Embedded Solutions

RC1 – Rugged MIPIOS®
Box Computer

Configuration example (shown with all additional interfaces)

User Manual

mikro elektronik
gmbh · nürnberg

RC1 – Rugged MIPIOS® Box Computer

The RC1 box computer is a rugged, fanless and maintenance-free control unit for harsh, mobile, mission-critical applications with or without visualization requirements in transportation, avionics, industrial automation and medical engineering.

Two standard models are available: One without a display and one with a 3.5" 4:3 262,144 color display (primarily for service purposes) with a resolution of 640x480 and touch functionality to control the unit.

Both standard models are powered by an Intel® Atom™ Z510 running at 1.1 GHz and are equipped with 512 MB RAM and a 2GB MicroSD card (a SATA solid-state drive and Flash memory are optional). All I/O signals are concentrated at the front side. They include 2 Fast Ethernet (on M12 connectors) and a service interface with one USB port (master or client), one RS232, a reset input and one GPIO, all combined on an 8-pin M12 connector. The RC1 offers two slots for additional I/O purposes for which a number of special SA-Adapter™ kits with M12 connectors are available. The FPGA-based concept of the RC1 enables easy implementation of various interfaces (e.g., CAN bus, RS485, IBIS, GPS or binary I/O).

A second power input makes it possible to connect a backup power source (e.g., a battery) that is automatically used in case of power failure on the main power input. As a fully EN50155 compliant power class S2 unit, the RC1 remains functional despite power interruption for up to 10 ms.

The unit's PCI Express® Mini card and SIM card slots can be used to add wireless functionality like Bluetooth, WLAN, WIMAX, GSM/GPRS, UMTS etc. For this case, two optional N-Type connectors can be made available at the unit's front panel.

The RC1 is one of the first members of the MIPIOS® family of extremely rugged IP67 compliant products designed for Ethernet connectivity. The unit is prepared for wall or DIN-rail mounting. Its robust stainless enclosure is protected against violent impacts and the whole unit is compliant with IP67. With a typical power consumption of only 12 W for the total system the design is always realized without fans, using conduction cooling to spread the dissipated heat to the outside of the housing. All electronic components are soldered to withstand shock and vibration and prepared for conformal coating. The standard versions of the RC1 comply with ISO 7637-2:2004 and the EN 50155, class Tx railway standard, i.e., the units are able to operate in a -40 to +70°C (+85°C for 10 minutes) environment. The optional display panel is designed for an operating temperatue of -30 to +70°C with automatic switch-off of the display at excess temperatures.

Technical Data

CPU

- Intel® Atom™ processor Z510 or Z530
  - Z510: 1.1 GHz processor core frequency, 400 MHz system bus frequency or
  - Z530: 1.6 GHz processor core frequency, 533 MHz system bus frequency

Display (06RC01-01 model)

- Screen size: 3.5"
- Aspect ratio: 4:3
- Resolution: 640 x 480
- Luminance (cd/m²): 250 cd/m²
- Contrast: 400 typ.
- Colors: 262,144
- Visible screen area: 72 mm x 52.5 mm
- Touch functionality to control the RC1 (HMI)
- Monitored and controlled by a temperature sensor (automatic switch-off of the display below -30°C and above +70°C)
- Display and touch functionality fully IP67 compliant!

Memory

- Up to 1 GB DDR2 SDRAM system memory
  - Soldered
  - 400 MHz or 533 MHz memory bus frequency locked to the FSB frequency
- 2GB MicroSD card

I/O

- All I/O available at front of housing
- Service interface
  - 1 USB 2.0 master or client (configurable via BIOS setting)
  - UHCI implementation
  - Data rates up to 480 Mbits/s
  - 1 RS232 or RS485 (half-duplex), redirection for BIOS settings and terminal function)
  - 1 reset input (hardware reset for the Intel® Atom™ CPU)
  - All accessible via the same 8-pin M12 connector (female)
- Ethernet
  - Two 10/100Base-T Ethernet channels
  - Accessible via 4-pin M12 connectors (female)
- Various I/O (optional)
  - Up to two additional I/O interfaces (RS232, RS422, RS485, IBIS, CAN bus, GPS or binary I/O) via various M12 connectors, realized through special SA-Adapter™ kits
- Audio
  - 1 piezo speaker

- Power
  - Power input via 4-pin M12 connector (male)
  - Backup power input via second 4-pin M12 connector (male)

Board Management Control

- Supervision of internal voltages
- Supervision of display temperature
- Control of power sequencing and reset behavior of the Intel® Atom™ CPU
- Emergency shutdown in case of failure
- Watchdog functionality for CPU with clock generator
- Accessible via SMBus

Electrical Specifications

- Isolation voltage:
  - 1,500 VDC (Ethernet interface)
  - 500 VDC (all other I/O)
- Buffered RTC
  - Gold cap for more than 12 h
- Power consumption:
  - 12 W typ. (without PCI Express® Mini card)
- Supply voltage:
  - 24 VDC (9 to 36 V) according to EN50155 (main and backup)
  - Power class S2 (functional despite power interruption up to 10ms)
  - Automatic failover to secondary input in case of power failure on the primary input
  - Reverse polarity protection
  - Overcurrent protection by fuse

Mechanical Specifications

- Dimensions: 220 mm x 130 mm x 70 mm (without connectors)
- Prepared for wall or DIN-rail mounting (EN 50022, BS 5584)
- Weight: 1.8 kg
- Aluminum enclosure
- IP67 compliant
- Conformal coating on request

Environmental Specifications

- Temperature range (operation):
  - -40°C to +70°C, with up to +85°C for 10 minutes according to class Tx (EN50155)
  - -30°C to +70°C for the display panel (with automatic switch-off of the display at excess temperatures)
  - Conductive cooling
  - Fanless operation
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing

- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to + 3,000 m
- Shock: according to EN 50155 (10.2.11)
- Vibration: according to EN 50155 (10.2.11)

MTBF

- 06RC01-00: MTBF 103,413 h @ 40°C according to IEC/TR 62380 (RDF 2000)
- 06RC01-01: MTBF 20,981 h @ 40°C according to IEC/TR 62380 (RDF 2000)

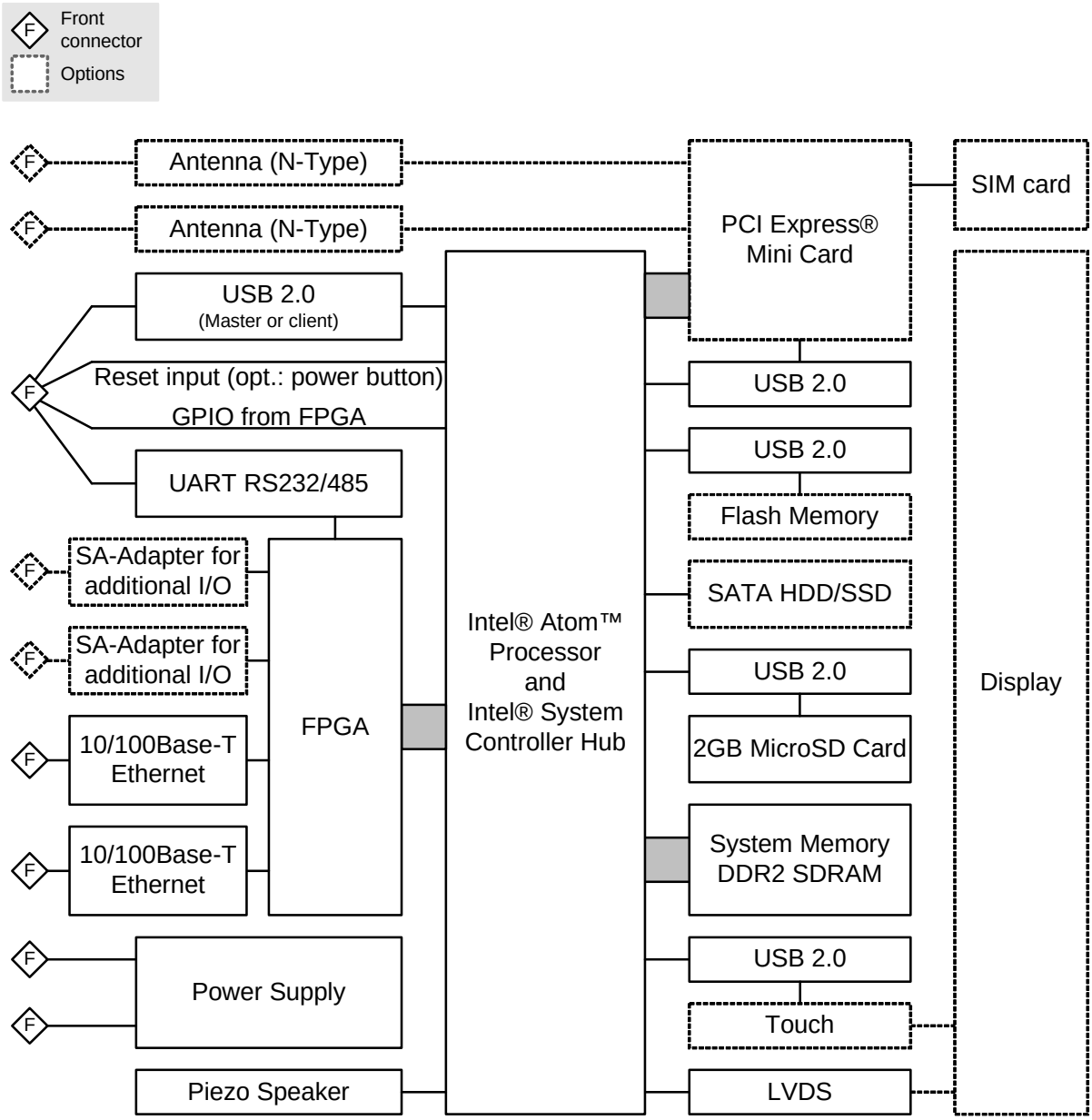
EMC

- Conforming to EN 50155, EN 50121-3-2/EN 61000-4-5, ISO 7637-2:2004
- e1 certified by the German Federal Motor Transport Authority

Software Support

- Windows® XP Embedded
  - 06RC01-01: Windows® XP Embedded image included (120-day trial version for evaluation purposes only)
- Linux
  - Deliverable with eval Linux pre-installed
- For more information on supported operating system versions and drivers see online data sheet.

