



**User Manual for the
*HE693CPU4xx***

PC CPU Module

**First Edition
30 June 2000**

MAN0051-01

PREFACE

This manual explains how to use the Horner APG PC CPU Module.

Copyright (C) 2000 Horner APG, LLC., 640 North Sherman Drive Indianapolis, Indiana 46201. All rights reserved. No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior agreement and written permission of Horner APG, LLC.

All software described in this document or media is also copyrighted material subject to the terms and conditions of the Horner Software License Agreement.

Information in this document is subject to change without notice and does not represent a commitment on the part of Horner APG, LLC.

For user manual updates, contact Horner APG, Technical Support Division, at (317) 916-4274 or visit our website at www.heapg.com.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Horner APG, LLC. ("HE-APG") warrants to the original purchaser that the PC CPU Module manufactured by HE-APG is free from defects in material and workmanship under normal use and service. The obligation of HE-APG under this warranty shall be limited to the repair or exchange of any part or parts which may prove defective under normal use and service within two (2) years from the date of manufacture or eighteen (18) months from the date of installation by the original purchaser whichever occurs first, such defect to be disclosed to the satisfaction of HE-APG after examination by HE-APG of the allegedly defective part or parts. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES AND HE-APG NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR HE-APG, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS PC CPU Module. THIS WARRANTY SHALL NOT APPLY TO THIS PC CPU Module OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. HE-APG MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY HE-APG. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE PC CPU Module IS ORIGINALLY INSTALLED. THIS WARRANTY SHALL APPLY ONLY WITHIN THE BOUNDARIES OF THE CONTINENTAL UNITED STATES.

In no event, whether as a result of breach of contract, warranty, tort (including negligence) or otherwise, shall HE-APG or its suppliers be liable of any special, consequential, incidental or penal damages including, but not limited to, loss of profit or revenues, loss of use of the products or any associated equipment, damage to associated equipment, cost of capital, cost of substitute products, facilities, services or replacement power, down time costs, or claims of original purchaser's customers for such damages.

To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing PC CPU Module to appropriately design the end system, to appropriately integrate the PC CPU Module and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

Revisions to This Manual

This version (MAN0051-01 of the **PC CPU Module User Manual** contains the following revisions, additions and deletions:

1. Converted manual into Word format.
2. Changed company name from Horner Electric, Inc.to Horner APG, LLC.

NOTES

Table of Contents

PREFACE.....	3
ABOUT PROGRAMMING EXAMPLES	4
Revisions to This Manual	5
CHAPTER 1: INTRODUCTION.....	9
1.1 What is the Horner APG PC CPU?.....	9
1.2 What you have.....	9
1.3 What you need.....	10
1.4 Product Features	10
1.5 Specifications.....	11
CHAPTER 2: PERSONAL COMPUTER HARDWARE.....	13
2.1 CARDIO Integrated Package.....	13
2.2 Hard Drive/Flash Drive.....	14
2.3 PCMCIA Socket.....	14
2.3.1 Installing the PC Card	15
2.4 I/O Connections	16
2.4.1 Printer Port.....	16
2.4.2 COM Port Connections.....	16
2.4.3 VGA Port.....	17
2.4.4 Keyboard Port.....	17
2.4.5 External 3.5" Floppy Diskette/CD ROM Option	17
2.4.6 Frame Ground Connection.....	17
2.4.7 External Power Connector.....	18
CHAPTER 3: BACKPLANE COMMUNICATIONS	19
3.1 Backplane Description.....	19
3.2 IOCM	20
3.3 Software Interface.....	20
3.4 Software Locations.....	22
CHAPTER 4: INSTALLATION AND WIRING.....	23
4.1 Serial Port.....	23
4.2 Parallel Port.....	24
4.3 Video Port.....	25
4.4 Keyboard Port.....	25
4.5 External Power Connector.....	26
APPENDIX A: PINOUT DIAGRAMS.....	27
A.1 RS-232 Port w/RJ-45 Connector (COM1).....	27
A.2 PLC Serial Port (COM2).....	28
A.3 25-Pin D-Sub Parallel Port	29
APPENDIX B: PIF DOCUMENTATION	31
B.1 Visual C++™ Demo.....	31
B.2 Visual Basic™ Demo	34
B.3 Installing the PIF300 32-Bit DLL.....	36
APPENDIX C: DIRECT CABLE CONNECTION INSTRUCTIONS.....	39
C.1 DIRECT CABLE CONNECTION INSTRUCTIONS.....	39
APPENDIX D: PC CARD INSTALLATION PROCEDURE.....	41
D.1 PC Card Installation Procedure	41

CHAPTER 1: INTRODUCTION

Congratulations on your purchase of the Horner APG PC CPU for the GE Fanuc Series 90-30 PLC. This product brings the power of a complete personal computing system to the Series 90-30 backplane. This product was designed utilizing state-of-the-art, miniaturized components, resulting in a superior product which is compact, rugged, powerful, and user friendly, which are top priorities in today's industrial environments. The advantage of the Horner APG PC CPU is that it allows customers to use familiar operating systems, in addition to the multitude of software and peripherals available to satisfy their particular needs.

1.1 What is the Horner APG PC CPU?

The PC CPU is a single-slot (Slot One) Series 90-30 CPU. As its name implies, it consists of a processor designed to provide processing power to replace the PLC CPU. The PC CPU has direct control over PLC I/O and performs some other function(s) that the PLC CPU is incapable of performing, or which if performed by the PLC CPU, would adversely affect its performance.

What sets the Horner APG PC CPU apart from standard PLC CPU is the fact that it is composed of standard personal computer (PC) hardware housed in an extremely compact package, allowing it to be used anywhere a Series 90-30 PLC can reside. The use of highly integrated components not only allows for a compact package, but also provides a high degree of reliability and ruggedness. The utilization of standard PC hardware allows the customer to choose from several different software and development packages designed for that platform.

The PC CPU communicates to the Series 90-30 backplane through the IOCM interface (same interface that is used by many of the standard PLC CPUs). A dedicated microprocessor handles bus communications, maximizing throughput without delaying the PC microprocessor.

1.2 What you have

The standard PC CPU package includes the following:

- PC CPU Module
- Operating System (OS) Software Manual and Master Diskettes (Microsoft™ MS-DOS™ 6.22, Windows™95 or Windows™NT)
- Development Libraries Diskettes
- 2 Adapter Cables (for serial and parallel ports)
- This Manual

1.3 What you need

The PC CPU module will require **at least** the following for development:

- Keyboard (PS/2™ Style connector)
- Monitor (VGA)
- External Floppy/CD drive accessory, PCMCIA Flash Disk or, Serial Transfer Program (i.e. LapLink™ or Windows95/NT™-based Direct Cable Connection)

1.4 Product Features

Integrated package consisting of the following:

- 1) Epson™ CARDIO™ (approx. size of a credit card), consisting of
 - Intel 386™ 20MHz, 486™ DX 25MHz, 486™ DX4 75MHz, or 486™ DX4 100 MHz microprocessor
 - 1MB, 8MB, 16MB*, or 32MB* RAM
 - Keyboard Interface (PS/2™ Style)
 - RS-232 port
 - RS-485 port (15-pin, SNP port)
 - Parallel port
 - VGA connector (CRT)
- 2) PCMCIA ATA Hard Disk Drive (170MB or 340MB) or PCMCIA ATA Flash Disk Drive (5MB, 10MB or 20MB)
- 3) Dedicated 89C31 microprocessor for Series 90-30 bus communications
Operating System pre-installed
(by default Microsoft™ MS-DOS™ 6.22)

* Specific CPUs only

1.5 Specifications

Model (HE693PCC4xx)	41x	44x	45x	46x
PC Specifications				
Microprocessor	Intel 386	Intel 486	Intel 486	Intel 486
Main Memory (RAM)	1	8	16	16
Processor Speed	20MHz	25MHz	75MHz	100MHz
Hard Drive Size	5MB, 10MB, 20MB Flash or 170MB, 340 MB Disk			
Average Seek Time for Hard Drive	12mS			
Video Resolution	640 x 480 (VGA)			
PLC Interface Specifications				
Number of PLC Racks	Up to 8 total			
PLC I/O Interface	IOCM Addressed at I/O space 300H			
Typical Power Consumption w/ 340MB Hard Drive (External and Backplane Supply same)	800mA @ 5VDC	1000mA @ 5VDC	1400mA @ 5VDC	1600mA @ 5VDC
Maximum Power Consumption w/ 340MB Hard Drive (External and Backplane Supply same)	1200mA @ 5VDC	1400mA @ 5VDC	1800mA @ 5VDC	2200mA @ 5VDC
Environmental & Physical				
Temperature	-5 to +55°C			
Relative Humidity	8 to 80% RH non-condensing			
Minimum Enclosure Depth	9" (229mm)			
Cable Specifications				
All cables (Serial, Parallel, etc.) must have a length of 3 meters or less to promote optimum performance.				

