GE
Intelligent Platforms

***Programmable Control Products***

# Genius* I/O PCIM

***User's Manual***

*GFK-0074A* *February 1988*

## *Warnings, Cautions, and Notes as Used in this Publication*

**Warning**

**Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.**

**In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.**

**Caution**

**Caution notices are used where equipment might be damaged if care is not taken.**

**Note:** Notes merely call attention to information that is especially significant to understanding and operating the equipment.

## PREFACE

The intent of this manual is to supply the user with enough information to establish the GENIUS I/O IBM PC interface Module (PCIM) as an entry point into the GENIUS I/O System. The PCIM is designed to be integrated into a user-developed IBM PC microprocessor-based system. It provides a low cost 'tap' on the GENIUS I/O bus, allowing a host system to monitor and control remote I/O utilizing the extensive diagnostics, high reliability and noise immunity of the GENIUS I/O System.

### Intended Audience

This manual is intended for design engineers and systems or applications programmers who are already familiar with Basic or C programming in the IBM personal computer environment. Readers are further assumed to **be** familiar with the GENIUS I/O System.

### How to use **this** Manual

This manual provides a description of the GENIUS I/O IBM PC Interface Module (PCIM), and procedures for its setup, programming, operation, and troubleshooting from a user's point of view. The manual should be regarded as a self-teaching tutorial if you are unfamiliar with the PCIM. The more experienced user will access it **as a** reference.

**DO NOT ATTEMPT INSTALLATION, OPERATION, OR PROGRAMMING OF THE PCIM UNTIL YOU HAVE READ THE USER'S MANUAL FRONT TO BACK.** Pay particular attention to the WARNINGS and CAUTIONS interspersed throughout the text, as ELECTRICAL HAZARDS exist which could cause PERSONAL INJURY or DEATH, or damage to the equipment.

## Structure of this Manual

This manual contains 6 chapters and **7** appendices:

- Chapter **1 -** Introduction
- Chapter 2 - Theory of Operation
- Chapter 3 - Getting Started
- Chapter 4 - Using PCIM - Software Drivers
- Chapter 5 - Communications
- Chapter 6 - Troubleshooting
- Appendix A - Example Application
- Appendix B - Glossary
- Appendix C - Connector Signal Descriptions
- Appendix D - Specifications
- Appendix E - **Part** Numbers
- Appendix F - Function Codes

## Related Publications

The following documents in association with this manual comprise the PCIM User's Package:

| | |
|---|---|
| a GENIUS IO Bus Datagram Reference Manual - | GFK-0090 |
| GENIUS IO User's Manual - | GEK-90486 |

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# CHAPTER 1
# INTRODUCTION

This manual provides a description of the GENIUS I/O IBM **PC Interface** Module (PCIM). It includes procedures for setup, programming, operation, and troubleshooting in conjunction with the GENlUS I/O System.

Normally, GENlUS I/O will be controlled by a PLC in machine control and fast closed loop control applications. There are various applications, however, where systems based on GENIUS I/O blocks will be utilized with IBM PC products.

The GENIUS I/O IBM PC interface Module (PCIM) is an entry point into the GENIUS I/O System for the IBM PC/AT/XT family. **The** PCIM is a motherboard/ daughterboard, designed to be integrated into a user-developed microprocessor system.

**The** PClM provides a **low** cost **'tap'** on the GENlUS I/O bus, allowing a **host** system to control remote I/O uti l izing the extensive diagnostics, high relbi llity and noise immunity of **the** GENIUS I/O System. Bus access is provided by **the** PClM Software Driver, a high level interface between applications software you develop and the PCtM. **The** PCIM Software Driver consists of easy to use macro-oriented function calls you code appropriately in your C language or Basic language applications routines.

## GENIUS I/O SYSTEM OVERVIEW

**The** GENWS I/O is a system of inherently distributed inputs and outputs, which consists of:

- GENIUS I/O Blocks AC, DC, Isolated, Analog (mounted at the point of control),
- a Bus Controller (which serves **as** the interface between the GENtUS I/O system and the Series Six PLC),

  and/or

- **a** PClM for interface with IBM PC ATs, XTs, or CIMSTAR I,
- a Hand Held Monitor (the portable diagnostic and configuration tool used for addressing, trouble-shooting, monitoring, scaling and configuring the I/O Biocks),
- and the GENIUS Serial Bus, which provides communications between the Bus Controller, Hand Held Monitor, and **up** to 30 I/O Blocks over **a** single shielded twisted wire pair.

GENIUS I/O Blocks provide superior, built-in Diagnostics which detect open **circuits,** short circuits, overloads, and a variety of other malfunctions which are beyond the power of conventional PLCs to detect.

A simplified diagram of the GENIUS I/O System is shown in Figure 1.1. The PLC, CPU, and I/O rack are standard Series Six units. The Host Controller is, for this application, an IBM PC compatible of your choice. The GENIUS serial bus connects I/O Blocks with a single shielded twisted pair up to 2000 feet from the Bus Controller.

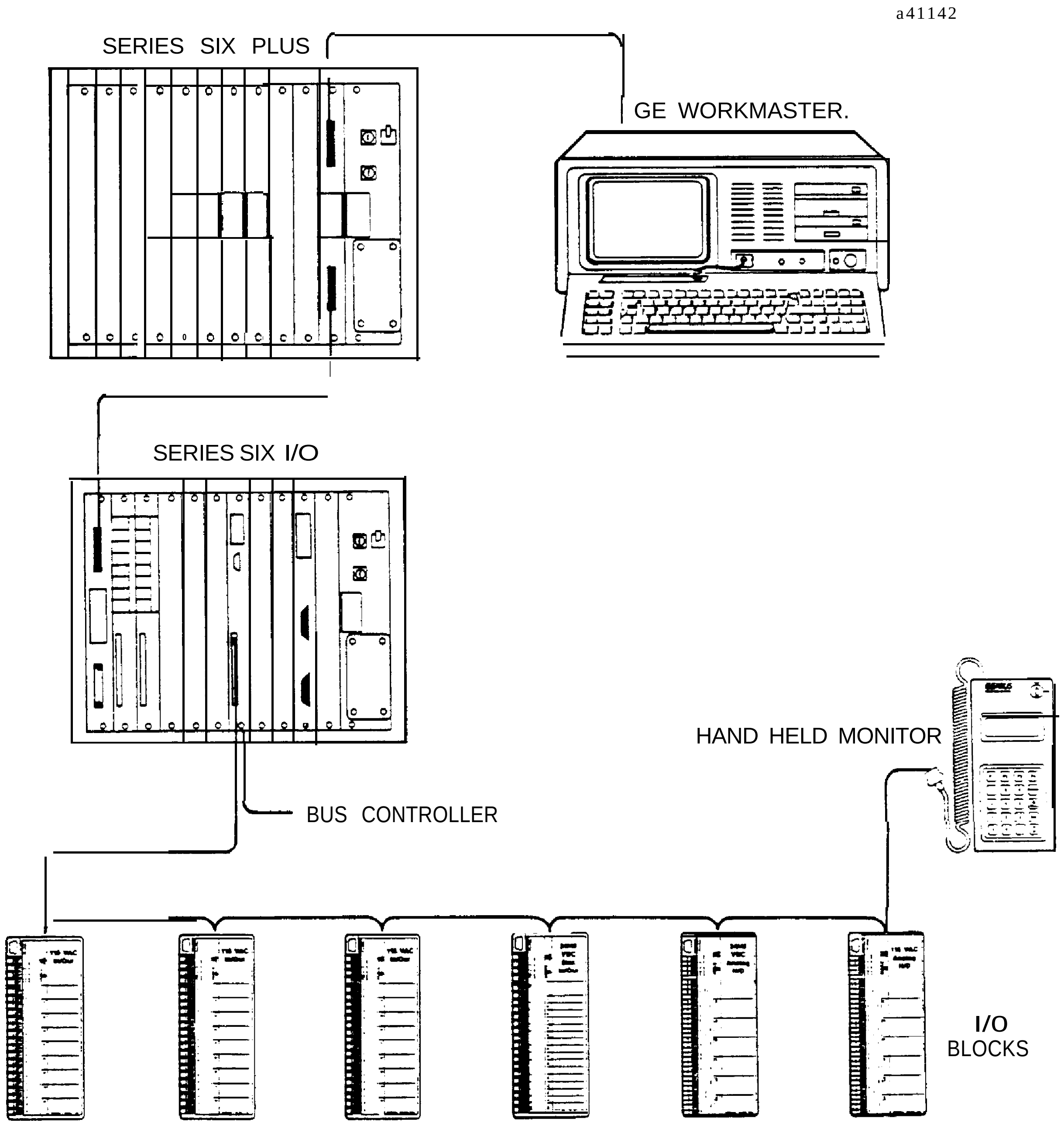

Figure 1.1 GENIUS I/O SYSTEM DIAGRAM

GENIUS I/O **IBM PC INTERFACE MODULE (PCIM)**

## Daughterboard

The GENIUS I/O IBM PC Interface Module (PCIM) daughterboard is **a** general purpose I/O Controller for the GENIUS I/O System. Like the Series Six PLC Bus Controller, the PCIM daughterboard provides **a** convenient method to control devices on the GENIUS serial bus. The PCIM daughterboard performs the housekeeping tasks of initialization and fault management for up to 30 bus devices, keeps up-to-date images of the I/O controlled by each device (whether the device is a GENIUS t/O Block or other bus device), and can communicate with other Controllers on the GENIUS bus by passing **background messages** not associated with I/O commands. The interface to this RAM is optimized for the IBM personal computer bus.

The network data rate is configurable by an on-board dip switch to 38.4, 76.8, or 153.6 kiiobits per second with twisted pair or twinaxial cable.

Thus, the PCIM daughterboard handles protocol and **provides** a general purpose, non-time critical method of tapping in **to** the GENIUS twisted pair network.

## Motherboard

The GENIUS I/O IBM PC Interface Module (PCIM) motherboard provides a convenient way **to** interface an Open Architecture daughterboard like the PCIM daughterboard to an IBM compatible Host system. All **the** signals necessary to communicate-to **a** daughterboard **are** buffered through the motherboard **to** the Host bus. In addition **to** the normal interface lines, **the** motherboard provides the following daughterboard control and monitoring functions:

- A standard ‘unit **load’ to** the IBM bus.
- Low supply voltage detection.
- **Power** up RESET signal sequencing.
- Host system address decoding over the full PC, XT or AT memory maps.
- A built-in watchdog timer (user-disabled by a jumper) that can monitor system operation and shut down the daughterboard if the Host system faults, preventing **any** conflicts on the GENIUS bus.

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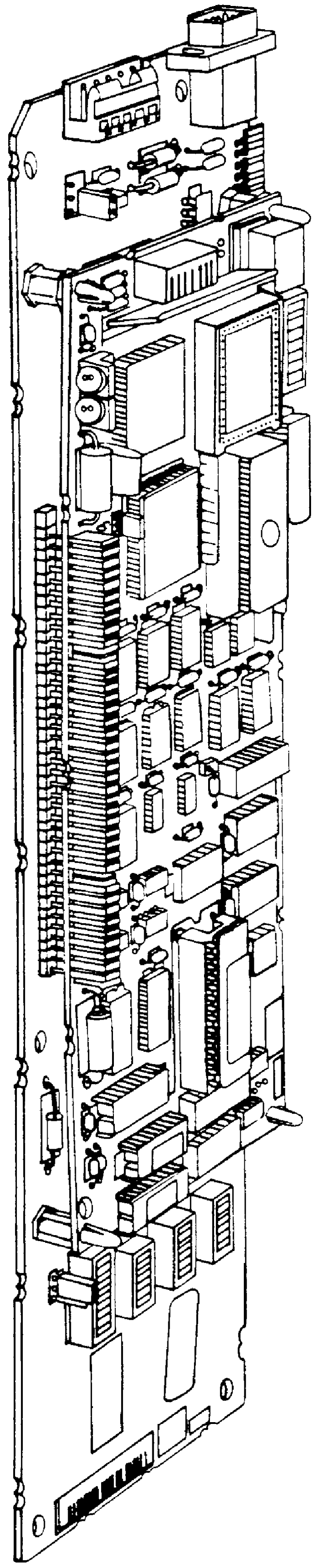

Figure 1.2 GENIUS I/O IBM PC INTERFACE MODULE (PCIM)

# CHAPTER 2
# THEORY OF OPERATION

## INTRODUCTION

This chapter explores the physical configuration/operation of the PCIM, and provides a description of module general capabilities. PCIM physical structure is described in the first sect ion. PCIM hardware, functionally divided into three primary sections, is discussed in the second section. PCIM software is functionally divided into two subsystems; explained in the following sect ion. PCIM motherboard functions are briefly discussed next, followed by a definition of electrical and signal requirements.

You need not be familiar with the material presented in chapter 2 in order to operate your PCIM. If you aren't interested in how it works, just go on to chapter 3.

## PCIM HARDWARE DESCRIPTION

Figure 2.1 shows the PCIM Interface Module. The PCIM occupies two slots of an IBM PC AT or XT and a single slot in a CIMSTAR I.

### PCIM Motherboard Physical Structure

The PCIM motherboard is a rectangular, 2-layer board, (4.2 by 13.15 inches), with four corner mounting holes provided. Components on the motherboard protrude no more than .75 inches above the board surface. No components are mounted on the 'foil' side of the board. Female 40 pin and a 10 pin connectors are used. Connections to the daughterboard are made by pins from the daughterboard into the 10 and 40 pin connectors. Connections to the Host are made by pins from the daughterboard into 36 and 64 pin edge connectors in the Host I/O rack. Figure 2.1 shows the physical configuration of the PCIM motherboard in more detail.

### PCIM Dauqhterboard Physical Structure

The PCIM daughterboard is a rectangular, 4-layer board, (3.6 by 8.4 inches), with four corner mounting holes provided. Components on the daughterboard protrude no more than .75 inches above the board surface. No components are mounted on the 'foil' side of the board. Two male connectors are used, a 40 pin connector and a 10 pin connector. The 40 pin connector passes all the logic signals, while the ten pin connector passes signals that require special handling (Le., GENIUS bus signals). The transformer and hybrid are located near the 10 pin connector to keep on-board electrical noise to a minimum. Connections to the motherboard are made by pins through the daughterboard into the I/O and 40 pin edge connectors. Figure 2.1 shows the physical configuration of the PCIM daughterboard in more detail.

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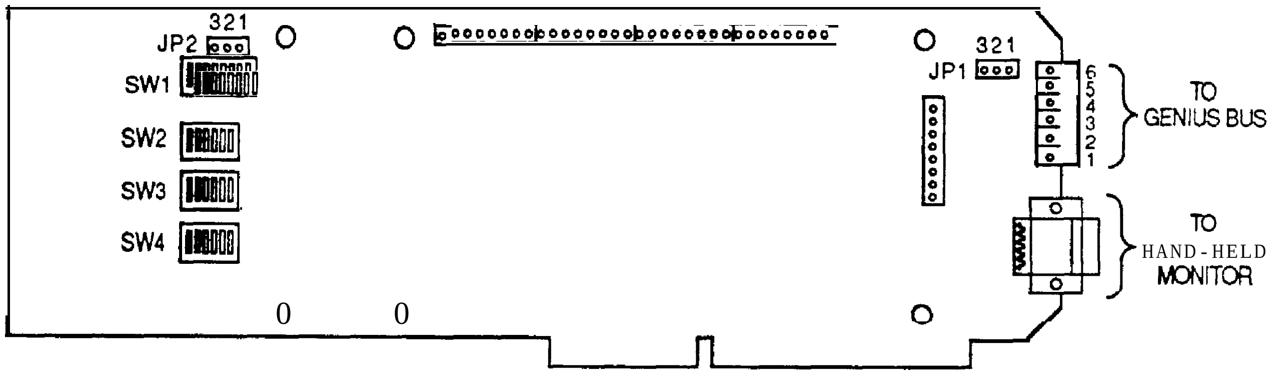

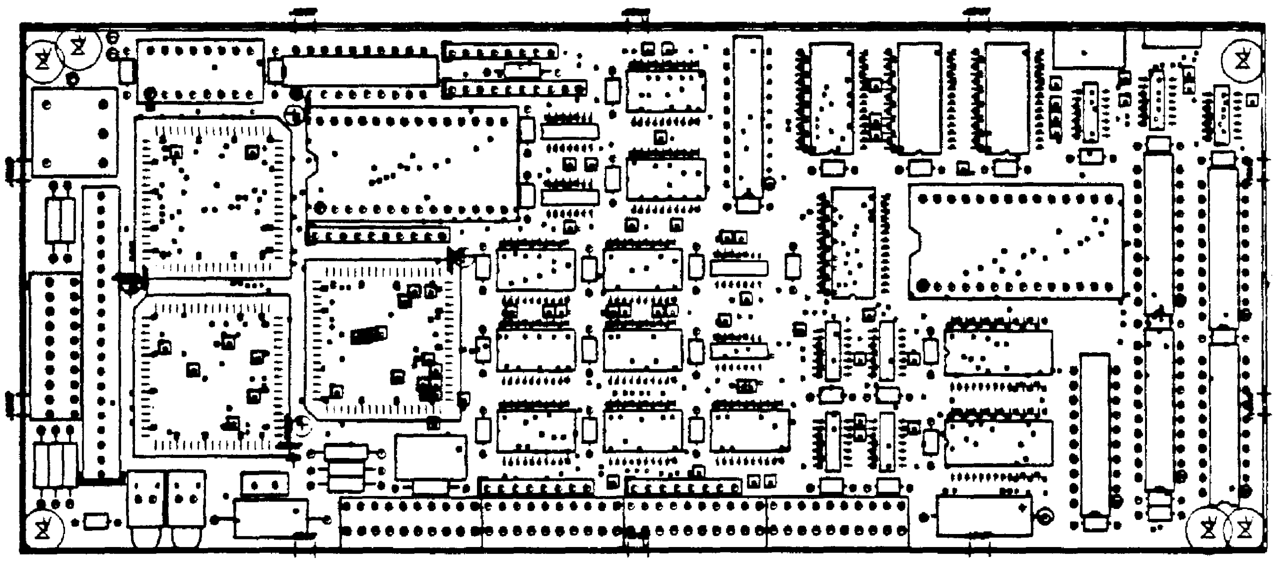

Figure 2.1 PCIM MOTHERBOARD/DAUGHTERBOARD LAYOUT

## PCIM HARDWARE OPERATION

As shown in figure 2.2, PCIM hardware is functionally divided into three primary sections; the Serial interface microprocessor (6303), the Dual Port RAM (DPR), and the PCIM Manager microprocessor (64180).

PCIM hardware primary sections include the following components:

- Serial Interf ace - 6303 microprocessor, MIT chip, crystal, transmit/receive hybrid circuit and isolation transformer.

- Data Buffer - 20K X 8 Dual Port Shared RAM (DPR).

- Host Interface - PCIM Manager (64180 microprocessor), 16K X 8 Shared RAM (SRI), EPLD, buffers and transceivers.

**PCIM** hardware operation is discussed below. Component interface details are shown in figure 2.3.

### Serial Interface

In the same way that the Series Six PLC **Bus** Controlfer serves as the communications interface with devices on the GENIUS serial bus and the Series Six PLC, the Serial Interface portion of the PCIM handles the details of the hardware interface to the serial bus.

The Serial Interface microprocessor (6303) sequences the actions of the Serial Interface. **Its** primary purpose is to transfer and format data between the Dual Port RAM (DPR) and the MIT chip.

The MIT handles the details of the hardware interface to the serial bus, and in addition, provides many support functions (such as CRC generation, error checking, **a** watchdog timer function, chip selects, LED drivers and processor clock signals). The MIT receives directed messages only if its current device number matches the device number of the broadcast message. The device number (serial bus address) of the PCIM is transmitted when directed messages are sent by the MIT. The device number is set in the MIT by the Serial Interface microprocessor (6303) according to the hardware dip switch (see figure 3.2).

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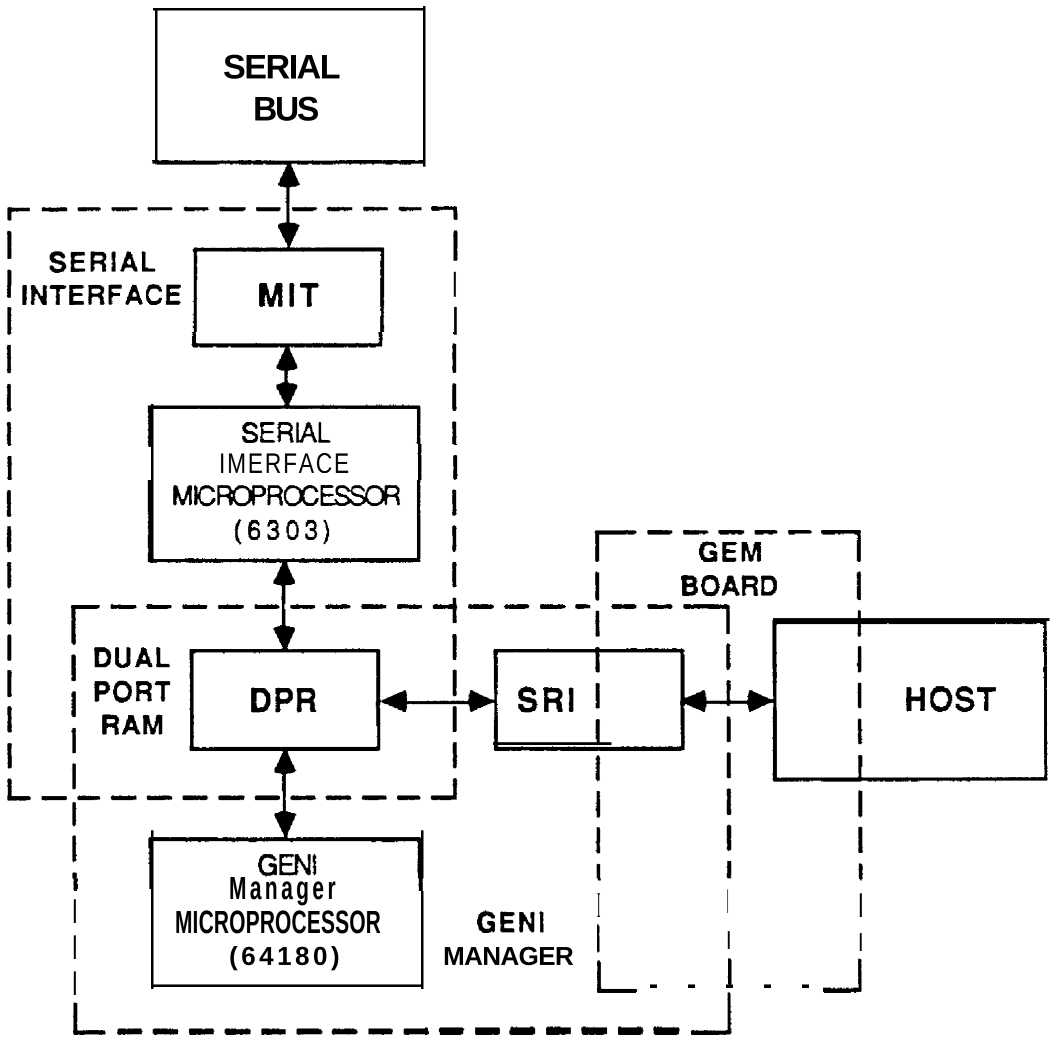

Figure 2.2 PCIM HARDWARE/SOFTWARE INTERFACE (SIMPLIFIED)

The PClM Serial Interface also includes a transmit/receive hybrid circuit and a transformer. Serial Interface components work together to communicate with the serial bus and implement the following specific functions:

- Transmit messages to the serial bus using the serial bus protocol. These messages are written to the transmit buffers in the MIT chip by the 6303 microprocessor. When the MIT chip determines that it is its turn on the bus, it allows the messages in the transmit buffers to be transmitted. The hybrid circuit translates MIT transmit and receive signals levels to levels appropriate for transmission on the serial bus. The transformer provides isolation between the twisted pair wires and the PC/M circuitry.

- Receive messages from the serial bus. These messages are read from the receive buffer in the MIT chip by the 6303 microprocessor.

- Manage an external clock for running the 64180 microprocessor.

- Control 2 LEDs which are used to indicate the status of the board (PCIM OK, COMM OK, diagnostic faults).

- Allow two chip selects - one for the 6303 microprocessor and one for accessing the Dual Port RAM (DPR).

- Permit a watchdog timer function for the PCIM.

## Data Buffer

The Dual Port RAM (DPR) is the area where the PCIM Manager microprocessor (64180) and the Serial Interface microprocessor (6303) exchange data. This hardware allows the 2OK Dual Port RAM to be accessed simultaneously without loss of data. The DPR, then, is arranged to prevent conflicts when both microprocessors try to move data through the RAM at the same time. In a manner similar to the arbitration used between the PClM Manager and the Host Shared RAM (SRI), the Dual Port RAM is controlled by an EPLD, which arbitrates memory requests on a byte-by-byte basis. The EPLD actually controls the buffers and transceivers each microprocessor uses to read or write from/to the Shared RAM. Thus, the Dual Port RAM removes any timing skews between the two processors which are running two separate, asynchronous systems.

## Host Interface

l-lost Interface hardware allows the Shared RAM Interface (SRI) to be accessed by either the PCIM Manager microprocessor (64180) or the Host system without a loss of data. The PCIM Manager microprocessor (64180) transfers data between the Shared RAM Interface (SRI) and the Serial Interface microprocessor (6303) through the Dual Port RAM (DPR).

Either source can access the SRI simultaneously, byte-by-byte, without worrying about software arbitration. The hardware arbitrates requests for the Shared RAM interface and keeps the timing straight. As a result, the SRI looks like a pure RAM device to both systems. If the Host requires that more than one byte of data be transferred without any intermediate byte accesses from the PCIM, a software lockout scheme is used. The interface signals are directly compatible with those of the PC backplane.

The PC Manager microprocessor (64180) sequences the actions of the PCIM Manager, whose primary purpose is to transfer and format data between the Shared RAM Interface (SRI) and Dual Port RAM (DPR) by executing a program located in the EPROM.

In addition, the PCIM Manager generates an interrupt when important information has been deposited into the SRI. When the Host desires to write or read grouped multi-byte data, it can request a lock out of the Shared RAM. The Host initiates this lock out by writing the request in the Command byte of the SRI, which causes an interrupt for the PCIM Manager. The PCIM Manager acknowledges the interrupt by setting a bit in the SRI and pulsing the interrupt line to the Host.

The Shared RAM interface (SRI) is the user’s interface to the PCIM. An EPLD arbitrates Shared RAM memory requests on a byte-by-byte basis and allows the Host and PCIM Manager equal simultaneous **access** to any byte of Shared RAM without loss of data. The SRI contains 16K bytes for I/O tables, configuration data, diagnostic data, labels and background message queues.

## PCIM SOFTWARE Operation

PCIM software is functionally divided into two subsystems:

- Serial Interface software.
- PCIM Manager software.

The Serial interface software provides the interface to the GENIUS serial bus from the Dual Port RAM (DPR), the shared RAM area between the Serial Interface and the PCIM Manager. PCIM Manager software primarily interfaces and formats data from the Dual Port RAM area into the Shared RAM Interface (SRI), the shared RAM area between the PCIM Manager and the Host system.

### Serial Interface

The primary responsibility of the the Serial Interface portion of PCIM software is GENIUS I/O Network Protocol. The Serial Interface handles keeping the PCIM active on the GENIUS serial bus. Since the PCIM is a control device, it must be able to receive control data from all devices on the bus and must be able to direct control data to any given station on the bus.

The secondary function of the Serial interface software is to maintain the overall operation of the PCIM. This is accomplished by servicing the MIT watchdog timer and maintaining a 'heartbeat' with the PCIM Manager. If any of these fail, then the Serial Interface generates a reset signal and the PCIM becomes inactive.

### Serial Interface Software Functionality

#### Power Up and Initialization

When power is applied to the PCIM, the Serial Interface begins performing power up initialization. The following set of circuitry/hardware power up diagnostic tests are run:

- EPROM Checksum Test
- Microprocessor Self Check Test
- MIT Bus lest
- RAM Test

If any of the tests fail, the software attempts to go into a controlled lock-up state preventing the PCIM from running at all. If the diagnostics pass, the Serial Interface completes initialization of its memory variables, Dual Port RAM, the MIT and other hardware or software related variables necessary to begin steady state operation.

The Serial Interface will read--the hardware dip switch (see figure 3.2) one time during power up. Information received from the dip switch will be provided to the PCIM manager via the Dual Port RAM. The dip switch setting will be ignored at all other times.

The Serial Interface will next initialize the MIT. During initialization, the MIT will also be set with the serial bus address of the PCIM and the serial bus baud rate (when available). The address and the baud rate **are** derived from the dip switch setting. The Serial Interface will complete the MIT initialization and begin transmitting its token on the serial bus.

The Serial Interface makes the value of **the** on-board dip switch setting available to the PCIM Manager software. This value indicates the serial bus address of the PCIM and the default output disable flags. The Serial Interface may begin collecting input control data from the bus but will not transmit output control data until there is data to transmit.

## Steady State Operation

During normal operation, the Serial Interface software is required to provide the following functions for the PCIM Manager software:

✍ Maintain a Dual Port RAM table of control inputs from all devices on the bus for the PCIM Manager. Maintain an information queue of device addresses which sent input data.

- Inform the PCIM Manager whenever new control data from any bus device is received.

- Maintain **a** queue of incoming datagram messages in the Dual Port RAM for the PCIM Manager **to** act on.

- Transmit the following message types when it **is** the PCIM's turn to access the serial **bus;**

|  |  |
|---|---|
| 0 Of 1 | Direct or Broadcast Background Message |
| 0 to 31 | Directed Control Message |
| 1 | Broadcast Control Message (token) |

✍ Direct control data outputs to individual bus devices as grouped data. These outputs will be maintained in the Dual Port RAM by the PCIM Manager.

- Maintain an information queue of device addresses to which the PCIM sent output data. Inform the PCIM Manager when each output is sent via this queue.

- Send datagram messages from a single message buffer as a Directed or Broadcast Background Message in either restricted or unrestricted mode. This single message buffer is maintained by the PCIM Manager in the Dual Port RAM.

- Reinitialize the MIT chip to support the two priority classes of Datagram Service - NORMAL and HIGH Priority.

- Inform the PCIM Manager whenever new control data for all bus devices is *received* from the serial bus.

- Inform the PCIM Manager whenever a datagram message is received from the serial bus.

- Interrupt the PCIM Manager each time the PCIM completes its turn on the bus.

- Maintain a minimum serial bus scan time of 3 ms.

- Stop any transmission on the serial bus on command from the PCIM Manager for a time period of 1.5 seconds.

- Report the bus scan time in milliseconds to the PCIM Manager every scan.

- Maintain a running count of serial bus errors.

- Implement a watchdog timer service routine.

- Continuously run a series of background diagnostic tests which verify its own local RAM and its EPROM (checksum).

- Detect a fatal failure with the PCIM Manager in order to cause the PCIM to halt.

- Inform the PCIM Manager of a fatal failure with the Serial Interface, and allow time for the PCIM Manager to report this to the host before causing the to halt.

- Maintain the LED indicators PCIM OK and COMM OK. If the PCIM Manager's heartbeat fails or any of the diagnostics fail, turn off the PCIM OK LED. If a serial bus error occurs, turn off the COMM OK LED for 200 msec. If the PCIM does not get a turn on the bus within the allotted time period dependant on the baud rate, turn off the COMM OK LED. In this last case, the LED will remain off until the PCIM gets its turn on the bus.

## PCIM Manager

The basic function of the PCIM Manager is to provide data flow between the serial bus and the Host via a formatted shared RAM interface. Key functions of **the PCIM** Manager include:

- transfer of sampled data (I/O or Global Data Services) **to** and from other devices on the **bus.** This data is **for** basic I/O devices, or global data which is shared between other types of **devices** such as processors
- transfer of unique data (Datagram Service) to and from other bus devices, This data includes configuration, diagnostic and other **types** of unique data
- maintenance of device characteristics in a Configuration Table
- device, PCIM, bus and syntax error reporting

## PCIM Manager Software Functionality

### Power Up and Initialization

When the Host is ready to use the PCIM function, it allows the PCIM **to be reset.** The Serial Interface then begins its power up sequence. Again, when the Serial Interface completes its power up and diagnostics, the PCIM Manager can begin operation.

During power up, **the** PCIM Manager performs diagnostic tests on all of its related hardware. **These** tests include:

- EPROM Checksum Test
- Microprocessor Test
- RAM Test

If an error is found in any **of** the diagnostics, the PCIM Manager reports the fault **to the Host** through the PCIM Status, then attempts to halt. The host will not be given a PCIM OK status, **nor** will **the** PCIM OK LED light.

If all diagnostic tests pass, the PCIM Manager then initializes its operating variables. The Loss of Device Timeout will be set to 3 bus scans. The Shared RAM variables will be defaulted as fol lows:

| | |
|---|---|
| • Device Present | = 0 |
| • Output Disable | setting based on daughterboard dip switch |
| • Serial Bus Address | setting based on daughterboard dip switch |
| • Serial Bus Baud Rate | setting based on daughterboard dip switch |
| • I/O Table Lockout State | = o |
| • Broadcast Control Data Length | = o |
| • Directed Control Data Length | = o |
| • I/O Table Length | **= 128 (80** hex) |
| • Status Table Address | = OFFFF (hex) |
| • All interrupt Status | = o |
| • All interrupt Disable | = o |
| • All PCIM Status | = o |
| • Receive Queue, Transmit Buffer, Request Queue | = empty |
| • Command Block Status Byte | = Command Complete |

During the PCIM Manager's power **up** sequence, the Host must not read or write **to** the Shared RAM for **1.7** seconds. After 1.7 seconds, the PCIM OK flag should be ON indicating self-test has passed (the PCIM sets the state of the PCIM OK byte to '1' within two seconds after power up).

The Serial Interface will not write to the Dual Port RAM **or** begin transmitting on the bus until the PCIM Manager informs it that power **up** processing has been successfully completed.

Once the PCIM OK flag is set to '1', the PCIM Manager will delay an additional 1.5 seconds to allow the Host to change the PCIM **default configuration. Since the** PCIM drops off of the bus after a configuration change, this feature allows the host to **change** configuration before any bus activity begins.

**Steady State Operation**

**From** this point, **the** PCIM Manager runs in steady state operation. Operation of the PCIM Manager **is** closely related to that of the Shared RAM Interface, including;

Self -Test - **During** steady state operation, the PCIM Manager is required to perform background diagnost ics. These tests include a non-destructive private RAM test, **a checksum** of the EPROM, and maintainenance of a heartbeat with the Serial Interface. If any faults are found in these background diagnostics, the PCIM Manager reports the fault through the PCIM Status area of the Shared RAM, disable outputs to the serial bus, and then attempt to halt all processing.

I/O Table Lockout - To ensure data coherency for all control data to and from **the** Host, the PCIM Manager will implement a ‘lockout’ of all control data tables during an I/O Lockout Request. During I/O Table Lockout, the PCIM Manager will NOT **access** the Input Tables, the Output Tables, the Broadcast Control Output Table and the Directed Control input Table.

Host Interrupts - There are seven conditions requiring immediate Host attention which **causes** the PCIM Manager to interrupt the Host. Before interrupting the Host, the PCIM Manager will set the interrupt condition in the Interrupt Status Table of the SRI by writing a ‘1’ to **the** byte indicating the interrupt condition. The i-lost w i ll clear the Interrupt Status Table entry when it has completed servicing that interrupt.

