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VM62(A) / VM42(A)

Intelligent Universal Controller Modules
for Stand-Alone and VMEbus

Manual Order No. 3368

User's Manual

Issue 3

Unpacking and Special Handling Instructions

This PepCard product is carefully designed for a long and fault-free life; nonetheless, its life expectancy can be drastically reduced by improper treatment during unpacking and installation.

Observe standard anti-static precautions when changing piggybacks, ROM devices, jumper settings, etc. If the product contains batteries for RTC or memory back-up, ensure that the board is not placed on conductive surfaces, including anti-static plastics or sponges. These can cause shorts and damage to the batteries or tracks on the board.

When installing the board, switch off the power mains to the chassis. Do not disconnect the mains as the ground connection prevents the chassis from static voltages, which can damage the board as it is inserted.

Furthermore, do not exceed the specified operational temperature ranges of the board version ordered. If batteries are present, their temperature restrictions must be taken into account.

Keep all of the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the board, re-pack it as it was originally packed.

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REVISION HISTORY
VM62(A) / VM42(A) User's Manual

Issue	Brief Description of Changes	PCB Index	Date of Issue
1	Issue 1	01-01/2	March, 1995
2	General Corrections throughout Manual	01-01/4	June, 1995
2.0.1	Correction of Figure 3.2.0.1 (Jumper Layout Solder Side)	01-01/4	July, 1995
3	Updated for board index 02	02	December, 1995

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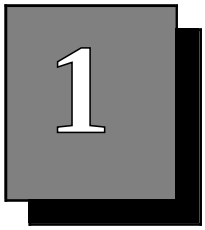
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1. INTRODUCTION

1.1 Product Overview

The computer user today requires high performance to meet high expectations. At the same time, the mass of data that has to be processed is dramatically increasing, for instance the data that a modern graphic user interface generates. Additionally, there is a further demand on the communications ability and multi-functionality of the computer.

The VM62(A)/VM42(A) meets all the above requirements, combining high computational performance with excellent communication ability via the AutoBahn™ Spanceiver™ chip.

A combination of the high performance CPU (Motorola MC68060 or 68040) and the Quad Integrated Communications Controller chip, the Motorola MC68EN360 or QUICC, not only enables a pure computation performance from approximately 35 MIPS to over 100 MIPS, but dispenses with the usual restrictions associated with communications over serial interfaces. Communication tasks are dealt with by the QUICC chip, freeing the CPU from such time-consuming chores. Fieldbus protocol, such as PROFIBUS, are also handled by the QUICC. In addition, the QUICC, used together with PEP's expanding CXC interface is ideally suited for communication tasks extending from 6 serial interfaces over LAN to WAN (X.25, ISDN) applications. The 'EN' version of the QUICC also supports Ethernet on 2 channels (only one usable on the VM42(A)/VM62(A) using PEP standard software).

The various I/O interfaces are realised using piggybacks attached to the main board. Five options are at the moment available. They are:

- *Ethernet 10Base 2;*
- *Ethernet 10Base 5 (AUI);*
- *Ethernet 10BaseT;*
- *2 * RS232 serial interfaces;*
- *PROFIBUS interface (RS485, isolated, half duplex, 2 wires).*

PEP's AutoBahn technology has solved one of the major problems that exist in information technology - data transfer over the various bus systems. Normally the data transfer rate over a bus system is below the data transfer capability of a modern CPU chip. The AutoBahn chip (the Spanceiver MC100SX1451) allows transfer rates of up to 100 Mbyte/sec over the VMEbus using the VMEbus lines SERA and SERB.

PEP has also developed a cost-effective VMEbus backplane series that support AutoBahn, called VBP4A, in 7, 12 and 15 slot options. These backplanes allow direct connection of the main power supply, hence reducing cabling costs dramatically.

A CXM-SIO3 module is available in order to make all three serial interfaces that are available on the CXC accessible on the VM62(A)/VM42(A). This is achieved by using RS232, SC-xxx or SI-xxx interfaces. *For more details, please refer to the CXM-SIO3 user's manual.*

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1.2 Ordering Information

Name	Description	Order No
VM62-BASE	VMEbus single board computer comprising MC68060 @ 50 MHz, MC68EN360 @ 25 MHz, 256 kByte dual-ported SRAM (with Gold Cap for backup), configured for use with the AutoBahn interface piggyback, up to 6 serial interfaces (2 available on the front panel as RS232 and an additional 4 divided between the CXC interface and SI-Interface), CXC Interface, PEPbug.	12349
VM62-BASE	Same as order no. 12349 but with 1 MByte dual-ported SRAM	12350
VM42-BASE	VMEbus single board computer comprising MC68040 @ 33 MHz, MC68EN360 @ 33 MHz, 256 kByte dual-ported SRAM (with Gold Cap for backup), configured for use with the AutoBahn interface piggyback, 6 serial interfaces (2 available on the front panel as RS232 and an additional 4 divided between the CXC interface and SI-Interface), CXC Interface, PEPbug.	12344
VM42-BASE	Same as order no. 12344 but with 1 MByte dual-ported SRAM	12345
VM42-BASE	Same as order no. 12344 but with MC68040V @ 33 MHz (3.3-V technology)	12346
VM42-BASE	Same as order no. 12346 but with 1 MByte dual-ported SRAM	12347
DM600	Memory piggyback with 4 MByte DRAM and 1 MByte Flash EPROM	11852
DM600	Memory piggyback with 4 MByte DRAM and 4 MByte Flash EPROM	11853
DM601	Memory piggyback with 16 MByte DRAM and 1 MByte Flash EPROM	11854
DM601	Memory piggyback with 16 MByte DRAM and 4 MByte Flash EPROM	11855
DM602	Memory piggyback with 1 MByte DRAM and 1 MByte Flash EPROM	12765
DM603	Memory piggyback with 32 MByte DRAM and 512 kByte Flash EPROM	13027
DM603	Memory piggyback with 32 MByte DRAM and 2 MByte Flash EPROM	13627
SI-10B2	10Base2 (Thin) Ethernet (cheapernet) interface with RG58 (coax) connector	9925
SI-10B5	10Base5 (AUI) Ethernet interface piggyback with 15-pin D-Sub connector	9924
SI-10BT	10BaseT (Twisted pair) Ethernet interface piggyback with RJ45 connector	9926
SI-DUMMY	Front panel only fitted when no SI piggyback required	12351
SI-PB232	Serial interface piggyback for 2 RS232 connections (Modem interface) with 2 RJ45 connectors	11850
SI-PB232-ISO	Serial interface piggyback for 1 RS232 optoisolated connection with 1 RJ45 connector (*Available in 1996 if requested*)	11851
SI-PBPRO	RS485 optoisolated interface piggyback for 2 wire half-duplex (PROFIBUS) connection with 9-pin D-Sub connector	9927
MP-AB100	AutoBahn interface piggyback complete with all control logic, 128 kByte 32-bit fast SRAM as buffer for AutoBahn data transfer with Spanceiver MC 100SX1451 of 50/100 MByte/s	9923
CABLE-VM42-232	3 meter RS232 Serial Interface cable for VM42(A) / VM62(A) with 9-pin female D-Sub (PC pinout) to RJ12 connector	12383

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Name	Description	Order No
CXM-SIO3-1	CXM module with 3 RJ45 connected RS232 ports for use with a CXC backplane	*TBD*
CXM-SIO3-1	CXM module with 3 RJ45 connected RS232 ports, compatible for direct connection to a CPU board	13692
CXM-SIO3-2	CXM module with 2 RJ45 connected SC piggyback ports and one SI piggyback interface, no front panel (*delivered with SC piggyback*) for use with a CXC backplane	*TBD*
CXM-SIO3-2	CXM module with 2 RJ45 connected SC piggyback ports and one SI piggyback interface, no front panel (*delivered with SC piggyback*), compatible for direct connection to a CPU board	13693
CXM-SIO3-3	CXM module with 3 RJ45 connected SC piggyback ports for use with a CXC backplane	*TBD*
CXM-SIO3-3	CXM module with 3 RJ45 connected SC piggyback ports, compatible for direct connection to a CPU board	13694
CXM-SIO3-4	CXM module with 3 15-pin D-Sub connected SC piggyback ports, 8TE front panel for use with a CXC backplane	*TBD*
CXM-SIO3-4	CXM module with 3 15-pin D-Sub connected SC piggyback ports, 8TE front panel, compatible for direct connection to a CPU board	13695

Each VM62(A)/VM42(A) comes complete with 2 RS232 serial interfaces situated on the lower half of the front panel- These interfaces are provided with TxD and RxD signals by the SMC1 and SMC2 channels of the 'QUICC' controller. The SCC1 channel of the 'QUICC' provides the interface to one of the available SI-xxx piggybacks. All other channels (SCC2, SCC3 and SCC4) of the 'QUICC' are ported to the CXC interface except for the SI-PB232 piggyback which has on-board additional control provided by the SCC4 channel through the SI Interface.

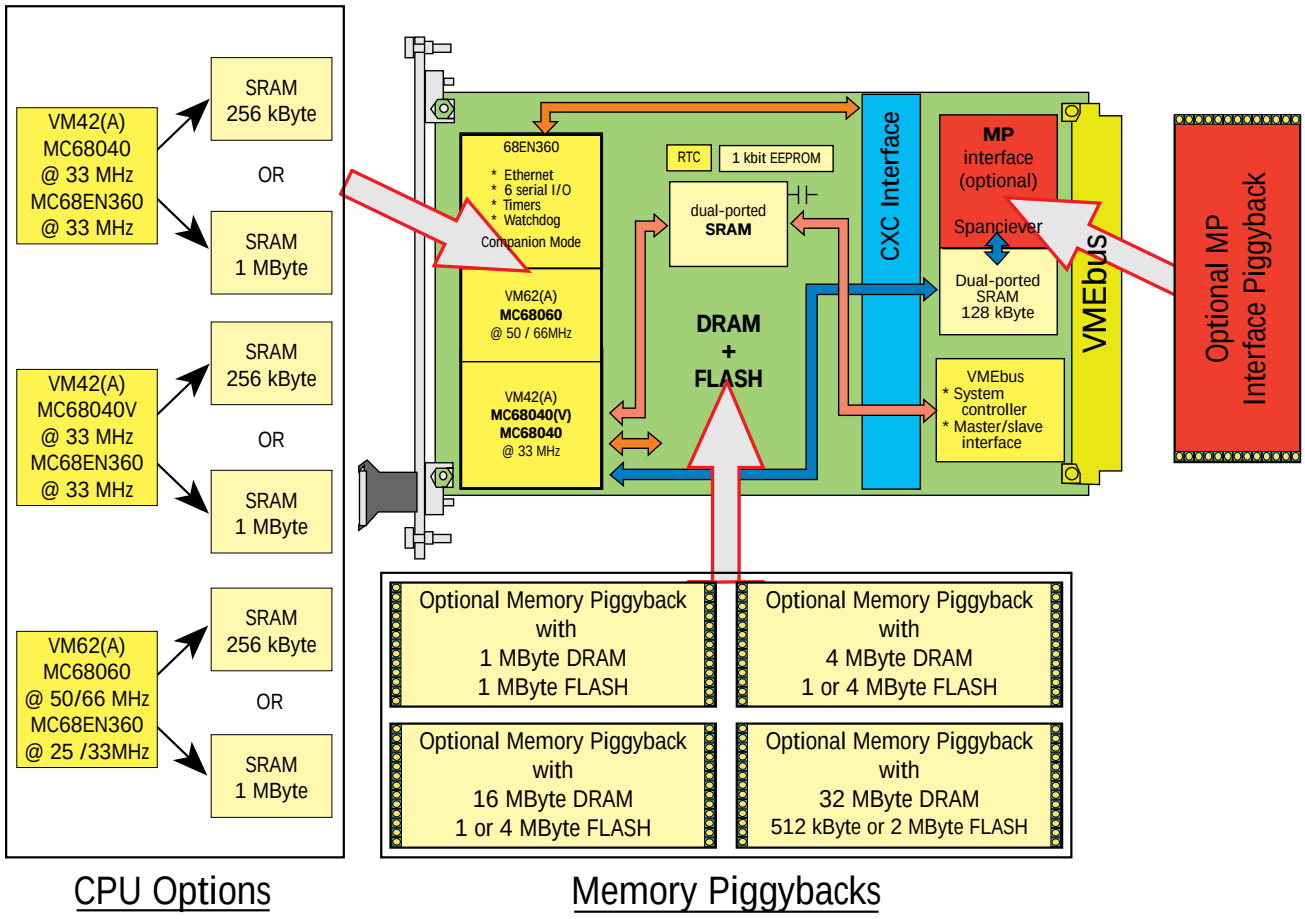
As mentioned above, a CXM-SIO3 module is available in order to make all the serial interfaces accessible on the VM62(A)/VM42(A). *For more details, please refer to the CXM-SIO3 user's manual.*

Important: The VM62(A)/VM42(A) must be ordered with a memory module (DM60x) and a front panel interface piggyback module (SI-xxx).

