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EUROCOM-27

Dual 68060 CPU Board with Graphics

Hardware Manual

Revision 1 A

Rev.	Changes	Date
1 A	First Edition valid for EUROCOM-27 Hardware Revision 1.A	31.01.95, T.K.

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ELTEC Elektronik AG
Galileo-Galilei-Str. 11 Postfach 42 13 63
D-55129 Mainz D-55071 Mainz

Telephone +49 (61 31) 9 18-0
Telefax +49 (61 31) 9 18-1 99

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Scope of Delivery

Description:		Order No.:
EUROCOM-27	Single 68060, 50 MHz, VME-32 SCSI, Ethernet, Graphics, 32 MB	V-E27.-A139
EUROCOM-27	Single 68060, 50 MHz, VME-32 SCSI, Ethernet, Graphics, 8 MB	V-E27.-A113
EUROCOM-27	Double 68060, 50 MHz, VME-32 SCSI, Ethernet, Graphics, 32 MB	V-E27.-A239

Options

Description:		Order No.:
VIC-64	instead of VIC-32	V-E17.-Z001

The last letter of the order numbers refers to the hardware revision and is subject to changes. Please contact ELTEC for information about valid order numbers.

Example: *V-E16.-B105*

Revision number, subject to change!

Related Products

Description:		Order No.:
Documentation:	Hardware Manual EUROCOM-27	**V-E27.-A990**
	Service Manual EUROCOM-27 including: Software Manual RMon (W-FIRM-A209) Hardware Manual CONV-300 (V-CONV-A993) LEB Specification (V-LEB.-A990) IOC-2 Data Sheet (V-DTBT-A924) MK48T02/12 (V-DTBT-A907) Z8536 (V-DTBT-A908) VIC068 (V-DTBT-B914) NCR53C720 (V-DTBT-A926) CL-CD2401 (V-DTBT-A923) ILACC AM79C900 (V-DTBT-A925) BT445 (V-DTBT-A933)	**V-E27.-A991**
Hardware:	ADAP: to adapt signals on P2 to SCSI (8-bit) and I/O signals	**V-ADAP-A200**
	ADAP: to connect AT-keyboard to PS/2 compatible connector	**V-ADAP-A210**
	ADAP: to adapt signals on P2 to SCSI (16-bit) and I/O signals	**V-ADAP-A220**
	CONV: converts I/O signals to 3 * RS 232 and parallel (TTL) or centronics, incl. 50-pin ribbon cable	**V-CONV-B300**
	CONV: Cheapernet/10BaseT MAU	**V-CONV-A500**
	RS 232 SILC	**V-SILC-E200**
	RS 422 SILC	**V-SILC-B300**
	RS 485 SILC	**V-SILC-A400**
	Cable (V.24 for terminal)	**V-CABL-A144**

The last letter of the order numbers refers to the hardware revision and is subject to changes. Please contact ELTEC for information about valid order numbers.

Example: *V-E16.-B105*

Revision number, subject to change!

Conventions

If not otherwise specified, addresses are written in hexadecimal notation and identified by a leading dollar sign ("$").

Signal names preceded by a slash ("/"), indicate that this signal is either active low or that this signal becomes active with the trailing edge.

b bit
B byte
K kilo, means the factor 400 in hex (1024 decimal)
M mega, the multiplication with 100 000 in hex (1 048576 decimal)
MHz 1 000 000 Hertz

Board-specific abbreviations:

ASR	Address Substitution Register
AUI	Attachment Unit Interface
BLT	Block Transfer
BTO	Bus Time-out
CAS2	Compare and Swap 2 Instruction
CLUT	Color Look-up Table
CPU	Central Processing Unit
CPU2CON	Secondary CPU Control Register
CSR	Control/Status Register
CTS	Clear to Send
DAC	Digital to Analog Converter
DMA	Direct Memory Access
DTE	Data Terminal Equipment
ESR	Enable Slave Register
FIFO	First In First Out
IACK	Interrupt Acknowledge
ICF	Interprocessor Communication Facility
ICGS	Interprocessor Communication Global Switches
ICMS	Interprocessor Communication Module Switches
ILACC	Integrated Local Area Communications Controller
IOC-2	I/O Controller Asic
LAN	Local Area Network
LEB	Local Extension Bus
LIRQ	Local Interrupt Request
MAU	Medium Attachment Unit
MBAR	Memory Base Address Register

MBLT	Multiplexed Block Transfer
MPC	Multi-Protocol Controller
PCB	Printed Circuit Board
PLL	Phase Locked Loop
RAM	Random Access Memory
RBF	Receive Buffer Full
RMC	Read-Modify-Write Cycle
RTC	Real-time Clock
RTS	Request to Send
SBR	Slave Base Address Register
SCSI	Small Computer Systems Interface
SCR	System Control Register
SILC	Serial Interface Level Converter
SRAM	Static RAM
SMR	Slave Mask Register
TBE	Transmit Buffer Empty
TTL	Transistor Transistor Logic
VIC	VMEbus Interface Chip
VRAM	Video RAM
VTG	Video Timing Generator
UAT	Unaligned Transfer

How to Use this Manual

Document Structure

This manual is divided into the following chapters:

Chapter 1 Specification contains a list of distinguishing features, a block diagram with a general description, a description of the main building blocks and the board parameters.

Chapter 2 Installation describes the requirements and the step-by-step installation. A table shows the default settings of jumpers and switches followed by a detailed description of adjustable functions.

Chapter 3 Programmer Reference shows the address map and describes the address ranges in detail. Special functions are also described in this chapter.

The **Appendix** contains references to additional literature, an index, and a glossary and necessary extracts of data sheets.

Document Conventions

Font Types:

Font	Use
Helvetica, 8 Pt	Tables and drawings
Helvetica, 10 Pt	Signal names, formulars
Times, italic	*Notes*
`Courier, bold`	`Program code, function names, commands`
Times, bold	**Emphasized text, e.g. headlines**

Other Conventions:

Indicates information that requires close attention.

Indicates critical information that is essential to read.

Indicates information that is imperative to read. Skipping this material, possibly causes damage to the system.

1 Specification

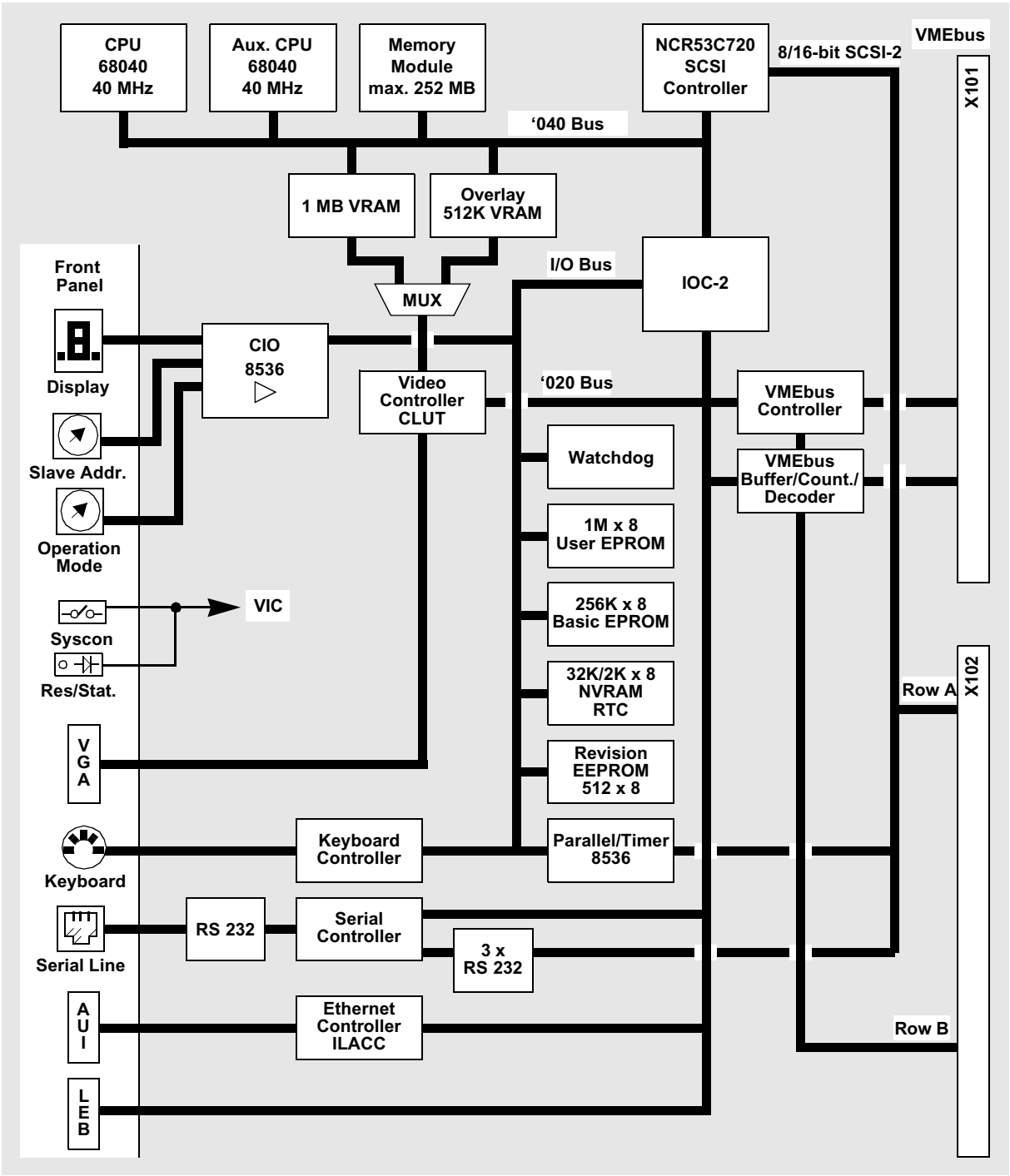
1.1 Distinguishing Features

- One or two close-coupled 68040 CPUs at 25 MHz, 33 MHz or 40 MHz
- Memory
  - Memory module (2, 8, 16, 32, 64 MB) with up to 252 MB RAM for data/program storage (79 MB/s)
  - 2 KB SRAM and RTC for storage of variable system parameters MK48T12 (MK48T18, DS1644)
  - Up to 1 MB user EPROM
  - 256 (512) KB basic EPROM for firmware, on-board programmable
  - 1 MB VRAM with 32-bit parallel CPU bus port
  - 512 KB overlay VRAM
- High resolution graphics interface for MGR, X-WINDOWS and CAD / CAM applications
  - Max. resolution 1152 x 900, 66 Hz (SUN-like)
  - Max. dotclock frequency 120 MHz
  - 256 simultaneously displayable colors out of 2^{24}
  - 4-bit overlay
  - Soft selectable video parameters like dotclock, frame resolution, video timing, sync polarity
  - Vertical and horizontal screen panning
  - Interlaced or non-interlaced RS-343A compatible video signal
  - 4-bit TTL outputs for flat displays
- Ethernet interface (32-bit ILACC)
- VMEbus Interface Controller:
  - System controller and arbiter
  - VMEbus interrupter and interrupt handler
  - 32-bit BLT 20 MB/s
  - Master / slave write posting
  - 64-bit MBLT 35 MB/s (VIC064 only)

- IOC-2 gate array:
  - 68040 to 68020 bus converter
  - Dynamic bus sizing for VMEbus and LEB
  - Translation of BLT into bursts on '040 bus to allow snooping of BLT cycles
  - Separate arbitration on '040 and '020 bus
  - I/O bus interface
  - Support for VMEbus UATs to allow snooping
  - Interface for a single bytewide EPROM
- Parallel I/O or Centronics port
- Six 16-bit timer / counter
- Four serial ports (RS 232, RS 422, RS 485)
- Smart SCSI-2 (NCR 53C720) interface with burst capability (max. transfer capacity 20 MB/s) and single-ended 8/16-bit SCSI data bus
- Two rotary switches on front panel for selection of operation modes and base address
- Status display on front panel
- IBM keyboard interface
- Watchdog timer with watchdog indicator on front panel
- LEB

1.2 General Description

Figure 1: Block Diagram



The EUROCOM-17-5xx is a highly integrated high-performance single-board VMEbus computer with graphics display. It is designed to offer as many features as possible on a single slot VMEbus board. Suitable intelligent or high integrated components are used to achieve this density of computing power.

There are two on-board 68040 CPUs, each clocked at 25, 33 or 40 MHz. On-chip caches for program and data (4 KB capacity each) and the on-chip floating-point units allow 35 MIPS/ 5.6 MFLOPS for each CPU.

Additionally, backward compatibility with existing 68000-family software is guaranteed. Due to the on-chip caches, neither of the CPUs makes full use of the available bus bandwidth. Thus, parallelizing two CPUs (closely coupled) puts only a small burden (15%) on processing speed for most programs.

The main memory is placed on a separate memory module. This easily allows to expand the memory up to 252 MB without making any changes necessary at the CPU board. The available memory modules supply different memory resources such as up to 64 MB DRAM, 4 MB Flash EPROM and up to 2 MB battery backed SRAM. The main memory can directly be accessed via the 32-bit processor bus.

The main memory is organized in two banks of interleaved DRAM. Therefore, burst mode transfers allow 70 MB/s on reads. Due to a buffered write mechanism, the transfer rate for writes is even bigger (79 MB/s). This is useful during cache flushes where the CPU may write large amounts of data.

The major drawback of the 68040 is the deletion of dynamic bus sizing. This requires 68020/30 applications to be modified if they access word devices with longword instructions. The longword accesses have to be split by software into two word accesses which slows down the performance. Instead of this, the IOC-2 hardware generates the needed bus cycles if the addressed device acknowledges a smaller data size than the CPU requested.

One of the main design goals of the EUROCOM-17-5xx is efficient use of the CPU's high speed bus. Thus, the following design rules are established:

- Use of intelligent peripheral devices which are able to perform tasks independent from the main CPU (NCR 53C720, CL-CD2401, ILACC).
- Independent 68020-like bus for VMEbus, Ethernet or LEB with separate arbitration.
- Minimum interference between CPU bus, ‘020 bus and I/O bus.
- Decoupling of VMEbus and CPU bus via FIFO for BLT.

On traditional designs there could only be one bus master on the whole board at a time. For example, if a BLT was in progress, the CPU was blocked for the duration of the BLT. At the EUROCOM-17-5xx the CPU bus is decoupled from the I/O bus.

The display hardware is capable of displaying up to 1152 * 900 pixels at a rate of 66 Hz, non-interlaced, at a dotclock of 100 MHz. Smaller monitors with 1024 * 768 or 640 * 480 non-interlaced are also supported. Every pixel is 1/2/4/8/15/16 bits wide. A color look-up table allows a selection of 256 simultaneously displayable colors out of a palette of 16 million. The use of video memories (VRAMs) allows immediate access to the frame buffer, virtually independent of ongoing display activities.

An additional 512 KB VRAM is implemented on the board to realize a 4-bit graphics overlay. To use the 4-bit graphics overlay, pixel width must be programmed to 8 bits.

In order to enhance system security, the EUROCOM-17-5xx incorporates a watchdog timer. It must be retriggered periodically, otherwise the watchdog generates a reset. After watchdog reset, the watchdog reset LED on the front panel signals this condition. The watchdog indicator is cleared only by power-on reset or by triggering the watchdog.

Four serial ports are located on the EUROCOM-17-5xx. One, using a 6-pin shielded RJ11 jack on the front panel, is intended for connection of a terminal or a mouse. The other three are fed to row A and C of the VMEbus P2 connector (X102). They can be connected via ADAP-220/200 and CONV-300 to three 9-pin Sub-D connectors. Two of the serial lines can be configured to support either RS 232 or RS 422/485 standard via SILCs (Serial Interface Level Converters).

Twelve parallel I/O-lines (X102) can be used either as centronics printer port or as TTL-level interface (CONV-300).

The integrated real-time clock allows the operating system to provide date and time for revision control. The clock is powered by an internal lithium battery. 2 (8, 32) KB of battery-backed RAM are used for storage of system dependent parameters.

An AT-compatible keyboard input (using a 6-pin PS/2 compatible connector) along with the graphics output provides a PC-type user interface.

Status display, reset switch, and two hex-code switches are located on the front panel. The status display indicates the condition of the processor and watchdog status. The hexadecimal display is an error status display. The hex-code switches (software readable) are used by the firmware to set up the operating mode and the VMEbus base address of the board.

The VMEbus interface of the EUROCOM-17-5xx uses the VIC068 VMEbus Interface Controller gate array. Optionally, a VIC064 may be used which supports D64 multiplexed block transfer according to IEEE 1014 Rev. D.

A 256 (512) K x 8 Flash EPROM holds the firmware. It is on-board reprogrammable to allow reconfiguration.

Up to 1M x 8 EPROM can be added to the board to hold user firmware.

The on-board Ethernet interface provides connection to most popular local area networks (LAN).

A sophisticated SCSI-2 (wide) interface is also located on the EUROCOM-17-5xx. The controller chip is very fast and intelligent so that it forms a very efficient SCSI interface with max. transfer rates of 20 MB/s.

The on-board local extension bus (LEB) allows easy hardware extension of the EUROCOM-17-5xx using ELTEC IPINs. The LEB of the EUROCOM-17-5xx supports dynamic bus sizing.

1.3 Technical Details

The EUROCOM-17-5xx consists of the following main blocks:

- CPUs
- RAM Module
- Basic EPROM
- User EPROM
- Graphics Interface
- Keyboard Interface
- Ethernet Interface
- SCSI Interface
- Serial I/0
- Parallel I/O
- CIO Counters / Timers
- Parameter RAM and Real-Time Clock
- Revision EEPROM
- VIC Timer
- Watchdog Timer
- Status Display
- Reset
- VMEbus Interface
- Interrupt Sources
- Local Extension Bus
- Software
- Connectors

1.3.1 CPUs

Equipped with Motorola's 68040 CPU, the CPUs are clocked with 25, 33 or 40 MHz. All internal bus operations are synchronous to this clock. The CPUs use burst mode only to access main memory and video RAM. Although both CPUs are connected mainly in parallel, a distinction into a primary and a secondary CPU can be made: The primary CPU (CPU1) receives all system interrupts and is always started first. The secondary CPU (CPU2) can be released from the reset state afterwards by the primary CPU (refer to Table 50: 'CPU2CON As Seen by Primary CPU').

CPU1 handles all interrupts generated by the VIC. CPU2 can interrupt CPU1 via the interprocessor communication module switch facility of the VIC. The secondary CPU2 is interrupted by accessing a separate mailbox location by CPU1, by the LEB or by the VIC timer (refer to Table 50: 'CPU2CON As Seen by Primary CPU'). Additionally, VMEbus interrupts can be handled with some restrictions by the secondary CPU. IACK cycles of CPU1 are always routed to the VIC while those of CPU2 always use autovector interrupt acknowledge mode.

Non-interruptable read-modify-write cycles (TAS command) are supported between VMEbus, CPU1, and CPU2. RMC cycles from the VMEbus to the local RAM are only indivisible when they are byte size. CAS2 instructions have limited support.

Table 1: CAS2 Operations on the Various Busses

1st op	2nd op	indivisible
local RAM	local RAM	yes
'020 bus (LEB)	local RAM	yes
VMEbus	local RAM	yes
local RAM	'020 bus (LEB)	no
'020 bus (LEB)	'020 bus (LEB)	yes
VMEbus	'020 bus (LEB)	yes
local RAM	VMEbus	no
'020 bus (LEB)	VMEbus	no
VMEbus	VMEbus	yes

The secondary CPU may not be used by the application. All system functions are served by the primary CPU.

Both CPUs can execute the same code, in case it is reentrant of course.

Each CPU can find out whether it is the primary or secondary CPU by reading bit 6 of the secondary CPU control register (CPU2CON).

1.3.2 RAM

The DRAM and the video RAM are accessed by the following sources:

- CPU1
- CPU2
- SCSI Controller
- Ethernet Controller
- LEB
- VMEbus

Burst mode is supported for accesses of:

- CPU1
- CPU2
- SCSI Controller
- VMEbus BLT

The base address of the DRAM seen from the CPUs is fixed to $0000.0000. To avoid programming of the MMU, the DRAM and VRAM are mirrored as non-cacheable RAM.

The base address for accessing the RAM from the VMEbus as well as the window size is programmable. The on-board firmware uses hex switch S901 to program the VMEbus address decoder and mask registers.

When using A24 addressing, including accesses from the LEB, to access the EUROCOM-17-5xx RAM, the address translation logic must be programmed to supply the local addresses A(24) to A(26). In this case either the video RAM or the DRAM can be reached from VMEbus (including A32 addressing) but not both (see Section 3.2.3 'Address Translation').

The following table summarizes the usable bandwidth of the RAM including precharge and refresh.

Table 2: Usable Bandwidth of the RAM

Bus Clock	40 MHz: (MB/s)	33 MHz: (MB/s)	25 MHz: (MB/s)
DRAM read	70	58	50
DRAM write	79	66	50
VRAM read	53	44	40
VRAM write	53	44	40

1.3.3 Basic EPROM

After reset, the basic EPROM is mapped to $0000.0000 so the initial stack pointer and reset vector can be read. During initialization, it is mapped to its normal address ($FE80.0000) and the DRAM is located at address $0000.0000. The basic EPROM is accessed with six wait-states (120 ns access time) per byte at 40 MHz.

The software in the basic EPROM (RMon) initializes all hardware according to the parameters in the basic EPROM or the NVRAM ($FEC2.0000).

Reprogramming is possible when the appropriate jumpers are set.

1.3.4 User EPROM

The pin assignment of the 32-pin socket corresponds with the JEDEC standard. The socket is designed for use with 32-pin EPROMs only. These EPROM types range from 1 Mb up to 8 Mb (27C010 to 27C080).

The EPROM access time is programmable via IOC-2 register from 4 to 36 wait-states (60 ns to 810 ns maximum access time).

