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PCIP-DMM/A

User's Manual

KEITHLEY

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by

Keithley MetraByte Corporation
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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

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When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL INTRODUCTION

Keithley MetraByte's PCIP-DMM/A is a 4 1/2 digit multimeter that plugs directly into any I/O slot of an IBM ® PC/XT/AT or IBM PS/2 model 25/30 or compatible. The board provides all the features and accuracy you would expect from a standard bench-top multimeter. However, instead of LED's or LCD's, the PCIP-DMM/A uses the computer screen as its display which is programmed by using the computer keyboard or a "mouse". The display operates in a "pop-up" mode. When activated, the DMM display takes up approximately one-third of the screen. When the DMM display is deactivated, the screen returns to its original display.

The PCIP-DMM/A also features automatic or manual data-logging. This records PCIP-DMM/A readings to a user-specified ASCII file. This file may be used as input to popular spread-sheet programs for plotting. When automatic logging is selected, the PCIP-DMM/A can be programmed to record up to 999999 readings at a rate of 1/2 seconds to 99.9 minutes between readings. Automatic logging may be setup to run in the background while the PC is used for other tasks.

The PCIP-DMM/A is fully isolated from the computer and line power. The voltage and current input protection assures that board will not be damaged by intentional or inadvertent connections to 120 Vac power. All connections are made through three IEC approved recessed safety jacks. The terminals are spaced at the standard 3/4 inches, and compatible with a wide variety of interconnecting and cabling schemes.

For users who have sophisticated applications, MetraByte provides a library of Language Independent Interface commands. These ASCII commands are incorporated into a user-designed application program. For example, to set the board to the 20 Vdc range, you would use the command `SET 20 Volt DC` . Application programs can be programmed in several languages including: BASIC ®, PASCAL, C, and FORTRAN.

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1.2 FUNCTIONAL DESCRIPTION

This section provides an overall functional description of the PCIP-DMM/A.

Isolation

The inputs to the PCIP-DMM/A are isolated (400 V) from the computer. This protects the computer in the event that there are high voltages present at the PCIP-DMM/A inputs. Power is supplied to the isolated side of the PCIP-DMM/A by a transformer-coupled DC to DC converter. A group of opto-couplers are used to isolate the various control signals travelling between the computer and these signals.

Voltage Measurements

Voltage measurements are made between the VOLT-OHM and COMMON connectors on the PCIP-DMM/A. There are four voltage ranges: 200mV, 2 V, 20V, and 200 V. A programmable resistor divider network scales the input voltage signal and also provides 10 MOhm input impedance. The signal is then buffered. AC signals are routed to a true RMS (TRMS) converter which is set to give an output DC voltage equal to the RMS value of a signal applied to its input. The signal is then routed to the analog to digital (A/D) converter. DC signals are routed directly to the A/D converter.

Current Measurements

Current Measurements are made between the MA and COMMON connectors on the PCIP-DMM/A. The PCIP-DMM/A is capable of measuring AC or DC current. The current develops a voltage across a programmable shunt resistance on the PCIP-DMM/A. This voltage signal is then routed to either the AC or DC converter and X10 amplifier used for voltage measurements.

Resistance Measurements

Resistance Measurements are made by a ratio technique. A reference voltage is connected to a voltage divider formed by a known programmable reference resistor and the resistance to be measured. The reference voltage is measured at a convenient time, typically when a resistance range is first selected. Then the voltage across the unknown resistance is measured. The value of the unknown resistance is related to the reference voltage and reference resistor as follows:

Unknown Resistance = Rx
Voltage across Rx = Vx
Reference Resistor = Rref
Reference Voltage = Vref

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$$Rx = (Vx \times Rref)/(Vref - Vx)$$

Range selection is accomplished by switching in the appropriate provided reference resistor.

1.3 PCIP-DMM/A DISTRIBUTION DISKETTES

The PCIP-DMM/A is shipped with a complete set of software drivers, support utilities, and examples. Refer to the file *FILES.DOC* for a complete listing of the files supplied. The Software is normally provided on 5 1/4" diskettes. It is optionally available on 3 1/2" diskettes.

1.4 SPECIFICATIONS

This section lists the operating specifications for the PCIP-DMM/A board.

DC Voltage

Range	Resolution	Accuracy +/- (% of reading + digits) (With zero set by REL function) 1 Year	Input Impedance
200 mV	10 µV	0.03 + 1d	>1000 MOhm
2 V	100 µV	0.03 + 1d	>1000 MOhm
20 V	1 mV	0.03 + 1d	10 MOhm
200 V	10 mV	0.03 + 1d	10 MOhm

Settling Time: 1 sec to within 3 counts of final reading on range.
Overload: 250 Vdc or peak AC

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AC Voltage (True RMS, AC Coupled)

Range	Resolution	Accuracy +/- (% of reading + digits)			Input Impedance
		60 Hz 1 Year	1000 Hz 1 year	10KHz 1 year	
200 mV	10 µV	1 + 1d	1 + 1d	3 + 1d	>10 MOhm ‖ 100pF
2 V	100 µV	1 + 1d	1 + 1d	3 + 1d	>1000 MOhm ‖ ‹100Pf
20 V	1 mV	1 + 1d	1 + 1d	3 + 1d	>1 MOhm ‖ ‹100Pf
200 V	10 mV	1 + 1d	1 + 1d	3 + 1d	>1 MOhm ‖ ‹100Pf

Overload: 250 Vdc or peak AC

NOTE: Accuracy is %FS and applies above 200 counts (1% of FS) and to the stated percent ± 30 counts (0.15%) crest factor (ratio of peak to RMS) up to 3:1 allowable, add ± 0.1% for 3:1 crest factor.

Resistance

Range	Resolution	Accuracy +/- (% of reading + digits) (With zero set by REL function) 1 Year
200 Ohm	0.01 Ohm	0.03 + 1d
2 KOhm	0.1 Ohm	0.03 + 1d
20 KOhm	1 Ohm	0.03 + 1d
200 KOhm	10 Ohm	0.03 + 1d
2 MOhm	100 Ohm	0.03 + 1d

Settling time: 2 sec. to within 3 counts of final value.
Overload: 250 V continuous
Open Circuit Voltage: ‹3.5V all ranges

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DC Current

Range	Resolution	Accuracy +/- (% of reading + digits) (With zero set by REL function) 1 Year	Burden Voltage
2 mA	0.1 µA	0.03 + 1d	0.3 V
20 mA	1 µA	0.03 + 1d	0.2 V
200 mA	10 µA	0.03 + 1d	0.2 V

Overload Protection: 0.5A, 100 Volts

AC Current

(above 1% of full scale)

Range	Resolution	Accuracy +/- (% of reading + digits) 1 Year	Burden Voltage
2 mA	0.1 µA	1 + 1d	0.3 V
20 mA	1 µA	1 + 1d	0.2 V
200 mA	10 µA	1 + 1d	0.2 V

Overload: 0.5 A, 100 Volts

Conversion Rate

2.5 Readings/sec.

Isolation

Input COM to computer ground, greater than 100 MOhm shunted by approx. 250pF. Max input, COM to computer ground, 400 Vdc.

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Power Drawn from the PC

+5 Volts - 985 mA typical, 1245 mA max.

Fuse Type

5 x 20 mm, Bussman GMA -1/2

Bus

XT/AT or compatible

Physical

Size: 13.25" X 4.20 "
Weight: 11 oz.

Environmental

Operating Temperature Range: 0 to 50° C
Storage Temperature Range: -20 to 70° C
Humidity: 0 to 90%, non-condensing

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1.5 ORDERING INFORMATION

Table 1-1 lists the part numbers for the PCIP-DMM/A and its accessories. A brief description of each is provided. Refer to the MetraByte Catalog for more information or call MetraByte's Technical Support Department. (See Chapter 7.)

Table 1-1. Ordering Information

Part Number	Description
PCIP-DMM/A	4 1/2 Digit Multimeter board for the IBM PC/XT/AT or IBM PS/2 model 25/30.
TCP-BAN	Dual banana-clip plug to clip ball test leads for direct plug-in to PCIP-DMM/A's terminal posts.
TCP-DBB	Dual banana plug to BNC adapter. Allows connection of a BNC cable to PCIP-DMM/A.
TCP-MCB	Dual Micro clips to BNC adapter. Allows direct connection of micro clips to a BNC connector cable.
TCP-ACB	Dual alligator clips to BNC adapter. Allows connection of alligator plug to BNC cable.
C-BMM-5	Male-Male, BNC cable, 5' long
C-BMM-15	Male-Male, BNC cable, 15' long

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1.6 HOW TO USE THIS MANUAL

This manual is designed for a knowledgeable computer user. It assumes that the user is familiar with the PC and its operation. At times, it may be necessary to refer to the Operator's Manual provided with the computer and a reference manual for the language used in custom application programs. Be sure to have these handy.

You may also find it useful to print out the example programs and the file *README.DOC*. This file provides additional information which may not be included in this manual.

Chapter 2,"Installation" describes unpacking and inspection procedures, setting the base address and memory configuration switches, installation of the board, and how to connect peripherals.

Chapter 3, "Getting Started" tells you how to make copies of the PCIP-DMM/A Distribution Diskettes. Additionally, the chapter describes how to install the device drivers and modify your *CONFIG.SYS* file. This chapter also describes how to use the PCIP-DMM/A's Setup Panel to set the operating parameters.

Chapter 4, "Operating the PCIP-DMM/A", describes how to use the Setup and Data Logging Panels.

Chapter 5, "Data File Structure", describes the format of the file to which data is logged.

Chapter 6, "Programming", describes the Language Independent Interface Commands and gives other programming information.

Chapter 7, "Maintenance and Repair" gives a procedure for calibrating the PCIP-DMM/A. Warranty information and Return-to-Factory instructions are also provided.

Appendix A gives instructions for the *PCIPMOD* program, used when installing multiple PCIP-type instruments. Appendix B provides register descriptions.

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CHAPTER 2
INSTALLATION

2.1 GENERAL

This chapter describes how to install your PCIP-DMM/A. The following information is provided: unpacking and inspection procedures, setting of the base address switch, installation of the board, and system connections.

If you have installed optional peripheral boards in your PC before, you may want to skip this chapter. Be sure however, that the base address switch has been set according to the instructions in section 2.3. The PCIP-DMM/A is factory-calibrated and should be re-calibrated when necessary. Calibration procedures are given in section 7.4.

2.2 UNPACKING AND INSPECTION

After you unpack the board from its outer shipping material:

1. Remove the item from its packing material, while placing one hand firmly on a metal portion of the system chassis. This will prevent any damage to the board components due to possible static electricity build-up during transit.

2. After allowing a moment for static electricity discharge, carefully unwrap the board from the anti-static material.

3. Inspect the board for any possible damage. If any sign of damage is detected, return the board to the factory as described in section 7.7.

Confirm that each item on the packing list has been shipped. It is a good idea to retain the packing material in the event that the board must be returned to the factory for repair.

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2.3 BASE ADDRESS SWITCH

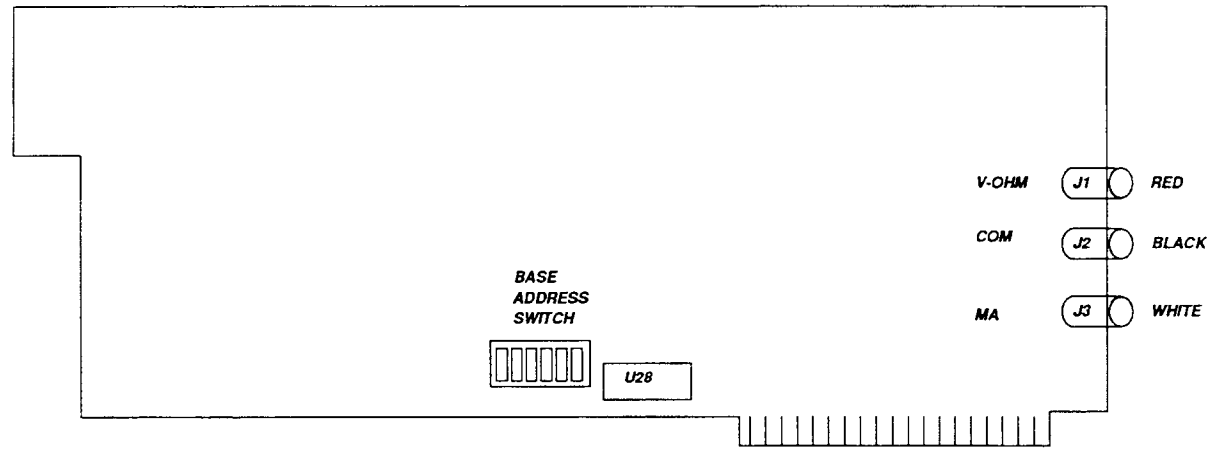


Figure 2-1. Location of Switches

The PCIP-DMM/A uses a block of eight non-overlapping I/O addresses. The Base Address Switch is used to set the Base Address of the Board. The PCIP-DMM/A has a default base address setting of 310 (hex). This slot may be occupied within your computer. Base addresses may be assigned within the range 100 to 3FF (hex). Check your system configuration and Operator's Manual for available addresses.

The Base Address Switch is a seven-position, DIP switch located in the lower right-hand corner of the board. (See Figure 2-1.) To set the appropriate base address, use a pen-tip to move the individual switches into the OFF position. For example, to set a base address of 310 hex (784 decimal), move switches 9, 8, and 4 into the OFF position as shown in Figure 2-2.

If you are unsure of how to set the Base Address Switch, you may find it helpful to run the PCIP-DMM/A *UTILITY.EXE* program. Refer to section 3.6.

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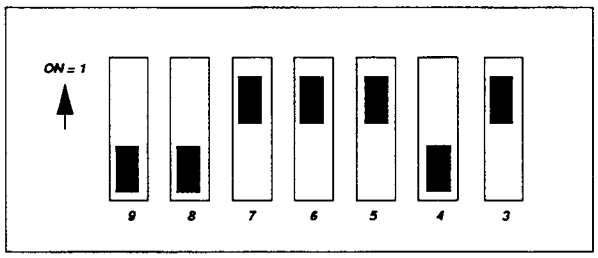


Figure 2-2. Example Base Address (310 hex) Switch Setting

2.4 BOARD INSTALLATION

This section provides general instructions for installing the PCIP-DMM/A Board. For more detailed information regarding installation of peripheral boards, consult the documentation provided with your computer.

WARNING

DO NOT ATTEMPT TO INSERT OR REMOVE ANY ADAPTER BOARD WITH THE COMPUTER POWER ON! THIS COULD CAUSE DAMAGE TO YOUR COMPUTER!

IBM PC/XT/AT

To install the PCIP-DMM/A Board:

1. Turn the power to the PC and to all attached options OFF.

2. Unplug the power cords of all attached options from the electrical outlets. Make a note of where all the cables and cords are attached to the rear of the system unit and disconnect.

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3. Remove the cover of the PC. To do this, first remove the five cover mounting screws on the rear panel of the computer. Then, slide the cover of the computer about 3/4 of the way forward. Tilt the cover upwards to remove.

4. Choose an available option slot. Loosen and remove the screw at the top of the blank adapter plate. Then slide the plate up and out to remove.

