SIEMENS

SIMATIC TI505

386/ATM Coprocessor

User Manual

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Preface

This manual describes installing and using the SIMATIC® TI505™ 386/ATM® Coprocessor Module.

Other Manuals

Refer to the manuals listed below for instructions on installing, programming, and troubleshooting your controller and I/O.

- *SIMATIC TI505 Programming Reference Manual*
- *SIMATIC® TI525™/TI535™ Hardware/Installation Manual*
- *SIMATIC® TI545™ System Manual*
- *SIMATIC® TI555™ System Manual*
- *SIMATIC® TI560T™/TI565T™ System Manual*
- *CVU10000™ Manual Set, Rel. 2.0*
- *CVU100™ Programming Reference Manual*
- *CVU100 Hardware and Installation Manual*
- The *TISOFT™ User Manual* for your release of TISOFT

Agency Approvals

The 386/ATM Coprocessor Module meets the standards of the following agencies:

- Underwriters Laboratories: UL® Listed (Industrial Control Equipment)
- Canadian Standards Association: CSA Certified (Process Control Equipment)
- Factory Mutual Approved; Class I, Div. 2 Hazardous Locations
- Verband Deutscher Elektrotechniker (VDE) 0160 Clearance/Creepage for Electrical Equipment (Self-Compliance)

Series 505™ products have been developed with consideration of the draft standard of the International Electrotechnical Commission Committee proposed standard (IEC-65A/WG6) for programmable controllers.

Telephoning for Assistance

If you need information that is not included in this manual, or if you have problems using the Series 505 386/ATM Coprocessor Module, contact your Siemens Industrial Automation, Inc. distributor or sales office. If you need assistance in contacting your distributor or sales office in the United States, call 1–800–964-4114.

Chapter 1

Module Features

1.1 Overview

Description

The 386/ATM Coprocessor is a general-purpose, high-speed IBM® PC/AT® compatible computer with a real-time interface to the SIMATIC® TI® family of programmable controllers. The 386/ATM integrates into a programmable controller the real-time, high-performance computing of a personal computer for space- and cost-sensitive applications. The 386/ATM runs off-the-shelf PC/AT application and development software. This allows high-speed PLC I/O bus interface for data processing, operator interface, and other high-level PC/AT functions.

The 386/ATM provides an industry-standard open architecture that allows you to combine the features of a programmable controller and a personal computer into one small package without being restricted to a proprietary operating system or to single sources for critical software. This allows you to integrate and use commercially available software packages that meet your requirements for features, function, and speed.

The 386/ATM provides:

- True IBM PC/AT-compatible computer that will run any of a wide variety of commercially available IBM PC/AT-compatible software packages
- Industry-standard Microsoft® MS-DOS® operating system
- Direct PLC I/O bus communication path between a PC/AT application and the control function being performed by the PLC
- Major increase in the survivability of personal-computing equipment in harsh control environments
- Built-in diagnostics to help confirm reliable operation and data integrity
- A small package that fits into the Series 505 base and communicates with any of the Series 505 and Series 500™ (e.g., SIMATIC® TI530C™) controllers and I/O
- Battery-backed real-time clock
- Socket for optional 80C387SX math coprocessor to provide high-speed arithmetic-processing capability

Using the 386/ATM Coprocessor

The 386/ATM Coprocessor is a standard IBM PC/AT computer with one added feature: a hardware interface to the PLC I/O bus which can be utilized by an appropriate application program.

Any IBM PC/AT-compatible software runs on the 386/ATM. If you require communication between the 386/ATM and the PLC, you can use the standard RS-232 capabilities that most vendors supply with their software products. These RS-232 device drivers are unique to each vendor's software product and generally serve to handle the communication between a personal computer (in this case, the 386/ATM) and the PLC.

When a higher speed communication path is required, the 386ATM device driver can be integrated with the application package. Some application packages are configurable to allow the use of a device driver, while others require changes to the application software by the software vendor. See Figure 1-1. Since it operates over the parallel PLC bus, the 386ATM device driver allows the maximum in versatility and speed between the PLC and the 386/ATM. This eliminates the slow serial link which restricts PLC access.

Applications

A wide variety of SIMATIC TI and third-party software packages is available which will run on the 386/ATM. In fact, software product/vendor selection is easy—if the software is IBM PC/AT-compatible, will operate with MS-DOS 5.0 and is compatible with memory and speed characteristics, it will run on the 386/ATM. Applications range from small to large. Examples include the following.

- Operator interface
- TISOFT2™ software
- Supervisor Control and Data Acquisition (SCADA)
- Statistical Quality Control (SQC)
- Statistical Process Control (SPC)
- Batch/Recipe management
- Report generation
- Math processing and data manipulation
- Production reporting and report generation
- Foreign device interface (intelligent sensor, etc., with RS-232 interfaces)
- Communication to third-party controllers
- Loop tuning

As a policy, Siemens Industrial Automation, Inc. does not recommend nor give testimonials for third-party products. However, if none of our software products meets your needs, you can use a third-party software package. IBM compatibility confirms that such software should run on the 386/ATM Coprocessor.

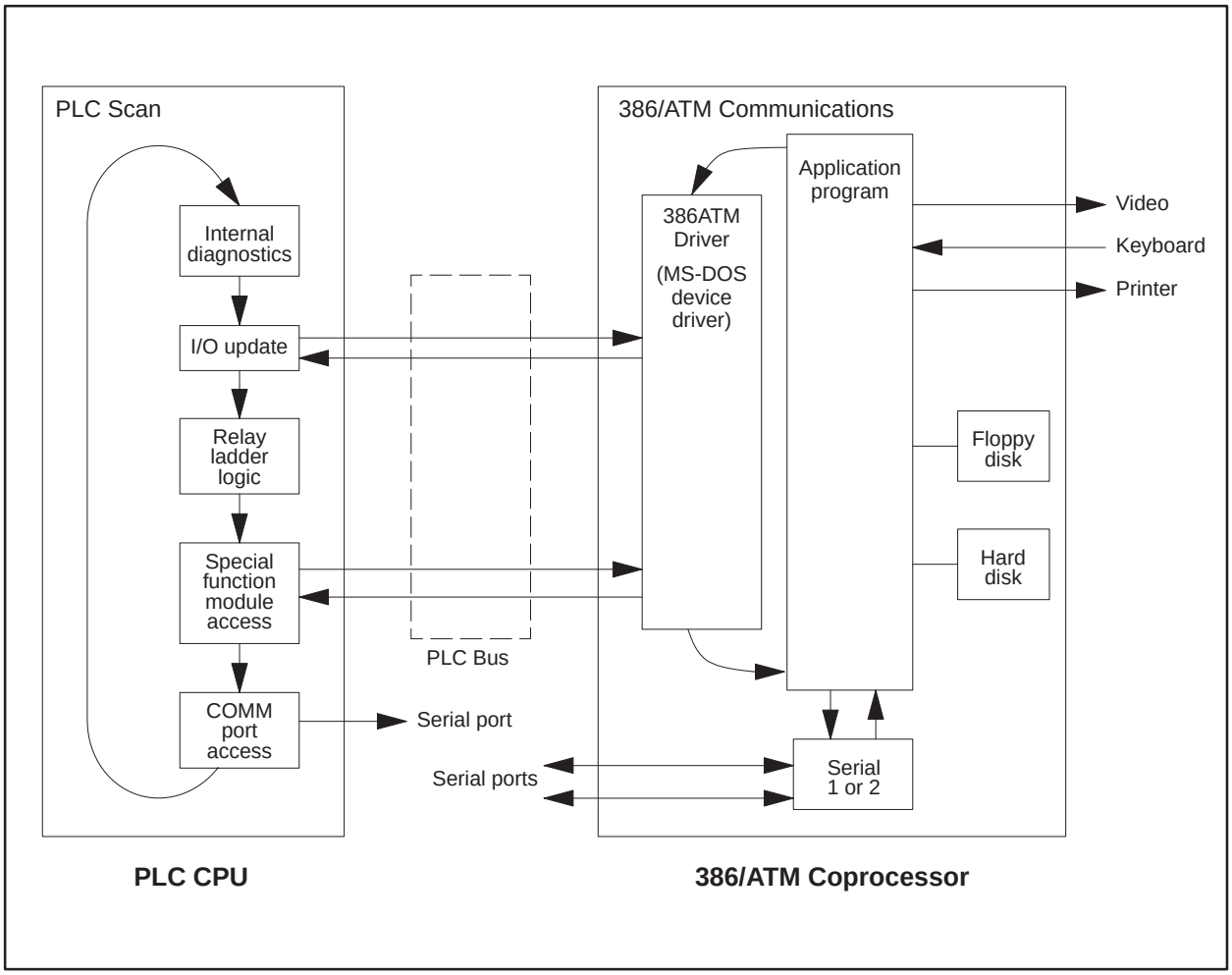


Figure 1-1 Interaction—386/ATM Coprocessor and PLC

1.2 Features

Three versions of the 386/ATM module are available. See Figure 1-2 for the standard configuration.

- Industrially hardened IBM PC/AT-compatible computer:

  Intel® 80C386SX CPU
  16 MHz, zero wait-state analog
  Socket for optional 80C387SX math coprocessor

  Microsoft MS-DOS 5.0 with QBasic™ (QuickBASIC)

  DRAM Memory: . . . . . 2M byte (505-ATM–0220)
  4M byte (505-ATM–0440)
  4M byte (505-ATM–4120)

  Diskette drive: . . . . . 3-1/2″ 720K byte/1.44M byte

  Hard disk drive: . . . . . 20M byte (505-ATM–0220)
  40M byte (505-ATM–0440)
  120 M byte (505-ATM–4120)

- Triple-wide Series 505 module
- Direct PLC I/O bus interface to PLC
- 2 serial ports, 110 – 57600 baud; (non-standard driving voltage)
- Limited mouse support (see section 2.4)
- 1 Centronics®-style parallel port
- Keyboard port (for PC/AT-compatible keyboard)
- TISOFT2 PLC I/O bus communications for high-speed PLC interface
- 386ATM language-independent device driver (can be used by any PC/AT language)
- No external power required
- Analog VGA monitor port (adapter cable from 9-pin to standard 15-pin VGA included)
- Built-in diagnostics

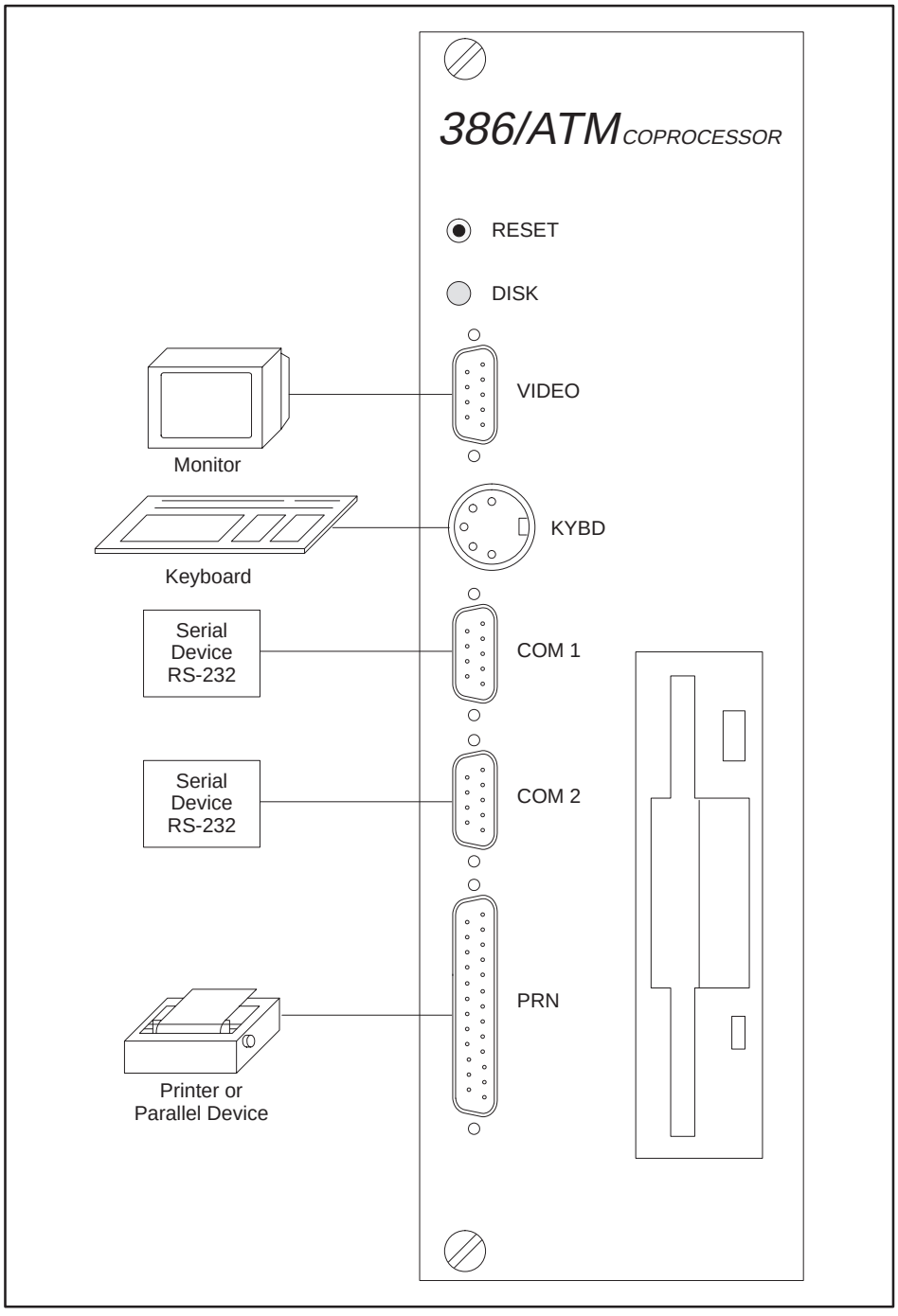


Figure 1-2 Typical Configuration

1.3 Standard Kit Part Lists

PPX:505–ATM–0220 Includes:

- ☐ Intel 80C386SX CPU
- ☐ Socket for optional 80C387SX math coprocessor
- ☐ DRAM Memory: 2M byte
  Diskette drive: 3-1/2″ 720K byte/1.44M byte
  Hard disk drive: 20M byte
- ☐ 2 serial ports (110 – 57600 baud)
- ☐ 1 Centronics-style parallel port
- ☐ Keyboard port (for PC/AT-compatible keyboard)
- ☐ Analog VGA monitor port
- ☐ 386ATM video cable adapter
- ☐ Microsoft MS-DOS 5.0 with QBasic and manual
- ☐ Floppy disk containing the following software:
  - 386ATM.DVR
  - INSTALL.BAT
  - AUTOEXEC.BAT
  - CONFIG.SYS
  - Example PCCOMM software (source code)
- ☐ *SIMATIC TI505 386/ATM Coprocessor User Manual*

PPX:505–ATM–0440 Same as PPX:505-ATM–0220, except:

- ☐ DRAM Memory: 4M byte
- ☐ Hard disk drive: 40M byte

PPX:505–ATM–4120 Same as PPX:505-ATM–0220, except:

- ☐ DRAM Memory: 4M byte
- ☐ Hard disk drive: 120M byte

Spare Parts The following components can be ordered as spare parts.

- 386ATM video cable adapter (PPX:2587716–8034)
- MS-DOS 5.0, 3.5″ disks, and manual (PPX:2587716–8037)
- 386ATM Backplane Communications Driver (PPX:2587716–8038)
- 14″ VGA color monitor, industrial black (6AP1–705–0BG00)

- 101-key PC/AT keyboard, industrial black (6AC1–015–7FG)

1.4 Recommended Order of Tasks

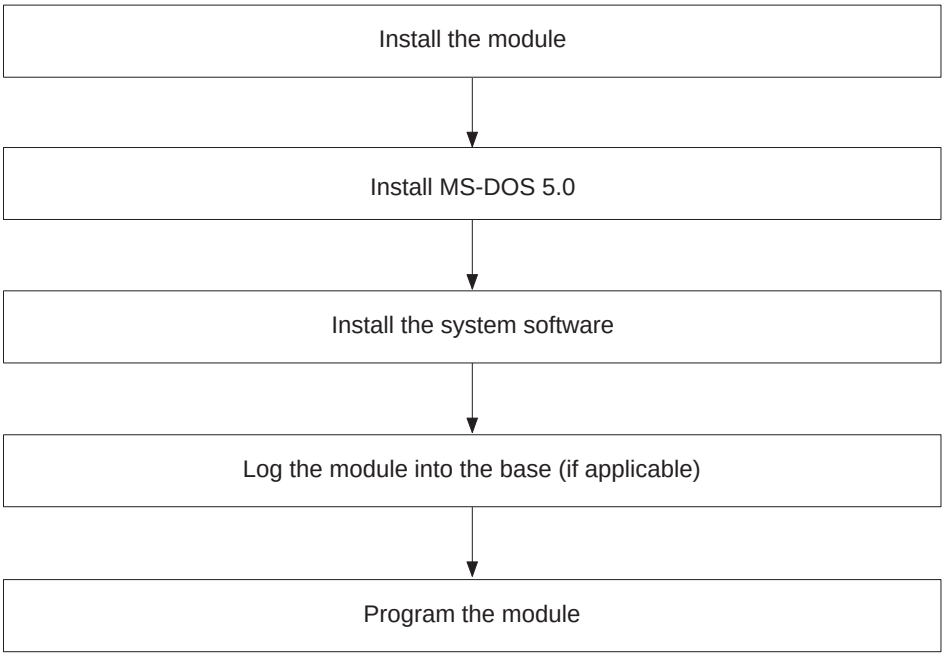


Figure 1-3 Lists of Tasks for Installing and Using the 386/ATM

Chapter 2

Installing the Module

2.1 Overview of Installation

Handling the Module

Many integrated circuit (IC) devices are susceptible to damage by the discharge of static electricity. Follow the suggestions listed below to reduce the probability of damage to these devices when you are handling a controller, a base controller, or any of the I/O modules.

Both the module and the person handling the module should be at the same ground potential. To accomplish this, fulfill the following conditions.

- Transport the module in an anti-static container or antistatic material.
- Ensure that the work area has a conductive pad with a lead connecting the work area to a common ground.
- Ground yourself by making contact with the conductive pad or by wearing a grounded wrist strap.

Visual Inspection

If there is any visible damage to the module, contact your vendor for a replacement.

Technical Assistance

If you need information that is not included in this manual, or if you have problems using the module, call your Siemens Industrial Automation, Inc. distributor or sales office. If you need assistance in contacting your U.S. distributor or sales office, call 1–800–964-4114.

Flow of Tasks

Figure 2-1 shows the organization of the tasks described in this chapter.

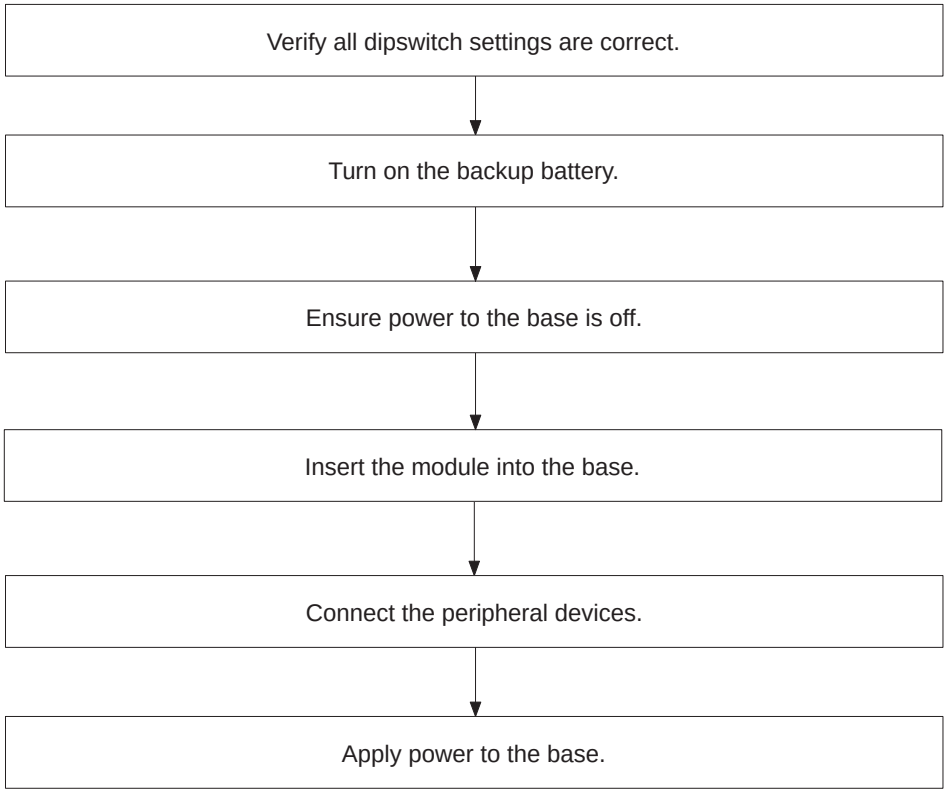


Figure 2-1 Flowchart of Installation

2.2 Configuring the Module

Before you install the 386/ATM Coprocessor, turn on the backup battery, and verify dipswitch settings.

To accomplish these tasks, locate the dipswitches shown in Figure 2-2 and set them according to Figure 2-3.

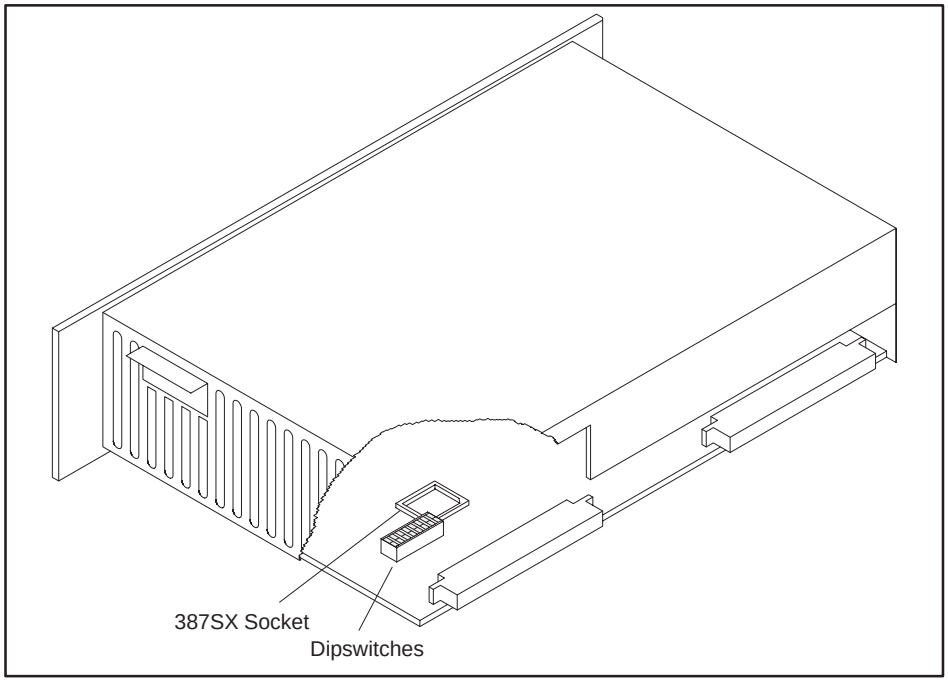


Figure 2-2 Location of Dipswitches

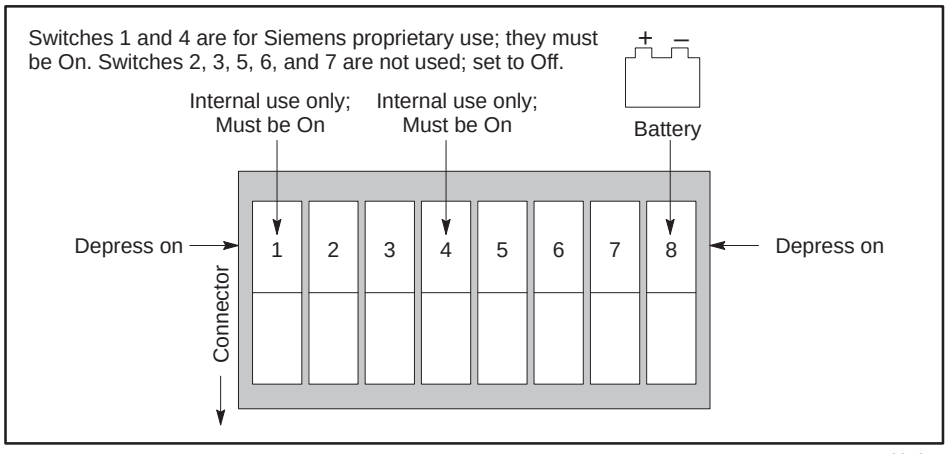


Figure 2-3 Dipswitch

2.3 Inserting the Module into the Base

⚠WARNING

To minimize potential shock, turn off power to the I/O base and to any modules installed in the base before you insert or remove a module or install a terminal block. Failure to do so may result in potential injury to personnel or damage to equipment.