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Figure 1.2.0.1: VM62(A)/VM42(A) Configuration Options



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1.3 Specifications

Main CPU	MC68060 66 or 50 MHz (3.3V) MC68040 33 or 25 MHz MC68040V 33 or 25 MHz (3.3V) MC68LC040 33 or 25 MHz
I/O Controller	MC68EN360, 25 or 33MHz used in companion mode
Memory	
DRAM	1, 4, 16 or 32 Mbyte
FLASH	0.5, 1, 2, or 4 MByte
SRAM	1 MByte or 256 kByte (dual-ported, backed-up using Gold-Caps)
EEPROM	2 kbit (serial); 1 kbit available for applications
VMEbus Interface	
A24:D16/D8	Master and slave with optional AutoBahn Interface (100 MBytes/sec)
Arbitration	Single level (BR3*), release-when-done daisy-chain
AM Codes	Standard Superv./User Prog./Data HEX 39/3A/3D/3E User Defined HEX 10-17/18-1F Short I/O HEX 29/2D System controller functions • Automatic First Slot Detection (FSD) • SYSRES* (disabled by jumper) • SYSCLK* (disabled by jumper) • ACFAIL* • SYSFAIL* • Power monitor • Bus monitor (programmable) • VME IRQ mask register
A24:D16	Slave
Dual-port SRAM	1 Mbyte window, software programmable base (1 out of 16 addresses)
1 Mailbox IRQ	Lower 8kBytes of the SRAM area
Interrupt Control	
7 Level VME IRQ Handler, maskable via VME IRQ mask register	
System vectors	ACFAIL* -> Level 7 autovectored ABORT -> Level 7 autovectored TICK -> Level 6 autovectored SYSFAIL* -> Level 3 autovectored (maskable)* Mailbox IRQ -> Level 5 autovectored AutoBahn IRQ 2 -> Level 2 autovectored AutoBahn IRQ 1 -> Level 1 autovectored 16 on-board Interrupters, Levels / Vectors programmable

* Available for Index 02 boards or later.

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I/O Ports	
Serial	RISC controller (in the 68EN360) with 14 dedicated DMA channels 4*multiprotocol SCCs up to 8 MBaud with one (two) supporting IEEE 802.3/Ethernet up to 10 Mbit/s 10Base5, 10Base2 or 10BaseT 2*UARTs RS232 (XON/XOFF) RS232 up to 120 kBaud 4 independent baud rate generators
Mezzanine Interface	CXC Interface - 16 bit asyncronous data transfer with 4 IRQs, independent DMA channel - 3 serial interfaces
Timers	
TICK	Periodic Interrupt Timer, programmable
General Purpose	4*16 bit or 2*32 bit, programmable
Watchdog	512 ms time-out for reset, programmable
Special Functions	
Real-time clock (backed-up)	Date (year, month, week, day) Time (hour, minute, second)
Serial EEPROM	1 kbit for board specific data (serial number, Internet address, etc.) + 1 kbit for application purposes
DMA	2 independent channels (supports single and dual address transfers between all offboard locations including DRAM, FLASH, AutoBahn memory, CXC and VME)
Front Panel Functions	RESET button ABORT button HALT LED (red) Watchdog LED (yellow) General purpose LED (green)
Data Retention	
Short term backup for RTC and SRAM via on-board Gold-Cap	Typ. 2µA/3V -> 50 hours
Long term backup via VME 5V Stby line	Dependent on the battery installed on the system 5V Stby. Automatic switching between 5V Stby and internal Gold-Cap Typ. 30µA/3V
Power Requirements	
VM62 /66 MHz	*To be defined*
VM62 /50 MHz	5 W with DM600 and SITB5 fitted
VM42 /33 MHz (68040)	7W with DM600 and SITB5 fitted
VM42 /25 MHz 3.3V (68040V)	4 W with DM600 and SITB5 fitted
Temperature Range	Standard 0 - 70˚C Optionally E2 -40˚C to +85˚C
Operating Humidity	0 to 95% non-condensing
Board Size	Single height Eurocard 100*160 mm
VMEbus Connector	DIN 41612 style C, 96 contacts, P1 connector
Front panel width	4 TE, 1 slot

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1.4 Features

CPU Options

The Table below illustrates the capabilities of the available CPUs. The 68060 processors operating at 50 MHz deliver up to 100 MIPs while the 68040 processors operating at 33 MHz give performances up to 35 MIPs.

Table 1.4.0.1: CPU Configuration

Processor	Product	CPU	MMU	FPU	Supply
MC68040	VM42(A)	√	√	√	5V
MC68LC040*	VM42(A)	√	√		5V
MC68040V	VM42(A)	√	√		3.3V
MC68060	VM62(A)	√	√	√	3.3V
MC68EC060 planned project	*VM62(A)*	√			*3.3V*

* Mask E71M required.

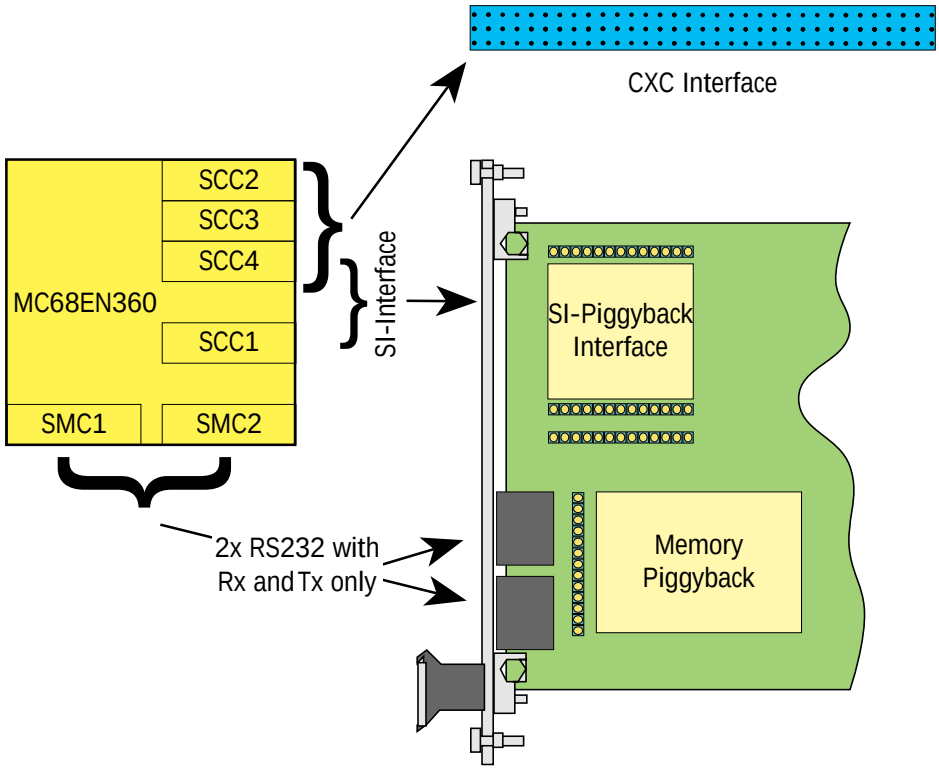
68EN360

25/33 MHz - the 'QUICC' chip used in 'companion mode' is tightly coupled to the CPU. Working as an I/O and system controller, it provides all the necessary interfaces, timers and clocks etc. in addition to the DRAM memory controller.

Serial Channels

Six are provided by the 'QUICC' - Two SMC channels are ported to the front panel and the remaining four SCC channels may be optionally configured as shown below.

Figure 1.4.0.2: MC68EN360 Intelligent Controller Schematic



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Ethernet Interface (*SI-10B2, SI-10B5, SI-10BT*)

Three different piggybacks complete with all the associated control logic are available providing 10Base5, 10Base2 or 10BaseT interfaces.

Note

The SI-10B5 piggyback requires an external +12V power source to operate.

Fieldbus Interface (*SI-PBPRO*)

This is a fully optoisolated RS485 (PROFIBUS) interface piggyback with a 9-pin D-Sub connector.

RS232 Serial Interface

Two piggybacks are available with RJ45 connectors for MODEM compatible communication.

AutoBahn Interface (*MP-AB100*)

This is realised via a piggyback containing all the necessary control logic, 128 kByte high speed SRAM (10 ns) as a memory buffer between the processor and the AutoBahn chip (MC 100SX1451) for communication on the high speed serial data lines over pins b21 and b22 of the VMEbus.

DMA Channels

2 independent channels are provided by the 'QUICC' chip and can be used by applications requiring data transfer between CXC-modules, DRAM, FLASH memory, dual-ported SRAM and AutoBahn memory buffers. This memory can be configured with different memory options allowing tremendous flexibility when customising memory requirements for real-time applications.

DRAM/FLASH

This memory, complete with a 32 bit data wide access bus is placed on a piggyback with addressing capability for up to two memory banks of 64 MByte each. On-board +5V FLASH memory provides the latest ROM technology allowing the user to take advantage of the on-board programming facility to produce low cost upgrades by simply overwriting existing stored data.

SRAM

This is a dual-ported battery-backed (Gold-Cap) memory area with a 16 bit data wide access bus. Users of the VMEbus and the on-board CPU both have access to this memory. The lower 8 kByte are reserved for the location monitor.

EEPROM

Although a 2 kbit EEPROM is provided on-board, 1 kbit has been pre-programmed with PEP production data (boot info, Ethernet registration, etc) leaving the remaining 1 kbit for user application code. A write protect jumper prevents accidental erasure.

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1.5 Related Publications

VITA

VMEbus Specifications Revision C1
MPI: Modpack and CXC Specification from PEP (Version 1.5 or later)

Motorola

M68060 Microprocessors User's Manual
M68040 Microprocessors User's Manual
MC68EN360 Quad Integrated Communications Controller User's Manual
AutoBahn Spanceiver Data Sheet

EM Microelectronic

V3021 1 Bit Real Time Clock Data Sheet

XICOR

X25C02 SPI Serial EEPROM Data Sheet

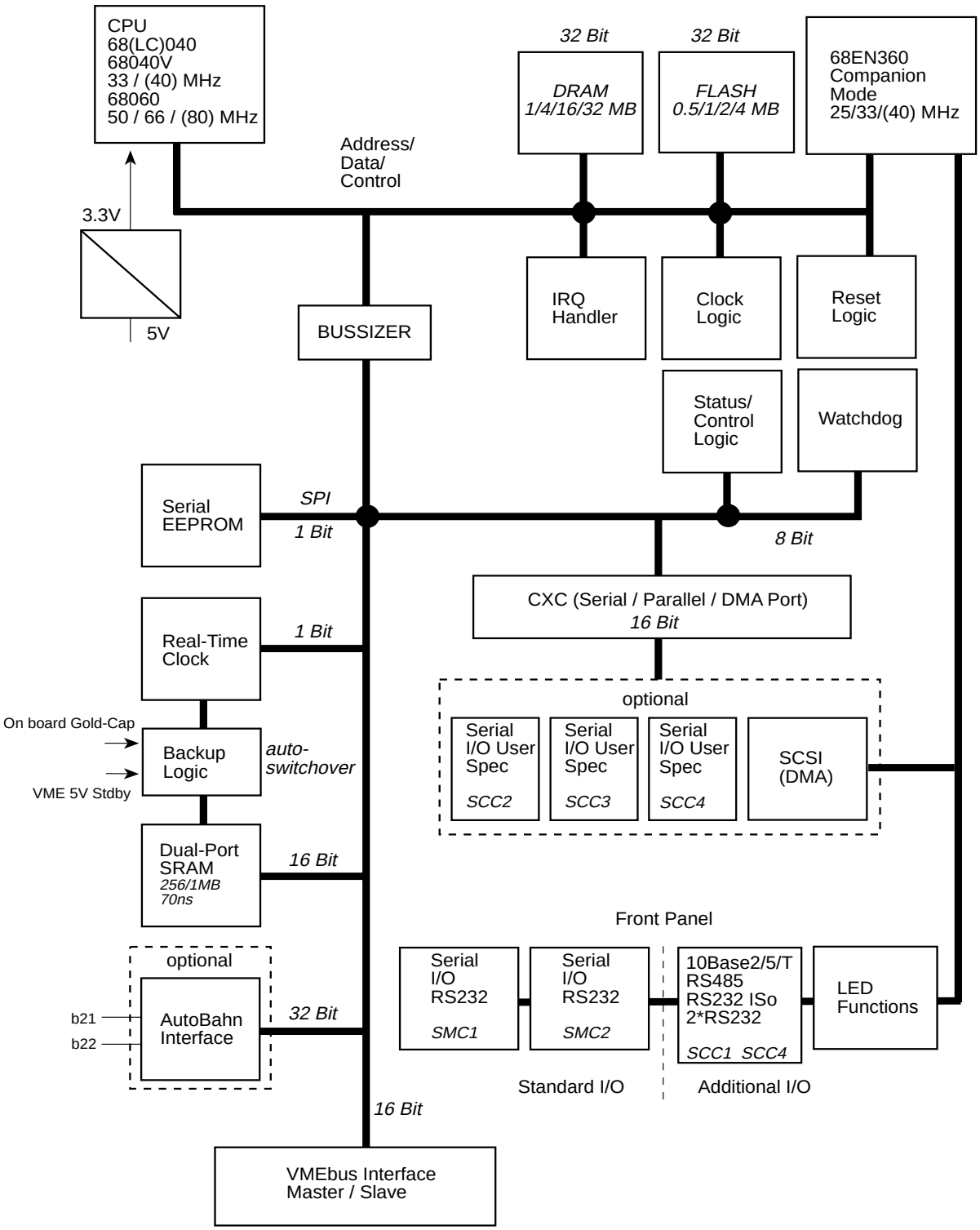
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2

2. FUNCTIONAL DESCRIPTION

Figure 2.0.0.1: VM62(A) / VM42(A) Block Diagram



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2.1 The 68EN360 (QUICC) on the VM62(A) / VM42(A)

Motorola's MC68EN360 is a 32 bit high performance communication controller, combining powerful peripheral functions with system integration functions and an on-chip microprocessor core (CPU32+).

