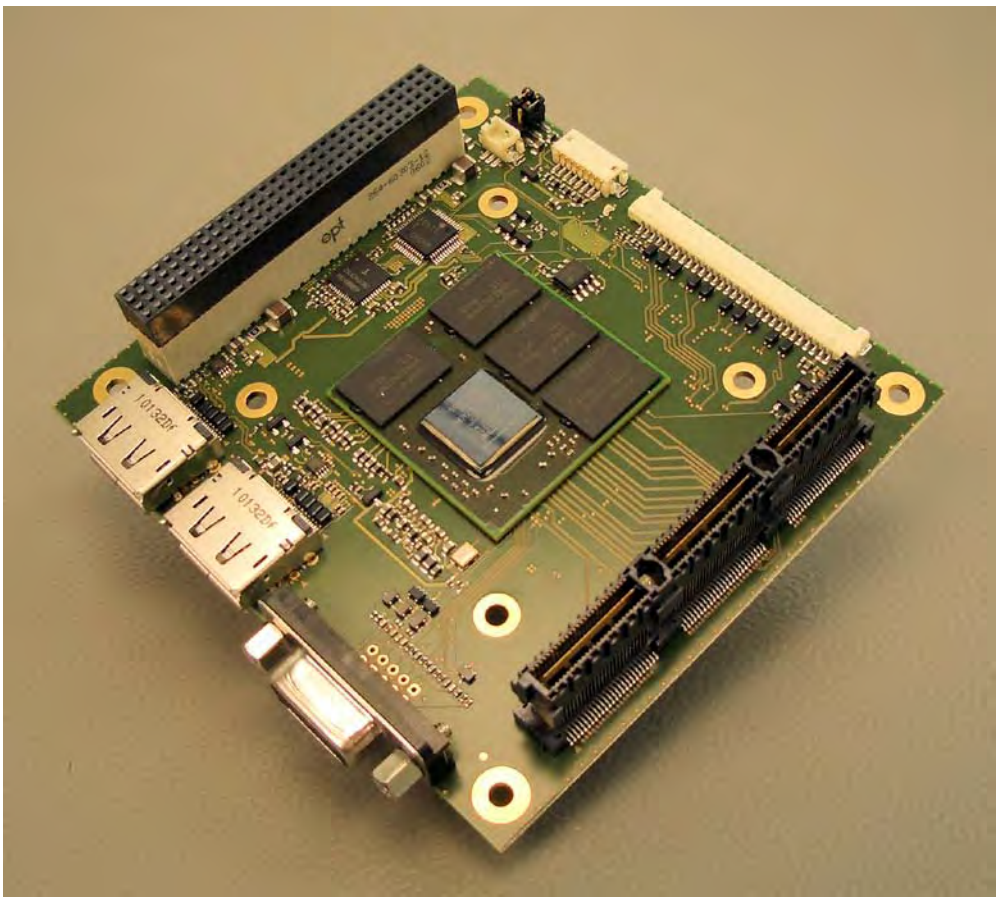
LiPPERT
THE EMBEDDED PC COMPANY

104X-E4690
PCI/104-Express Graphics Card

Technical Manual



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Technical Manual 104X-E4690

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Acronyms

ACPI	Advanced Configuration and Power Management Interface
AMD	Advanced Micro Peripherals
BIOS	Basic Input Output System
BPP	Bits Per Pixel
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DAC	Digital-to-Analog-Converter
DC	Direct Current
DDR	Double Date Rate
DMA	Direct Memory Access
EMC	Electromagnetic Compatibility
HDA	High Density Audio
I²C	Inter-Integrated Circuit
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LVDS	Low Voltage Differential Signaling
PCIe	Peripheral Component Interconnect Express
PLL	Phase-Locked Loop
PWM	Pulse Width Modulation
PWR	Power
ROM	Read Only Memory
SBC	Single Board Computer
SMB	System Management Bus
SMC	System Management Controller
SPI	Serial Peripheral Interface
VGA	Video Graphics Array

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1 Overview

1.1 Introduction

The 104X-E4690 is a graphics card with an ATI Radeon™ E4690 graphics processor for embedded applications with an excellent performance power ratio. The board adds unprecedented graphics performance to an embedded PC on a small 3.78" by 3.55" printed circuit board.

Based on 55nm technology, the E4690 delivers more than double the performance per watt* than previous generation processors. Built with ATI's PowerPlay™ technology the E4690 has dynamic power management delivering high performance when needed, while intuitively conserving energy at idle or when demand is low. The E4690 graphics processor also allows for exceptional scalability of performance between 8W and 25W.For analog monitors there is a VGA-interface and digital ones can be connected to LVDS or Display Port. Backlighting is provided for LCD modules, too.

For larger projects, the Display Port and VGA connectors can be left unstuffed while display cables can be soldered directly onboard.

System expansion can easily be realized over PCI/104-Express and PC/104-Plus bus connectors.

The 104X-E4690 is powered by the PCI/104-Express and PC/104-Plus bus connectors and needs no additional power supply.

The 104X-E4690 runs at Linux, Windows XP, Windows XP Embedded, Windows Vista and Windows 7.

