HP 1000 Computer Systems

Using PCIF/1000

with

Allen-Bradley

Programmable Controllers

HEWLETT
PACKARD
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Non-CDS	CDS	Description
[PCP LB	[PCP2C	PLC-2 family descriptor file
[PCPAB	[PCPAC	PLC-3 and PLC-5 family descriptor file
[PCHAB	[PCHAC	AB data highway descriptor file

Note that even if you are directly connected to a PC, you are using DH protocol. Therefore, you have only one highway descriptor file.

The descriptor files call in the proper relocatable files and the Z80 protocol needed to link the system. For a complete description of preconfiguration (PCGEN) and configuration (PCCON), see the "PCIF Reference Manual."

PRINTING HISTORY

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page and back cover of the manual change only when a new edition is published. When an edition is reprinted, all the prior updates to the edition are incorporated. No information is incorporated into a reprinting unless it appears in a prior update.

The software product part number printed alongside the date indicates the version and the update level of the software product at the time the manual edition or update was issued. Many updates and fixes do not require manual changes. Conversely, manual corrections may be done without any accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

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Second Edition	February 1986	94202RTE-A4.0
Third Edition	November 1986	94202RTE-A4.1
Fourth Edition	March 1988	94202RTE-A5.0

<directory> : the name of the CI directory location of %IDS00 and $DDP61.

<select code> : the 12041B card select code.

<LU number> : the number desired for the LU.

Table 2-2 is one example of an RTE-A answer file for PCIF with the interface driver located on a PCIF sub-directory.

```
* I/O MAPPING FOR 8 ALLEN-BRADLEY DATA HIGHWAYS
* 16 DOWNLOADABLE MUX LUs, SELECT CODE 34B, LU 120-135

IFT,/PCIF/PRECON/%IDS00,,SC:34B,QU:FI
DVT,PCIF/PRECON/%DDP61,,LU:120,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:121,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:122,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:123,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:124,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:125,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:126,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:127,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:128,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:129,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:130,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:131,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:132,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:133,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:134,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:135,TX:34
```

Note that LUs 120 & 121 correspond to port 0 on the MUX in select code 34; LUs 122 & 123 are for port 1, etc.

Table 2-2

Example of RTE-A Generation Answer File

LIST OF EFFECTIVE PAGES

The list of effective pages gives the date of the most recent version of each page in the manual. To verify that your manual contains the most current information, check the date printed at the bottom of each page with those listed below. The date on the bottom of each page reflects the edition or subsequent update in which that page was printed.

Effective Pages	Date
All	March 1988

2.4.1 Configuring the Allen-Bradley Highway Baud Rate

Use the normal configuration process to configure Allen-Bradley PCs and highways. Figure 2-1 shows the specific Allen-Bradley/PCIF Configuration Editor Screen provided.

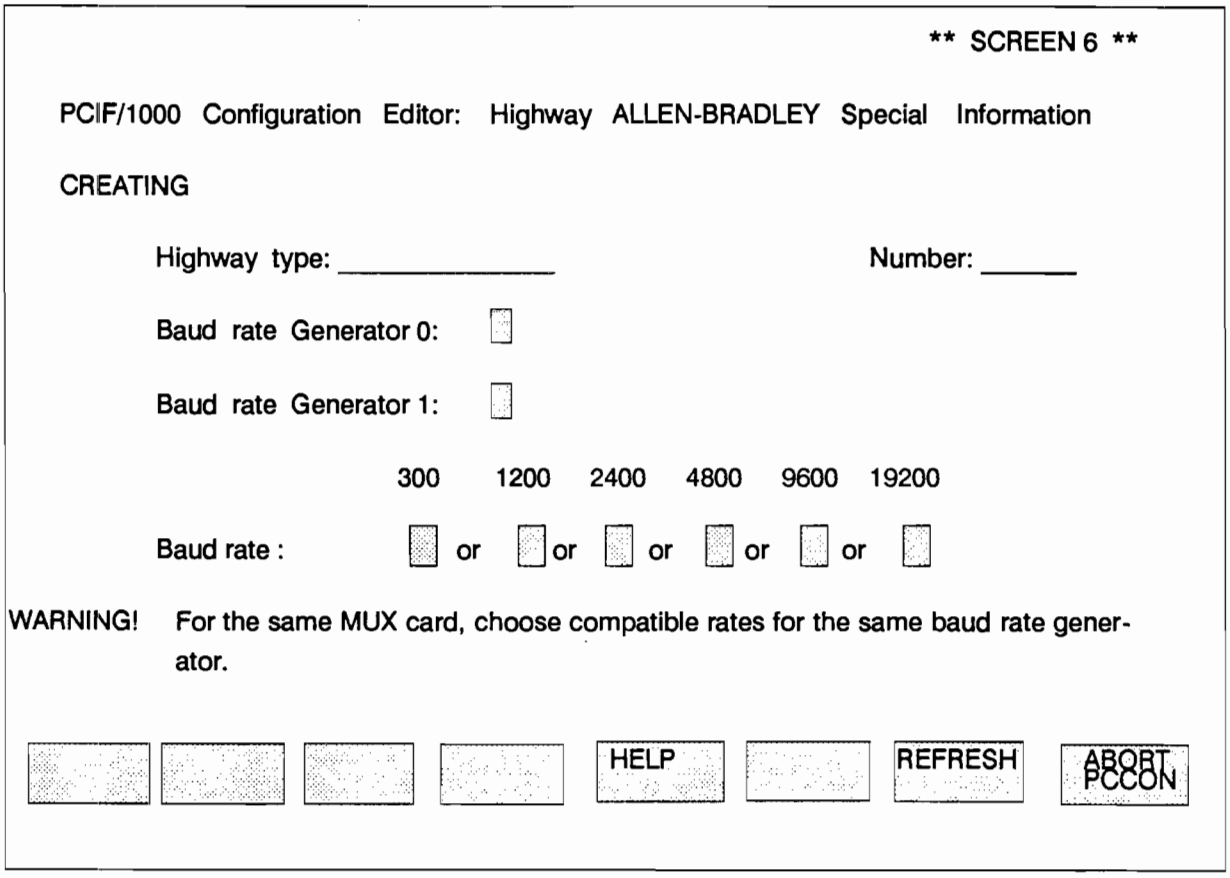


Figure 2-1

Allen-Bradley/PCIF Configuration Editor Screen

Use this screen to configure the Baud Rate Generator for this data highway, and the baud rate at which the MUX and target PC operations are compatible.

If the highway has not already been configured, the screen displays the message CREATING below "PCIF/1000." Otherwise, MODIFYING appears. The validation flag is not set unless all the required information on this screen is supplied.

CONTENTS

2.5 PC LOGICAL MEMORY AND ADDRESSING

The Allen-Bradley data highway protocol does not distinguish between different areas of the destination processor such as input, output, timer, counter in "data area" or physical address of the program area. In the PLC-2, the logical area maps into the physical location.

In the PC access routine PCADR, the "addr" parameter allows the programmer to address memory inside the processor. The processor then determines whether this is a valid address and when and how to service the request.

Specific information on the "addr" parameter and valid addressing examples are found in Chapter 3 of this book.

2.5.1 PC Station Addressing Examples (Internal PLC Addressing)

A computer can use three types of addressing in the command messages that it transmits to a PC station:

- Logical
- Physical
- Symbolic

The PLC/PLC-2 family of controllers access their data tables using an octal word address. This type of logical word address is represented by an equivalent byte address.

An example word address is:

0110

where

0 = output

1 = rack one, and

10 = word ten.

PREFACE

The purpose of this book is to provide information for system managers and application programmers who are now using, or will be using, PCIF/1000 to supervise and interact with programmable controllers (PCs) manufactured by Allen-Bradley. This documentation can be used both as a user guide and reference manual.

It is assumed that readers of this manual are knowledgeable about the HP/1000 computer and its RTE-A operating system, and the operating principles of programmable controllers. New users of PCIF/1000 should refer to the Hewlett-Packard "Programmable Controller Interface/1000 Reference Manual," hereafter referred to as the "PCIF Reference Manual."

HOW THIS MANUAL IS ORGANIZED

Chapter 1: Introduction

Provides general information about using PCIF/1000 with Allen-Bradley PLCs and includes detailed examples of connection methods.

Chapter 2: Installation

Outlines the process for installing the Allen-Bradley handler and PCIF/1000 onto an Allen-Bradley system. This information is especially useful for system managers who are installing an Allen-Bradley handler for the first time.

Chapter 3: Operation

Describes specific requirements for operating PCIF/1000 with Allen-Bradley PLCs. This information is especially useful for application programmers.

Chapter 4: Troubleshooting

A guide to troubleshooting problems that may arise while using PCIF/1000 with Allen-Bradley PLCs.

Appendix A: Error Messages

Lists and explains error codes that may be returned during the operation of your PCIF/Allen-Bradley system.

An example of logical ASCII addressing is:

```
$        N        10        :        360
```

where

$ = logical address symbol

N = file identifier

10 = file number

: = delimiter

360 = element

PCIF uses all the above addressing, within certain rules and limitations, in order to access data from the target station. Read carefully the examples in this manual on how to use types of addressing in conjunction with the specific access routines.

CHAPTER1
INTRODUCTION

1.1 GENERAL INFORMATION

This chapter provides general information on connecting and using Allen-Bradley PCs with PCIF/1000.

PCIF/1000 provides full duplex data communication between your HP/1000 application programs and Allen-Bradley programmmable controllers that are connected to Allen-Bradley data highways. These highways are multipoint communication networks that provide data transfer paths for up to 64 PCs. The protocol used is a floating master type.

When you install PCIF/1000 onto an Allen-Bradley system, pay particular attention to the following points (described in detail in Chapter 2):

- **AB (Target PC System Configuration)**
  - Communication modules (switch settings and cabling)
  - Processor models
  - Communication programming

- **HP/1000**
  - Hardware (memory, IO card)
  - System generation

- **PCIF System**
  - PC logical address
  - PC logical memory
  - PC logical time-out
  - PC capabilities (start; stop; make unsolicited request)

2.7 PC TIME-OUT

The time-out value is the maximum length of time a request from an application program to PCIF/1000 can remain pending. Once the time-out period is exceeded, the request is destroyed and any subsequent reply to this request is ignored by the PCIF monitor.

In PCIF, the time-out value for PCARs is defined in screen 9 of the configuration editor. This value determines how long the application program waits for a response from the PCIF monitor. If the value is set higher than 40 seconds, the error "257 Maximum retry number with PC exceeded" will be returned by the highway handler, rather than "38 Time-out" (the defined time-out value was exceeded).

If a PC fails to respond after receiving a request, a delay occurs and the multiplexer queries this PC, up to 11 times. If there is still no response, the request is aborted and an error message is returned to the user. The delay between two tries is 4 seconds.

Figure 1-2 shows a typical connection method for the Allen-Bradley PLC-3. For more information on the 1771KE/KF module, refer to the appropriate Allen-Bradley bulletins (see the list in Appendix B of this book).

