MVME162LX 200/300 Series Embedded Controller Installation and Use

V162LX2-3A/IH3

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Preface

The *MVME162LX 200/300 Series Embedded Controller Installation and Use Manual* provides a board-level description of the MVME162LX Embedded Controller. It contains a general overview of the product along with a list of hardware features and a detailed functional description.

The information contained in this manual applies to the MVME162LX-2xx and MVME162LX-3xx (200 and 300 series) models that are currently shipping as of the publication date of this manual.

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Safety Summary
Safety Depends On You

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola, Inc. assumes no liability for the customer's failure to comply with these requirements.

The safety precautions listed below represent warnings of certain dangers of which Motorola is aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

Ground the Instrument.

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor AC power cable. The power cable must be plugged into an approved three-contact electrical outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

Do Not Operate in an Explosive Atmosphere.

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

Keep Away From Live Circuits.

Operating personnel must not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service or Adjust Alone.

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present.

Use Caution When Exposing or Handling the CRT.

Breakage of the Cathode-Ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the equipment. Handling of the CRT should be done only by qualified maintenance personnel using approved safety mask and gloves.

Do Not Substitute Parts or Modify Equipment.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the equipment. Contact your local Motorola representative for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.



WARNING

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.

All Motorola printed wiring boards (PWBs) are manufactured by UL-recognized manufacturers, with a flammability rating of 94V-0.

WARNING

This equipment generates, uses, and can radiate electromagnetic energy. It may cause or be susceptible to electromagnetic interference (EMI) if not installed and used in a cabinet with adequate EMI protection.

CE

European Notice: Board products with the **CE** marking comply with the EMC Directive (89/336/EEC). Marking a system with the **CE** symbol indicates compliance of that Motorola system to the applicable directives of the European Community. A system with the **CE** marking meets or exceeds the following technical standards:

EN55022 (CISPR 22): Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment. Tested to Equipment Class B.

EN50082-1, 1992: Electromagnetic Compatibility -- Generic Immunity Standard, Part 1: Residential, Commercial and Light Industry.

IEC801-2: Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 2: Electrostatic Discharge Requirements.

IEC801-3: Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3: Radiated Electromagnetic Field Requirements.

IEC801-4: Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 4: Electrical Fast Transient/Burst Requirements.

The product also fulfills EN60950 (product safety) which is essentially the requirement for the Low Voltage Directive (73/23/EEC).

In accordance with European Community directives, a “Declaration of Conformity” has been made and is on file at Motorola, Inc. - Computer Group, 27 Market Street, Maidenhead, United Kingdom, SL6 8AE.

This board product was tested in a representative system to show compliance with the above mentioned requirements. A proper installation in a **CE**-marked system will maintain the required EMC/safety performance.

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Board Level Hardware Description

1

Introduction

This chapter provides a board-level hardware description of the MVME162LX Embedded Controller. It contains a general overview of the product along with a list of hardware features and a detailed functional description. The controller's front panel switches and indicators are included in the functional description. Additionally, a section on memory maps is provided at the end of this chapter to familiarize you with the controller's memory addresses and the corresponding devices accessed.

All of the controller's programmable registers that reside in ASICs are covered in the *MVME162LX Embedded Controller Programmer's Reference Guide*.

Overview

The MVME162LX Embedded Controller is based on the MC68040 or the MC68LC040 microprocessor. The MC68040 microprocessor has a floating-point (math) coprocessor and the MC68LC040 does not.

Various versions of the controller contain the following:

- 1 or 4 MB of parity-protected DRAM
- 4, 8, 16, or 32 MB of ECC-protected DRAM
- 128 KB of SRAM (with battery backup)
- Time of day clock (with battery backup)
- An optional LAN Ethernet transceiver interface
- Four serial ports with an EIA-232-D interface
- Six tick timers with watchdog timer(s)
- Four EPROM sockets
- 1 MB flash memory (one flash device)
- Two IndustryPack (IP) interfaces
- An optional SCSI bus interface with DMA
- An optional VMEbus interface (local bus to VMEbus/VMEbus to local bus, with A16/A24/A32, D8/D16/D32 bus widths and a VMEbus system controller)

Input/Output (I/O) signals are routed through industry standard connectors on the controller's front panel. This includes the I/O for the serial ports, which is provided by four RJ45 connectors.

The VMEbus interface is provided by an ASIC called the VMEchip2. It contains two tick timers, a watchdog timer, programmable map decoders for the master and slave interfaces, a VMEbus to/from local bus DMA controller, a VMEbus to/from local bus non-DMA programmed access interface, a VMEbus interrupter, a VMEbus system controller, a VMEbus interrupt handler, and a VMEbus requester.

Processor-to-VMEbus transfers can be D8, D16, or D32. VMEchip2 DMA transfers to the VMEbus, however, can be D16, D32, D16/BLT, D32/BLT, or D64/MBLT.

The MCchip ASIC provides four tick timers, the interface to the LAN chip, SCSI chip, serial port chip, BBRAM, EPROM/Flash, DRAM and SRAM.

The MCECC memory controller ASIC provides the programmable interface for the ECC-protected 16 MB DRAM mezzanine board.

The IndustryPack Interface Controller (IPIC) ASIC provides control and status information for up to two single size IndustryPacks (IPs) or one double size IP that can be plugged into the controller's PCB.

Related Documentation

The MVME162LX Embedded Controller does not ship with all of the documentation that is available for the product. Additional (optional) publications are available for the controller and are listed in Appendix I.

These publications can provide you with additional information about the product. Instructions on how to obtain them are also provided in Appendix I.

Models Available

As of the publication date of this manual, the MVME162LX Embedded Controller is available in a number of models shown in Table 1-1.

Table 1-1. MVME162LX Embedded Controller Models

Model	Description
-200	MC68LC040 25 MHz microprocessor, 1 MB DRAM, 128 KB SRAM,1 MB Flash memory, 2 IndustryPack sites
-201	MC68LC040 25 MHz microprocessor, 1 MB DRAM, 128 KB SRAM,1 MB Flash memory, 2 IndustryPack sites, 4 serial ports
-202	MC68LC040 25 MHz microprocessor, 1 MB DRAM, 128 KB SRAM,1 MB Flash memory, 2 IndustryPack sites, 4 serial ports
-210	MC68LC040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports
-211	MC68LC040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI
-212	MC68LC040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, Ethernet
-213	MC68LC040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-216	MC68LC040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, Ethernet, No VME
-220	MC68040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports
-222	MC68040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, Ethernet
-223	MC68040 25 MHz microprocessor, 4 MB DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-233	MC68LC040 25 MHz microprocessor, 4 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet

Table 1-1. MVME162LX Embedded Controller Models (Continued)

Model	Description
-243	MC68040 25 MHz microprocessor, 4 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-253	MC68LC040 25 MHz microprocessor, 16 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-262	MC68040 25 MHz microprocessor, 16 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, Ethernet
-263	MC68040 25 MHz microprocessor, 16 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-322	MC68LC040 25 MHz microprocessor, 8 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, Ethernet
-323	MC68LC040 25 MHz microprocessor, 8 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 2 IndustryPack sites, 4 serial ports, SCSI & Ethernet
-333	MC68040 25 MHz microprocessor, 8 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 4 serial ports, SCSI & Ethernet
-353	MC68040 25 MHz microprocessor, 32 MB ECC DRAM, 128 KB SRAM, 1 MB Flash memory, 4IndustryPack sites, 4 serial ports, SCSI & Ethernet

Document Requirements

The controller is designed to conform to the requirements of the following documents:

- VMEbus Specification (IEEE 1014-87)
- EIA-232-D Serial Interface Specification, EIA
- SCSI Specification, ANSI
- IndustryPack Specification, GreenSpring

Available Software

Available software for the controller includes the on-board debugger/monitor firmware, VMEexec driver packages for various IndustryPack modules, and numerous third-party applications for MC680*x*0-based systems. Contact your local Motorola sales office or distribution for more information.

Required Equipment

The following equipment is required to complete an MVME162LX system:

- System console terminal
- Disk drives and controllers
- Operating system

As mentioned earlier, transition modules are unnecessary, as the controller incorporates industry-standard SCSI, Ethernet, and RJ45 serial connectors on its front panel.

Features

General features of the MVME162LX Embedded Controller are shown in the following table:

Feature	Description	Models
Microprocessor	MC68LC040	See Table 1-1
	MC68040	See Table 1-1
Memory	1 or 4 MB of parity-protected DRAM	See Table 1-1
	4, 8, 16, or 32 MB of ECC-protected DRAM	See Table 1-1
	128 KB of SRAM (with battery backup)	All models
	1 MB of Flash memory	All models
Real-time clock	8KB NVRAM with RTC and battery backup (SGS-Thomson M48T18)	All models
Switches	RESET and ABORT	All models
Status LEDs	Four: FAIL, RUN, SCON, and FUSES	All models
Tick timers	Four programmable 32-bit timers	All models

Feature	Description	Models
Watchdog timer	Provided in MCchip ASIC (VMEchip2)	All models
Serial I/O	EIA-232-D DTE serial interface with four serial ports (Zilog Z85230 controller chips)	See Table 1-1
SCSI I/O	Optional Small Computer Systems Interface (SCSI) bus interface with 32-bit local bus burst Direct Memory Access (DMA) (NCR 53C710 controller)	See Table 1-1
Ethernet I/O	Optional LAN Ethernet transceiver interface with 32-bit local bus DMA (Intel 82596CA controller)	See Table 1-1
IndustryPack Interfaces	2 or 4 IndustryPack Interface sites	See Table 1-1
VMEbus interface (Optional) **NOTE:** **This option is a factory installed and cannot be added in the field.**	VMEbus system controller	All models
	VMEbus requester	
	VMEbus interrupter	
	VMEbus interrupt handler	
	Eight software interrupts	
	Programmable map decoders for the master and slave interfaces	
	VMEbus to local bus interface (A24/A32, D8/D16/D32 (D8/D16/D32/D64 BLT) (BLT = Block Transfer)	
	Local-bus-to-VMEbus interface (A16/A24/A32, D8/D16/D32)	
	Two 32-bit programmable Tick Timers and a programmable Watchdog Timer (in the VMEchip2 ASIC) for periodic interrupts	
	Global CSR for interprocessor communications	
	DMA for fast local memory - VMEbus transfers (A16/A24/A32, D16/D32 [D16/D32/D64 BLT])	

Specifications

Table 1-2 lists the specifications for an MVME162LX Embedded Controller without IndustryPacks.

Table 1-2. MVME162LX Specifications

Characteristics	Specifications
Power requirements (with EPROMs; without IPs)	+5Vdc (± 5%), 3.5 A typical, 4.5 A maximum +12 Vdc (± 5%), 100 mA maximum -12 Vdc (± 5%), 100 mA maximum
Operating temperature	0° to 70° C exit air with forced air cooling (see NOTE)
Storage temperature	-40° to +85° C
Relative humidity	5% to 90% (noncondensing)
Physical dimensions PC board with mezzanine module only Height Depth Thickness PC board with connectors and front panel Height Depth Thickness	Double-high VMEboard 9.20 inches (233 mm) 6.30 inches (160 mm) 0.66 inch (17 mm) 10.3 inches (262 mm) 7.4 inches (188 mm) 0.80 inch (20 mm)

Note: Refer to the sections on the following pages for information on *Cooling Requirements* and *Special Requirements for Elevated-Temperature Operation.*

Cooling Requirements

The Motorola MVME162LX Embedded Controller is designed and tested to operate reliably with an incoming air temperature range of 0° to 55° C (32° to 131° F). This is accomplished with forced air cooling at a velocity typically achievable by a 100 CFM axial fan. Temperature qualification is performed in a standard Motorola VME system chassis. 25 watt load boards are inserted in two card slots (one on each side), adjacent to the board under test, to simulate a high power density system configuration. An assembly of three axial fans, rated at 100 CFM per fan, is placed directly under the VME card cage. The incoming air temperature is measured between the fan assembly and the card cage, where the incoming airstream first encounters the controller under test. Test software is executed as the controller is subjected to ambient temperature variations. Case temperatures of critical, high power density integrated circuits are monitored to ensure the component vendor's specifications are not exceeded.

While the exact amount of air flow required for cooling depends on the ambient air temperature and the type, number, and location of boards and other heat sources; adequate cooling can usually be achieved with 10 CFM and 490 LFM flowing over the controller. Less air flow is required to cool the controller in environments having lower maximum ambient temperatures. Under more favorable thermal conditions, it may be possible to operate the controller reliably at higher than 55° C with increased air flow. It is important to note that there are several factors (in addition to the rated CFM of the fan), which determine the actual volume and speed of air flowing over the controller.

Special Considerations for Elevated-Temperature Operation

This section provides information pertinent to users whose applications for the MVME162LX Embedded Controller may subject it to high temperatures.

The controller's design uses commercial grade devices. Therefore, it can operate within an air temperature range of 0° C to 70° C. There are many factors that affect the ambient temperature felt by components on the controller: inlet air temperature; air flow characteristics; number, types, and locations of IndustryPack modules; power dissipation of adjacent boards in the system, etc.

A temperature profile of an MVME162LX Embedded Controller (MVME162-223) was developed in an MVME945 12-slot VME chassis. This board was loaded with one GreenSpring IP-Dual P/T module (position a) and one GreenSpring IP-488 module (position b). One twenty-five-watt load board was installed adjacent to each side of the board under test. The exit air velocity was approximately 200 LFM between the controller and the IP-Dual P/T module. Under these conditions, a 10° C rise between the inlet and exit air was observed. At 70° C exit air temperature (60° C inlet air), the junction temperatures of devices on the controller were calculated (from the measured case temperatures) and did not exceed 100° C.

The following are some steps that the user can take to help make elevated temperature operation possible:

1. Position the MVME162LX Embedded Controller in the chassis for maximum air flow over the component side of the board.
2. Avoid placing boards with high power dissipation adjacent to the controller.
3. Use low power IndustryPack modules only.

Manual Terminology

Throughout this manual, a convention is used which precedes data and address parameters by a character identifying the numeric format as follows:

$	dollar	specifies a hexadecimal character
%	percent	specifies a binary number
&	ampersand	specifies a decimal number

For example, "12" is the decimal number twelve, and "$12" is the decimal number eighteen. Unless otherwise specified, all address references are in hexadecimal.

An asterisk (*) following the signal name for signals which are level significant denotes that the signal is true or valid when the signal is low.

An asterisk (*) following the signal name for signals which are edge significant denotes that the actions initiated by that signal occur on high to low transition.

In this manual, assertion and negation are used to specify forcing a signal to a particular state. In particular, assertion and assert refer to a signal that is active or true; negation and negate indicate a signal that is inactive or false. These terms are used independently of the voltage level (high or low) that they represent.

Data and address sizes are defined as follows:

- A byte is eight bits, numbered 0 through 7, with bit 0 being the least significant.
- A word is 16 bits, numbered 0 through 15, with bit 0 being the least significant.
- A longword is 32 bits, numbered 0 through 31, with bit 0 being the least significant.

The terms "control bit" and "status bit" are used extensively in this document. The term control bit is used to describe a bit in a register that can be set and cleared under software control. The term "true" is used to indicate that a bit is in the state that enables the function it controls. The term "false" is used to indicate that the bit is in the state that disables the function it controls. In all tables, the terms 0 and 1 are used to describe the actual value that should be written to the bit, or the value that it yields when read. The term status bit is used to describe a bit in a register that reflects a specific condition. The status bit can be read by software to determine operational or exception conditions.

Block Diagram

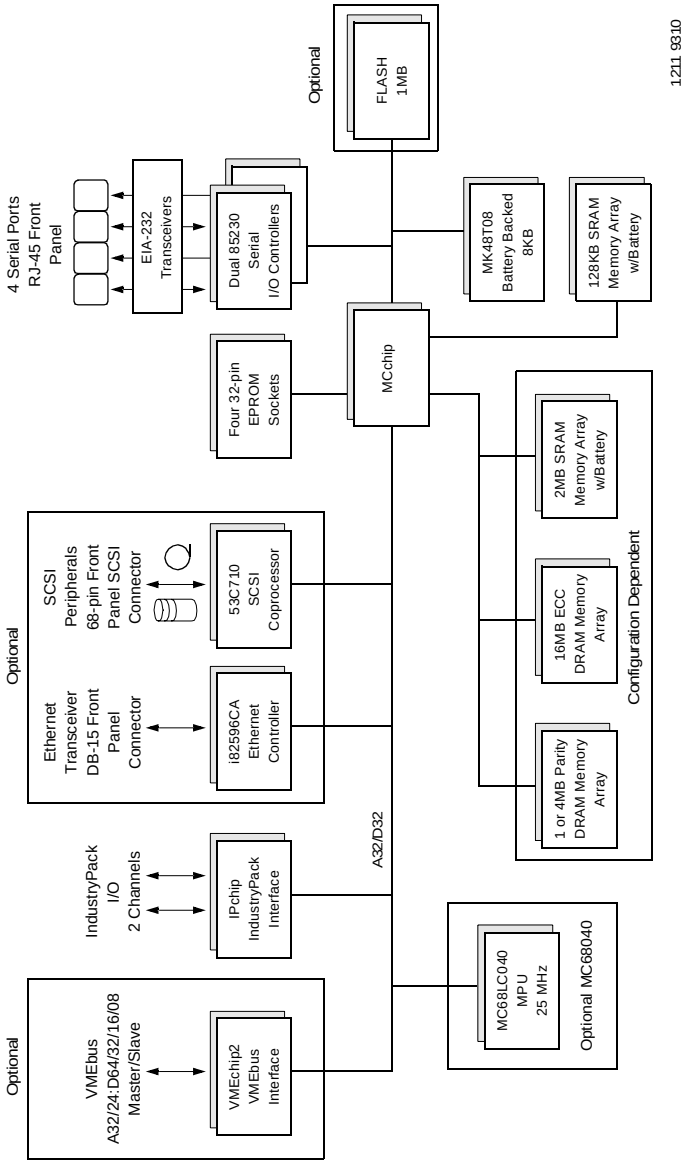


Figure 1-1. MVME162LX Block Diagram

Functional Description

This section contains a functional description of the MVME162LX Embedded Controller.

Switches and LEDs

The controller's front panel has an ABORT and RESET switch and four light-emitting diode (LED) indicators (FAIL, RUN, SCON, FUSES).

ABORT Switch

When enabled by software, the ABORT switch generates an interrupt at a user-programmable level. It is normally used to abort program execution and return to the 162Bug debugger firmware located in the controller's EPROMs and flash memory.

The ABORT switch interrupter in the MCchip ASIC is an edge-sensitive interrupter connected to the ABORT switch. This interrupter is filtered to remove switch bounce.

RESET Switch

Note: For an MVME162LX without the VMEbus option (no VMEchip2), the LCSR control bit is not available to reset the module. In this case, the watchdog timer is allowed to time out to reset the controller.

The RESET switch resets all onboard devices; it also drives SYSRESET* if the MVME162LX is operating as system controller. The RESET switch may be disabled by software.

The VMEchip2 includes both a global and a local reset driver. When the VMEchip2 operates as the VMEbus system controller, the reset driver provides a global system reset by asserting the VMEbus signal SYSRESET*. A SYSRESET* may be generated by the RESET switch, a power-up reset, a watchdog timeout, or by a control bit in the LCSR (local control/status register) in the VMEchip2. SYSRESET* remains asserted for at least 200 msec, as required by the VMEbus specification.

Similarly, the VMEchip2 provides an input signal and a control bit to initiate a local reset operation. By setting a control bit, software can maintain a board in a reset state, disabling a faulty board from participating in normal system operation. The local reset driver is enabled even when the VMEchip2 is not the system controller. A local reset may be generated by the RESET switch, a power-up reset, a watchdog timeout, a VMEbus SYSRESET*, or by a control bit in the global control/status register (GCSR).

Front Panel Indicators

There are four LEDs on the MVME162LX front panel: FAIL, RUN, SCON, and FUSES.

- FAIL LED (red). Lights when the BRDFAIL* signal line is active or when the processor is halted. Part of DS1.
- RUN LED (green or amber). Lights when the local bus TIP* signal line is low. This indicates one of the local bus masters is executing a local bus cycle. Part of DS1.
- SCON LED (green). Lights when the VMEchip2 in the MVME162LX is the VMEbus system controller. Part of DS2.
- FUSES LED (green). Lights when +5 Vdc, +12 Vdc, and -12 Vdc power is available to the LAN, IP, and SCSI interfaces. Part of DS2.

Data Bus Structure

The local bus on the MVME162LX Embedded Controller is a 32-bit synchronous bus that is based on the MC68040 bus, and supports burst transfers and snooping. The various local bus master and slave devices use the local bus to communicate. The local bus is arbitrated by priority type arbiter and the priority of the local bus masters from highest to lowest is: 82596CA LAN, 53C710 SCSI, VMEbus, and MPU. In the general case, any master can access any slave; however, not all combinations pass the common sense test. Refer to the *MVME162LX Embedded Controller Programmer's Reference Guide* to determine its port size, data bus connection, and any restrictions that apply when accessing the device.

MC68040 or MC68LC040 CPU

The MC68040 or MC68LC040 processor is used on the MVME162LX. The MC68040 has on-chip instruction and data caches and a floating point processor. The major difference between the two processors is that the MC68040 has a floating point coprocessor. Refer to the M68040 user's manual for additional information.

MC68*XX*040 Cache

The MVME162LX local bus masters (VMEchip2, MC68*XX*040, 53C710 SCSI controller, and 82596CA Ethernet controller) have programmable control of the snoop/caching mode. The MVME162LX local bus slaves which support MC68*XX*040 bus snooping are defined in the Local Bus Memory Map table later in this chapter.

No VMEbus Interface Option

The MVME162LX can be operated as an embedded controller without the VMEbus interface. To support this feature, certain logic in the VMEchip2 has been duplicated in the MCchip. This logic is inhibited in the MCchip if the VMEchip2 is present. The enables for these functions are controlled by software and MCchip hardware initialization.

Memory Options

The following memory options are used on the different versions of MVME162LX Embedded Controller boards.

DRAM Options

The controller offers various DRAM options (see Table 1-1): either 1 MB or 4 MB of parity-protected DRAM, or 4, 8, 16, or 32 MB ECC DRAM on a mezzanine board. Parity protection can be enabled with interrupts or bus exception when a parity error is detected. DRAM performance is specified in the *MVME162LX Embedded Controller Programmer's Reference Guide* in the section on the DRAM Memory Controller in the MCchip Programming Model.

The DRAM map decoder can be programmed to accommodate different base address(es) and sizes of mezzanine boards. The onboard DRAM is disabled by a local bus reset and must be programmed before the DRAM can be accessed. Refer to the MCchip and MCECC descriptions in the *MVME162LX Embedded Controller Programmer's Reference Guide* for detailed programming information.

Most DRAM devices require some number of access cycles before the DRAMs are fully operational. Normally this requirement is met by the onboard refresh circuitry and normal DRAM initialization. However, software should insure a minimum of 10 initialization cycles are performed to each bank of RAM.

SRAM Options

The controller provides 128 KB of 32-bit-wide onboard static RAM in a single non-interleaved architecture with onboard battery backup.

The battery backup function for the onboard SRAM is provided by a Dallas DS1210S device that supports primary and secondary power sources. In the event of a main board power failure, the DS1210S checks power sources and switches to the source with the higher voltage.

If the voltage of the backup source is less than two volts, the DS1210S blocks the second memory cycle; this allows software to provide an early warning to avoid data loss. Because the second access may be blocked during a power failure, software should do at least two accesses before relying on the data.

The controller provides jumpers (on J13) that allow either power source of the DS1210S to be connected to the VMEbus +5V STDBY pin or to one cell of the onboard battery. For example, the primary system backup source may be a battery connected to the VMEbus +5V STDBY pin and the secondary source may be the onboard battery. If the system source should fail or the board is removed from the chassis, the onboard battery takes over.

Further details on SRAM configuration and specifics on SRAM performance can be found in the section on the SRAM Memory Controller in the MCchip Programming Model in the *MVME162LX Embedded Controller Programmer's Reference Guide*. The SRAM arrays are not parity protected.



Caution

For proper operation of the SRAM, some jumper combination must be installed on the respective Backup Power Source Select Header. Refer to the jumper information in Chapter 2. If one of the jumpers is used to select the battery, the battery must be installed on the MVME162LX. The SRAM may malfunction if inputs to the DS1210S are left unconnected.

The SRAM is controlled by the MCchip, and the access time is programmable. Refer to the MCchip description in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information.

SRAM Batteries



Caution

Lithium batteries incorporate inflammable materials such as lithium and organic solvents. If lithium batteries are mistreated or handled incorrectly, they may burst open and ignite, possible resulting in injury and/or fire.

When dealing with lithium batteries, carefully follow the precautions listed below in order to prevent accidents.

- **Do not short circuit.**
- **Do not disassemble, deform, or apply excessive pressure.**
- **Do not heat or incinerate.**
- **Do not apply solder directly.**
- **Do not use different models, or new and old batteries together.**
- **Do not charge.**
- **Always check proper polarity.**

The power source for the onboard SRAM is a RAYOVAC FB1225 battery with two BR1225 type lithium cells. The battery is socketed for easy removal and replacement. The power source for the mezzanine SRAM is a Sanyo CR2430 battery. Small capacitors are provided so that the batteries can be quickly replaced without data loss.

The lifetime of the batteries is very dependent on the ambient temperature of the board and the power-on duty cycle. The lithium batteries supplied on the controller and on the SRAM mezzanine module should provide at least two years of backup time with the board powered off and with an ambient temperature of 40° C. If the power-on duty cycle is 50% (the board is powered on half of the time), the battery lifetime is four years. At lower ambient temperatures, the backup time is significantly longer and may approach the shelf life of the battery.

When a controller is stored, the battery should be disconnected to prolong battery life. This is especially important at high ambient temperatures. The controller is shipped with the batteries disconnected (with VMEbus +5V standby voltage selected as both primary and secondary power source). If you intend to use the battery as a power source, whether primary or secondary, it is necessary to reconfigure the jumpers on J13 before installing the module.

The power leads from the battery are exposed on the solder side of the board. The board should not be placed on a conductive surface or stored in a conductive bag unless the battery is removed.

To remove the battery from the module, carefully pull the battery from the socket. Before installing a new battery, ensure that the battery pins are clean. Note the battery polarity and press the battery into the socket. When the battery is in the socket, no soldering is required.

EPROM and Flash Memory

The MVME162LX Embedded Controller comes with 1 MB of flash memory and four EPROM sockets ready for the installation of EPROMs, which may be ordered separately. Flash memory is a single Intel 28F008SA device organized in a 1Mbit x 8 configuration. The EPROM locations are standard JEDEC 32-pin DIP sockets accommodating four jumper-selectable densities (128 Kbit x 8; 256 Kbit X 8; 512 Kbit x 8; 1 Mbit x8). A jumper setting (GPIO3, pins 7-8 on J11), allows reset code to be fetched either from flash memory (GPIO3 installed) or from EPROMs (GPIO3 removed).

Battery Backed Up RAM and Clock

An MK48T08 RAM and clock chip is used on the MVME162LX. This chip provides a time-of-day clock, oscillator, crystal, power fail detection, memory write protection, 8KB of RAM, and a battery in one 28-pin package. The clock provides seconds, minutes, hours, day, date, month, and year in BCD 24-hour format. Corrections for 28-, 29- (leap year), and 30-day months are automatically made. No interrupts are generated by the clock. Although the MK48T08 is an 8 bit device, the interface provided by the MCchip supports 8-, 16-, and 32-bit accesses to the MK48T08. Refer to the MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* and to the MK48T08 data sheet for additional programming and battery life information.

VMEbus Interface and VMEchip2

The local bus to VMEbus interface, VMEbus to local bus interface, and the DMA controller functions of the local VMEbus are provided by the VMEchip2. The VMEchip2 can also provide the VMEbus system controller functions. Refer to the VMEchip2 in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

Note that the ABORT switch logic in the VMEchip2 is not used. The GPI inputs to the VMEchip2 which are located at $FFF40088 bits 7-0 are not used. The ABORT switch interrupt is integrated into the MCchip ASIC at location $FFF42043. The GPI inputs are integrated into the MCchip ASIC at location $FFF4202C bits 23-16.

I/O Interfaces

The MVME162LX provides onboard Input/Output (I/O) for many system applications. The I/O functions include serial ports and optional interfaces for IndustryPack (IP) modules, LAN Ethernet transceivers, and SCSI mass storage devices.

I/O signals are routed through industry-standard connectors on the controller's front panel; no adapter boards or transition modules are necessary. I/O connections on the controller's front panel include an optional 68-pin SCSI connector, an optional DB15 Ethernet connector, and four 8-pin RJ45 serial connectors. In addition, the panel has cutouts for routing of flat cables to the optional IndustryPack modules.

Serial Communications Interface

The MVME162LX uses two Zilog Z85230 serial port controllers to implement the four serial communications interfaces. Each interface supports CTS, DCD, RTS, and DTR control signals, as well as the TXD and RXD transmit/receive data signals. Because the serial clocks are omitted in the controller's design, serial communications are strictly asynchronous. The controller's hardware supports serial baud rates of 110b/s to 38.4Kb/s.

The Z85230 supplies an interrupt vector during interrupt acknowledge cycles. The vector is modified based upon the interrupt source within the Z85230. Interrupt request levels are programmed via the MCchip.

The Z85230s are interfaced as DTE (data terminal equipment) with EIA-232-D signal levels. The four serial ports are routed to four RJ45 telephone connectors on the MVME162LX front panel.

Refer to the Z85230 data sheet and to the MCchip Programming Model in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information.

IndustryPack (IP) Interfaces

Up to two IndustryPack (IP) modules may be installed on the MVME162LX Embedded Controller as an option. The interface between the IPs and the MVME162LX is the IndustryPack Interface Controller (IPIC) ASIC. Access to the IPs is provided by two 3M connectors located behind the controller's front panel.

Refer to the chapter on the IPIC in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information on the IP interface.

Ethernet Interface

The MVME162LX Embedded Controller uses the 82596CA controller to implement the Ethernet transceiver interface. The 82596CA accesses local RAM using DMA operations to perform its normal functions. Because the 82596CA has small internal buffers and the VMEbus has an undefined latency period, buffer overrun may occur if the DMA is programmed to access the VMEbus. Therefore, the 82596CA should not be programmed to access the VMEbus.

Every MVME162LX that has the Ethernet interface is assigned an Ethernet Station Address. The address is $08003E2*XXXXX* where *XXXXX* is the unique 5-nibble number assigned to the board (every MVME162LX has a different value for *XXXXX*).

Each board has an Ethernet Station Address displayed on a label attached to the VMEbus P2 connector. In addition, the six bytes including the Ethernet address are stored in the configuration area of the BBRAM. That is, 08003E2*XXXXX* is stored in the BBRAM. At an address of $FFFC1F2C, the upper four bytes (08003E2*X*) can be read. At an address of $FFFC1F30, the lower two bytes (*XXXX*) can be read. The MVME162 debugger has the capability to retrieve or set the Ethernet address.

If the data in the BBRAM is lost, the user should use the number on the label on backplane connector P2 to restore it. The Ethernet transceiver interface is located on the controller's main circuit board, and the industry standard connector is located on its front panel.

Support functions for the 82596CA are provided by the MCchip ASIC. Refer to the 82596CA user's guide and to the MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

SCSI Interface

The controller supports mass storage subsystems through the industry-standard SCSI bus. These subsystems may include hard and floppy disk drives, streaming tape drives, and other mass storage devices. The SCSI interface is implemented using the NCR 53C710 SCSI I/O controller.

Support functions for the 53C710 are provided by the MCchip ASIC. The SCSI connector is located on the controller's front panel.

Refer to the NCR 53C710 user's guide and to the MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

SCSI Termination

The individual configuring the system must ensure that the SCSI bus is properly terminated at both ends. SCSI bus terminators are located on the controller. The SCSI terminators are enabled/disabled by a jumper on header J14. If the SCSI bus ends at the controller, then a jumper must be installed between J14 pins 1 and 2.

The controller provides +5 Vdc to the SCSI bus TERMPWR signal through fuse F4, located near J7. The FUSES LED (part of DS2) on the MVME162LX front panel monitors the SCSI bus TERMPWR signal in addition to LAN power; with the controller connected to an SCSI bus, the FUSES LED lights when SCSI terminator power is present.

Because any device on the SCSI bus can provide TERMPWR, the FUSES LED does not directly indicate the condition of the fuse. If the LED is not lit during SCSI bus operation, the fuse should still be checked.

Local Resources

The MVME162LX Embedded Controller includes many resources for the local processor. These include tick timers, software-programmable hardware interrupts, a watchdog timer, and a local bus timeout.

Programmable Tick Timers

Four 32-bit programmable tick timers with a 1 µs resolution are provided in the MCchip and two 32-bit programmable tick timers are provided in the optional VMEchip2. The tick timers can be programmed to generate periodic interrupts to the processor.

Refer to the VMEchip2 and MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

Watchdog Timer

A watchdog timer is provided in both the MCchip and the optional VMEchip2. The timers operate independently but in parallel. When the watchdog timers are enabled, they must be reset by software within the programmed time or they will time out. The watchdog timers can be programmed to generate a SYSRESET signal, local reset signal, or board fail signal if they time out.