Block Diagram



Configuration Options

Display

- Screen size: 3.5"
- Aspect ratio: 4:3
- Resolution: 640 x 480
- Luminance (cd/m²): 250 cd/m²
- Contrast: 400 typ.
- Colors: 262,144
- Visible screen area: 72 mm x 52.5 mm
- Touch functionality to control the RC1 (HMI)
- Monitored and controlled by a temperature sensor (automatic switch-off of the display below -30°C and above +70°C)
- Display and touch functionality fully IP67 compliant!

Wireless functionality

- Bluetooth, WLAN, WIMAX, GSM/GPRS, UMTS etc. via respective PCI Express® Mini card
  - PCI Express® Mini card slot features a SIM card slot
  - Uses optional N-type antenna connectors

Processor

- Intel® Atom™ processor Z510 or Z530
  - Z510: 1.1 GHz processor core frequency, 400 MHz system bus frequency or
  - Z530: 1.6 GHz processor core frequency, 533 MHz system bus frequency

Memory

- Up to 1GB DDR2 SDRAM system memory
- MicroSD card (various sizes available)
- SATA solid-state drive (various sizes available)
- USB Flash solid-state drive (various sizes available)

I/O interfaces

- Various combinations of interfaces with SA-Adapter™ kits via two M12 ports
  - RS232 (isolated)
  - RS422 (isolated)
  - RS485 (isolated)
  - IBIS (isolated)
  - CAN bus (isolated)
  - GPS (isolated)
  - Binary I/O (isolated)
- Two N-type connectors for antenna diversity
  - Adapter with SIM card slot for optional PCI Express® Mini card
  - For WLAN, WIMAX, GSM/GPRS, UMTS etc.

Electrical Specifications

- Other nominal input voltages: 48, 72, 96 or 110 VDC

Software

- VxWorks® (on request)
- QNX® (on request)
- Deliverable with customer application installed

For available standard configurations see online data sheet.

About this Document

This user manual describes the hardware functions of the computer. It also provides additional information for special applications and configurations of the computer.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2009-09-02
E2	Major update: Incorporated changes from new product revision (e.g., MicroSD card and SATA SSD option instead of Flash memory) Added paragraph on pressure compensating valve Added paragraph on earth connection Removed installation instructions for SA-Adapter kits (unit comes with additional I/O pre-installed) Added more detailed information regarding input voltage and primary/secondary input selection Added detailed information on connector types Modified general structure of document (swapped chapters 3 and 4) Removed warning regarding electrostatic discharge (new product revision is not meant to be opened) Cosmetics	2010-11-22
E3	Models without display come without operating system, added basic instructions for operating system installation via RS232 Clarified supported and/or pre-installed operating systems Removed outdated link to installation chapter in sub-chapter on SA-Adapters.	2010-12-15
E4	Dimensions in technical data now given without connectors	2011-01-31

Conventions

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics	Folder, file and function names are printed in *italics*.
bold	**Bold** type is used for emphasis.
`monospace`	A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".
hyperlink	Hyperlinks are printed in blue color.
	The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.
IRQ# /IRQ	Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.
in/out	Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".
	Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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Germany
MEN Mikro Elektronik GmbH
Neuwieder Straße 5-7
90411 Nuremberg
Phone +49-911-99 33 5-0
Fax +49-911-99 33 5-901
E-mail info@men.de
www.men.de

France
MEN Mikro Elektronik SA
18, rue René Cassin
ZA de la Châtelaine
74240 Gaillard
Phone +33 (0) 450-955-312
Fax +33 (0) 450-955-211
E-mail info@men-france.fr
www.men-france.fr

USA
MEN Micro, Inc.
24 North Main Street
Ambler, PA 19002
Phone (215) 542-9575
Fax (215) 542-9577
E-mail sales@menmicro.com
www.menmicro.com

Contents

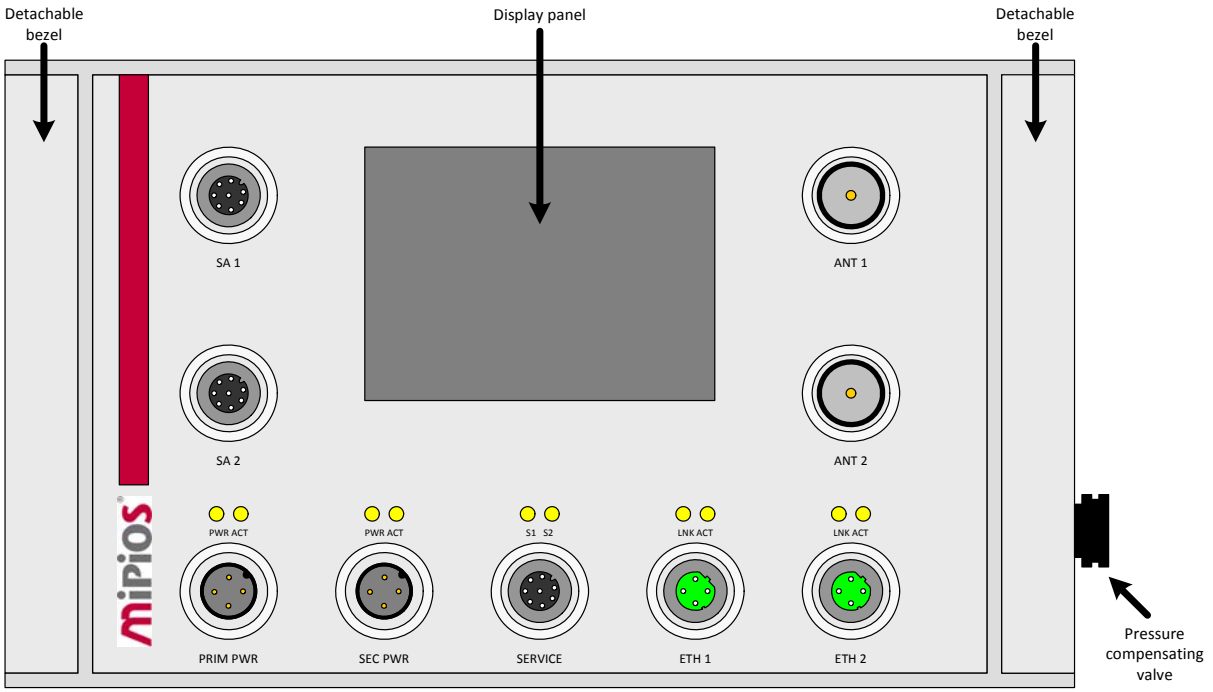
Figures

Tables

1 System Overview

1.1 Layout of the RC1

Figure 1. *The RC1 – front view (shown with all optional interfaces and display)*



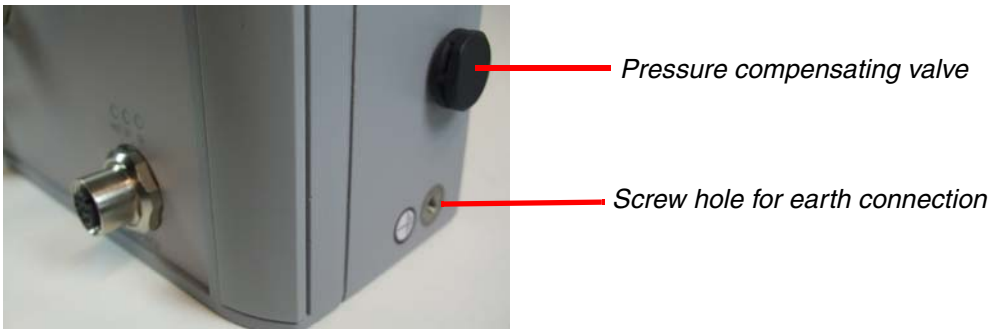
1.2 Pressure Compensating Valve

The sealed housing of the RC1 makes a pressure compensating valve necessary to prevent stress on the unit's housing seals. Its hydrophobic and oleophobic ePTFE membrane protects from the unit's interior from water and common automotive fluids and resists blocking after contact with common automotive fluids. It protects against contamination from dirt, dust, salt and road debris (down to 0.07 µm).

1.3 Earth Connection

An earth connection can be established via the respective screw hole on the right side of the unit (below the pressure compensating valve). Use an M4 screw.

Figure 2. *Earth connection and pressure compensating valve*



1.4 Interfaces

1.4.1 Power Input

The RC1 usually comes with an internal 24 VDC nom. (14.4 to 33.6 V) wide-range power supply with a primary and a secondary input. Both are connected via 4-pin M12 connectors. RC1 models with other input voltage ranges are also available from MEN to suit individual projects' needs.

The internal power supply is EN50155 compliant which implies that it has a built-in power-on threshold of 0.7xUn = 16.8 V for the 24 VDC model (for 110 VDC models, see Table 1, Voltage thresholds for 24 VDC and 110 VDC PSUs). Once the unit is turned on, the input voltage may drop as low as 12 V before the power supply switches over to the second power input (if a voltage in the valid range is applied to this input). Once the primary power supply is back and good for at least 200 ms, the unit switches back to the primary power supply.

If the second power input is not used, the input voltage on the primary input may drop as low as 9 V.