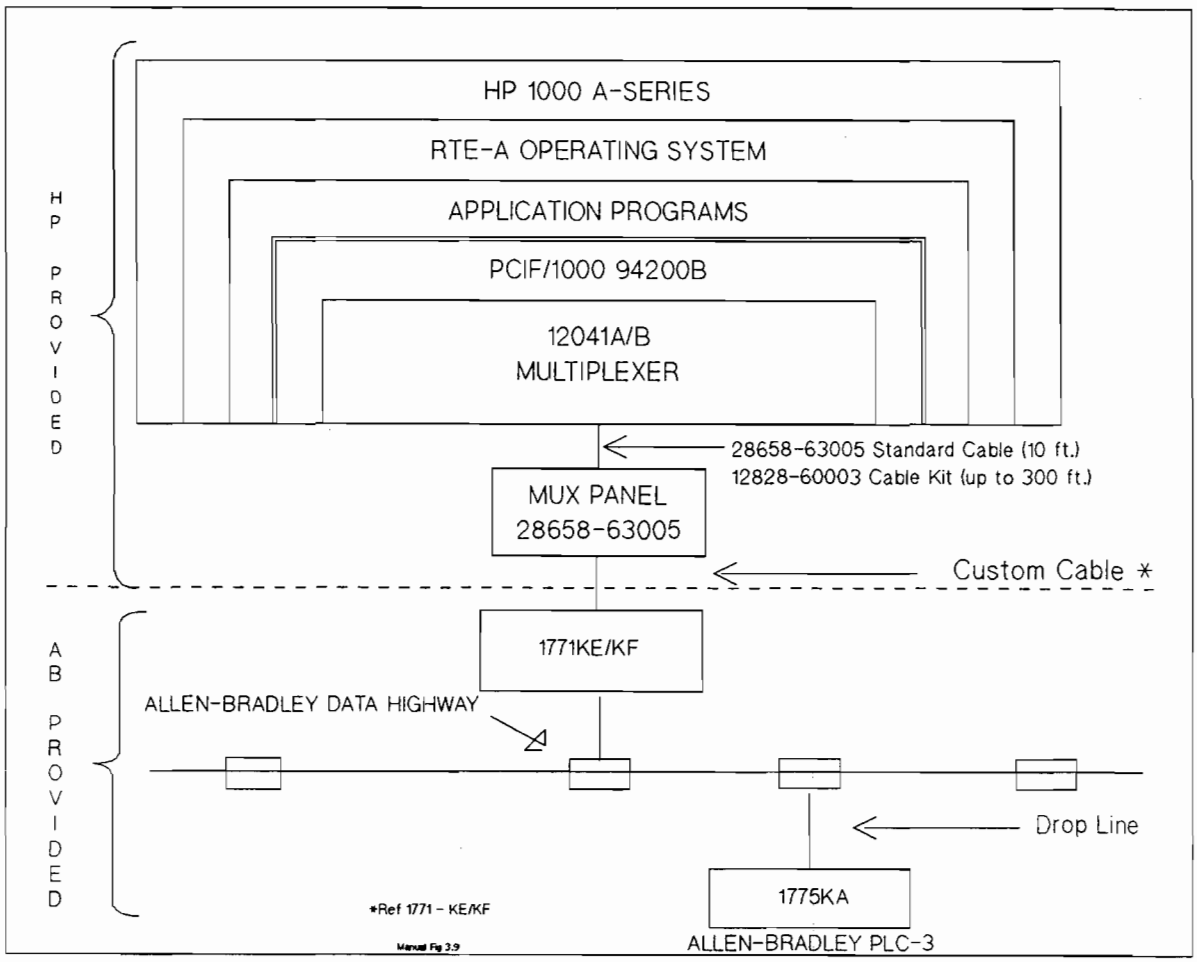


Figure 1-2

Typical System Diagram for PCIF/1000 and Allen-Bradley PLC-3 Family

Figure 1-4 illustrates a point-to-point connection for the PLC-3. For further information on the 1775KA module, refer to the appropriate Allen-Bradley bulletins.

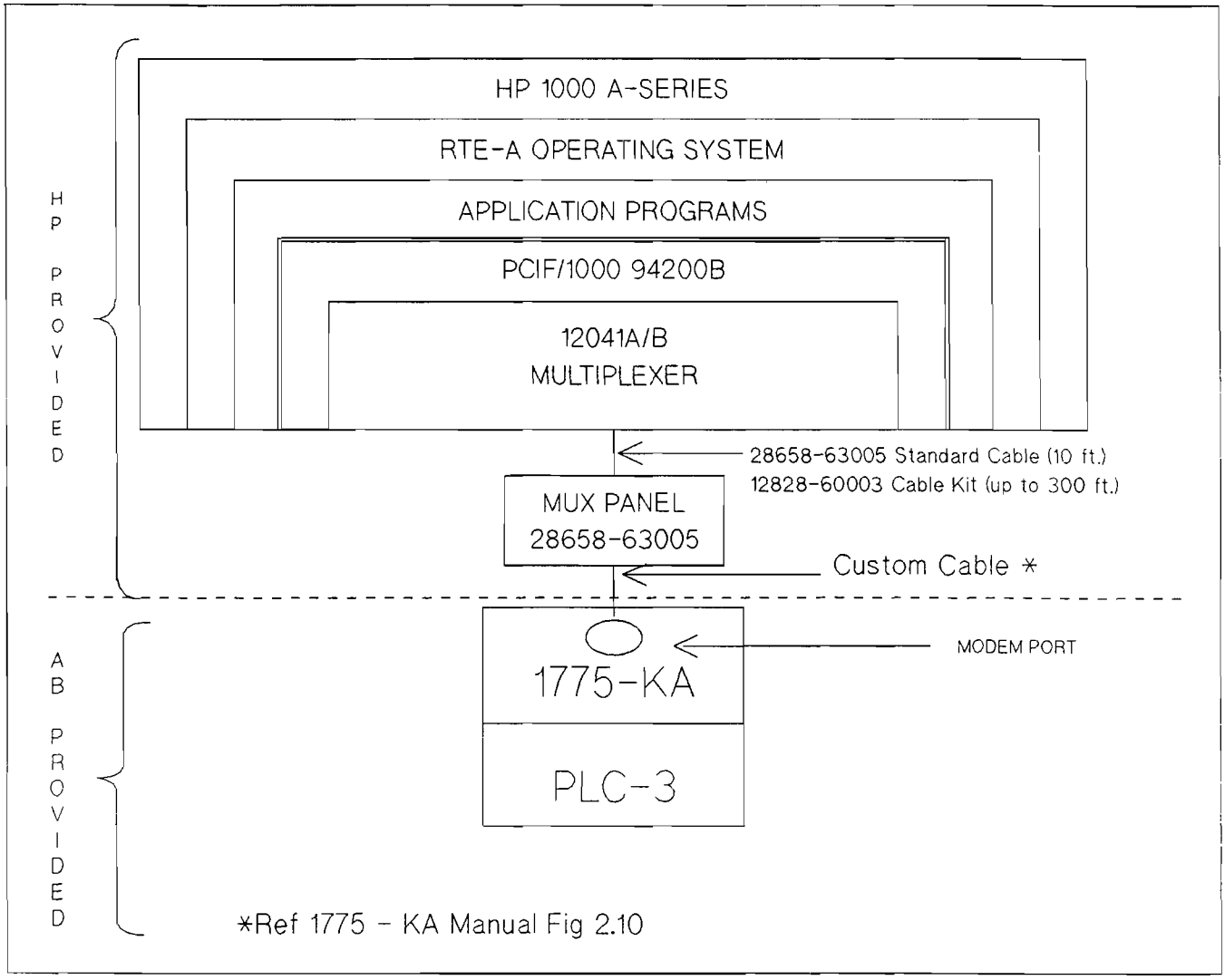


Figure 1-4

Typical System Diagram for PCIF/1000 and Allen-Bradley PLC-3 Family

3.2 PC ACCESS ROUTINE SUMMARY FOR THE PLC/PLC-2 FAMILIES

Access Routines	Supported	Specific Aspects	See Note #
PC_CANCEL	Yes	No Comment	1
PC_CONNECT	Yes	" "	1
PC_DISC	Yes	" "	1
PC_DIUNSOL	Yes	" "	3
PC_ENQUIRY	Yes	" "	8
PC_ENUNSOL	Yes	" "	3
PC_FREEZE	NO	" "	-
PC_GETKEY	Yes	" "	1
PC_IDENT	Yes	" "	9
PC_LOCK	Yes	" "	1
PC_PCSTAT	Yes	Diagnostic Status Used	1
PC_READD	Yes	Unprotected Read Used	4,6
PC_READD_EXT	NO	No Comment	-
PC_READP	Yes	Physical Read Used	4,7
PC_READP_EXT	NO	" "	-
PC_RELKEY	Yes	" "	1
PC_START	NO	" "	2
PC_STOP	NO	" "	2
PC_SYSTAT	Yes	" "	1
PC_TRANS	Yes	" "	10
PC_UNLOCK	Yes	" "	1
PC_WRITEB_EXT	NO	" "	-
PC_WRITED	Yes	Protected Write Used	4,5,6
PC_WRITED_EXT	NO	-	-
PC_WRITEP	Yes	Physical Write Used	4,7
PC_WRITEP_EXT	NO	-	-

Table 3-1

PC Access Routine Summary For the PLC/PLC-2 Families

Figure 1-6 shows the connection of HP/1000 to the PLC-5 via a data highway to PCL Link.

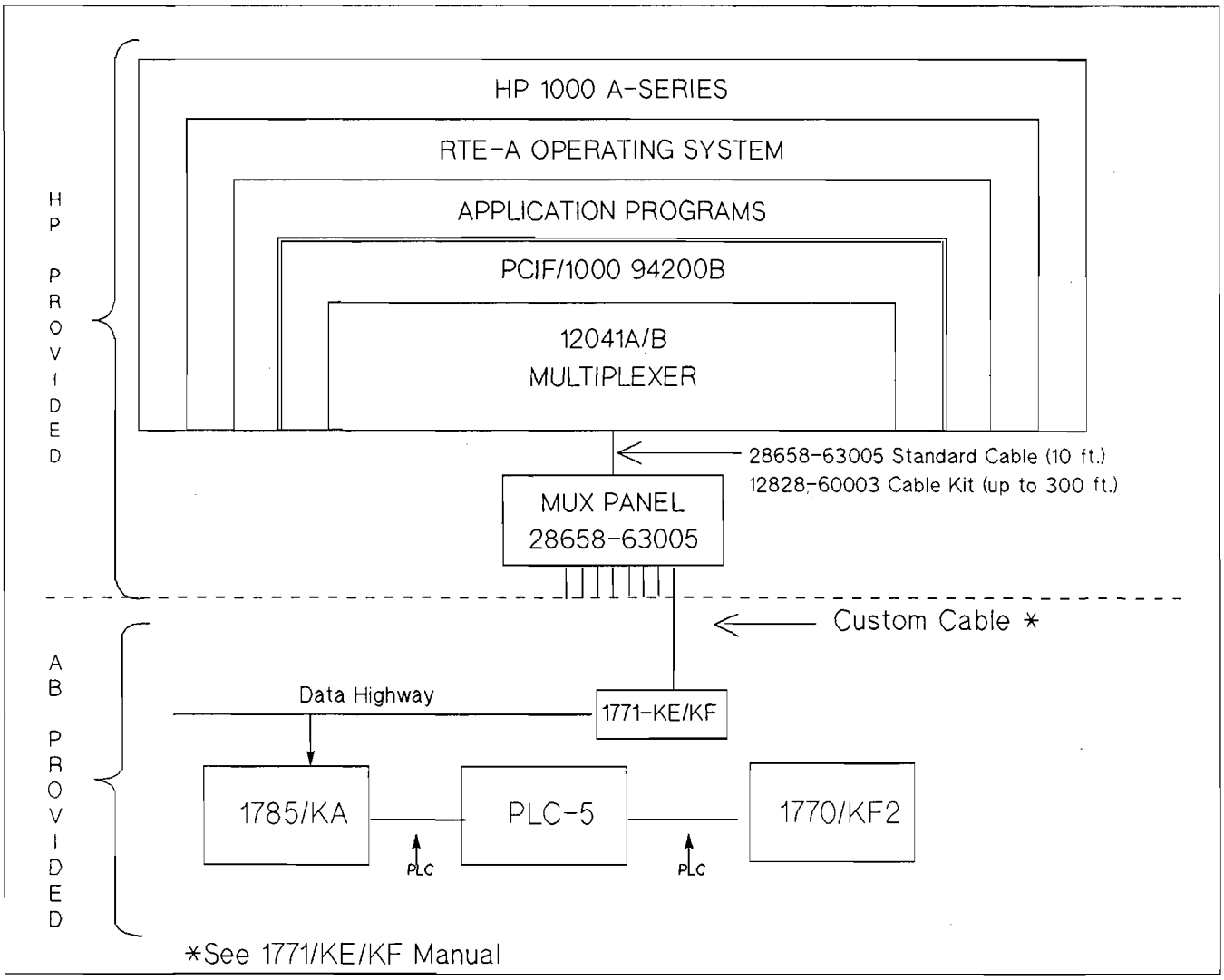


Figure 1-6

HP/1000 to PLC-5 via Data Highway to PCL Link

3.3 PC ACCESS ROUTINE SUMMARY FOR THE PLC-3/PLC-5 FAMILIES

Access Routines	Supported	Specific Aspects	See Note #
PC_CANCEL	Yes	No Comment	1
PC_CONNECT	Yes	" "	1
PC_DISC	Yes	" "	1
PC_DIUNSOL	Yes	" "	3
PC_ENQUIRY	Yes	" "	1
PC_ENUNSOL	Yes	" "	3
PC_FREEZE	Yes	Upload Stop	2,5
PC_GETKEY	Yes	No Comment	1
PC_IDENT	Yes	" "	1
PC_LOCK	Yes	" "	1
PC_PCSTAT	Yes	Diagnostic Status Used	1
PC_READD	NO	For Physical Memory	4,8
PC_READD_EXT	Yes	For Logical Memory	6,8
PC_READP	NO	For Physical Memory	4,7,8
PC_READP_EXT	Yes	No Comment	-
PC_RELKEY	Yes	" "	1
PC_START	Yes	" "	2,5
PC_STOP	Yes	Upload Stop	2,5
PC_SYSTAT	Yes	No Comment	1
PC_TRANS	Yes	" "	9
PC_UNLOCK	Yes	" "	1
PC_WRITEB_EXT	Yes	Bit Write	6,8
PC_WRITED	NO	For Physical Memory	4,8
PC_WRITED_EXT	Yes	For Logical Memory	6,8
PC_WRITEP	NO	For Physical Memory	4,7,8
PC_WRITEP_EXT	Yes	No Comment	

