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THE EMBEDDED PC COMPANY

Cool LiteRunner-ECO

PC/104 Carrier for CoreExpress®

Technical Manual

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Technical Manual Cool LiteRunner-ECO

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Acronyms

ACPI	Advanced Configuration and Power Management Interface
APM	Advanced Power Management
ATA	Advanced Technology Attachment
BIOS	Basic Input Output System
BPP	Bits per Pixel
CD	Compact Disc
CLR	Cool LiteRunner
COM	Communication Equipment
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DAC	Digital-to-Analog-Converter
DDR	Double Date Rate
DMA	Direct Memory Access
EIDE	Enhanced Integrated Device Electronics
EMC	Electromagnetic Compatibility
ETH	Ethernet
FIFO	First In First Out
FPU	Floating Point Unit
FWH	Firmware Hub
GPIO	General Purpose Input Output
HDD	Hard Disk Drive
I²C	Inter-Integrated Circuit
IP	Internet Protocol
LCD	Liquid Crystal Display
LEMT	LiPPERT Enhanced Management Technology
LED	Light Emitting Diode
LPC	Low Pin Count
LVDS	Low Voltage Differential Signaling
MAC	Media Access Control
MMU	Memory Management Unit
PCI	Peripheral Component Interconnect
PHY	Physical Interface
PLL	Phase-Locked Loop
PWR	Power
SMB	System Management Bus
SMC	System Management Controller
SPI	Serial Peripheral Interface
SVGA	Super Video Graphics Array
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
UDMA	Ultra-Direct Memory Access
UDP	User Datagram Protocol
VGA	Video Graphics Array

1. Overview

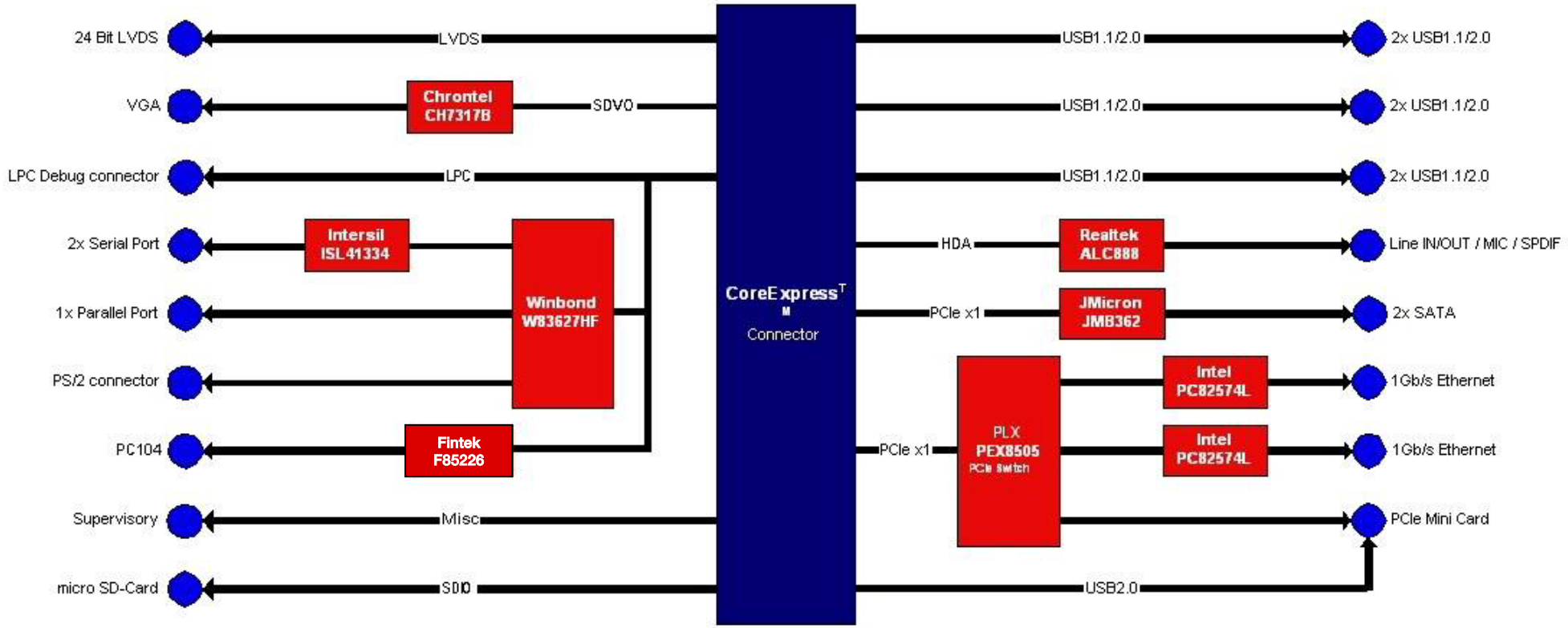
1.1 Introduction

The PC/104 Carrier Cool LiteRunner-ECO is specially designed for system on modules according to the CoreExpress specification. Depending on the used module, the board concept offers many standard I/O interfaces.

Carrier Features

- CoreExpress Carrier connector with 8mm stack height
- VGA
- LVDS, 24/18 bits
- 2 x Gigabit LAN
- 6 x USB 2.0
- 2 x SATA II
- High Definition Audio
- PS/2 mouse and keyboard
- 2 x RS232/RS485
- Parallel Port
- 1 x PC104 Slot
- µSD-Slot
- Supervisory connector
- Optionally extended temperature range -40 ... +85°C

Block Diagram



1.2 Ordering Information

Cool LiteRunner-ECO Models

Order number	Description
702-0012-10	PC/104, CLR-ECO, 1.1GHz, 0°C .. +60°C, 512MB RAM
702-0012-11	PC/104, CLR-ECO, 1.1GHz, 0°C .. +60°C, 1GB RAM
702-0012-12	PC/104, CLR-ECO, 1.1GHz, 0°C .. +60°C, 2GB RAM
702-0012-13	PC/104, CLR-ECO, 1.6GHz, 0°C .. +60°C, 512MB RAM
702-0012-14	PC/104, CLR-ECO, 1.6GHz, 0°C .. +60°C, 1GB RAM
702-0012-15	PC/104, CLR-ECO, 1.6GHz, 0°C .. +60°C, 2GB RAM
802-0012-10	PC/104, CLR-ECO, 1.1GHz, -20°C .. +60°C, 512MB RAM
802-0012-11	PC/104, CLR-ECO, 1.1GHz, -20°C .. +60°C, 1GB RAM
802-0012-12	PC/104, CLR-ECO, 1.1GHz, -20°C .. +60°C, 2GB RAM
802-0012-13	PC/104, CLR-ECO, 1.6GHz, -20°C .. +60°C, 512MB RAM
802-0012-14	PC/104, CLR-ECO, 1.6GHz, -20°C .. +60°C, 1GB RAM
802-0012-15	PC/104, CLR-ECO, 1.6GHz, -20°C .. +60°C, 2GB RAM
902-0012-10	PC/104, CLR-ECO, 1.1GHz, -40°C ..+85°C, 512MB RAM
902-0012-11	PC/104, CLR-ECO, 1.1GHz, -40°C .. +85°C, 1GB RAM
902-0012-12	PC/104, CLR-ECO, 1.1GHz, -40°C .. +85°C, 2GB RAM
902-0012-13	PC/104, CLR-ECO, 1.6GHz, -40°C .. +85°C, 512MB RAM
902-0012-14	PC/104, CLR-ECO, 1.6GHz, -40°C .. +85°C, 1GB RAM
902-0012-15	PC/104, CLR-ECO, 1.6GHz, -40°C .. +85°C, 2GB RAM

Cable Sets and Accessories

Order number	Description
763-0019-10	Adapter Cable Set
765-0028-10	Heat Spreader, CLR-ECO
765-0035-10	Heat sink, CLR-ECO (-20°C ..+60°C)
765-0035-10	Heat sink, CLR-ECO (-40°C ..+85°C)

1.3 Specifications

Electrical Specifications

Supply voltage	+5 V DC, +12V DC for LVDS backlight only if needed
Rise time	< 10 ms
Supply voltage tolerance	± 5% *
Inrush current	typical 2.0 A
Supply current	maximal 2.4 A depending on operating system and connected peripherals ** typical 1.4 A (Windows XP idle mode)

* Voltage must be measured on the board, not at the power supply

** only monitor, mouse and keyboard are attached. Additional peripherals rise up current.

Environmental Specifications

Operating:

Temperature range	0 … 60 °C (standard version, models with part numbers 7xx-xxxx-xx)
	-20 … 60 °C (industrial version, models with part numbers 8xx-xxxx-xx)
	-40 … 85 °C (extended version, models with part numbers 9xx-xxxx-xx)
Temperature change	max. 10K / 30 minutes
Humidity (relative)	10 … 90 % (non-condensing)
Pressure	450 … 1100 hPa

Non-Operating/Storage/Transport:

Temperature range	-40 … 85 °C
Temperature change	max. 10K / 30 minutes
Humidity (relative)	5 … 95 % (non-condensing)
Pressure	450 … 1100 hPa