5. Hold the PCIP-DMM/A in one hand. With the other hand, touch any metallic part of the PC/AT cabinet. This will safely discharge any static electricity which has built-up in your body.

6. Set the desired Base Address as described in section 2.3.

7. Align the gold edge connector with the edge socket and the back adapter place with the adapter plate screw. Gently press the board downward into the socket. Re-install the adapter plate screw.

8. Replace the computer's cover. Tilt the cover up and slide it onto the system's base, making sure the front of the cover is under the rail along the front of the frame. Install the mounting screws.

9. Plug in all cords and cables. Turn the power to the computer back on.

IBM PS/2 Models 25/30

This installation procedure is similar to the one outlined above. For specific information, refer to your operator's manual.

You are now ready to make any necessary system connections and install the software.

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2.5 SYSTEM CONNECTIONS

The PCIP-DMM/A is equipped with 3 banana-plug connectors which can be used in a variety of applications. These connectors are located on the rear edge of the card and are color-coded for easy identification. (Refer to Figure 2-1.) The connectors and their functions are as listed in Table 2-1.

Table 2-1. Connectors

Color	Connector Name	Function
Red	VOHM	Input for volts (AC, DC) and ohms.
Black	COM	Common for all measurements.
White	MA	Input for current measurement (AC, DC).

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CHAPTER 3
GETTING STARTED

3.1 GENERAL

This chapter describes the information necessary to begin operating the PCIP-DMM/A. Instructions for making back-up copies of the PCIP-DMM/A Diskette, and modifying the *CONFIG.SYS* file to include the necessary drivers are included. Also provided in this chapter are instructions for using the Pop-Up Menu to set the PCIP-DMM/A's operating parameters.

3.2 MAKING A BACK-UP COPY OF THE SOFTWARE

Before installing the PCIP-DMM/A software, first create a back-up copy of the PCIP-DMM/A Diskette(s). Follow the general procedure outlined below:

1. Turn on your computer and display.

2. Switch to the directory containing your *DISKCOPY.EXE* DOS utility.

3. At the DOS prompt, type:

   `DISKCOPY {source drive designator}: {copy drive designator}:`

4. The system will prompt you through the disk copying process. Insert the source diskette into the specified drive. Then, it will ask you to insert the target disk into the other drive. This is a blank, formatted disk which is to be your back-up disk. When the copying process has been completed, the computer will ask **`Copy another (Y/N)?`**. Enter **`N`**.

5. When your copy has been completed, put the original disk is a safe place. Label the back-up copy "PCIP-DMM/A Disk Back-Up Copy". Use this disk to install the software.

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3.3 INSTALLING THE PCIP-DMM/A SOFTWARE

If at all possible, the PCIP-DMM/A software should be installed on your computer's hard drive. Installing the PCIP-DMM/A software in this manner requires the use of the DOS COPY command. To install the PCIP-DMM/A software:

1. Turn on your PC and its display. You should see a prompt which indicates you are at the DOS level.

2. The following instructions create a special directory for the PCIP-DMM/A Disk files and assumes this directory is called DMM. At the DOS prompt, change to the root directory (or other directory you want the PCIP-DMM/A directory to be branched off from), i.e. type:

   ```
   cd \
   ```

3. Next, create the DMM directory. Type:

   ```
   mkdir \dmm
   ```
   OR
   ```
   md \dmm
   ```

   Change to the dmm directory by typing:

   ```
   cd \dmm
   ```

3. Place the PCIP-DMM/A Disk into the floppy drive (assume this is drive a:) and type:

   ```
   copy a:*.*
   ```

Repeat as needed.

You are now ready to install the driver software.

3.4 ADDING ANSI.SYS to CONFIG.SYS

The PCIP-DMM/A software requires that *ANSI.SYS* be loaded from your *CONFIG.SYS*. Be sure to add the following instruction to your *CONFIG.SYS* file:

```
DEVICE = {path}ANSI.SYS
```


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If the device drivers are installed from the *CONFIG.SYS* file, the *ANSI.SYS* instruction must precede the device driver instructions (See 3.5.1 and 3.5.2.).

3.5 INSTALLING THE DEVICE DRIVERS

Before operating your PCIP-DMM/A, you must load its driver files (*VI.SYS* and *DMM.SYS*). This can be done in one of two ways: either by loading the drivers from your *CONFIG.SYS* or by loading them directly from DOS using the Load/Unload Utility.

If you choose to load the drivers from your *CONFIG.SYS*, they will be automatically loaded every time your computer is booted up. This keeps the drivers memory-resident, allowing the PCIP-DMM/A to be used at any time. There are two ways to modify your *CONFIG.SYS* file: (1) Editing your *CONFIG.SYS* file (See section 3.5.1.) and (2) Using the DMMSETUP Program (See section 3.5.2).

If unoccupied memory is limited in your computer, you will probably want to manually load and unload the drivers from the DOS command line. After the drivers have been unloaded using this technique, 500 bytes will remain memory resident. We suggest creating batch files to invoke the load and unload options quickly. Section 3.5.3 discusses how to load the device drivers from the command line.

NOTE: If you have more than one PCIP-DMM/A installed in the same computer - or if you have an additional MetraByte PCIP family Virtual Instrument Products, refer to Appendix A for Driver Installation procedure.

Syntax Notes

The following syntax is used in this section:

{ } - Anything enclosed within curly brackets is optional. Do not include the curly brackets in the command. Choices are separated by commas.

3.5.1 Editing the CONFIG.SYS File

If you do not want to run the PCIP-DMM/A Set-Up Program and are familiar with your *CONFIG.SYS* file, you may want to edit the existing *CONFIG.SYS* file with a standard wordprocessor which handles ASCII input. Start by bringing the *CONFIG.SYS* file into the editor. Then, add the following two instructions (after the `DEVICE = ANSI.SYS` instruction).

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STEP 1. ADD THE VI.SYS DRIVER

Add the following line to the CONFIG.SYS file :

```
DEVICE = {PATH}VI.SYS {MONITOR} /HK = x  /MK = m /SK = s
```

Where:

HK designates the **Help Key**. Whenever the indicated key (x) is pressed, the help screen will be displayed. (If the PCIP-DMM/A is visible.) On-line help consists of a brief description of the PCIP-DMM/A, a listing of current Key settings, and a listing of all commands which can be incorporated into your application programs.

x represents the key combination -- Ctrl and/or Alt plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ?) spelled out. For example, "CTRL D" would indicate that Ctrl and D would be pressed at the same time to bring up the help screen. The default setting for the help key parameter is Alt H.

MK designates the **Mode Select Key**. This key combination places the visible PCIP-DMM/A into keyboard entry mode. Refer to the following section for more information.

m is the name of the key combination -- Ctrl and/or Alt plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ?. It must be spelled out, for example, "F1" assigns the function key F1 to be the Mode Select Key. The default Mode Select Key is Alt M.

SK defines the **Instrument Select Key**. If you have multiple MetraByte PCIP boards installed in your computer, this key or key combination is used to toggle between their setup menus.

s is the name of the key or key combination -- Ctrl and/or Alt plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ? spelled out. For example, "Alt I" would indicate that Alt and I must be pressed simultaneously. The default Instrument Select Key is Alt Tab.

MONO, COLOR determines which type of monitor is being used with the system. Enter **MONO** for a monochrome monitor or **COLOR** for a color monitor. COLOR is the default setting.

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NOTE: If optional parameters are not specified, their default values will be used.

Example:

```
DEVICE = C:\VI.SYS /HK=ALT H /MK=ALT M /SK=ALT TAB
```

If this example line were to be placed in the *CONFIG.SYS* file, the default selections for the Help Key (Alt H), Mode Select Key (Alt M),and Instrument Select Key (Alt →) are enabled.

STEP 2. ADD THE DMM.SYS DRIVER

NOTE: The *VI.SYS* driver must be installed as described in step 1, before installing the *DMM.SYS* driver.

Add the following line to the *CONFIG.SYS* file:

```
DEVICE = {PATH}DMM.SYS /PK=p  /BA=b
```

Where:

PK designates the Pop-Up Menu Key. Whenever the indicated key or key combination is pressed, the instrument's Pop-Up Setup Menu will be displayed. Each type of instrument must be assigned a different Pop-Up Key.

p is the name of the key combination. It must be spelled out. For example, "CTRL P" would indicate that Ctrl and P must be pressed at the same time to bring up the help screen. The default setting for the Pop-Up Menu Key is Ctrl F1.

> ***NOTE***
>
> We suggest that you avoid assigning only one key as a Pop-Up key – unless it is a function key. Assigning one key will most likely will disable that key for use in other software applications.

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BA defines the base address setting for the PCIP-DMM/A. If this parameter is not given, the default base address of &H310 (784 decimal) will be used.

b is the value of the base address. Base address values may be given in either hex or decimal; however, if they are given in hex they must be preceded by an ampersand and an H (i.e., &H). Make certain that the base address you give has not been already assigned to another peripheral.

NOTE: If optional parameters are not specified, their default values will be used.

STEP 3. RE-BOOT THE PC

Press Ctrl Alt Del. After the system start-up screens are displayed, a screen similar to Figure 3-1 should appear.

```
*******     VI.SYS loaded
            o Help Key is ALT H
            o Instrument Select Key is ALT TAB
            o Mode Select Key is ALT M

*******     DMM.SYS loaded
            o Pop-Up Key is CTRL F1
            o Base Address is 0310 hex
```

Figure 3-1. Start-Up Screen

3.5.2 Using DMMSETUP.EXE to Modify the CONFIG.SYS File

If you prefer not to manipulate the *CONFIG.SYS* file, use the PCIP-DMM/A Setup Program. This is a self-explanatory program which is contained on the PCIP-DMM/A Disk.

Before you begin to run the PCIP-DMM/A, make certain that the PCIP-DMM/A and its software have been installed correctly. Make note of the Base Address Switch setting, you will need this information later.

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1. Then, change to the directory where your PCIP-DMM/A software has been loaded. At the DOS prompt, type:

   DMMSETUP

   The program will then prompt you for the information required by the system driver (*VI.SYS*). Follow the instructions given. Sample screen dialogue is provided in Figures 3-2 through Figure 3-8.

   First, you will be asked to specify the drive where you want the *CONFIG.SYS* file to reside. Enter the appropriate letter (i.e., C).

```
                    PCIP-DMM Setup Program

 Drive letter for CONFIG.SYS file : C


                      Select Boot Drive

 Enter a drive letter where New/Revised CONFIG.SYS is to be placed.  Then hit 'ENTER'.
 Hitting 'ESC' will exit program.
```

Figure 3-2. Selecting the Boot Drive

2. You will then be asked for the full path name to the *VI.SYS* file. If you are unsure of what a path name is, refer to the operator's manual provide with your PC. Otherwise, provide the path name, being certain to include the correct drive specifier and directory name(s). See Figure 3-3.

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```
                    PCIP-DMM Setup Program

     Drive letter for CONFIG.SYS file : C
     Full path name to VI.SYS:  C:\DMM


                Generate the path name to VI.SYS

     The default path is .... ( C:\ )
     The path in the current CONFIG.SYS is .... ( C:\DMM\ )

     Enter one of the following..

     o  The complete path to VI.SYS followed by 'ENTER'
     o  'ENTER' to use default path
     o  'ESC' to exit Setup
```

Figure 3-3. Generating the Path Name to VI.SYS

3. Specify the type of monitor you are using: MONO or COLOR.

```
                    PCIP-DMM Setup Program

     Drive letter for CONFIG.SYS file : C
     Full path name to VI.SYS:  C:\DMM

     Declare type of monitor:  COLOR


                Specify the type of monitor in system

     The default monitor is .... ( COLOR )
     The current monitor is .... ( COLOR )

     Enter one of the following..

     o  The word COLOR or MONO followed by 'ENTER'
     o  'ENTER' to default monitor
     o  'ESC' to exit setup
```

Figure 3-4. Specifying the type of Monitor

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3. Set the Help Select Key, Mode Select Key, and Instrument Select Key as illustrated in Figures 3-5 through 3-7.

   Whenever the *Help Key* is pressed and the instrument is visible, the help screen will be displayed. On-line help consists of a brief description of the PCIP-DMM/A, a listing of current key settings, and a listing of all commands which can be incorporated into your application programs. The default setting for the help key is [Alt][H].

   The *Mode Select Key* is used to toggle between the mouse and keyboard setup modes. Refer to the following section for more information. The default Mode Select Key is [Alt][M].

   If you have other PCIP boards installed in your computer, the *Instrument Select Key* is used to toggle between their setup menus. The currently selected instrument's menu will appear first in the sequence. The default Instrument Select Key is [Alt][Tab].

   Keys may be a single function key (F1 through F10) or a combination of keys (Ctrl or Alt with another valid key). Hot keys are specified by "spelling out" the key(s) used. For example:

   "Alt I" means that [Alt] and [I] are pressed simultaneously.

   "F1" indicates [F1].

   "Ctrl I" is [Ctrl] and [I] pressed together.

   If an invalid key or key combination is entered, the following error message will appear:

```
The Definition for the Key is not valid.
Strike any key to try another.
```


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CAUTION

Single keystrokes may be defined as Keys; however, it is suggested that only function keys be assigned in this manner. If the *CONFIG.SYS* file resides in the root directory, assigning a single keystroke will disable that key from being used in other software applications.

```
                    PCIP-DMM Setup Program

     Drive letter for CONFIG.SYS file : C
     Full path name to VI.SYS:  C:\DMM

     Declare type of monitor:  COLOR
     HELP KEY definition: ALT ?
```

```
                    Help Key Definition

     The Help Key is defined by spelling out either or both the legal
     SHIFT KEYS (CTRL and ALT) plus 1 of the following character keys.

                    A through Z, F1 through F10, 0 through 9
                              TAB, ESC, ?


     The default HELP KEY is....( ALT H )
     The current HELP KEY is....( ALT ? )

     Enter one of the following..

     o  The definition for Help Key followed by 'ENTER'
     o  'ENTER' to use default HELP KEY
     o  'ESC' to end entry
```

Figure 3-5. Defining the Help Key

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```
                        PCIP-DMM Setup Program

     Drive letter for CONFIG.SYS file : C
     Full path name to VI.SYS:  C:\DMM

     Declare type of monitor:  COLOR
     HELP KEY definition: ALT ?
     MODE SELECT KEY definition: F2


                        Mode Select Key Definition

     The Mode Select Key is defined by spelling out either or both the
     legal SHIFT KEYS (CTRL and ALT) plus 1 of the following character keys.

                    A through Z, F1 through F10, 0 through 9
                                TAB, ESC, ?


     The default MODE SELECT KEY is....( ALT M )
     The current MODE SELECT KEY is....( F2 )

     Enter one of the following..

     o  The definition for Mode Select Key followed by 'ENTER'
     o  'ENTER' to use default HELP KEY
     o  'ESC' to end entry
```

Figure 3-6. Defining the Mode Select Key

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```
                    PCIP-DMM Setup Program

      Drive letter for CONFIG.SYS file : C
      Full path name to VI.SYS:  C:\DMM

      Declare type of monitor:  COLOR
      HELP KEY definition: ALT ?
      MODE SELECT KEY definition: F2
      INSTRUMENT SELECT KEY definition: CTRL I
```

```
                Instrument Select Key Definition

The Instrument Select Key is defined by spelling out either or both the legal
SHIFT KEYS (CTRL and ALT) plus 1 of the following character keys.