The watchdog timer logic is duplicated in the VMEchip2 and MCchip ASICs. Because the watchdog timer function in the VMEchip2 is a superset of that function in the MCchip (system reset function), the timer in the VMEchip2 is used in all cases except for the version of the MVME162LX which does not include the VMEbus interface ("No VMEbus Interface" option).

Refer to the VMEchip2 and the MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

Software-Programmable Hardware Interrupts

Eight software-programmable hardware interrupts are provided by the VMEchip2. These interrupts allow software to create a hardware interrupt. Refer to the VMEchip2 in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

Local Bus Timeout

The MVME162LX Embedded Controller provides timeout functions in the VMEchip2 and the MCchip for the local bus. When the timer is enabled and a local bus access times out, a Transfer Error Acknowledge (TEA) signal is sent to the local bus master. The timeout value is selectable by software for 8 µsec, 64 µsec, 256 µsec, or infinite. The local bus timer does not operate during VMEbus bound cycles. VMEbus bound cycles are timed by the VMEbus access timer and the VMEbus global timer. The MCchip also provides local bus timeout logic for controllers without the optional VMEbus interface (without the VMEchip2).

The access timer logic is duplicated in the VMEchip2 and MCchip ASICs. Because the local bus timer in the VMEchip2 can detect an offboard access and the MCchip local bus timer cannot, the timer in the VMEchip2 is used in all cases except for the version of the controller which does not include the VMEbus interface ("No VMEbus Interface option").

Refer to the VMEchip2 and the MCchip in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional programming information.

Local Bus Arbiter

The local bus arbiter implements a fixed priority which is described in the following table.

Table 1-3. Local Bus Arbitration Priority

Device	Priority	Note
LAN	0	Highest
SCSI	1	...
VMEbus	2	Next Lowest
MC68*XX*040	3	Lowest

Connectors

The MVME162LX Embedded Controller has two 96-position DIN connectors: P1 and P2. P1 rows A, B, C, and P2 row B provide the VMEbus interconnection. P2 rows A and C are not used. The MVME162LX has a 20-pin connector J2 mounted behind the front panel. When the MVME162LX board is enclosed in a chassis and the front panel is not visible, this connector allows the reset, abort and LED functions to be extended to the control panel of the system, where they are visible.

The serial ports on the controller are connected to four 8-pin RJ45 female connectors (J17) on the front panel. The two IPs connect to the controller by two pairs of 50-pin connectors. The two 50-pin connectors behind the front panel are for external connections to IP signals. The memory mezzanine board is plugged into two 100-pin connectors. The Ethernet LAN connector is J9, a 15-pin socket connector mounted on the front panel. The SCSI connector is J10, a 68-pin socket connector is also mounted on the front panel.

Memory Maps

There are two points of view for memory maps:

1. The mapping of all resources as viewed by local bus masters (local bus memory map).
2. The mapping of onboard resources as viewed by external masters (VMEbus memory map).

The memory and I/O maps which are described in the next three tables are correct for all local bus masters. There is some address translation capability in the VMEchip2. This allows multiple MVME162LXs on the same VMEbus with different virtual local bus maps as viewed by different VMEbus masters.

Local Bus Memory Map

The local bus memory map is split into different address spaces by the transfer type (TT) signals. The local resources respond to the normal access and interrupt acknowledge codes.

Normal Address Range

The memory map of devices that respond to the normal address range is shown in the following tables. The normal address range is defined by the Transfer Type (TT) signals on the local bus. On the MVME162LX Embedded Controller, Transfer Types 0, 1, and 2 define the normal address range. Table 1-4 is the entire map from $00000000 to $FFFFFFFF. Many areas of the map are user-programmable, and suggested uses are shown in the table. The cache inhibit function is programmable in the MC68*XX*040 MMU. The onboard I/O space must be marked cache inhibit and serialized in its page table. Table 1-5 further defines the map for the local I/O devices.

Table 1-4. Local Bus Memory Map

Address Range	Devices Accessed	Port Width	Size	Software Cache Inhibit	Notes
Programmable	DRAM on Parity Mezzanine	D32	1MB-4MB	N	2
Programmable	DRAM on ECC Mezzanine	D32	16MB	N	2
Programmable	On-Board SRAM	D32	128KB	N	2, 7
Programmable	SRAM on Mezzanine	D32	2MB	N	2, 7
Programmable	VMEbus A32/A24	D32/D16	--	Y/N	4
Programmable	IP_a Memory	D32-D8	64KB-8MB	Y/N	2, 4
Programmable	IP_b Memory	D32-D8	64KB-8MB	Y/N	2, 4
$FF800000-$FF9FFFFF	Flash/EPROM	D32	2MB	N	1, 5
$FFA00000-$FFBFFFFF	EPROM/Flash	D32	2MB	N	5
$FFC00000-$FFDFFFFF	Not Decoded	D32	2MB	N	7
$FFE00000-$FFE1FFFF	On-Board SRAM Default	D32	128KB	N	7
$FFE80000-$FFEFFFFF	Not Decoded	--	512KB	N	6
$FFF00000-$FFFEFFFF	Local I/O Devices (Refer to next table)	D32-D8	878KB	Y	3
$FFFF0000-$FFFFFFFF	VMEbus A16	D32/D16	64KB	Y/N	2, 4

Notes

1. Devices mapped at $FFF80000-$FFF9FFFF also appear at $00000000- $001FFFFF when the ROM0 bit in the MCchip EPROM control register is high (ROM0=1). ROM0 is set to 1 after each reset. The ROM0 bit must be cleared before other resources (DRAM or SRAM) can be mapped in this range ($00000000 - $001FFFFF).

2. The EPROM/Flash memory map is also controlled by the EPROM size and by control bit V19 in the MCchip ASIC. Refer to the EPROM/Flash configuration tables in the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information.

3. This area is user-programmable. The DRAM and SRAM decoder is programmed in the MCchip, the local-to-VMEbus decoders are programmed in the VMEchip2, and the IP memory space is programmed in the IPIC.

4. Size is approximate.

5. Cache inhibit depends on the devices in the area mapped.

6. The EPROM and Flash are dynamically sized by the MCchip ASIC from an 8-bit private bus to the 32-bit MPU local bus.

7. These areas are not decoded unless one of the programmable decoders is initialized to decode this space. If they are not decoded and the local timer is enabled, an access to this address range will generate a local bus timeout.

8. SRAM is 128 KB.

The following table focuses on the ‘‘Local I/O Devices’’ portion of the local bus main memory map.

Note The IPIC chip on the MVME162LX supports up to four IndustryPack (IP) interfaces, designated IP_a through IP_d. The MVME162LX itself accommodates two IPs: IP_a and IP_b. In the following map, the segments applicable to IP_c and IP_d are not used in the controller.

Table 1-5. Local I/O Devices Memory Map

Address Range	Devices Accessed	Port Width	Size	Notes
$FFF00000 - $FFF3FFFF	Reserved	- -	256 KB	4
$FFF40000 - $FFF400FF	VMEchip2 (LCSR)	D32	256 B	1, 3
$FFF40100 - $FFF401FF	VMEchip2 (GCSR)	D32-D8	256 B	1, 3
$FFF40200 - $FFF40FFF	Reserved	- -	3.5 KB	4, 5
$FFF41000 - $FFF41FFF	Reserved	- -	4 KB	4
$FFF42000 - $FFF42FFF	MCchip	D32-D8	4 KB	1
$FFF43000 - $FFF430FF	MCECC #1	D8	256 B	1, 9
$FFF43100 - $FFF431FF	MCECC #2	D8	256 B	1, 9
$FFF43200 - $FFF43FFF	MCECCs (repeated)	- -	3.5 KB	1, 5, 9
$FFF44000 - $FFF44FFF	Reserved	- -	8 KB	4
$FFF45000 - $FFF45800	SCC #1 (Z85230)	D8	2 KB	1, 2
$FFF45801 - $FFF45FFF	SCC #2 (Z85230)	D8	2 KB	1, 2
$FFF46000 - $FFF46FFF	LAN (82596CA)	D32	4 KB	1, 6
$FFF47000 - $FFF47FFF	SCSI (53C710)	D32-D8	4 KB	1
$FFF48000 - $FFF57FFF	Reserved	- -	64 KB	4
$FFF58000 - $FFF5807F	IPIC IP_a I/O	D16	128 B	1
$FFF58080 - $FFF580FF	IPIC IP_a ID	D16	128 B	1
$FFF58100 - $FFF5817F	IPIC IP_b I/O	D16	128 B	1
$FFF58180 - $FFF581FF	IPIC IP_b ID Read	D16	128 B	1

Table 1-5. Local I/O Devices Memory Map (Continued)

Address Range	Devices Accessed	Port Width	Size	Notes
$FFF58200 - $FFF5827F	IPIC IP_c I/O	D16	128 B	8
$FFF58280 - $FFF582FF	IPIC IP_c ID	D16	128 B	8
$FFF58300 - $FFF5837F	IPIC IP_d I/O	D16	128 B	8
$FFF58380 - $FFF583FF	IPIC IP_d ID Read	D16	128 B	8
$FFF58400 - $FFF584FF	IPIC IP_ab I/O	D32-D16	256 B	1
$FFF58500 - $FFF585FF	IPIC IP_cd I/O	D32-D16	256 B	8
$FFF58600 - $FFF586FF	IPIC IP_ab I/O Repeated	D32-D16	256 B	1
$FFF58700 - $FFF587FF	IPIC IP_cd I/O Repeated	D32-D16	256 B	8
$FFF58800 - $FFF5887F	Reserved	- -	128 B	1
$FFF58880 - $FFF588FF	Reserved	- -	128 B	1
$FFF58900 - $FFF5897F	Reserved	- -	128 B	1
$FFF58980 - $FFF589FF	Reserved	- -	128 B	1
$FFF58A00 - $FFF58A7F	Reserved	- -	128 B	1
$FFF58A80 - $FFF58AFF	Reserved	- -	128 B	1
$FFF58B00 - $FFF58B7F	Reserved	- -	128 B	1
$FFF58B80 - $FFF58BFF	Reserved	- -	128 B	1
$FFF58C00 - $FFF58CFF	Reserved	- -	256 B	1
$FFF58D00 - $FFF58DFF	Reserved	- -	256 B	1
$FFF58E00 - $FFF58EFF	Reserved	- -	256 B	1
$FFF58F00 - $FFF58FFF	Reserved	- -	256 B	1
$FFFBC000 - $FFFBC01F	IPIC Registers	D32-D8	2 KB	1
$FFFBC800 - $FFFBC81F	Reserved	- -	2 KB	1
$FFFBD000 - $FFFBFFFF	Reserved	- -	12 KB	4
$FFFC0000 - $FFFC7FFF	MK48T08 (BBRAM, TOD Clock)	D32-D8	32 KB	1
$FFFC8000 - $FFFCBFFF	MK48T08 & Disable Flash writes	D32-D8	16 KB	1, 7

Table 1-5. Local I/O Devices Memory Map (Continued)

Address Range	Devices Accessed	Port Width	Size	Notes
$FFFCC000 - $FFFCFFFF	MK48T08 & Enable Flash writes	D32-D8	16 KB	1, 7
$FFFD0000 - $FFFEFFFF	Reserved	- -	128 KB	4

Notes

1. For a complete description of the register bits, refer to the data sheet for the specific chip. For a more detailed memory map, refer to the following detailed peripheral device memory maps

2. The SCC is an 8-bit device located on an MCchip private data bus. Byte access is required.

3. Writes to the LCSR in the VMEchip2 must be 32 bits. LCSR writes of 8 or 16 bits terminate with a TEA signal. Writes to the GCSR may be 8, 16 or 32 bits. Reads to the LCSR and GCSR may be 8, 16 or 32 bits. Byte reads should be used to read the interrupt vector.

4. This area does not return an acknowledge signal. If the local bus timer is enabled, the access times out and is terminated by a TEA signal.

5. Size is approximate.

6. Port commands to the 82596CA must be written as two 16-bit writes: upper word first and lower word second.

7. Refer to the Flash and EPROM Interface section in the MCchip description in Chapter 3.

8. Not used.

9. To use this area, the ECC mezzanine board must be installed. If it is not installed, no acknowledge signal is returned; if the local bus timer is enabled, the access times out and is terminated by a TEA signal.

Detailed I/O Memory Maps

The following tables provide detailed memory maps for the VMEchip2, MCchip, the MCECC memory controller chip, the Zilog Z85230, the Intel 82596CA controller, the NCR 53C710 controller, the IPIC chip, and the MK48T08 BBRAM/TOD Clock.

Tables X-X - XX define the programming model for the Local Control and Status Registers (LCSR) in the VMEchip2. The local bus map decoder for the LCSR is included in the VMEchip2. The base address of the LCSR is $FFF40000 and the registers are 32-bits wide. Byte, two-byte, and four-byte read operations are permitted: however, byte and two-byte write operations are not permitted. Byte and two-byte write operations return a TEA signal to the local bus. Read-modify-write operations should be used to modify a byte or a two-byte of a register.

Each register definition includes a table with 5 lines:

- Line 1 is the base address of the register and the number of bits defined in the table.
- Line 2 shows the bits defined by this table.
- Line 3 defines the name of the register or the name of the bits in the register.
- Line 4 defines the operations possible on the register bits as follows:

  R This bit is a read-only status bit.
  R/W This bit is readable and writable.
  W/AC This bit can be set and it is automatically cleared. This bit can also be read.
  C Writing a one to this bit clears this bit or another bit. This bit reads zero.
  S Writing a one to this bit sets this bit or another bit. This bit reads zero.

- Line 5 defines the state of the bit following a reset as follows:

  P The bit is affected by powerup reset.
  S The bit is affected by SYSRESET.
  L The bit is affected by local reset.
  X The bit is not affected by reset.

Table 1-6. VMEchip2 Memory Map - LCSR Summary (Sheet 1 of 2)

VMEchip2 LCSR Base Address = $FFF40000

OFFSET:

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0	SLAVE ENDING ADDRESS 1															
4	SLAVE ENDING ADDRESS 2															
8	SLAVE ADDRESS TRANSLATION ADDRESS 1															
C	SLAVE ADDRESS TRANSLATION ADDRESS 2															
10					ADDER 2	SNP 2			WP 2	SUP 2	USR 2	A32 2	A24 2	BLK D64 2	BLK 2	PRGM 2	DATA 2
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
14	MASTER ENDING ADDRESS 1															
18	MASTER ENDING ADDRESS 2															
1C	MASTER ENDING ADDRESS 3															
20	MASTER ENDING ADDRESS 4															
24	MASTER ADDRESS TRANSLATION ADDRESS 4															
28	MAST D16 EN	MAST WP EN	MASTER AM 4						MAST D16 EN	MAST WP EN	MASTER AM 3					
2C	GCSR GROUP SELECT								GCSR BOARD SELECT				MAST 4 EN	MAST 3 EN	MAST 2 EN	MAST 1 EN
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
30											WAIT RMW	ROM ZERO	DMA TB SNP MODE		SRAM SPEED	
34																
38	DMA CONTROLLER															
3C	DMA CONTROLLER															
40	DMA CONTROLLER															
44	DMA CONTROLLER															
48		TICK 2/1	TICK IRQ 1 EN	CLR IRQ	IRQ STAT	VMEBUS INTERRUPT LEVEL			VMEBUS INTERRUPT VECTOR							

This sheet continues on facing page. →

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SLAVE STARTING ADDRESS 1															
SLAVE STARTING ADDRESS 2															
SLAVE ADDRESS TRANSLATION SELECT 1															
SLAVE ADDRESS TRANSLATION SELECT 2															
				ADDER 1	SNP 1		WP 1	SUP 1	USR 1	A32 1	A24 1	BLK D64 1	BLK 1	PRGM 1	DATA 1
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MASTER STARTING ADDRESS 1															
MASTER STARTING ADDRESS 2															
MASTER STARTING ADDRESS 3															
MASTER STARTING ADDRESS 4															
MASTER ADDRESS TRANSLATION SELECT 4															
MAST D16 EN	MAST WP EN	MASTER AM 2						MAST D16 EN	MAST WP EN	MASTER AM 1					
IO2 EN	IO2 WP EN	IO2 S/U	IO2 P/D	IO1 EN	IO1 D16 EN	IO1 WP EN	IO1 S/U	ROM SIZE		ROM BANK B SPEED			ROM BANK A SPEED		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ARB ROBN	MAST DHB	MAST DWB		MST FAIR	MST RWD	MASTER VMEBUS		DMA HALT	DMA EN	DMA TBL	DMA FAIR	DM RELM		DMA VMEBUS	
DMA TBL INT	DMA LB SNP MODE			DMA INC VME	DMA INC LB	DMA WRT	DMA D16	DMA D64 BLK	DMA BLK	DMA AM 5	DMA AM 4	DMA AM 3	DMA AM 2	DMA AM 1	DMA AM 0
LOCAL BUS ADDRESS COUNTER															
VMEBUS ADDRESS COUNTER															
BYTE COUNTER															
TABLE ADDRESS COUNTER															
DMA TABLE INTERRUPT COUNT				MPU CLR STAT	MPU LBE ERR	MPU LPE ERR	MPU LOB ERR	MPU LTO ERR	DMA LBE ERR	DMA LPE ERR	DMA LOB ERR	DMA LTO ERR	DMA TBL ERR	DMA VME ERR	DMA DONE

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Table 1-6. VMEchip2 Memory Map - LCSR Summary (Sheet 2 of 2)

VMEchip2 LCSR Base Address = $FFF40000
OFFSET:

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
4C								ARB BGTO EN	DMA TIME OFF			DMA TIME ON			VME GLOBAL TIMER	
50	TICK TIMER 1															
54	TICK TIMER 1															
58	TICK TIMER 2															
5C	TICK TIMER 2															
60		SCON	SYS FAIL	BRD FAIL STAT	PURS STAT	CLR PURS STAT	BRD FAIL OUT	RST SW EN	SYS RST	WD CLR TO	WD CLR CNT	WD TO STAT	TO BF EN	WD SRST LRST	WD RST EN	WD EN
64	PRE															
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
68	AC FAIL IRQ	AB IRQ	SYS FAIL IRQ	MWP BERR IRQ	PE IRQ	IRQ1E IRQ	TIC2 IRQ	TIC1 IRQ	VME IACK IRQ	DMA IRQ	SIG3 IRQ	SIG2 IRQ	SIG1 IRQ	SIG0 IRQ	LM1 IRQ	LM0 IRQ
6C	EN IRQ 31	EN IRQ 30	EN IRQ 29	EN IRQ 28	EN IRQ 27	EN IRQ 26	EN IRQ 25	EN IRQ 24	EN IRQ 23	EN IRQ 22	EN IRQ 21	EN IRQ 20	EN IRQ 19	EN IRQ 18	EN IRQ 17	EN IRQ 16
70																
74	CLR IRQ 31	CLR IRQ 30	CLR IRQ 29	CLR IRQ 28	CLR IRQ 27	CLR IRQ 26	CLR IRQ 25	CLR IRQ 24	CLR IRQ 23	CLR IRQ 22	CLR IRQ 21	CLR IRQ 20	CLR IRQ 19	CLR IRQ 18	CLR IRQ 17	CLR IRQ 16
78		AC FAIL IRQ LEVEL				ABORT IRQ LEVEL				SYS FAIL IRQ LEVEL				MST WP ERROR IRQ LEVEL		
7C		VME IACK IRQ LEVEL				DMA IRQ LEVEL				SIG 3 IRQ LEVEL				SIG 2 IRQ LEVEL		
80		SW7 IRQ LEVEL				SW6 IRQ LEVEL				SW5 IRQ LEVEL				SW4 IRQ LEVEL		
84		SPARE IRQ LEVEL				VME IRQ 7 IRQ LEVEL				VME IRQ 6 IRQ LEVEL				VME IRQ 5 IRQ LEVEL		
88	VECTOR BASE REGISTER 0				VECTOR BASE REGISTER 1				MST IRQ EN	SYS FAIL LEVEL	AC FAIL LEVEL	ABORT LEVEL	GPIOEN			
8C																

This sheet continues on facing page. →

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VME ACCESS TIMER		LOCAL BUS TIMER		WD TIME OUT SELECT				PRESCALER CLOCK ADJUST							
COMPARE REGISTER															
COUNTER															
COMPARE REGISTER															
COUNTER															
OVERFLOW COUNTER 2					CLR OVF 2	COC EN 2	TIC EN 2	OVERFLOW COUNTER 1					CLR OVF 1	COC EN 1	TIC EN 1
SCALER															
SW7 IRQ	SW6 IRQ	SW5 IRQ	SW4 IRQ	SW3 IRQ	SW2 IRQ	SW1 IRQ	SW0 IRQ	SPARE	VME IRQ7	VME IRQ6	VME IRQ5	VME IRQ4	VME IRQ3	VME IRQ2	VME IRQ1
EN IRQ 15	EN IRQ 14	EN IRQ 13	EN IRQ 12	EN IRQ 11	EN IRQ 10	EN IRQ 9	EN IRQ 8	EN IRQ 7	EN IRQ 6	EN IRQ 5	EN IRQ 4	EN IRQ 3	EN IRQ 2	EN IRQ 1	EN IRQ 0
SET IRQ 15	SET IRQ 14	SET IRQ 13	SET IRQ 12	SET IRQ 11	SET IRQ 10	SET IRQ 9	SET IRQ 8								
CLR IRQ 15	CLR IRQ 14	CLR IRQ 13	CLR IRQ 12	CLR IRQ 11	CLR IRQ 10	CLR IRQ 9	CLR IRQ 8								
	P ERROR IRQ LEVEL				IRQ1E IRQ LEVEL				TIC TIMER 2 IRQ LEVEL				TIC TIMER 1 IRQ LEVEL		
	SIG 1 IRQ LEVEL				SIG 0 IRQ LEVEL				LM 1 IRQ LEVEL				LM 0 IRQ LEVEL		
	SW3 IRQ LEVEL				SW2 IRQ LEVEL				SW1 IRQ LEVEL				SW0 IRQ LEVEL		
	VME IRQ 4 IRQ LEVEL				VMEB IRQ 3 IRQ LEVEL				VME IRQ 2 IRQ LEVEL				VME IRQ 1 IRQ LEVEL		
GPIOO				GPIOI				GPI							
								MP IRQ EN	REV EROM	DIS SRAM	DIS MST	NO EL BBSY	DIS BSYT	EN INT	DIS BGN

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Table 1-7. MCchip Register Map

MCchip Base Address = $FFF42000

Offset	D31-D24	D23-D16	D15-D8	D7-D0
$00	MCchip ID	MCchip Revision	General Control	Interrupt Vector Base Register
$04	Tick Timer 1 Compare Register			
$08	Tick Timer 1 Counter Register			
$0C	Tick Timer 2 Compare Register			
$10	Tick Timer 2 Counter Register			
$14	LSB Prescaler Count Register	Prescaler Clock Adjust	Tick Timer 2 Control	Tick Timer 1 Control
$18	Tick Timer 4 Interrupt Control	Tick Timer 3 Interrupt Control	Tick Timer 2 Interrupt Control	Tick Timer 1 Interrupt Control
$1C	DRAM Parity Error Interrupt Control	SCC Interrupt Control	Tick Timer 4 Control	Tick Timer 3 Control
$20	DRAM Space Base Address Register		SRAM Space Base Address Register	
$24	DRAM Space Size	DRAM/SRAM Options	SRAM Space Size	(*Reserved*)
$28	LANC Error Status	(*Reserved*)	LANC Interrupt Control	LANC Bus Error Interrupt Control
$2C	SCSI Error Status	General Purpose Inputs	MVME162LX Version	SCSI Interrupt Control
$30	Tick Timer 3 Compare Register			
$34	Tick Timer 3 Counter Register			
$38	Tick Timer 4 Compare Register			
$3C	Tick Timer 4 Counter Register			
$40	Bus Clock	PROM Access Time Control	Flash Access Time Control	ABORT Switch Interrupt Control
$44	RESET Switch Control	Watchdog Timer Control	Access & Watchdog Time Base Select	(*Reserved*)
$48	DRAM Control	(*Reserved*)	MPU Status	(*Reserved*)
$4C	32-bit Prescaler Count Register			

Table 1-8. MCECC Internal Register Memory Map

MCECC Base Address = $FFF43000 (1st); $FFF43100 (2nd)

Register Offset	Register Name	Register Bit Names							
		D31	D30	D29	D28	D27	D26	D25	D24
$00	CHIP ID	CID7	CID6	CID5	CID4	CID3	CID2	CID1	CID0
$04	CHIP REVISION	REV7	REV6	REV5	REV4	REV3	REV2	REV1	REV0
$08	MEM CONFIG			FSTRD	1	0	MSIZ2	MSIZ1	MSIZ0
$0C	DUMMY 0	0	0	0	0	0	0	0	0
$10	DUMMY 1	0	0	0	0	0	0	0	0
$14	BASE ADDRESS	BAD31	BAD30	BAD29	BAD28	BAD27	BAD26	BAD25	BAD24
$18	DRAM CONTRL	BAD23	BAD22	RWB5	SWAIT	RWB3	NCEIEN	NCEBEN	RAMEN
$1C	BCLK FREQ	BCK7	BCK6	BCK5	BCK4	BCK3	BCK2	BCK1	BCK0
$20	DATA CONTRL	0	0	DERC	ZFILL	RWCKB	0	0	0
$24	SCRUB CNTRL	RACODE	RADATA	HITDIS	SCRB	SCRBEN	0	SBEIEN	IDIS
$28	SCRUB PERIOD	SBPD15	SBPD14	SBPD13	SBPD12	SBPD11	SBPD10	SBPD9	SBPD8
$2C	SCRUB PERIOD	SBPD7	SBPD6	SBPD5	SBPD4	SBPD3	SBPD2	SBPD1	SBPD0
$30	CHIP PRESCALE	CPS7	CPS6	CPS5	CPS4	CPS3	CPS2	CPS1	CPS0
$34	SCRUB TIME ON/OFF	SRDIS	0	STON2	STON1	STON0	STOFF2	STOFF1	STOFF0
$38	SCRUB PRESCALE	0	0	SPS21	SPS20	SPS19	SPS18	SPS17	SPS16
$3C	SCRUB PRESCALE	SPS15	SPS14	SPS13	SPS12	SPS11	SPS10	SPS9	SPS8
$40	SCRUB PRESCALE	SPS7	SPS6	SPS5	SPS4	SPS3	SPS2	SPS1	SPS0
$44	SCRUB TIMER	ST15	ST14	ST13	ST12	ST11	ST10	ST9	ST8

Table 1-8. MCECC Internal Register Memory Map (Continued)

MCECC Base Address = $FFF43000 (1st); $FFF43100 (2nd)

Register Offset	Register Name	Register Bit Names							
		D31	D30	D29	D28	D27	D26	D25	D24
$48	SCRUB TIMER	ST7	ST6	ST5	ST4	ST3	ST2	ST1	ST0
$4C	SCRUB ADDR CNTRL	0	0	0	0	0	SAC26	SAC25	SAC24
$50	SCRUB ADDR CNTRL	SAC23	SAC22	SAC21	SAC20	SAC19	SAC18	SAC17	SAC16
$54	SCRUB ADDR CNTRL	SAC15	SAC14	SAC13	SAC12	SAC11	SAC10	SAC9	SAC8
$58	SCRUB ADDR CNTRL	SAC7	SAC6	SAC5	SAC4	0	0	0	0
$5C	ERROR LOGGER	ERRLOG	ERD	ESCRB	ERA	EALT	0	MBE	SBE
$60	ERROR ADDRESS	EA31	EA30	EA29	EA28	EA27	EA26	EA25	EA24
$64	ERROR ADDRESS	EA23	EA22	EA21	EA20	EA19	EA18	EA17	EA16
$68	ERROR ADDRESS	EA15	EA14	EA13	EA12	EA11	EA10	EA9	EA8
$6C	ERROR ADDRESS	EA7	EA6	EA5	EA4	0	0	0	0
$70	ERROR SYNDROME	S7	S6	S5	S4	S3	S2	S1	S0
$74	DEFAULTS1	WRHDIS	STATCOL	FSTRD	SELI1	SELI0	RSIZ2	RSIZ1	RSIZ0
$78	DEFAULTS2	FRC_OPN	XY_FLIP	REFDIS	TVECT	NOCACHE	RESST2	RESST1	RESST0

Table 1-9. Z85230 SCC Register Addresses

SCC	SCC Register	Address
SCC #1	Port B Control	$FFF45001
	Port B Data	$FFF45003
	Port A Control	$FFF45005
	Port A Data	$FFF45007
SCC #2	Port B Control	$FFF45801
	Port B Data	$FFF45803
	Port A Control	$FFF45805
	Port A Data	$FFF45807

Table 1-10. 82596CA Ethernet LAN Memory Map

	Data Bits			
Address	**D31**	**D16**	**D15**	**D0**
$FFF46000	Upper Command Word		Lower Command Word	
$FFF46004	MPU Channel Attention (CA)			

Notes 1. Refer to the MPU Port and MPU Channel Attention registers in the *MVME162 Embedded Controller Programmer's Reference Guide*.

2. After resetting, you must write the System Configuration Pointer to the command registers before writing to the MPU Channel Attention register. Writes to the System Configuration Pointer must be upper word first, lower word second.

Table 1-11. 53C710 SCSI Memory Map

53C710 Register Address Map			Base Address is $FFF47000		
Big Endian Mode					**SCRIPTs and Little Endian Mode**
00	SIEN	SDID	SCNTL1	SCNTL0	00
04	SOCL	SODL	SXFER	SCID	04
08	SBCL	SBDL	SIDL	SFBR	08
0C	SSTAT2	SSTAT1	SSTAT0	DSTAT	0C
10	DSA				10
14	CTEST3	CTEST2	CTEST1	CTEST0	14
18	CTEST7	CTEST6	CTEST5	CTEST4	18
1C	TEMP				1C
20	LCRC	CTEST8	ISTAT	DFIFO	20
24	DCMD	DBC			24
28	DNAD				28
2C	DSP				2C
30	DSPS				30
34	SCRATCH				34
38	DCNTL	DWT	DIEN	DMODE	38
3C	ADDER				3C

Note Accesses may be 8-bit or 32-bit, but not 16-bit.

IPIC Overall Memory Map

The following memory map table includes all devices selected by the IPIC map decoder.

Note The IPIC chip on the MVME162LX supports up to four IndustryPack (IP) interfaces, designated IP_a through IP_d. The controller itself accommodates two IPs: IP_a and IP_b. In the maps that follow, the segments applicable to IP_c and IP_d are not used in the controller.

Table 1-12. IPIC Overall Memory Map

Address Range	Selected Device	Port Width	Size
Programmable	IP_a/IP_ab Memory Space	D32-D8	64 KB-16 MB
Programmable	IP_b Memory Space	D16-D8	64 KB-8 MB
Programmable	IP_c/IP_cd Memory Space	D32-D8	64 KB-16 MB
Programmable	IP_d Memory Space	D16-D8	64 KB-8 MB
$FFF58000-$FFF5807F	IP_a I/O Space	D16	128 B
$FFF58080-$FFF580BF	IP_a ID Space	D16	64 B
$FFF580C0-$FFF580FF	IP_a ID Space Repeated	D16	64 B
$FFF58100-$FFF5817F	IP_b I/O Space	D16	128 B
$FFF58180-$FFF581BF	IP_b ID Space	D16	64 B
$FFF581C0-$FFF581FF	IP_b ID Space Repeated	D16	64 B
$FFF58200-$FFF5827F	IP_c I/O Space	D16	128 B
$FFF58280-$FFF582BF	IP_c ID Space	D16	64 B
$FFF582C0-$FFF582FF	IP_c ID Space Repeated	D16	64 B
$FFF58300-$FFF5837F	IP_d I/O Space	D16	128 B
$FFF58380-$FFF583BF	IP_d ID Space	D16	64 B
$FFF583C0-$FFF583FF	IP_d ID Space Repeated	D16	64 B
$FFF58400-$FFF584FF	IP_ab I/O Space	D32-D16	256 B
$FFF58500-$FFF585FF	IP_cd I/O Space	D32-D16	256 B
$FFF58600-$FFF586FF	IP_ab I/O Space Repeated	D32-D16	256 B
$FFF58700-$FFF587FF	IP_cd I/O Space Repeated	D32-D16	256 B
$FFFBC000-$FFFBC01F	Control/Status Registers	D32-D8	32 B

Table 1-13 contains a summary of the IPIC CSR registers. The CSR registers can be accessed as bytes, words, or longwords; they should not be accessed as lines. They are shown in the table as bytes.