Table 3-2

PC Access Routine Summary for the PLC-3

CHAPTER 2
INSTALLATION

2.1 ALLEN-BRADLEY REQUIREMENTS

2.1.1 Hardware

The list below shows which Allen-Bradley equipment is supported by PCIF. You must be certain to consult the appropriate AB reference manuals provided for each processor or module listed. (A partial list of these manuals can be found in Appendix B of this book). They are an important source of information for interfacing any computer to an AB processor via datacommunications interface modules. Consult the AB reference manuals for standard AB part numbers for cable pin-outs, if you wish to make custom cables. The manuals also provide installation instructions, including dip switch settings. (Most of the common configurations are covered in the diagrams in Chapter 1 of this book, along with suggested switch settings. Variations are possible, depending upon your application.)

The following equipment is supported by the PCIF/Allen-Bradley handler. (DH stands for data highway.)

PLC-2 LINE

DATA COMMUNICATIONS

1771 KC/KD	RS232 to DH	Early computer interface to DH as a unique station.
1771 KE/KF	RS232 to DH	Later computer interface to DH as a unique station.
1771 KG	RS232 to PLC-2	Computer interface to PLC-2 has no unique highway station number.
1771 KA/KA2	DH to PLC-2	Communications interface DH to PLC-2 family.

CONTROLLERS

All PLC and PLC-2/XX Processors	(Any PLC<old>, PLC-2 or Mini-PLC-2)

3.4 MAPPING BETWEEN PCIF CALLS & DATA HIGHWAY COMMANDS

3.4.1 Mapping PLC/PLC-2 Data Highway Commands

DATA HIGHWAY COMMAND	CMD VALUE HEX	FNC VALUE HEX	PCIF CALL	LENGTH TYPE	BYTE-SWAP BY USER REQUIRED	REFER TO NUMBERED NOTES
Protected Write	0	N/A	WRITED	Word, Byte	No	1,5
Unprotected Write	8	N/A	TRANS	Word, Byte, or Bit	Yes	2
Protected Bit Write	2	N/A	WRITED	Bit	No	5
Unprotected Bit Write	5	N/A	TRANS	Word, Byte, or Bit	Yes	2
Physical Write	3	N/A	WRITEP	Word Byte	No	3,5,6
Unprotected Read	1	N/A	READD	Word, Byte, or Bit	No	1,5
Physical Read	4	N/A	READP	Word Byte	No	3,5,6
Diagnostics	6	3	PCSTAT or TRANS	Word Byte, or Bit	Yes	4

Table 3-3

Mapping Between PCIF Calls and Data Highway Commands; PLC/PLC-2

2.2 HP/1000 REQUIREMENTS

2.2.1 Hardware

- Any HP/1000-A series computer: A-400, A-600, A-700, A-900
- 1.5Mb is the minimum RAM suggested for a standard application
- 20Mb disk (minimum)
- Any terminal that supports FORMS/1000 for the configuration sequence
- 12041 C or D, or programmable MUX card

NOTE

> Pay attention to the HP cable (hood pin-outs for baud rate generator) and junction box. See the information supplied with the equipment. Also, be aware if the cable is custom made.

For more information, refer to the "PCIF/1000 Reference Manual" (PN 94200-90001) and the" A-Series Handbook" (PN 5954-8571).

2.2.2 Software

REQUIRED LIBRARIES

- PCIF needs an RTE-A operating system.
- FORTRAN 77 and Pascal are required. FORTRAN is used for some of the utility programs; it is the preferred language for application programs. PCIF is written in Pascal, and it must be linked with those Pascal libraries during installation.
- Macro assembler.

SHIPPED SOFTWARE

- 94200 core product code is in "/pcif.dir". Consult the "PCIF Reference Manual" and the parts list for more information.
- 94202A handler product is in "AB.dir/". For a listing and description of the files, type "LI 94202A."

IMPORTANT AB FILES

The AB handler follows the FMGR naming conventions.

During the preconfiguration phase, the following descriptor command files are called in, depending upon your application. Note that this revision of the AB handler has split the PC descriptor file into two files. You need only load the one appropriate to your target network. If your target system has both families, load both files.

Non-CDS	CDS	Description
[PCP2B	[PCP2C	PLC-2 family descriptor file
[PCPAB	[PCPAC	PLC-3 and PLC-5 family descriptor file
[PCHAB	[PCHAC	AB data highway descriptor file

Note that even if you are directly connected to a PC, you are using DH protocol. Therefore, you have only one highway descriptor file.

The descriptor files call in the proper relocatable files and the Z80 protocol needed to link the system. For a complete description of preconfiguration (PCGEN) and configuration (PCCON), see the "PCIF Reference Manual."

2.3 RUN-TIME RTE-A REQUIREMENTS

2.3.1 Logical Units

Required # of LUs	Unit	Device Driver	Interface Driver
Two	For each Allen-Bradley data highway	%DDP61	%IDS00

Table 2-1

LU Requirements

NOTE

This table does not include LUs needed for the user's application, such as terminal and DS/1000 connection LUs.

For Allen-Bradley PCs, generate the LUs with %DDP61, provided with PCIF/1000. Use %IDS00 as an interface driver. Each LU should have a DVT extension of 34 words defined at generation time, as required by the %IDS00 interface driver.

Set the time-out on these LUs to zero.

2.3.2 Answer File

For the LU, put the following information in the RTE-A generation answer file:

IFT,%IDS00::<directory>,SC:<select code>,QU:FI [1]

DVT,%DDP61::<directory>,,LU:<LU number>,TX:34 [2]

where

[1] : definition of interface table (one per 12041B).

[2] : definition of LU on this IFT.

<directory> : the name of the CI directory location of %IDS00 and $DDP61.

<select code> : the 12041B card select code.

<LU number> : the number desired for the LU.

Table 2-2 is one example of an RTE-A answer file for PCIF with the interface driver located on a PCIF sub-directory.

```
* I/O MAPPING FOR 8 ALLEN-BRADLEY DATA HIGHWAYS
* 16 DOWNLOADABLE MUX LUs, SELECT CODE 34B, LU 120-135

IFT,/PCIF/PRECON/%IDS00,,SC:34B,QU:FI
DVT,PCIF/PRECON/%DDP61,,LU:120,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:121,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:122,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:123,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:124,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:125,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:126,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:127,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:128,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:129,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:130,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:131,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:132,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:133,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:134,TX:34
DVT,PCIF/PRECON/%DDP61,,LU:135,TX:34
```

Note that LUs 120 & 121 correspond to port 0 on the MUX in select code 34; LUs 122 & 123 are for port 1, etc.

Table 2-2

Example of RTE-A Generation Answer File

2.4 SOFTWARE INSTALLATION

The Allen-Bradley handler software is delivered on magnetic media and must be restored to the directory where the PCIF/1000 software resides. To do this, use the copy command CO in the utility program TF, as follows:

CI> TF

TF: CO,<media device LU>{<CI pathname>},<CI pathname>

where:

<media device LU> is the LU number of the device containing the handler.

<CI pathname> is the CI directory that PCIF is to be stored on.

For example:

TF: CO,8{/PCIF/AB/@},/PCIF/AB/@,V

Once this is done, you can change the directory reference of each handler file and program to suit your requirements. Finally, prepare the Allen-Bradley handler for use by invoking the following transfer file command:

CI> TR,/PCIF/AB/*AB

The default directory reference is /PCIF/AB. For instructions on changing the default, see Chapter 6 of your "PCIF/1000 Reference Manual."

If you are adding the Allen-Bradley handler to a PCIF/1000 system that already contains an implemented handler, you must rerun PCGEN. Before doing so, purge PCCON and PCIF from the working cartridge.

2.4.1 Configuring the Allen-Bradley Highway Baud Rate

Use the normal configuration process to configure Allen-Bradley PCs and highways. Figure 2-1 shows the specific Allen-Bradley/PCIF Configuration Editor Screen provided.

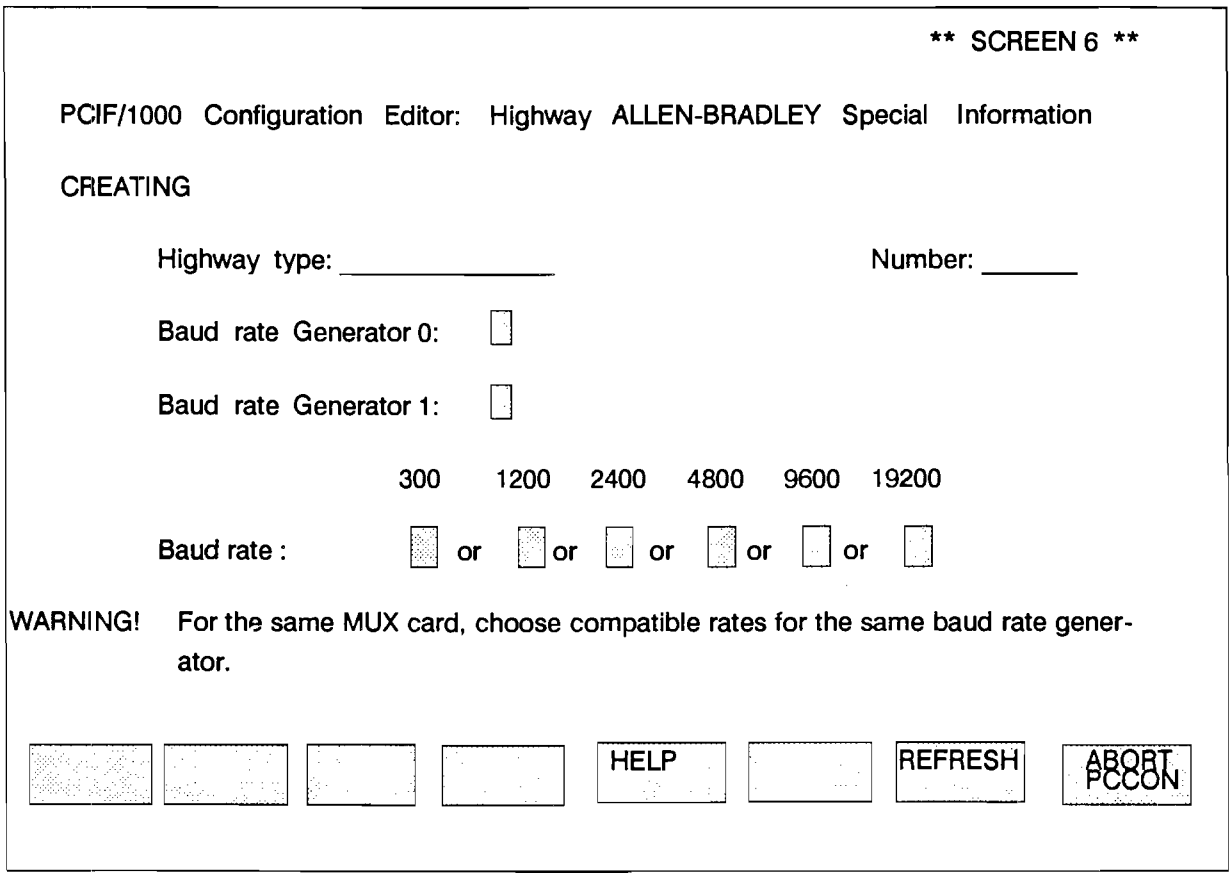


Figure 2-1

Allen-Bradley/PCIF Configuration Editor Screen

Use this screen to configure the Baud Rate Generator for this data highway, and the baud rate at which the MUX and target PC operations are compatible.