**The Host may** disable any of the seven interrupt conditions via the Interrupt Disable **Table.** When the PCIM Manager determines that one of the interrupt condition exists, that byte in the Interrupt Status Table is set. Then, the Interrupt Disable Table will be interrogated. If the corresponding disable flag is set, no interrupt will be generated to **the** HOST. The HOST will still be responsible for clearing the corresponding byte in the Interrupt Status Table (see chapter 4).

Whenever control data is received, the PCIM Manager will determine **if** that particular device is already ‘logged’ into the Configuration Table. **If** so, the PCIM Manager accepts the control data and places it into the Input Table. If not, the PCIM Manager requests control data parameters from that device. The control data is ignored until these parameters are received by the PCIM Manager.

Figure 2.3 shows the interrelationships among the various lines and components.

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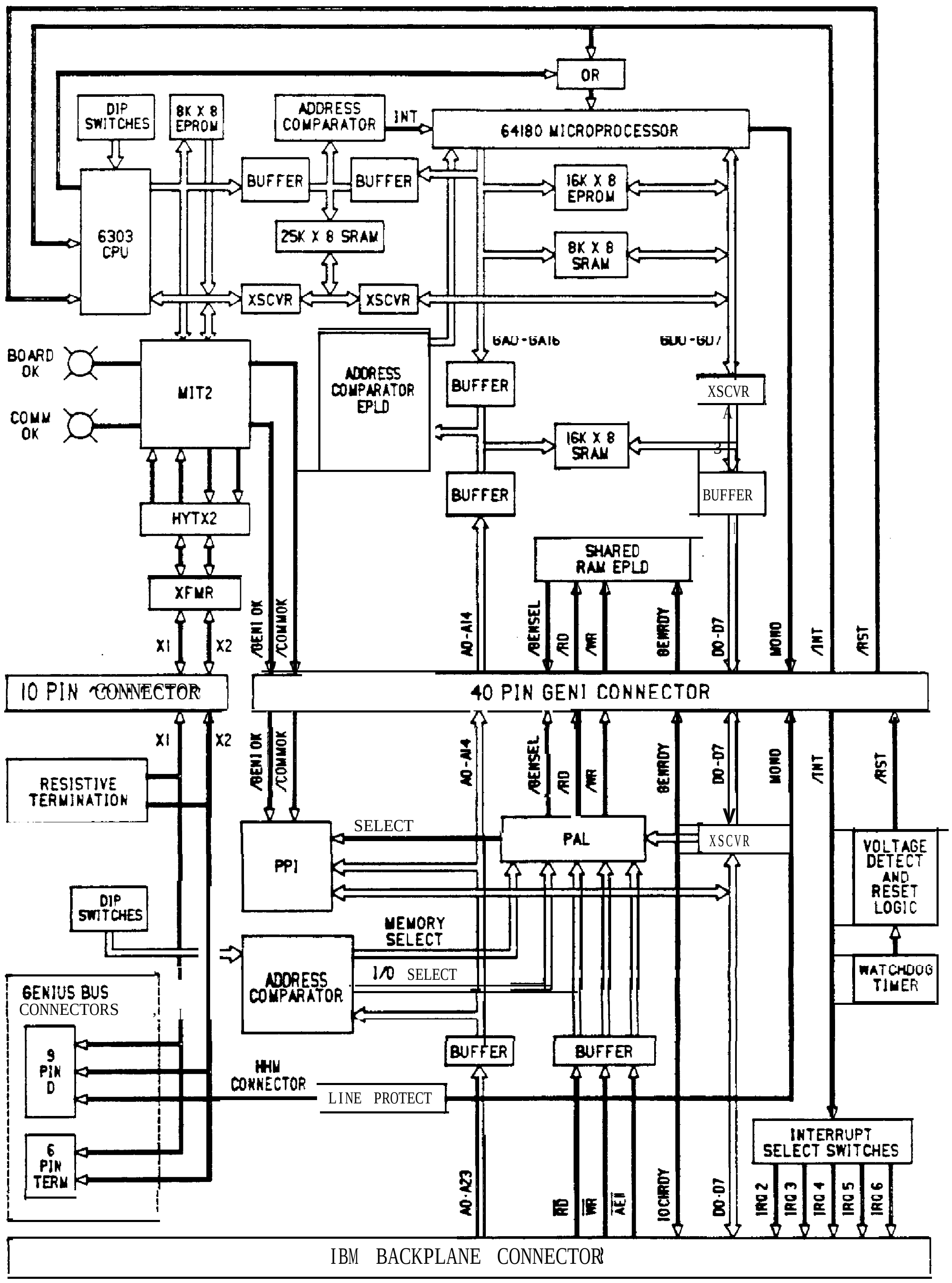


Figure2.3 PCIM BLOCK DIAGRAM

## SHARED RAM INTERFACE

As you remember, all data passed between the Host system and the. PCIM goes through Host shared RAM, referred to as the Shared RAM Interface (SRI). As stated, this RAM looks like an 16Kx8 static memory device to the Host system. Although all areas of RAM are 'read/write', that is, fully accessible by the Host to read or write to any RAM location, some areas of the RAM are not accessed by the Software Driver during normal operation (as shown in figure 2.4).

### Shared RAM Updates

Some data is transferred between the Shared RAM and the serial bus automatically by the PCIM manager. This type of communication includes I/O circuit updates, fault reports, and the like. The rest of the calls and message types must be initiated by the Host system using the Software Driver, explained in more detail in chapter 4.

### Device tog In

The PCIM Manager will log in a device whenever control data is received from a device that is NOT listed in the Host's SRI. A device is considered logged in, or on-line, when the PCIM Manager has that device's configuration data translated and stored in the SRI (a GetBusConfig call can be used to verify the presence of the device on the bus). At this point, the device is considered logged in and input control data from that device will be transferred to the SRI Input Table.

Heavy log in activity occurs after power up of the PCIM Manager if there are no devices logged in the SRI. Once in steady state, Jog in activity occurs whenever Broadcast Control data is received from a device that has just been included on the serial bus.

You may want to code the InitIM call (see chapter 4) in your program logic first (in order to allow devices on the bus to log in with the PCIM), and then perform the rest of your program logic initializations in order to optimize front-end timing.

### Device Log Out

The PClM Manager will log a device out whenever Broadcast Control data is not received for three (3) consecutive serial bus scans. This timeout period is fixed by the PCIM Manager. When Device Log Out occurs, the PCIM Manager will not direct output data to that device from the Serial Interface, and will inform the Host of the Loss of Device.

The device remains logged off until the PCIM Manager receives identification data from it. When new Broadcast Control data is received from any device which is not logged in, the PCIM Manager will begin its device log in procedure.

### Memory Configuration

Following is the memory map for the PCIM 16K Shared RAM Interface. It shows the different areas used to convey data, status, control and diagnostic information to and from the Host system. A complete map of the Shared RAM Interface is shown in figure 2.4.

| | |
|---|---|
| Request Queue<br>16 X 136 (2176) | Serial Bus access to Host memory |
| Request Queue * Head Pointer (1) | Pointer to buffer t-lost is reading |
| Request Queue Tail Pointer (1) | Pointer to buffer PCIM is writing |
| PCIM Setup Table (16) | PCIM and Serial Bus Characteristics |
| PCIM Status Table (16) | PCIM and Serial Bus Diagnostics |
| interrupt Status Table (16) | Host interrupts |
| Interrupt Disable Table (16) | Disable Host Interrupts |
| Command B lock * (16) | Driver Calls to PCtM Manager |
| Output Data Area (240) | Transmit Datagram Buffer RAM |

* Host write to these locations causes Interrupt to the PCIM Manager

figure 2.4 Shared RAM Interface Map

| | |
|---|---|
| Input Data Area (134) | Read Datagram Buffer RAM |
| I/O Table Lockout * Request/Relinquish (1) | PCIM Lockout of the I/O Tables |
| I/O Table Lockout State (1) | Lockout State according to PCIM |
| Host interrupt Clear (1) | Byte to Clear the Host Interrupt |
| Reserved RAM (5045) | Reserved RAM |
| Device Configuration Table 32 x 8 (256) | Device ID, status and setup |
| Directed Control Input Table (128) | Di rected Input to PCIM |
| Broadcast Control Output Table (128) | Broadcast Output from PCIM |
| - - Device Input/Output Tables - - | Device Inputs and Outputs to/from the serial bus |

* Host write to these locations causes Interrupt to PCIM Manager

Figure 2.4 Shared RAM Interface Map (Cont'd).

## I/O Table Lockout

To ensure data coherency for all control data to and from the Host, the PCN Manager will implement a 'lockout' of all control data tables during an I/O Lockout Request. This feature prevents the PClM Manager from accessing the SRI at the same time that the Host is updating it. Two bytes in the Shared RAM Interface (SRI) are dedicated to the I/O Lockout feature: I/O lockout Request/Relinquish, and t/O Table Lockout State.

The maximum response time to the t/O Table Lockout Request will be determined by the time required for the PCIM Manager to transfer 128 bytes to or from the Input or Output Table. Normally, the response will be less than this time. However, if the PCIM Manager is currently transferring data to or from the Input or Output Table, it will complete the current data transfer before accepting and enabling the lockout. When the Host has completed its control data access, the PCIM Manager will resume normal operation in servicing control data to and from the SRI.

## Device I/O Table

The Device l/O Table resides in the last 8K bytes of the Shared RAM memory and is divided into two tables - the Device Input Table, and the Device Output Table (see chapter 5). The Input Table wili contain the Broadcast Control Data from each logged in device. The input Table is updated every serial bus scan unless I/O Lockout is enabled. Data placed in the Output Table by the Host will be sent to each logged in device every serial bus scan.

Both the Input and Output Tables are organized in groups of up to 32 segments each (corresponding to the maximum possible number of devices on the bus). Segment lengths are fixed at 128 bytes.

## Jnput Table

All Broadcast Controt Data will be placed in the Input Table in the segment associated with that particular device. That is, control data from device #l2 will be placed in segment 12. As such, the Input Table can be thought of as an array table. The Host will be able to determine the type of I/O Block from the Device Configuration Table.

## Output Table

The PClM Manager will take the data placed in the Output Table and direct that data to the device associated with the given Output Table segment. If the Host wants to send control data to I/O Block #l2, it must place that data in segment 12 of the Output Table. As with the Input Table, the format of each individual segment is established in the InitIM call.

## PCIM Broadcast Control Output Table

The PCIM Manager will transmit its own Broadcast Control Data onto the serial bus once per scan. The Host will place data in the Broadcast Control Output Table for the PCIM Manager to broadcast (see chapter 5).

## PCIM Directed Control Input Table

The PCIM Manager may receive Directed Control Data from any device capable of sending this type of message to the PCIM. The Directed Control Input Table is provided in the SRI for this data (see chapter 5).

Thus, a series of Hosts may be placed on a single bus and communicate with each other. Using the Broadcast Control Output Table, all PCIMs can broadcast control data to all other PClMs on that serial bus. Using the Directed Control input Table, a single PCIM can be controlled by another PCIM. This a powerful feature of the PCIM Manager.

## Device Configuration Table

The Device Configuration Table, 256 bytes long, contains the device ID, status, setup and other characteristics of each device connected to the serial bus controlled by this PCIM. Parameters are received by the PCIM Manager via an InitIM or ChglMSetup call. These tables are formatted into 32 segments of 8 bytes per segment. One 8 byte segment is reserved for each of the 32 possible devices, with the lowest, device number 0, residing in the first 8 byte segment.

## PCIM Setup Table

The PCIM Setup Table contains parameters unique to a particular PCIM. These parameters consist of device related values. When the Host changes one or more of these parameters, the PCIM Manager will log all devices out of the database and drop all bus transmissions for 1.5 seconds, the time period necessary to cause all receiving devices to log out the PCIM. When the PCIM begins re-transmitting, these devices will re-log in to **the** PCIM with the new parameters.

## **PCIM** Status **Table**

The PCIM Status Table contains six bytes indicating the veracity of the PCIM software and the status of the PCIM hardware. When certain status bits change, the PCIM Manager will set the PCIM Status Change byte in the Interrupt Status Table. If this interrupt is not disabled, the PCIM Manager also will cause a Host interrupt to occur. interrupt Status will be set when for a RAM fault, an EPROM fault, or for excessive bus errors.

## Interrupt Tables

Several conditions occur which can cause the PCIM Manager to set a byte in the Interrupt Status Table, and possibly result in the generation of an interrupt for the Host. The following is an explanation of each condition:

- Interrupt Summary Status - Whenever the PCIM Manager causes an interrupt to the Host, the interrupt Summary Status byte will **be** set in the Interrupt Status Table. If this byte is set in the Interrupt Disable Table, the PCIM Manager will not interrupt the Host for any reason.

- Request Queue Entry - Certain messages received from devices on the bus will be separated out from all other messages and placed in the Request Queue. The PCIM Manager will then set the Request Queue Entry byte.

- PCIM Status Change - When certain items within the PCIM Status Table change, the PCIM Manager will indicate this change by setting the PCIM Status Change byte.

- Device Status Change - Anytime that a device on the bus is logged in, logged out or changes its configuration data, the PCIM Manager will set the Device Status Change byte.

- Outputs Sent - This status byte is set whenever the PCIM relinquishes its access to the serial bus. This interrupt status can be used to synchronize to the serial bus scan if required.

- Command Complete - Each time the Host initiates a command, and the PCIM Manager completes that command (with or without errors), this status byte will **be** set.

- Receive Queue Not Empty - Whenever any message is received from a device on the serial bus that is not part of Request Queue Entry, Serial Bus Requests, or a response from the command Transmit with Reply, this status byte will be **set.** Since these messages will be queued, the Host may retrieve them via the Read Datagram Command.

- I/O Table Lockout Grant - When the Host requests an I/O Table Lockout (not a Relinquish), this byte will be set to indicate when the PCIM Manager is able to enforce the lockout. The lockout is not enforced until this byte is returned to the Host.

## PCIM MOTHERBOARD OPERATION

The PCIM motherboard's primary function is to provide an electrical interface between the PCIM daughterboard and a Host system. The PCIM motherboard has no 'smart' components and therefore will be functionally transparent to the user. The motherboard does, however, provide support features that enhance daughterboard functions and allows **the** PCIM to function as an IBM PC type I/O board.

The PCIM motherboard includes the following components:

- Address buffers
- Data transceiver
- Address decoders
- PAL logic control
- Programmable Peripheral interface
- Watchdog timer
- Power supply control
- **Host** interrupt control
- Signal conditioning

Pertinent PCIM motherboard hardware operation **is** discussed below. Component interface details are shown in **figure** 2.3.

## Watchdog Timer

The watchdog timer is a hardware timer that can be periodically reset and is used to reset the motherboard. if the watchdog timer is enabled by jumper JP2 (see figure 3.1), it must be reset periodically or it will put the PClM into RESET. You can toggle the watchdog timer and use it as a failsafe timer to ensure that if the Host system 'hangs up', the PCIM will not send any erroneous messages to the serial bus. If the watchdog timer is disabled by JP2, you do not have to toggle it; it will stay turned off and will not put the PCIM into RESET.

## Power Supply Voltage Detector And RESET Circuit

In addition to the watchdog timer, the power supply voltage detector can put the PCIM into RESET if it detects a low power supply voltage.

The RESET circuit monitors the system reset signal on the Host bus (called RESETDRV on an IBM type bus), as well as the output of the voltage detector and the watchdog timer.

### Reset Restrictions

Do not enable interrupts, or read/write to the PCIM for 1.7 seconds (the period of time required for hardware/software initialization) after reset. One false interrupt occurs within this time period. Reading or writing to the PCIM during this time may cause the watchdog timer to time out. The PCIM OK flag wilt be invalid during this period of time.

## Host System Interrupt Control

The motherboard provides a method to interrupt the daughterboard and receive and route an interrupt request from the daughterboard to the Host system. The Host, using the motherboard, can interrupt the daughterboard by toggling the output line.

The daughterboard can also request an interrupt from the Host. The motherboard latches the edge of the interrupt where it can be read or routed through a selector switch (see figure 2.3) to one of five interrupt request lines on the Host bus. The motherboard can reset the latch, readying it for the next interrupt.

## PCIM Electrical Characteristics

### Power Supply Requirements

The PCIM requires a 5 volt DC source for logic power. Supply voltage should not vary more than 10% above or below nominal (below 4.5 V DC or above 5.5 V DC), or the PCIM will not function correctly. The PCIM typically draws 180 milliamperes at 5.0 volts (± 10%).

### Bus Loads/Drive Capability

All input lines to the PCIM present **no** more than one standard LSTTL load to the Host interface connector.

All output lines from the PCIM are capable of driving 10 standard LSTTL loads. These **lines,** with the exception of the /INT and /PCIM OK lines, are tri-state outputs. The /INT line is an open-collector output that can be wired-ORed to a single interrupt input. The /PCIM OK and /COMM OK lines are low-true open collector type outputs with built-in current limiting to IO ma suitable for driving LEDs directly.

All input signals **to** the PCIM from the Host system look like one LSTTL load to the Host system. These signals are TTL compatible and switch at TTL levels.

**The** control output signals to the Host system are open-collector LSTTL drivers with IOK resistive pull-ups, capable of sinking 4 mA while maintaining an output voltage of 0.4V or lower.

The data transceiver is a tri-state LSTTL device capable of sourcing or sinking 12 mA with VOL = 0.4V and VOH = 2.0V.

## Signal Conditioning

The PCIM has two connectors that you can **access** when the PCIM is installed in a **PC type** rack. One of the connectors, a six-pin terminal block, is for the standard twisted pair connection to **the** serial bus. The other connector, a nine-pin ‘D’ connector, is for **the** Hand-Held Monitor interconnect (see figure 3.3). A 150 ohm termination resistor is provided across the twisted pair bus **to** terminate the line by connecting jumper JPl.

All of **the** lines in from both connectors are either isolated or impedance limited to protect the PCIM from voltage spikes or the misapplication of high voltages on the serial bus connections.

The low-level (logic) signals are brought out on the 40 pin connector and the high level signals (analog) are on the IO pin connector. Signal conditioning is discussed in detail in the next chapter.

# CHAPTER 3
# GETTING STARTED

## INTRODUCTION

In order for you to interface the PCIM with the GENIUS serial bus, you must first perform the following steps:

- ✍ Correctly terminate the serial bus.
- - Set the appropriate P Cjumplers. M
- - Set PCIM dip switches SW1 through SW5
- ✍ Install **the** PCIM in the host.
- ✍ **Make a** cable for serial bus communications and install this cable from the **PCIM** to the serial bus.

### Hardware Reauired

In addition to the devices normally considered part of the GENIUS I/O system, the following hardware is required **to** effect a GENIUS I/O - PCIM - I-lost communications **interface:**

- - a Workmaster, Cimstar I, IBM-AT, IBM-XT, or IBM-Clone
- - a PCIM

### Software Required

The following software is required **to** effect GENIUS I/O - PCIM - Host communications:

- ✍ MS DOS 3.0 or higher

**and**

- - pcim.lib (C **Software Driver** - small memory model)/
- ✍ lpcim.lib (C Software Driver - large memory model)
- - pcim.h (C Software Driver **- include file)**

**or**

- - pcimx.exe (BASIC Software Driver)
- - pcim.bas (BASIC startup sequence)

**All** of the files above (except MS **DOS** 3.0) reside on the diskette you received with this manua l.

## Bus Termination, Jumpers, and Resistors

You must install a terminating resistor across Serial 1 and Serial 2 at both ends of each serial bus. The value of the resistors you install will be 75, 100, 120, or 150 ohms, depending upon the type of cable used (see chapter 2 of the GENIUS I/O User's Manual, GEK-90486).

There are two jumpers on the PCIM motherboard: JPI and JP2 (see figure 3.1). When the PCIM is placed at one end of the bus, the 150-ohm terminating resistor built into it can be used to terminate this end of the cable (when cables requiring a 150-ohm termination are used). Install this resistor by moving jumper JPI to the l-2 posit ion. When JPI is in the 2-3 position, no resistance is applied.

Jumper JP2 is used to enable or disable the motherboard on-board watchdog timer. This timer is provided for users who want to monitor the Host system and shut off the PCIM when the Host malfunctions. The timer is enabled when JP2 is in the 2-3 position. You must then pulse the timer input every 727 ms or the motherboard will reset the daughterboard. With JP2 in the f-2 position, the watchdog timer is disabled and needs no input from the Host system. The other portions of the RESET circuit, the voltage detection and Host RESERDRV monitor, still provide RESET capability, even with the watchdog timer disabled.

a4202 1

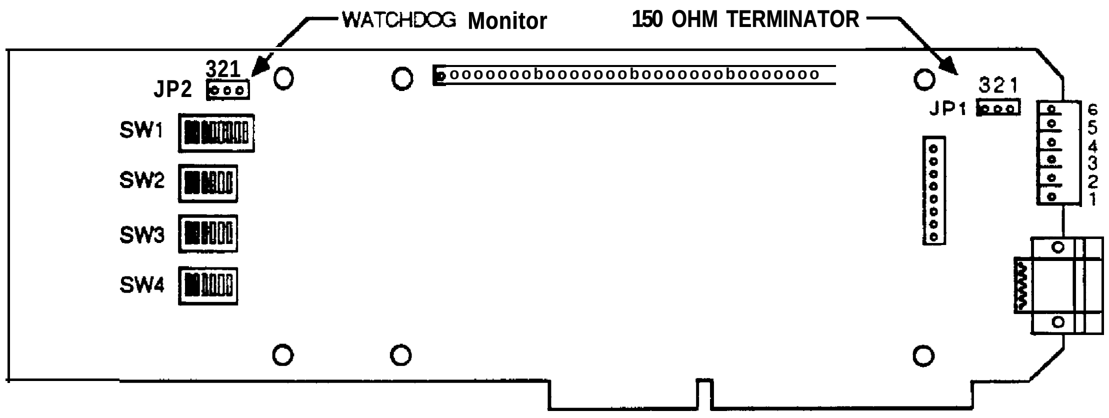


Figure 3.1 JUMPERS JP1 AND JP2

## ADDRESSING

Initial setup of the PCIM is easy; first set the I/O and t-lost memory addresses on the motherboard. Then, set the PCIM Serial Bus Address, Baud Rate, and output default on the daughterboard. Finally, begin using the IM through your applications program. The following sections show the setup procedures and provide a step-by-step example.

### Motherboard Memory Map

#### Segment Addressing

The memory map for the motherboard consists of four consecutive bytes of I/O space. 16K bytes of memory space suffice for the daughterboard. These I/O and **memory** locations should be mapped into a 'reserved' area in the Host system where no memory or device addresses reside. The dip switch settings on the motherboard (see figure 3.2) determine the exact absolute memory locations required by the PCIM. SW1 - SW4 switches are all set OPEN from the factory.

As an example, commonly used locations are:

| | | | |
|---|---|---|---|
| Segments | - CC00 hex (daughterboard) | I/O Addresses | - 3E0 hex (motherboard) |
| | DO00 hex | | 3E4 hex |

#### I/O Port Addressing

The four bytes of mapped I/O memory space are used by the Programmable Peripheral Interface (PPI) on the motherboard. The PPI chip consists of a microprocessor interface and three 8-line programmable I/O ports. I/O ports are configured as input or output, depending on the values put in the four program bytes of the PPI. The I/O base address for the four bytes is determined by the dip switch settings described in the next section.

a42022

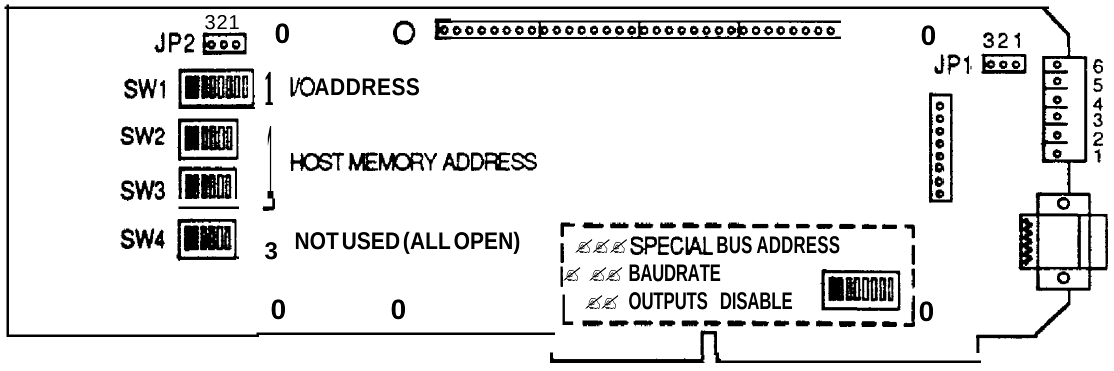


Figure 3.2 DIP SWITCHES ON THE PCIM

## Motherboard Dip Switch Settings

### SW1 - I/O Base Starting Address

The PPI-occupied 4 bytes of I/O space in **the** Host system is determined by the settings of dip switch SW1. The starting address of the 4 byte I/O space is calculated **as follows:**

```
         Dip Switch SW1
           position
             |
             |--> 1  2  3  4  5  6  7  8
                  |  |  |  |  |  |  |  |
         |--> A0 AI A2 A3 A4 A5 A6 A7 A8 A9
         |     \__________/\__________/\__/
       Host          |           |       |
      address       3rd         2nd     1st
       bus         digit       digit    digit  (notice that address is reversed)
```

The i/O addresses available for the motherboard must begin on 4 byte boundaries. That **is, the** third digit of the I/O address must end in a '0', '4', '8', or 'C' (hex). Therefore, the starting addresses **of** the 4 byte I/O space range from 0 to 3FC (hex). To determine the switch settings for a particular address, first establish the starting address of the 4 byte I/O space in I/O memory that the motherboard should use. Convert this address value to binary and from the figure above, set OPEN the switches on SW1 corresponding to the '1' values in the binary value.

Example:

To set dip switch SW1 for I/O address 3E0 (hex), first convert 3E0 to binary, which is

```
A0AI  A2 A3 A4 A5  A6 A7 A8 A9
 |     |           |  |  |  ||  |  |  |
 0  0  0  0  0  1  1  1  1  1
 \__________/ \__________/ \__/
      |            |         |
      0            E         3
```

**for** every occurrence of a 1, set the corresponding dip switch position of SW1 OPEN as follows:

```
A2 A3 A4 A5 A6 A7 A8 A9
|  |  |  |  |  |  |  |
0  0  0  1  1  1  1  1
|  |  |  |  |  |  |  |
 ________________________
|                        |
| C  C  C  O  O  O  O  O |      C = closed
|                        |      O = open
| 1  2  3  4  5  6  7  8 |
|________________________|
      Dip Switch SW1
```

**Reading and writing to the assigned I/O address provides data interchange between your programs and the PCIM.**

**SW2 and SW3 - Host Memory Address**

**As stated, the daughterboard uses up to 16K bytes of system memory. This block of memory is used to store I/O data, buffers for communication data, and a variety of other information the PCIM uses. Dip switches SW2 and SW3 determine where this 16K memory should reside. Address lines A0 through A13 are passed on from the t-lost bus to the PCIM** connector **and are not used in the address decoding** on the motherboard. These **14 address lines are necessary to decode addresses in the 16K** shared RAM memory on **the daughterboard.**

```
                            SW2                            SW3
                /-----------[###]------------\ /-----------[###]-------------\
                  1    2    3    4    5    6    1    2    3    4    5    6
                  |    |    |    |    |    |    |    |    |    |    |    |
    A0..11  A12  A13  A14  A15  A16  A17  A78  A19  |    |   A20  A21  A22  A23
    \____/  \_______________/  \_______________/  \|____|___________________/
       |                |                |          |    |         |
4,5,6th digits    3rd digit    2nd digit  (Type   N/A     1st Digit
       (Address for PC)       (High Address  of         (High Address
                                for PC)    AT/PC)          for AT)
```

**You can position this 16K shared RAM anywhere in PC, XT or AT memory** using dip **switches SW2 and SW3. Six switches on SW2 and four switches on SW3 decode the ten address lines needed to uniquely place the 16K bytes in a 16,777,216 byte memory map. An extra switch, switch position 1 on SW3,** will **enable or disable the decoding of the four high address lines A20 through A23. If the PCIM is to be used in a PC, XT, or other system without the address capability of the AT (24 address lines), SW3 switch 1 should be OPEN. If SW3 switch 1 is OPEN, the other switches on SW3 are ignored and can be left in any posit ion. If your system has 24 address lines and you want to address the PCIM at an address greater than 1M, SW3 switch l should be CLOSED. Currently, MS/PC DOS does not support addresses greater than 1M. The example below shows dip switches SW2 and** SW3 set **for** segment **value CC00 hex for a PC type Host.**

```
              SW2                         SW3
               |                           |
  /------------------------\   /-----------------------\
   1   2   3   4   5   6    1   2   3   4   5   6
   |   |   |   |   |   |    |   |   |   |   |   |
   1   1   0   0   1   1    1   X   X   X   X   X
   |   |   |   |   |   |    |   |   |   |   |   |
   0   0   C   C   0   0    0   X   X   X   X   X
```

The memory address space in the Host memory map must start on 16K byte boundaries. That is, the fourth, fifth, and sixth digits in the hex address of the start of the memory address space must be zero. The third digit must always be a '0', '4', '8', or 'C' (hex). So valid memory addresses for the start of the block could be F4C000 288000, 0E0000, etc.

In a manner similar to that used in I/O address decoding, dip switches SW2 and SW3 are set up to decode the desired memory address. Switches should be OPEN to correspond to a '1' in the desired address. Remember, switch 1 of SW3 shoutd be CLOSED for addresses greater than 1M and OPEN for addresses less then IM. Some example setups are shown below:

| | SW3 | | | | | | SW2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Addresses | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| F4C000 | c | x | o | o | o | o | o | o | c | c | o | c |
| 288000 | c | x | c | o | c | c | c | o | c | c | c | o |
| 0E0000 | c | x | c | c | c | c | c | c | c | 0 | 0 | 0 |
| CC000 | o | x | x | x | x | x | o | o | c | c | o | o |
| E0000 | o | x | x | x | x | x | c | c | c | 0 | 0 | 0 |

0 = OPEN C = CLOSED X = Don't Care

SW4

Switch 4 on the motherboard is the switch which controls interrupts. It determines which IRQ level appears in the PC. If the switch is closed, IRQ value is active.

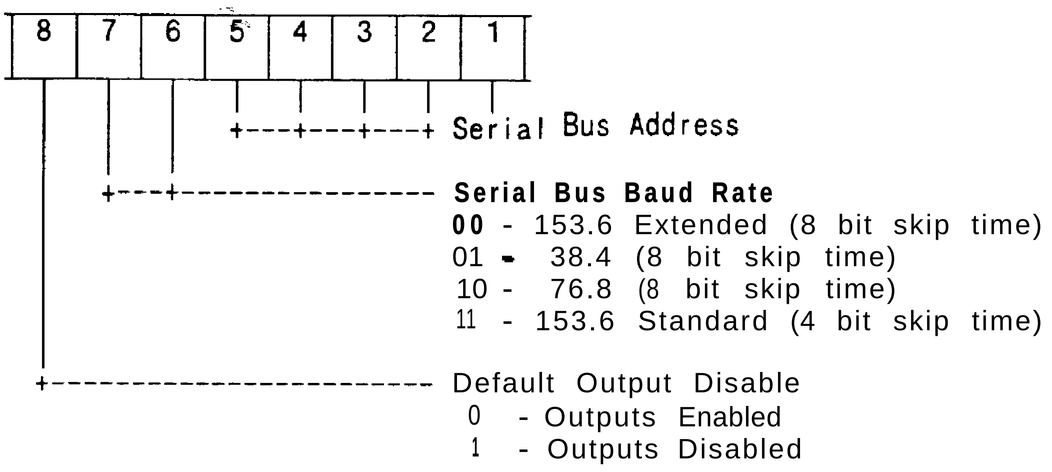
| | SW4 | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| IRQ | 2 | 6 | 5 | 4 | 3 | X |

## Daughterboard Dip Switch Settings

A single bank of Dip Switches is located on the daughterboard (as shown). These dip switches are used to set the Serial Bus Address of the PCIM, set the Serial Bus Baud Rate, and determine the default setting for Outputs (Enable or Disable). From the factory, the PCIM Serial Bus Address is set to 31 (IF hex/11111 binary), Baud Rate to 153.6 standard, and Outputs are Disabled. See the GENIUS I/O User's Manual (GEK-90486) for more information about the significance of these defaults.

**NOTE**

The PCIM Baud Rate should be set to 153.6 Standard when connected to a bus on which Phase A devices are used. See Appendix E for a list of Phase A devices.


8
7
6
5
4
3
2
1
Serial Bus Address
**Serial Bus Baud Rate**
**00** - 153.6 Extended (8 bit skip time)
01 - 38.4 (8 bit skip time)
10 - 76.8 (8 bit skip time)
11 - 153.6 Standard (4 bit skip time)
Default Output Disable
0 - Outputs Enabled
1 - Outputs Disabled

The four bytes of mapped I/O memory space are used by the Programmable Peripheral Interface (PPI) on the motherboard. The PPI chip consists of a microprocessor interface and three 8-line programmable I/O **ports.** These four bytes start at the I/O base address determined by the switch settings on SW1 and are in sequence as shown below. The four PPI I/O bytes then, are Port A Data, Port B Data, Port C Data and the Control Byte. I/O ports are configured as input or output, depending on the values put in the four program bytes of the PPI, which are as follows:

| Byte # | A8 - A0 | Description |
|---|---|---|
| 0 | xxxxxxxxoo | Port A Data byte |
| 1 | xxxxxxxo 1 | Port B Data byte |
| 2 | xxxxxxx10 | Port C Data byte |
| 3 | xxxxxxx 11 | Control **byte** |

For example, if the switches on SW1 are set for 3E0 (hex), you can perform I/O operations on the four PPI bytes at addresses:

```
(3E0 t 0)  = 3E0 Port A Data Byte (PCIM Status)
(3E0 t 1)  = 3E1 Port 5 Data Byte (PCIM Control)
(3E0 + 2)  = 3E2 Port C Data Byte (not used)
(3E0 t 3)  = 3E3 Control Byte
```

**Port** A, B and C **bytes** are read/write, whereas the Control byte is write-only.

On the motherboard, Port A of the PPI is **used as** in input port, Port B **as** an output port and Port C is not connected. When Port A is programmed **as** an input port, all eight lines will present high impedance load to the rest of the circuit. Port B, on the other hand, when programmed as an output port will look like all high (logic 1 outputs when it **is** first programmed as an output port. Therefore, you should lower some of the lines in Port B to their 'default' positions as outlined in the following descriptions.

The functions for each pin of tbe PPI are as follows;

- Port A:

  0 - low voltage/Host RESET detect

  This input monitors the output of a bi-stable latch controlled by the voltage detection circuit and the Host system RESETDRV line. It goes low and stays low (until reset) whenever the voltage on the motherboard drops below 3.12 volts or the system RESETDRV line goes high, indicating the Host system has gone into RESET. The latch controlling this line is reset by the '1' bit of Port B. During normal operation this line should stay high (logic 1).

