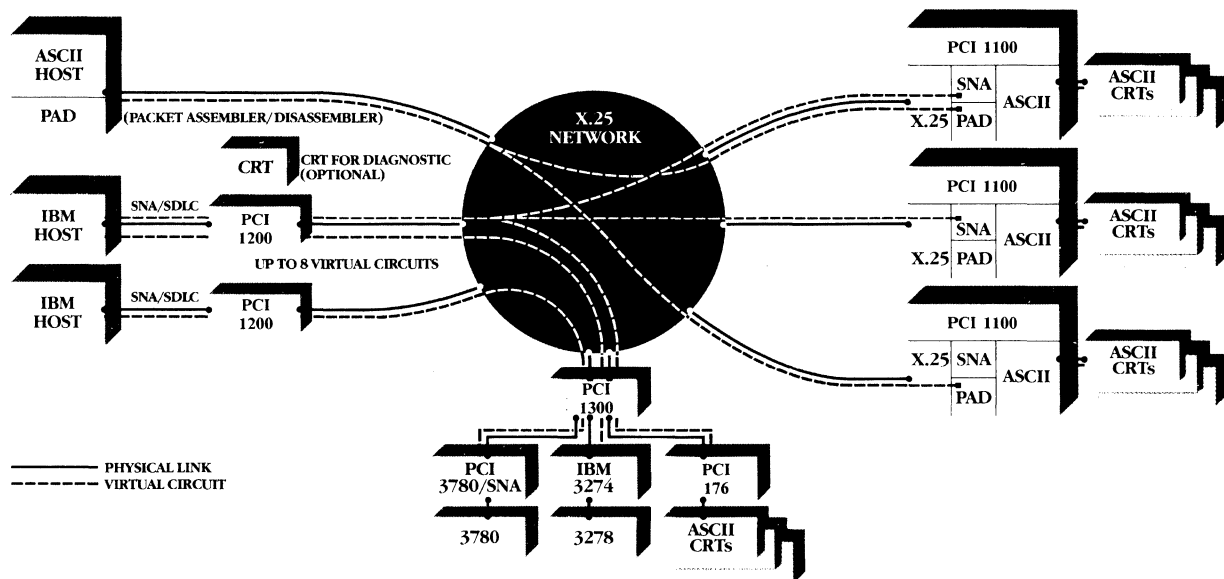## Protocol Converters

Figure 1. Shown here is a sample configuration of PCI's SmartNet Series 1000 converters. The 1100 provides interfacing between the X.25 network and up to seven ASCII devices. The 1200 links the SDLC host to the X.25 network and communicates with up to eight 1100s or 1300s. The 1300 lets up to three attached SDLC cluster controllers communicate with up to three SDLC hosts through the network.

equipment, such as graphics devices, plotters, APL terminals, and processor-control equipment, to the SNA network.

▷Another ASCII-to-SDLC unit, the PCI 176, emulates an IBM 3276 Physical Unit Type 2 control unit. Users can attach any combination of up to seven ASCII CRTs and printers to the 176, which appear to the host as IBM 3278s or 3287s.

Newer members of PCI's ASCII-to-SDLC conversion product line are the 251 and 276. The 251 emulates an IBM 5251-12 SNA/SDLC cluster controller and allows asynchronous ASCII devices to access a System 34/36/38. The unit supports up to 8 physical devices and one floating-point logical unit. For the 251, PCI offers an option that allows users of an IBM PC and the 251 to transfer data files to and from System 34/36/38 computers, and allocate, delete, and rename files on the PC's diskette. The utilities can translate files for format and data compatibility on either the PC or System 3X host. The 276, emulating an IBM 3274/76 SNA/SDLC Physical Unit Type 2 cluster controller, supports 18 concurrent IBM Logical Units and 32 user profiles; control-console functions are supported through a separate ASCII port. An ASCII terminal attached to a PCI 276 can use host applications that support full-screen 3270 devices. Both the 251 and the 276 store configuration information in nonvolatile memory and support protocol enveloping and line concentration in addition to protocol conversion. The units are password protected for security.

PCI's ASCII-to-BSC converters, the PCI 171 and 271, provide IBM 3271 controller emulation, permitting the use of ASCII peripherals in a BSC network. The 171 supports up to seven ASCII devices, allowing them to emulate standard 3270 BSC terminals. It also accommodates a ▷

readers, and card-punch devices; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

ASCII-to-SDLC and SDLC-to-SDLC Conversion through an X.25 Network:

• SmartNet Series 1100 (formerly 1076X)—provides interface between X.25 network and ASCII terminals to any ASCII or SDLC host; supports one, three, five, or seven ports; desktop or rackmount versions available.

• SmartNet Series 1200 (formerly 73SX)—emulates an IBM 3274/76 controller; links an SDLC host to the X.25 node; supports up to eight 1076X or R73SX units, each supporting their own attached devices; desktop or rackmount versions available.

• SmartNet Series 1300 (formerly R73SX)—used with 73SX: lets up to three IBM or equivalent 3274/6-type controllers communicate with SDLC hosts through an X.25 network; creates independent virtual circuits through network to 73SXs at up to three host sites.

Asynchronous-to-X.25:

• SmartNet Series 2500—asynchronous packet assembler/disassembler (PAD) allows asynchronous terminals, microcomputers, and hosts to access public and private packet switched networks; available with 11, 19, and 27 asynchronous ports and one X.25 link.

• SmartNet Series 2600—an asynchronous switching PAD that integrates switching and packet assembly/disassembly functions in one unit; allows for the concurrent attachment of X.25 packet-mode equipment and asynchronous terminal equipment. The unit supports up to 256 logical channels and 2, 3, 4, or 8 X.25 links. The number of asynchronous ports available varies from 8 to 26, depending upon the number of X.25 links operating. For example, a unit with 8 X.25 links supports 8 asynchronous ports, while a unit with 2 X.25 links supports 26 asynchronous ports. ▶

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▷ dynamic printer port. If CRT devices attached to the 171 support a printer port, the unit will support both the printer and the CRT on a single connection. On the host side, the 171 interfaces with a 3705 or 3725 controller. The newer 271 unit provides ASCII-to-BSC protocol conversion, line concentration, and ASCII graphic terminals. Asynchronous terminals attached to the 271 can use host applications that support full-screen 3270 CRTs and printers. Supporting up to 32 ports for terminal attachment, the 271 can be directly or remotely attached to an IBM 3705 or 3725 controller on the host side.

The 151, 167, 176, and 171 models described above are available with one, three, five, or seven ports, and permit the attachment of any combination of ASCII CRTs and printers. A dynamic printer allocation feature on each converter allows an additional printer to be added to the basic configuration. Configuring this port requires that one of the basic ports be selected as its "partner." Whenever the dynamic printer port is active, the keyboard of the terminal attached to the partner port is disabled.

In addition to host-terminal ports, Series 200 converters support a command port through which users can configure user profiles. These units accommodate virtually any ASCII device and offer additional capabilities, such as advanced security features, soft-configuration, and auto speed detection for incoming traffic. The Series 200 converters also feature a dynamic spooling feature for sending output to more than one device through a single port, thus allowing users to have simultaneous access between a personal computer, host and printer, or disk drive during a micro-to-mainframe connection. ▷

▶ Also part of the SmartNet Series 2000 product line is a Model 2700 packet switch that provides data switching between X.25 packet-mode equipment, X.25 host computers, and/or PADs. The device can route traffic between Smartnet Series 1000 and 2000 units and one or more host computers and/or packet data networks. Model 2700 switches can be interconnected to form private data networks.

TRANSMISSION SPECIFICATIONS

On Series 100 units, transmission is asynchronous, full-duplex on the terminal side of the converter, and synchronous, half- or full-duplex on the host side. Each model features one RS-232-C SDLC port (BSC for the 171); one, three, five, or seven RS-232-C ASCII terminal ports; and one dynamic printer allocation port that allows one additional printer to be added to the basic configuration. Whenever the dynamic printer port is active, the keyboard of a selected terminal in the basic configuration is temporarily disabled. All ports accept speeds up to 9600 bps. Most models in the 100 series feature automatic speed detection from 300 to 1200 bps. Connection can be to leased or dial-up facilities, or via direct connection to the host computer. Both IBM and non-IBM modems can be used on the communications link.

All of the Series 200 units support a maximum 19.2K bps transmission on the terminal and host lines. Transmission on the host line is synchronous in half- or full-duplex mode; on the terminal line transmission is asynchronous, and flow control is X-on/X-off. Each 200 converter supports the RS-232-C interface, configurable as DTE or DCE. The units can be used in point-to-point and multipoint configurations. Connections over dial-up lines are through synchronous modems.

The 71B/SNA, 75B/SNA, and 3780/SNA accommodate the following physical connections: one SDLC port at speeds up to 9600 bps and one BSC port at speeds up to 9600 bps, or up to three BSC ports at speeds up to 4800 bps. The units ▶
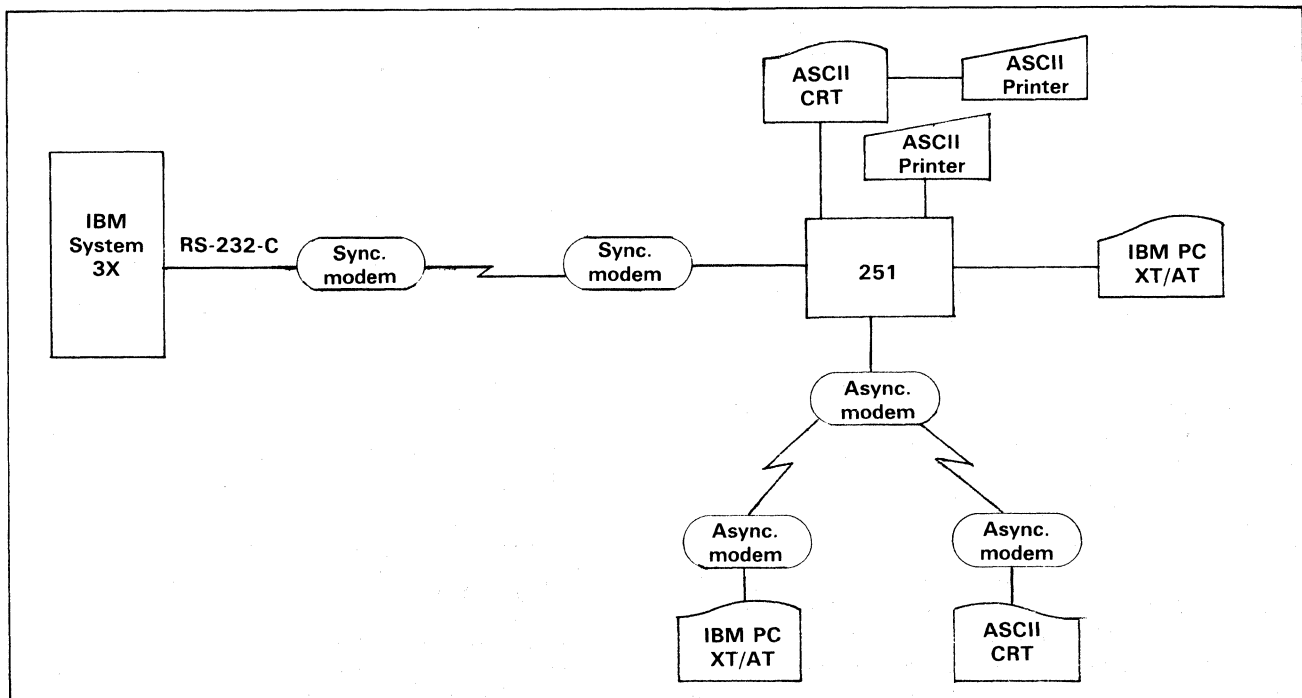

Figure 2. The 251 in this configuration is used to connect an IBM System 3X host with remotely located IBM PC/XT/ATs, ASCII CRTs, and printers. The 251 communicates with the host on a point-to-point link via a synchronous modem. The maximum transmission speed on this line is 19.2K bps.

