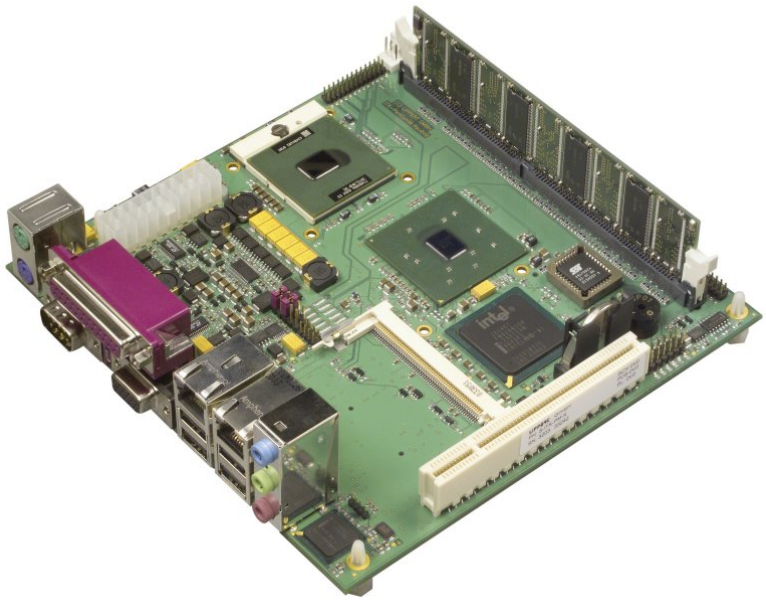
THE EMBEDDED PC COMPANY

Thunderbird
Mini-ITX Motherboard

Technical Manual



TME-ITX-PM-R4V1
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Contents

1 Functional Specification

1.1 General

The Thunderbird is a PC compatible motherboard conforming to the Mini-ITX form factor. At the core of the Thunderbird works the Intel® Pentium® M processor together with the Intel® i82855GME (855GME) chipset. Running at up to 2.0GHz, this processor consumes very little power while at the same time delivers outstanding performance figures. The processor's clock frequencies will even be increased when faster CPU chips will become available. At the other side of the performance spectrum, at lower clock frequencies, it is even possible to operate the Thunderbird with a heatsink only.

The i82855GME chipset features a high performance 2D graphics controller as well as an integrated display controller with improved unified memory architecture. Displays with resolutions up to 2048 x 1536 pixels at 75 Hz can be handled. Two channel LVDS allows interference-free connection of LCD modules.

The Thunderbird comes as a complete personal computer with floppy disk, PS/2 keyboard and mouse and a printer port. Four independent Ultra ATA 100 harddisks can be connected to the primary and secondary EIDE ports. An AC97 compatible sound I/O system is also integrated, allowing easy construction of embedded multimedia computers.

The communication possibilities match the processor's performance: a Gigabit-Ethernet (1000BaseT) together with a Fast-Ethernet (100/10BaseT) port is integrated on the board.
Further connection possibilities are provided by six independent USB 2.0 ports in USB host mode, which allow connection of all kinds of different USB peripheral devices. Two standard serial RS232C interfaces enhance the communication capabilities even more.

There are two PCI slots available for system expansion. One is a Mini-PCI slot, capable to hold all types of Mini-PCI modules. The second is a conventional 3.3 PCI slot, which can be used for all kinds of standard PCI cards.

The system’s main memory is expandable up to 1024 MB DDR-333 (PC2700) SDRAM in the on-board DIMM socket.

The board's basic functionality is supervised with the integrated status indicators. These indicators show the state of the supply voltages, Ethernet activity as well as EIDE accesses.
Embedded applications also profit from the on-board power supply. It is optionally available for +5V supply only, which is almost universally available in the embedded environment.

The Thunderbird is intended for OEMs in the gaming machine industry, entertainment and all other kinds of embedded high performance PC applications.

1.2 The Thunderbird at a glance

CPU:

- **Intel® Pentium® M Processor**

Cache Memory:

- On-die 32 KB Level 1 instruction and data caches
- 1 or 2 MB Level 2 cache (this depends on the CPU) with Advanced Transfer Cache Architecture

Main Memory:

- One memory slot for 64-bit memory, with up to 1 GB DDR-SDRAM (PC2700/333MHz).

Extension slots:

- 1x 32-bit PCI slot (3.3V)
- 1x 32-bit Mini-PCI slot (Type IIIA)

Interfaces:

- Power supply
- PS/2 Keyboard
- PS/2 Mouse
- One parallel port
- Two serial ports
- 6x USB 2.0
- IrDA
- Ethernet 10/100 BaseT
- Ethernet 10/100/1000 BaseT
- Floppy
- 2x EIDE
- SVGA graphics
- LVDS 18/24-bit dual channel LVDS
- PCI and Mini-PCI bus

Other configurations are possible at high volumes.

Dimensions:

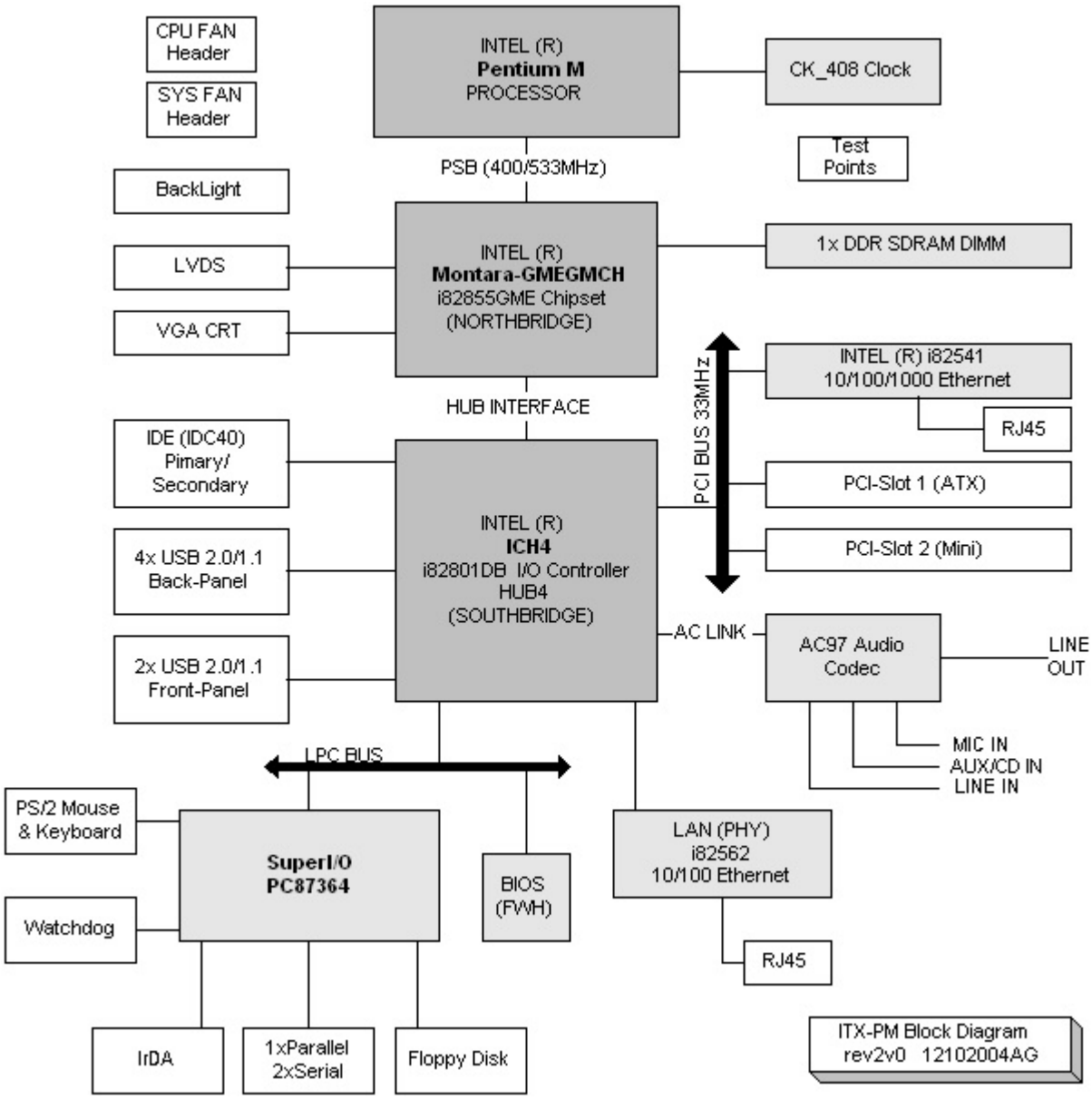
- 170mm x 170mm x 44mm

Mounting:

- 4 mounting holes for PCB
- 6 mounting holes for cooling system

> **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!

1.3 Functional Block Diagram



1.4 Processor

Intel® Pentium® M Processor, 600MHz…2.0GHz

The Intel® Pentium® M processor is a high performance, low power mobile processor with several micro-architectural enhancements over existing Intel mobile processors.