NOTES

CHAPTER 2: PERSONAL COMPUTER HARDWARE

The PC CPU is a highly integrated package, consisting of 4 main components, listed below:

- CARDIO™ integrated package
- Hard Drive
- PCMCIA socket
- Series 90-30 Bus Interface

2.1 CARDIO Integrated Package

The Epson™ CARDIO™ integrates key PC components in a credit card-sized package. The block diagram is shown in **Figure 2.1**, below:

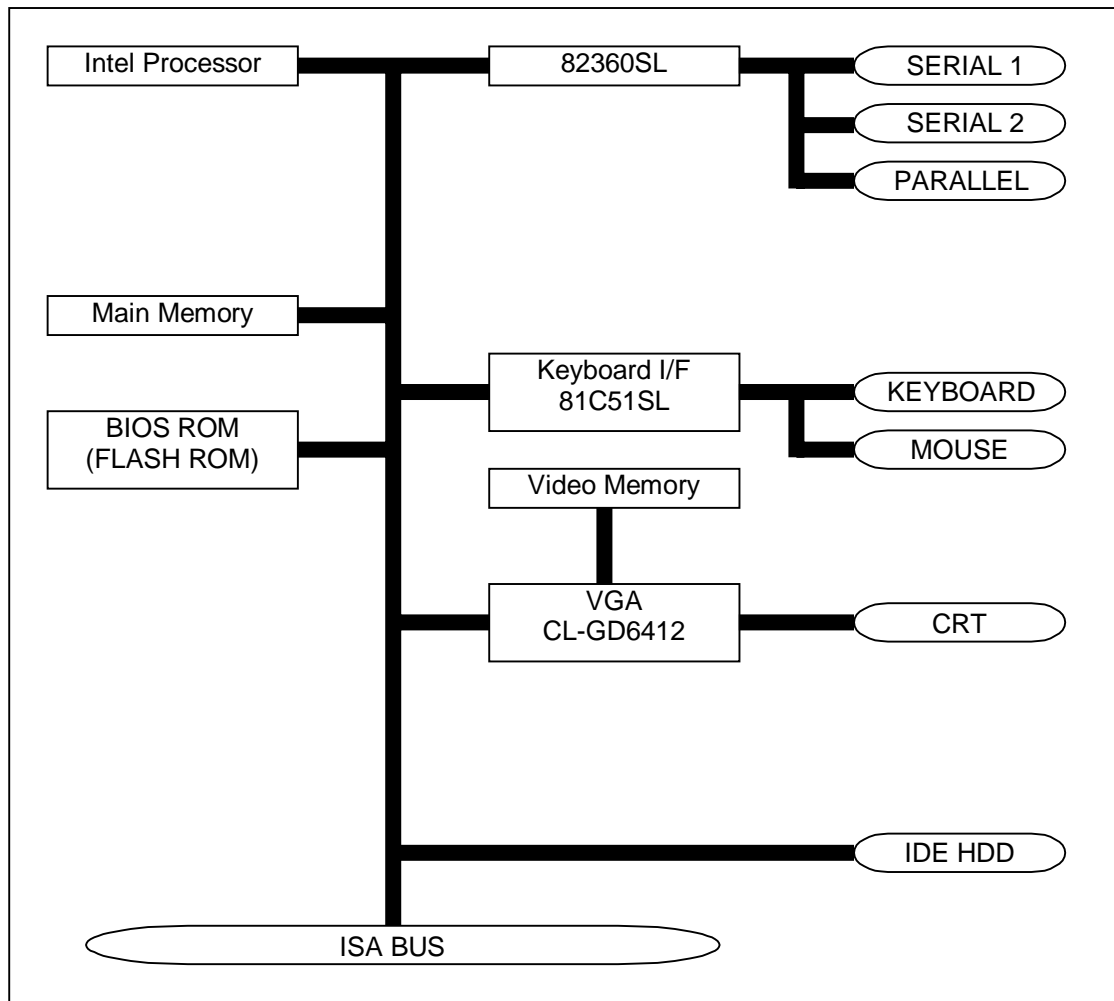


Figure 2.1 - CARDIO™ Block Diagram

The CARDIO™ resides on the PC CPU main circuit board in a 236-pin socket. Because the CARDIO™ is socketed, the unit can be easily upgraded. **Figure 2.2** shows an illustration of the CARDIO™.



Figure 2.2 - Epson™ CARDIO™

2.2 Hard Drive/Flash Drive

There are several Hard Drive/Flash Drive options for the PC CPU. The Hard Drive/Flash Drive is mounted on the PC CPU's secondary board. The Hard Drive is preconfigured at our factory as drive C: with the Operating System (Windows 95™ or NT™ and MS-DOS™ 6.22 by default) installed.

2.3 PCMCIA Socket

The PC CPU's secondary board includes a PCMCIA socket. "PCMCIA" stands for "Personal Computer Memory Card International Association". This is an organization which establishes standards for compact, credit card-sized memory cards for personal computers. The standards established by this organization have been adopted by several different peripherals and memory cards (Ex: Modems and Ethernet cards). PCMCIA established four different sizes of sockets; Type I, Type II, Type III, and Type IV. These socket types vary by the width of cards which they will accept. **The PC CPU PCMCIA socket is Type II, which supports Type I and Type II cards.**

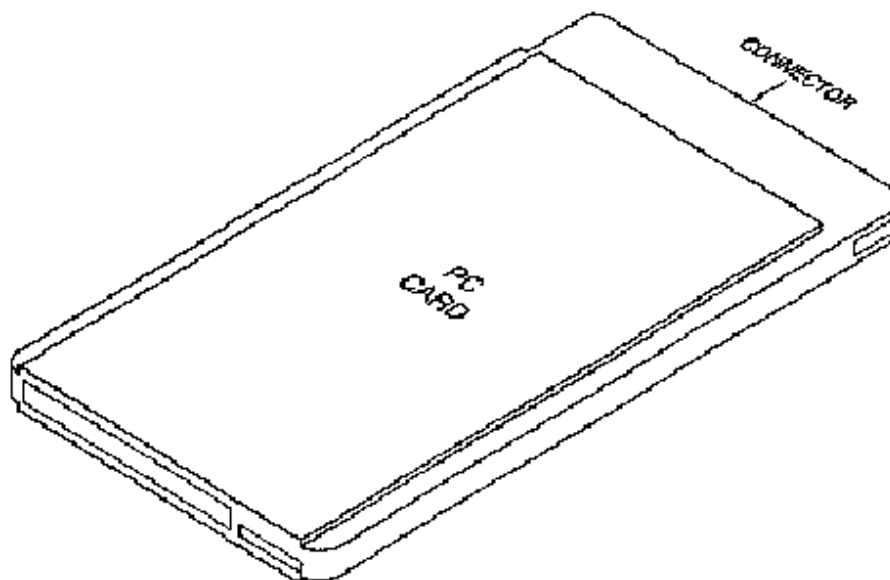


Figure 2.3 - Example PCMCIA Type II Peripheral

PCMCIA cards are typically provided with software drivers from the manufacturer. These should allow the peripheral to operate with most computers. However, because PCMCIA is a fairly new standard, compatibility problems can exist from card-to-card and computer-to-computer. Horner APG is testing a variety of PCMCIA peripherals. Contact Horner APG's Technical Support Department for a list of tested PCMCIA cards.

2.3.1 Installing the PC Card

Horner APG has successfully tested and installed a 3Com™ Etherlink™ III PCMCIA. See Appendix D, "Steps Taken for PC Card Installation", for documented procedures on installing a 3Com™ Etherlink™ III PCMCIA.

The physical installation of the PC Card is simple. The socket is located on the PC CPU's secondary board at the bottom left (if looking at the PC CPU from the front). The PCMCIA socket is shown in figure 2.4. The "top" of the PC Card should face toward the power supply. When properly inserted, the PC Card should fit snugly in the PCMCIA socket.