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▷ The PCI 71B/SNA, 75B/SNA, and 3780/SNA converters are designed to extend the life of BSC terminals in an SNA environment by allowing BSC terminals to communicate with an SDLC host. The PCI 71B/SNA lets IBM 3271s and compatible BSC equipment act as IBM 3274s. The converter permits attachment of up to three BSC control units and 32 devices. The 75B/SNA provides conversion of up to three IBM 3275 or equivalent controllers to 3276 emulation. The PCI 3780/SNA is a BSC-to-SDLC converter for up to three 3780-type batch terminals. When communicating through the PCI 3780/SNA, the 3780 terminals appear to the host as IBM 3776-2 single-logic unit RJE workstations. The unit also supports conversion for 3780-associated printers, card readers, and card-punch devices.

PCI's SmartNet Series 1000 units, which include the 1100, 1200, and 1300, allow ASCII terminals and printers to communicate with IBM SNA/SDLC hosts through an X.25 packet network. A PCI 1100 converter actually performs two conversions. It takes ASCII data output from asynchronous terminals and forms it into an SNA frame that becomes the data field on an X.25 packet. This packet travels a virtual path through the X.25 network to a 1200 converter that replaces the X.25 header with an SDLC header. This information is then sent to the SNA/SDLC host. On the reverse path, the 1200 converts messages from the host into X.25 packets, which are sent via a virtual path through the X.25 network to a 1076X. The 1100 strips away X.25 and SNA protocol elements and addresses the destination peripheral in ASCII code. In this arrangement, ASCII units appear to the host as 3278s with full-screen editors or as 3287 printers connected through 3274/6 cluster controllers. Each 1100 provides up to seven ports for the connection of ASCII devices. The 1200 can communicate with up to eight 1100s, since it is capable of maintaining up to eight virtual circuits through the X.25 network. The 1200 presents the data to its SDLC host by appearing to the host as one or more 3274/6 control units communicating over a point-to-point or multipoint line. Both the 1100 and 1200 come in desktop and rackmountable versions. (See Figure 1 for a diagram of the X.25 converters used in an X.25 packet network.)

For users not requiring the ASCII-to-SDLC conversion, PCI also offers the 1300, which lets attached SDLC cluster controllers communicate with up to three SDLC hosts through the X.25 network. Each 1300 can support up to three IBM 3274/6-type controllers, using a multidrop configuration. The 1300 maintains a virtual circuit through the X.25 network to a 1200 at each host site. The 1200 presents the data to its host from the SDLC controllers connected via the 1300s as if they were attached on a point-to-point multipoint line.

PCI's newest product line, the SmartNet 2000 Series, includes the 2500 asynchronous PAD, the 2600 switching PAD, and the 2700 packet switch. The 2500 unit allows asynchronous terminals, microcomputers, and hosts to access public and private packeted switched networks and to communicate with equipment that supports the X.25 protocol. It is available in 11-, 19-, and 27-port units, each of which supports one X.25 link. Transmission on the ▷

▷ support the RS-232-C interface and accommodate point-to-point and multipoint connections on dial-up lines.

The SmartNet Series 1000 units support full-duplex, asynchronous 9600 bps transmission on the X.25 side. On the terminal side, the 1100 supports full-duplex transmission at 1200 bps. The 1200 unit connection to the host, which can be direct or through a modem, is synchronous, full-duplex at speeds up to 9600 bps. On the terminal side, the 1300 unit supports up to three 3274/6-type devices. The 1100 lets each attached ASCII device establish its own virtual circuit to an ASCII host on the X.25 network or to share or establish a virtual circuit to an SDLC host. The 1200 supports switched or permanent virtual circuits, which are switch-selectable up to eight simultaneous circuits. The 1200 only accepts calls; both the 1100 and 1300 initiate and accept calls. X-on/X-off controls data flow on the 1100 and 1300 devices. Physical connection for these units is RS-232-C.

Units in the Smartnet Series 2000 support all end-to-end controls and procedures specified in CCITT Recommendations X.3, X.28, X.29, and X.121. On the terminal side, Series 2000 devices support asynchronous, half- or full-duplex transmission up to 9600 bps, as well as RS-232-C, V.35, and V.24 interfaces. On the host side, the units support full-duplex, synchronous transmission up to 9600 bps with an RS-232-C interface and up to 64K bps through a V.35 interface. The Model 2500 PAD supports modulo 8 and 128 for link and packet-level communication; dedicated, dial-in/out, and three-wire cable; autobaud rate detection from 300 to 9600 bps; autoparity; and switched and permanent virtual circuits. Packet size, window, and throughput are negotiated on a per-call basis. The 2500 units come with 11, 19, or 27 asynchronous ports.

The Model 2600 switching PAD supports up to eight X.25 links, one of which handles a maximum 64K bps transmission rate (with a V.35 interface), while the remaining links operate at speeds ranging from 1200 to 9600 bps. The unit supports bit-oriented, HDLC framing with LAPB (any link also can be configured to support CCITT 1976 LAP or have a DTE or DCE appearance) and modulo 8 or extended modulo 128 packet sequence numbering. The following frame-level parameters, all software configurable, are available: a frame-level window from 1 to 15; maximum frame size in 128, 256, 512, and 1024 octets; an acknowledgment timer for 1 to 300 seconds; a retransmission counter from 1 to 256; and a line watchdog timer for 0 to 300 seconds. The 2600 can be set to accept or reject reverse-charged calls and incoming fast-select calls.

DEVICE CONTROL

PCI Series 100 and SNA Series converters are operator configurable via switches located on logic boards inside the back cover of the unit. Installation involves configuration of the synchronous port and the asynchronous ports.

Examples of the functions that must be set on the host side of the converter include whether the unit will connect to the host directly, or via the modem; the polling address; at what speed the unit will be operating; and whether or not Non-Return-to-Zero-Inverted (NRZI) will be used.

The asynchronous ports must be configured for the following: whether the ASCII terminal will connect directly to the converter, or to a modem or modem sharing unit (MSU); which of the ports are assigned to CRTs; CRT brand (over 300 different models are supported by PCI); speed for each port; autospeed selection; which ports are assigned to printers; printer speeds; and whether the dynamic printer port will be used, and by which CRT. The synchronous ports must be configured for SDLC and/or BSC address; number of devices connected (e.g., up to 32 Logical Units, converted to one SNA Physical Unit Type 2); and SNA/SDLC timeout. ▶

▷ asynchronous port lines is from 300 to 9600 bps. The 2600 switching PAD integrates the functions of the 2500 and the 2700 packet switch. It allows for concurrent attachment of X.25 packet equipment and asynchronous devices. This unit supports up to 256 logical channels; 2, 3, 4, or 8 X.25 links; and 26, 25, 16, or 8 asynchronous ports. (The number of available asynchronous ports increases as the number of X.25 links decreases. For example, a unit accommodating 2 X.25 links supports 26 asynchronous ports, while one supporting 8 X.25 links supports 8 asynchronous ports.)

Units in the SmartNet 2000 Series operate under control of the SmartNet Network Management System that provides alarms reporting, call accounting statistics on a per-user basis, monitoring, statistics gathering, and configuration updates. Users configure and diagnose Series 2000 products through a console. Configuration and operating code is stored on diskette, which will automatically reload parameters into any Series 2000 device in the event of power failure, power restart, parity check, manual resetting of the unit, or watchdog timer detection.

All Series 2000 products support the required X.25, X.3, X.28, X.29, and X.121 CCITT Recommendations. The units are compatible with various public data networks, including GTE Telenet, Tymnet, Autonet, Uninet, and Datex-P (Germany), as well as PSS (United Kingdom), Transpac (France), Datapac (Canada), Telepac (Switzerland), DCS (Belguim), Telepak (Sweden), Finpak (Finland), Datapak (Denmark), Itapac (Italy), Datex (Austria), Saponet (South Africa), and Austpac (Australia).

Options available with the ASCII converters include the Graphics Option, the CoaxFace Option, and the PaperCRT option. The Graphics Option permits full-screen, color or black-and-white graphics by an ASCII graphics terminal on an SNA network. The CoaxFace Option is a device manufactured by PCI that permits ASCII terminals to plug into coaxial cable, by performing RS-232-C to RG-62A/U coaxial cable interface conversion. The CoaxFace devices allow connection distances up to 5,000 feet, as opposed to the 50-foot limitation placed on RS-232-C distances. The PaperCRT Option allows ASCII keyboard/printers to appear as full-screen IBM 3278 CRT terminals.

In addition to its protocol converters, PCI offers two terminals—Networker 51 and Networker 78. Networker 51, specifically designed to work with the PCI 151 protocol converter, provides IBM 5251-11 emulation in a System 34/38 environment. The Networker 78 is designed to work with the PCI 176 protocol converter and provides IBM 3278 emulation.

PCI also manufactures SmartLink, an emulation and communications package that allows an IBM PC or compatible microcomputer to emulate either a 3278 connected to a 327X controller, a 5251 connected to a System 34/36/38 host, or a Digital Equipment Corporation VT-100 connected to a non-IBM host. SmartLink uses 96K of random access memory (RAM) and can be adjusted with seven bit-rate settings that range from 110 to 19.2K bps. ▷

▶ At power-on, all internal hardware and firmware components are tested. In addition, all PCI units have built-in diagnostic line monitors and integrated trace capabilities. The following diagnostics test sequences are activated by keyboard command: display of switch settings; ASCII line test; monitor of SDLC address polling; display of SDLC address and control bytes; display of SDLC status; and SNA tracing of data at the port where the test is executed. Test results are displayed on a CRT and/or printer attached to the converter. A special port is provided for monitoring the converter itself.

Installing a Series 200 converter requires the simple insertion of a program pack into a PCI enclosure, which has front-panel LEDs for monitoring power, system operation, carrier detection, reception, and transmission. Users control the Series 200 converters via a terminal connected to a command port. Using setup mode, a manager can configure up to 32 user profiles, which contain information about a terminal's connection to the network. Setup mode allows creation and storage of automatic logon/logoff sequences. The command port may also function as an additional host access port.

In addition, all Series 200 asynchronous channels may be configured for non-IBM asynchronous host access, allowing terminals to switch between an IBM mainframe and asynchronous host or the X.25 network and an autodial modem. Users can monitor the status of both asynchronous and synchronous lines through any terminal connected to a Series 200 converter. Additional diagnostics features allow any Model 200 converter to display both the address and control bytes of the SDLC line.

All PCI 200 models provide four levels of password security: Level 1 creates and stores up to 32 individual passwords in nonvolatile memory; Level 2 allows the network manager to establish predefined session paths to ensure authorized application connections; Level 3 provides auto-callback security; and Level 4 limits the distribution of passwords and user identifications through an automatic logon/logoff.

Through a Series 200 dynamic spooling feature, a personal computer will communicate with an IBM host as a CRT or printer, letting users address and send output to more than one device at a time. PCI 200 converters are compatible with IBM mainframe file upload and download facilities, allowing personal computer users to share data between applications and host databases. Through a software option available on the 251, a personal computer attached to the converter can transfer data files to and from a System 34/36/38, and allocate, delete, and rename files on the PC's diskette.