  1 - watchdog timer status

  This line is high while the watchdog timer is enabled (by jumper JP2) and being pulsed every 727 ms by output 0 of Port B. If the timer times out, this line goes low (logic 0). It will go low if either the voltage detector detects a low voltage or the system RESETDRV line goes high and the timer times out. The timer will time out if not pulsed every 727 ms (with jumper JP2 in the 2-3/Enabled posit ion).

  2 - interrupt request

  When the daughterboard generates an interrupt to the motherboard, this line goes high (logic 1) and stays high until reset by output 2 of Port B. The bi-stable latch that stores this interrupt is edge triggered.

  3 - PClM OK signal

  The state of this line follows the condition of the PClM OK LED on the daughterboard. If the LED is lit, the PClM OK signal into the PPI is low (logic 0).

  4 - COMM (communications) OK signal

  Like the BOARD OK signal above, this signal also follows the output of one of the LEDs on the daughterboard. This line into the PPI is low (logic 0) if the COMM OK LED on the daughterboard is lit.

  5 - NC

  6 - N C

  7 - N C

- Port B:

0 - watchdog timer pulse signal

If the watchdog timer is enabled by jumper JP2 this line should be pulsed at least every 727 ms in order to keep the watchdog timer timing. The timer is triggered on the rising edge of the signal, so it is necessary for you to program the PPI to provide a low to high transition on this signal line. This line must be pulsed at least once to allow the daughterboard to come out of RESET.

1 - clear RESET request

When the system RESETDRV signal goes high indicating a system RESET, or when the voltage detector on the motherboard detects a low voltage condition, a bi-stable latch is set that drives the motherboard RESET circuit. The output of this latch can be read on bit 0 of Port A on the PPI (see above). This line (bit 1 of Port B) clears the latch when lowered (logic 0), and when raised again (logic 1), readies the latch for the next detection of RESET or low voltage condition.

2 - clear interrupt request

This line is used to clear the interrupt request bi-stable latch on the motherboard after an interrupt has been received from the daughterboard. Bringing the line logic 0 clears the latch and then back to logic 1 prepares it for the next interrupt. As long as this line is low, the latch will not latch incoming interrupt requests.

3 - HHM test

An HHM present can be indicated even when one isn't plugged in by raising this line to a logic 1. After power up and under normal conditions, lower (logic 0) this line and leave it low.

4 - factory test

This line should not be used and should be left low (logic 0) all the time.

5 - interrupt output **(to** the daughterboard)

This output from Port B drives the GENINT/ interrupt line to the PCIM connector. When pulsed low (logic 0) it requests an interrupt from the daughterboard. Not operational for the PCIM - should be logic 0.

6 - PCIM RESET

When this line is low (logic 0) it pulls the PCIM into RESET. Under normal conditions, it should be left high.

## Application Example

To set up the PCIM, first set up the PPI. The PPI is initialized by defining ports A and C as input ports and port B as an output port.

**In** BASIC, this statement would suffice:

```
100 OUT 959,153
```

This example statement writes a value of 153 decimal (99 hex) to the control byte of the PPI located in I/O memory at location 995 decimal, or 3E0 hex. For the purposes of **this** example, **assume** the dip switches have been set to respond to the I/O address range of 992 hex through 995 hex. The value of 99 hex **causes** ports A and C **to** be configured as inputs and port B as an output port. Port B is now an output port and all eight of its outputs are high - they shouldn't be left that way for long. Lines D1, D2, D3, D6 and D7 **of** port B should **be** lowered to prevent any interrupts to the Host system and make sure the PCIM is in RESET, always a good place to start. The BASIC statement **to** perform this is:

```
110 OUT 993,01
```

This statement writes a 1 decimal (1 hex) value to Port B byte. Then, to bring the PCIM out **of** RESET, execute the following statement:

```
120 OUT 993,67
```

This raises D1 and D6, and allows the PCIM daughterboard **to** run in the memory space determined by the dip switch settings.

That is:

```
nnn OUT Base t 3, 99h
nnn OUT Base t 1, l
nnn OUT Base t 1, 43h
```

In Microsoft C compiler, the library function 'outp (port, value)' is used,

Try coding **the** values shown in the Basic example above in the following in Microsoft C statements to set ON the PCIM:

```
outp ((BASE + 3), 0 x 99);
outp ((BASE + 1), 1);
outp ((BASE + 1), 0 x 43);
```

## Setting Dip Switches - Example

One board setup - Set the dip switches on the daughterboard as follows (closed = 0, open = 1):

| | |
|---|---|
| GENIUS Bus Address = 31 | SW1 - 1, 2, 3, 4, 5, 6, 7 open |
| Default Outputs Enabled | SW1 - 8 closed |

One board setup - Set the dip switches on the motherboard as follows:

| | |
|---|---|
| Motherboard I/O Address = 3E0 | SW1 - 4, 5, 6, open |
| | SW1 - 1, 2, 3 closed |
| SRI Address = CC00:0000 | SW2 - 1, 2, 5, 6 open |
| | SW2 - 3, 4, closed |
| Motherboard A20 to A23 Disabled | SW3 - 1 open |
| | SW3 - 2, 3, 4, 5, 6, closed |

Two board setup - Set the dip switches on the daughterboard as **follows:**

| | |
|---|---|
| GENIUS Bus Address = 30 | SW1 - 2, 3, 4, 5, 6, 7 open |
| Default Outputs disabled | SW1 - 1, 8 closed |

Two board setup - Set the dip switches on the motherboard **as** follows:

| | |
|---|---|
| Motherboard I/O Address = 3E4 | SW1 - 1, 4, 5, 6, 7, 8 open |
| | SW1 - 2, 3 closed |
| SRI Address = D000:0000 | SW2 - 3, 5, 6 open |
| | SW2 - 1, 2, 4, closed |
| Motherboard A20 to A23 Disabled | SW3 - 1 open |
| | SW3 - 2, 3, 4, 5, 6, closed |

## Communications Cable

PCIMs, 8us Controllers and I/O blocks have four terminals for the serial bus cable (Serial 1, Serial 2, Shield In, and Shield Out). PCIMs are connected to the GENIUS serial bus like all bus devices. You must construct a cable to go from these terminals on an I/O Block of your choice to the connector on the PCIM (see figure 3.3). The Serial 1 terminal on a PCIM must be connected to the Serial 1 terminal on an I/O Block. Likewise, the Serial 2 terminal should be connected to the I/O Block Serial 2 terminal. Shield In of a PCIM or I/O Block must be connected to the outgoing shield (Shield Out) of the preceeding device If the PCIM or I/O Block being wired starts (is at the beginning of) the bus, the Shield In can be left unconnected. Shield Out of an IM or block must be connected to Shield In of the next block. If the IM or block being wired is the last device on the bus, Shield Out can be ieft unconnected.

So, in construction of your cable, the plug from the PCIM must be wired to the communications cable as follows:

- Pin 1 to Serial 1 of next the block.
- Pin 2 to Serial 2 of the next block.
- Pin 3 not connected.
- Pin 4 to Shield in of the next block.

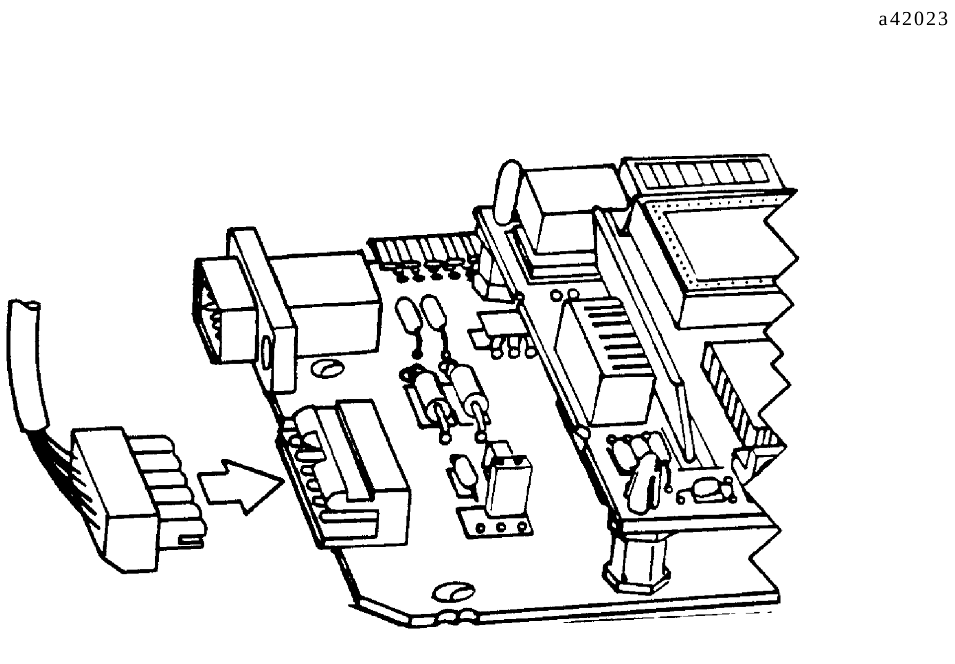


Figure 3.3 COMMUNICATIONS CABLE

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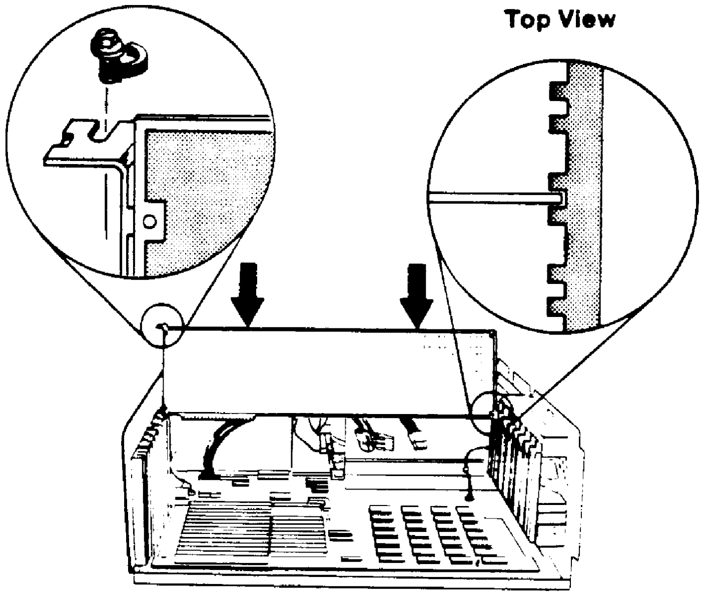


Figure **3.4 PCIM INSTALLATION**

## PCIM Installation

1) **Power** OFF the Host computer and unplug from power source.

2) **Plug** the PClM into any available slot (remember, space for two slots is required for an IBM PC AT, XT, or Workmaster - CIMSTAR I requires only one) in the Host as shown above. Make sure the edge connectors are firmly seated, and the mounting bracket aligned. Then, tighten the mounting screw.

**DO NOT**

- Mount the PCIM where air flow across it is obstructed
- Mount the PCIM nearer than 1/8" (.125") to **any** other boards or rack components
- Use adhesives or conformal coatings on any part of the PCIM

3) Connect one end of the communications cable you made to designated I/O Block on the serial bus, and the other end to the PCIM installed in the Host.

4) For board installation information for specific Hosts, refer to OEM user's manuals, such as IBM's "Guide to Operations".

## PCIM startup

You may now activate the PCIM as follows:

1) Plug in and power ON the Host computer.

   - The PCIM performs self tests verifying that processor, RAM, timers and the I ike are operational. If both LEDs are set ON, power up was successful.

2) Insert an MS DOS 3.0 (or higher) software disk into Drive A.

3) Insert the provided diskette containing the Software Driver and associated files into Drive B.

4) After MS DOS boots, set the active disk drive to 'B'.

   - Beyond the self tests, the PCIM will do nothing until it is explicitly taken out of RESET. This is accomplished via the application program code you write - specifically, through the INITIM Software Driver function call explained in chapter 4.

   - Before the Software Driver can **be** used, function call subroutines must first be loaded into your system. Further, each Basic program accessing the Driver must perform a short startup sequence. **The** details of these operations follow in chapter 4.

## HHM Connector

The HHM connector on the PCIM is a DB-9P sub-miniature male connector capable of accepting two 4-40 threaded screws. The unused pins on the D connector remain unconnected in order to maintain isolation between the Xl, X2, SHD lines and the MONO, 5VR lines

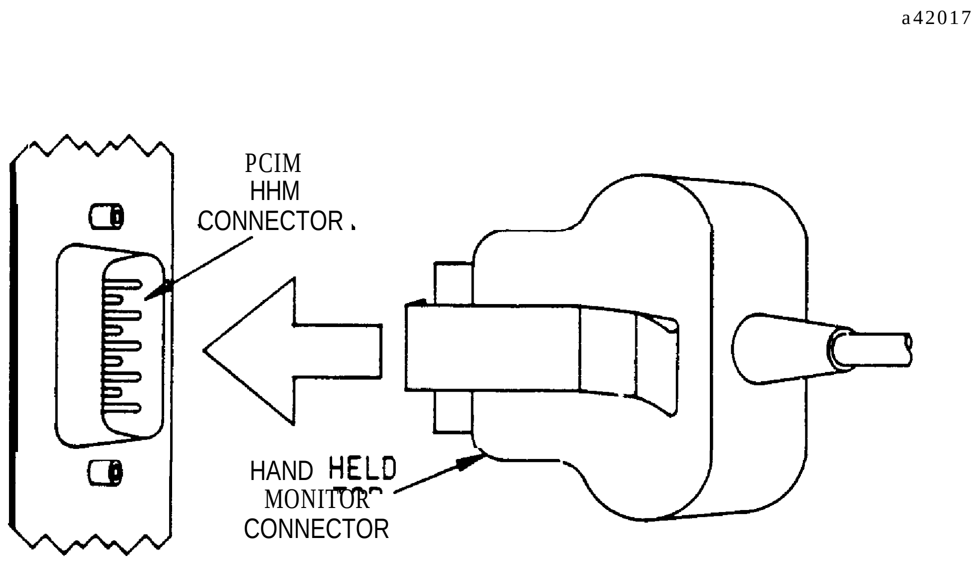


Figure 3.5 HHM Connector

## Faceplate Markings

The faceplate (if used) should provide the following names for the signals on the external bus connector to provide consistent labeling with all products using the serial bus.

| | | |
|---|---|---|
| Xl | ==> | SER1 |
| x2 | ==> | SER2 |
| SHD | ==> | SHD IN |
| AUXSHD | ==> | SHD OUT |

# CHAPTER 4
# PCIM SOFTWARE DRIVER

## INTRODUCTION

This chapter outlines the functionality of the PCIM Software Driver, which provides a high level interface between applications software you develop and the PCIM; and through the PCIM, devices on the GENIUS serial bus. The PCIM Software Driver is accessed through **a** set of subroutine calls. The PCIM Software Driver is compatible with applications software custom designed by your OEM, or prepackaged software such as CIMPAC.

### Languages

The PCIM Software Driver is provided in versions compatible with C language and Basic language, specified as **a** set of function calls in order to allow a consistent interface with both languages. Driver software is delivered in the form of object code in **a** single .exe/(.COM) file. Its guide covers both C language and Basic language applications.

### Host Operating System

The PCIM Software Driver is supplied in a version compatible **the** MSDOS operating system, as follows:

1) C/MSDOS

2) BASIC/MSDOS

### Software Driver Function Calls

The PCIM Software Driver consists of easy **to** use macro-oriented function calls you code appropriately in your C language or Basic **language** applications routines. Function calls are summarized below.

Functions that deal with PCIM configuration:

1) InitIM - assigns PCIM numbers and Global data parameters to all PCIMs. Performs any required hardware activation and initialization of the PCIMs (such as Reset).

2) ChgIMSetup - writes to the Setup Table of the selected PCIM from **the** Host memory to change PCIM parameters.

3) GetIMState - reads PCIM configuration and status from the selected PCIM Status Table and Setup Table into Host memory.

**Functions that deal with bus configuration:**

4) GetBusConfig - reads all Device Configuration Tables from the selected PCIM into Host memory.

5) GetDevConfiq - reads one device's configuration from the selected PCIM into Host memory.

6) DisableOut - writes to the Device Configuration Table of the selected PCIM to enable/disable selected outputs.

**Functions that deal with control data movement:**

7) GetBusIn - reads the entire Input Table (control data inputs) from a selected PCIM into Host memory.

8) PutBusOut - writes the entire Output Table (control data outputs) to a selected PCIM from Host memory.

9) GetDevIn - read control data inputs from a selected bus device into Host memory.

IO) PutDevOut - write control data outputs to a selected bus device from Host memory.

11) GetIMIn - reads all PCIM control data from Directed Control Input Table of selected PCIM into Host memory.

12) PutIMOut - writes all PCIM control data to Broadcast Control Output Table of selected PCIM from Host memory.

13) GetCir - reads an input circuit value (variable) into the Host memory from the Input Table of a selected PCIM.

14) GetWord - reads an input word value (variable) into the Host memory from the Input Table of a selected PCIM.

15) PutCir - writes an output circuit value (variable) from the Host memory to the Output Table of a selected PCIM.

16) PutWord - writes an output word value (variable) from the Host memory to the Output Table of a selected PCIM.

**Functions that deal with communications:**

17) GetMsg - reads a received message from a selected PCIM into Host memory.

18) SendMsq - writes a message from Host memory to the PCIM for transmission onto the bus.

**Functions that deal with communications (Cont'd):**

19) SendMsqReply - writes a message from Host memory to the PCIM for transmission onto the bus and expects a specified reply message from the destination.

20) ChkMsqStat - allows the Host to detect when a transmitted message has actually been completed, or if transmission is incomplete or has failed.

**Functions that deal with interrupt processing:**

21) GetINTR - reads the entire interrupt Status Table from a selected bus device into Host memory.

22) PutINTR - writes the entire Interrupt Status Table to a selected PCIM from Host memory.

## Using Software Driver Function Calls

When coding the PCIM Software Drivers in your application programs, you should have at hand the following:

- Starting Address (Segment Address) of the SRI.
- I/O Port Ease Address.
- Status Table Address (PCIMs) or Reference Address (Series Six).
- Serial Bus Address of each bus device.
- Global, Input, Output Data lengths.
- SW1 - SW5 Dipsw i tch values.
- GENIUS I/O Bus Datagram Services (GFK-0090)

It is also helpful to have the GENIUS I/O Manual (GEK-90486) and the Series Six Interface to the Genius I/O System Manual (GFK-0171) handy for reference.

## This Chapter Has Two Sections

If your application is coded in C language, go on to Section A. If you are using BASIC, notation and coding conventions for your application are described in section B.

CFK-0074

## SECTION A
C LANGUAGE PCIM SOFTWARE DRIVER

### C SOFTWARE DRIVER INSTALLATION

#### Compiling your Application with Microsoft

In order to make your C application compatible with the PCIM library, you must first invoke the Microsoft compiler with the following switch (option):

```
/Zp
```

This option permits user-packed data structures and is required for the GetlMState, GetlBusConf ig, and GetDevConf ig calls. For example:

```
C> msc application /Zp;     (small model)
```

OR

```
C> msc application /Zp/AL; (large model)
```

#### Software File Linkage

It is necessary to link and load the file named SPCIMLIB" (small model) or LPCIM.LIBVf (large model) before using the C Software Drivers in your programs. There are several ways to link the PCIM.LIB using the Microsoft Linker,

1) The simplest way is to type all of the necessary module information on the command line:

```
'LINK PROGRAM+MODULE,,,\SEARCH\PATH\SPCIM.LIB;'     (small model)
```

OR

```
'LINK PROGRAM+MODULE,,,\SEARCH\PATH\LPCIM.LIB;'     (large model)
```

2) However, if the program is divided up into several modules too numerous to fit on the command line, you can set up a response file to tink all of the associated object files. The contents of a response file might look like:

```
program+module1+module2+module3+
module4+....+moduleN,
program.exe,
program.map,
\search\path\pcim.lib
```

The command to fink the response file is:

```
LINK @RESPONSE.FIL
```

## C Software Driver Function Call Parameters

C Software Driver function calls require that you specify a number of parameters for each call. The data structures for each parameter, which are linked and loaded from your "pcim.h" file, are summarized as follows.

### Summary of C Data Structures

Data structures that deal with the PCIM configuration:

typedef
struct {

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned int | im.Segment; | 0-FFFE(h) | Starting address of SRI as described by the daughterboard Dipswitch. | Ch. 3 |
| unsigned int | im. IOPort; | 100(h)- 3FC(h) | I/O Port Base Address as described by the SW1 Dipswitch. | Ch. 3 |
| unsigned int | IMRef; | 0-8001/ 0-FFFF(h) | Global Data Reference Beginning address of **the** Global Data of the broadcasting CPU. | Ch. 5 |
| unsigned char | Outputlength; | O-128 | Global Data Length Number of bytes of Global Data to be broadcast by the PCIM. | Ch. 5 |
| unsigned char | Inputlength; | O-128 | Reserved - set to **'O'.** | Ch. 5 |
| unsigned char | Active; | ON/OFF | **Turn ON or** OFF PCIM. | ChglMSetup |

} IMPARMS;

The following **Macros are** to be used with the variable Active in the functions InitIM and the ChglMSetup.

| Macro | Value | Explanation |
|---|---|---|
| #define ON | 1 | Active set ON will enable the PClM |
| #define OFF | 0 | Active set OFF will disable the PClM |

**NOTE**

Any structures which do not indicate setting by Dipswitch (hardware actuated) are set by the Software Drivers (software actuated).

## Summary of C Data Structures (Cont'd)

Data structures that deal with the PCIM configuration (Cont'd):

{

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned char | DipSwitch; | **0-255(d)** | Daughterboard Dip Switch value. | **Ch. 3** |
| unsigned int | IMRef; | 0-8001 / 0-FFFF(h) | Global Data Reference Beginning address of the Global Data of the broadcasting CPU. | Ch. 5 |
| unsigned char | OutputLength; | 0-128 | Global Data Length Number of bytes of Global Data to be broadcast by **the PCIM.** | Ch. 5 |
| unsigned char | InputLength; | 0-l 28 | Reserved - set to '0'. | Ch. 5 |
| unsigned char | Revision; | | PCIM Firmware Revision Number. | GEK-90486 |
| unsigned char | GENI_OK; | **I/O** | PCIM OK=0- **every 200 ms, set to '1'.** | **Ch. 3** |
| unsigned char | Fault; | 0-1 5 | Overall fault byte - any PCIM **fault** shown below. | |
| **unsigned** char | Active; | 0-5 | Hand Held Monitor Present - one or combination of bit positions:<br>0 = HHM present<br>1 = reserved<br>2 = 10 CRC errors in 10 seconds.<br>On for one second, doesn't stop PCIM. | |
| **unsigned** int | SBerr; | 0-FFFF FFFF-0 | **Serial Bus error count -** roll over counter. Goes from 0 to FFFF to 0. | |
| unsigned int | ScanTime; | | **Bus** Scan Time in ms. | Ch. 3, 5 |

} IMSTATE;

The following Macros are to be used with the variable Fault in the function GetIMState.

| Macro | Value | Explanation |
|---|---|---|
| **#define** RAMERR | 0 | Random Access Memory error |
| **#define** EPROMERR | 1 | **EPROM error** |
| **#define** CPUERR | 2 | CPU error |
| **#define** COMMERR | 3 | Communications (Bus) error |
| **#define** SBAMASK | 0x1F | **Serial Bus Address** mask |

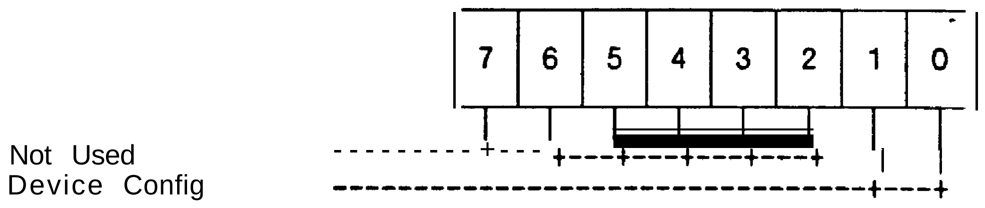
**Summary of C Data** Structures (Cont'd)

| Macro | Value | Explanation |
|---|---|---|
| #define BAUDMASK | 0x60 | Baud Rate Mask |
| #define OUTPUTMASK | 0x80 | Output Enable/Disable mask |

Data Structures that deal with Bus configuration:

{

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned **char** | Model; | 4-139 | Model Number **of** serial bus device. | GFK-0090 |
| unsigned char | OutputDisable; | 1/0 | Output Disable flag values shown below. | |
| unsigned char | Present; | 1/0 | Device Present flag | |
| unsigned int | Reference; | 0-8001/ 0-FFFF(h) | Global Data Reference Beginning address of **the** Global Data of the broadcasting CPU. | Ch. 5 |
| unsigned char | InputLength; | O-128 | Reserved - set to 'O'. | Ch. 5 |
| unsigned char | OutputLength; | O-128 | Global Data Length Number of bytes of Global Data **to be** broadcast by the PCIM. | Ch. 5 |
| unsigned char | Config; | 1-3 | Device Configuration **as** shown below. | |



} DEVICE;

The following Macros are to be used with the function GetBusConfig.

| Macro | Value | Explanation |
|---|---|---|
| In the variable OutputDisable - | | |
| #define ENABLE | 0 | Enable Outputs to a device |
| #define DISABLE | 1 | Disable Outputs to a device |
| #define ALL | 32 | Value to select all devices |
| #define MAXDEVICE | 32 | Maximum devices per PCIM |
| #define MAXIMS | 64 | Maximum number of PCIMs |
| In the value Present - | | |
| #define PRESENT | 1 | Device Present on PCIM |
| #define NOTPRESENT | 0 | Device Offline from PCIM |

Summary **of C Data** Structures (Cont'd)

Macros used with the function GetBusConfig (Cont'd).

| Macro | Value | Explanation |
|---|---|---|
| In the value Config - | | |
| #define INPUT0 | 1 | Input Data Only Device |
| #define OUTPUT0 | 2 | Output Data Only Device |
| #define COMBO | 3 | input and Output Data Device |

Data Structures that deal with Communications:

{

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned char | Source; | o-31 | Serial Bus Address of device. | GEK-90486 |
| unsigned char | Function; | 10/20(h) | Function Code. | Appendix F |
| unsigned char | SubFunction; | 0-26(h) | Sub Function Code. | Appendix F |
| unsigned char | DB_Indicator; | 1/0 | Message type - Directed (1) or Broadcast (0). | Ch. 5 |
| unsigned char | length; | O-134 | Length of message in bytes. | GFK-0090 |
| unsigned char | Data; | 134(d) | Actual Message Data in bytes. | GFK-0090 |

} READ-MESSAGE;

{

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned char | Destination; | O-311255 | Destination Serial Bus Address of target device. | |
| unsigned char | Function; | 10/20(h) | Function Code. | Appendix F |
| unsigned char | SubFunction; | 2-26(h) | Sub Function Code. | Appendix F |
| unsigned char | Priority; | 1/0 | Priority at which message is to be sent - (0 normal/l high) | Ch. 5 |
| unsigned char | Length; | o-134 | Length of message in bytes. | GFK-0090 |
| unsigned char | Data; | 134(d) | Actual Message Data in bytes. | GFK-0090 |

} SEND-MESSAGE;

**Summary of C Data** Structures (Cont'd)

Data Structures that deal with Communications (Cont'd):

{

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| unsigned char | Destination; | o-31 | Destination Serial Bus Address of target device. | GEK-90486 |
| unsigned char | Function; | 10/20(h) | Function Code. | Appendix F |
| unsigned char | TVSubFunction; | 2-26(h) | Sub Function Code - (transmitted). | Appendix F |
| **uns i** gned char | R_SubFunction; | 2-26(h) | Sub function Code - (expected reply). | Appendix F |
| unsigned char | Priority; | 1/0 | Priority at which message is to be sent - (0 normal/l high) | Ch. 5 |
| unsigned char | T-Length; | o-134 | length of message in bytes. | GFK-0090 |
| unsigned char | Data; | 134(d) | Actual Message Data in bytes. | GFK-0090 |

} SEND_MESSAGE_REPLY;

The following Macro is used by the Destination variable in the MESSAGE structures:

| Macro | Value | Explanation |
|---|---|---|
| #def ine BROADCAST | 255 | Message to be sent **at** Broadcast Control data priority. |

The Following Macros are used by the Priority variable in the MESSAGE structures.

| Macro | Value | Explanation |
|---|---|---|
| #define NORMALP | 0 | Message to be sent at normal priority. |
| #define HIGHP | 1 | Message to be sent at high priority. |

Summary of **C Data** Structures (Cont'd)

**The following Macros are used as shown** in **both the interrupt** Status **Table and** Interrupt **Disable Table:**

| Macro | Position | Explanation |
|---|---|---|
| #define I ENABLE | 0 | Enable the interrupt level. |
| #define I_DISABLE | 1 | Disable the interrupt level. |
| #define I SUMMARY | 0 | Summary if interrupt occurred. |
| #define I-REQUEST Q | 1 | Received memory datagram. |
| #define I_PCIM STAT | 2 | PCIM Status Change - usually fatal. |
| #define I DEV STAT | 3 | Device Status Change. |
| #define I_OUT_SENT | 4 | Outputs sent - end of bus access. |
| #define I CCOMPLETE | 5 | Command Block completed. |
| #define I_RECEIVE_D | 6 | Received Datagram. |

The following character buffers and integers are **used** in various calls:

| Type | Name | Range | Definition | Reference |
|---|---|---|---|---|
| int | IMcount; | I-64 | Total number of PCIMs. | Ch. 4 |
| int | IMnum; | I-64 | Relative number of PCIM. | Ch. 4 |
| int | Devicenum; | o-31 | Specifies device on Serial Bus. | Ch. 4 |
| unsigned int | Offset; | I-1024 | Specifies device on Seriat Bus. | Ch. 4 |
| unsigned int | Worddata; | 0-FFFF | Pointer to store the word requested. | Ch. 4 |
| char | IMf lags; | O-63 | Tells you which PCIMs initialized properly (or improperly). | Ch. 4 |
| char | Flag; | 0/1 | Enable/Disable outputs. | Ch. 4 |
| char | Datalngth; | O-128 | Character pointer to size of data buffer. | Ch. 4 |
| char | DevData; | O-128 | Character pointer to a buffer where data to be written will be located. | Ch. 4 |
| char | State; | 0/1 | ON or OFF condition of circuit read from PCIM. | Ch. 4 |

## Summary of C Data Structures (Cont'd)

**The following Macros are used as Return values for all calls:**

| Macro | Value | Explanation |
|---|---|---|
| #define SUCCESS | 0 | Successful completion of function. |
| #define INITFAIL | 1 | Initialization Failure. |
| #define IMFAIL | 2 | PCIM Failure. |
| #define BADSEG | 3 | Invalid Segment address . |
| #define BADPORT | 4 | Invalid I/O Port Address. |
| #define BADCFG | 5 | Invalid Configuration parameter |
| #define NOCFG | 6 | No Configuration changes found. |
| #define NOINIT | 7 | PCIM selected is not initialized. |
| #define NODATA | 8 | No data found. |
| #define UNDERFLOW | 9 | Insufficient device data length. |
| #define OVERFLOW | 10 | Exceeds device data length. |
| #define OFFLINE | 11 | Device is offline. |
| #define IMBUSY | 12 | PCIM busy |
| #define BADPARM | 13 | Invalid message parameter. |
| #define TXERR | 14 | Message transmit failure. |
| #define NOMSG | 15 | No Message available, |
| #define IMFREE | 16 | No message activity. |
| #define BADSBA | 17 | Invalid Serial Bus Address. |
| -#define BADIMNUM | 18 | Invalid PCIM Number. |
| #define PCIMERR | 19 | PCIM firmware problem. |

## C Software Driver function Call Presentation

This section provides a sample of the format and notation in which individual function calls are presented in C language. Individual function calls are discussed in the pages that follow. The presentation format for function calls is:

**Call Name - Brief Description**

**Summary**

include Fi ies Required

Return Type
Function Name (Parameter List)
Parameter types [* = pointer type]

**Description**

A detailed description of the function call; including a description of the function, a summary of the function's action sequence, and a summary of the parameters used in the call.

A parameter format listing for parms described for the first time (as shown in quotes in the text) is included for each call. If a parameter is complex, this information will be repeated for each using call. If containing only one field, format may not be shown.

**Return Value (Status)**

A detailed description of return code values and their meanings, as C returns a status value.

**Coding Example**

A description of a generic application, and sample coding using the call.

## **InitIM** - Setup and **Activate PCIM**

Summary

```
#include <pcim.h>

int
Ini t IM (IMcount, IMparms, IMf lags)

int IMcount;
char *IMf lags;
IMPARMS IMparms[];
```

### Description

The Initialize IM call specifies the total number of PCIMs in the l-lost system through the parameter "IMcount", and the characteristics of **each** IM through the parameter "IMparms".

**InitIM resets** the IMcount of **PCIMs** in **the** Host system and initializes each IM as defined by IMparms. You must create a separate IMparms entry for each PCIM in IMcount.

**The format of** "IMparms" **is:**

-IM 1 - Segment Address of PCIM shared RAM (dip sw2/sw3 setting) (two bytes LSB - MSB)
IM 1 - I/O Port Address (dipswitch swl setting) (two bytes LSB - MSB)
IM 1 - **PCIM** Global Reference (two bytes LSB - MSB)
IM 1 - Global data length (one byte)
IM **1** - Input data length (reserved **- one byte always set to '01)**
IM 1 - **Active (one byte)** 1 = ON, **0** = OFF)
IM 2 - Segment Address of PCIM **shared RAM** (dip switch setting) (two bytes LSB - MSB)
IM 2 - I/O Port Address (dip switch setting) **(two** bytes LSB - MSB)
IM 2 - PCIM **Global** Reference **(two bytes** LSB - MSB)
IM 2 - Global data length (one byte)
IM 2 - Input data length (reserved - one **byte** always set to 'O')
IM 2 - Active (one **byte)** 1 = **ON, 0 = OFF)**
.
.
.
etc.

**NOTE**

The memory pointer and I/O port assignments must correspond to **the** dip switch settings on the PCIM.

The **last** parameter, "IMf lags", is used by InitIM to tell you which PCIMs initialized properly (or improperly, as the case may be). The number of flags should equal IMcount.

**InitIM - Setup and Activate PCIM (Cont'd)**

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| **IMcount** | 1-64 | Total number of PCIMs |
| IMparms | varies | Shows the characteristics of each IM - see above |
| IMflags | varies | Tells you which PCIMs initialized properly (or improperly) - see above |

The initIM call performs the following sequence of actions:

1) **issues** a Reset to all defined PCIMs.

2) downloads Global **data parameters to** each PCIM after its PCIM OK LED turns **ON (may take up to five seconds).**

3) After all PCIMs have been downloaded or a five second timeout has occurred, returns with a 64 byte Status array (one byte for each defined PCIM). Status returned will be Fail for any syntax or execution errors detected. An example of an execution error is failure of the PCIM OK flag to be ON within five seconds after **Reset.**

**Return Value (Status)**

InitIM will **return** SUCCESS if all resets and data parameters were accepted by each PCIM. The following failure codes **are** returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). No more InitIM processing is performed. |
| INITFAIL | - | An **initialization** problem occurred in one or more PCIM. The individual status for each **PCIM** on the bus is located in the IMflags parameter. |

InitIM - **Setup** and **Activate PCIM** (Cont'd)

One of the following status codes will be stored in the appropriate location in the IMflags parameter if the return code is INITFAIL. Each status value in the IMflags array is unique to the associated PCIM and does not reflect the status of any other PCIM.

| | | |
|---|---|---|
| SUCCESS | - | This PCIM has been powered up and configured as specified. |
| IMFAIL | - | This PCIM never powered up. |
| BADCFG | - | This PCIM rejected the configuration because a parameter was out of range. |
| BADSEG | - | The segment value in IMparms is set to the illegal value 0 (zero). |
| BADPORT | - | The I/O port address is set to some illegal value less than 256. |

**NOTE**

If any of the PCIMs fail to initialize as you have specified **in** IMparms, InitIM turns OFF the failed PCIM.