                        A through Z, F1 through F10, 0 through 9
                                    TAB, ESC, ?


      The default INSTRUMENT SELECT KEY is....( ALT TAB )
      The current INSTRUMENT SELECT KEY is....( CTRL I )

      Enter one of the following..

      o  The definition for INSTRUMENT SELECT KEY followed by 'ENTER'
      o  'ENTER' to use default INSTRUMENT SELECT KEY
      o  'ESC' to end entry
```

Figure 3-7. Defining the Instrument Select Key

4. You will now be asked to confirm your selections. (See Figure 3-8.) If you wish to change an entry, press N and the program will return to the Boot Drive Selection Screen. To return to DOS, press Esc. Otherwise, press ↵.

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```
                    PCIP-DMM Setup Program

     Drive letter for CONFIG.SYS file : C
     Full path name to VI.SYS:  C:\DMM

     Declare type of monitor:  COLOR
     HELP KEY definition: ALT ?
     MODE SELECT KEY definition: F2
     INSTRUMENT SELECT KEY definition: CTRL I


                    VI Setup CONFIRMATION

     Enter one of the following..

     o  'N' if above entries are NOT OK
     o  'ENTER' to continue
     o  'ESC' to exit setup
```

Figure 3-8. Confirming the System Setup

5. Next, the program will ask you for the information required to setup the PCIP-DMM/A driver. It first prompts you for the path name to the file *DMM.SYS*. (See Figure 3-9.)

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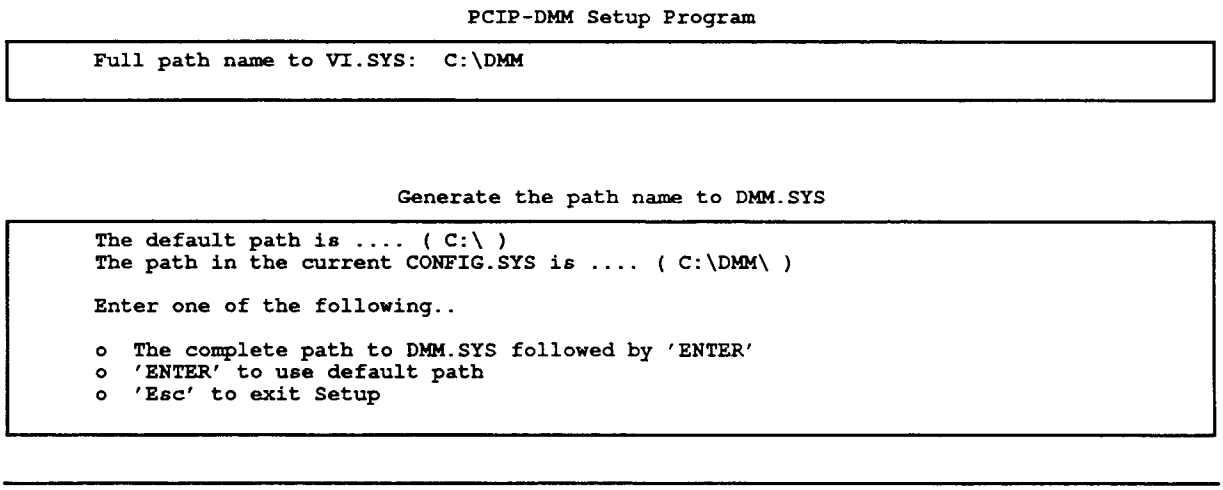


Figure 3-9. Generating the DMM.SYS Path

6. The program then asks you to select a Pop-Up Menu Key as shown in Figure 3-10. Whenever the *Pop-Up Menu Key* is pressed, the instrument's Pop-Up Setup Menu will be displayed. It is suggested that each type of instrument be assigned a different Pop-Up Key. The default setting for the Pop-Up Menu Key is Ctrl F1.

   Keys may be a single function key (F1 through F10) or a combination of keys (Ctrl or Alt with another valid key). Hot keys are specified by "spelling out" the key(s) used. (See Step #3 for specifics.)

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```
                        PCIP-DMM Setup Program

      Full path name to DMM.SYS:  C:\DMM
      POP UP MENU KEY definition: ALT P


                        POP UP Key Definition

The Pop Up Key is defined by spelling out either or both the legal
SHIFT KEYS (CTRL and ALT) plus 1 of the following character keys.

                          A through Z, F1 through F10, 0 through 9
                                       TAB, ESC, ?


      The default POP UP KEY is....( CTRL F1 )
      The current POP UP KEY is....( ALT P )

      Enter one of the following..

      o  The definition for POP UP KEY followed by 'ENTER'
      o  'ENTER' to use default POP UP KEY
      o  'ESC' to end entry
```

Figure 3-10. Pop Up Key Definition

7. You now will be asked for the Base Address of the PCIP-DMM/A. Base address values may be given in either hex or decimal; however, if they are given in hex they must be preceded by an ampersand and an H (i.e., &H). Make certain that the base address you give has not been already assigned to another peripheral and agrees with the Base Address Switch setting on the PCIP-DMM/A.

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```
                    PCIP-DMM Setup Program

     Full path name to DMM.SYS:  C:\DMM
     POP UP MENU KEY definition: ALT P
     Base Address for PCIP-DMM:  <Enter>
```

```
                PCIP-DMM I/O Base Address Selection

     The Base Address can be entered in either decimal or hex.
     If entered in hex, the number must be preceded by &H
     (i.e., &H310 is the same as 784)

     The default PCIP-DMM Base Address is ( &H310 ).
     The current PCIP-DMM Base Address is ( &H310 ).

     Enter one of the following..

     o  The BASE ADDRESS to use for the PCIP-DMM followed by 'ENTER'
     o  'ENTER' to use default BASE ADDRESS
     o  'ESC' to exit Setup
```

Figure 3-11. Selecting a Base Address

8. You will now be asked to confirm your selections. (See Figure 3-12.) If you wish to change an entry, press [N] and the program will return to the screen requesting a path name for the PCIP-DMM/A driver. To return to DOS, press [Esc]. Otherwise, press [↵].

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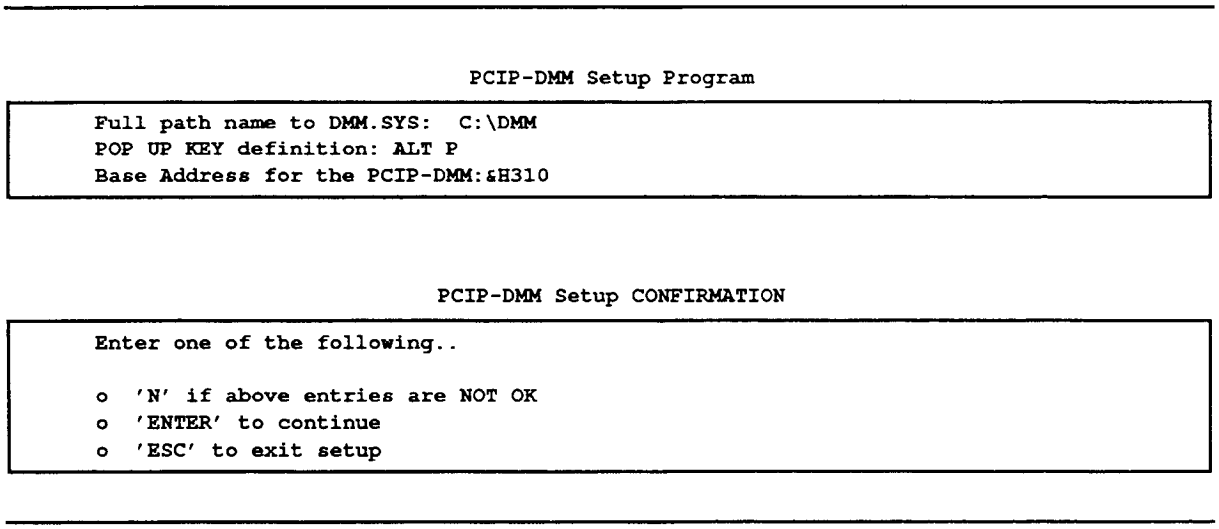


Figure 3-12. Confirming the PCIP-DMM/A Setup

9. The program will back-up your present *CONFIG.SYS* file to the file *CONFIG.BAK* and write the new set-up information to the *CONFIG.SYS* File. The *CONFIG.SYS* file is displayed. An example is given in Figure 3-13. If your system already has a *CONFIG.BAK* file, you will be asked if it should be deleted as shown in Figure 3-14.

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```
Backing old CONFIG.SYS file to CONFIG.BAK
and creating new CONFIG.SYS

DEVICE = C:\SYS\ANSI.SYS
DEVICE = C:\VI.SYS /HK=ALT H  /MK=ALT M  /SK=ALT TAB
DEVICE = C:\DMM.SYS  /PK= CTRL F1  /BA = &H310

files = 20
buffers = 10
```

Figure 3-13. Creation of the new CONFIG.SYS

```
Backing old CONFIG.SYS file to CONFIG.BAK
and creating new CONFIG.SYS

Backup file already exists
Delete it? (Y/N)


DEVICE = C:\SYS\ANSI.SYS
DEVICE = C:\VI.SYS /HK=ALT H  /MK=ALT M  /SK=ALT TAB
DEVICE = C:\DMM.SYS  /PK= CTRL F1  /BA = &H310

files = 20
buffers = 10
```

Figure 3-14. CONFIG.BAK Already Exists

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10. In order to activate the *CONFIG.SYS* file that was created, press Ctrl Alt Del simultaneously to re-boot the system.

3.5.3 Loading/Unloading the Drivers from DOS

The *VI.SYS* and *DMM.SYS* drivers can be "manually" loaded from the DOS command line, if desired. This is useful if you frequently run memory-resident programs. Using this technique, a maximum of 500 driver file bytes will remain memory resident once the drivers have been unloaded. You can create batch files which will alleviate the tediousness of this method. See ***Notes*** for specifics on batch files.

NOTE: Both of these drivers must be loaded for the PCIP-DMM/A to operate. Be sure that *ANSI.SYS* has been loaded. Refer to Appendix A if you have multiple PCIP-DMM/A's or another MetraByte PCIP instrument installed.

Syntax Conventions

The following syntax conventions are used in this section:

1. { } - Anything enclosed within curly brackets is optional. Do not include the curly brackets in the command.

Loading the Drivers

The *LS.COM* utility lets you load the PCIP-DMM/A driver files from the DOS command line. **Help** is available for this utility. The help screen briefly describes the function of, syntax for, and a sample usage for *LS.COM*. To access help, type `LS` at the DOS prompt.

VI.SYS

To load the *VI.SYS* driver, type the following at the DOS prompt:

```
LS {Path} VI.SYS {/HK = x} {/MK = m} {/SK = s}
```

Where

HK designates the **Help Key**. Whenever the indicated key (x) is pressed, the help screen will be displayed if the PCIP-DMM/A is visible. On-line help consists

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of a brief description of the PCIP-DMM/A, a listing of current Key settings, and a listing of all commands which can be incorporated into your application programs.

x represents the key combination -- Ctrl and/or Alt) plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ?), spelled out. For example, "CTRL D" would indicate that Ctrl and d would be pressed at the same time to bring up the help screen. The default setting for the help key parameter is Alt H.

MK designates the **Mode Select Key**. This key combination places the visible PCIP-DMM/A into keyboard entry mode. Refer to the following section for more information.

m is the name of the key combination -- Ctrl and/or Alt plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ?. It must be spelled out, for example, "F1" assigns the function key F1 to be the Mode Select Key. The default Mode Select Key is Alt M.

SK defines the **Instrument Select Key**. If you have multiple MetraByte PCIP boards installed in your computer, this key or key combination is used to toggle between their setup menus.

s is the name of the key or key combination -- Ctrl and/or Alt plus one of the following: a through z, F1 through F10, 0 through 9, Tab, Esc, or ? spelled out. For example, "Alt I" would indicate that Alt and I must be pressed simultaneously. The default Instrument Select Key is Alt Tab.

Examples

```
LS VI.SYS /HK=ALT H /MK=ALT M /SK=ALT TAB
LS VI.SYS
LS C:\PCIP\VI.SYS  /HK=?
```

DMM.SYS DRIVER

To load the *VI.SYS* driver, type the following at the DOS prompt:

```
LS {PATH} DMM.SYS {/PK=p}  {/BA=b}
```


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Where:

PK designates the Pop-Up Menu Key. Whenever the indicated key or key combination is pressed, the instrument's Pop-Up Setup Menu will be displayed. Each type of PCIP or PCIP-DMM/A instrument must be assigned a different Pop-Up Key.

p is the name of the key combination. It must be spelled out. For example, "CTRL P" would indicate that Ctrl and P must be pressed at the same time to bring up the help screen. The default setting for the Pop-Up Menu Key is Ctrl F1.

> *NOTE*
> We suggest that you avoid assigning only one key as a Pop-Up key -- unless it is a function key. Assigning one key will most likely will disable that key for use in other software applications.

BA defines the base address setting for the PCIP-DMM/A. If this parameter is not given, the default base address of &H310 (784 decimal) will be used.

b is the value of the base address. Base address values may be given in either hex or decimal; however, if they are given in hex they must be preceded by an ampersand and an H (i.e., &H). Make certain that the base address you give has not been already assigned to another peripheral.

NOTE: If optional parameters are not specified, their default values will be used.

Examples

```
LS D:\DMM\DMM.SYS  /PK= CTRL F1  /BA = &H310
LS C:\PCIP\DMM.SYS /BA=768
LS DMM.SYS
```


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Unloading the Drivers

The *US.COM* utility lets you unload the PCIP-DMM/A driver files from the DOS command line. Each driver must be unloaded separately. **Help** is available for this utility. The help screen briefly describes the function of, syntax for, and a sample usage for *US.COM*. To access help, type **US** at the DOS prompt.

To unload a driver, at the DOS prompt, type:

```
US {PATH} DRIVER_FILENAME
```

Where:

DRIVER_FILENAME is *VI.SYS* or *DMM.SYS*.

Examples

```
US D:\PCIP\VI.SYS
US C:\DMM\DMM.SYS
```

Notes

- *VI.SYS* loads into memory in two portions: a resident portion and a transient portion. The resident portion occupies about 500 bytes of memory and stays resident until the computer is rebooted or turned OFF. *VI.SYS* should be un-installed after *DMM.SYS*.

- When loading *VI.SYS* from a batch file, load it twice, i.e.:

```
LS {path}VI.SYS
LS {path}VI.SYS
...
```

  This is necessary because *VI.SYS* loads in two portions. Normally, this occurs automatically; however batch files do not allow this.

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- Load *VI.SYS* as soon as possible after power-up and then unload it if you do not need it. This action locates the resident portion as low as possible in memory, avoiding the creation of memory "holes". (DOS has no mechanism for recovering fragmented memory.)

- When *LS.COM* loads a *.SYS* file, it displays an **`Amount of Memory`** statement. The amount indicated may exceed the actual *.SYS* file size, because additional memory is allocated to the *.SYS* file as "working" space.

- In some instances, the *LS.COM* utility can be used to load non-MetraByte drivers - for example *MSMOUSE.SYS*. However, in general, MetraByte does not suggest this practice. Not all non-MetraByte drivers work and those that do cannot be unloaded without disrupting certain interrupt vectors. If you choose to experiment with this procedure, the *VI.SYS* driver must be loaded first.

- It is important that you specify the path to the driver files when calling *LS.COM* from the command line. If no path is specified, *LS.COM* will search the current directory and then the paths listed in the *CONFIG.SYS* file (using the **`PATH`** = command). *LS.COM* will load the first file it finds in the specified path, displaying the filename and path as well as the load destination.

- If two instrument drivers are installed, you must have two boards installed. DO NOT install two drivers at the same base address.

3.6 ADDITIONAL PCIP-DMM/A PROGRAMS

The PCIP-DMM/A Software has several programs which you may find useful to refer to. These are:

- *UTILITY.EXE* - aids in setting the Base Address Switch

- Various demo programs - (Refer to *FILES.DOC* on the diskette for a complete list.)

- *DEMO.BAT* - creates executable versions of the demo files

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The Base Address Utility Program

This program pictorially describes the appropriate base address switch setting for any given Base Address. You can exit from this program at any time by pressing Esc.

1. To invoke the Utility Program, first be certain that you are in the correct directory. Then, at the DOS prompt, type: **UTILITY** .

2. The program will respond with by displaying the first 2 lines of Figure 3-15. Enter the appropriate Base Address setting using the appropriate format. Only Base Addresses greater than or equal to 256 decimal (100 hex) are valid. If an invalid base address is entered, a beep sounds and a base address is prompted for again. If a hex value is given in an unrecognizable format (Valid format is &H???.), the following error message appears:

```
?Redo from start
Enter the Base Address Setting
```

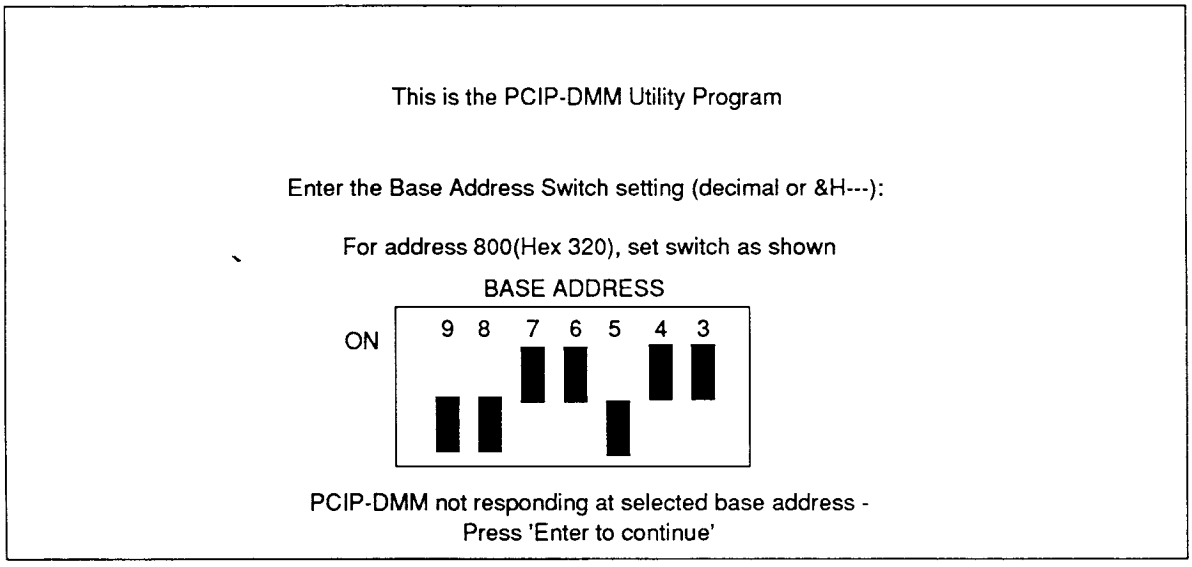


Figure 3-15 Utility Program Start-Up Screen

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3. The program then checks to see if the Base Address Switch is appropriately set for the given base address. If a valid base address is given, the program draws a picture of the corresponding base address switch setting and checks to see that the installed board is at the given address. If it is, this message is displayed:

```
 PCIP-DMM is responding at selected base address-
Press 'Enter' to continue
```

If the board is not installed at the given base address, you will be prompted as follows:

```
PCIP-DMM is not responding at selected base address-
Check switch setting or press 'Enter' to try again.
```

4. If the board is installed at the correct Base Address and you pressed ↵, the following question will appear:

```
Do you want to archive calibration constants stored in EEPROM (Y or
N)?
```

This should be done once to archive the factory calibration.

5. Follow the remaining instructions to complete the program.

The Demo Batch Program

This program creates executable programs from the provided demo programs. Before you begin, make certain that all paths to the necessary compilers and linkers are correct. To initiate the batch program, type `demo` ***`demo_filename`***. Help is provided for the batch program and can be accessed by `demo ?`.

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CHAPTER 4
OPERATING THE PCIP-DMM/A

4.1 GENERAL

The PCIP-DMM/A can be programmed by using the Pop-Up Menu or by writing your own application programs incorporating the PCIP-DMM/A driver commands. These commands are described in Chapter 6. The Pop-up Menus are convenient when you first begin to use the PCIP-DMM/A. They provide an easy means to exercise all of the PCIP-DMM/A's capabilities.

This chapter describes the Pop-Up Menu. To access this menu, press the defined Pop-Up Hot Key(s) (see Chapter 3). The default Pop-Up Hot Key sequence is Ctrl F1. Once the PCIP-DMM/A Set-up Menu is popped-up, you can use a mouse or the keyboard to select the PCIP-DMM/A's operating parameters.

4.2 USING A MOUSE

If your computer is equipped with a mouse, the mouse can be used to set the operating parameters of the PCIP-DMM/A. Once the PCIP-DMM/A's setup display is popped up, the mouse will be enabled. (Be sure to load the mouse driver before bringing up the PCIP-DMM/A's setup display.) As you move the mouse around, you will see the red rectangular cursor move. Make your selection by moving the cursor to the parameter to be changed or to select the operating mode. Then "click" the mouse.

4.3 USING A KEYBOARD

Keyboard mode can be invoked by pressing the Mode Select Key combination (See Chapter 3.) or, if in mouse mode, by selecting the **Keyboard** mode option. The default Mode Select Key is Alt M. The selected parameter will flash and appear in reverse type. Each parameter or value is changed individually. Once the value has been changed, you must press ↵. Information describing the legal strokes for the current parameter will be displayed at the bottom of the menu.

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4.4 ON-LINE HELP

On-line Help is always available by pressing the Help Key combination. (Refer to Chapter 3.) The programmed key combination displays in the upper left corner of the Pop-Up Menu. The default Help Key combination is Alt H.

4.5 THE SET-UP PANEL

Before you try to access the Setup Panel, ensure that the device drivers and the PCIP-DMM/A itself have been installed according to the directions given in the previous chapters. Then, press the Pop-Up Key (Ctrl F1 or other programmed Pop-Up Key). Figure 4-1 shows the PCIP-DMM/A's Setup Panel.

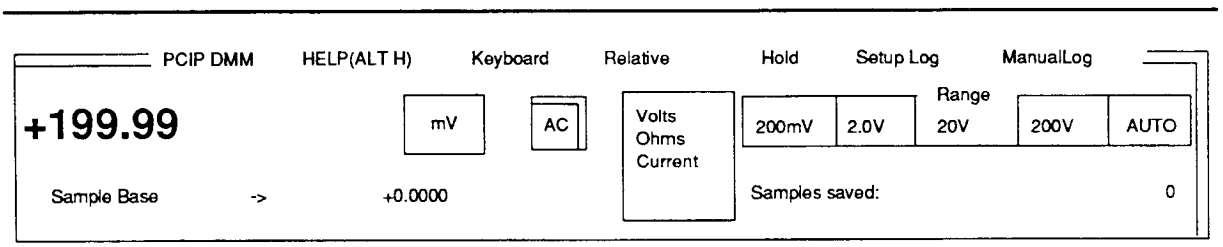


Figure 4-1. Setup Panel

> *NOTE*
> At this point, the data can only be changed by using the mouse. If you do not have a mouse installed, switch to keyboard entry by pressing the *Mode Select Key* combination. (Default is Alt M.) Refer to section 3.3 for more information regarding the *Mode Select Key*.

The Pop-Up Menu is divided into two sections. The main portion of the menu contains the PCIP-DMM/A's **Operating Parameters**. These are:

- **Current Type**
- **Unit of Measurement**
- **Range Select**

The **Operating Modes** are accessed by selecting the options on the top line.

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- **Keyboard**
- **Relative**
- **Hold**
- **SetupLog**
- **ManualLog**

The Operating Parameters and Operating Modes are discussed in detail below.

Operating Parameters

AC Selects the current type. Choices are AC or DC.

Volts
Ohms
Current Selects what type of measurement is to be taken. Choose voltage, resistance (ohms), or current.

Range The range is dependent upon the measurement type. Once the measurement type has been selected, an appropriate range is displayed. If AUTO is selected, the range is automatically set according to the signal.

Operating Modes

The PCIP-DMM/A's operating modes consist of:

Keyboard Enables keyboard control. When Keyboard is selected, the mouse is disabled and input is allowed from the keyboard only. To terminate keyboard entry and reactivate the mouse, press Esc.

Relative Enables/Disables Relative Mode. When enabled, a block cursor appears next to the **Relative** switch and a sample base value is prompted for. The 4 1/2 digit display now reflects values relative to the Sample Base value shown.

Hold Enables/Diasables Hold Mode. When enabled, a block cursor appears next to the **Hold** switch and the PCIP-DMM/A will maintain the current reading until this option is selected again.

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SetupLog Displays the PCIP-DMM/A Data Logging Panel. The Logging Panel is described in the following section.

ManualLog Logs the current reading to a file. This option can only be used when manual logging has been selected on the Data Logging Panel. See section 4.6. When selected, the current DMM reading is logged to the data file.

4.6 THE DATA LOGGING PANEL

When the **SetupLog** option is selected from the Setup Panel, the Data Logging Panel will appear. See Figure 4-2. This panel controls the operating parameters associated with data logging. Data can be logged either manually or automatically at a programmed interval. Data is logged to a specified file using the format described in Chapter 5.

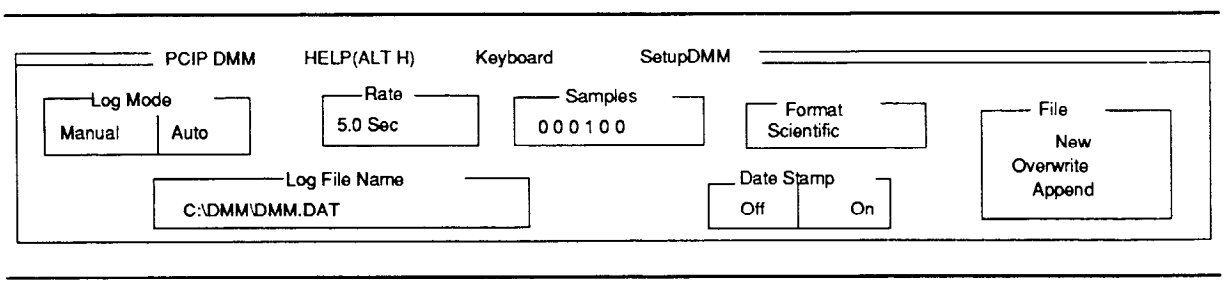


Figure 4-2. The Data Logging Panel

The **Keyboard** option works as described in the Setup Panel section. To return to the Setup Panel, select the **SetupDMM** option. The operating parameters are described below.

Log Mode Selects Automatic or Manual logging mode. Manual mode allows the operator to log the current sample reading to the data file when desired. The AUTOmatic mode lets the operator log a specified number of samples at a programmed rate to the current data file.

The default value is Manual.

Rate This is the sampling rate value. It can only be programmed in automatic logging mode. It specifies the time interval between successive sample

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readings to be saved. This value may be specified in seconds (0.5 - 99.9) or minutes (0.1 - 99.9). When in manual logging mode, this value is displayed as ***.

The default rate is 2.0 Sec.

Samples This specifies the total number of readings to store in the specified file. This option can only be programmed in automatic logging mode. The value can range from 1 to 999999 samples. In manual mode, this value is displayed as ***.

The default number of samples is 50.

Format This option selects the format in which sample readings are written to a file. This may be Scientific or Readout. If Scientific format is selected, data is written to the file in exponential notation. If Readout format is chosen, data is written to the file exactly as it appears on the display with the unit of measure appended.

The default format is Readout.

Log File Name This selects the file to which data is written. The specified filename can include a standard DOS drive and directory pathname.

The default filename is <current DOS drive and path>\DMM.DAT.

File This selects the file output mode. These are:

NEw - The specified file is new and will be created. The file cannot already exist.

OVerwrite - If the file to which data is to be written exists, the new data will be overwritten the existing data. If the file does not exist, it will be created.

Append - If the specified file already exists, the new data will be appended to it. Otherwise, the file will be created.

The default file mode is New.

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Date Stamp Enables(On) or Disables(Off) date stamping. The current date can be tagged to the sample record. The date is obtained from your computer's clock.

The default is Off.

4.7 LOGGING DATA

Logging can be done in either automatic or manual mode. The desired mode is selected using the Data Logging Setup Panel described in section 4.6. Data Logging is activated as follows:

Manual Data Logging

Select **ManualLog** from the Setup Panel, each time you want to log data.

Automatic Data Logging

Select **StartLog** from the Setup Panel. The Keyword menu list will change to offer these options **StopLog**, **Pause**, and **StartLog**. The Function and Range parameters cannot be changed while logging is occurring. The **Pause** option can be selected to suspend data logging. Data logging will resume when **Pause**or **StartLog** is chosen. Automatic Logging stops once the desired number of samples is reached or when **StopLog** is selected.

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CHAPTER 5
DATA FILE STRUCTURE

5.1 GENERAL

This chapter describes the format of the PCIP-DMM/A data file.

5.2 COMMENTS

All comment lines in the file are preceded by an asterisk(*). Thus, in a single line of a data file, all characters between the opening asterisk and the carriage return ([Enter]) are ignored during a read of the data-set.

5.3 DATA FILES

A *data file* contains one or more sets of data. The elements of these data sets are discussed in the following paragraphs. A commented example data file is given in section 5.4.

5.3.1 FILE HEADER

The data file header information is entered as comment lines into the file. The header provides such information as the number of samples taken, the mode in which they were taken, and the time and date when they were started.

There is only one file header per file, unless data is added to the file in the *append mode*. In this instance, each data set will have its own file header.

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A sample file header is shown in Figure 5-1.