On SmartNet Series 1000 units the following selections must be configured for the X.25 link: first logical channel number, packet window, packet length, frame timeout, packet-level timeout. On the asynchronous side, settings for direct or modem connection and auto speed detection must be made.

On the 2500 asynchronous PAD and 2500 switching PAD, operating parameters are configured through a system management service. Functions available through the service include updating routing tables, performing diagnostics, monitoring performance, and retrieving statistics locally or remotely from any point in the network. Services available through the SmartNet Network Management System (NMS) include alarms reporting, call accounting on a per-user basis, system monitoring, statistics gathering, and configuration updates. The 2500 also supports the downline loading of operating code via the packet switched network through the NMS. The unit saves all configuration and operating code on a 3½-inch diskette; system loading from the diskette is accomplished automatically in the event of ▶

COMPETITIVE POSITION

The protocol conversion market grossed approximately $70 million in revenues in 1983, and at that time was predicted to double by the end of 1984. While sales of converters remained strong throughout 1984 and 1985, prices of converters have begun to erode, and PCI, like most other vendors in this market segment, has felt the pinch. Other factors have also affected PCI's leading position in the protocol conversion market. Many strong competitors, including prominent data communications vendors, have emerged since 1983. Sales of Micom Systems' converters have been strong, and IBM has "sanctioned" protocol conversion technology by introducing products of its own. IBM poses the biggest threat to all protocol conversion manufacturers, as most of the products involve conversions within the IBM network. Users with IBM mainframes and older BSC equipment can now have a one-vendor solution when purchasing protocol converters.

PCI is a unique vendor in the data communications marketplace. It is one of the few companies that specializes in a particular data communications technology; most data communications vendors offer several different lines of products. PCI has researched and developed protocol conversion technology since 1980, when only Industrial Computer Controls, Inc. (later purchased by Micom) was offering significant competition. It is this specialized knowledge that marks PCI's strongest competitive advantage in the conversion marketplace. Although PCI now faces competition from a growing number of vendors, the company has a solid installed user base for its converters, and it offers the broadest line of converters available from one source.

To strengthen its financial position, PCI has aggressively sought agreements with other companies to distribute, OEM, or sell PCI converters under a private label. According to PCI's *1984 Annual Report*, sales to these organizations accounted for 82 percent of total revenues, up from 62 percent in 1983. Although PCI experienced a sharp drop in the percentage of total revenues from 1983 to 1984, the company's position in the market is still strong. Several factors beyond PCI's direct control accounted for decreased revenues: the general slump in the computer industry, increased competition in the conversion market, and price erosions. PCI's plan to increase its financial standing by opening up its distribution channels was further supported by the company's decision to greatly increase the amount of revenue plowed back into research and development to maintain a leading market position. Also, the company reduced its staff by one third to reduce overall operating expenses, and restructured its senior-management staff. With the introduction of the SmartNet Series 1000 and SmartNet Series 2000 product lines, PCI has fulfilled one of its main objectives, i.e., to enter the packet switching and wide-area network markets. Right now, this is surely where the action is.

power failure, parity check, manual resetting of the unit, or watchdog timer detection. Error logs are retained through power loss and system restart.

Several options are available on PCI converters. A PaperCRT option permits ASCII keyboard/printer terminals to appear as full-screen IBM 3278 CRT terminals, using full-screen editing applications programs. With the Graphics Option, ASCII terminals with graphics capabilities can be used in an SNA/SDLC network in conjunction with the host graphics package. The CoaxFace Option, available through two CoaxFace devices, each measuring 3 by 2 by 1 inches, allows existing coaxial cable to be used for RS-232-C connections, or coaxial cable can be installed instead of RS-232-C cable. RS-232-C cable connections are generally limited to distances of 50 feet; with CoaxFace, distances using coaxial cable may be extended to 5,000 feet.

PRICING

PCI Converters are available for purchase only. Quantity discounts are available for purchases of more than five units. Headquartered in Woodland Hills, CA, PCI maintains offices in New York, Boston, Chicago, Houston, Los Angeles, and England.

Prices for the models described in this report vary according to the number of ports and options chosen. PCI has provided the following pricing for its units:

- PCI 151, 167, 171, and 176 with 1 port sell for $2,850; 3-port models are $3,900; 5-port units are $4,600; and 7-portmodels are $5,300.

- Series 200 unit price ranges are for units with from 4 to 32 physical ports. Prices for the 251 range from $2,975 to $9,750. Costs of the PCI 271 range from 3,450 to $9,950. The PCI 276's price is between $3,275 to $9,000.

- Prices for the 71B/SNA, 75B/SNA, and 3780/SNA range between $3,100 and $4,100.

- SmartNet Series 1000 products cost between $1,650 and $3,800.

- SmartNet Series 2000 products cost between $4,750 and $6,250. ■

ADVANTAGES AND RESTRICTIONS

PCI offers a broad line of conversion products and is, therefore, an excellent source for prospective buyers whose needs are specialized or varied. As one of the oldest companies in the protocol conversion market, PCI has experience in researching and developing conversion technologies, which can be tricky and difficult to implement; therefore, one of the company's strongest advantages is its established position in a marketplace filled with newcomers.

PCI's Series 100 converters, offering the capability of older Series 1000 units at a price that is 40 percent less, are economic choices for users requiring a large number of units in the network. The Series 200 converters, although more expensive, are available on compact program packs which slide into the front of an enclosure. Should the user's needs change, switching to a different conversion requires only a simple pack replacement. These products also provide network management control features, available ▷

▷ through a command port on the units. Through an attached terminal, users can configure up to 32 user profiles for attached devices; the PCI 200 converter provides the prompts needed to change profile data. Another advantage offered on Series 200 units is dynamic spooling capability, which allows a personal computer to function as both a CRT and a printer through a single port. These new converters also provide four levels of security.

With the SmartNet Series products, PCI has entered the wide-area networking market, which is far more volatile than the protocol converter market at the present time. Several large data communications equipment vendors have entrenched positions in the PAD and packet switch markets, and PCI will have some tough competition selling these products. PCI's Series 1000 units offer the unique capability of allowing ASCII or SNA/SDLC devices to communicate through the X.25 network with IBM SDLC hosts. The SmartNet Series 2000 products will support one 64K bps X.25 link with a V.35 interface, a capability that is found on a few other PADs, but is relatively uncommon. (Maximum X.25 link speed on most PADs is 9600 or 19.2K bps.) The ability to manage SmartNet Series operation via a network management system offers another advantage.

Those contemplating the use of PCI converters should note that a different model will be necessary to handle each type of conversion. This can pose a restriction for networks in which several different types of protocols are in use at once. A few available conversion systems do offer line concentration and multiple protocol capability, whereby several different types of emulations are available on software modules loaded from an IBM host to the converter. In some cases, it will be cheaper to install a multiprotocol converter than a variety of converters, each handling a separate emulation. The major disadvantage of installing a multiconversion unit, however, is the extensive host-based programming involved in defining parameters for its operation. There are cost benefits of installing a multiprotocol converter instead of a variety of different units, and vice versa; therefore, users should carefully analyze network requirements in terms of both types of products.

USER REACTION

In Datapro's 1986 Terminal Users Survey, sent to a cross section of *Data Communications* magazine subscribers, 30 users rated 81 PCI converters, including six 167s, twenty-eight 171s, fourteen 176s, and thirty-three unspecified models. The combined ratings for all models are shown in the following table. (Note: not all respondents rated the converters in every category.)

	Excellent	Good	Fair	Poor	WA*
Ease of installation	7	18	3	2	3.0
Ease of operation	11	15	2	2	3.2
Device reliability	7	16	3	2	3.0
Maintenance service/ technical support	5	11	2	8	2.5
Overall performance	7	14	6	2	2.9

*Weighted Average based on a scale of 4.0 for Excellent.

When asked whether they would recommend their systems to other users, 21 of the 30 respondents said they would, while five users said they would not, and 4 were undecided. The lack of adequate maintenance service and technical support was cited as the major reason for dissatisfaction with PCI products. During 1985, the company was experiencing reorganization, staff reduction, and financial problems, and these factors undoubtedly influenced the company's ability to support its customers. However, during the past few months, PCI seems to be getting its act together on several fronts. The ability to efficiently handle inquiries concerning its products has improved tremendously.

In terms of technical characteristics, PCI's products are on par with other protocol conversion systems. PCI devices received a slightly higher rating for ease of operation than IBM (3.2 versus 2.8), and their 2.9 overall performance rating was comparable with other vendors with which the company competes, including Datastream (2.9), Icot (2.3), IBM (3.2), and Local Data (2.8). □

Protocol Computers, Inc.
Protocol Converters
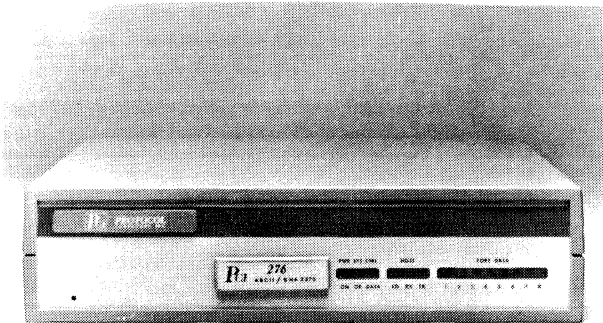
PCI's new 200 Series products are offered as program packs that slide into a space on an enclosure. The piece marked 276 in the above photograph pulls out of the unit and may be replaced with another 200 Series converter pack. All of the new converters offer network management capabilities and security features.

MANAGEMENT SUMMARY

UPDATE: *This report has been updated to include additions to Protocol Computers' product line. The company now offers Series 100 products, which provide the same conversion capabilities offered on the Series 1000 units at a cheaper price. Other new additions to the product line include the Series 200 converters and the PCI 7621.*

Protocol Computers, Inc. (PCI) has specialized in protocol conversion technology for a number of years and provides the broadest range of conversion products available from one vendor. PCI offers a number of different approaches to conversion. Some of its products are traditional "black box" units, while others, the new 200 Series units for example, are program packs that slide into a slot on a basic enclosure.

The company offered its first converter, the PCI 1067, in 1980—well before most other vendors introduced conversion products. The converter allowed inexpensive ASCII terminals to emulate IBM 3767s in an SNA/SDLC environment. The company's second offering, the PCI 1076, put PCI in a leading market position because the device gave customers the type of conversion they most desired— ASCII to 3270. As the data communications market grew, and protocol conversion became more accepted as a viable means to use inexpensive asynchronous devices in an IBM environment, PCI continued to expand its product line to include not only ASCII-to-SDLC converters, but also units that allow ASCII-to-BSC conversion, BSC-to-SDLC conversion, access to X.25 public networks, and the 74D unit that allows IBM 3278 or equivalent terminals to access asynchronous ASCII hosts. In 1984, PCI introduced the Series 100 versions of its converters. These units offer the same conversion capabilities found on Series 1000 devices, but at a lower price. PCI's newest converters, the 200 ▷

Protocol Computers, Inc. offers a broad line of protocol converters, including devices that handle asynchronous ASCII-to-SDLC, asynchronous ASCII-to-BSC, BSC-to-SDLC, SDLC-to-ASCII, and X.25 conversions.

MODELS: 151/1051, 167/1067, 176/1076, Videotext 67, 171/1071, 71B/SNA, 75B/SNA, 3780/SNA, 1076X, 73SX, R73SX, 74D, 251, 271, 276, and 7621.