If the highway has not already been configured, the screen displays the message CREATING below "PCIF/1000." Otherwise, MODIFYING appears. The validation flag is not set unless all the required information on this screen is supplied.

- Baud Rate Generator: Enter an X to define the baud rate generator.
- Baud Rate: Enter an X beneath the required baud rate. The rate must agree with the baud rate selected by a switch on the Allen-Bradley highway interface (i.e., 1771 KE/KF).

The operator defines the relationship between the generator and baud rate the first time a highway is configured for the MUX card. The baud rates are 300 and 1200 in the first group and 2400, 4800, 9600 and 19200 in the second group. When a baud rate is assigned to a baud rate generator, only baud rates in that group can be assigned to other highways using the same baud rate generator on the same MUX card.

If the softkey ABORT PCCON is pressed, a confirmation is required; press ABORT PCCON again to confirm the ABORT request and terminate the configuration editor. If the ABORT PCCON key is pressed once in error, press another key to disable the ABORT request.

2.5 PC LOGICAL MEMORY AND ADDRESSING

The Allen-Bradley data highway protocol does not distinguish between different areas of the destination processor such as input, output, timer, counter in "data area" or physical address of the program area. In the PLC-2, the logical area maps into the physical location.

In the PC access routine PCADR, the "addr" parameter allows the programmer to address memory inside the processor. The processor then determines whether this is a valid address and when and how to service the request.

Specific information on the "addr" parameter and valid addressing examples are found in Chapter 3 of this book.

2.5.1 PC Station Addressing Examples (Internal PLC Addressing)

A computer can use three types of addressing in the command messages that it transmits to a PC station:

- Logical
- Physical
- Symbolic

The PLC/PLC-2 family of controllers access their data tables using an octal word address. This type of logical word address is represented by an equivalent byte address.

An example word address is:

0110

where

0 = output

1 = rack one, and

10 = word ten.

2.5.2 PLC-3 and PLC-5 Memory Addressing Examples

The PLC-3 and PLC-5 memory uses a form of logical addressing known as "extended" addressing. With extended addressing, you specify the address for each level subdivision of the PLC memory down to the smallest subdivision you wish to access. With the PLC-3, you can use this method to specify up to six (6) levels. The PLC-5 allows access to only four (4) levels. All addressing is in decimal unless otherwise specified.

An example of the PLC-3 extended address is:

E3.1.5.1.0.0

where

E3 = data table area

1 = context

5 = section (5 is integer in this case)

1 = file

0 = structure

0 = word

The PLC-3 can be programmed to equate an ASCII symbol to an extended address. This symbol can then be used to refer to the word or file of words. PCIF can use this symbol as a value in its PCADR "addr" parameter to represent the destination of the data buffer.

The PLC-5 can be addressed in a logical binary or logical ASCII format. An example of the logical binary addressing is:

0 10 360 0

where

0 = data table area (level 1)

10 = file (level 2)

360 = element 360

0 = sub-element

An example of logical ASCII addressing is:

$ N 10 : 360

where

$ = logical address symbol

N = file identifier

10 = file number

: = delimiter

360 = element

PCIF uses all the above addressing, within certain rules and limitations, in order to access data from the target station. Read carefully the examples in this manual on how to use types of addressing in conjunction with the specific access routines.

2.6 PC LOGICAL IDENTIFICATION

At configuration time, one unique logical identifier is assigned to a specific combination of data highway and PC.

A logical data highway consists of a single port with two system LUs. For example, during PCCON, LU 120 and LU 121 are associated with port 0 of the MUX when logical highway 1 is configured. Later in PCCON, when a logical PC is configured, you are prompted for the logical highway number, which is then associated with a physical PC address on the AB data highway; for example, the dip switches and address in the command rung of the PLC-2.

2.7 PC TIME-OUT

The time-out value is the maximum length of time a request from an application program to PCIF/1000 can remain pending. Once the time-out period is exceeded, the request is destroyed and any subsequent reply to this request is ignored by the PCIF monitor.

In PCIF, the time-out value for PCARs is defined in screen 9 of the configuration editor. This value determines how long the application program waits for a response from the PCIF monitor. If the value is set higher than 40 seconds, the error "257 Maximum retry number with PC exceeded" will be returned by the highway handler, rather than "38 Time-out" (the defined time-out value was exceeded).

If a PC fails to respond after receiving a request, a delay occurs and the multiplexer queries this PC, up to 11 times. If there is still no response, the request is aborted and an error message is returned to the user. The delay between two tries is 4 seconds.

2.8 PC CAPABILITIES

Due to the AB peer-to-peer communication scheme, each PLC is able to generate unsolicited requests. However, this capability can be disabled for specified PCs at configuration-time. The PC may still generate requests, but PCIF/1000 will ignore them.

Similarly, at configuration time, the user can specify which PLC-2 can be accessed outside of its data area. PLC-3 and PLC-5 make no distinction between data and program memory areas.

Only the PLC-3 supports the START and STOP commands. This capability should be disabled for all other Allen-Bradley PCs at configuration-time.

CHAPTER 3
OPERATION

3.1 GENERAL INFORMATION

At run-time, when application programs are interacting with Allen-Bradley PCs, all the PCARs listed in Chapter 4, PC Access Routines, of the "PCIF Reference Manual," are available to the user. This chapter describes Allen-Bradley operational requirements for the programmer.

The PLC-2 does **NOT** use the "_EXT" calls. The PLC-3 and PLC-5 use **ONLY** "_EXT" calls, as shown in the tables that follow.

3.2 PC ACCESS ROUTINE SUMMARY FOR THE PLC/PLC-2 FAMILIES

Access Routines	Supported	Specific Aspects	See Note #
PC_CANCEL	Yes	No Comment	1
PC_CONNECT	Yes	" "	1
PC_DISC	Yes	" "	1
PC_DIUNSOL	Yes	" "	3
PC_ENQUIRY	Yes	" "	8
PC_ENUNSOL	Yes	" "	3
PC_FREEZE	NO	" "	-
PC_GETKEY	Yes	" "	1
PC_IDENT	Yes	" "	9
PC_LOCK	Yes	" "	1
PC_PCSTAT	Yes	Diagnostic Status Used	1
PC_READD	Yes	Unprotected Read Used	4,6
PC_READD_EXT	NO	No Comment	-
PC_READP	Yes	Physical Read Used	4,7
PC_READP_EXT	NO	" "	-
PC_RELKEY	Yes	" "	1
PC_START	NO	" "	2
PC_STOP	NO	" "	2
PC_SYSTAT	Yes	" "	1
PC_TRANS	Yes	" "	10
PC_UNLOCK	Yes	" "	1
PC_WRITEB_EXT	NO	" "	-
PC_WRITED	Yes	Protected Write Used	4,5,6
PC_WRITED_EXT	NO	-	-
PC_WRITEP	Yes	Physical Write Used	4,7
PC_WRITEP_EXT	NO	-	-

Table 3-1

PC Access Routine Summary For the PLC/PLC-2 Families

NOTES:

1. Refer to Chapter 4, PC Access Routines, in the "PCIF/1000 Reference Manual."

2. START and STOP are not supported by the PLC/PLC-2 interface modules.

3. Refer to Chapter 4, PC Access Routines, in the "PCIF Reference Manual" and to section 3-8, Unsolicited Requests, in this manual.

4. These requests use specific Allen-Bradley functions in the PC. The requests must be able to recognize PC programming and switch settings. Refer to the Allen-Bradley bulletins for details.

5. Refer to section 3-9, Bit Writes With PC_WRITED, in this manual.

6. The transmitted buffer must follow the rules explained in the Allen-Bradley bulletin. Also note that:

– The specified address PCADR given in the access routine must define a word address if the length defines the type of data as words, and a byte address if the length defines the type of data as bytes.

– PCIF need supply only the first byte address.

– An example of bit writes using a PC_WRITED call is given in section 3-9 of this manual.

7. The routines PC_READP and PC_WRITEP allow a 16-bit word only. No byte or bit addressing is allowed.

8. The first word returned in BUFFR from a PC_ENQUIRY call contains the PC memory destination address as specified in the command rung in the PC program. This can be used as a user-defined flag to get more information about an unsolicited message, but be sure to increase LENGR by one to include this value.

9. Refer to section 3-6, Identifying the PC, in this manual.

10. Refer to Chapter 4, PC Access Routines, in the "PCIF Reference Manual," and section 3-7, Requests in Transparent Mode, in this manual.

NOTE

All routines except PC_TRANS are sent to the Allen-Bradley data highway with equal priority. For PC_TRANS, the user can define the transmission priority from the PC's point of view with bit 5 of the CMD word. See section 3-5, START/STOP PC Requests, in this manual.

3.3 PC ACCESS ROUTINE SUMMARY FOR THE PLC-3/PLC-5 FAMILIES

Access Routines	Supported	Specific Aspects	See Note #
PC_CANCEL	Yes	No Comment	1
PC_CONNECT	Yes	" "	1
PC_DISC	Yes	" "	1
PC_DIUNSOL	Yes	" "	3
PC_ENQUIRY	Yes	" "	1
PC_ENUNSOL	Yes	" "	3
PC_FREEZE	Yes	Upload Stop	2,5
PC_GETKEY	Yes	No Comment	1
PC_IDENT	Yes	" "	1
PC_LOCK	Yes	" "	1
PC_PCSTAT	Yes	Diagnostic Status Used	1
PC_READD	NO	For Physical Memory	4,8
PC_READD_EXT	Yes	For Logical Memory	6,8
PC_READP	NO	For Physical Memory	4,7,8
PC_READP_EXT	Yes	No Comment	-
PC_RELKEY	Yes	" "	1
PC_START	Yes	" "	2,5
PC_STOP	Yes	Upload Stop	2,5
PC_SYSTAT	Yes	No Comment	1
PC_TRANS	Yes	" "	9
PC_UNLOCK	Yes	" "	1
PC_WRITEB_EXT	Yes	Bit Write	6,8
PC_WRITED	NO	For Physical Memory	4,8
PC_WRITED_EXT	Yes	For Logical Memory	6,8
PC_WRITEP	NO	For Physical Memory	4,7,8
PC_WRITEP_EXT	Yes	No Comment	

Table 3-2

PC Access Routine Summary for the PLC-3

NOTES:

1. Refer to Chapter 4, PC Access Routines, in the "PCIF/1000 Reference Manual."
2. Refer to section 3-5, START/STOP PC Request, in this manual.
3. Refer to Chapter 4, PC Access Routines, in the "PCIF Reference Manual" and to section 3-8, Unsolicited Requests, in this manual.
4. The PLC-3 and PLC-5 do not make any distinction between data and programs when referring to physical memory, so they interpret PC_READD and PC_READP as the same function. This is also true of PC_WRITED and and PC_WRITEP.
5. Remember to restart the PC after a STOP command.
6. Refer to Chapter 4, PC Access Routines, in the "PCIF/1000 Reference Manual."
7. Programs on the PLC-3 and PLC-5 are referenced by physical address only. To read and write programs, use the PC_READP and PC_WRITEP calls.
8. All read/write routines for the PLC-3 and PLC-5 use 16-bit words.
9. Refer to section 3-7, Requests In Transparent Mode, in this manual.

NOTE

All routines except PC_TRANS are sent on the Allen-Bradley data highway with equal priority. For PC_TRANS, the user can define the transmission priority from the PC's point of view with bit 5 of the CMD word.