On the VM62(A) / VM42(A), the on-chip CPU core is disabled and replaced with a more powerful external CPU, the MC68040 or MC68060. The 68EN360 operates as a slave to the CPU in so-called '*Companion Mode*'. In this mode, the 68EN360 provides complete I/O functionality. The DMA channels can still obtain ownership of the CPU's system bus and therefore all on-chip DMA channels can address the whole of the address space. Moreover, important functions for system integration, such as memory controller, clock generation, interrupt controller etc. are available in this mode, meeting the requirements for the initialisation of the 68EN360, described later in this manual.

The programming of the 68EN360 begins by determining the block of on-chip RAM and registers via the MBAR register. This register is located at a fixed address and can only be accessed in CPU space.

2.2 Address Decoder

2.2.1 Basic Structure

The address decoder of the VM62(A) / VM42(A) consists of two basic parts. A primary address decoder pre-decodes the select signals for the processor data bus (in front of the bussizer) and for the I/O data bus (behind the bussizer). With reference to initial boot cycles, the primary address decoder passes or enables a secondary address decoder stage. The secondary address decoder stage is realised using the programmable chip slect logic of the MC68EN360. The 8 outputs of the 68EN360 chip select logic are used for the base addresses of the various memory and I/O address ranges.

2.2.2 Boot Decoding

Due to the fact that the default boot memory used by the VM62(A) / VM42(A) is FLASH memory, which is completely reprogrammable, a special boot decoder is provided. The boot memory is jumper selectable, the user having the choice between FLASH (default), VMEbus memory or the on-board AutoBahn Interface. The boot decoder redirects the physical address range 0H to 1000000H from either FLASH (DM60x), VMEbus or MP piggyback, providing the selected boot memory is initially accessed.

Note

VMEbus boot memory must be located at VME base address 0H in Standard Supervisor Program/Data address space.

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2.2.3 Primary Address Decoder

The primary address decoder generates the following select signals.

CS_360	Secondary address decoder (68EN360, DRAM, FLASH)
CS_VME	VMEbus address range
CS_AUT	AutoBahn Interface address range
CS_BSS	Bussizer address range (VME, SRAM, AutoBahn, I/O)
BERR_0	Reserved address range (Bus Error)
EN_BSS	68EN360 DMA address range
IACK	Interrupt Acknowledge Cycle

2.2.4 Secondary Address Decoder

The secondary address decoder is built by the 68EN360 chip select logic and is therefore programmable. The outputs are used as base address selects, as shown below.

68EN360 Chip Select	Connected to
CS0	FLASH
CS1	DRAM
CS2	VME via 68EN360 DMA
CS3	AutoBahn Interface
CS4	SRAM
CS5	CXC
CS6	RTC
CS7	Control / Status Registers

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2.2.5 Address Map

The VM62(A) / VM42(A) address map shown in the Table below is based on the recommended default initialisation of the 68EN360 chip select logic.

Figure 2.2.5.1: VM62(A) / VM42(A) Address Map (*PEP Default*)

Address (Hex)	Device
00 xx xx xx	DRAM (68EN360's CS1)
04 xx xx xx	FLASH (68EN360's CS0)
07 00 0x xx	*Reserved, 68EN360 internal RAM / register*
09 xx xx xx	DMA AutoBahn (CS3)
0A xx xx xx	*Reserved, mirrored 68EN360's CS4*
0B xx xx xx	*Reserved, mirrored 68EN360's CS5*
0C xx xx xx	*Reserved, mirrored 68EN360's CS6*
0D xx xx xx	*Reserved, mirrored 68EN360's CS7*
1x xx xx xx	*Reserved (BERR_0)*
2x xx xx xx	*Reserved (BERR_0)*
3x xx xx xx	*Reserved (BERR_0)*
4x xx xx xx	MP interface (CS_AUT)
5x xx xx xx	*Reserved (BERR_0)*
6x xx xx xx	*Reserved (BERR_0)*
	The following address area is non-cachable serialised.
82 xx xx xx	VMEbus (CS_VME), user-defined AM code
83 xx xx xx	VMEbus (CS_VME), user-defined AM code
85 00 xx xx	VMEbus (CS_VME), short I/O AM code
87 xx xx xx	VMEbus (CS_VME), user-defined AM code
87 xx xx xx	DMA-VME, 68EN360's CS2
9x xx xx xx	*Reserved (BERR_0)*
Ax xx xx xx	*Reserved (BERR_0)*
Bx xx xx xx	*Reserved (BERR_0)*
C0 xx xx xx	*Reserved, mirrored DRAM*
C4 xx xx xx	*Reserved, mirrored FLASH*
C7 xx xx xx	Reserved, 68EN360 internal RAM / register
CA xx xx xx	68EN360's CS4, SRAM
CB F7 0x xx	68EN360's CS5, CXC
CC xx xx xx	68EN360's CS6, RTC
CD 00 00 01	68EN360's CS7+1, VME IRQ MASK register
CD 00 00 05	68EN360's CS7+5, VME control / status register
CD 00 00 07	68EN360's CS7+7, board control / status register
Dx xx xx xx	*Reserved (BERR_0)*
Ex xx xx xx	*Reserved (BERR_0)*
Fx xx xx xx	*Reserved (BERR_0)*

Note

In order to determine the base of the 68EN360's internal memory map, the module base address register (MBAR) must be set. The location of this register is fixed in the address area *Supervisor CPU Space* at 3FF00H. For more information, please refer to the *Software Configuration* chapter in this manual.

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2.2.6 DMA Transfers

Memory to memory transfers with the 68EN360 DMAs are possible with any combination of on-board and VME addresses. In order to achieve address compatibility between CPU/VME and DMA/VME transfers, it is recommended that the initialisation of CS2 be initialised to the standard VME address space as described in the *Software Configuration* chapter in this manual.

2.3 VMEbus Interface

The VM62(A) / VM42(A) has a complete master interface for the P1, J1 VMEbus connector. It consists of a VMEbus arbiter, requester, system controller and buffers for data/address/control signals. In addition, the VM62(A) / VM42(A) provides a VMEbus slave interface which consists of a programmable board address decoder, a dual-ported RAM and a mailbox interrupt controller.

2.3.1 System Controller

The VM62(A) / VM42(A) can act as a VME system controller with arbiter, system clock driver, power monitor with system reset driver, IACK daisy chain driver and 7-level VMEbus interrupt controller.

Arbitration is single level FAIR[1] on BR3*. If the VM62(A) / VM42(A) is used as system controller it has to be placed in slot 1 of the VMEbus backplane (furthermost left slot). There is no jumper setting necessary, as the board provides a 'first slot detection' function which is also readable within the VME control / status register. The IACK daisy chain driver is supplied by connecting the IACKIN* and IACKOUT* line. IACK* is connected via the VMEbus backplane for IACKIN* of slot 1.

VME SYSCLK* and SYSRES* can be routed from on-board using jumpers, leaving the choice of generating these signals by the system controller to the user. SYSFAIL* generates a maskable on-board autovectored interrupt (see also *External Autovector Requests*). ACFAIL* generates a non-maskable autovector level 7 interrupt (NMI) in the same way as the ABORT button. When an ACFAIL* NMI is detected, it can be differentiated from an ABORT by reading bit 1 of the Board Control/Status Register (bit 1 is set to '1' for ACFAIL*). If this is the case, the CPU should stay in the IRQ service routine and save any important data to non-volatile memory.

The VM62(A) / VM42(A) also provides a bus monitor for the VMEbus. A 128µs timeout timer monitors VMEbus data transfer cycle lengths and generates a VMEbus BERR* signal for error termination. This timer is enabled/disabled via the VME control / status register which also supplies a timeout status bit in order to identify bus errors generated by the bus monitor.

2.3.2 Dual-Ported SRAM

The VM62(A) / VM42(A) provides on-board SRAM of either 256 kByte or 1 Mbyte. The SRAM is 16- bit wide and dual-ported between the CPU/DMA and VME, accessible through an on-board arbiter. Read-Modify-Write cycles (TAS instruction used for semaphores) are supported in any direction. The location of the dual-ported SRAM as seen from the VME is programmable via the VME control / status register. There are 16 different base addresses possible that are all located in the VME standard supervisor / user data space. Enable / disable is selected using a separate bit.

Note

The lower 8 kBytes of dual-ported SRAM should not be accessed from the VME because this area is reserved for mailbox interrupts.

[1] FAIR according to VME 64 Specifications, Rule 3.14 and Observation 3.17.

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2.3.3 Mailbox Interrupt

An external VMEbus master may interrupt the VM62(A) / VM42(A) by setting P_IRQ5 (pending mailbox IRQ) in the VME control / status register. The address of this dual-ported register seen from VME is identical to the base address of the dual-ported SRAM, occupying the lower 8 kBytes (odd byte addresses) of the dual-ported SRAM.

Setting P_IRQ5 generates an autovector 5 interrupt on the CPU. Typically, the on-board CPU resets P_IRQ5 during the processing of the corresponding interrupt service routine.

Note

Although every odd address of the 8k block of the VME control / status register can be accessed from VME, only the P_IRQ5 bit can be set. All other bits are write protected from the VME. As the P_IRQ5 bit is located at bit 7 within the register, it can be directly used as a semaphore because read-modify-write (TAS instruction) is supported.

2.3.4 VMEbus Control / Status Register

Address: CS7 + $5 *PEP Default Address **$CD 00 00 05***
Format: Byte
Access: read / write
Value after HW reset: *see table*

	7	6	5	4	3	2	1	0
CS7 + $5	*P_IRQ5*	*EN_DPR*	*EN_BERR2*	*FSD*	*BADR3*	*BADR2*	*BADR1*	*BADR0*

Register Description

Name	Value	Reset (HW)		Reset PEP (SW)		Description
		Slot 1	*Other*	*Slot 1*	*Other*	
P_IRQ5 *bit 7*	1	0	0	0	0	Pending mailbox IRQ
EN_DPR *bit 6*	1	0	0	Value stored in EEPROM	Value stored in EEPROM	Dual-port RAM (including mailbox IRQ) for VME requester enabled. Base address fixed through BADRx bits
EN_BERR2 *bit 5*	1	0	0	1	0	Enable bus monitor timer, all VME cycles, timeout after 128µs
FSD *bit 4*	1	1	0	1	0	VMEbus 'First Slot Detection' flag, system controller
BADR3 - BADR0 *bits 3 - 0*		0	0	Value stored in EEPROM	Value stored in EEPROM	VME address location of dual-ported RAM. Equivalent to VME address lines A23 - A20, programmable from $0 - $F in 1 Mbyte windows, enabled with EN_DPR. *See Table on next page.*

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BADR [3 .. 0]	VME Board Base Address
0000	$00 00 00
0001	$10 00 00
0010	$20 00 00
0011	$30 00 00
0100	$40 00 00
0101	$50 00 00
0110	$60 00 00
0111	$70 00 00
1000	$80 00 00
1001	$90 00 00
1010	$A0 00 00
1011	$B0 00 00
1100	$C0 00 00
1101	$D0 00 00
1110	$E0 00 00
1111	$F0 00 00

2.4 Interrupt Control

The interrupt control logic processes internal interrupt requests (68EN360), together with external requests (VME) and external autovectored interrupt requests. The interrupt control logic is built up using the 68EN360 internal interrupt controlling and a 7-level VMEbus interrupt handler with the corresponding mask register.

2.4.1 Internal Requests

Internal requests are related to all interrupt requests caused by the 68EN360 sources, including the 68EN360 system integration functions (watchdog timer, periodic interrupt timer) and the communication processor module (RISC controller, timers, DMAs, SCCs and so on). For more information, please refer to the 68EN360 User's Manual.

In order to avoid conflicts regarding interrupt levels, it is recommended to use IRQ level 4 for 68EN360 CPU internal requests and IRQ level 6 for 68EN360 SIM60 internal requests.

Note

The 4 IRQ lines specified by CXC are supplied by the 68EN360 Port C lines and are therefore also processed as internal requests (PC0, 1, 2, 3).

2.4.2 External Autovector Requests

Some 68EN360 external interrupt sources are routed to the IRQ lines of the 68EN360 and generated as autovectored interrupts. Care must be taken that the relevant 68EN360 register is initialised with respect to the wiring (see also the *Software Configuration* chapter in this manual).

Source	68EN360 Pin	Autovector
ABORT / ACFAIL	IRQ7	7
TICK	IRQ6	6
Mailbox IRQ	IRQ5	5
SYSFAIL	IRQ3	3
AutoBahn IRQ2	IRQ2	2
AutoBahn IRQ1	IRQ1	1

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2.4.3 VME Interrupt Mask Register

Address: CS7 + $1 *PEP Default Address **$CD 00 00 01***
Format: Byte
Access: read / write
Value after HW reset: 0
Value after PEP SW initialization: Value of EEPROM

	7	6	5	4	3	2	1	0
CS7 + $1	*EN_IRQ7*	*EN_IRQ6*	*EN_IRQ5*	*EN_IRQ4*	*EN_IRQ3*	*EN_IRQ2*	*EN_IRQ1*	*SYSFAIL*

Register Description

Name	Value	Description
EN_IRQx	1	Enable VME IRQx where x = 1 to 7
SYSFAIL	1	Enable VME SYSFAIL IRQ autovector 3

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2.5 I/O Ports

2.5.1 Ethernet Port

The MC68EN360 is specified to support a full set of IEEE 802.3/Ethernet CSMA/CD media access control and channel interface functions. Since the 68EN360 requires an external interface adapter and transceiver function, the Ethernet port can be adapted to all standard Ethernet functions, such as 10BaseT, 10Base5 and 10Base2 via a piggyback connected to the SI Interface on the VM62(A) / VM42(A).