CONVERSION: 151/1051, 167/1067, 176/1076, Videotext 67, 7621, 251, 276— ASCII-to-SDLC; 171/1071, 271—ASCII-to-BSC; 71B/SNA, 75B/SNA, and 3780/SNA—BSC-to-SDLC; 1076X, 73SX, and R73SX—ASCII-or SDLC-to-X.25; 74D—SDLC-to-ASCII.

TRANSMISSION RATES: Up to 9600 bps, on both the terminal side and the host side for all models except those in 200 Series, which transmit up to 19.2K bps on both host and terminal sides, and the 1076X, 73SX, and R73SX, which transmit up to 9600 bps on the X.25 side and up to 1200 bps on each terminal line.

COMPETITION: Micom Systems, Icot, Datastream, Local Data, IBM.

PRICE: Ranges from $1,850 for a basic one-port Series 100 unit to $7,200 for a complete 21-port 7621.

CHARACTERISTICS

MODELS

In this report, we cover 16 PCI protocol converters. Each handles one of five conversions offered by the company. The conversions and corresponding models are as follows. ▶

▷ Series, offer a number of extra features, such as network management capabilities and security, that are generally not available on protocol converters.

PCI sells its products through direct sales and has strong commitments toward increasing revenues by selling more strongly to distributors and OEMs. According to PCI's *1984 Annual Report*, in 1983 the company derived 31 percent of its revenues from direct sales to end users. Realizing that a larger sales volume was needed to place PCI on sounder financial footing, the company sought and entered into OEM and private-label marketing agreements with several data communications companies. In fiscal 1984, 82 percent of total revenues came from sales to OEMs and distributors. During the same time period, PCI increased investment in research and development by 179 percent over the previous year. This was done to maintain PCI's leading market position, which has been threatened recently by price erosions and stiffer competition in the conversion marketplace.

PCI offers a wide number of units, which we have classified according to the type of conversion offered on each device. These conversions and corresponding products are as follows:

- Asynchronous ASCII to SDLC—PCI 151/1051, 167/1067, 176/1076, Videotext 67, 251, 276, and 7621.

- Asynchronous ASCII to BSC—171/1071, 271.

- BSC to SDLC—PCI 71B/SNA, 75B/SNA, and 3780/SNA.

- X.25 conversion—PCI 1076X, 73SX (converts ASCII to SDLC and links SDLC host to X.25 node), and R73SX (ASCII to SDLC and SDLC to SDLC through X.25).

- SDLC to ASCII—PCI 74D.

The PCI 151/1051 is designed for use in a System 34 or 38 terminal network. The converter attaches either remotely or directly to a System 34 or 38 and replaces an IBM 5251-12 controller. Up to seven ASCII displays and printers can be attached through the PCI 151/1051 and appear to the System 34 or 38 as 5251-11 CRTs with Model 5256 printers attached.

The PCI 167/1067 is an alternative to IBM's Network Terminal Operator (NTO) software. The 167/1067 emulates the 3767 controller and provides all NTO functions; it eliminates the need to purchase and maintain software, and frees up processor memory space. With the 167/1067, users can also link special equipment, such as graphics devices, plotters, APL terminals, and processor-control equipment, to the SNA network.

Another ASCII-to-SDLC unit, the PCI 176/1076, emulates an IBM 3276 Physical Unit Type 2 control unit. Users can attach any combination of up to seven ASCII CRTs and printers to the 176/1076, which appear to the host as IBM 3278s or 3287s. ▷

▶ **ASCII-to-SDLC Conversion:**

- **151/1051**—used with IBM System 34/38; emulates the IBM 5251-12 workstation, allowing any combination of ASCII CRTs and printers to be attached to a System 34/38; one, three, or seven terminal ports are available.

- **167/1067**—provides emulation of the IBM 3767 keyboard/printer terminal (Physical Unit Type 1); permits one, three, five, or seven ASCII devices to appear as 3767s in SNA network.

- **176/1076**—emulates the IBM 3276 controller; one, three, five, or seven ports available; lets any combination of ASCII CRTs or printers appear as IBM 3278/3287 terminals with dial-up access to SNA/SDLC networks.

- **Videotext 67**—used with videotext terminals; emulates IBM 3767 SDLC (PU Type 1) devices; one, three, five, or seven terminal ports are available.

- **251**—emulates an IBM 5251-12 SNA/SDLC cluster controller for an IBM System 34/36/38; supports eight physical ports and Logical Units; allows virtually any type of ASCII device to communicate with the IBM host.

- **276**—emulates an IBM 3274/76 Physical Unit Type 2 controller; supports 8 physical ports and 32 Logical Units; supports virtually any type of ASCII device.

- **7621**—emulates an IBM 3274/3276 Physical Unit Type 2 controller; provides 21 terminal ports and a control port; supports virtually any type of ASCII device.

ASCII-to-BSC:

- **1071**—emulates the IBM 3271; permits ASCII terminals to plug into BSC networks; available with one, three, five, or seven terminal ports.

- **271**—emulates an IBM 3271 controller, supports 8 physical devices and 32 Logical Units; allow virtually any ASCII device to access an IBM BSC network.

BSC-to-SDLC Conversion:

- **71B/SNA**—converts 3271-type controllers to IBM 3274 emulation; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

- **75B/SNA**—converts 3275-type controllers to 3276 emulation; provides up to three terminal ports operating at up to 4800 bps or one terminal port at 9600 bps.

- **3780/SNA**—provides conversion of IBM 3780-type batch terminals to emulation of IBM 3776-2 single logic unit RJE workstations (PU Type 2); supports printers, card readers, and card-punch devices; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

ASCII-to-SDLC and SDLC-to-SDLC Conversion through an X.25 Network:

- **1076X**—provides interface between X.25 network and ASCII terminals to any ASCII or SDLC host; supports one, three, five, or seven ports; desktop or rack-mount versions available.

- **73SX**—emulates an IBM 3274/76 controller; links an SDLC host to the X.25 node; supports up to eight 1076X or R73SX units, each supporting their own attached devices; desktop or rack-mount versions available. ▶
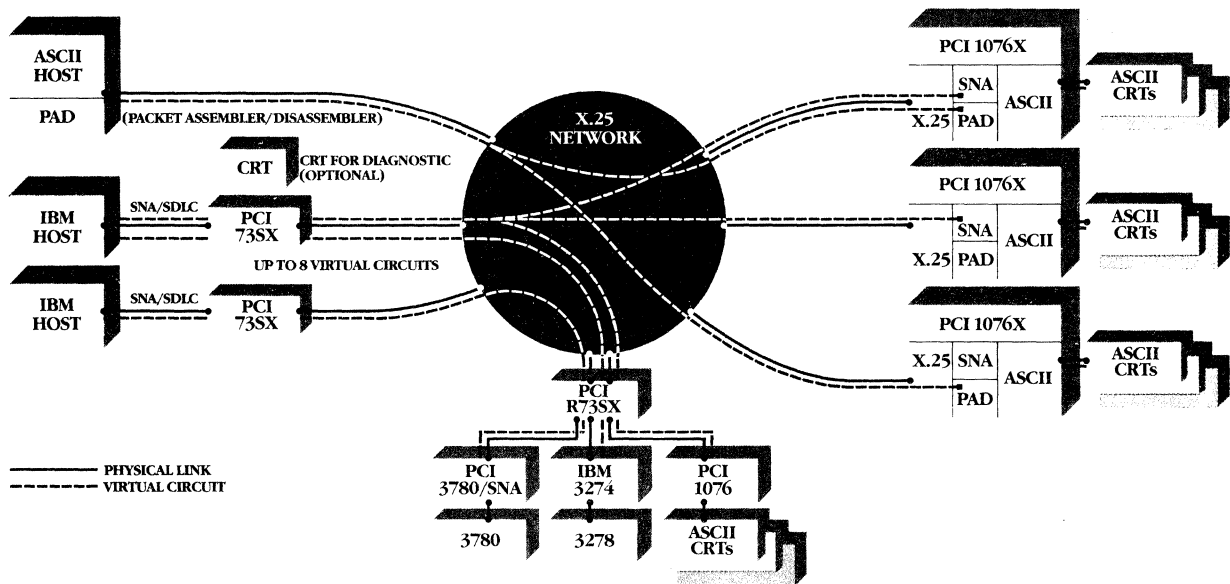
Figure 1. Shown here is a sample configuration of PCI's X.25 Series converters. The 1076X provides interfacing between the X.25 network and up to seven ASCII devices. The 73SX links the SDLC host to the X.25 network and communicates with up to eight 1076Xs or R73SXs. The R73SX lets up to three attached SDLC cluster controllers communicate with up to three SDLC hosts through the network.

A more recent member of the ASCII-to-SDLC conversion group, the Videotext 67, allows users to link various types of asynchronous videotext terminals to an IBM SDLC host port via leased telephone lines. Up to six PCI Videotext 67s multidropped on a leased line can interface with one IBM 3705 port. Each converter, in turn, supports seven terminals. Videotext 67 includes management functions that eliminate the need to purchase IBM Videotext Facility and Network Terminal Options software.

The newest members of PCI's ASCII-to-SDLC conversion products line are the 251, 276, and 7621. The 251 emulates an IBM 5251-12 SNA/SDLC cluster controller and allows asynchronous ASCII devices to access a System 34/36/38. For the 251, PCI offers an option that allows users of an IBM PC and the 251 to transfer data files to and from System 34/36/38 computers, and allocate, delete, and rename files on the PC's diskette. The utilities can translate files for format and data compatibility on either the PC or System 3X host. (This option is offered through an agreement with Software Systems, Inc.) The 276, emulating an IBM 3274/76 SNA/SDLC Physical Unit Type 2 cluster controller, supports 18 concurrent IBM Logical Units and 32 user profiles. The PCI 7621 is a 21-port unit, emulating an SNA/SDLC Physical Unit Type 2 device, that allows asynchronous personal computers, printers, terminals, and graphics devices to communicate in the SDLC environment.

PCI's ASCII-to-BSC converters, the PCI 171/1071 and 271, provide IBM 3271 controller emulation. The devices permit the use of ASCII peripherals in a BSC network. The 171/1071 supports up to seven terminals; the newer 271 supports 18 concurrent Logical Units and 32 user profiles.

- R73SX—used with 73SX: lets up to three IBM or equivalent 3274/6-type controllers communicate with SDLC hosts through an X.25 network; creates independent virtual circuits through network to 73SXs at up to three host sites.

SDLC-to-ASCII Conversion:

- 74D—lets up to seven IBM 3278 or equivalent terminals communicate with up to six ASCII hosts (including Digital Equipment Corporation hosts, public and private networks, personal computers, and local area networks); interfaces with an IBM 3274/6 cluster controller on the terminal side, and with an IBM 270X/37XX-type communications controller and up to six ASCII devices on the host side.

TRANSMISSION SPECIFICATIONS

For the 1051, 1067, 1076, 1071, and Videotext 67 transmission is asynchronous, full-duplex on the terminal side of the converter, and synchronous, half- or full-duplex on the host side. Each model features one RS-232-C SDLC port (BSC for the 1071); one, three, five, or seven RS-232-C ASCII terminal ports; and one dynamic printer allocation port. The dynamic printer allocation port allows one additional printer to be added to the basic configuration. Whenever the dynamic printer port is active, the keyboard of a selected terminal in the basic configuration is temporarily disabled. All ports accept speeds up to 9600 bps. Even or no parity can be selected. Each model features automatic speed detection, from 300 to 1200 bps. Connection can be to leased or dial-up facilities, or direct connection to the host computer. Both IBM and non-IBM modems can be used.