Mean Time Between Failures

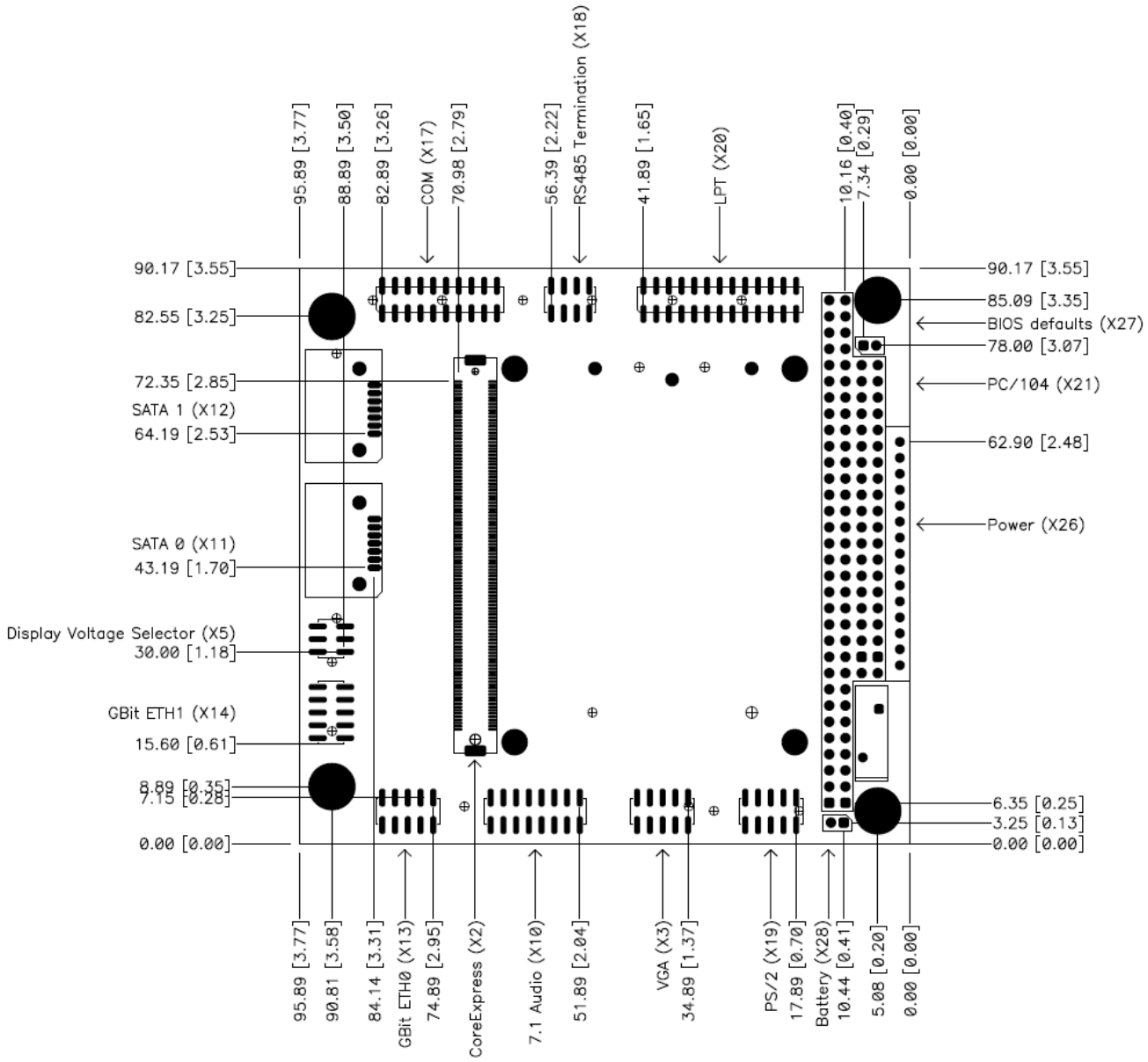
MTBF at 25°C	333,291 hours

1.4 Mechanical

Dimensions (L x W)	90.2 mm x 95.9 mm
Height	max. 14.3 mm on top side above PCB with CoreExpress-ECO and heat spreader max. 5.0 mm on bottom side below PCB at Mini PCI Express connector
Weight	150 gr. with CoreExpress-ECO and heat spreader
Mounting	4 mounting holes according to PC/104 specification 4 mounting holes for CoreExpress ECO

Note It is strongly recommend using plastic spacers instead of metal spacers to mount the board. With metal spacers, there is a possible danger to create a short circuit with the components located around the mounting holes.
This can damage the board!

Top


95.89 [3.77]
88.89 [3.50]
82.89 [3.26]
COM (X17)
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56.39 [2.22]
RS485 Termination (X18)
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3.25 [0.13]
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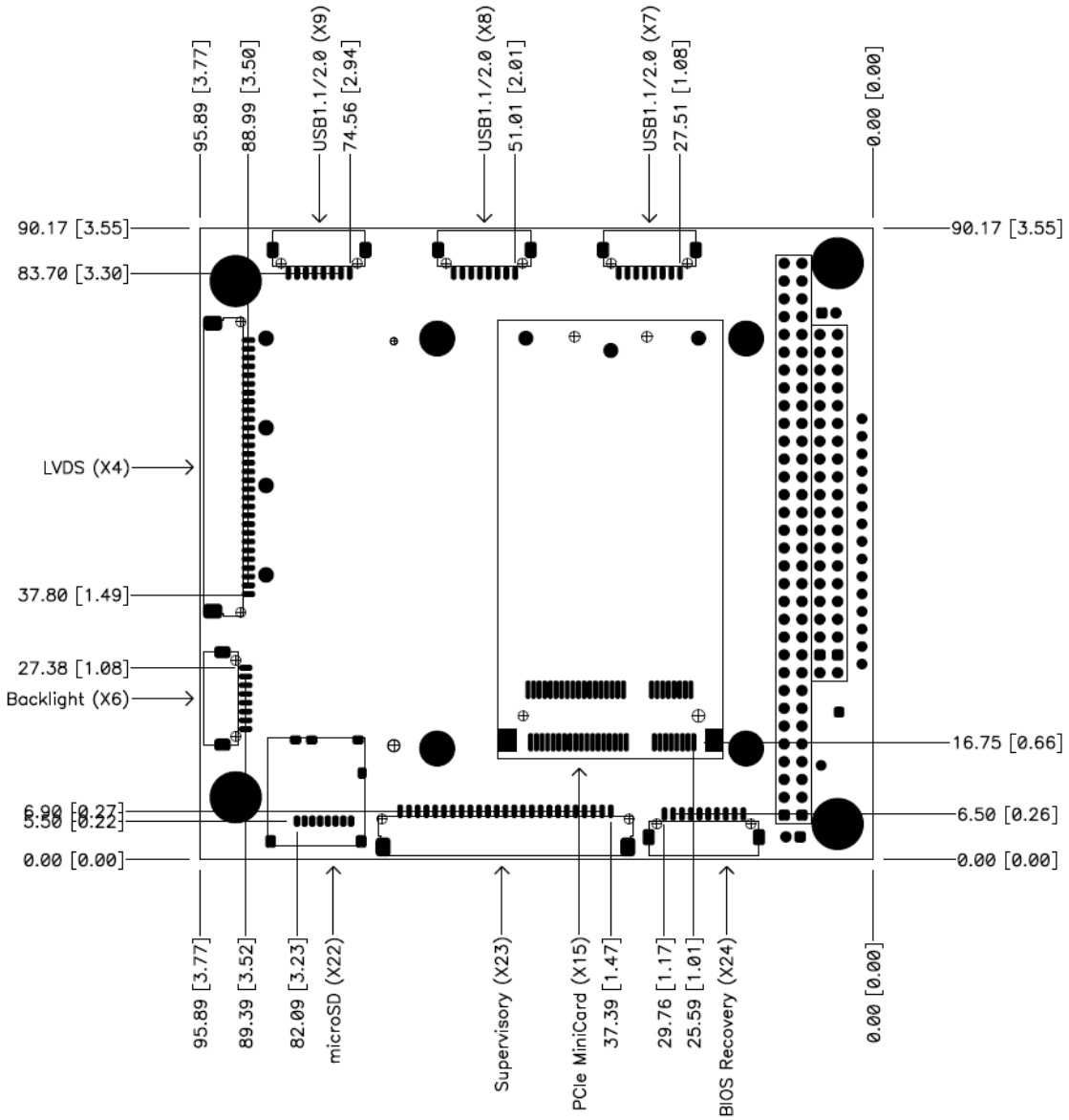
34.89 [1.37]
PS/2 (X19)
17.89 [0.70]
Battery (X28)
10.44 [0.41]
5.08 [0.20]
0.00 [0.00]