Features

GPU

- ATI Radeon™ E4690
- CPU Interface PCIe 2.0 (x1, x2, x4, x8, x16)
- 320 Shader Processing Units
- AVIVO Display Engine
- Full 30-bit Display Pipeline
- Stream Computing

Main Memory

- 512MByte GDDR3 700 MHz RAM (128Bit)

Graphics Acceleration

- DirectX 10.1
- Shader Model 4.0
- OpenGL 3.x
- OpenCL (2H09)
- Motion Video Decode for H.264, VC-1, MPEG2

Extension slots

- 1 x 32-bit PC/104-Plus 22 mm height on top
- 1 x PCI/104-Express 22m height on top

Interfaces

- VGA
- 2 x DisplayPort (v1.1a)
- 18Bit or 24Bit Dual Channel LVDS

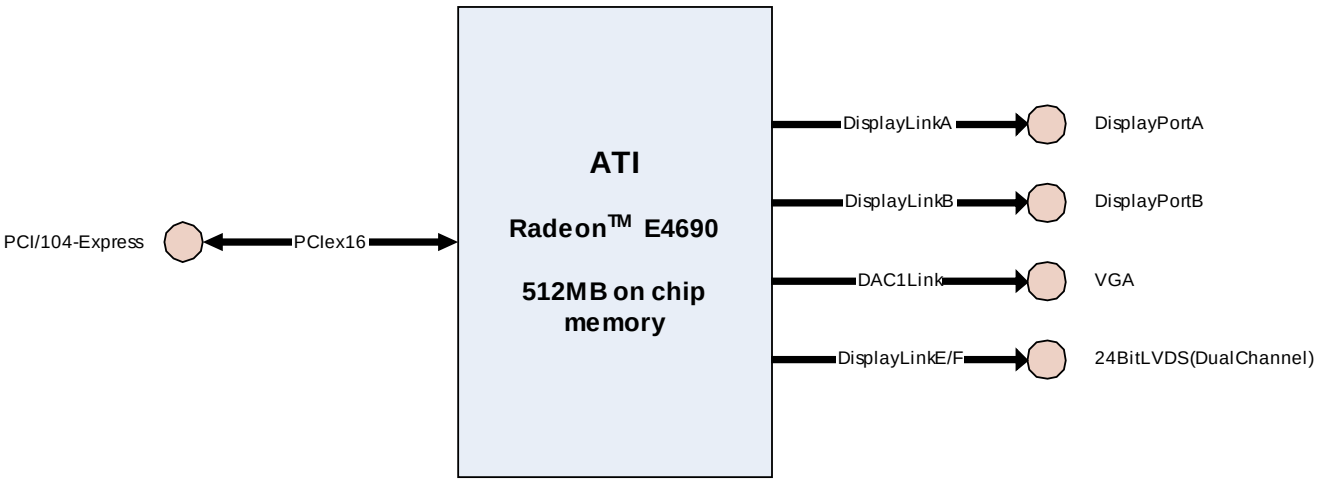
Other Features

- Integrated HD Audio Controller (Azalia)
- Temperature Controlled Fan

Other configurations are possible. Please contact your local LiPPERT representative to discuss requirements.

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Block Diagram



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1.2 Ordering Information

104X-E4690 Models

Order number	Description
712-0007-10	104X-E4690 Operating temp. range: 0°C…+60°C
812-0007-10	104X-E4690 Operating temp. range: -20°C…+60°C

Accessories

There are some options available for the 104X-E4690. Please check their availability before ordering.

Order number	Description
765-0033-10	Heat spreader 104X-E4690 (already included on delivery)
765-0034-10	Heat Pipe Adapter 104X-E4690
765-0026-10	Heat sink active 104X-E4690

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1.3 Specifications

Electrical Specifications

Supply voltage	+5 V DC
Rise time	< 10 ms
Supply voltage tolerance	± 5%
Inrush current	t.b.d.
Supply current	+5 V DC / max. 5A
	+3.3V DC / max. 2A

Environmental Specifications

Operating:

Temperature range	0 … 60 °C (standard version)
	-20 … 60 °C (industrial version)
Temperature change	10K / 30 minutes maximum
Humidity (relative)	10 … 90 % (non-condensing)
Pressure	450 … 1100 hPa

Non-Operating/Storage/Transport:

Temperature range	-55 … 85 °C
Temperature change	10K / 30 minutes maximum
Humidity (relative)	5 … 95 % (non-condensing)
Pressure	450 … 1100 hPa