Table 1-13. IPIC Memory Map—Control and Status Registers

IPIC Base Address = $FFFBC000

Register Offset	Register Name	Register Bit Names							
		D7	D6	D5	D4	D3	D2	D1	D0
$00	CHIP ID	0	0	1	0	0	0	1	1
$01	CHIP REVISION	0	0	0	0	0	0	0	0
$02	RESERVED	0	0	0	0	0	0	0	0
$03	RESERVED	0	0	0	0	0	0	0	0
$04	IP_a MEM BASE UPPER	a_BASE31	a_BASE30	a_BASE29	a_BASE28	a_BASE27	a_BASE26	a_BASE25	a_BASE24
$05	IP_a MEM BASE LOWER	a_BASE23	a_BASE22	a_BASE21	a_BASE20	a_BASE19	a_BASE18	a_BASE17	a_BASE16
$06	IP_b MEM BASE UPPER	b_BASE31	b_BASE30	b_BASE29	b_BASE28	b_BASE27	b_BASE26	b_BASE25	b_BASE24
$07	IP_b MEM BASE LOWER	b_BASE23	b_BASE22	b_BASE21	b_BASE20	b_BASE19	b_BASE18	b_BASE17	b_BASE16
$08	IP_c MEM BASE UPPER	c_BASE31	c_BASE30	c_BASE29	c_BASE28	c_BASE27	c_BASE26	c_BASE25	c_BASE24
$09	IP_c MEM BASE LOWER	c_BASE23	c_BASE22	c_BASE21	c_BASE20	c_BASE19	c_BASE18	c_BASE17	c_BASE16
$0A	IP_d MEM BASE UPPER	d_BASE31	d_BASE30	d_BASE29	d_BASE28	d_BASE27	d_BASE26	d_BASE25	d_BASE24
$0B	IP_d MEM BASE LOWER	d_BASE23	d_BASE22	d_BASE21	d_BASE20	d_BASE19	d_BASE18	d_BASE17	d_BASE16
$0C	IP_a MEM SIZE	a_SIZE23	a_SIZE22	a_SIZE21	a_SIZE20	a_SIZE19	a_SIZE18	a_SIZE17	a_SIZE16
$0D	IP_b MEM SIZE	b_SIZE23	b_SIZE22	b_SIZE21	b_SIZE20	b_SIZE19	b_SIZE18	b_SIZE17	b_SIZE16
$0E	IP_c MEM SIZE	c_SIZE23	c_SIZE22	c_SIZE21	c_SIZE20	c_SIZE19	c_SIZE18	c_SIZE17	c_SIZE16
$0F	IP_d MEM SIZE	d_SIZE23	d_SIZE22	d_SIZE21	d_SIZE20	d_SIZE19	d_SIZE18	d_SIZE17	d_SIZE16
$10	IP_a INT0 CONTROL	a0_PLTY	a0_E/L*	a0_INT	a0_IEN	a0_ICLR	a0_IL2	a0_IL1	a0_IL0
$11	IP_a INT1 CONTROL	a1_PLTY	a1_E/L*	a1_INT	a1_IEN	a1_ICLR	a1_IL2	a1_IL1	a1_IL0
$12	IP_b INT0 CONTROL	b0_PLTY	b0_E/L*	b0_INT	b0_IEN	b0_ICLR	b0_IL2	b0_IL1	b0_IL0
$13	IP_b INT1 CONTROL	b1_PLTY	b1_E/L*	b1_INT	b1_IEN	b1_ICLR	b1_IL2	b1_IL1	b1_IL0

Table 1-13. IPIC Memory Map—Control and Status Registers (Continued)

IPIC Base Address = $FFFBC000

Register Offset	Register Name	Register Bit Names							
		D7	D6	D5	D4	D3	D2	D1	D0
$14	IP_c INT0 CONTROL	c0_PLTY	c0_E/L*	c0_INT	c0_IEN	c0_ICLR	c0_IL2	c0_IL1	c0_IL0
$15	IP_c INT1 CONTROL	c1_PLTY	c1_E/L*	c1_INT	c1_IEN	c1_ICLR	c1_IL2	c1_IL1	c1_IL0
$16	IP_d INT0 CONTROL	d0_PLTY	d0_E/L*	d0_INT	d0_IEN	d0_ICLR	d0_IL2	d0_IL1	d0_IL0
$17	IP_d INT1 CONTROL	d1_PLTY	d1_E/L*	d1_INT	d1_IEN	d1_ICLR	d1_IL2	d1_IL1	d1_IL0
$18	IP_a GENERAL CONTROL	a_ERR	0	a_RT1	a_RT0	a_WIDTH1	a_WIDTH0	0	a_MEN
$19	IP_a GENERAL CONTROL	b_ERR	0	b_RT1	b_RT0	b_WIDTH1	b_WIDTH0	0	b_MEN
$1A	IP_b GENERAL CONTROL	c_ERR	0	c_RT1	c_RT0	c_WIDTH1	c_WIDTH0	0	c_MEN
$1B	IP_b GENERAL CONTROL	d_ERR	0	d_RT1	d_RT0	d_WIDTH1	d_WIDTH0	0	d_MEN
$1C	RESERVED	0	0	0	0	0	0	0	0
$1D	RESERVED	0	0	0	0	0	0	0	0
$1E	RESERVED	0	0	0	0	0	0	0	0
$1F	IP RESET	0	0	0	0	0	0	0	RES

Table 1-14. MK48T08 BBRAM/TOD Clock Memory Map

Address Range	Description	Size (Bytes)
$FFFC0000 - $FFFC0FFF	User Area	4096
$FFFC1000 - $FFFC10FF	Networking Area	256
$FFFC1100 - $FFFC16F7	Operating System Area	1528
$FFFC16F8 - $FFFC1EF7	Debugger Area	2048
$FFFC1EF8 - $FFFC1FF7	Configuration Area	256
$FFFC1FF8 - $FFFC1FFF	TOD Clock	8

Table 1-15. BBRAM Configuration Area Memory Map

Address Range	Description	Size (Bytes)
$FFFC1EF8 - $FFFC1EFB	Version	4
$FFFC1EFC - $FFFC1F07	Serial Number	12
$FFFC1F08 - $FFFC1F17	Board ID	16
$FFFC1F18 - $FFFC1F27	PWA	16
$FFFC1F28 - $FFFC1F2B	Speed	4
$FFFC1F2C - $FFFC1F31	Ethernet Address	6
$FFFC1F32 - $FFFC1F33	Reserved	2
$FFFC1F34 - $FFFC1F35	Local SCSI ID	2
$FFFC1F36 - $FFFC1F3D	Memory Mezzanine PWB	8
$FFFC1F3E - $FFFC1F45	Memory Mezzanine Serial Number	8
$FFFC1F46 - $FFFC1F4D	Serial Port 2 Personality PWB	8
$FFFC1F4E - $FFFC1F55	Serial Port 2 Personality Serial No.	8
$FFFC1F56 - $FFFC1F5D	IP_a Board ID	8
$FFFC1F5E - $FFFC1F65	IP_a Board Serial Number	8
$FFFC1F66 - $FFFC1F6D	IP_a Board PWB	8
$FFFC1F6E - $FFFC1F75	IP_b Board ID	8
$FFFC1F76 - $FFFC1F7D	IP_b Board Serial Number	8
$FFFC1F7E - $FFFC1F85	IP_b Board PWB	8
$FFFC1F86 - $FFFC1F8D	IP_c Board ID	8
$FFFC1F8E - $FFFC1F95	IP_c Board Serial Number	8
$FFFC1F96 - $FFFC1F9D	IP_c Board PWB	8
$FFFC1F9E - $FFFC1FA5	IP_d Board ID	8
$FFFC1FA6 - $FFFC1FAD	IP_d Board Serial Number	8
$FFFC1FAE - $FFFC1FB5	IP_d Board PWB	8
$FFFC1FB6 - $FFFC1FF6	Reserved	65
$FFFC1FF7	Checksum	1

Table 1-16. TOD Clock Memory Map

Address	Data Bits D7	D6	D5	D4	D3	D2	D1	D0	Function	
$FFFC1FF8	W	R	S	--	--	--	--	--	CONTROL	
$FFFC1FF9	ST	--	--	--	--	--	--	--	SECONDS	00
$FFFC1FFA	x	--	--	--	--	--	--	--	MINUTES	00
$FFFC1FFB	x	x	--	--	--	--	--	--	HOUR	00
$FFFC1FFC	x	FT	x	x	x	--	--	--	DAY	01
$FFFC1FFD	x	x	--	--	--	--	--	--	DATE	01
$FFFC1FFE	x	x	x	--	--	--	--	--	MONTH	01
$FFFC1FFF	--	--	--	--	--	--	--	--	YEAR	00

Note W = Write BitR = Read BitS = Signbit
ST = Stop BitFT = Frequency Testx = Unuse

BBRAM, TOD Clock Memory Map

The MK48T08 BBRAM (also called Non-Volatile RAM or NVRAM) is divided into six areas as shown in Table 1-14. The first five areas are defined by software, while the sixth area, the time-of-day (TOD) clock, is defined by the chip hardware. The first area is reserved for user data. The second area is used by Motorola networking software. The third area is used by the operating system. The fourth area is used by the MVME162LX board debugger (162Bug). The fifth area, detailed in Table 1-15, is the configuration area. The sixth area, the TOD clock, detailed in Table 1-16, is defined by the chip hardware.

The data structure of the configuration bytes starts at $FFFC1EF8 and is as follows.

```
struct brdi_cnfg {
      char      version[4];
      char      serial[12];
      char      id[16];
      char      pwa[16];
      char      speed[4];
      char      ethernet[6];
      char      fill[2];
      char      lscsiid[2];
      char      mem_pwb[8];
      char      mem_serial[8];
      char      port2_pwb[8];
      char      port2_serial[8];
      char      ipa_brdid[8];
      char      ipa_serial[8];
      char      ipa_pwb[8];
      char      ipb_brdid[8];
      char      ipb_serial[8];
      char      ipb_pwb[8];
      char      ipc_brdid[8];
      char      ipc_serial[8];
      char      ipc_pwb[8];
      char      ipd_brdid[8];
      char      ipd_serial[8];
      char      ipd_pwb[8];
      char      reserved[65];
      char      cksum[1]; }
```

The fields are defined as follows:

1. Four bytes are reserved for the revision or version of this structure. This revision is stored in ASCII format, with the first two bytes being the major version numbers and the last two bytes being the minor version numbers. For example, if the version of this structure is 1.0, this field contains:
   `0100`

2. Twelve bytes are reserved for the serial number of the board in ASCII format. For example, this field could contain:
   `000000470476`

3. Sixteen bytes are reserved for the board ID in ASCII format. For example, for an MVME162LX board with MC68040, SCSI, Ethernet, 4MB DRAM, and 128 KB SRAM, this field contains:
   `MVME162-223 (The 11 characters are followed byfive blanks).`

4. Sixteen bytes are reserved for the printed wiring assembly (PWA) number assigned to this board in ASCII format. This includes the `01-W` prefix. This is for the main logic board if more than one board is required for a set. Additional boards in a set are defined by a structure for that set. For example, for an MVME162LX board with MC68040, SCSI, Ethernet, 4MB DRAM, and 128 KB SRAM at revision A, the PWA field contains:
   `01-W3866B01A (The 12 characters are followed by four blanks.)`

5. Four bytes contain the speed of the board in MHz. The first two bytes are the whole number of MHz and the second two bytes are fractions of MHz. For example, for a 25.00 MHz board, this field contains:
   `2500`

6. Six bytes are reserved for the Ethernet address. The address is stored in hexadecimal format. (Refer to the detailed description in Chapter 4.) If the board does not support Ethernet, this field is filled with zeros.

7. These two bytes are reserved.

8. Two bytes are reserved for the local SCSI ID. The SCSI ID is stored in ASCII format.
9. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the memory mezzanine board in ASCII format. This does *not* include the `01-W` prefix.
10. Eight bytes are reserved for the serial number assigned to the memory mezzanine board in ASCII format.
11. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the serial port 2 personality board in ASCII format.
12. Eight bytes are reserved for the serial number assigned to the serial port 2 personality board in ASCII format.
13. Eight bytes are reserved for the board identifier, in ASCII format, assigned to the optional first IndustryPack a.
14. Eight bytes are reserved for the serial number, in ASCII format, assigned to the optional first IndustryPack a.
15. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the optional first IndustryPack a.
16. Eight bytes are reserved for the board identifier, in ASCII format, assigned to the optional second IndustryPack b.
17. Eight bytes are reserved for the serial number, in ASCII format, assigned to the optional second IndustryPack b.
18. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the optional second IndustryPack b.
19. Eight bytes are reserved for the board identifier, in ASCII format, assigned to the optional third IndustryPack c.
20. Eight bytes are reserved for the serial number, in ASCII format, assigned to the optional third IndustryPack c.
21. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the optional third IndustryPack c.
22. Eight bytes are reserved for the board identifier, in ASCII format, assigned to the optional fourth IndustryPack d.

23. Eight bytes are reserved for the serial number, in ASCII format, assigned to the optional fourth IndustryPack d.
24. Eight bytes are reserved for the printed wiring board (PWB) number assigned to the optional fourth IndustryPack d.
25. Growth space (65 bytes) is reserved. This pads the structure to an even 256 bytes.
26. The final one byte of the area is reserved for a checksum (as defined in the *MVME162Bug Debugging Package User's Manual*) for security and data integrity of the configuration area of the NVRAM. This data is stored in hexadecimal format.

Interrupt Acknowledge Map

The local bus distinguishes interrupt acknowledge cycles from other cycles by placing the binary value %11 on TT1-TT0. It also specifies the level that is being acknowledged using TM2-TM0. The interrupt handler selects which device within that level is being acknowledged.

VMEbus Memory Map

This section describes the mapping of local resources as viewed by VMEbus masters. Default addresses for the slave, master, and GCSR address decoders are provided by the **ENV** command. Refer to Appendix A for additional information.

VMEbus Accesses to the Local Bus

The VMEchip2 includes a user-programmable map decoder for the VMEbus to local bus interface. The map decoder allows you to program the starting and ending address and the modifiers that the controller responds to.

VMEbus Short I/O Memory Map

The VMEchip2 includes a user-programmable map decoder for the GCSR. The GCSR map decoder allows you to program the starting address of the GCSR in the VMEbus short I/O space.

Software Initialization

Most functions that have been done with switches or jumpers on other modules are done by setting control registers on the MVME162LX Embedded Controller. At power-up or reset, the PROMs that contain the 162Bug debugging package set up the default values of many of these registers.

Specific programming details may be determined by study of the *M68040 Microprocessor User's Manual*. Then check the details of all the controller's onboard registers as given in the *MVME162LX Embedded Controller Programmer's Reference Guide.*

Multi-MPU Programming Considerations

Good programming practice dictates that only one MPU at a time have control of the MVME162LX control registers. Of particular note are:

- Registers that modify the address map
- Registers that require two cycles to access
- VMEbus interrupt request registers

Local Reset Operation

Local reset (LRST) is a subset of system reset (SRST). Local reset can be generated five ways:

- Expiration of the watchdog timer
- Pressing the front panel RESET switch (if the system controller function is disabled)
- By asserting a bit in the board control register in the GCSR
- By SYSRESET*
- By powerup reset.

Note The GCSR allows a VMEbus master to reset the local bus. This feature is very dangerous and should be used with caution. The local reset feature is a partial system reset, not a complete system reset such as powerup reset or SYSRESET*. When the local bus reset signal is asserted, a local bus cycle may be aborted. The VMEchip2 is connected to both the local bus and the VMEbus and if the aborted cycle is bound for the VMEbus, erratic operation may result. Communications between the local processor and a VMEbus master should use interrupts or mailbox locations; reset should not be used in normal communications. Reset should be used only when the local processor is halted or the local bus is hung and reset is the last resort.

Any VMEbus access to the MVME162LX Embedded Controller while it is in the reset state is ignored. If a global bus timer is enabled, a bus error is generated.

EMC Compliance

The MVME162LX Embedded Controller was tested in an EMC-compliant chassis and meets the requirements for Class B equipment. CE compliance mark was achieved under the following conditions:

1. Shielded cables on all external I/O ports.
2. Cable shields connected to earth ground via metal shell connectors bonded to a conductive module front panel.
3. Conductive chassis rails connected to earth ground. This provides the path for connecting shields to earth ground.
4. Front panel screws properly tightened.

For minimum RF emissions, it is essential that the conditions above be implemented. Failure to do so could compromise the EMC compliance of the equipment containing the module.

Hardware Preparation and Installation

2

Introduction

This chapter provides unpacking instructions, hardware preparation guidelines, and installation instructions for the MVME162LX Embedded Controller.

Unpacking Instructions



Caution

If the shipping carton is damaged upon receipt, insist that the carrier's agent be present during the unpacking and inspection of the equipment.

Avoid touching areas of integrated circuitry; static discharge can damage circuits.

Unpack the equipment from the shipping carton. Place the equipment on a clean and adequately protected working surface. Refer to the packing list and verify that all items are present. Save the packing material for storing and reshipping of equipment.

Hardware Preparation

To select the desired configuration and ensure proper operation of the controller, certain option modifications may be necessary before installation. The controller provides software control for many of these options. Some options cannot be modified in software, and consequently are set by installing or removing jumpers on PCB headers. Most other modifications are performed by setting bits in control registers after the controller has been installed in a system.

The controller's registers are described in the *MVME162LX Embedded Controller Programmer's Reference Guide*.

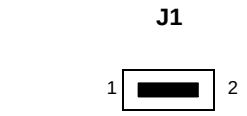
Figure 2-1 shows the placement of the switches, PCB jumper headers, connectors, and LED indicators on the controller. The controller has been factory tested and is shipped with the factory jumper settings listed in the following sections. It operates with its required and factory-installed debug monitor, MVME162Bug (162Bug), with these factory jumper settings. Settings can be made for:

- System controller selection (J1)
- General-purpose readable register configuration (J11)
- EPROM/Flash configuration (J12)
- SRAM backup power source selection (for onboard SRAM: J13 on the MVME162LX PCB; for the SRAM mezzanine: J1 on the SRAM mezzanine)
- SCSI bus termination (J14)

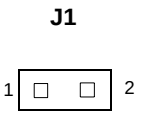
System Controller Select Header (J1)

The MVME162LX Embedded Controller is factory-configured as a VMEbus system controller (a jumper is installed across pins 1 and 2 of PCB header J1). Remove the J1 jumper if the controller is not to act as the system controller. Note that when the MVME162LX is functioning as a system controller, the SCON LED is turned on.

Note For controllers without the optional VMEbus interface (with no VMEchip2), the jumper may be installed or removed without affecting normal operation.



System Controller (factory configuration)



Not System Controller

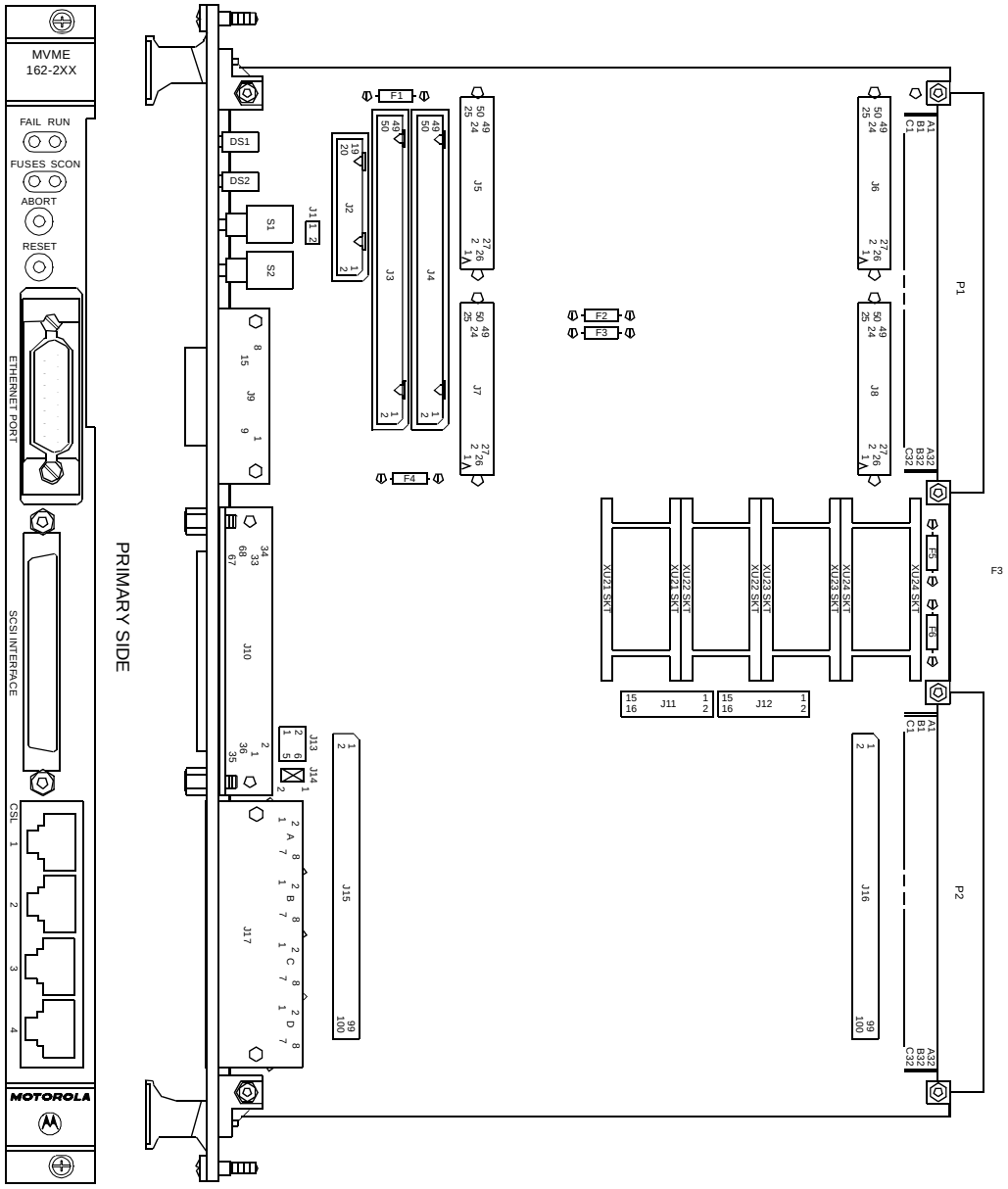


Figure 2-1. MVME162LX Switch, Header, Connector, Fuse, and LED Locations

2

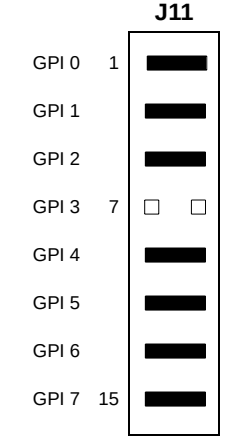
General-Purpose Readable Jumpers Header (J11)

PCB header J11 provides eight readable jumpers. These jumpers can be read as a register (at $FFF4202D) in the MCchip LCSR. The bit values are read as a zero when the jumper is installed, and as a one when the jumper is removed.

If the MVME162BUG firmware is installed, four jumpers are user-definable (pins 9-10, 11-12, 13-14, 15-16). If the MVME162BUG firmware is not installed, seven jumpers are user-definable (pins 1-2, 3-4, 5-6, 9-10, 11-12, 13-14, 15-16).

Note Pins 7-8 (GPI 3) are reserved to select either the Flash memory map (jumper installed) or the EPROM memory map (jumper removed). They are not user-definable. The address ranges for the various EPROM/Flash configurations appear in the next section of this chapter.

The controller is shipped from the factory with J11 set to all zeros (jumpers on all pins) except for GPI 3.



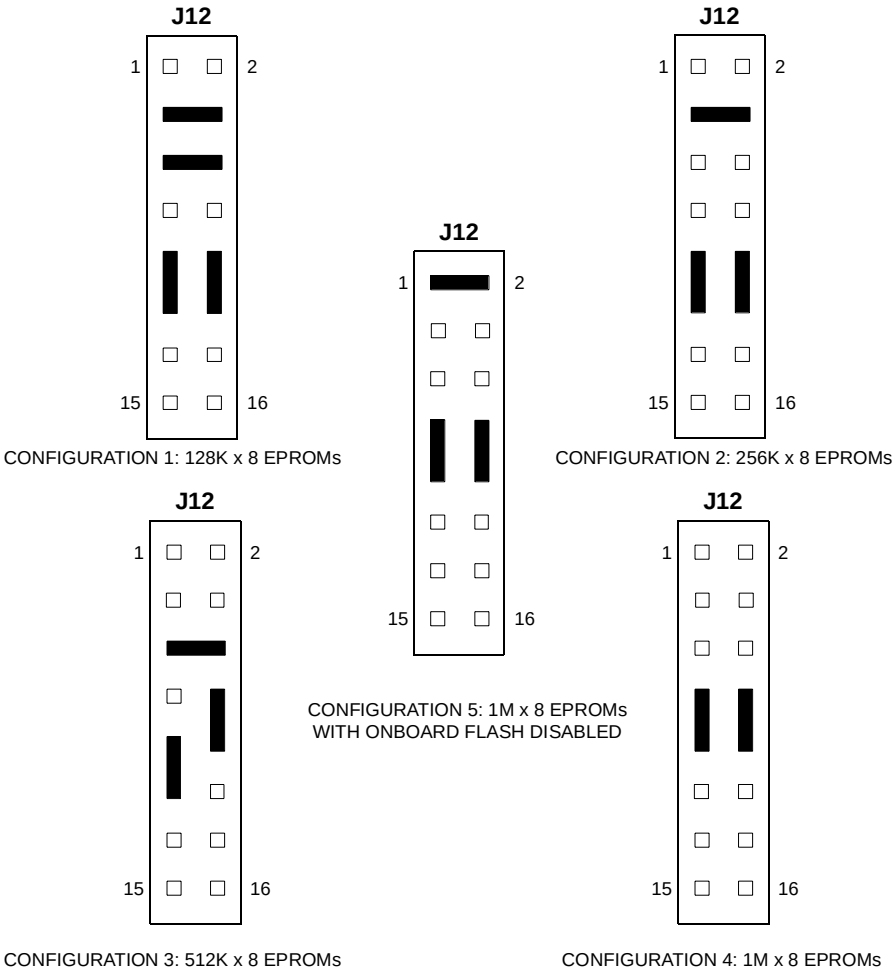
	162BUG INSTALLED	USER CODE INSTALLED
GPI 0	REFER TO 162BUG MANUAL	USER-DEFINABLE
GPI 1	REFER TO 162BUG MANUAL	USER-DEFINABLE
GPI 2	REFER TO 162BUG MANUAL	USER-DEFINABLE
GPI 3	IN=FLASH; OUT=EPROM	IN=FLASH; OUT=EPROM
GPI 4	USER-DEFINABLE	USER-DEFINABLE
GPI 5	USER-DEFINABLE	USER-DEFINABLE
GPI 6	USER-DEFINABLE	USER-DEFINABLE
GPI 7	USER-DEFINABLE	USER-DEFINABLE

EPROMs Selected (factory configuration)

EPROM/Flash Configuration Header (J12)

The MVME162LX Embedded Controller comes with 1 MB of flash memory and four EPROM sockets ready for the installation of EPROMs, which may be ordered separately. The EPROM locations are standard JEDEC 32-pin DIP sockets that accommodate four jumper-selectable densities (128 Kbit x 8; 256 Kbit x 8; 512 Kbit x 8; 1 Mbit x 8) and permit disabling of the flash memory.

Header J12 provides eight jumpers to configure the EPROM sockets.



The next five tables show the address range for each EPROM socket in all five configurations. GPI 3 (J11 pins 7-8) is a control bit in the MCchip ASIC that allows reset code to be fetched either from flash memory or from EPROMs.

Table 2-1. EPROM/Flash Mapping - 128K x 8 EPROMs

GPI 3		Address Range	Device Accessed
Removed	1	$FF800000 - $FF81FFFF	EPROM A (XU24)
		$FF820000 - $FF83FFFF	EPROM B (XU23)
		$FF840000 - $FF85FFFF	EPROM C (XU22)
		$FF860000 - $FF87FFFF	EPROM D (XU21)
		$FFA00000 - $FFBFFFFF	On-Board Flash
Installed	0	$FF800000 - $FF9FFFFF	On-Board Flash
		$FFA00000 - $FFA1FFFF	EPROM A (XU24)
		$FFA20000 - $FFA3FFFF	EPROM B (XU23)
		$FFA40000 - $FFA5FFFF	EPROM C (XU22)
		$FFA60000 - $FBA7FFFF	EPROM D (XU21)

Table 2-2. EPROM/Flash Mapping - 256K x 8 EPROMs

GPI 3		Address Range	Device Accessed
Removed	1	$FF800000 - $FF83FFFF	EPROM A (XU24)
		$FF840000 - $FF87FFFF	EPROM B (XU23)
		$FF880000 - $FF8BFFFF	EPROM C (XU22)
		$FF8C0000 - $FF8FFFFF	EPROM D (XU21)
		$FFA00000 - $FFBFFFFF	On-Board Flash
Installed	0	$FF800000 - $FF9FFFFF	On-Board Flash
		$FFA00000 - $FFA3FFFF	EPROM A (XU24)
		$FFA40000 - $FFA7FFFF	EPROM B (XU23)
		$FFA80000 - $FFABFFFF	EPROM C (XU22)
		$FFAC0000 - $FBAFFFFF	EPROM D (XU21)

Table 2-3. EPROM/Flash Mapping - 512K x 8 EPROMs

GPI 3		Address Range	Device Accessed
Removed	1	$FF800000 - $FF87FFFF	EPROM A (XU24)
		$FF880000 - $FF8FFFFF	EPROM B (XU23)
		$FF900000 - $FF97FFFF	EPROM C (XU22)
		$FF980000 - $FF9FFFFF	EPROM D (XU21)
		$FFA00000 - $FFBFFFFF	On-Board Flash
Installed	0	$FF800000 - $FF9FFFFF	On-Board Flash
		$FFA00000 - $FFA7FFFF	EPROM A (XU24)
		$FFA80000 - $FFAFFFFF	EPROM B (XU23)
		$FFB00000 - $FFB7FFFF	EPROM C (XU22)
		$FFB80000 - $FBF7FFFF	EPROM D (XU21)

Table 2-4. EPROM/Flash Mapping - 1M x 8 EPROMs

GPI 3		Address Range	Device Accessed
Removed	1	$FF800000 - $FF8FFFFF	EPROM A (XU24)
		$FF900000 - $FF9FFFFF	EPROM B (XU23)
		Not used	EPROM C (XU22)
		Not used	EPROM D (XU21)
		$FFA00000 - $FFBFFFFF	On-Board Flash
Installed	0	$FF800000 - $FF9FFFFF	On-Board Flash
		$FFA00000 - $FFAFFFFF	EPROM A (XU24)
		$FFB00000 - $FFBFFFFF	EPROM B (XU23)
		Not used	EPROM C (XU22)
		Not used	EPROM D (XU21)

Table 2-5. EPROM/Flash Mapping - 1M x 8 EPROMs, On-Board Flash Disabled

GPI 3		Address Range	Device Accessed
Removed	1	$FF800000 - $FF8FFFFF	EPROM A (XU24)
		$FF900000 - $FF9FFFFF	EPROM B (XU23)
		$FFA00000 - $FFAFFFFF	EPROM C (XU22)
		$FFB00000 - $FFBFFFFF	EPROM D (XU21)
		Not used	On-Board Flash
Installed	0	Not used	On-Board Flash
		$FF800000 - $FF8FFFFF	EPROM A (XU24)
		$FF900000 - $FF9FFFFF	EPROM B (XU23)
		$FFA00000 - $FFAFFFFF	EPROM C (XU22)
		$FFB00000 - $FFBFFFFF	EPROM D (XU21)

SRAM Backup Power Source Select Headers (J13, J1)

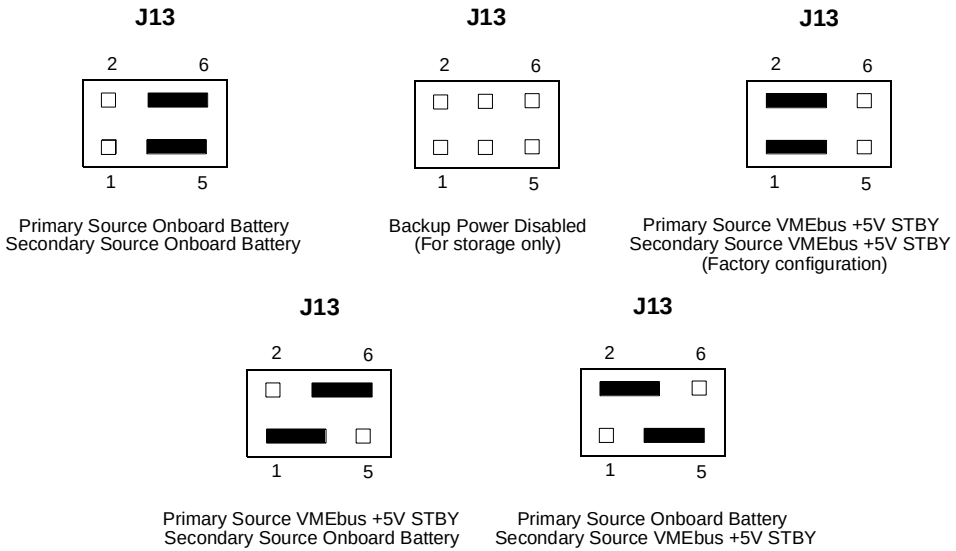
Jumper header J13 determines the source for onboard static RAM backup power on the controller's PCB. Header J1 determines the source for backup power on the 2MB SRAM mezzanine board (if installed).

The following backup power configurations are available for onboard SRAM through header J13. In the factory configuration, the VMEbus +5V standby voltage serves as primary and secondary power source (the onboard battery is disconnected).

Notes For controllers without the optional VMEbus interface (without the VMEchip2 ASIC), you must select the onboard battery as the backup power source.