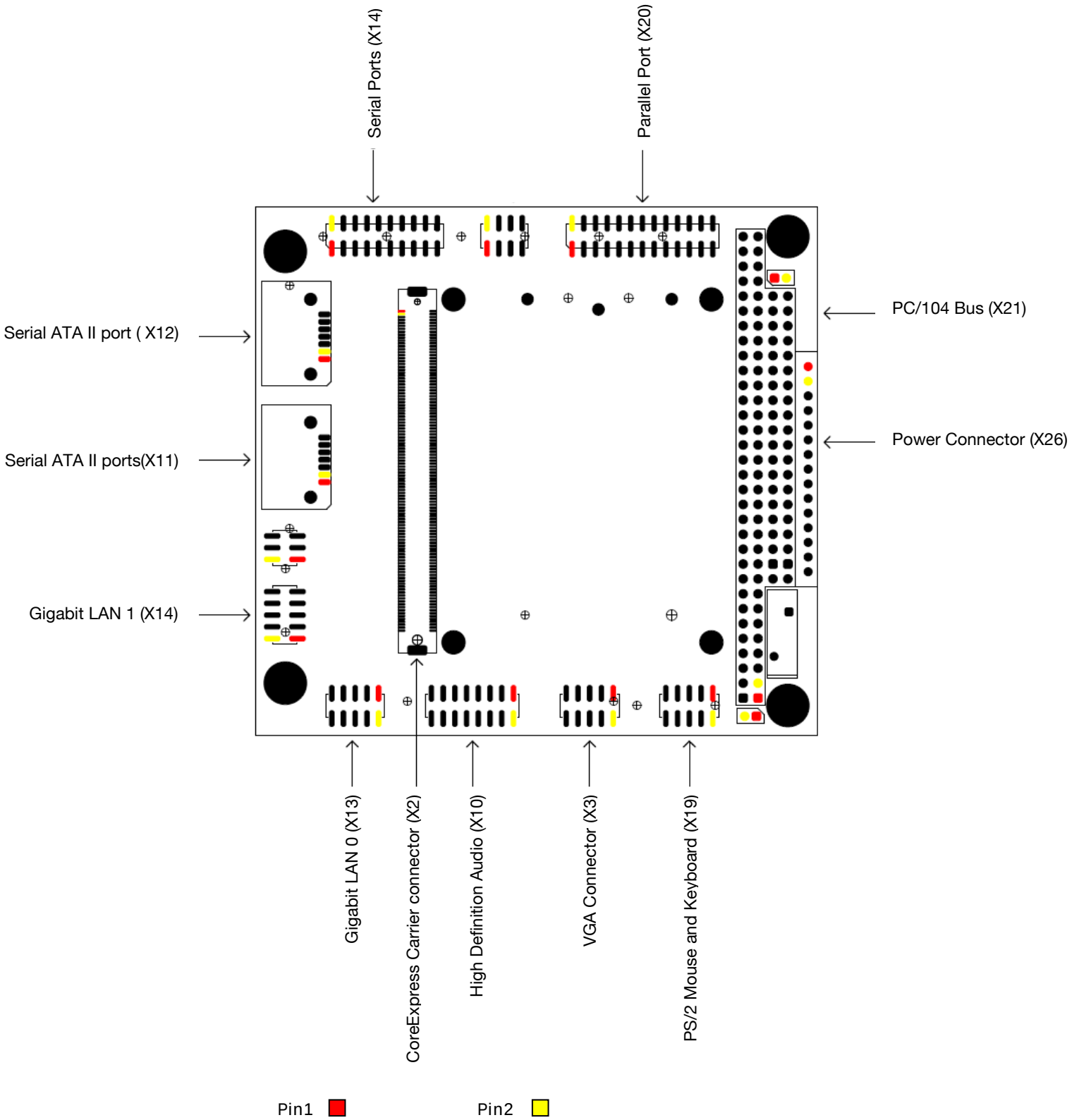
Bottom (vertically mirrored)



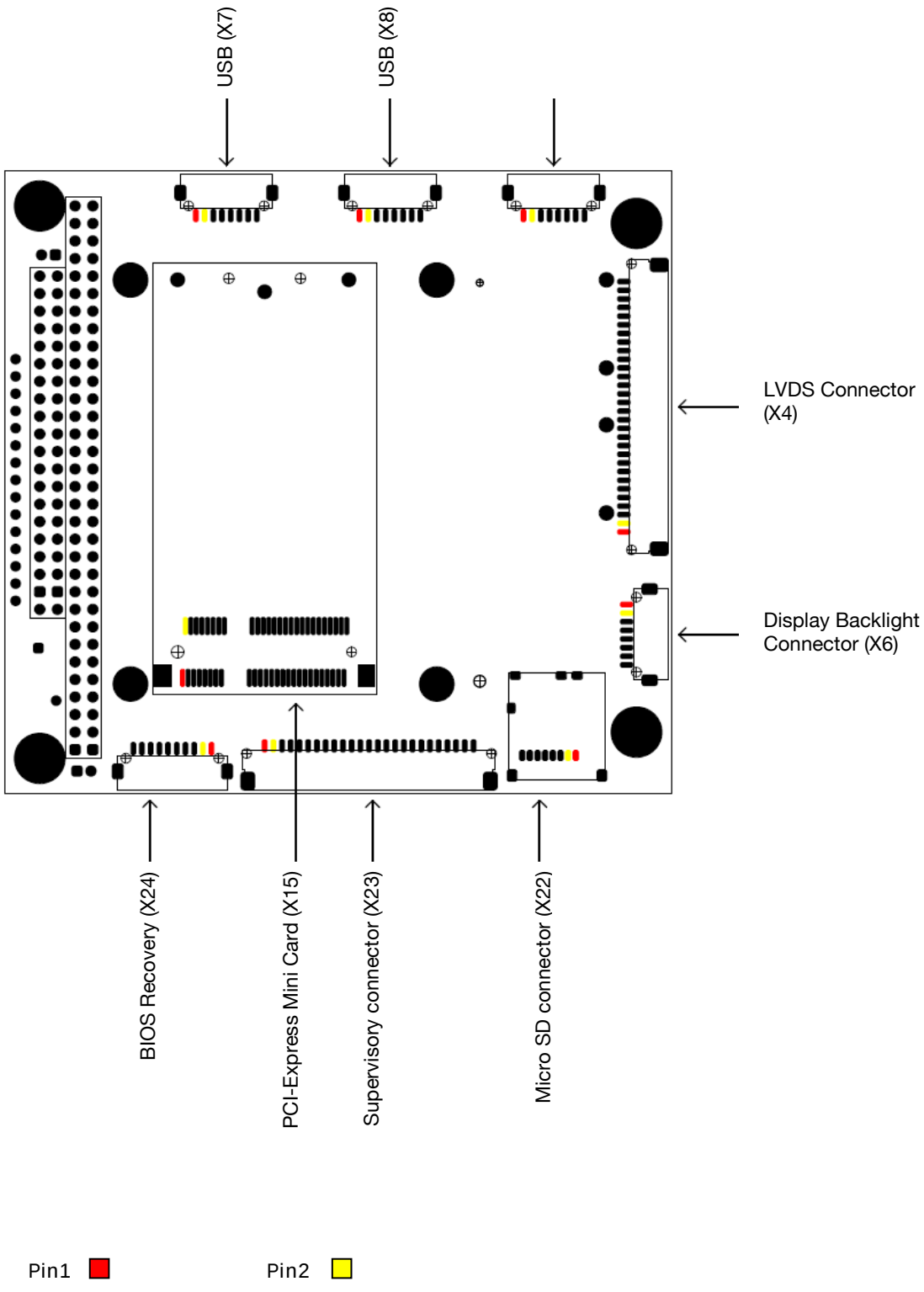
2. Getting Started

2.1 Connector Locations

Top

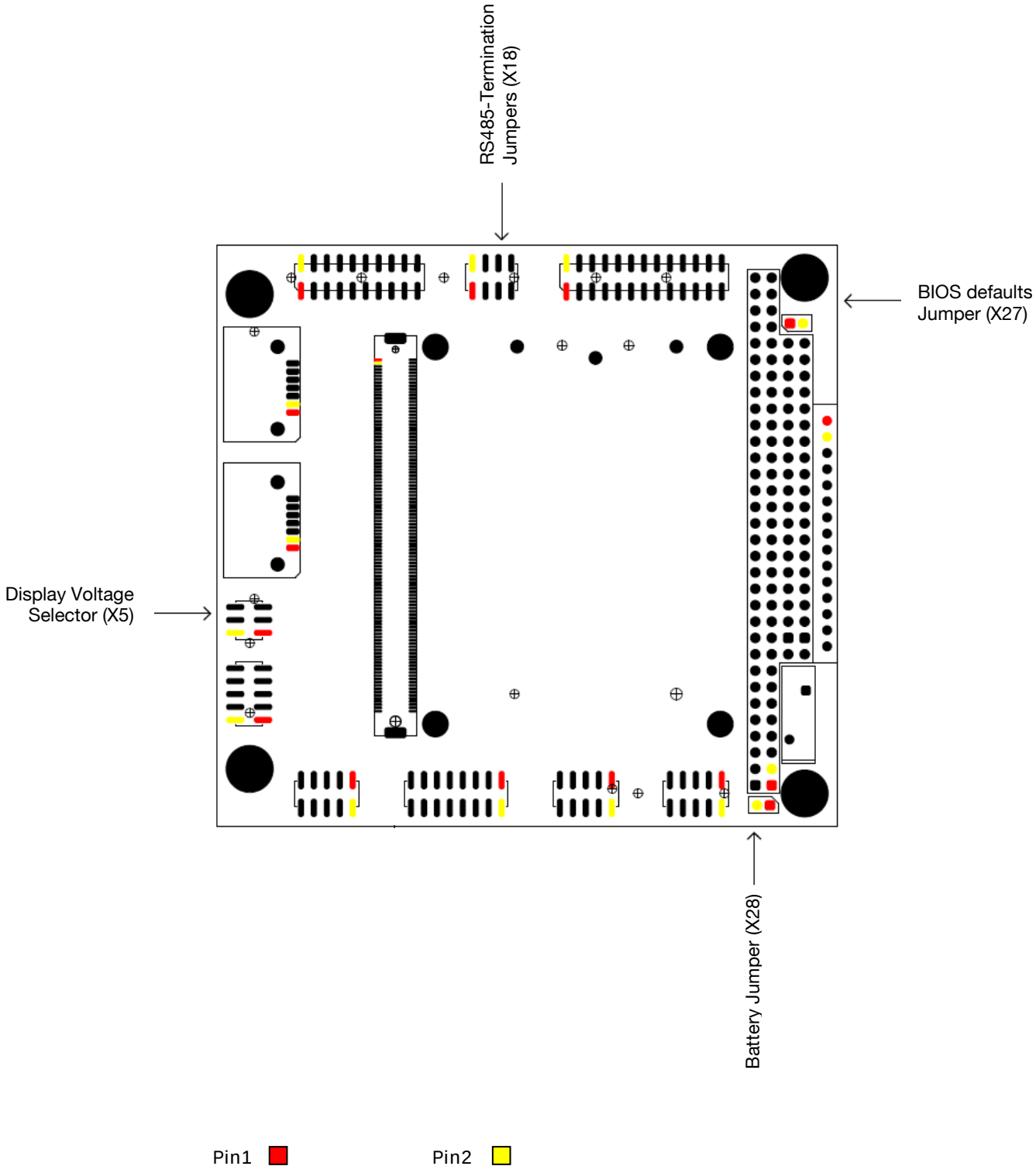


Bottom


USB (X7)
USB (X8)
LVDS Connector (X4)
Display Backlight Connector (X6)
BIOS Recovery (X24)
PCI-Express Mini Card (X15)
Supervisory connector (X23)
Micro SD connector (X22)
Pin1
Pin2