**Coding Example**

In this example are two PCIMs.

```
#include <pcim.h>

#define COUNT 2

int status; char IMf lags[COUNT];
IMPARMS IMparms[COUNT];

    IMparms[0].im.Segment = 0xD000;       */SRI begins at D000(h)/*
    IMparms[0].im.IOPort = 0x3E4;         */Port Base Address at 3E4(h)/*
    IMparms[0].IMRef = 0x7000;            */PCIM Global Reference - 7000(h)/*
    IMparms[0].OutputLength = 0;          */No Global Data/*
    IMparms[0].InputLength = 0 ;          */Always set to '0'/*
    IMparms[0].Active = ON;               */Turn PCIM #1 ON by default/*

    IMparms[1].im.Segment = 0xCC00;       */SRI begins at CC00(h)/*
    IMparms[1].im. IOPort = 0x3E0;        */Port Base Address at 3E0(h)/*
    IMparms[1].IMRef = 0x3000;            */PCIM Global Reference - 3000(h)/*
    IMparms[1].OutputLength = 0;          */No Global Data/*
    IMparms[1].InputLength = 0;           *'/Always set to '0'/*
    IMparms[1].Active = ON;               */Turn PCIM #2 ON by default/*

    status = InitIM (COUNT, IMparms, IMflags);
```

## ChgIMSetup **- Change PCIM Configuration**

Summary

```
#include <pcim.h>

int
ChgIMSetup (IMnum, IMparms)

int IMnum;
IMPARMS *IMparms;
```

### Description

Following initialization, any changes you make to the configuration of **a** specific PCIM must use the Change IM Setup call. This call allows you to make configuration changes to **a** specific PCIM Setup Table by writing the IMparms parameter from Host memory to it.

The "IMnum" parameter is an offset of the IMparms parameter which, after initialization, indicates the specific PCIM in the host system for which configuration changes are **intended. The** relative IMnum cannot itself be changed.

**NOTE**

Configuration changes to any PCIM while online causes that IM to stop transmitting **on the** serial bus for 1.5 seconds.

**Again, the** format **of** "IMparms" is:

IM 1 - Segment Address of PCIM shared RAM (dip switch setting) (two bytes LSB - MSB)
IM 1 - I/O Port Address (dipswitch setting) (two bytes LSB - MSB)
IM 1 - PCIM Global Reference (two bytes LSB - MSB)
**IM 1 - Global** data **length** (one byte)
IM 1 **- Input data** length (reserved - one byte always set to **O )**
IM 1 **- Active (one** byte) 1 = ON, 0 = OFF)
**IM 2** - Segment Address of PCIM shared RAM (dip switch setting) (two bytes LSB - MSB)
**IM** 2 **- I/O Port** Address (dip switch setting) (two bytes LSB - MSB)
**IM 2** - PCIM Global Reference (two bytes LSB - MSB)
**IM 2** - Global data length (one byte)
IM 2 - Input **data** length (reserved - one byte always set to **'O')**
**IM** 2 - Active (one byte) 1 = ON, 0 = OFF)
etc.

## ChglMSetup - Change PCIM Configuration (Cont'd)

Parameters **are** summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | I-64 | Relative number of PCIM |
| I Mpa rms | varies | Shows the characteristics of each IM - see above |

Return **Value (Status)**

ChglMSetup will return SUCCESS if all changes were accepted by the target IM. If the IM fails to change to the new parameters, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InitlM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = I), or never completed processing the config change command. |
| IMBUSY | - | The **PCIM** is otherwise engaged and cannot accept the config change command. |
| BADCFG | - | This PCIM rejected the configuration because a parameter was out of range. |
| NOCFG | - | The PCIM, after examining the received the config change command, found no changes to make. |

**Coding Example**

Change the PCIM Global Reference for PCIM #1.

```
#include <pcim.h>

#define COUNT 2

int status;
IMPARMS IMparms[COUNT];

      IMparms[0].IMref = 0x7070;

      status = ChglMSetup (1, &IMparms [O]);
```

## ChglMSetup - Change PCIM Configuration (Cont'd)

### Coding Example (Cont'd)

**Turn OFF PCIM #2.**

```
#include <pcim.h>

int status;
IMPARMS IMparms[COUNT];

     IMparms[l].Act ive = OFF;

     status = ChglMSetup (2, &IMparms [l]);
```

## GetIMState - Get Configuration and Status Information

Summary

```
#include <pcim.h>

int
GetIMState (IMnurn, IMstate)

int IMnum;
IMSTATE *IMstate;
```

### Description

The Get IM State call allows you to access configuration and status information about a specific PCIM by reading its Setup Table and Status Table into the “IMstate" parameter in Host memory.

The format of IMstate is:

| | |
|---|---|
| DipSwi tch | - Daugherboard Dip Switch Value |
| IMRef | - Reference Address |
| OutputLength | - Output Control Data Length |
| InputLength | - Input Control Data Length |
| Revision | - PCIM Firmware Revision Number |
| GENI OK | - PCIM OK = 0 - every 200 **ms, set to ‘1’** |
| Fau **lt** | - Overall fault byte - any PCIM fault |
| Active | - Hand Held Monitor Present |
| SBerr | - Serial Bus **error** count |
| ScanTime | - Bus Scan Time in ms |

Before returning, GetIMState will also clear the PCIM OK flag of the selected PCIM. Since the PCIM periodically sets its PCIM OK flag, this call allows the implementation of **a** PCIM OK heartbeat procedure.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | l-64 | Relative number of PCIM |
| IMstate | varies | PCIM Configuration and Status -see above |

## CetIMState - Get Configuration and Status Information (Cont'd)

### Return Value (Status)

GetIMState will almost always return SUCCESS. If the target IM is currently offline, has not been initialized, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of **64** or greater). |
| NOINIT | - | Indicated PCIM has not been initialized **(InitIM).** |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

### Coding Example

**Examine the state** of **PCIM #1.**

```
#include <pcim.h>

int status;
IMSTATE IMstate;

      status = GetIMState (1, &IMstate);
```

CFK-0074

## GetBusConfig - Get Serial Bus Configuration

Summary

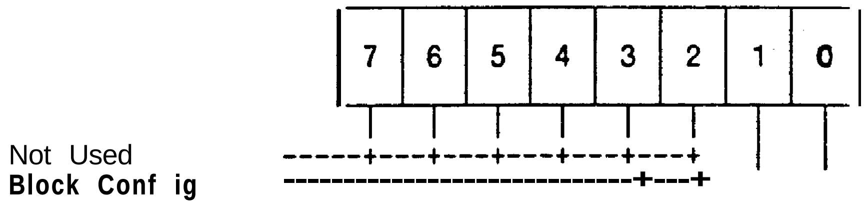
```
#include <pcim.h>

int
GetBusConf ig (IMnum, Config)

int IMnum;
DEVICE Conf ig[];
```

### Description

**The** Get Bus Configuration **call allows** you to read device configuration information **about** all devices on a serial bus. GetBusConf ig **reads** all 32 Device Configuration **Tables f tom the** PClM selected by IMnum into the Host memory "Config" **parameter. This information is** not packed and **wilt fill the** entire Config parm - 256 bytes in length.

The format of Config is:

| | |
|---|---|
| unsigned char Model | - Model Number of device |
| unsigned char OutputDisable | - Output disable flag |
| unsigned char Present | - Device Present **flag** |
| unsigned int Reference | **- Status Table or** |
| | **- Reference** Address |
| unsigned **char InputLength** | **- Control Input Data length** |
| unsigned char OutputLength | - Control Output **Data Length** |
| unsigned char Config | **- Device Configuration** |



Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | l-64 | Relative number of PCIM |
| **Conf ig** | 256 **bytes** | Device configuration **information about all devices on a serial bus - see above** |

## GetBusConfig - **Get Serial Bus Configuration** (Cont'd)

### Return Value (Status)

GetBusConfig will almost always return SUCCESS. If the target IM is currently off **line,** has not been initialized, or is out of range, the following FAIL indications will be returned:

| | |
|---|---|
| BADIMNUM - | IMcount is out o range (a count of 64 or greater). |
| NOINIT - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL - | The indicated PCIM has failed **(PCIM** OK = **1)**. |
| OFFLINE - | None of the devices specified are currently active on the bus. However, the appropriate buffer is still returned and wi ll contain configuration data for devices once l ogged in. Zeros wi l l **be** returned if no device has logged in to a particular slot. |

### Coding Example

Examine the configuration of the devices on PCIM #1.

```
#include <pcim.h>
int status;
DEVICE Conf ig[MAXDEVICE];

     status = GetBusConf ig (1, Conf ig);
```

## GetDevConfig - Get Device Configuration

Summary

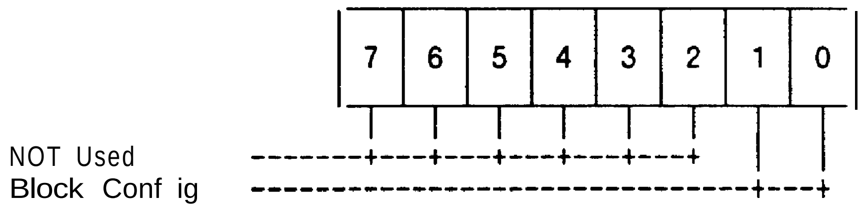
```
#include <pcim.h>

int
GetDevConfig (IMnum, Devicenum, Config)

int IMnum;
char Devicenum;
DEVICE *Config;
```

### Description

The Get Device Configuration call allows you to read device configuration information about a specific device on **the** serial bus. GetDevConfig reads this information from the PCIM selected by IMnum into the Host memory "Config" parameter, which should point to **a** character buffer with the format of one DEVICE structure.

Again, **the** format of Config is:

| | |
|---|---|
| unsigned char Mode1 | - Model Number of device |
| unsigned char OutputDisable | - Output disable flag |
| unsigned char Present | - Device Present flag |
| unsigned int Reference | - Status Table or |
| | - Reference Address |
| unsigned char InputLength | - Control Input Data Length |
| unsigned char Outputlength | - Control Output Data Length |
| unsigned char Config | - Device Configuration |



Parameters are summarized **as** follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| Devicenum | o-31 | Specifies device on serial bus |
| Config | 8 bytes | Device configuration information about all devices on a serial bus - see above |

**GetDevConf ig - Get Device Configuration (Cont'd)**

**Return Value (Status)**

GetDevConfig will almost always return SUCCESS. If the target IM is currently offline, has **not** been initialized, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| BADSBA | - | Speci **f** ied Devicenum is not in the range for GENIUS bus devices (0 -31 decimal). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has fai led (PCIM OK = 1), or never completed processing the config change command. |
| OFFLINE | - | The device requested is currently not on the bus, however, the appropriate buffer is sti ll returned and wi ll contain configuration data for devices once logged in. |

**Coding Example**

**Examine** the configuration of device #30 on PCIM #1.

```
#include <pcim.h>

int status;
DEVICE Conf igbuf;

      status = GetDevConf ig (1, 30, Conf igbuf);
```

## DisableOut - Disable/Enable Device Outputs

Summary

```
#include <pcim.h>

int
DisableOut (IMnum, Devicenum, Flag)

int IMnum, Devicenum;
char Flag;
```

### Description

The Disable (/Enable) Outputs call allows you to selectively disable (or enable) outputs to a specific device, or to all devices, on a serial bus.

If Flag is non-zero ('1'), outputs to the device will be disabled; if Flag is zero ('0'), outputs will be enabled to that device. If you code the Devicenum value equal to 'ALL', then the outputs to all devices will be set to the value of Flag. If Devicenum is a serial bus address value between 0 - 31 decimal, then the flag value will only affect that device. PCIM.H contains macros defined for ON or OFF values for Flag.

Parameters **are** summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | l-64 | Relative number of PCIM |
| Devicenum | O-31 | Specifies device on serial bus on which circuit resides |
| Flag | 0 or 1 | Enable/disable outputs |

### Return Value (Status)

DisableOut will return SUCCESS if the device specified by IMnum is present on the serial bus. Otherwise, DisableOut will return FAIL. If Devicenum indicates ALL, then DisableOut will almost **always** return SUCCESS. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCount is out of range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range **for** GENIUS bus devices (0 - 31 decimal). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

## DisableOut - Disable/Enable Device Outputs (Cont'd)

### Coding Example

Enable outputs to device #8 on PCIM #1.

```
    #include <pcim.h>

    int status;

        status = DisableOut (1, 8, ENABLE);
```

Disable outputs **to all** devices on PCIM #1.

```
    #include <pcim.h>

    int status;

        status = DisableOut (2, All, DISABLE);
```

## GetBusln - **Read all Input Values**

Summary

```
#include <pcim.h>

int
GetBusln (lMnum, IOdata)

int IMnum;
unsigned char *IOdata;
```

**Description**

A Get Bus Inputs call allows you to read input values from all active devices in the Input Table of the specified **PCIM.** Active inputs are those for which the Device Present flag is **set to '1' (it is the application's responsibility to** know **which devices are** present on the bus via the GetBusConf ig **call).** Active **input values are placed into the Host** memory "IOdata" parameter. **IOdata must point to a 4096-byte** buffer where the I/O information **will be saved.** The **IOdata parm has the** same **format** as the Input Table - 32 slots of 128 **bytes each. Slots are in serial bus address order.**

When GetBusln is called, **it begins by "locking out" the** PCIM **from updating its Input** Table (ensures **data coherency across bus scans).** GetBusln then searches the PCIM **specified by ltvlnum for active devices+ transferring only active device data to the corresponding slot of the IOdata** parm. When the entire **PCIM** Input Table has been **searched, the** PCiM is "unlocked".

**Parameters are** summarized as follows:

| Parameter | Va l ues | Function |
|---|---|---|
| I Mnum | 1-64 | Relative number of PCIM |
| IOdata | 4096 bytes | Data parameter will be copied **from Host memory to specified** PCIM |

**Return Value (Status)**

**GetBusln will return SUCCESS if any of the devices specified by the IMnum** are **active** and **data** was **transferred. If no devices are present on** the **target IM, if the** target IM is **currently off l ine, has not been initialized, or is out of range, the following FAIL indications will be returned:**

| | | |
|---|---|---|
| BADIMNUM | - | **IMCount is** out **of range (a count of 64 or greater).** |
| **NOINIT** | **-** | **Indicated** PCIM has not been initialized **(InitIM).** |
| IMFAIL | - | The **indicated** PCIM has failed **(PCIM OK = 1).** |
| OFFLINE | - | The device requested is currently not on the bus, however, the appropriate **buffer is sti l returned and** wi l l contain configuration data for devices once logged **in.** |

## GetBusIn - Read all Input Values (Cont'd)

### Coding Example

**Read all inputs from all active devices on PCIM #1.**

```
#include <pcim.h>

int status;
unsigned char IOdata[4096];

          status = GetBusIn (1, IOdata);
```

## PutBusOut - Write all Output Values

Summary

```
    #include <pcim.h>

    int
    PutBusOut (IMnum, IOdata)

    int IMnum;
    unsigned char *IOdata;
```

### Description

The Put Bus Outputs call allows you to update outputs to all active devices in the Output Table of **the** specified PCIM. Active outputs are those with the Device Present flag set to '1' (it is the application's responsibility to know which devices are present on the **bus** via the GetBusConfig call). Active output values **are** written from the Host memory IOdata parameter. IOdata must point to a 4096-byte buffer where the I/O information is saved. The IOdata parm **has** the same format as the Output Table - 32 slots of 128 bytes each. Slots are in serial bus address order.

When PutBusOut is called, it begins by "locking-out" the PCIM from updating its Output Table (ensures data coherency across PCIM scans>. PutBusOut then searches the PCIM specified by IMnum for active devices, transferring only to active devices data from the slot of the IOdata parm corresponding to the device's slot in the Output Table. When the entire PCIM Output Table has been searched, the PCIM is "unlocked".

Parameters are summarized as fotlows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| IOdata | 4096 bytes | Data parameter will be copied from Host memory to specified PCIM |

**PutBusOut - Write all Output Values (Cont'd)**

**Return** Value (Status)

PutBusOut will return SUCCESS if any of the devices specified by **the** IMnum are active and data was transferred. If no devices are present on the target IM, if the target IM is currently offline, has not been initialized, or is out of range, **the** following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of **range** (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not **been** initialized **(InitIM).** |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | Data was transferred to the specified buffer, however, no devices were found on the bus. |

**Coding Example .**

**Write all outputs to all active devices on** PCIM #1.

```
-#include <pcim.h>

 int status;
 unsigned char lOdata[4096];

       IOdata   = 1;
       IOdata[2561  = 2;
       IOdata[384]   = 4;
       iOdata[512]  = 8;
       IOdata[640]   = 0x10h;

      status  = PutBusOut (1, IOdata);
```

## GetDevln - Read Device Data Only

Summary

```
#include <pcim.h>

int
GetDevln (IMnum, Devicenum, DataLngth, Devdata)

int IMnum, Device;
char *DataLngth, *Devdata;
```

**Description**

The GetDevln function allows you to read the control data inputs received from a single serial bus device into the Host memory "Devdata" parameter.

IMnum **is** the PCIM number configured during initialization. The Devicenum parameter specifies the serial bus address of the device from which input data is to be written. The "DataLngth" parameter points to the location where the number of data bytes to be read is stored. This way, the function can determine whether or not it should update its current data base. The "Devdata" parameter is a character pointer to a buffer where the data to be written will be located. The size of this buffer is determined by the "InputLength" parameter located in the device's configuration data.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | **l-64** | Relative number of PCIM |
| Devicenum | o-31 | Specifies device on serial bus from which output word will be written |
| DataLngth | O-128 | Character pointer to size of data buffer |
| Devdata | variable | Character pointer to a buffer where the data to be written will be located - see above |

## GetDevln - Read Device Data Only

### Return Value (Status)

GetDevln will return SUCCESS **if the** device specified by IMnum is present on the serial bus, and after the data is transferred to the DevData buffer. If the target device is not present, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BAD IMNUM | - | IMcount **is** out **of** range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum **is** not in the range **for** GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | **The** indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested **is** currently not on the bus, and data is NOT transferred. |

### Coding Example

Get the inputs **from** device #8 on PCIM #1 .

```
#include <pcim.h>

int status;
unsigned char Devdata[l28];
              Length;

     status = GetDevln (1, 8, &Length, Devdata);
```

## PutDevOut - Write Device Data Only

Summary

```
#include <pcim.h>

int
PutDevOut (IMnum, Devicenum, Datalngth, Devdata)

int M-turn, Device;
char DataLngth, *Devdata;
```

### Description

**The** PutDevOut call allows you to write all of the control data **outputs to a single serial** bus device from the Host memory Devdata parameter.

IMnum is the PCIM number configured during initialization. **The Devicenum** parameter specifies the serial bus address of the device to which output data is to be written. The **DataLngth** parameter points to the location where the number of data bytes to write is stored. If the value differs from **the** PClM's current data base, an Overflow or Underflow error will be returned. The Devdata parameter is a character pointer **to a** buffer where **the** data to be written is located. The size of **this** buffer is determined by the **"OutputLength"** parameter located in the device's configuration data.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | 1-64 | Relative number of PCIM |
| Dev i cenum | o-31 | Specifies device to which output word will be written |
| Datalngth | O-128 | Character pointer **to size** of data buffer |
| Devdata | variable | Character pointer to a buffer where the data to be written will be located - see above |

## PutDevOut - Write Device Data Only

### Return Value (Status)

PutDevOut will return SUCCESS if the device indicated is present on the given IMnum **and** after the **data** is transferred to that device. If the target device is not present, or is out of **range,** the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range for GENIUS bus devices (0 -31 decimal), or **is** that of the PCIM - which has **its** own function. |
| **NOINIT** | **-** | Indicated PCIM has not been initialized **(InitIM).** |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the **bus,** and data **is** NOT transferred. |

### Coding Example

**Write** 2 bytes **of** output data to device #8 on **PCIM #1.**

```
#include <pcim.h>

int.status;
unsigned char Devdata[l28];

      Devdata [0] = 1;
      Devdata [l] = 0x10;

      status = PutDevOut (1, 8, 2, Devdata);
```

## GetIMIn - Read Directed Input Table

Summary

```
#include <pcim.h>

int
GetIMIn (IMnum, IMdata)

int IMnum;
unsigned char *IMdata;
```

Description

**The** Get IM Inputs call is reserved and should not be used.

## PutIMOut - Write the Global Output Table

### Summary

```
#include <pcim.h>

int
PutIMOut (IMnun, IMdata)

int IMnum;
unsigned char *IMdata;
```

### Description

The Put IM Outputs call allows you to write Global Data from the Host memory IMdata parameter to the Output Table of a specified PCIM. This data is subsequently broadcast to all CPUs on the bus every bus scan.

IMnum is the PCIM number configured during initialization. The IMdata parameter is a character pointer to a buffer where the data to be written is located. The size of this buffer is determined by the "OutputLength" Global Data Length) parameter located in the device's configuration data.

When PutIMOut is called, it begins by "locking-out" the PCIM from reading from its Output Table (ensures data coherency across bus scans). PutIMOut then transfers all the data from this parm to the PCIM's Global Output buffer. Once the transfer is complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| IMdata | variable | Character pointer to a buffer where the data is located. Length of buffer is equal to output length as specified in InitIM. |

### Return Value (Status)

PutIMOut will return SUCCESS if the GlobalLength is non-zero and the transfer is complete, The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InittM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| UNDERFLOW- | | The GlobalLength parameter in is set to zero (0). PARMS |

## PutIMOut - Write the Global Output Table (Cont'd)

### Coding Example

Write the specified Global Data **to** PCIM #1.

```
#include <pcim.h>
int status;
unsigned char IMdata[128];

     IMdata [2] = 0x10;
     status = PutIMOut (I, IMdata);
```

## GetCir - Read Input Circuit Value

Summary

```
#include <pcim.h>

int
GetCir IMnum, Devicenum, Offset, State)

int IMnum, Devicenum;
unsigned int Offset;
char *State;
```

### Description

A Get Circuit call allows the state of a single input circuit to be read from the specified PCIM's Input Table and be placed into the Host memory "State" parameter.

IMnum is the PCIM number configured during initialization. The Devicenum parameter specifies the serial bus address of the device which contains the input circuit. The "Offset" parameter indicates which bit of Devicenum is to be read. This value ranges from 1 through 1024 (in bits).

"State" is a character pointer in which GetCir will store the value of the circuit as indicated by the above parameters. The contents of State will be either a '1' or '0' (ON or OFF).

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | l-64 | Relative number of PCIM |
| Devicenum | o-31 | Specifies I/O device from which input circuit will be read |
| Offset | l-7024 | Input circuit offset in specified I/O device, in bits |
| State | 0/1 | ON or OFF condition of circuit read from PCIM |

GetCir - **Read Input Circuit Value** (Cont'd)

## Return Vafue **(Status)**

GetCir will return SUCCESS if the target device is present on the given IMnum. If the target device is not present, or is out of range, GetCir will return FAIL. If SUCCESS is returned, then the character pointed to by State will contain the value of the circuit requested. The following FAIL indications will be returned:

| | | |
|---|---|---|
| **BADIMNUM** | **-** | IMCount is out of range **(a** count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated **PCIM** has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently **not** on the bus, and data **is** NOT transferred. |
| OVERFLOW | - | The Offset specified is greater than the devices InputLength in circuits. |
| **UNDERFLOW** | **-** | The Offset is specified as zero (0). |

### Coding Example

Get the State value of circuit 2 of device #8 on PCIM #1.

```
#include <pcim.h>

int status;
char State;

      status = GetCir (1, 8, 2, &State);
```

## PutCir - Write Output Circuit Value

Summary

```
#include <pcim.h>

int
PutCir (Mnum, Devicenum, Offset, State)

int IMnum, Devicenum;
char State;
unsigned int Offset;
```

### Description

A Put Circuit call allows the state of a single output circuit to be changed from ON to OFF or vice-versa. In this call, the State parameter is written from the Host memory to the specified PCIM's Output Table.

IMnum is the PCIM number configured during initialization. The Devicenum parameter specifies the serial bus address of the device which contains the target output circuit. The Offset parameter indicates which bit of Devicenum is to be written. This value ranges from 1 through 1024 (in bits).

State is a character pointer in which PutCir will store the value of the circuit as indicated by the above parameters. The contents of State will be either a '1' or '0' (ON or OFF).

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| Devicenum | o-31 | Specifies I/O device to which output circuit will be written. |
| Offset | l-1024 | Output circuit offset in specified I/O device, in bits |
| State | 0/1 | Variable "State" is written from the Host memory to the specified PCIM |

## PutCir - Write Output Circuit Value (cont'd)

### Return Value (Status)

PutCir will return SUCCESS if the target device is present on the given IMnum. If the target device is not present, or is out of range, PutCir will return FAIL. If SUCCESS is returned, then the character pointed to by State will contain the value of the circuit changed. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the bus, and data is NOT transferred. |
| OVERFLOW | - | The Offset specified is greater than the devices OutputLength in circuits. |
| UNDERFLOW | - | The Offset is specified as zero (0). |

### Coding Example

Set the State value of circuit 2 of device #8 on PCIM #1 to '1'.

```
#include <pcim.h>

int status;

      status = PutCir (1, 8, 2, (Char) 1);
```

## GetWord - Read Input Word Value

### Summary

```
#include <pcim.h>

int
GetWord (IMnum, Devicenum, Offset, Worddata)

int IMnum, Devicenum;
unsigned int Offset;
unsigned int *Worddata;
```

### Description

A Get Word call allows you to read the value of a single input word from the specified PCIM's Input Table into the Host memory "Worddata" parameter. The "Worddata" parameter is an integer pointer which GetWord uses to store the word requested.

IMnum is the PCIM number configured during initialization. The Devicenum parameter specifies the serial bus address of the device where the input word is located. The Offset parameter indicates which word of the specified device is to be read. This value ranges from 1 through 64 (in word quantities).

When GetWord is called, it begins by "locking-out" the PCIM from updating the Shared RAM (ensures data coherency across bus scans). GetWord then transfers the word data into Host memory. Once the transfer is complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| Devicenum | o-31 | Specifies I/O device from which input word will be read |
| Offset | l-64 | Input word offset in specified I/O device, in words |
| Worddata | 2 bytes | Integer pointer used to store the word requested - see above |

**GetWord - Read Input Word Value** (Cont'd)

Return **Value (Status)**

GetWord will return SUCCESS if the device specified by IMnum is present on the serial bus, and after the data is transferred to the DevData buffer. If the target device is not present, or is out of range, GetWord will return FAIL. If SUCCESS is returned, then the requested word value will be saved in the location pointed to by Worddata. The following FAIL indications wilt be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has **its own** function. |
| NOINIT | - | Indicated PCIM has **not** been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the bus, and data is NOT transferred. |
| -OVERFLOW | - | The Offset specified is greater than the devices InputLength in circuits. |
| UNDERFLOW | - | The Offset is specified **as** zero (0). |

**Coding Example**

Get the first word of device #8 on PCIM #1.

```
    #include <pcim.h>

    int status;
    unsigned int Worddata;

        status = GetWord (1, 8,1, &Worddata);
```

## PutWord - Write Output Word Value

### Summary

```
#include <pcim.h>

int
PutWord (IMnum, Devicenum, Offset, Worddata)

int IMnum, Devicenum;
unsigned int Offset, Worddata;
```

### Description

A Put Word call allows you to write a single output word from the Host memory Worddata parameter to the specified PCIM's Output Table. The Worddata parameter is an integer pointer which PutWord uses to store the word to be transmitted.

IMnum is the PCIM number configured during initialization. The Devicenum parameter specifies the serial bus address of the device where the output word is to be sent. The Offset parameter indicates which word of the specified device is to be written. This value ranges from 1 through 64 (in word quantities).

When PutWord is called, it begins by "locking-out" the PCIM from updating the Shared RAM (ensures data coherency across bus scans). PutWord then transfers the word data to the device. Once the transfer is complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| Dev i cenum | 0-31 | Specifies device to which output word will be written |
| Offset | l-64 | Output word offset in specified device, in words |
| Worddata | 2 bytes | Integer pointer used to store the word requested - see above |

PutWord - Write Output **Word** Value (Cont'd)

## **Return** Value (Status)

PutWord will return SUCCESS if the device specified by IMnum **is** present on the serial bus. If the target device is not present, or is out **of** range, PutWord will return FAIL. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| BADSBA | - | Specified Devicenum is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has **not** been initialized **(InitIM).** |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | **The** device requested is currently not on the bus, and data is NOT transferred. |
| OVERFLOW | - | **The** Offset specified is greater than the devices OutputLength in circuits. |
| VNDERFLOW | - | The Offset is specified as zero (0). |

## Coding Example

Set the second word of device #8 on PCIM #1 to 10 hex.

```
#include <pcim.h>

int status;

      status = PutWord (1, 8,2, 0x10);
```

## SendMsg - Send a Message

### Summary

```
#include <pcim.h>

int
SendMsg IMnum, Msg)

int IMnum;
SEND-MESSAGE *Msg;
```

### Description

The Send Message call allows you to write a **memory or non-memory** message from the Host to the selected PCIM for transmission onto the serial bus (using **the Transmit** Datagram command). SendMsg **will** return control to the calling program without delay, before the message has been processed or transmitted by the PCIM.

IMnum defines the PCIM, as configured during initialization, **from** which to transmit the **message. The** Msg parameter is a pointer to the buffer where the transmit message is stored.

**The** format of **SEND-MESSAGE is:**

| | |
|---|---|
| Destination (0-31/255 brdcst) | - Destination address of Device |
| function code (0-111) | - Function Code |
| SubFunction code (O-255) | - Sub Function Code |
| Priority | - 0 - Normal, 1 - High |
| Length | - Data field Length/length of message |
| Data (O-134) | - Message Data - depends on length parm |

You **can check the** status of the message using ChkMsgStat to determine if the message completed processing properly.

Parameters **are** summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | 1-64 | Relative number of **PCIM** |
| Msg | see above | Pointer to the buffer where the transmitted message will be stored - see above |

SendMsg - Send a Message (Cont'd)

## Return Value (Status)

SendMsg will return SUCCESS if a message has been transferred from the Host memory to the PCIM. Otherwise, one of **the** following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is **out** of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has faited (PCIM OK = 1). |
| IMBUSY | - | The PCIM is otherwise engaged and cannot accept **the** command. |

**NOTE**

You **are** responsible for defining the device, the Function code, the Sub-Function code and the length of **the** transmit Datagram.

It is also your responsibility to interpret the Function code, the Sub-Function code and the meaning of **the** Reply message. See GFK-0090 for message codes.

**NOTE**

You cannot issue a SendMsg call or read a received unsolicited message while a SendMsgReply call is in progress. If this presents a timing problem, use the SendMsg ca I l.

## See Also

SendMsgReply, Gettvlsg and ChkMsgStat

### Coding Example

Send a Read Diagnostics message **to** device #8 on PCIM #1. This message will read 10 bytes of diagnostic data beginning at offset 0.

```
#include <pcim.h>

int status;
SEND-MESSAGE Msg;

    Msg.Dest inat ion = 8;        /*Device #8*/
    Msg.Function = 0x20;          /*GENIUS Function Code*/
    Msg.SubFunction = 8 ;         /*Read Diagnostic Subfunction Code*/
    Msg.Priority = NORMALP;       /*Transmit at Normal priority*/
    Msg.Length = 2;               /*Length of data in Data Buffer*/
    Msg.Data[0] = 0;              /*Offset of 0*/
    Msg.Data[1] = 0xA;            /*Length of 10 decimal*/

    status = SendMsg (1, &Msg);
```

## SendMsgReply - Send a Message Requesting a Reply

Summary

```
#include <pcim.h>

int
SendMsgReply (IMnum, Msg)

int IMnum;
SEND-MESSAGE-REPLY *Msg;
```

### Description

The Send Message Reply call allows you to write a memory or non-memory message from the Host to the selected PCIM for transmission onto the bus (using the Transmit Datagram With Reply command). SendMsgReply will return control to the calling program without waiting for the reply. You must call ChkMsgStat or GetMsg to check for completion or to read the reply message.

IMnum defines the PCIM, as configured during initialization, from which to transmit the message. The Msg parameter is a pointer to the buffer where the transmit message is stored.

The format of SEND-MESSAGE-REPLY is:

| | |
|---|---|
| Destination (0-31/255 brdcst) | - Destination address of Device |
| Function code (0-111) | - Function Code |
| T SubFunction code (0-255) | - Transmitted Reply Sub Function Code |
| R-SubFunction code (0-255) | - Expected Repty Sub Function Code |
| Priori ty | - 0 - Normal, 1 - High |
| T-Length | - Data field length/length of message |
| Data (0-134) | - Message Data - depends on length parm |

You can check the status of the message using ChkMsgStat to determine if the message completed processing properly.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | 1-64 | Relative number of PCIM |
| Msg | see above | Pointer to the buffer where the transmitted message will be stored - see above |

SendMsgReply - Send a Message Requesting **a Reply** (Cont'd)

The advantage of the SendMsgReply **call** over the Send&g call is twofold:

1) Allows a Read ID message to be sent (cannot be sent using the Sendblsg call).

2) Reduces user programming since a 10 second timeout to a non-responding device **is** automatically provided by the PCIM for a SendMsgReply cal l

The t-lost program sequence for **a** SendMsgReply is **as** follows:

1) Host sends a SendMsgReply to the PCIM.

2) Host **issues** GetMsg calfs until the Status indicates completion. GetMsg wilt also return the reply message into Host memory.

## Return Value (Status)

SendMsgReply will return SUCCESS if a message has been transferred from the Host memory to the PCIM. Otherwise, one of the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | lkount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| IMBUSY | - | The PCIM is otherwise engaged and cannot accept the command. |

UOTE

You are responsible for defininq the device, the Function code, the Sub-Function code and the length of the transmit Datagram.

**It is** also your responsibil to interpret the Function code, the Sub-Function y code and the meaning of the Reply message. See GFK-0090 for predefined message codes.

NOTE

You cannot issue a SendMsg call or read **a** received unsolicited **message** while **a** SendMsgReply call is in progress. If this presents a timing problem, use the SendMsg cal l.