1.3.5 Graphics Interface

The graphics hardware of the EUROCOM-17-5xx is built in the main by a video sync generator LM1882, a CLUT BT445 and an address generator which is implemented in a MACH445. The PLD provides the appropriate control signals for read/write access, transfer cycles and refresh cycles, too.

The programmable video timing generator allows the implementation of different screen resolutions and video standards. The pixel clock stream is fed to a 256 x 8 x 3 CLUT and converted by three DACs into a video signal (with/without composite sync).

The video RAM consists of two VRAMs building a memory array of 1 MB size and 32-bit parallel/serial port. The VRAM can be accessed by different bus masters from the 68040 bus (CPU, VMEbus, SCSI, LEB). Byte, word, longword and burst accesses are possible speeding up excessive pixel manipulations. Each byte represents one pixel in 8-bit resolution mode, so that 256 different colors out of a set of 2^{24} can be displayed at the same time. 1/2/4 bits per pixel are also available to speed up graphics operation.

The overlay RAM is 512 K of size and has the same structure as the video RAM. Overlay operates with 4 bits per pixel and is only available when the video RAM operates in 8 bits per pixel. Due to hardware configuration the overlay RAM is only accessible by word, longword or burst operation.

So, a longword holds the overlay data of four subsequent pixels. The data of each pixel are held in the lower nibble of each byte in the longword. The upper nibbles of each byte in the longword are don't care because these data lines are not connected to the overlay RAM.

Figure 2: Overlay Pixel Data Configuration

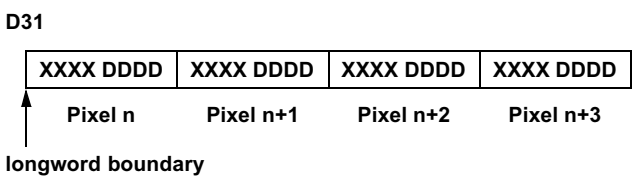
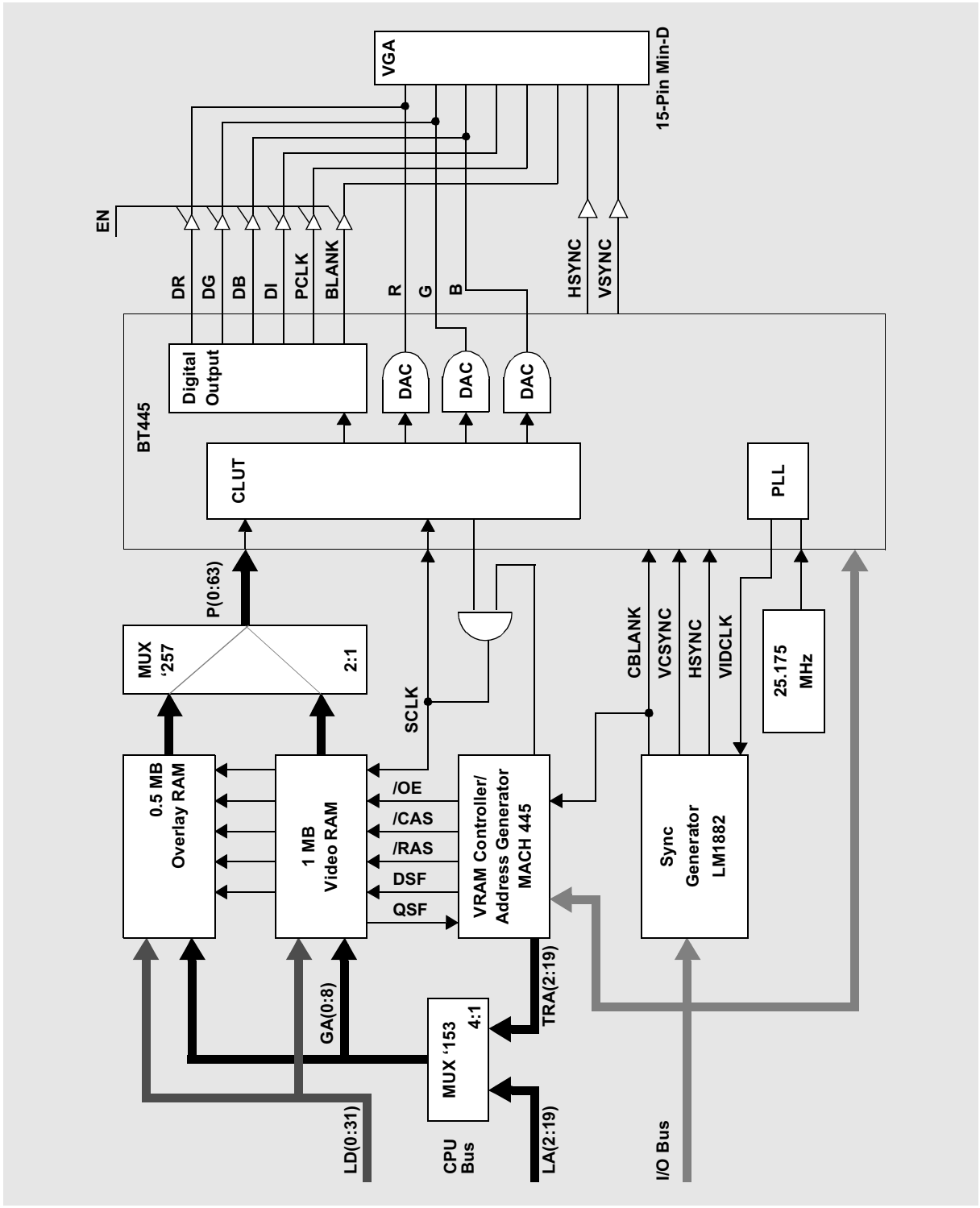


Figure 3: Graphic Interface Building Blocks



1.3.6 Keyboard Interface

The EUROCOM-17-5xx keyboard interface supports PS/2 compatible keyboards. This interface can receive data from and transmit data to the keyboard under interrupt control. The keyboard interface consists of two registers: the data register and the control / status register.

1.3.7 Ethernet Interface

The Ethernet interface is based on the Integrated Local Area Communications Controller (ILACC - AM79C900).

A main feature of the ILACC and its on-chip DMA channel is the flexibility and speed of communication. The internal Manchester Encoder / Decoder of the ILACC is compatible with the IEEE-802.3 specification. Via the AUI connector on the front panel the EUROCOM-17-5xx is attached to Ethernet (Cheapernet, 10BaseT) networks.

1.3.8 SCSI Interface

Single-ended 8/16 bit SCSI-2 signals are fed into row A and C of the VMEbus P2 connector (X102). An ADAP-220 is plugged onto the rear side of the backplane to interface to standard 8/16-bit SCSI connectors: a 50-pin flat cable connector, and a 68-pin, high density, half pitch connector (SCSI-2 P cable). The ADAP-220 is also used to interface between these types of cable, i.e. harddisks with different types of connectors can be mixed in the system.

For 8-bit SCSI devices also the ADAP-200 can be used.

The NCR53C720 SCSI controller uses its own code fetching and SCSI data transfer from the on-board DRAM. The processor executes SCSI SCRIPTS to control the actions on the SCSI and the CPU bus. SCRIPTS is a specially designed language for easy SCSI protocol handling. It dramatically reduces the CPU activities. The SCRIPTS processor starts SCSI I/O operations in approximately 500 ns where traditional intelligent host adapters require 2-8 ms.

1.3.9 Serial I/O

The EUROCOM-17-5xx offers four serial I/O lines, implemented by one CL-CD2401 Multi Protocol Controller. CHAN.1 and CHAN.2 are RS 232 two wired handshake interfaces. CHAN.3 and CHAN.4 use removable serial interface level converters (SILC). As shipped, two RS 232 level converter SILCs are installed featuring hardware handshake as well as the XON / XOFF protocol. Additional level converter plug-ins for RS 422 and RS 485 are available.
The baud rate generator is driven by 20 MHz, allowing baud rates from 50 b/s to 64 kb/s.

1.3.10 Parallel I/O

There is one 8-bit parallel port with handshake signals on the EUROCOM-17-5xx. This parallel port is based on a Zilog Z8536 device (user CIO). The port signals are routed via the VMEbus P2 connector and the ADAP-220/200 to the CONV-300 board. Three 9-pin Sub-D serial plugs, a 25-pin Sub-D parallel connector (Centronics printer interface) and a 26-pin connector for direct access to the CIO pins are installed on the CONV-300.

The I/O ports of the user CIO features programmable polarity, programmable direction (bit mode), pulse generators, and programmable open drain outputs. Four handshake modes, including 3-wire (like IEEE-488), are selectable. The CIO is also programmable as a 16-vector interrupt controller.

1.3.11 CIO Counters/ Timers

The EUROCOM-17-5xx offers three independent, programmable 16-bit counters / timers integrated in the user CIO. They can be used as general-purpose devices with up to four external access lines per counter / timer (count input, output, gate, and trigger). Port A and port C lines of the user CIO are routed to a 26-pin I/O connector on the CONV-300 for user applications.

1.3.12 Parameter RAM and Real-Time Clock

The real-time clock is designed with the MK48T12 timekeeper RAM. It combines a 2KBx8 CMOS SRAM (parameter RAM), a bytewide accessible real-time clock, a crystal, and a long-life lithium battery, all in one package. Alternatively, a MK48T18 device can be used which offers 8 KB SRAM or a DS1644 device which offers 32Kx8 KB SRAM.

1.3.13 Revision EEPROM

The revision EEPROM is realized by a 512x8B serial EEPROM which offers special board revision information. The lower half size of the EEPROM is programmed by ELTEC and should not be modified by the user to guarantee board revision consistency. The upper 256 B can be used by the user to store additional information.

1.3.14 VIC Timer

The VIC contains a timer which can be programmed to output a periodic wave form on LIRQ2. The available frequencies are 50 Hz, 100 Hz, and 1000 Hz. The VIC timer is typically used as a tick timer for multi-tasking operating systems.

1.3.15 Watchdog Timer

The watchdog timer monitors the activity of the microprocessor. If the microprocessor does not access the watchdog timer within the time-out period of 100 ms or 1.6 s, a reset pulse is generated. After reset, the watchdog timer is disabled. The normal time-out period of 100 ms/1.6 s becomes effective after the first access to the watchdog timer.

The left decimal point of the hex display located at the front panel is illuminated to indicate a watchdog reset. This watchdog indicator is only cleared by power-up reset, the reset switch, a VMEbus SYSRESET, or a VIC remote reset.

The state of the watchdog indicator can be read by software using bit PA7 of the system control register located in the system CIO.

1.3.16 Status Display

The EUROCOM-17-5xx features a seven-segment display on the front panel and displays hexadecimal values from 0 - F.

This status display ($FEC3.0000) is designed as a read / write register and uses the least significant nibble of the byte.

The right decimal point of the hex display is controlled by PA0 of the system control register. The right decimal point is used as an initialization status by the monitor program. After reset the right decimal point is illuminated. RMon switches the decimal point off before the user program in the user EPROM is called.

The LED next to the reset button shows the status of the primary CPU. It is illuminated when the CPU is running and it is off when the CPU is halted.

1.3.17 Reset

Reset may be initiated by six sources:

- supply voltage drop below 4.75 V or power-up
- reset switch on the front panel
- VMEbus SYSRESET
- VIC remote control reset register
- Watchdog
- CPU RESET instruction

1.3.18 VMEbus Interface

Each EUROCOM-17-5xx board offers VMEbus master and slave interfaces. Additionally, VMEbus system controller functions are available via the VMEbus gate array (VIC).

1.3.18.1 System Controller

The EUROCOM-17-5xx features a full slot-one system controller, including SYSCLK, SYSRESET, bus time-out, IACK daisy chain driver, and a four level arbitration circuit. System controller capabilities are enabled by switch S3 in position 'SC' on the front panel.

1.3.18.2 VMEbus Master Interface

The master interface of the EUROCOM-17-5xx board supports 8, 16, and 32-bit data transfer cycles in A32, A24, and A16 addressing modes.

A special feature is provided to support longword accesses from the local CPU to D16 VMEbus boards (dynamic bus sizing). Two control lines of the SCR enable longword breaking for the A32 and A24 area.

The VIC chip supplies the VMEbus address modifier signals. This is done by either routing FC0..2 line to AM0..2, or by driving these signals by an internal address modifier source register of the VIC ($FEC0.10B7). The AM3..5 lines are driven depending on the actual data size, or by the address modifier source register. One output signal of the system control register is used to control this option.

The EUROCOM-17-5xx supports master / slave block transfer cycles. Several options within the VIC chip allow the user to generate different block transfer cycle types.

The overall transfer rate from one EUROCOM-17-5xx to another EUROCOM-17-5xx is approximately 35 MB/s using D64 block transfer.

1.3.18.3 VMEbus Slave Interface

The EUROCOM-17-5xx supports A32 and A24 slave access to the DRAM and an A16 slave interface to access the interprocessor communication registers. The addresses for all of the slave interfaces are separately programmable.

For full support of the interprocessor features the EUROCOM-17-5xx has two A16 slave decoders. One for individual addressing and one for broadcast addressing of the VIC.

1.3.19 Interrupt Sources

The EUROCOM-17-5xx allows full utilization of both the powerful VMEbus interrupt structure and the 68040 CPU design.

1.3.20 Local Extension Bus

The LEB port of the EUROCOM-17-5xx can carry slave-only, master-only or master-slave boards. The IRQ line of the LEB is connected to VIC's LIRQ5 input. The VIC has to be programmed to generate interrupts on level 2, because only level 2 IACK cycles are routed to the LEB.

1.3.21 Software

The local EUROCOM-17-5xx firmware (RMon) is stored in the on-board Flash EPROM (FEPROM). RMon provides the basic software layer of the board. Any operating system or application software is based on the RMon and uses its functionality:

- Power-On Initialization
- Configuration
- Various Bootstraps
- Externally Callable I/O Functions
- Application Hooks

Power-On Initialization

After RESET or power-on, the local hardware (VIC, serial I/O, CIO, video, keyboard interface, etc.) must be initialized by the CPU. The initialization is affected by certain parameters taken either from the on-board NVRAM or from the Flash EPROM (default values). Hex switch S902 on the front panel selects whether the NVRAM or the default values are to be used.

The NVRAM parameters are certified by a checksum. If the checksum test fails, the default parameters are used independent of the switch setting.

After reset or power-on an automatic selftest routine checks the functional groups of the board and displays its results.

Configuration

The configuration program is completely menu driven. The program interactively shows the configuration parameters and allows their modification:

- I/O Configuration, e.g.: serial I/O, AT-keyboard, on-board video, baud rate, etc.
- Video Mode: VGA-Text, VGA-Graphics, SuperVGA, Custom Video
- Bootstrap Configuration
- Internet Address of ILACC
- VMEbus Interface Configuration (VIC Programming)

Various Bootstraps

- OS-9 from SCSI Floppy
- OS-9 from SCSI Harddisk
- OS-9 from SCSI Tape
- OS-9 from ROM/RAM Disk
- Lynx from Tape
- Lynx from Harddisk
- Lynx from Floppy
- tftp-bootstrap from Ethernet including ARP and RARP protocols
- ROMed application bootstrap, suitable as well for VMEbus-downloaded applications under control of a VMEbus host

External Callable I/O Functions

- Enable/Disable IRQs
- Get Device Status
- Set Device Mode
- Character Raw I/O
- C-like functions **`getchar`**, **`putchar`**, **`printf`**

Application Hooks

Application programs may freely use the externally callable I/O functions and other information provided in the ‘RMon Fixed Public Location’.

Furthermore, a ROMed application can very easily be started interactively or automatically after RESET or power-on from RMon. The application autostart mechanism can be installed simply by setting the respective bootstrap configuration parameters.

1.3.22 Connectors

Table 3: 15-Pin VGA Connector (MONITOR PORT X1201)

Pin	Signal (analog)
1	Red (0.7 V_{PP} / 1 V_{PP}) or Red 3 (TTL)
2	Green (0.7 V_{PP} / 1 V_{PP}) or Green 3 (TTL)
3	Blue (0.7 V_{PP} / 1 V_{PP}) or Blue 3 (TTL)
4	nc or Blue 2 (TTL)
5	GND
6	GND
7	GND
8	GND
9	nc
10	GND
11	nc
12	nc or DIGCLK
13	HSync (TTL) prog. (pos./neg.)
14	VSync (TTL) prog. (pos./neg.)
15	nc

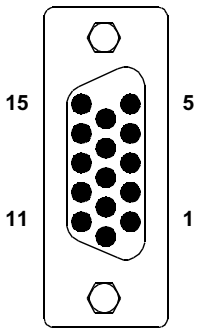


Table 4: 6-Pin Miniature Circular (mini-DIN) Connector (KEYBOARD X2)

Pin	Description
1	KBDATA
2	nc
3	GND
4	+5V (fused)
5	KBCLK
6	nc

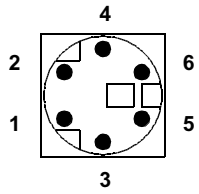


Table 5: 6-Pin Telephone Jack Connector CHAN.1 (MOUSE/RS 232 PORT X1202)

Pin	Signal	Description
1	DTR	Data Terminal Ready
2	TxD	Transmit Data
3	GND	Signal Ground
4	GND	Signal Ground
5	RxD	Receive Data
6	CTS	Clear to Send

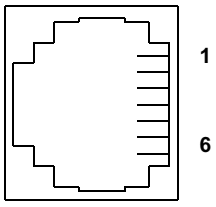


Table 6: 15-Pin AUI Connector (ETHERNET X801)

Pin	Signal	Description
1	CI-S	Control In circuit Shield
2	CI-A	Control In circuit A
3	DO-A	Data Out circuit A
4	DI-S	Data In circuit Shield
5	DI-A	Data In circuit A
6	VC	Voltage Common
7	CO-A	Control Out circuit A
8	CO-S	Control Out circuit Shield
9	CI-B	Control Out circuit B
10	DO-B	Data Out circuit B
11	DO-S	Data Out circuit Shield
12	DI-B	Data In circuit B
13	VP	Voltage Plus
14	VS	Voltage Shield
15	CO-B	Control Out circuit B

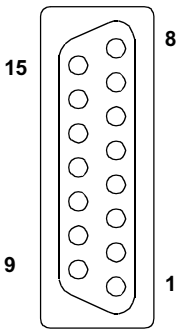


Table 7: Pin Assignment of VMEbus Connector (X101)

Pin	Row A	Row B	Row C
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	(SERCLK)	A17
22	/IACKOUT	(SERDAT)	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	-12 V	(+5STDBY)	+12 V
32	+ 5 V	+ 5 V	+ 5 V

Signals in parentheses are not connected.

Table 8: Pin Assignment of Connector X102

Pin	Signal Row A	Signal Row B	Signal Row C
1	SCSIDBP1	+ 5 V	SCSIDB1
2	SCSIDB0	GND	SCSIDB3
3	SCSIDB2	Reserved	SCSIDB5
4	SCSIDB4	A24	SCSIDB7
5	SCSIDB6	A25	SCSIDB9
6	SCSIDBP0	A26	SCSIDB11
7	SCSIDB8	A27	SCSIDB13
8	SCSIDB10	A28	SCSIDB15
9	SCSIDB12	A29	CIOPC3
10	SCSIDB14	A30	CIOPC1
11	CIOPC2	A31	CIOPA6
12	CIOPC0	GND	CIOPA4
13	CIOPA7	+ 5 V	CIOPA2
14	CIOPA5	D16	CIOPA0
15	CIOPA3	D17	/SCSIATN
16	CIOPA1	D18	GND
17	GND	D19	/SCSIBSY
18	/SCSIACK	D20	/SCSIRST
19	/SCSIMSG	D21	/SCSISEL
20	/SCSIC/D	D22	/SCSIREQ
21	/SCSII/O	D23	C4GND4
22	C4GND1	GND	C4DTR
23	C4CTS	D24	C4TxD
24	C4RTS	D25	C4RxD
25	C4DCD	D26	C3GND4
26	C3GND1	D27	C3DTR
27	C3CTS	D28	C3TxD
28	C3RTS	D29	C3RxD
29	C3DCD	D30	+ 5 V
30	C2DTR	D31	C2TxD
31	C2CTS	GND	C2RxD
32	C2RTS	+ 5 V	C2DCD

Lines on rows A and C are TTL-level, except Cx signals which have RS 232C level (SILC-200 used). Pin assignment changes for RS 422/485 configuration. Row B is reserved for 32-bit VMEbus extension.

Table 9: Pin Assignment of the 32-bit LEB (X201)

Pin	Row A	Row B	Row C	Row D	Row E
1	GND	A08	A16	A24	Reserved
2	A01	A09	A17	A25	Reserved
3	A02	A10	A18	A26	Reserved
4	A03	A11	A19	A27	Reserved
5	A04	A12	A20	A28	D08
6	A05	A13	A21	A29	D09
7	A06	A14	A22	A30	D10
8	A07	A15	A23	A31	D11
9	D16	D24	FC0	SIZE0	D12
10	D17	D25	FC1	SIZE1	D13
11	D18	D26	FC2	+5V	D14
12	D19	D27	/IRQ	/CPU20	D15
13	D20	D28	/IACK	+12V	D00
14	D21	D29	/RESET	-12V	D01
15	D22	D30	/BR	12VGND	D02
16	D23	D31	/BG	/DSACK0	D03
17	/DS	A00	GND	/HALT	D04
18	R/W	/AS	+5V	+5V	D05
19	/DSACK1	GND	/BGACK	GND	D06
20	/BERR	CLKCPU	/CSEXT	Reserved	D07

Signals in parentheses are not connected.