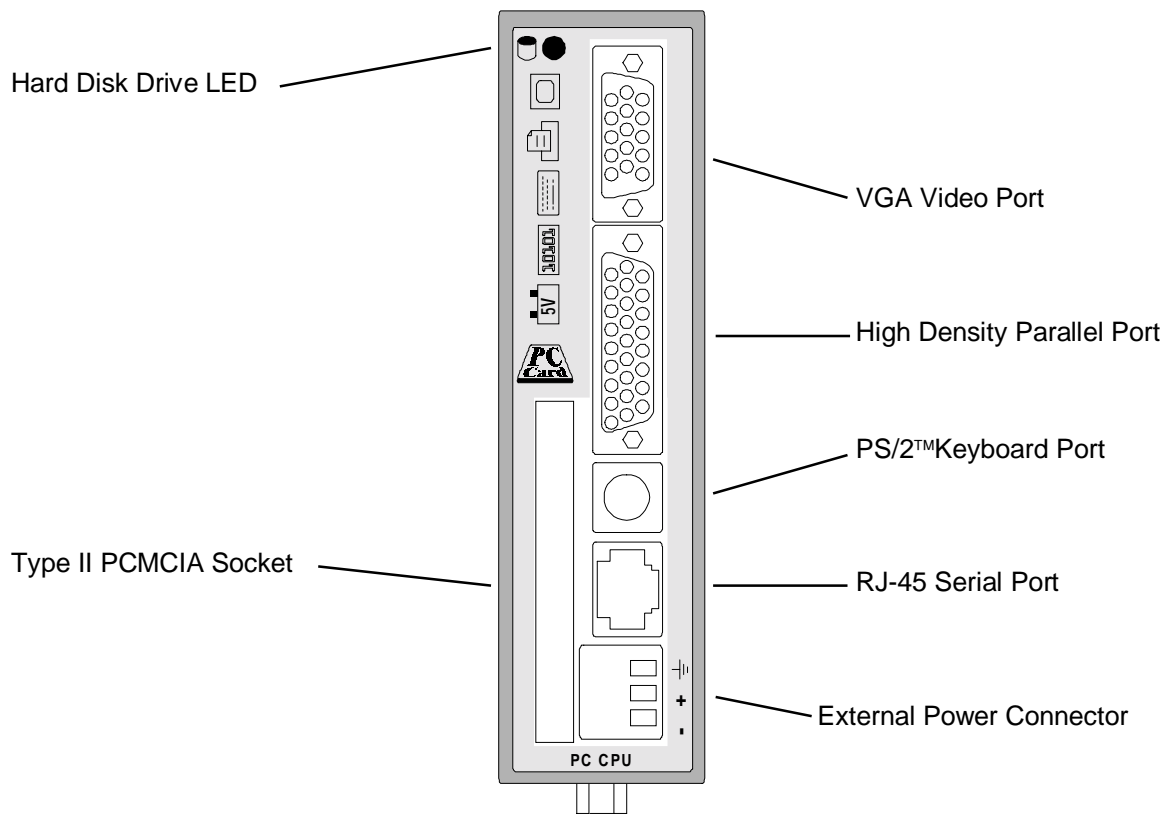


Figure 2.4 - Front Panel Layout.

2.4 I/O Connections

2.4.1 Printer Port

The Parallel Port features a 26-pin high density D-sub connector. Included with the PC CPU is a short adapter cable to convert this connector into a standard 25-pin D-sub Parallel Port. This is a standard pinout (shown in Appx-A), compatible with commercially available parallel printer cables and software keys.

2.4.2 COM Port Connections

The PC CPU supports two serial ports. COM1 is an RS-232 port with a RJ-45 connector. The pinout (shown in Appx-A) is compatible with an adapter cable (included), which will convert it to a standard personal computer 9-pin serial port. COM2 is the RS-422 port (with a DB15 female connector) on the PLC power supply. The pinout is the standard SNP pinout (shown in Appx-A).

2.4.3 *VGA Port*

The PC CPU provides a standard DE15 female connector for connection to VGA Monitors (CRTs). This is sometimes known as a 15-pin "high density" connector; as 15 pins reside in a connector the same width as a DB9 connector.

2.4.4 *Keyboard Port*

The PC CPU contains a 6-pin, PS/2™-style keyboard connector. Standard keyboards with this connector are widely available. To connect keyboards with the larger, AT™-style connector, adapter cables can be purchased from computer supply stores.

2.4.5 *External 3.5" Floppy Diskette/CD ROM Option*

For those customers ordering the external floppy diskette or CD option, a parallel port interface to the external drive is included. This drive is accessible from DOS as Drive D.

2.4.6 *Frame Ground Connection*

The Horner APG PC CPU has been carefully designed to withstand harsh industrial environments. The key to the success of this design is a solid ground connection made to the external power connector on the front of the module. A three-position terminal strip is present on the module for this purpose. A 12-gauge conductor should be connected between this terminal strip and the earth ground on the control panel. **Without a proper Earth Ground, the noise immunity of the PC CPU is significantly reduced.**

2.4.7 External Power Connector

Due to the significant power consumption of the PC CPU (up to 2A @ 5VDC), the module has been designed to accept external power. A three-position terminal strip is located on the bottom of the module and may be used to connect an external 5VDC power supply. **Note: For optimum performance, Horner APG recommends using an external power supply (rated at 3A or more @ 5VDC, low ripple) with the PC CPU.** The module overlay is labeled to indicate the proper polarity of the connection. Before external power can be provided at these terminals, a jumper must be removed within the PC CPU Module Assembly (note Figure 2.5 below).

Equipment damage will result if power is provided to the External Power Connector without the removal of this jumper.

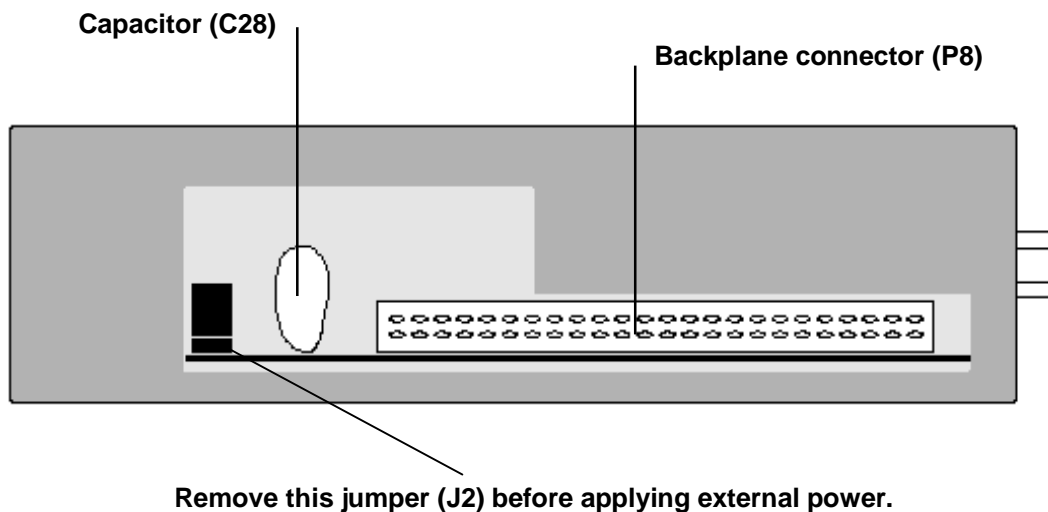


Figure 2.5 - External Power Jumper
(Rear View of Module)

CHAPTER 3: BACKPLANE COMMUNICATIONS

The PC CPU utilizes the standard Series 90-30 backplane. This chapter is a description of the capabilities of the PC CPU on this backplane.

3.1 Backplane Description

The PC CPU is intended to replace a CPU331-style CPU. Therefore, it resides in a Series 90-30 PLC Model 331, 340, 341, 351, or 352 CPU baseplate. The baseplates are available in two versions, a 5-slot (IC693CHS397), which is shown below in figure 3-1, and a 10-slot (IC693CHS391). This allows for either 5 slots or 10 slots for modules plus a slot for the power supply. The power supply must be installed in the leftmost slot on the baseplate. The Model 331/340/341/351/352 CPU baseplate must always contain the PC CPU module, which is installed in the slot labeled CPU/1 adjacent to the power supply.

The remaining four or nine slots in the CPU baseplate are available for analog I/O, discrete I/O, option modules, and specialized option modules. A 25-pin D-type female connector is located at the far right of the baseplate for connection to an expansion baseplate, if required. If additional system capacity is required beyond the CPU baseplate, up to eight expansion baseplates can be connected through available I/O expansion cables (or your custom made cables) in a chain to form an expansion system.