3.4 MAPPING BETWEEN PCIF CALLS & DATA HIGHWAY COMMANDS

3.4.1 Mapping PLC/PLC-2 Data Highway Commands

DATA HIGHWAY COMMAND	CMD VALUE HEX	FNC VALUE HEX	PCIF CALL	LENGTH TYPE	BYTE-SWAP BY USER REQUIRED	REFER TO NUMBERED NOTES
Protected Write	0	N/A	WRITED	Word, Byte	No	1,5
Unprotected Write	8	N/A	TRANS	Word, Byte, or Bit	Yes	2
Protected Bit Write	2	N/A	WRITED	Bit	No	5
Unprotected Bit Write	5	N/A	TRANS	Word, Byte, or Bit	Yes	2
Physical Write	3	N/A	WRITEP	Word Byte	No	3,5,6
Unprotected Read	1	N/A	READD	Word, Byte, or Bit	No	1,5
Physical Read	4	N/A	READP	Word Byte	No	3,5,6
Diagnostics	6	3	PCSTAT or TRANS	Word Byte, or Bit	Yes	4

Table 3-3

Mapping Between PCIF Calls and Data Highway Commands; PLC/PLC-2

NOTES:

1. For word addressing, set PCADR equal to the decimal equivalent of the PC's octal word addressing in memory. For byte addressing, set PCADR equal to two times the decimal equivalent of the PC's octal word address in memory (2 BYTES = 1 WORD).

2. The PC_TRANS call can be formatted for word, byte, or bit units. If the number of bytes to be transferred is not evenly divisible by 2, use BYTE addressing or BIT addressing.

   Since Allen-Bradley stores their serial data in memory low byte-high byte, the buffers in the PC_TRANS call must be byte-swapped before use. This only applies to a pair of bytes that is assumed to be a single word (i.e., an address or 16-bit value). The routine BSWAP in &ABLIB can be used for this. Refer to the source code listing of &ABLIB for instructions.

3. READP and WRITEP can only use word addressing.

4. PCSTAT returns only the run mode status and download status. To retrieve information about program start address, option settings, etc., use PC_TRANS to format and send a diagnostic request to the PC.

   Use:

   SUBFCT = 6;

   LENGW = 1 + 40000B;

   LENGR = 10 + 40000B;

   and put "3" into the first byte of BUFFW (BUFFW (1) = 3 * 400B). Refer to the source code of &ABLIB and review the routine called "Diag-status."

5. The parameter PCADR must be of type INTEGER * 4 (32 bits).

6. Refer to your AB programming manual to define the physical area of processor memory. Unless you are familiar with the internals of the PC, you may only wish to read the complete block of this section of memory. See ABUP and ABDN source code for examples on the use of this access routine.

3.4.2 Mapping PLC-3 Data Highway Commands

DATA HIGHWAY COMMAND	CMD VALUE HEX	FNC VALUE HEX	PCIF CALL	LENGTH TYPE	BYTE-SWAP BY USER REQUIRED	REFER TO NUMBERED NOTES
Word Range Write	F	0	WRITED_EXT	Word	No	4
Bit Write	F	2	WRITEB_EXT	Word	No	4
Physical Write	F	8	WRITEP WRITED	Word	No No	3
Word Range Read	F	1	READD_EXT	Word	No	4
Physical Read	F	9	READP READD	Word	No	3
Diagnostics	6	3	PCSTAT TRANS	Byte or Word	Yes	1,2
Restart Request	F	10	START	N/A	No	5
Download Request Shutdown Request	F F	5 7	STOP	N/A	No	5,6
Upload Request Shutdown Request	F F	6 7	FREEZE	N/A	No	5,7

Table 3-4

Mapping Between PCIF Calls and Data Highway Commands; PLC-3

NOTES:

1. Since Allen-Bradley stores their serial data in memory low byte-high byte, the buffers in the PC_TRANS call must be byte-swapped before use. This only applies to a pair of bytes that is assumed to be a single word (i.e., an address or 16-bit value). The routine BSWAP in &ABLIB can be used for this.

2. PCSTAT returns only the run mode status and download status. To retrieve information about program start address, option settings, etc., use PC_TRANS to format and send a diagnostic request to the PC.

   Use:

   SUBFCT = 6;

   LENGW = 1 + 40000B;

   LENGR = 10 + 40000B;

   and put "3" into the first byte of BUFFW (BUFFW (1) = 3 * 400B). Refer to the source code of &ABLIB and review the routine called "Diag-status."

3. The parameter PCADR must be of type INTEGER * 4 (32 bits).

4. Use PLC-3 extended or symbol addressing.

5. See section 3-5, START/STOP PC Request, in this manual.

6. A download request is sent, followed by a shutdown request.

7. An upload request is sent, followed by a shutdown request.

3.4.3 Mapping PLC-5 Data Highway Commands

DATA HIGHWAY COMMAND	CMD VALUE HEX	FNC VALUE HEX	PCIF CALL	LENGTH TYPE	BYTE-SWAP BY USER REQUIRED	REFER TO NUMBERED NOTES
Word Range Write	F	0	WRITED_EXT	Word	No	4
Read Modify Write	F	26	WRITEB_EXT	Word	No	4
Write Byte Physical	F	18	WRITEP WRITED	Word	No No	3
Word Range Read	F	1	READD_EXT	Word	No	4
Write Byte Physical	F	17	READP READD	Word	No	3
Diagnostics	6	3	PCSTAT TRANS	Word Byte	Yes	1,2
Upload Complete Download Complete	F F	55 52	START	N/A	No	
Download All Request	F	50	STOP	N/A	No	
Upload All Request	F	53	FREEZE	N/A	No	

Table 3-5

Mapping Between PCIF Calls and Data Highway Commands; PLC-5

NOTES:

1. Since Allen-Bradley stores their serial data in memory low byte-high byte, the buffers in the PC_TRANS call must be byte-swapped before use. This only applies to a pair of bytes that is assumed to be a single word (i.e., an address or 16-bit value). The routine BSWAP in &ABLIB can be used for this.

2. PCSTAT returns only the run mode status and download status. To retrieve information about program start address, option settings, etc., use PC_TRANS to format and send a diagnostic request to the PC.

   Use:

   SUBFCT = 6;

   LENGW = 1 + 40000B;

   and put "3" into the first byte of BUFFW (BUFFW (1) = 3 * 400B). Refer to the source code of &ABLIB and review the routine called "Diag-status."

3. The parameter PCADR must be of type INTEGER * 4 (32 bits).

4. Use logical binary addressing (similar to extended in PLC-3) or logical ASCII (similar to symbolic in PLC-3).

3.4.4 PLCs On the Same Highway

Any PLC on a single physical highway may reside on the PCIF logical highway.

3.5 START/STOP PC REQUESTS

You cannot use the PC_START or PC_STOP access routines for the Allen-Bradley PLC and PLC-2 series. You can PC_CONNECT and PC_DISCONNECT only to an already running PC.

During program downloading, the PC outputs are held in their last state by the PC processor in the PLC-2 series, and in their last state or off (user-definable) in the PLC-3 series.

The Allen-Bradley PLC-3 accepts three start/stop commands:

- **PC_STOP**

  This command causes the PLC-3 to perform a total shutdown. In this state, the application program may read from or write to physical memory, and the ladder logic program stops executing.

  WARNING! Be aware of the effect of a PLC-3 total shutdown before using this command.

- **PC_FREEZE**

  This command causes the PLC-3 to freeze file locations. In this state, physical memory may only be read, and attempts to write to physical memory result in errors. The ladder logic program continues executing.

- **PC_START**

  This command causes the PLC-3 to resume normal operation.

3.6 IDENTIFYING THE PC

The BUFFR parameter of the PC_IDENT access routine returns the following data for Allen-Bradley PCs:

- VENDOR = AB, Allen-Bradley (one 16-bit word containing the two ASCII characters "AB")
- MODEL = 0, PLC processor
  - 1, PLC-2 processor
  - 2, PLC-2/20 (LP1) processor
  - 3, Mini-PLC-2 processor
  - 4, PLC-3 processor
  - 5, PLC-2/20 (LP2) processor
  - 6, PLC-2/15 processor
  - 7, PLC-2/30 processor
  - 11, PLC-5/15 processor
  - 15, Computer

For a complete explanation of the PC_IDENT access routine, see Chapter 4, PC Access Routines, in the "PCIF/1000 Reference Manual."

3.7 REQUESTS IN TRANSPARENT MODE

You can use the PC_TRANS routine

PC_TRANS(STAT,TAG,CONTKEY,PC,SUBFCT,BUFFW,LENGW,BUFFR,LENGR)

to generate all the requests supported by the Allen-Bradley protocol directly from an application program. The requests are listed with their calling syntax in Allen-Bradley Bulletin 1771-802 (KE, KF Communication Module). The PC performs the function given in the SUBFCT parameter of the PC_TRANS routine, and the corresponding data is sent to the PC in the routine's BUFFW parameter. Remember that PCIF/1000 only checks once that a specified PC is capable of receiving a PC_TRANS call, as defined at configuration-time. The reply from the PC is returned in the BUFFR parameter of PC_TRANS. For details of this routine, refer to Chapter 4, PC Access Routines, in the "PCIF/1000 Reference Manual."

Figure 3-1 shows the message format of an Allen-Bradley PLC and its relationship with the PC access routine PC_TRANS.

DLE	STX	DST	SRC	CMD	STS	TNS	VARIOUS...	DLE	ETX	BCC

Figure 3-1

Message Format Protocol

where:

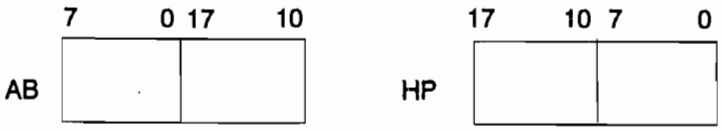
- DLE is filled by PCIF/1000
- STX is filled by PCIF/1000
- DST is filled by the PC (logical identifier) parameter of PC_TRANS
- SRC is filled by Allen-Bradley Communication Controller Module
- CMD is filled from the SUBFCT parameter of PC_TRANS
- STS is a return word supplied by the specified PC
- TNS is filled by PCIF/1000
- VARIOUS is filled from the BUFFW parameter of PC_TRANS
- DLE, ETX and BCC are filled by PCIF/1000

If you wish to use physical addressing in the PLC-3 or PLC-5, you must use the PC_TRANS routine (see the ABUP and ABDN source code for examples).

NOTE

All data in word format sent to or returned from AB PLCs via PC_TRANS must be byte-swapped by the user. This is because during internal AB processor storage, words are transmitted with the low byte before the high byte, which is the opposite of transmission in HP/1000 mode. For some helpful utilities, see ABLIB.

The following example illustrates byte-swapping:



In all other PCARs, PCIF takes care of byte-swapping transparently.

3.8 UNSOLICITED REQUESTS

3.8.1 PLC Programming

The HP/1000 is connected to the data highway via a KE/KF communication module. This module makes the 1000 a "station" on a peer link.

As a station on the peer link, the PLC-2 can be programmed to write information to a class buffer managed by PCIF. This is done by using the proper command code in the command rung of the communication zone (refer to the AB "1771-KA/2 Reference Manual"). Simply have the PLC-2 send the KE station any kind of "write" command. The "remote station data table address" is unimportant and ignored by PCIF. The AB handler will ignore and flush any message that does not contain a write command.

The PLC-3 and PLC-5 use the MESSAGE procedure to access a remote station on the highway. (Refer to Chapter 8 in the AB "1775-KA Manual" for an example of a MESSAGE block for the PLC-3, and to Chapter 18 of the AB "PLC-5/15 Programming Manual.")

In the case of a point-to-point link (such as a 1771-KG module and the MODEM port of the 1775-KA module), the remote station is the only other link on the highway. We suggest you use the station number 10 octal in these cases.

3.8.2 How to Set Up an Unsolicited Request Using PCARs

If you are going to use the unsolicited option with PCIF, you must take the following steps in your application program (these are described in Chapter 4 of the "PCIF Reference Manual"):

1. Get a "key" number by using the PC_GETKEY routine.

2. Enable the unsolicited response option by using the PC_ENUNSOL routine. Use the key value returned by PC_GETKEY.

3. Issue a PC_ENQUIRY routine. Be sure to set the "no wait" bit in the CONTKEY parameter if you want your application program to continue if there is no return information. Be aware of the TYPER parameter in order to determine what addressing format the BUFFR parameter is using. The LENGR parameter contains both the length and the units (bit, byte, or word) of the BUFFR information.