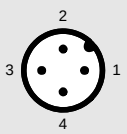
Table 1. *Voltage thresholds for 24 VDC and 110 VDC PSUs*

PSU:	24 VDC nom.	110 VDC nom.
Input voltage range	9..36V	77..150V
Power-on threshold	16.8V	77V
Power change-over threshold	12V	66V
Power-off threshold	9V	66V

Connector types:

- 4-pin M12 connector, male, A-coded (CONEC "SAL-12-FSH4-P12-9" 43-01066)
- Mating connector: e.g., CONEC "SAL-12-RK4-2/A1" 43-10020

Table 2. *Pin assignment of the power supply 4-pin male M12 connectors*

	Pin	Name	Description
	1	+VBAT	Positive input
	2	+VBAT	Positive input
	3	-VBAT	Negative input
	4	-VBAT	Negative input

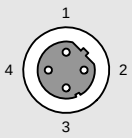
1.4.2 Ethernet Interface

The RC1 comes with two Fast Ethernet ports on 4-pin female M12 connectors.

Connector types:

- 4-pin M12 connector, female, D-coded (CONEC "SAL-12D-FKH4.2-P12-9" 43-01248)
- Mating connector: e.g., Harting 21032811405 R410925

Table 3. *Pin assignment of the Ethernet 4-pin female M12 connectors*

	Pin	Name	Description
	1	TX+	Transmitter positive output
	2	RX+	Receiver positive input
	3	TX-	Transmitter negative output
	4	RX-	Receiver negative input

The Ethernet controller has its own EEPROM to store the MAC address etc.

The unique MAC address is set at the factory and should not be changed. Any attempt to change this address may create node or bus contention and thereby render the unit inoperable. The MAC addresses on the RC1 are:

- LAN0: `0x 00 C0 3A 02 8x xx - 0x 00 C0 3A 02 BF FF`
- LAN1: `0x 00 C0 3A 02 Cx xx - 0x 00 C0 3A 02 FF FF`

where "`00 C0 3A`" is the MEN vendor code, "`02`" is the MEN product code. The last four digits depend on the interface and the serial number of the RC1's internal SBC board. The serial number is added to the offset, for example for LAN0:

• Serial number 0042: `0x xx xx = 0x8000 + 0x 00 2A = 0x 80 2A.`

Please note that due to the internal structure of the RC1, the serial number coded in the MAC addresses is different from the serial number of the entire RC1 unit. For the unit's overall serial number please refer to Chapter 7.3 Finding out the Board's Article Number, Revision and Serial Number on page 57.

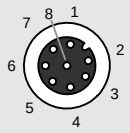
1.4.3 Service Interface (USB / RS232 / reset input)

The service interface combines several signals on one 8-pin male M12 connector.

Connector types:

- 8-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH8-P12-9" 43-01064)
- Mating connector: e.g., CONEC "SAL-12S-RS8-2/G3" 43-10980

Table 4. *Pin assignment of the service interface 8-pin male M12 connector*

	Pin	Name	Description
	1	+5V	USB supply voltage
	2	RxD	RS232 or RS485 receive
	3	TxD	RS232 or RS485 transmit
	4	USB7-	USB Host/Device Mode
	5	USB7+	USB Host/Device Mode
	6	Reset_BTN	Internal pull-up to 3.3 V
	7	FPGA GPIO	Connected to FPGA GPIO 0 on RC1 CPU (pull-up to 3.3 V)
	8	VSS	Signal ground

The maximum USB current is 500mA. To avoid overheating, make sure to avoid the maximum load of 2.5W when operating the RC1 close to the unit's maximum operating temperature!

The reset is active low, filtered against noise and ESD protected.

1.4.4 Additional I/O via SA-Adapter kits (optional)

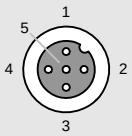
The RC1 offers up to two additional interfaces that can be accessed via special SA-Adapter kits. These kits use various types of M12 connectors for their individual I/O functions.

1.4.4.1 RS232 Interface

Connector types:

- 5-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH5" 43-01004)
- Mating connector: e.g., CONEC "SAL-12S-RS5.1-2/G3" 43-10360

Table 5. *Pin assignment of the RS232 interface 5-pin female M12 connector*

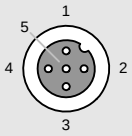
	Pin	Name	Description
	1	-	(not connected)
	2	TxD	Transmit data
	3	GND	Isolated ground
	4	RxD	Receive data
	5	-	(not connected)

1.4.4.2 RS422/RS485 Interface

Connector types:

- 5-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH5" 43-01004)
- Mating connector: e.g., CONEC "SAL-12S-RS5.1-2/G3" 43-10360

Table 6. *Pin assignment of the RS422/RS485 interface 5-pin female M12 connector*

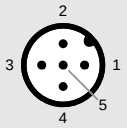
	Pin	Name	Description
	1	TxD- or TxD- / RxD-	Transmit data (full duplex) or transmit / receive data (half duplex)
	2	TxD+ or TxD+ / RxD+	Transmit data (full duplex) or transmit / receive data (half duplex)
	3	RxD-	Receive data (full duplex)
	4	RxD+	Receive data (full duplex)
	5	- (shield)	(not connected (shield))

1.4.4.3 IBIS Master Interface

Connector types:

- 5-pin M12 connector, male, A-coded (CONEC "SAL-12-FSH5" 43-01013)
- Mating connector: e.g., CONEC "SAL-12S-RK5.1-2/G3" 43-10344

Table 7. *Pin assignment of the IBIS master interface 5-pin male M12 connector*

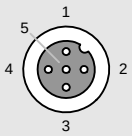
	Pin	Name	Description
	1	24V	24V power supply current-limited to 1.5A by a fuse
	2	MISO+	IBIS master in, slave out
	3	24V_GND	Ground
	4	MOSI+	IBIS master out, slave in
	5	24V_GND	Ground

1.4.4.4 IBIS Slave Interface

Connector types:

- 5-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH5" 43-01004)
- Mating connector: e.g., CONEC "SAL-12S-RS5.1-2/G3" 43-10360

Table 8. *Pin assignment of the IBIS slave interface 5-pin female M12 connector*

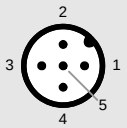
	Pin	Name	Description
	1	-	(not connected)
	2	MOSI+	IBIS master out, slave in
	3	24V_GND	Ground
	4	MISO+	IBIS master in, slave out
	5	24V_GND	Ground

1.4.4.5 CAN Bus Interface

Connector types:

- 5-pin M12 connector, male, A-coded (CONEC "SAL-12-FSH5" 43-01013)
- Mating connector: e.g., CONEC "SAL-12S-RK5.1-2/G3" 43-10344

Table 9. *Pin assignment of the CAN bus interface 5-pin male M12 connector*

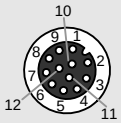
	Pin	Name	Description
	1	-	(not connected)
	2	CAN L-R	CAN termination resistance
	3	CAN GND	CAN isolated ground
	4	CAN H	CAN data line H
	5	CAN L	CAN data line L

1.4.4.6 GPIO Interface via SPI

Connector types:

- 12-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH12" 43-01343)
- Mating connector: e.g., CONEC "SAL-12S-RK12-2/G3" 43-11280

Table 10. *Pin assignment of the GPIO interface 12-pin female M12 connector*

	Pin	Name	Description
	1	Output0	Binary output 0
	2	Output1	Binary output 1
	3	Output2	Binary output 2
	4	Output3	Binary output 3
	5	Input0	Binary input 0
	6	Input1	Binary input 1
	7	Input2	Binary input 2
	8	Input3	Binary input 3
	9	IO0	Binary input/output 5
	10	IO1	Binary input/output 6
	11	VCC	Binary output pull-up voltage up to 28.8V
	12	GND	Ground

Note: Binary input 4, binary output 4 and binary input/output 7 are not connected.

1.4.5 Antenna Connectors (optional)

The RC1 can be equipped with N-type connectors for the antenna signals from a PCI Express Mini card. For more information on how to equip an RC1 with wireless functionality please refer to Chapter 7.1 Pin Assignment of PCI Express Mini Card Connector on page 55.

1.5 Audio Interface

The RC1 features a small piezo speaker behind its front panel which is controlled by an audio codec. It can be used for different alarm tones and service messages.

1.6 Front-Panel Status LEDs

The RC1 features a total of ten status LEDs at its front panel: Four for the power supply status, four for the Ethernet port status and two additional service LEDs.

1.6.1 Power Supply Status LEDs

Each of the two power supply ports provides two LEDs to display its status (*PWR* and *ACT*). The LEDs act as described in the following table.

Table 11. *Power supply status LEDs*

LED	Description
PWR	Input power status (ON = valid range)
ACT	Power supply input status (ON = input active)

1.6.2 Ethernet Port Status LEDs

Each of the two Ethernet user ports provides two LEDs to display its status (*LNK* and *ACT*). The LEDs act as described in the following table.