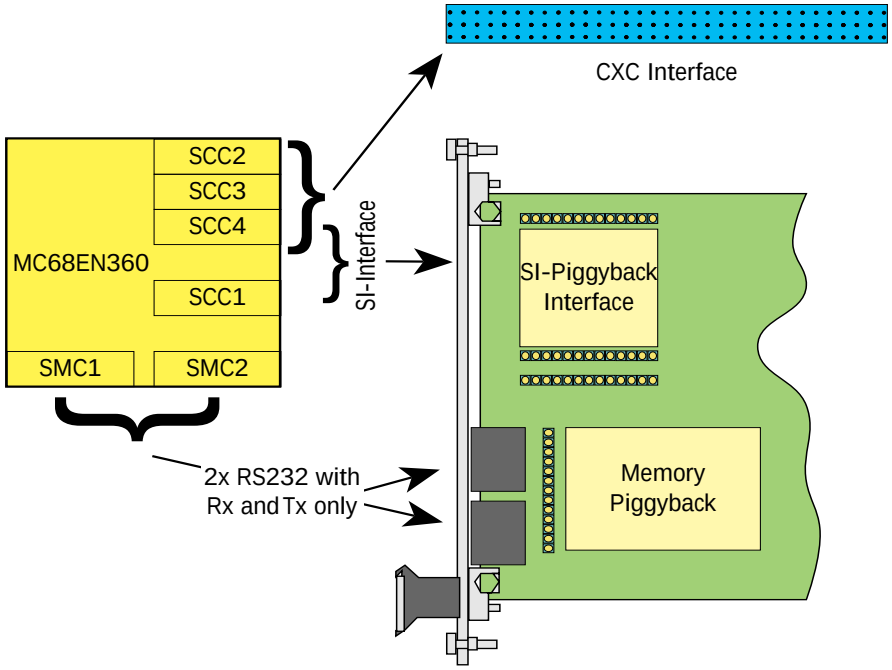
2.5.2 Serial Ports

The VM62(A) / VM42(A) provides 6 serial ports based on the 68EN360 communications processor. The ports can be configured in the following way:

- *2 * service / debug ports (SMC port / RxD / TxD only RS232);*
- *4 * full MODEM ports / multiprotocol channels (SCC ports).*

The service / debug ports are configured as default on the VM62(A) / VM42(A). These ports supply RxD/TxD RS232 Interfaces software handshake (XON/XOFF) capability. The full MODEM ports supply RxD, TxD, RTS, CTS, CD, DTR and RCLK/TCLK. Two of the full MODEM ports can be configured on the SI Interface with a variety of SI Modules (RS232/RS485, isolated/non-isolated and so on). Together with the two service/debug ports, a maximum of three (four) completely configured serial ports are available for the base board. Three (two) serial ports may be configured via the CXC where three of the four full MODEM Interfaces are routed.

Figure 2.5.2.1: MC68EN360 Intelligent Controller Schematic



Note

The serial channel SCC4 is routed to both the SI Interface and the CXC and can only be used by one or the other and not both at the same time.

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The Ethernet port can be configured via the SI Interface with 10BaseT, 10Base5 or 10Base2 SI Modules. The following configurations are therefore possible for the serial ports.

Versions with Ethernet Port

Port	68EN360 Resource	Configured via
Service/Debug 1	SMC1	Base board, upper RJ12
Service/Debug 2	SMC2	Base board, lower RJ12
Ethernet	SCC1	Base board, SI Module
Full MODEM 2	SCC2	CXC Module
Full MODEM 3	SCC3	CXC Module
Full MODEM 4	SCC4	CXC Module*

* The 10BaseX Modules do not make use of SCC4 and, therefore, can be used on the CXC.

Versions without Ethernet Port

Port	68EN360 Resource	Configured via
Service/Debug 1	SMC1	Base board, upper RJ12
Service/Debug 2	SMC2	Base board, lower RJ12
Full MODEM 1	SCC1	Base board, SI Module
Full MODEM 2	SCC2	CXC Module
Full MODEM 3	SCC3	CXC Module
Full MODEM 4	SCC4	Base board, SI Module or CXC Module*

* Can only be used once.

2.5.3 CXC Interface

The Controller Extension Connector (CXC) is a local mezzanine interface. The CXC contains a 16-bit data bus, 7 address lines and 8 decoded chip select lines. In total, there are 8 control signals. The base address of the CXC can be programmed via the CS5 line of the 68EN360. The 8 CXC chip selects (CXC_CS0 - CXC_CS7) occupy 256 Bytes each and have an address length of 400H (512 Bytes).

Furthermore, the CXC contains 4 IRQ capability (4 edge sensitive IRQs), DMA capability (1 channel, DREQ + DACK), serial ports (3 channels, Full MODEM) and a set of parallel port signals. These special CXC functions are based on the 68EN360 resources.

For general CXC information, including generic pinouts and a comparison of the 68(EN)360 and 68302 CPU pinouts on the CXC, please refer to the *CXC Specification User's Manual* and the *CXC Appendix* attached to this manual.

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Table 2.5.3.1: CXC Pinouts using the 68(EN)360

Pin	Row A Signals	Row B Signals	Row C Signals
1	PC0/_RTS1/L1ST1	PA8/CLK1/BRGO1/L1RCLKA/TIN1	PB6/SMTXD1/_DONE1
2	PC1/_RTS2/L1ST2	PA10/CLK3/BRGO2/L1TCLKA/TIN2	PB5/BRGO2/_DACK1
3	PC2/_RTS3/_L1RQB/L1ST3	GND	PB4/BRGO1/_DREQ1
4	PC3/_RTS4/_L1RQA/L1ST4	PA3/TXD2	PB11/SMRXD2/L1CLKOA
5	PB0/_SPISEL/_RRJCT1	PB13/_RTS2/L1ST2	PA14/CLK7/BRGO4/TIN4
6	PB1/SPICLK/_RSTRT2	GND	PA15/CLK8/_TOUT4/L1TCLKB
7	VCC	PB15/_RTS4/_L1RQA/L1ST4	VCC
8	PB2/SPIMOSI(SPITXD)/_RRJCT2	PC11/_CD4/_L1RSYNCA	PA7/TXD4/L1RXDA
9	PB3/SPIMISO(SPIRXD)/BRGO4	GND	PA6/RXD4/L1TXDA
10	PB8/_SMSYN1/_DREQ2	PA2/RXD2	PB7/SMRXD1/_DONE2
11	PB16/BRGO3/STRBO	PB10/SMTXD2/L1CLKOB	PC9/_CD3/_L1RSYNCB
12	PB9/_SMSYN2/_DACK2	GND	PB14/_RTS3/_L1RQB/L1ST3
13	PB17/_RSTRT1/STRBI	PC6/_CTS2	PC8/_CTS3/_L1TSYNCB/SDACK2
14	VCC	PC7/_CD2/_TGATE2	VCC
15	_CS-CXC (CS5 of 68360)	GND	PA12/CLK5/BRGO3/TIN3
16	_AS	PC10/_CTS4/_L1TSYNCA/_SDACK1	PA13/CLK6/_TOUT3/L1RCLKB/BRGCLK2
17	R/_W	_SYSR	PA5/TXD3/L1RXDB
18	_UDS	GND	PA4/RXD3/L1TXDB
19	_LDS	_EDTACK	VCC
20	VCC	16MHz CLOCK	_CXC-CS2
21	A1	GND	_CXC-CS3
22	A2	_CXC-CS0	_CXC-CS4
23	A3	_CXC-CS1	_CXC-CS5
24	A4	GND	_CXC-CS6
25	A5	A6	_CXC-CS7
26	VCC	A7	VCC
27	D0	GND	D10
28	D1	D6	D11
29	D2	D7	D12
30	D3	GND	D13
31	D4	D8	D14
32	D5	D9	D15

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CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
IRQ_1	a1	Yes	PC0	
IRQ_2	a2	Yes	PC1	
IRQ_3	a3	Yes	PC2	
IRQ_4	a4	Yes	PC3	

CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
DMA_ACK	c2	Yes	PB5	
DMA_REQ	c3	Yes	PB4	

CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
SER1_RCLK	b1	Yes	PA8	
SER1_TCLK	b2	Yes	PA10	
SER1_TXD	b4	Yes	PA3	
SER1_RXD	b10	Yes	PA2	
SER1_RTS	b5	Yes	PB13	
SER1_DTR	a13	Yes	PB17	
SER1_CTS	b13	Yes	PC6	
SER1_CD	b14	Yes	PC7	

CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
SER2_RCLK	c16	Yes	PA13	Cannot be used if J6 is set *See note 3*
SER2_TCLK	c15	Yes	PA12	
SER2_TXD	c17	Yes	PA5	
SER2_RXD	c18	Yes	PA4	
SER2_RTS	c12	Yes	PB14	
SER2_DTR	a11	Yes	PB16	
SER2_CTS	c13	Yes	PC8	
SER2_CD	c11	Yes	PC9	

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CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
SER3_RCLK	c6	Yes	PA15	Not usable if SI Module uses SCC4 *See note 4*
SER3_TCLK	c5	Yes	PA14	
SER3_TXD	c8	Yes	PA7	Not usable if SI Module uses SCC4 *See note 4*
SER3_RXD	c9	Yes	PA6	Not usable if SI Module uses SCC4 *See note 4*
SER3_RTS	b7	Yes	PB15	Not usable if SI Module uses SCC4 *See note 4*
SER3_DTR	a12	Yes	PB9	Not usable if SI Module uses SCC4 *See note 4*
SER3_CTS	b16	Yes	PC10	Not usable if SI Module uses SCC4 *See note 4*
SER3_CD	b8	Yes	PC11	Not usable if SI Module uses SCC4 *See note 4*

CXC Function	Pin Nr.	68302 HW Compatible	68(EN)360 Port	Comment
user defined	a5	No	PB0	Used on board SPI SEL for EEPROM. Cannot be used on CXC *See note 2*
	a6	No	PB1	SPI Clk: can be used if an 'SPI SEL' other than PB0 is used.
	a8	No	PB2	SPI TxD: can be used if an 'SPI SEL' other than PB0 is used.
	a9	No	PB3	SPI RxD: can be used if an 'SPI SEL' other than PB0 is used.
	a10	No	PB8	*See 68360 User Manual*
	b11	No	PB10	Used on board SMC2 (Transmit) *See note 1*
	c1	No	PB6	Used on board SMC1 (Transmit) *See note 1*
	c4	No	PB11	Used on board SMC2 (Receive) *See note 1*
	c10	No	PB7	Used on board SMC1 (Receive) *See note 1*

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Notes

Reserved Pins

1) On a standard VM62(A)/VM42(A) board, these signals are already used for UART ports at BU7 and BU8.

2) On a standard VM62(A)/VM42(A) board, these signals are used for SPI to which the EEPROM is already connected. PB0 is chip select of the EEPROM.

3) On PA13, a 24 MHz clock signal is routed via jumper J6. This signal is always needed for PEP standard software (serial drivers).

Dual Functioning Signal Pins

4) These signals are routed both to the base board SI Interface connector (ST5C) and the CXC connector and can only be used by one or the other and not both at the same time.

Due to this, a conflict exists if the SCC4 port is to be used with the SI232 piggyback and CXC boards (such as CXM-SIO3), as both boards access this port. The SCC4 port can, therefore, not be used at the same time by SI piggybacks and CXC boards.

The CXC ports SER1, SER2 and SER3 are equivalent to ports SCC2, SCC3 and SCC4 resp. on the 68xx360.

With regard to special CXC capabilities, the CXC pinout on the VM62(A) / VM42(A) has been developed to provide maximum compatibility between the standard CXC functions. In addition, all signals are available in order to configure 2 time division multiplexed channels via the CXC (ISDN, PCM, GCI and so on). Multi-function pins with incompatible functions with regard to the 68302 and 68EN360 (called *user defined* in the generic CXC specification) are not part of the VM42(A) / VM62(A) CXC specification.

Although the SMCs are configured on the base board, these ports are also integrated on the CXC. This is because of possible ISDN applications where SMCs can be integrated and other protocols supported by the 68EN360.