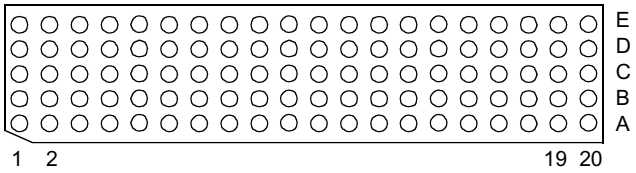


Table 10: Pin Assignment of 32-Bit Memory Module Connector (X202)

Pin	Description	Pin	Description		Pin	Description	Pin	Description
1A	+12 V	26A	LD5		1B	+3V3	26B	LD21
2A	GND	27A	LD6		2B	VCC	27B	LD22
3A	LA0	28A	LD7		3B	LA16	28B	LD23
4A	LA1	29A	GND		4B	LA17	29B	VCC
5A	LA2	30A	LD8		5B	LA18	30B	LD24
6A	LA3	31A	LD9		6B	LA19	31B	LD25
7A	LA4	32A	LD10		7B	LA20	32B	LD26
8A	LA5	33A	LD11		8B	LA21	33B	LD27
9A	LA6	34A	LD12		9B	LA22	34B	LD28
10A	LA7	35A	LD13		10B	LA23	35B	LD29
11A	GND	36A	LD14		11B	VCC	36B	LD30
12A	LA8	37A	LD15		12B	LA24	37B	LD31
13A	LA9	38A	GND		13B	LA25	38B	VCC
14A	LA10	39A	/BB		14B	LA26	39B	+3V3
15A	LA11	40A	/TIP		15B	LA27	40B	+3V3
16A	LA12	41A	/TS		16B	LA28	41B	+5VSTDBY
17A	LA13	42A	/LSIZ0		17B	LA29	42B	GND
18A	LA14	43A	/LSIZ1		18B	LA30	43B	GND
19A	LA15	44A	LR/W		19B	LA31	44B	BLCK
20A	GND	45A	/MI		20B	VCC	45B	GND
21A	LD0	46A	GND		21B	LD16	46B	LOCK
22A	LD1	47A	/TA		22B	LD17	47B	/RESET
23A	LD2	48A	/TEA		23B	LD18	48B	RFCLK
24A	LD3	49A	/RAMSEL		24B	LD19	49B	+3V3
25A	LD4	50A	GND		25B	LD20	50B	VCC

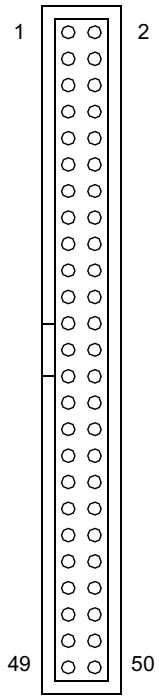
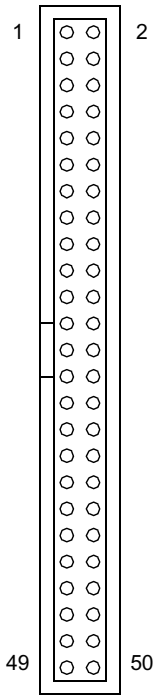


Table 11: 50-Pin I/O Connector X102 (on ADAP-200 and ADAP-220)

Pin	Dir	Description	Remark	
1 8	I/O	Not connected on ADAP-220, SCSIDB8 - SCSIDB15 on ADAP-200		SCSIDB8 - 15 must be left open on ADAP-200
9	-	GND		
10 13	I/O	CIO Port C 3 - CIO Port C 0		
14	-	GND		
15 22	I/O	CIO Port A 7 - CIO Port A 0		
23	-	+5 V		
24	-	Serial Channel 4	GND2	(may be changed if a non standard level-converter board SILC is installed)
25	-	Serial Channel 4	GND1	
26	-	Serial Channel 4	not connected	
27	I	Serial Channel 4	CTS	
28	O	Serial Channel 4	TXD	
29	O	Serial Channel 4	RTS	
30	I	Serial Channel 4	RXD	
31	-	not connected		
32	-	not connected		
33	-	Serial Channel 3	GND2	(may be changed if a non standard level-converter board SILC is installed)
34	-	Serial Channel 3	GND1	
35	-	Serial Channel 3	not connected	
36	I	Serial Channel 3	CTS	
37	O	Serial Channel 3	TXD	
38	O	Serial Channel 3	RTS	
39	I	Serial Channel 3	RXD	
40	-	not connected		
41	-	not connected		
42	-	Serial Channel 2	GND	
43	-	Serial Channel 2	+5 V	fused (300 mA max.)
44	O	Serial Channel 2	DTR	
45	I	Serial Channel 2	CTS	
46	O	Serial Channel 2	TXD	
47	O	Serial Channel 2	RTS	
48	I	Serial Channel 2	RXD	
49	-	not connected		
50	I	Serial Channel 2	DCD	

Table 12: SCSI Connector 8-bit X103 (on ADAP-200 and ADAP-220)

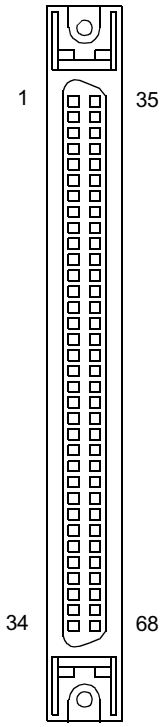
Pin	Description	Pin	Description
2	DB0	28	GND
4	DB1	30	GND
6	DB2	32	ATN
8	DB3	34	GND
10	DB4	36	BSY
12	DB5	38	ACK
14	DB6	40	RST
16	DB7	42	MSG
18	DB8	44	SEL
20	GND	46	CIO
22	GND	48	REQ
24	GND	50	I/O
26	TERM-PWR		



All odd pins of the 50-pin SCSI connector except pin 25 are connected to ground. Pin 25 is left open.
Pin 26 is connected to +5 V via a Shottky diode to supply power to an external SCSI terminator.

Table 13: SCSI Connector 16-bit X107 (on ADAP-220)

Pin	Description	Pin	Description
1 - 16	GND	50	GND
17	TERM	51	TERM
18	TERM	52	TERM
19	NC	53	NC
20 - 34	GND	54	GND
35	SCSIDB12	55	/SCSIATN
36	SCSIDB13	56	GND
37	SCSIDB14	57	/SCSIBSY
38	SCSIDB15	58	/SCSIACK
39	SCSIDP1	59	/SCSIRST
40	SCSIDB0	60	/SCSIMSG
41	SCSIDB1	61	/SCSISEL
42	SCSIDB2	62	/SCSIC/D
43	SCSIDB3	63	/SCSIREQ
44	SCSIDB4	64	/SCSII/O
45	SCSIDB5	65	SCSIDB8
46	SCSIDB6	66	SCSIDB9
47	SCSIDB7	67	SCSIDB10
48	SCSIDP0	68	SCSIDB11
49	GND		



1.4 Compatibility to the EUROCOM-17

The EUROCOM-17-5xx is built as an adequate substitute for the EUROCOM-17-1xx or EUROCOM-17-2xx. Nevertheless, some changes were necessary:

Differences between EUROCOM-17-5xx and EUROCOM-17-1xx/2xx:

- Address map slightly changed (see Chapter 3 ‘Programmers Reference’).
- The graphics interface has changed. For detailed information, see Section 3.4 ‘Graphics Interface’.
- 4-bit overlay implemented (see Section 1.3.5 ‘Graphics Interface’, Section 3.4.6 ‘Overlay Memory’).
- Revision EEPROM to save board revision information.
- Programmable interrupt level for system CIO, user CIO, CLCD2401.
- VMEbus interrupt for secondary CPU possible, see Section 2.3.8 ‘VMEbus Interrupts for Secondary CPU (J1703)’ for detailed information.
- Main memory is placed at changeable memory module.

1.5 Definition of Board Parameters

1.5.1 VMEbus

- **VMEbus interface according to specification ANSI/IEEE STD 1014-1987 (Rev. D1.4)**
- **VMEbus Master Capabilities**
  - MD32
  - MRMW8
  - BLT
- **VMEbus Slave Capabilities:**
  - SADO32
  - SRMW32
  - UAT
  - BLT
- **Arbiter Options**
  - PRI, RRS
  - BTO 4 µs to 480 µs
  - SYSCLOCK generation
  - BBSY filter
- **Requester Options**
  - Any one of BR(0), BR(1), BR(2) or BR(3)
  - Programmable Release when done (RWD)
  - Release-on-request (ROR)
  - Release-on-bus-clear (ROC)
  - Bus capture and hold (BCAP)
  - Programmable fair request timer 2 µs ... 30 µs.
- **Interrupt Handler and Generator Capabilities**
  - Interrupt handler and generator on IRQ1 to IRQ7.
- **For Secondary CPU**
  - Interrupt handler for IRQ 1, 3, 5 or 7 with RORA only

- **Interrupter Options**
  - Any one of I(n) where $1 \leq n \leq 7$.
- **Address Range**
  - programmable extended/standard/short I/O
    extended access (A31-A24 and mask)
    standard access (A23-A16 and mask)
    short I/O (A15 -A8)
  - Default: extended access 256 MB, short I/O 256 B

1.5.2 LEB

- **LEB Compliance**
  - D32 4M DBS IRQP IACK DMA A26 NFPM FP
- **Master (EUROCOM-17-5xx CPU) Data Transfer Options:**
  - A32 : D32 : D16 : D8
  - 4 MB
- **Slave (EUROCOM-17-5xx CPU) Data Transfer Options:**
  - A32 : D32
  - 256 MB (DRAM + VRAM)
- **Interrupter Options:**

  vectored IRQ
- **Clock Speed:**
  - 1/2 CPU clock (12.5 MHz, 16.5 MHz, 20 MHz)

1.5.3 Ethernet

- **AUI interface according to 802.3**

1.5.4 SCSI

- **SCSI-2 wide (8/16 bit single ended)**
- **Transfer Speed**
  - asynchronous transfer 5 MB/s (8-bit) 10 MB/s (16-bit)
  - synchronous transfer 10 MB/s (8-bit) 20 MB/s (16-bit)

1.5.5 Serial I/O

- **4 channels (50 b/s - 64 kb/s)**
- **Keyboard:**
  - MF2/AT mode

1.5.6 Parallel I/O

- **12-bit unbuffered TTL**
- **CONV-300:**
  - 12-bit buffered TTL
  - Centronics unidirectional

1.5.7 Video I/O

- **Dotclock:**
  - 10 MHz - 120 MHz
- **1/2/4/8/15/16 bit/pixel**
- **CLUT:**
  - 256 colors out of 2^{24}
  - 3x8-bit DAC
- **Video Resolution:**
  - 640 x 480 - 1152 x 900
- **Horizontal Frequencies:**
  - 31.5 kHz to 70 kHz
- **Vertical Frequencies:**
  - 60 Hz to 70 Hz

1.5.8 MTBF Values

- **7756 h (computed after MTL HDBK-217E)**
- **103930.4 h (realistic value from industry standard experience)**

1.5.9 Environmental Conditions

- **Storage Temperature:**
  -35°C to +85°C
- **Operating Temperature:**
  0°C to +60°C (non condensing)
- **Maximum Operating Humidity:**
  85% relative
- **Air temperature with forced air cooling of approx. 1 m/sec.**

1.5.10 Power Requirements

(with all/max. options; approx.):

- 7.0 A max.	5.0 A typ.	+5 VDC	±5 %
- 0.2 A max.	0.1 A typ.	+12 VDC	±10 %
- 0.2 A max.	0.1 A typ.	-12 VDC	±10 %

2 Installation

2.1 Introduction

- Carefully remove the board from the shipping carton.
  - Save the original shipping container and packing material for storing or reshipping the board.

Avoid touching integrated circuits except in an electrostatic free environment. Electrostatic discharge can damage circuits or shorten their lifetime.

- Inspect the board for any shipping damage. If undamaged, the board can be prepared for system installation.

When unplugging boards from the rack or otherwise handling boards, do always observe precautions for handling electrostatic devices.

2.1.1 Board Installation

The installation of the EUROCOM-17-5xx is not complicated, requiring only a VGA monitor, an AT-keyboard with PS/2 connector, a power supply, and a suitably terminated VMEbus backplane. The power supply must meet the specifications described in Section 1.5 ‘Definition of Board Parameters’. The processor board requires +5 V supply voltage; ±12 V are needed for the RS 232 serial interface and the Ethernet interface.

A standard VGA monitor has to be connected to the 15-pin Sub-D female connector and the keyboard has to be connected to 6-pin female miniature circular (mini-DIN) connector. Both connectors are located on the front panel. A standard VGA monitor and a standard PS/2 compatible keyboard will fit without modification. For connection to an AT-keyboard, ADAP-210 is available.

2.1.2 Serial Interface Level Converter (SILC)

The Serial Interface Level Converter (SILC) modules generally convert TTL-level signals generated or accepted by the SCC-2 to the appropriate signal levels for external transmission lines. SILC modules for RS 232C, RS 422 and RS 485 are available.

The mechanical outline of the SILC modules allows the changeability of the different SILC modules on the EUROCOM-17-5xx.

- SILC-200 for RS 232
- SILC-300 for RS 422
- SILC-400 for RS 485

The mechanical part of the installation is very easy. First switch off the VMEbus system and pull the board out of the rack. If a SILC module is already placed in the connector, remove it carefully. Now plug the new SILC module into the corresponding connector on the CPU or I/O board. Consider the polarization of the SILC module. To avoid damage, check that the pin 1 marked on the back of the SILC fits to pin 1 marked on the board.

2.1.3 Installation Parallel I/O

In addition, a 8-bit parallel port with handshake signals is available on the EUROCOM-17-5xx. The port signals are connected via connector X102 and the ADAP-200/220 to the CONV-300 board. The three 9-pin Sub-D serial plugs, a 25-pin Sub-D parallel connector to support Centronics printer interface and a 26-pin connector for direct access to the CIO pins for user applications are installed on the CONV-300.

The printer port has to be enabled by jumper J1 on the CONV-300 board. A general 25-pin Sub-D to Centronics printer port cable is used to connect a parallel printer to the EUROCOM-17-5xx. The printer port supports the following buffered hardware lines:

D(1:8), /STROBE, /ACK, BUSY, and PE.

For user-defined usage of the CIO parallel ports the printer port has to be disabled with jumper J1 located on the CONV-300. After that the 26-pin parallel I/O port supports two CIO parallel ports. For more information about the CIO, refer to the Z8536 data sheet and the CONV-300 Hardware Manual.

2.1.4 Ethernet Installation

A standard Ethernet/Cheapernet MAU or a CONV-500 Cheapernet/ 10BaseT MAU can be connected via AUI cable to the 15-pin AUI connector on the front panel of the EUROCOM-17-5xx. The length of the AUI cable is limited to 50 m. For connections up to about 2 m, flat cable can also be used. In order to avoid HF radiation, this cable should be shielded.

2.1.5 Pure 8-bit SCSI Installation

A 8-bit SCSI bus can be connected to X103 of ADAP-200/220. If the EUROCOM-17-5xx is located at either end of the SCSI bus, RN601-604 must be installed for signal termination, otherwise RN601-604 must be removed.

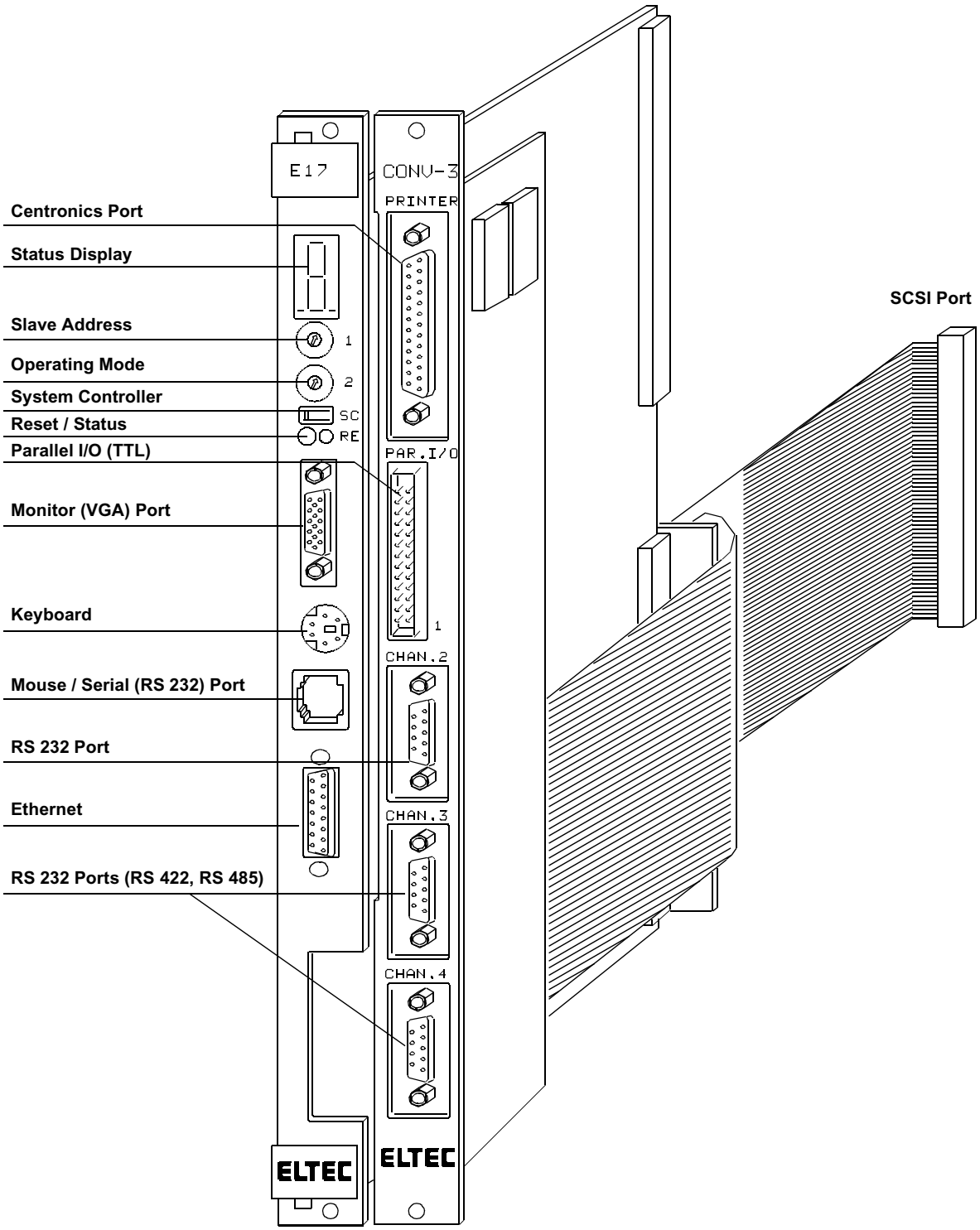
2.1.6 Pure 16-bit SCSI Installation

A 16-bit SCSI bus can be connected to X107 of ADAP-220. If the EUROCOM-17-5xx is located at either end of the SCSI bus, RN601-604 must be installed for signal termination, otherwise RN601-604 must be removed.

2.1.7 Mixed 8/16 bit SCSI Installation

ADAP-220 can be used to build mixed 8/16 bit SCSI bus systems. In this case X103 and X107 are used. RN601-604 must be removed from the EUROCOM-17-5xx and two of the resistor networks must be plugged into RN101-102 sockets of the ADAP-220 (note pin 1 marking of the networks and the sockets).