```
* Instrument: PCIP-DMM
* Date:       08/27/90
* Time:       13:48:11
* Samples:    000005
* Log Mode:   Auto
* Units:      VDC
```

Figure 5-1. Data File Header

The fields included within the header are as follows:

`Instrument:` Specifies the name of the PCIP Instrument presently in use, as shown in the upper-left corner of the Pop-Up menu - for example, **`PCIP-DMM`**.

NOTE: This should be the same name assigned by the *PCIPMOD* program. Refer to Appendix A for more information.

`Date:` The date the samples were taken appears in the standard format **`mm/dd/yy`**, where: **`mm`** is month, **`dd`** is day, and **`yy`** is year. This date is logged from your computer's calendar.

`Time:` The time, at which the samples were started, appears in the format **`hh:mm:ss`** where **`hh`** is hours, **`mm`** is minutes, and **`ss`** is seconds. This time is logged from your computer's clock.

`Samples:` This field only appears when data has been logged automatically. It specifies the number of data samples which are to be recorded. The number can range from 1 to 999999.

`Log Mode:` This field will contain the mode in which the data was saved. If **`manual`** appears here, the data was logged manually. If **`auto`** is in this field, the data was saved automatically at a programmed time interval.

`Units` This field appears only when data has been recorded in Scientific format. It represents the units in which the data was measured - mVdc, Vac, etc.

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5.3.2 DATA SECTION

A sample of the data storage section of the file is shown in Figure 5-2. Each data record includes the number of the sample in sequence, the time the sample was taken, the date (if specified), and the value (with units if in readout mode).

```
.
.
.
* Log Mode:    Manual
000001  13:41:39.2  +000.05 VDC
.
.
000025  14:24:15.7  +000.06 VDC
* Units:       VDC
Start Data
000001  08/27/90  13:48:15.2  +0.2280E+0
000002  08/27/90  13:48:21.6  +0.2286E+0
000003  08/27/90  13:48:26.8  +0.2290E+0
End
.
.
.
```

Figure 5-2. Data Section of the Data File

Data records are printable ASCII records. Each record ends with the CR and LF characters. Data records are of the following format (Optional fields appear in this ***typeface***.).

xxxxxx ***mm/dd/yy*** **hh:mm:ss** **b.bbbbbb** ***r.rrrr*** **uuuu**

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Where:

`xxxxxx`	is the number of the reading. This is a sequential number which will range from 1 to 999999.
`mm/dd/yy`	is an optional date stamp field. The PCIP-DMM/A must be programmed to date stamp records for this data to appear. This field represents standard date format where: `mm` is month, `dd` is day, and `yy` is year. This date is logged from your computer's clock.
`hh:mm:ss.s`	is the time at which the data was taken. This time is provided by your computer's clock. This field represents standard time format, where: `hh` is hours, `mm` is minutes, and `ss.s` is seconds.
`b.bbbb`	is the actual sample reading. This will appear either in READOUT (+0.1000 mV) or SCIENTIFIC (+0.1000E-3) format, depending on which format was selected.
`r.rrrr`	is an optional field containing the programmed relative value. This value is displayed in either READOUT (+1.2345) or SCIENTIFIC (+1.2345E0) format, depending on which is selected for the actual sample reading.
`uuuu`	is the unit of current measurement. It is present in READOUT format only.

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5.4 DATA-SET FILE (SAMPLE)

The following data file (See Figure 5-3.) is a typical example of file structure and recorded data. Explanatory comments appear in this **Typeface**.

```
* Instrument: PCIP-DMM                          Begin File Header.
* Date:       08/27/90
* Time:       13:41:40
* Log Mode:   Manual
000001  13:41:39  +000.05 VDC
000002  13:41:41  +000.06 VDC                    Begin recording data in manual
000003  13:41:45  +000.05 VDC                    mode. Data is stored using Readout
000004  13:41:47  +000.06 VDC                    format.
000005  13:41:48  +000.05 VDC
000006  13:41:49  +000.06 VDC
000007  13:41:50  +000.06 VDC
000008  13:41:51  +000.06 VDC
* Instrument: PCIP-DMM
* Date:       08/27/90
* Time:       13:48:11                          File header for next set of data. (Ap-
* Samples:    000005                            pears only in File Append mode.)
* Log Mode:   Auto
* Units:      VDC
Start Data                                      Begin recording data (in Vdc) in
000001  08/27/90  13:48:15  +0.2280E+0           automatic mode. Data is stored in
000002  08/27/90  13:48:21  +0.2286E+0           Scientific format.
000003  08/27/90  13:48:26  +0.2290E+0
End
* Units: ADC                                    Change unit of measurement to Adc.
000004  08/27/90  13:48:41  +0.0002E-1
000005  08/27/90  13:48:46  +0.0002E-1
End
```

Figure 5-3. Example Data File

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CHAPTER 6
PROGRAMMING

6.1 GENERAL

This chapter discusses the language interface command. These are useful to programmers who intend to create custom data collection programs. The on-board registers are described in Appendix B.

The chapter begins by describing the Independent Language Interface. A series of ASCII commands allows you to control the operation of the PCIP-DMM/A from a program written in any of several languages. Each of the commands is described in detail. The description includes a synopsis of the command's function, its syntax, and a few examples illustrating its use.

The chapter also contains a short procedure for incorporating the commands into a program. Two sample programs, written in C and BASIC, are given.

6.2 LANGUAGE INDEPENDENT INTERFACE COMMANDS

The PCIP-DMM/A is provided with a language independent interface. To open the interface file, use the standard file open command for the language you are using and the filename "$DMM". Once the device file has been opened, commands are passed to the device in ASCII using whatever print or write instructions are available with the language. The commands which are used with the language interface are described below.

An example of opening the language interface file in BASIC is provided in Figure 6-1. Figure 6-2 provides a similar example using C.

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```
10    OPEN "$DMM" FOR OUTPUT AS #1
15    PRINT #1, "CLEAR"
20    OPEN "$DMM" FOR INPUT AS #2
30    ON ERROR 1000
40    PRINT #1,"SET 20 MV DC"
...
...
...
100   STOP


1000  REM TO RETRIEVE ERROR ONE MUST READ FROM THE DEVICE
1010  INPUT #2,N: LINE INPUT #2,A$: LINE INPUT#2,B$
'RETRIEVE ERROR NUMBER AND MESSAGE
1020  PRINT "DMM Error Message";N      'DISPLAY ERROR MESSAGE
1030  PRINT "ERROR = " B$
1040  PRINT "ON command line of ..";A$
```

Figure 6-1. Opening the Language Interface File in BASIC

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```
main ()
{
     if ((DMM = fopen("$DMM","r+")) == NULL) /*DMM.SYS Not Installed */
     {
          puts("Error Opening Device $DMM !!) ; exit(1);
     }
     if (!(fputs("Clear",DMM)) GetError() ; /*Clear device buffers */
     fclose(COUNT) ;
}
GetError() /*Get the Three Diagnostic Messages Here and Print Them */
{
rewind(COUNT); /* Rewind Puts Device into Input Mode */
/* Use fgets, not fscanf because fgets uses carriage return-line feed */
/* as delimiters between strings, fscanf uses blanks   */
if (fgets(ErrorNum,10,COUNT) == NULL) exit(77);
printf("\nError Number => %d", ErrorNum);
if (fgets(OrigCommand,128,COUNT) == NULL) exit(78);
printf("\nOriginalCommand => %s", OrigCommand);
if (fgets(ErrorExplain,128,COUNT) == NULL) exit(79);
printf ("\nError Explanation => %d",ErrorExplain);
rewind(COUNT) ;    /*Rewind Puts Device Back In Output Mode */
}
```

Figure 6-2. Opening the Language Interface File in C

Nomenclature Rules

This section presents a few nomenclature rules to bear in mind while reading the command descriptions:

(1) Anything appearing in curly brackets, (i.e, { }) is optional. Don't enter the curly brackets.

(2) Uppercase defines the command's key letters which are the minimum set to be used. Upper and lower case in use do not matter.

(3) Variables denoting parameters will be in *italics*.

(4) Multiple commands may appear on one command line.

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Commands

Table 6-1 provides a listing of all the Language Interface Commands.

NOTE: All READ commands require the use of an "input" command to obtain the return values.

Table 6-1. Language Interface Commands

Commands
CLear
HIde
HOld *ON,OFf*
LOck
OUt *ON, OFf*
REad FUnction
REad LOG MOde
REad LOG RAte
REad LOG SAmples SAved
REad LOG SAmples SEt
REad LOG FOrmat
REad LOG DAte
REad LOG FIle NAme
REad LOG FIle MOde
REad LOG STatus
REad RAnge
REad VAlue
REad RELative
REad DAte
SEt *range_value units current_type*
{SEt} LOG MOde *MAnual, AUto*
{SEt} LOG RAte *r*
{SEt} LOG SAmples *s*
{SEt} LOG FOrmat *SCientific, REadout*
{SEt} LOG DAte *OFf, ON*
{SEt} LOG FIle NAme *filename*
{SEt} LOG FIle MOde *NEw, OVerwrite, APpend*
{SEt} LOG REadout
{SEt} LOG *STArt, STOp*
{SEt} LOG PAuse *OFf, ON*
SEt RElative *N,ON,OFf*
SHow *{1,2, DMM, SETup}*
WAIT *ON,OFf*
UNLock

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CLEAR

This command clears the internal I/O buffers and current error conditions.

Syntax `CLear`

Parameters None.

Examples
```
clear
cl
clea
```

Associated Error Messages `51 Unknown character encountered`

HIDE

This command is used to remove an instrument's operating panel from the screen. If multiple instruments are installed, the panel appearing on the top will be hidden. Otherwise, the instrument last opened in the file, will be hidden.

Syntax `HIde`

Parameters None.

Examples
```
hid
```

Associated Error Messages `51 Unknown character encountered`

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HOLD

This command halts the PCIP-DMM/A from taking another measurement. The PCIP-DMM/A will maintain the current reading.

Syntax `HOld x`

Parameters *x* is the on/off parameter. When x is set to *OFF*, the PCIP-DMM/A operates normally. When x is set to *ON*, the PCIP-DMM/A will maintain the current reading and no other measurements will be performed.

Examples
```
hold on
```

Associated Error Messages
```
51  Unknown character encountered
61  Illegal word after HOLD
```

LOCK

This command disables keyboard and mouse data entry.

Syntax `LOck`

Parameters None.

Examples
```
loc
```

Associated Error Messages
```
51  Unknown character encountered
```


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OUT

This controls the reporting of errors when the current reading is out of range.

Syntax `OUt x`

Parameters `x` may be ON or OFf. When ON, the *read value* and *read relative* commands will return an error whenever the current reading is out of range. Otherwise, when OFf (default), the error return is suppressed.

Examples

```
OUT ON
```

Associated Error Messages

```
71  Unknown keyword detected; use ON or OFf.
```

READ DATE

Upon execution of this command, the date of the last calibration is returned by an input command.

Syntax `REad DAte`

Returns This command returns a character string representing the date on which the last calibration procedure was performed.

Examples

```
read da
```

Associated Error Messages

```
51  Unknown character encountered
55  Keyword requires READ before it
54  Illegal word after READ command
```


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READ FUNCTION

When this command is executed, an integer representing the type of function performed is returned.

Syntax `REad FUnction`

Returns Returned Integers and their meanings are as follows:

0 Vdc
1 Ohms
2 MAdc
3 Vac
4 MAac

Examples

```
re func
```

Associated Error Messages

```
51 Unknown character encountered
55  Keyword requires READ before it
54  Illegal word after READ command
```

READ LOG MODE

This command returns the current logging mode of the PCIP-DMM/A.

Syntax `REad LOG MOde`

Returns The returned character number can be one of the following:

0 if in manual mode
1 if in automatic mode

Examples

```
re log mo
```

Associated Error Messages

```
72   Unknown keyword following REad LOG command.
```


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READ LOG RATE

This command is allowed in automatic logging mode only. It returns the value of the current data log rate.

Syntax `REad LOG RAte`

Returns This returns a character string representing the current data log rate. That is, the interval (in seconds) between successive sample readings to be logged. This is a value between 0.5 and 5994.0 seconds.

Examples `re log ra`

Associated Error Messages

```
72   Unknown keyword following REad LOG command.
```

READ LOG SAMPLES SET

This command is allowed in automatic logging mode only. It returns the currently programmed number of samples which are to be logged.

Syntax `REad LOG SAmples SEt`

Returns Returns a character string representing the target sample count. This is a value between 1 and 999999.

Examples `re log sa SE`

Associated Error Messages

```
72   Unknown keyword following REad LOG command.
74   Unknown keyword detected; use SEt or SAved
```


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READ LOG SAMPLES SAVED

This command returns the number of current data log samples which have been saved to a file.

Syntax `RE LOG SAmples SAved`

Returns The command returns character string representing a value between 1 and 999999.

Examples `re log sam save`

Associated Error Messages

```
72   Unknown keyword following REad LOG command.
74   Unknown keyword detected; use SEt or SAved
```

READ LOG FORMAT

This command returns the currently selected format of data written to a logging file.

Syntax `REad LOG FOrmat`

Returns This routine returns a character number representing the format. This can be one of the following:

0 Scientific
1 Readout

See *Set Format* command description for more information.

Examples `re log fo`

Associated Error Messages

```
72   Unknown keyword following REad LOG command.
```


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READ LOG DATE

This command returns the current date stamping status.

Syntax `REad LOG DAte`

Returns The character number returned has the following meaning:

0 Off - Date stamping is disabled.
1 On - Date stamping is enabled.

Examples `REad LOG DAte`

Associated Error Messages
`72 Unknown keyword following REad LOG command`

READ LOG FILE NAME

This command returns the name of the file to which data is logged.

Syntax `REad LOG FIle NAme`

Returns The character string returned is the full filename, including the drive and pathname.

Examples `rea Log fi nam`

Associated Error Messages
`72 Unknown keyword following REad LOG command.`
`73 Unknown keyword detected; use NAme or MOde.`

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READ LOG FILE MODE

This command returns the current file logging mode.

Syntax `REad LOG FIle MOde`

Returns The character number returned represents the file mode status as follows:

0 New - Data is written to a new file.
1 Overwrite - New data is written over data in an existing file.
2 Append - Data is added to the end of an existing file.

Examples `REad LOG FIle MOde`

Associated Error Messages

`72 Unknown keyword following REad LOG command.`
`73 Unknown keyword detected; use NAme or MOde.`

READ LOG STATUS

This command returns the current data logging status.

Syntax `REad LOG STatus`

Returns The character number returned has the following meanings:

0 Manual Mode
1 Automatic Mode - Idle
2 Automatic Mode - Logging
3 Automatic Mode - Paused

Examples `re log st`

Associated Error Messages

`72 Unknown keyword following REad LOG command.`

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READ RANGE

When this command is executed, a value is returned by an input command which represents the range that the PCIP-DMM/A is set to.

Syntax `REad RAnge`

Returns The returned values have the following meanings:

0 (lowest) to 3 (highest) for volts
0 (lowest) to 2 (highest) for amps
0 (lowest) to 4 (highest) for ohms

Examples

```
re ra
rea range
read range
```

Associated Error Messages

```
51  Unknown character encountered
55  Keyword requires READ before it
54  Illegal word after READ command
```


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READ RELATIVE

This command returns the relative value of the reading.

Syntax `REad RELative`

Returns The character number returned represents the relative value of the sample (i.e, the measured value minus the base value).

Examples