Note

*If the RCLK2 signal (CXM pin c16) is required, jumper J6 (24 MHz clock) must be **opened** and the serial drivers delivered by PEP modified.*

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Table 2.5.3.2: Further Explanation of 68(EN)360 Mnemonics

Group	Signal Name	Mneumonic	Function
SCC	Receive Data	RXD4-RXD1	Serial receive data input to the SCCs *(I)*
	Transmit Data	TXD4-TXD1	Serial transmit data output from the SCCs *(O)*
	Request to Send	_RTS4-_RTS1	Request to send outputs indicate that the SCC is ready to transmit data *(O)*
	Clear to Send	_CTS4-_CTS1	Clear to send inputs indicate to the SCC that data transmission may begin *(I)*
	Carrier Detect	_CD4-_CD1	Carrier detect inputs indicate that the SCC should begin reception of data *(I)*
	Receive Start	_RSTRT1	This output from SCC1 identifies the start of a receive frame. Can be used by an Ethernet CAM to perform address matching *(O)*
	Receive Reject	RRJCT1	This input to SCC1 allows a CAM to reject the current Ethernet frame after it determines the frame address did not match *(I)*
	Clocks	CLK8-CLK1	Input clocks to the SCCs, SMCs, SI, and the baud rate generators *(I)*
IDMA	DMA Request	_DREQ2-_DREQ1	A request (input) to an IDMA channel to start an IDMA transfer *(I)*
	DMA Acknowledge	_DACK2-_DACK1	An acknowledgement (output) by the IDMA that an IDMA transfer is in progress *(O)*
	DMA Done	_DONE2-_DONE1	A bidirectional signal that indicates the last IDMA transfer in a block of data *(I/O)*
TIMER	Timer Gate	_TGATE2-_TGATE1	An input to a timer that enables/disables the counting function *(I)*
	Timer Input	TIN4-TIN1	Time reference input to the timer that allows it to function as a counter *(I)*
	Timer Output	_TOUT4-_TOUT1	Output waveform (pulse or toggle) from the timer as a result of a reference value being reached *(O)*
SPI	SPI Master-In Slave-Out	SPIMISO	Serial data input to the SPI master *(I)*; serial data output from an SPI slave *(O)*
	SPI Master-Out Slave-In	SPIMOSI	Serial data output from the SPI master *(O)*; serial data input to an SPI slave *(I)*
	SPI Clock	SPICLK	Output clock from the SPI master *(O)*; input clock to the SPI slave *(I)*
	SPI Select	_SPISEL	SPI slave select input *(I)*
SMC	SMC Receive Data	SMRXD2-SMRXD1	Serial data input to the SMCs *(I)*
	SMC Transmit Data	SMTXD2-SMTXD1	Serial data output from the SMCs *(O)*
	SMC Sync	_SMSYN2-_SMSYN1	SMC syncronization signal *(I)*

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Group	Signal Name	Mneumonic	Function
SI	SI Receive Data	L1RXDA, L1RXDB	Serial input to the Time Division Multiplexed (TDM) channel A or channel B
	SI Transmit Data	L1TXDA, L1TXDB	Serial output from the TDM channel A or channel B
	SI Receive Clock	L1RCLKA, L1RCLKB	Input receive clock to TDM channel A or channel B
	SI Transmit Clock	L1TCLKA, L1TCLKB	Input transmit clock to TDM channel A or channel B
	SI Transmit Sync Signals	L1TSYNCA, L1TSYNCB	Input transmit data sync signal to TDM channel A or channel B
	SI Receive Sync Signals	L1RSYNCA, L1RSYNCB	Input receive data sync signal to TDM channel A or channel B
	IDL Interface Request	L1RQA, L1RQB	IDL interface request to transmit on the D channel. Output from the SI
	SI Output Clock	L1CLKOA, L1CLKOB	Output serial data rate clock. Can output a data rate clock when the input clock is 2x the data rate
	SI Data Strobes	L1ST4-L1ST1	Serial data strobe outputs can be used to gate clocks to external devices that do not have a biult-in Time Slot Assigner (TSA)
BRG	Baud Rate Generator Out 4-1	BRGO4-BRGO1	Baud rate generator output clock allows baud rate generator to be used externally
	BRG Input Clock	CLK2, CLK6	Baud rate generator input clock from which BRG will derive the baud rates
PIP	Port B 15-0	PB15-PB0	PIP Data I/O Pins
	Strobe Out	STRBO	This input causes the PIP output data to be placed on the PIP data pins
	Strobe In	STRBI	This input causes data on the PIP data pins to be latched by the PIP as input data
SDMA	SDMA Acknowledge 2-1	_SDACK2-_SDACK1	SDMA output signals used in RISC receiver to mark fields in the Ethernet receive frame

2.5.4 AutoBahn Interface

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2.6 Special Functions

2.6.1 Real-Time Clock

The RTC (V3021 3-wire serial interface) is a 1-bit device which is accessible over the CS6 of the 68EN360. Its timekeeping features include :-

- seconds, minutes, hours, day of month, month, year, week day and week number in BCD format.
- leap year and week number correction
- standby supply smaller than 1µA

See also the *Software Configuration* chapter in this manual and the *V3021* data sheet.

2.6.2 EEPROM

The serial EEPROM is a 1-bit device which is accessible over the SPI Interface (3-wire Interchip) of the 68EN360. The first half of the EEPROM (1 kbit) is reserved for factory data, including Board ID codes, Internet/Ethernet addresses, boot information etc. The second half of the EEPROM is available for the user. See also the *Software Configuration* chapter in this manual.

For more information on the EEPROM, please refer to the XICOR X25C02 data sheet.

2.6.3 TICK Generator

The 68EN360 internal Periodic Interrupt Timer is used by the PEP real-time operating system as TICK generator.

For more information please refer to the 68EN360 User's Manual.

2.6.4 On-board Bus Error Timer

The VM62(A) / VM62(A) provides an on-board bus error timer. An 8µs timeout timer monitors the cycle lengths of data transfers to and from locations beyond the bussizer, including on-board I/O, CXC, SRAM, AutoBahn and some VME. After a timeout occurs, it generates an on-board BERR signal for error termination. This timer is enabled/disabled via the board control/status register, which also supplies a timeout status bit in order to identify bus errors generated by the on-board bus error timer.

There are four cases of bus error.

Cause	Timeout	Enable / Disable possible
Reserved address *BERR0*	100ns	*None*
On-board *BERR1*	8µs	Yes, set in board control register
VME *BERR2*	128µs	Yes, set in VMEbus control register
Chip selects 68EN360	programmable	Yes, set in 68EN360 register

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Note

During VMEbus cycles, the on-board bus error timer is reset as soon as the VM62(A) / VM42(A) gains VMEbus ownership. This means that the time gap between a VMEbus request and the starting of the VMEbus cycle is monitored by the on-board BERR timer. VMEbus cycles themselves are monitored by the separate VMEbus BERR timer (BUS monitor).

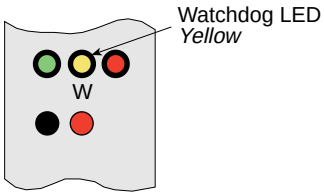
2.6.5 VME Bus Error Timer

The VM62(A) / VM42(A) also provides a bus monitor for the VMEbus. A 128µs timeout timer monitors VMEbus data transfer cycle lengths and generates a VMEbus BERR* signal for error termination. This timer is enabled/disabled via the VME control/status register which also supplies a timeout status bit in order to identify bus errors generated by the bus monitor.

2.6.6 Watchdog Timer

A 512ms watchdog timer triggers the on-board and VME system reset generator at timeout. Once enabled via the board control/status register, the watchdog timer cannot be reset by software. It must be re-triggered via the corresponding bit in the board control/status register periodically within the timeout period. 'Watchdog timer running' is a status that is displayed by the yellow front panel LED.

Figure 2.6.6.1: Watchdog LED Location



2.6.7 First Slot Detection (FSD)

The VM62(A)/VM62(A) detects during power-up whether the CPU in use is positioned in the far left slot of the system. This is achieved using a 100k pull-down resistor at the BG3IN* pin.

BG3IN low* = *system controller (far left slot)*
BG3IN high* = *no system controller*

This information can be read from the *VMEbus Control/Status register* and is valid until the next power down of the system.

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2.6.8 Board Control/Status Register

Address: CS7 + $7 *PEP Default Address* ***$CD 00 00 07***
Format: Byte
Access: read / write
Value after HW reset: 0

	7	6	5	4	3	2	1	0
CS7 + $7	*WDG*	*BERR2*	*BERR1*	*EN_WDG*	*TR_WDG*	*EN_BERR1*	*ACFAIL*	*LED_G*

Register Description

Name	Value	Access	Description
WDG *bit 7*		Read/Write	Set by watchdog timer when timout has been reached. Used to differentiate between resets caused by the watchdog and resets caused by the reset button (power up resets can be identified within the 68EN360)
BERR2 *bit 6*		Read/Write	Set by VMEbus BUS monitor when timeout has been reached. Used to identify BERR caused by this timer (*see also VMEbus Control/Status register*)
BERR1 *bit 5*		Read/Write	Set by on-board bus error timer when timeout has been reached. Used to identify BERR caused by this timer
EN_WDG *bit 4*	1	Read/Write	Enable the watchdog timer. It can only be set once, and remains enabled until the next reset
TR_WDG *bit 3*	1	Read/Write	Triggers the watchdog timer. Watchdog timeout = 512ms
EN_BERR1 *bit 2*	1	Read/Write	Enables the on-board bus error timer. It also monitors all on-board I/O cycles, including the time from the VMEbus request to the VMEbus grant. Timeout = 8µs
ACFAIL *bit 1*	1	Read/Write	VME ACFAIL signal latched when active in order to distinguish a level 7 NMI from an ABORT or ACFAIL
LED_G *bit 0*	1	Read/Write	Enables the green 'general purpose' front panel LED

Note

Information may be lost if the user writes to bit 7.

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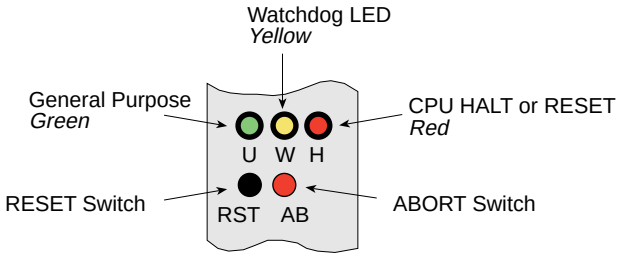
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2.6.9 Reset Sources

Reset Source	Identification
Push button	No
SYSRES* VME	No
Watchdog	WDG bit on-board (*Board Control/Status Register*)
Power monitor (4.65V)	Inside the 68EN360

2.7 Front Panel Functions

Figure 2.7.0.1: LED Port and Button Location



2.7.1 RESET Button

A RESET button is fitted to the front panel to avoid false operation. The RESET button triggers the on-board system reset generator, as well as the VME if jumper J2 is set.

2.7.2 ABORT Button

Together with the RESET button, an ABORT button is also fitted to the front panel. The ABORT button generates a level 7 IRQ (non-maskable interrupt) which is used for debugging purposes. In this case, bit 1 of the Board Control/Status Register is not set (remains '0').

2.7.3 LED Port

The front panel LED port consists of three LEDs with the following functions:

Red LED	*CPU in HALT or RESET status*
Yellow LED	*Watchdog timer running status*
Green LED	*General purpose, set via board control/status register*

The green LED is free to be used by the customer. It is set by the software during startup when the 68EN360 is initialized.

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2.8 Data Retention for RTC and SRAM

Short term data retention for RTC and SRAM is gained with two Gold-Caps, each with a value of 0.22 Farad. In contrast to Lithium cells, Gold-Caps do not require servicing. This short term backup is intended for short power failures or for reconfiguring systems. An empty Gold-Cap needs approximately three hours to charge up, with backup times dependant on the temperature, memory size and memory manufacturer tolerances. A well charged Gold-Cap provides a minimum of 10 hours backup time.

Laboratory tests at PEP indicate a typical backup time of 1 week for both 256kB and 1MByte SRAM plus RTC (typical onboard backup current is 2µA.

Long term data retention is made via the VMEbus 5V Stby line. With respect to the VM62(A) / VM42(A), this voltage can drop to 2.5V, with the typical current via the 5V Stby being 30µA at 3V.

Note

The VM42(A) / VM62(A) board can be removed from the system and then plugged in again without losing any information. Data retention switches from the VME 5V Stby to the on-board Gold-Caps automatically.

The on-board Gold-Caps are continuously reloaded via the 5V Stby line. The 5V Stby current is typically 7mA for a few minutes when the Gold-Caps are at the beginning of the loading phase (fully empty).

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2.9 Register Overview

VME Interrupt Mask Register (page 2-8)

Address: CS7 + $1 *PEP Default Address **$CD 00 00 01***
Format: Byte
Access: read / write
Value after HW reset: 0
Value after PEP SW initialization: Value of EEPROM

	7	6	5	4	3	2	1	0
CS7 + $1	*EN_IRQ7*	*EN_IRQ6*	*EN_IRQ5*	*EN_IRQ4*	*EN_IRQ3*	*EN_IRQ2*	*EN_IRQ1*	*SYSFAIL*

VMEbus Control / Status Register (page 2-6)

Address: CS7 + $5 *PEP Default Address **$CD 00 00 05***
Format: Byte
Access: read / write
Value after HW reset: *see table on page 2-6*

	7	6	5	4	3	2	1	0
CS7 + $5	*P_IRQ5*	*EN_DPR*	*EN_BERR2*	*FSD*	*BADR3*	*BADR2*	*BADR1*	*BADR0*

Board Control/Status Register (page 2-14)

Address: CS7 + $7 *PEP Default Address **$CD 00 00 07***
Format: Byte
Access: read / write
Value after HW reset: 0

	7	6	5	4	3	2	1	0
CS7 + $7	*WDG*	*BERR2*	*BERR1*	*EN_WDG*	*TR_WDG*	*EN_BERR1*	*ACFAIL*	*LED_G*

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3. CONFIGURATION

The VM62(A) / VM42(A) has twelve jumpers fitted to the board. The list of default jumper settings is shown below.