Refer to the *Safety Considerations* sheet (part # 2588015–0002) included with your module for a complete list of safety guidelines and recommendations.

Inserting the Module

This is a triple-wide module. Insert it into any available I/O slot on any Series 505 base. Insert the module as shown in Figure 2-4. Note the minimum torque required to ground the module.

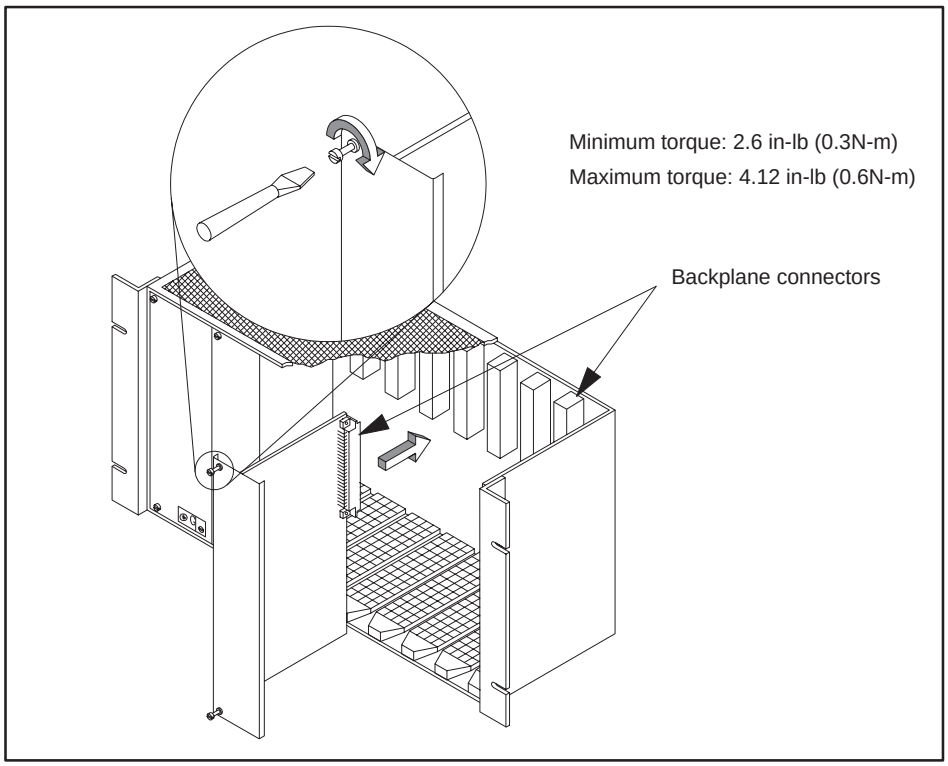


Figure 2-4 Inserting the Module into the Base

Power Requirements

This module requires 11.0 W of +5 V and 0.2 W of –5 V power from the Series 505 base. No additional power is required.

2.4 Connecting Peripherals

Monitor

The monitor connector is a 9-pin female connector (using the special adapter cable included) that supports high-resolution graphics modes of analog VGA-compatible monitors.

Keyboard

The module has a standard 5-pin DIN keyboard connector. Your keyboard must be designed for use with IBM PC/AT or compatible computers.

Communications

The module contains two non-standard 9-pin RS-232 serial ports. These ports are configured as COM1 and COM2. Use these ports to connect to PLCs, sensors, printers, modems, or other RS-232-compatible devices. Note, however, that these devices must be capable of running on 5 VDC rather than the 12 VDC normally provided by an IBM PC-compatible serial port. This precludes the use of most mechanical mouse devices except certain models manufactured by Microsoft.

Printer

The printer port supports any Centronics-style parallel printer or similar peripheral. Use a standard 25-pin IBM PC/AT-style connector.

See Appendix C for all cable pinouts.

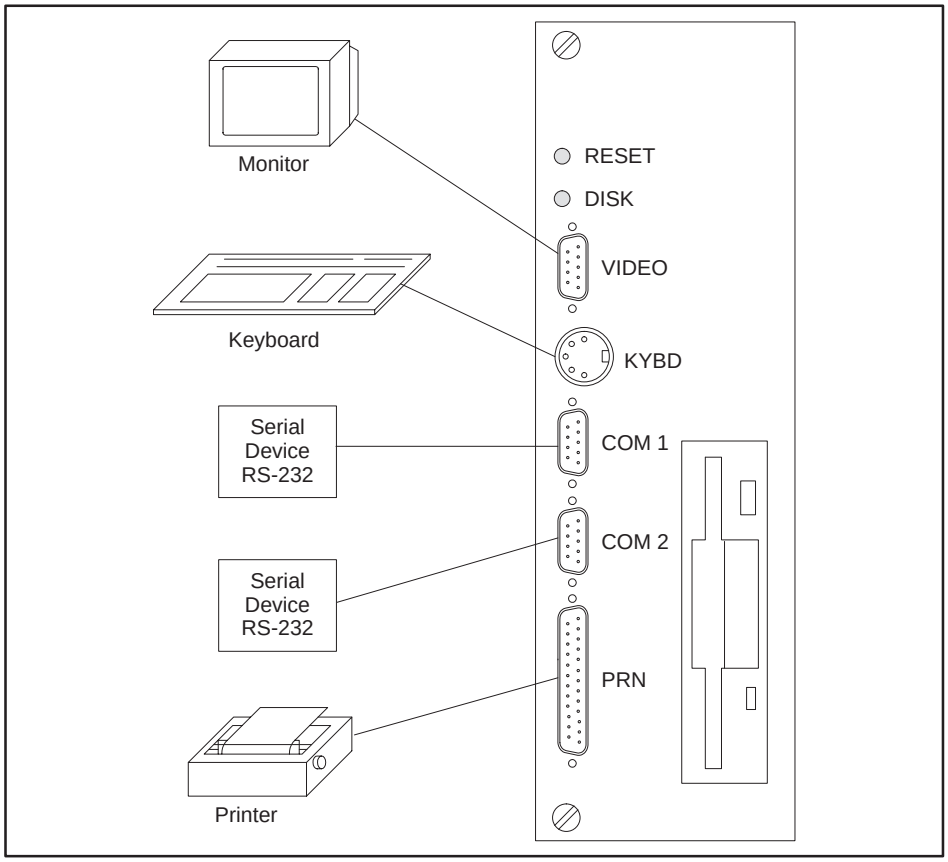


Figure 2-5 Peripheral Connection

Chapter 3

Loading System Software

3.1 Overview

Figure 3-1 shows the organization of software installation tasks as they are presented in this chapter. Perform these tasks in sequence.

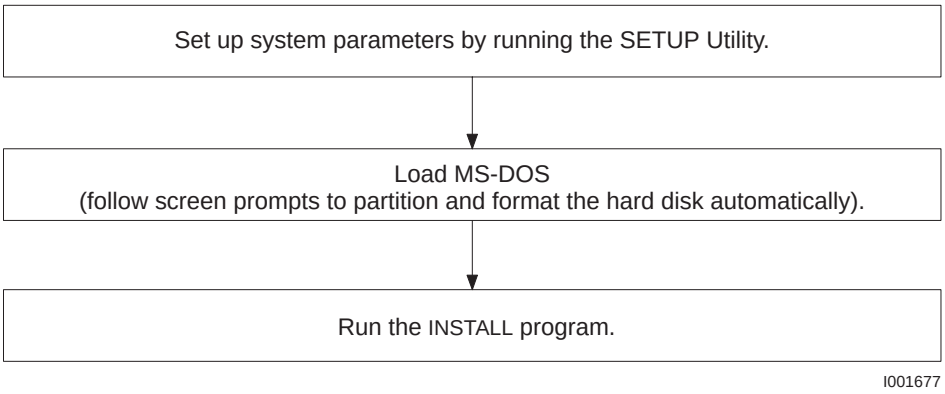


Figure 3-1 Software Installation Flowchart

NOTE: To extend battery life, the 386/ATM Coprocessor is shipped from the factory with the battery switch in the OFF position. Since the system parameters are stored in battery-backed CMOS RAM, you must run the SETUP Utility during initial module installation or after a battery failure.

Potential for Errors During Diskette Access

During periods of high conducted or radiated electrical noise conditions, diskette access may cause seek and/or read/write errors. These errors do not affect the operation of other parts of either the 386/ATM or the programmable controller system.

It is recommended that you start up with the diskette and then switch to the hard drive for operation. If you experience a seek or read/write error during a diskette access, please try the operation a second time. If the problem continues, wait for quiescent periods before performing diskette operations.

⚠WARNING

As in any electrical installation, the potential for live circuits may be present at the PLC and/or adjacent devices when the ultimate protective enclosure is opened for routine service, maintenance or programming. Accidental contact with live circuits may result in personal injury or damage to equipment. Installation, maintenance and programming must only be performed by qualified and authorized personnel familiar with recognized electrical practices and procedures in working with high voltage.

3.2 Setting System Parameters

After initial installation, after a battery failure, or if the battery is disabled, you must run the SETUP Utility to set the real-time clock date and time, to identify the number and type of hard disks and to identify the number and size of floppy diskettes. Setup parameters are saved in battery-backed CMOS RAM. Follow the steps shown in Figure 3-2.

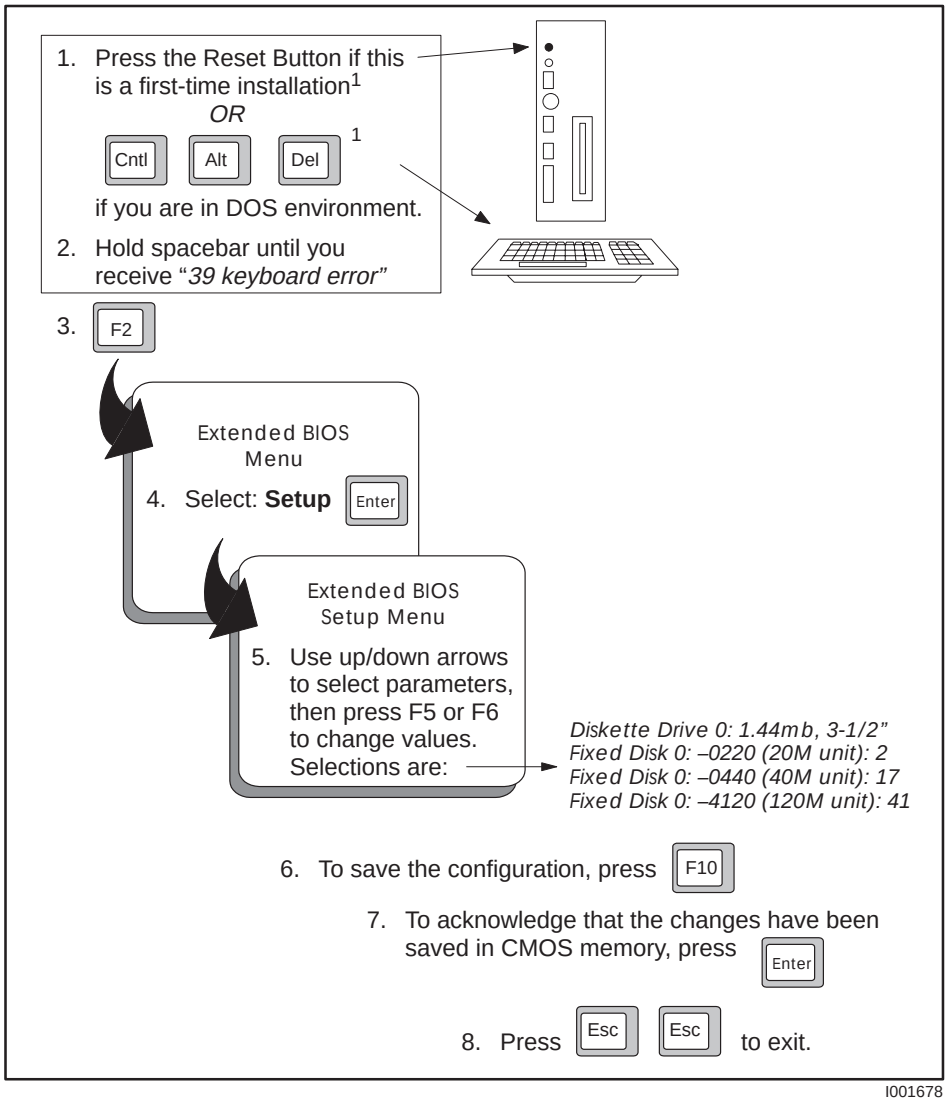


Figure 3-2 System Configuration

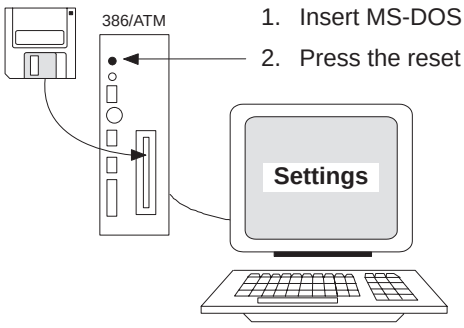
[1]You can speed up the boot process by pressing Esc at the prompt to skip the RAM diagnostics. Then, if you want to access the Setup utility, hold down the spacebar as described in step 2 above and continue when prompted by pressing F2 to access the Extended BIOS Menu and the Setup Utility option.

3.3 Preparing the Hard Disk and Loading MS-DOS

Booting the Module from the Diskette

Before you boot the module from the diskette the first time, make a backup copy of all the diskettes on another computer. Store the copy in a safe place.

You must boot the module from the MS-DOS diskette in order to start the automatic process that partitions and formats the hard disk and loads MS-DOS on the hard disk. Follow the steps shown in Figure 3-3. This creates a C: drive with total capacity in one partition. (For additional information or customizing options, refer to the MS-DOS manual.)



1. Insert MS-DOS disk 1 in the floppy drive.
2. Press the reset button.
3. At the initial screen, press **ENTER** to continue; (each screen has full instructions and prompts). Move the highlight bar with the arrow key to date/time and press **ENTER** to reset date or time if necessary.
4. Press **ENTER** when settings are correct.

Options

5. For CVU applications, move the highlight bar to “Run Shell on startup” and press **ENTER**. Select “Do not run MS-DOS Shell on startup” and press **ENTER**.
6. For other applications, select appropriate option.
7. Press **ENTER** when options are correct.

Partitioning

8. Select “Allocate all free hard disk space for MS-DOS” and press **ENTER**. The system reboots and begins partitioning and formatting the hard disk with its full capacity assigned to drive C. It then copies MS-DOS files onto the hard disk, showing the percent complete during execution.

Loading MS-DOS

9. Insert MS-DOS disk 2 when prompted and press **ENTER**. Repeat with disk 3 when requested.
10. When the loading is complete, remove the disk from the drive and press **ENTER** as prompted. The system will reboot and show a C:\> prompt or MS-DOS shell, depending on which option you selected previously.

Checking Disk Space

11. At the DOS prompt, type **chkdsk** and press **ENTER** to see if the total disk space matches the size of hard disk of your particular model of the 386/ATM module.

Figure 3-3 Installing MS-DOS on the 386/ATM Hard Disk

3.4 Installing System Software

Copying Software to the Hard Disk

To install a working copy of the ATM backplane driver and other software that is supplied with the 386/ATM, run the INSTALL program with the diskette installed. Follow the steps shown in Figure 3-4.

NOTE: If you are setting up your system to run CVU10000 software on the 386/ATM, you must perform this procedure after installing CVU software. Refer to your CVU manual for details.

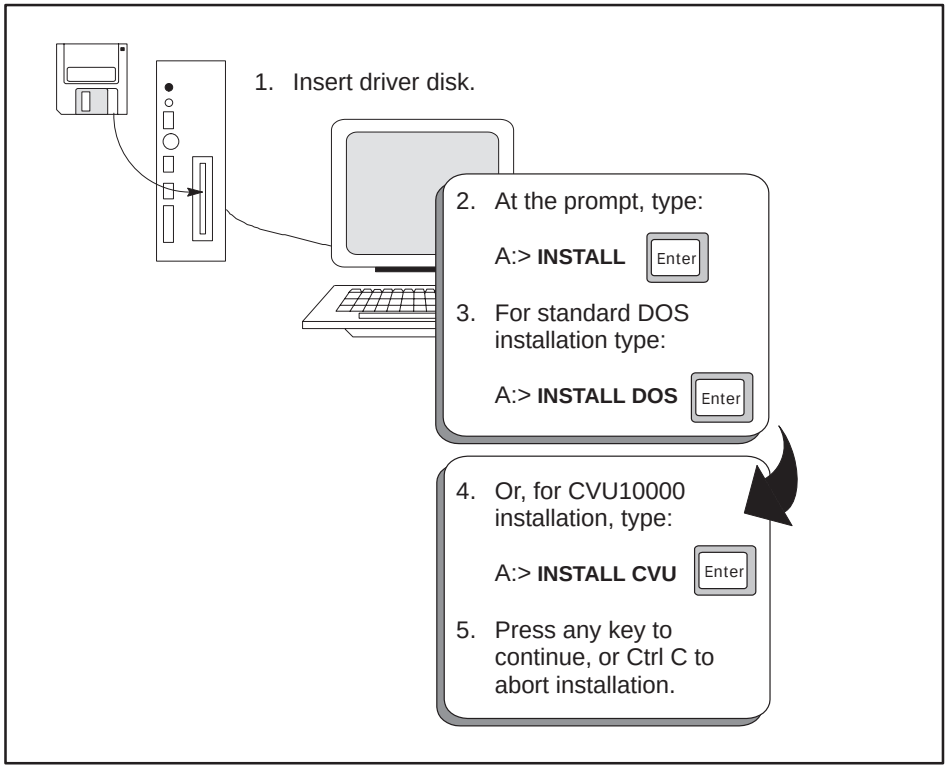


Figure 3-4 Software Copy Procedure

After approximately 90 seconds, you receive the "*Installations complete*" message.

Typical ATM Driver Files

After the automatic installation of the ATM driver is complete, your AUTOEXEC.BAT and CONFIG.SYS files will look like the following.

AUTOEXEC.BAT file for standard DOS installation.

```
@ECHO OFF
PROMPT $P$G
PATH=C:\;C:\DOS;C:\TI
```

CONFIG.SYS file for standard DOS installation.

```
FILES=30
BUFFERS=20
SHELL=C:\DOS\COMMAND.COM C:\DOS\ /P
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,umb
DEVICE=C:\DOS\EMM386.EXE X=C800-C900 NOEMS
DEVICEHIGH=C:\386ATM.EXE
```

AUTOEXEC.BAT file for CVU10000 installation.

```
@ECHO OFF
PROMPT $P$G
PATH=C:\CVU10;C:\;C:\DOS;C:\TI
CVU10000.BAT
```

CONFIG.SYS file for CVU10000 installation.

```
FILES=30
BUFFERS=20
SHELL=C:\DOS\COMMAND.COM C:\DOS\ /P
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,umb
DEVICE=C:\DOS\EMM386.EXE X=C800-C900 NOEMS
DEVICEHIGH=C:\386ATM.EXE
DEVICEHIGH=C:\CVU10\PRINTER.DEV
```

Installing Sample Programs

If you want to install sample programs to your hard disk, follow the steps shown in Figure 3-5.

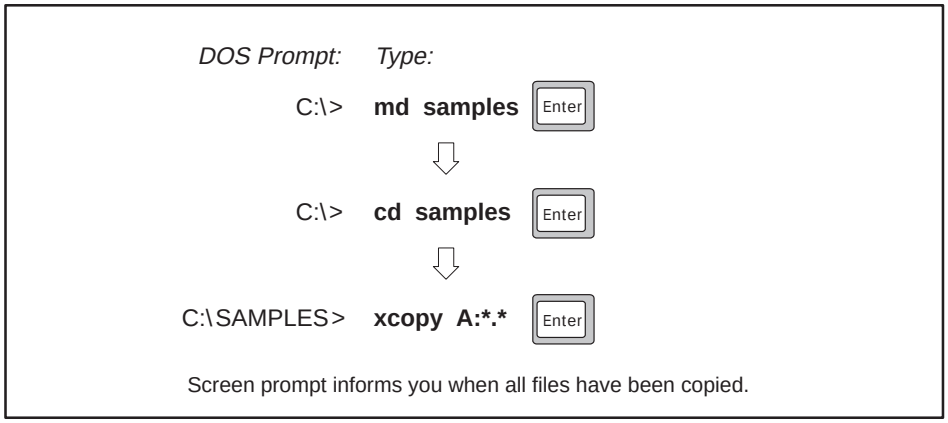


Figure 3-5 Sample Program Installation

Loading System Device Drivers

To load the system device drivers into memory, you must reboot the module. Follow the steps shown in Figure 3-6.

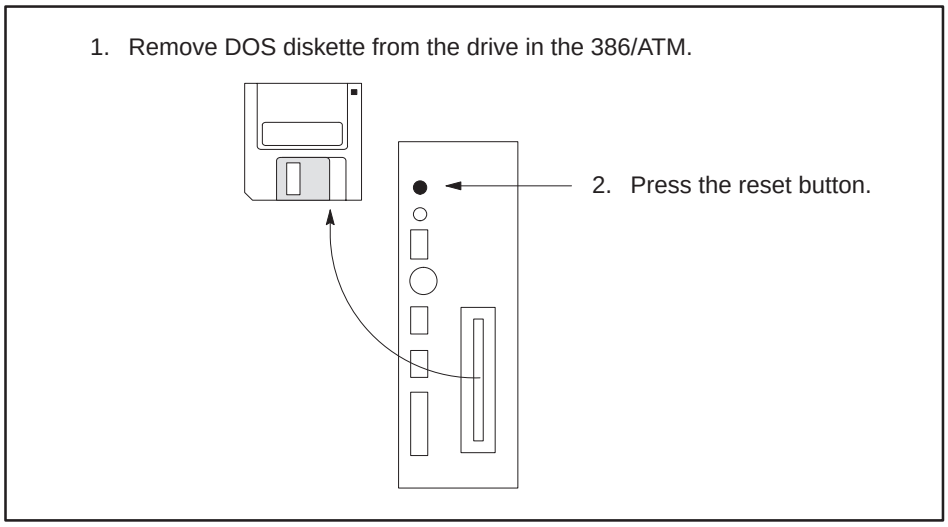


Figure 3-6 Module Boot Procedure

3.5 What Next?

After booting the system, you can either load development tools and begin application development or load and run your application software.