Caution

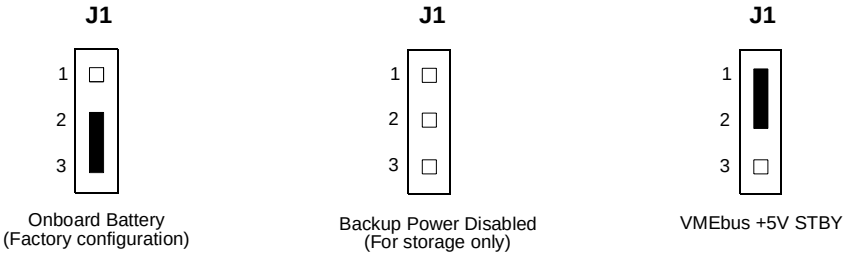
Removing all jumpers may temporarily disable the SRAM. Do not remove all jumpers from J13, except for storage.



The following backup power configurations are available for the 2MB mezzanine SRAM through header J1 (located on the mezzanine). In the factory configuration, the onboard battery serves as secondary power source.

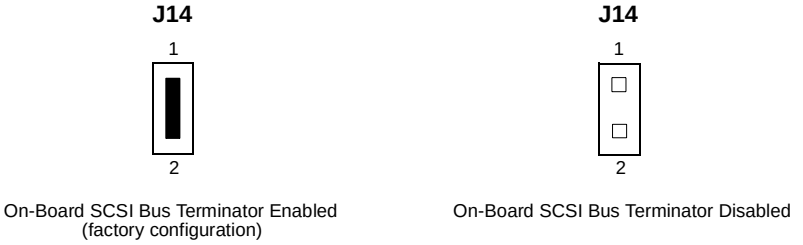
Caution

Removing the jumper may temporarily disable the SRAM mezzanine. Do not remove the jumper from J1, except for storage.



SCSI Terminator Enable Header (J14)

The controller provides terminators for the SCSI bus. The SCSI terminators are enabled/disabled by a jumper on header J14. The SCSI terminators may be configured as follows.



Caution

If the controller is to be used at one end of the SCSI bus, the SCSI bus terminators must be enabled.

Memory Mezzanine Options

Two 100-pin connectors (J15 and J16) are provided on the controller's main module to accommodate optional memory mezzanine boards. The following memory mezzanine options are available:

- 4 MB or 8 MB ECC DRAM (stackable on top)
- 16 MB or 32 MB ECC DRAM

The mezzanine boards may either be used individually or be combined in a stack (not more than two deep). The following connector options govern stacking arrangements:

- The 4 MB and 8 MB boards has connectors on the top and bottom (primary and secondary) sides of the board. It can be used as follows:
  - Individually as the only mezzanine board (with nothing stacked on top)
  - Stacked with another 4 MB or 8 MB board on top
  - Stacked with either an 8 MB or 32 MB board on top
- The 8 MB or 32 MB board has connectors on the bottom only. It can be used as follows:
  - Stacked on top of a 4 MB or 8 MB board
  - Individually as the only mezzanine board

Note When the mezzanines are stacked, the starting address of the larger board must be less than the starting address of the smaller board.

2

Installation Instructions

The following sections describe the installation of IndustryPacks (IPs) on the MVME162LX Embedded Controller and the installation of the controller in a VME chassis, and discuss system considerations relevant to the installation. Ensure that EPROM devices are installed as needed. Ensure that all header jumpers are configured as desired.

IP Installation on the MVME162LX

Up to two IP modules may be installed on the controller. Install the IPs on the controller as follows:

- Each IP has two 50-pin connectors that plug into two corresponding 50-pin connectors on the controller: J5/J6, J7/J8. See Figure 2-1 for the connector locations.
  - Orient the IP(s) so that the tapered connector shells mate properly. Plug IP_a into connectors J5 and J6; plug IP_b into J7 and J8. If a double-sized IP is used, plug IP_ab into J5, J6, J7, and J8.
- Two additional 50-pin connectors (J3 and J4) are provided behind the controller's front panel for external cabling connections to the IP modules. There is a one-to-one correspondence between the signals on the cabling connectors and the signals on the associated IP connectors (J4 has the same IP_a signals as J5; J3 has the same IP_b signals as J7).
  - Connect user-supplied 50-pin cables to J3 and J4 as needed. Because of the varying requirements for each different kind of IP, Motorola does not supply these cables.
  - Bring the IP cables out the narrow slot in the controller's front panel and attach them to the appropriate external equipment, depending on the nature of the particular IP(s).

MVME162LX Module Installation

With EPROMs and IndustryPacks installed and the controller's headers properly configured, proceed as follows to install the controller in the VME chassis:

1. Turn all equipment power OFF and disconnect the power cable from the AC power source.



Warning

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.



Caution

To prevent damage to the controller's components, do not install or remove the controller with the power applied.

2. Remove the chassis cover as instructed in the user's manual for the equipment.
3. Remove the filler panel from the card slot where you are going to install the controller.
   - If you intend to use the MVME162LX as system controller, it must occupy the leftmost card slot (slot 1). The system controller must be in slot 1 to correctly initiate the bus-grant daisy-chain and to ensure proper operation of the IACK daisy-chain driver.
   - If you do not intend to use the MVME162LX as system controller, it can occupy any unused double-height card slot.
4. Slide the controller into the selected card slot. Ensure it is seated properly in the P1 and P2 connectors on the backplane. Do not damage or bend connector pins.
5. Secure the controller in the chassis with the screws provided, making good contact with the transverse mounting rails to minimize RF emissions.

6. On the chassis backplane, remove the INTERRUPT ACKNOWLEDGE (IACK) and BUS GRANT (BG) jumpers from the header for the card slot occupied by the controller.
7. Connect the appropriate cable(s) to the controller's panel connectors for the EIA-232-D serial ports, SCSI port, and LAN Ethernet port.
   – Note that some cables are not provided with the MVME162LX module and must be made or purchased by the user (Motorola recommends shielded cable for all peripheral connections to minimize radiation).
8. Connect the peripheral(s) to the cable(s).
9. Install any other required VMEmodules in the system.
10. Replace the chassis cover.
11. Connect the power cable to the AC power source and turn the equipment power ON.

System Considerations

The MVME162LX Embedded Controller draws power from both the P1 and the P2 connectors on the VMEbus backplane. P2 is also used for the upper 16 bits of data in 32-bit transfers, and for the upper 8 address lines in extended addressing mode. The controller may not operate properly without its main board connected to VMEbus backplane connectors P1 & P2.

Whether the controller operates as a VMEbus master or as a VMEbus slave, it is configured for 32 bits of address and 32 bits of data (A32/D32). However, it handles A16 or A24 devices in the address ranges indicated in Chapter 3. D8 and/or D16 devices in the system must be handled by the MC68040/ MC68LC040 software. Refer to the memory maps in the *MVME162LX Embedded Controller Programmer's Reference Guide*.

The controller contains shared onboard DRAM whose base address is software-selectable. Both the onboard processor and offboard VMEbus devices see this local DRAM at base physical address $00000000, as programmed by the MVME162Bug firmware. This may be changed via software to any other base address. Refer to the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information.

If the MVME162LX tries to access offboard resources in a nonexistent location and is not system controller, and if the system does not have a global bus timeout, the MVME162LX waits forever for the VMEbus cycle to complete. This will cause the system to lock up. There is only one situation in which the system might lack this global bus timeout: when the MVME162LX is not the system controller and there is no global bus timeout elsewhere in the system.

Multiple controllers may be installed in a single VME chassis. In general, hardware multiprocessor features are supported.

Note If you are installing multiple controllers in an MVME945 chassis, do not install the controller in slot 12. The height of the IP modules may cause clearance difficulties in that slot position.

Other MPUs on the VMEbus can interrupt, disable, communicate with, and determine the operational status of the processor(s). One register of the GCSR (global control/status register) set includes four bits that function as location monitors to allow one controller processor to broadcast a signal to any other controller processors. All eight registers are accessible from any local processor as well as from the VMEbus.

The controller provides +5 Vdc power to the remote LED/switch connector (J2) as well as to IP_b through a 2A fuse (F3) located near J7. Connector J2 is the interface for a remote control and indicator panel. If none of the LEDs light and the ABORT and RESET switches do not operate, check fuse F3.

The controller provides +12 Vdc power to the Ethernet transceiver interface through a 1A fuse (F1) located near J3. The FUSES LED lights to indicate that +12 Vdc is available. If the Ethernet transceiver fails to operate, check fuse F1.

The controller provides +5 Vdc to the SCSI bus TERMPWR signal through fuse F4, located near J7. One function of the FUSES LED (part of DS2) on the front panel is to monitor the SCSI bus TERMPWR signal; with the controller connected to a SCSI bus, the FUSES LED lights when there is SCSI terminator power. Because any device on the SCSI bus can provide TERMPWR, the LED does not directly indicate the condition of the fuse. If the LED flickers during SCSI bus operation, check the fuse. This display also indicates the status of the +5 Vdc (F2, F3), +12 Vdc (F5), and -12 Vdc (F6) fuses for the IP modules.

The controller uses two Zilog Z85230 serial port controllers to implement the four serial communications interfaces. Each interface supports CTS, DCD, RTS, and DTR control signals as well as the TXD and RXD transmit/receive data signals. Because the serial clocks are omitted in the controller's implementation, serial communications are strictly asynchronous. The Z85230 is interfaced as DTE (data terminal equipment) with EIA-232-D signal levels. The serial ports are routed to four RJ45 connectors on the front panel.

This chapter provides connection diagrams for the four serial ports on the controller. These ports are connected to external devices through cables connected to the front panel. The figures showing this are as follows:

- Figure 2-2 shows the pin assignments required in a cable to adapt a DB25 DTE device to the RJ45 connectors.

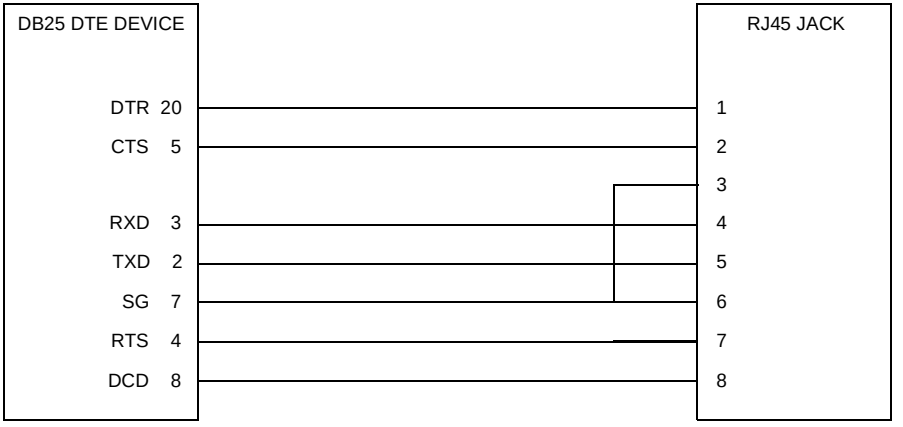


Figure 2-2. DB25-DTE-to-RJ45 Adapter

- Figure 2-3 shows the pin assignments required in a cable to adapt a DB25 DCE device to the RJ45 connectors.

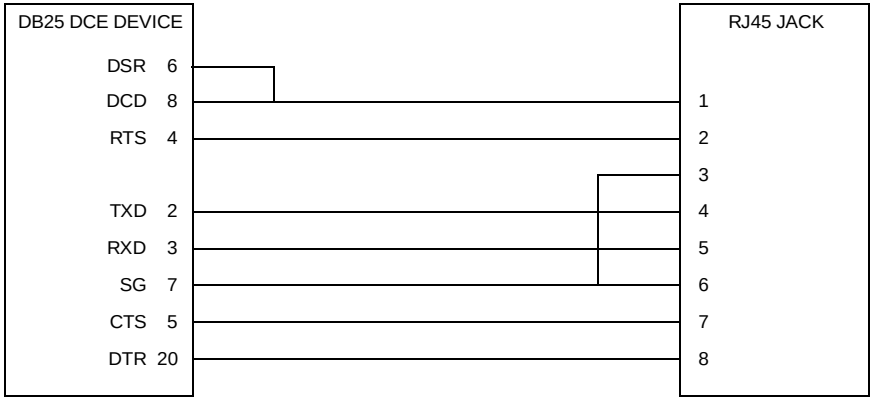


Figure 2-3. DB25-DCE-to-RJ45 Adapter

- Figure 2-4 diagrams the pin assignments required in a typical eight-conductor serial cable having RJ45 connectors at both ends. Note that all wires are crossed.

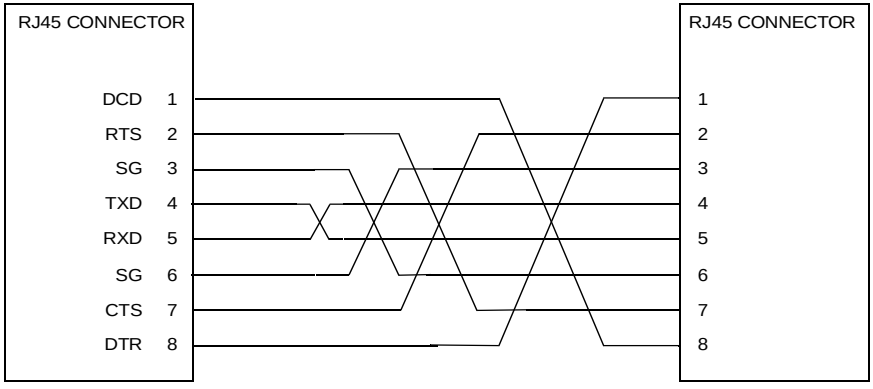


Figure 2-4. Typical RJ45 Serial Cable

Debugger General Information

3

Overview

This chapter describes the basic features of the debugger used on the MVME162LX Embedded Controller. The firmware is known as the "MVME162Bug" or simply the "162Bug". It includes diagnostics for testing and configuring Industry Pack (IP) modules.

Description of 162Bug

The162Bug is a powerful evaluation and debugging tool for systems built around the MVME162LX CISC-based microcomputers. Facilities are available for loading and executing user programs under complete operator control for system evaluation. The 162Bug includes commands for display and modification of memory, breakpoint and tracing capabilities, a powerful assembler/disassembler useful for patching programs, and a power-up self test which verifies the integrity of the system. Various 162Bug routines that handle I/O, data conversion, and string functions are available to user programs through the TRAP #15 system calls.

The 162Bug consists of three parts:

1. A command-driven user-interactive software debugger (referred to as the "debugger"). Its usage is described in Chapter 4.
2. A command-driven diagnostic package for the MVME162LX controller (referred to as the "diagnostics"). This is described in the *MVME162Bug Diagnostics Manual*.
3. A user interface which accepts commands from the system console terminal.

When using the 162Bug, you can operate out of the debugger directory or the diagnostic directory. If you are operating in the debugger directory, the debugger prompt `162-Bug>` is displayed and you have all of the debugger commands at your disposal.

If you are in the diagnostic directory, the diagnostic prompt `162-Diag>` is displayed and you have all of the diagnostic commands at your disposal as well as all of the debugger commands.

You may switch between directories by using the Switch Directories (**SD**) command, or you may examine the commands in the particular directory that you are currently in by using the Help (**HE**) command.

Because 162Bug is command-driven, it performs its various operations in direct response to user commands entered at the keyboard. When you enter a command, the162Bug executes it and then returns you to the prompt. However, if you enter a command that causes execution of the user target code (e.g., **"GO"**), then control may or may not return to the162Bug, depending on the outcome of the user's program.

If you have used one or more of Motorola's other debugging packages, you will find the CISC 162Bug very similar. Some effort has also been made to make the interactive commands more consistent. For example, delimiters between commands and arguments may now be commas or spaces interchangeably.

162Bug Implementation

The 162Bug is written mostly in the "C" programming language, providing the benefits of portability and maintainability. Where necessary, assembler language is used in the form of separately compiled modules containing only assembler code (no mixed language modules are used).

Physically, the 162Bug is contained in a single 27C040 DIP EPROM installed in socket XU24, providing 512KB (128K longwords) of storage. Optionally, the 162Bug can be loaded and executed in a single flash memory chip. The executable code is checksummed at every power-on or reset firmware entry, and the result (which includes a pre-calculated checksum contained in the memory devices), is tested for an expected zero. Thus, users are cautioned against modification of the memory devices unless re-checksum precautions are taken.

Installation and Start-up

Even though the 162Bug is installed on the MVME162LX Embedded Controller, you must follow the steps listed below in order for the 162Bug to operate properly with the controller.



Caution

To prevent damage to the controller's components, do not insert or remove the controller while power is applied.

1. Turn all equipment power OFF. Refer to the *Hardware Preparation* section in Chapter 2 and install/remove jumpers on headers as required for your particular application.

   Jumpers on header J11 affect the 162Bug operation as listed below. The default condition for the controller (MVME162-2xx) is with seven jumpers installed. This is between pins 1-2, 3-4, 5-6, 9-10, 11-12, 13-14, and 15-16. No jumper is installed on pins 7-8.

   These readable jumpers can be read as a register (at $FFF4202D) on the Memory Controller ASIC (MCchip). The bit values are read as a one when the jumper is removed (off), and as a zero when the jumper is installed (on). This jumper block (header J11) contains eight bits. Refer also to the *MVME162LX Embedded Controller Programmer's Reference Guide* for additional information on the MCchip.

   The MVME162Bug reserves/defines the four lower order bits (GPI3 to GPI0). The table on the following page provides a description for the bits reserved/defined by the debugger.

Bit	J11 Pins	Description
Bit #0 (GPI0)	1-2	When this bit is a one (high), it instructs the debugger to use local Static RAM for its work page (i.e., variables, stack, vector tables, etc.).
Bit #1 (GPI1)	3-4	When this bit is a one (high), it instructs the debugger to use the default setup/operation parameters in flash memory or ROM versus the user setup/operation parameters in Non-Volatile RAM (NVRAM). This is the same as depressing the RESET and ABORT switches at the same time. This feature can be used in the event the user setup is corrupted or does not meet a sanity check. Refer to the **ENV** command (described in Appendix A) for the flash memory/ROM defaults.
Bit #2 (GPI2)	5-6	Reserved for future use.
Bit #3 (GPI3)	7-8	When this bit is a zero (low), it informs the debugger that it is executing out of the flash memories. When this bit is a one (high), it informs the debugger that it is executing out of the PROM.
Bit #4 (GPI4)	9-10	Open to your application.
Bit #5 (GPI5)	11-12	Open to your application.
Bit #6 (GPI6)	13-14	Open to your application.
Bit #7 (GPI7)	15-16	Open to your application.

Note that when the controller starts in a cold reset, the 162Bug runs in Board Mode. Using the Environment (**ENV**) or **MENU** commands can make the162Bug run in System mode. Refer to Appendix A for additional information.

2. Configure header J1 by installing/removing a jumper between pins 1 and 2. A jumper installed/removed enables/disables the system controller function of the MVME162LX.

3. Refer to the setup procedure for your particular chassis or system for details concerning the installation of the MVME162LX Embedded Controller.

4. Connect the terminal that is to be used as the 162Bug system console to the default debug EIA-232-D port at serial port 1 on the front panel of the controller. Refer to Chapter 2 for other connection options. Set up the terminal as follows:
   - eight bits per character
   - one stop bit per character
   - parity disabled (no parity)
   - baud rate 9600 baud (default baud rate of controller's ports at power-up)

   After power-up, the baud rate of the debug port can be reconfigured by using the Port Format (**PF**) command of the 162Bug debugger.

Note In order for high speed serial communication between the 162Bug and the terminal to work, the terminal must do some form of handshaking. If the terminal being used does not do hardware handshaking via the CTS line, then it must do XON/XOFF handshaking. If you get garbled messages and missing characters, check the terminal to ensure XON/XOFF handshaking is enabled.

5. If you want to connect devices such as a host computer system and/or serial printer to the other EIA-232-D port connectors, you must connect the appropriate cables and configure the port(s) as shown in step 4 (above). After power-up, this(these) port(s) can be reconfigured by programming the MVME162LX Z85230 Serial Communications Controllers (SCCs), or by using the 162Bug **PF** command.
6. The EPROM/flash header J12 must be set to configuration 3, with jumpers between J12 pins 5 and 6, 8 and 10, and 9 and 11. This configures it for 512K x 8 EPROMs.
7. Power up the system. The 162Bug executes various self-checks and displays the debugger prompt "`162-Bug>`" (if it is operating in Board Mode). However, if the **ENV** command has put the 162Bug in System Mode, the system performs a self-test and tries to autoboot. Refer to the **ENV** and **MENU** commands (Table 4-3).

   If the confidence test fails, the test is aborted when the first fault is encountered. If possible, an appropriate message is displayed, and control then returns to the menu.

Note This product contains a Real Time Clock (RTC) device on board. The device is backed up with a self-contained battery. Before shipment of the controller, the RTC device was stopped to preserve battery life.

The board's "Self-Tests" (ST)and operating systems require that the RTC be operating. Before using the controller after the initial installation, start the clock by using the set **SET** command of the debugger. Set the date and time using the following syntax:

`162-Bug>` **SET** [*mmddyyhhmm*] | [<+/-*CAL*>;**C**]

Example: Nov. 7, 1998, 10:37 a.m. = **SET 1107981037**

The *C* option allows you to calibrate the real-time clock. Refer to the *MVME162Bug Debugging Package User's Manual* for details.

When storing the controller, ensure that the RTC is put into the power save mode. This will extend the life of the battery. To put the RTC into the power save mode, use the **PS** command of the debugger. For example: `162-Bug>` **PS** <*Return*>

Autoboot

Autoboot is a software routine that is contained in the 162Bug Flash/PROM to provide an independent mechanism for booting an operating system. This autoboot routine automatically scans for controllers and devices in a specified sequence until a valid bootable device containing the boot media is found or the list is exhausted. If a valid bootable device is found, a system boot from that device is started. The controller scanning sequence goes from the lowest controller Logical Unit Number (LUN) detected to the highest LUN detected. Controllers, devices, and their LUNs are listed in Appendix B.

At power-up, Autoboot is enabled, and providing the drive and controller numbers encountered are valid, the following message is displayed upon the system console:

```
"Autoboot in progress... To abort hit <BREAK>"
```

Following this message there is a delay to allow you an opportunity to abort the Autoboot process if you wish. Then the actual I/O is begun: the program pointed to within the volume ID of the media specified is loaded into RAM and control passed to it. If, however, during this time you want to gain control without Autoboot, you can press the <BREAK> key or the software ABORT or RESET switches.

Autoboot is controlled by parameters contained in the **ENV** command. These parameters allow the selection of specific boot devices and files, and allow programming of the Boot delay. Refer to the **ENV** command in Appendix A for more details.



Caution

Although streaming tape can be used to autoboot, the same power supply must be connected to the streaming tape drive, controller, and the MVME162LX. At power-up, the tape controller will position the streaming tape to the load point where the volume ID can correctly be read and used.

If, however, the MVME162LX loses power but the controller does not, and the tape happens to be at the load point, the sequences of commands required (attach and rewind) cannot be given to the controller and autoboot will not be successful.

ROMboot

As shipped from the factory, the 162Bug occupies an EPROM installed in socket XU24. This leaves three sockets (XU21 - XU23) and the flash available for your use. Contact your Motorola sales office for assistance. This function is configured/enabled by the Environment (**ENV**) command (refer to Appendix A) and executed at power-up (optionally also at reset) or by the **RB** command assuming there is valid code in the memory devices (or optionally elsewhere on the controller or VMEbus) to support it. If ROMboot code is installed, a user-written routine is given control (if the routine meets the format requirements). One use of ROMboot might be resetting SYSFAIL* on an unintelligent controller module. The **NORB** command disables the function.

For a user's ROMboot module to gain control through the ROMboot linkage, four requirements must be met:

1. Power must have just been applied (but the **ENV** command can change this to also respond to any reset).
2. Your routine must be located within the controller's Flash/PROM memory map (but the **ENV** command can change this to any other portion of the onboard memory, or even offboard VMEbus memory).

3. The ASCII string "BOOT" must be located within the specified memory range.
4. Your routine must pass a checksum test, which ensures that this routine was really intended to receive control at power-up.

For complete details on how to use ROMboot, refer to the *Debugging Package for Motorola 68K CISC CPUs User's Manual*.

Network Boot

Network Auto Boot is a software routine contained in the 162Bug Flash/PROM that provides a mechanism for booting an operating system using a network (local Ethernet interface) as the boot device. The Network Auto Boot routine automatically scans for controllers and devices in a specified sequence until a valid bootable device containing a boot media is found or the list is exhausted. If a valid bootable device is found, a boot from that device is started. The controller scanning sequence goes from the lowest controller Logical Unit Number (LUN) detected to the highest LUN detected. Refer to Appendix C for default LUNs).

At power-up, Network Boot is enabled, and providing the drive and controller numbers encountered are valid, the following message is displayed upon the system console:

```
"Network Boot in progress... To abort hit <BREAK>"
```

Following this message there is a delay to allow you to abort the Auto Boot process if you wish. Then the actual I/O is begun: the program pointed to within the volume ID of the media specified is loaded into RAM and control passed to it. If, however, during this time you want to gain control without Network Boot, you can press the <BREAK> key or the software ABORT or RESET switches.

Network Auto Boot is controlled by parameters contained in the **NIOT** and **ENV** commands. These parameters allow the selection of specific boot devices, systems, and files, and allow programming of the Boot delay. Refer to the **ENV** command in Appendix A for additional information.

Restarting the System

You can initialize the system to a known state in three different ways: reset, abort, and break. Each has characteristics which make it more appropriate than the others in certain situations.

The debugger has a special feature upon a reset condition. This feature is activated by depressing the RESET and ABORT switches at the same time. This feature instructs the debugger to use the default setup/operation parameters in ROM versus your setup/operation parameters in NVRAM. This feature can be used in the event your setup/operation parameters are corrupted or do not meet a sanity check. Refer to the **ENV** command (Appendix A) for the ROM defaults.

Reset



Caution

When the RESET button on the controller is depressed for an extended length of time (varies from board to board), DRAM refresh may be inhibited and memory contents may be lost. To ensure that the contents of DRAM will not be altered, press and release the RESET button as quickly as possible.

Pressing and releasing the controller's front panel RESET switch initiates a system reset. COLD and WARM reset modes are available. By default, the 162Bug is in COLD mode. During COLD reset, a total system initialization takes place, as if the controller had just been powered up. All static variables (including disk device and controller parameters) are restored to their default states. The breakpoint table and offset registers are cleared. The target registers are invalidated. Input and output character queues are cleared. Onboard devices (timer, serial ports, etc.) are reset, and the two serial ports are reconfigured to their default state.

During WARM reset, the 162Bug variables and tables are preserved, as well as the target state registers and breakpoints.

Reset must be used if the processor ever halts, or if the 162Bug environment is ever lost (vector table is destroyed, stack corrupted, etc.).

Abort

Abort is invoked by pressing and releasing the ABORT switch on the controller's front panel. Whenever Abort is invoked when executing a user program (running target code), a "snapshot" of the processor state is captured and stored in the target registers. For this reason, abort is most appropriate when terminating a user program that is being debugged. Abort should be used to regain control if the program gets caught in a loop, etc. The target PC, register contents, etc., help to pinpoint the malfunction.

Pressing and releasing the ABORT switch generates a local board condition which may interrupt the processor if enabled. The target registers, reflecting the machine state at the time the ABORT switch was pressed, are displayed on the screen. Any breakpoints installed in your code are removed and the breakpoint table remains intact. Control is returned to the debugger.

Break

A "Break" is generated by pressing and releasing the BREAK key on the terminal keyboard. Break does not generate an interrupt. The only time break is recognized is when characters are sent or received by the console port. Break removes any breakpoints in your code and keeps the breakpoint table intact. Break also takes a snapshot of the machine state if the function was entered using SYSCALL. This machine state is then accessible to you for diagnostic purposes.
Many times it may be desirable to terminate a debugger command prior to its completion; for example, during the display of a large block of memory. Break allows you to terminate the command.

SYSFAIL* Assertion/Negation

Upon a reset/powerup condition the debugger asserts the VMEbus SYSFAIL* line (refer to the VMEbus specification). SYSFAIL* stays asserted if any of the following has occurred:

- confidence test failure
- NVRAM checksum error
- NVRAM low battery condition
- local memory configuration status
- self test (if system mode) has completed with error
- MPU clock speed calculation failure

After debugger initialization is done and none of the above situations have occurred, the SYSFAIL* line is negated. This indicates to the user or VMEbus masters the state of the debugger. In a multi-computer configuration, other VMEbus masters could view the pertinent control and status registers to determine which CPU is asserting SYSFAIL*. SYSFAIL* assertion/negation is also affected by the **ENV** command. Refer to Appendix A for additional information.

MPU Clock Speed Calculation

The clock speed of the microprocessor is calculated and checked against a user definable parameter housed in NVRAM (refer to the **CNFG** command in Appendix A). If the check fails, a warning message is displayed. The calculated clock speed is also checked against known clock speeds and tolerances.

Memory Requirements

The program portion of the 162Bug is approximately 512KB of code, consisting of download, debugger, and diagnostic packages. It is contained entirely in Flash or PROM.

The 162Bug executes from $FF800000 whether in Flash or PROM. If you remove the jumper at J11 pins 7 and 8, the address spaces of the Flash and PROM are swapped. For the MVME162-2*XX* (MVME162LX), factory ship configuration is with jumper J11 pins 7-8 removed (162Bug operates out of EPROM).

The 162Bug initial stack completely changes 8KB of SRAM memory at addresses offset $C000 from the SRAM base address, at power up or reset.

ECC DRAM mezzanines are mapped contiguously starting at zero ($00000000), largest first. With two mezzanines of the same size, the bottom mezzanine is first.

Type of Memory Present	Default DRAM Base Address	Default on-board SRAM Base Address
Single ECC DRAM mezzanine	$00000000	FFE00000
Two ECC DRAM mezzanines stacked	$00000000	$FFE00000

The 162Bug requires 2KB of NVRAM for storage of board configuration, communication, and booting parameters. This storage area begins at $FFFC16F8 and ends at $FFFC1EF7.

The 162Bug also requires a minimum of 64KB of contiguous read/write memory to operate. The **ENV** command controls where this block of memory is located. Regardless of where the onboard RAM is located, the first 64KB is used for 162Bug stack and static variable space. The rest is reserved as user space. Whenever the controller is reset, the target PC is initialized to the address corresponding to the beginning of the user space; the target stack pointers are initialized to addresses within the user space, with the target Interrupt Stack Pointer (ISP) set to the top of the user space.

Terminal Input/Output Control

When entering a command at the prompt, the following control codes may be entered for limited command line editing:

Note **The presence of the caret (^) symbol before a character indicates that the Control (CTRL) key must be held down while striking the character key.**

^X	(cancel line)	The cursor is backspaced to the beginning of the line. If the terminal port is configured with the hardcopy or TTY option (refer to **PF** command), then a carriage return and line feed is issued along with another prompt.
^H	(backspace)	The cursor is moved back one position. The character at the new cursor position is erased. If the hardcopy option is selected, a "/" character is typed along with the deleted character.
<DEL>	(delete or rubout)	Performs the same function as **^H**.
^D	(redisplay)	The entire command line as entered so far is redisplayed on the following line.
^A	(repeat)	Repeats the previous line. This happens only at the command line. The last line entered is redisplayed but not executed. The cursor is positioned at the end of the line. You may enter the line as is or you can add more characters to it. You can edit the line by backspacing and typing over old characters.

When observing output from any 162Bug command, the XON and XOFF characters which are in effect for the terminal port may be entered to control the output, if the XON/XOFF protocol is enabled (default). These characters are initialized to **^S** and **^Q** respectively by 162Bug, but you may change them with the **PF** command. In the initialized (default) mode, operation is as follows:

^S	(wait)	Console output is halted.
^Q	(resume)	Console output is resumed.

Disk I/O Support

The 162Bug can initiate disk input/output by communicating with intelligent disk controller modules over the VMEbus. Disk support facilities built into 162Bug consist of command-level disk operations, disk I/O system calls (only via one of the TRAP #15 instructions) for use by user programs, and defined data structures for disk parameters.

Parameters such as the address where the module is mapped and the type and number of devices attached to the controller module are kept in tables by the 162Bug. Default values for these parameters are assigned at power-up and cold-start reset, but may be altered as described in the section on default parameters, later in this chapter.

Appendix B contains a list of the controllers presently supported, as well as a list of the default configurations for each controller.

Blocks Versus Sectors

The logical block defines the unit of information for disk devices. A disk is viewed by the 162Bug as a storage area divided into logical blocks. By default, the logical block size is set to 256 bytes for every block device in the system. The block size can be changed on a per device basis with the **IOT** command.

The sector defines the unit of information for the media, as viewed by the controller. The sector size varies for different controllers, and the value for a specific device can be displayed and changed with the **IOT** command.

When a disk transfer is requested, the start and size of the transfer is specified in blocks. The 162Bug translates this into an equivalent sector specification, which is then passed on to the controller to initiate the transfer. If the conversion from blocks to sectors yields a fractional sector count, an error is returned and no data is transferred.

Device Probe Function

A device probe with entry into the device descriptor table is done whenever a specified device is accessed (i.e., when system calls such as .DSKRD, .DSKWR, .DSKCFIG, .DSKFMT, and .DSKCTRL, and debugger commands **BH**, **BO**, **IOC**, **IOP**, **IOT**, **MAR**, and **MAW** are used).