Table 12. *Ethernet port status LEDs*

LED	Description
LNK	Ethernet link status (ON = link established)
ACT	Ethernet traffic activity status (ON = Ethernet traffic running)

1.6.3 Service LEDs

Table 13. *Service LEDs*

LED	Description
S 1	Board management controller LED
S 2	FPGA GPIO LED

After powering up, the board management controller software can use the LED connected to it to indicate the last occurred error. Depending on the error code, the status LED will flash for a defined number of times and pause for one second until the system is restarted or completely powered off. The supported error codes are as follows:

Table 14. *Error codes signaled by the BMC via LED flashes*

Number of flashes	Error	Description
1	XM01BCI_ERR_CTSTRPHC_SHTDWN	Catastrophic shutdown
2	XM01BCI_ERR_INP_TOO_LOW	Input voltage too low
3	XM01BCI_ERR_INP_TOO_HIGH	Input voltage too high
4	XM01BCI_ERR_NO_ATX_PWR_OK	ATX_PWR_OK Failure
5	XM01BCI_ERR_NO_PWRGD_5130_1	LVL_1_PWRGD Failure
6	XM01BCI_ERR_NO_DDRVR_PWRGD	DDRVR_PWRGD Failure
7	XM01BCI_ERR_NO_PWRGD_5130_2	LVL_2_PWRGD Failure
8	XM01BCI_ERR_NO_PM_CPU_PWRGD	CPU_PWRGD Failure
9	XM01BCI_ERR_BIOS_TIMEOUT_1	First time BIOS live sign timed out
10	XM01BCI_ERR_BIOS_TIMEOUT_2	Second time BIOS live sign timed out
11	XM01BCI_ERR_BIOS_TIMEOUT_3	Third time BIOS live sign timed out
12	XM01BCI_ERR_BIOS_TIMEOUT_4	Forth time BIOS live sign timed out
13	XM01BCI_ERR_CPU_RST_TIMEOUT	CPU Reset deassert timeout
255	XM01BCI_INVALID_MAIN_STATE	Invalid BMC main state

The FPGA GPIO LED has no pre-defined function and can be incorporated into applications as needed via the RC1's GPIO controller.

2 Getting Started

2.1 Installing Operating System and Driver Software

The RC1 supports Windows® XP Embedded, Linux, VxWorks® (on request) and QNX® (on request).

You can find any software available on MEN's website.

2.1.1 Model without a display (06RC01-00)

Standard RC1 models without a display are delivered without a pre-installed operating system. To install operating system software, connect a terminal to the standard RS232 interface available via the service connector.

Set your terminal to the following protocol:

- 115,200 baud data transmission rate
- 8 data bits
- 1 stop bit
- No parity

Please refer to the respective manufacturer's documentation on how to install operating system software!

2.1.2 Model with a display (06RC01-01)

Standard RC1 models with a display come with a 120-day trial version of Windows® XP Embedded and all necessary drivers pre-installed on the MicroSD card.

During the first power up of the system, the resealing process of the XP Embedded image will be started automatically, including a system reboot. This will take approximately 5 minutes. No action on behalf of the user is necessary at this time. The 120-day trial period starts the moment the resealing process has finished setting up the system.

Please note that the gold-cap-powered internal clock of the RC1 is used to determine how much of the trial period remains.

The following events can cause the trial period to end prematurely:

- The BIOS time is modified.
- The Windows® time is modified.
- The CPU is separated from the carrier board (the gold cap is located on the carrier board, so the CPU's internal clock is no longer buffered).
- A BIOS update has unforeseen side-effects.

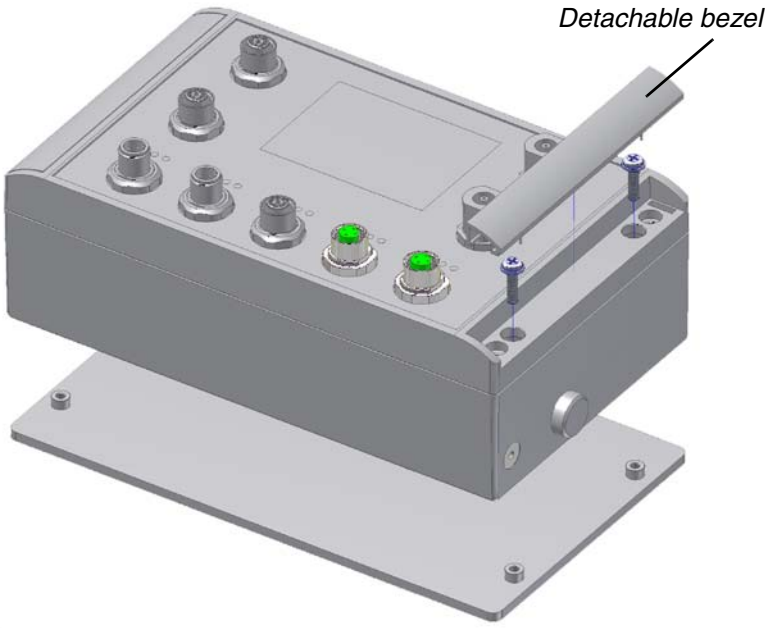
Should any of this happen and render the trial version of Windows® XP Embedded unusable prematurely, please contact MEN.

A board support package (BSP) containing all the necessary, hardware-specific components to create an individualized Windows® XP Embedded is available on MEN's website. A complete log of the standard Windows® XP Embedded image used on the RC1 is available from MEN on request.

An MDIS5 installset (13MM01-77) containing all MDIS driver packages for the RC1 is also available on MEN's website. Please refer to the installset's user documentation for a detailed description.

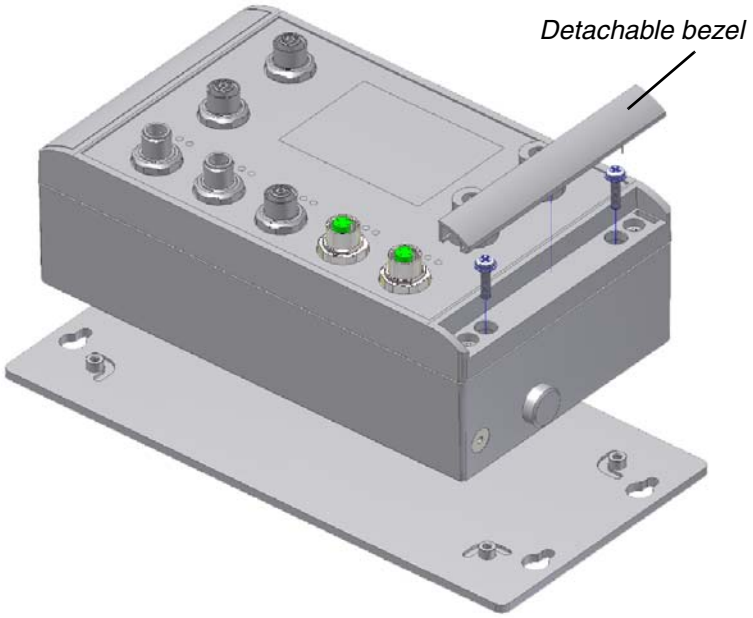
2.2 Mounting the RC1

Figure 3. *Mounting the RC1 to the DIN-rail mounting plate*



The RC1 is designed for mounting using one of two mounting plates, a DIN-rail mounting plate or a wall-mounting plate (available separately from MEN). To attach the unit to the mounting plate, remove the detachable bezel at the sides of the front panel to access the four holes (two on each side) reserved for the necessary screws as pictured above and below.

Figure 4. *Mounting the RC1 to the wall-mounting plate*



Make sure to use the following screw types in the process.

To fix the RC1 to the mounting plate:

- 4 DIN 7985 M4 x 20mm, A2 screws
- 4 M4 washers

To fix the wall-mounting plate to the wall:

- 4 DIN7985 M5 x min. 12mm, A2 screws
- 4 M5 washers

3 Functional Description

3.1 Reset

The RC1 generates its own reset signal. You can wake it up from reset state by externally switching the power supply off and on.

3.2 Real-Time Clock

The supply voltage for the RTC is buffered with an external gold cap for a minimum of 12 hours.

3.3 Memory

3.3.1 DRAM System Memory

The RC1 provides up to 1 GB on-board, soldered DDR2 (double data rate) SDRAM. The memory bus is 64 bits wide (one channel) and operates with up to 533 MHz.

The RC1 supports memory down technology. The memory is not realized with complete modules. Instead single memory chips with a maximum of 2 Gbit per chip are used.

3.3.2 Boot Flash

The RC1 has an 16-Mbit SPI Flash implemented as on-board Flash for BIOS and FPGA data.

3.3.3 EEPROM

The board has a 4-kbit serial EEPROM. The 4-kbit address space is divided into a 2-kbit block for customer specific data and another 2-kbit block for factory data. See Table 19, SMBus devices on page 53.

3.3.4 Mass Storage

The standard RC1 models are equipped with a 2GB MicroSD card. A 2.5" SATA solid-state drive and USB NAND Flash memory are optional.

3.4 Graphics

The graphics core of the RC1 provides an LVDS interface with a 112MHz maximum pixel clock and 18 bits pixel color depth.

3.5 Board Supervision

The RC1's CPU provides an intelligent board management controller (BMC) with the following main features:

- Control of power sequencing and reset behavior of the Intel Atom CPU
- Supervision of CPU supply voltage (+5V)
- Emergency shutdown in case of failure
- Watchdog functionality for CPU
- Accessible via SMBus

The watchdog device monitors the board on operating system level. If enabled, the watchdog must be triggered by application software. If the trigger is overdue, the watchdog initiates a board reset and this way can put the system back into operation when the software hangs.

The watchdog uses a configurable time interval or is disabled. Settings are made through BIOS or via an MEN software driver.

In addition, the RC1 uses a National LM95245 device to measure the CPU die temperature and the local board temperature.

3.6 Display Temperature Supervision

The temperature supervision is carried out by the temperature sensor LM50. The LM50 is a precision integrated-circuit temperature sensor that can sense a -40°C to +125°C temperature range. The display is automatically switched off at temperatures below -30°C and above +70°C.