All of the 200 Series units support a maximum 19.2K bps transmission on the terminal and host lines. Transmission on the host line is synchronous in half- or full-duplex mode; on the terminal line transmission is asynchronous, and flow control is X-on/X-off. Each 200 converter supports the

The 151/1051, 167/1067, 176/1076, Videotext 67, 171/1071 models described above are available with one, three, five, or seven ports, and permit the attachment of any combination of ASCII CRTs and printers. A dynamic printer allocation feature on each converter allows an additional printer to be added to the basic configuration. Configuring this port requires that one of the basic ports be selected as its "partner." Whenever the dynamic printer port is active, the keyboard of the terminal attached to the partner port is disabled.

The 200 Series converters support eight network ports and a command port through which users can configure user profiles. These units accommodate virtually any ASCII device and offer additional capabilities, such as advanced security features, soft-configuration, and auto speed detection for incoming traffic. The 200 Series converters also feature a dynamic spooling feature for sending output to more than one device through a single port, thus allowing users to have simultaneous access between a personal computer, host and printer, or disk drive during a micro-to-mainframe connection.

The PCI 71B/SNA, 75B/SNA, and 3780/SNA converters are designed to extend the life of BSC terminals in an SNA environment by allowing BSC terminals to communicate with an SDLC host. The PCI 71B/SNA lets IBM 3271s and compatible BSC equipment act as IBM 3274s. The converter permits attachment of up to three BSC control units and 32 devices. The 75B/SNA provides conversion of up to three IBM 3275 or equivalent controllers to 3276 emulation. The PCI 3780/SNA is a BSC-to-SDLC converter for up to three 3780-type batch terminals. When communicat-

RS-232-C interface, configurable as DTE or DCE. The units can be used in direct, point-to-point, and multipoint configurations. Connections over dial-up lines are through synchronous modems.

The 7621 supports 21 asynchronous terminal ports and one control port, as well as a synchronous host port. Transmission speed on the host and terminal lines is up to 9600 bps, and flow control on the asynchronous line is X-on/X-off. The 7621 supports the RS-232-C interface, configurable as DCE or DTE.

The 71B/SNA, 75B/SNA, and 3780/SNA support the following physical connections: one SDLC port at speeds up to 9600 bps; and, one BSC port at speeds up to 9600 bps; or up to three BSC ports at speeds up to 4800 bps. The units support the RS-232-C interface and support direct, point-to-point, and multipoint connections on dial-up lines.

The 1076X, 73SX, and R73SX support full-duplex, asynchronous 9600 bps transmission on the X.25 side. On the terminal side, the 1076X supports full-duplex transmission at 1200 bps. The 73SX-to-host connection, which can be direct or through a modem, is synchronous, full-duplex at speeds up to 9600 bps. On the terminal side, the R73SX supports up to three 3274/6-type devices.

The 1076X lets each attached ASCII device establish its own virtual circuit to an ASCII host on the X.25 network or to share or establish a virtual circuit to an SDLC host. The 73SX supports switched or permanent virtual circuits, which are switch-selectable up to eight simultaneous circuits. The 73SX only accepts calls; the 1076X and R73SX initiate the calls. On both the 1076X and the 73SX, X-on/X-off controls data flow. Physical connection for these units is RS-232-C.

The 74D supports one RS-232-C SDLC port on the terminal side, and one SDLC port plus up to six ASCII ports on the host side. All ports accept speeds of up to 9600 bps. Even or no parity can be selected. Automatic speed detection is
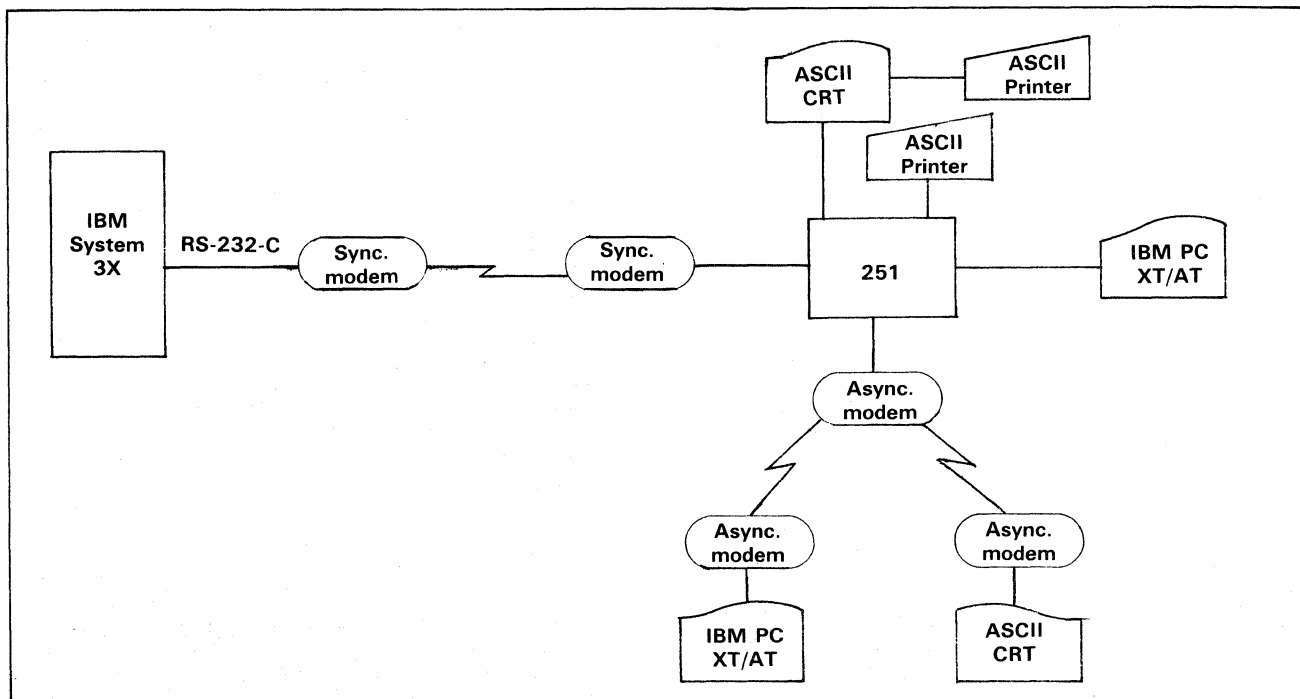

Figure 2. The 251 in this configuration is used to connect an IBM System 3X host with remotely located IBM PC/XT/ATs, ASCII CRTs, and printers. The 251 communicates with the host on a point-to-point link via a synchronous modem. The maximum transmission speed on this line is 19.2K bps.

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ing through the PCI 3780/SNA, the 3780 terminals appear to the host as IBM 3776-2 single-logic unit RJE workstations. The unit also supports conversion for 3780-associated printers, card readers, and card-punch devices.

PCI's family of X.25 converters, including the 1076X, 73SX, and R73SX, allow ASCII terminals and printers to communicate with IBM SNA/SDLC hosts through an X.25 packet network. A PCI 1076X converter actually performs two conversions. It takes ASCII data output from asynchronous terminals and forms it into an SNA frame that becomes the data field on an X.25 packet. This packet travels a virtual path through the X.25 network to a 73SX converter that replaces the X.25 header with an SDLC header. This information is then sent to the SNA/SDLC host. On the reverse path, the 73SX converts messages from the host into X.25 packets, which are sent via a virtual path through the X.25 network to a 1076X. The 1076X strips away X.25 and SNA protocol elements and addresses the destination peripheral in ASCII code. In this arrangement, ASCII units appear to the host as 3278s with full-screen editors or as 3287 printers connected through 3274/6 cluster controllers. Each 1076X provides up to seven ports for the connection of ASCII devices. The 73SX can communicate with up to eight 1076Xs, since the 73SX is capable of maintaining up to eight virtual circuits through the X.25 network. The 73SX presents the data to its SDLC host by appearing to the host as one or more 3274/6 control units communicating over a point-to-point or multipoint line. Both the 1076X and 73SX come in desktop and rack-mountable versions. (See Figure 1 for a diagram of the X.25 converters used in an X.25 packet network.)

For users not requiring the ASCII-to-SDLC conversion, PCI also offers the R73SX, which lets attached SDLC cluster controllers communicate with up to three SDLC hosts through the X.25 network. Each R73SX can support up to three IBM 3274/6-type controllers, using a multidrop configuration. The R73SX maintains a virtual circuit through the X.25 network to a 73SX at each host site. The 73SX presents the data to its host from the SDLC controllers connected via the R73SXs as if they were attached on a point-to-point multipoint line.

PCI's 74D is a protocol converter that performs a conversion that is the reverse of other PCI units. (The company calls this unit a deconverter.) While other PCI converters let ASCII terminals talk to SNA hosts, the 74D allows IBM 3278 or equivalent terminals to talk to an ASCII host. PCI 74D interfaces an IBM 3274/6-type cluster controller on the terminal side with an IBM 270X/37XX-type communications controller and with up to six ASCII computers, which can be DEC hosts, online databases, and remote computing services such as CompuServe, personal computers, or other ASCII resources, on the host side. Supported by 74D, the terminals can switch between SDLC and ASCII hosts. When the terminal talks to the SDLC host it communicates through the 270X/37XX communications controller. When it communicates with the ASCII host, the 74D performs the necessary conversion. The 74D can ▷

supported from 300 to 1200 bps. Communication to the host computers is asynchronous, full-duplex via leased or dial-up facilities or direct connection.

DEVICE CONTROL

PCI 100 and 1000 Series converters are operator configurable via switches located on logic boards inside the back cover of the unit. Installation involves configuration of the synchronous port and the asynchronous ports.

Examples of the functions that must be set on the synchronous side of the converter include whether the unit will connect to the host directly, or via the modem; the polling address; at what speed the unit will be operating; and whether or not Non-Return-to-Zero-Inverted (NRZI) will be used.

The asynchronous ports must be configured for the following: whether the ASCII terminal will connect directly to the converter, or to a modem or modem sharing unit (MSU); which of the ports are assigned to CRTs; CRT brand (over 300 different models are supported by PCI); speed for each port; autospeed selection; which ports are assigned to printers; printer speeds; and whether the dynamic printer port will be used, and by which CRT. The synchronous ports must be configured for SDLC and/or BSC address; number of devices connected (e.g., up to 32 Logical Units, converted to one SNA Physical Unit Type 2); and SNA/SDLC timeout. On X.25 Series units the following selections must be configured: first logical channel number, packet window, packet length, and frame timeout.

The PCI 74D starts a dialog with a 3278 terminal user by sending a menu, which displays on the 3278 screen. The user selects a desired destination, for example, a Digital Equipment Corporation host. Once a connection with an ASCII device is established, the 3278 emulates an ASCII terminal.

At power-on, all internal hardware and firmware components are tested. In addition, all PCI units have built-in diagnostic line monitors and integrated trace capabilities. The following diagnostics test sequences are activated by keyboard command: display of switch settings; ASCII line test; monitor of SDLC address polling; display of SDLC address and control bytes; display of SDLC status; display of X.25 frames and packets; and SNA tracing of data at the port where the test is executed. Test results are displayed on a CRT and/or printer attached to the converter. A special port is provided for monitoring the converter itself.

Installing a 200 Series converter requires the simple insertion of a program pack into a PCI enclosure, which has front-panel LEDs for monitoring power, system operation, carrier detection, reception, and transmission. Users control the 200 Series converters via a terminal connected to a command port. Using setup mode, a manager can configure up to 32 user profiles, which contain information about a terminal's connection to the network. Setup mode allows creation and storage of automatic logon/logoff sequences. The command port may also function as an additional host access port.

