GE Fanuc Automation

PMC695
PMC695TX

Very High Performance Intelligent Ethernet Controllers

HARDWARE REFERENCE MANUAL

Document Number: Rx-URMH 125

Embedded Systems

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1 Introduction

Incorporating state-of-the-art technology, the PMC695 and PMC695TX set new standards for high performance data exchange. Each has a 1000Mbit (GigaBit) Ethernet controller combined with a local Power PC processor and Embedded Bridge. The result is a very high performance, extremely flexible solution to a variety of data transfer requirements. Designed using standard protocols (1000Mbit Ethernet and PCI/PMC), these Ethernet controllers are intrinsically economical, both in terms of direct unit cost and the ability to utilize commodity local area network (LAN) switches.

1.1 Features

1.1.1 PMC695

The PMC695 is designed with one 1000Mbit Ethernet controller, driving Fiber media: available with SC or LC connector options. Design features include:

- PCI 64/66MHz interface
- High performance PPC processor executing at 400MHz on-board
- Single RS232 Console port
- Single 10/100BaseTX Ethernet port
- One 1000BaseFX Ethernet port

1.1.2 PMC695TX

The PMC695TX is designed with one 1000Mbit Ethernet controller driving Copper media. Design features include:

- PCI 64/66MHz interface
- High performance PPC processor executing at 400MHz on-board
- Single RS232 Console port
- Single 10/100BaseTX Ethernet port
- 10/100/1000Base TX Ethernet port

1.2 Software Support

GE Fanuc Embedded Systems provides full software support for all the popular software environments (e.g., VxWorks®, LynxOS®, Windows NT®, Linux®, Solaris™, etc.).

1.3 Prototype and Development

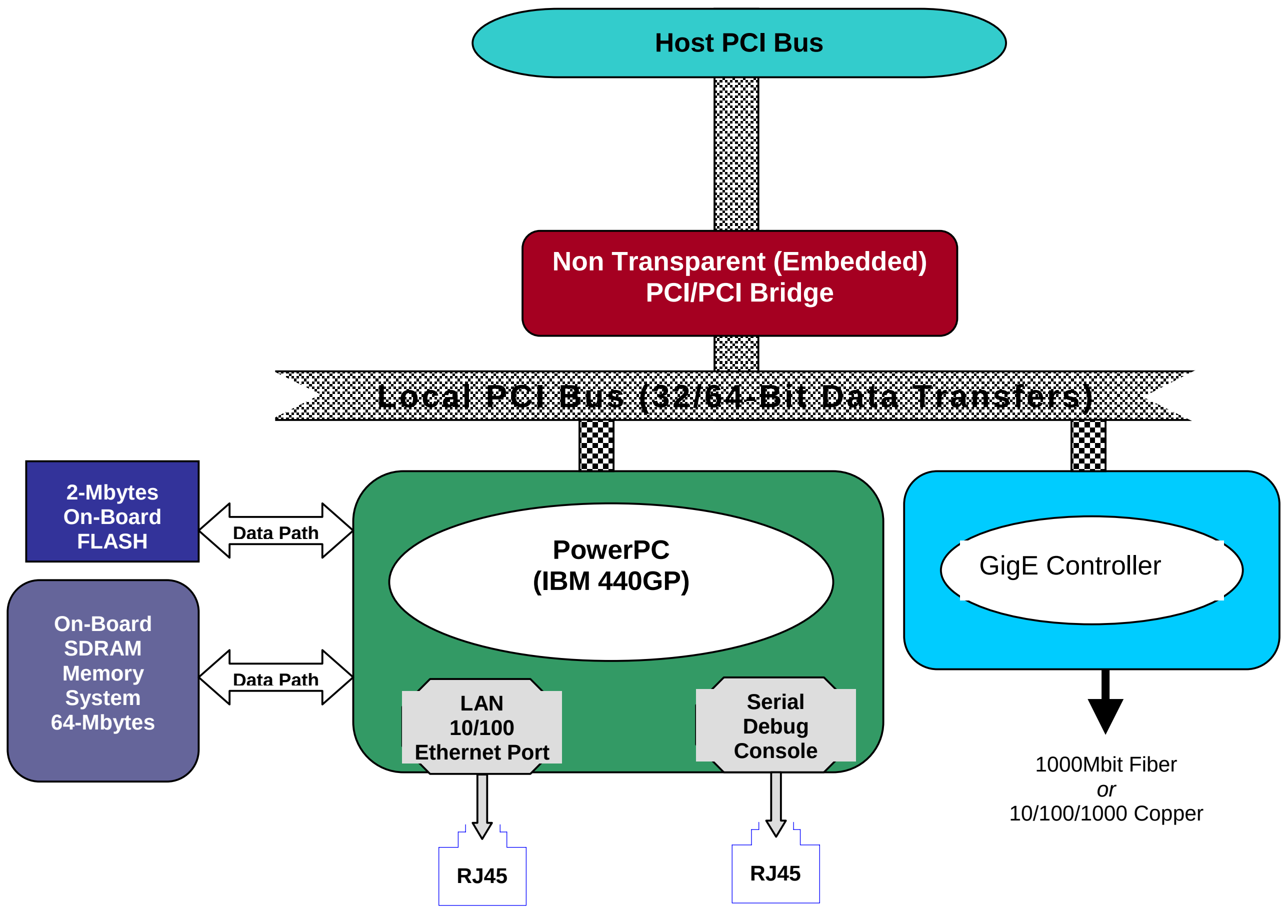
Card edge PCI systems can be accommodated using GE Fanuc Embedded Systems' PMC239 PCI-to-PMC adapter for rapid prototype and development. Ideal for lab development purposes, this adapter card features:

- 32 and 64-bit PCI
- Generates the +3.3 volt on-board for the PMC
- PCI edge connector style card to PMC (IEEE 1386) adapter

The PMC239 also comes with an optional Fan. The Fan can be disconnected from its power if not needed.

2 Theory of Operation

The PMC695 / PMC695TX architecture is illustrated in the block diagram below.



2.1 Local intelligence

The on-board PPC processor allows PMC675 to be utilized in a wide range of applications. In the simplest mode, all control can be kept in the system host. GE Fanuc Embedded Systems' embedded TCP/IP allows the host to off-load the TCP/IP overhead onto the PMC675 local processor. The local processor has 64-MBytes of dedicated system memory (DDR SDRAM), as well as 2-Mbytes of flash.

2.2 Add application-specific intelligence

Users can add application-specific functionality to the on-board firmware, migrating appropriate control into the PMC695 or PMC695TX.

2.3 Subsystems

There are three functional subsystems:

- Embedded (or Non Transparent) PCI to PCI Bridge.
- Local co-processor
- Gigabit Ethernet controller

2.4 Transaction Isolation

There are three independent busses contained on the module: host PCI bus, secondary PCI bus, and local co-processor bus. Data can flow between any pair. Transactions have no affect on traffic on the third bus. Thus, control and data flow between the co-processor and local memory system will consume no bandwidth on the host PCI. It is this isolation that allows the module to perform arbitrary manipulation, filter, etc., of data from the Ethernet without compromising the host system's performance. The co-processor contains direct memory access (DMA) engines with sufficient buffers to do burst transfers between the PCI and local memory. This is a critical factor as the actual (opposed to theoretical) bandwidth of a PCI bus decreases dramatically without burst (and relatively long burst) transfers.

2.5 Embedded Bridge

An Embedded (or non Transparent) PCI to PCI bridge does not expose the secondary (local) PCI bus directly to the host. To the host it appears as a standard PCI device requesting a section of address space. Translation registers within the bridge create a mapping between the address layout of the host, and an independent layout on the PMC675. As a result, it is possible for the co-processor to directly access the entire host PCI and for devices on the host PCI bus to target buffers created from the co-processor's local memory. No resources (e.g., Ethernet controller or processor) are visible to the host.

In addition to providing the PCI-PCI transaction bridging the embedded bridge has local register resources. These are in two categories:

- Scratchpad registers – which can be used by the host to control the firmware load on the co-processor
- I2O messaging registers – supporting the I2O programming interface.

2.6 Co-processor

The co-processor is an IBM 440GP highly integrated Power PC. This device includes a power full PPC processor, embedded 10/100 Ethernet and extremely powerful DMA engines.

The process memory bus runs at over 1Gbps and has an internal processor clock rate of 400MHz. The higher CPU clock rate ensures sufficient bandwidth for all protocols and data manipulation at the high data rate required when operating at gigbit Ethernet speeds. Local DDR SDRAM (64Mbytes) is used for firmware execution and data buffering. Firmware is loaded automatically on power-up from local flash memory. New firmware (e.g., upgrades) may be loaded in the field without removing the PMC module from the host. The processor directly controls the on-board UART for full software configuration.

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2.7 Ethernet Controllers

The Gigabit Ethernet controllers on the PCM695 and PMC695TX have enjoyed several years of active evolution, featuring improvements at both the PCI bus and network interface. Each controller is a fully independent unit with local FIFO buffers to decouple PCI and Ethernet activity. Decoupling the Ethernet and PCI ensures that data transfers will meet the timing requirements of each transaction (which is of particular importance on the Ethernet), regardless of the loading on the other bus interface. These FIFO buffers are sufficiently deep to support good burst transfers and presenting minimum overhead to the PCI bus. When doing data transfer on the PCI bus the Ethernet DMA engine will attempt to maximize the length of burst transactions, which is critical to obtain the potential bandwidth of the PCI protocol. These properties allow sustained full bandwidth transfers on both Ethernet ports.