Figure 4: Installation Diagram



2.2 Default Board Setting

Table 14: Default Settings

Jumpers/Switches	Position	Description
J301	1 - 2	VIC68
J1201	1 - 2	Digclk, see Section 2.3.1 'Digclk Invertion (J1201)'
J1202	open	TTL graphic outputs disabled, see Section 2.3.2 'Enable TTL Video (J1202)'
J1401	closed	Watchdog period 100 ms, see Section 2.3.3 'Watchdog Period (J1401)'
J1601	open	No programming voltage for Flash EPROM, see Section 2.3.4 'Flash EPROM Programming Voltage (J1601)'
J1605	1 - 2	See Section 2.3.5 'Pin 1 Connection of EPROM (J1605)'
J1701	open	Boot from Flash EPROM
J1702	closed	Write enable for serial EEPROM, seeSection 2.3.6 'EEPROM Write Enable (J1702)'
J1703	open	No VMEbus IRQs handled by secondary CPU. (See Section 2.3.8 'VMEbus Interrupts for Secondary CPU (J1703)')
J1801	1 - 2	See Section 2.3.7 'Snooping of Secondary CPU (J1801)'
S901	0	VMEbus slave address at $8000.0000, see Section 2.3.9.1 'VMEbus Slave Address (S901)'
S902	0	Default initialization values, see Section 2.3.9.2 'Hardware Configuration (S902)'
S3	SC	System controller enabled, see Section 2.3.9.3 'System Controller Switch (S3)'

Figure 5: Location of Jumpers (Bottom View)

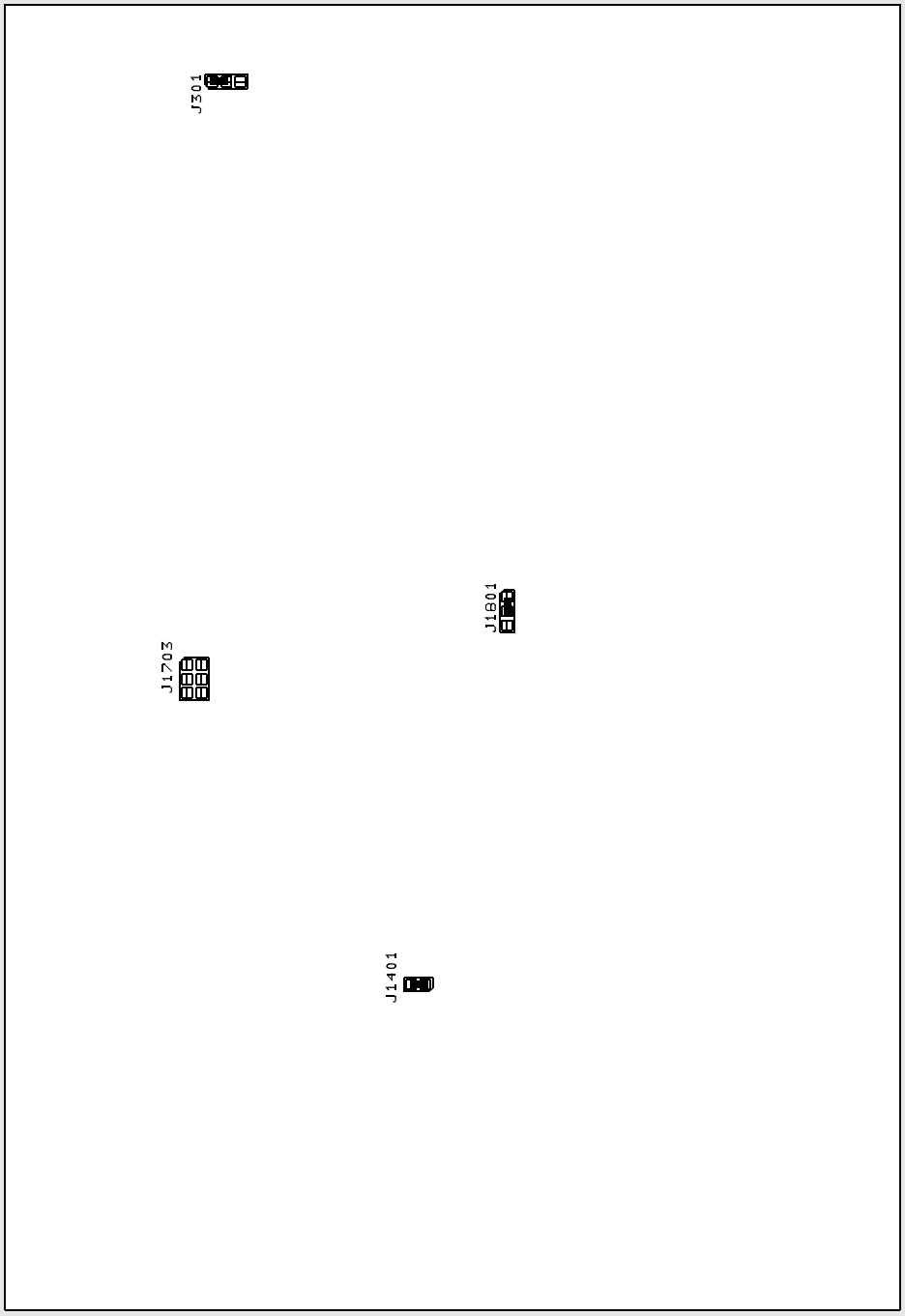
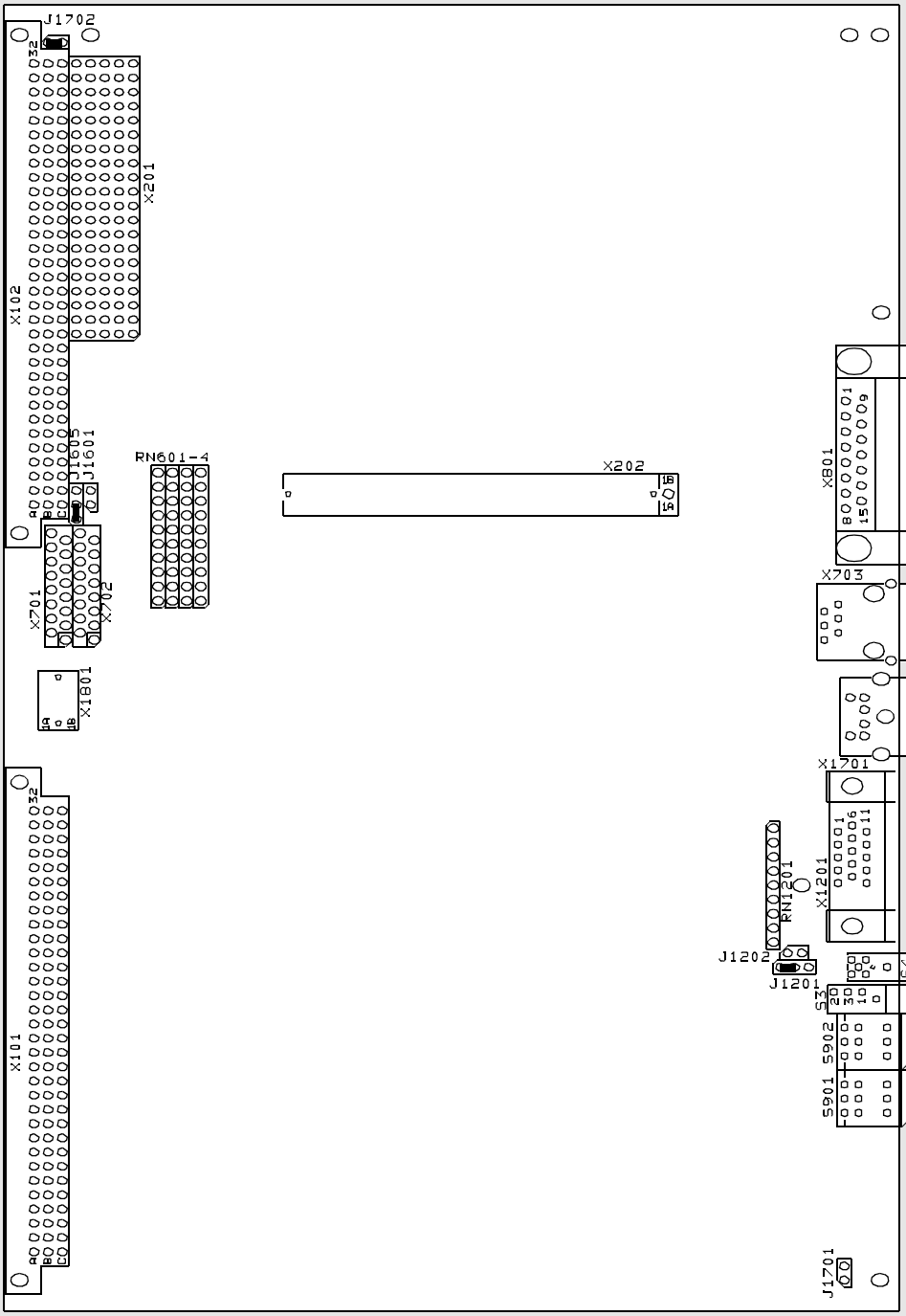


Figure 6: Location of Jumpers, Interface Connectors and Switches



2.3 Jumpers and Switches

This section lists all features user-selectable by jumpers and switches. For details, refer to the appropriate descriptions identified in parentheses.

All settings on a dark grey background ( ) indicate default settings. The EUROCOM-17-5xx operates as single board computer in this configuration.

There are only very few jumpers on the EUROCOM-17-5xx which typically need no changes after shipping. All other parameters are software programmable. Since the jumper connections are not changed easily, it is strongly recommended that these changes are performed by qualified personal only.

The user should refer to the silkscreen print on the component side of the EUROCOM-17-5xx for the following guidance on jumper area pin identification. Pin 1 of every jumper area is marked by a beveled corner on the silkscreen outline of the jumper. If you see this corner at the left upper side of the jumper area, then pin 2 is on the right-hand side of pin 1. Pin 3 can be found on the right of pin 2, and so on. Reaching the end of the row, counting must be continued beginning on the left-hand side of the next row.

2.3.1 Digclk Invertion (J1201)

J1201 allows to invert the Digclk signal.

Table 15: J1201 (Digclk Invertion)

Jumper J1201	Function
1 - 2	**Digclk**
2 - 3	Inverted Digclk

2.3.2 Enable TTL Video (J1202)

J1202 is used to enable the TTL video outputs at the VGA connector.

Table 16: J1202 (Enable TTL Video Outputs)

Jumper J1202	Function
open	**TTL outputs disabled**
closed	TTL outputs enabled

2.3.3 Watchdog Period (J1401)

J1401 is to select between 100 ms and 1.6 s watchdog periods. J1401 is a soldering jumper.

Table 17: J1401 (Watchdog Period)

Jumper J1401	Function
open	Watchdog period 1.6 s
closed	**Watchdog period 100 ms**

2.3.4 Flash EPROM Programming Voltage (J1601)

Table 18: J1601 (Flash EPROM Programming Voltage)

Jumper J1601	Function
open	**No programming voltage on Flash EPROM**
closed	Apply +12 V to Flash EPROM for programming

2.3.5 Pin 1 Connection of EPROM (J1605)

This jumper allows to select between EPROMs up to 4 Mbit and 8 Mbit.

Table 19: J1605 (Pin 1 Connection of EPROM)

Jumper J1605	Function
1 - 2	**Pin 1 connected to +5 V (< 8 Mbit)**
2 - 3	Pin 1 connected to A19 (8 Mbit)

2.3.6 EEPROM Write Enable (J1702)

J1702 enables/disables the hardware write protection for the serial EEPROM. Only the upper 256 B of the EEPROM can be write protected.

Table 20: J1702 (EEPROM Write Enable)

Jumper J1201	Function
open	Write protection enabled
closed	**Write protection disabled**

2.3.7 Snooping of Secondary CPU (J1801)

If snooping of the secondary CPU is enabled via the snoop control register SNCR, the /MI output of the secondary CPU must be observed (J1801 in position 2-3).

If snooping of the secondary CPU is disabled or in single processor systems, /MI of the secondary CPU can be ignored (J1801 in position 1-2).

Table 21: J1801 (Snooping of Secondary CPU)

Jumper J1801	Function
1 - 2	**Ignore /MI of secondary CPU**
2 - 3	Observe /MI of secondary CPU

2.3.8 VMEbus Interrupts for Secondary CPU (J1703)

To enable interrupt handling on the VMEbus by the secondary CPU, J1703 must be set to the corresponding level. Only one VMEbus interrupt level can be handled by the secondary CPU! For more information, see Section 3.19.3 ‘VMEbus Interrupts for the Secondary CPU’.

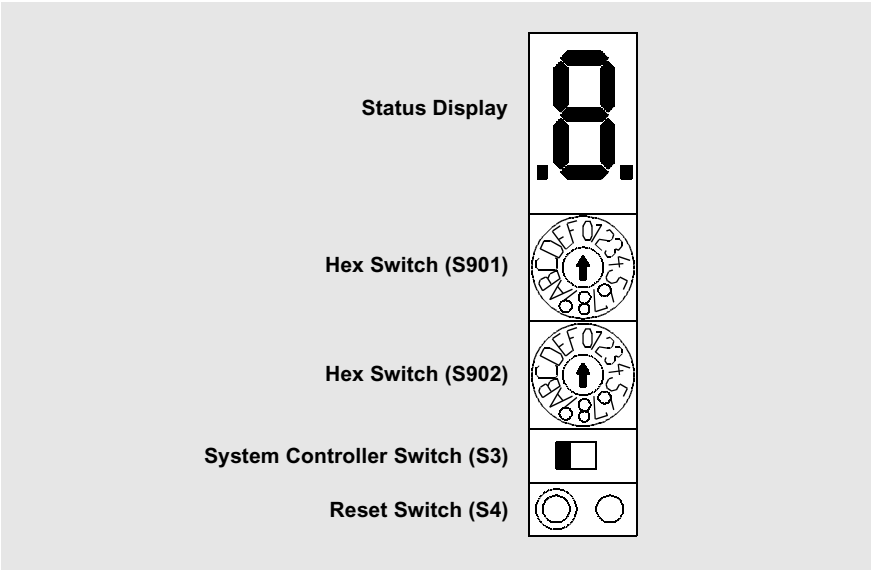
Table 22: J1703 (VMEbus Interrupts for Secondary CPU)

Jumper J1703	Function
5 - 3	VMEbus interrupt level 7
1 - 3	VMEbus interrupt level 5
2 - 4	VMEbus interrupt level 3
6 - 4	VMEbus interrupt level 1
open	**No VMEbus interrupts for secondary CPU**

2.3.9 Switches

Two rotary hex switches (S901 and S902), the system controller switch (S3) and the reset switch (S4) are all located on the front panel. If the system controller switch (S3) is switched to the 'SC' position, the board acts as VMEbus system controller.

Figure 7: Switches S901 to S4



Both hex switches (S901, S902) are used by RMon for the configuration setup (see RMon manual).

2.3.9.1 VMEbus Slave Address (S901)

The upper hex switch (S901) selects the EUROCOM-17-5xx slave window address. The size of the A32 slave window is normally 256 MB. This can be changed by the RMon setup menu. The size of the A16 slave window (used for VIC access) is 256 bytes.

Table 23: Hex Switch S901 (VMEbus Slave Address)

Hex Switch S901	VMEbus Base Address		
	A32	**A24**	**A16**
F	$F000.0000	disabled	$F000
E	$E000.0000	disabled	$E000
D	$D000.0000	disabled	$D000
.	.	.	.
1	$1000.0000	disabled	$1000
0	Use configuration value		

A24 access must be enabled separately.
For a detailed description, see Section 3.2.3 'Address Translation'.

2.3.9.2 Hardware Configuration (S902)

The lower switch (S902) defines the configuration source and the operation mode. For switch position 0, 1, RMon enters an interactive mode. If switch S902 is in position 8 to F, the program located in the user EPROM is called.

Table 24: Hex Switch S902 (Hardware Configuration)

Hex Switch S902	Function
0	Hardware configuration from basic EPROM
1	Hardware configuration from SRAM
2	Reserved for ELTEC
3	RMon interactive mode on serial port
4	RMon interactive mode on dual-ported RAM (local address $C000)
5 - 7	Reserved for ELTEC
8 - F	Hardware configuration from SRAM and start program in user EPROM.

S901 and S902 have no direct influence. A changed position becomes only effective after the next reset (i.e. the software reads the switches and programs the appropriate registers).

2.3.9.3 System Controller Switch (S3)

Table 25: Switch S3 (System Controller Switch)

Hex Switch S3	Function
left	System controller disabled
right 'SC'	**System controller enabled**

2 Installation

2.1 Introduction

- Carefully remove the board from the shipping carton.
  - Save the original shipping container and packing material for storing or reshipping the board.

Avoid touching integrated circuits except in an electrostatic free environment. Electrostatic discharge can damage circuits or shorten their lifetime.

- Inspect the board for any shipping damage. If undamaged, the board can be prepared for system installation.

When unplugging boards from the rack or otherwise handling boards, do always observe precautions for handling electrostatic devices.

2.1.1 Board Installation

The installation of the EUROCOM-17-5xx is not complicated, requiring only a VGA monitor, an AT-keyboard with PS/2 connector, a power supply, and a suitably terminated VMEbus backplane. The power supply must meet the specifications described in Section 1.5 ‘Definition of Board Parameters’. The processor board requires +5 V supply voltage; ±12 V are needed for the RS 232 serial interface and the Ethernet interface.

A standard VGA monitor has to be connected to the 15-pin Sub-D female connector and the keyboard has to be connected to 6-pin female miniature circular (mini-DIN) connector. Both connectors are located on the front panel. A standard VGA monitor and a standard PS/2 compatible keyboard will fit without modification. For connection to an AT-keyboard, ADAP-210 is available.

2.1.2 Serial Interface Level Converter (SILC)

The Serial Interface Level Converter (SILC) modules generally convert TTL-level signals generated or accepted by the SCC-2 to the appropriate signal levels for external transmission lines. SILC modules for RS 232C, RS 422 and RS 485 are available.

The mechanical outline of the SILC modules allows the changeability of the different SILC modules on the EUROCOM-17-5xx.

- SILC-200 for RS 232
- SILC-300 for RS 422
- SILC-400 for RS 485

The mechanical part of the installation is very easy. First switch off the VMEbus system and pull the board out of the rack. If a SILC module is already placed in the connector, remove it carefully. Now plug the new SILC module into the corresponding connector on the CPU or I/O board. Consider the polarization of the SILC module. To avoid damage, check that the pin 1 marked on the back of the SILC fits to pin 1 marked on the board.

2.1.3 Installation Parallel I/O

In addition, a 8-bit parallel port with handshake signals is available on the EUROCOM-17-5xx. The port signals are connected via connector X102 and the ADAP-200/220 to the CONV-300 board. The three 9-pin Sub-D serial plugs, a 25-pin Sub-D parallel connector to support Centronics printer interface and a 26-pin connector for direct access to the CIO pins for user applications are installed on the CONV-300.

The printer port has to be enabled by jumper J1 on the CONV-300 board. A general 25-pin Sub-D to Centronics printer port cable is used to connect a parallel printer to the EUROCOM-17-5xx. The printer port supports the following buffered hardware lines:

D(1:8), /STROBE, /ACK, BUSY, and PE.

For user-defined usage of the CIO parallel ports the printer port has to be disabled with jumper J1 located on the CONV-300. After that the 26-pin parallel I/O port supports two CIO parallel ports. For more information about the CIO, refer to the Z8536 data sheet and the CONV-300 Hardware Manual.

2.1.4 Ethernet Installation

A standard Ethernet/Cheapernet MAU or a CONV-500 Cheapernet/ 10BaseT MAU can be connected via AUI cable to the 15-pin AUI connector on the front panel of the EUROCOM-17-5xx. The length of the AUI cable is limited to 50 m. For connections up to about 2 m, flat cable can also be used. In order to avoid HF radiation, this cable should be shielded.

2.1.5 Pure 8-bit SCSI Installation

A 8-bit SCSI bus can be connected to X103 of ADAP-200/220. If the EUROCOM-17-5xx is located at either end of the SCSI bus, RN601-604 must be installed for signal termination, otherwise RN601-604 must be removed.

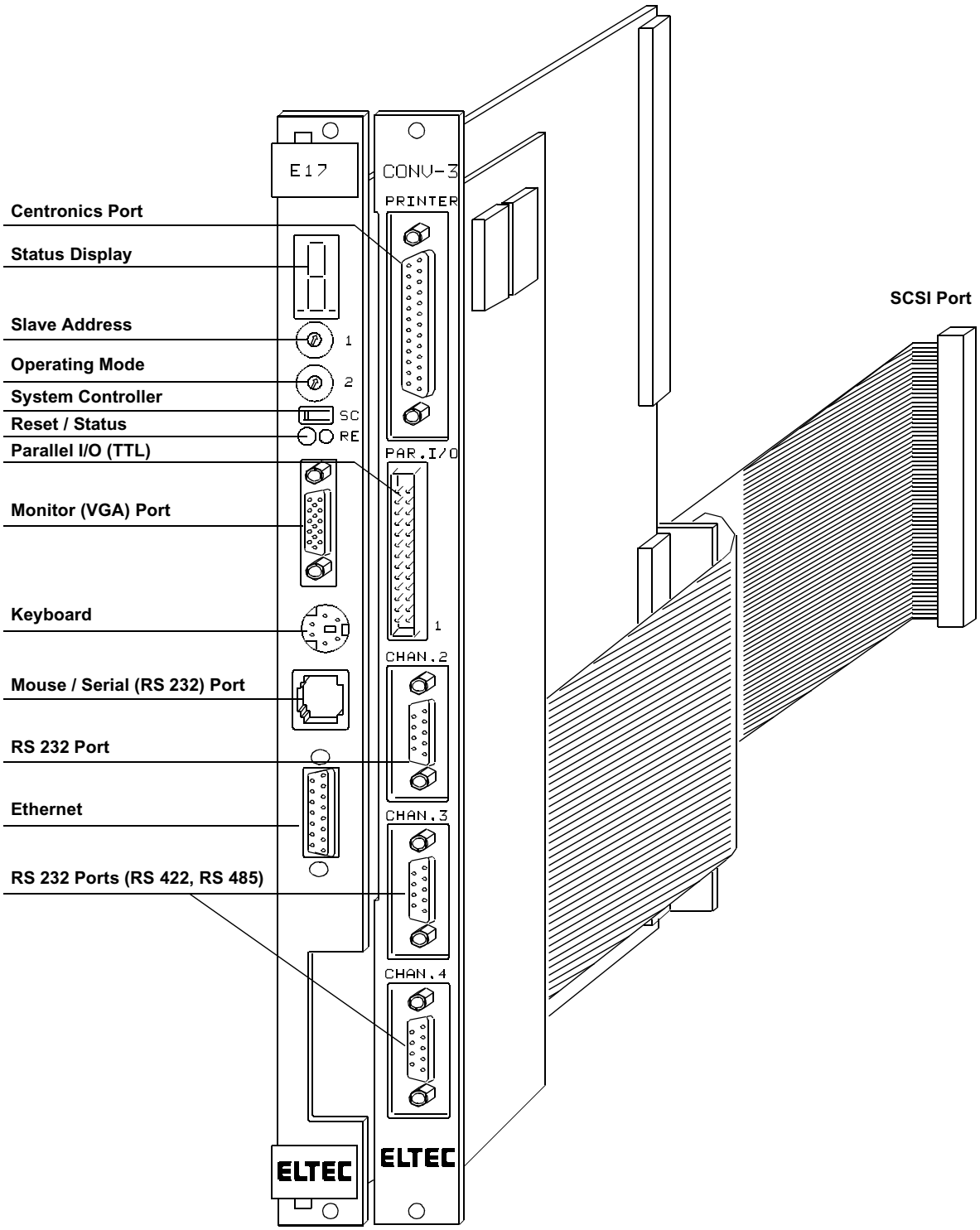
2.1.6 Pure 16-bit SCSI Installation

A 16-bit SCSI bus can be connected to X107 of ADAP-220. If the EUROCOM-17-5xx is located at either end of the SCSI bus, RN601-604 must be installed for signal termination, otherwise RN601-604 must be removed.

2.1.7 Mixed 8/16 bit SCSI Installation

ADAP-220 can be used to build mixed 8/16 bit SCSI bus systems. In this case X103 and X107 are used. RN601-604 must be removed from the EUROCOM-17-5xx and two of the resistor networks must be plugged into RN101-102 sockets of the ADAP-220 (note pin 1 marking of the networks and the sockets).