3.7 Power Supply Status Monitoring

It is possible to monitor the power input status by reading back the status of the power LEDs via SMBus. A read access to 0x40 will give the following result (all bits except bit 4 are read only!):

Table 15. *Power Supply Status and PCI Express Mini Card Enable/Disable Byte*

Bit	Description
0	0: Main power supply is in use and input voltage is OK 1: Main power supply is not used, input voltage not OK
1	0: Backup power supply is in use 1: Backup power supply is not in use
2	0: Backup power supply input voltage is OK 1: Backup power supply input voltage not OK
3	Not used
4	0: PCI Express Mini Card power is disabled 1: PCI Express Mini Card power is enabled
5	Not used
6	Not used
7	Not used

3.8 Enabling and Disabling the PCI Express Mini Card

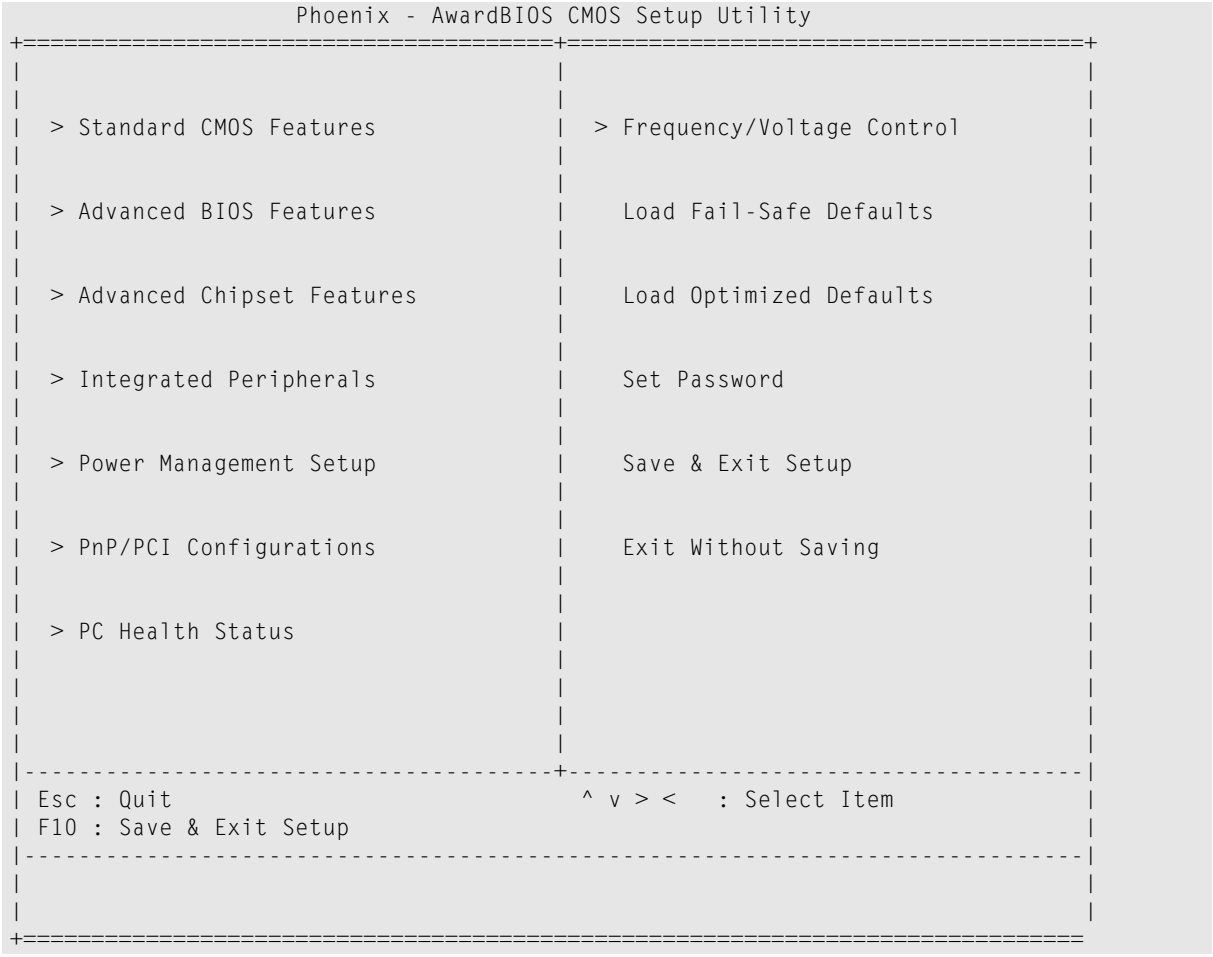
Sometimes it might become necessary to reset the PCI Express Mini Card. For this purpose, simply disable the power for the card by writing 0x00 to SMBus address 0x40. Then re-enable power by writing 0x10 to the same address. The status of the PCI Express Mini Card power supply can be read back from this address (see Table 15, Power Supply Status and PCI Express Mini Card Enable/Disable Byte).

4 BIOS

4.1 Entering the BIOS setup menu

You can start up the BIOS setup menu by hitting the <DEL> key after powering up the system.

4.2 Main Menu



The ">" character in front of a menu item means that a sub-menu is available. An "x" in front of a menu item means that there is a configuration option which needs to be activated through a higher configuration option before being accessible.

4.3 Standard CMOS Features

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                             Standard CMOS Features
+=================================================+=======================+
|    Date (mm:dd:yy)            Mon, Jan 23 2008  |         Item Help     |
|    Time (hh:mm:ss)            10 : 57 : 22      |-----------------------|
|                                                 | Menu Level   >        |
|  > IDE Channel 0 Master      [ None]            |                       |
|  > IDE Channel 0 Slave       [ None]            |                       |
|                                                 |                       |
|                                                 |                       |
|    Base Memory                   640K           |                       |
|    Extended Memory             2086912K         |                       |
|    Total Memory                2087936K         |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Date (mm:dd:yy)

Description	Change the day, month, year and century.	
Options	*mm*	Month
	dd	Day
	yy	Year

Time (hh:mm:ss)

Description	Change the internal clock.	
Options	*hh*	Hours
	mm	Minutes
	ss	Seconds

IDE Channel 0/1 Master/Slave — Sub-menu

```
IDE HDD Auto-Detection    [Press Enter]

IDE Channel 0 Master      [Auto]
Access Mode               [Auto]

Capacity                       0 MB

Cylinder                       0
Head                           0
Precomp                        0
Landing Zone                   0
Sector                         0
```

IDE HDD Auto-Detection

Description	Auto-detects the HDD's size, head etc. on this channel.
Options	None

IDE Channel 0/1 Master/Slave

Options	*None*	*Manual*
	Auto	

Access Mode

Options	*CHS*	*Large*
	LBA	*Auto*

Capacity / Cylinder / Head / Precomp / Landing Zone / Sector

Options	None

Base Memory / Extended Memory / Total Memory

Description	You cannot change any values in the Memory fields. They are only for information.

4.4 Advanced BIOS Features

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                           Advanced BIOS Features
+=================================================+=======================+
|  > CPU Feature                [Press Enter]     |        Item Help      |
|  > Hard Disk Boot Priority    [Press Enter]     |-----------------------|
|    CPU L1 & L2 Cache          [Enabled]         | Menu Level   >        |
|    Hyper-Threading Technology[Enabled]          |                       |
|    Quick Power On Self Test   [Enabled]         |                       |
|    First Boot Device          [Hard Disk]       |                       |
|    Second Boot Device         [ZIP100]          |                       |
|    Third Boot Device          [LS120]           |                       |
|    Boot Other Device          [Enabled]         |                       |
|    Boot Up NumLock Status     [On]              |                       |
|    Security Option            [Setup]           |                       |
|  x APIC Mode                  [Enabled]         |                       |
|    MPS Version Control For OS[1.4]              |                       |
|    OS Select For DRAM > 64MB [Non-OS2]          |                       |
|    HDD S.M.A.R.T Capability   [Disabled]        |                       |
|    Full Screen LOGO Show      [Disabled]        |                       |
|    Summary Screen Show        [Disabled]        |                       |
|                                                 |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

CPU Feature — Sub-menu

```
Thermal Management         [Thermal Monitor 2]
Limit CPUID MaxVal         [Disabled]
C1E Function               [Disabled]
CPU C State Capability     [Disabled]
On-Demand TCC              [Disabled]
Execute Disable Bit        [Enabled]
Virtualization Technology [Enabled]
```

Thermal Management

Description	Shows the active thermal management.	
Options	*Thermal Monitor 1*	On die throttling
	Thermal Monitor 2	Ratio & VID transition
	TM1 + TM2 enabled	
	Disabled	

Limit CPUID MaxVal

Description	Set Limit CPUID MaxVal to 3, should be disabled for WinXP	
Options	*Disabled*	*Enabled*

C1E Function

Description	Enables the Enhanced Halt State for power saving	
Options	*Disabled*	*Auto*

CPU C State Capability		
Description	User can select the lowest C state supported according to CPU and MB	
Options	*Disabled*	*C2*
	C4	*C6*

On-Demand TCC		
Description	When enabled, it indicates the clock on to clock off interval ratio.	
Options	*Disable*	*50.0%*
	12.5%	*62.5%*
	25.0%	*75.0%*
	37.5%	*87.5%*

Execute Disable Bit		
Description	When disabled, forces the XD feature flag to always return 0.	
Options	*Enabled*	*Disabled*

Virtualization Technology		
Description	When enabled, a VMM can utilize the addional hardware capabilities provided by Vanderpool Technology. (Not available for RC1 versions with the Atom Z510 processor.)	
Options	*Enabled*	*Disabled*

Hard Disk Boot Priority — Sub-menu

```
1. USB-HDD0  : Intel Value SSD
2. USB-HDD1  : Intel Value SSD
3. USB-HDD2  : SanDisk Cruzer Micro
2. Bootable Add-in-Cards

Boot priority [Dynamic]
```

Description	Selects the boot device priority of any hard disk recognized.	
Options	*Dynamic*	New detected devices are added to the end of the boot-list.
	Manual	The chosen setting is saved as long as the HDD configuration of the system is not changed. (This setting is advantageous if there is no battery in the system).
	Fixed	The BIOS scans the IDE controller and always fixes the boot sequence: 1. HDD from 1st controller 2. HDD from 2nd controller 3. USB-HDD devices