Some of the key features of this processor are:

- Supports Intel® Architecture with Dynamic Execution
- High performance, low-power core
- On-die, primary 32-kbyte instruction cache and 32-kbyte write-back data cache
- On-die, 1 or 2 MByte second level cache with Advanced Transfer Cache Architecture
- Advanced Branch Prediction and Data Prefetch Logic
- Streaming SIMD Extensions 2 (SSE2)
- 400-MHz, Source-Synchronous processor system bus
- Advanced Power Management features including Enhanced Intel® SpeedStep® technology
- Micro-FCPGA and Micro-FCBGA packaging technologies

The Intel Pentium M processor is manufactured on Intel’s advanced 0.13-micron and in 90 nm process technology with copper interconnect. The processor maintains support for MMX™ technology and Internet Streaming SIMD instructions and full compatibility with IA-32 software. The high performance core features architectural innovations like Micro-op Fusion and Advanced Stack Management that reduce the number of micro-ops handled by the processor. This results in more efficient scheduling and better performance at lower power. The on-die 32-kB Level 1 instruction and data caches and the 1-MB or 2MB Level 2 cache with Advanced Transfer Cache Architecture enable significant performance improvement over existing mobile processors. The processor also features a very advanced branch prediction architecture that significantly reduces the number of mispredicted branches. The processor’s Data Prefetch Logic speculatively fetches data to the L2 cache before an L1 cache requests occurs, resulting in reduced bus cycle penalties and improved performance.
The Streaming SIMD Extensions 2 (SSE2) enables break-through levels of performance in multimedia applications including 3-D graphics, video decoding/encoding, and speech recognition.
The new packed double-precision floating-point instructions enhance performance for applications that require greater range and precision, including scientific and engineering applications and advanced 3-D geometry techniques, such as ray tracing.

1.5 Northbridge

Intel® i82855GME, Chipset Graphics and Memory Controller Hub (GMCH)

- Processor/Host Bus at 400 MHz
- Memory System PC1600/PC2100/PC2700 DDR SDRAM (200/266/333MHz)
- System Interrupts Intel 8259
- Video Stream Decoder improved hardware motion compensation for MPEG2 and Software DVD at 60 Fields/second and 30 frames/second full screen, encoding at low CPU utilization
- Analog display support, 350-MHz integrated 24-bit RAMDAC that can drive a standard progressive scan analog monitor with pixel resolution up to 1600x1200 at 85 Hz and up to 2048x1536 at 75 Hz
- Dual independent pipe support
  - Concurrent: Different images and native display timings on each display device

  - Simultaneous: Same images and native display timings on each display device

- Dedicated LFP (local flat panel) LVDS interface, Single- or dual-channel LVDS panel support up to UXGA panel resolution with frequency range from 25 MHz to 112 MHz (single channel/dual channel), Supports data format up to 24 bpp

- Internal Graphics Features, 2D/3D graphics engine

For detailed information, please use the Intel® i82855GME datasheet.

1.6 Southbridge

Intel® i82801DB I/O Controller Hub 4 (ICH4)

The ICH4 provides extensive I/O support. Functions and capabilities include i.e.:

- *PCI Local Bus Specificatio*n, Revision 2.2-compliant with support for 33 MHz PCI operations.
- ACPI Power Management Logic Support
- Enhanced DMA controller, Interrupt controller, and timer functions
- Integrated IDE controller supports Ultra ATA100/66/33
- USB host interface with support for 6 USB ports; 3 UHCI host controllers; 1 EHCI high-speed USB 2.0 Host controller
- Integrated LAN controller
- *System Management Bus (SMBus) Specificatio*n, Version 2.0 with additional support for I2C devices
- Supports *Audio Codec ’9*7, Revision 2.3 specification (a.k.a., *AC ’97 Component Specificatio*n, Revision 2.3)
- Low Pin Count (LPC) interface

1.7 Board Types

There are two board types available.

1.7.1 Board Type I

The on-board power supply generates all necessary voltages from a standard ATX power supply. There is a socket for the CPU on board, so the CPU is changeable.

1.7.2 Board Type II

Optionally, the Thunderbird is available for use with a single supply voltage of +5V. The on-board power supply generates all necessary voltages (apart from +12V) from this. The +12V can also be supplied.
This “Board Type II” will be also usable for passive cooling.
The CPU is soldered on the board.

Note: The +12 VDC voltage will not be build on the board. If +12V DC is necessary for the PCI slot or inverter-power supply so also this +12 VDC must be connected to the power connector.

1.8 PCI bus interface

The main features are:

- Rev. 2.2 compliant implementation
- Integrated PCI arbitration interface (32 bit wide, 3.3V).
- Translation of PCI cycles to ISA bus.
- Translation of ISA master initiated cycle to PCI.
- Support for burst read/write from PCI master.
- 33 MHz PCI clock.

The Thunderbird supports on PCI only signal levels at 3.3 Volt. Adapter boards on the PCI slot must tolerate this voltage.

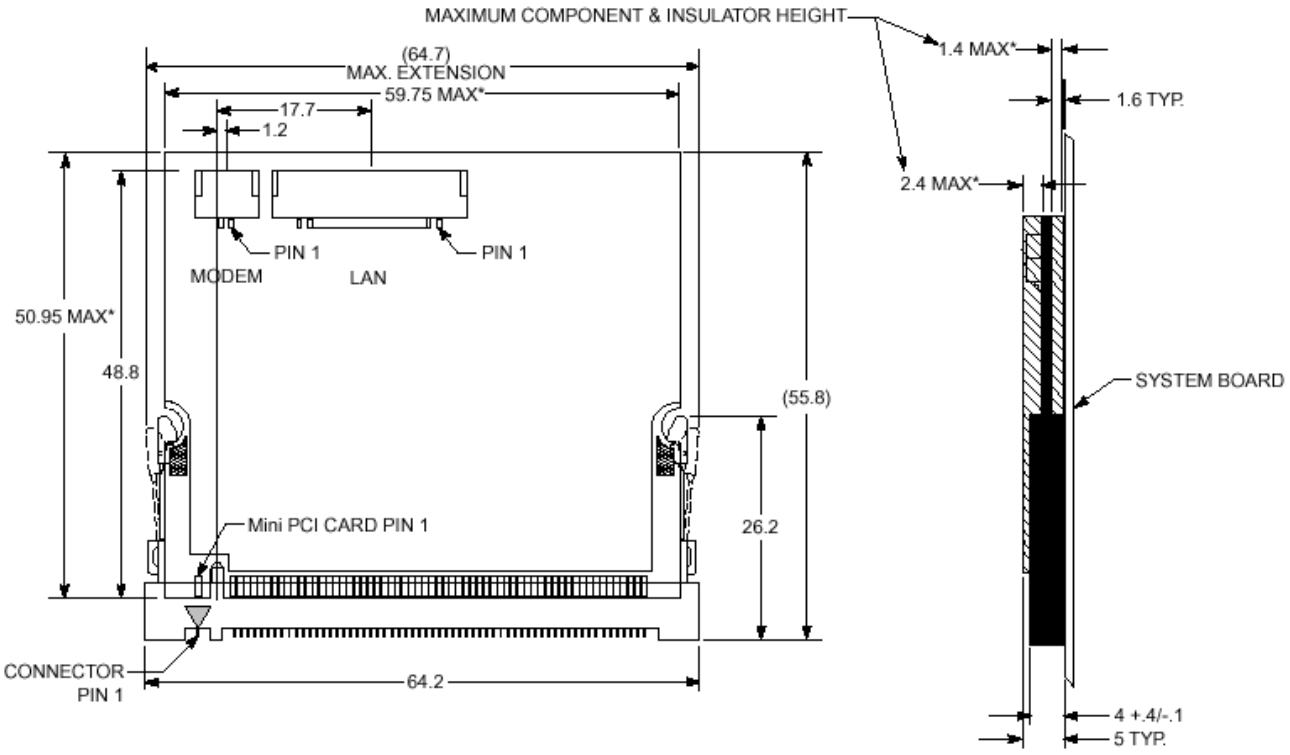
Note: Signal levels of 5 Volt are not allowed.

The internal DC/DC converter does supply the 3.3 Volt pins on the PCI bus.
The maximum supply current is 2.0A at 3.3 Volts.

1.9 Mini-PCI Bus Interface

The Mini-PCI specification defines a small form factor daughter card for the 32bit PCI bus that can be used on CPU-boards in which standard PCI cards cannot be used due to mechanical constraints. A CPU board with such a card can easily be enhanced with new functionality.

Mini-PCI Type IIIA:



1.10 Super I/O

The onboard Super I/O (National Semiconductor, PC87364) provides:

- PS2 keyboard interface
- PS/2 mouse interface
- Floppy disk interface on FFC connector
- COM1 (DSUB9) and COM2 (IDC10) connectors
- LPT1 on DSUB25 connector
- FAN speed control and monitor
- Watchdog

1.11 PS/2 Keyboard Interface

The keyboard interface is located on the PS2 “Keyboard/Mouse Connector”. A standard PS2 keyboard can be used.

1.12 PS/2 Mouse Interface

The PS/2 mouse function is always active. PS/2 Mouse function can be disabled.

1.13 Reset-In Signal

The RESET-IN signal is accessible on the IDC12 Header “System Panel Connector”. To reset the board, this signal must be pulled to GND.

1.14 Floppy Disk Interface

The floppy interface connector is built for slim line floppy disk drives. An adapter to connect a standard floppy drive is available.

1.15 Serial Ports

The serial ports are available through a DB9 connector for COM1 and an IDC10-header for COM2, respectively. An adapter cable with a standard DB9 male connector for COM2 is available.
The serial ports are configurable with the BIOS setup utility by pressing <**F2**> or <**DEL**> at boot time. Entering **Integrated Peripherals – SuperIO Device** and then choosing **Onboard Serial Port 1 or Onboard Serial Port 2** allows configuration of the serial ports.