PCIF stores information from the incoming highway message in a buffer associated with the key number. The Z80 firmware then replies to the PLC by using the reply bit in the CMD word and STS word of the message

packet. See the appropriate Allen-Bradley Manual for more information on data highway message formats. (For quick reference, see also Figure 3-1 in section 3.7 of this manual.)

Figure 3-2 below illustrates how an unsolicited request is set up using PCARs.

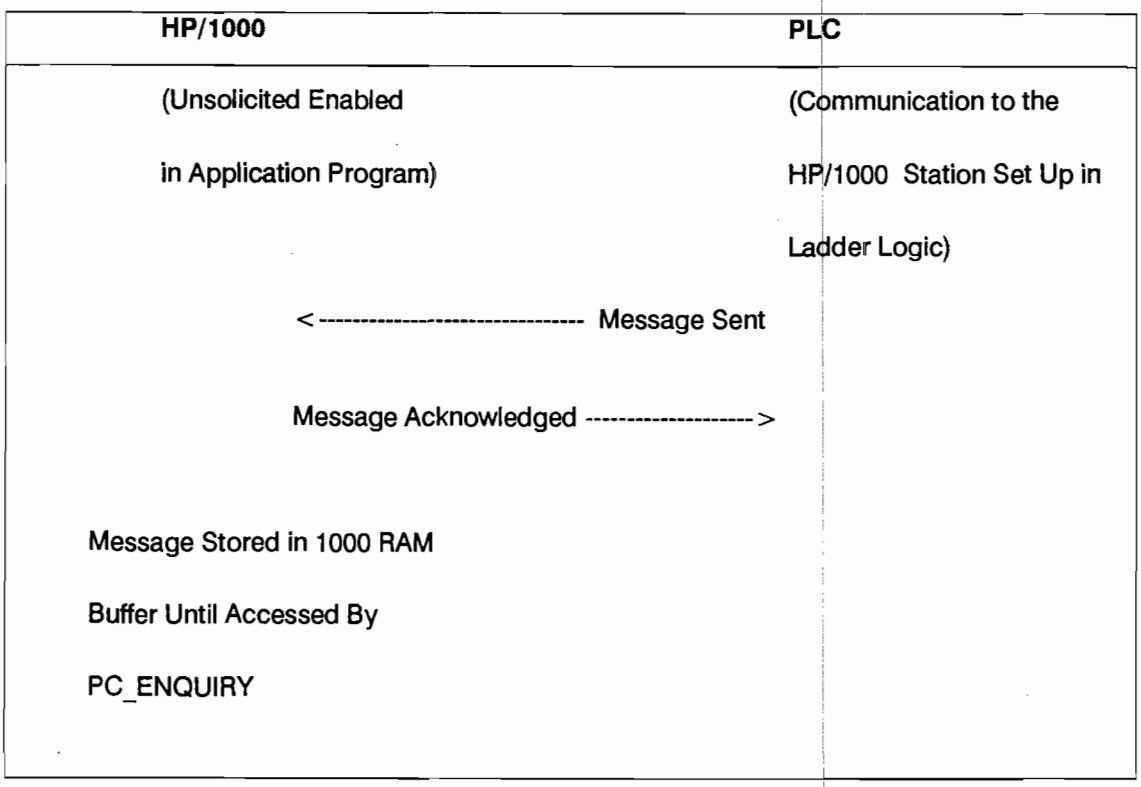


Figure 3-2

Setting Up an Unsolicited Request using PCARs

3.8.3 How a PLC May Read Data Stored in the HP/1000 Memory

PCIF stores the request in a buffer associated with an access key value. This buffer is then read by the application program via the PC_ENQUIRY call. The PLC data highway is replied to via the Z80 firmware on the MUX card.

Since the firmware cannot respond to the PLC in the case of a "read" request, PCIF can only reply to a read request from a remote PLC in the following way. First, the PLC must be programmed to issue a "write" request to the HP/1000, even though it wishes to read data. Secondly, the station must have been enabled for unsolicited, via PC_ENUNSOL, by the application program, and must have a pending read via a "PC_EN-

QUIRY" (with wait) request. The firmware will reply to the PLC write request and store the information in a buffer, which the application program will read.

It is now up to the programmer to have some "flag" value, usually a predefined address, to recognize that the PLC is requesting information. The application program can then provide this information via the "PC_WRITED" access routine. The following list summarizes these steps:

In The PLC Station That Needs To Read Data

1. Program the PLC to issue a write request when it needs data from the HP/1000. Assign a local data address that can be used as a flag for the application program.

In The HP/1000 Application Program

2. Decide whether you wish to use the "no wait" option for the PCARs. If you do, set the "key" value as described in Chapter 4 of the "PCIF Reference Manual."

3. Call PC_GETKEY and get a key number.

4. Enable an unsolicited by calling PC_ENUNSOL and passing it the key value.

5. Set up a PC_ENQUIRY.

6. When PLC issues a write to the HP/1000 over the D.H., it is completed by the MUX card firmware and the message is stored in the appropriate buffer.

7. The PC_ENQUIRY completes. Your application program determines the PLC is requesting data. It sends the PLC more data by issuing a PC_WRITED or PC_WRITED_EXT.

3.8.4 The Format of a PLC-3 and PLC-5 Message

The PLC-3/PLC-5 message format is shown below. You may use it as a guide in order to examine the data for a flag, as discussed in the previous sections.

ds	scr	cmd	tns	fnc	0	1	2-5	6-7	8 data--->

Table 3-6 describes the fields in the message format for the PLC-3 and PLC-5.

The numbers represent 16 bit words where:

NUMBER	NAME	DESCRIPTION
0	Packet Offset	Where in the buffer does the data start? For example, if there are 100 words of data and the offset is 25, there will be 75 words of data starting at word 25.
1	Total Transaction	Total number of words in the buffer; for example, the 100 in the last example.
2	Number of addressing levels	Encoded by the PLC-3 and PLC-5. High byte is always FF hex = -1. Low byte is "level" mask, a hex encoded binary value. For example: 0 1 1 1 = 7 hex - - - | = level 1 - - | - = level 2 - | - - = level 3
3	Level 1	This word equals level 1 value
4	Level 2	This word equals level 2 value
5	Level 3	This word equals level 3 value (for more levels, follow the same method)

NOTE: Words 6 and 7 apply to the PLC-5 only. The data type field is specific to the file write command of a PLC-5.

6 (PLC-5 ONLY)	Data Type	See section 5-15 in the AB "1770 KF2 Manual." Information is byte swapped and can be less than two words.
7 (PLC-5 ONLY)	Data Size	(Same as word 6 description.)
8	Data	

Table 3-6

Unsolicited Message Format (PLC-3, PLC-5) Using Extended Addressing in a Write Command

NOTE

The current PLC-5 firmware sends four byte data type fields (6 + 7) in Example A in the AB "1770-KF2 Manual." If this field changes, it may misalign the data that follows, as shown in the example below.

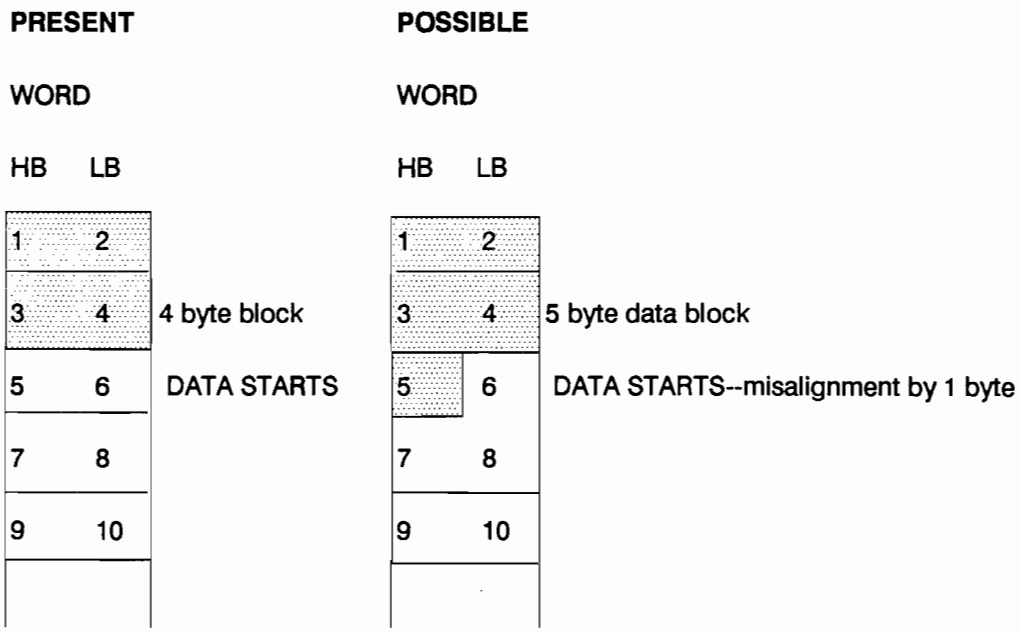


Table 3-7

Example of Data Misalignment

Table 3-8 shows the Unsolicited Message Format for a PLC-2 using a write command.

WORD NUMBER	NAME	DESCRIPTION
0	PLC-2 Memory Address	Address of the first byte/word of data
1	Data	
.	.	
.	.	
.	.	
n	Data	

Table 3-8

Unsolicited Message Format (PLC-2) Using a Write Command

Operation

Table 3-9 shows an unsolicited message format for the PLC-3, using a word symbol in a word range write command.

WORD NUMBER	NAME	DESCRIPTION
0	Packet Offset	Where in the buffer does the data start? For example, if there are 100 words of data and the offset is 25, there will be 75 words of data starting at word 25.
1	Total Transaction	Total number of words in the buffer. For example, the 100 in the last example.
2...m	Word Symbol Address	PLC-3 addressing method = word symbol. Encoded in ASCII
m + 1	Word Symbol Flag	Always 0
m + 2	Data	
.	.	
.	.	
.	.	
n	Data	

Table 3-9

Unsolicited Message Format (PLC-3) Using a Word Symbol in a Word Range Write Command

Table 3-10 shows the unsolicited message format for a PLC-3 using a file symbol in a word range write command.

WORD NUMBER	NAME	DESCRIPTION
0	Packet Offset	Where in the buffer does the data start? For example, if there are 100 words of data and the offset is 25, there will be 75 words of data starting at word 25.
1	Total Transaction	Total number of words in the buffer. For example, the 100 in the last example.
2...m	File Symbol Address	PLC-3 addressing method = file symbol. Encoded in ASCII
m + 1	File Symbol Flag	Always 1
m + 2	File Offset	The offset from the beginning of the file
m + 3	Data	
.	.	
.	.	
.	.	
n	Data	

Table 3-10

Unsolicited Message Format (PLC-3) Using a File Symbol in a Word Range Write Command

NOTE

Both the PLC-3 and the PLC-5 are capable of sending very large buffers; e.g., 1,000 bytes. Due to transmission size limitations, the buffer must be divided into five separate transmissions. The application program can make use of the "packet offset" and "total transactions" fields to recombine the five individual messages.

3.9 BIT WRITES WITH PC_WRITED (PLC-2 ONLY)

For writing bits into an Allen-Bradley PLC-2, the PC's message buffer must have the following format:

			PCADR	BUFFW											
DLE	STX	. . .	ADR1	RST1	SET1	ADR2	RST2	SET2	. . .	ADRn	SETn	RSTn	. . .	ETX	BCC

Table 3-11

PC's Message Buffer Format

The PC_WRITED routine has the following calling sequence:

PC_WRITED(STAT,TAG,KEY,PC,BUFFW,LENGW,PCADR)

The **BUFFW** parameter is used to fill RST1 - SET1 - ADR2 - RST2 - SET2 ... RSTn and is user-definable.

The **LENGW** parameter must indicate the data type in bits. To calculate the value of LENGW, use the following equation.

LENGW = 16 + 32(n-1) + 100000b

n	number of set/reset pairs to send
16	number of bits in RST1 and SET1
32(n-1)	number of bits in the rest of the addresses and RST and SET masks.
100000b	specifies bit units

NOTE

The eight-bit SET mask must be packed into the same 16-bit word as the eight-bit RESET mask. Use the upper byte for RESET mask and the lower byte for SET mask.