Figure 4: Installation Diagram



2.2 Default Board Setting

Table 14: Default Settings

Jumpers/Switches	Position	Description
J301	1 - 2	VIC68
J1201	1 - 2	Digclk, see Section 2.3.1 'Digclk Invertion (J1201)'
J1202	open	TTL graphic outputs disabled, see Section 2.3.2 'Enable TTL Video (J1202)'
J1401	closed	Watchdog period 100 ms, see Section 2.3.3 'Watchdog Period (J1401)'
J1601	open	No programming voltage for Flash EPROM, see Section 2.3.4 'Flash EPROM Programming Voltage (J1601)'
J1605	1 - 2	See Section 2.3.5 'Pin 1 Connection of EPROM (J1605)'
J1701	open	Boot from Flash EPROM
J1702	closed	Write enable for serial EEPROM, seeSection 2.3.6 'EEPROM Write Enable (J1702)'
J1703	open	No VMEbus IRQs handled by secondary CPU. (See Section 2.3.8 'VMEbus Interrupts for Secondary CPU (J1703)')
J1801	1 - 2	See Section 2.3.7 'Snooping of Secondary CPU (J1801)'
S901	0	VMEbus slave address at $8000.0000, see Section 2.3.9.1 'VMEbus Slave Address (S901)'
S902	0	Default initialization values, see Section 2.3.9.2 'Hardware Configuration (S902)'
S3	SC	System controller enabled, see Section 2.3.9.3 'System Controller Switch (S3)'

Figure 5: Location of Jumpers (Bottom View)

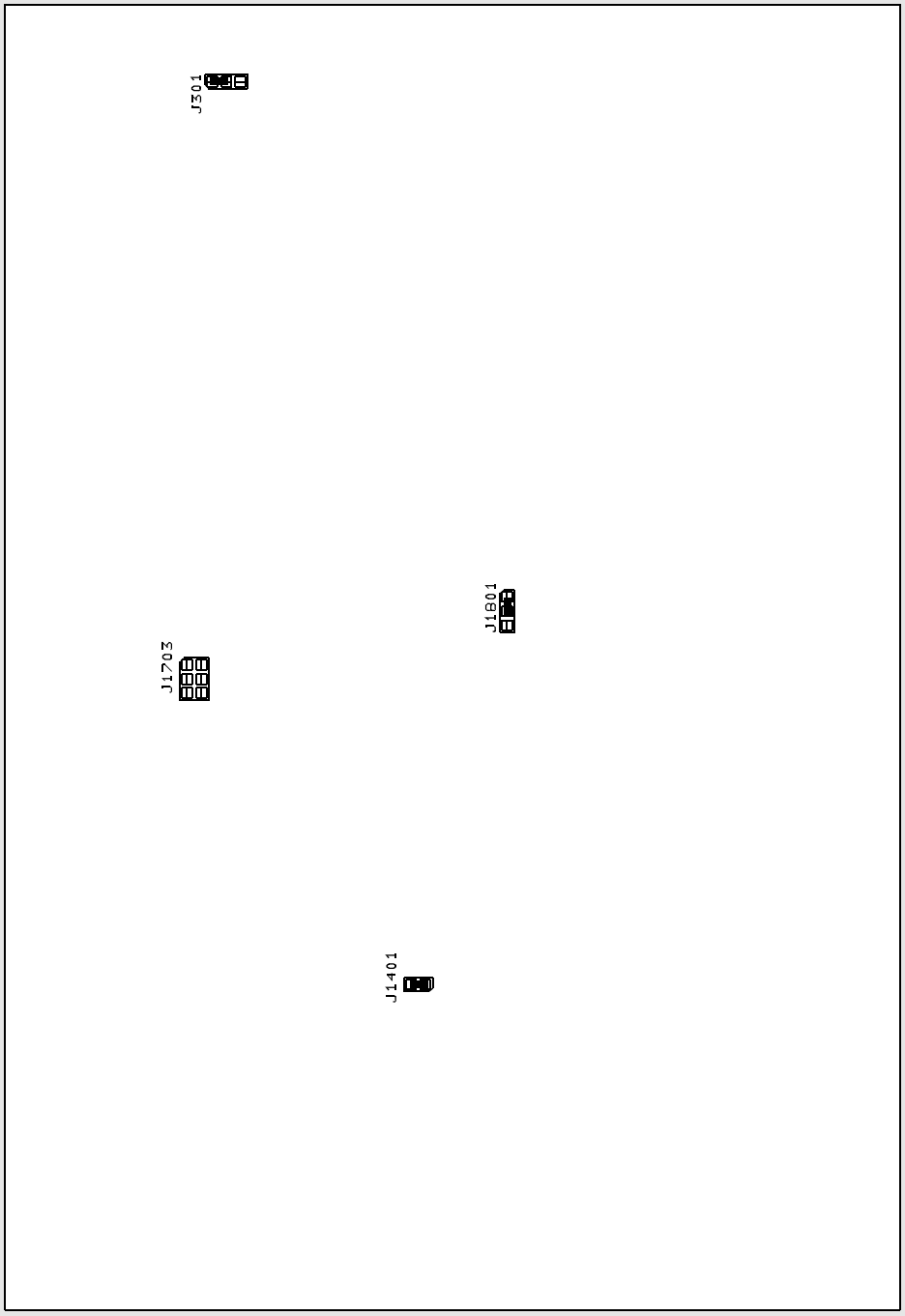
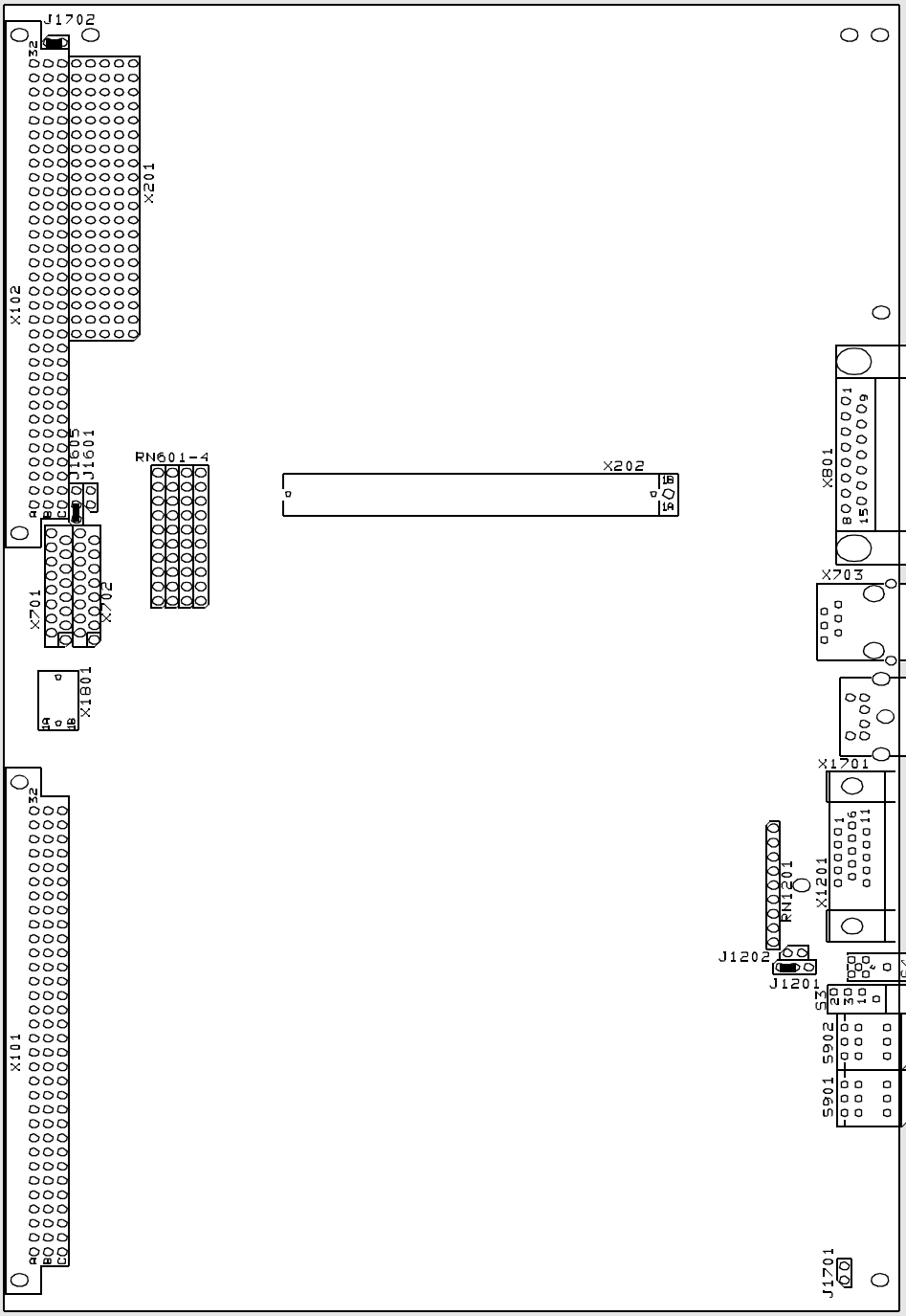


Figure 6: Location of Jumpers, Interface Connectors and Switches



2.3 Jumpers and Switches

This section lists all features user-selectable by jumpers and switches. For details, refer to the appropriate descriptions identified in parentheses.

All settings on a dark grey background ( ) indicate default settings. The EUROCOM-17-5xx operates as single board computer in this configuration.

There are only very few jumpers on the EUROCOM-17-5xx which typically need no changes after shipping. All other parameters are software programmable. Since the jumper connections are not changed easily, it is strongly recommended that these changes are performed by qualified personal only.

The user should refer to the silkscreen print on the component side of the EUROCOM-17-5xx for the following guidance on jumper area pin identification. Pin 1 of every jumper area is marked by a beveled corner on the silkscreen outline of the jumper. If you see this corner at the left upper side of the jumper area, then pin 2 is on the right-hand side of pin 1. Pin 3 can be found on the right of pin 2, and so on. Reaching the end of the row, counting must be continued beginning on the left-hand side of the next row.

2.3.1 Digclk Invertion (J1201)

J1201 allows to invert the Digclk signal.

Table 15: J1201 (Digclk Invertion)

Jumper J1201	Function
1 - 2	**Digclk**
2 - 3	Inverted Digclk

2.3.2 Enable TTL Video (J1202)

J1202 is used to enable the TTL video outputs at the VGA connector.

Table 16: J1202 (Enable TTL Video Outputs)

Jumper J1202	Function
open	**TTL outputs disabled**
closed	TTL outputs enabled

2.3.3 Watchdog Period (J1401)

J1401 is to select between 100 ms and 1.6 s watchdog periods. J1401 is a soldering jumper.

Table 17: J1401 (Watchdog Period)

Jumper J1401	Function
open	Watchdog period 1.6 s
closed	**Watchdog period 100 ms**

2.3.4 Flash EPROM Programming Voltage (J1601)

Table 18: J1601 (Flash EPROM Programming Voltage)

Jumper J1601	Function
open	**No programming voltage on Flash EPROM**
closed	Apply +12 V to Flash EPROM for programming

2.3.5 Pin 1 Connection of EPROM (J1605)

This jumper allows to select between EPROMs up to 4 Mbit and 8 Mbit.

Table 19: J1605 (Pin 1 Connection of EPROM)

Jumper J1605	Function
1 - 2	**Pin 1 connected to +5 V (< 8 Mbit)**
2 - 3	Pin 1 connected to A19 (8 Mbit)

2.3.6 EEPROM Write Enable (J1702)

J1702 enables/disables the hardware write protection for the serial EEPROM. Only the upper 256 B of the EEPROM can be write protected.

Table 20: J1702 (EEPROM Write Enable)

Jumper J1201	Function
open	Write protection enabled
closed	**Write protection disabled**

2.3.7 Snooping of Secondary CPU (J1801)

If snooping of the secondary CPU is enabled via the snoop control register SNCR, the /MI output of the secondary CPU must be observed (J1801 in position 2-3).

If snooping of the secondary CPU is disabled or in single processor systems, /MI of the secondary CPU can be ignored (J1801 in position 1-2).

Table 21: J1801 (Snooping of Secondary CPU)

Jumper J1801	Function
1 - 2	**Ignore /MI of secondary CPU**
2 - 3	Observe /MI of secondary CPU

2.3.8 VMEbus Interrupts for Secondary CPU (J1703)

To enable interrupt handling on the VMEbus by the secondary CPU, J1703 must be set to the corresponding level. Only one VMEbus interrupt level can be handled by the secondary CPU! For more information, see Section 3.19.3 ‘VMEbus Interrupts for the Secondary CPU’.

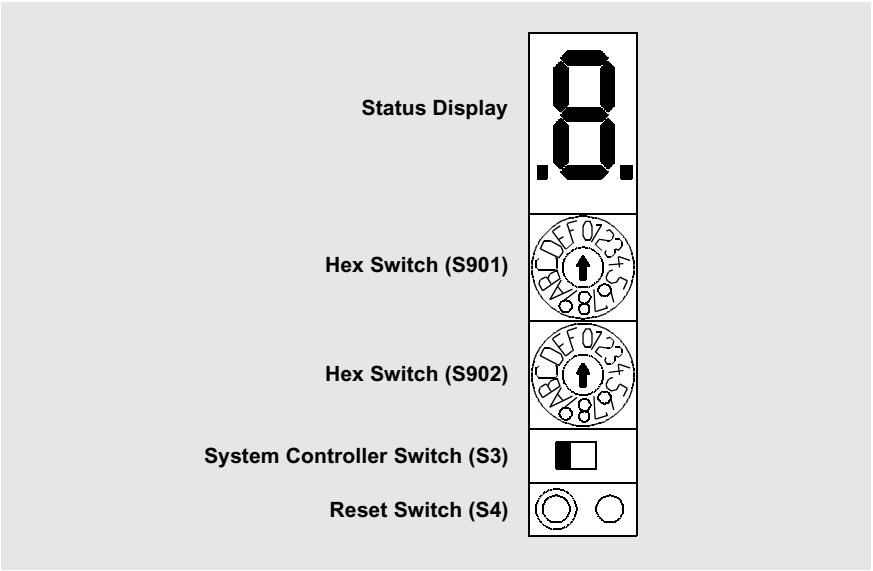
Table 22: J1703 (VMEbus Interrupts for Secondary CPU)

Jumper J1703	Function
5 - 3	VMEbus interrupt level 7
1 - 3	VMEbus interrupt level 5
2 - 4	VMEbus interrupt level 3
6 - 4	VMEbus interrupt level 1
open	**No VMEbus interrupts for secondary CPU**

2.3.9 Switches

Two rotary hex switches (S901 and S902), the system controller switch (S3) and the reset switch (S4) are all located on the front panel. If the system controller switch (S3) is switched to the 'SC' position, the board acts as VMEbus system controller.

Figure 7: Switches S901 to S4



Both hex switches (S901, S902) are used by RMon for the configuration setup (see RMon manual).

2.3.9.1 VMEbus Slave Address (S901)

The upper hex switch (S901) selects the EUROCOM-17-5xx slave window address. The size of the A32 slave window is normally 256 MB. This can be changed by the RMon setup menu. The size of the A16 slave window (used for VIC access) is 256 bytes.

Table 23: Hex Switch S901 (VMEbus Slave Address)

Hex Switch S901	VMEbus Base Address		
	A32	**A24**	**A16**
F	$F000.0000	disabled	$F000
E	$E000.0000	disabled	$E000
D	$D000.0000	disabled	$D000
.	.	.	.
1	$1000.0000	disabled	$1000
0	Use configuration value		

A24 access must be enabled separately.
For a detailed description, see Section 3.2.3 'Address Translation'.

2.3.9.2 Hardware Configuration (S902)

The lower switch (S902) defines the configuration source and the operation mode. For switch position 0, 1, RMon enters an interactive mode. If switch S902 is in position 8 to F, the program located in the user EPROM is called.

Table 24: Hex Switch S902 (Hardware Configuration)

Hex Switch S902	Function
0	Hardware configuration from basic EPROM
1	Hardware configuration from SRAM
2	Reserved for ELTEC
3	RMon interactive mode on serial port
4	RMon interactive mode on dual-ported RAM (local address $C000)
5 - 7	Reserved for ELTEC
8 - F	Hardware configuration from SRAM and start program in user EPROM.

S901 and S902 have no direct influence. A changed position becomes only effective after the next reset (i.e. the software reads the switches and programs the appropriate registers).

2.3.9.3 System Controller Switch (S3)

Table 25: Switch S3 (System Controller Switch)

Hex Switch S3	Function
left	System controller disabled
right 'SC'	**System controller enabled**

3 Programmers Reference

3.1 Address Map

The EUROCOM-17-5xx is designed to utilize the entire 4 GB address range of the 68040 chip. Using the address modifier of the VMEbus, the address range may be enlarged by subdivision into data and program areas and/or user and supervisor areas. The EUROCOM-17-5xx recognizes two address areas: the local address space and the global VMEbus address space.

Table 26: Address Assignment of EUROCOM-17-5xx

Address Range	Device	VMEbus Address Modifier	Cache [1]	Burst [2]	Access Width [b]
$0000.0000 - $0FBF. FFFF	Local RAM	local	Y	Y	32
$0FC0.0000 - $0FCF.FFFF	Video RAM	local	Y	Y	32
$0FD0.0000 - $0FDF.FFFF	Reserved	-	-	-	-
$0FE0.0000 - $0FEF.FFFF	Overlay RAM	local	Y	Y	32/16
$0FF0.0000 - $0FFF.FFFF	Reserved	-	-	-	-
$1000.0000 - $1FBF.FFFF	Local RAM (mirrored)	local	N	Y	32
$1FC0.0000 - $1FCF.FFFF	Video RAM (mirrored)	local	N	Y	32
$1FD0.0000 - $1FDF.FFFF	Reserved	-	-	-	-
$1FE0.0000 - $1FEF.FFFF	Overlay RAM (mirrored)	local	N	Y	32/16
$1FF0.0000 - $1FFF.FFFF	Reserved	-	-	-	-
$2000.0000 - $FE3F.FFFF	VMEbus Extended I/O	A32	N [3]	N	32/16/8
$FE40.0000 - $FE7F.FFFF	LEB	local	N	N	32/16/8
$FE80.0000 - $FE9F.FFFF	Flash EPROM	local	Y	N	8
$FEA0.0000 - $FEBF.FFFF	User EPROM	local	Y	N	8
$FEC0.0000 - $FECF.FFFF	Local I/O	local	N	N	32/16/8
$FED0.0000 - $FEFF.FFFF	Reserved	-	-	-	-
$FF00.0000 - $FFFE.FFFF	VMEbus Standard I/O	A24	N	N	32/16/8
$FFFF.0000 - $FFFF.FFFF	VMEbus Short I/O	A16	N	N	16/8

1. Y = /TCI driven high, N = /TCI driven low.
2. Y = /TBI driven high, N = /TBI driven low.
3. Caching may be enabled via system control register.

Accesses to reserved local RAM areas will generate a bus error.

Table 27: Local I/O Address Assignment for EUROCOM-17-5xx

Address	Device	Size	Access
$FEC0.0000 - $FEC0.7FFF	VIC (D0..7)	byte	read/write
$FEC0.8000 - $FEC0.FFFF	VMEbus Decoder (D0..31) see Section 3.2.2 'RAM Access from the VMEbus'	lword	write
$FEC1.0000 - $FEC1.FFFF	User CIO	byte	read/write
$FEC2.0000 - $FEC2.FFFF	NVRAM/RTC	byte	read/write
$FEC3.0000 - $FEC3.FFFF	System CIO	byte	read/write
$FEC4.0000 - $FEC4.FFFF	Video Controller	lword	read/write
$FEC5.0000 - $FEC5.3FFF	Watchdog	byte	read/write
$FEC5.4000 - $FEC5.7FFF	Revision EEPROM IRQ Control	byte	read
$FEC5.8000 - $FEC5.BFFF	Secondary CPU Control Register	byte	read/write
$FEC5.C000 - $FEC5.DFFF	Enable slave select (ESR) see Section 3.2.2 'RAM Access from the VMEbus'	byte	write
$FEC5.E000 - $FEC5.FFFF	Snoop Control Register	byte	write
$FEC6.0000 - $FEC6.3FFF	Keyboard Controller	byte	read/write
$FEC6.4000 - $FEC6.7FFF	Serial I/O	byte	read/write
$FEC6.8000 - $FEC6.BFFF	ILACC	lword	read/write
$FEC6.C000 - $FEC6.FFFF	SCSI Controller	lword	read/write
$FEC7.0000 - $FEC7.FFFF	IOC-2	lword	read/write
$FEC8.0000 - $FECF.FFFF	Reserved	-	-

3.2 DRAM

3.2.1 RAM Access from the Local CPUs

The base address of the DRAM is fixed to $0000.0000.

After reset, the basic EPROM is mapped to address $0000.0000. After some initialization the firmware enables the DRAM at $0000.0000 via PA5 of the system CIO.

3.2.2 RAM Access from the VMEbus

The base address and window size for VMEbus access is specified by the slave base address register (SBR), the slave mask register (SMR) and the enable slave select register (ESR) of the EUROCOM-17-5xx. The SBR and the SMR are only accessible by the local CPUs by longword write cycles. They are undefined after reset and must be written before the EUROCOM-17-5xx can be accessed from the VMEbus. The ESR is cleared (disabling all slave accesses) by power-on reset and the reset switch. The ESR can only be accessed by byte write cycles.