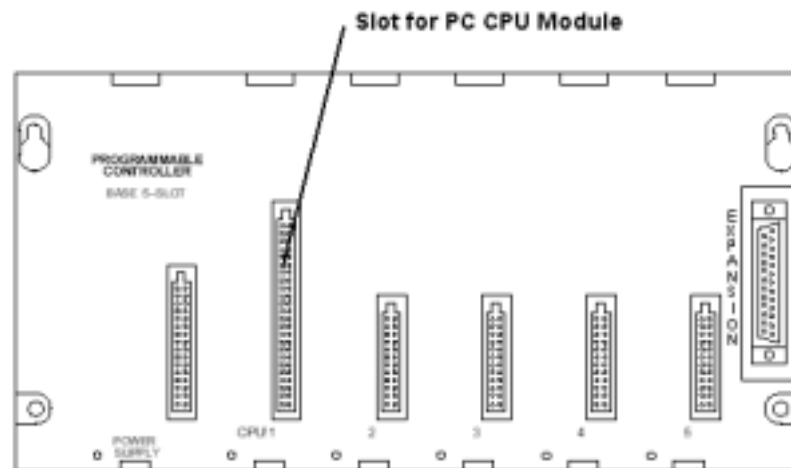


Figure 3.1 - Model 331/340/341/351/352 CPU 5-Slot Baseplate

3.2 IOCM

The PC CPU utilizes a GE Fanuc IOCM-Master chip. This silicon chip acts as a bridge between the PC CPU and the Series 90-30 backplane. This is the same type of chip that is in other CPU modules (like the CPU331).

3.3 Software Interface

The PC CPU communicates to the Series 90-30 backplane by means of the GE Fanuc IOCM chip and a PIF (personal interface card). Unlike an entire card, the GE Fanuc IC693PIF300 (PC interface board model) for instance, the PC CPU has a PIF "built into" the unit. This hardware allows the PC CPU to communicate to the Series 90-30 backplane, therefore providing communication with other available modules. In the interests of customer convenience, Horner APG has included a Visual Basic™ Demo, a Visual C++™ Demo, 32-Bit DLL libraries, and DOS libraries (demo included) with the PC CPU package. Documentation on these programs and libraries is located at the back of this manual in Appendix B.

By utilizing the PIF hardware, DLL libraries, and programs such as Visual Basic™ and Visual C++™, you will be able to use or write programs that will provide interfacing and communication to other modules connected to the backplane (or expansion rack(s)). By using these tools, attaining important information from modules and running practical applications will be possible.

To demonstrate how Visual C++™ can be used with the PIF on the PC CPU, a 32-Bit Diagnostic program has been created by Horner APG. The Visual C++™ demonstration software (PIF300Demo.exe) allows the user to view various characteristics of each module on an expansion rack. The PIF300 demo can only detect the characteristics of certain modules, one module at a time. It cannot detect parameters and settings for the whole chain or even for a whole rack. Characteristics tested by the demonstration software include the rack number, slot number, PIF card number, module information, and module data. The default PIF address for the PC CPU is 300. The following diagram (Figure 3.2) shows how the demonstration software appears.

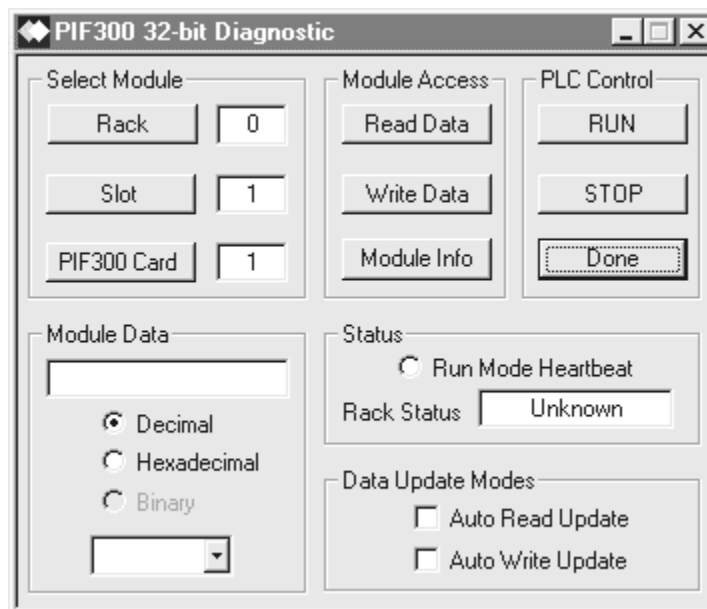


Figure 3.2 - PIF Demo Software Screen

In addition to the Visual C++™ Demo program, a 32-Bit Visual Basic™ Diagnostic Demo program has also been written by Horner APG. This program was written in Visual Basic™ 32-Bit Version 4.0. The purpose of the program is to demonstrate how Visual Basic™ can be used with the PIF in a practical application. The Visual Basic™ source code is included with the demonstration software. Visual Basic™ 32-Bit Version 4.0 is needed to open the source code file. The Visual Basic™ demo is very much the same in functionality and in appearance as the Visual C++™ demo. The options on the startup screens are very much the same. The “Rack”, “Slot”, “Read”, “Write”, “Module Info”, “Run”, “Stop”, and “Data Update Mode” all are nearly identical to the Visual C++™ demo (See Figure 3.3).

Select Module	Module Access	PLC Control
Rack: 0	Read	Run
Slot: 1	Write	Stop
PIF Address: Set Port	Module Info	Exit
Module Value: 0	Status: Rack Status	Rack Not Found
Benchmark: Test	Data Update Mode: <input checked="" type="checkbox"/> Auto Read Update	

Figure 3.3 - Visual Basic™ Screen

One feature that the Visual C++™ does not have is a "Benchmark Test." The Benchmark test allows the user to determine the scan times of certain cards located on a rack. This is accomplished by selecting the rack number and slot number of the desired module and clicking on “Test” under the “Benchmark” heading. The following screen will appear (Figure 3.4).

Results	
Scan Rate	1.253761E-04
Number of Scans	7976
Done	

Figure 3.4 - Benchmark screen

3.4 Software Locations

The files for the Visual Basic™ Demo, Visual C++™ Demo, 32-Bit DLL libraries, and DOS libraries (with demo included), are located on the Hard Drive (drive C). These files are located (from Windows Desktop) at My Computer/C:\Pif Software.

Periodic updates for these files will be available from the World Wide Web or from the Horner APG Web site. The address for the Horner APG site is <http://www.heapg.com>.

CHAPTER 4: INSTALLATION AND WIRING

The installation and wiring of the Horner APG PC CPU was intended to be just as easy to wire as a typical personal computer system. Like a typical PC, the PC CPU has a Serial Port, Parallel Port, Video Port and Keyboard Port. In addition to these ports and the PCMCIA Socket (described in Chapter 2), the PC CPU contains an External Power Connector. The location and instructions on connecting these devices are described in this chapter.

Horner APG requires that the cables used with the PC CPU (Video, Parallel, Serial, Network from PC Card, Keyboard and Power Supply) be 3 meters or less in length in order to promote maximum performance of the PC CPU.

4.1 Serial Port

The PC CPU supports two serial ports. COM1 is an RS-232 port with a RJ-45 connector. This port is located near the bottom of the PC CPU, shown below in figure 4.1. Horner APG provides a RS232 Cable Converter (Part #HEC 500A0004) with the PC CPU package that plugs into this port. This Cable Converter provides the user with RS232 communication (example use: serial mouse). This item is shown in figure 4.2 below. COM2 is the RS-485 port (with a DB15 female connector) on the PLC power supply.