The **PCADR** parameter is used to fill ADR1 only. It must be a byte address.

3.10 BIT WRITES WITH PC_WRITEB_EXT (PLC-3, PLC-5 ONLY)

The PC_WRITEB_EXT routine has the following calling sequence:

PC_WRITEB_EXT(STAT,TAG,KEY,PC,BUFFW,LENGA,LENGB)

The **BUFFW** parameter takes the following format:

ADDRESS	ADDRESS TYPE/ OFFSET WORD	SET MASK	RESET MASK

ADDRESS can address a word using extended or symbolic format. A symbolic address must be an ASCII buffer 8 bytes long.

ADDRESS TYPE/OFFSET WORD is one word, defined as follows:

VALUE	ADDRESS TYPE
-2	Extended
-1	Symbolic Word
Other*	Symbolic File (with Word Offset Value given)

*In this case, the **ADDRESS TYPE/OFFSET WORD** value is the location of the word within the file (greater than or equal to zero).

In other words,

-2 = Extended address used for bit write

-1 = Word address used for bit write

10 = File address, word 10 is destination in file of bit write operation

Operation

SET MASK: A series of bits that is logically ORed with the addressed word.

RESET MASK: The complement of the **RESET MASK** is ANDed with the result of the **SET MASK** operation.

LENGA: The length of the address in bytes.

LENGB: The length of data in words.

Since **SET** and **RESET MASK** are the only data sent, the **LENGB** parameter can never be greater than two.

The **ADDRESS** and **ADDRESS TYPE/OFFSET WORD** may be overwritten by PCIF/1000 and, therefore, should be set before each call.

3.11 DATA WRITES AND READS WITH PC_READD_EXT AND PC_WRITED_EXT (PLC-3, PLC-5 ONLY)

The PC_READD_EXT routine has the following calling sequence:

PC_READD_EXT(STAT,TAG,KEY,PC,BUFFR,LENGA,LENGB)

The PC_WRITED_EXT routine has the following calling sequence:

PC_WRITED_EXT(STAT,TAG,KEY,PC,BUFFW,LENGA,LENGB)

3.11.1 Parameters of the READD_EXT and WRITED_EXT Calls

The following information pertains to the parameters of the PC_READD_EXT access routines outlined in Chapter 4 of the "PCIF Reference Manual."

BUFFR or BUFFW breaks into the following blocks:

ADDRESS	OFFSET WORD	DATA

Address =	"logical binary"	PLC-5
	"word symbol"	PLC-3
	"logical ASCII"	PLC-5
	"block address"	PLC-3

See the appropriate Allen-Bradley documentation for definitions of the descriptions. For the PLC-3, leave off the "E" prefix on the first character of the "block address." For the PLC-5, you may retain the "$."

Offset Word =	-1	"logical ASCII"
		"block address"
	-2	"logical binary"
		"word symbol"

Operation

In the PLC-5, if the offset word value isn't -1 or -2, it is regarded as -1. If the offsets are wrong, PCIF will still send them out. The PLC-5 will return the following errors:

PC 515 "too many elements in the address"

PC 518 "not pointing to useful address"

> **WARNING! On the PLC-5, if you use a logical block address that uses data areas that start with other than "$ N : 0 0", for example, "$ T : 0 0", the data will be put in the output table of the target controller, and may turn an output on unexpectedly.**

Data = Data to be sent. It advises you to end data on word boundaries.

LENGA = Bytes of address.

LENGB = Words of data.

3.12 PROGRAM DOWNLOAD PROCEDURE

The ABDN program illustrates the steps required to download a program into an Allen-Bradley processor. Some important points to consider are:

1. Be sure the file to be downloaded contains the proper information for the target PC.

2. For the PLC/PLC-2 family: Use the PC_WRITEP routine to download the user program area. PC_WRITED should only be used for writes into the PC data table.

3. For the PLC-3 and PLC-5: Use the PC_STOP routine followed by the PC_WRITEP routine and do the reads in 100-word increments. Use the PC_WRITED_EXT or PC_WRITEP routine for writes into the PC data table.

4. When downloading the data table, use the PC_WRITED routine only if the memory access rungs in the communication zone of the PC are set up to allow access to the entire data table. Otherwise, use the PC_TRANS routine to perform the download using unprotected writes.

Also refer to the subroutine "AB_ERROR" in the listing of &ABLIB for an example of how to decode errors.

3.13 PROGRAM UPLOAD PROCEDURE

The ABUP program illustrates the steps required to upload the memory from a PLC-2 series processor to a file on the HP/1000 computer. The main steps include the following:

1. Determine if it is necessary to upload the entire memory or just the user program.

2. Perform a DIAGNOSTIC STATUS command using the PC_TRANS routine to obtain the starting program address.

3. Determine which area of memory is to be uploaded. If it is the data table, use the PC_READD routine. Otherwise, for the PLC/PLC-2 family, use the PC_READP routine and do the reads in 100-word increments. For the PLC-3 and PLC-5, use PC_STOP or PC_FREEZE with the PC_READP routine.

3.14 ERRORS

If a transmission error occurs, a status code is sent to the application program. The values are equal to the Allen-Bradley error values plus an offset of 512.

For example, the meaning of error 514 is "undeliverable message." Other errors may be issued directly by the handler, such as "257: ten NAKs have been sent by the communication controller module." This indicates that problems have occurred on the link between the Allen-Bradley interface and the multiplexer.

The error numbers and their meaning may be found by cross-referencing Allen-Bradley Bulletin 1771-802 and Appendix A of this manual.

CHAPTER 4
TROUBLESHOOTING

4.1 INTRODUCTION

This chapter introduces four utility programs for troubleshooting your PCIF/Allen-Bradley system: PCTST, ABTST, ABUP and ABDN.

The purpose of these utilities is to help find the cause of a problem. If you suspect that a problem is caused by a PC access routine, use the utility PCTST. It will help you confirm that a PCAR's parameters are being initialized with the correct values and that the expected information is being returned by the access routine.

A problem due to a suspected fault in communications along the data highway with Allen-Bradley PCs may be pinpointed by using the utility ABTST.

ABUP and ABDN are examples of how to upload and download the PC memory to and from the computer. They also give some helpful hints for the application programmer.

4.2 PCTST

PCIF/1000 is a programming tool that enables application programs to communicate with various programmable controllers. As an interface product, it allows application programmers to communicate with a PC using high-level subroutine calls that are independent of the PC manufacturer.

Programmers may read data from PCs, write data to PCs, start and stop PCs, query the status of a PC, and receive unsolicited requests from PCs. Typical applications include PC monitoring, PC program archiving and supervisory control functions.

Of course, application programs must be written to perform any of these functions. However, the PCTST program allows the subroutines of PCIF/1000 to be executed interactively, which aids in testing, verifying, program debugging, and learning PCIF.

Refer to Appendix B of the "PCIF/1000 Reference Manual" for program instructions, and to the PCTST source code listing for details.

4.3 ABTST

The ABTST utility allows you to interrogate the interface modules on the data highway. To run the program, enter the command:

CI RU,/PCIF/AB/ABTST,PC

where PC is the logical identifier of the target PC.

If the parameter "PC" is left out of the run string, the program prompts for it.

ABTST interrogates the communication adapter and the communication controller modules. It uses the PC_TRANS routine to do a DIAGNOSTIC STATUS command. The following status information is returned:

- the operating status of the PC processor,
- the type of station interface and processor,
- the octal word address of the start of the PC program,
- the series and revision level of the firmware in the station interface module, and
- the setting of the option switches on the station interface module.

To interrogate the communication controller module, ABTST must have a logical identifier that PCIF understands. To define this value, enter the configuration editor, PCCON, and configure another PC. When filling in the field that asks for the PC station number, enter the station number of the communication controller module.

When ABTST is running, it prompts for the PC identifier. Enter the logical identifier given to the configured PC (i.e., the communication controller module).

Refer to the ABTST source code listing for details.

4.4 ABUP

The ABUP program reads a PC's memory up to the end of the ladder logic program and saves it in a file. To run the program, enter the following command:

CI RU,/PCIF/AB/ABUP,PC

where PC is the logical identifier of the target PC.

If the parameter "PC" is left out of the runstring, the program will prompt for it.

The program will also ask these two questions before the actual uploading begins:

1. Do you have any messages in the memory of this PC (Y or N)?
2. Enter the name of the storage file.

If the answer to the first question is "Y", then all of the PC's memory will be uploaded (instead of just the program area). PCs store ASCII messages in the physical memory located beyond the program area.

Before uploading begins, a series of steps is excuted. They include:

1. Write a blank record to use as a place-saver which later will be overwritten with some PC-specific information.
2. Use a PC_TRANS call to do a DIAGNOSTIC READ to get the program start address and the PC type.
3. Get the number of words to upload from the data table and the program area.

At this point, the uploading starts. The PC_READD access routine is used to upload the data table. Note that only 100 words are read at a time. The PC_READP access routine is used to upload the program area. The reason that PC_READD is used to upload the PLC-2 data table is that it does not use privileged read. When a privileged read is done on the data table, the PC returns unusable data in every other word. An extended read is used for PLC-3 and PLC-5, using physical addressing.

Refer to the ABUP source code listing for details on how to upload PC programs using the PCIF/1000 access routines.

4.5 ABDN

The ABDN program reads a disc file created by the ABUP program and downloads it into a PC using PCIF/1000. To run the program, issue the command:

CI RU,/PCIF/AB/ABDN,PC

where PC is the logical identifier of the target PC.

If the parameter "PC" is left out of the run string, the program prompts for it.

The program prompts you for the name of the disc file where the contents of the PC memory are stored. This is the name you gave the storage file when you ran ABUP. Then it asks if the data table in the file is to be downloaded.

Before downloading begins, the program must make sure that the file contains the correct information for downloading. It uses the PC_TRANS access routine to determine the program start address and the type of PC to download to. This ensures that the information is uploaded and downloaded to the same type of PC. Note that this check can be overwritten if desired. The size of the data table in the target PC is also checked to be sure that it is large enough.

When the downloading begins, use the PC_WRITEP access routine to write to the program area. To download the PLC-2 data table, ABDN uses a subroutine called PC_WRITED_UNP, which uses PC_TRANS to do an unprotected write to the data table of a PC. The subroutine is called in the same fashion as a PC_WRITED, which does a protected write. It is useful when the PC memory access rung in the communication zone denies access to the complete data table. An extended write is used for PLC-3 and PLC-5, using physical addressing.

Refer to the ABDN source code listing for details on how to download PC programs using the PCIF/1000 access routines.

4.6 ABLIB

ABLIB is a library of helpful subroutines specifically for use with Allen-Bradley PLCs. This section lists and briefly describes these subroutines; refer to the &ABLIB source code listing for more details.

SUBROUTINE	DESCRIPTION
DIAG_STATUS	Returns all of the information available from a CMD 6, subfunction 3 data highway command, in a processed, ready-to-use format.
PC_WRITED_UNP	Does an unprotected write to a PC, with the same parameters as the PCIF PC_WRITED call (which does a protected write).
IT_QUITS	Closes out a program from PCIF and terminates the program.
REPORT_FMP_ERR	Displays a file management package error on a terminal.
REPORT_PCIF_ERR	Displays a PCIF error on a terminal or other LU.
AB_ERROR	Processes Allen-Bradley-specific errors that PCIF_ERROR doesn't handle.
CONVERT_PC_TYPE	Converts the Allen-Bradley code for a PC type into an ASCII string (i.e., converts 0 to "PLC").
CONVERT_IF_TYPE	Converts the Allen-Bradley code for an interface module into an ASCII string (i.e., converts 0 to "1771-KC/KD").
CONVERT_PC_MODE	Converts the Allen-Bradley code for the mode of a PC into an ASCII string (i.e., converts 0 to "PROGRAM").