In addition, all 200 Series asynchronous channels may be configured for non-IBM asynchronous host access, allowing terminals to switch between an IBM mainframe and asynchronous host or the X.25 network and an autodial modem. Users can monitor the status of both asynchronous and synchronous lines through any terminal connected to a 200 Series converter. Additional diagnostics features allow any Model 200 converter to display both the address and control bytes of the SDLC line.

All PCI 200 models provide four levels of password security: Level 1 creates and stores up to 32 individual passwords in ▷

support up to six simultaneous dialogs among six different 3278s and six selected ASCII hosts or other devices.

Options available with the ASCII converters include the Graphics Option, the CoaxFace Option, and the PaperCRT option. The Graphics Option permits full-screen, color or black-and-white graphics by an ASCII graphics terminal on an SNA network. The CoaxFace Option is a device manufactured by PCI that permits ASCII terminals to plug into coaxial cable, by performing RS-232-C to RG-62A/U coaxial cable interface conversion. The CoaxFace devices allow connection distances up to 5,000 feet, as opposed to the 50-foot limitation placed on RS-232-C distances. The PaperCRT Option allows ASCII keyboard/printers to appear as full-screen IBM 3278 CRT terminals.

In addition to its protocol converters, PCI offers two terminals—Networker 51 and Networker 78. Networker 51, specificially designed to work with the PCI 1051 protocol converter, provides IBM 5251-11 emulation in a System 34/38 environment. The Networker 78 is designed to work with the PCI 1076 protocol converter and provides IBM 3278 emulation.

PCI also manufactures PCI-Link for communications between IBM personal computers and IBM hosts, minicomputers, or other microcomputers. Another product, PCI-Term, is a communications support package for the IBM PC/XT/AT. In addition, PCI manufactures a cluster controller that allows Apple microcomputers to communicate with an IBM host as a 3270-type terminal. This product is marketed by Apple.

COMPETITIVE POSITION

The protocol conversion market grossed approximately $70 million in revenues in 1983, and at that time the market was predicted to double by the end of 1984. While sales of converters remained strong throughout 1984 and 1985, prices of converters have begun to erode, and PCI, like most other vendors in this market segment, has felt the pinch. Other factors have also affected PCI's leading position in the protocol conversion market. Many strong competitors, including prominent data communications vendors, have emerged since 1983. Sales of Micom Systems' converters have been strong, and IBM has "sanctioned" protocol conversion technology by introducing products of its own. IBM poses the biggest threat to all protocol conversion manufacturers, as most of the products involve conversions within the IBM network. Users with IBM mainframes and older BSC equipment can now have a one-vendor solution when purchasing protocol converters.

PCI is a unique vendor in the data communications marketplace. It is one of the few companies that specializes in a particular data communications technology; most data communications vendors offer several different lines of products. PCI has researched and developed protocol conversion technology since 1980, when only Industrial Computer Controls, Inc. (later purchased by Micom) was offering significant competition. It is this specialized ▷

nonvolatile memory; Level 2 allows the network manager to establish predefined session paths to ensure authorized application connections; Level 3 provides autocall back security; and Level 4 limits the distribution of passwords and user identifications through an automatic logon/logoff.

Through a 200 Series dynamic spooling feature, a personal computer will communicate with an IBM host as a CRT or printer, letting users address and send output to more than one device at a time. PCI 200 converters are compatible with IBM mainframe file upload and download facilities, allowing personal computer users to share data between applications and host databases. Through a software option available on the 251, a personal computer attached to the converter can transfer data files to and from a System 34/36/38, and allocate, delete, and rename files on the PC's diskette.

The PCI 7621, which is ideal for large networks as it supports 21 terminal connections, is configured through a command port. Users can monitor power, system status, host reception and transmission, and terminal lines through LEDs on the 7621 front panel. The unit incorporates four Z-80 microprocessors, which control system operation and offer built-in redundancy. Security features on the 7621 include password security on each port.

Several options are available on PCI converters. A PaperCRT option permits ASCII keyboard/printer terminals to appear as full-screen IBM 3278 CRT terminals, using full-screen editing applications programs. With the Graphics Option, ASCII terminals with graphics capabilities can be used in an SNA/SDLC network in conjunction with the host graphics package. The CoaxFace Option, available through two CoaxFace devices, each measuring 3 by 2 by 1 inches, allows existing coaxial cable to be used for RS-232-C connections, or coaxial cable can be installed instead of RS-232-C cable. RS-232-C cable connections are generally limited to distances of 50 feet; with CoaxFace, distances using coaxial cable may be extended to 5,000 feet.

PRICING

PCI Converters are available for purchase only. Quantity discounts are available for purchase of more than five units. Headquartered in Woodland Hills, CA, PCI maintains offices in New York, Boston, Chicago, Houston, Los Angeles, and England. Prices for the models described in this report are shown in the following table.

EQUIPMENT PRICES

	Purchase Price ($)
PCI 1051, 1067, 1071, 1076 with—	
One port	3,100
Three ports	4,500
Five ports	5,800
Seven ports	7,000
Videotext 67	Contact Vendor
PCI 151, 167, 171, 176 with—	
One port	2,850
Three ports	3,900
Five ports	4,600
Seven ports	5,300
PCI 7621	7,200

▷ knowledge that marks PCI's strongest competitive advantage in the conversion marketplace. Although PCI now faces competition from a growing number of vendors, the company has a solid installed user base for its converters, and it offers the broadest line of converters available from one source.

To strengthen its financial position, PCI has aggressively sought agreements with other companies to distribute, OEM, or sell PCI converters under a private label. According to PCI's *1984 Annual Report*, sales to these organizations accounted for 82 percent of total revenues, up from 62 percent in 1983. Although PCI experienced a sharp drop in the percentage of total revenues from 1983 to 1984, the company's position in the market is still strong. Several factors beyond PCI's direct control accounted for decreased revenues: the general slump in the computer industry, increased competition in the conversion market, and price erosions. PCI's plan to increase its financial standing by opening up its distribution channels was further supported by the company's decision to greatly increase the amount of revenue plowed back into research and development to maintain a leading market position. Also, the company recently reduced its staff by one third to reduce overall operating expenses, and named a new president and chief executive officer, who has announced PCI's intention to enter the packet switching and wide-area network markets. PCI's aggressive response to tough times reflects the company's desire to maintain a strong market position.

ADVANTAGES AND RESTRICTIONS

PCI offers a broad line of conversion products and is, therefore, an excellent source for prospective buyers whose needs are specialized or varied. As one of the oldest companies in the protocol conversion market, PCI has experience in researching and developing conversion technologies, which can be tricky and difficult to implement; therefore, one of the company's strongest advantages is its established position in a marketplace filled with newcomers.

PCI's new Series 100 converters, offering the capability of older Series 1000 units at a price that is 40 percent less, are economic choices for users requiring a large number of units in the network. The new 200 Series converters, although more expensive, are available on compact program packs which slide into the front of an enclosure. Should the user's needs change, switching to a different conversion requires only a simple pack replacement. The new Series 200 products also provide network management control features, available through a command port on the units. Through an attached terminal, users can configure up to 32 user profiles for attached devices; the PCI 200 converter provides the prompts needed to change profile data. Another advantage offered on Series 200 units is dynamic spooling capability, which allows a personal computer to function as both a CRT and a printer through a single port. These new converters also provide four levels of security.

Those contemplating the use of PCI converters should note that a different model will be necessary to handle each type of conversion. This can pose a restriction for networks in

▶

	Purchase Price ($)
PCI 71B/SNA, 75B/SNA, 3780/SNA with—	
One BSC port, one SDLC port, one logical unit*	3,100
PCI 1076 with—	
One port	3,350
Three ports	4,300
Five ports	5,150
Seven ports	5,800
PCI 73SX, R73SX	5,500
PCI 74D	5,200
PCI 251, 276	5,800
PCI 271	5,800
OPTIONS	
Graphics	450
PaperCRT	450
CoaxFace, per pair	150

For additional logic units add $150 per unit. ∎

which several different types of protocols are in use at once. A few available conversion systems do offer line concentration and multiple protocol capability, whereby several different types of emulations are available on software modules loaded from an IBM host to the converter. In some cases, it will be cheaper to install a multiprotocol converter than a variety of converters, each handling a separate emulation. The major disadvantage of installing a multiconversion unit, however, is the extensive host-based programming involved in defining parameters for its operation. There are cost benefits of installing a multiprotocol converter instead of a variety of different units, and vice versa; therefore, users should carefully analyze network requirements in terms of both types of products.

USER REACTION

In Datapro's 1985 Terminal Users Survey, sent to a cross section of *Data Communications* magazine subscribers, 83 users rated 393 PCI converters, including 4 151/1051s, 57 167/1067s, 32 171/1071s, 101 176/1076s, and 199 other and unspecified models. The combined ratings for all models is shown in the following table. (Note: not all respondents rated the converters in every category.)

|	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	31	37	10	4	3.2
Ease of installation	18	50	12	3	3.0
Ease of operation	27	44	9	3	3.1
Device reliability	28	32	17	4	3.0
Maintenance service/ technical support	13	32	24	10	2.6

*Weighted Average based on a scale of 4.0 for Excellent.

In the survey, PCI received, by far, the highest number of responses, followed by Datastream with 29 responses, IBM ▷

Protocol Computers, Inc.
Protocol Converters

▷ with 23 responses (ten of which were for a Series 1, which is a minicomputer that offers protocol conversion functions), Local Data with 18 responses, and Micom with 13 responses. Both PCI and IBM received an equivalent rating, 3.2, in the Overall Satisfaction category; Micom received the high-est overall rating, 3.5. PCI's lowest rating, 2.6, was in the Maintenance/Service category. The only major competitor to significantly top this rating was IBM, which received a 3.1 for support. □

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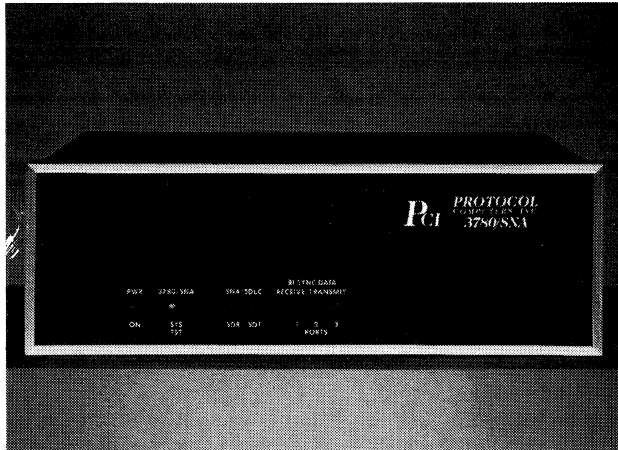
PCI's 3780/SNA is a BSC-to-SDLC protocol converter for 3780 emulation. With a 3780/SNA, a 3780 device appears to the host as an IBM 3776-2, single-logic unit RJE workstation.

MANAGEMENT SUMMARY

Protocol Computers, Inc. (PCI) is a company that specializes in protocol conversion technology. The company offered its first converter, the PCI 1067, in 1980—well before most other vendors introduced conversion products. The PCI 1067 allows inexpensive ASCII terminals to emulate IBM 3767s in an SNA/SDLC environment.

The company's second offering, the PCI 1076, put PCI in a leading market position because the device gave customers the type of conversion they most desired—ASCII to 3270. Today, many other companies offer conversion products that provide 3270 emulation for ASCII terminals. In fact, it is in this particular conversion market that PCI faces the strongest competition.