Table 3.0.0.1: VM62(A) / VM42(A) Default Jumper Settings

Jumper	Default Setting	Description
Wire		
J1	Set	SYSCLK connected to VME
J2	Set	On-board RESET generator to VME
J8	Open	Boot from VME disabled
J9	Open	Boot from MP memory interface disabled
Solder		
J3 J4 J5	Dependent on board	CPU frequency
J6	Set	Clock connected to 68EN360
J7	Dependent on board	CPU type
J10	Open	Write protection of EEPROM disabled
J11 J12	Dependent on board	SRAM size
J14	Open	Signal GND not connected to Protective GND
J131 - J134	Dependent on board	Processor power supply

Note

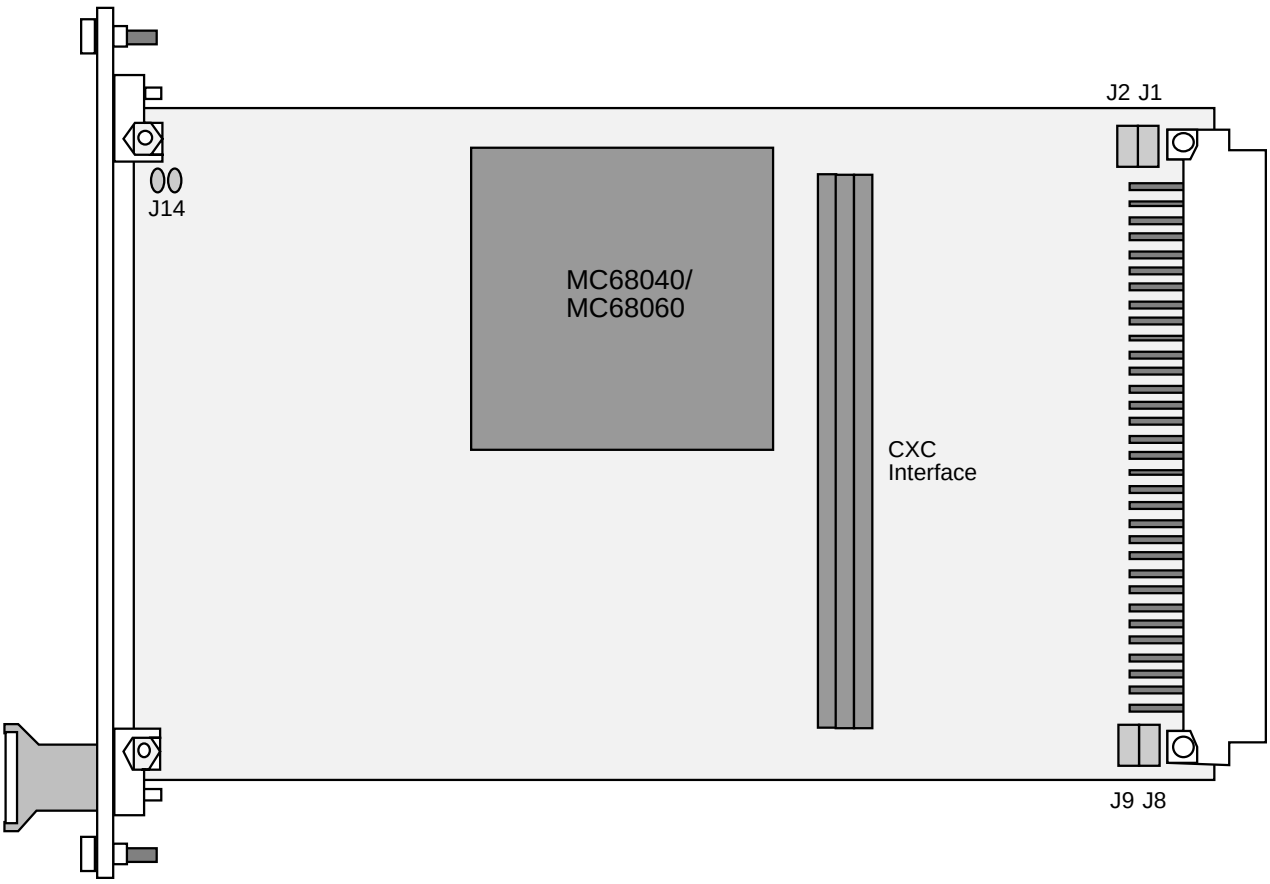
Jumpers J1, J2, J8 and J9 are normal wire jumpers that can be configured by the user. The other jumpers are solder jumpers and are factory set.

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3.1 Jumper Description (Component Side)

Figure 3.1.0.1: VM62(A) / VM42(A) Jumper Layout (Component Side)



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3.1.1 Jumper J1: VME-SYSCLK

Setting	Description
Set	*SYSCLK connected to VME* *Default*
Open	SYSCLK disconnected from VME

3.1.2 Jumper J2: VME-SYSRES

Setting	Description
Set	*On-board RESET generator to VME* *Default*
Open	On-board RESET disconnected from VME

3.1.3 Jumper J8: VME Boot (VBOOT)

Setting	Description
Set	Boot from VME enabled
Open	*Boot from VME disabled* *Default*

3.1.4 Jumper J9: AutoBahn Boot (ABOOT)

Setting	Description
Set	Boot from MP memory interface enabled
Open	*Boot from MP memory interface disabled* *Default*

3.1.5 Jumper J14: Connection of Protective and Signal GND

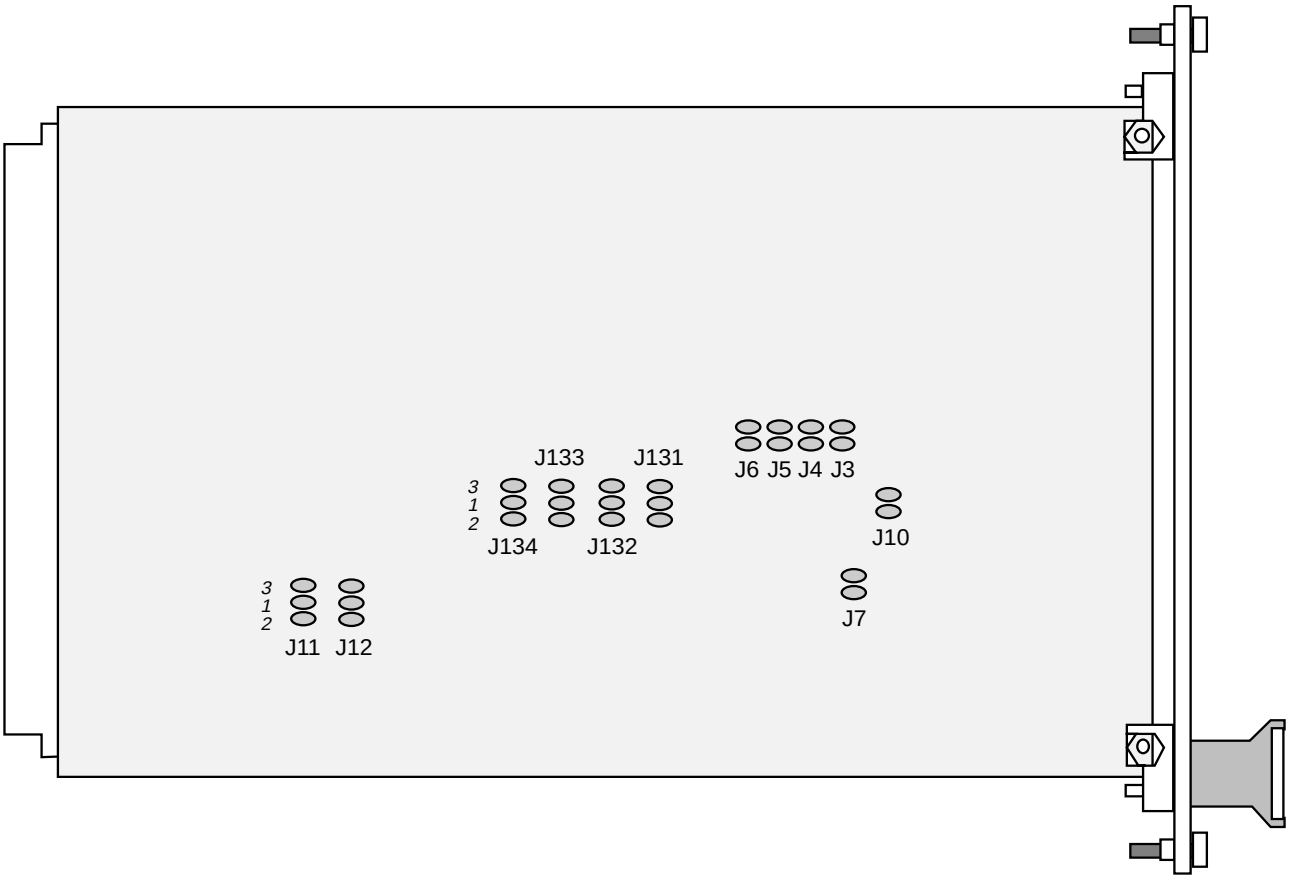
Setting	Description
Set	Signal GND connected to Protective GND ***Note:*** *Care must be taken to avoid grounding current if this jumper is set.*
Open	*Signal GND not connected to Protective GND* *Default*

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3.2 Jumper Description (Solder Side)

Figure 3.2.0.1: VM62(A) / VM42(A) Jumper Layout (Solder Side)



WARNING!

Solder jumpers are factory set and must not be altered by the user. Alteration of jumper settings can result in damage to the board (especially J131-134).

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3.2.1 Jumpers J3, J4 and J5: CPU (Bus) Clock

Setting J3	J4	J5	Description
Set	Set	Open	25 MHz
Open	Set	Open	33.3 MHz
Set	Open	Open	40 MHz

3.2.2 Jumper J6: 24 MHz Clock (Communications Clock)

Setting	Description	
Set	*Clock connected to 68EN360*	*Default*
Open	Clock not connected to 68EN360	

Note

*Jumper J6 must be **opened** if the RCLK2 signal (CXM pin c16) is required, as it is not compatible with PEP standard software.*

3.2.3 Jumper J7: CPU Type

Setting	Description
Set	68060 Processor
Open	68040 Processor

3.2.4 Jumper J10: Serial EEPROM Write Protection

Setting	Description	
Set	Write protection enabled	
Open	*Write protection disabled*	*Default*

3.2.5 Jumpers J11 and J12: SRAM Size

Setting J11	J12	Description
1-2	1-2	1 MByte
1-3	1-3	256 kByte

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3.2.6 Jumpers J131 - J134: Processor Power Supply

Setting J131 - J134	Description
1-2	5 Volt (68040 / 68LC040)
1-3	3.3 Volt (68040V / 68060)

WARNING!

Alteration of the settings of J131-J134 can result in damage to the board.

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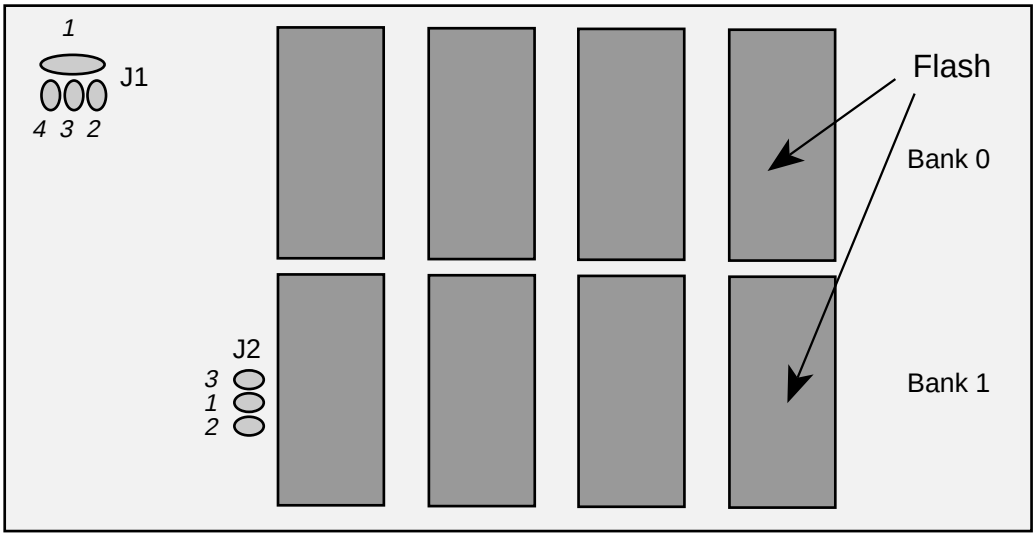
4. MEMORY PIGGYBACKS

4.1 DM600

4.1.1 Configuration

The DM600 is a memory piggyback fitted with 4MByte DRAM and either 1 or 4MByte Flash EPROM. Two configurable jumpers are present on the board, indicating if write protection is enabled or disabled and whether 1MBit or 4MBit Flash EPROM chips are fitted.