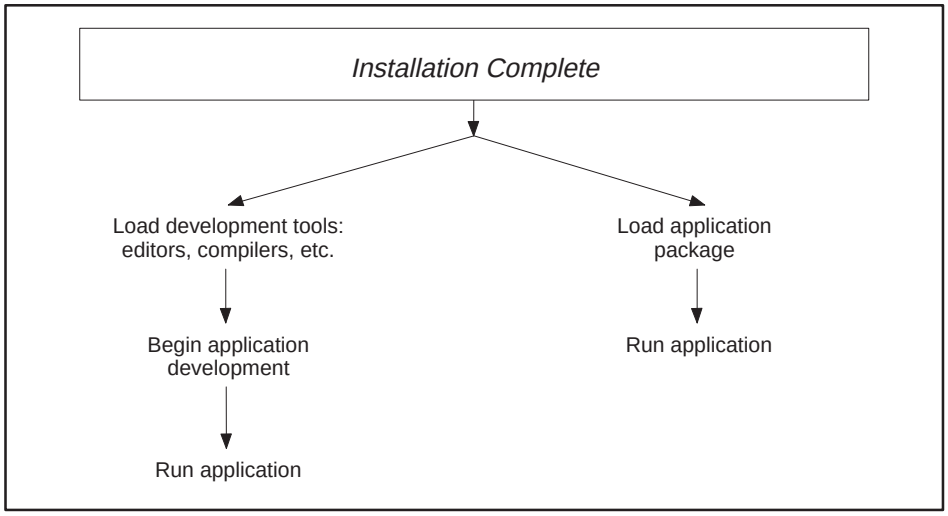


Figure 3-7 Decision Tree

Running the 386/ATM with Third-party Device Drivers and Memory Managers

Before installing third-party system software, read the following guidelines.

When interface circuitry (for example, a communications card) is added to a computer, it uses certain resources, such as memory ranges and interrupts, to operate. In general, these resources may not be shared by multiple devices.

System software, such as device drivers and memory managers, often need to know exactly which resources are in use in the machine, or at least which resources they may take for themselves.

The 386/ATM backplane interface uses the following resources:

- Memory range C818:0000—C818:007F (128 bytes)
- IRQ 10 (which in turn uses INT 72 hex)

Make sure that any third-party system software that you install on the 386/ATM does not try to use these addresses. Most such software can be configured to avoid conflicts by adding command line variables to exclude the use of the memory address range and software interrupts listed above. Refer to your third-party software manual for details.

See the example CONFIG.SYS file for DOS installation on page 3-7 for loading the 386EMM.SYS memory manager furnished with MS-DOS 5.0.

Chapter 4

Running TISOFT on the 386/ATM

4.1 Logging the 386/ATM into the PLC I/O Configuration Table

Overview

Log the 386/ATM into the PLC I/O configuration memory for maximum communication speed with the PLC over the I/O bus. The procedure required for logging modules varies with the type of PLC. (See Figure 4-1.)

- SIMATIC TI545/TI555 and TI560/TI565 PLCs require you to configure the I/O manually.
- All other Series 505/Series 500 PLCs automatically configure the I/O.

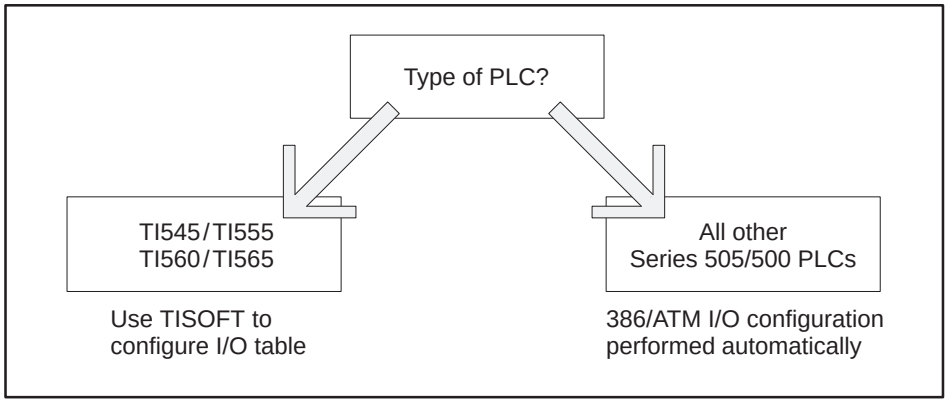


Figure 4-1 I/O Configuration Decision Tree

NOTE: The 386/ATM does not have to be logged into the I/O configuration table to run TISOFT2. Logging the module into the configuration table improves TISOFT2 communication performance.

Loading TISOFT2

Refer to the TISOFT2 manual for specific instructions on loading and running TISOFT2 software.

Verifying 386ATM.EXE in your Root Directory

The **config.sys** file must include an instruction to load 386ATM.EXE during the module's boot procedure. The INSTALL batch file included as part of the installation procedure does this automatically for both the standard DOS and CUV10000 options. (See page 3-7 for the listing of files created by the INSTALL procedure.)

Communicating with the PLC

You can communicate with the PLC via the I/O bus (Figure 4-2) or via the serial ports (Figure 4-3). Communicating via the serial port requires a cable and does not realize the improved speed offered by the I/O bus.

Running TISOFT2

To run TISOFT2, enter the command appropriate to the PLC and version of TISOFT2 you are using.

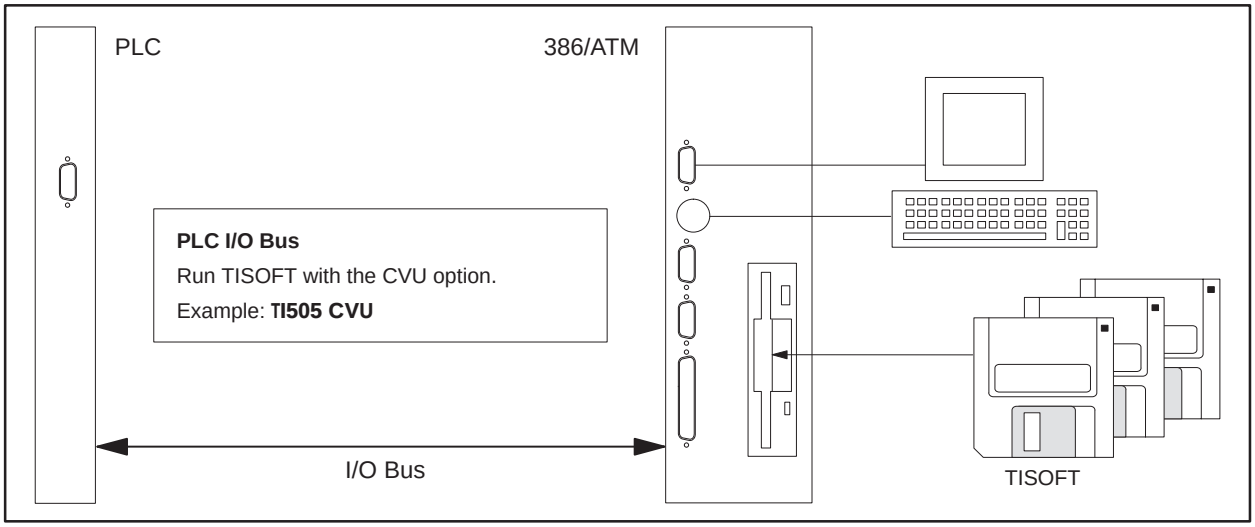


Figure 4-2 Running TISOFT2 via I/O Bus

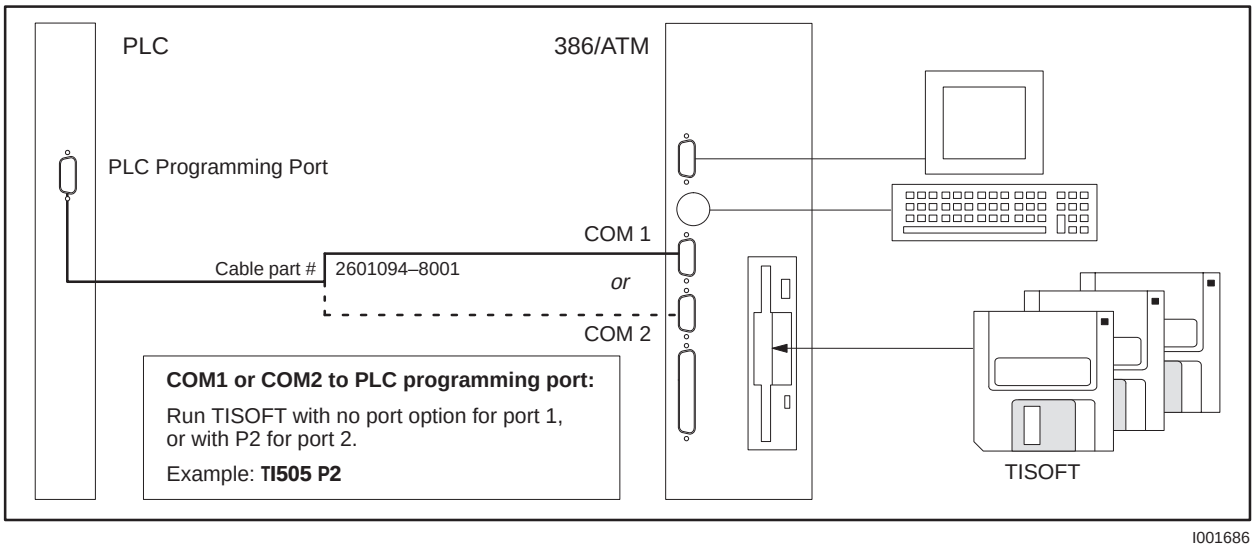


Figure 4-3 Running TISOFT2 via Serial Port

Selecting the I/O Definition Chart

Figure 4-4 shows a sample I/O definition chart with the 386/ATM installed in slot 1. Refer to your TISOFT2 manual for detailed instructions.

I/O MODULE DEFINITION FOR: CHANNEL 1 BASE 00

SLOT	I/O ADDRESS	NUMBER OF BIT AND WORD I/O X	Y	WX	WY	SPECIAL FUNCTION
1	0001	00	00	04	04	YES
2	0000	00	00	00	00	NO
3	0000	00	00	00	00	NO
4	0000	00	00	00	00	NO
5	0000	00	00	00	00	NO
6	0000	00	00	00	00	NO

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Figure 4-4 Sample I/O Definition Chart

Viewing the I/O Configuration Chart

Use SHOW or a similar menu selection to display the I/O Configuration Chart. The configurations in Figure 4-4 appear as shown in Figure 4-5.

I/O CONFIGURATION CHART FOR CHANNEL . . . 1 BASE 00

	I/O POINTS 1	2	3	4	5	6	7	8
SLOT 1	WX0001	WX0002	WX0003	WX0004	WY0005	WY0006	WY0007	WY0008
SLOT 2								
SLOT 3								
SLOT 4								
SLOT 5								
SLOT 6								

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Figure 4-5 I/O Configuration Chart

Chapter 5

PLC Communications

5.1 Overview

Communicating with the PLC

An application program in the 386/ATM communicates with the PLC using the PCCOMM service of the MS-DOS character device driver 386ATM.EXE. Figure 5-1 shows the sequence of communication used.

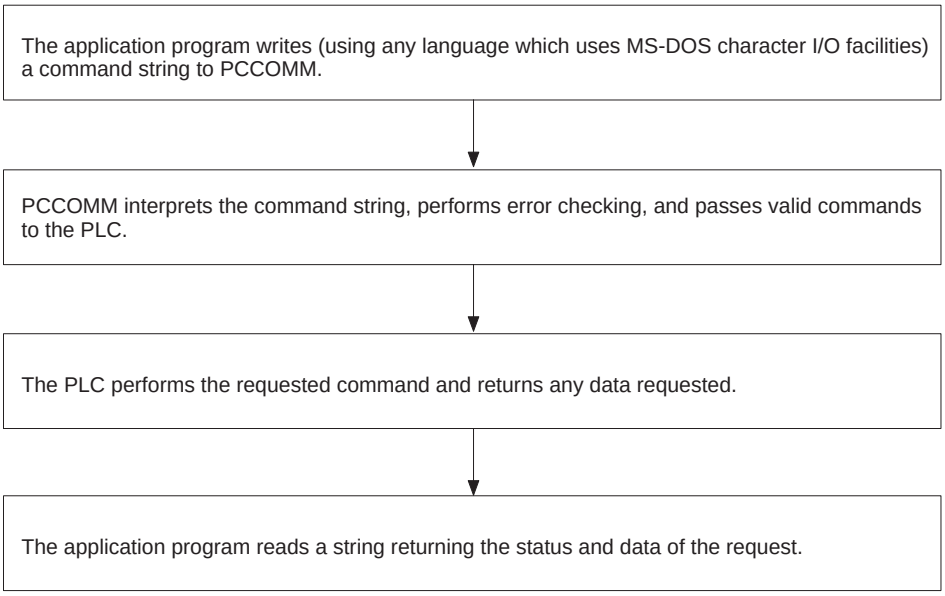

Figure 5-1 Communication Sequence

Verifying the CONFIG.SYS File in your Root Directory

The CONFIG.SYS file must contain the correct instructions for loading the 386ATM driver during the module's boot procedure in order to activate the PCCOMM service. The INSTALL batch file included as part of the installation procedure makes these modifications automatically. Make sure that the following lines are included in a file called CONFIG.SYS in the root directory.

```
FILES 30
BUFFERS 20
device=C:\HIMEM.SYS
device=C:\386ATM.EXE
```

See the example CONFIG.SYS file on page 3-7 if you want to load the ATM driver in high memory.

Using PCCOMM

The PCCOMM service provides two types of functions:

- IOREAD and IOWRITE access the 4 WX and 4 WY I/O points during the I/O cycle of the PLC scan
- PCREAD and PCWRITE access PLC memory during the Special Function Module cycle of the PLC scan

The following sequence of events is an outline for using the PCCOMM service to communicate to the local I/O points in the 386/ATM.

1. Make sure that the 386ATM device driver is loaded when the 386/ATM boots up.
2. Write an application program that communicates with the PCCOMM service.

Application Program I/O Bus Communication

Appendix B provides examples of application programs. The sequence of events in the program are as follows.

1. Open an unbuffered file stream with the name of PCCOMM.
2. Build a command string to perform the function required.
3. Send the command string to the open file stream.
4. Read the response string from the file stream.
5. Get the information from the response string.

Table 5-1 Maximum Words or Bits Transferred per PCCOMM Transaction

PCCOMM Operation	Maximum Transfer
IOREAD	4 words
IOWRITE	4 words
PCREAD/PCWRITE (V-mem, WX, etc.)	120 words
PCREAD/PCWRITE (CR, X, Y, etc.)	480 bits

5.2 Communicating during PLC Scan: I/O Cycle

The naming conventions used for the I/O points in the module are from the PLC perspective. For instance, 4 WX describes four analog words that will be read into the PLC, while 4 WY are analog words that are an output from the PLC. In other words, the points labeled as 4 WX are points that the 386/ATM writes to (remember, the PLC reads these points), and the 4 WY points are read into the 386/ATM. See Figure 5-2.

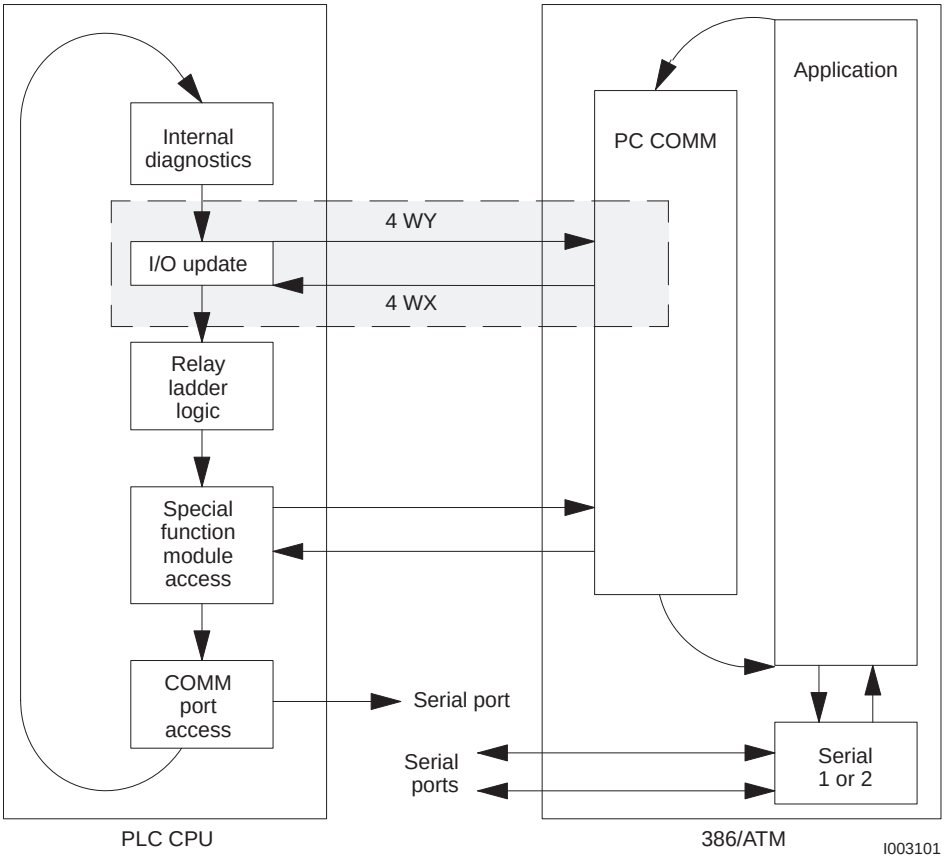

Figure 5-2 PLC Scan: I/O Cycle

Accessing I/O Points

The IOREAD and IOWRITE commands allow you to gain access to the eight local I/O points in the 386/ATM. The I/O points are configured locally in the 386/ATM as shown in Figure 5-3. You can configure the local I/O in your PLC as a set of eight analog points.

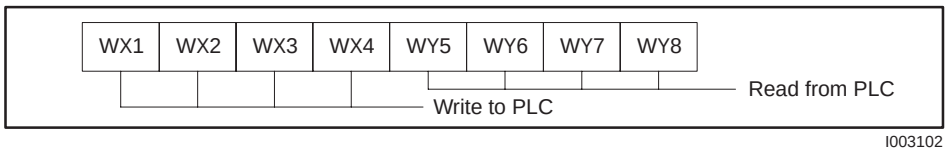

Figure 5-3 I/O Word Configuration

Command Syntax: IOREAD

The command syntax for performing an IOREAD operation is:

:ir:a:b::<cr>

where:

: is a required delimiter for the command string.

ir is the command for IOREAD (lower or upper case).

a is the local point number for the 4 local WY points in the 386/ATM. The 386/ATM start point is from 5 through 8, inclusive.

b is the number of IO points to read. Valid numbers for **b** are 1, 2, 3, and 4.

You cannot read beyond the boundary of the 4 WY points, and the count **b** is limited by the start point (value of **a**). For example, if you use address 5 for **a**, you can obtain up to 4 points of WY information. If you use address 6 as the start point for **a**, then you can read only up to a total of 3 points from the local WYs.

:: is the terminating delimiter for the command string; these characters must be present for the command to operate.

<cr> represents the ASCII character 0D HEX; this character must be present in order to tell PCCOMM that the command string is complete.

Response Syntax: IOREAD

After receiving an IOREAD, PCCOMM responds in the following format.

:ir:e:f:g:h:i::<cr>

where:

: is the delimiter for the response.

ir indicates the response is from an IOREAD operation.

e is the error code returned from the operation.

if positive, the number represents the number of data items read.

if zero, the number represents an error indicating a bad start point or a bad count, and no words were read.

f–i are the data values in ASCII/decimal that are returned as the result of the operation.

:: is the end delimiter of the response string.

<cr> is the ASCII character 0D HEX denoting the end of the response transaction.

Command Syntax: IOWRITE

The command syntax for performing an IOWRITE operation is:

:iw:a:b:f:g:h:i::<cr>

where:

: is a required delimiter for the command string.

iw is the command for IOWRITE (lower or upper case).

a is the starting point number for the four WX points in the 386/ATM. Possible entries in this field are WX1 through WX4.

b is the number of I/O points to write. Valid numbers are 1, 2, 3, and 4.

f–i are the data to write into the points selected.

:: is the terminating delimiter for the command string; these characters must be present for the command to operate.

<cr> represents the ASCII character 0D HEX; this character must be present in order to tell PCCOMM that the command string is complete.

Response Syntax: IOWRITE

After receiving an IOWRITE, PCCOMM responds in the following format.

:iw:e::<cr>

where

: is the delimiter for the response.

iw indicates the response is from an IOWRITE operation.

e is the response code where:

if the number is positive, it represents the count of items written.

if zero, the number represents a bad start address or a bad count, and no words were written.

:: is the end delimiter of the response string.

<cr> is the ASCII character 0D HEX denoting the end of the response transaction.

5.3 Communicating with the PLC Scan: Special Function Cycle

Description

The PCREAD and PCWRITE commands allow you to gain access to various types of memory in your PLC. The naming conventions used are from the PLC perspective. (See Figure 5-4.) For instance, PCWRITE passes information to the PLC, while PCREAD requests information from the PLC.

The memory types are categorized as:

- Word access: VMEM, WX, WY, TCC, TCP, DSC, DCP, STW, DCP, KMEM
- Discrete access: XREG, YREG, CREG

Consult your PLC programming manual for descriptions of each of the above memory types.

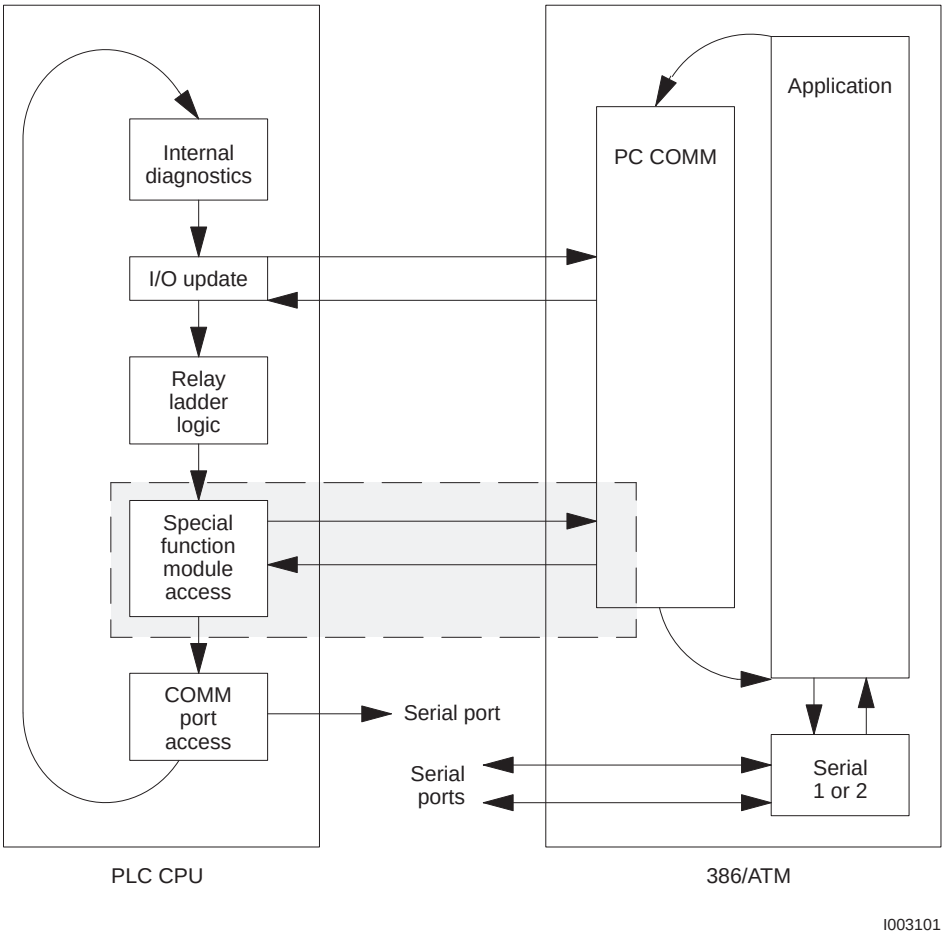

Figure 5-4 PLC Scan: Special Function Cycle

Command Syntax: PCREAD

PCREAD allows you to read PLC memory. The syntax of a PCREAD command is as follows.

:pr:memory_type:start_point:count::<cr>

where:

:	is the separating delimiter for the command.
pr	is the command syntax for PCREAD.
memory_type	is the memory type: VMEM, WX, WY, TCC, TCP, DSC, DCP, STW, DCP, KMEM, XREG, YREG, CREG
start_point	is the starting address for the memory type; ASCII/decimal.
count	is the number of data items that you want to read in this transaction; ASCII/decimal.
::	is the ending delimiter for the command.
<cr>	is the ASCII character 0D HEX denoting the end of the response transaction.