MTBF

MTBF at 25°C	450.937 hours

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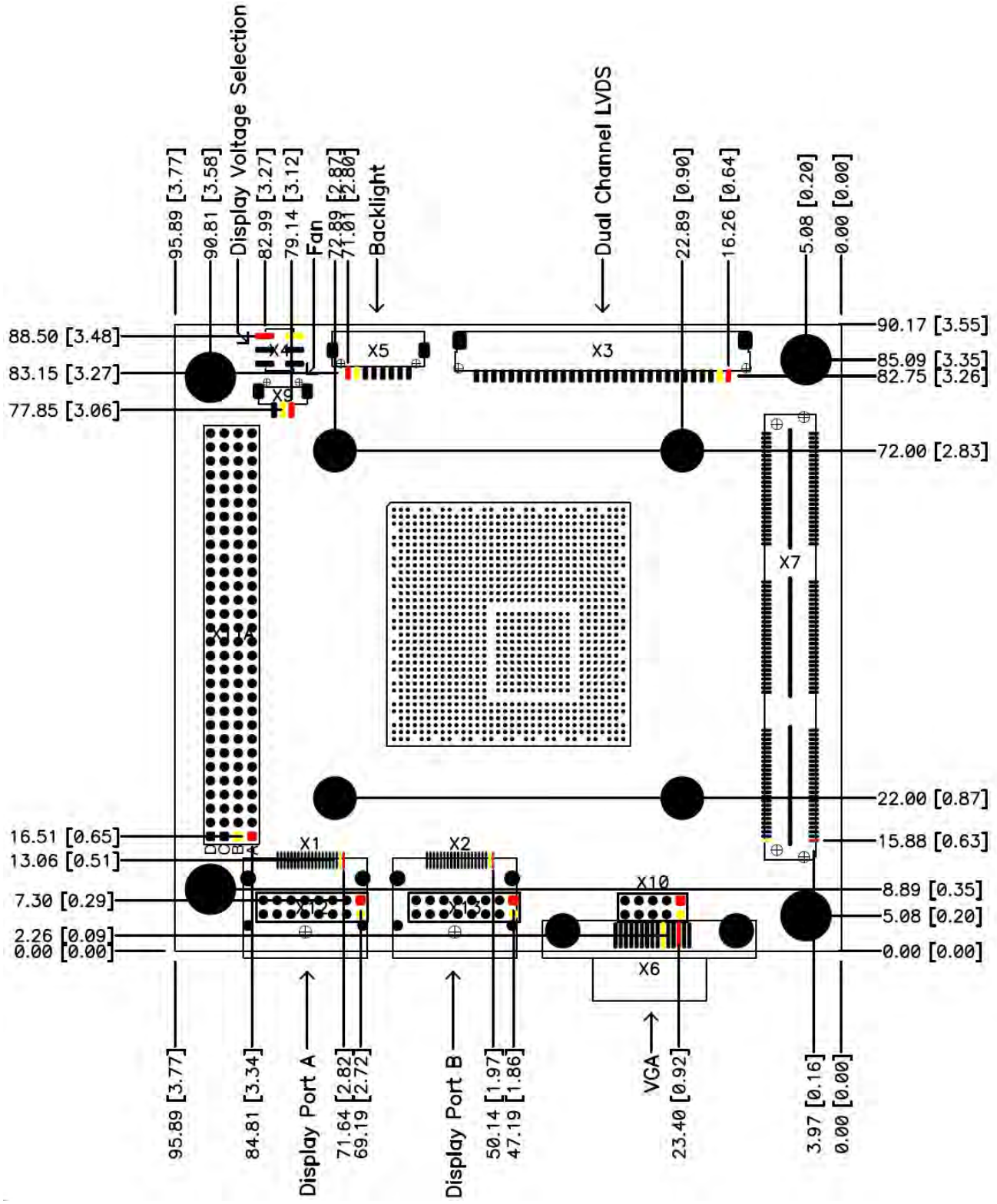
1.4 Mechanical

Dimensions (L x W)	90.2 mm x 95.9 mm
Height	max. 11mm on topside above PCB (without bus connectors) max. 5 mm on bottom side above PCB (without bus connectors)
Weight	approx 90 gr. without cooling solution approx 250 gr. with active heat sink
Mounting	4 mounting holes as defined in the PCI/104-Express specification 4 mounting holes for cooling device

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!