2.8 PCI Hardware Interface

The PCI interface is Revision 2.2 compatible, supporting 32/33Mhz and 64/66Mhz transactions. Both slave and master operations are available, the latter including DMA engines capable of long PCI bursts. As data is buffered in local DDR SDRAM, large blocking factors can be used when application level protocols allow. Both programmed I/O and message-based control are supported. The messaging system follows I2O hardware specifications.

2.9 Programming Interface

Flexibility, efficiency and simplicity were the guiding requirements during the design of the application Interface. A simple message based transaction interface using the I2O hardware support is the preferred method of control and communication from the host to the firmware executing on the co-processor.

The messaging interface allows simple, efficient transfers between host software and the PMC module. A control block contains transaction-specific information such as configuration, data or location of data buffers. The message queuing system (intrinsic to the I2O) makes transfer of the control blocks between the host and the PMC very simple, and requires only minimal software development. Once submitted to the PMC module, the local processor loads the transaction information. For large data blocks, the DMA engines are utilized to execute the data movement. This improves PCI bus utilization as well as allowing scatter/gather operation—useful in virtual memory operating systems.

3 Handling and Installation

3.1 Handling Precautions

Electronic assemblies use devices that are sensitive to static discharge. Observe anti-static procedures when handling these boards. All products should be in an anti-static plastic bag or conductive foam for storage or shipment. Work at an approved anti-static workstation when unpacking boards.

3.2 Unpacking and Verification

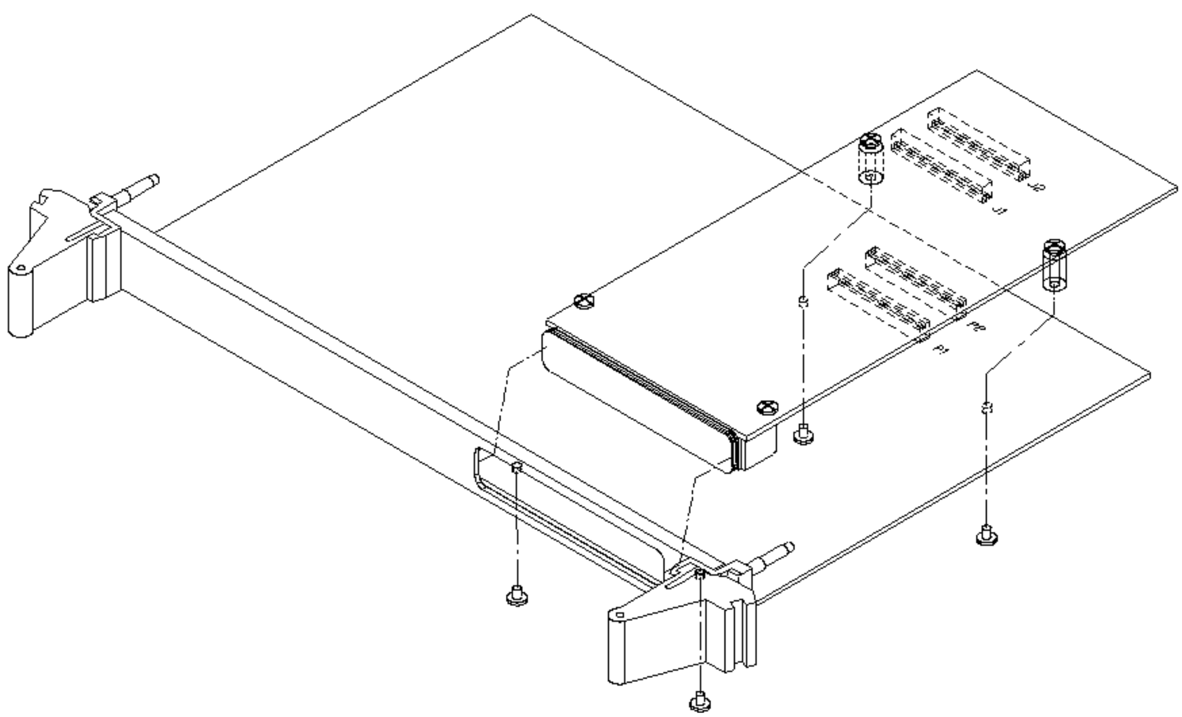
GE Fanuc Embedded Systems products are shipped in individual, reusable shipping boxes. When receiving the shipping container, inspect it for any evidence of physical damage. If the container is damaged, request that the carrier's agent be present during the unpacking of individual boxes and the inspection of each unit.

Remove the PMC module from the shipping box and anti-static packaging. Verify that it is not damaged and that all items are present by referring to the packing list.