Response Syntax: PCREAD

PCCOMM responds to the PCREAD command in the following format.

:pr:error_code:val_1:val_2:val_n::<cr>

where:

:	is the separating delimiter for the command.
pr	is the command response for PCREAD.
error_code	if positive, the number of values read from the PLC if zero, a bad memory_type, a bad start_point for the memory_type or a bound count. No words were returned. if negative, a communications failure with the PLC.
val_1 to val_n	are the values returned from the device driver.
::	is the ending delimiter for the command.
<cr>	is the ASCII character 0D HEX denoting the end of the response transaction.

Command Syntax: PCWRITE

PCWRITE allows you to write the PLC memory. The syntax of a PCWRITE command is as follows.

:pw:memory_type:start_point:count:val_1:val_2:val_n::<cr>

where:

:	is the separating delimiter for the command.
pw	is the command syntax for PCWRITE.
memory_type	is the memory type: VMEM, WX, WY, TCC, TCP, DSC, DCP, STW, DCP, KMEM, XREG, YREG, CREG.
start_point	is the starting address for the memory type.
count	is the number of data items that you want to read in this transaction.
val_1 to val_n	are the data values you are writing to the PLC.
::	is the ending delimiter for the command.
<cr>	is the ASCII character 0D HEX denoting the end of the response transaction.

Response Syntax: PCWRITE

PCCOMM responds to the PCWRITE command in the following format.

:pw:error_code::<cr>

where:

:	is the separating delimiter for the command.
pw	is the command response for PCWRITE
error_code	if positive, the number of values written to the PLC
	if zero, a bad memory_type, a bad start_point for the memory_type or a bad count. No words were returned.
	if negative, a comm failure with the PLC IOWRITE operation
::	is the end delimiter of the response string.
<cr>	is the ASCII character 0D HEX denoting the end of the response transaction.

Executing Commands from a File

Any of these commands can be entered from the keyboard or executed from a file. For instance, to send a message, use **echo:[message]::>pccom** or

```
c>  copy con: pccomm:
    :pr[message]::
    <ctrl-z>
```

To read a message, use **c> copy pccomm: con:**

Notes Concerning Writing to Memory Locations

Example programs are included in Appendix B. Source code for the examples is supplied on the 386/ATM device driver diskette.

Consider the following when reading or writing data.

- The PLC input scan, ladder execution, loop execution, or special function logic may overwrite any value written by PCWRITE. Ensure that all systems software and hardware are coordinated so that they work together.

⚠CAUTION

Care should be taken when using PCWRITE to send data to word memory areas. Unlike discrete memory points, word memory areas can be overwritten even if they are forced.

- All data and address values used in communications with PCCOMM are in decimal (i.e., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12).
- When reading or writing a discrete memory type, the data will be either 1 or 0.

  Address for all memory types start with 1, with the exception of DCP, which starts with address 0.

  The format for DCP addressing is:

  <drum_number> <step_number>

  where **drum_number** is 1 based (1 through n) and **step_number** is 0 through 15.

  Example:

  Event drum 1, step 1 uses address 16 (base 10).

  Event drum 1, step 2 uses address 17 (base 10).

  Event drum 2, step 1 uses address 32 (base 10).

  Event drum 2, step 2 uses address 33 (base 10).

5.4 Communicating with the PLC: COMM Port Cycle

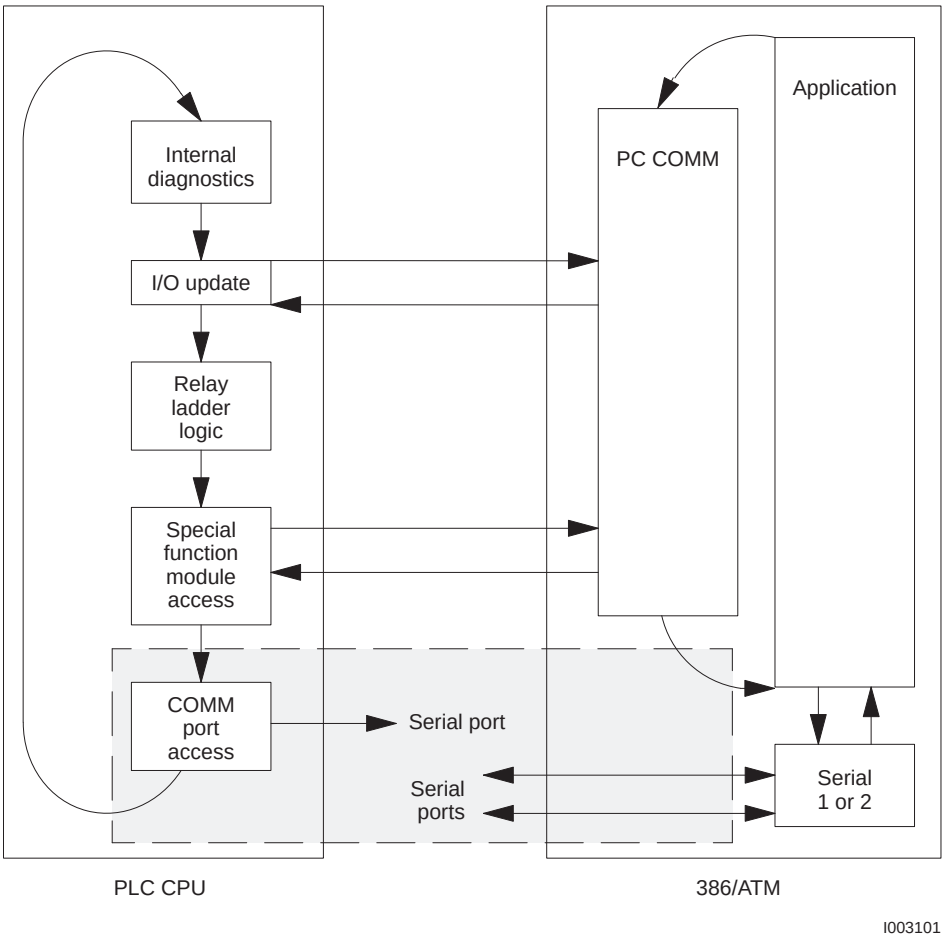

Figure 5-5 PLC Scan: COMM Port Cycle

Serial Port to PLC

All third party software that communicates with Series 505 or Series 500 families of PLCs through the PLC serial port will operate on the 386/ATM. Refer to the installation instructions accompanying the software package.

RS-232 Com1 and Com2

Com1 and Com2 are PC/AT-compatible serial communications ports with standard handshaking. All third party PC/AT-compatible software that is programmed for serial communications will operate on the module.

NOTE: The driving voltage is 5 VDC rather than the 12 VDC standard of IBM-compatible PCs and may not work with all hardware, especially a mouse.

Chapter 6
Troubleshooting

6.1 Diagnostics

Power-up and Run-time Diagnostics

The 386/ATM has an extensive set of ROM-resident hardware diagnostics. Following power-up or a manual reset (using the reset button), the 386/ATM automatically initiates a set of internal diagnostics to verify system memory, CPU, and functionality.

During operation, the 386/ATM generates and tests parity for each access to system DRAM to ensure integrity of the system DRAM memory.

User-Initiated Diagnostic Tests

You can initiate diagnostic testing at any time. Initiating diagnostic testing halts the current operation. To begin, press: CNTL ALT S

Use the arrow keys to highlight **DIAGNOSTICS** and press Enter. The system prompts you with information on selecting the diagnostic tests available.

The 386/ATM reboots after exiting the diagnostic menu.

NOTE: The Floppy Disk diagnostic requires a "scratch" 3.5″ high-density diskette (1.44M byte). All data on this diskette will be lost during the Floppy Drive test. The diskette will have to be reformatted before it can be used for MS-DOS applications.

NOTE: The Fixed Disk test is non-destructive; no data on the fixed disk will be lost as a result of the test.

To run the External Loop-back test on the serial ports, you must attach a loop-back connector to the serial port. Figure 6-1 shows the wiring diagram for the loop-back connector.

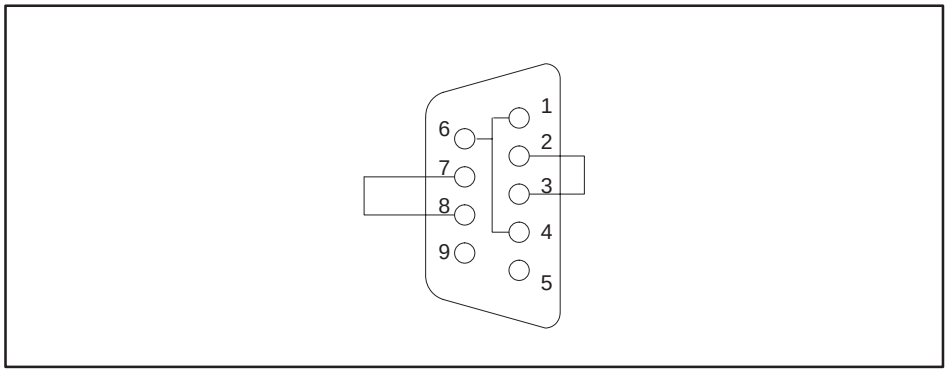

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Figure 6-1 Loop-back Connector for Serial Port Test (Wire-side View)

6.2 Troubleshooting

Condition	Possible Cause	Action
Does not run application software	Software problem (application software)	Contact software vendor to verify: • that software is IBM PC/AT-compatible. • that software does not require special "keys" to operate. If required, install special hardware or software as specified by vendor.
	Hardware failure (module)	Run module diagnostic program.
Does not communicate with PLC over I/O bus	Module not properly seated in base	Check that module is properly installed in base.
	Software problem (using TISOFT)	Verify that **386ATM.EXE** is installed in the CONFIG.SYS. Start TISOFT by entering: **TI505 CVU** (if you are communicating via the I/O bus); or **TI505** (if you are communicating via serial port 1); or **TI505 P2** (if you are communicating via serial port 2).
	Software problem (using application program)	Refer to manual for application program. Check operating instructions. Verify that **386ATM.EXE** is installed in the CONFIG.SYS. Verify that third-party I/O bus driver software (if used) will work. Contact software vendor. Verify that **PCREAD**, **PCWRITE**, **IOREAD**, and **IOWRITE** are properly formatted and have proper syntax in the application software. Refer to Chapter 5 and Appendix C.
Does not communicate through serial ports	Cabling problem	Check connections and cabling.
	Incompatible communication interface	Check interface. 386/ATM is DTE; devices attached to serial ports must be DCE, or must use appropriate crossover (e.g., null modem cable).
	Software problem (application program)	Verify software by running serial application on another machine/module.
	Hardware problem	Run module diagnostic program, using loop-back connector to check serial ports.
Does not communicate through parallel port	Cabling problem	Check connections and cabling.
	Printer problem	Check that printer is set for parallel communication. Verify printer operation.
	Hardware problem	Run module diagnostic program.
Video output not operating properly	Module not set correctly (switch 4)	Verify switch 4 is on. Refer to Chapter 2.
	Monitor not set correctly	If monitor requires setting switches for EGA/VGA or TTL/analog operation, verify that switches are set to VGA or analog.
	Interconnecting cable miswired or damaged	Verify wiring; see Appendix C.

Condition	Possible Cause	Action
Keyboard not operating properly	Keyboard failure	Replace keyboard.
Floppy disk drive does not work	Disk not set up properly	Run **SETUP** procedure and verify diskette drive is set up properly.
	Hardware problem	Run module diagnostics program.
Hard disk drive does not work	Disk not set up properly	Run **SETUP** procedure and verify hard drive is set up properly.
	Hardware problem	Run module diagnostics program.
Real time clock and disk setup data are lost after PLC power cycle	**SETUP** data not correctly entered and saved.	Verify **SETUP** procedures.
	Battery problem	Verify that module battery switch is on. Refer to Chapter 2. Replace module battery.
Seek and/or read/write errors occur during diskette access	Disk access during periods of high conducted or radiated electrical noise conditions	Use the diskette for startup, then operate with the hard drive.

Appendix A

387SX Math Coprocessor

A.1 Installing the 387SX Math Coprocessor

To enhance processing, the 386/ATM includes a socket for an optional CMOS 80C387SX math coprocessor (16 MHz or faster). See Figure A-1. Contact your local computer store to purchase a 387SX coprocessor.

Intel manufactures a 387SX coprocessor (Intel part number BOX387SX–16). Equivalent math coprocessor chips are available from other vendors. You can use one of these coprocessor chips, provided they are equivalent to the Intel coprocessor.

⚠ CAUTION

You must install the 387 coprocessor correctly. To help avoid damage to the 386/ATM or to the 387 coprocessor, refer to installation instructions provided with the coprocessor.

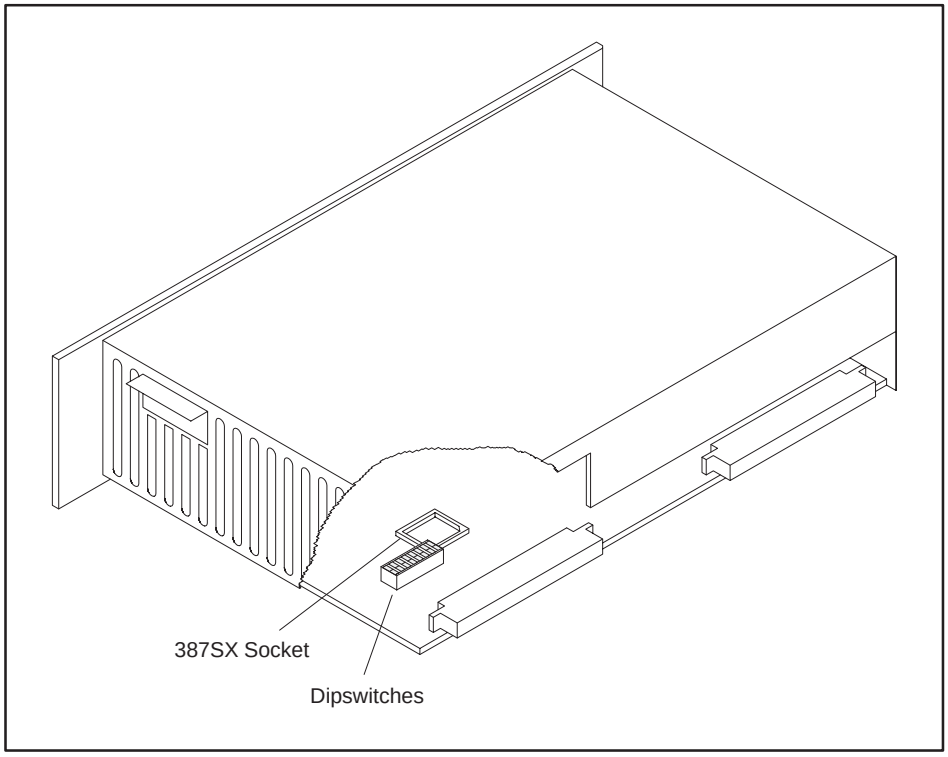

Figure A-1 387SX Socket Location

Procedure

Use the following procedure to install a 387 coprocessor in your 386/ATM. Refer to the installation instructions that accompany the 387SX coprocessor.

⚠ CAUTION

Both the 386/ATM and the 387 coprocessor can be damaged by electrostatic discharge. To help avoid potential damage, ground yourself and the 386/ATM before handling and installing the 387 coprocessor.

1. Place the 386/ATM on a flat surface, oriented as in Figure A-1 (with the printed circuit board down).
2. Orient the 387 coprocessor chip to correspond to the socket. See Figure A-2.
3. Refer to the installation instructions that accompany the 387SX coprocessor. Seat the 387 coprocessor into the socket by pressing firmly and evenly. Be careful that the pins are not bent or damaged and that the printed circuit board is not flexed.

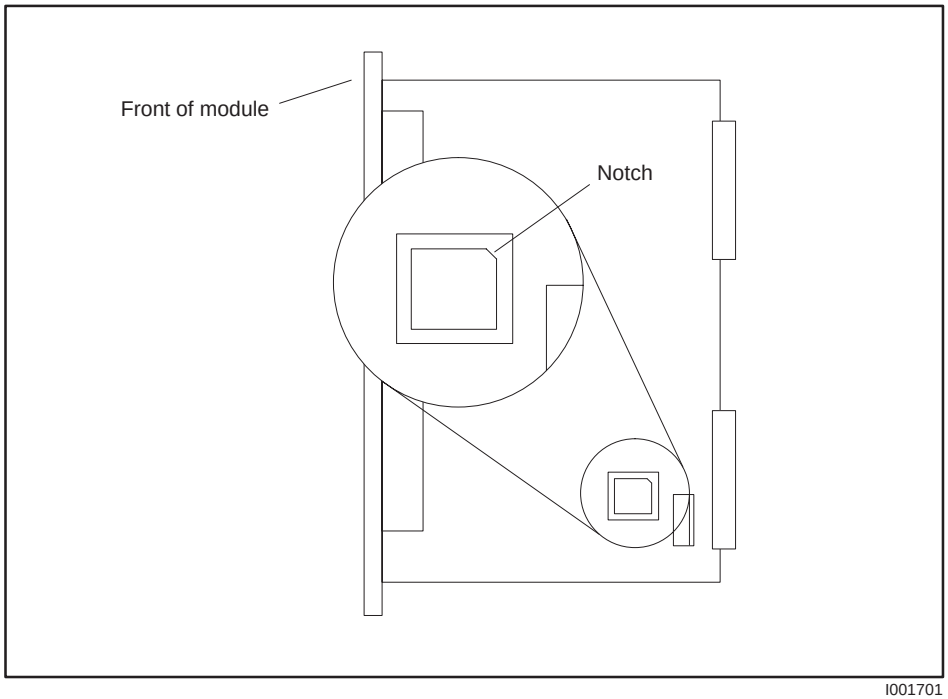

Figure A-2 387SX Socket Orientation (Top View)

Appendix B

Programming Examples

B.1 Overview

PCCOMM Communication Examples

The example programs are provided to demonstrate using the PCCOMM communications service. There are three sets of example programs, one for each of the following languages: Microsoft GW-BASIC®, Microsoft QBasic (QuickBASIC), and C.

C Programs

The following C programs have been successfully compiled and linked with Microsoft C 5.1 and Turbo C® 2.0.

- iord_c: Read the coprocessor module's WY values via IOREAD.
- iowr_c: Write to the coprocessor module's WX values via IOWRITE.
- pcrd_c: Read from V-memory, X registers and the WX points via PCREAD.
- pcwr_c: Write to V-memory, Y registers and the 386/ATM WY points via PCWRITE.

QuickBASIC Programs

Example programs for QuickBASIC are the following.

- iord_msb: Read the coprocessor module's WY values via IOREAD.
- iowr_msb: Write to the coprocessor module's WX values via IOWRITE.
- pcrd_msb: Read from V-memory, X registers and the 386/ATM WX points via PCREAD.
- pcwr_msb: Write to V-memory, Y registers and the 386/ATM WY points via PCWRITE.

GW-BASIC Programs

Example programs for GW-BASIC are the following.

- iord_gw: Read the coprocessor module's WY values via IOREAD.
- iowr_gw: Write to the coprocessor module's WX values via IOWRITE.
- pcrd_gw: Read from V-memory, X registers and the 386/ATM WX points via PCREAD.
- pcwr_gw: Write to V-memory, Y registers and the 386/ATM WY points via PCWRITE.

NOTE: GW-BASIC is not furnished with the 386/ATM Coprocessor module.

B.2 C Program: IOREAD

```
/*****************************************************************************
*   iord_c:   Read the coprocessor module's WY values.                       *
*                                                                            *
*   Language:   Turbo C 2.0 or Microsoft C 5.1                               *
*   Date:       11/8/90                                                      *
*                                                                            *
*   Description:  This routine demonstrates the usage of the PCCOMM service  *
*       command IOREAD. The 4 local WY points will be read and displayed to  *
*       the screen.                                                          *
*                                                                            *
*   Suggestions:  You may want to run PCWR_C prior to execution of this      *
*       program to verify that real values are being read by this routine.   *
*       The last part of PCWR_C allows the user to write to the WY values.   *
*                                                                            *
*   Hardware Requirements:                                                   *
*       Series 500/505 PLC                                                   *
*       386/ATM COPROCESSOR                                                  *
*                                                                            *
*   Software Requirements:                                                   *
*       1.  Turbo C 2.0 or Microsoft C 5.1                                   *
*                                                                            *
*   Warnings:                                                                *
*                                                                            *
*                                                                            *
*****************************************************************************/
#include <stdio.h>
/*****************************************************************************
* Data Declarations                                                          *
*****************************************************************************/
                                    /*************************************
                                    * File pointer for the device driver.  *
                                    *************************************/
FILE *driver;
                                    /*************************************
                                    * Buffer for strings received from the *
                                    * device driver.                       *
                                    *************************************/
char buffer[200];
                                    /*************************************
                                    * The number of values read by the     *
                                    * device driver.  This value is parsed *
                                    * from the return string.              *
                                    *************************************/
int input_count;
                                    /*************************************
                                    * Pointer to token parsed from the     *
                                    * response string.                     *
                                    *************************************/
char *token;
                                    /*************************************
                                    * Tell the compiler that strtok (a C   *
                                    * library function) returns character  *
                                    * pointers.                            *
                                    *************************************/
char *strtok();
                                    /*************************************
                                    * Loop counter used for all FOR loops. *
                                    *************************************/
int loop_counter;
/*****************************************************************************
* Program                                                                    *
*****************************************************************************/
int main(void)
{
```

C Program: IOREAD (continued)

```
                                    /*************************************
                                    * Display a message describing the     *
                                    * program.                             *
                                    *************************************/
printf("\n\n\n\n");
printf("IORD_C:   Example usage of the PCCOMM command IOREAD to read");
printf(" from the\n           module's WY points.\n");
printf("\nSee the file IORD_C.c for a more complete description of the");
printf("\noperation of this routine.\n");
                                    /*************************************
                                    * Open the device driver in update     *
                                    * mode (reading and writing).  If it   *
                                    * does not open correctly then exit    *
                                    * the program with an error message.   *
                                    *************************************/
if ((driver = fopen("PCCOMM", "r+")) == NULL)
  {
    printf("\nCould not open the device driver.\n");
    exit(1);
  }
                                    /*************************************
                                    * Write the request to the device      *
                                    * driver.                              *
                                    *************************************/
fprintf(driver, ":IR:5:4::\r");
                                    /*************************************
                                    * Flush the file buffer to ensure that *
                                    * the driver received the request.     *
                                    *************************************/
fflush(driver);
                                    /*************************************
                                    * The file pointer must be returned to *
                                    * the beginning of the file after each *
                                    * transaction with the device driver.  *
                                    *************************************/
fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Get a response from the device       *
                                    * driver.                              *
                                    *************************************/
fgets(buffer, 199, driver);
fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Skip to the 2nd token in the response*
                                    * string (it contains the number of    *
                                    * values read).                        *
                                    *************************************/
strtok(buffer, ":");
token = strtok(NULL, ":");
input_count = atoi(token);
                                    /*************************************
                                    * Print an error message if the number *
                                    * of values read does not equal 4.     *
                                    *************************************/
if (input_count != 4)
    printf("\nThe device driver was unable to read the 4 values!");
else
  {
```

```
                                        /*************************************
                                        * Display the 4 values to the screen.  *
                                        *************************************/
          for (loop_counter = 0; loop_counter < 4; ++loop_counter)
            {
              token = strtok(NULL, ":");
              printf("\nLocation %d: %05u", loop_counter + 5, atoi(token));
            }
          printf("\n");
        }
}
```