Protocol Computers has expanded its product line to include 12 different protocol converters, which provide five basic types of conversion:

- PCI 1051, 1067, 1076, and Videotext 67 offer ASCII-to-SDLC conversion;

- PCI 1071 converts ASCII to BSC;

- PCI 71B/SNA, 75B/SNA, and 3780/SNA units provide BSC-to-SDLC conversion;

- PCI 1076X, 73SX, and R73SX operate in X.25 networks. The 1076X allows up to seven ASCII terminals to communicate with an SDLC host through an X.25 network; the R73SX lets IBM or equivalent 3274/6 cluster controllers communicate with SDLC hosts through the X.25 network; ▷

PCI is the most prominent vendor in the current protocol converter marketplace. The company currently offers 12 different models that perform conversion within ASCII, BSC, and SDLC environments.

MODELS: 1051, 1067, 1076, Videotext 67, 1071, 71B/SNA, 75B/SNA, 3780/SNA, 1076X, 73SX, R73SX, 74D.
CONVERSION: 1051, 1067, 1076, and Videotext 67—ASCII-to-SDLC; 1071—ASCII-to-BSC; 71B/SNA, 75B/SNA, and 3780/SNA—BSC-to-SDLC; 1076X, 73SX, and R73SX—ASCII-or SDLC-to-X.25; 74D—SDLC-to-ASCII.
TRANSMISSION RATES: Up to 9600 bps, on both the terminal side and the host side.
COMPETITION: Micom (formerly ICCI), Icot, Datastream, Local Data.
PRICE: Ranges from $3,100 for a basic one-port ASCII-to-SDLC unit to $8,500 for a seven-port unit that combines ASCII-to-SDLC conversion with an X.25 PAD.

CHARACTERISTICS

VENDOR: Protocol Computers, Inc., 6150 Canoga Avenue, Woodland Hills, CA 91367-3773. Telephone (800) 423-5904; in California, (213) 716-5500.

DATE OF ANNOUNCEMENT: 1067—1st quarter 1980; 1076—October 1981; 1071 & 71B/SNA—June 1982; 1051—September 1982; 75B/SNA—1982; 74D—November 1983; Videotext 67, 3780/SNA, 1076X, 73SX, & R73SX—1983.

DATE OF FIRST DELIVERY: 1067—1st quarter 1980; 1076—October 1981; 1071 & 71B/SNA—June 1982; 1051—September 1982; 75B/SNA, 3780/SNA, 1076X, 735X, R73SX, Videotext 67, 74D—Information not available.

NUMBER INSTALLED TO DATE: Approximately 1500.

SERVICED BY: Protocol Computers, Inc.

MODELS

PCI manufactures 12 protocol converters. They handle five different types of conversion.

ASCII-to-SDLC Conversion:

- 1051—used with IBM System 34/38; emulates the IBM 5251-12 workstation, allowing any combination of ASCII CRTs and printers to be attached to a System 34/38; one, three, or seven terminal ports are available.

- 1067—provides emulation of the IBM 3767 keyboard/printer terminal (Physical Unit Type 1); permits one, three, five, or seven ASCII devices to appear as 3767s in SNA network. ▶

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▷ • PCI 74D provides SDLC-to-ASCII conversion.

The PCI 1051 is designed for use in a System 34 or 38 terminal network. The converter attaches either remotely or directly to a System 34 or 38 and replaces an IBM 5251-12 controller. Up to seven ASCII displays and printers can be attached through the PCI 1051 and appear to the System 34 or 38 as 5251-11 CRTs with Model 5256 printers attached.

The PCI 1067 is an alternative to IBM's Network Terminal Operator (NTO) software. The 1067 emulates the 3767 controller and provides all NTO functions; it eliminates the need to purchase and maintain software, and frees up processor memory space. With the 1067, users can also link special equipment, such as graphics devices, plotters, APL terminals, and processor-control equipment, to the SNA network.

Another ASCII-to-SDLC unit, the PCI 1076, emulates an IBM 3276 controller. Users can attach any combination of up to seven ASCII CRTs and printers to the 1076 which appear to the host as IBM 3278s or 3287s.

The newest member of the ASCII-to-SDLC conversion group, the Videotext 67, allows users to link various types of asynchronous videotext terminals to an IBM SDLC host port via leased telephone lines. Up to six PCI Videotext 67s multidropped on a leased line can interface with one IBM 3705 port. Each converter, in turn, supports seven terminals. Videotext 67 includes management functions that eliminate the need to purchase IBM Videotext Facility and Network Terminal Options software.

PCI's ASCII-to-BSC converter, the PCI 1071, provides IBM 3271 controller emulation. The device permits the use of ASCII peripherals in a BSC network; 1071 supports up to seven terminals.

All five of the models described above are available with one, three, five, or seven ports, and permit the attachment of any combination of ASCII CRTs and printers. A dynamic printer allocation feature on each converter allows an additional printer to be added to the basic configuration. Configuration of this port requires that one of the basic ports be selected as its "partner." Whenever the dynamic printer port is active, the keyboard of the terminal attached to the "partner" port is disabled.

The PCI 71B/SNA, 75B/SNA, and 3780/SNA converters are designed to extend the life of BSC terminals in an SNA environment by allowing BSC terminals to communicate with an SDLC host. The PCI 71B/SNA lets IBM 3271s and compatible BSC equipment act as IBM 3274s. The converter permits attachment of up to three BSC control units and 32 devices. The 75B/SNA provides conversion of up to three IBM 3275 or equivalent controllers to 3276 emulation. The PCI 3780/SNA is a BSC-to-SDLC converter for up to three 3780-type batch terminals. When communicating through the PCI 3780/SNA, the 3780 terminals appear to the host as IBM 3776-2 single-logic unit worksta- ▷

▶ • 1076—emulates the IBM 3276 controller; one, three, five, or seven ports available; lets any combination of ASCII CRTs or printers appear as IBM 3278/3287 terminals with dial-up access to SNA/SDLC networks.

• Videotext 67—used with videotext terminals; emulates IBM 3767 SDLC (PU Type 1) devices; one, three, five, or seven terminal ports are available.

ASCII-to-BSC:

• 1071—emulates the IBM 3271; permits ASCII terminals to plug into BSC networks; available with one, three, five, or seven terminal ports.

BSC-to-SDLC Conversion:

• 71B/SNA—converts 3271-type controllers to IBM 3274 emulation; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

• 75B/SNA—converts 3275-type controllers to 3276 emulation; provides up to three terminal ports operating at up to 4800 bps or one terminal port at 9600 bps.

• 3780/SNA—provides conversion of IBM 3780-type batch terminals to emulation of IBM 3776-2 single logic unit RJE workstations (PU Type 2); supports printers, card readers, and card-punch devices; provides up to three terminal ports at up to 4800 bps or one terminal port at 9600 bps.

ASCII-to-SDLC and SDLC-to-SDLC Conversion through an X.25 Network:

• 1076X—provides interface between X.25 network and ASCII terminals to any ASCII or SDLC host; supports one, three, five, or seven ports; desktop or rack-mount versions available.

• 73SX—emulates an IBM 3274/76 controller; links an SDLC host to the X.25 node; supports up to eight 1076X or R73SX units, each supporting their own attached devices; desktop or rack-mount versions available.

• R73SX—used with 73SX: lets up to three IBM or equivalent 3274/6-type controllers, communicate with SDLC hosts through an X.25 network; creates independent virtual circuits through network to 73SXs at up to three host sites.

SDLC-to-ASCII Conversion:

• 74D—lets up to seven IBM 3278 or equivalent terminals communicate with up to six ASCII hosts (including DEC host, public and private networks, personal computers, and local area networks); interfaces with an IBM 3274/6 cluster controller on the terminal side, and with an IBM 270X/37XX-type communications controller and up to six ASCII devices on the host side.

TRANSMISSION SPECIFICATIONS

For the 1051, 1067, 1076, 1071, and Videotext 67 transmission is asynchronous, full-duplex on the terminal side of the converter, and synchronous, half- or full-duplex on the modem side. Each model features one RS-232-C SDLC port (BSC for the 1071); one, three, five, or seven RS-232-C ASCII terminal ports; and one dynamic printer allocation port. The dynamic printer allocation port allows one additional printer to be added to the basic configuration. Whenever the dynamic printer port is active, the keyboard of a selected terminal in the basic configuration is temporarily ▶

Protocol Computers, Inc.
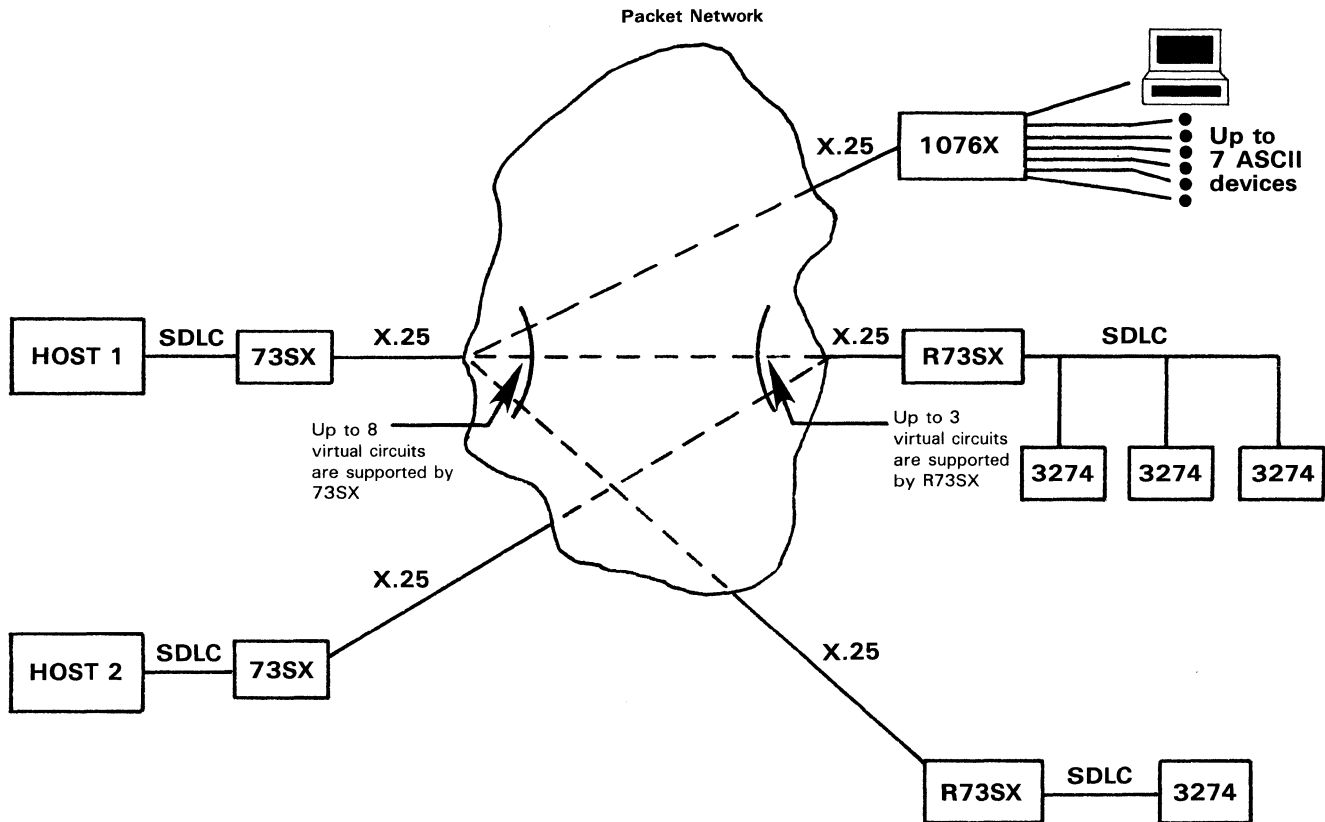## Protocol Converters

Figure 1. Shown here is a sample configuration of PCI's X.25 Series converters. The 1076X provides interfacing between the X.25 network and up to seven ASCII devices. The 73SX links the SDLC host to the X.25 network, and communicates with up to eight 1076Xs or R73SXs. The R73SX lets up to three attached SDLC cluster controllers communicate with up to three SDLC hosts through the network.

tions. The unit also supports conversion for 3780-associated printers, card readers, and card-punch devices.