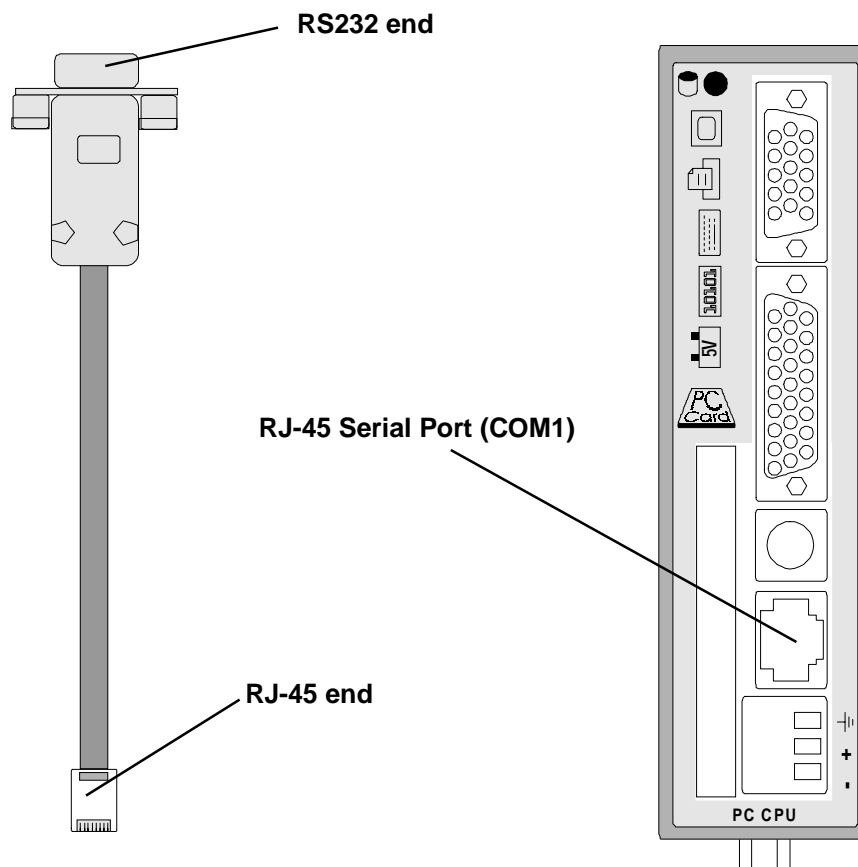


Figure 4.2 – RS232 Cable Converter

Figure 4.1 – Location of RJ-45 Serial Port

4.2 Parallel Port

The PC CPU contains 1 Parallel Port. This port is located near the center of the PC CPU, shown in figure 4.3 below. Due to the compactness of the PC CPU, this port is a “high density” 3-row 26-pin D-sub Parallel Port. As a result of the uniqueness of this port, Horner APG includes a Printer Cable Converter (Part #HEC 500A0003) which converts this pin configuration into the standard 2-row 25-pin D-sub connector configuration, which is compatible with commercially available parallel printer cables and software keys. This part is included with the PC CPU package. This item is shown in figure 4.4 below.

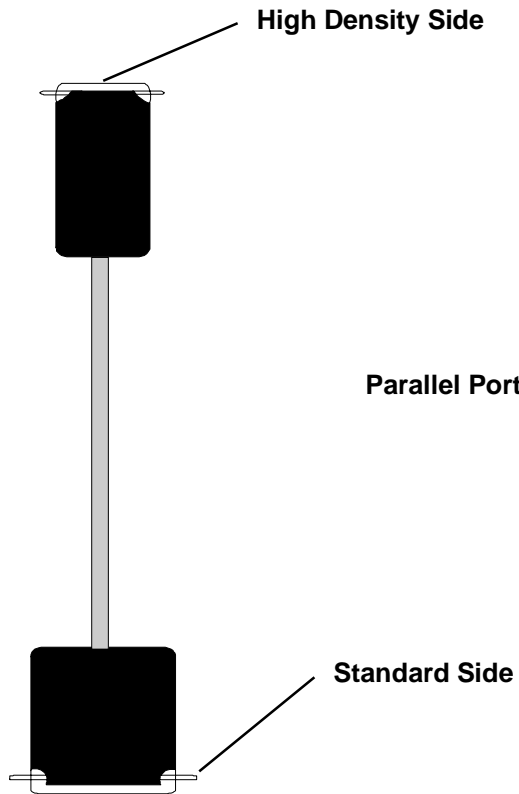


Figure 4.4 – Printer Cable Converter

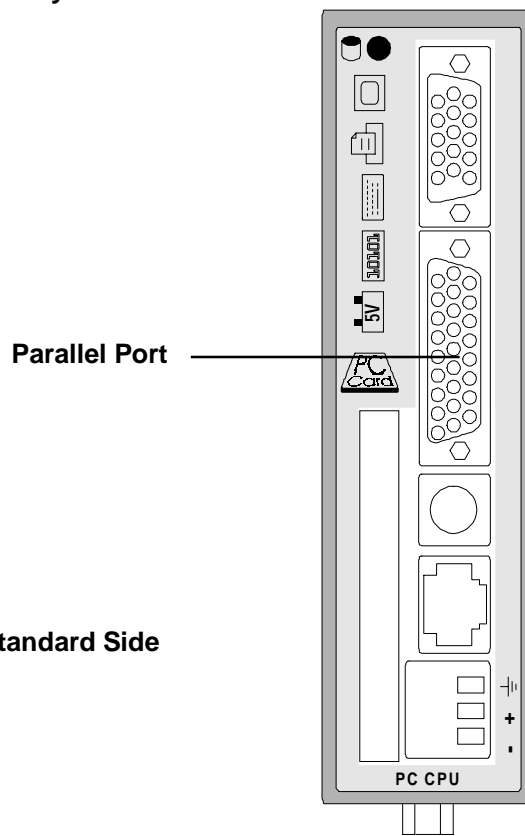


Figure 4.3 – Parallel Port Location

4.3 Video Port

The PC CPU provides a standard DE15 female connector for connection to VGA Monitors (CRTs). This is sometimes known as a 15-pin “high density” connector; as 15 pins reside in a connector the same width as a DB9 connector. This VGA Video Port is located at the top of the PC CPU, shown below in figure 4.5.

4.4 Keyboard Port

The PC CPU contains a 6-pin, PS/2™-style keyboard connector. Standard keyboards with this connector are widely available. To connect keyboards with the larger, AT™-style connector, adapter cables can be purchased from computer supply stores. The keyboard port is shown below in figure 4.5.

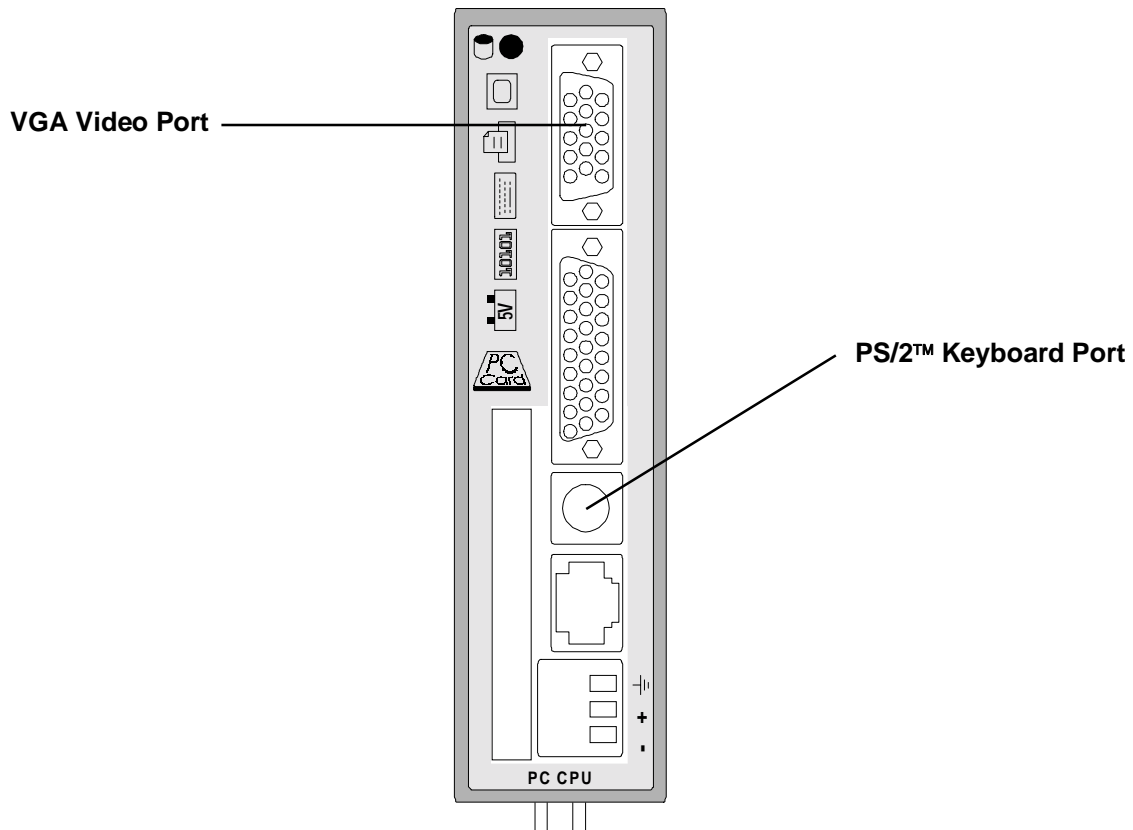


Figure 4.5 – Location of Video and Keyboard Ports

4.5 External Power Connector

Due to the significant power consumption of the PC CPU (up to 2A @ 5VDC), the unit has been designed to accept external power. **For optimum performance, Horner APG recommends using an external power supply (rated at least 3A or greater @ 5VDC, low ripple) with the PC CPU, rather than utilizing the power supply from the backplane.** Before operating the PC CPU with an external power supply, a jumper (J2) must be removed within the PC CPU Module assembly (see Figure 2.5). The use of needle-nose pliers would aid in the removal of this jumper. After this jumper has been removed, securely mount the unit to the PLC backplane (into Slot 1).