CPU L1 & L2 Cache

Description	Allows to enable or disable the processor cache memory. You should disable cache only if absolutely necessary, e.g. for testing purposes, since this slows down the system considerably.	
Options	*Enabled*	*Disabled*

Hyper-Threading Technology

Description	Enabled for Windows® XP and Linux 2.4.x (OS optimized for Hyper Threading Technology) and Disable for other OS (OS not optimized for Hyper Threading Technology). (Not available for RC1 versions with the Atom Z510 processor.)	
Options	*Enabled*	*Disabled*

Quick Power On Self Test

Description	Allows the system to skip certain tests while booting. This will decrease the time needed to boot the system.	
Options	*Enabled*	*Disabled*

First Boot Device / Second Boot Device / Third Boot Device

Description	Selects your boot device priority.		
Options	*LS120*	*ZIP100*	*USB-CDROM*
	Hard Disk	*USB-FDD*	*Legacy LAN*
	CDROM	*USB-ZIP*	*Disabled*

Boot Other Device

Description	Selects your boot device priority.	
Options	*Enabled*	*Disabled*

Boot Up NumLock Status

Description	Selects power on state for NumLock.	
Options	*Off*	*On*

Security Option

Description	Selects whether the password is required every time the system boots or only when you enter setup.	
Options	*Setup*	*System*

APIC Mode

Description	APIC mode extends the number of available IRQs (up to 23 IRQs) for operating systems which can use this (Windows® XP/2000).	
Options	*Enabled*	

MPS Version Control For OS

Description	Selects the multiprocessor specification (MPS) revision.	
Options	*1.4*	*1.1*

OS Select For DRAM > 64MB

Description	Select OS2 only if you are running an OS/2 operating system with greater than 64MB of RAM on the system.	
Options	*Non-OS2*	*OS2*

HDD S.M.A.R.T Capability

Description	Enables the hard disk drive S.M.A.R.T capability. The Self Monitoring Analysis And Reporting technology monitors the hard disk's condition and allows early prediction and warning of the hard disk failing. In order to use S.M.A.R.T you have to enable it and keep the S.M.A.R.T.-aware hardware monitoring utility running in the background all the time.	
Options	*Disabled*	*Enabled*

Full Screen LOGO Show

Description	Reserved to select between boot logos.	
Options	*Disabled*	

Summary Screen Show

Description	Show summary screen	
Options	*Enabled*	*Disabled*

4.5 Advanced Chipset Features

You should make changes in this menu only if you have thorough knowledge of your system! Setting wrong values in this section may cause the system to malfunction!

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                          Advanced Chipset Features
+=====================================================+=======================+
|    DRAM Timing Selectable     [By SPD]              |        Item Help      |
|     System BIOS Cacheable     [Enabled]             |-----------------------|
|     Video BIOS Cacheable      [Disabled]            | Menu Level   >>       |
|                                                     |                       |
|                                                     |                       |
|    ** VGA Setting **                                |                       |
|    On-Chip Frame Buffer Size  [8MB]                 |                       |
|    Boot Type                  [VBIOS Default]       |                       |
|    LCD Panel Type             [640x480 generic]     |                       |
|    Panel Scaling              [Auto]                |                       |
|    BIA Control                [VBIOS Default]       |                       |
|    TV Feature                 Press Enter           |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

DRAM Timing Selectable

Description	Sets the method by which the DRAM timing is selected. If *By SPD* is selected, the values for the following five items are configured from the contents of the SPD (Serial Presence Detect) device.
Options	*By SPD*

System BIOS Cacheable

Description	Selecting *Enabled* allows caching of the system BIOS ROM at 0xF0000 to 0xFFFFF, resulting in better system performance.	
Options	*Enabled*	*Disabled*

Video BIOS Cacheable

Description	Selecting *Enabled* allows caching of the video BIOS ROM at 0xC0000 to 0xCFFF, resulting in better video performance.	
Options	*Enabled*	*Disabled*

VGA — On-Chip Frame Buffer Size

Description	Controls the pre-allocated memory for frame buffer	
Options	*1MB*	*8MB*
	4 MB	

VGA — Boot Type

Description	Selects the video device that will be activated during POST
Options	*VBIOS Default* *SDVO* *LVDS*

VGA — LCD Panel Type

Warning: Do not change this setting to anything different than 640x480! While the internal hardware of the RC1 generally supports several different resolutions, the unit's display does not!

Description	Selects the LCD panel used by the internal graphics device by selecting the appropriate setup item. Some panels are not numbered due to size constraints	
Options	*640x480 generic*	*1024x600 TMD 5.61"*
	800x600 generic	*1024x600 Samsung 4.8"*
	1024x768 generic	*1024x768 Samsung 15"*
	640x480 NEC 8.4 "	*1024x768 Sharp 7.2"*
	800x480 NEC 9"	*1280x800 Samsung 15.4*

VGA — Panel Scaling

Description	Controls the type of panel scaling
Options	*Auto*

VGA — BIA Control

Description	Selects BIA control and aggressiveness level through this setup item
Options	*VBIOS Default*

4.6 Integrated Peripherals

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                              Integrated Peripherals
+=================================================+=======================+
|  > On-Chip IDE Device        [Press Enter]      |        Item Help      |
|  > Onboard Device            [Press Enter]      |-----------------------|
|  > PCI Express Root Port Func[Press Enter]      | Menu Level   >        |
|  > USB Device Setting        [Press Enter]      |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

On-Chip IDE Device — Sub-menu

```
IDE HDD Block Mode        [Enabled]
On-Chip Primary PCI IDE   [Enabled]
IDE Primary Master PIO    [Auto]
IDE Primary Slave  PIO    [Auto]
IDE Primary Master UDMA   [Auto]
IDE Primary Slave  UDMA   [Auto]
Delay for HDD (Secs)      [0]
```

IDE HDD Block Mode

Description If your IDE hard drive supports block mode, select *Enabled* for automatic detection of the optimal number of block read/writes per sector the drive can support.

Options *Enabled* *Disabled*

On-Chip Primary PCI IDE

Description The integrated peripheral controller contains an IDE interface with support for two IDE channels. Select *Enabled* to activate each channel.

Options *Enabled* *Disabled*

IDE Primary Master/Slave PIO

Description These fields allow your system hard disk controller to work faster. Rather than have the BIOS issue a series of commands that transfer to or from the disk drive, PIO (Programmed Input/Output) allows the BIOS to communicate with the controller and CPU directly.

The system supports five modes, numbered from 0 to 4, which primarily differ in timing. When *Auto* is selected, the BIOS will select the best available mode.

Options *Auto* *Mode 1* *Mode 3*
Mode 0 *Mode 2* *Mode 4*

IDE Primary Master/Slave UDMA			
Description	These fields allow your system to improve disk I/O throughput to up to 100MB/s with the Ultra DMA/100 feature.		
Options	*Auto*	*Disabled*	*UDMA33*
	UDMA66	*UDMA100*	

Delay for HDD	
Description	This feature allows users to set a higher delay for HDD detection
Options	*0-15 seconds*

Onboard Device — Sub-menu

```
Intel HD Audio Controller [Auto]
USB Client Controller     [Enabled]
SDIO/MMC Controller       [Enabled/Disabled]
Watchdog                  [Disabled]
Console Redirect          [COM1/Disabled]
  Serial Port Mode        [115200,8,n,1 19200,8,n,1 9600,8,n,1]
  After Boot              [Enabled/Disabled]
  Flow Control            [Ignore/Tested]
```

Intel HD Audio Controller		
Description	Enables/disables the audio controller.	
Options	*Auto*	*Disabled*

USB Client Controller		
Description	Enables/disables the USB client controller.	
Options	*Enabled*	*Disabled*

SDIO/MMC Controller		
Description	Enables/disables the Secure Digital I/O (SDIO)/Multimedia Card (MMC) controller. Note: The MicroSD card slot used in the RC1 is connected via USB, so it cannot be disabled via this setting!	
Options	*Enabled*	*Disabled*

Watchdog			
Description	If the watchdog is active the system will be rebooted after the configured time when no application triggers the watchdog		
Options	*Disabled*	*1 min*	*2 min*
	5 min	*10 min*	*15 min*
	20 min	*30 min*	

Console Redirect		
Description	Enables control via terminal program on serial port.	
Options	*COM1*	*Disabled*

Serial Port Mode		
Description	Selects the serial port settings	
Options	*115200,8,n,1*	*19200,8,n,1*
	9600,8,n,1	

After Boot		
Description	Console Redirect also active after Boot Up. Only supported by some OS.	
Options	*Enabled*	*Disabled*

Flow Control Signals		
Description	Enables hardware handshake. Ignore means hardware handshake is disabled.	
Options	*Ignore*	*Tested*

PCI Express Root Port Func — Sub-menu

```
PCI Express Port 1         [Auto]
PCI Express Port 2         [Auto]
```

PCI Express Port 1/2		
Description	Controls the activity of the PCI Express ports.	
Options	*Enabled*	*Disabled*
	Auto	

USB Device Setting — Sub-menu

```
USB 1.0 Controller       [Enabled]
USB 2.0 Controller       [Enabled]
USB Operation Mode       [High Speed]
USB Keyboard Function    [Enabled]
USB Storage Function     [Enabled]

***USB Mass Storage Device Boot Setting***
Intel Value SSD 2.00     [Auto Mode]
Intel Value SSD 2.00     [Auto Mode]
SanDisk Cruzer Micro 0.1 [Auto Mode]
```

USB 1.0 Controller		
Description	Enables/disables the Universal Host Controller interface for USB.	
Options	*Enabled*	*Disabled*

USB 2.0 Controller		
Description	Enables/disables the Enhanced Host Controller interface for USB.	
Options	*Enabled*	*Disabled*