Onboard Serial Port 1 (COM1) can be configured as follows:

- 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

Onboard Serial Port 2 (COM2) can be configured as follows:

- 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

1.16 Parallel Port LPT1

The parallel port is located on an IDC26 header. An adapter cable with a standard DB25 female connector is available.
The parallel port is programmable in BIOS setup by pressing <**F2**> or <**DEL**> at boot time.
Entering **Integrated Peripherals – SuperIO Device** and then choosing **Onboard Parallel Port** allows configuration of LPT1.

Onboard Parallel Port (LPT1) can be configured as follows:

- Disabled
- 378 / IRQ7 (base address / interrupt channel)
- 278 / IRQ5 (base address / interrupt channel)
- 3BC / IRQ7 (base address / interrupt channel)

While not disabled, **Parallel Port Mode** can be selected as:

- Standard
- SPP
- EPP1.7
- EPP1.9
- ECP
- ECP+EPP

If **Parallel Port Mode** is switched to **ECP** or **ECP+EPP,** the menu item **DMA channel** becomes accessible. DMA channel 1 or 3 can be selected.

1.17 USB Ports

Two USB ports are located on the 2mm IDC8 header on the CPU-board. The other four are on the USB headers. To use some legacy USB functions like “USB boot” or “USB keyboard”, they have to be enabled in the **Integrated Peripherals – Onboard Device** menu.

USB Controller: Enabled/Disable
USB 2.0 Controller: Enabled/Disable

1.18 EIDE Port

An EIDE (**E**xtended **I**ntelligent **D**rive **E**lectronics) port is provided by the chipset to connect intelligent drives that integrate the controller (hard disk, CD-ROM etc.). This port supports LBA (Logic Block Addressing) that allows the use of hard disks larger than 512 Mbytes. To enhance the performance, this port supports DMA F type of transfer. The EIDE port is located on two standard 40-pin headers (2.54mm) for hard disks. For optimal performance, an ATA100 cable should be used.

1.19 CRT / LCD Graphic-Controller

The GMCH IGD provides a highly integrated graphics accelerator delivering high performance 2D, 3D, and video capabilities. With its interfaces to UMA using a DVMT configuration, an analog

display, a LVDS port, and two digital display ports (e.g. flat panel), the GMCH can provide a complete graphics solution.
The GMCH also provides 2D hardware acceleration for block transfers of data (BLTs). The BLT engine provides the ability to copy a source block of data to a destination and perform raster operations (e.g., ROP1, ROP2, and ROP3) on the data using a pattern, and/or another destination. Performing these common tasks in hardware reduces CPU load, and thus improves performance. High bandwidth access to data is provided through the System Memory interface. The GMCH uses tiling architecture to increase System Memory efficiency and thus maximize effective rendering bandwidth. The Intel 855GME GMCH also improves 3D performance and quality with 3D Zone Rendering technology.
The GMCH has four display ports, one analog and three digital. These provide support for a progressive scan analog monitor, a dedicated dual channel LVDS LCD panel, and two DVO devices. DVO is not used on Thunderbird.

The Graphics Controller uses an integrated 350-MHz, 24-bit RAMDAC with maximum pixel resolution support up to 1600x1200 at 85 Hz and up to 2048x1536 at 72 Hz.

1.20 LVDS

The Intel 855GME GMCH has an integrated dual channel LFP Transmitter interface to support LVDS LCD panel resolutions up to UXGA with center and down spread SSC support of 0.5%, 1%, and 2.5% utilizing an external SSC clock. The display pipe provides panel upscaling to fit a smaller source image onto a specific native panel size, as well as provides panning and centering support. The LVDS port is only supported on Pipe B. The LVDS port can only be driven by Pipe B, either independent or simultaneous with the Analog Display port, respectively.

The Dedicated Dual Channel LFP LVDS interface with frequency range of 25 MHz to 112 MHz (single channel/dual channel) support up to UXGA (1600x1200 at 60 Hz) LCD panel resolution with maximum pixel format of 24-bpp.

There is a connector on-board to supply the LC-Display's inverter.

1.21 Gigabit Ethernet (1000BaseT)

The Intel® 82541PI integrates fourth generation Gigabit MAC design with fully integrated, physical layer circuitry to provide a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE_TX, and 10BASE-T applications (802.3, 802.3u, and 802.3ab). The controller is capable of transmitting and receiving data at rates of 1000 Mbps, 100 Mbps, or 10 Mbps.

1.22 Fast Ethernet (Intel PRO/100)

The ICH4 LAN solution that the 82562ET/EM enables is a 32-bit PCI device that features enhanced scatter-gather bus mastering capabilities, which allows the LAN solution to perform high-speed data transfers over the PCI bus. The bus mastering capabilities enable the LAN solution to process high-level commands and perform multiple operations, thereby offloading communications tasks from the system CPU. Two large transmit and receive FIFOs are also included in the architecture to enhance performance while minimizing the use of system resources.

The PHY unit (i82562ET/EM) supports Auto-Negotiation for 10BaseT-/100BaseTX Half Duplex and 10BaseT-/100BaseTX Full Duplex.

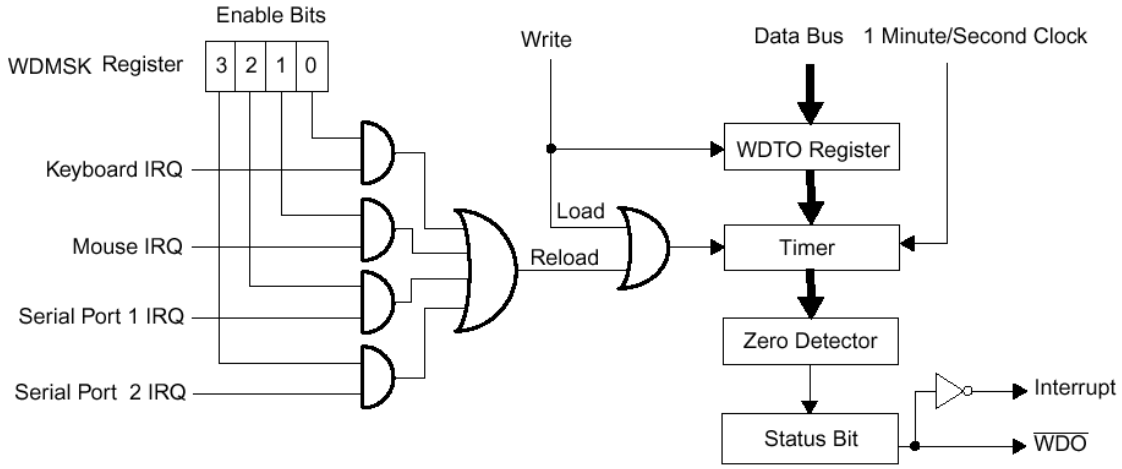
1.23 Audio

The Thunderbird features an AC97 Rev2.1 compliant audio system with a LM4549 Codec (National Semiconductor).

1.24 Watchdog

The watchdog timer consists of an 8-bit counter and three registers: Timeout register (WDTO), Mask register (WDMSK) and Status register (WDST). The counter is an 8-bit down counter that is clocked every minute or second and is used for the timeout period countdown. The WDTO register holds the programmable timeout, which is the period of inactivity after which the watchdog timer prompts the system (1 to 255 minutes or seconds). The WDMSK register determines which system events are enabled as watchdog Timer trigger events to restart the countdown. The WDST register holds the watchdog timer status bit that reflects the value of the WDO pin and indicates that the timeout period has expired. In addition, it sets the time unit (minutes or seconds). The figure shows the functionality of the watchdog timer.

Note: The watchdog function is disabled by hardware on boards before revision **PL:1V4** !



The following registers of the Super I/O are used for controlling the watchdog function:

Index register (0x4e)	Data register (0x4f)	Action
0x07	0x0a	Select functional group 10 (Watchdog)
0x60	0x03	Set WDT base address bits (15-8)
0x61	0x70	Set WDT base address bits (7-0)
0x30	0x01	Activate Watchdog

The following table shows the registers of the WATCHDOG Timer (WDT):

Register	Description
0x370	**WATCHDOG Timeout Register (WDTO)** This register holds the programmable timeout period, which is between 1 and 255 minutes or seconds. Writing to this register de-asserts the WDO output and sets the WDO status bit to 1 (inactive). Additionally, writing to this register is interpreted as a command for starting or stopping the WATCHDOG Timer, according to the data written. If a non-zero value is written, the timer is activated (countdown starts). If a non-zero value is written when the counter is running, the timer is immediately reloaded with the new value and starts counting down from the new value. If 00h is written, the timer and its outputs are deactivated.
0x371	**WATCHDOG Mask Register (WDMSK)** This register is used to determine which system events (IRQ) are enabled as WATCHDOG Timer trigger events. An enabled IRQ event becomes a trigger event that causes the timer to reload the WDTO and restart the countdown.
0x372	**WATCHDOG Status Register (WDST)** This register holds the WATCHDOG Timer status, which reflects the value of the WDO pin and indicates that the timeout period has expired.