The device probe mechanism utilizes the SCSI commands "Inquiry" and "Mode Sense". If the specified controller is non-SCSI, the probe simply returns a status of "device present and unknown". The device probe makes an entry into the device descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with "device present" status (pointer to the device descriptor).

Disk I/O via 162Bug Commands

These following 162Bug commands are provided for disk I/O. Detailed instructions for their use are found in the *Debugging Package for Motorola 68K CISC CPUs User's Manual*. When a command is issued to a particular controller LUN and device LUN, these LUNs are remembered by the 162Bug so that the next disk command defaults to use the same controller and device.

IOI (Input/Output Inquiry)

This command is used to probe the system for all possible CLUN/DLUN combinations and display inquiry data for devices which support it. The device descriptor table only has space for 16 device descriptors; with the **IOI** command, you can view the table and clear it if necessary.

IOP (Physical I/O to Disk)

IOP allows you to read or write blocks of data, or to format the specified device in a certain way. **IOP** creates a command packet from the arguments you have specified, and then invokes the proper system call function to carry out the operation.

IOT (I/O Teach)

IOT allows you to change any configurable parameters and attributes of the device. In addition, it allows you to see the controllers available in the system.

IOC (I/O Control)

IOC allows you to send command packets as defined by the particular controller directly. **IOC** can also be used to look at the resultant device packet after using the **IOP** command.

BO (Bootstrap Operating System)

BO reads an operating system or control program from the specified device into memory, and then transfers control to it.

BH (Bootstrap and Halt)

BH reads an operating system or control program from a specified device into memory, and then returns control to the 162Bug. It is used as a debugging tool.

Disk I/O via 162Bug System Calls

All operations that actually access the disk are done directly or indirectly by the 162Bug TRAP #15 system calls (the command-level disk operations provide a convenient way of using these system calls without writing and executing a program).

The following system calls are provided to allow user programs to do disk I/O:

.DSKRD	Disk read. System call to read blocks from a disk into memory.
.DSKWR	Disk write. System call to write blocks from memory onto a disk.
.DSKCFIG	Disk configure. This function allows you to change the configuration of the specified device.
.DSKFMT	Disk format. This function allows you to send a format command to the specified device.
.DSKCTRL	Disk control. This function is used to implement any special device control functions that cannot be accommodated easily with any of the other disk functions.

Refer to the *Debugging Package for Motorola 68K CISC CPUs User's Manual* for information on using the above and other system calls.

To perform a disk operation, the 162Bug must eventually present a particular disk controller module with a controller command packet which has been especially prepared for that type of controller module (this is accomplished in the respective controller driver module). It is important to note that a command packet for one type of controller module usually does not have the same format as a command packet for a different type of module. The system call facilities which do disk I/O accept a generalized (controller-independent) packet format as an argument, and translate it into a controller-specific packet, which is then sent to the specified device. Refer to the system call descriptions in the *Debugging Package for Motorola 68K CISC CPUs User's Manual* for additional information on the format and construction of these standardized "user" packets.

The packets which a controller module expects to be given vary from controller to controller. The disk driver module for the particular hardware module (board) must take the standardized packet given to a trap function and create a new packet which is specifically tailored for the disk drive controller it is sent to. Refer to documentation on the particular controller module for the format of its packets, and for using the **IOC** command.

Default 162Bug Controller and Device Parameters

The 162Bug initializes the parameter tables for a default configuration of controllers and devices (refer to Appendix B). If the system needs to be configured differently than this default configuration (for example, to use a 70MB Winchester drive where the default is a 40MB Winchester drive), then these tables must be changed.

There are three ways to change the parameter tables:

1. Using the **BO** or **BH** commands. When you invoke one of these commands, the configuration area of the disk is read and the parameters corresponding to that device are rewritten according to the parameter information contained in the configuration area. This is a temporary change. If a cold-start reset occurs, then the default parameter information is written back into the tables.
2. Using the **IOT** command. You can use this command to reconfigure the parameter table manually for any controller and/or device that is different from the default. This is also a temporary change and is overwritten if a cold-start reset occurs.
3. Obtain the source. You can then change the configuration files and rebuild the 162Bug so that it has different defaults. Changes made to the defaults are permanent until changed again.

Disk I/O Error Codes

The 162Bug returns an error code if an attempted disk operation is unsuccessful.

Network I/O Support

The Network Boot Firmware provides the capability to boot the CPU through the Flash/PROM debugger using a network (local Ethernet interface) as the boot device.

The booting process is executed in two distinct phases.

1. The first phase allows the diskless remote node to discover its network identify and the name of the file to be booted.
2. The second phase has the diskless remote node reading the boot file across the network into its memory.

The various modules (capabilities) and the dependencies of these modules that support the overall network boot function are described in the following paragraphs.

Intel 82596 LAN Coprocessor Ethernet Driver

This driver manages/surrounds the Intel 82596 LAN Coprocessor. Management is in the scope of the reception of packets, the transmission of packets, receive buffer flushing, and interface initialization.

This module ensures that the packaging and unpackaging of Ethernet packets is done correctly in the Boot PROM.

UDP/IP Protocol Modules

The Internet Protocol (IP) is designed for use in interconnected systems of packet-switched computer communication networks. The Internet protocol provides for transmitting of blocks of data called datagrams (hence User Datagram Protocol, or UDP) from sources to destinations, where sources and destinations are hosts identified by fixed length addresses.

The UDP/IP protocols are necessary for the TFTP and BOOTP protocols; TFTP and BOOTP require a UDP/IP connection.

RARP/ARP Protocol Modules

The Reverse Address Resolution Protocol (RARP) consists of an identity-less node broadcasting a "whoami" packet onto the Ethernet, and waiting for an answer. The RARP server fills an Ethernet reply packet up with the target's Internet Address and sends it.

The Address Resolution Protocol (ARP) provides a method of converting protocol addresses (i.e., IP addresses) to local area network addresses (i.e., Ethernet addresses). The RARP protocol module supports systems which do not support the BOOTP protocol (next paragraph).

BOOTP Protocol Module

The Bootstrap Protocol (BOOTP) allows a diskless client machine to discover its own IP address, the address of a server host, and the name of a file to be loaded into memory and executed.

TFTP Protocol Module

The Trivial File Transfer Protocol (TFTP) is a simple protocol to transfer files. It is implemented on top of the Internet User Datagram Protocol (UDP or Datagram) so it may be used to move files between machines on different networks implementing UDP. The only thing it can do is read and write files from/to a remote server.

Network Boot Control Module

The "control" capability of the Network Boot Control Module is needed to tie together all the necessary modules (capabilities) and to sequence the booting process. The booting sequence consists of two phases: the first phase is labeled "address determination and bootfile selection" and the second phase is labeled "file transfer". The first phase will utilize the RARP/BOOTP capability and the second phase will utilize the TFTP capability.

Network I/O Error Codes

The 162Bug returns an error code if an attempted network operation is unsuccessful.

Multiprocessor Support

The MVME162LX Embedded Controller dual-port RAM feature makes the shared RAM available to remote processors as well as to the local processor. This can be done by either of the following two methods. Either method can be enabled/disabled by the **ENV** command as its Remote Start Switch Method (refer to Appendix A).

Multiprocessor Control Register (MPCR) Method

A remote processor can initiate program execution in the local MVME162LX dual-port RAM by issuing a remote **GO** command using the Multiprocessor Control Register (MPCR). The MPCR, located at shared RAM location of $800 offset from the base address the debugger loads it at, contains one of two longwords used to control communication between processors. The MPCR contents are organized as follows:

$800	*	N/A	N/A	N/A	(MPCR)

The status codes stored in the MPCR are of two types:

1. Status returned (from the monitor)
2. Status set (by the bus master)

The status codes that may be returned from the monitor are:

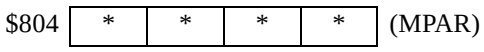
HEX	0	(HEX 00)	-	Wait. Initialization not yet complete.
ASCII	E	(HEX 45)	-	Code pointed to by the MPAR address is executing.
ASCII	P	(HEX 50)	-	Program Flash Memory. The MPAR is set to the address of the Flash memory program control packet.
ASCII	R	(HEX 52)	-	Ready. The firmware monitor is watching for a change.

You can only program flash memory by the MPCR method. Refer to the .PFLASH system call in the *MVME162Bug Debugging Package User's Manual* for a description of the flash memory program control packet structure.

The status codes that may be set by the bus master are:

ASCII	G	(HEX 47)	-	Use Go Direct (**GD**) logic specifying the MPAR address.
ASCII	B	(HEX 42)	-	Install breakpoints using the Go (**G**) logic.

The Multiprocessor Address Register (MPAR), located in shared RAM location of $804 offset from the base address the debugger loads it at, contains the second of two longwords used to control communication between processors. The MPAR contents specify the address at which execution for the remote processor is to begin if the MPCR contains a G or B. The MPAR is organized as follows:



At power-up, the debug monitor self-test routines initialize RAM, including the memory locations used for multiprocessor support ($800 through $807).

The MPCR contains $00 at power-up, indicating that initialization is not yet complete. As initialization proceeds, the execution path comes to the "prompt" routine. Before sending the prompt, this routine places an R in the MPCR to indicate that initialization is complete. Then the prompt is sent.

If no terminal is connected to the port, the MPCR is still polled to see whether an external processor requires control to be passed to the dual-port RAM. If a terminal does respond, the MPCR is polled for the same purpose while the serial port is being polled for user input.

An ASCII G placed in the MPCR by a remote processor indicates that the Go Direct type of transfer is requested. An ASCII B in the MPCR indicates that breakpoints are to be armed before control is transferred (as with the **GO** command).

In either sequence, an E is placed in the MPCR to indicate that execution is underway just before control is passed to RAM (any remote processor could examine the MPCR contents).

If the code being executed in dual-port RAM is to reenter the debug monitor, a TRAP #15 call using function $0063 (SYSCALL .RETURN) returns control to the monitor with a new display prompt. Note that every time the debug monitor returns to the prompt, an R is moved into the MPCR to indicate that control can be transferred once again to a specified RAM location.

GCSR Method

A remote processor can initiate program execution in the local MVME162LX dual-port RAM by issuing a remote **GO** command using the VMEchip2 Global Control and Status Registers (GCSR). The remote processor places the controller's execution address in general purpose registers 0 and 1 (GPCSR0 and GPCSR1). The remote processor then sets bit 8 (SIG0) of the VMEchip2 LM/SIG register. This causes the controller to install breakpoints and begin execution. The result is identical to the MPCR method (with status code B) described in the previous section.

The GCSR registers are accessed in the VMEbus short I/O space. Each general purpose register is two bytes wide, occurring at an even address. The general purpose register number 0 is at an offset of $8 (local bus) or $4 (VMEbus) from the start of the GCSR registers. The local bus base address for the GCSR is $FFF40100. The VMEbus base address for the GCSR depends on the group select value and the board select value programmed in the Local Control and Status Registers (LCSR) of the controller. The execution address is formed by reading the GCSR general purpose registers in the following manner:

GPCSR0 used as the upper 16 bits of the address
GPCSR1 used as the lower 16 bits of the address

The address appears as:

GPCSR0	GPCSR1

Diagnostic Facilities

The 162Bug package includes a set of hardware diagnostics for testing and troubleshooting the MVME162LX Embedded Controller. To use the diagnostics, switch directories to the diagnostic directory. If you are in the debugger directory, you can switch to the diagnostic directory with the Switch Directories (**SD**) command. The diagnostic prompt ("`162-Diag>`") appears. Refer to the *MVME162Bug Debugging Package User's Manual* for complete descriptions of the diagnostic routines available and instructions on how to invoke them.

Note that some diagnostics depend on restart defaults that are set up only in a particular restart mode. The documentation for such diagnostics includes restart information.

Manufacturing Test Process

During the manufacturing process for MVME162LX Embedded Controllers, the manufacturing test parameters and testing state flags are stored in NVRAM. These strings are installed during the manufacturing process and result in the product performing manufacturing tests. None of these tests harm the product or system into which a module is installed. Entering an ASCII break on the console port from a terminal terminates these tests.

The two state flags that start the test processes are:

```
FLASH EMPTY$00122984
```

and

```
Burnin test$00000000
```

If either string is in the first location of NVRAM ($FFFC0000), the test process starts.

Using The 162Bug Debugger

4

Entering Debugger Command Lines

162Bug is command-driven and performs its various operations in response to user commands entered at the keyboard. When the debugger prompt (`162-Bug>`) appears on the terminal screen, the debugger is ready to accept commands.

As the command line is entered, it is stored in an internal buffer. Execution begins only after the carriage return is entered, so that you can correct entry errors, if necessary, using the control characters described in Chapter 3.

When a command is entered, the debugger executes the command and the prompt reappears. However, if the command entered causes execution of user target code, for example **GO**, then control may or may not return to the debugger, depending on what the user program does. For example, if a breakpoint has been specified, then control returns to the debugger when the breakpoint is encountered during execution of the user program. Alternately, the user program could return to the debugger by means of the TRAP #15 function ".RETURN".

In general, a debugger command is made up of the following parts:

- The command identifier (i.e., **MD** or **md** for the Memory Display command). Note that either upper or lowercase is allowed.
- A port number if the command is set up to work with more than one port.
- At least one intervening space before the first argument.
- Any required arguments, as specified by command.
- An option field, set off by a semicolon (**;**) to specify conditions other than the default conditions of the command.

The commands are shown using a modified Backus-Naur form syntax. The metasymbols used are:

boldface strings	A boldface string is a literal such as a command or a program name, and is to be typed just as it appears.
italic strings	An italic string is a "syntactic variable" and is to be replaced by one of a class of items it represents.
|	A vertical bar separating two or more items indicates that a choice is to be made; only one of the items separated by this symbol should be selected.
[ ]	Square brackets enclose an item that is optional. The item may appear zero or one time.
{ }	Braces enclose an optional symbol that may occur zero or more times.

Syntactic Variables

The following syntactic variables are encountered in the command descriptions which follow. In addition, other syntactic variables may be used and are defined in the particular command description in which they occur.

DEL	Delimiter; either a comma or a space.
EXP	Expression (described in detail in a following section).
ADDR	Address (described in detail in a following section).
COUNT	Count; the syntax is the same as for *EXP*.
RANGE	A range of memory addresses which may be specified either by *ADDR DEL ADDR* or by *ADDR*: *COUNT*.
TEXT	An ASCII string of up to 255 characters, delimited at each end by the single quote mark (’).

Expression as a Parameter

An expression can be one or more numeric values separated by the arithmetic operators: plus (+), minus (-), multiplied by (*****), divided by (/), logical AND (**&**), shift left (<<), or shift right (>>).

Numeric values may be expressed in either hexadecimal, decimal, octal, or binary by immediately preceding them with the proper base identifier.

Data Type	Base	Identifier	Examples
Integer	Hexadecimal	$	$FFFFFFFF
Integer	Decimal	&	&1974, &10-&4
Integer	Octal	@	@456
Integer	Binary	%	%1000110

If no base identifier is specified, then the numeric value is assumed to be hexadecimal.

A numeric value may also be expressed as a string literal of up to four characters. The string literal must begin and end with the single quote mark (’). The numeric value is interpreted as the concatenation of the ASCII values of the characters. This value is right-justified, as any other numeric value would be.

String Literal	Numeric Value (In Hexadecimal)
’A’	41
’ABC’	414243
’TEST’	54455354

Evaluation of an expression is always from left to right unless parentheses are used to group part of the expression. There is no operator precedence. Sub-expressions within parentheses are evaluated first. Nested parenthetical sub-expressions are evaluated from the inside out.

Valid expression examples:

Expression	Result (In Hex)	Notes
FF0011	FF0011	
45+99	DE	
&45+&99	90	
@35+@67+@10	5C	
%10011110+%1001	A7	
88<<4	880	shift left
AA&F0	A0	logical AND

The total value of the expression must be between 0 and $FFFFFFFF.

Address as a Parameter

Many commands use *ADDR* as a parameter. The syntax accepted by the 162Bug is similar to the one accepted by the MC68040 one-line assembler. All control addressing modes are allowed. An "address + offset register" mode is also provided.

Address Formats

Table 4-1 summarizes the address formats which are acceptable for address parameters in debugger command lines.

Table 4-1. Debugger Address Parameter Formats

Format	Example	Description
N	140	Absolute address+contents of automatic offset register.
N+Rn	130+R5	Absolute address+contents of the specified offset register (not an assembler-accepted syntax).
(*An*)	(A1)	Address register indirect. (also postincrement, predecrement)
(*d*,*An*) or *d*(*An*)	(120,A1) 120(A1)	Address register indirect with displacement (two formats accepted).
(*d*,*An*,*Xn*) or *d*(*An*,*Xn*)	(&120,A1,D2) &120(A1,D2)	Address register indirect with index and displacement (two formats accepted).
([*bd*,*An*,*Xn*],*od*)	([C,A2,A3],&100)	Memory indirect preindexed.
([*bd*,*An*],*Xn*,*od*)	([12,A3],D2,&10)	Memory indirect postindexed.
For the memory indirect modes, fields can be omitted. For example, three of many permutations are as follows:		
([,*An*],*od*)	([,A1],4)	
([*bd*])	([FC1E])	
([*bd*,,*Xn*])	([8,,D2])	

NOTES:
- N — Absolute address (any valid expression).
- An — Address register *n*.
- Xn — Index register *n* (*An* or *Dn*).
- d — Displacement (any valid expression).
- bd — Base displacement (any valid expression).
- od — Outer displacement (any valid expression).
- n — Register number (0 to 7).
- Rn — Offset register *n*.

Note In commands with *RANGE* specified as *ADDR DEL ADDR*, and with size option W or L chosen, data at the second (ending) address is acted on only if the second address is a proper boundary for a word or longword, respectively.

Offset Registers

Eight pseudo-registers (R0 through R7) called offset registers are used to simplify the debugging of relocatable and position-independent modules. The listing files in these types of programs usually start at an address (normally 0) that is not the one at which they are loaded, so it is harder to correlate addresses in the listing with addresses in the loaded program. The offset registers solve this problem by taking into account this difference and forcing the display of addresses in a relative address+offset format. Offset registers have adjustable ranges and may even have overlapping ranges. The range for each offset register is set by two addresses: base and top. Specifying the base and top addresses for an offset register sets its range. In the event that an address falls in two or more offset registers' ranges, the one that yields the least offset is chosen.

Note Relative addresses are limited to 1MB (5 digits), regardless of the range of the closest offset register.

Example: A portion of the listing file of an assembled, relocatable module is shown below:

```
  1
  2                                *
  3                                * MOVE STRING SUBROUTINE
  4                                *
  5   0 00000000 48E78080          MOVESTR  MOVEM.L  D0/A0,—(A7)
  6   0 00000004 4280                       CLR.L    D0
  7   0 00000006 1018                       MOVE.B   (A0)+,D0
  8   0 00000008 5340                       SUBQ.W   #1,D0
  9   0 0000000A 12D8              LOOP     MOVE.B   (A0)+,(A1)+
 10   0 0000000C 51C8FFFC          MOVS     DBRA     D0,LOOP
 11   0 00000010 4CDF0101                   MOVEM.L  (A7)+,D0/A0
 12   0 00000014 4E75                       RTS
 13
 14                                         END
****** TOTAL ERRORS     0——
****** TOTAL WARNINGS   0——
```

The above program was loaded at address $0001327C.

The disassembled code is shown next:

```
162Bug>MD 1327C;DI
0001327C 48E78080                MOVEM.L  D0/A0,—(A7)
00013280 4280                    CLR.L    D0
00013282 1018                    MOVE.B   (A0)+,D0
00013284 5340                    SUBQ.W   #1,D0
00013286 12D8                    MOVE.B   (A0)+,(A1)+
00013288 51C8FFFC                DBF      D0,$13286
0001328C 4CDF0101                MOVEM.L  (A7)+,D0/A0
00013290 4E75                    RTS
162Bug>
```

By using one of the offset registers, the disassembled code addresses can be made to match the listing file addresses as follows:

```
162Bug>OF R0
R0 =00000000 00000000? 1327C.
162Bug>MD 0+R0;DI
00000+R0 48E78080                MOVEM.L  D0/A0,-(A7)
00004+R0 4280                    CLR.L    D0
00006+R0 1018                    MOVE.B   (A0)+,D0
00008+R0 5340                    SUBQ.W   #1,D0
0000A+R0 12D8                    MOVE.B   (A0)+,(A1)+
0000C+R0 51C8FFFC                DBF      D0,$A+R0
00010+R0 4CDF0101                MOVEM.L  (A7)+,D0/A0
00014+R0 4E75                    RTS
162Bug>
```

For additional information about the offset registers, refer to the *Debugging Package for Motorola 68K CISC CPUs User's Manual*.

Port Numbers

Some 162Bug commands give you the option to choose the port to be used to input or output. Valid port numbers which may be used for these commands are as follows:

1. MVME162LX EIA-232-D Debug (Terminal Port 0 or 00) (PORT 1 on the MVME162LX J17 front panel connector). Sometimes known as the "console port", it is used for interactive user I/O by default.
2. MVME162LX EIA-232-D (Terminal Port 1 or 01) (PORT 2 on the MVME162LX J17 front panel connector). Sometimes known as the "host port", this is the default for downloading, uploading, concurrent mode, and transparent modes.
3. MVME162LX EIA-232-D (Terminal Port 2 or 02 and 3 or 03) (PORT 3 and PORT 4 on the MVME162LX J17 front panel connector). Additional serial ports available.

Note These logical port numbers (0 and 1) are shown in the pinouts of the MVME162LX controller as "SERIAL PORT 1", "SERIAL PORT 2" and "SERIAL PORT 3", respectively. Physically, they are all part of connector P2. They are all part of the front panel eight-pin RJ45 connectors on J17.

Entering and Debugging Programs

There are various ways to enter a user program into system memory for execution. One way is to create the program using the Memory Modify (**MM**) command with the assembler/disassembler option. You enter the program one source line at a time. After each source line is entered, it is assembled and the object code is loaded to memory. Refer to the *Debugging Package for Motorola 68K CISC CPUs User's Manual* for complete details of the 162Bug Assembler/Disassembler.

Another way to enter a program is to download an object file from a host system. The program must be in S-record format (described in the *Debugging Package for Motorola 68K CISC CPUs User's Manual*) and may have been assembled or compiled on the host system. Alternately, the program may have been previously created using the 162Bug **MM** command as outlined above and stored to the host using the Dump (**DU**) command. A communication link must exist between the host system and the MVME162LX port 1 (Hardware configuration details are in the section on *Installation and Startup* in Chapter 3). The file is downloaded from the host to MVME162LX memory by the Load (**LO**) command.

Another way is by reading in the program from disk, using one of the disk commands (**BO**, **BH**, **IOP**). Once the object code has been loaded into memory, you can set breakpoints if desired and run the code or trace through it.

Calling System Utilities from User Programs

A convenient way of doing character input/output and many other useful operations has been provided so that you do not have to write these routines into the target code. You can access various 162Bug routines via one of the MC68040 TRAP instructions, using vector #15. Refer to the *Debugging Package for Motorola 68K CISC CPUs User's Manual* for additional information on the various TRAP #15 utilities available and how to invoke them from within a user program.

Preserving the Debugger Operating Environment

This section explains how to avoid contaminating the operating environment of the debugger. 162Bug uses certain of the MVME162LX onboard resources and also offboard system memory to contain temporary variables and exception vectors. If you disturb resources upon which 162Bug depends, then the debugger may function unreliably or not at all.

If your application enables translation through the Memory Management Units (MMUs), and if your application utilizes resources of the debugger (e.g., system calls), your application must create the necessary translation tables for the debugger to have access to its various resources. The debugger honors the enabling of the MMUs; it does not disable translation.

162Bug Vector Table and Workspace

As described in the *Memory Requirements* section in Chapter 3, the 162Bug needs 64KB of read/write memory to operate. The 162Bug reserves a 1024-byte area for a user program vector table area and then allocates another 1024-byte area and builds an exception vector table for the debugger itself to use. Next, 162Bug reserves space for static variables and initializes these static variables to predefined default values. After the static variables, 162Bug allocates space for the system stack, then initializes the system stack pointer to the top of this area.

With the exception of the first 1024-byte vector table area, you must be extremely careful not to use the above-mentioned memory areas for other purposes. You should refer to the *Memory Requirements* section in Chapter 3 to determine how to dictate the location of the reserved memory areas. If, for example, your program inadvertently wrote over the static variable area containing the serial communication parameters, these parameters would be lost, resulting in a loss of communication with the system console terminal. If your program corrupts the system stack, then an incorrect value may be loaded into the processor Program Counter (PC), causing a system crash.

Hardware Functions

The only hardware resources used by the debugger are the EIA-232-D ports, which are initialized to interface to the debug terminal. If these ports are reprogrammed, the terminal characteristics must be modified to suit, or the ports should be restored to the debugger-set characteristics prior to reinvoking the debugger.

Exception Vectors Used by 162Bug

The exception vectors used by the debugger are listed below. These vectors must reside at the specified offsets in the target program's vector table for the associated debugger facilities (breakpoints & trace mode) to operate.

Table 4-2. Exception Vectors Used by 162Bug

Vector Offset	Exception	162Bug Facility
$10	Illegal instruction	Breakpoints (used by **GO**, **GN**, **GT**)
$24	Trace	Trace operations (such as **T**, **TC**, **TT**)
$80-$B8	TRAP #0 - #14	Used internally
$BC	TRAP #15	System calls
NOTE 1	Level 7 interrupt	ABORT pushbutton
NOTE 2	Level 7 interrupt	AC Fail
$DC	FP Unimplemented Data Type	Software emulation and data type conversion of floating point data.

NOTES:
1. This depends on what the Vector Base Register (VBR) is set to in the MCchip.
2. This depends on what the Vector Base Register (VBR) is set to in the VMEchip2.

When the debugger handles one of the exceptions shown in Table 4-2, the target stack pointer is left pointing past the bottom of the exception stack frame created; that is, it reflects the system stack pointer values just before the exception occurred. In this way, the operation of the debugger facility (through an exception) is transparent to users.

Example: Trace one instruction using debugger.

```
162Bug>RD
PC   =00010000 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000000 D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010000 203C0000 0001    MOVE.L     #$1,D0
162Bug>T
PC   =00010006 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000001 D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010006 D280             ADD.L      D0,D1
162Bug>
```

Notice that the value of the target stack pointer register (A7) has not changed even though a trace exception has taken place. Your program may either use the exception vector table provided by the 162Bug or it may create a separate exception vector table of its own. The two following sections detail these two methods.

Using 162Bug Target Vector Table

The 162Bug initializes and maintains a vector table area for target programs. A target program is any program started by the bug, either manually with **GO** or **TR** type commands or automatically with the **BO** command. The start address of this target vector table area is the base address of the debugger memory. This address is loaded into the target-state VBR at power up and cold-start reset and can be observed by using the **RD** command to display the target-state registers immediately after power up.

The 162Bug initializes the target vector table with the debugger vectors listed in Table 4-2 and fills the other vector locations with the address of a generalized exception handler (refer to the *162Bug Generalized Exception Handler* section in this chapter). The target program may take over as many vectors as desired by simply writing its own exception vectors into the table. If the vector locations listed in Table 4-2 are overwritten then the accompanying debugger functions are lost.

The 162Bug maintains a separate vector table for its own use. In general, you do not have to be aware of the existence of the debugger vector table. It is completely transparent and you should never make any modifications to the vectors contained in it.

Creating a New Vector Table

Your program may create a separate vector table in memory to contain its exception vectors. If this is done, the program must change the value of the VBR to point at the new vector table. In order to use the debugger facilities you can copy the proper vectors from the 162Bug vector table into the corresponding vector locations in your program vector table.

The vector for the 162Bug generalized exception handler (described in detail in the *162Bug Generalized Exception Handler* section found in this chapter) may be copied from offset $08 (bus error vector) in the target vector table to all locations in your program vector table where a separate exception handler is not used. This provides diagnostic support in the event that your program is stopped by an unexpected exception. The generalized exception handler gives a formatted display of the target registers and identifies the type of the exception.

The following is an example of a routine which builds a separate vector table and then moves the VBR to point at it:

```
*
***  BUILDX - Build exception vector table ****
*
BUILDX  MOVEC.L  VBR,A0            Get copy of VBR.
        LEA      $10000,A1         New vectors at $10000.
        MOVE.L   $80(A0),D0        Get generalized exception vector.
        MOVE.W   $3FC,D1           Load count (all vectors).
LOOP    MOVE.L   D0,(A1,D1)        Store generalized exception vector.
        SUBQ.W   #4,D1
        BNE.B    LOOP              Initialize entire vector table.
        MOVE.L   $10(A0),$10(A1)   Copy breakpoints vector.
        MOVE.L   $24(A0),$24(A1)   Copy trace vector.
        MOVE.L   $BC(A0),$BC(A1)   Copy system call vector.
        LEA.L    COPROCC(PC),A2    Get your exception vector.
        MOVE.L   A2,$2C(A1)        Install as F-Line handler.
        MOVEC.L  A1,VBR            Change VBR to new table.
        RTS
        END
```

It may turn out that your program uses one or more of the exception vectors that are required for debugger operation. Debugger facilities may still be used, however, if your exception handler can determine when to handle the exception itself and when to pass the exception to the debugger.

When an exception occurs which you want to pass on to the debugger; i.e., **ABORT**, your exception handler must read the vector offset from the format word of the exception stack frame. This offset is added to the address of the 162Bug target program vector table (which your program saved), yielding the address of the 162Bug exception vector. The program then jumps to the address stored at this vector location, which is the address of the 162Bug exception handler.

Your program must make sure that there is an exception stack frame in the stack. It must be exactly the same as the processor would have created for the particular exception before jumping to the address of the exception handler.

The following is an example of an exception handler which can pass an exception along to the debugger:

```
*
***  EXCEPT - Exception handler  ****
*
EXCEPT  SUBQ.L   #4,A7              Save space in stack for a PC value.
        LINK     A6,#0              Frame pointer for accessing PC space.
        MOVEM.L  A0-A5/D0-D7,-(SP)  Save registers.
        :
        : decide here if your code handles exception, if so, branch...
        :
        MOVE.L   BUFVBR,A0          Pass exception to debugger; Get saved VBR.
        MOVE.W   14(A6),D0          Get the vector offset from stack frame.
        AND.W    #$0FFF,D0          Mask off the format information.
        MOVE.L   (A0,D0.W),4(A6)    Store address of debugger exc handler.
        MOVEM.L  (SP)+,A0-A5/D0-D7  Restore registers.
        UNLK     A6
        RTS                         Put addr of exc handler into PC and go.
```


162Bug Generalized Exception Handler

The 162Bug has a generalized exception handler which it uses to handle all of the exceptions not listed in Table 4-2. For all these exceptions, the target stack pointer is left pointing to the top of the exception stack frame created. In this way, if an unexpected exception occurs during execution of your code, you are presented with the exception stack frame to help determine the cause of the exception. The following example illustrates this:

Example: Bus error at address $F00000. It is assumed for this example that an access of memory location $F00000 initiates bus error exception processing.

```
162Bug>RD
PC   =00010000 SR   =2708=TR:OFF_S._7_.N...  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000001 D1   =00000001 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000002 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010000 203900F0 0000      MOVE.L      ($F00000).L,D0
162Bug>T

Exception: Access Fault (Local Off Board)
PC =FF839154 SR =2704
Format/Vector =7008
SSW =0145 Fault Address =00F00000 Effective Address =0000D4E8
PC   =00010000 SR   =2708=TR:OFF_S._7_.N...  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000001 D1   =00000001 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000002 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFC0
00010000 203900F0 0000      MOVE.L      ($F00000).L,D0
162Bug>
```

Notice that the target stack pointer is different. The target stack pointer now points to the last value of the exception stack frame that was stacked. The exception stack frame may now be examined using the **MD** command.

```
162Bug>MD (A7):&30
0000FFC0 2708 0001 0000 7008  0000 FFFC 0105 0005 '.....p.........
0000FFD0 0005 0005 00F0 0000  0000 0A64 0000 FFF4 ...........d....
0000FFE0 00F0 0000 FFFF FFFF  00F0 0000 FFFF FFFF ................
0000FFF0 2708 0001 A708 0001  0000 0000         '...........
162Bug>
```

Floating Point Support

The floating point unit (FPU) of the MC68040 microprocessor chip is supported in the 162Bug. For MVME162Bug, the commands **MD**, **MM**, **RM**, and **RS** have been extended to allow display and modification of floating point data in registers and in memory. Floating point instructions can be assembled/disassembled with the **DI** option of the **MD** and **MM** commands.

Valid data types that can be used when modifying a floating point data register or a floating point memory location:

Integer Data Types	
12	Byte
1234	Word
12345678	Longword

Floating Point Data Types	
1_FF_7FFFFF	Single Precision Real Format
1_7FF_FFFFFFFFFFFF	Double Precision Real Format
1_7FFF_FFFFFFFFFFFFFFFF	Extended Precision Real Format
1111_2103_123456789ABCDEF01	Packed Decimal Real Format
-3.12345678901234501_E+123	Scientific Notation Format (decimal)

When entering data in single, double, extended precision, or packed decimal format, the following rules must be observed:

1. The sign field is the first field and is a binary field.
2. The exponent field is the second field and is a hexadecimal field.
3. The mantissa field is the last field and is a hexadecimal field.
4. The sign field, the exponent field, and at least the first digit of the mantissa field must be present (any unspecified digits in the mantissa field are set to zero).
5. Each field must be separated from adjacent fields by an underscore.
6. All the digit positions in the sign and exponent fields must be present.