## SendMsgReply - Send a Message Requesting a Reply (Cont'd)

See Also

SendMsg, GetMsg and ChkMsgStat

### Coding Example

**This example** sends a Read Diagnostics Message **to** device #8 on PCIM #1 and expects **a reply** message of Read Diagnostic Reply. This message **requests 10 bytes of diagnostic data** beginning at offset 0.

```
#include <pcim.h>

int status;
SEND-MESSAGE-REPLY   Msg;

     Msg.Dest inat ion = 8;       /*Device #8*/
     Msg.Funct ion = 0x20;        /*GENIUS Function Code*/
     Msg.T-SubFunction  = 8;      /*Read Diagnostic Subfunction Code*/
     Msg.R SubFunction  = 9;      /*Read Diagnostic Reply Subfunction Code*/
     Msg.Priority   = NORMALP;    /*Transmit at Normal priority*/
     Msg.T-Length  = 2;           /*Length of data in Data Buffer*/
     Msg.DatalOI  = 0;            /*Offset of 0*/
     Msg.Data[l]  = 0xA;          /*Length of 10 decimal*/

     status  = SendMsgReply (1, &Msg);
```

## ChkMsgStat - Read Message Progress Status

Summary

```
#include <pcim.h>

int
ChkMsgStat (IMnum, Replystatus)

int IMnum;
char *Replystatus;
```

Description

**The** Check **Message** Status call allows you to determine the status of a previous SendMsg call - that is, to determine when a transmitted message has actually been received, and its completion status.

IMnum is the PCIM number configured during initialization. The "Replystatus" parameter is a pointer to a buffer where the Status will be stored.

The "Replystatus" parameter will contain the following Macro values:

| | |
|---|---|
| IMFREE | There is currently no activity. |
| IMBUSY | Message is still in progress. |
| SUCCESS | Message has successfully completed. |
| BADPARM | **Message** contained a syntax error. |
| **TXERR** | **Message** cannot be transmitted. |
| PCIMERR | **PCIM EPROM** error - completion code undefined. |

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | I-64 | Relative number of **PCIM** |
| Replystatus | 0/1 | Pointer to a buffer where the Status will be stored - see above |

**Return Value (Status)**

ChkMsgStat will normally **return the Status requested** and a SUCCESS indication. Otherwise, one of the following FAIL indications will be returned:

**BADIMNUM** - IMcount is out of range (a count of 64 or greater).

**NOINIT** - Indicated PCIM has not been initialized (InitIM).

**IMFAIL** - The indicated **PCIM** has failed (PCIM **OK = 1).**

**PCIMERR** - There may be a problem with the **PCIM** firmware.

## ChkMsgStat - Read Message Progress Status (Cont'd)

### See Also

SendMsgReply, SendMsg and GetMsg

### Coding Example

Check the message status area of PCIM #1.

```
#include <pcim.h>

int status;
char Status;

        status = ChkMsgStat (1, &Status);

        switch [STATUS]
        {
          case SUCCESS:
                 ,
               break;

          case IMFREE:
                  ---;
               break;

          case IMBUSY:
                  ---;
               break

          case BADPARM:
                  ---;
               break

          case TXERR :
                  --- ;
               break

          case PCIMERR:
                  --- ;
               break

          default:
                  --- ;
               break
}
```

## **GetMsg -** Read Received Message

Summary

```
#include <pcim.h>

int
GetMsg (IMnum, Msg)

int IMnum;
READ-MESSAGE *Msg;
```

### **Description**

The Get Message call allows you to read a received memory or non-memory message (or a reply to a previous SendMsgReply call) from the selected PCIM into the Host memory "Msg" parameter.

**IMnum** is the PCIM number configured during initialization. The "Msg" parameter is a pointer to the buffer where the received message will be stored.

The format of READ-MESSAGE is:

```
Source (o-311255 brdcst)  - Source address of Device
Function code (O-111)     - Function Code
SubFunction code (O-255) - Sub Function Code
DE-Indicator (O-134)      - Directed (1)/Broadcast (0)
Length                    - Data field length/length of message
Data (o-134)              - Message Data -depends on length parm
```

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMnum | l-64 | Relative number of PCIM |
| Msg | see above | Pointer to the buffer where the received message wi ll be stored - see above |

GetMsg performs the following sequence:

1) If there is a previous call to SendMsgReply, GetMsg checks to see if the transmission has successfully completed, and transfers the response back to you. If the response completed with an error, or if in progress, GetMsg will return a FAIL indication.

2) If there is no previous call to SendMsgReply, GetMsg checks to see if there is a memory message, and transfers that message back to you.

## GetMsg - Read Received Message (Cont'd)

3) If no memory messages exist, then GetMsg checks to see if there is a non-memory message, and transfers that message back to you.

4) If no messages are present, GetMsg returns with a FAIL status.

NOTE

Unsolicited memory or non-memory Datagrams received by the PCIM may not be read by the Host while a Send&g/Reply is in progress. This significantly affects Host response time to service received Datagrams. If this is a problem, use the SendMsg call instead of SendMsgReply.

## Return Value (Status)

GetMsg will return SUCCESS if a memory or non-memory message is returned to YOU. Otherwise, one of the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| IMBUSY | - | The PCIM is otherwise engaged and cannot **accept** the command. |
| **NOMSG** | **-** | No message is available to be received at this time. |
| TXERR | - | A message transmission has failed. |
| PCIMERR | - | There may be a problem with **the** PCIM firmware. |

See Also

SendMsgReply, SendMsg and ChkMsgStat

## Coding Example

Check to see if any messages exist on PCIM #1 and if so, store them into the location 'Msg'.

```
#include <pcim.h>

int status;
READ-MESSAGE Msg;

      status = GetMsg (1, &Msg);
```

## GetINTR - Read Interrupt Status table

Summary

```
#include <pcim.h>

int
GetINTR (IMnum, Intr)

int IMnum;
unsigned char *Intr;
```

### Description

The Get Interrupt call allows you **to** read the selected PCIM's Interrupt Status Table. You can read this table to:

- see why an interrupt in the Host system has occurred
- report the event in a non-interrupt environment, as is the default state of the Software Driver concept (the PCIM will still report the event even though the interrupt is disabled).

Thus, the Interrupt Status Table can be polled (by reading and interpreting it) to determine what is interrupting the PCIM. Interrupt conditions are discussed in chapter 3 of this manual.

When GetINTR is called, it transfers the data from the PCIM's Interrupt Status Table to the Host memory "Intr" parameter. **The** format of the Interrupt Status Table **and its** associated macros (shown below) **is** defined in the summary of data structures in this chapter and in <pcim.h>.

IMnum defines the PCIM, as configured during initialization, from which the Interrupt Status Table is to be read. The Intr parameter is a pointer to **the** buffer where the Interrupt Status Table information is stored.

The format of the Intr table is:

```
unsigned char Intr[8];
```

The following Macros are used as shown in the Interrupt Status Table.

| Macro | Position | Explanation |
|---|---|---|
| #define I_ENABLE | 0 | - Enable **the** interrupt level. |
| #define I_DISABLE | 1 | - Disable the interrupt level. |
| | | |
| #define I_SUMMARY | 0 | - Summary if interrupt occurred. |
| **#define I-REQUEST 0** | **1** | - Received memory datagram. |
| #define I_PCIM_STAT | 2 | - PCIM Status Change - usually fatal. |
| #define I_DEV_STAT | 3 | - Device Status Change. |
| #define I_OUT_SENT | 4 | - Outputs sent - end of bus access. |
| #define I_CCOMPLETE | 5 | - Command Block completed. |
| #define I_RECEIVE_D | 6 | - Received Datagram. |

## GetINTR - Read Interrupt Status Table (Cont'd)

After data transfer **to** the Host is complete, GetINTR clears all of **the** PCIM's Interrupt Status Table bytes each time it is called, This way, you can see the lastest event that has occurred each call.

Parameters are summarized as follows:

| Parameter | Values | function |
|---|---|---|
| IMnum | 1-64 | Relative number of PCIM |
| Intr | see above | Pointer to the buffer where the table data **will** be stored |

### Return Value (Status)

GetINTR will return SUCCESS if the device specified by IMnum is present on the serial bus. If the target device is not present, or is out of range, GetINTR will return FAIL. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BAD IMNUM | - | IMcount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized **(InitIM)**. |
| IMFAIL | - | **The** indicated PCIM has **failed** (PCIM OK = 1). |

### Coding Example

This example shows how, if an interrupt occurs on PCIM #1, **to** transfer the contents of that PCIM's Status Table. Interpretation of bits will depend on which interrupt is Enabled, and which application is **to be** run.

```
#include <pcim.h>

int status;
unsigned char Intr[8];

     if ((status = GetINTR (1, Intr)) !=SUCCESS)
          report=err (1, status);
     else
     [    /*do what's necessary for interrupt processing*/
     I
```

## PutINTR - Write to the Interrupt Disable Table

Summary

```
#include <pcim.h>

int
PutINTR (IMnum, DisableIntr)

int IMnum;
unsigned char *DisableIntr;
```

### Description

The Put Interrupt call allows you to write to the selected PCIM's Interrupt Disable Table. The PutINTR call first initializes a table to Enable and Disable individual interrupts as you require. The PutINTR call then writes this table to the Interrupt Disable Table on the PCIM. You can Enable or Disable interrupts in any mix; that is, on a single call, some interrupts may be Enabled and some Disabled, all may be Enabled, or all of the interrupts may be Disabled. Interrupt conditions are discussed in chapter 3 of this manual.

When PutINTR is called, it transfers the data from the Host memory "DisableIntr" parameter to the PCIM's Interrupt Disable Table. The format of the Interrupt Disable Table and its associated macros (shown below) is defined in the summary of data structures in this chapter and in <pcim.h>.

IMnum defines the PCIM, as configured during initialization, to which Disabletntr will be d. The DisableIntr parameter is a pointer to the buffer where the Interrupt Disable able information is stored.

The format of the DisableIntr table **is:**

unsigned char DisableIntr[B];

The following Macros are used **as** shown in the Interrupt Disable Table.

| Macro | Position | Explanation |
|---|---|---|
| #define I ENABLE | 0 | - Enable the interrupt level. |
| #define I_DISABLE | 1 | - Disable the interrupt level. |
| | | |
| #define I SUMMARY | 0 | - Summary if interrupt occurred. |
| #define I-REQUEST Q | 1 | - Received memory datagram. |
| #define I PCIM STAT | 2 | - PCIM Status Change - usually fatal. |
| #define I DEV STAT | 3 | - Device Status Change. |
| #define I_OUT_SENT | 4 | - Outputs sent - **end of** bus access. |
| #define ICCOMPLETE | 5 | - Command Block completed. |
| #define I_RECEIVE-D | 6 | - Received Datagram. |

## PutINTR - Write to the Interrupt Disable Table (Cont'd)

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| I Mnum | I-64 | Relative number of PCIM |
| DisableIntr | see above | Pointer to the buffer from which enable/disable data is sent |

Return Value (Status)

PutINTR will return SUCCESS if the device specified by IMnum is present on the serial bus. If the target device is not present, or is out of range, PutIntr will return FAIL. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMcount is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (InitIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

Coding Example

This example enables the Receive Datagram interrupt.

```
#include <pcim.h>

int status;

unsigned char DisableIntr[8];

/*Initialize the Disable Table*/
     for (x = 0; x < 8; xtt)
               DisableIntr [x] = I-DISABLE   /* Disable all Interrupts*/

/*Enable Receive Datagram Interrupt*/
     DisableIntr [I_RECEIVE_D] = J-ENABLE;

/*Now call use the call*/
     if ((status = Put\NTR (1, DisableIntr )) != SUCCESS)
               report_err (1, status);
```

## SECTION B
## BASIC LANGUAGE PCIM SOFTWARE DRIVER

### Basic Software Driver Installation

The Basic Software Driver function call subroutines are made resident in your system when you execute the Driver code file once under MS/DOS as follows:

1) Type 'PCIMX' in response to the DOS prompt ‘A>‘.

   - The Driver code file is loaded into memory.

   - A short initialization sequence inside the Driver is executed.

2) The Driver code displays the message ‘PCIM Drivers Version x.x are Resident’ and exits to DOS.

   - The Driver is resident in memory and available for use.

   - BASICA or GWBASIC can be loaded and calls to the Drivers performed.

If you need to recover the memory space occupied by the Driver, you must perform a system reset. In most cases, this will not be necessary since Driver code occupies only a small amount of memory (13K). If you plan to access the Driver frequently, the Driver code file can be moved to your system disk and executed from inside your AUTOEXEC.BAT file at startup. This will automatically make the Driver resident.

### Basic Software Driver Function Call Parameters

Software Driver function calls require that you specify a number of parameters for each call. The data structures for each parameter, which are linked and loaded from the Software Driver .exe file, are summarized below.

IBM PC BASICA interpreter does not allow the passing of constants in the parameter list of a CALL statement. Only variables may be passed. You must load all variables which supply information to the Driver before performing a function call. In the parameter lists which follow, all parameters are either single integers or are arrays of integers.

NOTE

BASICA interpreter requires that all arrays be called with subscript. If this is violated, incorrect data and/or system crash is the usual result.

## Basic Data Array Structures

### IMPARMS

The user-supplied IMPARMS() array sets parameters for the initialization of each IM.

The format of 'IMPARMS()" is:

Variable, depending on how many IMs are to be initialized, (can be up to 383)

| | |
|---|---|
| 0 | - Segment address of 1st PCIM SIR |
| 1 | - i/O Port address (dip switch setting) |
| 2 | - Starting Ref addr for global data |
| 3 | - Global data length (O-127) |
| 4 | - Input data length (O-127) |
| 5 | - Active (1=ON, O=OFF) |
| 6 | - Segment address of 2nd PCIM SIR |
| 7 | - I/O Point address (DIP switch setting) |
| 8 | . |
| | . |
| | |

### IMFLAGS

The IMFLAGS() array is a system return used by INITIM to tell you which PCIMs initialized properly (on improperly, as the case may be). The length of IMFLAGS should be equal to the number of IMs or IMCOUNT.

The format of IMFLAGS()" is:

Variable, depending on the number of IMs (can be up to 64)

| | |
|---|---|
| 0 | - Flag for the 1st IM |
| 1 | - Flag for the 2nd IM |
| 2 | - Flag for the 3rd IM |
| 3 | - Flag for the 4th IM |
| . | |
| . | |
| . | |
| . | |

## IMSTATE

The IMSTATE() array is a **system return** used for accessing configuration and status information about a specific PCIM by reading its Setup Table and Status Table.

The format of "IMSTATE()' is:

10

| | |
|---|---|
| **0** | - GENI board dip switch values |
| 1 | - **PCIM** Reference Address |
| 2 | - PCIM Output Data Length |
| 3 | - PCIM Input Data Length |
| 4 | - PCIM Software Revision number |
| 5 | - **PCIM** Hardware OK flag |
| 6 | - PCIM Fault Description |
| 7 | - PCIM Present/Excess Bus Errors flag |
| 8 | - HHM Present/Excess Bus Errors flag |
| 9 | - Serial Bus Error Count |
| 10 * | - I/O Scan Time |

## BUSCONFIG

The BUSCONFIG() array is a system return used to access the configuration of all 32 devices from the PCIM selected by the IMNUM parameter.

The format of "BUSCONFIG()" **is:**

224
(7 **for** each device)

| | |
|---|---|
| **0** | - Model number of device **#1** |
| 1 | - Output disable flag for device **#1** |
| **2** | - Device present flag for device #1 |
| 3 | - Reference address for device #1 |
| 4 | - Control Input data length for device #1 |
| **5** | - Control Output data length for device #1 |
| 6 | - Configuration for device #1 |
| 7 | - Model number of device #2 |
| **8** | - Output disable flag for device #2 |
| | . |
| . | . |
| | . |

## DEVCONFIG

The user-supplied DEVCONFIG() array is a system return very similar to BUSCONFIG array, except that it can only read the configuration of 1 device at a time.

The format of “DEVCONFIG()’ is:

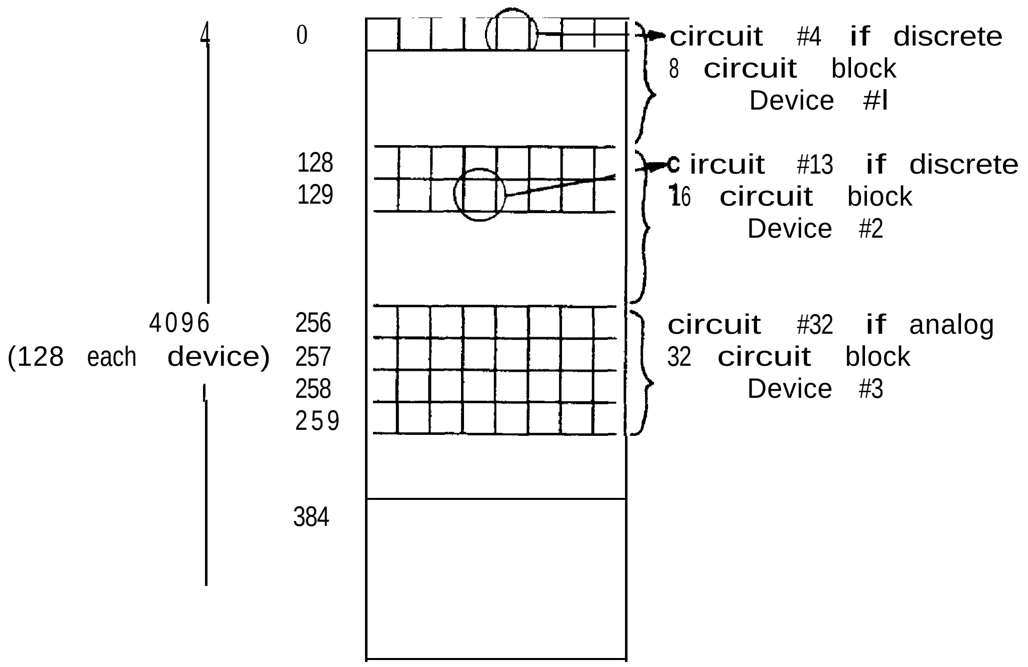
7

| | |
|---|---|
| 0 | - Model number of device specified |
| 1 | - Output Disable flag |
| 2 | - Devce Present flag |
| 3 | - Device Reference Address |
| 4 | - Device Input Data Length |
| 5 | - Device Output Data Length |
| 6 | - Device I/O Configuration |

## IODATA

The IODATA() array is used to read and/or write I/O data to and from the PCIM input/output tables to all the devices on the bus (User supplied for PUTBUSOUT call/System returned for GETBUSIN call).

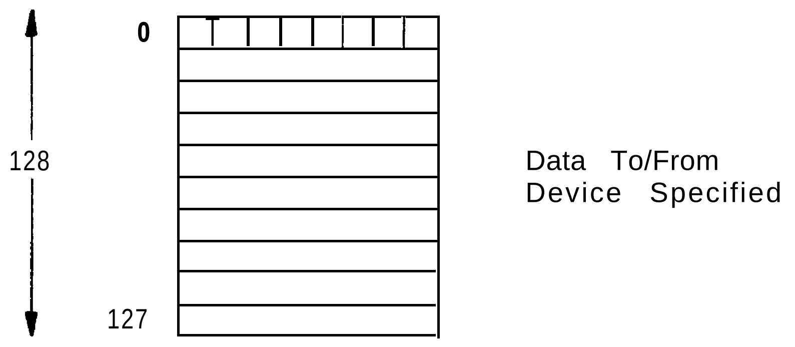
The format of “IODATA()” is:



### DEVDATA

The DEVDATA() array is very similar to IODATA() except that it is used to read and/or write I/O data to and from the PCIM input/output tables to a device on the bus (User supplied for PUTBUSOUT call/System returned for GETBUSIN call).

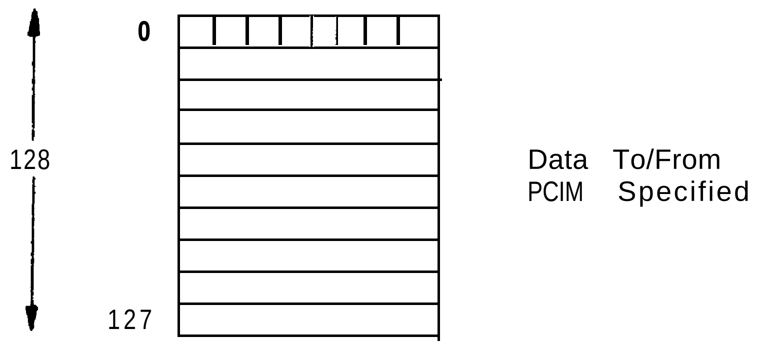
The format of "DEVDATA()" is:



### IMDATA

The IMDATA() array is a buffer where Global Data to be read will be located. The size of this parameter is determined by the "Inputlength" parameter located in the PCIM's configuration data.

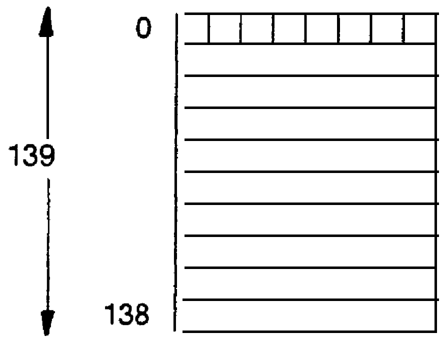
The format of "IMDATA()" is:



MSG

The MSG() array is a buffer where the message to be sent (SENDMSG) or message to be received (GETMSG) will be stored.

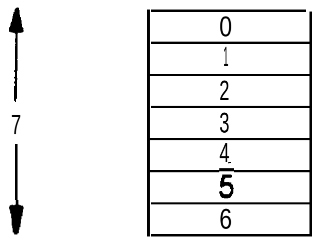
The format of “MSG()” is:



INTR/DISABLEINTR

The INTR and DtSABLEINTR arrays are used to read the selected PCIM’s Interrupt Status Table and write to the selected PCIM’s Interrupt Disable Table, respectively.

The format of “INTR” and DISABLEINTR” is:



- Summary if interrupt occurred
- Received Memory Datagram
- PCIM Status Change - usually fatal
- Device Status Change
- Outputs sent - end of bus access
- Command Block completed
- Received Datagram

## Error Status Indication

Any function call may return ah error condition. You are informed of error conditions by a non-zero error code returned in the STATUS variable included as the first parameter in every cal l. Normal completion of a function call is indicated by a zero STATUS returned. The table of error codes that follows will help you interpret these codes. A simple check for non-zero STATUS must be performed after each driver call to detect error conditions.

The following error codes are returned for all calls:

| | Error Code | Explanation |
|---|---|---|
| SUCCESS | 0 | Successful completion of function. |
| INITFAIL | 1 | Initialization Failure. |
| IMFAIL | 2 | PCIM Failure. |
| BADSEG | 3 | Inval id Segment address. |
| BADPORT | 4 | Invalid I/O Port Address. |
| BADCFG | 5 | Inval id Configuration parameter. |
| NOCFG | 6 | No Configuration changes found. |
| NOINIT | 7 | PCIM selected is not initialized. |
| NODATA | 8 | No data found. |
| UNDERFLOW | 9 | Insufficient device data length. |
| OVERFLOW | 10 | Exceeds device data length. |
| OFFLINE | 11 | Device is offline. |
| I MBUSY | 12 | PCIM busy. |
| BADPARM | 13 | Invalid message parameter. |
| TXERR | 14 | Message transmit failure. |
| NOMSG | 15 | No Message available. |
| IMFREE | 16 | No message activity. |
| BADSBA | 17 | Invalid Serial Bus Address. |
| BADIMNUM | 18 | Invalid PCIM Number. |
| PCIMERR | 19 | PCIM f i rmware problem. |
| DUPSEG | 20 | Duplicate segment values given. |
| DUPPORT | 21 | Duplicate IO Port values given. |

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## Access from BASIC

Every BASIC program which accesses the PCIM Software Driver must perform a short startup sequence to let BASIC know where each of the function call subroutines is located. This startup sequence is listed below. It is also included on the Driver diskette in the file PCIM.BAS so you can copy it at the beginning of new programs rather than re-code it every time you need it.

```
 10 OPTION BASE 0
 20 DEFINT A-Z
 30 DIM IMPARMS(383)JMFLAGS (63)IMSTATE (9),IMDATA(127),BUSCONFIG(223)
 40 DIM DEVDATA(127),IODATA(4095),MSG(139),DEVCONFtG(7)
 50 DIM tNTR(S),DISABLEINTR(7)
 60 DEF SEG=0
 70 SUBSEG=(PEEK(&H4F1)*256) t PEEK(&H4F0)
 80 DROFFSET=(PEEK(&H4F3>*256) t PEEK(&H4F2)
 90 IF SUBSEG<>0 THEN 180
100 '
110 'Non-resident return
120 '
130 PRINT "PCIM Drivers not resident?
140 SYSTEM
150 '
160 'Continue normally
170
180 DEF SEG=SUBSEG
190 INITIM=OtDROFFSET
200 GETDEVIN=4+DROFFSET
210 PUTDEVOUT=8+DROFFSET
220 GETBUStN=12+DROFFSET
230 PUTBUSOUT=16+DROFFSET
240 GETIMIN=2O+DRCFFSET
250 PUTtMOUT=24+DROFFSET
260 GETCtR=28+DROFFSET
270 GETWORD=32+DROFFSET
280 PUTClR=36+DROFFSET
290 PUTWORD=40+DROFFSET
300 CHGtMSETUP=44+DROFFSET
310 GEftMSTATE=48+DROFFSET
320 GETBUSCONFIG=52+DROFFSET
330 GETDEVCONFtG=56+DROFFSET
340 DISABLEOUT=6O+DROFFSET
350 GETMSG=64+DROFFSET
360 SENDMSG=68+DROFFSET
370 SENDMSGREPLY=72+DROFFSET
380 CHKMSGSTAT=76+DROFFSET
390 GETINTR=80+DROFFSET
400 PUTtNTR=84+DROFFSET
410 '
420 'Get inputs for initialization function call INITIM.
430 'INITIM must be called first to initialize PCIMs and
440 'check that they were initialized.
450
460 CALL INITIM (STATUS,IMCOUNT,IMPARMS(0),tMFLAGS(0))
```

In the above sequence:

- line 10 forces array indexing to start at zero since this is more convenient when using the Driver,
- line 20 defaults all variables to integer type (use the type overrides for single and double precision reals),
- fines 60 through 180 find the segment address in memory where the Driver has previously been installed and ensures **that it** is present,
- and lines 190 through 400 define the offsets in the segment for each of the function **cat** I subroutines.
- lines 410 through 460 are simply **a** reminder to call for initialization first (see the INITIM call).

## Coding Basic Function Calls

There are two ways to call a function in Basic, as shown below:

1) Segment relocation - first relocate the segment, perform the the call, then restore the segment. For example, to call INITIM, code:

```
1000 DEF SEG=SUBSEG
1010 CALL INITIM(parameters)
1020 DEF SEG
```

2) No relocation - if you know in advance that other BASICA statements which depend on segment relocation (PEEK, POKE, BLOAD, BSAVE, DEF USR, or CALLs to other user routines) will not be used, then the code in line 1000 above can be executed once at startup to **set** the segment **to** the Driver. Function calls can then be coded on a single line without segment relocation. Using the same example:

```
1010 CALL INITIMparameters)
```

## Basic Software Driver Function Call Presentation

This section provides a sample of the format and notation in which individual function calls are presented in Basic. Individual function calls are discussed in the pages that follow. The presentation format for function calls is:

CALL NAME CALL Statement

- Syntax

CALL NAME (STATUS, Parameter List)

a Act ion

A brief statement of the call's function.

- Remarks

A detailed description of the function call; including a description of the function, a summary of the function's action sequence, and a summary of the parameters used in the call.

A parameter format listing for parms described for the first time (as shown in quotes in the text) is included for each call. If **a** parameter is complex, this information will be repeated for each using call. If containing only one field, format may not be shown.

- Status Value

A detailed description of status values and their meanings.

a Coding Example

A description of a generic application, and sample coding using the call.

## INITIM CALL Statement

✍ Syntax

CALL INITIM (STATUS, IMCOUNT, IMPARMS(0)IMFLAGS(0))

- Action

Setup and Activate PCIM

- Remarks

The initialize IM call specifies the total number of PCIMs in the Host system through the parameter "IMCOUNT", and the characteristics of each IM through the parameter "IMPARMS".

INITIM resets the IMcount of PCIMs in **the** Host system and initializes each **IM** as defined by IMPARMS. You must create a separate IMPARMS entry for each PCIM **in IMCOUNT. Each PCIM** requires the entries in IMPARMS array.

The format of "IMPARMS" is:

| | | |
|---|---|---|
| IMPARMS(0) | -IM 1 | - Segment Address of 1st PCIM shared RAM (dipswitch setting) |
| IMPARMS(1) | -IM 1 | - **I/O** Port Address (dipswitch setting) |
| IMPARMS(2) | -IM 1 | - Reference Address |
| IMPARMS(3) | -IM 1 | - Global data length (O-128) |
| IMPARMS(4) | -IM 1 | - Input data length (O-128) |
| IMPARMS(5) | -IM 1 | - Active (1 = ON, 0 = OFF) |
| IMPARMS(6) | -IM 2 | - Segment Address of 2nd PCIM shared RAM (dipswitch setting) |
| IMPARMS(7) | -1M 2 | - I/O Port Address (dip switch setting) |
| IMPARMS8 | -IM 2 | - Reference Address |
| IMPARMS(9) | -IM 2 | - Global data length (O-128) |
| IMPARMS(10) | -IM 2 | - Input data length (O-128) |
| IMPARMS(11) | -IM 2 | - Active **(1 = ON, 0 = OFF)** |

etc.

**NOTE**

The memory pointer and I/O port assignments must correspond to the dip switch settings on the PCIM.

The last parameter, "IMFLAGS", is an array the size of IMCOUNT, **used** by INITIM to tell you which PCIMs initialized properly (or improperly, as the case may **be).** The number of flags should equal IMCOUNT.

**INITIM** CALL Statement (Cont'd)

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMCOUNT | 1-64 | Total number of PCIMs |
| IMPARMS | varies (6 entries/IM) | Shows the characteristics of each IM - see above |
| IMFLAGS | varies | Tells you which PCIMs initialized properly (or improperly) - see above |
| STATUS | 0/1 | SuccessIFai l |

The INITIM call performs the following sequence of actions:

1) issues a Reset to all defined PCIMs.

2) downloads Global data parameters to each PCIM after its PCIM OK LED turns ON (may take up to five seconds).

3) After all PCIMs have been downloaded or a five second timeout **has** occurred, returns with an IMFLAGS array (one for each defined PCIM). Status returned will be Fail for any syntax or execution errors detected. An example of an execution error is failure of the PCIM OK flag to be ON within five seconds after Reset.

- Status Value

INITIM will return SUCCESS if all resets and data parameters were accepted by each PCIM. The following failure codes are returned:

| | | |
|---|---|---|
| BADIMNUM | - | **IMCOUNT** is out of range (a count of 64 or greater). No more INITIM processing is performed. |
| INITFAIL | - | An initialization problem occurred in one or more PCIM. **The** individual status for **each** PCIM on the bus is located in the IMFLAGS parameter. |

## INITIM CALL Statement (Cont'd)

One of the following status codes will be stored in the appropriate location in the IMFLAGS parameter if the return **code** is **INITFAIL.** Each status value in the IMFLAGS array is unique to the associated PCIM and does not reflect the status of any other PCIM.

| | | |
|---|---|---|
| **INITFAIL** | - | This PCIM, failed to power up. (Incorrect segment address or port address.) |
| **SUCCESS** | - | This PCIM has been powered up and configured as specified. |
| IMFAIL | - | This PCIM never powered up. |
| **BADCFG** | - | This PCIM rejected the configuration because a parameter was out of **range.** |
| **BADSEG** | - | **The** segment value in IMPARMS is set to the i l legal value 0 (zero). |
| **BADPORT** | - | The I/O port address is set to some illegal value less than 256. |
| **DUPSEG** | - | The segment address is a duplicate of another PCIM. |
| **DUPPORT** | - | The Port address is a duplicate of another PCIM. |

NOTE

If any of the PCIMs fail to initialize as you specified in IMPARMS, INITIM turns OFF the failed PCIM.

✍ Coding Example

**fn this** example are two PCIMs.

```
410 IMCOUNT      =2            ; 2 PCIMs
420 IMPARMS (0) = &HDOOO       ;IMl - PCIM #1 Segment address
430 IMPARMS (1) = &H3E4        ;IM1 - Port address
440 IMPARMS (2) = &H7000       ;IM1 - Reference address
450 IMPARMS (3) = 0            ;IMl - No global data
460 IMPARMS (4) =0             ;IMl - No Directed data
470 IMPARMS (5) = 1            ;IMl - Turn PCI on by default
480 IMPARMS (6) = &HCC00       ;IM2 - PCIM #2 Segment address
490 IMPARMS (7) = &H3E0        ;IM2 - Port address
500 IMPARMS (8) = &H3000       ;IM2 - Reference address
510 IMPARMS (9) =0             ;IM2 - No global data
520 IMPARMS (10) = 0           ;IM2 - No Directed data
530 IMPARMS (11) = 1           ;IMl - Turn PCI on by default
540 Call INITIM(STATUS,IMCOUNT,IMPARMS(0),IMFLAGS(0))
```

## CHGIMSETUP **CALL Statement**

- Syntax

CALL CHGIMSETUP **(STATUS, IMNUM, IMPARMS(0))**

- Action

Change PCIM Configuration

- Remarks

Following initialization, any changes you make to the configuration of a specific PCIM must use the Change IM Setup call. This call allows you to make configuration changes to a specific PCIM Setup Table by writing the **IMPARMS** parameter from Host memory to it.

The IMMNUM" parameter is **an** offset **of the IMPARMS** parameter which, after initialization, indicates the specific PCIM in the host system for which configuration changes are intended. The relative IMNUM cannot itself be changed.

**NOTE**

Configuration changes to any PCIM while online causes that IM to stop transmitting on the serial bus for 1.5 seconds.

The format of "IMPARMS" is the same as shown in the INITIM call. However only four of **the** parameters should be allowed to be changed. These are as follows:

IMPARMS( I+2) - Reference Address
IMPARMS( I+3) - Global data length
**IMPARMS(** I+4) - Input data length
**IMPARM(** I+S) - Active (1 **= ON, 0 = OFF)**

I = (IMNUM-I)*6

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| **IMNUM** | 1-64 | Relative number of PCIM |
| IMPARMS | varies | Shows the characteristics of each IM - see above |
| **STATUS** | **0/1** | Success/Faill |

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## CHGIMSETUP CALL Statement (Cont'd)

- Status Value

CHGIMSETUP will return SUCCESS if all changes were accepted by the target IM. If the IM fails to change to the new parameters, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | Inval id PCIM number. |
| **NOINIT** | **-** | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1), or never completed processing the config change command. |
| IMBUSY | - | The PCIM is otherwise **engaged** and cannot accept the config change command. |
| BADCFG | - | This PCIM rejected **the** configuration because a parameter was out of range. |
| NOCFG | - | The PCIM, after examining the received the config change command, found no changes to make. |
| INITFAIL | - | The PCIM failed to power up. |

✍ Coding Example

Change the reference address for PCIM #1.

```
600 IMNUM =1
610 IMPARMS (2) = &H6000 ;new reference address
620 Call CHGIMSETUP(STATUS, IMNUM, IMPARMS(0))
```

Turn off PCIM #2,

```
690 IMNUM = 2
700 IMPARMS (2) = &H7500
720 Call CHGlMSETUP(STATUS,IMNUM,IMPARMS(0))
730 'Check status for next action
740 If STATUS = 0 Then 760 else 800
```

## GETIMSTATE CALL Statement

- Syntax

CALL GETIMSTATE (STATUS, IMNUM, IMSTATE(0))

- Act ion

Get Configuration and Status Information

- Remarks

The Get IM State call allows you to **access** configuration and status information about a specific PCIM by reading its Setup **Table** and Status Table into the "IMSTATE" parameter **in** iiost memory.