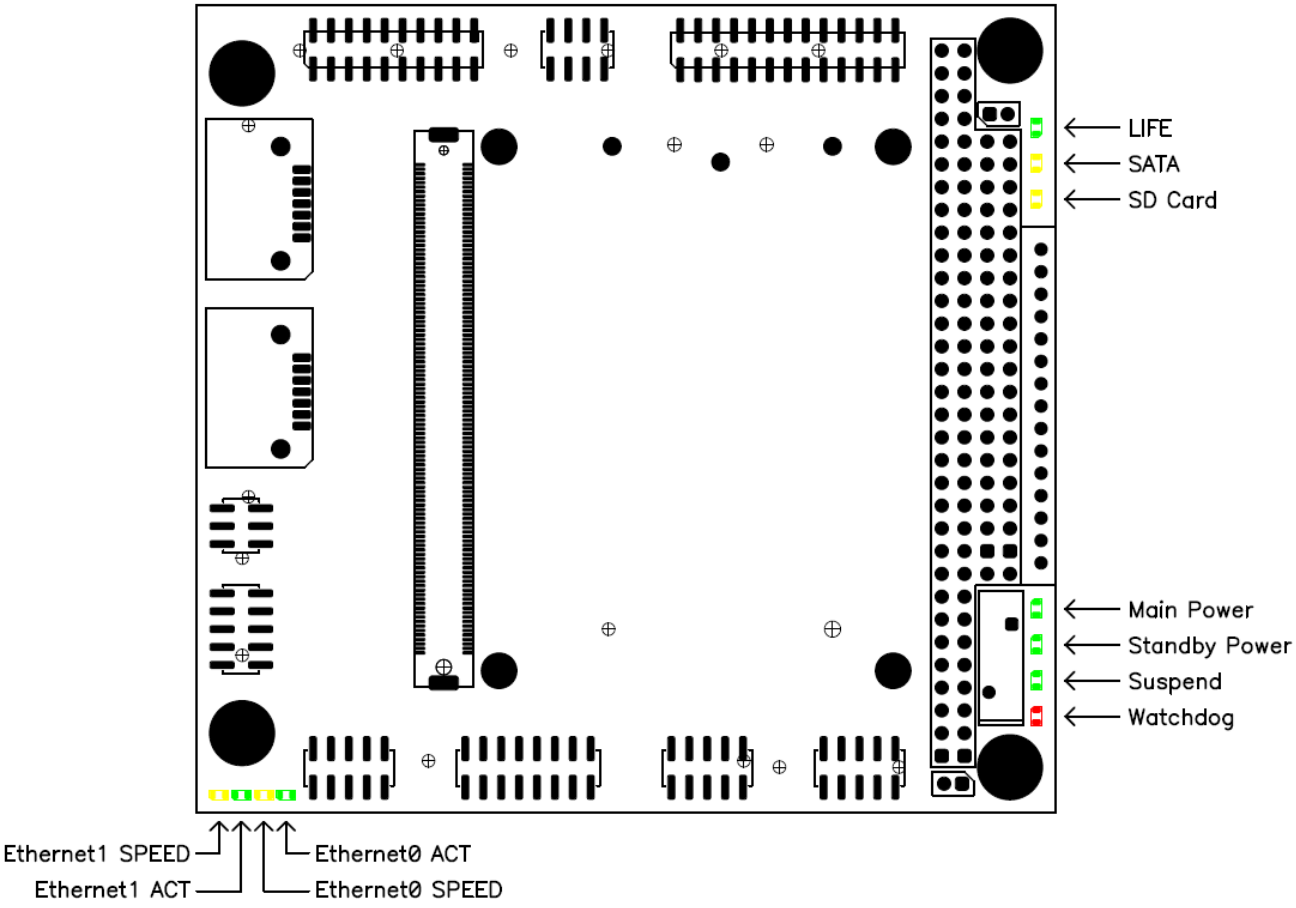
2.2 Jumper Locations

Top



2.3 LED Indicators

To facilitate problem solving, the Cool LiteRunner-ECO provides LED indicators for the following conditions:



Standby Power	- lights up when power for the standby domain is applied
Main Power	- lights up when power for the working domain is applied
Suspend	- blinks when board is in suspend mode
Watchdog	- lights up when a watchdog event has occurred
Life	- lights up during BIOS post, goes off when OS gets loaded
SATA	- flashes while there are accesses to SATA devices
SD card	- flashes while there are accesses to the SD card
Ethernet0 ACT	- flashes while there are accesses to Ethernet port 0
Ethernet0 SPEED	- lights up when Ethernet port 0 works at 100MBit speed, off at 10MBit and 1GBit
Ethernet1 ACT	- flashes while there are accesses to Ethernet port 1
Ethernet1 SPEED	- lights up when Ethernet port 1 works at 100MBit speed, off at 10MBit and 1GBit

2.4 Hardware Setup

Installing the Cool LiteRunner-ECO is very straightforward. First, unpack the board observing the usual electrostatic discharge (ESD) precautions.

Caution

Before you touch the board, make sure that you have discharged yourself and your gear towards a grounded terminal. Damages due to ESD are usually not immediately visible and will only show up later as failures in the field.

If not already done, mount the module and the cooling device.

Caution

Never operate the Cool LiteRunner-ECO without suitable cooling devices. Failing this can destroy the module.

Caution

Never connect or disconnect peripherals like hard drives while the board's power supply is connected and switched on!

Use the cable set provided by LiPPERT to connect the Cool LiteRunner-ECO to a VGA monitor. Connect USB keyboard and mouse, respectively. Connect a hard drive with a SATA cable (not part of the cable set) to start an operation system. Make sure that the pins match their counterparts correctly and are not bent! If you plan to use additional other peripherals, now is the time to connect them, too.

Connect a standard ATX with the adapter cable (art. no 862-0044-10) or a 5 volt, 5.0 A power supply to the power connector and switch the power on.

Note The 5.0 A value is the minimum you should have for the standard peripherals mentioned. If you want to use more and/or others, please plan your power budget first! The system will not work if there is not enough supply current for all your devices.

The display shows the BIOS messages. If you want to change the standard BIOS settings, press the <DEL> key to enter the BIOS menu. See BIOS chapter of the corresponding CoreExpress module for more details.

If you need to load the BIOS default values, the jumper “CMOS” have to be plugged during startup. This forces the BIOS to load the factory settings from Flash.

The Cool LiteRunner-ECO can boot from CD drives, USB floppy, USB stick, hard disk, or network. Provided any of these is connected and contains a valid operating system image, the display then shows the boot screen of your operating system.

Note Not all USB devices are suitable to boot the Cool LiteRunner-ECO. If there are problems, please try to use another device from another manufacturer.

3. Module Description

3.1 CoreExpress Carrier connector (X2)

The Cool LiteRunner-ECO provides a Carrier connector with 8 mm stack height according to the CoreExpress specification. The connector uses the following pinot.

Pin	Signal	Pin	Signal
A1	GND*	B1	GND*
A2	PCIE_TXAn	B2	PCIE_RXAn
A3	PCIE_TXAp	B3	PCIE_RXAp
A4	PCIE_CLKAn	B4	PCIE_CLKBn
A5	PCIE_CLKAp	B5	PCIE_CLKBp
A6	GND	B6	GND
A7	PCIE_TXBn	B7	PCIE_RXBn
A8	PCIE_TXBp	B8	PCIE_RXBp
A9	NC	B9	NC
A10	NC	B10	NC
A11	GND*	B11	GND*
A12	NC	B12	NC
A13	NC	B13	NC
A14	NC	B14	NC
A15	NC	B15	NC
A16	GND	B16	GND
A17	CLKREQA# (connected to GND)	B17	CLKREQB# (connected to GND)
A18	NC	B18	NC
A19	SDVOB_CLK#	B19	NC
A20	SDVOB_CLK	B20	NC
A21	GND*	B21	GND*
A22	SDVOB_GREEN	B22	SDVOB_BLUE
A23	SDVOB_GREEN#	B23	SDVOB_BLUE#
A24	NC	B24	NC
A25	NC	B25	NC
A26	GND	B26	GND
A27	SDVOB_RED	B27	SDVO_CTRL_CLK
A28	SDVOB_RED#	B28	SDVO_CTRL_DAT
A29	LA_DATA0p	B29	LA_DATA1p
A30	LA_DATA0n	B30	LA_DATA1n
A31	GND*	B31	GND*
A32	LA_DATA2p	B32	LA_CLKp
A33	LA_DATA2n	B33	LA_CLKn
A34	LA_DATA3p	B34	L_BKLTCTL
A35	LA_DATA3n	B35	L_BKLTEN
A36	GND	B36	L_DETECT
A37	L_DDC_DATA	B37	L_VDDEN
A38	L_DDC_CLK	B38	USB_C_DEVICE
A39	USB_P5p	B39	USB_P4p