PCI's family of X.25 converters provides ASCII-to-SDLC and SDLC-to-SDLC communication through X.25 public packet networks, thus completing the connection.

Using a 1076X converter on the terminals' side of an X.25 network and a 73SX on the host side, ASCII units can appear to the host as 3278s with full screen editors or as 3287 printers connected through 3274/6 cluster controllers. Each 1076X provides up to seven ports for the connection of ASCII devices. The 1076X is primarily a packet assembler/disassembler (PAD) that permits communications from the ASCII devices to an ASCII or SDLC host through the X.25 network; however, it also performs the ASCII-to-SDLC conversion required to communicate with an SDLC host.

On the host side, the 73SX can communicate with up to eight 1076Xs, since the 73SX is capable of maintaining up ▷

disabled. All ports accept speeds up to 9600 bps. Even or no parity can be selected. Each model features automatic speed detection, from 300 to 1200 bps. Connection can be to leased or dial-up facilities, or direct connection to the host computer. Both IBM and non-IBM modems can be used.

The 71B/SNA, 75B/SNA, and 3780/SNA support the following physical connections: one SDLC port at speeds up to 9600 bps; and, one BSC port at speeds up to 9600 bps; or up to three BSC ports at speeds up to 4800 bps.

The 1076X, 73SX, and R73SX support full-duplex, asynchronous 9600 bps transmission on the X.25 side. On the terminal side, the 1076X supports full-duplex transmission at 1200 bps. The 73SX-to-host connection, which can be direct or through a modem, is synchronous, full-duplex at speeds up to 9600 bps. On the terminal side, the R73SX supports up to three 3274/6-type devices.

The 1076X lets each attached ASCII devices establish its own virtual circuit to an ASCII host on the X.25 network or to share or establish a virtual circuit to an SDLC host. The 73SX supports switched or permanent virtual circuits, which are switch-selectable up to eight simultaneous circuits. The 73SX only accepts calls; the 1076X and R73SX initiate the calls. On both the 1076X and the 73SX, X-on-/X-off con- ▶

▷ to eight virtual circuits through the X.25 network. The 73SX presents the data to its SDLC host by appearing to the host as one or more 3274/6 control units communicating over a point-to-point or multipoint line. Both the 1076X and 73SX come in desktop and rack-mountable versions.

For users not requiring the ASCII-to-SDLC conversion, PCI also offers the R73SX, which lets attached SDLC cluster controllers communicate with up to three SDLC hosts through the X.25 network. Each R73SX can support up to three IBM 3274/6-type controllers, using a multidrop configuration. The R73SX maintains a virtual circuit through the X.25 network to a 73SX at each host site. The 73SX presents the data to its host from the SDLC controllers connected via the R73SXs as if they were attached on a point-to-point multipoint line. On the top of page 103, a diagram shows a typical configuration of PCI 1076X, 73SX, and R73SX devices.

PCI's most recent offering is the 74D, a protocol converter that performs a conversion that is the reverse of other PCI units. (The company calls this unit a deconverter.) While other PCI converters let ASCII terminals talk to SNA hosts, the 74D allows IBM 3278 or equivalent terminals to talk to an ASCII host. PCI 74D interfaces an IBM 3274/6-type cluster controller on the terminal side with an IBM 270X/37XX-type communications controller and with up to six ASCII computers, which can be DEC hosts, online databases and remote computing services such as CompuServe, personal computers, or other ASCII resources, on the host side. Supported by 74D, the terminals can switch between SDLC and ASCII hosts. When the terminal talks to the SDLC host it communicates through the 270X/37XX communications controller. When it communicates with the ASCII host, the 74D performs the necessary conversion. The 74D can support up to six simultaneous dialogs among six different 3278s and six selected ASCII hosts or other devices.

Options available with the ASCII converters include the Graphics Option, the CoaxFace Option, and the PaperCRT option. The Graphics Option permits full-screen, color or black-and-white graphics by an ASCII graphics terminal on an SNA network. The CoaxFace Option is a device manufactured by PCI that permits ASCII terminals to plug into coaxial cable, by performing RS-232-C to RG-62A/U coaxial cable interface conversion. The CoaxFace devices allow for connection distances of up to 5000 feet, as opposed to the 50-foot limitation placed on RS-232-C distances. The PaperCRT Option allows ASCII keyboard/printers to appear as full-screen IBM 3278 CRT terminals.

In addition to its protocol converters, PCI offers two terminals— Networker 51, and Networker 78. Networker 51, specificially designed to work with the PCI 1051 protocol converter, provides IBM 5251-11 emulation in a System 34/38 environment. The Networker 78 is designed to work with the PCI 1076 protocol converter and provides IBM 3278 emulation.

PCI also manufactures two communications software packages that let an IBM Personal Computer work both as ▷

▶ trols data flow. Physical connection for these units is RS-232-C.

The 74D supports one RS-232-C SDLC port on the terminal side, and one SDLC port plus up to six ASCII ports on the host side. All ports accept speeds of up to 9600 bps. Even or no parity can be selected. Automatic speed detection is support from 300 to 1200 bps. Communication to the host computers is asynchronous, full-duplex via leased or dial-up facilities or direct connection.

DEVICE CONTROL

PCI converters are operator configurable via switches located on logic boards inside the back cover of the unit. Installation involves configuration of the synchronous port and the asynchronous ports.

Examples of the functions that must be set on the synchronous side of the converter include: whether the unit will connect to the host directly, or via the modem; the polling address; at what speed the unit will be operating; and whether or not Non-Return-to-Zero-Inverted (NRZI) will be used.

The asynchronous ports must be configured for the following: whether the ASCII terminal will connect directly to the converter, or to a modem or modem sharing unit (MSU); which of the ports are assigned to CRTs; CRT brand (over 300 different models are supported by PCI); speed for each port; autospeed selection; which ports are assigned to printers; printer speeds; and whether the dynamic printer port will be used, and by which CRT. The synchronous ports must be configured for SDLC and/or BSC address; number of devices connected (e.g., up to 32 Logical Units, converted to one SNA Physical Unit Type 2); and SNA/SDLC timeout. On X.25 Series units the following selections must be configured: first logical channel number, packet window, packet length, and frame timeout.

The PCI 74D starts a dialog with a 3278 terminal user by sending a menu, which displays on the 3278 screen. The user selects a desired destination, for example, a DEC host. Once a connection with an ASCII device is established, the 3278 emulates an ASCII terminal.

At power-on, all internal hardware and firmware components are tested. In addition, all PCI units have built-in diagnostic line monitors and integrated trace capabilities. The following diagnostics test sequences are activated by keyboard command: display of switch settings; ASCII line test; monitor of SDLC address polling; display of SDLC address and control bytes; display of SDLC status; display of X.25 frames and packets; and SNA tracing of data at the port where the test is executed. Test results are displayed on a CRT and/or printer attached to the converter. A special port is provided for monitoring of the converter itself.

The PaperCRT option permits ASCII keyboard/printer terminals to appear as full-screen IBM 3278 CRT terminals, using full-screen editing applications programs.

With the Graphics Option, ASCII terminals with graphics capabilities are able to be utilized in an SNA/SDLC network in conjunction with the host graphic package.

The CoaxFace Option involves two CoaxFace devices, each measuring 3-by-2-by-1 inches. The devices interface between RS-232 and RG-62A/U coaxial cable. They are available at both ends of a coaxial cable. With CoaxFace, existing coaxial cable may be utilized for RS-232-C connections, or coaxial cable can be installed instead of RS-232 cable. RS-232 cable connections are generally limited to distances of 50 feet; with CoaxFace, distances using coaxial cable may be extended to 5000 feet. ▶

Protocol Computers, Inc.
Protocol Converters

▷ a microcomputer and as an intelligent, full-screen communications terminal in the network. One package, PCI 5156+, supports IBM PC operation in a System 34/38 network. The other package, PCI 7887+, operates in the SNA/SDLC or BSC 3270 network.

COMPETITIVE POSITION

The entire protocol conversion market has changed dramatically in just a few years. What was once a small, relatively obscure market in the data communications industry has become a $100 million a year business. At present, small, specialized firms vie with large data communications equipment manufacturers for a market share. Protocol Computers, Inc. is the most prominent of the small vendors.

PCI is a unique vendor in the data communications marketplace. It is one of the few companies that specializes in a particular data communications technology; most data communications vendors offer several different lines of products. PCI has researched and developed protocol conversion technology since 1980, when only Industrial Computer Controls, Inc. was offering significant competition. It is this specialized knowledge that marks PCI's strongest competitive advantage in the conversion marketplace. Although PCI now faces competition from a growing number of vendors, the company has a solid-installed user base for its converters.

PCI lost one of its major competitors when Micom acquired Industrial Computer Controls, Inc. in November 1983. But Micom has already announced the Micro7400, an upgraded replacement of ICCI's CA20 unit. The Micro7400 emulates an IBM 3274 Model 51C cluster controller, communicating in either BSC or SDLC protocol. Other major competitors now in the market include Icot, which manufactures the Virtual Terminal System 351/352 conversion units for use in the 3270 environment; Datastream, which offers a series of 3270 emulation units; and Local Data, which manufactures the Datalynx and Interlynx products in several versions. The Datalynx 3274 emulates IBM 3274/76 controllers and provides ASCII-to-BSC or –SDLC conversion. The Interlynx 3278 interfaces asynchronous personal computers, word processors, and ASCII terminals to IBM 3274/76 control units.

ADVANTAGES AND RESTRICTIONS

PCI offers a varied line of conversion products and is, therefore, an excellent source for prospective buyers whose

▶ **PRICING**

PCI Converters are available for purchase only. Quantity discounts are available for purchase of more than five units.

	Purchase	Monthly Maint.
PCI 1051, 1067, 1071, 1076—		
One-port unit	$ 3,100	$ 30
Three-port unit	4,500	45
Five-port unit	5,800	50
Seven-port unit	7,000	65
Videotext 67	Contact vendor	
PCI 71B/SNA, 75B/SNA, 3780/SNA—		
Includes one Bisync port, one SDLC port, one logical unit*	3,100	35
PCI 1076X—		
One-port unit	4,600	30
Three-port unit	6,000	45
Five-port unit	7,300	50
Seven-port unit	8,500	65
PCI 73SX, R73SX	5,500	50
PCI 74D	5,200	—

Options

	Purchase	Monthly Maint.
Graphics; available on 1051, 1067, 1071, 1076, & 1076X only	450	10
PaperCRT; available on 1051, 1071, 1076, 1076X, & 1076X only	450	—
CoaxFace; per pair; available on 1051, 1071, 1076, & 1076X only	150	—

*For additional logic units add $150 per unit. ■

needs are specialized. PCI has experience in researching and developing conversion technologies, which can be tricky and difficult to implement. The company's strongest advantage is its established position in the marketplace filled with newcomers.

USER REACTION

PCI did not provide a list of users for the products we cover in this report. Therefore, we could not conduct a user reaction survey. □