The format of IMSTATE **is:**

| | | |
|---|---|---|
| IMSTATE(0) | DipSwitch | - GENI Daughterboard Dip Switch Value |
| IMSTATE(1) | IMRef | - Reference Address |
| **IMSTATE(2)** | **OutputLength** | **-** Output Control **Data Length** |
| **IMSTATE(3)** | **InputLength** | **- input** Control Data Length |
| IMSTATE(4) | Revision | - PCIM Firmware Revision Number |
| **IMSTATE(5)** | PCIM OK | - PCIM OK = 0 - every 200 ms, set **to** '1' |
| **IMSTATE(6)** | **Fault** | - Overall fault byte - **any PCIM** fault |
| IMSTATE(7) | Active | - Hand Held Monitor Present |
| **IMSTATE(8)** | SBerr | - Serial **Bus** error count |
| **IMSTATE(9)** | ScanTime | **- Bus Scan Time** in ms |

Before returning, GETIMSTATE will **also** clear the PCIM OK flag **of** the selected PCIM. Since the PCIM periodically sets its PCIM OK flag, this **cal l allows the** implementation of **a PCIM OK** heartbeat procedure.

Parameters **are summarized as fol fows:**

| Parameter | **Values** | **Function** |
|---|---|---|
| IMNUM | l-64 | Relative number of PCIM |
| **IMSTATE** | varies | PCIM Configuration and Status -see above |
| STATUS | 0/1 | Success/Fail |

## GETIMSTATE CALL Statement (Cont'd)

✍ Status value

GETIMSTATE will almost always return SUCCESS. If the target IM **is** currently offline, has not been initialized, or is out of range, the following FAIL indications will **be** returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

✍ Coding Example

Examine the state of PCIM #1.

```
1000  IMNUM=1
1010  CALL GETIMSTATE(STATUS,IMNUM,IMSTATE(0))
```

**GETBUSCONFIG CALL Statement**

- Syntax

CALL GETBUSCONFIG (STATUS, IMNUM, MJSCONFIG(0))

a Act ion

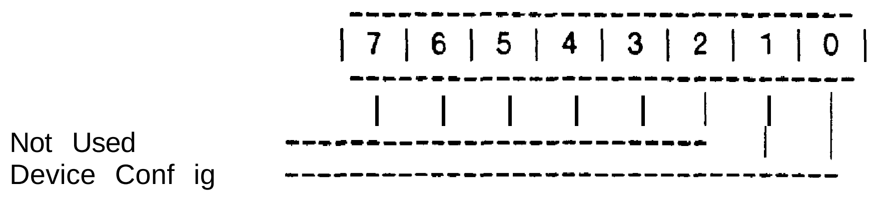
Get Serial Bus Configuration

a Remarks

The Get Bus Configuration call allows you to read device configuration information about all devices on a serial bus. GETBUSCONFIG reads all 32 Device Configuration **Tables** from the PCIM selected by IMNUM into the Host memory "BUSCONFIG" parameter. BUSCONFIG parm - 224 in length, 7 entries per device.

The format of BUSCONFIG is:

| | |
|---|---|
| BUSCONFIG (0) Model | - Model Number of device |
| BUSCONFIG (1) OutputDisable | - Output disable flag |
| BUSCONGIG (2) Present | - Device Present flag |
| BUSCONFIG (3) Reference | - Status Table or Reference Address |
| BUSCONFIG (4) InputLength | - Control Input Data Length |
| BUSCONFIG (5) Outputlength | - Control Output Data Length |
| BUSCONF I G (6) Con f i g | - Device Configuration<br>1 = al l inputs<br>2 = all outputs<br>3 = combination |



Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| BUSCONF I G | 224 entries (7 entries/device) | Device configuration information about all devices on a serial bus - see above |
| STATUS | 0/1 | Success/Fail |

## GETBUSCONFIG CALL Statement (Cont'd)

- Status Value

**GETBUSCONFIG** will almost always return SUCCESS. If the target IM is currently offline, has not been initialized, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| **IMFAIL** | **-** | The indicated PCIM has failed (PCIM OK = 1). |
| **OFFLINE** | **-** | None of the devices specified are currently active on the bus. However, **the** appropriate buffer **is** still returned and will contain configuration data for devices once logged **in.** Zeros will be returned if no device has logged in to a particular slot. |

✍ Coding Example

Examine the configuration of the devices on PCIM #1.

```
1100   IMNUM = 1
1110   Call GETBUSCONFIG (STATUS,IMNUM,BUSCONFIG(0))
```

## GETDEVCONFIG CALL Statement

- **Syntax**

**CALL** GETDEVCONFIG (STATUS, IMNUM, DEVICENUM, DEVCONFIG(0))

- Act ion

Get Device Configuration

- Remarks

The Get Device Configuration **call allows** you to read device configuration information about **a** specific device on the **serial bus.** GETDEVCONFIG **reads** this information from **the** PCIM selected by IMNUM into the Host **memory** "DEVCONFIG" parameter.

**Again, the format of DEVCONFIG is:**

| | | |
|---|---|---|
| DEVCONFIG(0) | Model | - Model Number of device |
| **DEVCONFIG(1)** | **OutputDisable** | - Output **disable flag** |
| DEVCONFIG(2) | Present | **- Device Present flag** |
| **DEVCONFIG(3)** | **Reference** | **- Status Table or Reference Address** |
| **DEVCONFIG(4)** | **InputLength** | - Control **Input Data Length** |
| **DEVCONFIG(5)** | **OutputLength** | **- Control Output Data Length** |
| **DEVCONFIG(6)** | **Config** | **- Device Configuration**<br>1 = **all inputs**<br>**2 = all outputs**<br>**3= combination** |

```
                               ---------------------------------
                               | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
                               ---------------------------------
                                 |   |   |   |   |   |   |
NOT Used       -----------------------------------------   |   |
Device Config  -------------------------------------------------
```

**Parameters are summarized as** follows:

| **Parameter** | **Values** | **Function** |
|---|---|---|
| IMNUM | **l-64** | **Relative number of PCIM** |
| DEVICENUM | **o-31** | **Specifies device on serial bus** |
| DEVCONFIG | **7 entries** | **Device configuration of DEVICENUM** |
| STATUS | 0/1 | **Success/Fail** |

## GETDEVCONFIG CALL Statement (Cont'd)

- Status Value

GETDEVCONFIG will almost always return SUCCESS. If the target IM is currently offline, has not been initialized, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | MCOUNT is out of range (a count of 64 or greater). |
| BADSBA | - | Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has fai led (PCIM OK = 1), or never completed processing the config change command. |
| OFFLINE | - | The device requested is currently not on the bus, however, the appropriate buffer is still returned and wi ll contain configuration data for devices once logged in. |

- Coding Example

Examine the configuration of device #30 on PCIM #1.

```
1200    IMNUM = 1
1210    DEVICENUM = 30
1220    Call GETDEVICECONFIG  (STATUS,IMNUM,DEVICENUM,DEVCONFIG(0))
```

## DISABLEOUT CALL Statement

- Syntax

CALL DISABLEOUT (STATUS, IMNUM, DEVICENUM, FLAG)

- Act ion

Disable/Enable Device Outputs

- Remarks

The Disable (/Enable) Outputs call allows you to selectively disable (or enable) outputs to a specific device, or to all devices, on a serial bus.

**If** FLAG is non-zero ('1'), outputs to the device will be disabled; if FLAG is zero ('0'), outputs will **be** enabled to that device. If you code the DEVICENUM value equal to 'ALL'(32), then the outputs to all devices will be set to the value of FLAG. If DEVICENUM is **a** serial bus address value between 0 - 31 decimal, then the flag value will only affect that device.

Parameters are summarized as follows:

| **Parameter** | Values | Function |
|---|---|---|
| **IMNUM** | l-64 | Relative number of PCIM |
| DEVICENUM | 0-32 | Specifies device on serial bus on which ci rcui t resides |
| | 32 | Specifies all devices |
| **FLAG** | 0 or 1 | Enable/disable outputs |
| STATUS | O/l | Success/Fail |

- Status Value

DISABLEOUT will return SUCCESS if the device specified by IMNUM is present on the serial **bus.** Otherwise, DISABLEOUT will return FAIL. **If** DEVICENUM indicates ALL, then DISABLEOUT will almost always return SUCCESS. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is **out** of **range** (a count of 64 or greater). |
| BADSBA | - | Specified DEVICENUM is not in the range for GENIUS **bus devices** (0 - 31 decimal). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

## DISABLEOUT CALL Statement (Cont'd)

### a Coding Example

Enable outputs to device #8 on PCIM #1.

```
1600   DEVICENUM = 8
1610   IMNUM = 1
1620   FLAG = 0
1630   Call DISABLEOUT(STATUS,IMNUM,DEVICENUM,FLAG)
```

Disable outputs to all devices on PCIM #1.

```
1700   DEVICENUM = 32
1710   IMNUM = 1
1720   FLAG = 1
1730   Call DISABLEOUT(STATUS,IMNUM,DEVICENUM,FLAG)
```

## GETBUSIN CALL Statement

- Syntax

CALL GETBUSIN (STATUS, IMNUM, IODATA(0))

✍ Act ion

Read all Input Values

- Remarks

A Get Bus Inputs call allows you to read input values from all active devices in the input Table of the specified PCIM. Active inputs are those for which the Device Present flag is set to '1' (it is the application's responsibility to know which devices **are present** on the bus via the GETBUSCONFIG call). Active input values are placed into **the** Host memory "IODATA" parameter. IODATA must be an array buffer where the I/O information will be saved. The IODATA parm is 4096 in length, 128 entries/device, times 32 devices.

When GETBUSIN is called, it begins by "locking out" the PCIM from updating its input Table (ensures data coherency across bus scans). GETBUSIN then searches the PCIM specified by IMNUM for active **devices,** transferring only active device data to the corresponding device number of the IODATA parm. When the entire PCIM Input Table has been searched, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| IOOATA | 4096 bytes | Data parameter will be copied to Host memory from specified PCIM |
| STATUS | 0/1 | Success/Fail |

✍ Status Value

GETBUSIN will return SUCCESS if any of the devices specified by the IMNUM are active and data was transferred. If no devices are present on the target IM, if the target IM is currently off line, has not been initialized, or is out of **range,** the following FAIL indications w i l l be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| **IMFAIL** | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the bus, however, the appropriate buffer is sti ll returned and wi **ll** contain configuration data for devices once logged in. |

## GETBUSIN CALL Statement (Cont'd)

- Coding Example

**Read all inputs from all active devices on PCIM #1.**

```
2000    IMNUM = 1
2010    Call GETBUSIN(STATUS,IMNUM,IODATA(O))
```

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## PUTBUSOUT CALL Statement

- Syntax

CALL PUTBUSOUT (STATUS, IMNUM, IODATA(0))

- Action

Write all Output Values

- Remarks

**The** Put Bus Outputs call allows you to update outputs to **ail** active devices in the Output Table **of** the specified PCIM. Active outputs are those with the Device Present flag set to '1' (it is the application's responsibility to know which devices are present on the bus via the GETBUSCONFIG call). Active output values are written from the Host memory IODATA parameter. IODATA must be an array buffer where the I/O information is saved. The IODATA parm is 4096 in length, 128 entries/device, times 32 devices

**When** PUTBUSOUT **is called, it** begins by "locking-out" **the** PCIM from **updating** its Output Table (ensures data coherency across PCIM scans). PUTBUSOUT then searches **the** PCIM specified by IMNUM for active devices, transferring only to active devices data from **the** device number of the IODATA parm corresponding to the device's slot in the Output Table. When the entire PCIM Output Table has been searched, **the PCIM is** "unlocked".

**Parameters** are summarized **as** follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | **l-64** | **Relative** number of PCIM |
| IODATA | 4096 bytes | Data parameter will **be** copied from Host memory to specified PCIM (not to exceed 255 **parameter value).** |
| STATUS | 0/1 | Success/Fail |

- Status Value

PUTBUSOUT will return SUCCESS if any of the **devices specified** by the IMNUM are **active** and data was transferred. **If no** devices are present on **the** target IM, if the target **IM** is currently offline, **has not** been initialized, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| QFFLINE | - | Data **was** transferred to the specified buffer, however, no devices were found on the bus. |

## PUTBUSOUT CALL Statement (Cont'd)

- Coding Example

Write **all** outputs **to** all active devices (4) on PCIM #1.

```
2100    IMNUM = 1
2110    IODATA (0) = 1
2120    IODATA (128) = 2
2130    IODATA (256) = 4
2140    IODATA (384) = 8
2150    Call PUTBUSOUT(STATUS,IMNUM,IODATA(O))
```

## GETDEVIN CALL Statement

- Syntax

CALL GETDEVIN (STATUS, IMNUM, DEVICENUM, LENGTH, DEVDATA(0))

- **Act** ion

**Read** Device Data Only

- Remarks

The GETDEVIN function allows you to read the control data inputs received from a single serial bus device into the Host memory "DEVDATA" parameter.

IMNUM is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device from which input data is to be read. The "LENGTH parameter is the length of the input data the device sent. This way, the function can determine whether or not it should update its current data base. The "DEVDATA" parameter **is** a buffer data read will be located. The size of this buffer is determined by the "InputLength" parameter located in the device's configuration data.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | I-64 | Relative **number of PCIM** |
| **DEV I CENUM** | **O-31** | Specifies device on **serial** bus from which input data will be read |
| **LENGTH** | O-128 | Size of data buffer |
| DEVDATA | **variable** | Buffer where data in Host stored - see above |
| STATUS | 0/1 | Success/Fail |

## GETDEVIN CALL Statement (Cont'd)

✍ **Status Value**

GETDEVIN will return SUCESS if the device specified by IMNUM is present on the serial bus, and after the data is transferred to the DEVDATA buffer. If the target device is not present, or is out of range, the following FAIL indications will be returned:

| | | |
|---|---|---|
| BAD IMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| BADS8A | - | Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the bus, and data is NOT transferred. |

- Coding Example

Get the inputs from device #8 on PCIM #1.

```
2300   IMNUM = 1
2310   DEVICENUM = 8
2320   Call GETDEVCONFIG(STATUS,IMNUM,DEVICENUM,DEVDATA(O))
2330   LENGTH = DEVCONFIG(4))
2340   Call GETDEVIN(STATUS,IMNUM,DEVICENUM,LENGTH,DEVCONFIG(O))
```

## PUTDEVOUT CALL Statement

- Syntax

CALL PUTDEVOUT (STATUS, IMNUM, DEVICENUM, LENGTH, DEVDATA(0))

- Act ion

**Write** Device Data Only

- Remarks

**The** PUTDEVOUT call allows you to write all of the control data outputs to a sing le ser ial bus device from the Host memory DEVDATA parameter.

IMNUM is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device to which output data is to be written. The LENGTH parameter is length of data sent to device. If the value differs from the PCIM's current data base, an Overflow or Underflow error will be returned. The DEVDATA parameter is a buffer where the data to be written is located. The size of this buffer is determined by the "LENGTH" parameter located in the device's configuration data.

Parameters are summarized as follows:

| Parameter | **Values** | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| DEVICENUM | o-31 | Specifies device **to** which output word will **be** written |
| LENGTH | O-128 | Size of data buffer |
| DEVDATA | variable | Character pointer to a buffer where the data to **be** written will **be located - see above** |
| STATUS | 0/1 | Success/Fail |

## PUTDEVOUT CALL Statement (Cont'd)

✍ Status Value

PUTDEVOUT will return SUCCESS if the device indicated is present **on the** given IMNUM and after the data is transferred to that device. If the target device is not present, or is out of **range, the** following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | **IMCOUNT** is out of **range (a** count of 64 or greater). |
| BADSBA | - | Specified DEVICENUM is not in the range for GENIUS bus **devices** (0 **-31** decimal), or is that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | **The** indicated PCIM **has** failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently not on the bus, and data is NOT transferred. |
| **OVERFLOW** | **-** | The Offset specified **is** greater than **the dev ices** InputLength in circuits. |
| UNDERFLOW | - | The Offset is specified **as zero (0).** |

- Coding **Example**

Write 2 bytes of output data to device #8 on PCIM #1.

```
2500  IMNUM = 1
2510  DEVICENUM = 8
2520  DEVDATA (0) = 1
2530  DEVDATA (1) = &H1O
2540  LENGTH = 2
2550  Call  PUTDEVOUT(STATUS,IMNUM,DEVICENUM,LENGTH,DEVDATA(O)~)
```

## GETIMN CALL Statement

- Syntax

CALL GETIMIN (STATUS, IMNUM, IMDATA(0))

- Act ion

Read Directed Input Table

- Remarks

The Get IM Inputs call **allows** you to read the Directed Control Input Table of a specified PCIM and write its contents into the Host memory "IMDATA" parameter.

IMNUM is the PCIM number configured during initialization. The "IMDATA" parameter is **a** buffer where the data to be read will be located. The size of this buffer is determined by the "InputLength" parameter located in the PCIM's configuration data.

When GETIMIN is called, it begins **by** "locking-out" the PCIM from updating the Directed Control Input Table (ensures data coherency across bus scans>. GETIMIN then transfers all the data in this table into Host memory. Once the transfer **is** complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | **Values** | Function |
|---|---|---|
| IMNUM | l-64 | Relative number of PCIM |
| I MDATA | variable | Buffer where the data read will be located - see **above** |
| STATUS | 0/1 | Success/Fail |

✍ Status Value

GETIMIN will return SUCCESS **if** the InputLength is non-zero and the data transfer is complete. The following FAIL indications will be returned:

| | |
|---|---|
| BAD IMNUM - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL - | The indicated PCIM has failed (PCIM OK = 1). |
| UNDERFLOW - | The Inputlength of the PCIM is set **to** zero (0). |

## CETIMIN CALL Statement (Cont'd)

✍ Coding Example

Get the directed input data from PCIM #1.

```
2700    IMNUM = 1
2710    Call GETIMIN(STATUS,IMNUM,IMDATA(0))
```

**PUTIMOUT CALL Statement**

✍ Syntax

CALL PUTIMOUT (STATUS, IMNUM, IMDATA(O))

✍ Act ion

Write the Global Output **Table**

- Remarks

**The** Put IM Outputs **call allows** you to write Control Data from the Host memory IMdata parameter to the Broadcast Control Output Table of a specified PCIM. This data is subsequently passed to ail devices on that PCIM.

IMNUM is the PCIM number configured during initialization. The IMDATA parameter is a buffer where the data to be written is located. The size of this buffer is determined by **the** "GlobalLength" parameter located in the device's configuration data.

When PUTIMOUT is called, **it** begins by "locking-out" the PCIM from reading from its Control Output Table (ensures data coherency across bus scans>. PUTIMOUT then transfers all the data from this parm to the PCIM's Global Output buffer. Once the transfer is complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | t-64 | Relative number of **PCIM** |
| I MDATA | variable | Buffer where the data **to** be written will be located - see above |
| STATUS | 0/1 | Success/Fail |

✍ Status Value

**PUTIMOUT** will return **SUCCESS if the** Globallength is non-zero and the transfer is complete. The following FAIL indications will be returned:

| | | |
|---|---|---|
| **BADIMNUM** | **-** | **IMCOUNT** is out **of range** (a count of 64 or greater). |
| NOINIT | - | Indicated **PCIM** has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| UNDERFLOW | - | The GlobalLength parameter **in** IMPARMS is set **to** zero (0). |

## PUTIMOUT CALL Statement (Cont'd)

✍ Coding Example

Write the specified global data to PCIM #1.

```
2800   IMNUM = 1
2810   IMDATA (0) = &H10
2820   Call PUTIMOUT(STATUS,IMNUM,iMDATA(0))
```

## GETCIR CALL Statement

- Syntax

CALL GETCIR (STATUS, IMNUM, DEVICENUM, CIROFFSET, STATE)

- Act ion

Read input Circuit Value

- Remarks

A Get Circuit calf allows the state of a single input circuit to be read from the specified PCIM's Input Table and be placed into the Host memory "STATE" parameter.

IMnum is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device which contains the input circuit. The "CIROFFSET" parameter indicates which bit of DEVICENUM is to be read. This value ranges from 1 through 1024 (in bits).

"STATE" is a variable in which GETCIR will store the value of the circuit as indicated by the above parameters. The contents of STATE will be either a '1' or '0' (ON or OFF).

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | I-64 | Relative number of PCIM |
| DEV I CENUM | O-31 | Specifies I/O device from which input circuit will be read |
| CIROFFSET | I-1024 | Input circuit offset in specified I/O device, in bits |
| STATE | 0/1 | ON or OFF condition of circuit read from PCIM |
| STATUS | 0/1 | Success/Fail |

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## GETCIR CALL Statement (Cont'd)

- Status Value

GETCIR will return SUCCESS if the target device is present on the given IMNUM. If the target device is not present, or is out of range, GETCIR will return FAIL. If SUCCESS is returned, then STATE will contain the value of the circuit requested. **The** following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| BADSBA | - | Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal), or **is** that of the PCIM - which has its own function. |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE | - | The device requested is currently **not on** the bus, and data **is** NOT transferred. |
| OVERFLOW | - | The OFFSET specified is greater than the devices InputLength in circuits. |
| UNDERFLOW | - | OFFSET is specified as zero (0). |

o Coding Example

Get the stat **value** of circuit 2 of device #8 on PCIM #1.

```
3000    IMNUM = 1
3010    DEVICENUM = 8
3020    CIROFFSET = 2
3030    Call GETCIR(IMNUM,DEVICENUM,CIROFFSET,STATE)
```

## PUTCIR CALL Statement

- Syntax

CALL PUTCIR (STATUS, IMNUM, DEVICENUM, CIROFFSET, STATE)

- Act ion

Write Output Circuit Value

- Remarks

A Put Circuit call allows the state of a single output circuit to be changed from ON to OFF or vice-versa. In this call, the STATE parameter is written from the Host memory to the specified PCIM's Output Table.

IMNUM is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device which contains the target output circuit. The CIROFFSET parameter indicates which bit of DEVICENUM is to be written. This value ranges from 1 through 1024 (in bits).

STATE is a variable containing the value of the circuit as indicated by the above parameters. The contents of STATE will be either a '1' or '0' (ON or OFF).

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| DEVICENUM | 0-31 | Specifies I/O device to which output circuit will be written. |
| CIROFFSET | 1-1024 | Output circuit offset in specified I/O device, in bits |
| STATE | 0/1 | Variable "STATE" is written from the Host memory to the specified PCIM |
| STATUS | 0/1 | Success/Fail |

## PUTCIR CALL Statement (Cont'd)

- Status Value

PUTCIR will return SUCCESS if the target device is present on the given IMNUM. If the target device is not present, or is out of range, PUTCIR will return FAIL. If SUCCESS is returned, then the character pointed to by STATE will contain the value of the circuit changed. The following FAIL indications will be returned:

| | |
|---|---|
| BAD IMNUM - | IMCOUNT is out of range (a count of 64 or greater). |
| BADSBA - | Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function. |
| NOINIT - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL - | The indicated PCIM has failed (PCIM OK = 1). |
| OFFLINE - | The device requested is currently not on the bus, and data is NOT transferred. |
| OVERFLOW - | The OFFSET specified is greater than the devices OutputLength in circuits. |
| UNDERFLOW - | OFFSET is specified as zero (0). |

- Coding Example

Set the state value of circuit 2 of device #8 on PCIM #1 to '1 l.

```
3200   IMNUM = 1
3210   DEVI CENUM = 8
3220   STATE = 1
3230   CIROFFSET = 2
3240   Call PUTCIR(STATUS,IMNUM,DEVICENUM,CIROFFSET,STATE)
```

## GETWORD CALL Statement

- Syntax

CALL GETWORD (STATUS, IMNUM, DEVICENUM, CIROFFSET, WORDDATA)

- Act ion

Read Input Word Value

- Remarks

A Get Word call allows you to read the value of a single input word from the specified PCIM's Input Table into the Host memory "WORDDATA" parameter. The "WORDDATATA parameter is an integer.

IMNUM is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device where the input word is located. The CIROFFSET parameter indicates which word of the specified device is to be read. This value ranges from 1 through 64 (in word quantities).

When GETWORD is called, it begins by "locking-out" the PCIM from updating the Shared RAM (ensures data coherency across bus scans>. GETWORD then transfers the word data into Host memory. Once the transfer is complete, the PCIM is 'unlocked".

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| DEVICENUM | o-31 | Specifies I/O device from which input word wi I I be read |
| CIROFFSET | 1-64 | Input word offset in specified I/O device, in words |
| WORDDATA | **1** entry | Word requested |
| STATUS | 0/1 | Success/Fail |

GETWORD CALL Statement (Cont'd)

- **Status Value**

**GETWORD will return SUCCESS if the device specified by IMNUM is present on the serial bus, and after the data is transferred to WORDDATA. If the target device is not present, or is out of range, GETWORD will return FAIL. If SUCCESS is returned, then the requested word value will be saved in the location WORDDATA. The following FAIL indications will be returned:**

| | | |
|---|---|---|
| **BADIMNUM** | - | **IMCOUNT is out of range (a count of 64 or greater).** |
| **BADSBA** | - | **Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function.** |
| **NOINIT** | - | **Indicated PCIM has not been initialized (INITIM).** |
| **IMFAIL** | - | **The indicated PCIM has failed (PCIM OK = 1).** |
| **OFFLINE** | - | **The device requested is currently not on the bus, and data is NOT transferred.** |
| **OVERFLOW** | - | **The OFFSET speci f ied is greater than the devices InputLength in circuits.** |
| **UNDERFLOW** | - | **OFFSET is specified as zero (0).** |

✍ **Coding Example**

**Get the first word of device #8 on PCIM #1.**

```
3300   IMNUM = 1
3310   DEVICENUM = 8
3320   CIROFFSET = 1
3330   Call GETWORD(STATUS,IMNUM,DEVICENUM,CIROFFSET,WORDDATA)
```

## PUTWORD CALL Statement

- Syntax

CALL PUTWORD (STATUS, IMNUM, DEVICENUM, CIROFFSET, WORDDATA)

- Act ion

Write Output Word Value

- Remarks

A Put Word call allows you to write a single output word from the Host memory WORDDATA parameter to the specified PCIM's Output Table. The WORDDATA parameter is an integer which PUTWORD uses to store the word to be transmitted.

IMNUM is the PCIM number configured during initialization. The DEVICENUM parameter specifies the serial bus address of the device where the output word is to be sent. The CIROFFSET parameter indicates which word of the specified device is to be written. This value ranges from 1 through 64 (in word quantities).

When PUTWORD is called, it begins by "locking-out" the PCIM from updating the Shared RAM (ensures data coherency across bus scans). PUTWORD then transfers the word data to the PCIM. Once the transfer is complete, the PCIM is "unlocked".

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| DEVICENUM | 0-31 | Specifies device to which output word will be written |
| CIROFFSET | 1-64 | Output word offset in specified device, in words |
| WORDDATA | 1 entry | Word requested |
| STATUS | 0/1 | Success/Fail |

## PUTWORD CALL Statement (Cont'd)

- **Status Value**

PUTWORD **will return SUCCESS if the** device **specified by IMNUM is present on** the serial bus. If the **target device is not present,** or is out of **range,** PUTWORD will return **FAIL. The following FAIL indications will be returned:**

| | | |
|---|---|---|
| **BADIMNUM** | - | **IMCOUNT is out of range (a count of 64 or greater).** |
| BADSBA | - | **Specified DEVICENUM is not in the range for GENIUS bus devices (0 -31 decimal), or is that of the PCIM - which has its own function.** |
| **NOINIT** | - | **Indicated PCIM has not been initialized (INITIM).** |
| **IMFAIL** | - | **The indicated PCIM has failed (PCIM OK = 1).** |
| **OFFLINE** | - | **The device requested is currently not on the bus,** and data **is NOT transferred.** |
| **OVERFLOW** | - | **The OFFSET specified is greater than the devices OutputLength in circuits.** |
| **UNDERFLOW** | - | **OFFSET is specified as zero (0).** |

- **Coding Example**

Set the second word of device #8 on **PCIM** #1 to 10 hex (circuit #21 if discrete block).

```
3400    IMNUM = 1
3410    DEVICENUM = 8
3420    CIROFFSET  =  2
3430    WORDDATA    =  &H10
3440    Call PUTWORD(STATUS,IMNUM,DEVICENUM,CIROFFSET,WORDDATA)
```

## SENDMSG CALL Statement

✍ Syntax

CALL SENDMSG (STATUS, IMNUM, MSG(0))

- Act ion

Send a Message

✍ Remarks

The Send Message call allows you to write a memory or non-memory message from the Host to the selected PCIM for transmission onto the serial bus (using the Transmit Datagram command). SENDMSG will return control to the calling program without delay, before the message has been processed or transmitted by the PCIM.

IMNUM defines the PCIM, as configured during initialization, from which to transmit the message. The MSG parameter is the buffer where the transmit message is stored.

The format of SENDMSG is:

| | | |
|---|---|---|
| MSGCO) | Destination (0-31/255 brdcst) | - Destination address of Device |
| MSG(1) | Function code (O-111) | - Function Code |
| MSG(2) | SubFunction code (O-255) | - Sub Function Code |
| MSG(3) | Priority | -O- Normal, 1 - High |
| MSGW(4) | Length | - Data field length/length of msg |
| MSG(5) | Data (variable) | - Message Data - length per MSG(4) |

You can check the status of the message using CHKMSGSTAT to determine if the message completed processing properly.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IIMNUM | 1-64 | Relative number of PCIM |
| MSG | see above | Buffer where message to be sent is stored - see above |
| STATUS | 0/1 | Success/Fail |

## SENDMSG CALL Statement (Cont'd)

✍ Status value

SENDMSG will return SUCCESS if a message has been transferred from the Host memory to the PCIM. Otherwise, one of the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| IMBUSY | - | The PCIM is otherwise engaged and cannot accept the command. |

**NOTE**

You are responsible for defining the device, the Function code, the Sub-Function code and the length of the transmit Datagram.

It is also your responsibility to interpret the Function code, the Sub-Function code and the meaning of the Reply message. See GFK-0090 for message codes.

**NOTE**

You cannot **issue a** SENDMSG call or read a received unsolicited message while a SENDMSGREPLY call is in progress. If this presents a timing problem, **use** the SENDMSG call.

See Also

SENDMSGREPLY, GETMSG and CHKMSGSTAT

- Coding Example

Send **a** Read Diagnostics message to device #8 on PCIM #1. This message will read 10 bytes of diagnostic data beginning at offset 0.

```
3800 IMNUM = 1
3810 MSG(0) = 8 'Destination
3820 MSG(1) = &H20 'Function Code
3830 MSG(2) = 0 'Sub Function Code
3840 MSG(3) = 0 'Priority
3850 MSG(4) = 2 'Message Length Sent
3860 MSG(5) = 0 'Offset
3870 MSG(6) = 16 'Length to be Read
3880 Call SENDMSG(STATUS,IMNUM,MSG(0))
```

To see how the message function calls work together, see Appendix A, Example 2.

## SENDMSGREPLY CALL Statement

- Syntax

CALL SENDMSGREPLY (STATUS, IMNUM, MSG(0))

- Action

Send a Message requesting a Reply

- Remarks

The Send Message Reply call allows you to write a memory or non-memory message from the Host to the selected PCIM for transmission onto **the** bus (using the Transmit Datagram With Reply command). SENDMSGREPLY will return control to the calling program without waiting for the reply. You must call CHKMSGSTAT or GETMSG to check for completion or to read the reply message.

IMNUM defines the PCIM, **as** configured during initialization, from which to transmit the message. The MSG parameter is a pointer to the buffer where the transmit message is stored.

The format of SENDMSGREPLY is:

| | | |
|---|---|---|
| MSG(0) | Destination (0-31/255 brdcst) | - Destination address of Device |
| MSG(1) | Function code (0-111) | - Function Code |
| MSG(2) | T SubFunction code (0-255) | - Transmted Reply SubFunction Code |
| MSG(3) | R SubFunction code (0-255) | - Expected Reply SubFunction Code |
| MSG(4) | Priority | - 0 - Normal, 1 - High |
| MSG(5) | Length (0-134) | - Data field length/length of msg |
| MSG(6) | Data (variable) | - Message Data - length per MSG(5) |

You can check the status of the message using CHKMSGSTAT to determine if the message completed processing properly.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| MSG | see above | Pointer to the buffer where the received message will be stored - see above |
| STATUS | 0/1 | Success/Fail |

**SENDMSGREPLY CALL Statement (Cont'd)**

The advantage of the SENDMSGREPLY call over the SENDMSG call is twofold:

1) Allows a Read ID message to be sent (cannot be sent using the SENDMSG call).

2) Reduces user programming since a 10 second timeout to a non-responding device is automatically provided by the PCIM for a SENDMSGREPLY calf.

The Host program sequence for a SENDMSGREPLY **is as** follows:

1) Host sends a SENDMSGREPLY to the PCIM.

2) Host issues GETMSG calls until the Status indicates completion. GETMSG will also return the reply message into Host memory.

- Status Value

SENDMSGREPLY will return SUCCESS if a message has been transferred from the Host memory to the PCIM. Otherwise, one of the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| IMBUSY | - | The **PCIM** is otherwise engaged and cannot accept the command. |

**NOTE**

You are responsible for defining the device, the Function code, the Sub-Function code and the length of the transmit Datagram.

It is also your responsibility to interpret the Function code, the Sub-Function code and the meaning of the Reply message. See GFK-0090 for message codes.

**NOTE**

You cannot issue a SENDMSG call or read a received unsolicited message while a SENDMSGREPLY call is in **progress. If** this presents a timing problem, **use** the SENDMSG call.

## SENDMSGREPLY CALL Statement (Cont'd)

See Also

SENDMSG, GETMSG and CHKMSGSTAT

- Coding Example

This example sends **a** Read Diagnostics message to device #8 on PCIM #1 and expects a reply message of Read Diagnostics Reply. This message requests 10 bytes of diagnostic data beginning at offset 10.

```
4000  IMNUM  = 1
4010  MSG(0) = 8 'Destination
4020  MSG(1) = &H20 'Function Code
4030  MSG(2) = 8 'Transmit SubFunction Code
4040  MSG(3) = 9 'Excepted Repty SubFunction Code
4050  MSG(4) = 0 'Priority
4060  MSGW(5) = 2 'Message Length Transmitted
4070  MSG(6) = 16 'Offset
4080  MSG(7) = 16 'Message Length to be Read
4090  Call SENDMSGREPLY(STATUS,IMNUM,MSG(0))
```

To see how the message function calls work together, see Appendix A, Example 2.

## CHKMSGSTAT CALL Statement

- Syntax

CALL **CHKMSGSTAT (STATUS, IMNUM,** MSGSTATUS(0))

- Act ion

**Read** Message Progress Status

- Remarks

The Check Message Status call allows you to determine the status of a previous SENDMSG call - that is, to determine when a transmitted **message has actually been** received, and its completion status.

IMNUM is the PCIM number configured during initialization. The "MSGSTATUS" **parameter is** the returned message status.