B.3 C Program: IOWRITE

```
/*****************************************************************************
*   iowr_c:   Write to the coprocessor module's WX values.                   *
*                                                                            *
*   Language:   Turbo C 2.0 or Microsoft C 5.1                               *
*   Date:       11/8/90                                                      *
*                                                                            *
*   Description:  This routine demonstrates the usage of the PCCOMM service  *
*       command IOWRITE. The 4 local WX points will be written as specified  *
*       by the user.                                                         *
*                                                                            *
*   Suggestions:  You may want to run PCRD_C after this program to verify    *
*       that the values were written correctly by this routine.  The last    *
*       part of PCRD_C allows the user to read the WX values.                *
*                                                                            *
*   Hardware Requirements:                                                   *
*       Series 500/505 PLC                                                   *
*       386/ATM COPROCESSOR                                                  *
*                                                                            *
*   Software Requirements:                                                   *
*       1.  Turbo C 2.0 or Microsoft C 5.1                                   *
*                                                                            *
*   Warnings:                                                                *
*                                                                            *
*                                                                            *
*****************************************************************************/
#include <stdio.h>
/*****************************************************************************
* Data Declarations                                                          *
*****************************************************************************/
                                    /*************************************
                                    * File pointer for the device driver.  *
                                    *************************************/
FILE *driver;
                                    /*************************************
                                    * Buffer for strings received from the *
                                    * device driver.                       *
                                    *************************************/
char buffer[200];
                                    /*************************************
                                    * The number of values written by the  *
                                    * device driver.  This value is parsed *
                                    * from the return string.              *
                                    *************************************/
int input_count;
                                    /*************************************
                                    * Pointer to token parsed from the     *
                                    * response string.                     *
                                    *************************************/
char *token;
                                    /*************************************
                                    * Tell the compiler that strtok (a C   *
                                    * library function) returns character  *
                                    * pointers.                            *
                                    *************************************/
char *strtok();
                                    /*************************************
                                    * Loop counter used for all FOR loops. *
                                    *************************************/
int loop_counter;
                                    /*************************************
                                    * Storage for values that are to be    *
                                    * written to the 4 local WX points.    *
                                    *************************************/
int values[4];
```

```
/*****************************************************************************
* Program                                                                    *
*****************************************************************************/
int main(void)
{
                                    /*************************************
                                    * Display a message describing the    *
                                    * program.                            *
                                    *************************************/
    printf("\n\n\n\n");
    printf("IOWR_C:    Example usage of the PCCOMM command IOWRITE to write ");
    printf("to the module's\n           WX points.\n");
    printf("\nSee the file IOWR_C.c for a more complete description of the");
    printf("\noperation of this routine.\n\n");
                                    /*************************************
                                    * Open the device driver in update    *
                                    * mode (reading and writing).  If it  *
                                    * does not open correctly then exit   *
                                    * the program with an error message.  *
                                    *************************************/
    if ((driver = fopen("PCCOMM", "r+")) == NULL)
      {
        printf("\nCould not open the device driver.\n");
        exit(1);
      }
                                    /*************************************
                                    * Prompt the user and accept entry of *
                                    * the 4 values that will be written to*
                                    * the WX points.                      *
                                    *************************************/
    for (loop_counter = 0; loop_counter < 4; ++loop_counter)
      {
        printf("Enter the value to write at location %d: ", loop_counter + 1);
        scanf("%d", &(values[loop_counter]));
      }
                                    /*************************************
                                    * Write the request to the device     *
                                    * driver.  Note that the values sent  *
                                    * to the device driver are unsigned.  *
                                    * This is because the device driver   *
                                    * does not accept values with a       *
                                    * negative sign in front of them.     *
                                    *************************************/
    fprintf(driver, ":IW:1:4:%u:%u:%u:%u::\r",
            values[0],
            values[1],
            values[2],
            values[3]);
                                    /*************************************
                                    * Flush the file buffer to ensure that*
                                    * the driver received the request.    *
                                    *************************************/
    fflush(driver);
                                    /*************************************
                                    * The file pointer must be returned to*
                                    * the beginning of the file after each*
                                    * transaction with the device driver. *
                                    *************************************/
    fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Get a response from the device      *
                                    * driver.                             *
                                    *************************************/
    fgets(buffer, 199, driver);
    fseek(driver,0L,SEEK_SET);
```

C Program: IOWRITE (continued)

```
                                        /*************************************
                                        * Skip to the 2nd token in the response*
                                        * string (it contains the number of    *
                                        * values written).                     *
                                        *************************************/
    strtok(buffer, ":");
    token = strtok(NULL, ":");
    input_count = atoi(token);
                                        /*************************************
                                        * Print an error message if the number *
                                        * of values written does not equal 4.  *
                                        *************************************/
    if (input_count != 4)
        printf("\nThe device driver was unable to write the 4 values!");
}
```

B.4 C Program: PCREAD

```
/*****************************************************************************
*   pcrd_c:  Read from V-mem, X registers and the coprocessor module's        *
*             WX points via PCREAD.                                           *
*                                                                             *
*   Language:   Turbo C 2.0 or Microsoft C 5.1                                *
*   Date:       11/8/90                                                       *
*                                                                             *
*   Description:  This routine demonstrates the usage of the PCCOMM service   *
*       command PCREAD.  V-memory, X registers and the module's WX points     *
*       will be read and displayed to the screen.                             *
*           The first part of the program will let the user read from 8       *
*       consecutive V-memory locations.  The user is prompted to enter        *
*       an integer value which specifies the first V-memory location to read  *
*       from.  Then the 8 values are displayed to the screen.  An error       *
*       message will be displayed if the device driver was unable to read     *
*       the 8 values from the PLC.                                            *
*           The second part of the program will let the user read 8 discrete  *
*       X register values.  The user is prompted to enter an integer value    *
*       which specifies the first X register location of the 8 to read from.  *
*       Then the 8 values are read and displayed on the screen.               *
*           The final section of the program will allow the user to read from *
*       the module's 4 WX locations.  The user is prompted to enter an        *
*       integer value which specifies the first WX register location of the   *
*       module.  Then the values are displayed to the screen.                 *
*                                                                             *
*   Suggestions:  You may want to run the routines PCWR_C and IOWR_C          *
*       prior to execution of this routine to verify that real values are     *
*       being read back from the PLC.  PCWR_C can be used to write to         *
*       v-memory and discrete locations, and IOWR_C can be used to write to   *
*       the 4 WX values on the module.                                        *
*                                                                             *
*   Hardware Requirements:                                                    *
*       Series 500/505 PLC                                                    *
*       386/ATM COPROCESSOR                                                   *
*                                                                             *
*   Software Requirements:                                                    *
*       1.  Turbo C 2.0 or Microsoft C 5.1                                    *
*                                                                             *
*   Warnings:                                                                 *
*                                                                             *
*                                                                             *
*****************************************************************************/
#include <stdio.h>
/*****************************************************************************
* Data Declarations                                                          *
*****************************************************************************/
                                    /*************************************
                                    * File pointer for the device driver.  *
                                    *************************************/
FILE *driver;
                                    /*************************************
                                    * Buffer for strings received from the *
                                    * device driver.                       *
                                    *************************************/
char buffer[200];
                                    /*************************************
                                    * The number of values read by the     *
                                    * device driver.  This value is parsed *
                                    * from the return string.              *
                                    *************************************/
int input_count;
                                    /*************************************
                                    * The beginning location that the      *
                                    * series of data is to be read from.   *
                                    *************************************/
int start_point;
```

C Program: PCREAD (continued)

```
                                        /*************************************
                                        * Pointer to token parsed from the    *
                                        * response string.                    *
                                        *************************************/
char *token;
                                        /*************************************
                                        * Tell the compiler that strtok (a C  *
                                        * library function) returns character *
                                        * pointers.                           *
                                        *************************************/
char *strtok();
                                        /*************************************
                                        * Loop counter used for all FOR loops.*
                                        *************************************/
int loop_counter;
/*****************************************************************************
* Program                                                                    *
*****************************************************************************/
int main(void)
{
                                        /*************************************
                                        * Display a message describing the    *
                                        * program.                            *
                                        *************************************/
    printf("\n\n\n\n");
    printf("PCRD_C:    Example usage of the PCCOMM command PCREAD.\n");
    printf("\nSee the file PCRD_C.c for a more complete description of the");
    printf("\noperation of this routine.\n");
                                        /*************************************
                                        * Open the device driver in update    *
                                        * mode (reading and writing).  If it  *
                                        * does not open correctly then exit   *
                                        * the program with an error message.  *
                                        *************************************/
    if ((driver = fopen("PCCOMM", "r+")) == NULL)
      {
        printf("\nCould not open the device driver.\n");
        exit(1);
      }
                                        /*************************************
                                        * Prompt the user for input and read  *
                                        * the V-mem start point from the      *
                                        * keyboard.                           *
                                        *************************************/
    printf("\nEnter the address of the first V-memory point to read from: ");
    scanf("%d", &start_point);
                                        /*************************************
                                        * Write the request to the device     *
                                        * driver.                             *
                                        *************************************/
    fprintf(driver,":pr:VMEM:%d:8::\r", start_point);
                                        /*************************************
                                        * Flush the file buffer to ensure that*
                                        * the driver received the request.    *
                                        *************************************/
    fflush(driver);
                                        /*************************************
                                        * The file pointer must be returned to*
                                        * the beginning of the file after each*
                                        * transaction with the device driver. *
                                        *************************************/
    fseek(driver,0L,SEEK_SET);
```

```
                                    /*************************************
                                    * Get a response from the device      *
                                    * driver.                             *
                                    *************************************/
fgets(buffer, 199, driver);
fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Skip to the 2nd token in the response*
                                    * string (it contains the number of   *
                                    * values read).                       *
                                    *************************************/
strtok(buffer, ":");
token = strtok(NULL, ":");
input_count = atoi(token);
                                    /*************************************
                                    * Print an error message if the number *
                                    * of values read does not equal 8.    *
                                    *************************************/
if (input_count != 8)
    printf("\nThe device driver was unable to read the 8 values!");
else
  {
                                    /*************************************
                                    * Display the 8 values to the screen.  *
                                    *************************************/
    for (loop_counter = 0; loop_counter < 8; ++loop_counter)
      {
        token = strtok(NULL, ":");
        printf("\nV-mem location %d: %05u", start_point + loop_counter,
               atoi(token));
      }
  }
                                    /*************************************
                                    * Prompt the user for input and read   *
                                    * from the keyboard the location of    *
                                    * the first X register to read from.   *
                                    *************************************/
printf("\n\nEnter the address of the first X register to read: ");
scanf("%d", &start_point);
                                    /*************************************
                                    * Write the request to the device     *
                                    * driver.                             *
                                    *************************************/
fprintf(driver, ":pr:XREG:%d:8::\r", start_point);
fflush(driver);
fseek(driver, 0L,SEEK_SET);
                                    /*************************************
                                    * Get a response from the device      *
                                    * driver.                             *
                                    *************************************/
fgets(buffer, 199, driver);
fseek(driver, 0L, SEEK_SET);
strtok(buffer, ":");
token = strtok(NULL, ":");
input_count = atoi(token);
```

C Program: PCREAD (continued)

```
                                        /*************************************
                                        * Print an error message if the number *
                                        * of values read does not equal 8.     *
                                        *************************************/
    if (input_count != 8)
        printf("\nThe device driver was unable to read the 8 values!");
    else
      {
                                        /*************************************
                                        * Display the 8 values to the screen.  *
                                        *************************************/
        for (loop_counter = 0; loop_counter < 8; ++loop_counter)
          {
            token = strtok(NULL, ":");
            printf("\nX%d: %u", start_point + loop_counter, atoi(token));
          }
      }
                                        /*************************************
                                        * Prompt the user for input and read   *
                                        * from the keyboard the location of    *
                                        * the first WX to read from.           *
                                        *************************************/
    printf("\n\nEnter the address of the first WX register on the module: ");
    scanf("%d", &start_point);
                                        /*************************************
                                        * Write the request to the device      *
                                        * driver.                              *
                                        *************************************/
    fprintf(driver, ":pr:WX:%d:4::\r", start_point);
    fflush(driver);
    fseek(driver, 0L, SEEK_SET);
                                        /*************************************
                                        * Get a response from the device       *
                                        * driver.                              *
                                        *************************************/
    fgets(buffer, 199, driver);
    fseek(driver, 0L, SEEK_SET);
    strtok(buffer, ":");
    token = strtok(NULL, ":");
    input_count = atoi(token);
                                        /*************************************
                                        * Print an error message if the number *
                                        * of values read does not equal 4.     *
                                        *************************************/
    if (input_count != 4)
        printf("\nThe device driver was unable to read the 4 values!");
    else
      {
                                        /*************************************
                                        * Display the 4 values to the screen.  *
                                        *************************************/
        for (loop_counter = 0; loop_counter < 4; ++loop_counter)
          {
            token = strtok(NULL, ":");
            printf("\nWX%d: %05u", start_point + loop_counter, atoi(token));
          }
      }
    printf("\n");
}
```

B.5 C Program: PCWRITE

```
/*****************************************************************************
*   pcwr_c:  Write to V-mem, Y registers and the coprocessor module's         *
*             WY points via PCWRITE.                                          *
*                                                                             *
*   Language:   Turbo C 2.0 or Microsoft C 5.1                                *
*   Date:       11/8/90                                                       *
*                                                                             *
*   Description:  This routine demonstrates the usage of the PCCOMM service   *
*       command PCWRITE.  V-memory, Y registers and the module's WY points    *
*       will be written as specified by the user.                             *
*           The first part of the program will let the user write to 8        *
*       consecutive V-memory locations.  The user is prompted to enter        *
*       an integer value which specifies the first V-memory location to write *
*       to.  Then the user is prompted to enter 8 values which will be        *
*       written to consecutive V-memory locations starting with the location  *
*       previously specified.  An error message will be displayed if the      *
*       device driver was unable to write the 8 values to the PLC.            *
*           The second part of the program will let the user write 8 discrete *
*       Y register values.  The user is prompted to enter an integer value    *
*       which specifies the first Y register location of the 8 to write to.   *
*       Then the user is prompted to enter the 8 values which will be         *
*       written to 8 consecutive Y registers starting with the location       *
*       specified.  Any non-zero value will be written as a 1.                *
*           The final section of the program will allow the user to write to  *
*       the module's 4 WY locations.  The user is prompted to enter an        *
*       integer value which specifies the first WY register location of the   *
*       module.  Remember that the four WYs are located AFTER the 4 WXs.      *
*       Then the user is prompted to enter the 4 values which will            *
*       be written to the 4 consecutive WY registers on the module.           *
*                                                                             *
*   Suggestions:  Since this routine writes to various PLC memory locations   *
*       you may want a means of reading back the locations to verify that the *
*       values were in fact written.  One means of doing this would be to run *
*       the example programs PCRD_C and IORD_C.  PCRD_C can be used           *
*       to read the 8 v-memory and discrete locations, and IORD_C can be      *
*       used to read the 4 WY values (assuming that the module is installed   *
*       in the slot that you wrote the 4 WY values to).                       *
*                                                                             *
*   Hardware Requirements:                                                    *
*       Series 500/505 PLC                                                    *
*       386/ATM COPROCESSOR                                                   *
*                                                                             *
*   Software Requirements:                                                    *
*       1.  Turbo C 2.0 or Microsoft C 5.1                                    *
*                                                                             *
*   Warnings:                                                                 *
*       1.  THIS ROUTINE WRITES TO V-MEMORY AND I/O POINTS.                   *
*                                                                             *
*                                                                             *
*****************************************************************************/
#include <stdio.h>
/*****************************************************************************
* Data Declarations                                                          *
*****************************************************************************/
                                    /*************************************
                                    * File pointer for the device driver.  *
                                    *************************************/
FILE *driver;
                                    /*************************************
                                    * Buffer for strings received from the *
                                    * device driver.                       *
                                    *************************************/
char buffer[200];
```

C Program: PCWRITE (continued)

```
                                    /*************************************
                                    * The number of values written by the  *
                                    * device driver.  This value is parsed *
                                    * from the return string.              *
                                    *************************************/
int input_count;
                                    /*************************************
                                    * The beginning location that the      *
                                    * series of data is to be written to.  *
                                    *************************************/
int start_point;
                                    /*************************************
                                    * Storage for 8 discrete or word       *
                                    * values that are to be written.       *
                                    *************************************/
int values[8];
                                    /*************************************
                                    * Pointer to token parsed from the     *
                                    * response string.                     *
                                    *************************************/
char *token;
                                    /*************************************
                                    * Tell the compiler that strtok (a C   *
                                    * library function) returns character  *
                                    * pointers.                            *
                                    *************************************/
char *strtok();
                                    /*************************************
                                    * Loop counter used for all FOR loops. *
                                    *************************************/
int loop_counter;
/*****************************************************************************
* Program                                                                    *
*****************************************************************************/
int main(void)
{
                                    /*************************************
                                    * Display a message describing the     *
                                    * program.                             *
                                    *************************************/
    printf("\n\n\n\n");
    printf("PCWR_C:    Example usage of the PCCOMM command PCWRITE.\n");
    printf("\nSee the file PCWR_C.c for a more complete description of the");
    printf("\noperation of this routine.\n");
                                    /*************************************
                                    * Print a warning message.             *
                                    *************************************/
    printf("\nWARNING: This program writes to V-memory and Y-registers!\n");
    printf("Hit <space> to continue and any other key to exit.\n\n");
    if (getch() != ' ')
        exit(1);
                                    /*************************************
                                    * Open the device driver in update     *
                                    * mode (reading and writing).  If it   *
                                    * does not open correctly then exit    *
                                    * the program with an error message.   *
                                    *************************************/
    if ((driver = fopen("PCCOMM", "r+")) == NULL)
      {
        printf("\nCould not open the device driver.\n\n");
        exit(1);
      }
```

```
                                    /*************************************
                                    * Prompt the user for input and read  *
                                    * the V-mem start point from the      *
                                    * keyboard.                           *
                                    *************************************/
printf("\nEnter the address of the first V-memory point to write to: ");
scanf("%d", &start_point);
                                    /*************************************
                                    * Allow the user to enter the 8 values *
                                    * at the keyboard.                    *
                                    *************************************/
for (loop_counter = 0; loop_counter < 8 ; ++loop_counter)
  {
    printf("Enter the value to write at location %d: ",
           loop_counter + start_point);
    scanf("%d", &(values[loop_counter]));
  }
                                    /*************************************
                                    * Write the request to the device     *
                                    * driver.  Note that the values sent  *
                                    * to the device driver are unsigned.  *
                                    * This is because the device driver   *
                                    * does not accept values with a       *
                                    * negative sign in front of them.     *
                                    *************************************/
fprintf(driver,":pw:VMEM:%d:8:%u:%u:%u:%u:%u:%u:%u:%u::\r",
        start_point,
        values[0],
        values[1],
        values[2],
        values[3],
        values[4],
        values[5],
        values[6],
        values[7]);
                                    /*************************************
                                    * Flush the file buffer to ensure that *
                                    * the driver received the request.    *
                                    *************************************/
fflush(driver);
                                    /*************************************
                                    * The file pointer must be returned to *
                                    * the beginning of the file after each *
                                    * transaction with the device driver.  *
                                    *************************************/
fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Get a response from the device      *
                                    * driver.                             *
                                    *************************************/
fgets(buffer, 199, driver);
fseek(driver,0L,SEEK_SET);
                                    /*************************************
                                    * Skip to the 2nd token in the response*
                                    * string (it contains the number of   *
                                    * values written).                    *
                                    *************************************/
strtok(buffer, ":");
token = strtok(NULL, ":");
input_count = atoi(token);
                                    /*************************************
                                    * Print an error message if the number *
                                    * of values written does not equal 8.  *
                                    *************************************/
if (input_count != 8)
    printf("\nERROR: The device driver was unable to write the 8 values\n");
```

C Program: PCWRITE (continued)

```
                                    /*************************************
                                    * Prompt the user for input and read   *
                                    * from the keyboard the location of    *
                                    * the first Y register to write to.    *
                                    *************************************/
printf("\nEnter the address of the first Y register to write to: ");
scanf("%d", &start_point);
                                    /*************************************
                                    * Allow the user to enter the 8 values *
                                    * at the keyboard.  Any non-zero value *
                                    * is written as a 1.                   *
                                    *************************************/
for (loop_counter = 0; loop_counter < 8; ++loop_counter)
  {
    printf("Enter the value to write at Y%d: ",
           start_point + loop_counter);
    scanf("%d", &(values[loop_counter]));
  }
                                    /*************************************
                                    * Write the request to the device      *
                                    * driver.                              *
                                    *************************************/
fprintf(driver, ":pw:YREG:%d:8:%u:%u:%u:%u:%u:%u:%u:%u::\r",
        start_point,
        values[0],
        values[1],
        values[2],
        values[3],
        values[4],
        values[5],
        values[6],
        values[7]);
fflush(driver);
fseek(driver, 0L,SEEK_SET);
                                    /*************************************
                                    * Get a response from the device       *
                                    * driver.                              *
                                    *************************************/
fgets(buffer, 199, driver);
fseek(driver, 0L, SEEK_SET);
strtok(buffer, ":");
token = strtok(NULL, ":");
input_count = atoi(token);
                                    /*************************************
                                    * Print an error message if the number *
                                    * of values written does not equal 8.  *
                                    *************************************/
if (input_count != 8)
    printf("\nERROR: The device driver was unable to write the 8 values\n");
                                    /*************************************
                                    * Prompt the user for input and read   *
                                    * from the keyboard the location of    *
                                    * the first WY to write to.            *
                                    *************************************/
printf("\nEnter the address of the first WY register on the module: ");
scanf("%d", &start_point);
```

```
                                        /*************************************
                                        * Allow the user to enter the 4 values *
                                        * that will be written to the module's *
                                        * 4 WY points.                         *
                                        *************************************/
    for (loop_counter = 0; loop_counter < 4; ++loop_counter)
      {
        printf("Enter the value to write at WY%d: ",
               start_point + loop_counter);
        scanf("%d", &(values[loop_counter]));
      }
                                        /*************************************
                                        * Write the request to the device      *
                                        * driver.                              *
                                        *************************************/
    fprintf(driver, ":pw:WY:%d:4:%u:%u:%u:%u::\r",
            start_point,
            values[0],
            values[1],
            values[2],
            values[3]);
    fflush(driver);
    fseek(driver, 0L, SEEK_SET);
                                        /*************************************
                                        * Get a response from the device       *
                                        * driver.                              *
                                        *************************************/
    fgets(buffer, 199, driver);
    fseek(driver, 0L, SEEK_SET);
    strtok(buffer, ":");
    token = strtok(NULL, ":");
    input_count = atoi(token);
                                        /*************************************
                                        * Print an error message if the number *
                                        * of values written does not equal 4.  *
                                        *************************************/
    if (input_count != 4)
        printf("\nERROR: The device driver was unable to write the 4 values\n");
}
```