Program example:

```
OUT (0x4e, 0x07)    (Select functional group)
OUT (0x4f, 0x0a)    (Set functional group 10 (Watchdog))
OUT (0x4e, 0x60)    (Select WDT base address bits (15-8))
OUT (0x4f, 0x03)    (Set WDT base address bits (15-8) to 0x03)
OUT (0x4e, 0x61)    (Select WDT base address bits (7-0))
OUT (0x4f, 0x70)    (Set WDT base address bits (7-0) to 0x70)
OUT (0x4e, 0x30)    (Select Enable/Disable register)
OUT (0x4f, 0x01)    (Enable Watchdog function device)
OUT (0x371, 0x01)   (Enable KBD IRQ as WDT trigger event)
OUT (0x372, 0x80)   (Set Time Unit to seconds)
OUT (0x372, 0x84)   (Set Time Unit to seconds)
OUT (0x370, 0x0a)   (Set Time-Out to 10 seconds and activate WDT)
```

To trigger the WDT, just rewrite the WDTO register with the Time-Out value:

```
OUT (0x370, 0x0a)   (Set Time-Out to 10 seconds)
```

Please check the Super-I/O's datasheet for details about the operation and the signals.

2 Hardware Installation

The Thunderbird is delivered with the correct jumper settings for proper operation. The customer must not change the default jumper settings. Improper jumper settings will cause system instability or system hang-ups.

> **Attention:** The board must not be connected or disconnected to peripherals (e.g. HDD, FDD, etc.) with the power supply switched ON!

2.1 Adapter Cable Set (optionally)

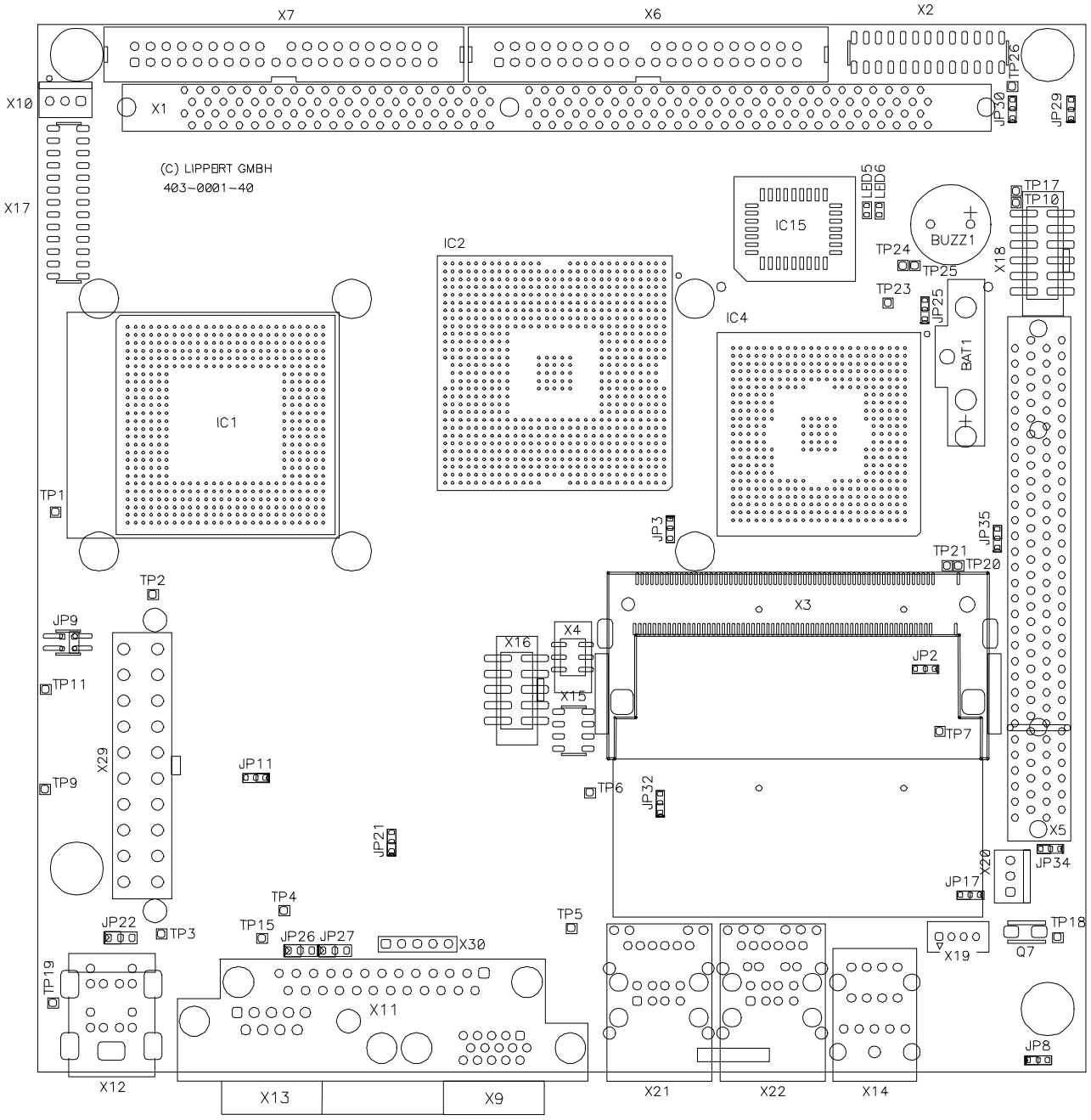
With the optionally available cable set, standard PC peripherals can be easily connected to the board. The adapter cable set comprises the following items:

- One adapter cable IDC10 female to DB9 male for serial port 2
- IDC40 / 2.54mm ATA100 or ATA133 cable to connect 3.5'' EIDE hard disks
- Flat foil cable 26p. plus PCB adapter to 34p. female 2 row 2.54mm grid (standard FDD connector)

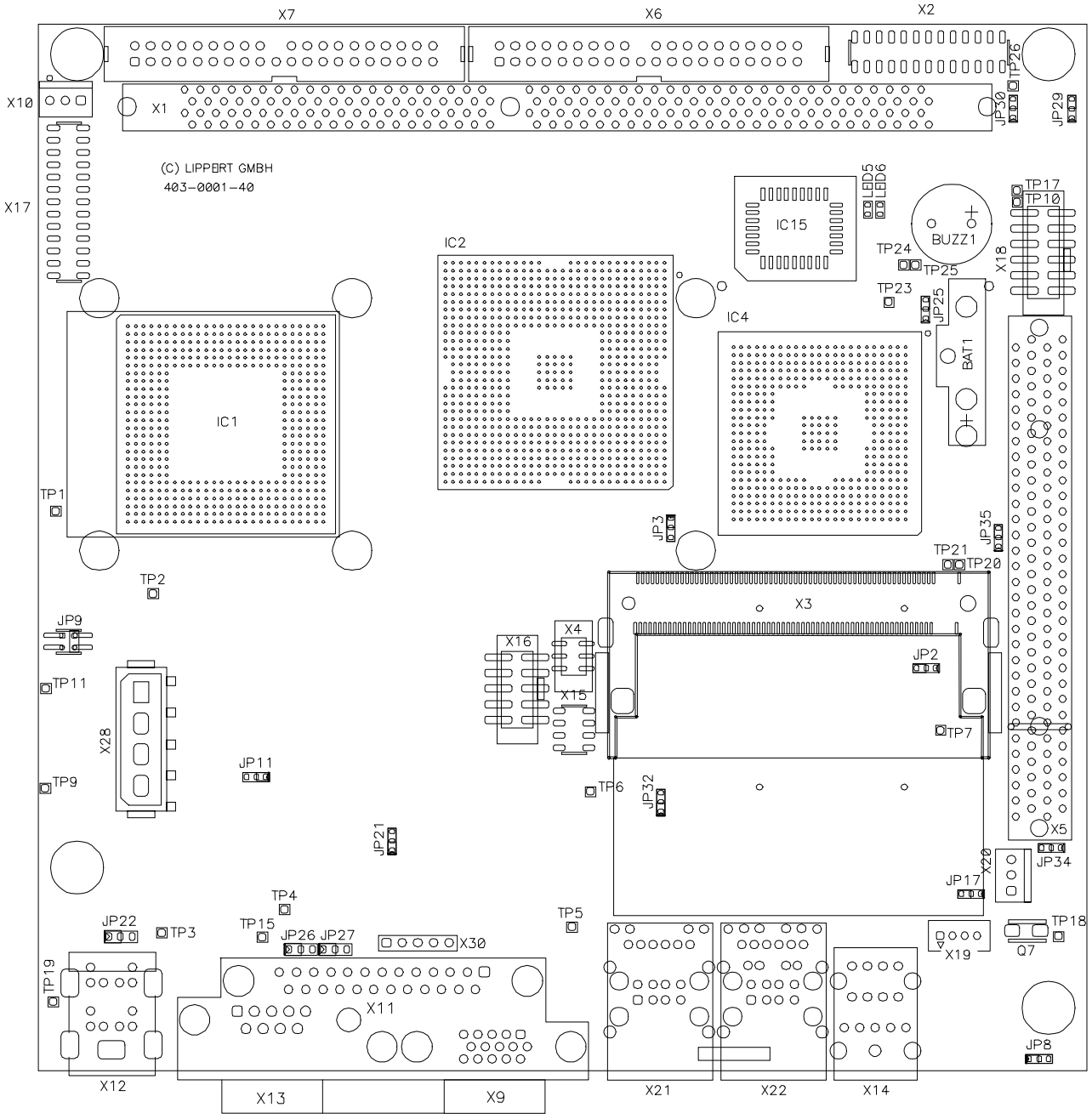
The flat foil cable must be inserted in the FFC connector with the blank side on the top. Be careful not to damage the small safety lever at the floppy connector.