Single Precision Real

This format would appear in memory as:

1-bit sign field	(1 binary digit)
8-bit biased exponent field	(2 hex digits. Bias = $7F)
23-bit fraction field	(6 hex digits)

A single precision number takes 4 bytes in memory.

Double Precision Real

This format would appear in memory as:

1-bit sign field	(1 binary digit)
11-bit biased exponent field	(3 hex digits. Bias = $3FF)
52-bit fraction field	(13 hex digits)

A double precision number takes 8 bytes in memory.

Note **The single and double precision formats have an implied integer bit (always 1).**

Extended Precision Real

This format would appear in memory as:

1-bit sign field	(1 binary digit)
15-bit biased exponent field	(4 hex digits. Bias = $3FFF)
64-bit mantissa field	(16 hex digits)

An extended precision number takes 10 bytes in memory.

Packed Decimal Real

This format would appear in memory as:

4-bit sign field	(4 binary digits)
16-bit exponent field	(4 hex digits)
68-bit mantissa field	(17 hex digits)

A packed decimal number takes 12 bytes in memory.

Scientific Notation

This format provides a convenient way to enter and display a floating point decimal number. Internally, the number is assembled into a packed decimal number and then converted into a number of the specified data type.

Entering data in this format requires the following fields:

- An optional sign bit (+ or -).
- One decimal digit followed by a decimal point.
- Up to 17 decimal digits (at least one must be entered).
- An optional exponent field that consists of:
  - An optional underscore.
  - The exponent field identifier, letter "E".
  - An optional exponent sign (+, -).
  - From 1 to 3 decimal digits.

For more information about the MC68040 floating point unit, refer to the *M68040 Microprocessor User's Manual*.

The 162Bug Debugger Command Set

The 162Bug debugger commands are summarized in Table 4-3.

HE is the 162Bug help facility. **HE <CR>** displays only the command names of all available commands along with their appropriate titles. **HE** *COMMAND* displays only the command name and title for that particular command, plus its complete command syntax. The command syntax is shown using the symbols explained earlier in this chapter.

The **CNFG** and **ENV** commands are explained in Chapter 5. Controllers, devices, and their LUNs are listed in Appendix B or Appendix C. All other command details are explained in the *Debugging Package for Motorola 68K CISC CPUs User's Manual.*

Table 4-3. Debugger Commands

Command Mnemonic	Title	Command Line Syntax
AB	Automatic Bootstrap Operating System	**AB** [**;V**]
NOAB	No Autoboot	NOAB
AS	One Line Assembler	**AS** *ADDR*
BC	Block of Memory Compare	**BC** *RANGE DEL ADDR* [**; B**|**W**|**L**]
BF	Block of Memory Fill	**BF** *RANGE DEL data* [*DEL increment*] [**; B**|**W**|**L**]
BH	Bootstrap Operating System and Halt	**BH** [*DEL Controller LUN*][*DEL Device LUN*] [*DEL String*]
BI	Block of Memory Initialize	**BI** *RANGE* [**;B**|**W**|**L**]
BM	Block of Memory Move	**BM** *RANGE DEL ADDR* [**; B**|**W**|**L**]
BO	Bootstrap Operating System	**BO** [*DEL Controller LUN*][*DEL Device LUN*] [*DEL String*]
BR	Breakpoint Insert	**BR** [*ADDR*[**:***COUNT*]]
NOBR	Breakpoint Delete	**NOBR** [*ADDR*]

Table 4-3. Debugger Commands (Continued)

Command Mnemonic	Title	Command Line Syntax
BS	Block of Memory Search	**BS** *RANGE DEL TEXT* [**;B**|**W**|**L**] or **BS** *RANGE DEL data* [*DEL mask*] [**;B**|**W**|**L** [**,N**][**,V**]]
BV	Block of Memory Verify	**BV** *RANGE DEL data* [*increment*] [**;B**|**W**|**L**]
CM	Concurrent Mode	**CM** [[*PORT*][*DEL ID-STRING*] [*DEL BAUD*][*DEL PHONE-NUMBER*]]|[**;A**]|[**;H**]
NOCM	No Concurrent Mode	NOCM
CNFG	Configure Board Information Block	**CNFG** [**;**[**I**][**M**]]
CS	Checksum	**CS** *RANGE* [**;B**|**W**|**L**]
DC	Data Conversion	**DC** ***EXP*** | *ADDR* [**;**[**B**][**O**][**A**]]
DMA	DMA Block of Memory Move	**DMA** *RANGE DEL ADDR DEL VDIR DEL AM DEL BLK* [**;B**|**W**|**L**]
DS	One Line Disassembler	**DS** *ADDR* [**:***COUNT* | *DEL ADDR*]
DU	Dump S-records	**DU** [*PORT*]*DEL RANGE* [*DEL TEXT*][*DEL ADDR*] [*DEL OFFSET*][**;B**|**W**|**L**]
ECHO	Echo String	**ECHO** [*PORT*]*DEL*{*hexadecimal number*} {**'***string***'**}
ENV	Set Environment to Bug/Operating System	**ENV** [**;**[**D**]]
GD	Go Direct (Ignore Breakpoints)	**GD** [*ADDR*]
GN	Go to Next Instruction	GN
GO	Go Execute User Program	**GO** [*ADDR*]
GT	Go to Temporary Breakpoint	**GT** *ADDR*
HE	Help	**HE** [*COMMAND*]
IOC	I/O Control for Disk	IOC

Table 4-3. Debugger Commands (Continued)

Command Mnemonic	Title	Command Line Syntax
IOI	I/O Inquiry	**IOI** [**;**[**C**|**L**]]
IOP	I/O Physical (Direct Disk Access)	IOP
IOT	I/O "TEACH" for Configuring Disk Controller	**IOT** [**;**[**A**][**F**][**H**][**T**]]
IRQM	Interrupt Request Mask	**IRQM** [*MASK*]
LO	Load S-records from Host	**LO** [*n*] [*ADDR*] [**;X**|**C**|**T**] [*=text*]
MA	Macro Define/Display	**MA** [*NAME* **; L**]
NOMA	Macro Delete	**NOMA** [*NAME*]
MAE	Macro Edit	**MAE** *name line#* [*string*]
MAL	Enable Macro Expansion Listing	MAL
NOMAL	Disable Macro Expansion Listing	NOMAL
MAW	Save Macros	**MAW** [*controller LUN*][*DEL*[*device LUN*] [*DEL block #*]]
MAR	Load Macros	**MAR** [*controller LUN*][*DEL*[*device LUN*] [*DEL block #*]]
MD	Memory Display	**MD**[**S**] *ADDR*[**:***COUNT* | *ADDR*] [**;** [**B**|**W**|**L**|**S**|**D**|**X**|**P**|**DI**]]
MENU	Menu	MENU
MM	Memory Modify	**MM** *ADDR*[**;**[[**B**|**W**|**L**|**S**|**D**|**X**|**P**][**A**][**N**]]|[**DI**]]
MMD	Memory Map Diagnostic	**MMD** *RANGE DEL increment*[**;B**|**W**|**L**]
MS	Memory Set	**MS** *ADDR* {*Hexadecimal number*} {**'***string***'**}
MW	Memory Write	**MW** *ADDR DATA* [**;B**|**W**|**L**]

Table 4-3. Debugger Commands (Continued)

Command Mnemonic	Title	Command Line Syntax
NAB	Automatic Network Boot Operating System	NAB
NBH	Network Boot Operating System and Halt	**NBH** [*Controller LUN*][*Device LUN*] [*Client IP Address*][*Server IP Address*][*String*]
NBO	Network Boot Operating System	**NBO** [*Controller LUN*][*Device LUN*] [*Client IP Address*][*Server IP Address*][*String*]
NIOC	Network I/O Control	NIOC
NIOP	Network I/O Physical	NIOP
NIOT	Network I/O Teach	**NIOT** [**;**[**H**]|[**A**]]
NPING	Network Ping	**NPING** *Controller-LUN Device-LUN Source-IP Destination-IP* [*N-Packets*]
OF	Offset Registers Display/Modify	**OF** [**R***n*[**;A**]]
PA	Printer Attach	**PA** [*n*]
NOPA	Printer Detach	**NOPA** [*n*]
PF	Port Format	**PF** [*PORT*]
NOPF	Port Detach	**NOPF** [*PORT*]
PFLASH	Program FLASH Memory	**PFLASH** *SSADDR SEADDR DSADDR* [*IEADDR*][**;**[**A**|**R**][**X**]] -or- **PFLASH** *SSADDR***:***COUNT DSADDR* [*IEADDR*] [**;**[**B**|**W**|**L**] [**A**|**R**] [**X**]]
PS	Put RTC Into Power Save Mode for Storage	PS
RB	ROMboot Enable	**RB**[**;V**]
NORB	ROMboot Disable	NORB
RD	Register Display	**RD** {[+|-|=][*DNAME*][/]} {[+|-|=] [*REG1*[-***REG2***]][/]} [**;E**]

Table 4-3. Debugger Commands (Continued)

Command Mnemonic	Title	Command Line Syntax
REMOTE	Connect the Remote Modem to CSO	REMOTE
RESET	Cold/Warm Reset	RESET
RL	Read Loop	**RL** *ADDR***;**[**B**|**W**|**L**]
RM	Register Modify	**RM** [*REG*] [**;**[**S**|**D**]]
RS	Register Set	**RS** *REG* [*DEL EXP*|*DEL ADDR*][**;**[**S**|**D**]]
SD	Switch Directories	SD
SET	Set Time and Date	**SET** *mmddyyhhmm* -or- **SET** *n***;C**
SYM	Symbol Table Attach	**SYM** [*ADDR*]
NOSYM	Symbol Table Detach	NOSYM
SYMS	Symbol Table Display/Search	**SYMS** [*symbol-name*]|[**;S**]
T	Trace	**T** [*COUNT*]
TA	Terminal Attach	**TA** [*port*]
TC	Trace on Change of Control Flow	**TC** [*count*]
TIME	Display Time and Date	**TIME** [**;**[**C**|**L**|**O**]]
TM	Transparent Mode	**TM** [*n*] [*ESCAPE*]
TT	Trace to Temporary Breakpoint	**TT** *ADDR*
VE	Verify S-records Against Memory	**VE** [*n*] [*ADDR*] [**;**[**X**][**C**]] [*=text*]
VER	Display Revision/Version	**VER** [**; E**]
WL	Write Loop	**WL** *ADDR***:***DATA***;**[**B**|**W**|**L**]

Configure and Environment Commands

A

Configure Board Information Block

CNFG [;[I][M]]

This command is used to display and configure the board information block. This block is resident within the Non-Volatile RAM (NVRAM). Refer to the *MVME162LX Embedded Controller Programmer's Reference Guide* for the actual location. The information block contains various elements detailing specific operation parameters of the hardware. The *MVME162LX Embedded Controller Programmer's Reference Guide* describes the elements within the board information block, and lists the size and logical offset of each element. The **CNFG** command does *not* describe the elements and their use. The board information block contents are checksummed for validation purposes. This checksum is the last element of the block.

Although the factory fills all fields except the Industry Pack fields, only these fields MUST contain correct information:

- MPU clock speed
- Ethernet address
- Local SCSI identifier

The board structure for the MVME162LX is as follows:

```
162-Bug>cnfg
Board (PWA) Serial Number                          = "     "
Board Identifier                                   = "     "
Artwork (PWA) Identifier                           = "     "
MPU Clock Speed                                    = "     "
Ethernet Address                                   = 08003E200000
Local SCSI Identifier                              = "     "
Parity Memory Mezzanine Artwork (PWA) Identifier   = "     "
Parity Memory Mezzanine (PWA) Serial Number        = "     "
Static Memory Mezzanine Artwork (PWA) Identifier   = "     "
Static Memory Mezzanine (PWA) Serial Number        = "     "
ECC Memory Mezzanine #1 Artwork (PWA) Identifier   = "     "
ECC Memory Mezzanine #1 (PWA) Serial Number        = "     "
```

```
ECC Memory Mezzanine #2 Artwork (PWA) Identifier    = "     "
ECC Memory Mezzanine #2 (PWA) Serial Number         = "     "
Serial Port 2 Personality Artwork (PWA) Identifier  = "     "
Serial Port 2 Personality Module (PWA) Serial Number = "     "
IndustryPack A Board Identifier                     = "     "
IndustryPack A (PWA) Serial Number                  = "     "
IndustryPack A Artwork (PWA) Identifier             = "     "
IndustryPack B Board Identifier                     = "     "
IndustryPack B (PWA) Serial Number                  = "     "
IndustryPack B Artwork (PWA) Identifier             = "     "
IndustryPack C Board Identifier                     = "     "
IndustryPack C (PWA) Serial Number                  = "     "
IndustryPack C Artwork (PWA) Identifier             = "     "
IndustryPack D Board Identifier                     = "     "
IndustryPack D (PWA) Serial Number                  = "     "
IndustryPack D Artwork (PWA) Identifier             = "     "
162-Bug>
```

Note that the parameters that are quoted are left-justified character (ASCII) strings padded with space characters, and the quotes (") are displayed to indicate the size of the string. Parameters that are not quoted are considered data strings, and data strings are right-justified. The data strings are padded with zeroes if the length is not met.

In the event of corruption of the board information block, the command displays a question mark "?" for nondisplayable characters. A warning message (`WARNING: Board Information Block Checksum Error`) is also displayed in the event of a checksum failure.

Using the **I** option initializes the unused area of the board information block to zero.

Modification is permitted by using the **M** option of the command. At the end of the modification session, you are prompted for the update to Non-Volatile RAM (NVRAM). A **Y** response must be made for the update to occur; any other response terminates the update (disregards all changes). The update also recalculates the checksum.

Exercise caution when modifying parameters. Some of these parameters are set up by the factory, and correct board operation is dependent upon these parameters.

Once modification/update is complete, you can now display the current contents as described earlier.

Set Environment to Bug/Operating System

ENV [**;**[**D**]]

The **ENV** command allows you to interactively view/configure all Bug operational parameters that are kept in Battery Backed Up RAM (BBRAM), also known as Non-Volatile RAM (NVRAM). The operational parameters are saved in NVRAM and used whenever power is lost.

Any time the Bug uses a parameter from NVRAM, the NVRAM contents are first tested by checksum to insure the integrity of the NVRAM contents. In the instance of BBRAM checksum failure, certain default values are assumed as stated below.

The bug operational parameters (which are kept in NVRAM) are not initialized automatically on power up/warm reset. It is up to the Bug user to invoke the **ENV** command. Once the **ENV** command is invoked and executed without error, Bug default and/or user parameters are loaded into NVRAM along with checksum data. If any of the operational parameters have been modified, the new parameters do not go into effect until a reset/powerup condition occurs.

If the **ENV** command is invoked with no options on the command line, you are prompted to configure all operational parameters. If the **ENV** command is invoked with the option **D**, ROM defaults will be loaded into NVRAM.

The parameters to be configured are listed in Table A-1.

Table A-1. ENV Command Parameters

ENV Parameter and Options	Default	Meaning of Default
Bug or System environment [B/S]	B	Bug mode
Field Service Menu Enable [Y/N]	N	Do not display field service menu.
Remote Start Method Switch [G/M/B/N]	B	Use both the Global Control and Status Register (GCSR) in the VMEchip2, and the Multiprocessor Control Register (MPCR) in shared RAM, methods to pass and start execution of cross-loaded program.
Probe System for Supported I/O Controllers [Y/N]	Y	Accesses will be made to the appropriate system busses (e.g., VMEbus, local MPU bus) to determine presence of supported controllers.
Negate VMEbus SYSFAIL* Always [Y/N]	N	Negate VMEbus SYSFAIL after successful completion or entrance into the bug command monitor.
Local SCSI Bus Reset on Debugger Startup [Y/N]	N	Local SCSI bus is not reset on debugger startup.
Local SCSI Bus Negotiations Type [A/S/N]	A	Asynchronous negotiations.
Industry Pack Reset on Debugger Startup [Y/N]	N	Industry Pack(s) is/are not reset on debugger startup.
Ignore CFGA Block on a Hard Disk Boot [Y/N]	Y	Enable the ignorance of the Configuration Area (CFGA) Block (hard disk only).
Auto Boot Enable [Y/N]	N	Auto Boot function is disabled.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Auto Boot at power-up only [Y/N]	Y	Auto Boot is attempted at power up reset only.
Auto Boot Controller LUN	00	LUN of a disk/tape controller module currently supported by the Bug. Default is $0.
Auto Boot Device LUN	00	LUN of a disk/tape device currently supported by the Bug. Default is $0.
Auto Boot Abort Delay	15	This is the time in seconds that the Auto Boot sequence will delay before starting the boot. The purpose for the delay is to allow you the option of stopping the boot by use of the Break key. The time value is from 0 through 255 seconds.
Auto Boot Default String [Y(NULL String)/(String)]		You may specify a string (filename) which is passed on to the code being booted. Maximum length is 16 characters. Default is the null string.
ROM Boot Enable [Y/N]	N	ROMboot function is disabled.
ROM Boot at power-up only [Y/N]	Y	ROMboot is attempted at power up only.
ROM Boot Enable search of VMEbus [Y/N]	N	VMEbus address space will not be accessed by ROMboot.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
ROM Boot Abort Delay	00	This is the time in seconds that the ROMboot sequence will delay before starting the boot. The purpose for the delay is to allow you the option of stopping the boot by use of the Break key. The time value is from 0 through 255 seconds.
ROM Boot Direct Starting Address	FF800000	First location tested when the Bug searches for a ROMboot module.
ROM Boot Direct Ending Address	FFDFFFFC	Last location tested when the Bug searches for a ROMboot module.
Network Auto Boot Enable [Y/N]	N	Network Auto Boot function is disabled.
Network Auto Boot at power-up only [Y/N]	Y	Network Auto Boot is attempted at power up reset only.
Network Auto Boot Controller LUN	00	LUN of a disk/tape controller module currently supported by the Bug. Default is $0.
Network Auto Boot Device LUN	00	LUN of a disk/tape device currently supported by the Bug. Default is $0.
Network Auto Boot Abort Delay	5	This is the time in seconds that the Network Boot sequence will delay before starting the boot. The purpose for the delay is to allow you the option of stopping the boot by use of the Break key. The time value is from 0 through 255 seconds.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Network Autoboot Configuration Parameters Pointer (NVRAM)	00000000	This is the address where the network interface configuration parameters are to be saved/retained in NVRAM; these parameters are the necessary parameters to perform an unattended network boot.
Memory Search Starting Address	00000000	Where the Bug begins to search for a work page (a 64KB block of memory) to use for vector table, stack, and variables. This must be a multiple of the debugger work page, modulo $10000 (64KB). In a multi-162LX environment, each controller could be set to start its work page at a unique address to allow multiple debuggers to operate simultaneously.
Memory Search Ending Address	00100000	Top limit of the Bug's search for a work page. If a contiguous block of memory, 64KB in size, is not found in the range specified by Memory Search Starting Address and Memory Search Ending Address parameters, then the bug will place its work page in the onboard static RAM on the MVME162LX. Default Memory Search Ending Address is the calculated size of local memory.
Memory Search Increment Size	00010000	This multi-CPU feature is used to offset the location of the Bug work page. This must be a multiple of the debugger work page, modulo $10000 (64KB). Typically, Memory Search Increment Size is the product of CPU number and size of the Bug work page. Example: first CPU $0 (0 x $10000), second CPU $10000 (1 x $10000), etc.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Memory Search Delay Enable [Y/N]	N	There will be no delay before the Bug begins its search for a work page.
Memory Search Delay Address	FFFFD20F	Default address is $FFFFD20F. This is the MVME162LX GCSR GPCSR0 as accessed through VMEbus A16 space and assumes the MVME162LX GRPAD (group address) and BDAD (board address within group) switches are set to "on". This byte-wide value is initialized to $FF by MVME162LX hardware after a System or Power-on Reset. In a multi-162LX environment, where the work pages of several Bugs will reside in the memory of the primary (first) MVME162LX, the non-primary CPUs will wait for the data at the Memory Search Delay Address to be set to $00, $01, or $02 (refer to the *Memory Requirements* section in Chapter 3 for the definition of these values) before attempting to locate their work page in the memory of the primary CPU.
Memory Size Enable [Y/N]	Y	Memory will be sized for Self Test diagnostics.
Memory Size Starting Address	00000000	Default Starting Address is $0.
Memory Size Ending Address	00100000	Default Ending Address is the calculated size of local memory.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Memory Configuration Defaults: The default configuration for Dynamic RAM mezzanine boards will position the mezzanine with the largest memory size to start at the address selected with the "ENV" parameter "Base Address of Dynamic Memory". The Base Address parameter defaults to 0. The smaller sized mezzanine will follow immediately above the larger in the memory map. If mezzanines of the same size and type are present, the first (closest to the board) is mapped to the selected base address. If mezzanines of same size but with different type (parity and ECC) are present, the parity type will be mapped to the selected base address and the ECC type mezzanine will follow. The SRAM does not default to a location in the memory map that is contiguous with Dynamic RAM.		
Base Address of Dynamic Memory	00000000	Beginning address of Dynamic Memory (Parity and/or ECC type memory). It must be a multiple of the Dynamic Memory board size, starting with 0. Default is $0.
Size of Parity Memory	00100000	This is the size of the Parity type dynamic RAM mezzanine, if any. The default is the calculated size of the Dynamic memory mezzanine board.
Size of ECC Memory Board 0	00000000	This is the size of the first ECC type memory mezzanine. The default is the calculated size of the memory mezzanine.
Size of ECC Memory Board 1	00000000	This is the size of the second ECC type memory mezzanine. The default is the calculated size of the memory mezzanine.
Base Address of Static Memory	FFE00000	This is the beginning address of SRAM. The default is FFE00000 for the onboard 128KB SRAM, or E1000000 for the 2MB SRAM mezzanine. If only 2MB SRAM is present, it defaults to address 00000000.
Size of Static Memory	00080000	This is the size of the SRAM type memory present. The default is the calculated size of the onboard SRAM or an SRAM type mezzanine.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
ENV asks the following series of questions to set up the VMEbus interface for the MVME162LX Embedded Controller. You should have a working knowledge of the VMEchip2 as given in the *MVME162LX Embedded Controller Programmer's Reference Guide* in order to perform this configuration. Also included in this series are questions for setting ROM and Flash access time. The slave address decoders are used to allow another VMEbus master to access a local resource of the MVME162LX. There are two slave address decoders set. They are set up as follows:		
Slave Enable #1 [Y/N]	Y	Yes, setup and enable the Slave Address Decoder #1.
Slave Starting Address #1	00000000	Base address of the local resource that is accessible by the VMEbus. Default is the base of local memory, $0.
Slave Ending Address #1	000FFFFF	Ending address of the local resource that is accessible by the VMEbus. Default is the end of calculated memory.
Slave Address Translation Address #1	00000000	This register will allow the VMEbus address and the local address to be different. The value in this register is the base address of local resource that is associated with the starting and ending address selection from the previous questions. Default is 0.
Slave Address Translation Select #1	00000000	This register defines which bits of the address are significant. A logical one "1" indicates significant address bits, logical zero "0" is non-significant. Default is 0.
Slave Control #1	03FF	Defines the access restriction for the address space defined with this slave address decoder. Default is $03FF.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Slave Enable #2 [Y/N]	N	Do not setup and enable the Slave Address Decoder #2.
Slave Starting Address #2	00000000	Base address of the local resource that is accessible by the VMEbus. Default is 0.
Slave Ending Address #2	00000000	Ending address of the local resource that is accessible by the VMEbus. Default is 0.
Slave Address Translation Address #2	00000000	Works the same as Slave Address Translation Address #1. Default is 0.
Slave Address Translation Select #2	00000000	Works the same as Slave Address Translation Select #1. Default is 0.
Slave Control #2	0000	Defines the access restriction for the address space defined with this slave address decoder. Default is $0000.
Master Enable #1 [Y/N]	Y	Yes, setup and enable the Master Address Decoder #1.
Master Starting Address #1	02000000	Base address of the VMEbus resource that is accessible from the local bus. Default is the end of calculated local memory, unless memory is less than 16MB, then this register will always be set to 01000000.
Master Ending Address #1	EFFFFFFF	Ending address of the VMEbus resource that is accessible from the local bus. Default is the end of calculated memory.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Master Control #1	0D	Defines the access characteristics for the address space defined with this master address decoder. Default is $0D.
Master Enable #2 [Y/N]	N	Do not setup and enable the Master Address Decoder #2.
Master Starting Address #2	00000000	Base address of the VMEbus resource that is accessible from the local bus. Default is $00000000.
Master Ending Address #2	00000000	Ending address of the VMEbus resource that is accessible from the local bus. Default is $00000000.
Master Control #2	00	Defines the access characteristics for the address space defined with this master address decoder. Default is $00.
Master Enable #3 [Y/N]	N	Yes, setup and enable the Master Address Decoder #3. This is the default if the board contains less than 16MB of calculated RAM. Do not setup and enable the Master Address Decoder #3. This is the default for boards containing at least 16MB of calculated RAM.
Master Starting Address #3	00000000	Base address of the VMEbus resource that is accessible from the local bus. If enabled, the value is calculated as one more than the calculated size of memory. If not enabled, the default is $00000000.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Master Ending Address #3	00000000	Ending address of the VMEbus resource that is accessible from the local bus. If enabled, the default is $00FFFFFF, otherwise $00000000.
Master Control #3	00	Defines the access characteristics for the address space defined with this master address decoder. If enabled, the default is $3D, otherwise $00.
Master Enable #4 [Y/N]	N	Do not set up and enable the Master Address Decoder #4.
Master Starting Address #4	00000000	Base address of the VMEbus resource that is accessible from the local bus. Default is $0.
Master Ending Address #4	00000000	Ending address of the VMEbus resource that is accessible from the local bus. Default is $0.
Master Address Translation Address #4	00000000	This register will allow the VMEbus address and the local address to be different. The value in this register is the base address of VMEbus resource that is associated with the starting and ending address selection from the previous questions. Default is 0.
Master Address Translation Select #4	00000000	This register defines which bits of the address are significant. A logical one "1" indicates significant address bits, logical zero "0" is non-significant. Default is 0.
Master Control #4	00	Defines the access characteristics for the address space defined with this master address decoder. Default is $00.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
Short I/O (VMEbus A16) Enable [Y/N]	Y	Yes, Enable the Short I/O Address Decoder.
Short I/O (VMEbus A16) Control	01	Defines the access characteristics for the address space defined with the Short I/O address decoder. Default is $01.
F-Page (VMEbus A24) Enable [Y/N]	Y	Yes, Enable the F-Page Address Decoder.
F-Page (VMEbus A24) Control	02	Defines the access characteristics for the address space defined with the F-Page address decoder. Default is $02.
ROM Access Time Code	03	This defines the ROM access time. The default is $03, which sets an access time of 180 ns.
Flash Access Time Code	02	This defines the FLASH access time. The default is $02, which sets an access time of 140 ns.
MCC Vector Base VMEC2 Vector Base #1 VMEC2 Vector Base #2	05 06 07	Base interrupt vector for the component specified. Default: MCchip = $05, VMEchip2 Vector 1 = $06, VMEchip2 Vector 2 = $07.
VMEC2 GCSR Group Base Address	D2	Specifies the group address ($FFFF*XX*00) in Short I/O for this board. Default = $D2.

Table A-1. ENV Command Parameters (Continued)

ENV Parameter and Options	Default	Meaning of Default
VMEC2 GCSR Board Base Address	00	Specifies the base address ($FFFFD2*XX*) in Short I/O for this board. Default = $00.
VMEbus Global Time Out Code	01	This controls the VMEbus timeout when the MVME162LX is systems controller. Default $01 = 64 µs.
Local Bus Time Out Code	02	This controls the local bus timeout. Default $02 = 256 µs.
VMEbus Access Time Out Code	02	This controls the local bus to VMEbus access timeout. Default $02 = 32 µs.

Configuring the IndustryPacks

ENV asks the following series of questions to set up IndustryPacks (IPs) on MVME162LX Embedded Controllers.

The *MVME162LX Embedded Controller Programmer's Reference Guide* describes the base addresses and the IP register settings. Refer to that manual for information on setting base addresses and register bits.

Note **The IPIC chip on the MVME162LX Embedded Controller supports up to four IndustryPack interfaces, designated IP_a through IP_d. The controller itself accommodates two IPs: IP_a and IP_b. In the following discussion, the segments applicable to IP_c and IP_d are not used in the controller.**

```
IP A Base Address   = 00000000?
IP B Base Address   = 00000000?
IP C Base Address   = 00000000?
IP D Base Address   = 00000000?
```

Base address for mapping IP modules. Only the upper 16 bits are significant.

```
IP D/C/B/A Memory Size     = 00000000?
```

Define the memory size requirements for the IP modules:

Bits	IP	Register Address
31-24	D	FFFBC00F
23-16	C	FFFBC00E
15-08	B	FFFBC00D
07-00	A	FFFBC00C

```
IP D/C/B/A General Control     = 00000000?
```

Define the general control requirements for the IP modules:

Bits	IP	Register Address
31-24	D	FFFBC01B
23-16	C	FFFBC01A
15-08	B	FFFBC019
07-00	A	FFFBC018

```
IP D/C/B/A Interrupt 0 Control = 00000000?
```

Define the interrupt control requirements for the IP modules channel 0:

Bits	IP	Register Address
31-24	D	FFFBC016
23-16	C	FFFBC014
15-08	B	FFFBC012
07-00	A	FFFBC010

```
IP D/C/B/A Interrupt 1 Control = 00000000?
```

Define the interrupt control requirements for the IP modules channel 1:

Bits	IP	Register Address
31-24	D	FFFBC017
23-16	C	FFFBC015
15-08	B	FFFBC013
07-00	A	FFFBC011



Caution

Before environment parameters are saved in the NVRAM, a warning message will appear if the user has specified environment parameters which will cause an overlap condition. The important information about each configurable element in the memory map is displayed, showing where any overlap conditions exist. This will allow the user to quickly identify and correct an undesirable configuration before it is saved.

ENV warning example:

```
WARNING: Memory MAP Overlap Condition Exists

S-Address   E-Address   Enable Overlap  M-Type  Memory-MAP-Name
$00000000   $FFFFFFFF   Yes    Yes      Master  Local Memory (DRAM)
$FFE00000   $FFE7FFFF   Yes    Yes      Master  Static RAM
$01000000   $EFFFFFFF   Yes    Yes      Master  VMEbus Master #1
$00000000   $00000000   No     No       Master  VMEbus Master #2
$00000000   $00FFFFFF   Yes    Yes      Master  VMEbus Master #3
$00000000   $00000000   No     No       Master  VMEbus Master #4
$F0000000   $FF7FFFFF   Yes    Yes      Master  VMEbus F Pages(A24/A32)
$FFFF0000   $FFFFFFFF   Yes    Yes      Master  VMEbus Short I/O (A16)
$FF800000   $FFBFFFFF   Yes    Yes      Master  Flash/PROM
$FFF00000   $FFFEFFFF   Yes    Yes      Master  Local I/O
$00000000   $00000000   No     No       Master  Industry Pack A
$00000000   $00000000   No     No       Master  Industry Pack B
$00000000   $00000000   No     No       Master  Industry Pack C
$00000000   $00000000   No     No       Master  Industry Pack D
$00000000   $00000000   No     No       Slave   VMEbus Slave #1
$00000000   $00000000   No     No       Slave   VMEbusSlave#2
```

Disk/Tape Controller Data

B

Disk/Tape Controller Modules Supported

Note The controllers listed below have been discontinued as of the publication date of this manual. The information contained in this appendix is provided for customers that may have ordered these controllers prior to the discontinuance date.

The following VMEbus disk/tape controller modules are supported by the 162Bug. The default address for each controller type is First Address and the controller can be addressed by First CLUN during commands **BH**, **BO**, or **IOP**, or during TRAP #15 calls .DSKRD or .DSKWR. Note that if another controller of the same type is used, the second one must have its address changed by its onboard jumpers and/or switches, so that it matches Second Address and can be called up by Second CLUN.

Controller Type	First CLUN	First Address	Second CLUN	Second Address
CISC Embedded Controller	$00 (NOTE 1)	--	--	--
MVME320 - Winchester/Floppy Controller	$11 (NOTE 2)	$FFFFB000	$12 (NOTE 2)	$FFFFAC00
MVME323 - ESDI Winchester Controller	$08	$FFFFA000	$09	$FFFFA200
MVME327A - SCSI Controller	$02	$FFFFA600	$03	$FFFFA700
MVME328 - SCSI Controller	$06	$FFFF9000	$07	$FFFF9800
MVME328 - SCSI Controller	$16	$FFFF4800	$17	$FFFF5800
MVME328 - SCSI Controller	$18	$FFFF7000	$19	$FFFF7800
MVME350 - Streaming Tape Controller	$04	$FFFF5000	$05	$FFFF5100

Notes: If an MVME162LX Embedded Controller with a SCSI port is used, then the controller has CLUN 0.

For MVME162LX Embedded Controllers, the first MVME320 has CLUN $11, and the second MVME320 has CLUN $12.

B

Disk/Tape Controller Default Configurations

Note SCSI Common Command Set (CCS) devices are only the ones tested by Motorola Computer Group.