```
re rel
read relative
rea relat
```

Associated Error Messages

```
51  Unknown character encountered
55  Keyword requires READ before it
54  Illegal word after READ command
79  Value specified or current reading is out of range
80  Relative measurements not allowed in Auto Range
```


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READ VALUE

This command returns the measured value of the reading.

Syntax `REad VAlue`

Returns A character number representing the value of the reading.

Examples
```
re va
rea value
```

Associated Error Messages
```
51  Unknown character encountered
55  Keyword requires READ before it
54  Illegal word after READ command
79  Value specified or current reading is out of range
```

SET LOG MODE

This command is used to select the Data Logging Mode.

Syntax `{SEt} LOG MOde x`

Parameters *x* can be AUtomatic or MAnual.

Examples

`Set log mode au`	Select auto mode.
`LOG MO MA`	Select manual mode.

Associated Error Messages
```
68  Unknown keyword detected; use MAnual or AUtomatic
70  Unknown keyword following LOG command
82  Operation not allowed when automatic logging is active.
```


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SET LOG RATE

Specifies automatic sample saving rate, in seconds.

Syntax `{SEt} LOG RAte r`

Parameters *r* is a value between 0.5 and 5994.0. This value is the elapsed time, in seconds, between samples to be logged.

NOTE: Rate values greater than 99.9 seconds are rounded down to the nearest 6-second multiple boundary and displayed as XX.X minutes.

Examples

`Set log rate 10.0`	Specifies 10.0 Sec rate.
`LOG RA 125`	Specifies 2.0 Min rate.

Associated Error Messages

```
70   Unknown keyword following LOG command
76   Number Out of Range; 0.5 <= r <= 5994.0 in seconds...
77   Operation not allowed in Manual Mode...
82   Operation not allowed when automatic logging is active.
```

SET LOG SAMPLES

This command defines the number-of-samples to save in automatic logging.

Syntax `{SEt} LOG SAmples s`

Parameters *s* is a value between 1 and 999999 samples.

Examples

`Set log samples 100`	Log 100 samples
`LOG SA 10`	Log 10 samples

Associated Error Messages

```
70   Unknown keyword following LOG command
75   Number Out of Range; 1 <= s => 999999...
77   Operation not allowed in Manual Mode...
82   Operation not allowed when automatic logging is active.
```


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SET LOG FORMAT

This command specifies the format of the data to be saved.

Syntax `{SEt}LOG FOrmat x`

Parameters *x* can be SCientific or REadout. Scientific format indicates that readings are saved as x.xxxxExx. REadout format saves data as it appears on the 4 1/2 digit display.

Examples

`set log format scien`	Data will be saved using the "scientific" format.
`log fo re`	Data will be saved as it appears on the display.

Associated Error Messages

```
70   Unknown keyword following LOG command
67   Unknown keyword detected; use SCientific or REadout
82   Operation not allowed when automatic logging is active.
```

SET LOG DATE

Enable/Disable Date Stamping of the saved data records.

Syntax `{SEt} LOG DAte x`

Parameters *x* can be OFf or ON, where OFf disables date stamping and ON enables date stamping.

Examples

`set log date on`	Enables date stamping.
`log da of`	Disables date stamping.

Associated Error Messages

```
70   Unknown keyword following LOG command
71   Unknown keyword detected; use ON or OFf.
82   Operation not allowed when automatic logging is active.
```


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SET LOG FILE NAME

Specifies the full DOS filename to be used to save sample data readings.

Syntax `{SEt} LOG FIle NAme filename`

Parameters ***filename*** is a standard DOS file name, including the drive and directory path name if necessary.

Examples

`Se log fi na c:\dmm\dmm.dat`	Specifies the file to be used for logging as the *dmm.dat* file existing in the dmm directory on the C drive.
`log file name a:\data.dat`	Specifies the file to be used for logging as the *data.dat* file existing in the root directory on the A drive.

Associated Error Messages

```
70   Unknown keyword following LOG command
73   Unknown keyword detected; use NAme or MOde.
```


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SET LOG FILE MODE

This command specifies the DOS file mode for writing to the log file.

Syntax `{SEt} LOG FIle MOde x`

Parameters *x* can be one of the following modes:

NEw - The specified file is new and will be created. The file cannot already exist.

OVerwrite - If the file which data is to be written to exists, the existing data will be overwritten with new data. If the file does not exist, it will be created.

Append - If the specified file already exists, the new data will be appended to it. Otherwise, the file will be created.

Examples

`set log fil mod over`	Sets file write mode to overwrite.
`log fi mo ap`	Sets file write mode to append.

Associated Error Messages

```
69   Unknown keyword detected; use NEw, OVerwrite, or
APpend.
70   Unknown keyword following LOG command
73   Unknown keyword detected; use NAme or MOde.
```


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SET LOG READOUT

This command is only used in manual mode. It logs the current reading to a file.

Syntax `{SEt} LOG REadout`

Parameters None.

Examples
```
set log readout

log re
```

Associated Error Messages
```
70   Unknown keyword following LOG command
78   Operation not allowed in Automatic Mode...
82   Operation not allowed when automatic logging is active.
```

SET LOG START/STOP

This command starts/stops automatic data logging.

Syntax `{SEt} LOG x`

Parameters *x* can be STArt or STOp.

Examples

`set log start`	Start automatic data logging.
`log sto`	Stop automatic data logging.

Associated Error Messages
```
70   Unknown keyword following LOG command.
77   Operation not allowed in Manual Mode...
```


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SET LOG PAUSE

This enables the pause/resume function for automatic logging.

Syntax `{SEt} LOG PAuse x`

Parameters *x* can be ON (pause) or OFf (resume).

Examples

`set log pause on`	Enables pause function.
`log pa of`	Resumes automatic data logging.

Associated Error Messages

```
70   Unknown keyword following LOG command
71   Unknown keyword detected; use ON or OFf.
77   Operation not allowed in Manual Mode...
81   Pause is allowed only when auto logging is active.
```


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SET RANGE

This command is used to select the range of the signal.

Syntax `{SEt} range_value units current_type`

Parameters

range_value is the numeric value of the voltage, current , or resistance range. Allowed values are *2*, *20*, *200*, or *Auto*. Auto allows the range to be automatically selected.

units is the units in which the voltage, current, or resistance is measured. Units can be defined as *MV* (millivolts), *V* (Volts), *MA* (milliamps), *O* (ohms), *KO* (killiohms), and *MO* (megaohms).

current_type is the type of current or voltage. Choices are *A* (ac) or *D* (dc).

Examples

`set 20 v Ac`	Sets the range to 20V ac.
`set au ma`	The range is auto ranging mA.
`20 KO`	Sets the range to 20 Kohm.

Associated Error Messages

```
51   Unknown character encountered
52   Invalid range setup parameters
58   Illegal voltage range
59   Illegal current range
60   Illegal ohm range
82   Operation not allowed when automatic logging is active.
```


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SET RELATIVE

This command sets the relative value for the measurement. The relative value is subtracted from the actual value.

Syntax `{SEt} RELative N`

Parameters **N** is the offset value, ON, or OFF. **The offset value** is the amount to be subtracted from or added to the value. Offsets can be in the following ranges:

-1.9999E2 to +1.9999E2 volts
-1.9999e-1 to +1.9999e-1 amps
-1.9999e6 to +1.9999e6 ohms

OFF and **ON** are used to disable or enable the relative mode, where *OFF* disables relative mode and *ON* enables relative mode.

Examples

`Relative OFF`	Disables relative mode.
`Relative On`	Enables relative mode. Because no offset value has been specified, the last absolute value read is used as the offset value.
`Rel 2.301`	Enables relative mode and uses 2.301 as the offset value.

Associated Error Messages

```
51   Unknown character encountered
79   Value specified or current reading is out of range
82   Operation not allowed when automatic logging is active.
83   Unknown keyword detected; use ON, OFf or <number>
```


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SHOW

This command forces the setup panel or the logging panel to appear on the screen.

Syntax `SHow {[x]}`

Parameters `x` can be 1, 2, DMM, or SETup. If 1 or DMM are selected, the main setup panel will appear. If 2 or SETup are used, the logging panel will appear. If no parameter is specified, the main setup panel is displayed.

Note: If `Show 2` or `Show SETup` is specified while automatically logging data, it is ignored.

Examples `show` Displays main setup panel.

Associated Error Messages `51 Unknown character encountered`

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UNLOCK

This command enables keyboard and mouse data entry.

Syntax `UNLock`

Parameters None.

Examples `UNL`

Associated Error Messages `51 Unknown character encountered`

WAIT

This command is useful for logging data and insuring that each data point represents a true measurement and not just the most recent result (which could have already been reported).

Syntax `WAIT x`

Parameters `x` can be ON or OFF. If the wait command is enabled (ON), the value returned by a *Read Value* command and an input will be new. If not (OFF), the value may be from a prior reading.

Examples
```
wait on
```

Associated Error Messages `51 Unknown character encountered`

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6.3 DIRECT SCREEN I/O

The *VI.SYS* driver is designed to maintain all of the MetraByte's Virtual Instruments' (PCIP-DMM/A, PCIP-CAL, PCIP-SST, etc.) visual characteristics. *VI.SYS* accomplishes this by intercepting and interpreting all INT 10h calls which would affect visible display instruments. Any program which uses DOS or INT 10h's to display data will not interfere with the way the visible instruments are displayed. If, however, a program which performs direct screen I/O (i.e., writes directly to the display's memory), is being used, the visible screen will be overwritten. The instrument screen can be redrawn by first "popping-down" the screen, then "popping-up" the screen. The instrument itself will be unaffected.

Most programs written in *BASIC* will not execute a direct screen I/O. It should be noted, however, that some BASICs perform a direct screen I/O when scrolling up the screen. In this instance, pop the instrument down (with a Hide) before the scroll occurs.

Programs written in *MS QuickC* will not change to the system screen unless there has been a write to the screen. If the Show command is used to pop-up the instrument before any normal screen I/O has occurred, the instrument will display over the QuickC screen, rather than the system screen.

BASIC files Specification

If BASICA is loaded without any command line switches, there will be only 3 files permitted to be open at one time. Since the instrument require two files to be open (1 for output and 1 for input) it may be necessary for your program to have more than 3 files. To do this, enter:

`BASIC \fn` where **`\fn`** is the number of files (up to 16).

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Microsoft C

If the PCIP-DMM/A is opened for reading and writing as below:

```
FILE *DMM;
DMM = fopen( "$DMM", "r+");
```

It is important to execute a rewind command between an input and output or an output and input command to the PCIP-DMM/A. In addition, in Microsoft C, it is necessary to issue a **`fflush ()`** command after the **`fprint()`** to ensure that the command is flushed from DOS' buffer immediately.

6.4 PROGRAMMING HINTS

This section provides a few programming hints for using the PCIP-DMM/A device driver with high-level languages such as Microsoft C (4.0 and higher), TURBO C (1.0, 1.5), Microsoft PASCAL (3.0. 3.3 and 4.0), and TURBO PASCAL (4.0 - 5.x). Each section gives specifics regarding opening the device, I/O operations, and handling error strings. An example program is given for each language.

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Microsoft C (Versions 4.0, 5.0, 5.1)

Keep the following rules in mind when creating application programs in Microsoft C.

Opening a Device

1. Use the **`fopen()`** function with the **`r+`** file mode parameter.

I/O Operations

1. In versions 5.0 and higher, before switching between read and write operations, call the **`rewind()`** function.

2. Strings are *OUTPUT* using the **`fprintf()`** function.

3. Use the **`fgets()`** to *INPUT* strings.

4. After each **`fprintf()`**, be sure to call **`fflush()`**. This will flush the output buffer and write an output string immediately. Otherwise, the output strings will be buffered and the device may fail due to overflow.

Error Strings

1. When **`fflush()`** is called, an EOF will be returned if a write error occurred.

2. The driver can return any of three diagnostic error strings. These are terminated by a CR,LF or newline sequence.

3. Note that the **`fscanf()`** function will not execute correctly due to the whitespace (blanks, line-feeds) contained in the returned diagnostic error strings. Use **`fgets()`** instead. This function treats the CR,LF sequence as string delimiters.

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Examples

```
main()                                  /*Opening the Device for I/O*/
{
  FILE *DMM;
  if ((DMM = fopen("$DMM", "r+")==NULL)
  {
     printf("Error Opening Device \n");
     exit(-1)
  }
  .
  .
}
-------------------------------------------------------------------------

OutCommand(CommandString)               /* A Function That Outputs */
char *CommandString;                    /* A String of Commands to */
{                                       /* a Device called DMM */
  fprintf(DMM, "%s  \n", CommandString);
  if (fflush(DMM) == EOF) GetError();
}

-------------------------------------------------------------------------

#define MaxErrorSize 255                /* longest possible error string*/
CalInputString(StringPointer)           /* A Function That Inputs */
char * StringPointer;                   /* A String of ASCII characters*/
{                                       /*From Device DMM */
rewind(DMM);                            /*(5.0 and above)/
                                        /* Prepares DMM for input*/
if(fgets(StringPointer, MaxErrorSize,DMM) == NULL)
{
  printf("Error - End of Input detected in Device DMM)\n");
  exit(-1);
}
  rewind(DMM);                          /*(5.0 and above)*/
                                        /*Prepares DMM for output*/
}
```


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TURBO C (Versions 1.x - 2.0)

The following suggestions apply to application programs written in TURBO C.

Opening a Device

1. Use the `fopen()` function with the `r+` file mode parameter.

I/O Operations

1. Don't use `rewind()` to switch from Input to Output mode. Instead, use `fclose()` and then re-open the file.
2. Strings are *OUTPUT* using the `fprintf()` function.
3. Use the `fgets()` to *INPUT* strings.
4. After each `fprintf()`, be sure to call `fflush()`. This will flush the output buffer and write an output string immediately. Otherwise, the output strings will be buffered and the device may fail due to overflow.

Error Strings

1. When `fflush()` is called, an EOF will be returned if a write error occurred.
2. The driver can return any of three diagnostic error strings. These are terminated by a CR,LF or a newline sequence.
3. Note that the `fscanf()` function will not execute correctly due to the whitespace (blanks, line-feeds) contained in the returned diagnostic error strings. Use `fgets()` instead. This function treats the CR,LF sequence as string delimiters.

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Examples

```
main()                                  /*Opening the Device for I/O*/
{
  FILE *DMM;
  if ((DMM = fopen("$DMM", "r+")==NULL)
  {
     printf("Error Opening Device \n");
     exit(-1)
  }
  .... other code here....}

-------------------------------------------------------------------------


OutCommand(CommandString)               /* A Function That Outputs */
char *CommandString;                    /* A String of Commands to */
{                                       /* a Device called DMM */
  fprintf(DMM, "%s  \n", CommandString);
  if (fflush(DMM) == EOF) GetError();
}

-------------------------------------------------------------------------

#define MaxErrorSize 255                /* longest possible error string*/
CalInputString(StringPointer)           /* A Function That Inputs */
char * StringPointer;                   /* A String of ASCII characters*/
{                                       /* From Device DMM */

  fclose(DMM);
  if ((DMM = fopen("$DMM", "r+")==NULL)
{
     printf("Error Opening Device \n");
     exit(-1)
  }
if(fgets (StringPointer, MaxErrorSize,DMM)==NULL)
{                                       printf("Error - End of Input in Device
DMM");
     exit(-1);}
  fclose (DMM); fopen(DMM, "r+");