Pin	Signal	Pin	Signal
A40	USB_P5n	B40	USB_P4n
A41	GND*	B41	GND*
A42	USB_P3p	B42	USB_P2p
A43	USB_P3n	B43	USB_P2n
A44	USB_P1p	B44	USB_P0p
A45	USB_P1n	B45	USB_P0n
A46	GND	B46	GND
A47	USB_P6p	B47	NC
A48	USB_P6n	B48	NC
A49	USB_OC4/5#	B49	USB_OC2/3#
A50	USB _OC0/1#	B50	NC
A51	GND*	B51	GND*
A52	NC	B52	NC
A53	NC	B53	NC
A54	NC	B54	NC
A55	NC	B55	NC
A56	SMB_CLK	B56	NC
A57	SMB_DATA	B57	NC
A58	SMB_ALERT#	B58	NC
A59	SATA_LED#**	B59	NC
A60	GND*	B60	GND*
A61	SATA_TXAp**	B61	SATA_TXBp**
A62	SATA_TXAn**	B62	SATA_TXBn**
A63	SATA_RXAp**	B63	SATA_RXBp**
A64	SATA_RXAn**	B64	SATA_RXBn**
A65	GND	B65	GND
A66	NC	B66	NC
A67	NC	B67	NC
A68	NC	B68	NC
A69	NC	B69	NC
A70	GND*	B70	GND*
A71	NC	B71	NC
A72	NC	B72	NC
A73	NC	B73	NC
A74	NC	B74	CAN_TX**
A75	NC	B75	CAN_RX**
A76	LPC_AD3	B76	LPC_CLK_OUT2
A77	LPC_AD1	B77	LPC_CLK_OUT1
A78	LPC_AD0	B78	LPC_SERIRQ
A79	LPC_FRAME#	B79	LPC_AD2
A80	GND*	B80	GND*
A81	SD0_WP	B81	NC
A82	SD0_CD#	B82	SD0_PWR#
A83	SD0_CLK	B83	SD0_DATA2
A84	SD0_DATA1	B84	SD0_LED
A85	SD0_DATA3	B85	NC
A86	NC	B86	SD0_DATA0

Pin	Signal	Pin	Signal
A87	NC	B87	SD0_CMD
A88	NC	B88	WD_OUT
A89	NC	B89	HDA_SPKR
A90	GND*	B90	GND*
A91	NC	B91	HDA_BITCLK
A92	NC	B92	NC
A93	HDA_SDATAOUT	B93	HDA_SDATAIN0
A94	HDA_RST#	B94	HDA_SYNC
A95	NC	B95	BIOS_DEFAULTS#
A96	NC	B96	PWR_GOOD
A97	NC	B97	PS_ON
A98	NC	B98	PWR_BTN#
A99	NC	B99	SUS_3#
A100	GND*	B100	GND*
A101	RST_OUT#	B101	SUS_4/5#
A102	RST_IN#	B102	BIOS_DISABLE#
A103	WAKE#	B103	BAT_IN
A104	+5V	B104	+5V-ALWAYS
A105	+5V	B105	+5V
A106	+5V	B106	+5V
A107	+5V	B107	+5V
A108	+5V	B108	+5V
A109	+5V	B109	+5V
A110	GND*	B110	GND*

* connected to metal shroud

** can be used if module supports SATA or CAN itself.

3.2 Display Interfaces

Depending on the used CoreExpress module, the carrier provides several display interfaces.

VGA Connector (X3)

Connector type: IDC10 pin header 2.0 mm
Matching connector: IDC10 pin female connector 2.0 mm

Pin	Signal	Pin	Signal
1	Red	2	GND
3	Green	4	NC
5	Blue	6	DDC_CLK
7	HSYNC	8	DDC_DATA
9	VSYNC	10	GND

LVDS

There is a LVDS transmitter channel in the LVDS interface. It consists of four data pairs and one clock pair.

The LVDS data pair is used to transfer pixel data as well as the LCD timing control signals.

There is a connector supplying the LC-Display's inverter, too.

LVDS Connector (X4)

Connector type: Hirose DF14 30 pin header 1.25 mm, single row
Matching connector: Hirose DF14-30S-1.25C, Part number 538-0012-3 00

Pin	Signal
1	VDD (+3.3V, opt.+5V)
2	VDD (+3.3V, opt.+5V)
3	GND
4	GND
5	TXA3 -
6	TXA3 +
7	TXACLK -
8	TXACLK +
9	GND
10	TXA2 -
11	TXA2 +
12	TXA1 -
13	TXA1 +
14	TXA0 -
15	TXA0 +
16	GND
17	NC
18	NC
19	NC
20	NC
21	GND
22	NC
23	NC
24	NC
25	NC
26	NC
27	NC
28	GND
29	LVDS DDC-CLK
30	LVDS DDC-DATA

Note: Maximum current on VDD pins is 1A per pin.

LVDS Color mapping

The Color mapping depends on the used module. Please refer to the corresponding manual for information on the color mapping.

Display Backlight Connector (X6)

Connector type: Hirose DF13 8 pin header 1.25 mm, single row
Matching connector: Hirose DF13-8S-1.25C, part number 536-0007-0 00

Pin	Direction	Signal
1	Output	+12V, max. 1A
2	Output	+12V, max. 1A
3	Output	+5V, max. 1A
4	Output	+5V, max. 1A
5	Output	Signal: Backlight control (level: 0..+3.3V)
6	Output	Switched Inverter Power, max. 1A
7		GND
8		GND

Display Voltage Selector (X5)

Jumper to select LVDS and Backlight voltage.

Connector type: IDC6 pin header 2.0 mm
Matching connector: 2.0 mm jumper

Use a 2mm jumper between 1-3 or 3-5 to select the backlight voltage.

Use a 2mm jumper between 2-4 or 4-6 to select the display voltage.

Pin	Signal	Pin	Signal
1	+3.3V	2	+12V
3	Display voltage	4	Backlight voltage
5	+5V	6	+5V

Note An arrow on the PCB marks Pin 1

Default jumper setting is 3,3V for LVDS display and 12V for the inverter.

3.3 Gigabit LAN (X13, X14)

There are two Intel 82574L Gigabit Ethernet controllers on board, providing two independent ports available on standard 2mm IDC10 pin headers.

The 82574L is a single, compact, low power component that offers a fully integrated Gigabit Ethernet Media Access Control (MAC) and Physical Layer (PHY) port.

The 82574L uses the PCI Express architecture. There are two LED per port indicating its status.
There is one LED for showing the controllers speed and one for showing Link and Activity.

Connector type: IDC10 pin header 2.0 mm
Matching connector: IDC10 pin female connector 2.0 mm

Pin	Signal	Pin	Signal
1	MX1-	2	MX1+
3	MX2-	4	MX2+
5	NC	6	KEY
7	MX3-	8	MX3+
9	MX4-	10	MX4+

3.4 USB (X7, X8, X9)

The Cool LiteRunner-ECO provides six USB2.0 compliant ports available on three connectors via adapter cable.

The maximum bandwidth of 480MBit/s may be shared by all six ports. Please refer to the modules manual for more information on the USB controllers.

Connector type: Hirose DF13 8 pin header 1.25 mm, single row
Matching connector: Hirose DF13-8S-1.25C, part number 536-0007-0 00

Pin	Signal
1	VCC_USB0
2	USB0-
3	USB0+
4	USB-GND
5	USB-GND
6	USB1-
7	USB1+
8	VCC_USB1

Note: Wake events from a connected USB mouse or keyboard will only work on the USB ports 0 and 1, while no device should be connected to another USB-port.

Note: Maximum current on VCC_USB pins is 0.5A per pin.

3.5 Serial ATA II ports (X11, X12)

The Cool LiteRunner-ECO provides two SATA II ports using the JMicron JMB362 Serial ATA controller.

JMB362 is a single chip, 1-lane PCI Express to 2-port Serial ATA II Host Controller. JMB362 supports both AHCI and Legacy IDE controller to increase system feasibility, including Native Command Queuing, ATAPI Device, and Port Multiplier with Command-based Switching, Hot Plugging like USB and eSATA (External SATA) connection on SATA port to enhance SATA II capability. It features PCI Express bus and Serial ATA II interface to express high performance storage devices.

There are two connectors with the same type and pin assignment, which support standard SATA cables and SATA cables with mechanical latch

Connector type: MOLEX 47080-4001 (horizontal)
Matching connector: 7 pin Serial ATA plug

Pin	Signal
1	GND
2	Data_TX+
3	Data_TX-
4	GND
5	Data_RX-
6	Data_RX+
7	GND

3.6 High Definition Audio (X10)

The Cool LiteRunner-ECO provides HD-Audio using a Realtek ALC888 High Definition Audio Codec. The following inputs and outputs are supported.