3 Connector Definitions

3.1 Connector Overview (Board Type I)



3.2 Connector Overview (Board Type II)

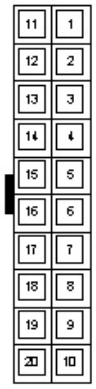


3.3 Power Connector

3.3.1 Board Type I (ATX)

Connector type: ATX-Power connector (X29)

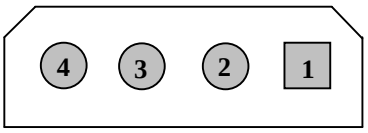
PIN	Signal	PIN	Signal
11	+3,3 V	1	+3,3 V
12	-12 V	2	+3,3 V
13	GND	3	GND
14	Power Switch ON	4	+5 V
15	GND	5	GND
16	GND	6	+5 V
17	GND	7	GND
18	-5 V	8	Power OK
19	+5 V	9	+5 V (stand by)
20	+5 V	10	+12 V



3.3.2 Board Type II (Single 5V Supply)

Connector type: AMP type 350211-1 connector (X28)

PIN	Signal
1	+12V (for PCI slot and Inverter power supply)
2	GND
3	GND
4	+5V



3.3.3 Battery

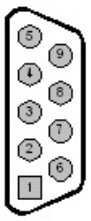
There is a changeable battery on board, used to power the real-time clock (RTC) if the power supply is switched off.

Battery Type: **CR2032**, 3 Volt

3.4 COM1 Port Connector

Connector type: D-SUB9, male (X13)

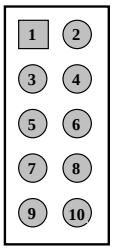
PIN	Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI



3.5 COM2 Port Connector

Connector type: IDC10 pin header 2.54 mm (X16)

PIN	Signal	PIN	Signal
1	DCD	2	DSR
3	RXD	4	RTS
5	TXD	6	CTS
7	DTR	8	RI
9	GND	10	+5V



3.6 LPT1 Port Connector

Connector type: D-SUB25, female (X11)

PIN	Signal
1	/Strobe
2	Data0
3	Data1
4	Data2
5	Data3
6	Data4
7	Data5
8	Data6
9	Data7
10	/ACK
11	BUSY
12	Paper End
13	Select
14	/Auto LF
15	/ERR
16	/INIT
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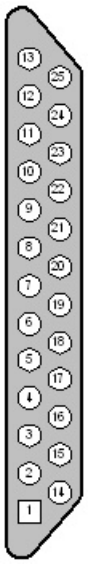
21	GND
22	GND
23	GND
24	GND
25	GND

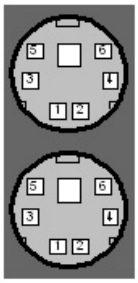


3.7 Keyboard/Mouse Connector

Connector type: PS/2 (X12)

PS/2 – Mouse – Connector (above)

PIN	Signal
1	Mouse Data
2	n.c.
3	GND (Power Supply Mouse)
4	+5V (Power Supply Mouse)
5	Mouse Clock
6	n.c.



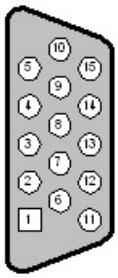
PS/2 – Keyboard – Connector (below)

PIN	Signal
1	Kbd Data
2	n.c.
3	GND (Power Supply Kbd)
4	+5V (Power Supply Kbd)
5	Kbd Clock
6	n.c.

3.8 VGA Connector

Connector type: D-SUB15, female (X9)

PIN	Signal
1	RED
2	GREEN
3	BLUE
4	Reserved
5	GND
6	GND
7	GND
8	GND
9	+5 VDC
10	GND
11	Reserved
12	DDC_DATA
13	HSYNC
14	VSYNC
15	DDC_CLK



Caution: The 5 VDC signal at pin 9 is not protected by a fuse (on PCB < 4.0). The Thunderbird board may be damaged if this is shorted to ground!

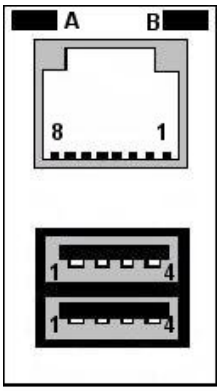
3.9 10/100BaseT Ethernet/USB Combi Connector

Connector type: RJ45/2xUSB (X21, left, back view)

3.9.1 X21-1: Ethernet – RJ 45 – Connector

PIN	Signal
1	TX+
2	TX-
3	RX+
4	PE
5	PE
6	RX-
7	PE
8	PE

LED	Signal	Color
A	Link	Green
B	Activity	Orange



3.9.2 X21-2: USB 0/1 – Connector

USB1 (top)

PIN	Signal
1	USB_VCC1
2	USB1-
3	USB1+
4	GND

USB0 (bottom)

PIN	Signal
1	USB VCC0
2	USB0-
3	USB0+
4	GND

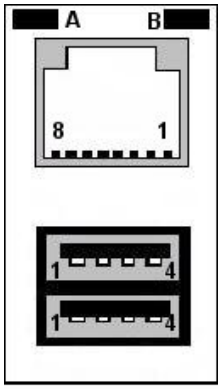
3.10 1000BaseT Ethernet/USB Combi Connector

Connector type: RJ45/2xUSB (X22, right, back view)

3.10.1 X22-1: Ethernet – RJ 45 – Connector

PIN	Signal
1	TRD1+
2	TRD1-
3	TRD2+
4	TRD2-
5	TRD3+
6	TRD3-
7	TRD4+
8	TRD4-

LED	Signal	Color
A	Link	Green
B	Activity	Orange



3.10.2 X22-2: USB 2/3 – Connector

USB3 (top)

PIN	Signal
1	USB_VCC3
2	USB3-
3	USB3+
4	GND

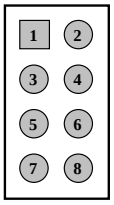
USB2 (bottom)

PIN	Signal
1	USB_VCC2
2	USB2-
3	USB2+
4	GND

3.11 Internal USB 4/5 – Connector

Connector type: IDC8 pin header 2 mm (X15)

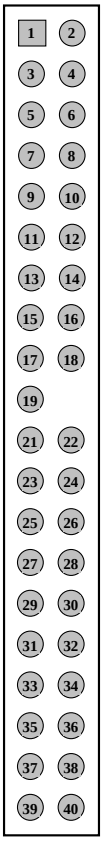
PIN	Signal	PIN	Signal
1	USB_VCC4	2	USB_VCC5
3	USB4-	4	USB5-
5	USB4+	6	USB5+
7	GND	8	GND



3.12 EIDE Connector

3.12.1 Primary IDE

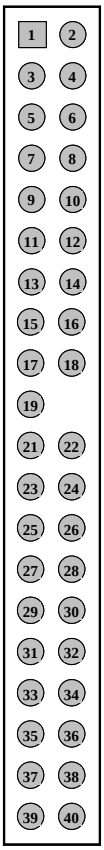
Connector type: IDC40 pin header 2.54 mm (X6, right)



PIN	Signal	PIN	Signal
1	/RST	2	GND
3	Data7	4	Data8
5	Data6	6	Data9
7	Data5	8	Data10
9	Data4	10	Data11
11	Data3	12	Data12
13	Data2	14	Data13
15	Data1	16	Data14
17	Data0	18	Data15
19	GND	20	n.c.
21	DRQ	22	GND
23	/IOW	24	GND
25	/IOR	26	GND
27	RDY	28	CSEL
29	/DACK	30	GND
31	IRQ	32	n.c.
33	Adr1	34	/PDIAG
35	Adr0	36	Adr2
37	/CS1	38	/CS3
39	LED	40	GND

3.12.2 Secondary IDE

Connector type: IDC40 pin header 2.54 mm (X7, left)

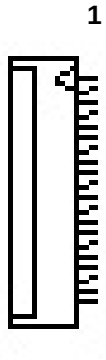


PIN	Signal	PIN	Signal
1	/RST	2	GND
3	Data7	4	Data8
5	Data6	6	Data9
7	Data5	8	Data10
9	Data4	10	Data11
11	Data3	12	Data12
13	Data2	14	Data13
15	Data1	16	Data14
17	Data0	18	Data15
19	GND	20	n.c.
21	DRQ	22	GND
23	/IOW	24	GND
25	/IOR	26	GND
27	RDY	28	CSEL
29	/DACK	30	GND
31	IRQ	32	n.c.
33	Adr1	34	/PDIAG
35	Adr0	36	Adr2
37	/CS1	38	/CS3
39	LED	40	GND

3.13 LVDS Connector

3.13.1 LVDS Channel A

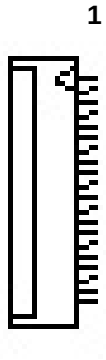
Connector type: DF14-20P-1.25H (Hirose) (X24, bottom)



PIN	Signal
1	VDD (3.3V, opt.5V)
2	VDD (3.3V, opt.5V)
3	GND
4	GND
5	TXA3 -
6	TXA3 +
7	GND
8	TXACLK -
9	TXACLK +
10	GND
11	TXA2 -
12	TXA2 +
13	GND
14	TXA1 -
15	TXA1 +
16	GND
17	TXA0 -
18	TXA0 +
19	GND
20	GND

3.13.2 LVDS Channel B

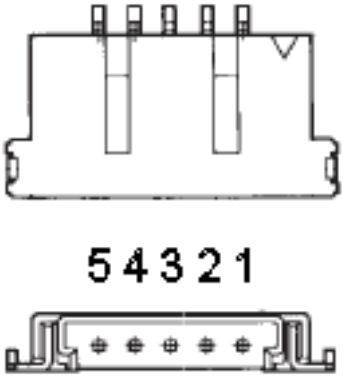
Connector type: DF14-20P-1.25H (Hirose) (X25, bottom)