B.6 QuickBASIC Program: IOREAD

```
DECLARE FUNCTION GetToken$ (String1$, FirstTime%)
'*************************************************************************
'   iord_msb: Read the coprocessor module's WY values.                    *
'                                                                         *
'   Language:   Microsoft Quick Basic                                     *
'   Date:       11/13/90                                                  *
'                                                                         *
'   Description:  This routine demonstrates the usage of the PCCOMM service   *
'       command IOREAD.  The 4 local WY points will be read and displayed     *
'       to the screen.                                                    *
'                                                                         *
'   Suggestions:  You may want to run PCWR_MSB prior to execution of this     *
'       program to verify that real values are being read by this routine.    *
'       The last part of PCWR_MSB allows the user to write to the WY values.  *
'                                                                         *
'   Hardware Requirements:                                                *
'       Series 500/505 PLC                                                *
'       386/ATM COPROCESSOR                                               *
'                                                                         *
'   Software Requirements:                                                *
'       1.  Microsoft Quick Basic                                         *
'                                                                         *
'   Warnings:                                                             *
'                                                                         *
'                                                                         *
'*************************************************************************
    CONST FALSE = 0
    CONST TRUE = NOT FALSE
    DEFINT A-Z
    DIM Values(3)
                                    '***************************************
                                    ' Clear the screen and display a       *
                                    ' message describing the program.      *
                                    '***************************************
    CLS
    PRINT "IORD_MSB:  Example usage of the PCCOMM command IOREAD to read";
    PRINT " from the module's"
    PRINT "           WY points."
    PRINT
    PRINT "See the file IORD_MSB.bas for a more complete description of the"
    PRINT "operation of this routine."
    PRINT
                                    '***************************************
                                    ' Open the device driver for reading   *
                                    ' and writing.                         *
                                    '***************************************
    OPEN "PCCOMM" FOR OUTPUT AS #1
    OPEN "PCCOMM" FOR INPUT AS #2
                                    '***************************************
                                    ' Write the request to the device      *
                                    ' driver.                              *
                                    '***************************************
    PRINT #1, ":IR:5:4::"
                                    '***************************************
                                    ' Get the response from the device     *
                                    ' driver.                              *
                                    '***************************************
    LINE INPUT #2, ResponseString$
                                    '***************************************
                                    ' Skip to the 2nd token in the response*
                                    ' string (it contains the number of    *
                                    ' values read).                        *
                                    '***************************************
    Token$ = GetToken$(ResponseString$, TRUE)
    Token$ = GetToken$(ResponseString$, FALSE)
    InputCount = VAL(Token$)
```

```
                                    '************************************
                                    ' Print an error message if the number *
                                    ' of values read does not equal 4.     *
                                    '************************************
    IF InputCount <> 4 THEN
        PRINT
        PRINT "The device driver was unable to read the 4 values!";
    ELSE
                                    '************************************
                                    ' Display the 4 values to the screen.  *
                                    '************************************
        FOR LoopCounter = 0 TO 3
            Token$ = GetToken$(ResponseString$, FALSE)
            PRINT
            PRINT "Location "; LoopCounter + 5; ":"; VAL(Token$);
        NEXT
        PRINT
    END IF
END
'*****************************************************************************
' Function Name: GetToken$                                                   *
' Usage: Token$ = GetToken$(String1$, FirstTime)                             *
' Parameters:                                                                *
'        Token$: The token parsed from String1$ ("" if the end of the string  *
'                has been reached).                                          *
'        String1$: The string that is being parsed                           *
'        FirstTime: TRUE causes the function to begin parsing at the         *
'                   beginning of the string.                                 *
'                FALSE causes the function to parse the token following      *
'                   the token parsed on the previous call.                   *
'                                                                            *
' Description:  This function extracts a token from String1$.  To parse the  *
'       first token from a string, pass a value of TRUE for the FirstTime    *
'       parameter.  To parse subsequent tokens from the string pass a value of*
'       FALSE for the FirstTime parameter.  For the purposes of this routine  *
'       a token is defined as a sequence of characters that have a preceding  *
'       ':' character and a following ':' character.  The ':' characters are  *
'       NOT returned with the token.                                         *
'                                                                            *
'*****************************************************************************
FUNCTION GetToken$ (String1$, FirstTime) STATIC
                                    '************************************
                                    ' If this is the first call for this   *
                                    ' particular string then set index to  *
                                    ' point to beginning of string and     *
                                    ' skip over the initial ':' character. *
                                    '************************************
    IF FirstTime = TRUE THEN
        I = 1
        I = INSTR(I, String1$, ":")
        I = I + 1
    END IF
```

QuickBASIC Program: IOREAD (continued)

```
                                        '************************************
                                        ' If I is greater than the length of   *
                                        ' the string then return "" as the     *
                                        ' token.  Otherwise parse the token    *
                                        ' from the string and update I to      *
                                        ' point to the beginning of the next   *
                                        ' token.                               *
                                        '************************************
    IF I > LEN(String1$) THEN
        GetToken$ = ""
    ELSE
        J = INSTR(I, String1$, ":")
        TokenLength = J - I
        GetToken$ = MID$(String1$, I, TokenLength)
        I = J + 1
    END IF
END FUNCTION
```

B.7 QuickBASIC Program: IOWRITE

```
DECLARE FUNCTION GetToken$ (String1$, FirstTime%)
'*************************************************************************
'   iowr_msb: Write to the coprocessor module's WX values.                *
'                                                                         *
'   Language:   Microsoft Quick Basic                                     *
'   Date:       11/13/90                                                  *
'                                                                         *
'   Description:  This routine demonstrates the usage of the PCCOMM service   *
'       command IOWRITE.  The 4 local WX points will be written as specified  *
'       by the user.                                                      *
'                                                                         *
'   Suggestions:  You may want to run PCRD_MSB after this program to verify   *
'       that the values were written correctly by this routine.  The last     *
'       part of PCRD_MSB allows the user to read the WX values.           *
'                                                                         *
'   Hardware Requirements:                                                *
'       Series 500/505 PLC                                                *
'       386/ATM COPROCESSOR                                               *
'                                                                         *
'   Software Requirements:                                                *
'       1.  Microsoft Quick Basic                                         *
'                                                                         *
'   Warnings:                                                             *
'                                                                         *
'                                                                         *
'*************************************************************************
    CONST FALSE = 0
    CONST TRUE = NOT FALSE
    DEFINT A-Z
    DIM Values(3)
                                    '************************************
                                    ' Clear the screen and display a    *
                                    ' message describing the program.   *
                                    '************************************
    CLS
    PRINT "IOWR_MSB:  Example usage of the PCCOMM command IOWRITE to write";
    PRINT " to the module's"
    PRINT "           WX points."
    PRINT
    PRINT "See the file IOWR_MSB.bas for a more complete description of the"
    PRINT "operation of this routine."
    PRINT
                                    '************************************
                                    ' Open the device driver for reading *
                                    ' and writing.                      *
                                    '************************************
    OPEN "PCCOMM" FOR OUTPUT AS #1
    OPEN "PCCOMM" FOR INPUT AS #2
                                    '************************************
                                    ' Prompt the user and accept entry of *
                                    ' the 4 values that will be written to *
                                    ' the WX points.                    *
                                    '************************************
    FOR LoopCounter = 0 TO 3
        PRINT "Enter the value to write at location ";
        PRINT LoopCounter + 1; ": ";
        INPUT "", Values(LoopCounter)
    NEXT
```

QuickBASIC Program: IOWRITE (continued)

```
                                    '*************************************
                                    ' Write the request to the device     *
                                    ' driver.  Note that leading blanks   *
                                    ' are removed from Values() via       *
                                    ' LTRIM$.                             *
                                    '*************************************
    RequestString$ = ":iw:1:4"
    FOR LoopCounter = 0 TO 3
        RequestString$ = RequestString$ + ":"
        RequestString$ = RequestString$ + LTRIM$(STR$(Values(LoopCounter)))
    NEXT
    RequestString$ = RequestString$ + "::"
    PRINT #1, RequestString$
                                    '*************************************
                                    ' Get a response from the device      *
                                    ' driver.                             *
                                    '*************************************
    LINE INPUT #2, ResponseString$
                                    '*************************************
                                    ' Skip to the 2nd token in the response*
                                    ' string (it contains the number of   *
                                    ' values written).                    *
                                    '*************************************
    Token$ = GetToken$(ResponseString$, TRUE)
    Token$ = GetToken$(ResponseString$, FALSE)
    InputCount = VAL(Token$)
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values written does not equal 4.  *
                                    '*************************************
    IF InputCount <> 4 THEN
        PRINT
        PRINT "The device driver was unable to write the 4 values!";
    END IF
    PRINT
END
'*****************************************************************************
' Function Name: GetToken$                                                    *
' Usage: Token$ = GetToken$(String1$, FirstTime)                              *
' Parameters:                                                                 *
'        Token$: The token parsed from String1$ ("" if the end of the string  *
'                has been reached).                                           *
'        String1$: The string that is being parsed                            *
'        FirstTime: TRUE causes the function to begin parsing at the          *
'                   beginning of the string.                                  *
'                FALSE causes the function to parse the token following       *
'                   the token parsed on the previous call.                    *
'                                                                             *
' Description:  This function extracts a token from String1$.  To parse the   *
'       first token from a string, pass a value of TRUE for the FirstTime     *
'       parameter.  To parse subsequent tokens from the string pass a value of*
'       FALSE for the FirstTime parameter.  For the purposes of this routine  *
'       a token is defined as a sequence of characters that have a preceding  *
'       ':' character and a following ':' character.  The ':' characters are  *
'       NOT returned with the token.                                          *
'                                                                             *
'*****************************************************************************
FUNCTION GetToken$ (String1$, FirstTime) STATIC
```

```
                                    '************************************
                                    ' If this is the first call for this   *
                                    ' particular string then set index to  *
                                    ' point to beginning of string and     *
                                    ' skip over the initial ':' character. *
                                    '************************************
    IF FirstTime = TRUE THEN
        I = 1
        I = INSTR(I, String1$, ":")
        I = I + 1
    END IF
                                    '************************************
                                    ' If I is greater than the length of   *
                                    ' the string then return "" as the     *
                                    ' token.  Otherwise parse the token    *
                                    ' from the string and update I to      *
                                    ' point to the beginning of the next   *
                                    ' token.                               *
                                    '************************************
    IF I > LEN(String1$) THEN
        GetToken$ = ""
    ELSE
        J = INSTR(I, String1$, ":")
        TokenLength = J - I
        GetToken$ = MID$(String1$, I, TokenLength)
        I = J + 1
    END IF
END FUNCTION
```

B.8 QuickBASIC Program: PCREAD

```
DECLARE FUNCTION GetToken$ (String1$, FirstTime%)
'*************************************************************************
'   pcrd_msb: Read from V-mem, X registers and the coprocessor module's       *
'             WX points via PCREAD.                                           *
'                                                                             *
'   Language:   Microsoft Quick Basic                                         *
'   Date:       11/12/90                                                      *
'                                                                             *
'   Description:  This routine demonstrates the usage of the PCCOMM service   *
'       command PCREAD.  V-memory, X registers and the module's WX points     *
'       will be read and displayed to the screen.                             *
'           The first part of the program will let the user read from 8       *
'       consecutive V-memory locations.  The user is prompted to enter an     *
'       integer value which specifies the first V-memory location to read     *
'       from.  Then the 8 values are displayed to the screen.  An error       *
'       message will be displayed if the device driver was unable to read the *
'       8 values from the PLC.                                                *
'           The second part of the program will let the user read 8 discrete  *
'       X register values.  The user is prompted to enter an integer value    *
'       which specifies the first X register location of the 8 to read from.  *
'       Then the 8 values are read and displayed on the screen.               *
'           The final section of the program will allow the user to read from *
'       the module's 4 WX locations.  The user is prompted to enter an        *
'       integer value which specifies the first WX register location of the   *
'       module.  Then the values are displayed to the screen.                 *
'                                                                             *
'   Suggestions:  You may want to run the routines PCWR_MSB and IOWR_MSB      *
'       prior to execution of this routine to verify that real values are     *
'       being read back from the PLC.  PCWR_MSB can be used to write to       *
'       v-memory and discrete locations, and IOWR_MSB can be used to write to *
'       the 4 WX values on the module.                                        *
'                                                                             *
'   Hardware Requirements:                                                    *
'       Series 500/505 PLC                                                    *
'       386/ATM COPROCESSOR                                                   *
'                                                                             *
'   Software Requirements:                                                    *
'       1.  Microsoft Quick Basic                                             *
'                                                                             *
'   Warnings:                                                                 *
'                                                                             *
'                                                                             *
'*************************************************************************
    CONST FALSE = 0
    CONST TRUE = NOT FALSE
    DEFINT A-Z
                                    '************************************
                                    ' Clear the screen and display a    *
                                    ' message describing the program.   *
                                    '************************************
    CLS
    PRINT "PCRD_MSB:   Example usage of the PCCOMM command PCREAD."
    PRINT
    PRINT "See the file PCRD_MSB.bas for a more complete description of the"
    PRINT "operation of this routine."
                                    '************************************
                                    ' Open the device driver for reading *
                                    ' and writing.                       *
                                    '************************************
    OPEN "PCCOMM" FOR OUTPUT AS #1
    OPEN "PCCOMM" FOR INPUT AS #2
                                    '************************************
                                    ' Prompt the user and read the V-mem *
                                    ' start point from the keyboard.    *
                                    '************************************
    PRINT
    PRINT "Enter the address of the first V-memory point to read from: ";
    INPUT "", StartPoint
```

```
                                    '*************************************
                                    ' Write the request to the device      *
                                    ' driver.  Note that leading blanks    *
                                    ' are removed from the StartPoint      *
                                    ' value via LTRIM$.                    *
                                    '*************************************
PRINT #1, ":pr:vmem:"; LTRIM$(STR$(StartPoint)); ":8::"
                                    '*************************************
                                    ' Get a response from the device       *
                                    ' driver.                              *
                                    '*************************************
LINE INPUT #2, ResponseString$
                                    '*************************************
                                    ' Skip to the 2nd token in the         *
                                    ' response string (it contains the     *
                                    ' number of values read).              *
                                    ' See GetToken$() at the bottom of     *
                                    ' this listing for more information.   *
                                    '*************************************
Token$ = GetToken$(ResponseString$, TRUE)
Token$ = GetToken$(ResponseString$, FALSE)
InputCount = VAL(Token$)
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values read does not equal 8.     *
                                    '*************************************
IF InputCount <> 8 THEN
    PRINT
    PRINT "The device driver was unable to read the 8 values!";
ELSE
                                    '*************************************
                                    ' Display the 8 values to the screen.  *
                                    '*************************************
    FOR LoopCounter = 0 TO 7
        Token$ = GetToken$(ResponseString$, FALSE)
        PRINT
        PRINT "V-mem location"; StartPoint + LoopCounter; ":"; VAL(Token$);
    NEXT
END IF
                                    '*************************************
                                    ' Prompt the user for input and read   *
                                    ' from the keyboard the location of    *
                                    ' the first X register to read from.   *
                                    '*************************************
PRINT
PRINT
PRINT "Enter the address of the first X register to read: ";
INPUT "", StartPoint
                                    '*************************************
                                    ' Write the request to the device      *
                                    ' driver.                              *
                                    '*************************************
PRINT #1, ":pr:XREG:"; LTRIM$(STR$(StartPoint)); ":8::"
                                    '*************************************
                                    ' Get the response from the device     *
                                    ' driver and parse the count value     *
                                    ' from the response via GetToken.  See *
                                    ' GetToken$() at the bottom of this    *
                                    ' listing.                             *
                                    '*************************************
LINE INPUT #2, ResponseString$
Token$ = GetToken$(ResponseString$, TRUE)
Token$ = GetToken$(ResponseString$, FALSE)
InputCount = VAL(Token$)
```

QuickBASIC Program: PCREAD (continued)

```
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values read does not equal 8.     *
                                    '*************************************
    IF InputCount <> 8 THEN
        PRINT
        PRINT "The device driver was unable to read the 8 values!";
    ELSE
                                    '*************************************
                                    ' Display the 8 values to the screen.  *
                                    '*************************************
        FOR LoopCounter = 0 TO 7
            Token$ = GetToken$(ResponseString$, FALSE)
            PRINT
            PRINT "X"; StartPoint + LoopCounter; ": "; VAL(Token$);
        NEXT
    END IF
                                    '*************************************
                                    ' Prompt the user for input and read   *
                                    ' from the keyboard the location of    *
                                    ' the first WX to read from.           *
                                    '*************************************
    PRINT
    PRINT
    PRINT "Enter the address of the first WX register on the module: ";
    INPUT "", StartPoint
                                    '*************************************
                                    ' Write the request to the device      *
                                    ' driver.                              *
                                    '*************************************
    PRINT #1, ":pr:WX:"; LTRIM$(STR$(StartPoint)); ":4::"
                                    '*************************************
                                    ' Get the response from the device     *
                                    ' driver and parse the count value     *
                                    ' from the response via GetToken.  See *
                                    ' GetToken$() at the bottom of this    *
                                    ' listing.                             *
                                    '*************************************
    LINE INPUT #2, ResponseString$
    Token$ = GetToken$(ResponseString$, TRUE)
    Token$ = GetToken$(ResponseString$, FALSE)
    InputCount = VAL(Token$)
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values read does not equal 4.     *
                                    '*************************************
    IF InputCount <> 4 THEN
        PRINT
        PRINT "The device driver was unable to read the 4 values!";
    ELSE
                                    '*************************************
                                    ' Display the 4 values to the screen.  *
                                    '*************************************
        FOR LoopCounter = 0 TO 3
            Token$ = GetToken$(ResponseString$, FALSE)
            PRINT
            PRINT "WX"; StartPoint + LoopCounter; ": "; VAL(Token$);
        NEXT
    END IF
    PRINT
END
```

```
'************************************************************************
' Function Name: GetToken$                                              *
' Usage: Token$ = GetToken$(String1$, FirstTime)                        *
' Parameters:                                                           *
'        Token$: The token parsed from String1$ ("" if the end of the string  *
'                has been reached).                                     *
'        String1$: The string that is being parsed                      *
'        FirstTime: TRUE causes the function to begin parsing at the    *
'                   beginning of the string.                            *
'                FALSE causes the function to parse the token following *
'                   the token parsed on the previous call.              *
'                                                                       *
' Description:  This function extracts a token from String1$.  To parse the   *
'       first token from a string, pass a value of TRUE for the FirstTime     *
'       parameter.  To parse subsequent tokens from the string pass a value of*
'       FALSE for the FirstTime parameter.  For the purposes of this routine  *
'       a token is defined as a sequence of characters that have a preceding  *
'       ':' character and a following ':' character.  The ':' characters are  *
'       NOT returned with the token.                                          *
'                                                                       *
'************************************************************************
FUNCTION GetToken$(String1$, FirstTime) STATIC
                                    '************************************
                                    ' If this is the first call for this   *
                                    ' particular string then set index to  *
                                    ' point to beginning of string and     *
                                    ' skip over the initial ':' character. *
                                    '************************************
    IF FirstTime = TRUE THEN
        I = 1
        I = INSTR(I, String1$, ":")
        I = I + 1
    END IF
                                    '************************************
                                    ' If I is greater than the length of   *
                                    ' the string then return "" as the     *
                                    ' token.  Otherwise parse the token    *
                                    ' from the string and update I to      *
                                    ' point to the beginning of the next   *
                                    ' token.                               *
                                    '************************************
    IF I > LEN(String1$) THEN
        GetToken$ = ""
    ELSE
        J = INSTR(I, String1$, ":")
        TokenLength = J - I
        GetToken$ = MID$(String1$, I, TokenLength)
        I = J + 1
    END IF
END FUNCTION
```

B.9 QuickBASIC Program: PCWRITE

```
DECLARE FUNCTION GetToken$ (String1$, FirstTime%)
'*************************************************************************
'   pcwr_msb: Write to V-mem, Y registers and the coprocessor module's      *
'             WY points via PCWRITE.                                        *
'                                                                           *
'   Language:   Microsoft Quick Basic                                       *
'   Date:       11/12/90                                                    *
'                                                                           *
'   Description:  This routine demonstrates the usage of the PCCOMM service *
'       command PCWRITE.  V-memory, Y registers and the module's WY points  *
'       will be written as specified by the user.                           *
'           The first part of the program will let the user write to 8      *
'       consecutive V-memory locations.  The user is prompted to enter      *
'       an integer value which specifies the first V-memory location to write *
'       to.  Then the user is prompted to enter 8 values which will be      *
'       written to consecutive V-memory locations starting with the location *
'       previously specified.  An error message will be displayed if the    *
'       device driver was unable to write the 8 values to the PLC.          *
'           The second part of the program will let the user write 8 discrete *
'       Y register values.  The user is prompted to enter an integer value  *
'       which specifies the first Y register location of the 8 to write to. *
'       Then the user is prompted to enter the 8 values which will be written *
'       to 8 consecutive Y registers starting with the location specified.  *
'       Any non-zero value will be written as a 1.                          *
'           The final section of the program will allow the user to write to *
'       the module's 4 WY locations.  The user is prompted to enter an      *
'       integer value which specifies the first WY register location of the *
'       module.  Remember that the four WYs are located AFTER the 4 WXs.    *
'       Then the user is prompted to enter the 4 values which will be written *
'       to the 4 consecutive WY registers on the module.                    *
'                                                                           *
'   Suggestions:    Since this routine writes to various PLC memory locations *
'       you may want a means of reading back the locations to verify that the *
'       values were in fact written.  One means of doing this would be to run *
'       the example programs PCRD_MSB and IORD_MSB.  PCRD_MSB can be used to *
'       read the 8 v-memory and discrete locations, and IORD_MSB can be used *
'       to read the 4 WY values (assuming that the module is installed in the *
'       slot that you wrote the 4 WY values to).                            *
'                                                                           *
'   Hardware Requirements:                                                  *
'       Series 500/505 PLC                                                  *
'       386/ATM COPROCESSOR                                                 *
'                                                                           *
'   Software Requirements:                                                  *
'       1.  Microsoft Quick Basic                                           *
'                                                                           *
'   Warnings:                                                               *
'       1.  THIS ROUTINE WRITES TO V-MEMORY AND I/O POINTS.                 *
'                                                                           *
'                                                                           *
'*************************************************************************
    CONST FALSE = 0
    CONST TRUE = NOT FALSE
    DEFINT A-Z
    DIM Values(7)
                                    '************************************
                                    ' Clear the screen and display a    *
                                    ' message describing the program.   *
                                    '************************************
    CLS
    PRINT "PCWR_MSB:   Example usage of the PCCOMM command PCWRITE."
    PRINT
    PRINT "See the file PCWR_MSB.bas for a more complete description of the"
    PRINT "operation of this routine."
```

```
                                    '*************************************
                                    ' Print a warning message.           *
                                    '*************************************
PRINT
PRINT "WARNING: This program writes to V-memory and Y-registers!"
PRINT "Hit <space> to continue and any other key to exit."
PRINT
KeyHit$ = INKEY$
WHILE KeyHit$ = ""
    KeyHit$ = INKEY$
WEND
IF KeyHit$ <> " " THEN
    END
END IF
                                    '*************************************
                                    ' Open the device driver for reading  *
                                    ' and writing.                       *
                                    '*************************************
OPEN "PCCOMM" FOR OUTPUT AS #1
OPEN "PCCOMM" FOR INPUT AS #2
                                    '*************************************
                                    ' Prompt the user and read the V-mem  *
                                    ' start point from the keyboard.     *
                                    '*************************************
PRINT
PRINT "Enter the address of the first V-memory point to write to: ";
INPUT "", StartPoint
                                    '*************************************
                                    ' Allow the user to enter the 8 values *
                                    ' at the keyboard.                   *
                                    '*************************************
FOR LoopCounter = 0 TO 7
    PRINT "Enter the value to write at location ";
    PRINT LoopCounter + StartPoint; ": ";
    INPUT "", Values(LoopCounter)
NEXT
                                    '*************************************
                                    ' Write the request to the device    *
                                    ' driver.  Note that leading blanks  *
                                    ' are removed from the StartPoint    *
                                    ' and Values() via LTRIM$.           *
                                    '*************************************
RequestString$ = ":pw:vmem:" + LTRIM$(STR$(StartPoint)) + ":8"
FOR LoopCounter = 0 TO 7
    RequestString$ = RequestString$ + ":"
    RequestString$ = RequestString$ + LTRIM$(STR$(Values(LoopCounter)))
NEXT
RequestString$ = RequestString$ + "::"
PRINT #1, RequestString$
                                    '*************************************
                                    ' Get a response from the device     *
                                    ' driver.                            *
                                    '*************************************
LINE INPUT #2, ResponseString$
                                    '*************************************
                                    ' Skip to the 2nd token in the       *
                                    ' response string (it contains the   *
                                    ' number of values written).         *
                                    ' See GetToken$() at the bottom of   *
                                    ' this listing for more information. *
                                    '*************************************
Token$ = GetToken$(ResponseString$, TRUE)
Token$ = GetToken$(ResponseString$, FALSE)
InputCount = VAL(Token$)
```