- Analog Input (All ADC support 44,1k/48k/96kHz sampling rate)
    - Microphone left and right
    - Line In left and right
- Analog output (All DAC support 44,1k/48k/96/192kHz sampling rate)
    - Front left and right
    - Rear left and right
    - Center and Subwoofer
- Digital input (16/20/24-bit S/PDIF-in support 44,1k/48k/96/192kHz sampling rate)
    - S/PDIF
- Digital output (16/20/24-bit S/PDIF-out support 44,1k/48k/96/192kHz sampling rate)
    - S/PDIF

Connector type: IDC16 pin header 2.0 mm
Matching connector: IDC16 pin female connector 2.0 mm

Pin	Signal	Pin	Signal
1	FRONT_L	2	FRONT_R
3	SURR_L	4	SURR_R
5	CENTER	6	LFE
7	GND_AU	8	GND_AU
9	LINE_IN_L	10	LINE_IN_R
11	MIC_L	12	MIC_R
13	GND	14	GND
15	SPDIF_IN	16	SPDIF_OUT

3.7 PS/2 Mouse and Keyboard (X19)

PS/2-connectors for mouse and keyboard are shared with several system signals as Reset-In and Power Button. An external battery with a maximum voltage of 3.6V can be connected here, too.

Connector type: IDC10 pin header 2.0 mm
Matching connector: IDC10 pin female connector 2.0 mm

Pin	Signal	Pin	Signal
1	GND	2	Mouse Clock
3	Reset-In	4	Mouse Data
5	KB Data	6	KB Clock
7	GND	8	+5V-ALWAYS
9	Ext. Battery	10	Power Button

3.8 Serial Ports (X17)

The Cool LiteRunner-ECO provides two multiprotocol serial ports. The maximum supported baud rates are:

RS485 mode: up to 1.5 MBit/s

RS232 mode: up to 500 Kbit/s

Two serial ports are located on one IDC header "COM". The ports either work in RS232 or RS485 mode, selectable in BIOS on entering ***Special CLR Features->Toggle COM1 Mode or Toggle COM2 Mode***.

Termination resistors for RS485 Mode can be set with jumpers on pin headers as described in that chapter.

To enable the transmitters of COM1 and COM2 in RS485 mode set the RTS# signal to '1'. Depending on your operating system driver's logic, this may mean setting a (non-inverted) RTS bit to '0' in your application software.

The serial ports are programmable in BIOS setup. When entering ***Integrated Peripherals -> SuperIO Device-> Onboard Serial Port 1*** **or** ***Onboard Serial Port 2***, configuration of the serial ports is accessible.

The following settings are possible for COM1 and COM2:

- Disabled
- 3F8 / IRQ4 (base address / interrupt channel)
- 2F8 / IRQ3 (base address / interrupt channel)
- 3E8 / IRQ4 (base address / interrupt channel)
- 2E8 / IRQ3 (base address / interrupt channel)
- Auto

COM Connector

Connector type: IDC20 pin header 2.0 mm
Matching connector: IDC20 pin female connector 2.0 mm

Pin	RS232	RS485	Pin	RS232	RS485
1	DCD1	*Not used*	2	DSR1	RXD1+
3	RXD1	RXD1-	4	RTS1	TXD1+
5	TXD1	TXD1-	6	CTS1	*Not used*
7	DTR1	*Not used*	8	*Not used*	*Not used*
9	GND	GND	10	+5V	+5V
11	DCD2	*Not used*	12	DSR2	RXD2+
13	RXD2	RXD2-	14	RTS2	TXD2+
15	TXD2	TXD2-	16	CTS2	*Not used*
17	DTR2	*Not used*	18	*Not used*	*Not used*
19	GND	GND	20	*key*	*key*

Note: *Maximum current on a +5V pin is 0.5A.*

RS485-Termination Jumpers (X18)

Connector type: IDC4 pin header 2.0 mm
Matching connector: 2.0 mm jumper

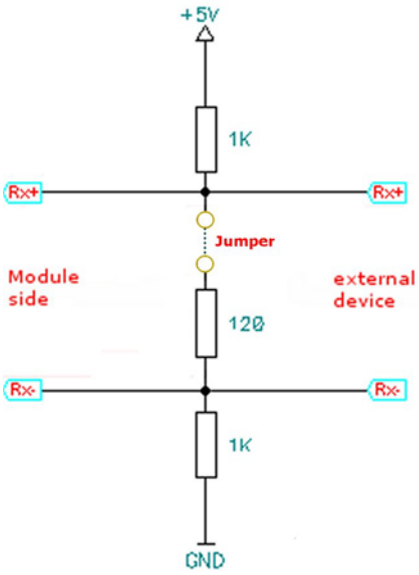
Use 2 mm jumpers to terminate lines correctly.

There are two jumpers COM1 and COM2, respectively.

The RS485 termination jumpers are located at the top of the printed circuit board, see chapter 1.4

At default setting, all jumpers are off.

Pin	Signal	Pin	Signal
1	TX1-	2	TX1+
3	RX1-	4	RX1+
5	TX2-	6	TX2+
7	RX2-	8	RX2+



When the jumper is set, the differential pairs are terminated with 120W resistors.
(RX+ and RX-, on the diagram)

Additionally, positive/negative receive lines are pulled up/down with 1kW to 5V/GND in order to protect the transceivers of the Cool LiteRunner-ECO from over voltages.

It is recommended to protect the ports of the external device in the same way!

Caution: Termination Resistors **should not** be used in RS232 Mode!
Otherwise, the serial ports will not work.

3.9 Parallel Port (X20)

The parallel port is located on an IDC26 header. An adapter cable with a standard DSUB-25 female connector is available.

The parallel port is programmable in BIOS.
Entering ***Integrated Peripherals -> SuperIO Device->Onboard Parallel Port***, configuration of LPT is accessible.

LPT Parameter	Possible Settings
Base Address/ IRQ	Disabled, 0x378 / IRQ7, 0x278/IRQ5, 0x3BC/IRQ7
Mode	SPP, EPP, ECP, ECP+EPP, Normal
EPP Mode	EPP1.9,/ EPP1.7
DMA	Channel 1, Channel 3

LPT Connector

Connector type: IDC26 pin header 2.0 mm
Matching connector: IDC26 pin female connector 2.0 mm

Pin	Signal	Pin	Signal
1	Strobe	2	Auto LF
3	Data0	4	Error
5	Data1	6	Init
7	Data2	8	Select In
9	Data3	10	GND
11	Data4	12	GND
13	Data5	14	GND
15	Data6	16	GND
17	Data7	18	GND
19	ACK	20	GND
21	Busy	22	GND
23	Paper End	24	GND
25	Select	26	+5V

Note: Maximum current on +5V pin is 0.5A.

3.10 PC/104 Bus (X21)

The PC/104 bus is a modification of the industry standard (ISA) PC bus specified in IEEE P996. The PC/104 bus has different mechanics than IEEE P966 to allow the stacking of modules.
The main features are:

- Supports programmable extra wait state for ISA cycles
- Supports I/O recovery time for back-to-back I/O cycles

The following table shows the pin assignment of the PC/104 connector.

Note: -5V0 on the PC/104 connector is not supported on this board.
Due to chipset limitations only IO transfers 8-bit and 16- bit and IRQs are possible on the PC/104 bus. DMA and Memory transfers are not supported.

PC/104 Bus Connector

Pin	Row D	Row C
0	GND	GND
1	MEMCS16	SBHE
2	IOCS16	LA23
3	IRQ	LA22
4	IRQ	LA21
5	IRQ	LA20
6	IRQ	LA19
7	IRQ	LA18
8	DACK	LA17
9	DRQ	MEMR
10	DACK	MEMW
11	DRQ	SD8
12	DACK	SD9
13	DRQ	SD10
14	DACK	SD11
15	DRQ	SD12
16	+5V-ALWAYS	SD13
17	MASTER	SD14
18	GND	SD15
19	GND	GND

Pin	Row A	Row B
1	IOCHCK	GND
2	D7	RSTDRV
3	D6	+5V-ALWAYS
4	D5	IRQ9
5	D4	NC
6	D3	DRQ2
7	D2	-12V
8	D1	NC
9	D0	+12V
10	IOCHRDY	NC
11	AEN	SMEMW
12	A19	SMEMR
13	A18	IOW
14	A17	IOR
15	A16	DACK3
16	A15	DRQ3
17	A14	DACK1
18	A13	DRQ1
19	A12	REFRESH
20	A11	SYSCLK
21	A10	IRQ7
22	A9	IRQ6
23	A8	IRQ5
24	A7	IRQ4
25	A6	IRQ3
26	A5	DACK2
27	A4	TC
28	A3	BALE
29	A2	+5V-ALWAYS
30	A1	OSC
31	A0	GND
32	GND	GND

Note: The voltages +5V-ALWAYS, +12V and -12V are not generated by the onboard power-supply but they are routed from the Power Supply Connector. The maximum current is limited depending on voltage:
+12V < 1A; -12V < 0.3 A; +5V-ALWAYS < 3 A
One pin can supply a maximum of 1A.

3.11 Micro SD connector (X22)

Depending on the used CoreExpress module, a wide variation of micro SD cards can be used with the Cool LiteRunner-ECO. For further information on suitable micro SD cards, please refer to the corresponding modules manual.

Connector type: Molex 502570-0893
Matching part: MicroSD card

3.12 Supervisory connector (X23)

The supervisory connector provides many status signals such as watchdog and LED signals and additional buses like SMB and CAN. Eight GPIOs are provided here, too.

Connector type: DF14-25 pin header 1.25 mm
Matching connector: Hirose DF14-25S-1.25C, part number 538-0064-7 00

Pin	Default Signal	Option
1	+5V-ALWAYS	
2	+3.3V-ALWAYS	
3	GPIO10	
4	GPIO11	
5	GPIO12	
6	GPIO13	
7	GPIO14	
8	GPIO15	
9	GPIO16	CAN_TX
10	GPIO17	CAN_RX
11	GND	
12	SMB_CLK	
13	SMB_DATA	
14	SMB_ALERT#	
15	MAIN_POWER_LED	
16	SBY_POWER_LED	
17	SUSPEND_LED	
18	SATA_LED#	
19	LIFE_LED	
20	ETH0_LINK/ACT_LED#	
21	ETH0_LINK/100_LED#	
22	ETH1_LINK/ACT_LED#	
23	ETH1_LINK/100_LED#	
24	WD_OUT	
25	GND	

Note: Maximum current on +5V-ALWAYS and +3.3V-ALWAYS pins is 0.5A.