USB Operation Mode		
Description	Auto-selects USB device operation mode	
Options	*High Speed*	If the USB device is a high speed device, it operates in high-speed mode. If the USB device is a full/low-speed device, it operates in full/low speed mode
	Full/Low Speed	All USB devices operate on full/low speed mode.
USB Keyboard Function		
Description	Enables/disables the USB Keyboard Function.	
Options	*Enabled*	
USB Storage Function		
Description	Enables/disables the legacy support of USB Mass Storage	
Options	*Enabled*	*Disabled*
Intel Value SSD 2.00/SanDisk Cruzer Micro 0.1		
Description	Selects the boot up type for the USB SSD	
Options	*Auto mode*	According to contents of USB mass storage device
	FDD mode	USB mass storage device boots up as floppy disk
	HDD mode	USB mass storage device boots up as hard disk

4.7 Power Management Setup

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                           Power Management Setup
+=====================================================+=======================+
|    Power-Supply Type          [AT]                  |        Item Help      |
|    ACPI Function              [Enabled]             |-----------------------|
|    ACPI Suspend Type          [S3(STR)]             | Menu Level   >        |
|    Soft-Off by PWR-BTTN       [Instant-Off]         |                       |
|    PWRON After PWR-Fail       [On]                  |                       |
|    ATX_PWRGD Failure Mode     [Check at Startup]    |                       |
|  > HPET Feature               [Press Enter]         |                       |
|  > Intel DTS Feature          [Press Enter]         |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Power-Supply Type

Description	Selects the type of power supply.	
Options	*AT*	*ATX*

ACPI Function

Description	Enables/disables support of ACPI (Advance Configuration and Power Interface).
Options	*Enabled*

ACPI Suspend Type

Description	Selects the ACPI state used for System Suspend.	
Options	*S3(STR)*	Activates "Suspend To RAM" function.

Soft-Off by PWR-BTTN

Description	This field defines the power-off mode when using an ATX power supply. The *Instant-Off* mode allows powering off immediately upon pressing the power button. In the *Delay 4 Sec.* mode, the system powers off when the power button is pressed for more than four seconds or enters the suspend mode when pressed for less than 4 seconds.	
Options	*Instant-Off*	*Delay 4 Sec.*

PWRON After PWR-Fail

Description	Sets the system power status when power returns to the system from a power failure situation.		
Options	*Former-Sts*	*On*	*Off*

ATX_PWRGD Failure Mode

Description	Determines the system behaviour in case of a failure at the ATX power good signal.	
Options	*Check at start up*	*Check always*

HPET Feature — Sub-menu

```
HPET Support          [Enabled]
```

HPET Support

Description	Enables/disables the high-precision event timer in the chipset.	
Options	*Enabled*	*Disabled*

Intel DTS Feature — Sub-menu

```
Intel DTS Function                [Enabled]
x DTS Active temperature          55°C
x Passive Cooling Trip Point      95°C
x Passive TC1 Value               2
x Passive TC2 Value               0
x Passive TSP Value               10
  Critical Trip Point             POR
```

Intel DTS Function

Description	Enables/disables Intel DTS Function.	
Options	*Enabled*	*Disabled*

DTS Active temperature/Passive Cooling Trip Point/Passive TC1 Value/Passive TC2 Value/Passive TSP Value

Description	These values are read-only values as monitored by the system when the Intel DTS Feature is enabled.	
Options	*None*	

Critical Trip Point

Description	This value controls the temperature of the ACPI Critical Trip Point; i.e., the point at which the operating system will shut down the system.		
Options	*POR[1]*	*15°C*	*23°C*
	31°C	*39°C*	*47°C*
	55°C	*63°C*	*71°C*
	79°C	*87°C*	*95°C*
	103°C	*111°C*	*119°C*
	127°C		

[1]POR = 100°C

4.8 PNP/PCI Configurations

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                              PnP/PCI Configurations
+=====================================================+=======================+
|    Init Display First        [Onboard]              |        Item Help      |
|    Reset Configuration Data  [Disabled]             |-----------------------|
|                                                     | Menu Level   >        |
|    Resources Controlled By   [Auto(ESCD)]           |                       |
|  x IRQ Resources             [Press Enter]          |                       |
|                                                     |                       |
|    PCI/VGA Palette Snoop     [Disabled]             |                       |
|    PCI Latency Timer(CLK)    [ 32]                  |                       |
|                                                     |                       |
|    ** PCI Express relative items **                 |                       |
|    Maximum Payload Size      [128]                  |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Init Display First

Description	Selects which graphics controller the system initializes when the system boots.	
Options	*PCI Slot*	*Onboard*

Reset Configuration Data

Description	Select *Enabled* to reset Extended System Configuration Data (ESCD) when you exit Setup if you have installed a new add-on and the system reconfiguration has caused such a serious conflict that the OS cannot boot. *Disabled* is the default.	
Options	*Enabled*	*Disabled*

Resources Controlled By

Description	BIOS can automatically configure all the boot and Plug&Play compatible devices. If you choose *Auto*, you cannot select IRQ, DMA and memory base address fields, since BIOS automatically assigns them.	
Options	*Auto(ESCD)*	*Manual*

IRQ Resources

Description	When resources are controlled manually, you must assign each system interrupt a type depending on the type of device using the interrupt, i.e. either a PCI/ISA Plug&Play device (default) or a Legacy ISA device.

PCI/VGA Palette Snoop

Description	Some non-standard VGA display cards may not show colors properly. This field allows you to set whether or not MPEG ISA/VESA VGA cards can work with PCI/VGA. When this field is enabled, a PCI/VGA can work with an MPEG ISA/VESA VGA card. When this field is disabled, a PCI/VGA cannot work with an MPEG ISA/VESA card.
Options	*Enabled* *Disabled*

PCI Latency Timer (CLK)

Description	This BIOS feature controls how long a PCI device can hold the PCI bus before another takes over. The longer the latency, the longer the PCI device can retain control of the bus before handing it over to another PCI device. Normally, the PCI Latency Timer is set to 32 cycles. This means the active PCI device has to complete its transactions within 32 clock cycles or hand it over to the next PCI device. For better PCI performance, a longer latency should be used, but a long latency can also reduce performance as the other PCI devices queuing up may be stalled for too long. The optimum latency time depends on your system configuration.
Options	Decimal value between 0 and 255

Maximum Payload Size

Description	Sets the maximum TLP payload size for the PCI Express devices. The unit is byte.
Options	*128*

4.9 PC Health Status

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                                PC Health Status
+================================================+=======================+
|    Current System Temp         41°C            |        Item Help      |
|    Current CPU1 Temperature    38°C            |-----------------------|
|                                                | Menu Level   >        |
|                                                |                       |
|                                                |                       |
|                                                |                       |
+================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Current System Temp/Current CPU1 Temperature

Description	These values are read-only values as monitored by the system.

4.10 Frequency/Voltage Control

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                          Frequency/Voltage Control
+================================================+=======================+
|    Spread Spectrum             [Enabled]       |        Item Help      |
|    XPD Clock                   [Disabled]      |-----------------------|
|                                                | Menu Level   >        |
|                                                |                       |
|                                                |                       |
+================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Spread Spectrum

Description	Sets the value of the spread spectrum. If enabled, this setting improves CE behavior.	
Options	*Disabled*	*Enabled*

XPD Clock

Description	Enables the clock for the debug connector	
Options	*Disabled*	*Enabled*

4.11 Load Fail-Safe Defaults

If this option is selected, a verified factory setup is loaded.

On the first BIOS setup configuration, this loads safe values for setup, which make the board boot up. This state is achieved again when the board is reprogrammed with the necessary parameters using the related Flash program.

4.12 Load Optimized Defaults

At the moment this option has the same effect as described for Load Fail-Safe Defaults.

If required, this option can be used to load optimized values, e.g. for the board to boot faster. These values have to be defined in the BIOS binary by the BIOS manufacturer. A special BIOS version is needed for this.

4.13 Set Password

This lets you set a password. Please note that this often leads to problems, since passwords are easily forgotten.

4.14 Save & Exit Setup

This option saves the settings made and exits setup.

4.15 Exit without Saving

This exits setup without saving any settings.

5 Organization of the System

5.1 Memory Mappings

5.1.1 Processor View of the Memory Map

The memory map is allocated dynamically and may vary depending on the system configuration.

Table 16. *Memory map – processor view*

Address Range	Function
0xFDF00000..0xFDF7FFFF	Video controller (VGA-compatible)
0xD8000000..0xDFFFFFFF	Video controller (VGA-compatible)
0xFDFC0000..0xFDFDFFFF	Video controller (VGA-compatible)
0xFDFFF000..0xFDFFFFFF	USB (Universal Serial Bus)-Controller
0xFDFF8000..0xFDFFBFFF	Microsoft UAA bus driver for High Definition Audio
0xFDB00000..0xFDBFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDE00000..0xFDEFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDBC0000..0xFDBDFFFF	Reserved
0xFDBFC000..0xFDBFFFFF	Reserved
0xFDD00000..0xFDDFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDC00000..0xFDCFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDFFE000..0xFDFFE3FF	Standard extended PCI-to-USB universal host controller
0xFED00000..0xFED003FF	High precision event timer
0xFED00000..0xFED003FF	System board
0xFFB80000..0xFFBFFFFF	Intel(R) 82802 firmware hub
0xE0000000..0xEFFFFFFF	Motherboard resources
0x0000..0x9FFFF	System board
0xFEC00000..0xFEC00FFF	System board
0xFED13000..0xFED1DFFF	System board
0xFED20000..0xFED8FFFF	System board
0xFEE00000..0xFEE00FFF	System board
0xFFB00000..0xFFB7FFFF	System board
0xFFF00000..0xFFFFFFFF	System board
0xA0000..0xBFFFF	PCI bus
0xA0000..0xBFFFF	VGASave
0xC0000..0xDFFFF	PCI bus
0xE0000..0xEFFFF	PCI bus
0xE0000..0xEFFFF	System board