QuickBASIC Program: PCWRITE (continued)

```
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values written does not equal 8.  *
                                    '*************************************
IF InputCount <> 8 THEN
    PRINT
    PRINT "The device driver was unable to write the 8 values!";
    PRINT
END IF
                                    '*************************************
                                    ' Prompt the user for input and read   *
                                    ' from the keyboard the location of    *
                                    ' the first Y register to write to.    *
                                    '*************************************
PRINT
PRINT "Enter the address of the first Y register to write to: ";
INPUT "", StartPoint
                                    '*************************************
                                    ' Allow the user to enter the 8 values *
                                    ' at the keyboard.  Any non-zero value *
                                    ' is written as a 1.                   *
                                    '*************************************
FOR LoopCounter = 0 TO 7
    PRINT "Enter the value to write at Y";
    PRINT LoopCounter + StartPoint; ": ";
    INPUT "", Values(LoopCounter)
NEXT
                                    '*************************************
                                    ' Write the request to the device      *
                                    ' driver.  Note that leading blanks    *
                                    ' are removed from the StartPoint      *
                                    ' and Values() via LTRIM$.             *
                                    '*************************************
RequestString$ = ":pw:YREG:" + LTRIM$(STR$(StartPoint)) + ":8"
FOR LoopCounter = 0 TO 7
    RequestString$ = RequestString$ + ":"
    RequestString$ = RequestString$ + LTRIM$(STR$(Values(LoopCounter)))
NEXT
RequestString$ = RequestString$ + "::"
PRINT #1, RequestString$
                                    '*************************************
                                    ' Get the response from the device     *
                                    ' driver and parse the count value     *
                                    ' from the response via GetToken.  See *
                                    ' GetToken$() at the bottom of this    *
                                    ' listing.                             *
                                    '*************************************
LINE INPUT #2, ResponseString$
Token$ = GetToken$(ResponseString$, TRUE)
Token$ = GetToken$(ResponseString$, FALSE)
InputCount = VAL(Token$)
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values written does not equal 8.  *
                                    '*************************************
IF InputCount <> 8 THEN
    PRINT
    PRINT "The device driver was unable to write the 8 values!";
    PRINT
END IF
                                    '*************************************
                                    ' Prompt the user for input and read   *
                                    ' from the keyboard the location of    *
                                    ' the first WY to write to.            *
                                    '*************************************
PRINT
PRINT "Enter the address of the first WY register on the module: ";
INPUT "", StartPoint
```

```
                                    '*************************************
                                    ' Allow the user to enter the 4 values *
                                    ' at the keyboard.                     *
                                    '*************************************
    FOR LoopCounter = 0 TO 3
        PRINT "Enter the value to write at WY";
        PRINT LoopCounter + StartPoint; ": ";
        INPUT "", Values(LoopCounter)
    NEXT
                                    '*************************************
                                    ' Write the request to the device      *
                                    ' driver.  Note that leading blanks    *
                                    ' are removed from the StartPoint      *
                                    ' and Values() via LTRIM$.             *
                                    '*************************************
    RequestString$ = ":pw:WY:" + LTRIM$(STR$(StartPoint)) + ":4"
    FOR LoopCounter = 0 TO 3
        RequestString$ = RequestString$ + ":"
        RequestString$ = RequestString$ + LTRIM$(STR$(Values(LoopCounter)))
    NEXT
    RequestString$ = RequestString$ + "::"
    PRINT #1, RequestString$
                                    '*************************************
                                    ' Get the response from the device     *
                                    ' driver and parse the count value     *
                                    ' from the response via GetToken.  See *
                                    ' GetToken$() at the bottom of this    *
                                    ' listing.                             *
                                    '*************************************
    LINE INPUT #2, ResponseString$
    Token$ = GetToken$(ResponseString$, TRUE)
    Token$ = GetToken$(ResponseString$, FALSE)
    InputCount = VAL(Token$)
                                    '*************************************
                                    ' Print an error message if the number *
                                    ' of values written does not equal 4.  *
                                    '*************************************
    IF InputCount <> 4 THEN
        PRINT
        PRINT "The device driver was unable to write the 4 values!";
        PRINT
    END IF
    PRINT
END
```

QuickBASIC Program: PCWRITE (continued)

```
'*************************************************************************
' Function Name: GetToken$                                                *
' Usage: Token$ = GetToken$(String1$, FirstTime)                          *
' Parameters:                                                             *
'        Token$: The token parsed from String1$ ("" if the end of the string  *
'                has been reached).                                       *
'        String1$: The string that is being parsed                        *
'        FirstTime: TRUE causes the function to begin parsing at the      *
'                   beginning of the string.                              *
'                FALSE causes the function to parse the token following    *
'                   the token parsed on the previous call.                *
'                                                                         *
' Description:  This function extracts a token from String1$.  To parse the   *
'       first token from a string, pass a value of TRUE for the FirstTime     *
'       parameter.  To parse subsequent tokens from the string pass a value of*
'       FALSE for the FirstTime parameter.  For the purposes of this routine  *
'       a token is defined as a sequence of characters that have a preceding  *
'       ':' character and a following ':' character.  The ':' characters are  *
'       NOT returned with the token.                                          *
'                                                                         *
'*************************************************************************
FUNCTION GetToken$ (String1$, FirstTime) STATIC
                                    '************************************
                                    ' If this is the first call for this   *
                                    ' particular string then set index to  *
                                    ' point to beginning of string and     *
                                    ' skip over the initial ':' character. *
                                    '************************************
    IF FirstTime = TRUE THEN
        I = 1
        I = INSTR(I, String1$, ":")
        I = I + 1
    END IF
                                    '************************************
                                    ' If I is greater than the length of   *
                                    ' the string then return "" as the     *
                                    ' token.  Otherwise parse the token    *
                                    ' from the string and update I to      *
                                    ' point to the beginning of the next   *
                                    ' token.                               *
                                    '************************************
    IF I > LEN(String1$) THEN
        GetToken$ = ""
    ELSE
        J = INSTR(I, String1$, ":")
        TokenLength = J - I
        GetToken$ = MID$(String1$, I, TokenLength)
        I = J + 1
    END IF
END FUNCTION
```

B.10 GW-BASIC Program: IOREAD

```
1  '*************************************************************************
2  ' iord_gw: Read the coprocessor module's WY values.                      *
3  '                                                                        *
5  ' Language:   Microsoft GW-Basic                                         *
6  ' Date:       11/13/90                                                   *
7  '                                                                        *
8  ' Description:  This routine demonstrates the usage of the PCCOMM service  *
9  '     command IOREAD.  The 4 local WY points will be read and displayed  *
10 '     to the screen.                                                     *
11 '                                                                        *
12 ' Suggestions:  You may want to run PCWR_GW prior to execution of this   *
13 '     program to verify that real values are being read by this routine. *
14 '     The last part of PCWR_GW allows the user to write to the WY values. *
15 '                                                                        *
16 ' Hardware Requirements:                                                *
17 '     Series 500/505 PLC                                                 *
18 '     386/ATM COPROCESSOR                                                *
19 '                                                                        *
20 ' Software Requirements:                                                *
21 '     1.  Microsoft GW-BASIC                                             *
22 '                                                                        *
23 ' Warnings:                                                             *
24 '                                                                        *
25 '                                                                        *
26 '*************************************************************************
40  DEFINT A-Z
50  FALSE = 0
60  TRUE = NOT FALSE
70  DIM VALUES(3)
90                                    '***************************************
110                                   ' Clear the screen and display a       *
130                                   ' message describing the program.      *
140                                   '***************************************
150 CLS
160 PRINT "IORD_GW:  Example usage of the PCCOMM command IOREAD to read";
170 PRINT " from the module's"
180 PRINT "           WY points."
190 PRINT
200 PRINT "See the file IORD_GW.bas for a more complete description of the"
210 PRINT "operation of this routine."
220 PRINT
230                                   '***************************************
240                                   ' Open the device driver for reading   *
250                                   ' and writing.                         *
260                                   '***************************************
270 OPEN "PCCOMM" FOR OUTPUT AS #1
280 OPEN "PCCOMM" FOR INPUT AS #2
290                                   '***************************************
300                                   ' Write the request to the device      *
310                                   ' driver.                              *
320                                   '***************************************
330 PRINT #1, ":IR:5:4::"
340                                   '***************************************
350                                   ' Get the response from the device     *
360                                   ' driver.                              *
370                                   '***************************************
380 LINE INPUT #2, RESPONSESTRING$
390                                   '***************************************
400                                   ' Skip to the 2nd token in the response*
410                                   ' string (it contains the number of    *
420                                   ' values read).  See GetToken          *
425                                   ' subroutine (line 700).               *
430                                   '***************************************
440 STRING1$ = RESPONSESTRING$
450 FIRSTTIME = TRUE
460 GOSUB 700
470 FIRSTTIME = FALSE
480 GOSUB 700
```

GW-BASIC Program: IOREAD (continued)

```
490  INPUTCOUNT = VAL(TOKEN$)
500                                   '*************************************
510                                   ' Print an error message if the number *
520                                   ' of values read does not equal 4.     *
530                                   '*************************************
540  IF INPUTCOUNT = 4 THEN GOTO 610
550  PRINT
560  PRINT "The device driver was unable to read the 4 values!";
570  GOTO 690
580                                   '*************************************
590                                   ' Display the 4 values to the screen.  *
600                                   '*************************************
610     FOR LOOPCOUNTER = 0 TO 3
620         STRING1$ = RESPONSESTRING$
630         FIRSTTIME = FALSE
640         GOSUB 700
650         PRINT
660         PRINT "Location "; LOOPCOUNTER + 5; ":"; VAL(TOKEN$);
670     NEXT
680  PRINT
690  END
700  '************************************************************************
701  ' Subroutine Name: GetToken
702  ' Global Parameters:
703  '      String1$: The string that is being parsed
704  '      FirstTime: TRUE causes the subroutine to begin parsing at the
705  '                  beginning of the string.
706  '                 FALSE causes the subroutine to parse the token
707  '                  following the token parsed on the previous call.
708  '      Token$: The token parsed from String1$ ("" if the end of the string
709  '              has been reached).
710  ' Description:  This routine extracts a token from String1$ and places
711  '      it in Token$.  To parse the first token from a string, pass a
712  '      value of TRUE for the FirstTime parameter.  To parse subsequent
713  '      tokens from the string pass a value of FALSE.  For the purposes
714  '      of this routine a token is defined as a sequence of characters
715  '      that have a preceding ':' character and a following ':' character.
716  '      The ':' characters are NOT returned with the token.
717  '
718  '  Assumptions:
719  '      1. No program lines use the variable 'I' except this routine.
720  '
721  '************************************************************************
730                                   '*************************************
731                                   ' If this is the first call for this   *
732                                   ' particular string then set index to  *
733                                   ' point to beginning of string and     *
734                                   ' skip over the initial ':' character. *
735                                   '*************************************
760  IF FIRSTTIME = TRUE THEN GOTO 770 ELSE GOTO 800
770  I = 1
780  I = INSTR(I, STRING1$, ":")
790  I = I + 1
800                                   '*************************************
810                                   ' If I is greater than the length of   *
820                                   ' the string then return "" as the     *
830                                   ' token.  Otherwise parse the token    *
840                                   ' from the string and update I to      *
850                                   ' point to the beginning of the next   *
860                                   ' token.                               *
870                                   '*************************************
880  IF I > LEN(STRING1$) THEN TOKEN$ = "":GOTO 930
890  J = INSTR(I, STRING1$, ":")
900  TOKENLENGTH = J - I
910  TOKEN$ = MID$(STRING1$, I, TOKENLENGTH)
920  I = J + 1
930  RETURN
```

B.11 GW-BASIC Program: IOWRITE

```
1  '************************************************************************
2  ' iowr_gw:  Write to the coprocessor module's WX values.                 *
3  '                                                                        *
5  ' Language:   Microsoft GW-Basic                                        *
6  ' Date:       11/13/90                                                  *
7  '                                                                        *
8  ' Description:  This routine demonstrates the usage of the PCCOMM service  *
9  '     command IOWRITE.  The 4 local WX points will be written as specified *
10 '     by the user.                                                       *
11 '                                                                        *
12 ' Suggestions:  You may want to run PCRD_GW after this program to verify   *
13 '     that the values were written correctly by this routine.  The last    *
14 '     part of PCRD_GW allows the user to read the WX values.             *
15 '                                                                        *
16 ' Hardware Requirements:                                                 *
17 '     Series 500/505 PLC                                                 *
18 '     386/ATM COPROCESSOR                                                *
19 '                                                                        *
20 ' Software Requirements:                                                 *
21 '     1.  Microsoft GW-BASIC                                             *
22 '                                                                        *
23 ' Warnings:                                                              *
24 '                                                                        *
25 '                                                                        *
26 '************************************************************************
100 DEFINT A-Z
110 FALSE = 0
120 TRUE = NOT FALSE
130 DIM Values(3)
140                                     '***************************************
150                                     ' Clear the screen and display a       *
160                                     ' message describing the program.      *
170                                     '***************************************
180 CLS
190 PRINT "IOWR_GW:  Example usage of the PCCOMM command IOWRITE to write";
200 PRINT " to the module's"
210 PRINT "           WX points."
220 PRINT
230 PRINT "See the file IOWR_GW.bas for a more complete description of the"
240 PRINT "operation of this routine."
250 PRINT
260                                     '***************************************
270                                     ' Open the device driver for reading   *
280                                     ' and writing.                         *
290                                     '***************************************
300 OPEN "PCCOMM" FOR OUTPUT AS #1
310 OPEN "PCCOMM" FOR INPUT AS #2
320                                     '***************************************
330                                     ' Prompt the user and accept entry of  *
340                                     ' the 4 values that will be written to *
350                                     ' the WX points.                       *
380                                     '***************************************
390 FOR LoopCounter = 0 TO 3
400     PRINT "Enter the value to write at location ";
410     PRINT LoopCounter + 1; ": ";
420     INPUT "", Values(LoopCounter)
430 NEXT
440                                     '***************************************
450                                     ' Write the request to the device      *
460                                     ' driver.  Note that leading blanks    *
470                                     ' are removed from Values() via        *
480                                     ' RemoveBlanks subroutine (line 2000). *
490                                     '***************************************
500 RequestString$ = ":iw:1:4"
510 FOR LoopCounter = 0 TO 3
520     RequestString$ = RequestString$ + ":"
525     String2$ = STR$(Values(LoopCounter))
527     GOSUB 2000
```

```
530     RequestString$ = RequestString$ + String2$
540 NEXT
550 RequestString$ = RequestString$ + "::"
560 PRINT #1, RequestString$
570                                     '**************************************
580                                     ' Get a response from the device       *
590                                     ' driver.                              *
600                                     '**************************************
610 LINE INPUT #2, ResponseString$
620                                     '**************************************
630                                     ' Skip to the 2nd token in the response*
640                                     ' string (it contains the number of    *
650                                     ' values written).  See GetToken       *
655                                     ' subroutine (line 800).               *
660                                     '**************************************
670 String1$ = ResponseString$: FirstTime = TRUE: GOSUB 800
680 FirstTime = FALSE: GOSUB 800
690 InputCount = VAL(Token$)
700                                     '**************************************
710                                     ' Print an error message if the number *
720                                     ' of values written does not equal 4.  *
730                                     '**************************************
740 IF InputCount = 4 THEN GOTO 770
750 PRINT
760 PRINT "The device driver was unable to write the 4 values!";
770 PRINT
780 END
800  '************************************************************************
801  ' Subroutine Name: GetToken
802  ' Global Parameters:
803  '      String1$: The string that is being parsed
804  '      FirstTime: TRUE causes the subroutine to begin parsing at the
805  '                 beginning of the string.
806  '                FALSE causes the subroutine to parse the token
807  '                 following the token parsed on the previous call.
808  '      Token$: The token parsed from String1$ ("" if the end of the string
809  '              has been reached).
810  ' Description:  This routine extracts a token from String1$ and places
811  '      it in Token$.  To parse the first token from a string, pass a
812  '      value of TRUE for the FirstTime parameter.  To parse subsequent
813  '      tokens from the string pass a value of FALSE.  For the purposes
814  '      of this routine a token is defined as a sequence of characters
815  '      that have a preceding ':' character and a following ':' character.
816  '      The ':' characters are NOT returned with the token.
817  '
818  '  Assumptions:
819  '      1. No program lines use the variable 'I' except this routine.
820  '
821  '************************************************************************
829                                     '**************************************
830                                     ' If this is the first call for this   *
835                                     ' particular string then set index to  *
840                                     ' point to beginning of string and     *
845                                     ' skip over the initial ':' character. *
850                                     '**************************************
860 IF FIRSTTIME = TRUE THEN GOTO 870 ELSE GOTO 900
870     I = 1
880     I = INSTR(I, STRING1$, ":")
890     I = I + 1
900                                     '**************************************
910                                     ' If I is greater than the length of   *
920                                     ' the string then return "" as the     *
930                                     ' token.  Otherwise parse the token    *
940                                     ' from the string and update I to      *
950                                     ' point to the beginning of the next   *
960                                     ' token.                               *
970                                     '**************************************
980 IF I > LEN(STRING1$) THEN TOKEN$ = "":GOTO 1030
```

```
990 J = INSTR(I, STRING1$, ":")
1000 TOKENLENGTH = J - I
1010 TOKEN$ = MID$(STRING1$, I, TOKENLENGTH)
1020 I = J + 1
1030 RETURN
2000 '*************************************************************************
2001 '  Subroutine Name: RemoveBlanks
2002 '  Global Parameters:
2003 '       String2$: The string that leading blanks are removed from
2004 '  Description:  This routine removes leading blanks from String2$.
2005 '
2006 '  Assumptions:
2007 '       1.  No program lines use the variable 'I2' except this routine.
2008 '
2009 '*************************************************************************
2030 I2 = LEN(String2$)
2040 FirstChar$ = MID$(String2$, 1, 1)
2050 WHILE FirstChar$ = " "
2060    I2 = I2 - 1
2070    String2$ = RIGHT$(String2$, I2)
2085    FirstChar$ = MID$(String2$, 1, 1)
2090 WEND
2100 RETURN
```

B.12 GW-BASIC Program: PCREAD

```
1  '*************************************************************************
2  ' pcrd_gw:  Read from V-mem, X registers and the coprocessor module's      *
3  '           WX points via PCREAD.                                          *
4  '                                                                          *
5  ' Language:   Microsoft GW-BASIC                                          *
6  ' Date:       11/12/90                                                     *
7  '                                                                          *
8  ' Description:  This routine demonstrates the usage of the PCCOMM service  *
9  '    command PCREAD.  V-memory, X registers and the module's WX points     *
10 '    will be read and displayed to the screen.                             *
11 '        The first part of the program will let the user read from 8       *
12 '    consecutive V-memory locations.  The user is prompted to enter an     *
13 '    integer value which specifies the first V-memory location to read     *
14 '    from.  Then the 8 values are displayed to the screen.  An error       *
15 '    message will be displayed if the device driver was unable to read the *
16 '    8 values from the PLC.                                                *
17 '        The second part of the program will let the user read 8 discrete  *
18 '    X register values.  The user is prompted to enter an integer value    *
19 '    which specifies the first X register location of the 8 to read from.  *
20 '    Then the 8 values are read and displayed on the screen.               *
21 '        The final section of the program will allow the user to read from *
22 '    the module's 4 WX locations.  The user is prompted to enter an        *
23 '    integer value which specifies the first WX register location of the   *
24 '    module.  Then the values are displayed to the screen.                 *
25 '                                                                          *
26 ' Suggestions:  You may want to run the routines PCWR_GW and IOWR_GW       *
27 '     prior to execution of this routine to verify that real values are    *
28 '     being read back from the PLC.  PCWR_GW can be used to write to       *
29 '     v-memory and discrete locations, and IOWR_GW can be used to write to *
30 '     the 4 WX values on the module.                                       *
31 '                                                                          *
32 ' Hardware Requirements:                                                  *
33 '     Series 500/505 PLC                                                   *
34 '     386/ATM COPROCESSOR                                                  *
35 '                                                                          *
36 ' Software Requirements:                                                  *
37 '     1.  Microsoft GW-BASIC                                               *
38 '                                                                          *
39 ' Warnings:                                                               *
40 '                                                                          *
41 '                                                                          *
42 '*************************************************************************
48  DEFINT A-Z
49  FALSE = 0
50  TRUE = NOT FALSE
55                                    '***************************************
60                                    ' Clear the screen and display a       *
65                                    ' message describing the program.      *
70                                    '***************************************
80  CLS
90  PRINT "PCRD_GW:   Example usage of the PCCOMM command PCREAD."
100 PRINT
110 PRINT "See the file PCRD_GW.bas for a more complete description of the"
120 PRINT "operation of this routine."
130                                   '***************************************
140                                   ' Open the device driver for reading   *
150                                   ' and writing.                         *
160                                   '***************************************
170 OPEN "PCCOMM" FOR OUTPUT AS #1
180 OPEN "PCCOMM" FOR INPUT AS #2
190                                   '***************************************
200                                   ' Prompt the user and read the V-mem   *
210                                   ' start point from the keyboard.       *
220                                   '***************************************
230 PRINT
240 PRINT "Enter the address of the first V-memory point to read from: ";
250 INPUT "", StartPoint
```

```
260                                     '*************************************
270                                     ' Write the request to the device      *
280                                     ' driver.  Note that leading blanks    *
290                                     ' are removed from the StartPoint      *
300                                     ' value via RemoveBlanks subroutine    *
305                                     ' (line number 1950).                  *
310                                     '*************************************
320 String2$ = STR$(StartPoint)
330 GOSUB 1950
340 PRINT #1, ":pr:vmem:"; String2$; ":8::"
350                                     '*************************************
360                                     ' Get a response from the device       *
370                                     ' driver.                              *
380                                     '*************************************
390 LINE INPUT #2, ResponseString$
400                                     '*************************************
410                                     ' Skip to the 2nd token in the         *
420                                     ' response string (it contains the     *
430                                     ' number of values read).              *
440                                     ' See GetToken subroutine (line 1700). *
460                                     '*************************************
470 String1$ = ResponseString$: FirstTime = TRUE
480 GOSUB 1700
490 FirstTime = FALSE
500 GOSUB 1700
510 InputCount = VAL(Token$)
520                                     '*************************************
530                                     ' Print an error message if the number *
540                                     ' of values read does not equal 8.     *
550                                     '*************************************
560 IF InputCount = 8 THEN GOTO 630
570 PRINT
580 PRINT "The device driver was unable to read the 8 values!";
590 GOTO 740
600                                     '*************************************
610                                     ' Display the 8 values to the screen.  *
620                                     '*************************************
630 FOR LoopCounter = 0 TO 7
640     String1$ = ResponseString$: FirstTime = FALSE: GOSUB 1700
650     PRINT
660     PRINT "V-mem location"; StartPoint + LoopCounter; ":"; VAL(Token$);
670 NEXT
690                                     '*************************************
700                                     ' Prompt the user for input and read   *
710                                     ' from the keyboard the location of    *
720                                     ' the first X register to read from.   *
730                                     '*************************************
740 PRINT
750 PRINT
760 PRINT "Enter the address of the first X register to read: ";
770 INPUT "", StartPoint
860                                     '*************************************
870                                     ' Write the request to the device      *
880                                     ' driver.  Then get the response and   *
885                                     ' parse the count value from it.       *
890                                     '*************************************
900 String2$ = STR$(StartPoint): GOSUB 1950
910 PRINT #1, ":pr:XREG:"; String2$; ":8::"
930 LINE INPUT #2, ResponseString$
950 String1$ = ResponseString$: FirstTime = TRUE
960 GOSUB 1700
970 FirstTime = FALSE
980 GOSUB 1700
990 InputCount = VAL(Token$)
```