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TOP

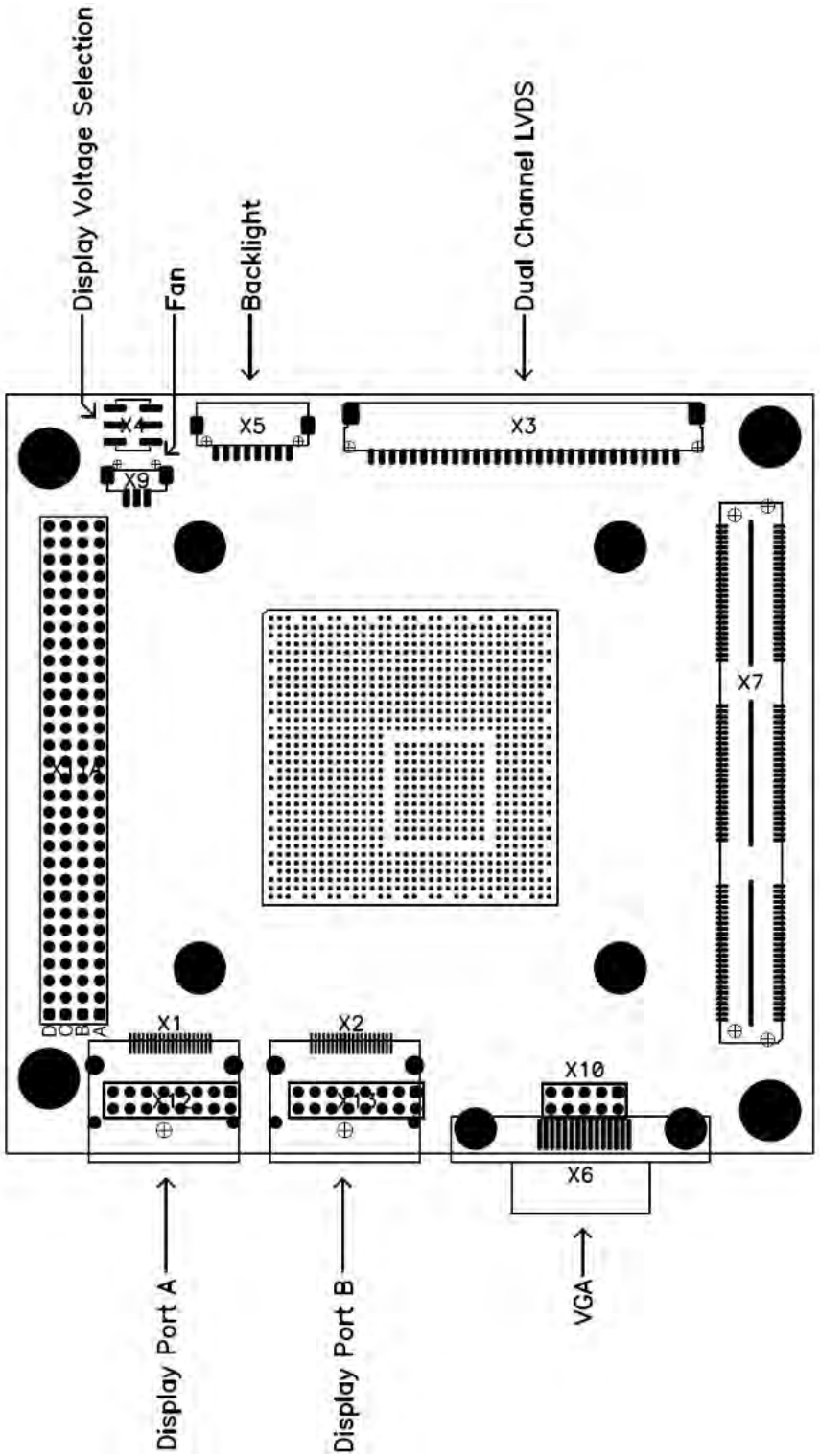


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2 Getting Started

2.1 Connector Locations

Top



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2.2 Hardware setup



Caution Be sure to observe the EMC security measures. Make sure you are always at the same potential as the module.



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

Plug the 104X-E4690 module on top or under a PCI/104-Express or EPIC-Express single board computer (SBC). Connect the 104X-E4690 to a VGA or Display Port monitor. Connect USB keyboard and mouse to the SBC. Use the soldered SSD or 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 twisted! If you plan to use additional other peripherals, now is the time to connect them, too.

Connect an appropriate power supply to the power connector of the SBC and switch the power on.

Note Be sure that your power supply is able to handle the overall inrush current!

Depending on the used SBC it might be necessary to change the primary display output in the SBC bios setup to ´PCI-Express´ or ´external VGA´ to get a screen output on the 104X-E4690. Please refer to the technical manual of the used SBC.

The 104X-E4690 needs additional cooling measures. Depending on the required graphics performance the fan will be controlled in speed to achieve the best cooling performance.

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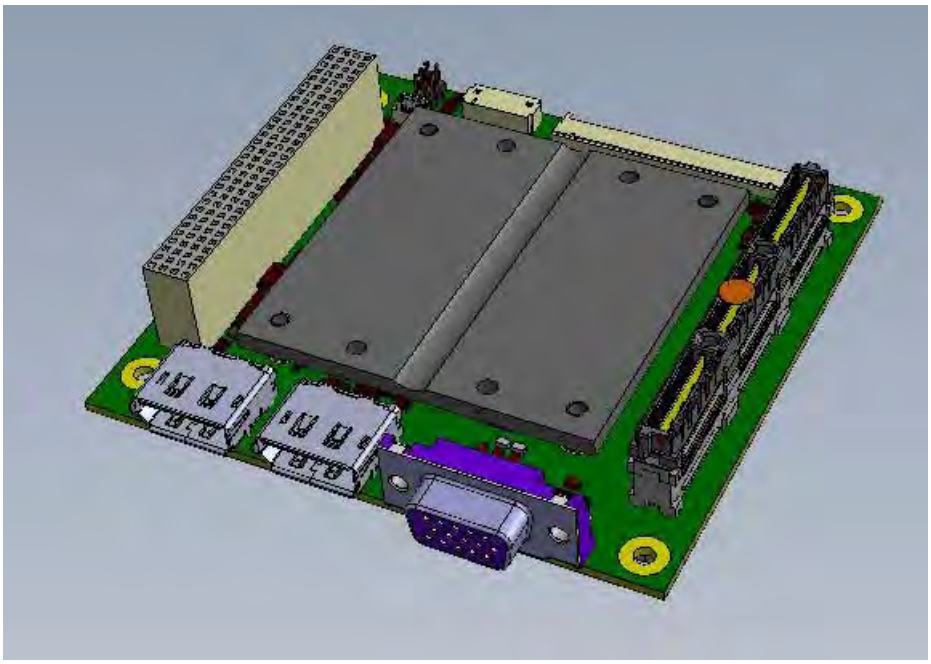
2.3 Cooling solutions

The following solutions are available for the 104X-E4690 as cooling device. Please ask our support department for detailed 3D drawings.