GPIOs

GPIOs come from Nuvoton W83627HF Super I/O and can be programmed using some simple I/O accesses. Refer to chapter 4.3 for some example code.

CAN-Bus

Depending on the used module, the CAN-Bus data lines are provided on the supervisory connector.

Note: Physical implementation of the CAN-Bus must be realized outside of the Carrier.

SM-Bus

Interface to the modules SM-Bus.

Main- and Standby Power LED

Signal goes to '1' when Standby Power and Main Power are ready.

Note: These signals cannot drive an LED directly. Use an appropriate FET to switch LEDs ON and OFF.

Suspend LED

LED is blinking when board goes to suspend.

This signal can drive a LED directly. Maximum output current is 5mA. Series resistor is needed.

LIFE LED

LED is ON when board is in POST and goes OFF when BIOS is passed. This LED is user programmable at runtime. Refer to chapter 4.4 for example code.

This signal can drive a LED directly. Maximum output current is 5mA. Series resistor is needed.

WD OUT

Signal goes to '1' when watchdog event occurs.

This signal can drive a LED directly. Maximum output current is 5mA. Series resistor is needed.

SATA LED#

Signal goes to '0' and LED lights up during HDD accesses.

This signal can sink a LED directly. Maximum sink capability is 5mA. Series resistor is needed.

Ethernet Status LEDs

Signals go to '0' during active Ethernet status

This signal can sink a LED directly. Maximum sink capability is 5mA. Series resistor is needed.

3.13 BIOS Recovery (X24)

In case the onboard BIOS has crashed, there is the possibility to plug in a recovery bios on the LPC bus.
If the system should boot from a connected FWH, pin 6 "BIOS_DISABLE#" needs to be pulled to ground.

The onboard BIOS will be disabled for booting activities and can be reprogrammed with a tool running in DOS.

To program the onboard BIOS the FWH can be disconnected after the operation system is loaded successfully.

Connector type: Hirose DF13-10 pin header 1.25 mm
Matching connector: Hirose DF13-10S-1.25C, part number 536-0009-6 00

Pin	Signal
1	+3.3V *
2	LAD0
3	LAD1
4	LAD2
5	LAD3
6	BIOS_DISABLE# **
7	LFRAME#
8	PCI_RST#
9	CLK_33_FWH
10	GND

Note: *0.3A is the maximum current for that pin

** Signal should be pushed to ground to use an external BIOS

3.14 BIOS defaults Jumper (X27)

In rare cases, it may happen that the system does not start because of certain BIOS settings. In this case, it is highly recommend to first restoring the BIOS factory settings before any debugging is done. This is achieved with "Load Defaults" in the main setup menu. If you cannot reach the BIOS setup because of bad system configuration, use the jumper BIOS defaults Jumper near the power connector:

- Power off the board
- Set the 2.00 mm jumper on X27
- Power on the board
- Remove the jumper from X27 after next power off

3.15 Battery Jumper (X28)

Removing the battery jumper increases the lifetime of the battery. In this case the battery only loses capacity by self-discharge. As default, the jumper battery is not set.

Note It is recommended to set the jumper battery for proper operation before using the module. Otherwise, date and time settings will always get lost.

3.16 Power Connector (X26)

The onboard power supply generates all necessary voltages from the single supply of 5 Volt. The generated 3.3 Volt are available on the connectors "Backlight" and "LVDS".

Note *This +3.3V must not be used to supply external electronic devices with high power consumption like other PC/104 boards or displays.*

Connector type: JST B15B-EH-A 15 pin
Matching connector: JST EHR-15 15 pin female connector

Pin	Signal (standard)	Signal (5V only)
1	+5V	+5V
2	GND	GND
3	+5V	+5V
4	GND	GND
5	+5V	+5V
6	NC	NC
7	GND	GND
8	GND	GND
9	NC	NC
10	NC	NC
11	GND	GND
12	+12V	NC
13	+12V	NC
14	GND	GND
15	-12V	NC

Note The default cable adapter supports the connection of ±12V power supply.
These pins are routed to the PC/104 bus as well as to the backlight port. If the 5 V only power supply is required leave these pins open.
The board can be supplied over the 5 V pins of the PC/104 bus, too.

3.17 PCI-Express Mini Card (X15)

This connector provides a PCI-Express x1 lane, as well as an USB2.0 port.

Connector type: Molex 67910-0001
Matching part: Mini PCI-Express card / MiniCard

Pin	Signal	Pin	Signal
1	WAKE#	2	+3.3V-ALWAYS
3	NC	4	GND
5	NC	6	+1.5V
7	CLKREQ#	8	UIM_PWR
9	GND	10	UIM_DATA
11	REFCLK-	12	UIM_CLK
13	REFCLK+	14	UIM_RESET
15	GND	16	UIM_VPP
17	NC	18	GND
19	NC	20	W_DISABLE#
21	GND	22	PERST#
23	PERn0	24	+3.3V-ALWAYS
25	PERp0	26	GND
27	GND	28	+1.5V
29	GND	30	SMB_CLK
31	PETn0	32	SMB_DATA
33	PETp0	34	GND
35	GND	36	USB_D-
37	GND	38	USB_D+
39	+3.3V-ALWAYS	40	GND
41	+3.3V-ALWAYS	42	NC
43	GND	44	NC
45	NC	46	NC
47	NC	48	+1.5V
49	NC	50	GND
51	NC	52	+3.3V-ALWAYS

4. Using the Module

4.1 BIOS

Since the Cool LiteRunner-ECO has no own BIOS please refer to the corresponding manual of the used CoreExpress module that is used.

4.2 Drivers

Software drivers for SATA, Ethernet and audio are available for the Cool LiteRunner-ECO. These drivers can be downloaded from LiPPERT's website http://www.lippertembedded.com. Follow the installation instructions that come with the drivers.

Drivers are available for Windows XP (embedded), Windows Vista, Windows 7 and Linux. Please ask sales@lippertembedded.com for availability of QNX BSP.

Please see the module's manual for information on drivers that are needed for the CoreExpress module.

Note *The JMICRON SATA controller is not supported by every windows operating system during installation. It will be necessary to manually add support for this device during windows installation process by adding the JMICRON driver. This is typically done at early setup by pressing <F6>. The driver must then be available either on an USB floppy drive with floppy disk or on USB stick.*

4.3 Programming Examples

The following programming examples have been made for Linux systems. If other operation systems are used, some header files could be unnecessary or they can have different names.

The "iopl()" function is a Linux specific one, in Windows XP a tool called "porttalk" can be used instead.

Be careful with the interpretation of the "outb" order in our examples:
Linux: "outb(value, address)"
DOS, Windows: "outb(address, value)"

The following example is meant to be compiled using gcc under Linux.

The W83627HF provides input/output ports that can be individually configured to perform a simple basic I/O function or a pre-defined alternate function. These I/O ports are divided into seven groups, of which group 7 is provided on the Cool LiteRunner-ECO for user-defined purposes·

SELECTION BIT (in reg. F0h) 0 = output 1 = input	INVERSION BIT (in reg. F2h) 0 = direct 1 = inverted	BASIC I/O OPERATIONS
0	0	Basic non-inverting output
0	1	Basic inverting output
1	0	Basic non-inverting input
1	1	Basic inverting input

GPIOs

The Cool LiteRunner-ECO's general-purpose I/O signals are handled by the Nuvotond W83627HF SuperIO and LPC interface (GPIO10-GPIO17 on SuperIO == GPIO10-GPIO17 on supervisory connector). They are located in Logical Device 7 of the SuperIO and can be programmed using simple IN/OUT instructions on Index/Data registers 4Eh/4Fh.

```
#include <stdio.h>
#include <sys/io.h>

#define SIO_ADDR 0x4e
#define SIO_DATA 0x4f

int main()
{
  iopl(3);               //get all I/O access rights
//initialize GPIO:
  outb(0x87, SIO_ADDR);
  outb(0x87, SIO_ADDR);  //unlock SIO
  outb(0x2A, SIO_ADDR);
  outb(0xFD, SIO_DATA);  //use GPIO1x function
  outb(0x07, SIO_ADDR);
  outb(0x07, SIO_DATA);  //select LDN7
  outb(0x30, SIO_ADDR);
  outb(0x01, SIO_DATA);  //enable device
  outb(0xF0, SIO_ADDR);
  outb(0x00, SIO_DATA);  //GPIO1x as outputs

//to set GPIO1x as input use following lines instead:
  //outb(0xF0, SIO_ADDR);
  //outb(0xFF, SIO_DATA);  //GPIO1x as inputs

  outb(0xF1, SIO_ADDR);
  outb(0x55, SIO_DATA);    //write out: 01010101
  printf("WRITE: 0x55\n");
  outb(0xF1, SIO_ADDR);
  printf("READ:  0x%02X\n", inb(SIO_DATA));   //read in the witten out

  outb(0xAA, SIO_ADDR);                       //lock SIO
  iopl(0);
  return 0;
}
```

For further information about programming the W83627HF super I/O, please refer to the datasheet.