GW-BASIC Program: PCREAD (continued)

```
1000                                    '**************************************
1010                                    ' Print an error message if the number *
1020                                    ' of values read does not equal 8.     *
1030                                    '**************************************
1040 IF InputCount = 8 THEN GOTO 1110
1050 PRINT
1060 PRINT "The device driver was unable to read the 8 values!";
1070 GOTO 1160
1080                                    '**************************************
1090                                    ' Display the 8 values to the screen.  *
1100                                    '**************************************
1110 FOR LoopCounter = 0 TO 7
1120     String1$ = ResponseString$: FirstTime = FALSE: GOSUB 1700
1130     PRINT
1140     PRINT "X"; StartPoint + LoopCounter; ": "; VAL(Token$);
1150 NEXT
1160                                    '**************************************
1170                                    ' Prompt the user for input and read   *
1180                                    ' from the keyboard the location of    *
1190                                    ' the first WX to read from.           *
1200                                    '**************************************
1210 PRINT
1220 PRINT
1230 PRINT "Enter the address of the first WX register on the module: ";
1240 INPUT "", StartPoint
1330                                    '**************************************
1340                                    ' Write the request to the device      *
1350                                    ' driver.  Then get response and parse *
1355                                    ' the count value from it.             *
1360                                    '**************************************
1370 String2$ = STR$(StartPoint)
1380 GOSUB 1950
1390 PRINT #1, ":pr:WX:"; String2$; ":4::"
1410 LINE INPUT #2, ResponseString$
1430 String1$ = ResponseString$: FirstTime = TRUE
1440 GOSUB 1700
1450 FirstTime = FALSE
1460 GOSUB 1700
1470 InputCount = VAL(Token$)
1480                                    '**************************************
1490                                    ' Print an error message if the number *
1500                                    ' of values read does not equal 4.     *
1510                                    '**************************************
1520 IF InputCount = 4 THEN GOTO 1590
1530 PRINT
1540 PRINT "The device driver was unable to read the 4 values!";
1550 GOTO 1650
1560                                    '**************************************
1570                                    ' Display the 4 values to the screen.  *
1580                                    '**************************************
1590 FOR LoopCounter = 0 TO 3
1600     String1$ = ResponseString$: FirstTime = FALSE: GOSUB 1700
1610     PRINT
1620     PRINT "WX"; StartPoint + LoopCounter; ": "; VAL(Token$);
1630 NEXT
1650 PRINT
1670 END
```

```
1700 '************************************************************************
1701 ' Subroutine Name: GetToken
1702 ' Global Parameters:
1703 '      String1$: The string that is being parsed
1704 '      FirstTime: TRUE causes the subroutine to begin parsing at the
1705 '                 beginning of the string.
1706 '                FALSE causes the subroutine to parse the token
1707 '                 following the token parsed on the previous call.
1708 '      Token$: The token parsed from String1$ ("" if the end of the string
1709 '              has been reached).
1710 ' Description:  This routine extracts a token from String1$ and places
1711 '      it in Token$.  To parse the first token from a string, pass a
1712 '      value of TRUE for the FirstTime parameter.  To parse subsequent
1713 '      tokens from the string pass a value of FALSE.  For the purposes
1714 '      of this routine a token is defined as a sequence of characters
1715 '      that have a preceding ':' character and a following ':' character.
1716 '      The ':' characters are NOT returned with the token.
1717 '
1718 '  Assumptions:
1719 '      1. No program lines use the variable 'I' except this routine.
1720 '
1721 '************************************************************************
1730                                  '*************************************
1731                                  ' If this is the first call for this   *
1732                                  ' particular string then set index to  *
1740                                  ' point to beginning of string and     *
1750                                  ' skip over the initial ':' character. *
1760                                  '*************************************
1770 IF FIRSTTIME = TRUE THEN GOTO 1780 ELSE GOTO 1890
1780     I = 1
1790     I = INSTR(I, STRING1$, ":")
1800     I = I + 1
1810                                  '*************************************
1820                                  ' If I is greater than the length of   *
1830                                  ' the string then return "" as the     *
1840                                  ' token.  Otherwise parse the token    *
1850                                  ' from the string and update I to      *
1860                                  ' point to the beginning of the next   *
1870                                  ' token.                               *
1880                                  '*************************************
1890 IF I > LEN(STRING1$) THEN TOKEN$ = "":GOTO 1940
1900 J = INSTR(I, STRING1$, ":")
1910 TOKENLENGTH = J - I
1920 TOKEN$ = MID$(STRING1$, I, TOKENLENGTH)
1930 I = J + 1
1940 RETURN
1950 '************************************************************************
1951 '  Subroutine Name: RemoveBlanks
1952 '  Global Parameters:
1953 '      String2$: The string that leading blanks are removed from
1954 '  Description:  This routine removes leading blanks from String2$.
1955 '
1956 '  Assumptions:
1957 '      1.  No program lines use the variable 'I2' except this routine.
1958 '
1959 '************************************************************************
1970 I2 = LEN(String2$)
1980 FirstChar$ = MID$(String2$, 1, 1)
1990 WHILE FirstChar$ = " "
2000    I2 = I2 - 1
2010    String2$ = RIGHT$(String2$, I2)
2020    FirstChar$ = MID$(String2$, 1, 1)
2030 WEND
2040 RETURN
```

B.13 GW-BASIC Program: PCWRITE

```
1  '************************************************************************
2  ' pcwr_gw: Write to V-mem, Y registers and the coprocessor module's        *
3  '          WY points via PCWRITE.                                         *
4  '                                                                         *
5  ' Language:   Microsoft GW-BASIC                                          *
6  ' Date:       11/12/90                                                    *
7  '                                                                         *
8  ' Description:  This routine demonstrates the usage of the PCCOMM service  *
9  '    command PCWRITE.  V-memory, Y registers and the module's WY points    *
10 '    will be written as specified by the user.                            *
11 '        The first part of the program will let the user write to 8       *
12 '    consecutive V-memory locations.  The user is prompted to enter       *
13 '    an integer value which specifies the first V-memory location to write *
14 '    to.  Then the user is prompted to enter 8 values which will be       *
15 '    written to consecutive V-memory locations starting with the location  *
16 '    previously specified.  An error message will be displayed if the     *
17 '    device driver was unable to write the 8 values to the PLC.           *
18 '        The second part of the program will let the user write 8 discrete *
19 '    Y register values.  The user is prompted to enter an integer value   *
20 '    which specifies the first Y register location of the 8 to write to.  *
21 '    Then the user is prompted to enter the 8 values which will be written *
22 '    to 8 consecutive Y registers starting with the location specified.   *
23 '    Any non-zero value will be written as a 1.                           *
24 '        The final section of the program will allow the user to write to  *
25 '    the module's 4 WY locations.  The user is prompted to enter an       *
26 '    integer value which specifies the first WY register location of the  *
27 '    module.  Remember that the four WYs are located AFTER the 4 WXs.     *
28 '    Then the user is prompted to enter the 4 values which will be written *
29 '    to the 4 consecutive WY registers on the module.                     *
30 '                                                                         *
31 ' Suggestions:    Since this routine writes to various PLC memory locations*
32 '     you may want a means of reading back the locations to verify that the*
33 '     values were in fact written.  One means of doing this would be to run*
34 '     the example programs PCRD_GW and IORD_GW.  PCRD_GW can be used to    *
35 '     read the 8 v-memory and discrete locations, and IORD_GW can be used  *
36 '     to read the 4 WY values (assuming that the module is installed in the*
37 '     slot that you wrote the 4 WY values to).                            *
38 '                                                                         *
39 ' Hardware Requirements:                                                  *
40 '     Series 500/505 PLC                                                  *
41 '     386/ATM COPROCESSOR                                                 *
42 '                                                                         *
43 ' Software Requirements:                                                  *
44 '     1.  Microsoft GW-BASIC                                              *
45 '                                                                         *
46 ' Warnings:                                                               *
47 '     1.  THIS ROUTINE WRITES TO V-MEMORY AND I/O POINTS.                 *
48 '                                                                         *
49 '                                                                         *
50 '************************************************************************
54  DEFINT A-Z
55  FALSE = 0
60  TRUE = NOT FALSE
65  DIM Values(7)
70                                    '***************************************
75                                    ' Clear the screen and display a       *
80                                    ' message describing the program.      *
85                                    '***************************************
90  CLS
100 PRINT "PCWR_GW:   Example usage of the PCCOMM command PCWRITE."
110 PRINT
120 PRINT "See the file PCWR_GW.bas for a more complete description of the"
130 PRINT "operation of this routine."
131                                   '***************************************
132                                   ' Print a warning message.             *
133                                   '***************************************
134 PRINT
135 PRINT "WARNING: This program writes to V-memory and Y-registers!"
```

```
136 PRINT ”Hit <space> to continue and any other key to exit.”
137 PRINT
138 KeyHit$ = INKEY$
139 WHILE KeyHit$ = ””
140     KeyHit$ = INKEY$
141 WEND
142 IF KeyHit$ <> ” ” THEN END
177                                 ’**************************************
178                                 ’ Open the device driver for reading   *
179                                 ’ and writing.                         *
180                                 ’**************************************
190 OPEN ”PCCOMM” FOR OUTPUT AS #1
200 OPEN ”PCCOMM” FOR INPUT AS #2
220                                 ’**************************************
230                                 ’ Prompt the user and read the V–mem   *
240                                 ’ start point from the keyboard.       *
250                                 ’**************************************
260 PRINT
270 PRINT ”Enter the address of the first V–memory point to write to: ”;
280 INPUT ””, StartPoint
300                                 ’**************************************
310                                 ’ Allow the user to enter the 8 values *
320                                 ’ at the keyboard.                     *
350                                 ’**************************************
360 FOR LoopCounter = 0 TO 7
370     PRINT ”Enter the value to write at location ”;
380     PRINT LoopCounter + StartPoint; ”: ”;
390     INPUT ””, Values(LoopCounter)
400 NEXT
420                                 ’**************************************
430                                 ’ Write the request to the device      *
440                                 ’ driver.  Note that leading blanks    *
450                                 ’ are removed from the StartPoint      *
460                                 ’ and Values() via RemoveBlanks        *
465                                 ’ subroutine (line number 2950).       *
470                                 ’**************************************
475 String2$ = STR$(StartPoint): GOSUB 2950
480 RequestString$ = ”:pw:vmem:” + String2$ + ”:8”
490 FOR LoopCounter = 0 TO 7
500     RequestString$ = RequestString$ + ”:”
505     String2$ = STR$(Values(LoopCounter)): GOSUB 2950
510     RequestString$ = RequestString$ + String2$
520 NEXT
530 RequestString$ = RequestString$ + ”::”
540 PRINT #1, RequestString$
560                                 ’**************************************
570                                 ’ Get a response from the device       *
580                                 ’ driver.                              *
590                                 ’**************************************
600 LINE INPUT #2, ResponseString$
620                                 ’**************************************
630                                 ’ Skip to the 2nd token in the         *
640                                 ’ response string (it contains the     *
650                                 ’ number of values written).  See      *
660                                 ’ GetToken subroutine (line 2700)      *
680                                 ’**************************************
690 String1$ = ResponseString$: FirstTime = TRUE: GOSUB 2700
700 FirstTime = FALSE: GOSUB 2700
710 InputCount = VAL(Token$)
730                                 ’**************************************
740                                 ’ Print an error message if the number *
750                                 ’ of values written does not equal 8.  *
760                                 ’**************************************
770 IF InputCount = 8 THEN GOTO 880
780 PRINT
790 PRINT ”The device driver was unable to write the 8 values!”;
800 PRINT
```

GW-BASIC Program: PCWRITE (continued)

```
830                                     '**************************************
840                                     ' Prompt the user for input and read   *
850                                     ' from the keyboard the location of    *
860                                     ' the first Y register to write to.    *
870                                     '**************************************
880 PRINT
890 PRINT "Enter the address of the first Y register to write to: ";
900 INPUT "", StartPoint
1010                                    '**************************************
1020                                    ' Allow the user to enter the 8 values *
1030                                    ' at the keyboard.  Any non-zero value *
1040                                    ' is written as a 1.                   *
1070                                    '**************************************
1080 FOR LoopCounter = 0 TO 7
1090     PRINT "Enter the value to write at Y";
1100     PRINT LoopCounter + StartPoint; ": ";
1110     INPUT "", Values(LoopCounter)
1120 NEXT
1140                                    '**************************************
1150                                    ' Write the request to the device      *
1160                                    ' driver.  Note that leading blanks    *
1170                                    ' are removed from the StartPoint      *
1180                                    ' and Values() via RemoveBlanks        *
1185                                    ' subroutine (line number 2950).       *
1190                                    '**************************************
1195 String2$ = STR$(StartPoint): GOSUB 2950
1200 RequestString$ = ":pw:YREG:" + String2$ + ":8"
1210 FOR LoopCounter = 0 TO 7
1220     RequestString$ = RequestString$ + ":"
1225     String2$ = STR$(Values(LoopCounter)): GOSUB 2950
1230     RequestString$ = RequestString$ + String2$
1240 NEXT
1250 RequestString$ = RequestString$ + "::"
1260 PRINT #1, RequestString$
1262                                    '**************************************
1265                                    ' Get response from device driver and  *
1267                                    ' parse the count value from reponse   *
1270                                    ' via GetToken subroutine (line 2700). *
1275                                    '**************************************
1280 LINE INPUT #2, ResponseString$
1300 String1$ = ResponseString$: FirstTime = TRUE: GOSUB 2700
1310 FirstTime = FALSE: GOSUB 2700
1320 InputCount = VAL(Token$)
1340                                    '**************************************
1350                                    ' Print an error message if the number *
1360                                    ' of values written does not equal 8.  *
1370                                    '**************************************
1380 IF InputCount = 8 THEN GOTO 1490
1390 PRINT
1400 PRINT "The device driver was unable to write the 8 values!";
1410 PRINT
1440                                    '**************************************
1450                                    ' Prompt the user for input and read   *
1460                                    ' from the keyboard the location of    *
1470                                    ' the first WY to write to.            *
1480                                    '**************************************
1490 PRINT
1500 PRINT "Enter the address of the first WY register on the module: ";
1510 INPUT "", StartPoint
1620                                    '**************************************
1630                                    ' Allow the user to enter the 4 values *
1640                                    ' at the keyboard.                     *
1670                                    '**************************************
1680 FOR LoopCounter = 0 TO 3
1690     PRINT "Enter the value to write at WY";
1700     PRINT LoopCounter + StartPoint; ": ";
1710     INPUT "", Values(LoopCounter)
1720 NEXT
```

```
1740                                    '*************************************
1750                                    ' Write the request to the device      *
1760                                    ' driver.  Note that leading blanks    *
1770                                    ' are removed from the StartPoint      *
1780                                    ' and Values() via RemoveBlanks        *
1785                                    ' subroutine (line number 2950).       *
1790                                    '*************************************
1795 String2$ = STR$(StartPoint): GOSUB 2950
1800 RequestString$ = ":pw:WY:" + String2$ + ":4"
1810 FOR LoopCounter = 0 TO 3
1820     RequestString$ = RequestString$ + ":"
1825     String2$ = STR$(Values(LoopCounter)): GOSUB 2950
1830     RequestString$ = RequestString$ + String2$
1840 NEXT
1850 RequestString$ = RequestString$ + "::"
1860 PRINT #1, RequestString$
1862                                    '*************************************
1865                                    ' Get response from device driver and  *
1867                                    ' parse the count value from reponse   *
1870                                    ' via GetToken subroutine (line 2700). *
1875                                    '*************************************
1880 LINE INPUT #2, ResponseString$
1900 String1$ = ResponseString$: FirstTime = TRUE: GOSUB 2700
1910 FirstTime = FALSE: GOSUB 2700
1920 InputCount = VAL(Token$)
1940                                    '*************************************
1950                                    ' Print an error message if the number *
1960                                    ' of values written does not equal 4.  *
1970                                    '*************************************
1980 IF InputCount = 4 THEN GOTO 2040
1990     PRINT
2000     PRINT "The device driver was unable to write the 4 values!";
2010     PRINT
2040 PRINT
2060 END
2699 '****************************************************************************
2700 ' Subroutine Name: GetToken
2701 ' Global Parameters:
2702 '      String1$: The string that is being parsed
2703 '      FirstTime: TRUE causes the subroutine to begin parsing at the
2704 '                  beginning of the string.
2705 '                 FALSE causes the subroutine to parse the token
2706 '                  following the token parsed on the previous call.
2707 '      Token$: The token parsed from String1$ ("" if the end of the string
2708 '              has been reached).
2709 ' Description:  This routine extracts a token from String1$ and places
2710 '      it in Token$.  To parse the first token from a string, pass a
2711 '      value of TRUE for the FirstTime parameter.  To parse subsequent
2712 '      tokens from the string pass a value of FALSE.  For the purposes
2713 '      of this routine a token is defined as a sequence of characters
2714 '      that have a preceding ':' character and a following ':' character.
2715 '      The ':' characters are NOT returned with the token.
2716 '
2717 '  Assumptions:
2718 '      1. No program lines use the variable 'I' except this routine.
2719 '
2720 '****************************************************************************
2725                                    '*************************************
2727                                    ' If this is the first call for this   *
2730                                    ' particular string then set index to  *
2740                                    ' point to beginning of string and     *
2750                                    ' skip over the initial ':' character. *
2760                                    '*************************************
2770 IF FIRSTTIME = TRUE THEN GOTO 2780 ELSE GOTO 2890
2780     I = 1
2790     I = INSTR(I, STRING1$, ":")
2800     I = I + 1
```

```
2810                                    '************************************
2820                                    ' If I is greater than the length of   *
2830                                    ' the string then return "" as the     *
2840                                    ' token.  Otherwise parse the token    *
2850                                    ' from the string and update I to      *
2860                                    ' point to the beginning of the next   *
2870                                    ' token.                               *
2880                                    '************************************
2890 IF I > LEN(STRING1$) THEN TOKEN$ = "":GOTO 2940
2900 J = INSTR(I, STRING1$, ":")
2910 TOKENLENGTH = J - I
2920 TOKEN$ = MID$(STRING1$, I, TOKENLENGTH)
2930 I = J + 1
2940 RETURN
2950 '*****************************************************************************
2951 '  Subroutine Name: RemoveBlanks
2952 '  Global Parameters:
2953 '       String2$: The string that leading blanks are removed from
2954 '  Description:  This routine removes leading blanks from String2$.
2955 '
2956 '  Assumptions:
2957 '       1.  No program lines use the variable 'I2' except this routine.
2958 '
2959 '*****************************************************************************
2975 I2 = LEN(String2$)
2980 FirstChar$ = MID$(String2$, 1, 1)
2990 WHILE FirstChar$ = " "
3000    I2 = I2 - 1
3010    String2$ = RIGHT$(String2$, I2)
3020    FirstChar$ = MID$(String2$, 1, 1)
3030 WEND
3040 RETURN
```

Appendix C
Pinouts

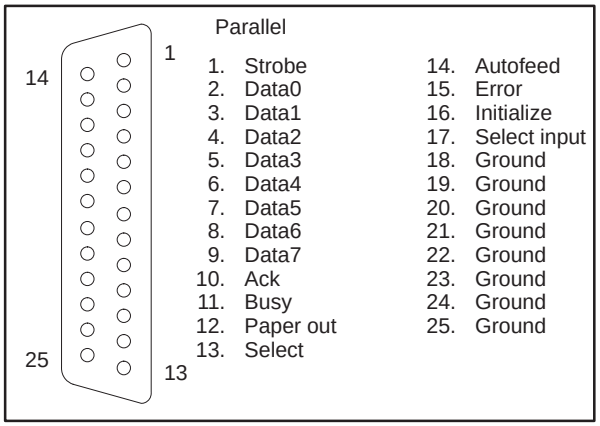

Figure C-1 Parallel Port Pinout

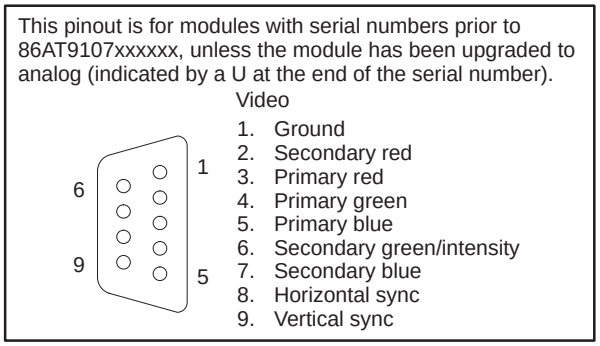

Figure C-2 TTL VGA Port Pinout

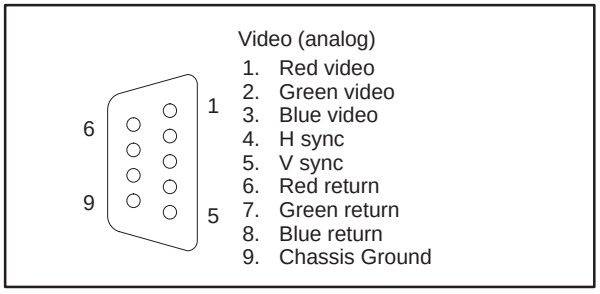

Figure C-3 Analog VGA Port Pinout

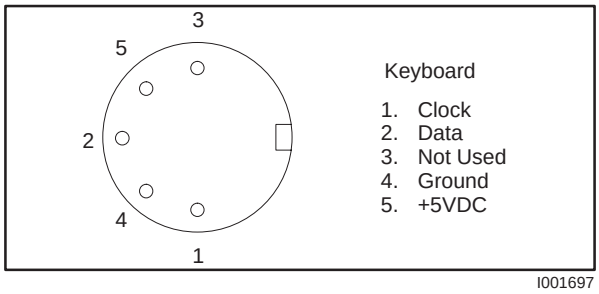

Figure C-4 Keyboard Connector Pinout

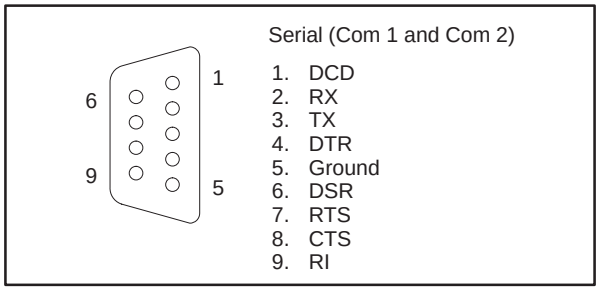

Figure C-5 Serial Port 1 and 2 Pinout

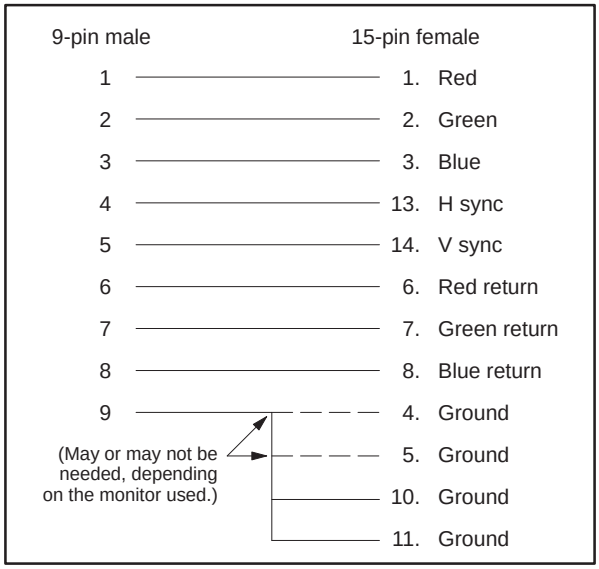

Figure C-6 9-pin Analog VGA to 15-Pin VGA Adapter Cable Pinout

Appendix D
Specifications

CPU	80C386SX (socket for 80C387SX math coprocessor)		
Memory DRAM w/parity Hard Disk	*Model –0220* 2M byte 20M byte type 2	*Model –0440* 4M byte 40M byte type 17	*Model –4120* 4M byte 120M byte type 41
Diskette Drive	3.5″ 720K byte/1.44M byte		
Operating System	Microsoft MS-DOS 5.0		
Communication Ports	2 Serial ports (RS-232/423); rates: 110 to 57600 baud (non-standard 5-volt operation) 1 Parallel printer port		
Other Ports	1 analog VGA port 1 IBM PC/AT-compatible keyboard port		
I/O Bus Communication	Integrated interface to the PLC I/O Bus		
Channels per Module	8 Analog I/O (4 WX, 4 WY)		
Data Communication Rate over PLC I/O Bus (maximum per PLC scan)	2048 bits + 8 analog I/O *or* 480 16-bit words + 8 analog I/O *or* combinations of both		
Power Consumption (Typical)	11 watts @ 5 VDC 0.2 watts @ –5 VDC		
Diagnostic	Internal diagnostic on power-up; Continuous DRAM parity check		
Operating Temperature	5° to 45°C (41° to 113°F)		
Storage Temperature	–40° to 60°C (–10° to 140°F)		
Relative Humidity	20% to 80%, non-condensing		
EMI	Meets MIL STD 461b RS01 and RS02–2		
Size	Triple-wide Series 505 I/O module		
Weight	1.6 Kg (3.3 lb.)		
Agency Certification Approvals	UL; CSA; FM Class I, Div. 2		

NOTE: During periods of high conducted or radiated electrical noise conditions, diskette access may cause seek and/or read/write errors. These errors do not affect the operation of other parts of either the 386/ATM or the programmable controller system. It is recommended that you start up with the diskette and then switch to the hard drive for operation. If you experience a seek or read/write error during a diskette access, please try the operation a second time. If the problem continues, wait for quiescent periods before performing diskette operations.

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