PIN	Signal
1	VDD (3.3V, opt.5V)
2	VDD (3.3V, opt.5V)
3	GND
4	GND
5	TXB3 -
6	TXB3 +
7	GND
8	TXBCLK -
9	TXBCLK +
10	GND
11	TXB2 -
12	TXB2 +
13	GND
14	TXB1 -
15	TXB1 +
16	GND
17	TXB0 -
18	TXB0 +
19	GND
20	GND

3.13.3 Inverter Supply

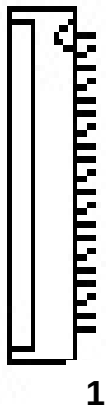
Connector type: LZ-5P-SL-SMT-E3000 (JAE) (X23)



PIN	Signal
1	+12V DC (optional +5V DC)
2	+12V DC (optional +5V DC)
3	GND
4	GND
5	Backlight enable (level: 3,3V DC; optional 5V DC)

3.14 Floppy Connector

Connector type: FFC 26 pin 1.00 mm (X31, bottom)
Ref: Molex 52207-2690



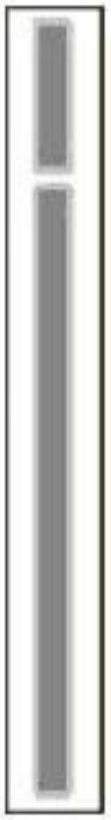
PIN	Signal
1	+5V
2	Index
3	+5V
4	Drive Select 0
5	+5V
6	Disk change
7	n.c.
8	n.c.
9	n.c.
10	Motor On 0
11	n.c.
12	Direction
13	n.c.
14	Step
15	GND
16	Write Data
17	GND
18	Write Gate
19	GND
20	Track 0
21	GND
22	Write Protect
23	GND
24	Read Data
25	GND
26	Head Select

3.15 PCI Bus

Connector type: PCI-Slot (X5)

PIN	Side B	Side A
1	-12V (not in single voltage version)	Reserved
2	Reserved	+12V
3	GND	Reserved
4	Reserved	Reserved
5	+5V	+5V
6	+5V	-INTA
7	-INTB	-INTC
8	-INTD	+5V
9	-PRSNT1	Reserved
10	Reserved	+3,3V (I/O)
11	-PRSNT2	Reserved
12	3,3 Volt connector key	
13		
14	Reserved	Reserved
15	GND	-RST
16	CLK	+3,3V (I/O)
17	GND	-GNT
18	-REQ	GND
19	+3,3V (I/O)	Reserved
20	AD[31]	AD[30]
21	AD[29]	+3,3V
22	GND	AD[28]
23	AD[27]	AD[26]
24	AD[25]	GND
25	+3,3V	AD[24]
26	C/-BE[3]	IDSEL
27	AD[23]	+3,3V
28	GND	AD[22]
29	AD[21]	AD[20]
30	AD[19]	GND
31	+3,3V	AD[18]
32	AD[17]	AD[16]
33	C/-BE[2]	+3,3V
34	GND	-FRAME
35	-IRDY	GND
36	+3,3V	-TRDY
37	-DEVSEL	GND
38	GND	-STOP
39	-LOCK	+3,3V
40	-PERR	SDONE
41	+3,3V	-SBO
42	-SERR	GND
43	+3,3V	PAR
44	C/-BE[1]	AD[15]
45	AD[14]	+3,3V
46	GND	AD[13]
47	AD[12]	AD[11]
48	AD[10]	GND
49	M66EN	AD[9]
50	GND	GND
51	GND	GND
52	AD[8]	C/-BE[0]
53	AD[7]	+3,3V
54	+3,3V	AD[6]
55	AD[5]	AD[4]
56	AD[3]	GND
57	GND	AD[2]
58	AD[1]	AD[0]
59	+3,3V (I/O)	+3,3V (I/O)
60	-ACK64	-REQ64
61	+5V	+5V
62	+5V	+5V

B1 A1



Note: -12V not supported in “single voltage version”

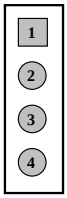
Note: All signals are 3.3V level by default.

3.16 Audio Connectors

3.16.1 CD-In

Connector type: 1x4 2mm (X19)

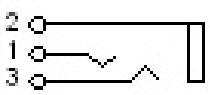
PIN	Signal
1	CD In Left
2	CD_GND
3	CD In Right
4	n.c.



3.16.2 Line Out

Color: green (X14)
Connector type: 1/8"

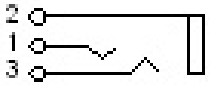
PIN	Signal
1	Line Out Left
2	GND
3	Line Out Right



3.16.3 Line In

Color: blue (X14)
Connector type: 1/8"

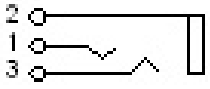
PIN	Signal
1	Line In Left
2	GND
3	Line In Right



3.16.4 Microphone

Color: red (X14)
Connector type: 1/8"

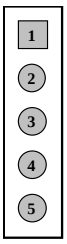
PIN	Signal
1	n.c.
2	GND
3	Microphone In



3.17 Infrared Adapter Connector

Connector type: 1x5 2,54mm (X30)

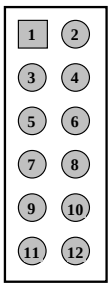
PIN	Signal
1	+3.3V
2	IR I/O
3	IR_RX
4	IR_TX
5	GND



3.18 System Panel Connector

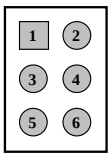
Connector type: 2x6 2,54mm (X18)

PIN	Signal	PIN	Signal
1	HDD LED +	2	POWER LED +
3	HDD LED -	4	n.c.
5	Power Button +	6	Power LED -
7	Power Button -	8	n.c.
9	Reset Button + (/ RST IN)	10	Watchdog + LED
11	Reset Button -	12	Watchdog – LED (/ WD OUT)



3.19 System Management Bus / I2C Bus

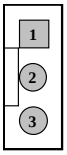
Connector type: 2x3 2,00mm (X4)



PIN	Signal	PIN	Signal
1	+3.3VDC	2	SMB Data
3	n.c.	4	SMB Clock
5	GND	6	Reserved

3.20 CPU Fan Connector

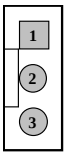
Connector type: 1x3 2,54mm (X10)



PIN	Signal
1	GND (black)
2	+5VDC (red)
3	Speed Signal from fan (yellow)

Current at +5VDC output: max.500mA. This Fan output can be regulated by software.

3.21 Cassis Fan Connector



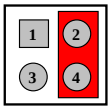
Connector type: 1x3 2,54mm (X20)

PIN	Signal
1	GND (black)
2	+5VDC (red)
3	Speed Signal from fan (yellow)

Current at +5VDC output: max.500mA

3.22 Auto-Power-Up Jumper

Available on Hardware Revision 4.0 and later.
Connector type: 2x2 2,00mm (JP9)



Pins	Function
1 – 3	Not used
2 – 4	Installed: Hardware Power-Up Not Installed: BIOS controlled Power Up

3.23 LED's

3.23.1 LED5

Color: green
Function: Primary IDE active

3.23.2 LED6

Color: green
Function: Secondary IDE active

3.23.3 LED9

Color: green
Function: Power Good

3.23.4 LED10

Color: green
Function: Power On

4 Software

4.1 BIOS

BIOS stands for *Basic Input and Output System*. The BIOS is the first program to run when you turn on your computer.

The Thunderbird is delivered with a standard PC BIOS. By default, all setup settings are done to have a “ready to run” system, even without a BIOS setup backup battery. The BIOS is located in a Flash PROM and can be easily updated on-board.

More BIOS information is available at

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

4.1.1 Setup

Pressing the <**F2**> key or <**DEL**> key at power-up time starts the setup utility.

4.1.2 Initialize BIOS at first startup

It is important to initialize the BIOS setting at first startup of the board.
Call the Setup by pressing <**F2**> key or <**DEL**> key at power-up time and choose
“**Load Optimized Defaults**”. In the next step use “**Save & Exit Setup**” to save and activate the new setup.
The “Optimized Defaults” is the preferred BIOS Setup for your Board.

4.1.3 Booting from alternative device

Pressing the <**ESC**> key at power-up starts the Boot Menu. Choose one of the listed bootable devices for booting.

4.1.4 Reload default BIOS values

The default values of the BIOS can be automatically reloaded at boot time. Therefore the key **<0 / INSERT>** on the NUM pad has to be pressed before the system is turned on. While pressing this key and turning the system on, the default values will be loaded.

4.2 Software Installation

The drivers for the Thunderbird are available either on the product CD or at LiPPERT's Website (www.lippertembedded.com). To install them correctly, please read the instructions on the driver disks previously.
The latest drivers are always available from Intel's website:

http://downloadfinder.intel.com/scripts-df/Support_Intel.asp

4.3 System Address Map

This section describes the mapping of the CPU memory and I/O address spaces. Also covered in this section are the PCI configuration space mapping.

> **Note**: Depending on enabled or disabled functions in the BIOS, other or more resources may be used.