Life LED

The Cool LiteRunner-ECO's Life LED is handled by the Nuvotond W83627HF SuperIO (GP31 on SuperIO == PIN19 on supervisory connector). This is located in Logical Device 7 of the SuperIO and can be programmed using simple IN/OUT instructions on Index/Data registers 4Eh/4Fh.

```
/*****************************************************
* Set LIFE-LED of Winbond W83627HF Super IO
*****************************************************
*
* Please note that this programming example is for
* Linux only. If it shall be ported to run in
* Windows, the IO commands must be switched and
* opened differentyl (Porttalk)
*/

#include <sys/io.h>
#include <stdio.h>

#define SIO_ADDR     0x4e
#define SIO_DATA     0x4f

/* LIFE-LED is off per default if board is booted properly */
#undef LIFE_OFF

int main()
{
char    temp;

/* open IO ports */
iopl(3);

/* initialize SuperIO */
outb(0x87, SIO_ADDR);
outb(0x87, SIO_ADDR);

/* set bit 3 of global CR29 to 1 to activate GP31 for toggling the
LIFE-LED */
outb(0x29, SIO_ADDR);
temp= inb(SIO_DATA);
temp= temp | 0x08;
outb(temp, SIO_DATA);
```

```
/* enter logical device 9 holding the register for GP31 */
outb(0x07, SIO_ADDR);
outb(0x09, SIO_DATA);

/* activate logical device 9 = Bit0 of CR30 */
outb(0x30, SIO_ADDR);
outb(0x01, SIO_DATA);

/* set GP31 to act as an output = Bit1 of CRF0 */
outb(0xF0, SIO_ADDR);
temp= inb(SIO_DATA);
temp= temp & 0xFD;
outb(temp, SIO_DATA);

/* set GP31 to be non-inverting = Bit1 of CRF2 */
outb(0xF2, SIO_ADDR);
temp= inb(SIO_DATA);
temp= temp & 0xFD;
outb(temp, SIO_DATA);

/* toggle LIFE-LED: Bit1 of CRF1 = 0 -> LIFE-LED off, Bit1 of CRF1 =
1 -> LIFE-LED on */
outb(0xF1, SIO_ADDR);
temp= inb(SIO_DATA);

#ifdef LIFE_OFF
/* turn off LIFE-LED */
temp= temp & 0xFD;
outb(temp, SIO_DATA);

#else

/* turn on LIFE-LED */
temp= temp | 0x02;
outb(temp, SIO_DATA);
#endif

/* close SuperIO */
outb(0xAA, SIO_ADDR);

return 0;
}
```

4.4 Hardware Resources

This section describes the layout of the CPU memory and I/O address spaces. Please have also a look at the CoreExpress module Technical Manual for further information.

Note *Depending on enabled or disabled functions in the BIOS, other or more resources may be used.*
Due to chipset limitations only IO transfers 8-bit and 16- bit and IRQs are possible on the PC/104 bus. DMA and Memory transfers are not supported.

Memory Address Map

The system occupies the following memory below 1 MByte.

Address Range		Address Range (Hex)			Size	Description
896K	- 1024K	E0000	-	FFFFF	128K	System BIOS
832K	- 895K	D0000	-	DFFFF	64K	PCI Bus
768K	- 832K	C0000	-	CFFFF	64K	Graphics BIOS
704K	- 767K	B0000	-	BFFFF	64K	VGA Memory
640K	- 704K	A0000	-	AFFFF	64K	VGA Memory
0K	- 640K	0	-	9FFFF	640K	Conventional Memory

I/O Address Map

The system chip set implements a number of registers in I/O address space. These registers occupy the following map in the I/O space.

Register Address	Size	Description
0000 – 000F	16 bytes	DMA Controller 1 (8237)
0020 – 0021	2 bytes	Interrupt Controller 1 (8259)
0040 – 005F	4 bytes	Timer Controller (8254)
0040 – 005F	32 bytes	Timer Controller (8254)
00A0 – 00A1	2 bytes	Interrupt Controller 2 (8259)
0170 – 0177	8 bytes	IDE Controller
01F0 – 01F7	8 bytes	IDE Controller
0376	1 byte	IDE Controller
03B0 – 03BB	11 bytes	VGA Adapter
03C0 – 03DF	32 bytes	VGA Adapter
03F6	1 byte	IDE Controller
2000-2FFF	4096 bytes	PCI-PCI bridge
2000-3FFF	4096 bytes	PCI-PCI bridge
4000-401E	29 bytes	USB Controller
4020-403E	29 bytes	USB Controller
4040-405E	29 bytes	USB Controller
4060-406E	15 bytes	IDE Controller
4070-4076	7 bytes	VGA Controller

Interrupts

IRQ	System Resource
NMI	Parity Error
0	Timer
1	Keyboard
2	Interrupt Controller 2
3	Available PCI or ISA(PC104) bus
4	Available PCI or ISA(PC104) bus
5	Available PCI or ISA(PC104) bus
6	Available PCI
7	USB Controller
8	Real Time Clock
9	ACPI
10	PCI-PCI Bridge
11	VGA Adapter
12	Available PCI or ISA(PC104) bus
13	Math coprocessor
14	EIDE
15	Available PCI or ISA(PC104) bus

Note Depending on the BIOS settings, it's possible to reserve several IRQ's for the PCI bus or ISA (PC104) bus. Please enter BIOS setup menu item `PnP/PCI CONFIFURATION`, set menu item `RESSOURCE CONTROLLED BY to MANUAL`. Then you can set the needed IRQs in setup item `IRQ RESSOURCES` to `PCI DEVICE` or `RESERVED (PC104 bus)`

DMA Channels

DMA	Data width	System Resource
0	8 bits	Available PCI
1	8 bits	Available PCI
2	8 bits	Available PCI
3	8 bits	Available PCI
4		Reserved, Cascade Channel
5	16 bits	IDE Controller
6	16 bits	Available PCI
7	16 bits	Available PCI

5. Troubleshooting

First steps if the board does not boot:

- Check the status LEDs on the board. Are all voltages properly available?
- Check the power connectors to the board, monitor and additional devices.
- Are all cables plugged on the correct connector and in the correct orientation? The board may not boot if some of the cables are not plugged in correctly!
- Check the power supply. Is the supply voltage correct for the board? If you are not sure, read the manual. Try plugging in a different power supply or multi-meter to check the power a wrong supply voltage can easily FRY a computer and other electrical devices.
- Is your display ok? Is the monitor powered on? Is the monitor's video cable plugged into the video connector? Double-check the brightness and contrast settings. Plug the monitor into another computer if possible to verify the monitor isn't the problem.
- Remove all additional devices from the system. Only the processor board, power supply, monitors and the keyboard should remain in the system.
- Assure your cooling measures work correctly and keep the processor at a reasonable temperature.
- If all else has failed, replace the CPU Board itself.
- If system comes up then load at first the OPTIMIZED DEFAULTS in the BIOS setup and reboot.

If you need to send the board to LiPPERT for repair, be sure you get a Return Material Authorization number (RMA) first.
Check also Appendix B (Getting Help).

Appendix A, Contact Information

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Appendix B, Getting Help

Should you have technical questions that are not covered by the respective manuals, please contact our support department at **support@lippertembedded.com**.

Please allow one working day for an answer!

Technical manuals as well as other literature for all LiPPERT products can be found in the *Products* section of LiPPERT's website www.lippertembedded.com. Simply locate the product in question and follow the link to its manual.

Returning Products for Repair

To return a product to LiPPERT for repair, you need to get a Return Material Authorization (RMA) number first. Please fill in the RMA Request Form at http://www.lippertembedded.com/service/repairs.html and send it to us. We will return it to you with the RMA number.

> Deliveries without a valid RMA number are returned to sender at his own cost!

LiPPERT has a written Warranty and Repair Policy, which can be retrieved from http://www.lippertembedded.com/service/warranty.html

It describes how defective products are handled and what the related costs are. Please read this document carefully before returning a product.

Appendix C, Further Resources

http://www.lippertembedded.com

LiPPERT Embedded Computers' website with news and detailed information.

http://www.intel.com

Information on the Ethernet controller.

http://www.smbus.org

Information about the System Management Bus (SMBus)

http://www.phoenix.com/en/customer+services/bios/awardbios

Additional BIOS information.

http://www.realtek.com.tw

Information on the HD-Audio Codec.

http://www.jmicron.com

Information on the SATA controller.

http://www.nuvoton.com

Information on the Super I/O controller.

Appendix D, Revision History

Filename	Date	Edited by	Change
TME-CLR-ECO-R0V0	2010-02-02	Oliver Freudenberg	Draft
TME-CLR-ECO-R0V1	2010-03-16	Matthias Fellhauer	Clarification of some TBD values New picture on front page
TME-CLR-ECO-R0V2	2010-05-20	PK	MTBF added Some spelling corrections Released
TME-CLR-ECO-R0V3	2010-06-18	OF	Ch. 2.1 Format corrections Ch. 2.2 LED descriptions corrected Ch. 3.3 part designators corrected
TME-CLR-ECO-R0V4	2010-07-14	MF	Ch. 1.2 removed CLR-ECO part numbers with onboard flash added CLR-ECO part numbers for -20°C to 60°C part number cable set corrected
TME-CLR-ECO-R0V5	2010-07-29	MS	Matching parts / connectors added
TME-CLR-ECO-R0V6	2010-09-06	OF	Ch. 2.1 Connector locations corrected Ch. 2.2 separate chapter jumper locations added
TME-CLR-ECO-R0V7	2010-10-10	OF	Ch. 1.2 Ordering Information corrected Ch. 3.2 Pinout for X3 (VGA) corrected
TME-CLR-ECO-R0V8	2011-02-28 2011-03-16	OF MF	Block diagram corrected New US office address Hardware resources/limitations explained in detail