Heat spreader

part number 765-0033-10

The heat spreader is included as default on the board. Additional cooling is necessary for the operation of the board by mounting an adequate cooling device on the heat spreader. With such an additional cooling device the heat spreader is suitable for a temperature range up to 60°C ambient temperature.

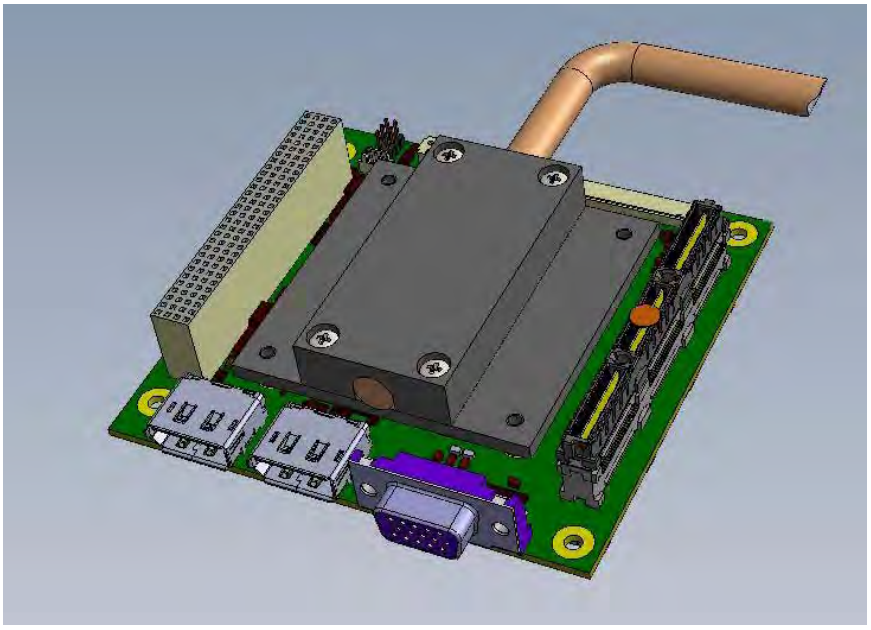


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Heat pipe adapter

part number 765-0034-10

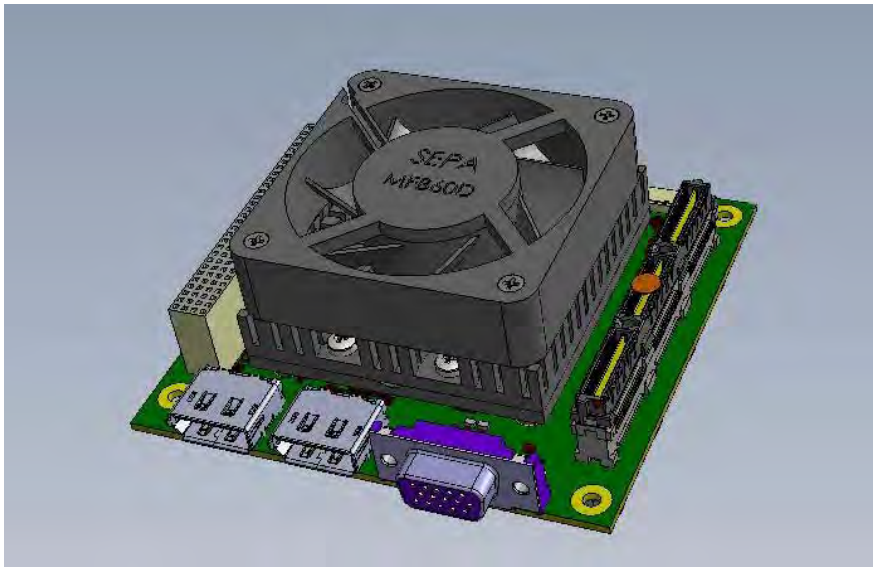
The heat pipe adapter is optionally available to use an 8 mm heat pipe and an condenser with adequate heat sink on the other end of the heat pipe for cooling. With such an additional cooling device the heat pipe adapter is suitable for a temperature range up to 60°C ambient temperature. Please note that the 8 mm heat pipe is not included.



Heat sink active

part number 765-0026-10

The active heat sink is optionally available and is suitable for a temperature range up to 60°C ambient temperature. Please note that the heat sink height does not allow to stack an additional PC/104 Express board on top of the 104X-E4690. Depending on the required graphics performance the fan will be controlled in speed to achieve the best cooling performance.