Figure 4.1.1.1: DM600 Jumper Layout (Component Side)



Jumper J1: FLASH Write Protection

Setting	Description	1 MB Flash (29F010)	4 MB Flash (29F040)
Open	All Flash EPROM write protected		
1-2	*No protection* *Default*		
1-3	Flash bank 1 write protected	upper 512 kB (*$40080000 - $40100000*)	upper 2 MB (*$40200000 - $40400000*)
1-4	Flash bank 0 write protected	lower 512 kB (*$40000000 - $40080000*)	lower 2 MB (*$40000000 - $40200000*)

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Jumper J2: Flash Chip Size

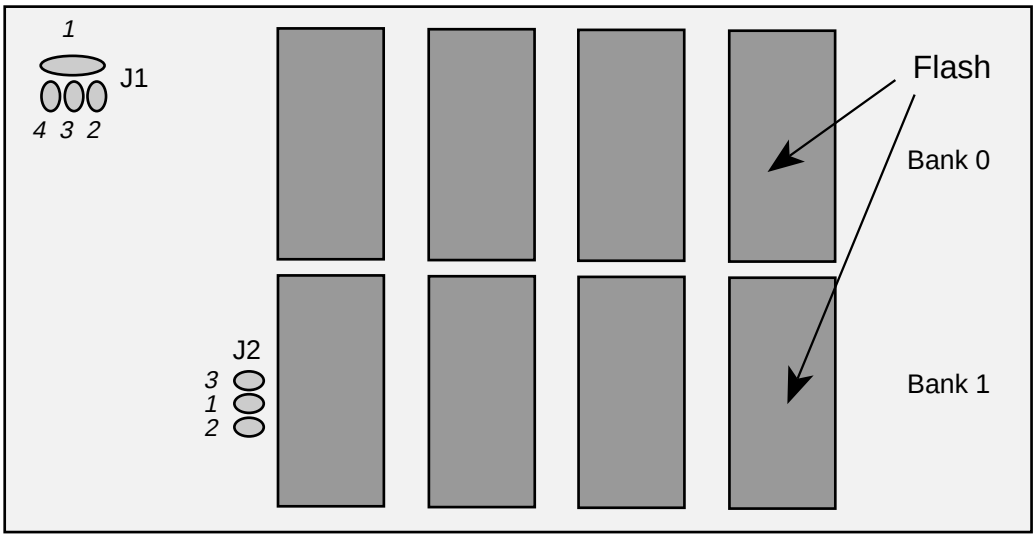
Setting	Description
1-2	4 Mbit Flash chips fitted
1-3	1 Mbit Flash chips fitted

4.2 DM601

4.2.1 Configuration

The DM601 is a memory piggyback fitted with 16MByte DRAM and either 1 or 4MByte Flash EPROM. Two configurable jumpers are present on the board, indicating if write protection is enabled or disabled and whether 1MBit or 4MBit Flash EPROM chips are fitted.

Figure 4.2.1.1: DM601 Jumper Layout (Component Side)



Jumper J1: Flash Write Protection

Setting	Description	1 MB Flash (29F010)	4 MB Flash (29F040)
Open	All Flash EPROM write protected		
1-2	*No protection* *Default*		
1-3	Flash bank 1 write protected	upper 512 kB (*$40080000 - $40100000*)	upper 2 MB (*$40200000 - $40400000*)
1-4	Flash bank 0 write protected	lower 512 kB (*$40000000 - $40080000*)	lower 2 MB (*$40000000 - $40200000*)

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Jumper J2: Flash Chip Size

Setting	Description
1-2	4 Mbit Flash chips fitted
1-3	1 Mbit Flash chips fitted

4.3 DM602

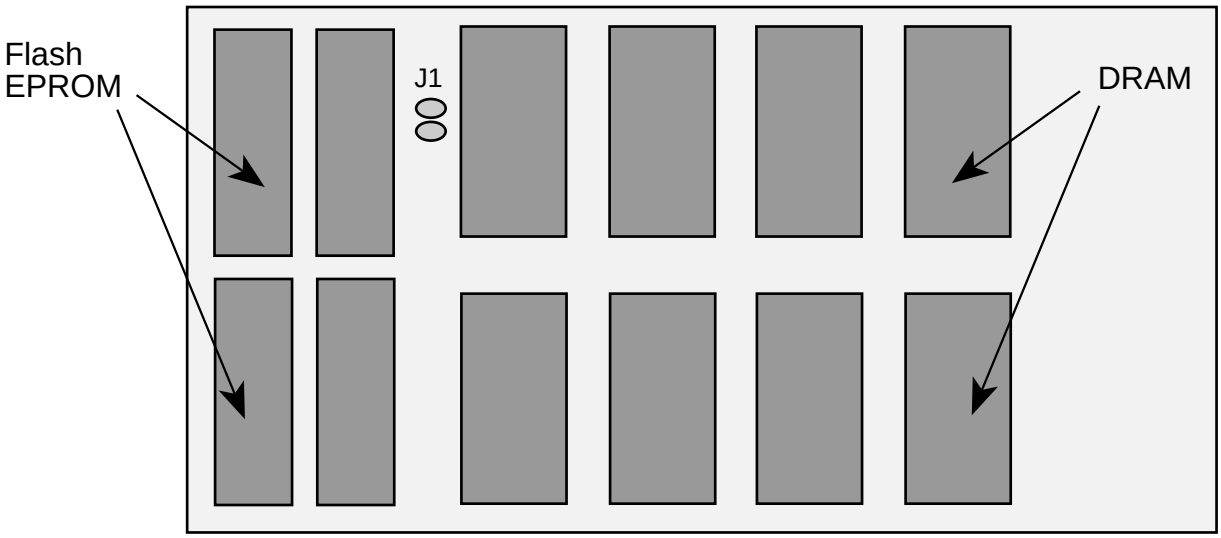
In preparation

4.4 DM603

4.4.1 Configuration

The DM603 is a memory piggyback fitted with 32MByte DRAM and 0.5MByte Flash EPROM. A version of the DM603 with 2MByte Flash EPROM fitted will soon be available. One configurable jumper is located on the board, indicating whether the Flash EPROMs are write protected.

Figure 4.4.1.1: DM603 Jumper Layout (Component Side)



Jumper J1: Flash Write Protection

Setting	Description	
Open	All Flash EPROM write protected	
Set	*No protection*	*Default*

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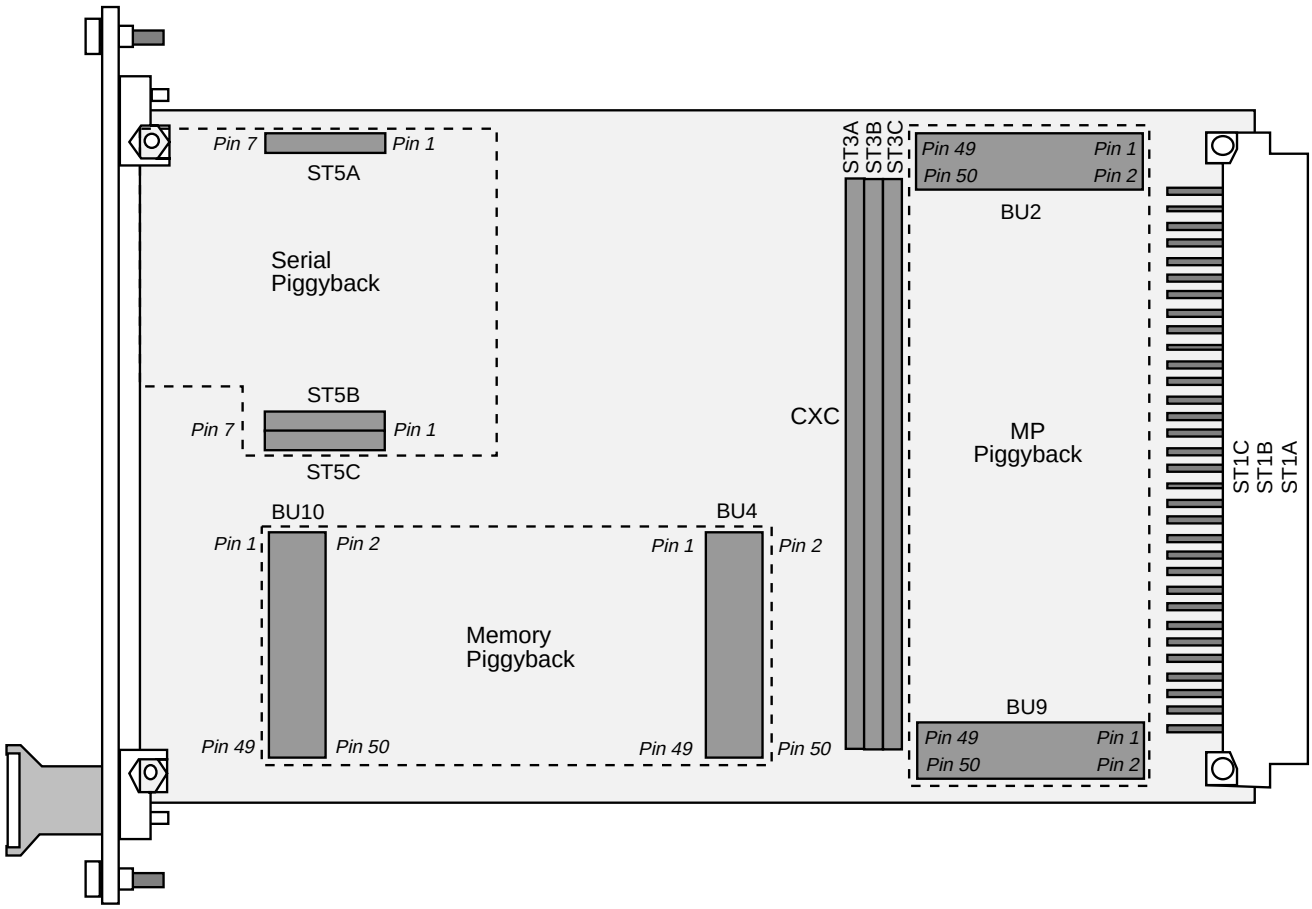
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5. PINOUTS

5.1 Main Board

Figure 5.1.0.1: Main Board Connector Overview



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5.1.1 VMEbus Connector (ST1)

Pin Nr.	Row A Signal	Row B Signal	Row C Signal
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL*	D10
4	D03	BG0IN*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1*	BR0*	SYSRESET*
13	DS0*	BR1*	LWORD*
14	WRITE*	BR2*	AM5
15	GND	BR3*	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN*	SERA	A17
22	IACKOUT*	SERB	A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A09
30	A01	IRQ1*	A08
31	-12V	+5VSTDBY	+12V
32	+5V	+5V	+5V

* *Active signal low*

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5.1.2 CXC Connector (ST3)

For CXC connector pinouts, please refer to the CXC Appendix.

5.2 Front Panel

The front panel connectors are dependent on which interface piggyback is mounted. They are:

Standard Connectors

- *2 * RS232 serial interfaces (BU7 and BU8).*
  A front panel is available with only the above standard RS232 connectors fitted (SI-DUMMY)

Piggyback Options

- *Ethernet 10Base2 (SI-10B2);*
- *Ethernet AUI / 10Base5 (SI-10B5);*
- *Ethernet 10BaseT (SI-10BT);*
- *2 * RS232 serial interfaces (SI-PB232);*
- *PROFIBUS interface (SI-PBPRO).*

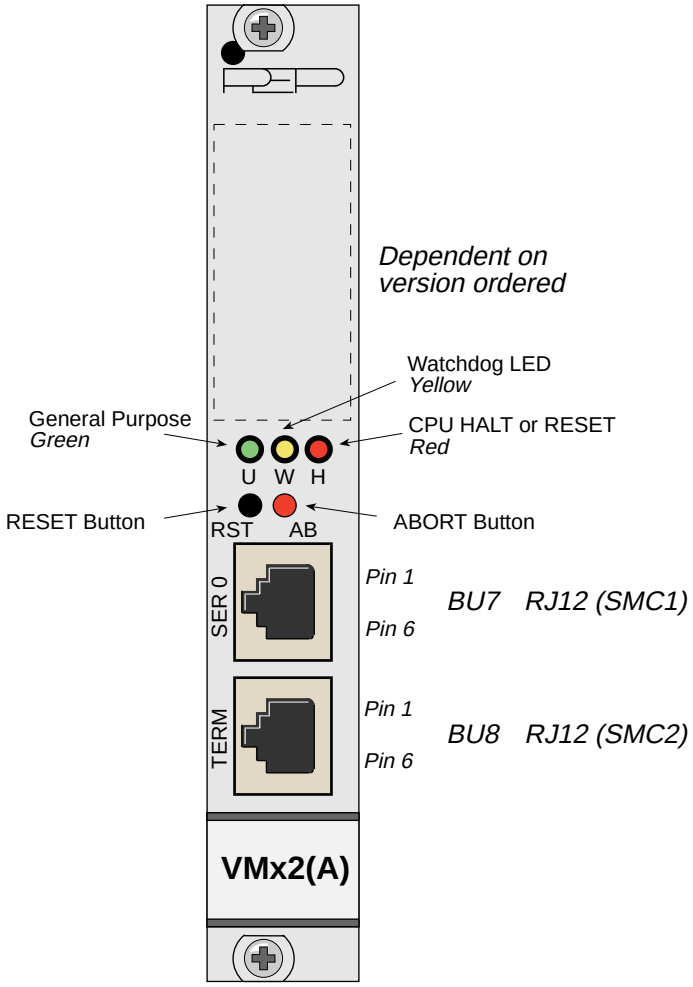
Each option is described in the following Sections.