}
```


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Microsoft PASCAL (Version 3.0, 3.3, 4.0)

Rules for creating programs in Microsoft PASCAL are described below.

Opening a Device

1. One file variable, "*x*" should be *ASSIGN*ed for both input and output.
2. Set the MODE field for file "*x*" to *DIRECT*.
3. Declare file "*x*" globally as *VAR X : Text(127);*

I/O Operations

1. Use *Writeln* to write commands to the device rather than *write*.
2. If an error occurs after an I/O operation has been executed, the ERRS field for file "*x*" will be non-zero.
3. After an error occurs, the ERRS field for file "*x*" must be cleared.
4. To detect runtime errors, the TRAP field for file "*x*" must be set.
5. You must use a *SEEK(X,1);* to rewind the file before any read or write is performed.

Error Strings

1. The driver can return any of three diagnostic error strings. These are terminated by a CR,LF.
2. Use *Readln* to read diagnostic strings, not *read*.
3. You must use a *SEEK(X,1);* to rewind the file before any read or write is performed.

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Examples

```
FUNCTION InputString(var Str:LSTring):integer;(* Returns 1 if error
occurs*)
var Result     :integer     ;
BEGIN   X.ERRS  :=0;        (*Input A String From The Device*)
        X.TRAP  :=TRUE;
        Seek(X,1);
        Readln(X,STR)   ;
        IF (X.ERRS <> 0) Then InputString := 1 else InputString :=0;

END;

------------------------------------------------------------------------


PROCEDURE GetError ;        (*Fetch the Three Diagnostic Strings*)
BEGIN                       (*That the Device Driver Returns)
     clearscreen;
     Seek (X,1);            (*Rewinds File and Flushes Previous Contents*)
     X.ERRS :=0;            (*Clear I/O Error Flag Before All File Ops*)
     X.TRAP :=TRUE;         (*Trap Errors Instead of Exit to DOS*)
     readln(X,ErrNum);
     readln(X,AStr);
     readln(X,BStr);
     writeln(char(7), (*BELL*) 'Driver Error Has Occurred !!');
     writeln('              1. Device Error Number ⇒ 'ErrNum);
     writeln('              2. Error ⇒ ', BStr);
     writeln('              3. On Command Line of ⇒ ', Astr);
END;

------------------------------------------------------------------------

PROCEDURE  OutputCommand (STR:String[128]);
BEGIN
  writeln(X,Str);
  if(X.ERRS <> 0) Then GetError; (*Call Error Handling Routine*)
END;

------------------------------------------------------------------------

BEGIN                       (*This would be the beginning of the main pro-
gram*)
  Assign(X,'$DMM')          (*Open a Device Driver called $DMM for Input *)
  Assign(X,'$DMM')          (*Open a Device Driver called $DMM for Output*)
  Reset(X);                 (*Input, PASCAL has no read/write text files *)
  Rewrite(X);               (*Output, see above*)
```


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TURBO PASCAL (Version 4.0, 5.x)

The following suggestions apply to application programs written in TURBO PASCAL.

Opening a Device

1. One file variable should be *ASSIGN*ed for input and another for output.
2. The *INPUT* file variable should be *RESET*.
3. *REWRITE* the *OUTPUT* file variable.

I/O Operations

1. Use *Writeln* to write commands to the device rather than *write*.
2. If an error occurs after an I/O operation has been executed, the IOResult will be non-zero.

Error Strings

1. The driver can return any of three diagnostic error strings. These are terminated by a CR,LF.
2. Use *Readln* to read diagnostic strings, not *read*.

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Examples

```
FUNCTION DeviceInputString(var Str:String[255]):integer;
BEGIN

  Readln(DMMIN,Str);
if  (IOResult <> 0) then DeviceInputString := 1(*Error in Read*)
else     DeviceInputString := 0;
END;

------------------------------------------------------------------------

PROCEDURE GetError ;      (*Fetch the Three Diagnostic Strings*)
BEGIN                     (*That the Device Driver Returns)

  readln(DEVIN,ErrNum);
  readln(DEVIN,AStr);
  readln(DEVIN,BStr);
  writeln(char(7), (*BELL*) 'Driver Error Has Occurred !!');
  writeln('               1. Device Error Number ⇒ 'ErrNum);
  writeln('               2. Error ⇒ ', BStr);
  writeln('               3. On Command Line of ⇒ ', Astr);
END;


------------------------------------------------------------------------

PROCEDURE  OutputCommand (STR:String[128]);
BEGIN
  writeln(DEVOUT,Str);
  if(IOResult <> 0) Then GetError; (*Call Error Handling Routine*)
END;

------------------------------------------------------------------------

BEGIN                     (*This would be the beginning of the main pro-
gram*)
  Assign(DEVIN,'$DMM')    (*Open a Device Driver called $DMM for Input *)
  Assign(DEVOUT,'$DMM')   (*Open a Device Driver called $DMM for Output*)
  Reset(DEVIN);           (*Input, PASCAL has no read/write text files *)
  Rewrite(DEVOUT);        (*Output, see above*)
```


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CHAPTER 7
MAINTENANCE AND REPAIR

7.1 GENERAL

This chapter provides instructions for verifying that the PCIP-DMM/A is performing accurately. Additionally, calibration procedures, recommended test equipment, warranty information, and return-to-factory instructions are given.

7.2 TEST EQUIPMENT

Recommended equipment for calibrating and testing the PCIP-DMM/A is listed in the table below. Alternate equipment may be used, assuming equipment accuracy is at least equal to the specifications listed in Table 7-1.

Table 7-1. Test Equipment Specifications

Manufacturer	Model #	Description	Specifications
EDC	520A	Precision DC Voltage Calibrator	Voltage Ranges: -199 to 199 Vdc Accuracy: 0.001%
EDC	4503	Precision AC Voltage Calibrator	Voltage Ranges: 0 to 100 Vac
EDC	PCS-2B with 520A for mADC 4503 for mAAC	Precision AC/DC Current Calibrator	Current Ranges: 0.3000 to 190.00 mADC and mAAC
Keithley	191	5 1/2 digit Multimeter	
		Resistors Approx Values: 50, 100, 300 Ohms 1.9, 3, 19, 30, 190, 300, 1900 KOhms	

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7.3 PERFORMANCE VERIFICATION

This section contains the information necessary to verify that the PCIP-DMM/A's performance is within specified accuracy. (Specifications are contained in section 1.3 of this manual.) Ideally, performance verification should be performed when the instrument is first received to ensure that no damage or change in calibration has occurred during shipment. The verification procedures may also be performed whenever the instrument accuracy is suspect or following calibration. If performance on any of the ranges or functions is inconsistent with specifications, calibration should be performed as described in the previous section.

WARNING

The following procedures require that high voltages may be applied to the input terminals of the PCIP-DMM/A. Obey standard safety precautions to avoid possible electrical shock which could result in personal injury or death.

7.3.1 DC Voltage Accuracy Check

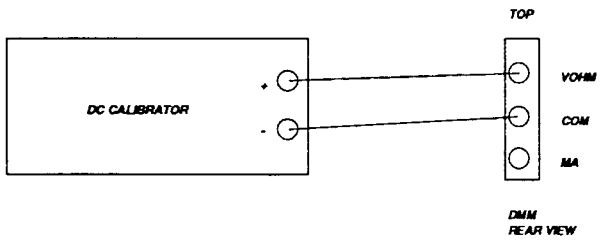


Figure 7-1. Connection of DC Calibrator to PCIP-DMM/A

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CAUTION

Do not exceed 250 V between the input HI and LO terminals. Damage to the instrument may occur.

1. Select the 200mV dc range.

2. Connect the calibrator to the PCIP-DMM/A boards as shown in Figure 7-2.

3. Set the calibrator to 0V and enable the REL mode. Check to see that the reading is 0.00 mV ± 0.01 mV.

4. Apply a positive 100 mV to the HI and LO input terminals. The reading must be within the limits specified in Table 7-2.

5. Select the 2 Vdc range on the PCIP-DMM/A. Set the calibrator to output 0 V and enable the relative (REL) mode. Check to see that the reading is 0.0000 V ± 0.0001V.

6. Apply a positive 1.0000 V to the HI and LO input terminals. The reading must be within the limits specified in Table 7-2.

7. Select the 20V dc range on the PCIP-DMM/A. Set the calibrator to output 0V and enable the relative (REL) mode. Check to see that the reading is 0.000 V ± 0.001 V.

8. Apply a positive 10.000 V to the HI and LO input terminals. The reading must be within the limits specified in Table 7-2.

9. Select the 200 Vdc range on the PCIP-DMM/A. Set the calibrator to output O V and enable the relative (REL) mode. Check to see that the reading is 0.00 V ± 0.01 V.

10. Apply a positive 50.00 V to the HI and LO INPUT terminals. The reading must be Within the limits specified in Table 7-2.

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Table 7-2. DC Voltage Readings

PCIP-DMM/A Range	Applied DC Voltage	Allowable Readings
200 mV	100 mV	99.85 to 100.015
2 V	1.000 V	0.9995 to 1.0005
20 V	10.000 V	9.995 to 10.005
200 V	50.000 V	49.91 to 50.09

7.3.2 AC Voltage Check

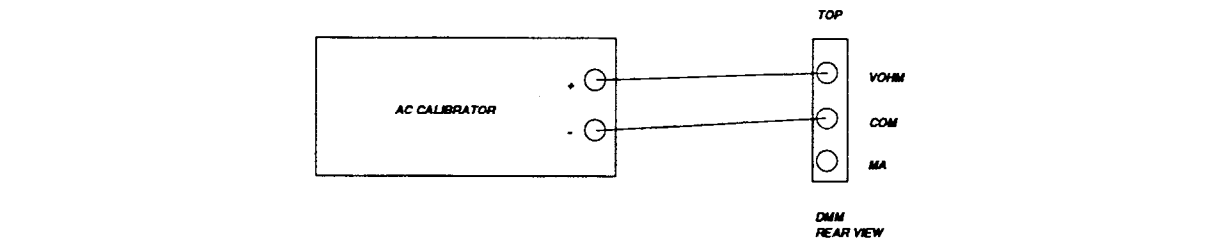


Figure 7-2. Connection of AC Calibrator to PCIP-DMM/A

To check the AC Voltage

1. Select the 200mV Ac range.

2. Connect the AC calibrator the HI and LO INPUT terminals of the PCIP-DMM/A as shown in Figure 7-3.

3. Set the calibrator to output 100.00 mVac at a frequency of 100 Hz. Verify that the reading is within the limits specified in Table 7-3.

4. Repeat the 100.00 mV ac measurement at a frequency of 1000 Hz.

5. Check the 2V, 20V, and 200V ranges by first setting the zero for the particular range (similar to the procedure described in step 3 above) and then applying the required voltage and frequency specified in Table 7-3 and verifying that the readings are within the specified limits.

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Table 7-3. PCIP-DMM/A AC Voltage Range

PCIP-DMM/A Range	Applied AC Voltage	Allowable Readings	
		100 Hz	10 KHz
200 mV 2 V 20 V 200 V	100.00 mV 1.000 V 10.000 V 90.00 V	99.00 to 101.00 0.9900 to 1.0100 9.900 to 10.100 89.00 to 91.00	97.00 to 103.00 .9700 to 1.0300 9.700 to 10.300 87.30 to 92.70

7.3.3 Resistance Accuracy Check

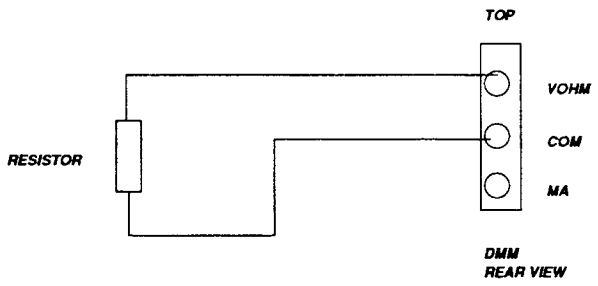


Figure 7-3. Connection of Calibration Resistor

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1. Select the ohms function and the 200 Ohm range.

2. Connect the test leads to the PCIP-DMM/A input HI and LO terminals. Short the leads together. Enable the relative (REL) mode. Check to see that the display reads 000.00.

3. Connect a 190 Ohm calibration resistor as shown in Figure 7-4.

4. Check to see that the displayed reading is within the limits specified in Table 7-4.

5. Check the 2K, 20K, 200K, and 2 MOhm ranges by first setting the zero on the particular range (similar to the procedure described in step 2 above) and then by applying the required value specified in Table 7-4 and verifying that the readings are within the specified limits.

Table 7-4. Resistance Readings

PCIP-DMM/A Range	Applied Resistance	Allowable Readings
200 Ohms	190 Ohms	189.92 to 190.08
2 KOhms	1.9 KOhms	1.8992 to 1.9008
20 KOhms	19 KOhms	18.992 to 19.008
200 KOhms	190 KOhms	189.92 to 190.08
2 MOhms	1.9 MOhm	1.8992 to 1.9008

7.3.4 AC Current Accuracy Check

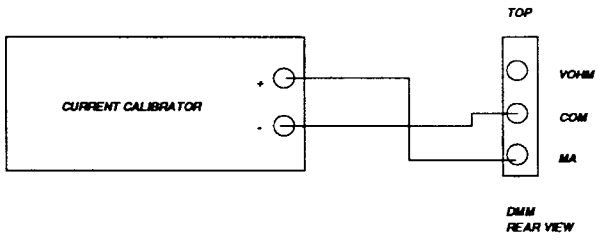


Figure 7-4. Connection of AC Current Calibrator to PCIP-DMM/A

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CAUTION

Do not exceed 1 amp to the MA and COM INPUT terminals or the protection fuse will blow.

1. Select the AC MA function. Select the 2 mA range.

2. Connect the AC current calibrator to the PCIP-DMM/A as shown in Figure 7-5. The HI side of the calibrator should be connected to the MA connector on the PCIP-DMM/A and the LO side of the calibrator should be connected to the COM connector of the PCIP-DMM/A.

3. Disable the relative (REL) mode. Set the calibrator to output 0.7000 mA at a frequency of 100 Hz. Verify that the displayed reading is within the limits specified in Table 7-5.

4. Select the 20 mA range on the PCIP-DMM/A. Set the calibrator to output 7.000 mA at a frequency of 100 Hz. Verify that the displayed reading is within the limits specified in Table 7-5.

5. Select the 200 mA range on the PCIP-DMM/A. Set the calibrator to output 70.00 mA at a frequency of 100 Hz. Verify that the reading is within the limits specified in Table 7-5.

Table 7-5. AC Current Values

PCIP-DMM/A Range	Applied AC Current (100 Hz)	Allowable Readings
2 mA	0.7000 mA	0.6930 to 0.7070
20 mA	7.0000 mA	6.930 to 7.070
200 mA	70.00 mA	69.30 to 70.70

7.3.5 DC Current Accuracy Check

CAUTION

Do not exceed 0.5 amp to the MA and COM INPUT terminals or the protection fuse will blow.

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1. Select the DC MA function. Select the 2 mA range.

2. Connect the DC current calibrator to the PCIP-DMM/A as shown in Figure 7-5. The HI side of the calibrator should be connected to the MA connector on the PCIP-DMM/A and the LO side of the calibrator should be connected to the COM connector of the PCIP-DMM/A.

3. Set the calibrator to 0.0000 mA.

4. Verify the displayed reading is 0.0000 ± 0.0001.

5. Set the calibrator to output 1.0000 mA. Verify that the displayed reading is within the limits specified in Table 7-6.

6. Select the 20 mA range on the PCIP-DMM/A. Set the calibrator to output 0.000 mA and enable the relative (REL) mode. Verify that the displayed reading is 0.000 ± 0.001.

7. Set the calibrator to output 10.000 mA. Verify that the displayed reading is within the limits specified in Table 7-6.

8. Select the 200 mA range on the PCIP-DMM/A. Set the calibrator to output 0.00 mA and enable the relative (REL) mode. Verify that the reading is 0.00 ± 0.01.

9. Set the calibrator to output 100.00 mA. Verify that the displayed reading is within the limits specified in Table 7-6.

Table 7-6. DC Current Values

PCIP-DMM/A Range	Applied DC Current	Allowable Readings
2 mA	1.0000 mA	0.9970 to 1.0030
20 mA	10.000 mA	9.970 to 10.030
200 mA	100.00 mA	99.70 to 100.30

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7.4 CALIBRATION

Calibration of the PCIP-DMM/A is performed at the factory prior to shipment. It is recommended, however, the PCIP-DMM/A be re-calibrated every 6 months. This will ensure that measurements remain accurate.

A calibration program (*CALDMM.EXE*) is provided on the PCIP-DMM/A Distribution Disk. This provides a step by step guide to calibrating the PCIP-DMM/A. The program calibrates each of the nineteen different PCIP-DMM/A ranges and functions and store the calibration constants in the PCIP-DMM/A's non-volatile memory. Be sure to archive the original constants to a disk file, using the *UTILITY.EXE* program found on the PCIP-DMM/A Distribution Disk. (Refer to section 3.6 for more information regarding this program.)

To start the calibration program:

1. Make sure you are in the correct directory. At the DOS prompt, type:

   ```
   CALDMM
   ```

2. The Start-Up screen pictured in Figure 7-5 will appear. Follow the directions given on this screen and the subsequent screens. You may wish to refer to Figure 7-1. Note that the procedure outlined are similar to the ones for performance verification. Skim the previous section prior to beginning calibration.

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```
USER CALIBRATION PROGRAM FOR THE PCIP-DMM

This program will allow the user to calibrate any or all of the
following PCIP-DMM functions:

1.  DC Voltage
2.  AC Voltage
3.  DC Current
4.  AC Current
5.  Resistance

      Calibration of each function above does not actually enter the
calibration  factors into the PCIP-DMM's non-volatile memory.  This is
done when the user selects the 'EXIT TO DOS' option from the menu.
At that time, the user is given the option of storing the calibration
constants and exiting to DOS or abandoning the new calibration
constants and returning to DOS.

      Before attempting a calibration, be sure to archive the present
calibration on disk.  This can be done by running the program
UTILITY.EXE supplied on the PCIP-DMM diskette.  Any calibration that
has been archived, can be restored after using the same UTILITY.EXE program.
```