Table 28: Slave Base Address Register and Slave Mask Register Layout

Reg.	Address	31 24	23 16	15 8	7 0
SMR	$FEC0.80F0	A32 Mask	A24 Mask	ICF1 Mask	ICF2 Decoder
SBR	$FEC0.80F4	A32 Decoder ext. access	A24 Decoder std. access	ICF1 Decoder short I/O	ICF2 Decoder short I/O

Do not use other addresses for the SMR and SBR registers.

The A32 decoder compares A31 to A24 of the VMEbus with the SBR bits 32 to 24 for VMEbus extended access. The A24 decoder compares A23 to A16 of the VMEbus with the SBR bits 23 to 16 for VMEbus standard access.

The ICF1 decoder compares A15 to A8 of the VMEbus with the SBR bits 15 to 8. If a SMR mask bit is set, then the corresponding VMEbus address bit is ‘don’t care’. For full support of the VIC’s interprocessor communication features, the EUROCOM-17-5xx has a second A16 decoder called ICF2 decoder. The ESR register allows separate enabling of the four comparators.

Table 29: Enable Slave Register Layout

Reg.	Address	7 ... 4	3	2	1	0
ESR	$FEC5.C000	unused	ICF2 (A16)	ICF1 (A16)	VSTD (A24)	VEXT (A32)

1 = Decoder enabled
0 = Decoder disabled

Writing the SBR clears all mask bits of the SMR, so that the SBR must be written before the SMR. Writing the SMR also writes the IFC2 decoder.

3.2.3 Address Translation

The address presented by the VMEbus, the LEB, or the ILACC is translated from the '020 bus (A_{020}) to the ‘040 bus (A_{040}) with the help of the MBAR (memory base address register) and ASR (address substitution register) of the IOC-2. The address on the ‘040 bus is calculated using the following formula:

A_{040} = (MBAR & ASR) + (A_{020} & /ASR)
& logical AND operation,
+ logical OR operation,
/ logical complement.

The translation is necessary for snooping of the primary CPU to keep its caches consistent with the memory.

The translated address must always be in the DRAM or VRAM. If not, the computer crashes in most cases. Accessing mirrored DRAM/VRAM locations has to be avoided because this causes inconsistencies between the memory and the caches of the primary CPU. For all address lines not driven by the source the corresponding bit position in the ASR must be 1 so that the invalid bits are substituted.

Unfortunately the address translation exists only once for the three address sources (VMEbus, LEB, ILACC). This leads to some restrictions when the DRAM/VRAM is accessed by A24 addressing from the VMEbus or the LEB. In this case only parts of the DRAM/VRAM can be reached by VMEbus A32 addressing or the ILACC.

Example:

1 MB slave window size for VMEbus A24 addressing at $C0.0000 to the first MB of the DRAM:

MBAR = $0000.0000
ASR = $FFF0.0000
SBR = $xxC0.xxxx
SMR = $xx0F.xxxx

In this case VMEbus A32 addressing, the LEB, or the ILACC also reach only the local address range $0000.0000 to $000F.FFFF, i.e. the first MB of the DRAM.

To avoid problems, ELTEC recommends that VMEbus A24 slave access is only used when absolutely necessary and with extreme care. DMA IPINs should deliver at least A0 to A26 for operation with the default configuration.

3.2.4 RAM Mirror

When the secondary CPU uses copyback or writethrough cache mode for the DRAM/VRAM and snooping is disabled, the DRAM/VRAM can become inconsistent with the cache of the secondary CPU. This can cause problems when such data should be accessed by another device (primary CPU, VMEbus, ILACC).

To avoid this, the secondary CPU has to use the cache inhibited RAM mirror ($1000.0000 - $1FFF.FFFF) for global data. The other devices must also use the mirrored RAM to avoid accessing data cached in the primary CPU.

3.2.5 RAM Access from the LEB

Access from the Local Extension Bus (LEB) is done by using a standard 68k-like requester with three-line handshake (/BR, /BG, /BGACK).

During master transfers from the LEB a minimum of 24 address lines (A0 - A23) must be driven. For operation with the default configuration (256 MB slave window) at least A0 to A27 must be driven (see Section 3.2.3 ‘Address Translation’).

3.2.6 RAM Access from ILACC

The AM79C900 Ethernet Controller uses DMA transfer cycles to transfer commands, data and status information to and from the DRAM.

3.3 VMEbus Interface

Each EUROCOM-17-5xx has a VMEbus master and a VMEbus slave interface. Additionally, VMEbus system controller functions are available via the VMEbus gate array (VIC) used on the EUROCOM-17-5xx board.

3.3.1 System Controller

The EUROCOM-17-5xx features a full slot-one system controller, including SYSCLK, SYSRESET, bus time-out, IACK daisy chain driver, and a four level arbitration circuit. System controller capabilities are enabled by switch S3 in position 'SC' at the front panel.

SYSCLK

The SYSCLK is always driven if the system controller is enabled.

SYSRESET

A low level on this signal resets the internal logic and asserts the local reset for a minimum of 200 ms. If the VIC is configured as system controller, the reset switch on the front panel (S3) asserts the SYSRESET for a minimum of 200 ms.

Writing a $F0 to the system reset register of the VIC at address $FEC0.10E3 resets all registers of the VIC and asserts the SYSRESET output for a minimum of 200 ms.

BTO

The VIC includes two independent bus time-out modules (BTO) for local cycles and for VMEbus cycles. The VMEbus time-out is only enabled when the VIC is configured as system controller. On VIC reset, the VMEbus time-out period is set to 64 µs and the local bus time-out period to 32 µs. This can be altered by programming the transfer time-out register of the VIC at address $FEC0.10A3. Use the RMon setup menu to change this value.

Four Level Arbiter

If the VIC is configured as system controller, the four level arbiter is enabled and programmed by writing into the arbiter / requester configuration register at address $FEC0.10B3. Use the RMon setup menu to change this value.

3.3.2 VMEbus Master Interface

The master interface of the EUROCOM-17-5xx board supports 8, 16, and 32-bit data transfer cycles in A32, A24, and A16 addressing modes. For a short overview, see Section 1.5 'Definition of Board Parameters'.

3.3.2.1 Longword Access to Wordwide Slaves

Two different control lines of the system CIO enable longword breaking for the A32 and A24/A16 area:

PA3: * 0 : forces A24(A16)/D16 data size on VMEbus
1 : allows A24(A16)/D32 data size on VMEbus

PA4: * 0 : allows A32/D32 data size on VMEbus
1 : forces A32/D16 data size on VMEbus

* specifies the default values set by RMon.
Use the RMon setup menu for changes.

3.3.2.2 Address Modifier Source

The VIC chip supplies the VMEbus address modifier signals. This is done by either routing FC0..2 line to AM0..2, or by driving these signals by an internal address modifier source register of the VIC ($FEC0.10B7). The AM3..5 lines are driven depending on the actual data size, or by the address modifier source register. One CIO output signal is used to control this option:

PA2: * 0 : uses CPU and address size dependent modifiers
1 : uses VIC's address modifier source register

* specifies the default values set by RMon.
Use the RMon setup menu for changes.

For a detailed description of the address modifier values, see Section A.2 'Address Modifiers on VMEbus'.

3.3.2.3 Read-Modify-Write Cycles

Read-modify-write cycles, like TAS or CAS2 are supported by the EUROCOM-17-5xx.

The CAS2 instruction has only limited support (see Table 1: 'CAS2 Operations on the Various Busses'). The easiest way to ensure that CAS2 instructions are indivisible is to have both operands of the CAS2 instruction within the same memory area (local RAM, VMEbus, LEB).

3.3.2.4 VMEbus Block Transfer Option

The EUROCOM-17-5xx board supports master/slave block transfer cycles. This is done by the **MOVEM.L** operation of the CPU, or by the local DMA device in the VIC. The data size is restricted to D32 and may cross 256 byte boundaries if the slave is also capable of boundary crossing.

Several options within the VIC chip allow to generate different block transfer cycle types. The following code initializes a DMA write block transfer of two times 256 bytes (write block):

```
          MOVE.L    #$4000,d0           local source address
          MOVE.L    #$80002000,A0       VMEbus target address
          MOVE.B    #$20,$FEC010D3      32 byte blocks
          MOVE.B    #$01,$FEC010DB      256 byte total
*  disable interrupts which may use VIC or VMEbus
          MOVE.B    #$00,$FEC010BF      clear DMA status
          MOVE.B    #$40,$FEC010D7      enables DMA block transfer
                                        mode
          MOVE.L    D0,(A0)             start DMA block transfer
          NOP
LOOP1     BTST      #0,$FEC010BF        wait for BLT finished
          BNE       LOOP1
          MOVE.B    #$00,$FEC010BF      clear DMA status
          ADD.L     #$100,D0            next block
          ADD.L     #$100,A0
          MOVE.L    D0,(A0)             start DMA block transfer
          NOP
LOOP2     BTST      #0,$FEC010BF        wait for BLT finished
          BNE       LOOP2
          MOVE.B    #$00,$FEC010D7      terminate block transfer
*  Interrupts may be enabled
          ...
```

During transfer, the user has to check the DMA status register ($FEC0.01BF) and the bus error register of the VIC ($FEC0.10BB) to see if a VMEbus error condition has occurred. To speed up block transfer cycles, set bit 1 of the interface configuration register of the VIC ($FEC0.10AF). This may violate the VMEbus specification, but is guaranteed to operate with any EUROCOM-17-5xx board.

Block transfer with byte or word size is impossible. Also the start address and the transfer length must be multiples of 16 bytes.

3.3.2.5 A16 Slave Interface (ICMS, ICGS)

A very useful feature of the VIC is a set of registers and switches for message passing or event signaling.

There are eight bytewide general-purpose interprocessor communication registers accessible from the VMEbus or the local bus (CPU).

- Registers 0 to 4 are general-purpose dual-port registers.
- Register 5 is a dual-port read-only ID register to identify the VIC and its revision level.
- Register 6 is a module status register which is read-only from the VMEbus.
- Register 7 provides semaphores for registers 0-4 and several system control functions like a remote reset function.

Four ‘Interprocessor Communication Module Switches’ (ICMS) and four ‘Interprocessor Communication Global Switches’ (ICGS) are provided by the VIC. These are bytewide mailbox switches to signal events by generating an interrupt to the local CPU if accessed from the VMEbus. To signal dedicated events/messages the ICMS locate a unique set of addresses. To support this feature, two separate ICF address decoders are installed on the EUROCOM-17-5xx board. The ICF1 decoder for dedicated board specific messages and the ICF2 decoder to feature global messages. Each decoder is enabled separately.

The intercommunication registers within the VIC chip are accessible in A16 VMEbus address space only.

For programming the ICF decoder registers, see the description of the slave base address register, slave mask register and enable slave select register in Section 3.2.2 ‘RAM Access from the VMEbus’.

Use the RMon setup menu to change the register values. Within the 256-byte space the VIC chip locates several intercommunication registers.

Table 30: Intercommunication Register Location on VMEbus

Register Type	A07	06	05	04	03	02	01	AM5..0
Interprocessor Communication Registers	X	X	0	0	#	#	#	$2D
Interprocessor Communication Global Switches	X	X	0	1	0	#	#	$2D
Interprocessor Communication Module Switches	X	X	1	0	0	#	#	$2D or $29

X : don't care.
: selects register/switch number.

For further information, refer to the VIC068 data sheet.

3.4 Graphics Interface

3.4.1 Video Graphics Address Map

Table 31: Video Address Map

Address	Access to	Port Size (Bit)	Access Type
$0FC0.0000-$0FCF.FFFF	Video Memory 1 MB	32/16/8	read/write burst
$0FE0.0000-$0FEF.FFFF	Overlay Memory 0.5 MB	32/16	read/write burst
$FEC4.0000-$FEC4.0007	Direct Register of Bt445	8	read/write
$FEC4.0008-$FEC4.7FFF	Mirrored Direct Register of Bt445		
$FEC4.8000-$FEC4.8007	Address and Sync Generator	8	write only
$FEC4.8008-$FEC4.FFFF	Mirrored Address/Sync Generator		

Table 32: Register of Bt445

Direct Address	Indirect Address	Name	Description
$FEC4.0000	$XX	BT_ADR	Address Register
$FEC4.0001	$00-$FF	BT_CLUT	Primary Color Palette RAM
$FEC4.0002	$00	IDR	ID Register
	$01	RR	Revision Register
	$04	RER	Read Enable Register
	$05	BER	Blink Enable Register
	$06	CR0	Command Register 0
	$07	TR0	Test Register 0
	$08-$FF		Reserved
$FEC4.0003	$00-$0F	BT_OVLU	Overlay Color Palette RAM
	$10-$FF		Reserved
$FEC4.0004	$XX		Reserved
$FEC4.0005	$00	RMSBP	Red MSB Position
	$01	RWC	Red Width Control
	$02	RDEC	Red Display Enable Control
	$03	RBER	Red Blink Enable Register
	$04-$07		Reserved
	$08	GMSBP	Green MSB Position
	$09	GWC	Green Width Control
	$0A	GDEC	Green Display Enable Control
	$0B	GBER	Green Blink Enable Register
	$0C-$0F		Reserved
	$10	BMSBP	Blue MSB Position
	$11	BWC	Blue Width Control
	$12	BDEC	Blue Display Enable Control
	$13	BBER	Blue Blink Enable Register
	$14-$17		Reserved
	$18	OMSBP	Overlay MSB Position
	$19	OWC	Overlay Width Control

Table 32: Register of Bt445 (Continued)

Direct Address	Indirect Address	Name	Description
$FEC4.0005	$1A	ODEC	Overlay Display Enable Control
	$1B	OBER	Overlay Blink Enable Register
	$1C-$1F	Reserved	Reserved
	$20	CMSBP	Cursor MSB Position
	$21	CWC	Cursor Width Control
	$22	CDEC	Cursor Display Enable Control
	$23	CBER	Cursor Blink Enable Register
	$24-$FF		Reserved
$FEC4.0006	$00	TR1	Test Register 1
	$01	CR1	Command Register 1
	$02	DOCR	Digital Output Control Register
	$03	VCCR	VIDCLK* Cycle Control Register
	$04		Reserved
	$05	PLLR0	PLL Rate Register 0
	$06	PLLR1	PLL Rate Register 1
	$07	PLLCR	PLL Control register
	$08	PLCR	Pixel Load Control Register
	$09	PPSPR	Pixel Port Start Position Register
	$0A	PFCR	Pixel Format Control Register
	$0B	MPXRR	MPX Rate Register
	$0C	SAR	Signature Analysis Register
	$0D	PDCR	Pixel Depth Control Register
	$0E	PBP	Palette Bypass Position
	$0F	PBWC	Palette Bypass Width Control
	$10-$FF		Reserved
$FEC4.0007	$00	CC0	Cursor Color 0
	$01	CC1	Cursor Color 1
	$02	CC2	Cursor Color 2
	$03	CC3	Cursor Color 3
	$04-$FF		Reserved

Table 33: Register of Address and Sync Generator

Address	Name	Description
$FEC4.8000	TRLSB	Transfer Address Least Significant Byte
$FEC4.8001	TRMIB	Transfer Address Middle Byte
$FEC4.8002	TRMSB	Transfer Address Most Significant Byte
$FEC4.8003		Reserved
$FEC4.8004	TRINC	Address Increment (pitch) in 128 byte steps: $01 = 128 bytes $02 = 256 bytes $03 = 384 bytes . . $0F = 1920 bytes $00 = 2048 bytes
$FEC4.8005	GRMODE	Bit No. Name Description 0 SPLIT 0 = sync. transfer, 1 = split transfer 1 DISOVERL 0 = 8 bit per pixel + 4 bit overlay 1 = 1/2/4/8 bit per pixel 2 PIXDEL 0 = don't delay digital pixel data, 1 = delay digital pixel data 3 INTERL 0 = noninterlaced, 1 = interlaced 4 ENTRA 0 = disable address transfer cycles, 1 = enable address transfer cycles 5 COMPSYN 1 = composite sync., 0 = separate sync.
$FEC4.8006	ADR1882	LM1882 Address Register
$FEC4.8007	DAT1882	LM1882 Data Register

3.4.2 Accessing the Internal Register of the Bt445

The Bt445 uses an indirect addressing scheme. To access a register, its indirect address must be written to the BT_ADR register at $FEC4.0000. Then the register can be accessed with a byte write or read operation to the appropriate direct address (see Table 32: ‘Register of Bt445’). After the access, the Bt445 increments the address register by one so that the following register can be accessed without writing the address register. Some registers use modulo 3 addressing. In this case incrementing will occur only every third access.

3.4.3 Address Generator

The address generator has five write-only registers. The three transfer address registers TRLSB, TRMIB, and TRMSB determine the address of the first displayed pixel of each frame. When the transfer increment register TRINC is programmed to a value larger than the line length and synchronous transfer mode is selected in the graphics mode register GRMODE, the address transfer register can be used to implement horizontal and vertical paning. When the SPLIT bit in the GRMODE register is set packed line mode is selected, which allows a resolution of up to 1152 x 900 with 8-bit per pixel. The ENOVERL bit enables 8-bit per pixel plus 4-bit overlay mode. PIXDEL is used to adjust horizontal backporch of the digital output with one pixel resolution. This is necessary for exact positioning on flat panel displays.

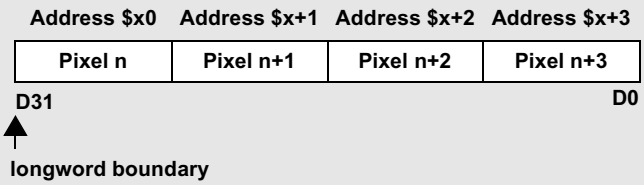
3.4.4 LM1882 Sync Generator

The EUROCOM-17-5xx implementation of the LM1882 uses Auto Addressing Mode and Auto-Load Mode (/LBYTE tied to high). For proper operation the bits B0 to B2 of REG0 must be programmed to either %100 or %110. Cursor location of the LM1882 is used to initiate the address transfer cycle for the next frame. Therefore cursor location must be programmed to be active for one line after the last displayed line. The cursor signal may be routed to LIRQ4 input of the VIC to trigger interrupts synchronous to the video signal.

3.4.5 Pixel Model

The video memory consists of two VRAMs (4-Mbit chips) with a total size of 1 MB and provides the serializer with an 8-bit x 4 data stream. The parallel port of the video RAM is 32-bit wide. Each byte represents one pixel in 8-bit mode allowing a resolution of 256 colors. The first displayed pixel of a longword is located at the lowest byte address. The last is located in the highest byte address of this longword. The first displayed longword of a frame is located at $0FC0.0000 plus the address stored in the transfer address registers TRLSB, TRMIB, and TRMSB of the address generator (top of screen address). Addressing a video line has to be done by adding a multiple of the address increment (pitch) to the top of screen address.

Figure 8: Pixel Model



For 1/2/4 bit per pixel operation, the most significant part of each byte represents the leftmost pixel and the least significant part represents the rightmost pixel on the screen.

3.4.6 Overlay Memory

The overlay memory has the same structure as the video memory. It starts at $0FE0.0000 and uses only the least significant nibble of each byte.

Overlay memory cannot be written with byte operations because the write enables of two adjacent pixels are tied together.

Overlay is only available when the video memory operates in 8-bit per pixel mode.

3.4.7 Video Parameter Restrictions

The EUROCOM-17-5xx graphic interface is rather freely programmable. However, some restrictions must be observed:

- Dotclock for analog output from 10 MHz to 120 MHz
- Dotclock for digital output from 10 MHz to 55 MHz
- Maximum SCLK (shift clock for serial port of VRAM) must be either 30 MHz or dotclock divided by two (whatever is less)
- Maximum VIDCLK (clock for sync generator) must be either 30 MHz or dotclock divided by two (whatever is less)
- PLL clock from 75 MHz to 150 MHz
- PLL reference clock is 25.175 MHz
- TRINC of the address register must be programmed to 512 for packed line format (i.e. if the SPLIT bit in the GRMODE register is set)
- TRINC of the address register must be programmed to 2048 for interlaced operation (this results in a pitch of 1024 bytes between two lines).

- In interlaced mode bit 2 of the TRMIB register can be used to swap the contents of the two frames.
- For interlaced operation REG4 of the LM1882 must be even.
- For interlaced operation with an odd number of lines (CCIR, EIA), the first and the last displayed line should be set to black because they are only displayed half.
- Interlaced mode can only be used when the SPLIT bit in the GRMODE register is clear.
- /PSYNC and /PHSYNC outputs of the Bt445 should never be enabled simultaneously because they are tied together.

3.4.8 Screen Resolutions

Table 34: Screen Resolutions

Resolution hor. x ver.	Horizontal Frequency	Vertical Frequency	Dotclock	Video Standard
1152 x 872	69.0 kHz	75 Hz	100 MHz	-
1152 x 900	62.0 kHz	66 Hz	93 MHz	SUN like
1024 x 768	56.0 kHz	70 Hz	80 MHz	SVGA like
1024 x 768	48.0 kHz	60 Hz	65 MHz	SVGA like
800 x 600	48.0 kHz	72 Hz	50 MHz	SVGA like
800 x 600	38.0 kHz	60 Hz	40 MHz	SVGA like
640 x 480	31.5 kHz	60 Hz	25 MHz	VGA like

3.4.9 Digital Video Output

Digital video output is enabled when J1202 is set and RN1201 is removed. J1201 selects whether inverted or non-inverted clock is sent to the display. This allows to satisfy the data setup- and hold times of a particular display type.

When using digital output it is essential to connect the display via a short piece of cable with minimum crosstalk and even propagation delay. Also the cable should be terminated at the display side. For distances up to 1 m, a flat cable with alternating ground and signal wires should be sufficient. The best solution, of course, are single shielded wires.

On the VGA connector the most significant bits of red, green, and blue and the second most significant bit of blue are available. The translation of the bits in the video memory to these bits can be programmed via the color palette of the Bt445.

3.5 Ethernet Interface (802.3/10base5)

The ILACC's internal registers are selected by writing the corresponding register number to address $FEC6.8006 and accessed at address $FEC6.8002. Both addresses must be accessed with word-size instructions.