CISC Embedded Controllers -- 7 Devices

Controller LUN	Address	Device LUN	Device Type
0	$*XXXXXXXX*	00 10 20 30 40 50 60	SCSI Common Command Set (CCS), which may be any of these: - Fixed direct access - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access

MVME320 -- 4 Devices

Controller LUN	Address	Device LUN	Device Type
11	$FFFFB000	0 1 2 3	Winchester hard drive Winchester hard drive 5-1/4" DS/DD 96 TPI floppy drive 5-1/4" DS/DD 96 TPI floppy drive
12	$FFFFAC00		

MVME323 -- 4 Devices

Controller LUN	Address	Device LUN	Device Type
8	$FFFFA000	0 1 2 3	ESDI Winchester hard drive ESDI Winchester hard drive ESDI Winchester hard drive ESDI Winchester hard drive
9	$FFFFA200		

MVME327A -- 9 Devices

Controller LUN	Address	Device LUN	Device Type
2	$FFFFA600	00 10 20 30 40 50 60	SCSI Common Command Set (CCS), which may be any of these: - Fixed direct access - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access
3	$FFFFA700		
		80 81	Local floppy drive Local floppy drive

MVME328 -- 14 Devices

Controller LUN	Address	Device LUN	Device Type
6	$FFFF9000	00 08 10 18 20 28 30	SCSI Common Command Set (CCS), which may be any of these: - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access
7	$FFFF9800		
16	$FFFF4800	40 48 50 58 60 68 70	Same as above, but these will only be available if the daughter card for the second SCSI channel is present.
17	$FFFF5800		
18	$FFFF7000		
19	$FFFF7800		

MVME350 -- 1 Device

Controller LUN	Address	Device LUN	Device Type
4	$FFFF5000	0	QIC-02 streaming tape drive
5	$FFFF5100		

IOT Command Parameters for Supported Floppy Types

The following table lists the proper **IOT** command parameters for floppies used with boards such as the MVME328 and MVME162LX.

IOT Parameter	Floppy Types and Formats						
	DSDD5	**PCXT8**	**PCXT9**	**PCXT9_3**	**PCAT**	**PS2**	**SHD**
Sector Size 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	1	2	2	2	2	2	2
Block Size: 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	1	1	1	1	1	1	1
Sectors/Track	10	8	9	9	F	12	24
Number of Heads =	2	2	2	2	2	2	2
Number of Cylinders =	50	28	28	50	50	50	50
Precomp. Cylinder =	50	28	28	50	50	50	50
Reduced Write Current Cylinder =	50	28	28	50	50	50	50
Step Rate Code =	0	0	0	0	0	0	0
Single/Double DATA Density =	D	D	D	D	D	D	D
Single/Double TRACK Density =	D	D	D	D	D	D	D
Single/Equal_in_all Track Zero Density =	S	E	E	E	E	E	E
Slow/Fast Data Rate =	S	S	S	S	F	F	F
Other Characteristics							
Number of Physical Sectors	0A00	0280	02D0	05A0	0960	0B40	1680
Number of Logical Blocks (100 in size)	09F8	0500	05A0	0B40	12C0	1680	2D00
Number of Bytes in Decimal	653312	327680	368460	737280	1228800	1474560	2949120
Media Size/Density	5.25/DD	5.25/DD	5.25/DD	3.5/DD	5.25/HD	3.5/HD	3.5/ED

Notes: All numerical parameters are in hexadecimal unless otherwise noted.

The DSDD5 type floppy is the default setting for the debugger.

Network Controller Modules Supported

The following VMEbus network controller modules are supported by the MVME162Bug. The default address for each type and position is showed to indicate where the controller must reside to be supported by the MVME162Bug. The controllers are accessed via the specified CLUN and DLUNs listed here. The CLUN and DLUNs are used in conjunction with the debugger commands **NBH**, **NBO**, **NIOP**, **NIOC**, **NIOT**, **NPING**, and **NAB**, and also with the debugger system calls .NETRD, .NETWR, .NETFOPN, .NETFRD, .NETCFIG, and .NETCTRL.

Controller Type	CLUN	DLUN	Address	Interface Type
MVME162LX	$00	$00	$FFF46000	Ethernet
MVME376	$02	$00	$FFFF1200	Ethernet
MVME376	$03	$00	$FFFF1400	Ethernet
MVME376	$04	$00	$FFFF1600	Ethernet
MVME376	$05	$00	$FFFF5400	Ethernet
MVME376	$06	$00	$FFFF5600	Ethernet
MVME376	$07	$00	$FFFFA400	Ethernet
MVME374	$10	$00	$FF000000	Ethernet
MVME374	$11	$00	$FF100000	Ethernet
MVME374	$12	$00	$FF200000	Ethernet
MVME374	$13	$00	$FF300000	Ethernet
MVME374	$14	$00	$FF400000	Ethernet
MVME374	$15	$00	$FF500000	Ethernet

EIA-232-D Interconnections

Connector J17 houses the four RJ45 sockets on the MVME162LX Embedded Controller's front panel which provide the serial interface connections. Table D-1 lists the pin numbers, signal mnemonics, and signal descriptions for the RJ45 connectors. The signals are identical for each serial port.

To interpret this information correctly, remember that the EIA-232-D interface was developed to connect a terminal to a modem. When computing equipment is interconnected without modems, one of the units must be configured as a terminal (data terminal equipment: DTE) and the other as a modem (data circuit-terminating equipment: DCE). Since computers are normally configured to work with terminals, they are said to be configured as a modem in most cases.

Table D-1. Connector J17 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
1	DCD	**Data Carrier Detect**. Output from modem to terminal to indicate that a valid carrier is being received.
2	RTS	**Request To Send**. Input to modem from terminal when required to transmit a message. With RTS off, the modem carrier remains off. When RTS is turned on, the modem immediately turns on the carrier.
3, 6	SG	**Signal Ground**. Common return line for all signals at the modem interface.
4	TxD	**Transmit Data**. Data to be transmitted; input to modem from terminal.
5	RxD	**Receive Data**. Data which is demodulated from the receive line; output from modem to terminal.
7	CTS	**Clear To Send**. Output from modem to terminal to indicate that message transmission can begin. When a modem is used, CTS follows the off-to-on transition of RTS after a time delay.
8	DTR	**Data Terminal Ready**. Input to modem from terminal; indicates that the terminal is ready to send or receive data.

The MVME162LX Embedded Controller uses two Zilog Z85230 serial port controllers to implement the four serial communications interfaces. Each interface supports CTS, DCD, RTS, and DTR control signals as well as the TXD and RXD transmit/receive data signals. Because the serial clocks are omitted in the MVME162LX implementation, serial communications are strictly asynchronous. The Z85230 is interfaced as DTE (data terminal equipment) with EIA-232-D signal levels.

Figure D-1 shows the connections between the Z85230 and the RJ45 connectors.

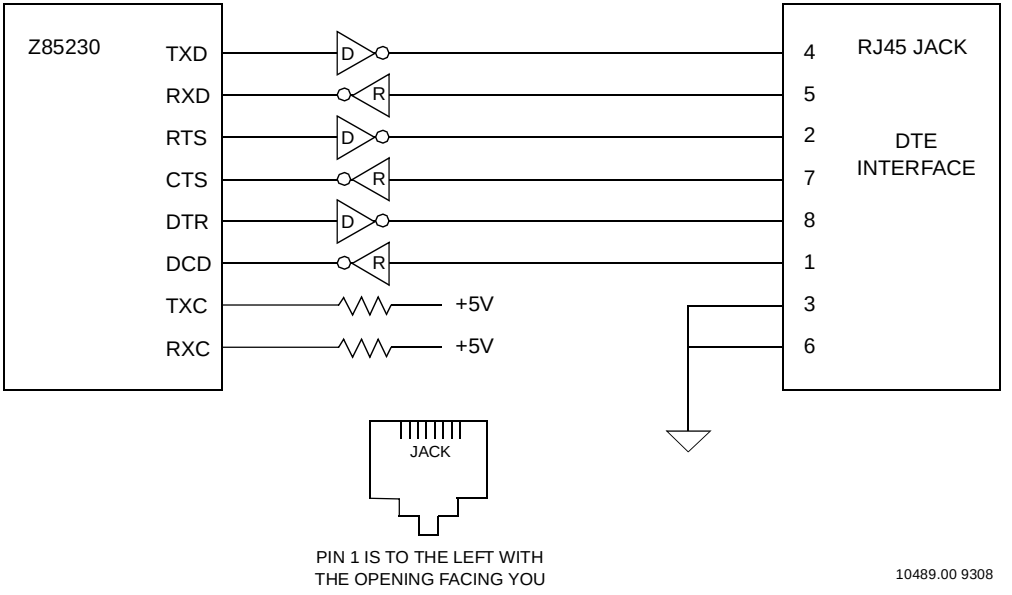


Figure D-1. Serial Interface Connections

Figure D-2 shows the pin assignments required in a cable to adapt a DB25 DTE device to the RJ45 connectors.

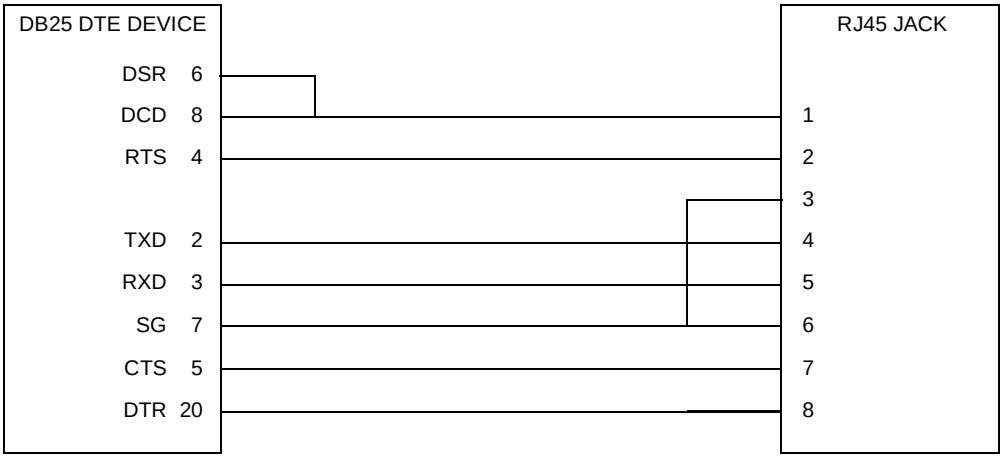


Figure D-2. DB25-DTE-to-RJ45 Adapter

Figure D-3 shows the pin assignments required in a cable to adapt a DB25 DCE device to the RJ45 connectors.

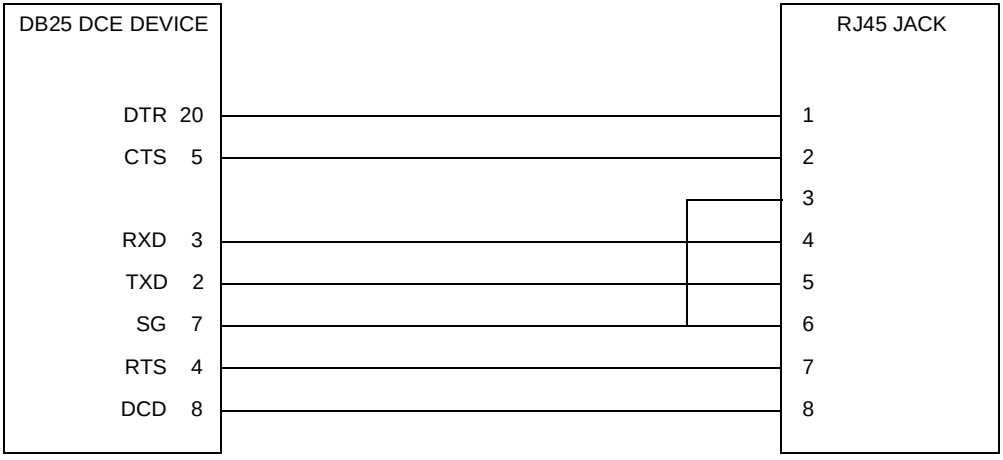


Figure D-3. DB25-DCE-to-RJ45 Adapter

Figure D-4 shows the pin assignments required in a typical eight-conductor serial cable having RJ45 connectors at both ends. Note that all wires are crossed.

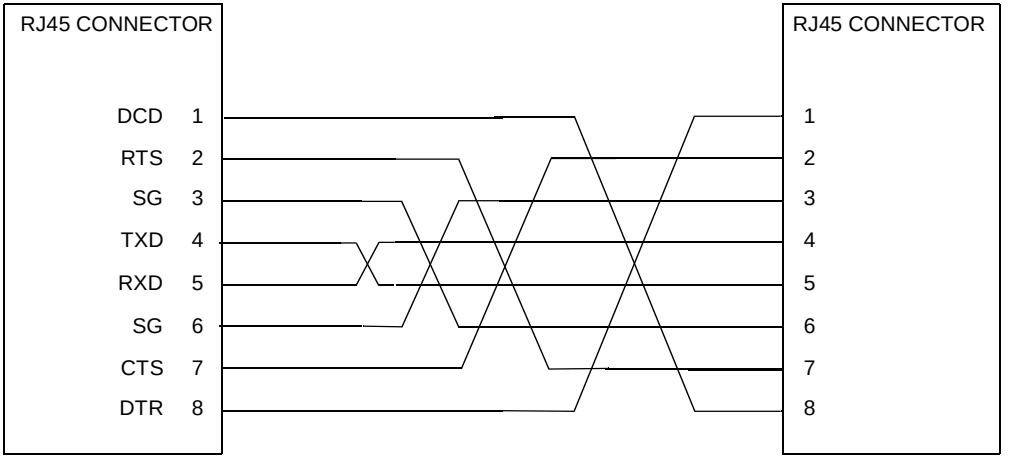


Figure D-4. Typical RJ45 Serial Cable

Ethernet Interconnections

Connector J9 is a 15-pin socket connector mounted on the front panel. It provides the Ethernet LAN (*Local Area Network*) port connections for the MVME162LX Embedded Controller. Table E-1 lists the pin numbers, signal mnemonics, and signal descriptions for J9.

Table E-1. Ethernet Connector J9 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
1		**Ground**.
2	C+	**Collision +** (Ethernet input). A signal to indicate that multiple stations are contending for access to the transmission medium.
3	T+	**Transmit +** (Ethernet output). A line intended for operation into terminated transmission lines.
4		**Ground**.
5	R+	**Receive +** (Ethernet input). A data input sourced by the Medium Attachment Unit (MAU).
6		**Ground**.
7	NC	Not used.
8		**Ground**.
9	C–	**Collision -** (Ethernet input). Part of a differential pair.
10	T–	**Transmit -** (Ethernet output). Part of a differential pair.
11		**Ground**.
12	R–	**Receive -** (Ethernet input). Part of a differential pair.
13	+12VLAN	**+12 Vdc** power (fused on MVME162LX main module).
14		**Ground**.
15	NC	Not used.

SCSI Interconnections

Connector J10 is a 68-pin socket connector mounted on the front panel. It provides the Small Computer System Interface (SCSI) I/O bus connections. Table F-1 lists the pin numbers, signal mnemonics, and signal descriptions for J10.

Table F-1. SCSI Connector J10 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
1-16		Return.
17, 18	TERMPWR	**Terminator Power**. +5 Vdc for SCSI terminators.
19	NC	Not used.
20-34	DTRB	Return.
35-38	DB12*-DB15*	**Data Bus** (bits 12-15). SCSI interconnect lines.
39	DBP1*	**Data Bus Parity 1** (parity for data bits 08-15). SCSI interconnect line.
40-47	DB00*-DB07*	**Data Bus** (bits 00-07). SCSI interconnect lines.
48	DBP*	**Data Bus Parity** (parity for data bits 00-07). SCSI interconnect line.
49, 50		Return.
51, 52	TERMPWR	**Terminator Power**. +5 Vdc for SCSI terminators.
53	NC	Not used.
54		Return.
55	ATN*	**Attention**. Driven by an initiator; indicates that the initiator has a message to send to the target.
56		Return.

Table F-1. SCSI Connector J10 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
57	BSY*	**Busy**. SCSI busy signal; indicates that the bus is in use.
58	ACK*	**Acknowledge**. Driven by an initiator; indicates an acknowledgment for a REQ/ACK data transfer handshake.
59	RST*	**Reset**. SCSI reset signal; clears the bus of all activity.
60	MSG*	**Message**. Driven by the target during the message transfer phase.
61	SEL*	**Select**. Used by the initiator to select a target or by a target to reselect an initiator.
62	D/C*	**Data/Command**. Driven by the target; indicates whether control or data information is on the data bus. True (low) indicates control information.
63	REQ*	**Request**. Driven by the target; indicates a request for a REQ/ACK data transfer handshake.
64	O/I*	**Output/Input**. Driven by a target; controls the direction of data movement on the SCSI bus. True (low) indicates input to the initiator. False (high) indicates output from the initiator. This signal is also used to distinguish between selection and reselection phases.
65-68	DB08*-DB11*	**Data Bus** (bits 08-11). SCSI interconnect lines.

Mezzanine Connector J15 Signals

Connector J15 is a standard double-row 100-pin socket connector mounted on the MVME162LX Embedded Controller PWB (see Figure 2-1). It connects to a corresponding 100-pin plug connector on the ECC DRAM mezzanine board and (together with J16) carries the DRAM address, data, and control signals to and from the mezzanine board. Table G-1 lists the pin numbers, signal mnemonics, and signal descriptions for J15.

Table G-1. Mezzanine Connector J15 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
1	GND		**Ground**.
2	MPUCLK1	Input	**MPU Clock 1**. Bus clock (25 MHz).
3, 4	GND		**Ground**.
5	PURESET*	Input	**Power-Up Reset**.
6	LTS*	Bidirectional	**Local Transfer Start**. MC68040 transfer start strobe.
7	LBRESET*	Input	**Local Bus Reset**.
8	GND		**Ground**.
9	LRD	Bidirectional	**Local Read**. MC68040 read/write attribute.
10	LTIP*	Bidirectional	**Local Transfer In Progress**. MC68040 transfer-in-progress strobe.
11	GND		**Ground**.
12	SELECT	Input	**Select**. Mezzanine selection (ECC mezzanines only). High = first slot; low = second slot.
13	LLOCK*	Bidirectional	**Local Bus Lock**. MC68040 lock attribute.

Table G-1. Mezzanine Connector J15 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
14	LTA*	Bidirectional	**Local Transfer Acknowledge**. MC68040 transfer acknowledge.
15	LSIZ0	Bidirectional	**Local Transfer Size 0**. MC68040 transfer size attribute.
16	GND		**Ground**.
17	LSIZ1	Bidirectional	**Local Transfer Size 1**. MC68040 transfer size attribute.
18	LTEA*	Bidirectional	**Local Transfer Error Acknowledge**. MC68040 transfer error acknowledge.
19	GND		**Ground**.
20	SRAMDIS*	Output	**SRAM Disable**. Disable SRAM on main module.
21	LTM0	Bidirectional	**Local Transfer Modifier 0**. MC68040 transfer modifier attribute.
22	MIACKIN*	Output	**Local IACK**. Daisy-chain signal: Assert MIACKIN* if the IACK cycle is not for the mezzanine in question.
23	LTM1	Bidirectional	**Local Transfer Modifier 1**. MC68040 transfer modifier attribute.
24	GND		**Ground**.
25	LTM2	Bidirectional	**Local Transfer Modifier 2**. MC68040 transfer modifier attribute.
26	LST0	Bidirectional	**Local Error Status 0**. Valid only when LTEA* is asserted and LTA* is negated.
27	GND		**Ground**.
28	LST1	Bidirectional	**Local Error Status 1**. Valid only when LTEA* is asserted and LTA* is negated.

Table G-1. Mezzanine Connector J15 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
29	LSC0	Bidirectional	**Local Snoop Control 0**. MC68040 snoop control attribute.
30	MEZZIPL0*	Output	**Mezzanine Interrupt Line 0**. Encoded interrupt line from mezzanine.
31	LSC1	Bidirectional	**Local Snoop Control 1**. MC68040 snoop control attribute.
32	GND		**Ground**.
33	LTT0	Bidirectional	**Local Transfer Type 0**. MC68040 transfer type attribute.
34	MEZZIPL1*	Output	**Mezzanine Interrupt Line 1**. Encoded interrupt line from mezzanine.
35	GND		**Ground**.
36	MEZZIPL2*	Output	**Mezzanine Interrupt Line 2**. Encoded interrupt line from mezzanine.
37	LTT1	Bidirectional	**Local Transfer Type 1**. MC68040 transfer type attribute.
38	MEZZBR*	Output	**Mezzanine Bus Request**. Local bus request from mezzanine.
39	LMI*	Input	**Local Memory Inhibit**. MC68040 memory inhibit signal.
40	GND		**Ground**.
41	LOCKOK	Input	**Lock OK**. OK to start a locked bus cycle.
42	MEZZBG*	Input	**Mezzanine Bus Grant**. Local bus grant from mezzanine.
43	GND		**Ground**.
44	LBB*	Bidirectional	**Local Bus Busy**.

Table G-1. Mezzanine Connector J15 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
45	PEIRQ*	Output	**Parity Error Interrupt Request**. Issued to VMEchip from mezzanine.
46	SRAMSIZ0	Output	**SRAM Size 0**. Encoded SRAM size.
47			**Reserved**.
48	GND		**Ground**.
49	LA<0>	Bidirectional	**Local Address bus** (bit 0). MC68040 address line. Bit 0 is the least significant bit.
50	SRAMSIZ1	Output	**SRAM Size 1**. Encoded SRAM size.
51	GND		**Ground**.
52-55	LA<1>-LA<4>	Bidirectional	**Local Address bus** (bits 1-4). MC68040 address lines.
56	GND		**Ground**.
57, 58	LA<6>, LA<5>	Bidirectional	**Local Address bus** (bits 6, 5). MC68040 address lines.
59	GND	GND	**Ground**.
60-63	LA<7>-LA<10>	Bidirectional	**Local Address bus** (bits 7-10). MC68040 address lines.
64	GND		**Ground**.
65, 66	LA<12>, LA<11>	Bidirectional	**Local Address bus** (bits 12, 11). MC68040 address lines.
67	GND		**Ground**.
68-71	LA<13>-LA<16>	Bidirectional	**Local Address bus** (bits 13-16). MC68040 address lines.
72	GND		**Ground**.
73, 74	LA<18>, LA<17>	Bidirectional	**Local Address bus** (bits 18, 17). MC68040 address lines.

Table G-1. Mezzanine Connector J15 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
75	GND		**Ground**.
76-79	LA<19>- LA<22>	Bidirectional	**Local Address bus** (bits 19-22). MC68040 address lines.
80	GND		**Ground**.
81, 82	LA<24>, LA<23>	Bidirectional	**Local Address bus** (bits 24, 23). MC68040 address lines.
83	GND		**Ground**.
84-87	LA<25>- LA<28>	Bidirectional	**Local Address bus** (bits 25-28). MC68040 address lines.
88	GND		**Ground**.
89, 90	LA<30>, LA<29>	Bidirectional	**Local Address bus** (bits 30, 29). MC68040 address lines.
91			**Reserved**.
92	LA<31>	Bidirectional	**Local Address bus** (bit 31). MC68040 address line. Bit 31 is the most significant bit.
93	+12 V		**+12 Vdc Power**.
94	–12 V		**–12 Vdc Power**.
95	+12 V		**+12 Vdc Power**.
96	–12 V		**–12 Vdc Power**.
97, 98	GND		**Ground**.
99, 100	+5 V		**+5 Vdc Power**.

G

Mezzanine Connector J16 Signals

Connector J16 is a standard double-row 100-pin socket connector mounted on the MVME162LX Embedded Controller PWB (see Figure 2-1). It connects to a corresponding 100-pin plug connector on the ECC DRAM mezzanine board and (together with J15) carries the DRAM address, data, and control signals to and from the mezzanine board. Table G-2 lists the pin numbers, signal mnemonics, and signal descriptions for J16.

Table G-2. Mezzanine Connector J16 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
1	GND		**Ground**.
2, 3	LD<1>, LD<0>	Bidirectional	**Local Data bus** (bits 1, 0). MC68040 data lines. Bit 0 is the least significant bit.
4, 5	LD<3>, LD<2>	Bidirectional	**Local Data bus** (bits 3, 2). MC68040 data lines.
6	GND		**Ground**.
7, 8	LD<4>, LD<5>	Bidirectional	**Local Data bus** (bits 4, 5). MC68040 data lines.
9	GND		**Ground**.
10, 11	LD<7>, LD<6>	Bidirectional	**Local Data bus** (bits 7, 6). MC68040 data lines.
12, 13	LD<9>, LD<8>	Bidirectional	**Local Data bus** (bits 9, 8). MC68040 data lines.
14	GND		**Ground**.
15, 16	LD<10>, LD<11>	Bidirectional	**Local Data bus** (bits 10, 11). MC68040 data lines.
17	GND		**Ground**.
18, 19	LD<13>, LD<12>	Bidirectional	**Local Data bus** (bits 13, 12). MC68040 data lines.
20, 21	LD<15>, LD<14>	Bidirectional	**Local Data bus** (bits 15, 14). MC68040 data lines.

Table G-2. Mezzanine Connector J16 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
22	GND		**Ground**.
23, 24	LD<16>, LD<17>	Bidirectional	**Local Data bus** (bits 16, 17). MC68040 data lines.
25	GND		**Ground**.
26, 27	LD<19>, LD<18>	Bidirectional	**Local Data bus** (bits 19, 18). MC68040 data lines.
28, 29	LD<21>, LD<20>	Bidirectional	**Local Data bus** (bits 21, 20). MC68040 data lines.
30	GND		**Ground**.
31, 32	LD<22>, LD<23>	Bidirectional	**Local Data bus** (bits 22, 23). MC68040 data lines.
33	GND		**Ground**.
34, 35	LD<25>, LD<24>	Bidirectional	**Local Data bus** (bits 25, 24). MC68040 data lines.
36, 37	LD<27>, LD<26>	Bidirectional	**Local Data bus** (bits 27, 26). MC68040 data lines.
38	GND		**Ground**.
39, 40	LD<28>, LD<29>	Bidirectional	**Local Data bus** (bits 28, 29). MC68040 data lines.
41	GND		**Ground**.
42	LD<30>	Bidirectional	**Local Data bus** (bit 30). MC68040 data line.
43	DRAM_PD0	Bidirectional	**DRAM Parity Data** (bit 0). Bit 0 is the least significant bit.
44	LD<31>	Bidirectional	**Local Data bus** (bit 31). MC68040 data line. Bit 31 is the most significant bit.
45	DRAM_PD1	Bidirectional	**DRAM Parity Data** (bit 1).

Table G-2. Mezzanine Connector J16 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
46	GND		**Ground**.
47	DRAM_PD2	Bidirectional	**DRAM Parity Data** (bit 2).
48	MEZ0	Output	**Mezzanine 0**. Encoded DRAM size from mezzanine.
49	DRAM_PD3	Bidirectional	**DRAM Parity Data** (bit 3). Bit 3 is the most significant bit.
50	MEZ1	Output	**Mezzanine 1**. Encoded DRAM size from mezzanine.
51	GND		**Ground**.
52	MEZ2	Output	**Mezzanine 2**. Encoded DRAM size from mezzanine.
53	RDRAM_A0	Input	**DRAM Address** (bit 0). Parity DRAM row/column address line.
54	RDRAM_A5	Input	**DRAM Address** (bit 5). Parity DRAM row/column address line.
55	RDRAM_A1	Input	**DRAM Address** (bit 1). Parity DRAM row/column address line.
56	RDRAM_A6	Input	**DRAM Address** (bit 6). Parity DRAM row/column address line.
57	RDRAM_A2	Input	**DRAM Address** (bit 2). Parity DRAM row/column address line.
58	GND		**Ground**.
59	RDRAM_A3	Input	**DRAM Address** (bit 3). Parity DRAM row/column address line.
60	RDRAM_A7	Input	**DRAM Address** (bit 7). Parity DRAM row/column address line.
61	RDRAM_A4	Input	**DRAM Address** (bit 4). Parity DRAM row/column address line.

Table G-2. Mezzanine Connector J16 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
62	RDRAM_A8	Input	**DRAM Address** (bit 8). Parity DRAM row/column address line.
63	GND		**Ground**.
64	RDRAM_A9	Input	**DRAM Address** (bit 9). Parity DRAM row/column address line.
65	DRAMCAS0*	Input	**DRAM Column Address Strobe** (line 0). Parity DRAM column address strobe.
66	DRAMRAS*	Input	**DRAM Row Address Strobe**. Parity DRAM row address strobe.
67	DRAMCAS1*	Input	**DRAM Column Address Strobe** (line 1). Parity DRAM column address strobe.
68	GND		**Ground**.
69	DRAMCAS2*	Input	**DRAM Column Address Strobe** (line 2). Parity DRAM column address strobe.
70	DRAMOE0*	Input	**DRAM Output Enable** (line 0). Parity DRAM output enable signal.
71	DRAMCAS3*	Input	**DRAM Column Address Strobe** (line 3). Parity DRAM column address strobe.
72	DRAMOE1*	Input	**DRAM Output Enable** (line 1). Parity DRAM output enable signal.
73	GND		**Ground**.
74	DRAMOE2*	Input	**DRAM Output Enable** (line 2). Parity DRAM output enable signal.
75	DRAMWELL*	Input	**DRAM Write Enable** (lines D07-D00). Parity DRAM write enable signal.
76	DRAMOE3*	Input	**DRAM Output Enable** (line 3). Parity DRAM output enable signal.
77	SRAMWELL*	Input	**SRAM Write Enable** (lines D07-D00).

Table G-2. Mezzanine Connector J16 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Direction	Signal Name and Description
78	GND		**Ground**.
79	DRAMWELM *	Input	**DRAM Write Enable** (lines D15-D08). Parity DRAM write enable signal.
80	DRAMWEUM *	Input	**DRAM Write Enable** (lines D23-D16). Parity DRAM write enable signal.
81	SRAMWELM*	Input	**SRAM Write Enable** (lines D15-D08).
82	SRAMWEUM*	Input	**SRAM Write Enable** (lines D23-D16).
83	GND		**Ground**.
84	DRAMWEUU*	Input	**DRAM Write Enable** (lines D31-D24). Parity DRAM write enable signal.
85	SRAMCS0*	Input	**SRAM Chip Select** (line 0).
86	SRAMWEUU*	Input	**SRAM Write Enable** (lines D31-D24).
87	SRAMCS1*	Input	**SRAM Chip Select** (line 1).
88	GND		**Ground**.
89	SRAMCS2*	Input	**SRAM Chip Select** (line 2).
90	SRAM_PA2	Input	**SRAM Address** (bit 2).
91	SRAMCS3*	Input	**SRAM Chip Select** (line 3).
92	SRAM_PA3	Input	**SRAM Address** (bit 3).
93, 94			**Reserved**.
95	GND		**Ground**.
96	+5V STDBY		**+5 Vdc Standby**. Secondary power for system logic circuits.
97-100	+5 V		**+5 Vdc Power**.

Mezzanine Board Dimensions

The following drawings specify the dimensions critical to connector and mounting hole placement on the mezzanine boards used with the MVME162LX Embedded Controller. They may be helpful in the event you wish to fabricate your own mezzanine boards for use with the controller.