3.3 Installation

The PMC module is now ready for installation. Installation is done generically as with the commercial versions of the card. Follow any specific procedures recommended by the manufacturer of the chassis used.

Turn all system power OFF. Remove the host board from the chassis (if currently installed). Locate the PMC connectors on the host board. Carefully plug the PMC module into the mating connectors on the host's printed circuit board. Be sure the PMC module is seated properly into the common mezzanine card (CMC) connectors on the host.

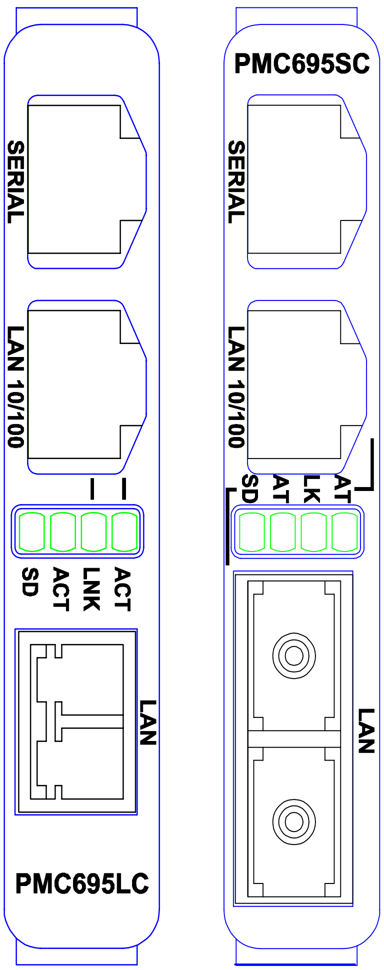


Use screws to fasten PMC card to the host CMC.

- Remove the four screws from the bottom of the stand-offs of the PMC.
- Line-up the J1 and J2 connectors on the host CMC to the J1 and J2 connectors on the PMC card.
- Ensure all connectors are properly aligned before pushing the connectors together.
- Use the four screws to connect the PMC stand-offs to the host CMC.

3.4 Front Panel Connectors and Indicators

FACE VIEWS - FIBER



The *LAN 10/100* is a simple copper Ethernet interface implemented as part of the co-processor.

The LAN Interface is the gigabit Ethernet connection, in fiber or copper depending upon the PMC675 model.

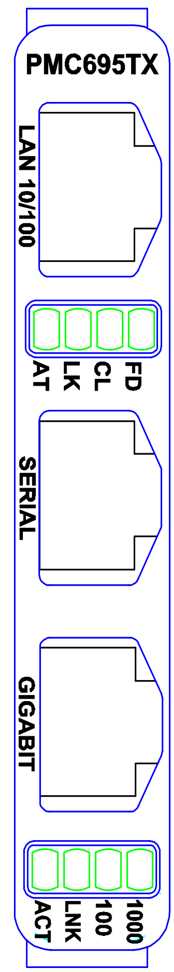
Link/Activity LEDs

The LAN port has an associated set of Link/Activity LEDs. These LEDs illuminate when valid links are detected.

A solid LINK LED illumination indicates a valid link. A blinking ACT LED indicates port activity—data traffic is on the port when packets are received/transmitted.

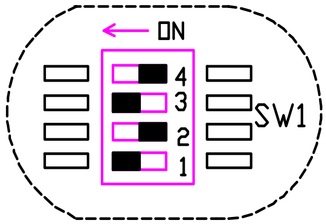
For the copper interface the operational speed is displayed (100/1000, off if 10)

FACE VIEW - COPPER



3.5 Factory Switch Settings

The PMC switch settings (illustrated below) for the LC, SC and TX versions are the same. Switches are positioned and verified at the factory before shipping. These factory default settings should not be changed by the customer.



4 Functional Specifications

The following functional specifications are common to the PMC695 and PMC695TX.

Power	**7 Total Watts**
@ 3.3 V	**1.5 Amps**
@ 5 V	**0.4 Amp**
Form Factor	
PMC	**Single Slot**
MTBF	
MIL 217-F Nav Shel 25 Deg. C	**205000 Hours**
Temperature	
Operating	**0 to +60° C**
Storage	**-40 to +85° C**
Humidity	
Operating	**5% to 95% Non-Condensing**
Storage	**5% to 95% Non-Condensing**

Conformal Coating	**Yes, additional charge**

PCI Bus Characteristics	
Signaling	**3 & 5V**
Specification	**2.2**
Speed	**33/66MHz**
Width	**32/64**

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1-800-GE FANUC or (256) 880-0444

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86 (10) 6561 1561

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33 (0)1 4324 6007

Additional Resources

For more information, please visit the
GE Fanuc Embedded Systems web site at:
www.gefanuc.com/embedded