4.3.1 Memory address map

Address Range (Dec)	Address Range (Hex)	Size	Description
1024K – XXXXXK	100000 – XXXXXX	xxxx	Extended Memory
960K – 1024K	0F0000 – 0FFFFF	64K	System Bios
823K – 880K	0CC800 – 0EFFFF	~142K	Free
768K – 823K	0C0000 – 0CC7FF	~50K	Adapter ROM
704K – 768K	0B0000 – 0BFFFF	64K	VGA Adapter
640K – 704K	0A0000 – 0AFFFF	64K	VGA Adapter
0K – 640K	0 – 9FFFF	640K	Conventional Memory

4.3.2 I/O address map

The system chipset implements a number of registers in I/O address space. These registers occupy the following map in the I/O space (depending on enabled or disabled functions in the BIOS other or more resources may be used).

Address Range (Hex)	Size (Hex)	Description
0000-000F	16 Bytes	DMA Controller 1 (8237)
0020-0021	2 Bytes	Interrupt Controller 1 (8259)
0040-0043	4 Bytes	Timer Controller (8254)
0060	1 Bytes	Keyboard Controller Data Byte
0061	1 Byte	Speaker Control
0064	1 Byte	Kbd Ctlr, CMD,STAT Byte
0070-0071	2 Bytes	Real Time Clock
0078	1 Byte	internal
0079	1 Byte	Watchdog
0080-0091	18 Bytes	DMA Page Registers
00A0-00A1	2 Bytes	Interrupt Controller 2 (8259)
00C0-00DF	32 Bytes	DMA Controller 1 (8237)
00F0-00FF	16 Byte	Math Coprozessor
0170-0177	8 Bytes	Secondary IDE Channel
01F0-01F7	8 Bytes	Primary IDE Channel
02F8-02FF	8 Bytes	Serial Port 2
0376	1 Byte	IDE Controller
0378-037F	8 Bytes	Parallel Port 1
03B0- 03BB	12 Bytes	VGA Registers
03C0-03DF	32 Bytes	VGA Registers
03F0-03F5	6 Bytes	Floppy Controller Registers
03F6	1 Byte	IDE Command Port
03F7	1 Byte	Floppy Command Port
03F8-03FF	8 Bytes	Serial Port 1
0400-04BF	192 Bytes	PCI Bus
04D0-04D1	2 Bytes	PCI Bus
0800-087F	128 Bytes	Motherboard Resource
0CF8-0CFF	8 Bytes	PCI Bus
9000-9FFF	4096 Bytes	PCI-PCI Bridge
A000 – A01E	31 Bytes	USB Controller
A400 – A41E	31 Bytes	USB Controller
A800 – A81E	31 Bytes	USB Controller
AC00 – AC06	7 Bytes	VGA Adapter
F000 – F00E	15 Bytes	IDE Controller

4.4 Interrupts And DMA Channels

Interrupts

IRQ	System Resource
NMI	Parity Error
0	Timer
1	Keyboard
2	Interrupt Controller 2
3	Serial Port 2
4	Serial Port 1
5	VGA Adapter
6	Floppy
7	Parallel Port 1
8	Real Time Clock
9	User available (PCI)
10	USB Controller
11	Ethernet Controller
12	Mouse
13	Math coprocessor
14	IDE Controller
15	IDE Controller

DMA channels

DMA	Data width	System Resource
0	8 bits	User available
1	8 bits	User available
2	8 bits	Floppy
3	8 bits	(Parallel Port)
4		Reserved, Cascade Channel
5	16 bits	User Available
6	16 bits	User Available
7	16 bits	User Available

5 Technical Characteristics

5.1 Electrical Specifications

5.1.1 Board Type I (ATX)

Supply voltages:	+5 VDC, +3.3 VDC
Supply current board (for 1.6GHz CPU):	max. approx. 5 A at +5 VDC
	max. approx. 3 A at +3.3 VDC
Supply current on PCI bus:	max. approx. 1.5 A at +5 VDC
	max. approx. 7.6 A at +3.3 VDC
Supply voltage ripple:	± 5 %

5.1.2 Board Type II (Single 5 V Supply)

Supply voltage:	+5 VDC
Supply current board (for 1.6GHz CPU):	max. approx. 6 A at +5 VDC
Supply current on PCI bus:	max. approx. 1.5 A at +5 VDC
	max. approx. 2.5 A at +3.3 VDC
Supply voltage ripple:	± 5%

5.2 Environmental Specifications

Operating:

Temperature range:	-20…60 °C standard
	-40…+85 °C for the 1.4 GHz model
Temperature change:	max. 10K / 30 minutes
Humidity (relative):	10…90 % (non-condensing)
Pressure:	450…1100 hPa

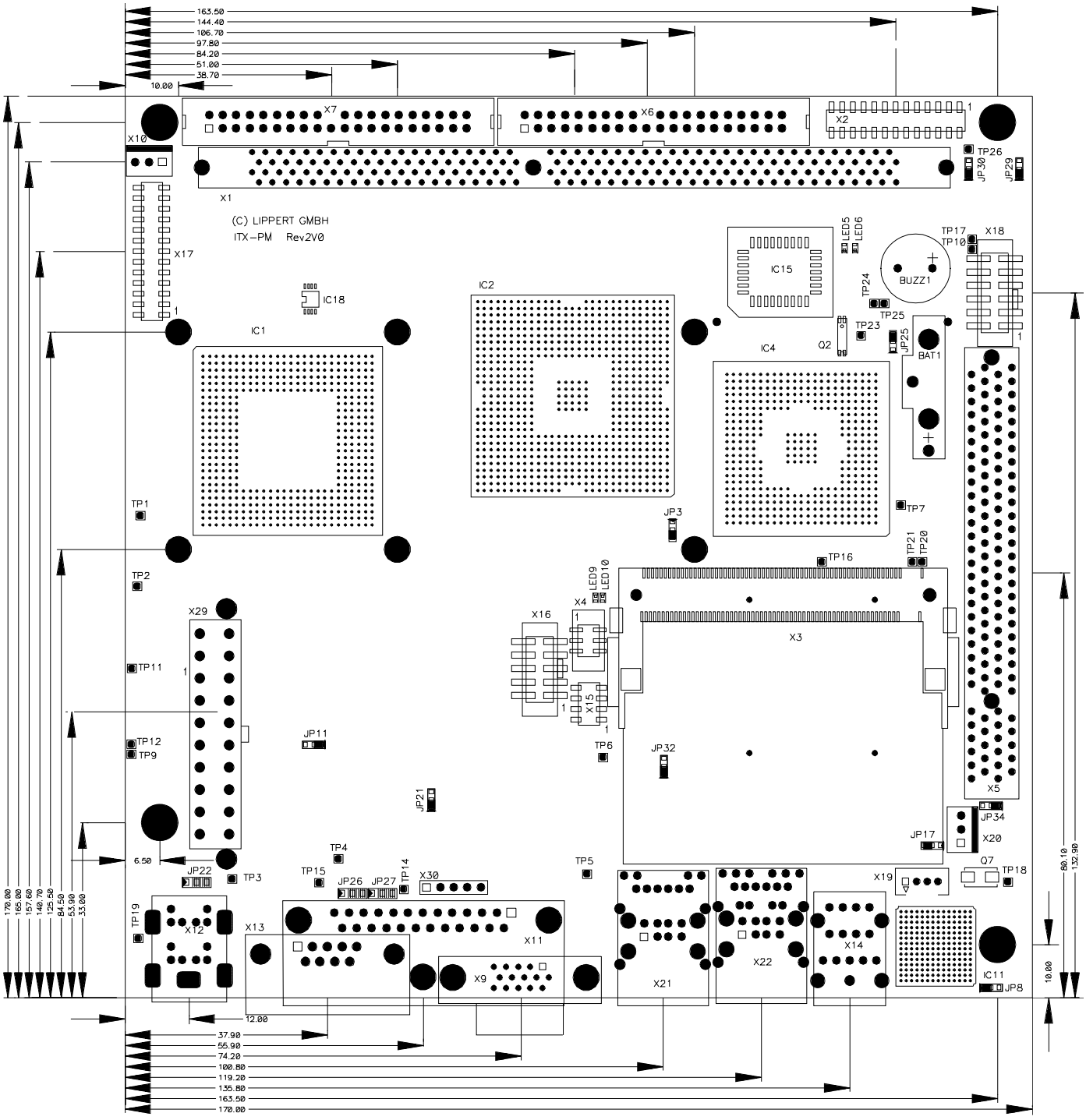
Non-Operating/Storage/Transport:

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

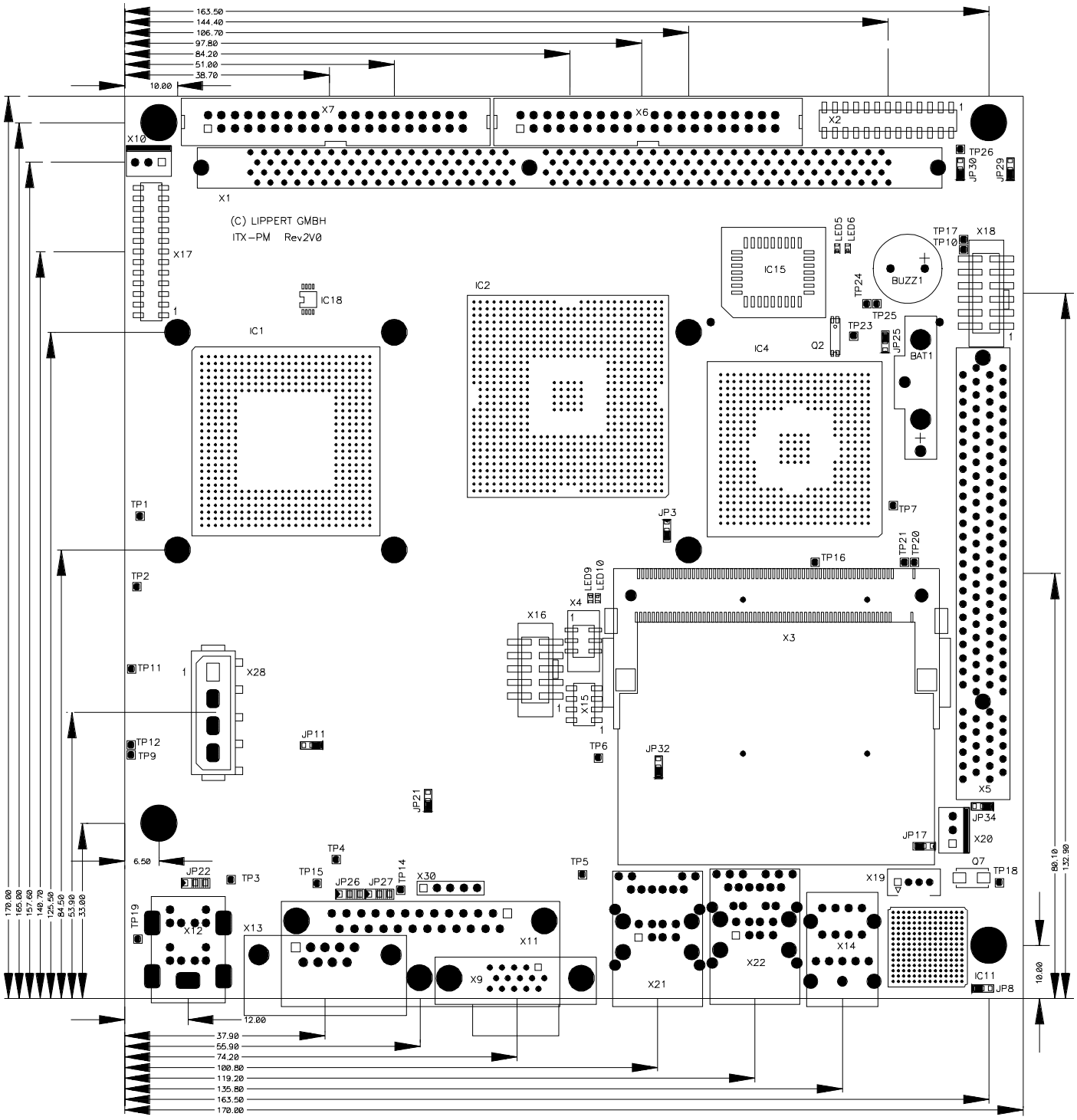
5.3 Mechanical Specification

Dimensions (LxW): 170.0mm x 170.0mm
Height: top: 38.5mm, PCB: 1.5mm, bottom: 3mm -> 43mm
Weight: approx. 300g

5.3.1 Top View (Board Type I)

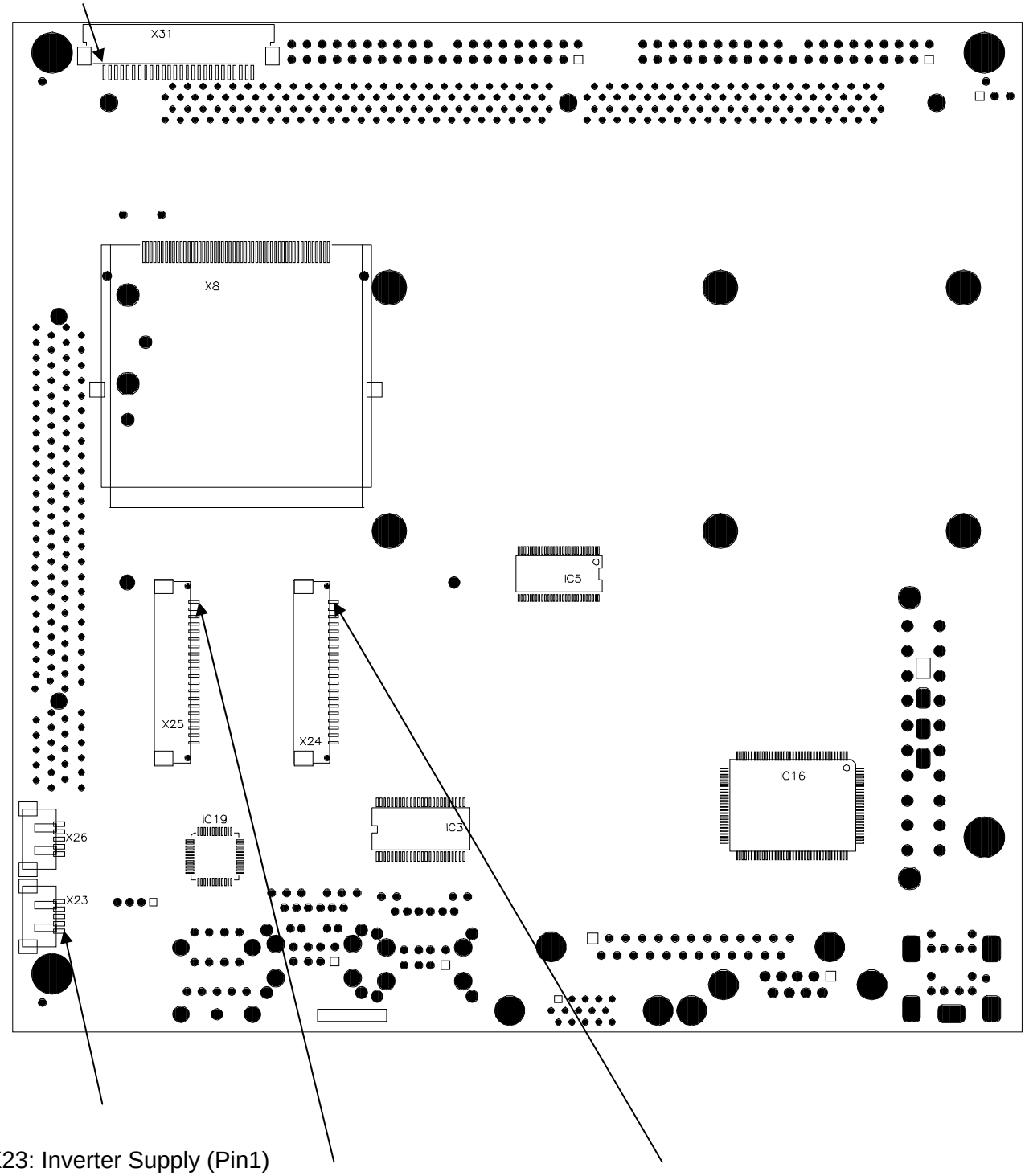


5.3.2 Top View (Board Type II)



5.3.3 Bottom View

X31: Floppy (Pin1)



X23: Inverter Supply (Pin1)

X25: LVDS Channel B (Pin1) X24: LVDS Channel A (Pin1)

6 Options

There are some options available for the Thunderbird. Please check their availability before ordering.

- Board Type II (+5V only supply)
- +12V only supply
- Extended temperature range
- Passive heatsink
- Cable set
- CompactFlash Adapter
  This is a configuration option and is only available for larger orders.
- LVDS with +5V VCC instead of +3.3V
  This is a configuration option and is only available for larger orders.
- MiniPCI modules

7 Revision History

Filename	Date	Edited by	Change
TME-ITX-PM-R0V0	03-06-02	Alfred Glass	Draft
TME-ITX-PM-R0V1	03-09-16	Alfred Glass	Make it Intel conform
TME-ITX-PM-R0V2	03-09-18	P. Kannegießer	- Various additions and changes - General formatting - Check spelling
TME-ITX-PM-R1V0	03-11-06	Alfred Glass	Redesign
TME-ITX-PM-R1V1	03-12-01	P. Kannegießer	Chapter 4.1.2: 5 V connector specified
TME-ITX-PM-R1V2	04-01-07	Alfred Glass	- Drawings with higher resolution - Various additions and changes
TME-ITX-PM-R1V3	04-02-12	Alfred Glass	Internal USB connector X15 added
TME-ITX-PM-R1V4	04-03-16	Alfred Glass P. Kannegießer	- Various additions and changes - Temperature range corrected - Connector X18 corrected
TME-ITX-PM-R1V5	04-08-11	Jürgen Stauffer	Programming of watchdog timer
TME-ITX-PM-R1V6	04-09-10	Alfred Glass	Textual corrections
TME-ITX-PM-R1V7	04-09-27	Alfred Glass	Power supply connector X28 corrected
TME-ITX-PM-R2V0	04-10-11	Alfred Glass	For PCB 2V0, Board Type I/II
TME-ITX-PM-R2V1	05-03-01	Alfred Glass	LED description, BIOS description
TME-ITX-PM-R2V2	07-10-10	P. Kannegießer	Ch. 3.8: VGA Connector corrected
TME-ITX-PM-R2V3	08-03-05	Jürgen Stauffer	- Description for new Jumper X9 (Auto Power-On) added - Reference to 1.1 version removed
TME-ITX-PM-R4V0	09-03-20	Jürgen Stauffer	- Document revision according to actual PCB revision changed. - Caution 5V on VGA Connector updated - Jumper X9 renamed to JP9 - Combi-Connector splitted into X9, X11, X13
TME-ITX-PM-R4V1	09-03-25	Jürgen Stauffer	- Electrical Specifications updated