Figure 7-5. CALDMM Start-Up Screen

7.5 FUSE REPLACEMENT

A protection fuse is mounted in a fuse holder which is accessible at the PCIP-DMM/A's mounting plate. If this fuse should blow, replace it with a 5 x 20 mm, 250 V, 0.5 Amp fuse. To replace the fuse, pull the blown fuse out of the metal holders. Push the new fuse into the holder, making sure that it is seated securely.

7.6 WARRANTY INFORMATION

All products manufactured by MetraByte are warranted against defective materials and workmanship for a period of **one year** from the date of delivery to the original purchaser. Any product that is found to be defective within the warranty period will, at the option of MetraByte, be repaired or replaced. This warranty does not apply to products damaged by improper use.

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CAUTION

MetraByte Corporation assumes no liability for damages consequent to the use of this product. This product is not designed with components of a level of reliability suitable for use in life support or critical applications.

7.7 RETURN-TO-FACTORY INFORMATION

Before returning any equipment to the factory for repair, you must first call the Technical Support Department at (508) 880-3000. They will try to diagnose and solve your problem over the phone. If they ascertain that the unit has to be returned to the factory for repair, they will issue a Return Material Authorization (RMA) number. Note that if the board is to be repaired under warranty, the Technical Support Department will need your invoice number and the date the board was purchased. Please reference the RMA number on any correspondence regarding the board.

When returning the Board for repair, please include the following information:

1. A brief description of the problem.

2. Your name, address, and telephone number.

3. The invoice number and the date when the board was purchased.

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4. Re-package the board in its original anti-static wrapping (Handle it with ground protection.) and ship it back to:

Repair Department
Keithley MetraByte Corporation
440 Myles Standish Boulevard
Taunton, Massachusetts 02780

Telephone:(508)880-3000
Telex:503989
FAX:(508)880-0179

Be sure to reference your RMA number on the outside of the package!

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APPENDIX A
INSTALLING MULTIPLE PCIP-TYPE INSTRUMENTS

PCIPMOD.EXE is a utility program which enables you to create unique drivers for each PCIP type board in your application. In general, the *PCIPMOD.EXE* utility should be run if you have installed multiple MetraByte PCIP-type products in one computer.

> ***NOTE***
> If two or more drivers for the same device type are to be loaded, define different Hot Keys (See Chapter 3) for each menu. This will allow you to display several Pop-Up Menus at once.

Using PCIPMOD.EXE

Table 1 names the PCIP device type supported by *PCIPMOD.EXE*:

Table 1. Devices and their SHOWNAMES

SHOWNAME	DEVICE NAME	DESCRIPTION
PCIP-AWFG	$AWFG	Arbitrary Waveform Generator
PCIP-DMM	$DMM	Digital Multimeter
DAS-50	$DAS50	High-speed Data Acquisition Interface
PCIP-CNTR	$COUNT	Frequency Counter/Timer
PCIP-CAL	$CAL	Voltage Calibrator
PCIP-SCAN	$SCAN	8/16 Channel Scanner/Multiplexer
PCIP-SCOPE	$SCOPE	Sampling Oscilloscope
PCIP-RES	$RES	Programmable Resistor Network
PCIP-SST	$SST	Sine/Square/Triangle Wave Source

To use *PCIPMOD.EXE*:

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1. Change to the device directory containing *PCIPMOD.EXE*. At the DOS prompt, type:

```
PCIPMOD
```

The program will open, as follows:

```
This program will modify the ORIGINAL PCIP Driver's
1)   Name that is to be used to Open the device
2)   Name that is displayed in the upper left corner of
     the instrument when the instrument is visible

Enter the name of the ORIGINAL driver to be modified.  Please
include the entire path name and drive where the device can now
be found. For example, ... C:\xxx\DAS50DRV.SYS

ENTER DEVICE TO MODIFY
```

2. Enter the name of and path to the ORIGINAL device driver file. For example, if you have two PCIP-DMM's and the PCIP-DMM driver files are loaded on the D: drive under the directory PCIP, enter:

```
d:\pcip\dmmdrv.sys
```

3. You will now be prompted for the new DEVICE NAME (See Table 1 for existing ones) as follows:

```
The current name used to open the device is        $DAS50
Enter the Name to be used for opening the device
```

Enter any name, up to eight characters long. You must include the $. For example, you could name the device `$MYDEV1`.

4. The program then prompts for the SHOWNAME (See Table 1 above.) of the original device:

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```
The current name use for the instrument popup is     PCIP-DMM
Enter the new name to be used.  This name can not be longer than
7 characters
```

Enter the new SHOWNAME. (This is the name which appears in the upper-left corner of the pop-up menu.) Be sure not to exceed 7 characters. For example, you could enter **dev1**.

5. You will then be prompted for the new driver filename and its path:

```
Enter the name to be used for the New Driver.  Please include the
drive and complete path of where the driver is to be placed.
```

Give the new filename making sure to include the correct path, i.e.: **C:\PCIP\DEVDR1.SYS**.

When the driver creation process has been completed, the message **NEW DEVICE HAS BEEN SUCCESSFULLY WRITTEN** will appear.

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APPENDIX B
REGISTER DESCRIPTIONS

Table B-1 lists and describes the Registers and their base offsets. More detailed information regarding each register is provided in the paragraphs following the table. It should be noted that RO is used to denote Read Only Registers and WO is used to denote Write Only Registers.

It is recommended that the user not utilize these registers directly; but, instead, run the software provided on the PCIP-DMM/A Utility Disk. The information provided in this section is provided for background purposes.

Table B-1. Register Map

Location	Description
Base Address + 0	(Read) Least significant byte from A/D. (Write) Not Used.
Base Address + 1	(Read) Most significant byte from A/D. (Write) Function and Range Register
Base Address + 2	(Read) Read A/D status - after conversion complete. (Write) Start A/D conversion
Base Address + 3	(Read) Read Calibration Data (Write) Write Calibration Data
Base Address + 4	(Read) Read A/D Polarity, over/underrange (Write) De-select calibration non-volatile RAM.

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Base Address + 0 (Read) - Least Significant Byte from A/D

This register contains the data from the least significant byte of the A/D as shown in Figure B-1.

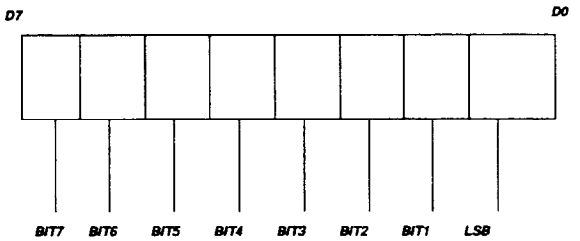


Figure B-1. Least Significant Byte from A/D

Base Address + 1 (Read) - Most Significant Byte from A/D

This register contains the data in the most significant byte from the A/D as shown in Figure B-2.

NOTE: To convert to correct reading, convert the 16 bits to decimal, subtract 10,001 and then divide by 10,000. Correct reading = (16 bits (converted to decimal) - 10,001)/10,000.

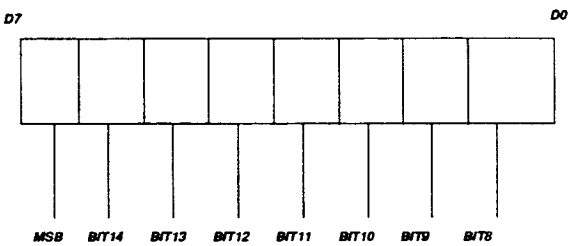


Figure B-2. Most Significant Byte from A/D

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Base Address + 1 (Write) - Function and Range Register

The function and range register is pictured in Figure B-3.

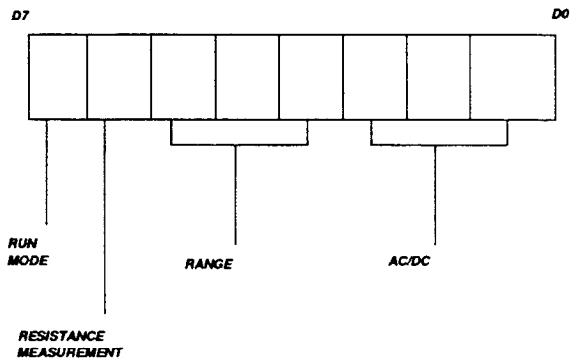


Figure B-3. Function and Range Register

D7 When this bit equals 0, a single A/D conversion takes place. If this bit is set to 1, the "free-run" mode is enabled. In this mode the A/D continually performs conversions without a command from the software. Each time a new mode or range is selected, the D7 bit must also be programmed for the correct mode

D6 The setting of this bit determines whether a resistance measurement is to be taken or not. If **D6** equals 0, then a resistance measurement is done; whereas, if **D6** is 1, then it is not.

D5-D3 The setting of these bits determines the range. Table B-2 lists the possible bit settings and their meanings.

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Table B-2. D5-D3 Settings

D5	D4	D3	Description
0	0	0	2 MOhm, 200 V
0	0	1	200 KOhm, 20 V, 2 mA
0	1	0	20 KOhm, 2V, 20 mA
0	1	1	2 KOhm, 200 mV, 200 mA
1	0	0	200 Ohm
1	0	1	Not Used
1	1	0	Not Used
1	1	1	Not Used

D2-D0 These bit settings determine what is to be measured. Table B-3 lists the possible bit settings and their meanings.

Note: Determining the value of an unknown resistance requires two measurements. First, the reference voltage must be measured (Bits **D2, D1,** and **D0** are set to 100). The two bytes of data which are read back are converted to a voltage, *Vref*. (See Base Address + 1 (read).) Then, the voltage across the unknown resistance must be measured (Bits **D2, D1, D0** are set to 101). Again, the data must be converted to a voltage, *VRx*.

The *Resistance Value* is then found from the following equation, where *Rx* is the unknown resistor:

$$RX = Vrx \backslash (Vref - Vrx)$$

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Table B-3. D2-D0 Settings

D2	D1	D0	Description
0	0	0	AC Voltage
0	0	1	AC Current
0	1	0	DC Voltage
0	1	1	DC Current
1	0	0	Reference Voltage
1	0	1	Unknown Resistance
1	1	0	Not Used
1	1	1	Not Used

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Base Address + 2 (Read) - Read A/D Status

D0 of this register indicates whether the converted data from the A/D is valid. When this bit equals 1, the data is valid. However, when it is equal to 0, the A/D is still converting data. All other bits are X's.

Base Address + 2 (Write) - Start A/D Conversion

Writing to this register initiates a single A/D conversion.

Base Address + 3 (Read) - Read Calibration Data

D5 of this register has the calibration data. Note that data from the Calibration RAM's is clocked out serially onto the bus. Each of the 64 words in RAM is 16 bits wide. All other bits are X's. Refer to the calibration routines for more information regarding the use of the EEPROM.

Base Address + 3 (Write) - Write Calibration Data

Calibration data is written to D1 and D0. All other bits are X's.

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Base Address + 4 (Read) - Read A/D Polarity

This register is shown in Figure B-4. Bit **D2** is the **overrange** bit. When this bit is set to 0 an overrange has occurred; likewise, when the bit is set to 1, no overrange exists.

Bit **D3** is the **polarity** bit. If this bit contains a 0, the positive polarity is used. Otherwise, when the bit is set to 1, a negative polarity exists.

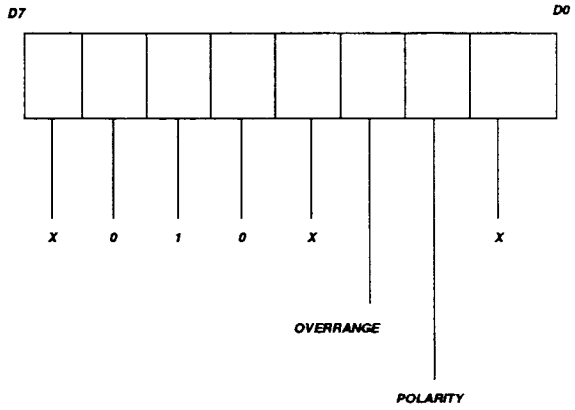


Figure B-4. Read A/D Polarity

Base Address + 4 (Write) - Deselect Calibration NOVRAM

Writing to this register de-selects the IC's used to store calibration data. This register must be written to after each instruction word is sent to the Calibration non-volatile RAM's and also when the calibration procedure is complete.

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