The PC CPU contains a green male, 3-Pin Phoenix connector for external 5VDC power. This connector is located at the bottom of the unit. The module overlay is labeled to indicate the proper polarity of the connection. The top-most pin is Earth Ground, the middle pin is Positive, and the bottom-most pin is Negative. Figure 4.6 shows a diagram of the location of the External Power Supply Input. Horner APG Provides a 3-terminal female Phoenix (Part #PHO 17 54 46 5) connector with the PC CPU package for customer convenience. This part is shown below in figure 4.7.

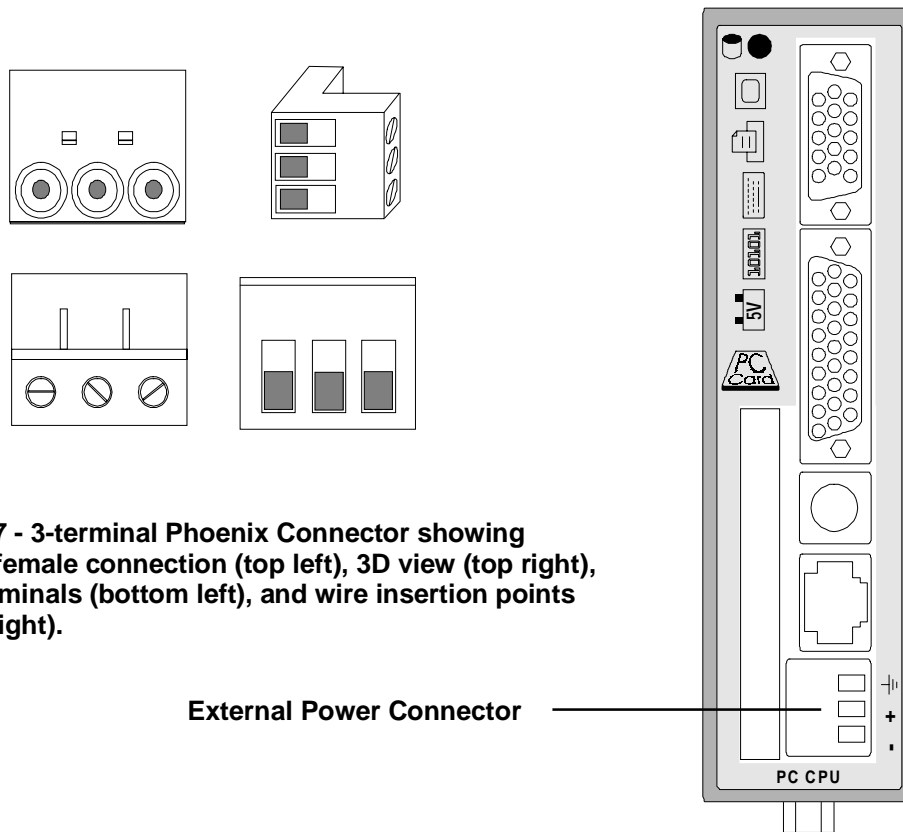


Figure 4.7 - 3-terminal Phoenix Connector showing views of female connection (top left), 3D view (top right), screw terminals (bottom left), and wire insertion points (bottom right).

Figure 4.6 – Location of External Power Supply Port

APPENDIX A: PINOUT DIAGRAMS

In order to provide as much information as possible on the ports of the PC CPU, this chapter, Appendix A, describes in detail the pin configurations and descriptions of COM1 (RS-232 port), COM2 (RS-422 port) and the Parallel Port. COM1 is described first, followed by COM2 and the Parallel Port.

A.1 RS-232 Port w/RJ-45 Connector (COM1)

COM1 is an RS-232 Port with a RJ-45 connector. The pinout (shown below) is compatible with an adapter cable (included), which will convert it to a standard personal computer 9-pin serial port. The pin configuration for the RS-232 side of the adapter cable is shown below in figure A.1. The pin numbers and corresponding descriptions are located below in table A.1.

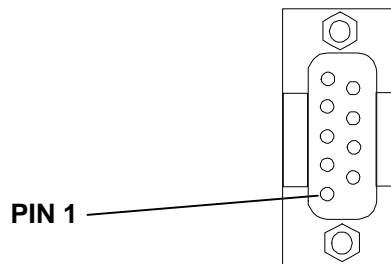


Figure A.1 – (COM1)

Pin Number	Signal Name	I/O	Description
1	N.C.		No Connection
2	RXD	Input	Receive Data
3	TXD	Output	Transmit Data
4	-DTR	Output	Data terminal Ready
5	GND		Ground
6	-DSR	Input	Data Set Ready
7	-RTS	Output	Request To Send
8	-CTS	Input	Clear To Send
9	N.C.		No Connection

A.2 PLC Serial Port (COM2)

The Series 90-30 PLC serial port is compatible with RS-422. An RS-232 to RS-422 converter is required to interface to systems that provide RS-232 compatible interfaces. This part is available from Horner APG (Part #HE693SNP232A). The Series 90-30 PLC, RS-422 serial port provides the physical connection for SNP communication. This port is a 15-pin D-type female connector located on the Series 90-30 PLC Power Supply. Figure A.2 shows the serial port orientation and connector layout for the Series 90-30 PLC types. Table A.2 shows the pin numbering and signal assignment applicable to the PLC.



Figure A.2 – Series 90 PLC, RS-422 Serial Port Connector Configuration (COM2).

Table A.2 – COM2 Pinout			
Pin Number	Signal Name	I/O	Description
1	Shield		
2	N.C.		No Connection
3	N.C.		No Connection
4	N.C.		No Connection
5	+5V *	Output	+5V Power for HHP and RS-232/485 Converter
6	-RTS	Output	Request To Send
7	GND		Ground
8	CTS	Input	Clear To Send
9	RT *		Terminating Resistor for RXD **
10	-RXD	Input	Receive Data
11	RXD	Input	Receive Data
12	-TXD	Output	Send Data
13	TXD	Output	Send Data
14	RTS	Output	Request To Send
15	-CTS	Input	Clear To Send

* Signals available at the Connector (RS-422) on the Series 90-30 PLC but not included in the RS-422 specification.

** Termination resistance for the Receive Data (RXD) signal needs to be connected only on units at the end of the lines. This is accomplished by connecting a jumper between pins 9 and 10 inside the 15-pin D-shell.

A.3 25-Pin D-Sub Parallel Port

The Parallel Port features a 26-pin high-density D-sub connector. Included with the PC CPU is a short adapter cable to convert this connector into a standard 25-pin D-sub Parallel Port. This is a standard pinout (shown below in figure A.3). This pinout is compatible with commercially available parallel printer cables and software keys. The pin numbers and corresponding descriptions are located on the following page in table A.3.

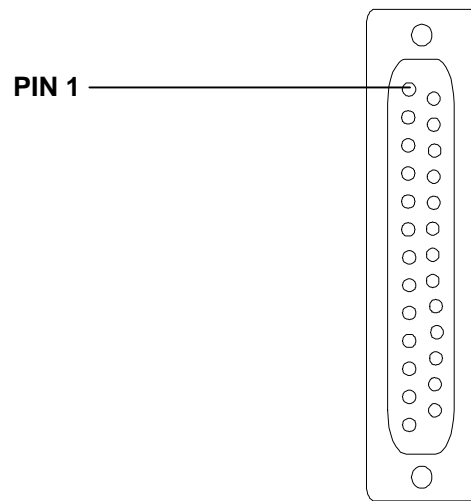


Figure A.3 – (Parallel Port)

Table A.3 – Parallel Port Pinout			
Pin Number	Signal Name	I/O	Description
1	LPTSTROBE	Bi-directional	Strobe
2	BLPTD0	Bi-directional	Data Bit 0
3	BLPTD1	Bi-directional	Data Bit 1
4	BLPTD2	Bi-directional	Data Bit 2
5	BLPTD3	Bi-directional	Data Bit 3
6	BLPTD4	Bi-directional	Data Bit 4
7	BLPTD5	Bi-directional	Data Bit 5
8	BLPTD6	Bi-directional	Data Bit 6
9	BLPTD7	Bi-directional	Data Bit 7
10	LPDACK	Input	Acknowledge
11	LPTBUSY	Input	Busy
12	LPTPE	Input	Paper End
13	LPTSLCT	Input	Select
14	LPDAFD	Output	Auto Feed
15	LPTERROR	Input	Error/Fault
16	LPTINIT	Output	Printer Init
17	LPTSLTCIN	Output	Select
18	GND		Ground
19	GND		Ground
20	GND		Ground
21	GND		Ground
22	GND		Ground
23	GND		Ground
24	GND		Ground
25	GND		Ground

APPENDIX B: PIF DOCUMENTATION

Included on every PC CPU Hard Drive are two demonstration programs (written in Visual C++™ Version 4.2 and Visual Basic™ 32-Bit Version 4.0), 32-bit DLL libraries and DOS libraries. These programs are available to the customer as **examples** of programs that may be written to interface with modules on the Series 90-30 backplanes. Descriptions of these programs are included in this chapter for the customer to examine. Also included are instructions for installing the PIF300 32-Bit DLL.