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3 Module Description

3.1 Interfaces

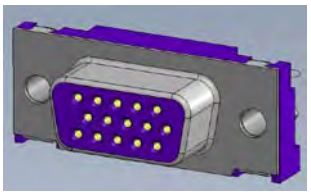
VGA (X6, X10)

The analog display port provides a RGB signal output along with a HSYNC and VSYNC signal.
There is an associated DDC signal pair that is implemented on the analog port. The intended target device is for a CRT based monitor with a VGA connector.
Display devices such as LCD panels with analog inputs may work satisfactory but no functionality has been added to the signals to enhance that capability.

The display function contains a RAM-based Digital-to-Analog Converter (RAMDAC) that transforms the digital data from the graphics and video subsystems to analog data for the CRT monitor. Maximum pixel frequency is 400MHz. Three 10-bit DAC provide the R, G, and B signals to the monitor.

Connector type DSUB15 HDF

Pin	Signal	Pin	Signal
1	Red	2	Green
3	Blue	4	Reserved
5	GND	6	GND
7	GND	8	GND
9	+5V	10	GND
11	Reserved	12	DDC_DAT
13	HSYNC	14	VSYNC
15	DDC_CLK		



Note The +5V signal at pin 9 is protected by a 3A fuse. The fuse gets damaged if this pin is shorted to ground!

There is an additional through-hole pattern that allows soldering a VGA cable directly on the board.

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

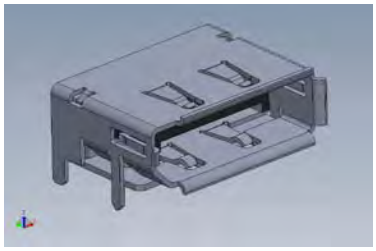
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DisplayPort (DP) Connector (X1 (X12), X2 (X13))

Two DisplayPort monitors can be used at the same time, each working with a maximum resolution of 2560 x 1600 pixels at 60Hz refresh rate.

Connector type: Molex 47272-0021

Pin	Signal	Pin	Signal
1	TD0+	2	GND
3	TD0-	4	TD1+
5	GND	6	TD1-
7	TD2+	8	GND
9	TD2-	10	TD3+
11	GND	12	TD3-
13	GND (CONFIG1)	14	GND (CONFIG2)
15	AUX+	16	GND
17	AUX-	18	HPDET
19	GND (RETURN)	20	+3.3V



Integrated HD Audio Controller (Azalia) and Codec

- Integrated HD Audio codec supports linear PCM and Dolby® Digital (7.1) audio formats for HDMI and DisplayPort outputs. (Note: Player applications may limit the audio output capabilities.)
- Separate logical chip function.
- Can encrypt data onto one associated HDMI or DisplayPort output.
- Compatible Microsoft UAA driver support for basic audio.
- For advanced functionality, a 3rd party driver is required.
- Internally connected to the integrated HDMI or DisplayPort interface, hence no external cable required.
- Support for basic audio (32, 44.1 or 48-kHz stereo) and Dolby® Digital or DTS at the same sample rates.
- LPCM PCM multi-channel support with up to 24-bps and 192-kHz sampling rate.
- Support for up to 8 channels.
- HDCP content protection support for software audio stack.
- True audio plug-and-play capability for enhanced audio modes.

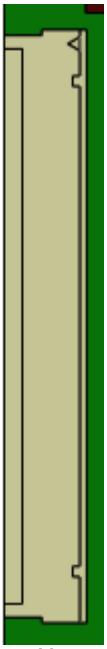
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LVDS (X3)

- Single-link or dual-link LVDS transmitter takes output from either one of the internal display controllers.
- LVDS can operate in either single- or dual-channel mode supporting displays from XGA (or below) up to QXGA.
- LVDS can drive either 18-bpp or 24-bpp displays with several dithering options from the internal 30-bpp display controller.
- Ratio metric expansion and compression supported on reduced blank panels.
- 3 pairs (+1 clock) and 4 pairs (+1 clock) modes for both single- and dual-channel LVDS.
- FPDI-2 compliant; compatible with receivers from National Semiconductor, Texas Instruments, and THine.

Connector type DF14 30-pin header

Pin	Signal
1	VDD (3.3 V, opt.5 V) [1]
2	VDD (3.3 V, opt.5 V) [1]
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	TXB3 -
18	TXB3 +
19	TXBCLK -
20	TXBCLK +
21	GND
22	TXB2 -
23	TXB2 +
24	TXB1 -
25	TXB1 +
26	TXB0 -
27	TXB0 +
28	GND
29	LVDS DDC-CLK
30	LVDS DDC-DATA



X3

[1] 1.0A is the maximum current for each pin

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LVDS Color Mapping

	1	2	3	4	5	6	7
CLKA	1	1	0	0	0	1	1
A0	G2	R7	R6	R5	R4	R3	R2
A1	B3	B2	G7	G6	G5	G4	G3
A2	DE	VS	HS	B7	B6	B5	B4
A3	0/B1	B1	B0	G1	G0	R1	R0
CLKB	1	1	0	0	0	1	1
B0	G2	R7	R6	R5	R4	R3	R2
B1	B3	B2	G7	G6	G5	G4	G3
B2	DE	VS	HS	B7	B6	B5	B4
B3	0/B1	B1	B0	G1	G0	R1	R0

In 18 Bit mode A3 and B3 will be unused.
In Dual Link Mode channel A contains even bits, channel B contains odd bits.