After initialization and starting, the ILACC operates without any CPU interaction. It transfers prepared data, receives incoming packets and stores them into reserved memory locations. To signal service requests, the ILACC interrupt signal is connected to the VIC's LIRQ7 input. The VIC has to be programmed to level-sensitive and has to supply the vector, because the ILACC has no provision built to do so.

Table 35: Ethernet Controller Address Layout

Address	Description
$FEC6.8002	Register Data Port (RDP)
$FEC6.8006	Register Address Port (RAP)

A detailed description of the AM79C900 can be found in the data sheet.

3.6 CIO Counter / Timers

The EUROCOM-17-5xx offers six independent, programmable 16-bit counter / timers integrated in two CIOs. Three of these counters, located in the user CIO ($FEC1.0000), can be used as general-purpose devices with up to four external access lines per counter / timer (count input, output, gate, and trigger). Port A and C of this CIO are connected to X102 for user application. Refer to Table 8: 'Pin Assignment of Connector X102'.

The three counters located in the system CIO are used for internal control tasks.

Table 36: Address Assignment of the CIOs

Address	Description
$FEC3.0000	Port C Data Register System CIO
$FEC3.0001	Port B Data Register System CIO
$FEC3.0002	Port A Data Register System CIO
$FEC3.0003	Control Register System CIO
$FEC1.0000	Port C Data Register User CIO
$FEC1.0001	Port A Data Register User CIO
$FEC1.0002	Port B Data Register User CIO
$FEC1.0003	Control Register User CIO

The peripheral clock of both CIOs is connected to a 5 MHz source. The interrupt request outputs of both CIOs are connected to the LIRQ6 input of the VIC. The system CIO has the higher interrupt priority in the daisy chain. Local interrupt control register 6 (LIRQ6) of the VIC has to be programmed for an active low, level-sensitive input. The vectors are supplied by the CIOs. The VIC has to be programmed to generate interrupts on level 5 to the CPU. Only CPU IACK level 5 cycles are routed to the CIO devices.

The address assignments of both CIOs are different! The address assignment of the user CIO (at address $FEC1.0000) is the same as on the EUROCOM-6.
The CIOs and the serial controller CL-CD2401 are default connected to LIRQ6 of the VIC with the CL-CD2401 of the higher interrupt priority.

On default setting, the system CIO, user CIO and the CL-CD2401 are routed to the same IRQ level (LIRQ6) of the VIC. The CL-CD2401 has the highest priority.

A special feature of the EUROCOM-17-5xx is the programmable interrupt level of the CIOs and the graphic frame interrupt. So, the CIOs can be routed to an other interrupt level as the serial controller CL-CD2401.

The CIO interrupt level register (at address $FEC5.4001) allows to route the CIO interrupts to LIRQ6 or LIRQ4. Routed to LIRQ4, the VIC must be programmed to supply the vector and to generate the desired interrupt level for the CPU.

The CL-CD2401 is always routed to the LIRQ6 of the VIC.

Table 37: SCIO, UCIO Interrupt Level Register

Address	D7 - D0			
$FEC5.4001	X X X X X	FR	UCIO	SCIO
	(Default	0	0	0)

X don't care
FR Frame interrupt request
UCIO User CIO interrupt
SCIO System CIO interrupt

Table 38: Interrupt Level Assignment for SCIO, UCIO and FR

	LIRQ4	LIRQ6	Disabled
FR	0	-	1
UCIO	1	0	-
SCIO	1	0	-

Example:

D7 ... D0
XXXXX 1 0 1
routes the system CIO to LIRQ4. So, the VIC must supply the IRQ vector. The user CIO is routed to LIRQ6 and the frame interrupt capability is disabled.

3.7 Serial I/O

The EUROCOM-17-5xx offers four serial I/O lines, implemented by a CL-CD2401 Multi-Protocol Controller (MPC). C1 and C2 are hardwired to feature RS 232 two-wire (C1) and four-wire (C2) hardware handshake mode, while C3 and C4 use removable serial interface level converters (SILC). As shipped, two RS 232 level converter SILCs are installed featuring hardware handshake as well as XON/XOFF protocol. Different level converter plug-ins, like RS 422 and RS 485, are available.

3.7.1 Multi-Protocol Controller (MPC)

The operating mode and data format of each channel is programmed independently.

The baud rate generator is driven by 20 MHz. The time constant values in the following table are based on that frequency.

Table 39: Time Constant Values for MPC

Bit Rate	Divisor	Clock	Error (%)
50	$C2	clk4	-0.16
110	$58	clk4	-0.25
150	$40	clk4	+0.16
300	$81	clk3	+0.16
600	$40	clk3	+0.16
1200	$81	clk2	+0.16
2400	$40	clk2	+0.16
3600	$AD	clk1	-0.22
4800	$81	clk1	+0.16
7200	$56	clk1	-0.23
9600	$40	clk1	+0.16
19200	$81	clk0	+0.16
38400	$40	clk0	+0.16
56000	$2C	clk0	-0.79
64000	$26	clk0	+0.16

The interrupt request of the MPC is connected to the LIRQ6 input of the VIC. The MPC has higher priority than the CIOs in the daisy chain.

The local interrupt control register 6 (LIRQ6) of the VIC has to be programmed for an active low, level-sensitive input. The vectors are supplied by the MPC. The VIC has to be programmed to generate interrupts on level 5 to the CPU. Only CPU IACK level 5 cycles are routed to the MPC.

For polled operation, the MPC can be switched to IACK context by reading address $FEC6.6000 - $FEC6.7FFF. A0-A6 must match one of the priority interrupt level registers of the MPC.

3.8 Watchdog Timer

The watchdog timer installed on the EUROCOM-17-5xx monitors the activity of the microprocessor. If the microprocessor does not write location $FEC5.0000 within the time-out period of 100 ms (min. 70 ms; max. 140 ms) or 1.6 s (±30%), a reset pulse is generated. After reset, the watchdog timer is disabled. The normal time-out period of 100 ms becomes effective after the first write access to address $FEC5.0000.

If the watchdog timer generates a reset pulse, the left decimal point of the hex display located at the front panel is illuminated to indicate a watchdog reset. This watchdog indicator is cleared by power-up reset, the reset switch, a VMEbus SYSRESET, a VIC remote reset, or by a write access to address $FEC5.0000.

The state of the watchdog indicator can be read by software using port A of the system CIO ($FEC3.0002). If the left decimal point of the hex display is illuminated, PA7 of the system CIO is read as '0'. As a result of this, software can distinguish between a watchdog reset and a reset generated by the other sources.

Table 40: Address Assignment of Watchdog Registers

Address	Description	Access Direction
$FEC3.0002	Port A Data Register System CIO	read PA7
$FEC5.0000	Watchdog trigger	write

If the watchdog timer function is enabled at the first access to $FEC5.0000, $FEC5.0000 must be accessed within the time-out period of 100 ms!

3.9 Keyboard Interface

The keyboard interface is designed to support PS/2 compatible keyboards. This interface receives data from and transmits data to the keyboard under interrupt control. The keyboard interface consists of two registers: the data register and the control/status register.

Table 41: Address Assignment of Keyboard Controller Registers

Address	Description	Width [b]
$FEC6.0000	Data Register	8
$FEC6.0001	Control/Status Register	8

A write access to the data register loads the transmit shift register with the corresponding data byte. The data is immediately transmitted to the keyboard. If enabled, an interrupt is generated when the data byte was sent and the keyboard controller has received the line control bit from the keyboard. The write access to the data register clears the transmit buffer empty (TBE) bit in the status register.

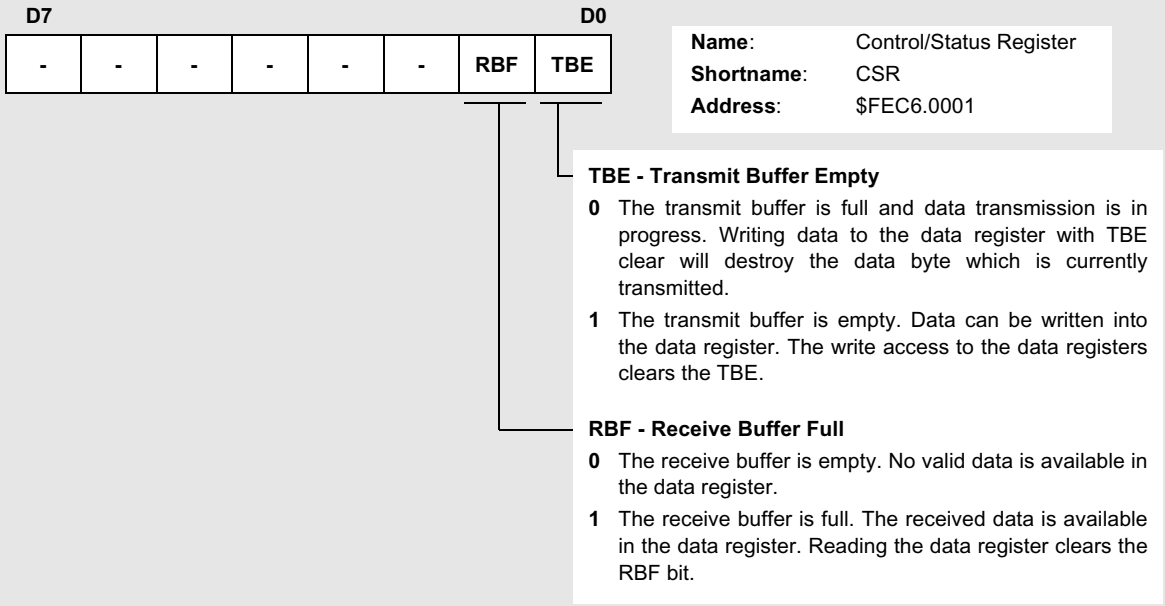
The received data is available in the data register. The contents of the data register is only valid if the receive buffer full (RBF) bit in the status register is set. The read access to the data register clears the RBF bit in the status register.

The keyboard interface is controlled by the control/status register (CSR). The following table shows the bits of the CSR. Read accesses to the CSR supply the control register, write accesses transfer data to the status register.

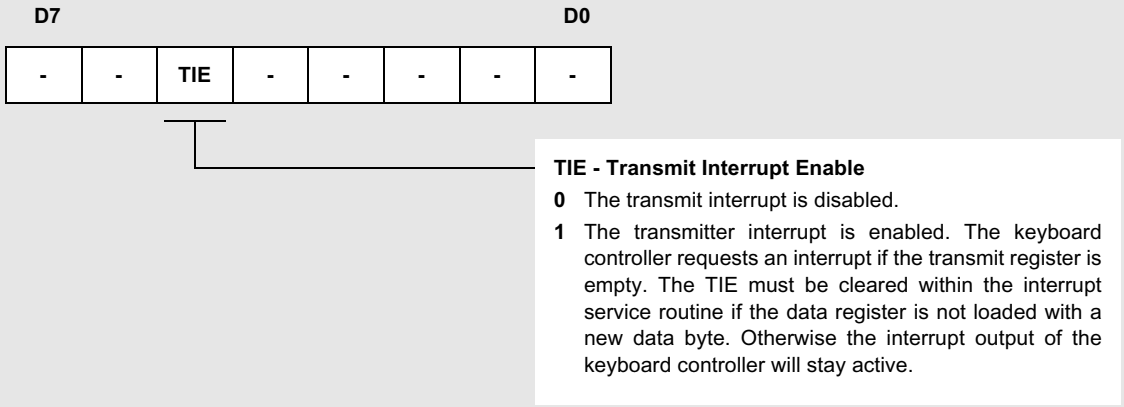
Do not use the M680xx **btst** *and* **bclr** *commands to access the CSR because read and write access do not affect the same bits.*

Table 42: Keyboard Control/Status Register CSR

Readable bits



Writable bits



To signal service requests the keyboard controller interrupt signal is connected to the VICs LIRQ1 input. The VIC has to be programmed to level-sensitive and has to supply the vector. The receiver interrupt can be enabled by the LIRQ1 of the VIC. If the transmitter interrupt enable (TIE) in the control register is set and the interrupts are enabled by the VIC, receiver and transmitter interrupts are serviced by the CPU.

3.10 IOC-2

ELTEC's Input/Output Controller (IOC-2) is an ASIC intended to maximize the performance of ELTEC's CPU boards. The IOC-2 is specially designed as data/address bridge between a 68040-type local bus and VIC068/064 to support fast VMEbus master/slave block transfers. A second main function is a universal programmable I/O bus interface with an appropriate address decoder.

3.10.1 Register Set

All 25 IOC-2 registers are read/write accessible using longword transfer cycles only. The internal address decoder reserves an IOC-2 address space of 64 KB. The following register map shows all internal registers and their corresponding register offset address. The complete CPU register address is calculated by:

IOALR value[1)] + Register OFFSET address

Table 43: Register Map

Offset Addr.	Symbol	Name	Reset Value
I/O Bus Interface Registers:			
$70000	IOALR	I/O Address Location Register	$FEC0.0000
$70004	IODCR0	I/O Device Control Register 0	$0000.0000
$70008	IODCR1	I/O Device Control Register 1	$0000.0000
$7000C	IODCR2	I/O Device Control Register 2	$0000.0000
$70010	IODCR3	I/O Device Control Register 3	$0000.0000
$70014	IODCR4	I/O Device Control Register 4	$0000.0000
$70018	IODCR5	I/O Device Control Register 5	$0000.0000
$7001C	IODCR6	I/O Device Control Register 6	$0000.0000
$70020	IODCR7	I/O Device Control Register 7	$0000.0000
$70024	IODCR8	I/O Device Control Register 8	$0000.0000
$70028	IODCR9	I/O Device Control Register 9	$0000.0000

1. Default register value: $FEC0.0000

Table 43: Register Map (Continued)

Offset Addr.	Symbol	Name	Reset Value
$7002C	IODCR10	I/O Device Control Register 10	$0000.0000
$70030	IODCR11	I/O Device Control Register 11	$0000.0000
$70034	IODCR12	I/O Device Control Register 12	$0000.0000
$70038	IOIACR	I/O IACK Control Register	$0000.0000
$7003C	--	reserved	
$70040	EBAR0	EPROM Begin Address Register 0	$0000.0000
$70044	EMAR0	EPROM Mask Register 0	$0000.0000
$70048	EDCR0	EPROM Device Control Register 0	$0000.020F $0000.0A0F
$7004C	- -	reserved	
$70050	EBAR01	EPROM Begin Address Register 1	$0000.0000
$70054	EMAR01	EPROM Mask Register 1	$0000.0000
$70058	EDCR1	EPROM Device Control Register 1	$0000.020F $0000.0A0F
$7005C - $7009C	- -	reserved	
Address Bus Interface Registers:			
$700A0	MBAR	Memory Base Address Register	$0000.0000
$700A4	ASR	Address Substitution Register	$FF80.0000
General Control Registers:			
$700A8	ICR	IOC-2 Control Register	$0000.22xx[1)]
$700AC	ITR	IOC-2 Test Register	$0000.0000

1. xx => IOD(7:0) during reset

3.11 SCSI Interface

A Small Computer System Interface (SCSI) controller is built around a NCR53C720 chip. The full specification (ANSI K3T 9.2) is implemented, supporting all standard SCSI features including arbitration, disconnect, reconnect, and parity.

3.11.1 SCSI Controller

The interrupt request line (IRQ) of the SCSI controller is connected to the LIRQ3 input of the VIC. The NCR53C720 cannot supply its own vector, so the VIC has to be programmed to supply a vector for the SCSI controller. The VIC LICR3 has to be programmed to level-sensitive and has to supply the IRQ vector.

The EUROCOM-17-5xx uses Big Endian Bus Mode 2 of the NCR53C720.

According to the SCSI specification, the interconnecting flat cable must be terminated at both ends. On the EUROCOM-17-5xx this is done through removable resistor networks (R601 - R604) between connector X101 and X102. If the EUROCOM-17-5xx board is not located at either end of the cable, these resistors must be removed.

A detailed description of the NCR53C720 controller chip can be found in the data sheet.

The first access to the NCR53C720 must set the EA bit in the DCNTL register of the NCR53C720. Accessing the NCR53C720 without the EA bit set will lock the CPU bus.

3.12 Status Display

The EUROCOM-17-5xx features a seven-segment display on the front panel and displays hexadecimal values from 0 to F.

This status display is designed as read/write register and uses the least significant nibble of the byte.

As an example, the following sequence moves a 'D' in the hex display:

move.b #$0D,$FEC30000

The left decimal point of the hex display is used as watchdog indicator. The watchdog indicator is illuminated if the watchdog timer has generated a reset pulse.

The right decimal point of the hex display is controlled by the PA0 output of the system CIO. After reset the right decimal point is illuminated. RMon switches the decimal point off before the user program in the user EPROMs is called.

The upper four bits of the display are write-enable bits for the lower four bits. Only those bits of the lower nibble are changed where the corresponding bit in the upper nibble is clear.

The display is only enabled when PA6 of the system CIO is low.

3.13 Battery-Backed Parameter RAM and Real-Time Clock

The real-time clock is designed with the MK 48T12 or MK 48T18 timekeeper RAM from SGS Thomson or DS1644 from Dallas. The chip combines a 2KBx8 (8KBx8, 32KBx8) CMOS SRAM (parameter RAM) a bytewide accessible real-time clock, a crystal, and a long life lithium battery, all in one package. The MK 48Txx devices have a battery lifetime of approximetly 3.7 years when the clock oscillator is running. To extend battery lifetime, the clock oscillator can be stopped. Alternatively a Dallas DS1642/1643 device can be used, which offers a lifetime of 10 years even if the oscillator is running. The Dallas devices do not offer the feature to check the internal battery via a battery OK flag like the SGS Thomson devices do.

3.13.1 Parameter RAM

The address area of this SRAM is divided into two main partitions:

- system dependent parameter data structure, defined by ELTEC to store setup parameters for hardware initialization and boot informations for operating systems,
- eight bytes of the SRAM for the registers of the real-time clock.

Table 44: Address Assignment of SRAM/RTC

Address	Description
$FEC2.0000 - $FEC2.07F7	Reserved for system configuration values. The structure of the system configuration values is defined in the RMon manual.
$FEC2.07F8 - $FEC2.7FF7	Free for user if DS1644 is installed.
$FEC2.7FF8 - $FEC2.7FFF	Real-time clock registers. See Section 3.13.2 ‘Real-Time Clock’ for more information.

The front panel hex switch position '00' uses the configuration values stored in the basic EPROM rather than values defined in the SRAM. For more details, see also the RMon description.

3.13.2 Real-Time Clock

The clock features BCD-coded year, month, day, hours, minutes, and seconds as well as a software controlled calibration. For lifetime calculations of the battery, please refer to the data sheet.

Access to the clock is as simple as conventional bytewide RAM access because the RAM and the clock are combined in the same chip.

Table 45: Address Assignment of the Real-Time Clock

MK 48T12 Address	Description
$FEC2.7FF8	RTC Control Register
$FEC2.7FF9	Seconds
$FEC2.7FFA	Minutes
$FEC2.7FFB	Hour
$FEC2.7FFC	Day
$FEC2.7FFD	Date
$FEC2.7FFE	Month
$FEC2.7FFF	Year

For further details, see the MK 48T12/MK 48T18 resp. DS1644 data sheet.

The SRAM/RTC can only be accessed with byte instructions.

3.14 VIC Timer

The VIC contains a timer which can be programmed to output a periodic wave form on LIRQ2. The frequencies available are 50 Hz, 100 Hz, and 1000 Hz. The timer is enabled and controlled by writing slave select control register 0. The interrupt is enabled and controlled by writing local interrupt control register 2.

The clock tick timer is typically used as a time base for multi-tasking operating systems, such as OS-9 or Lynx.
If other frequencies are needed, one of the six counters / timers that are included in the two CIOs may be used. For more details about the timer, refer to the VIC data sheet.

3.15 Reset

During power-up or after actuation of the reset switch (S4), /RESET is held low for approximately 1 s. If the system controller switch (S3) is in the 'SC' position, the VMEbus is also reset because the VIC is configured as the VMEbus system controller. Otherwise SYSRESET from the VMEbus is an input.

The reset switch or power-up reset affect all modules and chips on the EUROCOM-17-5xx board, and also the VMEbus SYSRESET line if switch S3 is in the 'SC' position. The LED included in the reset switching socket shows the status of the RESET line. RESET inactive means LED is illuminated.

If the reset is generated by the watchdog, the left decimal point of the hex display (watchdog indicator) is active and stays illuminated until it is reset by a voltage drop < 4.75 V, power-up, reset switch, SYSRESET, or VIC remote control reset. The state of the watchdog indicator can be read by port PA7 of the system CIO.

A remote reset via VIC's reset register or a VMEbus SYSRESET behaves the same way as a power-up reset, except that the VMEbus configuration (VIC register and master / slave address) is not changed.

Table 46: Reset Conditions

Reset Source	Effected Device
Voltage Drop < 4.75 V or Power-up or Reset Switch S3	CPUs, CL-CD2401, CIOs, Keyboard Controller, SCSI Controller, ILACC, VMEbus SYSRESET (if system controller), Watchdog Indicator, VMEbus Slave Decoder
VIC Remote Control Reset or SYSRESET	CPUs, CL-CD2401, CIOs, SCSI Controller, ILACC, Watchdog Indicator
Watchdog Reset	CPUs, CL-CD2401, CIOs, Keyboard Controller, SCSI Controller, ILACC,
Primary CPU	SCSI Controller, ILACC

3.16 Bus Time-Out

The EUROCOM-17-5xx features two independent, software-programmable bus time-out modules; one for the local time-out and one for the VMEbus time-out.

Both time-out modules are located in the VIC and are programmed by writing the transfer time-out register ($FEC0.10A3). The time-out period is programmable from 4 µs to 480 µs. Local time-out is not generated when waiting for VMEbus mastership. This is programmable within the VIC chip.