The "MSGSTATUS" parameter will contain the following values:

| | |
|---|---|
| I MFREE | There is currently no activity. |
| I MBUSY | Message is still in progress. |
| SUCCESS | Message has successfully completed. |
| BADPARM | Message contained a **syntax** error. |
| TXERR | Message cannot be transmitted. |

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | l-64 | Relative number of PCIM |
| MSGSTATUS | 0/1 | Returned message status |
| STATUS | 0/1 | Success/Fail |

- Status Value

CHKMSGSTAT will normally return the Status requested **and a** SUCCESS **indication.** Otherwise, one of **the following FAIL indications will be returned:**

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| PCIMERR | - | There may be a problem with the PCIM firmware. |

## CHKMSGSTAT CALL Statement (Cont'd)

See Also

SENDMSGREPLY, SENDMSG and GETMSG

- Coding Example

Check the message status area of PCIM #1.

```
4200    IMNUM = 1
4210    Call CHKMSGSTATUS(STATUS,IMNUM,MSGSTATUS)
```

**To** see how the message function calls work together, see Appendix A, Example 2.

## GETMSG CALL Statement

- Syntax

CALL GETMSG (STATUS, IMNUM, MSG(O))

- Act ion

Read Received Message

- Remarks

The Get Message call allows you to read a received memory or non-memory message (or **a** reply to a previous SENDMSGREPLY call) from the selected PCIM into the Host memory "MSG" parameter.

IMNUM is the PCIM number configured during initialization. The "MSG" parameter is the buffer where the received message will be stored.

The format of GETMSG is:

| | | |
|---|---|---|
| MSG (0) | Source (0-31/255 brdcst) | - Source address of Device |
| MSG (1) | Function code (0-111) | - Function Code |
| MSG (2) | SubFunction code (0-255) | - Sub Function Code |
| MSG (3) | DB_Indicator | - Directed (1)/Broadcast (0) |
| MSG (4) | Length (0-134) | - Data field length/length of message |
| MSG (5) | Data (variable) | - Message Data - length per MSG(4) |

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | f-64 | Relative number of PCIM |
| STATUS | 0/1 | Success/Fail |
| **MSG** | see above | Buffer where the received message will be stored - see above |

GETMSG performs the following sequence:

1) If there is a previous call to SENDMSGREPLY, GETMSG checks to see if the transmission has successfully completed, and transfers the response back to you. If the response completed with an error, or if in progress, GETMSG will return a FAIL indication.

2) If there is no previous call to SENDMSGREPLY, GETMSG checks to see if there is a memory message, and transfers that message back to you.

## GETMSG CALL Statement (Cont'd)

**3)** If no memory messages exist, then GETMSG checks to see if there is **a** non-memory message, and transfers that message back to you.

4) If no messages are present, GETMSG returns with a FAIL status.

**NOTE**

Unsolicited memory or non-memory Datagrams received by the PCIM may not be read by the Host while a SENDMSGREPLY is in progress. This significantly affects Host response time to service received Datagrams. If this is a problem, use the SENDMSG call instead of SENDMSGREPLY.

a Status Value

GETMSG will return SUCCESS if a memory or non-memory message is returned to you. Otherwise, one of the following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |
| IMBUSY | - | The PCIM is otherwise engaged and cannot accept the command. |
| **NOMSG** | **-** | No message is available to be received at this time. |
| TXERR | - | A message transmission has failed. |
| PCIMERR | - | There may be a problem with the PCIM firmware. |

See Also

SENDMSGREPLY, SENDMSG and CHKMSGSTAT

## GETINTR CALL Statement

✍ Syntax

CALL GETINTR (STATUS, IMNUM, INTR(0))

a Act ion

Read Interrupt Status Table

- Remarks

The Get Interrupt call allows you to read the selected PCIM's Interrupt Status Table. You can read this table to:

see why an interrupt in the Host system has occurred

report the event in a non-interrupt environment, as is the default state of the Software Driver concept (the PCIM will still report the event even though the interrupt is disabled).

Thus, the Interrupt Status Table can be polled (by reading and interpreting it) to determine what is interrupting the PCIM. Interrupt conditions are discussed in chapter 2 of this manual.

When GETINTR is called, it transfers the data from the PCIM's Interrupt Status Table to the Host memory "INTR" parameter. The format of the Interrupt Status Table is shown below.

IMNUM defines the PCIM, as configured during initiafization, from which the Interrupt Status Table is to be read. The INTR parameter is the buffer where the Interrupt Status Table information is stored. The values in the table below are: 0 = No interrupt occurred, 1 = Interrupt occurred.

**The** format of the INTR table is:

| Position | Explanation |
|---|---|
| **INTR(0)** | - Summary if interrupt occurred. |
| INTR(1) | - Received memory datagram. |
| INTR(2) | - PCIM Status Change - usually fatal. |
| INTR(3) | - Device Status Change. |
| INTR(4) | - Outputs sent - end of bus access. |
| INTR(5) | - Command Block completed. |
| INTR(6) | - Received Datagram. |

## GETINTR CALL Statement (Cont'd)

After data transfer to the Host is complete, GETINTR clears all of the PCIM's Interrupt Status Table bytes each time it is called. This way, you can see the latest event that has occurred each call.

Parameters are summarized as follows:

| Parameter | Values | Function |
|---|---|---|
| IMNUM | 1-64 | Relative number of PCIM |
| INTR | see above | Buffer where the table data will be stored |

- Status Value

GETINTR will return SUCCESS if the device specified **by** IMNUM is present on the serial bus. If the target device is not present, or is out of range, GETINTR will return FAIL. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

- Coding Example

This example shows **how,** if an interrupt occurs on PCIM #1, **to** transfer the contents of that PCIM's status table. Interpretation of bits will depend on which interrupt is enabled, and which application is to be run.

```
4300   IMNUM =1
4310 Call GETINTR(STATUS,IMNUM,INTR(0))
4320   'Do what is necessary for interrupt processing
```

## PUTINTR CALL Statement

- Syntax

CALL PUTINTR (STATUS, IMNUM, DISABLEINTR(0))

- Action

Write to the Interrupt Disable Table

- Remarks

The Put Interrupt call allows you to write to the selected PCIM's Interrupt Disable Table. The PUTINTR call first initializes a table to Enable and Disable individual interrupts as you require. The PUTINTR call then writes this table to the Interrupt Disable Table on the PCIM. You can Enable or Disable interrupts in any mix; that is, on a single call, some interrupts may be Enabled and some Disabled, all may be Enabled, or all of the interrupts may be Disabled. Interrupt conditions are discussed in chapter 2 of this manual.

When PUTINTR is called, it transfers the data from the Host memory "DISABLEINTR" parameter to the PCIM's Interrupt Disable Table. The format of the Interrupt Disable Table is shown below.

IMNUM defines the PCIM, as configured during initialization, to which DISABLEINTR will be read. The DISABLEINTR parameter is the buffer where the Interrupt Disable Table information is stored. The values in the table below are: 0 = Enable, 1 = Disable.

The format of the DISABLEINTR table is:

| Position | Explanation |
|---|---|
| DISABLINTR(0) | - Summary if interrupt occurred. |
| DISABLINTR(1) | - Received memory datagram, |
| DISABLINTR(2) | - PCIM Status Change - usually fatal. |
| DISABLINTR(3) | - Device Status Change. |
| DISABLINTR(4) | - Outputs sent - end of bus access. |
| DISABLINTR(5) | - Command Block completed. |
| DISABLINTR(6) | - Received Datagram. |

## PUTINTR CALL Statement (Cont'd)

Parameters are summarized as follows:

| Parameter | Values | Funct ion |
|---|---|---|
| IMNUM | l-64 | Relative number of PCIM |
| DISABLEINTR | see above | Buffer from which enable/disable data is sent |

✍ Status Value

PUTINTR will return SUCCESS if the device specified by IMNUM is present on the serial bus. If the target device is not present, or is out of range, PUTINTR will return FAIL. The following FAIL indications will be returned:

| | | |
|---|---|---|
| BADIMNUM | - | IMCOUNT is out of range (a count of 64 or greater). |
| NOINIT | - | Indicated PCIM has not been initialized (INITIM). |
| IMFAIL | - | The indicated PCIM has failed (PCIM OK = 1). |

- Coding Example

This example enables the Receive Datagram Interrupt.

```
7000   IMNUM = 1
7010   For I = 0 to 6
7020   DISABLEINTR(I)  = 0
7030   NEXT I
7040   DISABLEINTR(6) = 1
7050   Call PUTINTR(STATUS,IMNUM,DISABLEINTR(0))
```

# CHAPTER 5
# COMMUNICATIONS

## INTRODUCTION

PCIM applications may be considered on two levels; 'basic' operation, consisting of that which is necessary to set up the PCIM and use it as a simple I/O controller; and 'advanced' operation. Advanced operation details the use of expanded diagnostics, message handling, and other more sophisticated features - a class of applications dependent on the GENIUS I/O Network for low cost, peer-to-peer moderate performance communications between Hosts and I/O devices.

Chapter 4 outlined the 'basic' operational level - providing you with enough information to code the PCIM Software Driver function calls and run a system consisting of I/O Blocks. Chapter 5 explains the 'advanced' communications features of the PCIM.

Chapter 5 is organized into three sections - Types of Data, Response Time, and Bus Scan Time. The Types of Data section deals with the kinds of information handled by the PCIM. The Response Time and Scan Time sections help you to determine how best to optimize your application.

## TYPES OF DATA

Data communications provided include both the Global and Datagram classes of messages, explained below.

### Global Data

Global Data is data used for communicating data between CPUs simply, automatically, and repetitively. Once set up by the user at power up, assigned data is automatically and periodically routed among CPUs without further user programming.

Such data is termed "Global Data" since it is broadcast to all other CPUs on the bus and thus allows the formation of a global data base. Each Series Six PLC CPU stores the received data in the same place in its memory. Up to 128 bytes may be broadcast by each PCIM or Bus Controller (must be IC660CBB902 or IC66OCBB903). The PCIM or Bus Controller will broadcast these bytes once per bus scan.

A particular block of data is assigned to be broadcast by downloading a Global Data Reference and Global Data Length. The Global Data Reference is the beginning address of the Global Data of the broadcasting CPU. This reference is called IMRef in the PCIM. The Global Data length is the number of bytes of Global Data to *be* broadcast by the PCIM.

Global Data Length is called OutputLength. You will use the Software Driver function call InitIM to set IMRef and OutputLength parameters. Always set the MSB (Most Significant Bit) of the IMRef to 'I '.

When sending Global Data to a.- Series Six PLC, the lower 15 bits of IMRef specify a Register number in **the** Series Six CPU. For example:

> IMRef = 8005 hex will send Global Data to all Series Six CPU's on **the bus** starting at Register 5. **The** Global Data Length (OutputLength) is always specified in bytes. Therefore, if 15 Registers of Global Data are to **be** sent, OutputLength should be set to 1E hex, 30 decimal.

Global Data is automatically broadcast by the PCIM every serial bus scan. The user application program updates the PCIM **with** the latest Global Data by using the Software Driver Put IMOut.

When sending Global Data from a Series Six to a PCIM, the Global Data appears in the Input **Table** slot **of the** PCIM corresponding to **the** Serial Bus Address of the Bus Controller. You will **use** the Software Driver function call GetBusln or GetDevln to read **this** data.

Global Data increases the GENIUS I/O bus scan time approximately 72 microseconds for each Global Data byte broadcast **on the** bus. The impact on Series Six PLC CPU sweep **time** is such that logic execution time will be increased approximately 10 microseconds **for** each Global Data byte broadcast on the serial bus. For example:

> 8 CPUs with 32 registers (64 bytes) each means a 36.8 msec addition to each bus scan and a 5.1 msec addition to each Series Six CPU Sweep.

## Global Data Paths

**Trace the** Data Path lines on figure 5-l while reading the sentences below to see how Global data is transferred from one CPU **to** another.

1) Device #30 sends Global Data to all bus devices from **its** Global Output **Table to Input** Table Segment #30 of each bus device.
2) Global Data received from other **bus** devices Serial Bus Address O-29 and 31 is placed **in** corresponding Input Table segments O-29 and 31 of this device.
3) **Device #31** sends Global **Data** to all **bus** devices from its Global Output Table to Input Table Segment #31 of each **bus device.**

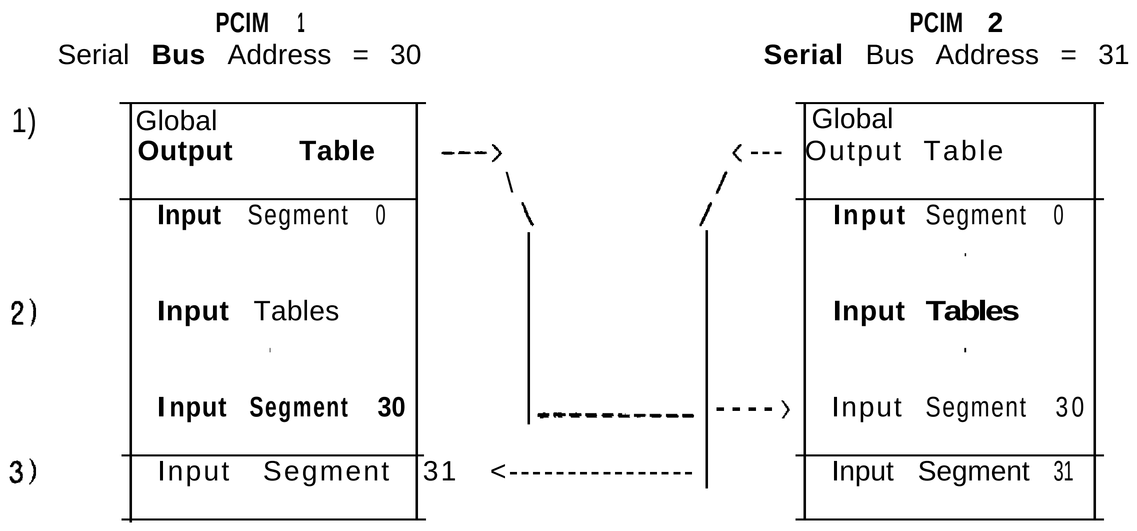

Figure 5.1 GLOBAL DATA PATHS

## Datagram Data

A Datagram **is a message** comprised of application-specific information with up to 128 bytes of user supplied data. Datagrams may be directed from one bus device to another, or broadcast to all devices.

A directed Datagram is secure in that the data link control layer of **the** protocol ensures it will be received at the destination device once and only once, or aborted and alarmed after retry.

Datagram Service should be considered instead of Global Data if any of the following are true:

1) Global Data takes up too much serial bus scan time for the application

2) More than 128 bytes of data are to be sent from one CPU to another

3) The data **does** not need to be sent every serial bus scan

**4)** The Series Six CPU sweep time becomes too large for the application

A Datagram may be transmitted with High Priority (the same priority as I/O Block inputs and outputs), or **at** Normal Priority. Normal Priority ensures that the bus scan time will only **be** modestly affected. Bus scan time affects the response time of any I/O data on **the bus.**

**CAUTION**

**Using the same serial bus for CPU to** CPU **communications and I/O block control may result in** variable I/O service **times unless Normal Priority datagrams are used.**

Your application must service the Datagram queue at least once every 10 milliseconds to ensure that the Datagram queue will not fill up, causing datagrams to be dropped without Host notif ication.

Use the Software Driver function calls GetMsg, SendMsg, SendMsgReply, and ChkMsgStat to transmit Datagrams. For the the bit/byte format **of** the following specific GENIUS I/O Datagrams, see the GENIUS **I/O** Bus Datagram Reference Manual, GFK-0090.

**The following Datagrams are transmi tted to and from I/O blocks:**

**Report Fault - faults are reported as they occur to the defined Controller of a specific I/O block or device. The controller of a device is the device which sends outputs to the device. The GetMsg call is used to access this message from the PCIM.**

**Clear Circuit Fault - the Host may clear a singlecircuit or controller fault using this message. The Host requires a SendMsg call to transmit this message to an I/O Block.**

**Clear All Circuit Faults - the Host may clear all circuit faults using this message The Host again requires a SendMsg call to transmit this message.**

**Write Configuration - downloads either partial or full configuration from the Host to an I/O Block or other bus device. The Host requires a SendMsg call to transmit this message to an I/O Block.**

**Read Diagnostics, Read Diagnostics Reply - allows the Host to read the** current **diagnostic state of all circuits or controllers. Use a SendMsgReply call, then a GetMsg call to perform this function using the PCIM.**

**Read Configuration, Read Configuration Reply - allows the Host to read the current configuration of an I/O Block or I/O device. Use a SendMsgReply call, then a GetMsg call to perform this function with the PCIM.**

**Switch BSM - allows the Host to switch a Bus Selector Module (BSM) to a specified bus** and **therefore test redundant bus operation while a system is running. The Host requires a SendMsg call to send this message to an I/O Block.**

**Assign Monitor - allows the Host to receive a Report Fault message from an I/O Block even though it is not defined as the controller of (is not sending data to) that device. Use a SendMsg call to send this message to the block.**

**Pulse Test, Pulse Test Complete - allows the Host to toggle all outputs on a specific discrete I/O block briefly to the opposite state. Any faults are reported from the block to the Host through a Report Fault message, and the block will reply with a Pulse Test Complete message when the test is finished. The Host uses a SendMsgReply call to transmit this message to the block, and a GetMsg call to retrieve the reply.**

**Configuration Change - I/O blocks and other I/O devices will report any configuration changes of I/O circuit conf guration, Status Table (Reference) Address, HHM forces, filter values, etc. The Host requires a GetMsg call to access this message from the PCIM.**

Communications applications of the PCIM will **for** the most part **be** established between devices such **as** Series SixPLC CPUs and **PCIM** Hosts (IBM PC AT/XTs). These applications will **use four** memory access Datagrams.

The following Datagrams are transmitted to and from CPUs:

> Read Device - the CPU may read the memory of another CPU on the bus through this message. The CPU may use **the** SendMsgReply call, then **the** GetMsg call, in order to send the Read Device message and access the eventual reply, respectively.
>
> **Read** Device Reply - When **a** Read Device message is received, the PCIM (and Host) will service it by returning a Read Device Reply to the requesting CPU through the SendMsg cal I.
>
> **Write** Device - the CPU may write the memory of another CPU using this message. Write Device allows byte writes. Use the SendMsg call to transmit this message.
>
> Bit **Write -** the **CPU** may **write** the memory of another CPU using this message. Bit Write is for setting or resetting **a** single circuit. Use the SendMsg call to transmit this message.

These Datagrams allow **the** registers or I/O Tables of a PLC CPU to be read or written from other bus devices, such as other Series Six PLC CPUs or CIMSTAR Is.

If a Host wishes its internal database to **be** accessible, user application programming must supply GetMsg calls to service Read Device and Write Device messages received by the PCIM. The PCIM Host need not allow Write Device access to its memory. This can be accomplished by rejecting all or specific Write Device messages.

Software **Driver function** calls are also used to transmit Datagram data.

The SendMsg call is used to send Read Device and Write Device datagams. When sending these Datagrams to **a** Series Six PLC, **an** address and a length must be specified. The address is the absolute memory address of the Series Six PLC CPU to which you want to read or write. **The** address is a four byte field which must be formatted as discussed below.

## Specifying the Address for Read Device and Write Device Datagrams

The first four bytes of a Read Device or Write Device Datagram indicate the Host address to be written or read by the datagram. For Read Device and Write Device datagrams to a Series Six PLC, the assignments of the bits in these four bytes depend on whether the target address for the Datagram is Series Six CPU Register memory, or the I/O Status Tables.

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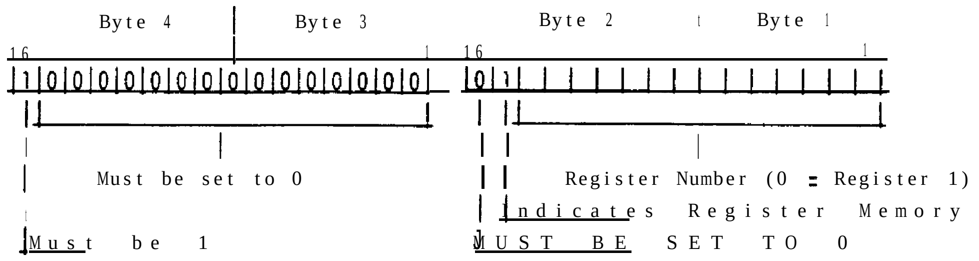
## When the Datagram Target Address is Register Memory

**If** the Read Device or Write Device Datagram target address is the Series Six PLC CPU's Register Memory, the bits in the first four **bytes** of the Datagram have the following assignments:

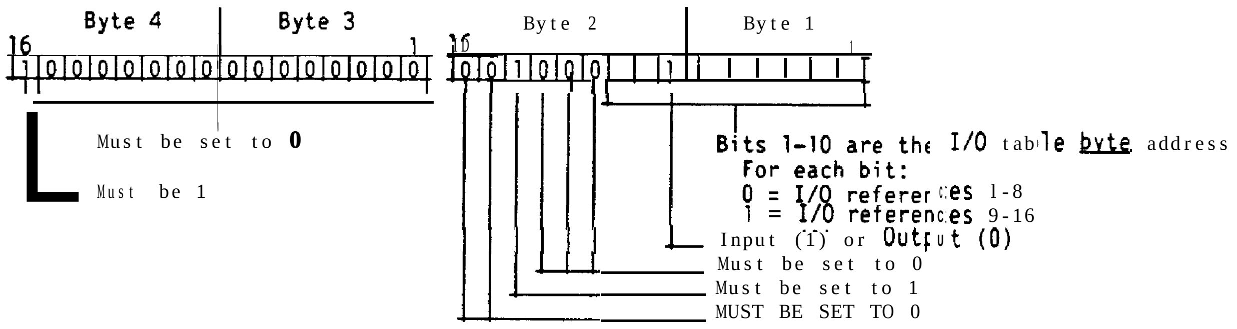


**WARNING**

**The Most Significant Bit of the second Address byte MUST BE SET TO 0. If this bit is not set to 0 the Datagram will be written to User Program Memory, and may cause unpredictable, hazardous control conditions.**

## When the Datagram Target Address is the Series Six PLC CPU I/O Status Tables

If the Read Device or Write Device the Datagram target address **is the** I/O Series Six **PLC** CPU Status Tables, the bits **in** the first four bytes of the Datagram have the following assignments:



**WARNING**

**Either bit 14 or bit 15 of the second Address byte MUST BE SET TO 1. If one of these bits is not set to 1, the Datagram will be written to User Program Memory or Scratchpad Memory, and may cause unpredictable, hazardous control conditions.**

The length **is** a **one** byte field which ranges **from 1 to 128 and specifies** the number of **bytes to be read** or written. When the Series Six PLC Bus Controller receives a Read Device or Write Device Datagram, it automatically services it during the next available window command.

When sending Read or Write Device Datagrams to PCIMs, the address must be interpreted by user application software. User application software must also service Read and Write Device Datagrams at the receiving PCIM via the GetMsg call. If a Read Device message is recieved by **a** PCIM, the user application program must send a Read Device reply to the requesting PCIM or Series Six PLC Bus Controller.

## RESPONSE TIME

Since all PCIM services are polled by the Software Driver, response time to a specific PCIM event will for the most part be determined by you and the Host environment. I/O or Global data response time can be calculated with the formula supplied in the GENIUS I/O Users Manual (GEK-90486). Datagram response time, however, varies with bus scan time, message priority, message length, Bus Controller or PCIM queue loading, and remote CPU sweep time or PC processing delays.

You may wish to optimize response time to certain events though the use of the PCIM interrupt calls GetINTR and PutINTR. See chapter 4 for an example of interrupt coding.

## BUS SCAN TIME

Bus scan time, or "token rotation time" is the period of time required for the token to move completely around the bus, permitting all devices one communications access each.

The maximum bus scan time which can be supported is 400 milliseconds on a bus with no BSM's attached and 100 milliseconds on a bus with BSM's attached.

Bus scan time is affected by:

- the number and types of I/O Blocks
- the number of Bus Controllers, PCIMs, and HHMs
- amount of Global Data traffic
- amount of Datagram traffic
- baud rate
- single or dual CPU operation

Inputs, outputs and Global data are sent every bus scan.

Datagrams are sent as required by system events, such as faults, logins, HHM communications, etc.

As stated, there are two priorities of Datagram transmission - Normal and High. Only one device is allowed to send a Normal Priority Datagram per bus scan. Every device can send a High Priority Datagram each bus scan. So in any one bus scan, there may be up to 31 High Priority Datagrams plus one Normal Priority Datagram, or 32 High Priority Datagrams.

Block fault reports are transmitted as Normal Priority only logins, which automatically occur as a device is initialized, are High Priority Datagrams. Using a Bus Controller or PCIM, you may send a Datagram with either Normal or High priority.

The worst case bus scan time for each GENIUS product is shown in the GENIUS I/O User's Manual (GEK-90486). The numbers shown for each device factor in its number of inputs, outputs, and some of its token passing overhead. Since these numbers are simplified, the actual bus scan time may be slightly less than that shown.

The worst case bus time for the PCIM is shown in figure 5-2. A calculation of the total bus scan time is started by summing the bus scan time contribution for each bus device. Then, add in an "Overhead" period which takes into account some of the token passing overhead plus communications for the HHM and block faults. If there are no Datagrams, the total bus scan time is the number previously calculated or 3 milliseconds, whichever is largest.

The following procedure is used to include the impact to bus scan time for Global Data and Datagrams:

1) Calculate the total number of Global Data bits (number of Global Data bytes X 11) transmitted by all PCIMs and Bus Controllers, divide by the baud rate, and add to the bus scan time.

2) If any PCIMs or Bus Controllers can send user-defined Normal Priority Datagrams, select the worst case number of data field bits which can be sent by any ONE of these devices (number of data field bytes X 11), then subtract 198. Divide by the baud rate, then add in the resulting time (if negative, add in zero> to the bus scan time.

3) For EACH Bus Controller or PCIM which will send user-defined High Priority Datagrams, sum the maximum number of data field bits (number of data field bytes X 11), then add 55. Divide by the baud rate and add the result into the accumulated bus scan time.

4) To arrive at the final bus scan time, select either the accumulated total from step 3, or 3 milliseconds, whichever is largest.

| | Bus Time (in ms) | | | |
|---|---|---|---|---|
| Product KBaud ---- | 153.6 Standard | 153.6 Extended | 76.8 | 38.4 |
| PCIM | 1.00 | 1.06 | 2.12 | 4.25 |

Figure 5.2 PCIM BUS TIME

# CHAPTER 6 TROUBLESHOOTING

## INTRODUCTION

This chapter provides the data required for basic troubleshooting and repair should a malfunction of your PCIM occur. Complete troubleshooting information for the Genius I/O System, Series Six CPU, Series Six Plus CPU, I/O Rack, and Workmaster computer can be found in GEK-90486, GEK-23561A, GEK-96602, and GEK-25373, respectively.

The technology used in the design of the PCIM is such that under normal operating conditions few hardware failures are expected. If any failures should occur, they can quickly be isolated and the defective assembly replaced with minimum downtime.

As with program debugging, hardware/firmware troubleshooting is accomplished by thinking logically of the function of each part of the system and how these functions interrelate. A basic understanding of the various indicator lights will help you quickly isolate the problem to the PCIM, a Bus Controller, an I/O rack, an I/O Block, or the CPU.

The total system has to be considered when problems occur. The CPU, Host computer, I/O Blocks and external devices connected to or controlled by the GENIUS I/O system must all be operating and connected properly. All cable connections as well as all screw-down or soldered connections should be checked carefully.

## TROUBLESHOOTING RESOURCES

The maintenance and troubleshooting section of this manual is designed to help you isolate and correct any problems that may arise in your PCIM. It is recommended that all maintenance and programming personnel read this section of the manual thoroughly, so that if a problem does arise, it can be isolated quickly; thus minimizing downtime of the system.

However, we realize that troubleshooting isn't always that simple. Sometimes you need someone to talk to who can answer your questions. When you do, first call your local authorized distributor. After business hours, please don't hesitate to call the Programmable Control Emergency Service Number, (804) 978-5747 ( DIAL COMM 8-227-5747). An automatic answering device will direct you to the home phone of one of our Programmable Control Service Personnel. Thus, you are never without backup help.

## REPLACEMENT MODULE CONCEPT

The troubleshooting and maintenance techniques described in this manual promote the concept of complete component replacement. The prime objective of this concept is to minimize system downtime.

When a problem arises, first isolate it to the major assembly, then to the defective module within that assembly. The defective module is then replaced from a duplicate set of modules maintained on site. Your production line or system is back up fast.

The defective module can be returned through normal channels under warranty or for service without keeping your production line or system down for an extended period of time. The replacement concept minimizes downtime to minutes as contrasted (potentially) to days. The potential savings far outweigh the comparatively small cost of duplicate modules.

If you did not purchase a duplicate set of modules with your initial system, we recommend that you contact your authorized distributor and do so. Then, with the help of this manual and the staff of your local authorized distributor, you will be able to troubleshoot and repair just about any problem that may arise.

## PCIM TROUBLESHOOT1NG

### Fault Isolation and Repair

A malfunction causing the improper operation of a PClM can generally be isolated by checking the condition of status indicator LEDs. The status indicator LEDs indicate the current operating condition of the PCIM (see table 6-1).

There are 2 status indicator LEDs on the PCIM. The normal condition of the status indicator LEDs is the ON state. If any of the status indicator LEDs are not ON, check the troubleshooting sequence in this section for the proper course of action.

Table 6.1 LEDS

| INDICATOR | STATUS | DEFINITION |
|---|---|---|
| BOARD OK | ON | Power is avai lable to the PCIM (adequate power must be available for it to function properly), and the on-board self-diagnostics test was passed. |
| | OFF | The watchdog timer has timed out, indicating a board fai lure or improper address assignment or /RST input line is low. |
| COMM OK | ON | Power is available, the controller's communications hardware is functional, and it can send data (receives the token) every serial bus scan. |
| | OFF | (or FLASHING) means an error has been detected in the communications hardware or access to the GENIUS serial bus. |

If the status indicator LEDs are in the correct state but the **bus** is not **functioning** properly, the malfunctions below **may** describe the problem. If so, follow the procedures listed under the appropriate malfunction.

- An LED doesn't come ON **when** a PCIM is plugged in **and** powered up and /RST input **is high.**

  If Board OK OFF/Comm OK ON -

  Check if dipswitches are set correctly on **the** I/O rack backplane, motherboard, daughterboard.

  If set different then the InitIM parameter, the BOARD OK LED will not come on.

  If all appears to be in order, assume hardware failure - replace PCIM.

  If Board OK ON/Comm OK OFF -

  Check for correct cable type and length (see Genius User's Manual, GEK-90486).

  See **if** correct terminating resistors (see Genius User's Manual, GEK-90486) are installed at both ends of bus.

  Make sure motherboard has JP1 jumper set for appropriate resistor (sent installed).

  Determine if serial bus wiring has been completed in a Daisy Chain fashion.

  Make sure cabling is not **in** proximity to high voltage runs.

  Look for a broken cable.

  If both LEDs off -

  Check to see if the PCIM is plugged in, seated properly, and receiving power.

  **Check** voltage receiving level of /RST. It must remain at 2.4 volts or higher (TTL logic 1).

  If both LEDs flashing together -

  Two devices on the same bus have probably been configured with the same device number (serial bus address).

  Check using the HHM.

- Repeated bus errors

  Ensure that cable shielding is properly installed and grounded (see Genius User's Manual, GEK-90486).

  Unplug bus communications cable from PCIM, refer to the Device number sheets from which you configured the system, and use the HHM to read configuration/compare device numbers and I/O reference numbers.

  If all appears to be in order, replace PCIM.

- System shuts down with parity errors.

  Duplicate or overlapping PCIM/I/O References.

  Input duplicated on same bus.

  Input references from other PClMs overlap.

- Bus Errors - can't get PCIM up and running

  Serial l/Serial 2 crossed

- Intermittent or total lack of communications.

  Mixed Baud Rates

  Power up blocks one at a time and confirm baud rate
  Any Change to baud rate in block will not take effect
  until block power is cycled.

- No Global Data.

  Destination device off-line

  Verify destination on-line.

- Unsuccessful Datagram completion.

  Destination device off-line

  Verify destination on-line.