SUBROUTINE	DESCRIPTION
PLC_STOP	Causes a PLC-2 to enter download mode. In some cases, the interface module stops the processor.
PLC2_START	Causes a PLC-2 to exit upload/download mode.
PLC2_SET_T_SIZE	Sets the PLC-2 data table size.
AB_MEM_CONFIG	Returns the starting and ending addresses of the data table, the starting address of the program and the ending address of used memory.
CONVERT_FW_REV	Converts the Allen-Bradley code for firmware revision level into an ASCII string (i.e., converts 0 to "A").
BSWAP	Swaps the bytes in a source buffer and stores them into a destination buffer. This is required whenever you use PC_TRANS, for data items that are words, not bytes, because Allen-Bradley stores integers with the bytes in the reverse order from Hewlett-Packard standard.
PLC2_FREEZE	Causes a PLC-2 to enter upload mode. In some cases, the interface module prevents the data table from changing.

APPENDIX A
ERROR MESSAGES

This appendix lists the status codes returned by the PCARs, the Allen-Bradley PC handler, the Allen-Bradley highway handler, and the Allen-Bradley PLC itself. The table below shows the different status code ranges.

1.....127 128.....255 256.....383 512.....n

ACCESS ROUTINES RETURNED STATUS	PC HANDLER RETURNED STATUS	HIGHWAY HANDLER RETURNED STATUS	PC BRAND RETURNED STATUS

ERROR CODE	DESCRIPTION
-1	Request accepted, but not completed (no wait call).
0	Request completed successfully.
1	Invalid SUBFNC parameter.
2	Length of buffer to transmit too long. Check for maximum request length value defined at configuration time.
3	Invalid length unit. Unit can only be WORD (0), BYTE (1) or BIT (2).
16	Missing PCIF_OPEN for this program. No PCIF_OPEN was made by this application program.

ERROR CODE	DESCRIPTION
17	Contact with PCIF monitor lost. Either PCIF monitor has stopped or it has been aborted. On PCIF_OPEN this may also indicate that the PCIF utility program "PCOPN" is not present in the system (no ID segment).
18	Illegal access key.
19	Illegal buffer address. This corresponds to RTE-A EXEC error "IO04" on the buffer address.
20	Not enough SAM. The PCIF routine was unable to send the request to the PCIF monitor because there was a shortage of RTE-A SAM (system available memory). This code is not returned in PCIF routine calls made with wait (i.e., for which the key value was set to 0).
21	Not enough EMA. There is insufficient EMA space to process the request. This may be temporary. An error message is sent on to the scheduling terminal. If this error occurs too frequently, then change EMA size of PCIF monitor.
22	RTE-A EXEC error while talking with PCIF monitor. When the PCIF routine sent the request to the PCIF monitor, RTE-A refused the transmission (e.g., RTE-A error IOxx/SCxx or CLxx).
23	PCIF_OPEN already made by this program.
24	Lacking RTE-A resources for using PCIF. The RTE-A system used for run time does not include enough class numbers (see Chapter 6, Installation, in the "PCIF Reference Manual").
25	Maximum number of possible OPENs exceeded. No more than 16 programs can use the PCIF monitor at the same time. Therefore a PCIF_CLOSE must be made for one of the active application programs.
26	Requested function not implemented on current system. This PC access routine is not supported on the current system.
32	Locked PC. The PC is locked by another application program.
33	Disconnected PC.

ERROR CODE	DESCRIPTION
35	Unknown PC logical identifier. The supplied PC identifier is not defined in the currently running configuration.
36	PC is missing capability to perform user request. The PC cannot perform the user request (for example, it is impossible for some PCs to generate unsolicited requests); or the PC has the capability, but this capability has been restricted at configuration time.
37	Maximum number of waiting requests on PC reached. This number can be changed with the configuration editor.
38	Time-out. The request was not completed and has exceeded the time-out value defined during configuration time.
39	Maximum number of available access keys exceeded. The maximum number of access keys is fixed at 16 for any application program (at any given time), and the sum of all access keys (for every currently connected program) is as defined in the present configuration.
40	PC already enabled (unsolicited) for this program.
41	PC is not enabled (unsolicited) for this program.
42	PC already enabled (unsolicited) for another program.
43	Invalid PCIF security code (a PC_DISC was made, but the password specified as parameter did not agree with the previously entered configuration password).

The following status codes are returned by the PC handler:

128	Invalid request. The PC handler does not support this request.
129	PC in run mode. Some PCs refuse to accept certain requests while in run mode.
130	Invalid logical PC memory address.
131	Logical PC memory address not allowed for this request type.

ERROR CODE	DESCRIPTION
132..233	See specific PC message. This set of codes is PC handler-dependent. The codes marked as internal errors should never be seen by the user. A problem exists in the PC handler. Please report an internal error to your HP representative. The following values are returned by the Allen-Bradley handler:
132	Invalid length unit.
133	Invalid length. The send buffer in PC_TRANS cannot equal zero.
232	Illegal length supplied for PC_IDENT. The length must be 10 words.
234..255	PC handler failure. This set of status values corresponds to an unknown "malfunction" of the PC handler. There is nothing wrong with the user's program. If this error persists, consult with your HP field representative.

The following set of status codes is returned by the highway handler:

256	Dialogue with MUX went into time-out. The downloadable MUX card did not answer after a certain amount of time.
257	Maximum retry number with PC exceeded. During dialogue between the IO card and the physical PC transmission or protocol, errors occurred. The card retried the request several times, but was unable to recover.
258..349	See specific highway message. This set of codes is highway handler dependent. The following values are returned by Allen-Bradley:
350	Error on RTE-A IO. An RTE-A error occurred during the operation of the PCIF monitor. A message was sent to the scheduling terminal (see Chapter 9 in the "PCIF Reference Manual"). If this error persists, contact local HP support services.
351	RTE-A refused to do IO. Same comment applies as for code 350 above.
352	Impossible to download MUX card. PCIF monitor was unable to download the 12041A MUX card. A message was sent to the scheduling terminal explaining the fault.
353	No LU associated with highway.

ERROR CODE	DESCRIPTION
354..383	Highway handler failure. This set of status values indicates the highway handler is not operating properly. There is nothing wrong with the user's program. If this error persists, contact your HP field representative.
Specific PC and highway brand messages:	
512 and over	An error was detected by the physical PC. The code returned (the Allen-Bradley-provided error code + 512) gives the status value. Refer to your Allen-Bradley documentation for more information about these errors.
513..527	Errors at a PLC-3 returned in the extended error byte (Remote).
513	Error in conversion of block address.
514	Improper format for PLC-3 word address, or the destination PC failed to respond.
515	Error in conversion of file address, or contention between master stations on the highway.
516	Invalid symbol.
517	Improper symbol specification format.
518	Invalid PLC-3 word address.
519	Improper file address.
520	File size changed during message execution.
521	File size too large.
522	Message size too large.
523	Write privileges not granted to remote station.
524	Upload/download access is not available.
525	Requesting station already has upload/download access.
526	Shutdown request could not be executed.

ERROR CODE	DESCRIPTION
527	Requesting station does not have upload/download access.

The following errors (528..688) at the PC are common to the PLC, PLC-2, PLC-3 and PLC-5:

528	The command or data size is illegal.
560	The remote PC had a fault, is off, or disconnected.
576	An IO error occurred at the PC.
592	The address is not allowed by protection at the PC.
608	The requested function is not allowed by the PC.
624	The PC is in the wrong mode.
640	The communication zone is incorrect at the PC.
656	The destination is out of buffer space.
688	The PC is in the wrong mode.

APPENDIX B
ALLEN-BRADLEY REFERENCE MANUALS

Allen-Bradley provides reference manuals and bulletins that contain important information about programming their processors and modules. These materials are particularly valuable for learning how to interface a computer to an AB processor via datacommunications interface modules. They also provide standard AB part numbers required for cable pins, for custom cabling, as well as installation instructions, including dip switch settings.

The list of publications that follows will help you locate the reference manual(s) you need to complete your application. You can also refer to the SD499 Publication Index for additional reference manuals.

CATALOG NO.	PUBLICATION NO.	DESCRIPTION
For the PLC-2 Family:		
1771-KG	1771-6.5.8	User's Manual
1771-KA2	1771-6.5.1	User's Manual
1771-KE,KF	1771-6.5.15	User's Manual
1772-LN	1772-6.6.3	Mini PLC-2 Installation and Assembly Manual
	1772-6.8.4	Programming and Operation Manual
1772-LP	1772-6.6.2	PLC-2/20/30 Installation & Assembly Manual
	1772-6.6.2	Programming and Operation Manual
1772-LS	1772-6.6.6	PLC-2/05 Installation and Assembly Manual
	1772-6.8.6	Programming and Operation Manual
	1772-6.8.2	Mini PLC-2/15 Programming and Operation Manual

Reference Materials

CATALOG NO.	PUBLICATION NO.	DESCRIPTION
For the PLC-3 Family:		
1775-A1	1775-6.7.1	PLC-3 Installation and Operation Manual
1775-KA	1775-6.5.1	User's Manual
	1775-6.4.1	PLC-3 Programming and Operation Manual
For the PLC-5 Family:		
1785-LT	1785-6.6.1	PLC-5/15 Installation and Assembly Manual
	1785-6.8.1	Processor Manual
1785-KA	1785-6.5.1	User's Manual
1770-KF2	1770-6.5.13	User's Manual

APPENDIX C
SAMPLE SOFTWARE NUMBERING FILE

PCIF/1000 ALLEN-BRADLEY HANDLER SOFTWARE NUMBERING FILE

FILE FILENAME: A94202

PRODUCT NUMBER: 94202A

DIRECTORY: /PCIF/AB/

NOTE: The file names listed below are for example purposes only. You must list A94202 on the AB subdirectory to see the actual file names for your latest version.

FILE NAME	PART NUMBER	REVISION	TYPE	DESCRIPTION
A94202	94202-17999	5000	4	PCIF/1000 A-B SNC
%PCPAB	94202-16001	4010	5	PC HANDLER (A-B)
%PCPAC	94202-16012	4010	5	PC HANDLER CDS (A-B)
%PCHAB	94202-16002	4010	5	HIGHWAY HANDLER (A-B)
%PCHAC	94202-16013	4010	5	HIGHWAY HANDLER CDS (A-B)
!PCFAB	94202-16003	4010	4	Z80 PROTOCOL HANDLER (A-B)
[PCPAB	94202-18004	4010	4	A-B : PC DESCRIPTOR
[PCPAC	94202-18010	4010	4	A-B : CDS PC DESCRIPTOR
[PCHAB	94202-18005	4010	4	A-B : HIGHWAY DESCRIPTOR
[PCHAC	94202-18011	4010	4	A-B : CDS HIGHWAY DESCRIPTOR
*AB	94202-17001	4010	4	CI CMD FILE FOR INSTALLING A-B

Sample Software Numbering File

FILE NAME	PART NUMBER	REVISION	TYPE	DESCRIPTION
&ABUP	94202-18006	2614	4	A-B PC UPLOAD UTILITY SOURCE
%ABUP	94202-16006	2614	5	A-B PC UPLOAD UTILITY RELOC.
#ABUP	94202-17002	5000	4	A-B PC UPLOAD UTILITY LINK CMDS
&ABDN	94202-18007	4010	4	A-B PC DOWNLOAD UTILITY SOURCE
%ABDN	94202-16007	4010	5	A-B PC DOWNLOAD UTILITY RELOC.
#ABDN	94202-17003	5000	4	A-B PC DOWNLOAD UTILITY LINK CMD
&ABTST	94202-18008	2435	4	A-B PC DIAGNOSTIC UTILITY SOURCE
%ABTST	94202-16008	2435	5	A-B PC DIAGNOSTIC UTILITY RELOC.
#ABTST	94202-17004	5000	4	A-B PC DIAGNOSTIC UTIL LINK CMDS
&ABLIB	94202-18009	4010	4	A-B PC SUBROUTINE LIB SOURCE
$ABLIB	94202-12001	4010	5	A-B PC SUBROUTINE LIB INDEXED
&ABLBC	94202-18018	4010	5	A-B PC CDS SUBROUTINE LIB SOURCE
$ABLBC	94202-12002	4010	5	A-B PC CDS SUBROUTINE LIB INDEXED
%PCCHA	94202-16016	4010	5	CONFIG SCREEN 6 PROCESSING
!PCCA6	94202-17009	2614	3	CONFIG FORM FILE SCREEN 6
"PCCA6	94202-17010	2606	4	CONFIG HELP FILE SCREEN 6

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