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5.2.1 Standard RS232 Connectors

Figure 5.2.1.1: Standard Front Panel Pinouts



6-pin RJ12 RS232 Serial Interface Connectors (BU7 and BU8)

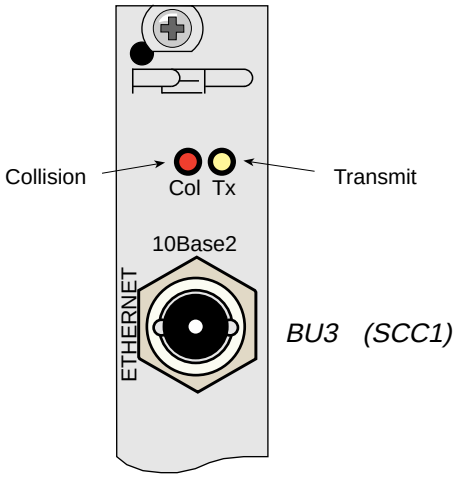
Pin Nr.	Signal
1	*Not Connected*
2	GND
3	TxD
4	RxD
5	*Not Connected*
6	*Not Connected*

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5.2.2 Ethernet 10Base2 (SI-10B2) *SITB2 on board*

Figure 5.2.2.1: SI-10B2 Front Panel Pinouts

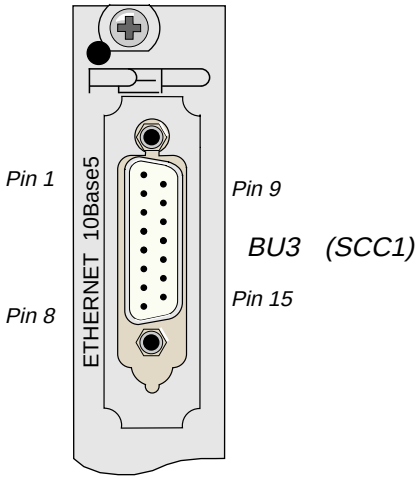


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5.2.3 Ethernet AUI / 10Base5 (SI-10B5) *SITB5 on board*

Figure 5.2.3.1: SI-10B5 Front Panel Pinouts



15-pin D-Sub Ethernet AIU / 10Base5 Connector (BU3)

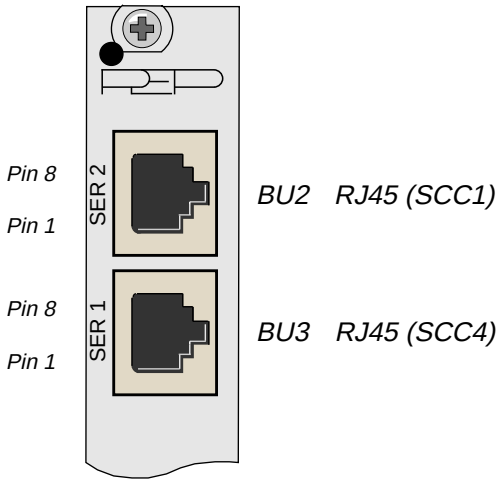
Pin Nr.	Signal
1	Control In circuit Shield
2	Control In circuit A
3	Data Out circuit A
4	Data In circuit Shield
5	Data In circuit A
6	Voltage Common
7	*Not Connected*
8	*Not Connected*
9	Control In circuit Shield
10	Data Out circuit B
11	Data Out circuit Shield
12	Data In circuit B
13	+12 Volts
14	GND
15	*Not Connected*

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5.2.4 Serial RS232 Interface (SI-PB232) *SI232 on board*

Figure 5.2.4.1: SI-PB232 Front Panel Pinouts



8-pin RJ45 Serial Interface Connectors (BU2 and BU3)

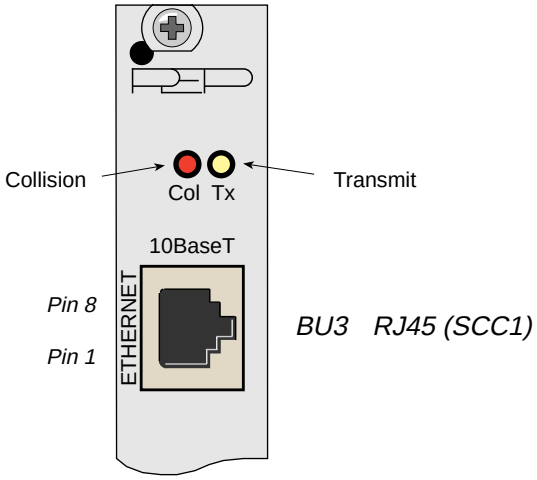
Pin Nr.	Signal
1	DSR
2	RTS
3	GND
4	TXD
5	RXD
6	DCD
7	CTS
8	DTR

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5.2.5 Ethernet 10BaseT (SI-10BT) *SITBT on board*

Figure 5.2.5.1: SI-10BT Front Panel Pinouts



8-pin RJ45 Serial Interface Connector (BU3)

Pin Nr.	Signal
1	TD+
2	TD-
3	RD+
4	*Not Connected*
5	*Not Connected*
6	RD-
7	*Not Connected*
8	*Not Connected*

Configuration

The SI-10BT piggyback has one configurable jumper that sets the shielding of the board. The jumper settings are shown below.

Jumper J1: Shielding

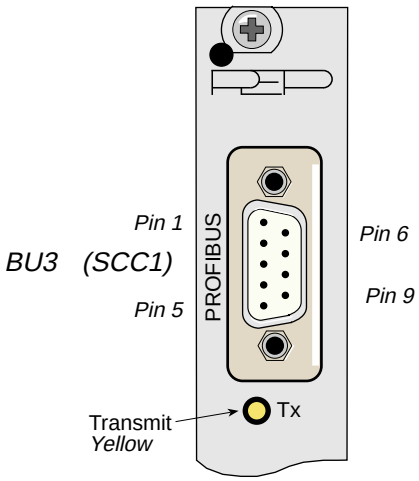
Setting	Description
1-2	*Shielded* *Default*
1-3	Not Shielded

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5.2.6 PROFIBUS Interface (SI-PBPRO) *SIPRO on board*

Figure 5.2.6.1: SI-PBPRO Front Panel Pinouts



9-pin D-Sub PROFIBUS Connector (BU3)

Pin Nr.	Signal	Description
1	SHIELD	Shield, Protective Ground resp.
2	RP	Reserved for power
3	RxD+/TxD+	Receive/Transmit Data +
4	CNTR+	Control +
5	DGND	Data Ground
6	VP	Voltage Plus
7	RP	Reserved for power
8	RxD-/TxD-	Receive/Transmit -
9	CNTR-	Control -

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6. SOFTWARE CONFIGURATION

6.1 Initializing the 68EN360

Many components of the VM62(A) / VM42(A) are controlled by the MC68EN360. Due to this fact, this chip requires a special initialization sequence before any other software can be started.

The following list describes how the initialization must be performed on the VM62(A) / VM42(A).

WARNING!

The order of the initialization listed below must not be changed, otherwise erratic behaviour of the board may result.

1) Set DPRBASE to 0x000000 ***0x7000001.L -> MBAR*** (in CPU space!)

Example

```
move.l      #7,d1          select CPU space
move.l      #$7000001,d0   value to write to MBAR
movec       d1,dfc         select CPU space
moves.l     d0,MBAR        set MBAR
```

2) Clear reset status register ***0xFF.B -> RSR***

3) Set system protection register
   - bus monitor enabled, 128 system clocks timeout ***0x7.B -> SYPCR***

4) Set module configuration register
   - bus request MC68040 arbitration ID: 3
   - arbitration synchronous timing mode
   - bus clear out arbitration ID: 3
   - SIM60 registers are Supervisor Data
   - BusClear in arbitration ID: 3
   - interrupt arbitration: 3 ***0x60008CB3.L -> MCR***

5) Set PLL enabled and lock access ***0xC000.W -> PLLCR***

6) Lock access to clock divider control register ***0x8000.W -> CDVCR***

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7) Configure CLK lines
   - COM2 to full strength
   - COM1 disabled
   - register access locked — ***0x83.B -> CLKOCR***

8) Configure PEPAR register
   - set /IOUT0-2 are PRTY0-2
   - select /RAS1DD function
   - select /WE0-3
   - select AMUX
   - select /CAS0-3 — ***0x51C0.W -> PEPAR***

9) Configure GMR register
   - set refresh counter period to 24
   - set refresh cycle length to 3
   - set DRAM port size to 32 bit
   - assert CS/RAS on CPU space
   - enable refresh — ***0x18800100.L -> GMR***

10) Configure autovector register
   - enable autovector on levels 2, 3, 5 and 7 — ***0xAC.B -> AVR***

11) Configure chip select lines
   - CS0: FLASH to 0x4000000, negate timing '040 — ***0x4000011.L -> BR0***
   - CS0: size to 16 MByte, port size 32 bit, tcyc 3 — ***0x3F000000.L -> OR0***
   - CS1: DRAM to 0x0, burst acknowledge '040 — ***0x21.L -> BR1***
   - CS1: size to 16 MByte, port size 32 bit, tcyc 0, bcyc 1 — ***0xF000001.L -> OR1***
   - CS2: DMA - VME to 0x87000000 — ***0x87000001.L -> BR2***
   - CS2: size to 16 MByte, port size external, tcyc 1 — ***0x1F000006.L -> OR2***
   - CS3: AutoBahn to 0x9000000 — ***0x9000001.L -> BR3***
   - CS3: size to 16 MByte, port size external, tcyc 1 — ***0x1F000006.L -> OR3***
   - CS4: SRAM to 0xA000000 — ***0xA000001.L -> BR4***
   - CS4: size to 16 MByte, port size external, tcyc 1 — ***0x1F000006.L -> OR4***
   - CS5: CXC to 0xBF70000 — ***0xBF70000.L -> BR5***
   - CS5: size to 8 kByte, port size external, tcyc 1 — ***0x1FFFE006.L -> OR5***
   - CS6: RTC to 0xC000000 — ***0xC000001.L -> BR6***
   - CS6: size to 2 kByte, port size external, tcyc 1 — ***0x1FFFF806.L -> OR6***
   - CS7: on-board control to 0xD000000 — ***0xD000001.L -> BR7***
   - CS7: size to 16 MByte, port size external, tcyc 1 — ***0x1F000006.L -> OR7***

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12) The system software normally determines the real sizes of the DRAM and SRAM installed and re-programs the CS lines accordingly. The simplest way to achieve this is to write a pattern to the first location and then search for that pattern at meaningful distances (e.g. 256kB, 512 kB, 1 MB, 2 MB, 4 MB, 8 MB, 16 MB). If the pattern is found at such an address, the original pattern must be altered and then checked to see if the mirrored pattern changes in the same way. If not, the search must be contined or, if yes, the memory size is found.

Note

The MC68040 normally operates in non-serialised mode, meaning that read accesses can occur before write accesses, even if they are programmed in the opposite way. It is therefore recommended that especially when changing the patterns, a 'nop' instruction should be inserted, as this forces all pending cycles to be completed.

13) Set vector and IRQ level for internal IRQ requester
- vector base = 0x40
- level = 4 ***0x8040.L -> CICR***

14) Set SDMA configuration register ***0x770.W -> SDCR***

15) If the card is in the first slot, enable the VMEbus monitor
If bit 4 in VCSR is set then set bit 5 in VCSR

16) Enable on-board I/O bus error timer ***Set bit 2 in BCSR***

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Address List of Involved Registers

MBAR	0x3FF00	(CPU space!)
RSR	0xC0001009	
SYPCR	0xC0001022	
MCR	0xC0001000	
PLLCR	0xC0001010	
CDVCR	0xC0001014	
CLKOCR	0xC000100C	
PEPAR	0xC0001016	
GMR	0xC0001040	
AVR	0xC0001008	
BR0	0xC0001050	
OR0	0xC0001054	
BR1	0xC0001060	
OR1	0xC0001064	
BR2	0xC0001070	
OR2	0xC0001074	
BR3	0xC0001080	
OR3	0xC0001084	
BR4	0xC0001090	
OR4	0xC0001094	
BR5	0xC00010A0	
OR5	0xC00010A4	
BR6	0xC00010B0	
OR6	0xC00010B4	
BR7	0xC00010C0	
OR7	0xC00010C4	
CICR	0xC0001540	
SDCR	0xC000151E	
VCSR	0xCD000005	
BCSR	0xCD000007	

6.2 Initialising the Cache

Before the system enables any cache present, they should be invalidated using:

```
cinva bc
```

Furthermore, the complete address range should not be cachable, as caching only makes sense on DRAM and FLASH EPROM. Other areas should **never** be cached and must be switched to serialised in order to prevent the MC68040/MC68060 from mixing up read and write cycles.

The easiest way of doing this is to make use of the DTT0 register, in the following way:

```
move.l          #$807FE040,d1
movec           d1,dtt0
```

The code above sets all addresses below $80000000 to cacheable and non-serialised, whereas all addresses above are set to non-cacheable and serialised.

Accesses to the DRAM and FLASH should be made at $0 and $4000000. All other components addressed by the MC68EN360 should always be accessed over the mirrored area with $Cxxxxxxx, as described in Section 2.2.5 *Address Map*.

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