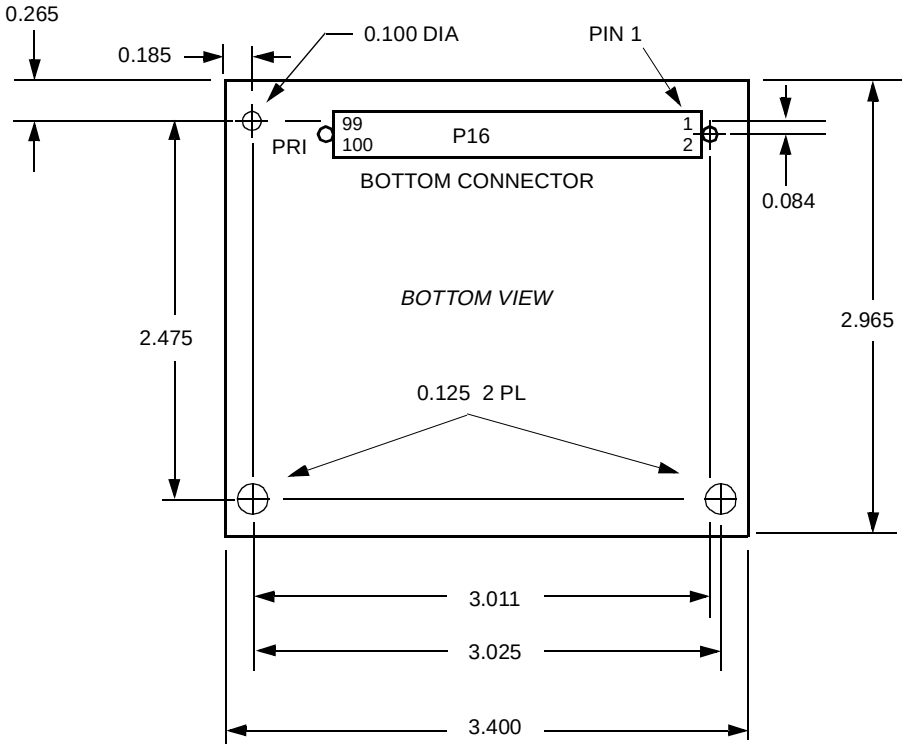


Figure G-1. Mezzanine Board Dimensions (Parity DRAM)

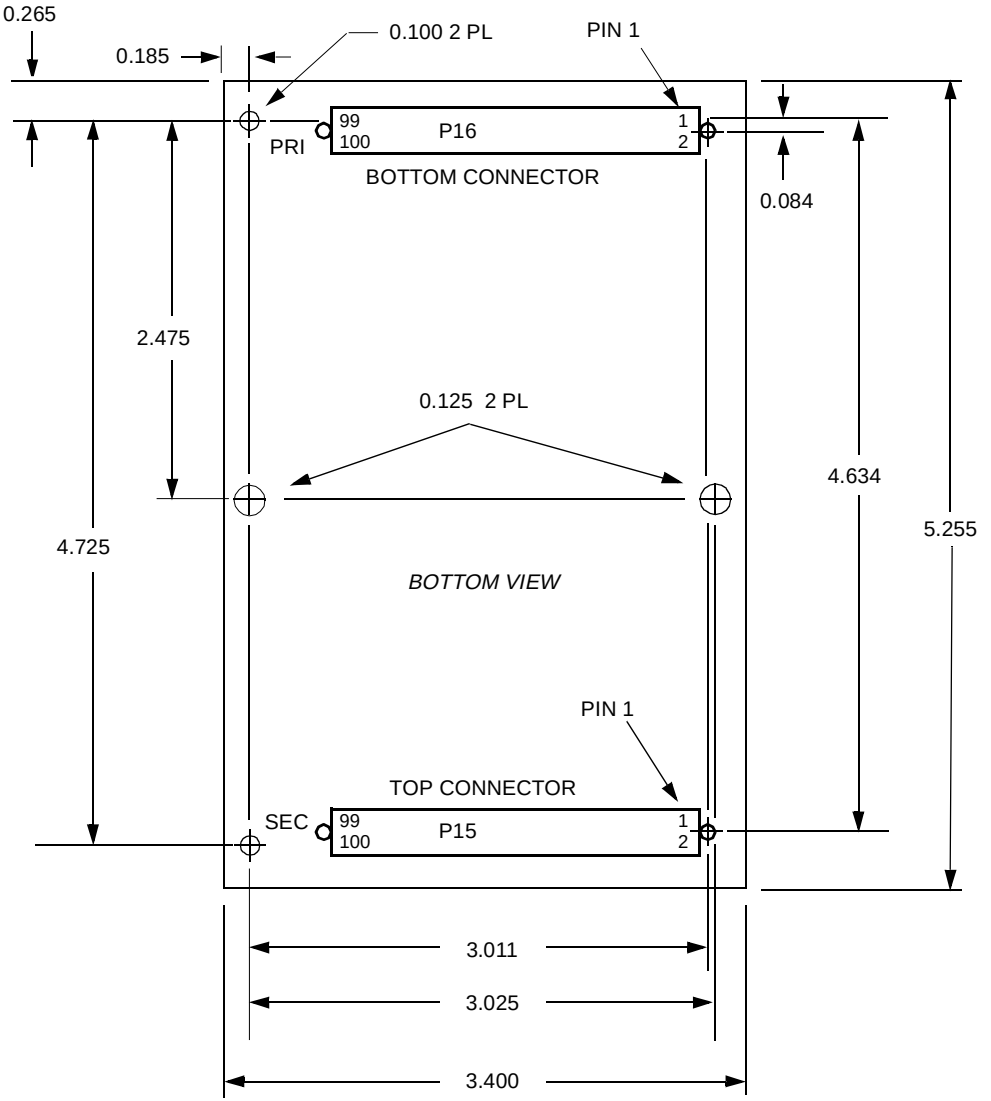


Figure G-2. Mezzanine Board Dimensions (SRAM and ECC DRAM)

Troubleshooting CPU Boards

H

Solving Startup Problems

In the event of difficulty with your CPU board, try the simple troubleshooting steps on the following pages before calling for help or sending the board back for repair. Some of the procedures will return the board to the factory debugger environment (the board was tested under those conditions before it left the factory). The self-tests may not run in all user-customized environments.

Table H-1. Troubleshooting MVME162LX Boards

Condition	Possible Problem	Try This:
I. Nothing works, no display on the terminal.	A. If the FUSES or RUN LED is not lit, the board may not be getting correct power.	1. Make sure the system is plugged in. 2. Check that the board is securely installed in its backplane or chassis. 3. Check that all necessary cables are connected to the board, per this manual. 4. Check for compliance with System Considerations, per this manual. 5. Review the Installation and Startup procedures, per this manual. This includes a step-by-step powerup routine. Try it.
	B. If the LEDs are lit, the board may be in the wrong slot.	1. For VME modules, the CPU board should be in the first (leftmost) slot. 2. Also check that the “system controller” function on the board is enabled, per this manual.
	C. The “system console” terminal may be configured incorrectly.	Configure the system console terminal per this manual.

Table H-1. Troubleshooting MVME162LX Boards (Continued)

Condition	Possible Problem	Try This:
II. There is a display on the terminal, but input from the keyboard and/or mouse has no effect.	A. The keyboard or mouse may be connected incorrectly.	Recheck the keyboard and/or mouse connections and power.
	B. Board jumpers may be configured incorrectly.	Check the board jumpers per this manual.
	C. You may have invoked flow control by pressing a HOLD or PAUSE key, or by typing**:** **<CTRL>-S** Also, a HOLD LED may be lit.	Press the HOLD or PAUSE key again. If this does not free up the keyboard, type in: **<CTRL>-Q**
III. Debug prompt `162-Bug>` does not appear at power-up, and the board does not autoboot.	A. Debugger EPROM/Flash may be missing	1. Disconnect *all* power from your system. 2. Check that the proper debugger EPROM or debugger Flash memory is installed per this manual. 3. Remove the jumper from J11, pins 7 and 8. This enables the use of the EPROM instead of the Flash memory. 3. Reconnect power. 4. Restart the system by "double-button reset": press the RESET and ABORT switches at the same time; quickly release RESET, wait seven seconds, then release ABORT. 5. If the debug prompt appears, go to step IV or step V, as indicated. If the debug prompt does not appear, go to step VI.
	B. The board may need to be reset.	
IV. Debug prompt `162-Bug>` appears at powerup, but the board does not autoboot.	A. The initial debugger environment parameters may be set incorrectly.	1. Start the onboard calendar clock and timer. Type: **set *mmddyyhhmm* <CR>** where the characters indicate the month, day, year, hour, and minute. The date and time will be displayed. Performing the next step (**env;d**) will change some parameters that may affect your system's operation. (continues>)
	B. There may be some fault in the board hardware.	

Table H-1. Troubleshooting MVME162LX Boards (Continued)

Condition	Possible Problem	Try This:
IV. *Continued*		2. At the command line prompt, type in: **env;d <CR>** This sets up the default parameters for the debugger environment. 3. When prompted to Update Non-Volatile RAM, type in: **y <CR>** 4. When prompted to Reset Local System, type in: **y <CR>** 5. After clock speed is displayed, immediately (within five seconds) press the Return key: **<CR>** or **BREAK** to exit to the System Menu. Then enter a 3 for "Go to System Debugger" and Return: **3 <CR>** Now the prompt should be: `162-Diag>` 6. You may need to use the **cnfg** command (see your board Debugger Manual) to change clock speed and/or Ethernet Address, and then later return to: **env <CR>** and step 3. 7. Run the selftests by typing in: **st <CR>** The tests take as much as 10 minutes, depending on RAM size. They are complete when the prompt returns. (The onboard selftest is a valuable tool in isolating defects.) 8. The system may indicate that it has passed all the selftests. Or, it may indicate a test that failed. If neither happens, enter: **de <CR>** Any errors should now be displayed. If there are any errors, go to step VI. If there are no errors, go to step V.

Table H-1. Troubleshooting MVME162LX Boards (Continued)

Condition	Possible Problem	Try This:
V. The debugger is in system mode and the board autoboots, or the board has passed selftests.	A. No apparent problems — troubleshooting is done.	No further troubleshooting steps are required.
VI. The board has failed one or more of the tests listed above, and cannot be corrected using the steps given.	A. There may be some fault in the board hardware or the on-board debugging and diagnostic firmware.	1. Document the problem and return the board for service. 2. Phone 1-800-222-5640.
TROUBLESHOOTING PROCEDURE COMPLETE.		

IndustryPack Logic Interface Interconnections

For each IP module, there are two 50-pin plug connectors on the MVME162LX Embedded Controller: J5/J6 and J7/J8. Connectors **J6** and **J8** provide the IndustryPack logic interface. Connectors **J5** and **J7** are application specific and their definition is dependent upon which IP modules are used.

Table I-1 lists the pin numbers, signal mnemonics, and signal descriptions for the IndustryPack logic interface connectors J6 and J8.

Table I-1. IndustryPack Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
1	GND	**Ground**. First of four ground pins. Serves as zero-volt reference for logic signals, and as return path for the power supplies furnishing operating voltages to the IndustryPack.
2	CLK	**Clock**. An 8 MHz clock signal supplied to the IndustryPack by the controller. Synchronizes all data transfers to or from the IndustryPack.
3	Reset*	**Reset**. Driven by the MVME162 to the IndustryPack to halt all IP activity and reset the IP circuitry to a known state.
4-19	D0-D15	**Data Bus** (bits 0-15). The 16 lines of the data bus used to read and write data between the MVME162 and the IndustryPack.
20, 21	BS0*, BS1*	**Byte Select**. Byte select lines; used on 16-bit IPs to support byte writes. BS0* selects the low or odd byte (D0-D7). BS1* selects the high or even byte (D8-D15).
22	-12V	**-12 Vdc Power**. Used primarily to power IndustryPack analog and communication functions.
23	+12V	**+12 Vdc Power**. Used primarily to power IndustryPack analog and communication functions.
24	+5V	**+5 Vdc Power**. First of two +5V pins. Primary supply for digital logic functions on the IndustryPack.

Table I-1. IndustryPack Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
25, 26	GND	**Ground**. Second and third of four ground pins. Serve as zero-volt reference for logic signals, and as return path for the power supplies furnishing operating voltages to the IndustryPack.
27	+5V	**+5 Vdc Power**. Second of two +5V pins. Primary supply for digital logic functions on the IndustryPack.
28	R/W*	**Read/Write**. Indicates the direction of data movement on the data bus. High indicates a read cycle (data lines driven by the IP); low indicates a write cycle (data lines driven by the MVME162).
29	IDSel*	**IndustryPack ID**. First of four ‘‘select’’ lines driven by the MVME162 to enable the IP. This line is used to read a 32-byte ROM containing the IP identification information. IDSel* is not bussed; the signal is unique to each IndustryPack.
30	DMAReq0	**DMA Request 0**. One of two DMA request lines; driven by the IndustryPack to indicate that the IP wishes to have a DMA cycle performed on DMA channel 0.
31	MemSel*	**Memory Select**. Second of four ‘‘select’’ lines driven by the MVME162 to enable the IP. This line is used in memory read or write cycles. MemSel* is not bussed; the signal is unique to each IndustryPack. An IP need not respond to MemSel* if it has no memory.
32	DMAReq1	**DMA Request 1**. One of two DMA request lines; driven by the IndustryPack to indicate that the IP wishes to have a DMA cycle performed on DMA channel 1.
33	IntSel*	**Interrupt Vector Select**. Third of four ‘‘select’’ lines driven by the MVME162 to enable the IP. This line is used in reading the IP’s interrupt vector during an interrupt acknowledge cycle. IntSel* is not bussed; the signal is unique to each IndustryPack. An IP need not respond to IntSel* if it has no interrupt requests asserted.
34	DMAck*	**DMA Acknowledge**. This is driven by the controller and is used to qualify a DMA cycle. It is bussed to the IP connectors.

Table I-1. IndustryPack Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
35	IOSel*	**I/O Select**. Fourth of four ‘‘select’’ lines driven by the MVME162 to enable the IP. This line is used in executing input or output cycles. IOSel* is not bussed; the signal is unique to each IndustryPack. I/O data width is an IP-specific function; an IP need not respond to IntSel* if it has no I/O functions.
36	Reserved	Reserved.
37	A1	**Address Line 1**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
38	DMAEnd*	**DMA Termination**. A bidirectional line which can be used to terminate DMA transfers. It can be asserted either by the DMA controller or by an IndustryPack module.
39	A2	**Address Line 2**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
40	Error*	**IP Error**. Asserted by an IndustryPack module in the event of a a non-recoverable error (e.g., component failure). Less serious errors are signaled by interrupts.
41	A3	**Address Line 3**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
42	IntReq0*	**Interrupt Request 0**. One of two interrupt request lines; driven by an IndustryPack to indicate that the IP is requesting service from the MVME162.
43	A4	**Address Line 4**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
44	IntReq1*	**Interrupt Request 1**. One of two interrupt request lines; driven by an IndustryPack to indicate that the IP is requesting service from the MVME162.
45	A5	**Address Line 5**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
46	Strobe*	**Function Strobe**. Available for use as an input to the IP module by a strobe or clock signal related to the bus interface logic.

Table I-1. IndustryPack Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
47	A6	**Address Line 6**. One of six address lines; driven by the MVME162 to address I/O locations on the IndustryPack module designated by the four ‘‘select’’ lines.
48	Ack*	**Data Acknowledge**. Asserted by an IndustryPack module to terminate each data transfer.
49	+5STBY	**+5 Vdc Standby**. Second of two +5V pins. Available for standby functions on the IndustryPack, such as non-volatile memory, real-time clocks, etc.
50	GND	**Ground**. Fourth of four ground pins. Serves as zero-volt reference for logic signals, and as return path for the power supplies furnishing operating voltages to the IndustryPack.

IndustryPack I/O Interconnections

Connectors **J3** and **J4** provide the I/O for the IndustryPack modules. On the controller’s PCB, they are connected in parallel with **J7** and **J5**. Connector J3 is wired in parallel with J7 and connector J4 is wired in parallel with J5. For example:

- Pin 1 is connected to pin 1
- Pin 25 is connected to pin 25
- Pin 50 is connected to pin 50

A 50-conductor ribbon cable is then attached to connector J3 and J4 to provide the I/O.

Remote Reset/LED Interconnection

Connector **J2** provides the interconnection for the Remote Reset switch and LED. Table I-2 lists the pin numbers and signal mnemonics for connector J2.

Table I-2. Remote Reset/LED interconnect Signals

Pin Number	Signal Mnemonic	
1	+5VF	
2	LAN LED	
3	+12V LED	
4	SCSI LED	
5	VME LED	
6	NC	
7	RUN LED	
8	STS LED	
9	FAIL STAT	
10	NC	
11	SCON LED	
12	ABORT SW	
13	RESET SW	
14	GND	
15	GND	
16	GPIO 1	TO VME CHIP
17	GPIO 2	
18	GPIO 3	
19	NC	
20	GND	

VME Bus Interconnection

The MVME162LX PCB interconnects with the VMEbus through rows A, B, and C of backplane connector P1 and through row B of backplane connector P2.

Connector P1 Interconnect Signals

Connector P1 is a standard DIN 41612 triple-row, 96-pin male connector. The MVME162 interconnects with the VMEbus through rows A, B, and C of connector P1 and through row B of connector P2. Each pin connection, signal mnemonic, and signal characteristic for the connector is listed in Table I-3.

Table I-3. Connector P1 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
A1-A8	D00-D07	**Data Bus** (bits 0-7). Eight of 16 three-state bidirectional data lines that provide the data path between the data transfer bus master and slave.
A9	GND	Ground
A10	SYSCLK	**System Clock**. A constant 16 MHz clock signal that is independent of processor speed or timing and is used as a timing reference.
A11	GND	Ground
A12	DS1*	**Data Strobe 1**. A three-state driven signal that indicates during byte and word transfers that a data transfer will occur on data bus lines D08 through D15 and data lines D24 through D31 for 32-bit data transfers.
A13	DS0*	**Data Strobe 0**. A three-state driven signal that indicates during byte and word transfers that a data transfer will occur on data bus lines D00 through D07 and data lines D16 through D23 for 32-bit data transfers.
A14	WRITE*	**Write**. A three-state driven signal that specifies that the data transfer cycle in progress is either a read or a write. A high level indicates a read operation; a low level indicates a write operation.
A15	GND	Ground

Table I-3. Connector P1 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
A16	DTACK*	**Data Transfer Acknowledge**. An open-collector driven signal generated by a data transfer bus slave. The falling edge of this signal indicates that valid data is available on the data bus during a read cycle, or that data has been accepted from the data bus during a write cycle.
A17	GND	Ground
A18	AS*	**Address Strobe**. The falling edge of this signal is used to indicate that a valid address is on the address bus. AS* is an active low, TTL three-state signal.
A19	GND	Ground
A20	IACK*	**Interrupt Acknowledge**. An open-collector-driven input signal that indicates a VME interrupt acknowledge cycle. The VME system controller has been interrupted on one of seven levels and is now acknowledging the interrupt.
A21	ACKIN*	(Interrupt) **Acknowledge In**. The ACKIN* and ACKOUT* lines form a daisy-chained acknowledge signal. The ACKIN* input signal is connected directly to ACKOUT* on the controller.
A22	ACKOUT*	(Interrupt) **Acknowledge Out**. See ACKIN* (pin A21).
A23	AM4	**Address Modifier** (bit 4). One of six input lines that provide additional information about the address bus, such as size, cycle type, and/or data transfer bus master identification.
A24-A27	A07-A04	**Address Bus** (bits 7-4). Four of 31 three-state input lines that specify an address in the memory map.
A28-A30	A03-A01	**Address Bus** (bits 3-1). Three of 31 three-state input lines that specify an address in the memory map. During an interrupt acknowledge cycle, address bus lines A01 through A03 are used to indicate the interrupt level that is being acknowledged.
A31	-12V	**-12 Vdc Power**. Used by the system logic circuits.
A32	+5V	**+5 Vdc Power**. Used by the system logic circuits.
B1	BBSY*	**VMEbus Busy**. An open-collector-driven signal driven by the bus master to indicate ownership of VMEbus.
B2	BCLR	**Bus Clear**. A totem-pole signal, generated by an arbiter to indicate when there is a higher priority request for the bus.

Table I-3. Connector P1 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
B3	ACFAIL*	**System AC Power Fail**. An open-collector-driven signal which indicates that the AC input to the power supply is not being provided or the required input voltage level is not being met.
B4	BG0IN*	**Bus Grant In** (level 0). The "bus grant in" and "bus grant out" form a daisy-chained bus grant. A grant received at the jumpered level indicates the module may become the bus master. The remaining three "bus grant in" lines are connected directly to their respective "bus grant out" lines.
B5	BG0OUT*	**Bus Grant Out** (level 0). See BG0IN* (pin B4).
B6	BG1IN*	**Bus Grant 1 In**. Same as BG0IN on pin B4.
B7	BG1OUT*	**Bus Grant 1 Out**. Same as BG0OUT on pin B5.
B8	BG2IN*	**Bus Grant 2 In**. Same as BG0IN on pin B4.
B9	BG2OUT*	**Bus Grant 2 Out**. Same as BG0OUT on pin B5.
B10	BG3IN*	**Bus Grant 3 In**. Same as BG0IN on pin B4.
B11	BG3OUT*	**Bus Grant 3 Out**. Same as BG0OUT on pin B5.
B12	BR0*	**Bus Request** (level 0). One of four open-collector driven signals generated by the bus requesters to request access to VMEbus.
B13	BR1*	**Bus Request** (level 1). Same as BR0* on pin B12.
B14	BR2*	**Bus Request** (level 2). Same as BR0* on pin B12.
B15	BR3*	**Bus Request** (level 3). Same as BR0* on pin B12.
B16-B19	AM0-AM3	**Address Modifier** (bits 0-3). Same as AM4 on pin A23.
B20	GND	Ground
B21	SERCLK	**Serial Clock**. Not connected on the MVME162.
B22	SERDAT	**Serial Data**. Not connected on the MVME162.
B23	GND	Ground
B24-B30	IRQ7*-IRQ1*	**Interrupt Request** (bits 7-1, reverse ordered). Generated by an interrupter; these signals carry the prioritized interrupt requests. Level 7 is the highest priority and level 1 the lowest.
B31	+5VSTDBY	**+5Vdc Standby**. Not connected on the MVME162.
B32	+5V	**+5 Vdc Power**. Used by system logic circuits.

Table I-3. Connector P1 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
C1-C8	D08-D15	**Data Bus** (bits 8-15). Eight of 16 three-state bidirectional data lines that provide the data path between the data transfer bus master and slave.
C9	GND	Ground
C10	SYSFAIL*	**System Failure**. An open-collector-driven signal that indicates a failure has occurred in the system. SYSFAIL* may be generated by any module on the VMEbus.
C11	BERR*	**Bus Error**. An open-collector-driven signal generated by a slave or the bus timer. A falling edge indicates that an error has been encountered during the data transfer cycle. A low level indicates the slave may be active on the data bus.
C12	SYSRESET*	**System Reset**. An open-collector-driven signal which, when low, will reset all modules in the system.
C13	LWORD*	**Longword**. A three-state-driven signal specifying that the cycle is a byte/word transfer (when high) or a longword transfer (when low).
C14	AM5	**Address Modifier** (bit 5). Same as AM4 on pin A23.
C15-C30	A23-A08	**Address Bus** (bits 23-08, reverse ordered). Sixteen of 31 three-state input lines that specify an address in the memory map.
C31	+12V	**+12 Vdc Power**. Used by system logic circuits.
C32	+5V	**+5 Vdc Power**. Used by system logic circuits.

Connector P2 Interconnect Signals

Connector P2 is a standard DIN 41612 triple-row, 96-pin male connector. Each pin connection, signal mnemonic, and signal characteristic for the connector is listed in Table I-4.

Table I-4. Connector P2 Interconnect Signals

Pin Number	Signal Mnemonic	Signal Name and Description
A1	DB0*	**Data Bus** (bit 0), SCSI. Least significant bit and the lowest priority during the arbitration phase.
A2	DB1*	**Data Bus** (bit 1), SCSI.
A3	DB2*	**Data Bus** (bit 2), SCSI.
A4	DB3*	**Data Bus** (bit 3), SCSI.
A5	DB4*	**Data Bus** (bit 4), SCSI.
A6	DB5*	**Data Bus** (bit 5), SCSI.
A7	DB6*	**Data Bus** (bit 6), SCSI.
A8	DB7*	**Data Bus** (bit 7), SCSI. Most significant bit and the highest priority during the arbitration phase.
A9	DBP*	**Data Bus Parity** (SCSI). Data parity is odd. Use of parity is a system option. Parity is not valid during the arbitration phase.
A10	ATN*	**Attention** (SCSI). Signal driven by the initiator. Indicates the attention condition.
A11	BSY*	**Bus Busy** (SCSI). OR-tied signal indicating that the bus is in use.
A12	ACK*	**Acknowledge** (SCSI). Signal driven by an initiator to indicate an acknowledgement for a REQ/ACK data transfer handshake.
A13	RST*	**Reset** (SCSI). OR-tied signal indicating the reset condition.
A14	MSG*	**Message** (SCSI). Signal driven by the target during the message phase.
A15	SEL*	**Select** (SCSI). Signal used by an initiator to select a target or used by a target to reselect an initiator.
A16	D/C*	**Data/Command** (SCSI). Signal driven by the target to indicate whether command or data information is on the data bus. True (low) indicates command.

Table I-4. Connector P2 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
A17	REQ*	**Request** (SCSI). Signal driven by a target to indicate a request for a REQ/ACK data transfer handshake.
A18	O/I*	**Output/Input** (SCSI). Signal driven by a target which controls the direction of data movement on the bus. True (low) indicates input to the initiator. False (high) indicates output from the initiator. This signal is also used to distinguish between selection and reselection phases.
A19	TXD3	**EIA-232-D Transmit Data** (serial port 3). Data to be transmitted; input to modem from terminal.
A20	RXD3	**EIA-232-D Receive Data** (serial port 3). Data which is demodulated from the receive line; output from modem to terminal.
A21	RTS3	**EIA-232-D Request to Send** (serial port 3). Input from modem to terminal when the modem is required to transmit a message. With RTS3 off, the modem carrier remains off. When RTS3 is turned on, the modem immediately turns on the carrier.
A22	CTS3	**EIA-232-D Clear to Send** (serial port 3). Output from modem to terminal to indicate that message transmission can begin. When a modem is used, CTS3 follows the off-to-on transition of RTS3 after a time delay.
A23	DTR3	**EIA-232-D Data Terminal Ready** (serial port 3). Input to modem from terminal; indicates that the terminal is ready to send or receive data.
A24	DCD3	**EIA-232-D Data Carrier Detect** (serial port 3). Output from modem to terminal to indicate that a valid carrier is being received.
A25	TXD4	EIA-232-D Transmit Data (serial port 4). Data to be transmitted; input to modem from terminal.
A26	RXD4	EIA-232-D Receive Data (serial port 4). Data which is demodulated from the receive line; output from modem to terminal.
A27	RTS4	EIA-232-D Request to Send (serial port 4). Input from modem to terminal when the modem is required to transmit a message. With RTS4 off, the modem carrier remains off. When RTS4 is turned on, the modem immediately turns on the carrier.

Table I-4. Connector P2 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
A28	TRXC4	EIA-232-D Transmit Clock (serial port 4). This line can be configured to clock output data to the modem from the terminal.
A29	CTS4	EIA-232-D Clear to Send (serial port 4). Output from modem to terminal to indicate that message transmission can begin. When a modem is used, CTS4 follows the off-to-on transition of RTS4 after a time delay.
A30	DTR4	EIA-232-D Data Terminal Ready (serial port 4). Input to modem from terminal; indicates that the terminal is ready to send or receive data.
A31	DCD4	**EIA-232-D Data Carrier Detect** (serial port 4). Output from modem to terminal to indicate that a valid carrier is being received.
A32	RTXC4	**EIA-232-D Receive Clock** (serial port 4). This line can be configured to clock input data from the terminal to the modem.
B1	+5V	**+5 Vdc Power**. Used by system logic circuits.
B2	GND	Ground
B3	Reserved	Not used
B4-B11	A24-A31	**Address Bus** (bits 24-31). Eight of 31 three-state lines that specify an address in the memory map. They are driven by the MVME162 as a master and received by the controller as a slave.
B12	GND	Ground
B13	+5V	**+5 Vdc Power**. Used by system logic circuits.
B14-B21	D16-D23	**Data Bus** (bits 16-23). Eight of 32 bidirectional three-state data lines that provide the data path between the VMEbus master and slave.
B22	GND	Ground
B23-B30	D24-D31	**Data Bus** (bits 24-31). Eight of 32 bidirectional three-state data lines that provide the data path between the VMEbus master and slave.
B31	GND	Ground
B32	+5V	**+5 Vdc Power**. Used by system logic circuits.
C1	C–	**Collision –** (input), Ethernet. A signal to indicate that multiple stations are contending for access to the transmission medium.
C2	C+	**Collision +** (input), Ethernet. Part of a differential pair.

Table I-4. Connector P2 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
C3	T–	**Transmit –** (output), Ethernet. This line is intended to operate into terminated transmission lines.
C4	T+	**Transmit +** (input), Ethernet. Part of a differential pair.
C5	R–	**Receive –** (input), Ethernet. A data input sourced by the MAU.
C6	R+	**Receive +** (input), Ethernet. Part of a differential pair.
C7	+12VLAN	**+12 Vdc Power** (fused), Ethernet. Fused +12 Vdc sourced by the DTE.
C8	PRSTB*	**Data Strobe** (printer). An active low output pulse used to clock data from the system to the printer.
C9	PRD0	**Data** (bit 0), printer.
C10	PRD1	**Data** (bit 1), printer.
C11	PRD2	**Data** (bit 2), printer.
C12	PRD3	**Data** (bit 3), printer.
C13	PRD4	**Data** (bit 4), printer.
C14	PRD5	**Data** (bit 5), printer.
C15	PRD6	**Data** (bit 6), printer.
C16	PRD7	**Data** (bit 7), printer.
C17	PRACK*	Data Acknowledge (printer). A low-level input pulse indicating that the next character may be sent.
C18	PRBSY	Busy (printer). An input signal indicating that the printer cannot receive data.
C19	PRPE	Paper Empty (printer). Out of paper.
C20	PRSEL	Selected (printer). An input signal indicating that the printer is selected.
C21	INPRIME*	**Input Prime** (printer). An output signal that clears the printer buffer and initializes the logic.
C22	PRFAULT*	**Fault** (printer). An input signal indicating a printer fault condition.
C23	TXD1	**EIA-232-D Transmit Data** (serial port 1). Data to be transmitted; input to modem from terminal.
C24	RXD1	EIA-232-D Receive Data (serial port 1). Data which is demodulated from the receive line; output from modem to terminal.

Table I-4. Connector P2 Interconnect Signals (Continued)

Pin Number	Signal Mnemonic	Signal Name and Description
C25	RTS1	**EIA-232-D Request to Send** (serial port 1). Input from modem to terminal when the modem is required to transmit a message. With RTS1 off, the modem carrier remains off. When RTS1 is turned on, the modem immediately turns on the carrier.
C26	CTS1	**EIA-232-D Clear to Send** (serial port 1). Output from modem to terminal to indicate that message transmission can begin. When a modem is used, CTS1 follows the off-to-on transition of RTS1 after a time delay.
C27	TXD2	**EIA-232-D Transmit Data** (serial port 2). Data to be transmitted; input to modem from terminal.
C28	RXD2	**EIA-232-D Receive Data** (serial port 2). Data which is demodulated from the receive line; output from modem to terminal.
C29	RTS2	**EIA-232-D Request to Send** (serial port 2). Input from modem to terminal when the modem is required to transmit a message. With RTS2 off, the modem carrier remains off. When RTS2 is turned on, the modem immediately turns on the carrier.
C30	CTS2	**EIA-232-D Clear to Send** (serial port 2). Output from modem to terminal to indicate that message transmission can begin. When a modem is used, CTS2 follows the off-to-on transition of RTS2 after a time delay.
C31	DTR2	**EIA-232-D Data Terminal Ready** (serial port 2). Input to modem from terminal; indicates that the terminal is ready to send or receive data.
C32	DCD2	**EIA-232-D Data Carrier Detect** (serial port 2). Output from modem to terminal to indicate that a valid carrier is being received.

Related Documentation J

Motorola Documentation

The MVME162LX Embedded Controller does not ship with all of the documentation that is available for the product. It only ships with the installation and use guide (the document you are presently reading) that includes all the information necessary for board installation, jumper configuration, memory maps, debugger/monitor commands, and any other data pertinent for proper start-up of the board.

The following publications are applicable to the MVME162LX and may provide additional reference information. You may download copies of this documentation in PDF and/or HTML format from the Motorola Computer Group's World Wide Web site at **http://www.mcg.mot.com/literature**.

Note Although not shown for each document in the following table, Motorola Computer Group manual publications numbers are suffixed with characters which represent the revision level of the document, such as "/*xx*2" (the second revision of a manual); a supplement bears the same number as a manual but has a suffix such as "/*xx*2A1" (the first supplement to the second edition of the manual).

Document Title	Motorola Publication Number
MVME162Bug Diagnostics Manual	V162DIAA/UM
Debugging Package for Motorola 68K CISC CPUs User's Manual	68KBUG 1/D and 2/D
MVME 162Bug Debugging Package User's Manual	MVME162BUG/D
MVME162LX 200/300 Series Embedded Controller Programmer's Reference Guide	V162LX2-3A/PG

Document Title	Motorola Publication Number
MVME162LX 700/800 Series Embedded Controller Programmer's Reference Guide	V162LX7-8A/PG
MVME1x7 Data Sheet Package (for use with the MVME162[LX] and the MVME166, MVME167, MVME187, and MVME197)	68-1X7DS
M68040 Microprocessors User's Manual	M68040UM
M68000 Family Reference Manual	M68000FR

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Non-Motorola Documentation

Non-Motorola documents may be purchased from the sources listed. The following publications are also available from the sources indicated.

Versatile Backplane Bus: VMEbus, ANSI/IEEE Std 1014-1987, The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 (VMEbus Specification). This is also available as *Microprocessor system bus for 1 to 4 byte data, IEC 821 BUS*, Bureau Central de la Commission Electrotechnique Internationale; 3, rue de Varembé, Geneva, Switzerland.

ANSI Small Computer System Interface-2 (SCSI-2), Draft Document X3.131-198X, Revision 10c; Global Engineering Documents, P.O. Box 19539, Irvine, CA 92714.

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Z85230 Serial Communications Controller data sheet; Zilog, Inc., 210 Hacienda Ave., Campbell, California 95008-6609.

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MK48T08(B) Timekeeper ™ *and 8Kx8 Zeropower* ™ *RAM* data sheet in *Static RAMs Databook*, order number DBSRAM71; SGS-THOMPSON Microelectronics Group; North & South American Marketing Headquarters, 1000 East Bell Road, Phoenix, AZ 85022-2699.

28F008SA Flash Memory Data Sheet, order number 2904351-001; Intel Literature Sales, P.O. Box 7641, Mt. Prospect, IL 60056-7641.

Support Information

You can obtain connector interconnect signal information, parts lists, and schematics for the MVME162LX Embedded Controller free of charge by contacting your local Motorola sales office.

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