Backlight (X5)

In order to meet the panel power timing specification requirements the LCD backlight inverter power supply is controlled by an integrated PWM interface.

Connector type DF13 8-pin header

Pin	Signal
1	+12V [2]
2	+12V [2]
3	+5V [2]
4	+5V [2]
5	CTRL
6	EN [3]
7	GND
8	GND



X5

[2] 0.5A is the maximum current for each pin

[3] That voltage can be selected via Jumper for backlight, shown on next page

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Display Voltage Jumpers (X4)

Jumper LVDS and Backlight

Connector type IDC6 jumper 2.00 mm.

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

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

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



X4

default jumper setting

LVDS		
Jumper	1-3	3-5
Power supply	+3.3 Volt	+5 Volt
Backlight		
Jumper	2-4	4-6
Power supply	+12 Volt	+5 Volt

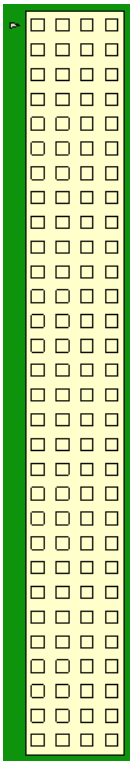
Note An arrow marks pin 1

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3.2 PC/104-Plus Bus Interface (X11)

The PC/104 Plus Bus connector is used only as stack through connector for the PCI bus of the CPU board and is not used on the 104X-E4690. The bus connector height on top side is 22 mm.

Pin	Row A	Row B	Row C	Row D
1	GND	NC	+V5A	AD00
2	VI/O	AD02	AD01	+V5A
3	AD05	GND	AD04	AD03
4	C/BE0#	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VI/O	AD10	NC
7	AD14	AD13	GND	AD12
8	+3V3S	C/BE1#	AD15	+3V3S
9	SERR#	GND	GND	PAR
10	GND	PERR#	+3V3S	PME#
11	STOP#	+3V3S	LOCK#	GND
12	+3V3S	TRDY#	GND	DEVSEL#
13	FRAME#	GND	IRDY#	+3V3S
14	GND	AD16	+3V3S	C/BE2#
15	AD18	+3V3S	AD17	GND
16	AD21	AD20	GND	AD19
17	+3V3S	AD23	AD22	+3V3S
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3#	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+V5A	AD28	AD27
22	+V5A	AD30	GND	AD31
23	REQ0#	GND	REQ1#	VI/O
24	GND	REQ2#	+V5A	GNT0#
25	GNT1#	VI/O	GNT2#	GND
26	+V5A	CLK0	GND	CLK1
27	CLK2	+V5A	CLK3	GND
28	GND	INTD	+V5A	RST#
29	+V12A	INTA	INTB#	INTC#
30	-V12A	REQ3#	GNT3#	GND



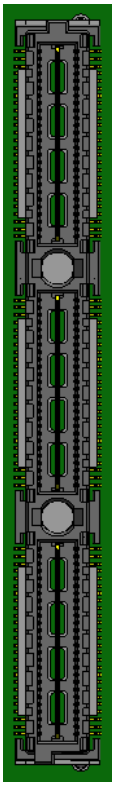
X11

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3.3 PCI/104-Express Bus Interface (X7)

The bus connector height on top side is 22 mm.