Address Range	Function
0xF0000..0xFFFFF	PCI bus
0xF0000..0xFFFFF	System board
0x100000..0x1F5DFFFF	System board
0x1F5E0000..0x1F5FFFFF	System board
0x1F600000..0x1F6FFFFF	System board
0x1F700000..0xFEBFFFFF	PCI bus

5.1.2 I/O Memory Map

Table 17. *Memory map – I/O*

Address Range	Function
0x00000000..0x00000CF7	PCI bus
0x00000000..0x00000CF7	DMA controller
0x00000010..0x0000001F	Motherboard resources
0x00000020..0x00000021	Programmable interrupt controller
0x00000022..0x0000003F	Motherboard resources
0x00000040..0x00000043	System timer
0x00000044..0x0000005F	Motherboard resources
0x00000061..0x00000061	Reserved
0x00000062..0x00000063	Motherboard resources
0x00000065..0x0000006F	Motherboard resources
0x00000070..0x00000073	System CMOS/real time clock
0x00000074..0x0000007F	Motherboard resources
0x00000080..0x00000090	DMA controller
0x00000091..0x00000093	Motherboard resources
0x00000094..0x0000009F	DMA controller
0x000000A0..0x000000A1	Programmable interrupt controller
0x000000A2..0x000000BF	Motherboard resources
0x000000C0..0x000000DF	DMA controller
0x000000E0..0x000000EF	Motherboard resources
0x000000F0..0x000000FF	Numerical coprocessor
0x00000170..0x00000177	Reserved
0x000001CE..0x000001CF	VgaSave
0x000001F0..0x000001F7	Reserved
0x00000274..0x00000277	ISAPnP data read port
0x00000279..0x00000279	ISAPnP data read port
0x000002E8..0x000002EF	VgaSave
0x00000376..0x00000376	Reserved

Address Range	Function
0x000003B0..0x000003BB	VgaSave
0x000003C0..0x000003DF	VgaSave
0x000003F6..0x000003F6	Reserved
0x000004D0..0x000004D1	Motherboard resources
0x00000880..0x0000088F	Motherboard resources
0x00000900..0x000009BF	Motherboard resources
0x00000A79..0x00000A79	ISAPnP data read port
0x00000D00..0x0000FFFF	PCI bus
0x0000D000..0x0000DFFF	PCI standard-PCI-to-PCI-bridge
0x0000E000..0x0000EFFF	PCI standard-PCI-to-PCI-bridge
0x0000EF00..0x0000EF1F	Reserved
0x0000FB00..0x0000FB0F	Standard dual channel PCI-IDE controller
0x0000FC00..0x0000FC1F	Standard PCI-to-USB universal host controller
0x0000FD00..0x0000FD1F	Standard PCI-to-USB universal host controller
0x0000FE00..0x0000FE1F	Standard PCI-to-USB universal host controller
0x0000FF00..0x0000FF07	Video controller (VGA-compatible)

5.2 PCI Devices

Table 18. *PCI Devices*

Bus	Device Number	Device Function	Vendor ID	Device ID	Function
0	0x00	0x0	0x8086	0x8100	Host bridge
0	0x02	0x0	0x8086	0x8108	Display Controller
0	0x1A	0x00	0x8086	0x8118	USB Client Controller
0	0x1B	0x00	0x8086	0x811B	HD Audio Controller
0	0x1C	0x00	0x8086	0x8110	PCI Express Root Port 1
0	0x1C	0x01	0x8086	0x8110	PCI Express Root Port 2
0	0x1D	0x00	0x8086	0x8114	USB UHCI Controller 1
0	0x1D	0x01	0x8086	0x8115	USB UHCI Controller 2
0	0x1D	0x02	0x8086	0x8116	USB UHCI Controller 3
0	0x1D	0x07	0x8086	0x8117	USB EHCI Controller
0	0x1E	0x00	0x8086	0x811C	SDIO/MMC Port 0
0	0x1E	0x01	0x8086	0x811D	SDIO/MMC Port 1
0	0x1E	0x02	0x8086	0x811E	SDIO/MMC Port 2
0	0x1F	0x00	0x8086	0x8119	LPC Controller
0	0x1F	0x01	0x8086	0x811A	Reserved
1	0x00	0x00	0x1A88	0x4D45	Bridge Device [MEN-FPGA]

5.3 SMBus Devices

Table 19. *SMBus devices*

Address	Function
0x40	IO expander (power supply states and PCI Express Mini Card enable/disable)
0x4C	Thermal sensor
0x9A	Board management controller
0xA0	SPD data for system memory
0xAA	CPU board information EEPROM
0xAC	EEPROM for customer specific data
0xAE	RC1 board information EEPROM
0xD2	Clock generator

5.4 Interrupt Mapping

Table 20. *Interrupts*

Interrupt	Function
IRQ 0	High precision event timer
IRQ 8	High precision event timer
IRQ 9	Microsoft ACPI-conformal system
IRQ 11	Video controller (VGA-compatible)
IRQ 11	USB (Universal Serial Bus) controller
IRQ 13	Numerical coprocessor
IRQ 14	Reserved
IRQ 16	Microsoft UAA bus driver for High Definition Audio
IRQ 16	PCI standard-PCI-to-PCI-bridge
IRQ 16	Standard PCI-to-USB universal host controller
IRQ 17	PCI standard-PCI-to-PCI-bridge
IRQ 17	Standard PCI-to-USB universal host controller
IRQ 18	Standard PCI-to-USB universal host controller
IRQ 19	Standard extended PCI-to-USB universal host controller

6 Maintenance

6.1 Cleaning the Display

Please clean the display of the RC1 with a moist, soft cloth. Do not use abrasive detergents in order to avoid damaging the laminated glass that protects the display.

6.2 Fuse Protection

The DC/DC converter inside the RC1's power supply unit is protected by a fuse. **This fuse is not intended to be exchanged by the customer. Your warranty for the Power Supply Unit will cease if you exchange the fuse on your own.** Please send your unit to MEN for repair if a fuse blows.

- Current rating:
  - 2.5A for a 24V nom. PSU (standard)
  - 1A for a 110V nom. PSU
- Type: fast
- Size: 4.5 x 12.1
- MEN part number: 5675-0010 (2.5A), 5675-0006 (1A)

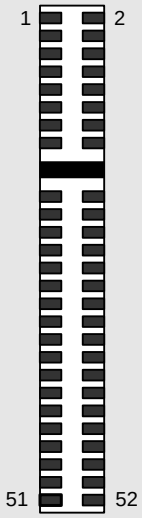
7 Appendix

7.1 Pin Assignment of PCI Express Mini Card Connector

The RC1 supports the PCI Express Mini Card standard as a means of adding wireless functionality to the unit. A PCI Express Mini Card is a small form factor optimized for mobile computing platforms and a card-system interconnection optimized for communication applications.

Internally, the RC1 is equipped with a 52-pin standard PCI Express Mini Card connector and a slot for an optional SIM card. The following signals are supported:

Table 21. *Pin assignment of 52-pin PCI Express Mini Card connector*

	Pin	Signal	Direction	Function
	1	WAKE#	out	not supported
	2	+3.3Vaux	out	Power
	3	COEX1		not supported
	4	GND	-	Power
	5	COEX2		not supported
	6	1.5V	out	Power
	7	CLKREQ#	out	Reference clock request signal
	8	UIM_PWR	out	SIM card ower
	9	GND	-	Power
	10	UIM_DATA	in/out	SIM card data
	11	REFCLK-	in	PCI Express differential reference clock
	12	UIM_CLK	in	SIM card clock
	13	REFCLK+	in	PCI Express differential reference clock
	14	UIM_RST	in	SIM card reset
	15	GND	-	Power
	16	UIM_VPP		not supported
	17	Reserved		not supported
	18	GND	-	Power
	19	Reserved		not supported
	20	W_DISABLE		not supported
	21	GND	-	Power
	22	PERST#	in	Reset for the Mini Card
	23	PERn0	out	PCI Express data receive line
	24	+3.3Vaux	out	Power
	25	PERp0	out	PCI Express data receive line
	26	GND	-	Power

	Pin	Signal	Direction	Function
	27	GND	-	Power
	28	+1.5V	out	Power
	29	GND	-	Power
	30	SMB_CLK	out	not supported
	31	PETn0	in	PCI Express data transmit line
	32	SMB_DATA	in/out	not supported
	33	PETp0	in	PCI Express data transmit line
	34	GND	-	Power
	35	GND	-	Power
	36	USB_D-	in/out	USB line
	37	Reserved		not supported
	38	USB_D+	in/out	USB line
	39	+3.3Vaux	out	Power
	40	GND	-	Power
	41	+3.3Vaux	out	Power
	42	LED_WWAN#		not supported
	43	GND	-	Power
	44	LED_WLAN#		not supported
	45	Reserved		not supported
	46	LED_WPAN#		not supported
	47	Reserved		not supported
	48	+1.5V	out	Power
	49	Reserved		not supported
	50	GND	-	Power
	51	Reserved		not supported
	52	+3.3Vaux	out	Power

7.2 Literature and Web Resources

- RC1 data sheet with up-to-date information and documentation:
  www.men.de/products/06RC01-.html

7.2.1 PCI Express Mini Card

- PCI Express Mini Card Electromechanical Specification
  Revision 1.2; October 26, 2007
  PCI Special Interest Group
  www.pcisig.com

7.3 Finding out the Board's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or hardware revisions of the RC1. You can find information on the article number, the board revision and the serial number on two labels attached to the board.

- **Article number:** Gives the board's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the hardware revision of the board.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 5. *Label giving the product's article number, revision and serial number*