In order for the customer to create their own programs, several steps will be necessary. To begin with, a programming package, such as Visual C++™ or Visual Basic™, will be necessary. We recommend installing these on a different computer system other than the PC CPU (due to the large memory requirements of some programs). After obtaining a programming package, the installation of 32- Bit DLL libraries or DOS libraries onto this system will be required (Horner APG provides these libraries on a floppy disk, which is included with the PC CPU package). This is required in order to link your program to the libraries.

After you have all of the necessary software and files on your separate computing system, it will be possible to create PIF 90-30 interface programs. When programming, you will use variables in the libraries in order to manipulate the PIF or to assign procedures in your program. This process will enable you to manipulate the **MODULES** on the Series 90-30 backplane. Once your executable program has been written, you will need to transfer the **compiled** program to the PC CPU (using direct cable connection, floppy, CD-ROM, or network connection). Horner APG has included the libraries on the Hard Drive so you will not be required to transfer these. Finally, in order to run your Visual Basic™ program, the PIF DLL, Visual Basic™ DLL and the Visual Basic™ executable files will be required. In order to run your Visual C++™ program, the PIF DLL and the Visual C++™ executable files will be required.

B.1 Visual C++™ Demo

This program was written in Visual C++™ Version 4.2. The purpose of the program is to demonstrate how Visual C++™ can be used in a practical application. The Visual C++™ source code is included with the demonstration software. Visual C++™ Version 4.2 is needed to open the source code file.

The Visual C++™ demonstration software (PIF300Demo.exe) allows the user to view various characteristics of each module on an expansion rack. It is important to remember that the PIF300 can only detect the characteristics of certain modules, one module at a time. It cannot detect parameters and settings for the entire chain or rack. Characteristics tested by the demonstration software include the following:

- 1.0.1. Rack number: Specifies what rack is being tested on the chain. Up to eight racks on a chain can be tested. **Rack 0 is reserved for the rack supporting the HE693CPUxxx.**
- 1.0.2. Slot number: Specifies what slot on a rack is being tested.
- 1.0.3. PIF card number: Specifies the PIF card being used. Up to four PIF cards can be configured at a time (HE693CPUxxx contains 1, at address 300).
- 1.0.4. Module Information: Reads the type of module, type of rack, speed of rack, and the number of %I's, %Q's, %AI's, %AQ's, %RI's, and %RQ's.
- 1.0.5. Module data: Reports to user what data is in the register of the specified module.

The following diagram (Figure B.1) shows how the demonstration software appears. Each of the “buttons” will be explained below.

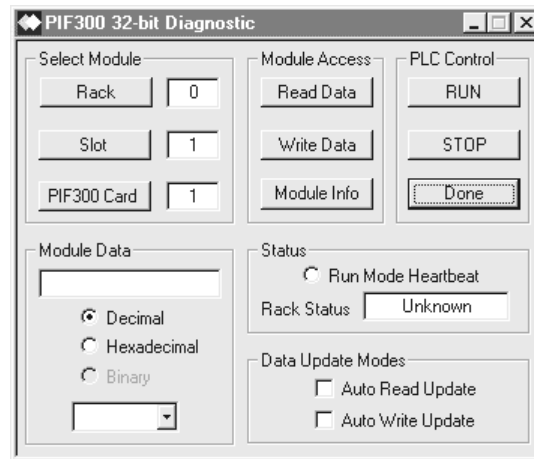


Figure B.1

The diagnostic software allows the user to choose a module on a certain rack in a “chain” of expansion racks. The module is selected by first choosing the PIF card that the rack or chain is connected to (with address set at 300). This is accomplished by “clicking” on the “PIF300 Card” button, then selecting the desired PIF card. The screen (Figure B.2) allows the user to configure up to four different PIF cards (only one card may configured with the PC CPU).

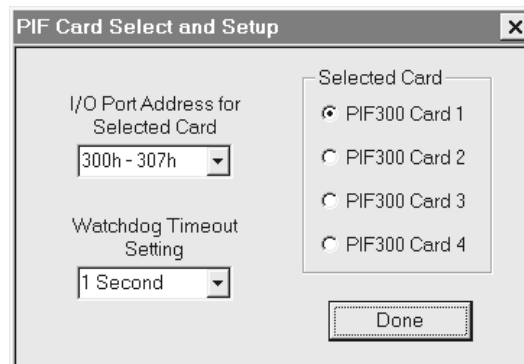


Figure B.2

To configure the PIF card, select a card number 1 through 4 (*in Figure B.2 card one is selected*) and choose the I/O Port Address (address 300) from the pull down menu. Next, choose the Watchdog Timeout Setting (defaults to 1 second). After the PIF card is selected, select the rack with the attached module. This is accomplished by placing the pointer over the “Rack” button and right clicking it on until the preferred rack is selected. The same procedure is performed on the “Slot” button until the preferred module is selected.

Module information is then viewed by placing the mouse pointer over the “Module Info.” Button and right clicking it on. The “Selected Module Information” screen will appear (Figure B.3). The rack type should specify whether a 5 slot or a 10 slot rack is being used. The rack speed will show what the baud rate of the rack is. The “Module Type” will display the type of module located in the slot selected, as described in the previous set of instructions.

Selected Module Information

Occupied Rack Information

Rack Type

Rack Speed

Module Information

Module Type

%Is %AIs %RIs

%Qs %AQs %RQs

OK

Figure B.3

In reference to the “start up” screen (Figure B.1), the “Read” button allows the user to read the registers in the selected module and the “Write” button allows the user to write data to the module. By selecting the write function (clicking on the “Write” button), the following screen will appear (Figure B.4).

Write Data to Selected Module

Module Type

Rack Number

Slot Number

Data To Be Written

Data Location

Write Data

Done

Figure B.4

The data to be written is entered in the “Data To Be Written” field and the register written to is entered in the “Data Location” field. Data read from a module appears in the “Module Data field”. This can be converted between Decimal, Hexadecimal, and Binary. Data can automatically be read and written to by selecting “Auto Read Update” and “Auto Write Update” on the startup screen.

The demonstration software controls the “Run” function of the PLC. To put the PLC in Run mode, simply click on the “Run” button on the start-up screen (Figure B.1). After run is selected, the “Run Mode Heartbeat” status indicator should be flashing and the “Rack Status” field should indicate “Running”. To stop the PLC, simply click on the “stop” button. The rack status field should indicate “Stopped”.

The “Run Mode Heartbeat” indicates the timing of the watchdog. This watchdog timing can be selected by using the pull down menu found in the “PIF Card Select and Setup” screen (see Figure B.2).

B.2 Visual Basic™ Demo

This program was written in Visual Basic™ 32-Bit Version 4.0. The purpose of the program is to demonstrate how Visual Basic™ can be used in a practical application. The Visual Basic™ source code is included with the demonstration software. **Note:** Visual Basic™ 32-Bit Version 4.0 is needed to open the source code file.

The Visual Basic™ demo is very similar in functionality and appearance as the Visual C++™ demo. The options on the startup screens are similar as well. The “Rack”, “Slot”, “Read”, “Write”, “Module Info”, “Run”, “Stop”, and “Data Update Mode” are nearly identical to the Visual C++™ demo (See Figure B.5).

The screenshot shows a graphical user interface with several sections:

- Select Module:** Includes buttons for "Rack" and "Slot", with input fields showing "0" and "1" respectively. Below these is a "PIF Address" section with a "Set Port" button.
- Module Access:** Contains buttons for "Read", "Write", and "Module Info".
- PLC Control:** Contains buttons for "Run", "Stop", and "Exit".
- Module Value:** A text input field containing the number "0".
- Benchmark:** A "Test" button.
- Status:** A "Rack Status" label followed by a text box containing "Rack Not Found".
- Data Update Mode:** A checked checkbox labeled "Auto Read Update".