Pin	Signal		Pin	Signal
1	GPIO0		2	PE_RST#
3	+3.3V		4	+3.3V
5	USB_1+		6	USB_0+
7	USB_1-		8	USB_0-
9	GND		10	GND
11	Pex1_1Tp		12	Pex1_0 Tp
13	Pex1_1Tn		14	Pex1_0 Tn
15	GND		16	GND
17	Pex1_2 Tp		18	Pex1_3 Tp
19	Pex1_2 Tn		20	Pex1_3 Tn
21	GND		22	GND
23	Pex1_1Rp		24	Pex1_0 Rp
25	Pex1_1Rn	+5V	26	Pex1_0 Rn
27	GND		28	GND
29	Pex1_2 Rp		30	Pex1_3 Rp
31	Pex1_2 Rn		32	Pex1_3 Rn
33	GND		34	GND
35	Pex1_1Clkp		36	Pex1_0Clkp
37	Pex1_1Clkn		38	Pex1_0Clkn
39	+5V_Always		40	+5V_Always
41	Pex1_2Clkp		42	Pex1_3Clkp
43	Pex1_2Clkn		44	Pex1_3Clkn
45	CPU_DIR		46	PWRGOOD
47	SMB_DAT		48	Pex16_Clkp
49	SMB_CLK		50	Pex16_Clkn
51	SMB_ALERT		52	PSON#
Pin	**Signal**		**Pin**	**Signal**
53	WAKE#		54	PEG_EN#
55	GND		56	GND
57	Pex16_0T(8)p		58	Pex16_0T(0)p
59	Pex16_0T(8)n		60	Pex16_0T(0)n
61	GND		62	GND
63	Pex16_0T(9)p		64	Pex16_0T(1)p
65	Pex16_0T(9)n		66	Pex16_0T(1)n
67	GND		68	GND
69	Pex16_0T(10)p		70	Pex16_0T(2)p
71	Pex16_0T(10)n		72	Pex16_0T(2)n
73	GND		74	GND
75	Pex16_0T(11)p		76	Pex16_0T(3)p
77	Pex16_0T(11)n	+5V	78	Pex16_0T(3)n
79	GND		80	GND
81	Pex16_0T(12)p		82	Pex16_0T(4)p
83	Pex16_0T(12)n		84	Pex16_0T(4)n
85	GND		86	GND
87	Pex16_0T(13)p		88	Pex16_0T(5)p
89	Pex16_0T(13)n		90	Pex16_0T(5)n
91	GND		92	GND
93	Pex16_0T(14)p		94	Pex16_0T(6)p
95	Pex16_0T(14)n		96	Pex16_0T(6)n
97	GND		98	GND
99	Pex16_0T(15)p		100	Pex16_0T(7)p
101	Pex16_0T(15)n		102	Pex16_0T(7)n
103	GND		104	GND



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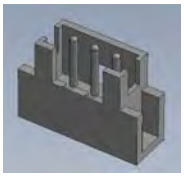
Pin	Signal		Pin	Signal
105	SDVO_DAT		106	SDVO_CLK
107	GND		108	GND
109	Pex16_0R(8)p		110	Pex16_0R(0)p
111	Pex16_0R(8)n		112	Pex16_0R(0)n
113	GND		114	GND
115	Pex16_0R(9)p		116	Pex16_0R(1)p
117	Pex16_0R(9)n		118	Pex16_0R(1)n
119	GND		120	GND
121	Pex16_0R(10)p		122	Pex16_0R(2)p
123	Pex16_0R(10)n		124	Pex16_0R(2)n
125	GND		126	GND
127	Pex16_0R(11)p		128	Pex16_0R(3)p
129	Pex16_0R(11)n	+12V	130	Pex16_0R(3)n
131	GND		132	GND
133	Pex16_0R(12)p		134	Pex16_0R(4)p
135	Pex16_0R(12)n		136	Pex16_0R(4)n
137	GND		138	GND
139	Pex16_0R(13)p		140	Pex16_0R(5)p
141	Pex16_0R(13)n		142	Pex16_0R(5)n
143	GND		144	GND
145	Pex16_0R(14)p		146	Pex16_0R(6)p
147	Pex16_0R(14)n		148	Pex16_0R(6)n
149	GND		150	GND
151	Pex16_0R(15)p		152	Pex16_0R(7)p
153	Pex16_0R(15)n		154	Pex16_0R(7)n
155	GND		156	GND

3.4 Fan Connector (X9)

The 104X-E4690 provides a connector to power a GPU fan if the module is actively cooled.

Connector type DF13 3-pin header

Pin	Signal
1	Speed Signal from fan (yellow)
2	+5VDC (red) [4]
3	GND (black)



X6

[4] 0,2 A is the maximum current for each pin

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4 Using the Module

4.1 Drivers

Software drivers are available for the 104X-E4690.

These drivers can be downloaded from AMD's website www.amd.com. Choose Product Line: Embedded on driver download page.

Follow the installation instructions that come with the drivers.

Scalable Power Consumption

By setting different speeds for GPU and GDDR3 memory in the driver settings it's possible to scale the graphics performance and the power consumption respectively. The following table shall give an example of different possibilities.

GPU speed	Memory speed	Power consumption	3DMark06 HDR/SM3.0
150 MHz	250 MHz	8W	784
300 MHz	400 MHz	12W	1425
450 MHz	600 MHz	17W	2161
600 MHz	700 MHz	25W	2669

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Appendix A, Contact Information

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Appendix B, Additional Information

ATI• Datasheets

Ask ATI or AMD support for the datasheet of Radeon™ E4690.

PCI/104-Express and PC/104-Plus Specifications

A copy of the latest PCI/104-Express and PC104-Plus specifications can be obtained from the PC/104 Consortium's website at http://www.pc104.org

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Appendix C, 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 use the RMA request form on our website www.lippertembedded.com/service/repairs.html or contact our support.

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
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.

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Appendix D, Revision History

Filename	Date	Editor	Change
TME-104X-E4690-0V0	2010-02-02	OF	draft
TME-104X-E4690-0V1	2010-09-10	MF	minor changes
TME-104X-E4690-0V2	2010-09-14	MF	Chapter 3.2. correction on description Chapter 3.3. correction on description
TME-104X-E4690-0V3	2011-04-21	OF	New front picture US office address corrected Electrical specifications corrected (supply voltage) MTBF added
TME-104X-E4690-1V0	2011-04-27	MF	Cooling solutions added

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