Local time-out is set to 32 µs and the VMEbus time-out is set to 16 µs by RMon. Use the RMon setup menu to change these values.

The VMEbus time-out is generated by the system controller and, therefore, is only used if the VIC is being used as the system controller. Switch S3 is used to enable/disable the board's system controller.

Access to the LEB triggers the local BTO generator.

3.17 System Control Register (SCR)

The EUROCOM-17-5xx features several status and control bits to monitor and change the system control signals. These are implemented using port lines of the system CIO. Reset initializes all ports as input. The default values are set during the RMon initialization routine.

Table 47: System Control Register Layout (System CIO)

Bit No.	Type	Name	Description
PA7	Input	WDS	Watchdog Status 0 = Watchdog Reset 1 = Normal Reset
PA6	Output	BLK	Blank Display 0 = Display enabled 1 = Display disabled
PA5	Output	RESCYC	Reset Cycle 0 = Address Decoder normal operation (default) 1 = Address Decoder reset operation (reset condition)
PA4	Output	DSCTRL0	VMEbus A32 Data Size Control 0 = normal longword operation for A32 (default) 1 = breaks longword cycles into two word cycles
PA3	Output	DSCTRL1	VMEbus A24 Data Size Control 0 = normal longword operation for A24 1 = breaks longword cycles into two word cycles (default)
PA2	Output	ASCTRL	VMEbus Address Modifier Source Control 0 = normal operation FC0..2 -> AM3..5 1 = VMEbus Address Modifier from VICs Address Modifier Source Register
PA1	Output	CACTRL	VMEbus Cache Control 0 = disables caching of VMEbus data (default) 1 = enables caching of VMEbus data
PA0	Output	INIT	Initialization Indicator on Front Panel 0 = on 1 = off
PB7..0	Input	HEXSW	Read Hex Switch on Front Panel
PC3..0	Output	DISPLAY	Write Hex Display on Front Panel

All outputs of the CIO are pulled high to ensure a valid logic level after reset.

3.18 Interrupt Sources

All seven priority levels of the VMEbus are implemented. The local modules can be served by interrupts without restricting the VMEbus interrupt capacity.

The interrupt handler is a part of the VIC gate array. This device contains seven registers to handle seven VMEbus interrupt sources. Each IRQ line on the VMEbus is enabled and disabled separately. Additionally, the level passed to the CPU can be changed for each of these lines through the control registers of the VIC.

The VIC also supports seven local interrupt request inputs, called LIRQ1 to LIRQ7. These lines are connected to several local devices generating an IRQ (referenced by Table 48: 'VIC Interrupt Priority Scheme'). Additionally, the VIC can generate local interrupts from eight interprocessor communication registers, ACFAIL, SYSFAIL, arbitration time-out, posted write cycles, and DMA completion.

To change the IRQ values in the VIC registers, use the RMon setup menu. Refer to the VIC068 data sheet for more information.

Table 48: VIC Interrupt Priority Scheme

IRQ	Source	Generated CPU Level	Vector supplied by
LIRQ7	ILACC	3	VIC
Error Group IRQ	ACFAIL from VMEbus	7	VIC
	Write Post Fail	7	VIC
	Arbitration Time-out	7	VIC
	SYSFAIL from VMEbus	7	VIC
LIRQ6	CL-CD2401 higher priority	5 [1)]	CL-CD2401
	System CIO medium priority	5 [1)]	System CIO
	User CIO lower priority	5 [1)]	User CIO
LIRQ5	LEB	2 [1)]	LEB
LIRQ4	Video Frame Inactive	5	VIC
LIRQ3	SCSI Controller	2	VIC
LIRQ2	Clock Tick Timer of VIC	6	VIC
LIRQ1	Keyboard Controller	1	VIC
ICGS Group IRQ	Interprocessor Communication Global Switches of VIC	6	VIC
ICMS Group IRQ	Interprocessor Communication Module Switches of VIC	7	VIC
IRQ7	VMEbus	7	VMEbus
IRQ6	VMEbus	6	VMEbus
IRQ5	VMEbus	5	VMEbus
IRQ4	VMEbus	4	VMEbus
IRQ3	VMEbus	3	VMEbus
IRQ2	VMEbus	2	VMEbus
IRQ1	VMEbus	1	VMEbus
DMA Status IRQ	VIC DMA Controller	1	VIC
VMEbus Interrupt Acknowledged	VIC Interrupter	1	VIC

1. The IRQ levels inside the VIC **have to** be programmed with the level mentioned in the column. All other IRQ levels are example values of the operating system's initialization, they may be changed by the user.

3.18.1 Local Interrupt Sources

The EUROCOM-17-5xx has eight local interrupt sources connected to six VIC inputs (LIRQ1, LIRQ3 to LIRQ7).

Table 49: Local Interrupt Sources

Device	VIC Input	Level	Vector	Supplied by
ILACC	LIRQ7	3	$47	VIC
System CIO	LIRQ6	5 [1)]	$xx	CIO
User CIO	LIRQ6	5 [1)]	$xx	CIO
Serial I/O	LIRQ6	5 [2)]	$xx	CL-CD2401
LEB	LIRQ5	2 [2)]	$xx	IPIN
Video Controller (FRAMEIN)	LIRQ4	4 [3)]	$44	VIC
SCSI Controller	LIRQ3	2	$43	VIC
VIC Timer	LIRQ2	6	$42	VIC
Keyboard Controller	LIRQ1	1	$41	VIC
VIC ACFAIL	-	7	$48	VIC
VIC Failed Write Post	-	7	$49	VIC
VIC Arbitration Time-out	-	7	$4A	VIC
VIC SYSFAIL	-	7	$4B	VIC
VIC Interrupter IACK	-	1	$4C	VIC
VIC DMA	-	1	$4D	VIC
VIC ICMS0..ICMS3	-	5	$1C - $1F	VIC
VIC ICGS0..ICGS3	-	7	$10 - $13	VIC

1. Can be programmed to LIRQ4. In this case the VIC must supply the vector, and the video controller interrupt is disabled.
2. These levels are not changeable (i.e. fixed in hardware), all other levels are programmable via VIC register. Also all vectors delivered by the VIC are programmable.
3. Can be disabled by software.

The system CIO and user CIO interrupt can be programmed to LIRQ6 or LIRQ4 independently. If programmed to LIRQ4, the VIC must be programmed to supply the vector. For more information, see Section 3.6 ‘CIO Counter / Timers’. The default setting is shown in Table 49: ‘Local Interrupt Sources’.

The video controller interrupt can be programmed to LIRQ4 or can be disabled.

3.18.2 VMEbus Interrupt Sources

Individual interrupt levels are masked dynamically under software control by programming the appropriate VMEbus interrupt control register (ICR1 to ICR7) of the VIC. This feature allows easy implementation of multi-processor systems. The VMEbus interrupt requests are always active low and level-sensitive.

All VMEbus IRQs are disabled after the initialization of RMon. To change this, use the RMon setup menu. For further details, see the data sheet VIC068.

3.19 Secondary CPU Support

The revision register must contain a dual-CPU order number to enable secondary CPU support. On single-CPU boards, the second CPU can be installed, but may not be usable. So, installing a second CPU must be done only at the factory!

The secondary CPU is controlled via the CPU2CON at $FEC5.8000. To run the secondary CPU the primary CPU must prepare stack pointer and program counter and release the secondary CPU from reset by setting the appropriate bits of the CPU2CON.

```
move.b    #$00, $FEC58000     ; reset secondary CPU
move.l    #STACK, $0          ; prepare stack pointer
move.l    #PCOUNT, $4         ; prepare program counter
move.b    #$20, $FEC58000     ; run secondary CPU
```

3.19.1 Interrupting the Secondary CPU

The secondary CPU can be interrupted by the primary CPU, by the VIC timer (positive edge-sensitive), the LEB (negative level-sensitive), and VMEbus. If the primary CPU writes bit 0-2 of the CPU2CON, an interrupt is generated for the secondary CPU. When servicing this interrupt, the secondary CPU has to write $05 to the CPU2CON to clear the interrupt and the mailbox interrupt pending flag. Interrupts from the VIC timer, the LEB, or the VMEbus are enabled or disabled by the secondary CPU by writing the appropriate code to the CPU2CON (see Table 50: ‘CPU2CON As Seen by Primary CPU’).

After reset the interrupts from the VIC timer and LEB are disabled. The interrupt routine for the VIC timer has to write $04 to the CPU2CON to clear the pending interrupt and the VIC interrupt request flag. All interrupts use autovector interrupt acknowledge cycles. The interrupt priority encoder for the secondary CPU uses level 4 for the VIC timer and level 3 for the LEB interrupts.

3.19.2 Interrupting the Primary CPU

The primary CPU is interrupted by the secondary CPU by writing bits 0-3 of the VIC's interprocessor communication switch register ($FEC0.105F). A clear to set transition of a bit interrupts the primary CPU when the corresponding bit in the ICMS interrupt control register ($FEC0.1047) is clear (see also VIC data sheet).

Table 50: CPU2CON As Seen by Primary CPU

Bit Pos.	Name	Read/ Write	Description
7	MIPEND	read	Mailbox Interrupt Pending 0 = interrupt acknowledged by secondary CPU 1 = mailbox interrupt pending
6	CPUID	read	CPU Identification always 1 when read by primary CPU
5	SRESET	write	Secondary CPU Reset This bit is connected to the reset input of the secondary CPU. 0 = reset secondary CPU 1 = run secondary CPU
2 1 0	SIPL2 SIPL1 SIPL0	write write write	Secondary CPU Interrupt Priority Lines 0-2. These bits are connected to the interrupt inputs of the secondary CPU. If one or more of these bits are set, an interrupt is generated for the secondary CPU and bit 7 (MIPEND) of this register is set.

SIPL2	SIPL1	SIPL0	Interrupt Level Generated
0	0	0	no interrupt
0	0	1	1
0	1	0	2
.	.	.	.
1	1	0	7

After the interrupt acknowledge of the secondary CPU, SIPL0-2 and MIPEND are cleared.

Table 51: CPU2CON As Seen by Secondary CPU

Bit Pos.	Name	Read/ Write	Description			
7	MIPEND	read	Mailbox Interrupt Pending 0 = interrupt acknowledged by secondary CPU 1 = mailbox interrupt pending			
6	CPUID	read	CPU Identification always 0 when read by secondary CPU			
5	VICIRQ	read	VIC Interrupt Request 0 = no interrupt from VIC clock 1 = interrupt from VIC clock			
2 1 0	SICF2 SICF1 SICF0	write write write	Secondary CPU Interrupt Control Function 0-2.			
			SICF2	SICF1	SICF0	Function
			0	0	0	disable IRQ from VIC clock
			0	0	1	enable IRQ from VIC clock
			0	1	0	disable IRQ from LEB
			0	1	1	enable IRQ from LEB
			1	0	0	IACK for IRQ from VIC
			1	0	1	IACK for mailbox IRQ
			1	1	0	disable VMEbus IRQs for CPU2
			1	1	1	enable VMEbus IRQs for CPU2

3.19.3 VMEbus Interrupts for the Secondary CPU

The EUROCOM-17-5xx allows to route VMEbus interrupts to the secondary CPU. Therefore, some restrictions must be considered.

- Only one VMEbus interrupt of IRQ1, IRQ3, IRQ5, IRQ7 can be routed to the secondary CPU. The adequate level is selected via J1703. For the secondary CPU, an autovectored level 2 interrupt will be generated if a VMEbus interrupt occurs.
- If an VMEbus IRQ is routed to the secondary CPU, it is necessary to disable this VMEbus IRQ in the VIC for the primary CPU.
- The interrupter must be able to support RORA for the secondary CPU performs always autovector interrupts.
- The secondary CPU never starts an IACK cycle on the VMEbus on respond to a VMEbus interrupt request. There will be only autovectored interrupts for the secondary CPU.

3.19.4 Cache Coherency and Snooping

To maintain cache coherency in a multi master system, the ‘040 has the capability of snooping. Snooping can be enabled via snoop control register at $FEC5.E000 (write only).

EUROCOM-17-5xx snooping:

Table 52: Snoop Control Register Layout for EUROCOM-17-5xx

Register	Address	7 - 4	3	2	1	0
SNCR	$FEC5.E000	unused	SC1 for secondary CPU	SC0 for secondary CPU	SC1 for prima-ry CPU	SC0 for prima-ry CPU

Table 53: Snoop Control Encoding for EUROCOM-17-5xx

SC1	SC0	Requested Snoop Operation	
		Alternate Bus Master Read Access	**Alternate Bus Master Write Access**
0	0	Inhibit Snooping	Inhibit Snooping
0	1	Supply Dirty Data and Leave Dirty	Sink Byte/Word/Longword
1	0	Supply Dirty Data and Mark Line Invalid	Invalidate Line
1	1	Reserved (Snoop Inhibited)	Reserved (Snoop Inhibited)

After reset snooping of both CPUs is disabled. Normally, the primary CPU should use SC1=0 and SC0=1 snoop mode. This ensures cache coherency with all non caching alternate bus masters. When data should be cached in both CPUs, the secondary CPU must also use this snooping mode and both CPUs must use writethrough caching mode for that data.

The EUROCOM-17-5xx does not support copyback cache mode in both CPUs for the same memory location. Data that is copyback in one CPU must be cache inhibited in the other.

Snooping of the secondary CPU can only be enabled when the secondary CPU is running otherwise the EUROCOM-17-5xx will crash (i.e. the SRESET bit in the CPU2CON register always has to be set before one of the snoop control bits in the snoop control register is set for the secondary CPU).

The snoop control register is write only. So the user must implement some mechanism to avoid that one CPU accidently alters the snooping mode of the other CPU.

Snooping of the secondary CPU has to be enabled only if J1802 is set to position 2-3. Enabling snooping of the secondary CPU with J1802 in position 1-2 will cause erratic behavior of the secondary CPU. If only the primary CPU is snooping, J1802 should be set to position 1-2 because this gives better memory performance.

3.20 Revision Information

Revision information is stored on the board to give software the chance to distinguish between different versions and derivates of the EUROCOM-17-5xx. The information may consist of two parts. First there are bits 3-7 of the IOC-2's control register at $FEC7.00A8.

Table 54: IOC-2 Control Register at $FEC7.00A8

Register	Address	31 - 8	7 - 5		4	3		2 - 0
ICR	$FEC7.00A8	used for IOC-2 internal purposes	0 0 0	ELTEC initial version	0	0	25 MHz	used for IOC-2 internal purposes
			0 0 1	EUROCOM-17-1xx/2xx	0	1	33 MHz	
			1 0 0	EUROCOM-27-xxx EUROCOM-17-5xx	1	0	40 MHz	
			other	reserved	1	1	reserved	

If bits 5-7 of the ICR are %100, extended revision information is available at the serial EEPROM.

The serial EEPROM is a 512 B FRAM which is used to store ELTEC specific board revision information. For the user, the upper 256 B of the FRAM are reserved to store additional information.

The lower 256 B of the FRAM contain the extended board revision information. These factory settings must never be modified by the user to guarantee system consistency.

Because the FRAM can only be handled via an I^2C bus protocol, data should only be modified using the implemented RMon utilities. Therefore, see RMon Documentation.

The FRAM is controlled in detail by the signals SDIO and SCLK. These signals can be set via a register at address $FEC5.4000.

Table 55: I^2C Control Register Layout

Register	Address	7 - 2	1	0
I^2C Control	$FEC5.4000	unused	SCLK	SDIO

Table 56: Address Map of the Serial EEPROM

Offset Address	Size (Byte)	Usage
$000	8	Initialization
$008	2	Revision code of structure
$00A	2	Size of CRC calculation
$00C	4	CRC
$010	16	Board revision information
$020	16	Option revision information
$030	16	Option revision information
$040	16	Option revision information
$050	16	Option revision information
$060	8	Serial number
$068	8	Reserved
$070	14	Revision codes
$07E	2	Category codes
$080	64	Text
$0C0	64	Reserved
$100	256	User data

The user data can be stored at address offset $100 - $1FF. To store the user data, see RMon documentation for more information.

Via J1702 the user data can be write protected.

3.21 Indivisible Cycle Operation

3.21.1 Deadlock Resolution

When a CPU performs a locked cycle to the '020 bus (e.g. TAS to the VMEbus) and someone wants to access the '040 bus from the '020 bus (e.g. slave access from VMEbus to the local RAM) there is a deadlock situation. On normal reads or writes such a deadlock is resolved by sending a retry acknowledge to the CPU. On locked cycles this does not work because the arbiter does not grant the bus from the current bus master as long as /LOCK is active. Such deadlocks are resolved by sending an error acknowledge to the CPU. Then there must be a bus error trap handler that inspects the stack frame whether there was a locked cycle or not. If not, normal bus error handling is continued. Else the locked cycle is retried by simply performing a RTE instruction. The trap handler also should inspect the VIC's bus error status register bits 5 and 6 whether there was a bus error. If so also normal bus error handling should be done to prevent that the trap handler retries the locked cycle infinitely.

3.21.2 TAS Violation

If a semaphore resides in a region that can be cached in the '040 in copyback mode TAS violation can occur if:

- the semaphore resides in a dirty cache line in the cache of the '040, and the semaphore is set,
- an alternate master performs the read of a TAS,
- the '040 snoops the read and supplies that the semaphore is set,
- the '040 clears the semaphore (in the cache),
- the alternate master performs the write of the TAS,
- the '040 snoops the write so that the semaphore is set again.

As a result of this the clearing of the semaphore is lost! This can be avoided by using the CAS instruction to clear the semaphore.

Appendix

A.1 Mnemonics Chart

This is the same mnemonics chart that can be found in the VMEbus Specification.

A.1.1 Addressing Capabilities

When the following mnemonic is applied to a board ...	It includes the following addressing capabilities:			
	A16	A24	A32	ADO
MASTER				
MA16	X			
MADO16	X			X
MA24	X	X		
MADO24	X	X		X
MA32	X	X	X	
MADO32	X	X	X	X
SLAVE				
SADO16	X			X
SADO24	X	X		X
SADO32	X	X	X	X
LOCATION MONITORS				
LMA16	X			
LMA24	X	X		
LMA32	X	X	X	

A.1.2 Data Transfer Capabilities

Master Data Transfer

When the following mnemonic is applied to a board ...	It means that the MASTER has the following data transfer capabilities:					
	D08(EO)	D16	D32	UAT	BLT	RMW
MD8	X					
MBLT8	X				X	
MRMW8	X					X
MALL8	X				X	X
MD16	X	X				
BMBLT16	X	X			X	
MRMW16	X	X				X
MALL16	X	X			X	X
MD32	X	X	X			
MBLT32	X	X	X		X	
MRMW32	X	X	X			X
MALL32	X	X	X		X	X
MD32+UAT	X	X	X	X		
MRMW32+UAT	X	X	X	X		X

Slave Data Transfer

When the following mnemonic is applied to a board ...	It means that the SLAVE has the following data transfer capabilities:						
	D08(O)	D08(O)	D16	D32	UAT	BLT	RMW
SD8(O)	X						
SRMW(O)	X						X
SD8		X					
SBLT8		X				X	
SRMW8		X					X
SALL8		X				X	X
SD16		X	X				
SBLT16		X	X			X	
SRMW16		X	X				X
SALL16		X	X			X	X
SD32		X	X	X	X		
SBLT32		X	X	X		X	
SRMW32		X	X	X	X		X
SALL32		X	X	X		X	X

Location Monitor Data Transfer

When the following mnemonic is applied to a board ...	It means that its LOCATION MONITOR has the following capabilities:					
	D08(O)	D16	D32	UAT	BLT	RMW
LMBLT32	X	X	X		X	
LMRMW32	X	X	X	X		X
LMALL32+UAT	X	X	X		X	X

A.1.3 Glossary

ADO	Address Only
UAT	Unaligned Transfer
BLT	Block Transfer
RMW	Read/Modify/Write
EO	Both Even and Odd Addresses
O	Odd Addresses Only

A.2 Address Modifiers on VMEbus

Hex Code	Address Modifier 5 4 3 2 1 0	Access	Note
3F	H H H H H H	Standard Supervisory Ascending	1
3E	H H H H H L	Standard Supervisory Program	1
3D	H H H H L H	Standard Supervisory Data	1
3C	H H H H L L	Undefined	2
3B	H H H L H H	Standard Non-Privileged Ascend	1
3A	H H H L H L	Standard Non-Privileged Program	1
39	H H H L L H	Standard Non-Privileged Data	1
38	H H H L L L	Undefined	2
30-37	H H L x x x	Undefined	2
2F	H L H H H H	Undefined	2
2E	H L H H H L	Undefined	2
2D	H L H H L H	Short Supervisory I/O	1
2C	H L H H L L	Undefined	2
2B	H L H L H H	Undefined	2
2A	H L H L H L	Undefined	2
29	H L H L L H	Short Non-Privileged I/O	1
28	H L H L L L	Undefined	2
20-27	H L L x x x	Undefined	2
10-1F	L H x x x x	Undefined	3
0F	L L H H H H	Extended Supervisory Ascending	1
0E	L L H H H L	Extended Supervisory Program	1
0D	L L H H L H	Extended Supervisory Data	1
0C	L L H H L L	Undefined	2
0B	L L H L H H	Extended Non-Privileged Ascend	1
0A	L L H L H L	Extended Non-Privileged Program	1
09	L L H L L H	Extended Non-Privileged Data	1
08	L L H L L L	Undefined	2
00-07	L L L x x x	Undefined	2

1 Defined by VMEbus Specification
2 Definition reserved

3 Defined by user

A.3 Index

A.4 References

For more information, we recommend the following additional literature:

MC68(EC/LC)040 M68040UM/AD
Microprocessors User's Manual
Motorola Ltd.; European Literature Centre;
88Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England

Further specifications and extracts of data sheets are available with the Service Manual. For ordering information, refer to 'Related Products', page X.