Figure B.5

Another feature of the program, the Benchmark Test, allows the user to determine the scan times of certain cards located on a rack. This is accomplished by selecting the rack number and slot number of the desired module and clicking on “Test” under the “Benchmark” heading. The following screen will appear (Figure B.6).

The screenshot displays the results of a benchmark test:

- Results:** A section header.
- Scan Rate:** A text input field showing the value "1.253761E-04".
- Number of Scans:** A text input field showing the value "7976".
- Done:** A button at the bottom of the screen.

Figure B.6

The "Scan Rate" is measured in seconds. The "Number of Scans" is the **actual number** of scans completed in one-second of scan time. This number will vary for different modules. The test is implemented by writing a "1" to the buffer and then reading the "1" back in a loop for a complete second. The "Number of Scans" and the "Scan Rate" will vary slightly depending on the system resources (hardware, RAM, Processor). It will also vary slightly with the operating system (WindowsNT™, Windows95™, network connections, etc...) of the PC.

B.3 Installing the PIF300 32-Bit DLL

The following instructions are for installing the PIF300 32-BIT DLL in both the Windows95™ and WindowsNT™ operating systems. **Note:** The instructions below have been written assuming that the customer has a 3.5" floppy to their disposal. If you do not have a floppy drive, you must transfer the program files by using a direct cable connection (Windows™95 only) or by the use of a CD-ROM drive. After the files have been transferred to a file folder or directory that you have created, the installation program can be ran from this folder/directory. The instructions below can be followed assuming that the actual floppy disks are not being utilized.

Windows95™ Installation:

1. Insert Disk 1 in the 3.5" disk drive.
2. Left click on the Start button or simultaneously press the "Alt" key and the "S" key.
3. Left click on Run or simultaneously press the "Alt" key and the "R" key.
4. A window should appear with an "Open" data field. In the data field type
A:\Disk1\Setup
5. A "Welcome" window will appear; click "Next" or press "Enter" after reading the dialog.
6. At the "Read me Information" window, click "Next" or press "Enter".
7. A "Choose destination Location" window will appear, choose a location, this location is here the software will be downloaded, if the default settings are chosen, the software will be saved under the following location.
C:\Program Files\PIF300 32-Bit DLL
8. After choosing the location press "Enter" or click on "Next".
9. The "Start Copying File" window will appear. Press "Enter" or click on the "Next" button.
10. The software will now download from the floppy drive to the hard drive.
11. Approximately a quarter of the way through the download a window will appear asking for disk 2. Remove disk 1 and insert disk 2. Press "Enter" or click on the "Next" button.
12. When the "Set Up Complete" window appears click on the "Finish" button.

The software is now installed and ready to be used. If all of the default selections were used, the executable file can be found by selecting:

For the Visual C++™ program:

My Computer\Program Files\PIF300 32-bit DLL\Visual C++ demo\PIF300Demo

For the Visual Basic™ Program:

My Computer\Program Files\PIF300 32-bit DLL\Visual Basic Demo\VBDemo

WindowsNT™ Installation:

1. Insert Disk 1 in the 3.5" disk drive.
2. Left click on the Start button or simultaneously press the "Alt" key and the "S" key.
3. Left click on Run or simultaneously press the "Alt" key and the "R" key.
4. A window should appear with an "Open" data field. In the data field type
A:\Disk1\Setup
5. A "Welcome" window will appear; click "Next" or press "Enter" after reading the dialog.
6. At the "Read me Information" window, click "Next" or press "Enter".
7. A "Choose destination Location" window will appear, choose a location, this location is where the software will be downloaded, if the default settings are chosen, the software will be saved under the following location: **C:\Program Files\PIF300 32-Bit DLL**
8. After choosing the location press "Enter" or click on "Next".
9. The "Start Copying File" window will appear. Press "Enter" or click on the "Next" button.
10. The software will now download from the floppy drive to the hard drive.

11. Approximately a quarter of the way through the download a window will appear asking for disk 2. Remove disk 1 and insert disk 2. Press "Enter" or click on the "OK" button.
12. When the "Set Up Complete" window appears choose if computer is to be shut down now or later and click on "Finish". **Note: In order to use the software, the computer must be restarted.**
13. At the next window, select "Finish".

The software is now installed, and is ready to be used. If all of the default selections were used, the executable file can be found by selecting:

For the Visual C++™ program:

My Computer\32-bit PIF DLL for WINNT\Visual C++ demo\PIF300Demo

For the Visual Basic™ Program:

My Computer\32-bit PIF DLL for WINNT\Visual Basic demo\VBDemo

NOTES

APPENDIX C: DIRECT CABLE CONNECTION INSTRUCTIONS

Due to the compact design of the PC CPU, there are no internal 3.5" floppy or CD-ROM drives. In order to download or upload data from the PC CPU, it is necessary to use an external 3.5" floppy drive or CD-ROM drive. **An alternative to this method** is to establish a direct cable connection between the PC CPU and another computer. By using the direct cable connection method, it is possible to set up the PC CPU as a host or guest computer. Once this is achieved, the transfer of data between the systems is possible. **Note: Windows™NT does not support a direct cable connection.**

C.1 DIRECT CABLE CONNECTION INSTRUCTIONS

The direct cable connection between a host computer and the HE693CPUXXX is a simple and straightforward procedure. This connection allows the transfer of data between two computers. This eliminates the need for a floppy or CD-ROM drive. Follow the instructions below when transferring data from a host computer to the HE693CPUXXX.

Connection

- 1) Locate the Parallel ports on both the host computer and the HE693CPUXXX.
- 2) Connect a 25-pin parallel cable between both ports.

Software Instructions

- 1) From Windows 95™ Desktop (on both of the computers), click **Start**.
- 2) Proceed to **Programs/Accessories/Direct Cable Connection**.
- 3) Click on **Direct Cable Connection**.
- 4) On the Direct Cable Connection Screen for the HE693CPUXXX, it should indicate "**Guest computer set up to connect to host using Parallel cable on LPT1.**" If the screen does not indicate this, proceed through the options and select **guest** for this computer, **Parallel cable on LPT1**, then click **Finish**.
- 5) On the Direct Cable Connection Screen for the host computer, it should indicate "**Host computer set up to listen on Parallel cable on LPT1.**" If the screen does not indicate this, proceed through the options and select **host** for this computer, **Parallel cable on LPT1**, then click **Finish**.
- 6) The next dialog box you should see on the guest computer (HE693CPUXXX) should indicate "**Status: Connecting via Parallel cable on LPT1...**"
- 7) The next dialog box you should see on the host computer should indicate "**Waiting for a guest computer to connect via Parallel cable on LPT1.**"
- 8) After a connection is made, the dialog box should indicate "**Verifying user name and password.**"
- 9) After this is completed, the guest computer is asked for the "**Host computer name.**" You can find the name of your computer in My Computer/Control Panel/Network/Identification.
- 10) After these steps are completed, the examination and transfer of files from the host computer to the guest computer may be initiated.

Note: If the connection between the host and the guest computer fails and you get an error message, try limiting the name of your computer to one word.

NOTES

APPENDIX D: PC CARD INSTALLATION PROCEDURE

This chapter, Appendix D, describes in step-by-step format the procedure to install a 3Com™ Etherlink™ III PCMCIA. This particular network card, a card that Horner APG has thoroughly tested, may be utilized with the PC CPU in network communications.

D.1 PC Card Installation Procedure

This installation procedure was used to install a 3Com™ Etherlink™ III PCMCIA. To enable this PC Card the following steps were taken;

- 1) From Windows™95 Desktop, go to **My Computer/Control Panel/System/Device Manager**, Then remove the PC Card Adapter from the screen.
- 2) next, go to **My Computer/Control Panel/Add new hardware**. Windows™95 should be able to detect the PC Card. Click finished
- 3) Next, the PC Card Wizard should appear. Choose **NO** for the questions, then click **Finished**.
- 4) Shut the computer down and restart, as indicated. When Windows™95 restarts, a message should appear that indicates that the new device was found. Click **Finished**.
- 5) Go to **My Computer/Control Panel/System Properties/Device Manager**. Next, manually select the proper device to install (3Com™ Card in this case). Go to **Other Devices/3Com™ Corporation-3C589D Driver/Update Device Driver Wizard**. Choose the option of manually selecting a driver from the list. I choose **Network Adapters/3Com™/3Com™ Etherlink™ III PCMCIA (3C589/3C589B)**. Windows™95 then proceeded to copy the necessary files from the Windows™95 CD-ROM.
- 6) After these steps are completed, configure the Network settings to your specific protocols and restart the computer. Windows™95 should then successfully load and should prompt you for your network password.

NOTES