# APPENDIX A
# EXAMPLE APPLICATIONS

```
        EXAMPLE APPLICATION 1
/*
        This programming example uses the InitIM and GetDevConfig function
        calls. Example devices include two PCIMS in a CIMSTAR I connected
        to a GENIUS I/O serial bus. The PCIMs have the following
        Configurations (The IMPARMS Structure is defined in PCIM.H):

          PCIM #2
               Serial Bus Address:          30 Dec
               IMPARMS.Segment:             DO00 Hex
               IMPARMSIOPort:               3E4 Hex
               tMPARMS.IMRef:               3434 Hex
               IMPARMS.OutputLength:        0
               IMPARMS.InputLength:         0
               IMPARMS.Act ive:             ON

          PCIM #1
               Serial Bus Address:          31 Dec
               IMPARMS.Segment:             CC00 Hex
               IMPARMSIOPort:               3E0 Hex
               IMPARMSIMRef:                1212 Hex
               IMPARMSOutputLength:         0
               tMPARMS.InputLength:         0
               IMPARMS.Act ive:             ON

        These are the only two devices on our example GENIUS bus. The
        GetBusConfig function can be used for any device on the bus by
        giving the Serial Bus Address of the device desired. If the
        device given is not online, GetDevConfig will return OFFLINE (11).

        This example can be built using MicroSof t C Compiler Ver 4.0 or greater
        with the following syntax:

               C> MSC gdctst /Zp;
               C> LINK gdctst, , , pcim;
*/

#include       <stdio.h>
#include       <pcim.h>          /* PCIM header file */

extern     int
           InitIM( ),
           ChgIMSetup( ),
           Get DevConf ig( );

IMPARMS  local[2];          /* PCIM Configuration Structure. . .allocate an element
                               per PCIM in your PC */

char f lags[2];             /* Error return for PCIM Init. . .allocate an
                               element per PCIM in your PC. */

DEVI CE conf ig;            /* Device Config Structure. . .32 may be al located */
```

```
#define PCIM1 &local[0]         /* Macro for easier remembering */
#define PCIM2 &local[l]         /* Macro for easier remembering */

*/

main( )
§
     int        ret,
                X,
                y,
                loop=1;

     printf("n\n\nCopyright  1987");
     printf("\n\nThis  is a test of the GetDevConfig  function. . .\n");

     printf("\nTurning   on two PCIMs\n\n");

/* Initialize the PCIM #1 Parameters */
     tocal[0].im.Segment   = OxCCOO;
     local[0].im.IOPort    = Ox3EO;
     local[0]   IMRef = 0x1212;
     local[0].OutputLength   = 0;
     local[0].InputLength   = 0;
     local[0].Active   = ON;

/* initialize the PCIM #2 Parameters */
     local[l].im.Segment    = OxDOOO;
     local[l].im.IOPort  = Ox3E4;
     local[l].IMRef  = 0x3434;
     local[l].OutputLength    = 0;
     locai[ll.InputLength  = 0;
     local[l].Act  ive = ON;

     if ( (ret = Init IM ( 2, local, flags ) ) != SUCCESS )
     {
          printf("\nInitIM   returned %d\ntest exit",ret);
          loop = 0;
     }

     while(loop)
     {
/*
     From PCIM #1 (which is SBA 31), GetDevConfig(uration)   for SBA 30,
     which in this case is PCIM #2. This can be used for any devices
     on the bus.
*/
          if ( (ret = GetDevConf  ig ( 1, 30, &conf ig) ) [= SUCCESS)

/*
          returned an error code...probably 7 or 11 . ..look in PCIM.H
          for Error Return MACROS
*/
               printf('\nGetDevConf   ig returned %d\ntest exit",ret);
               loop = 0;
          }/*
```

```
*/
            else
            {
                  printf("\n\nFor   Serial Bus Address  30");
                  pr intf (\nMode  l = %2d", conf ig *Mode  l)
                  printf("\nOutputs    are %s",  ((conf ig.OutputDisable)   ? "DI
                 SABLED"  :  "ENABLED"  )  );
                  printf('+\nDevice    is%spresent'+,     ((conf ig.Present)  ? " · :
                 " NOT  "') );
                  printf("\nInput  Length  = %2d", conf ig. Inputlength);
                  printf(+'\nOutput   Length = %2d", config.OutputLength);
                  printf("\nDevice     type is  ");
                  switch  (conf  ig.Conf  ig)
                  I
                   case  1:
                         printf("Input   Only");
                         break;
                   case 2:
                         printf("Output     Only++);
                         break;
                   case 3:
                         printf("Combinat     ion");
                         break;
                  }
            }
/*
      From  PCIM  #2 (which is SBA  30),  GetDevConf   ig(uration)  for SBA  31,
      which  in  this  case  is  PCIM  #1. This  can  be  used  for  any  devices
      on the bus.
*/
            if ( (ret =  GetDevConf   ig  ( 2, 31,  &conf  ig) ) != SUCCESS)
            {
/*
            returned an error  code...probably   7 or 11  look  in  PCIM.H
            for  Error  Return  MACROS.
*/
                  printf("\nGetDevConfig     returned  %d\ntest   exit",ret);
                  loop = 0;
            }
            else
            {
                  printf  ("\n\nFor   Seria!   Bus Address 31  ");
                  printf("\nModel    =  %2d", conf  ig.Model);
                  printf("\nOutputs    are  %s",  ((config.OutputDisable)    ?  "DI
                 SABLED"  :  "ENABLED"  )  );
                  printf('+\nDevice    is%spresent",    ((conf  ig.Present)  ?  '  I' :
                 " NOT  ") );
                  printf("\nInput  Length  = %2d", conf ig.InputLength);
                  printf("\nOutput  Length  = %2d",   conf  ig.OutputLength);
                  printf("\nDevice   type is   ");
                  switch  (conf  ig.Conf  ig)
                  {
```

```
*/

                        case 1:
                              printf("Input Only");
                              break;
                        case 2:
                              printf("Output Only");
                              break;/*
                        case 3:
                              printf("Combination");
                              break;
                        1
                  }
                  printf("\n\nPress return to continue ");
                  x = getchar();
                  if (x == 'q' 11 x == 'Q')
                        loop = 0;
            }

            printf(\n\nThat's    all");
/*
  These next instructions turn the two PCIMs  off
*/
            local[0]Active   = OFF;
            local[1].Active  = OFF;
/*
  These next two function calls may be checked for
  Error   Returns
*/
            ChglMSetup   (1, PCIM1 );
            ChglMSetup   (2, PCIM2 );
}
```

```
        EXAMPLE APPLICATION 2

        This example provides uses the most common call routines
        for the PCIM. Each call routine will be provided with
        a section of C code showing the proper use of the driver.

        These call routines have been setup using a discrete block
        connected to the PCIM in the following configuration:

            Serial Bus Address - 1
            Reference Address - 65
            Point Configuration - Pt 1 Input     Pt 5 output
                                  Pt 2 Output    Pt 6 Input
                                  Pt 3 output    Pt 7 Input
                                  Pt 4 Output    Pt 8 Input

        Any failures by the call routines will be displayed with the
        returned failure code.

        Time delays are inserted within the program to visually verify
        the correct operation of the driver where appropriate.
*/

#include        <stdio.h>
#include        "pcim.h"

extern int
        InitIM(),
        ChgIMSetup(),
        GetIMState(),
        GetBusConfig(),
        GetDevConfig(),
        DisableOut(),
        GetBusIn(),
        PutBusOut(),
        GetDevIn(),
        PutDevOut(),
        GetCir(),
        GetWord(),
        PutCir(),
        PutWord();

/*      Using the PCIM.H library, declare the following variables.
*/
IMPARMS  imparm;
IMSTATE  imstate;
DEVICE  device[32];
DEVICE config;

/*      The following arrays are declared for use as data storage
        in the program.
*/
unsigned  char     INdata[4096],
                   OUTdata[4096],
                   INDdata[128];
```

```
main0
1
        int     ret,
                x= 0,
                y = 0,
                pnum = 1,
                dnum = 1,
                offset = 3;

        char    val,
                valword[1],
                flags;

        unsigned char   lgth,
                        length;

/*      Define the PCIM parameters. This assignment reflects the hardware
        setup of the PCIM and its DIP switches.
*/
        imparm. im.Segment = OxD000;
        imparm. im. IOPort = Ox3E4;
        imparm.IMRef  = 0x0000;
        imparm.OutputLength  = 0 ;
        imparm. InputLength  = 0 ;
        imparm.Active  = UN;

/*      Use the InitIM driver to initialize the PCIM.
*/
        for ( x=0; x<OxFFF;  xtt );
        if ((ret = Ini tIM ( pnum, &imparm, &flags)) != SUCCESS )
        {
                printf("\nInitIM  fai lure,returned %d\n",ret);
        }
        else
        {
                printf("\nInitIM driver successful\n");
        }
        for  ( x=0; x<OxFFFF;  x++ )
                for  ( y=O; y<0xF; y++);

/*      Use the ChgIMSetup driver to change the IMREF value from
        0 to 0x1212. Note that all parameters in the imparm array
        are transferred to the PCIM.
*/
        imparm.IMRef  = 0x1212;
        if ((ret = ChgIMSetup  ( pnum, &imparm )) != SUCCESS )
        {
                printf("\nChgtMSetup      fai lure, returned %d\n",ret);
                printf("\nSegment       %x",imparm.im.Segment);
                printf(VnIOPort      %x",imparm.im.IOPort);
                printf("\nIMRef      %d",imparm.IMRef);
                printf("\nOutLength      %d",imparm.OutputLength);
                printf("\nInputLength      %d",imparm.InputLength);
                printf("\nActive      %d", imparm.Act ive);
        }
        else
        {
                printf("\nOhgIMSetup driver successful\n");
        }

/*      Use the GetIMState driver to read the Status Table and Setup
        Table of the PCIM. Display the DIP Switch value which is
        returned as part of this call.
*/
        if (( ret = GetIMState (pnum, &imstate) ) != SUCCESS ›
        }
                printf("\nGetIMState failure, returned %d\n",ret );
        }
        else
        {
                printf("\nGetIMState driver successful\n");
                printf("        DipSwitch value %x\n",imstate.DipSwitch);
        }
/*
        Use the GetBusConfig driver to display the configuration of
        the Genius Bus. Display a subset of the information returned.
*/
        for ( x=0; xt0xFFFF; xtt )
                for (y=0; y<OxF; y++);

        if (( ret = GetBusConfig ( pnum, device) ) != SUCCESS)
        {
                printf("\nGetBusConfig failure, returned %d\n", ret);
        }
        else
        {
                printf("\nGetBusConfig successful\n);
                printf("        Model # Device 1 = %d", device[1].Model);
                print f ('\n    Device Present = %d", device[1].Present);
                printf("\n      Device Configuration = %x\n", device[l].Config);
        }

/*      Use the GetDevConfig driver to display the configuration of a
        specific Mock. Display the reference address of the block.
*/
        if (( ret = GetDevConfig ( pnum, dnum, &config) › != SUCCESS )
        1
                printf("\nGetDevConf ig fai lure, returned %d\n);
        }
        else
        {
                printf("\nGetDevConfig successful\n");
                printf("     Device Present = %d",config.Present);
                pr intf ("\n Device reference address = %d\n",conf ig.Reference);
        }

/*      Use the PutCir driver to turn on pt 3 of the Genius I/O block.
*/

        for ( x=0 ; x<OxFFFF; xtt )
                for ( y=O; y,0xF; ytt);
        if (( ret = PutCir ( pnum, dnum, offset, (char) 1 )) != SUCCESS )
        {
                printf("\nRutCi   r fai lure, returned %d\n", ret );
        }
        else
        \
                printf("\nPutCir   driver successful. Pt 3 should be ON.\n");
        }
        for ( x=0 ; x<OxFFFF; xst )
                for (y=O; y<0xF; y++);

/*      Use the DisableOut driver to disable the updating of the block
        thus turning pt 3 off.
*/
        if (( ret = DisableOut ( pnum, dnum, DISABLE) ) != SUCCESS)
        {
                printf("\nDisableOut   failure, returned %d\n", ret);
        }
        else
        {
                printf("\nDisableOut   driver successful - Outputs shd be off\n");
        }
        for ( x=0 ; x<OxFFFF; xt+)
                for (y=O; yt0xF; y++);

        DisableOut   (pnum,dnum,ENABLE);

/*      Use the GetBusln driver to read all input data on the PCIM bus.
        Display input data for device 1.
*/
        if (( ret = GetBusln (pnum, INdata) ) != SUCCESS )
        {
                printf("\nGetBusln   failure, returned %d\n", ret);
        }
        else
        {
                printf("\nGetBusln      successful");
                printf("\n          Input data = %X\n, INdata[128]);
        }

/*      Use the PutBusOut driver to write output data to the discrete
        block.  Turn on pt 3,4,5 .
*/
        OUTdata[l28]   = 0x1C;

        if (( ret = PutBusOut ( pnum, OUTdata ) ) != SUCCESS )
        {
                printf("\nPutBusOut    fai lure, returned %d\n", ret);
        }
        eke
        {
                printf("\nPutBusOut      successful");
                printf("\n          Output data = %X n",OUTdata[128]);
                printf("           Pt 3, 4, and 5 should be ON\n");
        }
        for ( x=0; <0xFFFF; xtt )
                for ( y=O; y<0xF; ytt);
```

```
/*      Use the GetDevln driver to read input data from the discrete
        block. Value shouldindicate 0x1C.
*/
        if (( ret = GetDevln ( pnum, dnum, &length, INDdata )) != SUCCESS )
        {
                printf("\nGetDevln fai lure, returned %d\n", ret );
        }
        else
        {
                printf("\nGetDevln Successful");
                pr intf ("\n Discrete Block Input Data = %X\n",lNDdata[0];
        }

/*      Use the PutDevOut driver to turn on pt 3 and 5 on the discrete
        block.
*/
        lgth=1;

        OUTdata[0]=0x14;

        if (( ret = PutDevOut ( pnum, dnum, lgth, OUTdata )) != SUCCESS )
        {
                printf("\nPutDevOut failure, returned %d\n", ret);
        }
        else
        {
                printf("\nPutDevOut successful");
                printf("\n Pt 3 and Pt 5 shou ld be ON\n") ;
        }

/*      Use the GetCir and GetWord drivers to read the input status of
        the discrete block.
*/
        offset = 3;

        if (( ret = GetCir ( pnum, dnum, offset, &val)) != SUCCESS )
        {
                printf("\nGetCir failure, returned %d\n", ret);
        }
        else
        {
                printf("\nGetCir successful");
                printf("/n Value read should be 1, val= %x/n", val );
        }

        offset = 1;

        if (( ret = GetWord ( pnum, dnum, offset, valword)) != SUCCESS )
        {
                printf("\nGetWord fai lure, returned %d\n", ret);
        }
        else
```

```
                    printf("\nGetWord successful");
                    printf("\n-. Value read should be x14, val= %x\n", valword[0]);
        }
        for ( x=0; x<0xFFFF; x++)
                    for ( y=0; y<0xF; y++);

/*      Use the PutWord driver to turn on pt 4 on the discrete
        block.
*/

        offset = "1;
        valword[1] = 0x08;

        if (( ret = PutWord ( pnum, dnum, offset, valword[1] 1) != SUCCESS )
        {
                   printf("\nPutWord      failure, returned %d\n", ret);
        }
        else
        {
                   printf("\nPutWord       successful");
                   printf("\n          Pt 4 should be ON");
        }

        for ( x=0; x<0xFFFF; x++)
                   for ( y=0; y<0xF; y++);

/*      Exit the program by turning off the module.
*/
        imparm.Active = OFF;
        ChgIMSetup (pnum, &imparm);

}
```

## EXAMPLE APPLICATION 3

This example shows in BASIC the way the SENDMSG (or SENDMSGREPLY) and CHKMSGSTATUS message functions must be used together. The comments in the text provide a running commentary for the use of each driver.

```
2010    CALL SENDMSG (or SENDMSGREPLY) (STATUS, IMNUM, MSG(0))
2020    IF STATUS = 12 THEN 2050 ;IF PCIM is busy go to 2050
2030    IF STATUS <> 0 THEN 2170 ;IF STATUS is anything other then "0";
2040          ;something is wrong - go to 2170
2050    GO TO 2110      ;SENDMSG was executed O.K.; go to 9110 to
2060          ;check msg status
2070    CALL CHKMSGSTAT (STATUS,IMNUM,MSGSTATUS)
2080    IF STATUS <> 0 THEN 2170 ;If STATUS is anything other then "0";
2090          ;something is wrong - go to 2170
2100    If MSGSTATUS = 12 THEN 2050  ;If PCIM busy, stay in this loop and go
2110          ;back to 2050
2120    IF MSGSTATUS = 16 THEN 2010  ;If PCIM is free; go back to 2010 and
2130          ;execute SENDMSG
2140    IF MSGSTATUS <> 0 THEN 2170  ;If MSGSTATUS is anything else; go to 2170
2150          ;and decode
2160
2170    CALL CHKMSGSTAT (STATUS, IMNUM, MSGSTATUS) ;Did SENDMSG get
          ;on the bus
2180    IF STATUS <> 0 THEN 2170 ;If STATUS is anything other than "0"; go to
2190          ;2170 and decode
2200    IF MSGSTATUS = 12 THEN 2110  ;PCIM is busy; stay in this loop and go
2210          ;back to 21 10
2220    If MSGSTATUS <> 0 THEN 2170  ;If MSGSTATUS is anything other than "0";
2230          ;go to 2170 and decode
2240    RETURN  ;The SENDMSG call was executed properly; If
2250          ;SENDMSGREPLY the reply msg is ready to
2260          ;read with GETMSG
2270    CLS ;Clear Screen
2280    PRINT STATUS, MSGSTATUS      ;Interpret the code for STATUS and/or
2290          ;message status
```

GiK-0074

# APPENDIX B GLOSSARY

## INTRODUCTION

The following pages present a list of general technical terms used in the body of this manual. The list includes terms which are presented, but not discussed in detail, in earlier chapters. The list is provided to give you additional information about these terms. They are listed in alphabetical order followed by their definitions. Technical terms discussed in detail in the body of this manual are listed in the INDEX.

AC - Acronym for Alternating Current.

A/D Value - Analog to digital. Converts an analog electrical signal into a digital bit pat tern.

Address - A number of groups of ietters and numbers assigned to a specific location in memory, used to access that location.

Amps (Amperes) - Standard unit of electrical current (MKS system).

- Analoq A numerical expression of physical variables such as rotation and distance to represent a quantity. Also refers to analog type I/O Blocks and distinguishes them from discrete I/O Blocks.

ASCII (American Standard Code for Information Interchange) - An 8-level code (7 bits plus 1 parity bit) commonly used for exchange of data.

AWG - Acronym for American Wire Gauge, which defines wire size in O.D.

Background Message - The type of data on the serial bus that is called Background Data in the Serial Bus Specification. This data can be directed to a specific device or broadcast to all devices.

Battery-backed RAM - A RAM made non-volatile by the addition of a battery to supply data retention current when main power is gone.

Baud - A unit of transmission speed equal to the number of code elements (bits) per second.

Binary A numbering system which uses only the digits 0 and 1. This system is also called a ‘Base Two” numbering system.

Bit - A contraction of BInary digiT. The smallest unit of information in the binary numbering system, represented -by a 0 or 1. The smallest division of a Programmable Controller "Word".

BSM - (Bus Selector Module) an external device which selects one of two serial buses for redundancy.

Bus - An electrical path for receiving and transmitting data

Bus Controller - A printed circuit board which provides the interface between the GENIUS I/O system and the Series Six. The Bus Controller fits into any single high-capacity I/O slot and accommodates up to 30 I/O Blocks or Hand Held Monitors. Multiple Bus Controllers can exist without any limit (other than total Series Six I/O capacity). The Bus Controller also provides diagnostic fault reporting to the Series Six.

Bus Daisy Chain Configuration - The GENIUS serial bus is a token-passing, pulse transformer isolated, high-speed (150K baud) link. To connect GENIUS I/O elements together is a communications link formed by daisy-chain connection of twisted pair wire. This link requires only one pair.

Bus Scan - a method by which the Bus Controller or Serial Interface monitors all inputs and controls all outputs within a prescribed time. After serving all I/O Blocks and any additional HHMs, the token passes to the Bus Controller. The Bus Controller transmits all outputs and commands from the CPU, then communication begins again with device zero (or Controller address).

Byte - A group of binary digits (8 bits) that can be used to store a value from 0 to 255.

CPU Sweep - A method by which the CPU scans its associated I/O and solves its logic program based on the updated I/O data within a prescribed period of time.

CSB - The Command Status byte of the Command Block.

Communications Controller - A token bus local area network controller which allows GENIUS I/O devices to communicate over a single shielded twisted wire pair, rather than via bundles of point-to-point wires required in conventional systems.

Conf iqure - The act of changing GENIUS I/O system programmable input/output options and features initially performed to establish a new configuration different from those established at the factory. Configuration changes are effected on a block-by-block or circuit-by-circuit basis, using either the Hand Held Monitor or the Series Six CPU.

Configuration Data - GENIUS I/O module setup constants.

D/A Value - Digital to analog. Converts a digital bit pattern into a multi-level analog electrical signal.

DC - Acronym for Direct Current.

DPR Dual Port RAM - the shared RAM interface between the PCIM Manager Software and the PCIM Serial Interface.

Datagram Service - A type of data on the serial bus that is described in the Network Specification as Background Data. This data can be directed to a device or broadcast to all devices.

Daughterboard - A PC board that requires another board, called a motherboard, to operate. A daughterboard is usually mounted on, draws power from and is smaller than a motherboard.

Default - The value, display, function or program automatically selected if the user has not specified a choice.

Device Numbers - Each GENIUS device on the bus is assigned a device number (O-31) for communications indentif ication. Numbers can be assigned in any order as long as they are only assigned once per bus.

Digital - Having only two states: ON or OFF.

Dip (Dual lnline Package) Switch - A group of miniature toggle switches arranged side by side in a single package. Commonly used for setting the configuration of various parameters in electronic equipment.

Discrete - Consisting of individual, distinct entities such as bits, characters, circuits, or circuit components. Also refers to ON/OFF type I/O Blocks.

EEPROM (Electrically Erasable Programmable Read-Only Memory) - Located within the terminal assembly. The EEPROM stores all user-selectable options and retains these selections even during power OFF conditions. It can be read by the electronics assembly at any time and altered by commands from either the CPU or the Hand Held Monitor.

Electronics Assembly - The part of the I/O Block which contains the power **supply,** communications chip, microprocessor, smart sw itches, and other electronic components required to perform GENIUS I/O functions.

Engineering Units - 16-bit 2's complement numbers supplied by analog I/O Blocks to the Series Six CPU, or vice-versa. At the analog I/O Block, these are converted to/from the 13-bit signed magnitude quantities required by the A/D and D/A circuits per the user-supplied scaling factors.

EPLD - Erasable Programmable Logic Device; an integrated circuit similar to a PAL except that it is reprogrammable and uses less power.

EPROM - Eraseable Programmable Read-Only Memory device.

Filter - Normally, an electrical circuit designed to eliminate signals of certain frequencies. In GENIUS I/O Blocks, a programmable digital filter is provided.

FIFO - First In First Out.

Firmware - A series of instructions contained in ROM (Read Only Memory) which are used for internal processing functions only, and thus are transparent to the user.

Foreground tvlessaqe - The type of data on the serial bus that is called Foreground Data in the Serial Bus Specification. This data can be directed to a specific device or broadcast to all devices.

GENIUS I/O Bus - A high speed serial token passing bus providing communications between the Bus Controller, Hand Held Monitors, and I/O Blocks. It has high noise immunity (1500 volt common mode) and its operation is not affected by any block attachment, removal or failure. Each data bit is triply encoded for data integrity; error detection is further improved via cyclical redundancy check (CRC). Bus errors are reported automatically.

Global Data Service - A type of data on the bus that is described in the Network Specification as Control Data. This data can be directed to a specific device or broadcast to all devices.

Grouped - The 8-circuit Grouped AC I/O Block is so desigated because the I/O circuits all derive power from the block's power supply.

Hand Held Monitor (HHM) - A portable diagnostic and configuration tool used for addressing, trouble-shooting, monitoring, scaling and configuring the I/O Bfocks. The HHM plugs directly into any I/O Block, Bus Controller, or into the Series Six. A key feature of the HHM is its ability to manually perform functions and force discrete and analog I/O, whether or not there is a programmable controller connected to the system.

Hardware - All of the mechanical, electrical, and and electronic devices that comprise a GENIUS I/O system and its application.

Hexadecimal - A base 16 numbering system, represented by the digits 0 through 9 and then A through F.

High Alarm - A programmable value (in Engineering Units) against which the analog input signal is automatically compared on GENIUS I/O Blocks. A fault indication results if the input value exceeds or equals the high alarm value.

Host - The IBM PC that interfaces to the PCIM's shared RAM and other connector signals.

HYTX3 - The hybrid circuit that connects directly to the bus transformer on all GENIUS devices. It is the analog transceiver section of the Serial Interface, providing the analog to digital interface between the tine transformer and the MIT.

PCIM MANAGER - The software that controls the flow of data to/from the Host from/to the serial bus.

I/O - Commonly used abbreviation for Input/Output.

I/O Block - A microprocessor-based, configurable, ruggedized solid state device to which field I/O devices are attached. Measuring approximately 9"x4"x3", it can be mounted virtually anywhere. No separate rack or power supply is required. Field wiring is attached to a terminal block section which separates from the removable electronics package. Due to the microprocessor and intelligent switching, inputs and outputs may be mixed arbitrarily on blocks.

I/O Rack - 19" Series Six rack which accepts I/O boards, including the GENIUS Bus Controller.

I/O Scan - Each device on the bus has a turn to send information and can listen to all the broadcast data on the bus. The period required for all devices on the GENIUS bus to communicate.

Impedance - A measure of the total opposition to current flow in an electrical circuit.

Input - Information originating from an external device.

Input Devices - Devices that as a result of their mechanical or electrical action supply data to a programmable controller. Typical devices are limit switches, pushbuttons, pressure sw i tches, digital encoders, and analog devices.

Input Processing Time - The time required for input data to reach the microprocessor.

Inrush - Higher than normal currents experienced when output circuits are turned ON.

Isolation - A method of separating field wiring circuitry from logic level circuitry, typically done with optical isolation. Also refers to isolated type I/O Blocks.

ladder Loqic Diagram - A representation of of control logic relay system. User programmed logic is expressed in relay equivalent symbology.

Ladder Logic Programming - A method of solving complex relay problems through the use of simple functions that define or represent relay-oriented concepts.

Low Alarm - A programmable value (in Engineering Units) against which the analog input signal is automatically compared on GENIUS I/O Blocks. A fault indication results if the input value is equal to or less than the low alarm value.

Microsecond (uS) - One millionth of a second (0.000001).

Milliamp (mA) - One 1000th of an ampere.

Millisecond (mS) One thousanth of a second (0.001).

MIT2 - Multiple Interface Timer; This is the Gate Array which implements the hardware interface to the serial bus.

Module - In the Series Six, a combination of printed circuit board and its associated faceplate which, as a unit, form a complete assembly.

Motherboard - A generic name given to the board that a daughterboard plugs onto.

NVRAM - Non-volatile RAM; The generic term for any RAM that retains its data after power loss.

Output - Information trarrsferred from the CPU for control of external devices or processes.

Output Devices - Physical devices such as starter motors, solenoids, etc. that receive data from the programmable control.

Parity - A method of checking the accuracy of binary numbers.

Parity Bit - A bit added to a memory number to make the sum of the 1 bits in a word always even (even parity) or always odd (odd parity).

Parity Check - A check that tests whether the number of ones in a word is odd or even.

Peer-to-peer - A system where all devices have the same authority. In contrast, a 'master-slave' system assumes that the master has all the authority to control data traffic. A peer-to-peer system allows more flexibility to change configuration, but needs a more complicated method to prevent traffic conflicts,

Private RAM - RAM available only to a specific processor, as differentiated from Shared RAM, which may be available to two or more processors,

Programmable Controller - A solid-state control system which receives inputs from user-supplied control devices such as switches and sensors, implements them in a precise pattern determined by instructions stored in user memory, and provides outputs for control of user supplied devices such as relays and starter motors.

PROM - An acronym for Programmable Read Only Memory. A retentive digital storage device programmed at the factory and not readily alterable at the field.

Queue - An architectural construct used to store data in first-in, first-out order. It can be thought of as a holding area for data, usually equipped with pointers to al low insertion or removal of data.

RAM - An acronym for Random Access Memory. A solid state memory which allows individual bits to be stored and accessed. This type of memory is volatile; that is, stored data is lost under no power conditions. Therefore, a battery backup is required.

Register Reference Number - Memory address of the register used to store 16 bits of numerical information such as accumulated or preset times or counts, alarm limits, or the digital values of an analog output. Registers also may be used to store binary information, such as discrete references.

Serial Bus Address (SBA) - The station number of a device in the GENIUS serial bus token rotation scheme.

Serial Bus Scan - The time it takes the token to make one pass around the serial bus.

Serial Communication - A method of data transfer within the GENIUS I/O system whereby the bits are handled sequentially, rather than simultaniously as in parallel operation.

Serial Interf ace - The software that controls the GENIUS Serial Bus Protocol which interfaces the PCIM on the bus.

Series Six CPU (Central Processing Unit) - The central device or controller that interprets user instructions, makes decisions based on designated I/O data, and executes the instructions based on the decisions.

Shared RAM Interface (SRI) : the 16K X 8 SRAM and associated circuitry that arbitrates memory requests between the PCIM and the Host.

Signif icant Bit - A bit that contributes to the precision of a number. The number of significant bits is counted beginning with the bit contributing the most value (referred to as the Most Signif icant Bit (MSB)) and ending with the one contributing the least value (referred to as the Least Significant Bit (LSB)).

Smart Switch - A device with the built-in current and voltage sensors required for the extensive diagnostics available with GENIUS I/O. The Smart Switch allows detection of faults not only within the programmable controller I/O system, but also faults in the coils and other actuator devices under the control of the programmable controller, as well as the signal path from pushbuttons and other input devices.

State - ON or OFF condition of current to or from an input or output device.

Steady-State - Signal state after transients have died down.

Table - A group of consecutive registers combined to store data, such as fault information.

Terminal Assembly - The part of the I/O Block which is permanently installed. User field wiring is connected to the terminal assembly to transmit power and input signals to, and output status from the I/O Block.

Termination Jumper - A terminating resistor built into the Bus Controller printed circuit board, which may be connected to the GENIUS communications bus by moving a jumper (also provided).

Token Passing - The GENIUS I/O bus is a token passing system. Each device on the bus has a turn to send information and can listen to all the broadcast data on the bus. A round robin starts at device zero. While each device holds the token, it can transmit messages. When complete, the transmitting device sends a sign-off message. If the next higher device number is an I/O Block, it sends its input data to all other devices. Lower device numbers are serviced before higher device numbers. Unused device numbers are bypassed with very slight delays.

Volts - The St unit of electric potential and electromotive force.

Watchdog Timer - A hardware timer on firmware-driven systems used to determine that the system is meeting certain minimal timing requirements. Shuts the system down in a safe manner if timing requirements fail to be met.

Word - The basic measurement of memory size, which contains 16 bits of information.

# APPENDIX C
# CONNECTOR StGNAL DESCRIPTIONS

## Connector Signal Descriptions

The host interface to the PClM is through a 40 pin connector for 5 volt signals and a 10 pin connector for Genius signals. A description of the 5 volt connector signals is shown below.

Table C-1. 5 Volt Connector Signal Descriptions

| Signal Name | I/O | Definition |
|---|---|---|
| DO - D7 | I/O | Host bidirectional data bus used to transfer data from/to the Shared RAM. Tri-state output |
| A0 - Al3 | I | Host address bus to the Shared RAM which designates address of the Shared RAM to be written or read. |
| /WR | I | Write strobe; indicates that data on DO - D7 is valid and should be written to the Shared RAM. |
| /RD | I | Read strobe line; indicates that data should be placed on the data bus by the Shared RAM. |
| /GENSEL | I | Select line used by the t[redacted]to request access the Shared RAM. |
| /GENRDY | 0 | Signal from the PCIM which indicates that the host may complete its current read or write cycle. Tri-state output. |
| /INT | 0 | Interrupt strobe from the PCIM which indicates that an enabled interrupt condition has been sensed. Open collector output. |

Table C1 5 Volt Connector Signal Descriptions (Cont'd)

| | | |
|---|---|---|
| /RST | I | Reset signal which holds the microprocessor and the MIT in reset. On power up or power failure it must be held low during power up and for a minimum of 20 milliseconds after all power supplies are in tolerance. |
| MONO | I | Indicates that the Hand Held Monitor is present |
| /BOARD OK | 0 | Reflects BOARD-OK LED output. Low when BOARD is running normally. **High** when a hardware error has detected. This line is internally current limited to 10 ma. |
| /COMMOK | 0 | Indicates when communications with the GENIUS bus are taking place. It is low when communications are active. |
| 5 Volt | I | 5 volt +/- 10% power supply. |
| 0 Volt | I | Logic ground. |

## Connector Pin Designations

40 pin connector

| Pin # | Function |
|---|---|
| 1 | GND |
| 2 | +5v |
| 3 | NC |
| 4 | /GENIOK |
| 5 | /INT |
| 6 | /RST |
| 7 | FACTST |
| 8 | A0 |
| 9 | Al |
| 10 | A2 |
| 11 | A3 |
| 12 | A4 |
| 13 | A5 |
| 14 | A6 |
| 15 | A7 |
| 16 | A8 |
| 17 | A9 |
| 18 | Al0 |
| 19 | All |
| 20 | Al2 |
| 21 | Al3 |
| 22 | +5v |
| 23 | /RD |
| 24 | /WR |
| 25 | /GENSEL |
| 26 | MONO |
| 27 | /GENRDY |
| 28 | /COMM OK |
| 29 | NC |
| 30 | GND (OV*) |
| 31 | D3 |
| 32 | D2 |
| 33 | D4 |
| 34 | D1 |
| 35 | D5 |
| 36 | D0 |
| 37 | D6 |
| 38 | D7 |
| 39 | +5v |
| 40 | GND |

10 pin connector

| Pin # | Function |
|---|---|
| 1 | Xl |
| 2 | x2 |
| 3 | GSHD |
| 4 | NC |
| 5 | NC |
| 6 | NC |
| 7 | NC |
| 8 | NC |
| 9 | NC |
| 10 | NC |

# APPENDIX D
# SPECIFICATIONS

## ELECTRICAL

### Power Requirements

5 volts DC +/- 10%, 400 ma (maximum)

### Bus Loading

1 LS TTL load per input line

### Bus Drive Capability

10 LS TTL loads per output line

All output lines except INTERRUPT are tri-state outputs.

INTERRUPT is an open-collector output.

## MECHANICAL

### Daughterboard Dimensions

Height - .75" (19.05 mm) (@ tallest component )

Width - 3.6" (91.44 mm)

Depth - 8.4" (213.36 mm)

Board Thickness - .063" (1.60 mm)

### Motherboard Dimensions

Height - .75" (19.05 mm) (@ tallest component )

Width - 4.2" (106.68 mm)

Depth - 13.5" (342.9 mm)

Board Thickness - .063" (1 .60 mm)

## ENVIRONMENTAL REQUIREMENTS -- OPERATING

| | |
|---|---|
| Temperature | -0 to 70 degrees C<br>(ambient temperature at board) |
| Humidity | 5% to 95% non-condensing |
| Altitude | 10,000 feet |
| Vibration | 0.2 inch displacement 5 to 10 Hz<br>1 G 10 to 200 Hz |
| Shock | 5 G, 10 ms duration per MIL-STD 81OC,<br>method 516.2 |

## ENVIRONMENTAL REQUIREMENTS -- NON-OPERATING

| | |
|---|---|
| Temperature | -40 to 125 degrees C<br>(ambient temperature at board) |
| Humidity | 5% to 95% non-condensing |
| Altitude | 40,000 feet |
| Vibration | 0.2 inch displacement 5 to 10 Hz<br>1 G 10 to 200 Hz |
| Shock | Card packed in shipping container.<br>5 G, 10 ms duration per MIL-STD BfOC,<br>method 516.2 |

# APPENDIX E
# PCIM PART NUMBERS

| Product Informat ion | Catalog Number |
|---|---|
| ✍✍ PCIM Module, User's Manuals, and library of Software Drivers on 3 1/2" and 5 1/4" Diskettes | IC660ELB906 |
| ✍✍ PCIM User's Manual | GFK-0074 |
| ✍✍ Genius I/O Bus Datagram Reference Manua l | GFK-0090 |
| ✍✍ Library of "C" MSDCS Drivers on 3 1/2" and 5 l/4" Diskettes ( i nc l udes GFK-0074 and GFK-OO90)* | IC641GBE647 |

* Included when ordering IC660ELB906

## GENIUS I/O Phase A Products

| Catalog Number | Model Description |
|---|---|
| C660CBB900 | Series Six Bus Controller w/diagnostics |
| C660HHM500 | Hand Held Monitor |
| C660CBB901 | Series Six Bus Controller w/out diagnostics |
| C660cBD100 | 115 Vac 8-circuit Grouped Block |
| C660CBS100 | 115 Vac/125 Vdc 8-circuit isolated Block |
| C660CBDOZ 1 | 24-48 Vdc 16-circuit Grouped Sink Block |
| C660CBDO20 | 24-48 Vdc 16-circuit Grouped Source Block |
| C660CBAlOO | 115 Vac 4-input, 2-output Analog Block |
| C66OCBA020 | 24 Vdc 4-input, 2-output Analog Block |

# APPENDIX F FUNCTION CODES

**The** following hexadecimal function codes **have been** defined for **use** on the Genius network:

10H = GE Intelligent Platforms NA, **Inc**
20H = GE Intelligent Platforms NA, **Inc**

Users must contact GE Intelligent Platforms to reserve function codes.

## Subfunction Codes

The following hexadecimal subfunction codes may be used in messages on **the** Genius network:

| CODE | MESSAGE NAME | DATA LENGTH |
|---|---|---|
| 02 | Read Configuration | 2 |
| 03 | **Read** Config, **with Reply** | 3-134 |
| 04 | **Write** Configuration | 3-134 |
| 05 | Assign Monitor | 1 |
| 08 | Read Diagnostics | 2 |
| 09 | Read Diagnostics **Reply** | 3-134 |
| **OB** | Point Write | 9 |
| OF | Report Fault | 3 |
| 10 | Pulse **Test** | 0 |
| **11** | **Pulse Test** Complete | 0 |
| 12 | Clear Circuit Fault | 1 |
| 13 | Clear All C**ircuit Faults** | **0** |
| IC | Switch BSM | 1 |
| **1E** | **Read** Device | 6 |
| **1F** | **Read Device Reply** | 7-134 |
| 20 | **Write Device** | 7-134 |
| 22 | Configuration Change | 3-7 |

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